Journal of Physical and Chemical Reference Data

Pair, Triplet, and Total Atomic Cross Sections (and Mass Attenuation Coefficients) for 1 MeV-100 GeV Photons in Elements *Z*=1 to 100

Cite as: Journal of Physical and Chemical Reference Data **9**, 1023 (1980); https://doi.org/10.1063/1.555629
Published Online: 15 October 2009

J. H. Hubbell, H. A. Gimm, and I. O/verbo/

View Online
Export Citation

ARTICLES YOU MAY BE INTERESTED IN

Atomic form factors, incoherent scattering functions, and photon scattering cross sections
Journal of Physical and Chemical Reference Data **4**, 471 (1975); https://doi.org/10.1063/1.555523

Detailed Tabulation of Atomic Form Factors, Photoelectric Absorption and Scattering Cross Section, and Mass Attenuation Coefficients in the Vicinity of Absorption Edges in the Soft X-Ray (Z=30-36, Z=60-89, E=0.1 keV-10 keV), Addressing Convergence Issues of Earlier Work
Journal of Physical and Chemical Reference Data **29**, 597 (2000); https://doi.org/10.1063/1.1321055

Relativistic atomic form factors and photon coherent scattering cross sections
Journal of Physical and Chemical Reference Data **8**, 69 (1979); https://doi.org/10.1063/1.555593

© 1980 American Institute of Physics for the National Institute of Standards and Technology.

Pair, Triplet, and Total Atomic Cross Sections (and Mass Attenuation Coefficients) for 1 MeV–100 GeV Photons in Elements Z = 1 to 100

J. H. Hubbell

National Measurement Laboratory, National Bureau of Standards, Washington, D.C. 20234

H. A. Gimm

Nucl. Phys. Group MPI f. Chem., Mainz, W. Germany

I. Øverbø

Inst. Phys., Univ. Trondheim, Trondheim, Norway

Tables of photon cross sections and mass attenuation coefficients for all elements $Z=1$ to 100 are given for photon energies in the range 1 MeV to 100 GeV. The pair and triplet production cross sections take into account recent theoretical work, including atomic form factor and incoherent scattering function data, as well as extensive new total attenuation coefficient measurements at Mainz. Cross section values for the atomic photoeffect and coherent and incoherent (Compton) scattering are explicitly listed and are included in the total cross sections (excluding photonuclear) and mass attenuation coefficients.

Key words: Attenuation coefficient; coherent scattering; Compton scattering; gamma rays; pair production; photoelectric absorption; photons; triplet production; x-rays.

Contents

	Page
1. Introduction and Notation	1024
1.1. Introduction	1024
1.2. Physical Constants, Units, Notation	1025
2. Pair Production Cross Section (Coherent, in Screened Nuclear Field)	1026
2.1. Unscreened Born Approximation, $2 \ll k \leq \infty$	1026
2.2. Coulomb Correction	1026
2.2.1. The Davies-Bethe-Maximon High-Energy Coulomb Correction	1026
2.2.2. Coulomb Correction for Low Energies, $2<k<10$	1027
2.2.3. Coulomb Correction for Intermediate Energies	1027
2.3. Screening Correction	1028
2.3.1. Bethe-Heitler Screened Born Approximation, High Energies	1028
2.3.2. Tsai Screened Born Approximation, $2 \ll k \leq \infty$	1029
2.3.3. Exact Evaluation of Born-Approximation Screening Correction to the Total Cross Section	1030
2.3.4. Screening Corrections, Low Energies	1031
2.4. Radiative Correction	1033
2.5. Composited Nuclear-Field (Coherent) Pair Production Cross Section	1033
3. Incoherent Pair Production Cross Section (Pair Production with Excitation or Ionization (Triplet Production))	1036
3.1. General Remarks	1036
3.2. Unscreened Triplet Calculations	1037
3.2.1. Borsellino-Ghizzetti Triplet Formulas	1037
3.2.2. Votruba-Mork-Haug Triplet Calculations	1037
3.3. Triplet Screening Corrections	1037
3.3.1. Bethe-Heitler, Wheeler-Lamb Formulas	1037
3.3.2. Jost-Luttinger-Slotnick Triplet Screening	1038
3.3.3. Borsellino-Maximon-Gimm Triplet Screening	1039
3.4. Radiative Correction to the Triplet Cross Section	1039
3.5. Composited Triplet Production	1039
4. Incoherent (Compton) Scattering	1040
5. Coherent (Rayleigh) Scattering	1041
6. Atomic Photoeffect	1041
7. Photonuclear Absorption Cross Section	1042
8. Total Atomic Cross Sections, Mass Attenuation Coefficients	1042
8.1. Description of Tables	1042
8.2. Discussion of Errors	1043
References	1145

© 1981 by the U.S. Secretary of Commerce on behalf of the United States. This copyright is assigned to the American Institute of Physics and the American Chemical Society.

List of Tables

	Page
Table 1. Nuclear-field pair-production Born-approximation screening correction factors	1029
Table 2. Nuclear-field pair-production low-energy higher-order screening corrections	1032
Table 3. Radiative corrections to nuclear-field pair production	1033
Table 4. Ratio of the Haug unscreened exchange-corrected triplet cross section to the Borsellino-Ghizzetti cross section	1038
Table 5. Electron-field pair production (incoherent; triplet) screening correction factors	1039
Table 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100	1044
Table 7. Values of atomic weights A_r and typical densities ρ for elements $Z=1$ to 100	1144

List of Figures

Figure 1. Partial (theoretical) and total (measured) cross sections in C	1024
Figure 2. Partial (theoretical) and total (measured) cross sections in Cu	1024
Figure 3. Partial (theoretical) and total (measured) cross sections in Pb	1025
Figure 4. Screening, radiative, and Coulomb corrections to pair cross sections, C	1035
Figure 5. Screening, radiative, and Coulomb corrections to pair cross sections, Cu	1035
Figure 6. Screening, radiative, and Coulomb corrections to pair cross sections, Pb	1036

1. Introduction and Notation

1.1. Introduction

Photon absorption and cross section data above 1 MeV are required in a variety of applications which include, for example, medical radiology, industrial inspection and processing, nuclear power plant core and shielding design, and interpretation of nuclear physics experiments. The pair and triplet production processes, with thresholds of 1.022 MeV (twice the electron rest-mass energy) and 2.044 MeV (four times the electron rest-mass energy), respectively, dominate the total cross section for high photon energies. For a low-Z atom such as carbon ($Z=6$), these processes provide the major contribution to the total absorption cross-section in the photon energy region $E \gtrsim 100$ MeV (see fig. 1). For higher-Z atoms such as copper ($Z=29$) and lead ($Z=82$) these processes predominate throughout the region $E \gtrsim 10$ MeV (see figs 2 and 3).

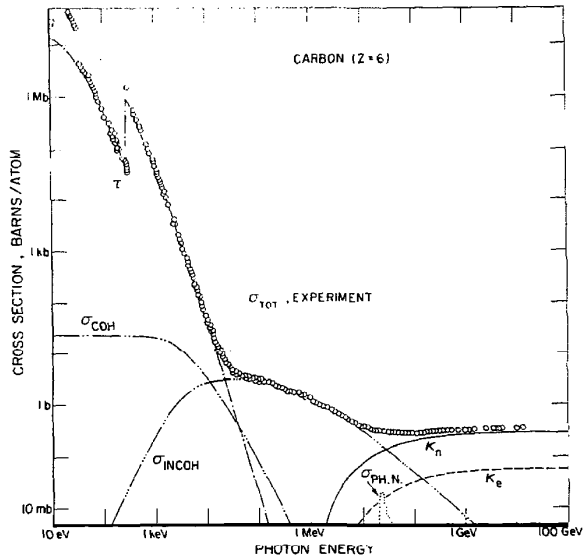

FIGURE 1. Contributions of (a) atomic photoeffect, τ, (b) coherent scattering, σ_{COH}, (c) incoherent (Compton) scattering, σ_{INCOH}, (d) nuclear-field pair production, κ_n, (e) electron-field pair production, κ_e, and (f) nuclear photoabsorption, $\sigma_{PH.N.}$, to the total measured cross section, σ_{TOT} (circles) in carbon over the photon energy range 10 eV to 100 GeV. The measured σ_{TOT} points, taken from 90 independent literature references, are not all shown in regions of high measurement density.

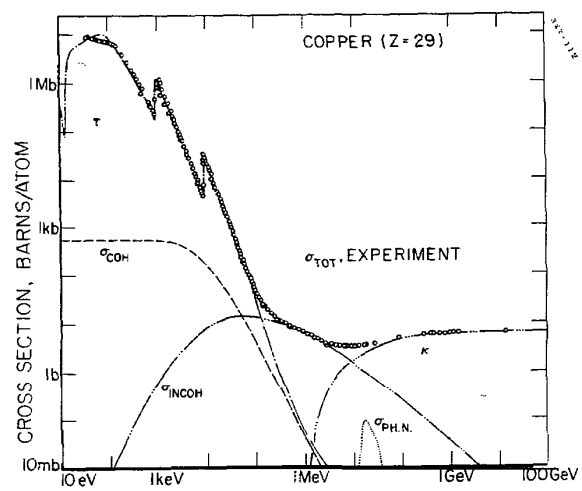

FIGURE 2. Contributions of (a) atomic photoeffect, τ, (b) coherent scattering, σ_{COH}, (c) incoherent (Compton) scattering, σ_{INCOH}, (d) total pair production, κ, and (d) nuclear photoabsorption, $\sigma_{PH.N.}$, to the total measured cross section, σ_{TOT} (circles) in copper over the photon energy range 10 eV to 100 GeV. The measured σ_{TOT} points, taken from 116 independent literature references, are not all shown in regions of high measurement density.

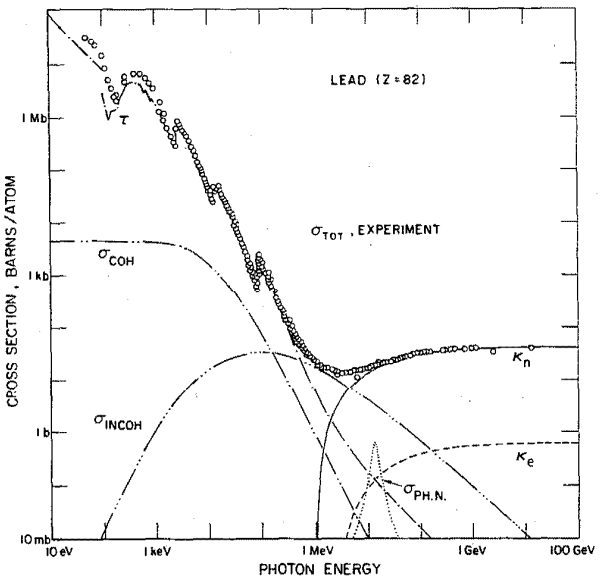

FIGURE 3. Contributions of (a) atomic photoeffect, τ, (b) coherent scattering, σ_{COH}, (c) incoherent (Compton) scattering, σ_{INCOH}, (d) nuclear-field pair production, κ_n, (e) electron-field pair production, κ_e, and (f) nuclear photoabsorption, $\sigma_{PH.N.}$, to the total measured cross section, σ_{TOT} (circles) in lead over the photon energy range 10 eV to 100 GeV. The measured σ_{TOT} points, taken from 121 independent literature references, are not all shown in regions of high measurement density.

Recent pair production and total absorption cross section measurements are reported in, e.g., references [1–23];[1] earlier measurements are summarized in [24–26]. New theoretical estimates of the pair production cross section are given, e.g., in references [27–44], and earlier theoretical developments are summarized in [45]. The above new material indicates that previous tabulations of photon cross section data above 1 MeV (see, e.g., [26], also [44–49], all with pair and triplet cross section values traceable to [26]) should be revised. In particular, for high-Z materials in the energy region 10 MeV to 30 MeV where photonuclear absorption [50, 51] is significant, the present total atomic cross sections differ from those in reference [26] by as much as 4 percent.

Reference [26] included photon cross section and attenuation coefficient data over the wider energy range 10 keV to 100 GeV, but for only 23 elements ranging from $Z=1$ to $Z=92$. The present tables expand this coverage, for photon energies above 1 MeV, to include all elements $Z=1$ to 100. Also, a more closely-spaced energy grid is used in the photon energy region 1 to 30 MeV to reduce interpolation errors. A low-energy compilation of cross-section and attenuation-coefficient data for photon energies 1 keV to 1 MeV, for all elements $Z=1$ to 100, is in preparation.

[1] Figures in brackets indicate literature references at the end of this paper.

1.2. Physical Constants, Units, Notation [2]

Symbols used in this work to denote physical quantities, as well as numerical values used for the physical constants, are listed as follows:

- c velocity of light $=2.99792458\cdot10^{8}$ m s^{-1}
- e elementary charge $=1.6021892\cdot10^{-19}$ C $=4.803242\cdot10^{-10}$ cm$^{3/2}$ g$^{1/2}$ s^{-1} (e.s.u.) $=1.5189186\cdot10^{-14}$ m$^{3/2}$ kg$^{1/2}$ s^{-1}
- m_e electron rest-mass $=9.109534\cdot10^{-31}$ kg
- m_ec^2 electron rest-mass energy $=5.110034\cdot10^{5}$ eV
- m_r recoil mass (e.g., nucleus or struck electron)
- b barn $=10^{-28}$ m^2
- r_e classical electron radius $=e^2/(m_ec^2)$ $=2.8179380\cdot10^{-15}$ m
- r_e^2 $=7.940775\cdot10^{-30}$ m^2 $=0.07940775$ b
- α fine structure constant $=e^2/(\hbar c)$ $=7.2973506\cdot10^{-3}=1/137.03604\approx1/137$
- $\bar{\phi}$ $Z^2\cdot r_e^2\cdot\alpha=Z^2\cdot5.794662\cdot10^{-32}$ m^2 $=Z^2\cdot5.794662\cdot10^{-4}$ b
- a_0 first Bohr radius $=r_e/\alpha^2=5.2917706\cdot10^{-11}$ m $=0.52917706$ Å
- E photon energy in eV units (e.g., keV, MeV or GeV)
- k photon energy in units of the electron rest-mass energy (i.e., m_ec^2 units) $=E(\text{eV})/511003.4$
- $\lambda(\text{Å})$ photon wavelength in angstroms (1 angstrom $=10^{-10}$ m $=0.1$ nm) $=12398.520/E(\text{eV})$
- θ angle between the photon directions of travel prior to and following a scattering interaction
- T_+, T_- kinetic energy of the positron or electron, respectively, for pair production in the laboratory system, in m_ec^2 units
- E_+, E_- total energy of the positron or electron, respectively, for pair production in the laboratory system, in m_ec^2 units, i.e., $E_+=T_++1$, $E_-=T_-+1$
- β_+, β_- ratio of the positron or electron velocity, respectively, to the velocity of light
- x $=\sin(\theta/2)/\lambda(\text{Å})$
- $\hbar q$ momentum transfer to an atom or electron (or, in vector notation, $\hbar\boldsymbol{q}=\boldsymbol{k}_i-\boldsymbol{k}_f$, where $\boldsymbol{k}_i$ and $\boldsymbol{k}_f$ are the initial and final momenta of the photon). In units of m_ec, $\hbar q=2k\sin(\theta/2)$. Conversion of q-arguments in m_ec units to x-arguments is accomplished by multiplication by the factor $20.60744=\frac{1}{2}\cdot511003.4/12398.52$
- Z atomic number = electrons/atom
- N_A Avogadro constant $=6.022045\cdot10^{23}$ mol^{-1}
- A_r relative atomic mass (atomic weight)
- σ_{coh} Rayleigh ("coherent") scattering cross sections per atom

[2] Numerical values given here are those recommended in 1973 by the Task Group on Fundamental Constants, Committee on Data for Science and Technology (CODATA) of the International Council of Scientific Unions (ICSU) [52], taken from an analysis by Cohen and Taylor [53].

σ_{incoh} Compton ("incoherent") collision cross section per atom

τ total atomic photoelectric absorption cross section per atom

κ_n cross section for pair production (coherent, in screened nuclear field)

κ_n^{BH} unscreened Born-approximation (Bethe-Heitler) pair production cross section

κ_e cross section for incoherent pair production (with excitation or ionization of the atom), frequently denoted "triplet production."

$\sigma_{\text{ph.n.}}$ total photonuclear absorption cross section $=\sigma(\gamma, \text{n})+\sigma(\gamma, \text{p})+\ldots$

σ_{elec} total cross section for photon interaction with an atom (total "electronic" cross section), excluding $\sigma_{\text{ph.n.}}$ $=\sigma_{\text{coh}}+\sigma_{\text{incoh}}+\tau+\kappa_n+\kappa_e$

σ_{tot} total cross section for photon interaction with an atom $=\sigma_{\text{elec}}+\sigma_{\text{ph.n.}}$

μ/ρ mass attenuation coefficient, excluding $\sigma_{\text{ph.n.}}$ $=\sigma_{\text{elec}}\cdot(N_A/A_r)$, in units of m^2/kg (multiply m^2/kg table-entries by 10 if cm^2/g units are desired).

2. Pair Production Cross Section (Coherent, in Screened Nuclear Field)

In coherent production an electron-positron pair is produced in the screened nuclear field (i.e. atomic field), and the atom recoils without internal excitation. This is in contrast to incoherent production (see section 3) in which the atom is either excited or ionized (triplet production).

2.1. Unscreened Born Approximation, $2 \ll k \lesssim \infty$

As in previous systematic cross section computations in this series [24, 26], the Bethe-Heitler Born-approximation unscreened pair-production cross section [54–56], κ_n^{BH}, is used as an initial approximation to which Coulomb corrections (treated in section 2.2), screening corrections (section 2.3) and radiative corrections (section 2.4) are applied. (See reference [45], equations (4.06)–(4.08), and table 6.01 for a definition and limitations of the Born approximation, and reference [38], section 2, for a definition of the Coulomb and screening corrections.) Racah [56] gives a rather compact formulation for κ_n^{BH} which involves no high-energy ($k \gg 1$) approximation:

$$\kappa_n^{BH}=\bar{\phi}\left\{\frac{692+468\eta+76\eta^2+108\eta^3}{27(1+\eta)^3}K(\eta)-\frac{692+360\eta+692\eta^2}{27(1+\eta)^3}E(\eta)-4\frac{(1-\eta)^2}{(1+\eta)^2}\left[\int_0^\eta\frac{K(\xi)}{1-\xi}\,d\xi-4\int_0^\eta\frac{d\zeta}{1-\zeta^2}\int_0^\zeta\frac{K(\xi)}{1-\xi}\,d\xi\right]\right\} \quad (1)$$

in which $\bar{\phi}=Z^2\cdot 5.794662\cdot 10^{-32}\text{m}^2$, $\eta=(k-2)/(k+2)$, k is the photon energy in m_ec^2 units and $K(\eta)$ {also $K(\xi)$} and $E(\eta)$ are complete elliptic integrals of the first and second kinds, respectively.

For convenience in computations, Maximon [57] has derived rapidly-converging series-expansions from equation (1) for high and low k-values by appropriately expanding K and E and performing term-by-term analytical integrations to give

$$\kappa_n^{BH}=\bar{\phi}\,\frac{2\pi}{3}\left(\frac{k-2}{k}\right)^3\times\left[1+\frac{1}{2}\rho+\frac{23}{40}\rho^2+\frac{11}{60}\rho^3+\frac{29}{960}\rho^4+\cdots\right],\ k\lesssim 4, \quad (2a)$$

in which

$$\rho=\frac{2k-4}{2+k+2\sqrt{2k}}$$

and

$$\kappa_n^{BH}=\bar{\phi}\left\{\frac{28}{9}\ln 2k-\frac{218}{27}+\left(\frac{2}{k}\right)^2\left[6\ln 2k-\frac{7}{2}+\frac{2}{3}\ln^3 2k-\ln^2 2k-\frac{1}{3}\pi^2\ln 2k+2\zeta(3)+\frac{\pi^2}{6}\right]-\left(\frac{2}{k}\right)^4\left[\frac{3}{16}\ln 2k+\frac{1}{8}\right]-\left(\frac{2}{k}\right)^6\left[\frac{29}{9\cdot 256}\ln 2k-\frac{77}{27\cdot 512}\right]+\cdots\right\},\ k\gtrsim 4, \quad (2b)$$

where

$$\zeta(3)=\sum_{n=1}^{\infty}\frac{1}{n^3}=1.2020569\ldots \quad \text{(Riemann's zeta-function).} \quad (3)$$

The two expansions (2a) and (2b), using only the terms given here, provide values of κ_n^{BH} (Born, unscreened) accurate to within 0.01 percent over the entire energy range from threshold to arbitrarily high energies.

2.2. Coulomb Correction

If one disregards screening and radiative corrections, the Coulomb interaction gives rise to a perturbation series, the first term of which is the Bethe-Heitler Born-approximation unscreened cross section κ_n^{BH}. The sum of the higher-order terms in this Born series is the so-called Coulomb correction. The importance of this correction in processes like pair production and bremsstrahlung stems from the fact that the expansion parameter is αZ rather than α.

2.2.1. The Davies-Bethe-Maximon High-Energy Coulomb Correction

Bethe and Maximon [58] have derived expressions for the pair production and bremsstrahlung differential cross sections valid for all Z for E_+, E_-, $k \gg 1m_ec^2$ by including the Coulomb interaction in the un-

perturbed Hamiltonian. Partial integration of these expressions by Davies, Bethe, and Maximon [59] gave the result

$$d\kappa_n/dE_+=2\bar{\phi}k^{-3}(E_+^2+E_-^2+\frac{2}{3}E_+E_-)\times\left[2\ln\frac{2E_+E_-}{k}-1-2f(Z)\right] \quad (4)$$

The last term in the square brackets is the so-called "Coulomb correction" term in which

$$f(Z)=a^2\sum_{\nu=1}^{\infty}\frac{1}{\nu(\nu^2+a^2)} \quad (5)$$

where $a=\alpha Z$.

For convenience in computation, equation (5) may be rewritten [59] as

$$f(Z)=a^2\left\{(1+a^2)^{-1}+\sum_{n=1}^{\infty}(-a^2)^{n-1}[\zeta(2n+1)-1]\right\} \quad (6)$$

in which $\zeta(s)$ is again the Riemann zeta function

$$\zeta(s)=\sum_{n=1}^{\infty}n^{-s} \quad (7)$$

such that

$$f(Z)=a^2\{(1+a^2)^{-1}+0.202059-0.03693a^2+0.00835a^4-0.00201a^6+0.00049a^8-0.00012a^{10}+0.00003a^{12}-\ldots\}. \quad (8)$$

Sørenssen [60] integrated equation (4) over the Coulomb-correction term to give

$$-\Delta\kappa_n^{\text{Sørr}}(\text{Coul})=-4Z^2\alpha r_e^2\left(\frac{7}{9}-\frac{2}{k}+\frac{4}{3k^2}-\frac{8}{9k^3}\right)f(Z)=-4\bar{\phi}\left(\frac{7}{9}-\frac{2}{k}+\frac{4}{3k^2}-\frac{8}{9k^3}\right)f(Z) \quad (9)$$

in which the leading term is seen to be the extreme relativistic Coulomb correction

$$-\Delta\kappa_n^{\text{DBM}}(\text{Coul})=-4Z^2\alpha r_e^2\left(\frac{7}{9}\right)f(Z)=-\frac{28}{9}\bar{\phi}f(Z) \quad (10)$$

given by Davies, Bethe, and Maximon [59].

Neither equation (9) nor (10) can be used for photon energies much below 100 MeV, particularly for heavy elements, and in fact either case, if unmodified, would result in a negative cross section for energies below about 4 MeV.

2.2.2. Coulomb Correction for Low Energies, $2<k<10$

For low energies, exact results for the Coulomb correction were obtained by Øverbø, Mork, and Olsen [35, 36], using relativistic Coulomb wave functions in the form of partial wave expansions. By this method, an analytic expression for the positron energy spectrum is obtained in terms of partial wave sums involving App ell-function series, both of which converge rapidly for incident photon energies near threshold ($k=2\,m_ec^2$) but not adequately for machine computation for $k\gtrsim 10\,m_ec^2$.

The positron energy spectra thus obtained by Øverbø, Mork, and Olsen [35, 36] are asymmetric, particularly for high-Z elements and for near-threshold incident photon energies, favoring positrons of high energy. The Coulomb correction to the total cross section is negative for photon energies very close to threshold, but is generally positive for $2.2\ m_ec^2\lesssim k\lesssim 10\ m_ec^2$. (For detailed results, see references [35, 36]; see also section 2.2.3.)

2.2.3. Coulomb Correction for Intermediate Energies

For photon energies between 5 and, say, 50 MeV there has been a gap in the theoretical understanding of the Coulomb correction, and hence of the pair cross section itself. Various empirical [26, 59] and semi-empirical [24, 35, 36, 61] low-energy modifications, based in part on experimental information at intermediate energies, have been offered to bridge this gap. However, interpretation of intermediate-energy measurements for this purpose is not straightforward, due to the broad and somewhat irregular photonuclear dipole giant resonance in the region ~5–30 MeV as will be discussed in section 7.

Øverbø [39] has derived a "bridging" expression by noting that a high-energy expansion of the exact differential expressions in references [35] and [36] should yield a Coulomb correction containing terms as given in equation (9) plus additional terms of the form k^{-1}, k^{-2}, . . ., $k^{-1}\ln(k/2)$, $k^{-1}\ln^2(k/2)$, $k^{-2}\ln^2(k/2)$, . . . A fit to the exact results in the region $3.5m_ec^2\lesssim k\leq 10\,m_ec^2$ [35, 36] gave the following result [39]

$$-\Delta\kappa_n^{\emptyset}(\text{Coul})=\bar{\phi}\left\{-4f(Z)\left(\frac{7}{9}-\frac{2}{k}+\frac{4}{3k^2}-\frac{8}{9k^3}\right)+\frac{1}{k}\left[c_1\ln^2\frac{k}{2}+c_2\ln\frac{k}{2}+c_3\left(1-\frac{2}{k}\right)\right]+\frac{1}{k^2}\left[c_4\ln^3\frac{k}{2}+c_5\ln^2\frac{k}{2}+c_6\left(1-\frac{2}{k}\right)\right]\right\} \quad (11)$$

in which $\bar{\phi}=\alpha Z^2r_e^2$ and, setting $a=\alpha Z$,

$$\begin{aligned}c_1&=a^2(-6.366+4.14a^2),\\ c_2&=a^2(54.039-43.126a^2+11.264a^4),\\ c_3&=a^2(-52.423+49.615a^2-14.082a^4),\\ c_4&=10.938a^2(1-a^2/0.324),\\ c_5&=-12.705a^2(1-a^2/0.324),\\ c_6&=9.093a^2(1-a^2/0.324).\end{aligned} \quad (12)$$

Equation (11) is seen to contain the Davies-Bethe-Maximon correction as the leading term. The maximum error, occurring somewhere in the intermediate region from 5 to 50 MeV, was estimated to be of the order of a few tenths of a percent of the total cross section, which was also shown in [34]. Recently, very accurate measurements of the total absorption cross

section for $Z=82$ and $Z=92$ have been made in the energy region of 50 to 250 MeV [62] where the photonuclear cross section is negligible in comparison with the total absorption cross section. These measurements serve as a check of the Coulomb correction computed using equations (11) and (12). It should be noted that equations (11) and (12) also give a convenient parametrization of the low-energy exact results [35, 36] in the range $3.5\ m_ec^2 \lesssim k \lesssim 10 m_ec^2$ (with errors of the order of 0.1 percent).

2.3. Screening Correction

As discussed by Davies, Bethe, and Maximon [59] and in [37, 38], screening is for high and intermediate energies well accounted for in the Born approximation. This may be understood semiclassically, considering the fact that the higher-order terms in the Born series (which give rise to the Coulomb correction in the unscreened case, as discussed in section 2.2) are related mainly to small distances from the nucleus, corresponding to high momentum transfer, for which screening is unimportant. Higher-order screening corrections are therefore negligible, except for low energies, as we shall discuss in subsection 2.3.4.

2.3.1. Bethe-Heitler Screened Born Approximation, High Energies

The Born approximation screened cross section,

$$\kappa_n^{BH}(\mathrm{scr}) = \kappa_n^{BH} - \Delta\kappa_n^{BH}(\mathrm{scr}) \tag{13}$$

was worked out in the high-energy approximation by Bethe and Heitler [54, 63]. For high energies ($E_+, E_-, k \gg 1$) and negligible nuclear recoil ($q^2 \ll k m_T/m_e$, where m_T is the mass of the recoiling nucleus), their result was

$$\kappa_n^{BH}(\mathrm{scr}) = \bar{\phi} k^{-3} \int_1^{k-1} dE_+ \Bigg[(E_+^2 + E_-^2) \Bigg\{ \int_\delta^1 (q-\delta)^2 \left[1 - \frac{F(q,Z)}{Z}\right]^2 \frac{dq}{q^3} + 1 \Bigg\} + \frac{2}{3} E_+ E_- \times \Bigg\{ \int_\delta^1 \left(q^3 - 6\delta^2 q \ln \frac{q}{\delta} + 3\delta^2 q - 4\delta^3 \right) \times \left[1 - \frac{F(q,Z)}{Z}\right]^2 \frac{dq}{q^4} + \frac{5}{6} \Bigg\} \Bigg] \tag{14}$$

in which E_+, E_- are the outgoing positron and electron energies, $\delta = k/(2E_+E_-)$ (hence $0 \leq \delta \leq 1.0$) and $F(q,Z)$ is the atomic form factor (see, e.g., references [64, 65] and references cited therein).

With the Thomas-Fermi [66, 67] statistical-model approximation for the atom, the double integrals in equation (14) can be reduced to single integrals [54, 68] as

$$\kappa_n^{TF}(\mathrm{scr}) = \bar{\phi} k^{-3} \int_1^{k-1} dE_+ \left[(E_+^2 + E_-^2) \left(\phi_1(\gamma) - \frac{4}{3} \ln Z \right) + \frac{2}{3} E_+ E_- \left(\phi_2(\gamma) - \frac{4}{3} \ln Z \right) \right] \tag{15}$$

in which the functions $\phi_1(\gamma)$ and $\phi_2(\gamma)$, where $\gamma = 100\ k/(E_+E_-Z^{1/3})$, were given graphically by Bethe and Heitler [54] and by Wheeler and Lamb [68] and have been recently discussed and tabulated by Tsai [41] who used the Molière [69] representation of the Thomas-Fermi atom.

With our present knowledge of the unscreened cross section κ_n^{BH} (cf., equations (2a, 2b)) we can get more accurate results, particularly for intermediate energies, by calculating only the screening-correction part of eq (14). Substituting $k - E_+ = E_-$ in equation (14) and replacing

$$\left[1 - \frac{F(q,Z)}{Z}\right]^2 \text{ by } \left\{ \left[1 - \frac{F(q,Z)}{Z}\right]^2 - 1 \right\}$$

and dropping the constant terms 1, $\frac{5}{6}$, which cancel, in the inner integrands, screening corrections to the nuclear-field pair production cross section in the Bethe-Heitler Born approximation are calculable according to

$$-\Delta\kappa_n^{BH}(\mathrm{scr}) = \bar{\phi} k^{-3} \int_1^{k-1} dE_+ \Bigg[\{E_+^2 + (k-E_+)^2\} \times \Bigg\{ \int_\delta^1 (q-\delta)^2 \left[-\frac{F(q,Z)}{Z} \left(2 - \frac{F(q,Z)}{Z} \right) \right] \frac{dq}{q^3} \Bigg\} + \frac{2}{3} E_+(k-E_+) \Bigg\{ \int_\delta^1 \left(q^3 - 6\delta^2 q \ln \frac{q}{\delta} + 3\delta^2 q - 4\delta^3 \right) \left[-\frac{F(q,Z)}{Z} \left(2 - \frac{F(q,Z)}{Z} \right) \right] \frac{dq}{q^4} \Bigg\} \Bigg], \tag{16}$$

in which

$$\delta = k/[2E_+(k-E_+)],\ 0 \leq \delta \leq 1.0.$$

Equations (14) and (16) are similar to expressions developed and used by Sørenssen [60] for his extensive numerical calculations (from 10 MeV to 100 GeV, 25 elements $Z=1$ to 92) of screened pair production cross sections. His results were the source of the pair-production screening corrections s^{BFS} listed (table 2.-13) and used in NSRDS-NBS 29 [26]. Sørenssen's expressions differ from equations (14) and (16) in that his inner integrals over q are taken from δ to ∞ (actually, truncated at $q=8\ m_ec$ for "relative error $<10^{-4}$") instead of from δ to $1\ m_ec$ as above and in reference [63]. Sørenssen used non-relativistic Hartree-Fock-Slater $F(q,Z)$ values from Hanson et al. [70] available over the range $0 \leq q \leq 0.3\ m_ec$, above which he used Thomas-Fermi-Molière [66, 67, 69] $F(q,Z)$ values over the remaining range $0.3 < q \leq 8\ m_ec$.

Equation (16) should be only approximately true, even in the high-energy limit. However, numerical computations of the screening correction in the form of the multiplicative factor $[\kappa_n^{BH} - \Delta\kappa_n^{BH}(\mathrm{scr})]/\kappa_n^{BH}$ differ from an exact Born-approximation screening correction (which will be given in section 2.3.3) by less than 0.2 percent (less than 0.05 percent for $k \geq 5\ m_ec^2$) over the entire photon energy range from threshold to extreme high energies, for elements $Z=1$ to 50. For a

heavier element such as U(Z=92) the difference (from exact Born, section 2.3.3) increases to a maximum of nearly 1 percent at threshold, decreasing with increasing energy to 0.2 percent or less for photon energies above 200 $m_e c^2$ ($\gtrsim$100 MeV).

A practical advantage of equation (16), in addition to its suitability for comprehensive and detailed coverage of the entire Z–E-ranges on a modest computational facility for interpolation, extrapolation and a rough check of the exact-Born results (sec. 2.3.3), is that the dependence of E_+ (or E_-) is explicitly given, as required for computations of energy deposition or mass energy absorption coefficients.

For the above purposes, particularly to aid in extrapolation (as will be discussed in section 2.5; see also table 1) of the Øverbø [37, 38] results to Z=1,2 and to Z=93 to 100, values of $-\Delta\kappa_n^{BH}$(scr) were systematically computed by numerical integration of equation (16) over the entire range of photon energies (1.022 MeV$\leq E \lesssim$100 GeV) and for all elements ($1 \leq Z \leq 100$) considered in this work. Values of the atomic form factor $F(q,Z)$ used in equation (16) are those compiled in reference [65] from the relativistic calculations by Doyle and Turner [71], Cromer and Waber [72] and Øverbø [73].

Table 1. Nuclear-field pair-production relativistic screening correction factors [1 - R], computed from Øverbø [37,38] parametrized $-\Delta\kappa_n^{B}$(scr) results for Z = 3 to 92, extrapolated to Z = 1 and to Z = 100 using $-\Delta\kappa_n^{BH}$(scr), eq (16), as discussed in section 2.5.

$k(m_e c^2)$	E(MeV)	$_1$H	$_6$C	$_{13}$Aℓ	$_{29}$Cu	$_{53}$I	$_{68}$Er	$_{82}$Pb	$_{92}$U	$_{100}$Fm
2.0	1.022	0.9997	0.9999	0.9992	0.9999	0.9976	0.9925	0.9925	0.9904	0.9843
3.0	1.533	0.9997	1.0000	0.9999	0.9994	0.9963	0.9936	0.9910	0.9890	0.9829
5.0	2.555	0.9998	1.0000	0.9999	0.9980	0.9937	0.9907	0.9878	0.9858	0.9798
10.	5.110	1.0000	0.9998	0.9982	0.9938	0.9875	0.9837	0.9803	0.9782	0.9720
20.	10.22	1.0000	0.9988	0.9936	0.9855	0.9764	0.9714	0.9669	0.9637	0.9578
30.	15.33	1.0000	0.9967	0.9886	0.9779	0.9665	0.9605	0.9547	0.9504	0.9446
50.	25.55	0.9999	0.9902	0.9780	0.9631	0.9488	0.9406	0.9337	0.9284	0.9227
100.	51.10	0.9991	0.9704	0.9538	0.9317	0.9105	0.9006	0.8916	0.8847	0.8793
200.	102.2	0.9935	0.9379	0.9151	0.8864	0.8583	0.8463	0.8349	0.8270	0.8220
300.	153.3	0.9840	0.9133	0.8844	0.8529	0.8223	0.8091	0.7968	0.7887	0.7833
500.	255.5	0.9616	0.8758	0.8398	0.8055	0.7735	0.7591	0.7462	0.7383	0.7327
1,000.	511.0	0.9133	0.8163	0.7742	0.7378	0.7059	0.6910	0.6780	0.6705	0.6650
2,000.	1,022.	0.8522	0.7527	0.7086	0.6721	0.6417	0.6270	0.6145	0.6077	0.6024
3,000	1,533.	0.8143	0.7160	0.6720	0.6362	0.6069	0.5926	0.5805	0.5740	0.5688
5,000	2,555.	0.7671	0.6719	0.6288	0.5942	0.5665	0.5527	0.5413	0.5352	0.5302
10,000	5,110.	0.7070	0.6169	0.5760	0.5434	0.5177	0.5048	0.4942	0.4887	0.4841
20,000	10,220.	0.6523	0.5680	0.5296	0.4992	0.4755	0.4635	0.4536	0.4485	0.4443
30,000	15,330.	0.6230	0.5422	0.5053	0.4761	0.4534	0.4419	0.4325	0.4277	0.4236
50,000	25,550.	0.5893	0.5125	0.4774	0.4496	0.4282	0.4173	0.4084	0.4038	0.3999
100,000	51,100.	0.5483	0.4765	0.4437	0.4178	0.3979	0.3877	0.3794	0.3751	0.3716
200,000	102,201.	0.5121	0.4450	0.4143	0.3900	0.3714	0.3619	0.3541	0.3501	0.3467

A modified Simpson-rule numerical integration procedure given by Spencer [74] was used for both the inner

$$\left(\int_\delta^1\right)$$

and outer

$$\left(\int_1^{k-1}\right)$$

integrals in equation (16), over a mesh of 500 and 200, respectively, logarithmically-spaced points. For each element Z=1 to 100 the inner integrals, analogous to the $\phi_1(\gamma)$ and $\phi_2(\gamma)$ functions in equation (15), were computed for a fixed grid of 34 δ-values over the range $10^{-8} \leq \delta \leq 1.0$. The outer integral in equation (16) was then computed to give $\Delta\kappa_n^{BH}$(scr) for each of 44 photon energy values spanning the range 1.022 MeV $\leq E \leq$100 GeV, obtaining inner-integral values by log-log quadratic interpolation from the above 34 point-values (as a function of δ) for each element Z=1 to 100.

2.3.2. Tsai Screened Born Approximation, $2 \ll k \leq \infty$

Tsai [41] has derived differential cross section expressions for bremsstrahlung and photoproduction of lepton pairs, including muons and heavy leptons as well as electron-positron pairs, based on work of Bjorken [75], Von Gehlen [76], and Drell and Walecka [77] who generalized the Bethe-Heitler result to deal with particles of arbitrary mass, spin, form factors

and arbitrary final states. Tsai's expressions, exact to order α^3 for pair production, are somewhat lengthy and cumbersome for use in numerical computations.

However, for electron-positron pairs at high energies ($E_+, E_-, k \gg 2m_ec^2$) and small opening angles ($\theta_+, \theta_- \ll 1$) Tsai's expression for the integral cross section, neglecting the particle rest-mass in the limits of integration, reduces to the triple integral

$$\kappa_n^{\mathrm{Tsai}}(\mathrm{scr})=4\bar{\phi}k^{-1}\int_0^1 \mathrm{d}x\int_0^x \mathrm{d}\ell\left\{\left[\frac{2x^2-2x+1}{(1+\ell)^2}+\frac{4\ell x(1-x)}{(1+\ell)^4}\right]\right.$$
$$\left.\times\int_{q'_{\min}}^{1+\ell}\left[(q^2-q'^2_{\min})\left(1-\frac{F(q,Z)}{Z}\right)^2\frac{dq}{q^3}\right]-f(Z)\right\} \quad (17)$$

in which $x=E_+/k$, $\ell=E_+^2\theta_+^2$, $q'^2_{\min}=(1+\ell)/[2kx(1-x)]$, $F(q,Z)$ is the atomic form factor and $f(Z)$ is the Davies-Bethe-Maximon [59] Coulomb correction discussed in section 2.2.1.

2.3.3. Exact Evaluation of Born-Approximation Screening Correction to the Total Cross Section

As was discussed in reference [3], including comparison with recent measurements [1, 2], Jost, Luttinger, and Slotnick (JLS) [78] derived an expression for nuclear-field pair production in the Born approximation and for small nuclear recoil but without the extreme high energy approximation. The JLS expression, also requiring atomic form factor data $F(q,Z)$ as input for numerical computations (e.g., references [3, 38]), was derived using a covariant method based on the unitary character of the scattering matrix, and is given, as typographically corrected by Borsellino [79], as

$$\kappa_n^{\mathrm{B}}(\mathrm{scr})=8\bar{\phi}k^{-2}\int_{k-\sqrt{k^2-4}}^{k+\sqrt{k^2-4}}\left[1-\frac{F(q,Z)}{Z}\right]^2\left\{\left(1-\frac{1}{2}q^2\right)J_1\right.$$
$$+\left(1-q^2-2qk+\frac{q^4-4}{3qk}\right)\ln(\sqrt{y}+\sqrt{y-1})+\left(3+\frac{2k}{3q}\right.$$
$$\left.+\frac{2q^2-4}{3qk}\right)\sqrt{y(y-1)}+\frac{1}{\sqrt{1+(4/q^2)}}\left[-\frac{1}{2}(4+q^2)\right.$$
$$\left.\left.+\frac{2k^2}{3}\left(\frac{1}{q^2}-1\right)\right]\ln\frac{\sqrt{1+(4/q^2)}-\sqrt{1-(1/y)}}{\sqrt{1+(4/q^2)}+\sqrt{1-(1/y)}}\right\}\frac{dq}{q^3} \quad (18)$$

in which

$$y=\frac{1}{4}(2qk-q^2), \quad (19)$$

$$J_1=L_2(-x_1)+L_2(-x_2)$$
$$+\frac{1}{2}\ln^2\lambda+(\ln v)\left(\frac{1}{2}\ln v-\ln 2qk\right)+\frac{\pi^2}{6}, \quad (20)$$

$$x_1=\frac{1}{v\lambda}, \qquad x_2=\frac{\lambda}{v}, \quad (21)$$

$$\lambda=\frac{1}{4}(q+\sqrt{q^2+4})^2, \quad (22)$$

and

$$v=(\sqrt{y-1}+\sqrt{y})^2. \quad (23)$$

L_2 is Euler's dilogarithm [80, 81], sometimes called the Spence [82] function, and is defined as

$$L_2(-x)=-\int_0^{-x}\frac{\ln(1-t)}{t}\,dt. \quad (24)$$

$L_2(-x)$ can be expanded

$$L_2(-x)=\sum_{i=1}^{\infty}\frac{(-x)^i}{i^2} \text{ for } |x|\leq 1. \quad (25)$$

Another useful relation is:

$$L_2(-x)=L_2\left(\frac{1}{1+x}\right)-\frac{1}{2}\ln(1+x)\ln\left(\frac{x^2}{1+x}\right)$$
$$-\frac{\pi^2}{6} \text{ for } x>0 \quad (26)$$

which was used in the computations in reference [3] for $|x|\geq 0.6$.

An expression for the screening correction $\Delta\kappa_n^{\mathrm{B}}(\mathrm{scr})$ analogous to equation (16) is obtained by again replacing the factor

$$\left[1-\frac{F(q,Z)}{Z}\right]^2$$

in equation (18) by

$$\left\{\left[1-\frac{F(q,Z)}{Z}\right]^2-1\right\} \text{ or } -\frac{F(q,Z)}{Z}\left[2-\frac{F(q,Z)}{Z}\right].$$

This method has been used by Øverbø [37, 38] and by Gimm and Hubbell [3].

For high energies, the JLS recoil distribution may be expanded and one gets [37]

$$\kappa_n^{\mathrm{B}}(\mathrm{scr})=c_1(Z)+c_2(Z)\frac{\ln k}{k}+c_3(Z)\frac{1}{k}$$
$$+\text{higher-order terms} \quad (27)$$

where the Z-dependent coefficients are given as

$$c_1(Z)=\frac{8}{3}\bar{\phi}\int_0^{\infty}\left[1-2\frac{1-\frac{1}{q^2}}{\left(1+\frac{4}{q^2}\right)^{1/2}}\ln\frac{\left(1+\frac{4}{q^2}\right)^{1/2}-1}{\left(1+\frac{4}{q^2}\right)^{1/2}+1}\right]$$
$$\times\frac{\left[1-\frac{F(q,Z)}{Z}\right]^2}{q^3}\,dq, \quad (27a)$$

$$c_2(Z)=-8\bar{\phi}\int_0^{\infty}\frac{\left[1-\frac{F(q,Z)}{Z}\right]^2}{q^2}\,dq, \quad (27b)$$

and

$$c_3(Z)=8\bar{\phi}\int_0^{\infty}\frac{\left[1-\frac{F(q,Z)}{Z}\right]^2}{q^2}[1-\ln(2q)]\,dq. \quad (27c)$$

The cross section $\kappa_n^{\mathrm{B}}(\mathrm{scr})$ is thus given in the high energy limit by $c_1(Z)$. A convenient expansion of the integrand in $c_1(Z)$ for small q may be found in [37].

Formula (18) has been used by Gimm and Hubbell [3] to calculate screening corrections for intermediate energies. Øverbø [37] has presented accurate results for 36 elements $Z=3$ through 92, parametrized in the form

$$\kappa_n^{\mathrm{B}}(\mathrm{scr})=c_1(Z)+c_2(Z)\frac{\ln k}{k}+c_3(Z)\frac{1}{k}+\frac{1}{k^2}[c_4(Z)\ln^3 k+c_5(Z)\ln^2 k+c_6(Z)\ln k+c_7(Z)] \quad (28)$$

in terms of the above coefficients $c_1(Z)$, $c_2(Z)$ and $c_3(Z)$ (equation (27a)–(27c)) plus four additional coefficients $c_4(Z)$–$c_7(Z)$ empirically fitted to the higher-order-terms contribution indicated in equation (27). In [37], interpolation vs Z was performed to obtain $c_1(Z)$–$c_7(Z)$ coefficients for 54 additional elements to provide systematic coverage for all elements $Z=3$ through 92. The modified expansion formula (28) covers the photon energy range from infinity down to ~15 MeV or 40 MeV (depending on the atomic number).

For the region not covered by these results, accurate numerical values for the screening correction may be obtained from the analytic fit [38]

$$-\Delta\kappa_n^{\mathrm{B}}(\mathrm{scr})=-R\kappa_n^{\mathrm{BH}} \quad (29)$$

with

$$\begin{aligned}R=&(1.61-5.62x+4.93x^2)/(100k)\\&+(-0.048-2.61x+6.36x^2-2.65x^3)\times10^{-2}\\&+(-3.69+42.3x-17.9x^2+0.826x^3)k\times10^{-4}\\&+(0.119+3.58x-17.2x^2+11.7x^3)k^2\times10^{-5}\\&+(0.087-2.8x+7.65x^2)k^3\times10^{-7}.\end{aligned} \quad (29a)$$

In this formula

$$x=(\alpha Z)^{2/3},\ (\alpha=1/137.036)$$

and k is the photon energy in units of m_ec^2. The fit reproduces the numerically calculated (reference [38]) values of R in the range

$$3.25\lesssim k\lesssim 90,\quad 3\leq Z\leq 25$$

$$3.25\lesssim k\lesssim 35,\ 26\leq Z\leq 92$$

with an r.m.s. deviation of 0.0003. Deviations larger than 0.001 occur only for $Z=3$. For the elements with $Z=3$ to 7 the following fit is better (with errors of the order of 10^{-4}):

$$R=c_1+c_2k+c_3k^2+c_4k^3;\ 3.25\lesssim k\lesssim 90; \quad (30)$$

with the constants c_1–c_4 (from reference [38]) given as

Z	c_1	c_2	c_3	c_4
3	5.12×10^{-4}	-6.22×10^{-5}	2.21×10^{-6}	-3.76×10^{-9}
4	7.22×10^{-4}	-1.01×10^{-4}	4.38×10^{-6}	-1.50×10^{-8}
5	6.10×10^{-4}	-1.08×10^{-4}	6.13×10^{-6}	-2.63×10^{-8}
6	2.21×10^{-4}	-7.94×10^{-5}	7.15×10^{-6}	-3.47×10^{-8}
7	-7.06×10^{-5}	-4.32×10^{-5}	7.80×10^{-6}	-4.14×10^{-8}

2.3.4. Screening Corrections, Low Energies

For low energies, screening is not adequately described in the Born approximation, as mentioned in the introduction to section 2.3.

This was shown by Tseng and Pratt [42] who computed low-energy screened cross sections using numerically calculated radial wave functions, with a screened potential of the form

$$V=-\alpha Z/r+V_{\mathrm{el}}(r)+V_{\mathrm{GKS}}(r) \quad (31)$$

where $V_{\mathrm{el}}(r)$ is the contribution from the atomic electrons to the potential energy of the created electron, and $V_{\mathrm{GKS}}(r)$ is the Gáspár-Kohn-Sham [83, 84] equivalent exchange potential

$$V_{\mathrm{GKS}}(r)=-\alpha[3\rho_{\mathrm{el}}(r)/\pi]^{1/3} \quad (32)$$

in which $\rho_{\mathrm{el}}(r)$ is the radial electron density distribution.

Tseng and Pratt observed that the results of the above detailed computation could be approximated to within ~1 percent, at least for $k\gtrsim 2.6\,m_ec^2$, by applying to the point-Coulomb positron energy spectra of Øverbø et al. [36] an energy-shift

$$\Delta=V_{\mathrm{el}}(r_{\mathrm{n}})+V_{\mathrm{GKS}}(r_{\mathrm{n}}), \quad (33)$$

in which r_{n} is the nuclear radius, leading to

$$d\kappa_{\mathrm{n}}^{\emptyset}(\mathrm{scr})=d\kappa_{\mathrm{C}}^{\emptyset\mathrm{MO}}(E_++\Delta,\ E_--\Delta). \quad (34)$$

Combining the above results, Tseng and Pratt in reference [43] provide a table of $\kappa_{\mathrm{n}}^{\mathrm{TP}}(\mathrm{scr})$ values for $Z=13$, 29, 53, 68, 82, and 92 over the range 2.1 $m_ec^2\leq k\leq 10.0m_ec^2$.

For photon energies in the range 5 to 10 m_ec^2 the Tseng-Pratt correction is decreasing fast, but still positive. It has been pointed out by Øverbø that the sign of the total screening correction in this region will change when one takes into account the Born screening term. The point made by Øverbø is that the energy-shift screening correction in this energy region represents only the higher-order screening corrections, so that the Born screening term must be added separately [38]. Arguing for a somewhat different energy-shift, viz.

$$\Delta=V_{\mathrm{el}}(0), \quad (35)$$

(corresponding to no exchange for the positron and neglect of exchange for the electron) Øverbø thereby gets screening corrections which are somewhat larger than those of Tseng and Pratt for $k\lesssim 3$ and smaller for $k\gtrsim 3$, becoming negative for $k\gtrsim 5\,m_ec^2$. Øverbø presents his results for the low-energy screening correction as

$$\kappa_{\mathrm{n}}(\mathrm{scr})=\kappa_{\mathrm{n}}^{\mathrm{BH}}+\Delta\kappa_{\mathrm{n}}^{\emptyset}(\mathrm{scr}),$$

$$\Delta\kappa_{\mathrm{n}}^{\emptyset}(\mathrm{scr})=-\Delta\kappa_{\mathrm{n}}^{\mathrm{B}}(\mathrm{scr})+\Delta\kappa_{\mathrm{n}}^{\emptyset}(\mathrm{scr,\ higher\ order}) \quad (36)$$

where the higher-order screening correction, obtained by integrating over equation (34), is given in parametrized form:

$$\Delta\kappa_n^{\emptyset}(\text{scr, higher order})=\alpha^2 Z^3 \exp(S) \text{ barns} \quad (37)$$

in which

$$S=-7.904-1.737a+7.465a^2 +(-0.048+0.894a-2.541a^2)\ \ln k +(-1.216+5.158a-4.83a^2)/(k-2) -0.219/(k-2)^2, \quad (37a)$$

with k in units of m_ec^2 and $a=\alpha Z$. Equation (38) reproduces the calculated values in the range $3m_ec^2 \lesssim k \lesssim 10\ m_ec^2$ with errors of the order of $10^{-4}\times\kappa_n^{BH}$, and may safely be used for extrapolation up to $k\sim(2+Z^{3/2}/40)\ m_ec^2$ (for large Z). For higher energies, the higher-order screening correction is negligible, as discussed at the beginning of section 2.3. For the region below $k\cong 3\ m_ec^2$, results are given [38] in terms of tables for the total cross section κ_n, including screening and Coulomb corrections.

In table 2 we present values of the low-energy higher-order screening correction factor composited by smoothly (log-linearly) joining the Tseng-Pratt and Øverbø results as follows

$$\Delta\kappa_n^{TP-\emptyset}(\text{scr, h.o.})\begin{cases} =\Delta\kappa_n^{TP}(\text{scr, h.o.}) & \text{for } k\lesssim 2.3m_ec^2 \ (E\lesssim 1.18\text{ MeV}) \\ =\exp\left\{\ln A-\ln\left(\frac{B}{A}\right)\frac{\ln\left(\frac{k-2.0}{2.3-2.0}\right)}{\ln\left(\frac{5.0-2.0}{2.3-2.0}\right)}\right\} & \text{for } 2.3<k<5.0 \\ =\Delta\kappa_n^{\emptyset}(\text{scr, h.o.}) & \text{for } k\gtrsim 5.0\ m_ec^2 \ (E\gtrsim 2.56\text{ MeV}) \end{cases} \quad (38)$$

in which "h.o." signifies "higher-order,"

$$A=\Delta\kappa_n^{TP}(\text{scr, h.o.}) \quad \text{at } k=2.3m_ec^2.$$

and

$$B=\Delta\kappa_n^{\emptyset}(\text{scr, h.o.}) \quad \text{at } k=5.0m_ec^2.$$

The values in table 2, $\Delta\kappa_n^{TP-\emptyset}(\text{scr, h.o.})/\kappa_n^{BH}$, are to be added to the entries in table 1, $1.0-\Delta\kappa_n^{B}(\text{scr})/\kappa_n^{BH}$, to give the total screening correction factor.

Table 2. Low-energy higher-order screening corrections $\Delta\kappa_n^{TP-\emptyset}(\text{scr,h.o.})/\kappa_n^{RH}$ to nuclear-field pair production, obtained by smoothly joining (a) the results of Tseng and Pratt [43] ($k \leq 2.3\ m_ec^2$) to (b) those of Øverbø [38] ($k \gtrsim 5.0\ m_ec^2$) These corrections, added to the [1 - R]-values in table 1, give the total screening factors used in computing the nuclear-field pair production cross sections in table 6.

$k(m_ec^2)$	E(MeV)	$_1H$	$_6C$	$_{13}Al$	$_{29}Cu$	$_{53}I$	$_{68}Er$	$_{82}Pb$	$_{92}U$	$_{100}Fm$
2.10	1.073	0.0079	0.0195	0.0430	0.1560	0.5100	0.8900	1.3150	1.6500	1.9400
2.15	1.099	0.0035	0.0086	0.0190	0.0890	0.2710	0.4750	0.7290	0.9700	1.1550
2.2	1.124	0.0022	0.0055	0.0122	0.0610	0.1750	0.3090	0.4940	0.6560	0.7900
2.3	1.175	0.0013	0.0031	0.0069	0.0344	0.0980	0.1725	0.2750	0.3640	0.4400
2.5	1.278	0.0006	0.0017	0.0039	0.0169	0.0481	0.0849	0.1373	0.1858	0.2308
3.0	1.533	0.0002	0.0008	0.0018	0.0065	0.0183	0.0324	0.0535	0.0746	0.0961
4.0	2.044	0.0001	0.0003	0.0008	0.0025	0.0070	0.0124	0.0208	0.0300	0.0400
5.0	2.555	0	0.0002	0.0005	0.0014	0.0040	0.0071	0.0120	0.0176	0.0240
6.0	3.066	0	0.0002	0.0004	0.0010	0.0027	0.0046	0.0075	0.0107	0.0143
8.0	4.088	0	0.0001	0.0002	0.0006	0.0016	0.0027	0.0041	0.0056	0.0073
10.0	5.110	0	0.0001	0.0002	0.0005	0.0012	0.0019	0.0028	0.0037	0.0046
15.0	7.665	0	0.0001	0.0001	0.0003	0.0008	0.0011	0.0016	0.0020	0.0023
20.0	10.22	0	0	0.0001	0.0003	0.0006	0.0008	0.0011	0.0013	0.0015
30.0	15.33	0	0	0.0001	0.0002	0.0004	0.0006	0.0007	0.0008	0.0008
40.0	20.44	0	0	0.0001	0.0002	0.0004	0.0005	0.0005	0.0006	0.0006
50.0	25.55	0	0	0.0001	0.0002	0.0003	0.0004	0.0004	0.0004	0.0004
60.0	30.66	0	0	0.0001	0.0002	0.0003	0.0003	0.0004	0.0004	0.0003
80.0	40.88	0	0	0.0001	0.0001	0.0003	0.0003	0.0003	0.0003	0.0002
100.0	51.10	0	0	0.0001	0.0001	0.0002	0.0003	0.0002	0.0002	0.0002

2.4. Radiative Correction

An additional correction, omitted from all the above unscreened and screened theoretical estimates of the nuclear-field pair production cross section, is the "radiative correction" [85–95]. This correction, of the order of 1/137, is associated with the emission and reabsorption of virtual photons and with the emission of both soft and hard real photons.

For purposes of the present work, numerical values for the radiative correction were obtained from formulas and tabulated values given by Mork and Olsen [92]. For moderately low energies and for extreme high energies Mork and Olsen give, respectively,

$$\Delta(\text{rad. corr.})=0.93\,\frac{\ln 2k-1.58}{\ln 2k-2.08}\,\%$$

$$(\text{no screening};\ 30\ m_ec^2\lesssim k\lesssim 100\ m_ec^2) \quad (39)$$

and

$$\Delta(\text{rad. corr.})=(0.93\pm 0.05)\%$$

$$(\text{complete screening};\ 1000\ m_ec^2\lesssim k\lesssim\infty) \quad (40)$$

In the intermediate region (partial screening; 100 $m_ec^2\lesssim k\lesssim 1000\ m_ec^2$) radiative correction values were obtained by interpolation and extrapolation of table IV of Mork and Olsen [92].

Mork and Olsen [92] do not claim any validity for equation (39) for $k\lesssim 30\ m_ec^2$, and it can be seen also that this equation has a singularity at $\ln 2k=2.08$ (or at $k=4.0\ m_ec^2$). Since no theoretical estimate, to the authors' knowledge, is available covering the region $2\ m_ec^2\leq k\lesssim 30\ m_ec^2$, an empirically-determined sine-function cut-off has in this work been applied to equation (39) to give a total attenuation coefficient in the region 5 to 10 MeV consistent with available recent measurements.

Sample values of the radiative correction Δ(rad. corr.), composited as described above including the sine-function low-energy cut-off, are listed in table 3.

Table 3. Radiative corrections Δ(rad corr) (percent, positive) to nuclear-field pair production, from Mork and Olsen [92] (their table IV, eqs X.3, X.4). with empirical (this work) low-energy sine-function cut-off.

E(MeV)	$_1$H	$_{13}$Aℓ	$_{29}$Cu	$_{50}$Sn	$_{82}$Pb	$_{100}$Fm
3.0	0%	0%	0%	0%	0%	0%
4.0	0.06	0.06	0.06	0	0	0
5.0	0.21	0.21	0.21	0	0	0
6.0	0.42	0.42	0.42	0.03	0	0
8.0	0.88	0.88	0.88	0.26	0.06	0.06
10.0	1.18	1.18	1.18	0.61	0.28	0.28
15	1.16	1.16	1.16	1.16	1.02	1.02
20	1.13	1.13	1.13	1.13	1.13	1.13
30	1.10	1.10	1.10	1.10	1.10	1.10
40	1.09	1.08	1.08	1.08	1.08	1.08
50	1.07	1.07	1.07	1.06	1.06	1.06
60	1.06	1.06	1.05	1.04	1.04	1.04
80	1.05	1.04	1.04	1.02	1.02	1.02
100	1.03	1.03	1.02	1.01	1.00	1.00
150	1.01	1.00	.99	.98	.96	.96
200	.99	.98	.97	.95	.94	.94
300	.96	.95	.94	.94	.93	.93
400	.95	.94	.93	.93	.93	.93
500	.94	.94	.93	.93	.93	.93
600	.93	.93	.93	.93	.93	.93
∞	.93	.93	.93	.93	.93	.93

2.5. Composited Nuclear-Field (Coherent) Pair Production Cross Section

For purposes of the present tabulation of photon cross section and mass attenuation coefficient data, we have constructed a table of coherent pair production total cross sections κ_n (listed as "PAIR PRODUCTION, NUCLEAR FIELD" in table 6). This was done by selecting among the above theoretical cross section estimates (including Coulomb, screening and radiative corrections) according to the following scheme:

$$1.022\ \text{MeV}\leq E\leq 5.0\ \text{MeV}(2.0\ m_ec^2\leq k\leq 9.78\ m_ec^2):$$

For this range, where theoretical estimates are mostly given in terms of more or less densely tabulated numerical values, the cross section was obtained as

$$\kappa_n = \kappa_n^{BH}[\kappa_n^{\emptyset MO}/\kappa_n^{BH}]\{[\kappa_L^{1\,H} - \Delta\kappa_n^{B}(\text{scr}) + \Delta\kappa_n^{TP-\emptyset}(\text{scr, h.o.})]/\kappa_n^{BH}\} \quad (41)$$

where κ_n^{BH} is the Bethe-Heitler [54] unscreened Born-approximation cross section computed using the Maximon [57] expansion in equation (2a) for $k \leq 4\ m_ec^2$ and in equation (2b) for $k > m_ec^2$. The ratio $\kappa_n^{\emptyset MO}/\kappa_n^{BH}$ was interpolated from the Øverbø-Mork-Olsen low-energy exact unscreened numerical results discussed in section 2.2.2. The exact-Born (B) and higher-order (TP-Ø) screening corrections, $-\Delta\kappa_n^{B}(\text{scr})$ and $\Delta\kappa_n^{TP-\emptyset}$ (scr, h.o.) have been discussed in sections 2.3.3 and 2.3.4, respectively, and are tabulated (in multiplicative-factor form) for some sample elements and photon energies in tables 1 and 2.

Although $-\Delta\kappa_n^{B}(\text{scr})$ is seen to be a small or negligible contribution in this energy region, it becomes comparable in magnitude to $\Delta\kappa_n^{TP-\emptyset}$(scr, h.o.) for high-$Z$ elements for $k \gtrsim 5.0\ m_ec^2$. The extrapolation of available ($Z=3$ to 92) $-\Delta\kappa_n^{B}(\text{scr})$ results to all elements $Z=1$ to 100 will be discussed below. As can be seen in table 1, and as discussed in reference [38] (section 3.4; see also fig. 2 in [38]), $-\Delta\kappa_n^{B}(\text{scr})$ remains a small but finite negative correction even at threshold ($k=2.0\ m_ec^2$) because "even for low energies a certain fraction of the pairs are produced in the electron charge region (mostly in the inner part) where the electric field is reduced compared to the unscreened case."

5.0 MeV $< E \leq$ 100 GeV ($9.8\ m_ec^2 < k < 1.96 \times 10^5\ m_ec^2$):

For $E > 5.0$ MeV, the cross section was obtained as

$$\kappa_n = [\kappa_n^{BH}\{[\kappa_n^{BH} - \Delta\kappa_n^{B}(\text{scr}) + \Delta\kappa_n^{\emptyset}(\text{scr, h.o.})]/\kappa_n^{BH}\} - \Delta\kappa_n^{\emptyset}(\text{Coul})]\cdot[1 + \Delta(\text{rad. corr.})]. \quad (42)$$

The quantities κ_n^{BH} and $-\Delta\kappa_n^{B}(\text{scr})$ were defined for equation (41), above, and $\Delta\kappa_n^{\emptyset}(\text{scr, h.o.}) = \Delta\kappa_n^{TP-\emptyset}$ (scr, h.o.) (equation (38)) in this energy region. Numerical values of $-\Delta\kappa_n^{B}(\text{scr})$, in the form of $[1-R] = [1-\Delta\kappa_n^{B}(\text{scr})/\kappa_n^{BH}]$, were assembled, for purposes of this compilation, as follows, in which R has the same meaning as in equations (29) and (30):

$[1-R]$, $Z=1,2$:

"Exact Born" (see sec. 2.3.3) screening corrections $\Delta\kappa_n^{B}$ were not computed in reference [37] for $Z=1$ and 2. However, for $Z=3$ to 6, $[1-R]$-values computed as $[1-(\Delta\kappa_n^{BH}(\text{scr})/\kappa_n^{BH})]$ using equation (16) were found to differ by less than 0.05 percent from $[1-R]$ computed as $[1-(\Delta\kappa_n^{B}(\text{scr})/\kappa_n^{BH})]$ using equations (28–30). Hence for $Z=1$ and 2, for which differences should be even smaller if $-\Delta\kappa_n^{B}(\text{scr})$ were available, $[1-R]$ values computed from equation (16) were used directly except for $k \leq 15 m_ec^2$, where the $-\Delta\kappa_n^{B}(\text{scr})$ energy-dependence for $Z=3$ was applied as a small ($\leq 0.03\%$) correction.

$[1-R]$, $Z=3$ to 92:

For all elements $Z=3$ to 92 the exact-Born screening factor $[1-R]$, sample values of which are given in table 1, were computed over the entire energy range $2.0\ m_ec^2 \leq k \leq 2.0 \times 10^5\ m_ec^2$ using equations (28, (29, 29a), and (30), each in its specified region of validity. Numerical values for the coefficients c_1 to c_7 used in equation (28) were taken from table I of reference [37]. These coefficients, as was discussed in section 2.3.3, were fitted to $-\Delta\kappa_n^{B}(\text{scr})$ values computed by Øverbø, using the Jost-Luttinger-Slotnick [74] formulation given in equation (18), for all elements $Z=3$ to 20 and for 18 elements in the range $Z=22$ to 92. Øverbø includes (in table 1, reference [37]) coefficients c_1 to c_7 for the remaining 54 elements in the range $Z=21$ to 91, obtained by Z-interpolation, also used in the present work.

$[1-R]$, $Z=93$ to 100:

For $Z=87$ to 92, $k \lesssim 200\ m_ec^2$, $[1-R]$ values obtained from equation (16) differ systematically from values from equation (28) by nearly a constant 0.2 percent increment, while for lower energies this difference increases by varying amounts to as much as +1.0 percent at $k=2.0\ m_ec^2$ for $Z=92$. This near-threshold larger difference results because $-\Delta\kappa_n^{B}(\text{scr})$ goes to a finite value at threshold, rather than to zero as does $-\Delta\kappa_n^{BH}(\text{scr})$, as discussed above and in section 3.4 of reference [38]. Thus $[1-R]$ values for $Z=93$ to 100 ($Z=100$ example given in table 1) were obtained for $k \geq 200\ m_ec^2$ from equation (16), decreased by 0.2 percent. For lower energies, the $Z=93$ to 100 $[1-R]$ values use the $Z=92$ $-\Delta\kappa_n^{B}(\text{scr})$ energy dependence, normalized to the $-\Delta\kappa_n^{BH}(\text{scr})$ values from equation (16) (less 0.2 percent) at $k=200\ m_ec^2$.

In equation (42) the Coulomb correction $\Delta\kappa_n^{\emptyset}(\text{Coul})$ is that of Øverbø [39] given in equations (11) and (12) in section 2.2.3. Finally, the radiative correction Δ(rad. corr.) in equation (42) is that of Mork and Olsen [92], extrapolated to energies below 15 MeV as discussed in section 2.4.

The magnitudes of the above corrections (screening, Coulomb and radiative) are shown in the form of percent contributions to κ_n (equations 41 and 42) in figures 4, 5, and 6 for carbon, copper and lead, respectively. Also shown, for comparison, are the Davies-Bethe-Maximon (DBM) [59] extreme high-energy Coulomb correction and the Sørenssen [65] Coulomb correction, both of which are restricted in application to energies above ~10 MeV for a light element such as carbon, and to above ~200 MeV for a heavy element such as lead.

We emphasize that in the region $E < 15$ MeV theoretical estimates of the radiative correction Δ(rad. corr.) are lacking, and that this correction has been extrapolated to threshold by an ad hoc procedure in which this correction is neglected altogether for $E \lesssim 4$ MeV for low-Z elements and for $E \lesssim 8$ MeV for

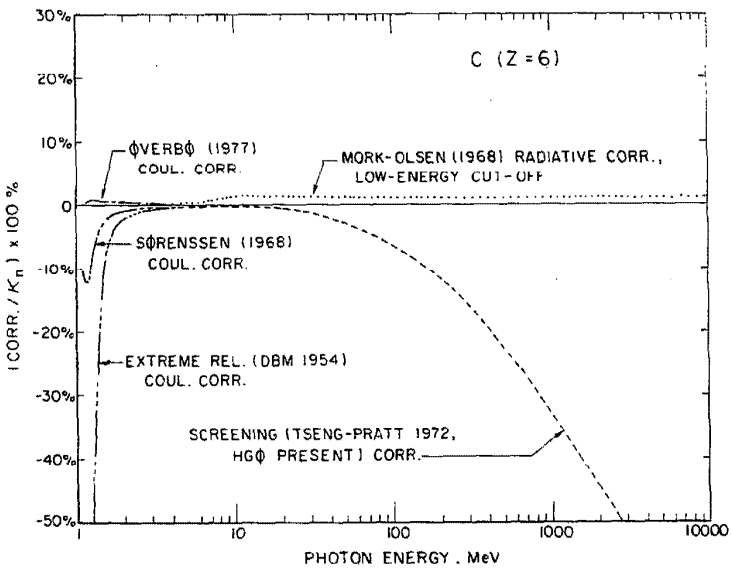

FIGURE 4. Percent contributions of (a) screening ([37, 38, 43] and this work), (b) the radiative correction ([92] and this work) and (c) the Øverbø [39] Coulomb correction to the composited nuclear-field pair production cross section κ_n in carbon from threshold (1.022 MeV) to 10 GeV. The high-energy Coulomb corrections of Davies, Bethe and Maximon [59] and Sørenssen [60], not used in this work, are shown also in percent form for comparison.

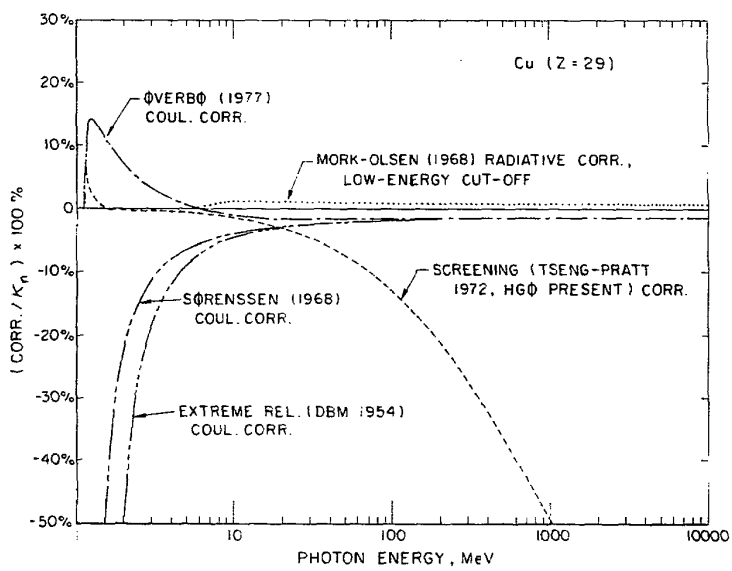

FIGURE 5. Percent contributions of (a) screening ([37, 38, 43] and this work), (b) the radiative correction ([92] and this work) and (c) the Øverbø [39] Coulomb correction to the composited nuclear-field pair production cross section κ_n in copper from threshold (1.022 MeV) to 10 GeV. The high-energy Coulomb corrections of Davies, Bethe and Maximon [59] and Sørenssen [60], not used in this work, are shown also in percent form for comparison.

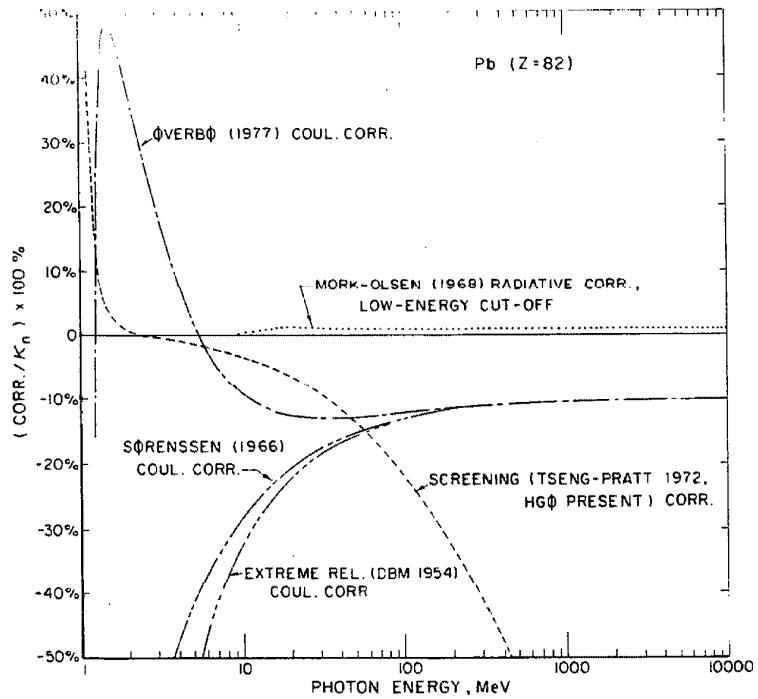

FIGURE 6. Percent contributions of (a) screening ([37, 38, 43] and this work), (b) the radiative correction ([92] and this work) and (c) the Øverbø [39] Coulomb correction to the composited nuclear-field pair production cross section κ_n in lead from threshold (1.022 MeV) to 10 GeV. The high-energy Coulomb corrections of Davies, Bethe and Maximon [59] and Sørenssen [60], not used in this work, are shown also in percent form for comparison.

high-Z elements (table 3). From this source, in the present tables for κ_n (equations (41) and (42)), one may expect errors of the order of 1 percent for the energy range 1–10 MeV.

In equation (42) the Mork-Olsen radiative correction is taken to apply also to the Coulomb correction. Strictly speaking, this is probably not quite correct, but the error introduced will probably be small, of the order of 0.1 percent. Errors of the same order are introduced by the neglect (except for low energies) of higher order screening corrections [3, 37, 38].

For intermediate energies, the uncertainty in the Coulomb correction may be a main source of error (cf. sec. 2.2.3). This uncertainty has been estimated to be a few tenths of a percent [39].

It should be noted that the form factors [64, 71–73] that were used in the screening calculations on which the present tables are based are free-atom form factors. For high energies, the screening effect depends strongly on the electron charge densities at large distances from the nucleus, i.e., at the interatomic boundaries. We have not estimated to what extent such interatomic "binding" effects may change the form factors for small momentum transfers and hence the screening correction $\Delta\kappa_n^B$(scr).

3. Incoherent Pair Production Cross Section (Pair Production with Excitation or Ionization (Triplet Production))

3.1. General Remarks

Whereas pair production on free electrons has a threshold of 4 m_ec^2 (=2.044 MeV), as required by the sharing of the photon energy and momentum between the target electron and the created pair, the threshold for incoherent production on atoms strictly speaking lies only slightly above 2 m_ec^2. The reason is that momentum can be transferred to the atom both in excitation and ionization [96]. The cross section below 4 m_ec^2 will however be very small, and is neglected in table 6.

In the case of ionization, the tracks of the two electrons and the positron may be visible as three-pronged events in a streamer or cloud chamber or in a photographic emulsion; hence the name "triplet production." In the present work, "triplet" or "triplet production" is frequently used as a synonym for the whole process of incoherent production, i.e., including also excitation.

An exact theoretical treatment should include the following effects:

(i) atomic binding of the target electron,

(ii) screening by the other atomic electrons and by the field of the nucleus,

(iii) retardation which occurs when the atomic electron recoil velocity is not negligible in comparison with the velocity of light.

(iv) the γ–e interaction of the incident photon with the atomic electron (i.e., virtual Compton scattering in which the scattered photon gives rise to an electron-positron pair).

(v) exchange terms resulting from the indistinguishability of the two electrons, and

(vi) the radiative corrections.

No one treatment has included all six of these effects, so numerical values are usually obtained from a combination of one or more of the following theoretical treatments, all of which employ the Born approximation.

3.2. Unscreened Triplet Calculations

3.2.1. Borsellino-Ghizzetti Triplet Formulas

Of the effects listed in section 3.1, above, Borsellino [97] took into account only retardation (iii) to derive an expression for the triplet cross section

$$\kappa_e(\text{Borsellino corrected})=Z\alpha r_e^2\left\{\frac{28}{9}\ln(2k)-\frac{218}{27}-\frac{1}{k}\left[\frac{4}{3}\ln^3(2k)-3\ln^2(2k)+6.84\ln(2k)-21.51\right]\right\} \quad (43)$$

in which a sign-error in the last term (-21.51), pointed out by Mork [98], has been corrected. Suh and Bethe [99] have shown that at high energies Borsellino's neglect of exchange (v) is unimportant.

Ghizzetti [100] derived additional terms, through k^{-7}, for equation (43) to give the Borsellino-Ghizzetti expansion

$$\begin{aligned}\kappa_e^{BG}=Z\alpha r_e^2\Bigg[&\frac{28}{9}\ln 2k-\frac{218}{27}\\&+\frac{1}{k}\left(-\frac{4}{3}\ln^3 2k+3\ln^2 2k-\frac{60+16a}{3}\ln 2k+\frac{123+12a+16b}{3}\right)\\&+\frac{1}{k^2}\left(\frac{8}{3}\ln^3 2k-4\ln^2 2k+\frac{51+32a}{3}\ln 2k-\frac{123+32a+64b}{6}\right)\\&+\frac{1}{k^3}\left(\ln^2 2k-\frac{53}{9}\ln 2k-\frac{2915-288a}{216}\right)\\&+\frac{1}{k^4}\left(-\frac{49}{18}\ln 2k-\frac{115}{432}\right)\\&+\frac{1}{k^5}\left(-\frac{77}{36}\ln 2k+\frac{10831}{8640}\right)\\&+\frac{1}{k^6}\left(-\frac{641}{300}\ln 2k+\frac{64573}{36000}\right)\\&+\frac{1}{k^7}\left(-\frac{4423}{1800}\ln 2k+\frac{394979}{216000}\right)+\cdots\Bigg]\end{aligned} \quad (44)$$

with $a=-2.4674$ and $b=-1.8031$.

3.2.2. Votruba-Mork-Haug Triplet Calculations

Votruba [101] derived differential expressions (of considerable complexity) for the triplet cross section which include the effects of γ–e interaction (iv) and exchange (v) in addition to retardation (iii). These expressions were integrated numerically by Mork [98] for photon energies $4m_ec^2\leq k\leq 16m_ec^2$. Later, Haug [102] derived a lengthy analytical expression for the integrated triplet cross section, from which he computed numerical values of the cross section κ_e^H over the range $4.001\ m_ec^2\leq k\leq 5000\ m_ec^2$, above which κ_e^H is indistinguishable from the Borsellino-Ghizzetti triplet cross section κ_e^{BG} given by equation (44). The Haug numerical results, which still neglect atomic binding (i), screening (ii) and radiative corrections (vi), but which include retardation (iii), γ–e interaction (iv) and exchange (v), are given in table 4 in the form of the ratio κ_e^H/κ_e^{BG}.

3.3. Triplet Screening Corrections

3.3.1. Bethe-Heitler, Wheeler-Lamb Formulas

Analogous to the nuclear-field pair-production cross section expression in equation (15) for a Thomas-Fermi [66, 67] atom, Wheeler and Lamb [68] derived from the Bethe-Heitler [54] results an expression for the cross section $\kappa_e^{TF}(\text{scr})$ for incoherent pair production on atoms ("screened triplet"), valid for high energies

$$\kappa_e^{TF}(\text{scr})=Z\alpha r_e^2k^{-3}\int_1^{k-1}dE_+\left[(E_+^2+E_-^2)\times\left(\psi_1(\gamma)-\frac{8}{3}\ln Z\right)+\frac{2}{3}E_+E_-\left(\psi_2(\gamma)-\frac{8}{3}\ln Z\right)\right] \quad (45)$$

in which the functions $\psi_1(\gamma)$ and $\psi_2(\gamma)$, where $\gamma=100\ k/E_+E_-Z^{2/3}$, were given numerically (graphically) by Wheeler and Lamb [68].

The Wheeler-Lamb $\psi_1(\gamma)$ and $\psi_2(\gamma)$ functions are associated with the inner integrals over dq of the Bethe-Heitler [54] formula (equation (14)) in which the form-factor bracket

$$\left[1-\frac{F(q,Z)}{Z}\right]^2$$

has been replaced by the incoherent scattering function

$$\frac{S(q,Z)}{Z}$$

counterpart. The Thomas-Fermi $S(q,Z)$ values used by Wheeler and Lamb to obtain $\psi_1(\gamma)$ and $\psi_2(\gamma)$ are the $S(v)$ values taken from the works of Heisenberg [103]

Table 4. Ratio κ_e^H/κ_e^{BG} of the Haug [102] unscreened exchange-corrected triplet cross section κ_e^H to the Borsellino-Ghizzetti [97,100] cross section κ_e^{BG} given in eq (44).

$k(m_ec^2)$	κ_e^H/κ_e^{BG}	$k(m_ec^2)$	κ_e^H/κ_e^{BG}	$k(m_ec^2)$	κ_e^H/κ_e^{BG}
4.000	0	6.6	.8305	60	1.0105
4.001	.000098	7.0	.8552	70	1.0099
4.002	.000393	7.4	.8746	80	1.0094
4.003	.000888	7.8	.8913	90	1.0089
4.004	.001583	8.0	.8988	100	1.0085
4.005	.002477	9	.9268	150	1.0067
4.01	.009871	10	.9463	200	1.0054
4.02	.03684	11	.9605	300	1.0040
4.03	.07284	12	.9708	400	1.0031
4.04	.1098	13	.9784	500	1.0026
4.05	.1444	14	.9841	600	1.0023
4.1	.2489	16	.9927	700	1.0019
4.2	.3418	18	.9984	800	1.0017
4.4	.4491	20	1.0025	900	1.0015
4.6	.5254	25	1.0073	1000	1.0014
5.0	.6335	30	1.0097	1500	1.0009
5.4	.7066	35	1.0106	2000	1.0007
5.8	.7595	40	1.0110	2500	1.0006
6.0	.7803	45	1.0110	3000	1.0005
6.2	.7990	50	1.0109	5000	1.0003

and Bewilogua [104]. It should be noted that the use of the incoherent scattering function in "screened triplet" calculations is equivalent to taking into account, at least approximately, both ionization and excitation of the atom [68]. This is the reason for making a principal distinction (as in sec. 2 and 3) between coherent and incoherent production, rather than between pair production and pair production with ionization.

In this work the Bethe-Heitler formulation is used directly, following Knasel [30], using the updated $S(q,Z)$ values compiled by Hubbell et al., [64] principally from the configuration-interaction $Z=2$ to 6 results of Brown [105] and nonrelativistic Hartree-Fock results of Cromer and Mann [106–108] for the remaining Z's. Cast in the form of the screening part only, analogous to equation (16), the triplet screening correction $-\Delta\kappa_e^{BH}(\text{scr})$ is

$$-\Delta\kappa_e^{BH}(\text{scr})=4Z\alpha r_e^2k^{-1}\int_1^{k-1}\mathrm{d}E_+\left[[E_+^2-(k-E_+)^2]\times\left\{\int_\delta^1(q-\delta)^2\left[\frac{S(q,Z)}{Z}-1\right]\frac{\mathrm{d}q}{q^3}\right\}+\frac{2}{3}E_+(k-E_+)\times\left\{\int_\delta^1\left(q^3-6\delta^2q\ln\frac{q}{\delta}-3\delta^2q-4\delta^3\right)\left[\frac{S(q,Z)}{Z}-1\right]\frac{\mathrm{d}q}{q^4}\right\}\right] \tag{46}$$

in which, again, $\delta=k/[2E_+(k-E_+)]$, E_+ is the positron (or electron) total energy in m_ec^2 units, k is the incident photon energy in m_ec^2 units and q is the momentum transfer in m_ec units.

Table 5 gives triplet screening corrections obtained by numerical integration of equation (46), using incoherent scattering functions $S(q,Z)$ from reference [64], in the form of a multiplicative factor $[\kappa_e^H-\Delta\kappa_e^{BH}(\text{scr})]/\kappa_e^H$ to be applied to the Haug [102] cross section κ_e^H. The differences between values of $-\Delta\kappa_e^{BH}(\text{scr})$ computed using equation (46) and values from a more exact calculation ($-\Delta\kappa_e^{BMG}(\text{scr})$, equation (48) in sec. 3.3.3, below) are less than 0.6 percent of the unscreened triplet cross section κ_e^H for high-Z elements, and even less for light elements.

3.3.2. Jost-Luttinger-Slotnick Triplet Screening

Other formulations have been used for obtaining numerical estimates of the screening effect on triplet production, all of them adapted from the nuclear-field cross-section expressions, and also requiring knowledge of the incoherent scattering function $S(q,Z)$. In the cross section analysis by Gimm and Hubbell [3], the Jost-Luttinger-Slotnick [78] nuclear-field formulation for $\kappa_n^B(\text{scr})$ in equation (18) was used, replacing the quantity $[1-(F(q,Z)/Z)]^2$ by $[S(q,Z)/Z]$ to give the screened electron-field cross section $\kappa_e^{JLS}(\text{scr})$.

Thus in reference [3] the triplet screening correction was computed as

$$-\Delta\kappa_e^{JLS}(\text{scr})=8Z\alpha r_e^2k^{-2}\int_{k-\sqrt{k^2-4}}^{k+\sqrt{k^2-4}}\left[\frac{S(q,Z)}{Z}-1\right]\left\{\quad\right\}\frac{\mathrm{d}q}{q^3} \tag{47}$$

in which the curly brackets { } represent the expression enclosed in equation (18), and $S(q,Z)$ was taken

Table 5. Electron-field pair production (triplet) screening corrections computed using eq (46) with S(q,Z)'s from [64] given here as a multiplicative factor $[\kappa_e^H - \Delta\kappa_e^{BH}(\mathrm{scr})]/\kappa_e^H$.

$k(m_ec^2)$	E(MeV)	$_1H$	$_6C$	$_{13}A\ell$	$_{29}Cu$	$_{53}I$	$_{68}Er$	$_{82}Pb$	$_{92}U$	$_{100}Fm$
4.0	2.044	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5.0	2.555	1.0000	1.0000	1.0000	0.9999	0.9991	0.9983	0.9976	0.9971	0.9967
10.	5.110	1.0000	1.0000	1.0000	0.9992	0.9965	0.9946	0.9929	0.9917	0.9907
20.	10.22	1.0000	1.0000	0.9995	0.9961	0.9898	0.9859	0.9824	0.9798	0.9778
30.	15.33	1.0000	0.9999	0.9983	0.9922	0.9825	0.9770	0.9719	0.9683	0.9656
50.	25.55	1.0000	0.9991	0.9945	0.9838	0.9685	0.9605	0.9529	0.9479	0.9441
100.	51.10	1.0000	0.9940	0.9833	0.9633	0.9390	0.9267	0.9155	0.9090	0.9040
200.	102.2	0.9997	0.9808	0.9606	0.9296	0.8971	0.8803	0.8661	0.8588	0.8527
300.	153.3	0.9983	0.9682	0.9408	0.9035	0.8676	0.8485	0.8329	0.8257	0.8189
500.	255.5	0.9924	0.9459	0.9097	0.8651	0.8266	0.8053	0.7885	0.7817	0.7741
1,000.	511.0	0.9706	0.9035	0.8593	0.8065	0.7672	0.7442	0.7265	0.7207	0.7124
2,000.	1,022.	0.9312	0.8502	0.8031	0.7453	0.7070	0.6840	0.6662	0.6613	0.6528
3,000	1,533.	0.9018	0.8162	0.7692	0.7100	0.6728	0.6502	0.6326	0.6283	0.6198
5,000	2,555.	0.8608	0.7727	0.7269	0.6674	0.6317	0.6101	0.5928	0.5892	0.5808
10,000	5,111.	0.8031	0.7155	0.6721	0.6141	0.5807	0.5605	0.5440	0.5411	0.5330
20,000	10,220.	0.7468	0.6623	0.6217	0.5662	0.5352	0.5164	0.5009	0.4984	0.4908
30,000	15,330.	0.7154	0.6334	0.5944	0.5407	0.5110	0.4930	0.4780	0.4757	0.4684
50,000	25,550.	0.6785	0.5997	0.5627	0.5113	0.4831	0.4661	0.4518	0.4497	0.4427
100,000	51,100.	0.6328	0.5586	0.5240	0.4757	0.4494	0.4335	0.4202	0.4183	0.4117
200,000	102,201.	0.5918	0.5220	0.4897	0.4443	0.4197	0.4049	0.3923	0.3906	0.3844

also from the compilation in reference [64]. In the high-energy region where screening becomes significant, as indicated in table 5, screening corrections computed using equations (46) and (47), respectively, tend toward numerically identical values.

3.3.3. Borsellino-Maximon-Gimm Triplet Screening

In addition to the above treatments, Maximon and Gimm [109] have recently obtained triplet screening corrections $\Delta\kappa_e^{BMG}(\mathrm{scr})$ by casting the Borsellino [97] recoil distribution $d\sigma_{Bors}/dq$ in a form from which this correction can be computed as

$$-\Delta\kappa_e^{BMG}(\mathrm{scr})=\int_{q_{min}}^{q_{max}} dq\left[\frac{S(q,Z)}{Z}-1\right]\frac{d\sigma_{Bors}}{dq} \quad (48)$$

analogous to equations (46) and (47) above. Maximon and Gimm provide numerical $\Delta\kappa_e^{BMG}(\mathrm{scr})$ results for several elements, computed using $S(q,Z)$ values compiled in reference [64]. Also, in addition to providing a tractable although lengthy expression for

$$\frac{d\sigma_{Bors}}{dq},$$

the Maximon and Gimm work provides an up-to-date survey of triplet cross section theoretical developments.

3.4. Radiative Correction to the Triplet Cross Section

Quantitative theoretical estimates of the radiative correction (vi) for the triplet cross section are available only for high energies, for which it has been argued by Mork [98] that the correction factor is the same as for pair production [92]. In the present work, as in references [3], [26], and [109], the triplet radiative correction factor is taken to be 1.01 for the entire energy range $E \geqslant 2.044$ MeV.

3.5. Composited Triplet Production

For purposes of numerical computations of the triplet cross section κ_e ("PAIR PRODUCTION, ELECTRON FIELD" in table 6), all effects (i) to (vi) listed in section 3.1 were taken into account at least approximately by using the expression

$$\kappa_e=\kappa_e^{BG}\cdot[\kappa_e^H/\kappa_e^{BG}]\cdot\{[\kappa_e^H-\Delta\kappa_e^{BH}(\mathrm{scr})]/\kappa_e^H\}\cdot 1.01 \quad (49)$$

consistent with the formulation suggested by Mork (in reference [26]).

In equation (49) the retardation (iii) effect is included in the Borsellino-Ghizzetti [97, 100] unscreened triplet cross section κ_e^{BG} computed using equation (44). The γ–e interaction (iv) and exchange (v) effects are included as the ratio κ_e^H/κ_e^{BG} of the Haug [102] numerical results κ_e^H to κ_e^{BG} as listed in table 4.

The atomic binding (i) and screening (ii) effects were computed using the Bethe-Heitler (Wheeler-Lamb) approximation $\Delta\kappa_e^{BH}(\text{scr})$ given in equation (46) using non-relativistic incoherent scattering functions $S(q, Z)$ from reference [64]. This correction was applied in equation (49) in the form of the ratio $\{[\kappa_e^{H}-\Delta\kappa_e^{BH}(\text{scr})]/\kappa_e^{H}\}$, some sample numerical values of which are listed in table 5.

4. Incoherent (Compton) Scattering

Extensive reviews of theoretical and experimental information on Compton scattering are given, e.g., in references [64, 111–113]. In this process a photon of energy k (in m_ec^2 units) collides with an electron and leaves the collision-site, with a reduced energy k', at an angle θ from its original direction of travel. The relationship between k, k', and θ, assuming the target electron to be initially free and at rest, is (Compton [113], Debye [114])

$$k'/k=\frac{1}{[1+k(1-\cos\theta)]} \tag{50}$$

as determined from conservation of momentum and of energy between the photon and the recoiling electron.

The angular distribution function for unpolarized photons, under the above assumptions and also neglecting radiative corrections (see, e.g., [115–117]) and double-Compton effects (see, e.g., [116, 118, 119]), is given by the Klein-Nishina [120] formula

$$\frac{d\sigma_{KN}(\theta)}{d\Omega}=\frac{r_e^2}{2}[1+k(1-\cos\theta)]^{-2}\times\left[1+\cos^2\theta+\frac{k^2(1-\cos\theta)^2}{1+k(1-\cos\theta)}\right] \tag{51}$$

in which the differential solid angle $d\Omega$ (in steradians) is

$$d\Omega=2\pi\sin\theta\, d\theta. \tag{52}$$

Integration of equation (51) over all angles from $\theta=0$ to $\theta=\pi$ gives the Klein-Nishina total Compton cross section σ_{KN} per target electron as [3]

$$\sigma_{KN}=\int_{\theta=0}^{\theta=\pi} d\sigma_{KN}(\theta)$$
$$=2\pi r_e^2\left\{\frac{1+k}{k^2}\left[\frac{2(1+k)}{1+2k}-\frac{\ln(1+2k)}{k}\right]+\frac{\ln(1+2k)}{2k}-\frac{1+3k}{(1+2k)^2}\right\}. \tag{53}$$

[3] Below 100 keV equation (53) becomes unsuitable for computation because of near-cancellation between the logarithmic and purely algebraic terms. In this energy region the expansion [26]

$$\sigma_{KN}=\frac{8}{3}\pi r_e^2\frac{1}{(1+2k)^2}\left(1+2k+\frac{6}{5}k^2-\frac{1}{2}k^3+\frac{2}{7}k^4-\frac{6}{35}k^5+\frac{8}{105}k^6+\frac{4}{105}k^7-\cdots\right), \tag{53a}$$

may be used.

Over most of the region in which Compton scattering is a major part of the total cross section, the Klein-Nishina theory is directly applicable. Departures from the Klein-Nishina formula occur at low energies because of electron binding effects, and at high energies because of the possibility of emission of an additional photon (double Compton effect) and radiative corrections associated with emission and reabsorption of virtual photons.

The electron binding effects can be taken into account in the impulse approximation [4] by including the incoherent scattering function $S(q,Z)$ as a factor in the Klein-Nishina integrand in equation (53) to give a total bound-electron Compton scattering cross section per atom

$$\sigma_{BD}=\int_{\theta=0}^{\theta=\pi} d\sigma_{KN}(\theta)\, S(q, Z) \tag{54}$$

in which the momentum transfer q for incoherent scattering is [5]

$$q(\text{incoh})=\frac{2k\sin(\theta/2)\cdot\sqrt{1+(k^2+2k)\sin^2(\theta/2)}}{[1+2k\sin^2(\theta/2)]} \tag{55}$$

and $d\sigma_{KN}(\theta)$ is given in equation (51).

The integration indicated in equation (54) for the bound-electron Compton scattering cross section σ_{BD} has been performed numerically in reference [64] using non-relativistic Hartree-Fock values of the incoherent scattering function $S(q,Z)$ which is compiled therein for all elements $Z=1$ to 100 for photon energies 0.1 keV to 100 MeV. The Mork [116] combined radiative and double-Compton correction $\Delta\sigma_C^M$ as interpolated and extrapolated in reference [26] (table 2.–8) was included in the total incoherent scattering cross sections σ_{incoh} listed in reference [64] (table II.) as

$$\sigma_{incoh}=\sigma_{BD}+\Delta\sigma_C^M. \tag{56}$$

In the present work, for photon energies 1 to 100 MeV, values of σ_{incoh} ("SCATTERING, INCOHER." in table 6) as given in equation (56) are taken directly from reference [64]. Above 100 MeV where electron binding effects are (in the impulse approximation/incoherent scattering function approximation) vanishingly small, table 6 values for σ_{incoh} were computed as

$$\sigma_{incoh}=\sigma_{KN}+\Delta\sigma_C^M,\ E>100\text{ Mev} \tag{57}$$

in which σ_{KN} is the total Klein-Nishina Compton cross section given in analytical form in equation (53) and $\Delta\sigma_C^M$ is again the Mork [116] combined radiative and double-Compton correction as listed in reference [26].

[4] See, e.g., Eisenberger and Platzman [121] and Cooper [122] for discussions of the validity of the impulse approximation.

[5] Equation (55) for q(incoh), here corrected, contained in reference [26] [equation (2.–20)] a typographical error, as pointed out by Tseng, Gavrila, and Pratt [123] in that θ should appear throughout the expression in the form $\sin(\theta/2)$.

5. Coherent (Rayleigh) Scattering

Coherent (or Rayleigh [124, 125]) scattering is a process by which photons are scattered by bound atomic electrons and in which the atom is neither ionized nor excited. The scattering from different parts of the atomic charge distribution is then "coherent", i.e., there are interference effects.

As indicated in figures 1–3 this process takes place predominantly below the energy range 1 MeV—100 GeV of the present tabulations, and for heavy elements. The maximum contribution of σ_{coh} to σ_{tot} in table 6 is for 1 MeV photons in Fm(Z=100) where σ_{coh} accounts for 5 percent of the total cross section, but rapidly decreases to two orders or more of magnitude less than σ_{tot} elsewhere in table 6.

Thus σ_{coh}, in the present tabulation-range, plays the role of a small or negligible correction to the predominant processes (atomic and nuclear photoeffect, Compton scattering and pair and triplet production) in the theoretical analysis of the total mass attenuation coefficient μ/ρ. However, this effect plays a major role in the analysis of measurements of much less probable elastic or quasi-elastic scattering processes such as Delbrück [126] scattering, nuclear Thomson scattering and nuclear resonance scattering (for reviews of these latter three processes see, e.g., references [127–130]).

The angular distribution $d\sigma_{coh}/d\Omega$ for coherent (Rayleigh) scattering is given approximately, neglecting multi-atom array interference effects (e.g., Bragg-law diffraction), by multiplying the distribution function $d\sigma_T/d\Omega$ for classical Thomson [131] scattering by an electron,

$$d\sigma_T/d\Omega = \frac{r_e^2}{2}(1+\cos^2\theta) \tag{58}$$

by the square of the atomic form factor $F(q,Z)$, giving

$$d\sigma_{coh}/d\Omega = \frac{r_e^2}{2}(1+\cos^2\theta)\,[F(q,Z)]^2. \tag{59}$$

In equation (59), since $k' \cong k$ in the coherent scattering process, the momentum transfer parameter q (see equation (55)) reduces to

$$q(\text{coh}) = 2k\sin(\theta/2). \tag{60}$$

From equation (59) the integrated coherent scattering cross section can be written

$$\sigma_{coh} = \pi r_e^2 \int_{-1}^{+1} (1+\cos^2\theta)\,[F(q,Z)]^2\, d(\cos\theta) \tag{61}$$

from which values of σ_{coh} were computed and tabulated in reference [65] for photon energies 0.1 keV to 100 MeV for all elements Z=1 to 100.

In table 6 the listed values of σ_{coh} "(SCATTERING, COHERENT") were taken directly from table II of reference [65] for photon energies 1 to 100 MeV. For photon energies 100 MeV to 100 GeV the listed values were extrapolated from the reference [65] 100-MeV values, making use of the high-energy E^{-2} dependence for this process.

6. Atomic Photoeffect

In the atomic photoeffect, a photon disappears and an electron is ejected from an atom. The electron carries away all the energy of the absorbed photon, minus the energy binding the electron to the atom. As can be seen in figures 1–3 this process is only slightly more important than coherent scattering in the photon energy range above 1 MeV here considered, making a small or negligible contribution to σ_{tot} except for high-Z elements and photon energies below 10 MeV.

The most extensive set of theoretical atomic photoeffect cross section values in an energy range relevant to the present tables is that of Scofield [132]. Scofield used a Hartree-Slater central potential to calculate the total photoeffect cross section τ and for all individual subshells τ_K, τ_{L_1}, τ_{L_2}, τ_{L_3}, τ_{M_1}, . . . for all atoms Z=1 to 101 for photon energies 1 keV to 1.5 MeV. Reference [132] also provides subshell renormalization factors for elements Z=2 to 54 to convert his results to the presumably more-accurate relativistic Hartree-Fock atomic model values. The un-renormalized Scofield values have been graphically compared by Hubbell and Veigele [133] with a large body of measured (total μ/ρ with theoretical scattering subtracted) photoeffect data.

For purposes of the present compilation the Scofield values have been renormalized as prescribed above (for Z=2 to 54, to the relativistic Hartree-Fock model) and are used in the energy region 1 to 1.5 MeV. For higher energies these renormalized Scofield total photoeffect τ values were extrapolated to 100 GeV using the energy- and Z-dependence of the K-shell photoeffect cross section τ_K empirical expression [26]

$$\tau_K \cong Z^5 \sum_{n=1}^{4} \frac{a_n + b_n Z}{1 + c_n Z} E^{-p_n} \frac{b}{\text{atom}} \tag{62}$$

in which E is in MeV and the parameters are

n	a_n	b_n	c_n	p_n
1	$1.6268\cdot10^{-9}$	$-2.683\cdot10^{-12}$	$4.173\cdot10^{-2}$	1
2	$1.5274\cdot10^{-9}$	$-5.110\cdot10^{-13}$	$1.027\cdot10^{-2}$	2
3	$1.1330\cdot10^{-9}$	$-2.177\cdot10^{-12}$	$2.013\cdot10^{-2}$	3.5
4	$-9.12\cdot10^{-11}$	0	0	4

Equation (62), fitted to a combination of theoretical and measured data, goes to the Pratt [134] numerical values for τ_K in the high energy limit.

In table 6 the listed values of the total atomic photoeffect cross section τ, "PHOTOELECTRIC," are

$$\tau \begin{cases} = \tau(\text{Scofield}, E) & E \leq 1.5 \text{ MeV} \\ = \dfrac{\tau(\text{Scofield}, 1.5 \text{ MeV})}{\tau_K(1.5 \text{ MeV})} \tau_K(E) & 1.5 \text{ MeV} < E \leq 100 \text{ GeV} \end{cases} \quad (63)$$

in which $\tau_K(E)$ was computed using equation (62).

7. Photonuclear Absorption Cross Section

This effect consists of nuclear interactions initiated by the absorption of a photon. The most likely result of such an interaction is the emission of a single neutron, but one must also consider the emission of charged particles, gamma rays, or more than one neutron. Available experimental and theoretical information on such interactions is discussed and reviewed in a collection of benchmark papers on this topic assembled and edited by Fuller and Hayward [135].

The most characteristic feature of the cross section for nuclear absorption of photons is the "giant resonance." This is a broad peak in the absorption cross section centered at about 24 MeV for light nuclei, decreasing in energy with increasing mass number to about 12 MeV for the heaviest stable nuclei. The width "Γ" (energy difference between the points at which the cross section drops to one half its maximum value) varies from about 3 MeV to 9 MeV depending on the detailed properties of individual nuclei. The relative magnitude of this resonance feature in the photonuclear cross section $\sigma_{\text{ph.n.}}$ is shown in figures 1–3 in comparison with the atomic cross sections.

When studied with finer resolution the gross "resonance" is found to have considerable sub-structure. A prominent feature of this sub-structure, for nuclei having large permanent deformations, is a splitting of the giant resonance into two main peaks. In general, those nuclei having either large permanent deformations or large "dynamic deformations" (resulting from the vibrational nature of the nuclear gound state) have their giant resonance spread over the widest energy range.

The gross parameters of the giant resonance: σ_0, the value of $\sigma_{\text{ph.n.}}$ at the peak-energy E_0, and Γ, the peak width at half-max, have been compiled by Fuller et al., [136] (table 1) and by Berman [137] (table I), [51] (tables IV, V) for a number of nuclides.

From these parameters the giant resonance can be approximately reconstructed by assuming that it has the shape of a Lorentz line (see, e.g., Fuller and Hayward [138], equation (2.5), p. 117, and Hayward [50], equation (1.4)):

$$\sigma_{\text{ph.n.}}(E) \approx \sigma_0 \frac{E^2\Gamma^2}{(E_0^2 - E^2)^2 + E^2\Gamma^2}, \quad (64)$$

or for a double peak, the sum of two such Lorentz lines, in which case two sets of σ_0, E_0, and Γ values are provided.

However, the best source of data for individual nuclei is at present the technical literature, especially for low Z elements where the Lorentz line representation of the nuclear absorption cross section can hardly be used. In addition it should be noted that besides the giant resonance there is considerable nuclear absorpgion above the pion threshold arising from the excitation of the first resonance state of the individual nucleons. Very few experiments [139–141] have been made in this so-called Δ-resonance region indicating a very broad peak around 300 MeV, the peak cross section of which is roughly 2–3 percent of the electronic cross section for light elements.

Available data in the literature can be located by means of the NBS Photonuclear Data Index [136, 142] which is an annotated index and bibliography of references containing experimental data on photonuclear reactions. Each index entry gives specific quantitative data about the type of information available in each reference. The source of data used to compile this index is the NBS Photonuclear Data File. This file consists of data sheets containing abstracts of the significant data (both numerical and graphical) from each reference. These data sheets, as well as a reprint collection of all references abstracted, are on deposit at the Photonuclear Data Center at the National Bureau of Standards.

8. Total Atomic Cross Sections, Mass Attenuation Coefficients

8.1. Description of Tables

Table 6 contains photon cross sections in units of barns/atom computed as described in sections 2 to 6 for the individual photon interaction processes, omitting the isotope-dependent photonuclear cross section $\sigma_{\text{ph.n.}}$ discussed in section 7.

In the first column of table 6 are listed 56 incident photon energies from 1 MeV up to 100 GeV. Included in this energy-grid are the pair and triplet threshold energies 1.022 MeV and 2.044 MeV, respectively, also 1.25 MeV to approximate the mean energy of the 1.17 MeV and 1.33 MeV Co^{60} gamma rays. From 2 MeV to 16 MeV the grid energies are in 1–MeV increments, and from 16 MeV to 30 MeV are in 2–MeV increments, to minimize imterpolation errors when applying this table to analyses of photonuclear cross sections and for other purposes. Above 30 MeV the Grodstein [24] energy grid ($10^n \times 1$, 1.5, 2, 3, 4, 5, 6, 8 and repeat with 10^{n+1}, 10^{n+2}, . . .) is used.

In columns 2 and 3 the "SCATTERING, COHERENT and INCOHERENT" cross sections σ_{coh} and σ_{incoh} are taken, respectively, from reference [65] as discussed in section 5, equation (61), and from reference [64] as discussed in section 4, equation (56). In column 4 the "PHOTOELECTRIC" cross section τ is an interpolation and extrapolation of the Scofield [132] results as discussed in section 6. In column 5 the "PAIR PRODUCTION, NUCLEAR FIELD"

cross section κ_n was computed using equations (41) and (42) (section 2.5) which include screening, Coulomb and radiative corrections. In column 6 the "PAIR PRODUCTION, ELECTRON FIELD" (triplet) cross section κ_e was computed using (49) in which screening, radiative, exchange and retardation effects are included, approximately, as discussed in section 3.5. Column 7, denoted "TOTAL", lists the total "electronic" cross section σ_{elec} which is the sum

$$\sigma_{elec}=\sigma_{coh}+\sigma_{incoh}+\tau+\kappa_n+\kappa_e \tag{65}$$

of the cross sections in the preceding columns 2 through 6.

For application to practical problems involving bulk media (shielding, medical and industrial radiography and dosimetry, etc.) the atomic cross sections (barns/atom) in column 7 must be converted to linear attenuation coefficients μ in units of reciprocal length (e.g., μ in m^{-1} or cm^{-1}) or to mass attenuation coefficients μ/ρ in units of reciprocal mass-per-unit-area (e.g., μ/ρ in m^2/kg or cm^2/g). The linear attenuation coefficient μ is dependent on the density ρ (see table 7) which can vary widely for a given element (gas vs liquid or solid, etc.). Hence the density-independent mass attenuation coefficient μ/ρ (in m^2/kg) is more customarily tabulated ,and is listed in column 13, "TOTAL", corresponding to the "TOTAL" electronic cross section σ_{elec} listed in column 7.

The conversion from column 7 σ_{elec} values (barns/atom) to column 13 μ/ρ values (m^2/kg) is accomplished according to

$$\mu/\rho(\mathrm{m^2/kg})=\sigma_{elec}(\mathrm{b/atom})\cdot \mathrm{N_A/A_r} \tag{66}$$

in which N_A is the Avogardo constant ($6.022045\cdot 10^{23}$ mol^{-1}). The atomic weights A_r [143–146] are listed in table 7, also in the heading for each element-page in table 6 followed by the conversion factor

$$(N_A/A_r)\left[\frac{\mathrm{m^2/kg}}{(\mathrm{b/atom})}\right].$$

The latter factor is also used for converting the remaining columns 2 to 6 to columns 8 to 12 for the individual interaction processes.

For users of these tables desiring μ/ρ in cm^2/g units, columns 8 to 13 are converted from m^2/kg to cm^2/g by multiplying the entries by 10.

8.2. Discussion of Errors

In view of the various approximations and corrections used in this work, also the random and possible systematic uncertainties in the measured data used for verification and for the one empirical adjustment (arbitrary sine-function low-energy cut-off of the radiative correction to κ_n), the absolute accuracy of σ_{elec} and μ/ρ in table 6 is probably not better than 1–2 percent. Uncertainties for the individual interaction cross sections σ_{coh}, σ_{incoh}, τ, κ_n, and κ_e may be several percent or more, particularly in regions where the given cross section makes a negligible contribution to σ_{elec}.

The present (table 6) values for σ_{elec} agree within a few tenths of a percent or better with σ_{elec} values deduced as

$$\sigma_{elec}=\sigma_{tot}-\sigma_{ph.n.} \tag{67}$$

from the extensive high-precision σ_{tot} measurements by the Mainz group (Ahrens et al. [1, 2]). This agreement, in which the $\sigma_{ph.n.}$ data [51, 136, 137, 142] used in such an analysis (see; e.g., reference [3]) is primarily (γ,n) data not dependent on assumed knowledge of σ_{elec}, suggest that the uncertainty in the total nonnuclear cross section σ_{elec} in the intermediate energy region ($\sim$10 MeV to $\sim$200 MeV) may be 0.5 percent or better.

TABLE 6. Cross sections (barns/atom) 1 MeV to 100 GeV, $Z=1$ to 100 for the photon-atom interaction processes: Coherent (Rayleigh) and incoherent (Compton) scattering, atomic photoeffect, pair production in the nuclear and electronic (triplet) fields, and the total for these processes. Corresponding mass attenuation coefficients (m^2/kg) for these processes, obtained using the (m^2/kg)/(barns/atom) conversion factor given following the atomic weight A_r, are listed in the last six columns.

Z = 1, H , HYDROGEN ATOMIC WT. = 1.0079 MSQ/KG = .05974844 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	4.625-06	2.114-01	1.961-09	0.000	0.000	2.114-01	2.763-07	1.263-02	1.172-10	0.000	0.000	1.263-02
1.022+06	4.428-06	2.092-01	1.880-09	0.000	0.000	2.092-01	2.646-07	1.250-02	1.123-10	0.000	0.000	1.250-02
1.250+06	2.960-06	1.890-01	1.304-09	7.805-06	0.000	1.890-01	1.769-07	1.129-02	7.791-11	4.663-07	0.000	1.129-02
1.500+06	2.056-06	1.718-01	9.732-10	4.385-05	0.000	1.718-01	1.228-07	1.026-02	5.815-11	2.620-06	0.000	1.027-02
2.000+06	1.156-06	1.466-01	6.201-10	1.758-04	0.000	1.468-01	6.907-08	8.759-03	3.705-11	1.050-05	0.000	8.770-03
2.044+06	1.107-06	1.448-01	6.004-10	1.895-04	0.000	1.450-01	6.614-08	8.652-03	3.587-11	1.132-05	0.000	8.663-03
3.000+06	5.139-07	1.153-01	3.524-10	5.048-04	4.035-05	1.158-01	3.070-08	6.889-03	2.106-11	3.016-05	2.411-06	6.922-03
4.000+06	2.891-07	9.620-02	2.444-10	8.202-04	1.647-04	9.719-02	1.727-08	5.748-03	1.460-11	4.901-05	9.841-06	5.807-03
5.000+06	1.850-07	8.308-02	1.866-10	1.102-03	3.283-04	8.451-02	1.105-08	4.964-03	1.115-11	6.584-05	1.962-05	5.049-03
6.000+06	1.285-07	7.343-02	1.508-10	1.355-03	5.042-04	7.529-02	7.678-09	4.387-03	9.010-12	8.096-05	3.013-05	4.498-03
7.000+06	9.439-08	6.600-02	1.264-10	1.580-03	6.798-04	6.826-02	5.640-09	3.943-03	7.552-12	9.440-05	4.062-05	4.078-03
8.000+06	7.227-08	6.007-02	1.088-10	1.784-03	8.503-04	6.270-02	4.318-09	3.589-03	6.501-12	1.066-04	5.080-05	3.746-03
9.000+06	5.710-08	5.522-02	9.546-11	1.970-03	1.014-03	5.820-02	3.412-09	3.299-03	5.704-12	1.177-04	6.058-05	3.478-03
1.000+07	4.625-08	5.116-02	8.503-11	2.138-03	1.170-03	5.447-02	2.763-09	3.057-03	5.080-12	1.277-04	6.991-05	3.254-03
1.100+07	3.823-08	4.772-02	7.665-11	2.292-03	1.318-03	5.133-02	2.284-09	2.851-03	4.580-12	1.369-04	7.875-05	3.067-03
1.200+07	3.212-08	4.475-02	6.977-11	2.433-03	1.458-03	4.864-02	1.919-09	2.674-03	4.169-12	1.454-04	8.711-05	2.906-03
1.300+07	2.737-08	4.216-02	6.401-11	2.565-03	1.590-03	4.632-02	1.635-09	2.519-03	3.824-12	1.533-04	9.500-05	2.767-03
1.400+07	2.360-08	3.988-02	5.914-11	2.688-03	1.716-03	4.428-02	1.410-09	2.383-03	3.534-12	1.606-04	1.025-04	2.646-03
1.500+07	2.056-08	3.786-02	5.495-11	2.803-03	1.836-03	4.250-02	1.228-09	2.262-03	3.283-12	1.675-04	1.097-04	2.539-03
1.600+07	1.807-08	3.606-02	5.131-11	2.912-03	1.951-03	4.092-02	1.080-09	2.155-03	3.066-12	1.740-04	1.166-04	2.445-03
1.800+07	1.428-08	3.296-02	4.531-11	3.112-03	2.164-03	3.824-02	8.532-10	1.969-03	2.707-12	1.859-04	1.293-04	2.285-03
2.000+07	1.156-08	3.039-02	4.057-11	3.292-03	2.359-03	3.604-02	6.907-10	1.816-03	2.424-12	1.967-04	1.409-04	2.153-03
2.200+07	9.556-09	2.823-02	3.672-11	3.457-03	2.539-03	3.423-02	5.710-10	1.687-03	2.194-12	2.066-04	1.517-04	2.045-03
2.400+07	8.030-09	2.638-02	3.354-11	3.608-03	2.706-03	3.269-02	4.798-10	1.576-03	2.004-12	2.156-04	1.617-04	1.953-03
2.600+07	6.842-09	2.477-02	3.087-11	3.747-03	2.862-03	3.138-02	4.088-10	1.480-03	1.844-12	2.239-04	1.710-04	1.875-03
2.800+07	5.899-09	2.336-02	2.859-11	3.877-03	3.007-03	3.024-02	3.525-10	1.396-03	1.708-12	2.316-04	1.797-04	1.807-03
3.000+07	5.139-09	2.212-02	2.662-11	3.998-03	3.143-03	2.926-02	3.070-10	1.322-03	1.591-12	2.389-04	1.878-04	1.748-03
4.000+07	2.890-09	1.758-02	1.981-11	4.506-03	3.719-03	2.581-02	1.727-10	1.050-03	1.184-12	2.692-04	2.222-04	1.542-03
5.000+07	1.850-09	1.468-02	1.577-11	4.962-03	4.173-03	2.376-02	1.105-10	8.771-04	9.422-13	2.929-04	2.493-04	1.419-03
6.000+07	1.284-09	1.264-02	1.310-11	5.225-03	4.546-03	2.241-02	7.672-11	7.552-04	7.827-13	3.122-04	2.716-04	1.339-03
8.000+07	7.222-10	9.972-03	9.787-12	5.731-03	5.136-03	2.084-02	4.315-11	5.958-04	5.848-13	3.424-04	3.069-04	1.245-03
1.000+08	4.620-10	8.276-03	7.811-12	6.116-03	5.593-03	1.999-02	2.760-11	4.945-04	4.667-13	3.654-04	3.342-04	1.194-03
1.500+08	2.054-10	5.894-03	5.191-12	6.781-03	6.412-03	1.909-02	1.227-11	3.522-04	3.102-13	4.052-04	3.831-04	1.140-03
2.000+08	1.155-10	4.621-03	3.887-12	7.214-03	6.976-03	1.881-02	6.901-12	2.761-04	2.322-13	4.310-04	4.168-04	1.124-03
3.000+08	5.134-11	3.275-03	2.587-12	7.753-03	7.731-03	1.876-02	3.067-12	1.957-04	1.546-13	4.632-04	4.619-04	1.121-03
4.000+08	2.888-11	2.565-03	1.939-12	8.079-03	8.223-03	1.887-02	1.726-12	1.533-04	1.159-13	4.827-04	4.913-04	1.127-03
5.000+08	1.848-11	2.123-03	1.550-12	8.300-03	8.575-03	1.900-02	1.104-12	1.268-04	9.261-14	4.959-04	5.123-04	1.135-03
6.000+08	1.283-11	1.818-03	1.291-12	8.461-03	8.841-03	1.912-02	7.666-13	1.086-04	7.714-14	5.055-04	5.282-04	1.142-03
8.000+08	7.219-12	1.420-03	9.682-13	8.680-03	9.223-03	1.932-02	4.313-13	8.484-05	5.785-14	5.186-04	5.511-04	1.155-03
1.000+09	4.620-12	1.168-03	7.744-13	8.824-03	9.465-03	1.948-02	2.760-13	6.979-05	4.627-14	5.272-04	5.667-04	1.164-03
1.500+09	2.054-12	8.159-04	5.161-13	9.035-03	9.888-03	1.974-02	1.227-13	4.875-05	3.084-14	5.398-04	5.908-04	1.179-03
2.000+09	1.155-12	6.314-04	3.870-13	9.153-03	1.012-02	1.990-02	6.901-14	3.773-05	2.312-14	5.469-04	6.047-04	1.189-03
3.000+09	5.134-13	4.390-04	2.580-13	9.277-03	1.038-02	2.010-02	3.067-14	2.623-05	1.542-14	5.542-04	6.202-04	1.201-03
4.000+09	2.888-13	3.389-04	1.934-13	9.353-03	1.053-02	2.022-02	1.726-14	2.025-05	1.156-14	5.588-04	6.292-04	1.208-03
5.000+09	1.848-13	2.771-04	1.548-13	9.397-03	1.063-02	2.030-02	1.104-14	1.656-05	9.249-15	5.615-04	6.351-04	1.213-03
6.000+09	1.283-13	2.350-04	1.290-13	9.428-03	1.070-02	2.036-02	7.666-15	1.404-05	7.708-15	5.633-04	6.393-04	1.217-03
8.000+09	7.219-14	1.810-04	9.671-14	9.469-03	1.079-02	2.044-02	4.313-15	1.081-05	5.778-15	5.658-04	6.447-04	1.221-03
1.000+10	4.620-14	1.478-04	7.737-14	9.495-03	1.085-02	2.049-02	2.760-15	8.831-06	4.623-15	5.673-04	6.483-04	1.224-03
1.500+10	2.054-14	1.021-04	5.158-14	9.529-03	1.093-02	2.056-02	1.227-15	6.100-06	3.082-15	5.693-04	6.531-04	1.228-03
2.000+10	1.155-14	7.853-05	3.868-14	9.549-03	1.097-02	2.060-02	6.901-16	4.692-06	2.311-15	5.705-04	6.554-04	1.231-03
3.000+10	5.134-15	5.416-05	2.579-14	9.567-03	1.102-02	2.064-02	3.067-16	3.236-06	1.541-15	5.716-04	6.584-04	1.233-03
4.000+10	2.888-15	4.158-05	1.934-14	9.581-03	1.105-02	2.067-02	1.726-16	2.484-06	1.156-15	5.724-04	6.602-04	1.235-03
5.000+10	1.848-15	3.386-05	1.547-14	9.588-03	1.106-02	2.068-02	1.104-16	2.023-06	9.243-16	5.729-04	6.608-04	1.236-03
6.000+10	1.283-15	2.862-05	1.289-14	9.592-03	1.108-02	2.070-02	7.666-17	1.710-06	7.702-16	5.731-04	6.620-04	1.237-03
8.000+10	7.219-16	2.195-05	9.670-15	9.597-03	1.109-02	2.071-02	4.313-17	1.311-06	5.778-16	5.734-04	6.626-04	1.237-03
1.000+11	4.620-16	1.785-05	7.736-15	9.601-03	1.110-02	2.072-02	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 2, HE, HELIUM ATOMIC WT. = 4.00260 MSQ/KG = .01504533 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	5.112-05	4.228-01	8.663-08	0.000	0.000	4.229-01	7.691-07	6.361-03	1.303-09	0.000	0.000	6.362-03
1.022+06	4.894-05	4.183-01	8.294-08	0.000	0.000	4.183-01	7.363-07	6.293-03	1.248-09	0.000	0.000	6.294-03
1.250+06	3.272-05	3.780-01	5.662-08	3.127-05	0.000	3.781-01	4.923-07	5.687-03	8.519-10	4.705-07	0.000	5.698-03
1.500+06	2.272-05	3.436-01	4.140-08	1.755-04	0.000	3.438-01	3.418-07	5.170-03	6.229-10	2.640-06	0.000	5.173-03
2.000+06	1.278-05	2.932-01	2.632-08	7.034-04	0.000	2.939-01	1.923-07	4.411-03	3.960-10	1.058-05	0.000	4.422-03
2.044+06	1.224-05	2.896-01	2.549-08	7.584-04	0.000	2.904-01	1.842-07	4.357-03	3.835-10	1.141-05	0.000	4.369-03
3.000+06	5.680-06	2.307-01	1.492-08	2.020-03	8.070-05	2.328-01	8.546-08	3.471-03	2.245-10	3.039-05	1.214-06	3.503-03
4.000+06	3.195-06	1.924-01	1.033-08	3.281-03	3.293-04	1.960-01	4.807-08	2.895-03	1.554-10	4.936-05	4.957-06	2.940-03
5.000+06	2.045-06	1.662-01	7.879-09	4.405-03	6.565-04	1.713-01	3.077-08	2.501-03	1.185-10	6.627-05	9.877-06	2.577-03
6.000+06	1.420-06	1.469-01	6.361-09	5.419-03	1.008-03	1.533-01	2.136-08	2.210-03	9.570-11	8.153-05	1.517-05	2.307-03
7.000+06	1.043-06	1.326-01	5.330-09	6.321-03	1.360-03	1.397-01	1.569-08	1.986-03	8.019-11	9.510-05	2.046-05	2.102-03
8.000+06	7.988-07	1.201-01	4.585-09	7.137-03	1.701-03	1.289-01	1.202-08	1.807-03	6.898-11	1.074-04	2.559-05	1.940-03
9.000+06	6.312-07	1.104-01	4.022-09	7.878-03	2.028-03	1.203-01	9.497-09	1.661-03	6.051-11	1.185-04	3.051-05	1.810-03
1.000+07	5.112-07	1.023-01	3.581-09	8.552-03	2.339-03	1.132-01	7.691-09	1.539-03	5.388-11	1.287-04	3.519-05	1.703-03
1.100+07	4.225-07	9.543-02	3.228-09	9.167-03	2.635-03	1.072-01	6.357-09	1.436-03	4.857-11	1.379-04	3.964-05	1.613-03
1.200+07	3.550-07	8.950-02	2.937-09	9.732-03	2.915-03	1.021-01	5.341-09	1.347-03	4.419-11	1.464-04	4.386-05	1.537-03
1.300+07	3.025-07	8.431-02	2.695-09	1.026-02	3.180-03	9.775-02	4.551-09	1.268-03	4.055-11	1.544-04	4.784-05	1.471-03
1.400+07	2.608-07	7.976-02	2.489-09	1.075-02	3.432-03	9.394-02	3.924-09	1.200-03	3.745-11	1.617-04	5.164-05	1.412-03
1.500+07	2.272-07	7.572-02	2.312-09	1.121-02	3.672-03	9.060-02	3.418-09	1.139-03	3.478-11	1.687-04	5.525-05	1.363-03
1.600+07	1.997-07	7.211-02	2.159-09	1.164-02	3.901-03	8.765-02	3.005-09	1.085-03	3.248-11	1.751-04	5.869-05	1.319-03
1.800+07	1.578-07	6.591-02	1.906-09	1.244-02	4.328-03	8.268-02	2.374-09	9.916-04	2.868-11	1.872-04	6.512-05	1.244-03
2.000+07	1.278-07	6.078-02	1.707-09	1.316-02	4.718-03	7.866-02	1.923-09	9.145-04	2.568-11	1.980-04	7.098-05	1.183-03
2.200+07	1.056-07	5.645-02	1.545-09	1.382-02	5.079-03	7.535-02	1.589-09	8.493-04	2.325-11	2.079-04	7.642-05	1.134-03
2.400+07	8.876-08	5.275-02	1.411-09	1.442-02	5.413-03	7.258-02	1.335-09	7.936-04	2.123-11	2.170-04	8.144-05	1.092-03
2.600+07	7.562-08	4.954-02	1.298-09	1.498-02	5.723-03	7.024-02	1.138-09	7.453-04	1.953-11	2.254-04	8.610-05	1.057-03
2.800+07	6.521-08	4.673-02	1.202-09	1.549-02	6.013-03	6.823-02	9.811-10	7.031-04	1.808-11	2.331-04	9.047-05	1.027-03
3.000+07	5.680-08	4.425-02	1.119-09	1.597-02	6.285-03	6.651-02	8.546-10	6.658-04	1.684-11	2.403-04	9.456-05	1.001-03
4.000+07	3.195-08	3.516-02	8.327-10	1.796-02	7.437-03	6.058-02	4.807-10	5.290-04	1.253-11	2.705-04	1.119-04	9.114-04
5.000+07	2.045-08	2.933-02	6.629-10	1.932-02	8.244-03	5.721-02	3.077-10	4.410-04	9.974-12	2.937-04	1.233-04	8.608-04
6.000+07	1.420-08	2.529-02	5.506-10	2.076-02	9.087-03	5.514-02	2.136-10	3.805-04	8.284-12	3.123-04	1.367-04	8.296-04
8.000+07	7.986-09	1.994-02	4.113-10	2.265-02	1.025-02	5.284-02	1.202-10	3.000-04	6.188-12	3.408-04	1.542-04	7.950-04
1.000+08	5.110-09	1.655-02	3.282-10	2.404-02	1.115-02	5.174-02	7.688-11	2.490-04	4.938-12	3.617-04	1.678-04	7.784-04
1.500+08	2.271-09	1.179-02	2.181-10	2.633-02	1.271-02	5.083-02	3.417-11	1.774-04	3.281-12	3.963-04	1.912-04	7.668-04
2.000+08	1.278-09	9.242-03	1.633-10	2.775-02	1.375-02	5.074-02	1.923-11	1.390-04	2.457-12	4.175-04	2.069-04	7.634-04
3.000+08	5.678-10	6.551-03	1.087-10	2.943-02	1.509-02	5.167-02	8.543-12	9.856-05	1.635-12	4.428-04	2.270-04	7.684-04
4.000+08	3.194-10	5.130-03	8.144-11	3.041-02	1.592-02	5.146-02	4.805-12	7.718-05	1.225-12	4.575-04	2.395-04	7.742-04
5.000+08	2.044-10	4.247-03	6.512-11	3.106-02	1.650-02	5.181-02	3.075-12	6.390-05	9.798-13	4.673-04	2.482-04	7.795-04
6.000+08	1.420-10	3.630-03	5.423-11	3.152-02	1.693-02	5.209-02	2.136-12	5.470-05	8.162-13	4.742-04	2.547-04	7.837-04
8.000+08	7.985-11	2.840-03	4.067-11	3.215-02	1.753-02	5.252-02	1.201-12	4.273-05	6.119-13	4.837-04	2.637-04	7.893-04
1.000+09	5.110-11	2.336-03	3.253-11	3.255-02	1.793-02	5.282-02	7.688-13	3.515-05	4.894-13	4.897-04	2.698-04	7.946-04
1.500+09	2.271-11	1.632-03	2.168-11	3.314-02	1.854-02	5.331-02	3.417-13	2.455-05	3.262-13	4.986-04	2.789-04	8.021-04
2.000+09	1.278-11	1.263-03	1.626-11	3.346-02	1.888-02	5.360-02	1.923-13	1.900-05	2.446-13	5.034-04	2.841-04	8.065-04
3.000+09	5.678-12	8.781-04	1.083-11	3.380-02	1.926-02	5.394-02	8.543-14	1.321-05	1.629-13	5.085-04	2.898-04	8.115-04
4.000+09	3.194-12	6.778-04	8.126-12	3.401-02	1.948-02	5.417-02	4.805-14	1.020-05	1.223-13	5.117-04	2.931-04	8.150-04
5.000+09	2.044-12	5.542-04	6.500-12	3.413-02	1.961-02	5.429-02	3.075-14	8.338-06	9.779-14	5.135-04	2.950-04	8.169-04
6.000+09	1.420-12	4.699-04	5.417-12	3.421-02	1.971-02	5.439-02	2.136-14	7.070-06	8.150-14	5.147-04	2.965-04	8.183-04
8.000+09	7.985-13	3.621-04	4.062-12	3.432-02	1.984-02	5.452-02	1.201-14	5.448-06	6.111-14	5.164-04	2.985-04	8.203-04
1.000+10	5.110-13	2.956-04	3.250-12	3.439-02	1.992-02	5.461-02	7.688-15	4.447-06	4.890-14	5.174-04	2.997-04	8.216-04
1.500+10	2.271-13	2.043-04	2.166-12	3.447-02	2.003-02	5.470-02	3.417-15	3.074-06	3.259-14	5.186-04	3.014-04	8.230-04
2.000+10	1.278-13	1.571-04	1.625-12	3.453-02	2.009-02	5.478-02	1.923-15	2.364-06	2.445-14	5.195-04	3.023-04	8.241-04
3.000+10	5.678-14	1.083-04	1.083-12	3.458-02	2.015-02	5.484-02	8.543-16	1.629-06	1.629-14	5.203-04	3.032-04	8.251-04
4.000+10	3.194-14	8.316-05	8.124-13	3.461-02	2.019-02	5.488-02	4.805-16	1.251-06	1.222-14	5.207-04	3.038-04	8.257-04
5.000+10	2.044-14	6.772-05	6.499-13	3.463-02	2.022-02	5.492-02	3.075-16	1.019-06	9.778-15	5.210-04	3.042-04	8.263-04
6.000+10	1.420-14	5.724-05	5.416-13	3.464-02	2.023-02	5.493-02	2.136-16	8.612-07	8.149-15	5.212-04	3.044-04	8.264-04
8.000+10	7.985-15	4.389-05	4.062-13	3.465-02	2.025-02	5.494-02	1.201-16	6.603-07	6.111-15	5.213-04	3.047-04	8.266-04
1.000+11	5.110-15	3.571-05	3.249-13	3.466-02	2.026-02	5.496-02	7.688-17	5.373-07	4.888-15	5.215-04	3.048-04	8.268-04

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV Z=1 to 100—Continued

Z = 3, LI, LITHIUM ATOMIC WT. = 6.941 MSQ/KG = .00867605 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.369-04	6.341-01	7.354-07	0.000	0.000	6.342-01	1.188-06	5.501-03	6.380-09	0.000	0.000	5.503-03
1.022+06	1.311-04	6.274-01	7.038-07	0.000	0.000	6.275-01	1.137-06	5.443-03	6.106-09	0.000	0.000	5.444-03
1.250+06	8.764-05	5.670-01	4.788-07	7.052-05	0.000	5.672-01	7.604-07	4.919-03	4.154-09	6.118-07	0.000	4.921-03
1.500+06	6.086-05	5.154-01	3.486-07	3.953-04	0.000	5.159-01	5.280-07	4.472-03	3.024-09	3.430-06	0.000	4.476-03
2.000+06	3.423-05	4.398-01	2.212-07	1.583-03	0.000	4.414-01	2.970-07	3.816-03	1.919-09	1.373-05	0.000	3.830-03
2.044+06	3.278-05	4.344-01	2.141-07	1.707-03	0.000	4.361-01	2.844-07	3.769-03	1.856-09	1.481-05	0.000	3.784-03
3.000+06	1.521-05	3.460-01	1.250-07	4.545-03	1.219-04	3.507-01	1.320-07	3.002-03	1.085-09	3.943-05	1.050-06	3.043-03
4.000+06	8.559-06	2.886-01	8.643-08	7.383-03	4.942-04	2.965-01	7.426-08	2.504-03	7.499-10	6.406-05	4.288-06	2.572-03
5.000+06	5.478-06	2.492-01	6.586-08	9.914-03	9.848-04	2.601-01	4.753-08	2.162-03	5.714-10	8.601-05	8.544-06	2.257-03
6.000+06	3.804-06	2.203-01	5.313-08	1.219-02	1.513-03	2.340-01	3.300-08	1.911-03	4.610-10	1.058-04	1.313-05	2.030-03
7.000+06	2.795-06	1.980-01	4.450-08	1.422-02	2.039-03	2.143-01	2.425-08	1.718-03	3.861-10	1.234-04	1.769-05	1.859-03
8.000+06	2.140-06	1.802-01	3.826-08	1.606-02	2.551-03	1.988-01	1.857-08	1.563-03	3.319-10	1.393-04	2.213-05	1.725-03
9.000+06	1.691-06	1.656-01	3.355-08	1.772-02	3.042-03	1.864-01	1.467-08	1.437-03	2.911-10	1.537-04	2.639-05	1.617-03
1.000+07	1.369-06	1.535-01	2.987-08	1.924-02	3.509-03	1.763-01	1.188-08	1.332-03	2.592-10	1.669-04	3.044-05	1.529-03
1.100+07	1.132-06	1.431-01	2.691-08	2.062-02	3.953-03	1.677-01	9.821-09	1.242-03	2.335-10	1.789-04	3.430-05	1.455-03
1.200+07	9.510-07	1.342-01	2.448-08	2.189-02	4.373-03	1.605-01	8.251-09	1.164-03	2.124-10	1.899-04	3.794-05	1.392-03
1.300+07	8.103-07	1.265-01	2.246-08	2.308-02	4.769-03	1.543-01	7.030-09	1.098-03	1.949-10	2.002-04	4.138-05	1.339-03
1.400+07	6.987-07	1.196-01	2.074-08	2.418-02	5.148-03	1.489-01	6.062-09	1.038-03	1.799-10	2.098-04	4.466-05	1.292-03
1.500+07	6.086-07	1.136-01	1.927-08	2.521-02	5.508-03	1.443-01	5.280-09	9.856-04	1.672-10	2.187-04	4.779-05	1.252-03
1.600+07	5.349-07	1.082-01	1.799-08	2.619-02	5.852-03	1.402-01	4.641-09	9.387-04	1.561-10	2.272-04	5.077-05	1.217-03
1.800+07	4.227-07	9.887-02	1.588-08	2.798-02	6.491-03	1.333-01	3.667-09	8.578-04	1.378-10	2.428-04	5.632-05	1.157-03
2.000+07	3.424-07	9.117-02	1.421-08	2.959-02	7.077-03	1.278-01	2.971-09	7.910-04	1.233-10	2.567-04	6.140-05	1.109-03
2.200+07	2.829-07	8.468-02	1.286-08	3.106-02	7.618-03	1.234-01	2.454-09	7.347-04	1.116-10	2.695-04	6.609-05	1.070-03
2.400+07	2.377-07	7.913-02	1.175-08	3.240-02	8.118-03	1.196-01	2.062-09	6.865-04	1.019-10	2.811-04	7.043-05	1.038-03
2.600+07	2.026-07	7.430-02	1.081-08	3.364-02	8.584-03	1.165-01	1.758-09	6.446-04	9.379-11	2.919-04	7.448-05	1.011-03
2.800+07	1.747-07	7.009-02	1.001-08	3.478-02	9.019-03	1.139-01	1.516-09	6.081-04	8.685-11	3.018-04	7.825-05	9.881-04
3.000+07	1.522-07	6.637-02	9.319-09	3.585-02	9.427-03	1.116-01	1.320-09	5.758-04	8.085-11	3.110-04	8.179-05	9.697-04
4.000+07	8.558-08	5.274-02	6.931-09	4.024-02	1.115-02	1.041-01	7.425-10	4.576-04	6.013-11	3.491-04	9.674-05	9.034-04
5.000+07	5.477-08	4.403-02	5.517-09	4.355-02	1.250-02	1.001-01	4.752-10	3.820-04	4.787-11	3.778-04	1.085-04	8.683-04
6.000+07	3.804-08	3.793-02	4.582-09	4.621-02	1.361-02	9.775-02	3.300-10	3.291-04	3.975-11	4.009-04	1.181-04	8.481-04
8.000+07	2.139-08	2.992-02	3.422-09	5.029-02	1.533-02	9.554-02	1.856-10	2.596-04	2.969-11	4.363-04	1.330-04	8.289-04
1.000+08	1.369-08	2.483-02	2.730-09	5.321-02	1.664-02	9.468-02	1.188-10	2.154-04	2.369-11	4.617-04	1.444-04	8.214-04
1.500+08	6.084-09	1.768-02	1.814-09	5.801-02	1.892-02	9.461-02	5.279-11	1.534-04	1.574-11	5.033-04	1.642-04	8.208-04
2.000+08	3.422-09	1.386-02	1.358-09	6.100-02	2.042-02	9.528-02	2.969-11	1.203-04	1.178-11	5.292-04	1.772-04	8.267-04
3.000+08	1.521-09	9.826-03	9.039-10	6.465-02	2.238-02	9.686-02	1.320-11	8.525-05	7.842-12	5.609-04	1.942-04	8.403-04
4.000+08	8.556-10	7.696-03	6.774-10	6.683-02	2.363-02	9.816-02	7.423-12	6.677-05	5.877-12	5.799-04	2.050-04	8.516-04
5.000+08	5.476-10	6.370-03	5.416-10	6.831-02	2.453-02	9.921-02	4.751-12	5.527-05	4.699-12	5.927-04	2.128-04	8.608-04
6.000+08	3.803-10	5.454-03	4.512-10	6.938-02	2.521-02	1.000-01	3.300-12	4.732-05	3.915-12	6.019-04	2.187-04	8.680-04
8.000+08	2.139-10	4.260-03	3.383-10	7.085-02	2.619-02	1.013-01	1.856-12	3.696-05	2.935-12	6.147-04	2.272-04	8.789-04
1.000+09	1.369-10	3.505-03	2.705-10	7.182-02	2.687-02	1.022-01	1.188-12	3.041-05	2.347-12	6.231-04	2.331-04	8.866-04
1.500+09	6.084-11	2.448-03	1.803-10	7.324-02	2.793-02	1.036-01	5.279-13	2.124-05	1.564-12	6.354-04	2.423-04	8.990-04
2.000+09	3.422-11	1.894-03	1.352-10	7.404-02	2.856-02	1.045-01	2.969-13	1.643-05	1.173-12	6.424-04	2.476-04	9.066-04
3.000+09	1.521-11	1.317-03	9.012-11	7.491-02	2.928-02	1.055-01	1.320-13	1.143-05	7.819-13	6.499-04	2.540-04	9.154-04
4.000+09	8.556-12	1.017-03	6.758-11	7.538-02	2.970-02	1.061-01	7.423-14	8.824-06	5.863-13	6.540-04	2.577-04	9.205-04
5.000+09	5.476-12	8.313-04	5.406-11	7.568-02	2.997-02	1.065-01	4.751-14	7.212-06	4.690-13	6.566-04	2.600-04	9.238-04
6.000+09	3.803-12	7.049-04	4.505-11	7.590-02	3.016-02	1.068-01	3.300-14	6.116-06	3.909-13	6.585-04	2.617-04	9.263-04
8.000+09	2.139-12	5.431-04	3.379-11	7.617-02	3.042-02	1.071-01	1.856-14	4.712-06	2.932-13	6.609-04	2.639-04	9.295-04
1.000+10	1.369-12	4.434-04	2.703-11	7.635-02	3.058-02	1.074-01	1.188-14	3.847-06	2.345-13	6.624-04	2.653-04	9.316-04
1.500+10	6.084-13	3.064-04	1.802-11	7.659-02	3.082-02	1.077-01	5.279-15	2.658-06	1.563-13	6.645-04	2.674-04	9.346-04
2.000+10	3.422-13	2.356-04	1.351-11	7.673-02	3.095-02	1.079-01	2.969-15	2.044-06	1.172-13	6.657-04	2.685-04	9.363-04
3.000+10	1.521-13	1.625-04	9.009-12	7.687-02	3.108-02	1.081-01	1.320-15	1.410-06	7.816-14	6.669-04	2.697-04	9.380-04
4.000+10	8.556-14	1.247-04	6.757-12	7.694-02	3.116-02	1.082-01	7.423-16	1.082-06	5.862-14	6.675-04	2.703-04	9.390-04
5.000+10	5.476-14	1.016-04	5.405-12	7.699-02	3.121-02	1.083-01	4.751-16	8.815-07	4.689-14	6.680-04	2.708-04	9.396-04
6.000+10	3.803-14	8.586-05	4.504-12	7.702-02	3.125-02	1.084-01	3.300-16	7.449-07	3.908-14	6.682-04	2.711-04	9.401-04
8.000+10	2.139-14	6.584-05	3.378-12	7.706-02	3.128-02	1.084-01	1.856-16	5.712-07	2.931-14	6.686-04	2.714-04	9.405-04
1.000+11	1.369-14	5.356-05	2.703-12	7.708-02	3.131-02	1.084-01	1.188-16	4.647-07	2.345-14	6.687-04	2.716-04	9.409-04

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, Z=1 to 100—Continued

Z = 4, BE, BERYLLIUM ATOMIC WT. = 9.01218 MSQ/KG = .00668212 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	2.778-06	8.455-01	3.285-06	0.000	0.000	8.458-01	1.856-06	5.650-03	2.195-08	0.000	0.000	5.652-03
1.022+06	2.660-04	8.365-01	3.144-06	0.000	0.000	8.368-01	1.777-06	5.590-03	2.101-08	0.000	0.000	5.591-03
1.250+06	1.778-04	7.560-01	2.137-06	1.260-04	0.000	7.563-01	1.188-06	5.052-03	1.428-08	8.419-07	0.000	5.054-03
1.500+06	1.235-04	6.872-01	1.555-06	7.043-04	0.000	6.880-01	8.252-07	4.592-03	1.039-08	4.706-06	0.000	4.597-03
2.000+06	6.947-05	5.864-01	9.844-07	2.818-03	0.000	5.893-01	4.642-07	3.918-03	6.578-09	1.683-05	0.000	3.938-03
2.044+06	6.651-05	5.792-01	9.528-07	3.038-03	0.000	5.823-01	4.444-07	3.870-03	6.367-09	2.030-05	0.000	3.891-03
3.000+06	3.087-05	4.613-01	5.550-07	8.082-03	1.614-04	4.696-01	2.063-07	3.082-03	3.709-09	5.400-05	1.078-06	3.138-03
4.000+06	1.737-05	3.848-01	3.831-07	1.313-02	6.590-04	3.986-01	1.161-07	2.571-03	2.560-09	8.774-05	4.404-06	2.664-03
5.000+06	1.112-05	3.323-01	2.916-07	1.763-02	1.313-03	3.513-01	7.431-08	2.220-03	1.949-09	1.178-04	8.774-06	2.347-03
6.000+06	7.719-06	2.937-01	2.351-07	2.167-02	2.017-03	3.174-01	5.158-08	1.963-03	1.571-09	1.448-04	1.348-05	2.121-03
7.000+06	5.671-06	2.640-01	1.968-07	2.528-02	2.719-03	2.920-01	3.789-08	1.764-03	1.315-09	1.689-04	1.817-05	1.951-03
8.000+06	4.342-06	2.403-01	1.691-07	2.854-02	3.401-03	2.722-01	2.901-08	1.606-03	1.130-09	1.907-04	2.273-05	1.819-03
9.000+06	3.431-06	2.209-01	1.482-07	3.150-02	4.055-03	2.565-01	2.293-08	1.476-03	9.903-10	2.105-04	2.710-05	1.714-03
1.000+07	2.779-06	2.046-01	1.319-07	3.420-02	4.679-03	2.435-01	1.857-08	1.367-03	8.814-10	2.285-04	3.127-05	1.627-03
1.100+07	2.296-06	1.909-01	1.189-07	3.665-02	5.271-03	2.328-01	1.534-08	1.276-03	7.945-10	2.449-04	3.522-05	1.556-03
1.200+07	1.930-06	1.790-01	1.081-07	3.890-02	5.830-03	2.237-01	1.290-08	1.196-03	7.223-10	2.599-04	3.896-05	1.495-03
1.300+07	1.644-06	1.686-01	9.916-08	4.100-02	6.359-03	2.160-01	1.099-08	1.127-03	6.626-10	2.740-04	4.249-05	1.443-03
1.400+07	1.418-06	1.595-01	9.156-08	4.296-02	6.865-03	2.093-01	9.475-09	1.066-03	6.118-10	2.871-04	4.587-05	1.399-03
1.500+07	1.235-06	1.515-01	8.505-08	4.479-02	7.344-03	2.036-01	8.252-09	1.012-03	5.683-10	2.993-04	4.907-05	1.361-03
1.600+07	1.085-06	1.442-01	7.939-08	4.651-02	7.802-03	1.985-01	7.250-09	9.636-04	5.305-10	3.108-04	5.213-05	1.326-03
1.800+07	8.576-07	1.318-01	7.007-08	4.968-02	8.655-03	1.901-01	5.731-09	8.807-04	4.682-10	3.320-04	5.783-05	1.271-03
2.000+07	6.947-07	1.216-01	6.271-08	5.253-02	9.436-03	1.836-01	4.642-09	8.125-04	4.190-10	3.510-04	6.305-05	1.227-03
2.200+07	5.741-07	1.129-01	5.674-08	5.511-02	1.016-02	1.782-01	3.836-09	7.544-04	3.791-10	3.683-04	6.789-05	1.191-03
2.400+07	4.824-07	1.055-01	5.181-08	5.748-02	1.082-02	1.738-01	3.223-09	7.050-04	3.462-10	3.841-04	7.230-05	1.161-03
2.600+07	4.110-07	9.907-02	4.767-08	5.965-02	1.144-02	1.702-01	2.746-09	6.620-04	3.185-10	3.986-04	7.644-05	1.137-03
2.800+07	3.544-07	9.346-02	4.414-08	6.166-02	1.202-02	1.671-01	2.368-09	6.245-04	2.949-10	4.120-04	8.032-05	1.117-03
3.000+07	3.087-07	8.849-02	4.110-08	6.352-02	1.256-02	1.646-01	2.063-09	5.913-04	2.746-10	4.244-04	8.393-05	1.100-03
4.000+07	1.737-07	7.032-02	3.056-08	7.122-02	1.485-02	1.564-01	1.161-09	4.699-04	2.042-10	4.759-04	9.923-05	1.045-03
5.000+07	1.111-07	5.870-02	2.432-08	7.699-02	1.665-02	1.523-01	7.424-10	3.922-04	1.625-10	5.145-04	1.113-04	1.018-03
6.000+07	7.718-08	5.058-02	2.020-08	8.158-02	1.810-02	1.503-01	5.157-10	3.380-04	1.350-10	5.451-04	1.209-04	1.004-03
8.000+07	4.341-08	3.989-02	1.508-08	8.852-02	2.037-02	1.488-01	2.901-10	2.665-04	1.008-10	5.915-04	1.361-04	9.942-04
1.000+08	2.778-08	3.311-02	1.203-08	9.355-02	2.209-02	1.488-01	1.856-10	2.212-04	8.039-11	6.251-04	1.476-04	9.949-04
1.500+08	1.235-08	2.358-02	7.994-09	1.019-01	2.507-02	1.506-01	8.252-11	1.576-04	5.342-11	6.809-04	1.675-04	1.006-03
2.000+08	6.945-09	1.848-02	5.985-09	1.072-01	2.706-02	1.527-01	4.641-11	1.235-04	3.999-11	7.163-04	1.808-04	1.021-03
3.000+08	3.087-09	1.310-02	3.983-09	1.138-01	2.965-02	1.566-01	2.063-11	8.754-05	2.661-11	7.604-04	1.981-04	1.046-03
4.000+08	1.736-09	1.026-02	2.985-09	1.177-01	3.130-02	1.593-01	1.160-11	6.856-05	1.995-11	7.865-04	2.092-04	1.064-03
5.000+08	1.111-09	8.494-03	2.386-09	1.203-01	3.248-02	1.613-01	7.424-12	5.676-05	1.594-11	8.039-04	2.170-04	1.078-03
6.000+08	7.717-10	7.273-03	1.988-09	1.223-01	3.337-02	1.629-01	5.157-12	4.860-05	1.328-11	8.172-04	2.230-04	1.089-03
8.000+08	4.341-10	5.680-03	1.490-09	1.249-01	3.463-02	1.652-01	2.901-12	3.795-05	9.956-12	8.346-04	2.314-04	1.104-03
1.000+09	2.778-10	4.673-03	1.192-09	1.267-01	3.550-02	1.669-01	1.856-12	3.123-05	7.965-12	8.466-04	2.372-04	1.115-03
1.500+09	1.235-10	3.263-03	7.944-10	1.293-01	3.683-02	1.694-01	8.252-13	2.180-05	5.308-12	8.640-04	2.461-04	1.132-03
2.000+09	6.945-11	2.526-03	5.957-10	1.307-01	3.761-02	1.708-01	4.641-13	1.688-05	3.981-12	8.734-04	2.513-04	1.142-03
3.000+09	3.087-11	1.756-03	3.970-10	1.323-01	3.848-02	1.725-01	2.063-13	1.173-05	2.653-12	8.840-04	2.571-04	1.153-03
4.000+09	1.736-11	1.356-03	2.978-10	1.331-01	3.898-02	1.734-01	1.160-13	9.061-06	1.990-12	8.894-04	2.605-04	1.159-03
5.000+09	1.111-11	1.108-03	2.382-10	1.337-01	3.930-02	1.741-01	7.424-14	7.404-06	1.592-12	8.934-04	2.626-04	1.163-03
6.000+09	7.717-12	9.399-04	1.985-10	1.341-01	3.953-02	1.746-01	5.157-14	6.281-06	1.326-12	8.961-04	2.641-04	1.166-03
8.000+09	4.341-12	7.241-04	1.489-10	1.346-01	3.983-02	1.752-01	2.901-14	4.839-06	9.950-13	8.994-04	2.661-04	1.170-03
1.000+10	2.778-12	5.912-04	1.191-10	1.349-01	4.003-02	1.755-01	1.856-14	3.950-06	7.958-13	9.014-04	2.675-04	1.173-03
1.500+10	1.235-12	4.086-04	7.939-11	1.353-01	4.030-02	1.760-01	8.252-15	2.730-06	5.305-13	9.041-04	2.692-04	1.176-03
2.000+10	6.945-13	3.141-04	5.954-11	1.356-01	4.045-02	1.764-01	4.641-15	2.099-06	3.979-13	9.061-04	2.703-04	1.178-03
3.000+10	3.087-13	2.166-04	3.969-11	1.358-01	4.060-02	1.766-01	2.063-15	1.447-06	2.652-13	9.074-04	2.712-04	1.180-03
4.000+10	1.736-13	1.663-04	2.977-11	1.360-01	4.070-02	1.769-01	1.160-15	1.111-06	1.989-13	9.088-04	2.720-04	1.182-03
5.000+10	1.111-13	1.354-04	2.381-11	1.360-01	4.075-02	1.769-01	7.424-16	9.048-07	1.591-13	9.088-04	2.723-04	1.182-03
6.000+10	7.717-14	1.145-04	1.985-11	1.361-01	4.079-02	1.770-01	5.157-16	7.651-07	1.326-13	9.094-04	2.726-04	1.183-03
8.000+10	4.341-14	8.778-05	1.488-11	1.362-01	4.083-02	1.771-01	2.901-16	5.866-07	9.943-14	9.101-04	2.728-04	1.184-03
1.000+11	2.778-14	7.142-05	1.191-11	1.362-01	4.086-02	1.771-01	1.856-16	4.772-07	7.958-14	9.101-04	2.730-04	1.184-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 5, B , BORON ATOMIC WT. = 10.81 MSQ/KG = .0055708 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	4.821-04	1.057+00	1.023-05	0.000	0.000	1.057+00	2.686-06	5.888-03	5.699-08	0.000	0.000	5.891-03
1.022+06	4.616-04	1.046+00	9.792-06	0.000	0.000	1.046+00	2.571-06	5.827-03	5.455-08	0.000	0.000	5.830-03
1.250+06	3.086-04	9.450-01	6.653-06	1.981-04	0.000	9.455-01	1.719-06	5.264-03	3.706-08	1.104-06	0.000	5.267-03
1.500+06	2.143-04	8.589-01	4.835-06	1.104-03	0.000	8.602-01	1.194-06	4.785-03	2.693-08	6.150-06	0.000	4.792-03
2.000+06	1.206-04	7.330-01	3.056-06	4.408-03	0.000	7.375-01	6.718-07	4.083-03	1.702-08	2.456-05	0.000	4.109-03
2.044+06	1.154-04	7.239-01	2.957-06	4.752-03	0.000	7.288-01	6.429-07	4.033-03	1.647-08	2.647-05	0.000	4.060-03
3.000+06	5.358-05	5.767-01	1.719-06	1.263-02	2.017-04	5.896-01	2.985-07	3.213-03	9.576-09	7.036-05	1.124-06	3.284-03
4.000+06	3.014-05	4.810-01	1.184-06	2.052-02	8.237-04	5.024-01	1.679-07	2.680-03	6.596-09	1.143-04	4.589-06	2.799-03
5.000+06	1.929-05	4.154-01	9.007-07	2.754-02	1.641-03	4.446-01	1.075-07	2.314-03	5.018-09	1.534-04	9.142-06	2.477-03
6.000+06	1.340-05	3.672-01	7.256-07	3.387-02	2.521-03	4.036-01	7.465-08	2.046-03	4.042-09	1.887-04	1.404-05	2.248-03
7.000+06	9.842-06	3.300-01	6.070-07	3.950-02	3.399-03	3.729-01	5.483-08	1.838-03	3.381-09	2.200-04	1.894-05	2.077-03
8.000+06	7.535-06	3.003-01	5.215-07	4.459-02	4.252-03	3.492-01	4.198-08	1.673-03	2.905-09	2.484-04	2.369-05	1.945-03
9.000+06	5.954-06	2.761-01	4.570-07	4.921-02	5.069-03	3.304-01	3.317-08	1.538-03	2.546-09	2.741-04	2.824-05	1.841-03
1.000+07	4.823-06	2.558-01	4.067-07	5.341-02	5.849-03	3.151-01	2.687-08	1.425-03	2.266-09	2.975-04	3.256-05	1.755-03
1.100+07	3.986-06	2.386-01	3.662-07	5.723-02	6.588-03	3.024-01	2.221-08	1.329-03	2.040-09	3.188-04	3.670-05	1.685-03
1.200+07	3.349-06	2.237-01	3.331-07	6.074-02	7.288-03	2.917-01	1.866-08	1.246-03	1.856-09	3.384-04	4.060-05	1.625-03
1.300+07	2.854-06	2.108-01	3.054-07	6.401-02	7.949-03	2.828-01	1.590-08	1.174-03	1.701-09	3.566-04	4.428-05	1.575-03
1.400+07	2.461-06	1.994-01	2.820-07	6.706-02	8.581-03	2.750-01	1.371-08	1.111-03	1.571-09	3.736-04	4.780-05	1.532-03
1.500+07	2.143-06	1.893-01	2.619-07	6.991-02	9.180-03	2.684-01	1.194-08	1.055-03	1.459-09	3.895-04	5.114-05	1.495-03
1.600+07	1.884-06	1.803-01	2.445-07	7.259-02	9.752-03	2.626-01	1.050-08	1.004-03	1.362-09	4.044-04	5.433-05	1.463-03
1.800+07	1.488-06	1.648-01	2.157-07	7.751-02	1.082-02	2.531-01	8.289-09	9.181-04	1.202-09	4.318-04	6.026-05	1.410-03
2.000+07	1.206-06	1.519-01	1.930-07	8.193-02	1.179-02	2.456-01	6.718-09	8.462-04	1.075-09	4.564-04	6.568-05	1.368-03
2.200+07	9.964-07	1.411-01	1.746-07	8.594-02	1.269-02	2.397-01	5.551-09	7.866-04	9.727-10	4.788-04	7.069-05	1.335-03
2.400+07	8.372-07	1.319-01	1.595-07	8.959-02	1.353-02	2.350-01	4.664-09	7.348-04	8.885-10	4.991-04	7.537-05	1.309-03
2.600+07	7.134-07	1.238-01	1.467-07	9.295-02	1.430-02	2.311-01	3.974-09	6.897-04	8.172-10	5.178-04	7.966-05	1.287-03
2.800+07	6.151-07	1.168-01	1.358-07	9.604-02	1.502-02	2.279-01	3.427-09	6.507-04	7.565-10	5.350-04	8.367-05	1.269-03
3.000+07	5.358-07	1.106-01	1.264-07	9.892-02	1.570-02	2.252-01	2.985-09	6.161-04	7.042-10	5.511-04	8.746-05	1.255-03
4.000+07	3.014-07	8.790-02	9.400-08	1.107-01	1.855-02	2.172-01	1.679-09	4.897-04	5.237-10	6.167-04	1.033-04	1.210-03
5.000+07	1.929-07	7.337-02	7.480-08	1.196-01	2.078-02	2.138-01	1.075-09	4.087-04	4.167-10	6.663-04	1.158-04	1.191-03
6.000+07	1.340-07	6.322-02	6.211-08	1.267-01	2.259-02	2.125-01	7.465-10	3.522-04	3.460-10	7.058-04	1.258-04	1.184-03
8.000+07	7.534-08	4.986-02	4.538-08	1.373-01	2.541-02	2.126-01	4.197-10	2.778-04	2.584-10	7.649-04	1.416-04	1.184-03
1.000+08	4.821-08	4.138-02	3.700-08	1.451-01	2.754-02	2.140-01	2.686-10	2.305-04	2.061-10	8.083-04	1.534-04	1.192-03
1.500+08	2.143-08	2.947-02	2.458-08	1.582-01	3.124-02	2.189-01	1.194-10	1.642-04	1.369-10	8.813-04	1.740-04	1.220-03
2.000+08	1.205-08	2.311-02	1.840-08	1.665-01	3.371-02	2.233-01	6.713-11	1.287-04	1.025-10	9.275-04	1.878-04	1.244-03
3.000+08	5.357-09	1.638-02	1.224-08	1.766-01	3.690-02	2.299-01	2.984-11	9.125-05	6.819-11	9.838-04	2.056-04	1.281-03
4.000+08	3.013-09	1.283-02	9.175-09	1.827-01	3.893-02	2.345-01	1.678-11	7.147-05	5.111-11	1.018-03	2.169-04	1.306-03
5.000+08	1.929-09	1.062-02	7.336-09	1.868-01	4.035-02	2.378-01	1.075-11	5.916-05	4.087-11	1.041-03	2.248-04	1.325-03
6.000+08	1.339-09	9.091-03	6.111-09	1.898-01	4.142-02	2.403-01	7.459-12	5.064-05	3.404-11	1.057-03	2.307-04	1.339-03
8.000+08	7.533-10	7.100-03	4.582-09	1.939-01	4.294-02	2.439-01	4.196-12	3.955-05	2.553-11	1.080-03	2.392-04	1.359-03
1.000+09	4.821-10	5.841-03	3.664-09	1.965-01	4.397-02	2.463-01	2.686-12	3.254-05	2.041-11	1.095-03	2.449-04	1.372-03
1.500+09	2.143-10	4.079-03	2.442-09	2.005-01	4.553-02	2.501-01	1.194-12	2.272-05	1.360-11	1.117-03	2.536-04	1.393-03
2.000+09	1.205-10	3.157-03	1.831-09	2.027-01	4.644-02	2.523-01	6.713-13	1.759-05	1.020-11	1.129-03	2.587-04	1.405-03
3.000+09	5.357-11	2.195-03	1.221-09	2.050-01	4.744-02	2.546-01	2.984-13	1.223-05	6.802-12	1.142-03	2.643-04	1.419-03
4.000+09	3.013-11	1.695-03	9.153-10	2.063-01	4.803-02	2.560-01	1.678-13	9.443-06	5.099-12	1.149-03	2.676-04	1.426-03
5.000+09	1.929-11	1.385-03	7.322-10	2.072-01	4.839-02	2.570-01	1.075-13	7.716-06	4.079-12	1.154-03	2.696-04	1.432-03
6.000+09	1.339-11	1.175-03	6.102-10	2.077-01	4.865-02	2.575-01	7.459-14	6.546-06	3.399-12	1.157-03	2.710-04	1.435-03
8.000+09	7.533-12	9.051-04	4.576-10	2.085-01	4.900-02	2.584-01	4.196-14	5.042-06	2.549-12	1.162-03	2.730-04	1.440-03
1.000+10	4.821-12	7.390-04	3.661-10	2.090-01	4.922-02	2.590-01	2.686-14	4.117-06	2.039-12	1.164-03	2.742-04	1.443-03
1.500+10	2.143-12	5.107-04	2.440-10	2.096-01	4.952-02	2.596-01	1.194-14	2.845-06	1.359-12	1.168-03	2.759-04	1.446-03
2.000+10	1.205-12	3.927-04	1.830-10	2.100-01	4.970-02	2.601-01	6.713-15	2.188-06	1.019-12	1.170-03	2.769-04	1.449-03
3.000+10	5.357-13	2.708-04	1.220-10	2.104-01	4.987-02	2.605-01	2.984-15	1.509-06	6.796-13	1.172-03	2.778-04	1.451-03
4.000+10	3.013-13	2.079-04	9.151-11	2.106-01	4.998-02	2.608-01	1.678-15	1.158-06	5.098-13	1.173-03	2.784-04	1.453-03
5.000+10	1.929-13	1.693-04	7.321-11	2.107-01	5.004-02	2.609-01	1.075-15	9.431-07	4.078-13	1.174-03	2.788-04	1.453-03
6.000+10	1.339-13	1.431-04	6.101-11	2.108-01	5.008-02	2.610-01	7.459-16	7.972-07	3.399-13	1.174-03	2.790-04	1.454-03
8.000+10	7.533-14	1.097-04	4.575-11	2.109-01	5.013-02	2.611-01	4.196-16	6.111-07	2.549-13	1.175-03	2.793-04	1.455-03
1.000+11	4.821-14	8.927-05	3.660-11	2.110-01	5.016-02	2.612-01	2.686-16	4.973-07	2.039-13	1.175-03	2.794-04	1.455-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 6, C , CARBON ATOMIC WT. = 12.011 MSQ/KG = .00501377 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CM^2/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	7.682-04	1.268+00	2.562-05	0.000	0.000	1.269+00	3.852-06	6.357-03	1.285-07	0.000	0.000	6.361-03
1.022+06	7.355-04	1.255+00	2.452-05	0.000	0.000	1.256+00	3.688-06	6.292-03	1.229-07	0.000	0.000	6.296-03
1.250+06	4.917-04	1.134+00	1.665-05	2.870-04	0.000	1.135+00	2.465-06	5.686-03	8.348-08	1.439-06	0.000	5.690-03
1.500+06	3.415-04	1.031+00	1.209-05	1.594-03	0.000	1.033+00	1.712-06	5.169-03	6.062-08	7.992-06	0.000	5.179-03
2.000+06	1.921-04	8.795-01	7.631-06	6.356-03	0.000	8.861-01	9.631-07	4.410-03	3.826-08	3.187-05	0.000	4.442-03
2.044+06	1.839-04	8.687-01	7.384-06	6.852-03	0.000	8.757-01	9.220-07	4.355-03	3.702-08	3.435-05	0.000	4.391-03
3.000+06	8.539-05	6.920-01	4.282-06	1.820-02	2.421-04	7.105-01	4.281-07	3.470-03	2.147-08	9.125-05	1.214-06	3.562-03
4.000+06	4.803-05	5.772-01	2.947-06	2.955-02	9.885-04	6.078-01	2.408-07	2.894-03	1.478-08	1.482-04	4.956-06	3.047-03
5.000+06	3.074-05	4.985-01	2.239-06	3.966-02	1.970-03	5.402-01	1.541-07	2.499-03	1.123-08	1.988-04	9.877-06	2.708-03
6.000+06	2.135-05	4.406-01	1.802-06	4.876-02	3.025-03	4.924-01	1.070-07	2.209-03	9.035-09	2.445-04	1.517-05	2.469-03
7.000+06	1.568-05	3.960-01	1.507-06	5.687-02	4.079-03	4.570-01	7.862-08	1.985-03	7.556-09	2.851-04	2.045-05	2.291-03
8.000+06	1.201-05	3.604-01	1.294-06	6.418-02	5.102-03	4.297-01	6.022-08	1.807-03	6.488-09	3.218-04	2.558-05	2.154-03
9.000+06	9.488-06	3.313-01	1.134-06	7.082-02	6.083-03	4.082-01	4.757-08	1.661-03	5.686-09	3.551-04	3.050-05	2.047-03
1.000+07	7.685-06	3.069-01	1.009-06	7.686-02	7.018-03	3.908-01	3.853-08	1.539-03	5.059-09	3.854-04	3.519-05	1.959-03
1.100+07	6.352-06	2.863-01	9.081-07	8.235-02	7.906-03	3.766-01	3.185-08	1.435-03	4.553-09	4.129-04	3.964-05	1.888-03
1.200+07	5.337-06	2.685-01	8.258-07	8.739-02	8.745-03	3.646-01	2.676-08	1.346-03	4.140-09	4.382-04	4.385-05	1.828-03
1.300+07	4.548-06	2.529-01	7.571-07	9.209-02	9.538-03	3.545-01	2.280-08	1.268-03	3.796-09	4.617-04	4.782-05	1.778-03
1.400+07	3.921-06	2.393-01	6.989-07	9.645-02	1.030-02	3.461-01	1.966-08	1.200-03	3.504-09	4.836-04	5.164-05	1.735-03
1.500+07	3.416-06	2.272-01	6.490-07	1.005-01	1.102-02	3.367-01	1.713-08	1.139-03	3.254-09	5.039-04	5.525-05	1.698-03
1.600+07	3.002-06	2.163-01	6.058-07	1.044-01	1.170-02	3.324-01	1.505-08	1.084-03	3.037-09	5.234-04	5.866-05	1.667-03
1.800+07	2.372-06	1.977-01	5.345-07	1.114-01	1.298-02	3.221-01	1.189-08	9.912-04	2.680-09	5.585-04	6.508-05	1.615-03
2.000+07	1.921-06	1.823-01	4.782-07	1.177-01	1.415-02	3.142-01	9.631-09	9.140-04	2.398-09	5.901-04	7.094-05	1.575-03
2.200+07	1.588-06	1.694-01	4.326-07	1.235-01	1.523-02	3.081-01	7.962-09	8.493-04	2.169-09	6.192-04	7.636-05	1.545-03
2.400+07	1.334-06	1.583-01	3.949-07	1.287-01	1.623-02	3.032-01	6.688-09	7.937-04	1.980-09	6.453-04	8.137-05	1.520-03
2.600+07	1.137-06	1.486-01	3.633-07	1.335-01	1.715-02	2.993-01	5.701-09	7.450-04	1.822-09	6.697-04	8.599-05	1.500-03
2.800+07	9.803-07	1.402-01	3.363-07	1.379-01	1.802-02	2.961-01	4.915-09	7.029-04	1.686-09	6.914-04	9.035-05	1.485-03
3.000+07	8.539-07	1.327-01	3.131-07	1.420-01	1.883-02	2.935-01	4.281-09	6.653-04	1.570-09	7.120-04	9.441-05	1.472-03
4.000+07	4.803-07	1.055-01	2.327-07	1.588-01	2.224-02	2.865-01	2.408-09	5.290-04	1.167-09	7.962-04	1.115-04	1.437-03
5.000+07	3.074-07	8.805-02	1.851-07	1.714-01	2.490-02	2.844-01	1.541-09	4.415-04	9.280-11	8.594-04	1.248-04	1.426-03
6.000+07	2.135-07	7.586-02	1.537-07	1.815-01	2.706-02	2.844-01	1.070-09	3.803-04	7.706-11	9.100-04	1.357-04	1.426-03
8.000+07	1.201-07	5.983-02	1.148-07	1.967-01	3.041-02	2.869-01	6.022-10	3.000-04	5.756-11	9.862-04	1.525-04	1.439-03
1.000+08	7.684-08	4.966-02	9.156-08	2.079-01	3.294-02	2.905-01	3.853-10	2.490-04	4.591-11	1.042-03	1.652-04	1.457-03
1.500+08	3.415-08	3.536-02	6.081-08	2.267-01	3.734-02	2.994-01	1.712-10	1.773-04	3.049-11	1.177-03	1.872-04	1.501-03
2.000+08	1.921-08	2.773-02	4.553-08	2.384-01	4.024-02	3.064-01	9.631-11	1.390-04	2.283-11	1.195-03	2.018-04	1.536-03
3.000+08	8.537-09	1.965-02	3.030-08	2.528-01	4.397-02	3.164-01	4.280-11	9.852-05	1.519-11	1.267-03	2.205-04	1.586-03
4.000+08	4.802-09	1.539-02	2.270-08	2.613-01	4.630-02	3.230-01	2.408-11	7.716-05	1.138-11	1.310-03	2.321-04	1.619-03
5.000+08	3.073-09	1.274-02	1.815-08	2.670-01	4.792-02	3.277-01	1.541-11	6.388-05	9.100-11	1.339-03	2.403-04	1.643-03
6.000+08	2.134-09	1.091-02	1.512-08	2.712-01	4.914-02	3.313-01	1.070-11	5.470-05	7.581-11	1.360-03	2.464-04	1.661-03
8.000+08	1.201-09	8.520-03	1.133-08	2.768-01	5.084-02	3.362-01	6.022-12	4.272-05	5.681-11	1.388-03	2.549-04	1.685-03
1.000+09	7.684-10	7.009-03	9.065-09	2.805-01	5.198-02	3.395-01	3.853-12	3.514-05	4.545-11	1.406-03	2.606-04	1.702-03
1.500+09	3.415-10	4.895-03	6.041-09	2.859-01	5.372-02	3.445-01	1.712-12	2.454-05	3.029-11	1.433-03	2.693-04	1.727-03
2.000+09	1.921-10	3.789-03	4.530-09	2.889-01	5.471-02	3.474-01	9.631-13	1.900-05	2.271-11	1.448-03	2.743-04	1.742-03
3.000+09	8.537-11	2.634-03	3.019-09	2.922-01	5.580-02	3.506-01	4.280-13	1.321-05	1.514-11	1.465-03	2.798-04	1.758-03
4.000+09	4.802-11	2.033-03	2.264-09	2.939-01	5.644-02	3.524-01	2.408-13	1.019-05	1.135-11	1.474-03	2.830-04	1.767-03
5.000+09	3.073-11	1.663-03	1.811-09	2.951-01	5.684-02	3.536-01	1.541-13	8.338-06	9.080-12	1.480-03	2.850-04	1.773-03
6.000+09	2.134-11	1.410-03	1.509-09	2.958-01	5.712-02	3.543-01	1.070-13	7.069-06	7.566-12	1.483-03	2.864-04	1.777-03
8.000+09	1.201-11	1.086-03	1.132-09	2.969-01	5.749-02	3.555-01	6.022-14	5.445-06	5.676-12	1.489-03	2.882-04	1.782-03
1.000+10	7.684-12	8.868-04	9.056-10	2.975-01	5.773-02	3.561-01	3.853-14	4.446-06	4.540-12	1.492-03	2.894-04	1.785-03
1.500+10	3.415-12	6.129-04	6.037-10	2.984-01	5.805-02	3.571-01	1.712-14	3.073-06	3.027-12	1.496-03	2.910-04	1.790-03
2.000+10	1.921-12	4.712-04	4.528-10	2.989-01	5.824-02	3.576-01	9.631-15	2.362-06	2.270-12	1.499-03	2.920-04	1.793-03
3.000+10	8.537-13	3.249-04	3.018-10	2.994-01	5.842-02	3.581-01	4.280-15	1.629-06	1.513-12	1.501-03	2.929-04	1.796-03
4.000+10	4.802-13	2.495-04	2.264-10	2.997-01	5.854-02	3.585-01	2.408-15	1.251-06	1.135-12	1.503-03	2.935-04	1.797-03
5.000+10	3.073-13	2.032-04	1.811-10	2.998-01	5.860-02	3.586-01	1.541-15	1.019-06	9.080-13	1.503-03	2.938-04	1.798-03
6.000+10	2.134-13	1.717-04	1.509-10	3.000-01	5.865-02	3.588-01	1.070-15	8.609-07	7.566-13	1.504-03	2.941-04	1.799-03
8.000+10	1.201-13	1.317-04	1.132-10	3.001-01	5.870-02	3.589-01	6.022-16	6.603-07	5.676-13	1.505-03	2.942-04	1.800-03
1.000+11	7.684-14	1.071-04	9.055-11	3.002-01	5.873-02	3.590-01	3.853-16	5.370-07	4.540-13	1.505-03	2.945-04	1.800-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 7, N , NITROGEN ATOMIC WT. = 14.0067 MSQ/KG = .00429940 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.158-03	1.479+00	5.530-05	0.000	0.000	1.480+00	4.979-06	6.359-03	2.378-07	0.000	0.000	6.364-03
1.022+06	1.109-03	1.464+00	5.293-05	0.000	0.000	1.465+00	4.768-06	6.294-03	2.276-07	0.000	0.000	6.299-03
1.250+06	7.414-04	1.323+00	3.593-05	3.931-04	0.000	1.324+00	3.188-06	5.688-03	1.545-07	1.690-06	0.000	5.693-03
1.500+06	5.149-04	1.202+00	2.609-05	2.177-03	0.000	1.205+00	2.214-06	5.168-03	1.122-07	9.360-06	0.000	5.180-03
2.000+06	2.897-04	1.026+00	1.643-05	8.667-03	0.000	1.035+00	1.246-06	4.411-03	7.064-08	3.726-05	0.000	4.450-03
2.044+06	2.773-04	1.013+00	1.590-05	9.343-03	0.000	1.023+00	1.192-06	4.355-03	6.836-08	4.017-05	0.000	4.397-03
3.000+06	1.287-04	8.073-01	9.200-06	2.479-02	2.824-04	8.325-01	5.533-07	3.471-03	3.955-08	1.066-04	1.214-06	3.579-03
4.000+06	7.243-05	6.734-01	6.323-06	4.023-02	1.153-03	7.149-01	3.114-07	2.895-03	2.719-08	1.730-04	4.957-06	3.073-03
5.000+06	4.635-05	5.815-01	4.799-06	5.398-02	2.298-03	6.378-01	1.993-07	2.500-03	2.063-08	2.321-04	9.880-06	2.742-03
6.000+06	3.219-05	5.140-01	3.861-06	6.636-02	3.529-03	5.839-01	1.384-07	2.210-03	1.660-08	2.853-04	1.517-05	2.511-03
7.000+06	2.365-05	4.620-01	3.227-06	7.737-02	4.759-03	5.442-01	1.017-07	1.986-03	1.387-08	3.326-04	2.046-05	2.340-03
8.000+06	1.811-05	4.205-01	2.770-06	8.731-02	5.952-03	5.138-01	7.786-08	1.808-03	1.191-08	3.754-04	2.559-05	2.209-03
9.000+06	1.431-05	3.865-01	2.426-06	9.633-02	7.097-03	4.899-01	6.152-08	1.662-03	1.043-08	4.142-04	3.051-05	2.106-03
1.000+07	1.159-05	3.581-01	2.157-06	1.045-01	8.188-03	4.708-01	4.983-08	1.540-03	9.274-09	4.493-04	3.520-05	2.024-03
1.100+07	9.577-06	3.340-01	1.942-06	1.120-01	9.223-03	4.552-01	4.118-08	1.436-03	8.349-09	4.815-04	3.965-05	1.957-03
1.200+07	8.047-06	3.132-01	1.766-06	1.188-01	1.020-02	4.422-01	3.460-08	1.347-03	7.592-09	5.108-04	4.385-05	1.901-03
1.300+07	6.857-06	2.951-01	1.619-06	1.252-01	1.113-02	4.314-01	2.948-08	1.269-03	6.961-09	5.383-04	4.785-05	1.855-03
1.400+07	5.912-06	2.792-01	1.494-06	1.311-01	1.201-02	4.223-01	2.542-08	1.200-03	6.423-09	5.637-04	5.164-05	1.816-03
1.500+07	5.150-06	2.650-01	1.387-06	1.367-01	1.285-02	4.146-01	2.214-08	1.139-03	5.963-09	5.877-04	5.525-05	1.782-03
1.600+07	4.527-06	2.524-01	1.295-06	1.419-01	1.365-02	4.080-01	1.946-08	1.085-03	5.568-09	6.101-04	5.869-05	1.754-03
1.800+07	3.577-06	2.307-01	1.142-06	1.514-01	1.514-02	3.972-01	1.538-08	9.919-04	4.910-09	6.509-04	6.509-05	1.708-03
2.000+07	2.897-06	2.127-01	1.022-06	1.599-01	1.650-02	3.891-01	1.246-08	9.145-04	4.394-09	6.875-04	7.094-05	1.673-03
2.200+07	2.394-06	1.976-01	9.241-07	1.677-01	1.776-02	3.831-01	1.029-08	8.496-04	3.973-09	7.210-04	7.636-05	1.647-03
2.400+07	2.012-06	1.846-01	8.435-07	1.747-01	1.892-02	3.782-01	8.650-09	7.937-04	3.627-09	7.511-04	8.134-05	1.626-03
2.600+07	1.714-06	1.734-01	7.759-07	1.812-01	2.000-02	3.746-01	7.369-09	7.455-04	3.336-09	7.791-04	8.599-05	1.611-03
2.800+07	1.478-06	1.636-01	7.183-07	1.871-01	2.101-02	3.717-01	6.355-09	7.034-04	3.088-09	8.044-04	9.033-05	1.598-03
3.000+07	1.288-06	1.549-01	6.686-07	1.926-01	2.195-02	3.695-01	5.538-09	6.660-04	2.875-09	8.281-04	9.437-05	1.588-03
4.000+07	7.242-07	1.231-01	4.968-07	2.153-01	2.591-02	3.643-01	3.114-09	5.293-04	2.136-09	9.257-04	1.114-04	1.566-03
5.000+07	4.635-07	1.027-01	3.952-07	2.325-01	2.900-02	3.642-01	1.993-09	4.415-04	1.699-09	9.996-04	1.247-04	1.566-03
6.000+07	3.219-07	8.851-02	3.281-07	2.462-01	3.150-02	3.662-01	1.384-09	3.805-04	1.411-09	1.059-03	1.354-04	1.574-03
8.000+07	1.810-07	6.980-02	2.450-07	2.667-01	3.539-02	3.719-01	7.782-10	3.001-04	1.053-09	1.147-03	1.522-04	1.599-03
1.000+08	1.159-07	5.794-02	1.954-07	2.819-01	3.832-02	3.782-01	4.983-10	2.491-04	8.401-10	1.212-03	1.648-04	1.626-03
1.500+08	5.149-08	4.126-02	1.298-07	3.071-01	4.340-02	3.918-01	2.214-10	1.774-04	5.581-10	1.320-03	1.866-04	1.684-03
2.000+08	2.896-08	3.235-02	9.715-08	3.229-01	4.675-02	4.020-01	1.245-10	1.391-04	4.177-10	1.388-03	2.010-04	1.728-03
3.000+08	1.287-08	2.293-02	6.465-08	3.418-01	5.102-02	4.158-01	5.533-11	9.859-05	2.780-10	1.470-03	2.194-04	1.787-03
4.000+08	7.241-09	1.796-02	4.844-08	3.530-01	5.368-02	4.246-01	3.113-11	7.722-05	2.083-10	1.518-03	2.308-04	1.826-03
5.000+08	4.634-09	1.486-02	3.873-08	3.605-01	5.554-02	4.309-01	1.992-11	6.389-05	1.665-10	1.550-03	2.388-04	1.853-03
6.000+08	3.218-09	1.273-02	3.226-08	3.659-01	5.692-02	4.356-01	1.384-11	5.473-05	1.387-10	1.573-03	2.447-04	1.873-03
8.000+08	1.810-09	9.940-03	2.418-08	3.731-01	5.884-02	4.419-01	7.782-12	4.274-05	1.040-10	1.604-03	2.530-04	1.900-03
1.000+09	1.159-09	8.178-03	1.934-08	3.779-01	6.014-02	4.462-01	4.983-12	3.516-05	8.315-11	1.625-03	2.586-04	1.918-03
1.500+09	5.149-10	5.711-03	1.289-08	3.848-01	6.209-02	4.526-01	2.214-12	2.455-05	5.542-11	1.654-03	2.669-04	1.946-03
2.000+09	2.896-10	4.420-03	9.666-09	3.887-01	6.320-02	4.563-01	1.245-12	1.900-05	4.156-11	1.671-03	2.717-04	1.962-03
3.000+09	1.287-10	3.073-03	6.443-09	3.928-01	6.443-02	4.603-01	5.533-13	1.321-05	2.770-11	1.689-03	2.770-04	1.979-03
4.000+09	7.241-11	2.372-03	4.831-09	3.951-01	6.515-02	4.626-01	3.113-13	1.020-05	2.077-11	1.699-03	2.801-04	1.989-03
5.000+09	4.634-11	1.940-03	3.865-09	3.965-01	6.559-02	4.640-01	1.992-13	8.341-06	1.662-11	1.705-03	2.820-04	1.995-03
6.000+09	3.218-11	1.645-03	3.221-09	3.975-01	6.590-02	4.650-01	1.384-13	7.073-06	1.385-11	1.709-03	2.833-04	1.999-03
8.000+09	1.810-11	1.267-03	2.415-09	3.988-01	6.632-02	4.664-01	7.782-14	5.447-06	1.038-11	1.715-03	2.851-04	2.005-03
1.000+10	1.159-11	1.035-03	1.932-09	3.996-01	6.658-02	4.672-01	4.983-14	4.450-06	8.306-12	1.718-03	2.863-04	2.009-03
1.500+10	5.149-12	7.150-04	1.288-09	4.008-01	6.694-02	4.685-01	2.214-14	3.074-06	5.538-12	1.723-03	2.878-04	2.014-03
2.000+10	2.896-12	5.497-04	9.661-10	4.014-01	6.715-02	4.691-01	1.245-14	2.363-06	4.154-12	1.726-03	2.887-04	2.017-03
3.000+10	1.287-12	3.791-04	6.440-10	4.020-01	6.735-02	4.697-01	5.533-15	1.630-06	2.769-12	1.728-03	2.896-04	2.020-03
4.000+10	7.241-13	2.911-04	4.830-10	4.024-01	6.746-02	4.702-01	3.113-15	1.252-06	2.077-12	1.730-03	2.901-04	2.021-03
5.000+10	4.634-13	2.370-04	3.864-10	4.026-01	6.755-02	4.704-01	1.992-15	1.019-06	1.661-12	1.731-03	2.904-04	2.022-03
6.000+10	3.218-13	2.003-04	3.220-10	4.027-01	6.760-02	4.705-01	1.384-15	8.612-07	1.384-12	1.731-03	2.906-04	2.022-03
8.000+10	1.810-13	1.536-04	2.415-10	4.029-01	6.766-02	4.707-01	7.782-16	6.604-07	1.038-12	1.732-03	2.909-04	2.024-03
1.000+11	1.159-13	1.250-04	1.932-10	4.030-01	6.770-02	4.708-01	4.983-16	5.374-07	8.306-13	1.733-03	2.911-04	2.024-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 8. O . OXYGEN ATOMIC WT. = 15.9994 MSQ/KG = .00376392 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.674-03	1.691+00	1.072-04	0.000	0.000	1.693+00	6.301-06	6.365-03	4.035-07	0.000	0.000	6.371-03
1.022+06	1.603-03	1.673+00	1.026-04	0.000	0.000	1.675+00	6.034-06	6.297-03	3.862-07	0.000	0.000	6.303-03
1.250+06	1.072-03	1.512+00	6.966-05	5.159-04	0.000	1.514+00	4.035-06	5.691-03	2.622-07	1.942-06	0.000	5.697-03
1.500+06	7.442-04	1.374+00	5.054-05	2.850-03	0.000	1.378+00	2.801-06	5.172-03	1.902-07	1.073-05	0.000	5.185-03
2.000+06	4.187-04	1.173+00	3.179-05	1.134-02	0.000	1.185+00	1.576-06	4.415-03	1.197-07	4.268-05	0.000	4.459-03
2.044+06	4.008-04	1.158+00	3.075-05	1.222-02	0.000	1.171+00	1.509-06	4.359-03	1.157-07	4.600-05	0.000	4.406-03
3.000+06	1.861-04	9.226-01	1.776-05	3.241-02	3.228-04	9.555-01	7.005-07	3.473-03	6.685-08	1.220-04	1.215-06	3.597-03
4.000+06	1.047-04	7.696-01	1.219-05	5.256-02	1.318-03	8.236-01	3.941-07	2.897-03	4.588-08	1.978-04	4.961-06	3.100-03
5.000+06	6.699-05	6.646-01	9.242-06	7.051-02	2.626-03	7.378-01	2.521-07	2.502-03	3.479-08	2.654-04	9.884-06	2.777-03
6.000+06	4.652-05	5.874-01	7.430-06	8.664-02	4.033-03	6.781-01	1.751-07	2.211-03	2.797-08	3.261-04	1.518-05	2.552-03
7.000+06	3.418-05	5.280-01	6.207-06	1.010-01	5.438-03	6.345-01	1.287-07	1.987-03	2.336-08	3.802-04	2.047-05	2.388-03
8.000+06	2.617-05	4.805-01	5.326-06	1.139-01	6.803-03	6.012-01	9.850-08	1.809-03	2.005-08	4.287-04	2.561-05	2.263-03
9.000+06	2.068-05	4.417-01	4.663-06	1.257-01	8.111-03	5.755-01	7.784-08	1.663-03	1.755-08	4.731-04	3.053-05	2.166-03
1.000+07	1.675-05	4.093-01	4.146-06	1.363-01	9.357-03	5.550-01	6.305-08	1.541-03	1.561-08	5.130-04	3.522-05	2.089-03
1.100+07	1.384-05	3.817-01	3.732-06	1.460-01	1.054-02	5.383-01	5.209-08	1.437-03	1.405-08	5.495-04	3.967-05	2.026-03
1.200+07	1.163-05	3.580-01	3.392-06	1.549-01	1.166-02	5.246-01	4.377-08	1.347-03	1.277-08	5.830-04	4.389-05	1.974-03
1.300+07	9.911-06	3.372-01	3.109-06	1.632-01	1.272-02	5.131-01	3.730-08	1.269-03	1.170-08	6.143-04	4.788-05	1.931-03
1.400+07	8.545-06	3.190-01	2.869-06	1.709-01	1.373-02	5.036-01	3.216-08	1.201-03	1.080-08	6.433-04	5.168-05	1.896-03
1.500+07	7.444-06	3.029-01	2.664-06	1.781-01	1.468-02	4.957-01	2.802-08	1.140-03	1.003-08	6.704-04	5.525-05	1.866-03
1.600+07	6.542-06	2.885-01	2.486-06	1.849-01	1.560-02	4.890-01	2.462-08	1.086-03	9.357-09	6.959-04	5.872-05	1.841-03
1.800+07	5.169-06	2.636-01	2.193-06	1.973-01	1.730-02	4.782-01	1.946-08	9.922-04	8.254-09	7.426-04	6.512-05	1.800-03
2.000+07	4.187-06	2.431-01	1.961-06	2.084-01	1.885-02	4.704-01	1.576-08	9.150-04	7.381-09	7.844-04	7.095-05	1.770-03
2.200+07	3.461-06	2.258-01	1.774-06	2.185-01	2.029-02	4.646-01	1.303-08	8.499-04	6.677-09	8.224-04	7.637-05	1.749-03
2.400+07	2.908-06	2.110-01	1.619-06	2.277-01	2.161-02	4.603-01	1.095-08	7.942-04	6.094-09	8.570-04	8.134-05	1.733-03
2.600+07	2.478-06	1.981-01	1.489-06	2.361-01	2.284-02	4.570-01	9.327-09	7.456-04	5.604-09	8.887-04	8.597-05	1.720-03
2.800+07	2.136-06	1.869-01	1.378-06	2.439-01	2.399-02	4.548-01	8.040-09	7.035-04	5.187-09	9.180-04	9.030-05	1.712-03
3.000+07	1.861-06	1.770-01	1.283-06	2.511-01	2.506-02	4.532-01	7.005-09	6.662-04	4.829-09	9.451-04	9.432-05	1.706-03
4.000+07	1.047-06	1.406-01	9.531-07	2.804-01	2.958-02	4.506-01	3.941-09	5.292-04	3.587-09	1.055-03	1.113-04	1.696-03
5.000+07	6.699-07	1.174-01	7.581-07	3.029-01	3.309-02	4.533-01	2.521-09	4.419-04	2.853-09	1.140-03	1.245-04	1.706-03
6.000+07	4.652-07	1.011-01	6.294-07	3.204-01	3.594-02	4.574-01	1.751-09	3.805-04	2.369-09	1.206-03	1.353-04	1.722-03
8.000+07	2.617-07	7.977-02	4.698-07	3.472-01	4.036-02	4.673-01	9.850-10	3.002-04	1.768-09	1.307-03	1.519-04	1.759-03
1.000+08	1.675-07	6.621-02	3.747-07	3.668-01	4.368-02	4.767-01	6.305-10	2.492-04	1.410-09	1.381-03	1.644-04	1.794-03
1.500+08	7.443-08	4.715-02	2.488-07	3.993-01	4.942-02	4.959-01	2.801-10	1.775-04	9.365-10	1.503-03	1.860-04	1.866-03
2.000+08	4.186-08	3.697-02	1.863-07	4.193-01	5.316-02	5.094-01	1.576-10	1.392-04	7.012-10	1.578-03	2.001-04	1.917-03
3.000+08	1.861-08	2.620-02	1.239-07	4.433-01	5.791-02	5.274-01	7.005-11	9.861-05	4.663-10	1.669-03	2.180-04	1.985-03
4.000+08	1.047-08	2.052-02	9.287-08	4.573-01	6.084-02	5.387-01	3.941-11	7.724-05	3.496-10	1.721-03	2.290-04	2.027-03
5.000+08	6.698-09	1.699-02	7.425-08	4.666-01	6.286-02	5.465-01	2.521-11	6.395-05	2.795-10	1.756-03	2.366-04	2.057-03
6.000+08	4.652-09	1.455-02	6.185-08	4.733-01	6.436-02	5.522-01	1.751-11	5.477-05	2.328-10	1.781-03	2.422-04	2.078-03
8.000+08	2.617-09	1.136-02	4.637-08	4.823-01	6.645-02	5.601-01	9.850-12	4.276-05	1.745-10	1.815-03	2.501-04	2.108-03
1.000+09	1.675-09	9.346-03	3.708-08	4.882-01	6.784-02	5.654-01	6.305-12	3.518-05	1.396-10	1.838-03	2.553-04	2.128-03
1.500+09	7.443-10	6.527-03	2.471-08	4.968-01	6.993-02	5.733-01	2.801-12	2.457-05	9.301-11	1.870-03	2.632-04	2.158-03
2.000+09	4.186-10	5.052-03	1.853-08	5.015-01	7.111-02	5.777-01	1.576-12	1.902-05	6.975-11	1.888-03	2.677-04	2.176-03
3.000+09	1.861-10	3.512-03	1.235-08	5.066-01	7.241-02	5.825-01	7.005-13	1.322-05	4.648-11	1.907-03	2.725-04	2.193-03
4.000+09	1.047-10	2.711-03	9.262-09	5.093-01	7.317-02	5.852-01	3.941-13	1.020-05	3.486-11	1.917-03	2.754-04	2.203-03
5.000+09	6.698-11	2.217-03	7.409-09	5.110-01	7.364-02	5.869-01	2.521-13	8.345-06	2.789-11	1.923-03	2.772-04	2.209-03
6.000+09	4.652-11	1.880-03	6.174-09	5.123-01	7.396-02	5.881-01	1.751-13	7.076-06	2.324-11	1.928-03	2.784-04	2.214-03
8.000+09	2.617-11	1.448-03	4.630-09	5.138-01	7.440-02	5.896-01	9.850-14	5.450-06	1.743-11	1.934-03	2.800-04	2.219-03
1.000+10	1.675-11	1.182-03	3.704-09	5.148-01	7.468-02	5.907-01	6.305-14	4.449-06	1.394-11	1.938-03	2.811-04	2.223-03
1.500+10	7.443-12	8.172-04	2.469-09	5.162-01	7.505-02	5.921-01	2.801-14	3.076-06	9.293-12	1.943-03	2.825-04	2.228-03
2.000+10	4.186-12	6.282-04	1.852-09	5.170-01	7.527-02	5.929-01	1.576-14	2.364-06	6.971-12	1.946-03	2.833-04	2.232-03
3.000+10	1.861-12	4.333-04	1.235-09	5.178-01	7.548-02	5.937-01	7.005-15	1.631-06	4.648-12	1.949-03	2.841-04	2.235-03
4.000+10	1.047-12	3.326-04	9.260-10	5.182-01	7.562-02	5.942-01	3.941-15	1.252-06	3.485-12	1.950-03	2.846-04	2.236-03
5.000+10	6.698-13	2.709-04	7.408-10	5.184-01	7.570-02	5.944-01	2.521-15	1.020-06	2.788-12	1.951-03	2.849-04	2.237-03
6.000+10	4.652-13	2.290-04	6.173-10	5.186-01	7.575-02	5.946-01	1.751-15	8.619-07	2.323-12	1.952-03	2.851-04	2.238-03
8.000+10	2.617-13	1.756-04	4.630-10	5.188-01	7.580-02	5.948-01	9.850-16	6.609-07	1.743-12	1.953-03	2.853-04	2.239-03
1.000+11	1.675-13	1.428-04	3.704-10	5.190-01	7.585-02	5.950-01	6.305-16	5.375-07	1.394-12	1.953-03	2.855-04	2.240-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, Z=1 to 100—Continued

Z = 9, F , FLUORINE ATOMIC WT. = 18.99840 MSQ/KG = .00316976 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	2.342-03	1.902+00	1.916-04	0.000	0.000	1.905+00	7.424-06	6.029-03	6.073-07	0.000	0.000	6.037-03
1.022+06	2.242-03	1.882+00	1.834-04	0.000	0.000	1.884+00	7.107-06	5.965-03	5.813-07	0.000	0.000	5.977-03
1.250+06	1.499-03	1.701+00	1.244-04	6.506-04	0.000	1.703+00	4.751-06	5.392-03	3.943-07	2.062-06	0.000	5.399-03
1.500+06	1.041-03	1.546+00	9.028-05	3.601-03	0.000	1.551+00	3.300-06	4.900-03	2.862-07	1.141-05	0.000	4.915-03
2.000+06	5.858-04	1.319+00	5.669-05	1.434-02	0.000	1.334+00	1.857-06	4.181-03	1.797-07	4.545-05	0.000	4.228-03
2.044+06	5.609-04	1.303+00	5.483-05	1.546-02	0.000	1.319+00	1.778-06	4.130-03	1.738-07	4.900-05	0.000	4.181-03
3.000+06	2.604-04	1.038+00	3.160-05	4.101-02	3.631-04	1.080+00	8.254-07	3.290-03	1.002-07	1.300-04	1.151-06	3.422-03
4.000+06	1.465-04	8.658-01	2.166-05	6.651-02	1.483-03	9.340-01	4.644-07	2.744-03	6.866-08	2.108-04	4.701-06	2.960-03
5.000+06	9.374-05	7.477-01	1.641-05	8.924-02	2.954-03	8.400-01	2.971-07	2.370-03	5.202-08	2.829-04	9.363-06	2.663-03
6.000+06	6.510-05	6.609-01	1.319-05	1.096-01	4.538-03	7.751-01	2.064-07	2.095-03	4.181-08	3.474-04	1.438-05	2.457-03
7.000+06	4.783-05	5.940-01	1.101-05	1.278-01	6.118-03	7.280-01	1.516-07	1.883-03	3.490-08	4.051-04	1.939-05	2.308-03
8.000+06	3.662-05	5.406-01	9.444-06	1.441-01	7.653-03	6.924-01	1.161-07	1.714-03	2.994-08	4.568-04	2.426-05	2.195-03
9.000+06	2.893-05	4.969-01	8.266-06	1.589-01	9.124-03	6.650-01	9.170-08	1.575-03	2.620-08	5.077-04	2.892-05	2.108-03
1.000+07	2.344-05	4.604-01	7.348-06	1.724-01	1.053-02	6.434-01	7.430-08	1.459-03	2.329-08	5.465-04	3.338-05	2.039-03
1.100+07	1.937-05	4.294-01	6.612-06	1.847-01	1.186-02	6.260-01	6.140-08	1.361-03	2.096-08	5.855-04	3.759-05	1.994-03
1.200+07	1.627-05	4.027-01	6.009-06	1.959-01	1.311-02	6.117-01	5.157-08	1.276-03	1.905-08	6.210-04	4.156-05	1.939-03
1.300+07	1.387-05	3.794-01	5.507-06	2.063-01	1.430-02	6.000-01	4.396-08	1.203-03	1.746-08	6.539-04	4.533-05	1.902-03
1.400+07	1.196-05	3.589-01	5.082-06	2.160-01	1.544-02	5.904-01	3.791-08	1.138-03	1.611-08	6.847-04	4.894-05	1.871-03
1.500+07	1.042-05	3.408-01	4.717-06	2.251-01	1.652-02	5.824-01	3.303-08	1.080-03	1.495-08	7.135-04	5.236-05	1.846-03
1.600+07	9.155-06	3.245-01	4.402-06	2.336-01	1.754-02	5.757-01	2.902-08	1.029-03	1.395-08	7.405-04	5.560-05	1.825-03
1.800+07	7.233-06	2.966-01	3.882-06	2.493-01	1.945-02	5.654-01	2.293-08	9.402-04	1.231-08	7.902-04	6.165-05	1.792-03
2.000+07	5.859-06	2.735-01	3.471-06	2.633-01	2.120-02	5.580-01	1.857-08	8.669-04	1.100-08	8.346-04	6.720-05	1.769-03
2.200+07	4.842-06	2.540-01	3.139-06	2.760-01	2.281-02	5.528-01	1.535-08	8.051-04	9.950-09	8.749-04	7.230-05	1.752-03
2.400+07	4.069-06	2.374-01	2.865-06	2.875-01	2.430-02	5.492-01	1.290-08	7.525-04	9.081-09	9.113-04	7.703-05	1.741-03
2.600+07	3.467-06	2.229-01	2.635-06	2.981-01	2.568-02	5.467-01	1.099-08	7.065-04	8.352-09	9.449-04	8.140-05	1.733-03
2.800+07	2.989-06	2.103-01	2.439-06	3.079-01	2.697-02	5.452-01	9.474-09	6.666-04	7.731-09	9.760-04	8.549-05	1.728-03
3.000+07	2.604-06	1.991-01	2.270-06	3.170-01	2.817-02	5.443-01	8.254-09	6.311-04	7.195-09	1.005-03	8.929-05	1.725-03
4.000+07	1.465-06	1.582-01	1.686-06	3.540-01	3.324-02	5.454-01	4.644-09	5.015-04	5.344-09	1.122-03	1.054-04	1.729-03
5.000+07	9.374-07	1.321-01	1.341-06	3.822-01	3.717-02	5.515-01	2.971-09	4.187-04	4.251-09	1.211-03	1.178-04	1.748-03
6.000+07	6.510-07	1.138-01	1.113-06	4.045-01	4.036-02	5.587-01	2.064-09	3.607-04	3.528-09	1.282-03	1.279-04	1.771-03
8.000+07	3.662-07	8.975-02	8.307-07	4.380-01	4.530-02	5.731-01	1.161-09	2.845-04	2.633-09	1.388-03	1.436-04	1.816-03
1.000+08	2.343-07	7.449-02	6.626-07	4.626-01	4.901-02	5.861-01	7.427-10	2.361-04	2.100-09	1.466-03	1.554-04	1.858-03
1.500+08	1.041-07	5.305-02	4.400-07	5.029-01	5.536-02	6.113-01	3.300-10	1.682-04	1.395-09	1.594-03	1.755-04	1.938-03
2.000+08	5.858-08	4.159-02	3.294-07	5.276-01	5.949-02	6.287-01	1.857-10	1.318-04	1.044-09	1.672-03	1.886-04	1.993-03
3.000+08	2.604-08	2.948-02	2.191-07	5.568-01	6.467-02	6.510-01	8.254-11	9.344-05	6.945-10	1.765-03	2.050-04	2.062-03
4.000+08	1.464-08	2.309-02	1.642-07	5.738-01	6.783-02	6.647-01	4.641-11	7.319-05	5.205-10	1.819-03	2.150-04	2.107-03
5.000+08	9.373-09	1.911-02	1.313-07	5.850-01	7.001-02	6.741-01	2.971-11	6.057-05	4.162-10	1.854-03	2.219-04	2.137-03
6.000+08	6.509-09	1.636-02	1.094-07	5.931-01	7.162-02	6.811-01	2.063-11	5.186-05	3.468-10	1.880-03	2.270-04	2.159-03
8.000+08	3.661-09	1.278-02	8.197-08	6.040-01	7.384-02	6.906-01	1.160-11	4.051-05	2.598-10	1.915-03	2.341-04	2.189-03
1.000+09	2.343-09	1.051-02	6.556-08	6.110-01	7.532-02	6.968-01	7.427-12	3.331-05	2.078-10	1.937-03	2.387-04	2.209-03
1.500+09	1.041-09	7.343-03	4.369-08	6.212-01	7.753-02	7.061-01	3.300-12	2.328-05	1.385-10	1.969-03	2.458-04	2.238-03
2.000+09	5.858-10	5.683-03	3.276-08	6.268-01	7.878-02	7.113-01	1.857-12	1.801-05	1.038-10	1.987-03	2.497-04	2.255-03
3.000+09	2.604-10	3.951-03	2.184-08	6.329-01	8.013-02	7.170-01	8.254-13	1.252-05	6.923-11	2.006-03	2.540-04	2.277-03
4.000+09	1.464-10	3.050-03	1.637-08	6.361-01	8.094-02	7.201-01	4.641-13	9.668-06	5.189-11	2.016-03	2.566-04	2.287-03
5.000+09	9.373-11	2.494-03	1.310-08	6.382-01	8.142-02	7.221-01	2.971-13	7.905-06	4.152-11	2.023-03	2.581-04	2.289-03
6.000+09	6.509-11	2.115-03	1.092-08	6.396-01	8.177-02	7.235-01	2.063-13	6.704-06	3.461-11	2.027-03	2.592-04	2.293-03
8.000+09	3.661-11	1.629-03	8.186-09	6.415-01	8.222-02	7.253-01	1.160-13	5.164-06	2.595-11	2.033-03	2.606-04	2.299-03
1.000+10	2.343-11	1.330-03	6.549-09	6.427-01	8.251-02	7.265-01	7.427-14	4.216-06	2.076-11	2.037-03	2.615-04	2.303-03
1.500+10	1.041-11	9.193-04	4.366-09	6.443-01	8.290-02	7.281-01	3.300-14	2.914-06	1.384-11	2.042-03	2.628-04	2.308-03
2.000+10	5.858-12	7.068-04	3.274-09	6.452-01	8.313-02	7.290-01	1.857-14	2.240-06	1.038-11	2.045-03	2.635-04	2.311-03
3.000+10	2.604-12	4.874-04	2.183-09	6.461-01	8.334-02	7.299-01	8.254-15	1.545-06	6.920-12	2.048-03	2.642-04	2.314-03
4.000+10	1.464-12	3.742-04	1.637-09	6.466-01	8.349-02	7.305-01	4.641-15	1.186-06	5.189-12	2.050-03	2.646-04	2.315-03
5.000+10	9.373-13	3.047-04	1.310-09	6.469-01	8.357-02	7.308-01	2.971-15	9.658-07	4.152-12	2.051-03	2.649-04	2.316-03
6.000+10	6.509-13	2.576-04	1.091-09	6.471-01	8.362-02	7.310-01	2.063-15	8.165-07	3.458-12	2.051-03	2.651-04	2.317-03
8.000+10	3.661-13	1.975-04	8.185-10	6.474-01	8.368-02	7.313-01	1.160-15	6.260-07	2.594-12	2.052-03	2.652-04	2.318-03
1.000+11	2.343-13	1.607-04	6.548-10	6.476-01	8.372-02	7.315-01	7.427-16	5.094-07	2.076-12	2.053-03	2.654-04	2.319-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 10, NE, NEON ATOMIC WT. = 20.179 MSQ/KG = .00298431 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	3.191-03	2.113+00	3.212-04	0.000	0.000	2.117+00	9.523-06	6.306-03	9.586-07	0.000	0.000	6.316-03
1.022+06	3.056-03	2.091+00	3.074-04	0.000	0.000	2.094+00	9.120-06	6.240-03	9.174-07	0.000	0.000	6.250-03
1.250+06	2.043-03	1.889+00	2.086-04	8.090-04	0.000	1.892+00	6.097-06	5.637-03	6.225-07	2.414-06	0.000	5.647-03
1.500+06	1.419-03	1.718+00	1.512-04	4.464-03	0.000	1.724+00	4.235-06	5.127-03	4.512-07	1.332-05	0.000	5.145-03
2.000+06	7.983-04	1.466+00	9.481-05	1.775-02	0.000	1.485+00	2.382-06	4.375-03	2.829-07	5.297-05	0.000	4.431-03
2.044+06	7.643-04	1.448+00	9.169-05	1.913-02	0.000	1.468+00	2.281-06	4.321-03	2.736-07	5.709-05	0.000	4.381-03
3.000+06	3.549-04	1.153+00	5.274-05	5.068-02	4.035-04	1.204+00	1.059-06	3.441-03	1.574-07	1.512-04	1.204-06	3.595-03
4.000+06	1.996-04	9.620-01	3.611-05	8.214-02	1.647-03	1.046+00	5.957-07	2.871-03	1.078-07	2.451-04	4.915-06	3.122-03
5.000+06	1.278-04	8.308-01	2.733-05	1.102-01	3.283-03	9.444-01	3.814-07	2.479-03	8.156-08	3.289-04	9.797-06	2.818-03
6.000+06	8.872-05	7.343-01	2.195-05	1.353-01	5.042-03	8.748-01	2.648-07	2.191-03	6.551-08	4.038-04	1.505-05	2.611-03
7.000+06	6.518-05	6.600-01	1.832-05	1.576-01	6.798-03	8.245-01	1.945-07	1.970-03	5.467-08	4.703-04	2.029-05	2.461-03
8.000+06	4.991-05	6.006-01	1.571-05	1.778-01	8.503-03	7.870-01	1.489-07	1.792-03	4.688-08	5.306-04	2.538-05	2.349-03
9.000+06	3.943-05	5.521-01	1.374-05	1.961-01	1.014-02	7.584-01	1.177-07	1.648-03	4.100-08	5.852-04	3.026-05	2.263-03
1.000+07	3.194-05	5.116-01	1.221-05	2.127-01	1.170-02	7.360-01	9.532-08	1.527-03	3.644-08	6.348-04	3.492-05	2.197-03
1.100+07	2.640-05	4.771-01	1.099-05	2.277-01	1.317-02	7.180-01	7.879-08	1.424-03	3.280-08	6.795-04	3.930-05	2.143-03
1.200+07	2.218-05	4.475-01	9.985-06	2.416-01	1.457-02	7.037-01	6.619-08	1.335-03	2.980-08	7.210-04	4.348-05	2.100-03
1.300+07	1.890-05	4.216-01	9.149-06	2.544-01	1.589-02	6.919-01	5.640-08	1.258-03	2.730-08	7.592-04	4.742-05	2.065-03
1.400+07	1.630-05	3.988-01	8.442-06	2.664-01	1.715-02	6.824-01	4.864-08	1.190-03	2.519-08	7.950-04	5.118-05	2.036-03
1.500+07	1.419-05	3.786-01	7.836-06	2.775-01	1.835-02	6.745-01	4.235-08	1.130-03	2.339-08	8.281-04	5.476-05	2.013-03
1.600+07	1.248-05	3.606-01	7.311-06	2.880-01	1.949-02	6.681-01	3.724-08	1.076-03	2.182-08	8.595-04	5.816-05	1.994-03
1.800+07	9.858-06	3.295-01	6.446-06	3.073-01	2.161-02	6.584-01	2.942-08	9.833-04	1.924-08	9.171-04	6.449-05	1.965-03
2.000+07	7.985-06	3.039-01	5.764-06	3.245-01	2.355-02	6.520-01	2.383-08	9.069-04	1.720-08	9.684-04	7.028-05	1.946-03
2.200+07	6.599-06	2.823-01	5.212-06	3.401-01	2.533-02	6.477-01	1.969-08	8.425-04	1.555-08	1.015-03	7.559-05	1.933-03
2.400+07	5.545-06	2.638-01	4.756-06	3.543-01	2.698-02	6.451-01	1.655-08	7.873-04	1.419-08	1.057-03	8.052-05	1.925-03
2.600+07	4.725-06	2.477-01	4.374-06	3.673-01	2.852-02	6.435-01	1.410-08	7.392-04	1.305-08	1.096-03	8.511-05	1.920-03
2.800+07	4.074-06	2.336-01	4.048-06	3.793-01	2.994-02	6.428-01	1.216-08	6.971-04	1.208-08	1.132-03	8.935-05	1.918-03
3.000+07	3.549-06	2.212-01	3.768-06	3.904-01	3.128-02	6.429-01	1.059-08	6.601-04	1.124-08	1.165-03	9.335-05	1.919-03
4.000+07	1.996-06	1.758-01	2.798-06	4.361-01	3.689-02	6.488-01	5.957-09	5.246-04	8.350-09	1.301-03	1.101-04	1.936-03
5.000+07	1.278-06	1.467-01	2.225-06	4.705-01	4.124-02	6.584-01	3.814-09	4.378-04	6.640-09	1.404-03	1.231-04	1.965-03
6.000+07	8.872-07	1.264-01	1.847-06	4.977-01	4.477-02	6.689-01	2.648-09	3.772-04	5.512-09	1.485-03	1.336-04	1.996-03
8.000+07	4.990-07	9.972-02	1.378-06	5.390-01	5.021-02	6.889-01	1.489-09	2.976-04	4.112-09	1.609-03	1.498-04	2.056-03
1.000+08	3.194-07	8.276-02	1.099-06	5.690-01	5.428-02	7.060-01	9.532-10	2.470-04	3.280-09	1.698-03	1.620-04	2.107-03
1.500+08	1.419-07	5.894-02	7.298-07	6.177-01	6.121-02	7.379-01	4.235-10	1.759-04	2.178-09	1.843-03	1.827-04	2.202-03
2.000+08	7.984-08	4.621-02	5.462-07	6.473-01	6.567-02	7.592-01	2.383-10	1.379-04	1.630-09	1.932-03	1.960-04	2.266-03
3.000+08	3.548-08	3.275-02	3.634-07	6.820-01	7.123-02	7.860-01	1.059-10	9.774-05	1.084-09	2.035-03	2.126-04	2.346-03
4.000+08	1.996-08	2.565-02	2.723-07	7.021-01	7.460-02	8.024-01	5.957-11	7.655-05	8.126-10	2.095-03	2.226-04	2.394-03
5.000+08	1.277-08	2.123-02	2.177-07	7.154-01	7.691-02	8.135-01	3.811-11	6.336-05	6.497-10	2.135-03	2.295-04	2.428-03
6.000+08	8.871-09	1.818-02	1.813-07	7.249-01	7.861-02	8.217-01	2.647-11	5.425-05	5.411-10	2.163-03	2.346-04	2.452-03
8.000+08	4.990-09	1.420-02	1.359-07	7.376-01	8.094-02	8.327-01	1.489-11	4.238-05	4.056-10	2.201-03	2.416-04	2.485-03
1.000+09	3.193-09	1.168-02	1.087-07	7.459-01	8.250-02	8.401-01	9.529-12	3.486-05	3.244-10	2.226-03	2.462-04	2.507-03
1.500+09	1.419-09	8.159-03	7.245-08	7.578-01	8.480-02	8.508-01	4.235-12	2.435-05	2.162-10	2.262-03	2.531-04	2.539-03
2.000+09	7.984-10	6.314-03	5.433-08	7.643-01	8.610-02	8.567-01	2.383-12	1.884-05	1.621-10	2.281-03	2.569-04	2.557-03
3.000+09	3.548-10	4.390-03	3.621-08	7.714-01	8.751-02	8.633-01	1.059-12	1.310-05	1.081-10	2.302-03	2.612-04	2.576-03
4.000+09	1.996-10	3.389-03	2.715-08	7.752-01	8.834-02	8.669-01	5.957-13	1.011-05	8.102-11	2.313-03	2.636-04	2.587-03
5.000+09	1.277-10	2.771-03	2.172-08	7.776-01	8.884-02	8.692-01	3.811-13	8.270-06	6.482-11	2.321-03	2.651-04	2.594-03
6.000+09	8.871-11	2.350-03	1.810-08	7.793-01	8.920-02	8.709-01	2.647-13	7.013-06	5.402-11	2.326-03	2.662-04	2.599-03
8.000+09	4.990-11	1.810-03	1.358-08	7.814-01	8.967-02	8.729-01	1.489-13	5.402-06	4.053-11	2.332-03	2.676-04	2.605-03
1.000+10	3.193-11	1.478-03	1.086-08	7.828-01	8.997-02	8.742-01	9.529-14	4.411-06	3.241-11	2.336-03	2.685-04	2.609-03
1.500+10	1.419-11	1.021-03	7.240-09	7.847-01	9.037-02	8.761-01	4.235-14	3.047-06	2.161-11	2.342-03	2.697-04	2.615-03
2.000+10	7.984-12	7.853-04	5.430-09	7.857-01	9.061-02	8.771-01	2.383-14	2.344-06	1.620-11	2.345-03	2.704-04	2.618-03
3.000+10	3.548-12	5.416-04	3.620-09	7.868-01	9.082-02	8.782-01	1.059-14	1.616-06	1.080-11	2.348-03	2.710-04	2.621-03
4.000+10	1.996-12	4.158-04	2.715-09	7.874-01	9.097-02	8.788-01	5.957-15	1.241-06	8.102-12	2.350-03	2.715-04	2.623-03
5.000+10	1.277-12	3.386-04	2.172-09	7.877-01	9.106-02	8.791-01	3.811-15	1.010-06	6.482-12	2.351-03	2.718-04	2.624-03
6.000+10	8.871-13	2.862-04	1.810-09	7.880-01	9.111-02	8.794-01	2.647-15	8.541-07	5.402-12	2.352-03	2.719-04	2.624-03
8.000+10	4.990-13	2.195-04	1.357-09	7.883-01	9.117-02	8.797-01	1.489-15	6.551-07	4.050-12	2.353-03	2.721-04	2.625-03
1.000+11	3.193-13	1.785-04	1.086-09	7.885-01	9.121-02	8.799-01	9.529-16	5.327-07	3.241-12	2.353-03	2.722-04	2.626-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV $Z=1$ to 100—Continued

Z = 11, NA, SODIUM ATOMIC WT. = 22.98977 MSQ/KG = .00261945 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	4.128-03	2.324+00	5.135-04	0.000	0.000	2.329+00	1.081-05	6.088-03	1.345-06	0.000	0.000	6.100-03
1.022+06	3.952-03	2.299+00	4.914-04	0.000	0.000	2.303+00	1.035-05	6.022-03	1.287-06	0.000	0.000	6.034-03
1.250+06	2.643-03	2.078+00	3.333-04	9.869-04	0.000	2.082+00	6.923-06	5.443-03	8.731-07	2.585-06	0.000	5.454-03
1.500+06	1.836-03	1.889+00	2.416-04	5.425-03	0.000	1.897+00	4.809-06	4.948-03	6.329-07	1.421-05	0.000	4.968-03
2.000+06	1.033-03	1.612+00	1.513-04	2.153-02	0.000	1.635+00	2.706-06	4.223-03	3.963-07	5.640-05	0.000	4.282-03
2.044+06	9.887-04	1.592+00	1.463-04	2.321-02	0.000	1.616+00	2.590-06	4.170-03	3.832-07	6.080-05	0.000	4.234-03
3.000+06	4.590-04	1.269+00	8.400-05	6.139-02	4.438-04	1.331+00	1.202-06	3.324-03	2.200-07	1.608-04	1.163-06	3.487-03
4.000+06	2.582-04	1.058+00	5.743-05	9.942-02	1.812-03	1.160+00	6.763-07	2.771-03	1.504-07	2.604-04	4.746-06	3.037-03
5.000+06	1.653-04	9.138-01	4.344-05	1.333-01	3.611-03	1.051+00	4.330-07	2.394-03	1.138-07	3.492-04	9.459-06	2.753-03
6.000+06	1.148-04	8.077-01	3.486-05	1.636-01	5.546-03	9.770-01	3.007-07	2.116-03	9.131-08	4.285-04	1.453-05	2.559-03
7.000+06	8.432-05	7.260-01	2.908-05	1.906-01	7.477-03	9.242-01	2.209-07	1.902-03	7.617-08	4.993-04	1.959-05	2.421-03
8.000+06	6.456-05	6.607-01	2.493-05	2.150-01	9.353-03	8.651-01	1.691-07	1.731-03	6.530-08	5.632-04	2.450-05	2.319-03
9.000+06	5.101-05	6.073-01	2.181-05	2.376-01	1.115-02	8.555-01	1.336-07	1.591-03	5.713-08	6.208-04	2.921-05	2.241-03
1.000+07	4.132-05	5.627-01	1.937-05	2.571-01	1.286-02	8.327-01	1.082-07	1.474-03	5.074-08	6.735-04	3.369-05	2.181-03
1.100+07	3.415-05	5.249-01	1.743-05	2.753-01	1.449-02	8.147-01	8.945-08	1.375-03	4.566-08	7.211-04	3.796-05	2.134-03
1.200+07	2.869-05	4.922-01	1.583-05	2.920-01	1.603-02	8.003-01	7.515-08	1.289-03	4.147-08	7.649-04	4.199-05	2.096-03
1.300+07	2.445-05	4.637-01	1.451-05	3.075-01	1.748-02	7.887-01	6.405-08	1.215-03	3.801-08	8.055-04	4.579-05	2.066-03
1.400+07	2.108-05	4.387-01	1.338-05	3.219-01	1.886-02	7.795-01	5.522-08	1.149-03	3.505-08	8.432-04	4.940-05	2.042-03
1.500+07	1.836-05	4.165-01	1.242-05	3.354-01	2.018-02	7.721-01	4.809-08	1.091-03	3.253-08	8.786-04	5.286-05	2.023-03
1.600+07	1.614-05	3.966-01	1.159-05	3.480-01	2.143-02	7.661-01	4.228-08	1.039-03	3.036-08	9.116-04	5.613-05	2.007-03
1.800+07	1.275-05	3.625-01	1.021-05	3.712-01	2.376-02	7.575-01	3.340-08	9.495-04	2.674-08	9.723-04	6.224-05	1.984-03
2.000+07	1.033-05	3.343-01	9.132-06	3.920-01	2.589-02	7.522-01	2.706-08	8.757-04	2.392-08	1.027-03	6.782-05	1.970-03
2.200+07	8.536-06	3.105-01	8.257-06	4.108-01	2.785-02	7.492-01	2.236-08	8.133-04	2.163-08	1.076-03	7.295-05	1.962-03
2.400+07	7.173-06	2.901-01	7.535-06	4.279-01	2.966-02	7.477-01	1.879-08	7.599-04	1.974-08	1.121-03	7.769-05	1.958-03
2.600+07	6.112-06	2.724-01	6.928-06	4.435-01	3.135-02	7.473-01	1.601-08	7.135-04	1.815-08	1.162-03	8.212-05	1.957-03
2.800+07	5.270-06	2.570-01	6.412-06	4.580-01	3.291-02	7.479-01	1.380-08	6.732-04	1.680-08	1.200-03	8.621-05	1.959-03
3.000+07	4.591-06	2.434-01	5.967-06	4.714-01	3.438-02	7.492-01	1.203-08	6.376-04	1.563-08	1.235-03	9.006-05	1.962-03
4.000+07	2.582-06	1.934-01	4.430-06	5.264-01	4.053-02	7.603-01	6.763-09	5.066-04	1.160-08	1.379-03	1.062-04	1.992-03
5.000+07	1.653-06	1.614-01	3.523-06	5.679-01	4.530-02	7.746-01	4.330-09	4.228-04	9.228-09	1.488-03	1.187-04	2.029-03
6.000+07	1.148-06	1.391-01	2.924-06	6.008-01	4.915-02	7.891-01	3.007-09	3.644-04	7.659-09	1.574-03	1.287-04	2.067-03
8.000+07	6.455-07	1.097-01	2.182-06	6.502-01	5.509-02	8.150-01	1.691-09	2.874-04	5.716-09	1.703-03	1.443-04	2.135-03
1.000+08	4.131-07	9.104-02	1.740-06	6.858-01	5.952-02	8.364-01	1.082-09	2.385-04	4.558-09	1.796-03	1.559-04	2.191-03
1.500+08	1.836-07	6.483-02	1.155-06	7.634-01	6.703-02	8.753-01	4.809-10	1.698-04	3.025-09	1.947-03	1.756-04	2.293-03
2.000+08	1.033-07	5.083-02	8.646-07	7.784-01	7.186-02	9.011-01	2.706-10	1.331-04	2.265-09	2.035-03	1.882-04	2.360-03
3.000+08	4.590-08	3.603-02	5.752-07	8.195-01	7.790-02	9.334-01	1.202-10	9.438-05	1.507-09	2.147-03	2.041-04	2.445-03
4.000+08	2.582-08	2.822-02	4.309-07	8.434-01	8.160-02	9.532-01	6.763-11	7.392-05	1.129-09	2.209-03	2.137-04	2.497-03
5.000+08	1.652-08	2.336-02	3.445-07	8.592-01	8.416-02	9.667-01	4.327-11	6.119-05	9.024-10	2.251-03	2.205-04	2.532-03
6.000+08	1.148-08	2.000-02	2.870-07	8.705-01	8.605-02	9.766-01	3.007-11	5.239-05	7.518-10	2.280-03	2.254-04	2.558-03
8.000+08	6.455-09	1.562-02	2.151-07	8.857-01	8.870-02	9.900-01	1.691-11	4.092-05	5.634-10	2.320-03	2.323-04	2.593-03
1.000+09	4.131-09	1.285-02	1.721-07	8.956-01	9.048-02	9.989-01	1.082-11	3.366-05	4.508-10	2.346-03	2.370-04	2.617-03
1.500+09	1.836-09	8.974-03	1.147-07	9.099-01	9.317-02	1.012+00	4.809-12	2.351-05	3.005-10	2.383-03	2.441-04	2.651-03
2.000+09	1.033-09	6.946-03	8.597-08	9.178-01	9.472-02	1.019+00	2.706-12	1.819-05	2.252-10	2.404-03	2.481-04	2.670-03
3.000+09	4.590-10	4.830-03	5.730-08	9.263-01	9.643-02	1.028+00	1.202-12	1.265-05	1.501-10	2.426-03	2.526-04	2.692-03
4.000+09	2.582-10	3.728-03	4.297-08	9.309-01	9.744-02	1.032+00	6.763-13	9.765-06	1.126-10	2.438-03	2.552-04	2.703-03
5.000+09	1.652-10	3.048-03	3.438-08	9.338-01	9.807-02	1.035+00	4.327-13	7.984-06	9.006-11	2.446-03	2.569-04	2.711-03
6.000+09	1.148-10	2.585-03	2.865-08	9.358-01	9.851-02	1.037+00	3.007-13	6.771-06	7.505-11	2.451-03	2.580-04	2.716-03
8.000+09	6.455-11	1.991-03	2.148-08	9.384-01	9.910-02	1.039+00	1.691-13	5.215-06	5.627-11	2.458-03	2.596-04	2.723-03
1.000+10	4.131-11	1.626-03	1.719-08	9.400-01	9.947-02	1.041+00	1.082-13	4.259-06	4.503-11	2.462-03	2.606-04	2.727-03
1.500+10	1.836-11	1.124-03	1.146-08	9.424-01	9.999-02	1.044+00	4.809-14	2.944-06	3.002-11	2.469-03	2.619-04	2.733-03
2.000+10	1.033-11	8.638-04	8.593-09	9.436-01	1.003-01	1.045+00	2.706-14	2.263-06	2.251-11	2.472-03	2.627-04	2.737-03
3.000+10	4.590-12	5.957-04	5.728-09	9.449-01	1.006-01	1.046+00	1.202-14	1.560-06	1.500-11	2.475-03	2.635-04	2.740-03
4.000+10	2.582-12	4.574-04	4.296-09	9.456-01	1.008-01	1.047+00	6.763-15	1.198-06	1.125-11	2.477-03	2.640-04	2.742-03
5.000+10	1.652-12	3.724-04	3.437-09	9.460-01	1.009-01	1.047+00	4.327-15	9.755-07	9.003-12	2.478-03	2.643-04	2.743-03
6.000+10	1.148-12	3.148-04	2.864-09	9.463-01	1.009-01	1.048+00	3.007-15	8.246-07	7.502-12	2.479-03	2.643-04	2.744-03
8.000+10	6.455-13	2.414-04	2.148-09	9.467-01	1.010-01	1.048+00	1.691-15	6.323-07	5.627-12	2.480-03	2.646-04	2.745-03
1.000+11	4.131-13	1.964-04	1.718-09	9.469-01	1.011-01	1.048+00	1.082-15	5.145-07	4.500-12	2.480-03	2.648-04	2.746-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 12, MG, MAGNESIUM ATOMIC WT. = 24.305 MSQ/KG = .00247770 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING		PAIR PRODUCTION				SCATTERING		PAIR PRODUCTION			
	COHERENT	INCOHER.	PHOTO-ELECTRIC	NUCLEAR FIELD	ELECTRON FIELD	TOTAL	COHERENT	INCOHER.	PHOTO-ELECTRIC	NUCLEAR FIELD	ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	5.212-03	2.535+00	7.877-04	0.000	0.000	2.541+00	1.291-05	6.281-03	1.952-06	0.000	0.000	6.296-03
1.022+06	4.991-03	2.508+00	7.538-04	0.000	0.000	2.514+00	1.237-05	6.214-03	1.868-06	0.000	0.000	6.228-03
1.250+06	3.337-03	2.267+00	5.111-04	1.185-03	0.000	2.272+00	8.268-06	5.617-03	1.266-06	2.936-06	0.000	5.629-03
1.500+06	2.318-03	2.061+00	3.704-04	6.487-03	0.000	2.070+00	5.743-06	5.107-03	9.177-07	1.607-05	0.000	5.129-03
2.000+06	1.304-03	1.759+00	2.316-04	2.569-02	0.000	1.786+00	3.231-06	4.358-03	5.738-07	6.365-05	0.000	4.426-03
2.044+06	1.249-03	1.737+00	2.239-04	2.769-02	0.000	1.766+00	3.095-06	4.304-03	5.548-07	6.861-05	0.000	4.376-03
3.000+06	5.797-04	1.384+00	1.284-04	7.314-02	4.842-04	1.458+00	1.436-06	3.429-03	3.181-07	1.812-04	1.200-06	3.613-03
4.000+06	3.261-04	1.154+00	8.766-05	1.184-01	1.977-03	1.275+00	8.080-07	2.859-03	2.172-07	2.934-04	4.898-06	3.159-03
5.000+06	2.087-04	9.969-01	6.625-05	1.586-01	3.939-03	1.160+00	5.171-07	2.470-03	1.641-07	3.930-04	9.760-06	2.873-03
6.000+06	1.449-04	8.811-01	5.313-05	1.947-01	6.050-03	1.082+00	3.590-07	2.183-03	1.316-07	4.824-04	1.499-05	2.681-03
7.000+06	1.065-04	7.919-01	4.430-05	2.268-01	8.157-03	1.027+00	2.639-07	1.962-03	1.098-07	5.619-04	2.021-05	2.545-03
8.000+06	8.153-05	7.208-01	3.796-05	2.557-01	1.020-02	9.868-01	2.020-07	1.786-03	9.405-08	6.335-04	2.527-05	2.445-03
9.000+06	6.442-05	6.626-01	3.320-05	2.819-01	1.216-02	9.568-01	1.596-07	1.642-03	8.226-08	6.985-04	3.013-05	2.371-03
1.000+07	5.218-05	6.139-01	2.949-05	3.057-01	1.403-02	9.337-01	1.293-07	1.521-03	7.307-08	7.574-04	3.476-05	2.313-03
1.100+07	4.312-05	5.726-01	2.652-05	3.273-01	1.580-02	9.158-01	1.068-07	1.419-03	6.571-08	8.110-04	3.915-05	2.269-03
1.200+07	3.623-05	5.370-01	2.409-05	3.471-01	1.748-02	9.016-01	8.977-08	1.331-03	5.969-08	8.600-04	4.331-05	2.234-03
1.300+07	3.087-05	5.059-01	2.207-05	3.655-01	1.906-02	8.905-01	7.649-08	1.253-03	5.468-08	9.056-04	4.722-05	2.206-03
1.400+07	2.662-05	4.786-01	2.036-05	3.826-01	2.057-02	8.818-01	6.596-08	1.186-03	5.045-08	9.480-04	5.097-05	2.185-03
1.500+07	2.319-05	4.543-01	1.889-05	3.986-01	2.200-02	8.749-01	5.746-08	1.126-03	4.680-08	9.876-04	5.451-05	2.168-03
1.600+07	2.038-05	4.327-01	1.762-05	4.136-01	2.337-02	8.697-01	5.050-08	1.072-03	4.366-08	1.025-03	5.790-05	2.155-03
1.800+07	1.610-05	3.955-01	1.553-05	4.411-01	2.591-02	8.625-01	3.989-08	9.799-04	3.848-08	1.093-03	6.420-05	2.137-03
2.000+07	1.305-05	3.647-01	1.389-05	4.657-01	2.823-02	8.587-01	3.233-08	9.036-04	3.442-08	1.154-03	6.995-05	2.127-03
2.200+07	1.078-05	3.387-01	1.255-05	4.880-01	3.037-02	8.571-01	2.671-08	8.392-04	3.110-08	1.209-03	7.525-05	2.124-03
2.400+07	9.059-06	3.165-01	1.145-05	5.083-01	3.234-02	8.572-01	2.245-08	7.842-04	2.837-08	1.259-03	8.013-05	2.124-03
2.600+07	7.719-06	2.972-01	1.053-05	5.268-01	3.417-02	8.582-01	1.913-08	7.364-04	2.609-08	1.305-03	8.466-05	2.126-03
2.800+07	6.655-06	2.804-01	9.746-06	5.440-01	3.588-02	8.603-01	1.649-08	6.947-04	2.415-08	1.348-03	8.890-05	2.132-03
3.000+07	5.797-06	2.655-01	9.070-06	5.598-01	3.747-02	8.628-01	1.436-08	6.578-04	2.247-08	1.387-03	9.284-05	2.138-03
4.000+07	3.261-06	2.110-01	6.733-06	6.251-01	4.416-02	8.803-01	8.080-09	5.228-04	1.668-08	1.549-03	1.094-04	2.181-03
5.000+07	2.087-06	1.761-01	5.353-06	6.740-01	4.934-02	8.994-01	5.171-09	4.363-04	1.326-08	1.670-03	1.222-04	2.229-03
6.000+07	1.449-06	1.517-01	4.442-06	7.128-01	5.352-02	9.180-01	3.590-09	3.759-04	1.101-08	1.766-03	1.326-04	2.275-03
8.000+07	8.152-07	1.197-01	3.314-06	7.712-01	5.995-02	9.509-01	2.020-09	2.966-04	8.211-09	1.911-03	1.485-04	2.356-03
1.000+08	5.217-07	9.932-02	2.643-06	8.130-01	6.473-02	9.771-01	1.293-09	2.461-04	6.549-09	2.014-03	1.604-04	2.421-03
1.500+08	2.319-07	7.073-02	1.755-06	8.803-01	7.284-02	1.024+00	5.746-10	1.752-04	4.348-09	2.181-03	1.805-04	2.537-03
2.000+08	1.304-07	5.545-02	1.313-06	9.211-01	7.806-02	1.055+00	3.231-10	1.374-04	3.253-09	2.282-03	1.934-04	2.613-03
3.000+08	5.797-08	3.931-02	8.736-07	9.696-01	8.461-02	1.093+00	1.436-10	9.740-05	2.165-09	2.402-03	2.096-04	2.709-03
4.000+08	3.261-08	3.078-02	6.545-07	9.975-01	8.866-02	1.117+00	8.080-11	7.626-05	1.622-09	2.472-03	2.197-04	2.767-03
5.000+08	2.087-08	2.548-02	5.233-07	1.016+00	9.148-02	1.133+00	5.171-11	6.313-05	1.297-09	2.517-03	2.267-04	2.807-03
6.000+08	1.449-08	2.182-02	4.359-07	1.030+00	9.357-02	1.145+00	3.590-11	5.406-05	1.080-09	2.552-03	2.318-04	2.838-03
8.000+08	8.152-09	1.704-02	3.267-07	1.048+00	9.652-02	1.162+00	2.020-11	4.222-05	8.095-10	2.597-03	2.391-04	2.878-03
1.000+09	5.217-09	1.402-02	2.613-07	1.059+00	9.851-02	1.172+00	1.293-11	3.474-05	6.474-10	2.624-03	2.441-04	2.903-03
1.500+09	2.319-09	9.790-03	1.741-07	1.077+00	1.015-01	1.188+00	5.746-12	2.426-05	4.314-10	2.668-03	2.515-04	2.944-03
2.000+09	1.304-09	7.577-03	1.306-07	1.086+00	1.033-01	1.197+00	3.231-12	1.877-05	3.236-10	2.691-03	2.559-04	2.965-03
3.000+09	5.797-10	5.269-03	8.703-08	1.096+00	1.052-01	1.206+00	1.436-12	1.305-05	2.156-10	2.716-03	2.607-04	2.989-03
4.000+09	3.261-10	4.067-03	6.526-08	1.102+00	1.064-01	1.212+00	8.080-13	1.008-05	1.617-10	2.730-03	2.636-04	3.004-03
5.000+09	2.087-10	3.325-03	5.221-08	1.105+00	1.071-01	1.215+00	5.171-13	8.238-06	1.294-10	2.738-03	2.654-04	3.011-03
6.000+09	1.449-10	2.820-03	4.350-08	1.107+00	1.076-01	1.217+00	3.590-13	6.987-06	1.078-10	2.743-03	2.666-04	3.016-03
8.000+09	8.152-11	2.172-03	3.263-08	1.111+00	1.083-01	1.221+00	2.020-13	5.382-06	8.085-11	2.753-03	2.683-04	3.026-03
1.000+10	5.217-11	1.774-03	2.610-08	1.113+00	1.087-01	1.223+00	1.293-13	4.395-06	6.467-11	2.758-03	2.693-04	3.031-03
1.500+10	2.319-11	1.226-03	1.740-08	1.115+00	1.093-01	1.226+00	5.746-14	3.038-06	4.311-11	2.763-03	2.708-04	3.036-03
2.000+10	1.304-11	9.424-04	1.305-08	1.117+00	1.096-01	1.228+00	3.231-14	2.335-06	3.233-11	2.768-03	2.716-04	3.041-03
3.000+10	5.797-12	6.499-04	8.699-09	1.118+00	1.099-01	1.229+00	1.436-14	1.610-06	2.155-11	2.770-03	2.723-04	3.044-03
4.000+10	3.261-12	4.989-04	6.524-09	1.119+00	1.102-01	1.230+00	8.080-15	1.236-06	1.616-11	2.773-03	2.730-04	3.047-03
5.000+10	2.087-12	4.063-04	5.220-09	1.120+00	1.103-01	1.231+00	5.171-15	1.007-06	1.293-11	2.775-03	2.733-04	3.049-03
6.000+10	1.449-12	3.435-04	4.350-09	1.120+00	1.104-01	1.231+00	3.590-15	8.511-07	1.078-11	2.775-03	2.735-04	3.049-03
8.000+10	8.152-13	2.634-04	3.262-09	1.120+00	1.105-01	1.231+00	2.020-15	6.526-07	8.082-12	2.775-03	2.738-04	3.049-03
1.000+11	5.217-13	2.143-04	2.610-09	1.121+00	1.105-01	1.232+00	1.293-15	5.310-07	6.467-12	2.777-03	2.738-04	3.052-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 13, AL, ALUMINUM ATOMIC WT. = 26.98154 MSO/KG = .00223191 BARNS/ATOM MULTIPLY MSO/KG BY 10 FOR CMSO/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSO/KG	MSO/KG	MSO/KG	MSO/KG	MSO/KG	MSO/KG
1.000+06	6.443-03	2.746+00	1.166-03	0.000	0.000	2.754+00	1.438-05	6.129-03	2.602-06	0.000	0.000	6.146-03
1.022+06	6.169-03	2.717+00	1.115-03	0.000	0.000	2.724+00	1.377-05	6.064-03	2.489-06	0.000	0.000	6.080-03
1.250+06	4.125-03	2.456+00	7.562-04	1.404-03	0.000	2.462+00	9.207-06	5.482-03	1.688-06	3.134-06	0.000	5.496-03
1.500+06	2.865-03	2.232+00	5.476-04	7.652-03	0.000	2.243+00	6.394-06	4.982-03	1.222-06	1.708-05	0.000	5.006-03
2.000+06	1.612-03	1.905+00	3.420-04	3.023-02	0.000	1.937+00	3.598-06	4.252-03	7.633-07	6.747-05	0.000	4.324-03
2.044+06	1.543-03	1.882+00	3.307-04	3.258-02	0.000	1.916+00	3.444-06	4.200-03	7.381-07	7.272-05	0.000	4.277-03
3.000+06	7.166-04	1.499+00	1.892-04	8.595-02	5.245-04	1.586+00	1.599-06	3.346-03	4.223-07	1.918-04	1.171-06	3.541-03
4.000+06	4.031-04	1.250+00	1.291-04	1.390-01	2.142-03	1.392+00	8.997-07	2.790-03	2.881-07	3.102-04	4.781-06	3.106-03
5.000+06	2.580-04	1.080+00	9.746-05	1.861-01	4.267-03	1.271+00	5.758-07	2.410-03	2.175-07	4.154-04	9.524-06	2.836-03
6.000+06	1.792-04	9.545-01	7.812-05	2.284-01	6.554-03	1.190+00	4.000-07	2.130-03	1.744-07	5.098-04	1.463-05	2.655-03
7.000+06	1.316-04	8.579-01	6.511-05	2.660-01	8.836-03	1.133+00	2.937-07	1.915-03	1.453-07	5.937-04	1.972-05	2.529-03
8.000+06	1.008-04	7.808-01	5.577-05	2.999-01	1.105-02	1.092+00	2.250-07	1.743-03	1.245-07	6.694-04	2.466-05	2.437-03
9.000+06	7.963-05	7.178-01	4.876-05	3.305-01	1.318-02	1.062+00	1.777-07	1.602-03	1.088-07	7.376-04	2.942-05	2.369-03
1.000+07	6.450-05	6.650-01	4.330-05	3.584-01	1.520-02	1.039+00	1.440-07	1.484-03	9.664-08	7.990-04	3.393-05	2.318-03
1.100+07	5.331-05	6.203-01	3.894-05	3.837-01	1.712-02	1.021+00	1.190-07	1.384-03	8.691-08	8.564-04	3.821-05	2.279-03
1.200+07	4.479-05	5.817-01	3.537-05	4.069-01	1.893-02	1.008+00	9.997-08	1.298-03	7.894-08	9.082-04	4.225-05	2.249-03
1.300+07	3.817-05	5.480-01	3.239-05	4.284-01	2.065-02	9.971-01	8.519-08	1.223-03	7.229-08	9.562-04	4.609-05	2.225-03
1.400+07	3.291-05	5.185-01	2.988-05	4.484-01	2.228-02	9.892-01	7.345-08	1.157-03	6.669-08	1.001-03	4.973-05	2.208-03
1.500+07	2.867-05	4.922-01	2.772-05	4.672-01	2.383-02	9.833-01	6.399-08	1.099-03	6.187-08	1.043-03	5.319-05	2.195-03
1.600+07	2.520-05	4.687-01	2.586-05	4.847-01	2.531-02	9.788-01	5.624-08	1.046-03	5.772-08	1.082-03	5.649-05	2.185-03
1.800+07	1.991-05	4.284-01	2.279-05	5.169-01	2.806-02	9.734-01	4.444-08	9.562-04	5.087-08	1.154-03	6.263-05	2.173-03
2.000+07	1.613-05	3.951-01	2.037-05	5.457-01	3.057-02	9.714-01	3.600-08	8.818-04	4.546-08	1.218-03	6.823-05	2.168-03
2.200+07	1.333-05	3.669-01	1.841-05	5.717-01	3.288-02	9.715-01	2.975-08	8.189-04	4.109-08	1.276-03	7.339-05	2.168-03
2.400+07	1.120-05	3.429-01	1.680-05	5.954-01	3.501-02	9.733-01	2.500-08	7.653-04	3.750-08	1.329-03	7.814-05	2.172-03
2.600+07	9.541-06	3.220-01	1.544-05	6.171-01	3.699-02	9.761-01	2.129-08	7.187-04	3.446-08	1.377-03	8.256-05	2.179-03
2.800+07	8.227-06	3.037-01	1.429-05	6.371-01	3.883-02	9.797-01	1.836-08	6.778-04	3.189-08	1.422-03	8.667-05	2.186-03
3.000+07	7.167-06	2.876-01	1.330-05	6.556-01	4.056-02	9.838-01	1.600-08	6.419-04	2.968-08	1.463-03	9.053-05	2.196-03
4.000+07	4.031-06	2.285-01	9.870-06	7.321-01	4.778-02	1.008+00	8.997-09	5.100-04	2.203-08	1.634-03	1.066-04	2.251-03
5.000+07	2.580-06	1.908-01	7.846-06	7.891-01	5.337-02	1.033+00	5.758-09	4.258-04	1.751-08	1.761-03	1.191-04	2.306-03
6.000+07	1.792-06	1.644-01	6.511-06	8.342-01	5.788-02	1.056+00	4.000-09	3.669-04	1.453-08	1.862-03	1.292-04	2.358-03
8.000+07	1.008-06	1.296-01	5.857-06	9.019-01	6.479-02	1.096+00	2.250-09	2.893-04	1.084-08	2.013-03	1.446-04	2.447-03
1.000+08	6.449-07	1.076-01	5.873-06	9.503-01	6.993-02	1.128+00	1.439-09	2.402-04	8.644-09	2.121-03	1.561-04	2.517-03
1.500+08	2.866-07	7.662-02	2.571-06	1.028+00	7.864-02	1.183+00	6.397-10	1.710-04	5.738-09	2.294-03	1.755-04	2.641-03
2.000+08	1.612-07	6.008-02	1.924-06	1.076+00	8.426-02	1.220+00	3.598-10	1.341-04	4.294-09	2.402-03	1.881-04	2.724-03
3.000+08	7.166-08	4.258-02	1.280-06	1.132+00	9.134-02	1.266+00	1.599-10	9.503-05	2.857-09	2.527-03	2.039-04	2.825-03
4.000+08	4.031-08	3.335-02	9.590-07	1.165+00	9.572-02	1.294+00	8.997-11	7.443-05	2.140-09	2.600-03	2.136-04	2.888-03
5.000+08	2.580-08	2.761-02	7.667-07	1.187+00	9.878-02	1.313+00	5.758-11	6.162-05	1.711-09	2.649-03	2.205-04	2.931-03
6.000+08	1.791-08	2.364-02	6.386-07	1.202+00	1.011-01	1.327+00	3.997-11	5.276-05	1.425-09	2.683-03	2.256-04	2.961-03
8.000+08	1.008-08	1.846-02	4.787-07	1.223+00	1.043-01	1.346+00	2.250-11	4.120-05	1.068-09	2.730-03	2.328-04	3.004-03
1.000+09	6.449-09	1.519-02	3.828-07	1.237+00	1.064-01	1.359+00	1.439-11	3.390-05	8.544-10	2.761-03	2.375-04	3.032-03
1.500+09	2.866-09	1.061-02	2.551-07	1.257+00	1.097-01	1.377+00	6.397-12	2.368-05	5.694-10	2.806-03	2.448-04	3.074-03
2.000+09	1.612-09	8.209-03	1.913-07	1.268+00	1.116-01	1.388+00	3.598-12	1.832-05	4.270-10	2.830-03	2.491-04	3.097-03
3.000+09	7.166-10	5.708-03	1.275-07	1.280+00	1.137-01	1.399+00	1.599-12	1.274-05	2.846-10	2.857-03	2.538-04	3.123-03
4.000+09	4.031-10	4.406-03	9.562-08	1.287+00	1.149-01	1.406+00	8.997-13	9.834-06	2.134-10	2.872-03	2.564-04	3.139-03
5.000+09	2.580-10	3.602-03	7.649-08	1.291+00	1.157-01	1.410+00	5.758-13	8.039-06	1.707-10	2.881-03	2.582-04	3.148-03
6.000+09	1.791-10	3.055-03	6.374-08	1.294+00	1.162-01	1.413+00	3.997-13	6.818-06	1.423-10	2.888-03	2.593-04	3.154-03
8.000+09	1.008-10	2.353-03	4.780-08	1.297+00	1.169-01	1.416+00	2.250-13	5.252-06	1.067-10	2.895-03	2.609-04	3.161-03
1.000+10	6.449-11	1.921-03	3.824-08	1.300+00	1.174-01	1.419+00	1.439-13	4.288-06	8.535-11	2.901-03	2.620-04	3.168-03
1.500+10	2.866-11	1.328-03	2.549-08	1.303+00	1.180-01	1.422+00	6.397-14	2.964-06	5.689-11	2.908-03	2.634-04	3.175-03
2.000+10	1.612-11	1.021-03	1.912-08	1.305+00	1.184-01	1.424+00	3.598-14	2.279-06	4.267-11	2.913-03	2.643-04	3.179-03
3.000+10	7.166-12	7.041-04	1.275-08	1.306+00	1.188-01	1.426+00	1.599-14	1.571-06	2.846-11	2.915-03	2.652-04	3.182-03
4.000+10	4.031-12	5.405-04	9.559-09	1.307+00	1.190-01	1.427+00	8.997-15	1.206-06	2.133-11	2.917-03	2.656-04	3.184-03
5.000+10	2.580-12	4.402-04	7.647-09	1.308+00	1.191-01	1.428+00	5.758-15	9.825-07	1.707-11	2.919-03	2.658-04	3.186-03
6.000+10	1.791-12	3.721-04	6.373-09	1.308+00	1.192-01	1.428+00	3.997-15	8.305-07	1.422-11	2.919-03	2.660-04	3.186-03
8.000+10	1.008-12	2.853-04	4.779-09	1.309+00	1.193-01	1.429+00	2.250-15	6.368-07	1.067-11	2.922-03	2.663-04	3.188-03
1.000+11	6.449-13	2.321-04	3.823-09	1.309+00	1.194-01	1.429+00	1.439-15	5.180-07	8.533-12	2.922-03	2.665-04	3.189-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 14, SI, SILICON ATOMIC WT. = 28.0855 MSQ/KG = .00214418 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	7.837-03	2.957+00	1.673-03	0.000	0.000	2.967+00	1.680-05	6.340-03	3.587-06	0.000	0.000	6.361-03
1.022+06	7.504-03	2.926+00	1.601-03	0.000	0.000	2.935+00	1.609-05	6.274-03	3.433-06	0.000	0.000	6.293-03
1.250+06	5.018-03	2.645+00	1.085-03	1.642-03	0.000	2.653+00	1.076-05	5.671-03	2.326-06	3.521-06	0.000	5.688-03
1.500+06	3.486-03	2.404+00	7.853-04	8.917-03	0.000	2.417+00	7.475-06	5.155-03	1.684-06	1.912-05	0.000	5.183-03
2.000+06	1.961-03	2.052+00	4.899-04	3.513-02	0.000	2.090+00	4.205-06	4.400-03	1.050-06	7.533-05	0.000	4.480-03
2.044+06	1.878-03	2.027+00	4.736-04	3.786-02	0.000	2.067+00	4.027-06	4.346-03	1.015-06	8.115-05	0.000	4.432-03
3.000+06	8.718-04	1.614+00	2.705-04	9.978-02	5.649-04	1.715+00	1.869-06	3.461-03	5.800-07	2.139-04	1.211-06	3.678-03
4.000+06	4.904-04	1.347+00	1.843-04	1.612-01	2.306-03	1.511+00	1.052-06	2.888-03	3.952-07	3.456-04	4.944-06	3.240-03
5.000+06	3.139-04	1.163+00	1.391-04	2.159-01	4.595-03	1.384+00	6.731-07	2.494-03	2.983-07	4.629-04	9.853-06	2.967-03
6.000+06	2.180-04	1.028+00	1.114-04	2.648-01	7.058-03	1.300+00	4.674-07	2.204-03	2.389-07	5.678-04	1.513-05	2.788-03
7.000+06	1.602-04	9.240-01	9.283-05	3.083-01	9.516-03	1.242+00	3.435-07	1.981-03	1.990-07	6.611-04	2.040-05	2.663-03
8.000+06	1.226-04	8.409-01	7.950-05	3.475-01	1.190-02	1.201+00	2.629-07	1.803-03	1.705-07	7.451-04	2.552-05	2.574-03
9.000+06	9.668-05	7.730-01	6.948-05	3.830-01	1.419-02	1.170+00	2.077-07	1.657-03	1.490-07	8.212-04	3.043-05	2.509-03
1.000+07	7.848-05	7.162-01	6.169-05	4.153-01	1.637-02	1.148+00	1.683-07	1.536-03	1.323-07	8.905-04	3.510-05	2.462-03
1.100+07	6.486-05	6.680-01	5.546-05	4.445-01	1.843-02	1.131+00	1.391-07	1.432-03	1.189-07	9.531-04	3.952-05	2.425-03
1.200+07	5.450-05	6.265-01	5.037-05	4.714-01	2.038-02	1.118+00	1.169-07	1.343-03	1.080-07	1.011-03	4.370-05	2.398-03
1.300+07	4.644-05	5.902-01	4.612-05	4.963-01	2.223-02	1.109+00	9.958-08	1.265-03	9.889-08	1.061-03	4.767-05	2.378-03
1.400+07	4.004-05	5.583-01	4.254-05	5.194-01	2.399-02	1.102+00	8.585-08	1.197-03	9.121-08	1.114-03	5.144-05	2.362-03
1.500+07	3.488-05	5.301-01	3.947-05	5.411-01	2.566-02	1.097+00	7.479-08	1.137-03	8.463-08	1.168-03	5.502-05	2.352-03
1.600+07	3.065-05	5.048-01	3.681-05	5.614-01	2.725-02	1.094+00	6.572-08	1.082-03	7.893-08	1.204-03	5.843-05	2.345-03
1.800+07	2.422-05	4.614-01	3.243-05	5.986-01	3.020-02	1.090+00	5.193-08	9.893-04	6.954-08	1.284-03	6.475-05	2.338-03
2.000+07	1.962-05	4.255-01	2.899-05	6.318-01	3.290-02	1.090+00	4.207-08	9.123-04	6.216-08	1.355-03	7.054-05	2.338-03
2.200+07	1.621-05	3.952-01	2.620-05	6.619-01	3.539-02	1.093+00	3.476-08	8.474-04	5.618-08	1.419-03	7.588-05	2.343-03
2.400+07	1.362-05	3.693-01	2.390-05	6.893-01	3.768-02	1.096+00	2.920-08	7.918-04	5.125-08	1.478-03	8.079-05	2.351-03
2.600+07	1.161-05	3.468-01	2.197-05	7.144-01	3.981-02	1.101+00	2.489-08	7.436-04	4.711-08	1.532-03	8.536-05	2.361-03
2.800+07	1.001-05	3.271-01	2.033-05	7.375-01	4.179-02	1.106+00	2.146-08	7.014-04	4.359-08	1.581-03	8.961-05	2.372-03
3.000+07	8.719-06	3.097-01	1.892-05	7.589-01	4.364-02	1.112+00	1.870-08	6.641-04	4.057-08	1.627-03	9.357-05	2.385-03
4.000+07	4.905-06	2.461-01	1.404-05	8.472-01	5.140-02	1.145+00	1.052-08	5.277-04	3.010-08	1.817-03	1.102-04	2.454-03
5.000+07	3.139-06	2.055-01	1.116-05	9.133-01	5.739-02	1.176+00	6.731-09	4.406-04	2.393-08	1.958-03	1.231-04	2.522-03
6.000+07	2.180-06	1.770-01	9.258-06	9.652-01	6.222-02	1.204+00	4.674-09	3.795-04	1.985-08	2.070-03	1.334-04	2.583-03
8.000+07	1.226-06	1.396-01	6.906-06	1.043+00	6.961-02	1.252+00	2.629-09	2.993-04	1.481-08	2.236-03	1.493-04	2.685-03
1.000+08	7.847-07	1.159-01	5.507-06	1.098+00	7.511-02	1.289+00	1.683-09	2.485-04	1.181-08	2.354-03	1.610-04	2.764-03
1.500+08	3.487-07	8.252-02	3.655-06	1.188+00	8.443-02	1.355+00	7.477-10	1.769-04	7.837-09	2.547-03	1.810-04	2.905-03
2.000+08	1.962-07	6.470-02	2.735-06	1.242+00	9.045-02	1.397+00	4.207-10	1.387-04	5.864-09	2.663-03	1.939-04	2.996-03
3.000+08	8.718-08	4.586-02	1.820-06	1.307+00	9.805-02	1.451+00	1.869-10	9.833-05	3.902-09	2.802-03	2.102-04	3.111-03
4.000+08	4.904-08	3.591-02	1.363-06	1.345+00	1.027-01	1.484+00	1.052-10	7.700-05	2.923-09	2.884-03	2.202-04	3.181-03
5.000+08	3.139-08	2.973-02	1.090-06	1.370+00	1.060-01	1.506+00	6.731-11	6.375-05	2.337-09	2.938-03	2.273-04	3.229-03
6.000+08	2.180-08	2.545-02	9.078-07	1.388+00	1.085-01	1.522+00	4.674-11	5.457-05	1.946-09	2.976-03	2.326-04	3.263-03
8.000+08	1.226-08	1.988-02	6.805-07	1.413+00	1.119-01	1.545+00	2.629-11	4.263-05	1.459-09	3.031-03	2.395-04	3.312-03
1.000+09	7.847-09	1.636-02	5.442-07	1.429+00	1.142-01	1.560+00	1.683-11	3.508-05	1.167-09	3.064-03	2.449-04	3.344-03
1.500+09	3.487-09	1.142-02	3.626-07	1.452+00	1.177-01	1.581+00	7.477-12	2.449-05	7.775-10	3.113-03	2.524-04	3.390-03
2.000+09	1.962-09	8.840-03	2.719-07	1.464+00	1.197-01	1.593+00	4.207-12	1.895-05	5.830-10	3.139-03	2.567-04	3.415-03
3.000+09	8.718-10	6.147-03	1.812-07	1.478+00	1.219-01	1.606+00	1.869-12	1.318-05	3.885-10	3.169-03	2.614-04	3.444-03
4.000+09	4.904-10	4.745-03	1.359-07	1.486+00	1.232-01	1.614+00	1.052-12	1.017-05	2.914-10	3.186-03	2.642-04	3.461-03
5.000+09	3.139-10	3.879-03	1.087-07	1.490+00	1.240-01	1.618+00	6.731-13	8.317-06	2.331-10	3.195-03	2.659-04	3.469-03
6.000+09	2.180-10	3.290-03	9.060-08	1.494+00	1.246-01	1.622+00	4.674-13	7.054-06	1.943-10	3.203-03	2.672-04	3.478-03
8.000+09	1.226-10	2.534-03	6.795-08	1.498+00	1.253-01	1.626+00	2.629-13	5.433-06	1.457-10	3.212-03	2.687-04	3.486-03
1.000+10	7.847-11	2.069-03	5.436-08	1.501+00	1.258-01	1.629+00	1.683-13	4.436-06	1.166-10	3.218-03	2.697-04	3.493-03
1.500+10	3.487-11	1.430-03	3.624-08	1.504+00	1.265-01	1.632+00	7.477-14	3.066-06	7.771-11	3.225-03	2.712-04	3.499-03
2.000+10	1.962-11	1.099-03	2.718-08	1.506+00	1.268-01	1.634+00	4.207-14	2.356-06	5.828-11	3.229-03	2.719-04	3.503-03
3.000+10	8.718-12	7.582-04	1.812-08	1.509+00	1.272-01	1.637+00	1.869-14	1.626-06	3.885-11	3.236-03	2.727-04	3.510-03
4.000+10	4.904-12	5.821-04	1.359-08	1.510+00	1.275-01	1.638+00	1.052-14	1.248-06	2.914-11	3.238-03	2.734-04	3.512-03
5.000+10	3.139-12	4.740-04	1.087-08	1.510+00	1.276-01	1.638+00	6.731-15	1.016-06	2.331-11	3.238-03	2.736-04	3.512-03
6.000+10	2.180-12	4.007-04	9.058-09	1.511+00	1.277-01	1.639+00	4.674-15	8.592-07	1.942-11	3.240-03	2.738-04	3.515-03
8.000+10	1.226-12	3.072-04	6.794-09	1.511+00	1.278-01	1.639+00	2.629-15	6.587-07	1.457-11	3.240-03	2.740-04	3.515-03
1.000+11	7.847-13	2.500-04	5.435-09	1.512+00	1.279-01	1.640+00	1.683-15	5.360-07	1.165-11	3.242-03	2.742-04	3.517-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 15, P , PHOSPHORUS ATOMIC WT. = 30.97376 MSQ/KG = .00194424 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	9.409-03	3.168+00	2.338-03	0.000	0.000	3.180+00	1.829-05	6.159-03	4.546-06	0.000	0.000	6.182-03
1.022+06	9.409-03	3.135+00	2.237-03	0.000	0.000	3.146+00	1.752-05	6.095-03	4.349-06	0.000	0.000	6.117-03
1.250+06	6.025-03	2.833+00	1.516-03	1.903-03	0.000	2.842+00	1.171-05	5.508-03	2.947-06	3.700-06	0.000	5.526-03
1.500+06	4.185-03	2.576+00	1.097-03	1.029-02	0.000	2.592+00	8.137-06	5.008-03	2.133-06	2.001-05	0.000	5.039-03
2.000+06	2.355-03	2.198+00	6.837-04	4.044-02	0.000	2.241+00	4.579-06	4.273-03	1.329-06	7.863-05	0.000	4.358-03
2.044+06	2.255-03	2.171+00	6.609-04	4.358-02	0.000	2.217+00	4.384-06	4.221-03	1.285-06	8.473-05	0.000	4.311-03
3.000+06	1.047-03	1.730+00	3.769-04	1.147-01	6.052-04	1.847+00	2.036-06	3.364-03	7.328-07	2.230-04	1.177-06	3.590-03
4.000+06	5.889-04	1.443+00	2.566-04	1.852-01	2.471-03	1.632+00	1.145-06	2.806-03	4.989-07	3.601-04	4.804-06	3.172-03
5.000+06	3.769-04	1.246+00	1.934-04	2.478-01	4.924-03	1.499+00	7.328-07	2.423-03	3.760-07	4.818-04	9.573-06	2.915-03
6.000+06	2.617-04	1.101+00	1.549-04	3.039-01	7.562-03	1.413+00	5.088-07	2.141-03	3.012-07	5.909-04	1.470-05	2.747-03
7.000+06	1.923-04	9.899-01	1.290-04	3.537-01	1.019-02	1.354+00	3.739-07	1.925-03	2.508-07	6.877-04	1.981-05	2.633-03
8.000+06	1.472-04	9.009-01	1.104-04	3.987-01	1.275-02	1.313+00	2.862-07	1.752-03	2.146-07	7.752-04	2.479-05	2.552-03
9.000+06	1.163-04	8.282-01	9.649-05	4.394-01	1.520-02	1.283+00	2.261-07	1.610-03	1.876-07	8.543-04	2.955-05	2.494-03
1.000+07	9.423-05	7.673-01	8.565-05	4.763-01	1.753-02	1.261+00	1.832-07	1.492-03	1.665-07	9.260-04	3.408-05	2.452-03
1.100+07	7.788-05	7.157-01	7.699-05	5.098-01	1.974-02	1.245+00	1.514-07	1.391-03	1.497-07	9.912-04	3.838-05	2.421-03
1.200+07	6.544-05	6.712-01	6.990-05	5.405-01	2.183-02	1.234+00	1.272-07	1.305-03	1.359-07	1.051-03	4.244-05	2.399-03
1.300+07	5.576-05	6.323-01	6.401-05	5.690-01	2.381-02	1.225+00	1.084-07	1.229-03	1.245-07	1.106-03	4.629-05	2.382-03
1.400+07	4.808-05	5.982-01	5.902-05	5.955-01	2.569-02	1.219+00	9.348-08	1.163-03	1.147-07	1.158-03	4.995-05	2.371-03
1.500+07	4.188-05	5.679-01	5.476-05	6.203-01	2.748-02	1.216+00	8.142-08	1.104-03	1.065-07	1.206-03	5.343-05	2.364-03
1.600+07	3.681-05	5.408-01	5.106-05	6.435-01	2.918-02	1.214+00	7.157-08	1.051-03	9.927-08	1.251-03	5.673-05	2.359-03
1.800+07	2.908-05	4.943-01	4.499-05	6.861-01	3.234-02	1.213+00	5.654-08	9.610-04	8.747-08	1.334-03	6.288-05	2.358-03
2.000+07	2.356-05	4.558-01	4.020-05	7.242-01	3.523-02	1.215+00	4.581-08	8.862-04	7.816-08	1.408-03	6.850-05	2.363-03
2.200+07	1.947-05	4.234-01	3.634-05	7.586-01	3.789-02	1.220+00	3.785-08	8.232-04	7.065-08	1.475-03	7.367-05	2.372-03
2.400+07	1.636-05	3.956-01	3.314-05	7.899-01	4.034-02	1.226+00	3.181-08	7.691-04	6.443-08	1.536-03	7.843-05	2.383-03
2.600+07	1.394-05	3.715-01	3.047-05	8.186-01	4.262-02	1.233+00	2.710-08	7.223-04	5.924-08	1.592-03	8.286-05	2.397-03
2.800+07	1.202-05	3.505-01	2.819-05	8.450-01	4.474-02	1.240+00	2.337-08	6.815-04	5.481-08	1.643-03	8.699-05	2.411-03
3.000+07	1.047-05	3.318-01	2.623-05	8.694-01	4.672-02	1.248+00	2.036-08	6.451-04	5.100-08	1.690-03	9.083-05	2.426-03
4.000+07	5.889-06	2.637-01	1.946-05	9.705-01	5.500-02	1.289+00	1.145-08	5.127-04	3.783-08	1.887-03	1.069-04	2.507-03
5.000+07	3.769-06	2.201-01	1.547-05	1.046+00	6.140-02	1.328+00	7.328-09	4.279-04	3.008-08	2.034-03	1.194-04	2.581-03
6.000+07	2.617-06	1.897-01	1.283-05	1.105+00	6.654-02	1.361+00	5.088-09	3.688-04	2.494-08	2.148-03	1.294-04	2.647-03
8.000+07	1.472-06	1.496-01	9.570-06	1.193+00	7.443-02	1.417+00	2.862-09	2.909-04	1.861-08	2.319-03	1.447-04	2.755-03
1.000+08	9.422-07	1.242-01	7.631-06	1.256+00	8.028-02	1.460+00	1.832-09	2.415-04	1.484-08	2.442-03	1.561-04	2.840-03
1.500+08	4.188-07	8.841-02	5.065-06	1.358+00	9.021-02	1.537+00	8.142-10	1.719-04	9.848-09	2.640-03	1.754-04	2.988-03
2.000+08	2.355-07	6.932-02	3.790-06	1.420+00	9.662-02	1.586+00	4.579-10	1.348-04	7.369-09	2.761-03	1.879-04	3.083-03
3.000+08	1.047-07	4.913-02	2.521-06	1.494+00	1.047-01	1.648+00	2.036-10	9.552-05	4.901-09	2.905-03	2.036-04	3.204-03
4.000+08	5.889-08	3.848-02	1.889-06	1.538+00	1.097-01	1.686+00	1.145-10	7.481-05	3.673-09	2.990-03	2.133-04	3.278-03
5.000+08	3.769-08	3.185-02	1.510-06	1.566+00	1.131-01	1.711+00	7.328-11	6.192-05	2.936-09	3.045-03	2.199-04	3.327-03
6.000+08	2.617-08	2.727-02	1.258-06	1.587+00	1.157-01	1.730+00	5.088-11	5.302-05	2.446-09	3.086-03	2.249-04	3.363-03
8.000+08	1.472-08	2.130-02	9.427-07	1.615+00	1.193-01	1.756+00	2.862-11	4.141-05	1.833-09	3.140-03	2.319-04	3.413-03
1.000+09	9.422-09	1.752-02	7.539-07	1.633+00	1.217-01	1.772+00	1.832-11	3.406-05	1.466-09	3.175-03	2.366-04	3.446-03
1.500+09	4.188-09	1.224-02	5.024-07	1.660+00	1.254-01	1.798+00	8.142-12	2.380-05	9.768-10	3.227-03	2.438-04	3.495-03
2.000+09	2.355-09	9.472-03	3.767-07	1.674+00	1.274-01	1.811+00	4.579-12	1.842-05	7.324-10	3.255-03	2.477-04	3.521-03
3.000+09	1.047-09	6.586-03	2.511-07	1.690+00	1.297-01	1.826+00	2.036-12	1.280-05	4.882-10	3.286-03	2.522-04	3.551-03
4.000+09	5.889-10	5.084-03	1.883-07	1.698+00	1.311-01	1.834+00	1.145-12	9.885-06	3.661-10	3.301-03	2.549-04	3.566-03
5.000+09	3.769-10	4.156-03	1.506-07	1.704+00	1.319-01	1.840+00	7.328-13	8.080-06	2.928-10	3.313-03	2.564-04	3.578-03
6.000+09	2.617-10	3.525-03	1.255-07	1.707+00	1.325-01	1.843+00	5.088-13	6.853-06	2.440-10	3.319-03	2.576-04	3.583-03
8.000+09	1.472-10	2.715-03	9.413-08	1.712+00	1.333-01	1.848+00	2.862-13	5.279-06	1.830-10	3.329-03	2.592-04	3.593-03
1.000+10	9.422-11	2.217-03	7.530-08	1.715+00	1.338-01	1.851+00	1.832-13	4.310-06	1.464-10	3.334-03	2.601-04	3.599-03
1.500+10	4.188-11	1.532-03	5.020-08	1.720+00	1.345-01	1.856+00	8.142-14	2.979-06	9.760-11	3.344-03	2.615-04	3.609-03
2.000+10	2.355-11	1.178-03	3.765-08	1.722+00	1.349-01	1.858+00	4.579-14	2.290-06	7.320-11	3.348-03	2.623-04	3.613-03
3.000+10	1.047-11	8.124-04	2.510-08	1.724+00	1.352-01	1.860+00	2.036-14	1.580-06	4.880-11	3.352-03	2.629-04	3.616-03
4.000+10	5.889-12	6.237-04	1.882-08	1.726+00	1.355-01	1.862+00	1.145-14	1.213-06	3.659-11	3.356-03	2.634-04	3.620-03
5.000+10	3.769-12	5.079-04	1.506-08	1.727+00	1.356-01	1.863+00	7.328-15	9.875-07	2.928-11	3.358-03	2.636-04	3.622-03
6.000+10	2.617-12	4.293-04	1.255-08	1.727+00	1.357-01	1.863+00	5.088-15	8.347-07	2.440-11	3.358-03	2.638-04	3.622-03
8.000+10	1.472-12	3.292-04	9.411-09	1.728+00	1.358-01	1.864+00	2.862-15	6.400-07	1.830-11	3.360-03	2.640-04	3.624-03
1.000+11	9.422-13	2.678-04	7.529-09	1.728+00	1.359-01	1.864+00	1.832-15	5.207-07	1.464-11	3.360-03	2.642-04	3.624-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 16. S , SULFUR ATOMIC WT. = 32.06 MSO/KG = .0018783/ BARNS/ATOM MULTIPLY MSO/KG BY 10 FOR CMSO/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSO/KG	MSO/KG	MSO/KG	MSO/KG	MSO/KG	MSO/KG
1.000+06	1.117-02	3.379+00	3.195-03	0.000	0.000	3.393+00	2.098-05	6.347-03	6.001-06	0.000	0.000	6.374-03
1.022+06	1.070-02	3.343+00	3.057-03	0.000	0.000	3.357+00	2.010-05	6.279-03	5.742-06	0.000	0.000	6.305-03
1.250+06	7.153-03	3.022+00	2.071-03	2.188-03	0.000	3.033+00	1.344-05	5.676-03	3.890-06	4.110-06	0.000	5.698-03
1.500+06	4.969-03	2.747+00	1.499-03	1.177-02	0.000	2.765+00	9.334-06	5.160-03	2.816-06	2.211-05	0.000	5.194-03
2.000+06	2.796-03	2.345+00	9.326-04	4.614-02	0.000	2.395+00	5.252-06	4.405-03	1.752-06	8.667-05	0.000	4.498-03
2.044+06	2.677-03	2.316+00	9.015-04	4.973-02	0.000	2.369+00	5.028-06	4.350-03	1.693-06	9.341-05	0.000	4.450-03
3.000+06	1.243-03	1.845+00	5.133-04	1.307-01	6.456-04	1.978+00	2.335-06	3.466-03	9.642-07	2.455-04	1.213-06	3.716-03
4.000+06	6.992-04	1.539+00	3.490-04	2.108-01	3.636-03	1.753+00	1.313-06	2.891-03	6.556-07	3.960-04	4.951-06	3.294-03
5.000+06	4.475-04	1.329+00	2.630-04	2.819-01	5.252-03	1.617+00	8.406-07	2.496-03	4.940-07	5.295-04	9.865-06	3.037-03
6.000+06	3.108-04	1.175+00	2.104-04	3.456-01	8.066-03	1.529+00	5.838-07	2.207-03	3.952-07	6.492-04	1.515-05	2.872-03
7.000+06	2.283-04	1.056+00	1.752-04	4.023-01	1.087-02	1.470+00	4.288-07	1.984-03	3.291-07	7.557-04	2.042-05	2.769-03
8.000+06	1.748-04	9.610-01	1.499-04	4.533-01	1.360-02	1.428+00	3.283-07	1.805-03	2.816-07	8.515-04	2.555-05	2.683-03
9.000+06	1.381-04	8.834-01	1.310-04	4.995-01	1.621-02	1.399+00	2.594-07	1.659-03	2.461-07	9.382-04	3.045-05	2.629-03
1.000+07	1.119-04	8.185-01	1.162-04	5.414-01	1.870-02	1.379+00	2.102-07	1.537-03	2.183-07	1.017-03	3.513-05	2.590-03
1.100+07	9.246-05	7.634-01	1.045-04	5.794-01	2.106-02	1.364+00	1.737-07	1.434-03	1.963-07	1.088-03	3.956-05	2.562-03
1.200+07	7.770-05	7.160-01	9.483-05	6.143-01	2.328-02	1.354+00	1.459-07	1.345-03	1.781-07	1.154-03	4.373-05	2.543-03
1.300+07	6.620-05	6.745-01	8.682-05	6.467-01	2.539-02	1.347+00	1.243-07	1.267-03	1.631-07	1.215-03	4.769-05	2.530-03
1.400+07	5.708-05	6.381-01	8.005-05	6.767-01	2.740-02	1.342+00	1.072-07	1.199-03	1.504-07	1.271-03	5.147-05	2.521-03
1.500+07	4.972-05	6.058-01	7.426-05	7.048-01	2.930-02	1.340+00	9.339-08	1.138-03	1.395-07	1.324-03	5.504-05	2.517-03
1.600+07	4.370-05	5.769-01	6.925-05	7.312-01	3.111-02	1.339+00	8.208-08	1.084-03	1.301-07	1.373-03	5.844-05	2.516-03
1.800+07	3.453-05	5.273-01	6.100-05	7.795-01	3.448-02	1.341+00	6.486-08	9.905-04	1.146-07	1.464-03	6.477-05	2.520-03
2.000+07	2.797-05	4.862-01	5.450-05	8.226-01	3.756-02	1.346+00	5.254-08	9.133-04	1.024-07	1.545-03	7.055-05	2.529-03
2.200+07	2.312-05	4.516-01	4.925-05	8.617-01	4.039-02	1.354+00	4.343-08	8.483-04	9.251-08	1.619-03	7.587-05	2.543-03
2.400+07	1.942-05	4.220-01	4.493-05	8.972-01	4.301-02	1.362+00	3.648-08	7.927-04	8.440-08	1.685-03	8.079-05	2.559-03
2.600+07	1.655-05	3.963-01	4.129-05	9.297-01	4.543-02	1.371+00	3.109-08	7.444-04	7.756-08	1.746-03	8.533-05	2.576-03
2.800+07	1.427-05	3.738-01	3.821-05	9.596-01	4.768-02	1.381+00	2.680-08	7.021-04	7.177-08	1.802-03	8.956-05	2.594-03
3.000+07	1.243-05	3.540-01	3.555-05	9.873-01	4.979-02	1.391+00	2.335-08	6.649-04	6.678-08	1.855-03	9.352-05	2.613-03
4.000+07	6.992-06	2.813-01	2.637-05	1.102+00	5.860-02	1.442+00	1.313-08	5.284-04	4.953-08	2.070-03	1.101-04	2.708-03
5.000+07	4.475-06	2.348-01	2.095-05	1.187+00	6.540-02	1.487+00	8.406-09	4.410-04	3.935-08	2.230-03	1.228-04	2.794-03
6.000+07	3.108-06	2.023-01	1.738-05	1.254+00	7.086-02	1.527+00	5.838-09	3.800-04	3.265-08	2.355-03	1.331-04	2.869-03
8.000+07	1.748-06	1.595-01	1.296-05	1.353+00	7.923-02	1.592+00	3.283-09	2.996-04	2.434-08	2.541-03	1.488-04	2.990-03
1.000+08	1.119-06	1.324-01	1.034-05	1.424+00	8.544-02	1.642+00	2.102-09	2.487-04	1.942-08	2.675-03	1.605-04	3.084-03
1.500+08	4.972-07	9.430-02	6.859-06	1.540+00	9.599-02	1.730+00	9.339-10	1.771-04	1.288-08	2.893-03	1.803-04	3.250-03
2.000+08	2.797-07	7.394-02	5.133-06	1.610+00	1.028-01	1.787+00	5.254-10	1.389-04	9.642-09	3.024-03	1.931-04	3.356-03
3.000+08	1.243-07	5.241-02	3.414-06	1.694+00	1.113-01	1.858+00	2.335-10	9.845-05	6.413-09	3.182-03	2.091-04	3.489-03
4.000+08	6.992-08	4.104-02	2.558-06	1.743+00	1.166-01	1.901+00	1.313-10	7.709-05	4.805-09	3.274-03	2.190-04	3.570-03
5.000+08	4.475-08	3.398-02	2.045-06	1.775+00	1.203-01	1.929+00	8.406-11	6.383-05	3.841-09	3.334-03	2.260-04	3.624-03
6.000+08	3.107-08	2.909-02	1.703-06	1.799+00	1.230-01	1.951+00	5.836-11	5.464-05	3.199-09	3.379-03	2.310-04	3.665-03
8.000+08	1.748-08	2.272-02	1.277-06	1.830+00	1.268-01	1.980+00	3.283-11	4.268-05	2.399-09	3.437-03	2.382-04	3.718-03
1.000+09	1.119-08	1.869-02	1.021-06	1.850+00	1.293-01	1.998+00	2.102-11	3.511-05	1.918-09	3.475-03	2.429-04	3.753-03
1.500+09	4.972-09	1.305-02	6.803-07	1.880+00	1.331-01	2.026+00	9.339-12	2.451-05	1.278-09	3.531-03	2.500-04	3.806-03
2.000+09	2.797-09	1.010-02	5.101-07	1.897+00	1.353-01	2.042+00	5.254-12	1.897-05	9.582-10	3.563-03	2.541-04	3.836-03
3.000+09	1.243-09	7.025-03	3.400-07	1.914+00	1.377-01	2.059+00	2.335-12	1.320-05	6.386-10	3.595-03	2.587-04	3.867-03
4.000+09	6.992-10	5.422-03	2.550-07	1.924+00	1.391-01	2.069+00	1.313-12	1.018-05	4.790-10	3.614-03	2.613-04	3.885-03
5.000+09	4.475-10	4.433-03	2.040-07	1.930+00	1.399-01	2.074+00	8.406-13	8.327-06	3.832-10	3.625-03	2.628-04	3.896-03
6.000+09	3.107-10	3.759-03	1.700-07	1.934+00	1.405-01	2.078+00	5.836-13	7.061-06	3.193-10	3.633-03	2.639-04	3.904-03
8.000+09	1.748-10	2.896-03	1.275-07	1.940+00	1.413-01	2.084+00	3.283-13	5.440-06	2.395-10	3.644-03	2.654-04	3.915-03
1.000+10	1.119-10	2.365-03	1.020-07	1.943+00	1.419-01	2.087+00	2.102-13	4.442-06	1.916-10	3.650-03	2.665-04	3.921-03
1.500+10	4.972-11	1.634-03	6.798-08	1.948+00	1.426-01	2.092+00	9.339-14	3.069-06	1.277-10	3.659-03	2.679-04	3.930-03
2.000+10	2.797-11	1.256-03	5.098-08	1.950+00	1.430-01	2.094+00	5.254-14	2.359-06	9.576-11	3.663-03	2.686-04	3.934-03
3.000+10	1.243-11	8.665-04	3.399-08	1.953+00	1.434-01	2.097+00	2.335-14	1.628-06	6.385-11	3.668-03	2.694-04	3.939-03
4.000+10	6.992-12	6.653-04	2.549-08	1.955+00	1.436-01	2.099+00	1.313-14	1.250-06	4.788-11	3.672-03	2.697-04	3.943-03
5.000+10	4.475-12	5.417-04	2.039-08	1.956+00	1.438-01	2.100+00	8.406-15	1.018-06	3.830-11	3.674-03	2.701-04	3.945-03
6.000+10	3.107-12	4.579-04	1.699-08	1.956+00	1.439-01	2.100+00	5.836-15	8.601-07	3.191-11	3.674-03	2.703-04	3.945-03
8.000+10	1.748-12	3.511-04	1.274-08	1.957+00	1.440-01	2.101+00	3.283-15	6.595-07	2.393-11	3.676-03	2.705-04	3.947-03
1.000+11	1.119-12	2.857-04	1.020-08	1.957+00	1.441-01	2.101+00	2.102-15	5.366-07	1.916-11	3.676-03	2.707-04	3.947-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 17, CL, CHLORINE ATOMIC WT. = 35.453 MSQ/KG = .00169860 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.313-02	3.590+00	4.279-03	0.000	0.000	3.607+00	2.230-05	6.098-03	7.268-06	0.000	0.000	6.128-03
1.022+06	1.257-02	3.552+00	4.095-03	0.000	0.000	3.569+00	2.135-05	6.033-03	6.956-06	0.000	0.000	6.062-03
1.250+06	8.410-03	3.211+00	2.774-03	2.497-03	0.000	3.225+00	1.429-05	5.454-03	4.712-06	4.241-06	0.000	5.477-03
1.500+06	5.842-03	2.919+00	2.006-03	1.337-02	0.000	2.940+00	9.923-06	4.958-03	3.407-06	2.271-05	0.000	4.994-03
2.000+06	3.287-03	2.491+00	1.247-03	5.227-02	0.000	2.548+00	5.583-06	4.231-03	2.118-06	8.879-05	0.000	4.328-03
2.044+06	3.147-03	2.461+00	1.205-03	5.632-02	0.000	2.522+00	5.345-06	4.180-03	2.047-06	9.567-05	0.000	4.287-03
3.000+06	1.461-03	1.960+00	6.854-04	1.477-01	6.859-04	2.111+00	2.482-06	3.329-03	1.164-06	2.509-04	1.165-06	3.585-03
4.000+06	8.221-04	1.635+00	4.655-04	2.380-01	2.801-03	1.877+00	1.396-06	2.777-03	7.907-07	4.043-04	4.758-06	3.188-03
5.000+06	5.262-04	1.412+00	3.505-04	3.183-01	5.580-03	1.737+00	8.938-07	2.398-03	5.954-07	5.407-04	9.478-06	2.950-03
6.000+06	3.654-04	1.248+00	2.803-04	3.900-01	8.569-03	1.647+00	6.207-07	2.120-03	4.761-07	6.625-04	1.456-05	2.798-03
7.000+06	2.685-04	1.122+00	2.333-04	4.539-01	1.155-02	1.588+00	4.561-07	1.906-03	3.963-07	7.710-04	1.962-05	2.697-03
8.000+06	2.055-04	1.021+00	1.996-04	5.113-01	1.445-02	1.547+00	3.491-07	1.734-03	3.390-07	8.685-04	2.454-05	2.628-03
9.000+06	1.624-04	9.386-01	1.743-04	5.634-01	1.722-02	1.520+00	2.759-07	1.594-03	2.961-07	9.570-04	2.925-05	2.581-03
1.000+07	1.315-04	8.696-01	1.547-04	6.106-01	1.986-02	1.500+00	2.234-07	1.477-03	2.628-07	1.037-03	3.373-05	2.548-03
1.100+07	1.087-04	8.111-01	1.390-04	6.534-01	2.237-02	1.487+00	1.846-07	1.378-03	2.361-07	1.110-03	3.800-05	2.526-03
1.200+07	9.135-05	7.607-01	1.261-04	6.927-01	2.473-02	1.478+00	1.552-07	1.292-03	2.142-07	1.177-03	4.201-05	2.511-03
1.300+07	7.784-05	7.166-01	1.155-04	7.291-01	2.697-02	1.473+00	1.322-07	1.217-03	1.962-07	1.238-03	4.581-05	2.502-03
1.400+07	6.712-05	6.780-01	1.065-04	7.630-01	2.910-02	1.470+00	1.140-07	1.152-03	1.809-07	1.296-03	4.943-05	2.497-03
1.500+07	5.847-05	6.437-01	9.875-05	7.946-01	3.112-02	1.470+00	9.932-08	1.093-03	1.677-07	1.350-03	5.286-05	2.496-03
1.600+07	5.139-05	6.130-01	9.207-05	8.243-01	3.304-02	1.470+00	8.729-08	1.041-03	1.564-07	1.400-03	5.612-05	2.499-03
1.800+07	4.060-05	5.602-01	8.109-05	8.786-01	3.662-02	1.476+00	6.896-08	9.516-04	1.377-07	1.492-03	6.220-05	2.506-03
2.000+07	3.289-05	5.166-01	7.245-05	9.272-01	3.989-02	1.484+00	5.587-08	8.775-04	1.231-07	1.575-03	6.776-05	2.520-03
2.200+07	2.718-05	4.798-01	6.546-05	9.711-01	4.289-02	1.494+00	4.617-08	8.158-04	1.112-07	1.650-03	7.285-05	2.538-03
2.400+07	2.284-05	4.484-01	5.971-05	1.011+00	4.566-02	1.505+00	3.880-08	7.617-04	1.016-07	1.717-03	7.756-05	2.557-03
2.600+07	1.946-05	4.211-01	5.488-05	1.048+00	4.823-02	1.517+00	3.305-08	7.153-04	9.322-08	1.780-03	8.192-05	2.577-03
2.800+07	1.678-05	3.972-01	5.077-05	1.081+00	5.062-02	1.529+00	2.850-08	6.747-04	8.626-08	1.836-03	8.598-05	2.597-03
3.000+07	1.462-05	3.761-01	4.723-05	1.112+00	5.285-02	1.541+00	2.483-08	6.388-04	8.022-08	1.889-03	8.977-05	2.618-03
4.000+07	8.222-06	2.989-01	3.503-05	1.241+00	6.219-02	1.602+00	1.397-08	5.077-04	5.950-08	2.108-03	1.056-04	2.721-03
5.000+07	5.262-06	2.495-01	2.783-05	1.337+00	6.939-02	1.656+00	8.938-09	4.238-04	4.727-08	2.271-03	1.179-04	2.813-03
6.000+07	3.654-06	2.150-01	2.309-05	1.412+00	7.517-02	1.702+00	6.207-09	3.652-04	3.922-08	2.398-03	1.277-04	2.891-03
8.000+07	2.055-06	1.695-01	1.722-05	1.522+00	8.402-02	1.776+00	3.491-09	2.879-04	2.925-08	2.585-03	1.427-04	3.016-03
1.000+08	1.315-06	1.407-01	1.373-05	1.602+00	9.059-02	1.833+00	2.234-09	2.390-04	2.332-08	2.721-03	1.539-04	3.114-03
1.500+08	5.846-07	1.002-01	9.109-06	1.732+00	1.017-01	1.934+00	9.930-10	1.702-04	1.547-08	2.942-03	1.727-04	3.285-03
2.000+08	3.288-07	7.856-02	6.816-06	1.812+00	1.089-01	1.999+00	5.585-10	1.334-04	1.158-08	3.078-03	1.850-04	3.396-03
3.000+08	1.462-07	5.568-02	4.533-06	1.906+00	1.180-01	2.080+00	2.483-10	9.458-05	7.700-09	3.238-03	2.004-04	3.533-03
4.000+08	8.221-08	4.361-02	3.396-06	1.960+00	1.235-01	2.127+00	1.396-10	7.408-05	5.768-09	3.329-03	2.098-04	3.613-03
5.000+08	5.262-08	3.610-02	2.715-06	1.997+00	1.273-01	2.160+00	8.938-11	6.132-05	4.612-09	3.392-03	2.162-04	3.670-03
6.000+08	3.654-08	3.091-02	2.261-06	2.023+00	1.302-01	2.184+00	6.207-11	5.250-05	3.841-09	3.436-03	2.212-04	3.710-03
8.000+08	2.055-08	2.414-02	1.695-06	2.058+00	1.341-01	2.216+00	3.491-11	4.100-05	2.879-09	3.496-03	2.278-04	3.765-03
1.000+09	1.315-08	1.986-02	1.356-06	2.081+00	1.367-01	2.238+00	2.234-11	3.373-05	2.303-09	3.535-03	2.322-04	3.801-03
1.500+09	5.846-09	1.387-02	9.033-07	2.114+00	1.407-01	2.269+00	9.930-12	2.356-05	1.534-09	3.591-03	2.390-04	3.853-03
2.000+09	3.288-09	1.073-02	6.773-07	2.132+00	1.429-01	2.286+00	5.585-12	1.823-05	1.150-09	3.621-03	2.427-04	3.882-03
3.000+09	1.462-09	7.664-03	4.514-07	2.157+00	1.454-01	2.304+00	2.483-12	1.268-05	7.667-10	3.654-03	2.470-04	3.913-03
4.000+09	8.221-10	5.761-03	3.385-07	2.162+00	1.469-01	2.315+00	1.396-12	9.786-06	5.750-10	3.672-03	2.495-04	3.932-03
5.000+09	5.262-10	4.710-03	2.708-07	2.169+00	1.478-01	2.322+00	8.938-13	8.000-06	4.600-10	3.684-03	2.511-04	3.943-03
6.000+09	3.654-10	3.994-03	2.257-07	2.173+00	1.484-01	2.325+00	6.207-13	6.784-06	3.834-10	3.691-03	2.521-04	3.950-03
8.000+09	2.055-10	3.078-03	1.692-07	2.180+00	1.492-01	2.332+00	3.491-13	5.228-06	2.874-10	3.703-03	2.534-04	3.962-03
1.000+10	1.315-10	2.513-03	1.354-07	2.183+00	1.497-01	2.335+00	2.234-13	4.269-06	2.300-10	3.708-03	2.543-04	3.967-03
1.500+10	5.846-11	1.736-03	9.026-08	2.189+00	1.505-01	2.341+00	9.930-14	2.949-06	1.533-10	3.718-03	2.556-04	3.977-03
2.000+10	3.288-11	1.335-03	6.769-08	2.192+00	1.509-01	2.344+00	5.585-14	2.268-06	1.150-10	3.723-03	2.563-04	3.982-03
3.000+10	1.462-11	9.207-04	4.513-08	2.195+00	1.513-01	2.347+00	2.483-14	1.564-06	7.666-11	3.728-03	2.570-04	3.987-03
4.000+10	8.221-12	7.068-04	3.384-08	2.196+00	1.515-01	2.348+00	1.396-14	1.201-06	5.748-11	3.730-03	2.573-04	3.989-03
5.000+10	5.262-12	5.756-04	2.707-08	2.197+00	1.517-01	2.349+00	8.938-15	9.777-07	4.598-11	3.732-03	2.577-04	3.990-03
6.000+10	3.654-12	4.866-04	2.256-08	2.198+00	1.518-01	2.350+00	6.207-15	8.265-07	3.832-11	3.734-03	2.578-04	3.992-03
8.000+10	2.055-12	3.731-04	1.692-08	2.199+00	1.519-01	2.351+00	3.491-15	6.337-07	2.874-11	3.735-03	2.580-04	3.994-03
1.000+11	1.315-12	3.035-04	1.354-08	2.199+00	1.520-01	2.351+00	2.234-15	5.155-07	2.300-11	3.735-03	2.582-04	3.994-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, Z=1 to 100—Continued

Z = 18, AR, ARGON ATOMIC WT. = 39.948 MSQ/KG = .00150747 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.531-02	3.801+00	5.632-03	0.000	0.000	3.822+00	2.308-05	5.730-03	8.490-06	0.000	0.000	5.761-03
1.022+06	1.466-02	3.761+00	5.389-03	0.000	0.000	3.781+00	2.210-05	5.670-03	8.124-06	0.000	0.000	5.700-03
1.250+06	9.804-03	3.400+00	3.651-03	2.826-03	0.000	3.416+00	1.478-05	5.125-03	5.504-06	4.260-06	0.000	5.150-03
1.500+06	6.811-03	3.090+00	2.639-03	1.507-02	0.000	3.115+00	1.027-05	4.658-03	3.978-06	2.272-05	0.000	4.695-03
2.000+06	3.833-03	2.638+00	1.639-03	5.880-02	0.000	2.702+00	5.778-06	3.977-03	2.471-06	8.864-05	0.000	4.074-03
2.044+06	3.669-03	2.605+00	1.584-03	6.336-02	0.000	2.674+00	5.531-06	3.927-03	2.388-06	9.551-05	0.000	4.030-03
3.000+06	1.704-03	2.076+00	8.991-04	1.658-01	7.263-04	2.245+00	2.569-06	3.130-03	1.355-06	2.499-04	1.095-06	3.384-03
4.000+06	9.585-04	1.731+00	6.101-04	2.670-01	2.965-03	2.003+00	1.445-06	2.609-03	9.197-07	4.025-04	4.470-06	3.019-03
5.000+06	6.135-04	1.495+00	4.590-04	3.568-01	5.908-03	1.859+00	9.248-07	2.254-03	6.919-07	5.379-04	8.906-06	2.802-03
6.000+06	4.260-04	1.322+00	3.669-04	4.371-01	9.073-03	1.769+00	6.422-07	1.993-03	5.531-07	6.589-04	1.368-05	2.667-03
7.000+06	3.130-04	1.188+00	3.052-04	5.086-01	1.223-02	1.709+00	4.718-07	1.791-03	4.601-07	7.667-04	1.844-05	2.577-03
8.000+06	2.397-04	1.081+00	2.610-04	5.729-01	1.530-02	1.670+00	3.613-07	1.630-03	3.934-07	8.636-04	2.306-05	2.517-03
9.000+06	1.894-04	9.938-01	2.279-04	6.311-01	1.823-02	1.644+00	2.855-07	1.498-03	3.436-07	9.514-04	2.748-05	2.478-03
1.000+07	1.534-04	9.208-01	2.022-04	6.839-01	2.103-02	1.626+00	2.312-07	1.388-03	3.048-07	1.031-03	3.170-05	2.451-03
1.100+07	1.268-04	8.588-01	1.817-04	7.318-01	2.368-02	1.615+00	1.911-07	1.295-03	2.739-07	1.103-03	3.570-05	2.434-03
1.200+07	1.065-04	8.054-01	1.649-04	7.757-01	2.618-02	1.608+00	1.605-07	1.214-03	2.486-07	1.169-03	3.947-05	2.423-03
1.300+07	9.076-05	7.588-01	1.509-04	8.164-01	2.855-02	1.604+00	1.368-07	1.144-03	2.275-07	1.231-03	4.304-05	2.418-03
1.400+07	7.825-05	7.178-01	1.391-04	8.543-01	3.080-02	1.603+00	1.180-07	1.082-03	2.097-07	1.288-03	4.643-05	2.417-03
1.500+07	6.817-05	6.815-01	1.290-04	8.897-01	3.294-02	1.604+00	1.028-07	1.027-03	1.945-07	1.341-03	4.966-05	2.418-03
1.600+07	5.991-05	6.490-01	1.203-04	9.229-01	3.497-02	1.607+00	9.031-08	9.783-04	1.813-07	1.391-03	5.272-05	2.423-03
1.800+07	4.734-05	5.932-01	1.059-04	9.836-01	3.876-02	1.616+00	7.136-08	8.942-04	1.596-07	1.483-03	5.843-05	2.436-03
2.000+07	3.834-05	5.470-01	9.463-05	1.038+00	4.221-02	1.627+00	5.780-08	8.246-04	1.427-07	1.565-03	6.363-05	2.453-03
2.200+07	3.169-05	5.081-01	8.550-05	1.087+00	4.539-02	1.641+00	4.777-08	7.659-04	1.289-07	1.639-03	6.842-05	2.473-03
2.400+07	2.663-05	4.748-01	7.797-05	1.132+00	4.832-02	1.655+00	4.014-08	7.157-04	1.175-07	1.706-03	7.284-05	2.495-03
2.600+07	2.269-05	4.458-01	7.166-05	1.172+00	5.103-02	1.669+00	3.420-08	6.720-04	1.080-07	1.767-03	7.693-05	2.516-03
2.800+07	1.956-05	4.205-01	6.629-05	1.210+00	5.356-02	1.684+00	2.949-08	6.339-04	9.993-08	1.824-03	8.074-05	2.539-03
3.000+07	1.704-05	3.982-01	6.167-05	1.245+00	5.591-02	1.699+00	2.569-08	6.003-04	9.297-08	1.877-03	8.428-05	2.561-03
4.000+07	9.586-06	3.164-01	4.573-05	1.388+00	6.577-02	1.770+00	1.445-08	4.770-04	6.894-08	2.092-03	9.915-05	2.669-03
5.000+07	6.135-06	2.642-01	3.633-05	1.495+00	7.337-02	1.833+00	9.248-09	3.983-04	5.477-08	2.254-03	1.106-04	2.763-03
6.000+07	4.260-06	2.276-01	3.014-05	1.578+00	7.947-02	1.885+00	6.422-09	3.431-04	4.544-08	2.379-03	1.198-04	2.842-03
8.000+07	2.396-06	1.795-01	2.247-05	1.702+00	8.880-02	1.970+00	3.612-09	2.706-04	3.387-08	2.566-03	1.339-04	2.970-03
1.000+08	1.534-06	1.490-01	1.791-05	1.791+00	9.573-02	2.036+00	2.312-09	2.246-04	2.700-08	2.700-03	1.443-04	3.069-03
1.500+08	6.816-07	1.061-01	1.189-05	1.936+00	1.075-01	2.150+00	1.027-09	1.599-04	1.792-08	2.918-03	1.621-04	3.240-03
2.000+08	3.834-07	8.318-02	8.894-06	2.024+00	1.150-01	2.222+00	5.780-10	1.254-04	1.341-08	3.051-03	1.734-04	3.350-03
3.000+08	1.704-07	5.896-02	5.915-06	2.129+00	1.245-01	2.312+00	2.569-10	8.888-05	8.917-09	3.209-03	1.877-04	3.486-03
4.000+08	9.586-08	4.617-02	4.431-06	2.190+00	1.302-01	2.366+00	1.445-10	6.960-05	6.680-09	3.301-03	1.963-04	3.567-03
5.000+08	6.135-08	3.822-02	3.542-06	2.230+00	1.342-01	2.402+00	9.248-11	5.762-05	5.339-09	3.362-03	2.023-04	3.622-03
6.000+08	4.260-08	3.273-02	2.951-06	2.259+00	1.372-01	2.429+00	6.422-11	4.934-05	4.449-09	3.405-03	2.068-04	3.662-03
8.000+08	2.396-08	2.556-02	2.212-06	2.298+00	1.412-01	2.465+00	3.612-11	3.853-05	3.335-09	3.464-03	2.129-04	3.716-03
1.000+09	1.534-08	2.103-02	1.769-06	2.323+00	1.440-01	2.488+00	2.312-11	3.170-05	2.667-09	3.502-03	2.171-04	3.751-03
1.500+09	6.816-09	1.469-02	1.179-06	2.360+00	1.480-01	2.523+00	1.027-11	2.214-05	1.777-09	3.558-03	2.231-04	3.803-03
2.000+09	3.834-09	1.137-02	8.837-07	2.380+00	1.503-01	2.542+00	5.780-12	1.714-05	1.332-09	3.588-03	2.266-04	3.831-03
3.000+09	1.704-09	7.903-03	5.890-07	2.402+00	1.529-01	2.563+00	2.569-12	1.191-05	8.879-10	3.621-03	2.305-04	3.863-03
4.000+09	9.586-10	6.100-03	4.417-07	2.414+00	1.544-01	2.575+00	1.445-12	9.196-06	6.658-10	3.639-03	2.328-04	3.881-03
5.000+09	6.135-10	4.988-03	3.533-07	2.421+00	1.553-01	2.581+00	9.248-13	7.519-06	5.326-10	3.650-03	2.341-04	3.891-03
6.000+09	4.260-10	4.229-03	2.944-07	2.426+00	1.559-01	2.586+00	6.422-13	6.375-06	4.438-10	3.657-03	2.350-04	3.899-03
8.000+09	2.396-10	3.259-03	2.208-07	2.433+00	1.568-01	2.593+00	3.612-13	4.913-06	3.328-10	3.668-03	2.364-04	3.909-03
1.000+10	1.534-10	2.660-03	1.766-07	2.437+00	1.573-01	2.597+00	2.312-13	4.010-06	2.662-10	3.674-03	2.371-04	3.915-03
1.500+10	6.816-11	1.839-03	1.178-07	2.443+00	1.580-01	2.603+00	1.027-13	2.772-06	1.776-10	3.683-03	2.382-04	3.924-03
2.000+10	3.834-11	1.414-03	8.832-08	2.447+00	1.585-01	2.607+00	5.780-14	2.132-06	1.331-10	3.689-03	2.389-04	3.930-03
3.000+10	1.704-11	9.748-04	5.888-08	2.450+00	1.589-01	2.610+00	2.569-14	1.469-06	8.876-11	3.693-03	2.395-04	3.934-03
4.000+10	9.586-12	7.484-04	4.416-08	2.452+00	1.591-01	2.612+00	1.445-14	1.128-06	6.657-11	3.696-03	2.398-04	3.937-03
5.000+10	6.135-12	6.095-04	3.533-08	2.453+00	1.593-01	2.613+00	9.248-15	9.188-07	5.326-11	3.698-03	2.401-04	3.939-03
6.000+10	4.260-12	5.152-04	2.944-08	2.453+00	1.594-01	2.613+00	6.422-15	7.766-07	4.438-11	3.698-03	2.403-04	3.939-03
8.000+10	2.396-12	3.950-04	2.208-08	2.454+00	1.595-01	2.614+00	3.612-15	5.955-07	3.328-11	3.699-03	2.404-04	3.940-03
1.000+11	1.534-12	3.214-04	1.766-08	2.455+00	1.596-01	2.615+00	2.312-15	4.845-07	2.662-11	3.701-03	2.406-04	3.942-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV $Z=1$ to 100—Continued

Z = 19, K = POTASSIUM ATOMIC WT. = 39.0983 MSO/KG = .00154023 BARNS/ATOM MULTIPLY MSO/KG BY 10 FOR CMSO/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSO/KG	MSO/KG	MSO/KG	MSO/KG	MSO/KG	[illegible]
1.000+06	1.763-02	4.011+00	7.301-03	0.000	0.000	4.036+00	2.715-05	6.178-03	1.125-05	0.000	0.000	[illegible]
1.022+06	1.688-02	3.969+00	6.987-03	0.000	0.000	3.993+00	2.600-05	6.113-03	1.076-05	0.000	0.000	[illegible]
1.250+06	1.129-02	3.588+00	4.731-03	3.185-03	0.000	3.607+00	1.739-05	5.526-03	7.287-06	4.906-06	0.000	[illegible]
1.500+06	7.844-03	3.262+00	3.419-03	1.689-02	0.000	3.290+00	1.208-05	5.024-03	5.266-06	2.601-05	0.000	[illegible]
2.000+06	4.414-03	2.784+00	2.121-03	6.577-02	0.000	2.856+00	6.799-06	4.288-03	3.267-06	1.013-04	0.000	[illegible]
2.044+06	4.226-03	2.750+00	2.050-03	7.086-02	0.000	2.827+00	6.509-06	4.236-03	3.157-06	1.091-04	0.000	[illegible]
3.000+06	1.962-03	2.191+00	1.162-03	1.850-01	7.666-04	2.380+00	3.022-06	3.375-03	1.790-06	2.849-04	1.181-06	[illegible]
4.000+06	1.104-03	1.828+00	7.877-04	2.977-01	3.130-03	2.131+00	1.700-06	2.816-03	1.213-06	4.585-04	4.821-06	[illegible]
5.000+06	7.066-04	1.578+00	5.923-04	3.976-01	6.236-03	1.983+00	1.088-06	2.430-03	9.123-07	6.124-04	9.605-06	[illegible]
6.000+06	4.907-04	1.395+00	4.732-04	4.869-01	9.576-03	1.892+00	7.558-07	2.149-03	7.288-07	7.490-04	1.475-05	[illegible]
7.000+06	3.605-04	1.254+00	3.935-04	5.663-01	1.291-02	1.834+00	5.553-07	1.931-03	6.051-07	8.722-04	1.988-05	[illegible]
8.000+06	2.760-04	1.141+00	3.364-04	6.378-01	1.614-02	1.796+00	4.251-07	1.757-03	5.181-07	9.824-04	2.486-05	2.766-03
9.000+06	2.181-04	1.049+00	2.937-04	7.025-01	1.924-02	1.771+00	3.359-07	1.616-03	4.524-07	1.082-03	2.963-05	2.728-03
1.000+07	1.767-04	9.719-01	2.605-04	7.612-01	2.219-02	1.756+00	2.722-07	1.497-03	4.012-07	1.172-03	3.418-05	2.704-03
1.100+07	1.460-04	9.065-01	2.340-04	8.145-01	2.499-02	1.746+00	2.249-07	1.396-03	3.604-07	1.255-03	3.849-05	2.690-03
1.200+07	1.227-04	8.502-01	2.123-04	8.633-01	2.763-02	1.741+00	1.891-07	1.310-03	3.270-07	1.330-03	4.256-05	2.682-03
1.300+07	1.045-04	8.009-01	1.943-04	9.086-01	3.012-02	1.740+00	1.611-07	1.234-03	2.993-07	1.399-03	4.639-05	2.680-03
1.400+07	9.013-05	7.577-01	1.791-04	9.506-01	3.250-02	1.741+00	1.388-07	1.167-03	2.759-07	1.464-03	5.006-05	2.682-03
1.500+07	7.851-05	7.194-01	1.661-04	9.899-01	3.475-02	1.744+00	1.209-07	1.108-03	2.558-07	1.525-03	5.352-05	2.687-03
1.600+07	6.901-05	6.851-01	1.548-04	1.027+00	3.690-02	1.749+00	1.063-07	1.055-03	2.384-07	1.582-03	5.683-05	2.694-03
1.800+07	5.452-05	6.261-01	1.363-04	1.094+00	4.089-02	1.761+00	8.397-08	9.643-04	2.099-07	1.685-03	6.298-05	2.713-03
2.000+07	4.416-05	5.774-01	1.218-04	1.155+00	4.453-02	1.777+00	6.802-08	8.893-04	1.876-07	1.779-03	6.859-05	2.737-03
2.200+07	3.650-05	5.363-01	1.100-04	1.209+00	4.788-02	1.793+00	5.622-08	8.260-04	1.694-07	1.862-03	7.375-05	2.762-03
2.400+07	3.067-05	5.011-01	1.003-04	1.259+00	5.097-02	1.811+00	4.721-08	7.718-04	1.545-07	1.939-03	7.851-05	2.790-03
2.600+07	2.613-05	4.706-01	9.221-05	1.304+00	5.383-02	1.829+00	4.025-08	7.248-04	1.420-07	2.008-03	8.291-05	2.816-03
2.800+07	2.253-05	4.439-01	8.529-05	1.346+00	5.649-02	1.846+00	3.470-08	6.837-04	1.314-07	2.073-03	8.701-05	2.844-03
3.000+07	1.963-05	4.203-01	7.934-05	1.384+00	5.897-02	1.863+00	3.023-08	6.474-04	1.222-07	2.132-03	9.083-05	2.870-03
4.000+07	1.104-05	3.340-01	5.882-05	1.543+00	6.935-02	1.946+00	1.700-08	5.144-04	9.050-08	2.377-03	1.068-04	2.998-03
5.000+07	7.066-06	2.788-01	4.673-05	1.662+00	7.734-02	2.018+00	1.083-08	4.294-04	7.196-08	2.560-03	1.191-04	3.108-03
6.000+07	4.907-06	2.402-01	3.876-05	1.754+00	8.376-02	2.078+00	7.558-09	3.700-04	5.970-08	2.702-03	1.290-04	3.201-03
8.000+07	2.760-06	1.895-01	2.890-05	1.891+00	9.357-02	2.174+00	4.251-09	2.919-04	4.451-08	2.913-03	1.441-04	3.349-03
1.000+08	1.766-06	1.573-01	2.303-05	1.990+00	1.009-01	2.248+00	2.720-09	2.423-04	3.547-08	3.065-03	1.554-04	3.443-03
1.500+08	7.851-07	1.120-01	1.528-05	2.150+00	1.132-01	2.375+00	1.209-09	1.725-04	2.353-08	3.311-03	1.744-04	3.658-03
2.000+08	4.416-07	8.780-02	1.143-05	2.248+00	1.211-01	2.457+00	6.802-10	1.352-04	1.760-08	3.462-03	1.865-04	3.784-03
3.000+08	1.963-07	6.223-02	7.605-06	2.364+00	1.311-01	2.557+00	3.023-10	9.585-05	1.171-08	3.641-03	2.019-04	3.939-03
4.000+08	1.104-07	4.874-02	5.697-06	2.432+00	1.371-01	2.618+00	1.700-10	7.507-05	8.775-09	3.746-03	2.112-04	4.032-03
5.000+08	7.066-08	4.035-02	4.554-06	2.476+00	1.414-01	2.658+00	1.088-10	6.215-05	7.014-09	3.814-03	2.178-04	4.094-03
6.000+08	4.907-08	3.454-02	3.793-06	2.509+00	1.445-01	2.688+00	7.558-11	5.320-05	5.842-09	3.864-03	2.226-04	4.140-03
8.000+08	2.760-08	2.698-02	2.843-06	2.552+00	1.489-01	2.728+00	4.251-11	4.156-05	4.379-09	3.931-03	2.293-04	4.202-03
1.000+09	1.766-08	2.220-02	2.274-06	2.580+00	1.518-01	2.754+00	2.720-11	3.419-05	3.502-09	3.974-03	2.338-04	4.242-03
1.500+09	7.851-09	1.550-02	1.515-06	2.621+00	1.563-01	2.793+00	1.209-11	2.387-05	2.333-09	4.037-03	2.407-04	4.302-03
2.000+09	4.416-09	1.200-02	1.136-06	2.644+00	1.589-01	2.815+00	6.802-12	1.848-05	1.750-09	4.072-03	2.447-04	4.336-03
3.000+09	1.963-09	8.342-03	7.572-07	2.668+00	1.617-01	2.838+00	3.023-12	1.285-05	1.166-09	4.109-03	2.491-04	4.371-03
4.000+09	1.104-09	6.439-03	5.679-07	2.681+00	1.634-01	2.851+00	1.700-12	9.918-06	8.747-10	4.129-03	2.517-04	4.391-03
5.000+09	7.066-10	5.265-03	4.542-07	2.689+00	1.644-01	2.859+00	1.088-12	8.109-06	6.996-10	4.142-03	2.532-04	4.403-03
6.000+09	4.907-10	4.464-03	3.785-07	2.695+00	1.651-01	2.865+00	7.558-13	6.876-06	5.830-10	4.151-03	2.543-04	4.412-03
8.000+09	2.760-10	3.440-03	2.839-07	2.703+00	1.661-01	2.873+00	4.251-13	5.298-06	4.373-10	4.163-03	2.558-04	4.424-03
1.000+10	1.766-10	2.808-03	2.271-07	2.708+00	1.667-01	2.878+00	2.720-13	4.325-06	3.498-10	4.171-03	2.568-04	4.432-03
1.500+10	7.851-11	1.941-03	1.514-07	2.714+00	1.676-01	2.884+00	1.209-13	2.990-06	2.332-10	4.180-03	2.581-04	4.441-03
2.000+10	4.416-11	1.492-03	1.135-07	2.718+00	1.681-01	2.888+00	6.802-14	2.298-06	1.748-10	4.186-03	2.589-04	4.448-03
3.000+10	1.963-11	1.029-03	7.569-08	2.722+00	1.686-01	2.892+00	3.023-14	1.585-06	1.166-10	4.193-03	2.597-04	4.454-03
4.000+10	1.104-11	7.900-04	5.677-08	2.724+00	1.689-01	2.894+00	1.700-14	1.217-06	8.744-11	4.196-03	2.601-04	4.457-03
5.000+10	7.066-12	6.433-04	4.541-08	2.725+00	1.691-01	2.895+00	1.088-14	9.908-07	6.994-11	4.197-03	2.605-04	4.459-03
6.000+10	4.907-12	5.438-04	3.784-08	2.726+00	1.692-01	2.896+00	7.558-15	8.376-07	5.828-11	4.199-03	2.606-04	4.460-03
8.000+10	2.760-12	4.170-04	2.838-08	2.727+00	1.693-01	2.897+00	4.251-15	6.423-07	4.371-11	4.200-03	2.608-04	4.462-03
1.000+11	1.766-12	3.392-04	2.271-08	2.727+00	1.694-01	2.897+00	2.720-15	5.224-07	3.498-11	4.200-03	2.609-04	4.462-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 20, CA, CALCIUM ATOMIC WT. = 40.08 MSQ/KG = .00150251 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	2.011-02	4.222+00	9.333-03	0.000	0.000	4.251+00	3.022-05	6.344-03	1.402-05	0.000	0.000	6.388-03
1.022+06	1.926-02	4.178+00	8.931-03	0.000	0.000	4.206+00	2.894-05	6.277-03	1.342-05	0.000	0.000	6.320-03
1.250+06	1.288-02	3.777+00	6.047-03	3.569-03	0.000	3.799+00	1.935-05	5.675-03	9.086-06	5.362-06	0.000	5.709-03
1.500+06	8.949-03	3.433+00	4.369-03	1.878-02	0.000	3.465+00	1.345-05	5.158-03	6.564-06	2.822-05	0.000	5.206-03
2.000+06	5.036-03	2.930+00	2.708-03	7.323-02	0.000	3.011+00	7.567-06	4.402-03	4.069-06	1.100-04	0.000	4.524-03
2.044+06	4.822-03	2.894+00	2.617-03	7.891-02	0.000	2.980+00	7.245-06	4.348-03	3.932-06	1.186-04	0.000	4.478-03
3.000+06	2.239-03	2.306+00	1.482-03	2.053-01	8.070-04	2.516+00	3.364-06	3.465-03	2.227-06	3.085-04	1.213-06	3.780-03
4.000+06	1.260-03	1.924+00	1.003-03	3.300-01	3.295-03	2.260+00	1.893-06	2.891-03	1.507-06	4.958-04	4.951-06	3.395-03
5.000+06	8.062-04	1.661+00	7.539-04	4.405-01	6.564-03	2.110+00	1.211-06	2.496-03	1.133-06	6.619-04	9.862-06	3.170-03
6.000+06	5.599-04	1.469+00	6.021-04	5.393-01	1.008-02	2.020+00	8.413-07	2.207-03	9.047-07	8.103-04	1.515-05	3.034-03
7.000+06	4.113-04	1.320+00	5.004-04	6.271-01	1.359-02	1.962+00	6.180-07	1.983-03	7.519-07	9.422-04	2.042-05	2.947-03
8.000+06	3.149-04	1.201+00	4.278-04	7.062-01	1.699-02	1.925+00	4.731-07	1.805-03	6.428-07	1.061-03	2.553-05	2.892-03
9.000+06	2.488-04	1.104+00	3.733-04	7.777-01	2.025-02	1.903+00	3.738-07	1.659-03	5.609-07	1.168-03	3.043-05	2.859-03
1.000+07	2.016-04	1.023+00	3.310-04	8.426-01	2.335-02	1.889+00	3.029-07	1.537-03	4.973-07	1.266-03	3.508-05	2.839-03
1.100+07	1.666-04	9.543-01	2.973-04	9.015-01	2.630-02	1.883+00	2.503-07	1.434-03	4.467-07	1.355-03	3.952-05	2.829-03
1.200+07	1.400-04	8.949-01	2.698-04	9.554-01	2.907-02	1.880+00	2.104-07	1.345-03	4.054-07	1.435-03	4.368-05	2.824-03
1.300+07	1.193-04	8.431-01	2.469-04	1.005+00	3.170-02	1.880+00	1.792-07	1.267-03	3.710-07	1.510-03	4.763-05	2.825-03
1.400+07	1.028-04	7.976-01	2.275-04	1.052+00	3.420-02	1.884+00	1.545-07	1.198-03	3.418-07	1.581-03	5.139-05	2.831-03
1.500+07	8.958-05	7.572-01	2.110-04	1.095+00	3.657-02	1.889+00	1.346-07	1.138-03	3.170-07	1.645-03	5.495-05	2.838-03
1.600+07	7.874-05	7.211-01	1.967-04	1.136+00	3.883-02	1.896+00	1.183-07	1.083-03	2.955-07	1.707-03	5.834-05	2.849-03
1.800+07	6.221-05	6.591-01	1.731-04	1.211+00	4.302-02	1.913+00	9.347-08	9.903-04	2.601-07	1.820-03	6.464-05	2.875-03
2.000+07	5.039-05	6.078-01	1.546-04	1.277+00	4.685-02	1.932+00	7.571-08	9.132-04	2.323-07	1.919-03	7.039-05	2.903-03
2.200+07	4.165-05	5.645-01	1.397-04	1.337+00	5.037-02	1.952+00	6.258-08	8.482-04	2.099-07	2.009-03	7.568-05	2.933-03
2.400+07	3.499-05	5.275-01	1.274-04	1.392+00	5.361-02	1.973+00	5.257-08	7.926-04	1.914-07	2.091-03	8.055-05	2.965-03
2.600+07	2.982-05	4.953-01	1.170-04	1.442+00	5.662-02	1.994+00	4.480-08	7.442-04	1.758-07	2.167-03	8.507-05	2.996-03
2.800+07	2.571-05	4.673-01	1.083-04	1.489+00	5.941-02	2.016+00	3.863-08	7.021-04	1.627-07	2.237-03	8.926-05	3.029-03
3.000+07	2.240-05	4.425-01	1.007-04	1.531+00	6.202-02	2.036+00	3.366-08	6.649-04	1.513-07	2.300-03	9.319-05	3.059-03
4.000+07	1.260-05	3.516-01	7.464-05	1.706+00	7.292-02	2.131+00	1.893-08	5.283-04	1.121-07	2.563-03	1.096-04	3.201-03
5.000+07	8.063-06	2.935-01	5.929-05	1.836+00	8.131-02	2.211+00	1.211-08	4.410-04	8.908-08	2.759-03	1.222-04	3.322-03
6.000+07	5.599-06	2.529-01	4.917-05	1.938+00	8.804-02	2.279+00	8.413-09	3.800-04	7.388-08	2.912-03	1.323-04	3.424-03
8.000+07	3.149-06	1.994-01	3.666-05	2.090+00	9.834-02	2.388+00	4.731-09	2.996-04	5.508-08	3.140-03	1.478-04	3.588-03
1.000+08	2.016-06	1.655-01	2.922-05	2.199+00	1.060-01	2.471+00	3.029-09	2.487-04	4.390-08	3.304-03	1.593-04	3.712-03
1.500+08	8.958-07	1.179-01	1.939-05	2.376+00	1.189-01	2.613+00	1.346-09	1.771-04	2.913-08	3.578-03	1.786-04	3.926-03
2.000+08	5.039-07	9.242-02	1.450-05	2.484+00	1.272-01	2.704+00	7.571-10	1.389-04	2.179-08	3.732-03	1.911-04	4.062-03
3.000+08	2.239-07	6.551-02	9.646-06	2.611+00	1.377-01	2.814+00	3.364-10	9.843-05	1.449-08	3.923-03	2.069-04	4.228-03
4.000+08	1.260-07	5.130-02	7.226-06	2.686+00	1.441-01	2.881+00	1.893-10	7.708-05	1.086-08	4.036-03	2.165-04	4.329-03
5.000+08	8.062-08	4.247-02	5.777-06	2.736+00	1.486-01	2.927+00	1.211-10	6.381-05	8.680-09	4.111-03	2.233-04	4.398-03
6.000+08	5.599-08	3.636-02	4.811-06	2.772+00	1.519-01	2.960+00	8.413-11	5.463-05	7.229-09	4.165-03	2.282-04	4.448-03
8.000+08	3.149-08	2.840-02	3.606-06	2.820+00	1.566-01	3.005+00	4.731-11	4.267-05	5.418-09	4.237-03	2.353-04	4.515-03
1.000+09	2.015-08	2.336-02	2.884-06	2.851+00	1.598-01	3.034+00	3.028-11	3.510-05	4.333-09	4.284-03	2.401-04	4.559-03
1.500+09	8.958-09	1.632-02	1.922-06	2.897+00	1.646-01	3.078+00	1.346-11	2.452-05	2.888-09	4.353-03	2.473-04	4.625-03
2.000+09	5.039-09	1.263-02	1.441-06	2.922+00	1.674-01	3.102+00	7.571-12	1.898-05	2.165-09	4.390-03	2.515-04	4.661-03
3.000+09	2.239-09	8.781-03	9.604-07	2.949+00	1.705-01	3.128+00	3.364-12	1.319-05	1.443-09	4.431-03	2.562-04	4.700-03
4.000+09	1.260-09	6.778-03	7.202-07	2.964+00	1.723-01	3.143+00	1.893-12	1.018-05	1.082-09	4.453-03	2.589-04	4.722-03
5.000+09	8.062-10	5.542-03	5.761-07	2.973+00	1.734-01	3.152+00	1.211-12	8.327-06	8.656-10	4.467-03	2.605-04	4.736-03
6.000+09	5.599-10	4.699-03	4.801-07	2.979+00	1.742-01	3.158+00	8.413-13	7.060-06	7.214-10	4.476-03	2.617-04	4.745-03
8.000+09	3.149-10	3.621-03	3.600-07	2.988+00	1.753-01	3.167+00	4.731-13	5.441-06	5.409-10	4.489-03	2.634-04	4.758-03
1.000+10	2.015-10	2.956-03	2.880-07	2.993+00	1.760-01	3.172+00	3.028-13	4.441-06	4.327-10	4.497-03	2.644-04	4.766-03
1.500+10	8.958-11	2.043-03	1.920-07	3.001+00	1.769-01	3.180+00	1.346-13	3.070-06	2.885-10	4.509-03	2.658-04	4.778-03
2.000+10	5.039-11	1.571-03	1.440-07	3.005+00	1.775-01	3.184+00	7.571-14	2.360-06	2.164-10	4.515-03	2.667-04	4.784-03
3.000+10	2.239-11	1.083-03	9.600-08	3.009+00	1.780-01	3.188+00	3.364-14	1.627-06	1.442-10	4.521-03	2.674-04	4.790-03
4.000+10	1.260-11	8.316-04	7.200-08	3.011+00	1.783-01	3.190+00	1.893-14	1.249-06	1.082-10	4.524-03	2.679-04	4.793-03
5.000+10	8.062-12	6.772-04	5.760-08	3.012+00	1.785-01	3.191+00	1.211-14	1.017-06	8.654-11	4.526-03	2.682-04	4.795-03
6.000+10	5.599-12	5.724-04	4.800-08	3.013+00	1.786-01	3.192+00	8.413-15	8.600-07	7.212-11	4.527-03	2.683-04	4.796-03
8.000+10	3.149-12	4.389-04	3.600-08	3.015+00	1.788-01	3.194+00	4.731-15	6.594-07	5.409-11	4.530-03	2.686-04	4.799-03
1.000+11	2.015-12	3.571-04	2.880-08	3.015+00	1.789-01	3.194+00	3.028-15	5.365-07	4.327-11	4.530-03	2.688-04	4.799-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, Z=1 to 100—Continued

Z = 21, SC, SCANDIUM ATOMIC WT. = 44.9559 MSQ/KG = .00133954 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	2.289-02	4.433+00	1.178-02	0.000	0.000	4.468+00	3.066-05	5.938-03	1.578-05	0.000	0.000	5.985-03
1.022+06	2.192-02	4.386+00	1.127-02	0.000	0.000	4.419+00	2.936-05	5.875-03	1.510-05	0.000	0.000	5.920-03
1.250+06	1.466-02	3.965+00	7.629-03	3.983-03	0.000	3.991+00	1.964-05	5.311-03	1.022-05	5.335-06	0.000	5.346-03
1.500+06	1.019-02	3.605+00	5.511-03	2.083-02	0.000	3.642+00	1.365-05	4.829-03	7.382-06	2.790-05	0.000	4.878-03
2.000+06	5.733-03	3.077+00	3.413-03	8.107-02	0.000	3.167+00	7.680-06	4.122-03	4.572-06	1.086-04	0.000	4.243-03
2.044+06	5.489-03	3.039+00	3.297-03	8.736-02	0.000	3.135+00	7.353-06	4.071-03	4.416-06	1.170-04	0.000	4.200-03
3.000+06	2.549-03	2.421+00	1.864-03	2.267-01	8.473-04	2.653+00	3.415-06	3.243-03	2.497-06	3.037-04	1.135-06	3.554-03
4.000+06	1.434-03	2.020+00	1.261-03	3.640-01	3.659-03	2.390+00	1.921-06	2.706-03	1.689-06	4.876-04	4.633-06	3.202-03
5.000+06	9.178-04	1.744+00	9.472-04	4.857-01	6.892-03	2.238+00	1.229-06	2.336-03	1.269-06	6.506-04	9.232-06	2.999-03
6.000+06	6.373-04	1.542+00	7.561-04	5.944-01	1.058-02	2.148+00	8.537-07	2.066-03	1.013-06	7.962-04	1.417-05	2.878-03
7.000+06	4.683-04	1.386+00	6.282-04	6.910-01	1.427-02	2.092+00	6.273-07	1.857-03	8.415-07	9.256-04	1.912-05	2.803-03
8.000+06	3.585-04	1.261+00	5.368-04	7.780-01	1.784-02	2.058+00	4.802-07	1.689-03	7.191-07	1.042-03	2.390-05	2.756-03
9.000+06	2.833-04	1.159+00	4.684-04	8.567-01	2.126-02	2.038+00	3.795-07	1.553-03	6.274-07	1.148-03	2.848-05	2.730-03
1.000+07	2.294-04	1.074+00	4.153-04	9.280-01	2.452-02	2.027+00	3.073-07	1.439-03	5.563-07	1.243-03	3.285-05	2.715-03
1.100+07	1.896-04	1.002+00	3.729-04	9.928-01	2.760-02	2.023+00	2.540-07	1.342-03	4.995-07	1.330-03	3.697-05	2.710-03
1.200+07	1.593-04	9.396-01	3.383-04	1.052+00	3.052-02	2.023+00	2.134-07	1.259-03	4.532-07	1.409-03	4.088-05	2.709-03
1.300+07	1.358-04	8.852-01	3.095-04	1.107+00	3.327-02	2.026+00	1.819-07	1.186-03	4.146-07	1.483-03	4.457-05	2.714-03
1.400+07	1.171-04	8.375-01	2.853-04	1.156+00	3.590-02	2.032+00	1.569-07	1.122-03	3.822-07	1.551-03	4.809-05	2.722-03
1.500+07	1.020-04	7.951-01	2.645-04	1.206+00	3.838-02	2.040+00	1.366-07	1.065-03	3.543-07	1.615-03	5.141-05	2.732-03
1.600+07	8.963-05	7.572-01	2.465-04	1.251+00	4.075-02	2.049+00	1.201-07	1.014-03	3.302-07	1.676-03	5.459-05	2.745-03
1.800+07	7.082-05	6.920-01	2.170-04	1.333+00	4.515-02	2.070+00	9.487-08	9.270-04	2.907-07	1.786-03	6.048-05	2.773-03
2.000+07	5.736-05	6.382-01	1.938-04	1.406+00	4.917-02	2.094+00	7.684-08	8.549-04	2.596-07	1.883-03	6.587-05	2.804-03
2.200+07	4.741-05	5.928-01	1.751-04	1.472+00	5.286-02	2.118+00	6.351-08	7.941-04	2.346-07	1.972-03	7.081-05	2.837-03
2.400+07	3.984-05	5.539-01	1.596-04	1.532+00	5.626-02	2.142+00	5.337-08	7.420-04	2.138-07	2.052-03	7.536-05	2.870-03
2.600+07	3.394-05	5.201-01	1.467-04	1.587+00	5.941-02	2.167+00	4.546-08	6.967-04	1.965-07	2.126-03	7.958-05	2.902-03
2.800+07	2.927-05	4.906-01	1.356-04	1.638+00	6.234-02	2.191+00	3.921-08	6.572-04	1.816-07	2.194-03	8.351-05	2.935-03
3.000+07	2.550-05	4.646-01	1.262-04	1.685+00	6.507-02	2.215+00	3.416-08	6.224-04	1.691-07	2.257-03	8.716-05	2.967-03
4.000+07	1.434-05	3.692-01	9.350-05	1.877+00	7.649-02	2.323+00	1.921-08	4.946-04	1.252-07	2.514-03	1.025-04	3.111-03
5.000+07	9.178-06	3.082-01	7.426-05	2.020+00	8.527-02	2.414+00	1.229-08	4.128-04	9.947-08	2.706-03	1.142-04	3.233-03
6.000+07	6.374-06	2.655-01	6.159-05	2.132+00	9.232-02	2.490+00	8.538-09	3.556-04	8.250-08	2.856-03	1.237-04	3.335-03
8.000+07	3.585-06	2.094-01	4.591-05	2.298+00	1.031-01	2.611+00	4.802-09	2.805-04	6.150-08	3.078-03	1.381-04	3.497-03
1.000+08	2.294-06	1.738-01	3.659-05	2.418+00	1.111-01	2.703+00	3.073-09	2.328-04	4.901-08	3.239-03	1.488-04	3.621-03
1.500+08	1.020-06	1.238-01	2.428-05	2.612+00	1.246-01	2.860+00	1.366-09	1.658-04	3.252-08	3.499-03	1.669-04	3.832-03
2.000+08	5.736-07	9.705-02	1.816-05	2.731+00	1.333-01	2.961+00	7.684-10	1.300-04	2.433-08	3.658-03	1.786-04	3.967-03
3.000+08	2.549-07	6.878-02	1.208-05	2.871+00	1.441-01	3.084+00	3.415-10	9.213-05	1.618-08	3.846-03	1.930-04	4.131-03
4.000+08	1.434-07	5.387-02	9.047-06	2.952+00	1.508-01	3.157+00	1.921-10	7.216-05	1.212-08	3.954-03	2.020-04	4.229-03
5.000+08	9.178-08	4.459-02	7.232-06	3.007+00	1.555-01	3.207+00	1.229-10	5.973-05	9.688-09	4.028-03	2.083-04	4.296-03
6.000+08	6.373-08	3.818-02	6.024-06	3.046+00	1.589-01	3.243+00	8.537-11	5.114-05	8.069-09	4.086-03	2.129-04	4.344-03
8.000+08	3.585-08	2.982-02	4.515-06	3.099+00	1.638-01	3.293+00	4.802-11	3.995-05	6.048-09	4.151-03	2.194-04	4.411-03
1.000+09	2.294-08	2.453-02	3.611-06	3.133+00	1.670-01	3.325+00	3.073-11	3.286-05	4.837-09	4.197-03	2.237-04	4.453-03
1.500+09	1.020-08	1.713-02	2.406-06	3.183+00	1.720-01	3.372+00	1.366-11	2.295-05	3.223-09	4.264-03	2.304-04	4.517-03
2.000+09	5.736-09	1.326-02	1.804-06	3.210+00	1.749-01	3.398+00	7.684-12	1.776-05	2.417-09	4.300-03	2.343-04	4.552-03
3.000+09	2.549-09	9.220-03	1.202-06	3.239+00	1.780-01	3.426+00	3.415-12	1.235-05	1.610-09	4.339-03	2.384-04	4.590-03
4.000+09	1.434-09	7.117-03	9.017-07	3.255+00	1.799-01	3.442+00	1.921-12	9.534-06	1.208-09	4.360-03	2.410-04	4.611-03
5.000+09	9.178-10	5.819-03	7.213-07	3.266+00	1.810-01	3.453+00	1.229-12	7.795-06	9.662-10	4.375-03	2.425-04	4.625-03
6.000+09	6.373-10	4.934-03	6.011-07	3.273+00	1.819-01	3.460+00	8.537-13	6.609-06	8.052-10	4.384-03	2.437-04	4.635-03
8.000+09	3.585-10	3.802-03	4.508-07	3.282+00	1.830-01	3.469+00	4.802-13	5.093-06	6.039-10	4.396-03	2.451-04	4.647-03
1.000+10	2.294-10	3.104-03	3.606-07	3.288+00	1.837-01	3.475+00	3.073-13	4.158-06	4.830-10	4.404-03	2.461-04	4.655-03
1.500+10	1.020-10	2.145-03	2.404-07	3.296+00	1.846-01	3.483+00	1.366-13	2.873-06	3.220-10	4.415-03	2.473-04	4.665-03
2.000+10	5.736-11	1.649-03	1.803-07	3.300+00	1.852-01	3.487+00	7.684-14	2.209-06	2.415-10	4.420-03	2.481-04	4.671-03
3.000+10	2.549-11	1.137-03	1.202-07	3.305+00	1.857-01	3.492+00	3.415-14	1.523-06	1.610-10	4.427-03	2.488-04	4.677-03
4.000+10	1.434-11	8.732-04	9.014-08	3.307+00	1.861-01	3.494+00	1.921-14	1.170-06	1.207-10	4.430-03	2.493-04	4.680-03
5.000+10	9.178-12	7.110-04	7.211-08	3.309+00	1.863-01	3.496+00	1.229-14	9.524-07	9.659-11	4.433-03	2.496-04	4.683-03
6.000+10	6.373-12	6.010-04	6.009-08	3.310+00	1.864-01	3.497+00	8.537-15	8.051-07	8.049-11	4.434-03	2.497-04	4.684-03
8.000+10	3.585-12	4.609-04	4.507-08	3.311+00	1.865-01	3.498+00	4.802-15	6.174-07	6.037-11	4.435-03	2.498-04	[illegible]
1.000+11	2.294-12	3.749-04	3.605-08	3.312+00	1.867-01	3.499+00	3.073-15	5.022-07	[illegible]	[illegible]	2.501-04	4.687-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 22, TI, TITANIUM ATOMIC WT. = 47.88 MSQ/KG = .00125774 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	2.590-02	4.643+00	1.469-02	0.000	0.000	4.684+00	3.258-05	5.840-03	1.848-05	0.000	0.000	5.891-03
1.022+06	2.480-02	4.594+00	1.406-02	0.000	0.000	4.633+00	3.119-05	5.778-03	1.768-05	0.000	0.000	5.827-03
1.250+06	1.659-02	4.154+00	9.516-03	4.427-03	0.000	4.185+00	2.087-05	5.225-03	1.197-05	5.568-06	0.000	5.263-03
1.500+06	1.153-02	3.776+00	6.871-03	2.302-02	0.000	3.817+00	1.450-05	4.749-03	8.642-06	2.895-05	0.000	4.801-03
2.000+06	6.488-03	3.223+00	4.251-03	8.934-02	0.000	3.323+00	8.160-06	4.054-03	5.347-06	1.124-04	0.000	4.180-03
2.044+06	6.212-03	3.184+00	4.107-03	9.626-02	0.000	3.291+00	7.813-06	4.005-03	5.166-06	1.211-04	0.000	4.139-03
3.000+06	2.885-03	2.537+00	2.320-03	2.492-01	8.876-04	2.792+00	3.629-06	3.191-03	2.918-06	3.134-04	1.116-06	3.512-03
4.000+06	1.623-03	2.116+00	1.568-03	3.998-01	3.624-03	2.523+00	2.041-06	2.661-03	1.972-06	5.028-04	4.558-06	3.173-03
5.000+06	1.039-03	1.828+00	1.177-03	5.331-01	7.220-03	2.371+00	1.307-06	2.299-03	1.480-06	6.705-04	9.081-06	2.982-03
6.000+06	7.214-04	1.615+00	9.388-04	6.522-01	1.109-02	2.280+00	9.073-07	2.031-03	1.181-06	8.203-04	1.395-05	2.868-03
7.000+06	5.300-04	1.452+00	7.797-04	7.580-01	1.494-02	2.226+00	6.666-07	1.826-03	9.807-07	9.534-04	1.879-05	2.800-03
8.000+06	4.058-04	1.321+00	6.661-04	8.532-01	1.868-02	2.194+00	5.104-07	1.661-03	8.378-07	1.073-03	2.349-05	2.759-03
9.000+06	3.206-04	1.215+00	5.810-04	9.394-01	2.227-02	2.178+00	4.032-07	1.528-03	7.307-07	1.182-03	2.801-05	2.739-03
1.000+07	2.597-04	1.125+00	5.151-04	1.017+00	2.568-02	2.168+00	3.266-07	1.415-03	6.479-07	1.279-03	3.230-05	2.727-03
1.100+07	2.146-04	1.050+00	4.624-04	1.088+00	2.891-02	2.168+00	2.699-07	1.321-03	5.816-07	1.368-03	3.636-05	2.726-03
1.200+07	1.803-04	9.844-01	4.195-04	1.153+00	3.196-02	2.170+00	2.268-07	1.238-03	5.276-07	1.450-03	4.020-05	2.729-03
1.300+07	1.537-04	9.274-01	3.838-04	1.214+00	3.484-02	2.177+00	1.933-07	1.166-03	4.827-07	1.527-03	4.382-05	2.738-03
1.400+07	1.325-04	8.774-01	3.536-04	1.269+00	3.759-02	2.184+00	1.667-07	1.104-03	4.447-07	1.596-03	4.728-05	2.747-03
1.500+07	1.154-04	8.330-01	3.278-04	1.322+00	4.020-02	2.196+00	1.451-07	1.048-03	4.123-07	1.663-03	5.056-05	2.762-03
1.600+07	1.014-04	7.932-01	3.055-04	1.371+00	4.268-02	2.207+00	1.275-07	9.976-04	3.842-07	1.724-03	5.368-05	2.776-03
1.800+07	8.015-05	7.250-01	2.689-04	1.460+00	4.728-02	2.233+00	1.008-07	9.119-04	3.382-07	1.836-03	5.947-05	2.808-03
2.000+07	6.493-05	6.685-01	2.401-04	1.541+00	5.148-02	2.261+00	8.166-08	8.408-04	3.020-07	1.938-03	6.475-05	2.844-03
2.200+07	5.366-05	6.210-01	2.169-04	1.613+00	5.534-02	2.290+00	6.749-08	7.811-04	2.728-07	2.029-03	6.960-05	2.880-03
2.400+07	4.509-05	5.803-01	1.977-04	1.679+00	5.890-02	2.318+00	5.671-08	7.299-04	2.487-07	2.112-03	7.408-05	2.916-03
2.600+07	3.842-05	5.449-01	1.817-04	1.739+00	6.219-02	2.346+00	4.832-08	6.853-04	2.265-07	2.187-03	7.822-05	2.951-03
2.800+07	3.313-05	5.140-01	1.680-04	1.795+00	6.526-02	2.374+00	4.167-08	6.465-04	2.113-07	2.258-03	8.208-05	2.986-03
3.000+07	2.886-05	4.867-01	1.563-04	1.846+00	6.812-02	2.401+00	3.630-08	6.121-04	1.966-07	2.322-03	8.568-05	3.020-03
4.000+07	1.623-05	3.868-01	1.158-04	2.056+00	8.005-02	2.523+00	2.041-08	4.865-04	1.456-07	2.586-03	1.007-04	3.173-03
5.000+07	1.039-05	3.228-01	9.196-05	2.212+00	8.923-02	2.624+00	1.307-08	4.060-04	1.157-07	2.782-03	1.122-04	3.300-03
6.000+07	7.214-06	2.782-01	7.626-05	2.334+00	9.659-02	2.709+00	9.073-09	3.499-04	9.592-08	2.936-03	1.215-04	3.407-03
8.000+07	4.058-06	2.194-01	5.684-05	2.517+00	1.078-01	2.844+00	5.104-09	2.759-04	7.149-08	3.166-03	1.356-04	3.577-03
1.000+08	2.597-06	1.821-01	4.530-05	2.648+00	1.162-01	2.946+00	3.266-09	2.290-04	5.698-08	3.330-03	1.461-04	3.706-03
1.500+08	1.154-06	1.297-01	3.005-05	2.860+00	1.302-01	3.120+00	1.451-09	1.631-04	3.779-08	3.597-03	1.638-04	3.924-03
2.000+08	6.492-07	1.017-01	2.248-05	2.989+00	1.392-01	3.230+00	8.165-10	1.279-04	2.827-08	3.759-03	1.751-04	4.062-03
3.000+08	2.885-07	7.206-02	1.495-05	3.141+00	1.505-01	3.364+00	3.629-10	9.063-05	1.880-08	3.951-03	1.893-04	4.230-03
4.000+08	1.623-07	5.644-02	1.120-05	3.230+00	1.574-01	3.444+00	2.041-10	7.099-05	1.409-08	4.062-03	1.980-04	4.331-03
5.000+08	1.039-07	4.672-02	8.953-06	3.289+00	1.622-01	3.498+00	1.307-10	5.876-05	1.126-08	4.137-03	2.040-04	4.399-03
6.000+08	7.214-08	4.000-02	7.457-06	3.332+00	1.658-01	3.538+00	9.073-11	5.031-05	9.379-09	4.191-03	2.085-04	4.450-03
8.000+08	4.058-08	3.124-02	5.589-06	3.389+00	1.708-01	3.591+00	5.104-11	3.929-05	7.029-09	4.262-03	2.148-04	4.517-03
1.000+09	2.597-08	2.570-02	4.670-06	3.426+00	1.742-01	3.626+00	3.266-11	3.232-05	5.622-09	4.309-03	2.191-04	4.560-03
1.500+09	1.154-08	1.795-02	2.978-06	3.480+00	1.792-01	3.677+00	1.451-11	2.258-05	3.746-09	4.377-03	2.254-04	4.625-03
2.000+09	6.492-09	1.389-02	2.233-06	3.509+00	1.822-01	3.705+00	8.165-12	1.747-05	2.809-09	4.413-03	2.292-04	4.660-03
3.000+09	2.885-09	9.659-03	1.488-06	3.541+00	1.854-01	3.736+00	3.629-12	1.215-05	1.872-09	4.454-03	2.332-04	4.699-03
4.000+09	1.623-09	7.456-03	1.116-06	3.558+00	1.873-01	3.753+00	2.041-12	9.378-06	1.404-09	4.475-03	2.356-04	4.720-03
5.000+09	1.039-09	6.096-03	8.928-07	3.569+00	1.885-01	3.764+00	1.307-12	7.667-06	1.123-09	4.489-03	2.371-04	4.734-03
6.000+09	7.214-10	5.169-03	7.440-07	3.577+00	1.893-01	3.771+00	9.073-13	6.501-06	9.358-10	4.499-03	2.381-04	4.744-03
8.000+09	4.058-10	3.983-03	5.580-07	3.587+00	1.904-01	3.781+00	5.104-13	5.010-06	7.018-10	4.512-03	2.395-04	4.756-03
1.000+10	2.597-10	3.252-03	4.464-07	3.593+00	1.911-01	3.787+00	3.266-13	4.090-06	5.615-10	4.519-03	2.404-04	4.763-03
1.500+10	1.154-10	2.247-03	2.976-07	3.602+00	1.921-01	3.796+00	1.451-13	2.826-06	3.743-10	4.530-03	2.416-04	4.775-03
2.000+10	6.492-11	1.728-03	2.232-07	3.607+00	1.927-01	3.801+00	8.165-14	2.173-06	2.807-10	4.537-03	2.424-04	4.781-03
3.000+10	2.885-11	1.191-03	1.488-07	3.611+00	1.932-01	3.805+00	3.629-14	1.498-06	1.872-10	4.542-03	2.430-04	4.786-03
4.000+10	1.623-11	9.147-04	1.116-07	3.614+00	1.936-01	3.809+00	2.041-14	1.150-06	1.404-10	4.545-03	2.435-04	4.790-03
5.000+10	1.039-11	7.449-04	8.926-08	3.616+00	1.938-01	3.811+00	1.307-14	9.369-07	1.123-10	4.548-03	2.437-04	4.793-03
6.000+10	7.214-12	6.297-04	7.438-08	3.617+00	1.939-01	3.812+00	9.073-15	7.920-07	9.355-11	4.549-03	2.439-04	4.794-03
8.000+10	4.058-12	4.828-04	5.579-08	3.618+00	1.941-01	3.813+00	5.104-15	6.072-07	7.017-11	4.550-03	2.441-04	4.795-03
1.000+11	2.597-12	3.928-04	4.463-08	3.619+00	1.942-01	3.814+00	3.266-15	4.940-07	5.613-11	4.552-03	2.443-04	4.796-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 23, V , VANADIUM ATOMIC WT. = 50.9415 MSQ/KG = .00118215 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	2.916-02	4.854+00	1.814-02	0.000	0.000	4.901+00	3.447-05	5.738-03	2.144-05	0.000	0.000	5.794-03
1.022+06	2.792-02	4.803+00	1.736-02	0.000	0.000	4.848+00	3.301-05	5.678-03	2.052-05	0.000	0.000	5.731-03
1.250+06	1.868-02	4.342+00	1.175-02	4.902-03	0.000	4.377+00	2.208-05	5.133-03	1.389-05	5.795-06	0.000	5.175-03
1.500+06	1.298-02	3.948+00	8.479-03	2.535-02	0.000	3.995+00	1.534-05	4.667-03	1.002-05	2.997-05	0.000	4.722-03
2.000+06	7.305-03	3.370+00	5.241-03	9.804-02	0.000	3.481+00	8.636-06	3.984-03	6.196-06	1.159-04	0.000	4.115-03
2.044+06	6.994-03	3.328+00	5.064-03	1.056-01	0.000	3.446+00	8.268-06	3.934-03	5.986-06	1.248-04	0.000	4.073-03
3.000+06	3.248-03	2.652+00	2.856-03	2.728-01	9.280-04	2.932+00	3.840-06	3.135-03	3.376-06	3.225-04	1.097-06	3.466-03
4.000+06	1.827-03	2.212+00	1.929-03	4.373-01	3.788-03	2.657+00	2.160-06	2.615-03	2.280-06	5.170-04	4.478-06	3.141-03
5.000+06	1.169-03	1.911+00	1.446-03	5.828-01	7.547-03	2.504+00	1.382-06	2.259-03	1.709-06	6.890-04	8.922-06	2.960-03
6.000+06	8.122-04	1.689+00	1.154-03	7.126-01	1.159-02	2.415+00	9.601-07	1.997-03	1.364-06	8.424-04	1.370-05	2.855-03
7.000+06	5.967-04	1.518+00	9.577-04	8.280-01	1.562-02	2.363+00	7.054-07	1.795-03	1.132-06	9.788-04	1.847-05	2.794-03
8.000+06	4.569-04	1.381+00	8.180-04	9.318-01	1.953-02	2.334+00	5.401-07	1.633-03	9.670-07	1.102-03	2.309-05	2.759-03
9.000+06	3.610-04	1.270+00	7.134-04	1.026+00	2.328-02	2.320+00	4.268-07	1.501-03	8.433-07	1.213-03	2.752-05	2.743-03
1.000+07	2.924-04	1.177+00	6.323-04	1.111+00	2.684-02	2.316+00	3.457-07	1.391-03	7.475-07	1.313-03	3.173-05	2.739-03
1.100+07	2.417-04	1.097+00	5.675-04	1.188+00	3.022-02	2.316+00	2.857-07	1.297-03	6.709-07	1.404-03	3.572-05	2.738-03
1.200+07	2.031-04	1.029+00	5.148-04	1.259+00	3.341-02	2.322+00	2.401-07	1.216-03	6.086-07	1.488-03	3.950-05	2.745-03
1.300+07	1.730-04	9.696-01	4.709-04	1.325+00	3.642-02	2.332+00	2.045-07	1.146-03	5.567-07	1.566-03	4.305-05	2.756-03
1.400+07	1.492-04	9.172-01	4.339-04	1.386+00	3.929-02	2.343+00	1.764-07	1.084-03	5.129-07	1.638-03	4.645-05	2.770-03
1.500+07	1.300-04	8.708-01	4.022-04	1.443+00	4.201-02	2.356+00	1.537-07	1.029-03	4.755-07	1.706-03	4.966-05	2.786-03
1.600+07	1.142-04	8.293-01	3.748-04	1.496+00	4.460-02	2.370+00	1.350-07	9.804-04	4.431-07	1.768-03	5.272-05	2.802-03
1.800+07	9.025-05	7.579-01	3.299-04	1.594+00	4.940-02	2.402+00	1.067-07	8.960-04	3.900-07	1.884-03	5.840-05	2.839-03
2.000+07	7.310-05	6.989-01	2.945-04	1.681+00	5.379-02	2.434+00	8.642-08	8.262-04	3.481-07	1.987-03	6.359-05	2.877-03
2.200+07	6.041-05	6.492-01	2.660-04	1.760+00	5.782-02	2.467+00	7.141-08	7.675-04	3.145-07	2.081-03	6.835-05	2.917-03
2.400+07	5.076-05	6.066-01	2.425-04	1.832+00	6.154-02	2.500+00	6.001-08	7.171-04	2.867-07	2.166-03	7.275-05	2.956-03
2.600+07	4.326-05	5.697-01	2.228-04	1.898+00	6.497-02	2.533+00	5.114-08	6.735-04	2.634-07	2.244-03	7.680-05	2.994-03
2.800+07	3.730-05	5.374-01	2.060-04	1.958+00	6.817-02	2.564+00	4.409-08	6.353-04	2.435-07	2.315-03	8.059-05	3.031-03
3.000+07	3.249-05	5.088-01	1.916-04	2.014+00	7.116-02	2.594+00	3.841-08	6.015-04	2.265-07	2.381-03	8.412-05	3.067-03
4.000+07	1.827-05	4.043-01	1.420-04	2.242+00	8.361-02	2.730+00	2.160-08	4.779-04	1.679-07	2.650-03	9.884-05	3.227-03
5.000+07	1.170-05	3.375-01	1.127-04	2.413+00	9.318-02	2.844+00	1.383-08	3.990-04	1.332-07	2.853-03	1.102-04	3.362-03
6.000+07	8.122-06	2.908-01	9.346-05	2.546+00	1.009-01	2.938+00	9.601-09	3.438-04	1.105-07	3.010-03	1.193-04	3.473-03
8.000+07	4.569-06	2.293-01	6.966-05	2.744+00	1.126-01	3.086+00	5.401-09	2.711-04	8.235-08	3.244-03	1.331-04	3.648-03
1.000+08	2.924-06	1.904-01	5.552-05	2.887+00	1.212-01	3.199+00	3.457-09	2.251-04	6.563-08	3.413-03	1.433-04	3.781-03
1.500+08	1.299-06	1.356-01	3.682-05	3.117+00	1.358-01	3.388+00	1.536-09	1.603-04	4.353-08	3.685-03	1.605-04	4.006-03
2.000+08	7.309-07	1.063-01	2.755-05	3.257+00	1.452-01	3.509+00	8.640-10	1.257-04	3.257-08	3.850-03	1.716-04	4.148-03
3.000+08	3.249-07	7.533-02	1.832-05	3.422+00	1.568-01	3.654+00	3.841-10	8.905-05	2.166-08	4.045-03	1.854-04	4.320-03
4.000+08	1.827-07	5.900-02	1.372-05	3.519+00	1.639-01	3.742+00	2.160-10	6.975-05	1.622-08	4.160-03	1.938-04	4.424-03
5.000+08	1.170-07	4.884-02	1.097-05	3.582+00	1.689-01	3.800+00	1.383-10	5.774-05	1.297-08	4.234-03	1.997-04	4.492-03
6.000+08	8.122-08	4.182-02	9.136-06	3.628+00	1.725-01	3.842+00	9.601-11	4.944-05	1.080-08	4.289-03	2.039-04	4.542-03
8.000+08	4.568-08	3.266-02	6.848-06	3.689+00	1.776-01	3.899+00	5.400-11	3.861-05	8.095-09	4.361-03	2.099-04	4.610-03
1.000+09	2.924-08	2.687-02	5.476-06	3.729+00	1.811-01	3.937+00	3.457-11	3.176-05	6.473-09	4.408-03	2.141-04	4.654-03
1.500+09	1.299-08	1.876-02	3.649-06	3.787+00	1.863-01	3.992+00	1.536-11	2.218-05	4.314-09	4.477-03	2.202-04	4.719-03
2.000+09	7.309-09	1.452-02	2.736-06	3.818+00	1.892-01	4.022+00	8.640-12	1.716-05	3.234-09	4.513-03	2.237-04	4.754-03
3.000+09	3.249-09	1.010-02	1.824-06	3.853+00	1.925-01	4.056+00	3.841-12	1.194-05	2.156-09	4.555-03	2.276-04	4.794-03
4.000+09	1.827-09	7.795-03	1.367-06	3.871+00	1.945-01	4.073+00	2.160-12	9.215-06	1.616-09	4.576-03	2.299-04	4.815-03
5.000+09	1.170-09	6.373-03	1.094-06	3.883+00	1.957-01	4.085+00	1.383-12	7.534-06	1.293-09	4.590-03	2.313-04	4.829-03
6.000+09	8.122-10	5.404-03	9.115-07	3.891+00	1.965-01	4.093+00	9.601-13	6.388-06	1.078-09	4.600-03	2.323-04	4.838-03
8.000+09	4.568-10	4.164-03	6.836-07	3.901+00	1.976-01	4.103+00	5.400-13	4.922-06	8.081-10	4.612-03	2.336-04	4.850-03
1.000+10	2.924-10	3.400-03	5.469-07	3.908+00	1.983-01	4.110+00	3.457-13	4.019-06	6.465-10	4.620-03	2.344-04	4.858-03
1.500+10	1.299-10	2.349-03	3.646-07	3.917+00	1.993-01	4.119+00	1.536-13	2.777-06	4.310-10	4.630-03	2.356-04	4.869-03
2.000+10	7.309-11	1.806-03	2.734-07	3.922+00	1.999-01	4.124+00	8.640-14	2.135-06	3.232-10	4.636-03	2.363-04	4.875-03
3.000+10	3.249-11	1.246-03	1.823-07	3.928+00	2.005-01	4.130+00	3.841-14	1.473-06	2.155-10	4.643-03	2.370-04	4.882-03
4.000+10	1.827-11	9.563-04	1.367-07	3.930+00	2.008-01	4.132+00	2.160-14	1.130-06	1.616-10	4.646-03	2.374-04	4.884-03
5.000+10	1.170-11	7.788-04	1.094-07	3.932+00	2.010-01	4.134+00	1.383-14	9.207-07	1.293-10	4.648-03	2.376-04	[illegible]
6.000+10	8.122-12	6.583-04	9.113-08	3.933+00	2.011-01	4.135+00	9.601-15	7.782-07	[illegible]	[illegible]	2.377-04	4.888-03
8.000+10	4.568-12	5.048-04	6.835-08	3.935+00	2.013-01	4.137+00	[illegible]	5.967-07	8.086-11	4.652-03	2.380-04	4.890-03
1.000+11	2.924-12	4.107-04	5.468-08	[illegible]	2.014-01	4.138+00	3.457-15	4.855-07	6.464-11	4.653-03	2.381-04	4.892-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 24, CR, CHROMIUM ATOMIC WT. = 51.996 MSQ/KG = .00115817 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	3.272-02	5.065+00	2.217-02	0.000	0.000	5.120+00	3.790-05	5.866-03	2.568-05	0.000	0.000	5.930-03
1.022+06	3.133-02	5.011+00	2.121-02	0.000	0.000	5.064+00	3.629-05	5.804-03	2.456-05	0.000	0.000	5.864-03
1.250+06	2.097-02	4.531+00	1.435-02	5.409-03	0.000	4.572+00	2.429-05	5.248-03	1.662-05	6.265-06	0.000	5.295-03
1.500+06	1.457-02	4.119+00	1.036-02	2.782-02	0.000	4.172+00	1.687-05	4.771-03	1.200-05	3.222-05	0.000	4.832-03
2.000+06	8.209-03	3.516+00	6.397-03	1.072-01	0.000	3.638+00	9.497-06	4.072-03	7.409-06	1.242-04	0.000	4.213-03
2.044+06	7.851-03	3.473+00	6.180-03	1.154-01	0.000	3.602+00	9.093-06	4.022-03	7.158-06	1.337-04	0.000	4.172-03
3.000+06	3.646-03	2.767+00	3.481-03	2.976-01	9.683-04	3.073+00	4.223-06	3.205-03	4.032-06	3.447-04	1.121-06	3.559-03
4.000+06	2.051-03	2.308+00	2.349-03	4.765-01	3.953-03	2.793+00	2.375-06	2.673-03	2.721-06	5.519-04	4.578-06	3.235-03
5.000+06	1.313-03	1.994+00	1.761-03	6.346-01	7.875-03	2.640+00	1.521-06	2.309-03	2.040-06	7.350-04	9.121-06	3.057-03
6.000+06	9.117-04	1.762+00	1.403-03	7.756-01	1.209-02	2.552+00	1.056-06	2.041-03	1.625-06	8.983-04	1.400-05	2.956-03
7.000+06	6.698-04	1.584+00	1.165-03	9.010-01	1.630-02	2.503+00	7.757-07	1.835-03	1.349-06	1.044-03	1.888-05	2.899-03
8.000+06	5.129-04	1.441+00	9.946-04	1.014+00	2.038-02	2.477+00	5.940-07	1.669-03	1.152-06	1.174-03	2.360-05	2.869-03
9.000+06	4.052-04	1.325+00	8.672-04	1.116+00	2.428-02	2.467+00	4.693-07	1.535-03	1.004-06	1.293-03	2.812-05	2.857-03
1.000+07	3.282-04	1.228+00	7.684-04	1.208+00	2.800-02	2.465+00	3.801-07	1.422-03	8.899-07	1.399-03	3.243-05	2.855-03
1.100+07	2.713-04	1.145+00	6.897-04	1.292+00	3.152-02	2.469+00	3.142-07	1.326-03	7.988-07	1.496-03	3.651-05	2.860-03
1.200+07	2.279-04	1.074+00	6.254-04	1.369+00	3.485-02	2.479+00	2.639-07	1.244-03	7.243-07	1.586-03	4.036-05	2.871-03
1.300+07	1.942-04	1.012+00	5.721-04	1.440+00	3.799-02	2.491+00	2.249-07	1.172-03	6.626-07	1.668-03	4.400-05	2.885-03
1.400+07	1.675-04	9.571-01	5.270-04	1.507+00	4.098-02	2.506+00	1.940-07	1.108-03	6.104-07	1.745-03	4.746-05	2.902-03
1.500+07	1.459-04	9.087-01	4.885-04	1.568+00	4.382-02	2.521+00	1.690-07	1.052-03	5.658-07	1.816-03	5.075-05	2.920-03
1.600+07	1.282-04	8.653-01	4.553-04	1.626+00	4.652-02	2.538+00	1.485-07	1.002-03	5.273-07	1.883-03	5.388-05	2.940-03
1.800+07	1.013-04	7.909-01	4.006-04	1.733+00	5.153-02	2.576+00	1.173-07	9.160-04	4.640-07	2.007-03	5.968-05	2.983-03
2.000+07	8.206-05	7.293-01	3.576-04	1.827+00	5.610-02	2.613+00	9.504-08	8.447-04	4.142-07	2.116-03	6.497-05	3.026-03
2.200+07	6.782-05	6.774-01	3.229-04	1.913+00	6.030-02	2.651+00	7.855-08	7.845-04	3.740-07	2.216-03	6.984-05	3.070-03
2.400+07	5.699-05	6.330-01	2.944-04	1.991+00	6.417-02	2.689+00	6.600-08	7.331-04	3.410-07	2.306-03	7.432-05	3.114-03
2.600+07	4.856-05	5.944-01	2.705-04	2.062+00	6.776-02	2.724+00	5.624-08	6.884-04	3.133-07	2.388-03	7.848-05	3.155-03
2.800+07	4.187-05	5.607-01	2.501-04	2.128+00	7.109-02	2.760+00	4.849-08	6.494-04	2.897-07	2.465-03	8.233-05	3.197-03
3.000+07	3.647-05	5.310-01	2.326-04	2.189+00	7.420-02	2.794+00	4.224-08	6.150-04	2.694-07	2.535-03	8.594-05	3.236-03
4.000+07	2.052-05	4.219-01	1.723-04	2.436+00	8.717-02	2.945+00	2.377-08	4.886-04	1.996-07	2.821-03	1.010-04	3.411-03
5.000+07	1.313-05	3.522-01	1.368-04	2.621+00	9.712-02	3.070+00	1.521-08	4.079-04	1.584-07	3.036-03	1.125-04	3.556-03
6.000+07	9.117-06	3.034-01	1.134-04	2.766+00	1.051-01	3.175+00	1.056-08	3.514-04	1.313-07	3.204-03	1.217-04	3.677-03
8.000+07	5.129-06	2.393-01	8.452-05	2.982+00	1.173-01	3.339+00	5.940-09	2.772-04	9.789-08	3.454-03	1.359-04	3.867-03
1.000+08	3.282-06	1.986-01	6.736-05	3.136+00	1.262-01	3.461+00	3.801-09	2.300-04	7.801-08	3.632-03	1.462-04	4.008-03
1.500+08	1.459-06	1.415-01	4.468-05	3.386+00	1.413-01	3.669+00	1.690-09	1.639-04	5.175-08	3.922-03	1.637-04	4.249-03
2.000+08	8.205-07	1.109-01	3.342-05	3.537+00	1.509-01	3.799+00	9.503-10	1.284-04	3.871-08	4.096-03	1.748-04	4.400-03
3.000+08	3.647-07	7.861-02	2.222-05	3.715+00	1.628-01	3.956+00	4.224-10	9.104-05	2.573-08	4.303-03	1.886-04	4.582-03
4.000+08	2.051-07	6.157-02	1.665-05	3.818+00	1.701-01	4.050+00	2.375-10	7.131-05	1.928-08	4.422-03	1.970-04	4.690-03
5.000+08	1.313-07	5.096-02	1.331-05	3.886+00	1.751-01	4.112+00	1.521-10	5.902-05	1.542-08	4.501-03	2.028-04	4.762-03
6.000+08	9.117-08	4.364-02	1.108-05	3.935+00	1.788-01	4.157+00	1.056-10	5.054-05	1.283-08	4.557-03	2.071-04	4.815-03
8.000+08	5.128-08	3.408-02	8.307-06	4.001+00	1.839-01	4.219+00	5.939-11	3.947-05	9.621-09	4.634-03	2.130-04	4.886-03
1.000+09	3.282-08	2.804-02	6.643-06	4.043+00	1.873-01	4.258+00	3.801-11	3.248-05	7.694-09	4.683-03	2.169-04	4.932-03
1.500+09	1.459-08	1.958-02	4.426-06	4.105+00	1.924-01	4.317+00	1.690-11	2.268-05	5.126-09	4.754-03	2.228-04	5.000-03
2.000+09	8.205-09	1.515-02	3.319-06	4.139+00	1.954-01	4.350+00	9.503-12	1.755-05	3.844-09	4.794-03	2.263-04	5.038-03
3.000+09	3.647-09	1.054-02	2.212-06	4.175+00	1.986-01	4.384+00	4.224-12	1.221-05	2.562-09	4.835-03	2.300-04	5.078-03
4.000+09	2.051-09	8.134-03	1.659-06	4.195+00	2.005-01	4.404+00	2.375-12	9.421-06	1.921-09	4.859-03	2.322-04	5.100-03
5.000+09	1.313-09	6.650-03	1.327-06	4.207+00	2.016-01	4.415+00	1.521-12	7.702-06	1.537-09	4.872-03	2.335-04	5.114-03
6.000+09	9.117-10	5.639-03	1.106-06	4.216+00	2.024-01	4.424+00	1.056-12	6.531-06	1.281-09	4.883-03	2.344-04	5.124-03
8.000+09	5.128-10	4.345-03	8.293-07	4.227+00	2.035-01	4.435+00	5.939-13	5.032-06	9.605-10	4.896-03	2.357-04	5.136-03
1.000+10	3.282-10	3.547-03	6.634-07	4.234+00	2.042-01	4.442+00	3.801-13	4.108-06	7.683-10	4.904-03	2.365-04	5.144-03
1.500+10	1.459-10	2.452-03	4.422-07	4.244+00	2.052-01	4.452+00	1.690-13	2.840-06	5.121-10	4.915-03	2.377-04	5.156-03
2.000+10	8.205-11	1.885-03	3.317-07	4.250+00	2.057-01	4.458+00	9.503-14	2.183-06	3.842-10	4.922-03	2.382-04	5.163-03
3.000+10	3.647-11	1.300-03	2.211-07	4.255+00	2.062-01	4.463+00	4.224-14	1.506-06	2.561-10	4.928-03	2.388-04	5.168-03
4.000+10	2.051-11	9.979-04	1.658-07	4.258+00	2.066-01	4.466+00	2.375-14	1.156-06	1.920-10	4.932-03	2.393-04	5.172-03
5.000+10	1.313-11	8.126-04	1.327-07	4.260+00	2.068-01	4.468+00	1.521-14	9.411-07	1.537-10	4.934-03	2.395-04	5.174-03
6.000+10	9.117-12	6.869-04	1.105-07	4.261+00	2.069-01	4.469+00	1.056-14	7.956-07	1.280-10	4.935-03	2.396-04	5.175-03
8.000+10	5.128-12	5.267-04	8.291-08	4.263+00	2.071-01	4.471+00	5.939-15	6.100-07	9.602-11	4.937-03	2.399-04	5.178-03
1.000+11	3.282-12	4.285-04	6.633-08	4.264+00	2.072-01	4.472+00	3.801-15	4.963-07	7.682-11	4.938-03	2.400-04	5.179-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 25, MN, MANGANESE ATOMIC WT. = 54.9380 MSO/KG = .00109615 BARNS/ATOM MULTIPLY MSO/KG BY 10 FOR CMSO/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSO/KG	MSO/KG	MSO/KG	MSO/KG	MSO/KG	MSO/KG
1.000+06	3.650-02	5.275+00	2.689-02	0.000	0.000	5.338+00	4.001-05	5.782-03	2.948-05	0.000	0.000	5.852-03
1.022+06	3.495-02	5.220+00	2.573-02	0.000	0.000	5.281+00	3.831-05	5.722-03	2.820-05	0.000	0.000	5.788-03
1.250+06	2.339-02	4.719+00	1.740-02	5.947-03	0.000	4.766+00	2.564-05	5.173-03	1.907-05	6.519-06	0.000	5.224-03
1.500+06	1.625-02	4.291+00	1.255-02	3.043-02	0.000	4.350+00	1.781-05	4.704-03	1.376-05	3.336-05	0.000	4.769-03
2.000+06	9.146-03	3.663+00	7.748-03	1.166-01	0.000	3.796+00	1.003-05	4.015-03	8.493-06	1.278-04	0.000	4.162-03
2.044+06	8.757-03	3.617+00	7.484-03	1.255-01	0.000	3.759+00	9.599-06	3.965-03	8.204-06	1.376-04	0.000	4.120-03
3.000+06	4.067-03	2.882+00	4.211-03	3.235-01	1.009-03	3.215+00	4.458-06	3.159-03	4.616-06	3.546-04	1.106-06	3.524-03
4.000+06	2.288-03	2.405+00	2.839-03	5.173-01	4.118-03	2.932+00	2.508-06	2.636-03	3.112-06	5.670-04	4.514-06	3.213-03
5.000+06	1.464-03	2.077+00	2.127-03	6.887-01	8.203-03	2.777+00	1.605-06	2.277-03	2.332-06	7.549-04	8.992-06	3.045-03
6.000+06	1.017-03	1.836+00	1.695-03	8.414-01	1.259-02	2.693+00	1.115-06	2.013-03	1.858-06	9.223-04	1.380-05	2.952-03
7.000+06	7.472-04	1.650+00	1.406-03	9.771-01	1.697-02	2.646+00	8.190-07	1.809-03	1.541-06	1.071-03	1.860-05	2.901-03
8.000+06	5.721-04	1.501+00	1.200-03	1.099+00	2.122-02	2.623+00	6.271-07	1.645-03	1.315-06	1.205-03	2.326-05	2.875-03
9.000+06	4.520-04	1.380+00	1.046-03	1.210+00	2.529-02	2.617+00	4.955-07	1.513-03	1.147-06	1.326-03	2.772-05	2.868-03
1.000+07	3.661-04	1.279+00	9.269-04	1.310+00	2.916-02	2.619+00	4.013-07	1.402-03	1.016-06	1.436-03	3.196-05	2.871-03
1.100+07	3.026-04	1.193+00	8.318-04	1.401+00	3.283-02	2.628+00	3.317-07	1.308-03	9.118-07	1.536-03	3.599-05	2.881-03
1.200+07	2.543-04	1.119+00	7.562-04	1.484+00	3.629-02	2.640+00	2.788-07	1.227-03	8.267-07	1.627-03	3.978-05	2.894-03
1.300+07	2.167-04	1.054+00	6.898-04	1.561+00	3.956-02	2.655+00	2.375-07	1.155-03	7.561-07	1.711-03	4.336-05	2.911-03
1.400+07	1.868-04	9.970-01	6.354-04	1.633+00	4.267-02	2.673+00	2.048-07	1.093-03	6.965-07	1.790-03	4.677-05	2.931-03
1.500+07	1.627-04	9.465-01	5.889-04	1.699+00	4.563-02	2.692+00	1.783-07	1.038-03	6.455-07	1.862-03	5.002-05	2.951-03
1.600+07	1.430-04	9.014-01	5.488-04	1.762+00	4.844-02	2.713+00	1.567-07	9.881-04	6.016-07	1.931-03	5.310-05	2.973-03
1.800+07	1.130-04	8.238-01	4.828-04	1.877+00	5.365-02	2.755+00	1.239-07	9.030-04	5.292-07	2.057-03	5.881-05	3.020-03
2.000+07	9.154-05	7.597-01	4.310-04	1.980+00	5.841-02	2.799+00	1.003-07	8.327-04	4.724-07	2.170-03	6.403-05	3.068-03
2.200+07	7.565-05	7.057-01	3.892-04	2.072+00	6.278-02	2.841+00	8.292-08	7.736-04	4.266-07	2.271-03	6.882-05	3.114-03
2.400+07	6.357-05	6.594-01	3.547-04	2.157+00	6.681-02	2.884+00	6.968-08	7.228-04	3.888-07	2.364-03	7.323-05	3.161-03
2.600+07	5.416-05	6.192-01	3.259-04	2.234+00	7.053-02	2.924+00	5.937-08	6.787-04	3.572-07	2.449-03	7.731-05	3.205-03
2.800+07	4.670-05	5.841-01	3.013-04	2.305+00	7.400-02	2.963+00	5.119-08	6.403-04	3.303-07	2.527-03	8.112-05	3.248-03
3.000+07	4.068-05	5.531-01	2.802-04	2.371+00	7.723-02	3.002+00	4.459-08	6.063-04	3.071-07	2.599-03	8.466-05	3.290-03
4.000+07	2.288-05	4.395-01	2.075-04	2.638+00	9.071-02	3.168+00	2.508-08	4.818-04	2.275-07	2.892-03	9.943-05	3.473-03
5.000+07	1.465-05	3.669-01	1.648-04	2.839+00	1.011-01	3.307+00	1.606-08	4.022-04	1.806-07	3.112-03	1.108-04	3.625-03
6.000+07	1.017-05	3.161-01	1.366-04	2.995+00	1.093-01	3.421+00	1.115-08	3.465-04	1.497-07	3.283-03	1.198-04	3.749-03
8.000+07	5.721-06	2.493-01	1.018-04	3.228+00	1.219-01	3.599+00	6.271-09	2.733-04	1.116-07	3.538-03	1.336-04	3.945-03
1.000+08	3.661-06	2.069-01	8.111-05	3.395+00	1.312-01	3.733+00	4.013-09	2.268-04	8.891-08	3.721-03	1.438-04	4.092-03
1.500+08	1.627-06	1.473-01	5.380-05	3.664+00	1.468-01	3.958+00	1.783-09	1.615-04	5.897-08	4.016-03	1.609-04	4.339-03
2.000+08	9.153-07	1.155-01	4.024-05	3.827+00	1.568-01	4.099+00	1.003-09	1.266-04	4.411-08	4.195-03	1.719-04	4.494-03
3.000+08	4.068-07	8.189-02	2.676-05	4.018+00	1.691-01	4.269+00	4.459-10	8.976-05	2.933-08	4.404-03	1.854-04	4.679-03
4.000+08	2.288-07	6.613-02	2.004-05	4.129+00	1.766-01	4.370+00	2.508-10	7.030-05	2.197-08	4.526-03	1.936-04	4.790-03
5.000+08	1.465-07	5.309-02	1.602-05	4.202+00	1.818-01	4.437+00	1.606-10	5.819-05	1.756-08	4.606-03	1.993-04	4.864-03
6.000+08	1.017-07	4.545-02	1.334-05	4.254+00	1.856-01	4.485+00	1.115-10	4.982-05	1.462-08	4.663-03	2.034-04	4.916-03
8.000+08	5.721-08	3.550-02	1.000-05	4.324+00	1.910-01	4.551+00	6.271-11	3.891-05	1.096-08	4.740-03	2.094-04	4.988-03
1.000+09	3.661-08	2.921-02	7.998-06	4.370+00	1.945-01	4.594+00	4.013-11	3.202-05	8.767-09	4.790-03	2.132-04	5.035-03
1.500+09	1.627-08	2.040-02	5.329-06	4.436+00	1.999-01	4.656+00	1.783-11	2.236-05	5.841-09	4.863-03	2.191-04	5.104-03
2.000+09	9.153-09	1.579-02	3.996-06	4.472+00	2.030-01	4.691+00	1.003-11	1.731-05	4.380-09	4.902-03	2.225-04	5.142-03
3.000+09	4.068-09	1.098-02	2.663-06	4.511+00	2.063-01	4.728+00	4.459-12	1.204-05	2.919-09	4.945-03	2.261-04	5.183-03
4.000+09	2.288-09	8.473-03	1.997-06	4.532+00	2.083-01	4.749+00	2.508-12	9.288-06	2.189-09	4.968-03	2.283-04	5.205-03
5.000+09	1.465-09	6.927-03	1.598-06	4.545+00	2.095-01	4.761+00	1.606-12	7.593-06	1.752-09	4.982-03	2.296-04	5.219-03
6.000+09	1.017-09	5.874-03	1.331-06	4.554+00	2.104-01	4.770+00	1.115-12	6.439-06	1.459-09	4.992-03	2.306-04	5.229-03
8.000+09	5.721-10	4.526-03	9.984-07	4.566+00	2.115-01	4.782+00	6.271-13	4.961-06	1.094-09	5.005-03	2.318-04	5.242-03
1.000+10	3.661-10	3.695-03	7.986-07	4.574+00	2.123-01	4.790+00	4.013-13	4.050-06	8.754-10	5.014-03	2.327-04	5.251-03
1.500+10	1.627-10	2.554-03	5.324-07	4.584+00	2.133-01	4.800+00	1.783-13	2.800-06	5.836-10	5.025-03	2.338-04	5.261-03
2.000+10	9.153-11	1.963-03	3.993-07	4.590+00	2.139-01	4.806+00	1.003-13	2.152-06	4.377-10	5.031-03	2.345-04	5.268-03
3.000+10	4.068-11	1.354-03	2.662-07	4.596+00	2.144-01	4.812+00	4.459-14	1.484-06	2.918-10	5.038-03	2.350-04	5.274-03
4.000+10	2.288-11	1.039-03	1.996-07	4.599+00	2.148-01	4.815+00	2.508-14	1.139-06	2.188-10	5.041-03	2.353-04	5.278-03
5.000+10	1.465-11	8.465-04	1.597-07	4.601+00	2.150-01	4.817+00	1.606-14	9.279-07	1.751-10	5.043-03	2.357-04	5.280-03
6.000+10	1.017-11	7.155-04	1.331-07	4.602+00	2.151-01	4.818+00	[illegible]	7.843-07	1.459-10	5.044-03	2.358-04	5.281-03
8.000+10	5.721-12	5.487-04	9.982-08	4.604+00	[illegible]	4.820+00	6.271-15	6.015-07	1.094-10	5.047-03	2.360-04	5.283-03
1.000+11	3.661-12	4.464-04	[illegible]	4.605+00	2.154-01	4.821+00	4.013-15	4.893-07	8.753-11	5.048-03	2.361-04	5.284-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV ≥ E ≥ 1 keV, $Z=1$ to 100—Continued

Z = 26, FE, IRON ATOMIC WT. = 55.847 MSQ/KG = .00107831 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	4.063-02	5.486+00	3.233-02	0.000	0.000	5.559+00	4.381-05	5.916-03	3.486-05	0.000	0.000	5.994-03
1.022+06	3.891-02	5.428+00	3.093-02	0.000	0.000	5.498+00	4.196-05	5.853-03	3.335-05	0.000	0.000	5.928-03
1.250+06	2.604-02	4.908+00	2.092-02	6.520-03	0.000	4.961+00	2.808-05	5.292-03	2.256-05	7.031-06	0.000	5.350-03
1.500+06	1.809-02	4.462+00	1.509-02	3.320-02	0.000	4.528+00	1.951-05	4.811-03	1.627-05	3.580-05	0.000	4.883-03
2.000+06	1.019-02	3.809+00	9.306-03	1.265-01	0.000	3.955+00	1.099-05	4.107-03	1.003-05	1.364-04	0.000	4.265-03
2.044+06	9.752-03	3.762+00	8.988-03	1.361-01	0.000	3.917+00	1.052-05	4.057-03	9.692-06	1.468-04	0.000	4.224-03
3.000+06	4.529-03	2.997+00	5.052-03	3.506-01	1.049-03	3.358+00	4.881-06	3.232-03	5.448-06	3.781-04	1.131-06	3.621-03
4.000+06	2.548-03	2.501+00	3.403-03	5.600-01	4.282-03	3.071+00	2.748-06	2.697-03	3.669-06	6.039-04	4.617-06	3.312-03
5.000+06	1.631-03	2.160+00	2.547-03	7.449-01	8.530-03	2.918+00	1.759-06	2.329-03	2.746-06	8.032-04	9.198-06	3.146-03
6.000+06	1.133-03	1.909+00	2.029-03	9.097-01	1.310-02	2.835+00	1.222-06	2.058-03	2.188-06	9.809-04	1.413-05	3.057-03
7.000+06	8.321-04	1.716+00	1.683-03	1.056+00	1.765-02	2.792+00	8.973-07	1.850-03	1.815-06	1.139-03	1.903-05	3.011-03
8.000+06	6.371-04	1.562+00	1.436-03	1.188+00	2.207-02	2.774+00	6.873-07	1.684-03	1.548-06	1.281-03	2.380-05	2.991-03
9.000+06	5.034-04	1.435+00	1.252-03	1.307+00	2.630-02	2.770+00	5.428-07	1.547-03	1.350-06	1.409-03	2.836-05	2.987-03
1.000+07	4.077-04	1.330+00	1.109-03	1.415+00	3.032-02	2.777+00	4.396-07	1.434-03	1.196-06	1.526-03	3.269-05	2.994-03
1.100+07	3.370-04	1.240+00	9.948-04	1.513+00	3.413-02	2.788+00	3.634-07	1.337-03	1.073-06	1.631-03	3.580-05	3.007-03
1.200+07	2.832-04	1.163+00	9.019-04	1.603+00	3.773-02	2.805+00	3.054-07	1.254-03	9.725-07	1.729-03	4.068-05	3.025-03
1.300+07	2.413-04	1.096+00	8.248-04	1.685+00	4.113-02	2.823+00	2.602-07	1.182-03	8.894-07	1.817-03	4.435-05	3.044-03
1.400+07	2.080-04	1.037+00	7.597-04	1.763+00	4.437-02	2.845+00	2.243-07	1.118-03	8.192-07	1.901-03	4.784-05	3.068-03
1.500+07	1.812-04	9.844-01	7.041-04	1.835+00	4.743-02	2.868+00	1.954-07	1.061-03	7.592-07	1.979-03	5.114-05	3.092-03
1.600+07	1.593-04	9.374-01	6.560-04	1.903+00	5.035-02	2.892+00	1.718-07	1.011-03	7.074-07	2.052-03	5.429-05	3.118-03
1.800+07	1.259-04	8.568-01	5.771-04	2.027+00	5.577-02	2.940+00	1.358-07	9.239-04	6.223-07	2.186-03	6.014-05	3.171-03
2.000+07	1.019-04	7.901-01	5.151-04	2.138+00	6.072-02	2.989+00	1.099-07	8.520-04	5.554-07	2.305-03	6.548-05	3.224-03
2.200+07	8.425-05	7.339-01	4.651-04	2.239+00	6.525-02	3.039+00	9.085-08	7.914-04	5.015-07	2.414-03	7.036-05	3.277-03
2.400+07	7.079-05	6.858-01	4.239-04	2.330+00	6.943-02	3.086+00	7.633-08	7.395-04	4.571-07	2.512-03	7.487-05	3.327-03
2.600+07	6.032-05	6.440-01	3.894-04	2.414+00	7.330-02	3.132+00	6.504-08	6.944-04	4.199-07	2.603-03	7.904-05	3.377-03
2.800+07	5.201-05	6.075-01	3.600-04	2.490+00	7.690-02	3.175+00	5.608-08	6.551-04	3.882-07	2.685-03	8.292-05	3.423-03
3.000+07	4.531-05	5.752-01	3.348-04	2.561+00	8.026-02	3.217+00	4.886-08	6.202-04	3.610-07	2.762-03	8.555-05	3.469-03
4.000+07	2.549-05	4.571-01	2.479-04	2.848+00	9.425-02	3.400+00	2.749-08	4.929-04	2.673-07	3.071-03	1.016-04	3.666-03
5.000+07	1.631-05	3.815-01	1.968-04	3.063+00	1.050-01	3.550+00	1.759-08	4.114-04	2.122-07	3.303-03	1.132-04	3.828-03
6.000+07	1.133-05	3.287-01	1.631-04	3.231+00	1.136-01	3.673+00	1.222-08	3.544-04	1.759-07	3.484-03	1.225-04	3.961-03
8.000+07	6.371-06	2.593-01	1.216-04	3.483+00	1.266-01	3.869+00	6.871-09	2.796-04	1.311-07	3.756-03	1.365-04	4.172-03
1.000+08	4.077-06	2.152-01	9.687-05	3.663+00	1.362-01	4.015+00	4.396-09	2.321-04	1.045-07	3.950-03	1.469-04	4.329-03
1.500+08	1.812-06	1.532-01	6.424-05	3.953+00	1.524-01	4.259+00	1.954-09	1.652-04	6.927-08	4.263-03	1.643-04	4.592-03
2.000+08	1.019-06	1.202-01	4.805-05	4.128+00	1.626-01	4.411+00	1.099-09	1.296-04	5.181-08	4.451-03	1.753-04	4.756-03
3.000+08	4.530-07	8.516-02	3.195-05	4.332+00	1.753-01	4.592+00	4.885-10	9.183-05	3.445-08	4.671-03	1.890-04	4.952-03
4.000+08	2.548-07	6.670-02	2.393-05	4.451+00	1.830-01	4.701+00	2.748-10	7.192-05	2.580-08	4.800-03	1.973-04	5.069-03
5.000+08	1.631-07	5.521-02	1.913-05	4.529+00	1.883-01	4.773+00	1.759-10	5.953-05	2.063-08	4.884-03	2.030-04	5.146-03
6.000+08	1.133-07	4.727-02	1.593-05	4.585+00	1.922-01	4.824+00	1.222-10	5.097-05	1.718-08	4.944-03	2.073-04	5.202-03
8.000+08	6.371-08	3.692-02	1.194-05	4.660+00	1.976-01	4.895+00	6.871-11	3.981-05	1.288-08	5.025-03	2.131-04	5.278-03
1.000+09	4.077-08	3.037-02	9.549-06	4.708+00	2.013-01	4.940+00	4.396-11	3.275-05	1.030-08	5.077-03	2.171-04	5.327-03
1.500+09	1.812-08	2.121-02	6.363-06	4.779+00	2.067-01	5.007+00	1.954-11	2.287-05	6.861-09	5.153-03	2.229-04	5.399-03
2.000+09	1.019-08	1.642-02	4.771-06	4.817+00	2.099-01	5.043+00	1.099-11	1.771-05	5.145-09	5.194-03	2.263-04	5.438-03
3.000+09	4.530-09	1.142-02	3.180-06	4.859+00	2.133-01	5.084+00	4.885-12	1.231-05	3.429-09	5.240-03	2.300-04	5.482-03
4.000+09	2.548-09	8.811-03	2.384-06	4.881+00	2.153-01	5.105+00	2.748-12	9.501-06	2.571-09	5.263-03	2.322-04	5.505-03
5.000+09	1.631-09	7.204-03	1.907-06	4.896+00	2.165-01	5.120+00	1.759-12	7.768-06	2.056-09	5.279-03	2.335-04	5.521-03
6.000+09	1.133-09	6.109-03	1.589-06	4.905+00	2.174-01	5.129+00	1.222-12	6.587-06	1.713-09	5.289-03	2.344-04	5.530-03
8.000+09	6.371-10	4.707-03	1.192-06	4.918+00	2.186-01	5.141+00	6.871-13	5.076-06	1.285-09	5.303-03	2.357-04	5.544-03
1.000+10	4.077-10	3.843-03	9.536-07	4.926+00	2.193-01	5.149+00	4.396-13	4.144-06	1.028-09	5.312-03	2.365-04	5.552-03
1.500+10	1.812-10	2.656-03	6.357-07	4.938+00	2.203-01	5.161+00	1.954-13	2.864-06	6.855-10	5.325-03	2.376-04	5.565-03
2.000+10	1.019-10	2.042-03	4.767-07	4.944+00	2.209-01	5.167+00	1.099-13	2.202-06	5.140-10	5.331-03	2.382-04	5.572-03
3.000+10	4.530-11	1.408-03	3.178-07	4.950+00	2.215-01	5.173+00	4.885-14	1.518-06	3.427-10	5.338-03	2.388-04	5.579-03
4.000+10	2.548-11	1.081-03	2.384-07	4.953+00	2.218-01	5.176+00	2.748-14	1.166-06	2.571-10	5.341-03	2.392-04	5.581-03
5.000+10	1.631-11	8.803-04	1.907-07	4.956+00	2.220-01	5.179+00	1.759-14	9.492-07	2.056-10	5.344-03	2.394-04	5.584-03
6.000+10	1.133-11	7.442-04	1.589-07	4.957+00	2.222-01	5.180+00	1.222-14	8.025-07	1.713-10	5.345-03	2.396-04	5.586-03
8.000+10	6.371-12	5.706-04	1.192-07	4.959+00	2.223-01	5.182+00	6.871-15	6.153-07	1.285-10	5.347-03	2.397-04	5.588-03
1.000+11	4.077-12	4.642-04	9.534-08	4.960+00	2.224-01	5.183+00	4.396-15	5.006-07	1.028-10	5.348-03	2.398-04	5.589-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 27, CO, COBALT ATOMIC WT. = 58.9332 MSQ/KG = .00102184 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMS2/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	4.510-02	5.696+00	3.859-02	0.000	0.000	5.780+00	4.609-05	5.820-03	3.943-05	0.000	0.000	5.906-03
1.022+06	4.318-02	5.636+00	3.693-02	0.000	0.000	5.716+00	4.412-05	5.759-03	3.774-05	0.000	0.000	5.841-03
1.250+06	2.890-02	5.096+00	2.497-02	7.130-03	0.000	5.157+00	2.953-05	5.207-03	2.552-05	7.286-06	0.000	5.270-03
1.500+06	2.008-02	4.633+00	1.800-02	3.613-02	0.000	4.707+00	2.052-05	4.734-03	1.839-05	3.692-05	0.000	4.810-03
2.000+06	1.131-02	3.955+00	1.109-02	1.369-01	0.000	4.114+00	1.156-05	4.041-03	1.133-05	1.399-04	0.000	4.204-03
2.044+06	1.082-02	3.907+00	1.072-02	1.473-01	0.000	4.076+00	1.106-05	3.992-03	1.095-05	1.505-04	0.000	4.165-03
3.000+06	5.027-03	3.113+00	6.016-03	3.788-01	1.089-03	3.504+00	5.137-06	3.181-03	6.147-06	3.871-04	1.113-06	3.580-03
4.000+06	2.828-03	2.597+00	4.049-03	6.043-01	4.447-03	3.213+00	2.890-06	2.654-03	4.137-06	6.175-04	4.544-06	3.283-03
5.000+06	1.810-03	2.243+00	3.029-03	8.034-01	8.858-03	3.060+00	1.850-06	2.292-03	3.095-06	8.209-04	9.051-06	3.127-03
6.000+06	1.257-03	1.982+00	2.412-03	9.807-01	1.360-02	2.980+00	1.284-06	2.025-03	2.465-06	1.002-03	1.390-05	3.045-03
7.000+06	9.237-04	1.782+00	2.000-03	1.138+00	1.833-02	2.941+00	9.439-07	1.821-03	2.044-06	1.163-03	1.873-05	3.005-03
8.000+06	7.072-04	1.622+00	1.706-03	1.280+00	2.291-02	2.927+00	7.226-07	1.657-03	1.743-06	1.308-03	2.341-05	2.991-03
9.000+06	5.588-04	1.491+00	1.487-03	1.408+00	2.730-02	2.928+00	5.710-07	1.524-03	1.519-06	1.439-03	2.790-05	2.992-03
1.000+07	4.526-04	1.381+00	1.317-03	1.524+00	3.148-02	2.938+00	4.625-07	1.411-03	1.346-06	1.557-03	3.217-05	3.002-03
1.100+07	3.741-04	1.288+00	1.181-03	1.630+00	3.543-02	2.955+00	3.823-07	1.316-03	1.207-06	1.666-03	3.620-05	3.020-03
1.200+07	3.143-04	1.208+00	1.071-03	1.726+00	3.917-02	2.975+00	3.212-07	1.234-03	1.094-06	1.764-03	4.003-05	3.040-03
1.300+07	2.678-04	1.138+00	9.791-04	1.815+00	4.270-02	2.997+00	2.736-07	1.163-03	1.000-06	1.855-03	4.363-05	3.062-03
1.400+07	2.309-04	1.077+00	9.017-04	1.899+00	4.606-02	3.023+00	2.359-07	1.101-03	9.214-07	1.940-03	4.707-05	3.089-03
1.500+07	2.012-04	1.022+00	8.357-04	1.976+00	4.924-02	3.048+00	2.056-07	1.044-03	8.540-07	2.019-03	5.032-05	3.115-03
1.600+07	1.768-04	9.735-01	7.785-04	2.049+00	5.227-02	3.076+00	1.807-07	9.948-04	7.955-07	2.094-03	5.341-05	3.143-03
1.800+07	1.397-04	8.897-01	6.848-04	2.183+00	5.789-02	3.131+00	1.428-07	9.091-04	6.998-07	2.231-03	5.915-05	3.200-03
2.000+07	1.132-04	8.205-01	6.112-04	2.302+00	6.302-02	3.186+00	1.157-07	8.384-04	6.246-07	2.352-03	6.440-05	3.256-03
2.200+07	9.352-05	7.621-01	5.518-04	2.410+00	6.773-02	3.240+00	9.556-08	7.787-04	5.639-07	2.463-03	6.921-05	3.311-03
2.400+07	7.858-05	7.121-01	5.029-04	2.508+00	7.206-02	3.293+00	8.030-08	7.277-04	5.139-07	2.563-03	7.363-05	3.365-03
2.600+07	6.696-05	6.687-01	4.619-04	2.598+00	7.608-02	3.343+00	6.842-08	6.833-04	4.720-07	2.655-03	7.774-05	3.416-03
2.800+07	5.773-05	6.308-01	4.271-04	2.680+00	7.981-02	3.391+00	5.899-08	6.446-04	4.364-07	2.739-03	8.155-05	3.465-03
3.000+07	5.029-05	5.973-01	3.971-04	2.756+00	8.326-02	3.437+00	5.139-08	6.103-04	4.058-07	2.816-03	8.510-05	3.511-03
4.000+07	2.829-05	4.747-01	2.940-04	3.065+00	9.778-02	3.638+00	2.891-08	4.851-04	3.004-07	3.132-03	9.992-05	3.717-03
5.000+07	1.811-05	3.962-01	2.334-04	3.296+00	1.089-01	3.801+00	1.851-08	4.049-04	2.385-07	3.368-03	1.113-04	3.884-03
6.000+07	1.257-05	3.414-01	1.935-04	3.478+00	1.178-01	3.937+00	1.284-08	3.489-04	1.977-07	3.554-03	1.204-04	4.023-03
8.000+07	7.072-06	2.692-01	1.441-04	3.768+00	1.313-01	4.149+00	7.226-09	2.751-04	1.472-07	3.830-03	1.342-04	4.239-03
1.000+08	4.526-06	2.235-01	1.148-04	3.941+00	1.412-01	4.306+00	4.625-09	2.284-04	1.173-07	4.027-03	1.443-04	4.400-03
1.500+08	2.012-06	1.591-01	7.616-05	4.251+00	1.578-01	4.568+00	2.056-09	1.626-04	7.782-08	4.344-03	1.612-04	4.668-03
2.000+08	1.131-06	1.248-01	5.697-05	4.437+00	1.684-01	4.730+00	1.156-09	1.275-04	5.821-08	4.534-03	1.721-04	4.834-03
3.000+08	5.029-07	8.844-02	3.787-05	4.655+00	1.814-01	4.925+00	5.139-10	9.037-05	3.870-08	4.757-03	1.854-04	5.032-03
4.000+08	2.829-07	6.926-02	2.837-05	4.781+00	1.893-01	5.040+00	2.891-10	7.077-05	2.899-08	4.885-03	1.934-04	5.150-03
5.000+08	1.810-07	5.733-02	2.268-05	4.864+00	1.947-01	5.116+00	1.850-10	5.858-05	2.318-08	4.970-03	1.990-04	5.228-03
6.000+08	1.257-07	4.909-02	1.889-05	4.924+00	1.987-01	5.172+00	1.284-10	5.016-05	1.930-08	5.032-03	2.030-04	5.285-03
8.000+08	7.072-08	3.834-02	1.416-05	5.003+00	2.042-01	5.246+00	7.226-11	3.918-05	1.447-08	5.112-03	2.087-04	5.360-03
1.000+09	4.526-08	3.154-02	1.132-05	5.054+00	2.080-01	5.294+00	4.625-11	3.223-05	1.157-08	5.164-03	2.125-04	5.409-03
1.500+09	2.012-08	2.203-02	7.542-06	5.129+00	2.135-01	5.365+00	2.056-11	2.251-05	7.707-09	5.241-03	2.182-04	5.482-03
2.000+09	1.131-08	1.705-02	5.655-06	5.169+00	2.167-01	5.403+00	1.156-11	1.742-05	5.779-09	5.282-03	2.214-04	5.521-03
3.000+09	5.029-09	1.185-02	3.769-06	5.213+00	2.201-01	5.445+00	5.139-12	1.211-05	3.851-09	5.327-03	2.249-04	5.564-03
4.000+09	2.829-09	9.150-03	2.826-06	5.237+00	2.222-01	5.468+00	2.891-12	9.350-06	2.888-09	5.351-03	2.271-04	5.588-03
5.000+09	1.810-09	7.481-03	2.261-06	5.252+00	2.234-01	5.483+00	1.850-12	7.644-06	2.310-09	5.367-03	2.283-04	5.603-03
6.000+09	1.257-09	6.344-03	1.884-06	5.262+00	2.243-01	5.493+00	1.284-12	6.483-06	1.925-09	5.377-03	2.292-04	5.613-03
8.000+09	7.072-10	4.888-03	1.413-06	5.276+00	2.255-01	5.506+00	7.226-13	4.995-06	1.444-09	5.391-03	2.304-04	5.627-03
1.000+10	4.526-10	3.991-03	1.130-06	5.285+00	2.262-01	5.515+00	4.625-13	4.078-06	1.155-09	5.400-03	2.311-04	5.636-03
1.500+10	2.012-10	2.758-03	7.535-07	5.296+00	2.273-01	5.526+00	2.056-13	2.818-06	7.700-10	5.412-03	[illegible]	5.647-03
2.000+10	1.131-10	2.120-03	5.651-07	5.303+00	2.278-01	5.533+00	1.156-13	2.166-06	[illegible]	5.419-03	2.328-04	5.654-03
3.000+10	5.029-11	1.462-03	3.767-07	5.309+00	2.284-01	5.539+00	[illegible]	1.494-06	3.849-10	5.425-03	2.334-04	5.660-03
4.000+10	2.829-11	1.123-03	2.825-07	5.313+00	[illegible]	5.543+00	2.891-14	1.148-06	2.887-10	5.429-03	2.338-04	5.664-03
5.000+10	1.810-11	9.142-04	[illegible]	5.315+00	2.290-01	5.545+00	1.850-14	9.342-07	2.309-10	5.431-03	2.340-04	5.666-03
6.000+10	[illegible]	7.728-04	1.884-07	5.317+00	2.291-01	5.547+00	1.284-14	7.897-07	1.925-10	5.433-03	2.341-04	5.668-03
8.000+10	7.072-12	5.925-04	1.413-07	5.319+00	2.293-01	5.549+00	7.226-15	6.054-07	1.444-10	5.435-03	2.343-04	5.670-03
1.000+11	4.526-12	4.821-04	1.130-07	5.320+00	2.294-01	5.550+00	4.625-15	4.926-07	1.155-10	5.436-03	2.344-04	5.671-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 28, NI, NICKEL ATOMIC WT. = 58.69 MSQ/KG = .00102608 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	4.990-02	5.907+00	4.575-02	0.000	0.000	6.003+00	5.120-05	6.061-03	4.694-05	0.000	0.000	6.159-03
1.022+06	4.778-02	5.844+00	4.378-02	0.000	0.000	5.936+00	4.903-05	5.996-03	4.492-05	0.000	0.000	6.090-03
1.250+06	3.198-02	5.285+00	2.960-02	7.777-03	0.000	5.354+00	3.281-05	5.423-03	3.037-05	7.980-06	0.000	5.494-03
1.500+06	2.222-02	4.805+00	2.135-02	3.921-02	0.000	4.888+00	2.280-05	4.930-03	2.189-05	4.023-05	0.000	5.015-03
2.000+06	1.251-02	4.102+00	1.314-02	1.479-01	0.000	4.276+00	1.284-05	4.200-03	1.348-05	1.518-04	0.000	4.387-03
2.044+06	1.198-02	4.051+00	1.269-02	1.590-01	0.000	4.235+00	1.229-05	4.157-03	1.302-05	1.631-04	0.000	4.345-03
3.000+06	5.563-03	3.228+00	7.115-03	4.082-01	1.130-03	3.650+00	5.708-06	3.312-03	7.301-06	4.188-04	1.159-06	3.745-03
4.000+06	3.130-03	2.693+00	4.785-03	6.505-01	4.611-03	3.356+00	3.212-06	2.763-03	4.910-06	6.675-04	4.731-06	3.444-03
5.000+06	2.003-03	2.326+00	3.578-03	8.642-01	9.185-03	3.205+00	2.055-06	2.387-03	3.671-06	8.867-04	9.425-06	3.289-03
6.000+06	1.391-03	2.056+00	2.847-03	1.054+00	1.410-02	3.128+00	1.427-06	2.110-03	2.921-06	1.081-03	1.447-05	3.210-03
7.000+06	1.022-03	1.848+00	2.360-03	1.223+00	1.900-02	3.093+00	1.049-06	1.896-03	2.422-06	1.255-03	1.950-05	3.174-03
8.000+06	7.826-04	1.682+00	2.013-03	1.375+00	2.376-02	3.084+00	8.030-07	1.726-03	2.065-06	1.411-03	2.438-05	3.164-03
9.000+06	6.184-04	1.546+00	1.754-03	1.513+00	2.831-02	3.090+00	6.345-07	1.586-03	1.800-06	1.552-03	2.905-05	3.170-03
1.000+07	5.009-04	1.432+00	1.553-03	1.637+00	3.264-02	3.104+00	5.140-07	1.469-03	1.593-06	1.680-03	3.349-05	3.185-03
1.100+07	4.140-04	1.336+00	1.393-03	1.751+00	3.674-02	3.126+00	4.248-07	1.371-03	1.429-06	1.797-03	3.770-05	3.207-03
1.200+07	3.478-04	1.253+00	1.263-03	1.854+00	4.061-02	3.149+00	3.569-07	1.286-03	1.296-06	1.902-03	4.167-05	3.231-03
1.300+07	2.964-04	1.180+00	1.154-03	1.950+00	4.426-02	3.176+00	3.041-07	1.211-03	1.184-06	2.001-03	4.541-05	3.259-03
1.400+07	2.556-04	1.117+00	1.063-03	2.039+00	4.775-02	3.205+00	2.623-07	1.146-03	1.091-06	2.092-03	4.900-05	3.289-03
1.500+07	2.226-04	1.060+00	9.851-04	2.123+00	5.104-02	3.235+00	2.284-07	1.088-03	1.011-06	2.178-03	5.237-05	3.320-03
1.600+07	1.957-04	1.010+00	9.177-04	2.201+00	5.418-02	3.266+00	2.008-07	1.036-03	9.416-07	2.258-03	5.559-05	3.351-03
1.800+07	1.546-04	9.227-01	8.072-04	2.344+00	6.001-02	3.328+00	1.586-07	9.468-04	8.282-07	2.405-03	6.157-05	3.414-03
2.000+07	1.252-04	8.509-01	7.203-04	2.471+00	6.532-02	3.388+00	1.285-07	8.731-04	7.391-07	2.535-03	6.702-05	3.476-03
2.200+07	1.035-04	7.903-01	6.502-04	2.587+00	7.020-02	3.448+00	1.062-07	8.109-04	6.672-07	2.654-03	7.203-05	3.538-03
2.400+07	8.697-05	7.385-01	5.925-04	2.692+00	7.469-02	3.506+00	8.924-08	7.578-04	6.080-07	2.762-03	7.664-05	3.597-03
2.600+07	7.410-05	6.935-01	5.442-04	2.788+00	7.884-02	3.561+00	7.603-08	7.116-04	5.584-07	2.861-03	8.090-05	3.654-03
2.800+07	6.389-05	6.542-01	5.032-04	2.876+00	8.271-02	3.613+00	6.556-08	6.713-04	5.163-07	2.951-03	8.487-05	3.708-03
3.000+07	5.566-05	6.195-01	4.679-04	2.957+00	8.631-02	3.663+00	5.711-08	6.357-04	4.801-07	3.034-03	8.856-05	3.759-03
4.000+07	3.131-05	4.922-01	3.463-04	3.289+00	1.013-01	3.883+00	3.213-08	5.050-04	3.553-07	3.375-03	1.039-04	3.984-03
5.000+07	2.004-05	4.109-01	2.749-04	3.537+00	1.128-01	4.061+00	2.056-08	4.216-04	2.821-07	3.629-03	1.157-04	4.167-03
6.000+07	1.391-05	3.540-01	2.278-04	3.732+00	1.220-01	4.208+00	1.427-08	3.632-04	2.337-07	3.829-03	1.252-04	4.318-03
8.000+07	7.826-06	2.792-01	1.697-04	4.021+00	1.359-01	4.436+00	8.030-09	2.865-04	1.741-07	4.126-03	1.394-04	4.552-03
1.000+08	5.009-06	2.317-01	1.352-04	4.228+00	1.461-01	4.606+00	5.140-09	2.377-04	1.387-07	4.338-03	1.499-04	4.726-03
1.500+08	2.226-06	1.650-01	8.968-05	4.559+00	1.632-01	4.887+00	2.284-09	1.693-04	9.202-08	4.678-03	1.675-04	5.015-03
2.000+08	1.252-06	1.294-01	6.708-05	4.757+00	1.740-01	5.060+00	1.285-09	1.328-04	6.883-08	4.881-03	1.785-04	5.192-03
3.000+08	5.565-07	9.171-02	4.460-05	4.989+00	1.874-01	5.268+00	5.710-10	9.410-05	4.576-08	5.119-03	1.923-04	5.406-03
4.000+08	3.130-07	7.183-02	3.340-05	5.122+00	1.954-01	5.389+00	3.212-10	7.370-05	3.427-08	5.256-03	2.005-04	5.530-03
5.000+08	2.003-07	5.946-02	2.670-05	5.210+00	2.010-01	5.470+00	2.055-10	6.101-05	2.740-08	5.346-03	2.062-04	5.613-03
6.000+08	1.391-07	5.091-02	2.224-05	5.273+00	2.051-01	5.529+00	1.427-10	5.224-05	2.282-08	5.411-03	2.104-04	5.673-03
8.000+08	7.826-08	3.976-02	1.667-05	5.356+00	2.107-01	5.606+00	8.030-11	4.080-05	1.710-08	5.496-03	2.162-04	5.753-03
1.000+09	5.009-08	3.271-02	1.333-05	5.411+00	2.145-01	5.658+00	5.140-11	3.356-05	1.368-08	5.552-03	2.201-04	5.806-03
1.500+09	2.226-08	2.284-02	8.880-06	5.489+00	2.201-01	5.732+00	2.284-11	2.344-05	9.112-09	5.632-03	2.258-04	5.881-03
2.000+09	1.252-08	1.768-02	6.658-06	5.532+00	2.233-01	5.773+00	1.285-11	1.814-05	6.832-09	5.676-03	2.291-04	5.924-03
3.000+09	5.565-09	1.229-02	4.438-06	5.578+00	2.268-01	5.817+00	5.710-12	1.261-05	4.554-09	5.723-03	2.327-04	5.969-03
4.000+09	3.130-09	9.489-03	3.328-06	5.603+00	2.289-01	5.841+00	3.212-12	9.736-06	3.415-09	5.749-03	2.349-04	5.994-03
5.000+09	2.003-09	7.758-03	2.662-06	5.619+00	2.301-01	5.857+00	2.055-12	7.960-06	2.731-09	5.766-03	2.361-04	6.010-03
6.000+09	1.391-09	6.579-03	2.218-06	5.630+00	2.310-01	5.868+00	1.427-12	6.751-06	2.276-09	5.777-03	2.370-04	6.021-03
8.000+09	7.826-10	5.069-03	1.664-06	5.644+00	2.322-01	5.881+00	8.030-13	5.201-06	1.707-09	5.791-03	2.383-04	6.035-03
1.000+10	5.009-10	4.139-03	1.331-06	5.653+00	2.330-01	5.890+00	5.140-13	4.247-06	1.366-09	5.800-03	2.391-04	6.044-03
1.500+10	2.226-10	2.860-03	8.872-07	5.665+00	2.340-01	5.902+00	2.284-13	2.935-06	9.103-10	5.813-03	2.401-04	6.056-03
2.000+10	1.252-10	2.199-03	6.654-07	5.672+00	2.346-01	5.909+00	1.285-13	2.256-06	6.828-10	5.820-03	2.407-04	6.063-03
3.000+10	5.565-11	1.516-03	4.436-07	5.679+00	2.352-01	5.916+00	5.710-14	1.556-06	4.552-10	5.827-03	2.413-04	6.070-03
4.000+10	3.130-11	1.164-03	3.327-07	5.683+00	2.355-01	5.920+00	3.212-14	1.194-06	3.414-10	5.831-03	2.416-04	6.074-03
5.000+10	2.003-11	9.480-04	2.661-07	5.685+00	2.358-01	5.922+00	2.055-14	9.727-07	2.730-10	5.833-03	2.419-04	6.076-03
6.000+10	1.391-11	8.014-04	2.218-07	5.686+00	2.359-01	5.923+00	1.427-14	8.223-07	2.276-10	5.834-03	2.421-04	6.077-03
8.000+10	7.826-12	6.145-04	1.663-07	5.689+00	2.360-01	5.926+00	8.030-15	6.305-07	1.706-10	5.837-03	2.422-04	6.080-03
1.000+11	5.009-12	4.999-04	1.331-07	5.690+00	2.362-01	5.927+00	5.140-15	5.129-07	1.366-10	5.838-03	2.424-04	6.081-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 29, CU, COPPER ATOMIC WT. = 63.546 MSQ/KG = .00094767 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	5.517-02	6.117+00	5.388-02	0.000	0.000	6.226+00	5.228-05	5.797-03	5.106-05	0.000	0.000	5.900-03
1.022+06	5.283-02	6.052+00	5.155-02	0.000	0.000	6.156+00	5.007-05	5.735-03	4.885-05	0.000	0.000	5.834-03
1.250+06	3.536-02	5.473+00	3.485-02	8.463-03	0.000	5.552+00	3.351-05	5.187-03	3.303-05	8.020-06	0.000	5.261-03
1.500+06	2.458-02	4.976+00	2.511-02	4.246-02	0.000	5.068+00	2.329-05	4.716-03	2.380-05	4.024-05	0.000	4.803-03
2.000+06	1.284-02	4.248+00	1.545-02	1.594-01	0.000	4.437+00	1.312-05	4.026-03	1.464-05	1.511-04	0.000	4.205-03
2.044+06	1.325-02	4.196+00	1.492-02	1.713-01	0.000	4.395+00	1.256-05	3.976-03	1.414-05	1.623-04	0.000	4.165-03
3.000+06	6.152-03	3.343+00	8.359-03	4.388-01	1.170-03	3.797+00	5.830-06	3.168-03	7.922-06	4.158-04	1.109-06	3.599-03
4.000+06	3.461-03	2.789+00	5.618-03	6.983-01	4.776-03	3.501+00	3.280-06	2.643-03	5.324-06	6.618-04	4.526-06	3.318-03
5.000+06	2.216-03	2.409+00	4.198-03	9.272-01	9.512-03	3.352+00	2.100-06	2.283-03	3.978-06	8.787-04	9.014-06	3.177-03
6.000+06	1.539-03	2.129+00	3.340-03	1.131+00	1.460-02	3.279+00	1.458-06	2.018-03	3.165-06	1.072-03	1.384-05	3.108-03
7.000+06	1.130-03	1.914+00	2.767-03	1.312+00	1.968-02	3.250+00	1.071-06	1.814-03	2.622-06	1.243-03	1.865-05	3.080-03
8.000+06	8.655-04	1.742+00	2.360-03	1.474+00	2.460-02	3.244+00	8.202-07	1.651-03	2.236-06	1.397-03	2.331-05	3.074-03
9.000+06	6.839-04	1.601+00	2.055-03	1.621+00	2.931-02	3.254+00	6.481-07	1.517-03	1.947-06	1.536-03	2.778-05	3.084-03
1.000+07	5.539-04	1.483+00	1.820-03	1.755+00	3.379-02	3.274+00	5.249-07	1.405-03	1.725-06	1.663-03	3.202-05	3.103-03
1.100+07	4.578-04	1.384+00	1.632-03	1.875+00	3.804-02	3.299+00	4.338-07	1.312-03	1.547-06	1.777-03	3.605-05	3.126-03
1.200+07	3.847-04	1.298+00	1.479-03	1.986+00	4.205-02	3.328+00	3.646-07	1.230-03	1.402-06	1.882-03	3.985-05	3.154-03
1.300+07	3.278-04	1.222+00	1.352-03	2.089+00	4.583-02	3.359+00	3.106-07	1.158-03	1.281-06	1.980-03	4.343-05	3.183-03
1.400+07	2.826-04	1.157+00	1.245-03	2.185+00	4.943-02	3.393+00	2.678-07	1.096-03	1.180-06	2.071-03	4.684-05	3.215-03
1.500+07	2.462-04	1.098+00	1.154-03	2.274+00	5.285-02	3.426+00	2.333-07	1.041-03	1.094-06	2.155-03	5.008-05	3.247-03
1.600+07	2.164-04	1.046+00	1.075-03	2.357+00	5.610-02	3.460+00	2.051-07	9.913-04	1.019-06	2.234-03	5.316-05	3.279-03
1.800+07	1.710-04	9.557-01	9.451-04	2.510+00	6.212-02	3.529+00	1.621-07	9.057-04	8.956-07	2.379-03	5.887-05	3.344-03
2.000+07	1.385-04	8.813-01	8.433-04	2.646+00	6.762-02	3.596+00	1.313-07	8.352-04	7.992-07	2.508-03	6.408-05	3.408-03
2.200+07	1.145-04	8.185-01	7.612-04	2.770+00	7.266-02	3.662+00	1.085-07	7.757-04	7.214-07	2.625-03	6.886-05	3.470-03
2.400+07	9.617-05	7.649-01	6.936-04	2.882+00	7.731-02	3.725+00	9.114-08	7.249-04	6.573-07	2.731-03	7.326-05	3.530-03
2.600+07	8.195-05	7.183-01	6.371-04	2.985+00	8.161-02	3.786+00	7.766-08	6.807-04	6.038-07	2.829-03	7.734-05	3.588-03
2.800+07	7.066-05	6.775-01	5.896-04	3.079+00	8.560-02	3.843+00	6.696-08	6.420-04	5.582-07	2.918-03	8.112-05	3.642-03
3.000+07	6.155-05	6.416-01	5.477-04	3.166+00	8.932-02	3.898+00	5.833-08	6.080-04	5.190-07	3.000-03	8.465-05	3.694-03
4.000+07	3.462-05	5.098-01	4.053-04	3.521+00	1.048-01	4.136+00	3.281-08	4.831-04	3.841-07	3.337-03	9.932-05	3.920-03
5.000+07	2.216-05	4.256-01	3.216-04	3.787+00	1.167-01	4.330+00	2.100-08	4.033-04	3.048-07	3.589-03	1.106-04	4.103-03
6.000+07	1.539-05	3.667-01	2.666-04	3.995+00	1.261-01	4.488+00	1.458-08	3.475-04	2.526-07	3.786-03	1.195-04	4.253-03
8.000+07	8.655-06	2.892-01	1.986-04	4.304+00	1.405-01	4.734+00	8.202-09	2.741-04	1.882-07	4.079-03	1.331-04	4.486-03
1.000+08	5.539-06	2.400-01	1.582-04	4.525+00	1.510-01	4.916+00	5.249-09	2.274-04	1.499-07	4.288-03	1.431-04	4.659-03
1.500+08	2.462-06	1.709-01	1.049-04	4.876+00	1.685-01	5.216+00	2.333-09	1.620-04	9.941-08	4.621-03	1.597-04	4.943-03
2.000+08	1.385-06	1.340-01	7.847-05	5.087+00	1.796-01	5.401+00	1.313-09	1.270-04	7.436-08	4.821-03	1.702-04	5.118-03
3.000+08	6.155-07	9.499-02	5.217-05	5.332+00	1.932-01	5.620+00	5.833-10	9.002-05	4.944-08	5.053-03	1.831-04	5.326-03
4.000+08	3.462-07	7.439-02	3.907-05	5.473+00	2.013-01	5.749+00	3.281-10	7.050-05	3.703-08	5.187-03	1.908-04	5.448-03
5.000+08	2.216-07	6.158-02	3.123-05	5.566+00	2.069-01	5.835+00	2.100-10	5.836-05	2.960-08	5.275-03	1.961-04	5.529-03
6.000+08	1.539-07	5.273-02	2.601-05	5.632+00	2.110-01	5.896+00	1.458-10	4.997-05	2.465-08	5.337-03	2.000-04	5.587-03
8.000+08	8.655-08	4.118-02	1.950-05	5.720+00	2.166-01	5.978+00	8.202-11	3.902-05	1.848-08	5.421-03	2.053-04	5.665-03
1.000+09	5.539-08	3.388-02	1.559-05	5.778+00	2.204-01	6.032+00	5.249-11	3.211-05	1.477-08	5.476-03	2.089-04	5.717-03
1.500+09	2.462-08	2.366-02	1.039-05	5.860+00	2.259-01	6.110+00	2.333-11	2.242-05	9.846-09	5.553-03	2.141-04	5.790-03
2.000+09	1.385-08	1.831-02	7.788-06	5.905+00	2.291-01	6.152+00	1.313-11	1.735-05	7.380-09	5.596-03	2.171-04	5.830-03
3.000+09	6.155-09	1.273-02	5.191-06	5.954+00	2.325-01	6.199+00	5.833-12	1.206-05	4.919-09	5.642-03	2.203-04	5.875-03
4.000+09	3.462-09	9.828-03	3.893-06	5.980+00	2.346-01	6.224+00	3.281-12	9.314-06	3.689-09	5.667-03	2.223-04	5.899-03
5.000+09	2.216-09	8.036-03	3.114-06	5.996+00	2.358-01	6.240+00	2.100-12	7.615-06	2.951-09	5.682-03	2.235-04	5.913-03
6.000+09	1.539-09	6.814-03	2.595-06	6.008+00	2.367-01	6.252+00	1.458-12	6.457-06	2.459-09	5.694-03	2.243-04	5.924-03
8.000+09	8.655-10	5.250-03	1.946-06	6.023+00	2.378-01	6.266+00	8.202-13	4.975-06	1.844-09	5.708-03	2.254-04	5.938-03
1.000+10	5.539-10	4.286-03	1.557-06	6.032+00	2.386-01	6.275+00	5.249-13	4.062-06	1.476-09	5.716-03	2.261-04	5.947-03
1.500+10	2.462-10	2.962-03	1.038-06	6.045+00	2.396-01	6.288+00	2.333-13	2.807-06	9.837-10	5.729-03	2.271-04	5.959-03
2.000+10	1.385-10	2.277-03	7.783-07	6.052+00	2.401-01	6.294+00	1.313-13	2.158-06	7.376-10	5.735-03	2.275-04	5.965-03
3.000+10	6.155-11	1.571-03	5.188-07	6.060+00	2.407-01	6.302+00	5.833-14	1.489-06	4.916-10	5.743-03	2.281-04	5.972-03
4.000+10	3.462-11	1.206-03	3.891-07	6.064+00	2.410-01	6.306+00	3.281-14	1.143-06	3.687-10	5.747-03	2.284-04	5.976-03
5.000+10	2.216-11	9.819-04	3.113-07	6.066+00	2.413-01	6.308+00	2.100-14	9.305-07	2.950-10	5.749-03	2.287-04	5.978-03
6.000+10	1.539-11	8.300-04	2.594-07	6.067+00	2.414-01	6.309+00	1.458-14	7.866-07	2.458-10	5.749-03	2.288-04	5.979-03
8.000+10	8.655-12	6.364-04	1.946-07	6.070+00	2.415-01	6.312+00	8.202-15	6.031-07	1.844-10	5.752-03	2.289-04	5.982-03
1.000+11	5.539-12	5.178-04	1.556-07	6.071+00	2.417-01	6.313+00	5.249-15	4.907-07	1.475-10	5.753-03	2.291-04	5.983-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 30, ZN, ZINC ATOMIC WT. = 65.38 MSQ/KG = .00092108 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	6.060-02	6.327+00	6.313-02	0.000	0.000	6.451+00	5.582-05	5.828-03	5.815-05	0.000	0.000	5.942-03
1.022+06	5.803-02	6.260+00	6.040-02	0.000	0.000	6.378+00	5.345-05	5.766-03	5.563-05	0.000	0.000	5.875-03
1.250+06	3.885-02	5.661+00	4.083-02	9.179-03	0.000	5.750+00	3.578-05	5.214-03	3.761-05	8.455-06	0.000	5.296-03
1.500+06	2.700-02	5.147+00	2.940-02	4.586-02	0.000	5.249+00	2.487-05	4.741-03	2.708-05	4.224-05	0.000	4.835-03
2.000+06	1.520-02	4.394+00	1.808-02	1.714-01	0.000	4.599+00	1.400-05	4.047-03	1.665-05	1.579-04	0.000	4.236-03
2.044+06	1.455-02	4.340+00	1.746-02	1.842-01	0.000	4.556+00	1.340-05	3.998-03	1.608-05	1.697-04	0.000	4.197-03
3.000+06	6.759-03	3.458+00	9.773-03	4.706-01	1.210-03	3.946+00	6.226-06	3.185-03	9.002-06	4.335-04	1.115-06	3.635-03
4.000+06	3.803-03	2.885+00	6.563-03	7.480-01	4.940-03	3.643+00	3.503-06	2.657-03	6.045-06	6.890-04	4.550-06	3.360-03
5.000+06	2.434-03	2.492+00	4.902-03	9.925-01	9.839-03	3.502+00	2.242-06	2.295-03	4.515-06	9.142-04	9.063-06	3.225-03
6.000+06	1.690-03	2.202+00	3.898-03	1.209+00	1.511-02	3.432+00	1.557-06	2.028-03	3.590-06	1.114-03	1.392-05	3.161-03
7.000+06	1.242-03	1.980+00	3.229-03	1.402+00	2.035-02	3.407+00	1.144-06	1.824-03	2.974-06	1.291-03	1.874-05	3.138-03
8.000+06	9.509-04	1.802+00	2.753-03	1.576+00	2.544-02	3.407+00	8.759-07	1.660-03	2.536-06	1.452-03	2.343-05	3.138-03
9.000+06	7.514-04	1.656+00	2.397-03	1.733+00	3.032-02	3.422+00	6.921-07	1.525-03	2.208-06	1.596-03	2.793-05	3.152-03
1.000+07	6.086-04	1.535+00	2.122-03	1.875+00	3.495-02	3.448+00	5.606-07	1.414-03	1.955-06	1.727-03	3.219-05	3.176-03
1.100+07	5.030-04	1.431+00	1.903-03	2.004+00	3.934-02	3.477+00	4.633-07	1.318-03	1.753-06	1.846-03	3.624-05	3.202-03
1.200+07	4.227-04	1.342+00	1.724-03	2.123+00	4.348-02	3.511+00	3.893-07	1.236-03	1.588-06	1.955-03	4.005-05	3.234-03
1.300+07	3.601-04	1.265+00	1.576-03	2.232+00	4.739-02	3.546+00	3.317-07	1.165-03	1.452-06	2.056-03	4.365-05	3.266-03
1.400+07	3.105-04	1.196+00	1.451-03	2.334+00	5.112-02	3.583+00	2.860-07	1.102-03	1.336-06	2.150-03	4.709-05	3.300-03
1.500+07	2.705-04	1.136+00	1.345-03	2.429+00	5.465-02	3.621+00	2.492-07	1.046-03	1.239-06	2.237-03	5.034-05	3.335-03
1.600+07	2.377-04	1.082+00	1.252-03	2.518+00	5.801-02	3.659+00	2.189-07	9.966-04	1.153-06	2.319-03	5.343-05	3.371-03
1.800+07	1.879-04	9.886-01	1.101-03	2.682+00	6.424-02	3.736+00	1.731-07	9.106-04	1.014-06	2.470-03	5.917-05	3.441-03
2.000+07	1.522-04	9.117-01	9.825-04	2.828+00	6.992-02	3.811+00	1.402-07	8.398-04	9.050-07	2.605-03	6.440-05	3.510-03
2.200+07	1.258-04	8.468-01	8.868-04	2.960+00	7.513-02	3.883+00	1.159-07	7.800-04	8.168-07	2.726-03	6.920-05	3.577-03
2.400+07	1.057-04	7.913-01	8.080-04	3.079+00	7.993-02	3.951+00	9.736-08	7.289-04	7.442-07	2.836-03	7.362-05	3.639-03
2.600+07	9.003-05	7.430-01	7.421-04	3.189+00	8.436-02	4.017+00	8.293-08	6.844-04	6.835-07	2.937-03	7.770-05	3.700-03
2.800+07	7.763-05	7.009-01	6.861-04	3.289+00	8.849-02	4.079+00	7.150-08	6.456-04	6.320-07	3.029-03	8.151-05	3.757-03
3.000+07	6.763-05	6.637-01	6.379-04	3.382+00	9.233-02	4.139+00	6.229-08	6.113-04	5.876-07	3.115-03	8.504-05	3.812-03
4.000+07	3.804-05	5.274-01	4.720-04	3.761+00	1.083-01	4.397+00	3.504-08	4.858-04	4.348-07	3.464-03	9.975-05	4.050-03
5.000+07	2.434-05	4.402-01	3.745-04	4.045+00	1.206-01	4.606+00	2.242-08	4.055-04	3.449-07	3.726-03	1.111-04	4.243-03
6.000+07	1.691-05	3.793-01	3.104-04	4.266+00	1.303-01	4.776+00	1.558-08	3.494-04	2.859-07	3.929-03	1.200-04	4.399-03
8.000+07	9.509-06	2.991-01	2.312-04	4.595+00	1.451-01	5.039+00	8.759-09	2.755-04	2.130-07	4.232-03	1.336-04	4.642-03
1.000+08	6.086-06	2.483-01	1.842-04	4.829+00	1.559-01	5.233+00	5.606-09	2.287-04	1.697-07	4.448-03	1.436-04	4.820-03
1.500+08	2.705-06	1.768-01	1.221-04	5.203+00	1.739-01	5.554+00	2.492-09	1.628-04	1.125-07	4.792-03	1.602-04	5.116-03
2.000+08	1.521-06	1.386-01	9.134-05	5.426+00	1.852-01	5.750+00	1.401-09	1.277-04	8.413-08	4.998-03	1.706-04	5.296-03
3.000+08	6.762-07	9.826-02	6.073-05	5.686+00	1.992-01	5.984+00	6.228-10	9.051-05	5.594-08	5.237-03	1.835-04	5.511-03
4.000+08	3.804-07	7.696-02	4.548-05	5.835+00	2.075-01	6.120+00	3.504-10	7.089-05	4.189-08	5.375-03	1.911-04	5.637-03
5.000+08	2.434-07	6.370-02	3.635-05	5.933+00	2.133-01	6.210+00	2.242-10	5.867-05	3.348-08	5.465-03	1.965-04	5.720-03
6.000+08	1.691-07	5.454-02	3.028-05	6.004+00	2.175-01	6.276+00	1.558-10	5.024-05	2.789-08	5.530-03	2.003-04	5.781-03
8.000+08	9.509-08	4.260-02	2.269-05	6.097+00	2.233-01	6.363+00	8.759-11	3.924-05	2.090-08	5.616-03	2.057-04	5.861-03
1.000+09	6.086-08	3.505-02	1.815-05	6.158+00	2.272-01	6.420+00	5.606-11	3.228-05	1.672-08	5.672-03	2.093-04	5.914-03
1.500+09	2.705-08	2.448-02	1.209-05	6.245+00	2.330-01	6.502+00	2.492-11	2.255-05	1.114-08	5.752-03	2.146-04	5.989-03
2.000+09	1.521-08	1.894-02	9.066-06	6.293+00	2.363-01	6.548+00	1.401-11	1.745-05	8.351-09	5.796-03	2.177-04	6.031-03
3.000+09	6.762-09	1.317-02	6.042-06	6.344+00	2.398-01	6.597+00	6.228-12	1.213-05	5.565-09	5.843-03	2.209-04	6.076-03
4.000+09	3.804-09	1.017-02	4.531-06	6.372+00	2.419-01	6.624+00	3.504-12	9.367-06	4.173-09	5.869-03	2.228-04	6.101-03
5.000+09	2.434-09	8.313-03	3.624-06	6.389+00	2.432-01	6.641+00	2.242-12	7.657-06	3.338-09	5.885-03	2.240-04	6.116-03
6.000+09	1.691-09	7.049-03	3.020-06	6.401+00	2.441-01	6.652+00	1.558-12	6.493-06	2.782-09	5.896-03	2.248-04	6.127-03
8.000+09	9.509-10	5.431-03	2.265-06	6.417+00	2.453-01	6.668+00	8.759-13	5.002-06	2.086-09	5.911-03	2.259-04	6.142-03
1.000+10	6.086-10	4.434-03	1.812-06	6.427+00	2.461-01	6.678+00	5.606-13	4.084-06	1.669-09	5.920-03	2.267-04	6.151-03
1.500+10	2.705-10	3.064-03	1.208-06	6.441+00	2.471-01	6.691+00	2.492-13	2.822-06	1.113-09	5.933-03	2.276-04	6.163-03
2.000+10	1.521-10	2.356-03	9.059-07	6.448+00	2.478-01	6.698+00	1.401-13	2.170-06	8.344-10	5.939-03	2.282-04	6.170-03
3.000+10	6.762-11	1.625-03	6.039-07	6.456+00	2.483-01	6.706+00	6.228-14	1.497-06	5.562-10	5.947-03	2.287-04	6.177-03
4.000+10	3.804-11	1.247-03	4.529-07	6.460+00	2.487-01	6.710+00	3.504-14	1.149-06	4.172-10	5.950-03	2.291-04	6.180-03
5.000+10	2.434-11	1.016-03	3.623-07	6.463+00	2.489-01	6.713+00	2.242-14	9.358-07	3.337-10	5.953-03	2.293-04	6.183-03
6.000+10	1.691-11	8.586-04	3.019-07	6.465+00	2.491-01	6.715+00	1.558-14	7.908-07	2.781-10	5.955-03	2.294-04	6.185-03
8.000+10	9.509-12	6.584-04	2.265-07	6.467+00	2.492-01	6.717+00	8.759-15	6.064-07	2.086-10	5.957-03	2.295-04	6.187-03
1.000+11	6.086-12	5.356-04	1.812-07	6.468+00	2.493-01	6.718+00	5.606-15	4.933-07	1.669-10	5.958-03	2.296-04	6.188-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 31, GA, GALLIUM ATOMIC WT. = 69.72 MSQ/KG = .00086375 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	6.635-02	6.537+00	7.355-02	0.000	0.000	6.677+00	5.731-05	5.646-03	6.353-05	0.000	0.000	5.767-03
1.022+06	6.353-02	6.468+00	7.037-02	0.000	0.000	6.602+00	5.487-05	5.587-03	6.078-05	0.000	0.000	5.702-03
1.250+06	4.253-02	5.850+00	4.756-02	9.935-03	0.000	5.950+00	3.674-05	5.053-03	4.108-05	8.581-06	0.000	5.139-03
1.500+06	2.956-02	5.319+00	3.424-02	4.944-02	0.000	5.432+00	2.553-05	4.594-03	2.957-05	4.270-05	0.000	4.692-03
2.000+06	1.664-02	4.540+00	2.105-02	1.840-01	0.000	4.762+00	1.437-05	3.921-03	1.818-05	1.589-04	0.000	4.113-03
2.044+06	1.593-02	4.485+00	2.032-02	1.976-01	0.000	4.719+00	1.376-05	3.874-03	1.755-05	1.707-04	0.000	4.076-03
3.000+06	7.401-03	3.573+00	1.136-02	5.036-01	1.251-03	4.097+00	6.393-06	3.086-03	9.812-06	4.350-04	1.081-06	3.538-03
4.000+06	4.164-03	2.981+00	7.624-03	7.994-01	5.104-03	3.797+00	3.597-06	2.575-03	6.585-06	6.905-04	4.409-06	3.280-03
5.000+06	2.665-03	2.575+00	5.692-03	1.060+00	1.017-02	3.654+00	2.302-06	2.224-03	4.916-06	9.156-04	8.784-06	3.156-03
6.000+06	1.851-03	2.276+00	4.524-03	1.290+00	1.561-02	3.588+00	1.599-06	1.966-03	3.908-06	1.114-03	1.348-05	3.099-03
7.000+06	1.360-03	2.046+00	3.746-03	1.496+00	2.103-02	3.568+00	1.175-06	1.767-03	3.236-06	1.292-03	1.816-05	3.082-03
8.000+06	1.041-03	1.862+00	3.193-03	1.680+00	2.629-02	3.573+00	8.992-07	1.608-03	2.758-06	1.451-03	2.271-05	3.086-03
9.000+06	8.228-04	1.711+00	2.780-03	1.848+00	3.132-02	3.594+00	7.107-07	1.478-03	2.401-06	1.596-03	2.705-05	3.104-03
1.000+07	6.664-04	1.586+00	2.460-03	1.999+00	3.611-02	3.624+00	5.756-07	1.370-03	2.125-06	1.727-03	3.119-05	3.130-03
1.100+07	5.508-04	1.479+00	2.206-03	2.137+00	4.064-02	3.659+00	4.758-07	1.277-03	1.905-06	1.846-03	3.510-05	3.161-03
1.200+07	4.628-04	1.387+00	1.999-03	2.263+00	4.492-02	3.697+00	3.997-07	1.198-03	1.727-06	1.955-03	3.880-05	3.194-03
1.300+07	3.943-04	1.307+00	1.827-03	2.379+00	4.896-02	3.737+00	3.406-07	1.129-03	1.578-06	2.055-03	4.229-05	3.228-03
1.400+07	3.400-04	1.236+00	1.682-03	2.487+00	5.281-02	3.778+00	2.937-07	1.068-03	1.453-06	2.148-03	4.561-05	3.263-03
1.500+07	2.962-04	1.174+00	1.558-03	2.588+00	5.645-02	3.820+00	2.558-07	1.014-03	1.346-06	2.235-03	4.876-05	3.300-03
1.600+07	2.603-04	1.118+00	1.451-03	2.683+00	5.991-02	3.863+00	2.248-07	9.657-04	1.253-06	2.317-03	5.175-05	3.336-03
1.800+07	2.057-04	1.022+00	1.276-03	2.858+00	6.635-02	3.948+00	1.777-07	8.827-04	1.102-06	2.469-03	5.731-05	3.410-03
2.000+07	1.666-04	9.420-01	1.138-03	3.013+00	7.221-02	4.029+00	1.439-07	8.136-04	9.829-07	2.602-03	6.237-05	3.480-03
2.200+07	1.377-04	8.750-01	1.027-03	3.154+00	7.759-02	4.108+00	1.189-07	7.558-04	8.871-07	2.724-03	6.702-05	3.548-03
2.400+07	1.157-04	8.176-01	9.361-04	3.282+00	8.254-02	4.183+00	9.994-08	7.062-04	8.086-07	2.835-03	7.129-05	3.613-03
2.600+07	9.859-05	7.678-01	8.596-04	3.398+00	8.712-02	4.254+00	8.516-08	6.632-04	7.425-07	2.935-03	7.525-05	3.674-03
2.800+07	8.501-05	7.243-01	7.947-04	3.506+00	9.137-02	4.323+00	7.343-08	6.256-04	6.864-07	3.028-03	7.892-05	3.734-03
3.000+07	7.405-05	6.858-01	7.388-04	3.604+00	9.534-02	4.386+00	6.396-08	5.924-04	6.381-07	3.113-03	8.235-05	3.788-03
4.000+07	4.165-05	5.450-01	5.466-04	4.008+00	1.118-01	4.665+00	3.598-08	4.707-04	4.721-07	3.462-03	9.657-05	4.030-03
5.000+07	2.666-05	4.549-01	4.337-04	4.309+00	1.244-01	4.889+00	2.303-08	3.929-04	3.746-07	3.722-03	1.075-04	4.223-03
6.000+07	1.851-05	3.920-01	3.594-04	4.545+00	1.345-01	5.072+00	1.599-08	3.386-04	3.104-07	3.926-03	1.162-04	4.381-03
8.000+07	1.041-05	3.091-01	2.677-04	4.894+00	1.497-01	5.353+00	8.992-09	2.670-04	2.312-07	4.227-03	1.293-04	4.624-03
1.000+08	6.664-06	2.566-01	2.133-04	5.143+00	1.608-01	5.561+00	5.756-09	2.216-04	1.842-07	4.442-03	1.389-04	4.803-03
1.500+08	2.962-06	1.827-01	1.414-04	5.539+00	1.793-01	5.901+00	2.558-09	1.578-04	1.221-07	4.784-03	1.549-04	5.097-03
2.000+08	1.666-06	1.433-01	1.057-04	5.775+00	1.909-01	6.109+00	1.439-09	1.238-04	9.130-08	4.988-03	1.649-04	5.277-03
3.000+08	7.404-07	1.015-01	7.030-05	6.050+00	2.052-01	6.357+00	6.395-10	8.767-05	6.072-08	5.226-03	1.772-04	5.491-03
4.000+08	4.165-07	7.952-02	5.265-05	6.209+00	2.138-01	6.502+00	3.598-10	6.869-05	4.548-08	5.363-03	1.847-04	5.616-03
5.000+08	2.666-07	6.583-02	4.208-05	6.313+00	2.197-01	6.599+00	2.303-10	5.686-05	3.635-08	5.453-03	1.898-04	5.699-03
6.000+08	1.851-07	5.636-02	3.505-05	6.387+00	2.241-01	6.667+00	1.599-10	4.868-05	3.027-08	5.517-03	1.936-04	5.759-03
8.000+08	1.041-07	4.402-02	2.627-05	6.486+00	2.301-01	6.760+00	8.992-11	3.802-05	2.269-08	5.602-03	1.987-04	5.839-03
1.000+09	6.664-08	3.621-02	2.101-05	6.550+00	2.341-01	6.820+00	5.756-11	3.128-05	1.815-08	5.658-03	2.022-04	5.891-03
1.500+09	2.962-08	2.529-02	1.400-05	6.643+00	2.400-01	6.908+00	2.558-11	2.184-05	1.209-08	5.738-03	2.073-04	5.967-03
2.000+09	1.666-08	1.957-02	1.049-05	6.693+00	2.434-01	6.956+00	1.439-11	1.690-05	9.061-09	5.781-03	2.102-04	6.008-03
3.000+09	7.404-09	1.361-02	6.994-06	6.748+00	2.471-01	7.009+00	6.395-12	1.176-05	6.041-09	5.829-03	2.134-04	6.054-03
4.000+09	4.165-09	1.051-02	5.245-06	6.777+00	2.493-01	7.037+00	3.598-12	9.078-06	4.530-09	5.854-03	2.153-04	6.078-03
5.000+09	2.666-09	8.590-03	4.195-06	6.796+00	2.506-01	7.055+00	2.303-12	7.420-06	3.623-09	5.873-03	2.165-04	6.094-03
6.000+09	1.851-09	7.284-03	3.496-06	6.809+00	2.515-01	7.068+00	1.599-12	6.292-06	3.020-09	5.881-03	2.172-04	6.105-03
8.000+09	1.041-09	5.612-03	2.622-06	6.825+00	2.528-01	7.083+00	8.992-13	4.847-06	2.265-09	5.895-03	2.184-04	6.118-03
1.000+10	6.664-10	4.582-03	2.097-06	6.836+00	2.536-01	7.094+00	5.756-13	3.958-06	1.811-09	5.905-03	2.190-04	6.128-03
1.500+10	2.962-10	3.167-03	1.398-06	6.850+00	2.546-01	7.108+00	2.558-13	2.735-06	1.208-09	5.917-03	2.199-04	6.139-03
2.000+10	1.666-10	2.434-03	1.049-06	6.858+00	2.553-01	7.116+00	1.439-13	2.102-06	9.061-10	5.924-03	2.205-04	6.146-03
3.000+10	7.404-11	1.679-03	6.990-07	6.867+00	2.559-01	7.125+00	6.395-14	1.450-06	6.038-10	5.931-03	2.210-04	6.154-03
4.000+10	4.165-11	1.289-03	5.243-07	6.871+00	2.563-01	7.129+00	3.598-14	1.113-06	4.529-10	5.935-03	2.214-04	6.157-03
5.000+10	2.666-11	1.050-03	4.194-07	6.874+00	2.565-01	7.132+00	2.303-14	9.069-07	3.623-10	5.937-03	2.216-04	6.160-03
6.000+10	1.851-11	8.873-04	3.495-07	6.876+00	2.566-01	7.133+00	1.599-14	7.664-07	3.019-10	5.939-03	2.216-04	6.162-03
8.000+10	1.041-11	6.803-04	2.621-07	6.878+00	2.568-01	7.135+00	8.992-15	5.876-07	2.264-10	5.941-03	2.218-04	6.163-03
1.000+11	6.664-12	5.535-04	2.097-07	6.879+00	2.569-01	7.136+00	5.756-15	4.781-07	1.811-10	5.942-03	2.219-04	6.164-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 32, GE, GERMANIUM ATOMIC WT. = 72.59 MSQ/KG = .00082960 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	7.242-02	6.747+00	8.526-02	0.000	0.000	6.905+00	6.008-05	5.597-03	7.073-05	0.000	0.000	5.728-03
1.022+06	6.935-02	6.676+00	8.158-02	0.000	0.000	6.827+00	5.753-05	5.538-03	6.768-05	0.000	0.000	5.664-03
1.250+06	4.643-02	6.038+00	5.512-02	1.073-02	0.000	6.150+00	3.852-05	5.009-03	4.573-05	8.902-06	0.000	5.102-03
1.500+06	3.227-02	5.490+00	3.968-02	5.320-02	0.000	5.615+00	2.677-05	4.554-03	3.292-05	4.413-05	0.000	4.658-03
2.000+06	1.817-02	4.687+00	2.437-02	1.971-01	0.000	4.927+00	1.507-05	3.888-03	2.022-05	1.635-04	0.000	4.087-03
2.044+06	1.740-02	4.629+00	2.353-02	2.116-01	0.000	4.882+00	1.443-05	3.840-03	1.952-05	1.755-04	0.000	4.050-03
3.000+06	8.080-03	3.689+00	1.314-02	5.378-01	1.291-03	4.249+00	6.703-06	3.060-03	1.090-05	4.462-04	1.071-06	3.525-03
4.000+06	4.546-03	3.077+00	8.813-03	8.526-01	5.269-03	3.948+00	3.771-06	2.553-03	7.311-06	7.073-04	4.371-06	3.275-03
5.000+06	2.910-03	2.658+00	6.576-03	1.130+00	1.049-02	3.808+00	2.414-06	2.205-03	5.455-06	9.374-04	8.702-06	3.159-03
6.000+06	2.021-03	2.349+00	5.225-03	1.374+00	1.611-02	3.746+00	1.677-06	1.949-03	4.335-06	1.140-03	1.336-05	3.108-03
7.000+06	1.485-03	2.112+00	4.325-03	1.592+00	2.170-02	3.732+00	1.232-06	1.752-03	3.588-06	1.321-03	1.800-05	3.096-03
8.000+06	1.137-03	1.922+00	3.685-03	1.788+00	2.713-02	3.742+00	9.433-07	1.594-03	3.057-06	1.483-03	2.251-05	3.104-03
9.000+06	8.982-04	1.767+00	3.208-03	1.966+00	3.232-02	3.769+00	7.451-07	1.466-03	2.661-06	1.631-03	2.681-05	3.127-03
1.000+07	7.276-04	1.637+00	2.839-03	2.127+00	3.726-02	3.805+00	6.036-07	1.358-03	2.355-06	1.765-03	3.091-05	3.156-03
1.100+07	6.013-04	1.527+00	2.545-03	2.274+00	4.194-02	3.846+00	4.988-07	1.267-03	2.111-06	1.887-03	3.479-05	3.191-03
1.200+07	5.053-04	1.432+00	2.306-03	2.408+00	4.636-02	3.889+00	4.192-07	1.188-03	1.913-06	1.998-03	3.846-05	3.226-03
1.300+07	4.305-04	1.349+00	2.107-03	2.533+00	5.052-02	3.935+00	3.571-07	1.119-03	1.748-06	2.101-03	4.191-05	3.265-03
1.400+07	3.712-04	1.276+00	1.940-03	2.648+00	5.449-02	3.981+00	3.079-07	1.059-03	1.609-06	2.197-03	4.520-05	3.302-03
1.500+07	3.234-04	1.212+00	1.797-03	2.755+00	5.825-02	4.027+00	2.683-07	1.005-03	1.491-06	2.286-03	4.832-05	3.341-03
1.600+07	2.842-04	1.154+00	1.674-03	2.856+00	6.182-02	4.074+00	2.358-07	9.574-04	1.389-06	2.369-03	5.129-05	3.380-03
1.800+07	2.246-04	1.054+00	1.471-03	3.040+00	6.846-02	4.164+00	1.863-07	8.744-04	1.220-06	2.522-03	5.679-05	3.455-03
2.000+07	1.819-04	9.724-01	1.312-03	3.205+00	7.450-02	4.253+00	1.509-07	8.067-04	1.088-06	2.659-03	6.180-05	3.529-03
2.200+07	1.503-04	9.032-01	1.184-03	3.354+00	8.004-02	4.339+00	1.247-07	7.493-04	9.822-07	2.782-03	6.640-05	3.599-03
2.400+07	1.263-04	8.440-01	1.079-03	3.490+00	8.515-02	4.420+00	1.048-07	7.002-04	8.951-07	2.895-03	7.064-05	3.667-03
2.600+07	1.076-04	7.925-01	9.909-04	3.614+00	8.987-02	4.497+00	8.926-08	6.575-04	8.220-07	2.998-03	7.456-05	3.731-03
2.800+07	9.281-05	7.476-01	9.160-04	3.728+00	9.425-02	4.571+00	7.699-08	6.202-04	7.599-07	3.093-03	7.819-05	3.792-03
3.000+07	8.085-05	7.079-01	8.516-04	3.833+00	9.834-02	4.640+00	6.707-08	5.873-04	7.065-07	3.180-03	8.158-05	3.849-03
4.000+07	4.548-05	5.626-01	6.300-04	4.262+00	1.153-01	4.941+00	3.773-08	4.667-04	5.226-07	3.536-03	9.565-05	4.099-03
5.000+07	2.910-05	4.696-01	4.998-04	4.581+00	1.283-01	5.179+00	2.414-08	3.896-04	4.166-07	3.800-03	1.064-04	4.297-03
6.000+07	2.021-05	4.046-01	4.142-04	4.831+00	1.386-01	5.375+00	1.677-08	3.357-04	3.436-07	4.008-03	1.150-04	4.459-03
8.000+07	1.137-05	3.191-01	3.085-04	5.201+00	1.542-01	5.675+00	9.433-09	2.647-04	2.559-07	4.315-03	1.279-04	4.708-03
1.000+08	7.276-06	2.648-01	2.457-04	5.464+00	1.656-01	5.895+00	6.036-09	2.197-04	2.038-07	4.533-03	1.374-04	4.890-03
1.500+08	3.234-06	1.886-01	1.629-04	5.883+00	1.846-01	6.256+00	2.683-09	1.565-04	1.351-07	4.881-03	1.531-04	5.190-03
2.000+08	1.819-06	1.479-01	1.218-04	6.134+00	1.966-01	6.479+00	1.509-09	1.227-04	1.010-07	5.089-03	1.631-04	5.375-03
3.000+08	8.084-07	1.048-01	8.098-05	6.425+00	2.113-01	6.741+00	6.706-10	8.694-05	6.718-08	5.330-03	1.753-04	5.592-03
4.000+08	4.547-07	8.209-02	6.065-05	6.592+00	2.201-01	6.894+00	3.772-10	6.810-05	5.032-08	5.469-03	1.826-04	5.719-03
5.000+08	2.910-07	6.795-02	4.848-05	6.703+00	2.262-01	6.997+00	2.414-10	5.637-05	4.022-08	5.561-03	1.877-04	5.805-03
6.000+08	2.021-07	5.818-02	4.037-05	6.781+00	2.307-01	7.070+00	1.677-10	4.827-05	3.349-08	5.625-03	1.914-04	5.865-03
8.000+08	1.137-07	4.544-02	3.026-05	6.886+00	2.368-01	7.168+00	9.433-11	3.770-05	2.510-08	5.713-03	1.964-04	5.947-03
1.000+09	7.276-08	3.738-02	2.420-05	6.954+00	2.409-01	7.232+00	6.036-11	3.101-05	2.008-08	5.769-03	1.998-04	6.000-03
1.500+09	3.234-08	2.611-02	1.612-05	7.052+00	2.470-01	7.325+00	2.683-11	2.166-05	1.337-08	5.850-03	2.049-04	6.077-03
2.000+09	1.819-08	2.021-02	1.209-05	7.106+00	2.505-01	7.377+00	1.509-11	1.677-05	1.003-08	5.895-03	2.076-04	6.120-03
3.000+09	8.084-09	1.405-02	8.056-06	7.164+00	2.543-01	7.432+00	6.706-12	1.166-05	6.683-09	5.943-03	2.110-04	6.166-03
4.000+09	4.547-09	1.084-02	6.041-06	7.195+00	2.565-01	7.462+00	3.772-12	8.993-06	5.012-09	5.969-03	2.128-04	6.191-03
5.000+09	2.910-09	8.867-03	4.833-06	7.215+00	2.579-01	7.482+00	2.414-12	7.356-06	4.009-09	5.986-03	2.140-04	6.207-03
6.000+09	2.021-09	7.519-03	4.027-06	7.228+00	2.589-01	7.494+00	1.677-12	6.238-06	3.341-09	5.996-03	2.148-04	6.217-03
8.000+09	1.137-09	5.793-03	3.020-06	7.246+00	2.601-01	7.512+00	9.433-13	4.806-06	2.505-09	6.011-03	2.158-04	6.232-03
1.000+10	7.276-10	4.730-03	2.416-06	7.257+00	2.609-01	7.523+00	6.036-13	3.924-06	2.004-09	6.020-03	2.164-04	6.241-03
1.500+10	3.234-10	3.269-03	1.611-06	7.273+00	2.620-01	7.538+00	2.683-13	2.712-06	1.336-09	6.034-03	2.174-04	6.254-03
2.000+10	1.819-10	2.513-03	1.208-06	7.281+00	2.627-01	7.546+00	1.509-13	2.085-06	1.002-09	6.040-03	2.179-04	6.260-03
3.000+10	8.084-11	1.733-03	8.052-07	7.290+00	2.633-01	7.555+00	6.706-14	1.438-06	6.680-10	6.048-03	2.184-04	6.268-03
4.000+10	4.547-11	1.331-03	6.039-07	7.295+00	2.637-01	7.560+00	3.772-14	1.104-06	5.010-10	6.052-03	2.188-04	6.272-03
5.000+10	2.910-11	1.083-03	4.831-07	7.297+00	2.639-01	7.562+00	2.414-14	8.985-07	4.008-10	6.054-03	2.189-04	6.273-03
6.000+10	2.021-11	9.159-04	4.026-07	7.299+00	2.641-01	7.564+00	1.677-14	7.598-07	3.340-10	6.055-03	2.191-04	6.275-03
8.000+10	1.137-11	7.023-04	3.019-07	7.302+00	2.642-01	7.567+00	9.433-15	5.826-07	2.505-10	6.058-03	2.192-04	6.277-03
1.000+11	7.276-12	5.714-04	2.416-07	7.303+00	2.643-01	7.568+00	6.036-15	4.740-07	2.004-10	6.059-03	2.193-04	6.278-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 33, AS, ARSENIC ATOMIC WT. = 74.9216 MSQ/KG = .00080378 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	7.883-02	6.957+00	9.836-02	0.000	0.000	7.134+00	6.336-05	5.592-03	7.906-05	0.000	0.000	5.734-03
1.022+06	7.549-02	6.884+00	9.411-02	0.000	0.000	7.054+00	6.068-05	5.533-03	7.564-05	0.000	0.000	5.670-03
1.250+06	5.054-02	6.226+00	6.358-02	1.158-02	0.000	6.352+00	4.062-05	5.004-03	5.110-05	9.308-06	0.000	5.105-03
1.500+06	3.513-02	5.661+00	4.575-02	5.713-02	0.000	5.799+00	2.824-05	4.550-03	3.677-05	4.592-05	0.000	4.661-03
2.000+06	1.978-02	4.833+00	2.808-02	2.108-01	0.000	5.092+00	1.590-05	3.885-03	2.257-05	1.694-04	0.000	4.093-03
2.044+06	1.894-02	4.774+00	2.712-02	2.262-01	0.000	5.046+00	1.522-05	3.837-03	2.180-05	1.818-04	0.000	4.056-03
3.000+06	8.797-03	3.804+00	1.513-02	5.732-01	1.331-03	4.402+00	7.071-06	3.058-03	1.216-05	4.607-04	1.070-06	3.539-03
4.000+06	4.950-03	3.173+00	1.014-02	9.075-01	5.433-03	4.101+00	3.979-06	2.550-03	8.150-06	7.294-04	4.367-06	3.296-03
5.000+06	3.168-03	2.741+00	7.561-03	1.202+00	1.082-02	3.965+00	2.546-06	2.203-03	6.077-06	9.661-04	8.697-06	3.187-03
6.000+06	2.200-03	2.423+00	6.005-03	1.460+00	1.661-02	3.908+00	1.768-06	1.948-03	4.827-06	1.174-03	1.335-05	3.141-03
7.000+06	1.617-03	2.178+00	4.970-03	1.691+00	2.238-02	3.898+00	1.300-06	1.751-03	3.995-06	1.359-03	1.799-05	3.133-03
8.000+06	1.238-03	1.982+00	4.234-03	1.899+00	2.797-02	3.914+00	9.951-07	1.593-03	3.403-06	1.526-03	2.248-05	3.146-03
9.000+06	9.780-04	1.822+00	3.685-03	2.088+00	3.333-02	3.948+00	7.861-07	1.464-03	2.962-06	1.678-03	2.679-05	3.173-03
1.000+07	7.922-04	1.688+00	3.260-03	2.259+00	3.842-02	3.989+00	6.368-07	1.357-03	2.620-06	1.816-03	3.088-05	3.207-03
1.100+07	6.547-04	1.574+00	2.922-03	2.415+00	4.324-02	4.036+00	5.262-07	1.265-03	2.349-06	1.941-03	3.476-05	3.244-03
1.200+07	5.501-04	1.477+00	2.647-03	2.558+00	4.779-02	4.086+00	4.422-07	1.187-03	2.128-06	2.056-03	3.841-05	3.284-03
1.300+07	4.687-04	1.391+00	2.419-03	2.689+00	5.208-02	4.135+00	3.767-07	1.118-03	1.944-06	2.161-03	4.186-05	3.324-03
1.400+07	4.042-04	1.316+00	2.227-03	2.811+00	5.617-02	4.186+00	3.249-07	1.058-03	1.790-06	2.259-03	4.515-05	3.364-03
1.500+07	3.521-04	1.249+00	2.063-03	2.925+00	6.004-02	4.236+00	2.830-07	1.004-03	1.658-06	2.351-03	4.826-05	3.405-03
1.600+07	3.094-04	1.190+00	1.921-03	3.032+00	6.373-02	4.288+00	2.487-07	9.565-04	1.544-06	2.437-03	5.122-05	3.447-03
1.800+07	2.445-04	1.087+00	1.689-03	3.227+00	7.056-02	4.386+00	1.965-07	8.737-04	1.358-06	2.594-03	5.671-05	3.526-03
2.000+07	1.981-04	1.003+00	1.506-03	3.401+00	7.679-02	4.482+00	1.592-07	8.062-04	1.210-06	2.734-03	6.172-05	3.603-03
2.200+07	1.637-04	9.314-01	1.359-03	3.560+00	8.250-02	4.575+00	1.316-07	7.486-04	1.092-06	2.861-03	6.631-05	3.678-03
2.400+07	1.375-04	8.704-01	1.238-03	3.704+00	8.775-02	4.664+00	1.105-07	6.996-04	9.951-07	2.977-03	7.053-05	3.748-03
2.600+07	1.172-04	8.173-01	1.137-03	3.835+00	9.261-02	4.746+00	9.420-08	6.569-04	9.139-07	3.082-03	7.444-05	3.815-03
2.800+07	1.010-04	7.710-01	1.051-03	3.956+00	9.713-02	4.825+00	8.118-08	6.197-04	8.448-07	3.180-03	7.807-05	3.878-03
3.000+07	8.802-05	7.301-01	9.769-04	4.068+00	1.013-01	4.900+00	7.075-08	5.868-04	7.852-07	3.270-03	8.142-05	3.939-03
4.000+07	4.951-05	5.801-01	7.226-04	4.522+00	1.188-01	5.222+00	3.980-08	4.663-04	5.808-07	3.635-03	9.549-05	4.197-03
5.000+07	3.169-05	4.843-01	5.732-04	4.861+00	1.321-01	5.478+00	2.547-08	3.893-04	4.607-07	3.907-03	1.062-04	4.403-03
6.000+07	2.200-05	4.172-01	4.750-04	5.125+00	1.427-01	5.685+00	1.768-08	3.353-04	3.818-07	4.119-03	1.147-04	4.570-03
8.000+07	1.238-05	3.291-01	3.537-04	5.517+00	1.588-01	6.005+00	9.951-09	2.645-04	2.843-07	4.436-03	1.276-04	4.827-03
1.000+08	7.921-06	2.731-01	2.818-04	5.795+00	1.705-01	6.239+00	6.367-09	2.195-04	2.265-07	4.658-03	1.370-04	5.015-03
1.500+08	3.521-06	1.945-01	1.868-04	6.238+00	1.900-01	6.623+00	2.830-09	1.563-04	1.501-07	5.014-03	1.527-04	5.323-03
2.000+08	1.980-06	1.525-01	1.397-04	6.502+00	2.022-01	6.857+00	1.591-09	1.226-04	1.123-07	5.226-03	1.625-04	5.511-03
3.000+08	8.802-07	1.081-01	9.285-05	6.810+00	2.173-01	7.135+00	7.075-10	8.689-05	7.463-08	5.474-03	1.747-04	5.735-03
4.000+08	4.951-07	8.465-02	6.953-05	6.987+00	2.264-01	7.298+00	3.980-10	6.804-05	5.589-08	5.616-03	1.820-04	5.866-03
5.000+08	3.169-07	7.008-02	5.558-05	7.103+00	2.326-01	7.406+00	2.547-10	5.633-05	4.467-08	5.709-03	1.870-04	5.953-03
6.000+08	2.200-07	6.000-02	4.629-05	7.186+00	2.372-01	7.483+00	1.768-10	4.823-05	3.721-08	5.776-03	1.907-04	6.015-03
8.000+08	1.238-07	4.686-02	3.469-05	7.297+00	2.435-01	7.587+00	9.951-11	3.767-05	2.788-08	5.865-03	1.957-04	6.099-03
1.000+09	7.921-08	3.855-02	2.774-05	7.369+00	2.477-01	7.655+00	6.367-11	3.099-05	2.230-08	5.923-03	1.991-04	6.153-03
1.500+09	3.521-08	2.692-02	1.848-05	7.473+00	2.539-01	7.754+00	2.830-11	2.164-05	1.485-08	6.007-03	2.041-04	6.232-03
2.000+09	1.980-08	2.084-02	1.386-05	7.530+00	2.575-01	7.808+00	1.591-11	1.675-05	1.114-08	6.052-03	2.070-04	6.276-03
3.000+09	8.802-09	1.449-02	9.236-06	7.591+00	2.613-01	7.867+00	7.075-12	1.165-05	7.424-09	6.101-03	2.100-04	6.323-03
4.000+09	4.951-09	1.118-02	6.926-06	7.624+00	2.636-01	7.899+00	3.980-12	8.986-06	5.567-09	6.128-03	2.119-04	6.349-03
5.000+09	3.169-09	9.144-03	5.541-06	7.644+00	2.650-01	7.918+00	2.547-12	7.350-06	4.454-09	6.144-03	2.130-04	6.364-03
6.000+09	2.200-09	7.754-03	4.617-06	7.659+00	2.659-01	7.933+00	1.768-12	6.233-06	3.711-09	6.156-03	2.137-04	6.376-03
8.000+09	1.238-09	5.974-03	3.462-06	7.678+00	2.672-01	7.951+00	9.951-13	4.802-06	2.783-09	6.171-03	2.148-04	6.391-03
1.000+10	7.921-10	4.878-03	2.770-06	7.689+00	2.681-01	7.962+00	6.367-13	3.921-06	2.226-09	6.180-03	2.155-04	6.400-03
1.500+10	3.521-10	3.371-03	1.846-06	7.706+00	2.692-01	7.979+00	2.830-13	2.710-06	1.484-09	6.194-03	2.164-04	6.413-03
2.000+10	1.980-10	2.592-03	1.385-06	7.715+00	2.698-01	7.987+00	1.591-13	2.083-06	1.113-09	6.201-03	2.169-04	6.420-03
3.000+10	8.802-11	1.787-03	9.232-07	7.724+00	2.704-01	7.996+00	7.075-14	1.436-06	7.420-10	6.208-03	2.173-04	6.427-03
4.000+10	4.951-11	1.372-03	6.924-07	7.729+00	2.708-01	8.001+00	3.980-14	1.103-06	5.565-10	6.212-03	2.177-04	6.431-03
5.000+10	3.169-11	1.117-03	5.539-07	7.732+00	2.711-01	8.004+00	2.547-14	8.978-07	4.452-10	6.215-03	2.179-04	6.434-03
6.000+10	2.200-11	9.445-04	4.616-07	7.734+00	2.712-01	8.006+00	1.768-14	7.592-07	3.710-10	6.216-03	2.180-04	6.435-03
8.000+10	1.238-11	7.242-04	3.462-07	7.737+00	2.714-01	8.009+00	9.951-15	5.821-07	2.783-10	6.219-03	2.181-04	6.438-03
1.000+11	7.921-12	5.892-04	2.769-07	7.738+00	2.715-01	8.010+00	6.367-15	4.736-07	2.226-10	6.220-03	2.182-04	6.438-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 34, SE, SELENIUM ATOMIC WT. = 78.96 MSQ/KG = .00076267 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	8.558-02	7.168+00	1.129-01	0.000	0.000	7.366+00	6.527-05	5.467-03	8.611-05	0.000	0.000	5.618-03
1.022+06	8.196-02	7.092+00	1.081-01	0.000	0.000	7.282+00	6.251-05	5.409-03	8.244-05	0.000	0.000	5.554-03
1.250+06	5.488-02	6.414+00	7.300-02	1.246-02	0.000	6.554+00	4.186-05	4.892-03	5.567-05	9.503-06	0.000	4.999-03
1.500+06	3.815-02	5.832+00	5.252-02	6.126-02	0.000	5.984+00	2.910-05	4.448-03	4.006-05	4.672-05	0.000	4.564-03
2.000+06	2.148-02	4.979+00	3.222-02	2.250-01	0.000	5.258+00	1.638-05	3.797-03	2.457-05	1.716-04	0.000	4.010-03
2.044+06	2.057-02	4.918+00	3.111-02	2.414-01	0.000	5.211+00	1.569-05	3.751-03	2.373-05	1.841-04	0.000	3.974-03
3.000+06	9.553-03	3.919+00	1.734-02	6.100-01	1.371-03	4.557+00	7.286-06	2.989-03	1.322-05	4.652-04	1.046-06	3.476-03
4.000+06	5.375-03	3.270+00	1.161-02	9.643-01	5.597-03	4.257+00	4.099-06	2.494-03	8.855-06	7.354-04	4.269-06	3.247-03
5.000+06	3.441-03	2.824+00	8.656-03	1.276+00	1.115-02	4.123+00	2.624-06	2.154-03	6.602-06	9.732-04	8.504-06	3.145-03
6.000+06	2.389-03	2.496+00	6.872-03	1.549+00	1.711-02	4.071+00	1.822-06	1.904-03	5.241-06	1.181-03	1.305-05	3.105-03
7.000+06	1.756-03	2.244+00	5.686-03	1.794+00	2.305-02	4.068+00	1.339-06	1.711-03	4.337-06	1.368-03	1.758-05	3.103-03
8.000+06	1.344-03	2.042+00	4.843-03	2.013+00	2.881-02	4.090+00	1.025-06	1.557-03	3.694-06	1.535-03	2.197-05	3.119-03
9.000+06	1.062-03	1.877+00	4.214-03	2.213+00	3.433-02	4.130+00	8.100-07	1.432-03	3.214-06	1.688-03	2.618-05	3.150-03
1.000+07	8.603-04	1.739+00	3.728-03	2.394+00	3.957-02	4.177+00	6.561-07	1.326-03	2.843-06	1.826-03	3.018-05	3.186-03
1.100+07	7.110-04	1.622+00	3.341-03	2.560+00	4.454-02	4.231+00	5.423-07	1.237-03	2.548-06	1.952-03	3.397-05	3.227-03
1.200+07	5.974-04	1.521+00	3.026-03	2.711+00	4.922-02	4.285+00	4.556-07	1.160-03	2.308-06	2.068-03	3.754-05	3.268-03
1.300+07	5.090-04	1.433+00	2.765-03	2.850+00	5.364-02	4.340+00	3.882-07	1.093-03	2.109-06	2.174-03	4.091-05	3.310-03
1.400+07	4.389-04	1.356+00	2.545-03	2.979+00	5.785-02	4.396+00	3.347-07	1.034-03	1.941-06	2.272-03	4.412-05	3.353-03
1.500+07	3.824-04	1.287+00	2.357-03	3.100+00	6.184-02	4.452+00	2.916-07	9.816-04	1.798-06	2.364-03	4.716-05	3.395-03
1.600+07	3.361-04	1.226+00	2.195-03	3.213+00	6.563-02	4.507+00	2.563-07	9.350-04	1.674-06	2.450-03	5.005-05	3.437-03
1.800+07	2.655-04	1.120+00	1.929-03	3.419+00	7.267-02	4.614+00	2.025-07	8.542-04	1.471-06	2.608-03	5.542-05	3.519-03
2.000+07	2.151-04	1.033+00	1.721-03	3.605+00	7.907-02	4.719+00	1.641-07	7.878-04	1.313-06	2.749-03	6.030-05	3.599-03
2.200+07	1.778-04	9.597-01	1.553-03	3.772+00	8.495-02	4.818+00	1.356-07	7.319-04	1.184-06	2.877-03	6.479-05	3.675-03
2.400+07	1.494-04	8.968-01	1.414-03	3.925+00	9.036-02	4.914+00	1.139-07	6.840-04	1.078-06	2.993-03	6.891-05	3.748-03
2.600+07	1.273-04	8.421-01	1.299-03	4.064+00	9.535-02	5.003+00	9.709-08	6.422-04	9.907-07	3.099-03	7.272-05	3.816-03
2.800+07	1.097-04	7.944-01	1.200-03	4.192+00	1.000-01	5.088+00	8.366-08	6.059-04	9.152-07	3.197-03	7.627-05	3.880-03
3.000+07	9.559-05	7.522-01	1.116-03	4.310+00	1.043-01	5.168+00	7.290-08	5.737-04	8.511-07	3.287-03	7.955-05	3.941-03
4.000+07	5.377-05	5.977-01	8.252-04	4.791+00	1.223-01	5.512+00	4.101-08	4.558-04	6.294-07	3.654-03	9.327-05	4.204-03
5.000+07	3.441-05	4.989-01	6.545-04	5.149+00	1.360-01	5.785+00	2.624-08	3.805-04	4.992-07	3.927-03	1.037-04	4.412-03
6.000+07	2.390-05	4.299-01	5.423-04	5.428+00	1.469-01	6.005+00	1.823-08	3.279-04	4.136-07	4.140-03	1.120-04	4.580-03
8.000+07	1.344-05	3.390-01	4.038-04	5.841+00	1.633-01	6.344+00	1.025-08	2.585-04	3.080-07	4.455-03	1.245-04	4.838-03
1.000+08	8.602-06	2.814-01	3.217-04	6.135+00	1.754-01	6.592+00	6.560-09	2.146-04	2.454-07	4.679-03	1.338-04	5.028-03
1.500+08	3.823-06	2.004-01	2.132-04	6.602+00	1.954-01	6.998+00	2.916-09	1.528-04	1.626-07	5.035-03	1.490-04	5.337-03
2.000+08	2.151-06	1.571-01	1.594-04	6.881+00	2.079-01	7.246+00	1.641-09	1.198-04	1.216-07	5.248-03	1.586-04	5.526-03
3.000+08	9.558-07	1.114-01	1.060-04	7.205+00	2.234-01	7.540+00	7.290-10	8.496-05	8.084-08	5.495-03	1.704-04	5.750-03
4.000+08	5.376-07	8.722-02	7.937-05	7.392+00	2.328-01	7.712+00	4.100-10	6.652-05	6.053-08	5.638-03	1.775-04	5.882-03
5.000+08	3.441-07	7.220-02	6.344-05	7.515+00	2.391-01	7.826+00	2.624-10	5.506-05	4.838-08	5.731-03	1.824-04	5.969-03
6.000+08	2.390-07	6.182-02	5.284-05	7.602+00	2.438-01	7.908+00	1.823-10	4.715-05	4.930-08	5.798-03	1.859-04	6.031-03
8.000+08	1.344-07	4.828-02	3.960-05	7.719+00	2.503-01	8.018+00	1.025-10	3.682-05	3.020-08	5.887-03	1.909-04	6.115-03
1.000+09	8.602-08	3.972-02	3.167-05	7.795+00	2.546-01	8.089+00	6.560-11	3.029-05	2.415-08	5.945-03	1.942-04	6.170-03
1.500+09	3.823-08	2.774-02	2.110-05	7.905+00	2.610-01	8.194+00	2.916-11	2.116-05	1.609-08	6.029-03	1.991-04	6.249-03
2.000+09	2.151-08	2.147-02	1.582-05	7.964+00	2.646-01	8.250+00	1.641-11	1.637-05	1.207-08	6.074-03	2.018-04	6.292-03
3.000+09	9.558-09	1.493-02	1.054-05	8.029+00	2.685-01	8.312+00	7.290-12	1.139-05	8.039-09	6.123-03	2.048-04	6.340-03
4.000+09	5.376-09	1.152-02	7.906-06	8.064+00	2.708-01	8.346+00	4.100-12	8.786-06	6.030-09	6.150-03	2.065-04	6.365-03
5.000+09	3.441-09	9.421-03	6.324-06	8.086+00	2.722-01	8.368+00	2.624-12	7.185-06	4.823-09	6.167-03	2.076-04	6.382-03
6.000+09	2.390-09	7.989-03	5.270-06	8.101+00	2.732-01	8.382+00	1.823-12	6.093-06	4.019-09	6.178-03	2.084-04	6.393-03
8.000+09	1.344-09	6.155-03	3.952-06	8.121+00	2.746-01	8.402+00	1.025-12	4.694-06	3.014-09	6.194-03	2.094-04	6.408-03
1.000+10	8.602-10	5.025-03	3.162-06	8.133+00	2.754-01	8.413+00	6.560-13	3.832-06	2.412-09	6.203-03	2.100-04	6.417-03
1.500+10	3.823-10	3.473-03	2.108-06	8.151+00	2.765-01	8.431+00	2.916-13	2.649-06	1.608-09	6.217-03	2.109-04	6.430-03
2.000+10	2.151-10	2.670-03	1.581-06	8.160+00	2.772-01	8.440+00	1.641-13	2.036-06	1.206-09	6.223-03	2.114-04	6.437-03
3.000+10	9.558-11	1.841-03	1.054-06	8.170+00	2.778-01	8.450+00	7.290-14	1.404-06	8.039-10	6.231-03	2.119-04	6.444-03
4.000+10	5.376-11	1.414-03	7.903-07	8.175+00	2.782-01	8.455+00	4.100-14	1.078-06	6.027-10	6.235-03	2.122-04	6.448-03
5.000+10	3.441-11	1.151-03	6.322-07	8.178+00	2.785-01	8.458+00	2.624-14	8.778-07	4.822-10	6.237-03	2.124-04	6.450-03
6.000+10	2.390-11	9.731-04	5.269-07	8.180+00	2.786-01	8.460+00	1.823-14	7.422-07	4.019-10	6.239-03	2.125-04	6.452-03
8.000+10	1.344-11	7.462-04	3.951-07	8.183+00	2.788-01	8.463+00	1.025-14	5.691-07	3.013-10	6.241-03	2.126-04	6.454-03
1.000+11	8.602-12	6.071-04	3.161-07	8.185+00	2.789-01	8.465+00	6.560-15	4.630-07	2.411-10	6.242-03	2.127-04	6.456-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 35, BR, BROMINE ATOMIC WT. = 79.904 MSQ/KG = .00075366 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	9.271-02	7.378+00	1.292-01	0.000	0.000	7.600+00	6.987-05	5.561-03	9.737-05	0.000	0.000	5.728-03
1.022+06	8.878-02	7.300+00	1.236-01	0.000	0.000	7.512+00	6.691-05	5.502-03	9.315-05	0.000	0.000	5.662-03
1.250+06	5.945-02	6.602+00	8.348-02	1.339-02	0.000	6.758+00	4.481-05	4.976-03	6.292-05	1.009-05	0.000	5.093-03
1.500+06	4.133-02	6.003+00	6.003-02	6.557-02	0.000	6.170+00	3.115-05	4.524-03	4.524-05	4.942-05	0.000	4.650-03
2.000+06	2.327-02	5.126+00	3.681-02	2.398-01	0.000	5.426+00	1.754-05	3.863-03	2.774-05	1.807-04	0.000	4.089-03
2.044+06	2.228-02	5.063+00	3.554-02	2.573-01	0.000	5.378+00	1.679-05	3.816-03	2.679-05	1.939-04	0.000	4.053-03
3.000+06	1.035-02	4.034+00	1.979-02	6.479-01	1.412-03	4.713+00	7.800-06	3.040-03	1.491-05	4.883-04	1.064-06	3.552-03
4.000+06	5.824-03	3.366+00	1.325-02	1.023+00	5.761-03	4.414+00	4.389-06	2.537-03	9.986-06	7.710-04	4.342-06	3.327-03
5.000+06	3.728-03	2.907+00	9.868-03	1.352+00	1.147-02	4.284+00	2.810-06	2.191-03	7.437-06	1.019-03	8.644-06	3.229-03
6.000+06	2.589-03	2.569+00	7.832-03	1.641+00	1.761-02	4.238+00	1.951-06	1.936-03	5.903-06	1.237-03	1.327-05	3.194-03
7.000+06	1.902-03	2.310+00	6.478-03	1.899+00	2.373-02	4.241+00	1.433-06	1.741-03	4.882-06	1.431-03	1.788-05	3.196-03
8.000+06	1.456-03	2.102+00	5.516-03	2.131+00	2.966-02	4.270+00	1.097-06	1.584-03	4.157-06	1.606-03	2.235-05	3.218-03
9.000+06	1.151-03	1.932+00	4.799-03	2.341+00	3.533-02	4.314+00	8.675-07	1.456-03	3.617-06	1.764-03	2.663-05	3.252-03
1.000+07	9.321-04	1.790+00	4.245-03	2.533+00	4.073-02	4.369+00	7.025-07	1.349-03	3.199-06	1.909-03	3.070-05	3.293-03
1.100+07	7.703-04	1.670+00	3.804-03	2.708+00	4.583-02	4.428+00	5.805-07	1.259-03	2.867-06	2.041-03	3.454-05	3.338-03
1.200+07	6.473-04	1.566+00	3.445-03	2.869+00	5.065-02	4.490+00	4.878-07	1.180-03	2.596-06	2.162-03	3.817-05	3.384-03
1.300+07	5.516-04	1.475+00	3.147-03	3.016+00	5.520-02	4.550+00	4.157-07	1.112-03	2.372-06	2.273-03	4.160-05	3.429-03
1.400+07	4.756-04	1.396+00	2.897-03	3.153+00	5.953-02	4.612+00	3.584-07	1.052-03	2.183-06	2.376-03	4.487-05	3.476-03
1.500+07	4.143-04	1.325+00	2.683-03	3.280+00	6.363-02	4.672+00	3.122-07	9.986-04	2.022-06	2.472-03	4.796-05	3.521-03
1.600+07	3.641-04	1.262+00	2.498-03	3.399+00	6.753-02	4.731+00	2.744-07	9.511-04	1.883-06	2.562-03	5.089-05	3.566-03
1.800+07	2.877-04	1.153+00	2.195-03	3.617+00	7.477-02	4.847+00	2.168-07	8.690-04	1.654-06	2.726-03	5.635-05	3.653-03
2.000+07	2.330-04	1.064+00	1.958-03	3.812+00	8.136-02	4.960+00	1.756-07	8.019-04	1.476-06	2.873-03	6.132-05	3.738-03
2.200+07	1.926-04	9.879-01	1.766-03	3.989+00	8.739-02	5.066+00	1.452-07	7.445-04	1.331-06	3.006-03	6.586-05	3.818-03
2.400+07	1.618-04	9.231-01	1.609-03	4.151+00	9.295-02	5.169+00	1.219-07	6.957-04	1.213-06	3.128-03	7.005-05	3.896-03
2.600+07	1.379-04	8.669-01	1.477-03	4.298+00	9.809-02	5.265+00	1.039-07	6.533-04	1.113-06	3.239-03	7.393-05	3.968-03
2.800+07	1.189-04	8.177-01	1.365-03	4.433+00	1.029-01	5.355+00	8.961-08	6.163-04	1.029-06	3.341-03	7.755-05	4.036-03
3.000+07	1.036-04	7.743-01	1.269-03	4.557+00	1.073-01	5.440+00	7.808-08	5.836-04	9.564-07	3.434-03	8.087-05	4.100-03
4.000+07	5.826-05	6.153-01	9.385-04	5.065+00	1.258-01	5.807+00	4.391-08	4.637-04	7.073-07	3.817-03	9.481-05	4.377-03
5.000+07	3.729-05	5.136-01	7.443-04	5.443+00	1.398-01	6.097+00	2.810-08	3.871-04	5.609-07	4.102-03	1.054-04	4.595-03
6.000+07	2.589-05	4.425-01	6.167-04	5.737+00	1.510-01	6.331+00	1.951-08	3.335-04	4.648-07	4.324-03	1.138-04	4.772-03
8.000+07	1.456-05	3.490-01	4.592-04	6.173+00	1.679-01	6.690+00	1.097-08	2.630-04	3.461-07	4.652-03	1.265-04	5.042-03
1.000+08	9.321-06	2.897-01	3.657-04	6.482+00	1.802-01	6.952+00	7.025-09	2.183-04	2.756-07	4.885-03	1.358-04	5.240-03
1.500+08	4.143-06	2.063-01	2.424-04	6.975+00	2.007-01	7.382+00	3.122-09	1.555-04	1.827-07	5.257-03	1.513-04	5.564-03
2.000+08	2.330-06	1.617-01	1.813-04	7.269+00	2.136-01	7.644+00	1.756-09	1.219-04	1.366-07	5.478-03	1.610-04	5.761-03
3.000+08	1.036-06	1.146-01	1.205-04	7.611+00	2.295-01	7.955+00	7.808-10	8.637-05	9.082-08	5.736-03	1.730-04	5.996-03
4.000+08	5.826-07	8.978-02	9.024-05	7.808+00	2.391-01	8.137+00	4.391-10	6.766-05	6.801-08	5.885-03	1.802-04	6.133-03
5.000+08	3.728-07	7.432-02	7.212-05	7.937+00	2.456-01	8.257+00	2.810-10	5.601-05	5.435-08	5.982-03	1.851-04	6.223-03
6.000+08	2.589-07	6.363-02	6.007-05	8.030+00	2.504-01	8.344+00	1.951-10	4.796-05	4.527-08	6.052-03	1.887-04	6.289-03
8.000+08	1.456-07	4.970-02	4.502-05	8.153+00	2.570-01	8.460+00	1.097-10	3.746-05	3.393-08	6.145-03	1.937-04	6.376-03
1.000+09	9.321-08	4.089-02	3.600-05	8.233+00	2.614-01	8.535+00	7.025-11	3.082-05	2.713-08	6.205-03	1.970-04	6.433-03
1.500+09	4.143-08	2.855-02	2.398-05	8.349+00	2.679-01	8.645+00	3.122-11	2.152-05	1.807-08	6.292-03	2.019-04	6.516-03
2.000+09	2.330-08	2.210-02	1.798-05	8.412+00	2.716-01	8.706+00	1.756-11	1.666-05	1.355-08	6.340-03	2.047-04	6.561-03
3.000+09	1.036-08	1.537-02	1.199-05	8.480+00	2.756-01	8.771+00	7.808-12	1.158-05	9.036-09	6.391-03	2.077-04	6.610-03
4.000+09	5.826-09	1.186-02	8.988-06	8.516+00	2.780-01	8.806+00	4.391-12	8.938-06	6.774-09	6.418-03	2.095-04	6.637-03
5.000+09	3.728-09	9.698-03	7.189-06	8.539+00	2.794-01	8.828+00	2.810-12	7.309-06	5.418-09	6.436-03	2.106-04	6.653-03
6.000+09	2.589-09	8.224-03	5.991-06	8.555+00	2.805-01	8.844+00	1.951-12	6.198-06	4.515-09	6.448-03	2.114-04	6.665-03
8.000+09	1.456-09	6.336-03	4.493-06	8.576+00	2.818-01	8.864+00	1.097-12	4.775-06	3.386-09	6.463-03	2.124-04	6.681-03
1.000+10	9.321-10	5.173-03	3.594-06	8.590+00	2.827-01	8.878+00	7.025-13	3.899-06	2.709-09	6.474-03	2.131-04	6.691-03
1.500+10	4.143-10	3.575-03	2.396-06	8.608+00	2.838-01	8.895+00	3.122-13	2.694-06	1.806-09	6.488-03	2.139-04	6.704-03
2.000+10	2.330-10	2.749-03	1.797-06	8.618+00	2.845-01	8.905+00	1.756-13	2.072-06	1.354-09	6.495-03	2.144-04	6.712-03
3.000+10	1.036-10	1.896-03	1.198-06	8.628+00	2.851-01	8.915+00	7.808-14	1.429-06	9.029-10	6.503-03	2.149-04	6.719-03
4.000+10	5.826-11	1.455-03	8.984-07	8.634+00	2.855-01	8.921+00	4.391-14	1.097-06	6.771-10	6.507-03	2.152-04	6.723-03
5.000+10	3.728-11	1.185-03	7.187-07	8.637+00	2.858-01	8.924+00	2.810-14	8.931-07	5.417-10	6.509-03	2.154-04	6.726-03
6.000+10	2.589-11	1.002-03	5.989-07	8.639+00	2.859-01	8.926+00	1.951-14	7.552-07	4.514-10	6.511-03	2.155-04	6.727-03
8.000+10	1.456-11	7.681-04	4.492-07	8.643+00	2.861-01	8.930+00	1.097-14	5.789-07	3.385-10	6.514-03	2.156-04	6.730-03
1.000+11	9.321-12	6.249-04	3.593-07	8.644+00	2.862-01	8.931+00	7.025-15	4.710-07	2.708-10	6.515-03	2.157-04	6.731-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 36, KR, KRYPTON ATOMIC WT. = 83.80 MSO/KG = .00071862 BARNS/ATOM MULTIPLY MSO/KG BY 10 FOR CMSO/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSO/KG	MSO/KG	MSO/KG	MSO/KG	MSO/KG	MSO/KG
1.000+06	1.002-01	7.588+00	1.471-01	0.000	0.000	7.835+00	7.201-05	5.453-03	1.057-04	0.000	0.000	5.631-03
1.022+06	9.596-02	7.508+00	1.408-01	0.000	0.000	7.745+00	6.896-05	5.395-03	1.012-04	0.000	0.000	5.566-03
1.250+06	6.426-02	6.790+00	9.508-02	1.437-02	0.000	6.964+00	4.618-05	4.879-03	6.833-05	1.033-05	0.000	5.004-03
1.500+06	4.467-02	6.175+00	6.836-02	7.008-02	0.000	6.358+00	3.210-05	4.437-03	4.912-05	5.036-05	0.000	4.569-03
2.000+06	2.516-02	5.272+00	4.189-02	2.552-01	0.000	5.594+00	1.808-05	3.789-03	3.010-05	1.834-04	0.000	4.020-03
2.044+06	2.409-02	5.207+00	4.044-02	2.737-01	0.000	5.545+00	1.731-05	3.742-03	2.906-05	1.967-04	0.000	3.985-03
3.000+06	1.119-02	4.149+00	2.251-02	6.872-01	1.452-03	4.871+00	8.041-06	2.982-03	1.618-05	4.938-04	1.043-06	3.501-03
4.000+06	6.296-03	3.462+00	1.505-02	1.083+00	5.926-03	4.572+00	4.524-06	2.488-03	1.082-05	7.785-04	4.259-06	3.286-03
5.000+06	4.030-03	2.990+00	1.121-02	1.431+00	1.180-02	4.448+00	2.896-06	2.149-03	8.056-06	1.028-03	8.480-06	3.196-03
6.000+06	2.799-03	2.643+00	8.891-03	1.735+00	1.811-02	4.408+00	2.011-06	1.899-03	6.389-06	1.247-03	1.301-05	3.168-03
7.000+06	2.056-03	2.375+00	7.352-03	2.007+00	2.440-02	4.416+00	1.477-06	1.707-03	5.283-06	1.442-03	1.753-05	3.173-03
8.000+06	1.574-03	2.162+00	6.259-03	2.251+00	3.050-02	4.451+00	1.131-06	1.554-03	4.498-06	1.618-03	2.192-05	3.199-03
9.000+06	1.244-03	1.987+00	5.444-03	2.476+00	3.633-02	4.504+00	8.940-07	1.428-03	3.912-06	1.778-03	2.611-05	3.237-03
1.000+07	1.008-03	1.841+00	4.815-03	2.676+00	4.188-02	4.565+00	7.244-07	1.323-03	3.460-06	1.923-03	3.010-05	3.280-03
1.100+07	8.328-04	1.718+00	4.314-03	2.861+00	4.713-02	4.631+00	5.985-07	1.235-03	3.100-06	2.056-03	3.387-05	3.328-03
1.200+07	6.998-04	1.611+00	3.907-03	3.030+00	5.209-02	4.698+00	5.029-07	1.158-03	2.808-06	2.177-03	3.743-05	3.376-03
1.300+07	5.963-04	1.518+00	3.569-03	3.185+00	5.676-02	4.764+00	4.285-07	1.091-03	2.565-06	2.289-03	4.079-05	3.423-03
1.400+07	5.142-04	1.436+00	3.285-03	3.329+00	6.121-02	4.830+00	3.695-07	1.032-03	2.361-06	2.392-03	4.399-05	3.471-03
1.500+07	4.479-04	1.363+00	3.042-03	3.463+00	6.542-02	4.895+00	3.219-07	9.795-04	2.186-06	2.489-03	4.701-05	3.518-03
1.600+07	3.937-04	1.298+00	2.832-03	3.589+00	6.943-02	4.960+00	2.829-07	9.328-04	2.035-06	2.579-03	4.989-05	3.564-03
1.800+07	3.110-04	1.186+00	2.489-03	3.820+00	7.687-02	5.086+00	2.235-07	8.523-04	1.789-06	2.745-03	5.524-05	3.655-03
2.000+07	2.519-04	1.094+00	2.219-03	4.026+00	8.364-02	5.206+00	1.810-07	7.862-04	1.595-06	2.893-03	6.011-05	3.741-03
2.200+07	2.082-04	1.016+00	2.002-03	4.213+00	8.984-02	5.321+00	1.496-07	7.301-04	1.439-06	3.028-03	6.456-05	3.824-03
2.400+07	1.750-04	9.495-01	1.824-03	4.384+00	9.555-02	5.431+00	1.258-07	6.823-04	1.311-06	3.150-03	6.866-05	3.903-03
2.600+07	1.491-04	8.916-01	1.674-03	4.539+00	1.008-01	5.533+00	1.071-07	6.407-04	1.203-06	3.262-03	7.244-05	3.976-03
2.800+07	1.285-04	8.411-01	1.547-03	4.681+00	1.057-01	5.629+00	9.234-08	6.044-04	1.112-06	3.364-03	7.596-05	4.045-03
3.000+07	1.120-04	7.964-01	1.438-03	4.813+00	1.103-01	5.721+00	8.049-08	5.723-04	1.033-06	3.459-03	7.926-05	4.111-03
4.000+07	6.298-05	6.329-01	1.063-03	5.348+00	1.292-01	6.111+00	4.526-08	4.548-04	7.639-07	3.843-03	9.285-05	4.392-03
5.000+07	4.031-05	5.283-01	8.433-04	5.746+00	1.436-01	6.419+00	2.897-08	3.796-04	6.060-07	4.129-03	1.032-04	4.613-03
6.000+07	2.799-05	4.552-01	6.986-04	6.056+00	1.551-01	6.667+00	2.011-08	3.271-04	5.020-07	4.352-03	1.115-04	4.791-03
8.000+07	1.575-05	3.590-01	5.202-04	6.514+00	1.724-01	7.046+00	1.132-08	2.580-04	3.738-07	4.681-03	1.239-04	5.063-03
1.000+08	1.008-05	2.980-01	4.143-04	6.839+00	1.851-01	7.323+00	7.244-09	2.141-04	2.977-07	4.915-03	1.330-04	5.262-03
1.500+08	4.479-06	2.122-01	2.746-04	7.357+00	2.061-01	7.776+00	3.219-09	1.525-04	1.973-07	5.287-03	1.481-04	5.588-03
2.000+08	2.519-06	1.664-01	2.053-04	7.666+00	2.193-01	8.052+00	1.810-09	1.196-04	1.475-07	5.509-03	1.576-04	5.786-03
3.000+08	1.120-06	1.179-01	1.365-04	8.026+00	2.356-01	8.380+00	8.049-10	8.473-05	9.809-08	5.768-03	1.693-04	6.022-03
4.000+08	6.298-07	9.235-02	1.022-04	8.233+00	2.453-01	8.571+00	4.526-10	6.636-05	7.344-08	5.916-03	1.763-04	6.159-03
5.000+08	4.031-07	7.645-02	8.168-05	8.369+00	2.520-01	8.698+00	2.897-10	5.494-05	5.870-08	6.014-03	1.811-04	6.250-03
6.000+08	2.799-07	6.545-02	6.803-05	8.467+00	2.569-01	8.789+00	2.011-10	4.703-05	4.889-08	6.085-03	1.846-04	6.316-03
8.000+08	1.575-07	5.112-02	5.098-05	8.597+00	2.636-01	8.912+00	1.132-10	3.674-05	3.664-08	6.178-03	1.894-04	6.404-03
1.000+09	1.008-07	4.206-02	4.077-05	8.681+00	2.681-01	8.991+00	7.244-11	3.023-05	2.930-08	6.238-03	1.927-04	6.461-03
1.500+09	4.479-08	2.937-02	2.716-05	8.803+00	2.747-01	9.107+00	3.219-11	2.111-05	1.952-08	6.326-03	1.974-04	6.545-03
2.000+09	2.519-08	2.273-02	2.037-05	8.869+00	2.785-01	9.170+00	1.810-11	1.633-05	1.464-08	6.373-03	2.001-04	6.590-03
3.000+09	1.120-08	1.581-02	1.357-05	8.941+00	2.825-01	9.239+00	8.049-12	1.136-05	9.752-09	6.425-03	2.030-04	6.640-03
4.000+09	6.298-09	1.220-02	1.018-05	8.979+00	2.850-01	9.276+00	4.526-12	8.767-06	7.316-09	6.452-03	2.048-04	6.666-03
5.000+09	4.031-09	9.975-03	8.142-06	9.004+00	2.864-01	9.300+00	2.897-12	7.168-06	5.851-09	6.470-03	2.058-04	6.683-03
6.000+09	2.799-09	8.459-03	6.785-06	9.021+00	2.874-01	9.317+00	2.011-12	6.079-06	4.876-09	6.483-03	2.065-04	6.695-03
8.000+09	1.575-09	6.517-03	5.088-06	9.043+00	2.888-01	9.338+00	1.132-12	4.683-06	3.656-09	6.498-03	2.075-04	6.711-03
1.000+10	1.008-09	5.321-03	4.070-06	9.057+00	2.897-01	9.352+00	7.244-13	3.824-06	2.925-09	6.509-03	2.082-04	6.721-03
1.500+10	4.479-10	3.677-03	2.713-06	9.076+00	2.908-01	9.370+00	3.219-13	2.642-06	1.950-09	6.522-03	2.090-04	6.734-03
2.000+10	2.519-10	2.827-03	2.035-06	9.087+00	2.915-01	9.381+00	1.810-13	2.032-06	1.462-09	6.530-03	2.095-04	6.742-03
3.000+10	1.120-10	1.950-03	1.357-06	9.097+00	2.922-01	9.391+00	8.049-14	1.401-06	9.752-10	6.537-03	2.100-04	6.749-03
4.000+10	6.298-11	1.497-03	1.017-06	9.103+00	2.926-01	9.397+00	4.526-14	1.076-06	7.308-10	6.542-03	2.103-04	6.753-03
5.000+10	4.031-11	1.219-03	8.139-07	9.107+00	2.928-01	9.401+00	2.897-14	8.760-07	5.849-10	6.544-03	2.104-04	6.756-03
6.000+10	2.799-11	1.030-03	6.783-07	9.109+00	2.930-01	9.403+00	2.011-14	7.402-07	4.874-10	6.545-03	2.106-04	6.757-03
8.000+10	1.575-11	7.901-04	5.087-07	9.112+00	2.931-01	9.406+00	1.132-14	5.678-07	3.656-10	6.548-03	2.106-04	6.759-03
1.000+11	1.008-11	6.428-04	4.070-07	9.114+00	2.933-01	9.408+00	7.244-15	4.619-07	2.925-10	6.550-03	2.108-04	6.761-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV $Z=1$ to 100—Continued

Z = 37, RB, RUBIDIUM ATOMIC WT. = 85.4678 MSQ/KG = .00070460 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.080-01	7.798+00	1.670-01	0.000	0.000	8.073+00	7.610-05	5.494-03	1.177-04	0.000	0.000	5.688-03
1.022+06	1.034-01	7.716+00	1.598-01	0.000	0.000	7.979+00	7.286-05	5.437-03	1.126-04	0.000	0.000	5.622-03
1.250+06	6.925-02	6.978+00	1.079-01	1.540-02	0.000	7.171+00	4.879-05	4.917-03	7.603-05	1.085-05	0.000	5.052-03
1.500+06	4.814-02	6.346+00	7.755-02	7.479-02	0.000	6.546+00	3.392-05	4.471-03	5.464-05	5.270-05	0.000	4.613-03
2.000+06	2.711-02	5.418+00	4.750-02	2.712-01	0.000	5.764+00	1.910-05	3.818-03	3.347-05	1.911-04	0.000	4.061-03
2.044+06	2.596-02	5.352+00	4.586-02	2.998-01	0.000	5.715+00	1.829-05	3.771-03	3.231-05	2.049-04	0.000	4.027-03
3.000+06	1.206-02	4.265+00	2.550-02	7.278-01	1.492-03	5.032+00	8.497-06	3.005-03	1.797-05	5.128-04	1.051-06	3.545-03
4.000+06	6.786-03	3.558+00	1.704-02	1.145+00	6.090-03	4.733+00	4.781-06	2.507-03	1.201-05	8.068-04	4.291-06	3.335-03
5.000+06	4.344-03	3.073+00	1.268-02	1.511+00	1.213-02	4.613+00	3.061-06	2.165-03	8.934-06	1.065-03	8.547-06	3.250-03
6.000+06	3.017-03	2.716+00	1.006-02	1.832+00	1.861-02	4.530+00	2.126-06	1.914-03	7.088-06	1.291-03	1.311-05	3.227-03
7.000+06	2.216-03	2.441+00	8.314-03	2.118+00	2.508-02	4.595+00	1.561-06	1.720-03	5.858-06	1.492-03	1.767-05	3.237-03
8.000+06	1.697-03	2.222+00	7.077-03	2.375+00	3.134-02	4.637+00	1.196-06	1.566-03	4.986-06	1.673-03	2.208-05	3.267-03
9.000+06	1.341-03	2.043+00	6.155-03	2.609+00	3.733-02	4.697+00	9.449-07	1.439-03	4.337-06	1.838-03	2.630-05	3.309-03
1.000+07	1.086-03	1.893+00	5.442-03	2.822+00	4.303-02	4.765+00	7.652-07	1.334-03	3.834-06	1.988-03	3.032-05	3.357-03
1.100+07	8.976-04	1.765+00	4.876-03	3.017+00	4.843-02	4.836+00	6.324-07	1.244-03	3.436-06	2.126-03	3.412-05	3.408-03
1.200+07	7.542-04	1.656+00	4.415-03	3.195+00	5.352-02	4.910+00	5.314-07	1.167-03	3.111-06	2.251-03	3.771-05	3.459-03
1.300+07	6.427-04	1.560+00	4.033-03	3.359+00	5.832-02	4.982+00	4.528-07	1.099-03	2.842-06	2.367-03	4.109-05	3.510-03
1.400+07	5.541-04	1.475+00	3.711-03	3.511+00	6.289-02	5.053+00	3.904-07	1.039-03	2.615-06	2.474-03	4.431-05	3.560-03
1.500+07	4.827-04	1.401+00	3.436-03	3.652+00	6.722-02	5.124+00	3.401-07	9.871-04	2.421-06	2.573-03	4.736-05	3.610-03
1.600+07	4.243-04	1.334+00	3.199-03	3.785+00	7.133-02	5.194+00	2.990-07	9.399-04	2.254-06	2.667-03	5.026-05	3.660-03
1.800+07	3.352-04	1.219+00	2.811-03	4.027+00	7.896-02	5.328+00	2.362-07	8.589-04	1.981-06	2.837-03	5.564-05	3.754-03
2.000+07	2.715-04	1.124+00	2.506-03	4.245+00	8.591-02	5.458+00	1.913-07	7.920-04	1.766-06	2.991-03	6.053-05	3.845-03
2.200+07	2.244-04	1.044+00	2.261-03	4.442+00	9.226-02	5.581+00	1.581-07	7.356-04	1.593-06	3.130-03	6.502-05	3.932-03
2.400+07	1.886-04	9.759-01	2.059-03	4.621+00	9.814-02	5.697+00	1.329-07	6.876-04	1.451-06	3.256-03	6.915-05	4.014-03
2.600+07	1.607-04	9.164-01	1.890-03	4.785+00	1.036-01	5.807+00	1.132-07	6.457-04	1.332-06	3.372-03	7.300-05	4.092-03
2.800+07	1.385-04	8.644-01	1.747-03	4.935+00	1.086-01	5.910+00	9.759-08	6.091-04	1.231-06	3.477-03	7.652-05	4.164-03
3.000+07	1.207-04	8.185-01	1.624-03	5.073+00	1.133-01	6.007+00	8.504-08	5.767-04	1.144-06	3.574-03	7.983-05	4.232-03
4.000+07	6.788-05	6.505-01	1.200-03	5.636+00	1.327-01	6.420+00	4.783-08	4.583-04	8.455-07	3.971-03	9.350-05	4.524-03
5.000+07	4.345-05	5.430-01	9.519-04	6.054+00	1.474-01	6.745+00	3.061-08	3.826-04	6.707-07	4.266-03	1.039-04	4.753-03
6.000+07	3.017-05	4.678-01	7.886-04	6.380+00	1.592-01	7.008+00	2.126-08	3.296-04	5.556-07	4.495-03	1.122-04	4.938-03
8.000+07	1.697-05	3.689-01	5.871-04	6.862+00	1.769-01	7.408+00	1.196-08	2.599-04	4.137-07	4.839-03	1.246-04	5.220-03
1.000+08	1.086-05	3.062-01	4.676-04	7.204+00	1.899-01	7.701+00	7.652-09	2.157-04	3.295-07	5.076-03	1.338-04	5.426-03
1.500+08	4.827-06	2.181-01	3.099-04	7.748+00	2.114-01	8.178+00	3.401-09	1.537-04	2.184-07	5.459-03	1.490-04	5.762-03
2.000+08	2.715-06	1.710-01	2.317-04	8.073+00	2.250-01	8.469+00	1.913-09	1.205-04	1.633-07	5.688-03	1.585-04	5.967-03
3.000+08	1.207-06	1.212-01	1.540-04	8.452+00	2.417-01	8.815+00	8.504-10	8.540-05	1.085-07	5.955-03	1.703-04	6.211-03
4.000+08	6.788-07	9.491-02	1.153-04	8.670+00	2.517-01	9.017+00	4.783-10	6.687-05	8.124-08	6.109-03	1.773-04	6.353-03
5.000+08	4.344-07	7.857-02	9.218-05	8.813+00	2.586-01	9.150+00	3.061-10	5.536-05	6.495-08	6.210-03	1.822-04	6.447-03
6.000+08	3.017-07	6.727-02	7.677-05	8.916+00	2.637-01	9.247+00	2.126-10	4.740-05	5.409-08	6.282-03	1.858-04	6.515-03
8.000+08	1.697-07	5.254-02	5.753-05	9.052+00	2.707-01	9.375+00	1.196-10	3.702-05	4.054-08	6.378-03	1.907-04	6.606-03
1.000+09	1.086-07	4.322-02	4.601-05	9.141+00	2.754-01	9.460+00	7.652-11	3.045-05	3.242-08	6.441-03	1.940-04	6.665-03
1.500+09	4.827-08	3.019-02	3.065-05	9.269+00	2.824-01	9.582+00	3.401-11	2.127-05	2.160-08	6.531-03	1.990-04	6.751-03
2.000+09	2.715-08	2.336-02	2.298-05	9.339+00	2.864-01	9.649+00	1.913-11	1.646-05	1.619-08	6.580-03	2.018-04	6.799-03
3.000+09	1.207-08	1.624-02	1.532-05	9.414+00	2.908-01	9.721+00	8.504-12	1.144-05	1.079-08	6.633-03	2.049-04	6.849-03
4.000+09	6.788-09	1.254-02	1.149-05	9.455+00	2.934-01	9.761+00	4.783-12	8.836-06	8.096-09	6.662-03	2.067-04	6.878-03
5.000+09	4.344-09	1.025-02	9.188-06	9.480+00	2.950-01	9.785+00	3.061-12	7.222-06	6.474-09	6.680-03	2.079-04	6.895-03
6.000+09	3.017-09	8.694-03	7.656-06	9.498+00	2.961-01	9.803+00	2.126-12	6.126-06	5.394-09	6.692-03	2.086-04	6.907-03
8.000+09	1.697-09	6.698-03	5.742-06	9.521+00	2.976-01	9.825+00	1.196-12	4.719-06	4.046-09	6.708-03	2.097-04	6.923-03
1.000+10	1.086-09	5.469-03	4.593-06	9.536+00	2.985-01	9.840+00	7.652-13	3.853-06	3.236-09	6.719-03	2.103-04	6.933-03
1.500+10	4.827-10	3.779-03	3.062-06	9.557+00	2.998-01	9.861+00	3.401-13	2.663-06	2.157-09	6.734-03	2.112-04	6.948-03
2.000+10	2.715-10	2.906-03	2.296-06	9.567+00	3.006-01	9.871+00	1.913-13	2.048-06	1.618-09	6.741-03	2.118-04	6.955-03
3.000+10	1.207-10	2.004-03	1.531-06	9.579+00	3.013-01	9.882+00	8.504-14	1.412-06	1.079-09	6.749-03	2.123-04	6.963-03
4.000+10	6.788-11	1.538-03	1.148-06	9.585+00	3.018-01	9.888+00	4.783-14	1.084-06	8.089-10	6.754-03	2.126-04	6.967-03
5.000+10	4.344-11	1.253-03	9.185-07	9.589+00	3.020-01	9.892+00	3.061-14	8.829-07	6.472-10	6.756-03	2.128-04	6.970-03
6.000+10	3.017-11	1.059-03	7.654-07	9.591+00	3.022-01	9.894+00	2.126-14	7.462-07	5.393-10	6.758-03	2.129-04	6.971-03
8.000+10	1.697-11	8.120-04	5.740-07	9.595+00	3.024-01	9.898+00	1.196-14	5.721-07	4.044-10	6.761-03	2.131-04	6.974-03
1.000+11	1.086-11	6.606-04	4.592-07	9.597+00	3.025-01	9.900+00	7.652-15	4.655-07	3.236-10	6.762-03	2.131-04	6.976-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, Z=1 to 100—Continued

Z = 38, SR, STRONTIUM ATOMIC WT. = 87.62 MSQ/KG = .00068729 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.161-01	8.007+00	1.889-01	0.000	0.000	8.312+00	7.979-05	5.503-03	1.298-04	0.000	0.000	5.713-03
1.022+06	1.112-01	7.923+00	1.807-01	0.000	0.000	8.215+00	7.643-05	5.445-03	1.242-04	0.000	0.000	5.646-03
1.250+06	7.447-02	7.166+00	1.220-01	1.648-02	0.000	7.379+00	5.118-05	4.925-03	8.385-05	1.133-05	0.000	5.071-03
1.500+06	5.177-02	6.517+00	8.768-02	7.971-02	0.000	6.736+00	3.558-05	4.479-03	6.026-05	5.478-05	0.000	4.630-03
2.000+06	2.916-02	5.564+00	5.368-02	2.878-01	0.000	5.935+00	2.004-05	3.824-03	3.689-05	1.978-04	0.000	4.079-03
2.044+06	2.792-02	5.496+00	5.181-02	3.085-01	0.000	5.884+00	1.919-05	3.777-03	3.561-05	2.120-04	0.000	4.044-03
3.000+06	1.297-02	4.380+00	2.879-02	7.696-01	1.533-03	5.193+00	8.914-06	3.010-03	1.979-05	5.289-04	1.054-06	3.569-03
4.000+06	7.298-03	3.654+00	1.922-02	1.209+00	6.254-03	4.896+00	5.016-06	2.511-03	1.321-05	8.309-04	4.298-06	3.365-03
5.000+06	4.672-03	3.156+00	1.430-02	1.594+00	1.245-02	4.781+00	3.211-06	2.169-03	9.828-06	1.096-03	8.557-06	3.286-03
6.000+06	3.244-03	2.790+00	1.134-02	1.931+00	1.911-02	4.755+00	2.230-06	1.918-03	7.794-06	1.327-03	1.313-05	3.268-03
7.000+06	2.384-03	2.507+00	9.370-03	2.232+00	2.575-02	4.777+00	1.639-06	1.723-03	6.440-06	1.534-03	1.770-05	3.283-03
8.000+06	1.825-03	2.282+00	7.974-03	2.502+00	3.218-02	4.826+00	1.254-06	1.568-03	5.480-06	1.720-03	2.212-05	3.317-03
9.000+06	1.442-03	2.098+00	6.934-03	2.748+00	3.833-02	4.893+00	9.911-07	1.442-03	4.766-06	1.889-03	2.634-05	3.363-03
1.000+07	1.168-03	1.944+00	6.130-03	2.972+00	4.418-02	4.967+00	8.028-07	1.336-03	4.213-06	2.043-03	3.036-05	3.414-03
1.100+07	9.654-04	1.813+00	5.491-03	3.177+00	4.972-02	5.046+00	6.635-07	1.246-03	3.774-06	2.184-03	3.417-05	3.468-03
1.200+07	8.112-04	1.700+00	4.972-03	3.365+00	5.494-02	5.126+00	5.575-07	1.168-03	3.417-06	2.313-03	3.776-05	3.523-03
1.300+07	6.912-04	1.602+00	4.541-03	3.539+00	5.987-02	5.206+00	4.751-07	1.101-03	3.121-06	2.432-03	4.115-05	3.578-03
1.400+07	5.960-04	1.515+00	4.178-03	3.698+00	6.456-02	5.282+00	4.096-07	1.041-03	2.872-06	2.542-03	4.437-05	3.631-03
1.500+07	5.192-04	1.439+00	3.869-03	3.847+00	6.900-02	5.359+00	3.568-07	9.890-04	2.659-06	2.644-03	4.742-05	3.683-03
1.600+07	4.563-04	1.370+00	3.602-03	3.986+00	7.323-02	5.433+00	3.136-07	9.416-04	2.476-06	2.740-03	5.033-05	3.734-03
1.800+07	3.606-04	1.252+00	3.164-03	4.240+00	8.106-02	5.577+00	2.478-07	8.605-04	2.175-06	2.914-03	5.571-05	3.833-03
2.000+07	2.920-04	1.155+00	2.821-03	4.468+00	8.819-02	5.714+00	2.007-07	7.938-04	1.939-06	3.071-03	6.061-05	3.927-03
2.200+07	2.414-04	1.073+00	2.545-03	4.676+00	9.472-02	5.847+00	1.659-07	7.375-04	1.749-06	3.214-03	6.510-05	4.018-03
2.400+07	2.028-04	1.002+00	2.318-03	4.864+00	1.007-01	5.969+00	1.394-07	6.887-04	1.593-06	3.343-03	6.921-05	4.103-03
2.600+07	1.728-04	9.411-01	2.127-03	5.036+00	1.063-01	6.086+00	1.188-07	6.468-04	1.462-06	3.461-03	7.306-05	4.183-03
2.800+07	1.490-04	8.878-01	1.966-03	5.194+00	1.114-01	6.195+00	1.024-07	6.102-04	1.351-06	3.570-03	7.656-05	4.258-03
3.000+07	1.298-04	8.407-01	1.827-03	5.339+00	1.162-01	6.298+00	8.921-08	5.778-04	1.256-06	3.669-03	7.986-05	4.328-03
4.000+07	7.301-05	6.680-01	1.351-03	5.931+00	1.361-01	6.737+00	5.018-08	4.591-04	9.285-07	4.076-03	9.354-05	4.630-03
5.000+07	4.673-05	5.576-01	1.071-03	6.370+00	1.513-01	7.080+00	3.212-08	3.832-04	7.361-07	4.378-03	1.040-04	4.866-03
6.000+07	3.245-05	4.805-01	8.872-04	6.712+00	1.633-01	7.357+00	2.230-08	3.302-04	6.098-07	4.613-03	1.122-04	5.056-03
8.000+07	1.825-05	3.789-01	6.604-04	7.218+00	1.815-01	7.779+00	1.254-08	2.604-04	4.539-07	4.961-03	1.247-04	5.346-03
1.000+08	1.168-05	3.145-01	5.259-04	7.577+00	1.947-01	8.087+00	8.028-09	2.162-04	3.614-07	5.208-03	1.338-04	5.558-03
1.500+08	5.192-06	2.240-01	3.485-04	8.149+00	2.168-01	8.590+00	3.568-09	1.540-04	2.395-07	5.601-03	1.490-04	5.904-03
2.000+08	2.920-06	1.756-01	2.606-04	8.490+00	2.307-01	8.897+00	2.007-09	1.207-04	1.791-07	5.835-03	1.586-04	6.115-03
3.000+08	1.298-06	1.245-01	1.732-04	8.888+00	2.479-01	9.261+00	8.921-10	8.557-05	1.190-07	6.109-03	1.704-04	6.365-03
4.000+08	7.301-07	9.748-02	1.297-04	9.117+00	2.582-01	9.473+00	5.018-10	6.700-05	8.914-08	6.266-03	1.775-04	6.511-03
5.000+08	4.672-07	8.069-02	1.037-04	9.267+00	2.654-01	9.613+00	3.211-10	5.546-05	7.127-08	6.369-03	1.824-04	6.607-03
6.000+08	3.245-07	6.909-02	8.634-05	9.375+00	2.706-01	9.715+00	2.230-10	4.749-05	5.934-08	6.443-03	1.860-04	6.677-03
8.000+08	1.825-07	5.396-02	6.470-05	9.519+00	2.779-01	9.851+00	1.254-10	3.709-05	4.447-08	6.542-03	1.910-04	6.770-03
1.000+09	1.168-07	4.439-02	5.174-05	9.612+00	2.828-01	9.939+00	8.028-11	3.051-05	3.556-08	6.606-03	1.944-04	6.831-03
1.500+09	5.192-08	3.100-02	3.447-05	9.747+00	2.902-01	1.007+01	3.568-11	2.131-05	2.369-08	6.699-03	1.995-04	6.920-03
2.000+09	2.920-08	2.399-02	2.585-05	9.820+00	2.944-01	1.014+01	2.007-11	1.649-05	1.777-08	6.749-03	2.023-04	6.968-03
3.000+09	1.298-08	1.668-02	1.723-05	9.899+00	2.990-01	1.021+01	8.921-12	1.146-05	1.184-08	6.803-03	2.055-04	7.020-03
4.000+09	7.301-09	1.288-02	1.292-05	9.942+00	3.017-01	1.026+01	5.018-12	8.852-06	8.880-09	6.833-03	2.074-04	7.049-03
5.000+09	4.672-09	1.053-02	1.033-05	9.969+00	3.034-01	1.028+01	3.211-12	7.237-06	7.100-09	6.852-03	2.085-04	7.067-03
6.000+09	3.245-09	8.929-03	8.610-06	9.988+00	3.046-01	1.030+01	2.230-12	6.137-06	5.918-09	6.865-03	2.093-04	7.080-03
8.000+09	1.825-09	6.879-03	6.457-06	1.001+01	3.062-01	1.032+01	1.254-12	4.728-06	4.438-09	6.880-03	2.104-04	7.095-03
1.000+10	1.168-09	5.617-03	5.165-06	1.003+01	3.072-01	1.034+01	8.028-13	3.861-06	3.550-09	6.894-03	2.111-04	7.109-03
1.500+10	5.192-10	3.882-03	3.443-06	1.005+01	3.086-01	1.036+01	3.568-13	2.668-06	2.366-09	6.907-03	2.121-04	7.122-03
2.000+10	2.920-10	2.984-03	2.582-06	1.006+01	3.094-01	1.037+01	2.007-13	2.051-06	1.775-09	6.914-03	2.126-04	7.129-03
3.000+10	1.298-10	2.058-03	1.722-06	1.007+01	3.102-01	1.038+01	8.921-14	1.414-06	1.184-09	6.921-03	2.132-04	7.136-03
4.000+10	7.301-11	1.580-03	1.291-06	1.008+01	3.107-01	1.039+01	5.018-14	1.086-06	8.873-10	6.928-03	2.135-04	7.143-03
5.000+10	4.672-11	1.287-03	1.033-06	1.008+01	3.110-01	1.039+01	3.211-14	8.845-07	7.100-10	6.928-03	2.137-04	7.143-03
6.000+10	3.245-11	1.088-03	8.608-07	1.009+01	3.112-01	1.040+01	2.230-14	7.478-07	5.916-10	6.935-03	2.139-04	7.149-03
8.000+10	1.825-11	8.340-04	6.456-07	1.009+01	3.114-01	1.040+01	1.254-14	5.732-07	4.437-10	6.935-03	2.140-04	7.149-03
1.000+11	1.168-11	6.785-04	5.165-07	1.009+01	3.115-01	1.040+01	8.028-15	4.663-07	3.550-10	6.935-03	2.141-04	7.149-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 39, Y , YTTRIUM ATOMIC WT. = 88.9059 MSQ/KG = .00067735 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.245-01	8.217+00	2.129-01	0.000	0.000	8.554+00	8.433-05	5.566-03	1.442-04	0.000	0.000	5.794-03
1.022+06	1.193-01	8.731+00	2.037-01	0.000	0.000	8.454+00	8.081-05	5.508-03	1.380-04	0.000	0.000	5.726-03
1.250+06	7.989-02	7.354+00	1.375-01	1.762-02	0.000	7.589+00	5.411-05	4.981-03	9.314-05	1.193-05	0.000	5.140-03
1.500+06	5.554-02	6.688+00	9.878-02	8.484-02	0.000	6.927+00	3.762-05	4.530-03	6.691-05	5.747-05	0.000	4.692-03
2.000+06	3.128-02	5.711+00	6.044-02	3.049-01	0.000	6.108+00	2.119-05	3.868-03	4.094-05	2.065-04	0.000	4.137-03
2.044+06	2.995-02	5.640+00	5.834-02	3.268-01	0.000	6.055+00	2.029-05	3.820-03	3.952-05	2.214-04	0.000	4.101-03
3.000+06	1.392-02	4.495+00	3.239-02	8.128-01	1.573-03	5.356+00	9.429-06	3.045-03	2.194-05	5.506-04	1.065-06	3.628-03
4.000+06	7.831-03	3.750+00	2.162-02	1.275+00	6.418-03	5.061+00	5.304-06	2.540-03	1.464-05	8.636-04	4.347-06	3.428-03
5.000+06	5.013-03	3.239+00	1.607-02	1.680+00	1.278-02	4.953+00	3.396-06	2.194-03	1.089-05	1.138-03	8.657-06	3.355-03
6.000+06	3.481-03	2.863+00	1.274-02	2.033+00	1.961-02	4.932+00	2.358-06	1.939-03	8.629-06	1.377-03	1.328-05	3.341-03
7.000+06	2.558-03	2.573+00	1.052-02	2.348+00	2.642-02	4.960+00	1.733-06	1.743-03	7.126-06	1.590-03	1.790-05	3.360-03
8.000+06	1.958-03	2.342+00	8.954-03	2.632+00	3.302-02	5.018+00	1.326-06	1.586-03	6.065-06	1.783-03	2.237-05	3.399-03
9.000+06	1.547-03	2.153+00	7.785-03	2.890+00	3.933-02	5.092+00	1.048-06	1.458-03	5.273-06	1.958-03	2.664-05	3.449-03
1.000+07	1.253-03	1.995+00	6.882-03	3.125+00	4.533-02	5.173+00	8.487-07	1.351-03	4.662-06	2.117-03	3.070-05	3.504-03
1.100+07	1.036-03	1.861+00	6.164-03	3.341+00	5.101-02	5.260+00	7.017-07	1.261-03	4.175-06	2.263-03	3.455-05	3.563-03
1.200+07	8.704-04	1.745+00	5.580-03	3.538+00	5.637-02	5.346+00	5.896-07	1.182-03	3.780-06	2.396-03	3.818-05	3.621-03
1.300+07	7.417-04	1.644+00	5.096-03	3.720+00	6.143-02	5.431+00	5.024-07	1.114-03	3.452-06	2.520-03	4.161-05	3.679-03
1.400+07	6.395-04	1.555+00	4.689-03	3.887+00	6.624-02	5.514+00	4.332-07	1.053-03	3.176-06	2.633-03	4.487-05	3.735-03
1.500+07	5.571-04	1.477+00	4.341-03	4.043+00	7.079-02	5.596+00	3.774-07	1.000-03	2.940-06	2.739-03	4.795-05	3.790-03
1.600+07	4.895-04	1.406+00	4.041-03	4.189+00	7.512-02	5.675+00	3.316-07	9.524-04	2.737-06	2.837-03	5.088-05	3.844-03
1.800+07	3.869-04	1.285+00	3.550-03	4.457+00	8.315-02	5.829+00	2.621-07	8.704-04	2.405-06	3.019-03	5.632-05	3.948-03
2.000+07	3.134-04	1.185+00	3.165-03	4.698+00	9.046-02	5.977+00	2.123-07	8.027-04	2.144-06	3.182-03	6.127-05	4.048-03
2.200+07	2.593-04	1.101+00	2.854-03	4.916+00	9.715-02	6.117+00	1.754-07	7.458-04	1.933-06	3.330-03	6.580-05	4.144-03
2.400+07	2.175-04	1.029+00	2.599-03	5.114+00	1.033-01	6.249+00	1.474-07	6.970-04	1.760-06	3.464-03	6.997-05	4.233-03
2.600+07	1.851-04	9.659-01	2.386-03	5.295+00	1.090-01	6.372+00	1.256-07	6.543-04	1.616-06	3.587-03	7.383-05	4.316-03
2.800+07	1.599-04	9.112-01	2.205-03	5.460+00	1.143-01	6.488+00	1.083-07	6.172-04	1.494-06	3.698-03	7.742-05	4.395-03
3.000+07	1.393-04	8.628-01	2.049-03	5.613+00	1.192-01	6.597+00	9.435-08	5.844-04	1.388-06	3.802-03	8.074-05	4.469-03
4.000+07	7.834-05	6.856-01	1.514-03	6.234+00	1.396-01	7.061+00	5.306-08	4.644-04	1.026-06	4.223-03	9.456-05	4.783-03
5.000+07	5.014-05	5.723-01	1.201-03	6.694+00	1.551-01	7.423+00	3.396-08	3.876-04	8.135-07	4.534-03	1.051-04	5.028-03
6.000+07	3.482-05	4.931-01	9.947-04	7.053+00	1.674-01	7.715+00	2.359-08	3.340-04	6.738-07	4.777-03	1.134-04	5.225-03
8.000+07	1.958-05	3.889-01	7.404-04	7.583+00	1.860-01	8.159+00	1.326-08	2.634-04	5.015-07	5.136-03	1.260-04	5.526-03
1.000+08	1.253-05	3.228-01	5.896-04	7.959+00	1.996-01	8.482+00	8.487-09	2.186-04	3.994-07	5.391-03	1.352-04	5.745-03
1.500+08	5.571-06	2.299-01	3.907-04	8.558+00	2.222-01	9.010+00	3.774-09	1.557-04	2.646-07	5.797-03	1.505-04	6.103-03
2.000+08	3.133-06	1.802-01	2.921-04	8.916+00	2.364-01	9.333+00	2.122-09	1.221-04	1.979-07	6.039-03	1.601-04	6.322-03
3.000+08	1.393-06	1.277-01	1.941-04	9.333+00	2.540-01	9.715+00	9.435-10	8.650-05	1.315-07	6.322-03	1.720-04	6.580-03
4.000+08	7.834-07	1.000-01	1.454-04	9.574+00	2.646-01	9.939+00	5.306-10	6.774-05	9.849-08	6.485-03	1.792-04	6.732-03
5.000+08	5.014-07	8.282-02	1.162-04	9.732+00	2.719-01	1.009+01	3.396-10	5.610-05	7.871-08	6.592-03	1.842-04	6.832-03
6.000+08	3.482-07	7.091-02	9.677-05	9.845+00	2.773-01	1.019+01	2.359-10	4.803-05	6.555-08	6.669-03	1.878-04	6.904-03
8.000+08	1.958-07	5.538-02	7.252-05	9.996+00	2.848-01	1.034+01	1.326-10	3.751-05	4.912-08	6.771-03	1.929-04	7.001-03
1.000+09	1.253-07	4.556-02	5.799-05	1.009+01	2.898-01	1.043+01	8.487-11	3.086-05	3.928-08	6.834-03	1.963-04	7.062-03
1.500+09	5.571-08	3.182-02	3.864-05	1.023+01	2.973-01	1.056+01	3.774-11	2.155-05	2.617-08	6.929-03	2.014-04	7.152-03
2.000+09	3.133-08	2.463-02	2.897-05	1.031+01	3.016-01	1.064+01	2.122-11	1.668-05	1.962-08	6.983-03	2.043-04	7.204-03
3.000+09	1.393-08	1.712-02	1.931-05	1.040+01	3.064-01	1.072+01	9.435-12	1.160-05	1.308-08	7.044-03	2.075-04	7.264-03
4.000+09	7.834-09	1.322-02	1.448-05	1.044+01	3.092-01	1.076+01	5.306-12	8.955-06	9.808-09	7.072-03	2.094-04	7.290-03
5.000+09	5.014-09	1.081-02	1.158-05	1.047+01	3.109-01	1.079+01	3.396-12	7.322-06	7.844-09	7.092-03	2.106-04	7.310-03
6.000+09	3.482-09	9.164-03	9.650-06	1.049+01	3.121-01	1.081+01	2.359-12	6.207-06	6.536-09	7.105-03	2.114-04	7.323-03
8.000+09	1.958-09	7.060-03	7.237-06	1.051+01	3.137-01	1.083+01	1.326-12	4.782-06	4.902-09	7.119-03	2.125-04	7.336-03
1.000+10	1.253-09	5.764-03	5.790-06	1.053+01	3.148-01	1.085+01	8.487-13	3.904-06	3.922-09	7.132-03	2.132-04	7.350-03
1.500+10	5.571-10	3.984-03	3.859-06	1.055+01	3.162-01	1.087+01	3.774-13	2.699-06	2.614-09	7.146-03	2.142-04	7.363-03
2.000+10	3.133-10	3.063-03	2.895-06	1.056+01	3.170-01	1.088+01	2.122-13	2.075-06	1.961-09	7.153-03	2.147-04	7.370-03
3.000+10	1.393-10	2.112-03	1.930-06	1.058+01	3.178-01	1.090+01	9.435-14	1.431-06	1.307-09	7.166-03	2.153-04	7.383-03
4.000+10	7.834-11	1.622-03	1.447-06	1.058+01	3.183-01	1.090+01	5.306-14	1.099-06	9.801-10	7.166-03	2.156-04	7.383-03
5.000+10	5.014-11	1.320-03	1.158-06	1.059+01	3.186-01	1.091+01	3.396-14	8.941-07	7.844-10	7.173-03	2.158-04	7.390-03
6.000+10	3.482-11	1.116-03	9.648-07	1.059+01	3.188-01	1.091+01	2.359-14	7.559-07	6.535-10	7.173-03	2.159-04	7.390-03
8.000+10	1.958-11	8.559-04	7.236-07	1.059+01	3.190-01	1.091+01	1.326-14	5.797-07	4.901-10	7.173-03	2.161-04	7.390-03
1.000+11	1.253-11	6.963-04	5.789-07	1.060+01	3.192-01	1.092+01	8.487-15	4.716-07	3.921-10	7.180-03	2.162-04	7.397-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 40, ZR, ZIRCONIUM ATOMIC WT. = 91.22 MSQ/KG = .00066017 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.334-01	8.427+00	2.391-01	0.000	0.000	8.799+00	8.807-05	5.563-03	1.578-04	0.000	0.000	5.809-03
1.022+06	1.278-01	8.339+00	2.288-01	0.000	0.000	8.696-00	8.437-05	5.505-03	1.510-04	0.000	0.000	5.741-03
1.250+06	8.562-02	7.542+00	1.544-01	1.880-02	0.000	7.801+00	5.652-05	4.979-03	1.019-04	1.241-05	0.000	5.150-03
1.500+06	5.953-02	6.859+00	1.109-01	9.018-02	0.000	7.120+00	3.930-05	4.528-03	7.321-05	5.953-05	0.000	4.700-03
2.000+06	3.353-02	5.857+00	6.785-02	3.227-01	0.000	6.281+00	2.214-05	3.867-03	4.479-05	2.130-04	0.000	4.147-03
2.044+06	3.211-02	5.785+00	6.549-02	3.458-01	0.000	6.228+00	2.120-05	3.819-03	4.323-05	2.283-04	0.000	4.112-03
3.000+06	1.492-02	4.610+00	3.632-02	8.574-01	1.613-03	5.520+00	9.850-06	3.043-03	2.398-05	5.660-04	1.065-06	3.644-03
4.000+06	8.394-03	3.846+00	2.423-02	1.343+00	6.582-03	5.228+00	5.541-06	2.539-03	1.600-05	8.866-04	4.345-06	3.451-03
5.000+06	5.373-03	3.322+00	1.801-02	1.767+00	1.311-02	5.125+00	3.547-06	2.193-03	1.189-05	1.167-03	8.655-06	3.384-03
6.000+06	3.732-03	2.936+00	1.427-02	2.137+00	2.011-02	5.111+00	2.464-06	1.938-03	9.421-06	1.411-03	1.328-05	3.374-03
7.000+06	2.742-03	2.639+00	1.178-02	2.468+00	2.709-02	5.149+00	1.810-06	1.742-03	7.777-06	1.629-03	1.788-05	3.399-03
8.000+06	2.099-03	2.402+00	1.002-02	2.765+00	3.386-02	5.213+00	1.386-06	1.586-03	6.615-06	1.825-03	2.235-05	3.441-03
9.000+06	1.659-03	2.208+00	8.713-03	3.035+00	4.033-02	5.294+00	1.095-06	1.458-03	5.752-06	2.004-03	2.662-05	3.495-03
1.000+07	1.344-03	2.046+00	7.701-03	3.282+00	4.648-02	5.384+00	8.873-07	1.351-03	5.084-06	2.167-03	3.068-05	3.554-03
1.100+07	1.110-03	1.908+00	6.897-03	3.508+00	5.231-02	5.476+00	7.328-07	1.260-03	4.553-06	2.316-03	3.453-05	3.615-03
1.200+07	9.331-04	1.790+00	6.243-03	3.716+00	5.780-02	5.571+00	6.160-07	1.182-03	4.121-06	2.453-03	3.816-05	3.678-03
1.300+07	7.950-04	1.686+00	5.701-03	3.907+00	6.298-02	5.662+00	5.248-07	1.113-03	3.764-06	2.579-03	4.158-05	3.738-03
1.400+07	6.855-04	1.595+00	5.245-03	4.083+00	6.791-02	5.752+00	4.525-07	1.053-03	3.463-06	2.695-03	4.483-05	3.797-03
1.500+07	5.972-04	1.514+00	4.856-03	4.247+00	7.258-02	5.839+00	3.943-07	9.995-04	3.206-06	2.804-03	4.791-05	3.855-03
1.600+07	5.249-04	1.442+00	4.520-03	4.401+00	7.702-02	5.925+00	3.463-07	9.520-04	2.984-06	2.905-03	5.085-05	3.912-03
1.800+07	4.147-04	1.318+00	3.970-03	4.681+00	8.524-02	6.089+00	2.738-07	8.701-04	2.621-06	3.090-03	5.627-05	4.020-03
2.000+07	3.359-04	1.215+00	3.539-03	4.932+00	9.273-02	6.244+00	2.218-07	8.021-04	2.336-06	3.256-03	6.122-05	4.122-03
2.200+07	2.776-04	1.129+00	3.192-03	5.161+00	9.959-02	6.393+00	1.833-07	7.453-04	2.107-06	3.407-03	6.575-05	4.220-03
2.400+07	2.333-04	1.055+00	2.906-03	5.368+00	1.059-01	6.532+00	1.540-07	6.965-04	1.918-06	3.544-03	6.991-05	4.312-03
2.600+07	1.988-04	9.907-01	2.668-03	5.558+00	1.117-01	6.663+00	1.312-07	6.540-04	1.761-06	3.669-03	7.374-05	4.399-03
2.800+07	1.714-04	9.345-01	2.465-03	5.731+00	1.171-01	6.785+00	1.132-07	6.169-04	1.627-06	3.783-03	7.731-05	4.479-03
3.000+07	1.493-04	8.849-01	2.291-03	5.891+00	1.222-01	6.901+00	9.856-08	5.842-04	1.512-06	3.889-03	8.067-05	4.556-03
4.000+07	8.398-05	7.032-01	1.693-03	6.542+00	1.430-01	7.390+00	5.544-08	4.642-04	1.118-06	4.319-03	9.440-05	4.879-03
5.000+07	5.375-05	5.870-01	1.342-03	7.024+00	1.589-01	7.771+00	3.548-08	3.875-04	8.859-07	4.637-03	1.049-04	5.130-03
6.000+07	3.732-05	5.058-01	1.112-03	7.399+00	1.715-01	8.077+00	2.464-08	3.339-04	7.341-07	4.885-03	1.132-04	5.332-03
8.000+07	2.099-05	3.989-01	8.274-04	7.954+00	1.905-01	8.544+00	1.386-08	2.633-04	5.452-07	5.251-03	1.258-04	5.641-03
1.000+08	1.344-05	3.311-01	6.589-04	8.349+00	2.044-01	8.885+00	8.873-09	2.186-04	4.330-07	5.512-03	1.349-04	5.866-03
1.500+08	5.972-06	2.358-01	4.366-04	8.976+00	2.275-01	9.440+00	3.943-09	1.557-04	2.882-07	5.926-03	1.502-04	6.232-03
2.000+08	3.359-06	1.848-01	3.264-04	9.352+00	2.421-01	9.779+00	2.218-09	1.220-04	2.155-07	6.174-03	1.598-04	6.456-03
3.000+08	1.493-06	1.310-01	2.169-04	9.789+00	2.600-01	1.018+01	9.856-10	8.648-05	1.432-07	6.462-03	1.716-04	6.721-03
4.000+08	8.397-07	1.026-01	1.624-04	1.004+01	2.709-01	1.041+01	5.543-10	6.773-05	1.072-07	6.628-03	1.788-04	6.875-03
5.000+08	5.374-07	8.494-02	1.298-04	1.021+01	2.784-01	1.057+01	3.548-10	5.607-05	8.569-08	6.740-03	1.838-04	6.980-03
6.000+08	3.732-07	7.273-02	1.081-04	1.033+01	2.839-01	1.069+01	2.464-10	4.801-05	7.136-08	6.820-03	1.874-04	7.055-03
8.000+08	2.099-07	5.680-02	8.103-05	1.048+01	2.915-01	1.083+01	1.386-10	3.750-05	5.349-08	6.919-03	1.924-04	7.149-03
1.000+09	1.344-07	4.673-02	6.480-05	1.059+01	2.966-01	1.093+01	8.873-11	3.085-05	4.278-08	6.991-03	1.958-04	7.218-03
1.500+09	5.972-08	3.263-02	4.317-05	1.073+01	3.043-01	1.107+01	3.943-11	2.154-05	2.850-08	7.084-03	2.009-04	7.306-03
2.000+09	3.359-08	2.526-02	3.237-05	1.082+01	3.087-01	1.115+01	2.218-11	1.668-05	2.137-08	7.143-03	2.038-04	7.363-03
3.000+09	1.493-08	1.756-02	2.157-05	1.090+01	3.136-01	1.123+01	9.856-12	1.159-05	1.424-08	7.196-03	2.070-04	7.414-03
4.000+09	8.397-09	1.356-02	1.618-05	1.095+01	3.164-01	1.128+01	5.543-12	8.952-06	1.068-08	7.229-03	2.089-04	7.447-03
5.000+09	5.374-09	1.108-02	1.294-05	1.098+01	3.182-01	1.131+01	3.548-12	7.315-06	8.543-09	7.249-03	2.101-04	7.466-03
6.000+09	3.732-09	9.399-03	1.078-05	1.100+01	3.194-01	1.133+01	2.464-12	6.205-06	7.117-09	7.262-03	2.109-04	7.479-03
8.000+09	2.099-09	7.241-03	8.086-06	1.103+01	3.210-01	1.136+01	1.386-12	4.780-06	5.338-09	7.282-03	2.119-04	7.498-03
1.000+10	1.344-09	5.912-03	6.469-06	1.104+01	3.221-01	1.137+01	8.873-13	3.903-06	4.271-09	7.288-03	2.126-04	7.505-03
1.500+10	5.972-10	4.086-03	4.312-06	1.107+01	3.235-01	1.140+01	3.943-13	2.697-06	2.847-09	7.308-03	2.136-04	7.524-03
2.000+10	3.359-10	3.141-03	3.234-06	1.108+01	3.243-01	1.141+01	2.218-13	2.074-06	2.135-09	7.315-03	2.141-04	7.531-03
3.000+10	1.493-10	2.166-03	2.156-06	1.109+01	3.251-01	1.142+01	9.856-14	1.430-06	1.423-09	7.321-03	2.146-04	7.537-03
4.000+10	8.397-11	1.663-03	1.617-06	1.110+01	3.257-01	1.143+01	5.543-14	1.098-06	1.067-09	7.328-03	2.150-04	7.544-03
5.000+10	5.374-11	1.354-03	1.294-06	1.111+01	3.260-01	1.144+01	3.548-14	8.939-07	8.543-10	7.334-03	2.152-04	7.551-03
6.000+10	3.732-11	1.145-03	1.078-06	1.111+01	3.262-01	1.144+01	2.464-14	7.559-07	7.117-10	7.334-03	2.153-04	7.551-03
8.000+10	2.099-11	8.778-04	8.085-07	1.111+01	3.264-01	1.144+01	1.386-14	5.795-07	5.337-10	7.334-03	2.155-04	7.551-03
1.000+11	1.344-11	7.142-04	6.468-07	1.111+01	3.265-01	1.144+01	8.873-15	4.715-07	4.270-10	7.334-03	2.155-04	7.550-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 41, NB, NIOBIUM ATOMIC WT. = 92.9064 MSQ/KG = .00064818 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.428-01	8.637+00	2.678-01	0.000	0.000	9.048+00	9.256-05	5.598-03	1.736-04	0.000	0.000	5.865-03
1.022+06	1.368-01	8.546+00	2.563-01	0.000	0.000	8.939+00	8.867-05	5.539-03	1.661-04	0.000	0.000	5.794-03
1.250+06	9.165-02	7.730+00	1.730-01	2.005-02	0.000	8.015+00	5.941-05	5.010-03	1.121-04	1.300-05	0.000	5.195-03
1.500+06	6.373-02	7.030+00	1.242-01	9.575-02	0.000	7.314+00	4.131-05	4.557-03	8.050-05	6.206-05	0.000	4.741-03
2.000+06	3.590-02	6.003+00	7.592-02	3.412-01	0.000	6.456+00	2.327-05	3.891-03	4.921-05	2.212-04	0.000	4.185-03
2.044+06	3.437-02	5.929+00	7.327-02	3.655-01	0.000	6.402+00	2.228-05	3.843-03	4.749-05	2.369-04	0.000	4.150-03
3.000+06	1.597-02	4.725+00	4.061-02	9.032-01	1.653-03	5.686+00	1.035-05	3.063-03	2.632-05	5.854-04	1.071-06	3.686-03
4.000+06	8.987-03	3.942+00	2.707-02	1.412+00	6.746-03	5.397+00	5.825-06	2.555-03	1.755-05	9.152-04	4.373-06	3.498-03
5.000+06	5.753-03	3.405+00	2.011-02	1.857+00	1.343-02	5.301+00	3.729-06	2.207-03	1.303-05	1.204-03	8.705-06	3.436-03
6.000+06	3.995-03	3.010+00	1.593-02	2.244+00	2.061-02	5.295+00	2.589-06	1.951-03	1.033-05	1.455-03	1.336-05	3.432-03
7.000+06	2.935-03	2.705+00	1.315-02	2.590+00	2.777-02	5.339+00	1.902-06	1.753-03	8.524-06	1.679-03	1.800-05	3.461-03
8.000+06	2.248-03	2.462+00	1.119-02	2.902+00	3.470-02	5.412+00	1.457-06	1.596-03	7.253-06	1.881-03	2.249-05	3.508-03
9.000+06	1.776-03	2.263+00	9.721-03	3.184+00	4.133-02	5.500+00	1.151-06	1.467-03	6.301-06	2.064-03	2.679-05	3.565-03
1.000+07	1.438-03	2.097+00	8.591-03	3.443+00	4.763-02	5.598+00	9.321-07	1.359-03	5.569-06	2.232-03	3.087-05	3.628-03
1.100+07	1.189-03	1.956+00	7.693-03	3.679+00	5.360-02	5.697+00	7.707-07	1.268-03	4.986-06	2.385-03	3.474-05	3.693-03
1.200+07	9.990-04	1.835+00	6.963-03	3.897+00	5.923-02	5.799+00	6.475-07	1.189-03	4.513-06	2.526-03	3.839-05	3.759-03
1.300+07	8.512-04	1.728+00	6.358-03	4.097+00	6.453-02	5.897+00	5.517-07	1.120-03	4.121-06	2.656-03	4.183-05	3.822-03
1.400+07	7.340-04	1.635+00	5.849-03	4.281+00	6.958-02	5.992+00	4.758-07	1.060-03	3.791-06	2.775-03	4.510-05	3.884-03
1.500+07	6.394-04	1.552+00	5.415-03	4.453+00	7.436-02	6.085+00	4.144-07	1.006-03	3.510-06	2.886-03	4.820-05	3.944-03
1.600+07	5.619-04	1.478+00	5.040-03	4.614+00	7.891-02	6.177+00	3.642-07	9.580-04	3.267-06	2.991-03	5.115-05	4.004-03
1.800+07	4.440-04	1.351+00	4.426-03	4.908+00	8.733-02	6.351+00	2.878-07	8.757-04	2.869-06	3.181-03	5.661-05	4.117-03
2.000+07	3.597-04	1.246+00	3.945-03	5.172+00	9.500-02	6.517+00	2.332-07	8.076-04	2.557-06	3.352-03	6.158-05	4.224-03
2.200+07	2.972-04	1.157+00	3.558-03	5.411+00	1.020-01	6.674+00	1.926-07	7.499-04	2.306-06	3.507-03	6.611-05	4.326-03
2.400+07	2.498-04	1.081+00	3.240-03	5.629+00	1.085-01	6.822+00	1.619-07	7.007-04	2.100-06	3.649-03	7.033-05	4.422-03
2.600+07	2.128-04	1.015+00	2.973-03	5.827+00	1.144-01	6.960+00	1.379-07	6.579-04	1.927-06	3.777-03	7.415-05	4.511-03
2.800+07	1.835-04	9.579-01	2.748-03	6.009+00	1.200-01	7.090+00	1.189-07	6.209-04	1.781-06	3.895-03	7.778-05	4.596-03
3.000+07	1.598-04	9.070-01	2.553-03	6.177+00	1.251-01	7.212+00	1.036-07	5.879-04	1.655-06	4.004-03	8.109-05	4.675-03
4.000+07	3.991-05	7.208-01	1.886-03	6.857+00	1.465-01	7.726+00	5.828-08	4.672-04	1.222-06	4.445-03	9.496-05	5.008-03
5.000+07	5.754-05	6.017-01	1.495-03	7.361+00	1.627-01	8.127+00	3.730-08	3.900-04	9.690-07	4.771-03	1.055-04	5.268-03
6.000+07	3.996-05	5.184-01	1.239-03	7.754+00	1.756-01	8.449+00	2.590-08	3.360-04	8.031-07	5.026-03	1.138-04	5.477-03
8.000+07	2.248-05	4.088-01	9.218-04	8.335+00	1.950-01	8.940+00	1.457-08	2.650-04	5.975-07	5.403-03	1.264-04	5.795-03
1.000+08	1.439-05	3.393-01	7.340-04	8.747+00	2.092-01	9.296+00	9.327-09	2.199-04	4.758-07	5.670-03	1.356-04	6.026-03
1.500+08	5.393-06	2.417-01	4.863-04	9.404+00	2.328-01	9.879+00	4.144-09	1.567-04	3.152-07	6.096-03	1.509-04	6.403-03
2.000+08	3.596-06	1.895-01	3.636-04	9.797+00	2.477-01	1.023+01	2.331-09	1.228-04	2.357-07	6.350-03	1.606-04	6.634-03
3.000+08	1.598-06	1.343-01	2.416-04	1.025+01	2.659-01	1.065+01	1.036-09	8.705-05	1.566-07	6.644-03	1.724-04	6.903-03
4.000+08	8.991-07	1.052-01	1.810-04	1.052+01	2.769-01	1.090+01	5.828-10	6.819-05	1.173-07	6.819-03	1.795-04	7.067-03
5.000+08	5.754-07	8.706-02	1.446-04	1.069+01	2.845-01	1.106+01	3.730-10	5.643-05	9.373-08	6.929-03	1.844-04	7.170-03
6.000+08	3.996-07	7.454-02	1.204-04	1.082+01	2.900-01	1.118+01	2.590-10	4.832-05	7.804-08	7.013-03	1.880-04	7.250-03
8.000+08	2.248-07	5.822-02	9.026-05	1.098+01	2.977-01	1.134+01	1.457-10	3.774-05	5.851-08	7.117-03	1.930-04	7.348-03
1.000+09	1.438-07	4.790-02	7.218-05	1.109+01	3.028-01	1.144+01	9.321-11	3.105-05	4.679-08	7.188-03	1.963-04	7.416-03
1.500+09	5.393-08	3.345-02	4.809-05	1.124+01	3.105-01	1.158+01	4.144-11	2.168-05	3.117-08	7.286-03	2.013-04	7.509-03
2.000+09	3.596-08	2.589-02	3.605-05	1.133+01	3.148-01	1.167+01	2.331-11	1.678-05	2.337-08	7.344-03	2.040-04	7.565-03
3.000+09	1.598-08	1.800-02	2.403-05	1.142+01	3.196-01	1.176+01	1.036-11	1.167-05	1.558-08	7.402-03	2.072-04	7.621-03
4.000+09	8.991-09	1.390-02	1.802-05	1.147+01	3.224-01	1.181+01	5.828-12	9.010-06	1.168-08	7.435-03	2.090-04	7.653-03
5.000+09	5.754-09	1.136-02	1.441-05	1.150+01	3.241-01	1.184+01	3.730-12	7.363-06	9.340-09	7.454-03	2.101-04	7.672-03
6.000+09	3.996-09	9.634-03	1.201-05	1.152+01	3.253-01	1.185+01	2.590-12	6.245-06	7.785-09	7.467-03	2.109-04	7.684-03
8.000+09	2.248-09	7.422-03	9.007-06	1.155+01	3.270-01	1.188+01	1.457-12	4.811-06	5.838-09	7.487-03	2.120-04	7.707-03
1.000+10	1.438-09	6.060-03	7.205-06	1.157+01	3.280-01	1.190+01	9.321-13	3.928-06	4.670-09	7.499-03	2.126-04	7.716-03
1.500+10	6.393-10	4.188-03	4.803-06	1.159+01	3.294-01	1.192+01	4.144-13	2.715-06	3.113-09	7.512-03	2.135-04	7.729-03
2.000+10	3.596-10	3.220-03	3.602-06	1.161+01	3.302-01	1.194+01	2.331-13	2.087-06	2.335-09	7.525-03	2.140-04	7.742-03
3.000+10	1.598-10	2.220-03	2.401-06	1.162+01	3.310-01	1.195+01	1.036-13	1.439-06	1.556-09	7.532-03	2.145-04	7.748-03
4.000+10	8.991-11	1.705-03	1.801-06	1.163+01	3.315-01	1.196+01	5.828-14	1.105-06	1.167-09	7.538-03	2.149-04	7.754-03
5.000+10	5.754-11	1.386-03	1.441-06	1.163+01	3.318-01	1.196+01	3.730-14	8.997-07	9.340-10	7.538-03	2.151-04	7.754-03
6.000+10	3.996-11	1.173-03	1.201-06	1.163+01	3.319-01	1.196+01	2.590-14	7.603-07	7.785-10	7.538-03	2.151-04	7.754-03
8.000+10	2.248-11	8.998-04	9.005-07	1.164+01	3.322-01	1.197+01	1.457-14	5.832-07	5.837-10	7.545-03	2.153-04	7.761-03
1.000+11	1.438-11	7.320-04	7.204-07	1.164+01	3.323-01	1.197+01	9.321-15	4.745-07	4.670-10	7.545-03	2.154-04	7.761-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 42, MO, MOLYBDENUM ATOMIC WT. = 95.94 MSQ/KG = .00662769 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING		PAIR PRODUCTION				SCATTERING		PAIR PRODUCTION			
	COHERENT	INCOHER.	PHOTO-ELECTRIC	NUCLEAR FIELD	ELECTRON FIELD	TOTAL	COHERENT	INCOHER.	PHOTO-ELECTRIC	NUCLEAR FIELD	ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.527-01	8.846+00	2.991-01	0.000	0.000	9.298+00	9.585-05	5.553-03	1.877-04	0.000	0.000	5.836-03
1.022+06	1.462-01	8.754+00	2.862-01	0.000	0.000	9.186+00	9.177-05	5.495-03	1.796-04	0.000	0.000	5.766-03
1.250+06	9.799-02	7.918+00	1.932-01	2.135-02	0.000	8.231+00	6.151-05	4.970-03	1.213-04	1.340-05	0.000	5.166-03
1.500+06	6.814-02	7.201+00	1.386-01	1.015-01	0.000	7.509+00	4.277-05	4.520-03	8.700-05	6.371-05	0.000	4.713-03
2.000+06	3.839-02	6.149+00	8.472-02	3.602-01	0.000	6.632+00	2.410-05	3.860-03	5.318-05	2.261-04	0.000	4.163-03
2.044+06	3.675-02	6.074+00	8.176-02	3.858-01	0.000	6.578+00	2.307-05	3.813-03	5.132-05	2.422-04	0.000	4.129-03
3.000+06	1.708-02	4.840+00	4.528-02	9.505-01	1.694-03	5.855+00	1.072-05	3.038-03	2.842-05	5.966-04	1.063-06	3.675-03
4.000+06	9.610-03	4.039+00	3.017-02	1.484+00	6.910-03	5.570+00	6.032-06	2.535-03	1.894-05	9.315-04	4.337-06	3.496-03
5.000+06	6.152-03	3.488+00	2.240-02	1.949+00	1.376-02	5.479+00	3.862-06	2.189-03	1.406-05	1.223-03	8.637-06	3.439-03
6.000+06	4.272-03	3.083+00	1.774-02	2.354+00	2.111-02	5.480+00	2.681-06	1.935-03	1.114-05	1.478-03	1.325-05	3.440-03
7.000+06	3.139-03	2.771+00	1.464-02	2.716+00	2.844-02	5.533+00	1.970-06	1.739-03	9.189-06	1.705-03	1.785-05	3.473-03
8.000+06	2.404-03	2.522+00	1.245-02	3.041+00	3.554-02	5.613+00	1.509-06	1.583-03	7.815-06	1.909-03	2.231-05	3.523-03
9.000+06	1.899-03	2.319+00	1.082-02	3.336+00	4.233-02	5.710+00	1.192-06	1.456-03	6.792-06	2.094-03	2.657-05	3.584-03
1.000+07	1.538-03	2.148+00	9.559-03	3.607+00	4.878-02	5.815+00	9.654-07	1.348-03	6.000-06	2.264-03	3.062-05	3.650-03
1.100+07	1.271-03	2.004+00	8.559-03	3.854+00	5.489-02	5.923+00	7.975-07	1.258-03	5.372-06	2.419-03	3.445-05	3.718-03
1.200+07	1.068-03	1.879+00	7.746-03	4.082+00	6.065-02	6.030+00	6.704-07	1.179-03	4.862-06	2.562-03	3.807-05	3.785-03
1.300+07	9.103-04	1.770+00	7.072-03	4.292+00	6.608-02	6.136+00	5.714-07	1.111-03	4.439-06	2.694-03	4.148-05	3.852-03
1.400+07	7.849-04	1.675+00	6.505-03	4.485+00	7.125-02	6.239+00	4.927-07	1.051-03	4.083-06	2.815-03	4.472-05	3.916-03
1.500+07	6.837-04	1.590+00	6.022-03	4.664+00	7.615-02	6.337+00	4.292-07	9.980-04	3.780-06	2.928-03	4.780-05	3.978-03
1.600+07	6.009-04	1.514+00	5.605-03	4.833+00	8.080-02	6.434+00	3.772-07	9.503-04	3.518-06	3.034-03	5.072-05	4.039-03
1.800+07	4.748-04	1.384+00	4.922-03	5.139+00	8.942-02	6.618+00	2.980-07	8.687-04	3.089-06	3.226-03	5.613-05	4.154-03
2.000+07	3.846-04	1.276+00	4.387-03	5.415+00	9.726-02	6.793+00	2.414-07	8.009-04	2.754-06	3.399-03	6.105-05	4.264-03
2.200+07	3.179-04	1.185+00	3.956-03	5.666+00	1.044-01	6.960+00	1.995-07	7.438-04	2.483-06	3.556-03	6.553-05	4.369-03
2.400+07	2.671-04	1.108+00	3.602-03	5.893+00	1.119-01	7.116+00	1.677-07	6.955-04	2.261-06	3.699-03	6.967-05	4.467-03
2.600+07	2.276-04	1.040+00	3.306-03	6.101+00	1.171-01	7.262+00	1.429-07	6.528-04	2.075-06	3.830-03	7.350-05	4.558-03
2.800+07	1.962-04	9.812-01	3.054-03	6.291+00	1.228-01	7.398+00	1.232-07	6.159-04	1.917-06	3.949-03	7.708-05	4.644-03
3.000+07	1.709-04	9.292-01	2.838-03	6.466+00	1.281-01	7.526+00	1.073-07	5.832-04	1.781-06	4.059-03	8.041-05	4.724-03
4.000+07	9.615-05	7.384-01	2.097-03	7.178+00	1.499-01	8.068+00	6.035-08	4.635-04	1.316-06	4.506-03	9.409-05	5.065-03
5.000+07	6.154-05	6.163-01	1.662-03	7.705+00	1.665-01	8.490+00	3.863-08	3.868-04	1.043-06	4.836-03	1.045-04	5.329-03
6.000+07	4.273-05	5.310-01	1.376-03	8.116+00	1.796-01	8.828+00	2.682-08	3.333-04	8.637-07	5.094-03	1.127-04	5.541-03
8.000+07	2.404-05	4.188-01	1.024-03	8.723+00	1.995-01	9.342+00	1.509-08	2.629-04	6.428-07	5.475-03	1.252-04	5.864-03
1.000+08	1.538-05	3.476-01	8.157-04	9.154+00	2.140-01	9.716+00	9.654-09	2.182-04	5.120-07	5.746-03	1.343-04	6.099-03
1.500+08	6.837-06	2.475-01	5.404-04	9.840+00	2.381-01	1.033+01	4.292-09	1.554-04	3.392-07	6.176-03	1.495-04	6.482-03
2.000+08	3.846-06	1.941-01	4.040-04	1.025+01	2.533-01	1.070+01	2.414-09	1.218-04	2.536-07	6.434-03	1.590-04	6.715-03
3.000+08	1.709-06	1.376-01	2.685-04	1.073+01	2.718-01	1.114+01	1.073-09	8.637-05	1.685-07	6.735-03	1.706-04	6.992-03
4.000+08	9.614-07	1.077-01	2.010-04	1.101+01	2.830-01	1.140+01	6.035-10	6.760-05	1.262-07	6.911-03	1.776-04	7.156-03
5.000+08	6.153-07	8.919-02	1.607-04	1.119+01	2.907-01	1.157+01	3.862-10	5.598-05	1.009-07	7.024-03	1.825-04	7.262-03
6.000+08	4.273-07	7.636-02	1.338-04	1.132+01	2.963-01	1.169+01	2.682-10	4.793-05	8.398-08	7.105-03	1.860-04	7.339-03
8.000+08	2.404-07	5.964-02	1.003-04	1.149+01	3.041-01	1.185+01	1.509-10	3.744-05	6.296-08	7.212-03	1.909-04	7.441-03
1.000+09	1.538-07	4.907-02	8.019-05	1.160+01	3.093-01	1.196+01	9.654-11	3.080-05	5.033-08	7.281-03	1.941-04	7.506-03
1.500+09	6.837-08	3.427-02	5.342-05	1.176+01	3.171-01	1.211+01	4.292-11	2.151-05	3.353-08	7.382-03	1.990-04	7.602-03
2.000+09	3.846-08	2.652-02	4.006-05	1.185+01	3.215-01	1.220+01	2.414-11	1.665-05	2.515-08	7.438-03	2.018-04	7.657-03
3.000+09	1.709-08	1.844-02	2.670-05	1.195+01	3.263-01	1.229+01	1.073-11	1.157-05	1.676-08	7.501-03	2.048-04	7.717-03
4.000+09	9.614-09	1.423-02	2.002-05	1.200+01	3.291-01	1.234+01	6.035-12	8.932-06	1.257-08	7.532-03	2.066-04	7.748-03
5.000+09	6.153-09	1.164-02	1.601-05	1.203+01	3.308-01	1.237+01	3.862-12	7.306-06	1.005-08	7.551-03	2.076-04	7.766-03
6.000+09	4.273-09	9.869-03	1.334-05	1.205+01	3.321-01	1.239+01	2.682-12	6.195-06	8.373-09	7.564-03	2.085-04	7.778-03
8.000+09	2.404-09	7.603-03	1.001-05	1.208+01	3.337-01	1.242+01	1.509-12	4.772-06	6.283-09	7.582-03	2.095-04	7.797-03
1.000+10	1.538-09	6.208-03	8.005-06	1.210+01	3.347-01	1.244+01	9.654-13	3.897-06	5.025-09	7.595-03	2.101-04	7.809-03
1.500+10	6.837-10	4.290-03	5.336-06	1.213+01	3.361-01	1.247+01	4.292-13	2.693-06	3.349-09	7.614-03	2.110-04	7.828-03
2.000+10	3.846-10	3.298-03	4.002-06	1.214+01	3.370-01	1.248+01	2.414-13	2.070-06	2.512-09	7.620-03	2.115-04	7.834-03
3.000+10	1.709-10	2.275-03	2.668-06	1.216+01	3.377-01	1.250+01	1.073-13	1.428-06	1.675-09	7.632-03	2.120-04	7.846-03
4.000+10	9.614-11	1.746-03	2.001-06	1.216+01	3.382-01	1.250+01	6.035-14	1.096-06	1.256-09	7.633-03	2.123-04	7.846-03
5.000+10	6.153-11	1.422-03	1.601-06	1.217+01	3.385-01	1.251+01	3.862-14	8.926-07	1.005-09	7.639-03	2.125-04	7.852-03
6.000+10	4.273-11	1.202-03	1.334-06	1.217+01	3.387-01	1.251+01	2.682-14	7.545-07	8.373-10	7.639-03	2.126-04	7.852-03
8.000+10	2.404-11	9.217-04	1.000-06	1.218+01	3.389-01	1.252+01	1.509-14	5.785-07	6.277-10	7.645-03	2.127-04	7.859-03
1.000+11	1.538-11	7.499-04	8.004-07	1.218+01	3.391-01	1.252+01	9.654-15	4.707-07	5.021-10	7.645-03	2.128-04	7.859-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 43, TC, TECHNETIUM ATOMIC WT. = 97.907 MSQ/KG = .00061508 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.627-01	9.056+00	3.332-01	0.000	0.000	9.552+00	1.001-04	5.570-03	2.049-04	0.000	0.000	5.875-03
1.022+06	1.558-01	8.961+00	3.188-01	0.000	0.000	9.436+00	9.583-05	5.512-03	1.961-04	0.000	0.000	5.804-03
1.250+06	1.044-01	8.106+00	2.151-01	2.270-02	0.000	8.448+00	6.421-05	4.986-03	1.323-04	1.396-05	0.000	5.196-03
1.500+06	7.260-02	7.372+00	1.544-01	1.076-01	0.000	7.707+00	4.465-05	4.534-03	9.497-05	6.618-05	0.000	4.740-03
2.000+06	4.090-02	6.295+00	9.428-02	3.799-01	0.000	6.810+00	2.516-05	3.872-03	5.799-05	2.337-04	0.000	4.189-03
2.044+06	3.917-02	6.218+00	9.099-02	4.069-01	0.000	6.755+00	2.409-05	3.825-03	5.597-05	2.503-04	0.000	4.155-03
3.000+06	1.820-02	4.955+00	5.035-02	9.590-01	1.734-03	6.024+00	1.119-05	3.048-03	3.097-05	6.145-04	1.067-06	3.705-03
4.000+06	1.024-02	4.135+00	3.353-02	1.557+00	7.074-03	5.743+00	6.298-06	2.543-03	2.062-05	9.577-04	4.351-06	3.532-03
5.000+06	6.556-03	3.571+00	2.489-02	2.044+00	1.408-02	5.661+00	4.032-06	2.196-03	1.531-05	1.257-03	8.660-06	3.482-03
6.000+06	4.553-03	3.157+00	1.970-02	2.466+00	2.161-02	5.669+00	2.800-06	1.942-03	1.212-05	1.517-03	1.329-05	3.487-03
7.000+06	3.345-03	2.837+00	1.626-02	2.844+00	2.911-02	5.730+00	2.057-06	1.745-03	1.000-05	1.749-03	1.790-05	3.524-03
8.000+06	2.561-03	2.582+00	1.382-02	3.183+00	3.638-02	5.818+00	1.575-06	1.588-03	8.500-06	1.958-03	2.238-05	3.578-03
9.000+06	2.024-03	2.374+00	1.201-02	3.492+00	4.333-02	5.923+00	1.245-06	1.460-03	7.387-06	2.148-03	2.665-05	3.642-03
1.000+07	1.639-03	2.199+00	1.061-02	3.774+00	4.993-02	6.035+00	1.008-06	1.353-03	6.526-06	2.321-03	3.071-05	3.712-03
1.100+07	1.355-03	2.051+00	9.496-03	4.033+00	5.618-02	6.151+00	8.334-07	1.262-03	5.841-06	2.481-03	3.456-05	3.783-03
1.200+07	1.138-03	1.924+00	8.594-03	4.271+00	6.208-02	6.267+00	7.000-07	1.183-03	5.286-06	2.627-03	3.818-05	3.855-03
1.300+07	9.700-04	1.812+00	7.846-03	4.491+00	6.763-02	6.379+00	5.966-07	1.115-03	4.826-06	2.762-03	4.160-05	3.924-03
1.400+07	8.364-04	1.715+00	7.216-03	4.693+00	7.292-02	6.489+00	5.145-07	1.055-03	4.438-06	2.887-03	4.485-05	3.991-03
1.500+07	7.286-04	1.628+00	6.680-03	4.880+00	7.793-02	6.593+00	4.481-07	1.001-03	4.109-06	3.002-03	4.793-05	4.055-03
1.600+07	6.404-04	1.550+00	6.217-03	5.056+00	8.268-02	6.696+00	3.939-07	9.534-04	3.824-06	3.110-03	5.085-05	4.118-03
1.800+07	5.060-04	1.417+00	5.459-03	5.377+00	9.150-02	6.891+00	3.112-07	8.716-04	3.358-06	3.307-03	5.628-05	4.239-03
2.000+07	4.098-04	1.307+00	4.865-03	5.665+00	9.952-02	7.077+00	2.521-07	8.039-04	2.992-06	3.484-03	6.121-05	4.353-03
2.200+07	3.387-04	1.214+00	4.386-03	5.927+00	1.069-01	7.253+00	2.083-07	7.467-04	2.698-06	3.646-03	6.575-05	4.461-03
2.400+07	2.846-04	1.134+00	3.994-03	6.164+00	1.136-01	7.416+00	1.751-07	6.975-04	2.457-06	3.791-03	6.987-05	4.561-03
2.600+07	2.425-04	1.065+00	3.665-03	6.381+00	1.199-01	7.570+00	1.492-07	6.551-04	2.254-06	3.925-03	7.375-05	4.656-03
2.800+07	2.091-04	1.005+00	3.386-03	6.580+00	1.256-01	7.714+00	1.286-07	6.182-04	2.083-06	4.047-03	7.725-05	4.745-03
3.000+07	1.822-04	9.513-01	3.147-03	6.763+00	1.310-01	7.849+00	1.121-07	5.851-04	1.936-06	4.160-03	8.058-05	4.828-03
4.000+07	1.025-04	7.559-01	2.324-03	7.506+00	1.533-01	8.418+00	6.305-08	4.649-04	1.429-06	4.617-03	9.429-05	5.177-03
5.000+07	6.558-05	6.310-01	1.842-03	8.057+00	1.703-01	8.860+00	4.034-08	3.881-04	1.133-06	4.956-03	1.047-04	5.450-03
6.000+07	4.554-05	5.437-01	1.526-03	8.485+00	1.837-01	9.214+00	2.801-08	3.344-04	9.386-07	5.219-03	1.130-04	5.667-03
8.000+07	2.561-05	4.288-01	1.135-03	9.119+00	2.040-01	9.753+00	1.575-08	2.637-04	6.981-07	5.609-03	1.255-04	5.999-03
1.000+08	1.639-05	3.559-01	9.039-04	9.569+00	2.188-01	1.014+01	1.008-08	2.189-04	5.560-07	5.886-03	1.346-04	6.240-03
1.500+08	7.286-06	2.534-01	5.988-04	1.029+01	2.434-01	1.079+01	4.481-09	1.559-04	3.683-07	6.329-03	1.497-04	6.635-03
2.000+08	4.098-06	1.987-01	4.477-04	1.071+01	2.589-01	1.117+01	2.521-09	1.222-04	2.754-07	6.587-03	1.592-04	6.869-03
3.000+08	1.822-06	1.488-01	2.975-04	1.121+01	2.779-01	1.163+01	1.121-09	8.660-05	1.830-07	6.895-03	1.709-04	7.153-03
4.000+08	1.025-06	1.193-01	2.228-04	1.150+01	2.893-01	1.190+01	6.305-10	6.784-05	1.370-07	7.073-03	1.779-04	7.319-03
5.000+08	6.558-07	9.131-02	1.780-04	1.169+01	2.972-01	1.208+01	4.034-10	5.616-05	1.095-07	7.190-03	1.828-04	7.429-03
6.000+08	4.554-07	7.818-02	1.483-04	1.183+01	3.030-01	1.221+01	2.801-10	4.809-05	9.122-08	7.276-03	1.864-04	7.511-03
8.000+08	2.562-07	6.166-02	1.111-04	1.201+01	3.110-01	1.238+01	1.576-10	3.756-05	6.834-08	7.387-03	1.913-04	7.616-03
1.000+09	1.639-07	5.023-02	8.885-05	1.212+01	3.163-01	1.249+01	1.008-10	3.090-05	5.465-08	7.455-03	1.945-04	7.680-03
1.500+09	7.286-08	3.508-02	5.920-05	1.229+01	3.243-01	1.265+01	4.481-11	2.158-05	3.641-08	7.559-03	1.995-04	7.780-03
2.000+09	4.098-08	2.715-02	4.438-05	1.239+01	3.289-01	1.275+01	2.521-11	1.670-05	2.730-08	7.621-03	2.023-04	7.640-03
3.000+09	1.822-08	1.888-02	2.958-05	1.249+01	3.339-01	1.284+01	1.121-11	1.161-05	1.819-08	7.687-03	2.054-04	7.899-03
4.000+09	1.025-08	1.457-02	2.218-05	1.254+01	3.368-01	1.289+01	6.305-12	8.962-06	1.364-08	7.713-03	2.072-04	7.929-03
5.000+09	6.558-09	1.191-02	1.774-05	1.257+01	3.386-01	1.292+01	4.034-12	7.326-06	1.091-08	7.772-03	2.083-04	7.947-03
6.000+09	4.554-09	1.010-02	1.478-05	1.260+01	3.399-01	1.295+01	2.801-12	6.212-06	9.091-09	7.750-03	2.091-04	7.965-03
8.000+09	2.562-09	7.784-03	1.109-05	1.263+01	3.416-01	1.298+01	1.576-12	4.788-06	6.821-09	7.768-03	2.101-04	7.983-03
1.000+10	1.639-09	6.356-03	8.870-06	1.265+01	3.427-01	1.300+01	1.008-12	3.909-06	5.456-09	7.781-03	2.108-04	7.995-03
1.500+10	7.286-10	4.392-03	5.913-06	1.267+01	3.441-01	1.302+01	4.481-13	2.701-06	3.637-09	7.793-03	2.116-04	8.007-03
2.000+10	4.098-10	3.377-03	4.434-06	1.269+01	3.450-01	1.304+01	2.521-13	2.077-06	2.727-09	7.805-03	2.122-04	8.020-03
3.000+10	1.822-10	2.329-03	2.956-06	1.270+01	3.458-01	1.305+01	1.121-13	1.433-06	1.818-09	7.811-03	2.127-04	8.026-03
4.000+10	1.025-10	1.788-03	2.217-06	1.271+01	3.463-01	1.306+01	6.305-14	1.100-06	1.364-09	7.818-03	2.130-04	8.032-03
5.000+10	6.558-11	1.456-03	1.774-06	1.272+01	3.466-01	1.307+01	4.034-14	8.956-07	1.091-09	7.824-03	2.132-04	8.038-03
6.000+10	4.554-11	1.231-03	1.478-06	1.272+01	3.468-01	1.307+01	2.801-14	7.572-07	9.091-10	7.824-03	2.133-04	8.038-03
8.000+10	2.562-11	9.437-04	1.109-06	1.272+01	3.470-01	1.307+01	1.576-14	5.804-07	6.821-10	7.824-03	2.134-04	8.038-03
1.000+11	1.639-11	7.678-04	8.868-07	1.273+01	3.472-01	1.308+01	1.008-14	4.723-07	5.455-10	7.830-03	2.136-04	8.044-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 44, RU, RUTHENIUM ATOMIC WT. = 101.07 MSQ/KG = .00059583 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.734-01	9.266+00	3.701-01	0.000	0.000	9.809+00	1.033-04	5.521-03	2.205-04	0.000	0.000	5.845-03
1.022+06	1.661-01	9.168+00	3.541-01	0.000	0.000	9.688+00	9.897-05	5.463-03	2.110-04	0.000	0.000	5.773-03
1.250+06	1.113-01	8.294+00	2.389-01	2.412-02	0.000	8.668+00	6.632-05	4.942-03	1.423-04	1.437-05	0.000	5.165-03
1.500+06	7.740-02	7.543+00	1.714-01	1.138-01	0.000	7.906+00	4.612-05	4.494-03	1.021-04	6.781-05	0.000	4.710-03
2.000+06	4.361-02	6.441+00	1.046-01	4.002-01	0.000	6.989+00	2.598-05	3.838-03	6.232-05	2.385-04	0.000	4.164-03
2.044+06	4.176-02	6.362+00	1.010-01	4.285-01	0.000	6.933+00	2.488-05	3.791-03	6.018-05	2.553-04	0.000	4.131-03
3.000+06	1.940-02	5.071+00	5.584-02	1.049+00	1.774-03	6.197+00	1.156-05	3.021-03	3.327-05	6.250-04	1.057-06	3.692-03
4.000+06	1.092-02	4.231+00	3.716-02	1.633+00	7.238-03	5.919+00	6.506-06	2.521-03	2.214-05	9.730-04	4.313-06	3.527-03
5.000+06	6.990-03	3.654+00	2.757-02	2.141+00	1.441-02	5.844+00	4.165-06	2.177-03	1.643-05	1.276-03	8.586-06	3.482-03
6.000+06	4.855-03	3.230+00	2.182-02	2.581+00	2.211-02	5.860+00	2.893-06	1.925-03	1.300-05	1.538-03	1.317-05	3.491-03
7.000+06	3.567-03	2.903+00	1.800-02	2.975+00	2.978-02	5.929+00	2.125-06	1.730-03	1.072-05	1.773-03	1.774-05	3.533-03
8.000+06	2.731-03	2.642+00	1.530-02	3.329+00	3.721-02	6.026+00	1.627-06	1.574-03	9.116-06	1.984-03	2.217-05	3.591-03
9.000+06	2.158-03	2.429+00	1.329-02	3.650+00	4.432-02	6.139+00	1.286-06	1.447-03	7.919-06	2.175-03	2.641-05	3.658-03
1.000+07	1.748-03	2.251+00	1.174-02	3.945+00	5.108-02	6.261+00	1.042-06	1.341-03	6.995-06	2.351-03	3.043-05	3.730-03
1.100+07	1.445-03	2.099+00	1.051-02	4.215+00	5.747-02	6.383+00	8.610-07	1.251-03	6.262-06	2.511-03	3.424-05	3.803-03
1.200+07	1.214-03	1.969+00	9.509-03	4.464+00	6.350-02	6.507+00	7.233-07	1.173-03	5.666-06	2.660-03	3.784-05	3.877-03
1.300+07	1.034-03	1.855+00	8.681-03	4.693+00	6.918-02	6.627+00	6.161-07	1.105-03	5.172-06	2.796-03	4.122-05	3.948-03
1.400+07	8.918-04	1.755+00	7.984-03	4.904+00	7.459-02	6.742+00	5.314-07	1.046-03	4.757-06	2.922-03	4.444-05	4.017-03
1.500+07	7.769-04	1.666+00	7.390-03	5.100+00	7.971-02	6.854+00	4.629-07	9.927-04	4.403-06	3.039-03	4.749-05	4.084-03
1.600+07	6.828-04	1.586+00	6.877-03	5.283+00	8.457-02	6.961+00	4.068-07	9.450-04	4.098-06	3.148-03	5.039-05	4.148-03
1.800+07	5.395-04	1.450+00	6.038-03	5.619+00	9.358-02	7.169+00	3.214-07	8.640-04	3.598-06	3.348-03	5.576-05	4.272-03
2.000+07	4.370-04	1.337+00	5.380-03	5.919+00	1.018-01	7.364+00	2.604-07	7.966-04	3.206-06	3.527-03	6.066-05	4.387-03
2.200+07	3.612-04	1.242+00	4.851-03	6.192+00	1.093-01	7.549+00	2.152-07	7.400-04	2.890-06	3.689-03	6.512-05	4.498-03
2.400+07	3.035-04	1.161+00	4.416-03	6.440+00	1.162-01	7.722+00	1.808-07	6.918-04	2.631-06	3.837-03	6.924-05	4.601-03
2.600+07	2.586-04	1.090+00	4.053-03	6.667+00	1.226-01	7.884+00	1.541-07	6.495-04	2.415-06	3.972-03	7.305-05	4.697-03
2.800+07	2.230-04	1.028+00	3.745-03	6.874+00	1.285-01	8.034+00	1.329-07	6.125-04	2.231-06	4.096-03	7.656-05	4.787-03
3.000+07	1.942-04	9.734-01	3.480-03	7.065+00	1.340-01	8.176+00	1.157-07	5.800-04	2.073-06	4.210-03	7.984-05	4.872-03
4.000+07	1.093-04	7.735-01	2.570-03	7.840+00	1.568-01	8.773+00	6.512-08	4.609-04	1.531-06	4.671-03	9.343-05	5.227-03
5.000+07	6.992-05	6.457-01	2.037-03	8.414+00	1.741-01	9.236+00	4.166-08	3.847-04	1.214-06	5.013-03	1.037-04	5.503-03
6.000+07	4.856-05	5.563-01	1.686-03	8.862+00	1.878-01	9.608+00	2.893-08	3.315-04	1.005-06	5.280-03	1.119-04	5.725-03
8.000+07	2.731-05	4.387-01	1.255-03	9.522+00	2.085-01	1.017+01	1.627-08	2.614-04	7.478-07	5.673-03	1.242-04	6.060-03
1.000+08	1.748-05	3.642-01	9.991-04	9.992+00	2.236-01	1.058+01	1.042-08	2.170-04	5.953-07	5.954-03	1.332-04	6.304-03
1.500+08	7.769-06	2.593-01	6.618-04	1.074+01	2.487-01	1.125+01	4.629-09	1.545-04	3.943-07	6.399-03	1.482-04	6.702-03
2.000+08	4.370-06	2.033-01	4.948-04	1.119+01	2.644-01	1.166+01	2.604-09	1.211-04	2.948-07	6.667-03	1.575-04	6.946-03
3.000+08	1.942-06	1.441-01	3.288-04	1.171+01	2.837-01	1.214+01	1.157-09	8.586-05	1.959-07	6.977-03	1.690-04	7.232-03
4.000+08	1.092-06	1.129-01	2.462-04	1.201+01	2.953-01	1.242+01	6.506-10	6.727-05	1.467-07	7.156-03	1.759-04	7.399-03
5.000+08	6.992-07	9.343-02	1.968-04	1.220+01	3.033-01	1.260+01	4.166-10	5.567-05	1.173-07	7.269-03	1.807-04	7.506-03
6.000+08	4.856-07	8.000-02	1.639-04	1.235+01	3.091-01	1.274+01	2.893-10	4.767-05	9.766-08	7.358-03	1.842-04	7.590-03
8.000+08	2.731-07	6.248-02	1.228-04	1.253+01	3.171-01	1.291+01	1.627-10	3.723-05	7.317-08	7.466-03	1.889-04	7.692-03
1.000+09	1.748-07	5.140-02	9.819-05	1.266+01	3.225-01	1.303+01	1.042-10	3.063-05	5.850-08	7.543-03	1.922-04	7.766-03
1.500+09	7.769-08	3.590-02	6.542-05	1.283+01	3.304-01	1.320+01	4.629-11	2.139-05	3.898-08	7.644-03	1.969-04	7.863-03
2.000+09	4.370-08	2.778-02	4.905-05	1.293+01	3.350-01	1.329+01	2.604-11	1.655-05	2.923-08	7.704-03	1.996-04	7.920-03
3.000+09	1.942-08	1.932-02	3.269-05	1.303+01	3.399-01	1.339+01	1.157-11	1.151-05	1.948-08	7.764-03	2.025-04	7.978-03
4.000+09	1.092-08	1.491-02	2.451-05	1.309+01	3.428-01	1.345+01	6.506-12	8.884-06	1.460-08	7.799-03	2.043-04	8.013-03
5.000+09	6.992-09	1.219-02	1.961-05	1.312+01	3.446-01	1.348+01	4.166-12	7.263-06	1.168-08	7.817-03	2.053-04	8.030-03
6.000+09	4.856-09	1.034-02	1.634-05	1.315+01	3.458-01	1.351+01	2.893-12	6.161-06	9.736-09	7.835-03	2.060-04	8.047-03
8.000+09	2.731-09	7.965-03	1.225-05	1.318+01	3.475-01	1.354+01	1.627-12	4.746-06	7.299-09	7.853-03	2.071-04	8.065-03
1.000+10	1.748-09	6.503-03	9.802-06	1.320+01	3.486-01	1.356+01	1.042-12	3.875-06	5.840-09	7.865-03	2.077-04	8.077-03
1.500+10	7.769-10	4.494-03	6.534-06	1.323+01	3.500-01	1.358+01	4.629-13	2.678-06	3.893-09	7.883-03	2.085-04	8.094-03
2.000+10	4.370-10	3.455-03	4.901-06	1.324+01	3.508-01	1.359+01	2.604-13	2.059-06	2.920-09	7.889-03	2.090-04	8.100-03
3.000+10	1.942-10	2.383-03	3.267-06	1.326+01	3.516-01	1.361+01	1.157-13	1.420-06	1.947-09	7.901-03	2.095-04	8.112-03
4.000+10	1.092-10	1.829-03	2.450-06	1.327+01	3.521-01	1.362+01	6.506-14	1.090-06	1.460-09	7.907-03	2.098-04	8.118-03
5.000+10	6.992-11	1.490-03	1.960-06	1.327+01	3.524-01	1.362+01	4.166-14	8.878-07	1.168-09	7.907-03	2.100-04	8.118-03
6.000+10	4.856-11	1.259-03	1.633-06	1.328+01	3.526-01	1.363+01	2.893-14	7.501-07	9.730-10	7.913-03	2.101-04	8.123-03
8.000+10	2.731-11	9.656-04	1.225-06	1.328+01	3.528-01	1.363+01	1.627-14	5.753-07	7.299-10	7.913-03	2.102-04	8.123-03
1.000+11	1.748-11	7.856-04	9.801-07	1.328+01	3.530-01	1.363+01	1.042-14	4.681-07	5.840-10	7.913-03	2.103-04	8.123-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, Z=1 to 100—Continued

Z = 45, RH, RHODIUM ATOMIC WT. = 102.9055 MSQ/KG = .00058520 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.845-01	9.475+00	4.101-01	0.000	0.000	1.007+01	1.080-04	5.545-03	2.400-04	0.000	0.000	5.893-03
1.022+06	1.767-01	9.376+00	3.924-01	0.000	0.000	9.945+00	1.034-04	5.487-03	2.296-04	0.000	0.000	5.820-03
1.250+06	1.185-01	8.482+00	2.647-01	2.559-02	0.000	8.891+00	6.935-05	4.964-03	1.549-04	1.498-05	0.000	5.207-03
1.500+06	8.239-02	7.714+00	1.899-01	1.204-01	0.000	8.107+00	4.821-05	4.514-03	1.111-04	7.046-05	0.000	4.744-03
2.000+06	4.642-02	6.588+00	1.159-01	4.213-01	0.000	7.172+00	2.717-05	3.855-03	6.782-05	2.465-04	0.000	4.197-03
2.044+06	4.445-02	6.507+00	1.118-01	4.511-01	0.000	7.114+00	2.601-05	3.808-03	6.543-05	2.640-04	0.000	4.163-03
3.000+06	2.066-02	5.186+00	6.179-02	1.100+00	1.814-03	6.370+00	1.209-05	3.035-03	3.616-05	6.437-04	1.062-06	3.728-03
4.000+06	1.162-02	4.327+00	4.110-02	1.710+00	7.402-03	6.097+00	6.800-06	2.532-03	2.405-05	1.001-03	4.332-06	3.568-03
5.000+06	7.441-03	3.737+00	3.048-02	2.240+00	1.474-02	6.030+00	4.354-06	2.187-03	1.784-05	1.311-03	8.626-06	3.529-03
6.000+06	5.168-03	3.303+00	2.411-02	2.698+00	2.261-02	6.053+00	3.024-06	1.933-03	1.411-05	1.579-03	1.323-05	3.542-03
7.000+06	3.797-03	2.969+00	1.989-02	3.108+00	3.045-02	6.131+00	2.222-06	1.737-03	1.164-05	1.819-03	1.782-05	3.588-03
8.000+06	2.907-03	2.702+00	1.690-02	3.477+00	3.805-02	6.237+00	1.701-06	1.581-03	9.890-06	2.035-03	2.227-05	3.650-03
9.000+06	2.297-03	2.484+00	1.468-02	3.812+00	4.532-02	6.358+00	1.344-06	1.454-03	8.591-06	2.231-03	2.652-05	3.721-03
1.000+07	1.861-03	2.302+00	1.296-02	4.119+00	5.223-02	6.488+00	1.089-06	1.347-03	7.584-06	2.410-03	3.057-05	3.797-03
1.100+07	1.538-03	2.147+00	1.160-02	4.401+00	5.876-02	6.620+00	9.000-07	1.256-03	6.788-06	2.575-03	3.439-05	3.874-03
1.200+07	1.292-03	2.013+00	1.050-02	4.660+00	6.492-02	6.750+00	7.561-07	1.178-03	6.145-06	2.727-03	3.799-05	3.950-03
1.300+07	1.101-03	1.897+00	9.583-03	4.900+00	7.073-02	6.878+00	6.443-07	1.110-03	5.608-06	2.867-03	4.139-05	4.025-03
1.400+07	9.494-04	1.795+00	8.813-03	5.121+00	7.626-02	7.002+00	5.556-07	1.050-03	5.157-06	2.997-03	4.463-05	4.098-03
1.500+07	8.271-04	1.704+00	8.156-03	5.325+00	8.149-02	7.119+00	4.840-07	9.972-04	4.773-06	3.116-03	4.769-05	4.166-03
1.600+07	7.269-04	1.622+00	7.590-03	5.516+00	8.646-02	7.233+00	4.254-07	9.492-04	4.442-06	3.226-03	5.060-05	4.233-03
1.800+07	5.744-04	1.483+00	6.663-03	5.866+00	9.566-02	7.452+00	3.361-07	8.679-04	3.899-06	3.433-03	5.598-05	4.361-03
2.000+07	4.652-04	1.367+00	5.937-03	6.179+00	1.040-01	7.656+00	2.722-07	8.000-04	3.474-06	3.616-03	6.086-05	4.481-03
2.200+07	3.845-04	1.270+00	5.353-03	6.464+00	1.117-01	7.851+00	2.250-07	7.432-04	3.133-06	3.783-03	6.537-05	4.595-03
2.400+07	3.231-04	1.187+00	4.873-03	6.722+00	1.188-01	8.033+00	1.891-07	6.946-04	2.852-06	3.934-03	6.952-05	4.701-03
2.600+07	2.753-04	1.115+00	4.472-03	6.958+00	1.253-01	8.203+00	1.611-07	6.525-04	2.617-06	4.072-03	7.333-05	4.800-03
2.800+07	2.374-04	1.051+00	4.131-03	7.174+00	1.313-01	8.361+00	1.389-07	6.150-04	2.417-06	4.198-03	7.684-05	4.893-03
3.000+07	2.068-04	9.955-01	3.839-03	7.373+00	1.369-01	8.509+00	1.210-07	5.826-04	2.247-06	4.315-03	8.011-05	4.990-03
4.000+07	1.163-04	7.911-01	2.835-03	8.180+00	1.602-01	9.134+00	6.806-08	4.630-04	1.659-06	4.787-03	9.375-05	5.345-03
5.000+07	7.444-05	6.604-01	2.246-03	8.778+00	1.778-01	9.619+00	4.356-08	3.865-04	1.314-06	5.137-03	1.040-04	5.629-03
6.000+07	5.169-05	5.690-01	1.860-03	9.245+00	1.919-01	1.001+01	3.025-08	3.330-04	1.088-06	5.410-03	1.123-04	5.857-03
8.000+07	2.908-05	4.487-01	1.384-03	9.934+00	2.130-01	1.060+01	1.702-08	2.626-04	8.099-07	5.813-03	1.246-04	6.201-03
1.000+08	1.861-05	3.724-01	1.102-03	1.042+01	2.284-01	1.102+01	1.089-08	2.179-04	6.449-07	6.098-03	1.337-04	6.450-03
1.500+08	8.271-06	2.652-01	7.298-04	1.120+01	2.540-01	1.172+01	4.840-09	1.552-04	4.271-07	6.554-03	1.486-04	6.859-03
2.000+08	4.652-06	2.080-01	5.456-04	1.167+01	2.700-01	1.215+01	2.722-09	1.217-04	3.193-07	6.829-03	1.580-04	7.109-03
3.000+08	2.068-06	1.474-01	3.626-04	1.221+01	2.896-01	1.265+01	1.210-09	8.626-05	2.122-07	7.145-03	1.695-04	7.401-03
4.000+08	1.163-06	1.154-01	2.715-04	1.252+01	3.014-01	1.294+01	6.806-10	6.753-05	1.589-07	7.327-03	1.764-04	7.571-03
5.000+08	7.444-07	9.556-02	2.170-04	1.273+01	3.094-01	1.314+01	4.356-10	5.592-05	1.270-07	7.450-03	1.811-04	7.687-03
6.000+08	5.169-07	8.182-02	1.807-04	1.287+01	3.153-01	1.327+01	3.025-10	4.788-05	1.057-07	7.532-03	1.845-04	7.764-03
8.000+08	2.908-07	6.390-02	1.354-04	1.307+01	3.235-01	1.346+01	1.702-10	3.739-05	7.924-08	7.649-03	1.893-04	7.875-03
1.000+09	1.861-07	5.257-02	1.083-04	1.319+01	3.289-01	1.357+01	1.089-10	3.076-05	6.338-08	7.719-03	1.925-04	7.942-03
1.500+09	8.271-08	3.671-02	7.213-05	1.338+01	3.370-01	1.375+01	4.840-11	2.148-05	4.221-08	7.830-03	1.972-04	8.049-03
2.000+09	4.652-08	2.842-02	5.408-05	1.348+01	3.415-01	1.385+01	2.722-11	1.663-05	3.165-08	7.889-03	1.998-04	8.105-03
3.000+09	2.068-08	1.976-02	3.604-05	1.358+01	3.465-01	1.395+01	1.210-11	1.156-05	2.109-08	7.947-03	2.028-04	8.161-03
4.000+09	1.163-08	1.525-02	2.703-05	1.364+01	3.494-01	1.400+01	6.806-12	8.924-06	1.582-08	7.982-03	2.045-04	8.196-03
5.000+09	7.444-09	1.247-02	2.162-05	1.368+01	3.512-01	1.404+01	4.356-12	7.297-06	1.265-08	8.006-03	2.055-04	8.218-03
6.000+09	5.169-09	1.057-02	1.802-05	1.371+01	3.525-01	1.407+01	3.025-12	6.186-06	1.055-08	8.023-03	2.063-04	8.236-03
8.000+09	2.908-09	8.146-03	1.351-05	1.374+01	3.541-01	1.410+01	1.702-12	4.767-06	7.906-09	8.041-03	2.072-04	8.253-03
1.000+10	1.861-09	6.651-03	1.081-05	1.376+01	3.552-01	1.412+01	1.089-12	3.892-06	6.326-09	8.052-03	2.079-04	8.264-03
1.500+10	8.271-10	4.597-03	7.205-06	1.379+01	3.566-01	1.415+01	4.840-13	2.690-06	4.216-09	8.070-03	2.087-04	8.281-03
2.000+10	4.652-10	3.534-03	5.403-06	1.380+01	3.575-01	1.416+01	2.722-13	2.068-06	3.162-09	8.076-03	2.092-04	8.287-03
3.000+10	2.068-10	2.437-03	3.602-06	1.382+01	3.583-01	1.418+01	1.210-13	1.426-06	2.108-09	8.087-03	2.097-04	8.299-03
4.000+10	1.163-10	1.871-03	2.702-06	1.383+01	3.588-01	1.419+01	6.806-14	1.095-06	1.581-09	8.093-03	2.100-04	8.304-03
5.000+10	7.444-11	1.524-03	2.161-06	1.383+01	3.591-01	1.419+01	4.356-14	8.918-07	1.265-09	8.093-03	2.101-04	8.304-03
6.000+10	5.169-11	1.288-03	1.801-06	1.384+01	3.593-01	1.420+01	3.025-14	7.537-07	1.054-09	8.099-03	2.103-04	8.310-03
8.000+10	2.908-11	9.876-04	1.351-06	1.384+01	3.595-01	1.420+01	1.702-14	5.779-07	7.906-10	8.099-03	2.104-04	8.310-03
1.000+11	1.861-11	8.035-04	1.081-06	1.385+01	3.597-01	1.421+01	1.089-14	4.702-07	6.326-10	8.105-03	2.105-04	8.316-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 46, PD, PALLADIUM ATOMIC WT. = 106.42 MSQ/KG = .00056538 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.962-01	9.685+00	4.534-01	0.000	0.000	1.033+01	1.110-04	5.481-03	2.566-04	0.000	0.000	5.848-03
1.022+06	1.879-01	9.583+00	4.338-01	0.000	0.000	1.020+01	1.063-04	5.423-03	2.455-04	0.000	0.000	5.775-03
1.250+06	1.260-01	8.670+00	2.927-01	2.713-02	0.000	9.116+00	7.130-05	4.906-03	1.656-04	1.535-05	0.000	5.158-03
1.500+06	8.761-02	7.885+00	2.099-01	1.272-01	0.000	8.310+00	4.958-05	4.462-03	1.188-04	7.198-05	0.000	4.702-03
2.000+06	4.937-02	6.734+00	1.280-01	4.433-01	0.000	7.355+00	2.794-05	3.811-03	7.243-05	2.509-04	0.000	4.162-03
2.044+06	4.727-02	6.651+00	1.235-01	4.745-01	0.000	7.296+00	2.675-05	3.764-03	6.989-05	2.685-04	0.000	4.129-03
3.000+06	2.197-02	5.301+00	6.822-02	1.153+00	1.854-03	6.546+00	1.243-05	3.000-03	3.860-05	6.525-04	1.049-06	3.704-03
4.000+06	1.236-02	4.423+00	4.535-02	1.789+00	7.565-03	6.277+00	6.994-06	2.503-03	2.566-05	1.012-03	4.281-06	3.552-03
5.000+06	7.914-03	3.820+00	3.362-02	2.341+00	1.506-02	6.218+00	4.478-06	2.162-03	1.902-05	1.325-03	8.522-06	3.518-03
6.000+06	5.497-03	3.377+00	2.658-02	2.818+00	2.311-02	6.250+00	3.111-06	1.911-03	1.504-05	1.595-03	1.308-05	3.537-03
7.000+06	4.039-03	3.035+00	2.192-02	3.245+00	3.113-02	6.337+00	2.286-06	1.717-03	1.240-05	1.836-03	1.762-05	3.586-03
8.000+06	3.092-03	2.762+00	1.863-02	3.629+00	3.889-02	6.452+00	1.750-06	1.563-03	1.054-05	2.054-03	2.201-05	3.651-03
9.000+06	2.443-03	2.539+00	1.617-02	3.977+00	4.632-02	6.581+00	1.382-06	1.437-03	9.150-06	2.250-03	2.621-05	3.724-03
1.000+07	1.979-03	2.353+00	1.428-02	4.296+00	5.337-02	6.719+00	1.120-06	1.332-03	8.081-06	2.431-03	3.020-05	3.802-03
1.100+07	1.636-03	2.195+00	1.278-02	4.590+00	6.005-02	6.859+00	9.258-07	1.242-03	7.232-06	2.597-03	3.396-05	3.882-03
1.200+07	1.374-03	2.058+00	1.156-02	4.860+00	6.634-02	6.997+00	7.775-07	1.165-03	6.542-06	2.750-03	3.754-05	3.961-03
1.300+07	1.171-03	1.939+00	1.056-02	5.111+00	7.228-02	7.134+00	6.626-07	1.097-03	5.976-06	2.892-03	4.090-05	4.037-03
1.400+07	1.010-03	1.834+00	9.707-03	5.341+00	7.792-02	7.264+00	5.715-07	1.038-03	5.493-06	3.022-03	4.409-05	4.110-03
1.500+07	8.796-04	1.742+00	8.983-03	5.554+00	8.326-02	7.389+00	4.977-07	9.858-04	5.083-06	3.143-03	4.711-05	4.181-03
1.600+07	7.731-04	1.658+00	8.359-03	5.753+00	8.834-02	7.508+00	4.375-07	9.382-04	4.730-06	3.255-03	4.999-05	4.249-03
1.800+07	6.109-04	1.516+00	7.337-03	6.117+00	9.774-02	7.739+00	3.457-07	8.579-04	4.152-06	3.461-03	5.531-05	4.379-03
2.000+07	4.948-04	1.398+00	6.537-03	6.443+00	1.063-01	7.954+00	2.800-07	7.911-04	3.699-06	3.646-03	6.015-05	4.501-03
2.200+07	4.089-04	1.298+00	5.894-03	6.739+00	1.141-01	8.157+00	2.314-07	7.345-04	3.335-06	3.813-03	6.457-05	4.616-03
2.400+07	3.436-04	1.213+00	5.365-03	7.008+00	1.213-01	8.348+00	1.944-07	6.864-04	3.036-06	3.966-03	6.864-05	4.724-03
2.600+07	2.928-04	1.139+00	4.923-03	7.253+00	1.280-01	8.525+00	1.657-07	6.445-04	2.786-06	4.104-03	7.243-05	4.824-03
2.800+07	2.525-04	1.075+00	4.548-03	7.477+00	1.341-01	8.691+00	1.429-07	6.083-04	2.574-06	4.231-03	7.588-05	4.918-03
3.000+07	2.199-04	1.018+00	4.226-03	7.684+00	1.399-01	8.846+00	1.244-07	5.761-04	2.391-06	4.348-03	7.917-05	5.006-03
4.000+07	1.237-04	8.087-01	3.120-03	8.525+00	1.636-01	9.501+00	7.000-08	4.576-04	1.766-06	4.824-03	9.258-05	5.376-03
5.000+07	7.917-05	6.750-01	2.472-03	9.148+00	1.816-01	1.001+01	4.480-08	3.820-04	1.399-06	5.177-03	1.028-04	5.663-03
6.000+07	5.498-05	5.816-01	2.047-03	9.634+00	1.959-01	1.041+01	3.111-08	3.291-04	1.158-06	5.452-03	1.109-04	5.893-03
8.000+07	3.093-05	4.587-01	1.523-03	1.035+01	2.175-01	1.103+01	1.750-08	2.596-04	8.618-07	5.857-03	1.231-04	6.241-03
1.000+08	1.979-05	3.807-01	1.212-03	1.086+01	2.332-01	1.148+01	1.120-08	2.154-04	6.858-07	6.145-03	1.320-04	6.493-03
1.500+08	8.796-06	2.711-01	8.031-04	1.167+01	2.592-01	1.220+01	4.977-09	1.534-04	4.545-07	6.604-03	1.467-04	6.904-03
2.000+08	4.948-06	2.126-01	6.003-04	1.215+01	2.754-01	1.264+01	2.800-09	1.203-04	3.397-07	6.875-03	1.558-04	7.152-03
3.000+08	2.199-06	1.507-01	3.989-04	1.272+01	2.953-01	1.317+01	1.244-09	8.528-05	2.257-07	7.198-03	1.671-04	7.451-03
4.000+08	1.237-06	1.180-01	2.987-04	1.304+01	3.072-01	1.347+01	7.000-10	6.677-05	1.690-07	7.379-03	1.738-04	7.623-03
5.000+08	7.917-07	9.768-02	2.387-04	1.325+01	3.153-01	1.366+01	4.480-10	5.527-05	1.351-07	7.498-03	1.784-04	7.732-03
6.000+08	5.498-07	8.363-02	1.988-04	1.341+01	3.213-01	1.382+01	3.111-10	4.732-05	1.125-07	7.588-03	1.818-04	7.818-03
8.000+08	3.092-07	6.532-02	1.490-04	1.361+01	3.294-01	1.400+01	1.750-10	3.696-05	8.432-08	7.702-03	1.864-04	7.925-03
1.000+09	1.979-07	5.374-02	1.191-04	1.374+01	3.348-01	1.413+01	1.120-10	3.041-05	6.740-08	7.775-03	1.895-04	7.995-03
1.500+09	8.796-08	3.753-02	7.936-05	1.393+01	3.428-01	1.431+01	4.977-11	2.124-05	4.491-08	7.883-03	1.940-04	8.098-03
2.000+09	4.948-08	2.905-02	5.950-05	1.404+01	3.473-01	1.442+01	2.800-11	1.644-05	3.367-08	7.945-03	1.965-04	8.158-03
3.000+09	2.199-08	2.020-02	3.966-05	1.415+01	3.522-01	1.452+01	1.244-11	1.143-05	2.244-08	8.007-03	1.993-04	8.218-03
4.000+09	1.237-08	1.559-02	2.974-05	1.421+01	3.551-01	1.458+01	7.000-12	8.822-06	1.683-08	8.041-03	2.009-04	8.251-03
5.000+09	7.917-09	1.275-02	2.379-05	1.425+01	3.569-01	1.462+01	4.480-12	7.215-06	1.346-08	8.064-03	2.020-04	8.273-03
6.000+09	5.498-09	1.081-02	1.982-05	1.427+01	3.581-01	1.464+01	3.111-12	6.117-06	1.122-08	8.075-03	2.026-04	8.284-03
8.000+09	3.092-09	8.327-03	1.486-05	1.431+01	3.597-01	1.468+01	1.750-12	4.712-06	8.409-09	8.098-03	2.035-04	8.305-03
1.000+10	1.979-09	6.799-03	1.189-05	1.433+01	3.608-01	1.470+01	1.120-12	3.847-06	6.728-09	8.109-03	2.042-04	8.317-03
1.500+10	8.796-10	4.699-03	7.927-06	1.436+01	3.622-01	1.473+01	4.977-13	2.659-06	4.486-09	8.126-03	2.050-04	8.334-03
2.000+10	4.948-10	3.612-03	5.945-06	1.437+01	3.630-01	1.474+01	2.800-13	2.044-06	3.364-09	8.132-03	2.054-04	8.339-03
3.000+10	2.199-10	2.491-03	3.963-06	1.439+01	3.638-01	1.476+01	1.244-13	1.410-06	2.243-09	8.143-03	2.059-04	8.351-03
4.000+10	1.237-10	1.913-03	2.972-06	1.440+01	3.643-01	1.477+01	7.000-14	1.083-06	1.682-09	8.149-03	2.061-04	8.356-03
5.000+10	7.917-11	1.558-03	2.378-06	1.441+01	3.646-01	1.478+01	4.480-14	8.816-07	1.346-09	8.154-03	2.063-04	8.361-03
6.000+10	5.498-11	1.317-03	1.982-06	1.441+01	3.647-01	1.478+01	3.111-14	7.453-07	1.122-09	8.154-03	2.064-04	8.361-03
8.000+10	3.092-11	1.010-03	1.486-06	1.441+01	3.649-01	1.478+01	1.750-14	5.715-07	8.409-10	8.154-03	2.065-04	8.361-03
1.000+11	1.979-11	8.213-04	1.189-06	1.442+01	3.651-01	1.479+01	1.120-14	4.648-07	6.728-10	8.160-03	2.066-04	8.367-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 47, AG, SILVER ATOMIC WT. = 107.868 MSQ/KG = .00055828 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	2.085-01	9.894+00	5.000-01	0.000	0.000	1.060+01	1.164-06	5.524-03	2.791-04	0.000	0.000	5.919-03
1.022+06	1.997-01	9.790+00	4.784-01	0.000	0.000	1.047+01	1.115-06	5.466-03	2.671-04	0.000	0.000	5.844-03
1.250+06	1.339-01	8.857+00	3.228-01	2.872-02	0.000	9.342+00	7.475-05	4.945-03	1.802-04	1.603-05	0.000	5.216-03
1.500+06	9.312-02	8.056+00	2.314-01	1.344-01	0.000	8.515+00	5.199-05	4.497-03	1.292-04	7.503-05	0.000	4.754-03
2.000+06	5.247-02	6.880+00	1.411-01	4.660-01	0.000	7.540+00	2.929-05	3.841-03	7.877-05	2.602-04	0.000	4.209-03
2.044+06	5.024-02	6.795+00	1.361-01	4.987-01	0.000	7.480+00	2.805-05	3.794-03	7.598-05	2.784-04	0.000	4.176-03
3.000+06	2.335-02	5.416+00	7.512-02	1.207+00	1.895-03	6.723+00	1.304-05	3.024-03	4.194-05	6.738-04	1.058-06	3.754-03
4.000+06	1.314-02	4.519+00	4.991-02	1.869+00	7.729-03	6.459+00	7.336-06	2.523-03	2.786-05	1.043-03	4.315-06	3.606-03
5.000+06	8.412-03	3.903+00	3.699-02	2.444+00	1.539-02	6.408+00	4.696-06	2.179-03	2.065-05	1.364-03	8.592-06	3.577-03
6.000+06	5.843-03	3.450+00	2.924-02	2.941+00	2.361-02	6.450+00	3.262-06	1.926-03	1.632-05	1.642-03	1.318-05	3.601-03
7.000+06	4.293-03	3.101+00	2.411-02	3.384+00	3.180-02	6.545+00	2.397-06	1.731-03	1.346-05	1.889-03	1.775-05	3.654-03
8.000+06	3.287-03	2.822+00	2.048-02	3.783+00	3.973-02	6.668+00	1.835-06	1.575-03	1.143-05	2.112-03	2.218-05	3.723-03
9.000+06	2.597-03	2.595+00	1.778-02	4.146+00	4.731-02	6.809+00	1.450-06	1.449-03	9.926-06	2.315-03	2.641-05	3.801-03
1.000+07	2.104-03	2.404+00	1.570-02	4.478+00	5.452-02	6.954+00	1.175-06	1.342-03	8.765-06	2.500-03	3.044-05	3.882-03
1.100+07	1.739-03	2.242+00	1.405-02	4.783+00	6.134-02	7.102+00	9.708-07	1.252-03	7.844-06	2.670-03	3.424-05	3.965-03
1.200+07	1.461-03	2.103+00	1.271-02	5.064+00	6.776-02	7.249+00	8.156-07	1.174-03	7.096-06	2.827-03	3.783-05	4.047-03
1.300+07	1.245-03	1.981+00	1.160-02	5.324+00	7.382-02	7.392+00	6.951-07	1.106-03	6.476-06	2.972-03	4.121-05	4.127-03
1.400+07	1.073-03	1.874+00	1.066-02	5.564+00	7.959-02	7.529+00	5.990-07	1.046-03	5.951-06	3.106-03	4.443-05	4.203-03
1.500+07	9.350-04	1.779+00	9.869-03	5.785+00	8.504-02	7.660+00	5.220-07	9.932-04	5.510-06	3.230-03	4.748-05	4.276-03
1.600+07	8.218-04	1.695+00	9.182-03	5.993+00	9.022-02	7.788+00	4.588-07	9.463-04	5.126-06	3.346-03	5.037-05	4.348-03
1.800+07	6.493-04	1.549+00	8.060-03	6.373+00	9.982-02	8.031+00	3.625-07	8.648-04	4.500-06	3.558-03	5.573-05	4.483-03
2.000+07	5.260-04	1.428+00	7.180-03	6.712+00	1.086-01	8.256+00	2.937-07	7.972-04	4.008-06	3.747-03	6.063-05	4.609-03
2.200+07	4.347-04	1.327+00	6.473-03	7.020+00	1.165-01	8.470+00	2.427-07	7.408-04	3.614-06	3.919-03	6.504-05	4.729-03
2.400+07	3.653-04	1.240+00	5.892-03	7.300+00	1.239-01	8.670+00	2.039-07	6.923-04	3.289-06	4.075-03	6.917-05	4.840-03
2.600+07	3.112-04	1.164+00	5.406-03	7.555+00	1.307-01	8.855+00	1.737-07	6.498-04	3.018-06	4.218-03	7.297-05	4.944-03
2.800+07	2.684-04	1.098+00	4.994-03	7.788+00	1.369-01	9.028+00	1.498-07	6.130-04	2.788-06	4.348-03	7.643-05	5.040-03
3.000+07	2.338-04	1.040+00	4.640-03	8.004+00	1.428-01	9.192+00	1.305-07	5.806-04	2.590-06	4.468-03	7.972-05	5.132-03
4.000+07	1.315-04	8.263-01	3.425-03	8.878+00	1.670-01	9.875+00	7.341-08	4.613-04	1.912-06	4.956-03	9.323-05	5.513-03
5.000+07	8.416-05	6.897-01	2.714-03	9.526+00	1.854-01	1.040+01	4.698-08	3.850-04	1.515-06	5.318-03	1.035-04	5.808-03
6.000+07	5.844-05	5.943-01	2.247-03	1.003+01	2.000-01	1.083+01	3.263-08	3.318-04	1.254-06	5.600-03	1.117-04	6.044-03
8.000+07	3.287-05	4.687-01	1.672-03	1.078+01	2.219-01	1.147+01	1.835-08	2.617-04	9.334-07	6.018-03	1.239-04	6.405-03
1.000+08	2.104-05	3.890-01	1.331-03	1.131+01	2.379-01	1.194+01	1.175-08	2.172-04	7.431-07	6.314-03	1.328-04	6.665-03
1.500+08	9.350-06	2.770-01	8.816-04	1.215+01	2.644-01	1.269+01	5.220-09	1.546-04	4.921-07	6.783-03	1.476-04	7.086-03
2.000+08	5.259-06	2.172-01	6.589-04	1.265+01	2.809-01	1.315+01	2.936-09	1.213-04	3.679-07	7.062-03	1.568-04	7.341-03
3.000+08	2.338-06	1.539-01	4.378-04	1.324+01	3.012-01	1.370+01	1.305-09	8.592-05	2.444-07	7.392-03	1.682-04	7.646-03
4.000+08	1.315-06	1.206-01	3.278-04	1.357+01	3.133-01	1.400+01	7.341-10	6.733-05	1.830-07	7.576-03	1.749-04	7.818-03
5.000+08	8.415-07	9.980-02	2.620-04	1.379+01	3.215-01	1.421+01	4.698-10	5.572-05	1.463-07	7.699-03	1.795-04	7.934-03
6.000+08	5.844-07	8.545-02	2.182-04	1.395+01	3.276-01	1.436+01	3.263-10	4.770-05	1.218-07	7.788-03	1.829-04	8.019-03
8.000+08	3.287-07	6.674-02	1.635-04	1.416+01	3.359-01	1.456+01	1.835-10	3.726-05	9.128-08	7.905-03	1.875-04	8.130-03
1.000+09	2.104-07	5.491-02	1.307-04	1.430+01	3.415-01	1.470+01	1.175-10	3.066-05	7.297-08	7.983-03	1.907-04	8.205-03
1.500+09	9.350-08	3.835-02	8.710-05	1.450+01	3.497-01	1.489+01	5.220-11	2.141-05	4.863-08	8.095-03	1.952-04	8.312-03
2.000+09	5.259-08	2.968-02	6.530-05	1.460+01	3.543-01	1.498+01	2.936-11	1.657-05	3.646-08	8.151-03	1.978-04	8.365-03
3.000+09	2.338-08	2.064-02	4.352-05	1.472+01	3.594-01	1.510+01	1.305-11	1.152-05	2.430-08	8.218-03	2.006-04	8.430-03
4.000+09	1.315-08	1.593-02	3.264-05	1.478+01	3.623-01	1.516+01	7.341-12	8.893-06	1.822-08	8.251-03	2.023-04	8.463-03
5.000+09	8.415-09	1.302-02	2.611-05	1.482+01	3.641-01	1.520+01	4.698-12	7.269-06	1.458-08	8.274-03	2.033-04	8.484-03
6.000+09	5.844-09	1.104-02	2.175-05	1.485+01	3.654-01	1.523+01	3.263-12	6.163-06	1.214-08	8.290-03	2.040-04	8.501-03
8.000+09	3.287-09	8.508-03	1.631-05	1.488+01	3.671-01	1.526+01	1.835-12	4.750-06	9.106-09	8.307-03	2.049-04	8.517-03
1.000+10	2.104-09	6.947-03	1.305-05	1.491+01	3.682-01	1.529+01	1.175-12	3.878-06	7.286-09	8.324-03	2.056-04	8.533-03
1.500+10	9.350-10	4.801-03	8.700-06	1.494+01	3.696-01	1.531+01	5.220-13	2.680-06	4.857-09	8.341-03	2.063-04	8.550-03
2.000+10	5.259-10	3.691-03	6.524-06	1.496+01	3.705-01	1.533+01	2.936-13	2.061-06	3.642-09	8.352-03	2.068-04	8.561-03
3.000+10	2.338-10	2.545-03	4.349-06	1.497+01	3.713-01	1.534+01	1.305-13	1.421-06	2.428-09	8.357-03	2.073-04	8.566-03
4.000+10	1.315-10	1.954-03	3.262-06	1.498+01	3.718-01	1.535+01	7.341-14	1.091-06	1.821-09	8.363-03	2.076-04	8.572-03
5.000+10	8.415-11	1.591-03	2.610-06	1.499+01	3.721-01	1.536+01	4.698-14	8.882-07	1.457-09	8.369-03	2.077-04	8.577-03
6.000+10	5.844-11	1.345-03	2.175-06	1.499+01	3.723-01	1.536+01	3.263-14	7.509-07	1.214-09	8.369-03	2.078-04	8.577-03
8.000+10	3.287-11	1.031-03	1.631-06	1.500+01	3.725-01	1.537+01	1.835-14	5.756-07	9.106-10	8.374-03	2.080-04	8.583-03
1.000+11	2.104-11	8.392-04	1.305-06	1.500+01	3.727-01	1.537+01	1.175-14	4.685-07	7.286-10	8.374-03	2.081-04	8.583-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 48, CD, CADMIUM ATOMIC WT. = 112.41 MSQ/KG = .00053572 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	2.210-01	1.010+01	5.505-01	0.000	0.000	1.087+01	1.184-04	5.411-03	2.949-04	0.000	0.000	5.824-03
1.022+06	2.117-01	9.997+00	5.267-01	0.000	0.000	1.074+01	1.134-04	5.356-03	2.822-04	0.000	0.000	5.751-03
1.250+06	1.419-01	9.045+00	3.553-01	3.038-02	0.000	9.573+00	7.602-05	4.846-03	1.903-04	1.628-05	0.000	5.128-03
1.500+06	9.872-02	8.227+00	2.546-01	1.418-01	0.000	8.722+00	5.289-05	4.407-03	1.364-04	7.597-05	0.000	4.673-03
2.000+06	5.564-02	7.026+00	1.552-01	4.894-01	0.000	7.726+00	2.981-05	3.764-03	8.314-05	2.622-04	0.000	4.139-03
2.044+06	5.327-02	6.940+00	1.498-01	5.236-01	0.000	7.667+00	2.854-05	3.718-03	8.025-05	2.805-04	0.000	4.107-03
3.000+06	2.476-02	5.531+00	8.259-02	1.263+00	1.935-03	6.903+00	1.326-05	2.963-03	4.425-05	6.766-04	1.037-06	3.698-03
4.000+06	1.394-02	4.615+00	5.484-02	1.952+00	7.893-03	6.644+00	7.468-06	2.472-03	2.938-05	1.046-03	4.228-06	3.559-03
5.000+06	8.920-03	3.986+00	4.062-02	2.550+00	1.571-02	6.601+00	4.779-06	2.135-03	2.176-05	1.366-03	8.416-06	3.536-03
6.000+06	6.195-03	3.523+00	3.210-02	3.066+00	2.411-02	6.651+00	3.319-06	1.887-03	1.720-05	1.643-03	1.292-05	3.563-03
7.000+06	4.552-03	3.167+00	2.646-02	3.526+00	3.247-02	6.756+00	2.439-06	1.697-03	1.418-05	1.889-03	1.739-05	3.620-03
8.000+06	3.485-03	2.882+00	2.247-02	3.941+00	4.056-02	6.890+00	1.867-06	1.544-03	1.204-05	2.111-03	2.173-05	3.691-03
9.000+06	2.754-03	2.650+00	1.951-02	4.317+00	4.831-02	7.038+00	1.475-06	1.420-03	1.045-05	2.313-03	2.588-05	3.770-03
1.000+07	2.231-03	2.455+00	1.723-02	4.662+00	5.566-02	7.192+00	1.195-06	1.315-03	9.230-06	2.498-03	2.982-05	3.853-03
1.100+07	1.844-03	2.290+00	1.541-02	4.979+00	6.262-02	7.349+00	9.879-07	1.227-03	8.255-06	2.667-03	3.355-05	3.937-03
1.200+07	1.549-03	2.148+00	1.394-02	5.272+00	6.918-02	7.505+00	8.298-07	1.151-03	7.466-06	2.824-03	3.706-05	4.020-03
1.300+07	1.320-03	2.023+00	1.272-02	5.543+00	7.537-02	7.655+00	7.072-07	1.084-03	6.814-06	2.970-03	4.038-05	4.101-03
1.400+07	1.138-03	1.914+00	1.170-02	5.792+00	8.125-02	7.800+00	6.097-07	1.025-03	6.268-06	3.103-03	4.353-05	4.179-03
1.500+07	9.915-04	1.817+00	1.082-02	6.023+00	8.681-02	7.939+00	5.312-07	9.734-04	5.797-06	3.227-03	4.651-05	4.253-03
1.600+07	8.714-04	1.731+00	1.007-02	6.238+00	9.210-02	8.072+00	4.668-07	9.273-04	5.395-06	3.342-03	4.934-05	4.324-03
1.800+07	6.885-04	1.582+00	8.838-03	6.632+00	1.019-01	8.325+00	3.688-07	8.475-04	4.735-06	3.553-03	5.459-05	4.460-03
2.000+07	5.577-04	1.459+00	7.873-03	6.985+00	1.108-01	8.563+00	2.988-07	7.816-04	4.218-06	3.742-03	5.936-05	4.582-03
2.200+07	4.609-04	1.355+00	7.097-03	7.305+00	1.190-01	8.787+00	2.469-07	7.259-04	3.802-06	3.913-03	6.375-05	4.707-03
2.400+07	3.873-04	1.266+00	6.459-03	7.596+00	1.264-01	8.995+00	2.075-07	6.782-04	3.460-06	4.069-03	6.772-05	4.819-03
2.600+07	3.300-04	1.189+00	5.927-03	7.861+00	1.334-01	9.190+00	1.768-07	6.370-04	3.175-06	4.211-03	7.147-05	4.923-03
2.800+07	2.846-04	1.121+00	5.475-03	8.103+00	1.398-01	9.370+00	1.525-07	6.005-04	2.933-06	4.341-03	7.489-05	5.019-03
3.000+07	2.479-04	1.062+00	5.087-03	8.327+00	1.457-01	9.540+00	1.328-07	5.689-04	2.725-06	4.461-03	7.805-05	5.111-03
4.000+07	1.394-04	8.438-01	3.755-03	9.236+00	1.704-01	1.025+01	7.468-08	4.520-04	2.012-06	4.948-03	9.129-05	5.493-03
5.000+07	8.924-05	7.044-01	2.975-03	9.909+00	1.892-01	1.081+01	4.781-08	3.774-04	1.594-06	5.308-03	1.014-04	5.789-03
6.000+07	6.197-05	6.069-01	2.463-03	1.043+01	2.040-01	1.124+01	3.320-08	3.251-04	1.319-06	5.588-03	1.093-04	6.023-03
8.000+07	3.486-05	4.786-01	1.832-03	1.121+01	2.264-01	1.192+01	1.868-08	2.564-04	9.814-07	6.005-03	1.213-04	6.384-03
1.000+08	2.231-05	3.973-01	1.458-03	1.176+01	2.427-01	1.240+01	1.195-08	2.128-04	7.811-07	6.300-03	1.300-04	6.644-03
1.500+08	9.915-06	2.829-01	9.659-04	1.263+01	2.696-01	1.318+01	5.312-09	1.516-04	5.175-07	6.766-03	1.444-04	7.063-03
2.000+08	5.577-06	2.218-01	7.220-04	1.316+01	2.865-01	1.367+01	2.988-09	1.188-04	3.868-07	7.050-03	1.535-04	7.323-03
3.000+08	2.479-06	1.572-01	4.797-04	1.376+01	3.071-01	1.422+01	1.328-09	8.422-05	2.570-07	7.372-03	1.645-04	7.621-03
4.000+08	1.394-06	1.231-01	3.592-04	1.411+01	3.194-01	1.455+01	7.468-10	6.595-05	1.924-07	7.559-03	1.711-04	7.796-03
5.000+08	8.924-07	1.019-01	2.871-04	1.434+01	3.279-01	1.477+01	4.781-10	5.459-05	1.538-07	7.682-03	1.757-04	7.913-03
6.000+08	6.197-07	8.727-02	2.391-04	1.451+01	3.341-01	1.493+01	3.320-10	4.675-05	1.281-07	7.773-03	1.790-04	7.999-03
8.000+08	3.486-07	6.816-02	1.791-04	1.473+01	3.426-01	1.514+01	1.868-10	3.651-05	9.595-08	7.891-03	1.835-04	8.111-03
1.000+09	2.231-07	5.607-02	1.432-04	1.487+01	3.482-01	1.527+01	1.195-10	3.004-05	7.672-08	7.966-03	1.865-04	8.183-03
1.500+09	9.915-08	3.916-02	9.543-05	1.507+01	3.567-01	1.547+01	5.312-11	2.098-05	5.112-08	8.073-03	1.911-04	8.285-03
2.000+09	5.577-08	3.031-02	7.155-05	1.519+01	3.615-01	1.558+01	2.988-11	1.624-05	3.833-08	8.138-03	1.937-04	8.348-03
3.000+09	2.479-08	2.107-02	4.768-05	1.531+01	3.667-01	1.570+01	1.328-11	1.129-05	2.554-08	8.202-03	1.964-04	8.410-03
4.000+09	1.394-08	1.627-02	3.576-05	1.537+01	3.697-01	1.576+01	7.468-12	8.716-06	1.916-08	8.234-03	1.981-04	8.441-03
5.000+09	8.924-09	1.330-02	2.860-05	1.541+01	3.716-01	1.579+01	4.781-12	7.125-06	1.532-08	8.255-03	1.991-04	8.462-03
6.000+09	6.197-09	1.128-02	2.383-05	1.544+01	3.729-01	1.582+01	3.320-12	6.043-06	1.277-08	8.272-03	1.998-04	8.477-03
8.000+09	3.486-09	8.689-03	1.787-05	1.548+01	3.747-01	1.586+01	1.868-12	4.655-06	9.573-09	8.293-03	2.007-04	8.498-03
1.000+10	2.231-09	7.095-03	1.430-05	1.550+01	3.758-01	1.588+01	1.195-12	3.801-06	7.661-09	8.304-03	2.013-04	8.509-03
1.500+10	9.915-10	4.903-03	9.532-06	1.553+01	3.773-01	1.591+01	5.312-13	2.627-06	5.106-09	8.320-03	2.021-04	8.525-03
2.000+10	5.577-10	3.769-03	7.148-06	1.555+01	3.782-01	1.593+01	2.988-13	2.019-06	3.829-09	8.330-03	2.026-04	8.535-03
3.000+10	2.479-10	2.600-03	4.765-06	1.557+01	3.790-01	1.595+01	1.328-13	1.393-06	2.553-09	8.341-03	2.030-04	8.546-03
4.000+10	1.394-10	1.996-03	3.574-06	1.558+01	3.796-01	1.596+01	7.468-14	1.069-06	1.915-09	8.347-03	2.034-04	8.551-03
5.000+10	8.924-11	1.625-03	2.859-06	1.558+01	3.799-01	1.596+01	4.781-14	8.705-07	1.532-09	8.347-03	2.035-04	8.551-03
6.000+10	6.197-11	1.374-03	2.383-06	1.559+01	3.801-01	1.597+01	3.320-14	7.361-07	1.277-09	8.352-03	2.036-04	8.556-03
8.000+10	3.486-11	1.053-03	1.787-06	1.559+01	3.803-01	1.597+01	1.868-14	5.641-07	9.573-10	8.352-03	2.037-04	8.556-03
1.000+11	2.231-11	8.570-04	1.430-06	1.560+01	3.805-01	1.598+01	1.195-14	4.591-07	7.661-10	8.357-03	2.038-04	8.562-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 49, IN, INDIUM ATOMIC WT. = 114.82 MSQ/KG = .00052448 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	2.340-01	1.031+01	6.046-01	0.000	0.000	1.115+01	1.227-04	5.407-03	3.171-04	0.000	0.000	5.847-03
1.022+06	2.241-01	1.021+01	5.785-01	0.000	0.000	1.101+01	1.175-04	5.355-03	3.034-04	0.000	0.000	5.776-03
1.250+06	1.503-01	9.233+00	3.902-01	3.213-02	0.000	9.806+00	7.883-05	4.842-03	2.047-04	1.685-05	0.000	5.143-03
1.500+06	1.045-01	8.398+00	2.796-01	1.496-01	0.000	8.932+00	5.481-05	4.405-03	1.466-04	7.846-05	0.000	4.684-03
2.000+06	5.891-02	7.172+00	1.704-01	5.137-01	0.000	7.915+00	3.090-05	3.762-03	8.937-05	2.694-04	0.000	4.151-03
2.044+06	5.641-02	7.084+00	1.644-01	5.494-01	0.000	7.854+00	2.959-05	3.715-03	8.622-05	2.881-04	0.000	4.119-03
3.000+06	2.622-02	5.646+00	9.059-02	1.318+00	1.975-03	7.083+00	1.375-05	2.961-03	4.751-05	6.913-04	1.036-06	3.715-03
4.000+06	1.476-02	4.711+00	6.012-02	2.036+00	8.057-03	6.830+00	7.741-06	2.471-03	3.153-05	1.068-03	4.226-06	3.582-03
5.000+06	9.446-03	4.069+00	4.452-02	2.657+00	1.604-02	6.796+00	4.954-06	2.134-03	2.335-05	1.394-03	8.413-06	3.564-03
6.000+06	6.561-03	3.597+00	3.517-02	3.193+00	2.461-02	6.856+00	3.441-06	1.887-03	1.845-05	1.675-03	1.291-05	3.596-03
7.000+06	4.821-03	3.233+00	2.899-02	3.671+00	3.314-02	6.971+00	2.529-06	1.696-03	1.520-05	1.925-03	1.738-05	3.656-03
8.000+06	3.691-03	2.942+00	2.461-02	4.101+00	4.140-02	7.113+00	1.936-06	1.543-03	1.291-05	2.151-03	2.171-05	3.730-03
9.000+06	2.916-03	2.705+00	2.136-02	4.492+00	4.930-02	7.271+00	1.529-06	1.419-03	1.120-05	2.356-03	2.586-05	3.813-03
1.000+07	2.362-03	2.506+00	1.886-02	4.849+00	5.681-02	7.433+00	1.239-06	1.314-03	9.892-06	2.543-03	2.980-05	3.898-03
1.100+07	1.952-03	2.338+00	1.687-02	5.179+00	6.391-02	7.600+00	1.024-06	1.226-03	8.848-06	2.716-03	3.352-05	3.986-03
1.200+07	1.641-03	2.192+00	1.526-02	5.483+00	7.060-02	7.763+00	8.607-07	1.150-03	8.004-06	2.876-03	3.703-05	4.071-03
1.300+07	1.398-03	2.065+00	1.392-02	5.765+00	7.691-02	7.922+00	7.332-07	1.083-03	7.301-06	3.024-03	4.034-05	4.155-03
1.400+07	1.205-03	1.954+00	1.280-02	6.024+00	8.291-02	8.075+00	6.320-07	1.025-03	6.713-06	3.159-03	4.348-05	4.235-03
1.500+07	1.050-03	1.855+00	1.184-02	6.264+00	8.858-02	8.220+00	5.507-07	9.729-04	6.210-06	3.285-03	4.646-05	4.311-03
1.600+07	9.229-04	1.767+00	1.102-02	6.488+00	9.398-02	8.361+00	4.840-07	9.268-04	5.780-06	3.407-03	4.929-05	4.385-03
1.800+07	7.292-04	1.615+00	9.670-03	6.897+00	1.040-01	8.626+00	3.824-07	8.470-04	5.072-06	3.617-03	5.455-05	4.524-03
2.000+07	5.906-04	1.489+00	8.614-03	7.263+00	1.131-01	8.874+00	3.098-07	7.809-04	4.518-06	3.809-03	5.932-05	4.654-03
2.200+07	4.881-04	1.383+00	7.764-03	7.595+00	1.214-01	9.108+00	2.560-07	7.254-04	4.072-06	3.983-03	6.367-05	4.777-03
2.400+07	4.102-04	1.292+00	7.066-03	7.896+00	1.290-01	9.324+00	2.151-07	6.776-04	3.706-06	4.141-03	6.766-05	4.890-03
2.600+07	3.495-04	1.214+00	6.483-03	8.171+00	1.360-01	9.528+00	1.833-07	6.367-04	3.400-06	4.286-03	7.133-05	4.997-03
2.800+07	3.014-04	1.145+00	5.989-03	8.423+00	1.426-01	9.717+00	1.581-07	6.005-04	3.141-06	4.418-03	7.479-05	5.096-03
3.000+07	2.625-04	1.084+00	5.564-03	8.656+00	1.487-01	9.895+00	1.377-07	5.685-04	2.918-06	4.540-03	7.799-05	5.189-03
4.000+07	1.477-04	8.614-01	4.106-03	9.599+00	1.738-01	1.064+01	7.747-08	4.518-04	2.154-06	5.034-03	9.115-05	5.580-03
5.000+07	9.450-05	7.190-01	3.253-03	1.030+01	1.929-01	1.122+01	4.956-08	3.771-04	1.706-06	5.402-03	1.012-04	5.882-03
6.000+07	6.563-05	6.195-01	2.693-03	1.084+01	2.081-01	1.167+01	3.442-08	3.249-04	1.412-06	5.685-03	1.091-04	6.121-03
8.000+07	3.691-05	4.886-01	2.003-03	1.165+01	2.309-01	1.237+01	1.936-08	2.563-04	1.051-06	6.110-03	1.211-04	6.489-03
1.000+08	2.363-05	4.055-01	1.595-03	1.222+01	2.474-01	1.287+01	1.239-08	2.127-04	8.365-07	6.409-03	1.298-04	6.752-03
1.500+08	1.050-05	2.888-01	1.056-03	1.313+01	2.749-01	1.369+01	5.507-09	1.515-04	5.538-07	6.886-03	1.442-04	7.183-03
2.000+08	5.906-06	2.264-01	7.894-04	1.367+01	2.920-01	1.419+01	3.098-09	1.187-04	4.140-07	7.170-03	1.531-04	7.442-03
3.000+08	2.625-06	1.605-01	5.245-04	1.430+01	3.130-01	1.477+01	1.377-09	8.478-05	2.751-07	7.500-03	1.642-04	7.749-03
4.000+08	1.477-06	1.257-01	3.927-04	1.466+01	3.256-01	1.511+01	7.747-10	6.593-05	2.060-07	7.689-03	1.708-04	7.926-03
5.000+08	9.450-07	1.041-01	3.138-04	1.490+01	3.342-01	1.534+01	4.956-10	5.460-05	1.646-07	7.815-03	1.753-04	8.045-03
6.000+08	6.562-07	8.909-02	2.614-04	1.507+01	3.405-01	1.550+01	3.442-10	4.673-05	1.371-07	7.904-03	1.786-04	8.129-03
8.000+08	3.691-07	6.958-02	1.958-04	1.530+01	3.492-01	1.572+01	1.936-10	3.649-05	1.027-07	8.024-03	1.831-04	8.244-03
1.000+09	2.362-07	5.724-02	1.566-04	1.545+01	3.550-01	1.586+01	1.239-10	3.002-05	8.213-08	8.103-03	1.862-04	8.319-03
1.500+09	1.050-07	3.998-02	1.043-04	1.566+01	3.637-01	1.606+01	5.507-11	2.097-05	5.470-08	8.213-03	1.908-04	8.425-03
2.000+09	5.906-08	3.094-02	7.822-05	1.578+01	3.686-01	1.618+01	3.098-11	1.623-05	4.102-08	8.276-03	1.933-04	8.486-03
3.000+09	2.625-08	2.151-02	5.213-05	1.590+01	3.739-01	1.630+01	1.377-11	1.128-05	2.734-08	8.339-03	1.961-04	8.547-03
4.000+09	1.477-08	1.661-02	3.909-05	1.597+01	3.770-01	1.636+01	7.747-12	8.712-06	2.050-08	8.376-03	1.977-04	8.582-03
5.000+09	9.450-09	1.358-02	3.127-05	1.601+01	3.789-01	1.640+01	4.956-12	7.122-06	1.640-08	8.397-03	1.987-04	8.603-03
6.000+09	6.562-09	1.151-02	2.606-05	1.604+01	3.803-01	1.643+01	3.442-12	6.037-06	1.367-08	8.413-03	1.995-04	8.618-03
8.000+09	3.691-09	8.870-03	1.954-05	1.608+01	3.821-01	1.647+01	1.936-12	4.652-06	1.025-08	8.434-03	2.004-04	8.639-03
1.000+10	2.362-09	7.242-03	1.563-05	1.611+01	3.832-01	1.650+01	1.239-12	3.798-06	8.198-09	8.449-03	2.010-04	8.654-03
1.500+10	1.050-09	5.005-03	1.042-05	1.614+01	3.848-01	1.653+01	5.507-13	2.625-06	5.465-09	8.465-03	2.018-04	8.670-03
2.000+10	5.906-10	3.848-03	7.815-06	1.616+01	3.857-01	1.655+01	3.098-13	2.018-06	4.099-09	8.476-03	2.022-04	8.680-03
3.000+10	2.625-10	2.654-03	5.210-06	1.618+01	3.865-01	1.657+01	1.377-13	1.392-06	2.733-09	8.486-03	2.027-04	8.690-03
4.000+10	1.477-10	2.037-03	3.907-06	1.619+01	3.871-01	1.658+01	7.747-14	1.068-06	2.049-09	8.491-03	2.030-04	8.695-03
5.000+10	9.450-11	1.659-03	3.126-06	1.619+01	3.874-01	1.658+01	4.956-14	8.701-07	1.640-09	8.491-03	2.032-04	8.695-03
6.000+10	6.562-11	1.402-03	2.605-06	1.620+01	3.876-01	1.659+01	3.442-14	7.353-07	1.366-09	8.497-03	2.033-04	8.701-03
8.000+10	3.691-11	1.075-03	1.954-06	1.620+01	3.878-01	1.659+01	1.936-14	5.638-07	1.025-09	8.497-03	2.034-04	8.700-03
1.000+11	2.362-11	8.749-04	1.563-06	1.621+01	3.880-01	1.660+01	1.239-14	4.589-07	8.198-10	8.502-03	2.035-04	8.706-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV $Z=1$ to 100—Continued

Z = 50, SN, TIN ATOMIC WT. = 118.69 MSQ/KG = .00050738 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	2.474-01	1.052+01	6.628-01	0.000	0.000	1.143+01	1.255-04	5.338-03	3.363-04	0.000	0.000	5.799-03
1.022+06	2.370-01	1.041+01	6.342-01	0.000	0.000	1.128+01	1.202-04	5.282-03	3.218-04	0.000	0.000	5.724-03
1.250+06	1.589-01	9.421+00	4.277-01	3.392-02	0.000	1.004+01	8.062-05	4.780-03	2.170-04	1.721-05	0.000	5.095-03
1.500+06	1.105-01	8.569+00	3.064-01	1.576-01	0.000	9.143+00	5.607-05	4.348-03	1.555-04	7.996-05	0.000	4.639-03
2.000+06	6.231-02	7.318+00	1.866-01	5.389-01	0.000	8.106+00	3.161-05	3.713-03	9.468-05	2.734-04	0.000	4.113-03
2.044+06	5.966-02	7.228+00	1.801-01	5.761-01	0.000	8.044+00	3.027-05	3.667-03	9.138-05	2.923-04	0.000	4.081-03
3.000+06	2.773-02	5.761+00	9.918-02	1.377+00	2.015-03	7.267+00	1.407-05	2.923-03	5.032-05	6.987-04	1.022-06	3.687-03
4.000+06	1.561-02	4.807+00	6.578-02	2.123+00	8.220-03	7.020+00	7.920-06	2.439-03	3.338-05	1.077-03	4.171-06	3.562-03
5.000+06	9.992-03	4.152+00	4.870-02	2.767+00	1.636-02	6.994+00	5.070-06	2.107-03	2.471-05	1.404-03	8.301-06	3.549-03
6.000+06	6.940-03	3.670+00	3.846-02	3.323+00	2.510-02	7.063+00	3.521-06	1.862-03	1.951-05	1.686-03	1.274-05	3.584-03
7.000+06	5.099-03	3.299+00	3.169-02	3.819+00	3.381-02	7.189+00	2.587-06	1.674-03	1.608-05	1.938-03	1.715-05	3.647-03
8.000+06	3.904-03	3.003+00	2.690-02	4.264+00	4.224-02	7.340+00	1.981-06	1.524-03	1.365-05	2.163-03	2.143-05	3.724-03
9.000+06	3.085-03	2.760+00	2.335-02	4.669+00	5.030-02	7.506+00	1.565-06	1.400-03	1.185-05	2.369-03	2.552-05	3.808-03
1.000+07	2.499-03	2.557+00	2.061-02	5.040+00	5.795-02	7.678+00	1.268-06	1.297-03	1.046-05	2.557-03	2.940-05	3.896-03
1.100+07	2.065-03	2.385+00	1.843-02	5.382+00	6.519-02	7.853+00	1.048-06	1.210-03	9.351-06	2.731-03	3.308-05	3.984-03
1.200+07	1.735-03	2.237+00	1.667-02	5.697+00	7.202-02	8.024+00	8.803-07	1.135-03	8.458-06	2.891-03	3.654-05	4.071-03
1.300+07	1.479-03	2.107+00	1.521-02	5.990+00	7.845-02	8.192+00	7.504-07	1.069-03	7.717-06	3.039-03	3.980-05	4.156-03
1.400+07	1.275-03	1.994+00	1.398-02	6.260+00	8.457-02	8.354+00	6.469-07	1.012-03	7.093-06	3.176-03	4.291-05	4.239-03
1.500+07	1.111-03	1.893+00	1.294-02	6.509+00	9.036-02	8.506+00	5.637-07	9.605-04	6.565-06	3.303-03	4.585-05	4.316-03
1.600+07	9.761-04	1.803+00	1.204-02	6.741+00	9.586-02	8.653+00	4.952-07	9.148-04	6.109-06	3.420-03	4.864-05	4.390-03
1.800+07	7.713-04	1.648+00	1.056-02	7.165+00	1.060-01	8.930+00	3.913-07	8.362-04	5.358-06	3.635-03	5.378-05	4.531-03
2.000+07	6.247-04	1.519+00	9.406-03	7.545+00	1.153-01	9.189+00	3.170-07	7.707-04	4.772-06	3.828-03	5.850-05	4.662-03
2.200+07	5.163-04	1.411+00	8.478-03	7.889+00	1.238-01	9.433+00	2.620-07	7.159-04	4.302-06	4.003-03	6.281-05	4.786-03
2.400+07	4.339-04	1.319+00	7.716-03	8.202+00	1.316-01	9.661+00	2.202-07	6.692-04	3.915-06	4.161-03	6.677-05	4.902-03
2.600+07	3.697-04	1.238+00	7.079-03	8.488+00	1.387-01	9.872+00	1.876-07	6.281-04	3.592-06	4.307-03	7.037-05	5.009-03
2.800+07	3.188-04	1.168+00	6.538-03	8.749+00	1.454-01	1.007+01	1.618-07	5.926-04	3.317-06	4.439-03	7.377-05	5.109-03
3.000+07	2.777-04	1.106+00	6.074-03	8.990+00	1.516-01	1.025+01	1.409-07	5.612-04	3.082-06	4.561-03	7.692-05	5.203-03
4.000+07	1.562-04	8.790-01	4.483-03	9.969+00	1.772-01	1.103+01	7.925-08	4.460-04	2.275-06	5.058-03	8.991-05	5.596-03
5.000+07	9.996-05	7.337-01	3.551-03	1.069+01	1.967-01	1.162+01	5.072-08	3.723-04	1.802-06	5.424-03	9.980-05	5.898-03
6.000+07	6.942-05	6.322-01	2.940-03	1.126+01	2.121-01	1.211+01	3.522-08	3.208-04	1.492-06	5.713-03	1.076-04	6.143-03
8.000+07	3.905-05	4.986-01	2.186-03	1.209+01	2.353-01	1.283+01	1.981-08	2.530-04	1.109-06	6.134-03	1.194-04	6.508-03
1.000+08	2.499-05	4.138-01	1.740-03	1.269+01	2.522-01	1.336+01	1.268-08	2.100-04	8.828-07	6.439-03	1.280-04	6.777-03
1.500+08	1.111-05	2.947-01	1.152-03	1.363+01	2.801-01	1.421+01	5.637-09	1.495-04	5.845-07	6.916-03	1.421-04	7.208-03
2.000+08	6.247-06	2.311-01	8.614-04	1.419+01	2.976-01	1.472+01	3.170-09	1.173-04	4.371-07	7.200-03	1.510-04	7.468-03
3.000+08	2.777-06	1.638-01	5.723-04	1.485+01	3.190-01	1.533+01	1.409-09	8.311-05	2.904-07	7.535-03	1.619-04	7.780-03
4.000+08	1.562-06	1.283-01	4.285-04	1.522+01	3.318-01	1.568+01	7.925-10	6.510-05	2.174-07	7.722-03	1.683-04	7.956-03
5.000+08	9.996-07	1.062-01	3.425-04	1.547+01	3.406-01	1.592+01	5.072-10	5.388-05	1.738-07	7.849-03	1.728-04	8.076-03
6.000+08	6.941-07	9.091-02	2.852-04	1.565+01	3.470-01	1.609+01	3.522-10	4.613-05	1.447-07	7.940-03	1.761-04	8.163-03
8.000+08	3.905-07	7.100-02	2.137-04	1.589+01	3.559-01	1.632+01	1.981-10	3.602-05	1.084-07	8.062-03	1.806-04	8.279-03
1.000+09	2.499-07	5.841-02	1.709-04	1.604+01	3.618-01	1.646+01	1.268-10	2.964-05	8.671-08	8.138-03	1.836-04	8.352-03
1.500+09	1.111-07	4.079-02	1.138-04	1.626+01	3.706-01	1.667+01	5.637-11	2.070-05	5.774-08	8.250-03	1.880-04	8.459-03
2.000+09	6.247-08	3.157-02	8.535-05	1.638+01	3.756-01	1.679+01	3.170-11	1.602-05	4.330-08	8.311-03	1.906-04	8.517-03
3.000+09	2.777-08	2.195-02	5.688-05	1.651+01	3.810-01	1.691+01	1.409-11	1.114-05	2.886-08	8.377-03	1.933-04	8.581-03
4.000+09	1.562-08	1.695-02	4.266-05	1.658+01	3.842-01	1.698+01	7.925-12	8.600-06	2.164-08	8.412-03	1.949-04	8.616-03
5.000+09	9.996-09	1.385-02	3.412-05	1.662+01	3.862-01	1.702+01	5.072-12	7.027-06	1.731-08	8.433-03	1.959-04	8.636-03
6.000+09	6.941-09	1.175-02	2.843-05	1.666+01	3.875-01	1.706+01	3.522-12	5.962-06	1.442-08	8.453-03	1.966-04	8.655-03
8.000+09	3.905-09	9.051-03	2.132-05	1.670+01	3.894-01	1.710+01	1.981-12	4.592-06	1.082-08	8.473-03	1.976-04	8.675-03
1.000+10	2.499-09	7.390-03	1.706-05	1.672+01	3.905-01	1.712+01	1.268-12	3.750-06	8.656-09	8.483-03	1.981-04	8.685-03
1.500+10	1.111-09	5.107-03	1.137-05	1.676+01	3.921-01	1.716+01	5.637-13	2.591-06	5.769-09	8.504-03	1.989-04	8.705-03
2.000+10	6.247-10	3.927-03	8.528-06	1.678+01	3.930-01	1.718+01	3.170-13	1.992-06	4.327-09	8.514-03	1.994-04	8.715-03
3.000+10	2.777-10	2.708-03	5.685-06	1.680+01	3.939-01	1.720+01	1.409-13	1.374-06	2.884-09	8.524-03	1.999-04	8.725-03
4.000+10	1.562-10	2.079-03	4.264-06	1.681+01	3.944-01	1.721+01	7.925-14	1.055-06	2.163-09	8.529-03	2.001-04	8.730-03
5.000+10	9.996-11	1.693-03	3.411-06	1.681+01	3.948-01	1.721+01	5.072-14	8.590-07	1.731-09	8.529-03	2.003-04	8.730-03
6.000+10	6.941-11	1.431-03	2.842-06	1.682+01	3.950-01	1.722+01	3.522-14	7.261-07	1.442-09	8.534-03	2.004-04	8.735-03
8.000+10	3.905-11	1.097-03	2.132-06	1.682+01	3.952-01	1.722+01	1.981-14	5.566-07	1.082-09	8.534-03	2.005-04	8.735-03
1.000+11	2.499-11	8.927-04	1.705-06	1.683+01	3.954-01	1.723+01	1.268-14	4.529-07	8.651-10	8.539-03	2.006-04	8.740-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, Z=1 to 100—Continued

Z = 51, SB, ANTIMONY ATOMIC WT. = 121.75 MSQ/KG = .00049462 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	2.613-01	1.073+01	7.253-01	0.000	0.000	1.172+01	1.292-04	5.307-03	3.588-04	0.000	0.000	5.795-03
1.022+06	2.503-01	1.062+01	6.940-01	0.000	0.000	1.156+01	1.238-04	5.253-03	3.433-04	0.000	0.000	5.720-03
1.250+06	1.679-01	9.608+00	4.680-01	3.578-02	0.000	1.028+01	8.305-05	4.752-03	2.315-04	1.770-05	0.000	5.085-03
1.500+06	1.168-01	8.739+00	3.352-01	1.660-01	0.000	9.357+00	5.777-05	4.323-03	1.658-04	8.211-05	0.000	4.628-03
2.000+06	6.583-02	7.464+00	2.341-01	5.648-01	0.000	8.299+00	3.256-05	3.692-03	1.010-04	2.794-04	0.000	4.105-03
2.044+06	6.304-02	7.372+00	1.969-01	6.037-01	0.000	8.236+00	3.118-05	3.646-03	9.739-05	2.986-04	0.000	4.074-03
3.000+06	2.930-02	5.876+00	1.084-01	1.437+00	2.055-03	7.453+00	1.449-05	2.906-03	5.362-05	7.108-04	1.016-06	3.686-03
4.000+06	1.649-02	4.903+00	7.186-02	2.211+00	8.384-03	7.211+00	8.156-06	2.425-03	3.554-05	1.094-03	4.147-06	3.567-03
5.000+06	1.056-02	4.235+00	5.317-02	2.879+00	1.669-02	7.194+00	5.223-06	2.095-03	2.630-05	1.424-03	8.255-06	3.559-03
6.000+06	7.333-03	3.744+00	4.198-02	3.456+00	2.560-02	7.275+00	3.627-06	1.852-03	2.076-05	1.709-03	1.266-05	3.598-03
7.000+06	5.388-03	3.365+00	3.458-02	3.969+00	3.448-02	7.408+00	2.665-06	1.664-03	1.710-05	1.963-03	1.705-05	3.664-03
8.000+06	4.125-03	3.063+00	2.935-02	4.431+00	4.307-02	7.571+00	2.040-06	1.515-03	1.452-05	2.192-03	2.130-05	3.745-03
9.000+06	3.260-03	2.815+00	2.547-02	4.850+00	5.129-02	7.745+00	1.612-06	1.392-03	1.260-05	2.399-03	2.537-05	3.831-03
1.000+07	2.640-03	2.609+00	2.248-02	5.234+00	5.910-02	7.927+00	1.306-06	1.290-03	1.112-05	2.589-03	2.923-05	3.921-03
1.100+07	2.182-03	2.433+00	2.011-02	5.588+00	6.648-02	8.110+00	1.079-06	1.203-03	9.947-06	2.764-03	3.288-05	4.011-03
1.200+07	1.834-03	2.282+00	1.818-02	5.915+00	7.344-02	8.290+00	9.071-07	1.129-03	8.992-06	2.926-03	3.633-05	4.101-03
1.300+07	1.562-03	2.150+00	1.659-02	6.220+00	7.999-02	8.468+00	7.726-07	1.063-03	8.206-06	3.077-03	3.956-05	4.189-03
1.400+07	1.347-03	2.034+00	1.525-02	6.500+00	8.623-02	8.637+00	6.663-07	1.006-03	7.543-06	3.215-03	4.265-05	4.272-03
1.500+07	1.174-03	1.931+00	1.411-02	6.759+00	9.213-02	8.797+00	5.807-07	9.551-04	6.979-06	3.343-03	4.557-05	4.351-03
1.600+07	1.031-03	1.839+00	1.312-02	6.999+00	9.773-02	8.950+00	5.100-07	9.096-04	6.489-06	3.462-03	4.834-05	4.427-03
1.800+07	8.150-04	1.681+00	1.151-02	7.439+00	1.081-01	9.240+00	4.031-07	8.315-04	5.693-06	3.680-03	5.347-05	4.571-03
2.000+07	6.602-04	1.550+00	1.025-02	7.832+00	1.175-01	9.510+00	3.266-07	7.667-04	5.070-06	3.874-03	5.812-05	4.704-03
2.200+07	5.456-04	1.439+00	9.242-03	8.189+00	1.262-01	9.764+00	2.699-07	7.118-04	4.571-06	4.050-03	6.242-05	4.830-03
2.400+07	4.584-04	1.345+00	8.410-03	8.513+00	1.341-01	1.000+01	2.267-07	6.653-04	4.160-06	4.211-03	6.633-05	4.947-03
2.600+07	3.906-04	1.263+00	7.715-03	8.809+00	1.414-01	1.022+01	1.932-07	6.247-04	3.816-06	4.357-03	6.994-05	5.056-03
2.800+07	3.368-04	1.192+00	7.126-03	9.080+00	1.482-01	1.043+01	1.666-07	5.896-04	3.525-06	4.491-03	7.330-05	5.158-03
3.000+07	2.934-04	1.128+00	6.620-03	9.330+00	1.545-01	1.062+01	1.451-07	5.579-04	3.274-06	4.615-03	7.642-05	5.253-03
4.000+07	1.650-04	8.966-01	4.885-03	1.034+01	1.806-01	1.142+01	8.161-08	4.435-04	2.416-06	5.114-03	8.933-05	5.650-03
5.000+07	1.056-04	7.484-01	3.869-03	1.110+01	2.004-01	1.205+01	5.223-08	3.702-04	1.914-06	5.490-03	9.912-05	5.962-03
6.000+07	7.335-05	6.448-01	3.203-03	1.168+01	2.161-01	1.254+01	3.628-08	3.189-04	1.584-06	5.777-03	1.069-04	6.205-03
8.000+07	4.126-05	5.086-01	2.382-03	1.255+01	2.398-01	1.330+01	2.041-08	2.516-04	1.178-06	6.208-03	1.186-04	6.579-03
1.000+08	2.641-05	4.221-01	1.896-03	1.316+01	2.569-01	1.384+01	1.306-08	2.088-04	9.378-07	6.509-03	1.271-04	6.846-03
1.500+08	1.174-05	3.006-01	1.256-03	1.414+01	2.853-01	1.473+01	5.807-09	1.487-04	6.212-07	6.994-03	1.411-04	7.284-03
2.000+08	6.601-06	2.357-01	9.384-04	1.472+01	3.031-01	1.526+01	3.265-09	1.166-04	4.642-07	7.281-03	1.499-04	7.548-03
3.000+08	2.934-06	1.670-01	6.235-04	1.540+01	3.249-01	1.589+01	1.451-09	8.260-05	3.084-07	7.617-03	1.607-04	7.861-03
4.000+08	1.650-06	1.308-01	4.668-04	1.579+01	3.380-01	1.626+01	8.161-10	6.470-05	2.309-07	7.810-03	1.672-04	8.042-03
5.000+08	1.056-06	1.083-01	3.731-04	1.605+01	3.469-01	1.651+01	5.223-10	5.357-05	1.845-07	7.939-03	1.716-04	8.164-03
6.000+08	7.335-07	9.272-02	3.107-04	1.623+01	3.535-01	1.668+01	3.628-10	4.586-05	1.537-07	8.028-03	1.748-04	8.249-03
8.000+08	4.126-07	7.242-02	2.328-04	1.648+01	3.625-01	1.692+01	2.041-10	3.582-05	1.151-07	8.151-03	1.793-04	8.367-03
1.000+09	2.640-07	5.958-02	1.862-04	1.664+01	3.685-01	1.707+01	1.306-10	2.947-05	9.210-08	8.231-03	1.823-04	8.442-03
1.500+09	1.174-07	4.161-02	1.240-04	1.687+01	3.774-01	1.729+01	5.807-11	2.058-05	6.133-08	8.344-03	1.867-04	8.552-03
2.000+09	6.601-08	3.220-02	9.298-05	1.699+01	3.825-01	1.740+01	3.265-11	1.593-05	4.599-08	8.404-03	1.892-04	8.609-03
3.000+09	2.934-08	2.239-02	6.196-05	1.713+01	3.880-01	1.754+01	1.451-11	1.107-05	3.065-08	8.473-03	1.919-04	8.676-03
4.000+09	1.650-08	1.728-02	4.647-05	1.720+01	3.912-01	1.761+01	8.161-12	8.547-06	2.299-08	8.508-03	1.935-04	8.710-03
5.000+09	1.056-08	1.413-02	3.717-05	1.725+01	3.932-01	1.766+01	5.223-12	6.989-06	1.839-08	8.532-03	1.945-04	8.734-03
6.000+09	7.335-09	1.198-02	3.097-05	1.728+01	3.946-01	1.769+01	3.628-12	5.926-06	1.532-08	8.547-03	1.952-04	8.748-03
8.000+09	4.126-09	9.233-03	2.323-05	1.732+01	3.964-01	1.773+01	2.041-12	4.567-06	1.149-08	8.567-03	1.961-04	8.768-03
1.000+10	2.640-09	7.538-03	1.858-05	1.735+01	3.976-01	1.776+01	1.306-12	3.728-06	9.190-09	8.582-03	1.967-04	8.782-03
1.500+10	1.174-09	5.209-03	1.239-05	1.738+01	3.992-01	1.778+01	5.807-13	2.576-06	6.128-09	8.597-03	1.975-04	8.797-03
2.000+10	6.601-10	4.005-03	9.289-06	1.740+01	4.001-01	1.780+01	3.265-13	1.981-06	4.595-09	8.606-03	1.979-04	8.806-03
3.000+10	2.934-10	2.762-03	6.193-06	1.742+01	4.010-01	1.782+01	1.451-13	1.366-06	3.063-09	8.616-03	1.983-04	8.816-03
4.000+10	1.650-10	2.121-03	4.644-06	1.743+01	4.016-01	1.783+01	8.161-14	1.049-06	2.297-09	8.621-03	1.986-04	8.821-03
5.000+10	1.056-10	1.727-03	3.715-06	1.744+01	4.019-01	1.784+01	5.223-14	8.542-07	1.838-09	8.626-03	1.988-04	8.826-03
6.000+10	7.335-11	1.460-03	3.096-06	1.745+01	4.021-01	1.785+01	3.628-14	7.222-07	1.531-09	8.631-03	1.989-04	8.831-03
8.000+10	4.126-11	1.119-03	2.322-06	1.745+01	4.023-01	1.785+01	2.041-14	5.535-07	1.149-09	8.631-03	1.990-04	8.831-03
1.000+11	2.640-11	9.106-04	1.858-06	1.746+01	4.025-01	1.786+01	1.306-14	4.504-07	9.190-10	8.636-03	1.991-04	8.836-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 52, TE, TELLURIUM ATOMIC WT. = 127.60 MSQ/KG = .00047195 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	2.755-01	1.094+01	7.922-01	0.000	0.000	1.201+01	1.300-04	5.163-03	3.739-04	0.000	0.000	5.667-03
1.022+06	2.639-01	1.083+01	7.580-01	0.000	0.000	1.185+01	1.245-04	5.111-03	3.577-04	0.000	0.000	5.593-03
1.250+06	1.770-01	9.796+00	5.112-01	3.770-02	0.000	1.052+01	8.353-05	4.623-03	2.413-04	1.779-05	0.000	4.966-03
1.500+06	1.231-01	8.910+00	3.660-01	1.746-01	0.000	9.574+00	5.810-05	4.205-03	1.727-04	8.240-05	0.000	4.518-03
2.000+06	6.942-02	7.610+00	2.228-01	5.916-01	0.000	8.494+00	3.276-05	3.592-03	1.051-04	2.792-04	0.000	4.009-03
2.044+06	6.647-02	7.517+00	2.149-01	6.321-01	0.000	8.430+00	3.137-05	3.548-03	1.014-04	2.983-04	0.000	3.979-03
3.000+06	3.090-02	5.991+00	1.182-01	1.498+00	2.096-03	7.640+00	1.458-05	2.827-03	5.576-05	7.070-04	9.892-07	3.606-03
4.000+06	1.739-02	4.999+00	7.834-02	2.301+00	8.547-03	7.404+00	8.207-06	2.359-03	3.697-05	1.086-03	4.034-06	3.494-03
5.000+06	1.114-02	4.318+00	5.795-02	2.994+00	1.701-02	7.398+00	5.257-06	2.038-03	2.735-05	1.413-03	8.028-06	3.492-03
6.000+06	7.734-03	3.817+00	4.574-02	3.591+00	2.610-02	7.488+00	3.650-06	1.801-03	2.159-05	1.693-03	1.232-05	3.534-03
7.000+06	5.682-03	3.431+00	3.767-02	4.122+00	3.515-02	7.632+00	2.682-06	1.619-03	1.778-05	1.943-03	1.659-05	3.602-03
8.000+06	4.351-03	3.123+00	3.197-02	4.660+00	4.391-02	7.803+00	2.053-06	1.474-03	1.509-05	2.171-03	2.072-05	3.683-03
9.000+06	3.438-03	2.871+00	2.773-02	5.034+00	5.228-02	7.988+00	1.623-06	1.355-03	1.309-05	2.376-03	2.467-05	3.770-03
1.000+07	2.785-03	2.660+00	2.447-02	5.432+00	6.024-02	8.179+00	1.314-06	1.255-03	1.155-05	2.564-03	2.843-05	3.860-03
1.100+07	2.301-03	2.481+00	2.189-02	5.798+00	6.776-02	8.371+00	1.086-06	1.171-03	1.033-05	2.736-03	3.198-05	3.951-03
1.200+07	1.934-03	2.327+00	1.979-02	6.137+00	7.485-02	8.561+00	9.127-07	1.098-03	9.340-06	2.896-03	3.533-05	4.040-03
1.300+07	1.648-03	2.192+00	1.805-02	6.452+00	8.153-02	8.745+00	7.778-07	1.035-03	8.519-06	3.045-03	3.848-05	4.127-03
1.400+07	1.421-03	2.074+00	1.660-02	6.742+00	8.789-02	8.922+00	6.706-07	9.788-04	7.834-06	3.182-03	4.148-05	4.211-03
1.500+07	1.238-03	1.969+00	1.535-02	7.011+00	9.389-02	9.090+00	5.843-07	9.293-04	7.244-06	3.309-03	4.431-05	4.290-03
1.600+07	1.088-03	1.875+00	1.428-02	7.260+00	9.960-02	9.250+00	5.135-07	8.849-04	6.739-06	3.425-03	4.701-05	4.365-03
1.800+07	8.595-04	1.713+00	1.253-02	7.716+00	1.102-01	9.553+00	4.056-07	8.084-04	5.913-06	3.642-03	5.201-05	4.508-03
2.000+07	6.962-04	1.580+00	1.116-02	8.124+00	1.198-01	9.836+00	3.286-07	7.457-04	5.267-06	3.834-03	5.654-05	4.642-03
2.200+07	5.754-04	1.468+00	1.006-02	8.494+00	1.286-01	1.010+01	2.716-07	6.928-04	4.748-06	4.009-03	6.069-05	4.767-03
2.400+07	4.835-04	1.371+00	9.150-03	8.830+00	1.367-01	1.035+01	2.282-07	6.470-04	4.318-06	4.167-03	6.452-05	4.883-03
2.600+07	4.120-04	1.288+00	8.394-03	9.137+00	1.441-01	1.058+01	1.944-07	6.079-04	3.962-06	4.312-03	6.801-05	4.992-03
2.800+07	3.552-04	1.215+00	7.753-03	9.417+00	1.510-01	1.079+01	1.676-07	5.734-04	3.659-06	4.444-03	7.126-05	5.093-03
3.000+07	3.095-04	1.150+00	7.202-03	9.676+00	1.574-01	1.099+01	1.461-07	5.427-04	3.395-06	4.567-03	7.428-05	5.187-03
4.000+07	1.741-04	9.141-01	5.313-03	1.073+01	1.840-01	1.183+01	8.217-08	4.314-04	2.507-06	5.064-03	8.684-05	5.585-03
5.000+07	1.114-04	7.631-01	4.208-03	1.151+01	2.042-01	1.248+01	5.257-08	3.601-04	1.986-06	5.432-03	9.637-05	5.891-03
6.000+07	7.736-05	6.575-01	3.483-03	1.211+01	2.202-01	1.299+01	3.651-08	3.103-04	1.644-06	5.715-03	1.039-04	6.131-03
8.000+07	4.351-05	5.185-01	2.591-03	1.301+01	2.442-01	1.378+01	2.053-08	2.447-04	1.223-06	6.140-03	1.152-04	6.501-03
1.000+08	2.785-05	4.304-01	2.062-03	1.364+01	2.617-01	1.433+01	1.314-08	2.031-04	9.732-07	6.437-03	1.235-04	6.765-03
1.500+08	1.238-05	3.065-01	1.365-03	1.465+01	2.906-01	1.525+01	5.843-09	1.447-04	6.442-07	6.914-03	1.371-04	7.196-03
2.000+08	6.962-06	2.493-01	1.020-03	1.526+01	3.087-01	1.581+01	3.286-09	1.134-04	4.814-07	7.202-03	1.457-04	7.461-03
3.000+08	3.094-06	1.703-01	6.780-04	1.596+01	3.309-01	1.646+01	1.460-09	8.037-05	3.200-07	7.532-03	1.562-04	7.769-03
4.000+08	1.741-06	1.334-01	5.076-04	1.637+01	3.442-01	1.685+01	8.217-10	6.296-05	2.396-07	7.726-03	1.624-04	7.951-03
5.000+08	1.114-06	1.104-01	4.056-04	1.664+01	3.533-01	1.710+01	5.257-10	5.210-05	1.914-07	7.853-03	1.667-04	8.072-03
6.000+08	7.736-07	9.454-02	3.378-04	1.683+01	3.600-01	1.728+01	3.651-10	4.462-05	1.594-07	7.943-03	1.699-04	8.158-03
8.000+08	4.351-07	7.384-02	2.531-04	1.708+01	3.692-01	1.752+01	2.053-10	3.485-05	1.194-07	8.061-03	1.742-04	8.270-03
1.000+09	2.785-07	6.075-02	2.024-04	1.725+01	3.753-01	1.769+01	1.314-10	2.867-05	9.552-08	8.141-03	1.771-04	8.347-03
1.500+09	1.238-07	4.242-02	1.348-04	1.748+01	3.844-01	1.791+01	5.843-11	2.002-05	6.362-08	8.250-03	1.814-04	8.451-03
2.000+09	6.962-08	3.284-02	1.011-04	1.761+01	3.895-01	1.803+01	3.286-11	1.550-05	4.771-08	8.311-03	1.838-04	8.510-03
3.000+09	3.094-08	2.283-02	6.737-05	1.775+01	3.951-01	1.817+01	1.460-11	1.077-05	3.180-08	8.377-03	1.865-04	8.574-03
4.000+09	1.741-08	1.762-02	5.052-05	1.783+01	3.984-01	1.825+01	8.217-12	8.316-06	2.384-08	8.415-03	1.880-04	8.611-03
5.000+09	1.114-08	1.441-02	4.041-05	1.788+01	4.004-01	1.829+01	5.257-12	6.801-06	1.907-08	8.438-03	1.890-04	8.634-03
6.000+09	7.736-09	1.222-02	3.368-05	1.791+01	4.018-01	1.832+01	3.651-12	5.767-06	1.590-08	8.453-03	1.896-04	8.648-03
8.000+09	4.351-09	9.414-03	2.525-05	1.795+01	4.037-01	1.836+01	2.053-12	4.443-06	1.192-08	8.471-03	1.905-04	8.666-03
1.000+10	2.785-09	7.686-03	2.020-05	1.798+01	4.049-01	1.839+01	1.314-12	3.627-06	9.533-09	8.486-03	1.911-04	8.680-03
1.500+10	1.238-09	5.312-03	1.347-05	1.802+01	4.065-01	1.843+01	5.843-13	2.507-06	6.357-09	8.504-03	1.918-04	8.699-03
2.000+10	6.962-10	4.084-03	1.010-05	1.804+01	4.074-01	1.845+01	3.286-13	1.927-06	4.767-09	8.514-03	1.923-04	8.708-03
3.000+10	3.094-10	2.816-03	6.733-06	1.806+01	4.083-01	1.847+01	1.460-13	1.329-06	3.178-09	8.523-03	1.927-04	8.717-03
4.000+10	1.741-10	2.162-03	5.050-06	1.807+01	4.089-01	1.848+01	8.217-14	1.020-06	2.383-09	8.528-03	1.930-04	8.722-03
5.000+10	1.114-10	1.761-03	4.040-06	1.808+01	4.092-01	1.849+01	5.257-14	8.311-07	1.907-09	8.533-03	1.931-04	8.727-03
6.000+10	7.736-11	1.488-03	3.366-06	1.808+01	4.095-01	1.849+01	3.651-14	7.023-07	1.589-09	8.533-03	1.933-04	8.727-03
8.000+10	4.351-11	1.141-03	2.525-06	1.809+01	4.097-01	1.850+01	2.053-14	5.385-07	1.192-09	8.538-03	1.934-04	8.731-03
1.000+11	2.785-11	9.284-04	2.020-06	1.809+01	4.099-01	1.850+01	1.314-14	4.382-07	9.533-10	8.538-03	1.935-04	8.731-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 53, I , IODINE ATOMIC WT. = 126.9045 MSQ/KG = .00047453 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	2.905-01	1.115+01	8.638-01	0.000	0.000	1.230+01	1.379-04	5.291-03	4.099-04	0.000	0.000	5.839-03
1.022+06	2.784-01	1.103+01	8.265-01	0.000	0.000	1.213+01	1.321-04	5.234-03	3.922-04	0.000	0.000	5.758-03
1.250+06	1.867-01	9.983+00	5.573-01	3.969-02	0.000	1.077+01	8.860-05	4.737-03	2.645-04	1.883-05	0.000	5.109-03
1.500+06	1.299-01	9.081+00	3.989-01	1.836-01	0.000	9.793+00	6.164-05	4.309-03	1.893-04	8.712-05	0.000	4.647-03
2.000+06	7.325-02	7.756+00	2.428-01	6.193-01	0.000	8.691+00	3.476-05	3.680-03	1.152-04	2.939-04	0.000	4.124-03
2.044+06	7.015-02	7.661+00	2.342-01	6.615-01	0.000	8.627+00	3.329-05	3.635-03	1.111-04	3.139-04	0.000	4.094-03
3.000+06	3.261-02	6.107+00	1.288-01	1.561+00	2.136-03	7.832+00	1.547-05	2.898-03	6.112-05	7.407-04	1.014-06	3.716-03
4.000+06	1.835-02	5.095+00	8.527-02	2.393+00	8.711-03	7.600+00	8.712-06	2.418-03	4.046-05	1.136-03	4.134-06	3.607-03
5.000+06	1.175-02	4.401+00	6.305-02	3.110+00	1.734-02	7.603+00	5.576-06	2.088-03	2.992-05	1.476-03	8.228-06	3.608-03
6.000+06	8.162-03	3.890+00	4.975-02	3.728+00	2.660-02	7.703+00	3.873-06	1.846-03	2.361-05	1.769-03	1.262-05	3.655-03
7.000+06	5.997-03	3.497+00	4.097-02	4.278+00	3.582-02	7.858+00	2.846-06	1.659-03	1.944-05	2.030-03	1.700-05	3.729-03
8.000+06	4.592-03	3.183+00	3.476-02	4.772+00	4.474-02	8.039+00	2.179-06	1.510-03	1.649-05	2.264-03	2.123-05	3.815-03
9.000+06	3.623-03	2.926+00	3.015-02	5.221+00	5.328-02	8.234+00	1.722-06	1.388-03	1.431-05	2.478-03	2.528-05	3.907-03
1.000+07	2.939-03	2.711+00	2.660-02	5.632+00	6.138-02	8.434+00	1.395-06	1.286-03	1.262-05	2.673-03	2.913-05	4.002-03
1.100+07	2.429-03	2.528+00	2.379-02	6.011+00	6.904-02	8.634+00	1.153-06	1.200-03	1.129-05	2.852-03	3.276-05	4.097-03
1.200+07	2.041-03	2.371+00	2.151-02	6.362+00	7.627-02	8.833+00	9.685-07	1.125-03	1.021-05	3.019-03	3.619-05	4.191-03
1.300+07	1.739-03	2.234+00	1.962-02	6.688+00	8.307-02	9.026+00	8.252-07	1.060-03	9.310-06	3.174-03	3.942-05	4.283-03
1.400+07	1.503-03	2.113+00	1.803-02	6.988+00	8.954-02	9.210+00	7.118-07	1.003-03	8.556-06	3.316-03	4.249-05	4.370-03
1.500+07	1.306-03	2.007+00	1.668-02	7.267+00	9.566-02	9.388+00	6.197-07	9.524-04	7.915-06	3.448-03	4.539-05	4.455-03
1.600+07	1.148-03	1.911+00	1.552-02	7.525+00	1.015-01	9.554+00	5.448-07	9.068-04	7.365-06	3.571-03	4.817-05	4.534-03
1.800+07	9.072-04	1.746+00	1.361-02	7.996+00	1.122-01	9.869+00	4.305-07	8.285-04	6.458-06	3.794-03	5.324-05	4.683-03
2.000+07	7.348-04	1.610+00	1.212-02	8.419+00	1.220-01	1.016+01	3.487-07	7.640-04	5.751-06	3.995-03	5.789-05	4.823-03
2.200+07	6.073-04	1.496+00	1.092-02	8.802+00	1.310-01	1.044+01	2.882-07	7.099-04	5.182-06	4.177-03	6.216-05	4.954-03
2.400+07	5.103-04	1.398+00	9.940-03	9.150+00	1.392-01	1.070+01	2.422-07	6.634-04	4.717-06	4.342-03	6.606-05	5.076-03
2.600+07	4.348-04	1.313+00	9.118-03	9.458+00	1.468-01	1.094+01	2.063-07	6.231-04	4.327-06	4.493-03	6.966-05	5.190-03
2.800+07	3.749-04	1.238+00	8.421-03	9.758+00	1.538-01	1.116+01	1.779-07	5.875-04	3.996-06	4.630-03	7.298-05	5.295-03
3.000+07	3.266-04	1.172+00	7.823-03	1.003+01	1.604-01	1.137+01	1.550-07	5.562-04	3.712-06	4.760-03	7.612-05	5.396-03
4.000+07	1.837-04	9.317-01	5.770-03	1.111+01	1.874-01	1.224+01	8.717-08	4.421-04	2.738-06	5.272-03	8.893-05	5.806-03
5.000+07	1.176-04	7.778-01	4.570-03	1.192+01	2.079-01	1.291+01	5.581-08	3.691-04	2.169-06	5.656-03	9.866-05	6.126-03
6.000+07	8.163-05	6.701-01	3.783-03	1.255+01	2.242-01	1.345+01	3.875-08	3.180-04	1.795-06	5.955-03	1.064-04	6.382-03
8.000+07	4.593-05	5.285-01	2.813-03	1.347+01	2.486-01	1.425+01	2.180-08	2.508-04	1.335-06	6.392-03	1.180-04	6.762-03
1.000+08	2.939-05	4.387-01	2.239-03	1.413+01	2.664-01	1.484+01	1.395-08	2.082-04	1.062-06	6.705-03	1.264-04	7.041-03
1.500+08	1.306-05	3.124-01	1.482-03	1.518+01	2.959-01	1.579+01	6.197-09	1.482-04	7.033-07	7.203-03	1.404-04	7.493-03
2.000+08	7.348-06	2.449-01	1.108-03	1.581+01	3.143-01	1.637+01	3.487-09	1.162-04	5.258-07	7.502-03	1.491-04	7.768-03
3.000+08	3.266-06	1.736-01	7.360-04	1.654+01	3.369-01	1.705+01	1.550-09	8.238-05	3.493-07	7.849-03	1.599-04	8.091-03
4.000+08	1.837-06	1.360-01	5.511-04	1.696+01	3.505-01	1.745+01	8.717-10	6.454-05	2.615-07	8.048-03	1.663-04	8.279-03
5.000+08	1.176-06	1.125-01	4.404-04	1.723+01	3.597-01	1.770+01	5.581-10	5.339-05	2.090-07	8.176-03	1.707-04	8.400-03
6.000+08	8.164-07	9.636-02	3.667-04	1.743+01	3.665-01	1.789+01	3.874-10	4.573-05	1.740-07	8.271-03	1.739-04	8.491-03
8.000+08	4.592-07	7.526-02	2.748-04	1.769+01	3.759-01	1.814+01	2.179-10	3.571-05	1.304-07	8.394-03	1.784-04	8.609-03
1.000+09	2.939-07	6.192-02	2.197-04	1.786+01	3.821-01	1.830+01	1.395-10	2.938-05	1.043-07	8.475-03	1.813-04	8.686-03
1.500+09	1.306-07	4.324-02	1.464-04	1.811+01	3.913-01	1.854+01	6.197-11	2.052-05	6.947-08	8.594-03	1.857-04	8.800-03
2.000+09	7.348-08	3.347-02	1.097-04	1.825+01	3.965-01	1.868+01	3.487-11	1.588-05	5.206-08	8.660-03	1.882-04	8.864-03
3.000+09	3.266-08	2.327-02	7.314-05	1.839+01	4.022-01	1.882+01	1.550-11	1.104-05	3.471-08	8.727-03	1.909-04	8.929-03
4.000+09	1.837-08	1.796-02	5.485-05	1.847+01	4.055-01	1.889+01	8.717-12	8.523-06	2.603-08	8.765-03	1.924-04	8.966-03
5.000+09	1.176-08	1.469-02	4.387-05	1.852+01	4.076-01	1.894+01	5.581-12	6.971-06	2.082-08	8.788-03	1.934-04	8.989-03
6.000+09	8.164-09	1.245-02	3.656-05	1.855+01	4.090-01	1.897+01	3.874-12	5.908-06	1.735-08	8.803-03	1.941-04	9.003-03
8.000+09	4.592-09	9.595-03	2.742-05	1.860+01	4.109-01	1.902+01	2.179-12	4.553-06	1.301-08	8.826-03	1.950-04	9.026-03
1.000+10	2.939-09	7.834-03	2.193-05	1.863+01	4.121-01	1.905+01	1.395-12	3.717-06	1.041-08	8.841-03	1.956-04	9.040-03
1.500+10	1.306-09	5.414-03	1.462-05	1.867+01	4.137-01	1.909+01	6.197-13	2.569-06	6.938-09	8.860-03	1.963-04	9.058-03
2.000+10	7.348-10	4.162-03	1.096-05	1.869+01	4.147-01	1.911+01	3.487-13	1.975-06	5.201-09	8.869-03	1.968-04	9.068-03
3.000+10	3.265-10	2.870-03	7.309-06	1.871+01	4.156-01	1.913+01	1.550-13	1.362-06	3.468-09	8.879-03	1.972-04	9.077-03
4.000+10	1.837-10	2.204-03	5.482-06	1.872+01	4.162-01	1.914+01	8.717-14	1.046-06	2.601-09	8.883-03	1.975-04	9.082-03
5.000+10	1.176-10	1.795-03	4.386-06	1.873+01	4.165-01	1.915+01	5.581-14	8.518-07	2.081-09	8.888-03	1.976-04	9.087-03
6.000+10	8.164-11	1.517-03	3.655-06	1.873+01	4.167-01	1.915+01	3.874-14	7.199-07	1.734-09	8.888-03	1.977-04	9.086-03
8.000+10	4.592-11	1.163-03	2.741-06	1.874+01	4.170-01	1.916+01	2.179-14	5.519-07	1.301-09	8.893-03	1.979-04	9.091-03
1.000+11	2.939-11	9.463-04	2.193-06	1.874+01	4.172-01	1.916+01	1.395-14	4.491-07	1.041-09	8.893-03	1.980-04	9.091-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 54, XE, XENON ATOMIC WT. = 131.29 MSQ/KG = .00045868 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	3.061-01	1.136+01	9.401-01	0.000	0.000	1.261+01	1.404-04	5.211-03	4.312-04	0.000	0.000	5.782-03
1.022+06	2.932-01	1.124+01	8.995-01	0.000	0.000	1.243+01	1.345-04	5.156-03	4.126-04	0.000	0.000	5.703-03
1.250+06	1.967-01	1.017+01	6.066-01	4.173-02	0.000	1.102+01	9.022-05	4.665-03	2.782-04	1.914-05	0.000	5.052-03
1.500+06	1.369-01	9.252+00	4.341-01	1.930-01	0.000	1.002+01	6.279-05	4.244-03	1.991-04	8.853-05	0.000	4.594-03
2.000+06	7.717-02	7.902+00	2.641-01	6.478-01	0.000	8.891+00	3.540-05	3.625-03	1.211-04	2.971-04	0.000	4.078-03
2.044+06	7.390-02	7.805+00	2.548-01	6.918-01	0.000	8.825+00	3.390-05	3.580-03	1.169-04	3.173-04	0.000	4.048-03
3.000+06	3.436-02	6.222+00	1.400-01	1.626+00	2.176-03	8.025+00	1.576-05	2.854-03	6.422-05	7.458-04	9.981-07	3.681-03
4.000+06	1.934-02	5.191+00	9.266-02	2.487+00	8.874-03	7.799+00	8.871-06	2.381-03	4.250-05	1.141-03	4.070-06	3.577-03
5.000+06	1.238-02	4.484+00	6.849-02	3.229+00	1.766-02	7.812+00	5.678-06	2.057-03	3.142-05	1.481-03	8.100-06	3.583-03
6.000+06	8.599-03	3.964+00	5.403-02	3.868+00	2.710-02	7.922+00	3.944-06	1.818-03	2.478-05	1.774-03	1.243-05	3.634-03
7.000+06	6.318-03	3.563+00	4.448-02	4.436+00	3.649-02	8.086+00	2.898-06	1.634-03	2.040-05	2.035-03	1.674-05	3.709-03
8.000+06	4.838-03	3.243+00	3.773-02	4.947+00	4.558-02	8.278+00	2.219-06	1.488-03	1.731-05	2.269-03	2.091-05	3.797-03
9.000+06	3.823-03	2.981+00	3.273-02	5.411+00	5.427-02	8.483+00	1.754-06	1.367-03	1.501-05	2.482-03	2.489-05	3.891-03
1.000+07	3.096-03	2.762+00	2.887-02	5.836+00	6.252-02	8.692+00	1.420-06	1.267-03	1.324-05	2.677-03	2.868-05	3.987-03
1.100+07	2.559-03	2.576+00	2.582-02	6.228+00	7.033-02	8.903+00	1.174-06	1.182-03	1.184-05	2.857-03	3.226-05	4.084-03
1.200+07	2.150-03	2.416+00	2.334-02	6.590+00	7.768-02	9.109+00	9.862-07	1.108-03	1.071-05	3.023-03	3.563-05	4.178-03
1.300+07	1.832-03	2.276+00	2.129-02	6.929+00	8.461-02	9.313+00	8.403-07	1.044-03	9.765-06	3.178-03	3.881-05	4.272-03
1.400+07	1.580-03	2.153+00	1.956-02	7.240+00	9.120-02	9.505+00	7.247-07	9.875-04	8.972-06	3.321-03	4.183-05	4.360-03
1.500+07	1.376-03	2.044+00	1.810-02	7.529+00	9.743-02	9.690+00	6.311-07	9.375-04	8.302-06	3.453-03	4.469-05	4.445-03
1.600+07	1.210-03	1.947+00	1.683-02	7.796+00	1.033-01	9.864+00	5.550-07	8.931-04	7.720-06	3.576-03	4.738-05	4.525-03
1.800+07	9.558-04	1.779+00	1.476-02	8.283+00	1.143-01	1.019+01	4.384-07	8.160-04	6.770-06	3.799-03	5.243-05	4.675-03
2.000+07	7.742-04	1.641+00	1.315-02	8.719+00	1.243-01	1.050+01	3.551-07	7.527-04	6.032-06	3.999-03	5.701-05	4.815-03
2.200+07	6.398-04	1.524+00	1.185-02	9.115+00	1.334-01	1.078+01	2.935-07	6.990-04	5.435-06	4.181-03	6.119-05	4.947-03
2.400+07	5.376-04	1.424+00	1.078-02	9.475+00	1.418-01	1.105+01	2.466-07	6.532-04	4.945-06	4.346-03	6.504-05	5.069-03
2.600+07	4.581-04	1.337+00	9.887-03	9.803+00	1.495-01	1.130+01	2.101-07	6.133-04	4.535-06	4.496-03	6.857-05	5.183-03
2.800+07	3.950-04	1.262+00	9.131-03	1.010+01	1.566-01	1.153+01	1.812-07	5.789-04	4.188-06	4.633-03	7.183-05	5.288-03
3.000+07	3.441-04	1.195+00	8.482-03	1.038+01	1.633-01	1.175+01	1.578-07	5.481-04	3.891-06	4.761-03	7.490-05	5.388-03
4.000+07	1.936-04	9.493-01	6.256-03	1.150+01	1.908-01	1.265+01	8.880-08	4.354-04	2.870-06	5.275-03	8.752-05	5.801-03
5.000+07	1.239-04	7.924-01	4.954-03	1.234+01	2.117-01	1.335+01	5.683-08	3.635-04	2.272-06	5.660-03	9.710-05	6.123-03
6.000+07	8.602-05	6.828-01	4.100-03	1.299+01	2.282-01	1.391+01	3.946-08	3.132-04	1.881-06	5.958-03	1.047-04	6.378-03
8.000+07	4.839-05	5.385-01	3.049-03	1.395+01	2.531-01	1.474+01	2.220-08	2.470-04	1.399-06	6.399-03	1.161-04	6.763-03
1.000+08	3.097-05	4.469-01	2.427-03	1.463+01	2.712-01	1.535+01	1.421-08	2.050-04	1.113-06	6.711-03	1.244-04	7.041-03
1.500+08	1.376-05	3.183-01	1.607-03	1.571+01	3.011-01	1.633+01	6.311-09	1.460-04	7.371-07	7.206-03	1.381-04	7.491-03
2.000+08	7.741-06	2.495-01	1.231-03	1.636+01	3.199-01	1.693+01	3.551-09	1.144-04	5.509-07	7.504-03	1.467-04	7.766-03
3.000+08	3.441-06	1.769-01	7.977-04	1.712+01	3.428-01	1.764+01	1.578-09	8.114-05	3.659-07	7.853-03	1.572-04	8.091-03
4.000+08	1.935-06	1.385-01	5.972-04	1.755+01	3.566-01	1.805+01	8.876-10	6.353-05	2.739-07	8.050-03	1.636-04	8.277-03
5.000+08	1.239-06	1.147-01	4.773-04	1.784+01	3.660-01	1.832+01	5.683-10	5.261-05	2.189-07	8.183-03	1.679-04	8.404-03
6.000+08	8.602-07	9.818-02	3.974-04	1.804+01	3.729-01	1.851+01	3.946-10	4.503-05	1.823-07	8.275-03	1.710-04	8.491-03
8.000+08	4.838-07	7.668-02	2.978-04	1.831+01	3.824-01	1.877+01	2.219-10	3.517-05	1.366-07	8.398-03	1.754-04	8.609-03
1.000+09	3.097-07	6.308-02	2.381-04	1.849+01	3.887-01	1.894+01	1.421-10	2.893-05	1.092-07	8.481-03	1.783-04	8.688-03
1.500+09	1.376-07	4.406-02	1.586-04	1.875+01	3.980-01	1.919+01	6.311-11	2.021-05	7.275-08	8.600-03	1.826-04	8.803-03
2.000+09	7.741-08	3.410-02	1.189-04	1.889+01	4.033-01	1.933+01	3.551-11	1.564-05	5.454-08	8.665-03	1.850-04	8.865-03
3.000+09	3.441-08	2.371-02	7.926-05	1.904+01	4.091-01	1.947+01	1.578-11	1.088-05	3.636-08	8.733-03	1.876-04	8.932-03
4.000+09	1.935-08	1.830-02	5.944-05	1.912+01	4.124-01	1.955+01	8.876-12	8.394-06	2.726-08	8.770-03	1.892-04	8.968-03
5.000+09	1.239-08	1.496-02	4.755-05	1.917+01	4.145-01	1.960+01	5.683-12	6.862-06	2.181-08	8.793-03	1.901-04	8.990-03
6.000+09	8.602-09	1.269-02	3.962-05	1.921+01	4.159-01	1.964+01	3.946-12	5.821-06	1.817-08	8.811-03	1.908-04	9.008-03
8.000+09	4.838-09	9.776-03	2.971-05	1.925+01	4.179-01	1.968+01	2.219-12	4.484-06	1.363-08	8.830-03	1.917-04	9.026-03
1.000+10	3.097-09	7.981-03	2.377-05	1.928+01	4.191-01	1.971+01	1.421-12	3.661-06	1.090-08	8.843-03	1.922-04	9.039-03
1.500+10	1.376-09	5.516-03	1.584-05	1.932+01	4.207-01	1.975+01	6.311-13	2.530-06	7.266-09	8.862-03	1.930-04	9.057-03
2.000+10	7.741-10	4.241-03	1.188-05	1.934+01	4.217-01	1.977+01	3.551-13	1.945-06	5.449-09	8.871-03	1.934-04	9.066-03
3.000+10	3.441-10	2.925-03	7.921-06	1.937+01	4.226-01	1.980+01	1.578-13	1.342-06	3.633-09	8.885-03	1.938-04	9.080-03
4.000+10	1.935-10	2.245-03	5.941-06	1.938+01	4.232-01	1.981+01	8.876-14	1.030-06	2.725-09	8.889-03	1.941-04	9.084-03
5.000+10	1.239-10	1.828-03	4.753-06	1.939+01	4.235-01	1.982+01	5.683-14	8.385-07	2.180-09	8.894-03	1.943-04	9.089-03
6.000+10	8.602-11	1.546-03	3.961-06	1.939+01	4.238-01	1.982+01	3.946-14	7.091-07	1.817-09	8.894-03	1.944-04	9.089-03
8.000+10	4.838-11	1.185-03	2.970-06	1.940+01	4.240-01	1.983+01	2.219-14	5.435-07	1.362-09	8.898-03	1.945-04	9.093-03
1.000+11	3.097-11	9.642-04	2.376-06	1.940+01	4.242-01	1.983+01	1.421-14	4.423-07	1.090-09	8.898-03	1.946-04	9.093-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV $Z=1$ to 100—Continued

Z = 55, CS, CESIUM ATOMIC WT. = 132.9054 MSQ/KG = .00045311 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	3.219-01	1.157+01	1.027+00	0.000	0.000	1.292+01	1.459-04	5.242-03	4.653-04	0.000	0.000	5.854-03
1.022+06	3.084-01	1.145+01	9.828-01	0.000	0.000	1.274+01	1.397-04	5.188-03	4.453-04	0.000	0.000	5.773-03
1.250+06	2.069-01	1.036+01	6.627-01	4.366-02	0.000	1.127+01	9.375-05	4.694-03	3.003-04	1.987-05	0.000	5.108-03
1.500+06	1.440-01	9.422+00	4.741-01	2.028-01	0.000	1.024+01	6.525-05	4.269-03	2.148-04	9.189-05	0.000	4.641-03
2.000+06	8.120-02	8.048+00	2.884-01	6.774-01	0.000	9.095+00	3.679-05	3.647-03	1.307-04	3.069-04	0.000	4.121-03
2.044+06	7.775-02	7.949+00	2.782-01	7.231-01	0.000	9.028+00	3.523-05	3.602-03	1.261-04	3.276-04	0.000	4.091-03
3.000+06	3.615-02	6.337+00	1.527-01	1.693+00	2.216-03	8.221+00	1.638-05	2.871-03	6.919-05	7.671-04	1.004-06	3.725-03
4.000+06	2.035-02	5.287+00	1.011-01	2.583+00	9.038-03	8.000+00	9.221-06	2.396-03	4.581-05	1.170-03	4.095-06	3.625-03
5.000+06	1.303-02	4.567+00	7.467-02	3.350+00	1.799-02	8.023+00	5.904-06	2.069-03	3.383-05	1.518-03	8.151-06	3.635-03
6.000+06	9.049-03	4.037+00	5.789-02	4.010+00	2.759-02	8.143+00	4.100-06	1.829-03	2.668-05	1.817-03	1.250-05	3.689-03
7.000+06	6.649-03	3.629+00	4.247-02	4.597+00	3.716-02	8.318+00	3.013-06	1.644-03	2.196-05	2.083-03	1.684-05	3.769-03
8.000+06	5.091-03	3.303+00	4.111-02	5.124+00	4.641-02	8.520+00	2.307-06	1.497-03	1.863-05	2.322-03	2.103-05	3.860-03
9.000+06	4.022-03	3.036+00	3.565-02	5.603+00	5.526-02	8.734+00	1.822-06	1.376-03	1.615-05	2.539-03	2.504-05	3.957-03
1.000+07	3.258-03	2.813+00	3.145-02	6.042+00	6.366-02	8.953+00	1.476-06	1.275-03	1.425-05	2.738-03	2.884-05	4.057-03
1.100+07	2.693-03	2.624+00	2.812-02	6.447+00	7.161-02	9.173+00	1.220-06	1.189-03	1.274-05	2.921-03	3.245-05	4.157-03
1.200+07	2.263-03	2.461+00	2.542-02	6.822+00	7.909-02	9.399+00	1.025-06	1.115-03	1.152-05	3.091-03	3.584-05	4.255-03
1.300+07	1.928-03	2.318+00	2.316-02	7.171+00	8.614-02	9.600+00	8.736-07	1.050-03	1.050-05	3.249-03	3.903-05	4.350-03
1.400+07	1.662-03	2.193+00	2.130-02	7.494+00	9.285-02	9.803+00	7.531-07	9.937-04	9.651-06	3.396-03	4.207-05	4.442-03
1.500+07	1.448-03	2.082+00	1.971-02	7.792+00	9.919-02	9.994+00	6.561-07	9.434-04	8.931-06	3.531-03	4.494-05	4.529-03
1.600+07	1.273-03	1.983+00	1.833-02	8.069+00	1.052-01	1.018+01	5.768-07	8.985-04	8.305-06	3.656-03	4.767-05	4.611-03
1.800+07	1.006-03	1.812+00	1.607-02	8.572+00	1.164-01	1.052+01	4.558-07	8.210-04	7.281-06	3.884-03	5.274-05	4.766-03
2.000+07	8.147-04	1.671+00	1.431-02	9.023+00	1.265-01	1.084+01	3.691-07	7.571-04	6.484-06	4.088-03	5.732-05	4.910-03
2.200+07	6.733-04	1.552+00	1.290-02	9.432+00	1.358-01	1.113+01	3.051-07	7.032-04	5.845-06	4.274-03	6.153-05	5.045-03
2.400+07	5.657-04	1.451+00	1.173-02	9.804+00	1.443-01	1.141+01	2.563-07	6.575-04	5.315-06	4.442-03	6.538-05	5.171-03
2.600+07	4.820-04	1.362+00	1.076-02	1.014+01	1.522-01	1.167+01	2.184-07	6.171-04	4.875-06	4.595-03	6.896-05	5.286-03
2.800+07	4.156-04	1.285+00	9.938-03	1.045+01	1.594-01	1.190+01	1.883-07	5.822-04	4.503-06	4.735-03	7.223-05	5.394-03
3.000+07	3.621-04	1.217+00	9.231-03	1.074+01	1.662-01	1.213+01	1.641-07	5.514-04	4.183-06	4.866-03	7.531-05	5.497-03
4.000+07	2.037-04	9.669-01	6.808-03	1.190+01	1.942-01	1.307+01	9.230-08	4.381-04	3.085-06	5.392-03	8.799-05	5.921-03
5.000+07	1.303-04	8.071-01	5.391-03	1.276+01	2.154-01	1.379+01	5.904-08	3.657-04	2.443-06	5.782-03	9.760-05	6.247-03
6.000+07	9.052-05	6.954-01	4.462-03	1.344+01	2.322-01	1.437+01	4.102-08	3.151-04	2.022-06	6.090-03	1.052-04	6.512-03
8.000+07	5.092-05	5.484-01	3.317-03	1.443+01	2.575-01	1.524+01	2.307-08	2.485-04	1.503-06	6.538-03	1.167-04	6.905-03
1.000+08	3.259-05	4.552-01	2.540-03	1.513+01	2.759-01	1.586+01	1.477-08	2.063-04	1.196-06	6.856-03	1.250-04	7.188-03
1.500+08	1.448-05	3.242-01	1.748-03	1.625+01	3.064-01	1.688+01	6.561-09	1.469-04	7.920-07	7.363-03	1.388-04	7.650-03
2.000+08	8.146-06	2.542-01	1.306-03	1.692+01	3.255-01	1.750+01	3.691-09	1.152-04	5.918-07	7.667-03	1.475-04	7.930-03
3.000+08	3.621-06	1.801-01	8.678-04	1.770+01	3.489-01	1.823+01	1.641-09	8.160-05	3.932-07	8.020-03	1.581-04	8.260-03
4.000+08	2.037-06	1.411-01	6.497-04	1.815+01	3.629-01	1.865+01	9.230-10	6.393-05	2.944-07	8.224-03	1.644-04	8.453-03
5.000+08	1.303-06	1.168-01	5.192-04	1.845+01	3.726-01	1.894+01	5.904-10	5.292-05	2.353-07	8.360-03	1.688-04	8.582-03
6.000+08	9.051-07	1.000-01	4.324-04	1.866+01	3.796-01	1.914+01	4.101-10	4.531-05	1.959-07	8.455-03	1.720-04	8.672-03
8.000+08	5.091-07	7.810-02	3.240-04	1.894+01	3.894-01	1.941+01	2.307-10	3.539-05	1.468-07	8.582-03	1.764-04	8.794-03
1.000+09	3.258-07	6.425-02	2.590-04	1.913+01	3.959-01	1.959+01	1.476-10	2.911-05	1.174-07	8.668-03	1.794-04	8.877-03
1.500+09	1.448-07	4.487-02	1.726-04	1.939+01	4.056-01	1.984+01	6.561-11	2.033-05	7.821-08	8.786-03	1.838-04	8.990-03
2.000+09	8.146-08	3.473-02	1.294-04	1.953+01	4.111-01	1.998+01	3.691-11	1.574-05	5.863-08	8.849-03	1.863-04	9.051-03
3.000+09	3.621-08	2.415-02	8.623-05	1.969+01	4.172-01	2.013+01	1.641-11	1.094-05	3.907-08	8.922-03	1.890-04	9.122-03
4.000+09	2.037-08	1.864-02	6.466-05	1.977+01	4.208-01	2.021+01	9.230-12	8.446-06	2.930-08	8.958-03	1.907-04	9.157-03
5.000+09	1.303-08	1.524-02	5.172-05	1.983+01	4.229-01	2.027+01	5.904-12	6.905-06	2.343-08	8.985-03	1.916-04	9.184-03
6.000+09	9.051-09	1.292-02	4.310-05	1.986+01	4.245-01	2.030+01	4.101-12	5.854-06	1.953-08	8.999-03	1.923-04	9.197-03
8.000+09	5.091-09	9.957-03	3.232-05	1.991+01	4.265-01	2.035+01	2.307-12	4.512-06	1.464-08	9.021-03	1.933-04	9.219-03
1.000+10	3.258-09	8.129-03	2.586-05	1.994+01	4.279-01	2.038+01	1.476-12	3.683-06	1.172-08	9.035-03	1.939-04	9.233-03
1.500+10	1.448-09	5.618-03	1.724-05	1.999+01	4.296-01	2.043+01	6.561-13	2.546-06	7.812-09	9.058-03	1.947-04	9.255-03
2.000+10	8.146-10	4.319-03	1.293-05	2.001+01	4.307-01	2.045+01	3.691-13	1.957-06	5.859-09	9.067-03	1.952-04	9.264-03
3.000+10	3.621-10	2.979-03	8.617-06	2.003+01	4.317-01	2.046+01	1.641-13	1.350-06	3.904-09	9.076-03	1.956-04	9.273-03
4.000+10	2.037-10	2.287-03	6.463-06	2.004+01	4.323-01	2.047+01	9.230-14	1.036-06	2.928-09	9.080-03	1.959-04	9.277-03
5.000+10	1.303-10	1.862-03	5.170-06	2.005+01	4.327-01	2.048+01	5.904-14	8.437-07	2.343-09	9.085-03	1.961-04	9.282-03
6.000+10	9.051-11	1.574-03	4.308-06	2.006+01	4.329-01	2.049+01	4.101-14	7.132-07	1.952-09	9.089-03	1.962-04	9.286-03
8.000+10	5.091-11	1.207-03	3.231-06	2.006+01	4.332-01	2.049+01	2.307-14	5.469-07	1.464-09	9.089-03	1.963-04	9.286-03
1.000+11	3.258-11	9.820-04	2.585-06	2.007+01	4.334-01	2.050+01	1.476-14	4.450-07	1.171-09	9.094-03	1.964-04	9.291-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 56, BA, BARIUM ATOMIC WT. = 137.33 MSQ/KG = .00043851 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	3.383-01	1.178+01	1.114+00	0.000	0.000	1.323+01	1.483-04	5.166-03	4.885-04	0.000	0.000	5.802-03
1.022+06	3.241-01	1.165+01	1.066+00	0.000	0.000	1.304+01	1.421-04	5.109-03	4.675-04	0.000	0.000	5.718-03
1.250+06	2.175-01	1.055+01	7.190-01	4.605-02	0.000	1.153+01	9.538-05	4.626-03	3.153-04	2.019-05	0.000	5.057-03
1.500+06	1.514-01	9.593+00	5.144-01	2.128-01	0.000	1.047+01	6.639-05	4.207-03	2.256-04	9.331-05	0.000	4.592-03
2.000+06	8.535-02	8.194+00	3.127-01	7.078-01	0.000	9.300+00	3.743-05	3.593-03	1.371-04	3.104-04	0.000	4.078-03
2.044+06	8.173-02	8.093+00	3.017-01	7.554-01	0.000	9.232+00	3.584-05	3.549-03	1.323-04	3.312-04	0.000	4.048-03
3.000+06	3.801-02	6.452+00	1.656-01	1.761+00	2.256-03	8.419+00	1.667-05	2.829-03	7.262-05	7.722-04	9.893-07	3.692-03
4.000+06	2.139-02	5.383+00	1.095-01	2.681+00	9.201-03	8.204+00	9.380-06	2.360-03	4.802-05	1.176-03	4.035-06	3.598-03
5.000+06	1.370-02	4.650+00	8.087-02	3.473+00	1.831-02	8.236+00	6.008-06	2.039-03	3.546-05	1.523-03	8.029-06	3.612-03
6.000+06	9.513-03	4.110+00	6.376-02	4.155+00	2.809-02	8.366+00	4.172-06	1.802-03	2.796-05	1.822-03	1.232-05	3.669-03
7.000+06	6.990-03	3.695+00	5.247-02	4.761+00	3.782-02	8.553+00	3.065-06	1.620-03	2.301-05	2.088-03	1.658-05	3.751-03
8.000+06	5.352-03	3.363+00	4.449-02	5.305+00	4.725-02	8.765+00	2.347-06	1.475-03	1.951-05	2.326-03	2.072-05	3.844-03
9.000+06	4.229-03	3.091+00	3.858-02	5.799+00	5.625-02	8.989+00	1.854-06	1.355-03	1.692-05	2.543-03	2.467-05	3.942-03
1.000+07	3.425-03	2.864+00	3.403-02	6.252+00	6.480-02	9.218+00	1.502-06	1.256-03	1.492-05	2.742-03	2.842-05	4.042-03
1.100+07	2.831-03	2.672+00	3.042-02	6.670+00	7.289-02	9.448+00	1.241-06	1.172-03	1.334-05	2.925-03	3.196-05	4.143-03
1.200+07	2.379-03	2.505+00	2.750-02	7.057+00	8.050-02	9.672+00	1.043-06	1.098-03	1.206-05	3.095-03	3.530-05	4.241-03
1.300+07	2.027-03	2.360+00	2.508-02	7.419+00	8.768-02	9.894+00	8.889-07	1.035-03	1.100-05	3.253-03	3.845-05	4.339-03
1.400+07	1.748-03	2.233+00	2.304-02	7.752+00	9.450-02	1.010+01	7.665-07	9.792-04	1.010-05	3.399-03	4.144-05	4.431-03
1.500+07	1.523-03	2.120+00	2.131-02	8.060+00	1.010-01	1.030+01	6.678-07	9.296-04	9.345-06	3.534-03	4.429-05	4.518-03
1.600+07	1.338-03	2.019+00	1.982-02	8.346+00	1.071-01	1.049+01	5.867-07	8.853-04	8.691-06	3.660-03	4.696-05	4.601-03
1.800+07	1.057-03	1.845+00	1.738-02	8.866+00	1.184-01	1.085+01	4.635-07	8.090-04	7.621-06	3.888-03	5.192-05	4.757-03
2.000+07	8.564-04	1.702+00	1.548-02	9.332+00	1.287-01	1.118+01	3.755-07	7.463-04	6.788-06	4.092-03	5.644-05	4.902-03
2.200+07	7.078-04	1.581+00	1.394-02	9.754+00	1.382-01	1.149+01	3.104-07	6.933-04	6.113-06	4.277-03	6.060-05	5.038-03
2.400+07	5.948-04	1.477+00	1.269-02	1.014+01	1.468-01	1.178+01	2.608-07	6.477-04	5.565-06	4.446-03	6.437-05	5.164-03
2.600+07	5.068-04	1.387+00	1.163-02	1.049+01	1.548-01	1.204+01	2.222-07	6.082-04	5.100-06	4.600-03	6.788-05	5.281-03
2.800+07	4.370-04	1.308+00	1.074-02	1.081+01	1.622-01	1.229+01	1.916-07	5.736-04	4.710-06	4.740-03	7.113-05	5.390-03
3.000+07	3.807-04	1.239+00	9.980-03	1.110+01	1.691-01	1.252+01	1.669-07	5.433-04	4.376-06	4.867-03	7.415-05	5.489-03
4.000+07	2.141-04	9.845-01	7.359-03	1.231+01	1.976-01	1.350+01	9.388-08	4.317-04	3.227-06	5.398-03	8.665-05	5.920-03
5.000+07	1.370-04	6.218-01	5.827-03	1.320+01	2.192-01	1.425+01	6.008-08	3.604-04	2.555-06	5.788-03	9.612-05	6.247-03
6.000+07	9.516-05	7.080-01	4.822-03	1.389+01	2.363-01	1.484+01	4.173-08	3.105-04	2.114-06	6.091-03	1.036-04	6.507-03
8.000+07	5.353-05	5.584-01	3.585-03	1.491+01	2.620-01	1.573+01	2.347-08	2.449-04	1.572-06	6.538-03	1.149-04	6.900-03
1.000+08	3.426-05	4.635-01	2.853-03	1.564+01	2.807-01	1.639+01	1.502-08	2.032-04	1.251-06	6.858-03	1.231-04	7.186-03
1.500+08	1.523-05	3.301-01	1.889-03	1.680+01	3.116-01	1.744+01	6.678-09	1.448-04	8.283-07	7.367-03	1.366-04	7.649-03
2.000+08	8.564-06	2.588-01	1.412-03	1.749+01	3.311-01	1.808+01	3.755-09	1.135-04	6.192-07	7.670-03	1.452-04	7.929-03
3.000+08	3.806-06	1.834-01	9.377-04	1.830+01	3.549-01	1.884+01	1.669-09	8.042-05	4.112-07	8.025-03	1.556-04	8.261-03
4.000+08	2.141-06	1.437-01	7.021-04	1.876+01	3.693-01	1.927+01	9.388-10	6.301-05	3.079-07	8.226-03	1.619-04	8.452-03
5.000+08	1.370-06	1.189-01	5.610-04	1.907+01	3.791-01	1.957+01	6.008-10	5.214-05	2.460-07	8.362-03	1.662-04	8.581-03
6.000+08	9.516-07	1.018-01	4.672-04	1.929+01	3.864-01	1.978+01	4.173-10	4.464-05	2.049-07	8.459-03	1.694-04	8.673-03
8.000+08	5.353-07	7.952-02	3.501-04	1.958+01	3.964-01	2.006+01	2.347-10	3.487-05	1.535-07	8.586-03	1.738-04	8.795-03
1.000+09	3.426-07	6.542-02	2.799-04	1.977+01	4.031-01	2.024+01	1.502-10	2.869-05	1.227-07	8.669-03	1.768-04	8.875-03
1.500+09	1.523-07	4.569-02	1.865-04	2.004+01	4.132-01	2.050+01	6.678-11	2.004-05	8.178-08	8.788-03	1.812-04	8.989-03
2.000+09	8.564-08	3.536-02	1.398-04	2.019+01	4.190-01	2.064+01	3.755-11	1.551-05	6.130-08	8.853-03	1.837-04	9.053-03
3.000+09	3.806-08	2.459-02	9.317-05	2.035+01	4.253-01	2.080+01	1.669-11	1.078-05	4.086-08	8.924-03	1.865-04	9.121-03
4.000+09	2.141-08	1.898-02	6.987-05	2.044+01	4.290-01	2.089+01	9.388-12	8.323-06	3.064-08	8.963-03	1.881-04	9.160-03
5.000+09	1.370-08	1.552-02	5.589-05	2.049+01	4.313-01	2.094+01	6.008-12	6.806-06	2.451-08	8.985-03	1.891-04	9.181-03
6.000+09	9.516-09	1.316-02	4.657-05	2.053+01	4.330-01	2.098+01	4.173-12	5.771-06	2.042-08	9.003-03	1.899-04	9.198-03
8.000+09	5.353-09	1.014-02	3.492-05	2.058+01	4.351-01	2.103+01	2.347-12	4.446-06	1.531-08	9.025-03	1.908-04	9.220-03
1.000+10	3.426-09	8.277-03	2.794-05	2.061+01	4.365-01	2.105+01	1.502-12	3.630-06	1.225-08	9.038-03	1.914-04	9.233-03
1.500+10	1.523-09	5.720-03	1.862-05	2.066+01	4.384-01	2.110+01	6.678-13	2.508-06	8.165-09	9.060-03	1.922-04	9.254-03
2.000+10	8.564-10	4.398-03	1.397-05	2.068+01	4.395-01	2.112+01	3.755-13	1.929-06	6.126-09	9.068-03	1.927-04	9.263-03
3.000+10	3.806-10	3.033-03	9.311-06	2.070+01	4.405-01	2.114+01	1.669-13	1.330-06	4.083-09	9.077-03	1.932-04	9.272-03
4.000+10	2.141-10	2.328-03	6.983-06	2.072+01	4.412-01	2.116+01	9.388-14	1.021-06	3.062-09	9.086-03	1.935-04	9.280-03
5.000+10	1.370-10	1.896-03	5.587-06	2.073+01	4.416-01	2.117+01	6.008-14	8.314-07	2.450-09	9.090-03	1.936-04	9.285-03
6.000+10	9.516-11	1.603-03	4.656-06	2.073+01	4.418-01	2.117+01	4.173-14	7.029-07	2.042-09	9.090-03	1.937-04	9.285-03
8.000+10	5.353-11	1.229-03	3.492-06	2.074+01	4.421-01	2.118+01	2.347-14	5.389-07	1.531-09	9.095-03	1.939-04	9.289-03
1.000+11	3.426-11	9.999-04	2.793-06	2.074+01	4.423-01	2.118+01	1.502-14	4.385-07	1.225-09	9.095-03	1.940-04	9.289-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 57, LA, LANTHANUM ATOMIC WT. = 138.9055 MSQ/KG = .00043354 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	3.552-01	1.199+01	1.208+00	0.000	0.000	1.355+01	1.540-04	5.198-03	5.237-04	0.000	0.000	5.876-03
1.022+06	3.403-01	1.186+01	1.155+00	0.000	0.000	1.336+01	1.475-04	5.142-03	5.007-04	0.000	0.000	5.790-03
1.250+06	2.284-01	1.073+01	7.791-01	4.831-02	0.000	1.179+01	9.902-05	4.652-03	3.378-04	2.094-05	0.000	5.110-03
1.500+06	1.590-01	9.764+00	5.572-01	2.232-01	0.000	1.070+01	6.893-05	4.233-03	2.416-04	9.677-05	0.000	4.640-03
2.000+06	8.965-02	8.340+00	3.387-01	7.391-01	0.000	9.507+00	3.887-05	3.616-03	1.468-04	3.204-04	0.000	4.122-03
2.044+06	8.585-02	8.238+00	3.267-01	7.886-01	0.000	9.439+00	3.722-05	3.571-03	1.416-04	3.419-04	0.000	4.092-03
3.000+06	3.992-02	6.567+00	1.792-01	1.831+00	2.296-03	8.619+00	1.731-05	2.847-03	7.769-05	7.938-04	9.954-07	3.737-03
4.000+06	2.247-02	5.479+00	1.184-01	2.781+00	9.365-03	8.410+00	9.742-06	2.375-03	5.133-05	1.206-03	4.060-06	3.646-03
5.000+06	1.439-02	4.733+00	8.745-02	3.599+00	1.864-02	8.452+00	6.239-06	2.052-03	3.791-05	1.560-03	8.081-06	3.664-03
6.000+06	9.993-03	4.184+00	6.893-02	4.303+00	2.859-02	8.595+00	4.332-06	1.814-03	2.988-05	1.866-03	1.239-05	3.726-03
7.000+06	7.343-03	3.761+00	5.671-02	4.927+00	3.849-02	8.791+00	3.183-06	1.631-03	2.459-05	2.136-03	1.669-05	3.811-03
8.000+06	5.622-03	3.423+00	4.808-02	5.488+00	4.808-02	9.013+00	2.437-06	1.484-03	2.084-05	2.379-03	2.084-05	3.907-03
9.000+06	4.442-03	3.146+00	4.169-02	5.998+00	5.724-02	9.247+00	1.926-06	1.364-03	1.807-05	2.600-03	2.482-05	4.009-03
1.000+07	3.598-03	2.915+00	3.676-02	6.465+00	6.594-02	9.486+00	1.560-06	1.264-03	1.594-05	2.803-03	2.859-05	4.113-03
1.100+07	2.974-03	2.719+00	3.286-02	6.896+00	7.417-02	9.725+00	1.289-06	1.179-03	1.425-05	2.990-03	3.216-05	4.216-03
1.200+07	2.499-03	2.550+00	2.970-02	7.296+00	8.192-02	9.960+00	1.083-06	1.106-03	1.288-05	3.163-03	3.552-05	4.318-03
1.300+07	2.129-03	2.402+00	2.708-02	7.669+00	8.921-02	1.019+01	9.230-07	1.041-03	1.174-05	3.325-03	3.868-05	4.417-03
1.400+07	1.836-03	2.273+00	2.489-02	8.013+00	9.616-02	1.041+01	7.960-07	9.854-04	1.079-05	3.474-03	4.169-05	4.513-03
1.500+07	1.599-03	2.158+00	2.302-02	8.332+00	1.027-01	1.062+01	6.932-07	9.356-04	9.980-06	3.612-03	4.452-05	4.603-03
1.600+07	1.406-03	2.055+00	2.141-02	8.627+00	1.090-01	1.081+01	6.096-07	8.909-04	9.282-06	3.740-03	4.726-05	4.688-03
1.800+07	1.111-03	1.878+00	1.877-02	9.163+00	1.205-01	1.118+01	4.817-07	8.142-04	8.137-06	3.972-03	5.224-05	4.848-03
2.000+07	8.997-04	1.732+00	1.671-02	9.643+00	1.310-01	1.152+01	3.901-07	7.509-04	7.244-06	4.181-03	5.679-05	4.996-03
2.200+07	7.436-04	1.609+00	1.505-02	1.008+01	1.406-01	1.185+01	3.224-07	6.976-04	6.525-06	4.370-03	6.096-05	5.135-03
2.400+07	6.248-04	1.503+00	1.370-02	1.048+01	1.494-01	1.215+01	2.709-07	6.516-04	5.939-06	4.543-03	6.477-05	5.266-03
2.600+07	5.324-04	1.412+00	1.256-02	1.084+01	1.575-01	1.242+01	2.308-07	6.122-04	5.445-06	4.700-03	6.828-05	5.386-03
2.800+07	4.590-04	1.332+00	1.160-02	1.117+01	1.650-01	1.268+01	1.990-07	5.775-04	5.029-06	4.843-03	7.153-05	5.497-03
3.000+07	3.999-04	1.261+00	1.077-02	1.147+01	1.720-01	1.291+01	1.734-07	5.467-04	4.669-06	4.973-03	7.457-05	5.599-03
4.000+07	2.249-04	1.002+00	7.943-03	1.271+01	2.010-01	1.392+01	9.750-08	4.344-04	3.444-06	5.510-03	8.714-05	6.035-03
5.000+07	1.439-04	8.364-01	6.289-03	1.363+01	2.229-01	1.470+01	6.239-08	3.626-04	2.727-06	5.909-03	9.664-05	6.371-03
6.000+07	9.997-05	7.207-01	5.204-03	1.435+01	2.403-01	1.532+01	4.334-08	3.124-04	2.256-06	6.221-03	1.042-04	6.640-03
8.000+07	5.623-05	5.684-01	3.869-03	1.541+01	2.664-01	1.625+01	2.438-08	2.464-04	1.677-06	6.681-03	1.155-04	7.044-03
1.000+08	3.599-05	4.718-01	3.079-03	1.616+01	2.854-01	1.692+01	1.560-08	2.045-04	1.335-06	7.006-03	1.237-04	7.336-03
1.500+08	1.599-05	3.360-01	2.038-03	1.735+01	3.169-01	1.800+01	6.932-09	1.457-04	8.835-07	7.522-03	1.374-04	7.806-03
2.000+08	8.997-06	2.634-01	1.523-03	1.807+01	3.367-01	1.867+01	3.901-09	1.142-04	6.603-07	7.834-03	1.460-04	8.095-03
3.000+08	3.999-06	1.867-01	1.012-03	1.890+01	3.609-01	1.945+01	1.734-09	8.094-05	4.387-07	8.194-03	1.565-04	8.432-03
4.000+08	2.249-06	1.462-01	7.575-04	1.938+01	3.755-01	1.990+01	9.750-10	6.338-05	3.284-07	8.402-03	1.628-04	8.628-03
5.000+08	1.439-06	1.210-01	6.054-04	1.970+01	3.856-01	2.021+01	6.239-10	5.246-05	2.625-07	8.541-03	1.672-04	8.761-03
6.000+08	9.996-07	1.036-01	5.041-04	1.992+01	3.930-01	2.042+01	4.334-10	4.491-05	2.185-07	8.636-03	1.704-04	8.852-03
8.000+08	5.623-07	8.094-02	3.777-04	2.022+01	4.032-01	2.070+01	2.438-10	3.509-05	1.637-07	8.766-03	1.748-04	8.976-03
1.000+09	3.599-07	6.659-02	3.020-04	2.042+01	4.100-01	2.090+01	1.560-10	2.887-05	1.309-07	8.853-03	1.777-04	9.060-03
1.500+09	1.599-07	4.650-02	2.012-04	2.070+01	4.203-01	2.117+01	6.932-11	2.016-05	8.723-08	8.974-03	1.822-04	9.177-03
2.000+09	8.997-08	3.599-02	1.509-04	2.085+01	4.261-01	2.131+01	3.901-11	1.560-05	6.542-08	9.039-03	1.847-04	9.240-03
3.000+09	3.999-08	2.503-02	1.005-04	2.102+01	4.326-01	2.148+01	1.734-11	1.085-05	4.357-08	9.113-03	1.875-04	9.311-03
4.000+09	2.249-08	1.932-02	7.538-05	2.111+01	4.364-01	2.157+01	9.750-12	8.376-06	3.268-08	9.152-03	1.892-04	9.350-03
5.000+09	1.439-08	1.579-02	6.030-05	2.117+01	4.387-01	2.162+01	6.239-12	6.846-06	2.614-08	9.178-03	1.902-04	9.375-03
6.000+09	9.996-09	1.339-02	5.025-05	2.121+01	4.404-01	2.166+01	4.334-12	5.805-06	2.179-08	9.195-03	1.909-04	9.392-03
8.000+09	5.623-09	1.032-02	3.768-05	2.126+01	4.426-01	2.171+01	2.438-12	4.474-06	1.634-08	9.217-03	1.919-04	9.413-03
1.000+10	3.599-09	8.425-03	3.014-05	2.129+01	4.440-01	2.174+01	1.560-12	3.653-06	1.307-08	9.230-03	1.925-04	9.426-03
1.500+10	1.599-09	5.822-03	2.009-05	2.134+01	4.458-01	2.179+01	6.932-13	2.524-06	8.710-09	9.252-03	1.933-04	9.447-03
2.000+10	8.997-10	4.476-03	1.507-05	2.136+01	4.470-01	2.181+01	3.901-13	1.941-06	6.533-09	9.260-03	1.938-04	9.456-03
3.000+10	3.999-10	3.087-03	1.005-05	2.139+01	4.480-01	2.184+01	1.734-13	1.338-06	4.357-09	9.273-03	1.942-04	9.469-03
4.000+10	2.249-10	2.370-03	7.535-06	2.140+01	4.487-01	2.185+01	9.750-14	1.027-06	3.267-09	9.278-03	1.945-04	9.473-03
5.000+10	1.439-10	1.930-03	6.028-06	2.141+01	4.491-01	2.186+01	6.239-14	8.367-07	2.613-09	9.282-03	1.947-04	9.478-03
6.000+10	9.996-11	1.631-03	5.023-06	2.141+01	4.494-01	2.186+01	4.334-14	7.071-07	2.178-09	9.282-03	1.948-04	9.478-03
8.000+10	5.623-11	1.251-03	3.767-06	2.142+01	4.497-01	2.187+01	2.438-14	5.424-07	1.633-09	9.286-03	1.950-04	9.482-03
1.000+11	3.599-11	1.018-03	3.014-06	2.142+01	4.499-01	2.187+01	1.560-14	4.413-07	1.307-09	9.286-03	1.950-04	9.482-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 58, CE, CERIUM ATOMIC WT. = 140.12 MSQ/KG = .00042978 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	3.730-01	1.219+01	1.306+00	0.000	0.000	1.387+01	1.603-04	5.239-03	5.613-04	0.000	0.000	5.961-03
1.022+06	3.573-01	1.207+01	1.250+00	0.000	0.000	1.368+01	1.536-04	5.187-03	5.372-04	0.000	0.000	5.878-03
1.250+06	2.398-01	1.092+01	8.427-01	5.064-02	0.000	1.205+01	1.031-04	4.693-03	3.622-04	2.176-05	0.000	5.180-03
1.500+06	1.670-01	9.936+00	6.026-01	2.340-01	0.000	1.094+01	7.177-05	4.269-03	2.590-04	1.006-04	0.000	4.701-03
2.000+06	9.416-02	8.486+00	3.662-01	7.714-01	0.000	9.718+00	4.047-05	3.647-03	1.574-04	3.315-04	0.000	4.170-03
2.044+06	9.017-02	8.382+00	3.532-01	8.227-01	0.000	9.648+00	3.875-05	3.602-03	1.518-04	3.536-04	0.000	4.147-03
3.000+06	4.194-02	6.682+00	1.936-01	1.902+00	2.336-03	8.822+00	1.802-05	2.872-03	8.320-05	8.174-04	1.004-06	3.791-03
4.000+06	2.361-02	5.576+00	1.279-01	2.883+00	9.528-03	8.620+00	1.015-05	2.396-03	5.497-05	1.239-03	4.095-06	3.705-03
5.000+06	1.511-02	4.816+00	9.442-02	3.726+00	1.896-02	8.670+00	6.494-06	2.070-03	4.058-05	1.601-03	8.169-06	3.726-03
6.000+06	1.050-02	4.257+00	7.440-02	4.452+00	2.909-02	8.823+00	4.513-06	1.830-03	3.198-05	1.913-03	1.250-05	3.792-03
7.000+06	7.713-03	3.827+00	6.128-02	5.096+00	3.916-02	9.031+00	3.315-06	1.645-03	2.630-05	2.190-03	1.683-05	3.881-03
8.000+06	5.906-03	3.483+00	5.188-02	5.674+00	4.891-02	9.264+00	2.538-06	1.497-03	2.230-05	2.439-03	2.102-05	3.981-03
9.000+06	4.666-03	3.202+00	4.492-02	6.199+00	5.823-02	9.509+00	2.005-06	1.376-03	1.933-05	2.664-03	2.503-05	4.087-03
1.000+07	3.780-03	2.967+00	3.966-02	6.681+00	6.708-02	9.759+00	1.625-06	1.275-03	1.704-05	2.871-03	2.883-05	4.194-03
1.100+07	3.124-03	2.767+00	3.545-02	7.125+00	7.545-02	1.001+01	1.343-06	1.189-03	1.524-05	3.062-03	3.263-05	4.300-03
1.200+07	2.625-03	2.595+00	3.203-02	7.537+00	8.333-02	1.025+01	1.128-06	1.115-03	1.377-05	3.239-03	3.581-05	4.405-03
1.300+07	2.237-03	2.445+00	2.921-02	7.921+00	9.075-02	1.049+01	9.614-07	1.051-03	1.255-05	3.404-03	3.900-05	4.508-03
1.400+07	1.929-03	2.313+00	2.684-02	8.276+00	9.781-02	1.072+01	8.290-07	9.941-04	1.154-05	3.557-03	4.204-05	4.605-03
1.500+07	1.680-03	2.196+00	2.482-02	8.606+00	1.045-01	1.093+01	7.220-07	9.438-04	1.067-05	3.699-03	4.491-05	4.699-03
1.600+07	1.477-03	2.091+00	2.308-02	8.911+00	1.108-01	1.114+01	6.348-07	8.987-04	9.919-06	3.830-03	4.762-05	4.787-03
1.800+07	1.167-03	1.911+00	2.024-02	9.464+00	1.226-01	1.152+01	5.016-07	8.213-04	8.699-06	4.067-03	5.269-05	4.951-03
2.000+07	9.451-04	1.762+00	1.801-02	9.900+00	1.332-01	1.187+01	4.062-07	7.573-04	7.740-06	4.281-03	5.725-05	5.103-03
2.200+07	7.811-04	1.637+00	1.623-02	1.041+01	1.430-01	1.221+01	3.357-07	7.035-04	6.975-06	4.474-03	6.146-05	5.246-03
2.400+07	6.563-04	1.530+00	1.476-02	1.082+01	1.519-01	1.252+01	2.821-07	6.576-04	6.344-06	4.650-03	6.528-05	5.380-03
2.600+07	5.592-04	1.436+00	1.354-02	1.119+01	1.602-01	1.280+01	2.403-07	6.172-04	5.819-06	4.809-03	6.885-05	5.501-03
2.800+07	4.822-04	1.355+00	1.250-02	1.153+01	1.678-01	1.307+01	2.072-07	5.823-04	5.372-06	4.955-03	7.212-05	5.615-03
3.000+07	4.200-04	1.283+00	1.161-02	1.185+01	1.749-01	1.332+01	1.805-07	5.514-04	4.990-06	5.093-03	7.517-05	5.725-03
4.000+07	2.363-04	1.020+00	8.561-03	1.313+01	2.044-01	1.436+01	1.016-07	4.384-04	3.679-06	5.643-03	8.785-05	6.173-03
5.000+07	1.512-04	8.511-01	6.777-03	1.408+01	2.266-01	1.516+01	6.498-08	3.658-04	2.913-06	6.051-03	9.739-05	6.517-03
6.000+07	1.050-04	7.333-01	5.608-03	1.482+01	2.443-01	1.580+01	4.513-08	3.152-04	2.410-06	6.369-03	1.050-04	6.792-03
8.000+07	5.907-05	5.784-01	4.169-03	1.591+01	2.708-01	1.676+01	2.539-08	2.486-04	1.792-06	6.838-03	1.164-04	7.205-03
1.000+08	3.780-05	4.800-01	3.318-03	1.668+01	2.901-01	1.745+01	1.625-08	2.063-04	1.426-06	7.169-03	1.247-04	7.501-03
1.500+08	1.680-05	3.418-01	2.196-03	1.792+01	3.220-01	1.859+01	7.220-09	1.469-04	9.438-07	7.702-03	1.384-04	7.988-03
2.000+08	9.451-06	2.680-01	1.641-03	1.865+01	3.420-01	1.926+01	4.062-09	1.152-04	7.053-07	8.015-03	1.470-04	8.278-03
3.000+08	4.200-06	1.900-01	1.090-03	1.951+01	3.666-01	2.007+01	1.805-09	8.166-05	4.685-07	8.385-03	1.576-04	8.625-03
4.000+08	2.363-06	1.488-01	8.161-04	2.001+01	3.814-01	2.056+01	1.016-09	6.395-05	3.507-07	8.600-03	1.639-04	8.828-03
5.000+08	1.512-06	1.232-01	6.522-04	2.033+01	3.915-01	2.085+01	6.498-10	5.295-05	2.803-07	8.737-03	1.683-04	8.959-03
6.000+08	1.050-06	1.055-01	5.431-04	2.057+01	3.989-01	2.107+01	4.513-10	4.534-05	2.334-07	8.841-03	1.714-04	9.058-03
8.000+08	5.907-07	8.236-02	4.070-04	2.088+01	4.093-01	2.137+01	2.539-10	3.540-05	1.749-07	8.974-03	1.759-04	9.185-03
1.000+09	3.780-07	6.776-02	3.254-04	2.108+01	4.162-01	2.156+01	1.625-10	2.912-05	1.398-07	9.060-03	1.789-04	9.268-03
1.500+09	1.680-07	4.732-02	2.168-04	2.137+01	4.265-01	2.184+01	7.220-11	2.034-05	9.318-08	9.184-03	1.833-04	9.388-03
2.000+09	9.451-08	3.662-02	1.625-04	2.153+01	4.324-01	2.200+01	4.062-11	1.574-05	6.984-08	9.253-03	1.858-04	9.455-03
3.000+09	4.200-08	2.546-02	1.083-04	2.170+01	4.389-01	2.216+01	1.805-11	1.094-05	4.654-08	9.326-03	1.886-04	9.526-03
4.000+09	2.363-08	1.900-02	8.121-05	2.179+01	4.427-01	2.225+01	1.016-11	8.449-06	3.490-08	9.365-03	1.903-04	9.564-03
5.000+09	1.512-08	1.607-02	6.496-05	2.185+01	4.450-01	2.231+01	6.498-12	6.907-06	2.792-08	9.391-03	1.913-04	9.589-03
6.000+09	1.050-08	1.363-02	5.413-05	2.189+01	4.467-01	2.235+01	4.513-12	5.858-06	2.326-08	9.408-03	1.920-04	9.606-03
8.000+09	5.907-09	1.050-02	4.060-05	2.194+01	4.489-01	2.240+01	2.539-12	4.513-06	1.745-08	9.429-03	1.929-04	9.627-03
1.000+10	3.780-09	8.573-03	3.247-05	2.198+01	4.503-01	2.244+01	1.625-12	3.684-06	1.395-08	9.447-03	1.935-04	9.644-03
1.500+10	1.680-09	5.925-03	2.165-05	2.202+01	4.522-01	2.248+01	7.220-13	2.546-06	9.305-09	9.464-03	1.943-04	9.661-03
2.000+10	9.451-10	4.555-03	1.624-05	2.205+01	4.533-01	2.251+01	4.062-13	1.958-06	6.980-09	9.477-03	1.948-04	9.673-03
3.000+10	4.200-10	3.141-03	1.082-05	2.207+01	4.544-01	2.253+01	1.805-13	1.350-06	4.650-09	9.485-03	1.953-04	9.682-03
4.000+10	2.363-10	2.412-03	8.117-06	2.209+01	4.551-01	2.255+01	1.016-13	1.037-06	3.489-09	9.494-03	1.956-04	9.690-03
5.000+10	1.512-10	1.966-03	6.494-06	2.210+01	4.555-01	2.256+01	6.498-14	8.441-07	2.791-09	9.498-03	1.958-04	9.695-03
6.000+10	1.050-10	1.660-03	5.411-06	2.210+01	4.557-01	2.256+01	4.513-14	7.134-07	2.326-09	9.498-03	1.958-04	9.695-03
8.000+10	5.907-11	1.273-03	4.059-06	2.211+01	4.560-01	2.257+01	2.539-14	5.471-07	1.744-09	9.502-03	1.960-04	9.699-03
1.000+11	3.780-11	1.036-03	3.247-06	2.211+01	4.563-01	2.257+01	1.625-14	4.452-07	1.395-09	9.502-03	1.961-04	9.699-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 59, PR, PRASEODYMIUM ATOMIC WT. = 140.9077 MSQ/KG = .00042738 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	3.917-01	1.240+01	1.411+00	0.000	0.000	1.420+01	1.674-04	5.299-03	6.030-04	0.000	0.000	6.070-03
1.022+06	3.752-01	1.227+01	1.350+00	0.000	0.000	1.400+01	1.604-04	5.244-03	5.770-04	0.000	0.000	5.981-03
1.250+06	2.519-01	1.111+01	9.103-01	5.305-02	0.000	1.233+01	1.077-04	4.748-03	3.890-04	2.267-05	0.000	5.268-03
1.500+06	1.753-01	1.011+01	6.508-01	2.451-01	0.000	1.118+01	7.492-05	4.321-03	2.781-04	1.047-04	0.000	4.779-03
2.000+06	9.890-02	8.632+00	3.954-01	8.046-01	0.000	9.931+00	4.227-05	3.689-03	1.690-04	3.439-04	0.000	4.244-03
2.044+06	9.471-02	8.526+00	3.814-01	8.579-01	0.000	9.860+00	4.048-05	3.644-03	1.630-04	3.666-04	0.000	4.214-03
3.000+06	4.405-02	6.797+00	2.089-01	1.974+00	2.377-03	9.026+00	1.883-05	2.905-03	8.928-05	8.436-04	1.016-06	3.858-03
4.000+06	2.480-02	5.672+00	1.380-01	2.987+00	9.691-03	8.831+00	1.060-05	2.424-03	5.898-05	1.277-03	4.142-06	3.774-03
5.000+06	1.588-02	4.899+00	1.018-01	3.856+00	1.929-02	8.892+00	6.787-06	2.094-03	4.351-05	1.648-03	8.244-06	3.800-03
6.000+06	1.103-02	4.330+00	8.021-02	4.604+00	2.958-02	9.055+00	4.714-06	1.851-03	3.428-05	1.968-03	1.264-05	3.870-03
7.000+06	8.102-03	3.892+00	6.596-02	5.267+00	3.983-02	9.273+00	3.463-06	1.663-03	2.819-05	2.251-03	1.702-05	3.963-03
8.000+06	6.204-03	3.543+00	5.591-02	5.862+00	4.975-02	9.517+00	2.651-06	1.514-03	2.389-05	2.505-03	2.126-05	4.067-03
9.000+06	4.902-03	3.257+00	4.846-02	6.403+00	5.922-02	9.773+00	2.095-06	1.392-03	2.071-05	2.736-03	2.531-05	4.177-03
1.000+07	3.971-03	3.018+00	4.272-02	6.909+00	6.822-02	1.003+01	1.697-06	1.290-03	1.826-05	2.949-03	2.910-05	4.288-03
1.100+07	3.282-03	2.815+00	3.818-02	7.358+00	7.673-02	1.029+01	1.403-06	1.203-03	1.632-05	3.145-03	3.279-05	4.398-03
1.200+07	2.758-03	2.640+00	3.450-02	7.782+00	8.474-02	1.054+01	1.179-06	1.128-03	1.474-05	3.326-03	3.622-05	4.506-03
1.300+07	2.350-03	2.487+00	3.146-02	8.178+00	9.228-02	1.079+01	1.004-06	1.063-03	1.345-05	3.495-03	3.944-05	4.612-03
1.400+07	2.026-03	2.353+00	2.890-02	8.544+00	9.946-02	1.103+01	8.659-07	1.006-03	1.235-05	3.651-03	4.251-05	4.713-03
1.500+07	1.765-03	2.234+00	2.673-02	8.884+00	1.062-01	1.125+01	7.543-07	9.548-04	1.142-05	3.797-03	4.539-05	4.809-03
1.600+07	1.551-03	2.127+00	2.485-02	9.199+00	1.127-01	1.147+01	6.629-07	9.098-04	1.062-05	3.931-03	4.817-05	4.900-03
1.800+07	1.226-03	1.944+00	2.179-02	9.770+00	1.246-01	1.186+01	5.240-07	8.308-04	9.313-06	4.175-03	5.325-05	5.069-03
2.000+07	9.928-04	1.793+00	1.940-02	1.028+01	1.355-01	1.223+01	4.243-07	7.663-04	8.291-06	4.393-03	5.791-05	5.226-03
2.200+07	8.205-04	1.665+00	1.747-02	1.075+01	1.454-01	1.258+01	3.507-07	7.116-04	7.466-06	4.594-03	6.214-05	5.376-03
2.400+07	6.895-04	1.556+00	1.589-02	1.117+01	1.545-01	1.290+01	2.947-07	6.650-04	6.791-06	4.774-03	6.603-05	5.512-03
2.600+07	5.875-04	1.461+00	1.458-02	1.155+01	1.629-01	1.319+01	2.511-07	6.244-04	6.231-06	4.936-03	6.962-05	5.637-03
2.800+07	5.065-04	1.378+00	1.346-02	1.190+01	1.706-01	1.346+01	2.165-07	5.889-04	5.752-06	5.086-03	7.291-05	5.754-03
3.000+07	4.413-04	1.305+00	1.250-02	1.223+01	1.779-01	1.373+01	1.886-07	5.577-04	5.342-06	5.227-03	7.603-05	5.866-03
4.000+07	2.482-04	1.037+00	9.214-03	1.355+01	2.077-01	1.480+01	1.061-07	4.432-04	3.938-06	5.791-03	8.877-05	6.327-03
5.000+07	1.588-04	8.658-01	7.294-03	1.453+01	2.303-01	1.563+01	6.787-08	3.700-04	3.117-06	6.210-03	9.842-05	6.681-03
6.000+07	1.103-04	7.460-01	6.036-03	1.529+01	2.482-01	1.629+01	4.714-08	3.188-04	2.580-06	6.535-03	1.061-04	6.962-03
8.000+07	6.205-05	5.883-01	4.487-03	1.642+01	2.751-01	1.729+01	2.652-08	2.514-04	1.918-06	7.018-03	1.176-04	7.388-03
1.000+08	3.971-05	4.883-01	3.570-03	1.721+01	2.946-01	1.800+01	1.697-08	2.087-04	1.526-06	7.355-03	1.259-04	7.691-03
1.500+08	1.765-05	3.477-01	2.363-03	1.848+01	3.269-01	1.916+01	7.543-09	1.486-04	1.010-06	7.898-03	1.397-04	8.187-03
2.000+08	9.928-06	2.727-01	1.766-03	1.924+01	3.471-01	1.986+01	4.243-09	1.165-04	7.547-07	8.223-03	1.483-04	8.488-03
3.000+08	4.413-06	1.932-01	1.173-03	2.013+01	3.719-01	2.070+01	1.886-09	8.257-05	5.013-07	8.603-03	1.589-04	8.845-03
4.000+08	2.482-06	1.513-01	8.781-04	2.064+01	3.868-01	2.118+01	1.061-09	6.466-05	3.753-07	8.821-03	1.653-04	9.051-03
5.000+08	1.589-06	1.253-01	7.017-04	2.097+01	3.970-01	2.149+01	6.791-10	5.355-05	2.999-07	8.962-03	1.697-04	9.186-03
6.000+08	1.103-06	1.073-01	5.844-04	2.121+01	4.045-01	2.172+01	4.714-10	4.586-05	2.498-07	9.065-03	1.729-04	9.284-03
8.000+08	6.205-07	8.378-02	4.379-04	2.153+01	4.148-01	2.203+01	2.652-10	3.581-05	1.871-07	9.201-03	1.773-04	9.415-03
1.000+09	3.971-07	6.893-02	3.501-04	2.174+01	4.217-01	2.223+01	1.697-10	2.946-05	1.496-07	9.291-03	1.802-04	9.501-03
1.500+09	1.765-07	4.814-02	2.332-04	2.204+01	4.321-01	2.252+01	7.543-11	2.057-05	9.966-08	9.419-03	1.847-04	9.625-03
2.000+09	9.928-08	3.726-02	1.749-04	2.220+01	4.380-01	2.268+01	4.243-11	1.592-05	7.475-08	9.488-03	1.872-04	9.691-03
3.000+09	4.413-08	2.593-02	1.165-04	2.238+01	4.445-01	2.285+01	1.886-11	1.107-05	4.979-08	9.565-03	1.900-04	9.766-03
4.000+09	2.482-08	2.000-02	8.736-05	2.248+01	4.483-01	2.295+01	1.061-11	8.548-06	3.734-08	9.607-03	1.916-04	9.808-03
5.000+09	1.589-08	1.635-02	6.990-05	2.254+01	4.506-01	2.301+01	6.791-12	6.988-06	2.987-08	9.633-03	1.926-04	9.833-03
6.000+09	1.103-08	1.386-02	5.824-05	2.258+01	4.523-01	2.305+01	4.714-12	5.923-06	2.489-08	9.650-03	1.933-04	9.849-03
8.000+09	6.205-09	1.068-02	4.368-05	2.263+01	4.545-01	2.310+01	2.652-12	4.564-06	1.867-08	9.671-03	1.942-04	9.870-03
1.000+10	3.971-09	8.720-03	3.494-05	2.267+01	4.559-01	2.313+01	1.697-12	3.727-06	1.493-08	9.689-03	1.948-04	9.887-03
1.500+10	1.765-09	6.027-03	2.329-05	2.271+01	4.578-01	2.317+01	7.543-13	2.576-06	9.954-09	9.706-03	1.957-04	9.904-03
2.000+10	9.928-10	4.633-03	1.747-05	2.274+01	4.589-01	2.320+01	4.243-13	1.980-06	7.466-09	9.719-03	1.961-04	9.917-03
3.000+10	4.413-10	3.195-03	1.165-05	2.277+01	4.600-01	2.323+01	1.886-13	1.365-06	4.979-09	9.731-03	1.966-04	9.929-03
4.000+10	2.482-10	2.453-03	8.736-06	2.278+01	4.607-01	2.324+01	1.061-13	1.048-06	3.733-09	9.736-03	1.969-04	9.934-03
5.000+10	1.589-10	1.998-03	6.987-06	2.279+01	4.611-01	2.325+01	6.791-14	8.539-07	2.986-09	9.740-03	1.971-04	9.938-03
6.000+10	1.103-10	1.689-03	5.822-06	2.280+01	4.613-01	2.326+01	4.714-14	7.318-07	2.489-09	9.744-03	1.971-04	9.943-03
8.000+10	6.205-11	1.295-03	4.367-06	2.280+01	4.616-01	2.326+01	2.652-14	5.535-07	1.866-09	9.744-03	1.973-04	9.942-03
1.000+11	3.971-11	1.053-03	3.493-06	2.281+01	4.616-01	2.327+01	1.697-14	4.500-07	1.493-09	9.748-03	1.974-04	9.946-03

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 60, ND, NEODYMIUM ATOMIC WT. = 144.24 MSQ/KG = .00041750 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	4.107-01	1.261+01	1.522+00	0.000	0.000	1.454+01	1.715-04	5.265-03	6.354-04	0.000	0.000	6.072-03
1.022+06	3.934-01	1.248+01	1.457+00	0.000	0.000	1.433+01	1.642-04	5.210-03	6.083-04	0.000	0.000	5.983-03
1.250+06	2.641-01	1.130+01	9.821-01	5.553-02	0.000	1.260+01	1.102-04	4.718-03	4.100-04	2.318-05	0.000	5.261-03
1.500+06	1.839-01	1.028+01	7.020-01	2.566-01	0.000	1.142+01	7.678-05	4.292-03	2.931-04	1.071-04	0.000	4.769-03
2.000+06	1.037-01	8.778+00	4.263-01	8.388-01	0.000	1.015+01	4.329-05	3.665-03	1.780-04	3.502-04	0.000	4.236-03
2.044+06	9.935-02	8.670+00	4.112-01	8.941-01	0.000	1.007+01	4.149-05	3.620-03	1.717-04	3.733-04	0.000	4.206-03
3.000+06	4.621-02	6.912+00	2.252-01	2.049+00	2.417-03	9.235+00	1.929-05	2.886-03	9.402-05	8.555-04	1.009-06	3.856-03
4.000+06	2.602-02	5.768+00	1.486-01	3.092+00	9.855-03	9.044+00	1.086-05	2.408-03	6.204-05	1.291-03	4.114-06	3.776-03
5.000+06	1.666-02	4.982+00	1.096-01	3.988+00	1.961-02	9.116+00	6.956-06	2.080-03	4.576-05	1.665-03	8.187-06	3.806-03
6.000+06	1.157-02	4.404+00	8.635-02	4.758+00	3.008-02	9.290+00	4.836-06	1.839-03	3.605-05	1.986-03	1.256-05	3.879-03
7.000+06	8.501-03	3.958+00	7.100-02	5.441+00	4.050-02	9.519+00	3.549-06	1.652-03	2.964-05	2.272-03	1.691-05	3.974-03
8.000+06	6.509-03	3.603+00	6.017-02	6.054+00	5.058-02	9.774+00	2.718-06	1.504-03	2.512-05	2.528-03	2.112-05	4.081-03
9.000+06	5.143-03	3.312+00	5.214-02	6.610+00	6.021-02	1.004+01	2.147-06	1.383-03	2.177-05	2.760-03	2.514-05	4.192-03
1.000+07	4.166-03	3.069+00	4.597-02	7.121+00	6.936-02	1.031+01	1.739-06	1.281-03	1.919-05	2.973-03	2.896-05	4.304-03
1.100+07	3.443-03	2.862+00	4.108-02	7.593+00	7.800-02	1.058+01	1.437-06	1.195-03	1.715-05	3.170-03	3.257-05	4.416-03
1.200+07	2.893-03	2.684+00	3.712-02	8.029+00	8.615-02	1.084+01	1.208-06	1.121-03	1.550-05	3.352-03	3.597-05	4.525-03
1.300+07	2.465-03	2.529+00	3.384-02	8.437+00	9.382-02	1.110+01	1.029-06	1.056-03	1.413-05	3.522-03	3.917-05	4.633-03
1.400+07	2.126-03	2.392+00	3.109-02	8.814+00	1.011-01	1.134+01	8.876-07	9.987-04	1.298-05	3.680-03	4.221-05	4.735-03
1.500+07	1.852-03	2.271+00	2.875-02	9.165+00	1.080-01	1.157+01	7.732-07	9.481-04	1.200-05	3.826-03	4.509-05	4.832-03
1.600+07	1.628-03	2.163+00	2.673-02	9.490+00	1.146-01	1.180+01	6.797-07	9.031-04	1.116-05	3.962-03	4.785-05	4.925-03
1.800+07	1.286-03	1.977+00	2.344-02	1.008+01	1.267-01	1.221+01	5.369-07	8.254-04	9.786-06	4.208-03	5.290-05	5.097-03
2.000+07	1.042-03	1.823+00	2.086-02	1.061+01	1.377-01	1.259+01	4.350-07	7.611-04	8.709-06	4.430-03	5.749-05	5.257-03
2.200+07	8.608-04	1.693+00	1.879-02	1.108+01	1.478-01	1.294+01	3.594-07	7.068-04	7.845-06	4.626-03	6.171-05	5.403-03
2.400+07	7.233-04	1.582+00	1.709-02	1.152+01	1.570-01	1.328+01	3.020-07	6.605-04	7.135-06	4.810-03	6.555-05	5.543-03
2.600+07	6.164-04	1.486+00	1.567-02	1.191+01	1.655-01	1.358+01	2.573-07	6.204-04	6.542-06	4.972-03	6.910-05	5.669-03
2.800+07	5.315-04	1.402+00	1.447-02	1.228+01	1.734-01	1.387+01	2.219-07	5.853-04	6.041-06	5.127-03	7.239-05	5.791-03
3.000+07	4.630-04	1.327+00	1.344-02	1.261+01	1.808-01	1.413+01	1.932-07	5.540-04	5.611-06	5.265-03	7.548-05	5.900-03
4.000+07	2.604-04	1.055+00	9.905-03	1.397+01	2.111-01	1.525+01	1.081-07	4.405-04	4.135-06	5.832-03	8.813-05	6.365-03
5.000+07	1.667-04	8.805-01	7.841-03	1.498+01	2.340-01	1.610+01	6.960-08	3.676-04	3.274-06	6.254-03	9.770-05	6.723-03
6.000+07	1.157-04	7.586-01	6.487-03	1.577+01	2.522-01	1.679+01	4.830-08	3.167-04	2.708-06	6.584-03	1.053-04	7.009-03
8.000+07	6.510-05	5.983-01	4.822-03	1.693+01	2.794-01	1.781+01	2.718-08	2.498-04	2.013-06	7.068-03	1.166-04	7.437-03
1.000+08	4.167-05	4.966-01	3.837-03	1.775+01	2.992-01	1.855+01	1.740-08	2.073-04	1.602-06	7.411-03	1.249-04	7.745-03
1.500+08	1.852-05	3.536-01	2.540-03	1.906+01	3.319-01	1.975+01	7.732-09	1.476-04	1.060-06	7.958-03	1.386-04	8.245-03
2.000+08	1.042-05	2.773-01	1.898-03	1.984+01	3.524-01	2.047+01	4.356-09	1.158-04	7.924-07	8.283-03	1.471-04	8.547-03
3.000+08	4.630-06	1.965-01	1.261-03	2.075+01	3.774-01	2.133+01	1.933-09	8.204-05	5.265-07	8.663-03	1.576-04	8.903-03
4.000+08	2.604-06	1.539-01	9.437-04	2.128+01	3.925-01	2.183+01	1.087-09	6.425-05	3.940-07	8.884-03	1.639-04	9.113-03
5.000+08	1.667-06	1.274-01	7.541-04	2.162+01	4.028-01	2.215+01	6.960-10	5.319-05	3.148-07	9.026-03	1.682-04	9.248-03
6.000+08	1.157-06	1.091-01	6.279-04	2.187+01	4.103-01	2.239+01	4.830-10	4.555-05	2.621-07	9.131-03	1.713-04	9.348-03
8.000+08	6.510-07	8.520-02	4.705-04	2.220+01	4.208-01	2.271+01	2.718-10	3.557-05	1.964-07	9.269-03	1.757-04	9.480-03
1.000+09	4.167-07	7.009-02	3.762-04	2.241+01	4.277-01	2.291+01	1.740-10	2.926-05	1.571-07	9.356-03	1.786-04	9.564-03
1.500+09	1.852-07	4.895-02	2.506-04	2.272+01	4.381-01	2.321+01	7.732-11	2.044-05	1.046-07	9.486-03	1.829-04	9.689-03
2.000+09	1.042-07	3.789-02	1.879-04	2.289+01	4.441-01	2.337+01	4.358-11	1.582-05	7.845-08	9.557-03	1.854-04	9.758-03
3.000+09	4.630-08	2.634-02	1.252-04	2.307+01	4.506-01	2.355+01	1.933-11	1.100-05	5.227-08	9.632-03	1.881-04	9.831-03
4.000+09	2.604-08	2.033-02	9.390-05	2.317+01	4.545-01	2.364+01	1.087-11	8.488-06	3.920-08	9.674-03	1.898-04	9.872-03
5.000+09	1.667-08	1.663-02	7.511-05	2.323+01	4.568-01	2.370+01	6.960-12	6.943-06	3.136-08	9.699-03	1.907-04	9.896-03
6.000+09	1.157-08	1.410-02	6.259-05	2.327+01	4.585-01	2.374+01	4.830-12	5.887-06	2.613-08	9.715-03	1.914-04	9.913-03
8.000+09	6.510-09	1.086-02	4.694-05	2.333+01	4.607-01	2.380+01	2.718-12	4.534-06	1.960-08	9.740-03	1.923-04	9.937-03
1.000+10	4.167-09	8.868-03	3.755-05	2.336+01	4.621-01	2.383+01	1.740-12	3.702-06	1.568-08	9.753-03	1.929-04	9.949-03
1.500+10	1.852-09	6.129-03	2.503-05	2.341+01	4.640-01	2.388+01	7.732-13	2.559-06	1.045-08	9.774-03	1.937-04	9.970-03
2.000+10	1.042-09	4.712-03	1.877-05	2.344+01	4.652-01	2.391+01	4.358-13	1.967-06	7.837-09	9.786-03	1.942-04	9.982-03
3.000+10	4.630-10	3.249-03	1.251-05	2.347+01	4.662-01	2.394+01	1.933-13	1.356-06	5.223-09	9.799-03	1.946-04	9.995-03
4.000+10	2.604-10	2.495-03	9.385-06	2.348+01	4.669-01	2.395+01	1.087-13	1.042-06	3.918-09	9.803-03	1.949-04	9.999-03
5.000+10	1.667-10	2.032-03	7.508-06	2.349+01	4.673-01	2.396+01	6.969-14	8.484-07	3.135-09	9.807-03	1.951-04	1.000-02
6.000+10	1.157-10	1.717-03	6.257-06	2.350+01	4.676-01	2.397+01	4.830-14	7.169-07	2.612-09	9.811-03	1.952-04	1.001-02
8.000+10	6.510-11	1.317-03	4.692-06	2.351+01	4.679-01	2.398+01	2.718-14	5.498-07	1.959-09	9.815-03	1.953-04	1.001-02
1.000+11	4.167-11	1.071-03	3.754-06	2.351+01	4.681-01	2.398+01	1.740-14	4.471-07	1.567-09	9.815-03	1.954-04	1.001-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 61, PM, PROMETHIUM ATOMIC WT. = 144.913 MSO/KG = .00041556 BARNS/ATOM MULTIPLY MSO/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSO/KG	MSO/KG	MSO/KG	MSO/KG	MSO/KG	MSO/KG
1.000+06	4.304-01	1.282+01	1.640+00	0.000	0.000	1.489+01	1.789-04	5.328-03	6.815-04	0.000	0.000	6.198-03
1.022+06	4.124-01	1.269+01	1.570+00	0.000	0.000	1.467+01	1.714-04	5.273-03	6.524-04	0.000	0.000	6.097-03
1.250+06	2.769-01	1.148+01	1.058+00	5.808-02	0.000	1.287+01	1.151-04	4.771-03	4.397-04	2.414-05	0.000	5.350-03
1.500+06	1.928-01	1.045+01	7.562-01	2.685-01	0.000	1.167+01	8.012-05	4.343-03	3.142-04	1.115-04	0.000	4.849-03
2.000+06	1.088-01	8.924+00	4.591-01	8.740-01	0.000	1.037+01	4.521-05	3.708-03	1.908-04	3.632-04	0.000	4.308-03
2.044+06	1.042-01	8.814+00	4.429-01	9.313-01	0.000	1.029+01	4.330-05	3.663-03	1.841-04	3.870-04	0.000	4.277-03
3.000+06	4.845-02	7.027+00	2.424-01	2.124+00	2.457-03	9.444+00	2.013-05	2.920-03	1.007-04	8.827-04	1.021-06	3.925-03
4.000+06	2.728-02	5.864+00	1.599-01	3.200+00	1.002-02	9.261+00	1.134-05	2.437-03	6.645-05	1.330-03	4.164-06	3.849-03
5.000+06	1.746-02	5.065+00	1.179-01	4.122+00	1.994-02	9.342+00	7.256-06	2.105-03	4.899-05	1.713-03	8.286-06	3.882-03
6.000+06	1.213-02	4.477+00	9.285-02	4.915+00	3.058-02	9.528+00	5.041-06	1.860-03	3.859-05	2.042-03	1.271-05	3.959-03
7.000+06	8.913-03	4.024+00	7.633-02	5.617+00	4.117-02	9.767+00	3.704-06	1.672-03	3.172-05	2.334-03	1.711-05	4.059-03
8.000+06	6.825-03	3.663+00	6.467-02	6.247+00	5.141-02	1.003+01	2.836-06	1.522-03	2.687-05	2.596-03	2.136-05	4.169-03
9.000+06	5.393-03	3.367+00	5.604-02	6.820+00	6.120-02	1.031+01	2.241-06	1.399-03	2.329-05	2.831-03	2.543-05	4.284-03
1.000+07	4.368-03	3.120+00	4.940-02	7.346+00	7.050-02	1.059+01	1.815-06	1.297-03	2.053-05	3.053-03	2.930-05	4.401-03
1.100+07	3.610-03	2.910+00	4.414-02	7.831+00	7.926-02	1.087+01	1.500-06	1.209-03	1.834-05	3.254-03	3.295-05	4.516-03
1.200+07	3.034-03	2.729+00	3.988-02	8.281+00	8.756-02	1.114+01	1.261-06	1.134-03	1.657-05	3.441-03	3.639-05	4.630-03
1.300+07	2.585-03	2.571+00	3.636-02	8.701+00	9.535-02	1.141+01	1.074-06	1.068-03	1.511-05	3.616-03	3.962-05	4.740-03
1.400+07	2.229-03	2.432+00	3.340-02	9.090+00	1.028-01	1.166+01	9.263-07	1.011-03	1.388-05	3.777-03	4.272-05	4.846-03
1.500+07	1.942-03	2.309+00	3.088-02	9.451+00	1.098-01	1.190+01	8.070-07	9.595-04	1.283-05	3.927-03	4.563-05	4.946-03
1.600+07	1.707-03	2.199+00	2.871-02	9.786+00	1.164-01	1.213+01	7.094-07	9.138-04	1.193-05	4.067-03	4.837-05	5.042-03
1.800+07	1.348-03	2.010+00	2.517-02	1.039+01	1.287-01	1.256+01	5.602-07	8.353-04	1.046-05	4.318-03	5.348-05	5.217-03
2.000+07	1.092-03	1.854+00	2.240-02	1.093+01	1.399-01	1.295+01	4.538-07	7.705-04	9.309-06	4.542-03	5.814-05	5.380-03
2.200+07	9.027-04	1.722+00	2.018-02	1.143+01	1.501-01	1.332+01	3.751-07	7.156-04	8.386-06	4.750-03	6.238-05	5.537-03
2.400+07	7.585-04	1.609+00	1.835-02	1.187+01	1.595-01	1.366+01	3.152-07	6.686-04	7.626-06	4.933-03	6.628-05	5.676-03
2.600+07	6.463-04	1.511+00	1.683-02	1.228+01	1.682-01	1.398+01	2.686-07	6.279-04	6.994-06	5.103-03	6.990-05	5.808-03
2.800+07	5.573-04	1.425+00	1.554-02	1.265+01	1.762-01	1.427+01	2.316-07	5.922-04	6.458-06	5.257-03	7.322-05	5.929-03
3.000+07	4.854-04	1.350+00	1.443-02	1.300+01	1.837-01	1.455+01	2.017-07	5.610-04	5.997-06	5.402-03	7.634-05	6.046-03
4.000+07	2.731-04	1.072+00	1.063-02	1.440+01	2.145-01	1.570+01	1.135-07	4.455-04	4.417-06	5.984-03	8.914-05	6.523-03
5.000+07	1.748-04	8.951-01	8.417-03	1.544+01	2.377-01	1.658+01	7.264-08	3.720-04	3.498-06	6.416-03	9.878-05	6.891-03
6.000+07	1.214-04	7.713-01	6.964-03	1.625+01	2.561-01	1.728+01	5.045-08	3.205-04	2.894-06	6.753-03	1.064-04	7.183-03
8.000+07	6.826-05	6.083-01	5.176-03	1.745+01	2.838-01	1.835+01	2.837-08	2.528-04	2.151-06	7.252-03	1.179-04	7.624-03
1.000+08	4.369-05	5.049-01	4.119-03	1.830+01	3.038-01	1.911+01	1.816-08	2.098-04	1.712-06	7.605-03	1.262-04	7.943-03
1.500+08	1.942-05	3.595-01	2.726-03	1.964+01	3.369-01	2.034+01	8.070-09	1.494-04	1.133-06	8.162-03	1.400-04	8.452-03
2.000+08	1.092-05	2.819-01	2.037-03	2.045+01	3.576-01	2.109+01	4.538-09	1.171-04	8.465-07	8.498-03	1.486-04	8.765-03
3.000+08	4.854-06	1.998-01	1.353-03	2.138+01	3.829-01	2.196+01	2.017-09	8.303-05	5.623-07	8.885-03	1.591-04	9.127-03
4.000+08	2.730-06	1.565-01	1.013-03	2.192+01	3.981-01	2.248+01	1.134-09	6.504-05	4.210-07	9.109-03	1.654-04	9.340-03
5.000+08	1.748-06	1.295-01	8.094-04	2.228+01	4.085-01	2.282+01	7.264-10	5.382-05	3.364-07	9.259-03	1.698-04	9.483-03
6.000+08	1.214-06	1.109-01	6.740-04	2.253+01	4.161-01	2.306+01	5.045-10	4.609-05	2.801-07	9.363-03	1.729-04	9.582-03
8.000+08	6.826-07	8.662-02	5.050-04	2.287+01	4.266-01	2.338+01	2.837-10	3.600-05	2.099-07	9.504-03	1.773-04	9.717-03
1.000+09	4.369-07	7.126-02	4.038-04	2.309+01	4.336-01	2.360+01	1.816-10	2.961-05	1.678-07	9.595-03	1.802-04	9.805-03
1.500+09	1.942-07	4.977-02	2.690-04	2.340+01	4.441-01	2.389+01	8.070-11	2.068-05	1.118-07	9.724-03	1.846-04	9.930-03
2.000+09	1.092-07	3.852-02	2.017-04	2.358+01	4.501-01	2.407+01	4.538-11	1.601-05	8.382-08	9.799-03	1.870-04	1.000-02
3.000+09	4.854-08	2.678-02	1.344-04	2.376+01	4.567-01	2.424+01	2.017-11	1.113-05	5.585-08	9.876-03	1.898-04	1.007-02
4.000+09	2.730-08	2.067-02	1.008-04	2.386+01	4.606-01	2.434+01	1.134-11	8.590-06	4.185-08	9.915-03	1.914-04	1.012-02
5.000+09	1.748-08	1.690-02	8.061-05	2.393+01	4.629-01	2.441+01	7.264-12	7.023-06	3.350-08	9.944-03	1.924-04	1.014-02
6.000+09	1.214-08	1.433-02	6.717-05	2.397+01	4.646-01	2.445+01	5.045-12	5.955-06	2.791-08	9.961-03	1.931-04	1.016-02
8.000+09	6.826-09	1.104-02	5.037-05	2.403+01	4.668-01	2.451+01	2.837-12	4.588-06	2.093-08	9.986-03	1.940-04	1.018-02
1.000+10	4.369-09	9.016-03	4.030-05	2.406+01	4.682-01	2.454+01	1.816-12	3.747-06	1.675-08	9.993-03	1.946-04	1.020-02
1.500+10	1.942-09	6.231-03	2.686-05	2.412+01	4.702-01	2.460+01	8.070-13	2.589-06	1.116-08	1.002-02	1.954-04	1.022-02
2.000+10	1.092-09	4.790-03	2.015-05	2.414+01	4.713-01	2.462+01	4.538-13	1.991-06	8.374-09	1.003-02	1.959-04	1.023-02
3.000+10	4.854-10	3.304-03	1.343-05	2.417+01	4.723-01	2.465+01	2.017-13	1.373-06	5.581-09	1.004-02	1.963-04	1.024-02
4.000+10	2.730-10	2.536-03	1.007-05	2.418+01	4.731-01	2.466+01	1.134-13	1.054-06	4.185-09	1.005-02	1.966-04	1.025-02
5.000+10	1.748-10	2.065-03	8.058-06	2.419+01	4.735-01	2.467+01	7.264-14	8.581-07	3.349-09	1.005-02	1.968-04	1.025-02
6.000+10	1.214-10	1.746-03	6.715-06	2.420+01	4.737-01	2.468+01	5.045-14	7.256-07	2.791-09	1.005-02	1.969-04	1.025-02
8.000+10	6.826-11	1.339-03	5.036-06	2.421+01	4.740-01	2.469+01	2.837-14	5.564-07	2.093-09	1.005-02	1.970-04	1.026-02
1.000+11	4.369-11	1.089-03	4.029-06	2.421+01	4.742-01	2.469+01	1.816-14	4.525-07	1.674-09	1.006-02	1.971-04	1.026-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV. $Z=1$ to 100—Continued

Z = 62, SM, SAMARIUM ATOMIC WT. = 150.36 MSQ/KG = .00040051 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	4.509-01	1.303+01	1.765+00	0.000	0.000	1.525+01	1.806-04	5.219-03	7.069-04	0.000	0.000	6.106-03
1.022+06	4.319-01	1.289+01	1.689+00	0.000	0.000	1.501+01	1.730-04	5.163-03	6.765-04	0.000	0.000	6.012-03
1.250+06	2.901-01	1.167+01	1.139+00	6.072-02	0.000	1.316+01	1.162-04	4.674-03	4.562-04	2.432-05	0.000	5.271-03
1.500+06	2.020-01	1.062+01	8.136-01	2.807-01	0.000	1.192+01	8.090-05	4.253-03	3.259-04	1.124-04	0.000	4.773-03
2.000+06	1.140-01	9.069+00	4.939-01	9.102-01	0.000	1.059+01	4.566-05	3.632-03	1.978-04	3.645-04	0.000	4.240-03
2.044+06	1.091-01	8.958+00	4.763-01	9.695-01	0.000	1.051+01	4.370-05	3.588-03	1.908-04	3.883-04	0.000	4.211-03
3.000+06	5.077-02	7.142+00	2.605-01	2.202+00	2.497-03	9.658+00	2.033-05	2.860-03	1.043-04	8.819-04	1.000-06	3.868-03
4.000+06	2.859-02	5.960+00	1.719-01	3.310+00	1.018-02	9.481+00	1.145-05	2.387-03	6.885-05	1.326-03	4.077-06	3.797-03
5.000+06	1.830-02	5.148+00	1.267-01	4.258+00	2.026-02	9.571+00	7.329-06	2.062-03	5.074-05	1.705-03	8.114-06	3.833-03
6.000+06	1.271-02	4.550+00	9.972-02	5.074+00	3.107-02	9.767+00	5.090-06	1.822-03	3.994-05	2.032-03	1.244-05	3.912-03
7.000+06	9.341-03	4.090+00	8.196-02	5.796+00	4.183-02	1.002+01	3.741-06	1.638-03	3.283-05	2.321-03	1.675-05	4.013-03
8.000+06	7.152-03	3.723+00	6.943-02	6.444+00	5.224-02	1.030+01	2.864-06	1.491-03	2.781-05	2.581-03	2.092-05	4.124-03
9.000+06	5.651-03	3.422+00	6.015-02	7.033+00	6.219-02	1.058+01	2.263-06	1.371-03	2.409-05	2.817-03	2.491-05	4.239-03
1.000+07	4.578-03	3.171+00	5.302-02	7.573+00	7.163-02	1.087+01	1.834-06	1.270-03	2.123-05	3.033-03	2.869-05	4.355-03
1.100+07	3.783-03	2.958+00	4.737-02	8.072+00	8.056-02	1.116+01	1.515-06	1.185-03	1.897-05	3.233-03	3.226-05	4.470-03
1.200+07	3.179-03	2.774+00	4.279-02	8.535+00	8.897-02	1.144+01	1.273-06	1.111-03	1.714-05	3.418-03	3.563-05	4.583-03
1.300+07	2.709-03	2.613+00	3.901-02	8.967+00	9.688-02	1.172+01	1.085-06	1.047-03	1.562-05	3.591-03	3.880-05	4.693-03
1.400+07	2.336-03	2.472+00	3.584-02	9.367+00	1.044-01	1.198+01	9.356-07	9.901-04	1.435-05	3.752-03	4.181-05	4.799-03
1.500+07	2.035-03	2.347+00	3.313-02	9.739+00	1.115-01	1.223+01	8.150-07	9.400-04	1.327-05	3.901-03	4.466-05	4.899-03
1.600+07	1.788-03	2.235+00	3.081-02	1.008+01	1.183-01	1.247+01	7.161-07	8.951-04	1.234-05	4.037-03	4.738-05	4.993-03
1.800+07	1.413-03	2.043+00	2.700-02	1.071+01	1.308-01	1.291+01	5.659-07	8.182-04	1.081-05	4.289-03	5.239-05	5.171-03
2.000+07	1.145-03	1.884+00	2.403-02	1.127+01	1.421-01	1.332+01	4.586-07	7.546-04	9.624-06	4.514-03	5.691-05	5.335-03
2.200+07	9.460-04	1.750+00	2.164-02	1.177+01	1.525-01	1.370+01	3.789-07	7.009-04	8.667-06	4.716-03	6.108-05	5.485-03
2.400+07	7.949-04	1.635+00	1.968-02	1.223+01	1.621-01	1.405+01	3.184-07	6.548-04	7.882-06	4.898-03	6.492-05	5.626-03
2.600+07	6.773-04	1.536+00	1.805-02	1.265+01	1.708-01	1.438+01	2.713-07	6.152-04	7.229-06	5.066-03	6.841-05	5.758-03
2.800+07	5.840-04	1.449+00	1.666-02	1.304+01	1.790-01	1.469+01	2.339-07	5.803-04	6.672-06	5.223-03	7.169-05	5.882-03
3.000+07	5.087-04	1.372+00	1.548-02	1.339+01	1.866-01	1.496+01	2.037-07	5.495-04	6.200-06	5.363-03	7.473-05	5.993-03
4.000+07	2.862-04	1.090+00	1.140-02	1.484+01	2.178-01	1.616+01	1.146-07	4.366-04	4.566-06	5.944-03	8.723-05	6.472-03
5.000+07	1.831-04	9.098-01	9.026-03	1.591+01	2.416-01	1.707+01	7.333-08	3.644-04	3.615-06	6.372-03	9.668-05	6.837-03
6.000+07	1.272-04	7.839-01	7.467-03	1.674+01	2.601-01	1.779+01	5.094-08	3.140-04	2.991-06	6.705-03	1.042-04	7.126-03
8.000+07	7.154-05	6.182-01	5.550-03	1.797+01	2.881-01	1.888+01	2.865-08	2.476-04	2.223-06	7.197-03	1.154-04	7.562-03
1.000+08	4.578-05	5.131-01	4.416-03	1.885+01	3.084-01	1.968+01	1.834-08	2.055-04	1.769-06	7.550-03	1.235-04	7.880-03
1.500+08	2.035-05	3.654-01	2.922-03	2.023+01	3.419-01	2.094+01	8.150-09	1.463-04	1.170-06	8.102-03	1.369-04	8.387-03
2.000+08	1.145-05	2.865-01	2.184-03	2.106+01	3.628-01	2.171+01	4.586-09	1.147-04	8.747-07	8.435-03	1.453-04	8.696-03
3.000+08	5.087-06	2.031-01	1.450-03	2.202+01	3.883-01	2.261+01	2.037-09	8.134-05	5.807-07	8.819-03	1.555-04	9.057-03
4.000+08	2.861-06	1.590-01	1.086-03	2.257+01	4.037-01	2.313+01	1.146-09	6.368-05	4.350-07	9.039-03	1.617-04	9.265-03
5.000+08	1.831-06	1.317-01	8.676-04	2.294+01	4.141-01	2.349+01	7.333-10	5.275-05	3.475-07	9.188-03	1.659-04	9.407-03
6.000+08	1.272-06	1.127-01	7.225-04	2.320+01	4.218-01	2.374+01	5.094-10	4.514-05	2.894-07	9.292-03	1.689-04	9.506-03
8.000+08	7.154-07	8.804-02	5.413-04	2.354+01	4.324-01	2.406+01	2.865-10	3.526-05	2.168-07	9.428-03	1.732-04	9.637-03
1.000+09	4.578-07	7.243-02	4.328-04	2.377+01	4.395-01	2.428+01	1.834-10	2.901-05	1.733-07	9.520-03	1.760-04	9.725-03
1.500+09	2.035-07	5.058-02	2.883-04	2.409+01	4.501-01	2.459+01	8.150-11	2.026-05	1.155-07	9.648-03	1.803-04	9.849-03
2.000+09	1.145-07	3.915-02	2.162-04	2.427+01	4.561-01	2.477+01	4.586-11	1.568-05	8.659-08	9.720-03	1.827-04	9.919-03
3.000+09	5.087-08	2.722-02	1.441-04	2.446+01	4.627-01	2.495+01	2.037-11	1.090-05	5.771-08	9.796-03	1.853-04	9.993-03
4.000+09	2.861-08	2.101-02	1.080-04	2.456+01	4.665-01	2.505+01	1.146-11	8.415-06	4.325-08	9.836-03	1.868-04	1.003-02
5.000+09	1.831-08	1.718-02	8.641-05	2.463+01	4.689-01	2.512+01	7.333-12	6.881-06	3.461-08	9.865-03	1.878-04	1.006-02
6.000+09	1.272-08	1.457-02	7.200-05	2.467+01	4.706-01	2.516+01	5.094-12	5.835-06	2.884-08	9.881-03	1.885-04	1.007-02
8.000+09	7.154-09	1.122-02	5.400-05	2.473+01	4.728-01	2.521+01	2.865-12	4.494-06	2.163-08	9.905-03	1.894-04	1.010-02
1.000+10	4.578-09	9.164-03	4.320-05	2.477+01	4.743-01	2.525+01	1.834-12	3.670-06	1.730-08	9.921-03	1.900-04	1.011-02
1.500+10	2.035-09	6.333-03	2.880-05	2.482+01	4.762-01	2.530+01	8.150-13	2.536-06	1.153-08	9.941-03	1.907-04	1.013-02
2.000+10	1.145-09	4.869-03	2.160-05	2.485+01	4.773-01	2.533+01	4.586-13	1.950-06	8.651-09	9.953-03	1.912-04	1.015-02
3.000+10	5.087-10	3.358-03	1.440-05	2.488+01	4.784-01	2.536+01	2.037-13	1.345-06	5.767-09	9.965-03	1.916-04	1.016-02
4.000+10	2.861-10	2.578-03	1.080-05	2.489+01	4.791-01	2.537+01	1.146-13	1.033-06	4.325-09	9.969-03	1.919-04	1.016-02
5.000+10	1.831-10	2.099-03	8.638-06	2.490+01	4.795-01	2.538+01	7.333-14	8.407-07	3.460-09	9.973-03	1.920-04	1.017-02
6.000+10	1.272-10	1.775-03	7.198-06	2.491+01	4.798-01	2.539+01	5.094-14	7.109-07	2.883-09	9.977-03	1.922-04	1.017-02
8.000+10	7.154-11	1.361-03	5.398-06	2.492+01	4.800-01	2.540+01	2.865-14	5.451-07	2.162-09	9.981-03	1.922-04	1.017-02
1.000+11	4.578-11	1.107-03	4.319-06	2.492+01	4.803-01	2.540+01	1.834-14	4.434-07	1.730-09	9.981-03	1.924-04	1.017-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 63, EU, EUROPIUM ATOMIC WT. = 151.96 MSQ/KG = .00039629 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	4.720-01	1.324+01	1.897+00	0.000	0.000	1.561+01	1.870-04	5.247-03	7.518-04	0.000	0.000	6.186-03
1.022+06	4.522-01	1.310+01	1.816+00	0.000	0.000	1.537+01	1.792-04	5.191-03	7.197-04	0.000	0.000	6.090-03
1.250+06	3.037-01	1.186+01	1.224+00	6.347-02	0.000	1.345+01	1.204-04	4.700-03	4.851-04	2.515-05	0.000	5.331-03
1.500+06	2.115-01	1.079+01	8.742-01	2.934-01	0.000	1.217+01	8.382-05	4.276-03	3.464-04	1.163-04	0.000	4.823-03
2.000+06	1.193-01	9.215+00	5.306-01	9.473-01	0.000	1.081+01	4.728-05	3.652-03	2.103-04	3.754-04	0.000	4.285-03
2.044+06	1.143-01	9.102+00	5.117-01	1.009+00	0.000	1.074+01	4.530-05	3.607-03	2.028-04	3.999-04	0.000	4.255-03
3.000+06	5.317-02	7.257+00	2.798-01	2.281+00	2.537-03	9.874+00	2.107-05	2.876-03	1.109-04	9.039-04	1.005-06	3.913-03
4.000+06	2.994-02	6.056+00	1.845-01	3.422+00	1.034-02	9.703+00	1.186-05	2.400-03	7.312-05	1.356-03	4.098-06	3.845-03
5.000+06	1.917-02	5.231+00	1.359-01	4.397+00	2.058-02	9.804+00	7.597-06	2.073-03	5.386-05	1.742-03	8.156-06	3.885-03
6.000+06	1.331-02	4.624+00	1.070-01	5.235+00	3.157-02	1.001+01	5.275-06	1.832-03	4.240-05	2.075-03	1.251-05	3.967-03
7.000+06	9.783-03	4.156+00	8.790-02	5.977+00	4.250-02	1.027+01	3.877-06	1.647-03	3.483-05	2.369-03	1.684-05	4.071-03
8.000+06	7.491-03	3.783+00	7.445-02	6.643+00	5.307-02	1.056+01	2.969-06	1.499-03	2.950-05	2.633-03	2.103-05	4.185-03
9.000+06	5.919-03	3.478+00	6.449-02	7.248+00	6.318-02	1.086+01	2.346-06	1.378-03	2.556-05	2.872-03	2.504-05	4.304-03
1.000+07	4.795-03	3.222+00	5.684-02	7.803+00	7.277-02	1.116+01	1.900-06	1.277-03	2.253-05	3.092-03	2.884-05	4.422-03
1.100+07	3.963-03	3.005+00	5.078-02	8.316+00	8.184-02	1.146+01	1.571-06	1.191-03	2.012-05	3.296-03	3.243-05	4.541-03
1.200+07	3.330-03	2.819+00	4.587-02	8.791+00	9.037-02	1.175+01	1.320-06	1.117-03	1.818-05	3.484-03	3.581-05	4.656-03
1.300+07	2.837-03	2.655+00	4.181-02	9.236+00	9.841-02	1.203+01	1.124-06	1.052-03	1.657-05	3.660-03	3.900-05	4.769-03
1.400+07	2.446-03	2.512+00	3.841-02	9.648+00	1.061-01	1.231+01	9.693-07	9.955-04	1.522-05	3.823-03	4.205-05	4.877-03
1.500+07	2.131-03	2.385+00	3.551-02	1.003+01	1.133-01	1.257+01	8.445-07	9.452-04	1.407-05	3.975-03	4.490-05	4.980-03
1.600+07	1.873-03	2.271+00	3.301-02	1.039+01	1.201-01	1.282+01	7.423-07	9.000-04	1.308-05	4.117-03	4.759-05	5.079-03
1.800+07	1.480-03	2.076+00	2.893-02	1.103+01	1.328-01	1.327+01	5.865-07	8.227-04	1.146-05	4.371-03	5.263-05	5.258-03
2.000+07	1.199-03	1.914+00	2.575-02	1.160+01	1.444-01	1.369+01	4.752-07	7.585-04	1.020-05	4.597-03	5.722-05	5.423-03
2.200+07	9.908-04	1.778+00	2.319-02	1.212+01	1.549-01	1.408+01	3.926-07	7.046-04	9.190-06	4.803-03	6.139-05	5.579-03
2.400+07	8.325-04	1.662+00	2.109-02	1.260+01	1.646-01	1.445+01	3.299-07	6.586-04	8.358-06	4.993-03	6.523-05	5.726-03
2.600+07	7.094-04	1.560+00	1.934-02	1.303+01	1.735-01	1.478+01	2.811-07	6.182-04	7.664-06	5.164-03	6.876-05	5.859-03
2.800+07	6.116-04	1.472+00	1.785-02	1.342+01	1.818-01	1.509+01	2.424-07	5.833-04	7.074-06	5.318-03	7.205-05	5.981-03
3.000+07	5.328-04	1.394+00	1.658-02	1.379+01	1.894-01	1.539+01	2.111-07	5.524-04	6.571-06	5.465-03	7.506-05	6.090-03
4.000+07	2.997-04	1.108+00	1.221-02	1.527+01	2.211-01	1.661+01	1.188-07	4.391-04	4.839-06	6.051-03	8.762-05	6.583-03
5.000+07	1.918-04	9.245-01	9.667-03	1.638+01	2.451-01	1.756+01	7.601-08	3.664-04	3.831-06	6.491-03	9.713-05	6.959-03
6.000+07	1.332-04	7.965-01	7.997-03	1.724+01	2.640-01	1.831+01	5.279-08	3.156-04	3.169-06	6.832-03	1.046-04	7.256-03
8.000+07	7.493-05	6.282-01	5.943-03	1.850+01	2.923-01	1.943+01	2.969-08	2.490-04	2.355-06	7.331-03	1.158-04	7.699-03
1.000+08	4.795-05	5.214-01	4.729-03	1.940+01	3.129-01	2.024+01	1.900-08	2.066-04	1.874-06	7.688-03	1.240-04	8.021-03
1.500+08	2.131-05	3.713-01	3.129-03	2.083+01	3.468-01	2.165+01	8.445-09	1.471-04	1.240-06	8.255-03	1.374-04	8.541-03
2.000+08	1.199-05	2.911-01	2.338-03	2.168+01	3.679-01	2.234+01	4.752-09	1.154-04	9.265-07	8.592-03	1.458-04	8.854-03
3.000+08	5.328-06	2.064-01	1.553-03	2.266+01	3.937-01	2.326+01	2.111-09	8.179-05	6.154-07	8.980-03	1.560-04	9.218-03
4.000+08	2.997-06	1.616-01	1.163-03	2.323+01	4.092-01	2.380+01	1.188-09	6.404-05	4.609-07	9.206-03	1.622-04	9.433-03
5.000+08	1.918-06	1.336-01	9.290-04	2.360+01	4.197-01	2.415+01	7.601-10	5.302-05	3.682-07	9.352-03	1.663-04	9.572-03
6.000+08	1.332-06	1.145-01	7.736-04	2.387+01	4.275-01	2.441+01	5.279-10	4.538-05	3.066-07	9.459-03	1.694-04	9.675-03
8.000+08	7.492-07	8.946-02	5.796-04	2.423+01	4.382-01	2.476+01	2.969-10	3.545-05	2.297-07	9.602-03	1.737-04	9.811-03
1.000+09	4.795-07	7.360-02	4.634-04	2.446+01	4.453-01	2.498+01	1.900-10	2.917-05	1.836-07	9.693-03	1.765-04	9.899-03
1.500+09	2.131-07	5.140-02	3.087-04	2.479+01	4.559-01	2.530+01	8.445-11	2.037-05	1.223-07	9.824-03	1.807-04	1.003-02
2.000+09	1.199-07	3.978-02	2.315-04	2.497+01	4.620-01	2.547+01	4.752-11	1.576-05	9.174-08	9.895-03	1.831-04	1.009-02
3.000+09	5.328-08	2.766-02	1.543-04	2.516+01	4.686-01	2.566+01	2.111-11	1.096-05	6.115-08	9.971-03	1.857-04	1.017-02
4.000+09	2.997-08	2.135-02	1.157-04	2.527+01	4.725-01	2.576+01	1.188-11	8.461-06	4.585-08	1.001-02	1.872-04	1.021-02
5.000+09	1.918-08	1.746-02	9.252-05	2.534+01	4.749-01	2.583+01	7.601-12	6.919-06	3.666-08	1.004-02	1.882-04	1.024-02
6.000+09	1.332-08	1.480-02	7.710-05	2.538+01	4.766-01	2.587+01	5.279-12	5.865-06	3.055-08	1.006-02	1.889-04	1.025-02
8.000+09	7.492-09	1.140-02	5.782-05	2.544+01	4.788-01	2.593+01	2.969-12	4.518-06	2.291-08	1.008-02	1.897-04	1.028-02
1.000+10	4.795-09	9.312-03	4.625-05	2.548+01	4.802-01	2.597+01	1.900-12	3.690-06	1.833-08	1.010-02	1.903-04	1.029-02
1.500+10	2.131-09	6.435-03	3.083-05	2.553+01	4.822-01	2.602+01	8.445-13	2.550-06	1.222-08	1.012-02	1.911-04	1.031-02
2.000+10	1.199-09	4.947-03	2.312-05	2.556+01	4.833-01	2.605+01	4.752-13	1.960-06	9.162-09	1.013-02	1.915-04	1.032-02
3.000+10	5.328-10	3.412-03	1.541-05	2.559+01	4.844-01	2.608+01	2.111-13	1.352-06	6.107-09	1.014-02	1.920-04	1.033-02
4.000+10	2.997-10	2.619-03	1.156-05	2.561+01	4.851-01	2.610+01	1.188-13	1.038-06	4.581-09	1.015-02	1.922-04	1.034-02
5.000+10	1.918-10	2.133-03	9.248-06	2.562+01	4.855-01	2.611+01	7.601-14	8.453-07	3.665-09	1.015-02	1.924-04	1.035-02
6.000+10	1.332-10	1.803-03	7.707-06	2.562+01	4.857-01	2.611+01	5.279-14	7.145-07	3.054-09	1.015-02	1.925-04	1.035-02
8.000+10	7.492-11	1.383-03	5.780-06	2.563+01	4.860-01	2.612+01	2.969-14	5.481-07	2.291-09	1.016-02	1.926-04	1.035-02
1.000+11	4.795-11	1.125-03	4.624-06	2.564+01	4.863-01	2.613+01	[illegible]	[illegible]58-07	1.832-09	1.016-02	1.927-04	1.035-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 64, GD, GADOLINIUM ATOMIC WT. = 157.25 MSQ/KG = .00038296 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	4.935-01	1.345+01	2.037+00	0.000	0.000	1.598+01	1.890-04	5.151-03	7.801-04	0.000	0.000	6.120-03
1.022+06	4.728-01	1.330+01	1.949+00	0.000	0.000	1.572+01	1.811-04	5.093-03	7.464-04	0.000	0.000	6.021-03
1.250+06	3.176-01	1.204+01	1.314+00	6.627-02	0.000	1.374+01	1.216-04	4.611-03	5.032-04	2.538-05	0.000	5.261-03
1.500+06	2.212-01	1.096+01	9.385-01	3.064-01	0.000	1.243+01	8.471-05	4.197-03	3.594-04	1.173-04	0.000	4.759-03
2.000+06	1.248-01	9.361+00	5.694-01	9.855-01	0.000	1.104+01	4.779-05	3.585-03	2.181-04	3.774-04	0.000	4.228-03
2.044+06	1.195-01	9.246+00	5.492-01	1.049+00	0.000	1.096+01	4.576-05	3.541-03	2.103-04	4.017-04	0.000	4.199-03
3.000+06	5.562-02	7.372+00	3.001-01	2.361+00	2.577-03	1.009+01	2.130-05	2.823-03	1.149-04	9.042-04	9.869-07	3.865-03
4.000+06	3.132-02	6.152+00	1.978-01	3.536+00	1.051-02	9.928+00	1.199-05	2.356-03	7.575-05	1.354-03	4.025-06	3.802-03
5.000+06	2.005-02	5.314+00	1.457-01	4.537+00	2.091-02	1.004+01	7.678-06	2.035-03	5.580-05	1.737-03	8.008-06	3.844-03
6.000+06	1.393-02	4.697+00	1.146-01	5.399+00	3.207-02	1.026+01	5.335-06	1.799-03	4.389-05	2.065-03	1.228-05	3.928-03
7.000+06	1.023-02	4.222+00	9.417-02	6.160+00	4.317-02	1.053+01	3.918-06	1.617-03	3.606-05	2.359-03	1.653-05	4.032-03
8.000+06	7.836-03	3.843+00	7.975-02	6.844+00	5.391-02	1.083+01	3.001-06	1.472-03	3.054-05	2.621-03	2.065-05	4.147-03
9.000+06	6.192-03	3.533+00	6.908-02	7.466+00	6.417-02	1.114+01	2.371-06	1.353-03	2.645-05	2.859-03	2.457-05	4.266-03
1.000+07	5.016-03	3.273+00	6.087-02	8.036+00	7.391-02	1.145+01	1.921-06	1.253-03	2.331-05	3.077-03	2.830-05	4.384-03
1.100+07	4.145-03	3.053+00	5.438-02	8.563+00	8.311-02	1.176+01	1.587-06	1.169-03	2.083-05	3.279-03	3.183-05	4.503-03
1.200+07	3.483-03	2.863+00	4.912-02	9.051+00	9.178-02	1.206+01	1.334-06	1.096-03	1.881-05	3.466-03	3.515-05	4.618-03
1.300+07	2.968-03	2.697+00	4.477-02	9.509+00	9.994-02	1.235+01	1.137-06	1.033-03	1.715-05	3.642-03	3.827-05	4.731-03
1.400+07	2.559-03	2.552+00	4.112-02	9.932+00	1.077-01	1.264+01	9.800-07	9.773-04	1.575-05	3.804-03	4.124-05	4.839-03
1.500+07	2.229-03	2.423+00	3.801-02	1.033+01	1.150-01	1.291+01	8.536-07	9.279-04	1.456-05	3.956-03	4.404-05	4.943-03
1.600+07	1.960-03	2.307+00	3.534-02	1.069+01	1.220-01	1.316+01	7.506-07	8.835-04	1.353-05	4.094-03	4.672-05	5.038-03
1.800+07	1.548-03	2.109+00	3.097-02	1.135+01	1.349-01	1.363+01	5.928-07	8.077-04	1.186-05	4.347-03	5.166-05	5.218-03
2.000+07	1.254-03	1.945+00	2.756-02	1.194+01	1.466-01	1.406+01	4.802-07	7.449-04	1.055-05	4.573-03	5.614-05	5.385-03
2.200+07	1.036-03	1.806+00	2.482-02	1.248+01	1.573-01	1.447+01	3.967-07	6.916-04	9.505-06	4.779-03	6.024-05	5.541-03
2.400+07	8.709-04	1.688+00	2.257-02	1.296+01	1.671-01	1.484+01	3.335-07	6.464-04	8.643-06	4.963-03	6.399-05	5.683-03
2.600+07	7.421-04	1.585+00	2.069-02	1.341+01	1.762-01	1.519+01	2.842-07	6.070-04	7.923-06	5.139-03	6.748-05	5.818-03
2.800+07	6.399-04	1.495+00	1.910-02	1.381+01	1.845-01	1.551+01	2.451-07	5.725-04	7.315-06	5.289-03	7.066-05	5.939-03
3.000+07	5.574-04	1.416+00	1.774-02	1.419+01	1.923-01	1.582+01	2.135-07	5.423-04	6.794-06	5.431-03	7.364-05	6.057-03
4.000+07	3.135-04	1.125+00	1.307-02	1.572+01	2.245-01	1.708+01	1.201-07	4.308-04	5.005-06	6.020-03	8.597-05	6.542-03
5.000+07	2.007-04	9.392-01	1.034-02	1.685+01	2.487-01	1.805+01	7.686-08	3.597-04	3.960-06	6.453-03	9.524-05	6.912-03
6.000+07	1.394-04	8.092-01	8.556-03	1.774+01	2.679-01	1.883+01	5.338-08	3.099-04	3.277-06	6.794-03	1.026-04	7.210-03
8.000+07	7.839-05	6.382-01	6.358-03	1.904+01	2.967-01	1.998+01	3.002-08	2.444-04	2.435-06	7.292-03	1.136-04	7.652-03
1.000+08	5.017-05	5.297-01	5.059-03	1.996+01	3.175-01	2.081+01	1.921-08	2.029-04	1.937-06	7.644-03	1.216-04	7.970-03
1.500+08	2.230-05	3.772-01	3.347-03	2.143+01	3.518-01	2.216+01	8.540-09	1.445-04	1.282-06	8.207-03	1.347-04	8.487-03
2.000+08	1.254-05	2.958-01	2.501-03	2.230+01	3.732-01	2.297+01	4.802-09	1.133-04	9.578-07	8.540-03	1.429-04	8.797-03
3.000+08	5.574-06	2.096-01	1.661-03	2.331+01	3.994-01	2.392+01	2.135-09	8.027-05	6.361-07	8.927-03	1.530-04	9.161-03
4.000+08	3.135-06	1.642-01	1.244-03	2.390+01	4.150-01	2.448+01	1.201-09	6.288-05	4.764-07	9.153-03	1.589-04	9.375-03
5.000+08	2.007-06	1.359-01	9.937-04	2.428+01	4.257-01	2.484+01	7.686-10	5.204-05	3.805-07	9.298-03	1.630-04	9.514-03
6.000+08	1.393-06	1.164-01	8.274-04	2.455+01	4.335-01	2.510+01	5.335-10	4.458-05	3.169-07	9.402-03	1.660-04	9.613-03
8.000+08	7.838-07	9.088-02	6.200-04	2.491+01	4.443-01	2.545+01	3.002-10	3.480-05	2.374-07	9.548-03	1.701-04	9.745-03
1.000+09	5.016-07	7.477-02	4.957-04	2.515+01	4.515-01	2.568+01	1.921-10	2.863-05	1.898-07	9.631-03	1.729-04	9.833-03
1.500+09	2.230-07	5.221-02	3.302-04	2.549+01	4.623-01	2.600+01	8.540-11	1.999-05	1.265-07	9.762-03	1.770-04	9.959-03
2.000+09	1.254-07	4.041-02	2.476-04	2.568+01	4.684-01	2.619+01	4.802-11	1.548-05	9.482-08	9.834-03	1.794-04	1.003-02
3.000+09	5.574-08	2.810-02	1.650-04	2.588+01	4.751-01	2.638+01	2.135-11	1.076-05	6.319-08	9.911-03	1.819-04	1.010-02
4.000+09	3.135-08	2.169-02	1.237-04	2.598+01	4.790-01	2.648+01	1.201-11	8.306-06	4.737-08	9.949-03	1.834-04	1.014-02
5.000+09	2.007-08	1.773-02	9.896-05	2.605+01	4.814-01	2.655+01	7.686-12	6.790-06	3.790-08	9.974-03	1.844-04	1.017-02
6.000+09	1.393-08	1.504-02	8.246-05	2.610+01	4.831-01	2.660+01	5.335-12	5.760-06	3.158-08	9.995-03	1.850-04	1.019-02
8.000+09	7.838-09	1.159-02	6.184-05	2.616+01	4.854-01	2.666+01	3.002-12	4.439-06	2.368-08	1.002-02	1.859-04	1.021-02
1.000+10	5.016-09	9.460-03	4.947-05	2.620+01	4.868-01	2.670+01	1.921-12	3.623-06	1.895-08	1.003-02	1.864-04	1.022-02
1.500+10	2.230-09	6.537-03	3.298-05	2.625+01	4.888-01	2.675+01	8.540-13	2.503-06	1.263-08	1.005-02	1.872-04	1.024-02
2.000+10	1.254-09	5.026-03	2.473-05	2.628+01	4.899-01	2.677+01	4.802-13	1.925-06	9.471-09	1.006-02	1.876-04	1.025-02
3.000+10	5.574-10	3.466-03	1.649-05	2.631+01	4.910-01	2.680+01	2.135-13	1.327-06	6.315-09	1.008-02	1.880-04	1.027-02
4.000+10	3.135-10	2.661-03	1.237-05	2.633+01	4.917-01	2.682+01	1.201-13	1.019-06	4.737-09	1.008-02	1.883-04	1.027-02
5.000+10	2.007-10	2.167-03	9.892-06	2.634+01	4.921-01	2.683+01	7.686-14	8.299-07	3.788-09	1.009-02	1.885-04	1.028-02
6.000+10	1.393-10	1.832-03	8.244-06	2.635+01	4.924-01	2.684+01	5.335-14	7.016-07	3.157-09	1.009-02	1.886-04	1.028-02
8.000+10	7.838-11	1.405-03	6.183-06	2.635+01	4.927-01	2.684+01	3.002-14	5.381-07	2.368-09	1.009-02	1.887-04	1.028-02
1.000+11	5.016-11	1.143-03	4.946-06	2.636+01	4.929-01	2.685+01	1.921-14	4.377-07	1.894-09	1.009-02	1.888-04	1.028-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 65, TB, TERBIUM ATOMIC WT. = 158.9254 MSQ/KG = .00037892 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	5.165-01	1.365+01	2.184+00	0.000	0.000	1.635+01	1.957-04	5.172-03	8.276-04	0.000	0.000	6.196-03
1.022+06	4.948-01	1.351+01	2.090+00	0.000	0.000	1.609+01	1.875-04	5.119-03	7.919-04	0.000	0.000	6.099-03
1.250+06	3.324-01	1.223+01	1.409+00	6.914-02	0.000	1.404+01	1.260-04	4.634-03	5.339-04	2.620-05	0.000	5.320-03
1.500+06	2.316-01	1.113+01	1.006+00	3.199-01	0.000	1.269+01	8.776-05	4.217-03	3.812-04	1.212-04	0.000	4.808-03
2.000+06	1.307-01	9.507+00	6.103-01	1.025+00	0.000	1.127+01	4.953-05	3.602-03	2.313-04	3.884-04	0.000	4.272-03
2.044+06	1.252-01	9.390+00	5.886-01	1.091+00	0.000	1.119+01	4.744-05	3.558-03	2.230-04	4.134-04	0.000	4.242-03
3.000+06	5.824-02	7.487+00	3.215-01	2.443+00	2.617-03	1.031+01	2.207-05	2.837-03	1.218-04	9.257-04	9.916-07	3.908-03
4.000+06	3.279-02	6.248+00	2.118-01	3.651+00	1.067-02	1.015+01	1.242-05	2.368-03	8.026-05	1.383-03	4.043-06	3.848-03
5.000+06	2.100-02	5.397+00	1.560-01	4.680+00	2.123-02	1.028+01	7.957-06	2.045-03	5.911-05	1.773-03	8.045-06	3.894-03
6.000+06	1.458-02	4.771+00	1.227-01	5.564+00	3.256-02	1.050+01	5.525-06	1.808-03	4.649-05	2.108-03	1.234-05	3.981-03
7.000+06	1.072-02	4.288+00	1.008-01	6.346+00	4.383-02	1.079+01	4.062-06	1.625-03	3.820-05	2.405-03	1.661-05	4.088-03
8.000+06	8.206-03	3.903+00	8.533-02	7.048+00	5.474-02	1.110+01	3.109-06	1.479-03	3.233-05	2.671-03	2.074-05	4.206-03
9.000+06	6.484-03	3.588+00	7.389-02	7.686+00	6.516-02	1.142+01	2.457-06	1.360-03	2.800-05	2.912-03	2.469-05	4.327-03
1.000+07	5.252-03	3.324+00	6.511-02	8.271+00	7.504-02	1.174+01	1.990-06	1.260-03	2.467-05	3.134-03	2.843-05	4.449-03
1.100+07	4.341-03	3.101+00	5.816-02	8.812+00	8.439-02	1.206+01	1.645-06	1.175-03	2.204-05	3.339-03	3.198-05	4.570-03
1.200+07	3.648-03	2.908+00	5.253-02	9.314+00	9.319-02	1.237+01	1.382-06	1.102-03	1.990-05	3.529-03	3.531-05	4.688-03
1.300+07	3.108-03	2.740+00	4.787-02	9.784+00	1.015-01	1.268+01	1.178-06	1.038-03	1.814-05	3.707-03	3.846-05	4.803-03
1.400+07	2.680-03	2.592+00	4.397-02	1.022+01	1.093-01	1.297+01	1.016-06	9.822-04	1.666-05	3.873-03	4.142-05	4.914-03
1.500+07	2.335-03	2.461+00	4.065-02	1.062+01	1.168-01	1.324+01	8.848-07	9.325-04	1.540-05	4.024-03	4.426-05	5.017-03
1.600+07	2.052-03	2.343+00	3.778-02	1.100+01	1.239-01	1.351+01	7.775-07	8.878-04	1.432-05	4.168-03	4.695-05	5.118-03
1.800+07	1.621-03	2.142+00	3.311-02	1.168+01	1.369-01	1.399+01	6.142-07	8.117-04	1.255-05	4.426-03	5.187-05	5.303-03
2.000+07	1.313-03	1.975+00	2.946-02	1.228+01	1.488-01	1.443+01	4.975-07	7.484-04	1.116-05	4.653-03	5.638-05	5.470-03
2.200+07	1.085-03	1.835+00	2.653-02	1.283+01	1.597-01	1.485+01	4.111-07	6.953-04	1.005-05	4.862-03	6.051-05	5.628-03
2.400+07	9.120-04	1.714+00	2.412-02	1.333+01	1.696-01	1.524+01	3.456-07	6.495-04	9.140-06	5.051-03	6.427-05	5.774-03
2.600+07	7.771-04	1.610+00	2.212-02	1.379+01	1.788-01	1.560+01	2.945-07	6.101-04	8.382-06	5.225-03	6.775-05	5.912-03
2.800+07	6.701-04	1.519+00	2.042-02	1.421+01	1.873-01	1.594+01	2.539-07	5.756-04	7.738-06	5.384-03	7.097-05	6.039-03
3.000+07	5.837-04	1.438+00	1.896-02	1.459+01	1.952-01	1.624+01	2.212-07	5.449-04	7.184-06	5.528-03	7.397-05	6.155-03
4.000+07	3.283-04	1.143+00	1.397-02	1.617+01	2.278-01	1.756+01	1.244-07	4.331-04	5.294-06	6.127-03	8.632-05	6.652-03
5.000+07	2.101-04	9.538-01	1.105-02	1.734+01	2.524-01	1.856+01	7.961-08	3.614-04	4.187-06	6.571-03	9.564-05	7.032-03
6.000+07	1.459-04	8.218-01	9.143-03	1.824+01	2.718-01	1.934+01	5.528-08	3.114-04	3.464-06	6.912-03	1.030-04	7.329-03
8.000+07	8.209-05	6.481-01	6.794-03	1.958+01	3.010-01	2.054+01	3.111-08	2.456-04	2.574-06	7.419-03	1.141-04	7.782-03
1.000+08	5.253-05	5.380-01	5.405-03	2.053+01	3.221-01	2.140+01	1.990-08	2.039-04	2.048-06	7.779-03	1.221-04	8.107-03
1.500+08	2.335-05	3.831-01	3.576-03	2.203+01	3.568-01	2.277+01	8.848-09	1.452-04	1.355-06	8.348-03	1.352-04	8.629-03
2.000+08	1.313-05	3.004-01	2.672-03	2.293+01	3.784-01	2.361+01	4.975-09	1.138-04	1.012-06	8.689-03	1.434-04	8.947-03
3.000+08	5.837-06	2.129-01	1.775-03	2.397+01	4.048-01	2.459+01	2.212-09	8.067-05	6.726-07	9.083-03	1.534-04	9.318-03
4.000+08	3.283-06	1.667-01	1.329-03	2.456+01	4.206-01	2.515+01	1.244-09	6.317-05	5.036-07	9.306-03	1.594-04	9.529-03
5.000+08	2.101-06	1.380-01	1.062-03	2.496+01	4.314-01	2.553+01	7.961-10	5.229-05	4.024-07	9.458-03	1.635-04	9.674-03
6.000+08	1.459-06	1.182-01	8.840-04	2.524+01	4.393-01	2.580+01	5.528-10	4.479-05	3.350-07	9.564-03	1.665-04	9.776-03
8.000+08	8.208-07	9.230-02	6.624-04	2.561+01	4.502-01	2.615+01	3.110-10	3.497-05	2.510-07	9.704-03	1.706-04	9.910-03
1.000+09	5.253-07	7.593-02	5.296-04	2.585+01	4.574-01	2.638+01	1.990-10	2.877-05	2.007-07	9.795-03	1.733-04	9.997-03
1.500+09	2.335-07	5.303-02	3.528-04	2.620+01	4.682-01	2.672+01	8.848-11	2.009-05	1.337-07	9.928-03	1.774-04	1.013-02
2.000+09	1.313-07	4.104-02	2.645-04	2.639+01	4.744-01	2.691+01	4.975-11	1.555-05	1.002-07	1.000-02	1.798-04	1.020-02
3.000+09	5.837-08	2.854-02	1.763-04	2.659+01	4.811-01	2.710+01	2.212-11	1.081-05	6.680-08	1.008-02	1.823-04	1.027-02
4.000+09	3.283-08	2.203-02	1.322-04	2.670+01	4.851-01	2.721+01	1.244-11	8.348-06	5.009-08	1.012-02	1.838-04	1.031-02
5.000+09	2.101-08	1.801-02	1.057-04	2.677+01	4.875-01	2.728+01	7.961-12	6.824-06	4.005-08	1.014-02	1.847-04	1.034-02
6.000+09	1.459-08	1.527-02	8.810-05	2.682+01	4.892-01	2.732+01	5.528-12	5.786-06	3.338-08	1.016-02	1.854-04	1.035-02
8.000+09	8.208-09	1.177-02	6.607-05	2.688+01	4.915-01	2.738+01	3.110-12	4.460-06	2.504-08	1.019-02	1.862-04	1.038-02
1.000+10	5.253-09	9.607-03	5.285-05	2.692+01	4.929-01	2.742+01	1.990-12	3.640-06	2.003-08	1.020-02	1.868-04	1.039-02
1.500+10	2.335-09	6.640-03	3.523-05	2.698+01	4.949-01	2.748+01	8.848-13	2.516-06	1.335-08	1.022-02	1.875-04	1.041-02
2.000+10	1.313-09	5.104-03	2.642-05	2.701+01	4.960-01	2.751+01	4.975-13	1.934-06	1.001-08	1.023-02	1.879-04	1.042-02
3.000+10	5.837-10	3.520-03	1.761-05	2.704+01	4.971-01	2.754+01	2.212-13	1.334-06	6.673-09	1.025-02	1.884-04	1.044-02
4.000+10	3.283-10	2.703-03	1.321-05	2.706+01	4.978-01	2.756+01	1.244-13	1.024-06	5.006-09	1.025-02	1.886-04	1.044-02
5.000+10	2.101-10	2.201-03	1.057-05	2.707+01	4.983-01	2.757+01	7.961-14	8.340-07	4.005-09	1.026-02	1.888-04	1.045-02
6.000+10	1.459-10	1.860-03	8.807-06	2.707+01	4.985-01	2.757+01	5.528-14	7.048-07	3.337-09	1.026-02	1.889-04	1.045-02
8.000+10	8.208-11	1.426-03	6.605-06	2.708+01	4.988-01	2.758+01	3.110-14	5.403-07	2.503-09	1.026-02	1.890-04	1.045-02
1.000+11	5.253-11	1.161-03	5.284-06	2.709+01	4.990-01	2.759+01	1.990-14	4.399-07	2.002-09	1.027-02	1.891-04	1.045-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 66, DY, DYSPROSIUM ATOMIC WT. = 162.50 MSQ/KG = .00037059 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	5.400-01	1.386+01	2.340+00	0.000	0.000	1.674+01	2.001-04	5.136-03	8.672-04	0.000	0.000	6.204-03
1.022+06	5.173-01	1.372+01	2.239+00	0.000	0.000	1.648+01	1.917-04	5.084-03	8.297-04	0.000	0.000	6.106-03
1.250+06	3.476-01	1.242+01	1.509+00	7.209-02	0.000	1.435+01	1.288-04	4.603-03	5.592-04	2.672-05	0.000	5.317-03
1.500+06	2.421-01	1.130+01	1.078+00	3.338-01	0.000	1.295+01	8.972-05	4.188-03	3.995-04	1.237-04	0.000	4.801-03
2.000+06	1.367-01	9.653+00	6.536-01	1.065+00	0.000	1.151+01	5.066-05	3.577-03	2.422-04	3.947-04	0.000	4.265-03
2.044+06	1.309-01	9.534+00	6.303-01	1.133+00	0.000	1.143+01	4.851-05	3.533-03	2.336-04	4.199-04	0.000	4.235-03
3.000+06	6.092-02	7.602+00	3.441-01	2.527+00	2.657-03	1.054+01	2.258-05	2.817-03	1.275-04	9.365-04	9.847-07	3.905-03
4.000+06	3.430-02	6.344+00	2.266-01	3.769+00	1.083-02	1.038+01	1.271-05	2.351-03	8.398-05	1.397-03	4.013-06	3.848-03
5.000+06	2.196-02	5.480+00	1.668-01	4.824+00	2.156-02	1.051+01	8.138-06	2.031-03	6.181-05	1.788-03	7.990-06	3.896-03
6.000+06	1.525-02	4.844+00	1.312-01	5.732+00	3.306-02	1.076+01	5.651-06	1.795-03	4.862-05	2.124-03	1.225-05	3.986-03
7.000+06	1.121-02	4.354+00	1.077-01	6.534+00	4.450-02	1.105+01	4.154-06	1.614-03	3.991-05	2.421-03	1.649-05	4.096-03
8.000+06	8.583-03	3.963+00	9.121-02	7.254+00	5.557-02	1.137+01	3.181-06	1.469-03	3.380-05	2.688-03	2.059-05	4.214-03
9.000+06	6.782-03	3.643+00	7.898-02	7.909+00	6.614-02	1.170+01	2.513-06	1.350-03	2.927-05	2.931-03	2.451-05	4.337-03
1.000+07	5.494-03	3.376+00	6.959-02	8.509+00	7.618-02	1.204+01	2.036-06	1.251-03	2.579-05	3.153-03	2.823-05	4.460-03
1.100+07	4.541-03	3.148+00	6.215-02	9.064+00	8.566-02	1.236+01	1.683-06	1.167-03	2.303-05	3.350-03	3.174-05	4.582-03
1.200+07	3.816-03	2.953+00	5.613-02	9.579+00	9.460-02	1.269+01	1.414-06	1.094-03	2.080-05	3.550-03	3.506-05	4.701-03
1.300+07	3.251-03	2.782+00	5.115-02	1.006+01	1.030-01	1.300+01	1.205-06	1.031-03	1.896-05	3.728-03	3.817-05	4.817-03
1.400+07	2.803-03	2.632+00	4.698-02	1.051+01	1.110-01	1.330+01	1.039-06	9.754-04	1.741-05	3.895-03	4.114-05	4.930-03
1.500+07	2.442-03	2.498+00	4.342-02	1.092+01	1.186-01	1.358+01	9.050-07	9.257-04	1.609-05	4.047-03	4.395-05	5.033-03
1.600+07	2.146-03	2.379+00	4.037-02	1.131+01	1.257-01	1.386+01	7.953-07	8.816-04	1.496-05	4.191-03	4.658-05	5.135-03
1.800+07	1.696-03	2.175+00	3.537-02	1.201+01	1.390-01	1.436+01	6.285-07	8.060-04	1.311-05	4.451-03	5.151-05	5.322-03
2.000+07	1.374-03	2.005+00	3.147-02	1.263+01	1.510-01	1.482+01	5.092-07	7.430-04	1.166-05	4.681-03	5.596-05	5.492-03
2.200+07	1.135-03	1.863+00	2.833-02	1.320+01	1.621-01	1.525+01	4.206-07	6.904-04	1.050-05	4.882-03	6.007-05	5.653-03
2.400+07	9.540-04	1.741+00	2.577-02	1.371+01	1.722-01	1.565+01	3.535-07	6.452-04	9.550-06	5.081-03	6.382-05	5.800-03
2.600+07	8.129-04	1.635+00	2.362-02	1.418+01	1.815-01	1.602+01	3.013-07	6.059-04	8.753-06	5.255-03	6.726-05	5.937-03
2.800+07	7.009-04	1.542+00	2.181-02	1.461+01	1.901-01	1.636+01	2.597-07	5.714-04	8.083-06	5.414-03	7.045-05	6.065-03
3.000+07	6.106-04	1.460+00	2.025-02	1.500+01	1.981-01	1.668+01	2.263-07	5.411-04	7.504-06	5.559-03	7.341-05	6.181-03
4.000+07	3.434-04	1.160+00	1.491-02	1.662+01	2.312-01	1.803+01	1.273-07	4.299-04	5.525-06	6.159-03	8.568-05	6.680-03
5.000+07	2.198-04	9.685-01	1.186-02	1.782+01	2.561-01	1.906+01	8.146-08	3.589-04	4.373-06	6.634-03	9.491-05	7.062-03
6.000+07	1.526-04	8.345-01	9.762-03	1.876+01	2.757-01	1.988+01	5.655-08	3.093-04	3.618-06	6.952-03	1.022-04	7.367-03
8.000+07	8.586-05	6.581-01	7.253-03	2.013+01	3.052-01	2.110+01	3.182-08	2.439-04	2.688-06	7.460-03	1.131-04	7.820-03
1.000+08	5.495-05	5.462-01	5.770-03	2.111+01	3.265-01	2.199+01	2.036-08	2.024-04	2.138-06	7.823-03	1.210-04	8.149-03
1.500+08	2.442-05	3.890-01	3.818-03	2.265+01	3.616-01	2.340+01	9.050-09	1.442-04	1.415-06	8.394-03	1.340-04	8.673-03
2.000+08	1.374-05	3.050-01	2.853-03	2.356+01	3.834-01	2.425+01	5.092-09	1.130-04	1.057-06	8.731-03	1.421-04	8.987-03
3.000+08	6.105-06	2.162-01	1.894-03	2.463+01	4.100-01	2.526+01	2.262-09	8.012-05	7.019-07	9.178-03	1.519-04	9.360-03
4.000+08	3.434-06	1.693-01	1.418-03	2.524+01	4.259-01	2.584+01	1.273-09	6.274-05	5.255-07	9.334-03	1.578-04	9.575-03
5.000+08	2.198-06	1.402-01	1.133-03	2.564+01	4.367-01	2.622+01	8.146-10	5.196-05	4.199-07	9.532-03	1.618-04	9.716-03
6.000+08	1.526-06	1.200-01	9.436-04	2.593+01	4.447-01	2.650+01	5.655-10	4.447-05	3.497-07	9.609-03	1.648-04	9.819-03
8.000+08	8.586-07	9.372-02	7.070-04	2.631+01	4.556-01	2.686+01	3.182-10	3.473-05	2.620-07	9.750-03	1.688-04	9.954-03
1.000+09	5.495-07	7.710-02	5.653-04	2.655+01	4.629-01	2.709+01	2.036-10	2.857-05	2.095-07	9.839-03	1.715-04	1.004-02
1.500+09	2.442-07	5.385-02	3.766-04	2.691+01	4.737-01	2.744+01	9.050-11	1.996-05	1.396-07	9.973-03	1.755-04	1.017-02
2.000+09	1.374-07	4.168-02	2.823-04	2.710+01	4.799-01	2.762+01	5.092-11	1.545-05	1.046-07	1.004-02	1.778-04	1.024-02
3.000+09	6.105-08	2.898-02	1.881-04	2.731+01	4.866-01	2.783+01	2.262-11	1.074-05	6.971-08	1.012-02	1.803-04	1.031-02
4.000+09	3.434-08	2.237-02	1.411-04	2.743+01	4.906-01	2.794+01	1.273-11	8.290-06	5.229-08	1.017-02	1.818-04	1.036-02
5.000+09	2.198-08	1.829-02	1.129-04	2.750+01	4.930-01	2.801+01	8.146-12	6.778-06	4.184-08	1.019-02	1.827-04	1.038-02
6.000+09	1.526-08	1.551-02	9.404-05	2.755+01	4.947-01	2.806+01	5.655-12	5.748-06	3.485-08	1.021-02	1.833-04	1.040-02
8.000+09	8.586-09	1.195-02	7.052-05	2.761+01	4.970-01	2.812+01	3.182-12	4.429-06	2.613-08	1.023-02	1.842-04	1.042-02
1.000+10	5.495-09	9.755-03	5.641-05	2.765+01	4.984-01	2.816+01	2.036-12	3.615-06	2.090-08	1.025-02	1.847-04	1.044-02
1.500+10	2.442-09	6.742-03	3.761-05	2.771+01	5.004-01	2.822+01	9.050-13	2.499-06	1.394-08	1.027-02	1.854-04	1.046-02
2.000+10	1.374-09	5.183-03	2.820-05	2.774+01	5.015-01	2.825+01	5.092-13	1.921-06	1.045-08	1.028-02	1.858-04	1.047-02
3.000+10	6.105-10	3.574-03	1.880-05	2.777+01	5.026-01	2.828+01	2.262-13	1.324-06	6.967-09	1.029-02	1.863-04	1.048-02
4.000+10	3.434-10	2.744-03	1.410-05	2.779+01	5.033-01	2.830+01	1.273-13	1.017-06	5.225-09	1.030-02	1.865-04	1.049-02
5.000+10	2.198-10	2.235-03	1.128-05	2.780+01	5.037-01	2.831+01	8.146-14	8.283-07	4.180-09	1.030-02	1.867-04	1.049-02
6.000+10	1.526-10	1.889-03	9.400-06	2.781+01	5.040-01	2.832+01	5.655-14	7.000-07	3.484-09	1.031-02	1.868-04	1.049-02
8.000+10	8.586-11	1.448-03	7.050-06	2.781+01	5.043-01	2.832+01	3.182-14	5.366-07	2.613-09	1.031-02	1.869-04	1.049-02
1.000+11	5.495-11	1.178-03	5.640-06	2.782+01	5.045-01	2.833+01	2.036-14	4.366-07	2.090-09	1.031-02	1.870-04	1.050-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 67, HO, HOLMIUM ATOMIC WT. = 164.9304 MSQ/KG = .00036513 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	5.638-01	1.407+01	2.504+00	0.000	0.000	1.714+01	2.059-04	5.137-03	9.143-04	0.000	0.000	6.257-03
1.022+06	5.482-01	1.392+01	2.396+00	0.000	0.000	1.686+01	1.972-04	5.083-03	8.748-04	0.000	0.000	6.155-03
1.250+06	3.630-01	1.260+01	1.615+00	7.511-02	0.000	1.465+01	1.325-04	4.601-03	5.897-04	2.742-05	0.000	5.350-03
1.500+06	2.529-01	1.147+01	1.153+00	3.481-01	0.000	1.322+01	9.234-05	4.188-03	4.210-04	1.271-04	0.000	4.828-03
2.000+06	1.428-01	9.798+00	6.991-01	1.107+00	0.000	1.175+01	5.214-05	3.578-03	2.553-04	4.042-04	0.000	4.289-03
2.044+06	1.367-01	9.678+00	6.742-01	1.177+00	0.000	1.167+01	4.991-05	3.534-03	2.462-04	4.298-04	0.000	4.260-03
3.000+06	6.364-02	7.717+00	3.679-01	2.613+00	2.697-03	1.076+01	2.324-05	2.818-03	1.343-04	9.541-04	9.847-07	3.930-03
4.000+06	3.583-02	6.440+00	2.422-01	3.888+00	1.100-02	1.062+01	1.308-05	2.351-03	8.843-05	1.420-03	4.016-06	3.877-03
5.000+06	2.294-02	5.562+00	1.782-01	4.971+00	2.188-02	1.076+01	8.376-06	2.031-03	6.567-05	1.815-03	7.989-06	3.927-03
6.000+06	1.594-02	4.917+00	1.401-01	5.902+00	3.355-02	1.101+01	5.820-06	1.795-03	5.115-05	2.155-03	1.225-05	4.020-03
7.000+06	1.171-02	4.420+00	1.151-01	6.724+00	4.517-02	1.132+01	4.276-06	1.614-03	4.203-05	2.455-03	1.649-05	4.132-03
8.000+06	8.968-03	4.023+00	9.739-02	7.463+00	5.640-02	1.165+01	3.274-06	1.469-03	3.556-05	2.725-03	2.059-05	4.253-03
9.000+06	7.086-03	3.698+00	8.432-02	8.134+00	6.713-02	1.199+01	2.587-06	1.350-03	3.079-05	2.970-03	2.451-05	4.378-03
1.000+07	5.740-03	3.427+00	7.426-02	8.750+00	7.731-02	1.233+01	2.096-06	1.251-03	2.712-05	3.195-03	2.823-05	4.504-03
1.100+07	4.714-03	3.196+00	6.634-02	9.319+00	8.694-02	1.267+01	1.732-06	1.167-03	2.422-05	3.403-03	3.174-05	4.627-03
1.200+07	3.986-03	2.997+00	5.990-02	9.848+00	9.600-02	1.300+01	1.455-06	1.094-03	2.187-05	3.596-03	3.505-05	4.748-03
1.300+07	3.397-03	2.824+00	5.459-02	1.034+01	1.045-01	1.333+01	1.240-06	1.031-03	1.993-05	3.775-03	3.816-05	4.866-03
1.400+07	2.929-03	2.672+00	5.013-02	1.080+01	1.126-01	1.364+01	1.069-06	9.756-04	1.830-05	3.943-03	4.111-05	4.979-03
1.500+07	2.551-03	2.536+00	4.634-02	1.123+01	1.203-01	1.394+01	9.314-07	9.260-04	1.692-05	4.100-03	4.392-05	5.088-03
1.600+07	2.242-03	2.415+00	4.307-02	1.163+01	1.276-01	1.422+01	8.186-07	8.818-04	1.573-05	4.246-03	4.659-05	5.191-03
1.800+07	1.772-03	2.208+00	3.774-02	1.234+01	1.410-01	1.473+01	6.470-07	8.062-04	1.378-05	4.506-03	5.148-05	5.378-03
2.000+07	1.435-03	2.036+00	3.357-02	1.298+01	1.533-01	1.520+01	5.240-07	7.434-04	1.226-05	4.739-03	5.597-05	5.551-03
2.200+07	1.186-03	1.891+00	3.023-02	1.356+01	1.644-01	1.565+01	4.330-07	6.905-04	1.104-05	4.951-03	6.003-05	5.713-03
2.400+07	9.967-04	1.767+00	2.749-02	1.409+01	1.747-01	1.606+01	3.639-07	6.452-04	1.004-05	5.145-03	6.379-05	5.864-03
2.600+07	8.493-04	1.659+00	2.520-02	1.457+01	1.841-01	1.644+01	3.101-07	6.057-04	9.201-06	5.320-03	6.722-05	6.002-03
2.800+07	7.323-04	1.565+00	2.326-02	1.501+01	1.929-01	1.679+01	2.674-07	5.714-04	8.493-06	5.481-03	7.043-05	6.131-03
3.000+07	6.379-04	1.482+00	2.160-02	1.542+01	2.010-01	1.713+01	2.329-07	5.411-04	7.887-06	5.630-03	7.339-05	6.253-03
4.000+07	3.588-04	1.178+00	1.591-02	1.708+01	2.345-01	1.851+01	1.310-07	4.301-04	5.809-06	6.236-03	8.562-05	6.758-03
5.000+07	2.296-04	9.832-01	1.259-02	1.831+01	2.597-01	1.957+01	8.383-08	3.590-04	4.597-06	6.685-03	9.482-05	7.144-03
6.000+07	1.595-04	8.471-01	1.041-02	1.927+01	2.796-01	2.041+01	5.824-08	3.093-04	3.801-06	7.036-03	1.021-04	7.451-03
8.000+07	8.970-05	6.681-01	7.735-03	2.069+01	3.094-01	2.168+01	3.275-08	2.439-04	2.824-06	7.554-03	1.130-04	7.914-03
1.000+08	5.741-05	5.545-01	6.153-03	2.168+01	3.310-01	2.257+01	2.096-08	2.025-04	2.247-06	7.916-03	1.209-04	8.242-03
1.500+08	2.552-05	3.949-01	4.071-03	2.326+01	3.665-01	2.403+01	9.318-09	1.442-04	1.486-06	8.493-03	1.338-04	8.772-03
2.000+08	1.435-05	3.096-01	3.042-03	2.420+01	3.885-01	2.490+01	5.240-09	1.130-04	1.111-06	8.836-03	1.419-04	9.092-03
3.000+08	6.379-06	2.195-01	2.020-03	2.530+01	4.153-01	2.594+01	2.329-09	8.015-05	7.376-07	9.238-03	1.516-04	9.470-03
4.000+08	3.588-06	1.719-01	1.512-03	2.592+01	4.314-01	2.652+01	1.310-09	6.277-05	5.521-07	9.464-03	1.575-04	9.685-03
5.000+08	2.296-06	1.423-01	1.208-03	2.633+01	4.423-01	2.692+01	8.383-10	5.196-05	4.411-07	9.614-03	1.615-04	9.828-03
6.000+08	1.595-06	1.218-01	1.006-03	2.662+01	4.503-01	2.719+01	5.824-10	4.447-05	3.673-07	9.720-03	1.644-04	9.929-03
8.000+08	8.970-07	9.514-02	7.539-04	2.701+01	4.613-01	2.757+01	3.275-10	3.474-05	2.753-07	9.862-03	1.684-04	1.007-02
1.000+09	5.741-07	7.827-02	6.027-04	2.727+01	4.686-01	2.782+01	2.096-10	2.858-05	2.201-07	9.957-03	1.711-04	1.016-02
1.500+09	2.552-07	5.466-02	4.015-04	2.763+01	4.795-01	2.816+01	9.318-11	1.996-05	1.466-07	1.009-02	1.751-04	1.028-02
2.000+09	1.435-07	4.231-02	3.010-04	2.783+01	4.857-01	2.836+01	5.240-11	1.545-05	1.099-07	1.016-02	1.773-04	1.035-02
3.000+09	6.379-08	2.942-02	2.006-04	2.804+01	4.924-01	2.856+01	2.329-11	1.074-05	7.324-08	1.024-02	1.798-04	1.043-02
4.000+09	3.588-08	2.271-02	1.504-04	2.816+01	4.964-01	2.868+01	1.310-11	8.292-06	5.492-08	1.028-02	1.812-04	1.047-02
5.000+09	2.296-08	1.856-02	1.203-04	2.823+01	4.989-01	2.875+01	8.383-12	6.777-06	4.392-08	1.031-02	1.822-04	1.050-02
6.000+09	1.595-08	1.574-02	1.003-04	2.828+01	5.006-01	2.880+01	5.824-12	5.747-06	3.662-08	1.033-02	1.828-04	1.051-02
8.000+09	8.970-09	1.213-02	7.519-05	2.835+01	5.029-01	2.887+01	3.275-12	4.429-06	2.745-08	1.035-02	1.836-04	1.054-02
1.000+10	5.741-09	9.903-03	6.015-05	2.839+01	5.043-01	2.890+01	2.096-12	3.616-06	2.196-08	1.037-02	1.841-04	1.055-02
1.500+10	2.552-09	6.844-03	4.010-05	2.845+01	5.063-01	2.896+01	9.318-13	2.499-06	1.464-08	1.039-02	1.849-04	1.058-02
2.000+10	1.435-09	5.262-03	3.007-05	2.848+01	5.074-01	2.899+01	5.240-13	1.921-06	1.098-08	1.040-02	1.853-04	1.059-02
3.000+10	6.379-10	3.629-03	2.005-05	2.851+01	5.085-01	2.902+01	2.329-13	1.325-06	7.321-09	1.041-02	1.857-04	1.060-02
4.000+10	3.588-10	2.786-03	1.503-05	2.853+01	5.092-01	2.904+01	1.310-13	1.017-06	5.488-09	1.042-02	1.859-04	1.060-02
5.000+10	2.296-10	2.269-03	1.203-05	2.854+01	5.096-01	2.905+01	8.383-14	8.285-07	4.392-09	1.042-02	1.861-04	1.061-02
6.000+10	1.595-10	1.918-03	1.002-05	2.855+01	5.099-01	2.906+01	5.824-14	7.003-07	3.659-09	1.042-02	1.862-04	1.061-02
8.000+10	8.970-11	1.470-03	7.517-06	2.855+01	5.102-01	2.906+01	3.275-14	5.367-07	2.745-09	1.042-02	1.863-04	1.061-02
1.000+11	5.741-11	1.196-03	6.014-06	2.856+01	5.104-01	2.907+01	2.096-14	4.367-07	2.196-09	1.043-02	1.864-04	1.061-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 68, ER, ERBIUM ATOMIC WT. = 167.26 MSQ/KG = .00036004 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	5.894-01	1.428+01	2.677+00	0.000	0.000	1.755+01	2.122-04	5.141-03	9.638-04	0.000	0.000	6.317-03
1.022+06	5.647-01	1.413+01	2.562+00	0.000	0.000	1.726+01	2.033-04	5.087-03	9.224-04	0.000	0.000	6.213-03
1.250+06	3.795-01	1.279+01	1.727+00	7.822-02	0.000	1.497+01	1.366-04	4.605-03	6.218-04	2.816-05	0.000	5.392-03
1.500+06	2.644-01	1.164+01	1.232+00	3.628-01	0.000	1.350+01	9.519-05	4.191-03	4.436-04	1.306-04	0.000	4.860-03
2.000+06	1.493-01	9.944+00	7.471-01	1.149+00	0.000	1.199+01	5.375-05	3.580-03	2.690-04	4.177-04	0.000	4.317-03
2.044+06	1.430-01	9.822+00	7.205-01	1.222+00	0.000	1.191+01	5.149-05	3.536-03	2.594-04	4.400-04	0.000	4.287-03
3.000+06	6.655-02	7.832+00	3.929-01	2.700+00	2.737-03	1.099+01	2.396-05	2.820-03	1.415-04	9.721-04	9.854-07	3.958-03
4.000+06	3.748-02	6.536+00	2.586-01	4.009+00	1.116-02	1.085+01	1.349-05	2.353-03	9.311-05	1.443-03	4.018-06	3.907-03
5.000+06	2.400-02	5.645+00	1.902-01	5.119+00	2.220-02	1.100+01	8.641-06	2.032-03	6.848-05	1.843-03	7.993-06	3.961-03
6.000+06	1.667-02	4.991+00	1.495-01	6.074+00	3.405-02	1.127+01	6.002-06	1.797-03	5.383-05	2.187-03	1.226-05	4.056-03
7.000+06	1.225-02	4.486+00	1.228-01	6.917+00	4.583-02	1.158+01	4.411-06	1.615-03	4.421-05	2.490-03	1.650-05	4.171-03
8.000+06	9.379-03	4.083+00	1.039-01	7.674+00	5.723-02	1.193+01	3.377-06	1.470-03	3.741-05	2.763-03	2.061-05	4.294-03
9.000+06	7.411-03	3.753+00	8.994-02	8.362+00	6.812-02	1.228+01	2.668-06	1.351-03	3.238-05	3.011-03	2.453-05	4.421-03
1.000+07	6.003-03	3.478+00	7.922-02	8.993+00	7.845-02	1.263+01	2.161-06	1.252-03	2.852-05	3.238-03	2.825-05	4.549-03
1.100+07	4.962-03	3.244+00	7.075-02	9.577+00	8.821-02	1.298+01	1.787-06	1.168-03	2.547-05	3.448-03	3.176-05	4.675-03
1.200+07	4.169-03	3.042+00	6.388-02	1.012+01	9.740-02	1.333+01	1.501-06	1.095-03	2.300-05	3.644-03	3.507-05	4.798-03
1.300+07	3.553-03	2.866+00	5.821-02	1.063+01	1.061-01	1.366+01	1.279-06	1.032-03	2.096-05	3.827-03	3.820-05	4.920-03
1.400+07	3.063-03	2.711+00	5.345-02	1.110+01	1.143-01	1.398+01	1.103-06	9.761-04	1.924-05	3.996-03	4.115-05	5.034-03
1.500+07	2.668-03	2.574+00	4.940-02	1.153+01	1.221-01	1.428+01	9.606-07	9.267-04	1.779-05	4.151-03	4.396-05	5.141-03
1.600+07	2.345-03	2.451+00	4.592-02	1.194+01	1.294-01	1.457+01	8.443-07	8.825-04	1.653-05	4.299-03	4.659-05	5.245-03
1.800+07	1.853-03	2.241+00	4.023-02	1.268+01	1.431-01	1.511+01	6.672-07	8.069-04	1.448-05	4.565-03	5.152-05	5.439-03
2.000+07	1.501-03	2.066+00	3.579-02	1.333+01	1.555-01	1.559+01	5.404-07	7.438-04	1.289-05	4.799-03	5.599-05	5.613-03
2.200+07	1.241-03	1.919+00	3.222-02	1.393+01	1.668-01	1.605+01	4.468-07	6.909-04	1.160-05	5.015-03	6.005-05	5.778-03
2.400+07	1.042-03	1.793+00	2.930-02	1.447+01	1.772-01	1.647+01	3.752-07	6.456-04	1.055-05	5.210-03	6.380-05	5.930-03
2.600+07	8.862-04	1.684+00	2.686-02	1.496+01	1.868-01	1.686+01	3.198-07	6.063-04	9.671-06	5.386-03	6.726-05	6.070-03
2.800+07	7.659-04	1.589+00	2.479-02	1.542+01	1.956-01	1.723+01	2.758-07	5.721-04	8.925-06	5.552-03	7.042-05	6.204-03
3.000+07	6.672-04	1.504+00	2.302-02	1.584+01	2.039-01	1.757+01	2.402-07	5.415-04	8.288-06	5.703-03	7.341-05	6.326-03
4.000+07	3.753-04	1.195+00	1.695-02	1.754+01	2.378-01	1.899+01	1.351-07	4.302-04	6.103-06	6.315-03	8.562-05	6.837-03
5.000+07	2.402-04	9.979-01	1.341-02	1.881+01	2.633-01	2.008+01	8.648-08	3.593-04	4.828-06	6.772-03	9.480-05	7.231-03
6.000+07	1.668-04	8.598-01	1.109-02	1.979+01	2.835-01	2.094+01	6.005-08	3.096-04	3.993-06	7.125-03	1.021-04	7.541-03
8.000+07	9.382-05	6.781-01	8.241-03	2.124+01	3.137-01	2.224+01	3.378-08	2.441-04	2.967-06	7.647-03	1.129-04	8.007-03
1.000+08	6.004-05	5.628-01	6.555-03	2.227+01	3.355-01	2.317+01	2.162-08	2.026-04	2.360-06	8.018-03	1.208-04	8.344-03
1.500+08	2.669-05	4.038-01	4.337-03	2.389+01	3.713-01	2.467+01	9.609-09	1.443-04	1.561-06	8.601-03	1.337-04	8.881-03
2.000+08	1.501-05	3.142-01	3.240-03	2.485+01	3.936-01	2.556+01	5.404-09	1.131-04	1.167-06	8.947-03	1.417-04	9.203-03
3.000+08	6.671-06	2.227-01	2.152-03	2.597+01	4.206-01	2.662+01	2.402-09	8.018-05	7.748-07	9.350-03	1.514-04	9.583-03
4.000+08	3.753-06	1.744-01	1.611-03	2.661+01	4.368-01	2.722+01	1.351-09	6.279-05	5.800-07	9.581-03	1.573-04	9.801-03
5.000+08	2.402-06	1.444-01	1.287-03	2.703+01	4.478-01	2.762+01	8.648-10	5.199-05	4.634-07	9.732-03	1.612-04	9.946-03
6.000+08	1.668-06	1.236-01	1.072-03	2.733+01	4.558-01	2.791+01	6.005-10	4.450-05	3.860-07	9.840-03	1.641-04	1.005-02
8.000+08	9.382-07	9.656-02	8.030-04	2.773+01	4.669-01	2.829+01	3.378-10	3.477-05	2.891-07	9.984-03	1.681-04	1.019-02
1.000+09	6.004-07	7.944-02	6.421-04	2.798+01	4.743-01	2.853+01	2.162-10	2.860-05	2.312-07	1.007-02	1.708-04	1.027-02
1.500+09	2.669-07	5.548-02	4.277-04	2.836+01	4.852-01	2.890+01	9.609-11	1.998-05	1.540-07	1.021-02	1.747-04	1.041-02
2.000+09	1.501-07	4.294-02	3.207-04	2.856+01	4.915-01	2.909+01	5.404-11	1.546-05	1.155-07	1.028-02	1.770-04	1.048-02
3.000+09	6.671-08	2.986-02	2.137-04	2.878+01	4.982-01	2.931+01	2.402-11	1.075-05	7.694-08	1.036-02	1.794-04	1.055-02
4.000+09	3.753-08	2.305-02	1.602-04	2.890+01	5.023-01	2.943+01	1.351-11	8.299-06	5.768-08	1.041-02	1.808-04	1.059-02
5.000+09	2.402-08	1.884-02	1.282-04	2.897+01	5.047-01	2.949+01	8.648-12	6.783-06	4.616-08	1.043-02	1.817-04	1.062-02
6.000+09	1.668-08	1.598-02	1.068-04	2.902+01	5.064-01	2.954+01	6.005-12	5.753-06	3.845-08	1.045-02	1.823-04	1.064-02
8.000+09	9.382-09	1.231-02	8.009-05	2.909+01	5.087-01	2.961+01	3.378-12	4.432-06	2.884-08	1.047-02	1.832-04	1.066-02
1.000+10	6.004-09	1.005-02	6.407-05	2.913+01	5.102-01	2.965+01	2.162-12	3.618-06	2.307-08	1.049-02	1.837-04	1.068-02
1.500+10	2.669-09	6.946-03	4.271-05	2.919+01	5.121-01	2.971+01	9.609-13	2.501-06	1.538-08	1.051-02	1.844-04	1.070-02
2.000+10	1.501-09	5.340-03	3.203-05	2.922+01	5.133-01	2.974+01	5.404-13	1.923-06	1.153-08	1.052-02	1.848-04	1.071-02
3.000+10	6.671-10	3.683-03	2.135-05	2.926+01	5.144-01	2.978+01	2.402-13	1.326-06	7.687-09	1.053-02	1.852-04	1.072-02
4.000+10	3.753-10	2.827-03	1.602-05	2.927+01	5.151-01	2.979+01	1.351-13	1.018-06	5.768-09	1.054-02	1.855-04	1.072-02
5.000+10	2.402-10	2.302-03	1.281-05	2.928+01	5.155-01	2.980+01	8.648-14	8.288-07	4.612-09	1.054-02	1.856-04	1.073-02
6.000+10	1.668-10	1.946-03	1.068-05	2.929+01	5.158-01	2.981+01	6.005-14	7.006-07	3.845-09	1.055-02	1.857-04	1.073-02
8.000+10	9.382-11	1.492-03	8.007-06	2.930+01	5.161-01	2.982+01	3.378-14	5.372-07	2.883-09	1.055-02	1.858-04	1.074-02
1.000+11	6.004-11	1.214-03	6.406-06	2.931+01	5.163-01	2.983+01	2.162-14	4.371-07	2.306-09	1.055-02	1.859-04	1.074-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 69, TM, THULIUM ATOMIC WT. = 168.9342 MSQ/KG = .00035647 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	6.153-01	1.449+01	2.858+00	0.000	0.000	1.796+01	2.193-04	5.165-03	1.019-03	0.000	0.000	6.403-03
1.022+06	5.895-01	1.434+01	2.736+00	0.000	0.000	1.767+01	2.101-04	5.112-03	9.755-04	0.000	0.000	6.297-03
1.250+06	3.963-01	1.298+01	1.844+00	8.140-02	0.000	1.530+01	1.413-04	4.627-03	6.573-04	2.902-05	0.000	5.455-03
1.500+06	2.762-01	1.181+01	1.316+00	3.780-01	0.000	1.378+01	9.846-05	4.210-03	4.691-04	1.347-04	0.000	4.912-03
2.000+06	1.560-01	1.009+01	7.976-01	1.193+00	0.000	1.224+01	5.561-05	3.597-03	2.843-04	4.253-04	0.000	4.362-03
2.044+06	1.493-01	9.967+00	7.692-01	1.268+00	0.000	1.215+01	5.322-05	3.553-03	2.742-04	4.520-04	0.000	4.332-03
2.000+06	6.952-02	7.947+00	4.193-01	2.789+00	2.777-03	1.123+01	2.478-05	2.833-03	1.495-04	9.942-04	9.899-07	4.002-03
4.000+06	3.915-02	6.632+00	2.758-01	4.133+00	1.132-02	1.109+01	1.396-05	2.364-03	9.832-05	1.473-03	4.035-06	3.954-03
5.000+06	2.507-02	5.728+00	2.029-01	5.270+00	2.253-02	1.125+01	8.937-06	2.042-03	7.233-05	1.879-03	8.031-06	4.010-03
6.000+06	1.741-02	5.064+00	1.594-01	6.248+00	3.455-02	1.152+01	6.206-06	1.805-03	5.682-05	2.227-03	1.232-05	4.108-03
7.000+06	1.280-02	4.552+00	1.308-01	7.112+00	4.650-02	1.185+01	4.563-06	1.623-03	4.663-05	2.535-03	1.656-05	4.226-03
8.000+06	9.798-03	4.143+00	1.107-01	7.887+00	5.806-02	1.221+01	3.493-06	1.477-03	3.946-05	2.812-03	2.070-05	4.352-03
9.000+06	7.742-03	3.809+00	9.584-02	8.592+00	6.910-02	1.257+01	2.760-06	1.358-03	3.416-05	3.062-03	2.463-05	4.482-03
1.000+07	6.271-03	3.529+00	8.441-02	9.239+00	7.958-02	1.294+01	2.235-06	1.258-03	3.009-05	3.293-03	2.837-05	4.612-03
1.100+07	5.183-03	3.292+00	7.537-02	9.837+00	8.948-02	1.330+01	1.848-06	1.174-03	2.687-05	3.507-03	3.190-05	4.741-03
1.200+07	4.355-03	3.087+00	6.805-02	1.039+01	9.881-02	1.365+01	1.552-06	1.100-03	2.425-05	3.704-03	3.522-05	4.865-03
1.300+07	3.711-03	2.908+00	6.201-02	1.091+01	1.076-01	1.399+01	1.323-06	1.037-03	2.210-05	3.889-03	3.836-05	4.988-03
1.400+07	3.200-03	2.751+00	5.694-02	1.140+01	1.159-01	1.433+01	1.141-06	9.807-04	2.030-05	4.064-03	4.132-05	5.107-03
1.500+07	2.788-03	2.612+00	5.262-02	1.184+01	1.238-01	1.463+01	9.938-07	9.311-04	1.876-05	4.221-03	4.413-05	5.216-03
1.600+07	2.450-03	2.488+00	4.891-02	1.226+01	1.313-01	1.493+01	8.734-07	8.869-04	1.741-05	4.370-03	4.680-05	5.322-03
1.800+07	1.936-03	2.274+00	4.285-02	1.302+01	1.451-01	1.548+01	6.901-07	8.106-04	1.527-05	4.641-03	5.172-05	5.520-03
2.000+07	1.568-03	2.097+00	3.811-02	1.369+01	1.577-01	1.598+01	5.589-07	7.475-04	1.359-05	4.880-03	5.622-05	5.698-03
2.200+07	1.296-03	1.947+00	3.431-02	1.430+01	1.692-01	1.645+01	4.620-07	6.941-04	1.223-05	5.098-03	6.032-05	5.865-03
2.400+07	1.089-03	1.820+00	3.120-02	1.486+01	1.797-01	1.689+01	3.882-07	6.488-04	1.112-05	5.297-03	6.406-05	6.022-03
2.600+07	9.279-04	1.709+00	2.860-02	1.536+01	1.894-01	1.729+01	3.308-07	6.092-04	1.020-05	5.475-03	6.752-05	6.163-03
2.800+07	8.001-04	1.612+00	2.640-02	1.583+01	1.984-01	1.767+01	2.852-07	5.746-04	9.411-06	5.642-03	7.072-05	6.298-03
3.000+07	6.970-04	1.526+00	2.451-02	1.626+01	2.067-01	1.802+01	2.485-07	5.440-04	8.737-06	5.796-03	7.368-05	6.423-03
4.000+07	3.921-04	1.213+00	1.805-02	1.801+01	2.411-01	1.948+01	1.398-07	4.324-04	6.436-06	6.420-03	8.595-05	6.945-03
5.000+07	2.509-04	1.013+00	1.428-02	1.931+01	2.670-01	2.060+01	8.944-08	3.611-04	5.090-06	6.883-03	9.518-05	7.345-03
6.000+07	1.742-04	8.724-01	1.181-02	2.032+01	2.874-01	2.149+01	6.210-08	3.110-04	4.210-06	7.244-03	1.025-04	7.661-03
8.000+07	9.801-05	6.880-01	8.772-03	2.181+01	3.179-01	2.282+01	3.494-08	2.453-04	3.127-06	7.775-03	1.133-04	8.136-03
1.000+08	6.273-05	5.711-01	6.977-03	2.286+01	3.399-01	2.378+01	2.236-08	2.036-04	2.487-06	8.149-03	1.212-04	8.476-03
1.500+08	2.788-05	4.067-01	4.616-03	2.452+01	3.761-01	2.531+01	9.938-09	1.450-04	1.645-06	8.741-03	1.341-04	9.021-03
2.000+08	1.568-05	3.189-01	3.449-03	2.550+01	3.986-01	2.622+01	5.589-09	1.137-04	1.229-06	9.090-03	1.421-04	9.347-03
3.000+08	6.970-06	2.260-01	2.290-03	2.665+01	4.259-01	2.730+01	2.485-09	8.056-05	8.163-07	9.500-03	1.518-04	9.733-03
4.000+08	3.920-06	1.770-01	1.714-03	2.730+01	4.421-01	2.792+01	1.397-09	6.310-05	6.110-07	9.732-03	1.576-04	9.953-03
5.000+08	2.509-06	1.465-01	1.370-03	2.773+01	4.532-01	2.833+01	8.944-10	5.222-05	4.884-07	9.885-03	1.616-04	1.010-02
6.000+08	1.742-06	1.255-01	1.141-03	2.804+01	4.613-01	2.863+01	6.210-10	4.474-05	4.067-07	9.995-03	1.644-04	1.021-02
8.000+08	9.801-07	9.798-02	8.547-04	2.845+01	4.725-01	2.902+01	3.494-10	3.493-05	3.047-07	1.014-02	1.684-04	1.035-02
1.000+09	6.273-07	8.061-02	6.833-04	2.871+01	4.799-01	2.927+01	2.236-10	2.874-05	2.436-07	1.023-02	1.711-04	1.043-02
1.500+09	2.788-07	5.629-02	4.552-04	2.909+01	4.909-01	2.964+01	9.938-11	2.007-05	1.623-07	1.037-02	1.750-04	1.057-02
2.000+09	1.568-07	4.357-02	3.413-04	2.930+01	4.971-01	2.984+01	5.589-11	1.553-05	1.217-07	1.044-02	1.772-04	1.064-02
3.000+09	6.970-08	3.029-02	2.274-04	2.952+01	5.040-01	3.005+01	2.485-11	1.080-05	8.106-08	1.052-02	1.797-04	1.071-02
4.000+09	3.920-08	2.338-02	1.705-04	2.964+01	5.080-01	3.017+01	1.397-11	8.334-06	6.078-08	1.057-02	1.811-04	1.076-02
5.000+09	2.509-08	1.912-02	1.364-04	2.972+01	5.105-01	3.025+01	8.944-12	6.816-06	4.862-08	1.059-02	1.820-04	1.078-02
6.000+09	1.742-08	1.621-02	1.137-04	2.977+01	5.122-01	3.030+01	6.210-12	5.778-06	4.053-08	1.061-02	1.826-04	1.080-02
8.000+09	9.801-09	1.249-02	8.524-05	2.984+01	5.145-01	3.037+01	3.494-12	4.452-06	3.039-08	1.064-02	1.834-04	1.083-02
1.000+10	6.273-09	1.020-02	6.819-05	2.988+01	5.159-01	3.041+01	2.236-12	3.636-06	2.431-08	1.065-02	1.839-04	1.084-02
1.500+10	2.788-09	7.048-03	4.546-05	2.995+01	5.179-01	3.047+01	9.938-13	2.512-06	1.621-08	1.068-02	1.846-04	1.086-02
2.000+10	1.568-09	5.419-03	3.409-05	2.998+01	5.191-01	3.050+01	5.589-13	1.932-06	1.215-08	1.069-02	1.850-04	1.087-02
3.000+10	6.970-10	3.737-03	2.273-05	3.001+01	5.202-01	3.053+01	2.485-13	1.332-06	8.103-09	1.070-02	1.854-04	1.088-02
4.000+10	3.920-10	2.869-03	1.704-05	3.003+01	5.209-01	3.055+01	1.397-13	1.023-06	6.074-09	1.070-02	1.857-04	1.089-02
5.000+10	2.509-10	2.336-03	1.364-05	3.004+01	5.213-01	3.056+01	8.944-14	8.327-07	4.862-09	1.071-02	1.858-04	1.090-02
6.000+10	1.742-10	1.975-03	1.136-05	3.005+01	5.216-01	3.057+01	6.210-14	7.040-07	4.050-09	1.071-02	1.859-04	1.090-02
8.000+10	9.801-11	1.514-03	8.522-06	3.006+01	5.218-01	3.058+01	3.494-14	5.397-07	3.038-09	1.072-02	1.860-04	1.090-02
1.000+11	6.273-11	1.232-03	6.817-06	3.006+01	5.221-01	3.058+01	2.236-14	4.392-07	2.430-09	1.072-02	1.861-04	1.090-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 70, YB, YTTERBIUM ATOMIC WT. = 173.04 MSQ/KG = .00034801 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	6.422-01	1.469+01	3.050+00	0.000	0.000	1.838+01	2.235-04	5.112-03	1.061-03	0.000	0.000	6.397-03
1.022+06	6.153-01	1.454+01	2.919+00	0.000	0.000	1.807+01	2.141-04	5.060-03	1.016-03	0.000	0.000	6.290-03
1.250+06	4.136-01	1.316+01	1.968+00	8.465-02	0.000	1.563+01	1.439-04	4.580-03	6.849-04	2.946-05	0.000	5.438-03
1.500+06	2.883-01	1.198+01	1.404+00	3.937-01	0.000	1.407+01	1.003-04	4.169-03	4.886-04	1.370-04	0.000	4.895-03
2.000+06	1.628-01	1.024+01	8.507-01	1.238+00	0.000	1.249+01	5.666-05	3.564-03	2.961-04	4.308-04	0.000	4.347-03
2.044+06	1.559-01	1.011+01	8.204-01	1.315+00	0.000	1.240+01	5.426-05	3.518-03	2.855-04	4.576-04	0.000	4.316-03
3.000+06	7.259-02	8.062+00	4.470-01	2.879+00	2.818-03	1.146+01	2.526-05	2.806-03	1.556-04	1.002-03	9.807-07	3.989-03
4.000+06	4.088-02	6.728+00	2.939-01	4.258+00	1.149-02	1.133+01	1.423-05	2.341-03	1.023-04	1.482-03	3.999-06	3.944-03
5.000+06	2.618-02	5.811+00	2.161-01	5.423+00	2.285-02	1.150+01	9.111-06	2.022-03	7.521-05	1.887-03	7.952-06	4.002-03
6.000+06	1.818-02	5.137+00	1.698-01	6.425+00	3.504-02	1.179+01	6.327-06	1.788-03	5.909-05	2.235-03	1.219-05	4.101-03
7.000+06	1.336-02	4.618+00	1.393-01	7.308+00	4.717-02	1.213+01	4.649-06	1.607-03	4.848-05	2.543-03	1.642-05	4.220-03
8.000+06	1.023-02	4.203+00	1.179-01	8.102+00	5.889-02	1.249+01	3.560-06	1.463-03	4.103-05	2.820-03	2.049-05	4.347-03
9.000+06	8.084-03	3.864+00	1.020-01	8.824+00	7.009-02	1.287+01	2.813-06	1.345-03	3.550-05	3.071-03	2.439-05	4.478-03
1.000+07	6.549-03	3.580+00	8.986-02	9.487+00	8.072-02	1.324+01	2.279-06	1.246-03	3.127-05	3.302-03	2.809-05	4.609-03
1.100+07	5.412-03	3.339+00	8.023-02	1.010+01	9.076-02	1.362+01	1.883-06	1.162-03	2.792-05	3.515-03	3.159-05	4.738-03
1.200+07	4.548-03	3.132+00	7.243-02	1.067+01	1.002-01	1.398+01	1.583-06	1.090-03	2.521-05	3.713-03	3.487-05	4.865-03
1.300+07	3.875-03	2.950+00	6.599-02	1.120+01	1.091-01	1.433+01	1.349-06	1.027-03	2.297-05	3.898-03	3.797-05	4.987-03
1.400+07	3.342-03	2.791+00	6.059-02	1.170+01	1.176-01	1.467+01	1.163-06	9.713-04	2.109-05	4.072-03	4.093-05	5.106-03
1.500+07	2.911-03	2.650+00	5.600-02	1.216+01	1.256-01	1.499+01	1.013-06	9.222-04	1.949-05	4.232-03	4.371-05	5.218-03
1.600+07	2.559-03	2.524+00	5.204-02	1.259+01	1.331-01	1.530+01	8.906-07	8.784-04	1.811-05	4.382-03	4.632-05	5.325-03
1.800+07	2.022-03	2.307+00	4.559-02	1.336+01	1.472-01	1.586+01	7.037-07	8.029-04	1.587-05	4.649-03	5.123-05	5.520-03
2.000+07	1.638-03	2.127+00	4.055-02	1.405+01	1.599-01	1.638+01	5.700-07	7.402-04	1.411-05	4.890-03	5.565-05	5.700-03
2.200+07	1.353-03	1.976+00	3.650-02	1.468+01	1.715-01	1.687+01	4.709-07	6.877-04	1.270-05	5.109-03	5.968-05	5.869-03
2.400+07	1.137-03	1.846+00	3.319-02	1.524+01	1.822-01	1.730+01	3.957-07	6.424-04	1.155-05	5.304-03	6.341-05	6.022-03
2.600+07	9.690-04	1.734+00	3.042-02	1.577+01	1.920-01	1.773+01	3.372-07	6.035-04	1.059-05	5.488-03	6.682-05	6.169-03
2.800+07	8.355-04	1.635+00	2.808-02	1.624+01	2.011-01	1.811+01	2.908-07	5.690-04	9.772-06	5.652-03	6.999-05	6.301-03
3.000+07	7.278-04	1.549+00	2.607-02	1.668+01	2.096-01	1.847+01	2.533-07	5.391-04	9.073-06	5.809-03	7.294-05	6.426-03
4.000+07	4.094-04	1.231+00	1.919-02	1.848+01	2.444-01	1.997+01	1.425-07	4.284-04	6.678-06	6.431-03	8.505-05	6.952-03
5.000+07	2.620-04	1.027+00	1.518-02	1.981+01	2.706-01	2.112+01	9.118-08	3.574-04	5.283-06	6.894-03	9.417-05	7.351-03
6.000+07	1.820-04	8.850-01	1.256-02	2.085+01	2.912-01	2.204+01	6.334-08	3.080-04	4.371-06	7.256-03	1.013-04	7.670-03
8.000+07	1.024-04	6.980-01	9.328-03	2.237+01	3.221-01	2.340+01	3.564-08	2.429-04	3.246-06	7.785-03	1.121-04	8.143-03
1.000+08	6.550-05	5.793-01	7.420-03	2.345+01	3.444-01	2.438+01	2.279-08	2.016-04	2.582-06	8.161-03	1.199-04	8.485-03
1.500+08	2.911-05	4.126-01	4.908-03	2.515+01	3.809-01	2.595+01	1.013-08	1.436-04	1.708-06	8.753-03	1.326-04	9.030-03
2.000+08	1.638-05	3.235-01	3.667-03	2.616+01	4.036-01	2.689+01	5.700-09	1.126-04	1.276-06	9.104-03	1.405-04	9.358-03
3.000+08	7.278-06	2.293-01	2.435-03	2.733+01	4.311-01	2.799+01	2.533-09	7.980-05	8.474-07	9.511-03	1.500-04	9.742-03
4.000+08	4.094-06	1.796-01	1.823-03	2.800+01	4.475-01	2.863+01	1.425-09	6.250-05	6.344-07	9.744-03	1.557-04	9.963-03
5.000+08	2.620-06	1.486-01	1.457-03	2.844+01	4.586-01	2.905+01	9.118-10	5.171-05	5.071-07	9.898-03	1.596-04	1.011-02
6.000+08	1.819-06	1.273-01	1.213-03	2.876+01	4.668-01	2.936+01	6.330-10	4.430-05	4.221-07	1.001-02	1.625-04	1.022-02
8.000+08	1.023-06	9.940-02	9.087-04	2.917+01	4.780-01	2.975+01	3.560-10	3.459-05	3.162-07	1.015-02	1.664-04	1.035-02
1.000+09	6.550-07	8.178-02	7.266-04	2.944+01	4.855-01	3.001+01	2.279-10	2.846-05	2.529-07	1.025-02	1.690-04	1.044-02
1.500+09	2.911-07	5.711-02	4.840-04	2.983+01	4.965-01	3.038+01	1.013-10	1.988-05	1.684-07	1.038-02	1.728-04	1.057-02
2.000+09	1.638-07	4.420-02	3.628-04	3.005+01	5.028-01	3.060+01	5.700-11	1.538-05	1.263-07	1.046-02	1.750-04	1.065-02
3.000+09	7.278-08	3.073-02	2.418-04	3.028+01	5.097-01	3.082+01	2.533-11	1.069-05	8.415-08	1.054-02	1.774-04	1.073-02
4.000+09	4.094-08	2.372-02	1.813-04	3.040+01	5.137-01	3.094+01	1.425-11	8.255-06	6.310-08	1.058-02	1.788-04	1.077-02
5.000+09	2.620-08	1.940-02	1.450-04	3.048+01	5.162-01	3.102+01	9.118-12	6.751-06	5.046-08	1.061-02	1.796-04	1.079-02
6.000+09	1.819-08	1.645-02	1.209-04	3.053+01	5.179-01	3.106+01	6.330-12	5.725-06	4.207-08	1.062-02	1.802-04	1.081-02
8.000+09	1.023-08	1.267-02	9.063-05	3.060+01	5.202-01	3.113+01	3.560-12	4.409-06	3.154-08	1.065-02	1.810-04	1.083-02
1.000+10	6.550-09	1.035-02	7.250-05	3.065+01	5.217-01	3.118+01	2.279-12	3.602-06	2.523-08	1.067-02	1.816-04	1.085-02
1.500+10	2.911-09	7.150-03	4.833-05	3.071+01	5.237-01	3.124+01	1.013-12	2.488-06	1.682-08	1.069-02	1.823-04	1.087-02
2.000+10	1.638-09	5.497-03	3.625-05	3.074+01	5.248-01	3.127+01	5.700-13	1.913-06	1.262-08	1.070-02	1.826-04	1.088-02
3.000+10	7.278-10	3.791-03	2.416-05	3.078+01	5.259-01	3.131+01	2.533-13	1.319-06	8.408-09	1.071-02	1.830-04	1.090-02
4.000+10	4.094-10	2.911-03	1.812-05	3.079+01	5.266-01	3.132+01	1.425-13	1.013-06	6.306-09	1.072-02	1.833-04	1.090-02
5.000+10	2.620-10	2.370-03	1.450-05	3.081+01	5.271-01	3.134+01	9.118-14	8.248-07	5.046-09	1.072-02	1.834-04	1.091-02
6.000+10	1.819-10	2.003-03	1.208-05	3.081+01	5.273-01	3.134+01	6.330-14	6.971-07	4.204-09	1.072-02	1.835-04	1.091-02
8.000+10	1.023-10	1.536-03	9.061-06	3.082+01	5.276-01	3.135+01	3.560-14	5.346-07	3.153-09	1.073-02	1.836-04	1.091-02
1.000+11	6.550-11	1.250-03	7.249-06	3.083+01	5.278-01	3.136+01	2.279-14	4.350-07	2.523-09	1.073-02	1.837-04	1.091-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 71, LU, LUTETIUM ATOMIC WT. = 174.967 MSQ/KG = .00034418 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	6.694-01	1.490+01	3.251+00	0.000	0.000	1.882+01	2.304-04	5.128-03	1.119-03	0.000	0.000	6.478-03
1.022+06	6.414-01	1.475+01	3.111+00	0.000	0.000	1.850+01	2.208-04	5.077-03	1.071-03	0.000	0.000	6.368-03
1.250+06	4.313-01	1.335+01	2.098+00	8.802-02	0.000	1.597+01	1.484-04	4.595-03	7.221-04	3.029-05	0.000	5.496-03
1.500+06	3.006-01	1.215+01	1.496+00	4.098-01	0.000	1.436+01	1.035-04	4.182-03	5.149-04	1.410-04	0.000	4.941-03
2.000+06	1.698-01	1.038+01	9.065-01	1.284+00	0.000	1.274+01	5.844-05	3.573-03	3.120-04	4.419-04	0.000	4.385-03
2.044+06	1.626-01	1.025+01	8.742-01	1.364+00	0.000	1.265+01	5.596-05	3.528-03	3.009-04	4.695-04	0.000	4.354-03
3.000+06	7.571-02	8.176+00	4.751-01	2.971+00	2.858-03	1.170+01	2.606-05	2.814-03	1.639-04	1.023-03	9.837-07	4.028-03
4.000+06	4.264-02	6.824+00	3.129-01	4.386+00	1.165-02	1.158+01	1.468-05	2.349-03	1.077-04	1.510-03	4.010-06	3.985-03
5.000+06	2.730-02	5.894+00	2.300-01	5.579+00	2.318-02	1.175+01	9.396-06	2.029-03	7.916-05	1.920-03	7.978-06	4.045-03
6.000+06	1.897-02	5.211+00	1.807-01	6.603+00	3.554-02	1.205+01	6.529-06	1.794-03	6.219-05	2.273-03	1.223-05	4.147-03
7.000+06	1.394-02	4.684+00	1.433-01	7.507+00	4.783-02	1.240+01	4.798-06	1.612-03	5.104-05	2.584-03	1.646-05	4.268-03
8.000+06	1.067-02	4.263+00	1.254-01	8.320+00	5.972-02	1.278+01	3.672-06	1.467-03	4.316-05	2.864-03	2.055-05	4.398-03
9.000+06	8.433-03	3.919+00	1.085-01	9.059+00	7.108-02	1.317+01	2.902-06	1.349-03	3.734-05	3.118-03	2.446-05	4.532-03
1.000+07	6.831-03	3.631+00	9.557-02	9.737+00	8.185-02	1.355+01	2.351-06	1.250-03	3.289-05	3.351-03	2.817-05	4.664-03
1.100+07	5.646-03	3.387+00	8.532-02	1.036+01	9.203-02	1.393+01	1.943-06	1.166-03	2.937-05	3.566-03	3.168-05	4.794-03
1.200+07	4.744-03	3.176+00	7.702-02	1.095+01	1.016-01	1.431+01	1.633-06	1.093-03	2.651-05	3.769-03	3.497-05	4.925-03
1.300+07	4.043-03	2.992+00	7.017-02	1.149+01	1.106-01	1.467+01	1.392-06	1.030-03	2.415-05	3.955-03	3.807-05	5.048-03
1.400+07	3.486-03	2.831+00	6.443-02	1.200+01	1.192-01	1.502+01	1.200-06	9.744-04	2.218-05	4.130-03	4.103-05	5.169-03
1.500+07	3.036-03	2.688+00	5.954-02	1.247+01	1.273-01	1.535+01	1.045-06	9.252-04	2.049-05	4.292-03	4.381-05	5.282-03
1.600+07	2.669-03	2.560+00	5.533-02	1.291+01	1.350-01	1.566+01	9.186-07	8.811-04	1.904-05	4.443-03	4.646-05	5.391-03
1.800+07	2.109-03	2.339+00	4.847-02	1.371+01	1.492-01	1.625+01	7.259-07	8.050-04	1.668-05	4.719-03	5.135-05	5.593-03
2.000+07	1.708-03	2.157+00	4.310-02	1.441+01	1.621-01	1.677+01	5.879-07	7.424-04	1.483-05	4.960-03	5.579-05	5.773-03
2.200+07	1.412-03	2.004+00	3.880-02	1.505+01	1.739-01	1.727+01	4.860-07	6.897-04	1.335-05	5.180-03	5.985-05	5.943-03
2.400+07	1.186-03	1.872+00	3.528-02	1.564+01	1.847-01	1.773+01	4.082-07	6.443-04	1.214-05	5.383-03	6.357-05	6.103-03
2.600+07	1.011-03	1.758+00	3.233-02	1.617+01	1.947-01	1.816+01	3.480-07	6.051-04	1.113-05	5.565-03	6.701-05	6.249-03
2.800+07	8.715-04	1.659+00	2.984-02	1.666+01	2.039-01	1.855+01	3.000-07	5.710-04	1.027-05	5.734-03	7.018-05	6.386-03
3.000+07	7.592-04	1.571+00	2.771-02	1.711+01	2.124-01	1.892+01	2.613-07	5.407-04	9.537-06	5.889-03	7.310-05	6.513-03
4.000+07	4.270-04	1.248+00	2.040-02	1.895+01	2.477-01	2.047+01	1.470-07	4.295-04	7.021-06	6.522-03	8.525-05	7.044-03
5.000+07	2.733-04	1.042+00	1.613-02	2.032+01	2.742-01	2.165+01	9.406-08	3.586-04	5.552-06	6.994-03	9.437-05	7.452-03
6.000+07	1.898-04	8.977-01	1.334-02	2.138+01	2.951-01	2.259+01	6.533-08	3.090-04	4.591-06	7.359-03	1.016-04	7.774-03
8.000+07	1.068-04	7.080-01	9.911-03	2.295+01	3.263-01	2.399+01	3.676-08	2.437-04	3.411-06	7.809-03	1.123-04	8.258-03
1.000+08	6.833-05	5.876-01	7.883-03	2.405+01	3.488-01	2.499+01	2.352-08	2.022-04	2.713-06	8.278-03	1.201-04	8.603-03
1.500+08	3.037-05	4.185-01	5.215-03	2.579+01	3.858-01	2.660+01	1.045-08	1.440-04	1.795-06	8.876-03	1.328-04	9.155-03
2.000+08	1.708-05	3.281-01	3.896-03	2.682+01	4.087-01	2.756+01	5.879-09	1.129-04	1.341-06	9.231-03	1.407-04	9.486-03
3.000+08	7.592-06	2.326-01	2.587-03	2.802+01	4.365-01	2.869+01	2.613-09	8.006-05	8.904-07	9.644-03	1.502-04	9.875-03
4.000+08	4.270-06	1.821-01	1.936-03	2.871+01	4.530-01	2.935+01	1.470-09	6.268-05	6.663-07	9.881-03	1.559-04	1.010-02
5.000+08	2.733-06	1.508-01	1.547-03	2.916+01	4.643-01	2.978+01	9.406-10	5.190-05	5.324-07	1.004-02	1.598-04	1.025-02
6.000+08	1.898-06	1.291-01	1.288-03	2.948+01	4.726-01	3.008+01	6.533-10	4.443-05	4.433-07	1.015-02	1.627-04	1.035-02
8.000+08	1.068-06	1.008-01	9.654-04	2.991+01	4.839-01	3.050+01	3.676-10	3.469-05	3.323-07	1.029-02	1.665-04	1.050-02
1.000+09	6.833-07	8.294-02	7.718-04	3.018+01	4.914-01	3.076+01	2.352-10	2.855-05	2.656-07	1.039-02	1.691-04	1.059-02
1.500+09	3.037-07	5.793-02	5.142-04	3.058+01	5.026-01	3.114+01	1.045-10	1.994-05	1.770-07	1.053-02	1.730-04	1.072-02
2.000+09	1.708-07	4.483-02	3.855-04	3.080+01	5.090-01	3.135+01	5.879-11	1.543-05	1.327-07	1.060-02	1.752-04	1.079-02
3.000+09	7.592-08	3.117-02	2.569-04	3.104+01	5.159-01	3.159+01	2.613-11	1.073-05	8.842-08	1.068-02	1.776-04	1.087-02
4.000+09	4.270-08	2.466-02	1.926-04	3.116+01	5.200-01	3.170+01	1.470-11	8.281-06	6.629-08	1.072-02	1.790-04	1.091-02
5.000+09	2.733-08	1.967-02	1.541-04	3.124+01	5.224-01	3.178+01	9.406-12	6.770-06	5.304-08	1.075-02	1.798-04	1.094-02
6.000+09	1.898-08	1.668-02	1.284-04	3.130+01	5.242-01	3.184+01	6.533-12	5.741-06	4.419-08	1.077-02	1.804-04	1.096-02
8.000+09	1.068-08	1.285-02	9.628-05	3.137+01	5.265-01	3.191+01	3.676-12	4.423-06	3.314-08	1.080-02	1.812-04	1.098-02
1.000+10	6.833-09	1.049-02	7.702-05	3.141+01	5.280-01	3.195+01	2.352-12	3.610-06	2.651-08	1.081-02	1.817-04	1.100-02
1.500+10	3.037-09	7.252-03	5.134-05	3.148+01	5.300-01	3.202+01	1.045-12	2.496-06	1.767-08	1.083-02	1.824-04	1.102-02
2.000+10	1.708-09	5.576-03	3.850-05	3.151+01	5.312-01	3.205+01	5.879-13	1.919-06	1.325-08	1.085-02	1.828-04	1.103-02
3.000+10	7.592-10	3.845-03	2.567-05	3.155+01	5.323-01	3.209+01	2.613-13	1.323-06	8.835-09	1.086-02	1.832-04	1.104-02
4.000+10	4.270-10	2.952-03	1.925-05	3.156+01	5.330-01	3.210+01	1.470-13	1.016-06	6.625-09	1.086-02	1.834-04	1.105-02
5.000+10	2.733-10	2.404-03	1.540-05	3.158+01	5.334-01	3.212+01	9.406-14	8.274-07	5.300-09	1.087-02	1.836-04	1.105-02
6.000+10	1.898-10	2.032-03	1.283-05	3.158+01	5.337-01	3.212+01	6.533-14	6.994-07	4.416-09	1.087-02	1.837-04	1.105-02
8.000+10	1.068-10	1.558-03	9.625-06	3.160+01	5.340-01	3.214+01	3.676-14	5.362-07	3.313-09	1.088-02	1.838-04	1.106-02
1.000+11	6.833-11	1.268-03	7.700-06	3.160+01	5.342-01	3.214+01	2.352-14	4.364-07	2.650-09	1.088-02	1.839-04	1.106-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 72, HF, HAFNIUM ATOMIC WT. = 178.49 MSQ/KG = .00033739 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	6.975-01	1.511+01	3.463+00	0.000	0.000	1.927+01	2.353-04	5.098-03	1.168-03	0.000	0.000	6.502-03
1.022+06	6.683-01	1.495+01	3.314+00	0.000	0.000	1.893+01	2.255-04	5.044-03	1.118-03	0.000	0.000	6.388-03
1.250+06	4.494-01	1.354+01	2.234+00	9.144-02	0.000	1.631+01	1.516-04	4.568-03	7.537-04	3.085-05	0.000	5.504-03
1.500+06	3.133-01	1.232+01	1.593+00	4.264-01	0.000	1.465+01	1.057-04	4.157-03	5.375-04	1.439-04	0.000	4.944-03
2.000+06	1.770-01	1.053+01	9.652-01	1.332+00	0.000	1.300+01	5.972-05	3.553-03	3.256-04	4.494-04	0.000	4.387-03
2.044+06	1.695-01	1.040+01	9.308-01	1.414+00	0.000	1.291+01	5.719-05	3.509-03	3.140-04	4.771-04	0.000	4.357-03
3.000+06	7.893-02	8.291+00	5.067-01	3.065+00	2.898-03	1.194+01	2.663-05	2.797-03	1.710-04	1.034-03	9.778-07	4.030-03
4.000+06	4.445-02	6.520+00	3.329-01	4.515+00	1.181-02	1.182+01	1.500-05	2.335-03	1.123-04	1.523-03	3.985-06	3.989-03
5.000+06	2.847-02	5.977+00	2.447-01	5.735+00	2.350-02	1.201+01	9.605-06	2.017-03	8.256-05	1.935-03	7.929-06	4.052-03
6.000+06	1.977-02	5.284+00	1.921-01	6.783+00	3.603-02	1.231+01	6.670-06	1.783-03	6.481-05	2.289-03	1.216-05	4.155-03
7.000+06	1.453-02	4.750+00	1.576-01	7.708+00	4.850-02	1.268+01	4.902-06	1.603-03	5.317-05	2.601-03	1.636-05	4.278-03
8.000+06	1.113-02	4.323+00	1.333-01	8.540+00	6.055-02	1.307+01	3.755-06	1.459-03	4.497-05	2.881-03	2.043-05	4.409-03
9.000+06	8.792-03	3.974+00	1.154-01	9.296+00	7.206-02	1.347+01	2.966-06	1.341-03	3.893-05	3.136-03	2.431-05	4.543-03
1.000+07	7.122-03	3.682+00	1.016-01	9.990+00	8.298-02	1.386+01	2.403-06	1.242-03	3.428-05	3.371-03	2.800-05	4.677-03
1.100+07	5.886-03	3.435+00	9.067-02	1.063+01	9.330-02	1.425+01	1.986-06	1.159-03	3.059-05	3.586-03	3.148-05	4.809-03
1.200+07	4.946-03	3.221+00	8.184-02	1.123+01	1.030-01	1.464+01	1.669-06	1.087-03	2.761-05	3.789-03	3.475-05	4.940-03
1.300+07	4.215-03	3.035+00	7.456-02	1.179+01	1.122-01	1.502+01	1.422-06	1.024-03	2.516-05	3.978-03	3.785-05	5.066-03
1.400+07	3.634-03	2.871+00	6.845-02	1.231+01	1.208-01	1.537+01	1.226-06	9.686-04	2.309-05	4.153-03	4.076-05	5.187-03
1.500+07	3.166-03	2.726+00	6.325-02	1.279+01	1.291-01	1.571+01	1.068-06	9.197-04	2.134-05	4.315-03	4.356-05	5.301-03
1.600+07	2.783-03	2.596+00	5.878-02	1.324+01	1.368-01	1.603+01	9.390-07	8.759-04	1.983-05	4.467-03	4.615-05	5.410-03
1.800+07	2.199-03	2.372+00	5.148-02	1.405+01	1.513-01	1.663+01	7.419-07	8.003-04	1.737-05	4.740-03	5.105-05	5.610-03
2.000+07	1.781-03	2.188+00	4.578-02	1.478+01	1.643-01	1.718+01	6.009-07	7.382-04	1.545-05	4.987-03	5.543-05	5.796-03
2.200+07	1.472-03	2.032+00	4.121-02	1.544+01	1.763-01	1.769+01	4.966-07	6.856-04	1.390-05	5.209-03	5.948-05	5.969-03
2.400+07	1.237-03	1.899+00	3.747-02	1.603+01	1.872-01	1.815+01	4.173-07	6.407-04	1.264-05	5.408-03	6.316-05	6.125-03
2.600+07	1.054-03	1.783+00	3.434-02	1.658+01	1.973-01	1.860+01	3.556-07	6.016-04	1.159-05	5.594-03	6.657-05	6.274-03
2.800+07	9.086-04	1.682+00	3.169-02	1.708+01	2.066-01	1.900+01	3.066-07	5.675-04	1.069-05	5.763-03	6.970-05	6.411-03
3.000+07	7.915-04	1.593+00	2.943-02	1.755+01	2.153-01	1.939+01	2.670-07	5.375-04	9.929-06	5.921-03	7.264-05	6.541-03
4.000+07	4.452-04	1.266+00	2.166-02	1.943+01	2.510-01	2.097+01	1.502-07	4.271-04	7.308-06	6.555-03	8.468-05	7.075-03
5.000+07	2.850-04	1.057+00	1.713-02	2.083+01	2.778-01	2.218+01	9.616-08	3.566-04	5.779-06	7.028-03	9.373-05	7.484-03
6.000+07	1.979-04	9.103-01	1.417-02	2.192+01	2.989-01	2.314+01	6.677-08	3.071-04	4.781-06	7.396-03	1.008-04	7.808-03
8.000+07	1.113-04	7.179-01	1.052-02	2.352+01	3.305-01	2.458+01	3.755-08	2.422-04	3.549-06	7.935-03	1.115-04	8.293-03
1.000+08	7.124-05	5.959-01	8.369-03	2.465+01	3.533-01	2.561+01	2.404-08	2.010-04	2.824-06	8.317-03	1.192-04	8.640-03
1.500+08	3.166-05	4.244-01	5.536-03	2.643+01	3.907-01	2.725+01	1.068-08	1.432-04	1.868-06	8.917-03	1.318-04	9.194-03
2.000+08	1.781-05	3.327-01	4.136-03	2.749+01	4.138-01	2.824+01	6.009-09	1.122-04	1.395-06	9.275-03	1.396-04	9.528-03
3.000+08	7.915-06	2.358-01	2.746-03	2.872+01	4.419-01	2.940+01	2.670-09	7.956-05	9.265-07	9.690-03	1.491-04	9.919-03
4.000+08	4.452-06	1.847-01	2.056-03	2.942+01	4.587-01	3.007+01	1.502-09	6.232-05	6.937-07	9.926-03	1.548-04	1.014-02
5.000+08	2.849-06	1.529-01	1.643-03	2.988+01	4.700-01	3.050+01	9.612-10	5.159-05	5.543-07	1.008-02	1.586-04	1.029-02
6.000+08	1.979-06	1.309-01	1.368-03	3.021+01	4.784-01	3.082+01	6.677-10	4.416-05	4.615-07	1.019-02	1.614-04	1.040-02
8.000+08	1.113-06	1.022-01	1.025-03	3.065+01	4.898-01	3.124+01	3.755-10	3.448-05	3.458-07	1.034-02	1.653-04	1.054-02
1.000+09	7.124-07	8.411-02	8.193-04	3.093+01	4.974-01	3.151+01	2.404-10	2.838-05	2.764-07	1.044-02	1.678-04	1.063-02
1.500+09	3.166-07	5.874-02	5.458-04	3.134+01	5.087-01	3.191+01	1.068-10	1.982-05	1.841-07	1.057-02	1.716-04	1.077-02
2.000+09	1.781-07	4.546-02	4.092-04	3.156+01	5.151-01	3.212+01	6.009-11	1.534-05	1.381-07	1.065-02	1.738-04	1.086-02
3.000+09	7.915-08	3.161-02	2.727-04	3.180+01	5.221-01	3.235+01	2.670-11	1.066-05	9.201-08	1.073-02	1.762-04	1.092-02
4.000+09	4.452-08	2.440-02	2.045-04	3.193+01	5.262-01	3.248+01	1.502-11	8.232-06	6.900-08	1.077-02	1.775-04	1.096-02
5.000+09	2.849-08	1.995-02	1.636-04	3.201+01	5.287-01	3.256+01	9.612-12	6.731-06	5.520-08	1.080-02	1.784-04	1.098-02
6.000+09	1.979-08	1.692-02	1.363-04	3.207+01	5.305-01	3.262+01	6.677-12	5.709-06	4.599-08	1.082-02	1.790-04	1.100-02
8.000+09	1.113-08	1.303-02	1.022-04	3.214+01	5.328-01	3.269+01	3.755-12	4.396-06	3.448-08	1.084-02	1.798-04	1.103-02
1.000+10	7.124-09	1.064-02	8.176-05	3.219+01	5.343-01	3.274+01	2.404-12	3.590-06	2.758-08	1.086-02	1.803-04	1.104-02
1.500+10	3.166-09	7.355-03	5.450-05	3.225+01	5.363-01	3.279+01	1.068-12	2.481-06	1.839-08	1.088-02	1.809-04	1.106-02
2.000+10	1.781-09	5.654-03	4.087-05	3.229+01	5.375-01	3.283+01	6.009-13	1.908-06	1.379-08	1.089-02	1.813-04	1.108-02
3.000+10	7.915-10	3.899-03	2.725-05	3.232+01	5.386-01	3.286+01	2.670-13	1.315-06	9.194-09	1.090-02	1.817-04	1.109-02
4.000+10	4.452-10	2.994-03	2.044-05	3.234+01	5.393-01	3.288+01	1.502-13	1.010-06	6.896-09	1.091-02	1.820-04	1.109-02
5.000+10	2.849-10	2.438-03	1.635-05	3.236+01	5.397-01	3.290+01	9.612-14	8.226-07	5.516-09	1.092-02	1.821-04	1.110-02
6.000+10	1.979-10	2.061-03	1.362-05	3.236+01	5.400-01	3.290+01	6.677-14	6.954-07	4.595-09	1.092-02	1.822-04	1.110-02
8.000+10	1.113-10	1.580-03	1.022-05	3.237+01	5.403-01	3.291+01	3.755-14	5.331-07	3.448-09	1.092-02	1.823-04	1.110-02
1.000+11	7.124-11	1.286-03	8.174-06	3.238+01	5.405-01	3.292+01	2.404-14	4.339-07	2.758-09	1.092-02	1.824-04	1.111-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 73, TA, TANTALUM ATOMIC WT. = 180.9479 MSQ/KG = .00033281 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	7.264-01	1.532+01	3.684+00	0.000	0.000	1.973+01	2.417-04	5.099-03	1.226-03	0.000	0.000	6.566-03
1.022+06	6.560-01	1.516+01	3.526+00	0.000	0.000	1.938+01	2.316-04	5.045-03	1.173-03	0.000	0.000	6.450-03
1.250+06	4.681-01	1.372+01	2.378+00	9.494-02	0.000	1.666+01	1.558-04	4.566-03	7.914-04	3.160-05	0.000	5.545-03
1.500+06	3.264-01	1.249+01	1.696+00	4.435-01	0.000	1.496+01	1.086-04	4.157-03	5.644-04	1.476-04	0.000	4.977-03
2.000+06	1.844-01	1.067+01	1.027+00	1.380+00	0.000	1.326+01	6.137-05	3.551-03	3.418-04	4.593-04	0.000	4.413-03
2.044+06	1.766-01	1.054+01	9.902-01	1.465+00	0.000	1.317+01	5.877-05	3.508-03	3.295-04	4.876-04	0.000	4.384-03
3.000+06	8.224-02	8.406+00	5.389-01	3.161+00	2.938-03	1.219+01	2.737-05	2.798-03	1.793-04	1.052-03	9.778-07	4.057-03
4.000+06	4.632-02	7.016+00	3.539-01	4.646+00	1.198-02	1.207+01	1.542-05	2.335-03	1.178-04	1.546-03	3.987-06	4.018-03
5.000+06	2.966-02	6.060+00	2.600-01	5.893+00	2.382-02	1.227+01	9.871-06	2.017-03	8.653-05	1.961-03	7.927-06	4.082-03
6.000+06	2.061-02	5.357+00	2.041-01	6.965+00	3.653-02	1.258+01	6.859-06	1.783-03	6.793-05	2.318-03	1.216-05	4.188-03
7.000+06	1.514-02	4.815+00	1.674-01	7.911+00	4.916-02	1.296+01	5.039-06	1.602-03	5.571-05	2.633-03	1.636-05	4.312-03
8.000+06	1.160-02	4.383+00	1.416-01	8.761+00	6.138-02	1.336+01	3.861-06	1.459-03	4.713-05	2.916-03	2.043-05	4.446-03
9.000+06	9.162-03	4.029+00	1.225-01	9.534+00	7.305-02	1.377+01	3.049-06	1.341-03	4.077-05	3.173-03	2.431-05	4.582-03
1.000+07	7.422-03	3.733+00	1.079-01	1.024+01	8.411-02	1.417+01	2.470-06	1.242-03	3.591-05	3.408-03	2.799-05	4.717-03
1.100+07	6.135-03	3.482+00	9.627-02	1.090+01	9.457-02	1.458+01	2.042-06	1.159-03	3.204-05	3.628-03	3.147-05	4.852-03
1.200+07	5.155-03	3.266+00	8.689-02	1.151+01	1.044-01	1.497+01	1.716-06	1.087-03	2.892-05	3.831-03	3.474-05	4.983-03
1.300+07	4.393-03	3.077+00	7.915-02	1.208+01	1.137-01	1.535+01	1.462-06	1.024-03	2.634-05	4.020-03	3.784-05	5.110-03
1.400+07	3.788-03	2.911+00	7.266-02	1.262+01	1.225-01	1.573+01	1.261-06	9.688-04	2.418-05	4.200-03	4.077-05	5.235-03
1.500+07	3.299-03	2.764+00	6.714-02	1.311+01	1.308-01	1.608+01	1.098-06	9.199-04	2.234-05	4.363-03	4.353-05	5.350-03
1.600+07	2.900-03	2.632+00	6.239-02	1.357+01	1.387-01	1.641+01	9.651-07	8.759-04	2.076-05	4.516-03	4.616-05	5.460-03
1.800+07	2.291-03	2.405+00	5.464-02	1.441+01	1.533-01	1.703+01	7.625-07	8.004-04	1.818-05	4.796-03	5.102-05	5.666-03
2.000+07	1.856-03	2.218+00	4.859-02	1.515+01	1.665-01	1.758+01	6.177-07	7.382-04	1.617-05	5.042-03	5.541-05	5.852-03
2.200+07	1.534-03	2.060+00	4.374-02	1.582+01	1.786-01	1.810+01	5.105-07	6.856-04	1.456-05	5.265-03	5.944-05	6.025-03
2.400+07	1.289-03	1.925+00	3.976-02	1.643+01	1.897-01	1.859+01	4.290-07	6.407-04	1.323-05	5.468-03	6.313-05	6.185-03
2.600+07	1.098-03	1.808+00	3.644-02	1.699+01	1.999-01	1.904+01	3.654-07	6.017-04	1.213-05	5.654-03	6.653-05	6.335-03
2.800+07	9.469-04	1.705+00	3.363-02	1.751+01	2.094-01	1.946+01	3.151-07	5.674-04	1.119-05	5.827-03	6.969-05	6.476-03
3.000+07	8.249-04	1.615+00	3.122-02	1.798+01	2.181-01	1.985+01	2.745-07	5.375-04	1.039-05	5.984-03	7.258-05	6.605-03
4.000+07	4.640-04	1.283+00	2.298-02	1.992+01	2.543-01	2.148+01	1.544-07	4.270-04	7.648-06	6.629-03	8.463-05	7.149-03
5.000+07	2.970-04	1.071+00	1.817-02	2.135+01	2.814-01	2.272+01	9.884-08	3.564-04	6.047-06	7.105-03	9.365-05	7.562-03
6.000+07	2.062-04	9.230-01	1.503-02	2.247+01	3.028-01	2.371+01	6.862-08	3.072-04	5.002-06	7.478-03	1.008-04	7.891-03
8.000+07	1.160-04	7.279-01	1.116-02	2.410+01	3.347-01	2.517+01	3.861-08	2.422-04	3.714-06	8.021-03	1.114-04	8.378-03
1.000+08	7.424-05	6.042-01	8.878-03	2.526+01	3.578-01	2.623+01	2.471-08	2.011-04	2.955-06	8.407-03	1.191-04	8.739-03
1.500+08	3.300-05	4.303-01	5.872-03	2.708+01	3.956-01	2.791+01	1.098-08	1.432-04	1.954-06	9.012-03	1.317-04	9.289-03
2.000+08	1.856-05	3.373-01	4.387-03	2.817+01	4.190-01	2.893+01	6.177-09	1.123-04	1.460-06	9.375-03	1.394-04	9.628-03
3.000+08	8.249-06	2.391-01	2.913-03	2.942+01	4.473-01	3.011+01	2.745-09	7.957-05	9.695-07	9.791-03	1.489-04	1.002-02
4.000+08	4.640-06	1.873-01	2.180-03	3.014+01	4.642-01	3.079+01	1.544-09	6.233-05	7.255-07	1.003-02	1.545-04	1.025-02
5.000+08	2.970-06	1.550-01	1.742-03	3.061+01	4.757-01	3.124+01	9.884-10	5.158-05	5.797-07	1.019-02	1.583-04	1.040-02
6.000+08	2.062-06	1.327-01	1.451-03	3.095+01	4.841-01	3.157+01	6.862-10	4.416-05	4.829-07	1.030-02	1.611-04	1.051-02
8.000+08	1.160-06	1.037-01	1.087-03	3.140+01	4.957-01	3.200+01	3.861-10	3.451-05	3.618-07	1.045-02	1.650-04	1.065-02
1.000+09	7.424-07	8.528-02	8.690-04	3.169+01	5.033-01	3.228+01	2.471-10	2.838-05	2.892-07	1.055-02	1.675-04	1.074-02
1.500+09	3.300-07	5.956-02	5.789-04	3.210+01	5.147-01	3.267+01	1.098-10	1.982-05	1.927-07	1.068-02	1.713-04	1.087-02
2.000+09	1.856-07	4.610-02	4.340-04	3.233+01	5.211-01	3.290+01	6.177-11	1.534-05	1.444-07	1.076-02	1.734-04	1.095-02
3.000+09	8.249-08	3.205-02	2.892-04	3.258+01	5.281-01	3.314+01	2.745-11	1.067-05	9.625-08	1.084-02	1.758-04	1.103-02
4.000+09	4.640-08	2.474-02	2.169-04	3.271+01	5.323-01	3.327+01	1.544-11	8.234-06	7.219-08	1.089-02	1.772-04	1.107-02
5.000+09	2.970-08	2.023-02	1.735-04	3.279+01	5.348-01	3.335+01	9.884-12	6.733-06	5.774-08	1.091-02	1.780-04	1.110-02
6.000+09	2.062-08	1.715-02	1.445-04	3.285+01	5.366-01	3.340+01	6.862-12	5.708-06	4.809-08	1.093-02	1.786-04	1.112-02
8.000+09	1.160-08	1.322-02	1.084-04	3.292+01	5.389-01	3.347+01	3.861-12	4.400-06	3.608-08	1.096-02	1.793-04	1.114-02
1.000+10	7.424-09	1.079-02	8.671-05	3.297+01	5.404-01	3.352+01	2.471-12	3.591-06	2.886-08	1.097-02	1.798-04	1.116-02
1.500+10	3.300-09	7.457-03	5.781-05	3.304+01	5.424-01	3.359+01	1.098-12	2.482-06	1.924-08	1.100-02	1.805-04	1.118-02
2.000+10	1.856-09	5.733-03	4.335-05	3.307+01	5.436-01	3.362+01	6.177-13	1.908-06	1.443-08	1.101-02	1.809-04	1.119-02
3.000+10	8.249-10	3.954-03	2.890-05	3.311+01	5.447-01	3.366+01	2.745-13	1.316-06	9.618-09	1.102-02	1.813-04	1.120-02
4.000+10	4.640-10	3.035-03	2.167-05	3.313+01	5.455-01	3.368+01	1.544-13	1.010-06	7.212-09	1.103-02	1.815-04	1.121-02
5.000+10	2.970-10	2.472-03	1.734-05	3.314+01	5.459-01	3.369+01	9.884-14	8.227-07	5.771-09	1.103-02	1.817-04	1.121-02
6.000+10	2.062-10	2.089-03	1.445-05	3.315+01	5.462-01	3.370+01	6.862-14	6.952-07	4.809-09	1.103-02	1.818-04	1.121-02
8.000+10	1.160-10	1.502-03	1.084-05	3.316+01	5.465-01	3.371+01	3.861-14	5.332-07	3.608-09	1.104-02	1.819-04	1.122-02
1.000+11	7.424-11	1.303-03	8.670-06	3.317+01	5.467-01	3.372+01	2.471-14	4.336-07	2.885-09	1.104-02	1.819-04	1.122-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 74, W , TUNGSTEN ATOMIC WT. = 183.85 MSQ/KG = .00032755 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	7.562-01	1.553+01	3.917+00	0.000	0.000	2.020+01	2.477-04	5.087-03	1.283-03	0.000	0.000	6.618-03
1.022+06	7.246-01	1.536+01	3.749+00	0.000	0.000	1.983+01	2.373-04	5.031-03	1.228-03	0.000	0.000	6.497-03
1.250+06	4.874-01	1.391+01	2.528+00	9.852-02	0.000	1.702+01	1.596-04	4.556-03	8.281-04	3.227-05	0.000	5.576-03
1.500+06	3.399-01	1.266+01	1.803+00	4.611-01	0.000	1.526+01	1.113-04	4.147-03	5.906-04	1.510-04	0.000	5.000-03
2.000+06	1.921-01	1.082+01	1.091+00	1.430+00	0.000	1.353+01	6.292-05	3.544-03	3.574-04	4.684-04	0.000	4.433-03
2.044+06	1.839-01	1.069+01	1.053+00	1.517+00	0.000	1.344+01	6.024-05	3.502-03	3.449-04	4.969-04	0.000	4.404-03
3.000+06	8.567-02	8.521+00	5.725-01	3.258+00	2.978-03	1.244+01	2.806-05	2.791-03	1.875-04	1.067-03	9.755-07	4.075-03
4.000+06	4.825-02	7.112+00	3.759-01	4.778+00	1.214-02	1.233+01	1.580-05	2.330-03	1.231-04	1.565-03	3.976-06	4.038-03
5.000+06	3.090-02	6.143+00	2.761-01	6.053+00	2.415-02	1.253+01	1.012-05	2.012-03	9.044-05	1.983-03	7.910-06	4.103-03
6.000+06	2.147-02	5.430+00	2.167-01	7.149+00	3.702-02	1.285+01	7.033-06	1.779-03	7.098-05	2.342-03	1.213-05	4.210-03
7.000+06	1.577-02	4.881+00	1.777-01	8.116+00	4.983-02	1.324+01	5.165-06	1.599-03	5.821-05	2.658-03	1.632-05	4.337-03
8.000+06	1.208-02	4.443+00	1.503-01	8.985+00	6.221-02	1.365+01	3.957-06	1.455-03	4.923-05	2.943-03	2.038-05	4.472-03
9.000+06	9.545-03	4.084+00	1.300-01	9.776+00	7.403-02	1.407+01	3.126-06	1.338-03	4.258-05	3.202-03	2.425-05	4.610-03
1.000+07	7.732-03	3.785+00	1.144-01	1.050+01	8.524-02	1.449+01	2.533-06	1.240-03	3.747-05	3.439-03	2.792-05	4.747-03
1.100+07	6.390-03	3.530+00	1.021-01	1.117+01	9.584-02	1.490+01	2.093-06	1.156-03	3.344-05	3.659-03	3.139-05	4.882-03
1.200+07	5.370-03	3.311+00	9.217-02	1.180+01	1.058-01	1.531+01	1.759-06	1.085-03	3.019-05	3.865-03	3.466-05	5.016-03
1.300+07	4.576-03	3.119+00	8.396-02	1.238+01	1.152-01	1.570+01	1.499-06	1.022-03	2.750-05	4.055-03	3.773-05	5.143-03
1.400+07	3.946-03	2.951+00	7.707-02	1.293+01	1.241-01	1.609+01	1.293-06	9.666-04	2.524-05	4.235-03	4.065-05	5.269-03
1.500+07	3.437-03	2.801+00	7.121-02	1.343+01	1.325-01	1.644+01	1.126-06	9.175-04	2.332-05	4.399-03	4.340-05	5.384-03
1.600+07	3.021-03	2.668+00	6.617-02	1.391+01	1.405-01	1.679+01	9.895-07	8.739-04	2.167-05	4.556-03	4.602-05	5.499-03
1.800+07	2.387-03	2.438+00	5.795-02	1.476+01	1.553-01	1.741+01	7.819-07	7.986-04	1.898-05	4.835-03	5.087-05	5.704-03
2.000+07	1.933-03	2.248+00	5.153-02	1.552+01	1.687-01	1.799+01	6.332-07	7.363-04	1.688-05	5.084-03	5.526-05	5.893-03
2.200+07	1.598-03	2.089+00	4.638-02	1.621+01	1.810-01	1.853+01	5.234-07	6.843-04	1.519-05	5.310-03	5.929-05	6.069-03
2.400+07	1.343-03	1.952+00	4.216-02	1.684+01	1.922-01	1.903+01	4.399-07	6.394-04	1.381-05	5.516-03	6.296-05	6.233-03
2.600+07	1.144-03	1.833+00	3.864-02	1.741+01	2.025-01	1.949+01	3.747-07	6.004-04	1.266-05	5.703-03	6.633-05	6.382-03
2.800+07	9.865-04	1.729+00	3.566-02	1.794+01	2.121-01	1.992+01	3.231-07	5.663-04	1.168-05	5.876-03	6.947-05	6.524-03
3.000+07	8.593-04	1.637+00	3.310-02	1.842+01	2.210-01	2.031+01	2.815-07	5.362-04	1.084-05	6.034-03	7.239-05	6.653-03
4.000+07	4.834-04	1.301+00	2.436-02	2.040+01	2.575-01	2.198+01	1.583-07	4.261-04	7.979-06	6.682-03	8.434-05	7.201-03
5.000+07	3.094-04	1.086+00	1.927-02	2.187+01	2.850-01	2.326+01	1.013-07	3.557-04	6.312-06	7.164-03	9.335-05	7.619-03
6.000+07	2.148-04	9.356-01	1.593-02	2.301+01	3.067-01	2.427+01	7.036-08	3.065-04	5.218-06	7.537-03	1.005-04	7.949-03
8.000+07	1.208-04	7.379-01	1.183-02	2.469+01	3.390-01	2.578+01	3.957-08	2.417-04	3.875-06	8.087-03	1.110-04	8.444-03
1.000+08	7.734-05	6.124-01	9.410-03	2.587+01	3.623-01	2.685+01	2.533-08	2.006-04	3.082-06	8.474-03	1.187-04	8.796-03
1.500+08	3.437-05	4.362-01	6.224-03	2.774+01	4.005-01	2.858+01	1.126-08	1.429-04	2.039-06	9.086-03	1.312-04	9.362-03
2.000+08	1.933-05	3.420-01	4.649-03	2.885+01	4.241-01	2.962+01	6.332-09	1.120-04	1.523-06	9.450-03	1.389-04	9.702-03
3.000+08	8.593-06	2.424-01	3.087-03	3.013+01	4.527-01	3.083+01	2.815-09	7.940-05	1.011-06	9.869-03	1.483-04	1.010-02
4.000+08	4.834-06	1.898-01	2.311-03	3.087+01	4.698-01	3.153+01	1.583-09	6.217-05	7.570-07	1.011-02	1.539-04	1.033-02
5.000+08	3.094-06	1.571-01	1.846-03	3.135+01	4.814-01	3.199+01	1.013-09	5.146-05	6.047-07	1.027-02	1.577-04	1.048-02
6.000+08	2.148-06	1.345-01	1.537-03	3.169+01	4.898-01	3.232+01	7.036-10	4.406-05	5.034-07	1.038-02	1.604-04	1.059-02
8.000+08	1.208-06	1.051-01	1.152-03	3.215+01	5.015-01	3.276+01	3.957-10	3.443-05	3.773-07	1.053-02	1.643-04	1.073-02
1.000+09	7.734-07	8.645-02	9.209-04	3.245+01	5.092-01	3.305+01	2.533-10	2.832-05	3.016-07	1.063-02	1.668-04	1.082-02
1.500+09	3.437-07	6.037-02	6.135-04	3.287+01	5.206-01	3.345+01	1.126-10	1.977-05	2.010-07	1.077-02	1.705-04	1.096-02
2.000+09	1.933-07	4.673-02	4.599-04	3.310+01	5.271-01	3.367+01	6.332-11	1.531-05	1.506-07	1.084-02	1.727-04	1.103-02
3.000+09	8.593-08	3.249-02	3.065-04	3.336+01	5.341-01	3.393+01	2.815-11	1.064-05	1.004-07	1.093-02	1.749-04	1.111-02
4.000+09	4.834-08	2.508-02	2.298-04	3.349+01	5.383-01	3.405+01	1.583-11	8.215-06	7.527-08	1.097-02	1.763-04	1.115-02
5.000+09	3.094-08	2.050-02	1.838-04	3.358+01	5.408-01	3.414+01	1.013-11	6.715-06	6.020-08	1.100-02	1.771-04	1.118-02
6.000+09	2.148-08	1.739-02	1.532-04	3.363+01	5.426-01	3.419+01	7.036-12	5.696-06	5.018-08	1.102-02	1.777-04	1.120-02
8.000+09	1.208-08	1.340-02	1.149-04	3.371+01	5.450-01	3.427+01	3.957-12	4.389-06	3.764-08	1.104-02	1.785-04	1.122-02
1.000+10	7.734-09	1.096-02	9.189-05	3.376+01	5.465-01	3.432+01	2.533-12	3.583-06	3.010-08	1.106-02	1.790-04	1.124-02
1.500+10	3.437-09	7.559-03	6.126-05	3.383+01	5.485-01	3.439+01	1.126-12	2.476-06	2.007-08	1.108-02	1.797-04	1.126-02
2.000+10	1.933-09	5.811-03	4.594-05	3.387+01	5.497-01	3.443+01	6.332-13	1.903-06	1.505-08	1.109-02	1.801-04	1.128-02
3.000+10	8.593-10	4.008-03	3.063-05	3.390+01	5.508-01	3.445+01	2.815-13	1.313-06	1.003-08	1.110-02	1.804-04	1.129-02
4.000+10	4.834-10	3.077-03	2.297-05	3.392+01	5.515-01	3.447+01	1.583-13	1.008-06	7.524-09	1.111-02	1.806-04	1.129-02
5.000+10	3.094-10	2.506-03	1.838-05	3.394+01	5.520-01	3.449+01	1.013-13	8.208-07	6.020-09	1.112-02	1.808-04	1.130-02
6.000+10	2.148-10	2.118-03	1.531-05	3.394+01	5.522-01	3.449+01	7.036-14	6.938-07	5.015-09	1.112-02	1.809-04	1.130-02
8.000+10	1.208-10	1.624-03	1.148-05	3.396+01	5.525-01	3.451+01	3.957-14	5.319-07	3.760-09	1.112-02	1.810-04	1.131-02
1.000+11	7.734-11	1.321-03	9.187-06	3.396+01	5.528-01	3.451+01	2.533-14	4.327-07	3.009-09	1.112-02	1.811-04	1.131-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 75, RE, RHENIUM ATOMIC WT. = 186.207 1SQ/KG = .00032341 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	7.869-01	1.573+01	4.162+00	0.000	0.000	2.068+01	2.545-04	5.087-03	1.346-03	0.000	0.000	6.688-03
1.022+06	7.540-01	1.537+01	3.983+00	0.000	0.000	2.031+01	2.438-04	5.035-03	1.288-03	0.000	0.000	6.567-03
1.250+06	5.073-01	1.410+01	2.686+00	1.022-01	0.000	1.740+01	1.641-04	4.560-03	8.687-04	3.305-05	0.000	5.626-03
1.500+06	3.538-01	1.283+01	1.915+00	4.793-01	0.000	1.558+01	1.144-04	4.149-03	6.193-04	1.550-04	0.000	5.038-03
2.000+06	2.000-01	1.096+01	1.159+00	1.481+00	0.000	1.380+01	6.468-05	3.545-03	3.748-04	4.790-04	0.000	4.463-03
2.044+06	1.915-01	1.083+01	1.118+00	1.571+00	0.000	1.371+01	6.193-05	3.502-03	3.616-04	5.081-04	0.000	4.434-03
3.000+06	8.920-02	8.636+00	6.078-01	3.357+00	3.018-03	1.269+01	2.885-05	2.793-03	1.966-04	1.086-03	9.760-07	4.105-03
4.000+06	5.024-02	7.287+00	3.989-01	4.911+00	1.230-02	1.258+01	1.625-05	2.331-03	1.290-04	1.588-03	3.978-06	4.068-03
5.000+06	3.218-02	6.226+00	2.929-01	6.215+00	2.447-02	1.279+01	1.041-05	2.014-03	9.473-05	2.010-03	7.914-06	4.137-03
6.000+06	2.235-02	5.504+00	2.299-01	7.335+00	3.752-02	1.313+01	7.228-06	1.780-03	7.435-05	2.372-03	1.213-05	4.246-03
7.000+06	1.643-02	4.947+00	1.885-01	8.323+00	5.049-02	1.353+01	5.314-06	1.600-03	6.096-05	2.692-03	1.633-05	4.374-03
8.000+06	1.258-02	4.503+00	1.593-01	9.211+00	6.303-02	1.395+01	4.068-06	1.456-03	5.152-05	2.979-03	2.038-05	4.511-03
9.000+06	9.940-03	4.140+00	1.378-01	1.002+01	7.501-02	1.438+01	3.215-06	1.339-03	4.457-05	3.241-03	2.426-05	4.651-03
1.000+07	8.052-03	3.836+00	1.213-01	1.076+01	8.637-02	1.481+01	2.604-06	1.241-03	3.923-05	3.480-03	2.793-05	4.790-03
1.100+07	6.655-03	3.578+00	1.083-01	1.145+01	9.711-02	1.524+01	2.152-06	1.157-03	3.502-05	3.703-03	3.141-05	4.929-03
1.200+07	5.592-03	3.355+00	9.771-02	1.209+01	1.072-01	1.566+01	1.808-06	1.085-03	3.160-05	3.910-03	3.467-05	5.063-03
1.300+07	4.765-03	3.161+00	8.899-02	1.268+01	1.167-01	1.605+01	1.541-06	1.022-03	2.878-05	4.101-03	3.774-05	5.191-03
1.400+07	4.109-03	2.991+00	8.169-02	1.324+01	1.258-01	1.644+01	1.329-06	9.673-04	2.642-05	4.282-03	4.068-05	5.318-03
1.500+07	3.579-03	2.839+00	7.547-02	1.376+01	1.343-01	1.681+01	1.157-06	9.181-04	2.441-05	4.450-03	4.343-05	5.437-03
1.600+07	3.146-03	2.704+00	7.013-02	1.424+01	1.424-01	1.716+01	1.017-06	8.745-04	2.268-05	4.605-03	4.605-05	5.550-03
1.800+07	2.486-03	2.471+00	6.141-02	1.512+01	1.574-01	1.781+01	8.040-07	7.991-04	1.986-05	4.890-03	5.090-05	5.761-03
2.000+07	2.013-03	2.279+00	5.460-02	1.590+01	1.709-01	1.841+01	6.510-07	7.370-04	1.766-05	5.142-03	5.527-05	5.953-03
2.200+07	1.664-03	2.117+00	4.914-02	1.660+01	1.833-01	1.895+01	5.381-07	6.847-04	1.589-05	5.369-03	5.928-05	6.129-03
2.400+07	1.398-03	1.978+00	4.467-02	1.724+01	1.947-01	1.946+01	4.521-07	6.397-04	1.445-05	5.576-03	6.297-05	6.293-03
2.600+07	1.191-03	1.857+00	4.094-02	1.783+01	2.052-01	1.993+01	3.852-07	6.006-04	1.324-05	5.766-03	6.636-05	6.447-03
2.800+07	1.027-03	1.752+00	3.778-02	1.837+01	2.148-01	2.038+01	3.321-07	5.666-04	1.222-05	5.941-03	6.947-05	6.590-03
3.000+07	8.949-04	1.659+00	3.507-02	1.887+01	2.238-01	2.079+01	2.894-07	5.365-04	1.134-05	6.103-03	7.238-05	6.723-03
4.000+07	5.034-04	1.318+00	2.581-02	2.089+01	2.608-01	2.250+01	1.628-07	4.262-04	8.347-06	6.756-03	8.434-05	7.275-03
5.000+07	3.222-04	1.101+00	2.041-02	2.240+01	2.886-01	2.381+01	1.042-07	3.561-04	6.601-06	7.244-03	9.333-05	7.700-03
6.000+07	2.237-04	9.433-01	1.687-02	2.357+01	3.105-01	2.485+01	7.235-08	3.067-04	5.456-06	7.623-03	1.004-04	8.035-03
8.000+07	1.258-04	7.479-01	1.253-02	2.528+01	3.432-01	2.638+01	4.068-08	2.419-04	4.052-06	8.176-03	1.110-04	8.533-03
1.000+08	8.054-05	6.207-01	9.966-03	2.649+01	3.668-01	2.749+01	2.605-08	2.007-04	3.223-06	8.567-03	1.186-04	8.890-03
1.500+08	3.580-05	4.420-01	6.591-03	2.840+01	4.053-01	2.925+01	1.158-08	1.429-04	2.132-06	9.185-03	1.311-04	9.461-03
2.000+08	2.013-05	3.466-01	4.924-03	2.953+01	4.292-01	3.031+01	6.510-09	1.121-04	1.592-06	9.550-03	1.388-04	9.803-03
3.000+08	8.949-06	2.457-01	3.269-03	3.085+01	4.581-01	3.156+01	2.894-09	7.946-05	1.057-06	9.977-03	1.482-04	1.021-02
4.000+08	5.034-06	1.924-01	2.447-03	3.160+01	4.753-01	3.227+01	1.628-09	6.222-05	7.914-07	1.022-02	1.537-04	1.044-02
5.000+08	3.222-06	1.593-01	1.955-03	3.209+01	4.870-01	3.274+01	1.042-09	5.152-05	6.323-07	1.038-02	1.575-04	1.059-02
6.000+08	2.237-06	1.364-01	1.628-03	3.244+01	4.955-01	3.307+01	7.235-10	4.411-05	5.265-07	1.049-02	1.602-04	1.070-02
8.000+08	1.258-06	1.065-01	1.220-03	3.291+01	5.072-01	3.352+01	4.068-10	3.444-05	3.946-07	1.064-02	1.640-04	1.084-02
1.000+09	8.054-07	8.762-02	9.753-04	3.321+01	5.150-01	3.381+01	2.605-10	2.834-05	3.154-07	1.074-02	1.666-04	1.094-02
1.500+09	3.580-07	6.119-02	6.496-04	3.365+01	5.265-01	3.424+01	1.158-10	1.979-05	2.101-07	1.088-02	1.703-04	1.107-02
2.000+09	2.013-07	4.736-02	4.870-04	3.389+01	5.330-01	3.447+01	6.510-11	1.532-05	1.575-07	1.096-02	1.724-04	1.115-02
3.000+09	8.949-08	3.293-02	3.246-04	3.414+01	5.401-01	3.471+01	2.894-11	1.065-05	1.050-07	1.104-02	1.747-04	1.123-02
4.000+09	5.034-08	2.542-02	2.434-04	3.428+01	5.443-01	3.485+01	1.628-11	8.221-06	7.872-08	1.109-02	1.760-04	1.127-02
5.000+09	3.222-08	2.078-02	1.947-04	3.437+01	5.468-01	3.494+01	1.042-11	6.720-06	6.297-08	1.112-02	1.768-04	1.130-02
6.000+09	2.237-08	1.762-02	1.622-04	3.443+01	5.486-01	3.500+01	7.235-12	5.698-06	5.246-08	1.113-02	1.774-04	1.132-02
8.000+09	1.258-08	1.358-02	1.216-04	3.451+01	5.510-01	3.507+01	4.068-12	4.392-06	3.933-08	1.116-02	1.782-04	1.134-02
1.000+10	8.054-09	1.109-02	9.731-05	3.456+01	5.525-01	3.512+01	2.605-12	3.587-06	3.147-08	1.118-02	1.787-04	1.136-02
1.500+10	3.580-09	7.661-03	6.487-05	3.463+01	5.545-01	3.519+01	1.158-12	2.478-06	2.098-08	1.120-02	1.793-04	1.138-02
2.000+10	2.013-09	5.890-03	4.865-05	3.466+01	5.557-01	3.522+01	6.510-13	1.905-06	1.573-08	1.121-02	1.797-04	1.139-02
3.000+10	8.949-10	4.062-03	3.243-05	3.470+01	5.568-01	3.526+01	2.894-13	1.314-06	1.049-08	1.122-02	1.801-04	1.140-02
4.000+10	5.034-10	3.118-03	2.432-05	3.472+01	5.576-01	3.528+01	1.628-13	1.008-06	7.865-09	1.123-02	1.803-04	1.141-02
5.000+10	3.222-10	2.539-03	1.946-05	3.474+01	5.580-01	3.530+01	1.042-13	8.211-07	6.293-09	1.124-02	1.805-04	1.142-02
6.000+10	2.237-10	2.147-03	1.622-05	3.474+01	5.583-01	3.530+01	7.235-14	6.944-07	5.246-09	1.124-02	1.806-04	1.142-02
8.000+10	1.258-10	1.646-03	1.216-05	3.476+01	5.585-01	3.532+01	4.068-14	5.323-07	3.933-09	1.124-02	1.806-04	1.142-02
1.000+11	8.054-11	1.339-03	9.729-06	3.476+01	5.588-01	3.532+01	2.605-14	4.330-07	3.146-09	1.124-02	1.807-04	1.142-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 76, OS, OSMIUM ATOMIC WT. = 190.2 MSQ/KG = .00031662 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	8.186-01	1.594+01	4.418+00	0.000	0.000	2.118+01	2.592-04	5.047-03	1.399-03	0.000	0.000	6.705-03
1.022+06	7.843-01	1.577+01	4.229+00	0.000	0.000	2.078+01	2.483-04	4.993-03	1.339-03	0.000	0.000	6.580-03
1.250+06	5.278-01	1.428+01	2.852+00	1.059-01	0.000	1.777+01	1.671-04	4.521-03	9.030-04	3.353-05	0.000	5.625-03
1.500+06	3.681-01	1.300+01	2.033+00	4.979-01	0.000	1.590+01	1.165-04	4.116-03	6.437-04	1.576-04	0.000	5.034-03
2.000+06	2.081-01	1.111+01	1.230+00	1.533+00	0.000	1.408+01	6.589-05	3.518-03	3.894-04	4.854-04	0.000	4.458-03
2.044+06	1.993-01	1.097+01	1.186+00	1.626+00	0.000	1.398+01	6.310-05	3.473-03	3.755-04	5.148-04	0.000	4.427-03
3.000+06	9.284-02	8.751+00	6.448-01	3.458+00	3.058-03	1.295+01	2.939-05	2.771-03	2.042-04	1.095-03	9.682-07	4.100-03
4.000+06	5.230-02	7.303+00	4.230-01	5.047+00	1.246-02	1.284+01	1.656-05	2.312-03	1.339-04	1.598-03	3.945-06	4.065-03
5.000+06	3.349-02	6.309+00	3.105-01	6.378+00	2.479-02	1.306+01	1.060-05	1.998-03	9.831-05	2.019-03	7.849-06	4.134-03
6.000+06	2.327-02	5.577+00	2.436-01	7.522+00	3.801-02	1.340+01	7.368-06	1.766-03	7.713-05	2.382-03	1.203-05	4.244-03
7.000+06	1.710-02	5.013+00	1.997-01	8.531+00	5.115-02	1.381+01	5.414-06	1.587-03	6.323-05	2.701-03	1.619-05	4.373-03
8.000+06	1.309-02	4.563+00	1.688-01	9.438+00	6.386-02	1.425+01	4.145-06	1.445-03	5.344-05	2.988-03	2.022-05	4.511-03
9.000+06	1.035-02	4.195+00	1.460-01	1.026+01	7.600-02	1.469+01	3.277-06	1.328-03	4.623-05	3.248-03	2.406-05	4.650-03
1.000+07	8.382-03	3.887+00	1.285-01	1.102+01	8.750-02	1.513+01	2.654-06	1.231-03	4.069-05	3.489-03	2.770-05	4.791-03
1.100+07	6.928-03	3.625+00	1.147-01	1.172+01	9.837-02	1.556+01	2.194-06	1.148-03	3.632-05	3.711-03	3.115-05	4.928-03
1.200+07	5.821-03	3.400+00	1.035-01	1.238+01	1.086-01	1.600+01	1.843-06	1.076-03	3.277-05	3.920-03	3.438-05	5.065-03
1.300+07	4.960-03	3.203+00	9.426-02	1.299+01	1.182-01	1.641+01	1.570-06	1.014-03	2.984-05	4.113-03	3.742-05	5.196-03
1.400+07	4.277-03	3.030+00	8.651-02	1.356+01	1.274-01	1.681+01	1.354-06	9.593-04	2.739-05	4.293-03	4.034-05	5.322-03
1.500+07	3.726-03	2.877+00	7.993-02	1.409+01	1.360-01	1.719+01	1.180-06	9.109-04	2.531-05	4.461-03	4.306-05	5.442-03
1.600+07	3.275-03	2.740+00	7.426-02	1.458+01	1.442-01	1.754+01	1.037-06	8.675-04	2.351-05	4.616-03	4.566-05	5.554-03
1.800+07	2.588-03	2.504+00	6.502-02	1.548+01	1.594-01	1.821+01	8.194-07	7.928-04	2.059-05	4.901-03	5.047-05	5.766-03
2.000+07	2.096-03	2.309+00	5.781-02	1.627+01	1.731-01	1.881+01	6.636-07	7.311-04	1.830-05	5.151-03	5.481-05	5.956-03
2.200+07	1.732-03	2.145+00	5.203-02	1.699+01	1.857-01	1.937+01	5.484-07	6.791-04	1.647-05	5.379-03	5.880-05	6.134-03
2.400+07	1.456-03	2.004+00	4.729-02	1.765+01	1.972-01	1.990+01	4.610-07	6.345-04	1.497-05	5.588-03	6.244-05	6.301-03
2.600+07	1.240-03	1.882+00	4.334-02	1.825+01	2.078-01	2.038+01	3.926-07	5.959-04	1.372-05	5.778-03	6.579-05	6.454-03
2.800+07	1.069-03	1.776+00	3.999-02	1.880+01	2.176-01	2.083+01	3.385-07	5.623-04	1.266-05	5.952-03	6.890-05	6.597-03
3.000+07	9.316-04	1.681+00	3.713-02	1.931+01	2.267-01	2.126+01	2.950-07	5.322-04	1.176-05	6.114-03	7.178-05	6.730-03
4.000+07	5.240-04	1.336+00	2.732-02	2.139+01	2.641-01	2.302+01	1.659-07	4.230-04	8.650-06	6.772-03	8.362-05	7.288-03
5.000+07	3.354-04	1.115+00	2.160-02	2.292+01	2.922-01	2.435+01	1.062-07	3.530-04	6.839-06	7.257-03	9.252-05	7.709-03
6.000+07	2.329-04	9.609-01	1.786-02	2.412+01	3.144-01	2.541+01	7.374-08	3.042-04	5.655-06	7.637-03	9.954-05	8.046-03
8.000+07	1.310-04	7.578-01	1.326-02	2.588+01	3.474-01	2.700+01	4.148-08	2.399-04	4.198-06	8.194-03	1.100-04	8.548-03
1.000+08	8.384-05	6.290-01	1.055-02	2.711+01	3.713-01	2.812+01	2.655-08	1.992-04	3.340-06	8.583-03	1.176-04	8.904-03
1.500+08	3.726-05	4.479-01	6.975-03	2.907+01	4.102-01	2.994+01	1.180-08	1.418-04	2.208-06	9.204-03	1.299-04	9.478-03
2.000+08	2.096-05	3.512-01	5.210-03	3.022+01	4.344-01	3.101+01	6.636-09	1.112-04	1.650-06	9.568-03	1.375-04	9.819-03
3.000+08	9.316-06	2.489-01	3.460-03	3.157+01	4.636-01	3.229+01	2.950-09	7.881-05	1.095-06	9.996-03	1.468-04	1.022-02
4.000+08	5.240-06	1.950-01	2.589-03	3.234+01	4.809-01	3.302+01	1.659-09	6.174-05	8.197-07	1.024-02	1.523-04	1.045-02
5.000+08	3.354-06	1.614-01	2.069-03	3.284+01	4.927-01	3.350+01	1.062-09	5.110-05	6.551-07	1.040-02	1.560-04	1.061-02
6.000+08	2.329-06	1.382-01	1.723-03	3.320+01	5.013-01	3.384+01	7.374-10	4.376-05	5.455-07	1.051-02	1.587-04	1.071-02
8.000+08	1.310-06	1.079-01	1.291-03	3.368+01	5.131-01	3.430+01	4.148-10	3.416-05	4.088-07	1.066-02	1.625-04	1.086-02
1.000+09	8.384-07	8.879-02	1.032-03	3.399+01	5.210-01	3.460+01	2.655-10	2.811-05	3.267-07	1.076-02	1.650-04	1.096-02
1.500+09	3.726-07	6.201-02	6.874-04	3.443+01	5.326-01	3.503+01	1.180-10	1.963-05	2.176-07	1.090-02	1.686-04	1.109-02
2.000+09	2.096-07	4.799-02	5.154-04	3.467+01	5.391-01	3.526+01	6.636-11	1.519-05	1.632-07	1.098-02	1.707-04	1.116-02
3.000+09	9.316-08	3.337-02	3.434-04	3.494+01	5.462-01	3.552+01	2.950-11	1.057-05	1.087-07	1.106-02	1.729-04	1.125-02
4.000+09	5.240-08	2.576-02	2.575-04	3.508+01	5.505-01	3.566+01	1.659-11	8.156-06	8.153-08	1.111-02	1.743-04	1.129-02
5.000+09	3.354-08	2.106-02	2.060-04	3.517+01	5.530-01	3.574+01	1.062-11	6.668-06	6.522-08	1.114-02	1.751-04	1.132-02
6.000+09	2.329-08	1.786-02	1.716-04	3.523+01	5.548-01	3.580+01	7.374-12	5.655-06	5.433-08	1.115-02	1.757-04	1.134-02
8.000+09	1.310-08	1.376-02	1.287-04	3.531+01	5.572-01	3.588+01	4.148-12	4.357-06	4.075-08	1.118-02	1.764-04	1.136-02
1.000+10	8.384-09	1.123-02	1.030-04	3.536+01	5.587-01	3.593+01	2.655-12	3.556-06	3.261-08	1.120-02	1.769-04	1.138-02
1.500+10	3.726-09	7.763-03	6.864-05	3.543+01	5.607-01	3.600+01	1.180-12	2.458-06	2.173-08	1.122-02	1.775-04	1.140-02
2.000+10	2.096-09	5.968-03	5.148-05	3.547+01	5.619-01	3.604+01	6.636-13	1.890-06	1.630-08	1.123-02	1.779-04	1.141-02
3.000+10	9.316-10	4.116-03	3.432-05	3.551+01	5.630-01	3.608+01	2.950-13	1.303-06	1.087-08	1.124-02	1.783-04	1.142-02
4.000+10	5.240-10	3.160-03	2.574-05	3.553+01	5.638-01	3.610+01	1.659-13	1.001-06	8.150-09	1.125-02	1.785-04	1.143-02
5.000+10	3.354-10	2.573-03	2.059-05	3.554+01	5.642-01	3.611+01	1.062-13	8.147-07	6.519-09	1.125-02	1.786-04	1.143-02
6.000+10	2.329-10	2.175-03	1.716-05	3.555+01	5.645-01	3.612+01	7.374-14	6.886-07	5.433-09	1.126-02	1.787-04	1.144-02
8.000+10	1.310-10	1.668-03	1.287-05	3.556+01	5.648-01	3.613+01	4.148-14	5.281-07	4.075-09	1.126-02	1.788-04	1.144-02
1.000+11	8.384-11	1.357-03	1.029-05	3.557+01	5.650-01	3.614+01	2.655-14	4.296-07	3.258-09	1.126-02	1.789-04	1.144-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV $Z=1$ to 100—Continued

Z = 77, IR, IRIDIUM ATOMIC WT. = 192.22 MSQ/KG = .00031329 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	8.512-01	1.615+01	4.686+00	0.000	0.000	2.169+01	2.667-04	5.060-03	1.468-03	0.000	0.000	6.794-03
1.022+06	8.156-01	1.598+01	4.485+00	0.000	0.000	2.128+01	2.555-04	5.006-03	1.405-03	0.000	0.000	6.667-03
1.250+06	5.489-01	1.447+01	3.025+00	1.098-01	0.000	1.815+01	1.720-04	4.533-03	9.477-04	3.440-05	0.000	5.687-03
1.500+06	3.829-01	1.317+01	2.156+00	5.171-01	0.000	1.623+01	1.200-04	4.126-03	6.755-04	1.620-04	0.000	5.083-03
2.000+06	2.165-01	1.126+01	1.305+00	1.587+00	0.000	1.437+01	6.783-05	3.528-03	4.088-04	4.972-04	0.000	4.501-03
2.044+06	2.073-01	1.112+01	1.258+00	1.682+00	0.000	1.427+01	6.494-05	3.484-03	3.941-04	5.270-04	0.000	4.470-03
3.000+06	9.660-02	8.866+00	6.834-01	3.561+00	3.098-03	1.321+01	3.026-05	2.778-03	2.141-04	1.116-03	9.706-07	4.139-03
4.000+06	5.442-02	7.399+00	4.482-01	5.184+00	1.263-02	1.310+01	1.705-05	2.318-03	1.404-04	1.624-03	3.957-06	4.104-03
5.000+06	3.485-02	6.392+00	3.289-01	6.542+00	2.512-02	1.332+01	1.092-05	2.003-03	1.030-04	2.050-03	7.870-06	4.174-03
6.000+06	2.421-02	5.650+00	2.386-01	7.711+00	3.851-02	1.368+01	7.585-06	1.770-03	8.083-05	2.416-03	1.206-05	4.286-03
7.000+06	1.779-02	5.079+00	2.115-01	8.741+00	5.182-02	1.410+01	5.573-06	1.591-03	6.626-05	2.738-03	1.623-05	4.418-03
8.000+06	1.363-02	4.623+00	1.788-01	9.668+00	6.469-02	1.455+01	4.270-06	1.448-03	5.602-05	3.029-03	2.027-05	4.558-03
9.000+06	1.077-02	4.250+00	1.546-01	1.051+01	7.698-02	1.500+01	3.374-06	1.331-03	4.843-05	3.293-03	2.412-05	4.700-03
1.000+07	8.722-03	3.938+00	1.360-01	1.129+01	8.863-02	1.546+01	2.733-06	1.234-03	4.261-05	3.537-03	2.777-05	4.844-03
1.100+07	7.209-03	3.673+00	1.214-01	1.200+01	9.964-02	1.590+01	2.259-06	1.151-03	3.803-05	3.759-03	3.122-05	4.982-03
1.200+07	6.058-03	3.445+00	1.095-01	1.267+01	1.100-01	1.634+01	1.898-06	1.079-03	3.431-05	3.969-03	3.446-05	5.119-03
1.300+07	5.162-03	3.245+00	9.975-02	1.329+01	1.198-01	1.676+01	1.617-06	1.017-03	3.125-05	4.164-03	3.753-05	5.251-03
1.400+07	4.451-03	3.070+00	9.155-02	1.387+01	1.290-01	1.717+01	1.394-06	9.618-04	2.868-05	4.345-03	4.041-05	5.378-03
1.500+07	3.877-03	2.915+00	8.458-02	1.442+01	1.378-01	1.756+01	1.215-06	9.132-04	2.650-05	4.518-03	4.317-05	5.502-03
1.600+07	3.408-03	2.776+00	7.858-02	1.492+01	1.461-01	1.792+01	1.068-06	8.697-04	2.462-05	4.674-03	4.577-05	5.615-03
1.800+07	2.693-03	2.537+00	6.880-02	1.584+01	1.614-01	1.861+01	8.437-07	7.948-04	2.155-05	4.963-03	5.056-05	5.830-03
2.000+07	2.181-03	2.340+00	6.116-02	1.665+01	1.753-01	1.923+01	6.833-07	7.331-04	1.916-05	5.216-03	5.492-05	6.024-03
2.200+07	1.803-03	2.173+00	5.504-02	1.739+01	1.880-01	1.981+01	5.649-07	6.808-04	1.724-05	5.448-03	5.890-05	6.206-03
2.400+07	1.515-03	2.031+00	5.003-02	1.806+01	1.997-01	2.034+01	4.746-07	6.363-04	1.567-05	5.658-03	6.256-05	6.373-03
2.600+07	1.291-03	1.907+00	4.585-02	1.868+01	2.104-01	2.084+01	4.045-07	5.974-04	1.436-05	5.852-03	6.592-05	6.530-03
2.800+07	1.113-03	1.799+00	4.231-02	1.924+01	2.203-01	2.130+01	3.487-07	5.636-04	1.326-05	6.028-03	6.902-05	6.674-03
3.000+07	9.694-04	1.703+00	3.927-02	1.976+01	2.295-01	2.173+01	3.037-07	5.335-04	1.230-05	6.191-03	7.190-05	6.809-03
4.000+07	5.453-04	1.354+00	2.889-02	2.188+01	2.674-01	2.353+01	1.708-07	4.242-04	9.051-06	6.855-03	8.377-05	7.372-03
5.000+07	3.490-04	1.130+00	2.284-02	2.346+01	2.958-01	2.491+01	1.093-07	3.540-04	7.156-06	7.350-03	9.267-05	7.804-03
6.000+07	2.424-04	9.735-01	1.889-02	2.468+01	3.182-01	2.599+01	7.594-08	3.050-04	5.918-06	7.732-03	9.969-05	8.143-03
8.000+07	1.363-04	7.678-01	1.403-02	2.647+01	3.516-01	2.760+01	4.270-08	2.405-04	4.395-06	8.293-03	1.102-04	8.648-03
1.000+08	8.725-05	6.373-01	1.115-02	2.774+01	3.757-01	2.876+01	2.733-08	1.997-04	3.493-06	8.691-03	1.177-04	9.012-03
1.500+08	3.878-05	4.538-01	7.376-03	2.974+01	4.151-01	3.062+01	1.215-08	1.422-04	2.311-06	9.317-03	1.300-04	9.592-03
2.000+08	2.181-05	3.556-01	5.509-03	3.092+01	4.395-01	3.172+01	6.833-09	1.115-04	1.726-06	9.687-03	1.377-04	9.938-03
3.000+08	9.694-06	2.522-01	3.658-03	3.230+01	4.690-01	3.302+01	3.037-09	7.901-05	1.146-06	1.012-02	1.469-04	1.035-02
4.000+08	5.453-06	1.975-01	2.738-03	3.308+01	4.865-01	3.377+01	1.708-09	6.187-05	8.578-07	1.036-02	1.524-04	1.058-02
5.000+08	3.490-06	1.635-01	2.188-03	3.359+01	4.984-01	3.425+01	1.093-09	5.122-05	6.855-07	1.052-02	1.561-04	1.073-02
6.000+08	2.424-06	1.400-01	1.822-03	3.396+01	5.071-01	3.461+01	7.594-10	4.386-05	5.708-07	1.064-02	1.589-04	1.084-02
8.000+08	1.363-06	1.093-01	1.365-03	3.445+01	5.190-01	3.508+01	4.270-10	3.424-05	4.276-07	1.079-02	1.626-04	1.099-02
1.000+09	8.725-07	8.995-02	1.091-03	3.477+01	5.269-01	3.539+01	2.733-10	2.818-05	3.418-07	1.089-02	1.651-04	1.109-02
1.500+09	3.878-07	6.282-02	7.268-04	3.522+01	5.386-01	3.582+01	1.215-10	1.968-05	2.277-07	1.103-02	1.687-04	1.122-02
2.000+09	2.181-07	4.862-02	5.449-04	3.547+01	5.452-01	3.606+01	6.833-11	1.523-05	1.707-07	1.111-02	1.708-04	1.130-02
3.000+09	9.694-08	3.381-02	3.631-04	3.574+01	5.524-01	3.633+01	3.037-11	1.059-05	1.138-07	1.120-02	1.731-04	1.138-02
4.000+09	5.453-08	2.610-02	2.723-04	3.588+01	5.566-01	3.646+01	1.708-11	8.177-06	8.531-08	1.124-02	1.744-04	1.142-02
5.000+09	3.490-08	2.134-02	2.178-04	3.597+01	5.592-01	3.655+01	1.093-11	6.686-06	6.823-08	1.127-02	1.752-04	1.145-02
6.000+09	2.424-08	1.809-02	1.815-04	3.604+01	5.610-01	3.662+01	7.594-12	5.667-06	5.686-08	1.129-02	1.758-04	1.147-02
8.000+09	1.363-08	1.394-02	1.361-04	3.612+01	5.634-01	3.670+01	4.270-12	4.367-06	4.264-08	1.132-02	1.765-04	1.150-02
1.000+10	8.725-09	1.138-02	1.089-04	3.617+01	5.649-01	3.675+01	2.733-12	3.565-06	3.412-08	1.133-02	1.770-04	1.151-02
1.500+10	3.878-09	7.865-03	7.258-05	3.624+01	5.669-01	3.681+01	1.215-12	2.464-06	2.274-08	1.135-02	1.776-04	1.153-02
2.000+10	2.181-09	6.047-03	5.443-05	3.628+01	5.682-01	3.685+01	6.833-13	1.894-06	1.705-08	1.137-02	1.780-04	1.155-02
3.000+10	9.694-10	4.170-03	3.628-05	3.632+01	5.693-01	3.689+01	3.037-13	1.306-06	1.137-08	1.138-02	1.784-04	1.156-02
4.000+10	5.453-10	3.202-03	2.721-05	3.634+01	5.700-01	3.691+01	1.708-13	1.003-06	8.525-09	1.138-02	1.786-04	1.156-02
5.000+10	3.490-10	2.607-03	2.177-05	3.636+01	5.705-01	3.693+01	1.093-13	8.167-07	6.820-09	1.139-02	1.787-04	1.157-02
6.000+10	2.424-10	2.204-03	1.814-05	3.637+01	5.707-01	3.694+01	7.594-14	6.905-07	5.683-09	1.139-02	1.788-04	1.157-02
8.000+10	1.363-10	1.690-03	1.361-05	3.638+01	5.710-01	3.695+01	4.270-14	5.295-07	4.264-09	1.140-02	1.789-04	1.158-02
1.000+11	8.725-11	1.375-03	1.088-05	3.638+01	5.713-01	3.695+01	2.733-14	4.308-07	3.409-09	1.140-02	1.790-04	1.158-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 78, PT, PLATINUM ATOMIC WT. = 195.08 MSQ/KG = .00030870 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	8.849-01	1.636+01	4.967+00	0.000	0.000	2.221+01	2.732-04	5.050-03	1.533-03	0.000	0.000	6.857-03
1.022+06	8.479-01	1.619+01	4.754+00	0.000	0.000	2.179+01	2.617-04	4.998-03	1.468-03	0.000	0.000	6.727-03
1.250+06	5.708-01	1.466+01	3.207+00	1.137-01	0.000	1.855+01	1.762-04	4.525-03	9.900-04	3.510-05	0.000	5.727-03
1.500+06	3.982-01	1.334+01	2.285+00	5.368-01	0.000	1.656+01	1.229-04	4.118-03	7.054-04	1.657-04	0.000	5.112-03
2.000+06	2.252-01	1.140+01	1.383+00	1.641+00	0.000	1.465+01	6.952-05	3.519-03	4.269-04	5.066-04	0.000	4.522-03
2.044+06	2.156-01	1.126+01	1.333+00	1.740+00	0.000	1.455+01	6.655-05	3.476-03	4.115-04	5.371-04	0.000	4.491-03
3.000+06	1.005-01	8.981+00	7.240-01	3.666+00	3.138-03	1.347+01	3.102-05	2.772-03	2.235-04	1.132-03	9.687-07	4.160-03
4.000+06	5.662-02	7.495+00	4.746-01	5.322+00	1.279-02	1.336+01	1.748-05	2.314-03	1.465-04	1.643-03	3.948-06	4.124-03
5.000+06	3.626-02	6.475+00	3.482-01	6.709+00	2.544-02	1.359+01	1.119-05	1.999-03	1.075-04	2.071-03	7.853-06	4.196-03
6.000+06	2.519-02	5.724+00	2.731-01	7.902+00	3.900-02	1.396+01	7.776-06	1.767-03	8.630-05	2.439-03	1.204-05	4.310-03
7.000+06	1.851-02	5.145+00	2.238-01	8.953+00	5.248-02	1.439+01	5.714-06	1.588-03	6.909-05	2.764-03	1.620-05	4.443-03
8.000+06	1.418-02	4.683+00	1.891-01	9.899+00	6.551-02	1.485+01	4.377-06	1.446-03	5.837-05	3.056-03	2.022-05	4.584-03
9.000+06	1.120-02	4.305+00	1.635-01	1.076+01	7.796-02	1.532+01	3.457-06	1.329-03	5.047-05	3.322-03	2.407-05	4.729-03
1.000+07	9.075-03	3.989+00	1.439-01	1.155+01	8.976-02	1.578+01	2.801-06	1.231-03	4.442-05	3.565-03	2.771-05	4.872-03
1.100+07	7.500-03	3.721+00	1.284-01	1.228+01	1.009-01	1.624+01	2.315-06	1.149-03	3.964-05	3.791-03	3.115-05	5.013-03
1.200+07	6.303-03	3.489+00	1.158-01	1.296+01	1.114-01	1.668+01	1.946-06	1.077-03	3.575-05	4.001-03	3.439-05	5.150-03
1.300+07	5.371-03	3.287+00	1.055-01	1.360+01	1.213-01	1.712+01	1.658-06	1.015-03	3.257-05	4.198-03	3.744-05	5.285-03
1.400+07	4.631-03	3.110+00	9.682-02	1.420+01	1.306-01	1.754+01	1.430-06	9.600-04	2.989-05	4.383-03	4.032-05	5.415-03
1.500+07	4.034-03	2.953+00	8.944-02	1.475+01	1.395-01	1.794+01	1.245-06	9.116-04	2.761-05	4.553-03	4.306-05	5.537-03
1.600+07	3.546-03	2.812+00	8.309-02	1.527+01	1.479-01	1.832+01	1.095-06	8.681-04	2.565-05	4.714-03	4.566-05	5.654-03
1.800+07	2.802-03	2.570+00	7.274-02	1.620+01	1.634-01	1.901+01	8.650-07	7.933-04	2.245-05	5.001-03	5.044-05	5.868-03
2.000+07	2.269-03	2.370+00	6.467-02	1.703+01	1.775-01	1.964+01	7.004-07	7.316-04	1.996-05	5.257-03	5.479-05	6.064-03
2.200+07	1.875-03	2.201+00	5.819-02	1.779+01	1.904-01	2.024+01	5.788-07	6.794-04	1.796-05	5.492-03	5.878-05	6.248-03
2.400+07	1.576-03	2.057+00	5.289-02	1.848+01	2.022-01	2.079+01	4.865-07	6.350-04	1.633-05	5.705-03	6.242-05	6.419-03
2.600+07	1.343-03	1.932+00	4.847-02	1.910+01	2.130-01	2.129+01	4.146-07	5.964-04	1.496-05	5.896-03	6.575-05	6.576-03
2.800+07	1.158-03	1.822+00	4.472-02	1.968+01	2.230-01	2.177+01	3.575-07	5.624-04	1.380-05	6.075-03	6.884-05	6.721-03
3.000+07	1.009-03	1.726+00	4.151-02	2.021+01	2.323-01	2.221+01	3.115-07	5.328-04	1.281-05	6.239-03	7.171-05	6.856-03
4.000+07	5.674-04	1.371+00	3.054-02	2.238+01	2.706-01	2.405+01	1.752-07	4.232-04	9.628-06	6.909-03	8.353-05	7.425-03
5.000+07	3.631-04	1.145+00	2.414-02	2.399+01	2.994-01	2.546+01	1.121-07	3.535-04	7.152-06	7.406-03	9.242-05	7.859-03
6.000+07	2.522-04	9.862-01	1.996-02	2.524+01	3.221-01	2.657+01	7.785-08	3.044-04	6.162-06	7.791-03	9.943-05	8.202-03
8.000+07	1.418-04	7.778-01	1.482-02	2.708+01	3.559-01	2.823+01	4.377-08	2.401-04	4.575-06	8.359-03	1.099-04	8.714-03
1.000+08	9.078-05	6.455-01	1.179-02	2.837+01	3.802-01	2.941+01	2.802-08	1.993-04	3.640-06	8.758-03	1.174-04	9.078-03
1.500+08	4.035-05	4.597-01	7.794-03	3.041+01	4.200-01	3.130+01	1.246-08	1.419-04	2.406-06	9.387-03	1.297-04	9.661-03
2.000+08	2.269-05	3.605-01	5.822-03	3.162+01	4.446-01	3.243+01	7.004-09	1.113-04	1.797-06	9.761-03	1.372-04	1.001-02
3.000+08	1.009-05	2.555-01	3.865-03	3.303+01	4.743-01	3.376+01	3.115-09	7.887-05	1.193-06	1.020-02	1.464-04	1.042-02
4.000+08	5.674-06	2.001-01	2.893-03	3.383+01	4.919-01	3.452+01	1.752-09	6.177-05	8.931-07	1.044-02	1.518-04	1.066-02
5.000+08	3.631-06	1.656-01	2.312-03	3.436+01	5.038-01	3.503+01	1.121-09	5.112-05	7.137-07	1.061-02	1.555-04	1.081-02
6.000+08	2.522-06	1.418-01	1.925-03	3.473+01	5.125-01	3.539+01	7.785-10	4.377-05	5.942-07	1.072-02	1.582-04	1.092-02
8.000+08	1.418-06	1.108-01	1.442-03	3.523+01	5.244-01	3.587+01	4.377-10	3.420-05	4.451-07	1.088-02	1.619-04	1.107-02
1.000+09	9.078-07	9.112-02	1.153-03	3.555+01	5.322-01	3.617+01	2.802-10	2.813-05	3.559-07	1.097-02	1.643-04	1.117-02
1.500+09	4.035-07	6.364-02	7.680-04	3.602+01	5.438-01	3.663+01	1.246-10	1.965-05	2.371-07	1.112-02	1.679-04	1.131-02
2.000+09	2.269-07	4.925-02	5.758-04	3.627+01	5.504-01	3.687+01	7.004-11	1.520-05	1.777-07	1.120-02	1.699-04	1.138-02
3.000+09	1.009-07	3.425-02	3.837-04	3.655+01	5.575-01	3.714+01	3.115-11	1.057-05	1.184-07	1.128-02	1.721-04	1.147-02
4.000+09	5.674-08	2.643-02	2.877-04	3.669+01	5.617-01	3.728+01	1.752-11	8.159-06	8.381-08	1.133-02	1.734-04	1.151-02
5.000+09	3.631-08	2.161-02	2.301-04	3.679+01	5.642-01	3.738+01	1.121-11	6.671-06	7.103-08	1.136-02	1.742-04	1.154-02
6.000+09	2.522-08	1.833-02	1.918-04	3.685+01	5.660-01	3.743+01	7.785-12	5.658-06	5.921-08	1.138-02	1.747-04	1.156-02
8.000+09	1.418-08	1.412-02	1.438-04	3.694+01	5.683-01	3.752+01	4.377-12	4.359-06	4.439-08	1.140-02	1.754-04	1.158-02
1.000+10	9.078-09	1.153-02	1.150-04	3.699+01	5.698-01	3.757+01	2.802-12	3.559-06	3.550-08	1.142-02	1.759-04	1.160-02
1.500+10	4.035-09	7.967-03	7.669-05	3.706+01	5.718-01	3.764+01	1.246-12	2.459-06	2.367-08	1.144-02	1.765-04	1.162-02
2.000+10	2.269-09	6.125-03	5.751-05	3.710+01	5.730-01	3.768+01	7.004-13	1.891-06	1.775-08	1.145-02	1.769-04	1.163-02
3.000+10	1.009-09	4.224-03	3.834-05	3.715+01	5.741-01	3.773+01	3.115-13	1.304-06	1.184-08	1.147-02	1.772-04	1.165-02
4.000+10	5.674-10	3.243-03	2.875-05	3.717+01	5.748-01	3.775+01	1.752-13	1.001-06	8.875-09	1.147-02	1.774-04	1.165-02
5.000+10	3.631-10	2.641-03	2.300-05	3.718+01	5.753-01	3.776+01	1.121-13	8.153-07	7.100-09	1.148-02	1.776-04	1.166-02
6.000+10	2.522-10	2.232-03	1.917-05	3.719+01	5.755-01	3.777+01	7.785-14	6.890-07	5.918-09	1.148-02	1.777-04	1.166-02
8.000+10	1.418-10	1.712-03	1.438-05	3.720+01	5.758-01	3.778+01	4.377-14	5.285-07	4.439-09	1.148-02	1.777-04	1.166-02
1.000+11	9.078-11	1.393-03	1.150-05	3.721+01	5.761-01	3.779+01	2.802-14	4.300-07	3.550-09	1.149-02	1.778-04	1.166-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 79, AU, GOLD ATOMIC WT. = 196.9665 MSQ/KG = .00630574 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	9.195-01	1.656+01	5.261+00	0.000	0.000	2.274+01	2.811-04	5.063-03	1.608-03	0.000	0.000	6.953-03
1.022+06	8.811-01	1.639+01	5.035+00	0.000	0.000	2.231+01	2.694-04	5.011-03	1.539-03	0.000	0.000	6.820-03
1.250+06	5.932-01	1.484+01	3.396+00	1.176-01	0.000	1.895+01	1.814-04	4.537-03	1.038-03	3.595-05	0.000	5.793-03
1.500+06	4.139-01	1.351+01	2.420+00	5.571-01	0.000	1.690+01	1.265-04	4.131-03	7.399-04	1.703-04	0.000	5.167-03
2.000+06	2.341-01	1.155+01	1.464+00	1.698+00	0.000	1.495+01	7.157-05	3.531-03	4.476-04	5.191-04	0.000	4.570-03
2.044+06	2.242-01	1.140+01	1.412+00	1.799+00	0.000	1.484+01	6.855-05	3.485-03	4.317-04	5.503-04	0.000	4.536-03
3.000+06	1.045-01	9.096+00	7.663-01	3.772+00	3.178-03	1.374+01	3.195-05	2.781-03	2.343-04	1.153-03	9.716-07	4.201-03
4.000+06	5.887-02	7.591+00	5.022-01	5.462+00	1.295-02	1.363+01	1.800-05	2.321-03	1.535-04	1.672-03	3.959-06	4.166-03
5.000+06	3.771-02	6.558+00	3.683-01	6.876+00	2.576-02	1.387+01	1.153-05	2.005-03	1.126-04	2.102-03	7.876-06	4.239-03
6.000+06	2.620-02	5.797+00	2.888-01	8.094+00	3.949-02	1.425+01	8.010-06	1.772-03	8.830-05	2.475-03	1.207-05	4.355-03
7.000+06	1.925-02	5.211+00	2.366-01	9.167+00	5.315-02	1.469+01	5.885-06	1.593-03	7.234-05	2.803-03	1.625-05	4.490-03
8.000+06	1.474-02	4.743+00	2.000-01	1.013+01	6.634-02	1.515+01	4.507-06	1.450-03	6.115-05	3.097-03	2.028-05	4.633-03
9.000+06	1.165-02	4.360+00	1.729-01	1.101+01	7.894-02	1.563+01	3.562-06	1.333-03	5.286-05	3.365-03	2.414-05	4.780-03
1.000+07	9.437-03	4.040+00	1.521-01	1.182+01	9.089-02	1.611+01	2.885-06	1.235-03	4.650-05	3.614-03	2.779-05	4.926-03
1.100+07	7.800-03	3.768+00	1.357-01	1.256+01	1.022-01	1.657+01	2.385-06	1.152-03	4.145-05	3.840-03	3.125-05	5.067-03
1.200+07	6.555-03	3.534+00	1.224-01	1.326+01	1.128-01	1.704+01	2.004-06	1.080-03	3.742-05	4.054-03	3.449-05	5.209-03
1.300+07	5.585-03	3.329+00	1.115-01	1.391+01	1.228-01	1.748+01	1.708-06	1.018-03	3.409-05	4.253-03	3.754-05	5.344-03
1.400+07	4.816-03	3.150+00	1.023-01	1.452+01	1.323-01	1.791+01	1.472-06	9.631-04	3.128-05	4.439-03	4.045-05	5.476-03
1.500+07	4.195-03	2.991+00	9.451-02	1.508+01	1.412-01	1.831+01	1.283-06	9.145-04	2.890-05	4.611-03	4.317-05	5.598-03
1.600+07	3.687-03	2.848+00	8.780-02	1.561+01	1.497-01	1.870+01	1.127-06	8.707-04	2.684-05	4.773-03	4.577-05	5.717-03
1.800+07	2.914-03	2.603+00	7.686-02	1.657+01	1.655-01	1.942+01	8.909-07	7.958-04	2.350-05	5.066-03	5.060-05	5.937-03
2.000+07	2.360-03	2.400+00	6.833-02	1.742+01	1.797-01	2.007+01	7.215-07	7.338-04	2.089-05	5.326-03	5.494-05	6.136-03
2.200+07	1.950-03	2.230+00	6.148-02	1.819+01	1.927-01	2.068+01	5.962-07	6.818-04	1.886-05	5.561-03	5.892-05	6.322-03
2.400+07	1.639-03	2.083+00	5.588-02	1.889+01	2.046-01	2.124+01	5.011-07	6.369-04	1.708-05	5.775-03	6.255-05	6.492-03
2.600+07	1.396-03	1.956+00	5.120-02	1.954+01	2.156-01	2.176+01	4.268-07	5.980-04	1.565-05	5.974-03	6.592-05	6.654-03
2.800+07	1.204-03	1.846+00	4.724-02	2.012+01	2.258-01	2.224+01	3.681-07	5.644-04	1.444-05	6.151-03	6.904-05	6.800-03
3.000+07	1.049-03	1.748+00	4.385-02	2.067+01	2.352-01	2.270+01	3.207-07	5.344-04	1.34[illegible]-05	6.320-03	7.191-05	6.940-03
4.000+07	5.901-04	1.389+00	3.226-02	2.289+01	2.739-01	2.459+01	1.804-07	4.247-04	9.863-06	6.998-03	8.374-05	7.517-03
5.000+07	3.776-04	1.159+00	2.550-02	2.453+01	3.030-01	2.602+01	1.154-07	3.544-04	7.796-06	7.500-03	9.264-05	7.955-03
6.000+07	2.622-04	9.988-01	2.108-02	2.581+01	3.259-01	2.716+01	8.016-08	3.054-04	6.445-06	7.891-03	9.964-05	8.303-03
8.000+07	1.475-04	7.877-01	1.565-02	2.768+01	3.601-01	2.884+01	4.510-08	2.408-04	4.735-06	8.463-03	1.101-04	8.819-03
1.000+08	9.441-05	6.538-01	1.245-02	2.901+01	3.847-01	3.006+01	2.886-08	1.999-04	3.806-06	8.870-03	1.176-04	9.191-03
1.500+08	4.196-05	4.656-01	8.231-03	3.109+01	4.248-01	3.199+01	1.283-08	1.424-04	2.517-06	9.505-03	1.299-04	9.780-03
2.000+08	2.360-05	3.651-01	6.148-03	3.233+01	4.497-01	3.315+01	7.215-09	1.116-04	1.880-06	9.885-03	1.375-04	1.014-02
3.000+08	1.049-05	2.588-01	4.082-03	3.377+01	4.796-01	3.451+01	3.207-09	7.913-05	1.248-06	1.032-02	1.466-04	1.055-02
4.000+08	5.900-06	2.027-01	3.055-03	3.459+01	4.974-01	3.529+01	1.804-09	6.197-05	9.340-07	1.058-02	1.521-04	1.079-02
5.000+08	3.776-06	1.678-01	2.441-03	3.512+01	5.094-01	3.580+01	1.154-09	5.130-05	7.463-07	1.074-02	1.557-04	1.095-02
6.000+08	2.622-06	1.436-01	2.032-03	3.551+01	5.181-01	3.617+01	8.016-10	4.390-05	6.213-07	1.086-02	1.584-04	1.106-02
8.000+08	1.475-06	1.122-01	1.523-03	3.602+01	5.301-01	3.666+01	4.510-10	3.430-05	4.656-07	1.101-02	1.621-04	1.121-02
1.000+09	9.441-07	9.229-02	1.217-03	3.635+01	5.380-01	3.698+01	2.886-10	2.822-05	3.721-07	1.111-02	1.645-04	1.131-02
1.500+09	4.196-07	6.445-02	8.109-04	3.682+01	5.497-01	3.743+01	1.283-10	1.970-05	2.479-07	1.126-02	1.681-04	1.145-02
2.000+09	2.360-07	4.988-02	6.080-04	3.708+01	5.563-01	3.769+01	7.215-11	1.525-05	1.859-07	1.134-02	1.701-04	1.152-02
3.000+09	1.049-07	3.468-02	4.051-04	3.736+01	5.634-01	3.796+01	3.207-11	1.060-05	1.239-07	1.142-02	1.723-04	1.161-02
4.000+09	5.900-08	2.677-02	3.038-04	3.751+01	5.676-01	3.810+01	1.804-11	8.185-06	9.288-08	1.147-02	1.735-04	1.165-02
5.000+09	3.776-08	2.189-02	2.430-04	3.761+01	5.701-01	3.820+01	1.154-11	6.693-06	7.429-08	1.150-02	1.743-04	1.168-02
6.000+09	2.622-08	1.856-02	2.025-04	3.768+01	5.719-01	3.827+01	8.016-12	5.675-06	6.191-08	1.152-02	1.749-04	1.170-02
8.000+09	1.475-08	1.430-02	1.518-04	3.776+01	5.743-01	3.835+01	4.510-12	4.372-06	4.641-08	1.154-02	1.756-04	1.172-02
1.000+10	9.441-09	1.168-02	1.215-04	3.782+01	5.758-01	3.841+01	2.886-12	3.571-06	3.715-08	1.156-02	1.760-04	1.174-02
1.500+10	4.196-09	8.070-03	8.097-05	3.789+01	5.778-01	3.848+01	1.283-12	2.467-06	2.476-08	1.158-02	1.767-04	1.176-02
2.000+10	2.360-09	6.204-03	6.073-05	3.793+01	5.790-01	3.852+01	7.215-13	1.897-06	1.857-08	1.160-02	1.770-04	1.178-02
3.000+10	1.049-09	4.279-03	4.048-05	3.797+01	5.801-01	3.855+01	3.207-13	1.308-06	1.238-08	1.161-02	1.774-04	1.179-02
4.000+10	5.900-10	3.285-03	3.036-05	3.800+01	5.808-01	3.858+01	1.804-13	1.004-06	9.282-09	1.162-02	1.776-04	1.180-02
5.000+10	3.776-10	2.675-03	2.429-05	3.801+01	5.812-01	3.859+01	1.154-13	8.179-07	7.425-09	1.162-02	1.777-04	1.180-02
6.000+10	2.622-10	2.261-03	2.024-05	3.802+01	5.815-01	3.860+01	8.016-14	6.913-07	6.188-09	1.162-02	1.778-04	1.180-02
8.000+10	1.475-10	1.734-03	1.518-05	3.803+01	5.818-01	3.861+01	4.510-14	5.302-07	4.641-09	1.163-02	1.779-04	1.181-02
1.000+11	9.441-11	1.411-03	1.214-05	3.804+01	5.820-01	3.862+01	2.886-14	4.314-07	3.712-09	1.163-02	1.779-04	1.181-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 80, HG, MERCURY ATOMIC WT. = 200.59 MSQ/KG = .00030022 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	9.549-01	1.677+01	5.568+00	0.000	0.000	2.329+01	2.867-04	5.035-03	1.672-03	0.000	0.000	6.993-03
1.022+06	9.151-01	1.660+01	5.330+00	0.000	0.000	2.285+01	2.747-04	4.984-03	1.600-03	0.000	0.000	6.858-03
1.250+06	6.162-01	1.503+01	3.595+00	1.218-01	0.000	1.936+01	1.850-04	4.512-03	1.079-03	3.657-05	0.000	5.813-03
1.500+06	4.200-01	1.368+01	2.561+00	5.785-01	0.000	1.725+01	1.291-04	4.107-03	7.689-04	1.737-04	0.000	5.179-03
2.000+06	2.432-01	1.169+01	1.549+00	1.756+00	0.000	1.524+01	7.301-05	3.510-03	4.650-04	5.272-04	0.000	4.575-03
2.044+06	2.330-01	1.155+01	1.494+00	1.860+00	0.000	1.514+01	6.995-05	3.468-03	4.485-04	5.584-04	0.000	4.544-03
3.000+06	1.086-01	9.210+00	8.106-01	3.882+00	3.218-03	1.401+01	3.260-05	2.765-03	2.434-04	1.165-03	9.661-07	4.207-03
4.000+06	6.119-02	7.687+00	5.311-01	5.604+00	1.312-02	1.390+01	1.837-05	2.308-03	1.594-04	1.682-03	3.939-06	4.172-03
5.000+06	3.919-02	6.641+00	3.894-01	7.046+00	2.609-02	1.414+01	1.177-05	1.994-03	1.169-04	2.115-03	7.833-06	4.246-03
6.000+06	2.723-02	5.870+00	3.053-01	8.288+00	3.999-02	1.453+01	8.175-06	1.762-03	9.166-05	2.488-03	1.201-05	4.362-03
7.000+06	2.001-02	5.277+00	2.501-01	9.382+00	5.381-02	1.498+01	6.007-06	1.584-03	7.508-05	2.817-03	1.615-05	4.498-03
8.000+06	1.532-02	4.803+00	2.113-01	1.037+01	6.717-02	1.547+01	4.599-06	1.442-03	6.344-05	3.113-03	2.017-05	4.643-03
9.000+06	1.211-02	4.415+00	1.827-01	1.126+01	7.992-02	1.595+01	3.636-06	1.325-03	5.485-05	3.380-03	2.399-05	4.788-03
1.000+07	9.810-03	4.091+00	1.607-01	1.209+01	9.202-02	1.644+01	2.945-06	1.228-03	4.824-05	3.630-03	2.763-05	4.937-03
1.100+07	8.108-03	3.816+00	1.434-01	1.285+01	1.034-01	1.692+01	2.434-06	1.146-03	4.305-05	3.858-03	3.104-05	5.080-03
1.200+07	6.813-03	3.579+00	1.293-01	1.356+01	1.142-01	1.739+01	2.045-06	1.074-03	3.882-05	4.071-03	3.428-05	5.221-03
1.300+07	5.805-03	3.372+00	1.178-01	1.422+01	1.243-01	1.784+01	1.743-06	1.012-03	3.537-05	4.269-03	3.732-05	5.356-03
1.400+07	5.006-03	3.190+00	1.081-01	1.484+01	1.339-01	1.828+01	1.503-06	9.577-04	3.245-05	4.455-03	4.020-05	5.487-03
1.500+07	4.361-03	3.028+00	9.982-02	1.542+01	1.430-01	1.870+01	1.309-06	9.091-04	2.997-05	4.629-03	4.293-05	5.613-03
1.600+07	3.833-03	2.884+00	9.273-02	1.596+01	1.516-01	1.909+01	1.151-06	8.658-04	2.784-05	4.791-03	4.551-05	5.732-03
1.800+07	3.028-03	2.636+00	8.117-02	1.694+01	1.675-01	1.983+01	9.091-07	7.914-04	2.437-05	5.086-03	5.029-05	5.953-03
2.000+07	2.453-03	2.431+00	7.215-02	1.781+01	1.819-01	2.050+01	7.364-07	7.298-04	2.166-05	5.347-03	5.461-05	6.154-03
2.200+07	2.027-03	2.258+00	6.492-02	1.859+01	1.951-01	2.111+01	6.085-07	6.779-04	1.949-05	5.581-03	5.857-05	6.338-03
2.400+07	1.704-03	2.110+00	5.899-02	1.931+01	2.071-01	2.169+01	5.116-07	6.335-04	1.771-05	5.797-03	6.217-05	6.511-03
2.600+07	1.452-03	1.981+00	5.406-02	1.997+01	2.182-01	2.222+01	4.359-07	5.947-04	1.623-05	5.995-03	6.551-05	6.672-03
2.800+07	1.252-03	1.869+00	4.988-02	2.057+01	2.285-01	2.272+01	3.759-07	5.611-04	1.497-05	6.175-03	6.860-05	6.821-03
3.000+07	1.090-03	1.770+00	4.630-02	2.113+01	2.380-01	2.319+01	3.272-07	5.314-04	1.390-05	6.344-03	7.145-05	6.961-03
4.000+07	6.133-04	1.406+00	3.405-02	2.339+01	2.772-01	2.511+01	1.841-07	4.221-04	1.022-05	7.022-03	8.322-05	7.538-03
5.000+07	3.925-04	1.174+00	2.692-02	2.507+01	3.066-01	2.658+01	1.178-07	3.525-04	8.082-06	7.526-03	9.205-05	7.979-03
6.000+07	2.726-04	1.012+00	2.225-02	2.638+01	3.297-01	2.774+01	8.184-08	3.038-04	6.680-06	7.920-03	9.898-05	8.329-03
8.000+07	1.533-04	7.977-01	1.652-02	2.830+01	3.643-01	2.948+01	4.602-08	2.395-04	4.960-06	8.496-03	1.094-04	8.850-03
1.000+08	9.813-05	6.621-01	1.314-02	2.965+01	3.891-01	3.071+01	2.946-08	1.988-04	3.945-06	8.901-03	1.168-04	9.221-03
1.500+08	4.361-05	4.715-01	8.686-03	3.178+01	4.297-01	3.269+01	1.309-08	1.416-04	2.608-06	9.541-03	1.290-04	9.814-03
2.000+08	2.453-05	3.697-01	6.488-03	3.304+01	4.548-01	3.387+01	7.364-09	1.110-04	1.948-06	9.919-03	1.365-04	1.017-02
3.000+08	1.090-05	2.620-01	4.307-03	3.451+01	4.851-01	3.526+01	3.272-09	7.866-05	1.293-06	1.036-02	1.456-04	1.059-02
4.000+08	6.133-06	2.052-01	3.224-03	3.535+01	5.031-01	3.606+01	1.841-09	6.160-05	9.679-07	1.061-02	1.510-04	1.083-02
5.000+08	3.925-06	1.699-01	2.576-03	3.590+01	5.153-01	3.659+01	1.178-09	5.101-05	7.734-07	1.078-02	1.547-04	1.098-02
6.000+08	2.726-06	1.455-01	2.145-03	3.629+01	5.241-01	3.696+01	8.184-10	4.368-05	6.440-07	1.089-02	1.573-04	1.110-02
8.000+08	1.533-06	1.136-01	1.607-03	3.681+01	5.363-01	3.746+01	4.602-10	3.410-05	4.824-07	1.105-02	1.610-04	1.125-02
1.000+09	9.813-07	9.346-02	1.285-03	3.715+01	5.443-01	3.779+01	2.946-10	2.806-05	3.858-07	1.115-02	1.634-04	1.134-02
1.500+09	4.361-07	6.527-02	8.558-04	3.764+01	5.562-01	3.826+01	1.309-10	1.960-05	2.569-07	1.130-02	1.670-04	1.149-02
2.000+09	2.453-07	5.052-02	6.416-04	3.790+01	5.629-01	3.851+01	7.364-11	1.517-05	1.926-07	1.138-02	1.690-04	1.156-02
3.000+09	1.090-07	3.512-02	4.275-04	3.819+01	5.702-01	3.880+01	3.272-11	1.054-05	1.283-07	1.147-02	1.712-04	1.165-02
4.000+09	6.133-08	2.711-02	3.206-04	3.834+01	5.745-01	3.894+01	1.841-11	8.139-06	9.625-08	1.151-02	1.725-04	1.169-02
5.000+09	3.925-08	2.217-02	2.564-04	3.844+01	5.771-01	3.904+01	1.178-11	6.656-06	7.698-08	1.154-02	1.733-04	1.172-02
6.000+09	2.726-08	1.880-02	2.137-04	3.851+01	5.789-01	3.911+01	8.184-12	5.644-06	6.416-08	1.156-02	1.738-04	1.174-02
8.000+09	1.533-08	1.448-02	1.602-04	3.859+01	5.814-01	3.919+01	4.602-12	4.347-06	4.809-08	1.159-02	1.745-04	1.176-02
1.000+10	9.813-09	1.182-02	1.282-04	3.865+01	5.829-01	3.924+01	2.946-12	3.549-06	3.849-08	1.160-02	1.750-04	1.178-02
1.500+10	4.361-09	8.172-03	8.545-05	3.873+01	5.849-01	3.932+01	1.309-12	2.453-06	2.565-08	1.163-02	1.756-04	1.181-02
2.000+10	2.453-09	6.282-03	6.408-05	3.877+01	5.862-01	3.936+01	7.364-13	1.886-06	1.924-08	1.164-02	1.760-04	1.182-02
3.000+10	1.090-09	4.333-03	4.272-05	3.881+01	5.873-01	3.940+01	3.272-13	1.301-06	1.283-08	1.165-02	1.763-04	1.183-02
4.000+10	6.133-10	3.326-03	3.204-05	3.883+01	5.881-01	3.942+01	1.841-13	9.985-07	9.619-09	1.166-02	1.766-04	1.183-02
5.000+10	3.925-10	2.709-03	2.563-05	3.885+01	5.885-01	3.944+01	1.178-13	8.133-07	7.695-09	1.166-02	1.767-04	1.184-02
6.000+10	2.726-10	2.290-03	2.136-05	3.886+01	5.888-01	3.945+01	8.184-14	6.875-07	6.413-09	1.167-02	1.768-04	1.184-02
8.000+10	1.533-10	1.756-03	1.602-05	3.887+01	5.891-01	3.946+01	4.602-14	5.272-07	4.809-09	1.167-02	1.769-04	1.185-02
1.000+11	9.813-11	1.428-03	1.282-05	3.888+01	5.893-01	3.947+01	2.946-14	4.287-07	3.849-09	1.167-02	1.769-04	1.185-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 81, TL, THALLIUM ATOMIC WT. = 204.383 MSQ/KG = .00029465 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	9.913-01	1.696+01	5.890+00	0.000	0.000	2.386+01	2.921-04	5.003-03	1.735-03	0.000	0.000	7.031-03
1.022+06	9.499-01	1.680+01	5.638+00	0.000	0.000	2.339+01	2.799-04	4.950-03	1.661-03	0.000	0.000	6.891-03
1.250+06	6.398-01	1.522+01	3.803+00	1.259-01	0.000	1.979+01	1.885-04	4.484-03	1.121-03	3.710-05	0.000	5.831-03
1.500+06	4.466-01	1.385+01	2.709+00	5.998-01	0.000	1.761+01	1.316-04	4.081-03	7.982-04	1.767-04	0.000	5.187-03
2.000+06	2.527-01	1.184+01	1.639+00	1.815+00	0.000	1.555+01	7.446-05	3.489-03	4.829-04	5.348-04	0.000	4.581-03
2.044+06	2.420-01	1.169+01	1.580+00	1.922+00	0.000	1.543+01	7.130-05	3.444-03	4.655-04	5.663-04	0.000	4.548-03
3.000+06	1.128-01	9.325+00	8.570-01	3.992+00	3.258-03	1.429+01	3.324-05	2.748-03	2.525-04	1.176-03	9.600-07	4.210-03
4.000+06	6.357-02	7.783+00	5.612-01	5.747+00	1.328-02	1.417+01	1.873-05	2.293-03	1.654-04	1.693-03	3.913-06	4.175-03
5.000+06	4.072-02	6.723+00	4.114-01	7.217+00	2.641-02	1.442+01	1.200-05	1.981-03	1.212-04	2.126-03	7.782-06	4.248-03
6.000+06	2.829-02	5.944+00	3.225-01	8.484+00	4.048-02	1.482+01	8.336-06	1.751-03	9.502-05	2.500-03	1.193-05	4.366-03
7.000+06	2.079-02	5.343+00	2.641-01	9.598+00	5.447-02	1.528+01	6.126-06	1.574-03	7.782-05	2.828-03	1.605-05	4.502-03
8.000+06	1.592-02	4.863+00	2.231-01	1.060+01	6.799-02	1.577+01	4.691-06	1.433-03	6.574-05	3.123-03	2.003-05	4.647-03
9.000+06	1.258-02	4.471+00	1.929-01	1.152+01	8.090-02	1.628+01	3.707-06	1.317-03	5.684-05	3.394-03	2.384-05	4.796-03
1.000+07	1.019-02	4.142+00	1.697-01	1.236+01	9.314-02	1.678+01	3.002-06	1.220-03	5.000-05	3.642-03	2.744-05	4.943-03
1.100+07	8.424-03	3.864+00	1.513-01	1.313+01	1.047-01	1.726+01	2.482-06	1.139-03	4.458-05	3.869-03	3.085-05	5.085-03
1.200+07	7.079-03	3.624+00	1.365-01	1.386+01	1.156-01	1.774+01	2.066-06	1.068-03	4.022-05	4.084-03	3.406-05	5.228-03
1.300+07	6.032-03	3.414+00	1.243-01	1.454+01	1.258-01	1.821+01	1.777-06	1.006-03	3.662-05	4.284-03	3.707-05	5.366-03
1.400+07	5.201-03	3.230+00	1.141-01	1.517+01	1.355-01	1.865+01	1.532-06	9.517-04	3.362-05	4.470-03	3.992-05	5.497-03
1.500+07	4.531-03	3.066+00	1.053-01	1.576+01	1.447-01	1.908+01	1.335-06	9.034-04	3.103-05	4.644-03	4.264-05	5.622-03
1.600+07	3.982-03	2.920+00	9.786-02	1.631+01	1.534-01	1.949+01	1.173-06	8.604-04	2.883-05	4.806-03	4.520-05	5.741-03
1.800+07	3.147-03	2.669+00	8.565-02	1.731+01	1.695-01	2.024+01	9.272-07	7.864-04	2.524-05	5.100-03	4.994-05	5.963-03
2.000+07	2.549-03	2.461+00	7.613-02	1.819+01	1.841-01	2.091+01	7.511-07	7.251-04	2.243-05	5.360-03	5.424-05	6.162-03
2.200+07	2.106-03	2.286+00	6.850-02	1.900+01	1.974-01	2.155+01	6.205-07	6.736-04	2.018-05	5.598-03	5.816-05	6.351-03
2.400+07	1.770-03	2.136+00	6.225-02	1.973+01	2.096-01	2.214+01	5.215-07	6.294-04	1.834-05	5.813-03	6.176-05	6.523-03
2.600+07	1.508-03	2.006+00	5.704-02	2.041+01	2.208-01	2.270+01	4.443-07	5.911-04	1.681-05	6.014-03	6.506-05	6.687-03
2.800+07	1.301-03	1.892+00	5.262-02	2.102+01	2.312-01	2.320+01	3.833-07	5.575-04	1.550-05	6.193-03	6.812-05	6.835-03
3.000+07	1.133-03	1.792+00	4.884-02	2.159+01	2.408-01	2.367+01	3.338-07	5.280-04	1.439-05	6.361-03	7.095-05	6.975-03
4.000+07	6.373-04	1.424+00	3.592-02	2.390+01	2.804-01	2.564+01	1.878-07	4.196-04	1.058-05	7.042-03	8.262-05	7.555-03
5.000+07	4.079-04	1.189+00	2.839-02	2.562+01	3.102-01	2.715+01	1.202-07	3.503-04	8.365-06	7.549-03	9.140-05	7.999-03
6.000+07	2.832-04	1.024+00	2.347-02	2.695+01	3.336-01	2.833+01	8.344-08	3.017-04	6.915-06	7.941-03	9.829-05	8.348-03
8.000+07	1.593-04	8.077-01	1.743-02	2.891+01	3.685-01	3.010+01	4.694-08	2.380-04	5.136-06	8.518-03	1.086-04	8.870-03
1.000+08	1.020-04	6.704-01	1.386-02	3.029+01	3.936-01	3.137+01	3.005-08	1.975-04	4.084-06	8.925-03	1.160-04	9.242-03
1.500+08	4.532-05	4.774-01	9.161-03	3.247+01	4.347-01	3.339+01	1.335-08	1.407-04	2.699-06	9.567-03	1.281-04	9.839-03
2.000+08	2.549-05	3.743-01	6.842-03	3.376+01	4.600-01	3.460+01	7.511-09	1.103-04	2.016-06	9.947-03	1.355-04	1.020-02
3.000+08	1.133-05	2.653-01	4.543-03	3.526+01	4.907-01	3.602+01	3.338-09	7.817-05	1.339-06	1.039-02	1.446-04	1.061-02
4.000+08	6.372-06	2.078-01	3.400-03	3.611+01	5.089-01	3.683+01	1.877-09	6.123-05	1.002-06	1.064-02	1.499-04	1.085-02
5.000+08	4.078-06	1.720-01	2.717-03	3.668+01	5.212-01	3.738+01	1.202-09	5.068-05	8.006-07	1.081-02	1.536-04	1.101-02
6.000+08	2.832-06	1.473-01	2.262-03	3.708+01	5.302-01	3.776+01	8.344-10	4.340-05	6.665-07	1.093-02	1.562-04	1.113-02
8.000+08	1.593-06	1.150-01	1.695-03	3.761+01	5.425-01	3.827+01	4.694-10	3.388-05	4.994-07	1.108-02	1.598-04	1.128-02
1.000+09	1.020-06	9.463-02	1.355-03	3.795+01	5.507-01	3.860+01	3.005-10	2.788-05	3.992-07	1.118-02	1.623-04	1.137-02
1.500+09	4.532-07	6.608-02	9.025-04	3.845+01	5.628-01	3.908+01	1.335-10	1.947-05	2.659-07	1.133-02	1.658-04	1.151-02
2.000+09	2.549-07	5.115-02	6.766-04	3.872+01	5.696-01	3.934+01	7.511-11	1.507-05	1.994-07	1.141-02	1.678-04	1.159-02
3.000+09	1.133-07	3.556-02	4.509-04	3.902+01	5.770-01	3.963+01	3.338-11	1.048-05	1.329-07	1.150-02	1.700-04	1.168-02
4.000+09	6.372-08	2.745-02	3.381-04	3.917+01	5.813-01	3.978+01	1.877-11	8.088-06	9.962-08	1.154-02	1.713-04	1.172-02
5.000+09	4.078-08	2.244-02	2.704-04	3.927+01	5.840-01	3.988+01	1.202-11	6.612-06	7.967-08	1.157-02	1.721-04	1.175-02
6.000+09	2.832-08	1.903-02	2.253-04	3.934+01	5.858-01	3.995+01	8.344-12	5.607-06	6.638-08	1.159-02	1.726-04	1.177-02
8.000+09	1.593-08	1.466-02	1.690-04	3.943+01	5.883-01	4.003+01	4.694-12	4.319-06	4.980-08	1.162-02	1.733-04	1.180-02
1.000+10	1.020-08	1.197-02	1.352-04	3.949+01	5.898-01	4.009+01	3.005-12	3.527-06	3.984-08	1.164-02	1.738-04	1.181-02
1.500+10	4.532-09	8.274-03	9.011-05	3.957+01	5.919-01	4.017+01	1.335-12	2.438-06	2.655-08	1.166-02	1.744-04	1.184-02
2.000+10	2.549-09	6.361-03	6.758-05	3.961+01	5.932-01	4.021+01	7.511-13	1.874-06	1.991-08	1.167-02	1.748-04	1.185-02
3.000+10	1.133-09	4.387-03	4.505-05	3.966+01	5.943-01	4.026+01	3.338-13	1.293-06	1.327-08	1.169-02	1.751-04	1.186-02
4.000+10	6.372-10	3.368-03	3.379-05	3.968+01	5.951-01	4.028+01	1.877-13	9.924-07	9.956-09	1.169-02	1.753-04	1.187-02
5.000+10	4.078-10	2.743-03	2.703-05	3.969+01	5.956-01	4.029+01	1.202-13	8.082-07	7.964-09	1.169-02	1.755-04	1.187-02
6.000+10	2.832-10	2.318-03	2.253-05	3.970+01	5.958-01	4.030+01	8.344-14	6.830-07	6.638-09	1.170-02	1.755-04	1.187-02
8.000+10	1.593-10	1.778-03	1.689-05	3.972+01	5.961-01	4.032+01	4.694-14	5.239-07	4.977-09	1.170-02	1.756-04	1.188-02
1.000+11	1.020-10	1.446-03	1.351-05	3.973+01	5.964-01	4.033+01	3.005-14	4.261-07	3.981-09	1.171-02	1.757-04	1.188-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 82, PB, LEAD ATOMIC WT. = 207.2 MSQ/KG = .00029064 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.029+00	1.718+01	6.226+00	0.000	0.000	2.443+01	2.991-04	4.993-03	1.810-03	0.000	0.000	7.102-03
1.022+06	9.859-01	1.701+01	5.959+00	0.000	0.000	2.395+01	2.865-04	4.944-03	1.732-03	0.000	0.000	6.962-03
1.250+06	6.642-01	1.540+01	4.020+00	1.301-01	0.000	2.021+01	1.930-04	4.476-03	1.168-03	3.781-05	0.000	5.875-03
1.500+06	4.636-01	1.402+01	2.863+00	6.215-01	0.000	1.797+01	1.347-04	4.075-03	8.321-04	1.806-04	0.000	5.222-03
2.000+06	2.624-01	1.198+01	1.732+00	1.875+00	0.000	1.585+01	7.626-05	3.482-03	5.034-04	5.449-04	0.000	4.606-03
2.044+06	2.513-01	1.184+01	1.670+00	1.985+00	0.000	1.575+01	7.304-05	3.441-03	4.854-04	5.769-04	0.000	4.576-03
3.000+06	1.172-01	9.440+00	9.054-01	4.102+00	3.298-03	1.457+01	3.406-05	2.744-03	2.631-04	1.192-03	9.585-07	4.234-03
4.000+06	6.603-02	7.879+00	5.927-01	5.891+00	1.344-02	1.444+01	1.919-05	2.290-03	1.723-04	1.712-03	3.906-06	4.197-03
5.000+06	4.230-02	6.806+00	4.344-01	7.389+00	2.673-02	1.470+01	1.229-05	1.978-03	1.263-04	2.148-03	7.769-06	4.272-03
6.000+06	2.939-02	6.017+00	3.404-01	8.680+00	4.098-02	1.511+01	8.542-06	1.749-03	9.893-05	2.523-03	1.191-05	4.391-03
7.000+06	2.160-02	5.409+00	2.788-01	9.816+00	5.513-02	1.558+01	6.278-06	1.572-03	8.103-05	2.853-03	1.602-05	4.528-03
8.000+06	1.654-02	4.923+00	2.355-01	1.094+01	6.882-02	1.608+01	4.807-06	1.431-03	6.845-05	3.151-03	2.000-05	4.675-03
9.000+06	1.307-02	4.526+00	2.035-01	1.177+01	8.188-02	1.659+01	3.799-06	1.315-03	5.915-05	3.421-03	2.380-05	4.823-03
1.000+07	1.059-02	4.193+00	1.790-01	1.263+01	9.427-02	1.711+01	3.078-06	1.219-03	5.202-05	3.671-03	2.740-05	4.972-03
1.100+07	8.750-03	3.911+00	1.597-01	1.342+01	1.060-01	1.761+01	2.543-06	1.137-03	4.642-05	3.900-03	3.081-05	5.117-03
1.200+07	7.353-03	3.668+00	1.440-01	1.416+01	1.170-01	1.810+01	2.137-06	1.066-03	4.185-05	4.115-03	3.400-05	5.260-03
1.300+07	6.266-03	3.456+00	1.311-01	1.485+01	1.273-01	1.857+01	1.821-06	1.004-03	3.810-05	4.316-03	3.700-05	5.397-03
1.400+07	5.403-03	3.270+00	1.203-01	1.550+01	1.372-01	1.903+01	1.570-06	9.504-04	3.496-05	4.505-03	3.988-05	5.532-03
1.500+07	4.707-03	3.104+00	1.111-01	1.610+01	1.464-01	1.947+01	1.368-06	9.021-04	3.229-05	4.679-03	4.255-05	5.658-03
1.600+07	4.137-03	2.956+00	1.032-01	1.666+01	1.552-01	1.988+01	1.202-06	8.591-04	2.999-05	4.842-03	4.511-05	5.777-03
1.800+07	3.269-03	2.702+00	9.033-02	1.768+01	1.715-01	2.065+01	9.501-07	7.853-04	2.625-05	5.139-03	4.984-05	6.001-03
2.000+07	2.648-03	2.492+00	8.029-02	1.859+01	1.863-01	2.135+01	7.696-07	7.243-04	2.334-05	5.403-03	5.415-05	6.206-03
2.200+07	2.188-03	2.314+00	7.223-02	1.941+01	1.997-01	2.200+01	6.359-07	6.725-04	2.099-05	5.641-03	5.804-05	6.394-03
2.400+07	1.839-03	2.163+00	6.544-02	2.016+01	2.121-01	2.260+01	5.345-07	6.287-04	1.908-05	5.859-03	6.164-05	6.569-03
2.600+07	1.567-03	2.031+00	6.014-02	2.084+01	2.234-01	2.316+01	4.554-07	5.903-04	1.748-05	6.057-03	6.493-05	6.730-03
2.800+07	1.351-03	1.916+00	5.549-02	2.147+01	2.339-01	2.368+01	3.927-07	5.569-04	1.613-05	6.240-03	6.798-05	6.881-03
3.000+07	1.177-03	1.814+00	5.150-02	2.205+01	2.437-01	2.416+01	3.421-07	5.272-04	1.497-05	6.409-03	7.083-05	7.022-03
4.000+07	6.620-04	1.441+00	3.787-02	2.442+01	2.837-01	2.618+01	1.924-07	4.188-04	1.101-05	7.097-03	8.245-05	7.610-03
5.000+07	4.237-04	1.203+00	2.993-02	2.617+01	3.138-01	2.772+01	1.231-07	3.496-04	8.699-06	7.606-03	9.120-05	8.056-03
6.000+07	2.942-04	1.037+00	2.474-02	2.753+01	3.374-01	2.893+01	8.551-08	3.014-04	7.190-06	8.001-03	9.806-05	8.408-03
8.000+07	1.655-04	8.176-01	1.837-02	2.953+01	3.727-01	3.074+01	4.810-08	2.376-04	5.339-06	8.583-03	1.083-04	8.934-03
1.000+08	1.059-04	6.786-01	1.460-02	3.094+01	3.981-01	3.203+01	3.078-08	1.972-04	4.243-06	8.992-03	1.157-04	9.310-03
1.500+08	4.708-05	4.833-01	9.656-03	3.316+01	4.396-01	3.409+01	1.368-08	1.405-04	2.806-06	9.638-03	1.278-04	9.909-03
2.000+08	2.648-05	3.789-01	7.212-03	3.448+01	4.652-01	3.533+01	7.696-09	1.101-04	2.096-06	1.002-02	1.352-04	1.027-02
3.000+08	1.177-05	2.686-01	4.786-03	3.601+01	4.963-01	3.678+01	3.421-09	7.807-05	1.392-06	1.047-02	1.442-04	1.069-02
4.000+08	6.620-06	2.103-01	3.583-03	3.689+01	5.147-01	3.762+01	1.924-09	6.112-05	1.041-06	1.072-02	1.496-04	1.093-02
5.000+08	4.237-06	1.741-01	2.863-03	3.746+01	5.272-01	3.816+01	1.231-09	5.060-05	8.321-07	1.089-02	1.532-04	1.109-02
6.000+08	2.942-06	1.491-01	2.384-03	3.787+01	5.363-01	3.856+01	8.551-10	4.333-05	6.929-07	1.101-02	1.559-04	1.121-02
8.000+08	1.655-06	1.164-01	1.786-03	3.842+01	5.488-01	3.909+01	4.810-10	3.383-05	5.191-07	1.117-02	1.595-04	1.136-02
1.000+09	1.059-06	9.579-02	1.428-03	3.877+01	5.570-01	3.942+01	3.078-10	2.784-05	4.150-07	1.127-02	1.619-04	1.146-02
1.500+09	4.708-07	6.690-02	9.512-04	3.928+01	5.693-01	3.992+01	1.368-10	1.944-05	2.765-07	1.142-02	1.655-04	1.160-02
2.000+09	2.648-07	5.178-02	7.131-04	3.956+01	5.762-01	4.019+01	7.696-11	1.505-05	2.073-07	1.150-02	1.675-04	1.168-02
3.000+09	1.177-07	3.600-02	4.752-04	3.986+01	5.836-01	4.048+01	3.421-11	1.046-05	1.381-07	1.158-02	1.696-04	1.177-02
4.000+09	6.620-08	2.779-02	3.563-04	4.002+01	5.881-01	4.064+01	1.924-11	8.077-06	1.036-07	1.163-02	1.709-04	1.181-02
5.000+09	4.237-08	2.272-02	2.850-04	4.012+01	5.908-01	4.073+01	1.231-11	6.603-06	8.283-08	1.166-02	1.717-04	1.184-02
6.000+09	2.942-08	1.927-02	2.375-04	4.019+01	5.926-01	4.080+01	8.551-12	5.601-06	6.903-08	1.168-02	1.722-04	1.186-02
8.000+09	1.655-08	1.484-02	1.781-04	4.028+01	5.951-01	4.089+01	4.810-12	4.313-06	5.176-08	1.171-02	1.730-04	1.188-02
1.000+10	1.059-08	1.212-02	1.425-04	4.034+01	5.967-01	4.095+01	3.078-12	3.523-06	4.142-08	1.172-02	1.734-04	1.190-02
1.500+10	4.708-09	8.376-03	9.497-05	4.042+01	5.988-01	4.103+01	1.368-12	2.434-06	2.760-08	1.175-02	1.740-04	1.192-02
2.000+10	2.648-09	6.440-03	7.123-05	4.047+01	6.001-01	4.108+01	7.696-13	1.872-06	2.070-08	1.176-02	1.744-04	1.194-02
3.000+10	1.177-09	4.441-03	4.748-05	4.051+01	6.013-01	4.112+01	3.421-13	1.291-06	1.380-08	1.177-02	1.748-04	1.195-02
4.000+10	6.620-10	3.409-03	3.561-05	4.053+01	6.020-01	4.114+01	1.924-13	9.998-07	1.035-08	1.178-02	1.750-04	1.196-02
5.000+10	4.237-10	2.776-03	2.849-05	4.055+01	6.025-01	4.116+01	1.231-13	8.068-07	8.280-09	1.179-02	1.751-04	1.196-02
6.000+10	2.942-10	2.347-03	2.374-05	4.056+01	6.028-01	4.117+01	8.551-14	6.821-07	6.900-09	1.179-02	1.752-04	1.196-02
8.000+10	1.655-10	1.800-03	1.780-05	4.057+01	6.031-01	4.117+01	4.810-14	5.232-07	5.173-09	1.179-02	1.753-04	1.197-02
1.000+11	1.059-10	1.464-03	1.424-05	4.058+01	6.033-01	4.118+01	3.078-14	4.255-07	4.139-09	1.179-02	1.753-04	1.197-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 83, BI, BISMUTH ATOMIC WT. = 208.9804 MSQ/KG = .00028816 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.067+00	1.739+01	6.577+00	0.000	0.000	2.503+01	3.075-04	5.011-03	1.895-03	0.000	0.000	7.214-03
1.022+06	1.023+00	1.721+01	6.295+00	0.000	0.000	2.453+01	2.948-04	4.959-03	1.814-03	0.000	0.000	7.068-03
1.250+06	6.891-01	1.559+01	4.247+00	1.344-01	0.000	2.066+01	1.986-04	4.492-03	1.224-03	3.873-05	0.000	5.954-03
1.500+06	4.812-01	1.419+01	3.025+00	6.438-01	0.000	1.834+01	1.387-04	4.089-03	8.717-04	1.855-04	0.000	5.285-03
2.000+06	2.723-01	1.213+01	1.829+00	1.936+00	0.000	1.617+01	7.847-05	3.495-03	5.271-04	5.579-04	0.000	4.659-03
2.044+06	2.608-01	1.198+01	1.763+00	2.049+00	0.000	1.605+01	7.515-05	3.452-03	5.080-04	5.904-04	0.000	4.626-03
3.000+06	1.217-01	9.555+00	9.559-01	4.215+00	3.338-03	1.485+01	3.507-05	2.753-03	2.755-04	1.215-03	9.619-07	4.279-03
4.000+06	6.856-02	7.975+00	6.256-01	6.037+00	1.360-02	1.472+01	1.976-05	2.298-03	1.803-04	1.740-03	3.919-06	4.242-03
5.000+06	4.392-02	6.889+00	4.584-01	7.563+00	2.705-02	1.498+01	1.266-05	1.985-03	1.321-04	2.179-03	7.795-06	4.317-03
6.000+06	3.052-02	6.090+00	3.591-01	8.878+00	4.147-02	1.540+01	8.795-06	1.755-03	1.035-04	2.558-03	1.195-05	4.437-03
7.000+06	2.243-02	5.475+00	2.940-01	1.004+01	5.580-02	1.589+01	6.463-06	1.578-03	8.472-05	2.893-03	1.608-05	4.578-03
8.000+06	1.717-02	4.983+00	2.483-01	1.108+01	6.964-02	1.640+01	4.948-06	1.436-03	7.155-05	3.193-03	2.007-05	4.725-03
9.000+06	1.357-02	4.581+00	2.146-01	1.203+01	8.286-02	1.692+01	3.910-06	1.320-03	6.184-05	3.467-03	2.388-05	4.876-03
1.000+07	1.099-02	4.244+00	1.888-01	1.290+01	9.539-02	1.744+01	3.167-06	1.223-03	5.441-05	3.717-03	2.749-05	5.025-03
1.100+07	9.087-03	3.959+00	1.683-01	1.371+01	1.072-01	1.795+01	2.619-06	1.141-03	4.850-05	3.951-03	3.089-05	5.174-03
1.200+07	7.636-03	3.713+00	1.518-01	1.446+01	1.184-01	1.845+01	2.200-06	1.070-03	4.374-05	4.167-03	3.412-05	5.317-03
1.300+07	6.507-03	3.498+00	1.382-01	1.517+01	1.288-01	1.894+01	1.875-06	1.008-03	3.982-05	4.371-03	3.712-05	5.458-03
1.400+07	5.611-03	3.309+00	1.268-01	1.583+01	1.388-01	1.941+01	1.617-06	9.535-04	3.654-05	4.562-03	4.000-05	5.593-03
1.500+07	4.888-03	3.142+00	1.171-01	1.644+01	1.482-01	1.985+01	1.409-06	9.054-04	3.374-05	4.737-03	4.271-05	5.721-03
1.600+07	4.296-03	2.992+00	1.088-01	1.702+01	1.571-01	2.028+01	1.238-06	8.622-04	3.135-05	4.905-03	4.527-05	5.845-03
1.800+07	3.394-03	2.735+00	9.521-02	1.806+01	1.735-01	2.107+01	9.780-07	7.881-04	2.744-05	5.204-03	5.000-05	6.071-03
2.000+07	2.750-03	2.522+00	8.462-02	1.898+01	1.885-01	2.178+01	7.924-07	7.267-04	2.438-05	5.469-03	5.432-05	6.276-03
2.200+07	2.272-03	2.343+00	7.613-02	1.982+01	2.021-01	2.244+01	6.547-07	6.752-04	2.194-05	5.711-03	5.824-05	6.467-03
2.400+07	1.909-03	2.189+00	6.917-02	2.059+01	2.145-01	2.306+01	5.501-07	6.308-04	1.993-05	5.933-03	6.181-05	6.646-03
2.600+07	1.627-03	2.056+00	6.338-02	2.129+01	2.260-01	2.364+01	4.688-07	5.925-04	1.826-05	6.135-03	6.512-05	6.811-03
2.800+07	1.403-03	1.939+00	5.847-02	2.193+01	2.366-01	2.417+01	4.043-07	5.587-04	1.685-05	6.319-03	6.818-05	6.964-03
3.000+07	1.222-03	1.836+00	5.427-02	2.252+01	2.465-01	2.466+01	3.521-07	5.291-04	1.564-05	6.489-03	7.103-05	7.106-03
4.000+07	6.874-04	1.459+00	3.990-02	2.493+01	2.870-01	2.672+01	1.981-07	4.204-04	1.150-05	7.184-03	8.270-05	7.699-03
5.000+07	4.400-04	1.218+00	3.154-02	2.672+01	3.174-01	2.829+01	1.268-07	3.510-04	9.089-06	7.700-03	9.146-05	8.151-03
6.000+07	3.055-04	1.049+00	2.607-02	2.811+01	3.413-01	2.953+01	8.803-08	3.023-04	7.512-06	8.100-03	9.835-05	8.508-03
8.000+07	1.719-04	8.276-01	1.935-02	3.015+01	3.769-01	3.137+01	4.954-08	2.385-04	5.576-06	8.688-03	1.086-04	9.041-03
1.000+08	1.100-04	6.869-01	1.539-02	3.159+01	4.026-01	3.269+01	3.170-08	1.979-04	4.435-06	9.103-03	1.160-04	9.421-03
1.500+08	4.888-05	4.892-01	1.017-02	3.386+01	4.445-01	3.480+01	1.409-08	1.410-04	2.931-06	9.757-03	1.281-04	1.003-02
2.000+08	2.750-05	3.836-01	7.597-03	3.521+01	4.705-01	3.607+01	7.924-09	1.105-04	2.189-06	1.015-02	1.356-04	1.039-02
3.000+08	1.222-05	2.719-01	5.043-03	3.677+01	5.019-01	3.755+01	3.521-09	7.835-05	1.453-06	1.060-02	1.446-04	1.082-02
4.000+08	6.874-06	2.129-01	3.775-03	3.767+01	5.205-01	3.841+01	1.981-09	6.135-05	1.088-06	1.086-02	1.500-04	1.107-02
5.000+08	4.400-06	1.762-01	3.016-03	3.825+01	5.331-01	3.896+01	1.268-09	5.077-05	8.691-07	1.102-02	1.536-04	1.123-02
6.000+08	3.055-06	1.509-01	2.511-03	3.867+01	5.423-01	3.937+01	8.803-10	4.348-05	7.236-07	1.114-02	1.563-04	1.134-02
8.000+08	1.719-06	1.179-01	1.881-03	3.923+01	5.550-01	3.990+01	4.954-10	3.397-05	5.420-07	1.130-02	1.599-04	1.150-02
1.000+09	1.100-06	9.696-02	1.504-03	3.959+01	5.633-01	4.025+01	3.170-10	2.794-05	4.334-07	1.141-02	1.623-04	1.160-02
1.500+09	4.888-07	6.772-02	1.002-03	4.011+01	5.757-01	4.075+01	1.409-10	1.951-05	2.887-07	1.156-02	1.659-04	1.174-02
2.000+09	2.750-07	5.241-02	7.511-04	4.039+01	5.827-01	4.103+01	7.924-11	1.510-05	2.164-07	1.164-02	1.679-04	1.182-02
3.000+09	1.222-07	3.644-02	5.005-04	4.070+01	5.902-01	4.133+01	3.521-11	1.050-05	1.442-07	1.173-02	1.701-04	1.191-02
4.000+09	6.874-08	2.813-02	3.753-04	4.086+01	5.947-01	4.148+01	1.981-11	8.106-06	1.081-07	1.177-02	1.714-04	1.195-02
5.000+09	4.400-08	2.300-02	3.002-04	4.097+01	5.974-01	4.159+01	1.268-11	6.628-06	8.651-08	1.181-02	1.721-04	1.198-02
6.000+09	3.055-08	1.950-02	2.502-04	4.104+01	5.993-01	4.166+01	8.803-12	5.619-06	7.210-08	1.183-02	1.727-04	1.200-02
8.000+09	1.719-08	1.503-02	1.876-04	4.114+01	6.018-01	4.176+01	4.954-12	4.331-06	5.406-08	1.186-02	1.734-04	1.203-02
1.000+10	1.100-08	1.227-02	1.501-04	4.120+01	6.034-01	4.182+01	3.170-12	3.536-06	4.325-08	1.187-02	1.739-04	1.205-02
1.500+10	4.888-09	8.478-03	1.000-04	4.128+01	6.055-01	4.189+01	1.409-12	2.443-06	2.882-08	1.190-02	1.745-04	1.207-02
2.000+10	2.750-09	6.518-03	7.502-05	4.132+01	6.068-01	4.193+01	7.924-13	1.878-06	2.162-08	1.191-02	1.749-04	1.208-02
3.000+10	1.222-09	4.495-03	5.001-05	4.137+01	6.079-01	4.198+01	3.521-13	1.295-06	1.441-08	1.192-02	1.752-04	1.210-02
4.000+10	6.874-10	3.451-03	3.751-05	4.139+01	6.087-01	4.200+01	1.981-13	9.945-07	1.081-08	1.193-02	1.754-04	1.210-02
5.000+10	4.400-10	2.810-03	3.001-05	4.141+01	6.092-01	4.202+01	1.268-13	8.097-07	8.648-09	1.193-02	1.755-04	1.211-02
6.000+10	3.055-10	2.376-03	2.501-05	4.142+01	6.095-01	4.203+01	8.803-14	6.847-07	7.207-09	1.194-02	1.756-04	1.211-02
8.000+10	1.719-10	1.822-03	1.875-05	4.143+01	6.098-01	4.204+01	4.954-14	5.250-07	5.403-09	1.194-02	1.757-04	1.211-02
1.000+11	1.100-10	1.482-03	1.500-05	4.144+01	6.100-01	4.205+01	3.170-14	4.271-07	4.322-09	1.194-02	1.758-04	1.212-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 84, PO, POLONIUM ATOMIC WT. = 208.982 MSQ/KG = .00028816 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.107+00	1.760+01	6.943+00	0.000	0.000	2.565+01	3.190-04	5.072-03	2.001-03	0.000	0.000	7.391-03
1.022+06	1.061+00	1.742+01	6.646+00	0.000	0.000	2.513+01	3.057-04	5.020-03	1.915-03	0.000	0.000	7.241-03
1.250+06	7.149-01	1.578+01	4.484+00	1.388-01	0.000	2.112+01	2.060-04	4.547-03	1.292-03	4.000-05	0.000	6.085-03
1.500+06	4.992-01	1.436+01	3.193+00	6.667-01	0.000	1.872+01	1.438-04	4.138-03	9.201-04	1.921-04	0.000	5.394-03
2.000+06	2.826-01	1.227+01	1.931+00	1.998+00	0.000	1.648+01	8.143-05	3.536-03	5.564-04	5.757-04	0.000	4.749-03
2.044+06	2.707-01	1.212+01	1.861+00	2.114+00	0.000	1.637+01	7.801-05	3.493-03	5.363-04	6.092-04	0.000	4.716-03
3.000+06	1.263-01	9.670+00	1.009+00	4.329+00	3.378-03	1.514+01	3.639-05	2.787-03	2.908-04	1.247-03	9.734-07	4.362-03
4.000+06	7.117-02	8.071+00	6.599-01	6.185+00	1.377-02	1.500+01	2.051-05	2.326-03	1.902-04	1.782-03	3.968-06	4.323-03
5.000+06	4.559-02	6.972+00	4.834-01	7.738+00	2.738-02	1.527+01	1.314-05	2.009-03	1.393-04	2.230-03	7.890-06	4.399-03
6.000+06	3.168-02	6.164+00	3.786-01	9.078+00	4.196-02	1.569+01	9.129-06	1.776-03	1.091-04	2.616-03	1.209-05	4.522-03
7.000+06	2.328-02	5.541+00	3.100-01	1.026+01	5.646-02	1.619+01	6.708-06	1.597-03	8.933-05	2.957-03	1.627-05	4.666-03
8.000+06	1.783-02	5.043+00	2.618-01	1.132+01	7.047-02	1.671+01	5.138-06	1.453-03	7.544-05	3.262-03	2.031-05	4.816-03
9.000+06	1.409-02	4.636+00	2.262-01	1.229+01	8.384-02	1.725+01	4.060-06	1.336-03	6.518-05	3.541-03	2.416-05	4.971-03
1.000+07	1.141-02	4.296+00	1.989-01	1.318+01	9.652-02	1.778+01	3.288-06	1.238-03	5.732-05	3.798-03	2.781-05	5.124-03
1.100+07	9.433-03	4.007+00	1.774-01	1.400+01	1.085-01	1.830+01	2.718-06	1.155-03	5.112-05	4.034-03	3.127-05	5.274-03
1.200+07	7.927-03	3.758+00	1.600-01	1.477+01	1.197-01	1.882+01	2.284-06	1.083-03	4.611-05	4.256-03	3.449-05	5.422-03
1.300+07	6.755-03	3.540+00	1.456-01	1.549+01	1.303-01	1.931+01	1.947-06	1.020-03	4.196-05	4.464-03	3.755-05	5.565-03
1.400+07	5.825-03	3.349+00	1.336-01	1.616+01	1.404-01	1.979+01	1.679-06	9.651-04	3.850-05	4.657-03	4.046-05	5.702-03
1.500+07	5.074-03	3.180+00	1.234-01	1.679+01	1.499-01	2.025+01	1.462-06	9.164-04	3.556-05	4.838-03	4.320-05	5.835-03
1.600+07	4.460-03	3.028+00	1.146-01	1.737+01	1.589-01	2.068+01	1.285-06	8.726-04	3.302-05	5.005-03	4.579-05	5.958-03
1.800+07	3.524-03	2.768+00	1.003-01	1.843+01	1.756-01	2.148+01	1.015-06	7.976-04	2.890-05	5.311-03	5.060-05	6.189-03
2.000+07	2.854-03	2.552+00	8.913-02	1.937+01	1.906-01	2.220+01	8.224-07	7.354-04	2.568-05	5.582-03	5.492-05	6.398-03
2.200+07	2.359-03	2.371+00	8.018-02	2.023+01	2.044-01	2.289+01	6.798-07	6.832-04	2.310-05	5.829-03	5.890-05	6.595-03
2.400+07	1.982-03	2.215+00	7.285-02	2.101+01	2.170-01	2.352+01	5.711-07	6.383-04	2.099-05	6.054-03	6.253-05	6.777-03
2.600+07	1.689-03	2.080+00	6.675-02	2.173+01	2.286-01	2.411+01	4.867-07	5.994-04	1.923-05	6.262-03	6.587-05	6.947-03
2.800+07	1.456-03	1.962+00	6.158-02	2.238+01	2.393-01	2.464+01	4.196-07	5.654-04	1.774-05	6.449-03	6.896-05	7.102-03
3.000+07	1.269-03	1.858+00	5.715-02	2.299+01	2.493-01	2.516+01	3.657-07	5.354-04	1.647-05	6.625-03	7.184-05	7.249-03
4.000+07	7.137-04	1.477+00	4.202-02	2.545+01	2.902-01	2.726+01	2.057-07	4.256-04	1.211-05	7.334-03	8.362-05	7.855-03
5.000+07	4.567-04	1.233+00	3.321-02	2.728+01	3.209-01	2.887+01	1.316-07	3.553-04	9.570-06	7.861-03	9.247-05	8.319-03
6.000+07	3.172-04	1.062+00	2.745-02	2.870+01	3.451-01	3.013+01	9.140-08	3.060-04	7.910-06	8.270-03	9.944-05	8.684-03
8.000+07	1.784-04	8.376-01	2.037-02	3.078+01	3.811-01	3.202+01	5.141-08	2.414-04	5.870-06	8.870-03	1.098-04	9.227-03
1.000+08	1.142-04	6.952-01	1.620-02	3.224+01	4.071-01	3.336+01	3.291-08	2.003-04	4.668-06	9.290-03	1.173-04	9.613-03
1.500+08	5.075-05	4.951-01	1.071-02	3.456+01	4.495-01	3.552+01	1.462-08	1.427-04	3.086-06	9.959-03	1.295-04	1.023-02
2.000+08	2.854-05	3.882-01	7.998-03	3.594+01	4.757-01	3.681+01	8.224-09	1.119-04	2.305-06	1.036-02	1.371-04	1.061-02
3.000+08	1.269-05	2.751-01	5.309-03	3.754+01	5.075-01	3.833+01	3.657-09	7.927-05	1.530-06	1.082-02	1.462-04	1.104-02
4.000+08	7.136-06	2.155-01	3.973-03	3.845+01	5.263-01	3.920+01	2.056-09	6.210-05	1.145-06	1.108-02	1.517-04	1.129-02
5.000+08	4.567-06	1.784-01	3.175-03	3.905+01	5.391-01	3.977+01	1.316-09	5.141-05	9.149-07	1.125-02	1.553-04	1.146-02
6.000+08	3.172-06	1.527-01	2.643-03	3.948+01	5.485-01	4.018+01	9.140-10	4.400-05	7.616-07	1.138-02	1.581-04	1.158-02
8.000+08	1.784-06	1.193-01	1.980-03	4.005+01	5.613-01	4.073+01	5.141-10	3.438-05	5.706-07	1.154-02	1.617-04	1.174-02
1.000+09	1.142-06	9.813-02	1.583-03	4.042+01	5.697-01	4.109+01	3.291-10	2.828-05	4.562-07	1.165-02	1.642-04	1.184-02
1.500+09	5.075-07	6.853-02	1.055-03	4.095+01	5.822-01	4.160+01	1.462-10	1.975-05	3.040-07	1.180-02	1.678-04	1.199-02
2.000+09	2.854-07	5.304-02	7.907-04	4.124+01	5.893-01	4.188+01	8.224-11	1.528-05	2.278-07	1.188-02	1.698-04	1.207-02
3.000+09	1.269-07	3.688-02	5.269-04	4.155+01	5.969-01	4.218+01	3.657-11	1.063-05	1.518-07	1.197-02	1.720-04	1.216-02
4.000+09	7.136-08	2.847-02	3.951-04	4.172+01	6.015-01	4.235+01	2.056-11	8.204-06	1.139-07	1.202-02	1.733-04	1.220-02
5.000+09	4.567-08	2.328-02	3.160-04	4.183+01	6.042-01	4.246+01	1.316-11	6.708-06	9.106-08	1.205-02	1.741-04	1.223-02
6.000+09	3.172-08	1.974-02	2.633-04	4.190+01	6.061-01	4.253+01	9.140-12	5.688-06	7.587-08	1.207-02	1.747-04	1.225-02
8.000+09	1.784-08	1.521-02	1.975-04	4.200+01	6.086-01	4.262+01	5.141-12	4.383-06	5.691-08	1.210-02	1.754-04	1.228-02
1.000+10	1.142-08	1.242-02	1.580-04	4.206+01	6.103-01	4.268+01	3.291-12	3.579-06	4.553-08	1.212-02	1.759-04	1.230-02
1.500+10	5.075-09	8.580-03	1.053-04	4.214+01	6.124-01	4.276+01	1.462-12	2.472-06	3.034-08	1.214-02	1.765-04	1.232-02
2.000+10	2.854-09	6.597-03	7.897-05	4.219+01	6.137-01	4.281+01	8.224-13	1.901-06	2.276-08	1.216-02	1.768-04	1.234-02
3.000+10	1.269-09	4.549-03	5.265-05	4.224+01	6.149-01	4.286+01	3.657-13	1.311-06	1.517-08	1.217-02	1.772-04	1.235-02
4.000+10	7.136-10	3.493-03	3.948-05	4.226+01	6.157-01	4.288+01	2.056-13	1.007-06	1.138-08	1.218-02	1.774-04	1.236-02
5.000+10	4.567-10	2.844-03	3.159-05	4.228+01	6.162-01	4.290+01	1.316-13	8.195-07	9.103-09	1.218-02	1.776-04	1.236-02
6.000+10	3.172-10	2.404-03	2.632-05	4.229+01	6.164-01	4.291+01	9.140-14	6.927-07	7.584-09	1.219-02	1.776-04	1.236-02
8.000+10	1.784-10	1.843-03	1.974-05	4.230+01	6.167-01	4.292+01	5.141-14	5.311-07	5.688-09	1.219-02	1.777-04	1.237-02
1.000+11	1.142-10	1.500-03	1.579-05	4.231+01	6.170-01	4.293+01	3.291-14	4.322-07	4.550-09	1.219-02	1.778-04	1.237-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 85, AT, ASTATINE ATOMIC WT. = 209.987 MSQ/KG = .00028678 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.148+00	1.781+01	7.325+00	0.000	0.000	2.628+01	3.292-04	5.108-03	2.101-03	0.000	0.000	7.537-03
1.022+06	1.100+00	1.762+01	7.012+00	0.000	0.000	2.573+01	3.155-04	5.053-03	2.011-03	0.000	0.000	7.379-03
1.250+06	7.414-01	1.596+01	4.732+00	1.432-01	0.000	2.158+01	2.126-04	4.577-03	1.357-03	4.107-05	0.000	6.188-03
1.500+06	5.178-01	1.453+01	3.369+00	6.900-01	0.000	1.911+01	1.485-04	4.167-03	9.662-04	1.979-04	0.000	5.479-03
2.000+06	2.932-01	1.242+01	2.037+00	2.062+00	0.000	1.681+01	8.408-05	3.562-03	5.842-04	5.913-04	0.000	4.821-03
2.044+06	2.808-01	1.227+01	1.964+00	2.181+00	0.000	1.670+01	8.053-05	3.519-03	5.632-04	6.255-04	0.000	4.788-03
3.000+06	1.310-01	9.785+00	1.064+00	4.444+00	3.418-03	1.543+01	3.757-05	2.806-03	3.051-04	1.274-03	9.802-07	4.424-03
4.000+06	7.386-02	8.167+00	6.957-01	6.334+00	1.393-02	1.528+01	2.118-05	2.342-03	1.995-04	1.816-03	3.995-06	4.383-03
5.000+06	4.732-02	7.055+00	5.095-01	7.915+00	2.770-02	1.555+01	1.357-05	2.023-03	1.461-04	2.270-03	7.944-06	4.461-03
6.000+06	3.288-02	6.237+00	3.993-01	9.278+00	4.246-02	1.599+01	9.429-06	1.789-03	1.144-04	2.661-03	1.218-05	4.585-03
7.000+06	2.416-02	5.606+00	3.266-01	1.048+01	5.712-02	1.649+01	6.929-06	1.608-03	9.366-05	3.005-03	1.638-05	4.730-03
8.000+06	1.850-02	5.103+00	2.758-01	1.156+01	7.129-02	1.703+01	5.305-06	1.463-03	7.909-05	3.315-03	2.044-05	4.883-03
9.000+06	1.462-02	4.691+00	2.382-01	1.254+01	8.482-02	1.757+01	4.193-06	1.345-03	6.831-05	3.596-03	2.432-05	5.038-03
1.000+07	1.185-02	4.347+00	2.095-01	1.345+01	9.764-02	1.812+01	3.398-06	1.247-03	6.008-05	3.857-03	2.800-05	5.195-03
1.100+07	9.791-03	4.054+00	1.868-01	1.429+01	1.097-01	1.865+01	2.808-06	1.163-03	5.357-05	4.098-03	3.146-05	5.349-03
1.200+07	8.228-03	3.802+00	1.685-01	1.508+01	1.211-01	1.918+01	2.360-06	1.090-03	4.832-05	4.325-03	3.473-05	5.500-03
1.300+07	7.011-03	3.582+00	1.534-01	1.581+01	1.319-01	1.968+01	2.011-06	1.027-03	4.399-05	4.534-03	3.783-05	5.645-03
1.400+07	6.045-03	3.389+00	1.407-01	1.649+01	1.420-01	2.017+01	1.734-06	9.719-04	4.035-05	4.729-03	4.072-05	5.784-03
1.500+07	5.266-03	3.218+00	1.299-01	1.713+01	1.516-01	2.063+01	1.510-06	9.229-04	3.725-05	4.913-03	4.348-05	5.918-03
1.600+07	4.629-03	3.064+00	1.207-01	1.773+01	1.607-01	2.108+01	1.328-06	8.787-04	3.461-05	5.085-03	4.609-05	6.045-03
1.800+07	3.657-03	2.801+00	1.056-01	1.881+01	1.776-01	2.190+01	1.049-06	8.033-04	3.028-05	5.394-03	5.093-05	6.280-03
2.000+07	2.963-03	2.583+00	9.383-02	1.977+01	1.928-01	2.264+01	8.497-07	7.408-04	2.691-05	5.670-03	5.529-05	6.493-03
2.200+07	2.448-03	2.399+00	8.440-02	2.065+01	2.067-01	2.334+01	7.020-07	6.880-04	2.420-05	5.922-03	5.928-05	6.694-03
2.400+07	2.057-03	2.242+00	7.669-02	2.144+01	2.195-01	2.398+01	5.899-07	6.430-04	2.199-05	6.149-03	6.295-05	6.877-03
2.600+07	1.753-03	2.105+00	7.026-02	2.217+01	2.312-01	2.458+01	5.027-07	6.037-04	2.015-05	6.358-03	6.630-05	7.049-03
2.800+07	1.512-03	1.986+00	6.482-02	2.284+01	2.421-01	2.513+01	4.336-07	5.695-04	1.859-05	6.550-03	6.943-05	7.208-03
3.000+07	1.317-03	1.880+00	6.015-02	2.346+01	2.521-01	2.565+01	3.777-07	5.391-04	1.725-05	6.728-03	7.230-05	7.357-03
4.000+07	7.407-04	1.494+00	4.422-02	2.597+01	2.935-01	2.780+01	2.124-07	4.285-04	1.268-05	7.448-03	8.417-05	7.973-03
5.000+07	4.741-04	1.247+00	3.495-02	2.784+01	3.245-01	2.945+01	1.360-07	3.576-04	1.002-05	7.984-03	9.306-05	8.445-03
6.000+07	3.292-04	1.075+00	2.888-02	2.928+01	3.489-01	3.073+01	9.441-08	3.083-04	8.282-06	8.397-03	1.001-04	8.814-03
8.000+07	1.852-04	8.476-01	2.144-02	3.141+01	3.853-01	3.266+01	5.311-08	2.431-04	6.149-06	9.008-03	1.105-04	9.368-03
1.000+08	1.185-04	7.035-01	1.704-02	3.290+01	4.116-01	3.403+01	3.398-08	2.018-04	4.887-06	9.435-03	1.180-04	9.760-03
1.500+08	5.268-05	5.010-01	1.127-02	3.527+01	4.544-01	3.624+01	1.511-08	1.437-04	3.232-06	1.011-02	1.303-04	1.039-02
2.000+08	2.963-05	3.928-01	8.415-03	3.667+01	4.810-01	3.755+01	8.497-09	1.126-04	2.413-06	1.052-02	1.379-04	1.077-02
3.000+08	1.317-05	2.784-01	5.586-03	3.831+01	5.131-01	3.911+01	3.777-09	7.984-05	1.602-06	1.099-02	1.471-04	1.122-02
4.000+08	7.407-06	2.180-01	4.181-03	3.924+01	5.322-01	3.999+01	2.124-09	6.252-05	1.199-06	1.125-02	1.526-04	1.147-02
5.000+08	4.741-06	1.805-01	3.340-03	3.985+01	5.451-01	4.058+01	1.360-09	5.176-05	9.579-07	1.143-02	1.563-04	1.164-02
6.000+08	3.292-06	1.545-01	2.781-03	4.029+01	5.546-01	4.100+01	9.441-10	4.431-05	7.975-07	1.155-02	1.590-04	1.176-02
8.000+08	1.852-06	1.207-01	2.084-03	4.087+01	5.675-01	4.156+01	5.311-10	3.461-05	5.977-07	1.172-02	1.627-04	1.192-02
1.000+09	1.185-06	9.930-02	1.666-03	4.125+01	5.761-01	4.193+01	3.398-10	2.848-05	4.778-07	1.183-02	1.652-04	1.202-02
1.500+09	5.268-07	6.935-02	1.110-03	4.179+01	5.888-01	4.245+01	1.511-10	1.989-05	3.183-07	1.198-02	1.689-04	1.217-02
2.000+09	2.963-07	5.367-02	8.319-04	4.209+01	5.959-01	4.274+01	8.497-11	1.539-05	2.386-07	1.207-02	1.709-04	1.226-02
3.000+09	1.317-07	3.732-02	5.543-04	4.241+01	6.036-01	4.305+01	3.777-11	1.070-05	1.590-07	1.216-02	1.731-04	1.235-02
4.000+09	7.407-08	2.881-02	4.157-04	4.258+01	6.082-01	4.322+01	2.124-11	8.262-06	1.192-07	1.221-02	1.744-04	1.239-02
5.000+09	4.741-08	2.355-02	3.325-04	4.269+01	6.110-01	4.332+01	1.360-11	6.754-06	9.535-08	1.224-02	1.752-04	1.242-02
6.000+09	3.292-08	1.997-02	2.770-04	4.277+01	6.129-01	4.340+01	9.441-12	5.727-06	7.944-08	1.227-02	1.758-04	1.245-02
8.000+09	1.852-08	1.539-02	2.078-04	4.287+01	6.155-01	4.350+01	5.311-12	4.414-06	5.959-08	1.229-02	1.765-04	1.248-02
1.000+10	1.185-08	1.256-02	1.662-04	4.293+01	6.171-01	4.356+01	3.398-12	3.602-06	4.766-08	1.231-02	1.770-04	1.249-02
1.500+10	5.268-09	8.682-03	1.108-04	4.302+01	6.193-01	4.365+01	1.511-12	2.490-06	3.178-08	1.234-02	1.776-04	1.252-02
2.000+10	2.963-09	6.675-03	8.309-05	4.306+01	6.206-01	4.369+01	8.497-13	1.914-06	2.383-08	1.235-02	1.780-04	1.253-02
3.000+10	1.317-09	4.603-03	5.539-05	4.311+01	6.218-01	4.374+01	3.777-13	1.320-06	1.588-08	1.236-02	1.783-04	1.254-02
4.000+10	7.407-10	3.534-03	4.154-05	4.314+01	6.226-01	4.377+01	2.124-13	1.013-06	1.191-08	1.237-02	1.786-04	1.255-02
5.000+10	4.741-10	2.878-03	3.323-05	4.315+01	6.231-01	4.378+01	1.360-13	8.254-07	9.530-09	1.237-02	1.787-04	1.255-02
6.000+10	3.292-10	2.433-03	2.769-05	4.316+01	6.233-01	4.379+01	9.441-14	6.977-07	7.941-09	1.238-02	1.788-04	1.256-02
8.000+10	1.852-10	1.865-03	2.077-05	4.318+01	6.237-01	4.381+01	5.311-14	5.348-07	5.956-09	1.238-02	1.789-04	1.256-02
1.000+11	1.185-10	1.518-03	1.662-05	4.319+01	6.239-01	4.382+01	3.398-14	4.353-07	4.766-09	1.239-02	1.789-04	1.257-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 86, RN, RADON ATOMIC WT. = 222.018 MSQ/KG = .00027124 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.190+00	1.801+01	7.724+00	0.000	0.000	2.692+01	3.228-04	4.885-03	2.095-03	0.000	0.000	7.303-03
1.022+06	1.140+00	1.783+01	7.394+00	0.000	0.000	2.636+01	3.092-04	4.836-03	2.006-03	0.000	0.000	7.151-03
1.250+06	7.687-01	1.615+01	4.991+00	1.477-01	0.000	2.206+01	2.085-04	4.381-03	1.354-03	4.006-05	0.000	5.983-03
1.500+06	5.370-01	1.470+01	3.553+00	7.139-01	0.000	1.950+01	1.457-04	3.987-03	9.637-04	1.936-04	0.000	5.290-03
2.000+06	3.041-01	1.256+01	2.148+00	2.127+00	0.000	1.714+01	8.248-05	3.407-03	5.826-04	5.769-04	0.000	4.649-03
2.044+06	2.913-01	1.241+01	2.070+00	2.249+00	0.000	1.702+01	7.901-05	3.366-03	5.615-04	6.100-04	0.000	4.617-03
3.000+06	1.359-01	9.899+00	1.121+00	4.561+00	3.458-03	1.572+01	3.686-05	2.685-03	3.041-04	1.237-03	9.380-07	4.264-03
4.000+06	7.663-02	8.263+00	7.330-01	6.485+00	1.409-02	1.557+01	2.079-05	2.241-03	1.988-04	1.759-03	3.822-06	4.224-03
5.000+06	4.910-02	7.138+00	5.367-01	8.093+00	2.802-02	1.584+01	1.332-05	1.936-03	1.456-04	2.195-03	7.600-06	4.298-03
6.000+06	3.411-02	6.310+00	4.202-01	9.480+00	4.295-02	1.629+01	9.252-06	1.712-03	1.140-04	2.571-03	1.165-05	4.418-03
7.000+06	2.507-02	5.672+00	3.439-01	1.070+01	5.778-02	1.680+01	6.800-06	1.538-03	9.328-05	2.902-03	1.567-05	4.557-03
8.000+06	1.920-02	5.163+00	2.903-01	1.180+01	7.212-02	1.734+01	5.208-06	1.400-03	7.874-05	3.201-03	1.956-05	4.705-03
9.000+06	1.517-02	4.746+00	2.508-01	1.280+01	8.580-02	1.790+01	4.115-06	1.287-03	6.803-05	3.472-03	2.327-05	4.855-03
1.000+07	1.229-02	4.398+00	2.205-01	1.373+01	9.877-02	1.846+01	3.334-06	1.193-03	5.981-05	3.724-03	2.679-05	5.007-03
1.100+07	1.016-02	4.102+00	1.966-01	1.459+01	1.110-01	1.901+01	2.756-06	1.113-03	5.333-05	3.957-03	3.011-05	5.156-03
1.200+07	8.538-03	3.847+00	1.773-01	1.538+01	1.225-01	1.954+01	2.316-06	1.043-03	4.809-05	4.172-03	3.323-05	5.299-03
1.300+07	7.275-03	3.624+00	1.614-01	1.613+01	1.334-01	2.006+01	1.973-06	9.830-04	4.378-05	4.375-03	3.618-05	5.440-03
1.400+07	6.273-03	3.429+00	1.481-01	1.683+01	1.436-01	2.056+01	1.701-06	9.391-04	4.017-05	4.565-03	3.895-05	5.576-03
1.500+07	5.465-03	3.255+00	1.367-01	1.748+01	1.534-01	2.103+01	1.482-06	8.829-04	3.708-05	4.741-03	4.161-05	5.704-03
1.600+07	4.803-03	3.100+00	1.270-01	1.809+01	1.626-01	2.148+01	1.303-06	8.408-04	3.445-05	4.907-03	4.410-05	5.827-03
1.800+07	3.795-03	2.834+00	1.111-01	1.919+01	1.796-01	2.232+01	1.029-06	7.687-04	3.013-05	5.205-03	4.871-05	6.054-03
2.000+07	3.074-03	2.613+00	9.872-02	2.017+01	1.950-01	2.308+01	8.338-07	7.088-04	2.678-05	5.471-03	5.289-05	6.260-03
2.200+07	2.541-03	2.427+00	8.880-02	2.106+01	2.091-01	2.379+01	6.892-07	6.583-04	2.409-05	5.712-03	5.672-05	6.452-03
2.400+07	2.135-03	2.268+00	8.068-02	2.188+01	2.219-01	2.445+01	5.791-07	6.152-04	2.188-05	5.935-03	6.019-05	6.633-03
2.600+07	1.819-03	2.130+00	7.391-02	2.262+01	2.338-01	2.506+01	4.934-07	5.777-04	2.005-05	6.135-03	6.342-05	6.797-03
2.800+07	1.569-03	2.009+00	6.819-02	2.330+01	2.448-01	2.562+01	4.256-07	5.449-04	1.850-05	6.320-03	6.640-05	6.950-03
3.000+07	1.367-03	1.902+00	6.328-02	2.393+01	2.549-01	2.615+01	3.708-07	5.159-04	1.716-05	6.491-03	6.914-05	7.093-03
4.000+07	7.687-04	1.512+00	4.651-02	2.649+01	2.967-01	2.835+01	2.085-07	4.101-04	1.262-05	7.185-03	8.048-05	7.689-03
5.000+07	4.919-04	1.262+00	3.676-02	2.840+01	3.281-01	3.003+01	1.334-07	3.423-04	9.971-06	7.703-03	8.899-05	8.145-03
6.000+07	3.416-04	1.087+00	3.038-02	2.987+01	3.528-01	3.134+01	9.266-08	2.948-04	8.240-06	8.102-03	9.569-05	8.501-03
8.000+07	1.922-04	8.575-01	2.255-02	3.204+01	3.896-01	3.331+01	5.213-08	2.326-04	6.116-06	8.691-03	1.057-04	9.035-03
1.000+08	1.230-04	7.118-01	1.792-02	3.357+01	4.161-01	3.472+01	3.336-08	1.931-04	4.861-06	9.106-03	1.129-04	9.416-03
1.500+08	5.466-05	5.069-01	1.185-02	3.598+01	4.594-01	3.696+01	1.483-08	1.375-04	3.214-06	9.759-03	1.246-04	1.002-02
2.000+08	3.075-05	3.974-01	8.849-03	3.741+01	4.862-01	3.830+01	8.341-09	1.078-04	2.400-06	1.015-02	1.319-04	1.039-02
3.000+08	1.367-05	2.817-01	5.874-03	3.908+01	5.187-01	3.989+01	3.708-09	7.641-05	1.593-06	1.060-02	1.407-04	1.082-02
4.000+08	7.687-06	2.206-01	4.396-03	4.003+01	5.380-01	4.079+01	2.085-09	5.934-05	1.192-06	1.086-02	1.459-04	1.106-02
5.000+08	4.920-06	1.826-01	3.512-03	4.066+01	5.511-01	4.140+01	1.335-09	4.953-05	9.526-07	1.103-02	1.495-04	1.123-02
6.000+08	3.416-06	1.564-01	2.925-03	4.111+01	5.606-01	4.183+01	9.266-10	4.242-05	7.934-07	1.115-02	1.521-04	1.135-02
8.000+08	1.922-06	1.221-01	2.191-03	4.170+01	5.737-01	4.240+01	5.213-10	3.312-05	5.943-07	1.131-02	1.556-04	1.150-02
1.000+09	1.230-06	1.005-01	1.752-03	4.209+01	5.824-01	4.277+01	3.336-10	2.726-05	4.752-07	1.142-02	1.580-04	1.160-02
1.500+09	5.466-07	7.016-02	1.167-03	4.264+01	5.951-01	4.331+01	1.483-10	1.993-05	3.165-07	1.157-02	1.614-04	1.175-02
2.000+09	3.075-07	5.430-02	8.747-04	4.294+01	6.024-01	4.360+01	8.341-11	1.473-05	2.373-07	1.165-02	1.634-04	1.183-02
3.000+09	1.367-07	3.776-02	5.829-04	4.327+01	6.101-01	4.392+01	3.708-11	1.024-05	1.581-07	1.174-02	1.655-04	1.191-02
4.000+09	7.687-08	2.915-02	4.371-04	4.345+01	6.147-01	4.409+01	2.085-11	7.907-06	1.186-07	1.179-02	1.667-04	1.196-02
5.000+09	4.920-08	2.383-02	3.496-04	4.356+01	6.175-01	4.420+01	1.335-11	6.464-06	9.483-08	1.182-02	1.675-04	1.199-02
6.000+09	3.416-08	2.021-02	2.913-04	4.364+01	6.195-01	4.428+01	9.266-12	5.482-06	7.901-08	1.184-02	1.680-04	1.201-02
8.000+09	1.922-08	1.557-02	2.185-04	4.374+01	6.221-01	4.438+01	5.213-12	4.223-06	5.927-08	1.186-02	1.687-04	1.204-02
1.000+10	1.230-08	1.271-02	1.748-04	4.380+01	6.237-01	4.444+01	3.336-12	3.447-06	4.741-08	1.188-02	1.692-04	1.205-02
1.500+10	5.466-09	8.785-03	1.165-04	4.389+01	6.259-01	4.452+01	1.483-12	2.383-06	3.160-08	1.190-02	1.698-04	1.208-02
2.000+10	3.075-09	6.754-03	8.737-05	4.394+01	6.272-01	4.457+01	8.341-13	1.832-06	2.370-08	1.192-02	1.701-04	1.209-02
3.000+10	1.367-09	4.658-03	5.824-05	4.399+01	6.284-01	4.462+01	3.708-13	1.263-06	1.580-08	1.193-02	1.704-04	1.210-02
4.000+10	7.687-10	3.576-03	4.368-05	4.402+01	6.292-01	4.465+01	2.085-13	9.700-07	1.185-08	1.194-02	1.707-04	1.211-02
5.000+10	4.920-10	2.912-03	3.495-05	4.403+01	6.297-01	4.466+01	1.335-13	7.899-07	9.480-09	1.194-02	1.708-04	1.211-02
6.000+10	3.416-10	2.461-03	2.912-05	4.404+01	6.300-01	4.467+01	9.266-14	6.675-07	7.899-09	1.195-02	1.709-04	1.212-02
8.000+10	1.922-10	1.887-03	2.184-05	4.406+01	6.303-01	4.469+01	5.213-14	5.118-07	5.924-09	1.195-02	1.710-04	1.212-02
1.000+11	1.230-10	1.536-03	1.747-05	4.407+01	6.306-01	4.470+01	3.336-14	4.166-07	4.739-09	1.195-02	1.710-04	1.213-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 87, FR, FRANCIUM ATOMIC WT. = 223.020 MSQ/KG = .00027002 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING		PAIR PRODUCTION				SCATTERING		PAIR PRODUCTION			
	COHERENT	INCOHER.	PHOTO-ELECTRIC	NUCLEAR FIELD	ELECTRON FIELD	TOTAL	COHERENT	INCOHER.	PHOTO-ELECTRIC	NUCLEAR FIELD	ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.232+00	1.822+01	8.140+00	0.000	0.000	2.759+01	3.327-04	4.920-03	2.158-03	0.000	0.000	7.450-03
1.022+06	1.181+00	1.803+01	7.794+00	0.000	0.000	2.700+01	3.189-04	4.869-03	2.105-03	0.000	0.000	7.292-03
1.250+06	7.966-01	1.633+01	5.264+00	1.525-01	0.000	2.254+01	2.151-04	4.409-03	1.421-03	4.118-05	0.000	6.087-03
1.500+06	5.566-01	1.487+01	3.744+00	7.292-01	0.000	1.991+01	1.503-04	4.015-03	1.011-03	1.996-04	0.000	5.376-03
2.000+06	3.153-01	1.271+01	2.263+00	2.196+00	0.000	1.748+01	8.514-05	3.432-03	6.111-04	5.930-04	0.000	4.721-03
2.044+06	3.020-01	1.255+01	2.182+00	2.321+00	0.000	1.735+01	8.155-05	3.389-03	5.892-04	6.267-04	0.000	4.686-03
3.000+06	1.410-01	1.001+01	1.181+00	4.678+00	3.498-03	1.601+01	3.807-05	2.703-03	3.189-04	1.253-03	9.445-07	4.324-03
4.000+06	7.947-02	8.358+00	7.719-01	6.637+00	1.425-02	1.586+01	2.146-05	2.257-03	2.084-04	1.792-03	3.948-06	4.283-03
5.000+06	5.092-02	7.221+00	5.650-01	8.273+00	2.834-02	1.614+01	1.375-05	1.950-03	1.526-04	2.234-03	7.652-06	4.358-03
6.000+06	3.539-02	6.384+00	4.423-01	9.682+00	4.344-02	1.659+01	9.556-06	1.724-03	1.194-04	2.614-03	1.173-05	4.479-03
7.000+06	2.601-02	5.738+00	3.619-01	1.092+01	5.844-02	1.710+01	7.023-06	1.549-03	9.772-05	2.949-03	1.578-05	4.619-03
8.000+06	1.992-02	5.223+00	3.055-01	1.204+01	7.294-02	1.766+01	5.379-06	1.410-03	8.249-05	3.251-03	1.970-05	4.769-03
9.000+06	1.574-02	4.801+00	2.639-01	1.307+01	8.678-02	1.824+01	4.250-06	1.296-03	7.126-05	3.529-03	2.343-05	4.925-03
1.000+07	1.275-02	4.449+00	2.320-01	1.401+01	9.989-02	1.880+01	3.443-06	1.201-03	6.265-05	3.783-03	2.697-05	5.077-03
1.100+07	1.054-02	4.150+00	2.069-01	1.488+01	1.123-01	1.936+01	2.846-06	1.121-03	5.587-05	4.018-03	3.032-05	5.228-03
1.200+07	8.856-03	3.892+00	1.865-01	1.569+01	1.239-01	1.990+01	2.391-06	1.051-03	5.036-05	4.237-03	3.346-05	5.374-03
1.300+07	7.546-03	3.667+00	1.698-01	1.645+01	1.349-01	2.043+01	2.038-06	9.902-04	4.585-05	4.442-03	3.643-05	5.516-03
1.400+07	6.507-03	3.469+00	1.557-01	1.716+01	1.453-01	2.094+01	1.757-06	9.367-04	4.204-05	4.634-03	3.923-05	5.653-03
1.500+07	5.669-03	3.293+00	1.438-01	1.783+01	1.551-01	2.143+01	1.531-06	8.892-04	3.883-05	4.815-03	4.188-05	5.786-03
1.600+07	4.982-03	3.136+00	1.335-01	1.845+01	1.644-01	2.189+01	1.345-06	8.468-04	3.605-05	4.982-03	4.439-05	5.910-03
1.800+07	3.937-03	2.867+00	1.168-01	1.957+01	1.816-01	2.274+01	1.063-06	7.742-04	3.154-05	5.284-03	4.904-05	6.140-03
2.000+07	3.189-03	2.644+00	1.038-01	2.057+01	1.972-01	2.352+01	8.611-07	7.139-04	2.803-05	5.554-03	5.325-05	6.350-03
2.200+07	2.636-03	2.455+00	9.337-02	2.148+01	2.114-01	2.424+01	7.118-07	6.629-04	2.521-05	5.800-03	5.708-05	6.546-03
2.400+07	2.215-03	2.294+00	8.483-02	2.231+01	2.244-01	2.492+01	5.981-07	6.194-04	2.291-05	6.024-03	6.059-05	6.728-03
2.600+07	1.887-03	2.155+00	7.771-02	2.307+01	2.364-01	2.554+01	5.095-07	5.819-04	2.098-05	6.229-03	6.383-05	6.897-03
2.800+07	1.627-03	2.032+00	7.169-02	2.376+01	2.475-01	2.611+01	4.393-07	5.487-04	1.936-05	6.416-03	6.683-05	7.051-03
3.000+07	1.417-03	1.925+00	6.653-02	2.441+01	2.577-01	2.666+01	3.826-07	5.198-04	1.796-05	6.591-03	6.958-05	7.199-03
4.000+07	7.973-04	1.529+00	4.890-02	2.702+01	3.000-01	2.890+01	2.153-07	4.129-04	1.320-05	7.296-03	8.101-05	7.803-03
5.000+07	5.103-04	1.277+00	3.864-02	2.896+01	3.317-01	3.061+01	1.378-07	3.448-04	1.043-05	7.820-03	8.957-05	8.265-03
6.000+07	3.544-04	1.100+00	3.193-02	3.047+01	3.566-01	3.196+01	9.570-08	2.970-04	8.622-06	8.278-03	9.629-05	8.630-03
8.000+07	1.993-04	8.675-01	2.370-02	3.268+01	3.938-01	3.397+01	5.382-08	2.342-04	6.400-06	8.824-03	1.063-04	9.171-03
1.000+08	1.276-04	7.200-01	1.884-02	3.423+01	4.206-01	3.539+01	3.445-08	1.944-04	5.087-06	9.263-03	1.136-04	9.556-03
1.500+08	5.670-05	5.128-01	1.245-02	3.670+01	4.644-01	3.769+01	1.531-08	1.385-04	3.362-06	9.910-03	1.254-04	1.018-02
2.000+08	3.189-05	4.020-01	9.300-03	3.816+01	4.915-01	3.906+01	8.611-09	1.085-04	2.511-06	1.030-02	1.327-04	1.055-02
3.000+08	1.417-05	2.850-01	6.174-03	3.986+01	5.244-01	4.068+01	3.826-09	7.696-05	1.667-06	1.076-02	1.416-04	1.098-02
4.000+08	7.973-06	2.232-01	4.620-03	4.083+01	5.440-01	4.160+01	2.153-09	6.027-05	1.248-06	1.103-02	1.469-04	1.123-02
5.000+08	5.103-06	1.847-01	3.691-03	4.147+01	5.573-01	4.222+01	1.378-09	4.987-05	9.967-07	1.120-02	1.505-04	1.140-02
6.000+08	3.544-06	1.582-01	3.074-03	4.193+01	5.670-01	4.266+01	9.570-10	4.272-05	8.300-07	1.132-02	1.531-04	1.152-02
8.000+08	1.993-06	1.235-01	2.303-03	4.254+01	5.803-01	4.325+01	5.382-10	3.335-05	6.219-07	1.149-02	1.567-04	1.168-02
1.000+09	1.276-06	1.016-01	1.841-03	4.293+01	5.892-01	4.362+01	3.445-10	2.743-05	4.971-07	1.159-02	1.591-04	1.178-02
1.500+09	5.670-07	7.098-02	1.226-03	4.350+01	6.023-01	4.417+01	1.531-10	1.917-05	3.310-07	1.175-02	1.626-04	1.193-02
2.000+09	3.189-07	5.494-02	9.193-04	4.381+01	6.098-01	4.448+01	8.611-11	1.484-05	2.482-07	1.183-02	1.647-04	1.201-02
3.000+09	1.417-07	3.820-02	6.126-04	4.414+01	6.179-01	4.480+01	3.826-11	1.031-05	1.654-07	1.192-02	1.668-04	1.210-02
4.000+09	7.973-08	2.948-02	4.593-04	4.432+01	6.227-01	4.497+01	2.153-11	7.960-06	1.240-07	1.197-02	1.681-04	1.214-02
5.000+09	5.103-08	2.411-02	3.674-04	4.444+01	6.256-01	4.509+01	1.378-11	6.510-06	9.921-08	1.200-02	1.689-04	1.218-02
6.000+09	3.544-08	2.044-02	3.062-04	4.452+01	6.276-01	4.517+01	9.570-12	5.519-06	8.268-08	1.202-02	1.695-04	1.220-02
8.000+09	1.993-08	1.575-02	2.296-04	4.462+01	6.304-01	4.527+01	5.382-12	4.253-06	6.200-08	1.205-02	1.702-04	1.222-02
1.000+10	1.276-08	1.286-02	1.837-04	4.469+01	6.321-01	4.534+01	3.445-12	3.472-06	4.960-08	1.207-02	1.707-04	1.224-02
1.500+10	5.670-09	8.887-03	1.224-04	4.478+01	6.344-01	4.542+01	1.531-12	2.400-06	3.305-08	1.209-02	1.713-04	1.227-02
2.000+10	3.189-09	6.832-03	9.182-05	4.483+01	6.358-01	4.547+01	8.611-13	1.845-06	2.479-08	1.211-02	1.717-04	1.228-02
3.000+10	1.417-09	4.712-03	6.121-05	4.488+01	6.371-01	4.552+01	3.826-13	1.272-06	1.653-08	1.212-02	1.720-04	1.229-02
4.000+10	7.973-10	3.617-03	4.591-05	4.490+01	6.380-01	4.554+01	2.153-13	9.767-07	1.240-08	1.212-02	1.723-04	1.230-02
5.000+10	5.103-10	2.946-03	3.672-05	4.492+01	6.385-01	4.556+01	1.378-13	7.955-07	9.915-09	1.213-02	1.724-04	1.230-02
6.000+10	3.544-10	2.490-03	3.060-05	4.493+01	6.388-01	4.557+01	9.570-14	6.724-07	8.263-09	1.213-02	1.725-04	1.231-02
8.000+10	1.993-10	1.909-03	2.295-05	4.495+01	6.391-01	4.559+01	5.382-14	5.155-07	6.197-09	1.214-02	1.726-04	1.231-02
1.000+11	1.276-10	1.553-03	1.836-05	4.496+01	6.394-01	4.560+01	3.445-14	4.193-07	4.958-09	1.214-02	1.727-04	1.231-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 88, RA, RADIUM ATOMIC WT. = 226.0254 MSQ/KG = .00026643 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.277+00	1.843+01	8.573+00	0.000	0.000	2.828+01	3.402-04	4.910-03	2.284-03	0.000	0.000	7.535-03
1.022+06	1.223+00	1.824+01	8.209+00	0.000	0.000	2.767+01	3.258-04	4.860-03	2.187-03	0.000	0.000	7.373-03
1.250+06	8.253-01	1.652+01	5.545+00	1.571-01	0.000	2.305+01	2.199-04	4.401-03	1.477-03	4.186-05	0.000	6.141-03
1.500+06	5.768-01	1.504+01	3.944+00	7.643-01	0.000	2.033+01	1.537-04	4.007-03	1.051-03	2.036-04	0.000	5.415-03
2.000+06	3.268-01	1.286+01	2.383+00	2.263+00	0.000	1.783+01	8.707-05	3.426-03	6.349-04	6.029-04	0.000	4.751-03
2.044+06	3.131-01	1.270+01	2.298+00	2.392+00	0.000	1.770+01	8.342-05	3.384-03	6.123-04	6.373-04	0.000	4.717-03
3.000+06	1.462-01	1.013+01	1.243+00	4.798+00	3.538-03	1.632+01	3.895-05	2.699-03	3.312-04	1.278-03	9.426-07	4.348-03
4.000+06	8.241-02	8.454+00	8.124-01	6.790+00	1.442-02	1.615+01	2.196-05	2.252-03	2.164-04	1.809-03	3.842-06	4.304-03
5.000+06	5.280-02	7.304+00	5.945-01	8.454+00	2.867-02	1.643+01	1.407-05	1.946-03	1.584-04	2.252-03	7.639-06	4.379-03
6.000+06	3.669-02	6.457+00	4.653-01	9.886+00	4.393-02	1.689+01	9.775-06	1.720-03	1.240-04	2.634-03	1.170-05	4.500-03
7.000+06	2.697-02	5.804+00	3.807-01	1.115+01	5.911-02	1.742+01	7.186-06	1.546-03	1.014-04	2.971-03	1.575-05	4.641-03
8.000+06	2.065-02	5.283+00	3.213-01	1.229+01	7.376-02	1.799+01	5.502-06	1.408-03	8.560-05	3.274-03	1.965-05	4.793-03
9.000+06	1.632-02	4.857+00	2.775-01	1.333+01	8.775-02	1.857+01	4.348-06	1.294-03	7.393-05	3.552-03	2.338-05	4.947-03
1.000+07	1.322-02	4.500+00	2.440-01	1.429+01	1.010-01	1.915+01	3.522-06	1.199-03	6.501-05	3.807-03	2.691-05	5.102-03
1.100+07	1.093-02	4.197+00	2.175-01	1.518+01	1.135-01	1.972+01	2.912-06	1.118-03	5.795-05	4.044-03	3.024-05	5.254-03
1.200+07	9.184-03	3.937+00	1.961-01	1.600+01	1.253-01	2.027+01	2.447-06	1.049-03	5.225-05	4.263-03	3.338-05	5.400-03
1.300+07	7.826-03	3.709+00	1.785-01	1.678+01	1.364-01	2.081+01	2.085-06	9.882-04	4.756-05	4.471-03	3.634-05	5.545-03
1.400+07	6.748-03	3.509+00	1.637-01	1.750+01	1.469-01	2.133+01	1.798-06	9.349-04	4.361-05	4.663-03	3.914-05	5.682-03
1.500+07	5.879-03	3.331+00	1.512-01	1.818+01	1.568-01	2.182+01	1.566-06	8.875-04	4.028-05	4.844-03	4.178-05	5.815-03
1.600+07	5.167-03	3.172+00	1.404-01	1.881+01	1.662-01	2.229+01	1.377-06	8.451-04	3.741-05	5.012-03	4.428-05	5.940-03
1.800+07	4.083-03	2.899+00	1.228-01	1.995+01	1.836-01	2.316+01	1.088-06	7.724-04	3.272-05	5.315-03	4.892-05	6.170-03
2.000+07	3.307-03	2.674+00	1.091-01	2.097+01	1.994-01	2.396+01	8.811-07	7.124-04	2.907-05	5.587-03	5.313-05	6.383-03
2.200+07	2.733-03	2.484+00	9.813-02	2.190+01	2.137-01	2.470+01	7.282-07	6.618-04	2.614-05	5.835-03	5.694-05	6.580-03
2.400+07	2.297-03	2.321+00	8.915-02	2.275+01	2.269-01	2.539+01	6.120-07	6.184-04	2.375-05	6.061-03	6.045-05	6.765-03
2.600+07	1.957-03	2.179+00	8.167-02	2.352+01	2.390-01	2.602+01	5.214-07	5.806-04	2.176-05	6.266-03	6.368-05	6.933-03
2.800+07	1.687-03	2.056+00	7.534-02	2.423+01	2.502-01	2.661+01	4.495-07	5.478-04	2.007-05	6.456-03	6.666-05	7.091-03
3.000+07	1.470-03	1.947+00	6.991-02	2.488+01	2.606-01	2.716+01	3.917-07	5.187-04	1.863-05	6.629-03	6.943-05	7.236-03
4.000+07	8.269-04	1.547+00	5.138-02	2.755+01	3.032-01	2.945+01	2.203-07	4.122-04	1.369-05	7.340-03	8.078-05	7.847-03
5.000+07	5.292-04	1.291+00	4.059-02	2.953+01	3.353-01	3.120+01	1.410-07	3.440-04	1.081-05	7.868-03	8.933-05	8.312-03
6.000+07	3.675-04	1.113+00	3.355-02	3.106+01	3.604-01	3.257+01	9.791-08	2.965-04	8.939-06	8.275-03	9.602-05	8.677-03
8.000+07	2.067-04	8.775-01	2.490-02	3.332+01	3.980-01	3.462+01	5.507-08	2.338-04	6.634-06	8.878-03	1.060-04	9.224-03
1.000+08	1.323-04	7.283-01	1.979-02	3.491+01	4.251-01	3.608+01	3.525-08	1.940-04	5.273-06	9.301-03	1.133-04	9.614-03
1.500+08	5.880-05	5.187-01	1.308-02	3.742+01	4.694-01	3.842+01	1.567-08	1.382-04	3.485-06	9.970-03	1.251-04	1.024-02
2.000+08	3.307-05	4.067-01	9.770-03	3.891+01	4.968-01	3.982+01	8.811-09	1.084-04	2.603-06	1.037-02	1.324-04	1.061-02
3.000+08	1.470-05	2.882-01	6.485-03	4.064+01	5.301-01	4.146+01	3.917-09	7.679-05	1.728-06	1.083-02	1.412-04	1.105-02
4.000+08	8.269-06	2.257-01	4.853-03	4.164+01	5.500-01	4.242+01	2.203-09	6.013-05	1.293-06	1.109-02	1.465-04	1.130-02
5.000+08	5.292-06	1.869-01	3.878-03	4.229+01	5.635-01	4.304+01	1.410-09	4.980-05	1.033-06	1.127-02	1.501-04	1.147-02
6.000+08	3.675-06	1.600-01	3.229-03	4.276+01	5.734-01	4.350+01	9.791-10	4.263-05	8.603-07	1.139-02	1.528-04	1.159-02
8.000+08	2.067-06	1.250-01	2.419-03	4.338+01	5.870-01	4.409+01	5.507-10	3.330-05	6.445-07	1.156-02	1.564-04	1.175-02
1.000+09	1.323-06	1.028-01	1.934-03	4.378+01	5.961-01	4.448+01	3.525-10	2.739-05	5.153-07	1.166-02	1.588-04	1.185-02
1.500+09	5.880-07	7.180-02	1.288-03	4.436+01	6.096-01	4.504+01	1.567-10	1.913-05	3.432-07	1.182-02	1.624-04	1.200-02
2.000+09	3.307-07	5.557-02	9.656-04	4.468+01	6.172-01	4.535+01	8.811-11	1.481-05	2.573-07	1.190-02	1.644-04	1.208-02
3.000+09	1.470-07	3.864-02	6.435-04	4.502+01	6.256-01	4.568+01	3.917-11	1.029-05	1.714-07	1.199-02	1.667-04	1.217-02
4.000+09	8.269-08	2.982-02	4.825-04	4.520+01	6.306-01	4.586+01	2.203-11	7.945-06	1.286-07	1.204-02	1.680-04	1.222-02
5.000+09	5.292-08	2.438-02	3.859-04	4.532+01	6.336-01	4.598+01	1.410-11	6.496-06	1.028-07	1.207-02	1.688-04	1.225-02
6.000+09	3.675-08	2.068-02	3.216-04	4.540+01	6.357-01	4.606+01	9.791-12	5.510-06	8.568-08	1.210-02	1.694-04	1.227-02
8.000+09	2.067-08	1.593-02	2.412-04	4.551+01	6.386-01	4.616+01	5.507-12	4.244-06	6.426-08	1.213-02	1.701-04	1.230-02
1.000+10	1.323-08	1.301-02	1.929-04	4.557+01	6.404-01	4.622+01	3.525-12	3.466-06	5.139-08	1.214-02	1.706-04	1.232-02
1.500+10	5.880-09	8.989-03	1.286-04	4.567+01	6.428-01	4.632+01	1.567-12	2.395-06	3.426-08	1.217-02	1.713-04	1.234-02
2.000+10	3.307-09	6.911-03	9.645-05	4.572+01	6.443-01	4.637+01	8.811-13	1.841-06	2.570-08	1.218-02	1.717-04	1.235-02
3.000+10	1.470-09	4.766-03	6.430-05	4.577+01	6.456-01	4.642+01	3.917-13	1.270-06	1.713-08	1.219-02	1.720-04	1.237-02
4.000+10	8.269-10	3.659-03	4.822-05	4.580+01	6.465-01	4.645+01	2.203-13	9.749-07	1.285-08	1.220-02	1.722-04	1.238-02
5.000+10	5.292-10	2.980-03	3.858-05	4.581+01	6.470-01	4.646+01	1.410-13	7.940-07	1.028-08	1.221-02	1.724-04	1.238-02
6.000+10	3.675-10	2.519-03	3.215-05	4.582+01	6.474-01	4.647+01	9.791-14	6.711-07	8.566-09	1.221-02	1.725-04	1.238-02
8.000+10	2.067-10	1.931-03	2.411-05	4.584+01	6.477-01	4.649+01	5.507-14	5.145-07	6.424-09	1.221-02	1.726-04	1.239-02
1.000+11	1.323-10	1.571-03	1.929-05	4.585+01	6.480-01	4.650+01	3.525-14	4.186-07	5.139-09	1.222-02	1.726-04	1.239-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, Z=1 to 100—Continued

Z = 89, AC, ACTINIUM ATOMIC WT. = 227.0278 MSQ/KG = .00026526 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.322+00	1.863+01	9.025+00	0.000	0.000	2.898+01	3.507-04	4.942-03	2.394-03	0.000	0.000	7.686-03
1.022+06	1.267+00	1.844+01	8.642+00	0.000	0.000	2.835+01	3.361-04	4.891-03	2.292-03	0.000	0.000	7.520-03
1.250+06	8.548-01	1.671+01	5.838+00	1.618-01	0.000	2.356+01	2.267-04	4.432-03	1.549-03	4.292-05	0.000	6.251-03
1.500+06	5.975-01	1.521+01	4.152+00	7.897-01	0.000	2.075+01	1.585-04	4.035-03	1.101-03	2.095-04	0.000	5.504-03
2.000+06	3.387-01	1.300+01	2.509+00	2.332+00	0.000	1.818+01	8.984-05	3.448-03	6.655-04	6.186-04	0.000	4.822-03
2.044+06	3.244-01	1.284+01	2.419+00	2.464+00	0.000	1.805+01	8.605-05	3.406-03	6.417-04	6.536-04	0.000	4.787-03
3.000+06	1.515-01	1.024+01	1.308+00	4.920+00	3.578-03	1.662+01	4.019-05	2.716-03	3.470-04	1.305-03	9.491-07	4.409-03
4.000+06	8.562-02	8.550+00	8.546-01	6.945+00	1.458-02	1.645+01	2.266-05	2.268-03	2.267-04	1.842-03	3.867-06	4.363-03
5.000+06	5.474-02	7.387+00	6.252-01	8.636+00	2.899-02	1.673+01	1.452-05	1.959-03	1.658-04	2.291-03	7.690-06	4.438-03
6.000+06	3.804-02	6.530+00	4.893-01	1.009+01	4.443-02	1.719+01	1.009-05	1.732-03	1.298-04	2.676-03	1.179-05	4.560-03
7.000+06	2.796-02	5.870+00	4.002-01	1.137+01	5.977-02	1.773+01	7.417-06	1.557-03	1.062-04	3.016-03	1.585-05	4.702-03
8.000+06	2.141-02	5.343+00	3.377-01	1.253+01	7.459-02	1.831+01	5.679-06	1.417-03	8.958-05	3.324-03	1.979-05	4.856-03
9.000+06	1.692-02	4.912+00	2.917-01	1.359+01	8.873-02	1.890+01	4.488-06	1.303-03	7.738-05	3.605-03	2.354-05	5.013-03
1.000+07	1.371-02	4.551+00	2.564-01	1.457+01	1.021-01	1.949+01	3.637-06	1.207-03	6.801-05	3.865-03	2.708-05	5.171-03
1.100+07	1.133-02	4.245+00	2.286-01	1.547+01	1.148-01	2.007+01	3.005-06	1.126-03	6.064-05	4.104-03	3.045-05	5.324-03
1.200+07	9.521-03	3.981+00	2.061-01	1.632+01	1.267-01	2.064+01	2.526-06	1.056-03	5.467-05	4.329-03	3.361-05	5.476-03
1.300+07	8.113-03	3.751+00	1.875-01	1.710+01	1.379-01	2.118+01	2.152-06	9.950-04	4.974-05	4.536-03	3.658-05	5.619-03
1.400+07	6.996-03	3.549+00	1.720-01	1.784+01	1.485-01	2.172+01	1.856-06	9.414-04	4.562-05	4.732-03	3.939-05	5.760-03
1.500+07	6.095-03	3.369+00	1.588-01	1.853+01	1.585-01	2.222+01	1.617-06	8.936-04	4.212-05	4.915-03	4.204-05	5.895-03
1.600+07	5.357-03	3.208+00	1.475-01	1.917+01	1.680-01	2.270+01	1.421-06	8.509-04	3.913-05	5.085-03	4.456-05	6.021-03
1.800+07	4.233-03	2.932+00	1.290-01	2.034+01	1.856-01	2.359+01	1.123-06	7.777-04	3.422-05	5.395-03	4.923-05	6.258-03
2.000+07	3.429-03	2.704+00	1.146-01	2.138+01	2.015-01	2.440+01	9.096-07	7.173-04	3.040-05	5.671-03	5.345-05	6.473-03
2.200+07	2.834-03	2.512+00	1.031-01	2.232+01	2.160-01	2.515+01	7.517-07	6.663-04	2.735-05	5.921-03	5.730-05	6.672-03
2.400+07	2.381-03	2.347+00	9.365-02	2.319+01	2.293-01	2.586+01	6.316-07	6.226-04	2.484-05	6.151-03	6.082-05	6.860-03
2.600+07	2.029-03	2.204+00	8.578-02	2.398+01	2.416-01	2.651+01	5.382-07	5.846-04	2.275-05	6.361-03	6.409-05	7.033-03
2.800+07	1.749-03	2.079+00	7.913-02	2.470+01	2.529-01	2.711+01	4.639-07	5.515-04	2.099-05	6.552-03	6.708-05	7.192-03
3.000+07	1.524-03	1.969+00	7.343-02	2.537+01	2.634-01	2.768+01	4.042-07	5.223-04	1.948-05	6.770-03	6.987-05	7.342-03
4.000+07	8.573-04	1.565+00	5.396-02	2.808+01	3.065-01	3.001+01	2.274-07	4.151-04	1.431-05	7.448-03	8.130-05	7.959-03
5.000+07	5.487-04	1.306+00	4.263-02	3.010+01	3.388-01	3.179+01	1.455-07	3.464-04	1.131-05	7.984-03	8.987-05	8.432-03
6.000+07	3.810-04	1.125+00	3.523-02	3.166+01	3.643-01	3.318+01	1.011-07	2.984-04	9.345-06	8.398-03	9.663-05	8.802-03
8.000+07	2.143-04	8.875-01	2.614-02	3.396+01	4.022-01	3.528+01	5.684-08	2.354-04	6.934-06	9.008-03	1.067-04	9.357-03
1.000+08	1.372-04	7.366-01	2.078-02	3.558+01	4.296-01	3.677+01	3.639-08	1.954-04	5.512-06	9.438-03	1.140-04	9.753-03
1.500+08	6.096-05	5.246-01	1.374-02	3.814+01	4.743-01	3.915+01	1.617-08	1.392-04	3.645-06	1.012-02	1.258-04	1.039-02
2.000+08	3.429-05	4.113-01	1.026-02	3.966+01	5.021-01	4.058+01	9.096-09	1.091-04	2.722-06	1.052-02	1.332-04	1.077-02
3.000+08	1.524-05	2.915-01	6.809-03	4.143+01	5.358-01	4.226+01	4.042-09	7.732-05	1.806-06	1.099-02	1.421-04	1.121-02
4.000+08	8.572-06	2.283-01	5.095-03	4.245+01	5.559-01	4.324+01	2.274-09	6.056-05	1.351-06	1.126-02	1.475-04	1.147-02
5.000+08	5.486-06	1.890-01	4.071-03	4.311+01	5.696-01	4.387+01	1.455-09	5.013-05	1.080-06	1.144-02	1.511-04	1.164-02
6.000+08	3.810-06	1.618-01	3.390-03	4.359+01	5.796-01	4.433+01	1.011-09	4.292-05	8.992-07	1.156-02	1.537-04	1.176-02
8.000+08	2.143-06	1.264-01	2.539-03	4.422+01	5.934-01	4.494+01	5.684-10	3.353-05	6.735-07	1.173-02	1.574-04	1.192-02
1.000+09	1.372-06	1.040-01	2.030-03	4.463+01	6.026-01	4.534+01	3.639-10	2.759-05	5.385-07	1.184-02	1.598-04	1.203-02
1.500+09	6.096-07	7.261-02	1.352-03	4.523+01	6.163-01	4.592+01	1.617-10	1.926-05	3.586-07	1.200-02	1.635-04	1.218-02
2.000+09	3.429-07	5.620-02	1.014-03	4.555+01	6.241-01	4.623+01	9.096-11	1.491-05	2.690-07	1.208-02	1.655-04	1.226-02
3.000+09	1.524-07	3.908-02	6.756-04	4.590+01	6.326-01	4.657+01	4.042-11	1.037-05	1.792-07	1.218-02	1.678-04	1.235-02
4.000+09	8.572-08	3.016-02	5.066-04	4.609+01	6.376-01	4.676+01	2.274-11	8.000-06	1.344-07	1.223-02	1.691-04	1.240-02
5.000+09	5.486-08	2.466-02	4.052-04	4.621+01	6.407-01	4.688+01	1.455-11	6.541-06	1.075-07	1.226-02	1.699-04	1.243-02
6.000+09	3.810-08	2.091-02	3.376-04	4.629+01	6.428-01	4.695+01	1.011-11	5.546-06	8.955-08	1.228-02	1.705-04	1.245-02
8.000+09	2.143-08	1.611-02	2.532-04	4.640+01	6.457-01	4.706+01	5.684-12	4.273-06	6.716-08	1.231-02	1.713-04	1.248-02
1.000+10	1.372-08	1.315-02	2.025-04	4.647+01	6.475-01	4.713+01	3.639-12	3.488-06	5.371-08	1.233-02	1.718-04	1.250-02
1.500+10	6.096-09	9.091-03	1.350-04	4.656+01	6.500-01	4.722+01	1.617-12	2.411-06	3.581-08	1.235-02	1.724-04	1.253-02
2.000+10	3.429-09	6.989-03	1.013-04	4.661+01	6.515-01	4.727+01	9.096-13	1.854-06	2.687-08	1.236-02	1.728-04	1.254-02
3.000+10	1.524-09	4.820-03	6.750-05	4.667+01	6.529-01	4.733+01	4.042-13	1.279-06	1.790-08	1.238-02	1.732-04	1.255-02
4.000+10	8.572-10	3.701-03	5.063-05	4.670+01	6.538-01	4.736+01	2.274-13	9.817-07	1.343-08	1.239-02	1.734-04	1.256-02
5.000+10	5.486-10	3.013-03	4.050-05	4.671+01	6.543-01	4.737+01	1.455-13	7.992-07	1.074-08	1.239-02	1.736-04	1.256-02
6.000+10	3.810-10	2.547-03	3.375-05	4.672+01	6.546-01	4.738+01	1.011-13	6.756-07	8.952-09	1.239-02	1.736-04	1.257-02
8.000+10	2.143-10	1.953-03	2.531-05	4.674+01	6.550-01	4.740+01	5.684-14	5.180-07	6.714-09	1.240-02	1.737-04	1.257-02
1.000+11	1.372-10	1.589-03	2.025-05	4.675+01	6.553-01	4.741+01	3.639-14	4.215-07	5.371-09	1.240-02	1.738-04	1.257-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 90, TH, THORIUM ATOMIC WT. = 232.0381 MSQ/KG = .00025953 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM
1.000+06	1.368+00	1.884+01	9.495+00	0.000	0.000	2.970+01
1.022+06	1.311+00	1.864+01	9.092+00	0.000	0.000	2.904+01
1.250+06	8.851-01	1.689+01	6.144+00	1.665-01	0.000	2.409+01
1.500+06	6.188-01	1.538+01	4.369+00	8.157-01	0.000	2.118+01
2.000+06	3.508-01	1.315+01	2.640+00	2.402+00	0.000	1.854+01
2.044+06	3.361-01	1.299+01	2.545+00	2.537+00	0.000	1.841+01
3.000+06	1.570-01	1.036+01	1.376+00	5.043+00	3.618-03	1.694+01
4.000+06	8.852-02	8.646+00	8.986-01	7.102+00	1.474-02	1.675+01
5.000+06	5.673-02	7.470+00	6.572-01	8.820+00	2.931-02	1.703+01
6.000+06	3.942-02	6.604+00	5.142-01	1.030+01	4.492-02	1.750+01
7.000+06	2.898-02	5.936+00	4.205-01	1.160+01	6.043-02	1.805+01
8.000+06	2.219-02	5.403+00	3.549-01	1.278+01	7.541-02	1.864+01
9.000+06	1.754-02	4.967+00	3.064-01	1.386+01	8.971-02	1.924+01
1.000+07	1.421-02	4.602+00	2.693-01	1.485+01	1.033-01	1.984+01
1.100+07	1.174-02	4.293+00	2.401-01	1.577+01	1.160-01	2.043+01
1.200+07	9.869-03	4.026+00	2.164-01	1.663+01	1.281-01	2.101+01
1.300+07	8.409-03	3.793+00	1.970-01	1.743+01	1.394-01	2.157+01
1.400+07	7.251-03	3.588+00	1.806-01	1.818+01	1.501-01	2.211+01
1.500+07	6.317-03	3.407+00	1.668-01	1.888+01	1.603-01	2.262+01
1.600+07	5.552-03	3.244+00	1.549-01	1.954+01	1.699-01	2.311+01
1.800+07	4.387-03	2.965+00	1.355-01	2.072+01	1.876-01	2.401+01
2.000+07	3.554-03	2.735+00	1.203-01	2.178+01	2.037-01	2.484+01
2.200+07	2.937-03	2.540+00	1.082-01	2.275+01	2.184-01	2.562+01
2.400+07	2.468-03	2.374+00	9.832-02	2.363+01	2.318-01	2.634+01
2.600+07	2.103-03	2.229+00	9.006-02	2.443+01	2.442-01	2.700+01
2.800+07	1.813-03	2.103+00	8.307-02	2.517+01	2.556-01	2.761+01
3.000+07	1.580-03	1.991+00	7.706-02	2.585+01	2.662-01	2.819+01
4.000+07	8.885-04	1.582+00	5.664-02	2.861+01	3.097-01	3.056+01
5.000+07	5.687-04	1.321+00	4.474-02	3.067+01	3.424-01	3.238+01
6.000+07	3.949-04	1.138+00	3.697-02	3.226+01	3.681-01	3.380+01
8.000+07	2.221-04	8.974-01	2.744-02	3.461+01	4.064-01	3.594+01
1.000+08	1.422-04	7.449-01	2.181-02	3.626+01	4.341-01	3.746+01
1.500+08	6.319-05	5.305-01	1.442-02	3.887+01	4.793-01	3.989+01
2.000+08	3.554-05	4.159-01	1.076-02	4.042+01	5.074-01	4.135+01
3.000+08	1.580-05	2.948-01	7.145-03	4.223+01	5.415-01	4.307+01
4.000+08	8.886-06	2.309-01	5.347-03	4.326+01	5.618-01	4.406+01
5.000+08	5.687-06	1.911-01	4.272-03	4.394+01	5.757-01	4.471+01
6.000+08	3.949-06	1.636-01	3.557-03	4.443+01	5.858-01	4.518+01
8.000+08	2.221-06	1.278-01	2.665-03	4.507+01	5.998-01	4.580+01
1.000+09	1.422-06	1.051-01	2.130-03	4.549+01	6.091-01	4.621+01
1.500+09	6.319-07	7.343-02	1.419-03	4.610+01	6.230-01	4.680+01
2.000+09	3.554-07	5.683-02	1.064-03	4.643+01	6.308-01	4.712+01
3.000+09	1.580-07	3.951-02	7.089-04	4.679+01	6.394-01	4.747+01
4.000+09	8.886-08	3.050-02	5.316-04	4.698+01	6.445-01	4.766+01
5.000+09	5.687-08	2.494-02	4.252-04	4.710+01	6.476-01	4.777+01
6.000+09	3.949-08	2.115-02	3.543-04	4.719+01	6.498-01	4.786+01
8.000+09	2.221-08	1.629-02	2.657-04	4.730+01	6.527-01	4.797+01
1.000+10	1.422-08	1.330-02	2.125-04	4.736+01	6.546-01	4.803+01
1.500+10	6.319-09	9.193-03	1.417-04	4.746+01	6.571-01	4.813+01
2.000+10	3.554-09	7.068-03	1.063-04	4.751+01	6.586-01	4.818+01
3.000+10	1.580-09	4.874-03	7.083-05	4.757+01	6.599-01	4.823+01
4.000+10	8.886-10	3.742-03	5.312-05	4.760+01	6.609-01	4.826+01
5.000+10	5.687-10	3.047-03	4.250-05	4.762+01	6.614-01	4.828+01
6.000+10	3.949-10	2.576-03	3.542-05	4.763+01	6.617-01	4.829+01
8.000+10	2.221-10	1.975-03	2.656-05	4.764+01	6.621-01	4.830+01
1.000+11	1.422-10	1.607-03	2.125-05	4.765+01	6.624-01	4.831+01

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	3.550-04	4.890-03	2.464-03	0.000	0.000	7.709-03
1.022+06	3.402-04	4.838-03	2.360-03	0.000	0.000	7.537-03
1.250+06	2.297-04	4.383-03	1.595-03	4.321-05	0.000	6.251-03
1.500+06	1.606-04	3.992-03	1.134-03	2.117-04	0.000	5.498-03
2.000+06	9.104-05	3.413-03	6.852-04	6.234-04	0.000	4.812-03
2.044+06	8.723-05	3.371-03	6.605-04	6.584-04	0.000	4.777-03
3.000+06	4.075-05	2.689-03	3.571-04	1.309-03	9.390-07	4.396-03
4.000+06	2.297-05	2.244-03	2.332-04	1.843-03	3.825-06	4.347-03
5.000+06	1.472-05	1.939-03	1.706-04	2.289-03	7.607-06	4.421-03
6.000+06	1.023-05	1.714-03	1.334-04	2.673-03	1.166-05	4.542-03
7.000+06	7.521-06	1.541-03	1.091-04	3.011-03	1.568-05	4.683-03
8.000+06	5.759-06	1.402-03	9.211-05	3.317-03	1.957-05	4.836-03
9.000+06	4.552-06	1.289-03	7.952-05	3.597-03	2.328-05	4.993-03
1.000+07	3.688-06	1.194-03	6.989-05	3.854-03	2.681-05	5.149-03
1.100+07	3.047-06	1.114-03	6.231-05	4.093-03	3.011-05	5.302-03
1.200+07	2.561-06	1.045-03	5.616-05	4.316-03	3.325-05	5.453-03
1.300+07	2.182-06	9.844-04	5.113-05	4.524-03	3.618-05	5.597-03
1.400+07	1.882-06	9.312-04	4.687-05	4.718-03	3.896-05	5.737-03
1.500+07	1.639-06	8.842-04	4.329-05	4.900-03	4.160-05	5.871-03
1.600+07	1.441-06	8.419-04	4.020-05	5.071-03	4.409-05	5.999-03
1.800+07	1.139-06	7.695-04	3.517-05	5.377-03	4.869-05	6.232-03
2.000+07	9.224-07	7.098-04	3.122-05	5.653-03	5.287-05	6.447-03
2.200+07	7.622-07	6.592-04	2.808-05	5.904-03	5.668-05	6.649-03
2.400+07	6.405-07	6.161-04	2.552-05	6.133-03	6.016-05	6.835-03
2.600+07	5.458-07	5.785-04	2.337-05	6.340-03	6.338-05	7.006-03
2.800+07	4.705-07	5.458-04	2.156-05	6.532-03	6.634-05	7.166-03
3.000+07	4.101-07	5.167-04	2.000-05	6.709-03	6.909-05	7.315-03
4.000+07	2.306-07	4.106-04	1.470-05	7.425-03	8.038-05	7.931-03
5.000+07	1.476-07	3.428-04	1.161-05	7.960-03	8.886-05	8.403-03
6.000+07	1.025-07	2.953-04	9.595-06	8.372-03	9.553-05	8.773-03
8.000+07	5.764-08	2.329-04	7.121-06	8.982-03	1.055-04	9.328-03
1.000+08	3.690-08	1.933-04	5.660-06	9.410-03	1.127-04	9.722-03
1.500+08	1.640-08	1.377-04	3.742-06	1.009-02	1.244-04	1.035-02
2.000+08	9.224-09	1.079-04	2.793-06	1.049-02	1.317-04	1.073-02
3.000+08	4.101-09	7.651-05	1.854-06	1.096-02	1.405-04	1.118-02
4.000+08	2.306-09	5.993-05	1.388-06	1.123-02	1.458-04	1.143-02
5.000+08	1.476-09	4.960-05	1.109-06	1.140-02	1.494-04	1.160-02
6.000+08	1.025-09	4.246-05	9.231-07	1.153-02	1.520-04	1.173-02
8.000+08	5.764-10	3.317-05	6.916-07	1.170-02	1.557-04	1.189-02
1.000+09	3.690-10	2.728-05	5.528-07	1.181-02	1.581-04	1.199-02
1.500+09	1.640-10	1.906-05	3.683-07	1.196-02	1.617-04	1.215-02
2.000+09	9.224-11	1.475-05	2.761-07	1.205-02	1.637-04	1.223-02
3.000+09	4.101-11	1.025-05	1.840-07	1.214-02	1.659-04	1.232-02
4.000+09	2.306-11	7.916-06	1.380-07	1.219-02	1.673-04	1.237-02
5.000+09	1.476-11	6.473-06	1.104-07	1.222-02	1.681-04	1.240-02
6.000+09	1.025-11	5.489-06	9.195-08	1.225-02	1.686-04	1.242-02
8.000+09	5.764-12	4.228-06	6.896-08	1.228-02	1.694-04	1.245-02
1.000+10	3.690-12	3.452-06	5.515-08	1.229-02	1.699-04	1.246-02
1.500+10	1.640-12	2.386-06	3.678-08	1.232-02	1.705-04	1.249-02
2.000+10	9.224-13	1.834-06	2.759-08	1.233-02	1.709-04	1.250-02
3.000+10	4.101-13	1.265-06	1.838-08	1.235-02	1.713-04	1.252-02
4.000+10	2.306-13	9.712-07	1.379-08	1.235-02	1.715-04	1.253-02
5.000+10	1.476-13	7.908-07	1.103-08	1.236-02	1.717-04	1.253-02
6.000+10	1.025-13	6.685-07	9.192-09	1.236-02	1.717-04	1.253-02
8.000+10	5.764-14	5.126-07	6.893-09	1.236-02	1.718-04	1.254-02
1.000+11	3.690-14	4.171-07	5.515-09	1.237-02	1.719-04	1.254-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 91, PA, PROTACTINIUM ATOMIC WT. = 231.0359 MSQ/KG = .00026065 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000-06	1.416+00	1.905+01	9.585+00	0.000	0.000	3.045+01	3.691-04	4.965-03	2.603-03	0.000	0.000	7.937-03
1.022-06	1.358+00	1.885+01	9.561+00	0.000	0.000	2.977+01	3.540-04	4.913-03	2.492-03	0.000	0.000	7.759-03
1.250-06	9.165-01	1.708+01	6.462+00	1.713-01	0.000	2.463+01	2.389-04	4.452-03	1.684-03	4.465-05	0.000	6.420-03
1.500-06	6.409-01	1.555+01	4.595+00	8.422-01	0.000	2.163+01	1.671-04	4.053-03	1.198-03	2.195-04	0.000	5.637-03
2.000-06	3.635-01	1.329+01	2.776+00	2.474+00	0.000	1.890+01	9.475-05	3.464-03	7.236-04	6.449-04	0.000	4.927-03
2.044-06	3.482-01	1.313+01	2.676+00	2.512+00	0.000	1.877+01	9.076-05	3.422-03	6.975-04	6.808-04	0.000	4.891-03
3.000-06	1.627-01	1.047+01	1.446+00	5.168+00	3.658-03	1.725+01	4.241-05	2.729-03	3.769-04	1.347-03	9.535-07	4.496-03
4.000-06	9.175-02	8.742+00	9.442-01	7.259+00	1.490-02	1.705+01	2.392-05	2.279-03	2.461-04	1.892-03	3.884-06	4.445-03
5.000-06	5.880-02	7.552+00	6.905-01	9.005+00	2.963-02	1.734+01	1.533-05	1.968-03	1.800-04	2.347-03	7.723-06	4.519-03
6.000-06	4.086-02	6.677+00	5.401-01	1.050+01	4.541-02	1.780+01	1.065-05	1.740-03	1.408-04	2.737-03	1.184-05	4.641-03
7.000+06	3.004-02	6.002+00	4.417-01	1.183+01	6.109-02	1.836+01	7.830-06	1.564-03	1.151-04	3.084-03	1.592-05	4.787-03
8.000+06	2.300-02	5.463+00	3.726-01	1.303+01	7.623-02	1.896+01	5.995-06	1.424-03	9.712-05	3.396-03	1.987-05	4.943-03
9.000+06	1.818-02	5.022+00	3.217-01	1.412+01	9.068-02	1.957+01	4.739-06	1.309-03	8.385-05	3.680-03	2.364-05	5.102-03
1.000+07	1.473-02	4.653+00	2.828-01	1.513+01	1.044-01	2.018+01	3.839-06	1.213-03	7.371-05	3.944-03	2.721-05	5.261-03
1.100+07	1.217-02	4.340+00	2.520-01	1.607+01	1.173-01	2.079+01	3.172-06	1.131-03	6.568-05	4.189-03	3.057-05	5.419-03
1.200+07	1.023-02	4.071+00	2.272-01	1.694+01	1.295-01	2.138+01	2.666-06	1.061-03	5.922-05	4.415-03	3.375-05	5.572-03
1.300+07	8.717-03	3.835+00	2.067-01	1.776+01	1.409-01	2.195+01	2.272-06	9.996-04	5.388-05	4.629-03	3.673-05	5.722-03
1.400+07	7.517-03	3.628+00	1.896-01	1.852+01	1.517-01	2.250+01	1.959-06	9.457-04	4.942-05	4.827-03	3.954-05	5.864-03
1.500+07	6.548-03	3.445+00	1.751-01	1.923+01	1.620-01	2.302+01	1.707-06	8.980-04	4.564-05	5.012-03	4.223-05	6.000-03
1.600+07	5.755-03	3.280+00	1.625-01	1.990+01	1.717-01	2.352+01	1.500-06	8.549-04	4.236-05	5.187-03	4.475-05	6.131-03
1.800+07	4.548-03	2.998+00	1.422-01	2.111+01	1.896-01	2.444+01	1.185-06	7.814-04	3.707-05	5.502-03	4.942-05	6.372-03
2.000+07	3.684-03	2.765+00	1.263-01	2.219+01	2.059-01	2.529+01	9.602-07	7.207-04	3.292-05	5.784-03	5.367-05	6.592-03
2.200+07	3.045-03	2.568+00	1.136-01	2.317+01	2.207-01	2.608+01	7.937-07	6.694-04	2.961-05	6.039-03	5.753-05	6.797-03
2.400+07	2.558-03	2.400+00	1.032-01	2.407+01	2.343-01	2.681+01	6.668-07	6.256-04	2.690-05	6.274-03	6.107-05	6.988-03
2.600+07	2.180-03	2.254+00	9.449-02	2.489+01	2.467-01	2.749+01	5.682-07	5.875-04	2.463-05	6.488-03	6.430-05	7.165-03
2.800+07	1.880-03	2.126+00	8.716-02	2.564+01	2.583-01	2.811+01	4.900-07	5.542-04	2.272-05	6.683-03	6.733-05	7.328-03
3.000+07	1.637-03	2.013+00	8.088-02	2.633+01	2.690-01	2.869+01	4.267-07	5.247-04	2.108-05	6.863-03	7.012-05	7.479-03
4.000+07	9.211-04	1.600+00	5.942-02	2.915+01	3.130-01	3.112+01	2.401-07	4.170-04	1.549-05	7.598-03	8.158-05	8.112-03
5.000+07	5.895-04	1.335+00	4.694-02	3.125+01	3.460-01	3.298+01	1.537-07	3.480-04	1.224-05	8.145-03	9.019-05	8.596-03
6.000+07	4.094-04	1.150+00	3.879-02	3.287+01	3.719-01	3.443+01	1.067-07	2.998-04	1.011-05	8.568-03	9.694-05	8.975-03
8.000+07	2.303-04	9.074-01	2.878-02	3.526+01	4.106-01	3.661+01	6.003-08	2.365-04	7.502-06	9.191-03	1.070-04	9.542-03
1.000+08	1.474-04	7.531-01	2.288-02	3.694+01	4.385-01	3.815+01	3.842-08	1.963-04	5.964-06	9.629-03	1.143-04	9.945-03
1.500+08	6.550-05	5.363-01	1.512-02	3.960+01	4.841-01	4.064+01	1.707-08	1.398-04	3.941-06	1.032-02	1.262-04	1.059-02
2.000+08	3.684-05	4.205-01	1.129-02	4.118+01	5.124-01	4.212+01	9.602-09	1.096-04	2.943-06	1.073-02	1.336-04	1.098-02
3.000+08	1.638-05	2.981-01	7.494-03	4.303+01	5.467-01	4.388+01	4.270-09	7.770-05	1.953-06	1.122-02	1.425-04	1.144-02
4.000+08	9.211-06	2.324-01	5.608-03	4.408+01	5.671-01	4.489+01	2.401-09	6.084-05	1.462-06	1.149-02	1.478-04	1.170-02
5.000+08	5.895-06	1.932-01	4.481-03	4.478+01	5.811-01	4.556+01	1.537-09	5.036-05	1.168-06	1.167-02	1.515-04	1.188-02
6.000+08	4.094-06	1.655-01	3.731-03	4.527+01	5.912-01	4.603+01	1.067-09	4.314-05	9.725-07	1.180-02	1.541-04	1.200-02
8.000+08	2.303-06	1.292-01	2.795-03	4.593+01	6.053-01	4.667+01	6.003-10	3.368-05	7.285-07	1.197-02	1.578-04	1.216-02
1.000+09	1.474-06	1.063-01	2.234-03	4.636+01	6.146-01	4.708+01	3.842-10	2.771-05	5.823-07	1.208-02	1.602-04	1.227-02
1.500+09	6.550-07	7.424-02	1.488-03	4.698+01	6.285-01	4.768+01	1.707-10	1.935-05	3.879-07	1.225-02	1.638-04	1.243-02
2.000+09	3.684-07	5.746-02	1.116-03	4.731+01	6.364-01	4.800+01	9.602-11	1.498-05	2.909-07	1.233-02	1.659-04	1.251-02
3.000+09	1.638-07	3.995-02	7.435-04	4.768+01	6.450-01	4.837+01	4.270-11	1.041-05	1.938-07	1.243-02	1.681-04	1.261-02
4.000+09	9.211-08	3.084-02	5.575-04	4.787+01	6.500-01	4.855+01	2.401-11	8.039-06	1.453-07	1.248-02	1.694-04	1.266-02
5.000+09	5.895-08	2.521-02	4.459-04	4.800+01	6.531-01	4.868+01	1.537-11	6.571-06	1.162-07	1.251-02	1.702-04	1.269-02
6.000+09	4.094-08	2.138-02	3.716-04	4.809+01	6.553-01	4.877+01	1.067-11	5.573-06	9.686-08	1.253-02	1.708-04	1.271-02
8.000+09	2.303-08	1.647-02	2.787-04	4.820+01	6.582-01	4.887+01	6.003-12	4.293-06	7.264-08	1.256-02	1.716-04	1.274-02
1.000+10	1.474-08	1.345-02	2.229-04	4.827+01	6.601-01	4.894+01	3.842-12	3.506-06	5.810-08	1.258-02	1.721-04	1.276-02
1.500+10	6.550-09	9.295-03	1.486-04	4.837+01	6.626-01	4.904+01	1.707-12	2.423-06	3.873-08	1.261-02	1.727-04	1.278-02
2.000+10	3.684-09	7.146-03	1.114-04	4.842+01	6.641-01	4.909+01	9.602-13	1.863-06	2.904-08	1.262-02	1.731-04	1.280-02
3.000+10	1.638-09	4.928-03	7.429-05	4.848+01	6.654-01	4.915+01	4.270-13	1.285-06	1.936-08	1.264-02	1.734-04	1.281-02
4.000+10	9.211-10	3.784-03	5.572-05	4.851+01	6.663-01	4.918+01	2.401-13	9.863-07	1.452-08	1.264-02	1.737-04	1.282-02
5.000+10	5.895-10	3.081-03	4.457-05	4.852+01	6.669-01	4.919+01	1.537-13	8.031-07	1.162-08	1.265-02	1.738-04	1.282-02
6.000+10	4.094-10	2.605-03	3.714-05	4.854+01	6.672-01	4.921+01	1.067-13	6.790-07	9.681-09	1.265-02	1.739-04	1.283-02
8.000+10	2.303-10	1.997-03	2.786-05	4.855+01	6.676-01	4.922+01	6.003-14	5.205-07	7.262-09	1.265-02	1.740-04	1.283-02
1.000+11	1.474-10	1.625-03	2.229-05	4.856+01	6.679-01	4.923+01	3.842-14	4.236-07	5.810-09	1.266-02	1.741-04	1.283-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 92, U , URANIUM ATOMIC WT. = 238.051 MSQ/KG = .00025297 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.466+00	1.925+01	1.049+01	0.000	0.000	3.121+01	3.709-04	4.870-03	2.654-03	0.000	0.000	7.894-03
1.022+06	1.405+00	1.905+01	1.005+01	0.000	0.000	3.050+01	3.554-04	4.819-03	2.542-03	0.000	0.000	7.717-03
1.250+06	9.487-01	1.726+01	6.792+00	1.761-01	0.000	2.518+01	2.400-04	4.366-03	1.718-03	4.455-05	0.000	6.369-03
1.500+06	6.635-01	1.572+01	4.830+00	8.691-01	0.000	2.208+01	1.678-04	3.977-03	1.222-03	2.199-04	0.000	5.586-03
2.000+06	3.764-01	1.344+01	2.917+00	2.546+00	0.000	1.928+01	9.522-05	3.400-03	7.379-04	6.441-04	0.000	4.877-03
2.044+06	3.606-01	1.327+01	2.812+00	2.688+00	0.000	1.913+01	9.122-05	3.357-03	7.114-04	6.808-04	0.000	4.840-03
3.000+06	1.685-01	1.059+01	1.520+00	5.294+00	3.698-03	1.758+01	4.263-05	2.679-03	3.845-04	1.339-03	9.355-07	4.446-03
4.000+06	9.505-02	8.838+00	9.918-01	7.419+00	1.507-02	1.736+01	2.405-05	2.236-03	2.509-04	1.877-03	3.812-06	4.391-03
5.000+06	6.092-02	7.635+00	7.251-01	9.191+00	2.966-02	1.764+01	1.541-05	1.931-03	1.834-04	2.325-03	7.579-06	4.463-03
6.000+06	4.234-02	6.750+00	5.671-01	1.071+01	4.590-02	1.812+01	1.071-05	1.708-03	1.435-04	2.709-03	1.161-05	4.583-03
7.000+06	3.112-02	6.068+00	4.637-01	1.206+01	6.175-02	1.868+01	7.873-06	1.535-03	1.173-04	3.051-03	1.562-05	4.727-03
8.000+06	2.383-02	5.523+00	3.911-01	1.327+01	7.705-02	1.928+01	6.028-06	1.397-03	9.894-05	3.357-03	1.949-05	4.879-03
9.000+06	1.884-02	5.077+00	3.377-01	1.439+01	9.166-02	1.992+01	4.766-06	1.284-03	8.543-05	3.640-03	2.319-05	5.038-03
1.000+07	1.526-02	4.705+00	2.968-01	1.541+01	1.055-01	2.053+01	3.860-06	1.190-03	7.508-05	3.892-03	2.669-05	5.194-03
1.100+07	1.261-02	4.388+00	2.645-01	1.637+01	1.186-01	2.115+01	3.190-06	1.110-03	6.691-05	4.141-03	3.000-05	5.351-03
1.200+07	1.060-02	4.116+00	2.384-01	1.725+01	1.308-01	2.175+01	2.682-06	1.041-03	6.031-05	4.364-03	3.309-05	5.501-03
1.300+07	9.033-03	3.877+00	2.169-01	1.808+01	1.424-01	2.233+01	2.285-06	9.808-04	5.487-05	4.574-03	3.602-05	5.648-03
1.400+07	7.789-03	3.668+00	1.989-01	1.886+01	1.533-01	2.289+01	1.970-06	9.279-04	5.032-05	4.771-03	3.876-05	5.790-03
1.500+07	6.785-03	3.482+00	1.837-01	1.959+01	1.637-01	2.343+01	1.716-06	8.809-04	4.647-05	4.956-03	4.141-05	5.926-03
1.600+07	5.964-03	3.316+00	1.705-01	2.027+01	1.735-01	2.394+01	1.509-06	8.389-04	4.313-05	5.128-03	4.389-05	6.055-03
1.800+07	4.713-03	3.031+00	1.491-01	2.150+01	1.916-01	2.488+01	1.192-06	7.668-04	3.772-05	5.439-03	4.847-05	6.293-03
2.000+07	3.817-03	2.795+00	1.325-01	2.260+01	2.081-01	2.574+01	9.656-07	7.071-04	3.352-05	5.717-03	5.264-05	6.511-03
2.200+07	3.155-03	2.596+00	1.191-01	2.360+01	2.230-01	2.654+01	7.981-07	6.567-04	3.013-05	5.970-03	5.641-05	6.714-03
2.400+07	2.651-03	2.426+00	1.082-01	2.451+01	2.367-01	2.728+01	6.706-07	6.137-04	2.737-05	6.200-03	5.988-05	6.902-03
2.600+07	2.259-03	2.278+00	9.911-02	2.535+01	2.493-01	2.798+01	5.715-07	5.763-04	2.507-05	6.413-03	6.307-05	7.078-03
2.800+07	1.948-03	2.149+00	9.141-02	2.611+01	2.610-01	2.861+01	4.928-07	5.436-04	2.312-05	6.605-03	6.603-05	7.238-03
3.000+07	1.697-03	2.035+00	8.482-02	2.682+01	2.718-01	2.921+01	4.293-07	5.148-04	2.146-05	6.785-03	6.876-05	7.390-03
4.000+07	9.545-04	1.617+00	6.231-02	2.969+01	3.162-01	3.169+01	2.415-07	4.091-04	1.576-05	7.511-03	7.999-05	8.016-03
5.000+07	6.109-04	1.350+00	4.922-02	3.182+01	3.495-01	3.357+01	1.545-07	3.415-04	1.245-05	8.050-03	8.841-05	8.492-03
6.000+07	4.242-04	1.163+00	4.067-02	3.346+01	3.757-01	3.506+01	1.073-07	2.942-04	1.029-05	8.470-03	9.504-05	8.869-03
8.000+07	2.386-04	9.174-01	3.018-02	3.591+01	4.148-01	3.727+01	6.036-08	2.321-04	7.635-06	9.084-03	1.049-04	9.429-03
1.000+08	1.527-04	7.614-01	2.399-02	3.763+01	4.429-01	3.886+01	3.863-08	1.926-04	6.069-06	9.519-03	1.120-04	9.830-03
1.500+08	6.788-05	5.422-01	1.585-02	4.034+01	4.889-01	4.139+01	1.717-08	1.372-04	4.010-06	1.020-02	1.237-04	1.047-02
2.000+08	3.818-05	4.251-01	1.184-02	4.195+01	5.175-01	4.290+01	9.659-09	1.075-04	2.995-06	1.061-02	1.309-04	1.085-02
3.000+08	1.697-05	3.013-01	7.857-03	4.383+01	5.520-01	4.469+01	4.293-09	7.622-05	1.988-06	1.109-02	1.396-04	1.131-02
4.000+08	9.545-06	2.360-01	5.880-03	4.491+01	5.726-01	4.572+01	2.415-09	5.970-05	1.487-06	1.136-02	1.449-04	1.157-02
5.000+08	6.109-06	1.954-01	4.697-03	4.562+01	5.867-01	4.641+01	1.545-09	4.943-05	1.188-06	1.154-02	1.484-04	1.174-02
6.000+08	4.242-06	1.673-01	3.911-03	4.612+01	5.969-01	4.689+01	1.073-09	4.232-05	9.894-07	1.167-02	1.510-04	1.186-02
8.000+08	2.386-06	1.306-01	2.930-03	4.679+01	6.110-01	4.753+01	6.036-10	3.304-05	7.412-07	1.184-02	1.546-04	1.202-02
1.000+09	1.527-06	1.075-01	2.342-03	4.723+01	6.204-01	4.796+01	3.863-10	2.719-05	5.925-07	1.195-02	1.569-04	1.213-02
1.500+09	6.788-07	7.506-02	1.560-03	4.786+01	6.344-01	4.857+01	1.717-10	1.899-05	3.946-07	1.211-02	1.605-04	1.229-02
2.000+09	3.818-07	5.809-02	1.170-03	4.820+01	6.423-01	4.890+01	9.659-11	1.470-05	2.960-07	1.219-02	1.625-04	1.237-02
3.000+09	1.697-07	4.039-02	7.794-04	4.857+01	6.509-01	4.926+01	4.293-11	1.022-05	1.972-07	1.229-02	1.647-04	1.246-02
4.000+09	9.545-08	3.118-02	5.845-04	4.878+01	6.561-01	4.947+01	2.415-11	7.888-06	1.479-07	1.234-02	1.660-04	1.251-02
5.000+09	6.109-08	2.549-02	4.675-04	4.890+01	6.592-01	4.959+01	1.545-11	6.448-06	1.183-07	1.237-02	1.668-04	1.254-02
6.000+09	4.242-08	2.162-02	3.895-04	4.899+01	6.614-01	4.967+01	1.073-11	5.469-06	9.853-08	1.239-02	1.673-04	1.257-02
8.000+09	2.386-08	1.665-02	2.921-04	4.911+01	6.643-01	4.979+01	6.036-12	4.212-06	7.389-08	1.242-02	1.680-04	1.260-02
1.000+10	1.527-08	1.360-02	2.337-04	4.918+01	6.662-01	4.986+01	3.863-12	3.440-06	5.912-08	1.244-02	1.685-04	1.261-02
1.500+10	6.788-09	9.397-03	1.558-04	4.928+01	6.686-01	4.996+01	1.717-12	2.377-06	3.941-08	1.247-02	1.691-04	1.264-02
2.000+10	3.818-09	7.225-03	1.168-04	4.933+01	6.701-01	5.001+01	9.659-13	1.828-06	2.955-08	1.248-02	1.695-04	1.265-02
3.000+10	1.697-09	4.983-03	7.788-05	4.939+01	6.715-01	5.007+01	4.293-13	1.261-06	1.970-08	1.249-02	1.699-04	1.267-02
4.000+10	9.545-10	3.825-03	5.841-05	4.942+01	6.724-01	5.010+01	2.415-13	9.676-07	1.478-08	1.250-02	1.701-04	1.267-02
5.000+10	6.109-10	3.115-03	4.673-05	4.944+01	6.730-01	5.012+01	1.545-13	7.880-07	1.182-08	1.251-02	1.703-04	1.268-02
6.000+10	4.242-10	2.633-03	3.894-05	4.945+01	6.733-01	5.013+01	1.073-13	6.661-07	9.851-09	1.251-02	1.703-04	1.268-02
8.000+10	2.386-10	2.019-03	2.920-05	4.947+01	6.737-01	5.015+01	6.036-14	5.198-07	7.387-09	1.251-02	1.704-04	1.269-02
1.000+11	1.527-10	1.643-03	2.336-05	4.948+01	6.740-01	5.016+01	3.863-14	4.156-07	5.909-09	1.252-02	1.705-04	1.269-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 93, NP, NEPTUNIUM ATOMIC WT. = 237.0482 MSQ/KG = .00025404 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.516+00	1.946+01	1.102+01	0.000	0.000	3.200+01	3.851-04	4.944-03	2.800-03	0.000	0.000	8.128-03
1.022+06	1.453+00	1.926+01	1.056+01	0.000	0.000	3.127+01	3.691-04	4.893-03	2.683-03	0.000	0.000	7.945-03
1.250+06	9.815-01	1.745+01	7.137+00	1.809-01	0.000	2.575+01	2.493-04	4.433-03	1.813-03	4.596-05	0.000	6.541-03
1.500+06	6.867-01	1.589+01	5.074+00	8.961-01	0.000	2.255+01	1.745-04	4.037-03	1.289-03	2.276-04	0.000	5.728-03
2.000+06	3.896-01	1.358+01	3.065+00	2.618+00	0.000	1.965+01	9.898-05	3.450-03	7.786-04	6.651-04	0.000	4.993-03
2.044+06	3.732-01	1.342+01	2.954+00	2.763+00	0.000	1.951+01	9.481-05	3.409-03	7.504-04	7.019-04	0.000	4.956-03
3.000+06	1.745-01	1.076+01	1.596+00	5.420+00	3.738-03	1.789+01	4.433-05	2.718-03	4.055-04	1.377-03	9.496-07	4.546-03
4.000+06	9.843-02	8.934+00	1.041+00	7.575+00	1.523-02	1.766+01	2.501-05	2.270-03	2.645-04	1.924-03	3.869-06	4.487-03
5.000+06	6.309-02	7.718+00	7.611-01	9.374+00	3.028-02	1.795+01	1.603-05	1.961-03	1.934-04	2.381-03	7.692-06	4.559-03
6.000+06	4.385-02	6.823+00	5.951-01	1.091+01	4.640-02	1.842+01	1.114-05	1.733-03	1.512-04	2.772-03	1.179-05	4.679-03
7.000+06	3.223-02	6.134+00	4.865-01	1.228+01	6.241-02	1.900+01	8.188-06	1.558-03	1.236-04	3.120-03	1.585-05	4.826-03
8.000+06	2.469-02	5.583+00	4.104-01	1.351+01	7.767-02	1.961+01	6.272-06	1.418-03	1.043-04	3.432-03	1.978-05	4.981-03
9.000+06	1.951-02	5.132+00	3.542-01	1.464+01	9.263-02	2.024+01	4.956-06	1.304-03	8.998-05	3.719-03	2.353-05	5.141-03
1.000+07	1.581-02	4.756+00	3.113-01	1.569+01	1.066-01	2.088+01	4.016-06	1.208-03	7.908-05	3.986-03	2.708-05	5.304-03
1.100+07	1.307-02	4.436+00	2.774-01	1.666+01	1.198-01	2.151+01	3.320-06	1.127-03	7.047-05	4.232-03	3.043-05	5.464-03
1.200+07	1.098-02	4.160+00	2.500-01	1.756+01	1.322-01	2.211+01	2.789-06	1.057-03	6.351-05	4.461-03	3.358-05	5.618-03
1.300+07	9.356-03	3.919+00	2.275-01	1.840+01	1.439-01	2.270+01	2.377-06	9.956-04	5.779-05	4.674-03	3.656-05	5.767-03
1.400+07	8.068-03	3.708+00	2.086-01	1.919+01	1.550-01	2.327+01	2.050-06	9.420-04	5.299-05	4.875-03	3.938-05	5.911-03
1.500+07	7.028-03	3.520+00	1.926-01	1.993+01	1.654-01	2.382+01	1.785-06	8.942-04	4.893-05	5.063-03	4.202-05	6.050-03
1.600+07	6.177-03	3.352+00	1.788-01	2.063+01	1.753-01	2.434+01	1.569-06	8.516-04	4.542-05	5.241-03	4.453-05	6.184-03
1.800+07	4.881-03	3.064+00	1.564-01	2.188+01	1.936-01	2.530+01	1.240-06	7.784-04	3.973-05	5.558-03	4.918-05	6.427-03
2.000+07	3.954-03	2.826+00	1.389-01	2.300+01	2.102-01	2.618+01	1.004-06	7.179-04	3.529-05	5.843-03	5.340-05	6.651-03
2.200+07	3.268-03	2.625+00	1.249-01	2.402+01	2.253-01	2.700+01	8.302-07	6.669-04	3.173-05	6.102-03	5.724-05	6.859-03
2.400+07	2.746-03	2.453+00	1.134-01	2.495+01	2.392-01	2.776+01	6.976-07	6.232-04	2.881-05	6.338-03	6.077-05	7.052-03
2.600+07	2.340-03	2.303+00	1.039-01	2.580+01	2.519-01	2.846+01	5.945-07	5.851-04	2.640-05	6.554-03	6.399-05	7.230-03
2.800+07	2.018-03	2.173+00	9.583-02	2.658+01	2.637-01	2.911+01	5.127-07	5.520-04	2.434-05	6.752-03	6.699-05	7.396-03
3.000+07	1.757-03	2.057+00	8.892-02	2.730+01	2.746-01	2.972+01	4.464-07	5.226-04	2.259-05	6.935-03	6.976-05	7.551-03
4.000+07	9.886-04	1.635+00	6.531-02	3.023+01	3.195-01	3.225+01	2.511-07	4.154-04	1.659-05	7.680-03	8.117-05	8.193-03
5.000+07	6.327-04	1.365+00	5.159-02	3.240+01	3.531-01	3.417+01	1.607-07	3.468-04	1.311-05	8.231-03	8.970-05	8.681-03
6.000+07	4.394-04	1.176+00	4.263-02	3.409+01	3.795-01	3.569+01	1.116-07	2.988-04	1.083-05	8.660-03	9.641-05	9.066-03
8.000+07	2.472-04	9.273-01	3.163-02	3.657+01	4.190-01	3.795+01	6.280-08	2.356-04	8.035-06	9.290-03	1.064-04	9.640-03
1.000+08	1.582-04	7.697-01	2.514-02	3.832+01	4.473-01	3.956+01	4.019-08	1.955-04	6.387-06	9.735-03	1.136-04	1.005-02
1.500+08	7.030-05	5.481-01	1.661-02	4.108+01	4.938-01	4.214+01	1.786-08	1.392-04	4.220-06	1.044-02	1.254-04	1.071-02
2.000+08	3.954-05	4.298-01	1.240-02	4.272+01	5.225-01	4.368+01	1.004-08	1.092-04	3.150-06	1.085-02	1.327-04	1.110-02
3.000+08	1.758-05	3.046-01	8.233-03	4.463+01	5.574-01	4.550+01	4.466-09	7.738-05	2.092-06	1.134-02	1.416-04	1.156-02
4.000+08	9.886-06	2.386-01	6.161-03	4.573+01	5.781-01	4.655+01	2.511-09	6.061-05	1.565-06	1.162-02	1.469-04	1.183-02
5.000+08	6.327-06	1.975-01	4.922-03	4.645+01	5.923-01	4.724+01	1.607-09	5.017-05	1.250-06	1.180-02	1.505-04	1.200-02
6.000+08	4.394-06	1.691-01	4.098-03	4.697+01	6.026-01	4.775+01	1.116-09	4.296-05	1.041-06	1.193-02	1.531-04	1.213-02
8.000+08	2.472-06	1.321-01	3.070-03	4.765+01	6.168-01	4.840+01	6.280-10	3.356-05	7.799-07	1.211-02	1.567-04	1.230-02
1.000+09	1.582-06	1.086-01	2.455-03	4.809+01	6.262-01	4.883+01	4.019-10	2.759-05	6.237-07	1.222-02	1.591-04	1.240-02
1.500+09	7.030-07	7.587-02	1.635-03	4.872+01	6.403-01	4.944+01	1.786-10	1.927-05	4.154-07	1.238-02	1.627-04	1.256-02
2.000+09	3.954-07	5.872-02	1.226-03	4.908+01	6.482-01	4.979+01	1.004-10	1.492-05	3.115-07	1.247-02	1.647-04	1.265-02
3.000+09	1.758-07	4.083-02	8.167-04	4.943+01	6.569-01	5.013+01	4.466-11	1.037-05	2.075-07	1.256-02	1.669-04	1.273-02
4.000+09	9.886-08	3.152-02	6.124-04	4.967+01	6.621-01	5.036+01	2.511-11	8.007-06	1.556-07	1.262-02	1.682-04	1.279-02
5.000+09	6.327-08	2.577-02	4.899-04	4.979+01	6.652-01	5.048+01	1.607-11	6.547-06	1.245-07	1.265-02	1.690-04	1.282-02
6.000+09	4.394-08	2.185-02	4.082-04	4.988+01	6.674-01	5.057+01	1.116-11	5.551-06	1.037-07	1.267-02	1.695-04	1.285-02
8.000+09	2.472-08	1.684-02	3.061-04	5.000+01	6.703-01	5.069+01	6.280-12	4.278-06	7.776-08	1.270-02	1.703-04	1.288-02
1.000+10	1.582-08	1.375-02	2.449-04	5.008+01	6.722-01	5.077+01	4.019-12	3.493-06	6.222-08	1.272-02	1.708-04	1.290-02
1.500+10	7.030-09	9.500-03	1.632-04	5.017+01	6.747-01	5.085+01	1.786-12	2.413-06	4.146-08	1.275-02	1.714-04	1.292-02
2.000+10	3.954-09	7.303-03	1.224-04	5.023+01	6.762-01	5.091+01	1.004-12	1.855-06	3.109-08	1.276-02	1.718-04	1.293-02
3.000+10	1.758-09	5.037-03	8.161-05	5.028+01	6.776-01	5.096+01	4.466-13	1.280-06	2.073-08	1.277-02	1.721-04	1.295-02
4.000+10	9.886-10	3.867-03	6.121-05	5.032+01	6.785-01	5.100+01	2.511-13	9.824-07	1.555-08	1.278-02	1.724-04	1.296-02
5.000+10	6.327-10	3.149-03	4.896-05	5.034+01	6.790-01	5.102+01	1.607-13	8.000-07	1.244-08	1.279-02	1.725-04	1.296-02
6.000+10	4.394-10	2.662-03	4.080-05	5.035+01	6.794-01	5.103+01	1.116-13	6.763-07	1.036-08	1.279-02	1.726-04	1.296-02
8.000+10	2.472-10	2.041-03	3.060-05	5.036+01	6.797-01	5.104+01	6.280-14	5.185-07	7.774-09	1.279-02	1.727-04	1.297-02
1.000+11	1.582-10	1.660-03	2.448-05	5.037+01	6.800-01	5.105+01	4.019-14	4.217-07	6.219-09	1.280-02	1.727-04	1.297-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 94, PU, PLUTONIUM ATOMIC WT. = 239.052 MSQ/KG = .00025191 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.568+00	1.966+01	1.157+01	0.000	0.000	3.280+01	3.950-04	4.953-03	2.915-03	0.000	0.000	8.262-03
1.022+06	1.503+00	1.946+01	1.109+01	0.000	0.000	3.205+01	3.786-04	4.902-03	2.794-03	0.000	0.000	8.075-03
1.250+06	1.015+00	1.763+01	7.455+00	1.857-01	0.000	2.633+01	2.557-04	4.441-03	1.888-03	4.678-05	0.000	6.632-03
1.500+06	7.105-01	1.606+01	5.329+00	9.236-01	0.000	2.302+01	1.790-04	4.046-03	1.342-03	2.327-04	0.000	5.800-03
2.000+06	4.033-01	1.373+01	3.218+00	2.692+00	0.000	2.004+01	1.016-04	3.459-03	8.107-04	6.782-04	0.000	5.049-03
2.044+06	3.863-01	1.356+01	3.102+00	2.840+00	0.000	1.989+01	9.731-05	3.416-03	7.814-04	7.154-04	0.000	5.010-03
3.000+06	1.806-01	1.082+01	1.675+00	5.546+00	3.778-03	1.823+01	4.550-05	2.726-03	4.220-04	1.397-03	9.517-07	4.591-03
4.000+06	1.019-01	9.030+00	1.093+00	7.733+00	1.539-02	1.797+01	2.567-05	2.275-03	2.753-04	1.948-03	3.877-06	4.528-03
5.000+06	6.534-02	7.801+00	7.985-01	9.557+00	3.060-02	1.825+01	1.646-05	1.965-03	2.012-04	2.408-03	7.709-06	4.598-03
6.000+06	4.541-02	6.897+00	6.243-01	1.111+01	4.689-02	1.872+01	1.144-05	1.737-03	1.573-04	2.799-03	1.181-05	4.717-03
7.000+06	3.338-02	6.200+00	5.102-01	1.250+01	6.307-02	1.931+01	8.409-06	1.562-03	1.285-04	3.149-03	1.589-05	4.864-03
8.000+06	2.557-02	5.643+00	4.303-01	1.375+01	7.870-02	1.993+01	6.441-06	1.422-03	1.084-04	3.464-03	1.983-05	5.020-03
9.000+06	2.021-02	5.188+00	3.714-01	1.490+01	9.361-02	2.057+01	5.091-06	1.307-03	9.356-05	3.754-03	2.358-05	5.183-03
1.000+07	1.637-02	4.807+00	3.264-01	1.596+01	1.077-01	2.122+01	4.124-06	1.211-03	8.222-05	4.021-03	2.713-05	5.345-03
1.100+07	1.353-02	4.483+00	2.908-01	1.695+01	1.211-01	2.186+01	3.408-06	1.129-03	7.326-05	4.270-03	3.051-05	5.506-03
1.200+07	1.137-02	4.205+00	2.621-01	1.787+01	1.336-01	2.248+01	2.864-06	1.059-03	6.603-05	4.502-03	3.366-05	5.664-03
1.300+07	9.690-03	3.961+00	2.385-01	1.872+01	1.454-01	2.307+01	2.441-06	9.978-04	6.008-05	4.716-03	3.663-05	5.813-03
1.400+07	8.356-03	3.748+00	2.187-01	1.953+01	1.566-01	2.366+01	2.105-06	9.442-04	5.509-05	4.920-03	3.945-05	5.961-03
1.500+07	7.279-03	3.558+00	2.019-01	2.028+01	1.671-01	2.421+01	1.834-06	8.963-04	5.086-05	5.109-03	4.209-05	6.100-03
1.600+07	6.398-03	3.389+00	1.874-01	2.098+01	1.772-01	2.474+01	1.612-06	8.537-04	4.721-05	5.285-03	4.464-05	6.232-03
1.800+07	5.056-03	3.097+00	1.639-01	2.226+01	1.956-01	2.572+01	1.274-06	7.802-04	4.129-05	5.608-03	4.927-05	6.480-03
2.000+07	4.095-03	2.856+00	1.456-01	2.340+01	2.124-01	2.662+01	1.032-06	7.195-04	3.668-05	5.895-03	5.351-05	6.705-03
2.200+07	3.385-03	2.653+00	1.309-01	2.444+01	2.277-01	2.745+01	8.527-07	6.683-04	3.298-05	6.157-03	5.736-05	6.916-03
2.400+07	2.844-03	2.479+00	1.189-01	2.539+01	2.416-01	2.823+01	7.164-07	6.245-04	2.995-05	6.396-03	6.086-05	7.112-03
2.600+07	2.423-03	2.328+00	1.089-01	2.626+01	2.545-01	2.895+01	6.104-07	5.865-04	2.743-05	6.615-03	6.411-05	7.294-03
2.800+07	2.090-03	2.196+00	1.004-01	2.705+01	2.664-01	2.961+01	5.265-07	5.532-04	2.529-05	6.814-03	6.711-05	7.460-03
3.000+07	1.820-03	2.079+00	9.317-02	2.778+01	2.774-01	3.023+01	4.585-07	5.237-04	2.347-05	6.998-03	6.988-05	7.616-03
4.000+07	1.024-03	1.652+00	6.843-02	3.076+01	3.227-01	3.280+01	2.580-07	4.162-04	1.724-05	7.749-03	8.129-05	8.264-03
5.000+07	6.554-04	1.379+00	5.405-02	3.298+01	3.566-01	3.477+01	1.651-07	3.474-04	1.362-05	8.308-03	8.983-05	8.759-03
6.000+07	4.551-04	1.189+00	4.466-02	3.470+01	3.833-01	3.632+01	1.146-07	2.995-04	1.125-05	8.741-03	9.656-05	9.149-03
8.000+07	2.560-04	9.373-01	3.313-02	3.723+01	4.231-01	3.862+01	6.449-08	2.361-04	8.346-06	9.379-03	1.066-04	9.730-03
1.000+08	1.638-04	7.780-01	2.633-02	3.902+01	4.517-01	4.028+01	4.126-08	1.960-04	6.633-06	9.830-03	1.138-04	1.015-02
1.500+08	7.282-05	5.540-01	1.740-02	4.183+01	4.984-01	4.290+01	1.834-08	1.396-04	4.383-06	1.054-02	1.256-04	1.081-02
2.000+08	4.096-05	4.344-01	1.299-02	4.350+01	5.273-01	4.447+01	1.032-08	1.094-04	3.272-06	1.096-02	1.328-04	1.120-02
3.000+08	1.820-05	3.079-01	8.624-03	4.545+01	5.624-01	4.633+01	4.585-09	7.756-05	2.173-06	1.145-02	1.417-04	1.167-02
4.000+08	1.024-05	2.411-01	6.453-03	4.656+01	5.832-01	4.739+01	2.580-09	6.074-05	1.626-06	1.173-02	1.469-04	1.194-02
5.000+08	6.554-06	1.996-01	5.156-03	4.729+01	5.974-01	4.809+01	1.651-09	5.028-05	1.299-06	1.191-02	1.505-04	1.212-02
6.000+08	4.551-06	1.709-01	4.293-03	4.782+01	6.078-01	4.860+01	1.146-09	4.305-05	1.081-06	1.205-02	1.531-04	1.224-02
8.000+08	2.560-06	1.335-01	3.216-03	4.851+01	6.229-01	4.927+01	6.449-10	3.363-05	8.102-07	1.222-02	1.567-04	1.241-02
1.000+09	1.638-06	1.098-01	2.571-03	4.896+01	6.315-01	4.970+01	4.126-10	2.766-05	6.477-07	1.233-02	1.591-04	1.252-02
1.500+09	7.282-07	7.669-02	1.712-03	4.960+01	6.456-01	5.032+01	1.834-10	1.932-05	4.313-07	1.249-02	1.626-04	1.268-02
2.000+09	4.096-07	5.936-02	1.284-03	4.996+01	6.536-01	5.067+01	1.032-10	1.495-05	3.235-07	1.259-02	1.647-04	1.277-02
3.000+09	1.820-07	4.127-02	8.555-04	5.033+01	6.622-01	5.103+01	4.585-11	1.040-05	2.155-07	1.268-02	1.668-04	1.286-02
4.000+09	1.024-07	3.186-02	6.414-04	5.056+01	6.674-01	5.126+01	2.580-11	8.026-06	1.616-07	1.274-02	1.681-04	1.291-02
5.000+09	6.554-08	2.605-02	5.131-04	5.069+01	6.705-01	5.139+01	1.651-11	6.562-06	1.293-07	1.277-02	1.689-04	1.295-02
6.000+09	4.551-08	2.209-02	4.275-04	5.078+01	6.727-01	5.148+01	1.146-11	5.565-06	1.077-07	1.279-02	1.695-04	1.297-02
8.000+09	2.560-08	1.702-02	3.206-04	5.090+01	6.757-01	5.159+01	6.449-12	4.288-06	8.076-08	1.282-02	1.702-04	1.300-02
1.000+10	1.638-08	1.389-02	2.565-04	5.098+01	6.776-01	5.167+01	4.126-12	3.499-06	6.462-08	1.284-02	1.707-04	1.302-02
1.500+10	7.282-09	9.602-03	1.710-04	5.107+01	6.801-01	5.176+01	1.834-12	2.419-06	4.308-08	1.287-02	1.713-04	1.304-02
2.000+10	4.096-09	7.382-03	1.282-04	5.113+01	6.816-01	5.182+01	1.032-12	1.860-06	3.230-08	1.288-02	1.717-04	1.305-02
3.000+10	1.820-09	5.091-03	8.548-05	5.118+01	6.829-01	5.187+01	4.585-13	1.282-06	2.153-08	1.289-02	1.720-04	1.307-02
4.000+10	1.024-09	3.908-03	6.411-05	5.122+01	6.839-01	5.191+01	2.580-13	9.845-07	1.615-08	1.290-02	1.723-04	1.308-02
5.000+10	6.554-10	3.183-03	5.128-05	5.125+01	6.844-01	5.194+01	1.651-13	8.018-07	1.292-08	1.291-02	1.724-04	1.308-02
6.000+10	4.551-10	2.690-03	4.274-05	5.126+01	6.847-01	5.195+01	1.146-13	6.776-07	1.077-08	1.291-02	1.725-04	1.309-02
8.000+10	2.560-10	2.063-03	3.205-05	5.127+01	6.851-01	5.196+01	6.449-14	5.197-07	8.074-09	1.292-02	1.726-04	1.309-02
1.000+11	1.638-10	1.678-03	2.564-05	5.128+01	6.854-01	5.197+01	4.126-14	4.227-07	6.459-09	1.292-02	1.727-04	1.309-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z = 1$ to 100—Continued

Z = 95, AM, AMERICIUM ATOMIC WT. = 243.061 MSQ/KG = .00024776 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.620+00	1.987+01	1.215+01	0.000	0.000	3.364+01	4.014-04	4.923-03	3.010-03	0.000	0.000	8.335-03
1.022+06	1.553+00	1.967+01	1.163+01	0.000	0.000	3.285+01	3.848-04	4.873-03	2.881-03	0.000	0.000	8.140-03
1.250+06	1.050+00	1.782+01	7.868+00	1.905-01	0.000	2.693+01	2.601-04	4.415-03	1.949-03	4.720-05	0.000	6.672-03
1.500+06	7.348-01	1.622+01	5.594+00	9.515-01	0.000	2.350+01	1.821-04	4.019-03	1.386-03	2.357-04	0.000	5.822-03
2.000+06	4.172-01	1.387+01	3.378+00	2.766+00	0.000	2.043+01	1.034-04	3.436-03	8.369-04	6.853-04	0.000	5.062-03
2.044+06	3.997-01	1.370+01	3.256+00	2.918+00	0.000	2.027+01	9.903-05	3.394-03	8.067-04	7.230-04	0.000	5.023-03
3.000+06	1.869-01	1.093+01	1.758+00	3.674+00	3.818-03	1.855+01	4.631-05	2.708-03	4.356-04	1.406-03	9.459-07	4.597-03
4.000+06	1.055-01	9.126+00	1.146+00	7.892+00	1.555-02	1.829+01	2.614-05	2.261-03	2.839-04	1.955-03	3.853-06	4.530-03
5.000+06	6.763-02	7.884+00	8.374-01	9.741+00	3.092-02	1.856+01	1.676-05	1.953-03	2.075-04	2.413-03	7.661-06	4.599-03
6.000+06	4.701-02	6.970+00	6.545-01	1.131+01	4.738-02	1.903+01	1.165-05	1.727-03	1.622-04	2.802-03	1.174-05	4.715-03
7.000+06	3.456-02	6.265+00	5.349-01	1.272+01	6.373-02	1.962+01	8.563-06	1.552-03	1.325-04	3.151-03	1.579-05	4.861-03
8.000+06	2.647-02	5.703+00	4.511-01	1.399+01	7.952-02	2.025+01	6.558-06	1.413-03	1.118-04	3.466-03	1.970-05	5.017-03
9.000+06	2.092-02	5.243+00	3.893-01	1.516+01	9.458-02	2.091+01	5.183-06	1.299-03	9.645-05	3.756-03	2.343-05	5.180-03
1.000+07	1.695-02	4.858+00	3.420-01	1.624+01	1.089-01	2.157+01	4.200-06	1.204-03	8.473-05	4.024-03	2.698-05	5.343-03
1.100+07	1.401-02	4.531+00	3.048-01	1.724+01	1.223-01	2.221+01	3.471-06	1.123-03	7.552-05	4.271-03	3.030-05	5.503-03
1.200+07	1.177-02	4.250+00	2.747-01	1.817+01	1.350-01	2.284+01	2.916-06	1.053-03	6.806-05	4.502-03	3.345-05	5.659-03
1.300+07	1.003-02	4.004+00	2.499-01	1.904+01	1.469-01	2.345+01	2.485-06	9.920-04	6.191-05	4.717-03	3.640-05	5.810-03
1.400+07	8.650-03	3.788+00	2.291-01	1.986+01	1.582-01	2.404+01	2.143-06	9.385-04	5.676-05	4.920-03	3.920-05	5.957-03
1.500+07	7.536-03	3.596+00	2.115-01	2.063+01	1.689-01	2.461+01	1.867-06	8.909-04	5.240-05	5.111-03	4.185-05	6.098-03
1.600+07	6.623-03	3.425+00	1.964-01	2.134+01	1.790-01	2.515+01	1.641-06	8.486-04	4.866-05	5.287-03	4.435-05	6.230-03
1.800+07	5.234-03	3.130+00	1.717-01	2.264+01	1.976-01	2.614+01	1.297-06	7.755-04	4.254-05	5.609-03	4.896-05	6.478-03
2.000+07	4.239-03	2.887+00	1.525-01	2.380+01	2.146-01	2.706+01	1.050-06	7.153-04	3.778-05	5.897-03	5.317-05	6.704-03
2.200+07	3.504-03	2.681+00	1.371-01	2.486+01	2.300-01	2.791+01	8.681-07	6.642-04	3.397-05	6.159-03	5.698-05	6.915-03
2.400+07	2.944-03	2.505+00	1.245-01	2.583+01	2.441-01	2.871+01	7.294-07	6.206-04	3.085-05	6.400-03	6.048-05	7.112-03
2.600+07	2.509-03	2.353+00	1.140-01	2.671+01	2.571-01	2.944+01	6.216-07	5.830-04	2.824-05	6.618-03	6.370-05	7.293-03
2.800+07	2.163-03	2.219+00	1.052-01	2.752+01	2.691-01	3.012+01	5.359-07	5.498-04	2.606-05	6.818-03	6.667-05	7.461-03
3.000+07	1.884-03	2.102+00	9.758-02	2.826+01	2.802-01	3.074+01	4.668-07	5.208-04	2.418-05	7.002-03	6.942-05	7.617-03
4.000+07	1.060-03	1.670+00	7.166-02	3.131+01	3.259-01	3.338+01	2.626-07	4.138-04	1.775-05	7.757-03	8.074-05	8.270-03
5.000+07	6.784-04	1.394+00	5.660-02	3.357+01	3.602-01	3.538+01	1.681-07	3.454-04	1.402-05	8.317-03	8.924-05	8.766-03
6.000+07	4.711-04	1.201+00	4.676-02	3.532+01	3.871-01	3.696+01	1.167-07	2.976-04	1.159-05	8.751-03	9.591-05	9.156-03
8.000+07	2.650-04	9.473-01	3.469-02	3.790+01	4.272-01	3.931+01	6.566-08	2.347-04	8.595-06	9.390-03	1.058-04	9.739-03
1.000+08	1.696-04	7.862-01	2.757-02	3.972+01	4.561-01	4.099+01	4.202-08	1.948-04	6.831-06	9.841-03	1.130-04	1.016-02
1.500+08	7.538-05	5.599-01	1.822-02	4.258+01	5.032-01	4.366+01	1.868-08	1.387-04	4.514-06	1.055-02	1.247-04	1.082-02
2.000+08	4.240-05	4.390-01	1.360-02	4.428+01	5.323-01	4.526+01	1.050-08	1.088-04	3.370-06	1.097-02	1.319-04	1.121-02
3.000+08	1.885-05	3.112-01	9.029-03	4.627+01	5.676-01	4.716+01	4.670-09	7.710-05	2.237-06	1.146-02	1.406-04	1.168-02
4.000+08	1.060-05	2.437-01	6.757-03	4.740+01	5.886-01	4.824+01	2.626-09	6.038-05	1.674-06	1.174-02	1.458-04	1.195-02
5.000+08	6.784-06	2.017-01	5.398-03	4.815+01	6.029-01	4.896+01	1.681-09	4.997-05	1.337-06	1.193-02	1.494-04	1.213-02
6.000+08	4.711-06	1.727-01	4.494-03	4.868+01	6.133-01	4.947+01	1.167-09	4.279-05	1.113-06	1.206-02	1.520-04	1.226-02
8.000+08	2.650-06	1.349-01	3.367-03	4.939+01	6.276-01	5.016+01	6.566-10	3.342-05	8.342-07	1.224-02	1.555-04	1.243-02
1.000+09	1.696-06	1.110-01	2.692-03	4.984+01	6.371-01	5.059+01	4.202-10	2.750-05	6.670-07	1.235-02	1.578-04	1.253-02
1.500+09	7.538-07	7.751-02	1.793-03	5.050+01	6.512-01	5.123+01	1.868-10	1.920-05	4.442-07	1.251-02	1.613-04	1.269-02
2.000+09	4.240-07	5.999-02	1.344-03	5.086+01	6.593-01	5.158+01	1.050-10	1.486-05	3.330-07	1.260-02	1.633-04	1.278-02
3.000+09	1.885-07	4.171-02	8.956-04	5.123+01	6.680-01	5.194+01	4.670-11	1.033-05	2.219-07	1.269-02	1.655-04	1.287-02
4.000+09	1.060-07	3.220-02	6.716-04	5.147+01	6.732-01	5.218+01	2.626-11	7.978-06	1.664-07	1.275-02	1.668-04	1.293-02
5.000+09	6.784-08	2.632-02	5.372-04	5.161+01	6.763-01	5.231+01	1.681-11	6.521-06	1.331-07	1.279-02	1.676-04	1.296-02
6.000+09	4.711-08	2.232-02	4.476-04	5.170+01	6.785-01	5.240+01	1.167-11	5.530-06	1.109-07	1.281-02	1.681-04	1.298-02
8.000+09	2.650-08	1.720-02	3.357-04	5.182+01	6.815-01	5.252+01	6.566-12	4.261-06	8.317-08	1.284-02	1.688-04	1.301-02
1.000+10	1.696-08	1.404-02	2.685-04	5.190+01	6.834-01	5.260+01	4.202-12	3.479-06	6.652-08	1.286-02	1.693-04	1.303-02
1.500+10	7.538-09	9.704-03	1.790-04	5.199+01	6.859-01	5.269+01	1.868-12	2.404-06	4.435-08	1.288-02	1.699-04	1.305-02
2.000+10	4.240-09	7.460-03	1.342-04	5.206+01	6.874-01	5.275+01	1.050-12	1.848-06	3.325-08	1.290-02	1.703-04	1.307-02
3.000+10	1.885-09	5.145-03	8.949-05	5.210+01	6.888-01	5.279+01	4.670-13	1.275-06	2.217-08	1.291-02	1.707-04	1.308-02
4.000+10	1.060-09	3.950-03	6.712-05	5.215+01	6.897-01	5.284+01	2.626-13	9.786-07	1.663-08	1.292-02	1.709-04	1.309-02
5.000+10	6.784-10	3.217-03	5.369-05	5.217+01	6.902-01	5.286+01	1.681-13	7.970-07	1.330-08	1.293-02	1.710-04	1.310-02
6.000+10	4.711-10	2.719-03	4.474-05	5.218+01	6.906-01	5.287+01	1.167-13	6.737-07	1.108-08	1.293-02	1.711-04	1.310-02
8.000+10	2.650-10	2.085-03	3.356-05	5.219+01	6.909-01	5.288+01	6.566-14	5.166-07	8.315-09	1.293-02	1.712-04	1.310-02
1.000+11	1.696-10	1.696-03	2.685-05	5.220+01	6.912-01	5.289+01	4.202-14	4.202-07	6.652-09	1.293-02	1.713-04	1.310-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 96, CM, CURIUM ATOMIC WT. = 247.070 MSQ/KG = .00024374 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.674+00	2.008+01	1.274+01	0.000	0.000	3.449+01	4.080-04	4.894-03	3.105-03	0.000	0.000	8.408-03
1.022+06	1.605+00	1.987+01	1.221+01	0.000	0.000	3.368+01	3.912-04	4.843-03	2.976-03	0.000	0.000	8.210-03
1.250+06	1.085+00	1.801+01	8.256+00	1.954-01	0.000	2.755+01	2.645-04	4.390-03	2.012-03	4.763-05	0.000	6.714-03
1.500+06	7.594-01	1.640+01	5.869+00	9.799-01	0.000	2.401+01	1.851-04	3.997-03	1.431-03	2.388-04	0.000	5.852-03
2.000+06	4.313-01	1.402+01	3.543+00	2.842+00	0.000	2.084+01	1.051-04	3.417-03	8.636-04	6.927-04	0.000	5.079-03
2.044+06	4.132-01	1.385+01	3.416+00	2.996+00	0.000	2.068+01	1.007-04	3.376-03	8.326-04	7.302-04	0.000	5.039-03
3.000+06	1.933-01	1.105+01	1.844+00	5.804+00	3.858-03	1.890+01	4.711-05	2.693-03	4.495-04	1.415-03	9.403-07	4.605-03
4.000+06	1.091-01	9.221+00	1.202+00	8.052+00	1.572-02	1.860+01	2.659-05	2.248-03	2.930-04	1.963-03	3.832-06	4.533-03
5.000+06	6.996-02	7.967+00	8.777-01	9.927+00	3.124-02	1.887+01	1.705-05	1.942-03	2.139-04	2.420-03	7.614-06	4.600-03
6.000+06	4.863-02	7.043+00	6.860-01	1.151+01	4.787-02	1.934+01	1.185-05	1.717-03	1.672-04	2.805-03	1.167-05	4.713-03
7.000+06	3.575-02	6.331+00	5.605-01	1.294+01	6.439-02	1.993+01	8.714-06	1.543-03	1.366-04	3.154-03	1.569-05	4.858-03
8.000+06	2.738-02	5.763+00	4.726-01	1.423+01	8.034-02	2.057+01	6.674-06	1.405-03	1.152-04	3.468-03	1.958-05	5.015-03
9.000+06	2.164-02	5.298+00	4.079-01	1.542+01	9.556-02	2.124+01	5.274-06	1.291-03	9.942-05	3.758-03	2.329-05	5.178-03
1.000+07	1.753-02	4.909+00	3.583-01	1.651+01	1.100-01	2.190+01	4.273-06	1.197-03	8.733-05	4.024-03	2.681-05	5.339-03
1.100+07	1.449-02	4.579+00	3.192-01	1.753+01	1.236-01	2.257+01	3.532-06	1.116-03	7.780-05	4.273-03	3.013-05	5.500-03
1.200+07	1.218-02	4.294+00	2.877-01	1.848+01	1.364-01	2.321+01	2.969-06	1.047-03	7.012-05	4.504-03	3.325-05	5.657-03
1.300+07	1.038-02	4.046+00	2.617-01	1.936+01	1.484-01	2.383+01	2.530-06	9.862-04	6.379-05	4.719-03	3.617-05	5.807-03
1.400+07	8.950-03	3.828+00	2.400-01	2.020+01	1.598-01	2.444+01	2.181-06	9.330-04	5.850-05	4.924-03	3.895-05	5.956-03
1.500+07	7.797-03	3.634+00	2.215-01	2.098+01	1.706-01	2.501+01	1.900-06	8.857-04	5.399-05	5.114-03	4.158-05	6.097-03
1.600+07	6.853-03	3.461+00	2.056-01	2.170+01	1.808-01	2.555+01	1.670-06	8.436-04	5.011-05	5.289-03	4.407-05	6.229-03
1.800+07	5.415-03	3.163+00	1.798-01	2.303+01	1.996-01	2.658+01	1.320-06	7.709-04	4.382-05	5.613-03	4.865-05	6.478-03
2.000+07	4.386-03	2.917+00	1.597-01	2.421+01	2.167-01	2.751+01	1.069-06	7.110-04	3.893-05	5.901-03	5.282-05	6.705-03
2.200+07	3.625-03	2.709+00	1.435-01	2.528+01	2.323-01	2.837+01	8.836-07	6.603-04	3.498-05	6.162-03	5.662-05	6.914-03
2.400+07	3.046-03	2.532+00	1.304-01	2.627+01	2.465-01	2.918+01	7.424-07	6.171-04	3.178-05	6.403-03	6.008-05	7.113-03
2.600+07	2.596-03	2.377+00	1.194-01	2.717+01	2.596-01	2.993+01	6.327-07	5.794-04	2.910-05	6.622-03	6.327-05	7.295-03
2.800+07	2.238-03	2.243+00	1.101-01	2.799+01	2.718-01	3.062+01	5.455-07	5.467-04	2.684-05	6.822-03	6.625-05	7.463-03
3.000+07	1.950-03	2.124+00	1.022-01	2.875+01	2.830-01	3.126+01	4.753-07	5.177-04	2.491-05	7.007-03	6.898-05	7.620-03
4.000+07	1.097-03	1.688+00	7.501-02	3.185+01	3.292-01	3.394+01	2.674-07	4.114-04	1.828-05	7.763-03	8.024-05	8.273-03
5.000+07	7.020-04	1.409+00	5.924-02	3.415+01	3.637-01	3.598+01	1.711-07	3.434-04	1.444-05	8.324-03	8.865-05	8.770-03
6.000+07	4.875-04	1.214+00	4.894-02	3.594+01	3.909-01	3.759+01	1.188-07	2.959-04	1.193-05	8.760-03	9.528-05	9.163-03
8.000+07	2.742-04	9.572-01	3.631-02	3.857+01	4.314-01	4.000+01	6.683-08	2.333-04	8.850-06	9.401-03	1.051-04	9.748-03
1.000+08	1.755-04	7.945-01	2.886-02	4.042+01	4.605-01	4.170+01	4.278-08	1.937-04	7.034-06	9.852-03	1.122-04	1.016-02
1.500+08	7.800-05	5.658-01	1.907-02	4.333+01	5.080-01	4.442+01	1.901-08	1.379-04	4.648-06	1.056-02	1.238-04	1.083-02
2.000+08	4.387-05	4.436-01	1.424-02	4.507+01	5.374-01	4.607+01	1.069-08	1.081-04	3.471-06	1.099-02	1.310-04	1.123-02
3.000+08	1.950-05	3.144-01	9.449-03	4.709+01	5.731-01	4.799+01	4.753-09	7.663-05	2.303-06	1.148-02	1.397-04	1.170-02
4.000+08	1.097-05	2.463-01	7.071-03	4.825+01	5.942-01	4.910+01	2.674-09	6.003-05	1.723-06	1.176-02	1.448-04	1.197-02
5.000+08	7.020-06	2.039-01	5.649-03	4.901+01	6.086-01	4.983+01	1.711-09	4.970-05	1.377-06	1.195-02	1.483-04	1.215-02
6.000+08	4.875-06	1.745-01	4.703-03	4.955+01	6.191-01	5.035+01	1.188-09	4.253-05	1.146-06	1.208-02	1.509-04	1.227-02
8.000+08	2.742-06	1.363-01	3.523-03	5.027+01	6.336-01	5.104+01	6.683-10	3.322-05	8.587-07	1.225-02	1.544-04	1.244-02
1.000+09	1.755-06	1.121-01	2.817-03	5.074+01	6.432-01	5.150+01	4.278-10	2.732-05	6.866-07	1.237-02	1.568-04	1.255-02
1.500+09	7.800-07	7.832-02	1.876-03	5.140+01	6.574-01	5.214+01	1.901-10	1.909-05	4.573-07	1.253-02	1.602-04	1.271-02
2.000+09	4.387-07	6.062-02	1.406-03	5.178+01	6.655-01	5.251+01	1.069-10	1.478-05	3.427-07	1.262-02	1.622-04	1.280-02
3.000+09	1.950-07	4.215-02	9.372-04	5.215+01	6.743-01	5.287+01	4.753-11	1.027-05	2.284-07	1.271-02	1.644-04	1.289-02
4.000+09	1.097-07	3.253-02	7.028-04	5.240+01	6.795-01	5.311+01	2.674-11	7.929-06	1.713-07	1.277-02	1.656-04	1.295-02
5.000+09	7.020-08	2.660-02	5.621-04	5.253+01	6.827-01	5.324+01	1.711-11	6.483-06	1.370-07	1.280-02	1.664-04	1.298-02
6.000+09	4.875-08	2.256-02	4.684-04	5.263+01	6.849-01	5.334+01	1.188-11	5.499-06	1.142-07	1.283-02	1.669-04	1.300-02
8.000+09	2.742-08	1.738-02	3.513-04	5.275+01	6.876-01	5.346+01	6.683-12	4.236-06	8.563-08	1.286-02	1.676-04	1.303-02
1.000+10	1.755-08	1.419-02	2.810-04	5.283+01	6.897-01	5.353+01	4.278-12	3.459-06	6.849-08	1.288-02	1.681-04	1.305-02
1.500+10	7.800-09	9.806-03	1.873-04	5.293+01	6.922-01	5.363+01	1.901-12	2.390-06	4.565-08	1.290-02	1.687-04	1.307-02
2.000+10	4.387-09	7.539-03	1.405-04	5.299+01	6.938-01	5.369+01	1.069-12	1.838-06	3.425-08	1.292-02	1.691-04	1.309-02
3.000+10	1.950-09	5.199-03	9.365-05	5.304+01	6.952-01	5.374+01	4.753-13	1.267-06	2.283-08	1.293-02	1.694-04	1.310-02
4.000+10	1.097-09	3.992-03	7.023-05	5.308+01	6.961-01	5.378+01	2.674-13	9.730-07	1.712-08	1.294-02	1.697-04	1.311-02
5.000+10	7.020-10	3.250-03	5.619-05	5.311+01	6.966-01	5.381+01	1.711-13	7.921-07	1.370-08	1.294-02	1.698-04	1.312-02
6.000+10	4.875-10	2.748-03	4.682-05	5.312+01	6.970-01	5.382+01	1.188-13	6.698-07	1.141-08	1.295-02	1.699-04	1.312-02
8.000+10	2.742-10	2.107-03	3.512-05	5.313+01	6.973-01	5.383+01	6.683-14	5.136-07	8.560-09	1.295-02	1.700-04	1.312-02
1.000+11	1.755-10	1.714-03	2.809-05	5.314+01	6.976-01	5.384+01	4.278-14	4.178-07	6.847-09	1.295-02	1.700-04	1.312-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 97, BK, BERKELIUM ATOMIC WT. = 247.070 MSQ/KG = .00624374 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PAIR PRODUCTION PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.729+00	2.028+01	1.336+01	0.000	0.000	3.537+01	4.214-04	4.943-03	3.256-03	0.000	0.000	8.621-03
1.022+06	1.657+00	2.007+01	1.280+01	0.000	0.000	3.453+01	4.039-04	4.892-03	3.120-03	0.000	0.000	8.416-03
1.250+06	1.121+00	1.819+01	8.661+00	2.003-01	0.000	2.817+01	2.732-04	4.434-03	2.111-03	4.882-05	0.000	6.867-03
1.500+06	7.848-01	1.656+01	6.155+00	1.009+00	0.000	2.451+01	1.913-04	4.036-03	1.500-03	2.459-04	0.000	5.974-03
2.000+06	4.459-01	1.416+01	3.716+00	2.919+00	0.000	2.124+01	1.087-04	3.451-03	9.057-04	7.115-04	0.000	5.177-03
2.044+06	4.271-01	1.399+01	3.582+00	3.077+00	0.000	2.108+01	1.041-04	3.410-03	8.731-04	7.500-04	0.000	5.137-03
3.000+06	1.999-01	1.116+01	1.933+00	5.935+00	3.898-03	1.923+01	4.872-05	2.720-03	4.711-04	1.447-03	9.501-07	4.688-03
4.000+06	1.128-01	9.317+00	1.260+00	8.214+00	1.588-02	1.892+01	2.749-05	2.271-03	3.071-04	2.002-03	3.871-06	4.611-03
5.000+06	7.236-02	8.050+00	9.198-01	1.011+01	3.156-02	1.918+01	1.764-05	1.962-03	2.242-04	2.464-03	7.692-06	4.676-03
6.000+06	5.030-02	7.117+00	7.187-01	1.171+01	4.836-02	1.964+01	1.226-05	1.735-03	1.752-04	2.854-03	1.179-05	4.788-03
7.000+06	3.698-02	6.397+00	5.872-01	1.316+01	6.505-02	2.025+01	9.013-06	1.559-03	1.431-04	3.208-03	1.586-05	4.935-03
8.000+06	2.833-02	5.823+00	4.950-01	1.447+01	8.116-02	2.090+01	6.905-06	1.419-03	1.207-04	3.527-03	1.978-05	5.094-03
9.000+06	2.239-02	5.353+00	4.272-01	1.568+01	9.653-02	2.158+01	5.457-06	1.305-03	1.041-04	3.822-03	2.353-05	5.260-03
1.000+07	1.814-02	4.960+00	3.752-01	1.679+01	1.111-01	2.225+01	4.421-06	1.209-03	9.145-05	4.092-03	2.708-05	5.424-03
1.100+07	1.499-02	4.626+00	3.343-01	1.782+01	1.248-01	2.292+01	3.654-06	1.128-03	8.148-05	4.343-03	3.042-05	5.587-03
1.200+07	1.260-02	4.339+00	3.012-01	1.879+01	1.377-01	2.358+01	3.071-06	1.058-03	7.341-05	4.580-03	3.356-05	5.747-03
1.300+07	1.074-02	4.088+00	2.740-01	1.969+01	1.499-01	2.421+01	2.618-06	9.964-04	6.678-05	4.799-03	3.654-05	5.902-03
1.400+07	9.259-03	3.867+00	2.512-01	2.053+01	1.614-01	2.482+01	2.257-06	9.425-04	6.123-05	5.004-03	3.934-05	6.049-03
1.500+07	8.066-03	3.672+00	2.319-01	2.132+01	1.723-01	2.540+01	1.966-06	8.950-04	5.652-05	5.197-03	4.200-05	6.192-03
1.600+07	7.090-03	3.497+00	2.153-01	2.207+01	1.826-01	2.597+01	1.728-06	8.524-04	5.248-05	5.379-03	4.451-05	6.330-03
1.800+07	5.602-03	3.196+00	1.882-01	2.341+01	2.016-01	2.700+01	1.365-06	7.790-04	4.587-05	5.706-03	4.914-05	6.581-03
2.000+07	4.538-03	2.947+00	1.671-01	2.461+01	2.189-01	2.795+01	1.106-06	7.183-04	4.073-05	5.998-03	5.335-05	6.812-03
2.200+07	3.751-03	2.738+00	1.503-01	2.571+01	2.346-01	2.884+01	9.143-07	6.674-04	3.663-05	6.267-03	5.718-05	7.029-03
2.400+07	3.152-03	2.558+00	1.364-01	2.671+01	2.490-01	2.966+01	7.683-07	6.235-04	3.325-05	6.510-03	6.069-05	7.228-03
2.600+07	2.686-03	2.402+00	1.250-01	2.763+01	2.622-01	3.042+01	6.547-07	5.855-04	3.047-05	6.734-03	6.391-05	7.415-03
2.800+07	2.316-03	2.266+00	1.152-01	2.847+01	2.745-01	3.113+01	5.645-07	5.523-04	2.805-05	6.939-03	6.691-05	7.587-03
3.000+07	2.017-03	2.146+00	1.069-01	2.924+01	2.858-01	3.178+01	4.916-07	5.231-04	2.606-05	7.127-03	6.966-05	7.746-03
4.000+07	1.135-03	1.705+00	7.850-02	3.239+01	3.324-01	3.451+01	2.766-07	4.156-04	1.913-05	7.895-03	8.102-05	8.411-03
5.000+07	7.262-04	1.423+00	6.199-02	3.474+01	3.673-01	3.659+01	1.770-07	3.468-04	1.511-05	8.467-03	8.953-05	8.919-03
6.000+07	5.043-04	1.226+00	5.121-02	3.656+01	3.947-01	3.823+01	1.229-07	2.988-04	1.248-05	8.911-03	9.620-05	9.319-03
8.000+07	2.837-04	9.672-01	3.799-02	3.924+01	4.355-01	4.068+01	6.915-08	2.357-04	9.260-06	9.564-03	1.061-04	9.916-03
1.000+08	1.816-04	8.028-01	3.019-02	4.113+01	4.649-01	4.243+01	4.426-08	1.957-04	7.358-06	1.002-02	1.133-04	1.034-02
1.500+08	8.069-05	5.717-01	1.995-02	4.410+01	5.129-01	4.520+01	1.967-08	1.393-04	4.863-06	1.075-02	1.250-04	1.102-02
2.000+08	4.539-05	4.483-01	1.489-02	4.586+01	5.425-01	4.687+01	1.106-08	1.093-04	3.629-06	1.118-02	1.322-04	1.142-02
3.000+08	2.017-05	3.177-01	9.885-03	4.792+01	5.784-01	4.883+01	4.916-09	7.744-05	2.409-06	1.168-02	1.410-04	1.190-02
4.000+08	1.135-05	2.488-01	7.397-03	4.909+01	5.997-01	4.995+01	2.766-09	6.064-05	1.803-06	1.197-02	1.462-04	1.217-02
5.000+08	7.262-06	2.060-01	5.910-03	4.987+01	6.142-01	5.070+01	1.770-09	5.021-05	1.440-06	1.216-02	1.497-04	1.236-02
6.000+08	5.043-06	1.764-01	4.920-03	5.042+01	6.248-01	5.123+01	1.229-09	4.300-05	1.199-06	1.229-02	1.523-04	1.249-02
8.000+08	2.837-06	1.377-01	3.686-03	5.115+01	6.393-01	5.193+01	6.915-10	3.356-05	8.984-07	1.247-02	1.558-04	1.266-02
1.000+09	1.816-06	1.133-01	2.947-03	5.163+01	6.490-01	5.240+01	4.426-10	2.762-05	7.183-07	1.258-02	1.582-04	1.277-02
1.500+09	8.069-07	7.914-02	1.963-03	5.230+01	6.633-01	5.304+01	1.967-10	1.929-05	4.785-07	1.275-02	1.617-04	1.293-02
2.000+09	4.539-07	6.125-02	1.471-03	5.268+01	6.714-01	5.341+01	1.106-10	1.493-05	3.585-07	1.284-02	1.636-04	1.302-02
3.000+09	2.017-07	4.259-02	9.805-04	5.307+01	6.802-01	5.379+01	4.916-11	1.038-05	2.390-07	1.294-02	1.658-04	1.311-02
4.000+09	1.135-07	3.287-02	7.352-04	5.332+01	6.855-01	5.404+01	2.766-11	8.012-06	1.792-07	1.300-02	1.671-04	1.317-02
5.000+09	7.262-08	2.688-02	5.881-04	5.345+01	6.887-01	5.417+01	1.770-11	6.552-06	1.433-07	1.303-02	1.679-04	1.320-02
6.000+09	5.043-08	2.279-02	4.900-04	5.355+01	6.909-01	5.426+01	1.229-11	5.555-06	1.194-07	1.305-02	1.684-04	1.323-02
8.000+09	2.837-08	1.756-02	3.675-04	5.368+01	6.939-01	5.439+01	6.915-12	4.280-06	8.957-08	1.308-02	1.691-04	1.326-02
1.000+10	1.816-08	1.434-02	2.940-04	5.376+01	6.958-01	5.447+01	4.426-12	3.495-06	7.166-08	1.310-02	1.696-04	1.328-02
1.500+10	8.069-09	9.908-03	1.960-04	5.385+01	6.983-01	5.456+01	1.967-12	2.415-06	4.777-08	1.313-02	1.702-04	1.330-02
2.000+10	4.539-09	7.617-03	1.470-04	5.392+01	6.998-01	5.463+01	1.106-12	1.857-06	3.583-08	1.314-02	1.706-04	1.331-02
3.000+10	2.017-09	5.253-03	9.797-05	5.397+01	7.012-01	5.468+01	4.916-13	1.280-06	2.388-08	1.315-02	1.709-04	1.333-02
4.000+10	1.135-09	4.033-03	7.348-05	5.402+01	7.022-01	5.473+01	2.766-13	9.830-07	1.791-08	1.317-02	1.712-04	1.334-02
5.000+10	7.262-10	3.284-03	5.878-05	5.404+01	7.027-01	5.475+01	1.770-13	8.004-07	1.433-08	1.317-02	1.713-04	1.334-02
6.000+10	5.043-10	2.776-03	4.898-05	5.405+01	7.030-01	5.476+01	1.229-13	6.766-07	1.194-08	1.317-02	1.713-04	1.335-02
8.000+10	2.837-10	2.129-03	3.674-05	5.406+01	7.034-01	5.477+01	6.915-14	5.189-07	8.955-09	1.318-02	1.714-04	1.335-02
1.000+11	1.816-10	1.732-03	2.939-05	5.407+01	7.037-01	5.478+01	4.426-14	4.222-07	7.163-09	1.318-02	1.715-04	1.335-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, Z=1 to 100—Continued

Z = 98, Cf, CALIFORNIUM ATOMIC WT. = 251.080 MSQ/KG = .00023985 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	PAIR PRODUCTION TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.785+00	2.049+01	1.401+01	0.000	0.000	3.628+01	4.281-04	4.914-03	3.361-03	0.000	0.000	8.703-03
1.022+06	1.711+00	2.022+01	1.342+01	0.000	0.000	3.541+01	4.104-04	4.864-03	3.219-03	0.000	0.000	8.493-03
1.250+06	1.157+00	1.838+01	9.080+00	2.053-0	0.000	2.882+01	2.775-04	4.408-03	2.178-03	4.924-05	0.000	6.913-03
1.500+06	8.107-01	1.673+01	6.453+00	1.038+00	0.000	2.503+01	1.944-04	4.013-03	1.548-03	2.490-04	0.000	6.004-03
2.000+06	4.607-01	1.431+01	3.896+00	2.997+00	0.000	2.166+01	1.105-04	3.432-03	9.344-04	7.188-04	0.000	5.196-03
2.044+06	4.414-01	1.413+01	3.755+00	3.158+00	0.000	2.148+01	1.059-04	3.389-03	9.006-04	7.574-04	0.000	5.153-03
3.000+06	2.067-01	1.128+01	2.026+00	6.068+00	3.938-03	1.958+01	4.958-05	2.705-03	4.859-04	1.455-03	9.445-07	4.697-03
4.000+06	1.167-01	9.413+00	1.320+00	8.377+00	1.604-02	1.924+01	2.799-05	2.258-03	3.166-04	2.009-03	3.847-06	4.615-03
5.000+06	7.482-02	8.132+00	9.634-01	1.030+01	3.188-02	1.950+01	1.795-05	1.950-03	2.311-04	2.470-03	7.646-06	4.677-03
6.000+06	5.202-02	7.190+00	7.526-01	1.191+01	4.895-02	1.995+01	1.248-05	1.724-03	1.805-04	2.857-03	1.172-05	4.786-03
7.000+06	3.824-02	6.463+00	6.148-01	1.338+01	6.569-02	2.056+01	9.172-06	1.550-03	1.475-04	3.209-03	1.576-05	4.932-03
8.000+06	2.929-02	5.883+00	5.183-01	1.471+01	8.196-02	2.122+01	7.025-06	1.411-03	1.243-04	3.528-03	1.966-05	5.090-03
9.000+06	2.315-02	5.408+00	4.472-01	1.593+01	9.748-02	2.191+01	5.552-06	1.297-03	1.073-04	3.821-03	2.338-05	5.254-03
1.000+07	1.876-02	5.011+00	3.928-01	1.706+01	1.122-01	2.259+01	4.500-06	1.202-03	9.421-05	4.092-03	2.691-05	5.419-03
1.100+07	1.551-02	4.674+00	3.499-01	1.811+01	1.260-01	2.328+01	3.720-06	1.121-03	8.392-05	4.344-03	3.022-05	5.583-03
1.200+07	1.303-02	4.384+00	3.153-01	1.909+01	1.391-01	2.394+01	3.125-06	1.051-03	7.562-05	4.579-03	3.336-05	5.742-03
1.300+07	1.110-02	4.130+00	2.868-01	2.001+01	1.513-01	2.459+01	2.662-06	9.906-04	6.879-05	4.799-03	3.629-05	5.898-03
1.400+07	9.575-03	3.907+00	2.629-01	2.087+01	1.630-01	2.521+01	2.297-06	9.371-04	6.306-05	5.006-03	3.909-05	6.047-03
1.500+07	8.342-03	3.710+00	2.427-01	2.167+01	1.740-01	2.581+01	2.001-06	8.898-04	5.821-05	5.197-03	4.173-05	6.189-03
1.600+07	7.332-03	3.533+00	2.253-01	2.243+01	1.844-01	2.638+01	1.759-06	8.474-04	5.401-05	5.380-03	4.423-05	6.327-03
1.800+07	5.794-03	3.229+00	1.969-01	2.380+01	2.036-01	2.744+01	1.390-06	7.745-04	4.723-05	5.708-03	4.883-05	6.580-03
2.000+07	4.693-03	2.978+00	1.749-01	2.502+01	2.210-01	2.840+01	1.126-06	7.143-04	4.193-05	6.001-03	5.301-05	6.811-03
2.200+07	3.879-03	2.766+00	1.572-01	2.613+01	2.368-01	2.929+01	9.304-07	6.634-04	3.770-05	6.267-03	5.680-05	7.026-03
2.400+07	3.259-03	2.584+00	1.428-01	2.715+01	2.514-01	3.013+01	7.817-07	6.198-04	3.425-05	6.512-03	6.030-05	7.227-03
2.600+07	2.777-03	2.427+00	1.307-01	2.809+01	2.647-01	3.092+01	6.661-07	5.821-04	3.135-05	6.737-03	6.349-05	7.415-03
2.800+07	2.395-03	2.289+00	1.206-01	2.894+01	2.771-01	3.163+01	5.744-07	5.490-04	2.893-05	6.943-03	6.646-05	7.586-03
3.000+07	2.086-03	2.168+00	1.118-01	2.973+01	2.885-01	3.230+01	5.003-07	5.200-04	2.681-05	7.131-03	6.920-05	7.747-03
4.000+07	1.174-03	1.723+00	8.211-02	3.294+01	3.355-01	3.508+01	2.816-07	4.133-04	1.969-05	7.901-03	8.047-05	8.414-03
5.000+07	7.511-04	1.438+00	6.484-02	3.533+01	3.707-01	3.720+01	1.801-07	3.449-04	1.555-05	8.474-03	8.891-05	8.923-03
6.000+07	5.216-04	1.239+00	5.357-02	3.719+01	3.984-01	3.888+01	1.251-07	2.972-04	1.285-05	8.920-03	9.555-05	9.326-03
8.000+07	2.934-04	9.772-01	3.973-02	3.992+01	4.395-01	4.138+01	7.037-08	2.344-04	9.529-06	9.575-03	1.054-04	9.924-03
1.000+08	1.878-04	8.111-01	3.158-02	4.184+01	4.691-01	4.315+01	4.504-08	1.945-04	7.574-06	1.004-02	1.125-04	1.035-02
1.500+08	8.346-05	5.776-01	2.086-02	4.686+01	5.174-01	4.598+01	2.002-08	1.385-04	5.003-06	1.076-02	1.241-04	1.103-02
2.000+08	4.694-05	4.529-01	1.558-02	4.666+01	5.473-01	4.768+01	1.126-08	1.086-04	3.737-06	1.119-02	1.313-04	1.143-02
3.000+08	2.086-05	3.210-01	1.034-02	4.875+01	5.834-01	4.966+01	5.003-09	7.699-05	2.480-06	1.169-02	1.399-04	1.191-02
4.000+08	1.174-05	2.514-01	7.736-03	4.995+01	6.048-01	5.081+01	2.816-09	6.030-05	1.855-06	1.198-02	1.451-04	1.219-02
5.000+08	7.511-06	2.081-01	6.180-03	5.073+01	6.194-01	5.156+01	1.801-09	4.991-05	1.482-06	1.217-02	1.486-04	1.237-02
6.000+08	5.216-06	1.782-01	5.145-03	5.130+01	6.300-01	5.211+01	1.251-09	4.274-05	1.234-06	1.230-02	1.511-04	1.250-02
8.000+08	2.934-06	1.392-01	3.855-03	5.204+01	6.446-01	5.283+01	7.037-10	3.339-05	9.246-07	1.248-02	1.546-04	1.267-02
1.000+09	1.878-06	1.145-01	3.082-03	5.252+01	6.543-01	5.329+01	4.504-10	2.746-05	7.392-07	1.260-02	1.569-04	1.278-02
1.500+09	8.346-07	7.995-02	2.053-03	5.321+01	6.686-01	5.396+01	2.002-10	1.918-05	4.924-07	1.276-02	1.604-04	1.294-02
2.000+09	4.694-07	6.188-02	1.539-03	5.360+01	6.768-01	5.434+01	1.126-10	1.484-05	3.691-07	1.286-02	1.623-04	1.303-02
3.000+09	2.086-07	4.303-02	1.025-03	5.399+01	6.856-01	5.472+01	5.003-11	1.032-05	2.458-07	1.295-02	1.644-04	1.312-02
4.000+09	1.174-07	3.321-02	7.688-04	5.424+01	6.909-01	5.496+01	2.816-11	7.965-06	1.844-07	1.301-02	1.657-04	1.318-02
5.000+09	7.511-08	2.715-02	6.150-04	5.438+01	6.941-01	5.510+01	1.801-11	6.512-06	1.475-07	1.304-02	1.665-04	1.322-02
6.000+09	5.216-08	2.303-02	5.124-04	5.448+01	6.963-01	5.520+01	1.251-11	5.524-06	1.229-07	1.307-02	1.670-04	1.324-02
8.000+09	2.934-08	1.774-02	3.843-04	5.461+01	6.993-01	5.533+01	7.037-12	4.255-06	9.217-08	1.310-02	1.677-04	1.327-02
1.000+10	1.878-08	1.448-02	3.074-04	5.469+01	7.012-01	5.541+01	4.504-12	3.473-06	7.373-08	1.312-02	1.682-04	1.329-02
1.500+10	8.346-09	1.001-02	2.049-04	5.479+01	7.037-01	5.550+01	2.002-12	2.401-06	4.914-08	1.314-02	1.688-04	1.331-02
2.000+10	4.694-09	7.696-03	1.537-04	5.485+01	7.053-01	5.556+01	1.126-12	1.846-06	3.686-08	1.316-02	1.692-04	1.333-02
3.000+10	2.086-09	5.308-03	1.024-04	5.491+01	7.066-01	5.562+01	5.003-13	1.273-06	2.456-08	1.317-02	1.695-04	1.334-02
4.000+10	1.174-09	4.075-03	7.683-05	5.495+01	7.076-01	5.566+01	2.816-13	9.774-07	1.843-08	1.318-02	1.697-04	1.335-02
5.000+10	7.511-10	3.318-03	6.147-05	5.497+01	7.081-01	5.568+01	1.801-13	7.958-07	1.475-08	1.318-02	1.698-04	1.335-02
6.000+10	5.216-10	2.805-03	5.122-05	5.499+01	7.085-01	5.570+01	1.251-13	6.728-07	1.229-08	1.319-02	1.699-04	1.336-02
8.000+10	2.934-10	2.151-03	3.842-05	5.500+01	7.088-01	5.571+01	7.037-14	5.159-07	9.215-09	1.319-02	1.700-04	1.336-02
1.000+11	1.878-10	1.750-03	3.073-05	5.501+01	7.091-01	5.572+01	4.504-14	4.197-07	7.370-09	1.319-02	1.701-04	1.336-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, $Z=1$ to 100—Continued

Z = 99, ES, EINSTEINIUM ATOMIC WT. = 252.083 MSQ/KG = .00023889 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.842+00	2.070+01	1.467+01	0.000	0.000	3.721+01	4.400-04	4.945-03	3.505-03	0.000	0.000	8.890-03
1.022+06	1.766+00	2.048+01	1.406+01	0.000	0.000	3.631+01	4.219-04	4.892-03	3.359-03	0.000	0.000	8.673-03
1.250+06	1.195+00	1.856+01	9.516+00	2.103-01	0.000	2.948+01	2.855-04	4.434-03	2.273-03	5.024-05	0.000	7.043-03
1.500+06	8.371-01	1.690+01	6.763+00	1.068+00	0.000	2.557+01	2.000-04	4.037-03	1.616-03	2.551-04	0.000	6.108-03
2.000+06	4.759-01	1.445+01	4.082+00	3.076+00	0.000	2.208+01	1.137-04	3.452-03	9.752-04	7.348-04	0.000	5.276-03
2.044+06	4.560-01	1.428+01	3.935+00	3.241+00	0.000	2.191+01	1.089-04	3.411-03	9.400-04	7.742-04	0.000	5.235-03
3.000+06	2.136-01	1.139+01	2.122+00	6.203+00	3.978-03	1.993+01	5.103-05	2.721-03	5.069-04	1.482-03	9.503-07	4.762-03
4.000+06	1.206-01	9.509+00	1.382+00	8.541+00	1.620-02	1.957+01	2.881-05	2.272-03	3.301-04	2.040-03	3.870-06	4.675-03
5.000+06	7.734-02	8.215+00	1.009+00	1.049+01	3.221-02	1.982+01	1.848-05	1.962-03	2.410-04	2.506-03	7.695-06	4.736-03
6.000+06	5.377-02	7.263+00	7.879-01	1.211+01	4.935-02	2.026+01	1.285-05	1.735-03	1.882-04	2.893-03	1.179-05	4.841-03
7.000+06	3.954-02	6.529+00	6.436-01	1.360+01	6.637-02	2.088+01	9.446-06	1.560-03	1.538-04	3.249-03	1.586-05	4.988-03
8.000+06	3.028-02	5.943+00	5.424-01	1.495+01	8.280-02	2.155+01	7.234-06	1.420-03	1.296-04	3.571-03	1.978-05	5.148-03
9.000+06	2.394-02	5.463+00	4.680-01	1.619+01	9.848-02	2.224+01	5.719-06	1.305-03	1.118-04	3.868-03	2.353-05	5.314-03
1.000+07	1.939-02	5.062+00	4.110-01	1.734+01	1.133-01	2.295+01	4.632-06	1.209-03	9.818-05	4.142-03	2.707-05	5.482-03
1.100+07	1.603-02	4.722+00	3.661-01	1.840+01	1.273-01	2.363+01	3.829-06	1.128-03	8.746-05	4.396-03	3.041-05	5.645-03
1.200+07	1.347-02	4.429+00	3.299-01	1.940+01	1.405-01	2.431+01	3.218-06	1.058-03	7.881-05	4.634-03	3.356-05	5.808-03
1.300+07	1.148-02	4.172+00	3.000-01	2.033+01	1.529-01	2.497+01	2.742-06	9.967-04	7.167-05	4.857-03	3.653-05	5.964-03
1.400+07	9.900-03	3.947+00	2.750-01	2.120+01	1.646-01	2.560+01	2.365-06	9.429-04	6.570-05	5.064-03	3.932-05	6.115-03
1.500+07	8.625-03	3.747+00	2.538-01	2.202+01	1.757-01	2.621+01	2.060-06	8.951-04	6.063-05	5.260-03	4.197-05	6.260-03
1.600+07	7.581-03	3.569+00	2.356-01	2.279+01	1.862-01	2.679+01	1.811-06	8.526-04	5.628-05	5.444-03	4.448-05	6.400-03
1.800+07	5.990-03	3.262+00	2.060-01	2.418+01	2.056-01	2.786+01	1.431-06	7.793-04	4.921-05	5.776-03	4.912-05	6.655-03
2.000+07	4.852-03	3.008+00	1.829-01	2.542+01	2.232-01	2.884+01	1.159-06	7.186-04	4.369-05	6.073-03	5.332-05	6.889-03
2.200+07	4.010-03	2.794+00	1.644-01	2.656+01	2.392-01	2.976+01	9.580-07	6.675-04	3.927-05	6.345-03	5.714-05	7.110-03
2.400+07	3.370-03	2.611+00	1.493-01	2.760+01	2.539-01	3.062+01	8.051-07	6.237-04	3.567-05	6.593-03	6.065-05	7.314-03
2.600+07	2.872-03	2.452+00	1.367-01	2.855+01	2.674-01	3.141+01	6.861-07	5.858-04	3.266-05	6.820-03	6.388-05	7.503-03
2.800+07	2.476-03	2.313+00	1.261-01	2.942+01	2.798-01	3.214+01	5.915-07	5.526-04	3.012-05	7.028-03	6.684-05	7.678-03
3.000+07	2.157-03	2.190+00	1.170-01	3.022+01	2.914-01	3.282+01	5.153-07	5.232-04	2.795-05	7.219-03	6.961-05	7.841-03
4.000+07	1.213-03	1.740+00	8.587-02	3.349+01	3.388-01	3.566+01	2.898-07	4.157-04	2.051-05	8.000-03	8.094-05	8.518-03
5.000+07	7.766-04	1.453+00	6.780-02	3.593+01	3.744-01	3.783+01	1.855-07	3.471-04	1.620-05	8.583-03	8.944-05	9.036-03
6.000+07	5.393-04	1.252+00	5.601-02	3.782+01	4.023-01	3.953+01	1.288-07	2.991-04	1.338-05	9.035-03	9.611-05	9.444-03
8.000+07	3.034-04	9.872-01	4.154-02	4.060+01	4.438-01	4.207+01	7.248-08	2.358-04	9.924-06	9.699-03	1.060-04	1.005-02
1.000+08	1.942-04	8.193-01	3.301-02	4.256+01	4.736-01	4.389+01	4.639-08	1.957-04	7.886-06	1.017-02	1.131-04	1.048-02
1.500+08	8.629-05	5.835-01	2.181-02	4.563+01	5.223-01	4.676+01	2.061-08	1.394-04	5.210-06	1.090-02	1.248-04	1.117-02
2.000+08	4.854-05	4.575-01	1.628-02	4.746+01	5.524-01	4.849+01	1.160-08	1.093-04	3.889-06	1.134-02	1.320-04	1.158-02
3.000+08	2.157-05	3.243-01	1.081-02	4.959+01	5.888-01	5.051+01	5.153-09	7.747-05	2.582-06	1.185-02	1.407-04	1.207-02
4.000+08	1.213-05	2.540-01	8.087-03	5.081+01	6.103-01	5.168+01	2.898-09	6.068-05	1.932-06	1.214-02	1.458-04	1.235-02
5.000+08	7.766-06	2.102-01	6.461-03	5.161+01	6.250-01	5.245+01	1.855-09	5.021-05	1.543-06	1.233-02	1.493-04	1.253-02
6.000+08	5.393-06	1.800-01	5.379-03	5.218+01	6.357-01	5.300+01	1.288-09	4.300-05	1.285-06	1.247-02	1.519-04	1.266-02
8.000+08	3.034-06	1.406-01	4.030-03	5.293+01	6.504-01	5.373+01	7.248-10	3.359-05	9.627-07	1.264-02	1.554-04	1.283-02
1.000+09	1.941-06	1.157-01	3.221-03	5.342+01	6.601-01	5.420+01	4.637-10	2.764-05	7.695-07	1.276-02	1.577-04	1.295-02
1.500+09	8.629-07	8.077-02	2.146-03	5.412+01	6.745-01	5.488+01	2.061-10	1.930-05	5.127-07	1.293-02	1.611-04	1.311-02
2.000+09	4.854-07	6.251-02	1.608-03	5.452+01	6.827-01	5.527+01	1.160-10	1.493-05	3.841-07	1.302-02	1.631-04	1.320-02
3.000+09	2.157-07	4.347-02	1.072-03	5.491+01	6.916-01	5.565+01	5.153-11	1.038-05	2.561-07	1.312-02	1.652-04	1.329-02
4.000+09	1.213-07	3.355-02	8.037-04	5.517+01	6.969-01	5.590+01	2.898-11	8.015-06	1.920-07	1.318-02	1.665-04	1.335-02
5.000+09	7.766-08	2.743-02	6.429-04	5.531+01	7.001-01	5.604+01	1.855-11	6.553-06	1.536-07	1.321-02	1.672-04	1.339-02
6.000+09	5.393-08	2.326-02	5.357-04	5.541+01	7.023-01	5.614+01	1.288-11	5.557-06	1.280-07	1.324-02	1.678-04	1.341-02
8.000+09	3.034-08	1.792-02	4.017-04	5.554+01	7.053-01	5.626+01	7.248-12	4.281-06	9.596-08	1.327-02	1.685-04	1.344-02
1.000+10	1.941-08	1.463-02	3.213-04	5.562+01	7.072-01	5.634+01	4.637-12	3.495-06	7.676-08	1.329-02	1.689-04	1.346-02
1.500+10	8.629-09	1.011-02	2.142-04	5.572+01	7.098-01	5.644+01	2.061-12	2.415-06	5.117-08	1.331-02	1.696-04	1.348-02
2.000+10	4.854-09	7.775-03	1.606-04	5.579+01	7.113-01	5.651+01	1.160-12	1.857-06	3.837-08	1.333-02	1.699-04	1.350-02
3.000+10	2.157-09	5.362-03	1.071-04	5.584+01	7.127-01	5.656+01	5.153-13	1.281-06	2.559-08	1.334-02	1.703-04	1.351-02
4.000+10	1.213-09	4.116-03	8.032-05	5.589+01	7.136-01	5.661+01	2.898-13	9.833-07	1.919-08	1.335-02	1.705-04	1.352-02
5.000+10	7.766-10	3.352-03	6.425-05	5.592+01	7.142-01	5.664+01	1.855-13	8.008-07	1.535-08	1.336-02	1.706-04	1.353-02
6.000+10	5.393-10	2.834-03	5.354-05	5.593+01	7.145-01	5.665+01	1.288-13	6.770-07	1.279-08	1.336-02	1.707-04	1.353-02
8.000+10	3.034-10	2.173-03	4.016-05	5.594+01	7.149-01	5.666+01	7.248-14	5.191-07	9.594-09	1.336-02	1.708-04	1.353-02
1.000+11	1.941-10	1.768-03	3.213-05	5.595+01	7.152-01	5.667+01	4.637-14	4.224-07	7.676-09	1.337-02	1.709-04	1.354-02

TABLE 6. Cross sections and mass attenuation coefficients for the individual and total photon atom interaction processes, 1 MeV to 100 GeV, Z=1 to 100—Continued

Z = 100, FM, FERMIUM ATOMIC WT. = 257.095 MSQ/KG = .00023423 BARNS/ATOM MULTIPLY MSQ/KG BY 10 FOR CMSQ/G

PHOTON ENERGY	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL	SCATTERING COHERENT	SCATTERING INCOHER.	PHOTO-ELECTRIC	PAIR PRODUCTION NUCLEAR FIELD	PAIR PRODUCTION ELECTRON FIELD	TOTAL
EV	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	B/ATOM	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG	MSQ/KG
1.000+06	1.900+00	2.090+01	1.537+01	0.000	0.000	3.817+01	4.450-04	4.895-03	3.600-03	0.000	0.000	8.941-0
1.022+06	1.822+00	2.069+01	1.472+01	0.000	0.000	3.723+01	4.268-04	4.846-03	3.448-03	0.000	0.000	8.721-0
1.250+06	1.233+00	1.875+01	9.970+00	2.153-01	0.000	3.017+01	2.888-04	4.392-03	2.335-03	5.043-05	0.000	7.066-0
1.500+06	8.642-01	1.707+01	7.085+00	1.099+00	0.000	2.612+01	2.024-04	3.998-03	1.660-03	2.574-04	0.000	6.118-0
2.000+06	4.915-01	1.460+01	4.276+00	3.157+00	0.000	2.252+01	1.151-04	3.420-03	1.002-03	7.395-04	0.000	5.276-0
2.044+06	4.709-01	1.442+01	4.122+00	3.325+00	0.000	2.234+01	1.103-04	3.378-03	9.655-04	7.788-04	0.000	5.232-0
3.000+06	2.206-01	1.151+01	2.222+00	6.339+00	4.018-03	2.030+01	5.167-05	2.696-03	5.205-04	1.485-03	9.412-07	4.754-0
4.000+06	1.246-01	9.605+00	1.447+00	8.707+00	1.636-02	1.990+01	2.919-05	2.250-03	3.389-04	2.039-03	3.832-06	4.661-0
5.000+06	7.992-02	8.298+00	1.056+00	1.068+01	3.253-02	2.015+01	1.872-05	1.944-03	2.474-04	2.502-03	7.620-06	4.719-0
6.000+06	5.557-02	7.336+00	8.246-01	1.231+01	4.984-02	2.058+01	1.302-05	1.718-03	1.931-04	2.883-03	1.167-05	4.820-0
7.000+06	4.086-02	6.595+00	6.734-01	1.382+01	6.702-02	2.120+01	9.571-06	1.545-03	1.577-04	3.237-03	1.570-05	4.965-0
8.000+06	3.130-02	6.003+00	5.675-01	1.519+01	8.362-02	2.188+01	7.332-06	1.406-03	1.329-04	3.558-03	1.955-05	5.124-0
9.000+06	2.474-02	5.519+00	4.895-01	1.645+01	9.945-02	2.258+01	5.795-06	1.293-03	1.147-04	3.853-03	2.329-05	5.290-0
1.000+07	2.004-02	5.113+00	4.299-01	1.761+01	1.144-01	2.329+01	4.694-06	1.198-03	1.007-04	4.125-03	2.680-05	5.455-0
1.100+07	1.657-02	4.770+00	3.829-01	1.870+01	1.286-01	2.400+01	3.881-06	1.117-03	8.969-05	4.380-03	3.012-05	5.621-0
1.200+07	1.392-02	4.473+00	3.450-01	1.971+01	1.419-01	2.468+01	3.261-06	1.048-03	8.081-05	4.617-03	3.324-05	5.782-0
1.300+07	1.187-02	4.214+00	3.138-01	2.065+01	1.544-01	2.534+01	2.780-06	9.871-04	7.350-05	4.837-03	3.617-05	5.936-0
1.400+07	1.023-02	3.987+00	2.876-01	2.154+01	1.662-01	2.599+01	2.396-06	9.339-04	6.737-05	5.045-03	3.893-05	6.088-0
1.500+07	8.915-03	3.785+00	2.655-01	2.237+01	1.774-01	2.661+01	2.088-06	8.866-04	6.219-05	5.240-03	4.155-05	6.232-0
1.600+07	7.836-03	3.605+00	2.464-01	2.315+01	1.880-01	2.720+01	1.835-06	8.444-04	5.772-05	5.423-03	4.404-05	6.371-0
1.800+07	6.192-03	3.295+00	2.154-01	2.457+01	2.076-01	2.829+01	1.450-06	7.718-04	5.045-05	5.755-03	4.863-05	6.627-0
2.000+07	5.016-03	3.038+00	1.912-01	2.583+01	2.254-01	2.929+01	1.175-06	7.116-04	4.479-05	6.050-03	5.280-05	6.861-0
2.200+07	4.145-03	2.822+00	1.719-01	2.699+01	2.415-01	3.023+01	9.709-07	6.610-04	4.026-05	6.322-03	5.657-05	7.081-0
2.400+07	3.483-03	2.637+00	1.561-01	2.804+01	2.563-01	3.109+01	8.158-07	6.177-04	3.656-05	6.568-03	6.003-05	7.283-0
2.600+07	2.968-03	2.476+00	1.429-01	2.901+01	2.699-01	3.190+01	6.952-07	5.800-04	3.347-05	6.795-03	6.322-05	7.472-0
2.800+07	2.559-03	2.336+00	1.318-01	2.990+01	2.825-01	3.265+01	5.994-07	5.472-04	3.087-05	7.004-03	6.617-05	7.648-0
3.000+07	2.230-03	2.212+00	1.223-01	3.071+01	2.942-01	3.334+01	5.223-07	5.181-04	2.865-05	7.193-03	6.891-05	7.810-0
4.000+07	1.254-03	1.758+00	8.975-02	3.404+01	3.420-01	3.623+01	2.937-07	4.118-04	2.102-05	7.973-03	8.011-05	8.487-0
5.000+07	8.027-04	1.467+00	7.087-02	3.652+01	3.779-01	3.844+01	1.880-07	3.436-04	1.660-05	8.554-03	8.852-05	9.003-0
6.000+07	5.575-04	1.264+00	5.854-02	3.845+01	4.060-01	4.018+01	1.306-07	2.961-04	1.371-05	9.006-03	9.510-05	9.411-0
8.000+07	3.136-04	9.971-01	4.342-02	4.128+01	4.479-01	4.277+01	7.346-08	2.336-04	1.017-05	9.669-03	1.049-04	1.002-02
1.000+08	2.007-04	8.276-01	3.450-02	4.328+01	4.780-01	4.462+01	4.701-08	1.939-04	8.081-06	1.014-02	1.120-04	1.045-02
1.500+08	8.919-05	5.894-01	2.279-02	4.640+01	5.271-01	4.754+01	2.089-08	1.381-04	5.338-06	1.087-02	1.235-04	1.114-02
2.000+08	5.017-05	4.621-01	1.702-02	4.826+01	5.574-01	4.930+01	1.175-08	1.082-04	3.987-06	1.130-02	1.306-04	1.155-02
3.000+08	2.230-05	3.275-01	1.129-02	5.043+01	5.940-01	5.136+01	5.223-09	7.671-05	2.645-06	1.181-02	1.391-04	1.203-02
4.000+08	1.254-05	2.565-01	8.451-03	5.167+01	6.157-01	5.255+01	2.937-09	6.008-05	1.980-06	1.210-02	1.442-04	1.231-02
5.000+08	8.027-06	2.123-01	6.751-03	5.248+01	6.304-01	5.333+01	1.880-09	4.973-05	1.581-06	1.229-02	1.477-04	1.249-02
6.000+08	5.574-06	1.818-01	5.621-03	5.306+01	6.412-01	5.389+01	1.306-09	4.258-05	1.317-06	1.243-02	1.502-04	1.262-02
8.000+08	3.136-06	1.420-01	4.211-03	5.383+01	6.559-01	5.463+01	7.346-10	3.326-05	9.864-07	1.261-02	1.536-04	1.280-02
1.000+09	2.007-06	1.168-01	3.366-03	5.433+01	6.657-01	5.512+01	4.701-10	2.736-05	7.884-07	1.273-02	1.559-04	1.291-02
1.500+09	8.919-07	8.159-02	2.242-03	5.504+01	6.802-01	5.580+01	2.089-10	1.911-05	5.252-07	1.289-02	1.593-04	1.307-02
2.000+09	5.017-07	6.314-02	1.681-03	5.544+01	6.884-01	5.619+01	1.175-10	1.479-05	3.937-07	1.299-02	1.612-04	1.316-02
3.000+09	2.230-07	4.390-02	1.120-03	5.584+01	6.973-01	5.658+01	5.223-11	1.028-05	2.623-07	1.308-02	1.633-04	1.325-02
4.000+09	1.254-07	3.389-02	8.398-04	5.610+01	7.027-01	5.684+01	2.937-11	7.938-06	1.967-07	1.314-02	1.646-04	1.331-02
5.000+09	8.027-08	2.771-02	6.718-04	5.625+01	7.058-01	5.698+01	1.880-11	6.491-06	1.574-07	1.318-02	1.653-04	1.335-02
6.000+09	5.574-08	2.350-02	5.598-04	5.635+01	7.081-01	5.708+01	1.306-11	5.505-06	1.311-07	1.320-02	1.659-04	1.337-02
8.000+09	3.136-08	1.810-02	4.198-04	5.648+01	7.111-01	5.721+01	7.346-12	4.240-06	9.833-08	1.323-02	1.666-04	1.340-02
1.000+10	2.007-08	1.478-02	3.358-04	5.656+01	7.130-01	5.729+01	4.701-12	3.462-06	7.866-08	1.325-02	1.670-04	1.342-02
1.500+10	8.919-09	1.021-02	2.238-04	5.667+01	7.156-01	5.740+01	2.089-12	2.392-06	5.242-08	1.327-02	1.676-04	1.344-02
2.000+10	5.017-09	7.853-03	1.679-04	5.674+01	7.171-01	5.747+01	1.175-12	1.839-06	3.933-08	1.329-02	1.680-04	1.346-02
3.000+10	2.230-09	5.416-03	1.119-04	5.679+01	7.185-01	5.751+01	5.223-13	1.269-06	2.621-08	1.330-02	1.683-04	1.347-02
4.000+10	1.254-09	4.158-03	8.393-05	5.684+01	7.194-01	5.756+01	2.937-13	9.739-07	1.966-08	1.331-02	1.685-04	1.348-02
5.000+10	8.027-10	3.386-03	6.714-05	5.686+01	7.200-01	5.758+01	1.880-13	7.931-07	1.573-08	1.332-02	1.686-04	1.349-02
6.000+10	5.574-10	2.862-03	5.595-05	5.687+01	7.203-01	5.759+01	1.306-13	6.704-07	1.311-08	1.332-02	1.687-04	1.349-02
8.000+10	3.136-10	2.195-03	4.196-05	5.688+01	7.207-01	5.760+01	7.346-14	5.141-07	9.828-09	1.332-02	1.688-04	1.349-02
1.000+11	2.007-10	1.785-03	3.357-05	5.690+01	7.210-01	5.762+01	4.701-14	4.181-07	7.863-09	1.333-02	1.689-04	1.350-02

Table 7. Values of atomic weights[a] A_r and typical densities[b] ρ for the elements.

Z	Symbol	A_r, atomic wt., 10^{-3} kg/mol	ρ, density, Mg/m^3 (= g/cm^3)
1	H	1.0079	0.00008988 (gas, H_2)
2	He	4.00260	0.0001785 (gas)
3	Li	6.941*	.534
4	Be	9.01218	1.85
5	B	10.81	2.535
6	C	12.011	1.4 - 2.25 (graphite)
7	N	14.0067	0.001250 (gas, N_2)
8	O	15.9994*	0.001429 (gas, O_2)
9	F	18.998403	0.001696 (gas, F_2)
10	Ne	20.179	0.0008999 (gas)
11	Na	22.98977	.971
12	Mg	24.305	1.74
13	Aℓ	26.98154	2.70
14	Si	28.0855*	2.42
15	P	30.97376	1.8 - 2.7
16	S	32.06	1.96 - 2.07
17	Cℓ	35.453	.003214 (gas, $C\ell_2$)
18	Ar	39.948	.001784 (gas)
19	K	39.0983	.87
20	Ca	40.08	1.55
21	Sc	44.9559	3.02
22	Ti	47.88*	4.5
23	V	50.9415	5.87
24	Cr	51.996	7.14
25	Mn	54.9380	7.3
26	Fe	55.847*	7.86
27	Co	58.9332	8.71
28	Ni	58.69	8.8
29	Cu	63.546*	8.93
30	Zn	65.38	6.92
31	Ga	69.72	5.93
32	Ge	72.59	5.46
33	As	74.9216	5.73
34	Se	78.96*	4.82
35	Br	79.904	3.12 (liquid)
36	Kr	83.80	0.003743 (gas)
37	Rb	85.4678*	1.53
38	Sr	87.62	2.6
39	Y	88.9059	3.8
40	Zr	91.22	6.44
41	Nb	92.9064	8.4
42	Mo	95.94	9.01
43	Tc	[97.907, 4.2×10^6 yr]	11.50
44	Ru	101.07*	12.1
45	Rh	102.9055	12.44

Table 7. (continued)

Z	Symbol	A_r, atomic wt., 10^{-3} kg/mol	ρ, density, Mg/m^3 (= g/cm^3)
46	Pd	106.42	12.25
47	Ag	107.868	10.49
48	Cd	112.41	8.65
49	In	114.82	7.43
50	Sn	118.69*	5.75 - 7.29
51	Sb	121.75*	6.62
52	Te	127.60	6.25
53	I	126.9045	4.94
54	Xe	131.29*	.005896 (gas)
55	Cs	132.9054	1.873
56	Ba	137.33	3.5
57	La	138.9055*	6.15
58	Ce	140.12	6.90
59	Pr	140.9077	6.48
60	Nd	144.24*	7.00
61	Pm	[144.913, 18 yr]	7.22
62	Sm	150.36*	7.7 - 7.8
63	Eu	151.96	5.259
64	Gd	157.25*	7.948
65	Tb	158.9254	8.272
66	Dy	162.50*	8.536
67	Ho	164.9304	8.803
68	Er	167.26*	9.051
69	Tm(Tu)	168.9342	9.332
70	Yb	173.04*	6.977
71	Lu	174.967*	9.872
72	Hf	178.49*	13.3
73	Ta	180.9479	17.1
74	W	183.85*	19.3
75	Re	186.207	20.53
76	Os	190.2	22.8
77	Ir	192.22*	22.42 - 22.8
78	Pt	195.08*	21.4
79	Au	196.9665	19.3
80	Hg	200.59*	13.55 (liquid)
81	Tℓ	204.383	11.86
82	Pb	207.2	11.34
83	Bi	208.9804	9.78
84	Po	[208.982, 102 yr]	9.32
85	At	[209.987, 8.1 hr]	-
86	Rn	[222.018, 3.824 d]	.00996 (gas)
87	Fr	[223.020, 22 min]	-
88	Ra	[226.0254, 1600 yr]	5. (?)
89	Ac	[227.0278, 21.77 yr]	10.07
90	Th	[232.0381, 1.40×10^{10} yr]	11.00
91	Pa	[231.0359, 3.28×10^4 yr]	15.37
92	U	[238.051, 4.47×10^9 yr]	18.7
93	Np	[237.0482, 2.14×10^6 yr]	19.36
94	Pu	[239.052, 2.41×10^4 yr]	15.92 - 19.84
95	Am	[243.061, 7370 yr]	11.7
96	Cm	[247.070, 1.55×10^7 yr]	~ 7
97	Bk	[247.070, 1400 yr]	
98	Cf	[251.080, 900 yr]	
99	Es	[252.083, 472 d]	
100	Fm	[257.095, 100.5 d]	

[a] Atomic weights (relative atomic masses) A_r for stable elements are for "natural" isotopic mixtures as recommended by the Commission on Atomic Weights, Inorganic Chemistry Division, International Union of Pure and Applied Chemistry (IUPAC) [143,144]. For unstable elements each listed A_r-value is for the longest known half-life [minutes (min.), hours (hr), days (d), and years (yr)] isotope taken from the CAW/IUPAC 1977 listed values [143] compiled by Wapstra [145] and Holden [146] except in the case of Pu(Z = 94) for the most technologically important isotope (mass-number 239 instead of 244). An asterisk (*) following an A_r value for a stable element signifies an estimated uncertainty of ± 3 in the last digit; for other stable elements the estimated uncertainty is ± 1.

[b] Typical densities ρ, reproduced here from the listing documented in reference [26] (Table 1.-1), are for common solids and liquids (where indicated) at 20° C, and for gases (where indicated) at S.T.P.: 0° C, 760 mm Hg.

Acknowledgement

This work was done under sponsorship and with support (to J. H. Hubbell, and, in part, to H. A. Gimm) from the NBS Office of Standard Reference Data.

References

[1] Ahrens, J., Borchert, H., Czock, K. H., Eppler, H. B., Gimm, H., Gundrum, H., Kröning, M., Riehn, P., Sita Ram, G., Zieger, A., and Ziegler, B., Nucl. Phys. **A251**, 479–492 (1975).

[2] Ahrens, J., Gimm, H., Sita Ram, G., Zieger, A., and Ziegler, B., unpublished.

[3] Gimm, H., and Hubbell, J. H., Nat. Bur. Stand. (U.S.), Tech. Note 968 (1978) 77 pages.

[4] Ahmed, K. U., and Cochran, R. G., Nucl. Technol. **17**, 66–70 (1973).

[5] Avignone, F. T., and Blankenship, S. M., Phys. Rev. **A10**, 793–796 (1974).

[6] Girard, T. A., Avignone, F. T., and Blankenship, S. M., Phys. Rev. **A17**, 218–222 (1978); Girard, T. A., Avignone, F. T., and Huntsberger, T. L., Phys. Letters **71A**, 33–34 (1979).

[7] Barkan, S. M., Phys. Rev. **A1**, 1022–1032 (1970).

[8] Barlett, R. H., and Donahue, D. J., Phys. Rev. **137**, A523–A526 (1965).

[9] Coquette, A., Nucl. Instr. Meth. **144**, 571–577 (1977); **164**, 337–342 (1979); J. Physique **39**, 1055–1058 (1978); **41**, 97–99 (1980).

[10] Gurevich, G. M., Lazareva, L. E., Mazur, V. M., Merkuliov, S. Yu., and Solodukhov, G. V., Nucl. Phys. **A338**, 97–104 (1980).

[11] Henry, L. G., and Kennett, T. J., Can. J. Phys. **49**, 1167–1178 (1971).

[12] Mashkour, M., Phys. Rev. **A8**, 2342–2347 (1973).

[13] Moreh, R., Salzman, D., and Wand, Y., Phys. Lett. **B30**, 536–537 (1969).

[14] Bar-Noy, T., and Moreh, R., Nucl. Phys. **A229**, 417–428 (1974).

[15] Moreh, R., and Wand, Y., Nucl. Phys. **A252**, 423–428 (1975).

[16] Peryt, W., Pluta, J., Slowinski, B., Strugalski, Z., Sadowska, M., and Jablonski, Z., Yad. Fiz. **24**, 966–968 (1976); transl. in Sov. J. Nucl. Phys. **24**, 506–507 (1976).

[17] Piowaty, J. M., Garritson, G. R., and Miller, W. C., Bull. Am. Phys. Soc. (Ser. II) **13**, 716 (1968); also personal communication 5/27/76.

[18] Rama Rao, J., and Parthasaradhi, K., Curr. Sci. **38**, 86 (1969).

[19] Rama Rao, J., Murty, M. S., Premchand, K., and Parthasaradhi, K., Indian J. Pure Appl. Phys. **8**, 670–671 (1970).

[20] Sherman, N. K., Lokan, K. H., Hutcheon, R. M., Funk, L. W., Brown, W. R., and Brown, P., Bull. Am. Phys. Soc. (Ser. II) **19**, 110 (1974); Med. Phys. **1**, 185–192 (1974).

[21] Sherman, N. K., paper pres. at the 4th Sem. on Electromagnetic Interactions of Nuclei at Low and Intermediate Energies, Moscow, Dec. 13–15 (1977).

[22] Sherman, N. K., Lokan, K. H., Ross, C. K., and Carlos, P., private communication; Sherman, N. K., Ross, C. K., and Lokan, K. H., Phys. Rev. *C21*, 2328–2341 (1980).

[23] Sugiyama, S., Res. Electrotech. Lab., No. 744 (1974), 56 pages.

[24] Grodstein, G. W., Natl. Bur. Stand. (U.S.) Circ. 583 (1957), 54 pages.

[25] McGinnies, R. T., Suppl. to Natl. Bur. Stand. (U.S.) Circ. 583 (1959), 10 pages.

[26] Hubbell, J. H., Natl. Stand. Ref. Data Ser., NSRDS-NBS 29 (1969) 80 pages.

[27] Borie, E., and Arenhövel, H., Z. Phys. **255**, 459–463 (1972).

[28] Borie, E., Grossetete, B., Parizet, M.-J., and Isabelle, D. B., to be published.

[29] Dugne, J. J., Phys. Lett. **A56**, 27–28 (1976).

[30] Knasel, T. M., Phys. Rev. **171**, 1643–1647 (1968).

[31] Knasel, T. M., Deutsches Elektronen-Synchrotron (Hamburg) reports DESY 70/2 (Pt. I), 1970, 10 pages; DESY 70/3 (Pt. II), 1970, 15 pages.

[32] Knasel, T. M., Nucl. Instrum. Methods **83**, 217–220 (1970).

[33] Maximon, L. C., Natl. Bur. Stand. (U.S.) Tech. Note 955 (1977), 51 pages.

[34] Maximon, L. C., and Gimm, H. A., Natl. Bur. Stand. (U.S.) unpubl. rep. NBSIR 78-1456 (1978), 32 pages.

[35] Øverbø, I., Mork, K. J., and Olsen, H. A., Phys. Rev. **175**, 1978–1981 (1968).

[36] Øverbø, I., Mork, K. J., and Olson, H. A., Phys. Rev. **A8**, 668–685 (1973); Øverbø, I., Thesis, Arkiv for Det Fysiske Seminar i Trondheim, No. 9, 1970 (unpublished), 170 pages.

[37] Øverbø, I., Nuovo Cimento A **47**, 43–58 (1978).

[38] Øverbø, I., Physica Scripta **19**, 299–306 (1979).

[39] Øverbø, I., Phys. Lett. **B71**, 412–414 (1977).

[40] Proriol, J., Lett. Nuovo Cimento **3**, 251–253 (1972).

[41] Tsai, Y.-S., Rev. Mod. Phys. **46**, 815–851 (1974).

[42] Tseng, H. K., and Pratt, R. H., Phys. Rev. **A4**, 1835–1843 (1971).

[43] Tseng, H. K., and Pratt, R. H., Phys. Rev. **A6**, 2049–2056 (1972); see also Phys. Rev. **A21**, 454–457 (1980).

[44] Fink, J. K., and Pratt, R. H., Phys. Rev. **A7**, 392–403 (1973).

[45] Motz, J. W., Olsen, H. A., and Koch, H. W., Rev. Mod. Phys. **41**, 581–639 (1969).

[46] Storm, E., Israel, H. I., At. Data Nuclear Data Tables **A7**, 565–681 (1970).

[47] Bigge, F., and Lighthill, R., Sandia Labs. (Albuquerque) report SC-RR-71 0507 (1971), 143 pages.

[48] Knipe, A. D., United Kingdom Atomic Energy Authority (Winfrith) report AEEW-M-1368 (1975), 63 pages.

[49] Plechaty, E. F., Cullen, D. E., and Howerton, R. J., Lawrence Livermore Lab. (Univ. Calif., Livermore) report UCRL-50400, Vol. 6, Rev. 2 (1978), 530 pages.

[50] Hayward, E., Natl. Bur. Stand. (U.S.) Monogr. 118 (1970), 46 pages.

[51] Berman, B. L., and Fultz, S. C., Rev. Mod. Phys. **47**, 713–761 (1975).

[52] CODATA Task Group on Fundamental Constants (E. R. Cohen, Chmn.), CODATA (ICSU CODATA Central Office, Frankfurt am Main, Germany) Bulletin No. 11 (Dec. 1973) 8 pages. See also Cohen, E. R., At. Data Nucl. Data Tables **18**, 587–594 (1976).

[53] Cohen, E. R., and Taylor, B. N., J. Phys. Chem. Ref. Data **2**, 663–734 (1973).

[54] Bethe, H. A., and Heitler, W., Proc. R. Soc. London **A146**, 83–112 (1934).

[55] Heitler, W., and Sauter, F., Nature (London) **132**, 892 (1933).

[56] Racah, G., Nuovo Cimento **11**, 461–476 (1934); **11**, 477–481 (1934); **13**, 66–73 (1936).

[57] Maximon, L. C., J. Res. Natl. Bur. Stand., Sect. B, **72**, 79–88 (1968).

[58] Bethe, H. A., and Maximon, L. C., Phys. Rev. **93**, 768–784 (1954).

[59] Davies, H., Bethe, H. A., and Maximon, L. C., Phys. Rev. **93**, 788–795 (1954).

[60] Sørenssen, A., Nuovo Cimento **38**, 745–770 (1965); **41**, 543–558 (1966).

[61] Maximon, L. C., in Koch, H. W., Nucl. Instrum. Methods **28**, 199–204 (1964).
[62] Gimm, H. A., to be published.
[63] Bethe, H. A., Proc. Cambridge Philos. Soc. **30**, 524–539 (1934).
[64] Hubbell, J. H., Veigele, Wm. J., Briggs, E. A., Brown, R. T., Cromer, D. T., and Howerton, R. J., J. Phys. Chem. Ref. Data **4**, 471–538 (1975); erratum in **6**, 615–616 (1977).
[65] Hubbell, J. H., and Øverbø, I., J. Phys. Chem. Ref. Data **8**, 69–105 (1979).
[66] Thomas, L. H., Proc. Cambridge Philos. Soc. **23**, 542–548 (1927).
[67] Fermi, E., Z. Phys. **48**, 73–79 (1928).
[68] Wheeler, J. A., and Lamb, W. E., Phys. Rev. **55**, 858–862 (1939); erratum in Phys. Rev. **101**, 1836 (1956).
[69] Molière, G., Z. Naturforsch. **2a**, 133–145 (1947).
[70] Hanson, H. P., Herman, F., Lea, J. D., and Skillman, S., Acta Crystallogr. **17**, 1040–1044 (1964).
[71] Doyle, P. A., and Turner, P. S., Acta Crystallogr. **A24**, 390–397 (1968).
[72] Cromer, D. T., and Waber, J. T., Sec. 2.2 of *International Tables for X-Ray Crystallography*, Vol. IV, Ibers and Hamilton, eds. (Kynoch Press, Birmingham, England 1974) pages 71–147.
[73] Øverbø, I., Nuovo Cimento **40B**, 330–338 (1977); Physica Scripta **17**, 547–548 (1978).
[74] Spencer, L. V., Vol. I of *Radiation Shielding*, Kimel, W. R., ed., Office of Civil Defense and Kansas State Univ. Rep. TR-40 (1966), page I-265.
[75] Bjorken, J. D., unpublished work (1960).
[76] von Gehlen, G., Phys. Rev. **118**, 1455–1457 (1960).
[77] Drell, S. D., and Walecka, J. D., Ann Phys. (N.Y.) **28**, 18–23 (1964).
[78] Jost, R., Luttinger, J. M., and Slotnick, M., Phys. Rev. **80**, 189–196 (1950).
[79] Borsellino, A., Phys. Rev. **89**, 1023–1025 (1953): correction to ref. [78] in footnote 6.
[80] Euler, L., *Institutiones Calculi Integralis*, Vol. I (1768), pages 110–113.
[81] Lewin, L., *Dilogarithms and Associated Functions* (MacDonald, London, 1958), pages 1–32.
[82] Spence, W., *An Essay on the Theory of the Various Orders of Logarithmic Transcendents* (Murray, London, and Constable and Co., Edinburgh, 1809), 128 pages.
[83] Kohn, W., and Sham, L. J., Phys. Rev. **A140**, 1133–1138 (1965).
[84] Gáspár, R., Acta Phys. Acad. Sci. Hung. **3**, 263–286 (1954).
[85] Feyman, R. P., Phys. Rev. **76**, 749–759 (1949).
[86] Bjorken, J. D., Drell, S. D., and Frautschi, S. C., Phys. Rev. **112**, 1409–1417 (1958).
[87] Fomin, P. I., Zh. Eksp. Teor. Fiz. **34**, 227–228 (1958); transl. in Sov. Phys.-JETP **7**, 156–157 (1958).
[88] Fomin, P. I., Zh. Eksp. Teor. Fiz. **35**, 707–718 (1958); transl. in Sov. Phys.-JETP **8**, 491–498 (1959).
[89] Guzenko, S. Ya., and Fomin, P. I., Zh. Eksp. Teor. Fiz. **38**, 513–517 (1960); transl. in Sov. Phys.-JETP **11**, 372–374 (1960).
[90] De Tollis, B., Lasinio, G. J. and Liotta, R. S., Nuovo Cimento **18**, 545–553 (1960).
[91] Mork, K., and Olsen, H., Nuovo Cimento **18**, 395–396 (1960).
[92] Mork, K., and Olsen, H., Phys. Rev. **140**, B1661–B1674 (1965); erratum in **166**, 1862 (1968); See also corrections to this work in Vinokurov, E. A., Kuraev, E. A., and Merenkov, N. P., Zh. Eksp. Teor. Fiz. **66**, 1916–1925 (1974); transl. in Sov. Phys.-JETP, **39**, 942–945 (1974).
[93] Olsen, H. A., in Höhler, G., ed., *Springer Tracts in Modern Physics*, Vol. 44 (Springer: Berlin/Heidelberg/New York 1968), p. 190.
[94] Dzhilkibaev, R. M., Kuraev, E. A., Fadin, V. S. and Khoze, V. A., Yad. Fiz. **19**, 699–703 (1974); transl. in Sov. J. Nucl. Phys. **19**, 353–355 (1974).
[95] Corbò, G., Phys. Rev. D, **17**, 725–728 (1978).
[96] Lervik, R., and Mork, K. J., to be published.
[97] Borsellino, A., Helv. Phys. Acta **20**, 136–138 (1947); Nuovo Cimento **4**, 112–130 (1947); Rev. Univ. Nac. Tucumán, **A6**, 7–35 (1947).
[98] Mork, K. J., Phys. Rev. **160**, 1065–1071 (1967).
[99] Suh, K. S., and Bethe, H. A., Phys. Rev. **115**, 672–677 (1959).
[100] Ghizzetti, A. G., Rev. Univ. Nac. Tucumán **A6**, 37–50 (1947).
[101] Votruba, V., Phys. Rev. **73**, 1468 (1948); Bull. Int. Acad. Tchèque Sci. **49**, 19–49 (1948).
[102] Haug, E., Z. Naturforsch. **30a**, 1099–1113 (1975).
[103] Heisenberg, W., Phys. Z. **32**, 737–740 (1931).
[104] Bewilogua, L., Phys. Z. **32**, 740–744 (1931).
[105] Brown, R. T., Phys. Rev. **A1**, 1342–1347 (1970); **A2**, 614–620 (1970); **A5**, 2141–2144 (1972); **A10**, 438–439 (1974).
[106] Cromer, D. T., and Mann, J. B., J. Chem. Phys. **47**, 1892–1893 (1967).
[107] Cromer, D. T., J. Chem. Phys. **50**, 4857–4859 (1969).
[108] Cromer, D. T., personal communication to Wm. J. Veigele.
[109] Maximon, L. C., and Gimm, H. A., to be published.
[110] Nelms, A. T., Nat. Bur. Stand. (U.S.), Circ. 542 (1953), 89 pages.
[111] Evans, R. D., in Flügge (ed.), Encyclopedia of Physics, Vol. 34 (Springer, Berlin/Göttingen/Heidelberg, 1958), pages 218–298.
[112] Roy, R. R., and Reed, R. D., *Interactions of Photons and Leptons with Matter* (Academic Press, New York/London 1968), pages 183–203.
[113] Compton, A. H., Phys. Rev. **21**, 483–502 (1923).
[114] Debye, P., Phys. Z. **24**, 161–166 (1923).
[115] Brown, L. M., and Feyman, R. P., Phys. Rev. **85**, 231–244 (1952).
[116] Mork, K. J., Phys. Rev. **A4**, 917–927 (1971).
[117] Frolov, G. V., Yad. Fiz. **17**, 355–359 (1973); transl. in Sov. J. Nucl. Phys. **17**, 180–182 (1973).
[118] Ram, M., and Wang, P. Y., Phys. Rev. Lett. **26**, 476–479 (1971); erratum in **26**, 1210 (1971).
[119] Smirnov, A. I., Izv. Vyssh. Uchebn. Zaved., Fiz., No. 3, 158–159 (1973), transl. in Sov. Phys. J. **16**, 443–444 (1973).
[120] Klein, O., and Nishina, Y., Z. Physik **52**, 853–868 (1929).
[121] Eisenberger, P., and Platzman, P. M., Phys. Rev. **A2**, 415–423 (1970).
[122] Cooper, M. Adv. Phys. **20**, 453–491 (1971).
[123] Tseng, H. K., Gavrila, M., and Pratt, R. H., unpublished work (Report No. 2) sponsored at the Univ. of Pittsburgh by the NBS (May 1973).
[124] Strutt, J. W. (Lord Rayleigh), Phil. Mag. **41** (4th Ser.), 107–120, 274–279 (1871).
[125] Rayleigh, J. W. S. (Lord), *Theory of Sound*, 2nd ed. (Macmillan, London, 1894–1896), page 323.
[126] Delbrück, M., in Meitner, L. and Kösters, H., Z. Physik **84**, 137–144 (1933).
[127] Dyson, N. A., *X-Rays in Atomic and Nuclear Physics* (Longman, London, 1973), pages 228–237.
[128] Papatzacos, P., Thesis, Ark. Det Fys. Sem. Trondheim (Norway) No. 5, 1974 (unpublished), 255 pages.
[129] Papatzacos, P., and Mork, K., Phys. Rep. **21C**, 81–118 (1975).
[130] Jauch, J. M., and Rohrlich, F., *The Theory of Photons and Electrons*, 2nd ed. (Springer, New York/Heidelberg/Berlin, 1976), pages 379–389.
[131] Thomson, J. J., *Conduction of Electricity through Gases*, 2nd ed. (Cambridge Univ. Press, 1906), pages 321–331.

[132] Scofield, J. H., Lawrence Livermore Lab. Rep. UCRL-51326 (1973), 375 pages.
[133] Hubbell, J. H., and Veigele, Wm. J., Nat. Bur. Stand. (U.S.), Tech. Note 901 (1976), 43 pages.
[134] Pratt, R. H., Phys. Rev. **117**, 1017–1028 (1960).
[135] Fuller, E. G., and Hayward, E. (eds.), *Photonuclear Reactions* (Dowden, Hutchinson and Ross, Stroudsburg, Pa. 1976) 427 pages.
[136] Fuller, E. G., Gerstenberg, H. M., Vander Molen, H., and Dunn, T. C., Nat. Bur. Stand. (U.S.), Spec. Publ. 380 (1973), 131 pages.
[137] Berman, B. L., At. Data Nucl. Data Tables **15**, 319–390 (1975).
[138] Fuller, E. G., and Hayward, E., in Endt, O. M., and Smith, P. B. (eds.), Nuclear Reactions, Vol. 2, Ch. 3, Amsterdam: North Holland Publ. 1962.
[139] Armstrong, T. A., et al., Nucl. Phys. **B41**, 445–473 (1972).
[140] Ahrens, J., et al., in *Photopion Nuclear Physics*, P. Stoher, ed. (Plenum Publ., N.Y., 1979) page 385.
[141] Vlasenka, V. G. et al, Yad. Fis. **23**, 504–511 (1976); transl. in Sov. J. Nucl. Phys. **23**, 265–269 (1976); also in *Photonuclear Reactions* II, Vol. 62 of Lecture Notes in Physics (Springer Verlag, Berlin/Heidelberg/New York 1977) page 216.
[142] Fuller, E. G., and Gerstenberg, H. M., Nat. Bur. Stand. (U.S.) Spec. Publ. 380, Suppl. 1 (1978), 102 pages.
[143] Commission on Atomic Weights, IUPAC (Titular Members: Chmn.: Roth, E., Sec. (prepared report for publication): Holden, N. E., Barnes, I. L., DeBièvre, P., Johnson, W. H., Martin, R. L., Thode, H. G., and Wapstra, A. H.), Pure Appl. Chem. **51**, 405–433 (1979).
[144] Commission on Atomic Weights, IUPAC, News release to editors of Inorganic Chemistry Journals (September 1979).
[145] Wapstra, A. H., and Bos. K., At. Data Nucl. Data Tables **19**, 177–214 (1977).
[146] Holden, N. E., private communication (January 1978) to the Commission on Atomic Weights, IUPAC.