Recommended Rest Frequencies for Observed Interstellar Molecular Microwave Transitions—1991 Revision

Cite as: Journal of Physical and Chemical Reference Data **21**, 181 (1992); https://doi.org/10.1063/1.555920
Submitted: 04 December 1991 . Published Online: 15 October 2009

F. J. Lovas

Recommended Rest Frequencies for Observed Interstellar Molecular MicrowaveTransitions—1991 Revision

Frank J. Lovas

Molecular Physics Division, National Institute of Standards and Technology, Gaithersburg, MD 20899

Received December 4, 1991; revised manuscript received January 14, 1992

Critically evaluated transition frequencies for the molecular transitions detected in interstellar and circumstellar clouds are presented. The tabulated transitions are recommended for reference in future astronomical observations in the microwave and millimeter wavelength regions. The transition frequencies have been selected through a critical examination and analysis of the laboratory spectral data obtained from the literature. The information tabulated includes the species identity, transition frequency, uncertainty, and quantum state labels. In addition, representative line antenna temperatures are listed for a typical astronomical source for each transition as a convenience to users, and the references are cited for the laboratory and astronomical literature which have been employed.

Key words: hyperfine structure; interstellar molecules; microwave spectra; molecular; radio astronomy; rotational spectra; spectra.

Contents

List of Tables

1. Introduction

The present tabulation of recommended transition frequencies for interstellar molecular species is the second revision of the previously published tables.[1,2] Since the last revision in 1985, approximately 1700 new transitions have been detected and 24 new molecular species have been identified. This report updates the previous summaries, provides a current source of radio-astronomical molecular line observations, and includes improved accuracy for many previously tabulated transition frequencies, which is important for determining physical properties of the molecular clouds investigated.

2. Source and Selection of the Transition Frequencies

The present tabulation covers the astronomical literature through the fall of 1991. About 80 molecular species, listed in Table 1, have now been identified in interstellar and circumstellar astronomical sources by means of their microwave spectrum. The sources of the transition frequencies selected are: laboratory measurement literature, previously published tabulations of spectral frequencies[3–24], or spectral prediction of transition frequencies from reanalysis of the literature data carried out for the present work.

The primary criterion for selection of the transition frequencies is the magnitude quoted or estimated for the accuracy of the measured frequency or the standard deviation of calculated frequencies. For well behaved species, i.e. those whose spectra can be fit well with established Hamiltonians, the calculated frequencies are often more accurate than individual measurements. For this reason many of the entries in Table 2 are calculated values and are identified with an asterisk (*) following the frequency entry. In entries where it was determined that the measured value was the most accurate value, a reference to the literature value is given.

For many of the interstellar species the previously published tabulations of critically evaluated laboratory data[3-26] were the source of both measured and calculated frequencies cited here. In several cases for species treated in the publications indicated above, new spectral data have been reported and have been combined with the earlier data sets and reanalyzed to provide predicted frequencies employed here. For CH_3CN, data from two recent publications[27,28] were used in a new analysis. For cyclic-C_3H_2 and C_6H, the data tabulated in Ref. 26 were used. The earlier reviews on CH_3OH[5], CH_3CHO[11], and $HCOOCH_3$[18] are out-dated. A series of papers on new measurements and spectral analyses of ground and torsionally excited CH_3OH have been reported by DeLucia and co-workers, with the following references in the list of references to Table 5: [Her84], [And87], [DeL89] and [And90] (note that this reference notation employs the first three letters of the first author's last name and the last two digits of the year of publication). For the ground torsional state of CH_3CHO the recent report by Kleiner *et al.* [Kle91] was the source of measured and calculated frequencies. Similarly, for $HCOOCH_3$ a series of publications by Plummer *et al.* [Plu84], [Plu86], and [Plu87] were employed.

Since 24 new interstellar species are represented in the present work, a summary of the literature sources for the measurements cited and for spectral predictions is given below. The data for AlCl, AlF, KCl, NaCl and PN were derived from the compilation by Lovas and Tiemann[25] and refit for predictions. Laboratory measurements on SiC were reported by Cernicharo *et al.* [Cer89]. Several ionic species have been identified based on recent laboratory studies, namely, $HOCO^+$, $HOCS^+$ and $HCNH^+$. The analysis of $HOCO^+$ is based on data from two paper by Bogey at al.[29,30], the tenative identification of $HOCS^+$ is based on calculations reported by Nakanaga and Amano[31], and the laboratory spectrum of $HCNH^+$ is reported by Bogey *et al.* [Bog85a]. Laboratory studies of the following free radical and transient species are cited: C_2S [Yam90]; C_3O [Bro83,Kle85], and Tang *et al.*[32]; C_3S [Yam87]; HCCN from Saito *et al.*[33]; CH_2CN [Sai88, Irv88a]; ℓ-HC_3 (here ℓ stands for linear-HC_3 and c-HC_3 referred to below is the cyclic isomer) [Got85] and Yamamoto *et al.*[34]; c-HC_3 [Yam87]; CH_2CC [Vrt90]; CH_2CCC [Kil90]; C_5H [Cer87, Cer86a, Got86]; and SiC_2 [Got89, Sue89, Cer90]. For the tentatively identified species SiC_4 [Ohi89] no laboratory confirmation has been reported. Literature references for newly identified stable species are: CH_3NC[35-37]; CH_3COCH_3 [Vac86]; and $HCCCHO$[38-41].

3. Description of the Tables

As mentioned above, Table 1 provides the identity of molecular species detected in astronomical sources. The species which are new, i.e. identified since the 1985 revision of this compilation, appear in bold typeface. For many of the species one or more isotopically substituted forms or vibrational states have been observed and these are listed as well in Table 1. The species are listed in alphabetic sequence according to empirical formula (Hill system) in the first column along with the common names of the molecule in the second column. The last column of Table 1 indicates the number of entries for a given species listed in Table 5 where specific frequencies and references to literature sources are provided. In Tables 2, 3, and 4 additional information regarding the data entries in Table 5 is given. Tables 2 and 3 are discussed further in Sec. 3.1.

The major emphasis of the present work is to provide the most accurate transition frequencies available for all of the astronomically observed spectral lines which are listed in Table 5. In Table 5 the recommended frequency is listed in column (1), followed by an asterisk in the case of calculated values, and its uncertainty (2σ) is shown in parentheses in column (2) with the number of digits referring to the last digit(s) given for the frequency. The chemical formula for each molecular species is given in column (3) and the quantum number labels are shown in column (4). Columns (5), (6), and (7) present astronomical information: antenna temperature (T_r^* or T_a^*), molecular cloud for the observation and abbreviation for the telescope employed (see Table 3 for a list of telescopes referenced), respectively. Most often the molecular cloud listed is Orion A (OriMC-1), Sagittarius B2 (SgrB2), Taurus Molecular Cloud 1 (TMC-1), or the circumstellar envelope of the infrared star IRC+10216, since these are the richest molecular sources and often provide the most intense emission lines. In column (8) the reference abbreviation for the astronomical observation is given and column (9) shows the reference to measured (or calculated) frequencies when taken from the literature. The reference code is based on the first three letters of the lead author's last name, plus the last two digits of the year of publication. If no laboratory reference appears, the frequencies presented are either calculated in the present work or were taken from the previously published spectral reviews[3-24]. The reference list for Table 5 then follows and Table 4 identifies the telescope abbreviations in Table 5.

3.1. Comments on the Tables

Since the last revision a number of previously unidentified lines have been assigned to newly identified species or transitions of already established species. In these cases the new identification (or assignment) is given and the previous frequency proceeded by "U" is eliminated. These new assignments are listed in Table 2, to the best of our ability to keep track of these changes. All previous entries which have been modified in any manner, e.g. improved frequency, are indicated with the letter M (for modified) at the end of the entry in Table 5 and new entries have the letter N (for new) in the last column.

The identification of the HNO and NaOH species were under question at the time of the last publication. Recently new measurements at higher frequency have confirmed the HNO identification, while the feature

attributed to NaOH is now assigned to CH_3NC. Three doublets which are harmonically related have been reported by Guélin *et al.* [Gué86] in IRC+10216. These workers suggested several species which might be the molecular source of these transitions, and we have used HSiCC as a label since the strongest arguments favor this identification. The suggested identifications of three species, HOC^+ [Woo83], $HOCS^+$ [Tur89], and HCl [Bla85b], are based on the observation of a single transition. Since there have been no supporting observations of other transitions or isotopic forms, these identifications remain questionable. This is indicated in the tables with a question mark following the molecular formula. It is quite likely that the feature attributed to HOC^+ at 89487.4 MHz arises from $^{28}Si^{33}S$ at 89489.2 MHz. The user is also encouraged to examine the comments to the prior publications[1,2], since these are not reproduced here, but these comments are still valid for the information presented in the present work.

A rather extensive survey of the SgrB2 and Orion A (OriMC-1) molecular clouds was published recently in two parts by B. E. Turner [Tur89 and Tur91]. A number of the preliminary species identifications or assignments given in the first paper [Tur89] were determined to be unlikely identifications after Turner completed the data analysis presented in the second paper [Tur91]. In the cases where the observed lines remain unassigned, i.e. unidentified molecular species, they are listed as "reassigned" in Table 5. Since Turner [Tur91] did not list a number of these "reassigned" transitions in his Table 2 which contains unidentified lines not attributed as such in Tur89, we provide a list of these here in Table 3. For a few entries in Table 3, the author felt that the assignments given in Tur91 were unlikely, or unverified by detections of other transitions of the type assigned. In particular the a-type transitions of CH_3CH_2OH and CH_3CH_2CN seem unlikely due to their small transition moments. These are listed in Tables 3 and 5 as unidentified, even though the assignments in Tur91 remained as given in the first paper [Tur89].

4. Acknowledgments

The author is pleased to acknowledge the following astronomers for providing preprints or unpublished observations: J.M. Hollis, L.E. Snyder, B.E. Turner, and L.M. Ziurys. The author also thanks Mrs. G. Rotter for coding much of the spectral data in Table 5.

5. References to Text

[1]Recommended Rest Frequencies for Observed Interstellar Molecular Transitions. F. J. Lovas, L. E. Snyder, and D. R. Johnson, Astrophys. J. Suppl. Series **41**, 451–480 (1979).

[2]Recommended Rest Frequencies for Observed Interstellar Molecular Microwave Transitions – 1985 Revision. F. J. Lovas, J. Phys. Chem. Ref. Data **15**, 251–303 (1986). Erratum: J. Phys. Chem. Ref. Data **16**, 153–154 (1987).

[3]Microwave Spectra of Molecules of Astrophysical Interest, I. Formaldehyde, Formamide, and Thioformaldehyde. D. R. Johnson, F. J. Lovas, and W. H. Kirchhoff, J. Phys. Chem. Ref. Data **1**, 1011–1046 (1972).

[4]Microwave Spectra of Molecules of Astrophysical Interest, II. Methylenimine. W. H. Kirchhoff, D. R. Johnson, and F. J. Lovas, J. Phys. Chem. Ref. Data **2**, 1–10 (1973).

[5]Microwave Spectra of Molecules of Astrophysical Interest, III. Methanol. R. M. Lees, F. J. Lovas, W. H. Kirchhoff, and D. R. Johnson, J. Phys. Chem. Ref. Data **2**, 205–214 (1973).

[6]Microwave Spectra of Molecules of Astrophysical Interest, IV. Hydrogen Sulfide. P. Helminger, F. C. DeLucia, and W. H. Kirchhoff. J. Phys. Chem. Ref. Data **2**, 215–224 (1973).

[7]Microwave Spectra of Molecules of Astrophysical Interest, V. Water Vapor. F. C. DeLucia, P. Helminger, and W. H. Kirchhoff, J. Phys. Chem. Ref. Data **3**, 211–219 (1974).

[8]Microwave Spectra of Molecules of Astrophysical Interest, VI. Carbonyl Sulfide and Hydrogen Cyanide. A. G. Maki, J. Phys. Chem. Ref. Data **3**, 221–244 (1974).

[9]Microwave Spectra of Molecules of Astrophysical Interest, VII. Carbon Monoxide, Carbon Monosulfide, and Silicon Monoxide. F. J. Lovas, and P. Krupenie, J. Phys. Chem. Ref. Data **3**, 245–257 (1974).

[10]Microwave Spectra of Molecules of Astrophysical Interest, VIII. Sulfur Monoxide. E. Tiemann, J. Phys. Chem. Ref. Data **3**, 259–268 (1974).

[11]Microwave Spectra of Molecules of Astrophysical Interest, IX. Acetaldehyde. A. Bauder, F. J. Lovas, and D. R. Johnson, J. Phys. Chem. Ref. Data **5**, 53–77 (1976).

[12]Microwave Spectra of Molecules of Astrophysical Interest, X. Isocyanic Acid. G. Winnewisser, W. H. Hocking, and M. C. L. Gerry, J. Phys. Chem. Ref. Data **5**, 79–101 (1976).

[13]Microwave Spectra of Molecules of Astrophysical Interest, XI. Silicon Sulfide. E. Tiemann, J. Phys. Chem. Ref. Data **5**, 1147–1156 (1976).

[14]Microwave Spectra of Molecules of Astophysical Interest, XII. Hydroxyl Radical. R. A. Beaudet and R. L. Poynter, J. Phys. Chem. Ref. Data **7**, 311–362 (1978).

[15]Microwave Spectra of Molecules of Astrophysical Interest. XIII. Cyanoacetylene. W. J. Lafferty and F. J. Lovas, J. Phys. Chem. Ref. Data **7**, 441–493 (1978).

[16]Microwave Spectra of Molecules of Astrophysical Interest. XIV. Vinyl Cyanide (Acrylonitrile). M. C. L. Gerry, K. Yamada, and G. Winnewisser, J. Phys. Chem. Ref. Data **8**, 107–123 (1979).

[17]Microwave Spectra of Molecules of Astrophysical Interest. XV. Propyne. A. Bauer, D. Boucher, J. Burie, J. Demaison, and A. Dubrulle, J. Phys. Chem. Ref. Data **8**, 537–558 (1979).

[18]Microwave Spectra of Molecules of Astrophysical Interest. XVI. Methyl Formate. A. Bauder, J. Phys. Chem. Ref. Data **8**, 583–618 (1979).

[19]Microwave Spectra of Molecules of Astrophysical Interest. XVII. Dimethyl Ether. F. J. Lovas, H. Lutz and H. Dreizler, J. Phys. Chem. Ref. Data **8**, 1051–1107 (1979).

[20]Microwave Spectra of Molecules of Astrophysical Interest. XVIII. Formic Acid. E. Willemot, D. Dangoisse, N. Mannanteuil, and J. Bellet. J. Phys. Chem. Ref. Data **9**, 59–160 (1980).

[21]Microwave Spectra of Molecules of Astrophysical Interest. XIX. Methyl Cyanide. D. Boucher, J. Burie, A. Bauer, A. Dubrulle, and J. Demaison. J. Phys. Chem. Ref. Data **9**, 659–734 (1980).

[22]Microwave Spectra of Molecules of Astrophysical Interest. XX. Methane. I. Ozier, M. C. L. Gerry, and A. G. Robiette. J. Phys. Chem. Ref. Data **10**, 1085–1095 (1981).

[23]Microwave Spectra of Molecules of Astrophysical Interest. XXI. Ethanol (C_2H_5OH) and Propionitrile (C_2H_5CN). F. J. Lovas, J. Phys. Chem. Ref. Data **11**, 251–312 (1982).

[24]Microwave Spectra of Molecules of Astrophysical Interest. XXII. Sulfur Dioxide (SO_2). F. J. Lovas, J. Phys. Chem. Ref. Data **14**, 395–488 (1985).

[25]Microwave Spectral Tables I. Diatomic Molecules. F. J. Lovas, and E. Tiemann, J. Phys. Chem. Ref. Data **3**, 609 (1974).

[26]Microwave Spectral Tables III. Hydrocarbons, CH to $C_{10}H_{10}$. F. J. Lovas, and R. D. Suenram, J. Phys. Chem. Ref. Data **18**, 1245 (1989).

[27]The Submillimeter-wave Rotational Spectrum of Methyl Cyanide: Analysis of the Ground and the Low-lying Excited Vibrational States. R. Bocquet, G. Wlodarczak, A. Bauer, and J. Demaison, J. Mol. Spectrosc. **127**, 382 (1988).

[28]The Rotational Spectrum of CH_3CN above 1000 GHz. F. X. Brown, D. Dangoisse, and J. Demaison, J. Mol. Spectrosc. **129**, 483 (1988).

[29]The Submillimeter Wave Spectrum of the Protonated and Deuterated Carbon Dioxide. M. Bogey, C. Demuynck, and J.-L. Destombes, J. Chem. Phys. **84**, 10 (1986).

[30]Molecular Structure of $HOCO^+$. M. Bogey, C. Demuynck, J.-L. Destombes and A. Krupnov, J. Mol. Spectrosc. **190**, 465 (1988).

[31]High Resolution Infrared Identification of $HOCS^+$ with Difference Frequency Laser Spectroscopy, T. Nakanaga and T. Amano, Mol. Phys. **61**, 313 (1987).

[32]CCCO: Generation by dc Glow Discharge in Carbon Suboxide, and Microwave Spectrum. T. B. Tang, H. Inokuchi, S. Saito, C. Yamada, and E. Hirota, Chem. Phys. Lett. **116**, 83 (1985).

[33]The Microwave Spectrum of a Triplet Carbene: HCCN in the $X^3\Sigma$ State. S. Saito, Y. Endo, and E. Hirota, J. Chem. Phys. **80**, 1427 (1984).

[34]Laboratory Microwave Spectrum of the Linear C_3H and C_3D Radicals and Related Astronomical Observation. S. Yamamoto, S. Saito, H. Suzuki, S. Deguchi, N. Kaifu, S.-I. Ishikawa, and M. Ohishi, Astrophys. J. **384**, 363 (1990).

[35]Spectre de Rotation de la Carbylamine dans l'etat fondamental de vibration. A. Bauer and M. Bogey, C. R. Acad. Sci. Paris B **271**, 892 (1970).

[36]High Resolution Measurements of Hyperfine Structure in the Rotational Spectrum of CH_3NC. S. G. Kukolich, J. Chem. Phys. **57**, 869 (1972).

[37]M. Gordon, PhD Thesis, University of Lille, 1974.

[38]Microwave Spectrum of Propiolic Aldehyde. J. A. Howe and J. H. Goldstein, J. Chem. Phys. **23**, 1223 (1955).

[39]Microwave Spectrum and Structure of Propynal (HCCCHO). C. C. Costain and J. R. Morton, J. Chem. Phys. **31**, 389 (1959).

[40]The Molecular g Values, Magnetic Susseptibility Anisotropies, and Molecular Quadrupole Moments in Propynal. R. C. Benson, R. S. Scott, and W. H. Flygare, J. Phys. Chem. **73**, 4359 (1969).

[41]The Ground State of Propynal. G. Winnewisser, J. Mol. Spectrosc. **46**, 16 (1973).

TABLE 1. Listing by empirical formula of the isotopic forms of the interstellar species appearing in Table 5

Emperical formula	Name	Isotopic species	Number of observed transitons gnd/excited[b]
AlCl	**Aluminum monochloride**	**AlCl**	**4**
		Al^{37}Cl	**2**
AlF	**Aluminum monofluoride**	**AlF**	**3**
CH	Methylene radical	CH	7
CHN	Hydrogen cyanide	HCN	6/ 8 ex.
		H^{13}CN	3
		HC^{15}N	3
		DCN	6
CHN	Hydrogen isocyanide	HNC	3
		H^{15}NC	1
		HC^{13}C	4
		DNC	3
		D^{15}NC	1
CHNO	Isocyanic acid	HNCO	35
		DNCO	1
CHNS	Thioisocyanic acid	HNCS	10
CHO	Formyl radical	HCO	9
CHO$^+$	Formylium	HCO$^+$	3
		H^{13}CO$^+$	4
		HC^{17}O$^+$	1
		HC^{18}O$^+$	2
		DCO$^+$	3
		D^{13}CO$^+$	1
CHO$^+$?	HOC$^+$ ion	HOC$^+$	1
CHOS$^+$?	**HOCS$^+$ ion**	**HOCS$^+$**	**1**
CHO_2^+	HOCO$^+$ ion	HOCO$^+$	3
CHS$^+$	Thioformylium	HCS$^+$	5
CH_2	**Methylene radical**	**CH_2**	**3**
CH_2N^+	Protonated hydrogen cyanide	HCNH$^+$	3
CH_2N_2	Cyanamide	NH_2CN	12
CH_2O	Formaldehyde (methanal)	H_2CO	27
		$H_2{}^{13}CO$	17
		$H_2C^{18}O$	5
		HDCO	9
		D_2CO	3
CH_2O_2	Formic acid	HCOOH	26
		H^{13}COOH	1
		HCOOD	2
		DCOOH	1
CH_2S	Thioformaldehyde	H_2CS	28
		$H_2{}^{13}CS$	3
		$H_2C^{34}S$	2
CH_3N	Methylenimine	CH_2NH	6
		$^{13}CH_2NH$	1
CH_3NO	Formamide	NH_2CHO	48
		$NH_2{}^{13}CHO$	1
CH_4O	Methanol (methyl alcohol)	CH_3OH	270
		$^{13}CH_3OH$	49
		CH_3OD	22
CH_4S	Methyl mercaptan (methanethiol)	CH_3SH	20
CH_5N	Methylamine	CH_3NH_2	12
CN	Cyanogen radical	CN	21
		^{13}CN	3
CO	Carbon monoxide	CO	16
		^{13}CO	6
		C^{17}O	3
		C^{18}O	2
		^{13}C^{18}O	1
COS	Carbonyl sulfide	OCS	19
		OC^{34}S	7
		O^{13}CS	6

TABLE 1. Listing by empirical formula of the isotopic forms of the interstellar species appearing in Table 5 – Continued

Emperical formula	Name	Isotopic species	Number of observed transitons gnd/excited[b]
CS	Carbon monosulfide	CS	7/ 2 ex.
		C^{33}S	4
		C^{34}S	7
		^{13}CS	4
		^{13}C^{34}S	1
CSi	**Silicon monocarbide**	**SiC**	**7**
C_2H	Ethynyl radical	HCC	14
		DCC	3
C_2HN	**HCCN radical**	**HCCN**	**10**
C_2HSi[b]	**HCCSi radical[b]**	**HCCSi[b]**	**6**
C_2H_2O	Ketene	H_2CCO	26
C_2H_2N	**CH_2CN radical**	**CH_2CN**	**24**
C_2H_3N	Acetonitrile (methyl cyanide)	CH_3CN	90/ 49 ex.
		$^{13}CH_3CN$	14
		$CH_3{}^{13}CN$	11
C_2H_3N	**Methyl isocyanide**	**CH_3NC**	**3**
C_2H_4O	Acetaldehyde	CH_3CHO	57
$C_2H_4O_2$	Methyl formate	$HCOOCH_3$	391
C_2H_6O	Ethanol (ethyl alcohol)	CH_3CH_2OH	42
C_2H_6O	Dimethyl ether	CH_3OCH_3	147
C_2S	**Dicarbon sulfide**	**CCS**	**18**
		CC^{34}S	**1**
C_2Si	Silacyclopropyne	SiC_2	13
		$^{29}SiC_2$	17
		$^{30}SiC_2$	15
		Si^{13}CC	13
c-C_3H	**Cyclopropenylidyne**	**c-C_3H**	**6**
l-C_3H	Propenylidyne	l-C_3H	14
C_3HN	Cyanoacetylene	HCCCN	21/ 43 ex.
		H^{13}CCCN	11
		HC^{13}CCN	7
		HCC^{13}CN	8
		HCCC^{15}N	1
		DCCCN	3
c-C_3H_2	Cyclopropenylidene	C_3H_2	15
		H^{13}CCCH	3
		HC^{13}CCH	1
		DCCCH	9
l-C_3H_2	**Propenylidene**	**H_2CCC**	**4**
C_3H_2O	**Propanal**	**HCCCHO**	**5**
C_3H_3N	Vinyl cyanide (acrylonitrile)	CH_2CHCN	116
C_3H_4	Propyne (methyl acetylene)	CH_3CCH	46
		$CH_3C^{13}CH$	3
C_3H_5N	Propionitrile (ethyl cyanide)	CH_3CH_2CN	209
C_3H_6O	**Acetone**	**CH_3COCH_3**	**15**
C_3N	cyanoethynyl radical	CCCN	20
C_3O	Tricarbon monoxide	CCCO	4
C_3S	**Tricarbon monosulfide**	**CCCS**	**14**
C_4H	Butadiynyl radical	HCCCC	33/ 40 ex.
		DCCCC	5
C_4H_2	**Butadienyl radical**	**CH_2CCC**	**8**
C_4H_3N	2-butynenitrile	CH_3CCCN	9
C_4Si	**Silicon tetracarbide**	**SiC_4**	**4**
C_5H	**Pentadiynyl radical**	**HCCCCC**	**21**

TABLE 1. Listing by empirical formula of the isotopic forms of the interstellar species appearing in Table 5 — Continued

Emperical formula	Name	Isotopic species	Number of observed transitons gnd/excited[b]
C_5HN	Cyanobutadiyne	HCCCCCN	40
		$H^{13}CCCCCN$	1
		$HC^{13}CCCCN$	2
		$HCC^{13}CCCN$	2
		$HCCC^{13}CCN$	2
		$HCCCC^{13}CN$	1
		DCCCCCN	2
C_5H_4	Penta-1,3-diyne (methyl diacetylene)	CH_3C_4H	5
C_6H	**Hexatriynyl radical**	**HC_6**	**55**
C_7HN	Cyanohexatriyne	HC_7N	20
C_9HN	Cyanooctatetrayne	HC_9N	8
$C_{11}HN$	Cyanodecapentyne	$HC_{11}N$	4
ClH ?	**Hydrochloric acid**	**HCl**	**3**
ClK	**Potassium chloride**	**KCl**	**6**
ClNa	**Sodium chloride**	**$Na^{35}Cl$**	**6**
		$Na^{37}Cl$	**1**
HNO	Nitroxyl hydride	HNO	2
HN_2^+	Diazenylium	HNN^+	8
		$HN^{15}N^+$	1
		$H^{15}NN^+$	3
		DNN^+	5
HO	Hydroxyl radical	OH	23
		^{17}OH	2
		^{18}OH	4
H_2O	Water	H_2O	7
		$H_2{}^{18}O$	2
		HDO	11
H_2S	Hydrogen sulfide	H_2S	2
		$H_2{}^{34}S$	1
		HDS	1
H_3N	Ammonia	NH_3	44
		$^{15}NH_3$	6
		NH_2D	13
		NHD_2	2
H_3O^+	**Protonated water**	**H_3O^+**	**1**
NO	Nitric oxide	NO	9
NS	Nitric sulfide	NS	4
		$N^{34}S$	1
NP	**Nitric phosphide**	**NP**	**4**
OS	Sulfur monoxide	SO	25
		^{34}SO	20
		^{33}SO	3
		$S^{18}O$	3
OSi	Silicon monoxide	SiO	8/ 12 ex.
		^{29}SiO	4
		^{30}SiO	4
O_2S	Sulfur dioxide	SO_2	108/ 11 ex.
		$^{33}SO_2$	9
		$^{34}SO_2$	49
SSi	Silicon monosulfide	SiS	12/ 3 ex.
		$Si^{33}S$	1
		$Si^{34}S$	1
		^{29}SiS	3
		^{30}SiS	1
U	unidentified transitions	765	

[a]Only resolved (unblended) components are enumerated in this table.
[b]Molecular species identification is tentative due to lack of laboratory assignment.

TABLE 2. Assignments of unidentified lines in 1985 revision[2]

U-line Freq. (MHz)	Present Frequency (MHz)	Assignment	Reference
U 45379.	45379.046	C_2S 4,3–3,2	Sai87
U 79220.	79221.9	duplicate entry	Cum86
U 80484.	80489.5	CH_2CN 4(0,4)–3(0,3)	Irv88a
U 81506.1	81505.170	C_2S 7(6)–6(5)	Sai87
U 81507.	"	"	"
U 84970.	84970.22	$^{13}CH_3OH$ 8(0)–7(1)	Kur86
U 85435.	85434.543	CH_2CHCN 9(3,6)–8(3,5)	
U 89087.	89087.92	HCN 1–0 l=0 ν_2=2	Luc88
U 90684.2	90686.381	C_2S 7(7)–6(6)	Sai87
U 92352.7	92353.43	CH_3CN 5(1)–4(1) l=1 ν_8=1	Tur90
U 93870.5	93870.107	C_2S 8(7)–7(6)	Sai87
U 99867.0	99866.521	C_2S 7(8)–6(7)	Sai87
U 100601.6	100598.34	CH_2CN 5(0,5)–4(0,4)	Irv88a
U 101000.	101002.35	CH_2CO 5(3)–4(3)	Cum86
U 102217.	102217.515	NH_2CHO 2(1,2)–1(0,1)	Tur89
U 102812.0	102807.32	$H_2C^{34}S$ 3(1,2)–2(1,1)	Tur89
U 103641.8	103640.759	C_2S 8(8)–7(7)	Sai87
U 106348.0	106347.726	C_2S 9(8)–8(7)	Sai87
U 131552.3	131551.796	C_2S 11(10)–10(9)	Sai87
U 144244.5	144244.841	C_2S 12(11)–11(10)	Sai87
U 163873.	163872.400	$^{13}CH_3OH$ 7(0)–6(1) E	And87
U 202688.	202690.687	NH_2CHO 6(2,5)–6(1,6)	Tur85
U 202815.	202818.966	CH_3CN 11(5)–10(5) ν_8=1	Tur85
U 205757.	incorrect, deleted		
U 215886.	215886.963	$^{13}CH_3OH$ 4(2)–3(1) E	And87
U 222720.	222722.9	CH_3OH 16(2)–15(1) A^+	Sut85
U 234936.	234935.69	PN 5–4	Tur87b
U 240097.	deleted, not reported		Tur85
U 281958.	281958.	CH_3OH 9(−3)−10(−2) E	Sut88

TABLE 3. Assignment changes by Turner [Tur91] for lines listed in TABLE 5 from Tur89 or changed in the present work

Frequency (MHz)	Old Assignment [Tur89]			New designation [Tur91]	Present
Source: SgrB2					
70540.	CH_3CH_2CN	17(1,16)–17(1,17)[a]	→	reassigned	U70540.
77458.	CH_3SH	8(2)–9(1) A^+	→	reassigned	U77458.
77687.	CH_3CH_2OH	5(4,2)–6(3,3)	→	reassigned	U77687.
79465.	CH_3CHO	4(2,2)–3(2,2)	→	reassigned	U79465.
87580.	CH_3CH_2OH	5(3,2)–4(3,1)[a]	→	reassigned	U87580.
87796.	$HCOOCH_3$		→	not listed	
90506.	CH_3OD	2(−1)−1(−1) E $v_t=1$	→	reassigned	U90506.
93355.	$HCOOCH_3$	8(3,6)–7(1,7)	→	reassigned	U93355.
98630.	CH_3CH_2CN	12(2,11)–12(0,12)	→	reassigned	U98630.
103868.	CH_3CH_2CN	21(1,20)–21(0,21)	→	reassigned	U103868.
104720.	CH_3CH_2OH	6(2,5)–5(2,4)[a]	→	reassigned	U104720.
112235.	CH_3CHO	10(2,9)–10(1,9) E	→	not listed	
Source: OriA					
75451.	CH_3CH_2OH	17(8,10)–18(7,11)	→	reassigned	U75451.
77511.	CH_3CH_2OH	11(1,10)–11(1,11)[a]	→	reassigned	U77511.
84215.	CH_3CH_2OH	5(1,5)–4(1,4)[a]	→	same	U84215.
84628.	$HCOOCH_3$	9(8,1)–10(7,4)	→	reassigned	U84628.
87110.	CH_3CHO	2(1,1)–1(0,1) E	→	reassigned	U87110.
87525.	CH3CH2OH	5(4)–4(4)[a]	→	same	U87525.
89411.	$HCOOCH_3$	11(1,10)–11(1,11)	→	reassigned	U89411.
91063.	CH_3OD	2(1)–1(1) A $v_t=2$	→	reassigned	U91063.
91913.	NH_2CHO	32(7,26)–33(6,27)	→	same	U91913.
92715.	CH_3OCH_3	8(5,3)–9(4,6)	→	same	U92715.
94077.	$^{13}CH_3OH$	2(1)–1(1) A^+ $v_t=1$	→	reassigned	U94077.
94902.	CH_3CH_2OH	7(5,2)–8(4,5)	→	same	U94902.
95073.	CH_2CHCN	3(2,2)–4(1,3)	→	reassigned	U95073.
95260.	$HCOOCH_3$	7(3,5)–7(1,6)	→	reassigned	U95260.
96437.	$HCOOCH_3$	11(2,10)–11(0,11)A	→	same	U96437.
96775.	$HCOOCH_3$	7(4,3)–7(3,5)E	→	reassigned	U96775.
97069.	$HCOOCH_3$	8(8,1)–9(7,2)A	→	reassigned	U97069.
98771.	HCOOH	11(1,10)–10(2,9)	→	same	U98771.
99011.	$HCOOCH_3$	8(4,4)–7(4,4)	→	reassigned	U99011.
99586.	NH_2CHO	26(6,20)–27(5,23)	→	same	U99586.
100421.	$HCOOCH_3$	16(4,12)–15(5,11)	→	reassigned	U100421.
100765.	$HCOOCH_3$	5(3,3)–5(1,4)	→	reassigned	U100765.
101384.	DNCO	5(1,5)–4(1,4)	→	not listed	U101384.
101877.	CH_3CH_2CN	21(1,20)–21(1,21)[a]	→	reassigned	not listed
103689.	$HCOOCH_3$	4(3,2)–4(1,3) A	→	reassigned	U103689.
103918.	CH_3CH_2CN	4(2,3)–3(1,2)	→	reassigned	U103918.
105023.	CH_3CH_2OH	6(5)–5(5)[a]	→	same	U105023.
106995.	$HCOOCH_3$	4(2,2)–3(0,3) A	→	reassigned	U106995.
113314.	CH_3CHO	6(2,5)–5(2,3) E	→	reassigned	U113314.

[a]Transitions are a-type with small line strength or dipole moment.

TABLE 4. List of telescope abbreviations employed in Table 5

ARO 46 m	Algonquin Radio Observatory Lake Traverse Ontario, Canada
Arecibo 350 m	Arecibo Observatory Puerto Rico
BTL 7 m	Bell Telephone Laboratory Holmdel, New Jersey
CAdY 13.7 m	Centro Astromico de Yebes Guadalajara, Spain
CSO 10.4m	Caltech Submillimeter Observatory Mauna Kea, Hawaii
FCRAO 14 m	Five College Radio Astronomy Observatory Massachusetts
Hale 5 m	Hale Telescope Mount Palomar, California
IRAM 30 m	IRAM Picoveleta, Spain
IRTF 3 m	Infrared Telescope Facility Mauna Kea, Hawaii
IRT 13.7 m	Itapetinga Radio Telescope Sao Paulo, Brazil
KAO 1 m	G. P. Kuiper Airborne Observatory
MMT	Multiple Mirror Telescope Mt. Lemmon, Arizona
MMWO 4.9 m	McDonald Millimeter Wave Observatory Fort Davis, Texas
MPI 100 m	Max-Planck-Institut fur Radioastronomie Effelsberg, Germany
NASA-C 70 m	NASA Canberra Deep Space Communications Complex, Australia
NEROC 37 m (120 ft)	Northeast Radio Observatory Corporation Haystack Observatory Westford, Massachusetts
NRAO 11 m (36 ft)	National Radio Astronomy Observatory Kitt Peak, Arizona
NRAO 43 m (140 ft)	National Radio Astronomy Observatory Greenbank, West Virginia
NRL 26 m (85 ft)	Naval Research Laboratory Maryland Point Observatory, Maryland
NRO 45 m	Nobeyama Radio Observatory University of Tokyo Nobeyama, Japan
OSO 26.6 m	Onsala Space Observatory Onsala, Sweden
OSO 20 m	Onsala Space Observatory Onsala, Sweden
OVRO 10.4 m	Owens Valley Radio Observatory Owens Valley, California
Parkes 64 m	Division of Radiophysics CSIRO Parkes, Australia
Pushino 22 m	Pushino, USSR
SEST 15 m	Swedish ESO Submillimerter Telescope LaSilla, Chile
SRCAL 25 m	SRC Appleton Laboratry Chilbolton Observatory Stockbridge, Hants, England
TAO 6 m	Tokyo Astronomical Observatory Tokyo, Japan
UKIRT 3.8 m	UK Infrared Telescope Mauna Kea, Hawaii
UM/UCSD 1.5 m	University of Minnesota/UCSD 60 in Mt. Lemmon, Arizona

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines

Frequency Unc. (MHz)	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
701.679 (4)	CH	$^2\Pi_{3/2}$ $J=3/2$ $F=2-2$	−0.6	W51	Arecibo	350m	Ziu85	Ziu85	
704.175*(10)	CH	$^2\Pi_{3/2}$ $J=3/2$ $F=2+-1-$	−0.10	W51	Arecibo	350m	Tur88	Tur88	N
722.303*(10)	CH	$^2\Pi_{3/2}$ $J=3/2$ $F=1+-2-$	−0.12	W51	Arecibo	350m	Tur88	Tur88	N
724.791 (4)	CH	$^2\Pi_{3/2}$ $J=3/2$ $F=1-1$	−0.5	W51	Arecibo	350m	Ziu85	Ziu85	
834.267 (2)	CH_3OH	1(1) − 1(1) A	0.58	Sgr A	NRAO	43m	Bal70	Rad72	
1065.075 (5)	CH_3CHO	1(1,0) − 1(1,1) A	0.3	Sgr A	NRAO	43m	Got73	Got73	
1371.709*(2)	CH_2CHCN	2(1,1) − 2(1,2) $F=1-1$	0.012	Sgr B2	Parkes	64m	Gar75	Gar75	
1371.794*(2)	CH_2CHCN	2(1,1) − 2(1,2) $F=3-3$	0.034	Sgr B2	Parkes	64m	Gar75	Gar75	
1371.947*(2)	CH_2CHCN	2(1,1) − 2(1,2) $F=2-2$	0.019	Sgr B2	Parkes	64m	Gar75	Gar75	
1538.113*(1)	NH_2CHO	1(1,0) − 1(1,1) $F=1-1$	0.08	Sgr B2	NRAO	43m	Got73a		
1538.678*(1)	NH_2CHO	1(1,0) − 1(1,1) $F=1-2$	0.09	Sgr B2	NRAO	43m	Got73a		
1539.265*(1)	NH_2CHO	1(1,0) − 1(1,1) $F=2-1$	0.10	Sgr B2	NRAO	43m	Got73a		
1539.526*(1)	NH_2CHO	1(1,0) − 1(1,1) $F=1-0$	0.08	Sgr B2	NRAO	43m	Got73a		
1539.831*(1)	NH_2CHO	1(1,0) − 1(1,1) $F=2-2$	0.36	Sgr B2	NRAO	43m	Got73a		
1540.994*(1)	NH_2CHO	1(1,0) − 1(1,1) $F=0-1$	0.10	Sgr B2	NRAO	43m	Got73a		
1570.805 (5)	$NH_2{}^{13}CHO$	1(1,0) − 1(1,1) $F=2-2$	0.04	Sgr B2	Parkes	64m	Gar80	Gar80	
1584.274 (2)	^{18}OH	$^2\Pi_{3/2}$ $J=3/2$ $F=1-2$	−0.05	Sgr B2	Parkes	64m	Wil81a	Bea78	
1610.249 (3)	$HCOOCH_3$	1(1,0) − 1(1,1) A	0.07	Sgr B2	Parkes	64m	Bro75	Bro75	
1610.906 (3)	$HCOOCH_3$	1(1,0) − 1(1,1) E	0.061	Sgr B2	MPI	100m	Chu75	Bro75	
1612.2310(2)	OH	$^2\Pi_{3/2}$ $J=3/2$ $F=1-2$	−0.80	OriMC-2	Parkes	64m	Gar64	ter72	
1624.518 (10)	^{17}OH	$^2\Pi_{3/2}$ $J=3/2$ $F,F_1=7/2,4-7/2,4$	−0.045	Sgr A	Parkes	64m	Gar76	Got74	
1626.161 (10)	^{17}OH	$^2\Pi_{3/2}$ $J=3/2$ $F,F_1=9/2,4-9/2,4$	−0.056	Sgr A	Parkes	64m	Gar76	Got74	
1637.564 (2)	^{18}OH	$^2\Pi_{3/2}$ $J=3/2$ $F=1-1$	−0.2	Sgr A	Parkes	64m	Gar70	Lov74	
1638.805 (3)	HCOOH	1(1,0) − 1(1,1)	0.04	Sgr B2	NRAO	43m	Zuc71	Zuc71	
1639.503 (2)	^{18}OH	$^2\Pi_{3/2}$ $J-3/2$ $F=2-2$	−0.5	Sgr A	Parkes	64m	Gar70	Lov74	
1665.4018(1)	OH	$^2\Pi_{3/2}$ $J=3/2$ $F=1-1$	−5.15	OriMC-2	NRAO	43m	Wei68	ter72	
1667.3590(1)	OH	$^2\Pi_{3/2}$ $J=3/2$ $F=2-2$	−6.30	OriMC-2	NRAO	43m	Wei63	ter72	
1692.795 (2)	^{18}OH	$^2\Pi_{3/2}$ $J=3/2$ $F=2-1$	−0.04	Sgr B2	Parkes	64m	Whi81	Bea78	
1720.5300(1)	OH	$^2\Pi_{3/2}$ $J=3/2$ $F=2-1$	−1.10	OriMC-2	Parkes	64m	Gar64	ter72	
2661.61 *(5)	HC_5N	1 − 0 $F=1-1$	0.020	Sgr B2	Parkes	64m	Bro76	Bro76	
2662.87 *(5)	HC_5N	1 − 0 $F=2-1$	0.036	Sgr B2	Parkes	64m	Bro76	Bro76	
2664.76 *(5)	HC_5N	1 − 0 $F=0-1$	0.023	Sgr B2	Parkes	64m	Bro76	Bro76	
3139.402*(1)	H_2CS	2(1,1) − 2(1,2)	−0.33	Sgr B2	Parkes	64m	Sin73		
3195.167 (10)	CH_3CHO	2(1,1) − 2(1,2) A	0.2	Sgr B2	Parkes	64m	Fou74	Fou74	
3263.794 (3)	CH	$^2\Pi_{1/2}$ $J=1/2$ $F=0-1$	0.24	Cas A	OSO	25.6m	Ryd76	Ryd74	
3335.481 (2)	CH	$^2\Pi_{1/2}$ $J=1/2$ $F=1-1$	0.25	Cas A	OSO	25.6m	Ryd76	Ryd74	
3349.193 (3)	CH	$^2\Pi_{1/2}$ $J=1/2$ $F=1-0$	0.18	Cas A	OSO	25.6m	Ryd76	Ryd74	
4388.7786(3)	$H_2C^{18}O$	1(1,0) − 1(1,1) $F=1-0$	[b]	Sgr B2	Parkes	64m	Gar71a	Tuc71	
4388.7960*(4)	$H_2C^{18}O$	1(1,0) − 1(1,1) $F=0-1$	[b]	Sgr B2	Parkes	64m	Gar71a	Tuc71	
4388.7963(2)	$H_2C^{18}O$	1(1,0) − 1(1,1) $F=2-2$	n.r.[c]	Sgr B2	Parkes	64m	Gar71a	Tuc71	
4388.8011(2)	$H_2C^{18}O$	1(1,0) − 1(1,1) $F=2-1$	[b]	Sgr B2	Parkes	64m	Gar71a	Tuc71	
4388.8035(3)	$H_2C^{18}O$	1(1,0) − 1(1,1) $F=1-2$	[b]	Sgr B2	Parkes	64m	Gar71a	Tuc71	
4388.8084(3)	$H_2C^{18}O$	1(1,0) − 1(1,1) $F=1-1$	[b]	Sgr B2	Parkes	64m	Gar71a	Tuc71	
4592.9563(1)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)1/2,1/2 − 1/2,3/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4592.9738(1)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)1/2,1/2 − 3/2,3/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4592.9759(3)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)3/2,1/2 − 1/2,3/2	−0.1[b]	W33	MPI	100m	Wil76b	Tuc71	
4592.9857(1)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)3/2,1/2 − 5/2,3/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4592.9934(1)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)3/2,1/2 − 3/2,3/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.0494(2)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)1/2,1/2 − 1/2,1/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.0690(1)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)3/2,1/2 − 1/2,1/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.0800(3)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)1/2,1/2 − 3/2,1/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.0812(1)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)1/2,3/2 − 1/2,3/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.08654(5)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)5/2,3/2 − 5/2,3/2	−0.55[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.0864(3)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)3/2,3/2 − 1/2,3/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.0942(2)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)5/2,3/2 − 3/2,3/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.0961(2)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)3/2,3/2 − 5/2,3/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.0985(2)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)1/2,3/2 − 3/2,3/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.0994(3)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)3/2,1/2 − 3/2,1/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.1039(1)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)3/2,3/2 − 3/2,3/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.1741(1)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)1/2,3/2 − 1/2,1/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.1795(1)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)3/2,3/2 − 1/2,1/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.2003(1)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)5/2,3/2 − 3/2,1/2	−0.1[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.2046(3)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)1/2,3/2 − 3/2,1/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4593.2099(2)	$H_2{}^{13}CO$	1(1,0) − 1(1,1)3/2,3/2 − 3/2,1/2	[b]	W33	MPI	100m	Wil76b	Tuc71	
4617.126*(1)	NH_2CHO	2(1,1) − 2(1,2) $F=2-2$	0.07	Sgr B2	NRAO	43m	Rub71	Rib73	

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
4618.966*(1)		NH_2CHO	2(1,1)−2(1,2) $F=3-3$	0.30[d]	Sgr B2	NRAO	43m	Rub71	Rib73	
4619.989*(1)		NH_2CHO	2(1,1)−2(1,2) $F=1-1$	<0.05	Sgr B2	NRAO	43m	Rub71	Rib73	
4660.242 (3)		OH	$^2\Pi_{1/2}$ $J=1/2$ $F=0-1$	0.3	Sgr B2	NRAO	43m	Tha70	Rad68	
4750.656 (3)		OH	$^2\Pi_{1/2}$ $J=1/2$ $F=1-1$	0.3[e]	Sgr B2	Parkes	64m	Gar71	Rad68	
4765.562 (3)		OH	$^2\Pi_{1/2}$ $J=1/2$ $F=1-0$	1.7	W3	NRAO	43m	Zuc68	Rad68	
4829.6412(2)		H_2CO	1(1,0)−1(1,1) $F=1-0$	−0.2	TMC-1	NRAO	43m	Pal69	Kuk75	
4829.6587(2)		H_2CO	1(1,0)−1(1,1) $F=0-1$	[b]	TMC-1	NRAO	43m	Pal69	Kuk75	
4829.6594(2)		H_2CO	1(1,0)−1(1,1) $F=2-2$	[b]	TMC-1	NRAO	43m	Pal69	Kuk75	
4829.6639(2)		H_2CO	1(1,0)−1(1,1) $F=2-1$	−0.8[b]	TMC-1	NRAO	43m	Pal69	Kuk75	
4829.6664(2)		H_2CO	1(1,0)−1(1,1) $F=1-2$	[b]	TMC-1	NRAO	43m	Pal69	Kuk75	
4829.6710(2)		H_2CO	1(1,0)−1(1,1) $F=1-1$	[b]	TMC-1	NRAO	43m	Pal69	Kuk75	
4916.312*(8)		HCOOH	2(1,1)−2(1,2)	0.04	Sgr B2	MPI	100m	Win75	Win75	
5005.3208(2)		CH_3OH	3(1)−3(1) A	0.05[d]	Sgr B2	Parkes	64m	Rob74	Heu73	
5289.015*(19)		CH_2NH	1(1,0)−1(1,1) $F=0-1$	0.05	Sgr B2	Parkes	64m	God73		
5289.678*(22)		CH_2NH	1(1,0)−1(1,1) $F=1-0$	[b]	Sgr B2	Parkes	64m	God73		
5289.813*(6)		CH_2NH	1(1,0)−1(1,1) $F=2-2$	0.15[b]	Sgr B2	Parkes	64m	God73		
5290.614*(13)		CH_2NH	1(1,0)−1(1,1) $F=2-1$	[b]	Sgr B2	Parkes	64m	God73		
5290.879*(11)		CH_2NH	1(1,0)−1(1,1) $F=1-2$	0.07[b]	Sgr B2	Parkes	64m	God73		
5291.680*(18)		CH_2NH	1(1,0)−1(1,1) $F=1-1$	0.05	Sgr B2	Parkes	64m	God73		
5324.058*(35)		HC_5N	2−1 $F=2-2$	0.01	Sgr B2	Parkes	64m	Gar78a	Gar78a	
5324.270*(35)		HC_5N	2−1 $F=1-0$	[b]	Sgr B2	Parkes	64m	Gar78a	Gar78a	
5325.330*(27)		HC_5N	2−1 $F=2-1$	[b]	Sgr B2	Parkes	64m	Gar78a	Gar78a	
5325.421*(27)		HC_5N	2−1 $F=3-2$	0.044	Sgr B2	Parkes	64m	Gar78a	Gar78a	
5327.451*(41)		HC_5N	2−1 $F=1-1$	0.01	Sgr B2	Parkes	64m	Gar78a	Gar78a	
6016.746 (8)		OH	$^2\Pi_{3/2}$ $J=5/2$ $F=2-3$	−0.12	G291.3−0.7	Parkes	64m	Whi76	Rad68	
6030.747 (5)		OH	$^2\Pi_{3/2}$ $J=5/2$ $F=2-2$	7.	W3(OH)	NRAO	43m	Zuc72a	Mee75	
6035.092 (5)		OH	$^2\Pi_{3/2}$ $J=5/2$ $F=3-3$	20.	W3(OH)	NRAO	43m	Zuc72a	Mee75	
6049.084 (8)		OH	$^2\Pi_{3/2}$ $J=5/2$ $F=3-2$	0.04	W33	MPI	100m	Gar83	Bea78	
6278.623*(1)		H_2CS	3(1,2)−3(1,3)	n.r.	Sgr B2	ARO	46m	Mac75		
6390.085 (40)		CH_3CHO	3(1,2)−3(1,3) A	0.045	Sgr B2	ARO	46m	Bel83b	Sch79	M
7761.747 (5)		OH	$^2\Pi_{1/2}$ $J=3/2$ $F=1-1$	−0.10	W3(OH)	MPI	100m	Wil90	Bal70a	N
7820.125 (5)		OH	$^2\Pi_{1/2}$ $J=3/2$ $F=2-2$	−0.026	W3(OH)	MPI	100m	Wil90	Bal70a	N
7895.983 (10)		HC_7N	7−6 $F=6-5$	[b]	TMC-1	NEROC	37m	Rod80	Rod80	
7896.005 (10)		HC_7N	7−6 $F=7-6$	0.006[b]	TMC-1	NEROC	37m	Rod80	Rod80	
7896.017 (10)		HC_7N	7−6 $F=8-7$	[b]	TMC-1	NEROC	37m	Rod80	Rod80	
7987.782 (10)		HC_5N	3−2 $F=2-1$	0.040	TMC-1	NEROC	37m	Rod80	Rod80	
7987.994 (10)		HC_5N	3−2 $F=3-2$	0.039	TMC-1	NEROC	37m	Rod80	Rod80	
7988.044 (10)		HC_5N	3−2 $F=4-3$	0.055	TMC-1	NEROC	37m	Rod80	Rod80	
8135.870 (5)		OH	$^2\Pi_{1/2}$ $J=5/2$ $F=2-2$	−0.031	W3(OH)	MPI	100m	Wil90	Mee75	N
8189.587 (5)		OH	$^2\Pi_{1/2}$ $J=5/2$ $F=3-3$	+0.009	W3(OH)	MPI	100m	Wil90	Mee75	N
8775.088 (10)		CH_3NH_2	2(0,2)−1(0,1) $F=1-0$ Aa	0.05	Sgr B2	Parkes	64m	Fou74a	Lov85	
8777.442 (10)		CH_3NH_2	2(0,2)−1(0,1) $F=3-2$ Aa	0.18	Sgr B2	Parkes	64m	Fou74a	Lov85	
8778.200 (10)		CH_3NH_2	2(0,2)−1(0,1) $F=2-2$ Aa	0.04[b]	Sgr B2	Parkes	64m	Fou74a	Lov85	
8778.260 (10)		CH_3NH_2	2(0,2)−1(0,1) $F=1-1$ Aa	[b]	Sgr B2	Parkes	64m	Fou74a	Lov85	
8779.496 (8)		CH_3NH_2	2(0,2)−1(0,1) $F=2-1$ Aa	0.1	Sgr B2	Parkes	64m	Fou74a	Lov85	
8815.814*(6)		$H^{13}CCCN$	1−0 $F=1-1$	0.039	Sgr B2	MPI	100m	Chu77		
8817.096*(2)		$H^{13}CCCN$	1−0 $F=2-1$	0.080	Sgr B2	MPI	100m	Chu77		
8819.019*(9)		$H^{13}CCCN$	1−0 $F=0-1$	0.025	Sgr B2	MPI	100m	Chu77		
9024.004 (10)		HC_7N	8−7	0.16	TMC-1	MPI	100m	Tol81	Tol81	
9058.447*(6)		$HC^{13}CCN$	1−0 $F=1-1$	0.025	Sgr B2	MPI	100m	Chu77		
9059.318*(2)		$HCC^{13}CN$	1−0 $F=1-1$	n.r.	Sgr B2	MPI	100m	Chu77		
9059.736*(3)		$HC^{13}CCN$	1−0 $F=2-1$	0.055	Sgr B2	MPI	100m	Chu77		
9060.6080*(9)		$HCC^{13}CN$	1−0 $F=2-1$	0.05	Sgr B2	MPI	100m	Chu77		
9097.0346(3)		HC_3N	1−0 $F=1-1$	0.82	Sgr B2	MPI	100m	Chu77	deZ71	
9098.3321(3)		HC_3N	1−0 $F=2-1$	2.11	Sgr B2	MPI	100m	Chu77	deZ71	
9100.2727(5)		HC_3N	1−0 $F=0-1$	0.16	Sgr B2	MPI	100m	Chu77	deZ71	
9118.818 (15)		CH_3OCH_3	2(0,2)−1(1,1) AA	[b]	Sgr B2	Parkes	64m	Win76	Win76	
9119.670 (15)		CH_3OCH_3	2(0,2)−1(1,1) EE	0.05[bg]	Sgr B2	Parkes	64m	Win76	Win76	
9120.517 (15)		CH_3OCH_3	2(0,2)−1(1,1) AE+EA	[b]	Sgr B2	Parkes	64m	Win76	Win76	
9235.120 (8)		NH_2CHO	3(1,2)−3(1,3) $F=3-3$	0.055	Sgr B2	NRAO	43m	God84	Lov88	M
9237.028 (8)		NH_2CHO	3(1,2)−3(1,3) $F=4-4$	0.080	Sgr B2	NRAO	43m	God84	Lov88	M
9237.714 (16)		NH_2CHO	3(1,2)−3(1,3) $F=2-2$	[b]	Sgr B2	NRAO	43m	God84	Lov88	M
	U 9486.71	unidentified		0.025	TMC-1	NRAO	43m	Mat83a		
9493.061*(4)		C_4H	1−0 $J=3/2-1/2$ $F=1-0$	0.090	TMC-1	NARO	43m	Bel83a	Got83	
	U 9496.4 (1)	unidentified		0.008	CasA	NRAO	43m	Bel83		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
9497.616*(2)		C_4H	$1-0\ J=3/2-1/2\ F=2-1$	0.245	TMC-1	NARO	43m	Bel83a	Got83	
9508.005*(4)		C_4H	$1-0\ J=3/2-1/2\ F=1-1$	0.080	TMC-1	NRAO	43m	Bel83a	Got83	
9547.953 (5)		C_4H	$1-0\ J=1/2-1/2\ F=1-0$	0.095	TMC-1	NRAO	43m	Bel83a	Gué82a	
9551.717*(4)		C_4H	$1-0\ J=1/2-1/2\ F=0-1$	0.080	TMC-1	NEROC	37m	Bel83a	Got83	
9562.904*(3)		C_4H	$1-0\ J=1/2-1/2\ F=1-1$	0.115	TMC-1	NRAO	43m	Bel83a	Got83	
9885.89 *(1)		C_3N	$1-0\ J=3/2-1/2\ F=5/2-3/2$	0.02	TMC-1	ARO	46m	Mac81a	Gué82a	
10152.002*(6)		HC_7N	9 – 8	0.08	TMC-1	ARO	46m	Kro78		
10278.246 (6)		HDO	2(2,0) – 2(2,1)	0.032	OriMC-116	NRAO	43m	Pet88	Tha64	N
10458.641*(1)		HC_9N	18 – 17	0.021	TMC-1	ARO	46m	Bro78		M
10463.956*(1)		H_2CS	4(1,3) – 4(1,4)	−0.040	Sgr B2	ARO	46m	Doh74		
10648.419 (4)		CH_3CHO	4(1,3) – 4(1,4) A	0.021	Sgr B2	ARO	46m	Bel83b	Lov90	M
10650.563*(5)		HC_5N	$4-3\ F=3-2$	0.13	TMC-1	NRO	45m	Tak90		N
10650.654*(5)		HC_5N	$4-3\ F=4-3$	0.24[b]	TMC-1	NRO	45m	Tak90		N
10650.686*(5)		HC_5N	$4-3\ F=5-4$	[b]	TMC-1	NRO	45m	Tak90		N
12162.979 (1)		OCS	1 – 0	0.115	Sgr B2	NRAO	43m	Mat87a	Kuk74	N
12178.593 (4)		CH_3OH	2(0) – 3(−1) E	429.Jy	345.01+1.79	Parks	64m	Nor87	Lov88	N
13043.814 (4)		SO	1(2) – 1(1)	0.4	Sgr B2	NRAO	43m	Cla78	Lov91	M
13434.596 (10)		OH	$^2\Pi_{3/2}\ J=7/2\ F=3-3$	−0.20	DR21	MPI	100m	Gui84	Des75	N
13441.4173(2)		OH	$^2\Pi_{3/2}\ J=7/2\ F=4-4$	3.2	W3(OH)	NRAO	43m	Tur70	ter76	
13778.804*(1)		$H_2{}^{13}CO$	2(1,1) – 2(1,2)	−0.47	Sgr B2	MPI	100m	Hen83a		
13880.537 (3)		$HC_{11}N$	41 – 40	0.014	TMC-1	NRAO	43m	Bel85	Bel85	
13944.838*(3)		HC_9N	24 – 23	0.058	TMC-1	NRAO	43m	Bel85	Bel85	M
14488.4589(2)		H_2CO	$2(1,1)-2(1,2)\ F=1-1$	[b]	Sgr B2	NRL	26m	Eva70	Kuk75	
14488.4712(2)		H_2CO	$2(1,1)-2(1,2)\ F=1-2$	[b]	Sgr B2	NRL	26m	Eva70	Kuk75	
14488.4801(2)		H_2CO	$2(1,1)-2(1,2)\ F=3-3$	−1.3[b]	Sgr B2	NRL	26m	Eva70	Kuk75	
14488.4899(2)		H_2CO	2(1,1) 2(1,2) F = 2 2	[b]	Sgr B2	NRL	26m	Eva70	Kuk75	
14525.869*(3)		HC_9N	25 – 24	0.073	TMC-1	NRAO	43m	Bro78		M
14663.985*(9)		HC_7N	13 – 12	0.06	TMC-1	Parkes	64m	Gar78		
14782.27 (1)		$^{13}CH_3OH$	2(0) – 3(−1) E	0.30	Sgr B2	NASA-c	70m	Kui89	Kur86	N
14893.050 (4)		c-C_3H	$1(1,0)-1(1,1)\ J=3/2-3/2\ F=2-2$	0.124	TMC 1	NRAO	43m	Man90a	Lov91	N
14895.243 (8)		c-C_3H	$1(1,0)-1(1,1)\ J=3/2-3/2\ F=1-1$	0.065	TMC-1	NRAO	43m	Man90a	Lov91	N
17647.479 (10)		C_4D	$2-1\ J=5/2-3/2\ F=5/2-3/2$	0.03	TMC-1	NRAO	43m	Tur89a	Tur89a	N
17647.526 (10)		C_4D	$2-1\ J=5/2-3/2\ F=3/2-1/2$	0.03	TMC-1	NRAO	43m	Tur89a	Tur89a	N
17647.716 (10)		C_4D	$2-1\ J=5/2-3/2\ F=7/2-5/2$	0.05	TMC-1	NRAO	43m	Tur89a	Tur89a	N
17683.961 (10)		C_4D	$2-1\ J=3/2-1/2\ F=5/2-3/2$	0.04	TMC-1	NRAO	43m	Tur89a	Tur89a	N
17684.662 (10)		C_4D	$2-1\ J=3/2-1/2\ F=3/2-1/2$	0.02	TMC-1	NRAO	43m	Tur89a	Tur89a	N
18154.887*(2)		SiS	1 – 0	1.0	IRC+10216	MPI	100m	Gra81		
18194.9206*(8)		HC_3N	$2-1\ F=2-2$	[b]	Sgr B2	Parkes	64m	McG77		
18195.3176*(6)		HC_3N	$2-1\ F=1-0$	[b]	Sgr B2	Parkes	64m	McG77		
18196.2183*(5)		HC_3N	$2-1\ F=2-1$	0.36[b]	Sgr B2	Parkes	64m	McG77		
18196.3119*(7)		HC_3N	$2-1\ F=3-2$	[b]	Sgr B2	Parkes	64m	McG77		
18197.078*(1)		HC_3N	$2-1\ F=1-2$	[b]	Sgr B2	Parkes	64m	McG77		
18198.3756*(9)		HC_3N	$2-1\ F=1-1$	[b]	Sgr B2	Parkes	64m	McG77		
18343.137 (4)		C_3H_2	1(1,0) – 1(0,1)	1.82	TMC-1	NRAO	43m	Mat85a	Lov91	M
18396.7252*(7)		CH_3CN	$1(0)-0(0)\ F=1-1$	0.081	TMC-1	NRAO	43m	Mat83		
18397.9965*(6)		CH_3CN	$1(0)-0(0)\ F=2-1$	0.120	TMC-1	NRAO	43m	Mat83		
18399.8924*(3)		CH_3CN	$1(0)-0(0)\ F=0-1$	0.031	TMC-1	NRAO	43m	Mat83		
18499.390 (5)		NH_3	9(6) – 9(6)	0.3	W51	NRAO	43m	Mad86	Poy75	N
18513.316*(5)		CH_2CHCN	$2(1,2)-1(1,1)\ F=3-2$	0.021	TMC-1	NRAO	43m	Mat83a		
18638.617*(1)		HC_5N	7 – 6	0.5	TMC-1	NRAO	43m	Jen82		
18650.303*(6)		HCCCHO	2(0,2) – 1(0,1)	0.012	TMC-1	NRAO	43m	Irv88		N
18654.298 (8)		$(CH_3)_2CO$	4(2,2) – 4(1,3) EE	0.010	Sgr B2	NRAO	43m	Com87	Lov89	N
18667.585 (8)		$(CH_3)_2CO$	4(2,2) – 4(1,3) AA	0.008	Sgr B2	NRAO	43m	Com87	Vac86	N
18807.888 (10)		NH_2D	3(1,3) – 3(0,3)	0.2	OriMC-1	MPI	100m	Wal87	Coh82	N
18808.507 (5)		NH_3	8(5) – 8(5)	0.39	OriMC-1	MPI	100m	Her88	Poy75	
18884.695 (5)		NH_3	6(2) – 6(2)	0.50	OriMC-1	MPI	100m	Her88	Poy75	
18965.588*(4)		CH_2CHCN	$2(0,2)-1(0,1)\ F=1-0$	0.010	TMC-1	NRAO	43m	Mat83a		
18966.535*(5)		CH_2CHCN	$2(0,2)-1(0,1)\ F=2-1$	0.032	TMC-1	NRAO	43m	Mat83a		
18966.616*(4)		CH_2CHCN	$2(0,2)-1(0,1)\ F=3-2$	0.045	TMC-1	NRAO	43m	Mat83a		
18968.48	U	unidentified		0.011	TMC-1	NRAO	43m	Mat83a		
18968.66	U	unidentified		0.009	TMC-1	NRAO	43m	Mat83a		
19014.7204(15)		C_4H	$2-1\ J=5/2-3/2\ F=2-1$	0.44	TMC-1	NRAO	43m	Gué82a	Gué82a	
19015.1435(15)		C_4H	$2-1\ J=5/2-3/2\ F=3-2$	0.65	TMC-1	NRAO	43m	Gué82a	Gué82a	
19025.107 (4)		C_4H	$2-1\ J=5/2-3/2\ F=2-2$	0.048	TMC-1	NRAO	43m	Gué82a	Gué82a	
19044.760 (4)		C_4H	$2-1\ J=3/2-1/2\ F=1-1$	0.055	TMC-1	NRAO	43m	Gué82a	Gué82a	

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
19054.4762	(15)	C_4H	$2-1\ J=3/2-1/2\ F=2-1$	0.42	TMC-1	NRAO	43m	Gué82a	Gué82a	
19055.9468	(15)	C_4H	$2-1\ J=3/2-1/2\ F=1-0$	0.15	TMC-1	NRAO	43m	Gué82a	Gué82a	
19099.656	(6)	C_4H	$2-1\ J=3/2-3/2\ F=1-1$	0.039	TMC-1	NRAO	43m	Gué82a	Gué82a	
19174.105*	(9)	HC_9N	33–32	0.003	IRC+10216	NRAO	43m	Mat85		M
19175.950*	(10)	HC_7N	17–16	0.465	TMC-1	NRAO	43m	Mat85		
19218.465	(5)	NH_3	7(4)–7(4)	0.6	OriMC-1	MPI	100m	Her88	Poy75	M
19243.521*	(2)	C_3O	2–1	0.035	TMC-1	NRAO	43m	Mat84		M
19262.140	(4)	CH_3CHO	1(0,1)–0(0,0) E	0.014	TMC-1	NRAO	43m	Mat85	Lov90	M
19265.096	(6)	CH_3CHO	1(0,1)–0(0,0) A	0.016	TMC-1	NRAO	43m	Mat85	Lov90	M
19413.827*	(1)	$H^{13}CCCH$	1(1,0)–1(0,1)	0.046	TMC-1	NRAO	43m	Bel87	Bog86	N
19418.661	(2)	C_3HD	$1(1,0)-1(0,1)\ F=1-1$	0.014	TMC-1	NRAO	43m	Bel87	Bel87	N
19418.686	(1)	C_3HD	$1(1,0)-1(0,1)\ F=2-1$	0.032	TMC-1	NRAO	43m	Bel87	Bel87	N
19418.712	(1)	C_3HD	$1(1,0)-1(0,1)\ F=1-2$	0.043	TMC-1	NRAO	43m	Bel87	Bel87	N
19418.724	(1)	C_3HD	$1(1,0)\ \ 1(0,1)\ F=0\ \ 1$	0.034	TMC-1	NRAO	43m	Bel87	Bel87	N
19418.740	(1)	C_3HD	$1(1,0)-1(0,1)\ F=2-2$	0.088	TMC-1	NRAO	43m	Bel86	Bel87	N
19418.796	(2)	C_3HD	$1(1,0)-1(0,1)\ F=1-0$	0.021	TMC-1	NRAO	43m	Bel87	Bel87	N
19426.679*	(4)	CH_2CHCN	$2(1,1)-1(1,0)\ F=2-1$	0.010	TMC-1	NRAO	43m	Mat83a		M
19427.851*	(4)	CH_2CHCN	$2(1,1)-1(1,0)\ F=3-2$	0.021	TMC-1	NRAO	43m	Mat83a		M
19429.098*	(7)	CH_2CHCN	$2(1,1)-1(1,0)\ F=1-0$	0.010	TMC-1	NRAO	43m	Mat83a		M
19757.538	(5)	NH_3	6(3)–6(3)	1.2	OriMC-1	MPI	100m	Her88	Poy75	M
19780.800	(3)	C_3N	$2-1\ J=5/2-3/2\ F=5/2-3/2$	0.058	TMC-1	NRAO	43m	Gué82a	Gué82a	
19780.826	(4)	C_3N	$2-1\ J=5/2-3/2\ F=3/2-1/2$	0.050	TMC-1	NRAO	43m	Gué82a	Gué82a	
19781.094	(3)	C_3N	$2-1\ J=5/2-3/2\ F=7/2-5/2$	0.094	TMC-1	NRAO	43m	Gué82a	Gué82a	
19799.951	(5)	C_3N	$2-1\ J=5/2-3/2\ F=3/2-1/2$	0.022	TMC-1	NRAO	43m	Gué82a	Gué82a	
19800.121	(3)	C_3N	$2-1\ J=5/2-3/2\ F=5/2-3/2$	0.055	TMC-1	NRAO	43m	Gué82a	Gué82a	
19838.346	(5)	NH_3	5(1)–5(1)	0.56	OriMC-1	MPI	100m	Her88	Poy75	M
19967.416	(33)	CH_3OH	2(1)–3(0) E	73.2	W3(OH)	MPI	100m	Wil85	Wil85	
20115.77		CH_2CN	$1/2-1/2\ F_1=3/2-3/2\ F=5/2-5/2$	0.060	TMC-1	NRAO	43m	Irv88a	Irv88a	N
20117.43		CH_2CN	$3/2-1/2\ F_1=5/2-3.2\ F=3/2-1/2$	0.050	TMC-1	NRAO	43m	Irv88a	Irv88a	N
20118.014		CH_2CN	$3/2-1/2\ F_1=5/2-3/2\ F=5/2-3/2$	0.111	TMC-1	NRAO	43m	Irv88a	Irv88a	N
20118.16		CH_2CN	$3/2-1/2\ F_1=1/2-1/2\ F=3/2-3/2$	0.030	TMC-1	NRAO	43m	Irv88a	Irv88a	N
20119.606		CH_2CN	$3/2-1/2\ F_1=5/3-3/2\ F=7/2-5/2$	0.160	TMC-1	NRAO	43m	Irv88a	Irv88a	N
20121.61		CH_2CN	$3/2-1/2\ F_1=3/2-3/2\ F=3/2-3/2$	0.050	TMC-1	NRAO	43m	Irv88a	Irv88a	N
20123.96		CH_2CN	$3/2-1/2\ F_1=1/2-1/2\ F=3/2-3/2$	0.030	TMC-1	NRAO	43m	Irv88a	Irv88a	N
20124.22		CH_2CN	$1/2-1/2\ F_1=3/2-1/2\ F=3/2-1/2$	[b]	TMC-1	NRAO	43m	Irv88a	Irv88a	N
20124.22		CH_2CN	$3/2-1/2\ F_1=3/2-3/2\ F=1/2-1/2$	0.020	TMC-1	NRAO	43m	Irv88a	Irv88a	N
20124.45		CH_2CN	$3/2-1/2\ F_1=3/2-1/2\ F=3/2-3/2$	0.080	TMC-1	NRAO	43m	Irv88a	Irv88a	N
20124.49		CH_2CN	$1/2-1/2\ F_1=3/2-3/2\ F=5/2-3/2$	0.020	TMC-1	NRAO	43m	Irv88a	Irv88a	N
20139.76		CH_2CN	$1/2-1/2\ F_1=1/2-3/2\ F=3/2-5/2$	0.060	TMC-1	NRAO	43m	Irv88a	Irv88a	N
20171.07	(10)	CH_3OH	11(1)–10(2) A+	–0.65	W3(OH)	MPI	100m	Men86a	Lee73	N
20209.198*	(9)	CH_2CO	1(0,1)–0(0,0)	0.017	TMC-1	NRAO	43m	Mat86		N
20357.226	(14)	CH_3C_4H	5(1)–4(1)	0.073	TMC-1	MPI	100m	Wal84	Wal84	
20357.423	(14)	CH_3C_4H	5(0)–4(0)	0.077	TMC-1	MPI	100m	Wal84	Wal84	
20371.45	(10)	NH_3	5(2)–5(2)	0.9	Sgr B2N	MPI	100m	Wal84	Poy75	
20460.01	(10)	HDO	3(2,1)–4(1,4)	0.16	OriMC-1	MPI	100m	Hen87	Bel70	N
20657.336*	(4)	CH_3CCCN	5(0)–4(0)	0.043	TMC-1	NRAO	43m	Bro84		
20719.221	(5)	NH_3	8(6)–8(6)	0.7	OriMC-1	MPI	100m	Her88	Poy75	M
20735.452	(5)	NH_3	9(7)–9(7)	0.25	OriMC-1	MPI	100m	Her88	Poy75	M
20792.568*	(4)	H_2CCC	1(0,1)–0(0,0)	0.233	TMC-1	MPI	100m	Cer87a		N
20792.872	(20)	C_6H	$^2\Pi_{3/2}\ J=15/2-13/2\ F=8-7$ f	0.40	TMC-1	MPI	100m	Gué87	Gué87	N
20792.944	(20)	C_6H	$^2\Pi_{3/2}\ J=15/2-13/2\ F=7-6$ f	0.36	TMC-1	MPI	100m	Gué87	Gué87	N
20794.441	(20)	C_6H	$^2\Pi_{3/2}\ J=15/2-13/2\ F=8-7$ e	0.37	TMC-1	MPI	100m	Gué87	Gué87	N
20794.511	(20)	C_6H	$^2\Pi_{3/2}\ J=15/2-13/2\ F=7-6$ e	0.38	TMC-1	MPI	100m	Gué87	Gué87	N
20804.830	(5)	NH_3	7(5)–7(5)	0.8	OriMC-1	MPI	100m	Her88	Poy75	M
20852.527	(5)	NH_3	10(8)-10(8)	0.17	OriMC-1	MPI	100m	Her88	Poy75	M
20970.65	(5)	CH_3OH	$10(1)-11(2)\ A+\ \nu_t=1$	0.2	W3(OH)	MPI	100m	Men86a	Lee68	M
20994.617	(5)	NH_3	6(4)–6(4)	1.0	OriMC-1	MPI	100m	Her88	Poy75	M
21070.739	(5)	NH_3	11(9)–11(9)	0.13	OriMC-1	MPI	100m	Mau87	Poy75	N
21134.311	(5)	NH_3	4(1)–4(1)	0.9	OriMC-1	MPI	100m	Her88	Poy75	M
21285.275	(5)	NH_3	5(3)–5(3)	2.1	OriMC-1	MPI	100m	Her88	Poy75	M
21301.262*	(1)	HC_5N	8–7	0.031	Sgr B2	ARO	46m	Bro76		
21431.923*	(10)	HC_7N	19–18	0.89	TMC-1	NRAO	43m	Buj81		
21480.823	(1)	C_5H	$^2\Pi_{1/2}\ J=9/2-7/2\ F=5-4$ a	0.08[f]	TMC-1	MPI	100m	Cer87	Cer87	N
21481.312	(2)	C_5H	$^2\Pi_{1/2}\ J=9/2-7/2\ F=4-3$ a	0.06[f]	TMC-1	MPI	100m	Cer87	Cer87	N
21484.710	(1)	C_5H	$^2\Pi_{1/2}\ J=9/2-7/2\ F=5-4$ b	0.07[f]	TMC-1	MPI	100m	Cer87	Cer87	N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
21485.262	(1)	C_5H	$^2\Pi_{1/2}$ $J=9/2-7/2$ $F=4-3$ b	0.06[f]	TMC-1	MPI	100m	Cer87	Cer87	N
21498.211*	(14)	HC_9N	37 – 36	0.06	TMC-1	NRAO	43m	Buj81		M
21550.31	(5)	CH_3OH	12(2) – 11(1) A – $\nu_t=1$	−0.4	W3(OH)	MPI	100m	Men86a	Lee68	M
21587.400*	(4)	C_3H_2	2(2,0) – 2(1,1)	−0.54	TMC-1	NRAO	43m	Mat86a		N
21608.605	(8)	$(CH_3)_2CO$	9(6,3) – 9(5,4) EE	0.002	Sgr B2	NRAO	43m	Com87	Lov89	N
21631.159	(8)	$(CH_3)_2CO$	9(6,3) – 9(5,4) AA	0.002	Sgr B2	NRAO	43m	Com87	Lov89	N
21703.3580	(2)	NH_3	4(2) – 4(2)	0.6	OriMC-1	MPI	100m	Nys78	Kuk70	
21950.	*(1)	$(CH_3)_2CO$	8(5,3) – 8(4,4) EA	0.003	Sgr B2	NRAO	43m	Com87	Vac86	N
21951.467	(8)	$(CH_3)_2CO$	8(5,3) – 8(4,4) AA	0.002[b]	Sgr B2	NRAO	43m	Com87	Lov89	N
21953.841	(8)	$(CH_3)_2CO$	8(5,3) – 8(4,4) EE	[b]	Sgr B2	NRAO	43m	Com87	Lov89	N
21980.5453	(1)	HNCO	1(0,1) – 0(0,0) $F=0-1$	0.025	TMC-1	NRAO	43m	Bro81	Kuk71	
21981.4706	(1)	HNCO	1(0,1) – 0(0,0) $F=2-1$	0.107	TMC-1	NRAO	43m	Bro81	Kuk71	
21982.0854	(1)	HNCO	1(0,1) – 0(0,0) $F=1-1$	0.040	TMC-1	NRAO	43m	Bro81	Kuk71	
22235.044	(5)	H_2O	6(1,6) – 5(2,3) $F=7-6$	[b]	W49	NRAO	43m	Mor73	Kuk69	
22235.077	(5)	H_2O	6(1,6) – 5(2,3) $F=6-5$	[b]	W49	NRAO	43m	Mor73	Kuk69	
22235.120	(5)	H_2O	6(1,6) – 5(2,3) $F=5-4$	2000[i]	W49	NRAO	43m	Mor73	Kuk69	
22235.253	(5)	H_2O	6(1,6) – 5(2,3) $F=6-6$	[b]	W49	NRAO	43m	Mor73	Kuk69	
22235.298	(5)	H_2O	6(1,6) – 5(2,3) $F=5-5$	[b]	W49	NRAO	43m	Mor73	Kuk69	
22307.670	(50)	HDO	5(3,2) – 5(3,3)	0.09	OriMC-1	MPI	100m	Hen87	Str48	N
22344.033*	(2)	C_2S	2,1 – 1,0	1.21	TMC-1	NRO	45m	Kai87	Yam90	N
22471.18	(1)	HCOOH	1(0,1) – 0(0,0)	0.01	L134N	NRAO	43m	Irv90	Bel71	N
22624.8892	(2)	$^{15}NH_3$	1(1) – 1(1) $F,F_1=1.5,1-1.3,1$	[b]	OriMC-1	MPI	100m	Her85	Kuk67	
22624.9331	(2)	$^{15}NH_3$	1(1) – 1(1) $F,F_1=1.5,1-0.8,1$	[b]	OriMC-1	MPI	100m	Her85	Kuk67	
22624.9410	(2)	$^{15}NH_3$	1(1) – 1(1) $F,F_1=0.5,1-0.8,1$	[b]	OriMC-1	MPI	100m	Her85	Kuk67	
22624.9469	(2)	$^{15}NH_3$	1(1) – 1(1) $F,F_1=1.5,2-1.5,2$	0.22[b]	OriMC-1	MPI	100m	Her85	Kuk67	
22649.843	(1)	$^{15}NH_3$	2(2) – 2(2)	0.36	OriMC-1	MPI	100m	Her85	Kuk68	
22653.022	(5)	NH_3	5(4) – 5(4)	0.6	OMC-1	MPI	100m	Nys78	Poy75	
22688.312	(5)	NH_3	4(3) – 4(3)	1.2	OMC-1	MPI	100m	Nys78	Poy75	
22732.429	(5)	NH_3	6(5) – 6(5)	0.6	OMC-1	MPI	100m	Nys78	Poy75	
22789.421	(1)	$^{15}NH_3$	3(3) – 3(3)	0.53	OriMC-1	MPI	100m	Her85	Kuk67	
22793.279	(8)	$(CH_3)_2CO$	2(0,2) – 1(1,1) AA	0.004	TMC-1	NRAO	43m	Com87	Lov89	N
22794.317	(8)	$(CH_3)_2CO$	2(0,2) – 1(1,1) AE	[b]	TMC-1	NRAO	43m	Com87	Lov89	N
22800.375	(8)	$(CH_3)_2CO$	2(0,2) – 1(1,1) EE	0.004	TMC-1	NRAO	43m	Com87	Lov89	N
22827.767	(20)	$HCOOCH_3$	2(1,2) – 1(1,1) E	0.15	OriMC-1	MPI	100m	Chu80	Bau79	M
22828.131	(20)	$HCOOCH_3$	2(1,2) – 1(1,1) A	0.15	OriMC-1	MPI	100m	Chu80	Bau79	M
22834.1851	(1)	NH_3	3(2) – 3(2)	0.11	Sgr B2	NRAO	11m	Mor73	Kuk65	
22878.949*	(10)	DC_5N	9 – 8	0.019	TMC-1	NRAO	43m	Sch81		
22924.940	(5)	NH_3	7(6) – 7(6)	1.0	OMC-1	MPI	100m	Nys78	Poy75	
23046.0158	(2)	$^{15}NH_3$	4(4) – 4(4)	0.26	OriMC-1	MPI	100m	Her85	Kuk68	
23098.8190	(1)	NH_3	2(1) – 2(1)	0.29	Sgr B2	NRAO	11m	Mor73	Kuk70	
23121.024	(1)	CH_3OH	9(2) – 10(1) A+	9.5 [e]	W3(OH)	MPI	100m	Wil84	Meh85	M
23122.983*	(5)	C_3S	4 3	0.55	TMC-1	NRO	45m	Kai87		N
23232.238	(5)	NH_3	8(7) – 8(7)	0.2	OMC-1	MPI	100m	Nys78	Poy75	
23421.9823	(2)	$^{15}NH_3$	5(5) – 5(5)	0.14	OriMC-1	MPI	100m	Her85	Kuk68	
23444.82	(10)	CH_3OH	10(1) – 9(2) A –	−0.77	W3(OH)	MPI	100m	Men85	Lee68	
23565.160	(20)	C_6H	$^2\Pi_{3/2}$ $J=17/2-15/2$ $F=9-8$ f	0.156	TMC-1	NRO	45m	Suz86	Suz86	N
23565.226	(20)	C_6H	$^2\Pi_{3/2}$ $J=17/2-15/2$ $F=8-7$ f	0.144	TMC-1	NRO	45m	Suz86	Suz86	N
23567.169	(20)	C_6H	$^2\Pi_{3/2}$ $J=17/2-15/2$ $F=9-8$ e	0.157	TMC-1	NRO	45m	Suz86	Suz86	N
23567.238	(20)	C_6H	$^2\Pi_{3/2}$ $J=17/2-15/2$ $F=8-7$ e	0.129	TMC-1	NRO	45m	Suz86	Suz86	N
23600.242	(4)	SiC_2	1(0,1) – 0(0,0)	0.11	IRC+10216	MPI	100m	Sny85	Suc89	M
23657.471	(5)	NH_3	9(8) – 9(8)	0.1	OMC-1	MPI	100m	NYs78	Poy75	
23687.889*	(10)	HC_7N	21 – 20	0.21	TMC-1	NEROC	37m	Kro78		
23692.9265	(2)	NH_3	1(1) – 1(1) $F,F_1=1/2,1-1/2,0$	0.16	L134N	OSO	20m	Ryd77	Ryd77	
23692.9688	(1)	NH_3	1(1) – 1(1) $F,F_1=3/2,1-1/2,0$	0.24	L134N	OSO	20m	Ryd77	Kuk67	
23693.8722	(1)	NH_3	1(1) – 1(1) $F,F_1=1/2,1-3/2,2$	0.17	L134N	OSO	20m	Ryd77	Kuk67	
23693.9051	(1)	NH_3	1(1) – 1(1) $F,F_1=3/2,1-5/2,2$	0.30[b]	L134N	OSO	20m	Ho 77	Kuk67	
23693.9145	(1)	NH_3	1(1) – 1(1) $F,F_1=3/2,1-3/2,2$	[b]	L134N	OSO	20m	Ho 77	Kuk67	
23694.4591	(1)	NH_3	1(1) – 1(1) $F,F_1=1/2,1-1/2,1$	[b]	L134N	OSO	20m	Ho 77	Kuk67	
23694.4709	(1)	NH_3	1(1) – 1(1) $F,F_1=3/2,2-5/2,2$	[b]	L134N	OSO	20m	Ho 77	Kuk67	
23694.4700	(1)	NH_3	1(1) – 1(1) $F,F_1=1/2,1-3/2,1$	0.40[b]	L134N	OSO	20m	Ho 77	Kuk67	
23694.4803	(1)	NH_3	1(1) – 1(1) $F,F_1=3/2,2-3/2,2$	[b]	L134N	OSO	20m	Ho 77	Kuk67	
23694.5014	(1)	NH_3	1(1) – 1(1) $F,F_1=3/2,1-1/2,1$	[b]	L134N	OSO	20m	Ho 77	Kuk67	
23694.5060	(1)	NH_3	1(1) – 1(1) $F,F_1=5/2,2-5/2,2$	0.50[b]	L134N	OSO	20m	Ho 77	Kuk67	
23694.5123	(1)	NH_3	1(1) – 1(1) $F,F_1=3/2,1-3/2,1$	[b]	L134N	OSO	20m	Ho 77	Kuk67	
23694.5153	(1)	NH_3	1(1) – 1(1) $F,F_1=5/2,2-3/2,2$	[b]	L134N	OSO	20m	Ho 77	Kuk67	

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
23695.0672(1)		NH_3	1(1)−1(1) F,F_1=3/2,2−3/2,1	0.18[b]	L134N	OSO	20m	Ho 77	Kuk67	
23695.0782(1)		NH_3	1(1)−1(1) F,F_1=3/2,2−3/2,1	[b]	L134N	OSO	20m	Ho 77	Kuk67	
23695.1132(1)		NH_3	1(1)−1(1) F,F_1=5/2,2−3/2,1	0.25	L134N	OSO	20m	Ho 77	Kuk67	
23696.0297(2)		NH_3	1(1)−1(1) F,F_1=1/2,0−1/2,1	0.29[b]	L134N	OSO	20m	Ho 77	Kuk67	
23696.0406(2)		NH_3	1(1)−1(1) F,F_1=1/2,0−3/2,1	[b]	L134N	OSO	20m	Ho 77	Kuk67	
23697.9 (4)		$HC_{11}N$	70−69	0.006	IRC+10216	NEROC	37m	Bel82	Bel82	
23718.31 *(5)		$HC^{13}CCCCN$	9−8	0.002	IRC+10216	NRAO	43m	Bel91	Ale76	I
23720.575 (5)		NH_3	2(2)−2(2) F_1=1−2	[b]	OriMC-1	NEROC	37m	Bar77	Kuk67	
23721.336 (5)		NH_3	2(2)−2(2) F_1=3−2	[b]	OriMC-1	NEROC	37m	Bar77	Kuk67	
23722.6323(5)		NH_3	2(2)−2(2) F_1=2−2	[b]	OriMC-1	NEROC	37m	Bar77	Kuk67	
23722.6336(1)		NH_3	2(2)−2(2) F_1=3−3	0.43[j]	OriMC-1	NEROC	37m	Bar77	Kuk67	
23722.6344(5)		NH_3	2(2)−2(2) F_1=1−1	[b]	OriMC-1	NEROC	37m	Bar77	Kuk67	
23723.929 (5)		NH_3	2(2)−2(2) F_1=2−3	[b]	OriMC-1	NEROC	37m	Bar77	Kuk67	
23724.691 (5)		NH_3	2(2) 2(2) F_1=2 1	[b]	OriMC-1	NEROC	37m	Bar77	Kuk67	
23817.6153(20)		OH	$^2\Pi_{3/2}$ J=9/2 F=4−4	−0.05	W3(OH)	MPI	100m	Win78	Mee75	
23826.6211(30)		OH	$^2\Pi_{3/2}$ J=9/2 F=5−5	−0.13	W3(OH)	MPI	100m	Win78	Mee75	
23867.805 (5)		NH_3	3(3)−3(3) F_1=2−3	[b]	OriMC-1	NEROC	37m	Bar77	Kuk67	
23868.450 (5)		NH_3	3(3)−3(3) F_1=4−3	[b]	OriMC-1	NEROC	37m	Bar77	Kuk67	
23870.1279(5)		NH_3	3(3)−3(3) F_1=3−3	[b]	OriMC-1	NEROC	37m	Bar77	Kuk67	
23870.1296(1)		NH_3	3(3)−3(3) F_1=4−4	0.53[j]	OriMC-1	NEROC	37m	Bar77	Kuk67	
23870.1302(5)		NH_3	3(3)−3(3) F_1=2−2	[b]	OriMC-1	NEROC	37m	Bar77	Kuk67	
23871.807 (5)		NH_3	3(3)−3(3) F_1=3−4	[b]	OriMC-1	NEROC	37m	Bar77	Kuk67	
23872.453 (5)		NH_3	3(3)−3(3) F_1=3−2	[b]	OriMC-1	NEROC	37m	Bar77	Kuk67	
23922.3132(2)		$^{15}NH_3$	6(6)−6(6)	0.13	OriMC-1	MPI	100m	Her85	Kuk68	
23939.10 *(5)		$HCC^{13}CCCN$	9−8	0.003	IRC+10216	NRAO	43m	Bel91	Ale76	N
23941.99 *(5)		$HCCC^{13}CCN$	9−8	0.002	IRC+10216	NRAO	43m	Bel91	Ale76	N
U 23959.5		unidentified		0.003	IRC+10216	NRAO	43m	Bel91		N
23963.901*(2)		HC_5N	9−8	1.2	TMC-1	SRCAL	25m	Lit77		
24037.1 (1)		$HC_{11}N$	71−70	0.006	IRC+10216	NEROC	37m	Bel82	Bel82	
24139.4169(1)		NH_3	4(4)−4(4)	0.25[j]	OriMC-1	NEROC	37m	Bar77	Kuk70	
24205.287 (5)		NH_3	10(9)−10(9)	0.1	OriMC-1	MPI	100m	Nys78	Poy75	
24296.523 (20)		$HCOOCH_3$	2(0,2)−1(0,1) E	0.09	OriMC-1	NRAO	43m	Chu80	Bau79	
24298.476 (20)		$HCOOCH_3$	2(0,2)−1(0,1) A	0.12	OriMC-1	NRAO	43m	Chu80	Bau79	
24325.927 (1)		OCS	2−1	0.30	Sgr B2	NEROC	37m	Gol81	Wan73	
24375.2 (2)		$HC_{11}N$	72−71	0.006	IRC+10216	NEROC	37m	Bel82	Bel82	
24428.652 (16)		CH_3C_4H	6(1)−5(1)	0.107	TMC-1	MPI	100m	Wal84	Wal84	
24428.886 (16)		CH_3C_4H	6(0)−5(0)	0.131	TMC-1	MPI	100m	Wal84	Wal84	
24532.9887(1)		NH_3	5(5)−5(5)	0.09[j]	OriMC-1	NEROC	37m	Bar77	Kuk70	
24788.539*(5)		CH_3CCCN	6(1)−5(1)	0.048	TMC-1	NEROC	37m	Bro84		
24788.778*(5)		CH_3CCCN	6(0)−5(0)	0.076	TMC-1	NEROC	37m	Bro84		
24815.869*(10)		HC_7N	22−21	0.24	TMC-1	SRCAL	25m	Lit78		
24899.505 (8)		$(CH_3)_2CO$	2(1,2)−1(0,1) EE	0.003	TMC-1	NRAO	43m	Com87	Vac86	N
24916.491 (8)		$(CH_3)_2CO$	2(1,2)−1(0,1) AA	0.003	TMC-1	NRAO	43m	Com87	Lov89	N
24928.70 (10)		CH_3OH	3(2)−3(1) E	1.2	OriMC-1	NEROC	37m	Bar75	Lee73	
24933.468 (2)		CH_3OH	4(2)−4(1) E	1.0[j]	OriMC-1	NEROC	37m	Bar71	Gai74	
24934.382 (5)		CH_3OH	2(2)−2(1) E	0.35	OriMC-1	NEROC	37m	Bar75	Gai74	
24959.080 (2)		CH_3OH	5(2)−5(1) E	1.1[i]	OriMC-1	NEROC	37m	Bar71	Gai74	
25018.123 (2)		CH_3OH	6(2)−6(1) E	1.7[i]	OriMC-1	NEROC	37m	Bar71	Gai74	
25023.792 (10)		NH_2D	4(1,4)−4(0,4)	0.08	OriMC-1	MPI	100m	Wal87	Coh82	N
25056.025 (5)		NH_3	6(6)−6(6)	0.17[j]	OriMC-1	NEROC	37m	Bar77	Kak75	
25124.873 (2)		CH_3OH	7(2)−7(1) E	1.5[i]	OriMC-1	NEROC	37m	Bar71	Gai74	
25294.411 (3)		CH_3OH	8(2)−8(1) E	0.7[i]	OriMC-1	NEROC	37m	Bar71	Gai74	
25421.036*(9)		DC_5N	10−9	0.027	TMC-1	NEROC	37m	Mac81		
25541.43 (10)		CH_3OH	9(2)−9(1) E	−0.17	W3(OH)	MPI	100m	Men86	Lee73	N
25715.182 (5)		NH_3	7(7)−7(7)	3.	OriMC-1	MPI	100m	Mau86	Poy75	
25878.18 (10)		CH_3OH	10(2)−10(1) E	0.9	OriMC-1	NRL	26m	Mat80	Lee73	
26518.981 (10)		NH_3	8(8)−8(8)	0.70	OriMC-1	MPI	100m	Ziu81	Poy75	
26626.534*(2)		HC_5N	10−9	1.0	TMC-1	NRAO	43m	Jen82		
27294.078*(1)		HC_3N	3−2 F=2−1	0.70	HCL2C	OSO	20m	Cer84		
27294.295*(1)		HC_3N	3−2 F=3−2	0.96	HCL2C	OSO	20m	Cer84		
27294.347*(1)		HC_3N	3−2 F=4−3	3.400	TMC-1	OSO	20m	Irv83a		
27477.943 (10)		NH_3	9(9)−9(9)	0.76	OriMC-1	MPI	100m	Ziu81	Poy75	
28532.31 (1)		C_4H	3−2 J=7/2−5/2 F=3−2	0.42	TMC-1	OSO	20m	Irv81	Gué82a	
28532.46 (1)		C_4H	3−2 J=7/2−5/2 F=4−3	0.49	TMC-1	OSO	20m	Irv81	Gué82a	
28571.37 (1)		C_4H	3−2 J=5/2−3/2 F=3−2	0.39	TMC-1	OSO	20m	Irv81	Gué82a	

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
28571.53	(2)	C_4H	$3-2\ J=5/2-3/2\ F=2-1$	0.23	TMC-1	OSO	20m	Irv81	Gué82a	
28919.929*	(6)	CH_3CCCN	7(1) − 6(1)	0.049	TMC-1	OSO	20m	Bro84		
28920.207*	(6)	CH_3CCCN	7(0) − 6(0)	0.053	TMC-1	OSO	20m	Bro84		
28974.781	(3)	H_2CO	$3(1,2)-3(1,3)\ F=2-2$	[b]	Sgr B2	n.r.		Wel70	Tak59	
28974.804	(2)	H_2CO	$3(1,2)-3(1,3)\ F=4-4$	n.r.[b]	Sgr B2	n.r.		Wel70	Tak59	
28974.814	(3)	H_2CO	$3(1,2)-3(1,3)\ F=3-3$	[b]	Sgr B2	n.r.		Wel70	Tak59	
29676.14	(2)	C_3N	$3-2\ J=7/2-5/2\ F=7/2-5/2$	0.11	TMC-1	OSO	20m	Fri80	Gué82a	
29676.28	(2)	C_3N	$3-2\ J=7/2-5/2\ F=9/2-7/2$	0.11	TMC-1	OSO	20m	Fri80	Gué82a	
29678.877*	(18)	^{34}SO	1(0) − 0(1)	0.25	L134N	OSO	20m	Ryd80		
29694.99	(2)	C_3N	$3-2\ J=5/2-3/2\ F=3/2-1/2$	0.04	TMC-1	OSO	20m	Fri80	Gué82a	
29695.14	(2)	C_3N	$3-2\ J=5/2-3/2\ F=7/2-5/2$	0.15	TMC-1	OSO	20m	Fri80	Gué82a	
30001.539*	(18)	SO	1(0) − 0(1)	0.44	Sgr B2	NRAO	11m	Got78		
31105.26	(10)	CH_3OCH_3	2(1,1) − 2(0,2) AE + EA	[b]	OriMC-1	NRL	26m	Sny74	Sny74	
31106.20	(5)	CH_3OCH_3	2(1,1) − 2(0,2) EE	0.2[b]	OriMC-1	NRL	26m	Sny74	Sny74	
31107.12	(10)	CH_3OCH_3	2(1,1) − 2(0,2) AA	[b]	OriMC-1	NRL	26m	Sny74	Sny74	
31583.706*	(6)	HC_7N	28 − 27	0.30	TMC-1	OSO	20m	Sne81		
31951.777*	(2)	HC_5N	12 − 11	1.77	TMC-1	OSO	20m	Sne81		
32627.221*	(60)	l-C_3H	$^2\Pi_{1/2}\ J=3/2-1/2, F=2-1b$	0.28	TMC-1	OSO	20m	Tha85	Tha85	
32634.336*	(60)	l-C_3H	$^2\Pi_{1/2}\ J=3/2-1/2, F=1-0b$	0.13	TMC-1	OSO	20m	Tha85	Tha85	
32660.614*	(60)	l-C_3H	$^2\Pi_{1/2}\ J=3/2-1/2, F=2-1a$	0.35	TMC-1	OSO	20m	Tha85	Tha85	
32663.312	(60)	l-C_3H	$^2\Pi_{1/2}\ J=3/2-1/2, F=1-0a$	0.17	TMC-1	OSO	20m	Tha85	Tha85	
33051.302*	(6)	CH_3CCCN	8(1) − 7(1)	0.043	TMC-1	OSO	20m	Bro84		
33051.621*	(6)	CH_3CCCN	8(0) − 7(0)	0.057	TMC-1	OSO	20m	Bro84		
34182.761*	(1)	CH_3CCH	2(1) − 1(1)	0.20	TMC-1	OSO	20m	Irv81		
34183.414*	(1)	CH_3CCH	2(0) − 1(0)	0.25	TMC-1	OSO	20m	Irv81		
34614.386*	(2)	HC_5N	13 − 12	1.50	TMC-1	OSO	20m	Sne81		
36169.24	(10)	CH_3OH	4(−1) − 3(0) E	12.5	Sgr B2	NRAO	11m	Lov76	Lee73	
36202.040*	(32)	SO	2(3) − 2(2)	0.4	OriMC-1	Parkes	64m	Bro80		
36306.63 *	(5)	$H^{13}CCCCCN$	14 − 13	0.036	TMC-1	NRO	45m	Tak90	Ale76	N
36309.629	(3)	SiS	2 − 1	0.5	IRC + 10216	MPI	100m	Gra81		
36392.238*	(1)	HC_3N	$4-3\ F=3-2$	1.7	TMC-1	Pushino	22m	Sor86		M
36392.332*	(1)	HC_3N	$4-3\ F=4-3$	3.1 [b]	TMC-1	Pushino	22m	Sor86		M
36392.365*	(1)	HC_3N	$4-3\ F=5-4$	[b]	TMC-1	Pushino	22m	Sor86		M
36793.739*	(1)	CH_3CN	$2(1)-1(1)\ F=2-1$	[b]	Sgr B2	Parkes	64m	Bla77		
36794.204*	(1)	CH_3CN	$2(0)-1(0)\ F=2-2$	[b]	Sgr B2	Parkes	64m	Bla77		
36794.340*	(1)	CH_3CN	$2(1)-1(1)\ F=2-2$	[b]	Sgr B2	Parkes	64m	Bla77		
36794.417*	(1)	CH_3CN	$2(0)-1(0)\ F=1-0$	[b]	Sgr B2	Parkes	64m	Bla77		
36795.021*	(1)	CH_3CN	$2(1)-1(1)\ F=3-2$	0.98[b]	Sgr B2	Parkes	64m	Bla77		
36795.475*	(1)	CH_3CN	$2(0)-1(0)\ F=2-1$	[b]	Sgr B2	Parkes	64m	Bla77		
36795.568*	(1)	CH_3CN	$2(0)-1(0)\ F=3-2$	[b]	Sgr B2	Parkes	64m	Bla77		
36796.348*	(1)	CH_3CN	$2(1)-1(1)\ F=1-0$	[b]	Sgr B2	Parkes	64m	Bla77		
36797.581*	(1)	CH_3CN	$2(0)-1(0)\ F=1-1$	[b]	Sgr B2	Parkes	64m	Bla77		
36810.1 *	(1)	SiC_4	12 − 11	0.03	TMC-1	NRO	45m	Ohi89	Ohi89	N
36894.99 *	(5)	$HC^{13}CCCCN$	14 − 13	0.032	TMC-1	NRO	45m	Tak90	Ale76	N
36908.73 *	(5)	$HCCCC^{13}CN$	14 − 13	0.058	TMC-1	NRO	45m	Tak90	Ale76	N
37238.39 *	(5)	$HCC^{13}CCCN$	14 − 13	0.042	TMC-1	NRO	45m	Tak90	Ale76	N
37242.92 *	(5)	$HCCC^{13}CCN$	14 − 13	0.044	TMC-1	NRO	45m	Tak90	Ale76	N
37276.985*	(3)	HC_5N	14 − 13	2.09	TMC-1	NRO	45m	Suz84a		
37290.145*	(12)	HCCCHO	4(0,4) − 3(0,3)	0.043	TMC-1	NRAO	43m	Irv88		N
37703.72	(10)	CH_3OH	7(−2) − 8(−1) E	4.0Jy	W3(OH)	NEROC	37m	Has89	Hug51	N
38293.50	(10)	CH_3OH	6(2) − 5(3) A−	9.0Jy	W3(OH)	NEROC	37m	Has89	Hug51	N
38452.60	(10)	CH_3OH	6(2) − 5(3) A+	15.0Jy	W3(OH)	NEROC	37m	Has89	Hug51	N
38866.423*	(4)	C_2S	3,3 − 2,2	0.43	TMC-1	NRO	45m	Kai87	Yam90	N
39877.6 *	(1)	SiC_4	13 − 12	0.02	TMC-1	NRO	45m	Ohi89	Ohi89	N
39939.575*	(5)	HC_5N	15 − 14	1.8	TMC-1	NRO	45m	Tak90	Ale76	N
40198.356	(30)	C_6H	$^2\Pi_{3/2}\ J=29/2-27/2$ f	0.084	TMC-1	NRO	45m	Suz86	Suz86	N
40204.150	(30)	C_6H	$^2\Pi_{3/2}\ J=29/2-27/2$ e	0.87	TMC-1	NRO	45m	Suz86	Suz86	N
40232.796		CH_2CN	$3/2-1/2\ F_1=3/2-1/2\ F=5/2-3/2$	0.038	TMC-1	NRO	45m	Irv88a	Irv88a	N
40239.188		CH_2CN	$5/2-3/2\ F_1=7/2-5/2\ F=5/2-3/2$	0.112	TMC-1	NRO	45m	Irv88a	Irv88a	N
40239.684		CH_2CN	$5/2-3/2\ F_1=7/2\ 5/2\ F=7/2-5/2$	0.141	TMC-1	NRO	45m	Irv88a	Irv88a	N
40239.993		CH_2CN	$5/2-3/2\ F_1=7/2\ 5/2\ F=9/2-7/2$	0.241	TMC-1	NRO	45m	Irv88a	Irv88a	N
40240.520		CH_2CN	$5/2-3/2\ F_1=5/2-5/2\ F=7/2-7/2$	0.062	TMC-1	NRO	45m	Irv88a	Irv88a	N
40241.360		CH_2CN	$5/2-3/2\ F_1=3/2-3/2\ F=3/2-5/2$	[b]	TMC-1	NRO	45m	Irv88a	Irv88a	N
40241.360		CH_2CN	$5/2-3/2\ F_1=5/2-3/2\ F=3/2-1/2$	0.034	TMC-1	NRO	45m	Irv88a	Irv88a	N
40242.208		CH_2CN	$5/2-3/2\ F_1=5/2-3/2\ F=5/2-3/2$	0.066	TMC-1	NRO	45m	Irv88a	Irv88a	N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
40243.207		CH_2CN	5/2–3/2 F_1=5/2–5/2 F=3/2–5/2	[b]	TMC-1	NRO	45m	Irv88a	Irv88a	I
40243.207		CH_2CN	5/2–3/2 F_1=3/2–3/2 F=5/2–3/2	0.103	TMC-1	NRO	45m	Irv88a	Irv88a	I
40244.330		CH_2CN	5/2–3/2 F_1=5/2–3/2 F=7/2–5/2	0.098	TMC-1	NRO	45m	Irv88a	Irv88a	I
40247.556		CH_2CN	3/2–1/2 F_1=5/2–3/2 F=5/2–3/2	[b]	TMC-1	NRO	45m	Irv88a	Irv88a	I
40247.556		CH_2CN	3/2–3/2 F_1=5/2–3/2 F=7/2–5/2	0.206[b]	TMC-1	NRO	45m	Irv88a	Irv88a	I
40465.012*(5)		C_3S	7–6	0.88	TMC-1	NRO	45m	Kai87		I
U 40880.0		unidentified		0.07	Sgr B2	NRAO	11m	Kut80		
42215.539*(5)		DC_3N	5–4 F=4–3	[b]	TMC-1	FCRAO	14m	Lan80		
42215.590*(5)		DC_3N	5–4 F=5–4	0.14[b]	TMC-1	FCRAO	14m	Lan80		
42215.613*(5)		DC_3N	5–4 F=6–5	[b]	TMC-1	FCRAO	14m	Lan80		
42373.359*(10)		^{30}SiO	1–0	28. Jy	VY CMa	CAdY	13.7m	Bar89		N
42519.379*(17)		SiO	1–0 v=3	2.0	VX Sgr	IRT	13.7m	Sca78		
42602.153*(3)		HC_5N	16–15	0.40	TMC-1	NEROC	37m	Irv83		
42674.205*(21)		HCS^+	1–0	0.085	TMC-1	NEROC	37m	Irv83		
42820.587*(15)		SiO	1–0 v=2	15.[i]	VY CMa	NRAO	11m	Buh74		
42879.916*(10)		^{29}SiO	1–0	3.1Jy	VY CMa	CAdY	13.7m		Bar89	N
42945.0 *(1)		SiC_4	14–13	0.03	TMC-1	NRO	45m	Ohi89	Ohi89	N
42970.453 (30)		C_6H	31/2–29/2 f	0.108	TMC-1	NRO	45m	Suz86	Suz86	N
42977.115 (30)		C_6H	31/2–29/2 e	0.13	TMC-1	NRO	45m	Suz86	Suz86	N
43122.080*(12)		SiO	1–0 v=1	29.[i]	OriMC-1	NRAO	11m	Sny75		
43423.858*(10)		SiO	1–0 v=0	0.50	OriMC-1	NEROC	37m	Sny78		
43962.998*(2)		HNCO	2(0,2)–1(0,1) F=3–2	<1[b]	Sgr B2	NRAO	11m	Sny72	Win76	
43963.042*(2)		HNCO	2(0,2)–1(0,1) F=2–1	[b]	Sgr B2	NRAO	11m	Sny72	Win76	
43981.023*(6)		C_2S	3,4–2,3	0.38	TMC-1	NRO	45m	Kai87	Yam90	N
44069.49 (10)		CH_3OH	7(0)–6(1) A+	3.9	Sgr B2	NRO	45m	Mor85	Sas84	
44497.599 (5)		CC34S	4,3–3,2	0.13	L1498	NRO	45m	Yam90	Yam90	N
44596.995*(8)		CH_3CH_2CN	5(0,5)–4(0,4)	0.31	OriMC-1	NRO	45m	Sai89		N
44730.273*(8)		CH_3CH_2CN	5(2,4)–4(2,3)	0.23	OriMC-1	NRO	45m	Sai89		N
44878.106*(8)		CH_3CH_2CN	5(2,3)–4(2,2)	0.30	OriMC-1	NRO	45m	Sai89		N
44911.75 (1)		HCOOH	2(0,2)–1(0,1)	0.044	L134N	NRO	45m	Irv90	Bel71	N
44955.81 (10)		CH_3OH	2(0)–3(1) E ν_t=1	0.85	OriMC-1	NRO	45m	Sai89	Sas84	N
45264.721*(3)		HC_5N	17–16	0.83	TMC-1	NRAO	11m	Buj81		
45379.033*(2)		C_2S	4,3–3,2	2.23	TMC-1	NRO	45m	Suz84	Yam90	M
45490.264*(1)		HC_3N	5–4 F=4–3	[b]	Sgr B2	NRAO	11m	Mor76		
45490.316*(1)		HC_3N	5–4 F=5–4	2.05[j]	Sgr B2	NRAO	11m	Mor76		
45490.340*(1)		HC_3N	5–4 F=6–5	[b]	Sgr B2	NRAO	11m	Mor76		
46245.621*(5)		C_3S	8–7	0.84	TMC-1	NRO	45m	Kai87		N
46247.578*(8)		^{13}CS	1–0	0.148	Sgr B2	NRAO	11m	Tur73		
46755.621*(6)		C_3H_2	2(1,1)–2(0,2)	1.00	TMC-1	NRO	45m	Suz85	Vrt87a	
47534.170 (20)		$HCOOCH_3$	4(0,4)–3(0,3) E	0.25	OriMC-1	NRO	45m	Sai89	Bau79	N
47536.992 (20)		$HCOOCH_3$	4(0,4)–3(0,3) A	0.23	OriMC-1	NRO	45m	Sai89	Bau79	N
47566.80 *(2)		C_4H	5–4 J=11/2–9/2	0.10	Sgr B2	NRO	45m	Sai89		N
47605.49 *(2)		C_4H	5–4 J=9/2–7/2	0.09	Sgr B2	NRO	45m	Sai89		N
47660.704*(17)		SO_2	31(5,27)–30(6,24)	0.08	OriMC-1	NRO	45m	Sai89		N
47674.95 *(2)		CH_3OCH_3	1(1,1)–0(0,0) EE	0.09	OriMC-1	NRO	45m	Sai89		N
47746.83 *(5)		CH_3CHO	1(1,0)–1(0,1) E	0.06	Sgr B2	NRO	45m	Sai89		N
U 47751.9		unidentified	(U45048.1 LSB)	0.13	OriMC-1	NRO	45m	Sai89		N
47820.666 (40)		CH_3CHO	1(1,0)–1(0,1) A	0.06	Sgr B2	NRO	45m	Sai89	Kle91	N
47913.440*(10)		SO_2	14(2,12)–13(3,11)	1.15	OriMC-1	NRO	45m	Sai89		N
47927.275*(3)		HC_5N	18–17	1.50	TMC-1	NRO	45m	Suz84a		
U 47935.5		unidentified	(U44864.5 LSB))	0.04	OriMC-1	NRO	45m	Sai89		N
U 47976.5		unidentified	(U45033.5 LSB)	0.10	OriMC-1	NRO	45m	Sai89		N
48108.475*(5)		C_3O	5–4	0.158	TMC-1	NRO	45m	Suz84a		M
48120.485*(29)		SO_2	21(2,20)–20(3,17)	0.39	OriMC-1	NRO	45m	Sai89		N
48178.333*(6)		CH_3OH	1(0)–0(0) E ν_t=2	0.03	OriMC-1	NRO	45m	Sai89	And90	N
48192.12 (10)		CH_3OH	1(0)–0(0) A ν_t=2	0.06	OriMC-1	NRO	45m	Sai89	Ven55	N
48206.956*(7)		$C^{34}S$	1–0	0.58	OriMC-1	NRO	45m	Sai89		N
48206.956*(7)		$C^{34}S$	1–0	0.380	DR21 (OH)	NRAO	11m	Tur73		
48247.536*(5)		CH_3OH	1(0)–0(0) E ν_t=1	0.23	OriMC-1	NRO	45m	Sai89	And90	N
48257.49 (10)		CH_3OH	1(0)–0(0) E ν_t=1	0.09	OriMC-1	NRO	45m	Sai89	Ven55	N
48284.521*(8)		H_2CO	4(1,3)–4(1,4)	2.92	OriMC-1	NRO	45m	Sai89		N
48284.521*(8)		H_2CO	4(1,3)–4(1,4)	0.63	OriMC-1	NRAO	11m	Hol77		
U 48292.3		unidentified	(U44507.7 LSB)	0.06	OriMC-1	NRO	45m	Sai89		N
48372.4670(2)		CH_3OH	1(0)–0(0) A+	0.44	OriMC-1	NRAO	11m	Hol77	Heu73	
48376.893*(4)		CH_3OH	1(0)–0(0) E	0.29	OriMC-1	NRAO	11m	Hol77	And90	M

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
48583.264	(10)	$C^{33}S$	1 – 0 F = 1/2 – 3/2	[b]	Sgr B2	NRAO	11m	Tur73	Moc55	
48585.906	(10)	$C^{33}S$	1 – 0 F = 5/2 – 3/2	< 0.12[b]	Sgr B2	NRAO	11m	Tur73	Moc55	
48589.068	(10)	$C^{33}S$	1 – 0 F = 3/2 – 3/2	[b]	Sgr B2	NRAO	11m	Tur73	Moc55	
48651.6043	(10)	OCS	4 – 3	0.45	Sgr B2	NRAO	11m	Hol77	Dub80	
48990.964*	(9)	CS	1 – 0	3.53	OriMC-1	NRAO	11m	Tur73		
49079.8 *	(1)	SiC_4	16 – 15	0.02	TMC-1	NRO	45m	Ohi89	Ohi89	N
51841.406*	(5)	C_3H_2	1(1,1) – 0(0,0)	1.5	TMC-1	FCRAO	14m	Mad86a		N
58886.0 *	(1)	SiC_4	28 – 27	0.04	TMC-1	NRO	45m	Ohi89	Ohi89	N
67768.761*	(35)	$^{34}SO_2$	6(1,5) – 6(0,6)	0.06	OriMC-1	NRAO	12m	Pet91		N
68305.620	(10)	CH_3OH	1,1 – 2,0 E	0.35	OriMC-1	NRAO	12m	Hol89	Sas84	N
U 68320.		unidentified		0.03	OriMC-1	NRAO	12m	Hol89	Lov82b	N
68354.502	(5)	CH_3CCH	4,3 – 3,3	0.05	OriMC-1	NRAO	12m	Hol89	Dub78	N
68361.035	(1)	CH_3CCH	4,2 – 3,2	0.06	OriMC-1	NRAO	12m	Hol89	Dub78	N
68364.955	(1)	CH_3CCH	4,1 – 3,1	[b]	OriMC-1	NRAO	12m	Hol89	Dub78	N
68366.264*	(1)	CH_3CCH	4,0 – 3,0	0.18[b]	OriMC-1	NRAO	12m	Hol89		N
68371.278*	(41)	CH_2	4(0,4) – 3(1,3) J = 5 – 4 F = 6 – 5	0.017	OriMC-1	NRAO	12m	Hol89	Lov82b	N
68375.875*	(39)	CH_2	4(0,4) – 3(1,3) J = 5 – 4 F = 5 – 4	0.012	OriMC-1	NRAO	12m	Hol89	Lov82b	N
68972.154*	(4)	SO_2	6(1,5) – 6(0,6)	0.8	OriMC-1	NRAO	11m	Joh76		
U 69460.		unidentified		0.18	OriMC-1	NRAO	11m	Tur89		N
69464.094*	(9)	SO_2	14(4,10) – 15(3,13)	0.70	OriMC-1	OSO	20m	Sch83		
69534.310*	(12)	CH_3CH_2CN	8(1,8) – 7(1,7)	0.20	OriMC-1	OSO	20m	Joh84		
69575.927*	(3)	SO_2	1(1,1) – 0(0,0)	0.6	OriMC-1	NRAO	11m	Joh76		
U 69591.		unidentified		n.r.	OriMC-1	NRAO	11m	Tur89		N
69607.15	(10)	CH_3OH	9(1) – 10(2) A+ ν_t = 1	0.30	OriMC-1	OSO	20m	Joh84		
69653.586*	(5)	SO_2	3(2,2) – 4(1,3)	0.60	OriMC-1	OSO	20m	Sch83		
70260.197*	(28)	SiC_2	3(0,3) – 2(0,2)	0.08	Sgr B2	NRAO	11m	Tur89		N
U 70525.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
70534.033*	(9)	$H^{13}CCCN$	9 – 8	0.24	Sgr B2	NRAO	11m	Tur89		N
U 70540.		unidentified		0.13	Sgr B2	NRAO	11m	Tur89		N
U 70592.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
70680.720*	(38)	CH_2	4(0,4) – 3(1,3) J = 4 – 3 F = 5 – 4	0.028	OriMC-1	NRAO	12m	Hol89	Lov82b	N
70733.213*	(52)	$D^{13}CO^+$	1 – 0	0.079	TMC-1	BTL	7m	Gué82b		
70762.542*	(22)	SiC_2	3(2,2) – 2(2,1)	0.10	IRC+10216	NRAO	12m	Hol89		N
70844.421*	(44)	CH_3OCH_3	3(3,0) – 4(2,3) AA	[b]	Sgr B2	NRAO	11m	Tur89		N
70845.85 *	(7)	CH_3OCH_3	3(3,0) – 4(2,3) EE	0.06[b]	Sgr B2	NRAO	11m	Tur89		N
70847.665*	(10)	CH_3OCH_3	3(3,0) – 4(2,3) AE	[b]	Sgr B2	NRAO	11m	Tur89		N
70926.03 *	(14)	$^{33}SO_2$	23(3,21) – 22(4,18)	0.05	OriMC-1	NRAO	11m	Tur89		N
70976.810*	(9)	CH_3CH_2OH	5(2,3) – 5(1,4)	0.06[b]	Sgr B2	NRAO	11m	Tur89		N
70979.630*	(11)	CH_3CH_2CN	8(0,8) – 7(0,7)	[b]	Sgr B2	NRAO	11m	Tur89		N
71024.781*	(4)	$H_2{}^{13}CO$	1(0,1) – 0(0,0)	0.06	OriMC-1	BTL	7m	Kah84		
U 71055.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U 71067.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
U 71208.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
U 71228.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
71324.72 *	(5)	$HCOOCH_3$	17(4,13) – 17(3,14) A	[b]	OriMC-1	NRAO	11m	Tur89	Plu84	N
71324.81 *	(1)	HCOOH	3(1,2) – 3(0,3)	0.04[b]	OriMC-1	NRAO	11m	Tur89		N
U 71362.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
U 71406.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U 71414.		unidentified		0.3	Sgr B2	NRAO	11m	Tur89		N
71464.138*	(33)	$^{13}CH_3CN$	4(1) – 3(1)	[b]	Sgr B2	NRAO	11m	Tur91		N
71465.497*	(34)	$^{13}CH_3CN$	4(0) – 3(0)	0.03 [b]	Sgr B2	NRAO	11m	Tur91		N
71500.531*	(11)	CH_3CH_2CN	8(2,7) – 7(2,6)	0.11	OriMC-1	NRAO	11m	Tur89		N
71514.65 *	(18)	$^{33}SO_2$	27(4,24) – 26(5,21)	0.15	OriMC-1	NRAO	11m	Tur89		N
U 71617.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
71627.848*	(37)	SO_2	6(0,6) – 5(1,5) ν_2 = 1	0.03	OriMC-1	NRAO	11m	Tur89		N
71643.170*	(11)	CH_3CH_2CN	8(5) – 7(5)	0.09[b]	OriMC-1	NRAO	11m	Tur89		N
71643.197*	(11)	CH_3CH_2CN	8(6) – 7(6)	[b]	OriMC-1	NRAO	11m	Tur89		N
71674.927*	(11)	CH_3CH_2CN	8(3,6) – 7(3,5)	0.10	OriMC-1	NRAO	11m	Tur89		N
71692.942*	(11)	CH_3CH_2CN	8(3,5) – 7(3,4)	0.06	OriMC-1	NRAO	11m	Tur89		N
71703.65 *	(13)	$HCOOCH_3$	6(3,4) – 6(2,5) E	0.05	OriMC-1	NRAO	11m	Tur89		N
U 71732.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
71743.90 *	(5)	$HCOOCH_3$	6(3,4) – 6(2,5) A	0.12	Sgr B2	NRAO	11m	Tur89		N
71889.596*	(4)	HC_5N	27 – 26	0.15	Sgr B2	NRAO	11m	Tur89		N
71971.61 *	(14)	CH_3CH_2OH	10(1,9) – 10(0,10)	0.05	Sgr B2	BTL	7m	Cum86		
72039.331*	(13)	DCO^+	1 – 0	0.87	L134	NRAO	11m	Hol76		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
U 72075.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
72108.609*(11)		CH_3CH_2CN	8(2,6)–7(2,5)	0.07	Sgr B2	BTL	7m	Cum86		
72298.70 *(25)		CH_3OCH_3	10(1,9)–10(0,10) AE+EA	[b]	OriMC-1	NRAO	11m	Tur89		N
72300.12 *(13)		CH_3OCH_3	10(1,9)–10(0,10) EE	0.05[b]	OriMC-1	NRAO	11m	Tur89		N
72301.53 *(7)		CH_3OCH_3	10(1,9)–10(0,10) AA	[b]	OriMC-1	NRAO	11m	Tur89		N
U 72403.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
72409.092*(12)		H_2CO	5(1,4)–5(1,5)	0.1	OriMC-1	NRAO	11m	Wil73		
72413.4843(10)		DCN	1–0 F'=1–1 F=1–0,1,2	[b]	OriMC-1	NRAO	11m	Wil73	DeL69	
72413.5143(10)		DCN	1–0 F'=1–1 F=2–1,2	0.2[b]	OriMC-1	NRAO	11m	Wil73	DeL69	
72413.5584(10)		DCN	1–0 F'=1–1 F=0–0,1	[b]	OriMC-1	NRAO	11m	Wil73	DeL69	
72414.9054(10)		DCN	1–0 F'=2–1 F=1–0,1,2	[b]	OriMC-1	NRAO	11m	Wil73	DeL69	
72414.9270(10)		DCN	1–0 F'=2–1 F=2–1,2	0.25[b]	OriMC-1	NRAO	11m	Wil73	DeL69	
72414.9732(10)		DCN	1–0 F'=2–1 F=3–2	[b]	OriMC-1	NRAO	11m	Wil73	Del69	
72417.0297(10)		DCN	1–0 F'=0–1 F=1–0.1.2	0.2	OriMC-1	NRAO	11m	Wil73	Del69	
U 72420.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
U 72426.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
72475.074*(11)		$HC^{13}CCN$	8–7	0.08	IRC+10216	OSO	20m	Joh84		
72482.056*(5)		$HCC^{13}CN$	8–7	0.08	IRC+10216	OSO	20m	Joh84		
U 72500.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
72568.90	(10)	CH_3NH_2	6(1,6)–6(0,6)	0.08	Sgr B2	NRAO	11m	Tur89	Tak71	N
U 72578.		unidentified		0.13	OriMC-1	NRAO	11m	Tur89		N
72618.102*(10)		SiS	4–3	0.77	IRC+10216	OSO	20m	Joh84		
72668.123*(24)		SO_2	26(4,22)–25(5,21)	0.30	OriMC-1	OSO	20m	Sch83		
72680.83 *(2)		$HCOOCH_3$	6(2,5)–5(2,4) E	0.18	OriMC-1	OSO	20m	Joh84	Plu86	M
72685.56 *(10)		$HCOOCH_3$	6(2,5)–5(2,4) A	0.18	OriMC-1	OSO	20m	Joh84	Plu84	M
U 72707.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
U 72721.		unidentified		0.15	OriMC-1	OSO	20m	Joh84		
72758.242*(2)		SO_2	6(0,6)–5(1,5)	0.8	OriMC-1	NRAO	11m	Joh76		
72783.824*(2)		HC_3N	8–7	2.29	Sgr B2	NRAO	11m	Mor76		
U 72823.		unidentified		0.15	Sgr B2	NRAO	11m	Tur89		N
72837.950*(5)		H_2CO	1(0,1)–0(0,0)	0.5	OriMC-1	TAO	6m	Aka74		
U 72942.		unidentified		0.20	OriMC-1	NRAO	11m	Tur89		N
72962.731*(23)		HC_3N	8–7 v_7=1 ℓ=1e	0.15	OriMC-1	OSO	20m	Joh84		
72976.7794(10)		OCS	6–5	0.25	Sgr B2	TAO	6m	Aka74	Dub80	
73001.940*(12)		CH_3CH_2OH	14(3,11)–13(4,10)	0.08	OriMC-1	NRAO	11m	Tur89		N
U 73013.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
73044.01	(10)	CH_3NH_2	5(1,5)–5(0,5) F=4–4	[b]	Sgr B2	TAO	6m	Kai74	Kai74	
73044.20	(10)	CH_3NH_2	5(1,5)–5(0,5) F=6–6	0.5[b]	Sgr B2	TAO	6m	Kai74	Kai74	
73045.15	(10)	CH_3NH_2	5(1,5)–5(0,5) F=5–5	[b]	Sgr B2	TAO	6m	Kai74	Kai74	
73081.190*(8)		CH_3CH_2OH	4(2,2)–4(1,3)	0.11	Sgr B2	BTL	7m	Cum86		M
U 73101.		unidentified	(real?)	0.08	Sgr B2	NRAO	11m	Tur89		N
U 73152.		unidentified		0.03	Sgr B2	NRAO	11m	Tur91		N
73161.972*(39)		SO_2	3(2,2)–4(1,3) v_2=1	0.04	OriMC-1	NRAO	11m	Tur89		N
U 73178.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
73245.034*(38)		HC_3N	8–7 v_7=2 ℓ=0	0.03[b]	Sgr B2	NRAO	11m	Tur91		N
73245.435*(42)		HC_3N	8–7 v_7=2 ℓ=2e	[b]	Sgr B2	NRAO	11m	Tur91		N
73246.708*(40)		HC_3N	8–7 v_7=2 ℓ=2f	[b]	Sgr B2	NRAO	11m	Tur91		N
73315.91 *(19)		HC_7N	65–64	0.05	OriMC-1	NRAO	11m	Tur89		N
U 73338.		unidentified	(real?)	0.03	Sgr B2	NRAO	11m	Tur89		N
73346.31 *(11)		CH_3CH_2CN	8(1,7)–7(1,6)	0.03	OriMC-1	NRAO	11m	Tur89		N
73460.7	(10)	C_6H	$^2\Pi_{3/2}$ J=53/2–51/2 f	0.04	IRC+10216	IRAM	30m	Gué87	Cer87a	N
U 73462.		unidentified		0.08	Sgr B2	NRAO	11m	Tur89		N
73466.93 *(10)		CH_3OCH_3	10(2,8)–10(1,9) EA+AE	[b]	OriMC-1	OSO	20m	Joh84		
73468.71 *(5)		CH_3OCH_3	10(2,8)–10(1,9) EE	0.20[b]	OriMC-1	OSO	20m	Joh84		
73470.49 *(5)		CH_3OCH_3	10(2,8)–10(1,9) AA	[b]	OriMC-1	OSO	20m	Joh84		
73481.2	(10)	C_6H	$^2\Pi_{3/2}$ J=53/2–51/2 e	0.03	IRC+10216	IRAM	30m	Gué87	Cer87a	N
73552.419*(5)		$CH_3{}^{13}CN$	4(1)–3(1)	[b]	Sgr B2	NRAO	11m	Tur89		N
73553.828*(5)		$CH_3{}^{13}CN$	4(0)–3(0)	0.06[b]	Sgr B2	NRAO	11m	Tur89		N
73577.454*(1)		CH_3CN	4(3)–3(3)	0.83	OriMC-1	OSO	20m	Joh84		M
73584.546*(1)		CH_3CN	4(2)–3(2)	1.00	OriMC-1	OSO	20m	Joh84		M
73588.802*(1)		CH_3CN	4(1)–3(1)	2.20[b]	OriMC-1	OSO	20m	Joh84		M
73590.221*(1)		CH_3CN	4(0)–3(0)	[b]	OriMC-1	OSO	20m	Joh84		M
73605.385*(26)		CH_2CHCN	14(1,13)–14(0,14)	0.14	OriMC-1	NRAO	12m	Hol89		N
73612.1	*(2)	$^{33}SO_2$	6(0,6)–5(1,5)	0.06	OriMC-1	NRAO	12m	Hol89		N
73658.27 *(2)		$HCOOCH_3$	6(5,1)–5(5,0) E	0.04	OriMC-1	NRAO	12m	Hol89	Plu86	N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
73663.99	*(2)	$HCOOCH_3$	6(5,2) – 5(5,1) E	[b]	OriMC-1	OSO	20m	Joh84	Plu86	M
73665.59	*(10)	$HCOOCH_3$	6(5,2) – 5(5,1) A	0.15[b]	OriMC-1	OSO	20m	Joh84	Plu84	M
73665.73	*(10)	$HCOOCH_3$	6(5,1) – 5(5,0) A	[b]	OriMC-1	OSO	20m	Joh84	Plu84	M
U 73699.		unidentified		0.03	OriMC-1	NRAO	12m	Hol89		N
73720.51	*(15)	CH_3OCH_3	9(2,7) – 9(1,8) AE + EA	[b]	OriMC-1	OSO	20m	Joh84		
73722.40	*(5)	CH_3OCH_3	9(2,7) – 9(1,8) EE	0.25[b]	OriMC-1	OSO	20m	Joh84		
73724.28	*(4)	CH_3OCH_3	9(2,7) – 9(1,8) AA	[b]	OriMC-1	OSO	20m	Joh84		
U 73766.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
73783.00	*(2)	$HCOOCH_3$	6(4,2) – 5(4,1) E	[b]	OriMC-1	OSO	20m	Joh84	Plu86	M
73784.51	*(10)	$HCOOCH_3$	6(4,3) – 5(4,2) A	0.15[b]	OriMC-1	OSO	20m	Joh84	Plu84	M
73787.60	*(2)	$HCOOCH_3$	6(4,3) – 5(4,2) E	[b]	OriMC-1	OSO	20m	Joh84	Plu86	M
73796.78	*(10)	$HCOOCH_3$	6(4,2) – 5(4,1) A	0.10	OriMC-1	OSO	20m	Joh84	Plu84	M
73810.008	*(7)	CH_3CN	4(0) – 3(0) $\nu_8=1$ $\ell=1$	0.03[b]	OriMC-1	NRAO	11m	Tur91		N
73811.589	*(8)	CH_3CN	4(2) – 3(2) $\nu_8=1$ $\ell=1$	[b]	OriMC-1	NRAO	11m	Tur91		N
73842.	(1)	CH_3OH	9(1) – 10(2) A – $\nu_t=1$	0.30	OriMC-1	OSO	20m	Joh84		
73883.939	*(33)	SO_2	4(2,2) – 5(1,5) $\nu_2=1$	[b]	OriMC-1	NRAO	11m	Tur89		N
73885.032	*(34)	$HCOOCH_3$	6(3,4) – 5(3,3) A	0.12[b]	OriMC-1	NRAO	11m	Tur89		N
73905.90	*(3)	$HCOOCH_3$	6(3,4) – 5(3,3) E	0.12	OriMC-1	NRAO	11m	Tur89	Plu86	N
73967.7	(3)	C_6H	$^2\Pi_{1/2}$ $J=53/2-51/2$ f	1.3 [f]	IRC+10216	IRAM	30m	Cer86	Cer87a	N
73981.562	*(18)	CH_2CHCN	8(1,8) – 7(1,7)	0.04	Sgr B2	NRAO	11m	Tur89		N
73993.8	(3)	C_5H	$^2\Pi_{1/2}$ $J=31/2-29/2$ a	2.0 [f]	IRC+10216	IRAM	30m	Cer86	Cer86	N
73998.9	(4)	C_5H	$^2\Pi_{1/2}$ $J=31/2-29/2$ b	1.9 [f]	IRC+10216	IRAM	30m	Cer86	Cer86	N
74008.5	(3)	C_6H	$^2\Pi_{1/2}$ $J=53/2-51/2$ e	1.3 [f]	IRC+10216	IRAM	30m	Cer86	Cer87a	N
U 74034.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U 74040.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
74111.31	*(6)	$HCNH^+$	1 – 0	0.10	Sgr B2	NRAO	12m	Ziu86a	Bog85a	N
74141.7	(3)	C_4H	$^2\Pi_{1/2}$ $J=15/2-13/2$ $\nu_7=1$e	1.38[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
74149.26	*(14)	CH_3OCH_3	11(2,9) – 11(1,10) EA + AE	[b]	OriMC-1	OSO	20m	Joh84		
74150.95	*(9)	CH_3OCH_3	11(2,9) – 11(1,10) EE	0.30[b]	OriMC-1	OSO	20m	Joh84		
74152.64	*(5)	CH_3OCH_3	11(2,9) – 11(1,10) AA	[b]	OriMC-1	OSO	20m	Joh84		
74155.73	(10)	NH_2D	2(1,2) – 2(0,2) U	0.04	OriMC-1	NRAO	11m	Tur89	Del75	N
74263.48	*(3)	$HCOOCH_3$	6(3,3) – 5(3,2) E	0.15	OriMC-1	OSO	20m	Joh84	Plu86	M
74296.74	*(10)	$HCOOCH_3$	6(3,3) – 5(3,2) A	0.20	OriMC-1	OSO	20m	Joh84	Plu84	M
U 74395.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
74404.579	*(39)	$^{34}SO_2$	6(0,6) – 5(1,5)	0.30	OriMC-1	OSO	20m	Sch83		
74497.18	*(5)	C_5H	$^2\Pi_{3/2}$ $J=31/2-29/2$ a	5.2[fb]	IRC+10216	IRAM	30m	Cer86a	Got86	N
74498.62	*(5)	C_5H	$^2\Pi_{3/2}$ $J=31/2-29/2$ b	[b]	IRC+10216	IRAM	30m	Cer86a	Got86	N
74551.989	*(4)	HC_5N	28 – 27	0.30	IRC+10216	OSO	20m	Joh84		
U 74655.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U 74661.		unidentified		0.06	Sgr B2	NRAO	11m	Tur89		N
74747.51	*(16)	CH_3OCH_3	8(2,6) – 8(1,7) AE + EA	[b]	OriMC-1	OSO	20m	Joh84		
74749.50	*(10)	CH_3OCH_3	8(2,6) – 8(1,7) EE	0.20[b]	OriMC-1	OSO	20m	Joh84		
74751.49	*(4)	CH_3OCH_3	8(2,6) – 8(1,7) AA	[b]	OriMC-1	OSO	20m	Joh84		
74866.514	*(16)	SO_2	24(6,18) – 25(5,21)	0.20	OriMC-1	OSO	20m	Sch83		
74891.65	*(5)	CH_3CHO	4(1,4) – 3(1,3) A	0.13	Sgr B2	BTL	7m	Cum86	Kle91	M
74924.61	*(5)	CH_3CHO	4(1,4) – 3(1,3) E	0.07	Sgr B2	BTL	7m	Cum86	Kle91	M
74970.62	*(28)	CH_3OCH_3	12(4,7) – 13(5,8) AE	0.05[b]	OriMC-1	NRAO	11m	Tur89		N
74975.87	*(17)	CH_3OCH_3	12(4,7) – 13(5,8) AA	[b]	OriMC-1	NRAO	11m	Tur89		N
74976.040	*(8)	CH_3CH_2OH	3(1,3) – 2(0,2)	0.23	Sgr B2	BTL	7m	Cum86		
U 75052.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
75147.927	(20)	C_3S	13 – 12	2.3 [f]	IRC+10216	IRAM	30m	Cer87b	Yam87	N
75159.94	*(5)	CH_3CHO	6(0,6) – 5(1,5) A	0.08	OriMC-1	NRAO	11m	Tur89	Kle91	N
U 75200.		unidentified		0.24	OriMC-1	NRAO	11m	Tur89		N
U 75235.		unidentified		0.20	OriMC-1	NRAO	11m	Tur89		N
U 75406.		unidentified		0.04	Sgr B2	NRAO	11m	Wil81		
U 75428.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
U 75451.		unidentified		0.12	OriMC-1	NRAO	11m	Tur91		N
75515.35	(10)	CH_3OH	13(–5) – 14(–4) E	0.37	OriMC-1	OSO	20m	Joh84	Sas84	
75528.7	*(8)	HC_9N	130 – 129	0.06	Sgr B2	NRAO	11m	Tur89		N
75571.51	*(21)	HC_7N	67 – 66	0.05	OriMC-1	NRAO	11m	Tur89		N
75585.695	*(12)	CH_2CHCN	8(0,8) – 7(0,7)	0.10	Sgr B2	BTL	7m	Cum86		
U 75595.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
U 75656.		unidentified		0.12	OriMC-1	OSO	20m	Joh84		
U 75717.	?	unidentified		0.20	OriMC-1	NRAO	11m	Tur89		N
75816.45	(5)	CH_3SH	3(–1) – 2(–1) E	<0.05	Sgr B2	BTL	7m	Lin79	Lee80	

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
75838.867	*(10)	CH_2CHCN	8(2,7) – 7(2,6)	0.06	Sgr B2	BTL	7m	Cum86		I
75862.92	(7)	CH_3SH	3(0) – 2(0) A+	0.19	Sgr B2	BTL	7m	Lin79	Koj80	I
75864.43	(5)	CH_3SH	3(0) – 2(0) E	0.12	Sgr B2	BTL	7m	Lin79	Lee80	
75869.454	*(44)	$HCOOCH_3$	3(2,2) – 2(1,1) A	[b]	Sgr B2	NRAO	11m	Tur89		I
75880.49	(5)	CH_3SH	3(2) – 2(2) A+	0.07	Sgr B2	NRAO	11m	Tur89	Lee80	I
75906.42	*(14)	CH_3OCH_3	12(2,10) – 12(1,11) AE+EA	[b]	OriMC-1	OSO	20m	Joh84		
75908.03	*(10)	CH_3OCH_3	12(2,10) – 12(1,11) EE	0.30[b]	OriMC-1	OSO	20m	Joh84		
75909.65	*(7)	CH_3OCH_3	12(2,10) – 12(1,11) AA	[b]	OriMC-1	OSO	20m	Joh84		
75921.979	*(10)	CH_2CHCN	8(4,5) – 7(4,4)	[b]	Sgr B2	BTL	7m	Cum86		M
75922.001	*(10)	CH_2CHCN	8(4,4) – 7(4,3)	[b]	Sgr B2	BTL	7m	Cum86		M
75926.796	*(12)	CH_2CHCN	8(5) – 7(5)	[b]	Sgr B2	BTL	7m	Cum86		M
75927.706	*(10)	CH_2CHCN	8(3,6) – 7(3,5)	0.06[b]	Sgr B2	BTL	7m	Cum86		M
75931.858	*(10)	CH_2CHCN	8(3,5) – 7(3,4)	[b]	Sgr B2	BTL	7m	Cum86		M
75937.823	*(14)	CH_2CHCN	8(6) – 7(6)	0.13	Sgr B2	BTL	7m	Cum86		M
U 75979.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
75987.149	*(4)	DC_3N	9 – 8	0.11	TMC-1	FCRAO	14m	Sch81		
U 76090.		unidentified		0.10	OriMC-1	OSO	20m	Joh84		
76117.43	*(1)	C_4H	8 – 7 J = 17/2 – 15/2	0.17	IRC+10216	OSO	20m	Joh84	Got83	
76128.890	*(10)	CH_2CHCN	8(2,6) – 7(2,5)	0.10	OriMC-1	OSO	20m	Joh84		M
U 76152.		unidentified		0.10	OriMC-1	OSO	20m	Joh84		
76156.02	*(1)	C_4H	8 – 7 J = 15/2 – 13/2	0.17	IRC+10216	OSO	20m	Joh84	Got83	
U 76162.		unidentified		0.20	OriMC-1	NRAO	11m	Tur89		N
U 76168.		unidentified		0.12	OriMC-1	OSO	20m	Joh84		
76199.199	(60)	l-C_3H	$^2\Pi_{1/2}$ J = 7/2 – 5/2b	0.12	IRC+10216	OSO	20m	Tha85	Tha85	
76204.501	(60)	l-C_3H	$^2\Pi_{1/2}$ J = 7/2 – 5/2a	0.12	IRC+10216	OSO	20m	Tha85	Tha85	
76247.27	(19)	CH_3OH	11(1) – 10(2) A–	0.6	OriMC-1	NRAO	11m	Jen79	Sas84	
76305.727	(50)	DNC	1 – 0	0.34	NGC 2264	NRAO	11m	God77	Cre76	
76362.17	*(16)	CH_3OCH_3	7(2,5) – 7(1,6) AE+EA	[b]	OriMC-1	OSO	20m	Joh84		
76364.26	*(10)	CH_3OCH_3	7(2,5) – 7(1,6) EE	0.30[b]	OriMC-1	OSO	20m	Joh84		
76366.35	*(4)	CH_3OCH_3	7(2,5) – 7(1,6) AA	[b]	OriMC-1	OSO	20m	Joh84		
U 76379.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
76383.84	*(4)	HCOOD	6(1,5) – 6(0,6)	0.03	Sgr B2	NRAO	11m	Tur89		N
76405.14	(10)	CH_3OH	13(2) – 12(1) ν_t = 1	0.10	OriMC-1	NRAO	11m	Tur89	Sas84	N
76412.170	*(5)	SO_2	10(1,9) – 9(2,8)	2.5	OriMC-1	OSO	20m	Sch83		
U 76415.		unidentified		0.12	SGR B2	NRAO	11m	Tur91		N
U 76491.		unidentified		0.20	OriMC-1	NRAO	11m	Tur89		N
U 76499.		unidentified		0.10	OriMC-1	NRAO	11m	Tur91		N
76509.67	(10)	CH_3OH	5(0) – 4(1) E	0.6	OriMC-1	NRAO	11m	Jen79	Sas84	
76539.02	(10)	CH_3SH	7(0) – 6(1) A+	0.07	Sgr B2	NRAO	11m	Tur89	Lee80	N
U 76648.6	(15)	unidentified		0.09	Sgr B2	BTL	7m	Cum86		
76662.440	*(7)	CH_3CH_2OH	2(2,0) – 2(1,1)	0.07	Sgr B2	NRAO	11m	Tur89		N
76699.30	*(22)	HC_7N	68 – 67	0.05[b]	OriMC-1	NRAO	11m	Tur91		N
76701.82	*(2)	$HCOOCH_3$	6(2,4) – 5(2,3) E	0.25[b]	OriMC-1	OSO	20m	Ell80	Plu86	M
76711.14	*(10)	$HCOOCH_3$	6(2,4) – 5(2,3) A	0.22	OriMC-1	OSO	20m	Ell80	Plu84	M
76796.09	*(2)	$HCOOCH_3$	6(1,5) – 5(1,4) E	0.22	OriMC-1	OSO	20m	Joh84	Plu86	M
76803.99	*(10)	$HCOOCH_3$	6(1,5) – 5(1,4) A	0.23	OriMC-1	OSO	20m	Joh84	Plu84	M
76838.70	(10)	CH_3NH_2	3(1,3) – 3(0,3) Aa	0.05	OriMC-1	NRAO	11m	Tur89	Tak73	N
76866.43	*(5)	CH_3CHO	4(0,4) – 3(0,3) E	0.13[b]	Sgr B2	BTL	7m	Cum86	Kle91	M
76868.83	(5)	CH_3OD	6(1) – 5(2) E	[b]	Sgr B2	NRAO	11m	Tur89	Kau80	N
76878.91	*(5)	CH_3CHO	4(0,4) – 3(0,3) A	0.10	Sgr B2	BTL	7m	Cum86	Kle91	M
U 76966.		unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
76972.590	*(7)	C_3O	8 – 7	0.059	TMC-1	NRAO	12m	Bro85		M
77038.59	*(5)	CH_3CHO	4(2,3) – 3(2,2) A	0.04	Sgr B2	NRAO	11m	Tur89	Kle91	N
U 77071.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
77107.86	(9)	N_2D^+	1 – 0 F_1 = 1 – 1	0.25	L134N	NRAO	11m	Sny77	And77	
77109.61	(8)	N_2D^+	1 – 0 F_1 = 2 – 1	0.30	L134N	NRAO	11m	Sny77	And77	
77112.2	(1)	N_2D^+	1 – 0 F_1 = 0 – 1	0.15	L134N	NRAO	11m	Sny77	And77	
77125.69	*(5)	CH_3CHO	4(2,2) – 3(2,1) E	0.05[b]	OriMC-1	NRAO	11m	Tur89	Kle91	N
77126.35	*(5)	CH_3CHO	4(2,3) – 3(2,2) E	[b]	OriMC-1	NRAO	11m	Tur89	Kle91	N
77214.361	*(4)	HC_5N	29 – 28	0.25	IRC+10216	OSO	20m	Joh84		
77214.361	*(4)	HC_5N	29 – 28	[b]	Sgr B2	NRAO	11m	Tur89		N
77218.28	*(5)	CH_3CHO	4(2,2) – 3(2,1) A	0.17[b]	Sgr B2	NRAO	11m	Tur89	Kle91	N
77231.41	*(6)	$^{34}SO_2$	20(3,17) – 19(4,16)	0.04[b]	OriMC-1	NRAO	11m	Tur89		N
77235.170	(13)	CH_3CH_2OH	8(5,3) – 9(4,6)	0.03[b]	OriMC-1	NRAO	11m	Tur89		N
77271.38	*(84)	HC_9N	133 – 132	0.12	Sgr B2	NRAO	11m	Tur89		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
U 77290.		unidentified		0.12	Sgr B2	NRAO	11m	Tur89		N
U 77445.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
U 77458.		unidentified		0.04	Sgr B2	NRAO	11m	Tur89		N
U 77498.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U 77511.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
77633.828*	(12)	CH_2CHCN	8(1,7) – 7(1,6)	0.12	Sgr B2	BTL	7m	Cum86		M
U 77687.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
77731.727*	(6)	C_2S	6(6) – 5(5)	0.07	Sgr B2	NRAO	11m	Tur91	Yam90	N
U 77736.		unidentified		0.20	Sgr B2	NRAO	11m	Tur89		N
U 77744.		unidentified		0.14	Sgr B2	NRAO	11m	Tur89		N
77827.09 *	(24)	HC_7N	69 – 68	0.05	Sgr B2	NRAO	11m	Tur91		N
U 77976.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
U 77978.5	(13)	unidentified		0.13	Sgr B2	BTL	7m	Cum86		
U 77983.		unidentified		0.20	OriMC-1	OSO	20m	Joh84		
U 77988.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
U 78063.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
78068.36 *	(53)	$^{13}CH_3OH$	8(2) – 9(1) A+	0.04	OriMC-1	NRAO	11m	Tur89	And87	N
78183.631*	(12)	CH_3CH_2CN	9(1,9) – 8(1,8)	0.25	OriMC-1	OSO	20m	Joh84		
U 78262.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
78361.41 *	(15)	CH_3OCH_3	6(2,4) – 6(1,5) AE+EA	[b]	OriMC-1	OSO	20m	Joh84		
78363.59 *	(9)	CH_3OCH_3	6(2,4) – 6(1,5) EE	0.25[b]	OriMC-1	OSO	20m	Joh84		
78365.77 *	(4)	CH_3OCH_3	6(2,4) – 6(1,5) AA	[b]	OriMC-1	OSO	20m	Joh84		
78397.033*	(50)	$^{34}SO_2$	8(3,5) – 9(2,8)	0.05	OriMC-1	NRAO	11m	Tur91		N
U 78437.		unidentified		0.05	Sgr B2	NRAO	11m	Tur91		N
78479.38 *	(3)	$HCOOCH_3$	7(1,7) – 6(1,6) E	0.75[b]	OriMC-1	OSO	20m	Joh84	Plu86	M
78481.39 *	(3)	$HCOOCH_3$	7(1,7) – 6(1,6) A	0.65[b]	OriMC-1	OSO	20m	Joh84	Plu84	M
78517.42 *	(16)	$HCOOCH_3$	10(1,9) – 10(0,10) E	0.09	OriMC-1	NRAO	11m	Tur89		N
78633.507*	(33)	NH_2CHO	16(2,14) – 15(3,13)	0.04	OriMC-1	NRAO	11m	Tur89		N
U 78640.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
78711.366*	(49)	SO_2	19(5,15) – 20(4,16) $\nu_2=1$	0.05	OriMC-1	NRAO	11m	Tur89		N
U 78752.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
78856.40 *	(10)	CH_3OCH_3	13(2,11) – 13(1,12) AE+EA	[b]	OriMC-1	OSO	20m	Joh84		
78857.91 *	(8)	CH_3OCH_3	13(2,11) – 13(1,12) EE	0.38[b]	OriMC-1	OSO	20m	Joh84		
78859.43 *	(6)	CH_3OCH_3	13(2,11) – 13(1,12) AA	[b]	OriMC-1	OSO	20m	Joh84		
U 78867.		unidentified		0.04	OriMC-1	NRAO	11m	Tur91		N
78912.323*	(5)	C_3HD	2(1,2) – 1(0,1)	0.34	TMC-1	NRAO	12m	Ger87	Bog87	N
78954.87 *	(25)	HC_7N	70 – 69	0.03	Sgr B2	NRAO	11m	Tur91		N
79007.11	(10)	CH_3NH_2	1(1,1) – 1(0,1) Aa $F=0-1$	[b]	Sgr B2	NRAO	11m	Tur89		N
79008.70	(10)	CH_3NH_2	1(1,1) – 1(0,1) Aa $F=2-2$	0.08[b]	Sgr B2	NRAO	11m	Tur89		N
79010.36	(10)	CH_3NH_2	1(1,1) – 1(0,1) Aa $F=1-0$	[b]	Sgr B2	NRAO	11m	Tur89		N
79014.04 *	(89)	HC_9N	136 – 135	[b]	Sgr B2	NRAO	11m	Tur89		N
U 79055.		unidentified		0.03	Sgr B2	NRAO	11m	Tur91		N
79099.28 *	(5)	CH_3CHO	4(1,3) – 3(1,2) E	0.15	Sgr B2	BTL	7m	Cum86	Kle91	M
79150.13 *	(5)	CH_3CHO	4(1,3) – 3(1,2) A	0.3	Sgr B2	NRAO	11m	Lis78	Kle91	M
79151.01 *	(2)	C_3N	8 – 7 $J=17/2-15/2$	0.27	IRC+10216	OSO	20m	Joh84	Got83	
79169.77 *	(2)	C_3N	8 – 7 $J=15/2-13/2$	0.27	IRC+10216	OSO	20m	Joh84	Got83	
U 79221.9	(50)	unidentified		0.05	Sgr B2	BTL	7m	Cum86		
U 79289.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
U 79334.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
79350.476*	(8)	$H^{13}CCCN$	9 – 8	0.56	Sgr B2	BTL	7m	Wan78		
79432.75 *	(5)	$HCOOCH_3$	9(3,7) – 9(2,8) A	0.06	Sgr B2	NRAO	11m	Tur89	Plu84	N
U 79438.		unidentified		0.06	Sgr B2	NRAO	11m	Tur89		N
79449.73	(9)	NH_2CN	4(1,4) – 3(1,3)	0.27	Sgr B2	BTL	7m	Wan78	Joh76a	
U 79465.		unidentified		0.08	Sgr B2	NRAO	11m	Tur89		N
79580.70 *	(25)	$^{13}CH_3OH$	5(–1) – 4(0) E	0.15	OriMC-1	OSO	20m	Joh84	And87	M
79677.507*	(7)	CH_3CH_2CN	9(0,9) – 8(0,8)	0.25	OriMC-1	OSO	20m	Joh84		
U 79699.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
79753.49 *	(7)	CH_3OCH_3	15(3,13) – 14(4,10) AA	[b]	OriMC-1	OSO	20m	Joh84		
79756.55 *	(20)	CH_3OCH_3	15(3,13) – 14(4,10) EE	0.06[b]	OriMC-1	OSO	20m	Joh84		
79759.52 *	(34)	CH_3OCH_3	15(3,13) – 14(4,10) EA	[b]	OriMC-1	OSO	20m	Joh84		
79759.68 *	(34)	CH_3OCH_3	15(3,13) – 14(4,10) AE	[b]	OriMC-1	OSO	20m	Joh84		
79781.68 *	(3)	$HCOOCH_3$	7(0,7) – 6(0,6) E	0.30[b]	OriMC-1	OSO	20m	Joh84	Plu86	M
79783.89 *	(3)	$HCOOCH_3$	7(0,7) – 6(0,6) A	[b]	OriMC-1	OSO	20m	Joh84	Plu84	M
U 79813.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
U 79870.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

	Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
	79876.712*(5)		HC_5N	30 – 29	0.25	IRC+10216	OSO	20m	Joh84		
	79963.619 (10)		NH_2CN	4(2,2) – 3(2,1)	0.07[b]	Sgr B2	NRAO	11m	Tur89	Joh76a	N
	79963.619 (10)		NH_2CN	4(2,3) – 3(2,2)	[b]	Sgr B2	NRAO	11m	Tur89	Joh76a	N
	79979.596 (90)		NH_2CN	4(0,4) – 3(0,3)	0.07	Sgr B2	NRAO	11m	Tur77	Joh76a	
	80076.606*(48)		CH_2CO	4(1,4) – 3(1,3)	0.1[b]	Sgr B2	NRAO	11m	Tur77		
	80082.64 *(26)		HC_7N	71 – 70	[b]	Sgr B2	NRAO	11m	Tur91		N
U	80160.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
	80266.200*(7)		CH_3CH_2OH	2(2,1) – 2(1,2)	0.07	Sgr B2	NRAO	11m	Tur89		N
U	80319.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
	80383.96 *(1)		H_2CCCC	9(0,9) – 8(0,8)	0.10	IRC+10216	IRAM	30m	Cer91a	Kil90	N
	80395.14 *(13)		$HCOOCH_3$	9(2,8) – 9(0,9) E	0.03	OriMC-1	NRAO	11m	Tur89		N
	80404.898*(12)		CH_3CH_2CN	9(2,8) – 8(2,7)	0.25	OriMC-1	OSO	20m	Joh84		
	80421.883*(5)		CH_3NC	4 – 3	2.7	Sgr B2	IRAM	30m	Cer88		N
U	80479.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
	80480.25		CH_2CN	4(0,4) – 3(0,3) $F_1 = 11/2 - 9/2$	0.12	Sgr B2	FCARO	14m	Irv88a	Irv88a	N
	80484.5		CH_2CN	4(0,4) – 3(0,3) $F_1 = 9/2 - 7/2$	0.12	Sgr B2	FCARO	14m	Irv88a	Irv88a	N
	80504.60	(10)	NH_2CN	4(1,3) – 3(1,2)	0.36[g]	Sgr B2	NRAO	11m	Tur75a	Joh76a	
	80536.24	(10)	CH_3OCH_3	5(2,3) – 5(1,4) AE + EA	[b]	Sgr B2	NRAO	11m	Tur75a	Lov79	
	80538.54	(10)	CH_3OCH_3	5(2,3) – 5(1,4) EE	0.2[bg]	Sgr B2	NRAO	11m	Tur75a	Lov79	
	80540.88	(10)	CH_3OCH_3	5(2,3) – 5(1,4) AA	[b]	Sgr B2	NRAO	11m	Tur75a	Lov79	
U	80547.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
U	80553.	?	unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
	80578.283*(53)		HDO	1(1,0) – 1(1,1)	<0.4[g]	OriMC-1	NRAO	11m	Tur75b		
	80602.135*(11)		CH_3CH_2CN	9(6,3) – 8(6,2)	0.3[b]	OriMC-1	OSO	20m	Olo84		
	80602.135*(11)		CH_3CH_2CN	9(6,4) – 8(6,2)	[b]	OriMC-1	OSO	20m	Olo84		
	80604.58 *(1)		CH_3CH_2CN	9(5,5) – 8(5,4)	0.4[b]	OriMC-1	OSO	20m	Olo84		
	80604.58 *(1)		CH_3CH_2CN	9(5,4) – 8(5,3)	[b]	OriMC-1	OSO	20m	Olo84		
	80606.211*(12)		CH_3CH_2CN	9(7,3) – 8(7,2)	0.2[b]	OriMC-1	OSO	20m	Olo84		
	80606.211*(12)		CH_3CH_2CN	9(7,2) – 8(7,1)	[b]	OriMC-1	OSO	20m	Olo84		
	80619.233*(12)		CH_3CH_2CN	9(4,6) – 8(4,5)	0.12[b]	OriMC-1	NRAO	11m	Hol80		
	80619.689*(12)		CH_3CH_2CN	9(4,5) – 8(4,4)	[b]	OriMC-1	NRAO	11m	Hol80		
	80649.873*(12)		CH_3CH_2CN	9(3,7) – 8(3,6)	0.04	OriMC-1	NRAO	11m	Hol80		
	80682.813*(12)		CH_3CH_2CN	9(3,6) – 8(3,5)	0.05	OriMC-1	NRAO	11m	Hol80		
	80723.194*(6)		C_3H_2	4(2,2) – 4(1,3)	0.05	Sgr B2	NRAO	11m	Tur89		N
U	80733.	(1)	unidentified		0.06	Sgr B2	NRAO	11m	Hol80		
	80802.044*(43)		CH_2CO	4(3,2) – 3(3,1)	0.10[b]	Sgr B2	NRAO	11m	Tur89		N
	80802.044*(43)		CH_2CO	4(3,1) – 3(3,0)	[b]	Sgr B2	NRAO	11m	Tur89		N
U	80808.		unidentified		0.12	OriMC-1	NRAO	11m	Tur89		N
	80820.376*(41)		CH_2CO	4(2,3) – 3(2,2)	[b]	Sgr B2	NRAO	11m	Tur89		N
	80824.278*(41)		CH_2CO	4(2,2) – 3(2,1)	0.06[b]	Sgr B2	NRAO	11m	Tur89		N
	80832.075*(51)		CH_2CO	4(0,4) – 3(0,3)	0.1	Sgr B2	NRAO	11m	Tur77		
U	80876.		unidentified		0.12	OriMC-1	NRAO	11m	Tur89		N
	80988.		SiC	$^3\Pi_1$ 2 – 1 e	0.03	IRC+10216	IRAM	30m	Cer89	Cer89	N
	80993.16	(10)	CH_3OH	7(2) – 8(1) A–	1.50	OriMC-1	OSO	20m	Joh84	Sas84	
U	81033.		unidentified		0.14	OriMC-1	NRAO	11m	Tur89		N
	81062.		SiC	$^3\Pi_1$ 2 – 1 f	0.03	IRC+10216	IRAM	30m	Cer89	Cer89	N
	81210.41 *(27)		HC_7N	72 – 71	0.04	Sgr B2	NRAO	11m	Tur91		N
U	81230.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
	81261.441*(12)		CH_3CH_2CN	9(2,7) – 8(2,6)	0.40	OriMC-1	OSO	20m	Joh84		
	81392.102*(42)		$HCOOCH_3$	3(2,1) – 2(1,2) A	0.06	Sgr B2	NRAO	11m	Tur89		N
U	81398.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U	81469.		unidentified		0.03	Sgr B2	NRAO	11m	Tur91		N
	81477.49	(10)	HNO	1(0,1) – 0(0,0)	0.033	Sgr B2	NRAO	11m	Uli77	Sai72	
	81505.211*(6)		C_2S	7,6 – 6,5	0.19	Sgr B2	BTL	7m	Cum86	Yam90	M
U	81518.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
	81534.125*(11)		$HC^{13}CCN$	9 – 8	0.050	Sgr B2	BTL	7m	Wan78		
	81541.981*(5)		$HCC^{13}CN$	9 – 8	0.052	Sgr B2	BTL	7m	Wan78		
U	81570.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
	81586.188*(48)		CH_2CO	4(1,3) – 3(1,2)	0.15	Sgr B2	NRAO	11m	Tur77		
	81653.08	(10)	CH_3OH	18(4) – 19(3) E	0.35	OriMC-1	OSO	20m	Joh84	Sas84	
U	81674.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
	81683.350*(8)		CH_3CH_2OH	8(1,7) – 7(2,6)	0.10	Sgr B2	NRAO	11m	Tur89		N
	81693.447*(4)		NH_2CHO	4(1,4) – 3(1,3)	0.18	Sgr B2	BTL	7m	Cum86		
U	81742.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
	81778.1	(4)	C_6H	$^2\Pi_{3/2}$ $J = 59/2 - 57/2$ f	0.05	IRC+10216	IRAM	30m	Gué87	Cer87a	N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

	Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
	81801.1	(4)	C_6H	$^2\Pi_{3/2}$ $J=59/2-57/2$ e	0.04	IRC+10216	IRAM	30m	Gué87	Cer87a	N
	81881.468*	(1)	HC_3N	9 – 8	2.51	Sgr B2	BTL	7m	Wan78		
	82082.730*	(26)	HC_3N	9 – 8 $v_7=1$ $\ell=1$e	0.30	OriMC-1	OSO	20m	Joh84		
	82093.559*	(6)	C_3H_2	2(0,2) – 1(1,1)	0.12	Sgr B2	BTL	7m	Cum86	Vrt86a	*M*
	82101.67 *	(5)	HNCS	7(0,7) – 6(0,6)	0.05	Sgr B2	NRAO	11m	Fre79		
	82115.660*	(7)	CH_3CH_2OH	3(2,2) – 3(1,3)	0.05	Sgr B2	NRAO	11m	Tur89		N
	82124.322*	(51)	$^{34}SO_2$	10(1,9) – 9(2,8)	0.10	OriMC-1	OSO	20m	Joh84		
	82200.372*	(26)	HC_3N	9 – 8 $v_7=1$ $\ell=1$f	0.23	OriMC-1	OSO	20m	Joh84		
	82242.89 *	(5)	$HCOOCH_3$	7(1,7) – 6(0,6) E	0.03[b]	Sgr B2(OH)	IRAM	30m	Gom86	Plu86	N
	82244.48 *	(5)	$HCOOCH_3$	7(1,7) – 6(0,6) A	[b]	Sgr B2(OH)	IRAM	30m	Gom86	Plu84	N
	82303.7		$HC^{13}CCH$	2(1,2) – 1(0,1)	0.035	Sgr B2(OH)	IRAM	30m	Gom87	Bog86	N
	82338.17 *	(29)	HC_7N	73 – 72	0.04	Sgr B2(OH)	IRAM	30m	Gom86		N
	82384.5	(5)	C_6H	$^2\Pi_{1/2}$ $J=59/2-57/2$ e	1.10[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
	82399.91 *	(4)	HC_3N	9 – 8 $v_7=2$ $\ell=0$	0.04	OriMC-1	NRAO	11m	Tur89		N
	82457.25 *	(30)	CH_3OCH_3	11(1,10) – 11(0,11) AE+EA	[b]	OriMC-1	NRAO	11m	Tur89		N
	82458.616*	(12)	CH_3CH_2CN	9(1,8) – 8(1,7)	0.45[b]	OriMC-1	OSO	20m	Joh84		
	82458.82 *	(19)	CH_3OCH_3	11(1,10) – 11(0,11) EE	[b]	OriMC-1	NRAO	11m	Tur89		N
	82460.38 *	(8)	CH_3OCH_3	11(1,10) – 11(0,11) AA	[b]	OriMC-1	NRAO	11m	Tur89		N
U	82472.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U	82516.		unidentified		0.04	OriMC-1	NRAO	11m	Tur91		N
	82539.041*	(5)	HC_5N	31 – 30	0.13	OriMC-1	NRAO	11m	Buj81		
	82539.375*	(47)	HC_3N	9 – 8 $v_7=3$ $\ell=1$e	0.03[b]	Sgr B2	NRAO	11m	Tur89		N
	82549.564*	(6)	NH_2CHO	1(1,1) – 0(0,0)	0.07[b]	Sgr B2	NRAO	11m	Tur89		N
	82649.30	(10)	CH_3OCH_3	3(1,3) – 2(0,2) AE+EA	[b]	OriMC-1	NRAO	11m	Cla79	Cla79	
	82650.150*	(17)	CH_3CH_2OH	11(1,10) – 11(0,11)	[b]	OriMC-1	NRAO	11m	Tur91		N
	82650.18	(10)	CH_3OCH_3	3(1,3) – 2(0,2) EE	0.2[b]	OriMC-1	NRAO	11m	Cla79	Cla79	
	82651.08	(10)	CH_3OCH_3	3(1,3) – 2(0,2) AA	[b]	OriMC-1	NRAO	11m	Cla79	Cla79	
	82659.675*	(35)	HC_3N	9 – 8 $v_7=3$ $\ell=3$	0.036	Sgr B2	NRAO	11m	Tur89		N
	82686.50	(10)	CH_3OCH_3	4(2,2) – 4(1,3) AE+EA	0.10	OriMC-1	NRAO	11m	Cla79	Cla79	
	82688.77	(10)	CH_3OCH_3	4(2,2) – 4(1,3) EE	0.12	OriMC-1	NRAO	11m	Cla79	Cla79	
	82691.14	(10)	CH_3OCH_3	4(2,2) – 4(1,3) AA	0.08	OriMC-1	NRAO	11m	Cla79	Cla79	
U	82700.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U	82783.		unidentified		0.03	Sgr B2	IRAM	30m	Com87		N
U	82870.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
U	82889.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
	82894.881*	(19)	$CH_3C^{13}CH$	5(2) – 4(2)	0.03	Sgr B2	IRAM	30m	Com87		N
	82897.08	(10)	CH_3OH	22(5) – 23(4) A+	0.03	Sgr B2	IRAM	30m	Com87	Sas84	N
	82899.545*	(19)	$CH_3C^{13}CH$	5(1) – 4(1)	0.02	Sgr B2	IRAM	30m	Com87		N
	82901.100*	(20)	$CH_3C^{13}CH$	5(0) – 4(0)	0.01	Sgr B2	IRAM	30m	Com87		N
	82908. *	(1)	$(CH_3)_2CO$	8(0,8) – 7(1,7) EA	0.02[b]	Sgr B2	NRAO	43m	Com87	Vac86	N
	82908. *	(1)	$(CH_3)_2CO$	8(1,8) – 7(0,7) EA	[b]	Sgr B2	NRAO	43m	Com87	Vac86	N
	82916.58 *	(5)	$(CH_3)_2CO$	8(0,8) – 7(1,7) EE	0.04[b]	Sgr B2	IRAM	30m	Com87	Vac86	N
	82916.61 *	(5)	$(CH_3)_2CO$	8(1,8) – 7(0,7) EE	[b]	Sgr B2	IRAM	30m	Com87	Vac86	N
U	82917.		unidentified		0.04	Sgr B2	NRAO	11m	Tur89		N
	82924.37 *	(5)	$(CH_3)_2CO$	8(0,8) – 7(1,7) AA	0.03[b]	Sgr B2	IRAM	30m	Com87	Vac86	N
	82924.48 *	(5)	$(CH_3)_2CO$	8(1,8) – 7(0,7) AA	[b]	Sgr B2	IRAM	30m	Com87	Vac86	N
	82951.970*	(10)	SO_2	13(4,10) – 14(3,11)	1.10	OriMC-1	OSO	20m	Sch83		
	82966.213	(7)	C_3H_2	3(1,2) – 3(0,3)	0.16	Sgr B2	BTL	7m	Cum86	Vrt86a	*M*
	83043.782*	(45)	$^{34}SO_2$	8(1,7) – 8(0,8)	0.50	OriMC-1	OSO	20m	Sch83		
	83057.99 *	(48)	$OC^{34}S$	7 – 6	0.040	Sgr B2	BTL	7m	Gol81		
	83097.53 *	(11)	CH_3OCH_3	14(2,12) – 14(1,13) AE+EA	[b]	OriMC-1	OSO	20m	Joh84		
	83099.00 *	(9)	CH_3OCH_3	14(2,12) – 14(1,13) EE	0.35[b]	OriMC-1	OSO	20m	Joh84		
	83100.47 *	(7)	CH_3OCH_3	14(2,12) – 14(1,13) AA	[b]	OriMC-1	OSO	20m	Joh84		
	83123.4	(3)	C_4H	$^2\Pi_{1/2}$ $J=17/2-15/2$ $v_7=1$f	2.10[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
U	83163.		unidentified		0.12	IRC+10216	OSO	20m	Joh84		
	83207.510*	(12)	CH_2CHCN	9(1,9) – 8(1,8)	0.20	OriMC-1	OSO	20m	Joh84		M
U	83215.		unidentified	(real?)	0.02	Sgr B2	NRAO	11m	Tur89		N
	83319.56 *	(5)	CH_3OCH_3	8(1,7) – 7(2,6) AA	[b]	OriMC-1	OSO	20m	Joh84		
	83321.43 *	(14)	CH_3OCH_3	8(1,7) – 7(2,6) EE	0.17[b]	OriMC-1	OSO	20m	Joh84		
	83323.30 *	(23)	CH_3OCH_3	8(1,7) – 7(2,6) AE+EA	[b]	OriMC-1	OSO	20m	Joh84		
U	83336.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
	83345.65 *	(23)	$^{33}SO_2$	8(1,7) – 8(0,8)	0.04	OriMC-1	NRAO	11m	Tur89		N
	83465.93 *	(30)	HC_7N	74 – 73	0.04	Sgr B2	NRAO	11m	Tur89		N
	83522.9	(3)	HCCSi ?	7 – 6 L	0.10	IRC+10216	IRAM	30m	Cer86	Cer86	N
	83538.0	(5)	HCCSi ?	7 – 6 U	0.11	IRC+10216	IRAM	30m	Cer86	Cer86	N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

	Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
	83540.28	*(41)	$^{33}SO_2$	18(5,13)–19(4,16)	0.02	OriMC-1	NRAO	11m	Tur89		N
	83541.5	(8)	C_5H	$^2\Pi_{1/2}$ J=35/2–33/2 a	1.7 [f]	IRC+10216	IRAM	30m	Cer86	Cer86	N
	83547.1	(6)	C_5H	$^2\Pi_{1/2}$ J=35/2–33/2 b	2.2 [f]	IRC+10216	IRAM	30m	Cer86	Cer86	N
	83584.26	(18)	CH_3CHO	2(1,2)–1(0,1) E	0.05	Sgr B2	NRAO	12m	Ziu86a	Bau76	N
	83688.086	*(7)	SO_2	8(1,7)–8(0,8)	0.86	OriMC-1	NRAO	11m	Tur91		
U	83805.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
	83842.		SiC	$^3\Pi_0$ 2–1 e	0.02	IRC+10216	IRAM	30m	Cer89	Cer89	N
	83879.8	(4)	C_4H	$^2\Pi_{1/2}$ J=17/2–15/2 ν_7=1e	1.52[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
	83903.30	(10)	CH_3OD	4(2)–5(1) A–	0.12	Sgr B2	NRAO	11m	Tur89	Kau80	N
	83978.60	(10)	CH_3NH_2	5(1,5)–5(0,5) As F=6–6	0.05[b]	Sgr B2	BTL	7m	Cum86	Tak73	
	83979.57	(10)	CH_3NH_2	5(1,5)–5(0,5) As F=5–5	[b]	Sgr B2	BTL	7m	Cum86	Tak73	
	84108.58	*(5)	C_5H	$^2\Pi_{3/2}$ J=35/2–33/2 a	4.7[fb]	IRC+10216	IRAM	30m	Cer86a	Got86	N
	84110.41	*(5)	C_5H	$^2\Pi_{3/2}$ J=35/2–33/2 b	[b]	IRC+10216	IRAM	30m	Cer86a	Got86	N
	84151.854	*(14)	CH_3CH_2CN	11(0,11)–10(1,10)	0.10[b]	Sgr B2(OH)	IRAM	30m	Gom86		N
U	84163.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
	84185.629	*(7)	$H^{13}CCCH$	2(1,2)–1(0,1)	0.13	TMC-1	NRAO	12m	Ger87	Bog86	N
U	84215.		unidentified	(CH_3CH_2OH? Tur91)	0.08	OriMC-1	NRAO	11m	Tur89		N
	84219.76	(5)	CH_3CHO	2(1,2)–1(0,1) A	0.05	Sgr B2	BTL	7m	Cum86	Bau76	
	84233.36	*(10)	$HCOOCH_3$	11(4,7)–11(3,8) A	0.06	OriMC-1	NRAO	11m	Tur89	Plu84	N
U	84308.		unidentified		0.10	OriMC-1	OSO	20m	Joh84		
	84320.936	*(32)	SO_2	32(5,27)–31(6,26)	0.10	OriMC-1	OSO	20m	Joh84		
U	84356.		unidentified		0.07	OriMC-1	NRAO	11m	Tur89		N
U	84385.		unidentified		0.08	OriMC-1	NRAO	11m	Tur91		N
	84410.68	*(12)	^{34}SO	2(2)–1(1)	0.03	Sgr B2	BTL	7m	Cum86		
	84423.81	(10)	CH_3OH	13(–3)–14(–2) E	0.80	OriMC-1	OSO	20m	Joh84	Sas84	
	84449.17	*(2)	$HCOOCH_3$	7(2,6)–6(2,5) E	0.45	OriMC-1	OSO	20m	Joh84	Plu86	M
	84454.75	*(3)	$HCOOCH_3$	7(2,6)–6(2,5) A	0.45	OriMC-1	OSO	20m	Joh84	Plu84	M
U	84468.		unidentified		0.18	OriMC-1	NRAO	11m	Tur89		N
U	84478.		unidentified		0.18	OriMC-1	NRAO	11m	Tur89		N
U	84496.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
U	84505.35		unidentified		0.08	OriMC-1	NRAO	11m	Kui77		
	84521.21	(8)	CH_3OH	5(–1)–4(0) E	2.8	Sgr B2	NRAO	11m	Zuc72	Zuc72	
	84542.331	*(3)	NH_2CHO	4(0,4)–3(0,3)	0.21	Sgr B2	BTL	7m	Cum86		
	84550.0	(4)	C_6H	$^2\Pi_{3/2}$ J=61/2–59/2 f	0.04	IRC+10216	IRAM	30m	Gué87	Cer87a	N
	84574.7	(5)	C_6H	$^2\Pi_{3/2}$ J=61/2–59/2 e	0.03	IRC+10216	IRAM	30m	Gué87	Cer87a	N
	84595.760	*(7)	CH_3CH_2OH	4(2,3)–4(1,4)	0.06[b]	Sgr B2	BTL	7m	Cum86		
	84597.64	(10)	CH_3NH_2	2(1)–2(0) Ea F=2–2	[b]	Sgr B2	BTL	7m	Cum86	Tak73	
	84598.54	(10)	CH_3NH_2	2(1)–2(0) Ea F=3–3	[b]	Sgr B2	BTL	7m	Cum86	Tak73	
U	84608.		unidentified		0.12	OriMC-1	NRAO	11m	Tur89		N
U	84616.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
U	84628.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
	84632.02	(10)	CH_3OCH_3	3(2,1)–3(1,2) AE+EA	0.14	OriMC-1	NRAO	11m	Cla79	Cla79	
	84634.40	(10)	CH_3OCH_3	3(2,1)–3(1,2) EE	<0.09[b]	OriMC-1	NRAO	11m	Cla79	Cla79	
	84636.80	(10)	CH_3OCH_3	3(2,1)–3(1,2) AA	[b]	OriMC-1	NRAO	11m	Cla79	Cla79	
	84727.696	*(6)	C_3H_2	3(2,2)–3(1,3)	0.04	Sgr B2	BTL	7m	Cum86	Vrt86a	M
U	84738.		unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
	84744.17	(10)	CH_3OH	19(4)–18(5) E	0.46[b]	OriMC-1	OSO	20m	Joh84	Sas84	
	84746.036	*(20)	^{30}SiO	2–1	0.08[b]	OriMC-1	NRAO	11m	Cla77		
	84807.797	*(10)	NH_2CHO	4(2,3)–3(2,2) n,t	0.18	Sgr B2	NRAO	11m	Wil81		
	84865.166	*(9)	$O^{13}CS$	7–6	0.032	Sgr B2	BTL	7m	Gol81		
	84888.996	*(18)	NH_2CHO	4(3,2)–3(3,1) n,t	0.08[b]	Sgr B2	NRAO	11m	Wil81		
	84890.989	*(18)	NH_2CHO	4(3,1)–3(3,0) n,t	[b]	Sgr B2	NRAO	11m	Wil81		
	84946.005	*(12)	CH_2CHCN	9(0,9)–8(0,8)	0.10	OriMC-1	OSO	20m	Joh84		M
	84970.22	(5)	$^{13}CH_3OH$	8(0)–7(1) A+	0.20	OriMC-1	OSO	20m	Joh84	Kur86	M
U	85067.	?	unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
	85093.274	*(10)	NH_2CHO	4(2,2)–3(2,1)	0.12	Sgr B2	BTL	7m	Cum86		
U	85102.	?	unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
	85131.1	(4)	C_6H	$^2\Pi_{1/2}$ J=61/2–59/2 f	1.37[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
	85139.108	*(2)	OCS	7–6	0.7	Sgr B2	NRAO	11m	Sol73		
	85162.256	(40)	$HC^{18}O^+$	1–0	0.1	L134N	BTL	7m	Lan78	Gué82b	
	85176.0	(4)	C_6H	$^2\Pi_{1/2}$ J=61/2–59/2 e	1.45[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
	85201.348	*(5)	HC_5N	32–31	0.030	IRC+10216	BTL	7m	Gol81		
U	85230.6	(6)	unidentified		0.07	Sgr B2	BTL	7m	Cum86		
	85265.470	*(7)	CH_3CH_2OH	6(0,6)–5(1,5)	0.25	Sgr B2	NRAO	11m	Zuc75		
	85302.655	*(12)	CH_2CHCN	9(2,8)–8(2,7)	0.12	Sgr B2	BTL	7m	Cum86		M

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

	Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
U	85315.	?	unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
U	85330.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
	85338.905*	(6)	C_3H_2	2(1,2) – 1(0,1)	3.1	TMC-1	NRAO	11m	Tha81	Vrt87	M
	85347.90	(30)	HCS^+	2 – 1	0.4	OriMC-1	NRAO	11m	Tha81	Gud81	
U	85370.	?	unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U	85396.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
	85416.763*	(10)	CH_2CHCN	9(4,6) – 8(4,5)	0.12[b]	OriMC-1	OSO	20m	Joh84		M
	85416.814*	(10)	CH_2CHCN	9(4,5) – 8(4,4)	[b]	OriMC-1	OSO	20m	Joh84		M
	85426.933*	(10)	CH_2CHCN	9(3,7) – 8(3,6)	0.10	OriMC-1	OSO	20m	Joh84		M
	85434.543*	(15)	CH_2CHCN	9(3,6) – 8(3,5)	0.03	Sgr B2	NRAO	11m	Tur91		M
	85442.601*	(1)	CH_3CCH	5(3) – 4(3)	0.11	OriMC-1	NRAO	11m	Chu83		
	85450.7660*	(7)	CH_3CCH	5(2) – 4(2)	0.14	OriMC-1	NRAO	11m	Chu83		
	85455.6665*	(6)	CH_3CCH	5(1) – 4(1)	0.23	OriMC-1	NRAO	11m	Chu83		
	85457.3002*	(7)	CH_3CCH	5(0) – 4(0)	0.28	OriMC-1	NRAO	11m	Chu83		
	85497.7	*(6)	CH_3C_4H	21(1) – 20(1)	[b]	Sgr B2	NRAO	11m	Tur89		N
	85498.5	*(6)	CH_3C_4H	21(0) – 20(0)	0.10[b]	Sgr B2	NRAO	11m	Tur89		N
U	85506.		unidentified		0.10	OriMC-1	OSO	20m	Joh84		
	85531.48	*(2)	$HOCO^+$	4(0,4) – 3(0,3)	0.5	Sgr B2	NRAO	11m	Tha81		M
U	85565.		unidentified		0.05	IRC+10216	OSO	20m	Joh84		
	85567.97	(10)	CH_3OH	6(–2) – 7(–1) E	0.3	OriMC-1	NRAO	11m	Lov76a	Sas84	
	85634.00	*(1)	C_4H	9 – 8 J = 19/2 – 17/2	0.08	IRC+10216	NRAO	11m	Gué78	Got83	
	85638.44	*(4)	$HCOOCH_3$	4(2,3) – 3(1,2) E	0.09	OriMC-1	NRAO	11m	Tur89		N
	85640.456*	(30)	SiO	2 – 1 v = 2	0.11	*R* Cas	NRAO	11m	Cla81		
	85655.63	*(5)	$HCOOCH_3$	4(2,3) – 3(1.2) A	0.09[b]	OriMC-1	NRAO	11m	Tur89		N
	85656.422*	(5)	C_3H_2	4(3,2) – 4(2,3)	[b]	OriMC-1	NRAO	11m	Tur89		N
	85672.57	*(1)	C_4H	9 – 8 J = 17/2 – 15/2	0.07	IRC+10216	NRAO	11m	Gué78	Got83	
U	85705.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
	85715.434*	(12)	CH_2CHCN	9(2,7) – 8(2,6)	0.06	Sgr B2	BTL	7m	Cum86		
	85759.132*	(20)	^{29}SiO	2 – 1	0.13	OriMC-1	NRAO	11m	Lov76a		
U	85781.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
U	85808.		unidentified		0.07	OriMC-1	NRAO	11m	Tur89		N
	85919.15	*(3)	$HCOOCH_3$	7(6,1) – 6(6,0) E	0.12	OriMC-1	OSO	20m	Ell80	Plu86	M
	85924.747	(20)	NH_2D	1(1,1)0+ – 1(0,1)0– F = 0 – 1	0.40	L183	OSO	20m	Olb85	Bes83	
	85925.684	(20)	NH_2D	1(1,1)0+ – 1(0,1)0– F = 2 – 1	0.40	L183	OSO	20m	Olb85	Bes83	
	85926.263	(10)	NH_2D	1(1,1)0+ – 1(0,1)0–	0.14	OriMC-1	NRAO	11m	Tur78	Bes83	
	85926.263	(10)	NH_2D	1(1,1)0+ – 1(0,1)0– F = 2 – 2	0.99[b]	L183	OSO	20m	Olb85	Bes83	
	85926.263	(10)	NH_2D	1(1,1)0+ – 1(0,1)0– F = 1 – 1	[b]	L183	OSO	20m	Olb85	Bes83	
	85926.66	*(3)	$HCOOCH_3$	7(6,2) – 6(6,1) A+E	0.3[b]	OriMC-1	OSO	20m	Ell80	Plu86	M
	85926.858	(20)	NH_2D	1(1,1)0+ – 1(0,1)0– F = 1 – 2	0.40	L183	OSO	20m	Olb85	Bes83	
	85927.23	*(4)	$HCOOCH_3$	7(6,1) – 6(6,0) A	[b]	OriMC-1	OSO	20m	Ell80	Plu84	M
	85927.721	(20)	NH_2D	1(1,1)0+ – 1(0,1)0– F = 1 – 0	0.40	L183	OSO	20m	Olb85	Bes83	
U	85943.		unidentified		0.04	Sgr B2	NRAO	11m	Tur89		N
	85973.13	*(9)	CH_3OCH_3	13(2,12) – 12(3,9) AA	[b]	OriMC-1	OSO	20m	Joh84		
	85976.04	*(17)	CH_3OCH_3	13(2,12) – 12(3,9) EE	0.06[b]	OriMC-1	OSO	20m	Joh84		
	85978.92	*(25)	CH_3OCH_3	13(2,12) – 12(3,9) EA+AE	[b]	OriMC-1	OSO	20m	Joh84		
	86021.08	*(3)	$HCOOCH_3$	7(5,2) – 6(5,1) E	0.12	OriMC-1	OSO	20m	Ell80	Plu86	M
	86027.80	*(3)	$HCOOCH_3$	7(5,3) – 6(5,2) E	[b]	OriMC-1	OSO	20m	Ell80	Plu86	M
	86029.43	*(10)	$HCOOCH_3$	7(5,3) – 6(5,2) A	0.20[b]	OriMC-1	OSO	20m	Ell80	Plu84	M
	86030.20	*(10)	$HCOOCH_3$	7(5,2) – 6(5,1) A	0.32	OriMC-1	OSO	20m	Ell80	Plu84	M
	86048.50	(25)	C_4H	$^2\Sigma$ J = 9 – 8 ν_7 = 2 L	n.r.	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
	86054.961	(25)	$HC^{15}N$	1 – 0	0.80[g]	OriMC-1	NRAO	11m	Lin77	Pea76	
	86074.20	(10)	CH_3NH_2	4(1,4) – 4(0,4) F = 3 – 3	[b]	Sgr B2	NRAO	11m	Kai74	Tak73	
	86074.44	(10)	CH_3NH_2	4(1,4) – 4(0,4) F = 5 – 5	0.2[b]	Sgr B2	NRAO	11m	Kai74	Tak73	
	86075.43	(10)	CH_3NH_2	4(1,4) – 4(0,4) F = 4 – 4	[b]	Sgr B2	NRAO	11m	Kai74	Tak73	
	86093.55	*(24)	SO	2(2) – 1(1)	< 1.7	OriMC-1	NRAO	11m	Cla74		
	86104.44	(25)	C_4H	$^2\Sigma$ J = 9 – 8 ν_7 = 2 U	n.r.	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
	86153.709*	(25)	SO_2	39(9,31) – 40(8,32)	0.07	OriMC-1	OSO	20m	Joh84		
	86181.413*	(10)	C_2S	6,7 – 5,6	1.6[f]	IRC+10216	IRAM	30m	Cer87b	Yam90	N
	86210.05	*(3)	$HCOOCH_3$	7(4,4) – 6(4,3) A	0.18	OriMC-1	OSO	20m	Joh84	Plu84	M
	86223.61	*(3)	$HCOOCH_3$	7(4,3) – 6(4,2) E	0.35[b]	OriMC-1	OSO	20m	Joh84	Plu86	M
	86223.76	(10)	CH_3OCH_3	2(2,0) – 2(1,1) AE	[b]	OriMC-1	NRAO	11m	Cla79	Cla79	
	86224.22	*(3)	$HCOOCH_3$	7(4,4) – 6(4,3) E	[b]	OriMC-1	OSO	20m	Joh84	Plu86	M
	86225.67	(12)	CH_3OCH_3	2(2,0) – 2(1,1) EA	[b]	OriMC-1	NRAO	11m	Cla79	Cla79	
	86226.728	(96)	CH_3OCH_3	2(2,0) – 2(1,1) EE	0.28[b]	OriMC-1	NRAO	11m	Cla79	Cla79	
	86228.72	(2)	CH_3OCH_3	2(2,0) – 2(1,1) AA	[b]	OriMC-1	NRAO	11m	Cla79	Cla79	

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

	Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
	86243.442*(24)		SiO	2−1 v=1	17.4[i]	OriMC-1	NRAO	11m	Sny74a		
	86250.55 *(4)		$HCOOCH_3$	7(4,3)−6(4,2) A	0.08	Sgr B2	NRAO	11m	Tur89	Plu84	]
	86265.79 *(3)		$HCOOCH_3$	7(3,5)−6(3,4) A	0.15	OriMC-1	OSO	20m	Joh84	Plu84	]
	86268.73 *(3)		$HCOOCH_3$	7(3,5)−6(3,4) E	0.20	OriMC-1	OSO	20m	Joh84	Plu86	]
U	86317.		unidentified		0.07	OriMC-1	NRAO	11m	Tur89		]
	86338.767 (30)		$H^{13}CN$	1−0 F=1−1	[b]	OriMC-1	NRAO	11m	Sny71	Pea76	
	86340.184 (30)		$H^{13}CN$	1−0 F=2−1	<2.[b]	OriMC-1	NRAO	11m	Sny71	Pea76	
	86342.274 (30)		$H^{13}CN$	1−0 F=0−1	[b]	OriMC-1	NRAO	11m	Sny71	Pea76	
U	86360.		unidentified		0.10	IRC+10216	OSO	20m	Joh84		
U	86395.8	(15)	unidentified		0.06	Sgr B2	BTL	7m	Cum86		
U	86401.	?	unidentified		0.07	OriMC-1	NRAO	11m	Tur89		N
U	86413.		unidentified		0.15	OriMC-1	OSO	20m	Joh84		
U	86416.9	(13)	unidentified		0.05	Sgr B2	BTL	7m	Cum86		
U	86418.		unidentified		0.20	OriMC-1	OSO	20m	Joh84		
U	86427.	?	unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
U	86432.	?	unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
U	86473.		unidentified		0.10	OriMC-1	NRAO	11m	Tur91		N
U	86481.		unidentified		0.07	OriMC-1	NRAO	11m	Tur91		N
	86492.97 *(2)		HCOOD	4(0,4)−3(0,3)	[b]	OMC-IRc2	SEST	15m	Ger89		N
	86546.18 *(1)		HCOOH	4(1,4)−3(1,3)	0.07	Sgr B2	BTL	7m	Cum86		
	86593.687*(8)		C_3O	9−8	0.028	TMC-1	FCRAO	14m	Bro85		M
	86615.76	(10)	CH_3OH	7(2)−6(3) A−	0.6	OriMC-1	NRAO	11m	Lov76a	Sas84	
	86639.108*(7)		SO_2	8(3,5)−9(2,8)	0.2	OriMC-1	NRAO	11m	Tur91		M
	86670.82	(4)	HCO	1(0,1)−0(0,0) 3/2−1/2 F=2−1	0.15	OriMC-2	NRAO	11m	Sny76	Pic78	
	86708.35	(4)	HCO	1(0,1)−0(0,0) 3/2−1/2 F=1−0	0.04	Sgr B2	BTL	7m	Cum86	Pic78	
	86708.379 (20)		C_3S	15−14	2.4[f]	IRC+10216	IRAM	30m	Cer87b	Yam87	N
	86745.315*(15)		CH_3CH_2CN	8(1,8)−7(0,7)	0.02	Sgr B2	NRAO	11m	Tur89		N
	86754.294 (30)		$H^{13}CO^+$	1−0	0.6	OriMC-1	NRAO	11m	Sny76a	Gué82b	
	86777.43	(4)	HCO	1(0,1)−0(0,0) 1/2−1/2 F=1−1	0.021	DR21	OSO	20m	Sch86	Pic78	M
	86805.75	(4)	HCO	1(0,1)−0(0,0) 1/2−1/2 F=0−1	0.015	DR21	OSO	20m	Sch86	Pic78	M
	86819.851*(13)		CH_3CH_2CN	10(1,10)−9(1,9)	0.50	OriMC-1	OSO	20m	Joh84		
	86846.998*(20)		SiO	2−1 v=0	0.9	OriMC-1	NRAO	11m	Dic72		
U	86864.		unidentified		0.08	OriMC-1	OSO	20m	Dow82		
U	86866.		unidentified		0.05	IRC+10216	OSO	20m	Joh84		
	86903.06	(10)	CH_3OH	7(2)−6(3) A+	0.2	OriMC-1	NRAO	11m	Lov76a	Sas84	
U	86980.		unidentified		0.10	OriMC-1	OSO	20m	Joh84		
	87057.5	(5)	$HC^{17}O^+$	1−0	0.05	Sgr B2	BTL	7m	Gué82	Gué82	
	87090.735 (46)		$HN^{13}C$	1−0 F=0−1	0.08	L134N	BTL	7m	Fre79a	Fre79a	
	87090.859 (46)		$HN^{13}C$	1−0 F=2−1	0.42	L134N	BTL	7m	Fre79a	Fre79a	
	87090.942 (46)		$HN^{13}C$	1−0 F=1−1	0.25	L134N	BTL	7m	Fre79a	Fre79a	
U	87110.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
U	87116.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
	87142.3	(4)	C_4H	$^2\Pi_{3/2}$ J=19/2−17/2 v_7=1e	1.45[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
	87143.29 *(3)		$HCOOCH_3$	7(3,4)−6(3,3) E	0.37	OriMC-1	OSO	20m	Joh84	Plu86	M
	87161.28 *(3)		$HCOOCH_3$	7(3,4)−6(3,3) A	0.25	OriMC-1	OSO	20m	Joh84	Plu84	M
U	87215.		unidentified	(CH_3CH_2CN?)	0.04	OriMC-1	NRAO	11m	Tur89		N
U	87260.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
	87284.156 (30)		C_2H	1−0 3/2−1/2 F=1−1	0.53	OriMC-1	NRAO	11m	Got83a	Got83a	
U	87299.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
	87312.827*(18)		CH_2CHCN	9(1,8)−8(1,7)	0.18	OriMC-1	NRAO	11m	Tur89		N
	87316.925 (4)		C_2H	1−0 3/2−1/2 F=2−1	4.00	OriMC-1	NRAO	11m	Got83a	Got83a	
U	87323.		unidentified		0.23	OriMC-1	NRAO	11m	Tur89		N
	87328.624 (6)		C_2H	1−0 3/2−1/2 F=1−0	2.27	OriMC-1	NRAO	11m	Got83a	Got83a	
	87348.3	(4)	C_6H	$^2\Pi_{3/2}$ J=63/2−61/2 e	0.05	IRC+10216	IRAM	30m	Gué87	Cer87a	N
	87371.8	(4)	C_4H	$^2\Pi_{3/2}$ J=19/2−17/2 v_7=1f	2.40[f]	IRC+10216	IRAM	30m	Gué87	Yam87b	N
	87402.004	(5)	C_2H	1−0 1/2−1/2 F=1−1	2.25	OriMC-1	NRAO	11m	Got83a	Got83a	
	87407.165	(11)	C_2H	1−0 1/2−1/2 F=0−1	1.02	OriMC-1	NRAO	11m	Got83a	Got83a	
	87446.512	(23)	C_2H	1−0 1/2−1/2 F=1−0	0.56	OriMC-1	NRAO	11m	Tuc78	Got83a	
	87458.286*(42)		AlCl	6−5	0.73[f]	IRC+10216	IRAM	30m	Cer87c		N
U	87479.		unidentified		0.05	IRC+10216	OSO	20m	Joh84		
U	87525.		unidentified	(CH_3CH_2OH? Tur90)	0.18	OriMC-1	NRAO	11m	Tur89		N
	87550.545*(28)		^{30}SiS	5−4	0.027	IRC+10216	FCRAO	14m	Ziu84		
U	87580.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
	87597.333*(3)		HNCO	4(1,4)−3(1,3)	0.13	OriMC-1	OSO	20m	Joh84		
	87715.980*(9)		CH_3CH_2OH	5(2,4)−5(1,5)	0.06	Sgr B2	BTL	7m	Cum86		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

	Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
U	87726.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
	87766.42	*(3)	$HCOOCH_3$	8(0,8) 7(1,7) E	0.03[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
	87767.5	(2)	HCCN	4,5 – 3,4	0.85[f]	IRC+10216	IRAM	30m	Gué91	Gué91	N
	87769.03	*(3)	$HCOOCH_3$	8(0,8) – 7(1,7) A	[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
U	87777.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
U	87779.		unidentified	(CH_3NH_2?)	0.08	OriMC-1	NRAO	11m	Tur89		N
	87782.23	(10)	CH_3NH_2	3(1,3) – 3(0,3) As F = 4 – 4	0.03[b]	Sgr B2	BTL	7m	Cum86	Tak73	
	87783.09	(10)	CH_3NH_2	3(1,3) – 3(0,3) As F = 3 – 3	[b]	Sgr B2	BTL	7m	Cum86	Tak73	
	87848.875	*(4)	NH_2CHO	4(1,3) – 3(1,2)	0.31	Sgr B2	BTL	7m	Cum86		
	87863.632	*(5)	HC_5N	33 – 32	0.23	IRC+10216	OSO	20m	Joh84		
	87876.57	*(6)	$S^{18}O$	4(5) – 4(4)	0.04	OriMC-1	NRAO	11m	Tur89		N
	87889.4	(4)	HCCN	4,4 – 3,3	0.72[f]	IRC+10216	IRAM	30m	Gué91	Gué91	N
	87898.416	*(4)	HNCO	4(2,3) – 3(2,2)	0.06[b]	Sgr B2	BTL	7m	Cum86		
	87898.620	*(4)	HNCO	4(2,2) – 3(2,1)	[b]	Sgr B2	BTL	7m	Cum86		
	87921.7	(3)	C_6H	$^2\Pi_{1/2}$ J = 63/2 – 61/2 f	1.19[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
	87925.238	*(4)	HNCO	4(0,4) – 3(0,3)	3.7	Sgr B2	NRAO	11m	Tur91		M
	87967.7	(3)	C_6H	$^2\Pi_{1/2}$ J = 63/2 – 61/2 e	1.31[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
U	88018.	(1)	unidentified		0.10	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
	88085.86	(5)	CH_3SH	14(1) – 13(2) A –	0.08	OriMC-1	NRAO	11m	Tur89	Lee80	N
U	88130.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
	88166.808	*(8)	$H^{13}CCCN$	10 – 9	0.15	IRC+10216	OSO	20m	Joh84		
U	88204.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
	88214.0	(10)	HCCN	4,4 – 3,3	0.9[f]	IRC+10216	IRAM	30m	Gué91	Gué91	N
	88239.027	*(3)	HNCO	4(1,3) – 3(1,2)	0.09	Sgr B2	NRAO	11m	Tur91		M
	88285.809	*(27)	$Si^{34}S$	5 – 4	0.10	IRC+10216	OSO	20m	Joh84		
U	88292.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
	88315.2	(4)	C_5H	$^2\Pi_{1/2}$ J = 37/2 – 35/2 a	0.8[f]	IRC+10216	IRAM	30m	Cer86	Cer86	N
	88321.0	(4)	C_5H	$^2\Pi_{1/2}$ J = 37/2 – 35/2 b	1.1[f]	IRC+10216	IRAM	30m	Cer86	Cer86	N
	88323.757	*(13)	CH_3CH_2CN	10(0,10) – 9(0,9)	0.12	OriMC-1	NRAO	11m	Joh77		
U	88349.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
	88358.53	*(10)	$HCOOCH_3$	22(5,17) – 22(4,18) A	0.07	OriMC-1	NRAO	11m	Tur89	Plu84	N
U	88402.		unidentified		0.04	Sgr B2	NRAO	11m	Tur89		N
U	88445.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
U	88481.		unidentified		0.05	OriMC-1	NRAO	11m	Tur91		N
	88594.96	(10)	CH_3OH	15(3) – 14(4) A+	0.73	OriMC-1	OSO	20m	Joh84	Sas84	
	88630.4157	(10)	HCN	1 – 0 F = 1 – 1	9.6	OriMC-1	NRAO	11m	Uli76	DeL69	
	88631.8473	(10)	HCN	1 – 0 F = 2 – 1	17.2	OriMC-1	NRAO	11m	Uli76	DeL69	
	88633.9360	(10)	HCN	1 – 0 F = 0 – 1	6.8	OriMC-1	NRAO	11m	Uli76	DeL69	
	88668.06	(10)	CH_3NH_2	2(0,2) – 1(0,1) Aa	[b]	Sgr B2	NRAO	11m	Kai75	Kai75	
	88668.62	(10)	CH_3NH_2	2(0,2) – 1(0,1) Es	0.15[b]	Sgr B2	NRAO	11m	Kai75	Kai75	
	88668.63	(10)	CH_3NH_2	2(0,2) – 1(0,1) A+E	0.04	Sgr B2	NRAO	11m	Kut80	Joh72	
	88669.61	(10)	CH_3NH_2	2(0,2) – 1(0,1) As,Ea	[b]	Sgr B2	NRAO	11m	Kai75	Kai75	
	88706.38	*(16)	CH_3OCH_3	15(2,13) – 15(1,14) EA+AE	[b]	OriMC-1	OSO	20m	Joh84		
	88707.64	(10)	CH_3OCH_3	15(2,13) – 15(1,14) EE	0.05	OriMC-1	NRAO	11m	Kut80		
	88707.78	*(12)	CH_3OCH_3	15(2,13) – 15(1,14) EE	0.27[b]	OriMC-1	OSO	20m	Joh84		
	88709.07	(10)	CH_3OCH_3	15(2,13) – 15(1,14) AA	0.06	OriMC-1	NRAO	11m	Kut80		
	88709.19	*(8)	CH_3OCH_3	15(2,13) – 15(1,14) AA	[b]	OriMC-1	OSO	20m	Joh84		
	88720.604	*(56)	$^{34}SO_2$	7(3,5) – 8(2,6)	0.10[b]	OriMC-1	OSO	20m	Sch83		
	88723.384	*(6)	$HCOOCH_3$	11(3,9) – 11(2,10) A	[b]	OriMC-1	OSO	20m	Sch83		M
U	88741.8		unidentified		0.03	OriMC-1	NRAO	11m	Kut80		
U	88749.8		unidentified		0.03	OriMC-1	NRAO	11m	Kut80		
U	88758.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
U	88770.8		unidentified		0.03	OriMC-1	NRAO	11m	Kut80		
	88843.24	*(3)	$HCOOCH_3$	7(1,6) – 6(1,5) E	0.09	OriMC-1	NRAO	11m	Kut80	Plu86	M
	88851.60	*(3)	$HCOOCH_3$	7(1,6) – 6(1,5) A	0.07	OriMC-1	NRAO	11m	Kut80	Plu84	M
U	88861.		unidentified		0.15	OriMC-1	OSO	20m	Gol81b		
	88865.692	(26)	$H^{15}NC$	1 – 0	0.15	DR21 (OH)	NRAO	11m	Bro77	Say76	
	88914.14	*(5)	C_5H	$^2\Pi_{3/2}$ J = 37/2 – 35/2 a	4.9[fb]	IRC+10216	IRAM	30m	Cer86a	Got86	N
U	88916.		unidentified		0.16	OriMC-1	NRAO	11m	Tur89		N
	88916.19	*(5)	C_5H	$^2\Pi_{3/2}$ J = 37/2 – 35/2 b	[b]	IRC+10216	IRAM	30m	Cer86a	Got86	N
	88940.21	*(1)	H_2CCCC	10(1,10) – 9(1,9)	0.099	IRC+10216	IRAM	30m	Cer91a	Kil90	N
	88940.09	(10)	CH_3OH	15(3) – 14(4) A –	1.30	OriMC-1	OSO	20m	Joh84	Sas84	
U	88957.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
U	88977.		unidentified		0.09	OriMC-1	NRAO	11m	Tur89		N
	89045.59	*(2)	C_3N	9 – 8 J = 19/2 – 17/2	0.13[l]	IRC+10216	NRAO	11m	Gué77	Got83	

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

	Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
	89060.930*(21)		CH_3CH_2OH	18(4,14)−17(5,13) ?	0.08	OriMC-1	NRAO	11m	Tur89		N
	89064.36 *(2)		C_3N	9−8 J=17/2−15/2	0.14[i]	IRC+10216	NRAO	11m	Gué77	Got83	
U	89084.		unidentified	(CH_3NH_2?)	0.07	OriMC-1	NRAO	11m	Tur89		N
	89086.53	(15)	HCN	1−0 ℓ=0 F=1−1 ν_2=2	[b]	IRC+10216	IRAM	30m	Luc88	Win71	N
	89087.92	(10)	HCN	1−0 ℓ=0 F=2−1 ν_2=2	0.20[b]	IRC+10216	IRAM	30m	Luc88	Win71	N
	89090.13	(15)	HCN	1−0 ℓ=0 F=0−1 ν_2=2	[b]	IRC+10216	IRAM	30m	Luc88	Win71	N
	89103.730*(26)		^{29}SiS	5−4	0.07	IRC+10216	OSO	20m	Joh84		
	89104.60 *(37)		HC_7N	79−78	0.03	OriMC-1	NRAO	11m	Tur91		N
	89188.518*(9)		HCO^+	1−0	10.8	OriMC-1	NRAO	11m	Uli76		
U	89234.		unidentified		0.15	OriMC-1	NRAO	11m	Tur89		N
	89297.651*(13)		CH_3CH_2CN	10(2,9)−9(2,8)	0.32	OriMC-1	OSO	20m	Joh84		
	89314.64 *(3)		$HCOOCH_3$	8(1,8)−7(1,7) E	0.35[b]	OriMC-1	OSO	20m	Joh84	Plu86	M
	89316.64 *(4)		$HCOOCH_3$	8(1,8)−7(1,7) A	[b]	OriMC-1	OSO	20m	Joh84	Plu84	M
	89329.527*(33)		$^{13}CH_3CN$	5(1)−4(1)	[b]	Sgr B2	BTL	7m	Cum86		M
	89331.203*(33)		$^{13}CH_3CN$	5(0)−4(0)	0.22[b]	Sgr B2	BTL	7m	Cum86		M
U	89411.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
U	89419.		unidentified		0.03	Sgr B2	FCRAO	14m	Woo83		N
	89487.415	(15)	HOC^+ ?	1−0	0.08	Sgr B2	FCRAO	14m	Woo83	Gud82	
	89489.223*(26)		$Si^{33}S$	5−4	0.022	IRC+10216	IRAM	30m	Kah88		N
	89505.86	(4)	CH_3OH	8(−4)−9(−3) E	0.3	OriMC-1	NRAO	11m	Lov76a	Lov78	
	89562.317*(12)		CH_3CH_2CN	10(6)−9(6)	0.08[b]	OriMC-1	NRAO	11m	Joh77		
	89565.031*(12)		CH_3CH_2CN	10(7)−9(7)	0.05[b]	OriMC-1	NRAO	11m	Joh77		
	89568.105*(12)		CH_3CH_2CN	10(5)−9(5)	0.11[b]	OriMC-1	NRAO	11m	Joh77		
	89573.052*(13)		CH_3CH_2CN	10(8)−9(8)	0.03[b]	OriMC-1	NRAO	11m	Joh77		
	89579.17* (1)		HCOOH	4(0,4)−3(0,3)	0.05	Sgr B2	FCRAO	14m	Woo83	Wil80	
	89590.035*(12)		CH_3CH_2CN	10(4,7)−9(4,6)	0.05[b]	OriMC-1	NRAO	11m	Joh77		
	89591.019*(12)		CH_3CH_2CN	10(4,6)−9(4,5)	0.05[b]	OriMC-1	NRAO	11m	Joh77		
	89628.451*(13)		CH_3CH_2CN	10(3,8)−9(3,7)	0.13	OriMC-1	NRAO	11m	Joh77		
U	89651.		unidentified		0.06	Sgr B2	NRAO	11m	Tur89		N
	89684.718*(13)		CH_3CH_2CN	10(3,7)−9(3,6)	0.22	OriMC-1	OSO	20m	Joh84		
	89699.76 *(8)		CH_3OCH_3	2(2,1)−2(1,2) EE	0.06[b]	OriMC-1	NRAO	11m	Tur89		N
	89702.76 *(4)		CH_3OCH_3	2(2,1)−2(1,2) AA	[b]	OriMC-1	NRAO	11m	Tur89		N
U	89726.		unidentified		0.07	IRC+10216	OSO	20m	Joh84		
	89745.55 *(23)		CH_3OCH_3	11(1,10)−11(0,11) E	0.06	OriMC-1	NRAO	11m	Tur89		N
U	89823.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
U	89834.		unidentified		0.11	OriMC-1	NRAO	11m	Tur89		N
	89861.48 *(1)		HCOOH	4(2,3)−3(2,2)	0.13	Sgr B2	BTL	7m	Cum86		
U	89898.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
	89927.70	(10)	CH_3SH	17(1)−16(2) A+ ?	0.07	OriMC-1	NRAO	11m	Tur89	Lee80	N
U	89936.		unidentified	(CH_3SH?)	0.20	OriMC-1	OSO	20m	Joh84		
U	89952.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U	89960.		unidentified	(CH_3OD?)	0.20	OriMC-1	OSO	20m	Joh84		
U	90038.		unidentified		0.04	Sgr B2	NRAO	11m	Tur89		N
U	90051.		unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
U	90061.		unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
	90093.0	(3)	C_6H	$^2\Pi_{3/2}$ J=65/2−63/2 f	0.05	IRC+10216	IRAM	30m	Gué87	Cer87a	N
	90117.600*(9)		CH_3CH_2OH	4(1,4)−3(0,3)	0.25[g]	Sgr B2	NRAO	11m	Zuc75		
	90121.4	(3)	C_6H	$^2\Pi_{3/2}$ J=65/2−63/2 e	0.06	IRC+10216	IRAM	30m	Gué87	Cer87a	N
	90145.72 *(3)		$HCOOCH_3$	7(2,5)−6(2,4) E	0.32	OriMC-1	OSO	20m	Joh83	Plu86	M
	90156.46 *(3)		$HCOOCH_3$	7(2,5)−6(2,4) A	0.25	OriMC-1	OSO	20m	Joh83	Plu84	M
U	90212.	(1)	unidentified		0.04	Sgr B2	NRAO	11m	Hol80		
	90227.63 *(3)		$HCOOCH_3$	8(0,8)−7(0,7) E	0.15	OriMC-1	NRAO	11m	Hol80	Plu86	M
	90229.63 *(4)		$HCOOCH_3$	8(0,8)−7(0,7) A	0.15	OriMC-1	NRAO	11m	Hol80	Plu84	M
	90263.833	(30)	$^{15}NNH^+$	1−0	0.035	DR21(OH)	BTL	7m	Lin83	Gud82a	
U	90286.	?	unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
U	90355.	?	unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
	90453.358*(13)		CH_3CH_2CN	10(2,8)−9(2,7)	0.35	OriMC-1	OSO	20m	Joh84		
	90482.482*(28)		CH_3CH_2CN	7(4,4)−8(3,5)	0.02	Sgr B2(OH)	IRAM	30m	Gom86		N
U	90506.		unidentified		0.12	Sgr B2	NRAO	11m	Tur89		N
	90515.644*(28)		CH_3CH_2CN	7(4,3)−8(3,6)	0.02	Sgr B2(OH)	IRAM	30m	Gom86		N
	90525.892*(5)		HC_5N	34−33	0.20	IRC+10216	OSO	20m	Joh84		
	90530.93 *(3)		CH_3CH_2CN	23(3,20)−23(2,21)	0.015	OriMC-1	FCRAO	14m	Ziu88		N
	90548.251*(28)		SO_2	25(3,23)−24(4,20)	0.6	OriMC-1	OSO	20m	Sch83		
	90562.1	(5)	$^{30}SiC_2$	4(0,4)−3(0,3)	0.06	IRC+10216	IRAM	30m	Cer86b	Cer91b	N
	90593.059*(11)		$HC^{13}CCN$	10−9	0.35	Sgr B2	NRAO	11m	Uli78		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

	Frequency (MHz)	Unc.	Formula	Quantum numbers		T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
	90601.791*(5)		$HCC^{13}CN$	10 – 9		0.18	Sgr B2	NRAO	11m	Uli78		
U	90609.		unidentified			0.015	OriMC-1	FCRAO	14m	Ziu88		N
U	90619.		unidentified			0.008	OriMC-1	FCRAO	14m	Ziu88		N
U	90635.		unidentified			0.015	OriMC-1	FCRAO	14m	Ziu88		N
	90663.450	(10)	HNC	1 – 0 F = 0 – 1		n.r.	L134N	BTL	7m	Fre79a	Fre79a	
	90663.543	(40)	HNC	1 – 0		1.6	L134	NRAO	11m	Sny77a	Pea76	
	90663.574	(10)	HNC	1 – 0 F = 2 – 1		n.r.	L134N	BTL	7m	Fre79a	Fre79a	
	90663.656	(10)	HNC	1 – 0 F = 1 – 1		n.r.	L134N	BTL	7m	Fre79a	Fre79a	
	90686.385*(8)		C_2S	7,7 – 6,6		0.2	Sgr B2	NRAO	11m	Sch85	Yam90	M
U	90689.		unidentified			0.025	OriMC-1	FCRAO	14m	Ziu88		N
U	90700.		unidentified			0.010	OriMC-1	FCRAO	14m	Ziu88		N
	90703.78	(5)	CH_3OD	2(– 1) – 1(– 1) E		0.14[b]	Sgr B2	NRAO	11m	Got79	Lov78	
	90705.77	(5)	CH_3OD	2(0) – 1(0) A		[b]	Sgr B2	NRAO	11m	Got79	Lov78	
	90712.2	(3)	C_6H	$^2\Pi_{1/2}$ J = 65/2 – 63/2 f		1.09[f]	IRC + 10216	IRAM	30m	Cer87a	Cer87a	N
U	90727.		unidentified			0.13	Sgr B2	NRAO	11m	Tur89		N
	90743.56	(5)	CH_3OD	2(1) – 1(1) E		0.09	Sgr B2	NRAO	11m	Tur91	Kau80	N
U	90757.		unidentified			0.10	Sgr B2	NRAO	11m	Tur89		N
	90759.3	(3)	C_6H	$^2\Pi_{1/2}$ J = 65/2 – 63/2 e		1.21[f]	IRC + 10216	IRAM	30m	Cer87a	Cer87a	N
U	90763.		unidentified			0.20	OriMC-1	OSO	20m	Joh84		
	90771.546*(26)		SiS	5 – 4		0.35	IRC + 10216	NRAO	11m	Mor75		
U	90809.		unidentified			0.010	OriMC-1	FCRAO	14m	Ziu88		N
U	90814.		unidentified			0.030	OriMC-1	FCRAO	14m	Ziu88		N
U	90820.		unidentified			0.008	OriMC-1	FCRAO	14m	Ziu88		N
U	90838.		unidentified			0.015	OriMC-1	FCRAO	14m	Ziu88		N
U	90841.	(3)	unidentified			0.08	Sgr B2	NRAO	11m	Cla79		
U	90864.		unidentified			0.18	Sgr B2	NRAO	11m	Tur91		N
	90889.20	(23)	CH_3OCH_3	15(3,12) – 14(4,11) AA		[b]	OriMC-1	FCRAO	14m	Ziu88	Lov79	N
	90892.26	(23)	CH_3OCH_3	15(3,12) – 14(4,11) EE		0.04[b]	OriMC-1	FCRAO	14m	Ziu88	Lov79	N
	90895.32	(23)	CH_3OCH_3	15(3,12) – 14(4,11) AE + EA		[b]	OriMC-1	FCRAO	14m	Ziu88	Lov79	N
U	90908.	(3)	unidentified			0.05	Sgr B2	NRAO	11m	Cla79		
U	90912.		unidentified			0.05	Sgr B2	NRAO	11m	Tur89		N
	90926.039*(17)		$^{13}C^{34}S$	2 – 1		0.10	OriMC-1	NRAO	11m	Tur89		N
U	90928.	(1)	unidentified			0.07	Sgr B2	NRAO	11m	Cla79		
	90937.539	(40)	CH_3OCH_3	6(0,6) – 5(1,5) AA		[b]	OriMC-1	NRAO	11m	Sny74	Cla79	
	90938.099	(30)	CH_3OCH_3	6(0,6) – 5(1,5) EE		0.17[b]	OriMC-1	NRAO	11m	Sny74	Cla79	
	90938.674	(50)	CH_3OCH_3	6(0,6) – 5(1,5) AE + EA		[b]	OriMC-1	NRAO	11m	Sny74	Cla79	
U	90949.		unidentified			0.01	OriMC-1	FCRAO	14m	Ziu88		N
U	90964.		unidentified			0.04	OriMC-1	FCRAO	14m	Ziu88		N
	90978.993*(2)		HC_3N	10 – 9		1.77	OriMC-1	NRAO	11m	Mor76		
U	91000.		unidentified			0.01	OriMC-1	FCRAO	14m	Ziu88		N
	91008.20	(41)	CH_3CH_2OH	14(2,13) – 13(3,10) ?		0.015	OriMC-1	FCRAO	14m	Ziu88		N
U	91022.		unidentified			0.008	OriMC-1	FCRAO	14m	Ziu88		N
U	91045.		unidentified			0.10	Sgr B2	NRAO	11m	Tur89		N
U	91063.		unidentified			0.09	OriMC-1	NRAO	11m	Tur89		N
U	91074.		unidentified			0.02	Sgr B2	NRAO	11m	Tur89		N
U	91086.		unidentified			0.06	Sgr B2	NRAO	11m	Tur89		N
U	91096.		unidentified			0.10	Sgr B2	NRAO	11m	Tur89		N
U	91106.	?	unidentified			0.03	OriMC-1	NRAO	11m	Tur89		N
	91128.19	*(3)	HC_3N	10 – 9 ℓ = 1e ν_6 = 1		0.10[h]	Sgr B2	NRAO	11m	Tur89		N
U	91135.		unidentified			0.10	Sgr B2	NRAO	11m	Tur91		N
	91169.93	*(6)	NaCl	7 – 6		1.91[f]	IRC + 10216	IRAM	30m	Cer87c		N
	91175.25	(10)	CH_3OCH_3	5(4,2) – 6(3,3) EE		0.04	OriMC-1	NRAO	11m	Tur89	Lov79	N
	91202.607*(27)		HC_3N	10 – 9 ν_7 = ℓ ℓ = 1e		0.2	OriMC-1	NRAO	11m	Cla76		
	91204.328	(30)	$N^{15}NH^+$	1 – 0 F = 1 – 1		0.02	DR21(OH)	BTL	7m	Lin83	Gud82a	
	91205.999	(30)	$N^{15}NH^+$	1 – 0 F = 2 – 1		0.025	DR21(OH)	BTL	7m	Lin83	Gud82a	
	91208.663	(70)	$N^{15}NH^+$	1 – 0 F = 0 – 1		0.01	DR21(OH)	BTL	7m	Lin83	Gud82a	
	91333.308*(27)		HC_3N	10 – 9 ν_7 = 1 ℓ = 1f		0.2	OriMC-1	NRAO	11m	Cla76		
	91366.30	*(5)	$HCOOCH_3$	9(4,5) – 9(3,6) E		0.08	Sgr B2	NRAO	11m	Tur89	Plu86	N
	91476.59	*(3)	CH_3OCH_3	3(2,2) – 3(1,3) EE		0.15[b]	OriMC-1	NRAO	11m	Tur89	Lov79	N
	91479.21	*(4)	CH_3OCH_3	3(2,2) – 3(1,3) AA		[b]	OriMC-1	NRAO	11m	Tur89	Lov79	N
	91485.030*(11)		CH_3CH_2OH	6(2,5) – 6(1,6)		0.07	Sgr B2	NRAO	11m	Tur89		N
	91494.349	(30)	c-C_3H	2(1,2) – 1(1,1)	5/2,3 – 3/2,2	0.19	TMC-1	NRO	45m	Yam87a	Yam87a	N
	91497.608	(30)	c-C_3H	2(1,2) – 1(1,1)	5/2,2 – 3/2,1	0.13	TMC-1	NRO	45m	Yam87a	Yam87a	N
U	91520.		unidentified			0.02	Sgr B2	NRAO	11m	Tur89		N
U	91541.		unidentified			0.03	Sgr B2	NRAO	11m	Tur89		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

	Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
	91549.122*(13)		CH_3CH_2CN	10(1,9) − 9(1,8)	0.36[b]	OriMC-1	NRAO	11m	Tur89		N
	91550.470*(13)		SO_2	18(5,13) − 19(4,16)	[b]	OriMC-1	NRAO	11m	Tur89		N
	91554.521*(43)		HC_3N	10 − 9 v_7=2 ℓ=0	[b]	OriMC-1	NRAO	11m	Tur89		N
	91555.932*(49)		HC_3N	10 − 9 v_7=2 ℓ=2e	[b]	OriMC-1	NRAO	11m	Tur89		N
	91558.432*(44)		HC_3N	10 − 9 v_7=2 ℓ=2f	[b]	OriMC-1	NRAO	11m	Tur89		N
	91572.54 *(3)		HCCCHO	10(1,10) − 9(1,9)	0.02	Sgr B2	NRAO	11m	Tur91		N
U	91587.		unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
U	91605.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
	91608.9	(5)	$^{30}SiC_2$	4(2,3) − 3(2,2)	0.06	IRC+10216	IRAM	30m	Cer86b	Cer91b	N
U	91636.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
U	91654.		unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
U	91662.		unidentified		0.04	Sgr B2	NRAO	11m	Tur89		N
U	91665.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
	91692.752	(30)	c-C_3H	2(1,2) − 1(1,1) 3/2,1 − 1/2,0	0.10	TMC-1	NRO	45m	Yam87a	Yam87a	N
	91699.471	(30)	c-C_3H	2(1,2) − 1(1,1) 3/2,2 − 1/2,1	0.16	TMC-1	NRO	45m	Yam87a	Yam87a	N
U	91703.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U	91749.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
	91771.8	(3)	$^{29}SiC_2$	4(0,4) − 3(0,3)	0.08	IRC+10216	IRAM	30m	Cer86b	Cer91b	N
U	91808.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U	91848.		unidentified		0.15	Sgr B2	NRAO	11m	Tur91		N
U	91913.		unidentified	(NH_2CHO?)	0.06	OriMC-1	NRAO	11m	Tur89		N
	91925.741*(12)		$CH_3{}^{13}CN$	5(3) − 4(3)	0.03	Sgr B2	IRAM	30m	Cer88		N
	91934.549*(7)		$CH_3{}^{13}CN$	5(2) − 4(2)	[b]	Sgr B2	IRAM	30m	Cer88		N
	91939.834*(8)		$CH_3{}^{13}CN$	5(1) − 4(1)	[b]	Sgr B2	IRAM	30m	Cer88		N
	91941.596*(9)		$CH_3{}^{13}CN$	5(0) − 4(0)	0.15[b]	Sgr B2	IRAM	30m	Cer88		N
	91959.024*(2)		CH_3CN	5(4) − 4(4) F=6 − 5	0.08[b]	OriMC-1	NRAO	11m	Lov76a		
	91959.359*(2)		CH_3CN	5(4) − 4(4) F=4 − 3	[b]	OriMC-1	NRAO	11m	Lov76a		
	91971.310*(1)		CH_3CN	5(3) − 4(3) F=6 − 5	0.20[b]	OriMC-1	NRAO	11m	Lov76a		
	91971.465*(1)		CH_3CN	5(3) − 4(3) F=4 − 3	[b]	OriMC-1	NRAO	11m	Lov76a		
	91980.089*(1)		CH_3CN	5(2) − 4(2) F=6 − 5	0.16	OriMC-1	NRAO	11m	Lov76a		
	91985.317*(1)		CH_3CN	5(1) − 4(1)	0.28[b]	OriMC-1	NRAO	11m	Lov76a		
	91987.090*(1)		CH_3CN	5(0) − 4(0)	[b]	OriMC-1	NRAO	11m	Lov76a		
U	92002.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
	92064.63 *(6)		$Si^{13}CC$	4(2,3) − 3(2,2)	0.4[f]	IRC+10216	IRAM	30m	Cer91b		N
	92075.51	(5)	CH_3OD	2(1) − 1(1) A−	0.07	OriMC-1	NRAO	11m	Tur89	Kau80	N
	92261.440	(60)	CH_3CN	5(0) − 4(0) v_8=1 ℓ=1	0.03?	OriMC-1	NRAO	11m	Tur91	Bou80	N
	92262.992	(60)	CH_3CN	5(0) − 4(0) v_8=1 ℓ=1	0.03?	OriMC-1	NRAO	11m	Tur91	Bou80	N
U	92334.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
U	92342.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
	92353.43 *(10)		CH_3CN	5(1) − 4(1) v_8=1 ℓ=1	0.035	OriMC-1	NRAO	11m	Tur91		N
	92426.260*(18)		CH_2CHCN	10(1,10) − 9(1,9)	0.05	Sgr B2	NRAO	11m	Tur89		N
U	92456.	?	unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
	92488.490	(20)	C_3S	16 − 15	2.2[f]	IRC+10216	IRAM	30m	Cer87b	Yam87	N
	92494.299*(17)		^{13}CS	2 − 1	0.215	OriMC-1	NRAO	11m	Tur73		
U	92715.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
	92793.6	(5)	$^{30}SiC_2$	4(2,2) − 3(2,1)	0.03	IRC+10216	IRAM	30m	Cer86b	Cer91b	N
	92865.2	(3)	C_6H	$^2\Pi_{3/2}$ J=67/2 − 65/2 f	0.05	IRC+10216	IRAM	30m	Gué87	Cer87a	N
U	92877.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
	92882.0	(3)	$^{29}SiC_2$	4(2,3) − 3(2,2)	0.06	IRC+10216	IRAM	30m	Cer86b	Cer91b	N
	92894.9	(3)	C_6H	$^2\Pi_{3/2}$ J=67/2 − 65/2 e	0.06	IRC+10216	IRAM	30m	Gué87	Cer87a	N
U	92916.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
	93063.639	(9)	SiC_2	4(0,4) − 3(0,3)	0.11	IRC+10216	NRAO	11m	Sny83	Got89	M
	93089.0	(3)	C_5H	$^2\Pi_{1/2}$ J=39/2 − 37/2 a	1.3[f]	IRC+10216	IRAM	30m	Cer86	Cer86	N
	93094.9	(4)	C_5H	$^2\Pi_{1/2}$ J=39/2 − 37/2 b	1.5[f]	IRC+10216	IRAM	30m	Cer86	Cer86	N
	93098.35 *(1)		HCOOH	4(1,3) − 3(1,2)	0.12	Sgr B2	NRAO	11m	Tur89		N
	93171.619	(10)	N_2H^+	1 − 0 F_1=1 − 1 F=0 − 1	0.5	L134N	NRAO	11m	Sny79	Caz86	
	93171.947	(10)	N_2H^+	1 − 0 F_1=1 − 1 F=2 − 2	0.7	L134N	NRAO	11m	Sny77	Caz86	M
	93172.098	(10)	N_2H^+	1 − 0 F_1=1 − 1 F=1 − 0	0.8	L134N	NRAO	11m	Sny77	Caz86	M
	93173.505	(10)	N_2H^+	1 − 0 F_1=2 − 1 F=2 − 1	0.9	L134N	NRAO	11m	Sny77	Caz86	M
	93173.809	(10)	N_2H^+	1 − 0 F_1=2 − 1 F=3 − 2	0.9	L134N	NRAO	11m	Sny77	Caz86	M
	93174.016	(10)	N_2H^+	1 − 0 F_1=2 − 1 F=1 − 1	0.6	L134N	NRAO	11m	Sny77	Caz86	M
	93176.310	(10)	N_2H^+	1 − 0 F_1=0 − 1 F=1 − 2	0.7	L134N	NRAO	11m	Sny77	Caz86	M
	93188.127*(5)		HC_5N	35 − 34	0.09	OriMC-1	NRAO	11m	Lov82		
	93196.62	(1)	CH_3OH	1(0) − 2(1) E v_t=1	0.18	OriMC-1	NRAO	11m	Lov82	Lov82	
	93213.030*(36)		CH_3CH_2OH	16(8,9) − 17(7,10) ?	[b]	OriMC-1	NRAO	11m	Tur89		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

	Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
	93213.150*(36)		CH_3CH_2OH	16(8,8) – 17(7,11) ?	0.06[b]	OriMC-1	NRAO	11m	Tur89		N
U	93231.		unidentified		0.01	Sgr B2	NRAO	11m	Tur89		N
	93261.70 *(10)		$HCOOCH_3$	14(2,12) – 14(1,13) A	0.07	OriMC-1	NRAO	11m	Tur89	Plu84	N
U	93294.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
U	93355.		unidentified		0.1	Sgr B2	NRAO	11m	Tur89		N
U	93361.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
	93502.2	(10)	C_6H	$^2\Pi_{1/2}$ $J = 67/2 - 65/2$ f	0.90[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
	93550.9	(5)	C_6H	$^2\Pi_{1/2}$ $J = 67/2 - 65/2$ e	1.20[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
U	93561.		unidentified	($HCOOCH_3$?)	0.04	OriMC-1	NRAO	11m	Tur89		N
	93580.86	(10)	CH_3CHO	5(1,5) – 4(1,4) A	0.17	Sgr B2	BTL	7m	Cum86	Bau76	
	93586.5	(3)	C_4H	$^2\Pi_{1/2}$ $J = 19/2 - 17/2$ $v_7 = 1$e	1.80[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
	93595.28	(10)	CH_3CHO	5(1,5) – 4(1,4) E	0.17	Sgr B2	BTL	7m	Cum86	Bau76	
	93619.46	(5)	$^{13}CH_3OH$	2(1) – 1(1) A+	0.12[b]	OriMC-1	NRAO	11m	Tur89	Kur86	N
U	93628.	?	unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
U	93656.		unidentified		0.07	OriMC-1	NRAO	11m	Tur89		N
	93660.00 *(7)		$HCOOCH_3$	8(4,4) – 8(3,5) A	0.09	OriMC-1	NRAO	11m	Tur89		N
	93666.65 *(12)		CH_3OCH_3	12(1,11) – 12(0,12) EE	0.10	OriMC-1	NRAO	11m	Hol80		
	93692.448*(2)		HNCS	8(1,8) – 7(1,7)	0.03	OriMC-1	NRAO	11m	Tur89		N
U	93730.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
	93812.630*(22)		CH_3CH_2OH	13(7,7) – 14(6,8) ?	0.03[b]	OriMC-1	NRAO	11m	Tur89		N
	93813.150*(22)		CH_3CH_2OH	13(7,6) – 14(6,9) ?	[b]	OriMC-1	NRAO	11m	Tur89		N
	93830.050 (20)		HNCS	8(0,8) – 7(0,7)	0.05	OriMC-1	BTL	7m	Fre79	Yam79	
U	93839.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U	93844.	(2)	unidentified		0.06	Sgr B2	NRAO	11m	Cla79		
	93854.44	(10)	CH_3OCH_3	4(2,3) – 4(1,4) AE + EA	0.14	OriMC-1	NRAO	11m	Cla79	Cla79	
	93857.11	(10)	CH_3OCH_3	4(2,3) – 4(1,4) EE	0.20	OriMC-1	NRAO	11m	Cla79	Cla79	
	93859.64	(10)	CH_3OCH_3	4(2,3) – 4(1,4) AA	0.03	OriMC-1	NRAO	11m	Cla79	Cla79	
	93863.3	(10)	C_4H	$^2\Pi_{1/2}$ $J = 19/2 - 17/2$ $v_7 = 1$f	2.4[bf]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
	93870.101*(8)		C_2S	8,7 – 7,6	0.2[bs]	Sgr B2	NRAO	11m	Cla79	Yam90	M
	93871.70 *(2)		NH_2CHO	3(2,2) – 4(1,3)	[b]	Sgr B2	NRAO	11m	Tur91		M
	93979.78	(10)	PN	2 – 1	0.023	OriMC-1	NRAO	12m	Tur87b	Wys72	N
	93995.203*(3)		HNCS	8(1,7) – 7(1,6)	0.01	Sgr B2	NRAO	11m	Tur89		N
	94014.404 (50)		$^{13}CH_3OH$	2(1) – 1(1) E	0.008	Sgr B2	NRAO	11m	Tur89	And87	N
	94064.779*(19)		SO_2	23(6,18) – 24(5,19)	0.13	OriMC-1	NRAO	11m	Tur89		N
U	94077.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
	94137.3	(3)	$^{29}SiC_2$	4(2,2) – 3(2,1)	0.06	IRC+10216	IRAM	30m	Cer86b	Cer91b	N
U	94175.		unidentified		0.12	Sgr B2	NRAO	11m	Tur89		N
U	94195.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
U	94200.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U	94237.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
	94245.393	(9)	SiC_2	4(2,3) – 3(2,2)	0.10	IRC+10216	NRAO	11m	Tha84	Got89	M
	94247.473*(16)		NH_2CHO	8(1,7) – 8(0,8)	0.05	Sgr B2	NRAO	11m	Tur89		N
	94276.640*(12)		CH_2CHCN	10(0,10) – 9(0,9)	0.08	Sgr B2	NRAO	11m	Joh77		M
U	94353.		unidentified	(CH_2CHCN? Tur90)	0.12	OriMC-1	NRAO	11m	Tur89		N
	94405.42	(5)	$^{13}CH_3OH$	2(–1) – 1(–1) E	[b]	Sgr B2	NRAO	11m	Got79	Kur86	M
	94407.28	(5)	$^{13}CH_3OH$	2(0) – 1(0) A+	0.8[b]	Sgr B2	NRAO	11m	Got79	Kur86	M
	94411.26	(5)	$^{13}CH_3OH$	2(0) – 1(0) E	[b]	Sgr B2	NRAO	11m	Got79	Kur86	M
	94420.61	(5)	$^{13}CH_3OH$	2(1) – 1(1) E	1.0	OriMC-1	IRAM	30m	Men88	Kur86	N
U	94473.		unidentified		0.09	OriMC-1	NRAO	11m	Tur91		N
U	94486.		unidentified		0.12	OriMC-1	NRAO	11m	Tur89		N
U	94499.		unidentified		0.17	OriMC-1	NRAO	11m	Tur89		N
	94541.81	(10)	CH_3OH	8(3) – 9(2) E	0.43	OriMC-1	NRAO	11m	Hol83	Sas84	
	94632.80 *(6)		$HCOOCH_3$	5(2,4) – 4(1,3) E	0.16	OriMC-1	NRAO	11m	Tur89		N
U	94774.		unidentified		0.16	OriMC-1	NRAO	11m	Tur89		N
U	94811.	?	unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
U	94832.	?	unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U	94880.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U	94902.		unidentified	(CH_3CH_2OH? Tur91)	0.04	OriMC-1	NRAO	11m	Tur89		N
	94913.139*(14)		CH_2CHCN	10(4,7) – 9(4,6)	[b]	Sgr B2	NRAO	11m	Tur89		N
	94913.250*(14)		CH_2CHCN	10(4,6) – 9(4,5)	0.04[b]	Sgr B2	NRAO	11m	Tur89		N
U	95052.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
U	95073.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U	95143.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
U	95145.		unidentified		0.24	Sgr B2	NRAO	11m	Tur89		N
	95150.32 *(2)		C_4H	10 – 9 $J = 21/2 - 19/2$	0.08	IRC+10216	NRAO	11m	Gué78	Got83	

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

	Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
	95169.44	(10)	CH_3OH	8(0) − 7(1) A+	0.85	OriMC-1	NRAO	11m	Lov76a	Lee68	
U	95188.		unidentified		0.06	Sgr B2	NRAO	11m	Tur89		N
	95188.94	*(2)	C_4H	10 − 9 J = 19/2 − 17/2	0.08	IRC+10216	NRAO	11m	Gué78	Got83	
	95208.67	(10)	$^{13}CH_3OH$	2(1) − 1(1) A−	0.15	OriMC-1	NRAO	11m	Tur89	Lee73	N
U	95220.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
	95247.1	*(5)	$HCOOCH_3$	7(4,3) − 7(3,4) E	0.11	OriMC-1	NRAO	11m	Tur89		N
U	95260.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
U	95295.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
	95325.490	*(17)	CH_2CHCN	10(2,8) − 9(2,7)	0.12	Sgr B2	NRAO	11m	Tur89		N
U	95339.		unidentified		0.04	Sgr B2	NRAO	11m	Tur89		N
	95442.482	*(14)	CH_3CH_2CN	11(1,11) − 10(1,10)	0.20[b]	OriMC-1	NRAO	11m	Joh77		
	95443.850	*(33)	CH_3CH_2OH	16(2,14) − 16(1,13)	[b]	OriMC-1	NRAO	11m	Tur89		N
	95454.4	(3)	HCCSi ?	8 − 7 L	0.09	IRC+10216	IRAM	30m	Gué86	Gué86	N
	95469.3	(2)	HCCSi ?	8 − 7 U	0.11	IRC+10216	IRAM	30m	Gué86	Gué86	N
	95502.421	*(21)	CH_3CH_2CN	14(2,13) − (14(1,14)	0.07	OriMC-1	NRO	45m	Sai89		N
	95548.441	*(43)	CH_3OCH_3	14(7,8) − 15(6,9) EE	0.16	OriMC-1	NRO	45m	Sai89		N
	95553.241	*(39)	CH_3OCH_3	14(7,7) − 15(6,10) EE	0.13	OriMC-1	NRO	45m	Sai89		N
U	95570.		unidentified		0.07	Sgr B2	NRAO	11m	Tur89		N
	95579.381	(15)	SiC_2	4(2,2) − 3(2,1)	0.10	IRC+10216	NRAO	11m	Cum80	Got89	M
U	95585.		unidentified		0.06	OriMC-1	NRAO	11m	Tur91		N
	95611.13	(25)	C_4H	$^2\Sigma$ J = 10 − 9 ν_7 = 2 L	n.r.	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
U	95613.0		unidentified		0.18	OriMC-1	NRO	45m	Sai89		N
	95636.6	(4)	C_6H	$^2\Pi_{3/2}$ J = 69/2 − 67/2 f	0.05	IRC+10216	IRAM	30m	Gué87	Cer87a	N
	95667.89	(25)	C_4H	$^2\Sigma$ J = 10 − 9 ν_7 = 2 U	n.r.	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
	95668.3	(6)	C_6H	$^2\Pi_{3/2}$ J = 69/2 − 67/2 e	0.09[b]	IRC+10216	IRAM	30m	Gué87	Gué87	N
	95689.778	*(17)	CH_3CH_2CN	3(2,2) − 2(1,1)	0.34	OriMC-1	NRO	45m	Sai89		N
U	95710.7		unidentified		0.05	OriMC-1	NRO	45m	Sai89		N
	95730.4		CH_3OCH_3	16(2,14) − 16(1,15) EA + AE	0.58	OriMC-1	NRO	45m	Sai89	Sai89	N
	95731.8		CH_3OCH_3	16(2,14) − 16(1,15) EE	1.14	OriMC-1	NRO	45m	Sai89	Sai89	N
	95732.68	*(11)	CH_3OCH_3	16(2,14) − 16(1,15) AA	0.53	OriMC-1	NRO	45m	Sai89		N
U	95741.3		unidentified		0.09	OriMC-1	NRO	45m	Sai89		N
U	95747.2		unidentified		0.08	OriMC-1	NRO	45m	Sai89		N
U	95783.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
	95810.425	*(56)	$^{34}SO_2$	2(2,0) − 3(1,3)	0.07	OriMC-1	NRAO	11m	Tur89		N
	95850.337	*(5)	HC_5N	36 − 35	19.5[f]	IRC+10216	IRAM	30m	Cer86a		N
	95870.8	*(5)	HC_7N	85 − 84	0.06	Sgr B2	NRAO	11m	Tur89		N
U	95877.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
	95914.29	(10)	CH_3OH	2(1) − 1(1) A+	0.81	OriMC-1	NRAO	11m	Tur89	Lee68	N
	95947.43	*(5)	CH_3CHO	5(0,5) − 4(0,4) E	0.35	Sgr B2	NRAO	11m	Tur89	Kle91	N
	95963.42	*(5)	CH_3CHO	5(0,5) − 4(0,4) A	0.30	Sgr B2	NRAO	11m	Tur89	Kle91	N
U	95989.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U	96033.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
	96070.73	*(3)	$HCOOCH_3$	8(2,7) − 7(2,6) E	0.08	Sgr B2	NRAO	11m	Tur89	Plu86	N
	96076.84	*(10)	$HCOOCH_3$	8(2,7) − 7(2,6) A	0.08	Sgr B2	NRAO	11m	Tur89	Plu84	N
	96086.51	*(8)	$HCOOCH_3$	6(4,2) − 6(3,3) A	0.03	Sgr B2	NRAO	11m	Tur89		N
	96166.9	*(5)	$HCOOCH_3$	6(4,2) − 6(3,3) E	0.03	Sgr B2	NRAO	11m	Tur89		N
U	96204.		unidentified		0.11	Sgr B2	NRAO	11m	Tur91		N
U	96258.		unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
	96261.16	(10)	H_2O	4(4,0) − 5(3,3) ν_2 = 1	4.2[f]	VY CMa	IRAM	30m	Men89	Kuz80	N
	96274.24	*(5)	CH_3CHO	5(2,4) − 4(2,3) A	0.09	Sgr B2	NRAO	11m	Tur89	Kle91	N
	96293.3	(3)	C_6H	$^2\Pi_{1/2}$ J = 69/2 − 67/2 f	1.12[f]	IRC+10216	IRAM	30m	Sai87	Cer87a	N
	96342.5	(3)	C_6H	$^2\Pi_{1/2}$ J = 69/2 − 67/2 e	1.28[f]	IRC+10216	IRAM	30m	Sai87	Cer87a	N
	96367.85	(10)	CH_3CHO	5(3,2) − 4(3,1) E	[b]	Sgr B2	NRAO	11m	Got78a	Kle91	M
	96368.32	(10)	CH_3CHO	5(3,3) − 4(3,2) A	0.07[b]	Sgr B2	NRAO	11m	Got78a	Kle91	M
	96371.718	(50)	CH_3CHO	5(3,2) − 4(3,1) A	[b]	Sgr B2	NRAO	11m	Got78a	Kle91	M
	96384.379	(50)	CH_3CHO	5(3,3) − 4(3,2) E	0.1	Sgr B2	NRAO	11m	Got78a	Kle91	M
	96396.01	(10)	CH_3OH	2(1) − 1(1) A+ ν_t = 1	0.09	OriMC-1	NRAO	11m	Tur89	Lee68	N
	96412.982	*(13)	$C^{34}S$	2 − 1	0.62	OriMC-1	NRAO	11m	Tur73		
	96425.618	(50)	CH_3CHO	5(2,4) − 4(2,3) E	0.10	Sgr B2	NRAO	11m	Tur89	Kle91	N
U	96437.		unidentified	($HCOOCH_3$?)	0.05	OriMC-1	NRAO	11m	Tur89		N
	96475.536	(50)	CH_3CHO	5(2,3) − 4(2,2) E	0.08	Sgr B2	NRAO	11m	Got78a	Kle91	M
	96478.3	(3)	C_4H	$^2\Pi_{3/2}$ J = 21/2 − 19/2 ν_7 = 1e	2.85[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
	96492.13	(1)	CH_3OH	2(1) − 1(1) E ν_t = 1	0.13	OriMC-1	NRAO	11m	Hol83	Lov82	
	96493.58	(1)	CH_3OH	2(0) − 1(0) E ν_t = 1	0.12	OriMC-1	NRAO	11m	Hol83	Lov82	
	96501.66	(1)	CH_3OH	2(−1) − 1(−1) E ν_t = 1	0.06	OriMC-1	NRAO	11m	Hol83	Lov82	

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

	Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
	96513.70	(1)	CH_3OH	2(0) – 1(0) A+ ν_t=1	0.08	OriMC-1	NRAO	11m	Hol83	Lov82	
U	96536.		unidentified		0.1	OriMC-1	NRAO	11m	Sny83		
	96588.60	(10)	CH_3OH	2(1) – 1(1) A– ν_t=1	0.10	OriMC-1	NRAO	11m	Tur89	Lee68	N
	96613.44	*(44)	$HCOOCH_3$	8(4,5) – 8(3,6) E	0.2	OMC-IRc2	IRAM	30m	Ger89		N
	96632.63	(10)	CH_3CHO	5(2,3) – 4(2,2) A	0.12	OMC-IRc2	IRAM	30m	Ger89	Kle91	N
	96637.69	*(7)	$HCOOCH_3$	7(4,4) – 7(3,5) A	0.2	OMC-IRc2	IRAM	30m	Ger89		N
	96647.60	*(44)	$HCOOCH_3$	5(4,1) – 5(3,2) E	n.r.	OMC-IRc2	IRAM	30m	Ger89		N
	96670.27	*(45)	$HCOOCH_3$	5(4,2) – 5(3,3) E	0.05	OMC-IRc2	IRAM	30m	Ger89		N
	96693.37	*(7)	$HCOOCH_3$	6(4,3) – 6(3,4) A	0.1	OMC-IRc2	IRAM	30m	Ger89		N
	96709.20	*(7)	$HCOOCH_3$	8(4,5) – 8(3,6) A	0.2	OMC-IRc2	IRAM	30m	Ger89		N
U	96720.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
	96739.39	(10)	CH_3OH	2(–1) – 1(–1) E	0.96	OriMC-1	NRAO	11m	Hol83	Lee68	
	96741.42	(10)	CH_3OH	2(0) – 1(0) A+	1.13	OriMC-1	NRAO	11m	Hol83	Lee68	
	96744.58	(10)	CH_3OH	2(0) – 1(0) E	0.88	OriMC-1	NRAO	11m	Hol83	Lee68	
	96755.51	(10)	CH_3OH	2(1) – 1(1) E	0.54	OriMC-1	NRAO	11m	Hol83	Lee68	
U	96775.		unidentified		0.20	OriMC-1	NRAO	11m	Tur89		N
	96781.849	*(60)	^{34}SO	4(5) – 4(4)	0.04[b]	OriMC-1	NRAO	11m	Tur89		N
U	96797.	(3)	unidentified		0.05	Sgr B2	NRAO	11m	Cla79		
U	96822.		unidentified		0.06	Sgr B2	NRAO	11m	Tur89		N
U	96841.	?	unidentified		0.06	Sgr B2	NRAO	11m	Tur89		N
	96847.25	(10)	CH_3OCH_3	5(2,4) – 5(1,5) AE+EA	0.11	OriMC-1	NRAO	11m	Cla79	Cla79	
	96849.85	(10)	CH_3OCH_3	5(2,4) – 5(1,5) EE	0.14	OriMC-1	NRAO	11m	Cla79	Cla79	
	96852.46	(10)	CH_3OCH_3	5(2,4) – 5(1,5) AA	0.13	OriMC-1	NRAO	11m	Cla79	Cla79	
	96919.757	*(14)	CH_3CH_2CN	11(0,11) – 10(0,10)	0.08	OriMC-1	NRAO	11m	Joh77		
	96988.139	*(9)	$O^{13}CS$	8 – 7	0.069	Sgr B2	BTL	7m	Gol81		
U	97069.		unidentified		0.12	OriMC-1	NRAO	11m	Tur89		N
	97172.086	*(13)	$C^{33}S$	2 – 1	0.17	Sgr B2	BTL	7m	Cum86		
U	97263.		unidentified		0.01	OriMC-1	NRAO	11m	Tur89		N
	97271.033	*(12)	CS	2 – 1 v=1	0.007	IRC+10216	NRAO	12m	Tur87		N
U	97276.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U	97282.		unidentified		0.01	OriMC-1	NRAO	11m	Tur89		N
	97286.836	*(28)	CH_2CHCN	6(1,6) – 5(0,5)	0.02	OriMC-1	NRAO	11m	Tur89		N
U	97293.		unidentified		0.03[b]	Sgr B2	NRAO	11m	Tur89		N
	97295.48	*(14)	$Si^{13}CC$	4(1,3) – 3(1,2)	0.6[f]	IRC+10216	IRAM	30m	Cer91b		N
	97301.2085	(2)	OCS	8 – 7	0.85	Sgr B2	NRAO	11m	Sol73	Dij71	
	97318.612	*(45)	$HCOOCH_3$	4(2,2) – 3(1,3) E	0.01	OriMC-1	NRAO	11m	Tur89		N
U	97536.9		unidentified		0.08	OriMC-1	NRO	45m	Ohi88		N
U	97547.3		unidentified		0.06	OriMC-1	NRO	45m	Ohi88		N
U	97550.1		unidentified		0.05	OriMC-1	NRO	45m	Ohi88		N
U	97563.2		unidentified		0.05	OriMC-1	NRO	45m	Ohi88		N
U	97569.0		unidentified		0.04	OriMC-1	NRO	45m	Ohi88		N
U	97574.7		unidentified		0.09	OriMC-1	NRO	45m	Ohi88		N
U	97577.9		unidentified		0.14	OriMC-1	NRO	45m	Ohi88		N
	97582.83	(1)	CH_3OH	2(1) – 1(1) A–	<2.5	OriMC-1	OSO	20m	Fri84	Lee68	
U	97597.8		unidentified		0.21	OriMC-1	NRO	45m	Ohi88		N
U	97603.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
U	97618.7		unidentified		0.05	OriMC-1	NRO	45m	Ohi88		N
	97632.218	*(21)	$H_2{}^{13}CS$	3(1,3) – 2(1,2)	0.04	Sgr B2	BTL	7m	Cum86		
U	97650.1		unidentified		0.12	OriMC-1	NRO	45m	Ohi88		N
	97651.35	*(3)	$HCOOCH_3$	10(4,7) – 10(3,8) E	0.22	OriMC-1	NRO	45m	Ohi88	Plu86	N
U	97662.0		unidentified		0.21	OriMC-1	NRO	45m	Ohi88		N
	97677.7		CH_3OH	21(6) – 22(5) A–	0.29	OriMC-1	NRO	45m	Ohi88		N
	97678.8		CH_3OH	21(6) – 22(5) A+	0.34	OriMC-1	NRO	45m	Ohi88		N
	97694.26	*(10)	$HCOOCH_3$	10(7,4) – 10(8,3) A	0.2	OriMC-1	NRO	45m	Ohi88	Plu84	N
	97702.359	*(8)	SO_2	7(3,5) – 8(2,6)	<0.3	OriMC-1	NRAO	11m	Sny75a		
	97715.388	*(38)	^{34}SO	3(2) – 2(1)	0.14	OriMC-1	NRAO	11m	Got78		
U	97729.4		unidentified		0.06	OriMC-1	NRO	45m	Ohi88		N
U	97739.3		unidentified		0.10	OriMC-1	NRO	45m	Ohi88		N
U	97753.4		unidentified		0.19	OriMC-1	NRO	45m	Ohi88		N
U	97756.4		unidentified		0.05	OriMC-1	NRO	45m	Ohi88		N
U	97774.9		unidentified		0.07	OriMC-1	NRO	45m	Ohi88		N
U	97815.4		unidentified		0.05	OriMC-1	NRO	45m	Ohi88		N
U	97816.8		unidentified		0.05	OriMC-1	NRO	45m	Ohi88		N
	97833.60	*(1)	H_2CCCC	11(1,11) – 10(1,10)	0.106	IRC+10216	IRAM	30m	Cer91a	Kil90	N
U	97846.3		unidentified		0.12	OriMC-1	NRO	45m	Ohi88		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

	Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
	97862.6	(4)	C_5H	$^2\Pi_{1/2}$ $J=41/2-39/2$ a	1.2[f]	IRC+10216	IRAM	30m	Cer86	Cer86	N
	97868.8	(4)	C_5H	$^2\Pi_{1/2}$ $J=41/2-39/2$ b	1.1[f]	IRC+10216	IRAM	30m	Cer86	Cer86	N
U	97869.8		unidentified		0.07	OriMC-1	NRO	45m	Ohi88		N
U	97874.0		unidentified		0.07	OriMC-1	NRO	45m	Ohi88		N
U	97886.0		unidentified		0.17	OriMC-1	NRO	45m	Ohi88		N
U	97897.5		unidentified		0.22	OriMC-1	NRO	45m	Ohi88		N
U	97915.6		unidentified		0.06	OriMC-1	NRO	45m	Ohi88		N
U	97926.		unidentified		0.02[b]	OriMC-1	NRAO	11m	Tur89		N
U	97931.2		unidentified		0.06	OriMC-1	NRO	45m	Ohi88		N
U	97933.1		unidentified		0.06	OriMC-1	NRO	45m	Ohi88		N
U	97957.2		unidentified		0.04	OriMC-1	NRO	45m	Ohi88		N
U	97963.2		unidentified		0.09	OriMC-1	NRO	45m	Ohi88		N
	97980.968*	(17)	CS	2−1	6.94	OriMC-1	NRAO	11m	Tur73		
U	97991.1		unidentified		0.2	OriMC-1	NRO	45m	Ohi88		N
U	97993.8		unidentified		0.3	OriMC-1	NRO	45m	Ohi88		N
	97995.166	(50)	l-C_3H	$^2\Pi_{1/2}$ $J=9/2-7/2$ $F=5-4$	0.1	OriMC-1	NRO	45m	Ohi88	Got85	N
	97995.213	(50)	l-C_3H	$^2\Pi_{1/2}$ $J=9/2-7/2$ $F=4-3$	0.2	OriMC-1	NRO	45m	Ohi88	Got85	N
	97995.450	(60)	l-C_3H	$^2\Pi_{1/2}$ $J=9/2-7/2$b	0.116	IRC+10216	OSO	20m	Tha85	Tha85	
	98012.064	(60)	l-C_3H	$^2\Pi_{1/2}$ $J=9/2-7/2$a	0.089	IRC+10216	OSO	20m	Tha85	Tha85	
	98177.581*	(14)	CH_3CH_2CN	11(2,10)−10(2,9)	0.15	OriMC-1	NRAO	11m	Joh77		
	98182.25 *	(4)	$HCOOCH_3$	8(7,1)−7(7,0) E	0.07[b]	OriMC-1	NRAO	11m	Tur89	Plu86	N
	98190.65 *	(4)	$HCOOCH_3$	8(7,2)−7(7,1) A	[b]	OriMC-1	NRAO	11m	Tur89	Plu84	N
	98190.65 *	(4)	$HCOOCH_3$	8(7,1)−7(7,0) A	0.08[b]	OriMC-1	NRAO	11m	Tur89	Plu84	N
	98191.61 *	(4)	$HCOOCH_3$	8(7,2)−7(7,1) E	[b]	OriMC-1	NRAO	11m	Tur89	Plu86	N
U	98218.		unidentified		0.08	IRC+10216	IRAM	30m	Cer87b		N
U	98230.2		unidentified		0.02	OriMC-1	NRAO	11m	Kut80		
U	98239.7		unidentified		0.03	OriMC-1	NRAO	11m	Kut80		
	98245.01 *	(1)	H_2CCCC	11(0,11)−10(0,10)	0.038	IRC+10216	IRAM	30m	Cer91a	Kil90	N
U	98257.7		unidentified		0.03	OriMC-1	NRAO	11m	Kut80		
U	98265.9	(9)	unidentified		0.04	Sgr B2	BTL	7m	Cum86		
	98268.516	(20)	C_3S	17−16	2.2[f]	IRC+10216	IRAM	30m	Cer87b	Yam87	N
	98270.44 *	(3)	$HCOOCH_3$	8(6,2)−7(6,1) E	0.06	OriMC-1	NRAO	11m	Kut80	Plu86	M
	98279.02 *	(3)	$HCOOCH_3$	8(6,3)−7(6,2) E	[b]	OriMC-1	NRAO	11m	Kut80	Plu86	M
	98279.74 *	(5)	$HCOOCH_3$	8(6,3)−7(6,2) A	0.12[b]	OriMC-1	NRAO	11m	Kut80	Plu84	M
	98279.78 *	(5)	$HCOOCH_3$	8(6,2)−7(6,1) A	[b]	OriMC-1	NRAO	11m	Kut80	Plu84	M
U	98333.9		unidentified		0.02	OriMC-1	NRAO	11m	Kut80		
U	98351.9		unidentified		0.02	OriMC-1	NRAO	11m	Kut80		
	98408.9	(3)	C_6H	$^2\Pi_{3/2}$ $J=71/2-69/2$ f	0.04	IRC+10216	IRAM	30m	Gué87	Cer87a	N
	98424.16 *	(3)	$HCOOCH_3$	8(5,3)−7(5,2) E	0.10	OriMC-1	NRAO	11m	Tur89	Plu86	N
	98431.88 *	(3)	$HCOOCH_3$	8(5,4)−7(5,3) E	[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
	98432.75 *	(5)	$HCOOCH_3$	8(5,4)−7(5,3) A	0.04[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
	98435.80 *	(5)	$HCOOCH_3$	8(5,3)−7(5,2) A	[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
	98441.7	(3)	C_6H	$^2\Pi_{3/2}$ $J=71/2-69/2$ e	0.04	IRC+10216	IRAM	30m	Gué87	Cer87a	N
	98474.55 *	(13)	^{33}SO	3(2)−2(1) $F=3/2-1/2$	[b]	OriMC-1	NRAO	11m	Tur89		N
	98482.15 *	(8)	^{33}SO	3(2)−2(1) $F=5/2-3/2$	[b]	OriMC-1	NRAO	11m	Tur89		N
	98489.08 *	(7)	^{33}SO	3(2)−2(1) $F=7/2-5/2$	0.10[b]	OriMC-1	NRAO	11m	Tur89		N
	98493.68 *	(13)	^{33}SO	3(2)−2(1) $F=9/2-7/2$	[b]	OriMC-1	NRAO	11m	Tur89		N
	98512.522*	(5)	HC_5N	37−36	0.08	OriMC-1	NRAO	11m	Buj81		
	98523.880*	(13)	CH_3CH_2CN	11(6)−10(6)	0.13	OriMC-1	NRAO	11m	Joh77		
	98524.661*	(13)	CH_3CH_2CN	11(7)−10(7)	0.10	OriMC-1	NRAO	11m	Joh77		
	98524.94 *	(5)	C_5H	$^2\Pi_{3/2}$ $J=41/2-39/2$ a	4.5[fb]	IRC+10216	IRAM	30m	Cer86a	Got86	N
	98527.44 *	(5)	C_5H	$^2\Pi_{3/2}$ $J=41/2-39/2$ b	[b]	IRC+10216	IRAM	30m	Cer86a	Got86	N
	98532.070*	(14)	CH_3CH_2CN	11(8)−10(8)	0.06	OriMC-1	NRAO	11m	Joh77		
	98533.985*	(26)	CH_3CH_2CN	11(5)−10(5)	0.17	OriMC-1	NRAO	11m	Joh77		
	98544.145*	(15)	CH_3CH_2CN	11(9,3)−10(9,2)	0.08[b]	OriMC-1	NRAO	11m	Tur89		N
	98544.145*	(15)	CH_3CH_2CN	11(9,2)−10(9,1)	[b]	OriMC-1	NRAO	11m	Tur89		N
	98564.834*	(13)	CH_3CH_2CN	11(4,8)−10(4,7)	0.09	OriMC-1	NRAO	11m	Joh77		
	98566.799*	(13)	CH_3CH_2CN	11(4,7)−10(4,6)	0.09	OriMC-1	NRAO	11m	Joh77		
	98606.85 *	(3)	$HCOOCH_3$	8(3,6)−7(3,5) E	[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
	98610.108*	(13)	CH_3CH_2CN	11(3,9)−10(3,8)	0.14	OriMC-1	NRAO	11m	Joh77		
	98611.15 *	(4)	$HCOOCH_3$	8(3,6)−7(3,5) A	0.08[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
U	98630.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
	98655.07 *	(1)	H_2CCCC	11(1,10)−10(1,9)	0.124	IRC+10216	IRAM	30m	Cer91a	Kil90	N
U	98663.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
	98682.60 *	(4)	$HCOOCH_3$	8(4,5)−7(4,4) A	0.02	Sgr B2	BTL	7m	Cum86	Plu84	M

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
U 98696.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
98701.109*(13)		CH_3CH_2CN	11(3,8) – 10(3,7)	0.12	OriMC-1	NRAO	11m	Joh77		
98712.06 *(3)		$HCOOCH_3$	8(4,5) – 7(4,4) E	0.04	Sgr B2	BTL	7m	Cum86	Plu86	M
98747.87 *(3)		$HCOOCH_3$	8(4,4) – 7(4,3) E	0.04	Sgr B2	BTL	7m	Cum86	Plu86	M
U 98771.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
98792.28 *(4)		$HCOOCH_3$	8(4,4) – 7(4,3) A	0.05	Sgr B2	BTL	7m	Cum86	Plu84	M
98863.328 (50)		CH_3CHO	5(1,4) – 4(1,3) E	0.23	Sgr B2	BTL	7m	Cum86	Kle91	M
98900.948 (50)		CH_3CHO	5(1,4) – 4(1,3) A	0.18	Sgr B2	BTL	7m	Cum86	Kle91	M
98926.723*(17)		AlF	3 – 2	0.97[f]	IRC+10216	IRAM	30m	Cer87c		N
98940.02 *(2)		C_3N	10 – 9 J = 21/2 – 19/2	0.18	IRC+10216	NRAO	11m	Gué77	Got83	
98958.78 *(2)		C_3N	10 – 9 J = 19/2 – 17/2	0.13	IRC+10216	NRAO	11m	Gué77	Got83	
98976.284*(22)		SO_2	28(7,21) – 29(6,24)	0.08	OriMC-1	NRAO	11m	Tur91		N
U 99011.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
U 99068.		unidentified		0.08	OriMC-1	NRAO	11m	Tur91		N
99083.2	(5)	C_6H	$^2\Pi_{1/2}$ J = 71/2 – 69/2 f	0.97[f]	IRC+10216	IRAM	30m	Sai87	Cer87a	N
U 99087.		unidentified		0.12	OriMC-1	NRAO	11m	Tur89		N
99118.6	(1)	NH_2D	5(2,4) – 4(1,4)	0.04	Sgr B2	BTL	7m	Cum86	DeL75	
U 99120.		unidentified	(NH_2D ?)	0.15	OriMC-1	OSO	20m	Fri84		
99133.8	(5)	C_6H	$^2\Pi_{1/2}$ J = 71/2 – 69/2 e	1.05[f]	IRC+10216	IRAM	30m	Sai87	Cer87a	N
U 99142.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
99203.46 *(10)		CH_3SH	2(1) – 2(0) E	0.10	Sgr B2	NRAO	11m	Tur89	Lee80	N
99264.98	(5)	CH_3SH	3(1) – 3(0) E	0.08	OriMC-1	NRAO	11m	Tur89	Lee80	N
99299.879*(38)		SO	3(2) – 2(1)	1.59[m]	OriMC-1	NRAO	11m	Got78		
99311.195 (75)		NH_2CN	5(1,5) – 4(1,4)	0.40	Sgr B2	BTL	7m	Cum86	Joh76a	
99325.25	(20)	CH_3OCH_3	4(1,4) – 3(0,3) EE	0.2	OriMC-1	NRAO	11m	Cla79	Lov79	
U 99361.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
U 99378.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
99392.645*(27)		SO_2	29(4,26) – 28(5,23)	<0.50	OriMC-1	OSO	20m	Fri84		
99409.74	(10)	CH_3SH	4(1) – 4(0) E	0.05	Sgr B2	NRAO	11m	Tur89	Lee80	N
U 99586.		unidentified		0.12	OriMC-1	NRAO	11m	Tur89		N
99651.863*(11)		$HC^{13}CCN$	11 – 10	0.13	Sgr B2	BTL	7m	Cum86		
99661.471*(6)		$HCC^{13}CN$	11 – 10	0.14	Sgr B2	BTL	7m	Cum86		
99681.516*(14)		CH_3CH_2CN	11(2,9) – 10(2,8)	0.05	Sgr B2	BTL	7m	Cum86		
U 99698.	?	unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
U 99727.0	(16)	unidentified		0.04	Sgr B2	BTL	7m	Cum86		
99730.92	(1)	CH_3OH	6(1) – 5(0) E ν_t = 1	0.20	OriMC-1	NRAO	11m	Chu80	Lov82	
99774.15	(5)	$H_2C^{34}S$	3(1,3) – 2(1,2)	<0.2	OriMC-1	OSO	20m	Gar85	Lov84	
99866.510*(12)		C_2S	7,8 – 6,7	0.08	Sgr B2	BTL	7m	Cum86	Yam90	M
U 99903.		unidentified		0.15	Sgr B2	NRAO	11m	Tur89		N
99929.54	(10)	KCl	13 – 12	0.43[f]	IRC+10216	IRAM	30m	Cer87c	Clo64	N
99953.27	(6)	NH_2CN	5(2,4) – 4(2,3)	0.08[b]	Sgr B2	BTL	7m	Cum86	Joh76a	
99956.60	(4)	NH_2CN	5(2,3) – 4(2,2)	[b]	Sgr B2	BTL	7m	Cum86	Joh76a	
99972.66	(8)	NH_2CN	5(0,5) – 4(0,4)	0.12	Sgr B2	BTL	7m	Cum86	Joh76a	
100029.569*(60)		SO	4(5) – 4(4)	0.38[m]	OriMC-1	NRAO	11m	Got78		
100076.389*(2)		HC_3N	11 – 10	1.28	OriMC-1	NRAO	11m	Mor76		
100094.461*(51)		CH_2CO	5(1,5) – 4(1,4)	0.17	Sgr B2	NRAO	11m	Tur77		
100110.27	(10)	CH_3SH	4(1) – 3(1) A+	0.06	Sgr B2	BTL	7m	Lin79	Lee80	
U 100122.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
U 100157.0		unidentified		0.07	Sgr B2	NRAO	11m	Tur77		
100173.10	(10)	CH_3SH	7(2) – 8(1) A+	0.08	OriMC-1	NRAO	11m	Tur89	Lee80	N
U 100185.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U 100197.2	(8)	unidentified		0.09	Sgr B2	BTL	7m	Cum85		
U 100200.4		unidentified		0.09	Sgr B2	NRAO	11m	Tur77		
100240.524*(31)		HC_3N	11 – 10 v_6 = 1 ℓ = 1e	0.02	Sgr B2	NRAO	11m	Tur91		N
100294.61 *(3)		$HCOOCH_3$	8(3,5) – 7(3,4) E	0.05	Sgr B2	BTL	7m	Cum86	Plu86	M
100308.17 *(5)		$HCOOCH_3$	8(3,5) – 7(3,4) A	0.08	OriMC-1	BTL	7m	Gol82	Plu84	M
100322.349*(29)		HC_3N	11 – 10 v_7 = 1 ℓ = 1e	0.07	OriMC-1	BTL	7m	Gol82		
U 100332.		unidentified		0.06	Sgr B2	NRAO	11m	Tur89		N
U 100365.		unidentified		0.18	OriMC-1	NRAO	11m	Tur89		N
U 100373.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
U 100421.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
U 100436.		unidentified		0.06	OriMC-1	NRAO	11m	Tur91		N
U 100453.		unidentified		0.08	Sgr B2	NRAO	11m	Tur89		N
100463.11	(3)	CH_3OCH_3	6(2,5) – 6(1,6) EE	0.12	OriMC-1	NRAO	11m	Wil81		
100466.106*(29)		HC_3N	11 – 10 v_7 = 1 ℓ = 1f	0.04	OriMC-1	NRAO	11m	Tur91		M

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
100482.27	*(3)	$HCOOCH_3$	8(1,7)–7(1,6) E	0.08	OriMC-1	BTL	7m	Gol82	Plu86	M
100490.67	*(5)	$HCOOCH_3$	8(1,7)–7(1,6) A	0.08	OriMC-1	BTL	7m	Gol82	Plu84	M
U 100498.5		unidentified		0.05	OriMC-1	NRAO	11m	Wil81		
100526.506	*(8)	CH_3NC	5–4	1.8	Sgr B2	IRAM	30m	Cer88		N
100598.34		CH_2CN	5(0,5)–4(0,4) 11/2–9/2	0.55	Sgr B2	FCARO	14m	Irv88a	Irv88a	N
100614.295	*(14)	CH_3CH_2CN	11(1,10)–10(1,9)	0.10	OriMC-1	NRAO	11m	Joh77		
100629.50	(12)	NH_2CN	5(1,4)–4(1,3)	0.17	Sgr B2	NRAO	11m	Tur75a	Joh76a	
100638.90	(10)	CH_3OH	13(2)–12(3) E1	0.35	OriMC-1	NRAO	11m	Tur89	Sas84	N
100681.51	*(3)	$HCOOCH_3$	9(0,9)–8(0,8) E	0.07[b]	Sgr B2	NRAO	11m	Chu80	Plu86	M
100683.36	*(5)	$HCOOCH_3$	9(0,9)–8(0,8) A	[b]	Sgr B2	NRAO	11m	Chu80	Plu84	M
100708.837	*(44)	HC_3N	11–10 $\nu_7=2$ $\ell=0$	0.05[b]	Sgr B2	BTL	7m	Cum86		
100710.972	*(52)	HC_3N	11–10 $\nu_7=2$ $\ell=2$ e	[b]	Sgr B2	BTL	7m	Cum86		
100714.306	*(46)	HC_3N	11–10 $\nu_7=2$ $\ell=2$ f	[b]	Sgr B2	BTL	7m	Cum86		
U 100765.	?	unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
100878.113	*(6)	SO_2	2(2,0)–3(1,3)	0.08	Sgr B2	BTL	7m	Cum86		
100989.940	*(16)	CH_3CH_2OH	8(2,7)–8(1,8)	0.05	Sgr B2	BTL	7m	Lin79		
101002.34	*(5)	CH_2CO	5(3,3)–4(3,2)	0.06[b]	Sgr B2	BTL	7m	Cum86		M
101002.35	*(5)	CH_2CO	5(3,2)–4(3,1)	[b]	Sgr B2	BTL	7m	Cum86		M
101024.401	*(44)	CH_2CO	5(2,4)–4(2,3)	0.05[b]	Sgr B2	NRAO	11m	Tur89		N
101029.75	(5)	CH_3SH	4(–1)–3(–1) E	[b]	Sgr B2	BTL	7m	Lin79	Lin79	
101036.56	*(6)	CH_2CO	5(0,5)–4(0,4)	0.12[b]	Sgr B2	NRAO	11m	Tur77		
101139.16	(5)	CH_3SH	4(0)–3(0) A	0.27[b]	Sgr B2	BTL	7m	Lin79	Lin79	
101139.65	(4)	CH_3SH	4(0)–3(0) E	[b]	Sgr B2	BTL	7m	Lin79	Lin79	
101159.46	(10)	CH_3SH	4(2)–3(2) A–	0.03	Sgr B2	BTL	7m	Cum86	Lee80	
101167.15	(4)	CH_3SH	4(–2)–3(–2) E	0.13[b]	Sgr B2	BTL	7m	Cum86	Lin79	
101168.34	(4)	CH_3SH	4(2)–3(2) E	[b]	Sgr B2	BTL	7m	Cum86	Lin79	
101174.679	*(5)	HC_5N	38–37	0.09[b]	Sgr B2	BTL	7m	Lin79		
101179.76	(10)	CH_3SH	4(2)–3(2) A	[b]	Sgr B2	BTL	7m	Lin79	Lee80	N
101180.3	(3)	C_6H	$^2\Pi_{3/2}$ $J=73/2-71/2$ f	1.20[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
101215.0	(15)	C_6H	$^2\Pi_{3/2}$ $J=73/2-71/2$ e	0.70[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
101284.36	(4)	CH_3SH	4(1)–3(1) E	0.09	Sgr B2	BTL	7m	Lin79	Lin79	
101332.984	*(17)	H_2CO	6(1,5)–6(1,6)	<0.1	Sgr B2	BTL	7m	Lin79		
101343.41	*(10)	CH_3CHO	3(1,3)–2(0,2) E	0.08	Sgr B2	BTL	7m	Cum86		M
U 101371.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U 101384.		unidentified	(DNCO?)	0.02	OriMC-1	NRAO	11m	Tur89		N
U 101461.	?	unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
101469.70	(10)	CH_3OH	8(–2)–8(1) E2	0.17	OriMC-1	NRAO	11m	Tur89	Sas84	N
101477.753	*(55)	H_2CS	3(1,3)–2(1,2)	0.49	OriMC-1	BTL	7m	Van84		
101559.35	(10)	CH_3OCH_3	12(2,10)–11(3,9) AA	[b]	OriMC-1	NRAO	11m	Tur89		N
101562.17	(10)	CH_3OCH_3	12(2,10)–11(3,9) EE	0.10[b]	OriMC-1	NRAO	11m	Tur89		N
101564.90	(10)	CH_3OCH_3	12(2,10)–11(3,9) AE+EA	[b]	OriMC-1	NRAO	11m	Tur89		N
101637.243	*(18)	CH_2CHCN	11(1,11)–10(1,10)	0.05	OriMC-1	NRAO	11m	Tur91		N
U 101677.		unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
101688.5	*(5)	$^{33}SO_2$	12(4,8)–12(3,11)	0.03	Sgr B2	NRAO	11m	Tur89		N
101737.08	(5)	CH_3OH	9(–2)–9(1) E	0.36	OriMC-1	OSO	20m	Mil87	Sas84	N
101771.95	*(10)	$HCOOCH_3$	24(5,19)–24(4,20) A	0.06	OriMC-1	OSO	20m	Mil87	Plu84	N
101873.6	(10)	C_6H	$^2\Pi_{1/2}$ $J=73/2-71/2$ f	0.75[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
101925.2	(7)	C_6H	$^2\Pi_{1/2}$ $J=73/2-71/2$ e	0.78[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
101961.53	*(7)	$Na^{37}Cl$	8–7	0.68[f]	IRC+10216	IRAM	30m	Cer87c		N
U 101970.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
101981.383	*(51)	CH_2CO	5(1,4)–4(1,3)	0.22	Sgr B2	NRAO	11m	Tur77		
102031.906	*(54)	$^{34}SO_2$	3(1,3)–2(0,2)	0.05	OriMC-1	NRAO	11m	Tur89		N
102031.94	*(5)	AlCl	7–6	0.82[f]	IRC+10216	IRAM	30m	Cer87c		N
U 102043.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
102064.268	*(8)	NH_2CHO	5(1,5)–4(1,4)	0.2	Sgr B2	NRAO	11m	Tur78a		
102122.59	(5)	CH_3OH	10(–2)–10(1) E	0.41	OriMC-1	OSO	20m	Mil87	Sas84	N
102202.49	(4)	CH_3SH	4(1)–3(1) A–	0.08	Sgr B2	BTL	7m	Lin79	Lin79	
102217.515	*(5)	NH_2CHO	2(1,2)–1(0,1)	0.09	Sgr B2	NRAO	11m	Tur89		N
U 102274.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
102298.08	*(3)	HCCCHO	11(0,11)–10(0,10)	0.03	Sgr B2	NRAO	11m	Tur89		N
U 102319.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
U 102375.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
U 102399.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
U 102407.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
U 102423.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
U 102432.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
U 102490.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
102530.346*	(1)	CH_3CCH	6(3) – 5(3)	0.14	OriMC-1	NRAO	11m	Chu83		
102540.144*	(1)	CH_3CCH	6(2) – 5(2)	0.23	OriMC-1	NRAO	11m	Chu83		
102546.024*	(1)	CH_3CCH	6(1) – 5(1)	0.29	OriMC-1	NRAO	11m	Chu83		
102547.984*	(1)	CH_3CCH	6(0) – 5(0)	0.33	OriMC-1	NRAO	11m	Chu83		
102635.7	(7)	C_5H	$^2\Pi_{1/2}$ J = 43/2 – 41/2 a	1.1[f]	IRC+10216	IRAM	30m	Cer86	Cer86	N
U 102640.		unidentified		0.08	OriMC-1	OSO	20m	Mil87		N
102642.4	(7)	C_5H	$^2\Pi_{1/2}$ J = 43/2 – 41/2 b	1.0[f]	IRC+10216	IRAM	30m	Cer86	Cer86	N
U 102644.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U 102650.		unidentified		0.07	OriMC-1	NRAO	11m	Tur89		N
102658.04	(10)	CH_3OH	11(–2) – 11(1) E	0.15	OriMC-1	NRAO	11m	Lov82	Sas84	
102690.022*	(26)	SO_2	33(8,26) – 34(7,27)	0.07	OriMC-1	OSO	20m	Mil87		N
102736.91 *	(10)	$HCOOCH_3$	16(5,11) – 16(4,12) A	0.12	OriMC-1	OSO	20m	Mil87	Plu84	N
102807.318*	(53)	$H_2C^{34}S$	3(1,2) – 2(1,1)	0.02	Sgr B2	NRAO	11m	Tur89		N
102957.73	(10)	CH_3OH	unassigned	0.12	OriMC-1	NRAO	11m	Tur89	Lee68	N
102992.38 *	(1)	H_2CCC	5(1,5) – 4(1,4)	0.230	TMC-1	IRAM	30m	Cer91	Vrt90	N
U 103028.		unidentified		0.03[b]	Sgr B2	NRAO	11m	Tur89		N
103040.399*	(53)	H_2CS	3(0,3) – 2(0,2)	0.2	Sgr B2	NRAO	11m	Got78a		
103051.785*	(58)	H_2CS	3(2,1) – 2(2,0)	0.13	Sgr B2	BTL	7m	Van84		
U 103071.		unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
U 103075.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
103114.897*	(10)	$HCOOCH_3$	21(4,17) – 21(3,18) A	0.05	OriMC-1	NRAO	11m	Tur89	Plu84	N
U 103133.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U 103151.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
103188.64 *	(10)	NH_2D	8(3,6) – 8(2,6) U	0.01	Sgr B2	NRAO	11m	Tur89		N
U 103196.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
U 103216.6	(12)	unidentified		0.04	Sgr B2	BTL	7m	Cum86		
U 103223.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
U 103227.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
103266.0	(3)	C_4H	$^2\Pi_{1/2}$ J = 21/2 – 19/2 ν_7 = 1e	2.75[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
U 103270.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U 103297.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
103319.611	(60)	l-C_3H	$^2\Pi_{3/2}$ J = 9/2 – 7/2a	0.054	IRC+10216	FCRAO	14m	Tha85	Tha85	
U 103328.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
103330.	(1)	C_5H	$^2\Pi_{3/2}$ J = 45/2 – 43/2	0.07	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
103372.658	(60)	l-C_3H	$^2\Pi_{3/2}$ J = 9/2 – 7/2b	0.078	IRC+10216	FCRAO	14m	Tha85	Tha85	
103381.11	(5)	CH_3OH	12(–2) – 12(1) E2	0.07	OriMC-1	NRAO	11m	Tur89	Sas84	N
U 103417.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
U 103426.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U 103458.		unidentified	(CH_3CH_2OH? Tur90)	0.16	OriMC-1	NRAO	11m	Tur89		N
103466.59 *	(3)	$HCOOCH_3$	8(2,6) – 7(2,5) E	0.07	Sgr B2	BTL	7m	Cum86	Plu86	M
103478.64 *	(4)	$HCOOCH_3$	8(2,6) – 7(2,5) A	0.04	Sgr B2	BTL	7m	Cum86	Plu84	M
U 103517.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
103524.232*	(20)	NH_2CHO	9(1,8) – 9(0,9)	0.08	OriMC-1	NRAO	11m	Tur89		N
U 103549.0	(19)	unidentified		0.04	Sgr B2	BTL	7m	Cum86		
103575.401*	(14)	CH_2CHCN	11(0,11) – 10(0,10)	0.07	Sgr B2	BTL	7m	Cum86		M
103576.5	(3)	C_4H	$^2\Pi_{1/2}$ J = 21/2 – 19/2 ν_7 = 1f	0.10	IRC+10216	IRAM	30m	Cer87b	Yam87b	N
103640.754*	(8)	C_2S	8,8 – 7,7	0.05	Sgr B2	BTL	7m	Cum86	Yam90	M
U 103680.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U 103689.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
103699.708*	(48)	SO_2	7(3,5) – 8(2,6) ν_2 = 1	0.04	OriMC-1	NRAO	11m	Tur89		N
103702.810*	(10)	CH_3CH_2OH	9(1,8) – 8(2,7)	0.04	Sgr B2	BTL	7m	Cum86		
U 103714.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
U 103787.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
U 103796.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
103836.809*	(5)	HC_5N	39 – 38	0.05	Sgr B2	BTL	7m	Cum86		
U 103868.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
U 103915.		unidentified	(H56c?)	0.1	OriMC-1	NRAO	11m	Kui77		
U 103918.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
U 103932.		unidentified		0.01	OriMC-1	NRAO	11m	Tur89		N
103951.9	(4)	C_6H	$^2\Pi_{3/2}$ J = 75/2 – 73/2 f	1.25[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
103989.0	(4)	C_6H	$^2\Pi_{3/2}$ J = 75/2 – 73/2 e	0.90[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
104029.416*	(5)	SO_2	3(1,3) – 2(0,2)	3.0	OriMC-1	NRAO	11m	Hol76a		
104048.455	(20)	C_3S	18 – 17	2.1[f]	IRC+10216	IRAM	30m	Cer87b	Yam87	N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
104051.281*	(14)	CH_3CH_2CN	12(1,12) – 11(1,11)	0.08	OriMC-1	NRAO	11m	Joh77		
104060.76	(10)	CH_3OH	13(–4) – 12(–3)	0.2	OriMC-1	NRAO	11m	Kui77	Lee68	
104175.92	(20)	CH_3OCH_3	17(2,15) – 17(1,16) EA + AE	[b]	OriMC-1	NRAO	11m	Tur89	Lov79	N
104177.37	(20)	CH_3OCH_3	17(2,15) – 17(1,16) EE	0.09[b]	OriMC-1	NRAO	11m	Tur89	Lov79	N
104178.80	(20)	CH_3OCH_3	17(2,15) – 17(1,16) AA	[b]	OriMC-1	NRAO	11m	Tur89	Lov79	N
104187.115*	(6)	C_3HD	3(0,3) – 2(1,2)	0.39	TMC-1	NRAO	12m	Ger87	Bog87	N
104189.74 *	(7)	NaCl	8 – 7	1.24[f]	IRC+10216	IRAM	30m	Cer87c		N
U 104200.1	(8)	unidentified		0.07	Sgr B2	BTL	7m	Cum86		
104212.655*	(12)	CH_2CHCN	11(2,10) – 10(2,9)	0.06	Sgr B2	BTL	7m	Cum86		
104239.293*	(10)	SO_2	10(1,9) – 10(0,10)	0.29	Sgr B2	BTL	7m	Cum86		
104300.46	(10)	CH_3OH	11(–1) – 10(–2) E	0.12	Sgr B2	BTL	7m	Cum86	Lee73	
104336.54	(5)	CH_3OH	13(–2) – 13(1) E	0.03	Sgr B2	BTL	7m	Cum86	Sas84	
104354.85	(10)	CH_3OH	10(4) – 11(3) A–	0.06	Sgr B2	BTL	7m	Cum86	Lee68	
104391.65 *	(6)	$^{34}SO_2$	10(1,9) – 10(0,10)	0.04	Sgr B2	BTL	7m	Cum86		
104408.903*	(13)	CH_2CHCN	11(5) – 10(5)	0.08[b]	Sgr B2	BTL	7m	Cum86		
104410.48	(10)	CH_3OH	10(4) – 11(3) A+	[b]	Sgr B2	BTL	7m	Cum86	Lee68	
104411.262*	(13)	CH_2CHCN	11(4,8) – 10(4,7)	[b]	Sgr B2	BTL	7m	Cum86		
104411.485*	(13)	CH_2CHCN	11(4,7) – 10(4,6)	[b]	Sgr B2	BTL	7m	Cum86		
104419.308*	(15)	CH_2CHCN	11(6) – 10(6)	[b]	Sgr B2	BTL	7m	Cum86		
U 104425.		unidentified		0.08	Sgr B2	NRAO	11m	Tur89		N
104432.793*	(15)	CH_2CHCN	11(3,9) – 10(3,8)	0.04[b]	Sgr B2	BTL	7m	Cum86		
104437.516*	(17)	CH_2CHCN	11(7) – 10(7)	[b]	Sgr B2	BTL	7m	Cum86		
104453.927*	(15)	CH_2CHCN	11(3,8) – 10(3,7)	0.06	Sgr B2	BTL	7m	Cum86		
104477.51 *	(30)	CH_3OD	4(2) – 5(1) A+	0.10	Sgr B2	NRAO	11m	Tur89		N
104487.220*	(9)	CH_3CH_2OH	7(0,7) – 6(1,6)	0.20	Sgr B2	BTL	7m	Cum86		
U 104531.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
U 104589.		unidentified		0.15[x]	Sgr B2	NRAO	11m	Lis78		
104616.975*	(55)	H_2CS	3(1,2) – 2(1,1)	0.77	Sgr B2	NRAO	11m	Lis78		
104666.56 *	(2)	C_4H	11 – 10 J = 23/2 – 21/2	0.10	IRC+10216	NRAO	11m	Gué78	Got83	
U 104696.		unidentified		0.04	Sgr B2	NRAO	11m	Tur89		N
104703.33 *	(4)	CH_3OCH_3	7(2,6) – 7(1,7) EE	0.08[b]	OriMC-1	NRAO	11m	Tur89		N
104705.10 *	(2)	C_4H	11 – 10 J = 21/2 – 19/2	0.10	IRC+10216	NRAO	11m	Gué78	Got83	
104705.95 *	(5)	CH_3OCH_3	7(2,6) – 7(1,7) AA	[b]	OriMC-1	NRAO	11m	Tur89		N
104711.385*	(20)	$^{13}C^{18}O$	1 – 0	n.r.	OriMC-2	NRAO	11m	Wan76		
U 104720.		unidentified		0.07	Sgr B2	NRAO	11m	Tur89		N
U 104798.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
104808.620*	(11)	CH_3CH_2OH	5(1,5) – 4(0,4)	0.18	Sgr B2	NRAO	11m	Zuc75		
U 104819.		unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
U 104874.8	(10)	unidentified		0.12	Sgr B2	BTL	7m	Cum86		
104891.9 *	(6)	HC_7N	93 – 92	0.09	Sgr B2	NRAO	11m	Tur89		N
104915.58 *	(1)	H_2CCC	5(1,4) – 4(1,3)	0.257	TMC-1	IRAM	30m	Cer91	Vrt90	N
U 104941.	?	unidentified		0.15	Sgr B2	NRAO	11m	Tur89		N
104960.550*	(16)	CH_2CHCN	11(2,9) – 10(2,8)	0.06	Sgr B2	BTL	7m	Cum86		
U 105023.		unidentified	(CH_3CH_2OH? Tur90)	0.04	OriMC-1	NRAO	11m	Tur89		N
U 105027.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
105063.70	(10)	CH_3OH	13(1) – 12(2)	0.55	OriMC-1	FCRAO	14m	Gol83	Lee68	
105174.58	(20)	C_4H	$^2\Sigma$ J = 11 – 10 v_7 = 2 L	0.15	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
105230.65	(20)	C_4H	$^2\Sigma$ J = 11 – 10 v_7 = 2 U	0.15	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
U 105278.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
105310.73 *	(12)	$HCOOCH_3$	27(6,21) – 27(5,22) A	0.10	OriMC-1	NRAO	11m	Tur89		N
105355.40 *	(4)	CH_3CH_2OH	17(2,15) – 17(1,16)	0.04	Sgr B2	NRAO	11m	Tur89		N
U 105412.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
105464.221	(6)	NH_2CHO	5(0,5) – 4(0,4)	0.31	Sgr B2	BTL	7m	Cum86		
105469.303*	(14)	CH_3CH_2CN	12(0,12) – 11(0,11)	0.2	OriMC-1	NRAO	11m	Kui77		
U 105540.		unidentified		0.05	OriMC-1	OSO	20m	Joh84		
105558.077*	(4)	HNCS	9(0,9) – 8(0,8)	0.05	Sgr B2	BTL	7m	Fre79		
105576.35	(10)	CH_3OH	14(–2) – 14(1) E	0.2[n]	OriMC-1	NRAO	11m	Kui77	Lee68	
U 105590.		unidentified		0.15	OriMC-1	OSO	20m	Joh84		
U 105610.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
U 105618.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
U 105728.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U 105739.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
105743.859*	(3)	HNCS	9(1,8) – 8(1,7)	0.13	OriMC-1	NRAO	11m	Tur89		N
105768.60 *	(43)	CH_3OCH_3	13(1,12) – 13(0,13) EA + AE	[b]	OriMC-1	OSO	20m	Joh84		
105770.50 *	(26)	CH_3OCH_3	13(1,12) – 13(0,13) EE	0.20[b]	OriMC-1	OSO	20m	Joh84		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
105772.41	*(12)	CH_3OCH_3	13(1,12) – 13(0,13) AA	[b]	OriMC-1	OSO	20m	Joh84		
U 105787.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
105794.057	*(58)	CH_2NH	4(0,4) – 3(1,3)	0.27[b]	Sgr B2	BTL	7m	Cum86		
105799.093	*(10)	$H^{13}CCCN$	12 – 11	[b]	Sgr B2	BTL	7m	Cum86		
105799.093	*(10)	$H^{13}CCCN$	12 – 11	0.10	OriMC-1	OSO	20m	Joh84		
105838.0	(3)	C_4H	$^2\Pi_{3/2}$ J = 23/2 – 21/2 ν_7 = 1e	3.50[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
105972.601	*(14)	NH_2CHO	5(2,4) – 4(2,3)	0.1[e]	Sgr B2	NRAO	11m	Got78a		
106132.8	(3)	C_4H	$^2\Pi_{3/2}$ J = 23/2 – 21/2 ν_7 = 1f	3.10[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
106134.430	*(25)	NH_2CHO	5(3,3) – 4(3,2)	0.10[b]	Sgr B2	BTL	7m	Cum86		
106141.403	*(25)	NH_2CHO	5(3,2) – 4(3,1)	[b]	Sgr B2	BTL	7m	Cum86		
U 106156.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
106347.742	*(10)	C_2S	9,8 – 8,7	0.19	Sgr B2	BTL	7m	Cum86	Yam90	M
U 106367.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
106374.18	*(27)	$^{34}SO_2$	33(5,27) – 32(6,26)	0.03[b]	OMC-IRc2	*SEST*	15m	Ger89		N
106375.003	*(20)	CH_3CH_2CN	15(3,12) – 12(2,13)	[b]	OMC-IRc2	*SEST*	15m	Ger89		N
U 106386.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
106493.94	*(4)	$HOCO^+$	5(1,5) – 4(1,4)	[b]	Sgr B2	NRAO	12m	Tur87b		N
106498.911	*(5)	HC_5N	40 – 39	0.04[b]	Sgr B2	NRAO	12m	Tur87b		M
106541.683	*(14)	NH_2CHO	5(2,3) – 4(2,2)	0.15	Sgr B2	BTL	7m	Cum86		
106641.394	*(17)	CH_2CHCN	11(1,10) – 10(1,9)	0.05	Sgr B2	BTL	7m	Cum86		
106723.410	*(18)	CH_3CH_2OH	9(2,8) – 9(1,9)	0.06	Sgr B2	BTL	7m	Cum86		
106743.365	*(36)	^{34}SO	2(3) – 1(2)	0.16[d]	OriMC-1	NRAO	11m	Got78		
106762.7	(3)	C_6H	$^2\Pi_{3/2}$ J = 77/2 – 75/2 e	1.00[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
106777.52	*(15)	CH_3OCH_3	9(1,8) – 8(2,7) EE	0.05	Sgr B2	BTL	7m	Cum86		
106787.38	*(4)	$OC^{34}S$	9 – 8	0.089	Sgr B2	BTL	7m	Gol81		
106913.52	*(3)	$HOCO^+$	5(0,5) – 4(0,4)	0.4	Sgr B2	BTL	7m	Tha81		M
106922.945	*(49)	^{29}SiS	6 – 5	0.012	IRC+10216	BTL	7m	Hen85		
U 106942.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
U 106963.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
U 106981.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
U 106995.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
107013.85	(10)	CH_3OH	3(1) – 4(0) A+	4.5	OriMC-1	FCRAO	14m	Gol83	Lee68	
107043.524	*(14)	CH_3CH_2CN	12(2,11) – 11(2,10)	0.05	Sgr B2	BTL	7m	Cum86		
107060.323	*(35)	SO_2	27(3,25) – 26(4,22)	0.07	Sgr B2	BTL	7m	Cum86		
107159.79	(5)	CH_3OH	15(–2) – 15(1) E2	0.31	OriMC-1	NRAO	11m	Tur89	Sas84	N
107178.486	*(31)	$^{13}CH_3CN$	6(3) – 5(3)	0.04[b]	Sgr B2	BTL	7m	Cum86		
107188.545	*(31)	$^{13}CH_3CN$	6(2) – 5(2)	[b]	Sgr B2	BTL	7m	Cum86		
107194.580	*(32)	$^{13}CH_3CN$	6(1) – 5(1)	[b]	Sgr B2	BTL	7m	Cum86		
107196.592	*(32)	$^{13}CH_3CN$	6(0) – 5(0)	0.07[b]	Sgr B2	BTL	7m	Cum86		
U 107207.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
107315.36	*(2)	$HOCO^+$	5(1,4) – 4(1,3)	[b]	Sgr B2	NRAO	12m	Tur87b		N
107316.46	*(10)	CH_3SH	3(–1) – 3(0) A	0.04[b]	Sgr B2	BTL	7m	Cum86		M
107384.6	(3)	HCCSi ?	9 – 8 L	0.12	IRC+10216	IRAM	30m	Gué86	Gué86	N
107399.8	(4)	HCCSi ?	9 – 8 U	0.11	IRC+10216	IRAM	30m	Gué86	Gué86	N
107423.658	*(6)	C_3HD	3(1,3) – 2(0,2)	0.5	TMC-1	IRAM	30m	Ger87	Bog87	N
U 107426.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
107453.2	(3)	C_6H	$^2\Pi_{1/2}$ J = 77/2 – 75/2 f	0.66[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
107481.468	*(23)	CH_3CH_2CN	17(2,16) – 17(1,17)	0.10[b]	Sgr B2(OH)	IRAM	30m	Gom86		N
107485.178	*(13)	CH_3CH_2CN	12(7,6) – 11(7,5)	0.05[b]	Sgr B2	BTL	7m	Cum86		
107485.178	*(13)	CH_3CH_2CN	12(7,5) – 11(7,4)	[b]	Sgr B2	BTL	7m	Cum86		
107486.961	*(13)	CH_3CH_2CN	12(6,7) – 11(6,6)	[b]	Sgr B2	BTL	7m	Cum86		
107486.961	*(13)	CH_3CH_2CN	12(6,6) – 11(6,5)	[b]	Sgr B2	BTL	7m	Cum86		
107491.573	*(14)	CH_3CH_2CN	12(8,5) – 11(8,4)	[b]	Sgr B2	BTL	7m	Cum86		
107491.573	*(14)	CH_3CH_2CN	12(8,4) – 11(8,3)	[b]	Sgr B2	BTL	7m	Cum86		
107502.426	*(13)	CH_3CH_2CN	12(5,8) – 11(5,7)	0.05[b]	Sgr B2	BTL	7m	Cum86		
107502.474	*(13)	CH_3CH_2CN	12(5,7) – 11(5,6)	[b]	Sgr B2	BTL	7m	Cum86		
107507.9	(4)	C_6H	$^2\Pi_{1/2}$ J = 77/2 – 75/2 e	0.58[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
U 107516.		unidentified		0.03	Sgr B2	BTL	7m	Cum86		M
107537.26	*(3)	$HCOOCH_3$	9(2,8) – 8(2,7) E	[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
107543.70	*(7)	$HCOOCH_3$	9(2,8) – 8(2,7) A	0.07[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
107543.926	*(13)	CH_3CH_2CN	12(4,9) – 11(4,8)	[b]	Sgr B2	BTL	7m	Cum86		
107547.601	*(13)	CH_3CH_2CN	12(4,8) – 11(4,7)	[b]	Sgr B2	BTL	7m	Cum86		
107594.049	*(14)	CH_3CH_2CN	12(3,10) – 11(3,9)	0.06	Sgr B2	BTL	7m	Cum86		
U 107604.		unidentified		0.02[b]	Sgr B2	NRAO	11m	Tur89		N
107611.54	*(14)	KCl	14 – 13	0.25[f]	IRC+10216	IRAM	30m	Cer87c		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
107622.92	*(1)	H_2CCCC	12(1,11) – 11(1,10)	0.103	IRC+10216	IRAM	30m	Cer91a	Kil90	N
107734.741	*(14)	CH_3CH_2CN	12(3,9) – 11(3,8)	0.04	Sgr B2	BTL	7m	Cum86		
U 107751.		unidentified		0.02	OriMC-1	NRAO	11m	Tur89		N
107843.508	*(11)	SO_2	12(4,8) – 13(3,11)	0.06	Sgr B2	BTL	7m	Cum86		
107971.65	*(20)	$Si^{13}CC$	5(1,4) – 4(1,4)	0.6[f]	IRC+10216	IRAM	30m	Cer91b		N
U 108024.		unidentified		0.15	OriMC-1	NRAO	11m	Tur89		N
108126.71	*(1)	HCOOH	5(1,5) – 4(1,4)	0.06	Sgr B2	BTL	7m	Cum86		
U 108210.		unidentified		0.08	Sgr B2	NRAO	11m	Tur89		N
U 108216.		unidentified		0.07	OriMC-1	NRAO	11m	Tur89		N
U 108255.		unidentified		0.07	OriMC-1	NRAO	11m	Tur89		N
U 108453.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
108651.297	(50)	^{13}CN	1/2 – 1/2 $F=2-1, F_1=0, F_2=1-0$	0.07	Sgr B2	BTL	7m	Ger84	Bog84a	
108657.646	(50)	^{13}CN	1/2 – 1/2 $F=2-2, F_1=1, F_2=1-1$	0.07[b]	Sgr B2	BTL	7m	Ger84	Bog84a	
108658.948	(50)	^{13}CN	1/2 – 1/2 $F=1-2, F_1=1, F_2=1-1$	[b]	Sgr B2	BTL	7m	Ger84	Bog84a	
108710.523	*(11)	$HC^{13}CCN$	12 – 11	0.15	Sgr B2	BTL	7m	Cum86		
108721.008	*(7)	$HCC^{13}CN$	12 – 11	0.15	Sgr B2	BTL	7m	Cum86		
108777.58	(10)	CH_3OH	unassigned	0.035	OriMC-1	FCRAO	14m	Ziu88	Lee68	N
108780.201	(50)	^{13}CN	3/2 – 1/2 $F=3-2, F_1=1, F_2=2-1$	0.13[b]	Sgr B2	BTL	7m	Ger84	Bog84a	
108782.374	(50)	^{13}CN	3/2 – 1/2 $F=2-1, F_1=1, F_2=2-1$	[b]	Sgr B2	BTL	7m	Ger84	Bog84a	
108786.982	(50)	^{13}CN	3/2 – 1/2 $F=1-0, F_1=1, F_2=2-1$	[b]	Sgr B2	BTL	7m	Ger84	Bog84a	
U 108796.		unidentified		0.04	OriMC-1	FCRAO	14m	Ziu88		N
U 108802.		unidentified		0.025	OriMC-1	FCRAO	14m	Ziu88		N
108813.575	*(52)	CH_2CHCN	20(1,19) – 20(0,20)	0.02	OriMC-1	FCRAO	14m	Ziu88		N
108834.27	*(3)	C_3N	11 – 10 $J=23/2-21/2$	0.45	IRC+10216	OSO	20m	Joh84	Got83	
108853.02	*(3)	C_3N	11 – 10 $J=21/2-19/2$	0.45	IRC+10216	OSO	20m	Joh84	Got83	
108883.55	*(10)	$HCOOCH_3$	14(3,12) – 14(2,13) A	0.02	OriMC-1	FCRAO	14m	Ziu88	Plu84	N
108893.94	(10)	CH_3OH	0(0) – 1(–1) E	0.98	Sgr B2	BTL	7m	Cum86	Lee68	
108924.267	*(48)	SiS	6 – 5	0.28	IRC+10216	NRAO	11m	Mor75		
108940.601	*(14)	CH_3CH_2CN	12(2,10) – 11(2,9)	0.24	OriMC-1	FCRAO	14m	Ziu88		N
U 108998.		unidentified		0.02	OriMC-1	FCRAO	14m	Ziu88		N
109008.67	*(3)	DCOOH ?	9(1,8) – 9(0,9)	0.04	OriMC-1	NRAO	11m	Tur89		N
U 109012.		unidentified		0.02	OriMC-1	FCRAO	14m	Ziu88		N
U 109018.		unidentified		0.15	Sgr B2	NRAO	11m	Tur89		N
U 109050.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U 109054.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U 109071.		unidentified		0.02	OriMC-1	FCRAO	14m	Ziu88		N
U 109093.		unidentified		0.02	OriMC-1	FCRAO	14m	Ziu88		N
109110.844	*(4)	$O^{13}CS$	9 – 8	0.08	Sgr B2	BTL	7m	Cum86		
109136.81	(10)	CH_3OH	unassigned or 14(5) – 15(4) E	0.3	OriMC-1	FCRAO	14m	Gol82	Lee68	
109153.19	(10)	CH_3OH	16(–2) – 16(1) E	0.3	OriMC-1	FCRAO	14m	Gol82	Sas84	
109160.984	*(5)	HC_5N	41 – 40	0.018	IRC+10216	NRAO	11m	Jew84		
109173.634	(4)	HC_3N	12 – 11	2.57	Sgr B2	NRAO	11m	Mor76	deZ71	
109252.184	*(36)	SO	2(3) – 1(2)	2.42[m]	OriMC-1	MMWO	4.9m	Got78		
109292.39	*(4)	$HCOOCH_3$	10(1,9) – 9(2,8) E	0.1	OriMC-1	NRAO	11m	Tur89	Plu86	N
109302.11	*(5)	$HCOOCH_3$	10(1,9) – 9(2,8) A	0.22	OriMC-1	NRAO	11m	Tur89	Plu84	N
109352.726	*(38)	HC_3N	12 – 11 $v_6=1$ $\ell=1$e	0.02	OriMC-1	FCRAO	14m	Gol85		
U 109387.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
U 109414.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
109438.572	*(49)	HC_3N	12 – 11 $v_6=1$ $\ell=1$f	0.02[b]	OriMC-1	FCRAO	14m	Gol85		N
109441.944	*(30)	HC_3N	12 – 11 $v_7=1$ $\ell=1$e	0.13	OriMC-1	FCRAO	14m	Gol82		
109463.063	*(1)	OCS	9 – 8	0.70	Sgr B2	NRAO	11m	Jef71		
109496.007	*(4)	HNCO	5(1,5) – 4(1,4)	0.16	OriMC-1	FCRAO	14m	Gol82		
U 109525.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
U 109530.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
U 109538.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
109571.54	(9)	CH_3OCH_3	8(2,7) – 8(1,8) EA	0.10[b]	OriMC-1	FCRAO	14m	Gol85		N
109571.54	(9)	CH_3OCH_3	8(2,7) – 8(1,8) AE	[b]	OriMC-1	FCRAO	14m	Gol85		N
109574.22	(4)	CH_3OCH_3	8(2,7) – 8(1,8) EE	0.16	OriMC-1	FCRAO	14m	Gol85		N
109576.88	(6)	CH_3OCH_3	8(2,7) – 8(1,8) AA	0.12	OriMC-1	FCRAO	14m	Gol85		N
109598.751	*(30)	HC_3N	12 – 11 $v_7=1$ $\ell=1$f	0.19	OriMC-1	FCRAO	14m	Gol85		
U 109641.	?	unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
109650.305	*(14)	CH_3CH_2CN	12(1,11) – 11(1,10)	0.07	OriMC-1	NRAO	11m	Joh77		
U 109720.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
U 109738.5		unidentified		0.02	OriMC-1	FCRAO	14m	Gol83		
109753.504	*(8)	NH_2CHO	5(1,4) – 4(1,3)	0.3	Sgr B2	BTL	7m	Lin81		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
109757.633*(15)		SO_2	17(5,13) − 18(4,14)	0.30	OriMC-1	FCRAO	14m	Gol82		
U 109770.5		unidentified		0.03	OriMC-1	FCRAO	14m	Gol83		
109771.8	(3)	HCCN	5,6 − 4,5	1.0[f]	IRC+10216	IRAM	30m	Gué91	Gué91	N
109782.160*(20)		$C^{18}O$	1 − 0	2.1	OriMC-1	NRAO	11m	Uli76		
U 109820.	?	unidentified		0.25	Sgr B2	NRAO	11m	Tur89		N
109828.290 (20)		C_3S	19 − 18	2.7[f]	IRC+10216	IRAM	30m	Cer87b	Yam87	N
109833.489*(6)		HNCO	5(3,3) − 4(3,2)	[b]	OriMC-1	FCRAO	14m	Gol82		
109833.489*(6)		HNCO	5(3,2) − 4(3,1)	0.03[b]	OriMC-1	FCRAO	14m	Gol82		
109862.5	(3)	HCCN	5,5 − 4,4	0.4[f]	IRC+10216	IRAM	30m	Gué91	Gué91	N
109862.828*(46)		HC_3N	12 − 11 v_7=2 ℓ=0	0.02[b]	OriMC-1	FCRAO	14m	Gol83		
109865.854*(55)		HC_3N	12 − 11 v_7=2 ℓ=2e	[b]	OriMC-1	FCRAO	14m	Gol83		
109870.188*(48)		HC_3N	12 − 11 v_7=2 ℓ=2f	[b]	Sgr B2	NRAO	11m	Tur89		N
109872.366*(5)		HNCO	5(2,4) − 4(2,3)	0.09[b]	OriMC-1	FCRAO	14m	Gol82		
109872.773*(5)		HNCO	5(2,3) − 4(2,2)	[b]	OriMC-1	FCRAO	14m	Gol82		
109905.753*(5)		HNCO	5(0,5) − 4(0,4)	1.1	Sgr B2	NRAO	11m	Sol73		
110044.2	(15)	HCCN	5,4 − 4,3	0.3[f]	IRC+10216	IRAM	30m	Gué91	Gué91	N
110050.77	*(9)	HC_3N	12 − 11 v_7=3 ℓ=1e	0.10[h]	Sgr B2	NRAO	11m	Tur89		N
110152.084 (20)		NH_2D	1(1,1)0 − − 1(0,1)0 + F=0 − 1	[b]	DR21(OH)	OSO	20m	Olb85	Bes83	
110152.995 (20)		NH_2D	1(1,1)0 − − 1(0,1)0 + F=2 − 1	[b]	DR21(OH)	OSO	20m	Olb85	Bes83	
110153.599 (10)		NH_2D	1(1,1)0 − − 1(0,1)0 + F=1 − 1	[b]	DR21(OH)	OSO	20m	Olb85	Bes83	
110153.599 (10)		NH_2D	1(1,1)0 − − 1(0,1)0 + F=2 − 2	0.11[b]	DR21(OH)	OSO	20m	Olb85	Bes83	
110153.599 (10)		NH_2D	1(1,1)0 − − 1(0,1)0 +	0.14	OriMC-1	NRAO	11m	Kui78	Bes83	
110154.222 (20)		NH_2D	1(1,1)0 − − 1(0,1)0 + F=1 − 2	[b]	DR21(OH)	OSO	20m	Olb85	Bes83	
110155.053 (20)		NH_2D	1(1,1)0 − − 1(0,1)0 + F=1 − 0	[b]	DR21(OH)	OSO	20m	Olb85	Bes83	
110188.860 (50)		CH_3OD	1(1) − 1(0) E	0.5[f]	OriMC-1	IRAM	30m	Mau88	And88	N
110201.353*(9)		^{13}CO	1 − 0	9.3	OriMC-1	NRAO	11m	Uli76		
110229.8	(10)	C_6H	$^4\Pi_{1/2}$ J=79/2 − 77/2 e	0.74[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
U 110240.		unidentified		0.12	OriMC-1	NRAO	11m	Tur91		N
110243.4	(10)	C_6H	$^2\Pi_{1/2}$ J=79/2 − 77/2 f	0.76[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
110262.640 (50)		CH_3OD	2(1) − 2(0) E	2.0[f]	OriMC-1	IRAM	30m	Mau88	And88	N
110298.098*(4)		HNCO	5(1,4) − 4(1,3)	0.23	Sgr B2	BTL	7m	Cum86		
110309.88	*(2)	$CH_3{}^{13}CN$	6(3) − 5(3)	0.05	OriMC-1	NRAO	11m	Tur89		N
110326.78	*(3)	$CH_3{}^{13}CN$	6(1) − 5(1)	[b]	Sgr B2	BTL	7m	Cum86		
110328.89	*(3)	$CH_3{}^{13}CN$	6(0) − 5(0)	0.14[b]	Sgr B2	BTL	7m	Cum86		M
110330.627*(3)		CH_3CN	6(5) − 5(5) F=7 − 6	0.2[bk]	Sgr B2	NRAO	11m	Sol71		
110330.872*(2)		CH_3CN	6(5) − 5(5) F=5 − 4	[b]	Sgr B2	NRAO	11m	Sol7l		
110349.659*(2)		CH_3CN	6(4) − 5(4) F=7 − 6	0.45[b]	Sgr B2	NRAO	11m	Sol73		
110349.797*(2)		CH_3CN	6(4) − 5(4) F=5 − 4	[b]	Sgr B2	NRAO	11m	Sol73		
110364.469*(1)		CH_3CN	6(3) − 5(3) F=7 − 6	0.31[b]	Sgr B2	NRAO	11m	Sol73		
110364.524*(1)		CH_3CN	6(3) − 5(3) F=5 − 4	[b]	Sgr B2	NRAO	11m	Sol73		
110375.052*(1)		CH_3CN	6(2) − 5(2) F=7 − 6	0.81	Sgr B2	NRAO	11m	Sol73		
110381.404*(1)		CH_3CN	6(1) − 5(1) F=7 − 6	1.09[b]	Sgr B2	NRAO	11m	Sol73		
110383.522*(1)		CH_3CN	6(0) − 5(0) F=7 − 6	[b]	Sgr B2	NRAO	11m	Sol73		
110413.59	*(2)	HCOOH	9(3,6) − 10(2,9)	0.04	OriMC-1	NRAO	11m	Tur89		N
110455.62	*(5)	$HCOOCH_3$	9(8,2) − 8(8,1) A	[b]	Sgr B2	NRAO	11m	Tur89		N
110455.62	*(5)	$HCOOCH_3$	9(8,1) − 8(8,0) A	0.06[b]	Sgr B2	NRAO	11m	Tur89		N
110458.22	*(4)	$HCOOCH_3$	9(8,2) − 8(8,1) E	[b]	Sgr B2	NRAO	11m	Tur89	Plu86	N
110475.76	(10)	CH_3OD	3(1) − 3(0) E1	0.10	Sgr B2	NRAO	11m	Tur89	Kau80	N
U 110486.		unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
110525.66	*(4)	$HCOOCH_3$	9(7,2) − 8(7,1) E	0.03	OriMC-1	NRAO	11m	Tur89	Plu86	N
110535.18	*(8)	$HCOOCH_3$	9(7,3) − 8(7,2) A	0.03[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
110535.18	*(8)	$HCOOCH_3$	9(7,2) − 8(7,1) A	[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
110536.15	*(4)	$HCOOCH_3$	9(7,3) − 8(7,2) E	[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
110550.22	*(40)	$HCOOCH_3$	7(2,6) − 6(1,5) E	0.05	Sgr B2	NRAO	11m	Tur89		N
110559.89	*(16)	$HCOOCH_3$	7(2,6) − 6(1,5) A	0.05	Sgr B2	NRAO	11m	Tur89		N
U 110599.		unidentified		0.05	Sgr B2	NRAO	11m	Tur89		N
110609.554*(60)		CH_3CN	6(1) − 5(1) v_8=1 ℓ=1	0.06	OriMC-1	FCRAO	14m	Gol83		
110652.76	*(3)	$HCOOCH_3$	9(6,3) − 8(6,2) E	0.10	OriMC-1	FCRAO	14m	Gol83	Plu86	M
110662.41	*(3)	$HCOOCH_3$	9(6,4) − 8(6,3) E	[b]	OriMC-1	FCRAO	14m	Gol83	Plu86	M
110663.25	*(7)	$HCOOCH_3$	9(6,4) − 8(6,3) A	0.23[b]	OriMC-1	FCRAO	14m	Gol83	Plu84	M
110663.44	*(7)	$HCOOCH_3$	9(6,3) − 8(6,2) A	[b]	OriMC-1	FCRAO	14m	Gol83	Plu84	M
110680.35	*(10)	CH_3CN	6(3) − 5(3) v_8=1 ℓ=-1	0.05[b]	OriMC-1	FCRAO	14m	Gol83		
110683.96	*(10)	CH_3CN	6(5) − 5(5) v_8=1 ℓ=1	[b]	OriMC-1	FCRAO	14m	Gol83		
110695.506*(10)		CH_3CN	6(2) − 5(2) v_8=1 ℓ=-1	0.05[b]	OriMC-1	FCRAO	14m	Gol83		
110698.701*(10)		CH_3CN	6(4) − 5(4) v_8=1 ℓ=1	[b]	OriMC-1	FCRAO	14m	Gol83		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
110706.251*(60)		CH_3CN	6(1)−5(1) $\nu_8=1$ $\ell=-/+1$	[b]	OriMC-1	FCRAO	14m	Gol83		
110709.313*(11)		CH_3CN	6(3)−5(3) $\nu_8=1$ $\ell=+1$	0.05[b]	OriMC-1	FCRAO	14m	Gol83		
110712.166*(11)		CH_3CN	6(0)−5(0) $\nu_8=1$ $\ell=1$	[b]	OriMC-1	FCRAO	14m	Gol83		
110716.272*(17)		CH_3CN	6(2)−5(2) $\nu_8=1$ $\ell=+/-1$	[b]	OriMC-1	FCRAO	14m	Gol83		
U 110770.5		unidentified		0.04	OriMC-1	FCRAO	14m	Gol83		
110788.64 *(3)		$HCOOCH_3$	10(1,10)−9(1,9) E	0.23[b]	OriMC-1	FCRAO	14m	Gol83	Plu86	M
110790.52 *(5)		$HCOOCH_3$	10(1,10)−9(1,9) A	[b]	OriMC-1	FCRAO	14m	Gol83	Plu84	M
110812.85	(10)	NHD_2	1(1,0)−1(0,1) O- (s)	0.025	OriMC-1	NRAO	12m	Tur90a	DeL75	N
110823.095*(60)		CH_3CN	6(1)−5(1) $\nu_8=1$ $\ell=+/-1$	0.05	OriMC-1	FCRAO	14m	Gol83		
110839.988*(18)		CH_2CHCN	12(1,12)−11(1,11)	0.06	OriMC-1	FCRAO	14m	Gol83		
U 110845.		unidentified		0.03[b]	Sgr B2	NRAO	11m	Tur89		N
110873.90 *(3)		$HCOOCH_3$	9(5,4)−8(5,3) E	0.06[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
110879.77 *(3)		$HCOOCH_3$	9(3,7)−8(3,6) E	[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
110880.44 *(7)		$HCOOCH_3$	9(5,5)−8(5,4) A	[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
110882.42 *(3)		$HCOOCH_3$	9(5,5)−8(5,4) E	[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
110887.08 *(7)		$HCOOCH_3$	9(3,7)−8(3,6) A	[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
110890.25 *(7)		$HCOOCH_3$	9(5,4)−9(5,3) A	[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
U 110906.		unidentified		0.13	OriMC-1	NRAO	11m	Tur89		N
110950.75	(10)	CH_3OD	4(1)−4(0) E1	0.04	Sgr B2	NRAO	11m	Tur89	Kau80	N
110962.18 *(10)		$HCOOCH_3$	15(4,12)−15(3,18) A	0.17[b]	OriMC-1	NRAO	11m	Tur89	Plu84	N
U 110968.		unidentified		[b]	OriMC-1	NRAO	11m	Tur89		N
U 111019.	?	unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
U 111038.		unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
111169.87 *(3)		$HCOOCH_3$	10(0,10)−9(0,9) E	[b]	OriMC-1	NRAO	11m	Tur89	Plu86	N
111171.63 *(5)		$HCOOCH_3$	10(0,10)−9(0,9) A	0.09[b]	OriMC-1	NRAO	11m	Tur89	Plu84	N
111195.95 *(5)		$HCOOCH_3$	9(4,6)−8(4,5) A	0.17	OriMC-1	NRAO	11m	Tur89	Plu84	N
U 111211.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
111223.49 *(3)		$HCOOCH_3$	9(4,6)−8(4,5) E	0.11	OriMC-1	NRAO	11m	Tur89	Plu86	N
111289.62	(10)	CH_3OH	7(2)−8(1) A+	0.58	OriMC-1	NRAO	11m	Tur89	Lee73	N
U 111312.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
111408.43 *(3)		$HCOOCH_3$	9(4,5)−8(4,4) E	0.10	OriMC-1	NRAO	11m	Tur89	Plu86	N
U 111432.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
111453.29 *(5)		$HCOOCH_3$	9(4,5)−8(4,4) A	0.34	OriMC-1	NRAO	11m	Tur89	Plu84	N
111492.27 *(3)		$HCOOCH_3$	13(1,12)−13(0,13) A	0.02	OriMC-1	NRAO	11m	Tur89		N
111538.210*(14)		CH_3CCCN	27(2)−26(2)	0.02	OriMC-1	NRAO	11m	Tur89		N
111542.501*(15)		CH_3CCCN	27(0)−26(0)	0.05	OriMC-1	NRAO	11m	Tur89		N
U 111575.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U 111580.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
U 111589.		unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
111626.53	(5)	CH_3OH	17(−2)−17(1) E2	0.22	OriMC-1	NRAO	11m	Tur89	Sas84	N
111674.13 *(3)		$HCOOCH_3$	9(1,8)−8(1,7) E	0.18	OriMC-1	NRAO	11m	Tur89	Plu86	N
U 111678.		unidentified		0.14	OriMC-1	NRAO	11m	Tur89		N
111682.18 *(5)		$HCOOCH_3$	9(1,8)−8(1,7) A	0.18	OriMC-1	NRAO	11m	Tur89	Plu84	N
U 111726.	?	unidentified		0.03	OriMC-1	NRAO	11m	Tur89		N
111733.94 *(3)		$HCOOCH_3$	10(1,10)−9(0,9) E	0.05[b]	OriMC-1	NRAO	11m	Tur89	Plu86	N
111735.30 *(5)		$HCOOCH_3$	10(1,10)−9(0,9) A	[b]	OriMC-1	NRAO	11m	Tur89	Plu84	N
111746.78 *(1)		HCOOH	5(0,5)−4(0,4)	0.10	Sgr B2	BTL	7m	Cum86		
111755.106*(46)		SO_2	31(3,29)−30(4,26)	0.06	Sgr B2	NRAO	11m	Tur91		N
111783.26 *(3)		CH_3OCH_3	7(0,7)−6(1,6) EE	0.12	Sgr B2	BTL	7m	Cum86		
111813.16 *(18)		CH_3OCH_3	7(5,2)−8(4,5) EE	0.12	OriMC-1	NRAO	11m	Tur89		N
111823.027*(5)		HC_5N	42−41	0.08	Sgr B2	NRAO	11m	Tur91		N
U 111827.6		unidentified	(HC_5N?)	0.13	OriMC-1	FCRAO	14m	Gol83		
U 111944.	?	unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
U 111967.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U 112006.		unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
U 112114.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
112248.728	(50)	CH_3CHO	6(1,6)−5(1,5) A	0.25	Sgr B2	NRAO	11m	Tur91	Kle91	M
112254.524	(50)	CH_3CHO	6(1,6)−5(1,5) E	0.24	Sgr B2	NRAO	11m	Tur91	Kle91	M
U 112348.		unidentified		0.08	Sgr B2	IRAM	30m	Com87		N
112354.9	(8)	$^{30}SiC_2$	5(0,5)−4(0,4)	0.10[b]	IRC+10216	IRAM	30m	Cer87b	Cer91b	N
112358.780	(15)	$C^{17}O$	1−0 $F=3/2-5/2$	0.20	B335	BTL	7m	Fre81	Fre81	
112358.988	(8)	$C^{17}O$	1−0 $F=7/2-5/2$	0.43	B335	BTL	7m	Fre81	Fre81	
112360.005	(8)	$C^{17}O$	1−0 $F=5/2-5/2$	0.38	B335	BTL	7m	Fre81	Fre81	
112370.	(2)	$(CH_3)_2CO$	11(1,11)−10(0,10) AA	0.03	TMC-1	IRAM	30m	Com87	Vac86	N
112380.	(2)	$(CH_3)_2CO$	11(0,11)−10(1,10) EE	0.04	TMC-1	IRAM	30m	Com87	Vac86	N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
112432.30	*(1)	HCOOH	5(4,2) – 4(4,1)	0.06[b]	Sgr B2	NRAO	11m	Tur89		N
112432.30	*(1)	HCOOH	5(4,1) – 4(4,0)	[b]	Sgr B2	NRAO	11m	Tur89		N
U112445.		unidentified	(real?)	0.2	Sgr B2	NRAO	11m	Tur89		N
112459.61	*(1)	HCOOH	5(3,3) – 4(3,2)	0.06[b]	Sgr B2	BTL	7m	Cum86		
112467.00	*(1)	HCOOH	5(3,2) – 4(3,1)	[b]	Sgr B2	BTL	7m	Cum86		
U112532.		unidentified		0.05	Sgr B2	NRAO	11m	Tur91		N
U112585.		unidentified		0.02	Sgr B2	NRAO	11m	Tur89		N
112593.44	*(10)	$Si^{13}CC$	5(0,5) – 4(0,4)	0.7[f]	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
112646.236	*(15)	CH_3CH_2CN	13(1,13) – 12(1,12)	0.10	Sgr B2	BTL	7m	Cum86		
112654.099	*(35)	NH_2CHO	8(3,6) – 9(2,7)	0.07	OriMC-1	NRAO	11m	Tur89		N
112807.100	*(11)	CH_3CH_2OH	2(2,1) – 1(1,0)	0.12	Sgr B2	NRAO	11m	Kut80		
112840.655	*(18)	CH_2CHCN	12(0,12) – 11(0,11)	0.06	Sgr B2	NRAO	11m	Kut80		
112869.45	*(9)	$HCOOCH_3$	14(3,11) – 13(4,10) A	0.07	OriMC-1	NRAO	11m	Tur89		N
U112874.		unidentified		0.08	OriMC-1	NRAO	11m	Tur89		N
112891.43	*(11)	HCOOH	5(2,3) – 4(2,2) n,t	0.06	Sgr B2	NRAO	11m	Kut80		
112922.5	(4)	C_4H	$^2\Pi_{1/2}$ $J = 23/2 - 21/2$ $\nu_7 = 1e$	3.01[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
U112997.		unidentified		0.10	OriMC-1	NRAO	11m	Tur89		N
U113001.		unidentified		0.11	OriMC-1	NRAO	11m	Tur89		N
113032.124	*(30)	CH_2CHCN	8(1,8) – 7(0,7)	0.09	Sgr B2	NRAO	11m	Tur89		N
U113061.		unidentified		0.11	OriMC-1	NRAO	11m	Tur89		N
113136.20	*(10)	$N^{34}S$	$^2\Pi_{1/2}$ $J = 5/2 - 3/2$ $F = 3/2 - 3/2$c	0.10	Sgr B2	NRAO	11m	Tur89		N
113144.192	(9)	CN	$1 - 0$ $J = 1/2 - 1/2$ $F = 1/2 - 3/2$	1.14	OriMC-1	NRAO	11m	Tur75	Dix77	
U113159.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
113170.528	(20)	CN	$1 - 0$ $J = 1/2 - 1/2$ $F = 3/2 - 1/2$	0.97	OriMC-1	NRAO	11m	Tur75	Dix77	
113191.317	(40)	CN	$1 - 0$ $J = 1/2 - 1/2$ $F = 3/2 - 3/2$	1.38	OriMC-1	NRAO	11m	Tur75	Dix77	
U113246.		unidentified		0.20	Sgr B2	NRAO	11m	Tur89		N
U113260.		unidentified		0.22	Sgr B2	NRAO	11m	Tur87b		N
113265.9	(3)	C_4H	$^2\Pi_{1/2}$ $J = 23/2 - 21/2$ $\nu_7 = 1f$	3.67[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
113266.74	*(4)	CH_2CHCN	20(2,18) – 20(1,19)	0.15	Sgr B2	NRAO	11m	Tur89		N
113278.39	*(18)	CH_3OCH_3	10(6,5) – 11(5,6) AA	[b]	OriMC-1	NRAO	11m	Tur89		N
113279.53	*(18)	CH_3OCH_3	10(6,4) – 11(5,7) AA	0.05[b]	OriMC-1	NRAO	11m	Tur89		N
113282.72	*(28)	CH_3OCH_3	10(6,4) – 11(5,7) EE	[b]	OriMC-1	NRAO	11m	Tur89		N
U113314.		unidentified		0.07	OriMC-1	NRAO	11m	Tur89		N
113350.80	(10)	CH_3OD	6(1) – 6(0) E1	0.04	OriMC-1	NRAO	11m	Tur89	Kau80	N
113410.207	*(12)	C_2S	8,9 – 7,8	2.1[f]	IRC+10216	IRAM	30m	Cer87b	Yam90	N
113488.140	(5)	CN	$1 - 0$ $J = 3/2 - 1/2$ $F = 3/2 - 1/2$	1.04	OriMC-1	NRAO	11m	Pen74	Dix77	
113490.982	(3)	CN	$1 - 0$ $J = 3/2 - 1/2$ $F = 5/2 - 3/2$	3.23	OriMC-1	NRAO	11m	Jef70	Dix77	
113499.639	(5)	CN	$1 - 0$ $J = 3/2 - 1/2$ $F = 1/2 - 1/2$	0.79	OriMC-1	NRAO	11m	Jef70	Dix77	
113508.944	(13)	CN	$1 - 0$ $J = 3/2 - 1/2$ $F = 3/2 - 3/2$	0.94	OriMC-1	NRAO	11m	Tur75	Dix77	
113520.414	*(10)	CN	$1 - 0$ $J = 3/2 - 1/2$ $F = 1/2 - 3/2$	<0.2	OriMC-1	NRAO	11m	All78		
U113523.		unidentified		0.22	OriMC-1	NRAO	11m	Tur89		N
U113544.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
113657.647	*(17)	CH_2CHCN	12(2,11) – 11(2,10)	0.12	OriMC-1	NRAO	11m	Tur89		N
U113729.		unidentified		0.04	OriMC-1	NRAO	11m	Tur89		N
113743.10	*(3)	$HCOOCH_3$	9(3,6) – 8(3,5) E	0.13	OriMC-1	NRAO	11m	Tur89	Plu86	N
113756.60	*(5)	$HCOOCH_3$	9(3,6) – 8(3,5) A	0.09	OriMC-1	NRAO	11m	Tur89	Plu84	N
113766.42	*(3)	HCCCHO	12(1,11) – 11(1,10)	0.04	Sgr B2	NRAO	11m	Tur91		N
U113818.		unidentified		0.20	Sgr B2	NRAO	11m	Tur89		N
113820.15	(40)	$^{29}SiC_2$	5(0,5) – 4(0,4)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
113831.197	*(41)	CH_2CHCN	18(2,16) – 18(1,17)	0.08	OriMC-1	NRAO	11m	Tur89		N
U113844.		unidentified		0.10	Sgr B2	NRAO	11m	Tur89		N
113978.251	*(15)	CH_3CH_2CN	13(0,13) – 12(0,12)	0.12	OriMC-1	NRAO	11m	Joh77		
U114005.		unidentified		0.11	OriMC-1	NRAO	11m	Tur89		N
114064.850	*(11)	CH_3CH_2OH	2(2,0) – 1(1,1)	0.12	Sgr B2	NRAO	11m	Tur89		N
U114092.		unidentified		0.07	OriMC-1	NRAO	11m	Tur89		N
U114113.		unidentified		0.07	OriMC-1	NRAO	11m	Tur89		N
114182.51	*(2)	C_4H	12 – 11 $J = 25/2 - 23/2$	0.23	IRC+10216	NRAO	11m	Sco78	Got83	
114221.04	*(2)	C_4H	12 – 11 $J = 23/2 - 21/2$	0.40	IRC+10216	NRAO	11m	Sco78	Got83	
U114291.		unidentified		0.09	OriMC-1	NRAO	11m	Tur89		N
U114313.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
U114336.		unidentified		0.05	OriMC-1	NRAO	11m	Tur89		N
114361.9	(10)	$^{30}SiC_2$	5(2,4) – 4(2,3)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
114445.02	*(16)	CH_3CH_2OH	17(2,11) – 16(3,13) ?	0.06	OriMC-1	NRAO	11m	Tur89		N
114485.040	*(5)	HC_5N	43 – 42	0.11	Sgr B2	BTL	7m	Cum86		
114531.0	*(9)	$HOCS^+$	? 10(0,10) – 9(0,9)	0.02	Sgr B2	NRAO	11m	Tur89		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
114565.476*(41)		SO_2	29(3,27) – 28(4,24)	0.17	OriMC-1	NRAO	11m	Tur89		N
114574.468*(71)		$^{34}SO_2$	6(3,3) – 7(2,6)	0.05	OriMC-1	NRAO	11m	Tur89		N
114615.021*(11)		$H^{13}CCCN$	13 – 12	0.13[b]	Sgr B2	BTL	7m	Cum86		
114621.577*(16)		CH_2CHCN	12(2,10) – 11(2,9)	[b]	Sgr B2	BTL	7m	Cum86		
114650.99	(5)	CH_3OH	18(–2) – 18(1) E2	0.35	OriMC-1	NRAO	11m	Tur89	Sas84	N
114737.17	(20)	C_4H	$^2\Sigma$ J = 12 – 11 ν_7 = 2 L	0.15	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
114793.82	(20)	C_4H	$^2\Sigma$ J = 12 – 11 ν_7 = 2 U	0.15	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
114831.084*(11)		$HC_3{}^{15}N$	13 – 12	0.03	Sgr B2	NRAO	11m	Tur89		N
U 114840.		unidentified		0.06	OriMC-1	NRAO	11m	Tur89		N
U 114861.		unidentified		0.03	Sgr B2	NRAO	11m	Tur89		N
114887.16	*(13)	$HCOOCH_3$	23(6,18) – 22(7,15) A	0.10	Sgr B2(OH)	IRAM	30m	Gom86		N
114897.368*	(9)	$H^{13}CCCH$	3(0,3) – 2(1,2)	0.07	TMC-1	NRAO	12m	Ger87	Bog86	N
114940.190	(50)	CH_3CHO	6(0,6) – 5(0,5) E	0.15	Sgr B2	BTL	7m	Cum86	Kle91	M
114959.911	(50)	CH_3CHO	6(0,6) – 5(0,5) A	0.38	Sgr B2	BTL	7m	Cum86	Kle91	M
U 115021.		unidentified		n.r.	OriMC-1	NRAO	11m	Tur89		N
115038.4	(7)	C_6H	$^2\Pi_{3/2}$ J = 83/2 – 81/2 f	0.52[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
115075.20	*(12)	CH_3OCH_3	9(2,8) – 9(1,9) EE	0.10[b]	OriMC-1	NRAO	11m	Tur89		N
115077.91	*(7)	CH_3OCH_3	9(2,8) – 9(1,9) AA	[b]	OriMC-1	NRAO	11m	Tur89		N
115084.0	(7)	C_6H	$^2\Pi_{3/2}$ J = 83/2 – 81/2 e	0.42[f]	IRC+10216	IRAM	30m	Cer87a	Cer87a	N
U 115141.		unidentified		n.r.	OriMC-1	NRAO	11m	Tur89		N
115153.835	(80)	NS	$^2\Pi_{1/2}$ J = 5/2 – 3/2 F = 7/2 – 5/2c	<0.3[b]	Sgr B2	MMWO	4.9m	Got75	Lov82a	
115156.799	(80)	NS	$^2\Pi_{1/2}$ J = 5/2 – 3/2 F = 5/2 – 3/2c	[b]	Sgr B2	MMWO	4.9m	Got75	Lov82a	
115185.33	*(8)	NS	$^2\Pi_{1/2}$ J = 5/2 – 3/2 F = 3/2 – 3/2c	0.26	Sgr B2	BTL	7m	Cum86		
U 115212.		unidentified		n.r.	OriMC-1	NRAO	11m	Tur89		N
115216.8	(3)	C_4H	$^2\Pi_{3/2}$ J = 25/2 – 23/2 ν_7 = 1f	3.05[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
115247.025*(58)		$HCOOCH_3$	5(2,3) – 4(1,4) A	n.r.	OriMC-1	NRAO	11m	Tur89		N
115271.204	(5)	CO	1 – 0	60.0	OriMC-1	NRAO	11m	Uli76	Ros58	
115382.38	*(6)	SiC_2	5(0,5) – 4(0,4)	0.22	IRC+10216	NRAO	11m	Kui77		M
115556.312	(60)	NS	$^2\Pi_{1/2}$ J = 5/2 – 3/2 F = 7/2 – 5/2d	0.24	Sgr B2	NRAO	11m	Got75	Lov82a	
115570.762	(50)	NS	$^2\Pi_{1/2}$ J = 5/2 – 3/2 F = 5/2 – 3/2d	0.28[b]	Sgr B2	NRAO	11m	Got75	Lov82a	
115571.93	(6)	NS	$^2\Pi_{1/2}$ J = 5/2 – 3/2 F = 3/2 – 1/2d	[b]	Sgr B2	NRAO	11m	Got75	Lov82a	
115894.368*(14)		CH_3CH_2CN	12(2,12) – 12(2,11)	0.09	OriMC-1	NRAO	11m	Joh77		
115943.69	(80)	$^{29}SiC_2$	5(2,4) – 4(2,3)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
116688.48	*(11)	D_2CO	2(0,2) – 1(0,1)	0.07	OriMC-1	NRAO	12m	Tur90a		N
120250.15	*(4)	SiC_2	5(2,3) – 4(2,2)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
122023.510*	(9)	C_3H_2	2(2,1) – 1(1,0)	1.0	TMC-1	FCRAO	14m	Mad86a		N
124496.497*(65)		$^{34}SO_2$	12(2,10) – 12(1,11)	0.12	Sgr B2	BTL	7m	Cum86		
124569.97	(10)	CH_3OH	6(0) – 5(1) E	0.44	Sgr B2	BTL	7m	Cum86	Lee68	
124614.117*(59)		$^{34}SO_2$	10(2,8) – 10(1,9)	0.08	Sgr B2	BTL	7m	Cum86		
124729.070*(14)		CH_3CH_2CN	14(2,13) – 13(2,12)	0.10	Sgr B2	BTL	7m	Cum86		
124789.84	(12)	$^{13}CH_2NH$	2(0,2) – 1(0,1)	0.07	Sgr B2	BTL	7m	Cum86	Pea77	
124864.805*(13)		SO_2	11(4,8) – 12(3,9)	0.07	Sgr B2	BTL	7m	Cum86		
125040.229*(27)		$^{13}CH_3CN$	7(3) – 6(3)	0.04[b]	Sgr B2	BTL	7m	Cum86		
125051.965*(28)		$^{13}CH_3CN$	7(2) – 6(2)	[b]	Sgr B2	BTL	7m	Cum86		
125059.006*(30)		$^{13}CH_3CN$	7(1) – 6(1)	0.05[b]	Sgr B2	BTL	7m	Cum86		
125061.353*(30)		$^{13}CH_3CN$	7(0) – 6(0)	[b]	Sgr B2	BTL	7m	Cum86		
125130.914	(50)	CH_3SH	5(1) – 4(1) A–	0.07	Sgr B2	BTL	7m	Cum86	Sas86	M
125132.774*	(5)	HC_5N	47 – 46	[b]	Sgr B2	BTL	7m	Cum86		
125173.200*(22)		CH_3CH_2OH	8(3,5) – 8(2,6)	0.07	Sgr B2	BTL	7m	Cum86		
125246.88	*(10)	CH_3OCH_3	2(2,1) – 1(1,0) EE	0.08	Sgr B2	BTL	7m	Cum86		
125564.489*(14)		CH_3CH_2CN	14(3,12) – 13(3,11)	0.07	Sgr B2	BTL	7m	Cum86		
U 125848.6	(12)	unidentified		0.12	Sgr B2	BTL	7m	Cum86		
125921.667*(17)		CH_2CHCN	13(1,12) – 12(1,11)	0.10	Sgr B2	BTL	7m	Cum86		
125947.250*(13)		CH_3CH_2OH	10(1,9) – 9(2,8)	0.13	Sgr B2	BTL	7m	Cum86		
126980.849*(37)		SO_2	35(5,31) – 34(6,28)	0.06	Sgr B2	BTL	7m	Cum86		
127076.117*(81)		SiS	7 – 6	0.8	IRC+10216	OVRO	10.4m	Sah84		
127112.680*(20)		NH_2CHO	6(2,5) – 5(2,4)	0.16[b]	Sgr B2	BTL	7m	Cum86		
127117.345*(30)		^{30}SiO	3 – 2	[b]	Sgr B2	BTL	7m	Cum86		
127215.130*(18)		CH_3CH_2OH	7(3,4) – 7(2,5)	0.05	Sgr B2	BTL	7m	Cum86		
U 127288.1	(11)	unidentified		0.04	Sgr B2	BTL	7m	Cum86		
U 127307.5	(12)	unidentified		0.03	Sgr B2	BTL	7m	Cum86		
127329.945*(70)		NH_2CHO	6(5,2) – 5(5,1)	[b]	Sgr B2	BTL	7m	Cum86		
127329.945*(70)		NH_2CHO	6(5,1) – 5(5,0)	0.03[b]	Sgr B2	BTL	7m	Cum86		
127348.310*(48)		NH_2CHO	6(4,3) – 5(4,2)	0.08[b]	Sgr B2	BTL	7m	Cum86		
127348.425*(48)		NH_2CHO	6(4,2) – 5(4,1)	[b]	Sgr B2	BTL	7m	Cum86		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
127367.658*	(2)	HC_3N	14 – 13	1.85	OriMC-1	MMWO	4.9m	Mor77		
127393.533*	(32)	NH_2CHO	6(3,4) – 5(3,3)	0.10	Sgr B2	BTL	7m	Cum86		
127412.107*	(32)	NH_2CHO	6(3,3) – 5(3,2)	0.09	Sgr B2	BTL	7m	Cum86		
127428.307*	(35)	SO_2	28(4,24) – 27(5,23)	0.04	Sgr B2	BTL	7m	Cum86		
128020.53	(5)	HCS^+	3 – 2	0.28	OriMC-1	BTL	7m	Tha81	Bog84	
128102.791*	(20)	NH_2CHO	6(2,4) – 5(2,3)	0.16	Sgr B2	BTL	7m	Cum86		
128294.89	(41)	$HOCO^+$	6(0,6) – 5(0,5)	0.4	Sgr B2	BTL	7m	Tha81	Tha81	
128458.888*	(44)	SiO	3 – 2 v=2	83.[e]	OriMC-1	NRAO	11m	Sch82		
128605.091*	(18)	SO_2	12(2,10) – 12(1,11)	0.58	OriMC-1	MMWO	4.9m	Lor84		
128622.14 *	(3)	C_3N	13 – 12 J = 27/2 – 25/2	0.097	IRC+10216	BTL	7m	Hen85	Got83	
128636.948*	(30)	^{29}SiO	3 – 2	0.11	OriMC-1	MMWO	4.9m	Lor84		
128640.90 *	(3)	C_3N	13 – 12 J = 25/2 – 23/2	0.093	IRC+10216	BTL	7m	Hen85	Got83	
128668.824*	(59)	$^{34}SO_2$	8(2,6) – 8(1,7)	0.06	OriMC-1	MMWO	4.9m	Lor84		
128689.620*	(15)	CH_3CH_2OH	6(3,3) – 6(2,4)	0.09[b]	Sgr B2	BTL	7m	Cum86		
128690.117*	(3)	CH_3CN	7(6) – 6(6)	0.07	OriMC-1	MMWO	4.9m	Lor84		M
U 128706.		unidentified		0.06[y]	OriMC-1	MMWO	4.9m	Lor84		
128713.183*	(30)	$CH_3{}^{13}CN$	7(1) – 6(1)	0.11[b]	Sgr B2	BTL	7m	Cum86		
128715.649*	(32)	$CH_3{}^{13}CN$	7(0) – 6(0)	[b]	Sgr B2	BTL	7m	Cum86		
128717.365*	(2)	CH_3CN	7(5) – 6(5)	0.09	OriMC-1	MMWO	4.9m	Lor84		M
128739.674*	(2)	CH_3CN	7(4) – 6(4)	0.18	OriMC-1	MMWO	4.9m	Lor84		M
128757.035*	(2)	CH_3CN	7(3) – 6(3)	0.39	OriMC-1	MMWO	4.9m	Lor84		M
128769.440*	(2)	CH_3CN	7(2) – 6(2)	0.38	OriMC-1	MMWO	4.9m	Lor84		M
128776.885*	(2)	CH_3CN	7(1) – 6(1)	0.52	OriMC-1	MMWO	4.9m	Lor84		M
128779.368*	(2)	CH_3CN	7(0) – 6(0)	0.62	OriMC-1	MMWO	4.9m	Lor84		M
128812.86	(10)	HDCO	2(0,2) – 1(0,1)	0.3	L134N	BTL	7m	Lan79	Dan78	
129013.260*	(4)	HNCS	11(0,11) – 10(0,10)	0.06	Sgr B2	BTL	7m	Fre79	Yam79	
129077.570*	(12)	CH_3CH_2OH	3(2,2) – 2(1,1)	0.13	Sgr B2	BTL	7m	Cum86		
129105.799*	(9)	SO_2	12(1,11) – 11(2,10)	0.20	Sgr B2	BTL	7m	Cum86		
129138.898*	(32)	SO	3(3) – 2(2)	1.5	rho Oph A	MMWO	4.9m	Lor84b		
129219.221*	(16)	CH_2CHCN	14(1,14) – 13(1,13)	0.05	Sgr B2	BTL	7m	Cum86		
129248.12 *	(23)	$Si^{13}CC$	6(1,6) – 5(1,5)	0.5[f]	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
129296.42 *	(3)	$HCOOCH_3$	10(2,8) – 9(2,7) E	0.03	Sgr B2	BTL	7m	Cum86	Plu86	M
129310.14 *	(10)	$HCOOCH_3$	10(2,8) – 9(2,7) A	0.05	Sgr B2	BTL	7m	Cum86	Plu84	M
129363.368*	(35)	SiO	3 – 2 v=1	0.9	OriMC-1	MMWO	4.9m	Dav74		
129433.41	(10)	CH_3OH	12(1) – 11(2) A –	0.07	Sgr B2	BTL	7m	Cum86	Lee68	
130010.10 *	(3)	$HCOOCH_3$	11(2,10) – 10(2,9) E	0.04[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
130016.77 *	(10)	$HCOOCH_3$	11(2,10) – 10(2,9) A	[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
130171.466*	(32)	$H_2{}^{13}CS$	4(1,4) – 3(1,3)	0.04	Sgr B2	BTL	7m	Cum86		
130223.70 *	(8)	NaCl	10 – 9	1.93[f]	IRC+10216	IRAM	30m	Cer87c		N
130268.702*	(30)	SiO	3 – 2 v=0	1.34	OriMC-1	MMWO	4.9m	Dic76		
130515.734*	(3)	$OC^{34}S$	11 – 10	[b]	NGC 6334I	IRAM	30m	Bac90		N
130516.45 *	(6)	CH_3OCH_3	10(1,9) – 9(2,8) AA	1.5[b]	NGC 6334I	IRAM	30m	Bac90		N
130518.02 *	(16)	CH_3OCH_3	10(1,9) – 9(2,8) EE	[b]	NGC 6334I	IRAM	30m	Bac90		N
130650.53 *	(15)	KCl	17 – 16	0.51[f]	IRC+10216	IRAM	30m	Cer87c		N
131014.837*	(15)	SO_2	12(1,11) – 12(0,12)	0.25	Sgr B2	BTL	7m	Cum86		
131102.971*	(12)	CH_3CH_2OH	5(3,3) – 5(2,4)	0.04	Sgr B2	BTL	7m	Cum86		
U 131134.0	(7)	unidentified		0.06	Sgr B2	BTL	7m	Cum86		
131267.478*	(17)	CH_2CHCN	14(0,14) – 13(0,13)	0.09[b]	Sgr B2	BTL	7m	Cum86		
131274.915*	(17)	SO_2	16(5,11) – 17(4,14)	[b]	Sgr B2	BTL	7m	Cum86		
131394.241*	(5)	HNCO	6(1,6) – 5(1,5)	0.18	OriMC-1	MMWO	4.9m	Lor84		
131405.84 *	(2)	CH_3OCH_3	6(1,6) – 5(0,5) EE	0.17	OriMC-1	MMWO	4.9m	Lor84		
131502.670*	(15)	CH_3CH_2OH	6(3,4) – 6(2,5)	0.05	Sgr B2	BTL	7m	Cum86		
131551.974*	(12)	C_2S	11(10) – 10(9)	0.09	Sgr B2	BTL	7m	Cum86	Yam90	M
131617.905*	(13)	NH_2CHO	6(1,5) – 5(1,4)	0.23	Sgr B2	BTL	7m	Cum86		
131761.8	(5)	HCCN	6,7 – 5,6	0.6[f]	IRC+10216	IRAM	30m	Gué91	Gué91	N
131799.292*	(7)	HNCO	6(3,4) – 5(3,3)	0.05[b]	Sgr B2	BTL	7m	Cum86		
131799.292*	(7)	HNCO	6(3,3) – 5(3,2)	[b]	Sgr B2	BTL	7m	Cum86		
131832.5	(4)	HCCN	6,6 – 5,5	0.8[f]	IRC+10216	IRAM	30m	Gué91	Gué91	N
131845.880*	(5)	HNCO	6(2,5) – 5(2,4)	0.06[b]	Sgr B2	BTL	7m	Cum86		
131846.590*	(6)	HNCO	6(2,4) – 5(2,3)	[b]	Sgr B2	BTL	7m	Cum86		
131885.740*	(6)	HNCO	6(0,6) – 5(0,5)	3.41	Sgr B2	BTL	7m	Cum86		
131898.786*	(21)	AlF	4 – 3	0.80[f]	IRC+10216	IRAM	30m	Cer87c		N
132089.902*	(80)	$H_2{}^{13}CS$	4(0,4) – 3(0,3)	0.08	Sgr B2	BTL	7m	Cum86		
132105.48 *	(3)	$HCOOCH_3$	12(1,12) – 11(1,11) E	0.10[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
132107.20 *	(10)	$HCOOCH_3$	12(1,12) – 11(1,11) A	[b]	Sgr B2	BTL	7m	Cum86	Plu84	M

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
132113.983*(74)		$^{34}SO_2$	12(1,11) – 12(0,12)	[b]	Sgr B2	BTL	7m	Cum86		
132178.9 (5)		C_4H	$^2\Pi_{1/2}$ J = 27/2 – 25/2 v_7 = 1e	5.90[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
132245.10 *(3)		$HCOOCH_3$	12(0,12) – 11(0,11) E	0.18[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
132246.385*(13)		$H^{13}CCCN$	15 – 14	[b]	Sgr B2	BTL	7m	Cum86		
132246.70 *(10)		$HCOOCH_3$	12(0,12) – 11(0,11) A	[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
132356.711*(5)		HNCO	6(1,5) – 5(1,4)	0.19	Sgr B2	BTL	7m	Cum86		
132524.590*(15)		CH_2CHCN	14(2,13) – 13(2,12)	0.15[b]	Sgr B2	BTL	7m	Cum86		
132525.39 *(10)		CH_3OCH_3	8(0,8) – 7(1,7) EE	[b]	Sgr B2	BTL	7m	Cum86		
132586.8 (3)		C_4H	$^2\Pi_{1/2}$ J = 27/2 – 25/2 v_7 = 1f	5.30[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
132621.94 (10)		CH_3OH	6(2) – 7(1) A –	0.12	Sgr B2	BTL	7m	Cum86	Lee68	
132744.808*(22)		SO_2	14(2,12) – 14(1,13)	0.57	OriMC-1	NRAO	11m	Pic79		
132890.79 (10)		CH_3OH	6(–1) – 5(0) E	2.07	Sgr B2	BTL	7m	Cum86	Lee68	
132917.762*(12)		CH_2CHCN	14(4,11) – 13(4,10)	0.11[b]	Sgr B2	BTL	7m	Cum86		
132919.017*(12)		CH_2CHCN	14(4,10) – 13(4,9)	[b]	Sgr B2	BTL	7m	Cum86		
132921.90 *(3)		$HCOOCH_3$	11(1,10) – 10(1,9) E	[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
132928.70 *(10)		$HCOOCH_3$	11(1,10) – 10(1,9) A	[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
132935.070*(12)		CH_3CH_2OH	3(2,1) – 2(1,2)	[b]	Sgr B2	BTL	7m	Cum86		
132946.571*(8)		C_3S	23 – 22	1.4[f]	IRC+10216	IRAM	30m	Cer87b		N
133405.23 *(1)		H_2CCCC	15(1,15) – 14(1,14)	0.063	IRC+10216	IRAM	30m	Cer91a	Kil90	N
133605.50 (10)		CH_3OH	5(–2) – 6(–1) E	0.19	Sgr B2	BTL	7m	Cum86	Lee68	
133672.86 (40)		$^{30}SiC_2$	6(0,6) – 5(0,5)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
133785.897*(1)		OCS	11 – 10	1.49	OriMC-1	BTL	7m	Gol81		
133813.85 *(14)		$Si^{13}CC$	6(0,6) – 5(0,5)	0.9[f]	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
133830.52 *(10)		CH_3CHO	7(0,7) – 6(0,6) E	0.16	Sgr B2	BTL	7m	Cum86		M
133854.10 *(10)		CH_3CHO	7(0,7) – 6(0,6) A	0.15	Sgr B2	BTL	7m	Cum86		M
133862.50 (20)		C_4H	$^2\Sigma$ J = 14 – 13 v_7 = 2 L	0.2	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
133918.54 (20)		C_4H	$^2\Sigma$ J = 14 – 13 v_7 = 2 U	0.2	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
134004.804*(11)		SO_2	8(2,6) – 8(1,7)	0.65	OriMC-1	MMWO	4.9m	Pic79		
134231.12 (10)		CH_3OH	12(–3) – 13(–2) E	0.24	OriMC-1	MMWO	4.9m	Lor85	Sas84	
134284.91 *(17)		HDCO	2(1,1) – 1(1,0)	0.19	OriMC-1	MMWO	4.9m	Lor85		M
134415.5 (3)		C_4H	$^2\Pi_{3/2}$ J = 29/2 – 27/2 v_7 = 1f	4.50[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
134525.20 *(1)		H_2CCCC	15(1,14) – 14(1,13)	0.070	IRC+10216	IRAM	30m	Cer91a	Kil90	N
135298.134*(75)		H_2CS	4(1,4) – 3(1,3)	0.64	OriMC-1	MMWO	4.9m	Van84		
135371.19 (30)		$^{29}SiC_2$	6(0,6) – 5(0,5)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
135696.011*(8)		SO_2	5(1,5) – 4(0,4)	1.5	rho Oph	MMWO	4.9m	Got78		
135775.633*(42)		^{34}SO	4(3) – 3(2)	0.62	rho Oph A	MMWO	4.9m	Lor85		
U 136250.7 (11)		unidentified		0.04	Sgr B2	BTL	7m	Cum86		
136280.03 *(3)		$HCOOCH_3$	11(4,8) – 10(4,7) E	0.12[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
136282.56 *(10)		$HCOOCH_3$	11(4,8) – 10(4,7) A	[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
U 136387.8 (15)		unidentified	($^{13}C^{34}S$?)	0.05	Sgr B2	BTL	7m	Cum86		
136464.400*(2)		HC_3N	15 – 14	1.5	Sgr B2	MMWO	4.9m	Mor77		
136541.301*(14)		CH_3CH_2CN	15(1,14) – 14(1,13)	0.10	Sgr B2	BTL	7m	Cum86		
136634.682*(68)		SO	5(6) – 5(5)	0.4	OriMC-1	MMWO	4.9m	Mun84		
136704.502*(1)		CH_3CCH	8(3) – 7(3)	0.17	OriMC-1	MMWO	4.9m	Mun84		
136717.560*(1)		CH_3CCH	8(2) – 7(2)	0.20	OriMC-1	MMWO	4.9m	Mun84		
136725.397*(1)		CH_3CCH	8(1) – 7(1)	0.41	OriMC-1	MMWO	4.9m	Mun84		
136728.010*(1)		CH_3CCH	8(0) – 7(0)	0.42	OriMC-1	MMWO	4.9m	Mun84		
136799.703*(30)		HC_3N	15 – 14 v_7 = 1 ℓ = 1e	0.09	Sgr B2	BTL	7m	Cum86		
137015.9 (8)		$^{30}SiC_2$	6(2,5) – 5(2,4)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
137180.77 *(7)		SiC_2	6(0,6) – 5(0,5)	0.138	IRC+10216	BTL	7m	Tha84		M
137369.315*(98)		H_2CS	4(3,2) – 3(3,1)	0.12[h]	OriMC-1	MMWO	4.9m	Van84		
137369.346*(98)		H_2CS	4(3,1) – 3(3,0)	[b]	OriMC-1	MMWO	4.9m	Van84		
137371.043*(84)		H_2CS	4(0,4) – 3(0,3)	0.37	OriMC-1	MMWO	4.9m	Van84		
137381.956*(64)		H_2CS	4(2,3) – 3(2,2)	0.10	OriMC-1	MMWO	4.9m	Van84		
137411.803*(64)		H_2CS	4(2,2) – 3(2,1)	0.09	OriMC-1	MMWO	4.9m	Van84		
137449.959*(6)		$H_2{}^{13}CO$	2(1,2) – 1(1,1)	0.2	OriMC-1	MMWO	4.9m	Kut76		
137637.08 *(8)		$Si^{13}CC$	6(2,5) – 5(2,4)	0.8[f]	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
137739.93 (80)		$^{30}SiC_2$	6(4,3) – 5(4,2)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
137742.42 (80)		$^{30}SiC_2$	6(4,2) – 5(4,1)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
137903.06 (10)		CH_3OH	7(–4) – 8(–3) E	0.8	OriMC-1	BTL	7m	Woo84	Lee68	
138178.648*(42)		SO	4(3) – 3(2)	2.0	OriMC-1	MMWO	4.9m	Got73b		
138284.88 (10)		CH_3CHO	7(1,6) – 6(1,5) E	0.15	Sgr B2	BTL	7m	Cum86	Lia86	M
138319.75 (10)		CH_3CHO	7(1,6) – 6(1,5) A	0.14	Sgr B2	BTL	7m	Cum86	Lia86	M
138351.055*(14)		CH_3CH_2CN	16(1,16) – 15(1,15)	0.15	Sgr B2	BTL	7m	Cum86		
U 138652.		unidentified		0.05	IRC+10216	IRAM	30m	Cer87b		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
138725.845*	(8)	C_3S	24 – 23	1.6[f]	IRC+10216	IRAM	30m	Ger87b		N
138739.309*	(29)	^{13}CS	3 – 2	0.5	OriMC-1	MMWO	4.9m	Wil71		
138901.77	(70)	$^{29}SiC_2$	6(2,5) – 5(2,4)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
139483.466*	(75)	H_2CS	4(1,3) – 3(1,2)	0.17	rho Oph B1	MMWO	4.9m	Lor84a		
139678.6	(10)	$^{29}SiC_2$	6(4,3) – 5(4,2)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
139681.2	(10)	$^{29}SiC_2$	6(4,2) – 5(4,1)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
U 139864.8		unidentified		> 0.3	OriMC-1	IRAM	30m	Mau88a		N
U 139873.4		unidentified		0.18	OriMC-1	IRAM	30m	Mau88a		N
U 139878.0		unidentified		0.58	OriMC-1	IRAM	30m	Mau88a		N
U 139880.9		unidentified		0.20	OriMC-1	IRAM	30m	Mau88a		N
U 139896.5		unidentified		0.08	OriMC-1	IRAM	30m	Mau88a		N
U 139902.5		unidentified		0.10	OriMC-1	IRAM	30m	Mau88a		N
U 139907.2		unidentified		0.09	OriMC-1	IRAM	30m	Mau88a		N
U 139918.6		unidentified		0.16	OriMC-1	IRAM	30m	Mau88a		N
U 139934.5		unidentified		0.12	OriMC-1	IRAM	30m	Mau88a		N
U 139944.7		unidentified		0.15	OriMC-1	IRAM	30m	Mau88a		N
139953.62 *	(72)	NH_2CN	7(0,7) – 6(0,6)	0.08	Sgr B2	BTL	7m	Cum86		
U 139960.3		unidentified		0.18	OriMC-1	IRAM	30m	Mau88a		N
U 139967.4		unidentified		0.16	OriMC-1	IRAM	30m	Mau88a		N
U 139999.9		unidentified		0.17	OriMC-1	IRAM	30m	Mau88a		N
U 140013.6		unidentified		0.08	OriMC-1	IRAM	30m	Mau88a		N
U 140019.7		unidentified		0.76	OriMC-1	IRAM	30m	Mau88a		N
140033.50	(10)	CH_3OH	unassigned	0.03	Sgr B2	BTL	7m	Cum86	Lee68	
U 140042.1		unidentified		0.06	OriMC-1	IRAM	30m	Mau88a		N
140047.36 *	(5)	$HCOOCH_3$	18(2,16) – 18(1,17) E	0.20	OriMC-1	IRAM	30m	Mau88a	Plu86	N
U 140058.9		unidentified		0.21	OriMC-1	IRAM	30m	Mau88a		N
U 140077.3		unidentified		0.07	OriMC-1	IRAM	30m	Mau88a		N
U 140083.2		unidentified		0.05	OriMC-1	IRAM	30m	Mau88a		N
140097.131*	(23)	CH_3CH_2CN	27(4,23) – 27(3,24)	0.47	OriMC-1	IRAM	30m	Mau88a		N
140118.53 *	(10)	$HCOOCH_3$	18(2,16) – 18(1,17) A	0.30	OriMC-1	IRAM	30m	Mau88a	Plu84	N
140127.473*	(48)	CH_2CO	7(1,7) – 6(1,6)	0.15	Sgr B2	BTL	7m	Cum86		
U 140137.2		unidentified		0.02	OriMC-1	IRAM	30m	Mau88a		N
140141.6	(6)	NH_3	2(1) – 1(1) $\nu_2=1$	0.11	OriMC-1	IRAM	30m	Mau88a	Sch90	N
140151.08	(10)	CH_3OH	18(0) – 18(–1) E	0.05	Sgr B2	BTL	7m	Cum86	Lee68	
U 140160.6		unidentified		0.20	OriMC-1	IRAM	30m	Mau88a		N
U 140166.0		unidentified		0.53	OriMC-1	IRAM	30m	Mau88a		N
140175.200	(50)	CH_3OD	4(1) – 4(0) A–	5.1[f]	OriMC-1	IRAM	30m	Mau88	And88	N
140180.751*	(14)	C_2S	10,11 – 9,10	1.8[f]	IRC+10216	IRAM	30m	Cer87b	Yam90	N
U 140180.2		unidentified		0.10	OriMC-1	IRAM	30m	Mau88a		N
140194.09 *	(10)	$HCOOCH_3$	24(4,20) – 24(4,21) A	0.15	OriMC-1	IRAM	30m	Mau88a	Plu84	N
U 140223.0		unidentified		0.26	OriMC-1	IRAM	30m	Mau88a		N
U 140236.6		unidentified		0.12	OriMC-1	IRAM	30m	Mau88a		N
U 140253.6		unidentified		0.16	OriMC-1	IRAM	30m	Mau88a		N
U 140283.0		unidentified		0.05	OriMC-1	IRAM	30m	Mau88a		N
140306.164*	(9)	SO_2	6(2,4) – 6(1,5)	0.75	OriMC-1	MMWO	4.9m	Pic79		
140348.0 *	(10)	$^{33}SO_2$	10(4,6) – 11(3,9)	0.13	OriMC-1	IRAM	30m	Mau88a		N
U 140371.5		unidentified		0.29	OriMC-1	IRAM	30m	Mau88a		N
140423.83	(4)	$^{13}CH_3OH$	3(1) – 2(1) A+	0.05[b]	Sgr B2	BTL	7m	Cum86	Haq74	
140429.438*	(17)	CH_2CHCN	15(0,15) – 14(0,14)	[b]	Sgr B2	BTL	7m	Cum86		
U 140687.3	(16)	unidentified		0.07	Sgr B2	BTL	7m	Cum86		
140733.941*	(22)	CH_3NC	7 – 6	1.9	Sgr B2	IRAM	30m	Cer88		N
140740.379*	(4)	HNCS	12(0,12) – 11(0,11)	0.05	Sgr B2	BTL	7m	Fre79	Yam79	
140839.518*	(7)	H_2CO	2(1,2) – 1(1,1)	4.5	OriMC-1	MMWO	4.9m	Kut76		
140877.42 *	(70)	NH_2CN	7(1,6) – 6(1,5)	0.05	Sgr B2	BTL	7m	Cum86		
U 140902.2	(14)	unidentified		0.07	Sgr B2	BTL	7m	Cum86		
140920.17 *	(3)	SiC_2	6(2,5) – 5(2,4)	0.123	IRC+10216	BTL	7m	Tha84		M
140956.2	(5)	$^{30}SiC_2$	6(2,4) – 5(2,3)	0.03	IRC+10216	IRAM	30m	Mik89	Cer91b	N
140967.75	(10)	PN	3 – 2	0.032	OriMC-1	BTL	7m	Tur87b	Wys72	N
141037.69 *	(3)	$HCOOCH_3$	12(2,11) – 11(2,10) E	0.07	OriMC-1	NRAO	12m	Tur87b	Plu86	N
141044.31 *	(5)	$HCOOCH_3$	12(2,11) – 11(2,10) A	0.07	OriMC-1	NRAO	12m	Tur87b	Plu84	N
141061.797*	(15)	$H^{13}CCCN$	16 – 15	0.10	IRC+10216	IRAM	30m	Mik89		N
141061.797*	(15)	$H^{13}CCCN$	16 – 15	0.07	Sgr B2	BTL	7m	Cum86		
141244.02 *	(3)	$HCOOCH_3$	11(3,8) – 10(3,7) E	0.5	OriMC-1	NRAO	11m	Wil81	Plu86	M
141260.41 *	(10)	$HCOOCH_3$	11(3,8) – 10(3,7) A	0.4	OriMC-1	NRAO	11m	Wil81	Plu84	M
141595.48	(5)	$^{13}CH_3OH$	3(0) – 2(0) E	0.44[b]	Sgr B2	BTL	7m	Cum86	Haq74	

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
141597.06	(5)	$^{13}CH_3OH$	3(−1)−2(−1) E	[b]	Sgr B2	BTL	7m	Cum86	Haq74	
141602.53	(4)	$^{13}CH_3OH$	3(0)−2(0) A+	[b]	Sgr B2	BTL	7m	Cum86	Haq74	
141636.055	(60)	l-C_3H	$^2\Pi_{1/2}$ J=13/2−11/2	0.042	IRC+10216	BTL	7m	Tha85	Tha85	
141709.128	(60)	l-C_3H	$^2\Pi_{1/2}$ J=13/2−11/2	0.062	IRC+10216	BTL	7m	Tha85	Tha85	
141751.54	*(3)	SiC_2	6(4,3)−5(4,2)	0.064	IRC+10216	BTL	7m	Tha84		M
141755.41	*(3)	SiC_2	6(4,2)−5(4,1)	0.064	IRC+10216	BTL	7m	Tha84		M
141783.3	(4)	C_4H	$^2\Pi_{1/2}$ J=29/2−27/2 ν_7=1e	4.60[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
141983.748	*(6)	$H_2{}^{13}CO$	2(0,2)−1(0,1)	0.21	OriMC-1	BTL	7m	Kah84		
142138.76	*(12)	$Si^{13}CC$	6(2,4)−5(2,3)	1.0[f]	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
142223.7	(3)	C_4H	$^2\Pi_{1/2}$ J=29/2−27/2 ν_7=1f	4.70[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
142285.061	*(17)	CH_3CH_2OH	9(0,9)−8(1,8)	0.14	Sgr B2	BTL	7m	Cum86		
142321.60	*(5)	$Al^{37}Cl$	10−9	1.10[f]	IRC+10216	IRAM	30m	Cer87c		N
142346.314	*(14)	CH_3CH_2CN	16(2,15)−15(2,14)	0.07	Sgr B2	BTL	7m	Cum86		
142379.431	*(3)	$OC^{34}S$	12−11	0.08	Sgr B2	BTL	7m	Cum86		
142399.489	*(14)	CH_2CHCN	15(5,11)−14(5,10)	0.07[b]	Sgr B2	BTL	7m	Cum86		
142399.510	*(14)	CH_2CHCN	15(5,10)−14(5,9)	[b]	Sgr B2	BTL	7m	Cum86		
142401.867	*(16)	CH_2CHCN	15(6)−14(6)	[b]	Sgr B2	BTL	7m	Cum86		
142419.704	*(19)	CH_2CHCN	15(7)−14(7)	0.06[b]	Sgr B2	BTL	7m	Cum86		
142424.454	*(13)	CH_2CHCN	15(4,12)−14(4,11)	[b]	Sgr B2	BTL	7m	Cum86		
142426.506	*(13)	CH_2CHCN	15(4,11)−14(4,10)	[b]	Sgr B2	BTL	7m	Cum86		
142447.936	*(21)	CH_2CHCN	15(8)−14(8)	0.07	Sgr B2	BTL	7m	Cum86		
142701.329	*(18)	NH_2CHO	7(1,7)−6(1,6)	0.11	Sgr B2	BTL	7m	Cum86		
142733.50	*(3)	$HCOOCH_3$	13(1,13)−12(1,12) E	0.05[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
142735.13	*(10)	$HCOOCH_3$	13(1,13)−12(1,12) A	[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
142768.884	*(48)	CH_2CO	7(1,6)−6(1,5)	0.11	Sgr B2	BTL	7m	Cum86		
142807.66	(4)	$^{13}CH_3OH$	3(1)−2(1) A-	[b]	Sgr B2	BTL	7m	Cum86	Haq74	
142815.44	*(3)	$HCOOCH_3$	13(0,13)−12(0,12) E	0.04[b]	Sgr B2	BTL	7m	Cum86	Plu86	M
142817.02	*(10)	$HCOOCH_3$	13(0,13)−12(0,12) A	[b]	Sgr B2	BTL	7m	Cum86	Plu84	M
143057.058	*(28)	SO_2	16(2,14)−16(1,15)	0.57	OriMC-1	MMWO	4.9m	Pic79		
143061.65	(40)	$^{29}SiC_2$	6(2,4)−5(2,3)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
143237.44	*(8)	NaCl	11−10	1.47[f]	IRC+10216	IRAM	30m	Cer87c		N
143424.39	(20)	C_4H	$^2\Sigma$ J=15−14 ν_7=2 L	0.2	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
143446.3	(3)	C_4H	$^2\Pi_{3/2}$ J=31/2−29/2 ν_7=1e	0.25	IRC+10216	IRAM	30m	Gué87a	Yam87b	N
U 143474.0		unidentified		1.2	OMC-IRc2	IRAM	30m	Jac90		N
143479.18	*(3)	CH_3CH_2CN	16(14,2)−15(14,1)	[b]	OMC-IRc2	IRAM	30m	Jac90		N
143479.18	*(3)	CH_3CH_2CN	16(14,3)−15(14,2)	0.7[b]	OMC-IRc2	IRAM	30m	Jac90		N
143480.41	(20)	C_4H	$^2\Sigma$ J=15−14 ν_7=2 U	0.2	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
143506.98	*(1)	CH_3CH_2CN	16(4,13)−15(4,12)	4.3	OMC-IRc2	IRAM	30m	Jac90		N
143519.11	*(3)	CH_3CH_2CN	16(15,2)−15(15,1)	[b]	OMC-IRc2	IRAM	30m	Jac90		N
143519.11	*(3)	CH_3CH_2CN	16(15,1)−15(15,0)	0.6[b]	OMC-IRc2	IRAM	30m	Jac90		N
143524.885	*(9)	DC_3N	17−16	1.5	OMC-IRc2	IRAM	30m	Jac90		N
143529.203	*(14)	CH_3CH_2CN	16(3,14)−15(3,13)	4.1	OMC-IRc2	IRAM	30m	Jac90		N
143535.295	*(13)	CH_3CH_2CN	16(4,12)−15(4,11)	4.4	OMC-IRc2	IRAM	30m	Jac90		N
143565.14	*(20)	NH_2CHO	24(6,19)−25(5,20)	1.0	OMC-IRc2	IRAM	30m	Jac90		N
143570.318	*(4)	DNCO	7(1,6)−6(1,5)	0.7	OMC-IRc2	IRAM	30m	Jac90		N
U 143577.8		unidentified		1.1	OMC-IRc2	IRAM	30m	Jac90		N
U 143589.9		unidentified		0.6	OMC-IRc2	IRAM	30m	Jac90		N
143599.44	*(16)	CH_3OCH_3	7(3,4)−7(2,5) AE	0.9	OMC-IRc2	IRAM	30m	Jac90		N
143600.16	*(13)	CH_3OCH_3	7(3,4)−7(2,5) EA	1.3	OMC-IRc2	IRAM	30m	Jac90		N
143603.06	*(7)	CH_3OCH_3	7(3,4)−7(2,5) EE	2.9	OMC-IRc2	IRAM	30m	Jac90		N
143603.06	*(14)	CH_3OCH_3	7(3,4)−7(2,5) EE	0.08	Sgr B2	BTL	7m	Cum86		
143606.30	*(7)	CH_3OCH_3	7(3,4)−7(2,5) AA	2.1	OMC-IRc2	IRAM	30m	Jac90		N
U 143617.5		unidentified		1.7	OMC-IRc2	IRAM	30m	Jac90		N
U 143627.7		unidentified		0.8	OMC-IRc2	IRAM	30m	Jac90		N
U 143642.2		unidentified		0.5	OMC-IRc2	IRAM	30m	Jac90		N
U 143646.6		unidentified		0.4	OMC-IRc2	IRAM	30m	Jac90		N
U 143652.4		unidentified		0.3	OMC-IRc2	IRAM	30m	Jac90		N
143663.780	*(59)	SO_2	6(2,4)−6(1,5) ν_2=1	0.4	OMC-IRc2	IRAM	30m	Jac90		N
U 143682.5		unidentified		0.7	OMC-IRc2	IRAM	30m	Jac90		N
143707.45	*(22)	$HCOOCH_3$	23(2,21)−24(1,24) A	0.3	OMC-IRc2	IRAM	30m	Jac90		N
143727.210	(37)	HDO	4(2,2)−4(2,3)	2.6	OMC-IRc2	IRAM	30m	Jac90	Del71	N
143741.650	(50)	CH_3OD	5(1)−5(0) A−	6.6[f]	OriMC-1	IRAM	30m	Mau88	And88	N
143759.252	*(16)	CH_2CHCN	15(2,13)−14(2,12)	1.2	OMC-IRc2	IRAM	30m	Jac90		N
143764.973	*(5)	HC_5N	54−53	0.3	OMC-IRc2	IRAM	30m	Jac90		N
U 143768.4	(15)	unidentified		0.07[z]	Sgr B2	BTL	7m	Cum86		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
U 143772.3		unidentified		0.8	OMC-IRc2	IRAM	30m	Jac90		N
U 143784.1		unidentified		0.3	OMC-IRc2	IRAM	30m	Jac90		N
143795.84	*(24)	$^{33}SO_2$	4(2,2) − 4(1,3)	0.5	OMC-IRc2	IRAM	30m	Jac90		N
U 143829.2		unidentified		0.8	OMC-IRc2	IRAM	30m	Jac90		N
143850.41	*(10)	$HCOOCH_3$	18(3,16) − 18(2,17) A	0.3	OMC-IRc2	IRAM	30m	Jac90	Plu84	N
143865.79	(10)	CH_3OH	3(1) − 2(1) A+	1.27	Sgr B2	BTL	7m	Cum86	Lee68	
143870.0	(3)	C_4H	$^2\Pi_{3/2}$ J = 31/2 − 29/2 ν_7 = 1f	5.10[f]	IRC+10216	IRAM	30m	Yam87b	Yam87b	N
143880.12	*(54)	$H^{13}COOH$	7(3,4) − 8(2,7)	0.7	OMC-IRc2	IRAM	30m	Jac90		N
144077.321	*(23)	DCO^+	2 − 1	0.3	OriMC-1	MMWO	4.9m	Gué77a		
144241.96	(3)	DC_2D	2 − 1 J = 5/2 − 3/2 F = 7/2 − 5/2	0.13[b]	OriMC-1	BTL	7m	Vrt85	Vrt85	
144243.05	(3)	DC_2D	2 − 1 J = 5/2 − 3/2 F = 5/2 − 3/2	[b]	OriMC-1	BTL	7m	Vrt85	Vrt85	
144243.05	(3)	DC_2D	2 − 1 J = 5/2 − 3/2 F = 3/2 − 1/2	[b]	OriMC-1	BTL	7m	Vrt85	Vrt85	
144244.836	*(12)	C_2S	12,11 − 11,10	0.13	Sgr B2	NRAO	11m	Hol81	Yam90	M
144296.72	(8)	DC_2D	2 − 1 J = 3/2 − 1/2 F = 5/2 − 3/2	0.09	OriMC-1	BTL	7m	Vrt85	Vrt85	
144504.990	*(8)	C_3S	25 − 24	1.4[f]	IRC+10216	IRAM	30m	Cer87b		N
144617.147	*(19)	$C^{34}S$	3 − 2	1.2	OriMC-1	MMWO	4.9m	Wil76a		
144826.573	*(2)	DCN	2 − 1 F' = 2 − 2	[b]	OriMC-1	MMWO	4.9m	Pen77	DeL69	
144826.8097	(10)	DCN	2 − 1 F' = 1 − 0 F = 2 − 1	[b]	OriMC-1	MMWO	4.9m	Pen77	DeL69	
144826.8414	(10)	DCN	2 − 1 F' = 1 − 0 F = 1 − 1	[b]	OriMC-1	MMWO	4.9m	Pen77	DeL69	
144828.000	*(2)	DCN	2 − 1 F' = 2 − 1	0.9[b]	OriMC-1	MMWO	4.9m	Pen77	DeL69	
144828.109	*(2)	DCN	2 − 1 F' = 3 − 2	[b]	OriMC-1	MMWO	4.9m	Pen77	DeL69	
144830.336	*(2)	DCN	2 − 1 F' = 1 − 1	[b]	OriMC-1	MMWO	4.9m	Pen77	DeL69	
U 145075.9	(5)	unidentified		0.25	OriMC-1	NRAO	11m	Hol81		
145093.75	(10)	CH_3OH	3(0) − 2(0) E	1.25	OriMC-1	NRAO	11m	Kut73	Lee68	
145097.47	(10)	CH_3OH	3(−1) − 2(−1) E	1.45	OriMC-1	NRAO	11m	Kut73	Lee68	
145103.23	(10)	CH_3OH	3(0) − 2(0) A+	1.35	OriMC-1	NRAO	11m	Kut73	Lee68	
145124.41	(10)	CH_3OH	3(2) − 2(2) A−	1.45[b]	OriMC-1	NRAO	11m	Kut73	Lee68	
145126.37	(10)	CH_3OH	3(2) − 2(2) E, 3(−2) − 3(−2) E	[b]	OriMC-1	NRAO	11m	Kut73	Lee68	
145131.88	(10)	CH_3OH	3(1) − 2(1) E	1.25[b]	OriMC-1	NRAO	11m	Kut73	Lee68	
145133.46	(10)	CH_3OH	3(2) − 2(2) A+	[b]	OriMC-1	NRAO	11m	Kut73	Lee68	
145136.95	*(17)	$Si^{13}CC$	6(1,5) − 5(1,5)	0.9[f]	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
145226.96	*(13)	SiS	8 − 7	0.25	IRC+10216	BTL	7m	Hen85		
145325.85	*(5)	SiC_2	6(2,4) − 5(2,3)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
145418.035	*(14)	CH_3CH_2CN	16(1,15) − 15(1,14)	0.1	OriMC-1	BTL	7m	Woo84		
145560.946	*(2)	HC_3N	16 − 15	0.8	Sgr B2	MMWO	4.9m	Mor77		
145602.953	*(10)	H_2CO	2(0,2) − 1(0,1)	1.9	OriMC-1	NRAO	11m	Tha71		
145680.54	*(14)	CH_3OCH_3	5(3,2) − 5(2,3) EE	0.1	OriMC-1	BTL	7m	Woo84		
145744.62	*(5)	AlCl	10 − 9	2.42[f]	IRC+10216	IRAM	30m	Cer87c		N
145755.620	*(50)	$C^{33}S$	3 − 2 F = 9/2 − 7/2	0.2[b]	OriMC-1	MMWO	4.9m	Wil76a	Bog81	
145755.620	*(50)	$C^{33}S$	3 − 2 F = 7/2 − 5/2	[b]	OriMC-1	MMWO	4.9m	Wil76a	Bog81	
145756.500	*(50)	$C^{33}S$	3 − 2 F = 5/2 − 3/2	[b]	OriMC-1	MMWO	4.9m	Wil76a	Bog81	
145756.500	*(50)	$C^{33}S$	3 − 2 F − 3/2 − 1/2	[b]	OriMC-1	MMWO	4.9m	Wil76a	Bog81	
145766.14	(10)	CH_3OH	16(0) − 16(−1) E	0.4	OriMC-1	BTL	7m	Woo84	Lee68	
145946.812	(2)	OCS	12 − 11	0.45	Sgr B2	NRAO	11m	Sol73	Dub80	
146003.33	*(15)	KCl	19 − 18	0.39[f]	IRC+10216	IRAM	30m	Cer87c		N
146635.675	*(6)	$H_2{}^{13}CO$	2(1,1) − 1(1,0)	n.r.	OriMC-1	MMWO	4.9m	Wan76		
146876.061	(9)	H_2CCC	7(1,6) − 6(1,5)	0.082	TMC-1	IRAM	30m	Cer91	Vrt90	N
U 146932.5	(10)	unidentified		0.6	OriMC-1	NRAO	11m	Hol81		
146969.049	*(23)	CS	3 − 2	8.1	OriMC-1	MMWO	4.9m	Lis75		
146977.67	*(3)	$HCOOCH_3$	12(3,10) − 11(3,9) E	< 0.08	OriMC-1	MMWO	4.9m	Lor84	Plu86	M
146988.03	*(10)	$HCOOCH_3$	12(3,10) − 11(3,9) A	0.11	OriMC-1	MMWO	4.9m	Lor84	Plu84	M
147024.94	*(2)	CH_3OCH_3	7(1,6) − 6(0,6) EE	0.20	OriMC-1	MMWO	4.9m	Lor84		
147072.609	*(4)	CH_3CN	8(6) − 7(6)	0.08	OriMC-1	MMWO	4.9m	Lor84		M
147103.744	*(3)	CH_3CN	8(5) − 7(5)	0.12	OriMC-1	MMWO	4.9m	Lor84		M
147129.236	*(2)	CH_3CN	8(4) − 7(4)	0.16	OriMC-1	MMWO	4.9m	Lor84		M
147149.073	*(2)	CH_3CN	8(3) − 7(3)	0.32	OriMC-1	MMWO	4.9m	Lor84		M
147163.248	*(2)	CH_3CN	8(2) − 7(2)	0.34	OriMC-1	MMWO	4.9m	Lor84		M
147171.756	*(2)	CH_3CN	8(1) − 7(1)	0.50	OriMC-1	MMWO	4.9m	Lor84		M
147174.592	*(2)	CH_3CN	8(0) − 7(0)	0.54	OriMC-1	MMWO	4.9m	Lor84		M
U 147243.		unidentified		0.12	OriMC-1	MMWO	4.9m	Lor84		
148221.42	(12)	$HCNH^+$	2 − 1	0.09[b]	Sgr B2	MWO	4.9m	Ziu86a	Bog85a	N
148223.144	*(27)	NH_2CHO	7(2,6) − 6(2,5)	[b]	Sgr B2	MWO	4.9m	Ziu86a		N
148359.772	(50)	CH_3OD	6(0) − 5(1) A+	3.3[f]	OriMC-1	IRAM	30m	Mau88	And88	N
150141.68	(10)	CH_3OH	14(0) − 14(−1) E	0.86	OriMC-1	FCRAO	14m	Ziu91	Lee68	N
U 150164.0		unidentified		0.12	OriMC-1	FCRAO	14m	Ziu91		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
150176.48	(4)	NO	$^2\Pi_{1/2}$ $J=3/2-1/2$ $F=5/2-3/2(-+)$	0.25	Sgr B2	NRAO	11m	Lis78a	Poy80	
150198.76	(4)	NO	$^2\Pi_{1/2}$ $J=3/2-1/2$ $F=3/2-1/2(-+)$	0.03	OriMC-1	FCRAO	14m	Ziu91	Poy80	N
150218.73	(4)	NO	$^2\Pi_{1/2}$ $J=3/2-1/2$ $F=3/2-3/2(-+)$	0.03[b]	OriMC-1	FCRAO	14m	Ziu91	Poy80	N
150225.66	(4)	NO	$^2\Pi_{1/2}$ $J=3/2-1/2$ $F=1/2-1/2(-+)$	[b]	OriMC-1	FCRAO	14m	Ziu91	Poy80	N
U 150328.0	(10)	unidentified		0.14	Sgr B2	NRAO	11m	Hol81		
150381.139*	(20)	SO_2	15(5,11)−16(4,12)	0.25	Sgr B2	NRAO	11m	Hol80a		
150415.344*	(49)	CH_3CH_2CN	27(1,26)−27(0,27)	0.03	OriMC-1	FCRAO	14m	Ziu91a		N
150439.12	(4)	NO	$^2\Pi_{1/2}$ $J=3/2-1/2$ $F=3/2-3/2(+-)$	0.15	OriMC-1	NRAO	11m	Hol80a	Poy80	
150449.24 *	(5)	$HCOOCH_3$	12(6,6)−12(5,7) E	0.03	OriMC-1	FCRAO	14m	Ziu91a	Plu86	N
150498.339*	(7)	H_2CO	2(1,1)−1(1,0)	2.7	OriMC-1	NRAO	11m	Tha71		
150546.52	(4)	NO	$^2\Pi_{1/2}$ $J=3/2-1/2$ $F=5/2-3/2(+-)$	0.25	Sgr B2	NRAO	11m	Lis78a	Poy80	
U 150594.5		unidentified		0.12	OriMC-1	FCRAO	14m	Ziu91		N
150600.78 *	(3)	$HCOOCH_3$	12(4,8)−11(4,7) E	0.2	OriMC-1	BTL	7m	Woo84	Plu86	M
150618.27 *	(10)	$HCOOCH_3$	12(4,8)−11(4,7) A	0.2	OriMC-1	BTL	7m	Woo84	Plu84	M
150636.87 *	(7)	$HCOOCH_3$	12(6,7)−12(5,8) A	0.04[b]	OriMC-1	FCRAO	14m	Ziu91a		N
150644.34	(4)	NO	$^2\Pi_{1/2}$ $J=3/2-1/2$ $F=3/2-1/2(+-)$	[b]	OriMC-1	FCRAO	14m	Ziu91	Poy80	N
U 150724.0		unidentified		0.09	OriMC-1	FCRAO	14m	Ziu91a		N
U 150736.0		unidentified		0.04	OriMC-1	FCRAO	14m	Ziu91a		N
150798.14 *	(4)	$HCOOCH_3$	26(18,8)−27(17,11) A	0.1[b]	OriMC-1	FCRAO	14m	Ziu91a		N
150798.14 *	(4)	$HCOOCH_3$	26(18,9)−27(17,10) A	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
150820.669*	(6)	C_3H_2	4(0,4)−3(1,3)	0.3	Sgr B2	NRAO	11m	Hol83a	Vrt87	M
150851.901*	(6)	C_3H_2	4(1,4)−3(0,3)	0.3	Sgr B2	NRAO	11m	Hol83a	Vrt87	M
150884.58	(10)	CH_3OH	12(−1)−11(−2) E n,t	1.5	Sgr B2	NRAO	11m	Sny80	Lee68	
150981.85 *	(10)	$HCOOCH_3$	22(6,17)−22(5,18) A	0.05	OriMC-1	FCRAO	14m	Ziu91a		N
150992.22 *	(25)	CH_3OCH_3	10(3,8)−10(2,9) EA	0.24[b]	OriMC-1	FCRAO	14m	Ziu91a		N
150992.30 *	(24)	CH_3OCH_3	10(3,8)−10(2,9) AE	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
150995.52 *	(17)	CH_3OCH_3	10(3,8)−10(2,9) EE	0.32	OriMC-1	FCRAO	14m	Ziu91a		N
150998.77 *	(10)	CH_3OCH_3	10(3,8)−10(2,9) AA	0.30	OriMC-1	FCRAO	14m	Ziu91a		N
151008.75 *	(3)	$HCOOCH_3$	11(6,6)−11(5,7) E	0.07	OriMC-1	FCRAO	14m	Ziu91a	Plu86	N
151009.21 *	(7)	$HCOOCH_3$	11(6,6)−11(5,7) A	0.12	OriMC-1	FCRAO	14m	Ziu91a		N
151036.02 *	(5)	$HCOOCH_3$	11(6,5)−11(5,6) E	0.07	OriMC-1	FCRAO	14m	Ziu91a	Plu86	N
151127.254*	(14)	CH_3CH_2CN	17(2,16)−16(2,15)	0.22	OriMC-1	FCRAO	14m	Ziu91a		N
U 151283.5		unidentified		0.1	OriMC-1	FCRAO	14m	Ziu91a		N
U 151305.5		unidentified		0.05	OriMC-1	FCRAO	14m	Ziu91a		N
151356.955*	(17)	CH_2CHCN	16(2,15)−15(2,14)	0.03	OriMC-1	FCRAO	14m	Ziu91a		N
151378.667*	(8)	SO_2	2(2,0)−2(1,1)	0.32	rho Oph A	MMWO	4.9m	Lor85		
151496.05 *	(7)	$HCOOCH_3$	10(6,5)−10(5,6) A	0.035	OriMC-1	FCRAO	14m	Ziu91a		N
151510.97 *	(8)	CH_3OCH_3	14(2,12)−13(3,11) AA	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151513.41 *	(26)	CH_3OCH_3	14(2,12)−13(3,11) EE	0.15[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151515.85 *	(45)	CH_3OCH_3	14(2,12)−13(3,11) AE	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151515.86 *	(45)	CH_3OCH_3	14(2,12)−13(3,11) EA	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151589.90	(8)	CH_3CHO	6(1,6)−5(0,5) E	[b]	OriMC-1	FCRAO	14m	Ziu91a	Lia86	N
151591.05 *	(43)	CH_3OCH_3	14(2,13)−14(1,14) AE+EA	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151594.12 *	(34)	CH_3OCH_3	14(2,13)−14(1,14) EE	0.18[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151597.18 *	(25)	CH_3OCH_3	14(2,13)−14(1,14) AA	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151616.190	(26)	HDO	7(3,4)−7(3,5)	0.2	OMC-IRc2	IRAM	30m	Jac90	Del71	N
151860.32	(10)	CH_3OH	13(0)−13(−1) E	0.48	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
151899.098*	(10)	CH_2CHCN	16(6,11)−15(6,10)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151899.098*	(10)	CH_2CHCN	16(6,10)−15(6,9)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151900.311*	(8)	CH_2CHCN	16(5,12)−15(5,11)	0.08[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151900.349*	(8)	CH_2CHCN	16(5,11)−15(5,10)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151915.903*	(11)	CH_2CHCN	16(7,9)−15(7,8)	0.07[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151915.903*	(11)	CH_2CHCN	16(7,10)−15(7,9)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151933.627*	(7)	CH_2CHCN	16(4,13)−15(4,12)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151936.870*	(7)	CH_2CHCN	16(4,12)−15(4,11)	0.05[b]	OriMC-1	FCRAO	14m	Ziu91a		N
151950.04 *	(3)	$HCOOCH_3$	13(2,12)−12(2,11) E	0.25	OriMC-1	FCRAO	14m	Ziu91a	Plu86	N
151956.459*	(54)	$HCOOCH_3$	13(2,12)−12(2,11) A	0.21	OriMC-1	FCRAO	14m	Ziu91a		N
151986.775*	(8)	CH_2CHCN	16(3,14)−15(3,13)	0.04	OriMC-1	FCRAO	14m	Ziu91a		N
U 151993.		unidentified		0.05	OriMC-1	FCRAO	14m	Ziu91a		N
152243.735*	(3)	HNCS	13(1,13)−12(1,12)	0.05[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152297.846*	(14)	CH_3CH_2CN	17(8,9)−16(8,8)	0.19[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152297.846*	(14)	CH_3CH_2CN	17(8,10)−16(8,9)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152303.836*	(13)	CH_3CH_2CN	17(7,11)−16(7,10)	0.3[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152303.836*	(13)	CH_3CH_2CN	17(7,10)−16(7,9)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152304.648*	(13)	CH_3CH_2CN	17(9,8)−16(9,7)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
152304.648*(13)		CH_3CH_2CN	17(9,9) – 16(9,8)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152320.512*(12)		CH_3CH_2CN	17(10,8) – 16(10,7)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152320.512*(12)		CH_3CH_2CN	17(10,7) – 16(10,6)	0.1	OriMC-1	FCRAO	14m	Ziu91a		N
152329.873*(12)		CH_3CH_2CN	17(6,12) – 16(6,11)	0.16[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152329.893*(12)		CH_3CH_2CN	17(6,11) – 16(6,10)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152332.614*(36)		CH_2CHCN	24(1,23) – 23(2,22)	0.06	OriMC-1	FCRAO	14m	Ziu91a		N
152343.346*(20)		CH_3CH_2CN	17(11,7) – 16(11,6)	0.09[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152343.346*(20)		CH_3CH_2CN	17(11,6) – 16(11,5)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
U 152366.0		unidentified		0.05	OriMC-1	FCRAO	14m	Ziu91a		N
152371.904*(22)		CH_3CH_2CN	17(12,6) – 16(12,5)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152371.904*(22)		CH_3CH_2CN	17(12,5) – 16(12,4)	0.08[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152383.32 *(11)		CH_3CH_2OH	15(3,13) – 15(2,14)	0.03	OriMC-1	FCRAO	14m	Ziu91a		N
152391.262*(12)		CH_3CH_2CN	17(5,13) – 16(5,12)	0.24[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152391.465*(12)		CH_3CH_2CN	17(5,12) – 16(5,11)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152405.398*(25)		CH_3CH_2CN	17(13,5) – 16(13,4)	0.07[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152405.398*(25)		CH_3CH_2CN	17(13,4) – 16(13,3)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152436.69 *(22)		CH3CH2OH ?	20(3,18) – 19(4,15)	0.06	OriMC-1	FCRAO	14m	Ziu91a		N
152443.14	(10)	CH_3OH	14(–3) – 13(–4) E	0.3	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
152485.281*(30)		CH_3CH_2CN	17(15,2) – 16(15,1)	0.05[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152485.281*(30)		CH_3CH_2CN	17(15,3) – 16(15,2)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152505.410*(13)		CH_3CH_2CN	17(3,15) – 16(3,14)	0.18	OriMC-1	FCRAO	14m	Ziu91a		N
152509.621*(13)		CH_3CH_2CN	17(3,14) – 16(3,13)	0.19	OriMC-1	FCRAO	14m	Ziu91a		N
U 152514.5		unidentified		0.1	OriMC-1	FCRAO	14m	Ziu91a		N
U 152525.0		unidentified		0.04	OriMC-1	FCRAO	14m	Ziu91a		N
152552.918*(13)		CH_3CH_2CN	17(4,13) – 16(4,12)	0.24	OriMC-1	FCRAO	14m	Ziu91a		N
U 152579.5		unidentified		0.07	OriMC-1	FCRAO	14m	Ziu91a		N
152598.05 *(9)		$HCOOCH_3$	17(2,16) – 17(1,17) A	0.07[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152607.625	(80)	CH_3CHO	8(0,8) – 7(0,7) E	[b]	OriMC-1	FCRAO	14m	Ziu91a	Lia86	N
152609.774	(50)	DNC	2 – 1	0.13[b]	OriMC-1	FCRAO	14m	Ziu91a	Cre76	N
152609.774	(50)	DNC	2 – 1	0.5[b]	L134	MMWO	4.9m	Snc77	Cre76	
U 152621.5		unidentified		0.08	OriMC-1	FCRAO	14m	Ziu91a		N
152635.07	(8)	CH_3CHO	8(0,8) – 7(0,7) A	0.06	OriMC-1	FCRAO	14m	Ziu91a	Lia86	N
U 152651.5		unidentified		0.04	OriMC-1	FCRAO	14m	Ziu91a		N
152656.779*(22)		CH3CH2OH ?	4(2,2) – 3(1,3)	0.05	OriMC-1	FCRAO	14m	Ziu91a		N
152669.521*(21)		CH_3CH_2CN	22(4,18) – 22(3,19)	0.04[b]	OriMC-1	FCRAO	14m	Ziu91a		N
U 152678.		unidentified		[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152708.51	(10)	CH_3OH	9(4) – 10(3) A–	0.35	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
152741.31	(10)	CH_3OH	9(4) – 10(3) A+	0.26	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
152828.29 *(27)		CH_3OCH_3	11(3,9) – 11(2,10) EA	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152828.33 *(27)		CH_3OCH_3	11(3,9) – 11(2,10) AE	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152831.48 *(20)		CH_3OCH_3	11(3,9) – 11(2,10) EE	0.1[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152834.67 *(12)		CH_3OCH_3	11(3,9) – 11(2,10) AA	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152883.57 *(46)		CH_3OCH_3	11(7,5) – 12(6,6) EA	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152887.69 *(40)		CH_3OCH_3	11(7,5) – 12(6,6) EE	0.07[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152889.04 *(43)		CH_3OCH_3	11(7,5) – 12(6,6) AE	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152889.07 *(43)		CH_3OCH_3	11(7,4) – 12(6,7) AE	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152891.85 *(35)		CH_3OCH_3	11(7,5) – 12(6,6) AA	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152891.88 *(35)		CH_3OCH_3	11(7,4) – 12(6,7) AA	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152893.19 *(41)		CH_3OCH_3	11(7,4) – 12(6,7) EE	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152894.51 *(47)		CH_3OCH_3	11(7,4) – 12(6,7) EA	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
152898.202*(78)		CH_2CHCN	16(4,13) – 17(3,14)	0.02	OriMC-1	FCRAO	14m	Ziu91a		N
152953.73 *(11)		$^{34}SO_2$	9(4,6) – 10(3,7)	0.06	OriMC-1	FCRAO	14m	Ziu91a		N
152986.00	(20)	C_4H	$^2\Sigma$ $J = 16 – 15$ $v_7 = 2$ L	n.r.	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
U 152989.5		unidentified		0.095	OriMC-1	FCRAO	14m	Ziu91a		N
153015.07 *(8)		$^{34}SO_2$	3(2,2) – 3(1,3)	0.08	OriMC-1	FCRAO	14m	Ziu91a		N
U 153026.0		unidentified		0.06	OriMC-1	FCRAO	14m	Ziu91a		N
153041.88	(20)	C_4H	$^2\Sigma$ $J = 16 – 15$ $v_7 = 2$ U	n.r.	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
153054.97 *(3)		CH_3OCH_3	9(0,9) – 8(1,8) EE	0.39	Sgr B2	NRAO	11m	Mer82		
U 153064.5		unidentified		0.045	OriMC-1	FCRAO	14m	Ziu91a		N
U 153070.5		unidentified		0.04	OriMC-1	FCRAO	14m	Ziu91a		N
U 153106.1		unidentified		0.04	OriMC-1	FCRAO	14m	Ziu91a		N
U 153129.1		unidentified		0.05	OriMC-1	FCRAO	14m	Ziu91a		N
153179.33 *(13)		HDS	2(1,1) – 2(1,2)	0.39	OriMC-1	FCRAO	14m	Min90	Hel73	N
153272.217*(13)		CH_3CH_2CN	17(3,14) – 16(3,13)	0.17	OriMC-1	FCRAO	14m	Ziu91a		N
153281.24	(10)	CH_3OH	12(0) – 12(–1) E2	0.78	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
153290.31	*(5)	$HCOOCH_3$	14(0,14) – 13(1,13) A	0.19[b]	OriMC-1	FCRAO	14m	Ziu91a		N
153291.946	*(6)	HNCO	7(1,7) – 6(1,6)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
153323.998	(50)	CH_3OD	7(1) – 7(0) A –	7.6[f]	OriMC-1	IRAM	30m	Mau88	And88	N
153351.86	*(6)	$HCOOCH_3$	14(1,14) – 13(1,13) A	0.26[b]	OriMC-1	FCRAO	14m	Ziu91a		N
153353.86	*(16)	$HCOOCH_3$	19(3,17) – 19(2,18) A	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
U 153386.6		unidentified		0.14	OriMC-1	FCRAO	14m	Ziu91a		N
153399.21	*(6)	$HCOOCH_3$	14(0,14) – 13(0,13) A	0.32	OriMC-1	FCRAO	14m	Ziu91a		N
153432.18	*(2)	NH_2CHO	7(1,6) – 6(1,5)	0.15	Sgr B2	NRAO	11m	Hol83a		
153460.76	*(6)	$HCOOCH_3$	14(1,14) – 13(0,13) A	0.1	OriMC-1	FCRAO	14m	Ziu91a		N
U 153487.5	(5)	unidentified		0.13	Sgr B2	NRAO	11m	Hol81		
U 153487.6		unidentified		0.08	OriMC-1	FCRAO	14m	Ziu91a		N
153512.66	*(3)	$HCOOCH_3$	13(1,12) – 12(1,11) E	0.1	OriMC-1	NRAO	11m	Hol83a	Plu86	M
153518.69	*(5)	$HCOOCH_3$	13(1,12) – 12(1,11) A	0.13	OriMC-1	NRAO	11m	Hol83a	Plu84	M
153553.25	*(3)	$HCOOCH_3$	12(2,10) – 11(2,9) E	0.13	OriMC-1	NRAO	11m	Hol83a	Plu86	M
153566.91	*(5)	$HCOOCH_3$	12(2,10) – 11(2,9) A	0.11	OriMC-1	NRAO	11m	Hol83a	Plu84	M
U 153668.3	(10)	unidentified		0.08	Sgr B2	NRAO	11m	Hol81		
153677.54	*(15)	KCl	20 – 19	0.71[f]	IRC+10216	IRAM	30m	Cer87c		N
153745.6	(5)	HCCN	7,8 – 6,7	0.45[f]	IRC+10216	IRAM	30m	Gué91	Gué91	N
153764.606	*(8)	HNCO	7(3,4) – 6(3,3)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
153764.606	*(8)	HNCO	7(3,5) – 6(3,4)	0.09[b]	OriMC-1	FCRAO	14m	Ziu91a		N
153770.214	*(3)	CH_3CCH	9(4) – 8(4)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
153790.770	*(2)	CH_3CCH	9(3) – 8(3)	0.23	Sgr B2	NRAO	11m	Hol81		
153805.458	*(1)	CH_3CCH	9(2) – 8(2)	0.18	Sgr B2	NRAO	11m	Hol81		
153814.273	*(1)	CH_3CCH	9(1) – 8(1)	[b]	Sgr B2	NRAO	11m	Hol81		
153817.212	*(1)	CH_3CCH	9(0) – 8(0)	0.59[b]	Sgr B2	NRAO	11m	Hol81		
153818.869	*(6)	HNCO	7(2,6) – 6(2,5)	0.3[b]	OriMC-1	FCRAO	14m	Ziu91a		N
153820.007	*(7)	HNCO	7(2,5) – 6(2,4)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
153865.092	*(6)	HNCO	7(0,7) – 6(0,6)	2.03	Sgr B2	NRAO	11m	Chu86		N
153872.754	(80)	CH_3CHO	8(2,7) – 7(2,6)	0.06[b]	OriMC-1	FCRAO	14m	Ziu91a	Lia86	N
153894.1	(4)	HCCN	7,6 – 6,5	0.5 [f]	IRC+10216	IRAM	30m	Gué91	Gué91	N
154016.096	*(11)	$HCC^{13}CN$	17 – 16	0.05	OriMC-1	FCRAO	14m	Ziu91a		N
154200.97	*(10)	CH_3CHO	8(4,5) – 7(4,4)	0.03[b]	OriMC-1	FCRAO	14m	Ziu91a	Kle91	N
154201.52	*(10)	CH_3CHO	8(4,4) – 7(4,3)	[b]	OriMC-1	FCRAO	14m	Ziu91a	Kle91	N
154217.20	(15)	N_2D^+	2 – 1	0.25	rho Oph B2	MMWO	4.9m	Lor84b	Sas81	
154242.770	*(3)	$OC^{34}S$	13 – 12	1.[b]	OriMC-1	FCRAO	14m	Ziu91a		N
154244.348	*(14)	CH_3CH_2CN	17(1,16) – 16(1,15)	0.14[b]	OriMC-1	FCRAO	14m	Ziu91a		N
U 154391.1		unidentified		0.07	OriMC-1	FCRAO	14m	Ziu91a		N
154414.776	*(6)	HNCO	7(1,6) – 6(1,5)	0.18	OriMC-1	FCRAO	14m	Ziu91a		N
154425.78	(10)	CH_3OH	11(0) – 11(–1) E	1.42	OriMC-1	NRAO	11m	Hol81	Lee68	
154453.81	*(7)	CH_3OCH_3	11(1,10) – 10(2,9) AA	[b]	NGC 6334I	IRAM	30m	Bac90		N
154455.22	*(18)	CH_3OCH_3	11(1,10) – 10(2,9) EE	1.5[b]	NGC 6334I	IRAM	30m	Bac90		N
U 154512.5		unidentified		0.04	OriMC-1	FCRAO	14m	Ziu91a		N
U 154608.6		unidentified		0.05	OriMC-1	FCRAO	14m	Ziu91a		N
154657.283	*(1)	HC_3N	17 – 16	1.54	OriMC-1	NRAO	11m	Hol81		
U 154663.		unidentified		0.5	NGC 6334I	IRAM	30m	Bac90		N
154724.533	*(10)	CH_2CHCN	16(1,15) – 15(1,14)	0.07	OriMC-1	FCRAO	14m	Ziu91a		N
154984.54	*(5)	$HCOOCH_3$	12(3,9) 11(3,8) E	0.135	OriMC-1	FCRAO	14m	Ziu91a	Plu86	N
155002.17	*(5)	$HCOOCH_3$	12(3,9) – 11(3,8) A	0.15	OriMC-1	FCRAO	14m	Ziu91a		N
155037.225	*(30)	HCCCN	17 – 16 $\nu_7=1$ $\ell=1e$	0.15	OriMC-1	FCRAO	14m	Ziu91a		N
U 155075.0		unidentified		0.05	OriMC-1	FCRAO	14m	Ziu91a		N
155088.15	(8)	CH_3CHO	8(4,5) 9(3,7)	0.04	OriMC-1	FCRAO	14m	Ziu91a	Lia86	N
155125.45	*(30)	CH_3OCH_3	12(3,10) – 12(2,11) EA	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
155125.46	*(30)	CH_3OCH_3	12(3,10) – 12(2,11) AE	0.22[b]	OriMC-1	FCRAO	14m	Ziu91a		N
155128.56	*(22)	CH_3OCH_3	12(3,10) – 12(2,11) EE	0.3	OriMC-1	FCRAO	14m	Ziu91a		N
155131.65	*(14)	CH_3OCH_3	12(3,10) – 12(2,11) AA	0.21	OriMC-1	FCRAO	14m	Ziu91a		N
U 155147.0		unidentified		0.06	OriMC-1	FCRAO	14m	Ziu91a		N
U 155154.0		unidentified		0.09	OriMC-1	FCRAO	14m	Ziu91a		N
155259.211	*(30)	HCCCN	17 – 16 $\nu_7=1$ $\ell=1f$	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
155262.012	(50)	$^{13}CH_3OH$	9(0) – 9(–1) E	0.23[b]	OriMC-1	FCRAO	14m	Ziu91a	And87	N
155320.92	(10)	CH_3OH	10(0) – 10(–1) E	1.3	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
155342.105	(80)	CH_3CHO	8(2,6) – 7(2,5) A	0.08	OriMC-1	FCRAO	14m	Ziu91a	Lia86	N
155389.678	*(26)	SO_2	20(6,14) – 21(5,17)	0.21	OriMC-1	FCRAO	14m	Ziu91a		N
155404.500	*(14)	CH_3CH_2CN	17(2,15) – 16(2,14)	0.20	OriMC-1	FCRAO	14m	Ziu91a		N
155426.771	*(14)	CH_3CH_2CN	18(1,18) – 17(1,17)	0.22	OriMC-1	FCRAO	14m	Ziu91a		N
155454.496	*(12)	C_2S	12,12 – 11,11	1.3[f]	IRC+10216	IRAM	30m	Cer87b	Yam90	N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
155506.801	*(42)	^{34}SO	3(4) – 2(3)	0.37	OriMC-1	FCRAO	14m	Ziu91a		N
155533.080	(50)	CH_3OD	1(1) – 0(0) E	0.85[f]	OriMC-1	IRAM	30m	Mau88	And88	N
155539.72	*(20)	CH_3CHO	8(4,4) – 9(3,7)	0.07[b]	OriMC-1	FCRAO	14m	Ziu91a	Kle91	N
155540.601	*(84)	$HCOOCH_3$	22(3,19) – 22(3,20) A	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
U 155549.7		unidentified		0.13	OriMC-1	FCRAO	14m	Ziu91a		N
155617.84	*(1)	HCOOH ?	7(0,7) – 6(0,6)	0.04	OriMC-1	FCRAO	14m	Ziu91a		N
155695.809	(50)	$^{13}CH_3OH$	8(0) – 8(–1) E	0.07	OriMC-1	FCRAO	14m	Ziu91a	And87	N
155994.273	(50)	$^{13}CH_3OH$	7(0) – 7(–1) E	0.53[b]	OriMC-1	FCRAO	14m	Ziu91a	And87	N
155997.52	(10)	CH_3OH	9(0) – 9(–1) E	2.3[b]	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
156062.872	*(9)	C_3S	27 – 26	1.0[f]	IRC+10216	IRAM	30m	Cer87b		N
156090.9	*(7)	$^{33}SO_2$	4(3,1) – 5(2,4)	0.14	OriMC-1	FCRAO	14m	Ziu91a		N
156112.947	*(28)	CH_3CH_2CN	25(2,23) – 24(3,22)	0.18	OriMC-1	FCRAO	14m	Ziu91a		N
156127.70	(10)	CH_3OH	6(2) – 7(1) A+	1.45	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
156165.18	*(8)	$HCOOCH_3$	22(3,19) – 22(2,20) A	0.07[b]	OriMC-1	FCRAO	14m	Ziu91a		N
156171.664	*(14)	CH_3CH_2CN	18(0,18) – 17(0,17)	0.23	OriMC-1	FCRAO	14m	Ziu91a		N
156186.559	(50)	$^{13}CH_3OH$	6(0) – 6(–1) E	0.23	OriMC-1	FCRAO	14m	Ziu91a	And87	N
156248.60	(10)	NaCl	12 – 11	1.52[f]	IRC+10216	IRAM	30m	Cer87c	Clo64	N
U 156325.		unidentified		0.05	IRC+10216	IRAM	30m	Cer87b		N
156456.48	(30)	$^{29}SiC_2$	7(0,7) – 6(0,6)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
156488.95	(10)	CH_3OH	8(0) – 8(–1) E	1.1	OriMC-1	NRAO	11m	Hol81	Lee68	
156547.15	*(5)	$Al^{37}Cl$	11 – 10	1.52[f]	IRC+10216	IRAM	30m	Cer87c		N
156602.42	(10)	CH_3OH	2(1) – 3(0) A+	1.5	OriMC-1	NRAO	11m	Hol81	Lee68	
156828.51	(10)	CH_3OH	7(0) – 7(–1) E	1.75	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
U 156842.2		unidentified		0.07	OriMC-1	FCRAO	14m	Ziu91a		N
U 156970.7		unidentified		0.04	OriMC-1	FCRAO	14m	Ziu91a		N
156981.665	*(12)	C_2S	13,12 – 12,11	1.7[f]	IRC+10216	IRAM	30m	Cer87b	Yam90	N
U 157000.7		unidentified		0.07	OriMC-1	FCRAO	14m	Ziu91a		N
157048.62	(10)	CH_3OH	6(0) – 6(–1) E	2.20	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
157135.428	*(47)	SO_2	33(4,30) – 32(5,27)	0.095	OriMC-1	FCRAO	14m	Ziu91a		N
157178.97	(10)	CH_3OH	5(0) – 5(–1) E	2.25	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
157246.10	(10)	CH_3OH	4(0) – 4(–1) E	2.25	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
157270.70	(10)	CH_3OH	1(0) – 1(–1) E	2.32[b]	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
157272.47	(10)	CH_3OH	3(0) – 3(–1) E	[b]	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
157276.04	(10)	CH_3OH	2(0) – 2(–1) E	2.0	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
U 157286.7		unidentified		0.08	OriMC-1	FCRAO	14m	Ziu91a		N
U 157304.7		unidentified		0.05	OriMC-1	FCRAO	14m	Ziu91a		N
U 157337.2		unidentified		0.04[b]	OriMC-1	FCRAO	14m	Ziu91a		N
157342.85	*(10)	CH_3CHO	3(3,1) – 4(2,3) E	[b]	OriMC-1	FCRAO	14m	Ziu91a	Kle91	N
157344.187	*(21)	CH_3CH_2CN	19(4,15) – 19(3,16)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
U 157354.7		unidentified		0.04[b]	OriMC-1	FCRAO	14m	Ziu91a		N
157494.101	(9)	SiC	$^3\Pi_2$ $J=4-3$ e,f	0.29	IRC+10216	IRAM	30m	Cer89	Cer89	N
157525.67	*(9)	CH_3CH_2OH	9(8,2) – 8(8,1)	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
157525.67	*(9)	CH_3CH_2OH	9(8,1) – 8(8,0)	0.08[b]	OriMC-1	FCRAO	14m	Ziu91a		N
U 157557.7		unidentified		0.18	OriMC-1	FCRAO	14m	Ziu91a		N
157574.96	(10)	CH_3OH	13(5) – 14(4) E	0.33	OriMC-1	FCRAO	14m	Ziu91a	Lee68	N
157598.615	*(5)	$O^{13}CS$	13 – 12	0.07	OriMC-1	FCRAO	14m	Ziu91a		N
157929.45	*(32)	CH_3OCH_3	13(3,11) – 13(2,12) EA	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
157929.47	*(32)	CH_3OCH_3	13(3,11) – 13(2,12) AE	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
157932.48	*(21)	CH_3OCH_3	13(3,11) – 13(2,12) EE	0.23[b]	OriMC-1	FCRAO	14m	Ziu91a		N
157935.50	*(11)	CH_3OCH_3	13(3,11) – 13(2,12) AA	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
157937.754	(80)	CH_3CHO	8(1,7) – 7(1,6) E	0.08	OriMC-1	FCRAO	14m	Ziu91a	Lia86	N
157974.57	*(10)	CH_3CHO	8(1,7) – 7(1,6) A	0.06	OriMC-1	FCRAO	14m	Ziu91a	Kle91	N
158107.357	*(1)	OCS	13 – 12	0.76	OriMC-1	FCRAO	14m	Ziu91a		N
158199.784	*(8)	SO_2	3(2,2) – 3(1,3)	0.71	OriMC-1	FCRAO	14m	Ziu91a		N
158296.96	*(8)	$HCOOCH_3$	5(4,1) – 4(3,2) A	0.06	OriMC-1	FCRAO	14m	Ziu91a		N
158499.23	*(8)	SiC_2	7(0,7) – 6(0,6)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
U 158522.0		unidentified		0.16	OriMC-1	FCRAO	14m	Ziu91a		N
158657.435	*(10)	CH_2CHCN	17(0,17) – 16(0,16)	0.06	OriMC-1	FCRAO	14m	Ziu91a		N
158692.020	*(19)	$H^{13}CCCN$	18 – 17	0.32	OriMC-1	FCRAO	14m	Ziu91a		N
158704.270	*(53)	$HCOOCH_3$	13(3,11) – 12(3,10) A	0.30	OriMC-1	FCRAO	14m	Ziu91a		N
158971.814	*(42)	SO	3(4) – 2(3)	3.5	OriMC-1	NRAO	11m	Hol81		
U 159007.0		unidentified		0.05	OriMC-1	FCRAO	14m	Ziu91a		N
U 159030.0		unidentified		0.05	OriMC-1	FCRAO	14m	Ziu91a		N
U 159318.0		unidentified		0.07	OriMC-1	FCRAO	14m	Ziu91a		N
159437.464	(50)	CH_3OD	8(1) – 8(0) A–	3.7[f]	OriMC-1	IRAM	30m	Mau88	And88	N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
159552.64	(60)	$^{30}SiC_2$	7(2,6) – 6(2,5)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
159571.086	(50)	CH_3OD	6(0) – 5(1) E	2.4[f]	OriMC-1	IRAM	30m	Mau88	And88	N
159582.38	*(7)	$HCOOCH_3$	13(11,3) – 12(11,2) A	0.06[b]	OriMC-1	FCRAO	14m	Ziu91a		N
159582.38	*(7)	$HCOOCH_3$	13(11,2) – 12(11,1) A	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
U 159654.0		unidentified		0.08	OriMC-1	FCRAO	14m	Ziu91a		N
159663.097	*(7)	$HCOOCH_3$	13(10,3) – 12(10,2) A	0.12[b]	OriMC-1	FCRAO	14m	Ziu91a		N
159663.097	*(7)	$HCOOCH_3$	13(10,4) – 12(10,3) A	[b]	OriMC-1	FCRAO	14m	Ziu91a		N
U 159673.0		unidentified		0.13	OriMC-1	FCRAO	14m	Ziu91a		N
159888.873	*(13)	CH_3CH_2CN	18(2,17) – 17(2,16)	0.15	Sgr B2	NRAO	11m	Hol81		
U 159915.6	(10)	unidentified		0.07	Sgr B2	NRAO	11m	Hol81		
160229.99	*(9)	$Si^{13}CC$	7(2,6) – 6(2,5)	1.1[f]	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
160312.16	*(5)	AlCl	11 – 10	3.56[f]	IRC+10216	IRAM	30m	Cer87c		N
160815.53	(40)	$^{30}SiC_2$	7(4,4) – 6(4,3)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
160825.62	(40)	$^{30}SiC_2$	7(4,3) – 6(4,2)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
160827.843	*(9)	SO_2	10(0,10) – 9(1,9)	2.4	OriMC-1	NRAO	11m	Hol81		
161350.19	*(15)	KCl	21 – 20	1.00[f]	IRC+10216	IRAM	30m	Cer87c		N
161977.186	(10)	SiC	$^3\Pi_1$ $J=4-3$ e	0.08	IRC+10216	IRAM	30m	Cer89	Cer89	N
162121.467	(17)	SiC	$^3\Pi_1$ $J=4-3$ f	0.12	IRC+10216	IRAM	30m	Cer89	Cer89	N
U 162410.		unidentified		0.5	NGC 6334I	IRAM	30m	Bac90		N
162529.62	*(11)	CH_3OCH_3	8(1,8) – 7(0,7) EE	0.1[b]	NGC 6334I	IRAM	30m	Bac90		N
162530.27	*(8)	CH_3OCH_3	8(1,8) – 7(0,7) AA	[b]	NGC 6334I	IRAM	30m	Bac90		N
162547.41	(15)	C_4H	$^2\Sigma$ $J=17-16$ $v_7=2$ L	0.2	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
162581.64	*(19)	SiS	9 – 8 v=1	0.1	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
162603.18	(15)	C_4H	$^2\Sigma$ $J=17-16$ $v_7=2$ U	0.2	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
U 162640.		unidentified		0.05	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
162775.93	*(8)	$^{34}SO_2$	7(1,7) – 6(0,6)	n.r.	Sgr B2	FCRAO	14m	Hol91		N
162937.95	*(5)	HNO	2(0,2) – 1(0,1)	0.06	Sgr B2	FCRAO	14m	Hol91		N
162958.66	*(3)	NH_2CHO	8(1,8) – 7(1,7)	0.10	Sgr B2	FCRAO	14m	Hol91		N
163081.9	(10)	$^{29}SiC_2$	7(4,4) – 6(4,3)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
163093.1	(10)	$^{29}SiC_2$	7(4,3) – 6(4,2)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
163119.437	*(21)	SO_2	18(2,16) – 17(3,15)	0.20	Sgr B2	NRAO	11m	Hol83a		
163160.825	*(53)	CH_2CO	8(1,7) – 7(1,6)	0.20	Sgr B2	NRAO	11m	Hol83a		
163829.61	*(3)	$HCOOCH_3$	14(1,13) – 13(1,12) E	0.35	OriMC-1	NRAO	11m	Sny85a	Plu86	M
163835.45	*(5)	$HCOOCH_3$	14(1,13) – 13(1,12) A	0.40	OriMC-1	NRAO	11m	Sny85a	Plu84	M
163872.400	(10)	$^{13}CH_3OH$	7(0) – 6(1) E	0.15	OriMC-1	NRAO	11m	Sny85a	And87	M
U 163902.	(1)	unidentified		0.10	OriMC-1	NRAO	11m	Sny85a		
163927.31	*(5)	$HCOOCH_3$	15(0,15) – 14(1,14) A	0.15	OriMC-1	NRAO	11m	Sny85a	Plu84	M
164069.08	*(3)	SiC_2	7(2,6) – 6(2,5)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
164770.54	*(5)	SiC_2	7(2,6) – 6(2,5)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
164867.840	*(25)	AlF	5 – 4	1.90[f]	IRC+10216	IRAM	30m	Cer87c		N
167620.172	*(9)	C_3S	29 – 28	1.0 [f]	IRC+10216	IRAM	30m	Cer87b		N
167910.516	(2)	$H_2{}^{34}S$	1(1,0) – 1(0,1)	0.1	W49	FCRAO	14m	Min91	Hui71	N
167931.13	(10)	CH_3OH	9(1) – 9(0) E1	0.13	SgrB2	FCRAO	14m	Min91	Sas84	N
168049.5	(10)	$^{29}SiC_2$	7(2,5) – 6(2,4)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
168657.72	*(18)	$Si^{13}CC$	7(1,6) – 6(1,5)	1.1[f]	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
168762.76237	(2)	H_2S	1(1,0) – 1(0,1)	2.3	OriMC-1	NRAO	11m	Tha72	Cup68	
168815.101	*(36)	^{34}SO	4(3) – 3(3)	0.9	OriMC-1	NRAO	11m	Hol81		
169257.38	*(8)	NaCl	13 – 12	1.54[f]	IRC+10216	IRAM	30m	Cer87c		N
169335.34	(10)	CH_3OH	10(1) – 10(0) E	0.7	OriMC-1	NRAO	11m	Wil72	Lee68	
170740.916	(9)	SiC_2	7(2,5) – 6(2,4)	0.16	IRC+10216	NRAO	11m	Tha84	Got89	M
170876.405	*(2)	CH_3CCH	10(3) – 9(3)	0.2	OriMC-1	MMWO	4.9m	Mun84		
170892.722	*(2)	CH_3CCH	10(2) – 9(2)	0.31	OriMC-1	MMWO	4.9m	Mun84		
170902.514	*(1)	CH_3CCH	10(1) – 9(1)	0.51	OriMC-1	MMWO	4.9m	Mun84		
170905.779	*(1)	CH_3CCH	10(0) – 9(0)	0.58	OriMC-1	MMWO	4.9m	Mun84		
171275.166	*(57)	SiO	4 – 3 v=2	87.[e]	X-Cyg	NRAO	11m	Sch82		
172107.956	(45)	$HC^{15}N$	2 – 1	0.45	OriMC-1	NRAO	11m	Wil72	Pea76	
172108.36	(50)	C_4H	$^2\Sigma$ $J=18-17$ $v_7=2$ L	n.r.	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
172164.12	(80)	C_4H	$^2\Sigma$ $J=18-17$ $v_7=2$ U	n.r.	IRC+10216	IRAM	30m	Gué87a	Gué87a	N
172481.140	*(45)	SiO	4 – 3 v=1	50.[e]	X-Cyg	NRAO	11m	Sch82		
172676.573	(50)	$H^{13}CN$	2 – 1 $F=1-0,2-2$	[b]	OriMC-1	NRAO	11m	Wil72	Pea76	
172677.959	(50)	$H^{13}CN$	2 – 1 $F=2-1,3-2$	0.91[b]	OriMC-1	NRAO	11m	Wil72	Pea76	
172680.209	(50)	$H^{13}CN$	2 – 1 $F=1-1$	[b]	OriMC-1	NRAO	11m	Wil72	Pea76	
173377.38	*(10)	HCO	2(0,2) – 1(0,1) 5/2 – 3/2 $F=3-2$	0.12	OriMC-2	NRAO	11m	Sny85a	Sny85a	
173391.211	*(16)	CH_3CH_2OH	5(2,3) – 4(1,4)	[b]	OriMC-2	NRAO	11m	Sny85a		M
173391.715	*(27)	CH_3CH_2CN	10(2,8) – 9(1,9)	0.05[b]	OriMC-2	NRAO	11m	Sny85a		M

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
173406.08	*(10)	HCO	2(0,2) – 1(0,1) 5/2 – 3/2 F = 2 – 1	0.05	OriMC-2	NRAO	11m	Sny85a	Sny85a	
173443.06	*(10)	HCO	2(0,2) – 1(0,1) 3/2 – 1/2 F = 2 – 1	0.06	OriMC-2	NRAO	11m	Sny85a	Sny85a	
173688.254	*(41)	SiO	4 – 3 v = 0	65[c]	OriMC-1	NRAO	11m	Sch82		
177238.71	(10)	HCN	2 – 1 ν_2 = 1 ℓ = 1c	80.	IRC+10216	IRAM	30m	Luc89	Win71	N
178136.50	(10)	HCN	2 – 1 ν_2 = 1 ℓ = 1d	1.	IRC+10216	IRAM	30m	Luc89	Win71	N
178170.38	(10)	HCN	2 – 1 ν_2 = 2 ℓ = 0	0.8	IRC+10216	IRAM	30m	Luc89	Del77	N
183310.0906	(15)	H_2O	3(1,3) – 2(2,0)	10.	OriMC-1	KAO	1m	Wat77	Hui71	
191040.302	*(4)	HC_3N	21 – 20	3.0	W49N	IRAM	30m	Cer90		N
195954.249	*(29)	CS	4 – 3	3.3	NGC2024	MMWO	4.9m	Mun84a		
200809.32	*(3)	SO_2	16(1,15) – 16(0,16)	4.87	OriMC-1	NRAO	12m	Jew89		N
200888.30	*(10)	SO_2	13(5,9) – 14(4,10) ν_2 = 1	0.28	OriMC-1	NRAO	12m	Jew89		N
200913.79	*(4)	HC_3N	22 – 21 ν_7 = 1 ℓ = 1f	0.73	OriMC-1	NRAO	12m	Jew89		N
U 200936.		unidentified	(U204070?)	0.50	OriMC-1	NRAO	12m	Jew89		N
200956.34	*(5)	$HCOOCH_3$	16(5,11) – 15(5,10) A	0.45	OriMC-1	NRAO	12m	Jew89	Plu84	N
U 201088.		unidentified	(U203918.?) note1	1.48	OriMC-1	NRAO	12m	Jew89		N
U 201200.		unidentified	(U203806.?)	0.27	OriMC-1	NRAO	12m	Jew89		N
U 201323.		unidentified	(U204707.?)	0.19	OriMC-1	NRAO	12m	Jew89		N
201341.35	(20)	HDCO	3(1,2) – 2(1,1)	0.79	OriMC-1	NRAO	12m	Jew89	Dan78	N
201376.45	(10)	$^{34}SO_2$	11(2,10) – 11(1,11)	0.62	OriMC-1	NRAO	12m	Jew89		N
201429.63	(10)	HC_3N	22 – 21 ν_7 = 2 ℓ = 2f	0.12	OriMC-1	NRAO	12m	Jew89		N
201445.59	(5)	CH_3OH	5(2) – 6(1) A+	2.52	OriMC-1	NRAO	12m	Jew89	Sas84	N
201539.79	*(30)	CH_3OCH_3	12(4,8) – 12(3,9) EE	0.51[b]	OriMC-1	NRAO	12m	Jew89		N
201543.09	*(23)	CH_3OCH_3	12(4,8) – 12(3,9) AA	[b]	OriMC-1	NRAO	12m	Jew89		N
201614.27	*(1)	$H_2C^{18}O$	3(1,3) – 2(1,2)	0.12	OriMC-1	NRAO	12m	Jew89		N
201691.96	*(1)	$OC^{34}S$	17 – 16	0.30	OriMC-1	NRAO	12m	Jew89		N
201846.65	*(4)	^{34}SO	4(5) – 3(4)	2.33	OriMC-1	NRAO	12m	Jew89		N
202040.684	*(11)	CH_3CN	11(9) – 10(9)	0.81	OriMC-1	NRAO	12m	Jew89		N
202106.617	*(9)	CH_3CN	11(8) – 10(8)	0.68	OriMC-1	NRAO	12m	Jew89		N
202164.855	*(7)	CH_3CN	11(7) – 10(7)	0.77	OriMC-1	NRAO	12m	Jew89		N
202215.377	*(5)	CH_3CN	11(6) – 10(6)	1.55	OriMC-1	NRAO	12m	Jew89		N
202258.160	*(3)	CH_3CN	11(5) – 10(5)	2.11	OriMC-1	NRAO	12m	Jew89		N
U 202673.		unidentified		0.32	Sgr B2	NRAO	12m	Tur85		N
202690.687	*(22)	NH_2CHO	6(2,5) – 6(1,6)	0.65	OriMC-1	NRAO	12m	Tur85		N
202708.6	*(1)	CH_3CN	11(7) – 10(7) ν_8 = 1 ℓ = -1	0.09	OriMC-1	NRAO	12m	Tur85		N
202721.4	*(1)	CH_3CN	11(9) – 10(9) ν_8 = 1 ℓ = +1	0.18	W51	NRAO	12m	Tur85		N
202767.7	*(1)	CH_3CN	11(6) – 10(6) ν_8 = 1 ℓ = -1	[b]	W51	NRAO	12m	Tur85		N
202769.65	*(7)	CH_3CN	11(1) – 10(1) ν_8 = 1 ℓ = +1	0.18[b]	W51	NRAO	12m	Tur85		N
202818.966	*(66)	CH_3CN	11(5) – 10(5) ν_8 = 1 ℓ = -1	0.18	W51	NRAO	12m	Tur85		N
203391.488	*(15)	SO_2	12(0,12) – 11(1,11)	2.0	OriMC-1	MMWO	4.9m	Eri84		
203407.52	(2)	$H_2^{18}O$	3(1,3) – 2(2,0)	0.10[b]	W51d	NRAO	12m	Jac88	Del72	N
203411.52	*(18)	CH_3OCH_3	3(3,0) – 2(2,1) AE	0.036	W51d	NRAO	12m	Jac88		N
U 203412.7		unidentified		0.056	W51d	NRAO	12m	Jac88		N
203418.82	*(9)	CH_3OCH_3	3(3,0) – 2(2,1) AA	0.10[b]	W51e1/e2	NRAO	12m	Jac90		N
203420.63	*(12)	CH_3OCH_3	3(3,0) – 2(2,1) EA	[b]	W51e1/e2	NRAO	12m	Jac90		N
U 203806.		unidentified	(U201200.?)	0.27	OriMC-1	NRAO	12m	Jew89		N
203853.71	*(3)	$HCOOCH_3$	17(3,15) – 16(3,14) E	0.82	OriMC-1	NRAO	12m	Jew89	Plu86	N
203864.14	*(5)	$HCOOCH_3$	17(3,15) – 16(3,14) A	0.68	OriMC-1	NRAO	12m	Jew89	Plu84	N
U 203918.		unidentified	(U201088?)	1.48	OriMC-1	NRAO	12m	Jew89		N
203936.77	*(7)	^{33}SO	4(5) – 3(4) F = 9/2 – 7/2	[b]	OriMC-1	NRAO	12m	Jew89		N
203937.37	*(8)	^{33}SO	4(5) – 3(4) F = 7/2 – 5/2	1.73[b]	OriMC-1	NRAO	12m	Jew89		N
203939.24	*(16)	^{33}SO	4(5) – 3(4) F = 11/2 – 9/2	[b]	OriMC-1	NRAO	12m	Jew89		N
203941.50	*(16)	^{33}SO	4(5) – 3(4) F = 5/2 – 3/2	[b]	OriMC-1	NRAO	12m	Jew89		N
U 204070.		unidentified	(U200936.?)	0.50	OriMC-1	NRAO	12m	Jew89		N
204136.25	*(9)	$^{34}SO_2$	12(0,12) – 11(1,11)	1.02	OriMC-1	NRAO	12m	Jew89		N
204158.18	*(13)	CH_3OCH_3	9(4,5) – 9(3,6) EE	0.50[b]	OriMC-1	NRAO	12m	Jew89		N
204160.29	*(13)	CH_3OCH_3	9(4,5) – 9(3,6) AA	[b]	OriMC-1	NRAO	12m	Jew89		N
204246.72	*(5)	SO_2	18(3,15) – 18(2,16)	3.88	OriMC-1	NRAO	12m	Jew89		N
204384.26	*(2)	SO_2	7(4,4) – 8(3,5)	1.77	OriMC-1	NRAO	12m	Jew89		N
204525.23	*(13)	$^{34}SO_2$	16(3,13) – 16(2,14)	0.94	OriMC-1	NRAO	12m	Jew89		N
204552.40	*(11)	CH_3OCH_3	8(4,4) – 8(3,5) EE	0.81[b]	OriMC-1	NRAO	12m	Jew89		N
204552.63	*(29)	CH_3OCH_3	11(4,8) – 11(3,9) EE	[b]	OriMC-1	NRAO	12m	Jew89		N
204553.20	*(10)	CH_3OCH_3	8(4,4) – (83,5) AA	[b]	OriMC-1	NRAO	12m	Jew89		N
204633.78	*(27)	CH_3OCH_3	10(4,7) – 10(3,8) EE	1.03[b]	OriMC-1	NRAO	12m	Jew89		N
204638.20	*(14)	CH_3OCH_3	10(4,7) – 10(3,8) AA	[b]	OriMC-1	NRAO	12m	Jew89		N
U 204707.		unidentified	(U201323.?) note2	0.19	OriMC-1	NRAO	12m	Jew89		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
204736.60	*(26)	CH_3OCH_3	9(4,6) – 9(3,7) EE	0.33[b]	OriMC-1	NRAO	12m	Jew89		N
204741.99	*(12)	CH_3OCH_3	9(4,6) – 9(3,7) AA	[b]	OriMC-1	NRAO	12m	Jew89		N
204758.63	*(41)	CH_3OCH_3	14(4,11) – 14(3,12) EE	0.43[b]	OriMC-1	NRAO	12m	Jew89		N
204761.85	*(29)	CH_3OCH_3	14(4,11) – 14(3,12) AA	[b]	OriMC-1	NRAO	12m	Jew89		N
204932.82	*(23)	CH_3OCH_3	7(4,4) – 7(3,5) EE	0.62	OriMC-1	NRAO	12m	Jew89		N
204961.16	*(7)	CH_3OCH_3	6(4,2) – 6(3,3) AA	0.73[b]	OriMC-1	NRAO	12m	Jew89		N
204961.72	*(8)	CH_3OCH_3	6(4,2) – 6(3,3) EE	[b]	OriMC-1	NRAO	12m	Jew89		N
205018.11	*(1)	CH_3CCH	12(4) – 11(4)	0.69	OriMC-1	NRAO	12m	Jew89		N
205045.50	*(1)	CH_3CCH	12(3) – 11(3)	0.67	OriMC-1	NRAO	12m	Jew89		N
205050.57	*(9)	CH_3OCH_3	5(4,1) – 5(3,2) EE	1.54[b]	OriMC-1	NRAO	12m	Jew89		N
205050.70	*(7)	CH_3OCH_3	5(4,1) – 5(3,2) AA	[b]	OriMC-1	NRAO	12m	Jew89		N
205060.98	*(16)	CH_3OCH_3	5(4,2) – 5(3,3) EE	[b]	OriMC-1	NRAO	12m	Jew89		N
205065.07	*(1)	CH_3CCH	12(2) – 11(2)	0.87	OriMC-1	NRAO	12m	Jew89		N
205076.81	*(1)	CH_3CCH	12(1) – 11(1)	0.91[b]	OriMC-1	NRAO	12m	Jew89		N
205080.73	*(1)	CH_3CCH	12(0) – 11(0)	[b]	OriMC-1	NRAO	12m	Jew89		N
205096.09	*(12)	CH_3OCH_3	4(4,0) – 4(3,1) EE	0.60[b]	OriMC-1	NRAO	12m	Jew89		N
205096.78	*(7)	CH_3OCH_3	4(4,1) – 4(3,2) EE	[b]	OriMC-1	NRAO	12m	Jew89		N
205118.20	*(48)	CH_3OCH_3	15(4,12) – 15(3,13) EE	0.61	OriMC-1	NRAO	12m	Jew89		N
205736.52	*(3)	CH_3CH_2CN	23(5,18) – 23(4,19)	0.07	OriMC-1	NRAO	12m	Tur85		N
206131.627	*(6)	$H_2{}^{13}CO$	3(1,2) – 2(1,2)	3.00	OriMC-1	FCRAO	14m	Eri84c		
206176.015	*(40)	SO	4(5) – 3(4)	9.00	OriMC-1	FCRAO	14m	Eri84c		
208700.338	*(11)	SO_2	3(2,2) – 2(1,1)	0.5	rho Oph A	MMWO	4.9m	Lor84a		
209230.221	*(26)	HC_3N	23 – 22	0.7	OriMC-1	MMWO	4.9m	Lor81		
211013.011	*(36)	^{34}SO	5(5) – 4(4)	0.45	OriMC-1	MMWO	4.9m	Tha84a		
211211.452	*(9)	H_2CO	3(1,3) – 2(1,2)	1.9	rho Oph B	MMWO	4.9m	Lor83		
211804.	*(1)	CH_3OH	16(2) – 15(1) A –	0.6	OriMC-1	OVRO	10.4m	Sut85	Sut88	N
213159.21	(10)	CH_3OH	20(–4) – 19(–5) E	0.5	OriMC-1	OVRO	10.4m	Sut85	Sas84	N
213293.594	*(29)	$H_2{}^{13}CO$	3(2,1) – 2(2,0)	<0.5	OriMC-1	BTL	7m	Tha81		
213360.55	(8)	HCS^+	5 – 4	0.6	OriMC-1	BTL	7m	Tha81	Bog84	
U213376.		unidentified	($H_2{}^{34}S$?)	0.7	OriMC-1	BTL	7m	Tha81		
213379.	*(1)	CH_3OH	13(6) – 14(5) E	0.6	OriMC-1	OVRO	10.4m	Sut85	Sut88	N
213427.117	*(40)	CH_3OH	1(1) – 0(0) E	5.4	OriMC-1	OVRO	10.4m	Sut85	And90	N
214088.570	*(69)	SiO	5 – 4 v = 2	110.[e]	VX Sgr	MMWO	4.9m	Cle83		
214509.66	*(16)	$Si^{13}CC$	9(1,8) – 8(1,7)	0.7[f]	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
214778.432	*(8)	$H_2C^{18}O$	3(1,2) – 2(1,1)	0.19	OriMC-1	MWO	4.9m	Man90		N
U214783.		unidentified	(CH_3CCCN 52 – 51 ?)	0.10	OriMC-1	MWO	4.9m	Man90		N
214790.761	(18)	HNCO	47(0,47) – 46(1,46)	[b]	OriMC-1	MWO	4.9m	Man90	Hoc75	N
214790.81	*(13)	$HCOOCH_3$	4(4,0) – 3(2,1) A	[b]	OriMC-1	MWO	4.9m	Man90		N
214792.48	*(5)	$HCOOCH_3$	18(3,16 – 17(3,15) A	0.20[b]	OriMC-1	MWO	4.9m	Man90	Plu84	N
215039.723	*(14)	CH_3CH_2CN	24(9,16) – 23(9,15)	1.1[b]	OriMC-1	OVRO	10.4m	Sut85		
215039.723	*(14)	CH_3CH_2CN	24(9,15) – 23(9,14)	[b]	OriMC-1	OVRO	10.4m	Sut85		
215041.89	*(2)	CH_3CH_2CN	24(10,14) – 23(10,13)	[b]	OriMC-1	OVRO	10.4m	Sut85		
215041.89	*(2)	CH_3CH_2CN	24(10,15) – 23(10,14)	[b]	OriMC-1	OVRO	10.4m	Sut85		
215058.02	*(1)	CH_3CH_2CN	24(3,22) – 23(3,21)	1.4[b]	OriMC-1	OVRO	10.4m	Sut85		
215058.58	*(1)	CH_3CH_2CN	24(8,17) – 23(8,16)	[b]	OriMC-1	OVRO	10.4m	Sut85		
215058.58	*(1)	CH_3CH_2CN	24(8,16) – 23(8,15)	[b]	OriMC-1	OVRO	10.4m	Sut85		
215059.23	*(2)	CH_3CH_2CN	24(11,13) – 23(11,12)	[b]	OriMC-1	OVRO	10.4m	Sut85		
215059.23	*(2)	CH_3CH_2CN	24(11,14) – 23(11,13)	[b]	OriMC-1	OVRO	10.4m	Sut85		
215088.23	*(2)	CH_3CH_2CN	24(12,13) – 23(12,12)	0.6[b]	OriMC-1	OVRO	10.4m	Sut85		
215088.23	*(2)	CH_3CH_2CN	24(12,12) – 23(12,11)	[b]	OriMC-1	OVRO	10.4m	Sut85		
215109.05	*(1)	CH_3CH_2CN	24(7,18) – 23(7,17)	1.2[b]	OriMC-1	OVRO	10.4m	Sut85		
215109.05	*(1)	CH_3CH_2CN	24(7,17) – 23(7,16)	[b]	OriMC-1	OVRO	10.4m	Sut85		
215119.22	*(2)	CH_3CH_2CN	25(0,25) – 24(0.24)	1.1	OriMC-1	OVRO	10.4m	Sut85		
215126.72	*(2)	CH_3CH_2CN	24(13,12) – 23(13,11)	0.5[b]	OriMC-1	OVRO	10.4m	Sut85		
215126.72	*(2)	CH_3CH_2CN	24(13,11) – 23(13,10)	[b]	OriMC-1	OVRO	10.4m	Sut85		
215173.25	*(2)	CH_3CH_2CN	24(14,11) – 23(14,10)	0.3[b]	OriMC-1	OVRO	10.4m	Sut85		
215173.25	*(2)	CH_3CH_2CN	24(14,10) – 23(14,9)	[b]	OriMC-1	OVRO	10.4m	Sut85		
215211.53	*(1)	CH_3CH_2CN	24(6,19) – 23(6,18)	[b]	OriMC-1	OVRO	10.4m	Sut85		
215212.47	*(1)	CH_3CH_2CN	24(6,18) – 23(6,17)	[b]	OriMC-1	OVRO	10.4m	Sut85		
215220.649	*(36)	SO	5(5) – 4(4)	3.0	OriMC-1	MMWO	4.9m	Cle84		
215302.23	(5)	CH_3OH	6(1) – 7(2) A + $\nu_7 = 1$	1.3	OriMC-1	OVRO	10.4m	Sut85	Sas84	
215400.81	*(1)	CH_3CH_2CN	24(5,20) – 23(5,19)	0.8	OriMC-1	OVRO	10.4m	Sut85		
215427.98	*(1)	CH_3CH_2CN	24(5,19) – 23(5,18)	1.0	OriMC-1	OVRO	10.4m	Sut85		
215596.040	*(55)	SiO	5 – 4 v = 1	150.[e]	VX Sgr	MMWO	4.9m	Cle83		
215620.19	*(1)	CH_3CH_2CN	24(4,21) – 23(4,20)	0.6	OriMC-1	OVRO	10.4m	Sut85		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
215839.903*(38)		^{34}SO	6(5) – 5(4)	0.50	OriMC-1	MMWO	4.9m	Sne84a		
215886.963 (5)		$^{13}CH_3OH$	4(2) – 3(1) E	0.9	OriMC-1	OVRO	10.4m	Sut85	And87	M
215965.59 *(2)		CH_3CH_2CN	25(1,25) – 24(0,24)	0.3	OriMC-1	OVRO	10.4m	Sut85		
215999.78 *(12)		$^{34}SO_2$	14(3,11) – 14(2,12)	0.7	OriMC-1	OVRO	10.4m	Sut85		
216077.20 *(1)		CH_3CH_2CN	24(4,20) – 23(4,19)	0.7	OriMC-1	OVRO	10.4m	Sut85		
216109.73 *(3)		$HCOOCH_3$	19(2,18) – 18(2,17) E	0.9	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
216112.623*(29)		DCO^+	3 – 2	2.5	p-Oph	MMWO	4.9m	Lor82		
216115.48 *(10)		$HCOOCH_3$	19(2,18) – 18(2,17) A	1.1	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
216210.86 *(3)		$HCOOCH_3$	19(1,16) – 18(1,17) E	0.8	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
216216.45 *(10)		$HCOOCH_3$	19(1,16) – 18(1,17) A	0.9	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
216278.730*(11)		C_3H_2	3(3,0) – 2(2,1)	3.4	TMC-1	FCRAO	14m	Mad86a		N
216373.32 (2)		DC_2D	1 – 0 J = 7/2 – 5/2 F = 9/2 – 7/2	0.27[b]	OriMC-1	MMWO	4.9m	Com85	Vrt85	M
216373.32 (2)		DC_2D	1 – 0 J = 7/2 – 5/2 F = 7/2 – 5/2	[b]	OriMC-1	MMWO	4.9m	Com85	Vrt85	M
216568.618*(43)		H_2CO	9(1,8) – 9(1,9)	1.3	OriMC-1	OVRO	10.4m	Sut85		
216643.329*(46)		SO_2	22(2,20) – 22(1,21)	0.3	OriMC-1	MMWO	4.9m	Lor84a		
216710.437*(2)		H_2S	2(2,0) – 2(1,1)	0.32	OriMC-1	MMWO	4.9m	Lor84a	Hui71	
216752.552*(10)		CH_3CH_2CN	26(1,25) – 25(2,24)	0.17	OriMC-1	MMWO	4.9m	Lor84a		
216757.32 *(46)		SiS	12 – 11 v = 1	0.046	IRC+10216	NRAO	12m	Tur87a		N
216830.15 *(3)		$HCOOCH_3$	18(2,16) – 17(2,15) E	1.2	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
216838.81 *(10)		$HCOOCH_3$	18(2,16) – 17(2,15) A	1.1	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
216936.68 *(4)		CH_2CHCN	23(2,22) – 22(2,21)	0.6	OriMC-1	OVRO	10.4m	Sut85		
216945.60 (5)		CH_3OH	4(2) – 5(1) E	3.1	OriMC-1	OVRO	10.4m	Sut85	Sas84	
216964.79 *(3)		$HCOOCH_3$	20(1,20) – 19(1,19) E	2.0[b]	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
216965.88 *(5)		$HCOOCH_3$	20(1,20) – 19(1,19) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
216966.2 *(1)		$HCOOCH_3$	20(0,20) – 19(0,19) E	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
216967.33 *(5)		$HCOOCH_3$	20(0,20) – 19(0,19) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
217104.935*(53)		SiO	5 – 4 v = 0	1.6	OriMC-1	MMWO	4.9m	Lor84a		
217238.531*(10)		DCN	3 – 2	0.7	OriMC-1	NRAO	11m	Phi74		
217299.202 (50)		CH_3OH	6(1) – 7(2) A –	1.2	OriMC-1	OVRO	10.4m	Sut85	Her84	N
217301.07 *(11)		$HCOOCH_3$	7(3,5) – 6(1,6) A	0.1	Sgr B2(OH)	IRAM	30m	Ger89		N
217817.32 *(46)		SiS	12 – 11	0.66	IRC+10216	MMWO	4.9m	Sah84		
217822.036*(12)		C_3H_2	6(0,6) – 5(1,5)	0.23[b]	OriMC-1	MMWO	4.9m	Lor84	Vrt87	M
217822.258*(12)		C_3H_2	6(1,6) – 5(0,5)	[b]	OriMC-1	MMWO	4.9m	Lor84	Vrt87	M
217827.14 *(11)		^{33}SO	6(5) – 5(4) F = 9/2 – 7/2	[b]	OriMC-1	MMWO	4.9m	Lor84		
217829.806*(54)		^{33}SO	6(5) – 5(4) F = 11/2 – 9/2	[b]	OriMC-1	MMWO	4.9m	Lor84		
217831.762*(54)		^{33}SO	6(5) – 5(4) F = 13/2 – 11/2	0.15[b]	OriMC-1	MMWO	4.9m	Lor84		
217832.67 *(11)		^{33}SO	6(5) – 5(4) F = 15/2 – 13/2	[b]	OriMC-1	MMWO	4.9m	Lor84		
217886.6 (1)		CH_3OH	20(1) – 20(0) E	0.9	OriMC-1	OVRO	10.4m	Sut85	Sut85	M
218198.998 (30)		$O^{13}CS$	18 – 17	0.5	OriMC-1	OVRO	10.4m	Sut85	Dub80	
218222.191*(13)		H_2CO	3(0,3) – 2(0,2)	4.0	OriMC-1	MMWO	4.9m	Lor84b		
218280.85 *(3)		$HCOOCH_3$	17(3,14) – 16(3,13) E	1.0	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
218297.81 *(10)		$HCOOCH_3$	17(3,14) – 16(3,13) A	1.2	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
218324.744*(35)		HC_3N	24 – 23	0.9	OriMC-1	MMWO	4.9m	Lor81		
218390.01 *(2)		CH_3CH_2CN	24(3,21) – 23(3,20)	0.8	OriMC-1	OVRO	10.4m	Sut85		
218398.50 *(9)		CH_2CHCN	23(7,17) – 22(7,16)	[b]	OriMC-1	OVRO	10.4m	Sut85		
218398.50 *(9)		CH_2CHCN	23(7,16) – 22(7,15)	[b]	OriMC-1	OVRO	10.4m	Sut85		
218402.39 *(7)		CH_2CHCN	23(6,18) – 22(6,17)	[b]	OriMC-1	OVRO	10.4m	Sut85		
218402.40 *(7)		CH_2CHCN	23(6,17) – 22(6,16)	0.4[b]	OriMC-1	OVRO	10.4m	Sut85		
218421.73 *(11)		CH_2CHCN	23(8,16) – 22(8,15)	0.3[b]	OriMC-1	OVRO	10.4m	Sut85		
218421.73 *(11)		CH_2CHCN	23(8,15) – 22(8,14)	[b]	OriMC-1	OVRO	10.4m	Sut85		
218440.05 (5)		CH_3OH	4(2) – 3(1) E	1.7	OriMC-1	MMWO	4.9m	Lor84b	Sas84	
218451.25 *(6)		CH_2CHCN	23(5,19) – 22(5,18)	0.2[b]	OriMC-1	OVRO	10.4m	Sut85		
218452.31 *(6)		CH_2CHCN	23(5,18) – 22(5,17)	[b]	OriMC-1	OVRO	10.4m	Sut85		
218475.639*(13)		H_2CO	3(2,2) – 2(2,1)	1.8	OriMC-1	MMWO	4.9m	Lor84b		
218507.1 (10)		$^{29}SiC_2$	9(2,7) – 8(2,6)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
218573.60 *(5)		CH_2CHCN	23(4,20) – 22(4,19)	0.3	OriMC-1	OVRO	10.4m	Sut85		
218585.03 *(5)		CH_2CHCN	23(3,21) – 22(3,20)	0.3	OriMC-1	OVRO	10.4m	Sut85		
218615.05 *(5)		CH_2CHCN	23(4,19) – 22(4,18)	0.2	OriMC-1	OVRO	10.4m	Sut85		
218760.068*(13)		H_2CO	3(2,1) – 2(2,0)	1.5	OriMC-1	MMWO	4.9m	Lor84a		
218837.00 *(6)		C_4H	23 – 22 J = 47/2 – 45/2	0.06	IRC+10216	MMWO	4.9m	Lor84a		
218860.629*(58)		HC_3N	24 – 23 v_7 = 1 ℓ = 1e	0.6	OriMC-1	OVRO	10.4m	Sut85		
218875.36 *(6)		C_4H	23 – 22 J = 45/2 – 43/2	0.06	IRC+10216	MMWO	4.9m	Lor84a		
218903.357 (3)		OCS	18 – 17	2.8	OriMC-1	BTL	7m	Gol81	Dub80	
218981.019*(12)		HNCO	10(1,10) – 9(1,9)	0.24	OriMC-1	MMWO	4.9m	Arm84a		
U 219002.		unidentified		0.1[u]	OriMC-1	MMWO	4.9m	Arm84a		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
219173.582	*(58)	HC_3N	24 – 23 v_7=1 ℓ=1f	0.6	OriMC-1	OVRO	10.4m	Sut85		
219276.00	*(5)	SO_2	22(7,15) – 23(6,16)	0.3	OriMC-1	OVRO	10.4m	Sut85		
219335.07	*(10)	$^{34}SO_2$	11(1,11) – 10(0,10)	1.3	OriMC-1	OVRO	10.4m	Sut85		
219400.54	*(5)	CH_2CHCN	23(3,20) – 22(3,19)	0.3	OriMC-1	OVRO	10.4m	Sut85		
219463.63	*(2)	CH_3CH_2CN	22(2,21) – 21(1,20)	0.3	OriMC-1	OVRO	10.4m	Sut85		
219505.59	*(2)	CH_3CH_2CN	24(2,22) – 23(2,21)	0.9	OriMC-1	OVRO	10.4m	Sut85		
219547.105	*(11)	HNCO	10(4,7) – 9(4,6)	0.4[b]	OriMC-1	OVRO	10.4m	Sut85		
219547.105	*(11)	HNCO	10(4,6) – 9(4,5)	[b]	OriMC-1	OVRO	10.4m	Sut85		
219560.319	*(46)	$C^{18}O$	2 – 1	3.5	DR 21	NRAO	11m	Phi77		
219656.805	*(11)	HNCO	10(3,8) – 9(3,7)	0.4[b]	OriMC-1	OVRO	10.4m	Sut85		
219656.805	*(11)	HNCO	10(3,7) – 9(3,6)	[b]	OriMC-1	OVRO	10.4m	Sut85		
219733.824	*(11)	HNCO	10(2,9) – 9(2,8)	0.6	OriMC-1	OVRO	10.4m	Sut85		
219737.175	*(13)	HNCO	10(2,8) – 9(2,7)	0.8	OriMC-1	OVRO	10.4m	Sut85		
U 219767.8		unidentified		0.15	IRC+10216	NRAO	12m	Tur87a		N
219798.282	*(8)	HNCO	10(0,10) – 9(0,9)	0.3	OriMC-1	MMWO	4.9m	Arm84		
219908.489	*(6)	$H_2{}^{13}CO$	3(1,2) – 2(1,1)	0.5	OriMC-1	MMWO	4.9m	Arm84a		
219949.391	*(38)	SO	6(5) – 5(4)	4.3	OriMC-1	MMWO	4.9m	Lor84a		
220037.96	*(1)	HCOOH	10(0,10) – 9(0,9)	0.3	OriMC-1	OVRO	10.4m	Sut85		
220078.6	(1)	CH_3OH	7(1) – 8(0) E	6.1	OriMC-1	OVRO	10.4m	Sut85	Sas84	
220166.85	*(3)	$HCOOCH_3$	17(4,13) – 16(4,12) E	1.3	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
220177.52	*(18)	CH_2CO	11(1,11) – 10(1,10)	1.0	OriMC-1	OVRO	10.4m	Sut85		
220190.20	*(10)	$HCOOCH_3$	17(4,13) – 16(4,12) A	1.3	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
220398.686	*(23)	^{13}CO	2 – 1	17.	OriMC-1	NRAO	11m	Phi77		
220475.812	*(10)	CH_3CN	12(8) – 11(8)	0.5	OriMC-1	OVRO	10.4m	Sut85		M
220539.329	*(7)	CH_3CN	12(7) – 11(7)	0.10	OriMC-1	MMWO	4.9m	Lor84		M
220561.33	*(7)	CH_2CHCN	24(1,24) – 23(1,23)	0.4	OriMC-1	OVRO	10.4m	Sut85		
220584.762	*(12)	HNCO	10(1,9) – 9(1,8)	0.13	OriMC-1	MMWO	4.9m	Lor84		
220594.428	*(5)	CH_3CN	12(6) – 11(6)	0.23	OriMC-1	MMWO	4.9m	Lor84		M
220599.94	*(14)	$CH_3{}^{13}CN$	12(3) – 11(3)	[b]	OriMC-1	OVRO	10.4m	Sut85		
220621.08	*(15)	$CH_3{}^{13}CN$	12(2) – 11(2)	0.5	OriMC-1	OVRO	10.4m	Sut85		
220633.77	*(16)	$CH_3{}^{13}CN$	12(1) – 11(1)	0.5[b]	OriMC-1	OVRO	10.4m	Sut85		
220641.089	*(4)	CH_3CN	12(5) – 11(5)	0.29	OriMC-1	MMWO	4.9m	Lor84		M
220660.91	*(2)	CH_3CH_2CN	25(2,24) – 24(2,23)	0.7	OriMC-1	OVRO	10.4m	Sut85		
U 220664.5		unidentified		0.14	OriMC-1	MMWO	4.9m	Lor84		
220679.296	*(4)	CH_3CN	12(4) – 11(4)	0.37	OriMC-1	MMWO	4.9m	Lor84		M
220709.025	*(3)	CH_3CN	12(3) – 11(3)	0.80	OriMC-1	MMWO	4.9m	Lor84		M
220730.268	*(3)	CH_3CN	12(2) – 11(2)	0.67	OriMC-1	MMWO	4.9m	Lor84		M
220743.018	*(3)	CH_3CN	12(1) – 11(1)	0.84	OriMC-1	MMWO	4.9m	Lor84		M
220747.268	*(3)	CH_3CN	12(0) – 11(0)	0.99	OriMC-1	MMWO	4.9m	Lor84		M
U 220792.5		unidentified		0.17[u]	OriMC-1	MMWO	4.9m	Lor84		
220811.69	*(3)	$HCOOCH_3$	18(3,16) – 17(2,15) E	0.4	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
220815.19	*(10)	$HCOOCH_3$	18(3,16) – 17(2,15) A	0.4	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
220889.02	*(10)	$HCOOCH_3$	18(17,2) – 17(17,1) A	0.4[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
220889.02	*(10)	$HCOOCH_3$	18(17,1) – 17(17,0) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
220926.20	*(10)	$HCOOCH_3$	18(16,3) – 17(16,2) A	0.5[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
220926.20	*(10)	$HCOOCH_3$	18(16,2) – 17(16,1) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
220977.84	*(10)	$HCOOCH_3$	18(15,3) – 17(15,2) A	0.5[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
220977.84	*(10)	$HCOOCH_3$	18(15,4) – 17(15,3) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
221047.67	*(10)	$HCOOCH_3$	18(14,4) – 17(14,3) A	0.5[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
221047.67	*(10)	$HCOOCH_3$	18(14,5) – 17(14,4) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
221049.47	*(6)	$HCOOCH_3$	18(14,4) – 17(14,3) E	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
221067.34	*(6)	$HCOOCH_3$	18(14,5) – 17(14,4) E	0.3	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
221123.82	*(4)	CH_2CHCN	23(1,22) – 22(1,21)	0.4	OriMC-1	OVRO	10.4m	Sut85		
221139.35	*(5)	$HCOOCH_3$	18(13,5) – 17(13,4) E	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
221141.02	*(10)	$HCOOCH_3$	18(13,6) – 17(13,5) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
221141.02	*(10)	$HCOOCH_3$	18(13,5) – 17(13,4) A	0.7[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
221158.84	*(5)	$HCOOCH_3$	18(13,6) – 17(13,5) E	0.2	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
221198.962	*(90)	CH_3CN	12(1) – 11(1) v_8=1 ℓ=1	0.7	OriMC-1	OVRO	10.4m	Sut85		
221252.388	*(83)	CH_3CN	12(5) – 11(5) v_8=1 ℓ=-1	0.3	OriMC-1	OVRO	10.4m	Sut85		
221260.50	*(4)	$HCOOCH_3$	18(12,6) – 17(12,5) E	0.4	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
221265.59	*(10)	$HCOOCH_3$	18(12,7) – 17(12,6) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
221265.59	*(10)	$HCOOCH_3$	18(12,6) – 17(12,5) A	0.6[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
221281.09	*(4)	$HCOOCH_3$	18(12,7) – 17(12,6) E	0.4	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
221299.576	*(80)	CH_3CN	12(4) – 11(4) v_8=1 ℓ=-1	0.2	OriMC-1	OVRO	10.4m	Sut85		
221311.925	*(78)	CH_3CN	12(6) – 11(6) v_8=1 ℓ=1	0.2	OriMC-1	OVRO	10.4m	Sut85		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
221338.038*(90)		CH_3CN	12(3)−11(3) $\nu_8=1$ $\ell=-1$	0.3	OriMC-1	OVRO	10.4m	Sut85		
221350.329*(81)		CH_3CN	12(5)−11(5) $\nu_8=1$ $\ell-1$	0.2	OriMC-1	OVRO	10.4m	Sut85		
221367.512*(90)		CH_3CN	12(2)−11(2) $\nu_8=1$ $\ell=-1$	0.6	OriMC-1	OVRO	10.4m	Sut85		
221380.61 *(10)		CH_3CN	12(4)−11(4) $\nu_8=1$ $\ell=1$	0.6	OriMC-1	OVRO	10.4m	Sut85		
221387.33 *(10)		CH_3CN	12(1)−11(1) $\nu_8=1$ $\ell=-1$	0.4	OriMC-1	OVRO	10.4m	Sut85		
221394.13 *(15)		CH_3CN	12(0)−11(0) $\nu_8=1$ $\ell=1$	0.5	OriMC-1	OVRO	10.4m	Sut85		
221403.51 *(11)		CH_3CN	12(3)−11(3) $\nu_8=1$ $\ell=1$	0.3	OriMC-1	OVRO	10.4m	Sut85		
221422.34 *(16)		CH_3CN	12(2)−11(2) $\nu_8=1$ $\ell=1$	0.3[b]	OriMC-1	OVRO	10.4m	Sut85		
221424.52 *(4)		$HCOOCH_3$	18(11,7)−17(11,6) E	0.8	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
221432.95 *(10)		$HCOOCH_3$	18(11,8)−17(11,7) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
221432.95 *(10)		$HCOOCH_3$	18(11,7)−17(11,6) A	0.9[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
221445.70 *(4)		$HCOOCH_3$	18(11,8)−17(11,7) E	0.6	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
221626.04 *(9)		CH_3CN	12(1)−11(1) $\nu_8=1$ $\ell=1$	0.4	OriMC-1	OVRO	10.4m	Sut85		
221649.39 *(4)		$HCOOCH_3$	18(10,8)−17(10,7) E	0.5	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
221660.46 *(3)		$HCOOCH_3$	18(4,15)−17(4,14) E	1.5[b]	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
221661.06 *(10)		$HCOOCH_3$	18(10,8)−17(10,7) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
221661.06 *(10)		$HCOOCH_3$	18(10,9)−17(10,8) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
221670.71 *(4)		$HCOOCH_3$	18(10,9)−17(10,8) E	0.4	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
221674.62 *(10)		$HCOOCH_3$	18(4,15)−17(4,14) A	0.8	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
221735.67 *(12)		$^{34}SO_2$	13(2,12)−13(1,13)	1.0	OriMC-1	OVRO	10.4m	Sut85		
221765.98 *(6)		CH_2CHCN	24(0,24)−23(0,23)	0.4	OriMC-1	OVRO	10.4m	Sut85		
221965.21 *(2)		SO_2	11(1,11)−10(0,10)	13.9	OriMC-1	OVRO	10.4m	Sut85		
222009.37 *(5)		SiC_2	9(2,7)−8(2,6)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
222099.152*(10)		CH_3CCH	13(4)−12(4)	0.2	OriMC-1	OVRO	10.4m	Sut85		
222128.814*(6)		CH_3CCH	13(3)−12(3)	0.13	OriMC-1	MMWO	4.9m	Lor84d		
222150.009*(3)		CH_3CCH	13(2)−12(2)	0.30	OriMC-1	MMWO	4.9m	Lor84d		
222153.45 *(5)		CH_2CHCN	23(2,21)−22(2,20)	0.4	OriMC-1	OVRO	10.4m	Sut85		
222162.729*(2)		CH_3CCH	13(1)−12(1)	0.27	OriMC-1	MMWO	4.9m	Lor84d		
222166.970*(2)		CH_3CCH	13(0)−12(0)	0.41	OriMC-1	MMWO	4.9m	Lor84d		
U 222177.		unidentified		0.4	OriMC-1	OVRO	10.4m	Sut85		
222197.65 *(28)		CH_2CO	11(0,11)−10(0,10)	0.6	OriMC-1	OVRO	10.4m	Sut85		
222228.61 *(20)		CH_2CO	11(2,10)−10(2,9)	0.2	OriMC-1	OVRO	10.4m	Sut85		
222238.67 *(35)		CH_3OCH_3	4(3,2)−3(2,1) EA	0.02	OriMC-1	OVRO	10.4m	Sut85		
222247.48 *(19)		CH_3OCH_3	4(3,2)−3(2,1) AE	1.3[b]	OriMC-1	OVRO	10.4m	Sut85		
222247.60 *(21)		CH_3OCH_3	4(3,2)−3(2,1) EE	[b]	OriMC-1	OVRO	10.4m	Sut85		
222254.74 *(9)		CH_3OCH_3	4(3,2)−3(2,1) AA	1.0	OriMC-1	OVRO	10.4m	Sut85		
U 222259.		unidentified		0.6	OriMC-1	OVRO	10.4m	Sut85		
222314.40 *(20)		CH_2CO	11(2,9)−10(2,8)	0.2	OriMC-1	OVRO	10.4m	Sut85		
222329.40	(18)	$HCNH^+$	2−1	0.11	Sgr B2	MWO	4.9m	Ziu86a	Bog85a	N
222421.46 *(4)		$HCOOCH_3$	18(8,10)−17(8,9) E	1.0	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
222426.82 *(19)		CH_3OCH_3	4(3,1)−3(2,2) AE	0.3	OriMC-1	OVRO	10.4m	Sut85		
222433.96 *(10)		CH_3OCH_3	4(3,1)−3(2,2) EE	1.5[b]	OriMC-1	OVRO	10.4m	Sut85		
222434.08 *(9)		CH_3OCH_3	4(3,1)−3(2,2) AA	[b]	OriMC-1	OVRO	10.4m	Sut85		
222435.63 *(13)		CH_3OCH_3	4(3,1)−3(2,2) EA	[b]	OriMC-1	OVRO	10.4m	Sut85		
222438.23 *(10)		$HCOOCH_3$	18(8,10)−17(8,9) A	1.2[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
222440.34 *(10)		$HCOOCH_3$	18(8,11)−17(8,10) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
222442.01 *(4)		$HCOOCH_3$	18(8,10)−17(8,9) E	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
222707.22 *(2)		CH_3CH_2CN	26(0,26)−25(1,25)	0.3	OriMC-1	OVRO	10.4m	Sut85		
222722.9	(1)	CH_3OH	16(2)− 15(1) A+	0.6	OriMC-1	OVRO	10.4m	Sut85	Sut85	M
222918.17 *(2)		CH_3CH_2CN	25(1,24)−24(1,23)	0.9	OriMC-1	OVRO	10.4m	Sut85		
223037.92 *(3)		$HCOOCH_3$	19(2,17)−18(3,16) E	0.3	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
223119.20 *(10)		$HCOOCH_3$	18(7,12)−17(7,11) A	1.1	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
223124.89 *(3)		$HCOOCH_3$	18(7,12)−17(7,11) E	1.0	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
223135.13 *(3)		$HCOOCH_3$	18(7,11)−17(7,10) E	1.0	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
223162.69 *(10)		$HCOOCH_3$	18(7,11)−17(7,10) A	0.8	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
223200.13 *(24)		CH_3OCH_3	8(2,7)−7(1,6) EA	[b]	OriMC-1	OVRO	10.4m	Sut85		
223200.13 *(24)		CH_3OCH_3	8(2,7)−7(1,6) AE	[b]	OriMC-1	OVRO	10.4m	Sut85		
223202.32 *(17)		CH_3OCH_3	8(2,7)−7(1,6) EA	1.1[b]	OriMC-1	OVRO	10.4m	Sut85		
223204.51 *(11)		CH_3OCH_3	8(2,7)−7(1,6) EA	[b]	OriMC-1	OVRO	10.4m	Sut85		
223385.32 *(2)		CH_3CH_2CN	26(1,26)−25(1,25)	0.9	OriMC-1	OVRO	10.4m	Sut85		
223434.43 *(6)		SO_2	27(6,20)−28(7,21)	0.3	OriMC-1	OVRO	10.4m	Sut85		
223553.58 *(2)		CH_3CH_2CN	26(0,26)−25(0,25)	0.6	OriMC-1	OVRO	10.4m	Sut85		
223650.13 *(10)		CH_3CHO	12(1,12)−11(1,11) E	0.2	OriMC-1	OVRO	10.4m	Sut85		M
223660.57 *(10)		CH_3CHO	12(1,12)−11(1,11) A	0.3	OriMC-1	OVRO	10.4m	Sut85		M
223883.64 *(2)		SO_2	6(4,2)−7(3,5)	1.4	OriMC-1	OVRO	10.4m	Sut85		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
223915.56	*(1)	HCOOH	10(2,9) – 9(2,8)	0.3	OriMC-1	OVRO	10.4m	Sut85		
223933.73	*(2)	CH_3CH_2CN	25(3,23) – 24(3,22)	0.6	OriMC-1	OVRO	10.4m	Sut85		
224002.12	*(2)	CH_3CH_2CN	25(10,16) – 24(10,15)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224002.12	*(2)	CH_3CH_2CN	25(10,15) – 24(10,14)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224003.44	*(2)	CH_3CH_2CN	25(9,16) – 24(9,15)	0.9[b]	OriMC-1	OVRO	10.4m	Sut85		
224003.44	*(2)	CH_3CH_2CN	25(9,17) – 24(9,16)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224017.54	*(2)	CH_3CH_2CN	25(11,14) – 24(11,13)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224017.54	*(2)	CH_3CH_2CN	25(11,15) – 24(11,14)	0.6[b]	OriMC-1	OVRO	10.4m	Sut85		
224021.4	*(1)	$HCOOCH_3$	18(6,13) – 17(6,12) E	1.0[b]	OriMC-1	OVRO	10.4m	Sut85	Sut85	
224024.05	*(10)	$HCOOCH_3$	18(6,13) – 17(6,12) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
224028.14	*(2)	CH_3CH_2CN	25(6,17) – 24(6,16)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224028.14	*(2)	CH_3CH_2CN	25(6,18) – 24(6,17)	0.8[b]	OriMC-1	OVRO	10.4m	Sut85		
224045.75	*(2)	CH_3CH_2CN	25(12,14) – 24(12,13)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224045.75	*(2)	CH_3CH_2CN	25(12,13) – 24(12,12)	0.3[b]	OriMC-1	OVRO	10.4m	Sut85		
224084.28	*(2)	CH_3CH_2CN	25(13,13) – 24(13,12)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224084.28	*(2)	CH_3CH_2CN	25(13,12) – 24(13,11)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224088.19	*(2)	CH_3CH_2CN	25(7,19) – 24(7,18)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224088.23	*(2)	CH_3CH_2CN	25(7,18) – 24(7,17)	0.8[b]	OriMC-1	OVRO	10.4m	Sut85		
224131.51	*(2)	CH_3CH_2CN	25(14,11) – 24(14,10)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224131.51	*(2)	CH_3CH_2CN	25(14,12) – 24(14,11)	0.2[b]	OriMC-1	OVRO	10.4m	Sut85		
224186.35	*(2)	CH_3CH_2CN	25(15,10) – 24(15,9)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224186.35	*(2)	CH_3CH_2CN	25(15,11) – 24(15,10)	0.2[b]	OriMC-1	OVRO	10.4m	Sut85		
224206.60	*(2)	CH_3CH_2CN	25(6,20) – 24(6,19)	0.7[b]	OriMC-1	OVRO	10.4m	Sut85		
224208.08	*(2)	CH_3CH_2CN	25(6,19) – 24(6,18)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224264.90	*(3)	SO_2	20(2,16) – 19(3,17)	2.6	OriMC-1	OVRO	10.4m	Sut85		
224313.08	*(3)	$HCOOCH_3$	18(5,14) – 17(5,13) E	0.8	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
224327.21	*(18)	CH_2CO	11(1,10) – 10(1,9)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224328.25	*(10)	$HCOOCH_3$	18(5,14) – 17(5,13) A	0.8[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
224419.82	*(2)	CH_3CH_2CN	25(5,21) – 24(5,20)	0.4	OriMC-1	OVRO	10.4m	Sut85		
224458.85	*(2)	CH_3CH_2CN	25(5,20) – 24(5,19)	0.7	OriMC-1	OVRO	10.4m	Sut85		
224469.02	*(3)	CH_3CH_2CN	25(19,6) – 24(19,5)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224469.02	*(3)	CH_3CH_2CN	25(19,7) – 24(19,6)	0.3[b]	OriMC-1	OVRO	10.4m	Sut85		
U 224493.		unidentified		0.5	OriMC-1	OVRO	10.4m	Sut85		
224582.45	*(3)	$HCOOCH_3$	18(6,12) – 17(6,11) E	0.8	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
224609.31	*(10)	$HCOOCH_3$	18(6,12) – 17(6,11) A	0.8	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
224638.70	*(2)	CH_3CH_2CN	25(4,22) – 24(4,21)	0.6[b]	OriMC-1	OVRO	10.4m	Sut85		
224643.26	*(5)	CH_3CH_2CN	25(21,4) – 24(21,3)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224643.26	*(5)	CH_3CH_2CN	25(21,5) – 24(21,4)	[b]	OriMC-1	OVRO	10.4m	Sut85		
224699.4	(1)	CH_3OH	20(–2) – 19(–3) E	0.7	OriMC-1	OVRO	10.4m	Sut85	Sut85	M
224714.368	*(30)	$C^{17}O$	2 – 1	1.5	OriMC-1	OVRO	10.4m	Sut85		
U 224895.		unidentified		0.7	OriMC-1	OVRO	10.4m	Sut85		
225153.69	*(2)	SO_2	13(2,12) – 13(1,13)	6.3	OriMC-1	OVRO	10.4m	Sut85		
225236.11	*(2)	CH_3CH_2CN	25(4,21) – 24(4,20)	0.8	OriMC-1	OVRO	10.4m	Sut85		
225413.638	(30)	$OC^{34}S$	19 – 18	0.7	OriMC-1	OVRO	10.4m	Sut85	Dub80	
225512.54	*(1)	HCOOH	10(3,7) – 9(3,6)	0.4	OriMC-1	OVRO	10.4m	Sut85		
225599.14	*(15)	CH_3OCH_3	12(1,12) – 11(0,11) EE	0.7	OriMC-1	MMWO	4.9m	Woo84		
225608.78	*(3)	$HCOOCH_3$	19(3,17) – 18(3,16) E	1.1	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
225618.66	*(10)	$HCOOCH_3$	19(3,17) – 18(3,16) A	1.3	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
U 225625.		unidentified		1.0	OriMC-1	OVRO	10.4m	Sut85		
225648.70	*(10)	$HCOOCH_3$	26(9,18) – 26(8,19) A	2.3	OMC-IRc2	IRAM	30m	Jac90	Plu84	N
U 225660.6		unidentified		1.6	OMC-IRc2	IRAM	30m	Jac90		N
225697.772	*(9)	H_2CO	3(1,2) – 2(1,1)	5.0	OriMC-1	MMWO	4.9m	Eva79		
U 225726.4		unidentified		1.6	OMC-IRc2	IRAM	30m	Jac90		N
U 225744.8		unidentified		1.9	OMC-IRc2	IRAM	30m	Jac90		N
U 225756.3		unidentified		2.3	OMC-IRc2	IRAM	30m	Jac90		N
U 225767.4		unidentified		0.8	OMC-IRc2	IRAM	30m	Jac90		N
U 225781.6		unidentified		1.2	OMC-IRc2	IRAM	30m	Jac90		N
U 225784.6		unidentified		0.6	OMC-IRc2	IRAM	30m	Jac90		N
U 225803.1		unidentified		1.3	OMC-IRc2	IRAM	30m	Jac90		N
225824.33	*(6)	HCOOH	31(3,28) – 31(3,29)	1.8	OMC-IRc2	IRAM	30m	Jac90		N
U 225840.8		unidentified		0.7	OMC-IRc2	IRAM	30m	Jac90		N
U 225850.8		unidentified		1.4	OMC-IRc2	IRAM	30m	Jac90		N
225853.841	*(1)	$D^{15}NC$	3 – 2	1.9	OMC-IRc2	IRAM	30m	Jac90		N
225896.720	(38)	HDO	3(1,2) – 2(2,1)	2.3	OriMC-1	OVRO	10.4m	Sut85	DeL71	
U 225915.8		unidentified		0.7	OMC-IRc2	IRAM	30m	Jac90		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
225928.56	*(10)	$HCOOCH_3$	6(6,1) – 5(5,0) A	0.4[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
225928.59	*(10)	$HCOOCH_3$	6(6,0) – 5(5,1) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
U225934.6		unidentified		0.9	OMC-IRc2	IRAM	30m	Jac90		N
U225944.6		unidentified		0.6	OMC-IRc2	IRAM	30m	Jac90		N
U226035.6		unidentified		1.0	OMC-IRc2	IRAM	30m	Jac90		N
U226043.3		unidentified		1.1	OMC-IRc2	IRAM	30m	Jac90		N
U226058.4		unidentified		0.7	OMC-IRc2	IRAM	30m	Jac90		N
U226072.4		unidentified		1.7	OMC-IRc2	IRAM	30m	Jac90		N
226078.0	*(6)	$HCOOCH_3$	10(3,7) – 9(1,8) E	0.6	OMC-IRc2	IRAM	30m	Jac90		N
U226090.2		unidentified		2.0	OMC-IRc2	IRAM	30m	Jac90		N
226094.6	*(2)	$HCOOCH_3$	5(4,1) – 4(2,2) A	0.9	OMC-IRc2	IRAM	30m	Jac90		N
226125.6	*(2)	$HCOOCH_3$	10(3,7) – 9(1,8) A	0.9	OMC-IRc2	IRAM	30m	Jac90		N
226256.83	*(5)	CH_2CHCN	24(2,23) – 23(2,22)	0.2	OriMC-1	OVRO	10.4m	Sut85		
226300.00	*(4)	SO_2	14(3,11) – 14(2,12)	5.8	OriMC-1	OVRO	10.4m	Sut85		
226332.519	*(20)	CN	2 – 1 J = 3/2 – 3/2 F = 3/2 – 5/2	0.3	OriMC-1	OVRO	10.4m	Sut85	Woo82	
226341.919	*(20)	CN	2 – 1 J = 3/2 – 3/2 F = 5/2 – 3/2	0.3	OriMC-1	OVRO	10.4m	Sut85	Woo82	
226346.00	*(13)	CH_3OCH_3	14(1,13) – 13(2,12) AA	[b]	OriMC-1	OVRO	10.4m	Sut85		
226346.89	*(25)	CH_3OCH_3	14(1,13) – 13(2,12) EE	1.6[b]	OriMC-1	OVRO	10.4m	Sut85		
226347.78	*(37)	CH_3OCH_3	14(1,13) – 13(2,12) AE	[b]	OriMC-1	OVRO	10.4m	Sut85		
226347.78	*(37)	CH_3OCH_3	14(1,13) – 13(2,12) EA	[b]	OriMC-1	OVRO	10.4m	Sut85		
226359.987	*(20)	CN	2 – 1 J = 3/2 – 3/2 F = 5/2 – 5/2	1.2	OriMC-1	OVRO	10.4m	Sut85	Woo82	
U226384.		unidentified		0.5	OriMC-1	OVRO	10.4m	Sut85		
U226436.		unidentified		0.4	OriMC-1	OVRO	10.4m	Sut85		
226538.674	(50)	CH_3OD	5(0) – 4(0) A	4.6[f]	OriMC-1	IRAM	30m	Mau88	And88	N
226551.59	(5)	CH_3CHO	12(0,12) – 11(0,11) E	0.3	OriMC-1	OVRO	10.4m	Sut85	Lia86	M
226592.71	(5)	CH_3CHO	12(0,12) – 11(0,11) A	0.2	OriMC-1	OVRO	10.4m	Sut85	Lia86	M
226616.520	*(20)	CN	2 – 1 J = 3/2 – 1/2 F = 1/2 – 3/2	0.2	OriMC-1	OVRO	10.4m	Sut85	Ska83	
226632.176	*(20)	CN	2 – 1 J = 3/2 – 1/2 F = 3/2 – 3/2	1.4	OriMC-1	OVRO	10.4m	Sut85	Ska83	
226659.543	*(20)	CN	2 – 1 J = 3/2 – 1/2 F = 5/2 – 3/2	4.3	OriMC-1	OVRO	10.4m	Sut85	Ska83	
226663.685	*(20)	CN	2 – 1 J = 3/2 – 1/2 F = 1/2 – 1/2	1.5	OriMC-1	OVRO	10.4m	Sut85	Ska83	
226679.341	*(20)	CN	2 – 1 J = 3/2 – 1/2 F = 3/2 – 1/2	1.9	OriMC-1	OVRO	10.4m	Sut85	Ska83	
226706.601	(50)	CH_3OD	5(2) – 4(2) A–	3.7[f]	OriMC-1	IRAM	30m	Mau88	And88	N
226713.04	*(3)	$HCOOCH_3$	20(2,19) – 19(2,18) E	0.9	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
226718.70	*(5)	$HCOOCH_3$	20(2,19) – 19(2,18) A	0.5	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
226738.864	(50)	CH_3OD	5(–4) – 4(–4) E	1.4[f]	OriMC-1	IRAM	30m	Mau88	And88	N
226773.17	*(3)	$HCOOCH_3$	20(1,19) – 19(1,18) E	0.9	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
226778.70	*(5)	$HCOOCH_3$	20(1,19) – 19(1,18) A	1.0	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
226856.81	*(3)	$HCOOCH_3$	20(2,19) – 19(1,18) E	0.5	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
226862.19	*(10)	$HCOOCH_3$	20(2,19) – 19(1,18) A	0.6	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
226874.183	*(20)	CN	2 – 1 J = 5/2 – 3/2 F = 5/2 – 3/2	[b]	OriMC-1	OVRO	10.4m	Woo82	Ska83	
226874.764	*(20)	CN	2 – 1 J = 5/2 – 3/2 F = 7/2 – 5/2	8.0[b]	OriMC-1	OVRO	10.4m	Woo82	Ska83	
226875.896	*(20)	CN	2 – 1 J = 5/2 – 3/2 F = 3/2 – 1/2	[b]	OriMC-1	OVRO	10.4m	Woo82	Ska83	
226887.399	*(20)	CN	2 – 1 J = 5/2 – 3/2 F = 3/2 – 3/2	1.0	OriMC-1	OVRO	10.4m	Woo82	Ska83	
226892.151	*(20)	CN	2 – 1 J = 5/2 – 3/2 F = 5/2 – 5/2	1.0	OriMC-1	OVRO	10.4m	Woo82	Ska83	
226922.584	(50)	CH_3OD	5(–2) – 4(–2) E	1.0[f]	OriMC-1	IRAM	30m	Mau88	And88	N
226942.830	(50)	CH_3OD	5(3) – 4(2) A+	1.2[f]	OriMC-1	IRAM	30m	Mau88	And88	N
227004.78	*(13)	$Si^{13}CC$	10(2,9) – 9(2,8)	0.7[f]	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
227019.49	*(3)	$HCOOCH_3$	19(2,17) – 18(2,16) E	1.0	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
227028.06	*(10)	$HCOOCH_3$	19(2,17) – 18(2,16) A	1.2	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
227031.94	*(11)	$^{34}SO_2$	12(3,9) – 12(2,10)	0.7	OriMC-1	OVRO	10.4m	Sut85		
227094.6	(1)	CH_3OH	21(1) – 20(0) E	0.9	OriMC-1	OVRO	10.4m	Sut85	Sut85	M
227418.957	*(46)	HC_3N	25 – 24	3.5	OriMC-1	OVRO	10.4m	Sut85		
227560.95	*(3)	$HCOOCH_3$	21(1,21) – 20(1,20) E	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
227561.75	*(3)	$HCOOCH_3$	21(0,21) – 20(0,20) E	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
227561.95	*(10)	$HCOOCH_3$	21(1,21) – 20(1,20) A	2.1[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
227562.77	*(10)	$HCOOCH_3$	21(0,21) – 20(0,20) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
227780.97	*(2)	CH_3CH_2CN	25(3,22) – 24(3,21)	0.5	OriMC-1	OVRO	10.4m	Sut85		
227814.5	(1)	CH_3OH	16(1) – 15(2) A+	1.4	OriMC-1	OVRO	10.4m	Sut85	Sut85	M
227897.52	*(11)	CH_2CHCN	24(7,17) – 23(7,16)	[b]	OriMC-1	OVRO	10.4m	Sut85		
227897.52	*(11)	CH_2CHCN	24(7,18) – 23(7,17)	0.5[b]	OriMC-1	OVRO	10.4m	Sut85		
227906.61	*(9)	CH_2CHCN	24(6,19) – 23(6,18)	0.5[b]	OriMC-1	OVRO	10.4m	Sut85		
227906.64	*(9)	CH_2CHCN	24(6,18) – 23(6,17)	[b]	OriMC-1	OVRO	10.4m	Sut85		
227918.54	*(13)	CH_2CHCN	24(8,17) – 23(8,16)	[b]	OriMC-1	OVRO	10.4m	Sut85		
227918.54	*(13)	CH_2CHCN	24(8,16) – 23(8,15)	0.5[b]	OriMC-1	OVRO	10.4m	Sut85		
227960.07	*(15)	CH_2CHCN	24(9,15) – 23(9,14)	[b]	OriMC-1	OVRO	10.4m	Sut85		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
227960.07	*(15)	CH_2CHCN	24(9,16) – 23(9,15)	[b]	OriMC-1	OVRO	10.4m	Sut85		
227965.97	*(7)	CH_2CHCN	24(5,20) – 23(5,19)	[b]	OriMC-1	OVRO	10.4m	Sut85		
227967.52	*(7)	CH_2CHCN	24(5,19) – 23(5,18)	0.5[b]	OriMC-1	OVRO	10.4m	Sut85		
227977.074	*(68)	HC_3N	25 – 24 $\nu_7=1$ $\ell=1e$	0.7	OriMC-1	OVRO	10.4m	Sut85		
228090.48	*(5)	CH_2CHCN	24(3,22) – 23(3,21)	0.4	OriMC-1	OVRO	10.4m	Sut85		
228104.55	*(6)	CH_2CHCN	24(4,21) – 23(4,20)	0.5	OriMC-1	OVRO	10.4m	Sut85		
228302.988	*(68)	HC_3N	25 – 24 $\nu_7=1$ $\ell=1f$	0.8	OriMC-1	OVRO	10.4m	Sut85		
228483.14	*(2)	CH_3CH_2CN	25(2,23) – 24(2,22)	0.9	OriMC-1	OVRO	10.4m	Sut85		
228544.07	*(1)	HCOOH	10(2,8) – 9(2,7)	0.4	OriMC-1	OVRO	10.4m	Sut85		
228628.82	*(3)	$HCOOCH_3$	18(5,13) – 17(5,12) E	1.2	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
228651.34	*(10)	$HCOOCH_3$	18(5,13) – 17(5,12) A	1.2	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
228797.47	*(4)	CH_3CH_2CN	14(2,12) – 13(1,13)	0.3	OriMC-1	OVRO	10.4m	Sut85		
228910.46	*(10)	DNC	3 – 2	0.23	OriMC-1	MMWO	4.9m	Lor84b		
228978.76	*(58)	CH_3OCH_3	7(7,1) – 8(6,2) EA	0.2	OriMC-1	OVRO	10.4m	Sut85		
228983.24	*(48)	CH_3OCH_3	7(7,1) – 8(6,2) EE	0.2[b]	OriMC-1	OVRO	10.4m	Sut85		
228984.83	*(48)	CH_3OCH_3	7(7,1) – 8(6,2) AE	[b]	OriMC-1	OVRO	10.4m	Sut85		
228984.83	*(48)	CH_3OCH_3	7(7,0) – 8(6,3) AE	[b]	OriMC-1	OVRO	10.4m	Sut85		
228987.74	*(37)	CH_3OCH_3	7(7,1) – 8(6,2) AA	[b]	OriMC-1	OVRO	10.4m	Sut85		
228987.74	*(37)	CH_3OCH_3	7(7,0) – 8(6,3) AA	[b]	OriMC-1	OVRO	10.4m	Sut85		
228989.33	*(40)	CH_3OCH_3	7(7,0) – 8(6,3) EE	[b]	OriMC-1	OVRO	10.4m	Sut85		
228990.91	*(44)	CH_3OCH_3	7(7,0) – 8(6,3) EA	[b]	OriMC-1	OVRO	10.4m	Sut85		
229086.99	*(5)	CH_2CHCN	24(3,21) – 23(3,20)	0.3	OriMC-1	OVRO	10.4m	Sut85		
229265.16	*(2)	CH_3CH_2CN	26(2,25) 25(2,24)	0.7	OriMC-1	OVRO	10.4m	Sut85		
229304.7	(10)	$^{29}SiC_2$	10(2,9) – 9(2,8)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
229347.73	*(3)	SO_2	11(5,7) – 12(4,8)	1.9	OriMC-1	OVRO	10.4m	Sut85		
229404.98	*(3)	$HCOOCH_3$	18(3,15) – 17(3,14) E	1.2	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
229420.30	*(10)	$HCOOCH_3$	18(3,15) – 17(3,14) A	1.3	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
229474.17	*(5)	$HCOOCH_3$	20(3,17) – 19(4,16) E	0.3	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
229504.59	*(10)	$HCOOCH_3$	20(3,17) – 19(4,16) A	0.3	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
229589.1	(1)	CH_3OH	15(4) – 16(3) E	1.3	OriMC-1	OVRO	10.4m	Sut85	Sut85	M
229647.75	*(9)	CH_2CHCN	25(1,25) – 24(1,24)	0.2	OriMC-1	OVRO	10.4m	Sut85		
229758.76	(5)	CH_3OH	8(–1) – 7(0) E	10.6	OriMC-1	OVRO	10.4m	Sut85	Sas84	
229857.66	*(11)	$^{34}SO_2$	4(2,2) – 3(1,3)	1.1	OriMC-1	OVRO	10.4m	Sut85		
229864.19	(5)	CH_3OH	19(5) – 20(4) A+	0.4	OriMC-1	OVRO	10.4m	Sut85	Sas84	
229939.18	(5)	CH_3OH	19(5) – 20(4) A–	0.5	OriMC-1	OVRO	10.4m	Sut85	Sas84	
230027.06	(5)	CH_3OH	3(–2) – 4(–1) E	5.1	OriMC-1	OVRO	10.4m	Sut85	Sas84	
U 230233.		unidentified		0.6	OriMC-1	OVRO	10.4m	Sut85		
230317.527	(30)	$O^{13}CS$	19 – 18	0.5	OriMC-1	OVRO	10.4m	Sut85	Dub80	
230368.69	(5)	CH_3OH	22(4) – 21(5) E	0.2	OriMC-1	OVRO	10.4m	Sut85	Sas84	
230465.75	*(71)	CH_3OCH_3	10(8,3) – 11(7,4) EA	[b]	OriMC-1	OVRO	10.4m	Sut85		
230467.78	*(64)	CH_3OCH_3	10(8,3) – 11(7,4) EE	0.4[b]	OriMC-1	OVRO	10.4m	Sut85		
230469.81	*(59)	CH_3OCH_3	10(8,3) – 11(7,4) AA	[b]	OriMC-1	OVRO	10.4m	Sut85		
230469.81	*(59)	CH_3OCH_3	10(8,2) – 11(7,5) AA	[b]	OriMC-1	OVRO	10.4m	Sut85		
230470.19	*(70)	CH_3OCH_3	10(8,3) – 11(7,4) AE	[b]	OriMC-1	OVRO	10.4m	Sut85		
230470.19	*(70)	CH_3OCH_3	10(8,2) – 11(7,5) AE	[b]	OriMC-1	OVRO	10.4m	Sut85		
230472.22	*(69)	CH_3OCH_3	10(8,2) – 11(7,5) EE	[b]	OriMC-1	OVRO	10.4m	Sut85		
230474.62	*(80)	CH_3OCH_3	10(8,2) – 11(7,5) EA	[b]	OriMC-1	OVRO	10.4m	Sut85		
230509.8	(15)	$^{30}SiC_2$	10(4,6) – 9(4,5)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
230538.000	(2)	CO	2 – 1	70.	OriMC-1	NRAO	11m	Phi77	Bel91a	M
230738.48	*(8)	CH_2CHCN	25(0,25) – 24(0,24)	0.4	OriMC-1	OVRO	10.4m	Sut85		
231060.991	*(2)	OCS	19 – 18	0.80	OriMC-1	FCRAO	14m	Sch84		
231199.27	*(10)	$HCOOCH_3$	21(9,12) – 21(8,13) A	0.3	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
231220.768	*(40)	^{13}CS	5 – 4	0.7	OriMC-1	MMWO	4.9m	Mun84a		
231239.06	*(10)	$HCOOCH_3$	21(9,13) – 21(8,14) A	0.4	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
231281.10	(5)	CH_3OH	10(2) – 9(3) A–	0.4	OriMC-1	MMWO	4.9m	Mun84a	Sas84	
231310.43	*(2)	CH_3CH_2CN	26(1,25) – 25(1,24)	[b]	OriMC-1	OVRO	10.4m	Sut85		
231312.30	*(2)	CH_3CH_2CN	27(0,27) – 26(1,26)	0.9[b]	OriMC-1	OVRO	10.4m	Sut85		
231313.23	*(2)	CH_3CH_2CN	24(2,23) – 23(1,22)	[b]	OriMC-1	OVRO	10.4m	Sut85		
231321.635	(50)	N_2D^+	3 – 2	0.17	rho Oph B2	MMWO	4.9m	Lor85	Sas81	
231410.21	*(22)	D_2CO	4(0,4) – 3(0,3)	0.12	OriMC-1	NRAO	12m	Tur90a		N
231505.59	*(1)	HCOOH	10(1,9) – 9(1,8)	0.8	OriMC-1	OVRO	10.4m	Sut85		
231854.21	*(2)	CH_3CH_2CN	27(1,27) – 26(1,26)	1.1	OriMC-1	OVRO	10.4m	Sut85		
231952.27	*(5)	CH_2CHCN	24(2,22) – 23(2,21)	0.3	OriMC-1	OVRO	10.4m	Sut85		
231966.91	*(10)	$HCOOCH_3$	20(9,11) – 20(8,12) A	0.4[b]	OriMC-1	NRAO	12m	Tur88b	Plu84	M
231968.42	(10)	CH_3CHO	12(3,9) – 11(3,8) A	[b]	OriMC-1	OVRO	12m	Tur87b	Lia86	N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
U231975.		unidentified		1.0	OriMC-1	NRAO	12m	Tur87b		N
231987.79	*(13)	CH_3OCH_3	13(0,13) – 12(1,12) AA	[b]	OriMC-1	OVRO	10.4m	Sut85		
231987.87	*(15)	CH_3OCH_3	13(0,13) – 12(1,12) EE	3.2[b]	OriMC-1	OVRO	10.4m	Sut85		
231987.95	*(18)	CH_3OCH_3	13(0,13) – 12(1,12) AE	[b]	OriMC-1	OVRO	10.4m	Sut85		
231987.95	*(18)	CH_3OCH_3	13(0,13) – 12(1,12) EA	[b]	OriMC-1	OVRO	10.4m	Sut85		
231990.41	*(2)	CH_3CH_2CN	27(0,27) – 26(0,26)	1.1	OriMC-1	OVRO	10.4m	Sut85		
U232008.		unidentified		0.2	OriMC-1	NRAO	12m	Tur87b		N
U232163.		unidentified		0.8	OriMC-1	OVRO	10.4m	Sut85		
232194.64	*(18)	$^{13}CH_3CN$	13(3) – 12(3)	0.7	OriMC-1	OVRO	10.4m	Sut85		
232216.43	*(18)	$^{13}CH_3CN$	13(2) – 12(2)	0.5	OriMC-1	OVRO	10.4m	Sut85		
232229.51	*(18)	$^{13}CH_3CN$	13(1) – 12(1)	0.5	OriMC-1	OVRO	10.4m	Sut85		
232233.87	*(18)	$^{13}CH_3CN$	13(0) – 12(0)	0.6	OriMC-1	OVRO	10.4m	Sut85		
232265.878	*(58)	$S^{18}O$	5(6) – 4(5)	0.3	OriMC-1	OVRO	10.4m	Sut85		
232418.59	(5)	CH_3OH	10(2) – 9(3) A+	3.9	OriMC-1	OVRO	10.4m	Sut85	Sas84	
232534.308	*(4)	SiC_2	10(2,9) – 9(2,8)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
232686.70	(5)	H_2O	5(5,0) – 6(4,3) $\nu_2=1$	2.8[f]	VY CMa	IRAM	30m	Men89	Bel87a	N
232783.50	(5)	CH_3OH	18(3) – 17(4) A+	1.4	OriMC-1	OVRO	10.4m	Sut85	Sas84	
232790.03	*(2)	CH_3CH_2CN	26(3,24) – 25(3,23)	1.1	OriMC-1	OVRO	10.4m	Sut85		
232945.	(1)	CH_3OH	10(–3) – 11(–2) E	3.0	OriMC-1	OVRO	10.4m	Sut85	Sut85	M
232962.34	*(2)	CH_3CH_2CN	26(10,17) – 25(10,16)	[b]	OriMC-1	OVRO	10.4m	Sut85		
232962.34	*(2)	CH_3CH_2CN	26(10,16) – 25(10,15)	[b]	OriMC-1	OVRO	10.4m	Sut85		
232967.58	*(2)	CH_3CH_2CN	26(9,17) – 25(9,16)	1.2[b]	OriMC-1	OVRO	10.4m	Sut85		
232967.58	*(2)	CH_3CH_2CN	26(9,18) – 25(9,17)	[b]	OriMC-1	OVRO	10.4m	Sut85		
232975.52	*(2)	CH_3CH_2CN	26(11,15) – 25(11,14)	0.8[b]	OriMC-1	OVRO	10.4m	Sut85		
232975.52	*(2)	CH_3CH_2CN	26(11,16) – 25(11,15)	[b]	OriMC-1	OVRO	10.4m	Sut85		
232998.74	*(2)	CH_3CH_2CN	26(8,18) – 25(8,17)	[b]	OriMC-1	OVRO	10.4m	Sut85		
232998.74	*(2)	CH_3CH_2CN	26(8,19) – 25(8,18)	1.1[b]	OriMC-1	OVRO	10.4m	Sut85		
233002.70	*(2)	CH_3CH_2CN	26(12,14) – 25(12,13)	[b]	OriMC-1	OVRO	10.4m	Sut85		
233002.70	*(2)	CH_3CH_2CN	26(12,15) – 25(12,14)	[b]	OriMC-1	OVRO	10.4m	Sut85		
233041.09	*(2)	CH_3CH_2CN	26(13,14) – 25(13,13)	0.4[b]	OriMC-1	OVRO	10.4m	Sut85		
233041.09	*(2)	CH_3CH_2CN	26(13,13) – 25(13,12)	[b]	OriMC-1	OVRO	10.4m	Sut85		
233069.31	*(2)	CH_3CH_2CN	26(7,19) – 25(7,18)	[b]	OriMC-1	OVRO	10.4m	Sut85		
233069.31	*(2)	CH_3CH_2CN	26(7,20) – 25(7,19)	1.0[b]	OriMC-1	OVRO	10.4m	Sut85		
233088.07	*(2)	CH_3CH_2CN	26(14,12) – 25(14,11)	0.5[b]	OriMC-1	OVRO	10.4m	Sut85		
233088.07	*(2)	CH_3CH_2CN	26(14,13) – 25(14,12)	[b]	OriMC-1	OVRO	10.4m	Sut85		
233144.82	*(2)	CH_3CH_2CN	26(15,11) – 25(15,10)	0.4[b]	OriMC-1	OVRO	10.4m	Sut85		
233144.82	*(2)	CH_3CH_2CN	26(15,12) – 25(15,11)	[b]	OriMC-1	OVRO	10.4m	Sut85		
233205.05	*(2)	CH_3CH_2CN	26(6,21) – 25(6,20)	1.5[b]	OriMC-1	OVRO	10.4m	Sut85		
233207.32	*(2)	CH_3CH_2CN	26(6,20) – 25(6,19)	[b]	OriMC-1	OVRO	10.4m	Sut85		
233208.07	*(2)	CH_3CH_2CN	26(16,10) – 25(16,9)	[b]	OriMC-1	OVRO	10.4m	Sut85		
233208.07	*(2)	CH_3CH_2CN	26(16,11) – 25(16,10)	[b]	OriMC-1	OVRO	10.4m	Sut85		
U233213.		unidentified		0.2	OriMC-1	MMWO	4.9m	Eri81		
233226.73	*(10)	$HCOOCH_3$	19(4,16) – 18(4,15) A	1.1	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
233310.00	*(10)	$HCOOCH_3$	19(15,5) – 18(15,4) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
233310.00	*(10)	$HCOOCH_3$	19(15,4) – 18(15,3) A	0.4[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
233394.55	*(10)	$HCOOCH_3$	19(14,6) – 18(14,5) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
233394.55	*(10)	$HCOOCH_3$	19(14,5) – 18(14,4) A	0.4[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
233443.09	*(2)	CH_3CH_2CN	26(5,22) – 25(5,21)	0.7	OriMC-1	OVRO	10.4m	Sut85		
233498.29	*(2)	CH_3CH_2CN	26(5,21) – 25(5,20)	0.8	OriMC-1	OVRO	10.4m	Sut85		
233506.59	*(10)	$HCOOCH_3$	19(13,7) – 18(13,6) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
233506.59	*(10)	$HCOOCH_3$	19(13,6) – 18(13,5) A	0.8[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
233523.54	*(4)	CH_3CH_2CN	26(20,7) – 25(20,6)	0.5[b]	OriMC-1	OVRO	10.4m	Sut85		
233523.54	*(4)	CH_3CH_2CN	26(20,6) – 25(20,5)	[b]	OriMC-1	OVRO	10.4m	Sut85		
233524.87	*(5)	$HCOOCH_3$	19(13,6) – 18(13,5) E	0.4	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
233627.06	*(10)	$HCOOCH_3$	17(9,8) – 17(8,9) A	0.4[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
233628.39	*(10)	$HCOOCH_3$	17(9,9) – 17(8,10) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
233649.77	*(4)	$HCOOCH_3$	19(12,7) – 18(12,6) E	0.5	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
233654.07	*(2)	CH_3CH_2CN	26(4,23) – 25(4,22)	1.1	OriMC-1	OVRO	10.4m	Sut85		
233655.27	*(10)	$HCOOCH_3$	19(12,8) – 18(12,7) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
233655.27	*(10)	$HCOOCH_3$	19(12,7) – 18(12,6) A	1.1[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
233671.08	*(4)	$HCOOCH_3$	19(12,6) – 18(12,7) E	0.3	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
233753.95	*(3)	$HCOOCH_3$	18(4,14) – 17(4,13) E	0.8	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
233777.45	*(10)	$HCOOCH_3$	18(4,14) – 17(4,13) A	0.8	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
233795.75	(5)	CH_3OH	18(3) – 17(4) A–	1.0	OriMC-1	OVRO	10.4m	Sut85	Sas84	
233845.21	*(4)	$HCOOCH_3$	19(11,8) – 18(11,7) E	0.5	OriMC-1	OVRO	10.4m	Sut85	Plu86	M

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
233854.23	*(10)	$HCOOCH_3$	19(11,9) – 18(11,8) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
233854.23	*(10)	$HCOOCH_3$	19(11,8) – 18(11,7) A	0.7[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
233867.15	*(4)	$HCOOCH_3$	19(11,9) – 18(11,8) E	0.4	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
234011.34	*(10)	$HCOOCH_3$	16(9,7) – 16(8,8) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
234011.58	(5)	$^{13}CH_3OH$	5(1) – 4(1) A+	0.76[b]	OriMC-1	OVRO	10.4m	Bla84	Bla84	
234011.81	*(10)	$HCOOCH_3$	16(9,8) – 16(8,9) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
234112.42	*(4)	$HCOOCH_3$	19(10,9) – 18(10,8) E	0.3	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
234124.84	*(10)	$HCOOCH_3$	19(10,9) – 18(10,8) A	0.6[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
234124.84	*(10)	$HCOOCH_3$	19(10,10) – 18(10,9) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
234134.53	*(4)	$HCOOCH_3$	19(10,10) – 18(10,9) E	0.6	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
234187.12	*(7)	SO_2	28(3,25) – 28(2,26)	1.6	OriMC-1	OVRO	10.4m	Sut85		
U 234291.		unidentified		0.6	OriMC-1	OVRO	10.4m	Sut85		
234421.67	*(4)	SO_2	16(6,10) – 17(5,13)	1.5	OriMC-1	OVRO	10.4m	Sut85		
234423.95	*(2)	CH_3CH_2CN	26(4,22) – 25(4,21)	[b]	OriMC-1	OVRO	10.4m	Sut85		
234486.57	*(4)	$HCOOCH_3$	19(9,10) – 18(9,9) E	0.6	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
234502.20	*(10)	$HCOOCH_3$	19(9,11) – 18(9,10) A	1.1[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
234502.42	*(10)	$HCOOCH_3$	19(9,10) – 18(9,9) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
234508.47	*(4)	$HCOOCH_3$	19(9,11) – 18(9,10) E	0.6	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
234683.39	(5)	CH_3OH	4(2) – 5(1) A–	2.6	OriMC-1	OVRO	10.4m	Sut85	Sas84	
234698.45	(5)	CH_3OH	5(–4) – 6(–3) E	1.2	OriMC-1	OVRO	10.4m	Sut85	Sas84	
234739.03	*(10)	$HCOOCH_3$	20(2,18) – 19(3,17) A	0.5	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
234758.750	*(25)	CH_3CH_2OH	6(3,4) 5(2,3)	1.8	OriMC-1	NRAO	12m	Tur87b		N
234781.60	(20)	CH_3CHO	8(3,6) – 8(2,7) E	0.70[b]	OriMC-1	NRAO	12m	Tur87b	Lia86	N
234783.22	*(5)	$HCOOCH_3$	9(5,4) – 8(4,4) E	[b]	OriMC-1	NRAO	12m	Tur87b	Plu87	N
234783.98	*(5)	$HCOOCH_3$	9(5,5) – 8(4,5) E	[b]	OriMC-1	NRAO	12m	Tur87b	Plu87	N
234795.46	(10)	CH_3CHO	12(2,10) – 11(2,9) E	[b]	OriMC-1	NRAO	12m	Tur87b	Lia86	N
234797.09	*(10)	$HCOOCH_3$	13(9,4) – 13(8,5) A	0.90[b]	OriMC-1	NRAO	12m	Tur87b	Plu84	N
234797.09	*(10)	$HCOOCH_3$	13(9,5) – 13(8,6) A	[b]	OriMC-1	NRAO	12m	Tur87b	Plu84	N
234812.61	*(5)	SiS	13 – 12 v=1	0.060	IRC+10216	NRAO	12m	Tur87a		N
234825.83	(10)	CH_3CHO	12(2,10) – 11(2,9) A	0.2	OriMC-1	NRAO	12m	Tur87b	Lia86	N
U 234831.		unidentified	(or U232041)	0.2	OriMC-1	NRAO	12m	Tur87b		N
234842.89	(15)	CH_3CHO	6(3,3) – 6(2,4) A	0.2	OriMC-1	NRAO	12m	Tur87b	Lia86	N
234852.99	*(39)	CH_3CH_2OH	9(5,4) – 8(4,5)	0.7	OriMC-1	NRAO	12m	Tur87b		N
234882.47	*(3)	CH_3CH_2CN	14(3,12) – 13(2,11)	0.2	OriMC-1	NRAO	12m	Tur87b		N
234916.78	*(10)	$HCOOCH_3$	9(5,4) – 8(4,5) A	0.4	OriMC-1	NRAO	12m	Tur87b	Plu84	N
234935.69	(10)	PN	5 – 4	0.400	OriMC-1	NRAO	12m	Tur87b	Wys72	N
234955.295	*(10)	HNCS	20(1,19) – 10(1,18)	0.3	OriMC-1	NRAO	12m	Tur87b		N
234962.98	*(5)	$HCOOCH_3$	12(9,3) – 12(8,4) A	[b]	OriMC-1	NRAO	12m	Tur87b	Plu84	N
234962.98	*(5)	$HCOOCH_3$	12(9,4) – 12(8,5) A	0.3[b]	OriMC-1	NRAO	12m	Tur87b	Plu84	N
235029.95	*(4)	$HCOOCH_3$	19(8,11) – 18(8,10) E	1.2	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
235046.48	*(10)	$HCOOCH_3$	19(8,12) – 18(8,11) A	0.6	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
235051.32	*(1)	$HCOOCH_3$	19(8,12) – 18(8,11) E	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
235051.37	*(10)	$HCOOCH_3$	19(8,11) – 18(8,10) A	1.2	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
235151.719	*(12)	SO_2	4(2,2) – 3(1,3)	1.0	OriMC-1	MMWO	4.9m	Lor84a		
U 235261.		unidentified		0.7	OriMC-1	OVRO	10.4m	Sut85		
235563.82	*(6)	CH_3CHCN	25(2,24) – 24(2,23)	0.3	OriMC-1	OVRO	10.4m	Sut85		
235844.50	*(5)	$HCOOCH_3$	19(7,13) – 18(7,12) A	0.54	OriMC-1	OVRO	10.4m	Bla84	Plu84	M
235866.04	*(3)	$HCOOCH_3$	19(7,13) – 18(7,12) E	0.48	OriMC-1	OVRO	10.4m	Bla84	Plu86	M
235881.17	(5)	$^{13}CH_3OH$	5(0) – 4(0) E	0.60	OriMC-1	OVRO	10.4m	Bla84	Bla84	
235886.96	*(3)	$HCOOCH_3$	19(7,12) – 18(7,11) E	0.54	OriMC-1	OVRO	10.4m	Bla84	Plu86	M
235927.55	*(11)	$^{34}SO_2$	5(2,4) – 4(1,3)	0.59	OriMC-1	OVRO	10.4m	Bla84		
235932.34	*(5)	$HCOOCH_3$	19(7,12) – 18(7,11) A	0.47	OriMC-1	OVRO	10.4m	Bla84	Plu84	M
235938.22	(5)	$^{13}CH_3OH$	5(–1) – 4(–1) E	0.68	OriMC-1	OVRO	10.4m	Bla84	Bla84	
235951.98	*(10)	$^{34}SO_2$	10(3,7) – 10(2,8)	0.71	OriMC-1	OVRO	10.4m	Bla84		
235960.37	(5)	$^{13}CH_3OH$	5(0) – 4(0) A+	0.71	OriMC-1	OVRO	10.4m	Bla84	Bla84	
235960.94	*(59)	SiS	13 – 12	0.39	IRC+10216	MMWO	4.9m	Sah84		
235971.07	(5)	$^{13}CH_3OH$	5(4) – 4(4) A+-	0.25	OriMC-1	OVRO	10.4m	Bla84	Bla84	
235978.62	(5)	$^{13}CH_3OH$	5(–4) – 4(–4) E	0.12	OriMC-1	OVRO	10.4m	Bla84	Bla84	
235994.42	(5)	$^{13}CH_3OH$	5(4) – 4(4) E	[b]	OriMC-1	OVRO	10.4m	Bla84	Bla84	
235997.23	(5)	$^{13}CH_3OH$	5(3) – 4(3) A+-	0.72[b]	OriMC-1	OVRO	10.4m	Bla84	Bla84	
236006.10	(5)	$^{13}CH_3OH$	5(3) – 4(3) E	0.35	OriMC-1	OVRO	10.4m	Bla84	Bla84	
236008.39	(5)	$^{13}CH_3OH$	5(2) – 4(2) A–	0.65	OriMC-1	OVRO	10.4m	Bla84	Bla84	
236016.55	(5)	$^{13}CH_3OH$	5(–3) – 4(–3) E	0.36	OriMC-1	OVRO	10.4m	Bla84	Bla84	
236041.40	(5)	$^{13}CH_3OH$	5(1) – 4(1) E	0.56	OriMC-1	OVRO	10.4m	Bla84	Bla84	
236042.2	*(10)	$^{13}CH_3OH$	5(1) – 4(1) E	0.3	OriMC-1	MMWO	4.9m	Eri81	Lee84	

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
236049.52	(5)	$^{13}CH_3OH$	5(2) – 4(2) A+	0.41	OriMC-1	OVRO	10.4m	Bla84	Bla84	
236062.00	(5)	$^{13}CH_3OH$	5(–2) – 4(–2) E	[b]	OriMC-1	OVRO	10.4m	Bla84	Bla84	
236062.85	(5)	$^{13}CH_3OH$	5(2) – 4(2) E	0.92[b]	OriMC-1	OVRO	10.4m	Bla84	Bla84	
236216.724*	(24)	SO_2	16(1,15) – 15(2,14)	1.1	OriMC-1	MMWO	4.9m	Lor81a		
236287.610	(9)	SiC	$^3\Pi_2$ J = 6 – 5 e,f	0.18	IRC+10216	IRAM	30m	Cer89	Cer89	N
236355.91 *	(3)	$HCOOCH_3$	20(3,18) – 19(3,17) E	0.9	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
236365.52 *	(10)	$HCOOCH_3$	20(3,18) – 19(3,17) A	0.7	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
236452.304*	(58)	SO	1(2) – 2(1)	0.4	OriMC-1	OVRO	10.4m	Sut85		
236512.850*	(61)	HC_3N	26 – 25	0.8	OriMC-1	MMWO	4.9m	Lor81		
236717.20 *	(1)	HCOOH	11(1,11) – 10(1,10)	0.4	OriMC-1	OVRO	10.4m	Sut85		
236726.27 *	(38)	H_2CS	7(1,7) – 6(1,6)	1.1	OriMC-1	MMWO	4.9m	Lor84a		
236743.63 *	(3)	$HCOOCH_3$	19(5,15) – 18(5,14) E	0.6	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
236759.63 *	(10)	$HCOOCH_3$	19(5,15) – 18(5,14) A	0.6	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
236800.43 *	(3)	$HCOOCH_3$	19(6,14) – 18(6,13) E	0.6	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
236810.28 *	(10)	$HCOOCH_3$	19(6,14) – 18(6,13) A	0.8	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
236936.13	(5)	CH_3OH	14(1) – 13(2) A–	2.3	OriMC-1	OVRO	10.4m	Sut85	Sas84	
U 236977.		unidentified		0.9	OriMC-1	OVRO	10.4m	Sut85		
237046.34 *	(21)	CH_3OCH_3	7(2,5) – 6(1,6) AE	[b]	OriMC-1	OVRO	10.4m	Sut85		
237046.34 *	(21)	CH_3OCH_3	7(2,5) – 6(1,6) EA	[b]	OriMC-1	OVRO	10.4m	Sut85		
237049.03 *	(15)	CH_3OCH_3	7(2,5) – 6(1,6) EE	1.5[b]	OriMC-1	OVRO	10.4m	Sut85		
237051.72 *	(9)	CH_3OCH_3	7(2,5) – 6(1,6) AA	[b]	OriMC-1	OVRO	10.4m	Sut85		
237068.826*	(28)	SO_2	12(3,9) – 12(2,10)	0.9	OriMC-1	MMWO	4.9m	Lei84a		
237093.183*	(79)	HC_3N	26 – 25 v_7 = 1 ℓ = 1e	0.8	OriMC-1	OVRO	10.4m	Sut85		
237129.4	(1)	CH_3OH	22(1) – 22(0) E	0.7	OriMC-1	OVRO	10.4m	Sut85	Sut85	M
237150.058*	(3)	SiC_2	10(4,7) – 9(4,6)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
237170.44 *	(2)	CH_3CH_2CN	26(3,23) – 25(3,22)	0.9	OriMC-1	OVRO	10.4m	Sut85		
237266.91 *	(10)	$HCOOCH_3$	21(1,20) – 20(2,19) A	0.4	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
237273.635	(30)	$OC^{34}S$	20 – 19	0.5	OriMC-1	OVRO	10.4m	Sut85	Dub80	
237297.46 *	(3)	$HCOOCH_3$	20(2,18) – 19(2,17) E	0.8	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
237305.98 *	(5)	$HCOOCH_3$	20(2,18) – 19(2,17) A	1.1[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
237309.53 *	(3)	$HCOOCH_3$	21(2,20) – 20(2,19) E	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
237315.09 *	(5)	$HCOOCH_3$	21(2,20) – 20(2,19) A	1.1	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
237331.358*	(3)	SiC_2	10(4,7) – 9(4,6)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
237344.89 *	(3)	$HCOOCH_3$	21(1,20) – 20(1,19) E	0.8	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
237350.33 *	(5)	$HCOOCH_3$	21(1,20) – 20(1,19) A	0.7	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
237405.18 *	(2)	CH_3CH_2CN	26(2,24) – 25(2,23)	0.7	OriMC-1	OVRO	10.4m	Sut85		
237432.049*	(79)	HC_3N	26 – 25 v_7 = 1 ℓ = 1f	0.7	OriMC-1	OVRO	10.4m	Sut85		
237456.25 *	(19)	CH_2CHCN	25(9,16) – 24(9,15)	[b]	OriMC-1	OVRO	10.4m	Sut85		
237456.25 *	(19)	CH_2CHCN	25(9,17) – 24(9,16)	0.2[b]	OriMC-1	OVRO	10.4m	Sut85		
237482.77 *	(9)	CH_2CHCN	25(5,21) – 24(5,20)	0.3[b]	OriMC-1	OVRO	10.4m	Sut85		
237485.01 *	(9)	CH_2CHCN	25(5,20) – 24(5,19)	[b]	OriMC-1	OVRO	10.4m	Sut85		
237591.40 *	(6)	CH_2CHCN	25(3,23) – 24(3,22)	0.4	OriMC-1	OVRO	10.4m	Sut85		
237618.87 *	(27)	CH_3OCH_3	9(2,8) – 8(1,7) EA	[b]	OriMC-1	OVRO	10.4m	Sut85		
237618.87 *	(27)	CH_3OCH_3	9(2,8) – 8(1,7) AE	[b]	OriMC-1	OVRO	10.4m	Sut85		
237620.96 *	(20)	CH_3OCH_3	9(2,8) – 8(1,7) EE	0.9[b]	OriMC-1	OVRO	10.4m	Sut85		
237623.05 *	(13)	CH_3OCH_3	9(2,8) – 8(1,7) AA	[b]	OriMC-1	OVRO	10.4m	Sut85		
237711.89 *	(7)	CH_2CHCN	25(4,21) – 24(4,20)	0.3	OriMC-1	OVRO	10.4m	Sut85		
237807.69 *	(3)	$HCOOCH_3$	19(6,13) – 18(6,12) E	0.5	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
237829.78 *	(10)	$HCOOCH_3$	19(6,13) – 18(6,12) A	0.6	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
237851.85 *	(2)	CH_3CH_2CN	27(2,26) – 26(2,25)	0.4	OriMC-1	OVRO	10.4m	Sut85		
237859.71 *	(7)	C_4H	25 – 24 J = 51/2 – 49/2	0.053	IRC+10216	MMWO	4.9m	Lor84a		
237898.03 *	(7)	C_4H	25 – 24 J = 49/2 – 47/2	0.055	IRC+10216	MMWO	4.9m	Lor84a		
237983.38	(5)	$^{13}CH_3OH$	5(1) – 4(1) A–	0.84	OriMC-1	OVRO	10.4m	Bla84	Bla84	
U 238017.		unidentified		0.4	OriMC-1	OVRO	10.4m	Sut85		
238155.90 *	(4)	$HCOOCH_3$	22(1,22) – 21(1,21) E	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
238156.34 *	(4)	$HCOOCH_3$	22(0,22) – 21(0,21) E	2.7[b]	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
238156.84 *	(10)	$HCOOCH_3$	22(1,22) – 21(1,21) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
238157.27 *	(10)	$HCOOCH_3$	22(0,22) – 21(0,21) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
238190.06 *	(10)	$HCOOCH_3$	7(6,2) – 6(5,1) A	0.2[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
238190.23 *	(10)	$HCOOCH_3$	7(6,1) – 6(5,2) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
238726.70 *	(12)	CH_2CHCN	26(1,26) – 25(1,25)	0.2	OriMC-1	OVRO	10.4m	Sut85		
238766.052*	(13)	CH_3CN	13(9) – 12(9)	0.4	OriMC-1	OVRO	10.4m	Sut85		M
238796.22 *	(7)	CH_2CHCN	25(3,22) – 24(3,21)	0.2	OriMC-1	OVRO	10.4m	Sut85		
238843.029*	(10)	CH_3CN	13(8) – 12(8)	0.6	OriMC-1	OVRO	10.4m	Sut85		M
238912.719*	(8)	CH_3CN	13(7) – 12(7)	0.7	OriMC-1	OVRO	10.4m	Sut85		M

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
238926.78	*(3)	$HCOOCH_3$	20(3,18) – 19(2,17) E	0.3	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
238972.394	*(6)	CH_3CN	13(6) – 12(6)	0.31	OriMC-1	MMWO	4.9m	Lor84		M
238992.562	*(54)	SO_2	21(7,15) – 22(6,16)	<0.12	OriMC-1	MMWO	4.9m	Lor84		
239001.21	*(21)	$CH_3{}^{13}CN$	12(2) – 11(2)	0.3	OriMC-1	OVRO	10.4m	Sut85		
239014.95	*(21)	$CH_3{}^{13}CN$	12(1) – 11(1)	0.5[b]	OriMC-1	OVRO	10.4m	Sut85		
239019.53	*(21)	$CH_3{}^{13}CN$	12(0) – 11(0)	[b]	OriMC-1	OVRO	10.4m	Sut85		
239022.928	*(4)	CH_3CN	13(5) – 12(5)	0.33	OriMC-1	MMWO	4.9m	Lor84		M
239064.303	*(3)	CH_3CN	13(4) – 12(4)	0.39	OriMC-1	MMWO	4.9m	Lor84		M
239096.500	*(3)	CH_3CN	13(3) – 12(3)	0.68	OriMC-1	MMWO	4.9m	Lor84		M
239119.507	*(3)	CH_3CN	13(2) – 12(2)	0.54	OriMC-1	MMWO	4.9m	Lor84		M
239133.316	*(3)	CH_3CN	13(1) – 12(1)	0.73	OriMC-1	MMWO	4.9m	Lor84		M
239137.919	*(3)	CH_3CN	13(0) – 12(0)	0.83	OriMC-1	MMWO	4.9m	Lor84		M
239179.284	*(15)	CH_3CCH	14(4) – 13(4)	0.16	OriMC-1	MMWO	4.9m	Lor84a		
239211.218	*(4)	CH_3CCH	14(3) – 13(3)	0.24	OriMC-1	MMWO	4.9m	Lor84a		
239234.036	*(4)	CH_3CCH	14(2) – 13(2)	0.19	OriMC-1	MMWO	4.9m	Lor84a		
239247.731	*(4)	CH_3CCH	14(1) – 13(1)	0.36	OriMC-1	MMWO	4.9m	Lor84a		
239252.296	*(4)	CH_3CCH	14(0) – 13(0)	0.37	OriMC-1	MMWO	4.9m	Lor84a		
239609.95	*(10)	$HCOOCH_3$	32(5,28) – 32(3,29) A	0.9	OMC-IRc2	IRAM	30m	Jac90	Plu84	N
239627.16	*(12)	CH_3CN	13(1) – 12(1) $v_8=1$ $\ell=1$	0.4	OriMC-1	OVRO	10.4m	Sut85		
239639.45	*(10)	CH_3CN	13(8) – 12(8) $v_8=1$ $\ell=1$	0.8	OMC-IRc2	IRAM	30m	Jac90		N
U 239650.8		unidentified		0.8	OMC-IRc2	IRAM	30m	Jac90		N
U 239674.0		unidentified		0.6	OMC-IRc2	IRAM	30m	Jac90		N
239682.80	*(2)	CH_3CH_2CN	27(1,26) – 26(1,25)	0.7	OriMC-1	OVRO	10.4m	Sut85		
239684.57	*(10)	CH_3CN	13(5) – 12(5) $v_8=1$ $\ell=-1$	7.2	OMC-IRc2	IRAM	30m	Jac90		N
239699.25	*(10)	CH_3CN	13(7) – 12(7) $v_8=1$ $\ell=1$	1.6	OMC-IRc2	IRAM	30m	Jac90		N
239708.28	*(11)	CH_2CHCN	26(0,26) – 25(0,25)	0.1	OriMC-1	OVRO	10.4m	Sut85		
239731.4	(1)	CH_3OH	16(7) – 17(6) A+-	0.6	OriMC-1	OVRO	10.4m	Sut85	Sut85	M
239735.65	*(10)	CH_3CN	13(4) – 12(4) $v_8=1$ $\ell=1$	2.2	OMC-IRc2	IRAM	30m	Jac90		N
239746.253	(12)	CH_3OH	4(1) – 4(1) A+	7.4	OriMC-1	OVRO	10.4m	Sut85	Pic81	
239777.19	*(11)	CH_3CN	13(3) – 12(3) $v_8=1$ $\ell=-1$	0.3	OriMC-1	OVRO	10.4m	Sut85		
239791.76	*(11)	CH_3CN	13(5) – 12(5) $v_8=1$ $\ell=1$	0.2	OriMC-1	OVRO	10.4m	Sut85		
239802.5	*( )	NH_2CN	12(4,8) – 11(4,7)	0.4[b]	OMC-IRc2	IRAM	30m	Jac90		N
239802.5	*( )	NH_2CN	12(4,9) – 11(4,8)	[b]	OMC-IRc2	IRAM	30m	Jac90		N
239808.91	*(12)	CH_3CN	13(2) – 12(2) $v_8=1$ $\ell=-1$	0.6	OriMC-1	OVRO	10.4m	Sut85		
239816.08	*(5)	CH_2CHCN	25(1,24) – 24(1,23)	0.5	OriMC-1	OVRO	10.4m	Sut85		
239824.78	*(12)	CH_3CN	13(4) – 12(4) $v_8=1$ $\ell=1$	0.8	OriMC-1	OVRO	10.4m	Sut85		
239829.96	*(13)	CH_3CN	13(1) – 12(1) $v_8=1$ $\ell=-1$	0.5	OriMC-1	OVRO	10.4m	Sut85		
239836.06	*(18)	CH_3CN	13(0) – 12(0) $v_8=1$ $\ell=1$	0.5	OriMC-1	OVRO	10.4m	Sut85		
239850.01	*(14)	CH_3CN	13(3) – 12(3) $v_8=1$ $\ell=1$	0.7	OriMC-1	OVRO	10.4m	Sut85		
239871.67	*(29)	CH_3CN	13(2) – 12(2) $v_8=1$ $\ell=1$	0.4	OriMC-1	OVRO	10.4m	Sut85		
239887.27	*(2)	CH_3CH_2CN	28(0,28) – 27(1,27)	1.8	OMC-IRc2	IRAM	30m	Jac90		N
239904.	*( )	NH_2CN	12(2,10) – 11(2,9)	0.16	OriMC-1	NRAO	12m	Tur85		N
U 239926.9		unidentified		0.6	OMC-IRc2	IRAM	30m	Jac90		N
239935.4	*(4)	$HCOOCH_3$	39(8,32) – 39(7,33) A	0.8	OMC-IRc2	IRAM	30m	Jac90		N
239945.17	*(37)	CH_3CH_2CN	23(4,20) – 23(2,21)	0.6	OMC-IRc2	IRAM	30m	Jac90		N
239951.81	*(6)	NH_2CHO	11(1,11) – 10(1,9)	2.1	OMC-IRc2	IRAM	30m	Jac90		N
U 239960.7		unidentified		1.2	OMC-IRc2	IRAM	30m	Jac90		N
U 239971.0		unidentified		0.4	OMC-IRc2	IRAM	30m	Jac90		N
U 239977.5		unidentified		2.0	OMC-IRc2	IRAM	30m	Jac90		N
U 239985.6		unidentified		0.9	OMC-IRc2	IRAM	30m	Jac90		N
U 239991.9		unidentified		1.4	OMC-IRc2	IRAM	30m	Jac90		N
U 239998.0		unidentified		0.5	OMC-IRc2	IRAM	30m	Jac90		N
U 240008.6		unidentified		0.4	OMC-IRc2	IRAM	30m	Jac90		N
240021.08	*(3)	$HCOOCH_3$	19(3,16) – 18(3,15) E	1.0	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
U 240045.3		unidentified		0.5	OMC-IRc2	IRAM	30m	Jac90		N
240050.1	(15)	$^{30}SiC_2$	10(2,8) – 9(2,7)	n.r.	IRC+10216	IRAM	30m	Cer91b	Cer91b	N
240057.4	*(1)	SO_2	11(5,7) – 12(4,8) $v_2=1$	0.28	OriMC-1	NRAO	12m	Tur85		N
U 240079.1		unidentified		0.5	OMC-IRc2	IRAM	30m	Jac90		N
240089.83	*(12)	CH_3CN	13(1) – 12(1) $v_8=1$ $\ell=1$	0.6	OriMC-1	OVRO	10.4m	Sut85		
240185.77	*(26)	CH_2CO	12(1,12) – 11(1,11)	0.5	OriMC-1	OVRO	10.4m	Sut85		
240241.50	(5)	CH_3OH	5(3) – 6(2) E	0.55	OriMC-1	MMWO	4.9m	Lor84a	Sas84	
240266.16	*(40)	H_2CS	7(0,7) – 6(0,6)	0.55	OriMC-1	MMWO	4.9m	Lor84a		
240319.338	*(21)	CH_3CH_2CN	28(1,28) – 27(1,27)	0.16	OriMC-1	MMWO	4.9m	Lor84a		
240331.44	*(26)	H_2CS	7(4,4) – 6(4,3)	0.07[b]	OriMC-1	MMWO	4.9m	Lor84a		
240331.44	*(26)	H_2CS	7(4,3) – 6(4,2)	[b]	OriMC-1	MMWO	4.9m	Lor84a		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines -- Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
240381.27	*(33)	H_2CS	7(2,6) – 6(2,5)	0.16	OriMC-1	MMWO	4.9m	Lor84a		
240392.29	*(26)	H_2CS	7(3,5) – 6(3,4)	0.38[b]	OriMC-1	MMWO	4.9m	Lor84a		
240392.96	*(26)	H_2CS	7(3,4) – 6(3,3)	[b]	OriMC-1	MMWO	4.9m	Lor84a		
240429.183	*(21)	CH_3CH_2CN	28(0,28) – 27(0,27)	0.12	OriMC-1	MMWO	4.9m	Lor84a		
U240473.4		unidentified		0.11	OriMC-1	MMWO	4.9m	Lor84a		
240548.29	*(33)	H_2CS	7(2,5) – 6(2,4)	0.16	OriMC-1	MMWO	4.9m	Lor84a		
240875.735	*(16)	HNCO	11(1,11) – 10(1,10)	1.0	OriMC-1	OVRO	10.4m	Sut85		
240942.793	*(37)	SO_2	18(1,17) – 18(0,18)	0.8	OriMC-1	MMWO	4.9m	Lei84		
240960.56	(5)	CH_3OH	5(1) – 4(2) A+ ν_t=1	0.9	OriMC-1	OVRO	10.4m	Sut85	Sas84	
240978.15	*(33)	CH_3OCH_3	5(3,3) – 4(2,2) EA	0.2	OriMC-1	OVRO	10.4m	Sut85		
240982.94	*(21)	CH_3OCH_3	5(3,3) – 4(2,2) AE	[b]	OriMC-1	OVRO	10.4m	Sut85		
240985.15	*(19)	CH_3OCH_3	5(3,3) – 4(2,2) EE	1.0[b]	OriMC-1	OVRO	10.4m	Sut85		
240990.14	*(10)	CH_3OCH_3	5(3,3) – 4(2,2) AA	0.7	OriMC-1	OVRO	10.4m	Sut85		
241016.176	*(29)	$C^{34}S$	5 – 4	0.83	OriMC-2	MMWO	4.9m	Snc84		
241146.20	*(1)	HCOOH	11(0,11) – 10(0,10)	0.2	OriMC-1	OVRO	10.4m	Sut85		
241159.13	(5)	CH_3OH	5(4) – 4(4) E ν_t=1	0.7	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241166.53	(5)	CH_3OH	5(3) – 4(3) E ν_t=1	0.8	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241178.42	(5)	CH_3OH	5(4) 4(4) A [illegible] ν_t=1	1.3[b]	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241179.90	(5)	CH_3OH	5(–3) – 4(–3) E ν_t=1	[b]	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241184.08	(5)	CH_3OH	5(–4) – 4(–4) E ν_t=1	1.1	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241187.40	(5)	CH_3OH	5(–2) – 4(–2) E ν_t=1	1.4	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241192.81	(5)	CH_3OH	5(2) – 4(2) A+ ν_t=1	1.9	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241196.35	(5)	CH_3OH	5(2) – 4(2) A– ν_t=1	2.1[b]	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241198.29	(5)	CH_3OH	5(3) – 4(3) A+ ν_t=1	[b]	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241203.69	(5)	CH_3OH	5(1) – 4(1) E ν_t=1	[b]	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241205.99	(5)	CH_3OH	5(0) – 4(0) E ν_t=1	2.8	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241210.68	(5)	CH_3OH	5(2) – 4(2) E ν_t=1	1.2[b]	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241238.16	(5)	CH_3OH	5(–1) – 4(–1) E ν_t=1	0.7	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241267.88	(5)	CH_3OH	5(0) – 4(0) A ν_t=1	0.4	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241365.35	*(6)	CH_2CHCN	19(3,17) – 20(0,20)	2.1	OMC-IRc2	IRAM	30m	Jac90		N
241420.880	(20)	HCO	10(0,10) – 9(1,9)	1.7	OMC-IRc2	IRAM	30m	Jac90	Bla84a	N
241436.41	*(10)	$HCOOCH_3$	28(2,26) – 28(2,27) A	[b]	OMC-IRc2	IRAM	30m	Jac90	Plu84	N
241437.28	*(10)	$HCOOCH_3$	28(2,26) – 28(1,27) A	2.6[b]	OMC-IRc2	IRAM	30m	Jac90	Plu84	N
241441.24	(5)	CH_3OH	5(1) – 4(1) A– ν_t=1	1.5	OriMC-1	OVRO	10.4m	Sut85	Sas84	
241464.25	*(10)	$HCOOCH_3$	28(3,26) – 28(2,27) A	1.0[b]	OMC-IRc2	IRAM	30m	Jac90	Plu84	N
241465.14	*(10)	$HCOOCH_3$	28(3,26) – 28(1,27) A	[b]	OMC-IRc2	IRAM	30m	Jac90	Plu84	N
241509.05	*(10)	$^{34}SO_2$	16(1,15) – 15(2,14)	0.9	OriMC-1	OVRO	10.4m	Sut85		
241523.98	*(20)	CH_3OCH_3	5(3,2) – 4(2,3) AE	0.9	OriMC-1	OVRO	10.4m	Sut85		
241528.76	*(11)	CH_3OCH_3	5(3,2) – 4(2,3) EA	[b]	OriMC-1	OVRO	10.4m	Sut85		
241528.97	*(11)	CH_3OCH_3	5(3,2) – 4(2,3) EE	1.7[b]	OriMC-1	OVRO	10.4m	Sut85		
241531.18	*(10)	CH_3OCH_3	5(3,2) – 4(2,3) AA	[b]	OriMC-1	OVRO	10.4m	Sut85		
U241534.		unidentified		0.4	OriMC-1	MMWO	4.9m	Eri84b		
241561.550	(37)	HDO	2(1,1) – 2(1,2)	1.0	OriMC-1	MMWO	4.9m	Bec82	DeL71	
U241589.3		unidentified		4.9	OMC-IRc2	IRAM	30m	Jac90		N
241615.795	*(13)	SO_2	5(2,4) – 4(1,3)	1.4	OriMC-1	MMWO	4.9m	Lor84e		
241700.219	(12)	CH_3OH	5(0) – 4(0) E	1.7	OriMC-1	MMWO	4.9m	Lor84	Pic81	
U241739.9		unidentified		2.5	OMC-IRc2	IRAM	30m	Jac90		N
241767.224	(12)	CH_3OH	5(–1) – 4(–1) E	1.8	OriMC-1	MMWO	4.9m	Lor84	Pic81	
241774.037	*(10)	HNCO	11(0,11) – 10(0,10)	3.1	OriMC-1	OVRO	10.4m	Sut85		
241791.431	(12)	CH_3OH	5(0) – 4(0) A+	1.8	OriMC-1	MMWO	4.9m	Lor84	Pic81	
241806.507	(12)	CH_3OH	5(4) – 4(4) A+	0.8[b]	OriMC-1	MMWO	4.9m	Lor84	Pic81	
241806.508	(12)	CH_3OH	5(4) – 4(4) A-	[b]	OriMC-1	MMWO	4.9m	Lor84	Pic81	
241813.257	(12)	CH_3OH	5(–4) – 4(–4) E	0.7	OriMC-1	MMWO	4.9m	Lor84	Pic81	
241829.646	(12)	CH_3OH	5(4) – 4(4) E	<0.7	OriMC-1	MMWO	4.9m	Lor84	Pic81	
241832.951	(12)	CH_3OH	5(3) – 4(3) A+,A–	1.6	OriMC-1	MMWO	4.9m	Lor84	Pic81	
241842.23	(12)	CH_3OH	5(2) – 4(2) A-	[b]	OriMC-1	MMWO	4.9m	Lor84	Pic81	
241843.646	(12)	CH_3OH	5(3) – 4(3) E	1.7[b]	OriMC-1	MMWO	4.9m	Lor84	Pic81	
241852.352	(12)	CH_3OH	5(–3) – 4(–3) E	0.9	OriMC-1	MMWO	4.9m	Lor84	Pic81	
241879.073	(12)	CH_3OH	5(1) – 4(1) E	1.4	OriMC-1	MMWO	4.9m	Lor84	Pic81	
241887.704	(12)	CH_3OH	5(2) – 4(2) A+	1.2	OriMC-1	MMWO	4.9m	Lor84	Pic81	
241904.119	(50)	CH_3OH	5(2) – 4(2) E	1.2[b]	OriMC-1	MMWO	4.9m	Lor81a	Pic81	
241904.407	(50)	CH_3OH	5(–2) – 4(–2) E	[b]	OriMC-1	MMWO	4.9m	Lor81a	Pic81	
241922.55	*(2)	CH_3CH_2CN	27(10,18) – 26(10,17)	0.9[b]	OriMC-1	OVRO	10.4m	Sut85		
241922.55	*(2)	CH_3CH_2CN	27(10,17) – 26(10,16)	[b]	OriMC-1	OVRO	10.4m	Sut85		
241932.18	*(2)	CH_3CH_2CN	27(9,19) – 26(9,18)	1.3[b]	OriMC-1	OVRO	10.4m	Sut85		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
241932.18	*(2)	CH_3CH_2CN	27(9,18) – 26(9,17)	[b]	OriMC-1	OVRO	10.4m	Sut85		
241933.16	*(2)	CH_3CH_2CN	27(11,16) – 26(11,15)	[b]	OriMC-1	OVRO	10.4m	Sut85		
241933.16	*(2)	CH_3CH_2CN	27(11,17) – 26(11,16)	[b]	OriMC-1	OVRO	10.4m	Sut85		
241946.86	*(15)	CH_3OCH_3	13(1,13) – 12(0,12) EE	0.5	OriMC-1	MMWO	4.9m	Lor81a		
241959.06	*(2)	CH_3CH_2CN	27(12,15) – 26(12,14)	0.7[b]	OriMC-1	OVRO	10.4m	Sut85		
241959.06	*(2)	CH_3CH_2CN	27(12,16) – 26(12,15)	[b]	OriMC-1	OVRO	10.4m	Sut85		
241970.44	*(2)	CH_3CH_2CN	27(6,19) – 26(6,18)	[b]	OriMC-1	OVRO	10.4m	Sut85		
241970.44	*(2)	CH_3CH_2CN	27(6,20) – 26(6,19)	0.8[b]	OriMC-1	OVRO	10.4m	Sut85		
241985.51	*(10)	$^{34}SO_2$	8(3,5) – 8(2,5)	1.4	OriMC-1	OVRO	10.4m	Sut85		
241997.11	*(2)	CH_3CH_2CN	27(13,15) – 26(13,14)	0.5[b]	OriMC-1	OVRO	10.4m	Sut85		
241997.11	*(2)	CH_3CH_2CN	27(13,14) – 26(13,13)	[b]	OriMC-1	OVRO	10.4m	Sut85		
242045.30	*(2)	CH_3CH_2CN	27(14,14) – 26(14,13)	[b]	OriMC-1	OVRO	10.4m	Sut85		
242045.30	*(2)	CH_3CH_2CN	27(14,13) – 26(14,12)	[b]	OriMC-1	OVRO	10.4m	Sut85		
242052.48	*(2)	CH_3CH_2CN	27(7,21) – 26(7,20)	[b]	OriMC-1	OVRO	10.4m	Sut85		
242052.58	*(2)	CH_3CH_2CN	27(7,20) – 26(7,19)	0.8[b]	OriMC-1	OVRO	10.4m	Sut85		
242102.24	*(2)	CH_3CH_2CN	27(15,12) – 26(15,11)	[b]	OriMC-1	OVRO	10.4m	Sut85		
242102.24	*(2)	CH_3CH_2CN	27(15,13) – 26(15,12)	0.8[b]	OriMC-1	OVRO	10.4m	Sut85		
242166.96	*(2)	CH_3CH_2CN	27(16,11) – 26(16,10)	[b]	OriMC-1	OVRO	10.4m	Sut85		
242166.96	*(2)	CH_3CH_2CN	27(16,12) – 26(16,11)	0.2[b]	OriMC-1	OVRO	10.4m	Sut85		
242206.97	*(2)	CH_3CH_2CN	27(6,22) – 26(6,21)	1.3[b]	OriMC-1	OVRO	10.4m	Sut85		
242210.41	*(2)	CH_3CH_2CN	27(6,21) – 26(6,20)	[b]	OriMC-1	OVRO	10.4m	Sut85		
242375.82	*(38)	CH_2CO	12(0,12) – 11(0,11)	0.5	OriMC-1	OVRO	10.4m	Sut85		
242398.66	*(23)	CH_2CO	12(3,10) – 11(3,9)	0.6[b]	OriMC-1	OVRO	10.4m	Sut85		
242399.16	*(23)	CH_2CO	12(3,9) – 11(3,8)	[b]	OriMC-1	OVRO	10.4m	Sut85		
242424.66	*(28)	CH_2CO	12(2,11) – 11(2,10)	0.2	OriMC-1	OVRO	10.4m	Sut85		
242446.21	(5)	CH_3OH	13(–2) – 14(–1) E	3.3	OriMC-1	OVRO	10.4m	Sut85	Sas84	
242470.39	*(2)	CH_3CH_2CN	27(5,23) – 26(5,22)	0.9	OriMC-1	OVRO	10.4m	Sut85		
242490.3	(1)	CH_3OH	24(–3) – 24(2) A	0.7	OriMC-1	OVRO	10.4m	Sut85	Sut85	
242536.16	*(28)	CH_2CO	12(2,10) – 11(2,9)	0.4	OriMC-1	OVRO	10.4m	Sut85		
242547.32	*(2)	CH_3CH_2CN	27(5,22) – 26(5,21)	0.7	OriMC-1	OVRO	10.4m	Sut85		
242639.717	*(16)	HNCO	11(1,10) – 10(1,9)	1.1	OriMC-1	OVRO	10.4m	Sut85		
242664.68	*(2)	CH_3CH_2CN	27(4,24) – 26(4,23)	1.0	OriMC-1	OVRO	10.4m	Sut85		
242871.52	*(3)	$HCOOCH_3$	19(5,14) – 18(5,13) E	1.1	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
242895.95	*(10)	$HCOOCH_3$	19(5,14) – 18(5,13) A	1.1	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
242913.680	*(26)	$C^{33}S$	5 – 4	1.5	OriMC-1	OVRO	10.4m	Sut85		
243039.344	*(54)	$S^{18}O$	7(5) – 6(5)	0.4	OriMC-1	OVRO	10.4m	Sut85		
243087.72	*(3)	SO_2	5(4,2) – 6(3,3)	1.4	OriMC-1	OVRO	10.4m	Sut85		
243160.753	*(25)	CS	5 – 4 v = 1	0.067	IRC + 10216	NRAO	12m	Tur87		N
243218.034	*(2)	OCS	20 – 19	0.67	OriMC-1	MMWO	4.9m	Lor84a		
243397.53	(5)	CH_3OH	18(6) – 19(5) A+	1.6	OriMC-1	OVRO	10.4m	Sut85	Sas84	
243412.6	(1)	CH_3OH	23(–3) – 23(2) A	0.9	OriMC-1	OVRO	10.4m	Sut85	Sut85	
243522.64	*(9)	SO_2	14(0,14) – 13(1,13) $\nu_2 = 1$	0.6	OriMC-1	OVRO	10.4m	Sut85		
243643.23	*(2)	CH_3CH_2CN	27(4,23) – 26(4,22)	0.9	OriMC-1	OVRO	10.4m	Sut85		
U 243740.		unidentified		0.8	OriMC-1	OVRO	10.4m	Sut85		
U 243747.		unidentified		1.1	OriMC-1	OVRO	10.4m	Sut85		
243915.826	(12)	CH_3OH	5(1) – 4(1) A–	8.1	OriMC 1	OVRO	10.4m	Sut85	Pic81	
243935.88	*(21)	$^{34}SO_2$	18(1,17) – 18(0,18)	0.4	OriMC-1	OVRO	10.4m	Sut85		
244047.75	*(48)	H_2CS	7(1,6) – 6(1,5)	0.91	OriMC-1	MMWO	4.9m	Lor85		M
244254.228	*(24)	SO_2	14(0,14) – 13(1,13)	1.5	OriMC-1	MMWO	4.9m	Lor85		M
244330.5	(1)	CH_3OH	22(–3) – 22(2) A	1.1	OriMC-1	OVRO	10.4m	Sut85	Sut85	
244338.02	(5)	CH_3OH	9(1) – 8(0) E $\nu_t = 1$	1.2	OriMC-1	OVRO	10.4m	Sut85	Sas84	
244481.54	*(11)	$^{34}SO_2$	14(0,14) – 13(1,13)	1.4	OriMC-1	OVRO	10.4m	Sut85		
244580.31	*(3)	$HCOOCH_3$	20(4,17) – 19(4,16) E	1.3	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
244593.98	*(10)	$HCOOCH_3$	20(4,17) – 19(4,16) A	1.1	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
244712.24	*(26)	CH_2CO	12(1,11) – 11(1,10)	0.8	OriMC-1	OVRO	10.4m	Sut85		
244857.39	*(7)	CH_2CHCN	26(2,25) – 25(2,24)	0.5	OriMC-1	OVRO	10.4m	Sut85		
244935.606	*(33)	CS	5 – 4	5.5	OriMC-2	MMWO	4.9m	Sne84		
245178.68	*(16)	$^{34}SO_2$	15(2,14) – 15(1,15)	0.8	OriMC-1	OVRO	10.4m	Sut85		
245223.0	(1)	CH_3OH	21(–3) – 21(2) A	1.3	OriMC-1	OVRO	10.4m	Sut85	Sut85	
245302.30	*(11)	$^{34}SO_2$	6(3,3) – 6(2,4)	0.9	OriMC-1	OVRO	10.4m	Sut85		
245339.40	*(5)	SO_2	26(3,23) – 25(4,22)	1.7	OriMC-1	OVRO	10.4m	Sut85		
245563.43	*(2)	SO_2	10(3,7) – 10(2,8)	7.8	OriMC-1	OVRO	10.4m	Sut85		
245606.406	*(78)	HC_3N	27 – 26	0.7	OriMC-1	MMWO	4.9m	Lor81		
245651.09	*(10)	$HCOOCH_3$	20(15,6) – 19(15,5) A	0.6[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
245651.09	*(10)	$HCOOCH_3$	20(15,5) – 19(15,4) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
245752.17	*(10)	$HCOOCH_3$	20(14,6) – 19(14,5) A	0.7[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
245752.17	*(10)	$HCOOCH_3$	20(14,7) – 19(14,6) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
245753.84	*(5)	$HCOOCH_3$	20(14,6) – 19(14,5) E	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
245772.81	*(5)	$HCOOCH_3$	20(14,7) – 19(14,6) E	0.5	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
245883.01	*(5)	$HCOOCH_3$	20(13,8) – 19(13,7) E	0.2	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
245885.14	*(10)	$HCOOCH_3$	20(13,8) – 19(13,7) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
245885.14	*(10)	$HCOOCH_3$	20(13,7) – 19(13,6) A	0.8[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
245903.76	*(5)	$HCOOCH_3$	20(13,7) – 19(13,6) E	0.2	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
246054.84	*(4)	$HCOOCH_3$	20(12,9) – 19(12,8) E	0.5	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
246060.75	*(10)	$HCOOCH_3$	20(12,8) – 19(12,7) A	0.8[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
246060.75	*(10)	$HCOOCH_3$	20(12,9) – 19(12,8) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
246074.65	(5)	CH_3OH	20(–3) – 20(2) A	1.6	OriMC-1	OVRO	10.4m	Sut85	Sas84	
246268.73	*(2)	CH_3CH_2CN	27(2,25) – 26(2,24)	0.9	OriMC-1	OVRO	10.4m	Sut85		
246285.47	*(4)	$HCOOCH_3$	20(11,9) – 19(11,8) E	0.4	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
246295.06	*(10)	$HCOOCH_3$	20(11,10) – 19(11,9) A	1.3[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
246295.06	*(10)	$HCOOCH_3$	20(11,9) – 19(11,8) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
246308.10	*(4)	$HCOOCH_3$	20(11,10) – 19(11,9) E	0.4	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
246421.91	*(2)	CH_3CH_2CN	28(2,27) – 27(2,26)	0.6	OriMC-1	OVRO	10.4m	Sut85		
246548.69	*(2)	CH_3CH_2CN	27(3,24) – 26(3,23)	0.6	OriMC-1	OVRO	10.4m	Sut85		
246560.749	*(91)	HC_3N	27 – 26 $v_7=1$ $\ell=1$f	1.1	OriMC-1	OVRO	10.4m	Sut85		
246600.16	*(4)	$HCOOCH_3$	20(10,11) – 19(10,10) E	0.7	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
246613.34	*(10)	$HCOOCH_3$	20(10,11) – 19(10,10) A	1.1[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
246613.38	*(10)	$HCOOCH_3$	20(10,10) – 19(10,9) A	[b]	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
246623.01	*(4)	$HCOOCH_3$	20(10,10) – 19(10,9) E	0.8	OriMC-1	OVRO	10.4m	Sut85	Plu86	M
246663.390	*(38)	^{34}SO	5(6) – 4(5)	2.9	OriMC-1	OVRO	10.4m	Sut85		
246686.18	*(13)	$^{34}SO_2$	4(3,1) – 4(2,2)	0.3	OriMC-1	OVRO	10.4m	Sut85		
246873.34	(5)	CH_3OH	19(3) – 19(2) A-+	0.30	OriMC-1	MMWO	4.9m	Lor85	Sas84	M
246891.62	*(3)	$HCOOCH_3$	19(4,15) – 18(4,14) E	0.18	OriMC-1	MMWO	4.9m	Lor85	Plu86	M
246896.87	*(16)	CH_2CHCN	26(7,20) – 25(7,19)	0.1[b]	OriMC-1	MMWO	4.9m	Lor85		M
246896.87	*(16)	CH_2CHCN	26(7,19) – 25(7,18)		[b]OriMC-1	OVRO	10.4m	Lor85		M
246914.59	*(10)	$HCOOCH_3$	19(4,15) – 18(4,14) A	1.2	OriMC-1	OVRO	10.4m	Sut85	Plu84	M
246924.65	*(31)	HDCO	4(1,4) – 3(1,3)	0.40	OriMC-1	MMWO	4.9m	Lor85		M
246945.78	*(5)	$HCOOCH_3$	10(5,6) – 9(4,6) E	0.16	OriMC-1	MMWO	4.9m	Lor85	Plu87	M
246952.14	*(23)	CH_2CHCN	26(9,18) – 25(9,17)	0.6[b]	OriMC-1	OVRO	10.4m	Sut85		
246952.14	*(23)	CH_2CHCN	26(9,17) – 25(9,16)	[b]	OriMC-1	OVRO	10.4m	Sut85		
247001.71	*(11)	CH_2CHCN	26(5,22) – 25(5,21)	0.2[b]	OriMC-1	OVRO	10.4m	Bla86		
247004.92	*(11)	CH_2CHCN	26(5,21) – 25(5,20)	[b]	OriMC-1	OVRO	10.4m	Bla86		
247040.77	*(4)	$HCOOCH_3$	20(9,11) – 19(9,10) E	0.6	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
247044.11	*(3)	$HCOOCH_3$	20(3,19) – 19(3,18) E	1.1	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
247053.45	*(5)	$HCOOCH_3$	20(3,19) – 19(3,18) A	1.2	OriMC-1	OVRO	10.4m	Bla86	Plu84	M
247057.25	*(10)	$HCOOCH_3$	20(9,12) – 19(9,11) A	1.2[b]	OriMC-1	OVRO	10.4m	Bla86	Plu84	M
247057.70	*(10)	$HCOOCH_3$	20(9,11) – 19(9,10) A	[b]	OriMC-1	OVRO	10.4m	Bla86	Plu84	M
247063.46	*(4)	$HCOOCH_3$	20(9,12) – 19(9,11) E	0.5	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
247086.93	*(8)	CH_2CHCN	26(3,24) – 25(3,23)	0.2	OriMC-1	OVRO	10.4m	Bla86		
247162.1	(1)	CH_3OH	16(2) – 15(3) E	1.6	OriMC-1	OVRO	10.4m	Bla86	Bla86	M
247228.693	(24)	CH_3OH	4(2) – 5(1) A+	3.9	OriMC-1	OVRO	10.4m	Bla86	Pic81	
247270.64	*(9)	CH_2CHCN	26(4,22) – 25(4,21)	0.3	OriMC-1	OVRO	10.4m	Bla86		
247440.36	*(12)	$^{34}SO_2$	5(3,3) – 5(2,4)	0.7	OriMC-1	OVRO	10.4m	Bla86		
U 247469.		unidentified		0.6	OriMC-1	OVRO	10.4m	Bla86		
247610.96	(5)	CH_3OH	18(3) – 18(2) A – +	1.1	OriMC-1	OVRO	10.4m	Bla86	Sas84	
U 247630.		unidentified		0.4	OriMC-1	OVRO	10.4m	Bla86		
U 247636.		unidentified		0.4	OriMC-1	OVRO	10.4m	Bla86		
247656.85	*(3)	$HCOOCH_3$	20(2,19) – 19(2,18) E	1.4	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
247665.34	*(10)	$HCOOCH_3$	20(2,19) – 19(2,18) A	1.2	OriMC-1	OVRO	10.4m	Bla86	Plu84	M
247682.65	*(4)	$HCOOCH_3$	20(8,12) – 19(8,11) E	0.2	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
247697.19	*(10)	$HCOOCH_3$	20(8,13) – 19(8,12) A	0.7	OriMC-1	OVRO	10.4m	Bla86	Plu84	M
247704.35	*(4)	$HCOOCH_3$	20(8,13) – 19(8,12) E	0.8	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
247707.95	*(10)	$HCOOCH_3$	20(8,12) – 19(8,11) A	1.1	OriMC-1	OVRO	10.4m	Bla86	Plu84	M
247798.55	*(15)	CH_2CHCN	27(1,27) – 26(1,26)	0.3	OriMC-1	OVRO	10.4m	Bla86		
247840.2	(1)	CH_3OH	12(–2) – 13(–3) E	1.0	OriMC-1	OVRO	10.4m	Bla86	Bla86	M
U 247875.		unidentified		0.7	OriMC-1	OVRO	10.4m	Bla86		
247901.65	*(3)	$HCOOCH_3$	22(8,21) – 21(8,20) E	0.7	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
247907.12	*(10)	$HCOOCH_3$	22(2,21) – 21(2,20) A	0.6	OriMC-1	OVRO	10.4m	Bla86	Plu84	M
U 247911.		unidentified		0.5	OriMC-1	OVRO	10.4m	Bla86		
247922.26	*(3)	$HCOOCH_3$	22(1,21) – 21(1,20) E	0.6	OriMC-1	OVRO	10.4m	Bla86	Plu86	M

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
247927.69	*(10)	$HCOOCH_3$	22(1,21) – 21(1,20) A	0.5	OriMC-1	OVRO	10.4m	Bla86	Plu84	M
248057.385	*(31)	SO_2	15(2,14) – 15(1,15)	6.1	OriMC-1	OVRO	10.4m	Bla86		
248242.5	(1)	CH_3OH	17(3) – 17(2) A – +	2.2	OriMC-1	OVRO	10.4m	Bla86	Bla86	
248364.82	*(11)	$^{34}SO_2$	7(3,5) – 7(2,6)	0.9	OriMC-1	OVRO	10.4m	Bla86		
248436.900	*(33)	SO_2	13(3,11) – 14(0,14)	0.6	OriMC-1	OVRO	10.4m	Bla86		
248528.95	*(78)	CH_2CHCN	26(3,23) – 25(3,22)	0.4	OriMC-1	OVRO	10.4m	Bla86		
248617.41	*(10)	$HCOOCH_3$	20(7,14) – 19(7,13) A	1.0	OriMC-1	OVRO	10.4m	Bla86	Plu84	M
248633.58	*(4)	$HCOOCH_3$	20(7,14) – 19(7,13) E	1.0	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
249887.47	(5)	CH_3OH	14(3) – 14(2) A – +	3.6	OriMC-1	OVRO	10.4m	Bla86	Sas84	
249924.31	*(28)	CH_3OCH_3	15(1,14) – 14(2,13) EE	1.1	OriMC-1	OVRO	10.4m	Bla86		
250050.21	*(24)	$^{13}CH_3CN$	14(3) – 13(3)	0.6	OriMC-1	OVRO	10.4m	Bla86	Bou80	
250073.68	*(24)	$^{13}CH_3CN$	14(2) – 13(2)	0.5	OriMC-1	OVRO	10.4m	Bla86	Bou80	
250087.76	*(25)	$^{13}CH_3CN$	14(1) – 13(1)	0.3	OriMC-1	OVRO	10.4m	Bla86	Bou80	
250092.46	*(25)	$^{13}CH_3CN$	14(0) – 13(0)	0.4	OriMC-1	OVRO	10.4m	Bla86	Bou80	
250246.46	*(3)	$HCOOCH_3$	20(3,17) – 19(3,16) E	1.0	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
250258.34	*(10)	$HCOOCH_3$	20(3,17) – 19(3,16) A	0.9	OriMC-1	OVRO	10.4m	Bla86	Plu84	M
250291.18	(5)	CH_3OH	13(3) – 13(2) A – +	4.2	OriMC-1	OVRO	10.4m	Bla86	Sas84	
250358.42	*(10)	$^{34}SO_2$	9(3,7) – 9(2,8)	0.9	OriMC-1	OVRO	10.4m	Bla86		
250440.328	*(20)	CH_3CH_2CN	28(3,26) – 27(3,25)	1.7[w]	OriMC-1	OVRO	10.4m	Bla86		
250482.94	(2)	NO	$^2\Pi_{1/2}$ $J,F = 5/2,5/2 - 3/2,3/2$ e	0.3	OriMC-1	OVRO	10.4m	Bla86	Poy80	
250506.98	(5)	CH_3OH	11(0) – 10(1) A+	5.8	OriMC-1	OVRO	10.4m	Bla86	Sas84	
250635.207	(12)	CH_3OH	12(3) – 12(2) A – +	5.9	OriMC-1	OVRO	10.4m	Bla86	Pic81	
251738.520	(12)	CH_3OH	6(3) – 6(2) A – +	2.0	OriMC-1	MMWO	4.9m	Cle84	Pic81	
251811.882	(12)	CH_3OH	5(3) – 5(2) A – +	1.2	OriMC-1	MMWO	4.9m	Cle84	Pic81	
251825.762	*(39)	SO	5(6) – 4(5)	3.3	OriMC-1	MMWO	4.9m	Cle84		
251866.579	(12)	CH_3OH	4(3) – 4(2) A – +	1.5	OriMC-1	MMWO	4.9m	Cle84	Pic81	
251890.901	(12)	CH_3OH	5(3) – 5(2) A+ –	1.8	OriMC-1	MMWO	4.9m	Cle84	Pic81	
251895.728	(12)	CH_3OH	6(3) – 6(2) A+ –	2.1	OriMC-1	MMWO	4.9m	Cle84	Pic81	
251900.495	(12)	CH_3OH	4(3) – 4(2) A+ –	1.7	OriMC-1	MMWO	4.9m	Cle84	Pic81	
251905.812	(12)	CH_3OH	3(3) – 3(2) A – +	1.0	OriMC-1	MMWO	4.9m	Cle84	Pic81	
251917.042	(12)	CH_3OH	3(3) – 3(2) A+ –	1.1	OriMC-1	MMWO	4.9m	Cle84	Pic81	
251923.631	(12)	CH_3OH	7(3) – 7(2) A+ –	1.8	OriMC-1	MMWO	4.9m	Cle84	Pic81	
U 251953.		unidentified		1.2	OriMC-1	MMWO	4.9m	Cle84		
252803.377	(24)	CH_3OH	12(3) – 12(2) A+ –	4.1	OriMC-1	OVRO	10.4m	Bla86	Pic81	
252896.045	*(20)	CH_3CH_2CN	28(4,24) – 27(4,23)	0.7	OriMC-1	OVRO	10.4m	Bla86		
253207.011	*(32)	^{34}SO	6(6) – 5(5)	3.0	OriMC-1	OVRO	10.4m	Bla86		
253221.39	(5)	CH_3OH	13(3) – 13(2) A+ –	3.1	OriMC-1	OVRO	10.4m	Bla86	Sas84	
253755.85	(5)	CH_3OH	14(3) – 14(–2) A+ –	0.73	OriMC-1	MMWO	4.9m	Lor84b	Sas84	
254015.34	(5)	CH_3OH	2(0) – 1(–1) E	0.95	OriMC-1	MMWO	4.9m	Lor84	Sas84	
254102.68	*(74)	SiS	14 – 13	0.85	IRC+10216	MMWO	4.9m	Sah84		
254216.241	*(67)	^{30}SiO	6 – 5	0.6	OriMC-1	MMWO	4.9m	Lor84b		
254423.58	(5)	CH_3OH	15(3) – 15(2) A+ –	3.0[b]	OriMC-1	OVRO	10.4m	Bla86	Sas84	
254423.58	(5)	CH_3OH	11(5) – 11(4) E	[b]	OriMC-1	OVRO	10.4m	Bla86	Sas84	
254573.657	*(10)	SO	8(9) – 8(8)	0.39	OriMC-1	MMWO	4.9m	Lor84		
254699.62	*(10)	HC_3N	28 – 27	5.0	OriMC-1	OVRO	10.4m	Bla86		
254841.818	(30)	$^{13}CH_3OH$	8(3) – 8(2) A A+	0.7	OriMC-1	OVRO	10.4m	Sut88	And87	N
254959.398	(30)	$^{13}CH_3OH$	7(3) – 7(2) A-A+	1.2	OriMC-1	OVRO	10.4m	Bla86	And87	N
254959.5	(1)	CH_3OH	unassigned	1.2	OriMC-1	OVRO	10.4m	Bla86	Bla86	
254976.344	*(20)	CH_3CH_2CN	29(2,28) – 28(2,27)	1.5	OriMC-1	OVRO	10.4m	Bla86		
255050.260	(59)	HDO	5(2,3) – 4(3,2)	2.1	OriMC-1	OVRO	10.4m	Bla86	Del71	
255050.965	(30)	$^{13}CH_3OH$	6(3) – 6(2) A-A+	n.r.	OriMC-1	OVRO	10.4m	Bla86d	And87	N
255120.837	(30)	$^{13}CH_3OH$	5(3) – 5(2) A-A+	1.7	OriMC-1	OVRO	10.4m	Bla86	And87	N
255173.019	(30)	$^{13}CH_3OH$	4(3) – 4(2) A-A+	1.2	OriMC-1	OVRO	10.4m	Bla86	And87	N
255193.329	(30)	$^{13}CH_3OH$	5(3) – 5(2) A+A-	[b]	OriMC-1	OVRO	10.4m	Bla86	And87	N
255193.329	(30)	$^{13}CH_3OH$	6(3) – 6(2) A+A–	1.8[b]	OriMC-1	OVRO	10.4m	Bla86	And87	N
255203.728	(30)	$^{13}CH_3OH$	4(3) – 4(2) A+A–	1.3	OriMC-1	OVRO	10.4m	Bla86	And87	N
255210.605	(30)	$^{13}CH_3OH$	3(3) – 3(2) A-A+	0.6	OriMC-1	OVRO	10.4m	Sut88	And87	N
255214.891	(30)	$^{13}CH_3OH$	7(3) – 7(2) A+A–	1.0	OriMC-1	OVRO	10.4m	Bla86	And87	N
255220.865	(30)	$^{13}CH_3OH$	3(3) – 3(2) A+A–	0.9	OriMC-1	OVRO	10.4m	Bla86	And87	N
255241.97	(5)	CH_3OH	16(3) – 16(2) A+ –	3.8	OriMC-1	OVRO	10.4m	Bla86	Sas84	
255265.637	(30)	$^{13}CH_3OH$	8(3) – 8(2) A+A–	1.4	OriMC-1	OVRO	10.4m	Bla86	And87	N
255324.34	*(11)	HC_3N	28 – 27 $v_7 = 1$ $\ell = 1$e	1.0	OriMC-1	OVRO	10.4m	Bla86		
255357.	(1)	$^{13}CH_3OH$	9(3) – 9(2) A+A–	1.0	OriMC-1	OVRO	10.4m	Bla86	Sut88	N
255374.453	*(2)	OCS	21 – 20	6.5	OriMC-1	OVRO	10.4m	Bla86		
255479.39	*(8)	$HC^{18}O^+$	3 – 2	1.0	OriMC-1	OVRO	10.4m	Bla86		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
255498.	(1)	$^{13}CH_3OH$	10(3) – 10(2) A+A–	0.8	OriMC-1	OVRO	10.4m	Bla86	Sut88	N
255553.328*	(14)	SO_2	4(3,1) – 4(2,2)	7.4	OriMC-1	OVRO	10.4m	Bla86		
255595.35 *	(13)	SO_2	51(7,45) – 50(8,42)	0.4[v]	OriMC-1	OVRO	10.4m	Bla86		
U255651.		unidentified		1.2	OriMC-1	OVRO	10.4m	Bla86		
255689.08 *	(11)	HC_3N	28 – 27 $v_7=1$ $\ell=1$f	1.1	OriMC-1	OVRO	10.4m	Bla86		
255776.13 *	(3)	$HCOOCH_3$	21(4,18) – 20(4,17) E	1.0	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
255789.41 *	(10)	$HCOOCH_3$	21(4,18) – 20(4,17) A	1.0	OriMC-1	OVRO	10.4m	Bla86	Plu84	M
255906.469*	(20)	CH_3CH_2CN	28(3,25) – 27(3,24)	0.9	OriMC-1	OVRO	10.4m	Bla86		
255958.073*	(15)	SO_2	3(3,1) – 3(2,2)	>3.	OriMC-1	BTL	7m	Tha81		
255980.	(1)	$^{13}CH_3OH$	12(3) – 12(2) A+A–	0.5	OriMC-1	OVRO	10.4m	Bla86	Sut88	N
256027.12	(8)	HCS^+	6 – 5	<1.	OriMC-1	BTL	7m	Tha81	Bog84	
256228.80	(5)	CH_3OH	17(3) – 17(2) A+ –	1.7	OriMC-1	OVRO	10.4m	Bla86	Sas84	
256246.969*	(14)	SO_2	5(3,3) – 5(2,4)	1.2	OriMC-1	MMWO	4.9m	Lor84b		
256292.639*	(13)	CH_3CCH	15(3) – 14(3)	0.3	OriMC-1	MMWO	4.9m	Lor84b		
256317.079*	(8)	CH_3CCH	15(2) – 14(2)	0.3	OriMC-1	MMWO	4.9m	Lor84b		
256331.746*	(6)	CH_3CCH	15(1) – 14(1)	0.4	OriMC-1	MMWO	4.9m	Lor84b		
256336.637*	(6)	CH_3CCH	15(0) – 14(0)	0.4	OriMC-1	MMWO	4.9m	Lor84b		
256395.926*	(22)	CH_3CH_2CN	29(1,28) – 28(1,27)	1.0	OriMC-1	OVRO	10.4m	Bla86		
256409.07 *	(29)	CH_2CHCN	27(8,19) – 26(8,18)	[b]	OriMC-1	OVRO	10.4m	Bla86		
256409.07 *	(29)	CH_2CHCN	27(8,20) – 26(8,19)	0.7[b]	OriMC-1	OVRO	10.4m	Bla86		
256425.85 *	(16)	CH_2CHCN	27(6,22) – 26(6,21)	0.7[b]	OriMC-1	OVRO	10.4m	Bla86		
256425.95 *	(16)	CH_2CHCN	27(6,21) – 26(6,20)	[b]	OriMC-1	OVRO	10.4m	Bla86		
256447.75 *	(28)	CH_2CHCN	27(9,18) – 26(9,17)	[b]	OriMC-1	OVRO	10.4m	Bla86		
256447.75 *	(28)	CH_2CHCN	27(9,19) – 26(9,18)	0.4[b]	OriMC-1	OVRO	10.4m	Bla86		
256522.86 *	(13)	CH_2CHCN	27(5,23) – 26(5,22)	0.8	OriMC-1	OVRO	10.4m	Bla86		
256527.36 *	(13)	CH_2CHCN	27(5,22) – 26(5,21)	0.5	OriMC-1	OVRO	10.4m	Bla86		
256585.34 *	(33)	HDCO	4(0,4) – 3(0,3)	0.54	OriMC-1	MMWO	4.9m	Lor85		M
256671.817	(30)	$^{13}CH_3OH$	9(0) – 8(1) E	0.5	OriMC-1	OVRO	10.4m	Bla86	And87	N
256711.75 *	(11)	CH_2CHCN	27(4,24) – 26(4,23)	0.3	OriMC-1	OVRO	10.4m	Bla86		
256837.22 *	(11)	CH_2CHCN	27(4,23) – 26(4,22)	0.3	OriMC-1	OVRO	10.4m	Bla86		
256877.802*	(32)	^{34}SO	7(6) – 6(5)	0.79	OriMC-1	MMWO	4.9m	Lor84		
256966.885*	(25)	CH_3CH_2CN	30(0,30) – 29(1,29)	0.2	OriMC-1	OVRO	10.4m	Bla86		
257033.444*	(18)	CH_3CN	14(10) – 13(10)	0.3	OriMC-1	OVRO	10.4m	Bla86		M
257099.982*	(14)	SO_2	7(3,5) – 7(2,6)	7.9	OriMC-1	OVRO	10.4m	Bla86		
257127.036*	(14)	CH_3CN	14(9) – 13(9)	0.6	OriMC-1	OVRO	10.4m	Bla86		M
257210.879*	(11)	CH_3CN	14(8) – 13(8)	0.6	OriMC-1	OVRO	10.4m	Bla86		M
257226.56 *	(3)	$HCOOCH_3$	20(5,15) – 19(5,14) E	0.8	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
257239.855*	(25)	CH_3CH_2CN	30(1,30) – 29(1,29)	0.4	OriMC-1	OVRO	10.4m	Bla86		
257252.59 *	(10)	$HCOOCH_3$	20(5,15) – 19(5,14) A	0.9	OriMC-1	OVRO	10.4m	Bla86	Plu84	
257255.002*	(67)	^{29}SiO	6 – 5	1.6	OriMC-1	OVRO	10.4m	Bla86		
257284.937*	(8)	CH_3CN	14(7) – 13(7)	1.0	OriMC-1	OVRO	10.4m	Bla86		M
257310.641*	(25)	CH_3CH_2CN	30(0,30) – 29(0,29)	0.8	OriMC-1	OVRO	10.4m	Bla86		
257349.182*	(6)	CH_3CN	14(6) – 13(6)	1.8	OriMC-1	OVRO	10.4m	Bla86		M
257380.15 *	(27)	$CH_3{}^{13}CN$	14(2) – 13(2)	0.3	OriMC-1	OVRO	10.4m	Bla86	Bou80	
257402.19	(5)	CH_3OH	18(3) – 18(2) A+ –	2.8[b]	OriMC-1	OVRO	10.4m	Bla86	Sas84	
257403.587*	(4)	CH_3CN	14(5) – 13(5)	0.5	OriMC-1	MMWO	4.9m	Lor84		M
257420.24 *	(14)	SO_2	24(2,22) – 24(1,23) $v_2=1$	0.4	OriMC-1	OVRO	10.4m	Bla86		
257448.131*	(3)	CH_3CN	14(4) – 13(4)	0.5	OriMC-1	MMWO	4.9m	Lor84		M
257482.794*	(3)	CH_3CN	14(3) – 13(3)	1.1	OriMC-1	MMWO	4.9m	Lor84		M
257507.564*	(3)	CH_3CN	14(2) – 13(2)	0.85	OriMC-1	MMWO	4.9m	Lor84		M
257522.429*	(3)	CH_3CN	14(1) – 13(1)	1.15	OriMC-1	MMWO	4.9m	Lor84		M
257527.385*	(3)	CH_3CN	14(0) – 13(0)	1.2	OriMC-1	MMWO	4.9m	Lor84		M
257583.611*	(25)	CH_3CH_2CN	30(1,30) – 29(0,29)	0.3	OriMC-1	OVRO	10.4m	Bla86		
257646.01 *	(19)	CH_2CHCN	28(0,28) – 27(0,27)	0.5	OriMC-1	OVRO	10.4m	Bla86		
257690.32 *	(3)	$HCOOCH_3$	22(3,20) – 21(3,19) E	1.4	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
257699.44 *	(10)	$HCOOCH_3$	22(3,20) – 21(3,19) A	0.9	OriMC-1	OVRO	10.4m	Bla86	Plu84	
257747.05	(3)	HDCO	4(2,3) – 3(2,2)	0.6	OriMC-1	OVRO	10.4m	Bla86	Dan78	
U257912.		unidentified		1.0	OriMC-1	OVRO	10.4m	Bla86		
257975.01 *	(1)	HCOOH	12(1,12) – 11(1,11)	0.3	OriMC-1	OVRO	10.4m	Bla86		
258054.14 *	(15)	CH_3CN	14(1) – 13(1) $v_8=1$ $\ell=1$	1.1	OriMC-1	OVRO	10.4m	Bla86	Bou80	
258070.96	(6)	HDCO	4(3,2) – 3(3,1)	0.3	OriMC-1	OVRO	10.4m	Bla86	Dan78	
258081.01 *	(3)	$HCOOCH_3$	22(2,20) – 21(2,19) E	1.2	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
258089.50 *	(10)	$HCOOCH_3$	22(2,20) – 21(2,19) A	1.1	OriMC-1	OVRO	10.4m	Bla86	Plu84	
258121.06 *	(10)	$HCOOCH_3$	21(14,7) – 20(14,6) A	[b]	OriMC-1	OVRO	10.4m	Bla86	Plu84	
258121.06 *	(10)	$HCOOCH_3$	21(14,8) – 20(14,7) A	1.0[b]	OriMC-1	OVRO	10.4m	Bla86	Plu84	

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
258122.69	*(5)	$HCOOCH_3$	21(14,7) – 20(14,6) E	[b]	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
258157.02	*(47)	$HC^{15}N$	3 – 2	5.2	OriMC-1	OVRO	10.4m	Bla86		
258186.99	*(13)	CH_3CN	14(6) – 13(5) v_8=1 ℓ=1	0.3	OriMC-1	OVRO	10.4m	Bla86	Bou80	
258255.828	*(32)	SO	6(6) – 5(5)	4.0	OriMC-1	MMWO	4.9m	Cle84		
258295.60	*(18)	CH_3CN	14(3) – 13(3) v_8=1 ℓ=1	1.1	OriMC-1	OVRO	10.4m	Bla86	Bou80	
258320.39	*(25)	CH_3CN	14(2) – 13(2) v_8=1 ℓ=1	0.7	OriMC-1	OVRO	10.4m	Bla86	Bou80	
258360.05	*(7)	CH_2CHCN	27(1,26) – 26(1,25)	0.6	OriMC-1	OVRO	10.4m	Bla86		
258388.81	*(12)	SO_2	32(4,28) – 32(3,29)	1.5	OriMC-1	OVRO	10.4m	Bla86		
258476.61	*(5)	$HCOOCH_3$	21(12,9) – 20(12,8) E	0.9	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
258482.92	*(10)	$HCOOCH_3$	21(12,10) – 20(12,9) A	1.0	OriMC-1	OVRO	10.4m	Bla86	Plu84	
258490.87	*(4)	$HCOOCH_3$	23(2,22) – 22(2,21) E	1.0	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
258496.27	*(10)	$HCOOCH_3$	23(2,23) – 22(2,21) A	1.1	OriMC-1	OVRO	10.4m	Bla86	Plu84	
258499.11	*(5)	$HCOOCH_3$	21(12,10) – 20(12,9) E	0.8	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
258502.78	*(4)	$HCOOCH_3$	23(1,22) – 22(1,21) E	1.0	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
258508.14	*(10)	$HCOOCH_3$	23(1,22) – 22(1,21) A	1.0	OriMC-1	OVRO	10.4m	Bla86	Plu84	
258549.04	*(20)	CH_3OCH_3	14(1,14) – 13(0,13) EE	3.2[b]	OriMC-1	OVRO	10.4m	Bla86		
258549.30	*(19)	CH_3OCH_3	14(1,14) – 13(0,13) AA	[b]	OriMC-1	OVRO	10.4m	Bla86		
258552.40	*(15)	CH_3CN	14(1) – 13(1) v_8=1 ℓ=1	0.6[b]	OriMC-1	OVRO	10.4m	Bla86	Bou80	
258667.002	*(61)	SO_2	20(7,13) – 21(6,16)	0.7	OriMC-1	OVRO	10.4m	Bla86		
258707.351	*(65)	SiO	6 – 5 v=1	41.7Jy	*R* Leo	OVRO	12m	Jew87		N
258746.44	*(5)	$HCOOCH_3$	21(11,10) – 20(11,9) E	0.5	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
258756.63	*(10)	$HCOOCH_3$	21(11,10) – 20(11,9) A	0.7[b]	OriMC-1	OVRO	10.4m	Bla86	Plu84	
258756.63	*(10)	$HCOOCH_3$	21(11,11) – 20(11,10) A	[b]	OriMC-1	OVRO	10.4m	Bla86	Plu84	
258769.68	*(5)	$HCOOCH_3$	21(11,11) – 20(11,10) E	0.4	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
258780.38	(5)	CH_3OH	19(3) – 19(2) A+ –	1.8	OriMC-1	OVRO	10.4m	Bla86	Sas84	
258942.207	*(18)	SO_2	9(3,7) – 9(2,8)	0.9	OriMC-1	MMWO	4.9m	Lor84b		
259011.79	*(55)	$H^{13}CN$	3 – 2	2.3	OriMC-1	MMWO	4.9m	Lor84b		
259035.13	*(33)	HDCO	4(2,2) – 3(2,1)	0.18	OriMC-1	MMWO	4.9m	Lor84b		
259114.18	*(4)	$HCOOCH_3$	21(10,11) – 20(10,10) E	0.6	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
259128.13	*(10)	$HCOOCH_3$	21(10,12) – 20(10,11) A	[b]	OriMC-1	OVRO	10.4m	Bla86	Plu84	
259128.17	*(10)	$HCOOCH_3$	21(10,11) – 20(10,10) A	1.1[b]	OriMC-1	OVRO	10.4m	Bla86	Plu84	
259137.69	*(4)	$HCOOCH_3$	21(10,12) – 20(10,11) E	0.3	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
259232.721	*(21)	CH_3CH_2CN	29(3,27) – 28(3,26)	0.7	OriMC-1	OVRO	10.4m	Bla86		
259273.7	(1)	CH_3OH	17(2) – 16(1) A–	1.0	OriMC-1	OVRO	10.4m	Bla86	Bla86	M
U 259285.		unidentified		0.8	OriMC-1	OVRO	10.4m	Bla86		
U 259311.		unidentified		0.6	OriMC-1	OVRO	10.4m	Bla86		
259341.93	*(5)	$HCOOCH_3$	24(1,24) – 23(1,23) E	2.0[b]	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
259342.07	*(5)	$HCOOCH_3$	24(0,24) – 23(0,23) E	[b]	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
259342.84	*(10)	$HCOOCH_3$	24(1,24) – 23(1,23) A	[b]	OriMC-1	OVRO	10.4m	Bla86	Plu84	
259342.95	*(10)	$HCOOCH_3$	24(0,24) – 23(0,23) A	[b]	OriMC-1	OVRO	10.4m	Bla86	Plu84	
259484.90	*(28)	CH_3OCH_3	6(3,4) – 5(2,3) EA	0.7[b]	OriMC-1	OVRO	10.4m	Bla86		
259486.79	*(22)	CH_3OCH_3	6(3,4) – 5(2,3) AE	[b]	OriMC-1	OVRO	10.4m	Bla86		
259488.87	*(17)	CH_3OCH_3	6(3,4) – 5(2,3) EE	1.3	OriMC-1	OVRO	10.4m	Bla86		
259493.92	*(10)	CH_3OCH_3	6(3,4) – 5(2,3) AA	0.6	OriMC-1	OVRO	10.4m	Bla86		
259499.92	*(3)	$HCOOCH_3$	20(4,16) – 19(4,15) E	0.8	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
259521.70	*(10)	$HCOOCH_3$	20(4,16) – 19(4,15) A	1.0	OriMC-1	OVRO	10.4m	Bla86	Plu84	
259599.48	*(11)	SO_2	30(4,26) – 30(3,27)	1.5	OriMC-1	OVRO	10.4m	Bla86		
259617.23	*(10)	$^{34}SO_2$	13(3,11) – 13(2,12)	1.0	OriMC-1	OVRO	10.4m	Bla86		
259629.42	*(4)	$HCOOCH_3$	21(9,12) – 20(9,11) E	0.6	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
259646.55	*(10)	$HCOOCH_3$	21(9,13) – 20(9,12) A	0.8[b]	OriMC-1	OVRO	10.4m	Bla86	Plu84	
259646.67	*(10)	$HCOOCH_3$	21(9,12) – 20(9,11) A	[b]	OriMC-1	OVRO	10.4m	Bla86	Plu84	
259652.84	*(4)	$HCOOCH_3$	21(9,13) – 20(9,12) E	0.5	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
U 259690.		unidentified		0.5	OriMC-1	OVRO	10.4m	Bla86		
U 259733.		unidentified		0.7	OriMC-1	OVRO	10.4m	Bla86		
259842.936	*(23)	CH_3CH_2CN	29(10,19) – 28(10,18)	1.0[b]	OriMC-1	OVRO	10.4m	Bla86		
259842.936	*(23)	CH_3CH_2CN	29(10,20) – 28(10,19)	[b]	OriMC-1	OVRO	10.4m	Bla86		
259847.373	*(24)	CH_3CH_2CN	29(11,19) – 28(11,18)	0.9[b]	OriMC-1	OVRO	10.4m	Bla86		
259847.373	*(24)	CH_3CH_2CN	29(11,18) – 28(11,17)	[b]	OriMC-1	OVRO	10.4m	Bla86		
259862.754	*(22)	CH_3CH_2CN	29(9,21) – 28(9,20)	0.9[b]	OriMC-1	OVRO	10.4m	Bla86		
259862.754	*(22)	CH_3CH_2CN	29(9,20) – 28(9,19)	[b]	OriMC-1	OVRO	10.4m	Bla86		
259869.904	*(25)	CH_3CH_2CN	29(12,18) – 28(12,17)	0.6[b]	OriMC-1	OVRO	10.4m	Bla86		
259869.904	*(25)	CH_3CH_2CN	29(12,17) – 28(12,16)	[b]	OriMC-1	OVRO	10.4m	Bla86		
259906.678	*(27)	CH_3CH_2CN	29(13,17) – 28(13,16)	0.5[b]	OriMC-1	OVRO	10.4m	Bla86		
259906.678	*(27)	CH_3CH_2CN	29(13,16) – 28(13,15)	[b]	OriMC-1	OVRO	10.4m	Bla86		
259917.265	*(25)	CH_3CH_2CN	29(8,22) – 28(8,21)	1.0[b]	OriMC-1	OVRO	10.4m	Bla86		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
259917.265*(25)		CH_3CH_2CN	29(8,21) – 28(8,20)	[b]	OriMC-1	OVRO	10.4m	Bla86		
259955.178*(28)		CH_3CH_2CN	29(14,16) – 28(14,15)	0.4[b]	OriMC-1	OVRO	10.4m	Bla86		
259955.178*(28)		CH_3CH_2CN	29(14,15) – 28(14,14)	[b]	OriMC-1	OVRO	10.4m	Bla86		
U 259986.		unidentified		0.8	OriMC-1	OVRO	10.4m	Bla86		
259986.530	(30)	$^{13}CH_3OH$	2(1) – 1(0) E	0.8	OriMC-1	OVRO	10.4m	Bla86	And87	N
260013.701*(30)		CH_3CH_2CN	29(15,14) – 28(15,13)	[b]	OriMC-1	OVRO	10.4m	Bla86		
260013.701*(30)		CH_3CH_2CN	29(15,15) – 28(15,14)	0.5[b]	OriMC-1	OVRO	10.4m	Bla86		
260025.312*(21)		CH_3CH_2CN	29(7,23) – 28(7,22)	0.8[b]	OriMC-1	OVRO	10.4m	Bla86		
260025.566*(21)		CH_3CH_2CN	29(7,23) – 28(7,22)	[b]	OriMC-1	OVRO	10.4m	Bla86		
260060.33	(10)	HCO	3(0,3) – 2(0,2) 7/2 – 5/2 F = 4 – 3	0.09	OriMC-2	MMWO	4.9m	Sny85a	Bla84a	
260081.055*(33)		CH_3CH_2CN	29(16,14) – 28(16,13)	0.3[b]	OriMC-1	OVRO	10.4m	Bla86		
260081.055*(33)		CH_3CH_2CN	29(16,13) – 28(16,12)	[b]	OriMC-1	OVRO	10.4m	Bla86		
260156.377*(37)		CH_3CH_2CN	29(17,13) – 28(17,12)	0.4[b]	OriMC-1	OVRO	10.4m	Bla86		
260156.377*(37)		CH_3CH_2CN	29(17,12) – 28(17,11)	[b]	OriMC-1	OVRO	10.4m	Bla86		
260191.99	*(36)	CH_2CO	13(1,13) – 12(1,12)	0.6	OriMC-1	OVRO	10.4m	Bla86		
260221.648*(21)		CH_3CH_2CN	29(6,24) – 28(6,23)	0.9[b]	OriMC-1	OVRO	10.4m	Bla86		
260229.152*(21)		CH_3CH_2CN	29(6,23) – 28(6,22)	[b]	OriMC-1	OVRO	10.4m	Bla86		
260244.42	*(4)	$HCOOCH_3$	21(3,18) – 20(3,17) E	0.8	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
260255.06	*(5)	$HCOOCH_3$	21(3,18) – 20(3,17) A	2.1[b]	OriMC-1	OVRO	10.4m	Bla86	Plu84	
260255.48	*(20)	$H^{13}CO^+$	3 – 2	0.95	OriMC-1	MMWO	4.9m	Woo84a		
260255.48	*(20)	$H^{13}CO^+$	3 – 2	>1.0[b]	OriMC-1	OVRO	10.4m	Bla86		
260327.00	*(22)	$^{34}SO_2$	24(2,22) – 24(1,23)	1.0	OriMC-1	OVRO	10.4m	Bla86		
260381.56	(5)	CH_3OH	20(3) – 20(2) A+ –	1.8[b]	OriMC-1	OVRO	10.4m	Bla86	Sas84	
260384.19	*(4)	$HCOOCH_3$	21(8,13) – 20(8,12) E	1.6[b]	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
260392.73	*(10)	$HCOOCH_3$	21(8,14) – 20(8,13) A	1.0	OriMC-1	OVRO	10.4m	Bla86	Plu84	
260404.09	*(4)	$HCOOCH_3$	21(8,14) – 20(8,13) E	1.8	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
260415.31	*(10)	$HCOOCH_3$	21(8,13) – 20(8,12) A	0.7	OriMC-1	OVRO	10.4m	Bla86	Plu84	
U 260440.		unidentified		1.2	OriMC-1	OVRO	10.4m	Bla86		
260518.027*(67)		SiO	6 – 5 v = 0	2.9	OriMC-1	MMWO	4.9m	Lor84b		
260664.770*(21)		CH_3CH_2CN	29(4,26) – 28(4,25)	0.9[b]	OriMC-1	OVRO	10.4m	Bla86		
260667.111*(30)		CH_3CH_2CN	11(4,7) – 10(3,6)	[b]	OriMC-1	OVRO	10.4m	Bla86		
260679.039*(21)		CH_3CH_2CN	29(5,24) – 28(5,23)	0.8	OriMC-1	OVRO	10.4m	Bla86		
U 260726.		unidentified		1.2	OriMC-1	OVRO	10.4m	Bla86		
260758.61	*(14)	CH_3OCH_3	6(3,3) – 5(2,4) EE	1.9	OriMC-1	OVRO	10.4m	Bla86		
260761.70	*(10)	CH_3OCH_3	6(3,3) – 5(2,4) AA	1.5	OriMC-1	OVRO	10.4m	Bla86		
261061.36	(5)	CH_3OH	21(–4) – 20(–5) E	0.5	OriMC-1	OVRO	10.4m	Bla86	Sas84	
261148.87	*(3)	$HCOOCH_3$	21(5,17) – 20(5,16) E	1.4	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
261165.41	*(10)	$HCOOCH_3$	21(5,17) – 20(5,16) A	1.2	OriMC-1	OVRO	10.4m	Bla86	Plu84	
261247.64	*(56)	CH_3OCH_3	15(5,10) – 15(4,11) EE	1.5	OriMC-1	OVRO	10.4m	Bla86		
261250.17	*(46)	CH_3OCH_3	15(5,10) – 15(4,11) AA	0.8	OriMC-1	OVRO	10.4m	Bla86		
261263.39	*(10)	$HN^{13}C$	3 – 2	0.2	OriMC-1	MMWO	4.9m	Lor84b		
261433.75	*(10)	$HCOOCH_3$	21(7,15) – 20(7,14) A	0.9	OriMC-1	OVRO	10.4m	Bla86	Plu84	
261436.51	*(4)	$HCOOCH_3$	21(7,15) – 20(7,14) E	1.3	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
U 261564.		unidentified		1.1	OriMC-1	OVRO	10.4m	Bla86		
261704.44	(5)	CH_3OH	12(6) – 11(5) E	0.9	OriMC-1	OVRO	10.4m	Bla86	Sas84	
261715.68	*(4)	$HCOOCH_3$	21(7,14) – 20(7,13) E	1.1	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
261746.56	*(10)	$HCOOCH_3$	21(7,14) – 20(7,13) A	1.1	OriMC-1	OVRO	10.4m	Bla86	Plu84	
261805.71	(5)	CH_3OH	2(1) – 1(0) E	1.0	OriMC-1	MMWO	4.9m	Lor85	Sas84	M
261843.715*(36)		SO	7(6) – 6(5)	4.2	OriMC-1	MMWO	4.9m	Lor85		M
261897.33	*(6)	CH_3OCH_3	14(5,9) – 14(4,10) EE	0.23	OriMC-1	MMWO	4.9m	Lor85		M
261955.99	*(14)	CH_3OCH_3	15(5,11) – 15(4,12) EE	0.28	OriMC-1	MMWO	4.9m	Lor85		M
261959.30	*(45)	CH_3OCH_3	15(5,11) – 15(4,12) AA	1.1	OriMC-1	OVRO	10.4m	Bla86		
262004.26	(5)	C_2H	3 – 2 J = 7/2 – 5/2 F = 4 – 3	3.5	OriMC-1	MMWO	4.9m	Ziu82	Ziu82	
262006.48	(5)	C_2H	3 – 2 J = 7/2 – 5/2 F = 3 – 2	3.0	OriMC-1	MMWO	4.9m	Ziu82	Ziu82	
262064.99	(5)	C_2H	3 – 2 J = 5/2 – 3/2 F = 3 – 2	2.8	OriMC-1	MMWO	4.9m	Ziu82	Ziu82	
262067.46	(5)	C_2H	3 – 2 J = 5/2 – 3/2 F = 2 – 1	2.4	OriMC-1	MMWO	4.9m	Ziu82	Ziu82	
262078.89	*(30)	C_2H	3 – 2 J = 5/2 – 3/2 F = 2 – 2	0.8	OriMC-1	OVRO	10.4m	Bla86		
262103.48	*(1)	HCOOH	12(0,12) – 11(0,11)	0.4	OriMC-1	OVRO	10.4m	Bla86		
262183.742*(22)		CH_3CH_2CN	29(4,25) – 28(4,24)	0.7	OriMC-1	OVRO	10.4m	Bla86		
262208.61	*(30)	C_2H	3 – 2 J = 5/2 – 3/2 F = 3 – 3	<0.8	OriMC-1	OVRO	10.4m	Bla86		
262224.2	(1)	CH_3OH	21(3) – 21(2) A+ –	1.3	OriMC-1	OVRO	10.4m	Bla86	Bla86	
262256.904*(25)		SO_2	11(3,9) – 11(2,10)	1.7	OriMC-1	MMWO	4.9m	Eri84a		
262307.30	*(81)	CH_3OCH_3	14(5,10) – 14(4,11) EA	0.8[b]	OriMC-1	OVRO	10.4m	Bla86		
262310.27	*(63)	CH_3OCH_3	14(5,10) – 14(4,11) AE	[b]	OriMC-1	OVRO	10.4m	Bla86		
262312.45	*(56)	CH_3OCH_3	14(5,10) – 14(4,11) EE	1.0	OriMC-1	OVRO	10.4m	Bla86		

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
262316.39	*(39)	CH_3OCH_3	14(5,10) – 14(4,11) AA	0.9	OriMC-1	OVRO	10.4m	Bla86		
262324.81	*(3)	$HCOOCH_3$	21(6,16) – 20(6,15) E	1.2	OriMC-1	OVRO	10.4m	Bla86	Plu86	M
262340.53	*(10)	$HCOOCH_3$	21(6,16) – 20(6,15) A	1.0	OriMC-1	OVRO	10.4m	Bla86	Plu84	
262393.39	*(36)	CH_3OCH_3	13(5,8) – 13(4,9) EE	1.3[b]	OriMC-1	OVRO	10.4m	Bla86		
262394.92	*(33)	CH_3OCH_3	13(5,8) – 13(4,9) AA	[b]	OriMC-1	OVRO	10.4m	Bla86		
262548.36	*(51)	CH_2CO	13(0,13) – 12(0,12)	0.5	OriMC-1	OVRO	10.4m	Bla86		
262624.70	*(51)	CH_3OCH_3	13(5,9) – 13(4,10) EE	1.6	OriMC-1	OVRO	10.4m	Bla86		
262629.54	*(33)	CH_3OCH_3	13(5,9) – 13(4,10) AA	0.6	OriMC-1	OVRO	10.4m	Bla86		
262768.94	*(29)	CH_3OCH_3	12(5,7) – 12,4,6) EE	1.3[b]	OriMC-1	OVRO	10.4m	Bla86		
262769.484	*(20)	HNCO	12(1,12) – 11(1,11)	1.3[b]	OriMC-1	OVRO	10.4m	Bla86		
262769.72	*(28)	CH_3OCH_3	12(5,7) – 12,4,6) AA	[b]	OriMC-1	OVRO	10.4m	Bla86		
262774.25	*(18)	CH_3OCH_3	8(2,6) – 7(1,7) EE	0.7	OriMC-1	OVRO	10.4m	Bla86		
262889.46	*(47)	CH_3OCH_3	12(5,8) – 11(4,9) EE	0.5	OriMC-1	OVRO	10.4m	Bla86		
262895.29	*(28)	CH_3OCH_3	12(5,8) – 11(4,9) AA	0.5	OriMC-1	OVRO	10.4m	Bla86		
263050.03	*(24)	CH_3OCH_3	11(5,6) – 11(4,7) EE	1.1[b]	OriMC-1	OVRO	10.4m	Bla86		
263050.33	*(23)	CH_3OCH_3	11(5,6) – 11(4,7) AA	[b]	OriMC-1	OVRO	10.4m	Bla86		
U 263065.		unidentified		0.9	OriMC-1	OVRO	10.4m	Bla86		
263107.25	*(39)	CH_3OCH_3	11(5,7) – 11(4,8) EE	0.3	OriMC-1	OVRO	10.4m	Bla86		
263113.70	*(23)	CH_3OCH_3	11(5,7) – 11(4,8) AA	1.2	OriMC-1	OVRO	10.4m	Bla86		
263748.630	*(13)	HNCO	12(0,12) – 11(0,11)	0.3	OriMC-1	MMWO	4.9m	Arm84		
263792.47	*(12)	HC_3N	29 – 28	0.6	OriMC-1	MMWO	4.9m	Arm84		
264270.05	*(6)	H_2CO	10(1,9) – 10(1,10)	1.0	OriMC-1	NRAO	12m	Ziu86		N
U 264330.		unidentified		1.0	OriMC-1	NRAO	12m	Ziu86		N
U 265698.		unidentified		0.16	OriMC-1	MMWO	4.9m	Lor84a		
U 265700.		unidentified		0.8	OriMC-1	NRAO	12m	Ziu86		N
265759.45	*(9)	C_3H_2	4(4,1) – 3(3,0)	0.21	OriMC-1	MMWO	4.9m	Lor84a	Vrt87	M
U 265760.		unidentified		0.8	OriMC-1	NRAO	12m	Ziu86		N
265852.68	(5)	HCN	3 – 2 v_2=1 ℓ=1c	1.5	OriMC-1	NRAO	12m	Ziu86	DeL77	M
265886.432	*(10)	HCN	3 – 2	20.	OriMC-1	Hale	5m	Hug79		
266838.13	(5)	CH_3OH	5(2) – 4(1) E	1.7	OriMC-1	MMWO	4.9m	Joh84	Sas84	
266943.5	*(8)	SO_2	30(9,21) – 31(8,24)	0.20	OriMC-1	NRAO	12m	Tur90		N
267109.37	(10)	HCN	3 – 2 v_2=2 ℓ=2c	0.2	IRC+10216	IRAM	30m	Luc89	Del77	N
267120.02	(10)	HCN	3 – 2 v_2=2 ℓ=2d	0.5	IRC+10216	IRAM	30m	Luc89	Del77	N
267199.37	(5)	HCN	3 – 2 v_2=1 ℓ=1d	1.5	OriMC-1	NRAO	12m	Ziu86	DeL77	M
267241.5	*(9)	^{29}SiS	15 – 14	0.1[b]	IRC+10216	NRAO	12m	Ziu86		N
267243.15	(10)	HCN	3 – 2 v_2=2 ℓ=0	0.17[b]	OriMC-1	NRAO	12m	Tur87		N
267403.44	(5)	CH_3OH	9(0) – 8(1) E	1.8	OriMC-1	UKIRT	3.8m	Den84	Sas84	
267530.218	(20)	OCS	22 – 21	[r]	OriMC-1	MMWO	4.9m	Lor84b	Sch83a	
267537.440	*(33)	SO_2	13(3,11) – 13(2,12)	[r]	OriMC-1	MMWO	4.9m	Lor84b		
267557.625	*(17)	HCO^+	3 – 2	12.	OriMC-1	Hale	5m	Hug79		
268745.769	*(12)	$H_2C^{18}O$	4(1,4) – 3(1,3)	0.64	OriMC-1	MWO	4.9m	Man90		N
271981.067	*(50)	HNC	3 – 2	10.	OriMC-1	Hale	5m	Hug79		
272242.40	*(91)	SiS	15 – 14	0.48	IRC+10216	MMWO	4.9m	Sah84		
272884.95	*(15)	HC_3N	30 – 29	0.8	OriMC-1	MMWO	4.9m	Lor81		
274762.114	*(9)	$H_2{}^{13}CO$	4(1,4) – 3(1,3)	1.20	OriMC-1	MWO	4.9m	Man90		N
275240.166	*(43)	SO_2	15(3,13) – 15(2,14)	1.7	OriMC-1	MMWO	4.9m	Lor84c		
275724.703	*(6)	CH_3CN	15(6) – 14(6)	0.47	OriMC-1	MMWO	4.9m	Lor84		M
275782.975	*(4)	CH_3CN	15(5) – 14(5)	0.39	OriMC-1	MMWO	4.9m	Lor84		M
275830.684	*(3)	CH_3CN	15(4) – 14(4)	0.42	OriMC-1	MMWO	4.9m	Lor84		M
275867.811	*(3)	CH_3CN	15(3) – 14(3)	0.96	OriMC-1	MMWO	4.9m	Lor84		M
275894.342	*(3)	CH_3CN	15(2) – 14(2)	0.83	OriMC-1	MMWO	4.9m	Lor84		M
275910.264	*(3)	CH_3CN	15(1) – 14(1)	1.17	OriMC-1	MMWO	4.9m	Lor84		M
275915.572	*(3)	CH_3CN	15(0) – 14(0)	1.24	OriMC-1	MMWO	4.9m	Lor84		M
U 278263.		unidentified		1.0	OriMC-1	MMWO	4.9m	Lor84c		
278304.51	(5)	CH_3OH	9(–1) – 8(0) E	1.5	OriMC-1	MMWO	4.9m	Lor84c	Sas84	
278886.49	*(59)	H_2CS	8(1,7) – 7(1,6)	0.8	OriMC-1	MMWO	4.9m	Lor84f		
279511.732	*(77)	N_2H^+	3 – 2	0.9	OriMC-1	MMWO	4.9m	Lor84g		
281526.922	*(12)	H_2CO	4(1,4) – 3(1,3)	1.4	rho Oph B	MMWO	4.9m	Lor83		
281762.598	*(38)	SO_2	15(1,15) – 14(0,14)	1.0	OriMC-1	MMWO	4.9m	Lor84c		
281914.13	(10)	PN	6 – 5	0.10	OriMC-1	NRAO	12m	Tur87b	Wys72	N
281958.		CH_3OH	9(–3) – 10(–2) E	0.8	OriMC-1	MMWO	4.9m	Lor81	Sut88	M
281977.05	*(18)	HC_3N	31 – 30	0.8	OriMC-1	MMWO	4.9m	Lor81		
282036.560	*(14)	SO_2	6(2,4) – 5(1,5)	1.6	OriMC-1	MMWO	4.9m	Lor81		
282292.795	*(51)	SO_2	20(1,19) – 20(0,20)	0.7	OriMC-1	MMWO	4.9m	Lor84f		
283441.872	*(9)	$H_2{}^{13}CO$	4(0,4) – 3(0,3)	0.50	OriMC-1	MWO	4.9m	Man90		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
286293.697*(12)		$H_2C^{18}O$	4(1,3) – 3(1,2)	0.10	OriMC-1	MWO	4.9m	Man90		N
U286342.45		unidentified		0.36	OriMC-1	MMWO	4.9m	Lor85		
286416.390*(45)		SO_2	22(2,20) – 21(3,19)	0.22	OriMC-1	MMWO	4.9m	Lor85		
288143.912*(28)		DCO^+	4 – 3	<1.3	p-Oph	MMWO	4.9m	Lor82		
289209.179*(39)		$C^{34}S$	6 – 5	0.8	OriMC-1	MMWO	4.9m	Lor85		
289644.897*(20)		DCN	4 – 3	0.77	OriMC-1	MMWO	4.9m	Woo85		
289939.477 (14)		CH_3OH	6(0) – 5(0) E	2.1	OriMC-1	MMWO	4.9m	Pla82	Pic81	
290307.563*(50)		CH_3OH	6(2) – 5(2) E1	[b]	OriMC-1	MWO	4.9m	Man90	Pic81	N
290307.563*(50)		CH_3OH	6(–2) – 5(–2) E2	4.0[b]	OriMC-1	MWO	4.9m	Man90	Pic81	N
290380.0 *(11)		SiS	16 – 15	0.22	IRC+10216	MMWO	4.9m	Sah84		
290479.934*(17)		CH_3CCH	17(2) – 16(2)	0.14	OriMC-1	MMWO	4.9m	Lor84b		
290496.545*(14)		CH_3CCH	17(1) – 16(1)	0.32	OriMC-1	MMWO	4.9m	Lor84b		
290502.083*(14)		CH_3CCH	17(0) – 16(0)	0.3	OriMC-1	MMWO	4.9m	Lor84b		
290562.242*(38)		^{34}SO	6(7) – 5(6)	0.4	OriMC-1	MMWO	4.9m	Lor84b		
290623.416*(13)		H_2CO	4(0,4) – 3(0,3)	3.8	OriMC-1	MMWO	4.9m	Lor84b		
291237.770*(22)		H_2CO	4(2,3) – 3(2,2)	2.2	OriMC-1	MMWO	4.9m	Lor84a		
291380.452*(32)		H_2CO	4(3,2) – 3(3,1)	2.3[b]	OriMC-1	MMWO	4.9m	Lor84a		
291384.371*(32)		H_2CO	4(3,1) – 3(3,0)	[b]	OriMC-1	MMWO	4.9m	Lor84a		
291839.652*(5)		OCS	24 – 23	0.53	OriMC-1	MMWO	4.9m	Lor84b		
291948.072*(22)		H_2CO	4(2,2) – 3(2,1)	1.9	OriMC-1	MMWO	4.9m	Lor84a		
U292414.		unidentified		0.36	OriMC-1	MMWO	4.9m	Woo85		
293126.507*(9)		$H_2{}^{13}CO$	4(1,3) – 3(1,2)	1.00	OriMC-1	MWO	4.9m	Man90		N
293463.99 (5)		CH_3OH	3(2) – 4(1) A+	0.95	OriMC-1	MMWO	4.9m	Lor84b	Sas84	
293912.160*(39)		CS	6 – 5	3.3	OriMC-2	MMWO	4.9m	Sne84		
294098.866*(7)		CH_3CN	16(6) – 15(6)	0.29	OriMC-1	MMWO	4.9m	Lor84a		M
294161.001*(5)		CH_3CN	16(5) – 15(5)	0.16	OriMC-1	MMWO	4.9m	Lor84a		M
294211.873*(3)		CH_3CN	16(4) – 15(4)	0.29	OriMC-1	MMWO	4.9m	Lor84a		M
298576.296*(24)		SO_2	9(2,8) – 8(1,7)	2.0	OriMC-1	MMWO	4.9m	Eri84		
300836.635*(12)		H_2CO	4(1,3) – 3(1,2)	3.9	OriMC-1	MMWO	4.9m	Lor86		M
301286.126*(32)		SO	7(7) – 6(6)	2.7	OriMC-1	MMWO	4.9m	Lor86		M
303926.81 *(9)		SiO	7 – 6 v=0	8.	OriMC-1	NRAO	12m	Hol86		N
303993.256*(3)		OCS	25 – 24	3.3	OriMC-1	NRAO	12m	Hol86		N
304077.88 *(4)		SO	8,7 – 7,6	13.	OriMC-1	NRAO	12m	Hol86		N
U304122.6		unidentified		0.4	OriMC-1	NRAOO	12m	Woo86		N
304208.35 (5)		CH_3OH	2,1 – 2,0 A	7.2	OriMC-1	NRAO	12m	Hol86	DeL89	N
304306.1 *(9)		H_2CS	9(1,9) – 8(1,8)	2.0	OriMC-1	NRAO	12m	Hol86		N
304332.1 *(2)		$^{34}SO_2$	3(3,1) – 2(2,0)	0.7	OriMC-1	NRAO	12m	Hol86		N
U304374.		unidentified		1.6	OriMC-1	NRAO	12m	Hol86		N
307165.94 (5)		CH_3OH	4(1) – 4(0) A	6.6	OriMC-1	NRAO	12m	Hol86	DeL89	N
307192.41 (5)		H_3O^+	1,1 – 2,1	0.6	OriMC-1	NRAO	12m	Hol86	Plu85	N
U307205.4		unidentified		0.5	OriMC-1	NRAO	12m	Woo86		N
307311.471 (50)		$^{13}CH_3OH$	4(0) – 4(1) A	1.0	OriMC-1	NRAO	12m	Woo86	And87	N
318318.793 (15)		CH_3OH	8(1) – 8(0) A	6.0	W51	CSO	10.4m	Men90	Pic81	N
321225.64 (24)		H_2O	10(2,9) – 9(3,6)	3.0	W51	CSO	10.4m	Men90	DeL72a	N
322161.6 *(4)		CH_2NH	5(2,3) – 4(2,2)	1.1	Ori-MC1	CSO	10.4m	Men90a		N
322239.45 (5)		CH_3OH	9(1) – 9(0) A	5.5	Ori-MC1	CSO	10.4m	Men90a	Sas84	N
322493.1 *(29)		HDCO	5(4,2) – 4(4,1)	1.0[b]	Ori-MC1	CSO	10.4m	Men90a		N
322493.1 *(29)		HDCO	5(4,1) – 4(4,0)	1.0[b]	Ori-MC1	CSO	10.4m	Men90a		N
322521.64 *(7)		$HCOOCH_3$	25(6,19) – 24(6,18)	0.5	Ori-MC1	CSO	10.4m	Men90a		N
322530.0 *(7)		CH_2CHCN	38(4,35) – 38(3,36)	1.0	Ori-MC1	CSO	10.4m	Men90a		N
322965.17 (5)		$H_2{}^{18}O$	5(1,5) – 4(2,2)	0.5	Ori-MC1	CSO	10.4m	Men90a	DeL72	N
325152.919 (27)		H_2O	5(1,5) – 4(2,2)	2.2	Ori-MC1	CSO	10.4m	Men90a	DeL72a	N
330587.957*(23)		^{13}CO	3 – 2	16.03	OriMC-1	NRAO	12m	Jew89		N
U330797.		unidentified	(CH_3OH 8(–3) – 9(–2) E?)	1.59	OriMC-1	NRAO	12m	Jew89		N
330842.757*(7)		CH_3CN	18(6) – 17(6)	1.23	OriMC-1	NRAO	12m	Jew89		N
330912.604*(5)		CH_3CN	18(5) – 17(5)	0.88	OriMC-1	NRAO	12m	Jew89		N
330969.791*(4)		CH_3CN	18(4) – 17(4)	1.38	OriMC-1	NRAO	12m	Jew89		N
331014.293*(3)		CH_3CN	18(3) – 17(3)	1.38	OriMC-1	NRAO	12m	Jew89		N
331046.093*(3)		CH_3CN	18(2) – 17(2)	1.60	OriMC-1	NRAO	12m	Jew89		N
331065.179*(4)		CH_3CN	18(1) – 17(1)	1.64	OriMC-1	NRAO	12m	Jew89		N
331071.541*(4)		CH_3CN	18(0) – 17(0)	1.77	OriMC-1	NRAO	12m	Jew89		N
331502.37 *(5)		CH_3OH	11(1) – 11(0) A+,A–	1.99	OriMC-1	NRAO	12m	Jew89	Sas84	N
332015.78 *(10)		CH_3CN	17(0) – 16(0) $\nu_8=1\ell=-1$	1.22[b]	OriMC-1	NRAO	12m	Jew89	Wlo88	N
332017.77 *(10)		CH_3CN	17(–1) – 16(–1) $\nu_8=1\ \ell=+1$	[b]	OriMC-1	NRAO	12m	Jew89	Wlo88	N
332091.38 *(7)		SO_2	21(2,20) – 21(1,21)	1.92	OriMC-1	NRAO	12m	Jew89		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
332505.26	*(2)	SO_2	4(3,1) – 3(2,2)	3.02	OriMC-1	NRAO	12m	Jew89		N
332575.94	*(10)	$HCOOCH_3$	30(2,29) – 29(2,28) A	[b]	OriMC-1	NRAO	12m	Jew89	Plu84	N
332576.16	*(10)	$HCOOCH_3$	30(1,29) – 29(1,28) A	0.64[b]	OriMC-1	NRAO	12m	Jew89	Plu84	N
333900.98	*(5)	^{34}SO	7(8) – 6(7)	2.18	OriMC-1	NRAO	12m	Jew89		N
334673.34	*(2)	^{34}SO	8(2,6) – 7(1,7)	3.25	OriMC-1	NRAO	12m	Jew89		N
335133.51	(2)	CH_3OH	2(2) – 3(1) A–	1.98	OriMC-1	NRAO	12m	Jew89	Pic81	N
335395.50	(3)	HDO	3(3,1) – 4(2,2)	0.52	OriMC-1	NRAO	12m	Jew89	Del71	N
33546.53	(10)	NHD_2	1(1,1) – 0(0,0) O- (a)	0.015	OriMC-1	NRAO	12m	Tur90a	DeL75	N
U335559.		unidentified		0.71	OriMC-1	NRAO	12m	Jew89		N
335582.005	(15)	CH_3OH	7(1) – 6(1) A+	3.37	OriMC-1	NRAO	12m	Jew89	Pic81	N
336089.24	*(8)	SO_2	23(3,21) – 23(2,22)	2.17	OriMC-1	NRAO	12m	Jew89		N
336351.51	*(11)	NH_2CHO	29(4,25) – 29(3,26)	0.62	OriMC-1	NRAO	12m	Jew89		N
336521.23	*(29)	HC_3N	37 – 36	1.09	OriMC-1	NRAO	12m	Jew89		N
336865.11	(5)	CH_3OH	12(1) – 12(0) A+,A–	3.47	OriMC-1	NRAO	12m	Jew89	Sas84	N
337061.10	*(4)	$C^{17}O$	3 – 2	1.47	OriMC-1	NRAO	12m	Jew89		N
337135.87	*(10)	CH_3OH	4(2) – 3(3) E	0.76	OriMC-1	NRAO	12m	Jew89		N
U337167.		unidentified		0.63	OriMC-1	NRAO	12m	Jew89		N
U337201.		unidentified		0.97	OriMC-1	NRAO	12m	Jew89		N
337300.94	*(15)	NH_2CHO	19(2,18) – 19(1,19)	0.88	OriMC-1	NRAO	12m	Jew89		N
U337353.		unidentified		0.72	OriMC-1	NRAO	12m	Jew89		N
337396.602	*(55)	$C^{34}S$	7 – 6	1.89	OriMC-1	NRAO	12m	Jew89		N
337580.15	*(5)	^{34}SO	8(8) – 7(7)	1.92	OriMC-1	NRAO	12m	Jew89		N
337643.864	*(52)	CH_3OH	7(0) – 6(0) E ν_t=1	1.05	OriMC-1	NRAO	12m	Jew89	And90	N
U337973.		unidentified		0.86	OriMC-1	NRAO	12m	Jew89		N
338081.00	*(123)	H_2CS	10(1,10) – 9(1,9)	1.78	OriMC-1	NRAO	12m	Jew89		N
338124.502	(17)	CH_3OH	7(0) – 6(0) E1	4.48	OriMC-1	NRAO	12m	Jew89	Pic81	N
U338147.		unidentified		0.67	OriMC-1	NRAO	12m	Jew89		N
338305.99	*(7)	SO_2	18(4,14) – 18(3,15)	3.42	OriMC-1	NRAO	12m	Jew89		N
338344.629	(22)	CH_3OH	7(–1) – 6(–1) E2	4.23	OriMC-1	NRAO	12m	Jew89	Pic81	N
338404.781	(30)	CH_3OH	7(6) – 6(6) E1	4.52[b]	OriMC-1	NRAO	12m	Jew89	Pic81	N
338408.681	(15)	CH_3OH	7(0) – 6(0) A+	[b]	OriMC-1	NRAO	12m	Jew89	Pic81	N
338414.09	*(10)	$HCOOCH_3$	27(7,21) – 26(7,20) A	1.2	OriMC-1	MMWO	4.9m	Lor85	Plu84	M
338430.987	(14)	CH_3OH	7(–6) – 6(–6) E2	0.80	OriMC-1	NRAO	12m	Jew89	Pic81	N
338442.441	(10)	CH_3OH	7(6) – 6(6) A+	1.08[b]	OriMC-1	NRAO	12m	Jew89	Pic81	N
338442.441	(10)	CH_3OH	7(6) – 6(6) A-	[b]	OriMC-1	NRAO	12m	Jew89	Pic81	N
338456.499	(15)	CH_3OH	7(–5) – 6(–5) E2	1.72	OriMC-1	NRAO	12m	Jew89	Pic81	N
338475.29	(10)	CH_3OH	7(5) – 6(5) E1	1.80	OriMC-1	NRAO	12m	Jew89	Pic81	N
338486.337	(14)	CH_3OH	7(5) – 6(5) A+	2.12[b]	OriMC-1	NRAO	12m	Jew89	Pic81	N
338486.338	(14)	CH_3OH	7(5) – 6(5) A-	[b]	OriMC-1	NRAO	12m	Jew89	Pic81	N
338504.099	(17)	CH_3OH	7(–4) – 6(–4) E2	3.05	OriMC-1	NRAO	12m	Jew89	Pic81	N
338512.762	(29)	CH_3OH	7(2) – 6(2) A-	[b]	OriMC-1	NRAO	12m	Jew89	Pic81	N
338512.762	(48)	CH_3OH	7(4) – 6(4) A-	[b]	OriMC-1	NRAO	12m	Jew89	Pic81	N
338512.762	(48)	CH_3OH	7(4) – 6(4) A+	4.13[b]	OriMC-1	NRAO	12m	Jew89	Pic81	N
338530.249	(17)	CH_3OH	7(4) – 6(4) E1	1.98	OriMC-1	NRAO	12m	Jew89	Pic81	N
338540.795	(15)	CH_3OH	7(3) – 6(3) A+	4.75[b]	OriMC-1	NRAO	12m	Jew89	Pic81	N
338543.204	(15)	CH_3OH	7(3) – 6(3) A-	[b]	OriMC-1	NRAO	12m	Jew89	Pic81	N
338559.928	(24)	CH_3OH	7(–3) – 6(–3) E2	3.05	OriMC-1	NRAO	12m	Jew89	Pic81	N
338583.195	(17)	CH_3OH	7(3) – 6(3) E1	4.05	OriMC-1	NRAO	12m	Jew89	Pic81	N
338614.999	(17)	CH_3OH	7(1) – 6(1) E1	7.75	OriMC-1	NRAO	12m	Jew89	Pic81	N
338639.939	(15)	CH_3OH	7(2) – 6(2) A+	3.82	OriMC-1	NRAO	12m	Jew89	Pic81	N
338721.65	(5)	CH_3OH	7(2) – 6(2) E1	5.08[b]	OriMC-1	NRAO	12m	Jew89	Sas84	N
338722.94	(5)	CH_3OH	7(–2) – 6(–2) E2	[b]	OriMC-1	NRAO	12m	Jew89	Sas84	N
338785.76	*(14)	$^{34}SO_2$	14(4,10) – 14(3,11)	0.53	OriMC-1	NRAO	12m	Jew89		N
338929.48	*(11)	^{30}SiO	8 – 7	1.07	OriMC-1	NRAO	12m	Jew89		N
339341.47	*(7)	SO	3(3) – 3(2)	1.90	OriMC-1	NRAO	12m	Jew89		N
339857.28	*(7)	^{34}SO	9(8) – 8(7)	3.29	OriMC-1	NRAO	12m	Jew89		N
339902.33	*(24)	NH_2CHO	16(6,11) – 15(6,10)	0.60[b]	OriMC-1	NRAO	12m	Jew89		N
339902.41	*(24)	NH_2CHO	16(6,10) – 15(6,9)	[b]	OriMC-1	NRAO	12m	Jew89		N
340031.567	*(40)	CN	3 – 2 J = 5/2 – 3/2 F = 7/2 – 5/2	1.6[b]	OriMC-1	MMWO	4.9m	Lor85	Sha83	
340035.281	*(50)	CN	3 – 2 J = 5/2 – 3/2 F = 3/2 – 1/2	[b]	OriMC-1	MMWO	4.9m	Lor85	Sha83	
340035.525	*(50)	CN	3 – 2 J = 5/2 – 3/2 F = 5/2 – 3/2	[b]	OriMC-1	MMWO	4.9m	Lor85	Sha83	
340141.223	(50)	CH_3OH	2(2) – 3(1) A+	1.47	OriMC-1	NRAO	12m	Jew89		N
340247.625	*(50)	CN	3 – 2 J = 7/2 – 5/2 F = 7/2 – 5/2	3.1[b]	OriMC-1	MMWO	4.9m	Lor85	Sha83	
340247.874	*(50)	CN	3 – 2 J = 7/2 – 5/2 F = 9/2 – 7/2	[b]	OriMC-1	MMWO	4.9m	Lor85	Sha83	
340248.573	*(50)	CN	3 – 2 J = 7/2 – 5/2 F = 5/2 – 3/2	[b]	OriMC-1	MMWO	4.9m	Lor85	Sha83	

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines – Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
340316.50	*(8)	SO_2	28(2,26) – 28(1,27)	1.07	OriMC-1	NRAO	12m	Jew89		N
340449.27	*(1)	OCS	28 – 27	2.23	OriMC-1	NRAO	12m	Jew89		N
340489.61	*(15)	NH_2CHO	16(3,14) – 15(3,13)	0.72	OriMC-1	NRAO	12m	Jew89		N
340616.18	*(19)	CH_3OCH_3	10(3,7) – 9(2,8) AA	0.79	OriMC-1	NRAO	12m	Jew89		N
340714.294	*(48)	SO	7(8) – 6(7)	2.7	OriMC-1	MMWO	4.9m	Lor85		
U340843.		unidentified		0.91	OriMC-1	NRAO	12m	Jew89		N
U341039.		unidentified		0.43	OriMC-1	NRAO	12m	Jew89		N
341415.500	(50)	CH_3OH	7(1) – 6(1) A–	2.93	OriMC-1	NRAO	12m	Jew89	Pic81	N
342332.10	*(13)	$^{34}SO_2$	12(4,8) – 12(3,9)	0.83	OriMC-1	NRAO	12m	Jew89		N
342435.88	*(20)	SO_2	23(3,21) – 23(2,22) $\nu_2=1$	0.48	OriMC-1	NRAO	12m	Jew89		N
342521.81	*(34)	D_2CO	6(0,6) – 5(0,5)	0.27	OriMC-1	NRAO	12m	Tur90a		N
342607.71	*(47)	CH_3OCH_3	19(0,19) – 18(1,18) AA	1.13	OriMC-1	NRAO	12m	Jew89		N
342729.83	(5)	CH_3OH	13(1) – 13(0) A+	4.83[b]	OriMC-1	NRAO	12m	Jew89	Sas84	N
342729.83	(5)	CH_3OH	13(1) – 13(0) A-	[b]	OriMC-1	NRAO	12m	Jew89	Sas84	N
342882.95	*(5)	CS	7 – 6	9.65	OriMC-1	NRAO	12m	Jew89		N
343083.10	*(15)	NH_2CHO	16(3,13) – 15(3,12)	1.01	OriMC-1	NRAO	12m	Jew89		N
343201.08	*(85)	H_2CS	10(5,6) – 9(5,5)	0.98[b]	OriMC-1	NRAO	12m	Jew89		N
343201.08	*(85)	H_2CS	10(5,5) – 9(5,4)	[b]	OriMC-1	NRAO	12m	Jew89		N
343325.67	*(2)	$H_2{}^{13}CO$	5(1,5) – 4(1,4)	1.32	OriMC-1	NRAO	12m	Jew89		N
343411.91	*(104)	H_2CS	10(3,7) – 9(3,6)	0.98	OriMC-1	NRAO	12m	Jew89		N
343443.97	*(10)	$HCOOCH_3$	28(4,24) – 27(4,23) A	0.95	OriMC-1	NRAO	12m	Jew89	Plu84	N
343755.08	*(53)	CH_3OCH_3	17(2,16) – 16(1,15) AA	0.88[b]	OriMC-1	NRAO	12m	Jew89		N
343757.97	*(10)	$HCOOCH_3$	27(7,20) – 26(7,19) A	[b]	OriMC-1	NRAO	12m	Jew89		N
343810.90	*(115)	H_2CS	10(2,8) – 9(2,7)	0.68	OriMC-1	NRAO	12m	Jew89		N
344029.59	*(10)	$HCOOCH_3$	32(0,32) – 31(0,31) A	0.81[b]	OriMC-1	NRAO	12m	Jew89	Plu84	N
344029.59	*(10)	$HCOOCH_3$	32(1,32) – 31(1,31) A	[b]	OriMC-1	NRAO	12m	Jew89	Plu84	N
U344111.		unidentified		0.85	OriMC-1	NRAO	12m	Jew89		N
U344201.		unidentified		2.22	OriMC-1	NRAO	12m	Jew89		N
344245.45	*(12)	$^{34}SO_2$	10(4,6) – 10(3,7)	0.94	OriMC-1	NRAO	12m	Jew89		N
344310.728	*(54)	SO	8(8) – 7(7)	10.93	OriMC-1	NRAO	12m	Jew89		N
344357.74	*(48)	CH_3OCH_3	19(1,19) – 18(0,18) AA	1.30	OriMC-1	NRAO	12m	Jew89		N
344581.11	*(19)	$^{34}SO_2$	19(1,19) – 18(0,18)	0.60	OriMC-1	NRAO	12m	Jew89		N
344807.99	*(13)	$^{34}SO_2$	13(4,10) – 13(3,11)	0.50	OriMC-1	NRAO	12m	Jew89		N
344987.65	*(15)	$^{34}SO_2$	15(4,12) – 15(3,13)	0.60	OriMC-1	NRAO	12m	Jew89		N
344998.25	*(12)	$^{34}SO_2$	11(4,8) – 11(3,9)	0.60	OriMC-1	NRAO	12m	Jew89		N
345338.519	*(44)	SO_2	13,(2,12) – 12(1,11)	7.71[b]	OriMC-1	NRAO	12m	Jew89		N
345339.7	*(12)	$H^{13}CN$	4 – 3	[b]	OriMC-1	NRAO	12m	Jew89		N
345610.37	*(35)	HC_3N	38 – 37	1.95	OriMC-1	NRAO	12m	Jew89		N
345795.991	(2)	CO	3 – 2	70.00	OriMC-1	NRAO	12m	Jew89	Bel91a	N
U345905.		unidentified	(CH_3OH 16(10 – 15(2) A– ?)	1.80	OriMC-1	NRAO	12m	Jew89		N
346523.89	*(6)	SO_2	16(4,12) – 16(3,13)	8.73[b]	OriMC-1	NRAO	12m	Jew89		N
346528.562	*(74)	SO	9(8) – 8(7)	[b]	OriMC-1	NRAO	12m	Jew89		N
346652.19	*(6)	SO_2	19(1,19) – 18(0,18)	4.82	OriMC-1	NRAO	12m	Jew89		N
346998.54	*(40)	$H^{13}CO^+$	4 – 3	1.03	OriMC-1	NRAO	12m	Jew89		N
U347191.		unidentified		0.72	OriMC-1	NRAO	12m	Jew89		N
347330.58	*(11)	SiO	8 – 7 v=0	6.81	OriMC-1	NRAO	12m	Jew89		N
348117.56	*(16)	$^{34}SO_2$	19(4,16) – 19(3,17)	1.32	OriMC-1	NRAO	12m	Jew89		N
U348269.		unidentified		0.97	OriMC-1	NRAO	12m	Jew89		N
348387.96	*(6)	SO_2	24(2,22) – 23(3,21)	4.13	OriMC-1	NRAO	12m	Jew89		N
348532.08	*(123)	H_2CS	10(1,9) – 9(1,8)	3.38	OriMC-1	NRAO	12m	Jew89		N
348911.387	*(18)	CH_3CN	19(9) – 18(9)	1.50	OriMC-1	NRAO	12m	Jew89		N
349024.958	*(14)	CH_3CN	19(8) – 18(8)	1.03	OriMC-1	NRAO	12m	Jew89		N
349107.02	(5)	CH_3OH	14(1) – 14(0) A+	3.52[b]	OriMC-1	NRAO	12m	Jew89	Sas84	N
349107.02	(5)	CH_3OH	14(1) – 14(0) A-	[b]	OriMC-1	NRAO	12m	Jew89	Sas84	N
349212.303	*(8)	CH_3CN	19(6) – 18(6)	0.71	OriMC-1	NRAO	12m	Jew89		N
349285.999	*(5)	CH_3CN	19(5) – 18(5)	0.79	OriMC-1	NRAO	12m	Jew89		N
349338.10	(5)	C_2H	4 – 3 $J=9/2-7/2$ $F=5-4$	1.2[b]	M17	MMWO	4.9m	Lor85	Sas81a	
349338.10	(5)	C_2H	4 – 3 $J=9/2-7/2$ $F=4-3$	[b]	M17	MMWO	4.9m	Lor85	Sas81a	
349346.338	*(4)	CH_3CN	19(4) – 18(4)	1.27	OriMC-1	NRAO	12m	Jew89		N
349393.293	*(3)	CH_3CN	19(3) – 18(3)	3.38[b]	OriMC-1	NRAO	12m	Jew89		N
349400.61	(5)	C_2H	4 – 3 $J=7/2-5/2$ $F=4-3$	1.0[b]	M17	MMWO	4.9m	Lor85	Sas81a	
349400.61	(5)	C_2H	4 – 3 $J=7/2-5/2$ $F=3-2$	[b]	M17	MMWO	4.9m	Lor85	Sas81a	
349426.845	*(4)	CH_3CN	19(2) – 18(2)	1.50	OriMC-1	NRAO	12m	Jew89		N
349446.983	*(4)	CH_3CN	19(1) – 18(1)	2.10[b]	OriMC-1	NRAO	12m	Jew89		N
349453.696	*(4)	CH_3CN	19(0) – 18(0)	[b]	OriMC-1	NRAO	12m	Jew89		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
U350149.		unidentified		0.78	OriMC-1	NRAO	12m	Jew89		N
350423.50	*(5)	CH_3CN	18(−2)−17(−2) ν_8=1 ℓ=+1	1.02[b]	OriMC-1	NRAO	12m	Jew89	Wlo88	N
350423.50	*(5)	CH_3CN	18(2)−17(2) ν_8=1 ℓ=-1	[b]	OriMC-1	NRAO	12m	Jew89	Wlo88	N
350449.53	*(5)	CH_3CN	18(−1)−17(−1) ν_8=1 ℓ=+1	1.27	OriMC-1	NRAO	12m	Jew89	Wlo88	N
U350515.		unidentified		0.95	OriMC-1	NRAO	12m	Jew89		N
350552.23	*(5)	CH_3CN	18(2)−17(2) ν_8=1 ℓ=+1	1.25	OriMC-1	NRAO	12m	Jew89	Wlo88	N
350687.73	(5)	CH_3OH	4(0)−3(−1) E2	5.12	OriMC-1	NRAO	12m	Jew89	Sas84	N
350862.88	*(8)	SO_2	10(6,4)−11(5,7)	2.10	OriMC-1	NRAO	12m	Jew89		N
350905.119	(17)	CH_3OH	1(1)−0(0) A+	3.33	OriMC-1	NRAO	12m	Jew89	Pic81	N
U351047.		unidentified		1.98	OriMC-1	NRAO	12m	Jew89		N
351257.24	*(2)	SO_2	5(3,3)−4(2,2)	7.52	OriMC-1	NRAO	12m	Jew89		N
351633.4	*(5)	HNCO	16(0,16)−15(0,15)	2.77	OriMC-1	NRAO	12m	Jew89		N
351768.639	*(18)	H_2CO	5(1,5)−4(1,4)	11.31	OriMC-1	NRAO	12m	Jew89		N
351873.896	*(43)	SO_2	14(4,10)−14(3,11)	6.67	OriMC-1	NRAO	12m	Jew89		N
U352041.		unidentified		1.37	OriMC-1	NRAO	12m	Jew89		N
U352083.		unidentified		1.46	OriMC-1	NRAO	12m	Jew89		N
352292.63	*(10)	$HCOOCH_3$	30(4,27)−29(4,26) A	1.17	OriMC-1	NRAO	12m	Jew89	Plu84	N
U352505.		unidentified		1.00	OriMC-1	NRAO	12m	Jew89		N
352599.56	*(1)	OCS	29−28	2.99	OriMC-1	NRAO	12m	Jew89		N
U352903.		unidentified		1.20	OriMC-1	NRAO	12m	Jew89		N
352925.62	*(10)	$HCOOCH_3$	31(3,29)−30(3,28) A	0.97[b]	OriMC-1	NRAO	12m	Jew89	Plu84	N
352929.63	*(10)	$HCOOCH_3$	31(2,29)−30(2,28) A	[b]	OriMC-1	NRAO	12m	Jew89	Plu84	N
353811.87	*(2)	$H_2{}^{13}CO$	5(0,5)−4(0,4)	0.58	OriMC-1	NRAO	12m	Jew89		N
354505.472	*(20)	HCN	4−3	17.40	OriMC-1	NRAO	12m	Jew89		N
U354610.		unidentified		1.5	Sgr B2N	CSO	10.4m	Lis90		N
354699.0	*(4)	HC_3N	39−38	2.0	Sgr B2N	CSO	10.4m	Lis90		N
355045.55	*(3)	SO_2	12(4,8)−12(3,9)	7.73	OriMC-1	NRAO	12m	Jew89		N
355191.02	*(20)	$H_2{}^{13}CO$	5(3,3)−4(3,2)	2.22[b]	OriMC-1	NRAO	12m	Jew89		N
355202.72	*(20)	$H_2{}^{13}CO$	5(3,2)−4(3,1)	[b]	OriMC-1	NRAO	12m	Jew89		N
U355571.		unidentified		1.08	OriMC-1	NRAO	12m	Jew89		N
U355603.		unidentified		4.58	OriMC-1	NRAO	12m	Jew89		N
U355759.		unidentified		0.90	OriMC-1	NRAO	12m	Jew89		N
U356009.		unidentified		3.80	OriMC-1	NRAO	12m	Jew89		N
356040.70	*(10)	SO_2	15(7,9)−16(6,10)	1.26	OriMC-1	NRAO	12m	Jew89		N
U356261.		unidentified		2.33	OriMC-1	NRAO	12m	Jew89		N
356734.25	*(3)	HCO^+	4−3	17.40	OriMC-1	NRAO	12m	Jew89		N
357165.42	*(4)	SO_2	13(4,10)−13(3,11)	3.46	OriMC-1	NRAO	12m	Jew89		N
357241.21	*(5)	SO_2	15(4,12)−15(3,13)	3.21	OriMC-1	NRAO	12m	Jew89		N
357387.62	*(3)	SO_2	11(4,8)−11(3,9)	3.21	OriMC-1	NRAO	12m	Jew89		N
357671.87	*(2)	SO_2	9(4,6)−9(3,7)	2.75	OriMC-1	NRAO	12m	Jew89		N
357892.50	*(2)	SO_2	7(4,4)−7(3,5)	3.13	OriMC-1	NRAO	12m	Jew89		N
357925.91	*(2)	SO_2	6(4,2)−6(3,3)	2.18	OriMC-1	NRAO	12m	Jew89		N
357962.91	*(6)	SO_2	17(4,14)−17(3,15)	1.83	OriMC-1	NRAO	12m	Jew89		N
358013.22	*(3)	SO_2	5(4,2)−5(3,3)	2.35	OriMC-1	NRAO	12m	Jew89		N
358215.68	*(6)	SO_2	20(0,20)−19(1,19)	2.50	OriMC-1	NRAO	12m	Jew89		N
358605.80	(5)	CH_3OH	4(1)−3(0) E1	3.18	OriMC-1	NRAO	12m	Jew89	Sas84	N
359151.18	*(9)	SO_2	25(3,23)−25(2,24)	2.21	OriMC-1	NRAO	12m	Jew89		N
359387.83	*(33)	CH_3OCH_3	12(3,10)−11(2,9) AA	0.63	OriMC-1	NRAO	12m	Jew89		N
359770.68	*(8)	SO_2	19(4,16)−19(3,17)	3.04	OriMC-1	NRAO	12m	Jew89		N
362630.092	*(1)	HNC	4−3	3.0	OriMC-1	MWO	4.9m	Man90		N
362735.014	*(8)	H_2CO	5(0,5)−4(0,4)	4.7	OriMC-1	MWO	4.9m	Man90		N
372421.34	(20)	H_2D^+	1(1,0)−1(1,1)	0.23	NGC2264	KAO	1m	Phi85	Bog84b	
380197.372	*(25)	H_2O	4(1,4)−3(2,1)	12.	OriMC-1	KAO	1m	Phi80		
461040.770	(2)	CO	4−3	60.	OriMC-1	KAO	1m	Phi80	Bel91a	*M*
461754.6	*(4)	SO	14(13)−13(13)	25.	OriMC-1	CSO	10.4m	Sch91	Poy80	N
461907.700	*(9)	OCS	38−37	10.	OriMC-1	CSO	10.4m	Sch91		N
462239.	*(10)	^{34}SO	11(10)−10(9)	20. [b]	OriMC-1	CSO	10.4m	Sch91	Poy80	N
462239.9	*(10)	CH_3OH	6(−4)−5(−5) E	20. [b]	OriMC-1	CSO	10.4m	Sch91	Poy80	N
464834.684	(50)	CH_3OH	9(2)−9(1) A	30.	OriMC-1	CSO	10.4m	Sch91	And90	N
464924.520	(32)	HDO	1(0,1)−0(0,0)	20.	OriMC-1	CSO	10.4m	Sch91	DeL71	N
572498.15	(10)	NH_3	1(0)−0(0)	3.5	OriMC-1	KAO	1m	Kee83		
625901.60	(10)	HCl ?	1−0 3/2−3/2	0.55	OriMC-1	KAO	1m	Bla85b	Del71a	N
625918.76	(10)	HCl ?	1−0 5/2−3/2	0.70	OriMC-1	KAO	1m	Bla85b	Del71a	N
625932.01	(10)	HCl ?	1−0 1/2−3/2	0.20	OriMC-1	KAO	1m	Bla85b	Del71a	N
661067.275	*(49)	^{13}CO	6−5	64.0	OMC-IRc2	JCMT		Gra90		N

TABLE 5. Recommended rest frequencies for observed interstellar molecular lines — Continued

Frequency (MHz)	Unc.	Formula	Quantum numbers	T_r(K) /T_a(K)	Source	Telescope		Astr. ref.	Lab. ref.	
691473.090	(12)	CO	6−5	100.	OriMC-1	IRTF	3m	Gol81a	Var91	M
796982.7	*(20)	SO_2	7(7,1)−6(6,0)	7.2	OriMC-1	IRTF	3m	Stu89		N
797433.4	*(20)	HCN	9−8	55.	OriMC-1	IRTF	3m	Stu88		N
802269.72	(5)	CH_3OH	13(1)−12(0) E	9.	OriMC-1	IRTF	3m	Stu89		N
806651.806	(10)	CO	7−6	110.	OriMC-1	IRTF	3m	Sch85a	Var91	M
U809583.		unidentified		3.5	OriMC-1	IRTF	3m	Stu89		N
991329.32	*(8)	^{13}CO	9−8	3.0	W3 IRS 5	KAO	1m	Bor91		N
1036912.403	(10)	CO	9−8	17.5	W3 IRS 5	KAO	1m	Bor91	Var91	N
1267014.504	(10)	CO	11−10	65.	OriMC-1	KAO	1m	Ros89	Var91	N
1381995.110	(13)	CO	12−1	65.	OriMC-1	KAO	1m	Ros89	Var91	N
1611793.517	(11)	CO	14−13		M17	KAO	1m	Har87	Var91	N
1834747.35	(50)	OH	$^2\Pi_{1/2}$ $J=3/2-1/2$ $F=2-1+$	2.2[aa]	SgrA West	KAO	1m	Gen85	Var91	N
1837816.82	(50)	OH	$^2\Pi_{1/2}$ $J=3/2-1/2$ $F=2+-1-$	2.3[aa]	SgrA West	KAO	1m	Gen85	Var91	N
1841354.512	(11)	CO	16−15	2.6[aa]	SgrA West	KAO	1m	Gen85	Var91	N
1956018.142	(11)	CO	17−16	0.7[q]	OriMC-1	KAO	1m	Sta82	Var91	M
1979729.59	*(33)	^{13}CO	18−17	2.3[e]	OriMC-1	KAO	1m	Gen90		N
2413917.118	(11)	CO	21−20	0.85[q]	OriMC-1	KAO	1m	Wat80	Var91	M
2509949.43	(50)	OH	$^2\Pi_{3/2}$ $J=5/2-3/2$ $F=3+-2-$	n.r.	Sgr B2	KAO	1m	Sto81	Fah85	M
2514317.17	(50)	OH	$^2\Pi_{3/2}$ $J=5/2-3/2$ $F=3-2+$	n.r.	Sgr B2	KAO	1m	Sto81	Fah85	M
2528172.060	(11)	CO	22−21	1.4[q]	OriMC-1	KAO	1m	Wat80	Var91	M
3097909.364	(17)	CO	27−26	0.43[q]	OriMC-1	KAO	1m	Sto81a	Var91	M
3438364.618	(10)	CO	30−29	0.16[q]	OriMC-1	KAO	1m	Sto81a	Var91	M

[a]The asterisk (*) following a rest frequency indicates that the frequency is a calculated value . A question mark (?) following the frequency indicates that this is a questionable line detection and should be verified by future observations. A question mark (?) following the formula indicates that the identification was uncertain in the astronomical reference. The symbol n.r. in the intensity column means that the intensity was not reported. The abreviation LSB = lower sideband and USB = upper sideband.

[b]Blended with adjacent transitions, see astronomical reference.

[c]Line-to-continuum ratio (T_L/T_c) = 0.0095.

[d]Blended with a recombination line.

[e]In flux units (fu). 1 fu = 10^{-26} Wm^{-2} Hz^{-1} = Jansky (Jy).

[f]Integrated intensity, $\int T_a dv$, in K km s^{-1}.

[g]Beam brightness temperature.

[h]Assignment questionable.

[i]Intensity varies with time.

[j]Astronomical reference shows partially resolved hyperfine structure.

[k]Blended with $CH_3{}^{13}CN$.

[l]Peak line radiation temperature.

[m]Only the strongest of several velocity components is listed.

[n]Reported as unidentified in astronomical reference.

[o]The acetaldehyde and formamide lines were observed in different sidebands and are blended in this observation.

[p]The frequency for this unidentified line reported by Clark *et al.* (1979) was in error. The correct frequency is 93.780 GHz as shown here.

[q]Units are 10^{-16} W/cm^2.

[r]Blended with HCO+ $J=3-2$.

[s]Originally attributed to NH_2CHO, however this assignment seems inconsistent with other observations. (Cum86)

[t]Assignment from Cum84.

[u]Not observed in Orion survey by Sutton *et al.* (Sut85).

[v]This line may be blended with NS J = 11/2−9/2.

[w]This line may be blended with NO J = 5/2−3/2.

[x]Confirmed in Tur90.

[y]Although this line is reported in a table of Lor84, it is not apparent in Fig. 2 of this reference.

[z]The J = 54−53 of HC_5N is calculated at 143764.97(10) MHz.

[aa]Units are 10^{-4} erg s^{-1} cm^{-2} sr^{-1}.

Note1: Assignment may be CH_3OH 8(4)−9(3) A+ at 201084.8 MHz.

Note2: Assignment of HCOOH 22(6,17)−23(5,18) at 204707.25(4) MHz seems unlikely.

6. References to Table 5

Aka74 K. Akabane, M. Morimoto, K. Nagane, K. Miyazawa, T. Miyaji, H. Tabara, H. Hirabayashi, N. Kaifu, and Y. Chikada, Publ. Astr. Soc. Japan **26**, 1 (1974). "Detection of interstellar lines of paraformaldehyde and OCS and searches for other molecular lines at 73 GHz."

Ale76 A. J. Alexander, H. W. Kroto, and D. R. M. Walton, J. Mol. Spectrosc. **62**, 175 (1976). "The microwave spectrum, substitution structure and dipole moment of cyanobutadiyne, HCCCCCN."

All78 M. Allen and G. R. Knapp, Astrophys. J. **225**, 843 (1978). "Radio observations of interstellar CN toward difuse clouds, dark clouds, black clouds, and circumstellar clouds."

And77 T. G. Anderson, T. A. Dixon, N. D. Piltch, R. J. Saykally, P. G. Szanto, and R. C. Woods, Astrophys. J. (Letters) **216**, L85 (1977). "Laboratory Rest Frequencies for N_2D^+."

And87 T. Anderson, E. Herbst, and F. C. DeLucia, Astrophys. J. Suppl. **64**, 703 (1987). "The laboratory millimeter and submillimeter wave spectrum of ^{13}C Methanol."

And88 T. Anderson, R. L. Crownover, E. Herbst, and F. C. DeLucia, Astrophys. J. Suppl. Ser. **67**, 135 (1988). "The laboratory millimeter- and submillimeter wave spectrum of CH_3OD."

And90 T. Anderson, F. C. DeLucia, and E. Herbst, Astrophys. J. Suppl. Ser. **72**, 797 (1990). "Additional measurements and a refined analysis of the millimeter- and submillimeter-wave spectrum of methanol."

Arm84 T. Armstrong (see Lor84a).

Arm84a T. Armstrong and R. B. Loren (see Lor84a).

Ave76 L. W. Avery, N. W. Broten, J. M. MacLeod, T. Oka, and H. W. Kroto, Astrophys. J. (Letters) **205**, L173 (1976). "Detection of the heavy intersellar molecule cyanodiacetylene."

Ave79 L. W. Avery, T. Oka, N. W. Broten, and J. M. MacLeod, Astrophys. J. **231**, 48 (1979). "Cyanodiacetylene (HC_5N) in Sagittarius B2."

Bac90 R. Bachiller and J. Cernicharo, Astron. Astrophys. **239**, 276 (1990). "Extremely high-velocity emission from molecular jets in NGC 6334I and NGC 1333 (HH 7–11)."

Bal70 J. A. Ball, C. A. Gottlieb, A. E. Lilley, and H. E. Radford, Astrophys. J. (Letters) **162**, L203 (1970). "Detection of methyl alcohol in Sagittarius."

Bal70a J. A. Ball, D. F. Dickinson, C. A. Gottlieb, and H. E. Radford, Astron. J. **75**, 762 (1970) "The 3. 8 cm Spectrum of OH: Laboratory measurement and low noise searchin W3(OH)."

Bar71 A. H. Barrett, P. R. Schwartz, and J. W. Waters, Astrophys. J. (Letters) **168**, L101 (1971). "Detection of methyl alcohol in Orion at a wavelength of ~1 centimeter."

Bar75 A. H. Barrett, P. Ho, and R. N. Martin, Astrophys. J. (Letters) **198**, L119 (1975). "Time variations and spectral structure of the methanol maser in Orion A."

Bar77 A. H. Barrett, P. T. P. Ho, and P. C. Myers, Astrophys. J. (Letters) **211**, L39 (1977). "Ammonia in the Kleinmann-Low nebula."

Bar89 A. Barcia, J. Alcolea, and V. Bujarrabal, Astron. Astrophys. **215**, L9 (1989). "A new circumstellar maser: ^{30}SiO."

Bau76 A. Bauder, F. J. Lovas, and D. R. Johnson, J. Phys. Chem. Ref. Data **5**, 53 (1976). "Microwave spectra of molecules of astrophysical interest. IX. Acetaldehyde."

Bau79 A. Bauder, J. Phys. Chem. Ref. Data **8**, 583 (1979). "Microwave Spectra of Molecules of Astrophysical Interest. XVI. Methyl Formate."

Bea78 R. A. Beaudet, and R. L. Poynter, J. Phys. Chem. Ref. Data **7**, 311 (1978). "Microwave spectra of molecules of astrophysical interest. XII. Hydroxyl radical."

Bec82 J. E. Beckman, G. D. Watt, G. J. White, J. P. Phillips, R. L. Frost, and J. H. Davis, M. N. R. A. S. **201**, 357 (1982). "Detection of the 2(1,1)–2(1,2) rotational emission line of HDO in the Orion molecular cloud."

Bel70 J. Bellet and G. Steenbeckeliers, C. R. Acad. Sci. Ser. B **271**, 1208 (1970). "Calcul des constantes rotationnelles des molecules H_2O, HDO, et D_2O dans leurs etats fondamentaux de vibration."

Bel71 J. Bellet, C. Samson, G. Steenbeckeliers, and R. Wertheimer, J. Mol. Struct. **9**, 49 (1971). "Etude of spectre de rotation de la molecule d'acide formique: A. Etude de la molecule $H^{12}COOH$ dan l'etat fondamental."

Bel82 M. B. Bell, P. A. Feldman, S. Kwok, and H. E. Matthews, Nature **295**, 389 (1982). "Detection of $HC_{11}N$ in IRC+10216."

Bel83 M. B. Bell, P. A. Feldman, and H. E. Matthews, Astrophys. J. (Letters) **273**, L35 (1983). "The detection of butadiynyl (C_4H) in absorption against Cassiopheia A."

Bel83a M. B. Bell, H. E. Matthews, and T. J. Sears, Astron. Astrophys. **127**, 241 (1983). "Further observations of the N=1–0 transition of C_4H."

Bel83b M. B. Bell, H. E. Matthews, and P. A. Feldman, Astron. Astrophys. **127**, 420 (1983). "Observations of microwave transitions of A-state acetaldehyde in Sgr B2."

Bel85 M. B. Bell, and H. E. Matthews, Astrophys. J. (Letters) **291**, L63 (1985). "Detection of $HC_{11}N$ in the cold dust cloud TMC-1."

Bel86 M. B. Bell, P. A. Feldman, H. E. Matthews, and L. W. Avery, Astrophys. J. (Letters) **311**, L89 (1986). "Detection of deuterated cyclopropenylidene (C_3HD) in TMC-1."

Bel87 M. B. Bell, J. K. G. Watson, P. A. Feldman, H. E. Matthews, S. C. Madden, andW. M. Irvine, Chem. Phys. Lett. **136**, 588 (1987). "Deuterium hyperfine structure in interstellar C_3HD."

Bel87a S. P. Belov, I. N. Kozin, O. L. Polyansky, M. Yu. Tretyakov, and N. F. Zobov, J. Mol. Spectrosc. **126**, 113 (1987). "Rotational spectrum of the $H_2{}^{16}O$ molecule in the (010) excited vibrational state."

Bel91 M. B. Bell and P. A. Feldman, Astrophys. J. (Letters) **367**, L33 (1991). "Detection of ^{13}C isotopomers of HC_5N (J=9–8) in the circumstellar envelope of IRC+10216."

Bel91a S. P. Belov, M. Yu. Tretyakov, and R. D. Suenram, private comm. 1991 "Laboratory measurement of the J=2–1, 3–2 and 4–3 transitions of CO."

Bes83 M. Bester, S. Urban, K. Yamada, and G. Winnewisser, Astron. Astrophys. **121**, L13 (1983). "The nuclear hyperfine structure of deuterated ammonia."

Bla77 G. L. Blackman, R. D. Brown, P. D. Godfrey, M. P. Bassez, A. L. Ottrey, D. Winkler, and B. J. Robinson, M. N. R. A. S. **180**, 1p (1977). "Detection of J=2–1 emission of acetonitrile (CH_3CN) in Sgr B2."

Bla84 G. A. Blake, E. C. Sutton, C. R. Masson, T. G. Phillips, E. Herbst, G. M. Plummer and F. C. DeLucia, Astrophys. J. **286**, 586 (1984). "$^{13}CH_3OH$ in OMC-1."

Bla84a G. A. Blake, K. V. L. N. Sastry, and F. C. DeLucia, J. Chem. Phys. **80**, 95 (1984). "The laboratory millimeter and submillimeter spectrum of HCO."

Bla85a G. A. Blake, and H. Pickett, private communication. 1985. (lab measurements on CH_3OH)

Bla85b G. A. Blake, J. Keene, and T. G. Phillips, Astrophys. J. **295**, 501 (1985). "Chlorine in dense interstellar clouds. The abundance of HCl in OMC-1."

Bla86 G. A. Blake, E. C. Sutton, C. R. Masson, and T. G. Phillips, Astrophys. J. Suppl. **60**, 357 (1986). "The rotational emission-line spectrum of Orion A between 247 and 263 GHz."

Bog81 M. Bogey, C. Demuynck, and J. L. Destombes, Chem. Phys. Lett. **81**, 256 (1981). "Millimeter spectrum of carbon monosulfide rare isotopes."

Bog84 M. Bogey, C. Demuynck, and J. L. Destombes, and B. Lemoine, J. Mol. Spectrosc. **107**, 417 (1984). "Millimeter wave spectrum of HCS^+."

Bog84a M. Bogey, C. Demuynck, and J. L. Destombes, Can. J. Phys. **62**, 1248 (1984). "The millimetre wave spectrum of the $^{13}C^{14}N$ radical in its ground state."

Bog84b M. Bogey, C. Demuynck, M. Denis, J. L. Destombes, and B. Lemoine, Astron. Astrophys. **137**, L15 (1984). "Laboratory measurements of the 1(1,0)–1(1,1) submillimeter line of H_2D^+."

Bog84c M. Bogey, C. Demuynck, J. L. Destombes, Astron. Astrophys. **138**, L11 (1984). "Laboratory detection of the protonated carbon dioxide by submillimeterwave spectroscopy."

Bog85 M. Bogey, C. Demuynck, and J. L. Destombes, Astron. Astrophys. **144**, L15 (1985). "Millimeter and submillimeter wave spectroscopy of the deuterated ethynyl radical."

Bog85a M. Bogey, C. Demuynck, and J. L. Destombes, J. Chem. Phys. **83**, 3703 (1985). "Millimeter and submillimeter wave spectrum of $HCNH^+$".

Bog86 M. Bogey and J. L. Destombes, Astron. Astrophys. **159**, L8 (1986). "Millimeter wave spectrum of ^{13}C substitutions of cyclopropenylidene C_3H_2."

Bog87 M. Bogey, C. Demuynck, J. L. Destombes, and H. Dubos. J. Mol. Spectrosc. **122**, 313 (1987). "Molecular structure of cyclopropenylidene, HCCCH from the millimeter wave spectra of its isotopomers."

Bor91 R. T. Boreiko and A. L. Betz. Astrophys. J. **369**, 382 (1991). "Observations of ^{12}CO and ^{13}CO $J = 9 - 8$ in galactic molecular clouds."

Bou80 D. Boucher, J. Burie, A. Bauer, A. Dubrulle, and J. Demaison, J. Phys. Chem. Ref. Data **9**, 659 (1980). "Microwave Spectra of Molecules of Astrophysical Interest. XIX. Methyl Cyanide."

Bro75 R. D. Brown, J. G. Crofts, F. F. Gardner, P. D. Godfrey, B. J. Robinson, and J. B. Whiteoak, Astrophys. J. (Letters) **197**, L29 (1975). "Discovery of interstellar methyl formate."

Bro76 N. W. Broten, J. M. MacLeod, T. Oka, L. W. Avery, J. W. Brooks, R. X. McGee,and L. M. Newton, Astrophys. J. (Letters) **309**, L143 (1976). "Evidence for weak maser action in interstellar cyanodiacetylene."

Bro77 R. D. Brown, P. D. Godfrey, H. I. Gunn, G. L. Blackman, and J. W. V. Storey, M. N. R. A. S. **180**, 87p (1977). "Observation of $J = 1 - 0$ emission from HNC."

Bro78 N. W. Broten, T. Oka, L. W. Avery, J. M. MacLeod, and H. Kroto, Astrophys. J. (Letters) **223**, L105 (1978). "The detection of HC_9N in interstellar space."

Bro80 R. D. Brown, P. D. Godfrey, and D. A. Winkler, M.N.R.A.S **190**, 1 (1980). "Detection of the 2,3–2,2 emission line of sulphur monoxide and its relevance to magnetic fields in Orion."

Bro81 R. L. Brown, Astrophys. J. (Letters) **248**, L119 (1981). "Isocyanic acid in the Taurus molecular cloud 1."

Bro82 J. M. Brown, J. E. Schubert, K. M. Evenson, and H. E. Radford, Astrophys. J. **258**, 899 (1982). "The far-infrared spectrum of the OH radical."

Bro83 R. D. Brown, F. W. Eastwood, P. S. Elms, and P. D. Godfrey, J. Am. Chem. Soc. **105**, 6496 (1983). "Tricarbon monoxide."

Bro84 N. W. Broten, J. M. MacLeod, L. W. Avery, W. M. Irine, B. Höglund, P. Friberg, and Å. Hjalmarson, Astrophys. J. (Letters) **276**, L25 (1984). "The detection of interstellar methylcyanoacetylene."

Bro85 R. D. Brown, P. D. Godfrey, D. M. Cragg, E. H. N. Rice, W. M. Irvine, P. Friberg, H. Suzuki, M. Ohishi, N. Kaifu, and M. Morimoto, Astrophys. J. **297**, 302 (1985). "Tricarbon monoxide in TMC-1."

Buh74 D. Buhl, L. E. Snyder, F. J. Lovas, and D. R. Johnson, Astrophys. J. (Letters) **192** L97 (1974). "Silicon monoxide: detection of maser emission from the second vibrationally excited state."

Buj81 V. Bujarrabal, M. Guélin, M. Morris, and P. Thaddeus, Astron. Astrophys. **99**, 239 (1981). "The abundance and excitation of the carbon chains in interstellar molecular clouds."

Bur53 C. A. Burrus, and W. Gordy, Phys. Rev. **92**, 1437 (1953). "One-to-two millimeter wave spectroscopy. III. NO and DI."

Caz86 G. Cazzoli, G. Corbelli, C. D. Esposti, and P. G. Favero, NBS Spec. Pub. **716**, 159 (1986). "Inner and outer nitrogen hyperfine structure in the HN_2^+ molecular ion."

Cer84 J. Cernicharo, M. Guélin, and J. Askne, Astron. Astrophys. **138**, 371 (1984). "TMC1-like cloudlets in HCL2."

Cer86 J. Cernicharo, C. Kahane, J. Gómez-González, and M. Guélin, Astron. Astrophys. **164**, L1 (1986). "Tentative detection of the C_5H radical."

Cer86a J. Cernicharo, C. Kahane, J. Gómez-González, and M. Guélin, Astron. Astrophys. **167**, L5 (1986). "Detection of the $^2\Pi_{3/2}$ state of C_5H."

Cer86b J. Cernicharo, C. Kahane, J. Gómez-González, and M. Guélin, Astron. Astrophys. **167**, L9 (1986). "Detection of $^{29}SiC_2$ and $^{30}SiC_2$ toward IRC+10216."

Cer87 J. Cernicharo, M. Guélin, and C. M. Walmsley, Astron. Astrophys. **172**, L5 (1987). "Detection of the hyperfine structure of the C_5H radical."

Cer87a J. Cernicharo, M. Guélin, K. M. Menten, and C. M. Walmsley, Astron. Astrophys. **181**, L1 (1987). "C_6H: astronomical study of its fine and hyperfine stucture."

Cer87b J. Cernicharo, M. Guélin, H. Hein, and C. Kahane, Astron. Astrophys. **181**, L9 (1987). "Sulfur in IRC+10216."

Cer87c J. Cernicharo, and M. Guélin, Astron. Astrophys. **183**, L10 (1987). "Metals in IRC+10216: detection of NaCl, AlCl, and KCl and tenative detection of AlF."

Cer88 J. Cernicharo, C. Kahane, M. Guélin, and J. Gómez-González, Astron. Astrophys. **189**, L1 (1988). "Tenative detection of CH_3NC towards SgrB2."

Cer89 J. Cernicharo, C. A. Gottlieb, M. Guélin, P. Thaddeus, and J. M. Vrtilek, Astrophys. J. (Letters) **341**, L25 (1989). Astronomical and laboratory detection of the SiC radical."

Cer90 J. Cernicharo, C. Thum, H. Heim, D. John, P. Garcia, and F. Mattioco, Astron. Astrophys. **231**, L15 (1990). "Detection of 183 GHz water vapor maser emission from interstellar and circumstellar sources."

Cer91 J. Cernicharo, C. A. Gottlieb, M. Guélin, T. C. Killian, G. Paubert, P. Thaddeus, and J. M. Vrtilek, Astrophys. J. (Letters) **368**, L39 (1991). "Astronomical detection of H_2CCC."

Cer91a J. Cernicharo, C. A. Gottlieb, M. Guélin, T. C. Killian, P. Thaddeus, and J. M. Vrtilek, Astrophys. J. (Letters) **368**, L43 (1991). "Astronomical detection of H_2CCCC."

Cer91b J. Cernicharo, M. Guélin, C. Kahane, M. Bogey, C. Demuynch, and J. L. Destombes, Astron. Astrophys. **246**, 213 (1991). "Astronomical and laboratory study of $Si^{13}CC$."

Chu73 F. Y. Chu and S. M. Freund, J. Mol. Spectrosc. **48**, 183 (1973). "Millimeter rotation-inversion transition of $^{14}NH_3$ and $^{15}NH_3$ in the v_2 state."

Chu75 E. Churchwell and G. Winnewisser, Astron. Astrophys. **45**, 229 (1975). "Observations of methyl formate in the galactic center."

Chu77 E. Churchwell, C. M. Walmsley, and G. Winnewisser, Astron. Astrophys. **54**, 925 (1977). "Observational Evidence for chemical fractionation in Sgr B2."

Chu80 E. Churchwell, A. Nash, J. Rahe, C. M. Walmsley, O. Lochner and G. Winnewisser, Astrophys. J. (Letters) **241**, L169 (1980). "Abundances and excitation of interstellar methyl formate."

Chu83 E. Churchwell and J. M. Hollis, Astrophys. J. **272**, 591 (1983). "The kinetic temperature and CH_3CCH column density profile in Sgr B2, Orion, and DR 21."

Chu86 E. Churchwell, D. Wood, P. C. Myers, and R. V. Myers, Astrophys. J. **305**, 405 (1986). "The excitation, abundance, and distribution of HNCO in Sagittarius B2."

Cla74 F. O. Clark and D. R. Johnson, Astrophys. J. (Letters) **191**, L87 (1974). "Magnetic fields in the Orion molecular cloud from the Zeeman effect in SO."

Cla76 F. O. Clark, R. D. Brown, P. D. Godfrey, J. W. V. Storey, and D. R. Johnson, Astrophys. J. (Letters) **210**, L139 (1976). "Detection of interstellar vibrationally excited cyanoacetylene."

Cla77 F. O. Clark and F. J. Lovas, Astrophys. J. (Letters) **217**, L47 (1977). "SiO in the interstellar medium."

Cla78 F. O. Clark, D. R. Johnson, C. E. Heiles, and T. H. Troland, Astrophys. J. **226**, 824 (1978). "Upper limits to the ambient magnetic field in several dense molecular clouds."

Cla79 F. O. Clark, F. J. Lovas, and D. R. Johnson, Astrophys. J. **229**, 553 (1979). "Dimethyl ether in Orion."

Cla81 F. O. Clark, T. H. Troland, F. J. Lovas, and P. R. Schwartz, Astrophys. J. (Letters) **244**, L99 (1981). "Detection of the 3. 5 millimeter $J=2-1$, $v=2$ transition of circumstellar SiO."

Cle83 D. P. Clemens and A. P. Lane, Astrophys. J. (Letters) **266**, L117 (1983). "Detection of $J=5-4$ SiO masers in late-type stars."

Clo64 P. L. Clouser and W. Gordy, Phys. Rev. **A134**, 863 (1964). "Millimeter wave molecular-beam spectroscopy: alkali chlorides."

Cle84 D. P. Clemens (see Lor84a).

Coh82 E. A. Cohen and H. M. Pickett, J. Mol. Spectrosc. **93**, 83 (1982). "The rotation-inversion spectra and vibration-rotation interaction in NH_2D."

Com85 F. Combes, F. Boulanger, P. J. Encrenaz, M. Gerin, M. Bogey, C. Demuynck, and J. L. Destombes, Astron. Astrophys. **147**, L25 (1985). "Detection of interstellar CCD."

Com87 F. Combes, M. Gerin, A. Wootten, G. Wlodarczak, F. Clausset, and P. J. Encrenaz, Astron. Astrophys. **180**, L13 (1987). "Acetone in interstellar space."

Cre76 R. A. Creswell, E. F. Pearson, M. Winnewisser, and G. Winnewisser, Z. Naturforsch. **31a**, 221 (1976). "Detection of the millimeter wave spectrum of hydrogen isocyanide, HNC."

Cum80 S. E. Cummins, M. Morris, and P. Thaddeus, Astrophys. J. **235**, 886 (1980). "On C_4H versus vibrationally excited CO in IRC+10216."

Cum86 S. E. Cummins, R. A. Linke, and P. Thaddeus, Astrophys. J. Suppl. **60**, 819 (1986). "A survey of the millimeter spectrum of Sagittarius B2."

Cup68 R. E. Cupp, R. A. Kempf, and J. J. Gallagher, Phys. Rev. **171**, 60 (1968). "Hyperfine structure in the millimeter spectrum of hydrogen sulfide: electric resonance spectroscopy on asymmetric-top molecules."

Dan78 D. Dangoisse, E. Willemot, and J. Bellet, J. Mol. Spectrosc. **71**, 414 (1978). "Microwave spectrum of formaldehyde and its isotopic species in D, ^{13}C and ^{18}O: study of Coriolis resonance between υ_4 and υ_6 vibrational excited states."

Dav74 J. H. Davis, G. N. Blair, H. Van Till, and P. Thaddeus, Astrophys. J. (Letters) **190**, L117 (1974). "Vibrationally excited silicon monoxide in the Orion nebula."

DeL69 F. C. DeLucia and W. Gordy, Phys. Rev. **187**, 58 (1969). "Molecular-beam maser for the shorter-millimeter wave region: spectral constants of HCN and DCN."

DeL71 F. C. DeLucia, R. L. Cook, P. Helminger, and W. Gordy, J. Chem. Phys. **55**, 5334 (1971). "Millimeter and submillimeter wave rotational spectrum and centrifugal distortion effects of HDO."

DeL71a F. C. DeLucia, P. Helminger, and W. Gordy, Phys. Rev. **A3**, 1849 (1971). "Submillimeter-wave spectra and equilibrium structures of the hydrogen halides."

DeL72 F. C. DeLucia, P. Helminger, R. L. Cook, and W. Gordy, Phys. Rev. **A6**, 1324 (1972). "Submillimeter microwave spectrum of $H_2{}^{18}O$."

DeL72a F. C. DeLucia, P. Helminger, R. L. Cook, and W. Gordy, Phys. Rev. **A5**, 487 (1972). "Submillimeter microwave spectrum of $H_2{}^{16}O$."

DeL75 F. C. DeLucia and P. Helminger, J. Mol. Spectrosc. **54**, 200 (1975). "Millimeter- and submillimeter-wave length spectrum of partially deuterated ammonias; a study of inversion, centrifugal distortion, and rotation-inversion interactions."

DeL77 F. C. DeLucia and P. Helminger, J. Chem. Phys. **67**, 4262 (1977). "Millimeter spectroscopy of active laser plasmas; the excited vibrational states of HCN."

Den84 W. R. F. Dent, L. T. L. Little, P. W. Riley, and D. Vizard, Private communication, 1984. (observation of CH_3OH)

Des75 J. L. Destombes and C. Marliere, Chem. Phys. Lett. **39**, 532 (1975). "Measurement of hyperfine splitting in the OH radical by a radio-frequency microwave double resonance method."

deZ71 R. L. deZafra, Astrophys. J. **170**, 165 (1971). "Precise laboratory determination of rotational transition frequencies in cyanoacetylene."

Dic72 D. F. Dickinson, Astrophys. Lett. **12**, 235 (1972). "Detection of cyanoacetylene at 18 GHz."

Dic76 D. F. Dickinson, C. A. Gottlieb, E. W. Gottlieb, and M. M. Litvak, Astrophys. J. **206**, 79 (1976). "Observations of interstellar silicon monoxide."

Dij71 F. A. Dijk, Ph. D. Dissertation, Katholicke Universiteit, Nijmegen, Netherlands (1971).

Dix77 T. A. Dixon and R. C. Woods, J. Chem. Phys. **67**, 3956 (1977). "The laboratory microwave spectrum of the cyanide radical in its $X^2\Sigma^+$ ground state."

Doh74 L. H. Doherty, J. M. MacLeod, and T. Oka, Astrophys. J. (Letters) **192**, L157 (1974). "Detection of the 10. 464 GHz transition of interstellar thioformaldehyde."

Dow82 D. Downes, R. Genzel, Å. Hjalmarson, L. A. Nyman, and B. Ronnang, Astrophys. J. (Letters) **252**, L29 (1982). "Thermal SiO as a probe of high velocity motions in regions of star formation."

Dub78 A. Dubrulle, D. Boucher, J. Burie, and J. Demaison, J. Mol. Spectrosc. **72**, 158 (1978). "Microwave spectra of propyne and its [^{13}C] isotopic species. Refined molecular structure of propyne."

Dub80 A. Dubrulle, J. Demaison, J. Burie, and D. Boucher, Z. Naturforsch. **35a**, 471 (1980). "The millimeter wave rotational spectra of carbonyl sulfide."

Ell80 J. Elldér, P. Freiberg, Å. Hjalmarson, B. Höglund, W. M. Irvine, L. E. B. Johansson, H. Olofsson, G. Rydbeck, and O. E. H. Rydbeck, Astrophys. J. (Letters) **242**, L93 (1980). "On methyl formate, methane, and deuterated ammonia in Orion A."

Eri81 N. R. Erickson, R. L. Snell, R. B. Loren, L. Mundy, and R. L. Plambeck, Astrophys. J. (Letters) **245**, L83 (1981). "Detection of interstellar CO^+ toward OMC-1."

Eri84 N. R. Erickson and R. L. Plambeck (see Lor84a).

Eri84a N. R. Erickson and R. B. Loren (see Lor84a).

Eri84b N. R. Erickson (see Lor84a).

Eri84c N. Erickson and R. L. Snell, Private communication, 1984.

Eva70 N. J. Evans, II, A. C. Cheung, and R. M. Sloanaker, Astrophys. J. (Letters) **159**, L9 (1970). "Microwave absorption of the $2_{12}-2_{11}$ rotational transition in interstellar formaldehyde."

Eva79 N. J. Evans, II, R. L. Plambeck, and J. H. Davis, Astrophys. J. (Letters) **227**, L25 (1979). "Detection of the $3_{12}-2_{11}$ transitions of interstellar formaldehyde at 1.3 millimeters."

Far85 J. Farhoomand, G. Blake, and H. M. Pickett, Astrophys. J. (Letters) **291**, L19 (1985). "Direct measurement of the fundamental rotational transitions of the OH radical by laser sideband spectroscopy."

Fou74 N. Fourikis, M. W. Sinclair, B. J. Robinson, P. D. Godfrey, and R. D. Brown, Aust. J. Phys. **27**, 425 (1974). "Microwave emission of the $2_{11}-2_{12}$ rotational transition in interstellar acetaldehyde."

Fou74a N. Fourikis, K. Takagi, and M. Morimoto, Astrophys. J. (Letters) **191**, L139 (1974). "Detection of interstellar methylamine by its $2_{02}-1_{10}$ Aa-state transition."

Fou77 N. Fourikis, K. Takagi, and S. Saito, Astrophys. J. (Letters) **212**, L33 (1977). "Probable detection of interstellar methylamine-D (CH_3NHD)."

Fre79 M. A. Frerking, R. A. Linke, and P. Thaddeus, Astrophys. J. (Letters) **234**, L143 (1979). "Interstellar isothiocyanic acid."

Fre79a M. A. Frerking, and W. D. Langer, and R. W. Wilson, Astrophys. J. (Letters) **232**, L65 (1979). "Determination of the hyperfine structure of $HN^{13}C$ and HNC."

Fre81 M. A. Frerking, and W. D. Langer, J. Chem. Phys. **74**, 6990 (1981). "A measurement of the hyperfine structure of $C^{17}O$."

Fri80 P. Friberg, Å. Hjalmarson, and W. M. Irvine, Astrophys. J. (Letters) **241**, L99 (1980). "Interstellar C_3N: detection in Taurus dark clouds."

Fri80 P. Friberg, Å. Hjalmarson, and W. M. Irvine, Astrophys. J. (Letters) **241**, L99 (1980). "Interstellar C_3N: detection in Taurus dark clouds."

Fri84 P. Friberg, Astron. Astrophys. **132**, 265 (1984). "SO (3,2–2,1) mapping of the Orion KL cloud components."

Gai74 L. Gaines, K. H. Casleton, and S. G. Kukolich, Astrophys. J. (Letters) **191**, L99 (1974). "Beam maser measurements of CH_3OH rotational transitions."

Gar64 F. F. Gardner, B. J. Robinson, J. G. Bolton, and K. J. van Damme, Phys. Rev. Lett. **13**, 3 (1964). "Detection of interstellar OH lines at 1612 and 1720 Mc/sec."

Gar70 F. F. Gardner, R. X. McGee, and M. W. Sinclair, Astrophys. Letters **5**, 67 (1970). "^{18}OH in Sagittarius."

Gar71 F. F. Gardner and J. C. Ribes, Astrophys. Lett. **9**, 175 (1971). "Observations of the excited lines of HO near 4700 MHz."

Gar71a F. F. Gardner, J. C. Ribes, and B. F. C. Cooper, Astrophys. Lett. **9**, 181 (1971). "Detection of the O^{18} isotope of formaldehyde at 4388 MHz."

Gar75 F. F. Gardner and G. Winnewisser, Astrophys. J. (Letters) **195**, L127 (1975). "The detection of interstellar vinyl cyanide (acrylonitrile)."

Gar76 F. F. Gardner and J. B. Whiteoak, M. N. R. A. S. 176, 57p (1976). "The detection of interstellar ^{17}OH."

Gar78 F. F. Gardner, J. B. Whiteoak, and G. Winnewisser, Astron. Astrophys. **67**, L23 (1978). "Observations of the $J=13-12$ transition of HC_7N at 14. 7 GHz."

Gar78a F. F. Gardner and G. Winnewisser, M. N. R. A. S. **185**, 57P (1978). "Detection of the $J=2-1$ transition of interstellar HC_5N."

Gar80 F. F. Gardner, P. D. Godfrey, and D. R. Williams, M.N.R.A.S. **193**, 713 (1980). "Observations of the ^{12}C and ^{13}C isotopes of formamide at 19 cm."

Gar83 F. F. Gardner and J. Martin-Pintado, M.N.R.A.S. **204**, 709 (1983). "Quasi-thermal excitation of the satellite lines of OH at 5 cm."

Gar85 F. F. Gardner, B. Höglund, C. Shurke, A. Stark, and T. L. Wilson, Astron. Astrophys. **146**, 303 (1985). "Observations of *ortho* and *para* thioformaldehyde."

Gen85 R. Genzel, D. M. Watson, M. K. Crawford, and C. H. Townes, Astrophys. J. **297**, 766 (1985). "The neutral-gas disk around the galactic center."

Gen90 R. Genzel, A. Poglitsch, and G. Stacey, Astrophys. Space Sci. Lib. **151**, 261 (1990). "Detection of far-infrared ^{13}CO line emission."

Ger84 M. Gerin, F. Combes, P. Encrenaz, R. Linke, J. L. Destombes, and C. Demuynck, Astron. Astrophys. **136**, L17 (1984). "Detection of ^{13}CN in three galactic sources."

Ger87 M. Gerin, H. A. Wooten, F. Combes, F. Boulanger, W. L. Peters, III, T. B. Kuiper, P. J. Encrenaz, and M. Bogey. Astron. Astrophys. **173**, L1 (1987). "Deuterated C_3H_2 as a clue to deuterium chemistry."

Gil76 W. Gilmore, M. Morris, D. R. Johnson, F. J. Lovas, B. Zuckerman, B. E. Turner, and P. Palmer, Astrophys. J. **204**, 43 (1976). "Observations of the 6_{16}–5_{15} transitions of acetaldehyde in Sagittarius B2."

God73 P. D. Godfrey, R. D. Brown, B. J. Robinson, and M. W. Sinclair, Astrophys. Lett. **13**, 119 (1973). "Discovery of interstellar methanimine (formaldimine)."

God77 P. D. Godfrey, R. D. Brown, H. I. Gunn, G. L. Blackman, and J. W. V. Storey, M. N. R. A. S. **180**, 83p (1977). "Detection of interstellar DNC: difficulties of chemical equilibrium hypothesis for enrichment."

God84 P. D. Godfrey, L. M. Tack, and W. M. Irvine, Private communication, 1984.

Gol81 P. F. Goldsmith and R. A. Linke, Astrophys. J. **245**, 482 (1981). "A study of interstellar carbonyl sulfide."

Gol81a P. F. Goldsmith, N. R. Erickson, H. R. Fetterman, B. J. Clifton, D. D. Peck,P. E. Tannenwald, G. A. Koepf, D. Buhl, and N. McAvoy, Astrophys. J. (Letters) **243**, L79 (1981). "Detection of the $J=6-5$ transition of carbon monoxide."

Gol81b P. F. Goldsmith, W. D. Langer, J. Elldér, W. Irvine, and E. Kollberg, Astrophys. J. **249**, 524 (1981). "Determination of the HNC to HCN abundance ratio in giant molecular clouds."

Gol82 P. F. Goldsmith, R. L. Snell, S. Deguchi, and R. Krotkov, Astrophys. J. **260**, 147 (1982). "Vibrationally excited cyanoacetylene in the Orion molecular cloud."

Gol83 P. F. Goldsmith, R. Krotkov, R. L. Snell, R. D. Brown, and P. Godfrey, Astrophys. J. 274, 184 (1983). "Vibrationally excited CH_3CN and HC_3N in Orion."

Gol85 P. F. Goldsmith, R. Krotkov, and R. L. Snell, Astrophys. J. **299**, 405 (1985). "Further studies of vibrationally excited cyanoacetylene near Orion IRc2 and other sources."

Gom86 J. Gómez-González, M. Guélin, J. Cernicharo, C. Kahane, and M. Bogey, Astron. Astrophys. 168, L11 (1986). "Detection of interstellar ^{13}C isotopes of C_3H_2."

Got73 C. A. Gottlieb, In "Molecules in the Galactic Environment" Eds. M. A. Gordon and L. E. Snyder (New York: Wiley-Interscience), p. 181 (1973). "Detection of acetaldehyde in Sagittarius."

Got73a C. A. Gottlieb, P. Palmer, L. J. Richard, and B. Zuckerman, Astrophys. J. **182**, 699 (1973). "Studies of interstellar formamide."

Got73b C. A. Gottlieb and J. A. Ball, Astrophys. J. (Letters) **184**, L59 (1973). "Interstellar sulfur monoxide."

Got74 C. A. Gottlieb, H. E. Radford, and B. P. Smith, unpublished data, 1974.

Got75 C. A. Gottlieb, J. A. Ball, E. W. Gottlieb, C. J. Lada, and H. Penfield, Astrophys. J. (Letters) **200**, L147 (1975). "Detection of interstellar nitrogen sulfide."

Got78 C. A. Gottlieb, E. W. Gottlieb, M. M. Litvak, J. A. Ball, and H. Penfield, Astrophys. J. **219**, 77 (1978). "Observations of interstellar sulfur monoxide."

Got78a C. A. Gottlieb, Private communication, 1978.

Got79 C. A. Gottlieb, J. A. Ball, E. W. Gottlieb, and D. F. Dickinson, Astrophys. J. **227**, 422 (1979). "Interstellar methyl alcohol."

Got83 C. A. Gottlieb, E. W. Gottlieb, P. Thaddeus, and H. Kawamura, Astrophys. J. **275**, 916 (1983). "Laboratory detection of the C_3N and C_4H free radicals."

Got83a C. A. Gottlieb, E. W. Gottlieb, and P. Thaddeus, Astrophys. J. **264**, 740 (1983). "Laboratory and astronomical measurement of the millimeter wave spectrum of the ethynyl radical CCH."

Got85 C. A. Gottlieb, J. M. Vrtilek, E. W. Gottlieb, and P. Thaddeus, Astrophys. J. (Letters) **294**, L55 (1985) "Laboratory detection of the C_3H-radical."

Got86 C. A. Gottlieb, E. W. Gottlieb, and P. Thaddeus, Astron. Astrophys. **164**, L5 (1986). "Laboratory detection of the C_5H radical."

Got89 C. A. Gottlieb, J. M. Vrtilek, and P. Thaddeus, Astrophys. J. (Letters) **343**, L29 (1989). "Laboratory measurement of the rotational spectrum of SiCC."

Gra90 U. U. Graf, R. Genzel, A. I. Harris, R. E. Hills, A. P. G. Russell, and J. Stutski, Astrophys. J. (Letters) **358**, L49 (1990). "Detection of an isotopic short submillimeter CO line: Column densities of warm gas in molecular clouds."

Gra81 M. Grasshoff, E. Tiemann, and C. Henkel, Astrophys. J. **101**, 238 (1981). "Detection of the $J=1-0$ and $J=2-1$ rotational lines of SiS in the molecular envelope of IRC+10216."

Gud81 C. S. Gudeman, N. H. Haese, N. D. Piltch, and R. C. Woods, Astrophys. J. (Letters) **246**, L47 (1981). "The observation of the $J=1-2$ transition of HCS^+ in a laboratory glow discharge."

Gud82 C. S. Gudeman and R. C. Woods, Phys. Rev. Lett. **48**, 1344 (1982). "Experimental detection of HOC^+ by microwave spectroscopy."

Gud82a C. S. Gudeman, Ph. D. Thesis (University of Wisconsin, 1982).

Gué77 M. Guélin and P. Thaddeus, Astrophys. J. (Letters) **212**, L81 (1977). "Tentative detection of the C_3N radical."

Gué77a M. Guélin, W. D. Langer, R. L. Snell, and H. A. Wootten, Astrophys. J. (Letters) **217**, L165 (1977). "Observations of DCO^+: the electron abundance in dark clouds."

Gué78 M. Guélin, S. Green, and P. Thaddeus, Astrophys. J. (Letters) **224**, L27 (1978). "Detection of the C_4H radical toward IRC+10216."

Gué82 M. Guélin, J. Cernicharo, and R. A. Linke, Astrophys. J. (Letters) **263**, L89 (1982). "Detection of $HC^{17}O^+$ in Sagittarius B2."

Gué82a M. Guélin, P. Friberg, and A. Mezaoui, Astron. Astrophys. **109**, 23 (1982). "Astronomical study of the C_3N and C_4H radicals: hyperfine interactionsand ρ-type doubling."

Gué82b M. Guélin, W. D. Langer, and R. W. Wilson, Astron. Astrophys. **107**, 107 (1982). "The state of ionization in dense molecular clouds."

Gué86 M. Guélin, J. Cernicharo, C, Kahane, and J. Gómez-Gonzáles, Astron. Astrophys. **157**, L17 (1986). "A new free radical in IRC+10216."

Gué87 M. Guélin, J. Cernicharo, C, Kahane, J. Gómez-Gonzáles, and C. M. Walmsley, Astron. Astrophys. **175**, L5 (1987). "Detection of heavy radical in IRC+10216: The hexatriynyl radical C_6H?"

Gué87a M. Guélin, J. Cernicharo, S. Navarro, D. R. Woodward, C. A. Gottlieb, and P. Thaddeus, Astron. Astrophys. **182**, L37 (1987). "New doublets in IRC+10216: Vibrationally excited C_4H."

Gué91 M. Guélin, and J. Cernicharo, Astron. Astrophys. **244**, L21 (1991). "Astronomical detection of the HCCN radical. Toward a new family of carbon-chain molecules?"

Gui84 S. Guilloteau, A. Baudry, C. M. Walmsley, T. L. Wilson, and A. Winnberg, Astron. Astrophys. **131**, 45 (1984). "Rotationally excited OH: emission and absorption toward HII/OH regions."

Gui87 S. Guilloteau, A. Omont, and R. Lucas, Astron. Astrophys. **176**, L24 (1987). "A new strong maser: HCN."

Haq74 S. S. Haque, R. M. Lees, J. M. Saint Clair, Y. Beers, and D. R. Johnson, Astrophys. J. (Letters) **187**, L15 (1974). "Microwave spectrum of ^{13}C methanol."

Har87 A. I. Harris, J. Stutzki, R. Genzel, J. B. Lugten, G. J. Stacey, and D. T. Jaffe, Astrophys. J. (Letters) **322**, L49 (1987). "Submillimeter and far-infrared spectroscopy of M17 and S106: UV-heated, quiescent molecular gas?"

Has89 A. D. Haschick, W. A. Baan, and K. M. Menten, Astrophys. J. **346**, 330 (1989). "Detection of three new methanol maser transitions toward star forming regions."

Hel70 P. Helminger, F. C. DeLucia, and W. Gordy, Phys. Rev. Lett. **25**, 1397 (1970). "Extension of microwave absorption spectroscopy to 0. 37 mm wavelength."

Hel71 P. Helminger, F. C. DeLucia, and W. Gordy, J. Mol. Spectrosc. **39**, 94 (1971). "Rotational spectra of NH_3 and ND_3 in the 0. 5 mm wavelength region."

Hel73 P. Helminger, F. C. DeLucia, and W. H. Kirchhoff, J. Phys. Chem. Ref. Data **2**, 215 (1973). "Microwave spectra of molecules of astrophysical interest. IV. Hydrogen sulfide."

Hen83 C. Henkel, H. E. Matthews, and M. Morris, Astrophys. J. **267**, 184 (1983). "SiS maser emission from IRC+10216."

Hen83a C. Henkel, T. L. Wilson, C. M. Walmsley, and T. Pauls, Astron. Astrophys. **127**, 388 (1983). "Formaldehyde towards compact *H* II regions: densities and isotopic ratios."

Hen85 C. Henkel, H. E. Matthews, M. Morris, S. Trebey, and M. Fich, Astron. Astrophys. **147**, 143 (1985). "Molecular lines in IRC+10216 AND CIT6."

Hen87 C. Henkel, R. Mauersberger, T. L. Wilson, L. E. Snyder, K. M. Menten, and J. G. A. Wouterloot, Astron. Astrophys. **182**, 299 (1987). "Deuterated water in Orion·KL and NGC 7538."

Her84 E. Herbst, J. K. Messer, F. C. DeLucia, and P. Helminger, J. Mol. Spectrosc. **108**, 42 (1984). "A new analysis and additional measurements of the millimeter and submillimeter spectrum of methanol."

Her85 W. Hermsen, T. L. Wilson, C. M. Walmsley and W. Batrla Astron. Astrophys. **146**, 134 (1985). "$^{15}NH_3$ in Orion·KL: the hot core isn't so hot."

Her85a W. Hermsen, Private communication, 1985. (NH_3 observations)

Her88 W. Hermsen, T. L. Wilson, C. M. Walmsley, and C. Henkel, Astron. Astrophys. **201**, 285 (1988). "A multilevel study of ammonia in star-forming regions III. Orion·KL."

Heu73 J. E. M. Heuvel and A. Dymanus, J. Mol. Spectrosc. **45**, 282 (1973). "Hyperfine structure of CH_3OH."

Hja84 Å. Hjalmarson and L. Johansson, private communication, (1984).

Ho77 P. T. P. Ho, R. N. Martin, P. C. Myers, and A. H. Barrett, Astrophys. J. (Letters) **215**, L29 (1977). "Gas temperatures and motion in the Taurus dark cloud."

Hoc75 W. H. Hocking, M. C. L. Gerry, and G. Winnewisser, Can. J. Phys. **53**, 1869 (1975). "The microwave and millimeter wave spectrum, molecular constants, dipole moment, and structure of isocyanic acid, HNCO."

Hol76 J. M. Hollis, L. E. Snyder, F. J. Lovas, and D. Buhl, Astrophs. (Letters) **209**, L83 (1976). "Radio detection of interstellar DCO^+."

Hol76a J. M. Hollis and P. J. Rhodes, NRAO Documentation Memo No. 1, Tucson, Arizona. "Spectral line calibrations."

Hol77 J. M. Hollis and B. L. Ulich, Astrophys. J. **214**, 699 (1977). "Detection of new interstellar transitions of H, OCS, and H_2CO and a search for interstellar fluorine."

Hol80 J. M. Hollis, L. E. Snyder, R. D. Suenram, and F. J. Lovas, Astrophys. J. **241**, 1001 (1980). "A search for the lowest-energy conformer of interstellar glycine."

Hol80a J. M. Hollis, L. E. Snyder, F. J. Lovas, and B. L. Ulich, Astrophys. J. **241**, 158 (1980). "A radio search for intersteller phosphorus compounds."

Hol81 J. M. Hollis, L. E. Snyder, D. H. Blake, F. J. Lovas, R. D. Suenram, and B. L. Ulich, Astrophys. J. **251**, 541 (1981). "New interstellar molecular transitions in the 2 millimeter range."

Hol83 J. M. Hollis, F. J. Lovas, R. D. Suenram, P. R. Jewell, and L. E. Snyder, Astrophys. J. **264**, 543 (1983). "Simultaneous observations of corresponding rotational transitions in the ground and torsionally excited states."

Hol83a J. M. Hollis, R. D. Suenram, F. J. Lovas, and L. E. Snyder, Astron. Astrophys. **126**, 393 (1983). "Radio searches for additional interstellar molecules."

Hol86 J. M. Hollis, E. D. Churchwell, E. Herbst, and F. C. DeLucia, Nature **322**, 524 (1986). "An interstellar line coincident with the P(2,1) transition of hydronium (H_3O^+)."

Hol89 J. M. Hollis, P. R. Jewel, and F. J. Lovas, Astrophys. J. **346**, 794 (1989). "A search of methylene in the Orion Nebula."

Hol91 J. M. Hollis, L. E. Snyder, L. M. Ziurys, and D. McGonagle, in Astron. Soc. Pac. Conf. Ser. Vol. 16, eds. A. D. Haschick and P. T. Ho, p. 407, 1991. "Interstellar HNO. Confirming the identification."

Hug51 R. H. Hughes, W. E. Good, and D. K. Coles, Phys. Rev. **84**, 418 (1951). "Microwave spectrum of methyl alcohol."

Hug79 P. J. Huggins, T. G. Phillips, G. Neugebauer, M. W. Werner, P. G. Wannier, and D. Ennis, Astrophys. J. **227**, 441 (1979). "The detection of the $J=3-2$ lines of HCN, HNC, and HCO^+ in the Orion molecular cloud."

Hui71 C. Huiszoon, Rev. Sci. Instrum. **42**, 477 (1971). "A high resolution spectrometer for the shorter millimeter wavelength region."

Irv81 W. M. Irvine, B. Höglund, P. Friberg, J. Askne, and J. Elldér, Astrophys. J. (Letters) **248**, L113 (1981). "The increasing chemical complexity of the Taurus dark clouds: detection of CH_3CCH and C_4H."

Irv83 W. M. Irvine, J. C. Good, and F. P. Schloerb, Astron. Astrophys. **127**, L10 (1983). "Observations of SO_2 and HCS^+ in cold molecular clouds."

Irv83a W. M. Irvine and Å. Hjalmarson, "Cosmochemistry and the Origin of Life." Ed. C. Ponnamperuma, (Dordrecht: D. Reidel p 113, 1983).

Irv84 W. M. Irvine and P. Friberg, Private communication, 1984.

Irv88 W. M. Irvine, R. D. Brown, D. M. Cragg, P. Friberg, P. D. Godfrey, N. Kaifu, H. E. Matthews, M. Ohishi, H. Suzuki, and H. Takeo, Astrophys. J. (Letters) **335**, L89 (1988). "A new interstellar polyatomic molecule: Detection of propynal in the cold cloud TMC-1."

Irv88a W. M. Irvine, P. Friberg, Å. Hjalmarson, S. Ishikawa, N. Kaifu, K. Kawaguchi, S. C. Madden, H. E. Matthews, M. Ohishi, S. Saito, H. Suzuki, P. Thaddeus, B. E. Turner, S. Yamamoto, and L. M. Ziurys, Astrophys. J. (Letters) **334**, L107 (1988). "Identification of the interstellar cyanomethyl radical (CH_2CN) in the molecular clouds TMC-1 and Sagittarius B2."

Irv90 W. M. Irvine, P. Friberg, N. Kaifu, H. E. Matthews, Y.-C. Minh, M. Ohishi, and S. Ishikawa. Astron. Astrophys. (Letters) **229**, L9 (1990). "Detection of formic acid in the cold, dark cloud L134N."

Jac88 T. Jacq, P. R. Jewell, C. Henkel, C. M. Walmsley, and A. Baudry, Astron. Astrophys. **199**, L5 (1988). "$H_2{}^{18}O$ in hot dense molecular cloud cores."

Jac90 T. Jacq, C. M. Walmsley, C. Henkel, A. Baudry, R. Mauersberger, and P. R. Jewell, Astron. Astrophys. **228**, 447 (1990). "Deuterated water and ammonia in hot cores."

Jef70 K. B. Jefferts, A. A. Penzias, and R. W. Wilson, Astrophys. J. (Letters) **161**, L87 (1970). "Observation of the CN Radical in the Orion nebula and W51."

Jef71 K. B. Jefferts, A. A. Penzias, R. W. Wilson, and P. M. Solomon, Astrophys. J. (Letters) **168**, L111 (1971). "Detection of interstellar carbonyl sulfide."

Jen79 D. E. Jennings and K. Fox, Astrophys. J. **227**, 433 (1979). "Two new methanol transitions in Orion A."

Jen82 D. E. Jennings and K. Fox, Astrophys. J. **254**, 111 (1982). "Rotational temperatures of cyanodiacetylene in Sagittarius B2, TMC-1, and IRC + 10216."

Jew84 P. R. Jewell and L. E. Snyder, Astrophys. J. **278**, 176 (1984). "Observations and analysis of circumstellar cyanoacetylene."

Jew87 P. R. Jewell, D. F. Dickinson, L. E. Snyder, and D. P. Clemens, Astrophys. J. **323**, 749 (1987). "High-excitation SiO masers in evolved stars."

Jew89 P. R. Jewell, J. M. Hollis, F. J. Lovas, and L. E. Snyder, Astrophys. J. Suppl. **70**, 833 (1989). "Millimeter and submillimeter wave survey of Orion A emission lines in the ranges 200.7–202.3 GHz, 203.7–205.3 GHz and 330–360 GHz."

Joh72 D. R. Johnson, Private communication, 1972.

Joh76 D. R. Johnson, L. E. Snyder, and F. J. Lovas, Bull AAS **8**, 349 (1976). "Sulfur dioxide in Orion and Sgr B2."

Joh76a D. R. Johnson, R. D. Suenram, and W. J. Lafferty, Astrophys. J. **208**, 245 (1976). "Laboratory microwave spectrum of cyanamide."

Joh77 D. R. Johnson, F. J. Lovas, C. A. Gottlieb, E. W. Gottlieb, M. M. Litvak, M. Guélin, and P. Thaddeus, Astrophys. J. **218**, 370 (1977). "Detection of interstellar ethyl cyanide."

Joh84 L. E. B. Johansson, C. Andersson, J. Elldér, P. Friberg, Å. Hjalmarson, B. Höglund, W. M. Irvine, H. Olofsson, and G. Rydbeck, Astron. Astrophys. **130**, 227 (1984). "Spectral scan of Orion A and IRC + 10216 from 72 to 91 GHz."

Kah84 C. Kahane, M. A. Frerking, W. D. Langer, P. Encrenaz, and R. Lucas, Astron. Astrophys. **137**, 211 (1984). "Measurement of the formaldehyde *ortho* to *para* ratio in three molecular clouds."

Kah88 C. Kahane, J. Gómez-Gonalez, J. Cernicharo, and M. Guélin, Astron. Astrophys. **190**, 167 (1988). "Carbon, nitrogen, sulfur, and silicon isotopic ratios in the envelope of IRC + 10216."

Kai74 N. Kaifu, M. Morimoto, K. Nagane, K. Akabane, T. Iguchi, and K. Takagi,Astrophys. J. (Letters) **191**, L135 (1974). "Detection of interstellar methylamine."

Kai75 N. Kaifu, K. Takagi, and T. Kojima, Astrophys. J. (Letters) **198**, L85 (1975). "Excitation of interstellar methylamine."

Kai87 N. Kaifu, H. Suzuki, M. Ohishi, T. Miyaji, S. Ishikawa, T. Kasuga, M. Morimoto, and S. Saito, Astrophys. J. (Letters) **317**, L111 (1987). "Detection of intense unidentified lines in TMC-1."

Kak75 R. K. Kakar and R. L. Poynter, J. Mol. Spectrosc. **54**, 475 (1975). "Precision line parameter measurements for selected $K=J$ inversion lines of ammonia."

Kau79 V. K. Kaushik and K. Takagi, Publ. Astron. Soc. Japan **31**, 423 (1979). "Laboratory frequencies of the $J=2-1$, a-type transitions of CH_3OD."

Kau80 V. K. Kaushik, K. Takagi, and C. Matsumura, J. Mol. Spectrosc. **82**, 418 (1980). "Microwave spectrum of CH_3OD."

Kee83 J. Keene, G. A. Blake, and T. G. Phillips, Astrophys. J. (Letters) **271**, L27 (1983). "First detection of the ground-state $J,K=1,0-0,1$, submillimeter transition of interstellar ammonia."

Kil90 T. C. Killian, J. M. Vrtilek, C. A. Gottlieb, E. W. Gottlieb, and P. Thaddeus, Astrophys. J. (Letters) **365**, L89 (1990). "Laboratory detection of a second carbon chain carbene: butatrieneylidene, H_2C_4."

Kle85 W. Klebsch, M. Bester, K. M. T. Yamada, G. Winnewisser, W. Joentgen, H. J. Altenbach, and E. Vogel, Astron. Astrophys. **152**, L12 (1985). "Millimeter wave spectrum of tricarbon monoxide, CCCO."

Kle91 I. Kleiner, J. T. Hougen, R. D. Suenram, F. J. Lovas and M. Godefroid. J. Mol. Spectrosc. **148**, 38 (1991). "The ground torsional state of acetaldehyde."

Koj80 T. Kojima, J. Phys. Soc. Japan **49**, 1197 (1980). "Microwave spectrum of methyl mercaptan a-type R-branch transitions."

Kro78 H. W. Kroto, C. Kirby, D. R. M. Walton, L. W. Avery, N. W. Broton, J. M. MacLeod, and T. Oka, Astrophys. J. (Letters) **219**, L133 (1978). "The detection of cyanohexatriyne $H(C=C)_3CN$, in Heiles's cloud 2."

Kui75 E. N. R. Kuiper and T. B. H. Kuiper, Private communication, 1975.

Kui77 E. N. R. Kuiper, T. B. H. Kuiper, B. Zuckerman, and R. K. Kakar, Astrophys. J. **214**, 394 (1977). "Unidentified lines in molecular clouds and a search for ^{14}C in IRC + 10216."

Kui78 E. N. R. Kuiper, B. Zuckerman, and T. B. H. Kuiper, Astrophys. J. (Letters) **219**, L49 (1978). "Deuterated ammonia toward the Orion nebula."

Kui84 T. B. H. Kuiper, E. N. R. Kuiper, D. F. Dickinson, B. E. Turner and B. Zuckerman, Astrophys. J. **276**, 211 (1984). "Methyl acetylene as a temperature probe for dense interstellar clouds."

Kui89 T. B. H. Kuiper, W. L. Peters, III, F. F. Gardner, J. B. Whiteoak, and J. E. Reynolds, Astrophys. J. (Letters) **340**, L41 (1989). "Detection of the 2_0-3_{-1} transition of $^{13}CH_3OH$ at 14.8 GHz."

Kuk65 S. G. Kukolich, Phys. Rev. **138**, A1322 (1965). "Measurement of hyperfine structure of the $J=3$, $K=2$ inversion line of $N^{14}H_3$."

Kuk67 S. G. Kukolich, Phys. Rev. **156**, 83 (1967). "Measurement of ammonia hyperfine structure with a two-cavity maser."

Kuk68 S. G. Kukolich, Phys. Rev. **172**, 59 (1968). "Hyperfine structure of $N^{15}H_3$."

Kuk69 S. G. Kukolich, J. Chem. Phys. **50**, 3751 (1969). "Measurement of the molecular g values in H_2O ad D_2O and hyperfine structure in H_2O."

Kuk70 S. G. Kukolich and S. G. Wofsky, J. Chem. Phys. **52**, 5477 (1970). "$^{14}NH_3$ hyperfine and quadrupole coupling."

Kuk71 S. G. Kukolich, A. C. Nelson, and B. S. Yamanashi, J. Am. Chem. Soc. **93**, 6769 (1971). "Molecular-beam microwave spectra of HNCO and DNCO."

Kuk74 S. G. Kukolich, D. E. Oates, and J. H. S. Wang, J. Chem. Phys. **61**, 4686 (1974). "Rotational energy distribution in a nozzle beam."

Kuk75 S. G. Kukolich, J. Am. Chem. Soc. **97**, 5704 (1975). "Proton magnetic shielding tensors from spin-rotation measurements on H_2CO and NH_3."

Kur86 H. Kuriyama, K. Takagi, H. Takeo, and C. Matusumara, Astropyhys. J. **311**, 1073 (1986). "Laboratory microwave spectrum of $^{13}CH_3OH$."

Kut73 M. L. Kutner, P. Thaddeus, A. A. Penzias, R. W. Wilson, and K. B. Jefferts,Astrophys. J. (Letters) **183**, L27 (1973). "New interstellar methanol lines."

Kut76 M. L. Kutner, N. J. Evans, II, and K. D. Tucker, Astrophys. J. **209**, 452 (1976). "A dense molecular cloud in the OMC-1/ OMC-2 region."

Kut80 M. L. Kutner, D. E. Machnik, K. D. Tucker, and R. L. Dickman, Astrophys. J. **242**, 541 (1980). "Search for interstellar pyrole and furan."

Kuz80 H. Kuze, Astrophys. J. **239**, 1131 (1980). "Microwave spectrum of water in the v_2 excited vibrational state."

Lan78 W. D. Langer, R. W. Wilson, P. S. Henry, and M. Guélin, Astrophys. J. (Letters) **225**, L139 (1978). "Observations of anomalous intensities in the lines of the HCO^+ isotopes."

Lan79 W. D. Langer, M. A. Frerking, R. A. Linke, and R. W. Wilson, Astrophys. J. (Letters) **232**, L169 (1979). "Detection of deuterated formaldehyde in interstellar clouds."

Lan80 W. D. Langer, F. P. Schloerb, R. L. Snell, and J. S. Young, Astrophys. J. (Letters) **239**, L125 (1980). "Detection of deuterated cyanoacetylene in the interstellar cloud TMC 1."

Lee68 R. M. Lees and J. G. Baker, J. Chem. Phys. **48**, 5299 (1968). "Torsion-vibration-rotation interactions in methanol. I. Millimeter wave spectrum."

Lee73 R. M. Lees, F. J. Lovas, W. H. Kirchhoff, and D. R. Johnson, J. Phys. Chem. Ref. Data **2**, 205 (1973). "Microwave spectra of molecules of astrophysical interest. III. Methanol."

Lee80 R. M. Lees and M. A. Mohammadi, Can. J. Phys. **58**, 1640 (1980). "Millimeter wave spectrum of methyl mercaptan."

Lee84 R. M. Lees, Private communication, 1984.

Lei84 D. T. Leisawitz (see Lor84a).

Lei84a D. T. Leisawitz, R. B. Loren, and J. H. Davis (see Lor84a).

Lia86 W. Liang, J. G. Baker, E. Herbst, R. A. Booker, and F. C. DeLucia, J. Mol. Spectrosc. **120**, 298 (1986). "The millimeter-wave spectrum of acetaldehyde in its two lowest torsional states."

Lin77 R. A. Linke, P. F. Goldsmith, P. G. Wannier, R. W. Wilson, and A. A. Penzias, Astrophys. J. **214**, 50 (1977). "Isotopic abundance variations in interstellar HCN."

Lin79 R. A. Linke, M. A. Frerking, and P. Thaddeus, Astrophys. J. (Letters) **234**, L139 (1979). "Interstellar methyl mercaptan."

Lin81 R. A. Linke, A. A. Stark, and M. A. Frerking, Astrophys. J. **243**, 147 (1981). "Millimeter wave absorption features toward the galactic center: evidence for a massive nuclear disk."

Lin83 R. A. Linke, M. Guélin, and W. D. Langer, Astrophys. J. (Letters) **271**, L85 (1983). "Detection of $H^{15}NN^+$ and $HN^{15}N^+$ in interstellar clouds."

Lis75 H. S. Liszt and R. A. Linke, Astrophys. J. **196**, 709 (1975). "Interstellar carbon monosulfide."

Lis78 H. S. Liszt, Astrophys. J. **219**, 454 (1978). "Upper limits on the abundance of the sulfur dimer in molecular clouds."

Lis78a H. S. Liszt and B. E. Turner, Astrophys. J. (Letters) **224**, L73 (1978). "Microwave detection of interstellar NO."

Lis90 D. C. Lis, and P. F. Goldsmith, Astrophys. J., (1990). "High density gas in the core of the Sagittarius B2 molecular cloud."

Lit77 L. T. Little, P. W. Riley, and D. N. Matheson, M.N.R.A.S. **181**, 33p (1977). "Detection of the $J = 9 - 8$ transition of interstellar cyanodiacetylene."

Lit78 L. T. Little, G. H. Macdonald, P. W. Riley, and D. N. Matheson, M. N. R. A. S. **183**, 45p (1978). "Observations of interstellar HC_5N and HC_7N in dark dust clouds."

Lor81 R. B. Loren, N. R. Erickson, R. L. Snell, L. Mundy, and J. H. Davis, Astrophys. J. (Letters) **244**, L107 (1981). "Detection of high-excitation rotational lines of cyanoacetylene in the OMC-1 region."

Lor81a R. B. Loren, L. Mundy, and N. R. Erickson, Astrophys. J. **250**, 573 (1981). "High-temperature methyl cyanide in Orion molecular cloud 1."

Lor82 R. B. Loren and A. Wootten, Proc. 16th ESLAB Symposium on Galactic and Extragalactic Infrared Spectroscopy. Toledo, Spain Dec. (ESA SP-192) pp. 93–99 (1982). "The relationship between the cold and dense regions in ρ Oph: The DCO^+ lines."

Lor83 R. B. Loren, Aa. Sandqvist, and A. Wootten, Astrophys. J. **270**, 620 (1983). "Molecular clouds on the threshold of star formation: the radial density profile of the cores of the ρ Ophiuchi and *R* Coronae Australis clouds."

Lor84 R. B. Loren and L. G. Mundy, Astrophys. J. **286**, 232 (1984). "The methyl cyanide hot and warm cores in Orion: statistical equilibrium excitation models of a symmetric top molecule."

Lor84a R. B. Loren, Tech. Rep. AST 8116403–1 June 1984. "MWO spectral line detections from 128 to 357 GHz 1979–1984."

Lor84b R. B. Loren and A. Wootten (see Lor84a).

Lor84c R. B. Loren and N. R. Erickson (see Lor84a).

Lor84d R. B. Loren and L. G. Mundy (see Lor84a).

Lor84e R. B. Loren and D. T. Leisawitz (see Lor84a).

Lor84f R. B. Loren and W. L. Peters (see Lor84a).

Lor84g R. B. Loren, N. R. Erickson, and L. G. Mundy (see Lor84a),

Lor85 R. B. Loren,, and A. Wooten, Astrophys. J. **299**, 947 (1985). "High-excitation lines of deuterated formaldehyde (HDCO) in the Orion molecular cloud."

Lor86 R. B. Loren and A. Wootten, Astrophys. J. **310**, 889 (1986). "Submillimeter molecular spectroscopy with the Texas Millimeter Wave Observatory Radio Telescscope."

Lov74 F. J. Lovas and E. Tiemann, J. Phys. Chem. Ref. Data **3**, 609 (1974). "Microwave spectral tables. I. Diatomic molecules."

Lov76 F. J. Lovas, L. E. Snyder, and D. Buhl, Private communication, 1976.

Lov76a F. J. Lovas, D. R. Johnson, D. Buhl, and L. E. Snyder, Astrophys. J. **209**, 770 (1976). "Millimeter emission lines in Orion A."

Lov78 F. J. Lovas and R. D. Suenram, private communication, 1978. "Lab measurement of CH_3OH and CH_3OD."

Lov79 F. J. Lovas, H. Lutz, and H. Dreizler, J. Phys. Chem. Ref. Data **8**, 1051 (1979). "Microwave spectra of molecules of astrophysical interest. XVII. Dimethyl ether."

Lov82 F. J. Lovas, R. D. Suenram, L. E. Snyder, J. M. Hollis, and R. M. Lees, Astrophys. J. **253**, 149 (1982). "Detection of the torsionally excited state of methanol in Orion A."

Lov82a F. J. Lovas and R. D. Suenram, J. Mol. Spectrosc. **93**, 416 (1982). "Reaction products from a microwave discharge in N_2 and H_2S. The microwave spectrum of NS."

Lov82b F. J. Lovas, R. D. Suenram, and K. M. Evenson, Astrophys. J. (Letters) **267**, L131 (1982). "Laboratory measurement of the 4_{04}–3_{13} 70 GHz transition of ground state methylene (CH_2)."

Lov84 F. J. Lovas, private communication, 1984. "Lab measurement of $H_2C^{34}S$".

Lov85 F. J. Lovas, private communication, 1985. "Lab measurement of CH_3NH_2."

Lov88 F. J. Lovas, R. D. Suenram, G. T. Fraser, C. W. Gillies, J. Zozom, J. Chem. Phys. **88**, 722 (1988). "The microwave spectrum of formamide-water and formamide-methanol complexes."

Lov89 F. J. Lovas and R. D. Suenram, private communication, 1989. "Lab measurements of $(CH_3)_2CO$."

Lov91 F. J. Lovas, private communication, 1991.

Luc88 R. Lucas, S. Guilloteau, and A. Omont, Astron. Astrophys. **194**, 230 (1988). "New HCN masers in stars."

Luc89 R. Lucas and J. Cernicharo Astron. Astrophys. **218**, L20 (1989). "Discovery of strong maser emission from HCN in IRC+10216."

McG77 R. X. McGee, M. Balister, and L. M. Newton, M.N.R.A.S. **180**, 585 (1977). "Interstellar cyanoacetylene $J=2-1$, $J=4-3$ transitions."

Mac75 J. M. MacLeod and L. H. Doherty, Bull. A. A. S. **7**, 265 (1975). "Detection of the 3_{13}–3_{12} transitions of thioformaldehyde and acetaldehyde in Sgr B2."

Mac81 J. M. MacLeod, L. W. Avery, and N. W. Broten, Astrophys. J. (Letters) **251**, L33 (1981). "Detection of deuterated cyanodiacetylene (DC_5N) in Taurus molecular cloud 1."

Mac81a J. M. MacLeod, N. W. Broton, T. Oka, and L. W. Avery, Private communication, 1981.

Mad86 S. C. Madden, W. M. Irvine, H. E. Matthews, R. D. Brown, and P. D. Godfrey, Astrophys. J. (Letters) **300**, L79 (1986). "New interstellar maser in nonmetastable ammonia."

Mad86a S. C. Madden, W. M. Irvine, H. E. Matthews, and L. W. Avery, NASA Tech. Memo. 88342. p. 155 (1986). "Multi-level study of C_3H_2: The first interstellar hydrocarbon ring."

Mak74 A. G. Maki, J. Phys. Chem. Ref. Data **3**, 221 (1974). "Microwave spectra of molcules of astrophysical interest. VI. Carbonyl sulfide and hydrogen cyanide."

Man71 R. N. Manchester and M. A. Gordon, Astrophys. J. **169**, 507 (1971). "Excitation temperatures of the 18 centimeter OH transitions in an absorbing cloud."

Man90 J. G. Mangum, A. Wootten, R. B. Loren, and E. J. Wadiak, Astrophys. J. **348**, 542 (1990). "Observations of the formaldehyde emission in Orion·KL: Abundances, distribution, and kinematics of the dense gas in the Orion molecular ridge."

Man90a J. G. Mangum and A. Wootten, Astron. Astrophys. **239**, 319 (1990). "Observations of the cyclic C_3H radical in the interstellar medium."

Mat80 D. N. Matsakis, A. C. Cheung, M. C. H. Wright, J. I. H. Askne, C. H. Townes, and W. J. Welch, Astrophys. J. **236**, 481 (1980). "An interferometric and multitransitional study of the Orion methanol masers."

Mat83 H. E. Matthews and T. J. Sears, Astrophys. J. Letters **267**, L53 (1983). "Detection of the $J=1-0$ transition of CH_3CN."

Mat83a H. E. Matthews and T. J. Sears, Astrophys. J. **272** 149 (1983). "The detection of vinyl cyanide in TMC-1."

Mat84 H. E. Matthews, W. M. Irvine, P. Friberg, R. D. Brown, and P. D. Godfrey, Nature **310**, 125 (1984). "A new interstellar molcule: tricarbon monoxide."

Mat85 H. E. Matthews, P. Friberg, and W. M. Irvine, Astrophys. J. **240**, 609 (1985). "The detection of acetaldehyde in cold dust clouds."

Mat85a H. E. Matthews, and W. M. Irvine, Astrophys. J. (Letters) **298**, L61 (1985). "The hydrocarbon ring C_3H_2 is ubiquitous in the galaxy."

Mat86 H. E. Matthews, and T. J. Sears, Astrophys. J. **300**, 766 (1986). "Interstellar molecular line searches at 1. 5 centimeters."

Mat86a H. E. Matthews, S. C. Madden, L. W. Avery, and W. M. Irvine, Astrophys. J. (Letters) **307**, L69 (1986). "The C_3H_2 2_{20}–2_{11} transition: absorption in cold dark clouds."

Mat87 H. E. Matthews, P. A. Feldman, and P. F. Bernath, Astrophys. J. **312**, 358 (1987). "Upper limits to interstellar PO."

Mat87a H. E. Matthews, J. M. MacLeod, N. W. Broten, S. C. Madden, and P. Friberg, Astrophys. J. **315**, 646 (1987). "Observations of OCS and a search for OC_3S in the interstellar medium."

Mau86 R. Mauersberger, T. L. Wilson, C. Henkel, C. M. Walmsley, and W. Hermsen,Astron. Astrophys. **162**, 199 (1986). "Hot ammonia in the galaxy."

Mau87 R. Mauersberger, C. Henkel, and T. L. Wilson, Astron. Astrophys. **173**, 352 (1987). "A multilevel study of ammonia in star-forming regions. I. Maser and thermal emission toward W51 IRS2."

Mau88 R. Mauersberger, C. Henkel, T. Jacq, and C. M. Walmsley, Astron. Astrophys. **194**, L1 (1988). "Deuterated methanol in Orion."

Mau88a R. Mauersberger, C. Henkel, and T. L. Wilson, Astron. Astrophys. **205**, 235 (1988). "Vibrationally excited ammonia toward Orion·KL."

Mee75 W. L. Meerts and H. Dymanus, Can. J. Phys. **53**, 2123 (1975). "A molecular beam electric resonance study of the hyperfine L doubling spectrum of OH, OD, SH, and SD."

Meh85 S. C. Mehrotra, H. Dreizler, and H. Mäder, J. Naturforsch. **40a**, 683 (1985). "J-Dependence of T_2-parameters for rotational transitions of SO_2 and CH_3OH in K-band."

Men85 K. M. Menten, K. J. Johnston, T. L. Wilson, C. M. Walmsley, R. Mauersberger, and C. Henkel, Astrophys. J. (Letters) **293**, L83 (1985). VLA observations of the 9,2–10,1 A^+ methanol masers toward W3(OH)."

Men86 K. M. Menten, C. M. Walmsley, C. Henkel, T. L. Wilson, Astron. Astrophys. **157**, 318 (1986). "The centimeter transitions of E-type methanol."

Men86a K. M. Menten, C. M. Walmsley, C. Henkel, T. L. Wilson, L. E. Snyder, J. M. Hollis, and F. J. Lovas, Astron. Astrophys. **169**, 271 (1986). "Torsionally excited methanol in hot molecular cloud cores."

Men88 K. M. Menten, C. M. Walmsley, C. Henkel, T. L. Wilson, Astron. Astrophys. **198**, 253 (1988). "Methanol in the Orion region. I. Millimeter wave observations."

Men89 K. M. Menten, and G. J. Melnick, Astophys. J. (Letters) **341**, L91 (1989). "Hot water around late-type stars: Detection of two millimeter wave emission lines from the ν_2 vibrationally excited state."

Men90 K. M. Menten, G. J. Melnick, and T. G. Phillips, Astophys. J. (Letters) **350**, L41 (1990). "Submillimeter water masers."

Men90a K. M. Menten, G. J. Melnick, T. G. Phillips, and D. A. Neufeld, Astophys. J. (Letters) **363**, L27 (1990). "A new submillimeter water maser transition at 325 GHz."

Mer82 A. J. Merer, C. M. Walmsley, and E. Churchwell, Astrophys. J. **256**, 151 (1982). "A search for interstellar and stellar iron monoxide."

Mik89 H. Mikami, S. Yamamoto, S. Saito, and M. Guélin, Astron. Astrophys. **217**, L5 (1989). "Laboratory microwave spectroscopy of the C_3N radical in the vibrationally excited state ν_2."

Mil87 T. J. Millar, J. Elldér, Å. Hjalmarson, and H. Olofsson, Astron. Astrophys. **182**, 143 (1987). "Searches for interstellar and circumstellar metal oxides and chlorides."

Min90 Y. C. Minh, L. M. Ziurys, W. M. Irvine, and D. McGonagle, Astrophys. J. **360**, 136 (1990). "Observations of H_2S toward OMC-1."

Min91 Y. C. Minh, L. M. Ziurys, W. M. Irvine, and D. McGonagle, Astrophys. J. **366**, 192 (1991). "Abundances of hydrogen sulfide in star-forming regions."

Moc55 R. C. Mockler and G. R. Bird, Phys. Rev. **98**, 1837 (1955). "Microwave spectrum of carbon monosulfide."

Mor73 J. M. Moran, G. D. Papadopoulos, B. F. Burke, K. Y. Lo, P. R. Schwartz, D. L. Thacker, K. J. Johnson, S. H. Knowles, A. C. Reisz and I. I. Shapiro, Astrophys. J. (Letters) **185**, 535 (1973). "Very long baseline interferometric observations of the H_2O sources in W49N, W3(OH), Orion A, and VY Canus Majoris."

Mor73a M. Morris, B. Zuckerman, P. Palmer, and B. E. Turner, Astrophys. J. **186**, 501 (1973). "Interstellar ammonia."

Mor75 M. Morris, W. Gilmore, P. Palmer, B. E. Turner, and B. Zuckerman, Astrophys. J. (Letters) **199**, L47 (1975). "Detection of interstellar SiS and a study of the IRC+10216 molecular envelope."

Mor76 M. Morris, B. E. Turner, P. Palmer, and B. Zuckerman, Astrophys. J. **205**, 82 (1976). "Cyanoacetylene in dense interstellar clouds."

Mor77 M. Morris, R. L. Snell, and P. Vanden Bout, Astrophys. J. **216**, 738 (1977). "Emission from highly excited rotational states of HC_3N in dense clouds."

Mor85 M. Morimoto, M. Ohishi, and T. Kanzawa, Astrophys. J. (Letters) **288**, L11 (1985). "New maser lines of methanol."

Mun84 L. G. Mundy and R. B. Loren (see Lor84a).

Mun84a L. G. Mundy (see Lor84a).

Nor87 R. P. Norris, J. L. Caswell, F. F. Gardner, and K. J. Wellington, Astrophys. J. (Letters) **321**, L159 (1987). "Widespread strong methanol masers near H II regions."

Nys78 H. J. Nystrom, P. Palmer, and B. Zuckerman, Bull. AAS **10**, 393 (1978). "Observations of inversion lines of nonmetastable states of NH_3 in Orion."

Ohi88 M. Ohishi, S. Yamamoto, S. Saito, K. Kawaguchi, H. Suzuki, N. Kaifu, S. I. Ishikawa, S. Takano, T. Tsuh, and W. Unno, Astrophys. J. **329**, 511 (1988). "The laboratory spectrum of the PS radical and related astronomical search."

Ohi89 M. Ohishi, N. Kaifu, K. Kawaguchi, A. Murakami, S. Saito, S. Yamamoto, and W. M. Irvine, Astrophys. J. (Letters) **345**, L83 (1989). "Detection of a circumstellar carbon chain molecule C_4Si."

Olb85 M. Olberg, M. Bester, G. Rao, T. Pauls, G. Winnewisser, L. E. B. Johansson, and Å. Hjalmarson, Astron. Astrophys. **142**, L1 (1985). "A new search for and discovery of deuterated ammonia in three molecular clouds."

Olo84 H. Olofsson, Astron. Astrophys. **134**, 36 (1984). "Deuterated water in Orion-KL and W51M."

Pal69 P. Palmer, B. Zuckerman, D. Buhl, and L. E. Snyder, Astrophys. J. (Letters) **156**, L147 (1969). "Formaldehyde absorption in dark nebulae."

Pea76 E. F. Pearson, R. A. Creswell, M. Winnewisser, and G. Winnewisser, Z. Naturforsch. **31a**, 1394 (1976). "The molecular structure of HNC and HCN derived from the eight stable isotopic species."

Pea77 R. Pearson,Jr., and F. J. Lovas, J. Chem. Phys. **66**, 4149 (1977). "Microwave spectrum and molecular structure of methylenimine (CH_2NH)."

Pen74 A. A. Penzias, R. W. Wilson, and K. B. Jefferts, Phys. Rev. Lett. **32**, 701 (1974). "Hyperfine structure of the CN radical determined from astronomical observations."

Pen77 A. A. Penzias, P. G. Wannier, R. W. Wilson, and R. A. Linke, Astrophys. J. **211**, 108 (1977). "Deuterium in the galaxy."

Pet88 S. J. Petuchowski, and C. L. Bennett, Astrophys. J. **326**, 376 (1988). "Detection of the 2_{20}–2_{21} transition of HDO in Orion A: Evidence for dense clumped gas in the hot core."

Pet91 S. J. Petuchowski, and C. L. Bennett, Astrophys. J. **367**, 168 (1991). "A search for vibrationally excited H_2O at 68 GHz."

Phi74 T. G. Phillips, K. B. Jefferts, and P. G. Wannier, Astrophys. J. (Letters) **192**, L153 (1974). "A new DCN line: DCN (HCN) excitation."

Phi77 T. G. Phillips and P. J. Huggins, Astrophys. J. **211**, 798 (1977). "Observations of carbon monoxide $J=2-1$ isotopic lines in DR21, W51, and Orion."

Phi80 T. G. Phillips, J. Kwan, and P. J. Huggins, "Interstellar Molecules", ed. B. H. Andrew, (Dordrecht: D. Reidel p 21, (1980). "Detection of submillimeter lines of CO (0.65 mm) and H_2O (0.79 mm)."

Phi85 P. G. Phillips, G. A. Blake, J. Keene, R. C. Woods, and E. Churchwell, Astrophys. J. (Letters) **294**, L45 (1985). Interstellar H_3^+: Possible detection of the 1(1,0)–1(1,1) transition H_2D^+."

Pic78 H. M. Pickett and T. L. Boyd, Chem. Phys. Lett. 58, 446 (1978). Microwave detection of photolysis products: HCO from acetaldehyde using mercury sensitization."

Pic79 H. M. Pickett and J. H. Davis, Astrophys. J. **227**, 446 (1979). "Rotational temperature of sulfur dioxide in OMC-1."

Pic81 H. M. Pickett, E. A. Cohen, D. B. Brinza, and M. M. Schaefer, J. Mol. Spectrosc. **89**, 542 (1981). "The submillimeter wavelength spectrum of methanol."

Pla82 R. L. Plambeck and N. R. Erickson, Astrophys. J. **262**, 606 (1982). "A search for NaH in dense molecular clouds: evidence against formationon grains."

Plu84 G. M. Plummer, E. Herbst, F. C. DeLucia, and G. A. Blake, Astrophys. J. Suppl. **55**, 633 (1984). "The millimeter and submillimeter laboratory spectrum of methyl formate in its ground symmetric torsional state."

Plu85 G. M. Plummer, E. Herbst, and F. C. DeLucia, J. Chem. Phys. **83**, 1428 (1985). "Laboratory measurement of the P(2,1) submillimeter transition frequency of H_3O^+".

Plu86 G. M. Plummer, E. Herbst, F. C. DeLucia, and G. A. Blake, Astrophys. J. Suppl. **60**, 949 (1986). "The laboratory millimeter-wave spectrum of methyl formate in its ground torsional E state."

Plu87 G. M. Plummer, E. Herbst, and F. C. DeLucia, Astrophys. J. **318**, 873 (1987). "C-type transitions in methyl formate."

Poy75 R. L. Poynter and R. K. Kakar, Astrophys. J. Suppl. **29**, 87 (1975). "The microwave frequencies, line parameters, and spectral constants for $^{14}NH_3$."

Poy80 R. L. Poynter and H. M. Pickett, JPL Pub. 80–23, magnetic tape catalogue. "Submillimeter, millimeter, and microwave spectral line catalogue."

Rad68 H. E. Radford, Rev. Sci. Instrum. **39**, 1687 (1968). "Scanning microwave echo box spectrometer."

Rad71 H. E. Radford, Astrophys. J. **174**, 207 (1972). "Rest frequency of the 36 cm radio line of methanol remeasured."

Rib73 J. C. Ribes, J. G. Ables, P. D. Godfrey, and R. D. Brown, Aust. J. Phys. **26**, 79 (1973). "Observations of formamide at 6 cm in Sagittarius B2."

Rob74 B. J. Robinson, J. W. Brooks, P. D. Godfrey, and R. D. Brown, Aust. J. Phys. **27**, 865 (1974). "Detection of the 3,1–3,1 (A) transition of methanol in Sagittarius B2."

Rod80 L. F. Rodriguez and E. J. Chaisson, M. N. R. A. S. **192**, 651 (1980). "Observations of HC_5N and HC_7N in Sgr B2 and Cloud 2."

Ros58 B. Rosenblum, A. H. Nethercot, and C. H. Townes, Phys. Rev. **109**, 400 (1958). "Isotopic mass ratios, magnetic moments and the sign of the electric dipole moment in carbon monoxide."

Rös89 H. P. Röser, J. Schmid-Burgk, G. Schwaab, and R. U. Titz, Proc. 14th Int. Conf. Infrared and Millimeter Waves, p. 374 (1989). "Line emission in the 100–500 μm region from galactic clouds."

Rub71 R. H. Rubin, G. W. Swenson, Jr., R. C. Benson, H. L. Tigelaar, and W. H. Flygare, Astrophys. J. (Letters) **169**, L39 (1971). "Microwave detection of interstellar formamide."

Ryd74 O. E. H. Rydbeck, J. Elldér, W. M. Irvine, A. Sume, and Å. Hjalmarson, Astron. Astrophys. **34**, 479 (1974). "Radio astronomical determination of ground state transition frequencies of CH."

Ryd76 O. E. H. Rydbeck, E. Kollberg, Å. Hjalmarson, A. Sume, J. Elldér, and W. M. Irvine." Astrophys. J. Suppl. **31**, 333 (1976). "Radio observations of interstellar CH. I."

Ryd77 O. E. H. Rydbeck, A. Sume, Å. Hjalmarson, J. Elldér, B. O. Ronnang, and E. Kollberg, Astrophys. J. (Letters) **215**, L35 (1977). "Hyperfine structure of interstellar ammonia in dark clouds."

Ryd80 O. E. H. Rydbeck, W. M. Irvine, Å. Hjalmarson, G. Rydbeck, J. Elldér, and E. Kollberg, Astrophys. J. (Letters) **235**, L171 (1980). "Observations of SO in dark and molecular clouds."

Sah84 R. Sahai, A. Wootten, and R. E. S. Clegg, Astrophys. J. **284**, 144 (1984). "SiS in circumstellar shells."

Sai72 S. Saito and K. Takagi, Astrophys. J. (Letters) **175**, L47 (1972). "Laboratory detection of microwave spectrum for HNO."

Sai87 S. Saito, K. Kawaguchi, H. Suzuki, M. Ohishi, N. Kaifu, and S. Ishikawa, Publ. Astron. Soc. Japan **39**, 193 (1987). "Detection of C_6H in the $^2\Pi_{1/2}$ state toward IRC+10216."

Sai88 S. Saito, S. Yamamoto, W. M. Irvine, L. M. Ziurys, H. Suzuki, M. Ohishi, and N. Kaifu. Astrphys. J. (Letters) **334**, L113 (1988). "Laboratory detection of a new interstellar free radical CH_2CN (2B1)."

Sai89 S. Saito, S. Yamamoto, K. Kawaguchi, M. Ohish, H. Suzuki, S. I. Ishikawa, and N. Kaifu, Astrophys. J. **341**, 1114 (1989). "The microwave spectrum of the CP radical and related astronomical search."

Sas81 K. V. L. N. Sastry, P. Helminger, E. Herbst, and F. C. DeLucia, Chem. Phys. Letters **84**, 286 (1981). "Millimeter and submillimeter spectra of HN_2^+ and DN_2^+."

Sas81a K. V. L. N. Sastry, P. Helminger, A. Charo, E. Herbst, and F. C. DeLucia, Astrophys. J. (Letters) **251**, L119 (1981). "Laboratory millimeter and submillimeter spectrum of CCH."

Sas84 K. V. L. N. Sastry, R. M. Lees, and F. C. DeLucia, J. Mol. Spectrosc. **103**, 486 (1984). "Microwave and submillimeter wave spectra of CH_3OH."

Sas84a K. V. L. N. Sastry, P. Helminger, G. M. Plummer, E. Herbst, and F. C. DeLucia. Astrophys. J. Suppl. **55**, 563 (1984). "Laboratory millimeter and submillimeter spectra of HNO and DNO."

Sas86 K. V. L. N. Sastry, E. Herbst, R. A. Booker, and F. C. DeLucia, J. Mol. Spectrosc. **116**, 120 (1986). "The millimeter-wave spectrum of methyl mercaptan."

Say76 R. J. Saykally, P. G. Szanto, T. G. Anderson, and R. C. Woods, 31st Symposium on Molecular Spectroscopy, Columbus, Ohio (1976). "The microwave spectrum and molecular structure of HNC."

Sca78 E. Scalise, Jr. and J. R. D. Lepine, Astron. Astrophys. **65**, L7 (1978). "Detection of a new transition of SiO in OH/IR stars."

Sch79 W. Schrepp and H. Dreizler, Z. Naturforsch. **34a**, 903 (1979). "A contribution to the Stark-spectroscopy at low microwave frequencies."

Sch81 F. P. Schloerb, R. L. Snell, W. D. Langer, and Y. S. Young, Astrophys. J. (Letters) **251**, L37 (1981). "Detection of deuterocyanobutadiyne (DC_5N) in the interstellar cloud TMC-1."

Sch82 P. R. Schwartz, B. Zuckerman, and J. M. Bologna, Astrophys. J. (Letters) **256**, L55 (1982). "Nearly smultaneous observations of vibrationally excited $J=1-0$, $J=2-1$, $J=3-2$, and $J=4-3$ SiO masers."

Sch83 F. P. Schloerb, P. Friberg, Å. Hjalmarson, B. Höglund, and W. M. Irvine, Astrophys. J. **264**, 161 (1983). "Observations of sulfur dioxide in the Kleinmann-Low Nebula."

Sch83a E. Schafer and M. Winnewisser, Ber. Bunsenges. Phys. Chem. **87**, 327 (1983). "A broadband submillimeter wave spectrometer system with on-line microcomputer data analysis."

Sch84 F. P. Schloerb and R. L. Snell, Private communication, 1984.

Sch85 M. S. Schenewerk, P. R. Jewell, L. E. Snyder, L. W. Buxton, E. J. Campbell, and W. H. Flygare, Astrophys. J. **296**, 218 (1985). "A search for the interstellar HCN dimer."

Sch85a G. V. Schultz, E. J. Durwen, H. P. Roser, W. A. Sherwood, and R. Wattenbach, Astrophys. J. (Letters) **291**, L59 (1985). "Detection of the CO ($J=7-6$) rotational transition at $\lambda=0.37$ millimeters toward Orion."

Sch86 M. S. Schenewerk, L. E. Snyder, and Å. Hjalmarson, Astrophys. J. (Letters) **303**, L71 (1986). "Interstellar HCO: Detection of the missing 3 millimeter quartet."

Sch90 P. Schilke, R. Mauersberger, C. M. Walmsley, and T. L. Wilson, Astron. Astrophys. **227**, 220 (1990). "Vibrationally excited ammonia in the galaxy."

Sch91 A. Schulz, R. Güsten, E. Serabyn, and C. M. Walmsley, Astron. Astrophys. **246**, L55 (1991). "Detection of the ground-state transition of HDO."

Sco78 N. Z. Scoville, and P. M. Solomon, Astrophys. J. (Letters) **220**, L103 (1978). "Vibrationally excited carbon monoxide in IRC+10216."

Sin73 M. W. Sinclair, N. Fourikis, J. C. Ribes, B. J. Robinson, R. D. Brown, and P. D. Godfrey, Aust. J. Phys. **26**, 85 (1973). "Detection of interstellar thioformaldehyde."

Ska83 D. D. Skatrud, F. C. DeLucia, G. A. Blake, and K. V. L. N. Sastry, J. Mol. Spectrosc. **99**, 35 (1983). "The millimeter and submillimeter spectrum of CN in its first four vibrational states."

Sne77 R. L. Snell and H. A. Wootten, Astrophys. J. (Letters) **216**, L111 (1977). "Detection of interstellar DNC."

Sne81 R. L. Snell, F. P. Schloerb, J. S. Young, Å. Hjalmarson, and P. Friberg, Astrophys. J. **244**, 45 (1981). "Observations of HC_3N, HC_5N, and HC_7N in molecular clouds."

Sne84 R. L. Snell, L. G. Mundy, P. F. Goldsmith, N. J. Evans, II., and N. R. Erickson, Astrophys. J. **276**, 625 (1984). "Models of molecular clouds. I. Multitransitional study of CS."

Sne84a R. L. Snell, N. Z. Scoville, and F. P. Schloerb, Private communication, 1984.

Sny69 L. E. Snyder, D. Buhl, B. Zuckerman, and P. Palmer, Phys. Rev. Lett. **22**, 679 (1969). "Microwave detection of interstellar formaldehyde."

Sny71 L. E. Snyder and D. Buhl, Bull. AAS **3**, 388 (1971). "Detection of interstellar isocyanic acid, methylacetylene and hydrogenisocyanide."

Sny72 L. E. Snyder and D. Buhl, Private communication, 1972.

Sny73 L. E. Snyder and D. Buhl, Nature Phys. Sci. **243**, 45 (1973). "Interstellar methylacetylene and isocyanic acid."

Sny74 L. E. Snyder, D. Buhl, P. R. Schwartz, F. O. Clark, D. R. Johnson, F. J. Lovas, and P. T. Giguere, Astrophys. J. (Letters) **191**, L79 (1974). "Radio detection of interstellar dimethyl ether."

Sny74a L. E. Snyder and D. Buhl, Astrophys. J. (Letters) **189**, L31 (1974). "Detection of possible maser emission near 3. 48 millimeters from an unidentified molecular species in Orion."

Sny75 L. E. Snyder and D. Buhl, Astrophys. J. **197**, 329 (1975). "Detection of new stellar sources of vibrationally excited silicon monoxide maser emission at 6. 95 millimeters."

Sny75a L. E. Snyder, J. M. Hollis, B. L. Ulich, F. J. Lovas, D. R. Johnson, and D. Buhl, Astrophys. J. (Letters) **198**, L81 (1975). "Radio detection of interstellar sulfur dioxide."

Sny76 L. E. Snyder, J. M. Hollis, and B. L. Ulich, Astrophys. J. (Letters) **208**, L91 (1976). "Radio detection of the interstellar formyl radical."

Sny76a L. E. Snyder, J. M. Hollis, F. J. Lovas, and B. L. Ulich, Astrophys. J. **209**, 67 (1976). "Detection, identification and observations of interstellar $H^{13}CO^+$."

Sny77 L. E. Snyder, J. M. Hollis, D. Buhl, and W. D. Watson, Astrophys. J. (Letters) **218**, L61 (1977). "Radio detection of interstellar N_2D^+."

Sny77a L. E. Snyder, J. M. Hollis, and D. Buhl, Astrophys. J. (Letters) **215**, L87 (1977). "The quadrupole coupling constant of HNC."

Sny78 L. E. Snyder, D. F. Dickinson, L. W. Brown, and D. Buhl, Astrophys. J. **224**, 512 (1978). "Detection of a weak maser emission pedestal associated with the SiO maser."

Sny80 L. E. Snyder, Private communication, 1980.

Sny83 L. E. Snyder, J. M. Hollis, R. D. Suenram, F. J. Lovas, L. W. Brown, and D. Buhl, Astrophys. J. **268**, 123 (1983). "An extensive galactic search for conformer II glycine."

Sny85 L. E. Snyder, C. Henkel, J. M. Hollis, and F. J. Lovas, Astrophys. J. (Letters) **290**, L29 (1985). "Observations of the SiC_2 radical toward IRC+10216 at 1. 27 cm."

Sny85a L. E. Snyder, M. S. Schenewerk, and J. M. Hollis, Astrophys. J. **298**, 360 (1985). "Observations of several new transitions of interstellar HCO."

Sol71 P. M. Solomon, K. B. Jefferts, A. A. Penzias, and R. W. Wilson, Astrophys. J. (Letters) **168**, L107 (1971). "Detection of millimeter emission lines from interstellar methyl cyanide."

Sol73 P. M. Solomon, A. A. Penzias, K. B. Jefferts, and R. W. Wilson, Astrophys. J. (Letters) **185**, L63 (1973). "Millimeter emission lines of polyatomic molecules in Sagittarius B2."

Sor86 R. L. Sorochenko, A. M. Tolmochev, and G. Winnewisser, Astron. Astrophys. **155**, 237 (1986). "High resolution measurements of cyanoacetylene in dark clouds."

Sta82 G. J. Stacey, N. T. Kurtz, S. D. Smyers, M. Harwit, R. W. Russell, and G. Melnick, Astrophys. J. (Letters) **257**, L37 (1982). "The mass of hot, shocked CO in Orion: first observations of the $J=17-16$ transition at 153 microns."

Sto81 J. W. V. Storey, D. M. Watson, and C. H. Townes Astrophys. J. (Letters) **244**, L27 (1981). "Detection of interstellar OH in the far-infrared."

Sto81a J. W. V. Storey, D. M. Watson, C. H. Townes, E. E. Haller, and W. L. Hansen, Astrophys. J. **247**, 136 (1981). "Far-infrared observations of shocked CO in Orion."

Str48 M. W. P. Strandberg, T. Wentink, R. E. Hillger, G. H. Wannier, and M. L. Deutsch." Phys. Rev. **73**, 188 (1948). "Stark spectrum of HDO."

Stu88 J. Stutzki, R. Genzel, A. I. Harris, J. Herman, and D. T. Jaffe, Astrophys. J. (Letters) **330**, L125 (1988). "First detection of HCN $J=9-8$ (797 GHz) line emission: Very high densities in the Orion core."

Stu89 J. Stutzki, R. Genzel, U. U. Grae, A. I. Harris, and D. T. Jaffe, Astrophys. J. (Letters) **340**, L37 (1989). "First detection of SO_2 and CH_3OH emission and one unidentified line near 800 GHz."

Sue89 R. D. Suenram, F. J. Lovas, and K. Matsumura, Astrophys. J. (Letters) **342**, L103 (1989). "Laboratory measurements of the 1_{01}–0_{00} transition and electric dipole moment of SiC_2."

Sut85 E. C. Sutton, G. A. Blake, C. R. Masson, and T. G. Phillips, Astrophys. J. Suppl. **58**, 341 (1985). "Molecular line survey of Orion A from 215 to 247 GHz."

Sut88 E. C. Sutton and E. Herbst, Astrophys. J. **333**, 359 (1988). "Identification of interstellar methanol lines."

Suz84 H. Suzuki, N. Kaifu, T. Miyaji, M. Morimoto, M. Ohishi, and S. Saito, Astrophys. J. (Letters) **282**, 197 (1984). "Detection of U45. 379: an intense, peculiar unidentified line."

Suz84a H. Suzuki, M. Ohishi, M. Morimoto, N. Kaifu, P. Friberg, M. W. Irvine, H. E. Matthews, and S. Saito, "The Search for Extraterrestrial Life", ed. M. Papagiannis (Dordrecht: D. Reidel, 1984). "Recent observations of organic molecules in nearby cold, dark interstellar clouds."

Suz85 H. Suzuki, N. Kaifu, M. Ohishi, M. Morimoto, and T. Miyaji, private comm. (1985). "Obs. of C_3H_2."

Suz86 H. Suzuki, M. Ohishi, N. Kaifu, S. Ishikawa, T. Kasuga, S. Saito, and K. Kawaguchi, Publ. Astron. Soc. Japan **38**, 911 (1986). "Detection of the interstellar C_6H radical.

Tak59 H. Takuma, T. Schimizu, and K. Shimoda, J. Phys. Soc. Japan **14**, 1595 (1959). "Magnetic hyperfine spectrum of H_2CO by a maser."

Tak73 K. Takagi and T. Kojima, Astrophys. J. (Letters) **181**, L91 (1973). "Laboratory microwave spectrum of methylamine."

Tak90 S. Takano, H. Suzuki, M. Ohishi, S-I. Ishikawa, N. Kaifu, Y. Hirahara, and A. Masuda, Astrophys. J. (Letters) **361**, L15 (1990). "Detection of five ^{13}C isotopic species of HC_5N in TMC-1."

ter72 J. J. ter Meulen and A. Dymanus, Astrophys. J. (Letters) **172**, L21 (1972). "Beam-maser measurements of the ground-state transition frequencies of OH."

ter76 J. J. ter Meulen, W. L. Meerts, G. W. M. van Mierlo, and A. Dymanus, Phys. Rev. Lett. **36**, 1031 (1976). "Observations of population inversion between the L-doublet states of OH."

Tha64 P. Thaddeus, L. C. Krisher, and J. H. N. Loubser, J. Chem. Phys. **40**, 257 (1964). "Hyperfine structure in the microwave spectrum of HDO, HDS, CH_2O, and CHDO: Beam maser spectroscopy on asymmetric-top molecules."

Tha70 D. L. Thacker, W. J. Wilson, and A. H. Barrett, Astrophys. J. (Letters) **161**, L191 (1970). "Observations of the $^2\Pi_{1/2}$ $J=1/2$ state of OH."

Tha71 P. Thaddeus, R. W. Wilson, M. Kutner, A. A. Penzias, and K. B. Jefferts, Astrophys. J. (Letters) **168**, L59 (1971.) "Discovery of para-formaldehyde and the 2-millimeter formaldehyde distribution in the Orion infrared nebula."

Tha72 P. Thaddeus, M. L. Kutner, A. A. Penzias, R. W. Wilson, and K. B. Jefferts,Astrophys. J. (Letters) **176**, L73 (1972). "Interstellar hydrogen sulfide."

Tha81 P. Thaddeus, M. Guélin, and R. A. Linke, Astrophys. J. (Letters) **246**, L41 (1981). "Three new "nonterrestrial" molecules."

Tha84 P. Thaddeus, S. E. Cummins, and R. A. Linke, Astrophys. J. (Letters) **283**, L45 (1984). "Identification of the SiCC radical toward IRC+10216: the first molecular ring in an astronomical source."

Tha84a P. Thaddeus (see Lor84a).

Tha85 P. Thaddeus, C. A. Gottlieb, Å. Hjalmarson, L. E. B. Johansson, W. M. Irvine, P. Friberg, and R. A. Linke, Astrophys. J. (Letters) **294**, L49 (1985). "Astronomical identification of the C_3H radical."

Tie76 E. Tiemann, J. Phys. Chem. Ref. Data **5**, 1147 (1976). "Microwave Spectra of Molecules of Astrophysical Interest. XI. Silicon Sulfide."

Tol81 F. Tolle, H. Ungerechts, C. M. Walmsley, G. Winnewisser, and E. Churchwell, Astron. Astrophys. **95**, 143 (1981). "A molecular line study of the elongated dark dust cloud TMC-1."

Tow83 C. H. Townes, R. Genzel, D. M. Watson, and J. W. V. Storey, Astrophys. J. (Letters) **269**, L11 (1983). "Detection of interstellar NH_3 in the far-infrared warm and dense gas in Orion-KL."

Tuc71 K. D. Tucker, G. R. Tomasevich, and P. Thaddeus, Astrophys. J. **169**, 429 (1971). "Laboratory measurement of the 6-centimeter formaldehyde transitions."

Tuc78 K. D. Tucker, and M. L. Kutner, Astrophys. J. **222**, 859 (1978). "The abundance and distribution of interstellar C_2H."

Tur70 B. E. Turner, P. Palmer, and B. Zuckerman, Astrophys. J. (Letters) **160**, L125 (1970). "Detection of the $^2\Pi_{3/2}$, $J=7/2$ state of interstellar OH at a wavelength of 2.2 centimeters."

Tur73 B. E. Turner, B. Zuckerman, P. Palmer, and M. Morris, Astrophys. J. **186**, 123 (1973). "Interstellar CS: observations of new transitions and isotopic species and a study of its excitation."

Tur75 B. E. Turner and R. H. Gammon, Astrophys. J. **198**, 71 (1975). "Interstellar CN at radio wavelengths."

Tur75a B. E. Turner, A. G. Kislyakov, H. S. Liszt, and N. Kaifu, Astrophys. J. (Letters) **201**, L149 (1975). "Microwave detection of interstellar cyanamide."

Tur75b B. E. Turner, B. Zuckerman, N. Fourikis, M. Morris, and P. Palmer, Astrophys. J. (Letters) **198**, L125 (1975). "Microwave detection of interstellar HDO."

Tur77 B. E. Turner, Astrophys. J. (Letters) **213**, L75 (1977). "Microwave detection of interstellar ketene."

Tur78 B. E. Turner, B. Zuckerman, M. Morris, and P. Palmer, Astrophys. J. (Letters) **219**, L43 (1978). "Microwave detection of interstellar deuterated ammonia."

Tur78a B. E. Turner, Private communication, 1978.

Tur85 B. E. Turner and T. C. Steimle, Astrophys. J. **299**, 956 (1985). "Interstellar MgO."

Tur87 B. E. Turner, Astron. Astrophys. **182**, L15 (1987). "Vibrationally excited CS in IRC+10216."

Tur87a B. E. Turner, Astron. Astrophys. **183**, L23 (1987). "Detection of vibrationally excited SiS in IRC + 10216."

Tur87b B. E. Turner and J. Bally, Astrophys. J. (Letters) **321**, L75 (1987). "Detection of interstellar PN: The first identified phospherous compound in the interestellar medium."

Tur88 B. E. Turner, Astrophys. J. **329**, 425 (1988). "Rotationally excited interstellar CH: detection of satellite lines and analysis of abundance and excitation."

Tur89 B. E. Turner, Astrophys. J. Suppl. **70**, 539 (1989). "A molecular line survey of Sagittarius B2 and Orion-KL from 70 to 115 GHz. I. The observational data."

Tur89a B. E. Turner, Astrophys. J. (Letters) **347**, L39 (1989). "Detection of interstellar C_4D: implications for ion-molecule chemistry."

Tur90 B. E. Turner, T. Tsuji, J. Bally, M. Guélin, and J. Cernicharo, Astrophys. J. **365**, 569 (1990). "Phosphorus in the dense interstellar medium."

Tur90a B. E. Turner, Astrophys. J. (Letters) **362**, L29 (1990). "Detection of doubly deuterated interstellar formaldehyde (D_2CO) as an indicator of active grain surface chemistry."

Tur91 B. E. Turner, Astrophys. J. Suppl. **76**, 617 (1991). "A molecular line survey of Sagittarius B2 and Orion(KL) from 70 to 115 GHz. II. Analysis of the data."

Uli76 B. L. Ulich and R. W. Haas, Astrophys. J. Suppl. **30**, 247 (1976). "Absolute calibration of millimeter-wavelength spectral lines."

Uli77 B. L. Ulich, J. M. Hollis, and L. E. Snyder, Astrophys. J. (Letters) **217**, L105 (1977). "Radio detection of nitroxyl (HNO): the first interstellar NO bond."

Uli78 B. L. Ulich, Private communication, 1978.

Vac86 J. M. Vacerand, B. P. Van Eijck, J. Burie, and J. Demaison, J. Mol. Spectrosc. **118**, 355 (1986). "The rotational spectrum of acetone: Internal rotation and centrifugal distortion analysis."

Van84 P. Vanden Bout (see Lor84a).

Var91 T. D. Varberg, and K. M. Evenson, Astrophys. J. (Letters), (1991). "Accurate far-infrared rotational frequencies of carbon monoxide."

Ven55 P. Venkateswarlu, H. D. Edwards, and W. Gordy, J. Chem. Phys. **23**, 1195 (1955). "Methyl alcohol. I. Microwave Spectrum."

Vrt85 J. M. Vrtilek, C. A. Gottlieb, W. D. Langer, P. Thaddeus, and R. W. Wilson, Astrophys. J. (Letters) **296**, L35 (1985). "Laboratory and astronomical detection of the deuterated ethynyl radical CCD."

Vrt87 J. M. Vrtilek, C. A. Gottlieb, and P. Thaddeus, Astrophys. J. **314**, 716 (1987). "Laboratory and astronomical spectroscopy of C_3H_2, the first interstellar organic ring."

Vrt90 J. M. Vrtilek, C. A. Gottlieb, T. C. Killian, and P. Thaddeus, Astrophys. J. (Letters) **364**, L53 (1990). "Laboratory detection of propadienylidene, H_2CCC."

Wal84 C. M. Walmsley, P. R. Jewell, L. E. Snyder, and G. Winnewisser, Astron. Astrophys. **134**, L11 (1984). "Detection of interstellar methyldiacetylene (CH_3C_4H) in the dark dust cloud TMC-1."

Wal87 C. M. Walmsley, W. Hermsen, C. Henkel, R. Mauersberger, and T. L. Wilson, Astron. Astrophys. **172**, 311 (1987). "Deuterated ammonia in the Orion hot core."

Wan73 J. H. S. Wang, D. E. Oates, A. Ben-Reuven, and S. G. Kukolich, J. Chem. Phys. **59**, 5268 (1973). "Measurements of relaxation cross sections for NH_3 and OCS with a molecular beam maser spectrometer."

Wan76 P. G. Wannier, A. A. Penzias, R. A. Linke, and R. W. Wilson, Astrophys. J. **204**, 26 (1976). "Isotope abundance in interstellar molecular clouds."

Wan78 P. G. Wannier and R. A. Linke, Astrophys. J. **226**, 817 (1978). "Cyanoacetylene and its ^{13}C species: evidence against relative isotope fractionation and improved $^{12}C/^{13}C$ abundance ratios."

Wat77 J. W. Waters, J. J. Gustinic, R. K. Kakar, T. B. H. Kuiper, P. N. Swanson, A. R. Kerr, and P. Thaddeus, Bull. AAS **9**, 564 (1977). "Detection of 183 GHz water emission from the Orion nebula."

Wat80 D. M. Watson, J. W. V. Storey, C. H. Townes, E. E. Haller, and W. L. Hansen, Astrophys. J. (Letters) **239**, L129 (1980). "Detection of CO $J=21-20$ (124.2 μm) and $J=22-21$ (118.6 μm) emission from the Orion nebula."

Wei63 S. Weinreb, A. A. Barrett, M. S. Meeks, and J. C. Henry, Nature **200**, 829 (1963). "Radio observations of OH in the interstellar medium."

Wel70 W. J. Welch, Bull. AAS **2**, 355 (1970). "Absorption by the Lambda 1 cm ($3_{13}-3_{12}$) rotational transition."

Whi86a G. J. White, T. S. Monteiro, K. J. Richardson, M. J. Griffin, and R. Rainey, Astron. Astrophys. **162**, 253 (1986). "Submillimeter wavelength spectral line search of the Orion molecular cloud core."

Whi81 J. B. Whiteoak and F. F. Gardner, M. N. R. A. S. **197**, 39p (1981). "The abundance ratio $^{16}OH/^{18}OH$ in Sgr A and Sgr B2."

Wil71 R. W. Wilson, A. A. Penzias, K. B. Jefferts, M. Kutner, and P. Thaddeus, Astrophys. J. (Letters) **167**, L97 (1971). "Discovery of interstellar silicon monoxide."

Wil72 R. W. Wilson, A. A. Penzias, K. B. Jefferts, P. Thaddeus, and M. L. Kutner,Astrophys. J. (Letters) **176**, L77 (1972). "Interstellar nitrogen-15 and U169. 3− possibly a new methanol line."

Wil73 R. W. Wilson, A. A. Penzias, K. B. Jefferts, and P. M. Solomon, Astrophys. J. (Letters) **179**, L107 (1973). "Interstellar deuterium: the hyperfine structure of DCN."

Wil76 W. J. Wilson and R. Kakar, Private communication, 1976.

Wil76a R. W. Wilson, A. A. Penzias, P. G. Wannier, and R. Linke, Astrophys. J. (Letters) **204**, L135 (1976). "Isotopic abundances in interstellar carbon monosulfide."

Wil76b T. L. Wilson, J. Bieging, D. Downes, and F. F. Gardner, Astron. Astrophys. **51**, 303 (1976). "Observations of the carbon-13 isotope of formaldehyde."

Wil79 T. L. Wilson and T. Pauls, Astron. Astrophys. **73**, L10 (1979). "The detection of interstellar $^{15}NH_3$."

Wil80 E. Willemot, D. Dangoisse, W. Mannanteuil, and J. Bellet, J. Phys. Chem. Ref. Data **9**, 59 (1980). "Microwave spectra of molecules of astrophysical interest. XVIII. Formic acid."

Wil81 W. J. Wilson and L. E. Snyder, Astrophys. J. **246**, 86 (1981). "A search for interstellar nitrous oxide."

Wil81a D. R. Williams and F. F. Gardner, Pub. Astron. Soc. Proc. **93**, 82 (1981). "Detection of the $^2\Pi_{1/2}$, $F=3/2$, $F=1-2$ transition of ^{18}OH at 1584 MHz toward Sagittarius B2."

Wil84 T. L. Wilson, C. M. Walmsley, L. E. Snyder, and P. R. Jewell, Astron. Astrophys. **134**, L7 (1984). "Detection of a new type of methanol maser."

Wil85 T. L. Wilson, C. M. Walmsley, K. M. Menten, and W. Hermsen, Astron. Astrophys. **147**, L19 (1985). "The discovery of a new masering transition of interstellar methanol."

Wil90 T. L. Wilson, C. M. Walmsley, and A. Baudry, Astron. Astrophys. **231**, 159 (1990). "The detection of rotational excited $^2\Pi_{1/2}$ $J=3/2$ and $J=5/2$ main lines of OH."

Win71 G. Winnewisser, A. G. Maki, and D. R. Johnson, J. Mol. Spectrosc. **39**, 149 (1971). "Rotational constants for HCN and DCN."

Win75 G. Winnewisser and E. Churchwell, Astrophys. J. (Letters) **200**, L33 (1975). "Detection of formic acid in Sagittarius B2 by its $2_{11}-2_{12}$ transition."

Win76 G. Winnewisser and F. F. Gardner, Astron. Astrophys. **48**, 159 (1976). "Detection of dimethyl ether in SGR B2."

Win78 A. Winnberg, C. M. Walmsley, and E. Churchwell, Astron. Astrophys. **66**, 431 (1978). "Detection of the $^2\Pi_{3/2}$ $J=9/2$ λ-doublet line of OH."

Wlo88 G. Wlodarczak, Private communication, 1988.

Woo82 A. Wootten, S. M. Lichten, R. Sahai, and P. G. Wannier, Astrophys. J. **257**, 151 (1982). "CN abundance variations in the shell of IRC+10216."

Woo83 R. C. Woods, C. S. Gudeman, R. L. Dickman, P. F. Goldsmith, G. R. Huguenin, W. M. Irvine, Å. Hjalmarson, L. A. Nyman, and H. Olofsson, Astrophys. J. **270**, 583 (1983). "The $(HCO^+)/(HOC^+)$ abundance ratio in molecular clouds."

Woo84 A. Wootten, R. B. Loren, and J. Bally, Astrophys. J. **277**, 189 (1984). "Formaldehyde in the Orion molecular flow: evidence for a gentle acceleration."

Woo84a A. Wootten (see Lor84a).

Woo86 A. Wootten, Astron. Astrophys. **166**, L15 (1986). "A search for interstellar H_3O^+."

Wys72 F. C. Wyse, E. L. Manson, and W. Gordy, J. Chem. Phys. **57**, 1106 (1972). "Millimeter wave rotational spectrum and molecular constants of $^{31}P^{14}N$."

Wys72a F. C. Wyse and W. Gordy, J. Chem. Phys. **56**, 2130 (1972). "Millimeter-wave rotational spectra of AlCl, AlBr, and AlI."

Yam79 K. Yamada, M. Winnewisser, G. Winnewisser, L. B. Szalanski, and M. C. L. Gerry, J. Mol. Spectrosc. **78**, 189 (1979). "Ground state spectroscopic constants of isothiocyanic acid, HNCS, from its microwave and millimeter wave spectra combined with far infrared data."

Yam87 S. Yamamoto, S. Saito, K. Kawaguchi, N. Kaifu, H. Suzuki, and M. Ohishi, Astrophys. J. (Letters) **317**, L119 (1987). "Laboratory detection of a new carbon-chain molecular C_3S and its astronomical identification."

Yam87a S. Yamamoto, S. Saito, M. Ohishi, H. Suzuki, S. I. Ishikawa, N. Kaifu, and A. Murakami, Astrophys. J. (Letters) **322**, L55 (1987). "Laboratory and Astronomical detection of the cyclic C_3H radical."

Yam87b S. Yamamoto, S. Saito, M. Guélin, J. Cernicharo, H. Suzuki, and M. Ohishi, Astrophys. J. (Letters) **323**, L149 (1987). "Laboratory microwave spectroscopy of the vibrational satellites for v_7 and $2v_7$ states of C_4H and their astronomical identification."

Yam90 S. Yamamoto, S. Saito, K. Kawaguchi, Y. Chikada, H. Suzuki, N. Kaifu, S. Ishikawa, and M. Ohishi, Astrophys. J. **361**, 318 (1990). "Rotational spectrum of the CCS radical studied by laboratory microwave spectroscopy and radio-astronomical observations."

Ziu81 L. M. Ziurys, R. N. Martin, T. A. Pauls, and T. L. Wilson, Astron. Astrophys. **104**, 288 (1981). "Ammonia in Orion II. The gas in and around OMC-1."

Ziu82 L. M. Ziurys, R. J. Saykally, R. L. Plambeck, and N. R. Erickson, Astrophys. J. **254**, 94 (1982). "Detection of the $N=3-2$ transition of CCH in Orion and determination of the molecular rotational constants."

Ziu84 L. M. Ziurys, D. P. Clemens, R. J. Saykally, M. Calvin, and H. F. Schaefer,Astrophys. J. **281**, 219 (1984). "A search for interstellar silicon nitride."

Ziu85 L. M. Ziurys and B. E. Turner, Astrophys. J. (Letters) **292**, L25 (1985). "Detection of interstellar rotationally excited CH."

Ziu86 L. M. Ziurys and B. E. Turner, Astrophys. J. (letters) **300**, L19 (1986). "Detection of interstellar vibrationally excited HCN."

Ziu86a L. M. Ziurys and B. E. Turner, Astrophys. J. (letters) **302**, L31 (1986). "$HCNH^+$: A new interstellar molecular ion."

Ziu88 L. M. Ziurys, Astrophys. J. **324**, 544 (1988). "SiS in Orion-KL: Evidence for "outflow" chemistry."

Ziu91 L. M. Ziurys, D. McGonagle, Y. Minh, and W. M. Irvine, Astrophys. J. **373**, 534 (1991). "Nitric oxide in star-forming regions: Further evidence for interstellar N-O bonds."

Ziu91a L. M. Ziurys, and D. McGonagle, Asatrjophys. J. Suppl. (1991). "Survey of Orion A at 150–160 GHz."

Zuc68 B. Zuckerman, P. Palmer, H. Penfield, and A. E. Lilley, Astrophys. J. (Letters) **153**, L69 (1968). "Detection of microwave radiation from the $^2\Pi_{1/2}$, $J=1/2$ state of OH."

Zuc69 B. Zuckerman, P. Palmer, L. E. Snyder, and D. Buhl, Astrophys. J. (Letters) **157**, L167 (1969). "Detection of interstellar $H_2{}^{13}C^{16}O$."

Zuc71 B. Zuckerman, J. A. Ball, and C. A. Gottlieb, Astrophys. J. (Letters) **163**, L41 (1971). "Microwave detection of interstellar formic acid."

Zuc72 B. Zuckerman, B. E. Turner, D. R. Johnson, P. Palmer, and M. Morris, Astrophys. J. **177**, 601 (1972). "A new interstellar line: the 5,1–4,0 (E2) transition in methyl alcohol."

Zuc72a B. Zuckerman, J. L. Yen, C. A. Gottlieb, and P. Palmer, Astrophys. J. **177**, 59 (1972). "Observations of the $^2\Pi_{3/2}$, $J=5/2$ state of interstellar OH."

Zuc75 B. Zuckerman, B. E. Turner, D. R. Johnson, F. O. Clark, F. J. Lovas, N. Fourikis, A. E. Lilley, J. A. Ball, C. A. Gottlieb, M. M. Litvak, and H. Penfield, Astrophys. J. (Letters) **196**, L99 (1975). "Detection of interstellar *trans*-ethyl alcohol."