

Molecular Microwave Spectra Tables¹

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This paper presents a group of tables that give the frequencies, assignment of quantum numbers, and intensities of over 700 microwave absorption lines. The best available values of other pertinent molecular data, such as moments of inertia, dipole moments, quadrupole coupling constants, and rotation-vibration constants are also included. The frequencies are listed once for each molecule and again in consecutive ascending order of frequency. References are given for all data included. Frequencies listed to the nearest megacycle were generally measured with a cavity wave meter and may be in error by as much as 10 megacycles, whereas those given to a fraction of a megacycle are generally known to an accuracy of about 0.1 megacycle.

A short discussion of microwave spectra and important formulas is given. For easy calculation of hyperfine structure Casimir's function is tabulated up to $J=10$ and $I=9/2$.

Introduction

These tables were undertaken because of the interest and encouragement of a number of workers in microwave spectroscopy. Beside encouragement, our colleagues have provided a considerable amount of unpublished information so that the tables could be as complete and up-to-date as possible. However, the considerable activity in microwave spectroscopy makes obsolescence of the present tables inevitable, and it is expected that they will be revised and republished from time to time. Suggestions or additions for future editions of these tables will be gladly received, either by the authors or the Microwave Standards Section, National Bureau of Standards, Washington, D. C. A supplement to bring these tables up to date will soon be issued. It is especially hoped that information obtained on microwave spectral lines that is not otherwise published will be received so that it may be included in the tables and thus made available.

Only molecular lines of frequency greater than 1,000 megacycles have been listed. This excludes nuclear resonances found by molecular beam techniques rather than the usual microwave absorption measurements, as well as the lines of atomic hydrogen and cesium that fall in the microwave region. All lines reported in the

literature or otherwise available prior to February 1949 have been listed. In addition to those actually observed and listed, a large number of other lines may readily be predicted from the information provided.

The primary information is presented in an alphabetic listing of the molecules by isotopic species, which is subdivided according to the transition, except for the hyperfine components, which are presented in order of frequency. With the listing of each molecule, all available molecular constants are given that are needed in interpreting the spectra. These include moments of inertia, dipole moments, quadrupole coupling constants, and rotation-vibration constants. In addition to the observed frequency and the transition assigned to each line, we have included a calculated value for the intensity and references to the latest sources of data from each laboratory that has measured the line. The most precise reported values of the frequencies were used, or the average if there seemed no reason for preference. Frequencies listed to the nearest megacycle were generally measured with a cavity wavemeter and are subject to an error of 10 or more megacycles, whereas those given to a fraction of a megacycle are generally known to an accuracy of about 0.1 megacycle.

Another listing of all the lines in order of frequency is included, with sufficient information to locate the line in the first table and a classification

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of the line as strong, medium, or weak. We have arbitrarily taken lines of maximum absorption coefficient less than $5 \times 10^{-7} \text{cm}^{-1}$ as weak, those from 5×10^{-7} to 10^{-5}cm^{-1} as medium, and those greater than 10^{-5}cm^{-1} as strong.

The general characteristics of the microwave spectra of most molecules may be explained on the basis of a rigid rotator model. Molecules are conveniently divided into three classes; linear molecules, symmetric tops, and asymmetric tops [26].³ For linear molecules the frequency of pure rotational lines is given to a good approximation by: [26]

$$\nu_{J \rightarrow J+1} = 2(J+1)B_e - 4D_v\{(J+1)^3 - (J+1)l^2\} \text{ sec}^{-1}$$

$$\text{and } B_v = \frac{h}{8\pi^2} \left\langle \frac{1}{I} \right\rangle_{Av} = B_e - \sum_i \alpha_i \left(v_i + \frac{d_i}{2} \right)$$

where J is the total angular momentum quantum number,

l is the angular momentum quantum number along the figure axis (zero for the ground vibrational state),

D_v is the centrifugal distortion coefficient in sec^{-1} ,

B_v is the average reciprocal moment of the molecule in sec^{-1} ,

B_e is the reciprocal moment in sec^{-1} if the nuclei were in the equilibrium position,

α_i is a coefficient of the change in reciprocal moment per quantum of excitation of the i^{th} vibrational state, and v_i and d_i are the corresponding quantum number and degree of degeneracy.

In addition there is a splitting term for the degenerate vibrational states [53]. To a somewhat rougher approximation the frequencies for both linear molecules and symmetric tops is given by $\nu = 2B(J+1)$, where B is a slowly varying function of the quantum numbers. The case of the asymmetric top is complex, and is discussed in reference [9, 29] and earlier papers quoted therein.

In the event that one or more of the nuclei has a quadrupole moment different from zero, the resulting coupling to the molecular electric field splits the energy levels into a hyperfine structure which depends on the various possible orientations

³ Figures in brackets indicate the literature references at the end of this paper.

of the nuclear spin. The interaction between nuclear magnetic moments and molecular magnetic fields is usually much smaller, and has thus far been observed only as a small correction in the ammonia spectrum. The quadrupole interaction for the case of a single nucleus in a linear or symmetric top molecule is given by references [5, 7a, and 58a]. The energies are given by

$$E_Q = (eQq) \left\{ \frac{3K^2}{J(J+1)} - 1 \right\} \left[\frac{\frac{3}{4} C(C+1) - I(I+1)J(J+1)}{2(2J+3)(2J-1)I(2I-1)} \right],$$

where

$$C = F(F+1) - I(I+1) - J(J+1),$$

$$F = J+I, J+I-1 \dots |J-I|,$$

eQq = quadrupole coupling constant.

K = projection of J on molecular symmetry axis.

A tabulation of the function in square brackets for $J=0$ to 10 is given in table 3. The somewhat more complex situation when two nuclei have quadrupole coupling is discussed in reference [51].

The maximum absorption of a spectral line is independent of pressure and may be written [58]

$$\alpha_{max.} = \frac{8\pi^2 N f |\mu_{ij}|^2 \nu^2}{3ckT\Delta\nu},$$

where N is the number of molecules per cubic centimeter,

f is the fraction of the molecules in the lower state of the transition,

ν is the frequency of the line,

c is the velocity of light,

k is Boltzmann's constant,

T is the absolute temperature,

$\Delta\nu$ is the half width of the line at half maximum,

μ_{ij} is the electric dipole matrix element.

The vibrational frequencies and the classical approximation for the sum of rotational states necessary to calculate f , as well as expressions for the dipole matrix elements for the various types of molecules may be found in Herzberg [26], or Wu [61], who also discuss more accurate formulae for the energy levels. The corresponding information for asymmetric molecules is tabulated in the papers of King, Hainer, and Cross [9, 29]. Since the hyperfine splitting is small compared to the

line frequency, a total absorption coefficient may be calculated ignoring the nuclear interaction, the result being then divided among the hyperfine components. Relative intensities of the hyperfine components can be obtained from tables of relative intensities of the analogous fine structure components [8, 60].

Thus the only quantity not as yet evaluated on the right-hand side of the formula above is $\Delta\nu$ the half width of the line at half maximum intensity. Although it surely depends on the dipole moment, among other things, no good theoretical evaluation is possible at present.* It has in a few cases been measured experimentally, however, and in these cases the formula for the intensity given above has been satisfactorily confirmed [53]. At low pressures $p/\Delta\nu$ is constant for a given transition, and for the cases where $\Delta\nu$ has not been measured, we have assumed the reasonable value of $\Delta\nu=25$ mc for 1 mm of mercury. It is this approximation that limits the accuracy of most of the intensities listed in these tables rather than the basic assumptions of the theory or the use of the classical sum of states, except in certain cases where the dipole moments have not been accurately measured. Errors as large as a factor of two or more would not be at all surprising in the cases where the half-widths have not been measured, but we consider that intensities with errors of even this magnitude may be useful, and may be easily corrected when better half-widths become available. The relative intensities for the various isotopes, hyperfine components, and excited states of a single molecule are considerably more reliable.

After substituting the accepted values for the universal constants and putting $e^{-h\nu/kT} \cong 1$, we find for the assumed temperature of 300° K and $\Delta\nu=25$ mc, the intensities of pure rotational spectra become:

For linear molecules

$$\gamma_{max.} = 2.19 \times 10^{-18} \mu^2 \nu^3 \text{ cm}^{-1}.$$

For symmetric top molecules

$$\gamma_{max.} = 4.83 \times 10^{-22} \sqrt{A} \mu^2 \nu^3 \left\{ 1 - \frac{K^2}{(J+1)^2} \right\} \text{ cm}^{-1},$$

where

μ is in Debye units (10^{-18} esu/cm),

ν is the frequency in megacycles,

*A considerable amount of work has been published on this problem since this introduction was written.

A is the reciprocal moment of inertia in megacycles = $10^{-6}h/8^2\pi I_A$,

J is the quantum number of total angular momentum,

K is the quantum number of the component of the angular momentum along the figure axis.

In some molecules, nuclear spin and molecular symmetry considerations influence intensities. The only common case involves three identical nuclei of spin $\frac{1}{2}$ off the molecular axis as in CH_3Cl or AsF_3 . In such molecules, the intensity of each line involving a value of K that is a multiple of three (including zero) is enhanced with respect to other lines by a factor of two.

Throughout the table we have given reciprocal moments of inertia, B and A , quadrupole couplings, (eqQ), doubling constants, q , and the α 's and D_v 's in megacycles per second. The dipole moment, μ , is always in Debye units, and is taken from "Tables of Electric Dipole Moments" by L. G. Wesson, published by Massachusetts Institute of Technology Laboratory for Insulation Research, unless otherwise stated.

The cases of ammonia and O_2 , and probably some of the spectra not yet analyzed are in one way or another exceptions to the cursory treatment above, and are, where possible, discussed individually.

Symbols Used in Tables

- A , Largest reciprocal moment of inertia for asymmetric molecules, or unique reciprocal moment of inertia for symmetric top molecules, in megacycles.
- α_i , Change in reciprocal moment of inertia per quantum of excitation of the i^{th} vibrational state, in megacycles.
- B , Intermediate moment of inertia for asymmetric top molecules, or nonunique reciprocal moment of inertia for symmetric top molecules, in megacycles.
- B_0 , Average B for ground vibrational state, in megacycles.
- C , Smallest reciprocal moment of inertia for asymmetric top molecules, in megacycles.
- D , Centrifugal distortion coefficient in megacycles.
- $\Delta\nu$, Half-width of line in megacycles at half maximum (line width parameter) with gas pressure 1 mm of mercury.

- eqQ , Quadrupole coupling constant, in megacycles.
- F , Total angular momentum quantum number.
- F_i , F of initial or lower energy state.
- F_{ii} , Vector sum of J and spin of nucleus with larger quadrupole coupling, in cases where two nuclei have appreciable quadrupole coupling. Subscript i indicates initial or lower energy state.
- F_f , F of final or higher energy state.
- F_{if} , Same as F_{ii} , but for final or higher energy state.
- γ , Maximum absorption coefficient in cm^{-1} , or "intensity."
- I , Nuclear spin (in units $h/2\pi$).
- J , Total orbital angular momentum quantum number.
- K , Projection of J on molecular symmetry axis.
- M , Medium intensity ($5 \times 10^{-7} - 10^{-5} \text{cm}^{-1}$).
- μ , Dipole moment in Debye Units (10^{-18}esu).
- q , l -type doubling constant in megacycles.
- S , Strong Intensity. ($> 10^{-5} \text{cm}^{-1}$).
- v_i , Quantum number of the i^{th} normal vibration.
- W , Weak Intensity. ($< 5 \times 10^{-7} \text{cm}^{-1}$).

TABLE I

Molecules Listed Alphabetically by Chemical Symbol

AsF_3 (Arsenic trifluoride).

The value of A was calculated from the estimates of internuclear angles and distances given by reference [13], and the intensities of the lines for which the transitions have not been assigned were calculated by comparing the observed relative intensities with those of the identified lines. The fraction of molecules in the ground vibrational state was assumed to be 0.9.

$$\left. \begin{aligned} \mu &= 2.65 \\ B &= 5,883.0 \\ A &= 3900. \end{aligned} \right\} \text{Reference [13].}$$

$$(eqQ)_{As} = -235$$

AsF_3
 $J=1-2, K=0$

F_i	F_f	Frequency	Intensity	Reference
1/2	3/2	23,458.6	3.1×10^{-7}	[13]
5/2	5/2	23,463.0	3.4×10^{-7}	
1/2	1/2	23,517.0	3.1×10^{-7}	
5/2	7/2	23,522.4	2.3×10^{-6}	
3/2	5/2			
3/2	3/2	23,564.6	3.9×10^{-7}	

$J=1-2, K=1$

3/2	5/2	23,472.6	5.8×10^{-7}	[13]
3/2	3/2	23,494.2	3.0×10^{-7}	
5/2	5/2	23,501.6	2.4×10^{-7}	
5/2	7/2	23,532.1	1.1×10^{-6}	
1/2	1/2	23,575.3	2.3×10^{-7}	

unidentified (probably excited states)

		23,512.9	1.5×10^{-7}	[13]
		23,543.2	3×10^{-7}	
		23,553.0	5×10^{-7}	

BH_3CO (Borine carbonyl).

Vibrational frequencies of BH_3CO have not been analyzed. The excited vibrational levels for which B and μ are given here are hence arbitrarily labeled with subscripts 1 and 2. For calculation of intensities, the fraction of molecules in the ground vibrational state was assumed to be 0.9.

$$\begin{aligned} \mu &= 1.79 \quad [49d] \\ \mu_{v_2=1} &= 1.77 \quad [49d] \\ A &\approx 122,000 \quad [22] \end{aligned}$$

	$\text{B}^{10}\text{H}_3\text{CO}$	$\text{B}^{11}\text{H}_3\text{CO}$	
B_0	8979.4	8657.2	[22, 49d]
$B_{v_1=1}$	9002.7		[49d]
$B_{v_2=1}$	8985.8		[49d]
D_J	0.177		[49d]
(eq Q) B	+3.30	+1.55	[22]

$\text{B}^{10}\text{H}_3\text{C}^{12}\text{O}^{16}$ F_i F_f Frequency Intensity [49d]

$J=0-1$ 17,961.2 7.8×10^{-7}

$J=1-2, K=0$

3	2	35,919.02	3.0×10^{-7}	[22]
3	3	35,919.53	4.2×10^{-6}	
2	1			
3	4			
4	5			
2	2	35,919.86	5.9×10^{-7}	
4	3	35,920.14	1.1×10^{-6}	
4	4			
2	3			
$J=1-2, K=1$				
2	1	35,917.62	4.1×10^{-7}	[22]
4	5	35,917.88	2.0×10^{-6}	
2	2			
4	4	35,918.20	4.5×10^{-7}	
3	3	35,918.50	1.3×10^{-6}	
3	4			

$\text{B}^{11}\text{H}_3\text{C}^{12}\text{O}^{16}$
 $J=1-2, K=0$

1/2	3/2	34,628.62	2.1×10^{-6}	[22]
3/2	5/2	34,628.90	4.8×10^{-5}	
5/2	7/2			
3/2	3/2	34,629.32	4.8×10^{-6}	
5/2	5/2			
$J=1-2, K=1$				
1/2	1/2	34,627.24	1.5×10^{-6}	[22]
5/2	7/2	34,627.50	7.3×10^{-6}	
5/2	5/2	34,627.73	3.6×10^{-6}	
3/2	3/2			
3/2	5/2	34,627.89	3.8×10^{-6}	

BrCN (*Cyanogen bromide*).

The half-width reported in [53] has been used in calculating the intensity.

$$\mu = 2.94$$

$$\Delta\nu = 21. \pm 3. [53]$$

Br ⁷⁹ C ¹² N ¹⁴	Br ⁸¹ C ¹² N ¹⁴	Br ⁷⁹ C ¹³ N ¹⁴	Br ⁸¹ C ¹³ N ¹⁴	} [53, 42]
B ₀ = 4120. 190	4096. 760	4073. 355	4049. 606	
(eqQ) _{Br} = 686. 2	573. 2			
^v (eqQ) _N = -3. 83				
α ₁ = 11. 36	11. 23			
α ₂ = -11. 49	-11. 49			
q = 3. 91	3. 845			

$$\text{Br}^{79}\text{C}^{12}\text{N}^{14} \quad J=9-10, v=0 \quad 82, 405 \quad 4.0 \times 10^{-3} \quad [41]$$

$J=2-3, v=0$	F_i	F_f	<i>Frequency</i>	<i>Intensity</i>	} [53]	Br ⁷⁹ C ¹³ N ¹⁴	$J=3-4, v=0$	} [42]
	3/2	3/2	24, 583. 00	4.3×10^{-6}		7/2	9/2	
	5/2	5/2	24, 633. 71	5.6×10^{-6}		9/2	11/2	} [42]
	5/2	7/2	24, 713. 05	6.5×10^{-5}	3/2	5/2	32, 601. 46	
	7/2	9/2			1/2	3/2		24, 755. 22
	3/2	5/2	24, 884. 57	4.3×10^{-6}	7/2	7/2	24, 884. 57	4.3×10^{-6}
	7/2	7/2			Br ⁸¹ C ¹² N ¹⁴	$J=2-3, v=0$		

$J=2-3, v_1=1$	5/2	7/2	24, 645. 82	4.0×10^{-6}	} [53]	3/2	3/2	24, 465. 33	4.2×10^{-6}	} [53]
	7/2	9/2				5/2	5/2	24, 507. 38	5.4×10^{-6}	
	1/2	3/2	24, 687. 11	1.8×10^{-6}		7/2	9/2	24, 573. 86	6.3×10^{-5}	
	3/2	5/2			1/2	3/2	24, 608. 92	2.7×10^{-5}		
						3/2	5/2	24, 608. 92	2.7×10^{-5}	
						7/2	7/2	24, 717. 19	4.2×10^{-6}	

$J=2-3, v_1=1$	1 ₁	1/2	3/2	24, 760. 76	7.5×10^{-6}	} [53]	$J=2-3, v_1=1$	5/2	7/2	24, 506. 75	3.9×10^{-6}	} [53]
		7/2	9/2				7/2	9/2				
	1 ₂	1/2	3/2	24, 784. 02	7.5×10^{-6}		1/2	3/2	24, 541. 18	1.7×10^{-6}		
		7/2	9/2			3/2	5/2					
	1 ₁	3/2	5/2	24, 803. 00	6.9×10^{-6}		$J=2-3, v_2=1$	1 ₁	1/2	3/2	24, 622. 93	7.7×10^{-6}
		5/2	7/2			5/2	7/2	1 ₂	1/2	3/2		
	1 ₂	3/2	5/2	24, 826. 70	6.9×10^{-6}			7/2	9/2	24, 658. 89	6.8×10^{-6}	
		5/2	7/2			1 ₁	3/2	5/2	1 ₂			3/2
	1 ₁	7/2	7/2	24, 890. 0	7.3×10^{-7}			5/2	7/2			
	1 ₂	7/2	7/2	25, 006. 0	7.3×10^{-7}							

$J=2-3, v_2=2$	1=2	3/2	3/2	24, 860. 6	6.5×10^{-7}	} [30]	$J=3-4, v=0$	5/2	5/2	32, 643. 13	5.6×10^{-6}	} [42]
		3/2	5/2				7/2	7/2	32, 720. 28	7.4×10^{-6}		
	1=2	5/2	3/2	24, 981. 5	9.8×10^{-7}		7/2	9/2	32, 770. 13	1.4×10^{-4}		
		5/2	5/2			9/2	11/2	32, 770. 13	1.4×10^{-4}			
		5/2	7/2			3/2	5/2	32, 786. 65	8.2×10^{-5}			
						5/2	7/2	32, 786. 65	8.2×10^{-5}			
						9/2	9/2	32, 913. 24	5.7×10^{-6}			

$J=3-4, v=0$	5/2	5/2	32, 804. 56	5.8×10^{-6}	} [42]	$J=8-9, v=0$	73, 742	2.8×10^{-3}	} [41]
	7/2	9/2	32, 956. 68	1.5×10^{-4}		$J=9-10, v=0$	81, 936	3.8×10^{-3}	
	9/2	11/2	32, 976. 40	8.6×10^{-5}					
	3/2	5/2			5/2	7/2			

$$J=8-9, v=0 \quad 74, 165 \quad 2.9 \times 10^{-3} \quad [41]$$

$\text{Br}^{81}\text{C}^{13}\text{N}^{14}$ —Continued

$J=3-4, v=0$	F_i	F_f	Frequency	Intensity	
	7/2	9/2	32, 392. 59	1.5×10^{-6}	} [42]
	9/2	11/2			
	3/2	5/2	32, 409. 06	9.2×10^{-7}	
	5/2	7/2			

CF_3CH_3 . Since the dipole moment and vibrational frequencies of this molecule are not available, it is impossible to calculate the intensity. However, observed intensities are estimated in [5], and these are given. The weaker line is probably due to an excited vibrational state.

$$B_0=5185 \quad [17]$$

$$\mu=2.33 \quad [39b]$$

CF_3CH_3

	Frequency	Intensity	
$J=1-2, K=0,1$	20, 679. 9	5×10^{-7}	[39a]
	20, 710. 6	1×10^{-6}	[17, 39a]
	20, 742. 32	2×10^{-6}	[17, 39a]
$J=2-3$	31, 020. 7		[39a]
	31, 066. 8		
	31, 114. 4		

CHClF_2 . The spectrum of this asymmetric top molecule has not been analyzed. The assignment of weak, medium, or strong is that of the reference and does not correspond necessarily to the convention adopted in this table.

$$\mu=1.29$$

Frequency	Intensity	
22, 217	W	} [11]
22, 247	W	
22, 305	M	
22, 353	W	
22, 386	W	
22, 410	S	
22, 436	W	
22, 462	W	
22, 481	M	
22, 545	W	
22, 553	W	
23, 308	S	
23, 644	W	
23, 680	W	
23, 733	S	
23, 803	W	
23, 826		
23, 845	S	

CH_2Br_2 (Methylene bromide)

$$\mu \cong 1.6$$

Frequency	
25, 056	[57]

CH_2CF_2 (Unsymmetrical difluoroethylene)

$$\mu=1.366$$

$$A_0=11,002$$

$$B_0=10,428.5$$

$$C_0=5,345.6$$

[37a]

$\text{C}^{12}\text{H}_2\text{C}^{12}\text{F}_2$

Transition	Frequency	Observed intensity
	21, 482	M
	21, 549	W
	21, 573	W
	21, 689	M
8_3-8_4	21, 734	M
	22, 236	M
	22, 281	S
	22, 383	M
	22, 391	M
	22, 660	W
	22, 752	S
	23, 181	M
	23, 206	W
	23, 214	M
	23, 220	M
	23, 234	W
	23, 323	M
	23, 361	M
7_2-7_3	23, 433	S
	23, 649	M
	23, 770	M
	23, 812	M
	23, 986	M
	24, 021	M
	24, 150	W
	24, 294	M
	24, 323	S
	24, 352	M
	24, 357	W
	24, 450	S
	24, 545	M
	24, 579	W
	24, 602	W
	24, 639	M
	24, 734	M
6_1-6_2	24, 770	S
	24, 806	W
	24, 808	W
6_2-6_5	25, 248	M
	25, 350	S
	25, 450	M
	25, 516	S
5_0-5_1	25, 729	S
	25, 741	M
	26, 118	S
	26, 163	M
$4_{-1}-4_0$	26, 328	S
	26, 337	M
1_0-2_{-1}	26, 410	W
1_0-2_{-1}	26, 466	M

[37a]
(excited vibrational state)

Transition	Frequency	Observed intensity
	26, 634	S
3 ₋₂ -3 ₋₁	26, 649	M
	26, 723	W
	26, 832	M
	26, 865	S
3 ₋₃ -3 ₀	26, 880	M
1 ₋₁ -2 ₋₂	26, 992	S
4 ₋₂ -4 ₁	27, 014	S
	27, 112	M
	27, 216	M
5 ₋₁ -5 ₂	27, 297	S
	27, 412	M
	27, 681	S
6 ₀ -6 ₃	27, 818	S
	27, 972	S
	28, 174	S
	28, 314	W
	28, 339	M
	28, 412	S
	28, 439	M
	28, 458	M
	28, 551	W
	28, 575	W
	28, 615	W
7 ₁ -7 ₄	28, 689	W
	28, 852	
	28, 858	
	28, 954	S
1 ₁ -2 ₀	36, 632	M

[37a]

25, 073	[57, 11]	7
25, 099	[57, 11]	2
25, 123	[57, 11]	8
25, 221	[11]	
25, 269	[57, 11]	7
25, 280	[57]	6
25, 710	[57]	7
25, 745	[57]	2
25, 748	[57]	6
25, 751	[57]	2
25, 848	[57]	10
26, 007	[57]	7
26, 295	[57]	9

CH₃Br (*Methyl bromide*) $\mu=1.79$ $A \approx 150,000$
 CH₃Br⁷⁹ CH₃Br⁸¹
 Br₀=9568.4 9532
 (eqQ)_{Br}= 577.3 482.4 } Reference [23, 38a].

C ¹² H ₃ Br ⁷⁹	F _i	F _f	Frequency	Intensity	
J=0-1, K=0					
	3/2	1/2	18, 922. 41	4. 8×10 ⁻⁷	[38a]
	3/2	3/2	19, 252. 13	9. 7×10 ⁻⁷	
	3/2	5/2	19, 107. 97	1. 5×10 ⁻⁶	
J=1-2, K=0					
	3/2	3/2	38, 157. 30	2. 5×10 ⁻⁶	[23]
	3/2	5/2	38, 260. 10	1. 4×10 ⁻⁵	
	5/2	7/2			
	1/2	1/2	38, 272. 40	1. 9×10 ⁻⁶	
	5/2	5/2	38, 404. 49	2. 1×10 ⁻⁶	
	1/2	3/2	38, 417. 09	1. 9×10 ⁻⁶	

CH₂Cl₂ (*Methylene chloride*).

Turner [57] has given the relative intensities listed for this asymmetric top molecule. This author has also made transition assignments but they have been questioned by Gwinn [23a], and are not listed here. Frequencies given are a plausible compromise between those of reference [57] and [11].

$\mu=1.6$

Frequency	Observed relative intensity
23, 476	[11]
24, 440	[57] 4
24, 471	[57] 7
24, 577	[57, 11] 4
24, 627	[57] 4
24, 631	[57] 4
24, 636	[57, 11] 4
24, 842	[57, 11] 2
24, 916	[57] 2
24, 967	[57] 2
24, 970	[57] 4
24, 976	[57] 6
24, 996	[11]
25, 018	[57] 2
25, 038	[57] 6
25, 046	[57] 6
25, 047	[57] 2
25, 053	[57, 11] 2

J=1-2, K=1					
	1/2	1/2	38, 128. 40	1. 4×10 ⁻⁶	[23]
	1/2	3/2	38, 200. 52	1. 4×10 ⁻⁶	
	5/2	7/2	38, 237. 14	7. 0×10 ⁻⁶	
	5/2	5/2	38, 309. 45	1. 6×10 ⁻⁶	
	3/2	3/2	38, 330. 25	1. 9×10 ⁻⁶	
	3/2	5/2	38, 381. 70	3. 5×10 ⁻⁶	
C ¹² H ₃ Br ⁸¹					
J=0-1, K=0					
	3/2	1/2	18, 943. 77	4. 7×10 ⁻⁷	[38a]
	3/2	3/2	19, 160. 82	9. 5×10 ⁻⁷	
	3/2	5/2	19, 040. 32	1. 4×10 ⁻⁶	
J=1-2, K=0					
	3/2	3/2	38, 030. 77	2. 4×10 ⁻⁶	[23]
	3/2	5/2	38, 116. 65	1. 4×10 ⁻⁵	
	5/2	7/2			
	1/2	1/2	38, 126. 97	1. 9×10 ⁻⁶	
	5/2	5/2	38, 237. 14	2. 1×10 ⁻⁶	
	1/2	3/2	38, 247. 77	1. 9×10 ⁻⁶	
J=1-2, K=1					
	1/2	1/2	38, 006. 47	1. 4×10 ⁻⁶	[23]
	1/2	3/2	38, 066. 72	1. 4×10 ⁻⁶	
	5/2	7/2	38, 097. 45	6. 7×10 ⁻⁶	
	5/2	5/2	38, 157. 70	1. 5×10 ⁻⁶	
	3/2	3/2	38, 175. 08	1. 8×10 ⁻⁶	
	3/2	5/2	38, 218. 21	3. 5×10 ⁻⁶	

CH₃CCH (*Methyl acetylene*).

This molecule, while probably a symmetric top, has ten distinct vibrational frequencies, two or three of which are low enough to be appreciably excited at room temperature, the lowest ($\nu_{10}=336\text{ cm}^{-1}$) to several quanta of vibrational energy. In addition, centrifugal distortion will separate levels of equal J but different K . The transitions have not been assigned, but we include the observed relative intensities.

$$\mu = .75$$

$$B \simeq 8,408$$

CH₃CCH

$J=2-3$	Frequency	Relative intensity
	51, 260	50
	51, 264	80
	51, 266	100
	51, 296	10
	51, 313	10
	51, 314	10
	51, 318	5
	51, 319	5
	51, 334	15
	51, 363	30
	51, 410	30
	51, 416	30
	51, 418	15
	51, 419	15
	51, 464	15

[35]

CH₃Cl (*Methyl chloride*).

$$\mu = 1.86$$

$$A \simeq 150,000$$

C ¹² H ₃ Cl ³⁵	C ¹² H ₃ Cl ³⁷
$B_0 = 13,292.89$ [23]	$13,088.19$ [23]
$(eqQ) = -75.33$ [23,27b]	-58.5 [23, 27b]

C ¹³ H ₃ Cl ³⁵	C ¹³ H ₃ Cl ³⁷
$B_0 = 12,796.2$ [11]	$12,590.0$ [11]

C ¹² H ₃ Cl ³⁵	F_i	F_f	Frequency	Intensity
$J=0-1, K=0$				
	3/2	3/2	26, 570. 77	4.4×10^{-6}
	3/2	5/2	26, 589. 49	6.6×10^{-6}
	3/2	1/2	26, 604. 57	2.2×10^{-6}

[23]

C ¹² H ₃ Cl ³⁷	F_i	F_f	Frequency	Intensity
$J=0-1, K=0$				
	3/2	3/2	26, 164. 57	1.4×10^{-6}
	3/2	5/2	26, 179. 30	2.1×10^{-6}
	3/2	1/2	26, 191. 13	7.1×10^{-7}

[23]

C¹³H₃Cl³⁵

$$J=0-1, K=0$$

F_i	F_f	Frequency	Intensity
3/2	3/2	25, 577. 2	4.5×10^{-8}
3/2	5/2	25, 596. 0	6.7×10^{-8}
3/2	1/2	25, 611. 2	2.2×10^{-8}

[11]

C¹³H₃Cl³⁷

$$J=0-1, K=0$$

F_i	F_f	Frequency	Intensity
3/2	3/2	25, 195. 2	1.4×10^{-9}
3/2	5/2	26, 183. 0	2.1×10^{-9}
3/2	1/2	25, 167. 4	6.9×10^{-10}

[11]

CH₃CN (*Methyl cyanide*).

$$\mu \simeq 3.4$$

$$(eqQ)_N = -4.67$$

$$A \simeq 150,000$$

$$B_0 = 9198.45$$

[28]

	F_i	F_f	K	Frequency	Intensity
$J=0-1$	1	1	0	18, 400-1. 40	4.7×10^{-6}
	1	2	0	18, 400	7.8×10^{-6}
	1	0	0	18, 400+2. 10	1.6×10^{-6}
$J=1-2$	1	2	1	36, 793. 64	3.1×10^{-5}
	0	1	0	36, 794. 26	2.8×10^{-5}
2	2	1			
	2	3	1	36, 794. 88	5.7×10^{-5}
	1	2	0	36, 795. 38	1.2×10^{-4}
2	3	0			
	0	1	1	36, 796. 27	1.4×10^{-5}
	1	1	0	36, 797. 52	1.4×10^{-5}

[36]

[28]

Excited vibrational states

36, 870. 94
36, 903. 40
36, 942. 15

[27]

CH₃F (*Methyl fluoride*)

$$\mu = 1.81$$

$$A \simeq 150,000$$

$$\Delta\nu = 20. \text{ Reference [19]}$$

C ¹² H ₃ F	C ¹³ H ₃ F
$B_0 = 25,535.85$	$24,862.37$

C ¹² H ₃ F	F_i	F_f	Frequency	Intensity
$J=0-1, K=0$				
	51,	071. 69		1.4×10^{-4}

[23, 19, and private communication.]

C ¹³ H ₃ F	F_i	F_f	Frequency	Intensity
$J=0-1, K=0$				
	49,	724. 73		1.5×10^{-6}

[19]

CH₃I (*Methyl iodide*).

$$\mu = 1.5$$

$$A \simeq 150,000$$

$$(eqQ)_I = -1934$$

$$B_0 = \text{C}^{12}\text{H}_3\text{I} \quad \text{C}^{13}\text{H}_3\text{I}$$

$$7501.250 \quad 7119.040 \quad [23]$$

$C^{12}H_3I$				$\mu = 3.18$	CH_3NCS^{32}	CH_3NCS^{34}				
F_i	F_f	Frequency	Intensity	$\frac{1}{2}(B+C) =$	2526.2	2461.7	[1a]			
$J=1-2, K=0$				[23]	<i>Transition</i>	<i>Frequency</i>	<i>Observed relative intensity</i>			
3/2	5/2	29, 598. 95	9.2×10^{-7}	$C^{12}H_3N^{14}C^{12}S^{32}$	$J=3-4$	20, 020	<1			
7/2	7/2	29, 673. 95	1.4×10^{-6}		$3_{-2}-4_{-3}$	20, 140	10			
7/2	5/2	29, 773. 95	2.3×10^{-7}		Deg. line	20, 216	100			
3/2	3/2	29, 872. 52	1.4×10^{-6}			20, 230	<1			
7/2	9/2	30, 046. 99	5.0×10^{-6}			Deg. line, E	20, 241	7		
5/2	7/2	30, 079. 72	2.6×10^{-6}			Deg. line, D	20, 350	20		
3/2	1/2	30, 121. 32	1.0×10^{-6}				20, 413	<1		
5/2	5/2	30, 179. 71	2.6×10^{-6}			Deg. line, J	20, 443	40		
5/2	3/2	30, 453. 46	6.3×10^{-7}							
$J=1-2, K=1$				[23]	$J=4-5$	24, 824	1			
5/2	7/2	29, 735. 71	2.5×10^{-6}			24, 971	1			
5/2	5/2	29, 782. 71	1.8×10^{-6}			25, 077	1			
5/2	3/2	29, 923. 50	1.8×10^{-6}			25, 100	<1			
7/2	7/2	29, 939. 87	1.4×10^{-6}			25, 161	<1			
7/2	5/2	29, 986. 84	2.4×10^{-7}			$4_{-3}-5_{-4}$	25, 195	10		
3/2	5/2	30, 075. 08	9.5×10^{-7}			Deg. line	25, 269	100		
7/2	9/2	30, 123. 64	5.1×10^{-6}			Deg. line, E	25, 306	7		
3/2	3/2	30, 215. 95	1.4×10^{-6}			$4_{-2}-5_{-3}$	25, 333	10		
$C^{13}H_3I$						25, 390	<1			
$J=1-2, K=0$				[23]		25, 409	1			
3/2	5/2	28, 069. 99	1.0×10^{-8}			Deg. line, D	25, 442	25		
7/2	7/2	28, 145. 01	1.5×10^{-8}			Deg. line, J	25, 550	40		
3/2	3/2	28, 343. 64	1.5×10^{-8}			$4_{-2}-5_{-3}, J$	25, 653	<1		
7/2	9/2	28, 518. 14	5.5×10^{-8}							
5/2	7/2	28, 550. 86	2.9×10^{-8}							
5/2	5/2	28, 650. 91	2.9×10^{-8}							
$J=1-2, K=1$				[23]	$C^{13}H_3N^{14}C^{12}S^{32}$	$J=4-5$	Deg. line	24, 143	<1	
5/2	7/2	28, 206. 90	2.8×10^{-8}			$C^{12}H_3N^{14}C^{12}S^{32}$	$J=4-5$	Deg. line	25, 002	<1
5/2	5/2	28, 253. 84	2.0×10^{-8}			$C^{12}H_3N^{14}C^{12}S^{32}$	$J=4-5$	Deg. line	24, 930	<1
7/2	7/2	28, 411. 19	1.5×10^{-8}			$C^{12}H_3N^{14}C^{12}S^{34}$	$J=3-4$	Deg. line	19, 700	5
7/2	9/2	28, 594. 74	5.6×10^{-8}				$J=3-4$	Deg. line, J	19, 929	1
3/2	3/2	28, 687. 21	1.5×10^{-8}				4-5	Deg. line	24, 609	5
CH_3NC (<i>Methyl isocyanide</i>).				[28]				Deg. line, J	24, 910	2
$(eqQ)_N < 0.5, A \approx 150,000$								Deg. line	29, 700	
$B_0 = \frac{C^{12}H_3NC^{12}}{10,052.79} \frac{C^{12}H_3NC^{13}}{9,695.802}$										
$C^{12}H_3N^{14}C^{12}$				[36]	CH_3NH_2 (<i>Methylamine</i>).	$\mu = 1.2$				
$J=0-1, K=0$						$1/2(B+C) \approx 22,700$	[18]			
$J=1-2, K=1$						<i>Frequency</i>				
$J=1-2, K=0$						21, 712				
Excited vibrational states				[28]		21, 935				
						22, 258				
						22, 535				
$C^{12}H_3N^{14}C^{13}$						22, 590				
$J=1-2, K=1$						22, 595				
$J=1-2, K=0$						22, 612				
						22, 732				
						22, 740				
						22, 977				
						23, 115				
						23, 205				

Frequency					
23, 295	}	[25]	24, 911	[33]	
23, 300			24, 926	[33]	
23, 305			3	24, 928. 70	[14, 33, 6]
23, 335			4	24, 933. 47	[6]
23, 404			2	24, 934. 38	[14, 25, 6]
23, 425			5	24, 959. 08	[14, 25, 33, 6]
23, 430			6	25, 018. 14	[14, 25, 33, 6]
23, 446				25, 053	[33]
23, 510			7	25, 124. 88	[14, 25, 33, 6]
23, 680			8	25, 294. 41	[14, 25, 33, 6]
24, 015				25, 381	[33]
24, 078			9	25, 541. 43	[14, 25, 33, 6]
24, 320				25, 797	[14, 33]
24, 528			10	25, 878. 18	[14, 33, 6]
24, 890				26, 120	[33]
24, 896				26, 310	[14, 33]
25, 000				26, 562	[14]
25, 065				47, 840	[18]
25, 200				48, 010	[18]
25, 470				48, 357	[18]
		48, 363	[18]		
		48, 396	[18]		
		48, 404	[18]		
		48, 700	[18]		

$J=0-1$ 45, 324. 24 } [18]
45, 324. 94 }

CH₃NO₂ (Nitromethane).

$\mu \approx 3.1$			
Frequency	Observed relative intensity		
20, 385	75	}	[11, 15]
23, 250	115		
23, 021			
23, 467			
23, 483			
23, 706			
24, 017			
24, 428			
24, 448			
24, 599			
25, 400	118		
25, 412	60		

CH₃OH. This asymmetric top molecule has been investigated by five different laboratories. The listed lines represent a reasonable compromise between their somewhat conflicting results. The lines for which a single J is listed are probably due to a hindered internal rotation and are discussed in reference [6].

$\mu \approx 1.66$		
J	Frequency	
	20, 910	[14, 25]
	20, 971	[14, 25]
	21, 350	[25]
	21, 550	[14, 25]
	22, 305	[25]
	23, 121. 2	[14, 25, 33]
	23, 346. 8	[14, 25]
	23, 425	[14, 25, 33]
	23, 854. 4	[14, 25, 33]

CH₃OD

$J=0-1$	Frequency	
	47, 052	}
	47, 266	
	47, 346	

[18]

CH₃SCN (Methyl thiocyanate). Only the strongest lines of this slightly asymmetric molecule have been measured.

$$\mu = 3.16$$

$$\frac{1}{2}(B+C) = 2877. \quad [1a]$$

C ¹² H ₃ S ³² C ¹² N ¹⁴	Frequency	
$J=3-4$	22, 680	}
$J=4-5$	28, 380	

[1a]

C₂H₃Cl (Vinyl chloride)

$$\mu = 1.44$$

C ₂ H ₃ Cl ³⁵	C ₂ H ₃ Cl ³⁷	
A ₀ = 56, 100	56, 070	}
B ₀ = 6030. 5	5903. 7	
C ₀ = 5445. 2	5341. 3	
$eQ(\partial^2 V/\partial a^2)_{C1} = -57. 4$		}
$eQ(\partial^2 V/\partial b^2)_{C1} = 26. 2$		

[20a]

	Transition	Frequency	
C ¹² H ₃ Cl ³⁵	1 ₀₁ -2 ₀₂	22, 946. 9	}
	1 ₁₀ -2 ₁₁	23, 538. 9	
	1 ₁₁ -2 ₁₂	22, 369. 6	
C ¹² H ₃ Cl ³⁷	1 ₀₁ -2 ₀₂	22, 485. 9	}
	1 ₁₀ -2 ₁₁	23, 055. 0	
	1 ₁₁ -2 ₁₂	21, 930. 2	

[20a]

C₂H₄O (*Ethylene oxide*). This asymmetric top has been investigated in two laboratories. Frequencies given are those of reference [10] and [10a] which appear to be the more precise. The lines C₂D₄O¹⁶ were observed with enriched material, not with the intensities listed for the deuterium natural abundance of 0.02 percent.

$$\mu = 1.88$$

C ₂ H ₄ O	C ₂ D ₄ O	
A ₀ = 25, 471	20, 389	
B ₀ = 22, 110	15, 449	[10, 10a]
C ₀ = 14, 091	11, 538	

	Transition	Frequency	Intensity	
C ¹² H ₄ O ¹⁶	3 ₁ -3 ₃	23, 134	3.9 × 10 ⁻⁶	[10, 39]
	3 ₋₁ -3 ₁	23, 610	4.1 × 10 ⁻⁶	[20, 39]
	4 ₀ -4 ₂	24, 834. 3	1.2 × 10 ⁻⁵	[10, 39]
	2 ₋₂ -2 ₀	24, 924. 4	3.9 × 10 ⁻⁶	[10, 39]
	5 ₁ -5 ₃	29, 688	1.2 × 10 ⁻⁵	[10]
	4 ₂ -4 ₄	34, 150	1.3 × 10 ⁻⁵	[10a]
	2 ₋₁ -2 ₁	34, 158	3.0 × 10 ⁻⁶	[10a]
	6 ₀ -6 ₂	36, 791	3.4 × 10 ⁻⁵	[10]
	7 ₁ -7 ₃	37, 329	2.5 × 10 ⁻⁵	[10]
	5 ₋₁ -5 ₁	37, 781	1.7 × 10 ⁻⁵	[10]
	6 ₂ -6 ₄	38, 702	3.4 × 10 ⁻⁵	[10]
	0 ₀ -1 ₀	39, 582	8.3 × 10 ⁻⁶	[10]
	3 ₀ -3 ₂	39, 677	1.2 × 10 ⁻⁵	[10]
	4 ₋₂ -4 ₀	41, 581	1.9 × 10 ⁻⁵	[10a]
8 ₂ -8 ₄	43, 398	6.6 × 10 ⁻⁵	[10a]	
C ¹² D ₄ O ¹⁶	4 ₋₂ -4 ₀	21, 964	7.4 × 10 ⁻²¹	[10a]
	3 ₋₃ -3 ₁	24, 055	3.4 × 10 ⁻²¹	
	5 ₋₁ -5 ₁	24, 668	1.1 × 10 ⁻²⁰	
	2 ₋₁ -2 ₁	26, 365	2.4 × 10 ⁻²¹	
	6 ₋₂ -6 ₀	28, 495	1.8 × 10 ⁻²⁰	
	3 ₁ -3 ₁	29, 080	5.0 × 10 ⁻²¹	
	0 ₀ -1 ₀	31, 943	5.1 × 10 ⁻²¹	
	3 ₋₂ -3 ₀	33, 285	6.4 × 10 ⁻²¹	
	8 ₋₂ -8 ₀	35, 068	3.7 × 10 ⁻²⁰	
	3 ₀ -3 ₂	35, 341	7.4 × 10 ⁻²¹	
5 ₁ -5 ₃	39, 592	1.8 × 10 ⁻²⁰		

C₁CN (*Cyanogen chloride*)

$$\mu = 2.66 \quad [53]$$

$$\Delta\nu = 25 \quad [53]$$

	C ¹³⁵ C ¹² N ¹⁴	C ¹³⁷ C ¹² N ¹⁴	C ¹³⁵ C ¹³ N ¹⁴	C ¹³⁷ C ¹³ N ¹⁴	[42, 53]
B ₀ =	5970. 821	5847. 252	5939. 795	5814. 710	
(eqQ) _{C1} =	-83. 4	-65. 3			
(eqQ) _N =	-3. 63				

C¹³⁵C¹²N¹⁴

	F _{li}	F _i	F _{lf}	F _f	Frequency	Intensity
J=1-2, v=0						
	1/2		3/2		23, 862. 57	9.3 × 10 ⁻⁶
	5/2	3/2	5/2	5/2	23, 863. 5	3.6 × 10 ⁻⁷
	5/2	7/2	5/2	5/2	23, 863. 8	3.6 × 10 ⁻⁷
	5/2	3/2	5/2	3/2	23, 864. 0	1.9 × 10 ⁻⁶
	5/2	7/2	5/2	7/2	23, 864. 2	4.1 × 10 ⁻⁶
	5/2	5/2	5/2	5/2	23, 864. 5	2.6 × 10 ⁻⁶
	5/2	5/2	5/2	7/2	23, 864. 9	3.6 × 10 ⁻⁷
	5/2	5/2	3/2	3/2	23, 865. 1	3.5 × 10 ⁻⁷
	5/2	5/2	3/2	1/2		
	5/2	3/2	3/2	3/2	23, 878. 6	5.5 × 10 ⁻⁷
	5/2	3/2	3/2	5/2		
	5/2	7/2	3/2	5/2	23, 878. 9	5.0 × 10 ⁻⁷
	5/2	5/2	3/2	3/2	23, 879. 7	6.2 × 10 ⁻⁸
	5/2	5/2	3/2	5/2		
	1/2		1/2		23, 883. 30	9.2 × 10 ⁻⁶
	5/2	7/2	7/2	7/2	23, 884. 2	7.7 × 10 ⁻⁶
	3/2	3/2	5/2	5/2		
	3/2	3/2	5/2	3/2	23, 884. 8	1.2 × 10 ⁻⁶
	3/2	5/2	5/2	5/2	23, 884. 9	1.5 × 10 ⁻⁵
	5/2	5/2	7/2	7/2		
	5/2	7/2	7/2	9/2	23, 885. 16	2.9 × 10 ⁻⁵
	5/2	3/2	7/2	5/2		
	3/2	5/2	5/2	7/2	23, 885. 3	1.1 × 10 ⁻⁵
	3/2	1/2	5/2	3/2	23, 886. 0	4.0 × 10 ⁻⁶
	5/2	5/2	7/2	5/2	23, 886. 2	1.2 × 10 ⁻⁶
	5/2	5/2	7/2	1/2		
	3/2	3/2	3/2	3/2	23, 899. 59	3.9 × 10 ⁻⁶
	3/2	3/2	3/2	5/2		
	3/2	5/2	3/2	3/2	23, 900. 20	9.6 × 10 ⁻⁶
	3/2	5/2	3/2	5/2		
	3/2	1/2	3/2	1/2	23, 900. 7	2.1 × 10 ⁻⁶
	3/2	1/2	3/2	3/2		
	3/2		1/2		23, 920. 91	1.9 × 10 ⁻⁶
J=1-2, v ₂ =1						
	3/2		5/2	1 ₁	23, 917. 9	4.5 × 10 ⁻⁶
	3/2		3/2	1 ₁	23, 925. 5	1.8 × 10 ⁻⁶
	5/2		5/2	1 ₁	23, 928. 7	1.4 × 10 ⁻⁶
	5/2		7/2	1 ₁	23, 938. 6	8.2 × 10 ⁻⁶
	1/2		3/2	1 ₁	23, 944. 4	1.7 × 10 ⁻⁶
	3/2		5/2	1 ₂	23, 948. 2	4.5 × 10 ⁻⁶
	1/2		1/2	1 ₁	23, 954. 5	3.5 × 10 ⁻⁶
	3/2		3/2	1 ₂		
	5/2		5/2	1 ₂	23, 958. 4	1.8 × 10 ⁻⁶
	5/2		7/2	1 ₂	23, 968. 6	8.2 × 10 ⁻⁶
	1/2		3/2	1 ₂	23, 974. 4	1.7 × 10 ⁻⁶
	1/2		1/2	1 ₂	23, 984. 6	1.7 × 10 ⁻⁶

[53]

$$J=2-3, v=0$$

F_i	F_f	Frequency	Intensity
7/2	7/2	35, 805. 09	1.4×10^{-5}
1/2	3/2	35, 820. 65	1.0×10^{-4}
3/2	5/2		
5/2	7/2	35, 825. 95	2.3×10^{-4}
7/2	9/2		
5/2	5/2	35, 835. 74	2.0×10^{-5}

[42]



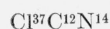
$$J=1-2, v=0$$

5/2	7/2	9/2	23, 760. 98	3×10^{-7}	[53]
-----	-----	-----	-------------	--------------------	------

$$J=2-3, v=0$$

7/2	7/2	35, 618. 81	1.5×10^{-7}
1/2	3/2	35, 634. 85	1.1×10^{-6}
3/2	5/2		
5/2	7/2	35, 639. 78	2.4×10^{-6}
7/2	9/2		
5/2	5/2	35, 649. 56	2.1×10^{-7}

[42]



$$J=1-2, v=0$$

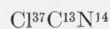
1/2	3/2	3/2	5/2	23, 372. 72	1.5×10^{-6}
1/2	1/2			23, 389. 00	3.0×10^{-6}
3/2	3/2	5/2	5/2	23, 389. 61	2.1×10^{-6}
5/2	7/2	7/2	9/2	23, 390. 53	9.4×10^{-6}
5/2	3/2	7/2	5/2		
3/2	5/2	3/2	5/2	23, 402. 47	1.3×10^{-6}

[53]

$$J=2-3, v=0$$

7/2	7/2	35, 067. 99	4.4×10^{-6}
1/2	3/2	35, 080. 39	3.1×10^{-5}
3/2	5/2		
5/2	7/2	35, 084. 15	7.2×10^{-5}
7/2	9/2		
5/2	5/2	35, 091. 97	6.2×10^{-6}

[42]



$$J=1-2, v=0$$

5/2	7/2	9/2	23, 260. 3	1×10^{-7}	[53]
-----	-----	-----	------------	--------------------	------

$$J=2-3, v=0$$

7/2	9/2	34, 889. 05	4.5×10^{-7}	[42]
-----	-----	-------------	----------------------	------

HCF₃ (*Fluoroform*). In the absence of other information, A was calculated using the $C-F$ distance estimated by the authors, assuming tetrahedral angles. It was also assumed that 0.9 of the molecules were in the ground vibrational state.



$\frac{1}{2}(B+C)$	$\frac{HN^{14}C^{12}S^{32}}{5866.0}$	$\frac{DN^{14}C^{12}S^{32}}{5474.3}$	$\frac{HN^{14}C^{13}S^{32}}{5847.3}$	$\frac{DN^{14}C^{13}S^{32}}{5459.8}$	$\frac{HN^{14}C^{12}S^{34}}{5728.8}$	[1]
		$J=1-2$	Frequency			
		HN ¹⁴ C ¹² S ³²	23, 464			[1]
		DN ¹⁴ C ¹² S ³²	21, 897			
		HN ¹⁴ C ¹³ S ³²	23, 389			
		DN ¹⁴ C ¹³ S ³²	21, 839			
		HN ¹⁴ C ¹² S ³⁴	22, 915			

$$\left. \begin{array}{l} \Delta\nu=18 \\ \mu=1.59 \\ B_0=10,348.74 \\ A=5,600 \end{array} \right\} [19]$$



$$J=1-2, K=0,1,2$$

Frequency	Intensity
41, 394. 95	2.2×10^{-5}

[19]

HCN (*Hydrocyanic acid*). This line is really a triplet, and the calculated intensity is for the sum of all three hyperfine components.

$$\left. \begin{array}{l} \mu=2.8 \\ B_0=44,336 \\ (eqQ)_N=-4.7 \\ \Delta\nu=25. \end{array} \right\} [41]$$



$$J=O-1$$

88, 671	1.1×10^{-2}
---------	----------------------

[41]



$$\left. \begin{array}{l} \mu=2.3 \\ A_0=364,500 \\ B_0=51,720 \\ C_0=45,338 \end{array} \right\} [49a]$$

Transition	Frequency
3 ₋₁ -3 ₋₂	28, 974. 85
4 ₋₂ -4 ₋₃	48, 284. 60
5 ₋₃ -5 ₋₄	72, 409. 35
0 ₀ -1 ₋₁	72, 838. 14

[49a]

H₂O (*Water*). The water line has been investigated at higher pressures by several workers not quoted herein. The intensity of the HDO lines follows the procedure adopted throughout this table of using natural abundances where possible, the abundance of D being taken as 0.02 percent.

H ₂ O	Reference	HDO	
$\mu=1.94$	[20]	1.84	[49b, 48]
$\Delta\nu=7$	[2, 55]	6.5	[49b]

H ₂ O ¹⁶	Transition	Frequency	Intensity	
	5 ₋₁ -6 ₋₅	22, 235. 22	9.6×10^{-6}	[20, 24, 55]
HDO ¹⁶	2 ₋₁ -2 ₋₂	10, 278. 99	8.6×10^{-9}	[49b]
	4 ₋₃ -3 ₋₁	20, 460. 40	1.3×10^{-8}	[44, 49b]
	5 ₀ -5 ₁	22, 307. 67	1.0×10^{-8}	[24, 48]
	3 ₀ -3 ₁	50, 236. 90	1.1×10^{-7}	[49b]

ICl. The half widths, dipole moment and intensities are discussed in reference [54].

$$\begin{aligned} \mu &= 0.65 & [54] \\ B_0 &= 3422.300 \\ (eqQ)_{C135} &= -82.5 \\ (eqQ)_I &= -2930.0 \\ &= 16.060 \\ \Delta\nu_{3-4} &= 5.5 \\ \Delta\nu_{0-1} &= 3.15 & [59] \end{aligned}$$

ICl³⁵

$$\begin{aligned} J=0-1, F_1=5/2-7/2 & \quad \text{Frequency} \quad \text{Intensity} \\ J=3-4, v=0 & \quad 6,980 \quad 1.1 \times 10^{-6} \quad [59] \end{aligned}$$

F_i	F_j	F_{ij}	F_f	Frequency	Intensity	
3/2	2	5/2	3	27,194.75	9.1×10^{-7}	[54]
3/2	1	5/2	2	27,202.64	5.0×10^{-7}	
3/2	3	5/2	4	27,204.99	1.5×10^{-6}	
5/2	3	7/2	4	27,217.51	1.4×10^{-6}	
5/2	2	7/2	3	27,221.02	1.0×10^{-6}	
5/2	4	7/2	5	27,225.32	2.0×10^{-6}	
5/2	1	7/2	2	27,228.34	7.3×10^{-7}	
1/2	1	3/2	2	27,242.59	3.9×10^{-7}	
1/2	2	3/2	3	27,254.90	1.1×10^{-6}	
7/2, 9/2		9/2		27,283.66		
7/2, 9/2		9/2		27,286.25		
7/2, 9/2		9/2		27,292.63		
7/2, 9/2		9/2		27,295.05		
7/2, 9/2	5	11/2	6	27,333.85	2.8×10^{-6}	
11/2	5	13/2	6	27,336.68	6.8×10^{-6}	
11/2	6	13/2	7			
11/2	4	13/2	5	27,337.38	6.8×10^{-6}	
11/2	7	13/2	8			
9/2	3	11/2	4	27,346.31	1.9×10^{-6}	
9/2	4	11/2	5	27,554.71	2.3×10^{-6}	
9/2	6	11/2	7	27,356.58	3.4×10^{-6}	
9/2	5	11/2	6	27,357.73	2.8×10^{-6}	
v=1						
11/2		13/2		27,208.54	2.2×10^{-6}	

ICl³⁷

$$\begin{aligned} J=0-1 & \quad 5/2 \quad 7/2 \quad 6,684 \quad 3.1 \times 10^{-7} \\ J=3-4 & \quad 11/2 \quad 13/2 \quad 26,181.6 \quad 4.4 \times 10^{-6} \end{aligned}$$

ICN (Cyanogen iodide).

$$\begin{aligned} \mu &= 3.71 \\ B_0 &= 3225.527 \text{ for IC}^{12}\text{N} \\ &= 3177.035 \text{ for IC}^{13}\text{N} \\ (eqQ)_N &= 3.80 \\ (eqQ)_I &= -2420. \\ \Delta\nu &= 20. \\ \alpha_1 &= 9.33 \\ \alpha_2 &= -9.50 \\ q &= 2.69 \end{aligned} \quad [53]$$

IC¹²N¹⁴

F_i	F_f	Frequency	Intensity	
$J=3-4, v=0$				
11/2	11/2	25,393.87	7.1×10^{-6}	[53]
3/2	5/2	25,711.50	2.0×10^{-5}	
5/2	7/2	25,728.77	2.9×10^{-5}	
1/2	3/2	25,752.65	1.4×10^{-5}	
7/2	9/2	25,783.50	4.2×10^{-5}	
9/2	9/2	25,789.85	1.1×10^{-5}	
11/2	13/2	25,823.08	7.5×10^{-5}	
9/2	11/2	25,837.64	5.7×10^{-5}	
7/2	7/2	25,954.36	1.2×10^{-5}	
3/2	3/2	25,969.58	6.9×10^{-6}	
5/2	5/2	25,991.92	1.0×10^{-5}	

$v_1=1$

11/2	13/2	25,748.18	7.0×10^{-6}	[53]
9/2	11/2	25,763.23	5.3×10^{-6}	

$v_2=1$

1 ₁	5/2	7/2	25,802.92	3.8×10^{-6}	[53]
1 ₁	3/2	5/2	25,815.34	3.8×10^{-6}	
1 ₁	7/2	9/2	25,829.31	7.8×10^{-6}	
1 ₂	7/2	9/2	25,850.78	7.8×10^{-6}	
1 ₁	9/2	11/2	25,872.24	1.1×10^{-5}	
1 ₂	9/2	11/2	25,893.73	1.1×10^{-5}	
1 ₁	11/2	13/2	25,906.28	1.4×10^{-5}	
1 ₂	11/2	13/2	25,927.66	1.4×10^{-5}	

$v_2=2$

F_i	F_j	F_{ij}	F_f	Frequency	Intensity	
$l=2$						
11/2	13/2	1 ₂		26,046.32	3.5×10^{-6}	P [30]
$J=4-5, v=0$						
13/2	13/2			31,848.77	8.5×10^{-6}	[42]
11/2	11/2			32,200.58	1.5×10^{-5}	
5/2	7/2			32,203.57	5.7×10^{-5}	
7/2	9/2			32,215.56	7.3×10^{-5}	
3/2	5/2			32,226.85	4.4×10^{-5}	
9/2	11/2			32,248.52	9.3×10^{-5}	
13/2	15/2			32,268.33	1.5×10^{-4}	
11/2	13/2			32,278.55	1.2×10^{-4}	
9/2	9/2			32,386.29	1.8×10^{-5}	

$J=11-12, v=0$

$$77,413. \quad 7.7 \times 10^{-3} \quad [41]$$

$J=12-13, v=0$

$$83,864. \quad 9.7 \times 10^{-3} \quad [41]$$

IC¹³N¹⁴

F_i	F_f	Frequency	Intensity	
$J=4-5, v=0$				
5/2	7/2	31,718.28	5.5×10^{-7}	[42]
7/2	9/2	31,730.50	7.2×10^{-7}	
3/2	5/2	31,741.50	4.3×10^{-7}	
9/2	11/2	31,763.34	9.1×10^{-7}	
13/2	15/2	31,783.31	1.4×10^{-6}	
11/2	13/2	31,793.46	1.1×10^{-6}	

NH₃ (*Ammonia*). The ammonia spectrum is unusual in being produced primarily by inversion or vibration rather than rotation of the molecule. It has considerably greater intensity than other micro-wave spectra of the same frequency, with the result that it is the first known and most widely studied microwave spectrum. The dependence of inversion frequency on the rotational quantum numbers J and K of the molecule produces a "fine" structure with frequencies given by the formula [45]

$$\nu = 23,785.75 - 151.450(J^2 + J - K^2) + 59.892K^2 + 0.49569(J^2 + J - K^2)^2 - 0.37674K^2(J^2 + J - K^2) + 0.06554K^4.$$

This formula applies with an accuracy of about 2 mc for small J and K up to about $J=12$ except when $K=3$, for which deviations are somewhat larger [45, 34]. The expression [40]

$$\nu = 23,787 - 151.3 J(J+1) + 211.0 K^2 + 0.5503 J^2(J+1)^2 - 1.531 J(J+1) + 1.055 K^4,$$

applies with an accuracy of about 30 mc up to $J=16$. Each one of the lines listed for N¹⁴H₃ may be expected to show hyperfine structure due to the N¹⁴ quadrupole coupling [7a, 58a]. Additional small frequency shifts of this hyperfine structure due to the N¹⁴ nuclear magnetic coupling have been detected [40, 24a, 27a]. The resulting symmetric patterns of two weak lines on each side of the lines listed have been studied up to $J=9$ [40], but the weak lines are not listed in this table. The frequency difference between these lines and the strong component that is listed are given by

$$\delta\nu = \pm \left\{ \frac{3}{4} eqQ \left[1 - \frac{3K^2}{J(J+1)} \right] \frac{J+1}{2J+3} - J \left[\frac{0.0104K^2}{J(J+1)} + 0.0022 \right] \right\},$$

$$\delta\nu' = \pm \left\{ \frac{3}{4} eqQ \left[1 - \frac{3K^2}{J(J+1)} \right] \frac{J}{2J-1} + (J+1) \left[\frac{0.0104K^2}{J(J+1)} + 0.0022 \right] \right\}.$$

The sign of eqQ cannot be definitely measured experimentally, but is very probably negative, and is assumed negative in the expressions for $\delta\nu$ and $\delta\nu'$. N¹⁵H₃ shows no hyperfine structure, since the N¹⁵ quadrupole moment is zero. Intensities of the weak hyperfine components relative to the strong component decrease approximately as $1/J^2$. The rather involved expressions for exact intensities are given by Candler [4c] and (with some typographical errors) in reference [40].

Intensities listed in the table are for the entire fine structure lines (without resolution of hyperfine components) assuming for each line, including the N¹⁵H₃ lines, the same value of half width $\Delta\nu$ measured for the N¹⁴H₃, $J=3$, $K=3$ line [50]*. Bleaney et al. [4a] find actually that for a number of NH₃ lines $\Delta\nu$ depends on J and K according to the formula

$$\Delta\nu \propto \left[\frac{K^2}{J(J+1)} \right]^{1/2}$$

so that intensities should be obtained from those in the table by multiplying by the factor $[3J(J+1)/4K^2]^{1/2}$. The apparent frequencies and values of $\Delta\nu$ at atmospheric and higher pressures differ widely from those given here [4a, 59a, 4b]. See also [33a].

NH₃ (*Ammonia*).

	N ¹⁴ H ₃	N ¹⁵ H ₃	
$\mu = 1.45$		1.45	
$\Delta\nu = 28.$			[50]
$A_0 = 189,000$		189,000	[26]
$B_0 = 298,000$			[26]
$eqQ = -4.10$		0	[40]

*Note that in reference [50] the value of $\Delta\nu$ in fig. 3 ($\Delta\nu = 29.4$ p mm Hg) is correct and the value of $\tau = 1/2\pi\Delta\nu$ on p. 667 is incorrect.

N¹⁴H₃

<i>J</i>	<i>K</i>	<i>Frequency</i>	<i>Intensity</i>	<i>Earlier refer- ences by workers other than those already quoted</i>
7	4	19,218.52	2.9×10 ⁻⁵ [45]	
6	3	19,757.56	6.8×10 ⁻⁵ [45, 21]	[4]
5	1	19,829	6.9×10 ⁻⁶ [4]	
5	2	20,371.48	3.1×10 ⁻⁵ [45, 21]	[4]
8	6	20,719.20	8.8×10 ⁻⁵ [45, 21]	[4]
9	7	20,735.46	2.9×10 ⁻⁵ [45, 21]	[4]
7	5	20,804.80	6.2×10 ⁻⁵ [45, 21]	[4]
10	8	20,852.51	1.7×10 ⁻⁵ [45, 21]	[4]
6	4	20,994.62	7.8×10 ⁻⁵ [45, 21]	[4]
11	9	21,070.73	1.9×10 ⁻⁵ [45, 21]	[4]
4	1	21,134.37	1.6×10 ⁻⁵ [45, 21]	[4]
5	3	21,285.30	1.7×10 ⁻⁴ [45, 21]	[4]
12	10	21,391.55	4.9×10 ⁻⁶ [45]	
4	2	21,703.34	6.9×10 ⁻⁵ [45, 21]	[4]
3	1	22,234.51	3.3×10 ⁻⁵ [45, 21]	[4]
14	12	22,355	2.1×10 ⁻⁶ [56]	
5	4	22,653.00	1.9×10 ⁻⁴ [45, 21]	[4]
4	3	22,688.24	3.7×10 ⁻⁴ [45, 21, 46]	[4]
6	5	22,732.45	1.6×10 ⁻⁴ [45, 21]	[4]
3	2	22,834.10	1.5×10 ⁻⁴ [45, 21]	[4, 50]
7	6	22,924.91	2.7×10 ⁻⁴ [45, 21]	[4, 50]
15	13	23,004	4.7×10 ⁻⁷ [56]	
2	1	23,098.78	6.7×10 ⁻⁵ [45, 21]	[4, 50]
8	7	23,232.20	9.5×10 ⁻⁵ [45, 21]	[4, 50]
9	8	23,657.46	6.3×10 ⁻⁵ [45, 21]	[4, 50]
1	1	23,694.48	1.6×10 ⁻⁴ [45, 21]	[4, 50]
2	2	23,722.61	3.0×10 ⁻⁴ [45, 21]	[4, 50]
3	3	23,870.11	7.9×10 ⁻⁴ [45, 21]	[4, 50]
4	4	24,139.45	4.3×10 ⁻⁴ [45, 21]	[4, 50]
10	9	24,205.25	7.8×10 ⁻⁵ [45, 21]	[4, 50]
5	5	24,532.94	4.1×10 ⁻⁴ [45, 21]	[4, 50]
11	10	24,881.90	2.2×10 ⁻⁵ [21]	[50]
6	6	25,056.04	7.1×10 ⁻⁴ [45, 21]	[4, 50]
12	11	25,695.23	1.3×10 ⁻⁵ [21]	
7	7	25,715.14	2.8×10 ⁻⁴ [45, 21]	[4]
8	8	26,518.91	2.1×10 ⁻⁴ [40]	
13	12	26,655.00	1.3×10 ⁻⁵ [40]	
9	9	27,478.00	2.9×10 ⁻⁴ [40]	
14	13	27,772.52	3.0×10 ⁻⁶ [40]	
10	10	28,604.73	9.5×10 ⁻⁵ [40]	
15	14	29,061.14	1.4×10 ⁻⁶ [40]	
11	11	29,914.66	5.8×10 ⁻⁵ [40]	
12	12	31,424.97	6.6×10 ⁻⁵ [40]	
13	13	33,156.95	1.8×10 ⁻⁵ [40]	
14	14	35,134.44	9.2×10 ⁻⁶ [40]	
15	15	37,385.18	8.9×10 ⁻⁶ [40]	
16	16	39,941.54	2.0×10 ⁻⁶ [40]	

<i>J</i>	<i>K</i>	Frequency	Intensity
5	3	20, 272. 04	6. 4×10 ⁻⁷
4	2	20, 682. 87	2. 6×10 ⁻⁷
3	1	21, 202. 30	1. 3×10 ⁻⁷
5	4	21, 597. 86	7. 2×10 ⁻⁷
4	3	21, 637. 91	1. 4×10 ⁻⁶
6	5	21, 667. 93	6. 0×10 ⁻⁷
3	2	21, 783. 98	5. 6×10 ⁻⁷
7	6	21, 846. 41	9. 9×10 ⁻⁷
2	1	22, 044. 28	2. 6×10 ⁻⁷
8	7	22, 134. 89	3. 5×10 ⁻⁷
9	8	22, 536. 26	2. 3×10 ⁻⁷
1	1	22, 624. 96	6. 0×10 ⁻⁷
2	2	22, 649. 85	1. 2×10 ⁻⁶
3	3	22, 789. 41	3. 0×10 ⁻⁶
4	4	23, 046. 10	1. 6×10 ⁻⁶
10	9	23, 054. 97	3. 0×10 ⁻⁷
5	5	23, 421. 99	1. 5×10 ⁻⁶
6	6	23, 922. 32	2. 6×10 ⁻⁶
7	7	24, 553. 42	1. 1×10 ⁻⁶
8	8	25, 323. 51	8. 0×10 ⁻⁷

[21]

	N ₂ ¹⁴ O ¹⁶	N ¹⁵ N ¹⁴ O ¹⁶	
<i>B</i> ₀	= 12, 561. 64	12, 137. 31	[7]
	central	end	
(<i>eqQ</i>) _N	= - . 27	- 1. 03	[7, 43]
N ¹⁴ N ¹⁴ O ¹⁶			

<i>J</i>	<i>F</i> _i	<i>F</i> _f	Frequency	Intensity	
<i>J</i> =0-1	1	1	25, 123. 03	1. 1×10 ⁻⁵	[7]
	1	2	25, 123. 28	1. 7×10 ⁻⁵	
	1	0	25, 123. 64	3. 4×10 ⁻⁶	
N ¹⁵ N ¹⁴ O ¹⁶					
<i>J</i> =0-1	1	1	24, 274. 53	3. 5×10 ⁻⁸	[7]
	1	2	24, 274. 61	5. 8×10 ⁻⁸	
	1	0	24, 274. 73	1. 1×10 ⁻⁸	
N ¹⁴ N ¹⁵ O ¹⁶ , <i>J</i> =0-1			25, 121. 55	1. 1×10 ⁻⁷	[7b]
N ¹⁵ N ¹⁵ O ¹⁶ , <i>J</i> =0-1			24, 274. 78	4. 0×10 ⁻¹⁰	[7b]

O₂ (Oxygen). This spectrum is of a fundamentally different nature than the other molecular spectra recorded herein, being due to a magnetic coupling to the electromagnetic field rather than an electric dipole coupling. The theory of the transition has been discussed by Van Vleck [58b].

$\Delta\nu = . 8 - 1. 3$ [3]

O ₂ ¹⁶	Frequency
	Ca. 60,000 [3, 31, 48a]

N₂O (Nitrous oxide)

$\Delta\nu = 3. 35$	[7b]
$\mu = . 16$	[39c]

OCS (Carbonyl sulfide).

$\mu(\text{O}^{16}\text{C}^{12}\text{S}^{32}) = . 732$	[16, 27]
$\mu_{v_2=1} = . 694$	[49c]
$\mu(\text{O}^{16}\text{C}^{13}\text{S}^{32}) = . 722$	[16, 27]
(<i>eqQ</i>)S ³³ = -28. 5	[52]
$\Delta\nu = 6.$	[53]

	O ¹⁶ C ¹² S ³²	O ¹⁶ C ¹² S ³³	O ¹⁶ C ¹² S ³⁴	O ¹⁶ C ¹³ S ³²	O ¹⁶ C ¹³ S ³⁴	O ¹⁶ C ¹⁴ S ³²	O ¹⁸ C ¹² S ³²
<i>B</i> ₀	6081. 453	6004. 918	5932. 843	6061. 939	5911. 730	6043. 25	5704. 825
α_1	18. 12						
α_2	-10. 59		-10. 37			-9. 4	
α_3	55. 1		6. 07			6. 7	
<i>q</i>	6. 393		6. 07			6. 7	
	[16]	[52]	[53]	[53]	[53]	[37]	[53]

The *B*₀'s listed above are those for the lowest observed *J* transition, since they may be expected to increase with *J* because of centrifugal stretching.

O¹⁶C¹²S³²

<i>J</i>	<i>v</i>	Frequency	Intensity		<i>F</i> _i	<i>F</i> _f	Frequency	Intensity	
<i>J</i> =1-2, <i>v</i> =0		24, 325. 92	5. 5×10 ⁻⁵	[16]	1/2	3/2	24, 013. 04	7. 2×10 ⁻⁸	[52]
	<i>v</i> ₁ =1	24, 253. 44	8. 7×10 ⁻⁷	[52]	5/2	5/2			
	<i>v</i> ₂ =1, 1 ₁	24, 355. 50	4. 4×10 ⁻⁶	[16]	1/2	1/2	24, 020. 21	2. 9×10 ⁻⁷	[52]
	1 ₂	24, 380. 84	4. 4×10 ⁻⁶	[16]	3/2	5/2			
	<i>v</i> ₂ =2	24, 401	1. 3×10 ⁻⁶	[39b]	5/2	7/2	24, 025. 39	4. 6×10 ⁻⁸	[52]
	<i>v</i> ₂ =3	24, 411	1×10 ⁻⁷	[39b]	3/2	3/2			
		24, 459	1×10 ⁻⁷	[39b]	3/2	1/2	24, 032. 75	7. 2×10 ⁻⁹	[52]
<i>J</i> =2-3, <i>v</i> =0		36, 488. 82	4. 6×10 ⁻⁵	[49]					
<i>J</i> =3-4, <i>v</i> =0		48, 651. 64	4. 4×10 ⁻⁴	[27]					
<i>J</i> =4-5, <i>v</i> =0		60, 814. 08	8. 7×10 ⁻⁴	[27]					
O ¹⁶ C ¹² S ³³									
					<i>J</i> =1-2, <i>v</i> =0		23, 731. 33	2. 2×10 ⁻⁶	[16]
						<i>v</i> ₁ =1	23, 661	4. 1×10 ⁻⁸	[32]
						<i>v</i> ₂ =1, 1 ₁	23, 760. 67	1. 4×10 ⁻⁷	[52]
						1 ₂	23, 784. 95	1. 4×10 ⁻⁷	[52]
					<i>J</i> =3-4, <i>v</i> =0		47, 462. 40	1. 9×10 ⁻⁵	[27]
					O ¹⁶ C ¹² S ³⁶				
					<i>J</i> =1-2, <i>v</i> =0		23, 198. 66	8×10 ⁻⁹	[32]

$O^{16}C^{13}S^{32}$				$O^{16}C^{14}S^{32}$			
	Frequency	Intensity					
$J=1-2, v=0$	24, 247. 76	5.9×10^{-7}	[53]	$J=1-2, v=0$	24, 173. 0	5.7×10^{-5}	[37]
$v_2=1, 1_1$	24, 275. 25	6.6×10^{-8}	[53]	$v_2=1, 1_1$	24, 197	6.4×10^{-6}	[37]
1_2	24, 301. 05	6.6×10^{-8}	[53]	1_2	24, 224	6.4×10^{-6}	[37]
$O^{16}C^{13}S^{34}$				$O^{17}C^{12}S^{32}$			
$J=1-2, v=0$	23, 646. 92	2.8×10^{-8}	[53]	$J=1-2, v=0$	23, 534. 67	2.2×10^{-8}	[32]
$O^{16}C^{13}S^{32}$				$O^{18}C^{12}S^{32}$			
$J=1-2, v=0$				$J=1-2, v=0$	22, 819. 30	9.6×10^{-8}	[53]

OCS_e (Carbonyl selenide).

$\mu = .754$	[47]
$\mu_{v=1} = .728$	
$\mu_{v=1} = .730$	

Molecule	B_{000}	α_1	α_2	q	D_v /sec	
$O^{16}C^{12}Se^{82}$	3994. 009 ± . 005	13. 12 ± . 005	-6. 86 ± . 005	3. 12 ± . 005	875 ± 50	[47]
Se ⁸⁰	4017. 677	13. 27	-6. 92	3. 15	755 ± 20	
Se ⁷⁸	4042. 460	13. 40	-6. 96	3. 19	830 ± 50	
Se ⁷⁷	4055. 300	13. 48	-6. 98	3. 21		
Se ⁷⁶	4068. 465		-7. 00	3. 24		
Se ⁷⁴	4095. 793					
$O^{16}C^{13}Se^{80}$	3980. 045					
Se ⁷⁸	4005. 112					

$O^{16}C^{12}Se^{74}$		
	Frequency	Intensity
$J=2-3, v=0$	24, 574. 67	1.3×10^{-7}
$O^{16}C^{12}Se^{76}$		
$J=2-3, v=0$	24, 410. 70	1.4×10^{-6}
$v_2=1, 1_1$	24, 442. 98	1.8×10^{-7}
$v_2=1, 1_2$	24, 462. 42	1.8×10^{-7}
$O^{16}C^{12}Se^{77}$		
$J=2-3, v=0$	24, 331. 71	1.2×10^{-6}
$v_1=1$	24, 250. 84	5.5×10^{-8}
$v_2=1, 1_1$	24, 363. 97	1.6×10^{-7}
$v_2=1, 1_2$	24, 383. 21	1.6×10^{-7}
$O^{16}C^{12}Se^{78}$		
$J=2-3, v=0$	24, 254. 67	3.4×10^{-6}
$v_1=1$	24, 174. 30	1.6×10^{-8}
$v_2=1, 1_1$	24, 286. 82	4.5×10^{-7}
$v_2=1, 1_2$	24, 305. 95	4.5×10^{-7}
$J=5-6$	48, 508. 88	2.8×10^{-5}
$J=6-7$	56, 593. 16	4.4×10^{-5}
$O^{16}C^{12}Se^{80}$		
$J=2-3, v=0$	24, 105. 98	6.8×10^{-6}
$v_1=1$	24, 026. 39	3.1×10^{-7}
$v_2=1, 1_1$	24, 138. 05	9.0×10^{-7}
$v_2=1, 1_2$	24, 156. 93	9.0×10^{-7}
$J=5-6$	48, 211. 46	5.6×10^{-5}
$J=6-7$	56, 246. 47	8.8×10^{-5}
$O^{16}C^{12}Se^{82}$		
$J=2-3, v=0$	23, 964. 50	1.3×10^{-6}
$v_1=1$	23, 885. 76	6.0×10^{-8}
$v_2=1, 1_1$	23, 996. 26	1.7×10^{-7}
$v_2=1, 1_2$	24, 014. 97	1.7×10^{-7}
$J=6-7$	55, 916. 19	1.1×10^{-5}
$O^{16}C^{13}Se^{78}$		
$J=2-3, v=0$	24, 030. 58	3.7×10^{-8}
$O^{16}C^{13}Se^{80}$		
$J=2-3, v=0$	23, 880. 18	7.5×10^{-8}

PF₃ (Phosphorus trifluoride)

$\mu = 1.02$	[39c]
$\Delta\nu = 16.$	[19]
$B_0 = 7819.90$	[19]

PF ₃	Frequency	Intensity*	
$J=1-2, K=0, 1$	31, 279. 60	2.3×10^{-6}	[19]
$J=2-3, K=0, 1$	46, 918. 82	6.7×10^{-6}	[19]
$K=2$	46, 919. 02	1.5×10^{-6}	

*Assuming 80% in ground vibrational state.

excited vibrational states	$\left\{ \begin{array}{l} 46, 940 \\ 47, 010 \\ 47, 033 \\ 47, 040 \end{array} \right\}$	[19]
----------------------------	--	------

[47] SiH ₃ Cl (Chlorosilane)	$\mu = 1.28$
$A_0 = 95,500$	
$B_0 = SiH_3Cl^{35}$	SiH ₃ Cl ³⁷
6673.81	6,512.40
(<i>eqQ</i>)Cl = -40.0	-30.8
	[38]
	[38]

SiH ₃ Cl ³⁵	F_i	F_f	Frequency	Intensity*	
$J=1-2, K=0$					[38]
	1/2	3/2	26, 685. 25	3.4×10^{-7}	
	5/2	5/2	26, 686. 15	3.7×10^{-7}	
	1/2	1/2	26, 695. 00	3.4×10^{-7}	
	3/2	5/2	26, 696. 10	2.5×10^{-6}	
	5/2	7/2			
	3/2	3/2	26, 703. 34	4.5×10^{-7}	
	3/2	1/2	26, 713. 07	7.0×10^{-8}	

*Assuming 90% of the molecules are in ground vibrational state.

$J=1-2, K=1$	F_i	F_f	Frequency	Intensity
	3/2	5/2	26, 687. 34	6.6×10^{-7}
	3/2	3/2	26, 690. 92	3.4×10^{-7}
	5/2	5/2	26, 692. 66	2.8×10^{-7}
	5/2	7/2	26, 697. 45	1.3×10^{-6}
	1/2	3/2	26, 700. 48	2.6×10^{-7}
	1/2	1/2	26, 705. 02	2.6×10^{-7}

SiH₃Cl³⁷

$J=1-2, K=0$

	1/2	3/2	26, 042. 41	2.2×10^{-7}	[38]
	5/2	5/2			
	3/2	5/2	26, 050. 26	7.9×10^{-7}	[38]
	5/2	7/2			
	3/2	3/2	26, 055. 86	1.4×10^{-7}	[38]
	3/2	1/2	26, 063. 52	2.2×10^{-8}	
$K=1$	3/2	5/2	26, 043. 29	2.0×10^{-7}	[38]
	3/2	3/2	26, 046. 30	1.0×10^{-7}	
	5/2	5/2	26, 047. 97	8.7×10^{-8}	[38]
	5/2	7/2	26, 051. 09	3.9×10^{-7}	
	1/2	3/2	26, 053. 35	8.1×10^{-8}	[38]
	1/2	1/2	26, 057. 10	8.1×10^{-8}	

SO₂ (Sulfur dioxide)

$$\begin{aligned} \mu &= 1.7 \\ A &= 61,100 \\ B &= 10,400 \\ C &= 8,870 \end{aligned} \quad [12]$$

S³²O₂¹⁶

Transition	Frequency
13 ₋₁₀ -12 ₋₆	20, 420
	22, 064
	22, 225
	22, 475
	22, 735
	22, 904
	22, 934
	23, 033
	23, 413
	23, 738
6 ₋₄ -5 ₋₂	24, 037
	24, 083
	24, 342
	25, 047
9 ₋₈ -8 ₋₄	25, 170
	25, 392
7 ₋₄ -8 ₋₆	29, 460
	29, 460
3 ₋₂ -4 ₋₄	

SPF₃

$$B_0 = 2657. 6$$

SPF₃

$J=3-4$	21, 262	[37b]
$J=4-5$	26, 574	
Exc. states	21, 283	[37b]
	26, 553	

TABLE 2. Lines listed by frequency

Frequency	Intensity	Transition	Molecule
6, 684	W	0-1	ICl ³⁷
6, 980	M	0-1	ICl ³⁵
10, 278. 99	W	-----	HDO ¹⁶
17, 961. 2	M	0-1	B ¹⁰ H ₃ C ¹² O ¹⁶
18, 398. 6	M	0-1	C ¹² H ₃ C ¹² N ¹⁴
18, 400	M	0-1	C ¹² H ₃ C ¹² N ¹⁴
18, 402. 1	M	0-1	C ¹² H ₃ C ¹² N ¹⁴
18, 943. 77	W	0-1	C ¹² H ₃ Br ⁸¹
18, 992. 36	W	0-1	C ¹² H ₃ Br ⁷⁹
19, 040. 32	M	0-1	C ¹² H ₃ Br ⁸¹
19, 107. 97	M	0-1	C ¹² H ₃ Br ⁷⁹
19, 160. 82	M	0-1	C ¹² H ₃ Br ⁸¹
19, 218. 52	S	0-1	N ¹⁴ H ₃
19, 252. 13	M	0-1	C ¹² H ₃ Br ⁷⁹
19, 700	-----	3-4	C ¹² H ₃ N ¹⁴ C ¹² S ³⁴
19, 757. 56	S	-----	N ¹⁴ H ₃
19, 829	M	-----	N ¹⁴ H ₃
19, 929	-----	3-4	C ¹² H ₃ N ¹⁴ C ¹² S ³⁴
20, 020	-----	3-4	C ¹² H ₃ N ¹⁴ C ¹² S ³²
20, 140	-----	3-4	C ¹² H ₃ N ¹⁴ C ¹² S ³²
20, 160	-----	3-4	C ¹² H ₃ N ¹⁴ C ¹²
20, 216	-----	3-4	C ¹² H ₃ N ¹⁴ C ¹² S ³²
20, 230	-----	3-4	C ¹² H ₃ N ¹⁴ C ¹² S ³²
20, 241	-----	3-4	C ¹² H ₃ N ¹⁴ C ¹² S ³²
20, 272. 04	M	-----	N ¹⁵ H ₃
20, 350	-----	3-4	C ¹² H ₃ N ¹⁴ C ¹² S ³²
20, 371. 48	S	-----	N ¹⁴ H ₃
20, 385	-----	-----	CH ₃ NO ₂
20, 413	-----	3-4	C ¹² H ₃ N ¹⁴ C ¹² S ³²
20, 443	-----	3-4	C ¹² H ₃ N ¹⁴ C ¹² S ³²
20, 421	-----	-----	SO ₂
20, 460. 40	W	-----	HDO ¹⁶
20, 679. 9	W	1-2	CF ₃ CH ₃
20, 682. 87	W	-----	N ¹⁵ H ₃
20, 710. 6	M	1-2	CF ₃ CH ₃
20, 719. 20	S	-----	N ¹⁴ H ₃
20, 735. 46	S	-----	N ¹⁴ H ₃
20, 742. 3	M	1-2	CF ₃ CH ₃
20, 804. 80	S	-----	N ¹⁴ H ₃
20, 852. 51	S	-----	N ¹⁴ H ₃
20, 910	-----	-----	CH ₃ OH
20, 971	-----	-----	CH ₃ OH
20, 994. 62	S	-----	N ¹⁴ H ₃
21, 070. 73	S	-----	N ¹⁴ H ₃
21, 134. 37	S	-----	N ¹⁴ H ₃
21, 202. 30	W	-----	N ¹⁵ H ₃
21, 262	-----	-----	SPF ₃
21, 283	-----	-----	SPF ₃

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
21, 285. 30	S	-----	N ¹⁴ H ₃
21, 350	-----	-----	CH ₃ OH
21, 391. 55	M	-----	N ¹⁴ H ₃
21, 482	M	-----	CH ₂ CF ₂
21, 549	W	-----	CH ₂ CF ₂
21, 551	-----	-----	CH ₃ OH
21, 573	W	-----	CH ₂ CF ₂
21, 597. 86	M	-----	N ¹⁵ H ₃
21, 637. 91	M	-----	N ¹⁵ H ₃
21, 664	-----	-----	C ² D ₄ O ¹⁶
21, 667. 93	M	-----	N ¹⁵ H ₃
21, 689	M	-----	CH ₂ CF ₂
21, 703. 34	S	-----	N ¹⁴ H ₃
21, 712	-----	-----	CH ₃ NH ₂
21, 734	M	-----	CH ₂ CF ₂
21, 783. 98	M	-----	N ¹⁵ H ₃
21, 839	-----	1-2	DN ¹⁴ C ¹³ S ³²
21, 846. 41	M	1-2	DN ¹⁴ C ¹³ S ³²
21, 897	-----	1-2	DN ¹⁴ C ¹³ S ³²
21, 930. 2	-----	1-2	C ₂ H ₃ Cl
21, 935	-----	-----	CH ₃ NH ₂
22, 044. 28	W	-----	N ¹⁵ H ₃
22, 064	-----	-----	SO ₂
22, 134. 89	W	-----	N ¹⁵ H ₃
22, 217	-----	-----	CHClF ₂
22, 225	-----	-----	SO ₂
22, 234. 51	S	-----	N ¹⁴ H ₃
22, 235. 22	M	-----	H ₂ O
22, 236	M	-----	CH ₂ CF ₂
22, 247	-----	-----	CHClF ₂
22, 258	-----	-----	CH ₃ NH ₂
22, 281	S	-----	CH ₂ CF ₂
22, 305	-----	-----	CHClF ₂ , CH ₃ OH
22, 307. 67	W	-----	HDO
22, 353	-----	-----	CHClF ₂
22, 355	M	-----	N ¹⁴ H ₃
22, 369. 6	-----	1-2	C ₂ H ₃ Cl
22, 383	M	-----	CH ₂ CF ₂
22, 386	-----	-----	CHClF ₂
22, 391	M	-----	CH ₂ CF ₂
22, 410	-----	-----	CHClF ₂
22, 436	-----	-----	CHClF ₂
22, 462	-----	-----	CHClF ₂
22, 475	-----	-----	SO ₂
22, 481	-----	-----	CHClF ₂
22, 485. 9	-----	1-2	C ₂ H ₃ Cl

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
22, 535	-----	-----	CH ₃ NH ₂
22, 536. 26	W	-----	N ¹⁵ H ₃
22, 545	-----	-----	CHClF ₂
22, 553	-----	-----	CHClF ₂
22, 590	-----	-----	CH ₃ NH ₂
22, 595	-----	-----	CH ₃ NH ₂
22, 612	-----	-----	CH ₃ NH ₂
22, 624. 96	M	-----	N ¹⁵ H ₂
22, 649. 85	M	-----	N ¹⁵ H ₃
22, 653. 00	S	-----	N ¹⁴ H ₃
22, 660	W	-----	CH ₂ CF ₂
22, 680	-----	3-4	C ¹² H ₃ S ³² C ¹² N ¹⁴
22, 688. 24	S	-----	N ¹⁴ H ₃
22, 732	-----	-----	CH ₃ NH ₂
22, 732. 45	S	-----	N ¹⁴ H ₃
22, 735	-----	-----	SO ₂
22, 740	-----	-----	CH ₃ NH ₂
22, 752	S	-----	CH ₂ CF ₂
22, 789. 41	M	-----	N ¹⁵ H ₃
22, 819. 30	W	1-2	O ¹⁸ C ¹² S ³²
22, 834. 10	S	-----	N ¹⁴ H ₃
22, 904	-----	-----	SO ₂
22, 915	-----	1-2	HN ¹⁴ C ¹² S ³⁴
22, 924. 91	S	-----	N ¹⁴ H ₃
22, 934	-----	-----	SO ₂
22, 946. 9	-----	1-2	C ₂ H ₃ Cl
22, 977	-----	-----	CH ₃ NH ₂
23, 004	W	-----	N ¹⁴ H ₃
23, 021	-----	-----	CH ₃ NO ₃
23, 033	-----	-----	SO ₂
23, 046. 10	M	-----	N ¹⁵ H ₃
23, 054. 97	W	-----	N ¹⁵ H ₃
23, 055. 0	-----	1-2	C ₂ H ₃ Cl
23, 098. 78	S	-----	N ¹⁴ H ₃
23, 115	-----	-----	CH ³ NH ₂
23, 121. 2	-----	-----	CH ₃ OH
23, 134	M	-----	C ₂ H ₄ O
23, 181	-----	-----	CH ₂ CF ₂
23, 198. 66	W	1-2	O ¹⁶ C ¹² S ³⁶
23, 205	-----	-----	CH ₃ NH ₂
23, 206	W	-----	CH ₂ CF ₂
23, 214	M	-----	CH ₂ CF ₂
23, 220	M	-----	CH ₂ CF ₂
23, 232. 20	S	-----	N ¹⁴ H ₃
23, 234	W	-----	CH ₂ CF ₂
23, 250	-----	-----	CH ₃ NO ₂

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
23, 295	-----	-----	CH ₃ NH ₂
23, 300	-----	-----	CH ₃ NH ₂
23, 305	-----	-----	CH ₃ NH ₂
23, 308	-----	-----	CHClF ₂
23, 323	M	-----	CH ₂ CF ₂
23, 335	M	-----	CH ₃ NH ₂
23, 346. 8	-----	-----	CH ₃ OH
23, 361	M	-----	CH ₂ CF ₂
23, 372. 72	M	1-2	Cl ³⁷ C ¹² N ¹⁴
23, 389. 00	M	1-2	Cl ³⁷ C ¹² N ¹⁴
23, 389	-----	1-2	HN ¹⁴ C ¹³ S ³²
23, 389. 61	M	1-2	Cl ³⁷ C ¹² N ¹⁴
23, 390. 53	M	1-2	Cl ³⁷ C ¹² N ¹⁴
23, 402. 47	M	1-2	Cl ³⁷ C ¹² N ¹⁴
23, 404	-----	-----	CH ₃ NH ₂
23, 413	-----	-----	SO ₂
23, 421. 99	M	-----	N ¹⁵ H ₃
23, 425	-----	-----	CH ₃ OH, CH ₃ NH ₂
23, 430	-----	-----	CH ₃ NH ₂
23, 433	S	-----	CH ₂ CF ₂
23, 446	-----	-----	CH ₃ NH ₂
23, 458. 6	W	1-2, K=0	AsF ₃
23, 463. 0	W	1-2, K=0	AsF ₃
23, 464	-----	1-2	HN ¹⁴ C ¹² S ³²
23, 467	-----	-----	CH ₃ NO ₂
23, 472. 6	W	1-2, K=1	AsF ₃
23, 476	-----	-----	CH ₂ Cl ₂
23, 483	-----	-----	CH ₃ NO ₂
23, 494. 2	W	1-2, K=1	AsF ₃
23, 501. 6	W	1-2, K=1	AsF ₃
23, 510	-----	-----	CH ₃ NH ₂
23, 512. 9	W	-----	AsF ₃
23, 517. 0	W	1-2, K=0	AsF ₃
23, 522. 4	M	1-2, K=0	AsF ₃
23, 532. 1	M	1-2, K=1	AsF ₃
23, 534. 67	W	1-2	O ¹⁷ C ¹² S ³²
23, 538. 9	-----	1-2	C ₂ H ₃ Cl
23, 543. 2	W	-----	AsF ₃
23, 553. 0	W	-----	AsF ₃
23, 564. 6	W	1-2, K=0	AsF ₃
23, 575. 3	W	1-2, K=1	AsF ₃
23, 610	M	-----	C ₂ H ₄ O
23, 644	-----	-----	CHClF ₂
23, 646. 92	W	1-2, v=0	O ¹⁶ C ¹³ C ³⁴
23, 649	M	-----	CH ₂ CF ₂
23, 657. 46	S	-----	N ¹⁴ H ₃
23, 661	W	1-2, v ₁ =1	O ¹⁶ C ¹² S ³⁴
23, 680	-----	-----	CHClF ₂ , CH ₃ NH ₂

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
23, 694. 48	S	-----	N ¹⁴ H ₃
23, 706	-----	-----	CH ₃ NO ₂
23, 722. 61	S	-----	N ¹⁴ H ₃
23, 731. 33	M	1-2, v=0	O ¹⁶ C ¹² S ³⁴
23, 733	-----	-----	CHClF ₂
23, 738	-----	-----	SO ₂
23, 760. 67	W	1-2, v ₂ =1	O ¹⁶ C ¹² S ³⁴
23, 770	M	-----	CH ₂ CF ₂
23, 784. 95	W	1-2, v ₂ =1	O ¹⁶ C ¹² S ³⁴
23, 803	-----	-----	CHClF ₂
23, 812	M	-----	CH ₂ CF ₂
23, 826	-----	-----	CHClF ₂
23, 845	-----	-----	CHClF ₂
23, 854. 4	-----	-----	CH ₃ OH
23, 862. 57	M	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 863. 5	W	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 863. 8	W	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 864. 0	M	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 864. 2	M	1-2, v=0	Cl ³⁵ C ¹⁴ N ¹⁴
23, 864. 5	M	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 864. 9	W	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 865. 1	W	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 870. 11	S	-----	N ¹⁴ H ₃
23, 878. 6	M	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 878. 9	W	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 879. 7	W	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 880. 18	W	2-3, v=0	O ¹⁶ C ¹³ Se ⁸⁰
23, 883. 30	M	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 884. 2	M	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 884. 8	M	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 884. 9	S	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 885. 16	S	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 885. 3	M	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 885. 76	W	1-2, v ₁ =1	O ¹⁶ O ¹² Se ⁸²
23, 886. 0	M	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 886. 2	M	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 899. 59	M	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 900. 20	M	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 900. 7	M	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 917. 9	S	1-2, v ₂ =1	Cl ³⁵ C ¹² N ¹⁴
23, 920. 91	M	1-2, v=0	Cl ³⁵ C ¹² N ¹⁴
23, 922. 32	M	-----	N ¹⁵ H ₃
23, 925. 5	M	1-2, v ₂ =1	Cl ³⁵ C ¹² N ¹⁴
23, 928. 7	M	1-2, v ₂ =1	Cl ³⁵ C ¹² N ¹⁴
23, 938. 6	S	1-2, v ₂ =1	Cl ³⁵ C ¹² N ¹⁴
23, 944. 4	M	1-2, v ₂ =1	Cl ³⁵ C ¹² N ¹⁴
23, 948. 2	S	1-2, v ₂ =1	Cl ³⁵ C ¹² N ¹⁴

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
23, 954. 5	M	1-2, $v_2=1$	$\text{Cl}^{35}\text{C}^{12}\text{N}^{14}$
23, 958. 4	M	1-2, $v_2=1$	$\text{Cl}^{35}\text{C}^{12}\text{N}^{14}$
23, 964. 50	M	2-3, $v=0$	$\text{O}^{16}\text{C}^{12}\text{Se}^{82}$
23, 968. 6	S	1-2, $v_2=1$	$\text{Cl}^{35}\text{C}^{12}\text{N}^{14}$
23, 974. 4	M	1-2, $v_2=1$	$\text{Cl}^{35}\text{C}^{12}\text{N}^{14}$
23, 984. 6	M	1-2, $v_2=1$	$\text{Cl}^{35}\text{C}^{12}\text{N}^{14}$
23, 986	M	1-2, $v_2=1$	CH_2CF_2
23, 996. 26	W	2-3, $v_2=1$	$\text{O}^{16}\text{C}^{12}\text{Se}^{82}$
24, 013. 04	W	1-2, $v=0$	$\text{O}^{16}\text{C}^{12}\text{S}^{33}$
24, 014. 97	W	2-3, $v_2=1$	$\text{O}^{16}\text{C}^{12}\text{Se}^{82}$
24, 015			CH_3NH_2
24, 017			CH_3NO_2
24, 020. 21	W	1-2, $v=0$	$\text{O}^{16}\text{C}^{12}\text{S}^{33}$
24, 021	M		CH_2CF_2
24, 025. 39	W	1-2, $v=0$	$\text{O}^{16}\text{C}^{12}\text{S}^{33}$
24, 026. 39	W	2-3, $v_1=1$	$\text{O}^{16}\text{C}^{12}\text{Se}^{80}$
24, 030. 58	W	2-3, $v=0$	$\text{O}^{16}\text{C}^{13}\text{Se}^{78}$
24, 032. 75	W	1-2, $v=0$	$\text{O}^{16}\text{C}^{12}\text{S}^{33}$
24, 037			SO_2
24, 055			$\text{C}^{12}\text{D}_4\text{O}^{16}$
24, 078			CH_3NH_2
24, 083			SO_2
24, 105. 98	M	2-3, $v=0$	$\text{O}^{16}\text{C}^{12}\text{Se}^{80}$
24, 138. 05	M	2-3, $v_2=1$	$\text{O}^{16}\text{C}^{12}\text{Se}^{80}$
24, 139. 45	S		N^{14}H_3
24, 143		4-5	$\text{C}^{13}\text{H}_3\text{N}^{14}\text{C}^{12}\text{S}^{32}$
24, 150	W		CH_2CF_2
24, 156. 93	M	2-3, $v_2=1$	$\text{O}^{16}\text{C}^{12}\text{Se}^{80}$
24, 173. 0	W	1-2, $v=0$	$\text{O}^{16}\text{C}^{14}\text{S}^{32}$
24, 174. 30	W	2-3, $v_1=1$	$\text{O}^{16}\text{C}^{12}\text{Se}^{78}$
24, 205. 25	S		N^{14}H_3
24, 247. 76	M	1-2, $v=0$	$\text{O}^{16}\text{C}^{13}\text{S}^{32}$
24, 250. 84	W	2-3, $v_1=1$	$\text{O}^{16}\text{C}^{12}\text{Se}^{77}$
24, 253. 44	M	1-2, $v_1=1$	$\text{O}^{16}\text{C}^{12}\text{S}^{32}$
24, 254. 67	M	2-3, $v=0$	$\text{O}^{16}\text{C}^{12}\text{Se}^{78}$
24, 274. 53	W	0-1	$\text{N}^{15}\text{N}^{14}\text{O}^{16}$
24, 274. 61	W	0-1	$\text{N}^{15}\text{N}^{14}\text{O}^{16}$
24, 274. 73	W	0-1	$\text{N}^{15}\text{N}^{14}\text{O}^{16}$
24, 274. 78	W	0-1	$\text{N}^{15}\text{N}^{15}\text{O}^{16}$
24, 275. 25	W	1-2, $v_2=1$	$\text{O}^{16}\text{C}^{13}\text{S}^{32}$
24, 286. 82	W	2-3, $v_2=1$	$\text{O}^{16}\text{C}^{12}\text{Se}^{78}$
24, 294	M		CH_2CF_2
24, 301. 05	W	1-2, $v_2=1$	$\text{O}^{16}\text{C}^{13}\text{S}^{32}$
24, 305. 95	W	2-3, $v_2=1$	$\text{O}^{16}\text{C}^{12}\text{Se}^{78}$
24, 320			CH_3NH_2
24, 323	S		CH_2CF_2
24, 325. 92	S	1-2, $v=2$	$\text{O}^{16}\text{C}^{12}\text{S}^{32}$

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
24, 331. 71	M	2-3, $v=0$	$\text{O}^{16}\text{C}^{12}\text{Se}^{77}$
24, 342			SO_2
24, 352	M		CH_2CF_2
24, 355. 50	M	1-2, $v_2=1$	$\text{O}^{16}\text{C}^{12}\text{S}^{32}$
24, 357	W		CH_2CF_2
24, 363. 97	W	2-3, $v_2=1$	$\text{O}^{16}\text{C}^{12}\text{Se}^{77}$
24, 380. 84	M	1-2, $v_2=1$	$\text{O}^{16}\text{C}^{12}\text{S}^{32}$
24, 383. 21	W	2-3, $v_2=1$	$\text{O}^{16}\text{C}^{12}\text{Se}^{77}$
24, 401	M	2-3, $v_2=2$	$\text{O}^{16}\text{C}^{12}\text{S}^{32}$
24, 410. 70	M	2-3, $v=0$	$\text{O}^{16}\text{C}^{12}\text{Se}^{76}$
24, 411	W	1-2, $v=3$	$\text{O}^{16}\text{C}^{12}\text{S}^{22}$
24, 428			CH_3NO_2
24, 440			CH_2Cl_2
24, 442. 98	W	2-3, $v_2=1$	$\text{O}^{16}\text{C}^{12}\text{Se}^{76}$
24, 448			CH_3NO_2
24, 450	S		CH_2CF_2
24, 459	W	1-2, $v_2=3$	$\text{O}^{16}\text{C}^{12}\text{S}^{32}$
24, 462. 42	W	2-3, $v_2=1$	$\text{O}^{16}\text{C}^{12}\text{Se}^{76}$
24, 465. 33	M	2-3, $v=0$	$\text{Br}^{81}\text{C}^{12}\text{N}^{14}$
24, 471			CH_2Cl_2
24, 506. 75	M	2-3, $v_1=1$	$\text{Br}^{81}\text{C}^{12}\text{N}^{14}$
24, 507. 38	M	2-3, $v=0$	$\text{Br}^{81}\text{C}^{12}\text{N}^{14}$
24, 528			CH_3NH_2
24, 532. 94	S		N^{14}H_3
24, 541. 18	M	2-3, $v_1=1$	$\text{Br}^{81}\text{C}^{12}\text{N}^{14}$
24, 545	M		CH_2CF_2
24, 553. 42	M		N^{15}H_3
24, 573. 86	S	2-3, $v=0$	$\text{Br}^{81}\text{C}^{12}\text{N}^{14}$
24, 574. 67	W	2-3, $v=0$	$\text{O}^{16}\text{C}^{12}\text{Se}^{74}$
24, 577			CH_2Cl_2
24, 579	W		CH_2CF_2
24, 583. 00	M	2-3, $v=0$	$\text{Br}^{79}\text{C}^{12}\text{N}^{14}$
24, 599			CH_3NO_2
24, 602	W		CH_2CF_2
24, 608. 92	S	2-3, $v=0$	$\text{Br}^{81}\text{C}^{12}\text{N}^{14}$
24, 609		4-5	$\text{C}^{12}\text{H}_3\text{N}^{14}\text{C}^{12}\text{S}^{34}$
24, 622. 93	M	2-3, $v_2=1$	$\text{Br}^{81}\text{C}^{12}\text{N}^{14}$
24, 627			CH_2Cl_2
24, 631			CH_2Cl_2
24, 633. 71	M	2-3, $v=0$	$\text{Br}^{79}\text{C}^{12}\text{N}^{14}$
24, 636			CH_2Cl_2
24, 639	M		CH_2CF_2
24, 645. 82	M	2-3, $v_1=1$	$\text{Br}^{79}\text{C}^{12}\text{N}^{14}$
24, 658. 89	M	2-3, $v_2=1$	$\text{Br}^{81}\text{C}^{12}\text{N}^{14}$
24, 668			$\text{C}_2^{12}\text{D}_4\text{O}^{16}$
24, 682. 13	M	2-3, $v_2=1$	$\text{Br}^{81}\text{C}^{12}\text{N}^{14}$
24, 687. 11	M	2-3, $v_1=1$	$\text{Br}^{79}\text{C}^{12}\text{N}^{14}$

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
24, 713. 05	S	2-3, $v=0$	Br ⁷⁹ C ¹² N ¹⁴
24, 717. 19	M	2-3, $v=0$	Br ⁸¹ C ¹² N ¹⁴
24, 734	M	-----	CH ₂ CF ₂
24, 755. 22	S	2-3, $v=0$	Br ⁷⁹ C ¹² N ¹⁴
24, 760. 76	M	2-3, $v_2=1$	Br ⁷⁹ C ¹² N ¹⁴
24, 770	S	-----	CH ₂ CF ₂
24, 784. 02	M	2-3, $v_2=1$	Br ⁷⁹ C ¹² N ¹⁴
24, 803. 00	M	2-3, $v_2=1$	Br ⁷⁹ C ¹² N ¹⁴
24, 806	W	-----	CH ₂ CF ₂
24, 808	W	-----	CH ₂ CF ₂
24, 824	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³²
24, 826. 70	M	2-3, $v_2=1$	Br ⁷⁹ C ¹² N ¹⁴
24, 834. 3	S	-----	C ₂ H ₄ O
24, 842	-----	-----	CH ₂ Cl ₂
24, 860. 6	M	2-3, $v_2=2$	Br ⁷⁹ C ¹² N ¹⁴
24, 881. 90	S	-----	N ¹⁴ H ₃
24, 884. 57	M	2-3, $v=0$	Br ⁷⁹ C ¹² N ¹⁴
24, 890. 0	M	2-3, $v_2=1$	Br ⁷⁹ C ¹² N ¹⁴
24, 890	-----	-----	CH ₃ NH ₂
24, 896	-----	-----	CH ₃ NH ₂
24, 910	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹³ S ³⁴
24, 911	-----	-----	CH ₃ OH
24, 916	-----	-----	CH ₂ Cl ₂
24, 924. 4	S	-----	C ₂ H ₄ O
24, 926	-----	-----	CH ₃ OH
24, 928. 70	-----	-----	CH ₃ OH
24, 930	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³³
24, 933. 47	-----	-----	CH ₃ OH
24, 934. 38	-----	-----	CH ₃ OH
24, 959. 08	-----	-----	CH ₃ OH
24, 967	-----	-----	CH ₂ Cl ₂
24, 970	-----	-----	CH ₂ Cl ₂
24, 971	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³²
24, 976	-----	-----	CH ₂ Cl ₂
24, 981. 5	M	2-3, $v_2=2$	Br ⁷⁹ C ¹² N ¹⁴
24, 996	-----	-----	CH ₂ Cl ₂
25, 000	-----	-----	CH ₂ NH ₂
25, 002	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹³ S ³²
25, 006. 0	M	2-3, $v_2=1$	Br ⁷⁹ C ¹² N ¹⁴
25, 018	-----	-----	CH ₂ Cl ₂
25, 018. 14	-----	-----	CH ₃ OH
25, 038	-----	-----	CH ₂ Cl ₂
25, 046	-----	-----	CH ₂ Cl ₂
25, 047	-----	-----	CH ₂ Cl ₂
25, 053	-----	-----	CH ₂ Cl ₂ , CH ₃ OH
25, 056	-----	-----	CH ₂ Br ₂
25, 056. 04	S	-----	N ¹⁴ H ₃
25, 065	-----	-----	CH ₃ NH ₂

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
25, 073	-----	-----	CH ₂ Cl ₂
25, 077	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³²
25, 099	-----	-----	CH ₂ Cl ₂
25, 100	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³²
25, 121. 55	W	0-1	N ¹⁴ N ¹⁵ O ¹⁶
25, 123	-----	-----	CH ₂ Cl ₂
25, 123. 03	M	0-1	N ₂ ¹⁴ O ¹⁶
25, 123. 28	M	0-1	N ₂ ¹⁴ O ¹⁶
25, 123. 64	W	0-1	N ₂ ¹⁴ O ¹⁶
25, 124. 88	-----	-----	CH ₃ OH
25, 161	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³²
25, 167. 4	W	0-1, $K=0$	C ¹³ H ₃ Cl ³⁷
25, 170	-----	-----	SO ₂
25, 183. 0	W	0-1, $K=0$	C ¹³ H ₃ Cl ³⁷
25, 195	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³²
25, 195. 2	W	0-1, $K=0$	C ¹³ H ₃ Cl ³⁷
25, 200	-----	-----	CH ₃ NH ₂
25, 221	-----	-----	CH ₂ Cl ₂
25, 248	M	-----	CH ₂ CF ₂
25, 269	-----	-----	CH ₂ Cl ₂
25, 269	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³²
25, 280	-----	-----	CH ₂ Cl ₂
25, 294. 41	-----	-----	CH ₃ OH
25, 306	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³²
25, 323. 51	M	-----	N ¹⁵ H ₃
25, 333	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³²
25, 350	S	-----	CH ₂ CF ₂
25, 381	-----	-----	CH ₃ OH
25, 390	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³²
25, 392	-----	-----	SO ₂
25, 393. 87	M	3-4, $v=0$	IC ¹² N ¹⁴
25, 404	-----	-----	CH ₃ NO ₂
25, 409	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³²
25, 414	-----	-----	CH ₃ NO ₂
25, 442	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³²
25, 450	M	-----	CH ₂ CF ₂
25, 470	-----	-----	CH ₃ NH ₂
25, 516	S	-----	CH ₂ CF ₂
25, 541. 43	-----	4-5	CH ₃ OH
25, 550	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³²
25, 577. 2	W	0-1, $K=0$	C ¹³ H ₃ Cl ³⁵
25, 596. 0	W	0-1, $K=0$	C ¹³ H ₃ Cl ³⁵
25, 611. 2	W	0-1, $K=0$	C ¹³ H ₃ Cl ³⁵
25, 653	-----	4-5	C ¹² H ₃ N ¹⁴ C ¹² S ³²
25, 695. 23	S	-----	N ¹⁴ H ₃
25, 710	-----	-----	CH ₂ Cl ₂
25, 711. 50	S	3-4, $v=0$	IC ¹² N ¹⁴

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
25, 715. 14	S	-----	N ¹⁴ H ₃
25, 728. 77	S	3-4, $v=0$	IC ¹² N ¹⁴
25, 729	S	-----	CH ₂ CF ₂
25, 741	M	-----	CH ₂ CF ₂
25, 745	-----	-----	CH ₂ Cl ₂
25, 748	-----	-----	CH ₂ Cl ₂
25, 748. 18	M	3-4, $v_1=1$	IC ¹² N ¹⁴
25, 751	-----	-----	CH ₂ Cl ₂
25, 752. 65	S	3-4, $v=0$	IC ¹² N ¹⁴
25, 763. 23	M	3-4, $v_1=1$	IC ¹² N ¹⁴
25, 783. 50	S	3-4, $v=0$	IC ¹² N ¹⁴
25, 789. 85	S	3-4, $v=0$	IC ¹² N ¹⁴
25, 797	-----	-----	CH ₃ OH
25, 802. 92	M	3-4, $v_2=1$	IC ¹² N ¹⁴
25, 815. 34	M	3-4, $v_2=1$	IC ¹² N ¹⁴
25, 823. 08	S	3-4, $v=0$	IC ¹² N ¹⁴
25, 829. 31	M	3-4, $v_2=1$	IC ¹² N ¹⁴
25, 837. 64	S	3-4, $v=0$	IC ¹² N ¹⁴
25, 848	-----	-----	CH ₂ Cl ₂
25, 850. 78	M	3-4, $v_2=1$	IC ¹² N ¹⁴
25, 872. 24	S	3-4, $v_2=1$	IC ¹² N ¹⁴
25, 878. 18	-----	-----	CH ₃ OH
25, 893. 73	S	3-4, $v_2=1$	IC ¹² N ¹⁴
25, 906. 28	S	3-4, $v_2=1$	IC ¹² N ¹⁴
25, 927. 66	S	3-4, $v_2=1$	IC ¹² N ¹⁴
24, 954. 36	S	3-4, $v=0$	IC ¹² N ¹⁴
25, 969. 58	M	3-4, $v=0$	IC ¹² N ¹⁴
25, 991. 92	S	3-4, $v=0$	IC ¹² N ¹⁴
26, 007	-----	-----	CH ₂ Cl ₂
26, 042. 41	W	1-2, $K=0$	SiH ₃ Cl ³⁷
26, 043. 29	W	1-2, $K=1$	SiH ₃ Cl ³⁷
26, 046. 30	W	1-2, $K=1$	SiH ₃ Cl ³⁷
26, 046. 32	M	3-4, $v_2=2$	IC ¹² N ¹⁴
26, 047. 97	W	1-2, $K=1$	SiH ₃ Cl ³⁷
26, 050. 26	M	1-2, $K=0$	SiH ₃ Cl ³⁷
26, 051. 09	W	1-2, $K=1$	SiH ₃ Cl ³⁷
26, 053. 35	W	1-2, $K=1$	SiH ₃ Cl ³⁷
26, 055. 86	W	1-2, $K=0$	SiH ₃ Cl ³⁷
26, 057. 10	W	1-2, $K=1$	SiH ₃ Cl ³⁷
26, 063. 52	W	1-2, $K=0$	SiH ₃ Cl ³⁷
26, 118	S	-----	CH ₂ CF ₂
26, 120	-----	-----	CH ₃ OH
26, 163	M	-----	CH ₂ CF ₂
26, 164. 57	M	0-1, $K=0$	CH ₃ Cl ³⁷
26, 179. 30	M	0-1, $K=0$	CH ₃ Cl ³⁷
26, 181. 6	M	3-4, $v=0$	ICl ³⁷
26, 191. 13	M	0-1, $K=0$	CH ₃ Cl ³⁷

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
26, 295	-----	-----	CH ₂ Cl ₂
26, 310	-----	-----	CH ₃ OH
26, 328	S	-----	CH ₂ CF ₂
26, 337	M	-----	CH ₂ CF ₂
26, 410	W	-----	CH ₂ CF ₂
26, 466	M	-----	CH ₂ CF ₂
26, 518. 91	S	-----	N ¹⁴ H ₃
26, 553	-----	-----	SPF ₃
26, 562	-----	-----	CH ₃ OH
26, 565	-----	-----	C ¹² D ₄ O ¹⁶
26, 570. 77	M	0-1, $K=0$	CH ₃ Cl ³⁵
26, 574	-----	-----	SPF ₃
26, 589. 49	M	0-1, $K=0$	CH ₃ Cl ³⁵
26, 604. 57	M	0-1, $K=0$	CH ₃ Cl ³⁵
26, 634	S	-----	CH ₂ CF ₂
26, 649	M	-----	CH ₂ CF ₂
26, 655. 00	S	-----	N ¹⁴ H ₃
26, 685. 25	W	1-2, $K=0$	SiH ₃ Cl ³⁵
26, 686. 15	W	1-2, $K=0$	SiH ₃ Cl ³⁵
26, 687. 34	W	1-2, $K=1$	SiH ₃ Cl ³⁵
26, 690. 92	W	1-2, $K=1$	SiH ₃ Cl ³⁵
26, 692. 66	W	1-2, $K=1$	SiH ₃ Cl ³⁵
26, 695. 00	W	1-2, $K=0$	SiH ₃ Cl ³⁵
26, 696. 10	M	1-2, $K=0$	SiH ₃ Cl ³⁵
26, 697. 45	M	1-2, $K=1$	SiH ₃ Cl ³⁵
26, 700. 48	W	1-2, $K=1$	SiH ₃ Cl ³⁵
26, 703. 34	W	1-2, $K=0$	SiH ₃ Cl ³⁵
26, 705. 02	W	1-2, $K=1$	SiH ₃ Cl ³⁵
26, 713. 07	W	1-2, $K=0$	SiH ₃ Cl ³⁵
26, 723	W	-----	CH ₂ CF ₂
26, 832	M	-----	CH ₂ CF ₂
26, 865	S	-----	CH ₂ CF ₂
26, 880	M	-----	CH ₂ CF ₂
26, 992	S	-----	CH ₂ CF ₂
27, 014	S	-----	CH ₂ CF ₂
27, 112	M	-----	CH ₂ CF ₂
27, 194. 75	M	3-4, $v=0$	ICl ³⁵
27, 202. 64	W	3-4, $v=0$	ICl ³⁵
27, 204. 99	M	3-4, $v=0$	ICl ³⁵
27, 208. 54	M	3-4, $v=1$	ICl ³⁵
27, 216	M	-----	CH ₂ CF ₂
27, 217. 51	M	3-4, $v=0$	ICl ³⁵
27, 221. 02	M	3-4, $v=0$	ICl ³⁵
27, 225. 32	M	3-4, $v=0$	ICl ³⁵
27, 228. 34	M	3-4, $v=0$	ICl ³⁵
27, 242. 59	W	3-4, $v=0$	ICl ³⁵
27, 254. 90	M	3-4, $v=0$	ICl ³⁵
27, 283. 66	-----	3-4, $v=0$	ICl ³⁵

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
27, 286. 25	-----	3-4, $v=0$	ICl ³⁵
27, 292. 63	-----	3-4, $v=0$	ICl ³⁵
27, 295. 05	-----	3-4, $v=0$	ICl ³⁵
27, 297	S	-----	CH ₂ CF ₂
27, 333. 85	M	3-4, $v=0$	ICl ³⁵
27, 336. 68	M	3-4, $v=0$	ICl ³⁵
27, 337. 38	M	3-4, $v=0$	ICl ³⁵
27, 346. 31	M	3-4, $v=0$	ICl ³⁵
27, 354. 71	M	3-4, $v=0$	ICl ³⁵
27, 356. 58	M	3-4, $v=0$	ICl ³⁵
27, 357. 73	M	3-4, $v=0$	ICl ³⁵
27, 412	M	-----	CH ₂ CF ₂
27, 478	S	-----	N ¹⁴ H ₃
27, 681	S	-----	CH ₂ CF ₂
27, 772. 52	M	-----	N ¹⁴ H ₃
27, 818	S	-----	CH ₂ CF ₂
27, 972	S	-----	CH ₂ CF ₂
28, 069. 99	W	1-2, $K=0$	C ¹³ H ₃ I
28, 145. 01	W	1-2, $K=0$	C ¹³ H ₃ I
28, 174	S	-----	CH ₂ CF ₂
28, 206. 90	W	1-2, $K=1$	C ¹³ H ₃ I
28, 253. 84	W	1-2, $K=1$	C ¹³ H ₃ I
28, 314	W	-----	CH ₂ CF ₂
28, 339	M	-----	CH ₂ CF ₂
28, 343. 64	W	1-2, $K=0$	C ¹³ H ₃ I
28, 380	-----	4-5	C ¹² H ₃ S ³² C ¹² N ¹⁴
28, 411. 19	W	1-2, $K=1$	C ¹³ H ₃ I
28, 412	S	-----	CH ₂ CF ₂
28, 439	M	-----	CH ₂ CF ₂
28, 458	M	-----	CH ₂ CF ₂
28, 495	-----	-----	C ¹² D ₄ O ¹⁶
28, 518. 14	W	1-2, $K=0$	C ¹³ H ₃ I
28, 550. 86	W	1-2, $K=0$	C ¹³ H ₃ I
28, 551	W	-----	CH ₂ CF ₂
28, 575	W	-----	CH ₂ CF ₂
28, 594. 74	W	1-2, $K=1$	C ¹³ H ₃ I
28, 604. 73	S	-----	N ¹⁴ H ₃
28, 615	W	-----	CH ₂ CF ₂
28, 650. 91	W	1-2, $K=0$	C ¹³ H ₃ I
28, 687. 21	W	1-2, $K=1$	C ¹³ H ₃ I
28, 689	W	-----	CH ₂ CF ₂
28, 852	-----	-----	CH ₂ CF ₂
28, 858	-----	-----	CH ₂ CF ₂
28, 954	S	-----	CH ₂ CF ₂
28, 974. 85	-----	-----	H ₂ CO

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
29, 061. 14	M	-----	N ¹⁴ H ₃
29, 080	-----	-----	C ¹² D ₄ O ¹⁶
29, 460	-----	-----	SO ₂
29, 598. 95	M	1-2, $K=0$	C ¹² H ₃ I
29, 673. 95	M	1-2, $K=0$	C ¹² H ₃ I
29, 688	S	-----	C ₂ ¹² H ₄ O ¹⁶
29, 700	-----	5-6	C ¹² H ₃ N ¹⁴ C ¹² S ³²
29, 735. 71	M	1-2, $K=1$	C ¹² H ₃ I
29, 773. 95	W	1-2, $K=0$	C ¹² H ₃ I
29, 782. 71	M	1-2, $K=1$	C ¹² H ₃ I
29, 872. 52	M	1-2, $K=0$	C ¹² H ₃ I
29, 914. 66	S	-----	N ¹⁴ H ₃
29, 923. 50	M	1-2, $K=1$	C ¹² H ₃ I
29, 939. 87	M	1-2, $K=1$	C ¹² H ₃ I
29, 986. 84	W	1-2, $K=1$	C ¹² H ₃ I
30, 046. 99	M	1-2, $K=0$	C ¹² H ₃ I
30, 075. 08	M	1-2, $K=1$	C ¹² H ₃ I
30, 079. 72	M	1-2, $K=0$	C ¹² H ₃ I
30, 121. 32	M	1-2, $K=0$	C ¹² H ₃ I
30, 123. 64	M	1-2, $K=1$	C ¹² H ₃ I
30, 179. 71	M	1-2, $K=0$	C ¹² H ₃ I
30, 215. 95	M	1-2, $K=1$	C ¹² H ₃ I
30, 453. 46	M	1-2, $K=0$	C ¹² H ₃ I
31, 020. 7	-----	2-3	CF ₃ CH ₃
31, 066. 8	-----	2-3	CF ₃ CH ₃
31, 114. 4	-----	2-3	CF ₃ CH ₃
31, 279. 60	M	1-2	PF ₃
31, 424. 97	S	-----	N ¹⁴ H ₃
31, 718. 28	M	4-5, $v=0$	IC ¹³ N ¹⁴
31, 730. 50	M	4-5, $v=0$	IC ¹³ N ¹⁴
31, 741. 50	W	4-5, $v=0$	IC ¹³ N ¹⁴
31, 763. 34	M	4-5, $v=0$	IC ¹³ N ¹⁴
31, 783. 31	M	4-5, $v=0$	IC ¹³ N ¹⁴
31, 793. 46	M	4-5, $v=0$	IC ¹³ N ¹⁴
31, 848. 77	M	4-5, $v=0$	IC ¹³ N ¹⁴
31, 943	-----	-----	C ¹² D ₄ O ¹⁶
32, 200. 58	S	4-5, $v=0$	IC ¹² N ¹⁴
32, 203. 57	S	4-5, $v=0$	IC ¹² N ¹⁴
32, 215. 56	S	4-5, $v=0$	IC ¹² N ¹⁴
32, 226. 85	S	4-5, $v=0$	IC ¹² N ¹⁴
32, 248. 52	S	4-5, $v=0$	IC ¹² N ¹⁴
32, 268. 33	S	4-5, $v=0$	IC ¹² N ¹⁴
32, 278. 55	S	4-5, $v=0$	IC ¹² N ¹⁴
32, 386. 29	S	4-5, $v=0$	IC ¹² N ¹⁴
32, 392. 59	M	3-4, $v=0$	Br ⁸¹ C ¹³ N ¹⁴
32, 409. 06	M	3-4, $v=0$	Br ⁸¹ C ¹³ N ¹⁴
32, 581. 73	M	3-4, $v=0$	Br ⁷⁹ C ¹³ N ¹⁴

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
32, 601. 46	M	3-4, $v=0$	Br ⁷⁹ C ¹³ N ¹⁴
32, 643. 13	M	3-4, $v=0$	Br ⁸¹ C ¹² N ¹⁴
32, 720. 28	M	3-4, $v=0$	Br ⁸¹ C ¹² N ¹⁴
32, 770. 13	S	3-4, $v=0$	Br ⁸¹ C ¹² N ¹⁴
32, 786. 65	M	3-4, $v=0$	Br ⁸¹ C ¹² N ¹⁴
32, 804. 56	M	3-4, $v=0$	Br ⁷⁹ C ¹² N ¹⁴
32, 913. 24	M	3-4, $v=0$	Br ⁸¹ C ¹² N ¹⁴
32, 956. 68	M	3-4, $v=0$	Br ⁷⁹ C ¹² N ¹⁴
32, 976. 40	S	3-4, $v=0$	Br ⁷⁹ C ¹² N ¹⁴
33, 156. 95	S	-----	N ¹⁴ H ₃
33, 285	-----	-----	C ¹² D ₄ O ¹⁶
34, 150	-----	-----	C ¹² H ₄ O ¹⁶
34, 158	-----	-----	C ¹² H ₄ O ¹⁶
34, 627. 24	M	1-2, $K=1$	B ¹¹ H ₃ C ¹² O ¹⁶
34, 627. 50	M	1-2, $K=1$	B ¹¹ H ₃ C ¹² O ¹⁶
34, 627. 73	M	1-2, $K=1$	B ¹¹ H ₃ C ¹² O ¹⁶
34, 627. 89	M	1-2, $K=1$	B ¹¹ H ₃ C ¹² O ¹⁶
34, 628. 62	M	1-2, $K=0$	B ¹¹ H ₃ C ¹² O ¹⁶
34, 628. 90	S	1-2, $K=0$	B ¹¹ H ₃ C ¹² O ¹⁶
34, 629. 32	M	1-2, $K=0$	B ¹¹ H ₃ C ¹² O ¹⁶
34, 889. 05	W	2-3, $v=0$	C ¹³ Br ⁷⁹ C ¹² N ¹⁴
35, 067. 99	M	2-3, $v=0$	C ¹³ Br ⁷⁹ C ¹² N ¹⁴
35, 068	-----	-----	C ¹² D ₄ O ¹⁶
35, 080. 39	S	2-3, $v=0$	C ¹³ Br ⁷⁹ C ¹² N ¹⁴
35, 084. 15	S	2-3, $v=0$	C ¹³ Br ⁷⁹ C ¹² N ¹⁴
35, 091. 97	M	2-3, $v=0$	C ¹³ Br ⁷⁹ C ¹² N ¹⁴
35, 134. 44	M	2-3, $v=0$	N ¹⁴ H ₃
35, 341	-----	-----	C ¹² D ₄ O ¹⁶
35, 618. 81	W	2-3, $v=0$	C ¹³ Br ⁷⁹ C ¹² N ¹⁴
35, 634. 85	M	2-3, $v=0$	C ¹³ Br ⁷⁹ C ¹² N ¹⁴
35, 639. 78	M	2-3, $v=0$	C ¹³ Br ⁷⁹ C ¹² N ¹⁴
35, 649. 56	W	2-3, $v=0$	C ¹³ Br ⁷⁹ C ¹² N ¹⁴
35, 805. 09	S	2-3, $v=0$	C ¹³ Br ⁷⁹ C ¹² N ¹⁴
35, 820. 65	S	2-3, $v=0$	C ¹³ Br ⁷⁹ C ¹² N ¹⁴
35, 825. 95	S	2-3, $v=0$	C ¹³ Br ⁷⁹ C ¹² N ¹⁴
35, 835. 74	S	2-3, $v=0$	C ¹³ Br ⁷⁹ C ¹² N ¹⁴
35, 917. 62	M	1-2, $K=1$	B ¹⁰ H ₃ C ¹² O ¹⁶
35, 917. 88	M	1-2, $K=1$	B ¹⁰ H ₃ C ¹² O ¹⁶
35, 918. 20	W	1-2, $K=1$	B ¹⁰ H ₃ C ¹² O ¹⁶
35, 918. 50	M	1-2, $K=1$	B ¹⁰ H ₃ C ¹² O ¹⁶
35, 919. 02	W	1-2, $K=0$	B ¹⁰ H ₃ C ¹² O ¹⁶
35, 919. 53	M	1-2, $K=0$	B ¹⁰ H ₃ C ¹² O ¹⁶
35, 919. 86	M	1-2, $K=0$	B ¹⁰ H ₃ C ¹² O ¹⁶
35, 920. 14	M	1-2, $K=0$	B ¹⁰ H ₃ C ¹² O ¹⁶

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
36, 488. 82	S	2-3, $v=0$	O ¹⁶ C ¹² S ³²
36, 632	M	-----	CH ₃ CF ₂
36, 791	S	-----	C ₂ ¹² H ₄ O ¹⁶
36, 793. 64	-----	0-1	C ¹² H ₃ C ¹² N ¹⁴
36, 794. 26	-----	0-1	C ¹² H ₃ C ¹² N ¹⁴
36, 794. 88	-----	0-1	C ¹² H ₃ C ¹² N ¹⁴
36, 795. 38	-----	0-1	C ¹² H ₃ C ¹² N ¹⁴
36, 796. 27	-----	0-1	C ¹² H ₃ C ¹² N ¹⁴
36, 797. 52	-----	0-1	C ¹² H ₃ C ¹² N ¹⁴
36, 870. 94	-----	0-1	C ¹² H ₃ C ¹² N ¹⁴
36, 903. 40	-----	0-1	C ¹² H ₃ C ¹² N ¹⁴
36, 942. 15	-----	0-1	C ¹² H ₃ C ¹² N ¹⁴
37, 329	S	-----	C ₂ ¹² H ₄ O ¹⁶
37, 385. 18	M	-----	N ¹⁴ H ₃
37, 781	S	-----	C ₂ ¹² H ₄ O ¹⁶
38, 006. 47	W	1-2, $K=1$	CH ₃ Br ⁸¹
38, 030. 77	M	1-2, $K=0$	CH ₃ Br ⁸¹
38, 066. 72	W	1-2, $K=1$	CH ₃ Br ⁸¹
38, 097. 45	M	1-2, $K=1$	CH ₃ Br ⁸¹
38, 116. 65	M	1-2, $K=0$	CH ₃ Br ⁸¹
38, 126. 97	M	1-2, $K=0$	CH ₃ Br ⁸¹
38, 128. 40	W	1-2, $K=1$	C ¹² H ₃ Br ⁷⁹
38, 157. 30	M	1-2, $K=0$	C ¹² H ₃ Br ⁷⁹
38, 157. 70	W	1-2, $K=1$	C ¹² H ₃ Br ⁸¹
38, 175. 08	M	1-2, $K=1$	C ¹² H ₃ Br ⁸¹
38, 200. 52	W	1-2, $K=1$	C ¹² H ₃ Br ⁷⁹
38, 218. 21	M	1-2, $K=1$	C ¹² H ₃ Br ⁸¹
38, 237. 14	M	1-2, $K=1$	C ¹² H ₃ Br ⁷⁹
38, 247. 77	M	1-2, $K=0$	C ¹² H ₃ Br ⁸¹
38, 260. 10	M	1-2, $K=0$	C ¹² H ₃ Br ⁷⁹
38, 272. 40	M	1-2, $K=0$	C ¹² H ₃ Br ⁷⁹
38, 309. 45	W	1-2, $K=1$	C ¹² H ₃ Br ⁷⁹
38, 330. 25	M	1-2, $K=1$	C ¹² H ₃ Br ⁷⁹
38, 381. 70	M	1-2, $K=1$	C ¹² H ₃ Br ⁷⁹
38, 404. 49	M	1-2, $K=0$	C ¹² H ₃ Br ⁷⁹
38, 417. 09	M	1-2, $K=0$	C ¹² H ₃ Br ⁷⁹
38, 702	S	-----	C ₂ ¹² H ₄ O ¹⁶
38, 782. 21	-----	1-2, $K=1$	C ¹² H ₃ N ¹⁴ C ¹³
38, 783. 21	-----	1-2, $K=0$	C ¹² H ₃ N ¹⁴ C ¹³
39, 582	M	-----	C ₂ ¹² H ₄ O ¹⁶
39, 592	-----	-----	C ¹² D ₄ O ¹⁶
39, 677	S	-----	C ₂ ¹² H ₄ O ¹⁶
39, 941. 54	M	-----	N ¹⁴ H ₃
40, 210. 27	-----	1-2, $K=1$	C ¹² H ₃ N ¹⁴ C ¹²

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
40, 211. 16	-----	1-2, $K=0$	$C^{12}H_3N^{14}C^{12}$
40, 313. 37	-----	1-2, $K=0$	$C^{12}H_3N^{14}C^{12}$
40, 364. 07	-----		$C^{12}H_3N^{14}C^{12}$
40, 366. 55	-----		$C^{12}H_3N^{14}C^{12}$
40, 424. 49	-----		$C^{12}H_3N^{14}C^{12}$
41, 394. 95	S	1-2	$HC^{12}F_3$
41, 581	-----		$C_2^{12}H_4O^{16}$
43, 398	-----		$C^{12}H_4O^{16}$
45, 324. 24	-----	0-1	CH_3NH_2
46, 918. 82	M	2-3, $K=0, 1$	PF_3
46, 919. 02	M	2-3, $K=2$	PF_3
46, 940	-----		PF_3
47, 010	-----		PF_3
47, 033	-----		PF_3
47, 040	-----		PF_3
45, 324. 94	-----	0-1	CH_3NH_2
47, 052	-----		$C^{12}H_3OD$
47, 266	-----		$C^{12}H_3OD$
47, 346	-----		$C^{12}H_3OD$
47, 462. 40	S	3-4, $v=0$	$O^{16}C^{12}S^{34}$
47, 840	-----		CH_3OH
48, 010	-----		CH_3OH
48, 211. 46	S	5-6	$O^{16}C^{12}Se^{80}$
48, 284. 60	-----		H_2CO
48, 357	-----		CH_3OH
48, 363	-----		CH_3OH
48, 396	-----		CH_3OH
48, 404	-----		CH_3OH
48, 508. 88	S	5-6	$O^{16}C^{12}Se^{78}$
48, 700	-----		CH_3OH

TABLE 2. Lines listed by frequency—Continued

Frequency	Intensity	Transition	Molecule
49, 724. 73	M	0-1, $K=0$	$C^{13}H_3F$
50, 236. 90	W	-----	HDO^{16}
51, 071. 69	S	-----	$C^{12}H_3F$
51. 260	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
51, 264	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
51, 266	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
51, 296	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
51, 313	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
51, 314	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
51, 318	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
51, 319	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
51, 334	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
51, 363	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
51, 410	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
51, 416	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
51, 418	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
51, 419	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
51, 464	-----	2-3	$C^{12}H_3C^{12}C^{12}H$
55, 916. 19	S	6-7	$O^{16}C^{12}Se^{82}$
56, 246. 47	S	6-7	$O^{16}C^{12}Se^{80}$
56, 593. 16	S	6-7	$O^{16}C^{12}Se^{78}$
60, 814. 08	S	4-5, $v=0$	$O^{16}C^{12}S^{32}$
72, 409. 35	-----	-----	H_2CO
72, 838. 14	-----	-----	H_2CO
73, 742	S	8-9, $v=0$	$Br^{81}C^{12}N^{14}$
74, 165	S	8-9, $v=0$	$Br^{79}C^{12}N^{14}$
77, 413	S	11-12, $v=0$	$IC^{12}N^{14}$
81, 936	S	9-10, $v=0$	$Br^{81}C^{12}N^{14}$
82, 405	S	9-10, $v=0$	$Br^{79}C^{12}N^{14}$
83, 864	S	12-13, $v=0$	$IC^{12}N^{14}$
88, 671	S	0-1	$HC^{12}N^{14}$

TABLE 3. Values of $[3/4C(C+1) - I(I+1)J(J+1)]/2I(2I-1)(2J-1)(2J+3)$, where $C=F(F+1) - I(I+1) - J(J+1)$

	<i>I</i>	1	3/2	2	5/2	3	7/2	4	9/2
1	<i>J</i>								
	<i>F</i>								
	11/2	-----	-----	-----	-----	-----	-----	-----	0.050000
	5	-----	-----	-----	-----	-----	-----	0.050000	-----
	9/2	-----	-----	-----	-----	-----	0.050000	-----	-0.133333
	4	-----	-----	-----	-----	0.050000	-----	-0.137500	-----
	7/2	-----	-----	-----	0.050000	-----	-0.142857	-----	0.091667
	3	-----	-----	0.050000	-----	-0.150000	-----	0.098214	-----
	5/2	-----	0.050000	-----	-0.160000	-----	0.107143	-----	-----
	2	0.050000	-----	-0.175000	-----	0.120000	-----	-----	-----
3/2	-----	-0.200000	-----	0.140000	-----	-----	-----	-----	
1	-0.250000	-----	0.175000	-----	-----	-----	-----	-----	
1/2	-----	0.250000	-----	-----	-----	-----	-----	-----	
0	0.500000	-----	-----	-----	-----	-----	-----	-----	
2	13/2	-----	-----	-----	-----	-----	-----	-----	0.071429
	6	-----	-----	-----	-----	-----	-----	0.071429	-----
	11/2	-----	-----	-----	-----	-----	0.071429	-----	-0.083333
	5	-----	-----	-----	-----	0.071429	-----	-0.089286	-----
	9/2	-----	-----	-----	0.071429	-----	-0.096939	-----	-0.083333
	4	-----	-----	0.071429	-----	-0.107142	-----	-0.082908	-----
	7/2	-----	0.071429	-----	-0.121428	-----	-0.081633	-----	0.005952
	3	0.071429	-----	-0.142857	-----	-0.078571	-----	0.014031	-----
	5/2	-----	-0.178571	-----	-0.071429	-----	0.025510	-----	0.130952
	2	-0.250000	-----	-0.053571	-----	0.042857	-----	0.140306	-----
3/2	-----	0	-----	0.071429	-----	0.153061	-----	-----	
1	0.250000	-----	0.125000	-----	0.171429	-----	-----	-----	
1/2	-----	0.250000	-----	0.200000	-----	-----	-----	-----	
0	-----	-----	0.250000	-----	-----	-----	-----	-----	
3	15/2	-----	-----	-----	-----	-----	-----	-----	0.083333
	7	-----	-----	-----	-----	-----	-----	0.083333	-----
	13/2	-----	-----	-----	-----	-----	0.083333	-----	-0.055556
	6	-----	-----	-----	-----	0.083333	-----	-0.062500	-----
	11/2	-----	-----	-----	0.083333	-----	-0.071429	-----	-0.091667
	5	-----	-----	0.083333	-----	-0.083333	-----	-0.094643	-----
	9/2	-----	0.083333	-----	-0.100000	-----	-0.097619	-----	-0.061111
	4	0.083333	-----	-0.125000	-----	-0.100000	-----	-0.055952	-----
	7/2	-----	-0.166667	-----	-0.100000	-----	-0.047619	-----	0.005556
	3	-0.250000	-----	-0.091667	-----	-0.033333	-----	0.017857	-----
5/2	-----	-0.050000	-----	-0.006667	-----	0.035714	-----	0.083333	
2	0.200000	-----	0.050000	-----	0.063333	-----	0.098214	-----	
3/2	-----	0.200000	-----	0.110000	-----	0.119048	-----	0.152777	
1	-----	-----	0.200000	-----	0.150000	-----	0.163690	-----	
1/2	-----	-----	-----	0.200000	-----	0.178571	-----	-----	
0	-----	-----	-----	-----	0.200000	-----	-----	-----	

TABLE 3. Values of $[3/4C(C+1) - I(I+1)J(J+1)]/2I(2I-1)(2J-1)(2J+3)$, where $C = F(F+1) - I(I+1) - J(J+1) -$
Continued

	<i>I</i>	1	3/2	2	5/2	3	7/2	4	9/2
4	<i>J</i>	<i>F</i>							
		17/2							0.090909
		8						0.090909	
		15/2					0.090909		-0.037879
		7					0.090909	-0.045455	
		13/2			0.090909	0.090909		-0.055195	-0.086580
		6			0.090909		-0.068182	-0.091721	
		11/2	0.090909	0.090909		-0.086364		-0.097403	-0.079545
		5	0.090909		-0.113636		-0.103246	-0.077110	
		9/2		-0.159091		-0.107792		-0.071892	-0.037879
		4	-0.250000		-0.105519		-0.061039	-0.026670	
		7/2		-0.071429		-0.037662		-0.009276	0.020563
		3	0.178571		0.017857		0.019481	0.038729	
		5/2		0.178571		0.071429		0.065399	0.081169
		2			0.178571		0.107143	0.102389	
		3/2				0.178571		0.132653	0.132576
	1					0.178571	0.151786		
	1/2						0.178571	0.166667	
	0							0.178571	
5		19/2							0.096154
		9						0.096154	
		17/2						0.096154	-0.025641
		8					0.096154	-0.033654	
		15/2			0.096154	0.096154		-0.043956	-0.080128
		7			0.096154		-0.057692	-0.086767	
		13/2		0.096154		-0.076923		-0.094322	-0.085470
		6	0.096154		-0.105769		-0.102564	-0.085165	
		11/2		-0.153846		-0.110256		-0.082418	-0.057692
		5	-0.250000		-0.112179		-0.074571	-0.048077	
		9/2		-0.083333		-0.053846		-0.032051	-0.010684
		4	0.166667		0		-0.003846	0.008013	
		7/2		0.166667		0.050000		0.036630	0.043803
		3			0.166667		0.083333	0.069368	
		5/2				0.166667		0.107143	0.096154
		2					0.166667	0.125000	
	3/2						0.166667	0.138889	
	1							0.166667	
	1/2							0.166667	
6		21/2							0.100000
		10						0.100000	
		19/2						0.100000	-0.016667
		9					0.100000	-0.025000	
		17/2				0.100000		-0.035174	-0.074242
		8			0.100000		-0.050000	-0.081981	
		15/2		0.100000		-0.070000		-0.090909	-0.087121
		7	0.100000		-0.100000		-0.100909	-0.088474	
		13/2		-0.150000		-0.110909		-0.087662	-0.068182
		6	-0.250000		-0.115909		-0.081818	-0.060065	
		11/2		-0.090909		-0.063636		-0.045455	-0.028788
		5	0.159091		-0.011364		-0.018182	-0.001039	
		9/2		0.159091		0.036364		0.018831	0.021212
		4			0.159091		0.068182	0.048864	
		7/2				0.159091		0.090909	0.073485
		3					0.159091	0.107955	
	5/2						0.159091	0.121212	
	2							0.159091	
	3/2							0.159091	

TABLE 3. Values of $[3/4C(C+1) - I(I+1)J(J+1)]/2I(2I-1)(2J-1)(2J+3)$, where $C=F(F+1) - I(I+1) - J(J+1) -$
Continued

<i>J</i>	<i>F</i>	1	3/2	2	5/2	3	7/2	4	9/2
7	23/2								. 102941
	11							. 102941	
	21/2						. 102941		-. 009804
	10					. 102941		-. 018382	
	19/2				. 102941		-. 029412		-. 069193
	9			. 102941		-. 044118		-. 077771	
	17/2		. 102941	. 102941	-. 064746		-. 087750		-. 087104
	8	. 102941		-. 095588		-. 099095		-. 090417	
	15/2		-. 147059		-. 110859		-. 090498		-. 074284
	7	-. 250000		-. 118212		-. 086425		-. 067469	
	13/2		-. 096154		-. 070136		-. 054137		-. 040347
	6	. 153846		-. 019231		-. 027828		-. 022503	
	11/2		. 153846		. 026923		. 006787		. 006222
	5			. 153846		. 057692		. 034947	
	9/2				. 153846		. 079670		. 058069
8	4					. 153846		. 096154	
	7/2						. 153846		. 108974
	3							. 153846	
	5/2								. 153846
	25/2								0. 015263
	12							0. 105263	
	23/2						0. 105263		-. 004386
	11					0. 105263		-. 013158	
	21/2				0. 105263		-. 024436		-. 064912
	10			0. 105263		-. 039474		-. 074154	
	19/2		0. 105263		-. 060526		-. 084962		-. 086404
	9	0. 105263		-. 092105		-. 097368		-. 090132	
	17/2		-. 144737		-. 110526		-. 092105		-. 078070
	8	-. 250000		-. 119737		-. 089474		-. 072368	
	15/2		-. 100000		-. 074737		-. 060150		-. 048246
7	. 150000		-. 025000		-. 034737		-. 031015		
13/2		. 150000		. 020000		-. 001880		-. 004386	
6			. 150000		. 050000		. 024906		
11/2				. 150000		. 071429		. 046930	
5					. 150000		. 087500		
9/2						. 150000		. 100000	
4							. 150000		
7/2								. 150000	
9	27/2								. 107143
	13							. 107143	
	25/2						. 107143		0
	12					. 107143		-. 008929	
	23/2				. 107143		-. 020408		-. 061275
	11			. 107143		-. 035714		-. 071053	
	21/2		. 107143		-. 057143		-. 082533		-. 085434
	10	. 107143		-. 089286		-. 095798		-. 090036	
	19/2		-. 142857		-. 110084		-. 093037		-. 080532
	9	-. 250000		-. 120798		-. 091597		-. 075780	
	17/2		-. 102941		-. 078151		-. 064526		-. 053922
	8	. 147059		-. 029412		-. 039916		-. 037290	
	15/2		. 147059		. 014706		-. 008403		-. 012255
	7			. 147059		. 044118		. 017332	
	13/2				. 147059		. 065126		. 038515
6					. 147059		. 080882		
11/2						. 147059		. 093137	
5							. 147059		
9/2								. 147059	

TABLE 3. Values of $[\frac{3}{4}C(C+1) - I(I+1)J(J+1)]/2I(2I-1)(2J-1)(2J+3)$, where $C = F(F+1) - I(I+1) - J(J+1)$ —
Continued

	<i>I</i>	1	3/2	2	5/2	3	7/2	4	9/2
<i>J</i>	<i>F</i>								
	29/2	-----	-----	-----	-----	-----	-----	-----	0. 108696
	14	-----	-----	-----	-----	-----	-----	0. 108696	-----
	27/2	-----	-----	-----	-----	-----	0. 018696	-----	-. 003623
	13	-----	-----	-----	-----	0. 108696	-----	-. 005435	-----
	25/2	-----	-----	-----	0. 108696	-----	-. 017081	-----	-. 058162
	12	-----	-----	0. 108696	-----	-. 032609	-----	-. 068384	-----
	23/2	-----	0. 108696	-----	-. 054348	-----	-. 080418	-----	-. 084382
	11	0. 108696	-----	-. 086957	-----	-. 094394	-----	-. 089715	-----
	21/2	-----	-. 141304	-----	-. 109610	-----	-. 093576	-----	-. 082189
	10	-. 250000	-----	-. 121568	-----	-. 093135	-----	-. 078253	-----
	19/2	-----	-. 105263	-----	-. 080778	-----	-. 067833	-----	-. 058162
	9	. 144737	-----	-. 032895	-----	-. 043936	-----	-. 042089	-----
	17/2	-----	. 144737	-----	. 010526	-----	-. 013485	-----	-. 018307
	8	-----	-----	. 144737	-----	. 039474	-----	. 001142	-----
	15/2	-----	-----	-----	. 144737	-----	. 060150	-----	. 031941
	7	-----	-----	-----	-----	. 144737	-----	. 075658	-----
	13/2	-----	-----	-----	-----	-----	. 144737	-----	. 087719
	6	-----	-----	-----	-----	-----	-----	. 144737	-----
	11/2	-----	-----	-----	-----	-----	-----	-----	. 144737

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1. AsF ₃	614	Ammonia.....	624
2. BH ₃ CO.....	614	Arsenic trifluoride.....	614
3. BrCN.....	615	Borine carbonyl.....	614
4. CF ₂ CH ₂	616	Carbonyl selenide.....	627
5. CF ₃ CH ₃	616	Carbonyl sulfide.....	626
6. CHClF ₂	616	Chlorodifluoromethane.....	616
7. CH ₂ Br ₂	616	Chlorosilane.....	627
8. CH ₂ CF ₂	616	Cyanogen bromide.....	615
9. CH ₂ Cl ₂	617	Cyanogen chloride.....	621
10. CH ₃ Br.....	617	Cyanogen iodide.....	623
11. CH ₃ CCH.....	618	Difluorochloroform.....	616
12. CH ₃ Cl.....	618	Difluoroethylene (Uns.).....	616
13. CH ₃ CN.....	618	Ethylene oxide.....	621
14. CH ₃ F.....	618	Fluoroform.....	622
15. CH ₃ I.....	618	Formaldehyde.....	622
16. CH ₃ NC.....	619	Hydrocyanic acid.....	622
17. CH ₃ NCS.....	619	Iodine chloride.....	623
18. CH ₃ NH ₂	619	Isothiocyanic acid.....	622
19. CH ₃ NO ₂	620	Methanol.....	620
20. CH ₃ OH.....	620	Methyl acetylene.....	618
21. CH ₃ SCN.....	620	Methyl alcohol.....	620
22. C ₂ H ₃ Cl.....	620	Methyl bromide.....	617
23. C ₂ H ₄ O.....	621	Methyl chloride.....	618
24. C ₃ H ₄	618	Methyl cyanide.....	618
25. ClCN.....	621	Methyl fluoride.....	618
26. COS.....	626	Methyl fluoroform.....	616
27. COSe.....	627	Methyl iodide.....	618
28. HCF ₃	622	Methyl isocyanide.....	619
29. HCN.....	622	Methyl isothiocyanate.....	619
30. H ₂ CO.....	622	Methyl thiocyanate.....	620
31. H ₂ O.....	622	Methylamine.....	619
32. HNCS.....	622	Methylene bromide.....	616
33. ICl.....	623	Methylene chloride.....	617
34. ICN.....	623	Nitromethane.....	620
35. NH ₃	624	Nitrous oxide.....	626
36. N ₂ O.....	626	Oxygen.....	626
37. O ₂	626	Phosphorus trifluoride.....	627
38. OCS.....	626	Phosphorus sulfatrifluoride.....	628
39. OCSe.....	627	Propyne.....	618
40. PF ₃	627	Sulfur dioxide.....	628
41. SiH ₃ Cl.....	627	Vinyl chloride.....	620
42. SO ₂	628	Water.....	622
43. SPF ₃	628		

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