Microwave Spectra of Molecules of Astrophysical Interest. XVIII. Formic Acid

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The available data on the microwave spectrum of formic acid are critically reviewed for information applicable to radioastronomy. Molecular data such as the derived rotational constants, centrifugal distortion constants and electric dipole moment are tabulated. The observed rotational transitions are presented for the astronomically interesting isotopic forms. Calculated rotational transitions up to 300 GHz are presented for the ground vibrational state of $H^{12}C^{16}O^{16}OH$, $H^{12}C^{16}O^{16}OD$, $D^{12}C^{16}O^{16}OH$ and $H^{13}C^{16}O^{16}OH$. Some observed transitions are also listed for $H^{12}C^{16}O^{18}OH$ and $H^{12}C^{18}O^{16}OH$. Estimated error limits have been reported for all measured transitions.

Key words: Formic acid; interstellar molecules; line strengths, microwave spectra; molecular constants; radioastronomy; rotational transitions.

Contents

1. Introduction

Numerous studies concerning the rotational spectra of formic acid and its various isotopic species have been reported [1A–22A][1]. The most recent and complete studies of the ground state have been investigated by C. Samson [25A, 27A] for $H^{12}COOH$ and A. Deldalle [23A, 26A] for the ^{13}C and deuterated species. More recently, this molecule has been identified in interstellar observations [1B, 2B]. It is a very interesting discovery because formic acid was the first organic acid detected in interstellar space.

Astrophysicists need experimental data as complete and precise as possible. In order to perform studies of rotational spectra of vibrational excited states in Coriolis resonance [20A], we have recently reinvestigated the ground state spectra of formic acid and its various isotopic species, D, ^{13}C and ^{18}O, and their molecular parameters have been consequently improved. The present tables are a complete summary of all the results which are actually known. They are intended to update and revise the existing literature on these molecules of interstellar interest.

In addition to the 284 observed transitions of $H^{12}COOH$ from 8 GHz to 300 GHz, all transitions in this range whose relative intensities, defined in section 1.2., are at least 0.0001 are tabulated as predicted transitions. Since the radioastronomical study of interstellar molecules is a rapidly developing field, HCOOD and DCOOH are also included in this review although the cosmic abundance of deuterium is low. Eighty-eight transitions and 121 transitions have been observed for HCOOD and DCOOH, respectively, in the frequency range 8–300 GHz. A systematic calculation has been undertaken for each of these two molecules with the same restrictive conditions as for $H^{12}COOH$. Also, the ^{13}C species might be observed by existing telescopes or by those likely to be developed in the next several years. Therefore, we present the results deduced from the 111 observed lines in the frequency

[1] Figures in brackets indicate literature references.

range 8–300 GHz. A systematic calculation similar to those which have been carried out for the other species is presented.

Although no detailed analysis of ^{18}O species has been done, several lines of these isotopic species have been identified and measured. These lines are also listed in this review.

1.1. Molecular Parameter Tables

The rotational constants and centrifugal distortion constants shown in tables 1, 2, 3, 4 and 5 were obtained from a least-squares analysis of the observed spectral lines. Watson's theory of the semi-rigid rotator [1C] has been used. The Hamiltonian operator developed up to the J^6 terms has the following form [20A]:

$$H=[A-1/2(B+C)]\,J_a^2+1/2(B+C)\,J^2+1/2(B-C)\,(J_b^2-J_c^2)$$

$$-\Delta_J(J^2)^2-\Delta_{JK}J^2J_a^2-\Delta_K J_a^4-2\delta_J J^2(J_b^2-J_c^2)-\delta_K[J_a^2(J_b^2-J_c^2)+(J_b^2-J_c^2)J_a^2]$$

$$+H_J(J^2)^3+H_{JK}\,J_a^2(J^2)^2+H_{KJ}\,J_a^4J^2+H_K J_a^6+2h_J\,(J_b^2-J_c^2)\,(J^2)^2$$

$$+h_{JK}\,J^2[(J_b^2-J_c^2)\,J_a^2+J_a^2\,(J_b^2-J_c^2)]$$

$$+h_K\,[(J_b^2-J_c^2)\,J_a^4+J_a^4(J_b^2-J_c^2)]$$

Table 1 shows the rotational and centrifugal distortion constants for $H^{12}COOH$ determined from a set of 424 measured frequencies, ranging from 87 kHz to 475 GHz. The 28 measurements below 8 GHz were taken from M. Takami [21A] and J. C. Chardon et al. [29A], the frequency measurements above 300 GHz from S. P. Belov et al [28A]. The observed transitions from 8 GHz to 300 GHz are reported in tables 6 and 11, most of these measurements were performed by J. Bellet et al. [25A]. The range of the uncertainties in the measurements is large and the transitions have been weighted in the fit.

For $D^{12}COOH$, HCOOD and $H^{13}COOH$, the number of the measured transitions included in the fits is, respectively, 121, 88 and 111. All these frequencies ranging from 8 GHz to 300 GHz are reported in tables 7, 8, 9 and 11. The measurements were mostly performed by the authors. The uncertainties in the measurements are not significantly different and the transitions have not been weighted in the fits.

Although only 9 lines have been observed for $HC^{18}O^{16}OH$ and 10 lines for $HC^{16}O^{18}OH$, estimated rotational constants for these two molecules are reported in table 5. For these fits, the centrifugal distortion constants have been fixed to the $H^{12}COOH$ values.

1.2. Microwave Spectral Tables

The tables 6, 7, 8 and 9 contain the results of the centrifugal distortion calculation of the microwave spectra parameters obtained in the least squares fit for $H^{12}COOH$, HCOOD, DCOOH and $H^{13}COOH$, respectively. For each spectral line the first two columns of each table contain the upper state and lower state quantum numbers in Mulliken notation $J\ K_{-1}\ K_{+1}$ for a rigid asymmetric rotor. The third column shows the calculated frequency. The fourth column contains the estimated standard deviation from the least-squares analysis. The observed frequencies and the associated experimental uncertainties are shown in the fifth and sixth columns. The line strengths denoted $S(J\ K_{-1}\ K_{+1}, J'\ K'_{-1}\ K'_{+1})$ are defined, by King, Hainer and Cross [2C] as:

$$S(J\ K_{-1}\ K_{+1}, J'\ K'_{-1}\ K'_{+1})$$
$$=3|\Phi_{Zg}(J,J')|^2\times|\Phi^A_{Zg}(J\ K_{-1}\ K_{+1}, J'K'_{-1}K'_{+1})|^2$$
$$\times\sum_{MM'}|\Phi_{Zg}\,J\,M,\,J'M')|^2$$

$$S(J\ K_{-1}\ K_{+1}, J'K'_{-1}\ K'_{+1}) = C\bullet|\Phi^A_{Zg}(J\ K_{-1}\ K_{+1}, J'\ K'_{-1}K'_{+1})|^2$$

with $C=1/4(J+1)$ if $J'=J+1$

$C=(2J+1)/4J(J+1)$ if $J'=J$

$C=1/4J$ if $J'=J-1$

Φ^A_{Zg} is the direction cosine matrix element connecting the lower $J\ K_{-1}K_{+1}$ and the upper $J'\ K'_{-1}\ K'_{+1}$ rotational levels involved in the transition, in the eigenvector basis of the Hamiltonian.

$g = a,b,c$ shows the direction of the principal axes of the molecule and Z represents the Z direction of the space-fixed frame. All those elements are calculated in B. Maillard's thesis [3C]. The line strengths values are tabulated in the eighth column. The restrictive conditions upon intensities are based on the relative intensities which are defined as

$$I_\tau = S(J\ K_{-1}\ K_{+1}, J'\ K'_{-1}\ K'_{+1})(e^{-W/kT}-e^{-W'/kT}),$$

where W represents the energy value of the lower state and W' the energy value of the upper state. All the experiments were performed at room temperature (300 K). The $(\mu_b/\mu_a)^2$ ratio of the components of the permanent dipole moment equals 0.035 for formic acid. Therefore the b-type lines are appreciably weaker than the a-type lines. References to the laboratory measurements are reported in the last column of the tables. When no reference is given, the measurement is from our recent unpublished reinvestigation. The ^{18}O transitions would appear to be important for astrophysical observations so that, although few lines were measured, we have reported all the known results in table 10. As a convenience to the user, the calculated transitions of the normal, deuterated and ^{13}C isotopic species are gathered and listed according to increasing frequency in table 11.

1.3. List of Symbols

A, B, C	Rotational constants (MHz). A > B > C.
Δ, δ	Quartic centrifugal distortion constants (MHz) in Watson's theory.
H,h	Sextic centrifugal distortion constants (MHz) in Watson's theory.
a, b, c	Principal axes corresponding to A, B, and C, respectively.
μ	Electric dipole moment (Debye).
J	Total rotational angular momentum quantum number.

K_{-1} Projection of J on the symmetry axis in the limiting prolate symmetric top.

K_{+1} Projection of J on the symmetry axis in the limiting oblate symmetric top.

2. Formic Acid Spectral Tables

Table I. Molecular parameters for $H^{12}COOH$

Rotational and centrifugal distortion constants

Constants	Value in MHz	
	constants [a]	σ [b]
A	77512.2310	0.0063
B	12055.1045	0.0008
C	10416.1145	0.0008
Δ_J	0.0099894	0.0000015
Δ_{JK}	-0.086250	0.000620
Δ_K	1.70229	0.00019
δ_J	0.00194920	0.00000024
δ_K	0.042600	0.000029
H_J	0.928×10^{-8}	0.039×10^{-8}
H_{KJ}	-0.1026×10^{-4}	0.0014×10^{-4}
H_K	0.1195×10^{-3}	0.0018×10^{-3}
h_J	0.6035×10^{-6}	0.0048×10^{-8}
h_K	0.1255×10^{-4}	0.0048×10^{-4}

[a] The number of figures quoted is necessary to reproduce the spectra within experimental error.

[b] σ is one estimated standard deviation.

Dipole moment (in Debye) [Ref.18A]	
μ	1.415 ± 0.001
μ_a	1.391 ± 0.005
μ_b	0.26 ± 0.04

Table 2. Molecular parameters for DCOOH

Rotational and centrifugal distortion constants

Constants	Value in MHz	
	constants [a]	σ [b]
A	57709.185	0.015
B	12055.9737	0.0027
C	9955.6058	0.0024
Δ_J	0.009403	0.000018
Δ_{JK}	-0.03952	0.00012
Δ_K	0.7552	0.0011
δ_J	0.0022239	0.0000029
δ_K	0.03773	0.00022
H_{KJ}	-0.31×10^{-5}	0.22×10^{-5}
H_K	0.20×10^{-4}	0.19×10^{-4}
h_J	0.59×10^{-8}	0.26×10^{-8}
h_K	0.60×10^{-5}	0.59×10^{-5}

[a] The number of figures quoted is necessary to reproduce the spectral within experimental error.

[b] σ is one estimated standard deviation.

Table 3. Molecular parameters for HCOOD

Rotational and centrifugal distortion constants

Constants	Value in MHz	
	Constants [a]	σ [b]
A	66099.557	0.050
B	11762.5524	0.0030
C	9969.9561	0.0033
Δ_J	0.0101847	0.0000099
Δ_{JK}	-0.05967	0.00012
Δ_K	0.988	0.035
δ_J	0.0021464	0.0000038
δ_K	0.04438	0.00084
H_{KJ}	-0.124×10^{-4}	0.016×10^{-4}
H_K	0.187×10^{-2}	0.045×10^{-2}
h_J	-0.80×10^{-8}	0.18×10^{-8}

[a] The number of figures quoted is necessary to reproduce the spectra within experimental error.

[b] σ is one estimated standard deviation.

Dipole moment (in Debye) [Ref.18A]	
μ	1.39 ± 0.01
μ_a	1.377 ± 0.005
μ_b	0.22 ± 0.02

Table 4. Molecular parameters for $H^{13}COOH$

Rotational and centrifugal distortion constants

Constants [a]	Value in MHz	
	Constants [b]	σ [c]
A	75580.801	0.069
B	12053.5663	0.0033
C	10378.9988	0.0033
Δ_J	0.009914	0.000017
Δ_{JK}	-0.084800	0.000055
Δ_K	1.655	0.013
δ_J	0.0019784	0.0000013
δ_K	0.04229	0.00026

[a] The sextic centrifugal distortion constants are fixed to the $H^{12}COOH$ values.

[b] The number of figures quoted is necessary to reproduce the spectra within experimental error.

[c] σ is one estimated standard deviation.

Table 5. Molecular parameters for $H^{12}C^{18}O^{16}OH$ and $H^{12}C^{16}O^{18}OH$

Rotational Constants [a]	Value in MHz	
	$H^{12}C^{18}O^{16}OH$	$H^{12}C^{16}O^{18}OH$
A	76635	77283
B	11397	11384
C	9905	9906

[a] Centrifugal distortion constants are fixed to the $H^{12}COOH$ values

Because of very few measurements, no statistical uncertainty is indicated.

TABLE 6. The microwave spectrum of $H^{12}COOH$. Frequencies in MHz.

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
1(0, 1) – 0(0, 0)	22471.18	0.00	22471.18	0.10	0.000	1.0000	[25A]
1(1, 1) – 0(0, 0)	87926.87	0.01			0.000	0.0350	
1(1, 0) – 1(0, 1)	67094.49	0.01	67094.56	0.05	0.750	0.0525	[25A]
2(0, 2) – 1(0, 1)	44911.73	0.00	44911.75	0.05	0.750	1.9998	[25A]
2(1, 2) – 1(0, 1)	108759.40	0.01			0.750	0.0525	
1(1, 0) – 1(1, 1)	1638.80	0.00			2.933	1.5000	
2(1, 2) – 1(1, 1)	43303.71	0.00	43303.71	0.05	2.933	1.5000	[25A]
2(2, 0) – 1(1, 1)	244598.14	0.02			2.933	0.0518	
2(1, 1) – 1(1, 0)	46581.22	0.00	46581.22	0.05	2.988	1.5000	[25A]
2(2, 1) – 1(1, 0)	242928.95	0.02			2.988	0.0525	
1(1, 1) – 2(0, 2)	20543.96	0.00	20543.96	0.10	2.248	0.0182	[25A]
2(1, 1) – 2(0, 2)	68763.98	0.01	68763.97	0.05	2.248	0.0864	[25A]
3(0, 3) – 2(0, 2)	67291.12	0.00	67291.05	0.05	2.248	2.9991	[25A]
3(2, 1) – 2(2, 0)	67536.10	0.00	67536.09	0.05	11.092	1.6667	[25A]
3(1, 3) – 2(0, 2)	128783.93	0.01			2.248	0.0704	
3(2, 2) 2(2, 1)	67414.65	0.00	67414.74	0.05	11.091	1.6667	[25A]
2(1, 1) – 2(1, 2)	4916.32	0.00			4.377	0.8333	
2(2, 1) – 2(1, 2)	201264.05	0.02			4.377	0.0292	
3(1, 3) – 2(1, 2)	64936.27	0.00	64936.30	0.05	4.377	2.6666	[25A]
3(2, 1) – 2(1, 2)	268830.53	0.02			4.377	0.0562	
2(2, 0) – 2(1, 1)	196378.11	0.02			4.541	0.0303	
3(1, 2) – 2(1, 1)	69851.96	0.00	69852.03	0.05	4.541	2.6666	[25A]
3(2, 2) – 2(1, 1)	263762.38	0.02			4.541	0.0583	
3(2, 2) – 3(0, 3)	265235.23	0.02			4.492	0.0013	
3(1, 2) – 3(0, 3)	71324.81	0.01	71324.89	0.05	4.492	0.1187	[25A]
4(0, 4) – 3(0, 3)	89579.17	0.01			4.492	3.9977	
4(2, 2) – 3(2, 1)	90164.62	0.01			13.345	2.9999	
4(1, 4) – 3(0, 3)	148038.99	0.01			4.492	0.0891	
4(2, 3) – 3(2, 2)	89861.48	0.01			13.340	2.9999	
2(2, 0) – 3(1, 3)	136358.16	0.01			6.543	0.0057	
3(1, 2) – 3(1, 3)	9832.00	0.00	9832.01	0.10	6.543	0.5834	[25A]
3(2, 2) – 3(1, 3)	203742.43	0.02			6.543	0.0506	
4(1, 4) – 3(1, 3)	86546.18	0.01			6.543	3.7497	
4(3, 2) – 3(3, 1)	89948.21	0.01			24.390	1.7501	
4(0, 4) – 3(1, 3)	28086.36	0.00	28086.36	0.10	6.543	0.0574	[25A]
4(2, 2) – 3(1, 3)	294058.89	0.02			6.543	0.0609	
2(2, 1) – 3(1, 2)	126495.77	0.01			6.871	0.0061	
3(2, 1) – 3(1, 2)	194062.26	0.02			6.871	0.0544	
4(1, 3) – 3(1, 2)	93098.35	0.01			6.871	3.7497	
4(3, 1) – 3(3, 0)	89950.32	0.01			24.390	1.7501	
4(2, 3) – 3(1, 2)	283771.90	0.02			6.871	0.0658	
3(3, 1) – 4(2, 2)	240980.05	0.02			16.352	0.0044	
4(2, 3) – 4(0, 4)	265517.54	0.02			7.480	0.0031	
4(1, 3) – 4(0, 4)	74843.99	0.01			7.480	0.1487	
5(0, 5) – 4(0, 4)	111746.78	0.01	111746.79	0.08	7.480	4.9955	[25A]
5(2, 3) – 4(2, 2)	112891.43	0.01	112891.41	0.08	16.352	4.1997	[25A]
5(4, 1) – 4(4, 0)	112432.31	0.01	112432.30	0.08	42.855	1.8001	[25A]
5(1, 5) – 4(0, 4)	166586.53	0.01			7.480	0.1089	
3(3, 0) – 4(2, 3)	241435.39	0.02			16.337	0.0044	
5(2, 4) – 4(2, 3)	112287.14	0.01	112287.12	0.08	16.337	4.1997	[25A]
5(4, 2) – 4(4, 1)	112432.29	0.01	112432.30	0.08	42.855	1.8001	[25A]
3(2, 1) – 4(1, 4)	117348.08	0.01			9.430	0.0123	
4(1, 3) – 4(1, 4)	16384.17	0.00	16384.19	0.10	9.430	0.4503	[25A]
4(2, 3) – 4(1, 4)	207057.72	0.02			9.430	0.0694	
5(1, 5) – 4(1, 4)	108126.71	0.01	108126.70	0.08	9.430	4.7993	[25A]
5(3, 3) – 4(3, 2)	112459.61	0.01	112459.60	0.08	27.391	3.2001	[25A]
5(0, 5) – 4(1, 4)	53286.95	0.01	53286.95	0.10	9.430	0.0791	[25A]
3(2, 2) – 4(1, 3)	100812.07	0.01			9.977	0.0140	
4(2, 2) – 4(1, 3)	191128.53	0.02			9.977	0.0781	
5(1, 4) – 4(1, 3)	116311.48	0.01	116311.48	0.08	9.977	4.7992	[25A]
5(3, 2) – 4(3, 1)	112467.00	0.01	112467.00	0.08	27.391	3.2001	[25A]
4(3, 2) – 5(2, 3)	218036.82	0.02			20.118	0.0106	
5(2, 4) – 5(0, 5)	266057.90	0.02			11.208	0.0058	

TABLE 6. The microwave spectrum of $H^{12}COOH$. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
5(1, 4) – 5(0, 5)	79408.70	0.01	79408.60	0.05	11.208	0.1758	
6(0, 6) – 5(0, 5)	133767.18	0.01	133767.07	0.08	11.208	5.9922	[25A]
6(2, 4) – 5(2, 3)	135737.75	0.01	135737.70	0.08	20.118	5.3328	[2kA]
6(4, 2) – 5(4, 1)	134938.50	0.01	134938.48	0.08	46.605	3.3334	[25A]
6(1, 6) – 5(0, 5)	184511.57	0.01	184511.57	0.12	11.208	0.1300	
4(3, 1) – 5(2, 4)	219098.57	0.02			20.082	0.0106	
5(2, 3) – 5(2, 4)	1059.28	0.00			20.082	1.4612	
6(2, 5) – 5(2, 4)	134686.36	0.01	134686.37	0.08	20.082	5.3327	[25A]
6(4, 3) – 5(4, 2)	134938.38	0.01	134938.48	0.08	46.605	3.3334	[25A]
4(2, 2) – 5(1, 5)	99385.99	0.01			13.037	0.0189	
5(1, 4) – 5(1, 5)	24568.94	0.00	24568.96	0.10	13.037	0.3673	[25A]
5(2, 4) – 5(1, 5)	211218.14	0.02			13.037	0.0866	
6(1, 6) – 5(1, 5)	129671.81	0.01	129671.75	0.08	13.037	5.8321	[25A]
6(3, 4) – 5(3, 3)	134985.36	0.01	134985.63	0.08	31.142	4.5001	[25A]
6(5, 2) – 5(5, 1)	134920.24	0.01	134920.24	0.08	66.480	1.8334	[25A]
6(0, 6) – 5(1, 5)	78927.42	0.01			13.037	0.1025	
4(2, 3) – 5(1, 4)	74362.07	0.01			13.857	0.0229	
5(2, 3) – 5(1, 4)	187708.49	0.02			13.857	0.1031	
6(1, 5) – 5(1, 4)	139481.68	0.01	139481.72	0.08	13.857	5.8319	[25A]
6(3, 3) – 5(3, 2)	135005.04	0.01	135004.87	0.08	31.142	4.5001	[25A]
6(5, 1) – 5(5, 0)	134920.24	0.01	134920.24	0.08	66.480	1.8334	[25A]
5(3, 3) – 6(2, 4)	194758.69	0.02			24.646	0.0176	
6(2, 5) – 6(0, 6)	266977.09	0.02			15.670	0.0097	
6(1, 5) – 6(0, 6)	85123.20	0.01			15.670	0.1994	
7(0, 7) – 6(0, 6)	155617.84	0.01	155617.84	0.08	15.670	6.9879	
7(2, 5) – 6(2, 4)	158720.52	0.01	158720.51	0.08	24.646	6.4278	
7(4, 3) – 6(4, 2)	157455.52	0.01	157455.17	0.08	51.106	4.7144	
7(6, 1) – 6(6, 0)	157412.83	0.01	157412.82	0.08	95.259	1.8572	
7(1, 7) – 6(0, 6)	201920.63	0.01	201920.76	0.12	15.670	0.1526	
5(3, 2) – 6(2, 5)	196879.21	0.02			24.575	0.0176	
6(2, 4) – 6(2, 5)	2110.67	0.00			24.575	1.2291	
7(2, 6) – 6(2, 5)	157053.94	0.01	157053.92	0.08	24.575	6.4275	
7(4, 4) – 6(4, 3)	157455.11	0.01	157455.17	0.08	51.106	4.7144	
7(6, 2) – 6(6, 1)	157412.83	0.01	157412.82	0.08	95.259	1.8572	
5(2, 3) – 6(1, 6)	82605.61	0.01			17.362	0.0248	
6(1, 5) – 6(1, 6)	34378.81	0.01	34378.83	0.10	17.362	0.3106	[25A]
6(2, 5) – 6(1, 6)	216232.70	0.02			17.362	0.1026	
7(1, 7) – 6(1, 6)	151176.24	0.01	151176.24	0.08	17.362	6.8552	
7(3, 5) – 6(3, 4)	157526.47	0.01	157526.45	0.08	35.645	5.7143	
7(5, 3) – 6(5, 2)	157422.56	0.01	157422.55	0.08	70.980	3.4287	
7(0, 7) – 6(1, 6)	104873.45	0.01			17.362	0.1278	
5(2, 4) – 6(1, 5)	47167.52	0.01			18.509	0.0326	
6(2, 4) – 6(1, 5)	183964.55	0.01	183964.51	0.12	18.509	0.1300	
7(1, 6) – 6(1, 5)	162598.44	0.01			18.509	6.8547	
7(3, 4) – 6(3, 3)	157570.67	0.01	157570.65	0.08	35.646	5.7143	
7(5, 2) – 6(5, 1)	157422.56	0.01	157422.55	0.08	70.980	3.4287	
6(3, 4) – 7(2, 5)	171023.53	0.02			29.940	0.0251	
7(2, 6) – 7(0, 7)	268413.18	0.02			20.861	0.0149	
7(1, 6) – 7(0, 7)	92103.80	0.01			20.861	0.2191	
8(0, 8) – 7(0, 7)	177282.79	0.01	177282.80	0.12	20.861	7.9825	
8(2, 6) – 7(2, 5)	181850.08	0.01	181850.06	0.12	29.940	7.4989	
8(4, 4) – 7(4, 3)	179985.27	0.01	179985.34	0.12	56.358	6.0002	
8(6, 2) – 7(6, 1)	179913.00	0.01	179912.96	0.12	100.510	3.5001	
8(1, 8) – 7(0, 7)	218938.51	0.01			20.861	0.1771	
6(3, 3) – 7(2, 6)	174830.31	0.02			29.814	0.0249	
7(2, 5) – 7(2, 6)	3777.25	0.00			29.814	1.0578	
8(2, 7) – 7(2, 6)	179384.69	0.01	179384.66	0.12	29.814	7.4983	
8(4, 5) – 7(4, 4)	179984.16	0.01	179984.04	0.12	56.358	6.0002	
8(6, 3) – 7(6, 2)	179913.00	0.01	179912.96	0.12	100.510	3.5001	
8(1, 7) – 7(2, 6)	9340.74	0.01			29.814	0.0544	
6(2, 4) – 7(1, 7)	67167.12	0.01	67167.13	0.10	22.405	0.0298	[25A]
7(1, 6) – 7(1, 7)	45801.01	0.01	45801.01	0.05	22.405	0.2696	[25A]
7(2, 6) – 7(1, 7)	222110.39	0.02			22.405	0.1173	

TABLE 6. The microwave spectrum of $H^{12}COOH$. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
8(1, 8) – 7(1, 7)	172635.72	0.01	172635.70	0.12	22.405	7.8720	
8(3, 6) – 7(3, 5)	180083.04	0.01	180083.03	0.12	40.899	6.8750	
8(5, 4) – 7(5, 3)	179932.07	0.01	179932.15	0.12	76.231	4.8752	
8(7, 2) – 7(7, 1)	179910.48	0.01			129.187	1.8751	
8(0, 8) – 7(1, 7)	130980.00	0.01	130980.19	0.08	22.405	0.1552	[25A]
6(2, 5) – 7(1, 6)	19255.45	0.01	19255.60	0.10	23.933	0.0431	[25A]
7(2, 5) – 7(1, 6)	180086.63	0.01	180086.71	0.12	23.933	0.1594	
8(1, 7) – 7(1, 6)	185650.12	0.01	185650.12	0.12	23.933	7.8712	
8(3, 5) – 7(3, 4)	180171.21	0.01	180171.19	0.12	40.902	6.8750	
8(5, 3) – 7(5, 2)	179932.07	0.01	179932.15	0.12	76.231	4.8752	
8(7, 1) – 7(7, 0)	179910.48	0.01			129.187	1.8751	
7(3, 5) – 8(2, 6)	146699.93	0.02			36.006	0.0329	
8(2, 7) – 8(0, 8)	270515.08	0.02			26.774	0.0213	
8(1, 7) – 8(0, 8)	100471.13	0.01			26.774	0.2347	
9(0, 9) – 8(0, 8)	198754.98	0.01	198754.96	0.12	26.774	8.9762	
9(2, 7) – 8(2, 6)	205127.74	0.01	205127.82	0.12	36.006	8.5544	[25A]
9(4, 5) – 8(4, 4)	202529.78	0.01	202529.76	0.12	62.362	7.2224	[25A]
9(6, 3) – 8(6, 2)	202418.21	0.01	202418.30	0.12	106.511	5.0002	[25A]
9(8, 1) – 8(8, 0)	202413.77	0.01	202413.65	0.12	168.253	1.8890	[25A]
9(1, 9) – 8(0, 8)	235702.70	0.01			26.774	0.2035	
7(3, 4) – 8(2, 7)	153016.28	0.02			35.798	0.0324	
8(2, 6) – 8(2, 7)	6242.64	0.00			35.798	0.9251	
9(2, 8) – 8(2, 7)	201673.55	0.01	201673.72	0.12	35.798	8.5530	[25A]
9(4, 6) – 8(4, 5)	202527.11	0.01	202527.30	0.12	62.362	7.2224	[25A]
9(6, 4) – 8(6, 3)	202418.21	0.01	202418.30	0.12	106.511	5.0002	[25A]
9(8, 2) – 8(8, 1)	202413.77	0.01	202413.65	0.12	168.253	1.8890	[25A]
9(1, 8) – 8(2, 7)	38579.95	0.01	38579.95	0.10	35.798	0.0668	[25A]
7(2, 5) – 8(1, 8)	53251.92	0.01	53251.92	0.10	28.164	0.0335	[25A]
7(4, 3) – 8(3, 6)	283367.85	0.03			46.906	0.0220	
8(1, 7) – 8(1, 8)	58815.41	0.01	58815.41	0.05	28.164	0.2387	[25A]
8(2, 7) – 8(1, 8)	228859.36	0.02			28.164	0.1310	
9(1, 9) – 8(1, 8)	194046.98	0.01	194046.93	0.12	28.164	8.8848	
9(3, 7) – 8(3, 6)	202654.13	0.01	202654.46	0.12	46.906	7.9999	[25A]
9(5, 5) – 8(5, 4)	202449.79	0.01	202450.01	0.12	82.233	6.2224	[25A]
9(7, 3) – 8(7, 2)	202409.38	0.01	202409.17	0.12	135.188	3.5557	[25A]
9(0, 9) – 8(1, 8)	157099.26	0.01	157099.22	0.08	28.164	0.1846	
7(4, 4) – 8(3, 5)	283205.41	0.03			46.911	0.0220	
8(2, 6) – 8(1, 7)	176286.59	0.01	176286.59	0.12	30.125	0.1913	
9(1, 8) – 8(1, 7)	208623.90	0.01	208623.86	0.12	30.125	8.8832	[25A]
9(3, 6) – 8(3, 5)	202815.20	0.01	202815.16	0.12	46.911	7.9999	[25A]
9(5, 4) – 8(5, 3)	202449.81	0.01	202450.01	0.12	82.233	6.2224	[25A]
9(7, 2) – 8(7, 1)	202409.38	0.01	202409.17	0.12	135.188	3.5557	[25A]
8(3, 6) – 9(2, 7)	121655.23	0.02			42.848	0.0407	
9(2, 8) – 9(0, 9)	273433.64	0.02			33.404	0.0290	
9(1, 8) – 9(0, 9)	110340.05	0.01	110340.07	0.08	33.404	0.2459	[25A]
10(0,10) – 9(0, 9)	220037.96	0.01	220037.90	0.12	33.404	9.9694	[25A]
10(2, 8) – 9(2, 7)	228544.07	0.01	228544.05	0.12	42.848	9.5992	
10(4, 6) – 9(4, 5)	225091.21	0.01	225091.22	0.12	69.118	8.4002	
10(6, 4) – 9(6, 3)	224929.09	0.01	224929.17	0.12	113.263	6.4002	
10(8, 2) – 9(8, 1)	224911.95	0.01	224912.44	0.12	175.005	3.6001	[28A]
10(1,10) – 9(0, 9)	252355.55	0.01			33.404	0.2318	
8(3, 5) – 9(2, 8)	131513.94	0.02			42.525	0.0399	
9(2, 7) – 9(2, 8)	9696.83	0.00	9696.87	0.10	42.525	0.8184	[25A]
10(2, 9) – 9(2, 8)	223915.56	0.01	223915.53	0.12	42.525	9.5963	[25A]
10(4, 7) – 9(4, 6)	225085.44	0.01	225085.40	0.12	69.117	8.4002	
10(6, 5) – 9(6, 4)	224929.09	0.01	224929.17	0.12	113.263	6.4002	
10(8, 3) – 9(8, 2)	224911.95	0.01	224912.44	0.12	175.005	3.6001	[28A]
10(1, 9) – 9(2, 8)	68411.99	0.01	68412.01	0.10	42.525	0.0802	[25A]
8(2, 6) – 9(1, 9)	41055.02	0.01	41054.99	0.10	34.636	0.0360	[25A]
8(4, 4) – 9(3, 7)	260698.99	0.03			53.666	0.0293	
9(1, 8) – 9(1, 9)	73392.33	0.01	73392.31	0.05	34.636	0.2148	[25A]
9(2, 8) – 9(1, 9)	236485.93	0.02			34.636	0.1434	
10(1,10) – 9(1, 9)	215407.84	0.01	215407.90	0.12	34.636	9.8945	

TABLE 6. The microwave spectrum of $H^{12}COOH$. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
10(3, 8) - 9(3, 7)	225237.75	0.01	225237.62	0.12	53.666	9.0998	
10(5, 6) - 9(5, 5)	224976.76	0.01	224976.74	0.12	88.986	7.5002	
10(7, 4) - 9(7, 3)	224911.84	0.01	224912.44	0.12	141.939	5.1002	[28A]
10(9, 2) - 9(9, 1)	224923.34	0.02	224923.30	0.12	212.450	1.9001	
10(0,10) - 9(1, 9)	183090.25	0.01	183090.22	0.12	34.636	0.2159	
8(4, 5) - 9(3, 6)	260374.36	0.03			53.677	0.0293	
9(2, 7) - 9(1, 8)	172790.43	0.01	172790.38	0.12	37.084	0.2256	
10(1, 9) - 9(1, 8)	231505.59	0.01	231505.39	0.12	37.084	9.8918	
10(3, 7) - 9(3, 6)	225512.54	0.01	225512.50	0.12	53.677	9.0998	
10(5, 5) - 9(5, 4)	224976.82	0.01	224976.74	0.12	88.986	7.5002	
10(7, 3) - 9(7, 2)	224911.84	0.01	224912.44	0.12	141.939	5.1002	[28A]
10(9, 1) - 9(9, 0)	224923.34	0.02	224923.30	0.12	212.450	1.9001	
9(3, 7) - 10(2, 8)	95765.29	0.02			50.471	0.0487	
10(2, 9) - 10(0,10)	277311.24	0.02			40.744	0.0377	
10(1, 9) - 10(0,10)	121807.67	0.01	121807.67	0.08	40.744	0.2530	[25A]
11(0,11) - 10(0,10)	241146.20	0.01	241146.22	1.00	40.744	10.9625	[28A]
11(2, 9) - 10(2, 8)	252078.49	0.01	252078.45	0.16	50.471	10.6363	
11(4, 7) - 10(4, 6)	247671.96	0.01	247670.76	1.00	76.626	9.5456	[28A]
11(6, 5) - 10(6, 4)	247446.25	0.01	247445.68	1.00	120.766	7.7275	[28A]
11(8, 3) - 10(8, 2)	247412.57	0.02			182.508	5.1820	
11(10, 1) - 10(10, 0)	247439.85	0.02			261.766	1.9092	
11(1,11) - 10(0,10)	269034.79	0.02			40.744	0.2619	
9(3, 6) - 10(2, 9)	110413.59	0.02			49.994	0.0472	
10(2, 8) - 10(2, 9)	14325.34	0.00	14325.37	0.10	49.994	0.7301	[25A]
11(2,10) - 10(2, 9)	246105.97	0.01	246106.52	1.00	49.994	10.6314	[28A]
11(4, 8) - 10(4, 7)	247660.45	0.01	247661.36	1.00	76.625	9.5456	[28A]
11(6, 6) - 10(6, 5)	247446.25	0.01	247445.68	1.00	120.766	7.7275	[28A]
11(8, 4) - 10(8, 3)	247412.57	0.02			182.508	5.1820	
11(10, 2) - 10(10, 1)	247439.85	0.02			261.766	1.9092	
11(1,10) - 10(2, 9)	98776.09	0.01			49.994	0.0949	
9(2, 7) - 10(1,10)	30774.93	0.01	30774.90	0.10	41.822	0.0371	[25A]
9(4, 5) - 10(3, 8)	237991.02	0.03			61.179	0.0368	
10(1, 9) - 10(1,10)	89490.08	0.01			41.822	0.1960	
10(2, 9) - 10(1,10)	244993.65	0.02			41.822	0.1547	
11(1,11) - 10(1,10)	236717.20	0.01	236717.22	0.12	41.822	10.9020	
11(3, 9) - 10(3, 8)	247830.81	0.01	247830.62	1.00	61.179	10.1814	[28A]
11(5, 7) - 10(5, 6)	247513.97	0.01	247514.13	1.00	96.490	8.7275	[28A]
11(7, 5) - 10(7, 4)	247418.25	0.01	247418.09	1.00	149.442	6.5457	[28A]
11(9, 3) - 10(9, 2)	247421.16	0.02	247418.09	1.00	219.953	3.6365	[28A]
11(0,11) - 10(1,10)	208828.61	0.01			41.822	0.2488	
9(4, 6) - 10(3, 7)	237388.92	0.03			61.199	0.0368	
10(2, 8) - 10(1, 9)	169828.91	0.01			44.807	0.2618	
11(1,10) - 10(1, 9)	254279.65	0.01	254279.59	0.16	44.807	10.8976	
11(3, 8) - 10(3, 7)	248274.48	0.01			61.199	10.1814	
11(5, 6) - 10(5, 5)	247514.12	0.01	247514.13	1.00	96.490	8.7275	[28A]
11(7, 4) - 10(7, 3)	247418.25	0.01	247418.09	1.00	149.442	6.5457	[28A]
11(9, 2) - 10(9, 1)	247421.16	0.02	247418.09	1.00	219.953	3.6365	[28A]
10(3, 8) - 11(2, 9)	68924.55	0.02	68924.51	0.10	58.880	0.0568	[25A]
11(2,10) - 11(0,11)	282271.01	0.02			48.787	0.0470	
11(1,10) - 11(0,11)	134941.13	0.01			48.787	0.2564	
12(0,12) - 11(0,11)	262103.48	0.01			48.787	11.9559	
12(2,10) - 11(2, 9)	275700.81	0.01			58.880	11.6679	
12(4, 8) - 11(4, 7)	270274.73	0.01	270274.63	0.16	84.887	10.6668	
12(6, 6) - 11(6, 5)	269970.33	0.01	269970.26	0.16	129.020	9.0003	
12(8, 4) - 11(8, 3)	269915.87	0.02	269915.85	0.16	190.760	6.6669	
12(10, 2) - 11(10, 1)	269937.59	0.02	269937.45	0.16	270.020	3.6668	
12(1,12) - 11(0,11)	285863.61	0.02			48.787	0.2936	
10(3, 7) - 11(2,10)	89820.16	0.02			58.203	0.0541	
11(2, 9) - 11(2,10)	20297.86	0.01	20297.89	0.10	58.203	0.6555	[25A]
12(2,11) - 11(2,10)	268240.23	0.01			58.203	11.6601	
12(4, 9) - 11(4, 8)	270253.20	0.01	270253.19	0.16	84.886	10.6668	
12(6, 7) - 11(6, 6)	269970.33	0.01	269970.26	0.16	129.020	9.0003	
12(8, 5) - 11(8, 4)	269915.87	0.02	269915.85	0.16	190.760	6.6669	

TABLE 6. The microwave spectrum of $H^{12}COOH$. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
12(10, 3) – 11(10, 2)	269937.59	0.02	269937.45	0.16	270.020	3.6668	
12(1,11) – 11(2,10)	129599.39	0.01			58.203	0.1110	
10(2, 8) – 11(1,11)	22601.79	0.02	22601.70	0.10	49.718	0.0370	[25A]
10(4, 6) – 11(3, 9)	215251.42	0.03			69.446	0.0444	
11(1,10) – 11(1,11)	107052.54	0.01			49.718	0.1810	
11(3, 8) – 11(3, 9)	1041.43	0.00			69.446	1.5516	
11(2,10) – 11(1,11)	254382.42	0.02			49.718	0.1649	
12(1,12) – 11(1,11)	257975.01	0.01			49.718	11.9079	
12(3,10) – 11(3, 9)	270429.21	0.01	270429.20	0.16	69.446	11.2493	
12(5, 8) – 11(5, 7)	270062.45	0.01	270062.56	0.16	104.747	9.9170	
12(7, 6) – 11(7, 5)	269928.98	0.02	269928.91	0.16	157.695	7.9170	
12(9, 4) – 11(9, 3)	269920.54	0.02	269920.52	0.16	228.206	5.2502	
12(11, 2) – 11(11, 1)	269963.95	0.03	269963.87	0.16	316.189	1.9167	
12(0,12) – 11(1,11)	234214.89	0.01			49.718	0.2831	
10(4, 7) – 11(3, 8)	214199.88	0.03			69.480	0.0444	
11(2, 9) – 11(1,10)	167627.74	0.01			53.288	0.2991	
12(1,11) – 11(1,10)	276929.27	0.01	276929.25	0.16	53.288	11.9011	
12(3, 9) – 11(3, 8)	271113.54	0.01	271113.98	0.16	69.480	11.2494	
12(5, 7) – 11(5, 6)	270062.78	0.01	270062.56	0.16	104.747	9.9170	
12(7, 5) – 11(7, 4)	269928.98	0.02	269928.91	0.16	157.695	7.9170	
12(9, 3) – 11(9, 2)	269920.54	0.02	269920.52	0.16	228.206	5.2502	
12(11, 1) – 11(11, 0)	269963.95	0.03	269963.87	0.16	316.189	1.9167	
11(3, 9) – 12(2,10)	41054.55	0.02	41054.53	0.10	68.076	0.0651	[25A]
12(2,11) – 12(0,12)	288407.75	0.02			57.530	0.0567	
12(1,11) – 12(0,12)	149766.91	0.01			57.530	0.2568	
13(0,13) – 12(0,12)	282939.75	0.01	282939.80	0.16	57.530	12.9499	[25A]
13(2,11) – 12(2,10)	299374.30	0.01			68.076	12.6952	
13(4, 9) – 12(4, 8)	292902.61	0.01	292902.60	0.16	93.903	11.7693	[25A]
13(6, 7) – 12(6, 6)	292501.95	0.02	292501.89	0.16	138.025	10.2311	[25A]
13(8, 5) – 12(8, 4)	292422.09	0.02	292421.90	0.16	199.764	8.0772	[25A]
13(10, 3) – 12(10, 2)	292436.14	0.02	292436.10	0.16	279.024	5.3079	[25A]
13(12, 1) – 12(12, 0)	292496.26	0.04	292496.10	0.16	375.706	1.9231	[25A]
11(3, 8) – 12(2,11)	69854.42	0.02	69854.37	0.10	67.150	0.0606	[25A]
12(2,10) – 12(2,11)	27758.44	0.01	27758.48	0.10	67.150	0.5916	[25A]
13(2,12) – 12(2,11)	290314.11	0.01	290314.10	0.16	67.150	12.6839	[25A]
13(4,10) – 12(4, 9)	292864.49	0.01	292864.50	0.16	93.901	11.7693	[25A]
13(6, 8) – 12(6, 7)	292501.95	0.02	292501.89	0.16	138.025	10.2311	[25A]
13(8, 6) – 12(8, 5)	292422.09	0.02	292421.90	0.16	199.764	8.0772	[25A]
13(10, 4) – 12(10, 3)	292436.14	0.02	292436.10	0.16	279.024	5.3079	[25A]
13(12, 2) – 12(12, 1)	292496.26	0.04	292496.10	0.16	375.706	1.9231	[25A]
13(1,12) – 12(2,11)	160795.79	0.01			67.150	0.1288	
11(2, 9) – 12(1,12)	16705.27	0.02			58.323	0.0358	
11(4, 7) – 12(3,10)	192494.17	0.03			78.466	0.0521	
12(1,11) – 12(1,12)	126006.79	0.02			58.323	0.1689	
12(3, 9) – 12(3,10)	1725.75	0.00			78.466	1.4209	
12(2,11) – 12(1,12)	264647.63	0.02			58.323	0.1739	
13(1,13) – 12(1,12)	279182.20	0.01	279182.10	0.16	58.323	12.9124	[25A]
13(3,11) – 12(3,10)	293027.89	0.01	293027.70	0.16	78.466	12.3067	[25A]
13(5, 9) – 12(5, 8)	292623.19	0.01	292623.00	0.16	113.755	11.0772	[25A]
13(7, 7) – 12(7, 6)	292444.43	0.02	292444.40	0.16	166.699	9.2311	[25A]
13(9, 5) – 12(9, 4)	292421.62	0.02	292421.90	0.16	237.209	6.7695	[25A]
13(11, 3) – 12(11, 2)	292461.80	0.03	292461.70	0.16	325.194	3.6924	[25A]
13(0,13) – 12(1,12)	259179.63	0.01			58.323	0.3185	
11(4, 8) – 12(3, 9)	190746.79	0.03			78.524	0.0522	
12(2,10) – 12(1,11)	166399.28	0.01			62.526	0.3366	
13(1,12) – 12(1,11)	299436.63	0.01			62.526	12.9025	
13(3,10) – 12(3, 9)	294043.18	0.01	294043.20	0.16	78.524	12.3069	[25A]
13(5, 8) – 12(5, 7)	292623.90	0.01	292623.00	0.16	113.755	11.0772	[25A]
13(7, 6) – 12(7, 5)	292444.43	0.02	292444.40	0.16	166.699	9.2311	[25A]
13(9, 4) – 12(9, 3)	292421.62	0.02	292421.90	0.16	237.209	6.7695	[25A]
13(11, 2) – 12(11, 1)	292461.80	0.03	292461.70	0.16	325.194	3.6924	[25A]
12(3,10) – 13(2,11)	12109.46	0.02			78.062	0.0735	
13(2,12) – 13(0,13)	295782.11	0.02			66.968	0.0664	

TABLE 6. The microwave spectrum of $H^{12}COOH$. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
13(1,12) - 13(0,13)	166263.79	0.02			66.968	0.2549	
12(3, 9) - 13(2,12)	50653.85	0.02	50653.62	0.10	76.834	0.0665	[25A]
13(2,11) - 13(2,12)	36818.64	0.01	36818.63	0.05	76.834	0.5364	[25A]
14(1,13) - 13(2,12)	192265.22	0.01			76.834	0.1483	
12(2,10) - 13(1,13)	13228.87	0.02			67.635	0.0338	
12(4, 8) - 13(3,11)	169741.00	0.03			88.241	0.0598	
13(1,12) - 13(1,13)	146261.22	0.02			67.635	0.1593	
13(3,10) - 13(3,11)	2741.04	0.00			88.241	1.3080	
13(2,12) - 13(1,13)	275779.54	0.02			67.635	0.1818	
14(0,14) - 13(1,13)	283684.42	0.01			67.635	0.3545	
14(2,12) - 13(3,11)	17922.33	0.02	17922.30	0.10	88.241	0.0823	
12(4, 9) - 13(3,10)	166956.82	0.03			88.332	0.0599	
13(2,11) - 13(1,12)	166336.96	0.01			72.514	0.3731	
13(5, 9) - 14(4,10)	279315.60	0.05			114.199	0.0562	
14(1,13) - 14(0,14)	184360.34	0.02	184360.37	0.12	77.098	0.2514	
13(3,10) - 14(2,13)	32373.27	0.01			87.252	0.0716	
13(5, 8) - 14(4,11)	279462.66	0.05			114.194	0.0561	
14(2,12) - 14(2,13)	47554.57	0.01	47554.55	0.05	87.252	0.4884	[25A]
15(1,14) - 14(2,13)	223893.78	0.02			87.252	0.1698	
13(4, 9) - 14(3,12)	147022.67	0.03			98.769	0.0674	
14(1,13) - 14(1,14)	167704.22	0.02			77.653	0.1516	
14(3,11) - 14(3,12)	4197.35	0.00			98.769	1.2089	
14(2,13) - 14(1,14)	287762.75	0.02			77.653	0.1888	
15(2,13) - 14(3,12)	49020.22	0.02	49020.24	0.10	98.769	0.0915	[25A]
13(4,10) - 14(3,11)	142744.04	0.02			98.909	0.0676	
14(2,12) - 14(1,13)	167618.11	0.01			88.248	0.4074	
14(5,10) - 15(4,11)	256263.96	0.05			125.481	0.0638	
15(1,14) - 15(0,15)	203937.27	0.02			87.918	0.2472	
15(3,12) - 15(2,13)	295406.20	0.02			100.404	0.3188	
14(3,11) - 15(2,14)	15184.77	0.01	15184.54	0.10	98.402	0.0758	
14(5, 9) - 15(4,12)	256517.41	0.05			125.473	0.0638	
15(2,13) - 15(2,14)	60007.64	0.01	60007.61	0.05	98.402	0.4468	[25A]
16(1,15) - 15(2,14)	255555.11	0.02			98.402	0.1934	
14(4,10) - 15(3,13)	124380.07	0.02			110.050	0.0749	
15(1,14) - 15(1,15)	190204.00	0.02			88.376	0.1456	
15(3,12) - 15(3,13)	6224.61	0.00			110.050	1.1207	
16(2,14) - 15(3,13)	81135.84	0.02			110.050	0.1012	
14(4,11) - 15(3,12)	118009.67	0.02			110.257	0.0753	
15(2,13) - 15(1,14)	170379.62	0.01			94.721	0.4383	
15(5,11) - 16(4,12)	233072.92	0.04			137.522	0.0716	
16(1,15) - 16(0,16)	224833.81	0.03	224834.25	0.12	99.427	0.2426	
16(3,13) - 16(2,14)	288598.77	0.02			112.756	0.3517	
15(5,10) - 16(4,13)	233494.14	0.04			137.508	0.0716	
16(2,14) - 16(2,15)	74187.80	0.01			110.282	0.4106	
17(1,16) - 16(2,15)	287113.33	0.02			110.282	0.2191	
15(4,11) - 16(3,14)	101865.44	0.02			122.084	0.0822	
16(1,15) - 16(1,16)	213609.91	0.03			99.801	0.1409	
16(3,13) - 16(3,14)	8971.18	0.00	8971.18	0.10	122.084	1.0411	[25A]
17(2,15) - 16(3,14)	114198.57	0.02	114198.63	0.08	122.084	0.1117	[25A]
15(4,12) - 16(3,13)	92643.50	0.02			122.383	0.0829	
16(2,14) - 16(1,15)	174769.96	0.01			106.927	0.4651	
17(2,16) - 16(3,13)	15149.43	0.01			122.383	0.0809	
16(5,12) - 17(4,13)	209713.69	0.04			150.323	0.0793	
17(1,16) - 17(0,17)	246857.09	0.03	246857.42	0.16	111.624	0.2383	
17(3,14) - 17(2,15)	281700.45	0.02			125.893	0.3872	
16(5,11) - 17(4,14)	210391.70	0.04			150.301	0.0793	
17(2,15) - 17(2,16)	90077.96	0.02			122.888	0.3794	
16(2,14) - 17(1,17)	24829.95	0.04	24830.00	0.10	111.928	0.0227	[25A]
16(4,12) - 17(3,15)	79543.38	0.02			134.869	0.0893	
17(1,16) - 17(1,17)	237755.49	0.03			111.928	0.1374	
17(3,14) - 17(3,15)	12600.58	0.01	12600.56	0.10	134.869	0.9686	[25A]
18(2,16) - 17(3,15)	148120.80	0.02			134.869	0.1231	
16(4,13) - 17(3,14)	66526.94	0.02	66526.97	0.10	135.289	0.0905	[25A]

TABLE 6. The microwave spectrum of $H^{12}COOH$. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
17(2,15) - 17(1,16)	180900.63	0.01	180900.61	0.12	119.859	0.4869	
18(2,17) - 17(3,14)	27881.98	0.02	27882.30	0.10	135.289	0.0815	[25A]
17(5,13) - 18(4,14)	186151.37	0.04			163.885	0.0870	
18(1,17) - 18(0,18)	269793.50	0.04			124.510	0.2345	
18(3,15) - 18(2,16)	274964.66	0.02			139.810	0.4254	
17(5,12) - 18(4,15)	187212.13	0.04			163.850	0.0869	
18(2,16) - 18(2,17)	107638.24	0.02	107638.11	0.08	136.219	0.3525	[25A]
18(4,14) - 18(4,15)	1042.11	0.00			163.850	1.6959	
17(2,15) - 18(1,18)	34113.79	0.04			124.755	0.0200	
17(4,13) - 18(3,16)	57491.88	0.02	57491.85	0.10	148.405	0.0961	[25A]
18(1,17) - 18(1,18)	262463.68	0.04			124.755	0.1349	
18(3,15) - 18(3,16)	17286.11	0.01	17286.10	0.10	148.405	0.9017	[25A]
19(2,17) - 18(3,16)	182802.11	0.02	182802.13	0.12	148.405	0.1355	
17(4,14) - 18(3,15)	39537.97	0.02	39537.98	0.10	148.982	0.0980	[25A]
18(2,16) - 18(1,17)	188870.78	0.01			133.510	0.5035	
19(2,18) - 18(3,15)	38706.69	0.02	38706.69	0.10	148.982	0.0810	[25A]
18(5,14) - 19(4,15)	162343.83	0.03			178.209	0.0946	
19(1,18) - 19(0,19)	293421.02	0.05	293421.62	0.16	138.085	0.2312	[25A]
19(3,16) - 19(2,17)	268660.05	0.02			154.503	0.4658	
18(5,13) - 19(4,16)	163961.59	0.03			178.157	0.0946	
19(2,17) - 19(2,18)	126809.31	0.02			150.273	0.3294	
19(4,15) - 19(4,16)	1584.88	0.00			178.157	1.6008	
20(3,17) - 19(4,16)	17521.29	0.02	17521.12	0.10	178.157	0.1129	
18(2,16) - 19(1,19)	45832.37	0.05			138.281	0.0176	
18(4,14) - 19(3,17)	35803.31	0.02	35803.30	0.10	162.690	0.1025	[25A]
18(6,12) - 19(5,15)	297956.09	0.07			197.911	0.0832	
19(1,18) - 19(1,19)	287553.91	0.05			138.281	0.1333	
19(3,16) - 19(3,17)	23203.42	0.01	23203.40	0.10	162.690	0.8398	[25A]
20(2,18) - 19(3,17)	218132.10	0.02			162.690	0.1492	
18(4,15) - 19(3,16)	11557.78	0.02			163.464	0.1054	
18(6,13) - 19(5,14)	297899.33	0.07			197.913	0.0832	
19(2,17) - 19(1,18)	198759.12	0.01			147.873	0.5146	
20(2,19) - 19(3,16)	47414.15	0.02			163.464	0.0791	
19(5,15) - 20(4,16)	138240.40	0.03	138240.43	0.08	193.300	0.1022	[25A]
20(3,17) - 20(2,18)	263058.99	0.02			169.966	0.5078	
19(5,14) - 20(4,17)	140651.26	0.03			193.221	0.1021	
20(2,18) - 20(2,19)	147514.53	0.02			165.046	0.3098	
20(4,16) - 20(4,17)	2354.74	0.00			193.221	1.5135	
21(3,18) - 20(4,17)	47787.52	0.02	47787.49	0.10	193.221	0.1203	[25A]
19(2,17) - 20(1,20)	59880.26	0.06			152.505	0.0155	
19(4,15) - 20(3,18)	14585.25	0.01	14585.10	0.10	177.723	0.1084	
19(6,13) - 20(5,16)	274873.21	0.06			212.954	0.0910	
20(3,17) - 20(3,18)	30521.66	0.01	30521.65	0.10	177.723	0.7820	[25A]
21(2,19) - 20(3,18)	253991.96	0.03			177.723	0.1642	
19(6,14) - 20(5,15)	274778.92	0.06			212.957	0.0910	
20(2,18) - 20(1,19)	210618.42	0.02			162.941	0.5207	
21(2,20) - 20(3,17)	53809.37	0.02	53809.34	0.10	178.741	0.0762	[25A]
20(5,16) - 21(4,17)	113780.64	0.03			209.159	0.1097	
21(3,18) - 21(2,19)	258426.71	0.02			186.195	0.5507	
22(3,20) - 21(4,17)	25928.44	0.01	25928.50	0.10	209.159	0.1186	[25A]
20(5,15) - 21(4,18)	117298.39	0.03			209.044	0.1095	
21(2,19) - 21(2,20)	169660.93	0.02			180.536	0.2932	
21(4,17) - 21(4,18)	3424.68	0.00			209.044	1.4329	
22(3,19) - 21(4,18)	79302.46	0.02	79302.57	0.10	209.044	0.1279	
20(2,18) - 21(1,21)	76131.19	0.08			167.427	0.0137	
20(6,14) - 21(5,17)	251703.21	0.06			228.753	0.0987	
21(3,18) - 21(3,19)	39394.05	0.01	39394.06	0.10	193.501	0.7282	[25A]
22(2,20) - 21(3,19)	290255.00	0.03			193.501	0.1809	
20(6,15) - 21(5,16)	251550.55	0.06			228.758	0.0987	
21(2,19) - 21(1,20)	224468.57	0.02	224468.94	0.12	178.708	0.5222	[25A]
22(2,21) - 21(3,18)	57721.57	0.03	57721.48	0.10	194.815	0.0723	[25A]
21(5,17) - 22(4,18)	88893.33	0.02			225.788	0.1172	
22(3,19) - 22(2,20)	255012.29	0.03			203.183	0.5932	

TABLE 6. The microwave spectrum of $H^{12}COOH$. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
23(3,21) - 22(4,18)	44926.87	0.02	44926.87	0.10	225.788	0.1225	[25A]
21(5,16) - 22(4,19)	93927.39	0.02			225.625	0.1168	
22(2,20) - 22(2,21)	193139.38	0.03	193139.37	0.12	196.741	0.2794	
22(4,18) - 22(4,19)	4883.66	0.00			225.625	1.3578	
23(3,20) - 22(4,19)	112095.68	0.02	112095.64	0.08	225.625	0.1358	
21(2,19) - 22(1,22)	94440.16	0.09			183.045	0.0121	
21(6,15) - 22(5,18)	228440.61	0.06			245.310	0.1064	
22(3,19) - 22(3,20)	49949.34	0.01	49949.28	0.10	210.023	0.6782	[25A]
21(6,16) - 22(5,17)	228199.19	0.06			245.318	0.1064	
22(2,20) - 22(1,21)	240289.87	0.02	240289.88	0.12	195.168	0.5198	
23(2,22) - 22(3,19)	59013.00	0.03	59012.89	0.10	211.690	0.0676	[25A]
22(5,18) - 23(4,19)	63495.68	0.02	63495.67	0.10	243.192	0.1245	[25A]
23(3,20) - 23(2,21)	253042.06	0.03			220.924	0.6341	
24(3,22) - 23(4,19)	62860.31	0.02			243.192	0.1255	
22(5,17) - 23(4,20)	70570.92	0.02	70570.90	0.10	242.964	0.1240	[25A]
23(2,21) - 23(2,22)	217824.48	0.03			213.658	0.2679	
23(4,19) - 23(4,20)	6837.86	0.00			242.964	1.2874	
24(3,21) - 23(4,20)	146162.45	0.02			242.964	0.1440	
22(2,20) - 23(1,23)	114644.62	0.11			199.359	0.0108	
22(6,16) - 23(5,19)	205080.93	0.05			262.625	0.1140	
23(3,20) - 23(3,21)	62285.15	0.01	62285.14	0.10	227.287	0.6318	[25A]
22(6,17) - 23(5,18)	204707.25	0.05			262.638	0.1141	
23(2,21) - 23(1,22)	258018.03	0.03			212.317	0.5146	
24(2,23) - 23(3,20)	57585.65	0.04			229.364	0.0626	
23(5,19) - 24(4,20)	37493.23	0.02	37493.25	0.10	261.375	0.1317	[25A]
24(3,21) - 24(2,22)	252715.93	0.03			239.410	0.6722	
25(3,23) - 24(4,20)	79539.29	0.02			261.375	0.1275	
23(5,18) - 24(4,21)	47270.99	0.02	47270.98	0.10	261.061	0.1309	[25A]
24(2,22) - 24(2,23)	243574.46	0.04			231.285	0.2586	
24(4,20) - 24(4,21)	9411.13	0.01	9411.14	0.10	261.061	1.2209	[25A]
25(3,22) - 24(4,21)	181464.35	0.03			261.061	0.1527	
23(2,21) - 24(1,24)	136565.42	0.14			216.369	0.0096	
23(6,17) - 24(5,20)	181621.05	0.05			280.699	0.1216	
24(3,21) - 24(3,22)	76464.27	0.02			245.289	0.5892	
23(6,18) - 24(5,19)	181053.94	0.05			280.718	0.1217	
24(2,22) - 24(1,23)	277542.39	0.04			230.152	0.5074	
25(2,24) - 24(3,21)	53384.82	0.05			247.840	0.0573	
24(5,20) - 25(4,21)	10780.63	0.02			280.339	0.1387	
24(7,18) - 25(6,19)	293076.68	0.08			323.608	0.1181	
25(3,22) - 25(2,23)	254206.16	0.03			258.634	0.7062	
26(3,24) - 25(4,21)	94760.48	0.03			280.339	0.1283	
24(5,19) - 25(4,22)	24080.12	0.01	24080.25	0.10	279.914	0.1376	
24(7,17) - 25(6,20)	293109.39	0.08	293109.30	0.16	323.606	0.1181	[25A]
25(2,23) - 25(2,24)	270231.90	0.05			249.620	0.2513	
25(4,21) - 25(4,22)	12744.36	0.01	12744.33	0.10	279.914	1.1576	[25A]
26(3,23) - 25(4,22)	217932.49	0.03			279.914	0.1621	
24(2,22) - 25(1,25)	160007.76	0.16			234.073	0.0087	
24(6,18) - 25(5,21)	158059.75	0.04			299.532	0.1292	
25(3,22) - 25(3,23)	92513.94	0.02			264.028	0.5502	
26(4,22) - 25(5,21)	16756.45	0.02			299.532	0.1457	
24(6,19) - 25(5,20)	157214.63	0.04			299.559	0.1292	
25(2,23) - 25(1,24)	298707.83	0.05			248.671	0.4992	
26(2,25) - 25(3,22)	46399.61	0.06			267.114	0.0520	
25(7,19) - 26(6,20)	269814.05	0.08			343.168	0.1258	
26(3,23) - 26(2,24)	257657.79	0.03			278.589	0.7353	
27(3,25) - 26(4,22)	108309.90	0.03			300.091	0.1279	
25(7,18) - 26(6,21)	269866.15	0.08			343.166	0.1258	
26(2,24) - 26(2,25)	297625.45	0.06			268.662	0.2457	
26(4,22) - 26(4,23)	16993.59	0.01	16993.60	0.10	299.524	1.0970	[25A]
27(3,24) - 26(4,23)	255472.13	0.04			299.524	0.1723	
25(2,23) - 26(1,26)	184762.76	0.19			252.471	0.0079	
25(6,19) - 26(5,22)	134398.23	0.04			319.125	0.1366	
26(3,23) - 26(3,24)	110427.66	0.02	110427.70	0.08	283.500	0.5150	[25A]

TABLE 6. The microwave spectrum of $H^{12}COOH$. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
26(5,21) - 26(5,22)	1206.06	0.00			319.125	1.8242	
27(4,23) - 26(5,22)	45237.86	0.02	45237.87	0.10	319.125	0.1525	[25A]
25(6,20) - 26(5,21)	133159.93	0.04			319.165	0.1367	
27(2,26) - 26(3,23)	36660.59	0.08			287.184	0.0469	
27(4,24) - 26(5,21)	21705.46	0.01	21705.60	0.10	319.165	0.1500	[25A]
26(7,20) - 27(6,21)	246452.24	0.07	246456.16	1.00	363.486	0.1335	[28A]
27(3,24) - 27(2,25)	263189.30	0.04			299.267	0.7585	
28(3,26) - 27(4,23)	119967.65	0.04			320.633	0.1262	
26(7,19) - 27(6,22)	246533.70	0.07			363.483	0.1335	
27(4,23) - 27(4,24)	22326.35	0.01	22326.28	0.10	319.889	1.0389	[25A]
28(3,25) - 27(4,24)	293967.86	0.05	293968.65	0.16	319.889	0.1836	[25A]
26(2,24) - 27(1,27)	210609.92	0.23			271.564	0.0072	
26(6,20) - 27(5,23)	110640.81	0.03			339.477	0.1440	
27(3,24) - 27(3,25)	130168.65	0.03	130168.72	0.08	303.704	0.4834	[25A]
27(5,22) - 27(5,23)	1734.71	0.00			339.477	1.7477	
28(4,24) - 27(5,23)	74784.03	0.02	74783.93	0.10	339.477	0.1592	
26(6,21) - 27(5,22)	108854.83	0.03			339.535	0.1441	
28(4,25) - 27(5,22)	44133.09	0.02	44133.09	0.10	339.535	0.1556	[25A]
27(7,21) - 28(6,22)	222981.17	0.07			384.562	0.1411	
28(3,25) - 28(2,26)	270892.45	0.04			320.658	0.7756	
29(3,27) - 28(4,24)	129514.32	0.04			341.972	0.1233	
27(7,20) - 28(6,23)	223106.36	0.07			384.558	0.1411	
28(4,24) - 28(4,25)	28916.23	0.01	28916.28	0.10	341.007	0.9828	[25A]
27(2,25) - 28(1,28)	237321.05	0.26			291.350	0.0067	
27(6,21) - 28(5,24)	86795.62	0.03			360.590	0.1512	
28(3,25) - 28(3,26)	151673.86	0.03	151673.85	0.08	324.635	0.4554	
28(5,23) - 28(5,24)	2458.01	0.00			360.590	1.6753	
29(4,25) - 28(5,24)	105509.50	0.02			360.590	0.1659	
27(6,22) - 28(5,23)	84257.61	0.03			360.672	0.1514	
29(4,26) - 28(5,23)	66115.61	0.02	66115.60	0.10	360.672	0.1608	[25A]
28(7,22) - 29(6,23)	199389.43	0.06			406.397	0.1487	
29(3,26) - 29(2,27)	280830.29	0.05			342.757	0.7865	
30(3,28) - 29(4,25)	136738.83	0.05			364.110	0.1191	
28(7,21) - 29(6,24)	199578.74	0.06			406.391	0.1487	
29(4,25) - 29(4,26)	36935.87	0.01	36935.83	0.10	362.878	0.9287	[25A]
28(2,26) - 29(1,29)	264665.59	0.31			311.830	0.0062	
28(6,22) - 29(5,25)	62875.48	0.02	62875.47	0.10	382.464	0.1583	[25A]
29(3,26) - 29(3,27)	174857.76	0.04			346.292	0.4308	
29(5,24) - 29(5,25)	3434.05	0.00			382.464	1.6064	
30(4,26) - 29(5,25)	137515.52	0.03			382.464	0.1725	
28(6,23) - 29(5,24)	59318.72	0.02	59318.73	0.10	382.579	0.1585	[25A]
30(4,27) - 29(5,24)	87532.77	0.03			382.579	0.1654	
29(7,23) - 30(6,24)	175663.96	0.05			428.992	0.1562	
30(3,27) - 30(2,28)	293033.62	0.05			365.555	0.7915	
31(3,29) - 30(4,26)	141447.34	0.06			387.051	0.1139	
29(7,22) - 30(6,25)	175945.96	0.05			428.983	0.1562	
30(4,26) - 30(4,27)	46548.70	0.02	46548.73	0.10	385.499	0.8765	[25A]
29(2,27) - 30(1,30)	292417.37	0.35			333.003	0.0058	
29(6,23) - 30(5,26)	38898.74	0.02	38898.75	0.10	405.099	0.1653	[25A]
30(3,27) - 30(3,28)	199615.36	0.05			368.671	0.4094	
30(5,25) - 30(5,26)	4733.80	0.00			405.099	1.5406	
31(4,27) - 30(5,26)	170882.48	0.04			405.099	0.1793	
29(6,24) - 30(5,25)	33979.74	0.02	33979.90	0.10	405.257	0.1656	[25A]
31(4,28) - 30(5,25)	108248.33	0.03			405.257	0.1693	
30(7,24) - 31(6,25)	151789.70	0.05			452.347	0.1636	
32(3,30) - 31(4,27)	143472.29	0.07			410.799	0.1077	
30(7,23) - 31(6,26)	152203.86	0.05			452.334	0.1636	
31(4,27) - 31(4,28)	57900.35	0.02	57900.36	0.10	408.868	0.8264	
32(5,27) - 31(6,26)	18182.66	0.02			452.334	0.1793	
30(6,24) - 31(5,27)	14890.25	0.02			428.495	0.1721	
30(8,22) - 31(7,25)	287986.95	0.10			480.726	0.1528	
31(3,28) - 31(3,29)	225824.33	0.06			391.770	0.3910	
31(5,26) - 31(5,27)	6442.64	0.01			428.495	1.4775	

TABLE 6. The microwave spectrum of H ^{12}COOH. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
32(4,28) - 31(5,27)	205663.02	0.04			428.495	0.1862	
30(8,23) - 31(7,24)	287969.89	0.10			480.726	0.1528	
32(4,29) - 31(5,26)	128109.68	0.04			428.710	0.1724	
31(7,25) - 32(6,26)	127749.09	0.04			476.464	0.1710	
33(3,31) - 32(4,28)	142680.62	0.08			435.355	0.1009	
33(5,29) - 32(6,26)	33083.98	0.02	33084.00	0.10	476.464	0.1850	[25A]
31(7,24) - 32(6,27)	128349.30	0.04			476.445	0.1710	
32(4,28) - 32(4,29)	71110.71	0.02	71110.88	0.10	432.983	0.7786	[25A]
33(5,28) - 32(6,27)	45175.29	0.02	45175.55	0.10	476.445	0.1860	[25A]
31(8,23) - 32(7,26)	264632.69	0.09			504.798	0.1605	
32(3,29) - 32(3,30)	253346.32	0.08			415.585	0.3755	
32(5,27) - 32(5,28)	8661.55	0.01	8661.55	0.10	452.651	1.4165	[25A]
33(4,29) - 32(5,28)	241877.06	0.05			452.651	0.1934	
31(8,24) - 32(7,25)	264606.23	0.09			504.798	0.1605	
33(4,30) - 32(5,27)	146947.83	0.04			452.940	0.1747	
32(7,26) - 33(6,27)	103521.59	0.04			501.344	0.1783	
34(3,32) - 33(4,29)	138980.13	0.10			460.720	0.0937	
34(5,30) - 33(6,27)	56958.32	0.02	56958.30	0.10	501.344	0.1911	[25A]
32(7,25) - 33(6,28)	104380.54	0.04			501.317	0.1783	
33(4,29) - 33(4,30)	86267.69	0.03			457.842	0.7332	
34(5,29) - 33(6,28)	72906.57	0.02			501.317	0.1925	
32(8,24) - 33(7,27)	241192.35	0.09			529.626	0.1681	
33(3,30) - 33(3,31)	282027.90	0.09			440.115	0.3626	
33(5,28) - 33(5,29)	11507.87	0.01			477.568	1.3575	
34(4,30) - 33(5,29)	279509.23	0.06			477.568	0.2010	
32(8,25) - 33(7,26)	241151.90	0.09			529.628	0.1681	
34(4,31) - 33(5,28)	164577.94	0.05			477.952	0.1759	
33(7,27) - 34(6,28)	79082.99	0.03	79083.15	0.10	526.988	0.1855	
35(3,33) - 34(4,30)	132323.17	0.12			486.891	0.0864	
35(5,31) - 34(6,28)	80679.49	0.03			526.988	0.1969	
33(7,26) - 34(6,29)	80297.60	0.03			526.949	0.1854	
34(4,30) - 34(4,31)	103423.42	0.04			483.442	0.6906	
35(5,30) - 34(6,29)	101487.16	0.03			526.949	0.1988	
33(8,25) - 34(7,28)	217660.71	0.08			555.212	0.1756	
34(5,29) - 34(5,30)	15115.26	0.01	15114.96	0.10	503.244	1.2999	
33(8,26) - 34(7,27)	217599.72	0.08			555.214	0.1756	
35(4,32) - 34(5,29)	180800.65	0.06			503.749	0.1761	
34(7,28) - 35(6,29)	54404.70	0.03	54404.71	0.10	553.398	0.1926	[25A]
36(3,34) - 35(4,31)	122707.50	0.14			513.869	0.0791	
36(5,32) - 35(6,29)	104174.64	0.03			553.398	0.2023	
34(7,27) - 35(6,30)	56102.82	0.03	56102.83	0.10	553.343	0.1925	[25A]
35(4,31) - 35(4,32)	122593.13	0.04			509.779	0.6509	
36(5,31) - 35(6,30)	131035.17	0.04			553.343	0.2050	
34(8,26) - 35(7,29)	194032.60	0.07			581.556	0.1831	
35(5,30) - 35(5,31)	19632.68	0.01	19632.71	0.10	529.680	1.2437	[25A]
34(8,27) - 35(7,28)	193941.81	0.07			581.559	0.1831	
36(4,33) - 35(5,30)	195404.32	0.06			530.334	0.1751	
35(7,29) - 36(6,30)	29452.95	0.02	29452.90	0.10	580.574	0.1996	[25A]
37(3,35) - 36(4,32)	110174.55	0.17			541.648	0.0720	
37(5,33) - 36(6,30)	127358.20	0.04			580.574	0.2074	
35(7,28) - 36(6,31)	31801.37	0.02	31801.40	0.10	580.499	0.1995	[25A]
36(4,32) - 36(4,33)	143756.45	0.06			536.852	0.6144	
37(5,32) - 36(6,31)	161672.44	0.04			580.499	0.2111	
35(8,27) - 36(7,30)	170302.92	0.06			608.659	0.1906	
36(5,31) - 36(5,32)	25222.06	0.01	25222.20	0.10	556.873	1.1886	[25A]
35(8,28) - 36(7,29)	170169.41	0.06			608.663	0.1906	
37(4,34) - 36(5,31)	208168.57	0.07			557.714	0.1728	
36(9,28) - 37(8,29)	282729.04	0.13			669.227	0.1875	
38(3,36) - 37(4,33)	94805.76	0.20			570.224	0.0654	
38(5,34) - 37(6,31)	150130.98	0.05			608.519	0.2119	
36(9,27) - 37(8,30)	282737.39	0.13			669.226	0.1875	
37(4,33) - 37(4,34)	166860.44	0.07			564.658	0.5813	
38(5,33) - 37(6,32)	193519.64	0.05			608.416	0.2171	

TABLE 6. The microwave spectrum of $H^{12}COOH$. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
36(8,28) - 37(7,31)	146466.79	0.05			636.520	0.1979	
37(5,32) - 37(5,33)	32054.45	0.02	32054.41	0.10	584.822	1.1345	[25A]
36(8,29) - 37(7,30)	146272.70	0.05			636.526	0.1979	
38(4,35) - 37(5,32)	218869.24	0.08			585.891	0.1692	
37(9,29) - 38(8,30)	259302.55	0.12			697.804	0.1950	
39(5,35) - 38(6,32)	172379.29	0.05			637.235	0.2159	
37(9,28) - 38(8,31)	259315.24	0.12			697.804	0.1950	
38(4,34) - 38(4,35)	191823.50	0.09			593.192	0.5514	
38(6,32) - 38(6,33)	4166.43	0.01			637.096	1.7358	
39(5,34) - 38(6,33)	226689.91	0.06			637.096	0.2230	
37(8,29) - 38(7,32)	122519.65	0.05			665.140	0.2052	
38(5,33) - 38(5,34)	40304.62	0.02	40304.66	0.10	613.527	1.0813	[25A]
39(6,33) - 38(7,32)	47479.06	0.02	47478.88	0.10	665.140	0.2198	[25A]
37(8,30) - 38(7,31)	122240.57	0.05			665.149	0.2052	
39(4,36) - 38(5,33)	227284.76	0.09			614.871	0.1643	
39(6,34) - 38(7,31)	41634.40	0.02	41634.47	0.10	665.149	0.2195	[25A]
38(9,30) - 39(8,31)	235793.47	0.11			727.137	0.2026	
40(5,36) - 39(6,33)	193974.21	0.06			666.724	0.2193	
38(9,29) - 39(8,32)	235812.57	0.11			727.137	0.2026	
39(4,35) - 39(4,36)	218539.39	0.11			622.453	0.5249	
39(6,33) - 39(6,34)	5573.76	0.01			666.538	1.6765	
40(5,35) - 39(6,34)	261281.80	0.07			666.538	0.2289	
38(8,30) - 39(7,33)	98457.45	0.04			694.520	0.2125	
39(5,34) - 39(5,35)	50144.19	0.03			642.985	1.0291	
40(6,34) - 39(7,33)	74000.21	0.03			694.520	0.2263	
38(8,31) - 39(7,32)	98060.37	0.04			694.533	0.2125	
40(4,37) - 39(5,34)	233203.79	0.10			644.657	0.1582	
40(6,35) - 39(7,32)	66229.72	0.03	66229.70	0.10	694.533	0.2258	
39(9,31) - 40(8,32)	212196.44	0.10			757.227	0.2101	
41(5,37) - 40(6,34)	214771.09	0.07			696.988	0.2219	
39(9,30) - 40(8,33)	212224.85	0.10			757.226	0.2101	
40(4,36) - 40(4,37)	246880.80	0.13			652.436	0.5016	
40(6,34) - 40(6,35)	7385.84	0.01			696.742	1.6187	
41(5,36) - 40(6,35)	297371.99	0.08			696.742	0.2350	
39(8,31) - 40(7,34)	74276.87	0.03			724.660	0.2196	
40(5,35) - 40(5,36)	61733.82	0.03	61733.87	0.10	673.194	0.9780	[25A]
41(6,35) - 40(7,34)	101075.50	0.03			724.660	0.2326	
39(8,32) - 40(7,33)	73717.52	0.03			724.678	0.2196	
41(4,38) - 40(5,35)	236433.80	0.12			675.253	0.1511	
41(6,36) - 40(7,33)	90838.13	0.03			724.678	0.2319	
40(9,32) - 41(8,33)	188505.69	0.09			788.074	0.2175	
42(5,38) - 41(6,35)	234609.32	0.08			728.031	0.2237	
40(9,31) - 41(8,34)	188547.51	0.09			788.072	0.2175	
41(4,37) - 41(4,38)	276702.13	0.15			683.140	0.4814	
41(6,35) - 41(6,36)	9696.71	0.01	9696.87	0.10	727.708	1.5621	[25A]
41(5,36) - 41(5,37)	75215.06	0.04			704.152	0.9283	
42(6,36) - 41(7,35)	128789.67	0.04			755.560	0.2388	
42(4,39) - 41(5,36)	236809.65	0.14			706.661	0.1430	
42(6,37) - 41(7,34)	115421.47	0.04			755.585	0.2378	
41(9,33) - 42(8,34)	164714.97	0.08			819.678	0.2249	
43(5,39) - 42(6,36)	253312.47	0.09			759.856	0.2246	
41(9,32) - 42(8,35)	164775.88	0.08			819.676	0.2249	
42(6,36) - 42(6,37)	12615.57	0.01			759.435	1.5065	
42(5,37) - 42(5,38)	90702.76	0.05			735.857	0.8801	
43(6,37) - 42(7,36)	157238.13	0.05			787.222	0.2448	
43(4,40) - 42(5,37)	234201.47	0.16			738.882	0.1344	
43(6,38) - 42(7,35)	139932.95	0.05			787.256	0.2434	
42(9,34) - 43(8,35)	140817.45	0.07			852.039	0.2322	
44(5,40) - 43(6,37)	270689.08	0.10			792.466	0.2244	
42(9,33) - 43(8,36)	140905.31	0.07			852.037	0.2322	
43(6,37) - 43(6,38)	16267.23	0.01			791.924	1.4517	
42(10,32) - 43(9,35)	277478.96	0.19			889.055	0.2220	
43(5,38) - 43(5,39)	108279.08	0.06			768.306	0.8340	

TABLE 6. The microwave spectrum of $H^{12}COOH$. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
44(6,38) - 43(7,37)	186526.46	0.05			819.644	0.2506	
42(10,33) - 43(9,34)	277475.07	0.19			889.056	0.2220	
44(4,41) - 43(5,38)	228520.86	0.19			771.917	0.1253	
44(6,39) - 43(7,36)	164316.06	0.05			819.692	0.2487	
43(9,35) - 44(8,36)	116805.60	0.06			885.159	0.2394	
45(5,41) - 44(6,38)	286534.13	0.11			825.866	0.2230	
43(9,34) - 44(8,37)	116931.17	0.06			885.155	0.2394	
44(6,38) - 44(6,39)	20791.76	0.02	20791.61	0.10	825.173	1.3976	[25A]
43(10,33) - 44(9,36)	254026.32	0.18			922.129	0.2295	
44(5,39) - 44(5,40)	127989.55	0.08			801.496	0.7902	
45(6,39) - 44(7,38)	216769.07	0.06			852.829	0.2563	
43(10,34) - 44(9,35)	254020.48	0.18			922.129	0.2295	
45(4,42) - 44(5,39)	219724.73	0.22			805.765	0.1161	
45(6,40) - 44(7,37)	188503.66	0.06			852.893	0.2536	
45(6,39) - 45(6,40)	26343.22	0.02			859.180	1.3439	
44(10,34) - 45(9,37)	230499.72	0.16			955.957	0.2370	
45(5,40) - 45(5,41)	149841.62	0.10			835.424	0.7490	
46(6,40) - 45(7,39)	248086.74	0.07			886.775	0.2618	
44(10,35) - 45(9,36)	230491.04	0.16			955.957	0.2370	
46(4,43) - 45(5,40)	207816.51	0.26			840.422	0.1070	
46(6,41) - 45(7,38)	212416.94	0.07			886.861	0.2582	
46(6,40) - 46(6,41)	33087.15	0.02	33087.20	0.10	893.946	1.2906	[25A]
45(10,35) - 46(9,38)	206895.37	0.15			990.540	0.2444	
46(5,41) - 46(5,42)	173805.64	0.12			870.087	0.7107	
47(6,41) - 46(7,40)	280603.02	0.09			921.483	0.2672	
45(10,36) - 46(9,37)	206882.58	0.15			990.540	0.2444	
47(6,42) - 46(7,39)	235964.47	0.09			921.598	0.2623	
47(6,41) - 47(6,42)	41196.72	0.03	41196.65	0.10	929.469	1.2377	[25A]
46(10,36) - 47(9,39)	183209.34	0.14			1025.878	0.2518	
47(5,42) - 47(5,43)	199817.48	0.14			905.483	0.6755	
46(10,37) - 47(9,38)	183190.69	0.14			1025.879	0.2518	
48(6,43) - 47(7,40)	259041.38	0.10			957.106	0.2659	
47(11,37) - 48(10,38)	295694.63	0.33			1103.343	0.2489	
47(11,36) - 48(10,39)	295695.80	0.33			1103.343	0.2489	
48(6,42) - 48(6,43)	50847.40	0.03	50847.48	0.10	965.746	1.1851	[25A]
49(7,42) - 48(8,41)	156683.55	0.06			1025.214	0.2789	
48(5,43) - 48(5,44)	227782.36	0.16			941.607	0.6436	
49(6,44) - 48(7,41)	281528.51	0.12			993.386	0.2689	
49(6,43) - 49(6,44)	62210.43	0.04	62210.46	0.10	1002.777	1.1331	[25A]
50(7,43) - 49(8,42)	184260.36	0.07			1062.127	0.2848	
49(5,44) - 49(5,45)	257578.99	0.19			978.456	0.6150	
50(6,44) - 50(6,45)	75445.28	0.05			1040.558	1.0817	
50(5,45) - 50(5,46)	289063.48	0.23			1016.028	0.5898	
51(6,45) - 51(6,46)	90691.89	0.06			1079.087	1.0312	
52(6,46) - 52(6,47)	108063.41	0.07			1118.363	0.9821	
53(6,47) - 53(6,48)	127640.14	0.09			1158.381	0.9346	
54(6,48) - 54(6,49)	149465.46	0.10			1199.140	0.8891	
55(6,49) - 55(6,50)	173544.04	0.12			1240.636	0.8461	
56(6,50) - 56(6,51)	199842.23	0.14			1282.866	0.8058	

TABLE 7. The microwave spectrum of H ^{12}COOD. Frequencies in MHz.

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
1(0, 1) – 0(0, 0)	21732.47	0.00			0.000	1.0000	
1(1, 1) – 0(0, 0)	76068.70	0.05			0.000	0.0350	
1(1, 0) – 1(0, 1)	56128.64	0.05	56128.75	0.05	0.725	0.0525	
2(0, 2) – 1(0, 1)	43421.08	0.01	43421.10	0.05	0.725	1.9996	[26A]
2(1, 2) – 1(0, 1)	96008.81	0.05			0.725	0.0525	
1(1, 0) – 1(1, 1)	1792.40	0.00			2.537	1.5000	
2(1, 2) – 1(1, 1)	41672.58	0.01	41672.52	0.05	2.537	1.5000	[26A]
2(2, 0) – 1(1, 1)	210091.02	0.45			2.537	0.0516	
2(1, 1) – 1(1, 0)	45257.28	0.01	45257.37	0.05	2.597	1.5000	[26A]
2(2, 1) – 1(1, 0)	208255.01	0.45			2.597	0.0525	
2(1, 1) – 2(0, 2)	57964.84	0.05	57965.03	0.05	2.173	0.0861	
3(0, 3) – 2(0, 2)	65022.18	0.01	65022.21	0.05	2.173	2.9984	
3(2, 1) – 2(0, 2)	286378.28	0.48			2.173	0.0013	
3(2, 1) – 2(2, 0)	65372.11	0.01	65372.08	0.05	9.545	1.6667	
3(1, 3) – 2(0, 2)	115069.20	0.05			2.173	0.0706	
3(2, 2) – 2(2, 1)	65197.86	0.01	65197.90	0.05	9.544	1.6667	
2(1, 1) – 2(1, 2)	5377.10	0.01			3.927	0.8333	
2(2, 1) – 2(1, 2)	168374.83	0.45			3.927	0.0292	
3(1, 3) – 2(1, 2)	62481.47	0.01			3.927	2.6665	
3(0, 3) – 2(1, 2)	12434.44	0.05			3.927	0.0379	
3(2, 1) – 2(1, 2)	233790.55	0.45			3.927	0.0555	
2(2, 0) – 2(1, 1)	163041.34	0.45			4.107	0.0306	
3(1, 2) – 2(1, 1)	67857.60	0.01	67857.62	0.05	4.107	2.6665	[26A]
3(2, 2) – 2(1, 1)	228195.59	0.45			4.107	0.0583	
3(2, 2) – 3(0, 3)	221138.25	0.48			4.342	0.0023	
3(1, 2) – 3(0, 3)	60800.26	0.05	60800.33	0.05	4.342	0.1175	
3(3, 0) – 3(2, 1)	275916.84	1.96			11.726	0.0313	
4(0, 4) – 3(0, 3)	86492.97	0.02			4.342	3.9961	
4(2, 2) – 3(2, 1)	87329.90	0.01			11.726	2.9999	
4(1, 4) – 3(0, 3)	133305.44	0.05			4.342	0.0896	
3(3, 1) – 3(2, 2)	276134.04	1.96			11.719	0.0312	
4(2, 3) – 3(2, 2)	86895.46	0.01			11.719	2.9998	
2(2, 0) – 3(1, 3)	105936.97	0.45			6.012	0.0056	
3(1, 2) – 3(1, 3)	10753.23	0.01			6.012	0.5835	
3(2, 2) – 3(1, 3)	171091.22	0.45			6.012	0.0504	
4(1, 4) – 3(1, 3)	83258.41	0.02			6.012	3.7495	
4(3, 2) – 3(3, 1)	87016.92	0.01			20.929	1.7501	
4(0, 4) – 3(1, 3)	36445.95	0.05	36446.15	0.05	6.012	0.0589	
4(2, 2) – 3(1, 3)	258638.98	0.45			6.012	0.0595	
2(2, 1) – 3(1, 2)	95140.13	0.45			6.370	0.0062	
3(2, 1) – 3(1, 2)	160555.84	0.45			6.370	0.0554	
4(1, 3) – 3(1, 2)	90423.01	0.02			6.370	3.7494	
4(3, 1) – 3(3, 0)	87020.90	0.01			20.929	1.7501	
4(2, 3) – 3(1, 2)	247233.45	0.46			6.370	0.0659	
3(3, 1) – 4(2, 2)	188586.28	1.96			14.639	0.0044	
4(2, 3) – 4(0, 4)	221540.73	0.47			7.227	0.0053	
4(1, 3) – 4(0, 4)	64730.30	0.05	64730.12	0.05	7.227	0.1459	
4(3, 1) – 4(2, 2)	275607.84	1.96			14.639	0.0566	
5(0, 5) – 4(0, 4)	107793.29	0.02	107793.28	0.08	7.227	4.9923	
5(2, 3) – 4(2, 2)	109427.18	0.02			14.639	4.1996	
5(4, 1) – 4(4, 0)	108763.79	0.02	108763.77	0.08	36.721	1.8001	
5(1, 5) – 4(0, 4)	150806.74	0.05			7.227	0.1100	
3(3, 0) – 4(2, 3)	189239.24	1.96			14.617	0.0044	
4(3, 2) – 4(2, 3)	276255.50	1.96			14.617	0.0565	
5(2, 4) – 4(2, 3)	108563.08	0.02			14.617	4.1995	
5(4, 2) – 4(4, 1)	108763.72	0.02	108763.77	0.08	36.721	1.8001	
3(2, 1) – 4(1, 4)	88050.67	0.45			8.789	0.0121	
4(1, 3) – 4(1, 4)	17917.84	0.02	17917.85	0.10	8.789	0.4505	
4(2, 3) – 4(1, 4)	174728.27	0.45			8.789	0.0689	
5(1, 5) – 4(1, 4)	103994.28	0.02			8.789	4.7988	
5(3, 3) – 4(3, 2)	108805.81	0.02	108805.84	0.08	23.832	3.2001	
5(0, 5) – 4(1, 4)	60980.82	0.05			8.789	0.0818	
5(2, 3) – 4(1, 4)	284807.75	0.45			8.789	0.0625	

TABLE 7. The microwave spectrum of H ^{12}COOD. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
3(2, 2) – 4(1, 3)	69914.98	0.46			9.386	0.0143	
4(2, 2) – 4(1, 3)	157462.74	0.46			9.386	0.0804	
5(1, 4) – 4(1, 3)	112940.32	0.02			9.386	4.7987	
5(3, 2) – 4(3, 1)	108819.72	0.02	108819.76	0.08	23.832	3.2001	
5(2, 4) – 4(1, 3)	265373.52	0.46			9.386	0.0744	
4(3, 2) – 5(2, 3)	166176.02	1.96			18.289	0.0106	
5(2, 4) – 5(0, 5)	222310.53	0.47			10.823	0.0099	
5(1, 4) – 5(0, 5)	69877.33	0.05			10.823	0.1706	
5(3, 2) – 5(2, 3)	275000.38	1.96			18.289	0.0796	
6(0, 6) – 5(0, 5)	128888.49	0.02	128888.51	0.08	10.823	5.9869	
6(2, 4) – 5(2, 3)	131690.76	0.02	131690.58	0.08	18.289	5.3326	[26A]
6(4, 2) – 5(4, 1)	130546.00	0.02			40.349	3.3335	
6(1, 6) – 5(0, 5)	167694.66	0.05			10.823	0.1322	
4(3, 1) – 5(2, 4)	167697.06	1.96			18.238	0.0106	
5(2, 3) – 5(2, 4)	1516.40	0.00			18.238	1.4573	
5(3, 3) – 5(2, 4)	276498.23	1.96			18.238	0.0793	
6(2, 5) – 5(2, 4)	130193.29	0.02	130193.24	0.08	18.238	5.3323	[26A]
6(4, 3) – 5(4, 2)	130545.70	0.02			40.349	3.3335	
4(2, 2) – 5(1, 5)	71386.29	0.44			12.258	0.0182	
4(4, 0) – 5(3, 3)	277590.82	4.97			27.461	0.0036	
5(1, 4) – 5(1, 5)	26863.88	0.03			12.258	0.3677	
5(2, 4) – 5(1, 5)	179297.07	0.44			12.258	0.0856	
6(1, 6) – 5(1, 5)	124681.20	0.02	124681.25	0.08	12.258	5.8312	
6(3, 4) – 5(3, 3)	130614.29	0.02	130614.48	0.08	27.461	4.5001	[26A]
6(5, 2) – 5(5, 1)	130512.82	0.02	130512.69	0.08	56.916	1.8334	[26A]
6(0, 6) – 5(1, 5)	85875.03	0.05			12.258	0.1070	
4(2, 3) – 5(1, 4)	43870.11	0.46			13.154	0.0235	
4(4, 1) – 5(3, 2)	277572.26	4.97			27.462	0.0036	
5(2, 3) – 5(1, 4)	153949.59	0.46			13.154	0.1071	
6(1, 5) – 5(1, 4)	135394.99	0.02	135394.82	0.08	13.154	5.8308	[26A]
6(3, 3) – 5(3, 2)	130651.31	0.02	130651.42	0.08	27.462	4.5001	[26A]
6(5, 1) – 5(5, 0)	130512.82	0.02	130512.69	0.08	56.916	1.8334	[26A]
6(2, 5) – 5(1, 4)	282626.48	0.46			13.154	0.0838	
5(3, 3) – 6(2, 4)	143291.08	1.96			22.682	0.0177	
6(2, 5) – 6(0, 6)	223615.33	0.47			15.122	0.0165	
6(1, 5) – 6(0, 6)	76383.84	0.05			15.122	0.1909	
6(3, 3) – 6(2, 4)	273960.93	1.97			22.682	0.1017	
7(0, 7) – 6(0, 6)	149753.65	0.02	149753.66	0.08	15.122	6.9799	[16A]
7(2, 5) – 6(2, 4)	154137.68	0.02	154137.58	0.08	22.682	6.4275	[16A]
7(4, 3) – 6(4, 2)	152344.46	0.02	152344.38	0.08	44.703	4.7145	[16A]
7(6, 1) – 6(6, 0)	152265.07	0.03	152264.95	0.08	81.513	1.8573	[16A]
7(1, 7) – 6(0, 6)	184118.98	0.05			15.122	0.1564	
5(3, 2) – 6(2, 5)	146323.49	1.96			22.581	0.0176	
6(2, 4) – 6(2, 5)	3013.86	0.01			22.581	1.2228	
6(3, 4) – 6(2, 5)	276919.23	1.97			22.581	0.1010	
7(2, 6) – 6(2, 5)	151778.74	0.02	151778.74	0.08	22.581	6.4267	[16A]
7(4, 4) – 6(4, 3)	152343.46	0.02	152343.36	0.08	44.703	4.7145	[16A]
7(6, 2) – 6(6, 1)	152265.07	0.03	152264.95	0.08	81.513	1.8573	[16A]
7(1, 6) – 6(2, 5)	10539.29	0.46			22.581	0.0450	
5(2, 3) – 6(1, 6)	56132.27	0.44			16.417	0.0235	
5(4, 1) – 6(3, 4)	255740.31	4.97			31.818	0.0089	
6(1, 5) – 6(1, 6)	37577.67	0.04	37577.84	0.05	16.417	0.3114	
6(2, 5) – 6(1, 6)	184809.16	0.44			16.417	0.1009	
7(1, 7) – 6(1, 6)	145312.81	0.02	145312.87	0.08	16.417	6.8538	
7(3, 5) – 6(3, 4)	152442.87	0.02	152442.80	0.08	31.818	5.7144	[16A]
7(5, 3) – 6(5, 2)	152288.85	0.02	152288.87	0.08	61.270	3.4288	[16A]
7(0, 7) – 6(1, 6)	110947.48	0.05			16.417	0.1345	
5(2, 4) – 6(1, 5)	17038.20	0.46			17.670	0.0337	
5(4, 2) – 6(3, 3)	255684.67	4.97			31.820	0.0089	
6(2, 4) – 6(1, 5)	150245.36	0.46			17.670	0.1364	
7(1, 6) – 6(1, 5)	157770.78	0.02	157770.81	0.08	17.670	6.8528	[16A]
7(3, 4) – 6(3, 3)	152525.93	0.02	152526.01	0.08	31.820	5.7144	[16A]
7(5, 2) – 6(5, 1)	152288.86	0.02	152288.87	0.08	61.270	3.4288	[16A]

TABLE 7. The microwave spectrum of H ^{12}COOD. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
7(2, 6) - 6(1, 5)	299010.24	0.46			17.670	0.0939	
6(3, 4) - 7(2, 5)	119767.69	1.97			27.823	0.0252	
7(2, 6) - 7(0, 7)	225640.43	0.46			20.117	0.0250	
7(1, 6) - 7(0, 7)	84400.97	0.05			20.117	0.2063	
7(3, 4) - 7(2, 5)	272349.18	1.97			27.823	0.1236	
8(0, 8) - 7(0, 7)	170377.99	0.03			20.117	7.9716	
8(2, 6) - 7(2, 5)	176770.70	0.02			27.823	7.4989	
8(4, 4) - 7(4, 3)	174162.15	0.02			49.785	6.0003	
8(6, 2) - 7(6, 1)	174037.30	0.03			86.592	3.5002	
8(1, 8) - 7(0, 7)	200249.72	0.05			20.117	0.1827	
6(3, 3) - 7(2, 6)	125196.05	1.97			27.644	0.0248	
7(2, 5) - 7(2, 6)	5372.80	0.01			27.644	1.0486	
7(3, 5) - 7(2, 6)	277583.35	1.97			27.644	0.1221	
8(2, 7) - 7(2, 6)	173312.23	0.02			27.644	7.4970	
8(4, 5) - 7(4, 4)	174159.40	0.02			49.785	6.0003	
8(6, 3) - 7(6, 2)	174037.30	0.03			86.592	3.5002	
8(1, 7) - 7(2, 6)	38810.01	0.47			27.644	0.0574	
6(2, 4) - 7(1, 7)	42510.22	0.43			21.264	0.0274	
6(4, 2) - 7(3, 5)	233843.45	4.98			36.903	0.0152	
7(1, 6) - 7(1, 7)	50035.64	0.05	50035.60	0.05	21.264	0.2708	[26A]
7(2, 6) - 7(1, 7)	191275.10	0.43			21.264	0.1147	
8(1, 8) - 7(1, 7)	165884.39	0.02			21.264	7.8701	
8(3, 6) - 7(3, 5)	174290.40	0.02			36.903	6.8750	
8(5, 4) - 7(5, 3)	174075.91	0.02			66.350	4.8753	
8(7, 2) - 7(7, 1)	174020.44	0.03			110.509	1.8751	
8(0, 8) - 7(1, 7)	136012.66	0.05			21.264	0.1642	
6(4, 3) - 7(3, 4)	233704.44	4.98			36.908	0.0152	
7(2, 5) - 7(1, 6)	146612.26	0.46			22.933	0.1686	
8(1, 7) - 7(1, 6)	180049.47	0.02	180049.47	0.12	22.933	7.8681	
8(3, 5) - 7(3, 4)	174455.87	0.02	174455.89	0.12	36.908	6.8750	
8(5, 3) - 7(5, 2)	174075.93	0.02			66.350	4.8753	
8(7, 1) - 7(7, 0)	174020.44	0.03			110.509	1.8751	
7(3, 5) - 8(2, 6)	95439.86	1.97			33.720	0.0329	
8(2, 7) - 8(0, 8)	228574.66	0.45			25.801	0.0352	
8(1, 7) - 8(0, 8)	94072.44	0.06			25.801	0.2169	
8(3, 5) - 8(2, 6)	270034.36	1.97			33.720	0.1457	
9(0, 9) - 8(0, 8)	190768.08	0.03			25.801	8.9626	
9(2, 7) - 8(2, 6)	199574.95	0.02	199575.06	0.12	33.720	8.5549	
9(4, 5) - 8(4, 4)	196002.31	0.02			55.594	7.2225	
9(6, 3) - 8(6, 2)	195817.55	0.03			92.398	5.0003	
9(8, 1) - 8(8, 0)	195779.12	0.04			143.900	1.8890	
9(1, 9) - 8(0, 8)	216264.75	0.05			25.801	0.2112	
7(3, 4) - 8(2, 7)	104409.76	1.97			33.425	0.0322	
8(2, 6) - 8(2, 7)	8831.27	0.01	8831.27	0.10	33.425	0.9126	[26A]
8(3, 6) - 8(2, 7)	278561.53	1.97			33.425	0.1427	
9(2, 8) - 8(2, 7)	194786.73	0.02			33.425	8.5511	
9(4, 6) - 8(4, 5)	195995.72	0.02			55.594	7.2225	
9(6, 4) - 8(6, 3)	195817.55	0.03			92.398	5.0003	
9(8, 2) - 8(8, 1)	195779.12	0.04			143.900	1.8890	
9(1, 8) - 8(2, 7)	67708.39	0.47			33.425	0.0711	
7(2, 5) - 8(1, 8)	30763.50	0.43			26.797	0.0300	
7(4, 3) - 8(3, 6)	211897.50	4.98			42.717	0.0221	
8(1, 7) - 8(1, 8)	64200.71	0.06	64200.63	0.05	26.797	0.2406	
8(2, 7) - 8(1, 8)	198702.93	0.42			26.797	0.1271	
9(1, 9) - 8(1, 8)	186393.02	0.03	186393.10	0.12	26.797	8.8822	
9(3, 7) - 8(3, 6)	196153.99	0.02			42.717	7.9998	
9(5, 5) - 8(5, 4)	195875.55	0.03			72.156	6.2226	
9(7, 3) - 8(7, 2)	195789.97	0.03			116.314	3.5558	
9(0, 9) - 8(1, 8)	160896.35	0.05			26.797	0.1962	
7(4, 4) - 8(3, 5)	211592.03	4.98			42.727	0.0221	
8(2, 6) - 8(1, 7)	143333.49	0.46			28.939	0.2035	
9(1, 8) - 8(1, 7)	202210.61	0.03			28.939	8.8785	
9(3, 6) - 8(3, 5)	196455.59	0.02			42.727	7.9998	

TABLE 7. The microwave spectrum of H ^{12}COOD. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
9(5, 4) - 8(5, 3)	195875.62	0.03			72.156	6.2226	
9(7, 2) - 8(7, 1)	195789.97	0.03			116.314	3.5558	
8(3, 6) - 9(2, 7)	70155.31	1.98			40.377	0.0409	
9(2, 8) - 9(0, 9)	232593.32	0.44			32.164	0.0469	
9(1, 8) - 9(0, 9)	105514.97	0.07			32.164	0.2228	
9(3, 6) - 9(2, 7)	266915.00	1.97			40.377	0.1685	
10(0,10) - 9(0, 9)	210948.03	0.03	210948.03	0.12	32.164	9.9536	[16A]
10(2, 8) - 9(2, 7)	222517.65	0.03			40.377	9.6006	
10(4, 6) - 9(4, 5)	217868.57	0.02	217868.60	0.12	62.132	8.4003	
10(6, 4) - 9(6, 3)	217606.83	0.04	217606.89	0.12	98.929	6.4004	[16A]
10(8, 2) - 9(8, 1)	217546.56	0.04	217546.55	0.12	150.431	3.6002	[16A]
10(1,10) - 9(0, 9)	232334.20	0.05			32.164	0.2418	
8(3, 5) - 9(2, 8)	84078.89	1.98			39.922	0.0394	
9(2, 7) - 9(2, 8)	13619.48	0.02	13619.41	0.10	39.922	0.8026	[26A]
9(3, 7) - 9(2, 8)	279928.79	1.97			39.922	0.1631	
10(2, 9) - 9(2, 8)	216195.56	0.03	216195.58	0.12	39.922	9.5937	[16A]
10(4, 7) - 9(4, 6)	217854.34	0.03	217854.44	0.12	62.132	8.4003	
10(6, 5) - 9(6, 4)	217606.83	0.04	217606.89	0.12	98.929	6.4004	[16A]
10(8, 3) - 9(8, 2)	217546.56	0.04	217546.55	0.12	150.431	3.6002	[16A]
10(1, 9) - 9(2, 8)	97153.16	0.48			39.922	0.0864	
8(2, 6) - 9(1, 9)	21141.18	0.42			33.014	0.0310	
8(4, 4) - 9(3, 7)	189905.66	4.99			49.260	0.0293	
9(1, 8) - 9(1, 9)	80018.30	0.09			33.014	0.2175	
9(2, 8) - 9(1, 9)	207096.64	0.41			33.014	0.1382	
10(1,10) - 9(1, 9)	206837.53	0.03			33.014	9.8911	
10(3, 8) - 9(3, 7)	218028.98	0.02	218028.88	0.12	49.260	9.0996	
10(5, 6) - 9(5, 5)	217689.34	0.03	217689.54	0.12	78.690	7.5004	[16A]
10(7, 4) - 9(7, 3)	217565.48	0.04	217565.45	0.12	122.845	5.1003	[16A]
10(9, 2) - 9(9, 1)	217541.41	0.07	217541.42	0.12	181.685	1.9001	[16A]
10(0,10) - 9(1, 9)	185451.36	0.05			33.014	0.2299	
8(4, 5) - 9(3, 6)	189295.84	4.99			49.280	0.0293	
9(2, 7) - 9(1, 8)	140697.83	0.47			35.684	0.2403	
10(1, 9) - 9(1, 8)	224231.51	0.03			35.684	9.8850	
10(3, 7) - 9(3, 6)	218541.82	0.02			49.280	9.0996	
10(5, 5) - 9(5, 4)	217689.53	0.03	217689.54	0.12	78.690	7.5004	[16A]
10(7, 3) - 9(7, 2)	217565.48	0.04	217565.45	0.12	122.845	5.1003	[16A]
10(9, 1) - 9(9, 0)	217541.41	0.07	217541.42	0.12	181.685	1.9001	[16A]
9(3, 7) - 10(2, 8)	43791.66	1.98			47.799	0.0490	
9(5, 5) - 10(4, 6)	278512.52	9.61			69.400	0.0265	
10(2, 9) - 10(0,10)	237840.85	0.43			39.200	0.0595	
10(1, 9) - 10(0,10)	118798.45	0.10			39.200	0.2248	
10(3, 7) - 10(2, 8)	262939.16	1.98			47.799	0.1925	
11(0,11) - 10(0,10)	230955.82	0.04			39.200	10.9453	
11(2, 9) - 10(2, 8)	245551.60	0.04			47.799	10.6390	
11(4, 7) - 10(4, 6)	239765.11	0.03			69.400	9.5457	
11(6, 5) - 10(6, 4)	239406.12	0.04			106.188	7.7277	
11(8, 3) - 10(8, 2)	239318.47	0.05			157.688	5.1821	
11(10, 1) - 10(10, 0)	239307.61	0.14			223.862	1.9092	
11(1,11) - 10(0,10)	248604.64	0.06			39.200	0.2740	
9(3, 6) - 10(2, 9)	64338.92	1.98			47.134	0.0462	
9(5, 4) - 10(4, 7)	278537.55	9.61			69.399	0.0265	
10(2, 8) - 10(2, 9)	19941.57	0.02	19941.66	0.10	47.134	0.7113	
10(3, 8) - 10(2, 9)	281762.21	1.98			47.134	0.1831	
11(2,10) - 10(2, 9)	237532.41	0.04	237532.34	0.12	47.134	10.6278	[16A]
11(4, 8) - 10(4, 7)	239736.76	0.03			69.399	9.5457	
11(6, 6) - 10(6, 5)	239406.12	0.04			106.188	7.7277	
11(8, 4) - 10(8, 3)	239318.47	0.05			157.688	5.1821	
11(10, 2) - 10(10, 1)	239307.61	0.14			223.862	1.9092	
11(1,10) - 10(2, 9)	127045.10	0.48			47.134	0.1035	
9(2, 7) - 10(1,10)	13878.60	0.41			39.914	0.0306	
9(4, 5) - 10(3, 8)	167878.99	4.99			56.532	0.0368	
10(1, 9) - 10(1,10)	97412.28	0.11			39.914	0.1996	
10(3, 7) - 10(3, 8)	1118.53	0.01			56.532	1.6965	

TABLE 7. The microwave spectrum of H ^{12}COOD. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
10(2, 9) – 10(1,10)	216454.67	0.40			39.914	0.1480	
11(1,11) – 10(1,10)	227218.46	0.03			39.914	10.8979	
11(3, 9) – 10(3, 8)	239909.01	0.03			56.532	10.1810	
11(5, 7) – 10(5, 6)	239518.83	0.04			85.951	8.7277	
11(7, 5) – 10(7, 4)	239347.62	0.04			130.102	6.5459	
11(9, 3) – 10(9, 2)	239307.12	0.07			188.942	3.6366	
11(0,11) – 10(1,10)	209569.65	0.05			39.914	0.2649	
9(4, 6) – 10(3, 7)	166749.75	4.99			56.570	0.0368	
10(2, 8) – 10(1, 9)	138983.97	0.47			43.163	0.2780	
11(1,10) – 10(1, 9)	246087.49	0.04			43.163	10.8881	
11(3, 8) – 10(3, 7)	240733.25	0.03			56.570	10.1812	
11(5, 6) – 10(5, 5)	239519.31	0.04			85.951	8.7277	
11(7, 4) – 10(7, 3)	239347.62	0.04			130.102	6.5459	
11(9, 2) – 10(9, 1)	239307.12	0.07			188.942	3.6366	
10(3, 8) – 11(2, 9)	16269.03	1.99			55.990	0.0573	
10(5, 6) – 11(4, 7)	256436.75	9.62			77.397	0.0337	
11(2,10) – 11(0,11)	244417.43	0.41			46.904	0.0723	
11(1,10) – 11(0,11)	133930.12	0.13			46.904	0.2287	
11(3, 8) – 11(2, 9)	258120.81	1.98			55.990	0.2180	
12(0,12) – 11(0,11)	250836.56	0.04			46.904	11.9382	
12(2,10) – 11(2, 9)	268621.76	0.05			55.990	11.6719	
12(4, 8) – 11(4, 7)	261696.86	0.05			77.397	10.6669	
12(6, 6) – 11(6, 5)	261216.44	0.05			114.174	9.0005	
12(8, 4) – 11(8, 3)	261095.29	0.06			165.670	6.6671	
12(10, 2) – 11(10, 1)	261071.80	0.16			231.844	3.6669	
12(1,12) – 11(0,11)	265186.69	0.06			46.904	0.3077	
10(3, 7) – 11(2,10)	45348.33	1.99			55.057	0.0524	
10(5, 5) – 11(4, 8)	256490.32	9.62			77.396	0.0337	
11(2, 9) – 11(2,10)	27960.77	0.03	27960.55	0.05	55.057	0.6343	
11(3, 9) – 11(2,10)	284138.80	1.98			55.057	0.2027	
12(2,11) – 11(2,10)	258791.54	0.05			55.057	11.6555	
12(4, 9) – 11(4, 8)	261643.95	0.05			77.396	10.6669	
12(6, 7) – 11(6, 6)	261216.43	0.05			114.174	9.0005	
12(8, 5) – 11(8, 4)	261095.29	0.06			165.670	6.6671	
12(10, 3) – 11(10, 2)	261071.80	0.16			231.844	3.6669	
12(1,11) – 11(2,10)	157265.31	0.48			55.057	0.1225	
10(4, 6) – 11(3, 9)	145838.56	5.00			64.535	0.0443	
11(1,10) – 11(1,11)	116281.30	0.15			47.493	0.1857	
11(3, 8) – 11(3, 9)	1942.77	0.01			64.535	1.5394	
11(2,10) – 11(1,11)	226768.62	0.38			47.493	0.1564	
12(1,12) – 11(1,11)	247537.88	0.04			47.493	11.9029	
12(3,10) – 11(3, 9)	261786.26	0.05			64.535	11.2487	
12(5, 8) – 11(5, 7)	261365.55	0.05			93.941	9.9172	
12(7, 6) – 11(7, 5)	261137.06	0.05			138.086	7.9172	
12(9, 4) – 11(9, 3)	261076.12	0.08			196.924	5.2503	
12(11, 2) – 11(11, 1)	261078.03	0.28			270.429	1.9168	
12(0,12) – 11(1,11)	233187.75	0.06			47.493	0.3009	
12(2,10) – 11(3, 9)	12443.73	1.99			64.535	0.0660	
10(4, 7) – 11(3, 8)	143870.85	5.00			64.600	0.0444	
11(2, 9) – 11(1,10)	138448.08	0.47			51.372	0.3152	
12(1,11) – 11(1,10)	267752.62	0.06			51.372	11.8881	
12(3, 9) – 11(3, 8)	263049.77	0.04			64.600	11.2490	
12(5, 7) – 11(5, 6)	261366.63	0.05			93.941	9.9172	
12(7, 5) – 11(7, 4)	261137.06	0.05			138.086	7.9172	
12(9, 3) – 11(9, 2)	261076.12	0.08			196.924	5.2503	
12(11, 1) – 11(11, 0)	261078.03	0.28			270.429	1.9168	
11(5, 7) – 12(4, 8)	234258.72	9.63			86.127	0.0410	
12(2,11) – 12(0,12)	252372.41	0.38			55.271	0.0847	
12(1,11) – 12(0,12)	150846.18	0.17			55.271	0.2205	
12(3, 9) – 12(2,10)	252548.81	1.98			64.950	0.2457	
13(0,13) – 12(0,12)	270634.87	0.06			55.271	12.9325	
13(2,11) – 12(2,10)	291672.59	0.07			64.950	12.7002	
13(4, 9) – 12(4, 8)	283669.69	0.06			86.127	11.7694	

TABLE 7. The microwave spectrum of H ^{12}COOD. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
13(6, 7) – 12(6, 6)	283038.79	0.07			122.887	10.2314	
13(8, 5) – 12(8, 4)	282877.47	0.07			174.380	8.0774	
13(10, 3) – 12(10, 2)	282838.32	0.17			240.553	5.3080	
13(12, 1) – 12(12, 0)	282852.97	0.49			321.389	1.9232	
13(1,13) – 12(0,12)	282149.22	0.07			55.271	0.3424	
11(3, 8) – 12(2,11)	27290.04	2.00			63.689	0.0579	
11(5, 6) – 12(4, 9)	234365.67	9.66			86.123	0.0410	
12(2,10) – 12(2,11)	37790.99	0.03	37791.00	0.05	63.689	0.5690	[26A]
12(3,10) – 12(2,11)	287133.52	1.98			63.689	0.2218	
13(2,12) – 12(2,11)	279967.88	0.07			63.689	12.6780	
13(4,10) – 12(4, 9)	283576.20	0.06			86.123	11.7694	
13(6, 8) – 12(6, 7)	283038.76	0.07			122.887	10.2314	
13(8, 6) – 12(8, 5)	282877.47	0.07			174.380	8.0774	
13(10, 4) – 12(10, 3)	282838.32	0.17			240.553	5.3080	
13(12, 2) – 12(12, 1)	282852.97	0.49			321.389	1.9232	
13(1,12) – 12(2,11)	187674.91	0.48			63.689	0.1438	
11(4, 7) – 12(3,10)	123817.41	5.01			73.267	0.0519	
12(1,11) – 12(1,12)	136496.05	0.20			55.750	0.1750	
12(3, 9) – 12(3,10)	3206.28	0.01			73.267	1.4049	
12(2,11) – 12(1,12)	238022.28	0.37			55.750	0.1637	
13(1,13) – 12(1,12)	267799.09	0.06			55.750	12.9067	
13(3,11) – 12(3,10)	283651.67	0.06			73.267	12.3058	
13(5, 9) – 12(5, 8)	283230.99	0.07			102.659	11.0774	
13(7, 7) – 12(7, 6)	282934.46	0.07			146.796	9.2313	
13(9, 5) – 12(9, 4)	282848.70	0.10			205.633	6.7697	
13(11, 3) – 12(11, 2)	282840.84	0.30			279.138	3.6925	
13(0,13) – 12(1,12)	256284.75	0.06			55.750	0.3373	
13(2,11) – 12(3,10)	42330.06	2.00			73.267	0.0751	
11(4, 8) – 12(3, 9)	120557.84	5.01			73.374	0.0521	
12(2,10) – 12(1,11)	139317.22	0.46			60.303	0.3502	
13(1,12) – 12(1,11)	289201.14	0.07			60.303	12.8852	
13(3,10) – 12(3, 9)	285511.02	0.06			73.374	12.3064	
13(5, 8) – 12(5, 7)	283233.27	0.07			102.659	11.0774	
13(7, 6) – 12(7, 5)	282934.46	0.07			146.796	9.2313	
13(9, 4) – 12(9, 3)	282848.70	0.10			205.633	6.7697	
13(11, 2) – 12(11, 1)	282840.84	0.30			279.138	3.6925	
12(5, 8) – 13(4, 9)	211954.58	9.64			95.589	0.0485	
13(2,12) – 13(0,13)	261705.41	0.36			64.299	0.0962	
13(1,12) – 13(0,13)	169412.44	0.23			64.299	0.2162	
13(3,10) – 13(2,11)	246387.25	1.98			74.679	0.2758	
14(0,14) – 13(0,13)	290388.96	0.07			64.299	13.9281	
14(1,14) – 13(0,13)	299520.73	0.08			64.299	0.3776	
12(3, 9) – 13(2,12)	10371.93	2.01			73.028	0.0625	
12(5, 7) – 13(4,10)	212156.10	9.64			95.582	0.0485	
13(2,11) – 13(2,12)	49495.71	0.04	49495.71	0.05	73.028	0.5134	[26A]
13(3,11) – 13(2,12)	290817.32	1.99			73.028	0.2403	
14(1,13) – 13(2,12)	218116.69	0.49			73.028	0.1675	
12(4, 8) – 13(3,11)	101862.59	5.02			82.729	0.0594	
13(1,12) – 13(1,13)	157898.10	0.26			64.683	0.1668	
13(3,10) – 13(3,11)	5065.63	0.02			82.729	1.2876	
13(2,12) – 13(1,13)	250191.07	0.36			64.683	0.1698	
14(1,14) – 13(1,13)	288006.39	0.07			64.683	13.9094	
14(0,14) – 13(1,13)	278874.62	0.08			64.683	0.3740	
14(2,12) – 13(3,11)	73332.13	2.00			82.729	0.0849	
12(4, 9) – 13(3,10)	96690.77	5.02			82.898	0.0597	
13(2,11) – 13(1,12)	141788.67	0.46			69.950	0.3818	
13(5, 9) – 14(4,10)	189494.86	9.65			105.786	0.0561	
14(2,13) – 14(0,14)	272373.66	0.35			73.985	0.1065	
14(1,13) – 14(0,14)	189433.14	0.30			73.985	0.2117	
14(3,11) – 14(2,12)	239867.68	1.97			85.175	0.3090	
13(5, 8) – 14(4,11)	189856.42	9.65			105.774	0.0561	
14(2,12) – 14(2,13)	63092.25	0.05	63092.29	0.05	83.070	0.4661	
14(3,12) – 14(2,13)	295255.42	1.99			83.070	0.2579	

TABLE 7. The microwave spectrum of H ^{12}COOD. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
15(1,14) - 14(2,13)	248419.70	0.49			83.070	0.1937	
13(4, 9) - 14(3,12)	80036.98	5.03			92.919	0.0667	
14(1,13) - 14(1,14)	180301.37	0.33			74.290	0.1607	
14(3,11) - 14(3,12)	7704.51	0.02			92.919	1.1835	
14(2,13) - 14(1,14)	263241.88	0.35			74.290	0.1749	
15(2,13) - 14(3,12)	105359.72	2.01			92.919	0.0956	
13(4,10) - 14(3,11)	72132.79	5.03			93.176	0.0673	
14(2,12) - 14(1,13)	146032.76	0.46			80.304	0.4085	
15(2,14) - 14(3,11)	19096.36	2.04			93.176	0.0679	
14(5,10) - 15(4,11)	166842.94	9.66			116.719	0.0637	
15(2,14) - 15(0,15)	284302.37	0.36			84.330	0.1156	
15(1,14) - 15(0,15)	210665.78	0.39			84.330	0.2074	
15(3,12) - 15(2,13)	233275.59	1.96			96.433	0.3451	
14(5, 9) - 15(4,12)	167464.84	9.67			116.698	0.0637	
15(2,13) - 15(2,14)	78558.86	0.08			93.813	0.4262	
16(1,15) - 15(2,14)	278407.15	0.49			93.813	0.2224	
14(4,10) - 15(3,13)	58421.03	5.05			103.837	0.0738	
15(1,14) - 15(1,15)	203496.86	0.42			84.569	0.1564	
15(3,12) - 15(3,13)	11328.65	0.03	11328.67	0.10	103.837	1.0896	[26A]
15(2,14) - 15(1,15)	277133.45	0.37			84.569	0.1791	
16(2,14) - 15(3,13)	138298.78	2.01			103.837	0.1073	
14(4,11) - 15(3,12)	46734.95	5.04			104.215	0.0749	
15(2,13) - 15(1,14)	152195.45	0.46			91.357	0.4294	
16(2,15) - 15(3,12)	31128.55	2.05			104.215	0.0685	
15(5,11) - 16(4,12)	143953.31	9.68			128.391	0.0714	
16(2,15) - 16(0,16)	297395.65	0.39			95.333	0.1233	
16(1,15) - 16(0,16)	232839.81	0.50			95.333	0.2037	
16(3,13) - 16(2,14)	226933.18	1.95			108.450	0.3842	
15(5,10) - 16(4,13)	144984.32	9.68			128.357	0.0713	
16(2,14) - 16(2,15)	95841.58	0.11			105.253	0.3925	
16(4,12) - 16(4,13)	1013.70	0.01			128.357	1.8983	
17(3,14) - 16(4,13)	7184.41	5.08			128.357	0.0899	
15(4,11) - 16(3,14)	37114.50	5.07			115.481	0.0806	
16(1,15) - 16(1,16)	227261.27	0.52			95.519	0.1535	
16(3,13) - 16(3,14)	16156.92	0.03	16156.94	0.10	115.481	1.0041	
16(2,15) - 16(1,16)	291817.11	0.41			95.519	0.1826	
17(2,15) - 16(3,14)	172017.96	2.01			115.481	0.1203	
15(4,12) - 16(3,13)	20344.36	5.06			116.020	0.0824	
16(2,14) - 16(1,15)	160397.42	0.45			103.100	0.4443	
17(2,16) - 16(3,13)	41001.67	2.06			116.020	0.0677	
16(5,12) - 17(4,13)	120769.56	9.70			140.804	0.0790	
17(1,16) - 17(0,17)	255676.96	0.62			106.995	0.2007	
17(3,14) - 17(2,15)	221180.55	1.93			121.219	0.4257	
16(5,11) - 17(4,14)	122423.95	9.70			140.750	0.0789	
17(2,15) - 17(2,16)	114859.38	0.16			117.387	0.3644	
17(4,13) - 17(4,14)	1621.48	0.01			140.750	1.7785	
18(3,15) - 17(4,14)	35975.93	5.10			140.750	0.0974	
16(2,14) - 17(1,17)	39303.13	0.54			107.139	0.0141	
16(4,12) - 17(3,15)	16237.90	5.09			127.849	0.0869	
17(1,16) - 17(1,17)	251369.07	0.64			107.139	0.1518	
17(3,14) - 17(3,15)	22408.61	0.03	22408.64	0.10	127.849	0.9254	
18(2,16) - 17(3,15)	206372.62	2.01			127.849	0.1349	
17(2,15) - 17(1,16)	170728.28	0.45			115.524	0.4530	
18(2,17) - 17(3,14)	48457.03	2.08			128.596	0.0655	
17(5,13) - 18(4,14)	97222.29	9.72			153.961	0.0865	
18(1,17) - 18(0,18)	278911.49	0.76			119.317	0.1985	
18(3,15) - 18(2,16)	216356.98	1.91			134.733	0.4685	
19(3,17) - 18(4,14)	23631.09	5.13			153.961	0.0978	
17(5,12) - 18(4,15)	99800.62	9.72			153.877	0.0864	
18(2,16) - 18(2,17)	135506.97	0.21			130.213	0.3412	
18(4,14) - 18(4,15)	2518.30	0.02			153.877	1.6694	
19(3,16) - 18(4,15)	66120.90	5.12			153.877	0.1051	
17(2,15) - 18(1,18)	53698.81	0.66			119.427	0.0122	

TABLE 7. The microwave spectrum of H ^{12} COOD. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
18(1,17) - 18(1,18)	275606.87	0.78			119.427	0.1510	
18(3,15) - 18(3,16)	30288.44	0.03			140.939	0.8528	
19(2,17) - 18(3,16)	241206.53	2.00			140.939	0.1512	
18(2,16) - 18(1,17)	183236.49	0.45			128.621	0.4562	
19(2,18) - 18(3,15)	53262.32	2.09			141.950	0.0621	
18(5,14) - 19(4,15)	73227.20	9.74			167.867	0.0940	
19(3,16) - 19(2,17)	212784.37	1.89			148.985	0.5113	
20(3,18) - 19(4,15)	42267.07	5.16			167.867	0.1021	
18(5,13) - 19(4,16)	77140.73	9.75			167.740	0.0937	
19(2,17) - 19(2,18)	157655.77	0.28			143.726	0.3221	
19(4,15) - 19(4,16)	3807.93	0.02			167.740	1.5693	
20(3,17) - 19(4,16)	97665.96	5.14			167.740	0.1130	
18(2,16) - 19(1,19)	70430.30	0.82			132.383	0.0105	
19(1,18) - 19(1,19)	299787.48	0.94			132.383	0.1508	
19(3,16) - 19(3,17)	39971.51	0.03	39971.54	0.10	154.750	0.7859	[26A]
20(2,18) - 19(3,17)	276352.36	1.99			154.750	0.1696	
19(2,17) - 19(1,18)	197917.89	0.46			142.383	0.4547	
20(2,19) - 19(3,16)	55227.14	2.10			156.083	0.0578	
19(5,15) - 20(4,16)	48683.64	9.77			182.525	0.1013	
20(3,17) - 20(2,18)	210754.74	1.86			163.968	0.5526	
21(3,19) - 20(4,16)	59759.50	5.19			182.525	0.1053	
19(5,14) - 20(4,17)	54481.98	9.77			182.337	0.1009	
20(2,18) - 20(2,19)	181153.71	0.36			157.925	0.3068	
20(4,16) - 20(4,17)	5618.52	0.03			182.337	1.4763	
21(3,18) - 20(4,17)	130608.63	5.15			182.337	0.1213	
19(2,17) - 20(1,20)	89301.95	1.02			146.006	0.0092	
20(3,17) - 20(3,18)	51590.95	0.04	51590.97	0.10	169.277	0.7245	[26A]
20(2,18) - 20(1,19)	214706.11	0.48			156.806	0.4496	
21(2,20) - 20(3,17)	54215.55	2.12			170.998	0.0529	
20(5,16) - 21(4,17)	23474.11	9.80			197.940	0.1086	
21(3,18) - 21(2,19)	210523.00	1.83			179.672	0.5907	
22(3,20) - 21(4,17)	75870.94	5.22			197.940	0.1074	
20(5,15) - 21(4,18)	31875.23	9.80			197.669	0.1079	
21(2,19) - 21(2,20)	205825.13	0.45			172.806	0.2948	
21(4,17) - 21(4,18)	8103.72	0.03			197.669	1.3891	
22(3,19) - 21(4,18)	164897.93	5.17			197.669	0.1303	
20(2,18) - 21(1,21)	110093.72	1.25			160.295	0.0081	
21(3,18) - 21(3,19)	65230.61	0.06	65230.62	0.10	184.518	0.6687	
21(2,19) - 21(1,20)	233468.19	0.51			171.884	0.4423	
22(2,21) - 21(3,18)	50153.36	2.14			186.694	0.0478	
22(3,19) - 22(2,20)	212304.51	1.80			196.088	0.6239	
23(3,21) - 22(4,18)	90343.91	5.25			214.117	0.1082	
21(5,16) - 22(4,19)	9386.33	9.84			213.735	0.1147	
22(2,20) - 22(2,21)	231471.64	0.55			188.367	0.2856	
22(4,18) - 22(4,19)	11441.89	0.04	11441.90	0.10	213.735	1.3068	[26A]
23(3,20) - 22(4,19)	200439.58	5.17			213.735	0.1401	
21(2,19) - 22(1,22)	132562.79	1.51			175.250	0.0072	
22(3,19) - 22(3,20)	80923.27	0.10			200.470	0.6185	
23(4,19) - 22(5,18)	29488.04	9.87			230.078	0.1227	
22(2,20) - 22(1,21)	254007.10	0.57			187.615	0.4339	
23(2,22) - 22(3,19)	43029.34	2.16			203.170	0.0497	
23(4,20) - 22(5,17)	12902.09	9.88			230.103	0.1211	
23(3,20) - 23(2,21)	216275.70	1.76			213.207	0.6511	
24(3,22) - 23(4,19)	102906.36	5.28			231.062	0.1075	
23(2,21) - 23(2,22)	257875.16	0.66			204.605	0.2789	
23(4,19) - 23(4,20)	15832.80	0.04	15832.80	0.10	230.534	1.2284	[26A]
24(3,21) - 23(4,20)	237104.00	5.18			230.534	0.1509	
22(2,20) - 23(1,23)	156445.87	1.82			190.870	0.0065	
23(3,20) - 23(3,21)	98653.77	0.15			217.130	0.5739	
23(5,18) - 23(5,19)	1158.13	0.01			246.861	2.0524	
24(4,20) - 23(5,19)	57538.02	9.92			246.861	0.1296	
23(2,21) - 23(1,22)	276071.24	0.65			203.998	0.4255	
24(2,23) - 23(3,20)	32891.42	2.19			220.421	0.0378	

TABLE 7. The microwave spectrum of H ^{12}COOD. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
24(4,21) - 23(5,18)	34866.09	9.92			246.900	0.1271	
24(3,21) - 24(2,22)	222574.96	1.72			231.018	0.6714	
25(3,23) - 24(4,20)	113279.99	5.31			248.780	0.1054	
24(2,22) - 24(2,23)	284803.82	0.78			221.518	0.2744	
24(4,20) - 24(4,21)	21491.00	0.04			248.063	1.1534	
25(3,22) - 24(4,21)	274734.62	5.17			248.063	0.1630	
23(2,21) - 24(1,24)	181463.55	2.15			207.154	0.0058	
24(3,21) - 24(3,22)	118364.83	0.22			234.494	0.5347	
24(5,19) - 24(5,20)	1744.62	0.01			264.382	1.9547	
25(4,21) - 24(5,20)	86833.39	9.97			264.382	0.1364	
24(2,22) - 24(1,23)	299369.68	0.75			221.032	0.4176	
25(4,22) - 24(5,19)	56452.81	9.96			264.440	0.1326	
25(3,22) - 25(2,23)	231301.26	1.68			249.512	0.6846	
26(3,24) - 25(4,21)	121191.71	5.34			267.278	0.1019	
25(4,21) - 25(4,22)	28635.97	0.04	28636.02	0.10	266.323	1.0813	
24(2,22) - 25(1,25)	207327.09	2.52			224.103	0.0054	
25(3,22) - 25(3,23)	139963.63	0.30			252.559	0.5008	
25(5,20) - 25(5,21)	2578.22	0.02			282.640	1.8627	
26(3,23) - 26(2,24)	242509.52	1.64			268.679	0.6908	
27(3,25) - 26(4,22)	126387.60	5.37			286.560	0.0971	
26(4,22) - 26(4,23)	37479.37	0.04	37479.36	0.10	285.310	1.0122	[26A]
25(2,23) - 26(1,26)	233748.09	2.93			241.715	0.0050	
26(3,23) - 26(3,24)	163327.41	0.38			271.321	0.4718	
26(5,21) - 26(5,22)	3742.22	0.02			301.637	1.7754	
26(4,22) - 26(3,23)	293538.46	4.76			276.769	0.6551	
27(3,24) - 27(2,25)	256203.30	1.61			288.511	0.6907	
28(3,26) - 27(4,23)	128647.89	5.40			306.630	0.0912	
27(4,23) - 27(4,24)	48210.94	0.05	48210.92	0.10	305.022	0.9462	[26A]
26(2,24) - 27(1,27)	260450.55	3.37			259.992	0.0046	
27(3,24) - 27(3,25)	188307.51	0.48			290.776	0.4474	
27(5,22) - 27(5,23)	5340.15	0.03			321.373	1.6922	
27(4,23) - 27(3,24)	286987.43	4.67			297.057	0.7027	
28(3,25) - 28(2,26)	272326.84	1.59			309.000	0.6856	
29(3,27) - 28(4,24)	127801.08	5.44			327.490	0.0846	
28(4,24) - 28(4,25)	60984.95	0.07	60984.87	0.10	325.456	0.8835	
27(2,25) - 28(1,28)	287183.87	3.85			278.932	0.0043	
28(3,25) - 28(3,26)	214731.75	0.59			310.921	0.4273	
28(5,23) - 28(5,24)	7498.04	0.03			341.847	1.6124	
28(4,24) - 28(3,25)	281999.63	4.57			318.084	0.7496	
29(3,26) - 29(2,27)	290759.25	1.57			330.140	0.6768	
30(3,28) - 29(4,25)	123734.59	5.48			349.142	0.0775	
29(4,25) - 29(4,26)	75909.67	0.10			346.610	0.8246	
29(3,26) - 29(3,27)	242405.99	0.71			331.753	0.4111	
29(5,24) - 29(5,25)	10365.64	0.04			363.059	1.5352	
29(4,25) - 29(3,26)	278886.28	4.46			339.839	0.7939	
31(3,29) - 30(4,26)	116400.69	5.53			371.583	0.0703	
30(4,26) - 30(4,27)	93041.34	0.14			368.479	0.7700	
30(6,24) - 30(6,25)	1125.19	0.02			404.744	2.2482	
30(3,27) - 30(3,28)	271115.58	0.83			353.269	0.3983	
30(5,25) - 30(5,26)	14116.39	0.04	14116.32	0.10	385.009	1.4603	[26A]
30(4,26) - 30(3,27)	277915.25	4.35			362.313	0.8339	
32(3,30) - 31(4,27)	105816.89	5.60			394.810	0.0633	
30(3,27) - 31(2,30)	109275.60	2.69			358.668	0.0166	
31(4,27) - 31(4,28)	112383.18	0.19			391.061	0.7200	
31(6,25) - 31(6,26)	1639.16	0.03			427.391	2.1609	
31(5,26) - 31(5,27)	18945.21	0.05	18945.12	0.10	407.695	1.3872	
31(4,27) - 31(3,28)	279307.88	4.23			385.493	0.8681	
33(3,31) - 32(4,28)	92061.87	5.69			418.818	0.0567	
31(3,28) - 32(2,31)	136948.35	2.80			380.925	0.0152	
32(4,28) - 32(4,29)	133888.65	0.28			414.352	0.6749	
32(6,26) - 32(6,27)	2354.30	0.04			450.778	2.0772	
32(5,27) - 32(5,28)	25063.76	0.05	25063.62	0.10	431.115	1.3156	
32(4,28) - 32(3,29)	283238.47	4.10			409.371	0.8952	

TABLE 7. The microwave spectrum of H ^{12}COOD. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
34(3,32) - 33(4,29)	75260.40	5.00			443.601	0.0507	
32(3,29) - 33(2,32)	165599.40	2.93			403.847	0.0139	
33(4,29) - 33(4,30)	157467.32	0.39			438.349	0.6349	
33(6,27) - 33(6,28)	3335.95	0.06			474.905	1.9966	
33(5,28) - 33(5,29)	32692.72	0.05	32692.99	0.10	455.269	1.2454	
33(4,29) - 33(3,30)	289834.18	3.98			433.933	0.9144	
33(3,30) - 34(2,33)	194915.13	3.07			427.432	0.0129	
34(4,30) - 34(4,31)	182991.42	0.53			463.046	0.5998	
34(6,28) - 34(6,29)	4665.81	0.08			499.773	1.9186	
34(5,29) - 34(5,30)	42051.12	0.05			480.154	1.3767	
34(4,30) - 34(3,31)	299173.28	3.87			459.171	0.9256	
35(4,31) - 35(4,32)	210301.94	0.73			488.441	0.5697	
35(6,29) - 35(6,30)	6444.38	0.11			525.382	1.8427	
35(5,30) - 35(5,31)	53343.55	0.06	53343.43	0.10	505.768	1.1096	
36(4,32) - 36(4,33)	239213.30	0.98			514.530	0.5442	
36(6,30) - 36(6,31)	8793.05	0.14			551.732	1.7686	
36(5,31) - 36(5,32)	66746.59	0.09	66746.59	0.10	532.107	1.0446	
37(4,33) - 37(4,34)	269516.78	1.29			541.309	0.5232	
37(6,31) - 37(6,32)	11855.54	0.18			578.822	1.6959	
37(5,32) - 37(5,33)	82396.44	0.17			559.170	0.9822	
38(6,32) - 38(6,33)	15798.53	0.22			606.651	1.6243	
38(5,33) - 38(5,34)	100379.64	0.30			586.952	0.9231	
39(6,33) - 39(6,34)	20810.39	0.27			635.219	1.5534	
39(5,34) - 39(5,35)	120728.09	0.51			615.451	0.8678	
40(6,34) - 40(6,35)	27098.00	0.32			664.524	1.4832	
40(5,35) - 40(5,36)	143418.90	0.80			644.662	0.8168	
41(6,35) - 41(6,36)	34880.99	0.38			694.564	1.4134	
41(5,36) - 41(5,37)	168377.93	1.20			674.581	0.7705	
42(6,36) - 42(6,37)	44383.14	0.45			725.338	1.3442	
42(5,37) - 42(5,38)	195485.83	1.72			705.205	0.7292	
43(6,37) - 43(6,38)	55821.34	0.56			756.844	1.2758	
43(5,38) - 43(5,39)	224584.88	2.37			736.530	0.6928	
43(7,36) - 43(7,37)	7118.87	0.38			779.657	2.0048	
44(6,38) - 44(6,39)	69392.87	0.74			789.077	1.2086	
44(5,39) - 44(5,40)	255485.32	3.18			768.551	0.6615	
44(7,37) - 44(7,38)	9531.00	0.48			811.871	1.9338	
45(6,39) - 45(6,40)	85262.37	1.02			822.037	1.1430	
45(5,40) - 45(5,41)	287970.68	4.17			801.265	0.6350	
45(7,38) - 45(7,39)	12637.06	0.61			844.827	1.8634	
46(6,40) - 46(6,41)	103550.36	1.43			855.718	1.0797	
46(7,39) - 46(7,40)	16594.55	0.76			878.523	1.7935	
47(6,41) - 47(6,42)	124324.93	2.02			890.118	1.0194	
47(7,40) - 47(7,41)	21582.69	0.95			912.959	1.7238	
48(6,42) - 48(6,43)	147597.65	2.82			925.234	0.9628	
48(7,41) - 48(7,42)	27800.52	1.17			948.133	1.6542	
49(6,43) - 49(6,44)	173323.85	3.85			961.060	0.9104	
49(7,42) - 49(7,43)	35462.88	1.44			984.044	1.5845	
50(6,44) - 50(6,45)	201406.52	5.16			997.594	0.8626	
50(7,43) - 50(7,44)	44793.99	1.78			1020.690	1.5149	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
1(0, 1) – 0(0, 0)	22011.54	0.01			0.000	1.0000	
1(1, 1) – 0(0, 0)	67664.16	0.02			0.000	0.0350	
1(1, 0) – 1(0, 1)	47752.82	0.01	47752.57	0.10	0.734	0.0525	
2(0, 2) – 1(0, 1)	43952.06	0.01	43952.08	0.05	0.734	1.9992	[26A]
2(1, 2) – 1(0, 1)	87575.49	0.02			0.734	0.0525	
1(1, 0) – 1(1, 1)	2100.20	0.00			2.257	1.5000	
2(1, 2) – 1(1, 1)	41922.87	0.01	41922.88	0.05	2.257	1.5000	[26A]
2(2, 0) – 1(1, 1)	185243.48	0.04			2.257	0.0513	
2(1, 1) – 1(1, 0)	46123.16	0.01	46123.18	0.05	2.327	1.5000	[26A]
2(2, 1) – 1(1, 0)	183072.49	0.04			2.327	0.0525	
2(1, 1) – 2(0, 2)	49923.92	0.01	49923.61	0.10	2.200	0.0855	
3(0, 3) – 2(0, 2)	65751.09	0.01	65751.14	0.05	2.200	2.9970	[26A]
3(2, 1) – 2(0, 2)	253261.35	0.05			2.200	0.0025	
3(2, 1) – 2(2, 0)	66317.31	0.01	66317.28	0.05	8.436	1.6667	[26A]
3(1, 3) – 2(0, 2)	106463.80	0.02			2.200	0.0708	
3(3, 1) – 2(2, 0)	299477.66	0.07			8.436	0.0870	
3(2, 2) – 2(2, 1)	66034.67	0.01	66034.60	0.05	8.434	1.6667	[26A]
3(3, 0) – 2(2, 1)	299549.95	0.07			8.434	0.0870	
2(1, 1) – 2(1, 2)	6300.49	0.00			3.655	0.8333	
2(2, 1) – 2(1, 2)	143249.82	0.04			3.655	0.0292	
3(1, 3) – 2(1, 2)	62840.37	0.01	62840.40	0.05	3.655	2.6664	[26A]
3(0, 3) – 2(1, 2)	22127.66	0.01	22127.38	0.10	3.655	0.0390	
3(2, 1) – 2(1, 2)	209637.92	0.04			3.655	0.0544	
2(2, 0) – 2(1, 1)	137020.12	0.03			3.866	0.0312	
3(1, 2) – 2(1, 1)	69139.04	0.01	69139.14	0.05	3.866	2.6663	[26A]
3(2, 2) – 2(1, 1)	202984.00	0.04			3.866	0.0583	
3(2, 2) – 3(0, 3)	187156.83	0.05			4.394	0.0044	
3(1, 2) – 3(0, 3)	53311.88	0.01	53311.93	0.10	4.394	0.1155	
3(3, 0) – 3(2, 1)	233161.84	0.07			10.648	0.0315	
4(0, 4) – 3(0, 3)	87340.86	0.02			4.394	3.9926	
4(2, 2) – 3(0, 3)	276203.44	0.06			4.394	0.0055	
4(2, 2) – 3(2, 1)	88693.18	0.02			10.648	2.9998	
4(1, 4) – 3(0, 3)	124419.92	0.03			4.394	0.0904	
3(3, 1) – 3(2, 2)	233513.78	0.07			10.636	0.0315	
4(2, 3) – 3(2, 2)	87990.15	0.02			10.636	2.9997	
2(2, 0) – 3(1, 3)	80480.25	0.03			5.752	0.0055	
3(1, 2) – 3(1, 3)	12599.17	0.01	12599.17	0.10	5.752	0.5836	[26A]
3(2, 2) – 3(1, 3)	146444.12	0.03			5.752	0.0502	
4(1, 4) – 3(1, 3)	83707.21	0.02			5.752	3.7490	
4(3, 2) – 3(3, 1)	88183.91	0.01			18.426	1.7502	
4(0, 4) – 3(1, 3)	46028.15	0.01	46028.20	0.10	5.752	0.0613	
4(2, 2) – 3(1, 3)	235490.73	0.04			5.752	0.0571	
2(2, 1) – 3(1, 2)	67810.28	0.03			6.172	0.0063	
3(2, 1) – 3(1, 2)	134198.39	0.03			6.172	0.0571	
4(1, 3) – 3(1, 2)	92097.99	0.02			6.172	3.7489	
4(3, 1) – 3(3, 0)	88192.85	0.01			18.426	1.7502	
4(2, 3) – 3(1, 2)	221835.10	0.04			6.172	0.0660	
3(3, 1) – 4(2, 2)	144467.17	0.07			13.607	0.0045	
4(2, 3) – 4(0, 4)	187806.12	0.04			7.307	0.0101	
4(1, 3) – 4(0, 4)	58069.01	0.01	58069.04	0.10	7.307	0.1415	
4(3, 1) – 4(2, 2)	232661.52	0.06			13.607	0.0572	
5(0, 5) – 4(0, 4)	108661.39	0.02	108661.43	0.08	7.307	4.9856	
5(2, 3) – 4(2, 2)	111289.24	0.02	111289.27	0.08	13.607	4.1993	
5(4, 1) – 4(4, 0)	110216.85	0.02	110216.80	0.08	32.264	1.8002	
5(1, 5) – 4(0, 4)	141588.96	0.03			7.307	0.1119	
3(3, 0) – 4(2, 3)	145525.12	0.07			13.571	0.0045	
4(2, 2) – 4(2, 3)	1056.46	0.00			13.571	1.7903	
4(3, 2) – 4(2, 3)	233707.54	0.07			13.571	0.0570	
5(2, 4) – 4(2, 3)	109897.64	0.02	109897.68	0.08	13.571	4.1991	
5(4, 2) – 4(4, 1)	110216.64	0.02	110216.80	0.08	32.264	1.8002	
3(2, 1) – 4(1, 4)	63090.35	0.03			8.544	0.0117	
4(1, 3) – 4(1, 4)	20989.95	0.01			8.544	0.4509	
4(2, 3) – 4(1, 4)	150727.06	0.03			8.544	0.0682	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
5(1, 5) – 4(1, 4)	104509.90	0.02	104509.91	0.08	8.544	4.7978	
5(3, 3) – 4(3, 2)	110284.73	0.02	110284.78	0.08	21.367	3.2002	
5(0, 5) – 4(1, 4)	71582.33	0.02			8.544	0.0863	
5(2, 3) – 4(1, 4)	263072.76	0.05			8.544	0.0584	
3(2, 2) – 4(1, 3)	41746.96	0.03			9.244	0.0148	
4(2, 2) – 4(1, 3)	130793.57	0.03			9.244	0.0839	
5(1, 4) – 4(1, 3)	114977.50	0.02	114977.49	0.08	9.244	4.7974	
5(3, 2) – 4(3, 1)	110315.99	0.02	110316.02	0.08	21.367	3.2002	
5(2, 4) – 4(1, 3)	239634.76	0.04			9.244	0.0748	
4(3, 2) – 5(2, 3)	121361.84	0.06			17.319	0.0107	
5(2, 4) – 5(0, 5)	189042.38	0.04			10.931	0.0188	
5(1, 4) – 5(0, 5)	64385.12	0.02	64385.15	0.10	10.931	0.1624	
5(3, 2) – 5(2, 3)	231688.27	0.06			17.319	0.0807	
6(0, 6) – 5(0, 5)	129668.80	0.02	129668.67	0.08	10.931	5.9759	[26A]
6(2, 4) – 5(2, 3)	134136.94	0.02	134136.96	0.08	17.319	5.3323	[26A]
6(4, 2) – 5(4, 1)	132310.11	0.02	132310.03	0.08	35.940	3.3337	[26A]
6(1, 6) – 5(0, 5)	158165.23	0.03	158165.35	0.08	10.931	0.1358	
4(3, 1) – 5(2, 4)	123820.33	0.07			17.237	0.0106	
5(2, 3) – 5(2, 4)	2448.06	0.00			17.237	1.4490	
5(3, 3) – 5(2, 4)	234094.63	0.06			17.237	0.0801	
6(2, 5) – 5(2, 4)	131745.33	0.02	131745.38	0.08	17.237	5.3313	[26A]
6(4, 3) – 5(4, 2)	132309.17	0.02	132309.13	0.08	35.940	3.3337	[26A]
6(1, 5) – 5(2, 4)	13094.75	0.03	13094.70	0.10	17.237	0.0357	
4(2, 2) – 5(1, 5)	47273.62	0.03	47273.49	0.10	12.030	0.0172	
4(4, 0) – 5(3, 3)	216386.86	0.16			25.046	0.0036	
5(1, 4) – 5(1, 5)	31457.55	0.02	31457.26	0.05	12.030	0.3686	
5(2, 4) – 5(1, 5)	156114.81	0.03			12.030	0.0841	
6(1, 6) – 5(1, 5)	125237.66	0.02			12.030	5.8295	
6(3, 4) – 5(3, 3)	132414.33	0.02	132414.24	0.08	25.046	4.5002	[26A]
6(5, 2) – 5(5, 1)	132249.91	0.02	132249.75	0.08	49.947	1.8336	[26A]
6(0, 6) – 5(1, 5)	96741.23	0.02			12.030	0.1140	
6(2, 4) – 5(1, 5)	292699.81	0.05			12.030	0.0578	
4(2, 3) – 5(1, 4)	14759.61	0.03			13.079	0.0246	
4(4, 1) – 5(3, 2)	216345.13	0.16			25.047	0.0036	
5(2, 3) – 5(1, 4)	127105.31	0.03	127105.36	0.08	13.079	0.1134	
6(1, 5) – 5(1, 4)	137752.01	0.02	137752.14	0.08	13.079	5.8283	[26A]
6(3, 3) – 5(3, 2)	132497.44	0.02	132497.46	0.08	25.047	4.5002	[26A]
6(5, 1) – 5(5, 0)	132249.91	0.02	132249.75	0.08	49.947	1.8336	[26A]
6(2, 5) – 5(1, 4)	256402.58	0.04			13.079	0.0846	
5(3, 3) – 6(2, 4)	97509.63	0.06			21.793	0.0178	
5(5, 1) – 6(4, 2)	287606.55	0.35			40.354	0.0030	
6(2, 5) – 6(0, 6)	191118.90	0.04			15.257	0.0306	
6(1, 5) – 6(0, 6)	72468.33	0.02	72468.39	0.10	15.257	0.1776	
6(3, 3) – 6(2, 4)	230048.76	0.06			21.793	0.1035	
7(0, 7) – 6(0, 6)	150345.14	0.02	150345.06	0.08	15.257	6.9643	[16A]
7(2, 5) – 6(2, 4)	157241.51	0.02	157241.48	0.08	21.793	6.4276	[16A]
7(4, 3) – 6(4, 2)	154431.16	0.02	154431.13	0.08	40.354	4.7148	[16A]
7(6, 1) – 6(6, 0)	154285.72	0.02	154285.66	0.08	71.473	1.8574	[16A]
7(1, 7) – 6(0, 6)	174379.30	0.03			15.257	0.1621	
5(3, 2) – 6(2, 5)	102390.99	0.06			21.632	0.0175	
5(5, 0) – 6(4, 3)	287607.72	0.35			40.353	0.0030	
6(2, 4) – 6(2, 5)	4839.67	0.01			21.632	1.2098	
6(3, 4) – 6(2, 5)	234763.63	0.06			21.632	0.1021	
7(2, 6) – 6(2, 5)	153521.62	0.02	153521.68	0.08	21.632	6.4250	[16A]
7(4, 4) – 6(4, 3)	154428.04	0.02	154427.84	0.08	40.353	4.7148	[16A]
7(6, 2) – 6(6, 1)	154285.72	0.02	154285.66	0.08	71.473	1.8574	[16A]
7(1, 6) – 6(2, 5)	41741.62	0.03	41741.57	0.10	21.632	0.0482	
5(2, 3) – 6(1, 6)	33325.20	0.03	33325.21	0.10	16.207	0.0214	
5(4, 1) – 6(3, 4)	194189.38	0.16			29.463	0.0089	
6(1, 5) – 6(1, 6)	43971.90	0.02	43971.96	0.05	16.207	0.3130	[26A]
6(2, 5) – 6(1, 6)	162622.48	0.03			16.207	0.0982	
7(1, 7) – 6(1, 6)	145882.87	0.02	145882.95	0.08	16.207	6.8511	
7(3, 5) – 6(3, 4)	154571.12	0.02			29.463	5.7144	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
7(5, 3) – 6(5, 2)	154332.96	0.02	154332.94	0.08	54.358	3.4290	[16A]
7(0, 7) – 6(1, 6)	121848.71	0.02			16.207	0.1444	
5(4, 2) – 6(3, 3)	194064.34	0.16			29.467	0.0089	
6(2, 4) – 6(1, 5)	123490.25	0.03			17.674	0.1462	
7(1, 6) – 6(1, 5)	160392.19	0.02	160392.07	0.08	17.674	6.8485	[16A]
7(3, 4) – 6(3, 3)	154757.19	0.02	154757.18	0.08	29.467	5.7144	[16A]
7(5, 2) – 6(5, 1)	154332.99	0.02	154332.94	0.08	54.358	3.4290	[16A]
7(2, 6) – 6(1, 5)	272172.19	0.04			17.674	0.0955	
6(3, 4) – 7(2, 5)	72682.44	0.05			27.038	0.0253	
6(5, 2) – 7(4, 3)	265425.30	0.34			45.505	0.0077	
7(2, 6) – 7(0, 7)	194295.38	0.04			20.272	0.0453	
7(1, 6) – 7(0, 7)	82515.38	0.02			20.272	0.1870	
7(3, 4) – 7(2, 5)	227564.44	0.05			27.038	0.1264	
8(0, 8) – 7(0, 7)	170705.42	0.02			20.272	7.9517	
8(2, 6) – 7(2, 5)	180574.71	0.02	180574.72	0.12	27.038	7.5000	
8(4, 4) – 7(4, 3)	176585.53	0.02	176585.55	0.12	45.505	6.0005	
8(6, 2) – 7(6, 1)	176362.59	0.02	176362.61	0.12	76.619	3.5004	
8(1, 8) – 7(0, 7)	190475.44	0.03			20.272	0.1910	
6(3, 3) – 7(2, 6)	81366.81	0.05			26.753	0.0247	
6(5, 1) – 7(4, 4)	265429.60	0.34			45.505	0.0077	
7(2, 5) – 7(2, 6)	8559.57	0.01	8559.58	0.10	26.753	1.0302	[26A]
7(3, 5) – 7(2, 6)	235813.13	0.06			26.753	0.1234	
8(2, 7) – 7(2, 6)	175215.32	0.02	175215.31	0.12	26.753	7.4945	
8(4, 5) – 7(4, 4)	176576.97	0.02	176576.97	0.12	45.505	6.0005	
8(6, 3) – 7(6, 2)	176362.59	0.02	176362.61	0.12	76.619	3.5004	
8(1, 7) – 7(2, 6)	71084.46	0.04			26.753	0.0625	
6(2, 4) – 7(1, 7)	21579.28	0.03	21579.09	0.10	21.073	0.0239	
6(4, 2) – 7(3, 5)	171928.37	0.15			34.619	0.0153	
7(1, 6) – 7(1, 7)	58481.22	0.02	58481.27	0.05	21.073	0.2735	
7(2, 6) – 7(1, 7)	170261.23	0.03			21.073	0.1106	
8(1, 8) – 7(1, 7)	166441.28	0.02			21.073	7.8663	
8(3, 6) – 7(3, 5)	176750.14	0.02			34.619	6.8749	
8(5, 4) – 7(5, 3)	176435.12	0.02	176435.17	0.12	59.506	4.8755	
8(7, 2) – 7(7, 1)	176323.61	0.03	176323.68	0.12	96.839	1.8752	
8(0, 8) – 7(1, 7)	146671.27	0.03	146671.27	0.08	21.073	0.1772	
6(4, 3) – 7(3, 4)	171616.32	0.15			34.629	0.0153	
7(2, 5) – 7(1, 6)	120339.57	0.03			23.024	0.1819	
8(1, 7) – 7(1, 6)	182864.46	0.02	182864.45	0.12	23.024	7.8610	
8(3, 5) – 7(3, 4)	177119.51	0.02	177119.51	0.12	34.629	6.8750	
8(5, 3) – 7(5, 2)	176435.21	0.02	176435.17	0.12	59.506	4.8755	
8(7, 1) – 7(7, 0)	176323.61	0.03	176323.68	0.12	96.839	1.8752	
8(2, 7) – 7(1, 6)	286995.32	0.04			23.024	0.1077	
7(3, 5) – 8(2, 6)	46678.85	0.05			33.062	0.0332	
7(5, 3) – 8(4, 4)	243172.74	0.33			51.395	0.0134	
8(2, 7) – 8(0, 8)	198805.27	0.04			25.966	0.0621	
8(1, 7) – 8(0, 8)	94674.42	0.02			25.966	0.1911	
8(3, 5) – 8(2, 6)	224109.24	0.05			33.062	0.1502	
9(0, 9) – 8(0, 8)	190796.73	0.03			25.966	8.9397	
9(2, 7) – 8(2, 6)	204075.44	0.03			33.062	8.5578	
9(4, 5) – 8(4, 4)	198779.53	0.03	198779.52	0.12	51.395	7.2228	
9(6, 3) – 8(6, 2)	198453.86	0.03	198453.85	0.12	82.502	5.0006	
9(8, 1) – 8(8, 0)	198363.46	0.06	198363.46	0.12	126.040	1.8891	
9(1, 9) – 8(0, 8)	206682.06	0.03			25.966	0.2222	
7(3, 4) – 8(2, 7)	60908.69	0.05			32.597	0.0317	
7(5, 2) – 8(4, 5)	243185.62	0.33			51.395	0.0134	
8(2, 6) – 8(2, 7)	13918.96	0.02	13918.98	0.10	32.597	0.8889	[26A]
8(3, 6) – 8(2, 7)	237347.96	0.05			32.597	0.1442	
9(2, 8) – 8(2, 7)	196815.84	0.03			32.597	8.5471	
9(4, 6) – 8(4, 5)	198759.07	0.03	198759.07	0.12	51.395	7.2228	
9(6, 4) – 8(6, 3)	198453.86	0.03	198453.85	0.12	82.502	5.0006	
9(8, 2) – 8(8, 1)	198363.46	0.06	198363.46	0.12	126.040	1.8891	
9(1, 8) – 8(2, 7)	101000.12	0.04			32.597	0.0787	
7(4, 3) – 8(3, 6)	149609.38	0.14			40.514	0.0221	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
8(1, 7) – 8(1, 8)	74904.40	0.03			*26.625*	*0.2446*	
8(2, 7) – 8(1, 8)	179035.26	0.03			26.625	0.1213	
9(1, 9) – 8(1, 8)	186912.04	0.03	186912.04	0.12	26.625	8.8770	
9(3, 7) – 8(3, 6)	198943.09	0.03	198943.07	0.12	40.514	7.9996	
9(5, 5) – 8(5, 4)	198559.08	0.03	198559.21	0.12	65.392	6.2229	
9(7, 3) – 8(7, 2)	198396.04	0.03	198396.05	0.12	102.720	3.5560	
9(0, 9) – 8(1, 8)	171026.71	0.04			26.625	0.2119	
7(4, 4) – 8(3, 5)	148924.85	0.14			40.537	0.0222	
8(2, 6) – 8(1, 7)	118049.82	0.03			29.124	0.2195	
9(1, 8) – 8(1, 7)	205130.98	0.03	205130.95	0.12	29.124	8.8677	
9(3, 6) – 8(3, 5)	199612.84	0.03	199612.82	0.12	40.537	7.9997	
9(5, 4) – 8(5, 3)	198559.37	0.03	198559.21	0.12	65.392	6.2229	
9(7, 2) – 8(7, 1)	198396.04	0.03	198396.05	0.12	102.720	3.5560	
8(3, 6) – 9(2, 7)	19353.55	0.04			39.869	0.0414	
8(5, 4) – 9(4, 5)	220828.32	0.32			58.026	0.0198	
9(2, 8) – 9(0, 9)	204824.39	0.04			*32.330*	*0.0798*	
9(1, 8) – 9(0, 9)	109008.67	0.03			32.330	0.1911	
9(3, 6) – 9(2, 7)	219646.64	0.05			39.869	0.1754	
10(0,10) – 9(0, 9)	210687.55	0.04			32.330	9.9293	
10(2, 8) – 9(2, 7)	227659.98	0.04			39.869	9.6056	
10(4, 6) – 9(4, 5)	221020.70	0.04			58.026	8.4006	
10(6, 4) – 9(6, 3)	220561.36	0.04			89.122	6.4007	
10(8, 2) – 9(8, 1)	220432.42	0.07			132.657	3.6004	
10(1,10) – 9(0, 9)	223182.71	0.04			32.330	0.2552	
8(3, 5) – 9(2, 8)	41212.36	0.04			39.162	0.0383	
8(5, 3) – 9(4, 6)	220861.76	0.32			58.024	0.0198	
9(2, 7) – 9(2, 8)	21178.56	0.02	21178.58	0.10	39.162	0.7743	
9(3, 7) – 9(2, 8)	239475.20	0.05			39.162	0.1645	
10(2, 9) – 9(2, 8)	218313.48	0.04			39.162	9.5880	
10(4, 7) – 9(4, 6)	220976.57	0.04			58.024	8.4006	
10(6, 5) – 9(6, 4)	220561.35	0.04			89.122	6.4007	
10(8, 3) – 9(8, 2)	220432.42	0.07			132.657	3.6004	
10(1, 9) – 9(2, 8)	131334.86	0.06			39.162	0.0972	
8(4, 4) – 9(3, 7)	127251.82	0.13			47.150	0.0294	
9(1, 8) – 9(1, 9)	93123.34	0.03			*32.860*	*0.2232*	
9(3, 6) – 9(3, 7)	1349.99	0.00			47.150	1.8691	
9(2, 8) – 9(1, 9)	188939.06	0.04			32.860	0.1305	
10(1,10) – 9(1, 9)	207297.38	0.04			32.860	9.8847	
10(3, 8) – 9(3, 7)	221138.56	0.04			47.150	9.0990	
10(5, 6) – 9(5, 5)	220707.54	0.04			72.015	7.5008	
10(7, 4) – 9(7, 3)	220479.74	0.04			109.338	5.1006	
10(9, 2) – 9(9, 1)	220405.31	0.13			159.073	1.9002	
10(0,10) – 9(1, 9)	194802.22	0.05			32.860	0.2479	
10(2, 8) – 9(3, 7)	9363.33	0.04			47.150	0.0499	
8(4, 5) – 9(3, 6)	125888.98	0.12			47.195	0.0294	
9(2, 7) – 9(1, 8)	116994.28	0.03			35.966	0.2573	
10(1, 9) – 9(1, 8)	227150.58	0.04			35.966	9.8690	
10(3, 7) – 9(3, 6)	222268.94	0.04			47.195	9.0993	
10(5, 5) – 9(5, 4)	220708.36	0.04			72.015	7.5008	
10(7, 3) – 9(7, 2)	220479.74	0.04			*109.338*	*5.1006*	
10(9, 1) – 9(9, 0)	220405.31	0.13			159.073	1.9002	
9(5, 5) – 10(4, 6)	198366.70	0.30			65.398	0.0266	
10(2, 9) – 10(0,10)	212450.31	0.05			39.358	0.0972	
10(1, 9) – 10(0,10)	125471.69	0.03	125471.89	0.08	39.358	0.1883	
10(3, 7) – 10(2, 8)	214255.60	0.05			47.463	0.2029	
11(0,11) – 10(0,10)	230451.45	0.06			39.358	10.9210	
11(2, 9) – 10(2, 8)	251237.86	0.06			47.463	10.6457	
11(4, 7) – 10(4, 6)	243318.22	0.06			65.398	9.5460	
11(6, 5) – 10(6, 4)	242686.89	0.06			96.479	7.7282	
11(8, 3) – 10(8, 2)	242510.39	0.08			140.009	5.1825	
11(10, 1) – 10(10, 0)	242449.26	0.26			195.932	1.9093	
11(1,11) – 10(0,10)	240097.36	0.06			39.358	0.2895	
9(3, 6) – 10(2, 9)	22511.72	0.04			46.444	0.0442	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref
9(5, 4) - 10(4, 7)	198444.56	0.30			65.395	0.0266	
10(2, 8) - 10(2, 9)	30525.06	0.02			46.444	0.6801	
10(3, 8) - 10(2, 9)	242300.29	0.05			46.444	0.1841	
11(2,10) - 10(2, 9)	239699.70	0.06			46.444	10.6202	
11(4, 8) - 10(4, 7)	243230.54	0.06			65.395	9.5460	
11(6, 6) - 10(6, 5)	242686.87	0.06			96.479	7.7282	
11(8, 4) - 10(8, 3)	242510.39	0.08			140.009	5.1825	
11(10, 2) - 10(10, 1)	242449.26	0.26			195.932	1.9093	
11(1,10) - 10(2, 9)	161902.49	0.07			46.444	0.1184	
9(4, 5) - 10(3, 8)	104892.79	0.11			54.527	0.0367	
9(6, 3) - 10(5, 6)	292151.58	0.66			79.377	0.0178	
10(1, 9) - 10(1,10)	112976.53	0.04			39.775	0.2073	
10(3, 7) - 10(3, 8)	2480.37	0.01			54.527	1.6758	
10(2, 9) - 10(1,10)	199955.15	0.04			39.775	0.1381	
11(1,11) - 10(1,10)	227602.20	0.06			39.775	10.8901	
11(3, 9) - 10(3, 8)	243322.59	0.06			54.527	10.1800	
11(5, 7) - 10(5, 6)	242883.14	0.06			79.377	8.7281	
11(7, 5) - 10(7, 4)	242575.96	0.06			116.692	6.5462	
11(9, 3) - 10(9, 2)	242471.38	0.15			166.424	3.6368	
11(0,11) - 10(1,10)	217956.29	0.07			39.775	0.2844	
11(2, 9) - 10(3, 8)	39462.63	0.05			54.527	0.0590	
9(4, 6) - 10(3, 7)	102379.10	0.11			54.609	0.0369	
9(6, 4) - 10(5, 5)	292150.35	0.66			79.377	0.0178	
10(2, 8) - 10(1, 9)	117503.68	0.03			43.543	0.2933	
11(1,10) - 10(1, 9)	248881.11	0.06			43.543	10.8656	
11(3, 8) - 10(3, 7)	245120.36	0.06			54.609	10.1807	
11(5, 6) - 10(5, 5)	242885.18	0.06			79.377	8.7281	
11(7, 4) - 10(7, 3)	242575.96	0.06			116.692	6.5462	
11(9, 2) - 10(9, 1)	242471.38	0.15			166.424	3.6368	
10(5, 6) - 11(4, 7)	175756.02	0.28			73.514	0.0338	
11(2,10) - 11(0,11)	221698.56	0.06			47.045	0.1132	
11(1,10) - 11(0,11)	143901.35	0.05	143901.35	0.08	47.045	0.1840	
11(3, 8) - 11(2, 9)	208138.10	0.05			55.843	0.2332	
12(0,12) - 11(0,11)	250152.31	0.09			47.045	11.9150	
12(2,10) - 11(2, 9)	274726.07	0.08			55.843	11.6791	
12(4, 8) - 11(4, 7)	265683.53	0.08			73.514	10.6671	
12(6, 6) - 11(6, 5)	264832.31	0.08			104.574	9.0010	
12(8, 4) - 11(8, 3)	264598.27	0.10			148.099	6.6675	
12(10, 2) - 11(10, 1)	264512.80	0.28			204.019	3.6671	
12(1,12) - 11(0,11)	257479.26	0.09			47.045	0.3247	
10(5, 5) - 11(4, 8)	175922.37	0.28			73.509	0.0338	
11(2, 9) - 11(2,10)	42063.22	0.03	42063.25	0.05	54.440	0.6022	
11(3, 9) - 11(2,10)	245923.18	0.05			54.440	0.2029	
12(2,11) - 11(2,10)	260967.50	0.08			54.440	11.6456	
12(4, 9) - 11(4, 8)	265520.52	0.08			73.509	10.6671	
12(6, 7) - 11(6, 6)	264832.23	0.08			104.574	9.0010	
12(8, 5) - 11(8, 4)	264598.27	0.10			148.099	6.6675	
12(10, 3) - 11(10, 2)	264512.80	0.28			204.019	3.6671	
12(1,11) - 11(2,10)	192486.67	0.10			54.440	0.1424	
10(4, 6) - 11(3, 9)	82590.90	0.09			62.643	0.0441	
10(6, 4) - 11(5, 7)	269829.80	0.63			87.479	0.0243	
11(1,10) - 11(1,11)	134255.44	0.05			47.367	0.1958	
11(3, 8) - 11(3, 9)	4278.14	0.01			62.643	1.5119	
11(2,10) - 11(1,11)	212052.65	0.05			47.367	0.1444	
12(1,12) - 11(1,11)	247833.35	0.09			47.367	11.8939	
12(3,10) - 11(3, 9)	265479.32	0.08			62.643	11.2470	
12(5, 8) - 11(5, 7)	265088.43	0.08			87.479	9.9176	
12(7, 6) - 11(7, 5)	264685.96	0.08			124.784	7.9176	
12(9, 4) - 11(9, 3)	264544.73	0.16			174.512	5.2506	
12(11, 2) - 11(11, 1)	264495.46	0.47			236.612	1.9169	
12(0,12) - 11(1,11)	240506.40	0.09			47.367	0.3212	
12(2,10) - 11(3, 9)	70866.10	0.07			62.643	0.0689	
10(4, 7) - 11(3, 8)	78235.32	0.09			62.786	0.0444	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
10(6, 5) - 11(5, 6)	269826.52	0.63			87.479	0.0243	
11(2, 9) - 11(1,10)	119860.43	0.03			51.845	0.3252	
12(1,11) - 11(1,10)	270283.88	0.08			51.845	11.8576	
12(3, 9) - 11(3, 8)	268196.01	0.08			62.786	11.2486	
12(5, 7) - 11(5, 6)	265093.08	0.08			87.479	9.9176	
12(7, 5) - 11(7, 4)	264685.96	0.08			124.784	7.9176	
12(9, 3) - 11(9, 2)	264544.73	0.16			174.512	5.2506	
12(11, 1) - 11(11, 0)	264495.46	0.47			236.612	1.9169	
12(2,11) - 11(3, 8)	10766.18	0.06	10766.28	0.10	62.786	0.0526	
11(5, 7) - 12(4, 8)	152955.64	0.25			82.377	0.0411	
12(2,11) - 12(0,12)	232513.75	0.07			55.389	0.1274	
12(1,11) - 12(0,12)	164032.93	0.07			55.389	0.1794	
12(3, 9) - 12(2,10)	201608.05	0.06			65.007	0.2670	
13(0,13) - 12(0,12)	269836.47	0.12			55.389	12.9107	
13(2,11) - 12(2,10)	298056.32	0.11			65.007	12.7061	
13(4, 9) - 12(4, 8)	288130.82	0.11			82.377	11.7695	
13(6, 7) - 12(6, 6)	286999.47	0.11			113.408	10.2319	
13(8, 5) - 12(8, 4)	286696.94	0.12			156.925	8.0779	
13(10, 3) - 12(10, 2)	286582.24	0.31			212.842	5.3083	
13(12, 1) - 12(12, 0)	286544.07	0.79			281.107	1.9233	
13(1,13) - 12(0,12)	275325.94	0.12			55.389	0.3603	
11(5, 6) - 12(4, 9)	153287.04	0.25			82.366	0.0411	
12(2,10) - 12(2,11)	55821.79	0.03	55821.65	0.10	63.145	0.5379	
12(3,10) - 12(2,11)	250435.01	0.05			63.145	0.2207	
13(2,12) - 12(2,11)	282111.72	0.11			63.145	12.6657	
13(4,10) - 12(4, 9)	287844.19	0.11			82.366	11.7695	
13(6, 8) - 12(6, 7)	286999.28	0.11			113.408	10.2319	
13(8, 6) - 12(8, 5)	286696.94	0.12			156.925	8.0779	
13(10, 4) - 12(10, 3)	286582.24	0.31			212.842	5.3083	
13(12, 2) - 12(12, 1)	286544.07	0.79			281.107	1.9233	
13(1,12) - 12(2,11)	222849.38	0.12			63.145	0.1694	
11(4, 7) - 12(3,10)	60429.80	0.06			71.499	0.0514	
11(6, 5) - 12(5, 8)	247428.26	0.60			96.321	0.0311	
12(1,11) - 12(1,12)	156705.98	0.07			55.634	0.1876	
12(3, 9) - 12(3,10)	6994.83	0.01			71.499	1.3693	
12(2,11) - 12(1,12)	225186.80	0.07			55.634	0.1495	
13(1,13) - 12(1,12)	267998.99	0.12			55.634	12.8965	
13(3,11) - 12(3,10)	287591.78	0.11			71.499	12.3031	
13(5, 9) - 12(5, 8)	287325.79	0.11			96.321	11.0779	
13(7, 7) - 12(7, 6)	286810.99	0.11			133.613	9.2319	
13(9, 5) - 12(9, 4)	286626.01	0.18			183.337	6.7701	
13(11, 3) - 12(11, 2)	286556.69	0.51			245.435	3.6928	
13(0,13) - 12(1,12)	262509.52	0.12			55.634	0.3580	
13(2,11) - 12(3,10)	103443.10	0.10			71.499	0.0799	
11(4, 8) - 12(3, 9)	53269.84	0.06	53269.87	0.10	71.732	0.0520	
11(6, 6) - 12(5, 7)	247420.30	0.60			96.321	0.0311	
12(2,10) - 12(1,11)	124302.61	0.03	124302.68	0.08	60.861	0.3515	
13(1,12) - 12(1,11)	291330.20	0.11			60.861	12.8456	
13(3,10) - 12(3, 9)	291514.50	0.11			71.732	12.3064	
13(5, 8) - 12(5, 7)	287335.62	0.11			96.321	11.0779	
13(7, 6) - 12(7, 5)	286810.99	0.11			133.613	9.2319	
13(9, 4) - 12(9, 3)	286626.01	0.18			183.337	6.7701	
13(11, 2) - 12(11, 1)	286556.69	0.51			245.435	3.6928	
13(2,12) - 12(3, 9)	24681.88	0.09			71.732	0.0547	
12(5, 8) - 13(4, 9)	129913.25	0.22			91.988	0.0486	
13(2,12) - 13(0,13)	244789.00	0.09			64.390	0.1393	
13(1,12) - 13(0,13)	185526.65	0.09			64.390	0.1753	
13(3,10) - 13(2,11)	195066.23	0.07			74.949	0.3043	
14(0,14) - 13(0,13)	289532.11	0.15			64.390	13.9077	
14(1,14) - 13(0,13)	293597.31	0.15			64.390	0.3961	
12(5, 7) - 13(4,10)	130535.94	0.22			91.967	0.0485	
13(2,11) - 13(2,12)	71766.38	0.03	71766.42	0.05	72.555	0.4851	
13(3,11) - 13(2,12)	255915.06	0.06			72.555	0.2373	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
14(1,13) – 13(2,12)	252746.78	0.16			72.555	0.1994	
12(4, 8) – 13(3,11)	38521.55	0.04			81.092	0.0585	
12(6, 6) – 13(5, 9)	224934.77	0.57			105.905	0.0382	
13(1,12) – 13(1,13)	180037.19	0.10			64.573	0.1823	
13(3,10) – 13(3,11)	10917.55	0.02	10917.59	0.10	81.092	1.2428	[26A]
13(2,12) – 13(1,13)	239299.53	0.10			64.573	0.1535	
14(1,14) – 13(1,13)	288107.84	0.15			64.573	13.8982	
14(0,14) – 13(1,13)	284042.64	0.15			64.573	0.3945	
14(2,12) – 13(3,11)	137026.48	0.14			81.092	0.0922	
12(4, 9) – 13(3,10)	27275.87	0.05	27275.81	0.10	81.456	0.0595	
12(6, 7) – 13(5, 8)	224916.91	0.57			105.906	0.0382	
13(2,11) – 13(1,12)	131028.72	0.04			70.578	0.3708	
14(2,13) – 13(3,10)	36296.76	0.13			81.456	0.0551	
13(5, 9) – 14(4,10)	106561.42	0.18			102.351	0.0561	
13(7, 7) – 14(6, 8)	296338.96	1.16			133.295	0.0355	
14(2,13) – 14(0,14)	258386.26	0.12			74.048	0.1492	
14(1,13) – 14(0,14)	208003.67	0.13			74.048	0.1719	
14(3,11) – 14(2,12)	188967.20	0.08			85.662	0.3449	
13(5, 8) – 14(4,11)	107674.49	0.18			102.314	0.0560	
13(7, 6) – 14(6, 9)	296339.72	1.16			133.295	0.0355	
14(2,12) – 14(2,13)	89812.17	0.03			82.666	0.4422	
14(4,10) – 14(4,11)	1095.32	0.00			102.314	2.1535	
14(3,12) – 14(2,13)	262428.38	0.07			82.666	0.2525	
15(1,14) – 14(2,13)	281951.69	0.20			82.666	0.2321	
15(3,12) – 14(4,11)	28614.95	0.09			102.314	0.0747	
13(4, 9) – 14(3,12)	17009.67	0.05			91.420	0.0652	
13(6, 7) – 14(5,10)	202336.90	0.52			116.232	0.0454	
14(1,13) – 14(1,14)	203938.47	0.13			74.183	0.1790	
14(3,11) – 14(3,12)	16350.98	0.02	16351.02	0.10	91.420	1.1288	[26A]
14(2,13) – 14(1,14)	254321.06	0.13			74.183	0.1567	
15(2,13) – 14(3,12)	171423.76	0.18			91.420	0.1062	
13(6, 8) – 14(5, 9)	202299.31	0.52			116.233	0.0454	
14(2,12) – 14(1,13)	140194.76	0.04	140194.89	0.08	80.986	0.3828	
15(2,14) – 14(3,11)	45240.48	0.17			91.966	0.0538	
14(5,10) – 15(4,11)	82813.69	0.13			113.470	0.0636	
14(7, 8) – 15(6, 9)	273884.48	1.10			144.349	0.0426	
15(2,14) – 15(0,15)	273153.24	0.16			84.363	0.1571	
15(1,14) – 15(0,15)	231085.09	0.17			84.363	0.1694	
15(3,12) – 15(2,13)	183783.16	0.09			97.138	0.3876	
16(3,14) – 15(4,11)	24076.46	0.13			113.470	0.0769	
14(5, 9) – 15(4,12)	84719.06	0.13			113.408	0.0635	
14(7, 7) – 15(6,10)	273886.26	1.10			144.349	0.0426	
15(2,13) – 15(2,14)	109832.30	0.04			93.475	0.4077	
15(4,11) – 15(4,12)	1868.08	0.01			113.408	1.9974	
15(3,13) – 15(2,14)	270023.77	0.08			93.475	0.2663	
16(3,13) – 15(4,12)	58843.51	0.14			113.408	0.0824	
14(6, 8) – 15(5,11)	179622.38	0.48			127.303	0.0528	
15(1,14) – 15(1,15)	228104.16	0.18			84.463	0.1775	
15(3,12) – 15(3,13)	23591.70	0.03			102.482	1.0252	
15(2,14) – 15(1,15)	270172.32	0.16			84.463	0.1591	
16(2,14) – 15(3,13)	206422.69	0.23			102.482	0.1223	
14(6, 9) – 15(5,10)	179547.49	0.48			127.306	0.0528	
15(2,13) – 15(1,14)	151900.46	0.04	151900.57	0.08	92.071	0.3878	
16(2,15) – 15(3,12)	51169.51	0.22			103.269	0.0511	
15(5,11) – 16(4,12)	58560.71	0.09			125.350	0.0710	
15(7, 9) – 16(6,10)	251344.66	1.03			156.146	0.0497	
16(2,15) – 16(0,16)	288935.46	0.20			95.338	0.1635	
16(1,15) – 16(0,16)	254428.72	0.22			95.338	0.1677	
16(3,13) – 16(2,14)	179969.89	0.11			109.367	0.4308	
17(3,15) – 16(4,12)	43182.31	0.19			125.350	0.0815	
15(5,10) – 16(4,13)	61700.08	0.09			125.248	0.0709	
15(7, 8) – 16(6,11)	251348.56	1.03			156.146	0.0497	
16(2,14) – 16(2,15)	131661.48	0.05	131661.46	0.08	104.975	0.3803	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
16(4,12) - 16(4,13)	3065.24	0.01			125.248	1.8566	
16(3,14) - 16(2,15)	278732.40	0.10			104.975	0.2784	
17(3,14) - 16(4,13)	90716.60	0.19			125.248	0.0904	
15(6, 9) - 16(5,12)	156779.80	0.42			139.120	0.0603	
16(1,15) - 16(1,16)	252261.14	0.22			95.410	0.1771	
16(3,13) - 16(3,14)	32898.98	0.03	32898.80	0.10	114.273	0.9311	
16(2,15) - 16(1,16)	286767.88	0.21			95.410	0.1609	
17(2,15) - 16(3,14)	241792.86	0.29			114.273	0.1407	
15(6,10) - 16(5,11)	156637.53	0.42			139.125	0.0603	
16(2,14) - 16(1,15)	166168.22	0.05			103.824	0.3870	
16(4,12) - 16(3,13)	299182.38	0.15			115.370	0.3222	
17(2,16) - 16(3,13)	53797.66	0.27			115.370	0.0472	
16(5,12) - 17(4,13)	33667.01	0.05			137.997	0.0784	
16(7,10) - 17(6,11)	228708.35	0.96			168.685	0.0571	
17(1,16) - 17(0,17)	277757.30	0.27			106.972	0.1667	
17(3,14) - 17(2,15)	177939.85	0.13			122.338	0.4723	
18(3,16) - 17(4,13)	60952.45	0.26			137.997	0.0849	
16(5,11) - 17(4,14)	38665.50	0.05	38665.45	0.10	137.835	0.0781	
16(7, 9) - 17(6,12)	228716.46	0.96			168.685	0.0571	
17(2,15) - 17(2,16)	155096.23	0.07	155096.21	0.08	117.165	0.3590	
17(4,13) - 17(4,14)	4857.99	0.01			137.835	1.7277	
17(3,15) - 17(2,16)	288567.02	0.11			117.165	0.2890	
18(3,15) - 17(4,14)	124229.57	0.26			137.835	0.0990	
16(6,10) - 17(5,13)	133799.44	0.36			151.683	0.0678	
17(1,16) - 17(1,17)	276192.47	0.28			107.024	0.1776	
17(3,14) - 17(3,15)	44469.05	0.03	44469.09	0.10	126.790	0.8460	
18(2,16) - 17(3,15)	277285.93	0.35			126.790	0.1618	
16(6,11) - 17(5,12)	133540.19	0.36			151.691	0.0678	
17(2,15) - 17(1,16)	182923.04	0.06			116.237	0.3820	
17(4,13) - 17(3,14)	291491.72	0.17			128.274	0.3524	
18(2,17) - 17(3,14)	52922.46	0.34			128.274	0.0425	
17(5,13) - 18(4,14)	7969.77	0.08			151.417	0.0857	
17(7,11) - 18(6,12)	205963.21	0.88			181.969	0.0645	
18(3,15) - 18(2,16)	178046.41	0.14			136.040	0.5098	
19(3,17) - 18(4,14)	77056.22	0.33			151.417	0.0870	
17(5,12) - 18(4,15)	15684.25	0.08			151.168	0.0852	
17(7,10) - 18(6,13)	205979.37	0.88			181.969	0.0645	
18(2,16) - 18(2,17)	179894.42	0.09			130.039	0.3431	
18(4,14) - 18(4,15)	7459.10	0.02			151.168	1.6082	
18(3,16) - 18(2,17)	299521.70	0.13			130.039	0.2980	
19(3,16) - 18(4,15)	159299.22	0.34			151.168	0.1083	
17(2,15) - 18(1,18)	90975.84	0.55			119.304	0.0064	
17(6,11) - 18(5,14)	110674.48	0.29			164.994	0.0753	
18(1,17) - 18(1,18)	299750.58	0.34			119.304	0.1785	
18(3,15) - 18(3,16)	58419.13	0.03	58419.19	0.10	140.030	0.7700	
19(4,15) - 18(5,14)	18719.00	0.15			164.994	0.0929	
17(6,12) - 18(5,13)	110219.18	0.29			165.009	0.0753	
18(2,16) - 18(1,17)	201981.98	0.08			129.302	0.3743	
18(4,14) - 18(3,15)	282957.06	0.20			141.979	0.3857	
19(2,18) - 18(3,15)	48440.99	0.42			141.979	0.0376	
18(7,12) - 19(6,13)	183095.45	0.79			195.998	0.0720	
19(3,16) - 19(2,17)	180579.10	0.16			150.458	0.5412	
20(3,18) - 19(4,15)	91131.12	0.42			165.618	0.0875	
18(7,11) - 19(6,14)	183126.38	0.79			195.997	0.0720	
19(2,17) - 19(2,18)	205777.10	0.12			143.594	0.3316	
19(4,15) - 19(4,16)	11121.51	0.02	11121.56	0.10	165.247	1.4961	[26A]
20(3,17) - 19(4,16)	195774.94	0.43			165.247	0.1188	
18(2,16) - 19(1,19)	113651.78	0.68			132.249	0.0056	
18(6,12) - 19(5,15)	87462.51	0.21			179.054	0.0827	
18(8,10) - 19(7,13)	277672.38	1.85			216.113	0.0614	
19(3,16) - 19(3,17)	74783.90	0.03			153.987	0.7031	
20(4,16) - 19(5,15)	46605.07	0.24			179.054	0.1000	
18(6,13) - 19(5,14)	86628.91	0.21			179.079	0.0828	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
18(8,11) - 19(7,12)	277671.56	1.85			216.113	0.0614	
19(2,17) - 19(1,18)	223058.98	0.10			143.018	0.3657	
19(4,15) - 19(3,16)	273898.91	0.23			156.482	0.4227	
20(2,19) - 19(3,16)	40352.43	0.50			156.482	0.0328	
20(4,17) - 19(5,14)	29716.65	0.24			179.079	0.0983	
19(7,13) - 20(6,14)	160089.36	0.69			210.773	0.0795	
20(3,17) - 20(2,18)	185764.74	0.17			165.581	0.5649	
21(3,19) - 20(4,16)	102794.11	0.51			180.608	0.0863	
19(7,12) - 20(6,15)	160146.46	0.69			210.771	0.0795	
20(2,18) - 20(2,19)	232435.18	0.16			157.828	0.3240	
20(4,16) - 20(4,17)	16130.82	0.02	16130.88	0.10	180.070	1.3899	[26A]
21(3,18) - 20(4,17)	233454.39	0.52			180.070	0.1306	
19(2,17) - 20(1,20)	137910.95	0.82			145.858	0.0049	
19(6,13) - 20(5,16)	63987.36	0.12			193.864	0.0901	
19(8,11) - 20(7,14)	255023.61	1.72			230.864	0.0687	
20(3,17) - 20(3,18)	93522.32	0.04			168.658	0.6453	
20(5,15) - 20(5,16)	1245.10	0.01			193.864	2.3429	
21(4,17) - 20(5,16)	75898.08	0.33			193.864	0.1070	
19(6,14) - 20(5,15)	62711.71	0.12			193.905	0.0902	
19(8,12) - 20(7,13)	255021.91	1.72			230.864	0.0687	
20(2,18) - 20(1,19)	245784.89	0.14			157.383	0.3575	
20(4,16) - 20(3,17)	264736.67	0.27			171.778	0.4635	
21(2,20) - 20(3,17)	28749.61	0.60			171.778	0.0284	
21(4,18) - 20(5,15)	51862.52	0.34			193.905	0.1042	
20(7,14) - 21(6,15)	136926.77	0.58			226.297	0.0870	
21(3,18) - 21(2,19)	193767.77	0.18			181.394	0.5802	
22(3,20) - 21(4,17)	111659.88	0.62			196.395	0.0835	
20(7,13) - 21(6,16)	137028.86	0.58			226.293	0.0870	
21(2,19) - 21(2,20)	259542.86	0.19			172.737	0.3196	
21(4,17) - 21(4,18)	22790.47	0.03			195.635	1.2889	
22(3,19) - 21(4,18)	272098.53	0.63			195.635	0.1442	
20(2,18) - 21(1,21)	163360.91	0.97			160.132	0.0044	
20(6,14) - 21(5,17)	40441.36	0.06			209.424	0.0974	
20(8,12) - 21(7,15)	232282.48	1.59			246.358	0.0762	
21(3,18) - 21(3,19)	114529.46	0.05			184.037	0.5961	
21(5,16) - 21(5,17)	1990.44	0.01			209.424	2.2132	
22(4,18) - 21(5,17)	106791.35	0.45			209.424	0.1140	
20(6,15) - 21(5,16)	38394.63	0.06			209.491	0.0975	
20(8,13) - 21(7,14)	232279.10	1.59			246.358	0.0762	
21(2,19) - 21(1,20)	269739.41	0.18			172.396	0.3503	
21(4,17) - 21(3,18)	255958.70	0.32			187.857	0.5078	
22(4,19) - 21(5,16)	73401.25	0.45			209.491	0.1095	
21(7,15) - 22(6,16)	113586.22	0.45			242.569	0.0945	
22(3,19) - 22(2,20)	204684.18	0.19			197.884	0.5871	
23(3,21) - 22(4,18)	117365.53	0.73			212.987	0.0791	
21(7,14) - 22(6,17)	113763.46	0.45			242.564	0.0945	
22(2,20) - 22(2,21)	286777.80	0.23			188.318	0.3179	
22(4,18) - 22(4,19)	31399.66	0.03			211.939	1.1925	
23(5,18) - 22(6,17)	11828.61	0.25			242.564	0.1119	
21(2,19) - 22(1,22)	189600.45	1.14			175.070	0.0040	
21(6,15) - 22(5,18)	16787.94	0.13			225.737	0.1046	
21(8,13) - 22(7,16)	209440.18	1.45			262.597	0.0836	
22(3,19) - 22(3,20)	137648.18	0.06			200.120	0.5552	
22(5,17) - 22(5,18)	3101.65	0.01			225.737	2.0915	
23(4,19) - 22(5,18)	139437.97	0.57			225.737	0.1211	
21(6,16) - 22(5,17)	13585.89	0.13			225.840	0.1048	
21(8,14) - 22(7,15)	209433.68	1.45			262.597	0.0836	
22(2,20) - 22(1,21)	294489.40	0.22			188.061	0.3446	
22(4,18) - 22(3,19)	248085.90	0.36			204.711	0.5548	
23(4,20) - 22(5,17)	94109.57	0.57			225.840	0.1140	
22(7,16) - 23(6,17)	90041.94	0.32			259.594	0.1019	
22(9,14) - 23(8,15)	281245.74	3.00			302.763	0.0804	
23(3,20) - 23(2,21)	218528.62	0.21			215.038	0.5867	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
24(3,22) - 23(4,19)	119599.11	0.86			230.388	0.0734	
24(5,20) - 23(6,17)	30674.39	0.39			259.594	0.1184	
22(7,15) - 23(6,18)	90341.54	0.32			259.584	0.1019	
22(9,13) - 23(8,16)	281246.09	3.00			302.763	0.0804	
23(4,19) - 23(4,20)	42226.75	0.03	42226.82	0.10	228.979	1.1012	
24(5,19) - 23(6,18)	37988.12	0.39			259.584	0.1189	
22(2,20) - 23(1,23)	216240.69	1.32			190.671	0.0037	
22(8,14) - 23(7,17)	186487.52	1.29			279.581	0.0911	
23(3,20) - 23(3,21)	162677.63	0.08			216.901	0.5218	
23(5,18) - 23(5,19)	4719.23	0.02			242.801	1.9765	
24(4,20) - 23(5,19)	173928.06	0.70			242.801	0.1284	
22(8,15) - 23(7,16)	186475.41	1.29			279.582	0.0911	
23(4,19) - 23(3,20)	241634.54	0.41			222.328	0.6026	
24(4,21) - 23(5,18)	113725.74	0.70			242.958	0.1175	
23(7,17) - 24(6,18)	66262.45	0.18			277.371	0.1093	
23(9,15) - 24(8,16)	258509.05	2.78			320.467	0.0878	
24(3,21) - 24(2,22)	235219.07	0.23			232.848	0.5805	
25(3,23) - 24(4,20)	118126.87	1.00			248.602	0.0669	
25(5,21) - 24(6,18)	54353.76	0.54			277.371	0.1249	
23(7,16) - 24(6,19)	66756.53	0.18			277.355	0.1093	
23(9,14) - 24(8,17)	258509.74	2.78			320.467	0.0878	
24(4,20) - 24(4,21)	55483.09	0.04			246.752	1.0154	
25(5,20) - 24(6,19)	65058.18	0.54			277.355	0.1257	
23(8,15) - 24(7,18)	163414.93	1.11			297.312	0.0987	
24(3,21) - 24(3,22)	189378.19	0.11			234.377	0.4952	
24(5,19) - 24(5,20)	7020.55	0.02			260.617	1.8667	
25(4,21) - 24(5,20)	210272.86	0.85			260.617	0.1363	
23(8,16) - 24(7,17)	163393.00	1.11			297.313	0.0987	
24(4,20) - 24(3,21)	237083.88	0.45			240.694	0.6493	
25(4,22) - 24(5,19)	131949.04	0.85			260.851	0.1199	
24(7,18) - 25(6,19)	42208.79	0.07			295.904	0.1167	
24(9,16) - 25(8,17)	235683.76	2.55			338.915	0.0953	
25(3,22) - 25(2,23)	254566.37	0.26			251.305	0.5704	
26(3,24) - 25(4,21)	112813.35	1.16			267.631	0.0601	
26(5,22) - 25(6,19)	77874.76	0.71			295.904	0.1310	
24(7,17) - 25(6,20)	43005.23	0.07	43005.42	0.10	295.878	0.1166	
24(9,15) - 25(8,18)	235685.09	2.55			338.915	0.0953	
25(4,21) - 25(4,22)	71303.27	0.04	71303.30	0.10	265.252	0.9361	
26(5,21) - 25(6,20)	93228.91	0.71			295.878	0.1324	
24(8,16) - 25(7,19)	140212.63	0.92			315.790	0.1062	
25(3,22) - 25(3,23)	217474.32	0.15			252.543	0.4748	
25(5,20) - 25(5,21)	10222.28	0.03			279.184	1.7611	
26(4,22) - 25(5,21)	248399.55	1.01			279.184	0.1449	
24(8,17) - 25(7,18)	140173.92	0.92			315.791	0.1062	
25(4,21) - 25(3,22)	234852.91	0.49			259.797	0.6922	
26(4,23) - 25(5,20)	148441.52	1.01			279.525	0.1208	
25(7,19) - 26(6,20)	17832.40	0.20			315.195	0.1239	
25(9,17) - 26(8,18)	212762.37	2.31			358.108	0.1028	
26(3,23) - 26(2,24)	276274.91	0.32			270.406	0.5584	
27(3,25) - 26(4,22)	103630.16	1.34			287.470	0.0532	
27(5,23) - 26(6,20)	101111.30	0.89			315.195	0.1368	
25(7,18) - 26(6,21)	19089.19	0.20			315.154	0.1238	
25(9,16) - 26(8,19)	212764.87	2.31			358.108	0.1028	
26(4,22) - 26(4,23)	89735.75	0.05			284.477	0.8641	
26(6,20) - 26(6,21)	1218.77	0.01			315.154	2.5745	
27(5,22) - 26(6,21)	122708.67	0.90			315.154	0.1389	
25(8,17) - 26(7,20)	116870.71	0.72			335.017	0.1136	
26(3,23) - 26(3,24)	246657.74	0.21			271.394	0.4599	
26(5,21) - 26(5,22)	14579.30	0.03	14579.40	0.10	298.502	1.6586	[26A]
27(4,23) - 26(5,22)	288156.99	1.18			298.502	0.1547	
25(8,18) - 26(7,19)	116804.06	0.72			335.019	0.1136	
26(4,22) - 26(3,23)	235287.96	0.53			279.621	0.7291	
27(4,24) - 26(5,21)	162833.23	1.18			298.988	0.1201	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
26(9,18) - 27(8,19)	189736.85	2.04			378.046	0.1103	
27(3,24) - 27(2,25)	299957.44	0.39			290.147	0.5463	
28(3,26) - 27(4,23)	90653.05	1.55			308.113	0.0467	
28(5,24) - 27(6,21)	123906.80	1.09			335.248	0.1419	
26(3,23) - 27(2,26)	101064.65	1.58			276.250	0.0125	
26(9,17) - 27(8,20)	189741.42	2.04			378.046	0.1103	
27(4,23) - 27(4,24)	110744.46	0.06			304.419	0.8000	
27(6,21) - 27(6,22)	1878.71	0.01			335.185	2.4574	
28(5,23) - 27(6,22)	153712.10	1.10			335.185	0.1453	
26(8,18) - 27(7,21)	93379.42	0.50			354.993	0.1211	
26(10,16) - 27(9,19)	284651.17	4.68			404.287	0.0995	
27(3,24) - 27(3,25)	276593.60	0.29			290.927	0.4498	
27(5,22) - 27(5,23)	20378.60	0.04	20378.46	0.10	318.568	1.5588	
28(6,22) - 27(7,21)	32147.34	0.61			354.993	0.1380	
26(8,19) - 27(7,20)	93267.19	0.50			354.996	0.1211	
26(10,17) - 27(9,18)	284651.03	4.68			404.287	0.0995	
27(4,23) - 27(3,24)	238658.94	0.57			300.153	0.7579	
28(4,25) - 27(5,22)	174732.35	1.37			319.248	0.1178	
28(6,23) - 27(7,20)	29196.35	0.60			354.996	0.1379	
27(9,19) - 28(8,20)	166598.59	1.76			398.730	0.1178	
29(3,27) - 28(4,24)	74050.51	1.78			329.553	0.0409	
29(5,25) - 28(6,22)	146071.12	1.31			356.065	0.1464	
27(3,24) - 28(2,27)	129497.71	1.83			295.833	0.0113	
27(9,18) - 28(8,21)	166606.76	1.76			398.730	0.1178	
28(4,24) - 28(4,25)	134218.19	0.10	134218.14	0.08	325.076	0.7441	
28(6,22) - 28(6,23)	2841.23	0.02			355.970	2.3453	
29(5,24) - 28(6,23)	186442.13	1.32			355.970	0.1516	
27(8,19) - 28(7,22)	69729.48	0.26			375.720	0.1285	
27(10,17) - 28(9,20)	261848.12	4.33			424.943	0.1070	
28(5,23) - 28(5,24)	27926.60	0.05			339.381	1.4612	
29(6,23) - 28(7,22)	57921.58	0.84			375.720	0.1449	
27(8,20) - 28(7,21)	69544.44	0.26			375.726	0.1285	
27(10,18) - 28(9,19)	261847.85	4.33			424.943	0.1070	
28(4,24) - 28(3,25)	245158.91	0.62			321.375	0.7774	
29(4,26) - 28(5,23)	183741.37	1.58			340.312	0.1137	
29(6,24) - 28(7,21)	53521.61	0.83			375.726	0.1446	
28(9,20) - 29(8,21)	143338.25	1.45			420.162	0.1253	
30(3,28) - 29(4,25)	54068.69	2.06			351.778	0.0357	
30(5,26) - 29(6,23)	167378.00	1.54			377.652	0.1501	
28(3,25) - 29(2,28)	158771.01	2.13			316.079	0.0103	
28(9,19) - 29(8,22)	143352.52	1.45			420.162	0.1253	
29(4,25) - 29(4,26)	159903.00	0.16			346.441	0.6964	
29(6,23) - 29(6,24)	4219.44	0.02			377.511	2.2374	
30(5,25) - 29(6,24)	221067.52	1.55			377.511	0.1581	
28(8,20) - 29(7,23)	45912.58	0.07			397.199	0.1358	
28(10,18) - 29(9,21)	238961.70	3.96			446.343	0.1145	
29(5,24) - 29(5,25)	37529.78	0.05	37529.52	0.10	360.938	1.3660	
30(6,24) - 29(7,23)	84366.91	1.09			397.199	0.1516	
28(8,21) - 29(7,22)	45613.41	0.07	45613.23	0.10	397.208	0.1358	
28(10,19) - 29(9,20)	238961.20	3.96			446.343	0.1145	
29(4,25) - 29(3,26)	254901.33	0.68			343.275	0.7875	
30(4,27) - 29(5,24)	189479.51	1.81			362.189	0.1080	
30(6,25) - 29(7,22)	77917.99	1.08			397.208	0.1512	
29(9,21) - 30(8,22)	119945.63	1.13			442.342	0.1328	
31(5,27) - 30(6,24)	187563.13	1.79			400.013	0.1528	
29(3,26) - 30(2,29)	188458.14	2.49			336.989	0.0096	
29(9,20) - 30(8,23)	119970.05	1.13			442.341	0.1328	
30(4,26) - 30(4,27)	187813.67	0.25			368.510	0.6566	
30(6,24) - 30(6,25)	6157.78	0.08			399.808	2.1329	
31(5,26) - 30(6,25)	257699.66	1.80			399.808	0.1647	
29(8,21) - 30(7,24)	21921.99	0.29			419.431	0.1430	
29(10,19) - 30(9,22)	215985.87	3.56			468.487	0.1220	
30(5,25) - 30(5,26)	49470.08	0.05	49470.21	0.10	383.235	1.2736	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
31(6,25) - 30(7,24)	111624.43	1.37			419.431	0.1581	
29(8,22) - 30(7,23)	21447.12	0.30			419.446	0.1430	
29(10,20) - 30(9,21)	215984.94	3.56			468.487	0.1220	
30(4,26) - 30(3,27)	267912.25	0.75			365.838	0.7888	
31(4,28) - 30(5,25)	191609.67	2.06			384.885	0.1009	
31(6,26) - 30(7,23)	102327.52	1.35			419.446	0.1575	
30(9,22) - 31(8,23)	96409.47	0.78			465.271	0.1402	
30(11,20) - 31(10,21)	287920.78	7.05			520.674	0.1186	
31(5,26) - 31(4,27)	296009.47	1.26			398.530	0.8232	
32(5,28) - 31(6,25)	206323.56	2.06			423.154	0.1543	
32(7,26) - 31(8,23)	26593.87	0.91			465.271	0.1571	
30(3,27) - 31(2,30)	218165.43	2.91			358.561	0.0089	
30(9,21) - 31(8,24)	96450.45	0.78			465.270	0.1402	
30(11,19) - 31(10,22)	287920.83	7.05			520.674	0.1186	
31(4,27) - 31(4,28)	217442.39	0.39			391.277	0.6244	
31(6,25) - 31(6,26)	8836.04	0.04			422.859	2.0310	
32(5,27) - 31(6,26)	296373.57	2.05			422.859	0.1719	
32(7,25) - 31(8,24)	27730.49	0.92			465.270	0.1572	
30(10,20) - 31(9,23)	192914.28	3.14			491.377	0.1295	
31(5,26) - 31(5,27)	63978.75	0.05	63978.83	0.10	406.269	1.1850	
32(6,26) - 31(7,25)	139861.06	1.66			442.417	0.1645	
30(10,21) - 31(9,22)	192912.61	3.14			491.377	0.1295	
31(4,27) - 31(3,28)	284118.95	0.86			389.052	0.7827	
32(4,29) - 31(5,26)	189866.10	2.35			408.403	0.0929	
32(6,27) - 31(7,24)	126672.35	1.64			442.441	0.1634	
31(9,23) - 32(8,24)	72717.14	0.41			488.951	0.1476	
31(11,21) - 32(10,22)	265069.36	6.51			544.279	0.1261	
32(5,27) - 32(4,28)	291321.15	1.35			423.028	0.8715	
33(5,29) - 32(6,26)	223318.99	2.35			447.082	0.1543	
33(7,27) - 32(8,24)	51115.80	1.25			488.951	0.1640	
31(3,28) - 32(2,31)	247555.44	3.41			380.795	0.0084	
31(9,22) - 32(8,25)	72784.69	0.41			488.949	0.1476	
31(11,20) - 32(10,23)	265069.46	6.51			544.279	0.1261	
32(4,28) - 32(4,29)	248564.69	0.58			414.737	0.5992	
32(6,26) - 32(6,27)	12471.87	0.06			446.666	1.9310	
33(7,26) - 32(8,25)	52832.61	1.26			488.949	0.1641	
31(10,21) - 32(9,24)	169740.29	2.70			515.012	0.1370	
32(5,27) - 32(5,28)	81213.97	0.06			430.036	1.1012	
32(7,25) - 32(7,26)	1096.55	0.02			466.158	2.8241	
33(6,27) - 32(7,26)	169268.29	1.98			466.158	0.1706	
31(10,22) - 32(9,23)	169737.33	2.70			515.012	0.1370	
33(4,30) - 32(5,27)	184077.52	2.68			432.745	0.0843	
33(6,28) - 32(7,25)	150851.52	1.95			466.195	0.1690	
32(9,24) - 33(8,25)	48854.33	0.10	48854.37	0.10	513.382	0.1549	
32(11,22) - 33(10,23)	242139.77	5.93			568.628	0.1336	
33(5,28) - 33(4,29)	289451.55	1.45			448.254	0.9140	
34(5,30) - 33(6,27)	238176.27	2.66			471.805	0.1528	
34(7,28) - 33(8,25)	75801.74	1.62			513.382	0.1708	
32(9,23) - 33(8,26)	48963.76	0.10			513.379	0.1549	
32(11,21) - 33(10,24)	242139.96	5.93			568.628	0.1336	
33(4,29) - 33(4,30)	280844.45	0.83			438.886	0.5803	
33(6,27) - 33(6,28)	17320.22	0.07			471.227	1.8324	
34(7,27) - 33(8,26)	78356.21	1.64			513.379	0.1709	
32(10,22) - 33(9,25)	146456.93	2.23			539.394	0.1445	
33(5,28) - 33(5,29)	101246.79	0.12			454.531	1.0235	
33(7,26) - 33(7,27)	1650.92	0.02			490.656	2.7141	
34(6,28) - 33(7,27)	200057.12	2.31			490.656	0.1766	
32(10,23) - 33(9,24)	146451.79	2.23			539.394	0.1445	
34(4,31) - 33(5,28)	174181.19	3.06			457.909	0.0756	
34(6,29) - 33(7,26)	174737.63	2.27			490.711	0.1741	
33(11,23) - 34(10,24)	219126.93	5.32			593.721	0.1411	
34(5,29) - 34(4,30)	290724.19	1.56			474.190	0.9485	
35(5,31) - 34(6,28)	250498.11	3.00			497.329	0.1496	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
35(7,29) - 34(8,26)	100632.62	2.01			538.567	0.1773	
33(11,22) - 34(10,25)	219127.27	5.32			593.721	0.1411	
34(6,28) - 34(6,29)	23668.56	0.07			496.540	1.7346	
35(7,28) - 34(8,27)	104378.86	2.04			538.561	0.1775	
33(10,23) - 34(9,26)	123056.90	1.73			564.523	0.1519	
34(5,29) - 34(5,30)	124057.60	0.23			479.749	0.9529	
34(7,27) - 34(7,28)	2447.95	0.03			515.911	2.6077	
35(6,29) - 34(7,28)	232447.79	2.67			515.911	0.1824	
33(10,24) - 34(9,25)	123048.14	1.73			564.524	0.1519	
35(4,32) - 34(5,29)	160225.44	3.52			483.887	0.0672	
35(6,30) - 34(7,27)	198173.58	2.62			515.992	0.1787	
34(11,24) - 35(10,25)	196025.50	4.69			619.559	0.1486	
35(5,30) - 35(4,31)	295375.01	1.70			500.821	0.9734	
36(5,32) - 35(6,29)	259877.28	3.38			523.664	0.1446	
36(7,30) - 35(8,27)	125578.64	2.42			564.505	0.1837	
34(11,23) - 35(10,26)	196026.10	4.69			619.559	0.1486	
35(6,29) - 35(6,30)	31826.26	0.08			522.603	1.6377	
36(7,29) - 35(8,28)	130996.31	2.46			564.496	0.1840	
34(10,24) - 35(9,27)	99532.59	1.21			590.401	0.1593	
35(5,30) - 35(5,31)	149541.98	0.40			505.685	0.8900	
35(7,28) - 35(7,29)	3576.86	0.04			541.923	2.5042	
36(6,30) - 35(7,29)	266653.97	3.04			541.923	0.1882	
34(10,25) - 35(9,26)	99517.93	1.21			590.401	0.1593	
36(4,33) - 35(5,30)	142362.31	4.07			510.673	0.0595	
36(6,31) - 35(7,28)	220969.49	2.99			542.043	0.1826	
35(11,25) - 36(10,26)	172829.86	4.02			646.142	0.1561	
37(5,33) - 36(6,30)	265916.83	3.80			550.818	0.1379	
37(7,31) - 36(8,28)	150596.76	2.86			591.199	0.1898	
35(11,24) - 36(10,27)	172830.91	4.02			646.142	0.1561	
36(6,30) - 36(6,31)	42107.62	0.08			549.413	1.5417	
37(7,30) - 36(8,29)	158325.57	2.91			591.186	0.1903	
35(10,25) - 36(9,28)	75876.11	0.69			617.028	0.1667	
35(12,23) - 36(11,26)	268197.24	9.46			678.458	0.1453	
36(5,31) - 36(5,32)	177522.16	0.64			532.333	0.8354	
36(7,29) - 36(7,30)	5152.48	0.06			568.694	2.4031	
37(8,29) - 36(9,28)	48679.29	1.87			617.028	0.1833	
35(10,26) - 36(9,27)	75851.96	0.69			617.029	0.1667	
35(12,24) - 36(11,25)	268197.21	9.46			678.458	0.1453	
37(4,34) - 36(5,31)	120833.74	4.74			538.255	0.0525	
37(6,32) - 36(7,29)	242900.09	3.38			568.866	0.1856	
37(8,30) - 36(9,27)	48033.65	1.85			617.029	0.1833	
36(11,26) - 37(10,27)	149534.09	3.33			673.471	0.1636	
38(5,34) - 37(6,31)	268255.23	4.28			578.796	0.1296	
38(7,32) - 37(8,29)	175627.82	3.32			618.652	0.1956	
36(11,25) - 37(10,28)	149535.91	3.33			673.471	0.1636	
37(6,31) - 37(6,32)	54809.36	0.10	54809.37	0.10	576.968	1.4473	
38(7,31) - 37(8,30)	186507.59	3.39			618.631	0.1963	
36(10,26) - 37(9,29)	52079.31	0.31			644.405	0.1740	
36(12,24) - 37(11,27)	245240.92	8.61			705.753	0.1528	
37(5,32) - 37(5,33)	207760.01	0.96			559.688	0.7890	
37(7,30) - 37(7,31)	7319.76	0.08			596.223	2.3037	
38(8,30) - 37(9,29)	73712.10	2.41			644.405	0.1902	
36(10,27) - 37(9,28)	52040.13	0.31			644.406	0.1740	
36(12,25) - 37(11,26)	245240.86	8.61			705.753	0.1528	
38(6,33) - 37(7,30)	263702.66	3.80			596.467	0.1876	
38(8,31) - 37(9,28)	72740.70	2.39			644.406	0.1901	
37(11,27) - 38(10,28)	126131.92	2.61			701.546	0.1710	
39(5,35) - 38(6,32)	266593.82	4.84			607.604	0.1203	
39(7,33) - 38(8,30)	200593.62	3.81			646.863	0.2011	
37(11,26) - 38(10,29)	126135.00	2.61			701.546	0.1710	
38(6,32) - 38(6,33)	70185.06	0.18			605.263	1.3553	
39(7,32) - 38(8,31)	215708.70	3.89			646.832	0.2022	
37(12,25) - 38(11,28)	222207.48	7.72			733.792	0.1603	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
38(5,33) - 38(5,34)	239968.45	1.38			587.744	0.7506	
38(7,31) - 38(7,32)	10257.68	0.09			624.510	2.2056	
39(8,31) - 38(9,30)	99076.65	2.98			672.532	0.1969	
37(12,26) - 38(11,27)	222207.36	7.72			733.792	0.1603	
39(6,34) - 38(7,31)	283076.14	4.25			624.852	0.1884	
39(8,32) - 38(9,29)	97633.97	2.95			672.534	0.1968	
38(11,28) - 39(10,29)	102616.68	1.87			730.369	0.1784	
40(5,36) - 39(6,33)	260722.09	5.50			637.244	0.1102	
40(7,34) - 39(8,31)	225393.64	4.32			675.837	0.2062	
38(11,27) - 39(10,30)	102621.83	1.87			730.369	0.1784	
39(6,33) - 39(6,34)	88421.03	0.32			634.294	1.2669	
40(7,33) - 39(8,32)	246120.10	4.42			675.791	0.2079	
38(12,26) - 39(11,29)	199092.47	6.80			762.574	0.1678	
39(5,34) - 39(5,35)	273820.42	1.92			616.497	0.7200	
39(7,32) - 39(7,33)	14181.84	0.11			653.554	2.1081	
40(8,32) - 39(9,31)	124823.78	3.58			701.412	0.2034	
38(12,27) - 39(11,28)	199092.26	6.80			762.574	0.1678	
40(8,33) - 39(9,30)	122707.85	3.55			701.415	0.2033	
39(11,29) - 40(10,30)	78981.25	1.16			759.939	0.1858	
41(5,37) - 40(6,34)	250536.12	6.30			667.714	0.0998	
41(7,35) - 40(8,32)	249901.90	4.85			705.575	0.2108	
39(11,28) - 40(10,31)	78989.73	1.16			759.939	0.1858	
40(6,34) - 40(6,35)	109618.32	0.55			664.057	1.1835	
41(7,34) - 40(8,33)	277953.85	4.96			705.508	0.2134	
39(12,27) - 40(11,30)	175891.25	5.84			792.101	0.1752	
40(7,33) - 40(7,34)	19344.64	0.14			683.355	2.0110	
41(8,33) - 40(9,32)	151016.27	4.22			731.044	0.2099	
39(12,28) - 40(11,29)	175890.88	5.84			792.101	0.1752	
41(8,34) - 40(9,31)	147950.33	4.17			731.049	0.2097	
42(5,38) - 41(6,35)	236046.70	7.27			699.009	0.0897	
42(7,36) - 41(8,33)	273963.71	5.41			736.081	0.2148	
42(9,34) - 41(10,31)	69298.70	3.47			790.259	0.2093	
41(6,35) - 41(6,36)	133784.11	0.89			694.546	1.1064	
42(9,33) - 41(10,32)	69656.90	3.49			790.258	0.2094	
40(12,28) - 41(11,31)	152598.98	4.85			822.373	0.1827	
41(7,34) - 41(7,35)	26031.77	0.16			713.911	1.9138	
42(8,34) - 41(9,33)	177731.54	4.89			761.430	0.2161	
40(12,29) - 41(11,30)	152598.34	4.85			822.373	0.1827	
42(8,35) - 41(9,32)	173341.28	4.82			761.437	0.2159	
43(5,39) - 42(6,36)	217376.75	8.47			731.121	0.0801	
43(7,37) - 42(8,34)	297392.62	6.00			767.358	0.2182	
43(9,35) - 42(10,32)	94106.52	4.27			821.328	0.2161	
42(6,36) - 42(6,37)	160833.12	1.36			725.756	1.0366	
43(9,34) - 42(10,33)	94643.69	4.30			821.327	0.2162	
41(12,29) - 42(11,32)	129210.56	3.83			853.390	0.1901	
42(7,35) - 42(7,36)	34553.58	0.20			745.220	1.8165	
43(8,35) - 42(9,34)	205064.57	5.60			792.570	0.2222	
41(12,30) - 42(11,31)	129209.49	3.83			853.390	0.1901	
43(8,36) - 42(9,33)	198850.21	5.50			792.582	0.2218	
42(13,30) - 43(12,31)	202125.77	9.60			920.403	0.1869	
44(5,40) - 43(6,37)	194750.41	9.92			764.039	0.0713	
44(9,36) - 43(10,33)	119105.10	5.11			853.147	0.2228	
42(13,29) - 43(12,32)	202125.85	9.60			920.403	0.1869	
43(6,37) - 43(6,38)	190596.67	1.97			757.682	0.9748	
43(8,35) - 43(8,36)	5869.57	0.12			799.215	2.5781	
44(9,35) - 43(10,34)	119901.51	5.15			853.146	0.2228	
43(7,36) - 43(7,37)	45230.67	0.29			777.278	1.7193	
44(8,36) - 43(9,35)	233130.90	6.33			824.467	0.2281	
44(8,37) - 43(9,34)	224434.00	6.21			824.484	0.2276	
43(13,31) - 44(12,32)	178931.59	8.26			952.869	0.1943	
45(9,37) - 44(10,34)	144296.24	5.99			885.718	0.2293	
43(13,30) - 44(12,33)	178931.71	8.26			952.869	0.1943	
44(6,38) - 44(6,39)	222835.65	2.76			790.317	0.9214	

TABLE 8. The microwave spectrum of D ^{12}COOH. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
44(8,36) - 44(8,37)	8181.19	0.15			831.970	2.4815	
45(9,36) - 44(10,35)	145464.04	6.03			885.716	0.2294	
44(7,37) - 44(7,38)	58373.56	0.46			810.084	1.6226	
45(8,37) - 44(9,36)	262069.23	7.09			857.120	0.2338	
45(8,38) - 44(9,35)	250034.16	6.94			857.146	0.2330	
46(9,38) - 45(10,35)	169678.25	6.90			919.041	0.2357	
45(6,39) - 45(6,40)	257253.80	3.75			823.656	0.8765	
45(8,37) - 45(8,38)	11272.54	0.19			865.486	2.3853	
46(9,37) - 45(10,36)	171372.35	6.96			919.038	0.2358	
45(7,38) - 45(7,39)	74258.47	0.74			843.632	1.5273	
46(8,38) - 45(9,37)	292043.22	7.87			890.531	0.2392	
46(8,39) - 45(9,36)	275574.02	7.70			890.568	0.2380	
47(9,39) - 46(10,36)	195244.79	7.85			953.116	0.2419	
46(6,40) - 46(6,41)	293509.18	4.95			857.694	0.8397	
46(8,38) - 46(8,39)	15354.25	0.24			899.760	2.2891	
47(9,38) - 46(10,37)	197676.82	7.93			953.112	0.2420	
46(7,39) - 46(7,40)	93102.41	1.15			877.920	1.4345	
48(9,40) - 47(10,37)	220983.44	8.83			987.947	0.2479	
47(8,39) - 47(8,40)	20673.25	0.31			934.793	2.1926	
48(9,39) - 47(10,38)	224439.31	8.94			987.940	0.2481	
47(7,40) - 47(7,41)	115041.97	1.74			912.941	1.3458	
49(9,41) - 48(10,38)	246873.99	9.84			1023.532	0.2538	
48(8,40) - 48(8,41)	27510.47	0.43			970.582	2.0954	
49(9,40) - 48(10,39)	251735.67	9.98			1023.523	0.2540	
48(7,41) - 48(7,42)	140120.03	2.54			948.692	1.2624	
49(8,41) - 49(8,42)	36174.29	0.62			1007.126	1.9975	
49(7,42) - 49(7,43)	168282.05	3.58			985.167	1.1857	
50(8,42) - 50(8,43)	46988.57	0.92			1044.422	1.8990	
50(7,43) - 50(7,44)	199381.38	4.91			1022.359	1.1166	

TABLE 9. The microwave spectrum of $H^{13}COOH$. Frequencies in MHz.

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
1(0, 1) – 0(0, 0)	22432.53	0.01	22432.50	0.05	0.000	1.0000	[26A]
1(1, 1) – 0(0, 0)	85958.37	0.06			0.000	0.0350	
1(1, 0) – 1(0, 1)	65200.22	0.06			0.748	0.0525	
2(0, 2) – 1(0, 1)	44832.15	0.01	44832.21	0.05	0.748	1.9997	[26A]
2(1, 2) – 1(0, 1)	106716.66	0.06			0.748	0.0525	
1(1, 0) – 1(1, 1)	1674.38	0.00			2.867	1.5000	
2(1, 2) – 1(1, 1)	43190.82	0.01	43190.80	0.05	2.867	1.5000	[26A]
2(2, 0) – 1(1, 1)	238805.26	0.08			2.867	0.0518	
2(1, 1) – 1(1, 0)	46539.49	0.01	46539.49	0.05	2.923	1.5000	
2(2, 1) – 1(1, 0)	237098.22	0.08			2.923	0.0525	
1(1, 1) – 2(0, 2)	18693.69	0.06			2.244	0.0182	
2(1, 1) – 2(0, 2)	66907.56	0.06			2.244	0.0864	
3(0, 3) – 2(0, 2)	67166.08	0.02	67166.09	0.05	2.244	2.9990	[26A]
3(2, 1) – 2(2, 0)	67429.20	0.02	67429.22	0.05	10.833	1.6667	[26A]
3(1, 3) – 2(0, 2)	126650.05	0.06			2.244	0.0705	
3(2, 2) – 2(2, 1)	67298.66	0.02	67298.62	0.05	10.832	1.6667	[26A]
2(1, 1) – 2(1, 2)	5023.05	0.00			4.308	0.8333	
2(2, 1) – 2(1, 2)	195581.79	0.08			4.308	0.0292	
3(1, 3) – 2(1, 2)	64765.54	0.02	64765.57	0.05	4.308	2.6666	[26A]
3(2, 1) – 2(1, 2)	263043.65	0.09			4.308	0.0560	
2(2, 0) – 2(1, 1)	190591.39	0.08			4.476	0.0303	
3(1, 2) – 2(1, 1)	69787.91	0.02	69787.93	0.05	4.476	2.6666	[26A]
3(2, 2) – 2(1, 1)	257857.39	0.09			4.476	0.0583	
3(2, 2) – 3(0, 3)	257598.87	0.12			4.484	0.0015	
3(1, 2) – 3(0, 3)	69529.39	0.06	69529.23	0.05	4.484	0.1185	[26A]
4(0, 4) – 3(0, 3)	89401.94	0.02			4.484	3.9975	
4(2, 2) – 3(2, 1)	90030.84	0.02			13.082	2.9999	
4(1, 4) – 3(0, 3)	145799.98	0.06			4.484	0.0892	
4(2, 3) – 3(2, 2)	89705.06	0.02			13.077	2.9999	
2(2, 0) – 3(1, 3)	130848.90	0.08			6.468	0.0057	
3(1, 2) – 3(1, 3)	10045.42	0.01			6.468	0.5834	
3(2, 2) – 3(1, 3)	198114.90	0.08			6.468	0.0505	
4(1, 4) – 3(1, 3)	86316.01	0.02			6.468	3.7497	
4(3, 2) – 3(3, 1)	89797.92	0.02			23.809	1.7501	
4(0, 4) – 3(1, 3)	29917.97	0.06			6.468	0.0576	
4(2, 2) – 3(1, 3)	288308.95	0.09			6.468	0.0607	
2(2, 1) – 3(1, 2)	120770.82	0.08			6.803	0.0061	
3(2, 1) – 3(1, 2)	188232.68	0.08			6.803	0.0545	
4(1, 3) – 3(1, 2)	93010.20	0.02			6.803	3.7496	
4(3, 1) – 3(3, 0)	89800.31	0.02			23.809	1.7501	
4(2, 3) – 3(1, 2)	277774.54	0.09			6.803	0.0658	
3(3, 1) – 4(2, 2)	231546.32	0.55			16.085	0.0044	
4(2, 3) – 4(0, 4)	257901.99	0.12			7.466	0.0034	
4(1, 3) – 4(0, 4)	73137.65	0.06	73137.45	0.10	7.466	0.1482	
5(0, 5) – 4(0, 4)	111508.64	0.02	111508.63	0.08	7.466	4.9950	[26A]
5(2, 3) – 4(2, 2)	112737.99	0.02	112737.95	0.08	16.085	4.1997	[26A]
5(4, 1) – 4(4, 0)	112243.91	0.02			41.822	1.8001	
5(1, 5) – 4(0, 4)	164233.10	0.06			7.466	0.1091	
3(3, 0) – 4(2, 3)	232035.70	0.55			16.069	0.0044	
5(2, 4) – 4(2, 3)	112088.79	0.02	112088.78	0.08	16.069	4.1997	[26A]
5(4, 2) – 4(4, 1)	112243.87	0.02			41.822	1.8001	
3(2, 1) – 4(1, 4)	111962.09	0.09			9.347	0.0123	
4(1, 3) – 4(1, 4)	16739.62	0.01			9.347	0.4503	
4(2, 3) – 4(1, 4)	201503.96	0.08			9.347	0.0693	
5(1, 5) – 4(1, 4)	107835.06	0.02			9.347	4.7992	
5(3, 3) – 4(3, 2)	112273.59	0.02			26.804	3.2001	
5(0, 5) – 4(1, 4)	55110.60	0.06			9.347	0.0795	
3(2, 2) – 4(1, 3)	95059.28	0.08			9.906	0.0140	
4(2, 2) – 4(1, 3)	185253.32	0.08			9.906	0.0785	
5(1, 4) – 4(1, 3)	116196.72	0.03	116196.75	0.08	9.906	4.7992	[26A]
5(3, 2) – 4(3, 1)	112281.95	0.02			26.804	3.2001	
5(2, 4) – 4(1, 3)	296853.13	0.09			9.906	0.0742	
4(3, 2) – 5(2, 3)	208606.25	0.55			19.846	0.0106	

TABLE 9. The microwave spectrum of $H^{13}COOH$. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
5(2, 4) – 5(0, 5)	258482.15	0.12			11.186	0.0064	
5(1, 4) – 5(0, 5)	77825.74	0.06	77825.87	0.10	11.186	0.1749	
6(0, 6) – 5(0, 5)	133457.84	0.03	133457.83	0.08	11.186	5.9914	[26A]
6(2, 4) – 5(2, 3)	135573.05	0.03	135573.05	0.08	19.846	5.3328	[26A]
6(4, 2) – 5(4, 1)	134714.11	0.03	134714.07	0.08	45.566	3.3335	[26A]
6(1, 6) – 5(0, 5)	182040.75	0.06			11.186	0.1303	
4(3, 1) – 5(2, 4)	209747.22	0.55			19.808	0.0106	
5(2, 3) – 5(2, 4)	1138.18	0.00			19.808	1.4606	
6(2, 5) – 5(2, 4)	134444.21	0.03	134444.24	0.08	19.808	5.3327	
6(4, 3) – 5(4, 2)	134713.96	0.03	134714.07	0.08	45.566	3.3335	[26A]
4(2, 2) – 5(1, 5)	94157.88	0.09			12.944	0.0188	
5(1, 4) – 5(1, 5)	25101.28	0.02	25101.25	0.05	12.944	0.3673	[26A]
5(2, 4) – 5(1, 5)	205757.69	0.08			12.944	0.0864	
6(1, 6) – 5(1, 5)	129316.29	0.03	129316.37	0.08	12.944	5.8320	
6(3, 4) – 5(3, 3)	134764.59	0.03	134764.58	0.08	30.549	4.5001	
6(5, 2) – 5(5, 1)	134693.63	0.03	134693.66	0.08	64.867	1.8334	
6(0, 6) – 5(1, 5)	80733.38	0.06			12.944	0.1032	
4(2, 3) – 5(1, 4)	68567.62	0.08			13.782	0.0230	
5(2, 3) – 5(1, 4)	181794.59	0.08	181794.51	0.12	13.782	0.1038	
6(1, 5) – 5(1, 4)	139337.01	0.03	139337.06	0.08	13.782	5.8317	[26A]
6(3, 3) – 5(3, 2)	134786.84	0.03	134786.79	0.08	30.550	4.5001	
6(5, 1) – 5(5, 0)	134693.63	0.03	134693.66	0.08	64.867	1.8334	
5(3, 3) – 6(2, 4)	185306.80	0.55			24.368	0.0176	
6(2, 5) – 6(0, 6)	259468.52	0.12			15.637	0.0107	
6(1, 5) – 6(0, 6)	83704.91	0.07			15.637	0.1980	
7(0, 7) – 6(0, 6)	155226.19	0.03			15.637	6.9866	
7(2, 5) – 6(2, 4)	158553.40	0.03			24.368	6.4277	
7(4, 3) – 6(4, 2)	157196.08	0.02	157195.83	0.08	50.059	4.7144	
7(6, 1) – 6(6, 0)	157147.98	0.03	157147.99	0.08	92.938	1.8572	
7(1, 7) – 6(0, 6)	199337.18	0.05			15.637	0.1533	
5(3, 2) – 6(2, 5)	187584.96	0.55			24.292	0.0176	
6(2, 4) – 6(2, 5)	2267.02	0.00			24.292	1.2282	
7(2, 6) – 6(2, 5)	156765.73	0.03	156765.71	0.08	24.292	6.4274	
7(4, 4) – 6(4, 3)	157195.60	0.02	157195.83	0.08	50.059	4.7144	
7(6, 2) – 6(6, 1)	157147.98	0.03	157147.99	0.08	92.938	1.8572	
5(2, 3) – 6(1, 6)	77579.58	0.09			17.258	0.0246	
6(1, 5) – 6(1, 6)	35122.00	0.03	35122.00	0.05	17.258	0.3107	
6(2, 5) – 6(1, 6)	210885.61	0.08			17.258	0.1023	
7(1, 7) – 6(1, 6)	150754.23	0.03	150754.16	0.08	17.258	6.8549	
7(3, 5) – 6(3, 4)	157271.90	0.02	157271.90	0.08	35.044	5.7143	
7(5, 3) – 6(5, 2)	157159.64	0.03	157159.63	0.08	69.360	3.4287	
7(0, 7) – 6(1, 6)	106643.29	0.06			17.258	0.1290	
5(2, 4) – 6(1, 5)	41319.40	0.09			18.430	0.0398	
6(2, 4) – 6(1, 5)	178030.63	0.08	178030.51	0.12	18.430	0.1311	
7(1, 6) – 6(1, 5)	162419.63	0.03			18.430	6.8544	
7(3, 4) – 6(3, 3)	157321.86	0.02	157321.86	0.08	35.046	5.7143	
7(5, 2) – 6(5, 1)	157159.64	0.03	157159.63	0.08	69.360	3.4287	
6(3, 4) – 7(2, 5)	161517.99	0.55			29.657	0.0251	
7(2, 6) – 7(0, 7)	261008.05	0.12			20.815	0.0164	
7(1, 6) – 7(0, 7)	90898.34	0.07			20.815	0.2170	
8(0, 8) – 7(0, 7)	176797.98	0.03	176797.95	0.12	20.815	7.9808	
8(2, 6) – 7(2, 5)	181688.73	0.03	181688.71	0.12	29.657	7.4989	
8(4, 4) – 7(4, 3)	179691.90	0.02	179691.93	0.12	55.303	6.0002	
8(6, 2) – 7(6, 1)	179611.64	0.03	179611.62	0.12	98.180	3.5001	
8(1, 8) – 7(0, 7)	216255.40	0.05			20.815	0.1781	
6(3, 3) – 7(2, 6)	165606.07	0.55			29.522	0.0249	
7(2, 5) – 7(2, 6)	4054.69	0.01			29.522	1.0564	
8(2, 7) – 7(2, 6)	179047.82	0.02	179047.82	0.12	29.522	7.4981	
8(4, 5) – 7(4, 4)	179690.58	0.02			55.303	6.0002	
8(6, 3) – 7(6, 2)	179611.64	0.03	179611.62	0.12	98.180	3.5001	
8(1, 7) – 7(2, 6)	15322.18	0.08			29.522	0.0549	
6(2, 4) – 7(1, 7)	62398.40	0.09			22.287	0.0294	
6(4, 2) – 7(3, 5)	292863.20	1.85			40.290	0.0151	

TABLE 9. The microwave spectrum of $H^{13}COOH$. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
7(1, 6) – 7(1, 7)	46787.40	0.03	46787.50	0.05	22.287	0.2698	[26A]
7(2, 6) – 7(1, 7)	216897.11	0.08			22.287	0.1169	
8(1, 8) – 7(1, 7)	172144.46	0.03	172144.39	0.12	22.287	7.8718	
8(3, 6) – 7(3, 5)	179795.46	0.02	179795.49	0.12	40.290	6.8750	
8(5, 4) – 7(5, 3)	179633.51	0.02	179633.53	0.12	74.602	4.8752	
8(7, 2) – 7(7, 1)	179607.31	0.04	179607.31	0.12	126.029	1.8751	
8(0, 8) – 7(1, 7)	132687.04	0.06			22.287	0.1568	
6(2, 5) – 7(1, 6)	13343.98	0.08			23.847	0.0434	
6(4, 3) – 7(3, 4)	292779.67	1.85			40.293	0.0151	
7(2, 5) – 7(1, 6)	174164.40	0.08	174164.39	0.12	23.847	0.1610	
8(1, 7) – 7(1, 6)	185431.89	0.03	185431.89	0.12	23.847	7.8707	
8(3, 5) – 7(3, 4)	179895.11	0.02	179895.07	0.12	40.293	6.8750	
8(5, 3) – 7(5, 2)	179633.52	0.02	179633.53	0.12	74.602	4.8752	
8(7, 1) – 7(7, 0)	179607.31	0.04	179607.31	0.12	126.029	1.8751	
7(3, 5) – 8(2, 6)	137101.17	0.55			35.717	0.0329	
8(2, 7) – 8(0, 8)	263257.88	0.12			26.713	0.0235	
8(1, 7) – 8(0, 8)	99532.24	0.08			26.713	0.2316	
9(0, 9) – 8(0, 8)	198167.74	0.03	198167.68	0.12	26.713	8.9740	
9(2, 7) – 8(2, 6)	204978.34	0.03	204978.32	0.12	35.717	8.5545	
9(4, 5) – 8(4, 4)	202203.80	0.02			61.297	7.2224	
9(6, 3) – 8(6, 2)	202080.88	0.03	202081.11	0.12	104.171	5.0002	
9(8, 1) – 8(8, 0)	202072.17	0.05			164.131	1.8890	
9(1, 9) – 8(0, 8)	232941.14	0.05			26.713	0.2048	
7(3, 4) – 8(2, 7)	143880.12	0.55			35.494	0.0324	
8(2, 6) – 8(2, 7)	6695.60	0.01			35.494	0.9232	
9(2, 8) – 8(2, 7)	201285.07	0.03			35.494	8.5527	
9(4, 6) – 8(4, 5)	202200.63	0.02	202200.35	0.12	61.297	7.2224	
9(6, 4) – 8(6, 3)	202080.88	0.03	202081.11	0.12	104.171	5.0002	
9(8, 2) – 8(8, 1)	202072.17	0.05			164.131	1.8890	
9(1, 8) – 8(2, 7)	44634.11	0.09			35.494	0.0675	
7(2, 5) – 8(1, 8)	48807.34	0.09			28.029	0.0329	
7(4, 3) – 8(3, 6)	270263.82	1.85			46.288	0.0220	
8(1, 7) – 8(1, 8)	60074.82	0.04			28.029	0.2390	
8(2, 7) – 8(1, 8)	223800.46	0.09			28.029	0.1303	
9(1, 9) – 8(1, 8)	193483.72	0.03	193483.67	0.12	28.029	8.8844	
9(3, 7) – 8(3, 6)	202334.07	0.02	202334.15	0.12	46.288	7.9999	
9(5, 5) – 8(5, 4)	202116.38	0.02			80.594	6.2224	
9(7, 3) – 8(7, 2)	202069.56	0.04			132.020	3.5557	
9(0, 9) – 8(1, 8)	158710.32	0.05	158710.32	0.08	28.029	0.1866	
7(4, 4) – 8(3, 5)	270080.16	1.85			46.294	0.0220	
8(2, 6) – 8(1, 7)	170421.24	0.08			30.033	0.1935	
9(1, 8) – 8(1, 7)	208359.74	0.03			30.033	8.8825	
9(3, 6) – 8(3, 5)	202516.07	0.02	202515.95	0.12	46.294	7.9999	
9(5, 4) – 8(5, 3)	202116.40	0.02			80.594	6.2224	
9(7, 2) – 8(7, 1)	202069.56	0.04			132.020	3.5557	
8(3, 6) – 9(2, 7)	111918.29	0.55			42.555	0.0408	
9(2, 8) – 9(0, 9)	266375.22	0.12			33.323	0.0318	
9(1, 8) – 9(0, 9)	109724.25	0.08			33.323	0.2419	
10(0,10) – 9(0, 9)	219341.88	0.03	219341.85	0.12	33.323	9.9668	
10(2, 8) – 9(2, 7)	228409.47	0.03	228409.36	0.12	42.555	9.5993	
10(4, 6) – 9(4, 5)	224734.17	0.02	224734.16	0.12	68.042	8.4002	
10(6, 4) – 9(6, 3)	224556.37	0.03	224556.39	0.12	110.912	6.4002	
10(8, 2) – 9(8, 1)	224533.58	0.05	224533.60	0.12	170.872	3.6001	
10(1,10) – 9(0, 9)	249543.31	0.05			33.323	0.2336	
8(3, 5) – 9(2, 8)	122490.16	0.55			42.208	0.0398	
9(2, 7) – 9(2, 8)	10388.86	0.02			42.208	0.8159	
10(2, 9) – 9(2, 8)	223472.23	0.03	223471.93	0.12	42.208	9.5959	
10(4, 7) – 9(4, 6)	224727.30	0.02	224727.26	0.12	68.041	8.4002	
10(6, 5) – 9(6, 4)	224556.37	0.03	224556.39	0.12	110.912	6.4002	
10(8, 3) – 9(8, 2)	224533.58	0.05	224533.60	0.12	170.872	3.6001	
10(1, 9) – 9(2, 8)	74536.69	0.09			42.208	0.0812	
8(2, 6) – 9(1, 9)	37012.35	0.09			34.483	0.0351	
8(4, 4) – 9(3, 7)	247621.65	1.85			53.037	0.0293	

Table 9. The microwave spectrum of $H^{13}COOH$. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
9(1, 8) – 9(1, 9)	74950.85	0.05			34.483	0.2152	
9(2, 8) – 9(1, 9)	231601.82	0.09			34.483	0.1425	
10(1,10) – 9(1, 9)	214769.91	0.03			34.483	9.8940	
10(3, 8) – 9(3, 7)	224885.35	0.03	224885.35	0.12	53.037	9.0997	
10(5, 6) – 9(5, 5)	224609.35	0.02	224609.31	0.12	87.336	7.5003	
10(7, 4) – 9(7, 3)	224535.80	0.04	224533.60	0.12	138.760	5.1002	
10(9, 2) – 9(9, 1)	224543.18	0.07	224543.09	0.12	207.236	1.9001	
10(0,10) – 9(1, 9)	184568.48	0.06			34.483	0.2184	
8(4, 5) – 9(3, 6)	247254.67	1.85			53.049	0.0293	
9(2, 7) – 9(1, 8)	167039.83	0.08			36.983	0.2283	
10(1, 9) – 9(1, 8)	231187.65	0.03	231188.74	0.12	36.983	9.8908	
10(3, 7) – 9(3, 6)	225195.70	0.03	225195.69	0.12	53.049	9.0998	
10(5, 5) – 9(5, 4)	224609.42	0.02	224609.31	0.12	87.336	7.5003	
10(7, 3) – 9(7, 2)	224535.80	0.04	224533.60	0.12	138.760	5.1002	
10(9, 1) – 9(9, 0)	224543.18	0.07	224543.09	0.12	207.236	1.9001	
9(3, 7) – 10(2, 8)	85842.89	0.55			50.174	0.0488	
10(2, 9) – 10(0,10)	270505.56	0.12			40.639	0.0411	
10(1, 9) – 10(0,10)	121570.02	0.09			40.639	0.2480	
11(0,11) – 10(0,10)	240338.63	0.05	240338.70	0.12	40.639	10.9596	
11(2, 9) – 10(2, 8)	251957.32	0.04	251957.28	0.16	50.174	10.6366	
11(4, 7) – 10(4, 6)	247285.66	0.04			75.538	9.5456	
11(6, 5) – 10(6, 4)	247038.83	0.04			118.402	7.7276	
11(8, 3) – 10(8, 2)	246997.80	0.06			178.361	5.1820	
11(10, 1) – 10(10, 0)	247020.98	0.10			255.332	1.9092	
11(1,11) – 10(0,10)	266203.58	0.06			40.639	0.2641	
9(3, 6) – 10(2, 9)	101534.00	0.54			49.662	0.0470	
10(2, 8) – 10(2, 9)	15326.11	0.02	15326.00	0.10	49.662	0.7271	[26A]
11(2,10) – 10(2, 9)	245604.22	0.04			49.662	10.6308	
11(4, 8) – 10(4, 7)	247271.97	0.04			75.537	9.5456	
11(6, 6) – 10(6, 5)	247038.83	0.04			118.402	7.7276	
11(8, 4) – 10(8, 3)	246997.80	0.06			178.361	5.1820	
11(10, 2) – 10(10, 1)	247020.98	0.10			255.332	1.9092	
11(1,10) – 10(2, 9)	104963.02	0.09			49.662	0.0963	
9(2, 7) – 10(1,10)	27220.77	0.09			41.647	0.0359	
9(4, 5) – 10(3, 8)	224940.10	1.85			60.538	0.0368	
10(1, 9) – 10(1,10)	91368.59	0.06			41.647	0.1965	
10(2, 9) – 10(1,10)	240304.13	0.09			41.647	0.1536	
11(1,11) – 10(1,10)	236002.16	0.05	236002.08	0.12	41.647	10.9014	
11(3, 9) – 10(3, 8)	247445.74	0.04			60.538	10.1814	
11(5, 7) – 10(5, 6)	247113.53	0.03			94.828	8.7276	
11(7, 5) – 10(7, 4)	247006.48	0.05			146.250	6.5457	
11(9, 3) – 10(9, 2)	247004.13	0.08			214.726	3.6365	
11(0,11) – 10(1,10)	210137.20	0.06			41.647	0.2518	
9(4, 6) – 10(3, 7)	224259.60	1.85			60.561	0.0368	
10(2, 8) – 10(1, 9)	164261.65	0.08			44.694	0.2649	
11(1,10) – 10(1, 9)	253898.56	0.04	253898.46	0.16	44.694	10.8963	
11(3, 8) – 10(3, 7)	247946.47	0.04			60.561	10.1814	
11(5, 6) – 10(5, 5)	247113.71	0.03			94.828	8.7276	
11(7, 4) – 10(7, 3)	247006.48	0.05			146.250	6.5457	
11(9, 2) – 10(9, 1)	247004.13	0.08			214.726	3.6365	
10(3, 8) – 11(2, 9)	58770.92	0.55			58.578	0.0569	
11(2,10) – 11(0,11)	275771.15	0.12			48.656	0.0511	
11(1,10) – 11(0,11)	135129.96	0.09			48.656	0.2505	
12(0,12) – 11(0,11)	261185.72	0.06			48.656	11.9528	
12(2,10) – 11(2, 9)	275587.21	0.06			58.578	11.6684	
12(4, 8) – 11(4, 7)	269861.32	0.05	269861.28	0.16	83.786	10.6668	
12(6, 6) – 11(6, 5)	269528.93	0.05	269529.07	0.16	126.643	9.0003	
12(8, 4) – 11(8, 3)	269465.11	0.07			186.600	6.6669	
12(10, 2) – 11(10, 1)	269481.74	0.11			263.572	3.6668	
12(1,12) – 11(0,11)	283045.66	0.07			48.656	0.2962	
10(3, 7) – 11(2,10)	81125.48	0.54			57.855	0.0539	
11(2, 9) – 11(2,10)	21679.22	0.03	21679.25	0.10	57.855	0.6520	
12(2,11) – 11(2,10)	267676.27	0.06			57.855	11.6594	

TABLE 9. The microwave spectrum of $H^{13}COOH$. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$-$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
12(4, 9) - 11(4, 8)	269835.73	0.05	269835.79	0.16	83.786	10.6668	
12(6, 7) - 11(6, 6)	269528.92	0.05	269529.07	0.16	126.643	9.0003	
12(8, 5) - 11(8, 4)	269465.11	0.07			186.600	6.6669	
12(10, 3) - 11(10, 2)	269481.74	0.11			263.572	3.6668	
12(1,11) - 11(2,10)	135832.89	0.10			57.855	0.1129	
10(2, 8) - 11(1,11)	19628.09	0.10			49.519	0.0356	
10(4, 6) - 11(3, 9)	202228.53	1.85			68.792	0.0444	
11(1,10) - 11(1,11)	109265.00	0.07			49.519	0.1817	
11(3, 8) - 11(3, 9)	1176.07	0.01			68.792	1.5498	
11(2,10) - 11(1,11)	249906.19	0.09			49.519	0.1634	
12(1,12) - 11(1,11)	257180.71	0.06			49.519	11.9071	
12(3,10) - 11(3, 9)	270010.55	0.06			68.792	11.2493	
12(5, 8) - 11(5, 7)	269630.02	0.05	269630.11	0.16	103.071	9.9170	
12(7, 6) - 11(7, 5)	269482.02	0.06			154.489	7.9170	
12(9, 4) - 11(9, 3)	269466.95	0.09			222.965	5.2502	
12(11, 2) - 11(11, 1)	269506.19	0.13			308.409	1.9167	
12(0,12) - 11(1,11)	235320.77	0.08			49.519	0.2864	
10(4, 7) - 11(3, 8)	201040.43	1.85			68.831	0.0444	
11(2, 9) - 11(1,10)	162320.41	0.08			53.163	0.3024	
12(1,11) - 11(1,10)	276474.08	0.06			53.163	11.8993	
12(3, 9) - 11(3, 8)	270782.19	0.06			68.831	11.2494	
12(5, 7) - 11(5, 6)	269630.44	0.05	269630.11	0.16	103.071	9.9170	
12(7, 5) - 11(7, 4)	269482.02	0.06			154.489	7.9170	
12(9, 3) - 11(9, 2)	269466.95	0.09			222.965	5.2502	
12(11, 1) - 11(11, 0)	269506.19	0.13			308.409	1.9167	
11(3, 9) - 12(2,10)	30629.45	0.55			67.771	0.0652	
12(2,11) - 12(0,12)	282261.70	0.12			57.368	0.0614	
12(1,11) - 12(0,12)	150418.32	0.10			57.368	0.2501	
13(0,13) - 12(0,12)	281916.43	0.09			57.368	12.9468	
13(2,11) - 12(2,10)	299258.42	0.09			67.771	12.6960	
13(4, 9) - 12(4, 8)	292464.63	0.08			92.788	11.7694	
13(6, 7) - 12(6, 6)	292027.36	0.08			135.633	10.2311	
13(8, 5) - 12(8, 4)	291935.78	0.09			195.589	8.0773	
13(10, 3) - 12(10, 2)	291943.60	0.13			272.561	5.3079	
13(12, 1) - 12(12, 0)	291999.42	0.18			366.452	1.9232	
11(3, 8) - 12(2,11)	61395.68	0.54			66.784	0.0602	
12(2,10) - 12(2,11)	29590.16	0.03	29590.45	0.05	66.784	0.5878	[26A]
13(2,12) - 12(2,11)	289683.95	0.09			66.784	12.6830	
13(4,10) - 12(4, 9)	292419.33	0.08			92.786	11.7694	
13(6, 8) - 12(6, 7)	292027.35	0.08			135.633	10.2311	
13(8, 6) - 12(8, 5)	291935.78	0.09			195.589	8.0773	
13(10, 4) - 12(10, 3)	291943.60	0.13			272.561	5.3079	
13(12, 2) - 12(12, 1)	291999.42	0.18			366.452	1.9232	
13(1,12) - 12(2,11)	167051.52	0.12			66.784	0.1312	
11(2, 9) - 12(1,12)	14404.71	0.12			58.097	0.0341	
11(4, 7) - 12(3,10)	179503.64	1.84			77.799	0.0521	
12(1,11) - 12(1,12)	128558.38	0.09	128558.42	0.08	58.097	0.1698	
12(3, 9) - 12(3,10)	1947.72	0.01			77.799	1.4186	
12(2,11) - 12(1,12)	260401.76	0.10			58.097	0.1721	
13(1,13) - 12(1,12)	278306.85	0.09			58.097	12.9115	
13(3,11) - 12(3,10)	292574.07	0.08			77.799	12.3066	
13(5, 9) - 12(5, 8)	292159.92	0.08			112.065	11.0773	
13(7, 7) - 12(7, 6)	291962.86	0.08			163.478	9.2311	
13(9, 5) - 12(9, 4)	291931.82	0.11			231.954	6.7695	
13(11, 3) - 12(11, 2)	291966.97	0.15			317.396	3.6925	
13(0,13) - 12(1,12)	260056.49	0.10			58.097	0.3220	
11(4, 8) - 12(3, 9)	177530.21	1.85			77.864	0.0521	
12(2,10) - 12(1,11)	161433.53	0.08			62.386	0.3397	
13(1,12) - 12(1,11)	298894.89	0.09			62.386	12.9000	
13(3,10) - 12(3, 9)	293717.57	0.08			77.864	12.3068	
13(5, 8) - 12(5, 7)	292160.81	0.08			112.065	11.0773	
13(7, 6) - 12(7, 5)	291962.86	0.08			163.478	9.2311	
13(9, 4) - 12(9, 3)	291931.82	0.11			231.954	6.7695	

TABLE 9. The microwave spectrum of $H^{13}COOH$. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
13(11, 2) - 12(11, 1)	291966.97	0.15			317.398	3.6925	
12(5, 8) - 13(4, 9)	285431.11	4.25			102.544	0.0485	
13(2,12) - 13(0,13)	290029.22	0.13			66.772	0.0715	
13(1,12) - 13(0,13)	167396.78	0.12			66.772	0.2475	
13(3,10) - 13(2,11)	297046.87	0.55			77.753	0.2630	
12(3, 9) - 13(2,12)	42493.92	0.55			76.446	0.0659	
12(5, 7) - 13(4,10)	285528.44	4.25			102.540	0.0485	
13(2,11) - 13(2,12)	39164.63	0.04	39164.80	0.05	76.446	0.5323	[26A]
14(1,13) - 13(2,12)	198509.04	0.15			76.446	0.1514	
12(4, 8) - 13(3,11)	156790.89	1.84			87.558	0.0597	
13(1,12) - 13(1,13)	149146.42	0.10	149146.54	0.08	67.381	0.1604	
13(3,10) - 13(3,11)	3091.22	0.01			87.558	1.3050	
13(2,12) - 13(1,13)	271778.86	0.11			67.381	0.1797	
14(1,14) - 13(1,13)	299382.78	0.12			67.381	13.9149	
14(0,14) - 13(1,13)	284314.56	0.12			67.381	0.3582	
14(2,12) - 13(3,11)	28973.14	0.56			87.558	0.0826	
12(4, 9) - 13(3,10)	153648.37	1.85			87.661	0.0599	
13(2,11) - 13(1,12)	161797.06	0.08			72.356	0.3756	
13(5, 9) - 14(4,10)	262491.31	4.25			113.054	0.0561	
14(2,13) - 14(0,14)	299087.58	0.14			76.864	0.0811	
14(1,13) - 14(0,14)	185973.33	0.13			76.864	0.2437	
14(3,11) - 14(2,12)	290885.52	0.54			88.524	0.2918	
13(3,10) - 14(2,13)	24588.21	0.55			86.841	0.0707	
13(5, 8) - 14(4,11)	262666.17	4.25			113.048	0.0561	
14(2,12) - 14(2,13)	50470.13	0.04			86.841	0.4843	
15(1,14) - 14(2,13)	230081.08	0.18			86.841	0.1737	
13(4, 9) - 14(3,12)	134125.79	1.84			98.070	0.0673	
14(1,13) - 14(1,14)	170905.12	0.13			77.367	0.1530	
14(3,11) - 14(3,12)	4728.93	0.02			98.070	1.2052	
14(2,13) - 14(1,14)	284019.36	0.13			77.367	0.1863	
15(2,13) - 14(3,12)	60401.93	0.57			98.070	0.0920	
13(4,10) - 14(3,11)	129300.24	1.85			98.227	0.0676	
14(2,12) - 14(1,13)	163584.38	0.08			83.068	0.4088	
14(5,10) - 15(4,11)	239424.18	4.25			124.321	0.0638	
15(1,14) - 15(0,15)	206006.45	0.16			87.644	0.2393	
15(3,12) - 15(2,13)	284272.61	0.54			100.084	0.3230	
14(3,11) - 15(2,14)	7864.85	0.56			97.965	0.0745	
14(5, 9) - 15(4,12)	239725.44	4.24			124.311	0.0638	
15(2,13) - 15(2,14)	63537.86	0.05	63537.65	0.05	97.965	0.4428	
16(1,15) - 15(2,14)	261630.86	0.22			97.965	0.1982	
14(4,10) - 15(3,13)	111555.21	1.84			109.333	0.0747	
15(1,14) - 15(1,15)	193689.04	0.16			88.055	0.1472	
15(3,12) - 15(3,13)	7004.25	0.03			109.333	1.1161	
15(2,14) - 15(1,15)	297098.76	0.15			88.055	0.1919	
16(2,14) - 15(3,13)	92844.33	0.58			109.333	0.1020	
14(4,11) - 15(3,12)	104377.71	1.85			109.567	0.0752	
15(2,13) - 15(1,14)	166947.58	0.08			94.516	0.4383	
16(2,15) - 15(3,12)	7473.20	0.57			109.567	0.0772	
15(5,11) - 16(4,12)	216202.83	4.25			136.346	0.0715	
16(1,15) - 16(0,16)	227313.46	0.19			99.110	0.2348	
16(3,13) - 16(2,14)	277423.06	0.54			112.430	0.3570	
15(5,10) - 16(4,13)	216703.34	4.24			136.329	0.0715	
16(2,14) - 16(2,15)	78366.88	0.05			109.816	0.4070	
17(1,16) - 16(2,15)	293013.16	0.27			109.816	0.2249	
15(4,11) - 16(3,14)	89138.60	1.84			121.348	0.0819	
16(1,15) - 16(1,16)	217333.46	0.20			99.443	0.1429	
16(3,13) - 16(3,14)	10079.36	0.03			121.348	1.0356	
17(2,15) - 16(3,14)	126218.27	0.59			121.348	0.1129	
15(4,12) - 16(3,13)	78761.35	1.85			121.684	0.0828	
16(2,14) - 16(1,15)	172019.70	0.08			106.692	0.4631	
17(2,16) - 16(3,13)	21209.80	0.59			121.684	0.0787	
16(5,12) - 17(4,13)	192794.56	4.25			149.129	0.0792	
17(1,16) - 17(0,17)	249681.83	0.24			111.261	0.2306	

TABLE 9. The microwave spectrum of $H^{13}COOH$. Frequencies in MHz.—Continued

$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
17(3,14) - 17(2,15)	270587.41	0.53			125.558	0.3937	
16(5,11) - 17(4,14)	193599.84	4.24			149.103	0.0792	
17(2,15) - 17(2,16)	94929.11	0.06			122.391	0.3762	
16(2,14) - 17(1,17)	27012.34	0.34			111.529	0.0208	
16(4,12) - 17(3,15)	66949.16	1.84			134.112	0.0889	
17(1,16) - 17(1,17)	241658.62	0.25			111.529	0.1397	
17(3,14) - 17(3,15)	14130.72	0.04	14130.66	0.10	134.112	0.9620	
18(2,16) - 17(3,15)	160425.47	0.62			134.112	0.1247	
16(4,13) - 17(3,14)	52324.65	1.86			134.584	0.0904	
17(2,15) - 17(1,16)	178915.70	0.08	178915.84	0.12	119.590	0.4827	
18(2,17) - 17(3,14)	33121.14	0.62			134.584	0.0789	
17(5,13) - 18(4,14)	169159.60	4.25			162.674	0.0869	
18(1,17) - 18(0,18)	272882.25	0.29			124.099	0.2270	
18(3,15) - 18(2,16)	264039.77	0.52			139.464	0.4330	
17(5,12) - 18(4,15)	170418.78	4.24			162.633	0.0869	
18(2,16) - 18(2,17)	113173.61	0.07			135.688	0.3498	
18(4,14) - 18(4,15)	1235.86	0.01			162.633	1.6921	
17(2,15) - 18(1,18)	37324.98	0.42			124.313	0.0183	
17(4,13) - 18(3,16)	45074.91	1.85			147.626	0.0956	
18(1,17) - 18(1,18)	266476.32	0.30			124.313	0.1375	
18(3,15) - 18(3,16)	19342.18	0.05			147.626	0.8941	
19(2,17) - 18(3,16)	195355.41	0.65			147.626	0.1378	
17(4,14) - 18(3,15)	24940.22	1.87			148.271	0.0978	
18(2,16) - 18(1,17)	187730.82	0.08	187730.98	0.12	133.202	0.4967	
19(2,18) - 18(3,15)	42983.53	0.66			148.271	0.0777	
18(5,14) - 19(4,15)	145249.75	4.25			176.983	0.0945	
19(1,18) - 19(0,19)	296682.40	0.36			137.623	0.2241	
19(3,16) - 19(2,17)	258065.04	0.52			154.142	0.4743	
18(5,13) - 19(4,16)	147168.84	4.24			176.920	0.0944	
19(2,17) - 19(2,18)	133029.70	0.08	133029.63	0.08	149.705	0.3274	
19(4,15) - 19(4,16)	1878.00	0.02			176.920	1.5962	
20(3,17) - 19(4,16)	33136.45	1.89			176.920	0.1127	
18(2,16) - 19(1,19)	50081.51	0.52			137.793	0.0161	
18(4,14) - 19(3,17)	23619.71	1.85			161.886	0.1018	
18(6,12) - 19(5,15)	277422.83	8.05			196.094	0.0832	
19(1,18) - 19(1,19)	291598.57	0.37			137.793	0.1361	
19(3,16) - 19(3,17)	25896.01	0.06	25895.95	0.10	161.886	0.8312	[26A]
20(2,18) - 19(3,17)	230887.79	0.69			161.886	0.1521	
18(6,13) - 19(5,14)	277351.06	8.05			196.096	0.0832	
19(2,17) - 19(1,18)	198535.94	0.09			147.520	0.5054	
20(2,19) - 19(3,16)	50583.05	0.71			162.750	0.0754	
19(5,15) - 20(4,16)	121007.01	4.26			192.057	0.1021	
20(3,17) - 20(2,18)	252946.46	0.51			169.588	0.5169	
21(3,19) - 20(4,16)	17533.40	1.88			192.057	0.1126	
19(5,14) - 20(4,17)	123864.63	4.24			191.964	0.1019	
20(2,18) - 20(2,19)	154408.73	0.11	154408.61	0.08	164.438	0.3084	
20(4,16) - 20(4,17)	2787.49	0.03			191.964	1.5081	
21(3,18) - 20(4,17)	64011.63	1.91			191.964	0.1203	
19(2,17) - 20(1,20)	65161.03	0.64			151.969	0.0141	
19(6,13) - 20(5,16)	254328.20	8.05			211.115	0.0909	
20(3,17) - 20(3,18)	33962.67	0.07	33962.85	0.10	176.893	0.7726	[26A]
21(2,19) - 20(3,18)	266893.65	0.74			176.893	0.1681	
19(6,14) - 20(5,15)	254210.33	8.05			211.119	0.0909	
20(2,18) - 20(1,19)	211370.62	0.10			162.537	0.5090	
21(2,20) - 20(3,17)	55726.33	0.77			178.025	0.0719	
20(5,16) - 21(4,17)	96362.29	4.26			207.901	0.1096	
21(3,18) - 21(2,19)	248954.50	0.50			185.795	0.5598	
22(3,20) - 21(4,17)	36936.90	1.90			207.901	0.1169	
20(5,15) - 21(4,18)	100527.83	4.25			207.765	0.1093	
21(2,19) - 21(2,20)	177204.65	0.14			179.884	0.2925	
21(4,17) - 21(4,18)	4049.28	0.03			207.765	1.4266	
22(3,19) - 21(4,18)	96184.61	1.93			207.765	0.1280	
20(2,18) - 21(1,21)	82421.40	0.78			166.839	0.0124	

TABLE 9. The microwave spectrum of $H^{13}COOH$. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
20(6,14) - 21(5,17)	231140.61	8.05			226.892	0.0986	
21(3,18) - 21(3,19)	43690.75	0.08			192.642	0.7181	
20(6,15) - 21(5,16)	230949.85	8.05			226.899	0.0986	
21(2,19) - 21(1,20)	226935.29	0.12			178.249	0.5083	
22(2,21) - 21(3,18)	58250.99	0.84			194.099	0.0676	
21(5,17) - 22(4,18)	71234.38	4.28			224.516	0.1169	
22(3,19) - 22(2,20)	246338.19	0.50			202.757	0.6016	
23(3,21) - 22(4,18)	55331.96	1.93			224.516	0.1204	
21(5,16) - 22(4,19)	77188.47	4.25			224.324	0.1165	
22(2,20) - 22(2,21)	201293.95	0.19			196.042	0.2794	
22(4,18) - 22(4,19)	5766.30	0.05			224.324	1.3505	
23(3,20) - 22(4,19)	129666.10	1.96			224.324	0.1361	
21(2,19) - 22(1,22)	101701.05	0.95			182.403	0.0110	
21(6,15) - 22(5,18)	207854.78	8.05			243.427	0.1063	
22(3,19) - 22(3,20)	55198.42	0.08	55198.20	0.10	209.133	0.6676	[26A]
21(6,16) - 22(5,17)	207553.24	8.06			243.437	0.1063	
22(2,20) - 22(1,21)	243084.67	0.15			194.648	0.5042	
23(2,22) - 22(3,19)	58034.29	0.94			210.974	0.0627	
22(5,18) - 23(4,19)	45529.49	4.29			241.908	0.1242	
23(3,20) - 23(2,21)	245319.58	0.49			220.466	0.6410	
24(3,22) - 23(4,19)	72526.73	1.97			241.908	0.1228	
22(5,17) - 23(4,20)	53886.06	4.26			241.639	0.1235	
23(2,21) - 23(2,22)	226535.50	0.25			212.910	0.2688	
23(4,19) - 23(4,20)	8060.36	0.06			241.639	1.2789	
24(3,21) - 23(4,20)	164429.95	2.00			241.639	0.1446	
22(2,20) - 23(1,23)	122820.09	1.14			198.660	0.0098	
22(6,16) - 23(5,19)	184466.70	8.05			260.718	0.1139	
23(3,20) - 23(3,21)	68567.84	0.09			226.362	0.6211	
22(6,17) - 23(5,18)	184000.20	8.06			260.734	0.1139	
23(2,21) - 23(1,22)	261823.97	0.20			211.733	0.4977	
24(2,23) - 23(3,20)	54998.80	1.04			228.649	0.0575	
23(5,19) - 24(4,20)	19141.60	4.31			260.080	0.1313	
24(3,21) - 24(2,22)	246091.31	0.49			238.915	0.6767	
25(3,23) - 24(4,20)	88313.43	2.02			260.080	0.1241	
23(5,18) - 24(4,21)	30670.93	4.27			259.711	0.1303	
24(2,22) - 24(2,23)	252770.89	0.33			230.484	0.2603	
24(4,20) - 24(4,21)	11072.11	0.08			259.711	1.2110	
25(3,22) - 24(4,21)	200415.57	2.04			259.711	0.1538	
23(2,21) - 24(1,24)	145581.28	1.36			215.610	0.0088	
23(6,17) - 24(5,20)	160974.16	8.06			278.768	0.1215	
24(3,21) - 24(3,22)	83842.86	0.08			244.327	0.5787	
23(6,18) - 24(5,19)	160266.62	8.07			278.791	0.1215	
24(2,22) - 24(1,23)	282309.23	0.27			229.498	0.4897	
25(2,24) - 24(3,21)	49114.35	1.17			247.124	0.0523	
25(3,22) - 25(2,23)	248816.46	0.49			258.096	0.7077	
26(3,24) - 25(4,21)	102471.26	2.08			279.037	0.1242	
25(2,23) - 25(2,24)	279825.77	0.42			248.762	0.2537	
25(4,21) - 25(4,22)	14959.50	0.10			278.538	1.1463	
26(3,23) - 25(4,22)	237532.60	2.09			278.538	0.1637	
24(2,22) - 25(1,25)	169771.41	1.61			233.252	0.0079	
24(6,18) - 25(5,21)	137377.29	8.06			297.577	0.1290	
25(3,22) - 25(3,23)	101030.04	0.08			263.026	0.5402	
25(5,20) - 25(5,21)	1027.53	0.02			297.577	1.8993	
26(4,22) - 25(5,21)	36157.30	4.37			297.577	0.1452	
24(6,19) - 25(5,20)	136323.64	8.07			297.611	0.1290	
26(2,25) - 25(3,22)	40396.68	1.32			266.396	0.0471	
26(4,23) - 25(5,20)	15235.23	4.30			297.611	0.1430	
26(3,23) - 26(2,24)	253629.36	0.49			278.001	0.7329	
27(3,25) - 26(4,22)	114770.96	2.15			298.783	0.1230	
26(4,22) - 26(4,23)	19894.54	0.12			298.119	1.0843	
27(3,24) - 26(4,23)	275666.48	2.15			298.119	0.1747	
25(2,23) - 26(1,26)	195163.55	1.89			251.586	0.0072	
25(6,19) - 26(5,22)	113679.31	8.07			317.145	0.1363	

TABLE 9. The microwave spectrum of H^{13}COOH. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
26(3,23) – 26(3,24)	120101.84	0.08	120101.84	0.08	282.455	0.5057	
26(5,21) – 26(5,22)	1500.22	0.08			317.145	1.8172	
27(4,23) – 26(5,22)	65319.29	4.41			317.145	0.1520	
25(6,20) – 26(5,21)	112136.74	8.09			317.195	0.1364	
27(4,24) – 26(5,21)	37761.05	4.32			317.195	0.1489	
27(3,24) – 27(2,25)	260635.81	0.49			298.621	0.7519	
28(3,26) – 27(4,23)	124981.24	2.24			319.323	0.1205	
27(4,23) – 27(4,24)	26058.02	0.14			318.454	1.0247	
26(2,24) – 27(1,27)	221520.74	2.21			270.612	0.0066	
26(6,20) – 27(5,23)	89887.27	8.08			337.472	0.1436	
27(3,24) – 27(3,25)	141000.98	0.10			302.611	0.4751	
27(5,22) – 27(5,23)	2155.40	0.04			337.472	1.7397	
28(4,24) – 27(5,23)	95654.74	4.45			337.472	0.1587	
26(6,21) – 27(5,22)	87664.56	8.10			337.544	0.1438	
28(4,25) – 27(5,22)	59867.03	4.35			337.544	0.1542	
28(3,25) – 28(2,26)	269911.64	0.49			319.948	0.7646	
29(3,27) – 28(4,24)	132876.89	2.35			340.662	0.1167	
28(4,24) – 28(4,25)	33632.30	0.16			339.541	0.9672	
27(2,25) – 28(1,28)	248601.28	2.56			290.328	0.0061	
27(6,21) – 28(5,24)	66012.92	8.09			358.559	0.1508	
28(3,25) – 28(3,26)	163644.73	0.14			323.492	0.4482	
28(5,23) – 28(5,24)	3050.23	0.05			358.559	1.6663	
29(4,25) – 28(5,24)	127274.58	4.51			358.559	0.1653	
27(6,22) – 28(5,23)	62857.71	8.13			358.661	0.1510	
29(4,26) – 28(5,23)	81431.82	4.39			358.661	0.1590	
29(3,26) – 29(2,27)	281499.25	0.50			341.974	0.7710	
30(3,28) – 29(4,25)	138248.40	2.48			362.804	0.1117	
29(4,25) – 29(4,26)	42792.53	0.17			361.377	0.9117	
28(2,26) – 29(1,29)	276165.75	2.95			310.736	0.0057	
28(6,22) – 29(5,25)	42073.73	8.11			380.406	0.1578	
29(3,26) – 29(3,27)	187928.55	0.21			345.095	0.4248	
29(5,24) – 29(5,25)	4255.22	0.07			380.406	1.5963	
30(4,26) – 29(5,25)	160269.40	4.57			380.406	0.1721	
28(6,23) – 29(5,24)	37657.58	8.15			380.548	0.1581	
30(4,27) – 29(5,24)	102317.00	4.43			380.548	0.1631	
30(3,27) – 30(2,28)	295402.61	0.52			364.692	0.7718	
31(3,29) – 30(4,26)	140911.98	2.62			385.752	0.1058	
30(4,26) – 30(4,27)	53697.19	0.19			383.961	0.8585	
31(5,26) – 30(6,25)	14210.08	8.23			426.172	0.1719	
29(6,23) – 30(5,26)	18093.83	8.13			403.014	0.1647	
30(3,27) – 30(3,28)	213728.70	0.29			367.416	0.4048	
30(5,25) – 30(5,26)	5856.00	0.09			403.014	1.5292	
31(4,27) – 30(5,26)	194701.60	4.64			403.014	0.1790	
31(4,28) – 30(5,25)	122366.59	4.49			403.209	0.1664	
32(3,30) – 31(4,27)	140718.96	2.79			409.508	0.0992	
32(5,28) – 31(6,25)	29851.22	8.18			449.512	0.1777	
31(4,27) – 31(4,28)	66479.01	0.19			407.291	0.8076	
32(5,27) – 31(6,26)	41050.31	8.28			449.495	0.1786	
31(3,28) – 31(3,29)	240903.90	0.40			390.453	0.3879	
31(5,26) – 31(5,27)	7954.75	0.11			426.381	1.4646	
32(4,28) – 31(5,27)	230599.28	4.72			426.381	0.1861	
32(4,29) – 31(5,26)	141406.95	4.56			426.646	0.1689	
33(3,31) – 32(4,28)	137563.42	2.98			434.073	0.0920	
33(5,29) – 32(6,26)	53724.43	8.22			473.602	0.1839	
32(4,28) – 32(4,29)	81237.58	0.19			431.363	0.7594	
33(5,28) – 32(6,27)	68629.66	8.35			473.577	0.1851	
32(3,29) – 32(3,30)	269296.41	0.53			414.202	0.3738	
32(5,27) – 32(5,28)	10671.15	0.14			450.508	1.4022	
33(4,29) – 32(5,28)	267952.84	4.80			450.508	0.1937	
33(4,30) – 32(5,27)	159247.15	4.64			450.864	0.1704	
34(3,32) – 33(4,29)	131386.83	3.20			459.446	0.0847	
34(5,30) – 33(6,27)	77452.10	8.26			498.455	0.1898	
33(4,29) – 33(4,30)	98034.54	0.18			456.176	0.7141	

TABLE 9. The microwave spectrum of $H^{13}COOH$. Frequencies in MHz.—Continued

J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
34(5,29) - 33(6,28)	97062.94	8.42			498.419	0.1915	
33(3,30) - 33(3,31)	298732.94	0.67			438.662	0.3624	
33(5,28) - 33(5,29)	14142.57	0.17			475.394	1.3414	
34(4,31) - 33(5,28)	175680.27	4.73			475.866	0.1707	
35(3,33) - 34(4,30)	122179.64	3.45			485.625	0.0774	
35(5,31) - 34(6,28)	100959.46	8.31			524.073	0.1953	
34(4,30) - 34(4,31)	116891.83	0.17			481.726	0.6720	
35(5,30) - 34(6,29)	126473.36	8.50			524.021	0.1978	
34(5,29) - 34(5,30)	18523.16	0.21			501.039	1.2821	
35(4,32) - 34(5,29)	190485.68	4.85			501.656	0.1699	
36(3,34) - 35(4,31)	109979.71	3.73			512.607	0.0704	
36(5,32) - 35(6,29)	124158.20	8.37			550.456	0.2004	
35(4,31) - 35(4,32)	137792.73	0.16			508.010	0.6332	
36(5,31) - 35(6,30)	156988.71	8.60			550.385	0.2039	
35(5,30) - 35(5,31)	23981.45	0.25			527.440	1.2240	
36(4,33) - 35(5,30)	203432.73	4.98			528.240	0.1678	
37(3,35) - 36(4,32)	94868.51	4.04			540.386	0.0638	
37(5,33) - 36(6,30)	146945.39	8.43			577.608	0.2050	
36(4,32) - 36(4,33)	160685.03	0.17	160685.08	0.08	535.026	0.5981	
36(6,30) - 36(6,31)	2938.99	0.08			577.510	1.8468	
37(5,32) - 36(6,31)	188736.00	8.72			577.510	0.2099	
36(5,31) - 36(5,32)	30696.43	0.30			554.598	1.1670	
37(4,34) - 36(5,31)	214285.98	5.13			555.622	0.1643	
38(5,34) - 37(6,31)	169202.53	8.51			605.531	0.2090	
37(4,33) - 37(4,34)	185485.29	0.22			562.770	0.5665	
37(6,31) - 37(6,32)	4004.35	0.11			605.397	1.7825	
38(5,33) - 37(6,32)	221834.56	8.84			605.397	0.2159	
37(5,32) - 37(5,33)	38851.62	0.34			582.510	1.1109	
38(4,35) - 37(5,32)	222812.16	5.30			583.806	0.1595	
39(5,35) - 38(6,32)	190794.72	8.60			634.225	0.2125	
38(4,34) - 38(4,35)	212083.23	0.31			591.238	0.5385	
38(6,32) - 38(6,33)	5399.77	0.14			634.045	1.7201	
39(5,34) - 38(6,33)	256388.23	8.98			634.045	0.2219	
38(5,33) - 38(5,34)	48627.68	0.39			611.174	1.0559	
39(4,36) - 38(5,33)	228788.51	5.50			612.797	0.1535	
40(5,36) - 39(6,33)	211570.12	8.70			663.696	0.2151	
39(4,35) - 39(4,36)	240345.71	0.45			620.428	0.5140	
39(6,33) - 39(6,34)	7208.81	0.17			663.455	1.6593	
40(5,35) - 39(6,34)	292477.37	9.13			663.455	0.2279	
39(5,34) - 39(5,35)	60193.75	0.43			640.590	1.0022	
40(4,37) - 39(5,34)	232012.19	5.73			642.597	0.1464	
41(5,37) - 40(6,34)	231359.62	8.82			693.944	0.2169	
40(4,36) - 40(4,37)	270119.91	0.62			650.337	0.4929	
40(6,34) - 40(6,35)	9530.43	0.22			693.627	1.5997	
40(5,35) - 40(5,36)	73698.44	0.47			670.753	0.9498	
41(4,38) - 40(5,35)	232309.84	5.98			673.211	0.1384	
42(5,38) - 41(6,35)	249977.11	8.96			724.975	0.2177	
41(6,35) - 41(6,36)	12479.96	0.27			724.559	1.5413	
41(5,36) - 41(5,37)	89261.51	0.50			701.662	0.8993	
42(4,39) - 41(5,36)	229546.25	6.27			704.639	0.1297	
43(5,39) - 42(6,36)	267220.25	9.11			756.792	0.2175	
42(6,36) - 42(6,37)	16189.58	0.33			756.252	1.4837	
42(5,37) - 42(5,38)	106967.21	0.52			733.314	0.8509	
43(4,40) - 42(5,37)	223631.18	6.59			736.882	0.1207	
44(5,40) - 43(6,37)	282872.22	9.28			789.398	0.2160	
43(6,37) - 43(6,38)	20807.89	0.40			788.704	1.4267	
43(5,38) - 43(5,39)	126860.12	0.53			765.705	0.8050	
44(4,41) - 43(5,38)	214523.40	6.95			769.937	0.1115	
45(5,41) - 44(6,38)	296704.55	9.47			822.799	0.2133	
44(6,38) - 44(6,39)	26498.41	0.48			821.916	1.3703	
44(5,39) - 44(5,40)	148943.80	0.55			798.834	0.7621	
45(4,42) - 44(5,39)	202231.82	7.36			803.802	0.1025	
45(6,39) - 45(6,40)	33436.66	0.57			855.884	1.3142	

TABLE 9. The microwave spectrum of $H^{13}COOH$. Frequencies in MHz.—Continued

$J' (K'_{-1}, K'_{+1})$–$J (K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (cm^{-1})	S	Ref.
45(5,40) – 45(5,41)	173182.03	0.57			832.696	0.7223	
46(6,40) – 46(6,41)	41805.61	0.66			890.608	1.2586	
46(5,41) – 46(5,42)	199502.03	0.61			867.289	0.6859	
47(6,41) – 47(6,42)	51789.58	0.76			926.086	1.2033	
47(5,42) – 47(5,43)	227798.67	0.68			902.609	0.6531	
48(6,42) – 48(6,43)	63566.74	0.86			962.317	1.1486	
48(5,43) – 48(5,44)	257939.12	0.81			938.652	0.6239	
49(6,43) – 49(6,44)	77300.64	0.97			999.297	1.0948	
49(5,44) – 49(5,45)	289767.02	0.99			975.416	0.5982	
50(6,44) – 50(6,45)	93131.65	1.07			1037.024	1.0420	
50(6,44) – 50(6,45)	93131.65	1.07			1037.024	1.0420	

Table 10. Rotational transitions of ^{18}O isotopic species - in MHz

Molecule $HC^{18}O^{16}OH$			Molecule $HC^{16}O^{18}OH$		
Transition		Observed	Transition		Observed
Lower	Upper	Frequency	Lower	Upper	Frequency
4 1 4	4 1 3	14919.20	4 1 4	4 1 3	14773.56
0 0 0	1 0 1	21301.67	0 0 0	1 0 1	21289.64
5 1 5	5 1 4	22372.49	5 1 5	5 1 4	22154.85
6 1 6	6 1 5	31311.70	6 1 6	6 1 5	31003.73
1 1 0	2 1 1	44095.50	1 1 0	2 1 1	44056.80
2 0 2	3 0 3	63803.21	2 1 2	3 1 3	61636.09
2 2 1	3 2 2	63906.69	2 0 2	3 0 3	63769.92
2 2 0	3 2 1	64007.60	2 2 1	3 2 2	63870.58
2 1 1	3 1 2	66127.29	2 2 0	3 2 1	63968.50
			2 1 1	3 1 2	66069.71

TABLE 11. Microwave transitions in order of frequency (MHz).

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOD$	16(4,12) – 16(4,13)	1013.70	0.01			128.357	1.8983	
$H^{13}COOH$	25(5,20) – 25(5,21)	1027.53	0.02			297.577	1.8993	
$H^{12}COOH$	11(3, 8) – 11(3, 9)	1041.43	0.00			69.446	1.5516	
$H^{12}COOH$	18(4,14) – 18(4,15)	1042.11	0.00			163.850	1.6959	
$D^{12}COOH$	4(2, 2) – 4(2, 3)	1056.46	0.00			13.571	1.7903	
$H^{12}COOH$	5(2, 3) – 5(2, 4)	1059.28	0.00			20.082	1.4612	
$D^{12}COOH$	14(4,10) – 14(4,11)	1095.32	0.00			102.314	2.1535	
$D^{12}COOH$	32(7,25) – 32(7,26)	1096.55	0.02			466.158	2.8241	
$H^{12}COOD$	10(3, 7) – 10(3, 8)	1118.53	0.01			56.532	1.6965	
$H^{12}COOD$	30(6,24) – 30(6,25)	1125.19	0.02			404.744	2.2482	
$H^{13}COOH$	5(2, 3) – 5(2, 4)	1138.18	0.00			19.808	1.4606	
$H^{12}COOD$	23(5,18) – 23(5,19)	1158.13	0.01			246.861	2.0524	
$H^{13}COOH$	11(3, 8) – 11(3, 9)	1176.07	0.01			68.792	1.5498	
$H^{12}COOH$	26(5,21) – 26(5,22)	1206.06	0.00			319.125	1.8242	
$D^{12}COOH$	26(6,20) – 26(6,21)	1218.77	0.01			315.154	2.5745	
$H^{13}COOH$	18(4,14) – 18(4,15)	1235.86	0.01			162.633	1.6921	
$D^{12}COOH$	20(5,15) – 20(5,16)	1245.10	0.01			193.864	2.3429	
$D^{12}COOH$	9(3, 6) – 9(3, 7)	1349.99	0.00			47.150	1.8691	
$H^{13}COOH$	26(5,21) – 26(5,22)	1500.22	0.03			317.145	1.8172	
$H^{12}COOD$	5(2, 3) – 5(2, 4)	1516.40	0.00			18.238	1.4573	
$H^{12}COOH$	19(4,15) – 19(4,16)	1584.88	0.00			178.157	1.6008	
$H^{12}COOD$	17(4,13) – 17(4,14)	1621.48	0.01			140.750	1.7785	
$H^{12}COOH$	1(1, 0) – 1(1, 1)	1638.80	0.00			2.933	1.5000	
$H^{12}COOD$	31(6,25) – 31(6,26)	1639.16	0.03			427.391	2.1609	
$D^{12}COOH$	33(7,26) – 33(7,27)	1650.92	0.02			490.656	2.7141	
$H^{13}COOH$	1(1, 0) – 1(1, 1)	1674.38	0.00			2.867	1.5000	
$H^{12}COOH$	12(3, 9) – 12(3,10)	1725.75	0.00			78.466	1.4209	
$H^{12}COOH$	27(5,22) – 27(5,23)	1734.71	0.00			339.477	1.7477	
$H^{12}COOD$	24(5,19) – 24(5,20)	1744.62	0.01			264.382	1.9547	
$H^{12}COOD$	1(1, 0) – 1(1, 1)	1792.40	0.00			2.537	1.5000	
$D^{12}COOH$	15(4,11) – 15(4,12)	1868.08	0.01			113.408	1.9974	
$H^{13}COOH$	19(4,15) – 19(4,16)	1878.00	0.02			176.920	1.5962	
$D^{12}COOH$	27(6,21) – 27(6,22)	1878.71	0.01			335.185	2.4574	
$H^{12}COOD$	11(3, 8) – 11(3, 9)	1942.77	0.01			64.535	1.5394	
$H^{13}COOH$	12(3, 9) – 12(3,10)	1947.72	0.01			77.799	1.4186	
$D^{12}COOH$	21(5,16) – 21(5,17)	1990.44	0.01			209.424	2.2132	
$D^{12}COOH$	1(1, 0) – 1(1, 1)	2100.20	0.00			2.257	1.5000	
$H^{12}COOH$	6(2, 4) – 6(2, 5)	2110.67	0.00			24.575	1.2291	
$H^{13}COOH$	27(5,22) – 27(5,23)	2155.40	0.04			337.472	1.7397	
$H^{13}COOH$	6(2, 4) – 6(2, 5)	2267.02	0.00			24.292	1.2282	
$H^{12}COOD$	32(6,26) – 32(6,27)	2354.30	0.04			450.778	2.0772	
$H^{12}COOH$	20(4,16) – 20(4,17)	2354.74	0.00			193.221	1.5135	
$D^{12}COOH$	34(7,27) – 34(7,28)	2447.95	0.03			515.911	2.6077	
$D^{12}COOH$	5(2, 3) – 5(2, 4)	2448.06	0.00			17.237	1.4490	
$H^{12}COOH$	28(5,23) – 28(5,24)	2458.01	0.00			360.590	1.6753	
$D^{12}COOH$	10(3, 7) – 10(3, 8)	2480.37	0.01			54.527	1.6758	
$H^{12}COOD$	18(4,14) – 18(4,15)	2518.30	0.02			153.877	1.6694	
$H^{12}COOD$	25(5,20) – 25(5,21)	2578.22	0.02			282.640	1.8627	
$H^{12}COOH$	13(3,10) – 13(3,11)	2741.04	0.00			88.241	1.3080	
$H^{13}COOH$	20(4,16) – 20(4,17)	2787.49	0.03			191.964	1.5081	
$D^{12}COOH$	28(6,22) – 28(6,23)	2841.23	0.02			355.970	2.3453	
$H^{13}COOH$	36(6,30) – 36(6,31)	2938.99	0.08			577.510	1.8468	
$H^{12}COOD$	6(2, 4) – 6(2, 5)	3013.86	0.01			22.581	1.2228	
$H^{13}COOH$	28(5,23) – 28(5,24)	3050.23	0.05			358.559	1.6663	
$D^{12}COOH$	16(4,12) – 16(4,13)	3065.24	0.01			125.248	1.8566	
$H^{13}COOH$	13(3,10) – 13(3,11)	3091.22	0.01			87.558	1.3050	
$D^{12}COOH$	22(5,17) – 22(5,18)	3101.65	0.01			225.737	2.0915	
$H^{12}COOD$	12(3, 9) – 12(3,10)	3206.28	0.01			73.267	1.4049	
$H^{12}COOD$	33(6,27) – 33(6,28)	3335.95	0.06			474.905	1.9966	
$H^{12}COOH$	21(4,17) – 21(4,18)	3424.68	0.00			209.044	1.4329	
$H^{12}COOH$	29(5,24) – 29(5,25)	3434.05	0.00			382.464	1.6064	
$D^{12}COOH$	35(7,28) – 35(7,29)	3576.86	0.04			541.923	2.5042	
$H^{12}COOD$	26(5,21) – 26(5,22)	3742.22	0.02			301.637	1.7754	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Re
$H^{12}COOH$	7(2, 5) - 7(2, 6)	3777.25	0.00			29.814	1.0578	
$H^{12}COOD$	19(4,15) - 19(4,16)	3807.93	0.02			167.740	1.5693	
$H^{13}COOH$	37(6,31) - 37(6,32)	4004.35	0.11			605.397	1.7825	
$H^{13}COOH$	21(4,17) - 21(4,18)	4049.28	0.03			207.765	1.4266	
$H^{13}COOH$	7(2, 5) - 7(2, 6)	4054.69	0.01			29.522	1.0564	
$H^{12}COOH$	38(6,32) - 38(6,33)	4166.43	0.01			637.096	1.7358	
$H^{12}COOH$	14(3,11) - 14(3,12)	4197.35	0.00			98.769	1.2089	
$D^{12}COOH$	29(6,23) - 29(6,24)	4219.44	0.02			377.511	2.2374	
$H^{13}COOH$	29(5,24) - 29(5,25)	4255.22	0.07			380.406	1.5963	
$D^{12}COOH$	11(3, 8) - 11(3, 9)	4278.14	0.01			62.643	1.5119	
$H^{12}COOD$	34(6,28) - 34(6,29)	4665.81	0.08			499.773	1.9186	
$D^{12}COOH$	23(5,18) - 23(5,19)	4719.23	0.02			242.801	1.9765	
$H^{13}COOH$	14(3,11) - 14(3,12)	4728.93	0.02			98.070	1.2052	
$H^{12}COOH$	30(5,25) - 30(5,26)	4733.80	0.00			405.099	1.5406	
$D^{12}COOH$	6(2, 4) - 6(2, 5)	4839.67	0.01			21.632	1.2098	
$D^{12}COOH$	17(4,13) - 17(4,14)	4857.99	0.01			137.835	1.7277	
$H^{12}COOH$	22(4,18) - 22(4,19)	4883.66	0.00			225.625	1.3578	
$H^{12}COOH$	2(1, 1) - 2(1, 2)	4916.32	0.00			4.377	0.8333	
$H^{13}COOH$	2(1, 1) - 2(1, 2)	5023.05	0.00			4.308	0.8333	
$H^{12}COOD$	13(3,10) - 13(3,11)	5065.63	0.02			82.729	1.2876	
$D^{12}COOH$	36(7,29) - 36(7,30)	5152.48	0.06			568.694	2.4031	
$H^{12}COOD$	27(5,22) - 27(5,23)	5340.15	0.03			321.373	1.6922	
$H^{12}COOD$	7(2, 5) - 7(2, 6)	5372.80	0.01			27.644	1.0486	
$H^{12}COOD$	2(1, 1) - 2(1, 2)	5377.10	0.01			3.927	0.8333	
$H^{13}COOH$	38(6,32) - 38(6,33)	5399.77	0.14			634.045	1.7201	
$H^{12}COOH$	39(6,33) - 39(6,34)	5573.76	0.01			666.538	1.6765	
$H^{12}COOD$	20(4,16) - 20(4,17)	5618.52	0.03			182.337	1.4763	
$H^{13}COOH$	22(4,18) - 22(4,19)	5766.30	0.05			224.324	1.3505	
$H^{13}COOH$	30(5,25) - 30(5,26)	5856.00	0.09			403.014	1.5292	
$D^{12}COOH$	43(8,35) - 43(8,36)	5869.57	0.12			799.215	2.5781	
$D^{12}COOH$	30(6,24) - 30(6,25)	6157.78	0.03			399.808	2.1329	
$H^{12}COOH$	15(3,12) - 15(3,13)	6224.61	0.00			110.050	1.1207	
$H^{12}COOH$	8(2, 6) - 8(2, 7)	6242.64	0.00			35.798	0.9251	
$D^{12}COOH$	2(1, 1) - 2(1, 2)	6300.49	0.00			3.655	0.8333	
$H^{12}COOH$	31(5,26) - 31(5,27)	6442.64	0.01			428.495	1.4775	
$H^{12}COOD$	35(6,29) - 35(6,30)	6444.38	0.11			525.382	1.8427	
$H^{13}COOH$	8(2, 6) - 8(2, 7)	6695.60	0.01			35.494	0.9232	
$H^{12}COOH$	23(4,19) - 23(4,20)	6837.86	0.00			242.964	1.2874	
$D^{12}COOH$	12(3, 9) - 12(3,10)	6994.83	0.01			71.499	1.3693	
$H^{13}COOH$	15(3,12) - 15(3,13)	7004.25	0.03			109.333	1.1161	
$D^{12}COOH$	24(5,19) - 24(5,20)	7020.55	0.02			260.617	1.8667	
$H^{12}COOD$	43(7,36) - 43(7,37)	7118.87	0.38			779.657	2.0048	
$H^{12}COOD$	17(3,14) - 16(4,13)	7184.41	5.08			128.357	0.0899	
$H^{13}COOH$	39(6,33) - 39(6,34)	7208.81	0.17			663.455	1.6593	
$D^{12}COOH$	37(7,30) - 37(7,31)	7319.76	0.08			596.223	2.3037	
$H^{12}COOH$	40(6,34) - 40(6,35)	7385.84	0.01			696.742	1.6187	
$D^{12}COOH$	18(4,14) - 18(4,15)	7459.10	0.02			151.168	1.6082	
$H^{13}COOH$	16(2,15) - 15(3,12)	7473.20	0.57			109.567	0.0772	
$H^{12}COOD$	28(5,23) - 28(5,24)	7498.04	0.03			341.847	1.6124	
$H^{12}COOD$	14(3,11) - 14(3,12)	7704.51	0.02			92.919	1.1835	
$H^{13}COOH$	14(3,11) - 15(2,14)	7864.85	0.56			97.965	0.0745	
$H^{13}COOH$	31(5,26) - 31(5,27)	7954.75	0.11			426.381	1.4646	
$D^{12}COOH$	17(5,13) - 18(4,14)	7969.77	0.08			151.417	0.0857	
$H^{13}COOH$	23(4,19) - 23(4,20)	8060.36	0.06			241.639	1.2789	
$H^{12}COOD$	21(4,17) - 21(4,18)	8103.72	0.03			197.669	1.3891	
$D^{12}COOH$	44(8,36) - 44(8,37)	8181.19	0.15			831.970	2.4815	
$D^{12}COOH$	7(2, 5) - 7(2, 6)	8559.57	0.01	8559.58	0.10	26.753	1.0302	[26A]
$H^{12}COOH$	32(5,27) - 32(5,28)	8661.55	0.01	8661.55	0.10	452.651	1.4165	[25A]
$H^{12}COOD$	36(6,30) - 36(6,31)	8793.03	0.14			551.732	1.7686	
$H^{12}COOD$	8(2, 6) - 8(2, 7)	8831.27	0.01	8831.27	0.10	33.425	0.9126	[26A]
$D^{12}COOH$	31(6,25) - 31(6,26)	8836.04	0.04			422.859	2.0310	
$H^{12}COOH$	16(3,13) - 16(3,14)	8971.18	0.00	8971.18	0.10	122.084	1.0411	[25A]
$H^{12}COOH$	8(1, 7) - 7(2, 6)	9340.74	0.01			29.814	0.0544	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{13}COOH$	10(2, 8) - 9(3, 7)	9363.33	0.04			47.150	0.0499	
$H^{13}COOD$	21(5,16) - 22(4,19)	9386.33	9.84			213.735	0.1147	
$H^{13}COOH$	24(4,20) - 24(4,21)	9411.13	0.01	9411.14	0.10	261.061	1.2209	[25A]
$H^{13}COOH$	40(6,34) - 40(6,35)	9530.43	0.22			693.627	1.5997	
$H^{13}COOD$	44(7,37) - 44(7,38)	9531.00	0.48			811.871	1.9338	
$H^{13}COOH$	41(6,35) - 41(6,36)	9696.71	0.01	9696.87	0.10	727.708	1.5621	[25A]
$H^{13}COOH$	9(2, 7) - 9(2, 8)	9696.83	0.00	9696.87	0.10	42.525	0.8184	[25A]
$H^{13}COOH$	3(1, 2) - 3(1, 3)	9832.00	0.00	9832.01	0.10	6.543	0.5834	[25A]
$H^{13}COOH$	3(1, 2) - 3(1, 3)	10045.42	0.01			6.468	0.5834	
$H^{13}COOH$	16(3,13) - 16(3,14)	10079.36	0.03			121.348	1.0356	
$D^{13}COOH$	25(5,20) - 25(5,21)	10222.28	0.03			279.184	1.7611	
$D^{13}COOH$	38(7,31) - 38(7,32)	10257.68	0.09			624.510	2.2056	
$H^{13}COOD$	29(5,24) - 29(5,25)	10365.64	0.04			363.059	1.5352	
$H^{13}COOD$	12(3, 9) - 13(2,12)	10371.93	2.01			73.028	0.0625	
$H^{13}COOH$	9(2, 7) - 9(2, 8)	10388.86	0.02			42.208	0.8159	
$H^{13}COOD$	7(1, 6) - 6(2, 5)	10539.29	0.46			22.581	0.0450	
$H^{13}COOH$	32(5,27) - 32(5,28)	10671.15	0.14			450.508	1.4022	
$H^{13}COOD$	3(1, 2) - 3(1, 3)	10753.23	0.01			6.012	0.5835	
$D^{13}COOH$	12(2,11) - 11(3, 8)	10766.18	0.06	10766.28	0.10	62.786	0.0526	
$H^{13}COOH$	24(5,20) - 25(4,21)	10780.63	0.02			280.339	0.1387	
$D^{13}COOH$	13(3,10) - 13(3,11)	10917.55	0.02	10917.59	0.10	81.099	1.2428	[26A]
$H^{13}COOH$	24(4,20) - 24(4,21)	11072.11	0.08			259.711	1.2110	
$D^{13}COOH$	19(4,15) - 19(4,16)	11121.51	0.02	11121.56	0.10	165.247	1.4961	[26A]
$D^{13}COOH$	45(8,37) - 45(8,38)	11272.54	0.19			865.486	2.3853	
$H^{13}COOD$	15(3,12) - 15(3,13)	11328.65	0.03	11328.67	0.10	103.837	1.0896	[26A]
$H^{13}COOD$	22(4,18) - 22(4,19)	11441.89	0.04	11441.90	0.10	213.735	1.3068	[26A]
$H^{13}COOH$	33(5,28) - 33(5,29)	11507.87	0.01			477.568	1.3575	
$H^{13}COOH$	18(4,15) - 19(3,16)	11557.78	0.02			163.464	0.1054	
$D^{13}COOH$	23(5,18) - 22(6,17)	11828.61	0.25			242.564	0.1119	
$H^{13}COOD$	37(6,31) - 37(6,32)	11855.54	0.18			578.822	1.6959	
$H^{13}COOH$	12(3,10) - 13(2,11)	12109.46	0.02			78.062	0.0735	
$H^{13}COOD$	3(0, 3) - 2(1, 2)	12434.44	0.05			3.927	0.0379	
$H^{13}COOD$	12(2,10) - 11(3, 9)	12443.73	1.99			64.535	0.0660	
$D^{13}COOH$	32(6,26) - 32(6,27)	12471.87	0.06			446.666	1.9810	
$H^{13}COOH$	41(6,35) - 41(6,36)	12479.96	0.27			724.559	1.5413	
$D^{13}COOH$	3(1, 2) - 3(1, 3)	12599.17	0.01	12599.17	0.10	5.752	0.5836	[26A]
$H^{13}COOH$	17(3,14) - 17(3,15)	12600.58	0.01	12600.56	0.10	134.869	0.9686	[25A]
$H^{13}COOH$	42(6,36) - 42(6,37)	12615.57	0.01			759.435	1.5065	
$H^{13}COOD$	45(7,38) - 45(7,39)	12637.06	0.61			844.827	1.8634	
$H^{13}COOH$	25(4,21) - 25(4,22)	12744.36	0.01	12744.33	0.10	279.914	1.1576	[25A]
$H^{13}COOD$	23(4,20) - 22(5,17)	12902.09	9.88			230.103	0.1211	
$D^{13}COOH$	6(1, 5) - 5(2, 4)	13094.75	0.03	13094.70	0.10	17.237	0.0357	
$H^{13}COOH$	12(2,10) - 13(1,13)	13223.87	0.02			67.635	0.0338	
$H^{13}COOH$	6(2, 5) - 7(1, 6)	13343.98	0.08			23.847	0.0434	
$D^{13}COOH$	21(6,16) - 22(5,17)	13585.89	0.13			225.840	0.1048	
$H^{13}COOD$	9(2, 7) - 9(2, 8)	13619.48	0.02	13619.41	0.10	39.922	0.8026	[26A]
$H^{13}COOD$	9(2, 7) - 10(1,10)	13878.60	0.41			39.914	0.0306	
$D^{13}COOH$	8(2, 6) - 8(2, 7)	13918.96	0.02	13918.98	0.10	32.597	0.8889	[26A]
$H^{13}COOD$	30(5,25) - 30(5,26)	14116.39	0.04	14116.32	0.10	385.009	1.4603	[26A]
$H^{13}COOH$	17(3,14) - 17(3,15)	14130.72	0.04	14130.66	0.10	134.112	0.9620	
$H^{13}COOH$	33(5,28) - 33(5,29)	14142.57	0.17			475.394	1.3414	
$D^{13}COOH$	39(7,32) - 39(7,33)	14181.84	0.11			653.554	2.1081	
$H^{13}COOH$	31(5,26) - 30(6,25)	14210.08	8.23			426.172	0.1719	
$H^{13}COOH$	10(2, 8) - 10(2, 9)	14325.34	0.00	14325.37	0.10	49.994	0.7301	[25A]
$H^{13}COOH$	11(2, 9) - 12(1,12)	14404.71	0.12			58.097	0.0341	
$D^{13}COOH$	26(5,21) - 26(5,22)	14579.30	0.03	14579.40	0.10	298.502	1.6586	[26A]
$H^{13}COOH$	19(4,15) - 20(3,18)	14585.25	0.01	14585.10	0.10	177.723	0.1084	
$D^{13}COOH$	4(2, 3) - 5(1, 4)	14759.61	0.03			13.079	0.0246	
$H^{13}COOH$	30(6,24) - 31(5,27)	14890.25	0.02			428.495	0.1721	
$H^{13}COOH$	25(4,21) - 25(4,22)	14959.50	0.10			278.538	1.1463	
$H^{13}COOH$	34(5,29) - 34(5,30)	15115.26	0.01	15114.96	0.10	503.244	1.2999	
$H^{13}COOH$	17(2,16) - 16(3,13)	15149.43	0.01			122.383	0.0809	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOH$	14(3,11) - 15(2,14)	15184.77	0.01	15184.54	0.10	98.402	0.0758	
$H^{13}COOH$	26(4,23) - 25(5,20)	15235.23	4.30			297.611	0.1430	
$H^{13}COOH$	8(1, 7) - 7(2, 6)	15322.18	0.08			29.522	0.0549	
$H^{13}COOH$	10(2, 8) - 10(2, 9)	15326.11	0.02	15326.00	0.10	49.662	0.7271	[26A]
$D^{12}COOH$	46(8,38) - 46(8,39)	15354.25	0.24			899.760	2.2891	
$D^{12}COOH$	17(5,12) - 18(4,15)	15684.25	0.08			151.168	0.0852	
$H^{12}COOD$	38(6,32) - 38(6,33)	15798.53	0.22			606.651	1.6243	
$H^{12}COOD$	23(4,19) - 23(4,20)	15832.80	0.04	15832.80	0.10	230.534	1.2284	[26A]
$D^{12}COOH$	20(4,16) - 20(4,17)	16130.82	0.02	16130.88	0.10	180.070	1.3899	[26A]
$H^{12}COOD$	16(3,13) - 16(3,14)	16156.92	0.03	16156.94	0.10	115.481	1.0041	
$H^{13}COOH$	42(6,36) - 42(6,37)	16189.58	0.33			756.252	1.4837	
$H^{12}COOD$	16(4,12) - 17(3,15)	16237.90	5.09			127.849	0.0869	
$H^{12}COOH$	43(6,37) - 43(6,38)	16267.23	0.01			791.924	1.4517	
$H^{12}COOD$	10(3, 8) - 11(2, 9)	16269.03	1.99			55.990	0.0573	
$D^{12}COOH$	14(3,11) - 14(3,12)	16350.98	0.02	16351.02	0.10	91.420	1.1288	[26A]
$H^{12}COOH$	4(1, 3) - 4(1, 4)	16384.17	0.00	16384.19	0.10	9.430	0.4503	[25A]
$H^{12}COOD$	46(7,39) - 46(7,40)	16594.55	0.76			878.523	1.7935	
$H^{12}COOH$	11(2, 9) - 12(1,12)	16705.27	0.02			58.323	0.0358	
$H^{13}COOH$	4(1, 3) - 4(1, 4)	16739.62	0.01			9.347	0.4503	
$H^{12}COOH$	26(4,22) - 25(5,21)	16756.45	0.02			299.532	0.1457	
$D^{12}COOH$	21(6,15) - 22(5,18)	16787.94	0.13			225.737	0.1046	
$H^{12}COOH$	26(4,22) - 26(4,23)	16993.59	0.01	16993.60	0.10	299.524	1.0970	[25A]
$D^{12}COOH$	13(4, 9) - 14(3,12)	17009.67	0.05			91.420	0.0652	
$H^{12}COOD$	5(2, 4) - 6(1, 5)	17038.20	0.46			17.670	0.0337	
$H^{12}COOH$	18(3,15) - 18(3,16)	17286.11	0.01	17286.10	0.10	148.405	0.9017	[25A]
$D^{12}COOH$	33(6,27) - 33(6,28)	17320.22	0.07			471.227	1.8324	
$H^{12}COOH$	20(3,17) - 19(4,16)	17521.29	0.02	17521.12	0.10	178.157	0.1129	
$H^{13}COOH$	21(3,19) - 20(4,16)	17533.40	1.88			192.057	0.1126	
$D^{12}COOH$	25(7,19) - 26(6,20)	17832.40	0.20			315.195	0.1239	
$H^{12}COOD$	4(1, 3) - 4(1, 4)	17917.84	0.02	17917.85	0.10	8.789	0.4505	
$H^{12}COOH$	14(2,12) - 13(3,11)	17922.33	0.02	17922.30	0.10	88.241	0.0823	
$H^{13}COOH$	29(6,23) - 30(5,26)	18093.83	8.13			403.014	0.1647	
$H^{12}COOH$	32(5,27) - 31(6,26)	18182.66	0.02			452.334	0.1793	
$H^{13}COOH$	34(5,29) - 34(5,30)	18523.16	0.21			501.039	1.2821	
$H^{13}COOH$	1(1, 1) - 2(0, 2)	18693.69	0.06			2.244	0.0182	
$D^{12}COOH$	19(4,15) - 18(5,14)	18719.00	0.15			164.994	0.0929	
$H^{12}COOD$	31(5,26) - 31(5,27)	18945.21	0.05	18945.12	0.10	407.695	1.3872	
$D^{12}COOH$	25(7,18) - 26(6,21)	19089.19	0.20			315.154	0.1238	
$H^{12}COOD$	15(2,14) - 14(3,11)	19096.36	2.04			93.176	0.0679	
$H^{13}COOH$	23(5,19) - 24(4,20)	19141.60	4.31			260.080	0.1313	
$H^{12}COOH$	6(2, 5) - 7(1, 6)	19255.45	0.01	19255.60	0.10	23.933	0.0431	[25A]
$H^{13}COOH$	18(3,15) - 18(3,16)	19342.18	0.05			147.626	0.8941	
$D^{12}COOH$	40(7,33) - 40(7,34)	19344.64	0.14			683.355	2.0110	
$D^{12}COOH$	8(3, 6) - 9(2, 7)	19353.55	0.04			39.869	0.0414	
$H^{13}COOH$	10(2, 8) - 11(1,11)	19628.09	0.10			49.519	0.0356	
$H^{12}COOH$	35(5,30) - 35(5,31)	19632.68	0.01	19632.71	0.10	529.680	1.2437	[25A]
$H^{13}COOH$	26(4,22) - 26(4,23)	19894.54	0.12			298.119	1.0843	
$H^{12}COOD$	10(2, 8) - 10(2, 9)	19941.57	0.02	19941.66	0.10	47.134	0.7113	
$H^{12}COOH$	11(2, 9) - 11(2,10)	20297.86	0.01	20297.89	0.10	58.203	0.6555	[25A]
$H^{12}COOD$	15(4,12) - 16(3,13)	20344.36	5.06			116.020	0.0824	
$D^{12}COOH$	27(5,22) - 27(5,23)	20378.60	0.04	20378.46	0.10	318.568	1.5588	
$H^{12}COOH$	1(1, 1) - 2(0, 2)	20543.96	0.00	20543.96	0.10	2.248	0.0182	[25A]
$D^{12}COOH$	47(8,39) - 47(8,40)	20673.25	0.31			934.793	2.1926	
$H^{12}COOH$	44(6,38) - 44(6,39)	20791.76	0.02	20791.61	0.10	825.173	1.3976	[25A]
$H^{13}COOH$	43(6,37) - 43(6,38)	20807.89	0.40			788.704	1.4267	
$H^{12}COOD$	39(6,33) - 39(6,34)	20810.39	0.27			635.219	1.5534	
$D^{12}COOH$	4(1, 3) - 4(1, 4)	20989.95	0.01			8.544	0.4509	
$H^{12}COOD$	8(2, 6) - 9(1, 9)	21141.18	0.42			33.014	0.0310	
$D^{12}COOH$	9(2, 7) - 9(2, 8)	21178.56	0.02	21178.58	0.10	39.162	0.7743	
$H^{13}COOH$	17(2,16) - 16(3,13)	21209.80	0.59			121.684	0.0787	

TABLE 11. Microwave transitions in order of frequency (MHz) — Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})		Ref
$D^{12}COOH$	29(8,22) - 30(7,23)	21447.12	0.30			419.446	0.1430	
$H^{12}COOD$	24(4,20) - 24(4,21)	21491.00	0.04			248.063	1.1534	
$D^{12}COOH$	6(2, 4) - 7(1, 7)	21579.28	0.03	21579.09	0.10	21.073	0.0239	
$H^{12}COOD$	47(7,40) - 47(7,41)	21582.69	0.95			912.959	1.7238	
$H^{13}COOH$	11(2, 9) - 11(2,10)	21679.22	0.03	21679.25	0.10	57.855	0.6520	
$H^{12}COOH$	27(4,24) - 26(5,21)	21705.46	0.01	21705.60	0.10	319.165	0.1500	[25A]
$H^{12}COOD$	1(0, 1) - 0(0, 0)	21732.47	0.00			0.000	1.0000	
$D^{12}COOH$	29(8,21) - 30(7,24)	21921.99	0.29			419.431	0.1430	
$D^{12}COOH$	1(0, 1) - 0(0, 0)	22011.54	0.01			0.000	1.0000	
$D^{12}COOH$	3(0, 3) - 2(1, 2)	22127.66	0.01	22127.38	0.10	3.655	0.0390	
$H^{12}COOH$	27(4,23) - 27(4,24)	22326.35	0.01	22326.28	0.10	319.889	1.0389	[25A]
$H^{12}COOD$	17(3,14) - 17(3,15)	22408.61	0.03	22408.64	0.10	127.849	0.9254	
$H^{13}COOH$	1(0, 1) - 0(0, 0)	22432.53	0.01	22432.50	0.05	0.000	1.0000	[26A]
$H^{12}COOH$	1(0, 1) - 0(0, 0)	22471.18	0.00	22471.18	0.10	0.000	1.0000	[25A]
$D^{12}COOH$	9(3, 6) - 10(2, 9)	22511.72	0.04			46.444	0.0442	
$H^{12}COOH$	10(2, 8) - 11(1,11)	22601.79	0.02	22601.70	0.10	49.718	0.0370	[25A]
$D^{12}COOH$	21(4,17) - 21(4,18)	22790.47	0.03			195.635	1.2889	
$H^{12}COOH$	19(3,16) - 19(3,17)	23203.42	0.01	23203.40	0.10	162.690	0.8398	[25A]
$H^{12}COOD$	20(5,16) - 21(4,17)	23474.11	9.80			197.940	0.1086	
$D^{12}COOH$	15(3,12) - 15(3,13)	23591.70	0.03			102.482	1.0252	
$H^{13}COOH$	18(4,14) - 19(3,17)	23619.71	1.85			161.886	0.1018	
$H^{12}COOD$	19(3,17) - 18(4,14)	23631.09	5.13			153.961	0.0978	
$D^{12}COOH$	34(6,28) - 34(6,29)	23668.56	0.07			496.540	1.7346	
$H^{13}COOH$	35(5,30) - 35(5,31)	23981.45	0.25			527.440	1.2240	
$D^{12}COOH$	16(3,14) - 15(4,11)	24076.46	0.13			113.470	0.0769	
$H^{12}COOH$	24(5,19) - 25(4,22)	24080.12	0.01	24080.25	0.10	279.914	0.1376	
$H^{12}COOH$	5(1, 4) - 5(1, 5)	24568.94	0.00	24568.96	0.10	13.037	0.3673	[25A]
$H^{13}COOH$	13(3,10) - 14(2,13)	24588.21	0.55			86.841	0.0707	
$D^{12}COOH$	13(2,12) - 12(3, 9)	24681.88	0.09			71.732	0.0547	
$H^{12}COOH$	16(2,14) - 17(1,17)	24829.95	0.04	24830.00	0.10	111.928	0.0227	[25A]
$H^{13}COOH$	17(4,14) - 18(3,15)	24940.22	1.87			148.271	0.0978	
$H^{12}COOD$	32(5,27) - 32(5,28)	25063.76	0.05	25063.62	0.10	431.115	1.3156	
$H^{13}COOH$	5(1, 4) - 5(1, 5)	25101.28	0.02	25101.25	0.05	12.944	0.3673	[26A]
$H^{12}COOH$	36(5,31) - 36(5,32)	25222.06	0.01	25222.20	0.10	556.873	1.1886	[25A]
$H^{13}COOH$	19(3,16) - 19(3,17)	25896.01	0.06	25895.95	0.10	161.886	0.8312	[26A]
$H^{12}COOH$	22(3,20) - 21(4,17)	25928.44	0.01	25928.50	0.10	209.159	0.1186	[25A]
$D^{12}COOH$	41(7,34) - 41(7,35)	26031.77	0.16			713.911	1.9138	
$H^{13}COOH$	27(4,23) - 27(4,24)	26058.02	0.14			318.454	1.0247	
$H^{12}COOH$	45(6,39) - 45(6,40)	26343.22	0.02			859.180	1.3439	
$H^{13}COOH$	44(6,38) - 44(6,39)	26498.41	0.48			821.916	1.3703	
$D^{12}COOH$	32(7,26) - 31(8,23)	26593.87	0.91			465.271	0.1571	
$H^{12}COOD$	5(1, 4) - 5(1, 5)	26863.88	0.03			12.258	0.3677	
$H^{13}COOH$	16(2,14) - 17(1,17)	27012.34	0.34			111.529	0.0208	
$H^{12}COOD$	40(6,34) - 40(6,35)	27098.00	0.32			664.524	1.4832	
$H^{13}COOH$	9(2, 7) - 10(1,10)	27220.77	0.09			41.647	0.0359	
$D^{12}COOH$	12(4, 9) - 13(3,10)	27275.87	0.05	27275.81	0.10	81.456	0.0595	
$H^{12}COOD$	11(3, 8) - 12(2,11)	27290.04	2.00			63.689	0.0579	
$D^{12}COOH$	48(8,40) - 48(8,41)	27510.47	0.43			970.582	2.0954	
$D^{12}COOH$	32(7,25) - 31(8,24)	27730.49	0.92			465.270	0.1572	
$H^{12}COOH$	12(2,10) - 12(2,11)	27758.44	0.01	27758.48	0.10	67.150	0.5916	[25A]
$H^{12}COOD$	48(7,41) - 48(7,42)	27800.52	1.17			948.133	1.6542	
$H^{12}COOH$	18(2,17) - 17(3,14)	27881.98	0.02	27882.30	0.10	135.289	0.0815	[25A]
$D^{12}COOH$	28(5,23) - 28(5,24)	27926.60	0.05			339.381	1.4612	
$H^{12}COOD$	11(2, 9) - 11(2,10)	27960.77	0.03	27960.55	0.05	55.057	0.6343	
$H^{12}COOH$	4(0, 4) - 3(1, 3)	28086.36	0.00	28086.36	0.10	6.543	0.0574	[25A]
$D^{12}COOH$	15(3,12) - 14(4,11)	28614.95	0.09			102.314	0.0747	
$H^{12}COOD$	25(4,21) - 25(4,22)	28635.97	0.04	28636.02	0.10	266.323	1.0813	
$D^{12}COOH$	21(2,20) - 20(3,17)	28749.61	0.60			171.778	0.0284	
$H^{12}COOH$	28(4,24) - 28(4,25)	28916.23	0.01	28916.28	0.10	341.007	0.9828	[25A]
$H^{13}COOH$	14(2,12) - 13(3,11)	28973.14	0.56			87.558	0.0826	
$D^{12}COOH$	28(6,23) - 27(7,20)	29196.35	0.60			354.996	0.1379	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOH$	35(7,29) – 36(6,30)	29452.95	0.02	29452.90	0.10	580.574	0.1996	[25A]
$H^{12}COOD$	23(4,19) – 22(5,18)	29488.04	9.87			230.078	0.1227	
$H^{13}COOH$	12(2,10) – 12(2,11)	29590.16	0.03	29590.45	0.05	66.784	0.5878	[26A]
$D^{12}COOH$	20(4,17) – 19(5,14)	29716.65	0.24			179.079	0.0983	
$H^{13}COOH$	32(5,28) – 31(6,25)	29851.22	8.18			449.512	0.1777	
$H^{13}COOH$	4(0, 4) – 3(1, 3)	29917.97	0.06			6.468	0.0576	
$H^{12}COOD$	18(3,15) – 18(3,16)	30288.44	0.03			140.939	0.8528	
$H^{12}COOH$	20(3,17) – 20(3,18)	30521.66	0.01	30521.65	0.10	177.723	0.7820	[25A]
$D^{12}COOH$	10(2, 8) – 10(2, 9)	30525.06	0.02			46.444	0.6801	
$H^{13}COOH$	11(3, 9) – 12(2,10)	30629.45	0.55			67.771	0.0652	
$H^{13}COOH$	23(5,18) – 24(4,21)	30670.93	4.27			259.711	0.1303	
$D^{12}COOH$	24(5,20) – 23(6,17)	30674.39	0.39			259.594	0.1184	
$H^{13}COOH$	36(5,31) – 36(5,32)	30696.43	0.30			554.598	1.1670	
$H^{12}COOD$	7(2, 5) – 8(1, 8)	30763.50	0.43			26.797	0.0300	
$H^{12}COOH$	9(2, 7) – 10(1,10)	30774.93	0.01	30774.90	0.10	41.822	0.0371	[25A]
$H^{12}COOD$	16(2,15) – 15(3,12)	31128.55	2.05			104.215	0.0685	
$D^{12}COOH$	22(4,18) – 22(4,19)	31399.66	0.03			211.939	1.1925	
$D^{12}COOH$	5(1, 4) – 5(1, 5)	31457.55	0.02	31457.26	0.05	12.030	0.3686	
$H^{12}COOH$	35(7,28) – 36(6,31)	31801.37	0.02	31801.40	0.10	580.499	0.1995	[25A]
$D^{12}COOH$	35(6,29) – 35(6,30)	31826.26	0.08			522.603	1.6377	
$H^{12}COOD$	20(5,15) – 21(4,18)	31875.23	9.80			197.669	0.1079	
$H^{12}COOH$	37(5,32) – 37(5,33)	32054.45	0.02	32054.41	0.10	584.822	1.1345	[25A]
$D^{12}COOH$	28(6,22) – 27(7,21)	32147.34	0.61			354.993	0.1380	
$H^{12}COOH$	13(3,10) – 14(2,13)	32373.27	0.01			87.252	0.0716	
$H^{12}COOD$	33(5,28) – 33(5,29)	32692.72	0.05	32692.99	0.10	455.269	1.2454	
$H^{12}COOD$	24(2,23) – 23(3,20)	32891.42	2.19			220.421	0.0378	
$D^{12}COOH$	16(3,13) – 16(3,14)	32898.98	0.03	32898.80	0.10	114.273	0.9311	
$H^{12}COOH$	33(5,29) – 32(6,26)	33083.98	0.02	33084.00	0.10	476.464	0.1850	[25A]
$H^{12}COOH$	46(6,40) – 46(6,41)	33087.15	0.02	33087.20	0.10	893.946	1.2906	[25A]
$H^{13}COOH$	18(2,17) – 17(3,14)	33121.14	0.62			134.584	0.0789	
$H^{13}COOH$	20(3,17) – 19(4,16)	33136.45	1.89			176.920	0.1127	
$D^{12}COOH$	5(2, 3) – 6(1, 6)	33325.20	0.03	33325.21	0.10	16.207	0.0214	
$H^{13}COOH$	45(6,39) – 45(6,40)	33436.66	0.57			855.884	1.3142	
$H^{13}COOH$	28(4,24) – 28(4,25)	33632.30	0.16			339.541	0.9672	
$D^{12}COOH$	16(5,12) – 17(4,13)	33667.01	0.05			137.997	0.0784	
$H^{13}COOH$	20(3,17) – 20(3,18)	33962.67	0.07	33962.85	0.10	176.893	0.7726	[26A]
$H^{12}COOH$	29(6,24) – 30(5,25)	33979.74	0.02	33979.90	0.10	405.257	0.1656	[25A]
$H^{12}COOH$	17(2,15) – 18(1,18)	34113.79	0.04			124.755	0.0200	
$H^{12}COOH$	6(1, 5) – 6(1, 6)	34378.81	0.01	34378.83	0.10	17.362	0.3106	[25A]
$D^{12}COOH$	42(7,35) – 42(7,36)	34553.58	0.20			745.220	1.8165	
$H^{12}COOD$	41(6,35) – 41(6,36)	34880.99	0.38			694.564	1.4134	
$H^{12}COOD$	24(4,21) – 23(5,18)	34888.89	9.92			246.900	0.1271	
$H^{13}COOH$	6(1, 5) – 6(1, 6)	35122.00	0.03	35122.00	0.05	17.258	0.3107	
$H^{12}COOD$	49(7,42) – 49(7,43)	35462.88	1.44			984.044	1.5845	
$H^{12}COOH$	18(4,14) – 19(3,17)	35803.31	0.02	35803.30	0.10	162.690	0.1025	[25A]
$H^{12}COOD$	18(3,15) – 17(4,14)	35975.93	5.10			140.750	0.0974	
$H^{13}COOH$	26(4,22) – 25(5,21)	36157.30	4.37			297.577	0.1452	
$D^{12}COOH$	49(8,41) – 49(8,42)	36174.29	0.62			1007.126	1.9975	
$D^{12}COOH$	14(2,13) – 13(3,10)	36296.76	0.13			81.456	0.0551	
$H^{12}COOD$	4(0, 4) – 3(1, 3)	36445.95	0.05	36446.15	0.05	6.012	0.0589	
$H^{12}COOH$	27(2,26) – 26(3,23)	36660.59	0.08			287.184	0.0469	
$H^{12}COOH$	13(2,11) – 13(2,12)	36818.64	0.01	36818.63	0.05	76.834	0.5364	[25A]
$H^{12}COOH$	29(4,25) – 29(4,26)	36935.87	0.01	36935.83	0.10	362.878	0.9287	[25A]
$H^{13}COOH$	22(3,20) – 21(4,17)	36936.90	1.90			207.901	0.1169	
$H^{13}COOH$	8(2, 6) – 9(1, 9)	37012.35	0.09			34.483	0.0351	
$H^{12}COOD$	15(4,11) – 16(3,14)	37114.50	5.07			115.481	0.0806	
$H^{13}COOH$	17(2,15) – 18(1,18)	37324.98	0.42			124.313	0.0183	
$H^{12}COOD$	26(4,22) – 26(4,23)	37479.37	0.04	37479.36	0.10	285.310	1.0122	[26A]
$H^{12}COOH$	23(5,19) – 24(4,20)	37493.23	0.02	37493.25	0.10	261.375	0.1317	[25A]
$D^{12}COOH$	29(5,24) – 29(5,25)	37529.78	0.05	37529.52	0.10	360.938	1.3660	
$H^{12}COOD$	6(1, 5) – 6(1, 6)	37577.67	0.04	37577.84	0.05	16.417	0.3114	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{13}COOH$	28(6,23) - 29(5,24)	37657.58	8.15			380.548	0.1581	
$H^{13}COOH$	27(4,24) - 26(5,21)	37761.05	4.32			317.195	0.1489	
$H^{12}COOD$	12(2,10) - 12(2,11)	37790.99	0.03	37791.00	0.05	63.689	0.5690	[26A]
$D^{13}COOH$	24(5,19) - 23(6,18)	37988.12	0.39			259.584	0.1189	
$D^{12}COOH$	20(6,15) - 21(5,16)	38394.63	0.06			209.491	0.0975	
$D^{12}COOH$	12(4, 8) - 13(3,11)	38521.55	0.04			81.092	0.0585	
$H^{12}COOH$	9(1, 8) - 8(2, 7)	38579.95	0.01	38579.95	0.10	35.798	0.0668	[25A]
$D^{12}COOH$	16(5,11) - 17(4,14)	38665.50	0.05	38665.45	0.10	137.835	0.0781	
$H^{12}COOH$	19(2,18) - 18(3,15)	38706.69	0.02	38706.69	0.10	148.982	0.0810	[25A]
$H^{12}COOD$	8(1, 7) - 7(2, 6)	38810.01	0.47			27.644	0.0574	
$H^{13}COOH$	37(5,32) - 37(5,33)	38851.62	0.34			582.510	1.1109	
$H^{12}COOH$	29(6,23) - 30(5,26)	38898.74	0.02	38898.75	0.10	405.099	0.1653	[25A]
$H^{13}COOH$	13(2,11) - 13(2,12)	39164.63	0.04	39164.80	0.05	76.446	0.5323	[26A]
$H^{12}COOD$	16(2,14) - 17(1,17)	39303.13	0.54			107.139	0.0141	
$H^{12}COOH$	21(3,18) - 21(3,19)	39394.05	0.01	39394.06	0.10	193.501	0.7282	[25A]
$D^{12}COOH$	11(2, 9) - 10(3, 8)	39462.63	0.05			54.527	0.0590	
$H^{12}COOH$	17(4,14) - 18(3,15)	39537.97	0.02	39537.98	0.10	148.982	0.0980	[25A]
$H^{12}COOD$	19(3,16) - 19(3,17)	39971.51	0.03	39971.54	0.10	154.750	0.7859	[26A]
$H^{12}COOH$	38(5,33) - 38(5,34)	40304.62	0.02	40304.66	0.10	613.527	1.0813	[25A]
$D^{12}COOH$	20(2,19) - 19(3,16)	40352.43	0.50			156.482	0.0328	
$H^{13}COOH$	26(2,25) - 25(3,22)	40396.68	1.32			266.396	0.0471	
$D^{12}COOH$	20(6,14) - 21(5,17)	40441.36	0.06			209.424	0.0974	
$H^{12}COOD$	17(2,16) - 16(3,13)	41001.67	2.06			116.020	0.0677	
$H^{13}COOH$	32(5,27) - 31(6,26)	41050.31	8.28			449.495	0.1786	
$H^{12}COOH$	11(3, 9) - 12(2,10)	41054.55	0.02	41054.53	0.10	68.076	0.0651	[25A]
$H^{12}COOH$	8(2, 6) - 9(1, 9)	41055.02	0.01	41054.99	0.10	34.636	0.0360	[25A]
$H^{12}COOH$	47(6,41) - 47(6,42)	41196.72	0.03	41196.65	0.10	929.469	1.2377	[25A]
$D^{12}COOH$	8(3, 5) - 9(2, 8)	41212.36	0.04			39.162	0.0383	
$H^{13}COOH$	5(2, 4) - 6(1, 5)	41319.40	0.09			18.430	0.0328	
$H^{12}COOH$	39(6,34) - 38(7,31)	41634.40	0.02	41634.47	0.10	665.149	0.2195	[25A]
$H^{12}COOD$	2(1, 2) - 1(1, 1)	41672.58	0.01	41672.52	0.05	2.537	1.5000	[26A]
$D^{12}COOH$	7(1, 6) - 6(2, 5)	41741.62	0.03	41741.57	0.10	21.632	0.0482	
$D^{12}COOH$	3(2, 2) - 4(1, 3)	41746.96	0.03			9.244	0.0148	
$H^{13}COOH$	46(6,40) - 46(6,41)	41805.61	0.66			890.608	1.2586	
$D^{12}COOH$	2(1, 2) - 1(1, 1)	41922.87	0.01	41922.88	0.05	2.257	1.5000	[26A]
$H^{12}COOD$	34(5,29) - 34(5,30)	42051.12	0.05			480.154	1.1767	
$D^{12}COOH$	11(2, 9) - 11(2,10)	42063.22	0.03	42063.25	0.05	54.440	0.6022	
$H^{13}COOH$	28(6,22) - 29(5,25)	42073.73	8.11			380.406	0.1578	
$D^{12}COOH$	36(6,30) - 36(6,31)	42107.62	0.08			549.413	1.5417	
$D^{12}COOH$	24(7,18) - 25(6,19)	42208.79	0.07			295.904	0.1167	
$D^{12}COOH$	23(4,19) - 23(4,20)	42226.75	0.03	42226.82	0.10	228.979	1.1012	
$H^{12}COOD$	20(3,18) - 19(4,15)	42267.07	5.16			167.067	0.1021	
$H^{12}COOD$	13(2,11) - 12(3,10)	42330.06	2.00			73.267	0.0751	
$H^{13}COOH$	12(3, 9) - 13(2,12)	42493.92	0.55			76.446	0.0659	
$H^{12}COOD$	6(2, 4) - 7(1, 7)	42510.22	0.43			21.264	0.0274	
$H^{13}COOH$	29(4,25) - 29(4,26)	42792.53	0.17			361.377	0.9117	
$H^{13}COOH$	19(2,18) - 18(3,15)	42983.53	0.66			148.271	0.0777	
$D^{12}COOH$	24(7,17) - 25(6,20)	43005.23	0.07	43005.42	0.10	295.878	0.1166	
$H^{12}COOD$	23(2,22) - 22(3,19)	43029.34	2.16			203.170	0.0427	
$D^{12}COOH$	17(3,15) - 16(4,12)	43182.31	0.19			125.350	0.0815	
$H^{13}COOH$	2(1, 2) - 1(1, 1)	43190.82	0.01	43190.80	0.05	2.867	1.5000	[26A]
$H^{15}COOH$	2(1, 2) - 1(1, 1)	43303.71	0.00	43303.71	0.05	2.933	1.5000	[25A]
$H^{12}COOD$	2(0, 2) - 1(0, 1)	43421.08	0.01	43421.10	0.05	0.725	1.9996	[26A]
$H^{13}COOH$	21(3,18) - 21(3,19)	43690.75	0.08			192.642	0.7181	
$H^{12}COOD$	9(3, 7) - 10(2, 8)	43791.66	1.98			47.799	0.0490	
$H^{12}COOD$	4(2, 3) - 5(1, 4)	43870.11	0.46			13.154	0.0235	
$D^{12}COOH$	2(0, 2) - 1(0, 1)	43952.06	0.01	43952.08	0.05	0.734	1.9992	[26A]
$D^{12}COOH$	6(1, 5) - 6(1, 6)	43971.90	0.02	43971.96	0.05	16.207	0.3130	[26A]
$H^{15}COOH$	28(4,25) - 27(5,22)	44133.09	0.02	44133.09	0.10	339.535	0.1556	[25A]
$H^{12}COOD$	42(6,36) - 42(6,37)	44383.14	0.45			725.338	1.3442	
$D^{12}COOH$	17(3,14) - 17(3,15)	44469.05	0.03	44469.09	0.10	126.790	0.8460	
$H^{13}COOH$	9(1, 8) - 8(2, 7)	44634.11	0.09			35.494	0.0675	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOD$	50(7,43) - 50(7,44)	44793.99	1.78			1020.690	1.5149	
$H^{12}COOD$	50(7,43) - 50(7,44)	44793.99	1.78			1020.690	1.5149	
$H^{13}COOH$	2(0, 2) - 1(0, 1)	44832.15	0.01	44832.21	0.05	0.748	1.9997	[26A]
$H^{12}COOH$	2(0, 2) - 1(0, 1)	44911.73	0.00	44911.75	0.05	0.750	1.9998	[25A]
$H^{12}COOH$	23(3,21) - 22(4,18)	44926.87	0.02	44926.87	0.10	225.788	0.1225	[25A]
$H^{13}COOH$	17(4,13) - 18(3,16)	45074.91	1.85			147.626	0.0956	
$H^{12}COOH$	33(5,28) - 32(6,27)	45175.29	0.02	45175.55	0.10	476.445	0.1860	[25A]
$D^{12}COOH$	43(7,36) - 43(7,37)	45230.67	0.29			777.278	1.7193	
$H^{12}COOH$	27(4,23) - 26(5,22)	45237.86	0.02	45237.87	0.10	319.125	0.1525	[25A]
$D^{12}COOH$	15(2,14) - 14(3,11)	45240.48	0.17			91.966	0.0538	
$H^{12}COOD$	2(1, 1) - 1(1, 0)	45257.28	0.01	45257.37	0.05	2.597	1.5000	[26A]
$H^{12}COOD$	10(3, 7) - 11(2,10)	45348.33	1.99			55.057	0.0524	
$H^{13}COOH$	22(5,18) - 23(4,19)	45529.49	4.29			241.908	0.1242	
$D^{12}COOH$	28(8,21) - 29(7,22)	45613.41	0.07	45613.23	0.10	397.208	0.1358	
$H^{12}COOH$	7(1, 6) - 7(1, 7)	45801.01	0.01	45801.01	0.05	22.405	0.2696	[25A]
$H^{12}COOH$	18(2,16) - 19(1,19)	45832.37	0.05			138.281	0.0176	
$D^{12}COOH$	28(8,20) - 29(7,23)	45912.58	0.07			397.199	0.1358	
$D^{12}COOH$	2(1, 1) - 1(1, 0)	46123.16	0.01	46123.18	0.05	2.327	1.5000	[26A]
$H^{12}COOH$	26(2,25) - 25(3,22)	46399.61	0.06			267.114	0.0520	
$H^{13}COOH$	2(1, 1) - 1(1, 0)	46539.49	0.01	46539.49	0.05	2.923	1.5000	
$H^{12}COOH$	30(4,26) - 30(4,27)	46548.70	0.02	46548.73	0.10	385.499	0.8765	[25A]
$H^{12}COOH$	2(1, 1) - 1(1, 0)	46581.22	0.00	46581.22	0.05	2.988	1.5000	[25A]
$D^{12}COOH$	20(4,16) - 19(5,15)	46605.07	0.24			179.054	0.1000	
$D^{12}COOH$	4(0, 4) - 3(1, 3)	46628.15	0.01	46628.20	0.10	5.752	0.0613	
$D^{12}COOH$	7(3, 5) - 8(2, 6)	46678.85	0.05			33.062	0.0332	
$H^{12}COOD$	14(4,11) - 15(3,12)	46734.95	5.04			104.215	0.0749	
$H^{13}COOH$	7(1, 6) - 7(1, 7)	46787.40	0.03	46787.50	0.05	22.287	0.2698	[26A]
$D^{12}COOH$	50(8,42) - 50(8,43)	46988.57	0.92			1044.422	1.8990	
$H^{12}COOH$	5(2, 4) - 6(1, 5)	47167.52	0.01			18.509	0.0326	
$H^{12}COOH$	23(5,18) - 24(4,21)	47270.99	0.02	47270.98	0.10	261.061	0.1309	[25A]
$D^{12}COOH$	4(2, 2) - 5(1, 5)	47273.62	0.03	47273.49	0.10	12.030	0.0172	
$H^{12}COOH$	20(2,19) - 19(3,16)	47414.15	0.02			163.464	0.0791	
$H^{12}COOH$	39(6,33) - 38(7,32)	47479.06	0.02	47478.88	0.10	665.140	0.2198	[25A]
$H^{12}COOH$	14(2,12) - 14(2,13)	47554.57	0.01	47554.53	0.05	87.252	0.4884	[25A]
$D^{12}COOH$	1(1, 0) - 1(0, 1)	47752.82	0.01	47752.57	0.10	0.734	0.0525	
$H^{12}COOH$	21(3,18) - 20(4,17)	47787.52	0.02	47787.49	0.10	193.221	0.1203	[25A]
$D^{12}COOH$	37(8,30) - 36(9,27)	48033.65	1.85			617.029	0.1833	
$H^{12}COOD$	27(4,23) - 27(4,24)	48210.94	0.05	48210.92	0.10	305.022	0.9462	[26A]
$D^{12}COOH$	19(2,18) - 18(3,15)	48440.99	0.42			141.979	0.0376	
$H^{12}COOD$	18(2,17) - 17(3,14)	48457.03	2.08			128.596	0.0655	
$H^{13}COOH$	38(5,33) - 38(5,34)	48627.68	0.39			611.174	1.0559	
$D^{12}COOH$	37(8,29) - 36(9,28)	48679.29	1.87			617.028	0.1833	
$H^{12}COOD$	19(5,15) - 20(4,16)	48683.64	9.77			182.525	0.1013	
$H^{13}COOH$	7(2, 5) - 8(1, 8)	48807.34	0.09			28.029	0.0329	
$D^{12}COOH$	32(9,24) - 33(8,25)	48854.33	0.10	48854.37	0.10	513.382	0.1549	
$D^{12}COOH$	32(9,23) - 33(8,26)	48963.76	0.10			513.379	0.1549	
$H^{12}COOH$	15(2,13) - 14(3,12)	49020.22	0.02	49020.24	0.10	98.769	0.0915	[25A]
$H^{13}COOH$	25(2,24) - 24(3,21)	49114.35	1.17			247.124	0.0523	
$D^{12}COOH$	30(5,25) - 30(5,26)	49470.08	0.05	49470.21	0.10	383.235	1.2736	
$H^{12}COOD$	13(2,11) - 13(2,12)	49495.71	0.04	49495.71	0.05	73.028	0.5134	[26A]
$D^{12}COOH$	2(1, 1) - 2(0, 2)	49923.92	0.01	49923.61	0.10	2.200	0.0855	
$H^{12}COOH$	22(3,19) - 22(3,20)	49949.34	0.01	49949.28	0.10	210.023	0.6782	[25A]
$H^{12}COOD$	7(1, 6) - 7(1, 7)	50035.64	0.05	50035.60	0.05	21.264	0.2708	[26A]
$H^{13}COOH$	18(2,16) - 19(1,19)	50081.51	0.52			137.793	0.0161	
$H^{12}COOH$	39(5,34) - 39(5,35)	50144.19	0.03			642.985	1.0291	
$H^{12}COOD$	22(2,21) - 21(3,18)	50153.36	2.14			186.694	0.0478	
$H^{13}COOH$	14(2,12) - 14(2,13)	50470.13	0.04			86.841	0.4843	
$H^{13}COOH$	20(2,19) - 19(3,16)	50583.05	0.71			162.750	0.0754	
$H^{12}COOH$	12(3, 9) - 13(2,12)	50653.85	0.02	50653.62	0.10	76.834	0.0665	[25A]
$H^{12}COOH$	48(6,42) - 48(6,43)	50847.40	0.03	50847.48	0.10	965.746	1.1851	[25A]
$D^{12}COOH$	33(7,27) - 32(8,24)	51115.80	1.25			488.951	0.1640	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$-$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{12}COOH$	16(2,15) - 15(3,12)	51169.51	0.22			103.269	0.0511	
$H^{12}COOD$	20(3,17) - 20(3,18)	51590.95	0.04	51590.97	0.10	169.277	0.7245	[26A]
$H^{13}COOH$	47(6,41) - 47(6,42)	51789.58	0.76			926.086	1.2033	
$D^{12}COOH$	21(4,18) - 20(5,15)	51862.52	0.34			193.905	0.1042	
$D^{12}COOH$	36(10,27) - 37(9,28)	52040.13	0.31			644.406	0.1740	
$D^{12}COOH$	36(10,26) - 37(9,29)	52079.31	0.31			644.405	0.1740	
$H^{13}COOH$	16(4,13) - 17(3,14)	52324.65	1.86			134.584	0.0904	
$D^{12}COOH$	33(7,26) - 32(8,25)	52832.61	1.26			488.949	0.1641	
$D^{12}COOH$	18(2,17) - 17(3,14)	52922.46	0.34			128.274	0.0425	
$H^{12}COOH$	7(2, 5) - 8(1, 8)	53251.92	0.01	53251.92	0.10	28.164	0.0335	[25A]
$H^{12}COOD$	19(2,18) - 18(3,15)	53262.32	2.09			141.950	0.0621	
$D^{12}COOH$	11(4, 8) - 12(3, 9)	53269.84	0.06	53269.87	0.10	71.732	0.0520	
$H^{12}COOH$	5(0, 5) - 4(1, 4)	53286.95	0.01	53286.95	0.10	9.430	0.0791	[25A]
$D^{12}COOH$	3(1, 2) - 3(0, 3)	53311.88	0.01	53311.93	0.10	4.394	0.1155	
$H^{12}COOD$	35(5,30) - 35(5,31)	53343.55	0.06	53343.43	0.10	505.768	1.1096	
$H^{12}COOH$	25(2,24) - 24(3,21)	53384.82	0.05			247.840	0.0573	
$D^{12}COOH$	29(6,24) - 28(7,21)	53521.61	0.83			375.726	0.1446	
$H^{13}COOH$	30(4,26) - 30(4,27)	53697.19	0.19			383.961	0.8585	
$H^{12}COOD$	17(2,15) - 18(1,18)	53698.81	0.66			119.427	0.0122	
$H^{13}COOH$	33(5,29) - 32(6,26)	53724.43	8.22			473.602	0.1839	
$D^{12}COOH$	17(2,16) - 16(3,13)	53797.66	0.27			115.370	0.0472	
$H^{12}COOH$	21(2,20) - 20(3,17)	53809.37	0.02	53809.34	0.10	178.741	0.0762	[25A]
$H^{13}COOH$	22(5,17) - 23(4,20)	53886.06	4.26			241.639	0.1235	
$D^{12}COOH$	30(3,28) - 29(4,25)	54068.69	2.06			351.778	0.0357	
$H^{12}COOD$	21(2,20) - 20(3,17)	54215.55	2.12			170.998	0.0529	
$D^{12}COOH$	25(5,21) - 24(6,18)	54353.76	0.54			277.371	0.1249	
$H^{12}COOH$	34(7,28) - 35(6,29)	54404.70	0.03	54404.71	0.10	553.398	0.1926	[25A]
$H^{12}COOD$	19(5,14) - 20(4,17)	54481.98	9.77			182.337	0.1009	
$D^{12}COOH$	37(6,31) - 37(6,32)	54809.36	0.10	54809.37	0.10	576.968	1.4473	
$H^{13}COOH$	24(2,23) - 23(3,20)	54998.80	1.04			228.649	0.0575	
$H^{13}COOH$	5(0, 5) - 4(1, 4)	55110.60	0.06			9.347	0.0795	
$H^{13}COOH$	22(3,19) - 22(3,20)	55198.42	0.08	55198.20	0.10	209.133	0.6676	[26A]
$H^{12}COOD$	20(2,19) - 19(3,16)	55227.14	2.10			156.083	0.0578	
$H^{13}COOH$	23(3,21) - 22(4,18)	55331.96	1.93			224.516	0.1204	
$D^{12}COOH$	24(4,20) - 24(4,21)	55483.09	0.04			246.752	1.0154	
$H^{13}COOH$	21(2,20) - 20(3,17)	55726.33	0.77			178.025	0.0719	
$H^{12}COOD$	43(6,37) - 43(6,38)	55821.34	0.56			756.844	1.2758	
$D^{12}COOH$	12(2,10) - 12(2,11)	55821.79	0.03	55821.65	0.10	63.145	0.5379	
$H^{12}COOH$	34(7,27) - 35(6,30)	56102.82	0.03	56102.83	0.10	553.343	0.1925	[25A]
$H^{12}COOD$	1(1, 0) - 1(0, 1)	56128.64	0.05	56128.75	0.05	0.725	0.0525	
$H^{12}COOD$	5(2, 3) - 6(1, 6)	56132.27	0.44			16.417	0.0235	
$H^{12}COOD$	25(4,22) - 24(5,19)	56452.81	9.96			264.440	0.1326	
$H^{13}COOH$	34(5,30) - 33(6,27)	56956.32	0.02	56956.30	0.10	501.344	0.1911	[25A]
$H^{12}COOH$	17(4,13) - 18(5,16)	57491.88	0.02	57491.85	0.10	148.405	0.0961	[25A]
$H^{12}COOD$	24(4,20) - 23(5,19)	57538.02	9.92			246.861	0.1296	
$H^{12}COOH$	24(2,23) - 23(3,20)	57585.65	0.04			229.364	0.0626	
$H^{12}COOH$	22(2,21) - 21(3,18)	57721.57	0.03	57721.48	0.10	194.815	0.0723	[25A]
$H^{12}COOH$	31(4,27) - 31(4,28)	57900.35	0.02	57900.36	0.10	408.868	0.8264	
$D^{12}COOH$	29(6,23) - 28(7,22)	57921.58	0.84			375.720	0.1449	
$H^{12}COOD$	2(1, 1) - 2(0, 2)	57964.84	0.05	57965.03	0.05	2.173	0.0861	
$H^{13}COOH$	23(2,22) - 22(3,19)	58034.29	0.94			210.974	0.0627	
$D^{12}COOH$	4(1, 3) - 4(0, 4)	58069.01	0.01	58069.04	0.10	7.307	0.1415	
$H^{13}COOH$	22(2,21) - 21(3,18)	58250.99	0.84			194.099	0.0676	
$D^{12}COOH$	44(7,37) - 44(7,38)	58373.56	0.46			810.084	1.6226	
$D^{12}COOH$	18(3,15) - 18(3,16)	58419.13	0.03	58419.19	0.10	140.030	0.7700	
$H^{12}COOD$	14(4,10) - 15(3,13)	58421.03	5.05			103.837	0.0738	
$D^{12}COOH$	7(1, 6) - 7(1, 7)	58481.22	0.02	58481.27	0.05	21.073	0.2735	
$D^{12}COOH$	15(5,11) - 16(4,12)	58560.71	0.09			125.350	0.0710	
$H^{13}COOH$	10(3, 8) - 11(2, 9)	58770.92	0.55			58.578	0.0569	
$H^{12}COOH$	8(1, 7) - 8(1, 8)	58815.41	0.01	58815.41	0.05	28.164	0.2387	[25A]
$D^{12}COOH$	16(3,13) - 15(4,12)	58843.51	0.14			113.408	0.0824	
$H^{12}COOH$	23(2,22) - 22(3,19)	59013.00	0.03	59012.89	0.10	211.690	0.0676	[25A]
$H^{12}COOH$	28(6,23) - 29(5,24)	59318.72	0.02	59318.73	0.10	382.579	0.1585	[25A]

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$-$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOD$	21(3,19) - 20(4,16)	59759.50	5.19			182.525	0.1053	
$H^{13}COOH$	28(4,25) - 27(5,22)	59867.03	4.35			337.544	0.1542	
$H^{12}COOH$	19(2,17) - 20(1,20)	59880.26	0.06			152.505	0.0155	
$H^{12}COOH$	15(2,13) - 15(2,14)	60007.64	0.01	60007.61	0.05	98.402	0.4468	[25A]
$H^{13}COOH$	8(1, 7) - 8(1, 8)	60074.82	0.04			28.029	0.2390	
$H^{13}COOH$	39(5,34) - 39(5,35)	60193.75	0.43			640.590	1.0022	
$H^{13}COOH$	15(2,13) - 14(3,12)	60401.93	0.57			98.070	0.0920	
$D^{12}COOH$	11(4, 7) - 12(3,10)	60429.80	0.06			71.499	0.0514	
$H^{12}COOD$	3(1, 2) - 3(0, 3)	60800.26	0.05	60800.33	0.05	4.342	0.1175	
$D^{12}COOH$	7(3, 4) - 8(2, 7)	60908.69	0.05			32.597	0.0317	
$D^{12}COOH$	18(3,16) - 17(4,13)	60952.45	0.26			137.997	0.0849	
$H^{12}COOD$	5(0, 5) - 4(1, 4)	60980.82	0.05			8.789	0.0818	
$H^{12}COOD$	28(4,24) - 28(4,25)	60984.95	0.07	60984.87	0.10	325.456	0.8835	
$H^{13}COOH$	11(3, 8) - 12(2,11)	61395.68	0.54			66.784	0.0602	
$D^{12}COOH$	15(5,10) - 16(4,13)	61700.08	0.09			125.248	0.0709	
$H^{12}COOH$	40(5,35) - 40(5,36)	61733.82	0.03	61733.87	0.10	673.194	0.9780	[25A]
$H^{12}COOH$	49(6,43) - 49(6,44)	62210.43	0.04	62210.46	0.10	1002.777	1.1331	[25A]
$H^{12}COOH$	23(3,20) - 23(3,21)	62285.15	0.01	62285.14	0.10	227.287	0.6318	[25A]
$H^{13}COOH$	6(2, 4) - 7(1, 7)	62398.40	0.09			22.287	0.0294	
$H^{12}COOD$	3(1, 3) - 2(1, 2)	62481.47	0.01			3.927	2.6665	
$D^{12}COOH$	19(6,14) - 20(5,15)	62711.71	0.12			193.905	0.0902	
$D^{12}COOH$	3(1, 3) - 2(1, 2)	62840.37	0.01	62840.40	0.05	3.655	2.6664	[26A]
$H^{13}COOH$	27(6,22) - 28(5,23)	62857.71	8.13			358.661	0.1510	
$H^{12}COOH$	24(3,22) - 23(4,19)	62860.31	0.02			243.192	0.1255	
$H^{12}COOH$	28(6,22) - 29(5,25)	62875.48	0.02	62875.47	0.10	382.464	0.1583	[25A]
$D^{12}COOH$	3(2, 1) - 4(1, 4)	63090.35	0.03			8.544	0.0117	
$H^{12}COOD$	14(2,12) - 14(2,13)	63092.25	0.05	63092.29	0.05	83.070	0.4661	
$H^{12}COOH$	22(5,18) - 23(4,19)	63495.68	0.02	63495.67	0.10	243.192	0.1245	[25A]
$H^{13}COOH$	15(2,13) - 15(2,14)	63537.86	0.05	63537.65	0.05	97.965	0.4428	
$H^{13}COOH$	48(6,42) - 48(6,43)	63566.74	0.86			962.317	1.1486	
$D^{12}COOH$	31(5,26) - 31(5,27)	63978.75	0.05	63978.83	0.10	406.269	1.1850	
$D^{12}COOH$	19(6,13) - 20(5,16)	63987.36	0.12			193.864	0.0901	
$H^{13}COOH$	21(3,18) - 20(4,17)	64011.63	1.91			191.964	0.1203	
$H^{12}COOD$	8(1, 7) - 8(1, 8)	64200.71	0.06	64200.63	0.05	26.797	0.2406	
$H^{12}COOD$	9(3, 6) - 10(2, 9)	64338.92	1.98			47.134	0.0462	
$D^{12}COOH$	5(1, 4) - 5(0, 5)	64385.12	0.02	64385.15	0.10	10.931	0.1624	
$H^{12}COOD$	4(1, 3) - 4(0, 4)	64730.30	0.05	64730.12	0.05	7.227	0.1459	
$H^{13}COOH$	3(1, 3) - 2(1, 2)	64765.54	0.02	64765.57	0.05	4.308	2.6666	[26A]
$H^{12}COOH$	3(1, 3) - 2(1, 2)	64936.27	0.00	64936.30	0.05	4.377	2.6666	[25A]
$H^{12}COOD$	3(0, 3) - 2(0, 2)	65022.18	0.01	65022.21	0.05	2.173	2.9984	
$D^{12}COOH$	25(5,20) - 24(6,19)	65058.18	0.54			277.355	0.1257	
$H^{13}COOH$	19(2,17) - 20(1,20)	65161.03	0.64			151.969	0.0141	
$H^{12}COOD$	3(2, 2) - 2(2, 1)	65197.86	0.01	65197.90	0.05	9.544	1.6667	
$H^{13}COOH$	1(1, 0) - 1(0, 1)	65200.22	0.06			0.748	0.0525	
$H^{12}COOD$	21(3,18) - 21(3,19)	65230.61	0.06	65230.62	0.10	184.518	0.6687	
$H^{13}COOH$	27(4,23) - 26(5,22)	65319.29	4.41			317.145	0.1520	
$H^{12}COOD$	3(2, 1) - 2(2, 0)	65372.11	0.01	65372.08	0.05	9.545	1.6667	
$D^{12}COOH$	3(0, 3) - 2(0, 2)	65751.09	0.01	65751.14	0.05	2.200	2.9970	[26A]
$H^{13}COOH$	27(6,21) - 28(5,24)	66012.92	8.09			358.559	0.1508	
$D^{12}COOH$	3(2, 2) - 2(2, 1)	66034.67	0.01	66034.60	0.05	8.434	1.6667	[26A]
$H^{12}COOH$	29(4,26) - 28(5,23)	66115.61	0.02	66115.60	0.10	360.672	0.1608	[25A]
$H^{12}COOD$	19(3,16) - 18(4,15)	66120.90	5.12			153.877	0.1051	
$H^{12}COOH$	40(6,35) - 39(7,32)	66229.72	0.03	66229.70	0.10	694.533	0.2258	
$D^{12}COOH$	23(7,17) - 24(6,18)	66262.45	0.18			277.371	0.1093	
$D^{12}COOH$	3(2, 1) - 2(2, 0)	66317.31	0.01	66317.28	0.05	8.436	1.6667	[26A]
$H^{13}COOH$	31(4,27) - 31(4,28)	66479.01	0.19			407.291	0.8076	
$H^{12}COOH$	16(4,13) - 17(3,14)	66526.94	0.02	66526.97	0.10	135.289	0.0905	[25A]
$H^{12}COOD$	36(5,31) - 36(5,32)	66746.59	0.09	66746.59	0.10	532.107	1.0446	
$D^{12}COOH$	23(7,16) - 24(6,19)	66756.53	0.18			277.355	0.1093	
$H^{13}COOH$	2(1, 1) - 2(0, 2)	66907.56	0.06			2.244	0.0864	
$H^{13}COOH$	16(4,12) - 17(3,15)	66949.16	1.84			134.112	0.0889	
$H^{12}COOH$	1(1, 0) - 1(0, 1)	67094.49	0.01	67094.56	0.05	0.750	0.0525	[25A]

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{13}COOH$	3(0, 3) – 2(0, 2)	67166.08	0.02	67166.09	0.05	2.244	2.9990	[26A]
$H^{12}COOH$	6(2, 4) – 7(1, 7)	67167.12	0.01	67167.13	0.10	22.405	0.0298	[25A]
$H^{12}COOH$	3(0, 3) – 2(0, 2)	67291.12	0.00	67291.05	0.05	2.248	2.9991	[25A]
$H^{13}COOH$	3(2, 2) – 2(2, 1)	67298.66	0.02	67298.62	0.05	10.832	1.6667	[26A]
$H^{12}COOH$	3(2, 2) – 2(2, 1)	67414.65	0.00	67414.74	0.05	11.091	1.6667	[25A]
$H^{13}COOH$	3(2, 1) – 2(2, 0)	67429.20	0.02	67429.22	0.05	10.833	1.6667	[26A]
$H^{12}COOH$	3(2, 1) – 2(2, 0)	67536.10	0.00	67536.09	0.05	11.092	1.6667	[25A]
$D^{12}COOH$	1(1, 1) – 0(0, 0)	67664.16	0.02			0.000	0.0350	
$H^{12}COOD$	9(1, 8) – 8(2, 7)	67708.39	0.47			33.425	0.0711	
$D^{12}COOH$	2(2, 1) – 3(1, 2)	67810.28	0.03			6.172	0.0063	
$H^{12}COOD$	3(1, 2) – 2(1, 1)	67857.60	0.01	67857.62	0.05	4.107	2.6665	[26A]
$H^{12}COOH$	10(1, 9) – 9(2, 8)	68411.99	0.01	68412.01	0.10	42.525	0.0802	[25A]
$H^{13}COOH$	4(2, 3) – 5(1, 4)	68567.62	0.08			13.782	0.0230	
$H^{13}COOH$	23(3,20) – 23(3,21)	68567.84	0.09			226.362	0.6211	
$H^{13}COOH$	33(5,28) – 32(6,27)	68629.66	8.35			473.577	0.1851	
$H^{12}COOH$	2(1, 1) – 2(0, 2)	68763.98	0.01	68763.97	0.05	2.248	0.0864	[25A]
$H^{12}COOH$	10(3, 8) – 11(2, 9)	68924.55	0.02	68924.51	0.10	58.880	0.0568	[25A]
$D^{12}COOH$	3(1, 2) – 2(1, 1)	69139.04	0.01	69139.14	0.05	3.866	2.6663	[26A]
$D^{12}COOH$	42(9,34) – 41(10,31)	69298.70	3.47			790.259	0.2093	
$H^{12}COOD$	44(6,38) – 44(6,39)	69392.87	0.74			789.077	1.2086	
$H^{13}COOH$	3(1, 2) – 3(0, 3)	69529.39	0.06	69529.23	0.05	4.484	0.1185	[26A]
$D^{12}COOH$	27(8,20) – 28(7,21)	69544.44	0.26			375.726	0.1285	
$D^{12}COOH$	42(9,33) – 41(10,32)	69656.90	3.49			790.258	0.2094	
$D^{12}COOH$	27(8,19) – 28(7,22)	69729.48	0.26			375.720	0.1285	
$H^{13}COOH$	3(1, 2) – 2(1, 1)	69787.91	0.02	69787.93	0.05	4.476	2.6666	[26A]
$H^{12}COOH$	3(1, 2) – 2(1, 1)	69851.96	0.00	69852.03	0.05	4.541	2.6666	[25A]
$H^{12}COOH$	11(3, 8) – 12(2,11)	69854.42	0.02	69854.37	0.10	67.150	0.0606	[25A]
$H^{12}COOD$	5(1, 4) – 5(0, 5)	69877.33	0.05			10.823	0.1706	
$H^{12}COOD$	3(2, 2) – 4(1, 3)	69914.98	0.46			9.386	0.0143	
$H^{12}COOD$	8(3, 6) – 9(2, 7)	70155.31	1.98			40.377	0.0409	
$D^{12}COOH$	38(6,32) – 38(6,33)	70185.06	0.18			605.263	1.3553	
$H^{12}COOD$	18(2,16) – 19(1,19)	70430.30	0.82			132.383	0.0105	
$H^{12}COOH$	22(5,17) – 23(4,20)	70570.92	0.02	70570.90	0.10	242.964	0.1240	[25A]
$D^{12}COOH$	12(2,10) – 11(3, 9)	70866.10	0.07			62.643	0.0689	
$D^{12}COOH$	8(1, 7) – 7(2, 6)	71084.46	0.04			26.753	0.0625	
$H^{12}COOH$	32(4,28) – 32(4,29)	71110.71	0.02	71110.88	0.10	432.983	0.7786	[25A]
$H^{13}COOH$	21(5,17) – 22(4,18)	71234.38	4.28			224.516	0.1169	
$D^{12}COOH$	25(4,21) – 25(4,22)	71303.27	0.04	71303.30	0.10	265.252	0.9361	
$H^{12}COOH$	3(1, 2) – 3(0, 3)	71324.81	0.01	71324.89	0.05	4.492	0.1187	[25A]
$H^{12}COOD$	4(2, 2) – 5(1, 5)	71386.29	0.44			12.258	0.0182	
$D^{12}COOH$	5(0, 5) – 4(1, 4)	71582.33	0.02			8.544	0.0863	
$D^{12}COOH$	13(2,11) – 13(2,12)	71766.38	0.03	71766.42	0.05	72.555	0.4851	
$H^{12}COOD$	13(4,10) – 14(3,11)	72132.79	5.03			93.176	0.0673	
$D^{12}COOH$	6(1, 5) – 6(0, 6)	72468.33	0.02	72468.39	0.10	15.257	0.1776	
$H^{13}COOH$	24(3,22) – 23(4,19)	72526.73	1.97			241.908	0.1228	
$D^{12}COOH$	6(3, 4) – 7(2, 5)	72682.44	0.05			27.038	0.0253	
$D^{12}COOH$	31(9,23) – 32(8,24)	72717.14	0.41			488.951	0.1476	
$D^{12}COOH$	38(8,31) – 37(9,28)	72740.70	2.39			644.406	0.1901	
$D^{12}COOH$	31(9,22) – 32(8,25)	72784.69	0.41			488.949	0.1476	
$H^{12}COOH$	34(5,29) – 33(6,28)	72906.57	0.02			501.317	0.1925	
$H^{13}COOH$	4(1, 3) – 4(0, 4)	73137.65	0.06	73137.45	0.10	7.466	0.1482	
$H^{12}COOD$	18(5,14) – 19(4,15)	73227.20	9.74			167.867	0.0940	
$H^{12}COOD$	14(2,12) – 13(3,11)	73332.13	2.00			82.729	0.0849	
$H^{12}COOH$	9(1, 8) – 9(1, 9)	73392.33	0.01	73392.31	0.05	34.636	0.2148	[25A]
$D^{12}COOH$	22(4,19) – 21(5,16)	73401.25	0.45			209.491	0.1095	
$H^{13}COOH$	40(5,35) – 40(5,36)	73698.44	0.47			670.753	0.9498	
$D^{12}COOH$	38(8,30) – 37(9,29)	73712.10	2.41			644.405	0.1902	
$H^{12}COOH$	39(8,32) – 40(7,33)	73717.52	0.03			724.678	0.2196	
$H^{12}COOH$	40(6,34) – 39(7,33)	74000.21	0.03			694.520	0.2263	
$D^{12}COOH$	29(3,27) – 28(4,24)	74050.51	1.78			329.553	0.0409	
$H^{12}COOH$	16(2,14) – 16(2,15)	74187.80	0.01			110.282	0.4106	
$D^{12}COOH$	45(7,38) – 45(7,39)	74258.47	0.74			843.632	1.5273	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOH$	39(8,31) - 40(7,34)	74276.87	0.03			724.660	0.2196	
$H^{12}COOH$	4(2, 3) - 5(1, 4)	74362.07	0.01			13.857	0.0229	
$H^{13}COOH$	10(1, 9) - 9(2, 8)	74536.69	0.09			42.208	0.0812	
$D^{13}COOH$	19(3,16) - 19(3,17)	74783.90	0.03			153.987	0.7031	
$H^{12}COOH$	28(4,24) - 27(5,23)	74784.03	0.02	74783.93	0.10	339.477	0.1592	
$H^{12}COOH$	4(1, 3) - 4(0, 4)	74843.99	0.01			7.480	0.1487	
$D^{12}COOH$	8(1, 7) - 8(1, 8)	74904.40	0.03			26.625	0.2446	
$H^{13}COOH$	9(1, 8) - 9(1, 9)	74950.85	0.05			34.483	0.2152	
$H^{12}COOH$	41(5,36) - 41(5,37)	75215.06	0.04			704.152	0.9283	
$H^{12}COOD$	34(3,32) - 33(4,29)	75268.48	5.80			443.601	0.0507	
$H^{12}COOH$	50(6,44) - 50(6,45)	75445.28	0.05			1040.558	1.0817	
$D^{12}COOH$	34(7,28) - 33(6,25)	75801.74	1.62			513.382	0.1708	
$D^{12}COOH$	35(10,26) - 36(9,27)	75851.96	0.69			617.029	0.1667	
$H^{12}COOD$	22(3,20) - 21(4,17)	75870.94	5.22			197.940	0.1074	
$D^{12}COOH$	35(10,25) - 36(9,28)	75876.11	0.69			617.028	0.1667	
$D^{12}COOH$	21(4,17) - 20(5,16)	75898.08	0.38			193.864	0.1070	
$H^{12}COOD$	29(4,25) - 29(4,26)	75909.67	0.10			346.610	0.8246	
$H^{12}COOD$	1(1, 1) - 0(0, 0)	76068.70	0.05			0.000	0.0350	
$H^{12}COOH$	20(2,18) - 21(1,21)	76131.19	0.08			167.427	0.0137	
$H^{12}COOD$	6(1, 5) - 6(0, 6)	76383.84	0.05			15.122	0.1909	
$H^{12}COOH$	24(3,21) - 24(3,22)	76464.27	0.02			245.289	0.5892	
$D^{12}COOH$	19(3,17) - 18(4,14)	77056.22	0.33			151.417	0.0870	
$H^{12}COOD$	18(5,13) - 19(4,16)	77140.73	9.75			167.740	0.0937	
$H^{13}COOH$	21(5,16) - 22(4,19)	77188.47	4.25			224.324	0.1165	
$H^{13}COOH$	49(6,43) - 49(6,44)	77300.64	0.97			999.297	1.0948	
$H^{13}COOH$	34(5,30) - 33(6,27)	77452.10	8.26			498.455	0.1898	
$H^{13}COOH$	5(2, 3) - 6(1, 6)	77579.58	0.09			17.258	0.0246	
$H^{13}COOH$	5(1, 4) - 5(0, 5)	77825.74	0.06	77825.87	0.10	11.186	0.1749	
$D^{12}COOH$	26(5,22) - 25(6,19)	77874.76	0.71			295.904	0.1310	
$D^{12}COOH$	30(6,25) - 29(7,22)	77917.99	1.08			397.208	0.1512	
$D^{12}COOH$	10(4, 7) - 11(3, 8)	78235.32	0.09			62.786	0.0444	
$D^{12}COOH$	34(7,27) - 33(8,26)	78356.21	1.64			513.379	0.1709	
$H^{13}COOH$	16(2,14) - 16(2,15)	78366.88	0.05			109.816	0.4070	
$H^{12}COOD$	15(2,13) - 15(2,14)	78558.86	0.08			93.813	0.4262	
$H^{13}COOH$	15(4,12) - 16(3,13)	78761.35	1.85			121.684	0.0828	
$H^{12}COOH$	6(0, 6) - 5(1, 5)	78927.42	0.01			13.037	0.1025	
$D^{12}COOH$	39(11,29) - 40(10,30)	78981.25	1.16			759.939	0.1858	
$D^{12}COOH$	39(11,28) - 40(10,31)	78909.73	1.16			759.939	0.1858	
$H^{12}COOH$	33(7,27) - 34(6,28)	79082.99	0.03	79083.15	0.10	526.988	0.1855	
$H^{12}COOH$	22(3,19) - 21(4,18)	79302.46	0.02	79302.57	0.10	209.044	0.1279	
$H^{12}COOH$	5(1, 4) - 5(0, 5)	79408.70	0.01	79408.60	0.05	11.208	0.1758	
$H^{12}COOH$	25(3,23) - 24(4,20)	79539.29	0.02			261.375	0.1275	
$H^{12}COOH$	16(4,12) - 17(3,15)	79543.38	0.02			134.869	0.0893	
$H^{12}COOD$	9(1, 8) - 9(1, 9)	80018.30	0.09			33.014	0.2175	
$H^{12}COOD$	13(4, 9) - 14(3,12)	80036.98	5.03			92.919	0.0667	
$H^{12}COOH$	33(7,26) - 34(6,29)	80297.60	0.03			526.949	0.1854	
$D^{12}COOH$	2(2, 0) - 3(1, 3)	80480.25	0.03			5.752	0.0055	
$H^{12}COOH$	35(5,31) - 34(6,28)	80679.49	0.03			526.988	0.1969	
$H^{13}COOH$	6(0, 6) - 5(1, 5)	80733.38	0.06			12.944	0.1032	
$H^{12}COOD$	22(3,19) - 22(3,20)	80923.27	0.10			200.470	0.6185	
$H^{13}COOH$	10(3, 7) - 11(2,10)	81125.48	0.54			57.855	0.0539	
$H^{12}COOH$	16(2,14) - 15(3,13)	81135.84	0.02			110.050	0.1012	
$D^{12}COOH$	32(5,27) - 32(5,28)	81213.97	0.06			430.036	1.1012	
$H^{13}COOH$	32(4,28) - 32(4,29)	81237.58	0.19			431.363	0.7594	
$D^{12}COOH$	6(3, 3) - 7(2, 6)	81366.81	0.05			26.753	0.0247	
$H^{13}COOH$	29(4,26) - 28(5,23)	81431.82	4.39			358.661	0.1590	
$H^{12}COOD$	37(5,32) - 37(5,33)	82396.44	0.17			559.170	0.9822	
$H^{13}COOH$	20(2,18) - 21(1,21)	82421.40	0.78			166.839	0.0124	
$D^{12}COOH$	7(1, 6) - 7(0, 7)	82515.38	0.02			20.272	0.1870	
$D^{12}COOH$	10(4, 6) - 11(3, 9)	82590.90	0.09			62.643	0.0441	
$H^{12}COOH$	5(2, 3) - 6(1, 6)	82605.61	0.01			17.362	0.0248	
$D^{12}COOH$	14(5,10) - 15(4,11)	82813.69	0.13			113.476	0.0636	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOD$	4(1, 4) – 3(1, 3)	83258.41	0.02			6.012	3.7495	
$H^{13}COOH$	6(1, 5) – 6(0, 6)	83704.91	0.07			15.637	0.1980	
$D^{12}COOH$	4(1, 4) – 3(1, 3)	83707.21	0.02			5.752	3.7490	
$H^{13}COOH$	24(3,21) – 24(3,22)	83842.86	0.08			244.327	0.5787	
$H^{12}COOD$	8(3, 5) – 9(2, 8)	84078.89	1.98			39.922	0.0394	
$H^{12}COOH$	27(6,22) – 28(5,23)	84257.61	0.03			360.672	0.1514	
$D^{12}COOH$	30(6,24) – 29(7,23)	84366.91	1.09			397.199	0.1516	
$H^{12}COOD$	7(1, 6) – 7(0, 7)	84400.97	0.05			20.117	0.2063	
$D^{12}COOH$	14(5, 9) – 15(4,12)	84719.06	0.13			113.408	0.0635	
$H^{12}COOH$	6(1, 5) – 6(0, 6)	85123.20	0.01			15.670	0.1994	
$H^{12}COOD$	45(6,39) – 45(6,40)	85262.37	1.02			822.037	1.1430	
$H^{13}COOH$	9(3, 7) – 10(2, 8)	85842.89	0.55			50.174	0.0488	
$H^{12}COOD$	6(0, 6) – 5(1, 5)	85875.03	0.05			12.258	0.1070	
$H^{13}COOH$	1(1, 1) – 0(0, 0)	85958.37	0.06			0.000	0.0350	
$H^{12}COOH$	33(4,29) – 33(4,30)	86267.69	0.08			457.042	0.7332	
$H^{13}COOH$	4(1, 4) – 3(1, 3)	86316.01	0.02			6.468	3.7497	
$H^{12}COOD$	4(0, 4) – 3(0, 3)	86492.97	0.02			4.342	3.9961	
$H^{12}COOH$	4(1, 4) – 3(1, 3)	86546.18	0.01			6.543	3.7497	
$D^{12}COOH$	18(6,13) – 19(5,14)	86628.91	0.21			179.079	0.0828	
$H^{12}COOH$	27(6,21) – 28(5,24)	86795.62	0.03			360.590	0.1512	
$H^{12}COOD$	25(4,21) – 24(5,20)	86833.39	9.97			264.382	0.1364	
$H^{12}COOD$	4(2, 3) – 3(2, 2)	86895.46	0.01			11.719	2.9998	
$H^{12}COOD$	4(3, 2) – 3(3, 1)	87016.92	0.01			20.929	1.7501	
$H^{12}COOD$	4(3, 1) – 3(3, 0)	87020.90	0.01			20.929	1.7501	
$H^{12}COOD$	4(2, 2) – 3(2, 1)	87329.90	0.01			11.726	2.9999	
$D^{12}COOH$	4(0, 4) – 3(0, 3)	87340.86	0.02			4.394	3.9926	
$D^{12}COOH$	18(6,12) – 19(5,15)	87402.51	0.21			179.054	0.0827	
$H^{12}COOH$	30(4,27) – 29(5,24)	87532.77	0.03			382.579	0.1654	
$D^{12}COOH$	2(1, 2) – 1(0, 1)	87575.49	0.02			0.734	0.0525	
$H^{13}COOH$	26(6,21) – 27(5,22)	87664.56	8.10			337.544	0.1438	
$H^{12}COOH$	1(1, 1) – 0(0, 0)	87926.87	0.01			0.000	0.0350	
$D^{12}COOH$	4(2, 3) – 3(2, 2)	87990.15	0.02			10.636	2.9997	
$H^{12}COOD$	3(2, 1) – 4(1, 4)	88050.67	0.45			8.789	0.0121	
$D^{12}COOH$	4(3, 2) – 3(3, 1)	88183.91	0.01			18.426	1.7502	
$D^{12}COOH$	4(3, 1) – 3(3, 0)	88192.85	0.01			18.426	1.7502	
$H^{13}COOH$	25(3,23) – 24(4,20)	88313.43	2.02			260.080	0.1241	
$D^{12}COOH$	39(6,33) – 39(6,34)	88421.03	0.32			634.294	1.2669	
$D^{12}COOH$	4(2, 2) – 3(2, 1)	88693.18	0.02			10.648	2.9998	
$H^{12}COOH$	21(5,17) – 22(4,18)	88893.33	0.02			225.788	0.1172	
$H^{13}COOH$	15(4,11) – 16(3,14)	89138.60	1.84			121.348	0.0819	
$H^{13}COOH$	41(5,36) – 41(5,37)	89261.51	0.50			701.662	0.8993	
$H^{12}COOD$	19(2,17) – 20(1,20)	89301.95	1.02			146.006	0.0092	
$H^{13}COOH$	4(0, 4) – 3(0, 3)	89401.94	0.02			4.484	3.9975	
$H^{12}COOH$	10(1, 9) – 10(1,10)	89490.08	0.01			41.822	0.1960	
$H^{12}COOH$	4(0, 4) – 3(0, 3)	89579.17	0.01			4.492	3.9977	
$H^{13}COOH$	4(2, 3) – 3(2, 2)	89705.06	0.02			13.077	2.9999	
$D^{12}COOH$	26(4,22) – 26(4,23)	89735.75	0.05			284.477	0.8641	
$H^{13}COOH$	4(3, 2) – 3(3, 1)	89797.92	0.02			23.809	1.7501	
$H^{13}COOH$	4(3, 1) – 3(3, 0)	89800.31	0.02			23.809	1.7501	
$D^{12}COOH$	14(2,12) – 14(2,13)	89812.17	0.03			82.666	0.4422	
$H^{12}COOH$	10(3, 7) – 11(2,10)	89820.16	0.02			58.203	0.0541	
$H^{12}COOH$	4(2, 3) – 3(2, 2)	89861.48	0.01			13.340	2.9999	
$H^{13}COOH$	26(6,20) – 27(5,23)	89887.27	8.08			337.472	0.1436	
$H^{13}COOH$	4(3, 2) – 3(3, 1)	89948.21	0.01			24.390	1.7501	
$H^{12}COOH$	4(3, 1) – 3(3, 0)	89950.32	0.01			24.390	1.7501	
$H^{13}COOH$	4(2, 2) – 3(2, 1)	90030.84	0.02			13.082	2.9999	
$D^{12}COOH$	22(7,16) – 23(6,17)	90041.94	0.32			259.594	0.1019	
$H^{12}COOH$	17(2,15) – 17(2,16)	90077.96	0.02			122.888	0.3794	
$H^{13}COOH$	4(2, 2) – 3(2, 1)	90164.62	0.01			13.345	2.9999	
$D^{12}COOH$	22(7,15) – 23(6,18)	90341.54	0.32			259.584	0.1019	
$H^{12}COOD$	23(3,21) – 22(4,18)	90343.91	5.25			214.117	0.1082	
$H^{12}COOD$	4(1, 3) – 3(1, 2)	90423.01	0.02			6.370	3.7494	
$D^{12}COOH$	28(3,26) – 27(4,23)	90653.05	1.55			308.113	0.0467	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOH$	51(6,45) - 51(6,46)	90691.89	0.06			1079.087	1.0312	
$H^{12}COOH$	51(6,45) - 51(6,46)	90691.89	0.06			1079.087	1.0312	
$H^{12}COOH$	42(5,37) - 42(5,38)	90702.76	0.05			735.857	0.8801	
$D^{12}COOH$	17(3,14) - 16(4,13)	90716.60	0.19			125.248	0.0904	
$H^{12}COOH$	41(6,36) - 40(7,33)	90838.13	0.03			724.678	0.2319	
$H^{13}COOH$	7(1, 6) - 7(0, 7)	90898.34	0.07			20.815	0.2170	
$D^{12}COOH$	17(2,15) - 18(1,18)	90975.84	0.55			119.304	0.0064	
$D^{12}COOH$	20(3,18) - 19(4,15)	91131.12	0.42			165.618	0.0875	
$H^{13}COOH$	10(1, 9) - 10(1,10)	91368.59	0.06			41.647	0.1965	
$H^{12}COOD$	33(3,31) - 32(4,28)	92061.87	5.69			418.818	0.0567	
$D^{12}COOH$	4(1, 3) - 3(1, 2)	92097.99	0.02			6.172	3.7489	
$H^{12}COOH$	7(1, 6) - 7(0, 7)	92103.80	0.01			20.861	0.2191	
$H^{12}COOH$	25(3,22) - 25(3,23)	92513.94	0.02			264.028	0.5502	
$H^{12}COOH$	15(4,12) - 16(3,13)	92643.50	0.02			122.383	0.0829	
$H^{13}COOH$	16(2,14) - 15(3,13)	92844.33	0.58			109.333	0.1020	
$H^{13}COOH$	4(1, 3) - 3(1, 2)	93010.20	0.02			6.803	3.7496	
$H^{12}COOD$	30(4,26) - 30(4,27)	93041.34	0.14			368.479	0.7700	
$H^{12}COOH$	4(1, 3) - 3(1, 2)	93098.35	0.01			6.871	3.7497	
$D^{12}COOH$	46(7,39) - 46(7,40)	93102.41	1.15			877.920	1.4345	
$D^{12}COOH$	9(1, 8) - 9(1, 9)	93123.34	0.03			32.860	0.2232	
$H^{13}COOH$	50(6,44) - 50(6,45)	93131.65	1.07			1037.024	1.0420	
$D^{12}COOH$	26(5,21) - 25(6,20)	93228.91	0.71			295.878	0.1324	
$D^{12}COOH$	26(8,19) - 27(7,20)	93267.19	0.50			354.996	0.1211	
$D^{12}COOH$	26(8,18) - 27(7,21)	93379.42	0.50			354.993	0.1211	
$D^{12}COOH$	20(3,17) - 20(3,18)	93522.32	0.04			168.658	0.6453	
$H^{12}COOH$	21(5,16) - 22(4,19)	93927.39	0.02			225.625	0.1168	
$H^{12}COOD$	8(1, 7) - 8(0, 8)	94072.44	0.06			25.801	0.2169	
$D^{12}COOH$	43(9,35) - 42(10,32)	94106.52	4.27			821.328	0.2161	
$D^{12}COOH$	23(4,20) - 22(5,17)	94109.57	0.57			225.840	0.1140	
$H^{13}COOH$	4(2, 2) - 5(1, 5)	94157.88	0.09			12.944	0.0188	
$H^{12}COOH$	21(2,19) - 22(1,22)	94440.16	0.09			183.045	0.0121	
$D^{12}COOH$	43(9,34) - 42(10,33)	94643.69	4.30			821.327	0.2162	
$D^{12}COOH$	8(1, 7) - 8(0, 8)	94674.42	0.02			25.966	0.1911	
$H^{12}COOH$	26(3,24) - 25(4,21)	94760.48	0.03			280.339	0.1283	
$H^{12}COOH$	38(3,36) - 37(4,33)	94805.76	0.20			570.224	0.0654	
$H^{13}COOH$	37(3,35) - 36(4,32)	94868.51	4.04			540.386	0.0638	
$H^{13}COOH$	17(2,15) - 17(2,16)	94929.11	0.06			122.391	0.3762	
$H^{13}COOH$	3(2, 2) - 4(1, 3)	95059.28	0.08			9.906	0.0140	
$H^{12}COOD$	2(2, 1) - 3(1, 2)	95140.13	0.45			6.370	0.0062	
$H^{12}COOD$	7(3, 5) - 8(2, 6)	95439.86	1.97			33.720	0.0329	
$H^{13}COOH$	28(4,24) - 27(5,23)	95654.74	4.45			337.472	0.1587	
$H^{12}COOH$	9(3, 7) - 10(2, 8)	95765.29	0.02			50.471	0.0487	
$H^{12}COOD$	16(2,14) - 16(2,15)	95841.58	0.11			105.253	0.3925	
$H^{12}COOD$	2(1, 2) - 1(0, 1)	96008.81	0.05			0.725	0.0525	
$H^{13}COOH$	22(3,19) - 21(4,18)	96184.61	1.93			207.765	0.1280	
$H^{13}COOH$	20(5,16) - 21(4,17)	96362.29	4.26			207.901	0.1096	
$D^{12}COOH$	30(9,22) - 31(8,23)	96409.47	0.78			465.271	0.1402	
$D^{12}COOH$	30(9,21) - 31(8,24)	96450.45	0.78			465.270	0.1402	
$H^{12}COOD$	12(4, 9) - 13(3,10)	96690.77	5.02			82.898	0.0597	
$D^{12}COOH$	6(0, 6) - 5(1, 5)	96741.23	0.02			12.030	0.1140	
$H^{13}COOH$	34(5,29) - 33(6,28)	97062.94	8.42			498.419	0.1915	
$H^{12}COOD$	10(1, 9) - 9(2, 8)	97153.16	0.48			39.922	0.0864	
$H^{12}COOD$	17(5,13) - 18(4,14)	97222.29	9.72			153.961	0.0865	
$H^{12}COOD$	10(1, 9) - 10(1,10)	97412.28	0.11			39.914	0.1996	
$D^{12}COOH$	5(3, 3) - 6(2, 4)	97509.63	0.06			21.793	0.0178	
$D^{12}COOH$	39(8,32) - 38(9,29)	97633.97	2.95			672.534	0.1968	
$H^{12}COOD$	20(3,17) - 19(4,16)	97665.96	5.14			167.740	0.1130	
$H^{13}COOH$	33(4,29) - 33(4,30)	98034.54	0.18			456.176	0.7141	
$H^{12}COOH$	38(8,31) - 39(7,32)	98060.37	0.04			694.533	0.2125	
$H^{12}COOH$	38(8,30) - 39(7,33)	98457.45	0.04			694.520	0.2125	
$H^{12}COOD$	23(3,20) - 23(3,21)	98653.77	0.15			217.130	0.5739	
$H^{12}COOH$	11(1,10) - 10(2, 9)	98776.09	0.01			49.994	0.0949	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{12}COOH$	39(8,31) - 38(9,30)	99076.65	2.98			672.532	0.1969	
$H^{12}COOH$	4(2, 2) - 5(1, 5)	99385.99	0.01			13.037	0.0189	
$D^{12}COOH$	34(10,25) - 35(9,26)	99517.93	1.21			590.401	0.1593	
$H^{13}COOH$	8(1, 7) - 8(0, 8)	99532.24	0.08			26.713	0.2316	
$D^{12}COOH$	34(10,24) - 35(9,27)	99532.59	1.21			590.401	0.1593	
$H^{12}COOD$	17(5,12) - 18(4,15)	99800.62	9.72			153.877	0.0864	
$H^{12}COOD$	38(5,33) - 38(5,34)	100379.64	0.30			586.952	0.9231	
$H^{12}COOH$	8(1, 7) - 8(0, 8)	100471.13	0.01			26.774	0.2347	
$H^{13}COOH$	20(5,15) - 21(4,18)	100527.83	4.25			207.765	0.1093	
$D^{12}COOH$	35(7,29) - 34(8,26)	100632.62	2.01			538.567	0.1773	
$H^{12}COOH$	3(2, 2) - 4(1, 3)	100812.07	0.01			9.977	0.0140	
$H^{13}COOH$	35(5,31) - 34(6,28)	100959.46	8.31			524.073	0.1953	
$D^{12}COOH$	9(1, 8) - 8(2, 7)	101000.12	0.04			32.597	0.0787	
$H^{13}COOH$	25(3,22) - 25(3,23)	101030.04	0.08			263.026	0.5402	
$D^{12}COOH$	26(3,23) - 27(2,26)	101064.65	1.58			276.250	0.0125	
$H^{12}COOH$	41(6,35) - 40(7,34)	101075.50	0.03			724.660	0.2326	
$D^{12}COOH$	27(5,23) - 26(6,20)	101111.30	0.89			315.195	0.1368	
$D^{12}COOH$	33(5,28) - 33(5,29)	101246.79	0.12			454.531	1.0235	
$H^{12}COOH$	35(5,30) - 34(6,29)	101487.16	0.03			526.949	0.1988	
$H^{13}COOH$	9(3, 6) - 10(2, 9)	101534.00	0.54			49.662	0.0470	
$H^{13}COOH$	21(2,19) - 22(1,22)	101701.05	0.95			182.403	0.0110	
$H^{12}COOD$	12(4, 8) - 13(3,11)	101862.59	5.02			82.729	0.0594	
$H^{12}COOH$	15(4,11) - 16(3,14)	101865.44	0.02			122.084	0.0822	
$H^{13}COOH$	30(4,27) - 29(5,24)	102317.00	4.43			380.548	0.1631	
$D^{12}COOH$	31(6,26) - 30(7,23)	102327.52	1.35			419.446	0.1575	
$D^{12}COOH$	9(4, 6) - 10(3, 7)	102379.10	0.11			54.609	0.0369	
$D^{12}COOH$	5(3, 2) - 6(2, 5)	102390.99	0.06			21.632	0.0175	
$H^{13}COOH$	26(3,24) - 25(4,21)	102471.26	2.08			279.037	0.1242	
$D^{12}COOH$	38(11,28) - 39(10,29)	102616.68	1.87			730.369	0.1784	
$D^{12}COOH$	38(11,27) - 39(10,30)	102621.83	1.87			730.369	0.1784	
$D^{12}COOH$	21(3,19) - 20(4,16)	102794.11	0.51			180.608	0.0863	
$H^{12}COOD$	24(3,22) - 23(4,19)	102906.36	5.28			231.062	0.1075	
$H^{12}COOH$	34(4,30) - 34(4,31)	103423.42	0.04			483.442	0.6906	
$D^{12}COOH$	13(2,11) - 12(3,10)	103443.10	0.10			71.499	0.0799	
$H^{12}COOH$	32(7,26) - 33(6,27)	103521.59	0.04			501.344	0.1783	
$H^{12}COOD$	46(6,40) - 46(6,41)	103550.36	1.43			855.718	1.0797	
$D^{12}COOH$	27(3,25) - 26(4,22)	103630.16	1.34			287.470	0.0532	
$H^{12}COOD$	5(1, 5) - 4(1, 4)	103994.28	0.02			8.789	4.7988	
$H^{12}COOH$	36(5,32) - 35(6,29)	104174.64	0.03			553.398	0.2023	
$H^{13}COOH$	14(4,11) - 15(3,12)	104377.71	1.85			109.567	0.0752	
$D^{12}COOH$	35(7,28) - 34(8,27)	104378.86	2.04			538.561	0.1775	
$H^{12}COOH$	32(7,25) - 33(6,28)	104380.54	0.04			501.317	0.1783	
$H^{12}COOD$	7(3, 4) - 8(2, 7)	104409.76	1.97			33.425	0.0322	
$D^{12}COOH$	5(1, 5) - 4(1, 4)	104509.90	0.02	104509.91	0.08	8.544	4.7978	
$H^{12}COOH$	7(0, 7) - 6(1, 6)	104873.45	0.01			17.362	0.1278	
$D^{12}COOH$	9(4, 5) - 10(3, 8)	104892.79	0.11			54.527	0.0367	
$H^{13}COOH$	11(1,10) - 10(2, 9)	104963.02	0.09			49.662	0.0963	
$H^{12}COOD$	15(2,13) - 14(3,12)	105359.72	2.01			92.919	0.0956	
$H^{12}COOH$	29(4,25) - 28(5,24)	105509.50	0.02			360.590	0.1659	
$H^{12}COOD$	9(1, 8) - 9(0, 9)	105514.97	0.07			32.164	0.2228	
$H^{12}COOD$	32(3,30) - 31(4,27)	105816.89	5.60			394.810	0.0633	
$H^{12}COOD$	2(2, 0) - 3(1, 3)	105936.97	0.45			6.012	0.0056	
$D^{12}COOH$	3(1, 3) - 2(0, 2)	106463.80	0.02			2.200	0.0708	
$D^{12}COOH$	13(5, 9) - 14(4,10)	106561.42	0.18			102.351	0.0561	
$H^{13}COOH$	7(0, 7) - 6(1, 6)	106643.29	0.06			17.258	0.1290	
$H^{13}COOH$	2(1, 2) - 1(0, 1)	106716.66	0.06			0.748	0.0525	
$D^{12}COOH$	22(4,18) - 21(5,17)	106791.35	0.45			209.424	0.1140	
$H^{13}COOH$	42(5,37) - 42(5,38)	106967.21	0.52			733.314	0.8509	
$H^{12}COOH$	11(1,10) - 11(1,11)	107052.54	0.01			49.718	0.1810	
$H^{12}COOH$	18(2,16) - 18(2,17)	107638.24	0.02	107638.11	0.08	136.219	0.3525	[25A]
$D^{12}COOH$	13(5, 8) - 14(4,11)	107674.49	0.18			102.314	0.0560	
$H^{12}COOD$	5(0, 5) - 4(0, 4)	107793.29	0.02	107793.28	0.08	7.227	4.9923	
$H^{13}COOH$	5(1, 5) - 4(1, 4)	107835.06	0.02			9.347	4.7992	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOH$	52(6,46) - 52(6,47)	108063.41	0.07			1118.363	0.9821	
$H^{12}COOH$	5(1, 5) - 4(1, 4)	108126.71	0.01	108126.70	0.08	9.430	4.7993	[25A]
$H^{12}COOH$	31(4,28) - 30(5,25)	108248.33	0.03			405.257	0.1693	
$H^{12}COOH$	43(5,38) - 43(5,39)	108279.08	0.06			768.306	0.8340	
$H^{12}COOH$	27(3,25) - 26(4,22)	108309.90	0.03			300.091	0.1279	
$H^{12}COOD$	5(2, 4) - 4(2, 3)	108563.08	0.02			14.617	4.1995	
$D^{12}COOH$	5(0, 5) - 4(0, 4)	108661.39	0.02	108661.43	0.08	7.307	4.9856	
$H^{12}COOH$	2(1, 2) - 1(0, 1)	108759.40	0.01			0.750	0.0525	
$H^{12}COOD$	5(4, 2) - 4(4, 1)	108763.72	0.02	108763.77	0.08	36.721	1.8001	
$H^{12}COOD$	5(4, 1) - 4(4, 0)	108763.79	0.02	108763.77	0.08	36.721	1.8001	
$H^{12}COOD$	5(3, 3) - 4(3, 2)	108805.81	0.02	108805.84	0.08	23.832	3.2001	
$H^{12}COOD$	5(3, 2) - 4(3, 1)	108819.72	0.02	108819.76	0.08	23.832	3.2001	
$H^{12}COOH$	26(6,21) - 27(5,22)	108854.83	0.03			339.535	0.1441	
$D^{12}COOH$	9(1, 8) - 9(0, 9)	109008.67	0.03			32.330	0.1911	
$H^{13}COOH$	11(1,10) - 11(1,11)	109265.00	0.07			49.519	0.1817	
$H^{12}COOD$	30(3,27) - 31(2,30)	109275.60	2.69			358.668	0.0166	
$H^{12}COOD$	5(2, 3) - 4(2, 2)	109427.18	0.02			14.639	4.1996	
$D^{12}COOH$	40(6,34) - 40(6,35)	109618.32	0.55			664.057	1.1835	
$H^{13}COOH$	9(1, 8) - 9(0, 9)	109724.25	0.08			33.323	0.2419	
$D^{12}COOH$	15(2,13) - 15(2,14)	109832.30	0.04			93.475	0.4077	
$D^{12}COOH$	5(2, 4) - 4(2, 3)	109897.64	0.02	109897.68	0.08	13.571	4.1991	
$H^{13}COOH$	36(3,34) - 35(4,31)	109979.71	3.73			512.607	0.0704	
$H^{12}COOD$	20(2,18) - 21(1,21)	110093.72	1.25			160.295	0.0081	
$H^{12}COOH$	37(3,35) - 36(4,32)	110174.55	0.17			541.648	0.0720	
$D^{12}COOH$	5(4, 2) - 4(4, 1)	110216.64	0.02	110216.80	0.08	32.264	1.8002	
$D^{12}COOH$	5(4, 1) - 4(4, 0)	110216.85	0.02	110216.80	0.08	32.264	1.8002	
$D^{12}COOH$	17(6,12) - 18(5,13)	110219.18	0.29			165.009	0.0753	
$D^{12}COOH$	5(3, 3) - 4(3, 2)	110284.73	0.02	110284.78	0.08	21.367	3.2002	
$D^{12}COOH$	5(3, 2) - 4(3, 1)	110315.99	0.02	110316.02	0.08	21.367	3.2002	
$H^{12}COOH$	9(1, 8) - 9(0, 9)	110340.05	0.01	110340.07	0.08	33.404	0.2459	[25A]
$H^{12}COOH$	9(3, 6) - 10(2, 9)	110413.59	0.02			49.994	0.0472	
$H^{12}COOH$	26(3,23) - 26(3,24)	110427.66	0.02	110427.70	0.08	283.500	0.5150	[25A]
$H^{12}COOH$	26(6,20) - 27(5,23)	110640.81	0.03			339.477	0.1440	
$D^{12}COOH$	17(6,11) - 18(5,14)	110674.48	0.29			164.994	0.0753	
$D^{12}COOH$	27(4,23) - 27(4,24)	110744.46	0.06			304.419	0.8000	
$H^{12}COOD$	7(0, 7) - 6(1, 6)	110947.48	0.05			16.417	0.1345	
$D^{12}COOH$	5(2, 3) - 4(2, 2)	111289.24	0.02	111289.27	0.08	13.607	4.1993	
$H^{13}COOH$	5(0, 5) - 4(0, 4)	111508.64	0.02	111508.63	0.08	7.466	4.9950	[26A]
$H^{13}COOH$	14(4,10) - 15(3,13)	111555.21	1.84			109.333	0.0747	
$D^{12}COOH$	31(6,25) - 30(7,24)	111624.43	1.37			419.431	0.1581	
$D^{12}COOH$	22(3,20) - 21(4,17)	111659.88	0.62			196.395	0.0835	
$H^{12}COOH$	5(0, 5) - 4(0, 4)	111746.78	0.01	111746.79	0.08	7.480	4.9955	[25A]
$H^{13}COOH$	8(3, 6) - 9(2, 7)	111918.29	0.55			42.555	0.0408	
$H^{13}COOH$	3(2, 1) - 4(1, 4)	111962.09	0.09			9.347	0.0123	
$H^{13}COOH$	5(2, 4) - 4(2, 3)	112088.79	0.02	112088.78	0.08	16.069	4.1997	[26A]
$H^{12}COOH$	23(3,20) - 22(4,19)	112095.68	0.02	112095.64	0.08	225.625	0.1358	
$H^{13}COOH$	25(6,20) - 26(5,21)	112136.74	0.09			317.195	0.1364	
$H^{13}COOH$	5(4, 2) - 4(4, 1)	112243.87	0.02			41.822	1.8001	
$H^{13}COOH$	5(4, 1) - 4(4, 0)	112243.91	0.02			41.822	1.8001	
$H^{13}COOH$	5(3, 3) - 4(3, 2)	112273.59	0.02			26.804	3.2001	
$H^{13}COOH$	5(3, 2) - 4(3, 1)	112281.95	0.02			26.804	3.2001	
$H^{12}COOH$	5(2, 4) - 4(2, 3)	112287.14	0.01	112287.12	0.08	16.337	4.1997	[25A]
$H^{12}COOD$	31(4,27) - 31(4,28)	112383.18	0.19			391.061	0.7200	
$H^{12}COOH$	5(4, 2) - 4(4, 1)	112432.29	0.01	112432.30	0.08	42.855	1.8001	[25A]
$H^{12}COOH$	5(4, 1) - 4(4, 0)	112432.31	0.01	112432.30	0.08	42.855	1.8001	[25A]
$H^{12}COOH$	5(3, 3) - 4(3, 2)	112459.61	0.01	112459.60	0.08	27.391	3.2001	[25A]
$H^{12}COOH$	5(3, 2) - 4(3, 1)	112467.00	0.01	112467.00	0.08	27.391	3.2001	[25A]
$H^{13}COOH$	5(2, 3) - 4(2, 2)	112737.99	0.02	112737.95	0.08	16.085	4.1997	[26A]
$D^{12}COOH$	26(3,24) - 25(4,21)	112813.35	1.16			267.631	0.0601	
$H^{12}COOH$	5(2, 3) - 4(2, 2)	112891.43	0.01	112891.41	0.08	16.352	4.1997	[25A]
$H^{12}COOD$	5(1, 4) - 4(1, 3)	112940.32	0.02			9.386	4.7987	
$D^{12}COOH$	10(1, 9) - 10(1,10)	112976.53	0.04			39.775	0.2073	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'\ (K'_{-1}, K'_{+1})$–$J\ (K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{13}COOH$	18(2,16) - 18(2,17)	113173.61	0.07			135.688	0.3498	
$H^{12}COOD$	25(3,23) - 24(4,20)	113279.99	5.31			248.780	0.1054	
$D^{12}COOH$	21(7,15) - 22(6,16)	113586.22	0.45			242.569	0.0945	
$D^{12}COOH$	18(2,16) - 19(1,19)	113651.78	0.68			132.249	0.0056	
$H^{13}COOH$	25(6,19) - 26(5,22)	113679.31	8.07			317.145	0.1363	
$D^{12}COOH$	24(4,21) - 23(5,18)	113725.74	0.70			242.958	0.1175	
$D^{12}COOH$	21(7,14) - 22(6,17)	113763.46	0.45			242.564	0.0945	
$H^{12}COOH$	20(5,16) - 21(4,17)	113780.64	0.03			209.159	0.1097	
$H^{12}COOH$	17(2,15) - 16(3,14)	114198.57	0.02	114198.63	0.08	122.084	0.1117	[25A]
$D^{12}COOH$	21(3,18) - 21(3,19)	114529.46	0.05			184.037	0.5961	
$H^{12}COOH$	22(2,20) - 23(1,23)	114644.62	0.11			199.359	0.0108	
$H^{13}COOH$	27(3,25) - 26(4,22)	114770.96	2.15			298.783	0.1230	
$H^{12}COOD$	17(2,15) - 17(2,16)	114859.38	0.16			117.387	0.3644	
$D^{12}COOH$	5(1, 4) - 4(1, 3)	114977.50	0.02	114977.49	0.08	9.244	4.7974	
$D^{12}COOH$	47(7,40) - 47(7,41)	115041.97	1.74			912.941	1.3458	
$H^{12}COOD$	3(1, 3) - 2(0, 2)	115069.20	0.05			2.173	0.0706	
$H^{12}COOH$	42(6,37) - 41(7,34)	115421.47	0.04			755.585	0.2378	
$H^{13}COOH$	5(1, 4) - 4(1, 3)	116196.72	0.03	116196.75	0.08	9.906	4.7992	[26A]
$H^{12}COOD$	11(1,10) - 11(1,11)	116281.30	0.15			47.493	0.1857	
$H^{12}COOH$	5(1, 4) - 4(1, 3)	116311.48	0.01	116311.48	0.08	9.977	4.7992	[25A]
$H^{12}COOD$	31(3,29) - 30(4,26)	116400.69	5.53			371.583	0.0703	
$D^{12}COOH$	25(8,18) - 26(7,19)	116804.06	0.72			335.019	0.1136	
$H^{12}COOH$	43(9,35) - 44(8,36)	116805.60	0.06			885.159	0.2394	
$D^{12}COOH$	25(8,17) - 26(7,20)	116870.71	0.72			335.017	0.1136	
$H^{13}COOH$	34(4,30) - 34(4,31)	116891.83	0.17			481.726	0.6720	
$H^{12}COOH$	43(9,34) - 44(8,37)	116931.17	0.06			885.155	0.2394	
$D^{12}COOH$	9(2, 7) - 9(1, 8)	116994.28	0.03			35.966	0.2573	
$H^{12}COOH$	20(5,15) - 21(4,18)	117298.39	0.03			209.044	0.1095	
$H^{12}COOH$	3(2, 1) - 4(1, 4)	117348.08	0.01			9.430	0.0123	
$D^{12}COOH$	23(3,21) - 22(4,18)	117365.53	0.73			212.987	0.0791	
$D^{12}COOH$	10(2, 8) - 10(1, 9)	117503.68	0.03			43.543	0.2933	
$H^{12}COOH$	14(4,11) - 15(3,12)	118009.67	0.02			110.257	0.0753	
$D^{12}COOH$	8(2, 6) - 8(1, 7)	118049.82	0.03			29.124	0.2195	
$D^{12}COOH$	25(3,23) - 24(4,20)	118126.87	1.00			248.602	0.0669	
$H^{12}COOD$	24(3,21) - 24(3,22)	118364.83	0.22			234.494	0.5347	
$H^{12}COOD$	10(1, 9) - 10(0,10)	118798.45	0.10			39.200	0.2248	
$D^{12}COOH$	44(9,36) - 43(10,33)	119105.10	5.11			853.147	0.2228	
$D^{12}COOH$	24(3,22) - 23(4,19)	119599.11	0.86			230.388	0.0734	
$H^{12}COOD$	6(3, 4) - 7(2, 5)	119767.69	1.97			27.823	0.0252	
$D^{12}COOH$	11(2, 9) - 11(1,10)	119860.43	0.03			51.845	0.3252	
$D^{12}COOH$	44(9,35) - 43(10,34)	119901.51	5.15			853.146	0.2228	
$D^{12}COOH$	29(9,21) - 30(8,22)	119945.63	1.13			442.342	0.1328	
$H^{12}COOH$	28(3,26) - 27(4,23)	119967.65	0.04			320.633	0.1262	
$D^{12}COOH$	29(9,20) - 30(8,23)	119970.05	1.13			442.341	0.1328	
$H^{13}COOH$	26(3,23) - 26(3,24)	120101.84	0.08	120101.84	0.08	282.455	0.5057	
$D^{12}COOH$	7(2, 5) - 7(1, 6)	120339.57	0.03			23.024	0.1819	
$H^{12}COOD$	11(4, 8) - 12(3, 9)	120557.84	5.01			73.374	0.0521	
$H^{12}COOD$	39(5,34) - 39(5,35)	120728.09	0.51			615.451	0.8678	
$H^{12}COOD$	16(5,12) - 17(4,13)	120769.56	9.70			140.804	0.0790	
$H^{13}COOH$	2(2, 1) - 3(1, 2)	120770.82	0.08			6.803	0.0061	
$D^{12}COOH$	37(4,34) - 36(5,31)	120833.74	4.74			538.255	0.0525	
$H^{13}COOH$	19(5,15) - 20(4,16)	121007.01	4.26			192.057	0.1021	
$H^{12}COOD$	26(3,24) - 25(4,21)	121191.71	5.34			267.278	0.1019	
$D^{12}COOH$	4(3, 2) - 5(2, 3)	121361.84	0.06			17.319	0.0107	
$H^{13}COOH$	10(1, 9) - 10(0,10)	121570.02	0.09			40.639	0.2480	
$H^{12}COOH$	8(3, 6) - 9(2, 7)	121655.23	0.02			42.848	0.0407	
$H^{12}COOH$	10(1, 9) - 10(0,10)	121807.67	0.01	121807.67	0.08	40.744	0.2530	[25A]
$D^{12}COOH$	7(0, 7) - 6(1, 6)	121848.71	0.02			16.207	0.1444	
$H^{13}COOH$	35(3,33) - 34(4,30)	122179.64	3.45			485.625	0.0774	
$H^{12}COOH$	37(8,30) - 38(7,31)	122240.57	0.05			665.149	0.2052	
$H^{13}COOH$	31(4,28) - 30(5,25)	122366.59	4.49			403.209	0.1664	
$H^{12}COOD$	16(5,11) - 17(4,14)	122423.95	9.70			140.750	0.0789	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{13}COOH$	8(3, 5) - 9(2, 8)	122490.16	0.55			42.208	0.0398	
$H^{12}COOH$	37(8,29) - 38(7,32)	122519.65	0.05			665.140	0.2052	
$H^{12}COOH$	35(4,31) - 35(4,32)	122593.13	0.04			509.779	0.6509	
$H^{12}COOH$	36(3,34) - 35(4,31)	122707.50	0.14			513.869	0.0791	
$D^{12}COOH$	40(8,33) - 39(9,30)	122707.85	3.55			701.415	0.2033	
$D^{12}COOH$	27(5,22) - 26(6,21)	122708.67	0.90			315.154	0.1389	
$H^{13}COOH$	22(2,20) - 23(1,23)	122820.09	1.14			198.660	0.0098	
$D^{12}COOH$	33(10,24) - 34(9,25)	123048.14	1.73			564.524	0.1519	
$D^{12}COOH$	33(10,23) - 34(9,26)	123056.90	1.73			564.523	0.1519	
$D^{12}COOH$	6(2, 4) - 6(1, 5)	123490.25	0.03			17.674	0.1462	
$H^{12}COOD$	30(3,28) - 29(4,25)	123734.59	5.48			349.142	0.0775	
$H^{12}COOD$	11(4, 7) - 12(3,10)	123817.41	5.01			73.267	0.0519	
$D^{12}COOH$	4(3, 1) - 5(2, 4)	123820.33	0.07			17.237	0.0106	
$H^{13}COOH$	19(5,14) - 20(4,17)	123864.63	4.24			191.964	0.1019	
$D^{12}COOH$	28(5,24) - 27(6,21)	123906.80	1.09			335.248	0.1419	
$D^{12}COOH$	34(5,29) - 34(5,30)	124057.60	0.23			479.749	0.9529	
$H^{13}COOH$	36(5,32) - 35(6,29)	124158.20	8.37			550.456	0.2004	
$D^{12}COOH$	18(3,15) - 17(4,14)	124229.57	0.26			137.835	0.0990	
$D^{12}COOH$	12(2,10) - 12(1,11)	124302.61	0.03	124302.68	0.08	60.861	0.3515	
$H^{12}COOD$	47(6,41) - 47(6,42)	124324.93	2.02			890.118	1.0194	
$H^{12}COOH$	14(4,10) - 15(3,13)	124380.07	0.02			110.050	0.0749	
$D^{12}COOH$	4(1, 4) - 3(0, 3)	124419.92	0.03			4.394	0.0904	
$H^{12}COOD$	6(1, 6) - 5(1, 5)	124681.20	0.02	124681.25	0.08	12.258	5.8312	
$D^{12}COOH$	40(8,32) - 39(9,31)	124823.78	3.58			701.412	0.2034	
$H^{13}COOH$	28(3,26) - 27(4,23)	124981.24	2.24			319.323	0.1205	
$H^{12}COOD$	6(3, 3) - 7(2, 6)	125196.05	1.97			27.644	0.0248	
$D^{12}COOH$	6(1, 6) - 5(1, 5)	125237.66	0.02			12.030	5.8295	
$D^{12}COOH$	10(1, 9) - 10(0,10)	125471.69	0.03	125471.89	0.08	39.358	0.1883	
$D^{12}COOH$	36(7,30) - 35(8,27)	125578.64	2.42			564.505	0.1837	
$D^{12}COOH$	8(4, 5) - 9(3, 6)	125888.98	0.12			47.195	0.0294	
$H^{12}COOH$	12(1,11) - 12(1,12)	126006.79	0.02			58.323	0.1689	
$D^{12}COOH$	37(11,27) - 38(10,28)	126131.92	2.61			701.546	0.1710	
$D^{12}COOH$	37(11,26) - 38(10,29)	126135.00	2.61			701.546	0.1710	
$H^{13}COOH$	17(2,15) - 16(3,14)	126218.27	0.59			121.348	0.1129	
$H^{12}COOD$	27(3,25) - 26(4,22)	126387.60	5.37			286.560	0.0971	
$H^{13}COOH$	35(5,30) - 34(6,29)	126473.36	8.50			524.021	0.1978	
$H^{12}COOH$	2(2, 1) - 3(1, 2)	126495.77	0.01			6.871	0.0061	
$H^{13}COOH$	3(1, 3) - 2(0, 2)	126650.05	0.06			2.244	0.0705	
$D^{12}COOH$	32(6,27) - 31(7,24)	126672.35	1.64			442.441	0.1634	
$H^{12}COOH$	19(2,17) - 19(2,18)	126809.31	0.02			150.273	0.3294	
$H^{13}COOH$	43(5,38) - 43(5,39)	126860.12	0.53			765.705	0.8050	
$H^{12}COOD$	11(1,10) - 10(2, 9)	127045.10	0.48			47.134	0.1035	
$D^{12}COOH$	5(2, 3) - 5(1, 4)	127105.31	0.03	127105.36	0.08	13.079	0.1134	
$D^{12}COOH$	8(4, 4) - 9(3, 7)	127251.82	0.13			47.150	0.0294	
$H^{13}COOH$	29(4,25) - 28(5,24)	127274.58	4.51			358.559	0.1653	
$H^{12}COOH$	37(5,33) - 36(6,30)	127358.20	0.04			580.574	0.2074	
$H^{12}COOH$	53(6,47) - 53(6,48)	127640.14	0.09			1158.381	0.9346	
$H^{12}COOH$	31(7,25) - 32(6,26)	127749.09	0.04			476.464	0.1710	
$H^{12}COOD$	29(3,27) - 28(4,24)	127801.08	5.44			327.490	0.0846	
$H^{12}COOH$	44(5,39) - 44(5,40)	127989.55	0.08			801.496	0.7902	
$H^{12}COOH$	32(4,29) - 31(5,26)	128109.68	0.04			428.710	0.1724	
$H^{12}COOH$	31(7,24) - 32(6,27)	128349.30	0.04			476.445	0.1710	
$H^{13}COOH$	12(1,11) - 12(1,12)	128558.38	0.09	128558.42	0.08	58.097	0.1698	
$H^{12}COOD$	28(3,26) - 27(4,23)	128647.89	5.40			306.630	0.0912	
$H^{12}COOH$	3(1, 3) - 2(0, 2)	128783.93	0.01			2.248	0.0704	
$H^{12}COOH$	42(6,36) - 41(7,35)	128789.67	0.04			755.560	0.2388	
$H^{12}COOD$	6(0, 6) - 5(0, 5)	128888.49	0.02	128888.51	0.08	10.823	5.9869	
$D^{12}COOH$	41(12,30) - 42(11,31)	129209.49	3.83			853.390	0.1901	
$D^{12}COOH$	41(12,29) - 42(11,32)	129210.56	3.83			853.390	0.1901	
$H^{13}COOH$	13(4,10) - 14(3,11)	129300.24	1.85			98.227	0.0676	
$H^{13}COOH$	6(1, 6) - 5(1, 5)	129316.29	0.03	129316.37	0.08	12.944	5.8320	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{12}COOH$	27(3,24) - 28(2,27)	129497.71	1.83			295.833	0.0113	
$H^{12}COOH$	29(3,27) - 28(4,24)	129514.32	0.04			341.972	0.1233	
$H^{12}COOH$	12(1,11) - 11(2,10)	129599.39	0.01			58.203	0.1110	
$H^{13}COOH$	23(3,20) - 22(4,19)	129666.10	1.96			224.324	0.1361	
$D^{12}COOH$	6(0, 6) - 5(0, 5)	129668.80	0.02	129668.67	0.08	10.931	5.9759	[26A]
$H^{12}COOH$	6(1, 6) - 5(1, 5)	129671.81	0.01	129671.75	0.08	13.037	5.8321	[25A]
$D^{12}COOH$	12(5, 8) - 13(4, 9)	129913.25	0.22			91.988	0.0486	
$H^{12}COOH$	27(3,24) - 27(3,25)	130168.65	0.03	130168.72	0.08	303.704	0.4834	[25A]
$H^{12}COOD$	6(2, 5) - 5(2, 4)	130193.29	0.02	130193.24	0.08	18.238	5.3323	[26A]
$H^{12}COOD$	6(5, 2) - 5(5, 1)	130512.82	0.02	130512.69	0.08	56.916	1.8334	[26A]
$H^{12}COOD$	6(5, 1) - 5(5, 0)	130512.82	0.02	130512.69	0.08	56.916	1.8334	[26A]
$D^{12}COOH$	12(5, 7) - 13(4,10)	130535.94	0.22			91.967	0.0485	
$H^{12}COOD$	6(4, 3) - 5(4, 2)	130545.70	0.02			40.349	3.3335	
$H^{12}COOD$	6(4, 2) - 5(4, 1)	130546.00	0.02			40.349	3.3335	
$H^{12}COOD$	21(3,18) - 20(4,17)	130608.63	5.15			182.337	0.1213	
$H^{12}COOD$	6(3, 4) - 5(3, 3)	130614.29	0.02	130614.48	0.08	27.461	4.5001	[26A]
$H^{12}COOD$	6(3, 3) - 5(3, 2)	130651.31	0.02	130651.42	0.08	27.462	4.5001	[26A]
$D^{12}COOH$	4(2, 2) - 4(1, 3)	130793.57	0.03			9.244	0.0839	
$H^{13}COOH$	2(2, 0) - 3(1, 3)	130848.90	0.08			6.468	0.0057	
$H^{12}COOH$	8(0, 8) - 7(1, 7)	130980.00	0.01	130980.19	0.08	22.405	0.1552	[25A]
$D^{12}COOH$	36(7,29) - 35(8,28)	130996.31	2.46			564.496	0.1840	
$D^{12}COOH$	13(2,11) - 13(1,12)	131028.72	0.04			70.578	0.3708	
$H^{12}COOH$	36(5,31) - 35(6,30)	131035.17	0.04			553.343	0.2050	
$D^{12}COOH$	10(1, 9) - 9(2, 8)	131334.86	0.06			39.162	0.0972	
$H^{13}COOH$	34(3,32) - 33(4,29)	131386.83	3.20			459.446	0.0847	
$H^{12}COOH$	8(3, 5) - 9(2, 8)	131513.94	0.02			42.525	0.0399	
$D^{12}COOH$	16(2,14) - 16(2,15)	131661.48	0.05	131661.46	0.08	104.975	0.3803	
$H^{12}COOD$	6(2, 4) - 5(2, 3)	131690.76	0.02	131690.58	0.08	18.289	5.3326	[26A]
$D^{12}COOH$	6(2, 5) - 5(2, 4)	131745.33	0.02	131745.38	0.08	17.237	5.3313	[26A]
$D^{12}COOH$	25(4,22) - 24(5,19)	131949.04	0.85			260.851	0.1199	
$D^{12}COOH$	6(5, 2) - 5(5, 1)	132249.91	0.02	132249.75	0.08	49.947	1.8336	[26A]
$D^{12}COOH$	6(5, 1) - 5(5, 0)	132249.91	0.02	132249.75	0.08	49.947	1.8336	[26A]
$D^{12}COOH$	6(4, 3) - 5(4, 2)	132309.17	0.02	132309.13	0.08	35.940	3.3337	[26A]
$D^{12}COOH$	6(4, 2) - 5(4, 1)	132310.11	0.02	132310.03	0.08	35.940	3.3337	[26A]
$H^{12}COOH$	35(3,33) - 34(4,30)	132323.17	0.12			486.891	0.0864	
$D^{12}COOH$	6(3, 4) - 5(3, 3)	132414.33	0.02	132414.24	0.08	25.046	4.5002	[26A]
$D^{12}COOH$	6(3, 3) - 5(3, 2)	132497.44	0.02	132497.46	0.08	25.047	4.5002	[26A]
$H^{12}COOD$	21(2,19) - 22(1,22)	132562.79	1.51			175.250	0.0072	
$H^{13}COOH$	8(0, 8) - 7(1, 7)	132687.04	0.06			22.287	0.1568	
$H^{13}COOH$	29(3,27) - 28(4,24)	132876.89	2.35			340.662	0.1167	
$H^{13}COOH$	19(2,17) - 19(2,18)	133029.70	0.08	133029.63	0.08	149.705	0.3274	
$H^{12}COOH$	25(6,20) - 26(5,21)	133159.93	0.04			319.165	0.1367	
$H^{12}COOD$	4(1, 4) - 3(0, 3)	133305.44	0.05			4.342	0.0896	
$H^{13}COOH$	6(0, 6) - 5(0, 5)	133457.84	0.03	133457.83	0.08	11.186	5.9914	[26A]
$D^{12}COOH$	16(6,11) - 17(5,12)	133540.19	0.36			151.691	0.0678	
$H^{12}COOH$	6(0, 6) - 5(0, 5)	133767.18	0.01	133767.07	0.08	11.208	5.9922	[25A]
$D^{12}COOH$	41(6,35) - 41(6,36)	133784.11	0.89			694.546	1.1064	
$D^{12}COOH$	16(6,10) - 17(5,13)	133799.44	0.36			151.683	0.0678	
$H^{12}COOD$	32(4,28) - 32(4,29)	133888.65	0.28			414.352	0.6749	
$H^{12}COOD$	11(1,10) - 11(0,11)	133930.12	0.13			46.904	0.2237	
$H^{13}COOH$	13(4, 9) - 14(3,12)	134125.79	1.84			98.070	0.0673	
$D^{12}COOH$	6(2, 4) - 5(2, 3)	134136.94	0.02	134136.96	0.08	17.319	5.3323	[26A]
$D^{12}COOH$	3(2, 1) - 3(1, 2)	134198.39	0.03			6.172	0.0571	
$D^{12}COOH$	28(4,24) - 28(4,25)	134218.19	0.10	134218.14	0.08	325.076	0.7441	
$D^{12}COOH$	11(1,10) - 11(1,11)	134255.44	0.05			47.367	0.1958	
$H^{12}COOH$	25(6,19) - 26(5,22)	134398.23	0.04			319.125	0.1366	
$H^{13}COOH$	6(2, 5) - 5(2, 4)	134444.21	0.03	134444.24	0.08	19.808	5.3327	
$H^{12}COOH$	6(2, 5) - 5(2, 4)	134686.36	0.01	134686.37	0.08	20.082	5.3327	[25A]
$H^{13}COOH$	6(5, 2) - 5(5, 1)	134693.63	0.03	134693.66	0.08	64.867	1.8334	
$H^{13}COOH$	6(5, 1) - 5(5, 0)	134693.63	0.03	134693.66	0.08	64.867	1.8334	
$H^{13}COOH$	6(4, 3) - 5(4, 2)	134713.96	0.03	134714.07	0.08	45.566	3.3335	[26A]
$H^{13}COOH$	6(4, 2) - 5(4, 1)	134714.11	0.03	134714.07	0.08	45.566	3.3335	[26A]
$H^{13}COOH$	6(3, 4) - 5(3, 3)	134764.59	0.03	134764.58	0.08	30.549	4.5001	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{13}COOH$	6(3, 3) - 5(3, 2)	134786.84	0.03	134786.79	0.08	30.550	4.5001	
$H^{12}COOH$	6(5, 2) - 5(5, 1)	134920.24	0.01	134920.24	0.08	66.480	1.8334	[25A]
$H^{12}COOH$	6(5, 1) - 5(5, 0)	134920.24	0.01	134920.24	0.08	66.480	1.8334	[25A]
$H^{12}COOH$	6(4, 3) - 5(4, 2)	134938.38	0.01	134938.48	0.08	46.605	3.3334	[25A]
$H^{12}COOH$	6(4, 2) - 5(4, 1)	134938.50	0.01	134938.48	0.08	46.605	3.3334	[25A]
$H^{12}COOH$	11(1,10) - 11(0,11)	134941.13	0.01			48.787	0.2564	
$H^{12}COOH$	6(3, 4) - 5(3, 3)	134985.36	0.01	134985.63	0.08	31.142	4.5001	[25A]
$H^{12}COOH$	6(3, 3) - 5(3, 2)	135005.04	0.01	135004.87	0.08	31.142	4.5001	[25A]
$H^{13}COOH$	11(1,10) - 11(0,11)	135129.96	0.09			48.656	0.2505	
$H^{12}COOD$	6(1, 5) - 5(1, 4)	135394.99	0.02	135394.82	0.08	13.154	5.8308	[26A]
$H^{12}COOD$	18(2,16) - 18(2,17)	135506.97	0.21			130.213	0.3412	
$H^{13}COOH$	6(2, 4) - 5(2, 3)	135573.05	0.03	135573.05	0.08	19.846	5.3328	[26A]
$H^{12}COOH$	6(2, 4) - 5(2, 3)	135737.75	0.01	135737.70	0.08	20.118	5.3328	[2kA]
$H^{13}COOH$	12(1,11) - 11(2,10)	135832.89	0.10			57.855	0.1129	
$H^{12}COOD$	8(0, 8) - 7(1, 7)	136012.66	0.05			21.264	0.1642	
$H^{13}COOH$	24(6,19) - 25(5,20)	136323.64	8.07			297.611	0.1290	
$H^{12}COOH$	2(2, 0) - 3(1, 3)	136358.16	0.01			6.543	0.0057	
$H^{12}COOD$	12(1,11) - 12(1,12)	136496.05	0.20			55.750	0.1750	
$H^{12}COOH$	23(2,21) - 24(1,24)	136565.42	0.14			216.369	0.0096	
$H^{12}COOH$	30(3,28) - 29(4,25)	136738.83	0.05			364.110	0.1191	
$D^{12}COOH$	20(7,14) - 21(6,15)	136926.77	0.58			226.297	0.0870	
$H^{12}COOD$	31(3,28) - 32(2,31)	136948.35	2.80			380.925	0.0152	
$D^{12}COOH$	2(2, 0) - 2(1, 1)	137020.12	0.03			3.866	0.0312	
$D^{12}COOH$	14(2,12) - 13(3,11)	137026.48	0.14			81.092	0.0922	
$D^{12}COOH$	20(7,13) - 21(6,16)	137028.86	0.58			226.293	0.0870	
$H^{13}COOH$	7(3, 5) - 8(2, 6)	137101.17	0.55			35.717	0.0329	
$H^{13}COOH$	24(6,18) - 25(5,21)	137377.29	8.06			297.577	0.1290	
$H^{12}COOH$	30(4,26) - 29(5,25)	137515.52	0.03			382.464	0.1725	
$H^{13}COOH$	33(3,31) - 32(4,28)	137563.42	2.98			434.073	0.0920	
$D^{12}COOH$	22(3,19) - 22(3,20)	137648.18	0.06			200.120	0.5552	
$D^{12}COOH$	6(1, 5) - 5(1, 4)	137752.01	0.02	137752.14	0.08	13.079	5.8283	[26A]
$H^{13}COOH$	35(4,31) - 35(4,32)	137792.73	0.16			508.010	0.6332	
$D^{12}COOH$	19(2,17) - 20(1,20)	137910.95	0.82			145.858	0.0049	
$H^{12}COOH$	19(5,15) - 20(4,16)	138240.40	0.03	138240.43	0.08	193.300	0.1022	[25A]
$H^{13}COOH$	30(3,28) - 29(4,25)	138248.40	2.48			362.804	0.1117	
$H^{12}COOD$	16(2,14) - 15(3,13)	138298.78	2.01			103.837	0.1073	
$H^{12}COOD$	11(2, 9) - 11(1,10)	138448.08	0.47			51.372	0.3152	
$H^{12}COOH$	34(3,32) - 33(4,29)	138980.13	0.10			460.720	0.0937	
$H^{12}COOD$	10(2, 8) - 10(1, 9)	138983.97	0.47			43.163	0.2780	
$H^{12}COOD$	12(2,10) - 12(1,11)	139317.22	0.46			60.303	0.3502	
$H^{13}COOH$	6(1, 5) - 5(1, 4)	139337.01	0.03	139337.06	0.08	13.782	5.8317	[26A]
$D^{12}COOH$	23(4,19) - 22(5,18)	139437.97	0.57			225.737	0.1211	
$H^{13}COOH$	6(1, 5) - 5(1, 4)	139481.68	0.01	139481.72	0.08	13.857	5.8319	[25A]
$D^{12}COOH$	32(6,26) - 31(7,25)	139861.06	1.66			442.417	0.1645	
$H^{12}COOH$	43(6,38) - 42(7,35)	139932.95	0.05			787.256	0.2434	
$H^{12}COOD$	25(3,22) - 25(3,23)	139963.63	0.30			252.559	0.5008	
$D^{12}COOH$	48(7,41) - 48(7,42)	140120.03	2.54			948.692	1.2624	
$D^{12}COOH$	24(8,17) - 25(7,18)	140173.92	0.92			315.791	0.1062	
$D^{12}COOH$	14(2,12) - 14(1,13)	140194.76	0.04	140194.89	0.08	80.986	0.3828	
$D^{12}COOH$	24(8,16) - 25(7,19)	140212.63	0.92			315.790	0.1062	
$H^{12}COOH$	19(5,14) - 20(4,17)	140651.26	0.03			193.221	0.1021	
$H^{12}COOD$	9(2, 7) - 9(1, 8)	140697.83	0.47			35.684	0.2403	
$H^{13}COOH$	32(3,30) - 31(4,27)	140718.96	2.79			409.508	0.0992	
$H^{12}COOH$	42(9,34) - 43(8,35)	140817.45	0.07			852.039	0.2322	
$H^{12}COOH$	42(9,33) - 43(8,36)	140905.31	0.07			852.037	0.2322	
$H^{13}COOH$	31(3,29) - 30(4,26)	140911.98	2.62			385.752	0.1058	
$H^{13}COOH$	27(3,24) - 27(3,25)	141000.98	0.10			302.611	0.4751	
$H^{13}COOH$	32(4,29) - 31(5,26)	141406.95	4.56			426.646	0.1689	
$H^{12}COOH$	31(3,29) - 30(4,26)	141447.34	0.06			387.051	0.1139	
$D^{12}COOH$	5(1, 5) - 4(0, 4)	141588.96	0.03			7.307	0.1119	
$H^{12}COOD$	13(2,11) - 13(1,12)	141788.67	0.46			69.950	0.3818	
$D^{12}COOH$	36(4,33) - 35(5,30)	142362.31	4.07			510.673	0.0595	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOH$	33(3,31) - 32(4,28)	142680.62	0.08			435.355	0.1009	
$H^{12}COOH$	13(4,10) - 14(3,11)	142744.04	0.02			98.909	0.0676	
$D^{12}COOH$	2(2, 1) - 2(1, 2)	143249.82	0.04			3.655	0.0292	
$H^{12}COOD$	5(3, 3) - 6(2, 4)	143291.08	1.96			22.682	0.0177	
$H^{12}COOD$	8(2, 6) - 8(1, 7)	143333.49	0.46			28.939	0.2035	
$D^{12}COOH$	28(9,20) - 29(8,21)	143338.25	1.45			420.162	0.1253	
$D^{12}COOH$	28(9,19) - 29(8,22)	143352.52	1.45			420.162	0.1253	
$H^{12}COOD$	40(5,35) - 40(5,36)	143418.90	0.80			644.662	0.8168	
$H^{12}COOH$	32(3,30) - 31(4,27)	143472.29	0.07			410.799	0.1077	
$H^{12}COOH$	36(4,32) - 36(4,33)	143756.45	0.06			536.852	0.6144	
$H^{12}COOD$	10(4, 7) - 11(3, 8)	143870.85	5.00			64.600	0.0444	
$H^{13}COOH$	7(3, 4) - 8(2, 7)	143880.12	0.55			35.494	0.0324	
$D^{12}COOH$	11(1,10) - 11(0,11)	143901.35	0.05	143901.35	0.08	47.045	0.1840	
$H^{12}COOD$	15(5,11) - 16(4,12)	143953.31	9.68			128.391	0.0714	
$D^{12}COOH$	45(9,37) - 44(10,34)	144296.24	5.99			885.718	0.2293	
$D^{12}COOH$	3(3, 1) - 4(2, 2)	144467.17	0.07			13.607	0.0045	
$H^{12}COOD$	15(5,10) - 16(4,13)	144984.32	9.68			128.357	0.0713	
$H^{13}COOH$	18(5,14) - 19(4,15)	145249.75	4.25			176.983	0.0945	
$H^{12}COOD$	7(1, 7) - 6(1, 6)	145312.81	0.02	145312.87	0.08	16.417	6.8538	
$D^{12}COOH$	45(9,36) - 44(10,35)	145464.04	6.03			885.716	0.2294	
$D^{12}COOH$	3(3, 0) - 4(2, 3)	145525.12	0.07			13.571	0.0045	
$H^{13}COOH$	23(2,21) - 24(1,24)	145581.28	1.36			215.610	0.0088	
$H^{13}COOH$	4(1, 4) - 3(0, 3)	145799.98	0.06			4.484	0.0892	
$H^{12}COOD$	10(4, 6) - 11(3, 9)	145838.56	5.00			64.535	0.0443	
$D^{12}COOH$	7(1, 7) - 6(1, 6)	145882.87	0.02	145882.95	0.08	16.207	6.8511	
$H^{12}COOD$	14(2,12) - 14(1,13)	146032.76	0.46			80.304	0.4085	
$D^{12}COOH$	29(5,25) - 28(6,22)	146071.12	1.31			356.065	0.1464	
$H^{12}COOH$	24(3,21) - 23(4,20)	146162.45	0.02			242.964	0.1440	
$H^{12}COOH$	13(1,12) - 13(1,13)	146261.22	0.02			67.635	0.1593	
$H^{12}COOH$	36(8,29) - 37(7,30)	146272.70	0.05			636.526	0.1979	
$H^{12}COOD$	5(3, 2) - 6(2, 5)	146323.49	1.96			22.581	0.0176	
$D^{12}COOH$	3(2, 2) - 3(1, 3)	146444.12	0.03			5.752	0.0502	
$D^{12}COOH$	32(10,23) - 33(9,24)	146451.79	2.23			539.394	0.1445	
$D^{12}COOH$	32(10,22) - 33(9,25)	146456.93	2.23			539.394	0.1445	
$H^{12}COOH$	36(8,28) - 37(7,31)	146466.79	0.05			636.520	0.1979	
$H^{12}COOD$	7(2, 5) - 7(1, 6)	146612.26	0.46			22.933	0.1686	
$D^{12}COOH$	8(0, 8) - 7(1, 7)	146671.27	0.03	146671.27	0.08	21.073	0.1772	
$H^{12}COOH$	7(3, 5) - 8(2, 6)	146699.93	0.02			36.006	0.0329	
$H^{13}COOH$	37(5,33) - 36(6,30)	146945.39	8.43			577.608	0.2050	
$H^{12}COOH$	33(4,30) - 32(5,27)	146947.83	0.04			452.940	0.1747	
$H^{12}COOH$	13(4, 9) - 14(3,12)	147022.67	0.03			98.769	0.0674	
$H^{13}COOH$	18(5,13) - 19(4,16)	147168.84	4.24			176.920	0.0944	
$H^{12}COOH$	20(2,18) - 20(2,19)	147514.53	0.02			165.046	0.3098	
$H^{12}COOD$	48(6,42) - 48(6,43)	147597.65	2.82			925.234	0.9628	
$D^{12}COOH$	41(8,34) - 40(9,31)	147950.33	4.17			731.049	0.2097	
$H^{12}COOH$	4(1, 4) - 3(0, 3)	148038.99	0.01			4.492	0.0891	
$H^{13}COOH$	18(2,16) - 17(3,15)	148120.80	0.02			134.869	0.1231	
$D^{12}COOH$	26(4,23) - 25(5,20)	148441.52	1.01			279.525	0.1208	
$D^{12}COOH$	7(4, 4) - 8(3, 5)	148924.85	0.14			40.537	0.0222	
$H^{13}COOH$	44(5,39) - 44(5,40)	148943.80	0.55			798.834	0.7621	
$H^{13}COOH$	13(1,12) - 13(1,13)	149146.42	0.10	149146.54	0.08	67.881	0.1604	
$H^{12}COOH$	54(6,48) - 54(6,49)	149465.46	0.10			1199.140	0.8891	
$D^{12}COOH$	36(11,26) - 37(10,27)	149534.09	3.33			673.471	0.1636	
$D^{12}COOH$	36(11,25) - 37(10,28)	149535.91	3.33			673.471	0.1636	
$D^{12}COOH$	35(5,30) - 35(5,31)	149541.98	0.40			505.685	0.8900	
$D^{12}COOH$	7(4, 3) - 8(3, 6)	149609.38	0.14			40.514	0.0221	
$H^{12}COOD$	7(0, 7) - 6(0, 6)	149753.65	0.02	149753.66	0.08	15.122	6.9799	[16A]
$H^{12}COOH$	12(1,11) - 12(0,12)	149766.91	0.01			57.530	0.2568	
$H^{12}COOH$	45(5,40) - 45(5,41)	149841.62	0.10			835.424	0.7490	
$H^{12}COOH$	38(5,34) - 37(6,31)	150130.98	0.05			608.519	0.2119	
$H^{12}COOD$	6(2, 4) - 6(1, 5)	150245.36	0.46			17.670	0.1364	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{12}COOH$	7(0, 7) - 6(0, 6)	150345.14	0.02	150345.06	0.08	15.257	6.9643	[16A]
$H^{13}COOH$	12(1,11) - 12(0,12)	150418.32	0.10			57.368	0.2501	
$D^{12}COOH$	37(7,31) - 36(8,28)	150596.76	2.86			591.199	0.1898	
$D^{12}COOH$	4(2, 3) - 4(1, 4)	150727.06	0.03			8.544	0.0682	
$H^{13}COOH$	7(1, 7) - 6(1, 6)	150754.23	0.03	150754.16	0.08	17.258	6.8549	
$H^{12}COOD$	5(1, 5) - 4(0, 4)	150806.74	0.05			7.227	0.1100	
$H^{12}COOD$	12(1,11) - 12(0,12)	150846.18	0.17			55.271	0.2205	
$D^{12}COOH$	33(6,28) - 32(7,25)	150851.52	1.95			466.195	0.1690	
$D^{12}COOH$	41(8,33) - 40(9,32)	151016.27	4.22			731.044	0.2099	
$H^{12}COOH$	7(1, 7) - 6(1, 6)	151176.24	0.01	151176.24	0.08	17.362	6.8552	
$H^{12}COOH$	28(3,25) - 28(3,26)	151673.86	0.03	151673.85	0.08	324.635	0.4554	
$H^{12}COOD$	7(2, 6) - 6(2, 5)	151778.74	0.02	151778.74	0.08	22.581	6.4267	[16A]
$H^{12}COOH$	30(7,24) - 31(6,25)	151789.70	0.05			452.347	0.1636	
$D^{12}COOH$	15(2,13) - 15(1,14)	151900.46	0.04	151900.57	0.08	92.071	0.3878	
$H^{12}COOD$	15(2,13) - 15(1,14)	152195.45	0.46			91.357	0.4294	
$H^{12}COOH$	30(7,23) - 31(6,26)	152203.86	0.05			452.334	0.1636	
$H^{12}COOD$	7(6, 2) - 6(6, 1)	152265.07	0.03	152264.95	0.08	81.513	1.8573	[16A]
$H^{12}COOD$	7(6, 1) - 6(6, 0)	152265.07	0.03	152264.95	0.08	81.513	1.8573	[16A]
$H^{12}COOD$	7(5, 3) - 6(5, 2)	152288.85	0.02	152288.87	0.08	61.270	3.4288	[16A]
$H^{12}COOD$	7(5, 2) - 6(5, 1)	152288.86	0.02	152288.87	0.08	61.270	3.4288	[16A]
$H^{12}COOD$	7(4, 4) - 6(4, 3)	152343.46	0.02	152343.36	0.08	44.703	4.7145	[16A]
$H^{12}COOD$	7(4, 3) - 6(4, 2)	152344.46	0.02	152344.38	0.08	44.703	4.7145	[16A]
$H^{12}COOD$	7(3, 5) - 6(3, 4)	152442.87	0.02	152442.80	0.08	31.818	5.7144	[16A]
$H^{12}COOD$	7(3, 4) - 6(3, 3)	152525.93	0.02	152526.01	0.08	31.820	5.7144	[16A]
$D^{12}COOH$	40(12,29) - 41(11,30)	152598.34	4.85			822.373	0.1827	
$D^{12}COOH$	40(12,28) - 41(11,31)	152598.98	4.85			822.373	0.1827	
$D^{12}COOH$	11(5, 7) - 12(4, 8)	152955.64	0.25			82.377	0.0411	
$H^{12}COOH$	7(3, 4) - 8(2, 7)	153016.28	0.02			35.798	0.0324	
$D^{12}COOH$	11(5, 6) - 12(4, 9)	153287.04	0.25			82.366	0.0411	
$D^{12}COOH$	7(2, 6) - 6(2, 5)	153521.62	0.02	153521.68	0.08	21.632	6.4250	[16A]
$H^{13}COOH$	12(4, 9) - 13(3,10)	153648.37	1.85			87.661	0.0599	
$D^{12}COOH$	28(5,23) - 27(6,22)	153712.10	1.10			335.185	0.1453	
$H^{12}COOD$	5(2, 3) - 5(1, 4)	153949.59	0.46			13.154	0.1071	
$H^{12}COOD$	7(2, 5) - 6(2, 4)	154137.68	0.02	154137.58	0.08	22.682	6.4275	[16A]
$D^{12}COOH$	7(6, 2) - 6(6, 1)	154285.72	0.02	154285.66	0.08	71.473	1.8574	[16A]
$D^{12}COOH$	7(6, 1) - 6(6, 0)	154285.72	0.02	154285.66	0.08	71.473	1.8574	[16A]
$D^{12}COOH$	7(5, 3) - 6(5, 2)	154332.96	0.02	154332.94	0.08	54.358	3.4290	[16A]
$D^{12}COOH$	7(5, 2) - 6(5, 1)	154332.99	0.02	154332.94	0.08	54.358	3.4290	[16A]
$H^{13}COOH$	20(2,18) - 20(2,19)	154408.73	0.11	154408.61	0.08	164.438	0.3084	
$D^{12}COOH$	7(4, 4) - 6(4, 3)	154428.04	0.02	154427.84	0.08	40.353	4.7148	[16A]
$D^{12}COOH$	7(4, 3) - 6(4, 2)	154431.16	0.02	154431.13	0.08	40.354	4.7148	[16A]
$D^{12}COOH$	7(3, 5) - 6(3, 4)	154571.12	0.02			29.463	5.7144	
$D^{12}COOH$	7(3, 4) - 6(3, 3)	154757.19	0.02	154757.18	0.08	29.467	5.7144	[16A]
$D^{12}COOH$	17(2,15) - 17(2,16)	155096.23	0.07	155096.21	0.08	117.165	0.3590	
$H^{13}COOH$	7(0, 7) - 6(0, 6)	155226.19	0.03			15.637	6.9866	
$H^{12}COOH$	7(0, 7) - 6(0, 6)	155617.84	0.01	155617.84	0.08	15.670	6.9879	
$D^{12}COOH$	5(2, 4) - 5(1, 5)	156114.81	0.03			12.030	0.0841	
$H^{12}COOD$	22(2,20) - 23(1,23)	156445.87	1.82			190.870	0.0065	
$D^{12}COOH$	15(6,10) - 16(5,11)	156637.53	0.42			139.125	0.0603	
$H^{12}COOH$	49(7,42) - 48(8,41)	156683.55	0.06			1025.214	0.2789	
$D^{12}COOH$	12(1,11) - 12(1,12)	156705.98	0.07			55.634	0.1876	
$H^{13}COOH$	7(2, 6) - 6(2, 5)	156765.73	0.03	156765.71	0.08	24.292	6.4274	
$D^{12}COOH$	15(6, 9) - 16(5,12)	156779.80	0.42			139.120	0.0603	
$H^{13}COOH$	12(4, 8) - 13(3,11)	156790.89	1.84			87.558	0.0597	
$H^{13}COOH$	36(5,31) - 35(6,30)	156988.71	8.60			550.385	0.2039	
$H^{12}COOH$	7(2, 6) - 6(2, 5)	157053.94	0.01	157053.92	0.08	24.575	6.4275	
$H^{12}COOH$	9(0, 9) - 8(1, 8)	157099.26	0.01	157099.22	0.08	28.164	0.1846	
$H^{13}COOH$	7(6, 2) - 6(6, 1)	157147.98	0.03	157147.99	0.08	92.938	1.8572	
$H^{13}COOH$	7(6, 1) - 6(6, 0)	157147.98	0.03	157147.99	0.08	92.938	1.8572	
$H^{13}COOH$	7(5, 3) - 6(5, 2)	157159.64	0.03	157159.63	0.08	69.360	3.4287	
$H^{13}COOH$	7(5, 2) - 6(5, 1)	157159.64	0.03	157159.63	0.08	69.360	3.4287	
$H^{13}COOH$	7(4, 4) - 6(4, 3)	157195.60	0.02	157195.83	0.08	50.059	4.7144	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{13}COOH$	7(4, 3) - 6(4, 2)	157196.08	0.02	157195.83	0.08	50.059	4.7144	
$H^{12}COOH$	24(6,19) - 25(5,20)	157214.63	0.04			299.559	0.1292	
$H^{12}COOH$	43(6,37) - 42(7,36)	157238.13	0.05			787.222	0.2448	
$D^{12}COOH$	7(2, 5) - 6(2, 4)	157241.51	0.02	157241.48	0.08	21.798	6.4276	[16A]
$H^{12}COOD$	12(1,11) - 11(2,10)	157265.31	0.48			55.057	0.1225	
$H^{13}COOH$	7(3, 5) - 6(3, 4)	157271.90	0.02	157271.90	0.08	35.044	5.7143	
$H^{13}COOH$	7(3, 4) - 6(3, 3)	157321.86	0.02	157321.86	0.08	35.046	5.7143	
$H^{12}COOH$	7(6, 2) - 6(6, 1)	157412.83	0.01	157412.82	0.08	95.259	1.8572	
$H^{12}COOH$	7(6, 1) - 6(6, 0)	157412.83	0.01	157412.82	0.08	95.259	1.8572	
$H^{12}COOH$	7(5, 3) - 6(5, 2)	157422.56	0.01	157422.55	0.08	70.980	3.4287	
$H^{12}COOH$	7(5, 2) - 6(5, 1)	157422.56	0.01	157422.55	0.08	70.980	3.4287	
$H^{12}COOH$	7(4, 4) - 6(4, 3)	157455.11	0.01	157455.17	0.08	51.106	4.7144	
$H^{12}COOH$	7(4, 3) - 6(4, 2)	157455.52	0.01	157455.17	0.08	51.106	4.7144	
$H^{12}COOD$	4(2, 2) - 4(1, 3)	157462.74	0.46			9.386	0.0804	
$H^{12}COOD$	33(4,29) - 33(4,30)	157467.32	0.39			438.349	0.6349	
$H^{12}COOH$	7(3, 5) - 6(3, 4)	157526.47	0.01	157526.45	0.08	35.645	5.7143	
$H^{12}COOH$	7(3, 4) - 6(3, 3)	157570.67	0.01	157570.65	0.08	35.646	5.7143	
$H^{12}COOD$	19(2,17) - 19(2,18)	157655.77	0.28			143.726	0.3221	
$H^{12}COOD$	7(1, 6) - 6(1, 5)	157770.78	0.02	157770.81	0.08	17.670	6.8528	[16A]
$H^{12}COOD$	13(1,12) - 13(1,13)	157898.10	0.26			64.683	0.1668	
$H^{12}COOH$	24(6,18) - 25(5,21)	158059.75	0.04			299.532	0.1292	
$D^{12}COOH$	6(1, 6) - 5(0, 5)	158165.23	0.03	158165.35	0.08	10.931	0.1358	
$D^{12}COOH$	37(7,30) - 36(8,29)	158325.57	2.91			591.186	0.1903	
$H^{13}COOH$	7(2, 5) - 6(2, 4)	158553.40	0.03			24.368	6.4277	
$H^{13}COOH$	9(0, 9) - 8(1, 8)	158710.32	0.05	158710.32	0.08	28.029	0.1866	
$H^{12}COOH$	7(2, 5) - 6(2, 4)	158720.52	0.01	158720.51	0.08	24.646	6.4278	
$D^{12}COOH$	28(3,25) - 29(2,28)	158771.01	2.13			316.079	0.0103	
$H^{13}COOH$	33(4,30) - 32(5,27)	159247.15	4.64			450.864	0.1704	
$D^{12}COOH$	19(3,16) - 18(4,15)	159299.22	0.34			151.168	0.1083	
$D^{13}COOH$	29(4,25) - 29(4,26)	159983.00	0.16			346.441	0.6964	
$H^{12}COOH$	24(2,22) - 25(1,25)	160007.76	0.16			234.073	0.0087	
$D^{12}COOH$	19(7,13) - 20(6,14)	160089.36	0.69			210.773	0.0795	
$D^{12}COOH$	19(7,12) - 20(6,15)	160146.46	0.69			210.771	0.0795	
$D^{12}COOH$	35(4,32) - 34(5,29)	160225.44	3.52			483.887	0.0672	
$H^{13}COOH$	23(6,18) - 24(5,19)	160266.62	8.07			278.791	0.1215	
$H^{13}COOH$	30(4,26) - 29(5,25)	160269.40	4.57			380.406	0.1721	
$D^{12}COOH$	7(1, 6) - 6(1, 5)	160392.19	0.02	160392.07	0.08	17.674	6.8485	[16A]
$H^{12}COOD$	16(2,14) - 16(1,15)	160397.42	0.45			103.100	0.4443	
$H^{13}COOH$	18(2,16) - 17(3,15)	160425.47	0.62			134.112	0.1247	
$H^{12}COOD$	3(2, 1) - 3(1, 2)	160555.84	0.45			6.370	0.0554	
$H^{13}COOH$	36(4,32) - 36(4,33)	160685.03	0.17	160685.08	0.08	535.026	0.5981	
$H^{12}COOH$	13(1,12) - 12(2,11)	160795.79	0.01			67.150	0.1288	
$D^{12}COOH$	42(6,36) - 42(6,37)	160833.12	1.36			725.756	1.0366	
$H^{12}COOD$	9(0, 9) - 8(1, 8)	160896.35	0.05			26.797	0.1962	
$H^{13}COOH$	23(6,17) - 24(5,20)	160974.16	8.06			278.768	0.1215	
$H^{13}COOH$	12(2,10) - 12(1,11)	161433.53	0.08			62.386	0.3397	
$H^{13}COOH$	6(3, 4) - 7(2, 5)	161517.99	0.55			29.657	0.0251	
$H^{12}COOH$	37(5,32) - 36(6,31)	161672.44	0.04			580.499	0.2111	
$H^{13}COOH$	13(2,11) - 13(1,12)	161797.06	0.08			72.356	0.3756	
$D^{12}COOH$	11(1,10) - 10(2, 9)	161902.49	0.07			46.444	0.1184	
$H^{13}COOH$	11(2, 9) - 11(1,10)	162320.41	0.08			53.163	0.3024	
$H^{12}COOH$	18(5,14) - 19(4,15)	162343.83	0.03			178.209	0.0946	
$H^{13}COOH$	7(1, 6) - 6(1, 5)	162419.63	0.03			18.430	6.8544	
$H^{12}COOH$	7(1, 6) - 6(1, 5)	162598.44	0.01			18.509	6.8547	
$D^{12}COOH$	6(2, 5) - 6(1, 6)	162622.48	0.03			16.207	0.0982	
$D^{12}COOH$	23(3,20) - 23(3,21)	162677.63	0.08			216.901	0.5218	
$D^{12}COOH$	27(4,24) - 26(5,21)	162833.23	1.18			298.988	0.1201	
$H^{12}COOD$	2(2, 0) - 2(1, 1)	163041.34	0.45			4.107	0.0306	
$H^{12}COOD$	26(3,23) - 26(3,24)	163327.41	0.38			271.321	0.4718	
$D^{12}COOH$	20(2,18) - 21(1,21)	163360.91	0.97			160.132	0.0044	
$D^{12}COOH$	23(8,16) - 24(7,17)	163393.00	1.11			297.313	0.0987	
$D^{12}COOH$	23(8,15) - 24(7,18)	163414.93	1.11			297.312	0.0987	
$H^{13}COOH$	14(2,12) - 14(1,13)	163584.38	0.08			83.068	0.4088	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{13}COOH$	28(3,25) - 28(3,26)	163644.73	0.14			323.492	0.4482	
$H^{12}COOH$	18(5,13) - 19(4,16)	163961.59	0.03			178.157	0.0946	
$D^{12}COOH$	12(1,11) - 12(0,12)	164032.93	0.07			55.389	0.1794	
$H^{13}COOH$	5(1, 5) - 4(0, 4)	164233.10	0.06			7.466	0.1091	
$H^{13}COOH$	10(2, 8) - 10(1, 9)	164261.65	0.08			44.694	0.2649	
$H^{12}COOH$	44(6,39) - 43(7,36)	164316.06	0.05			819.692	0.2487	
$H^{13}COOH$	24(3,21) - 23(4,20)	164429.95	2.00			241.639	0.1446	
$H^{12}COOH$	34(4,31) - 33(5,28)	164577.94	0.05			477.952	0.1759	
$H^{12}COOH$	41(9,33) - 42(8,34)	164714.97	0.08			819.678	0.2249	
$H^{12}COOH$	41(9,32) - 42(8,35)	164775.88	0.08			819.676	0.2249	
$H^{12}COOD$	22(3,19) - 21(4,18)	164897.93	5.17			197.669	0.1303	
$H^{12}COOD$	32(3,29) - 33(2,32)	165599.40	2.93			403.847	0.0139	
$H^{13}COOH$	6(3, 3) - 7(2, 6)	165606.07	0.55			29.522	0.0249	
$H^{12}COOD$	8(1, 8) - 7(1, 7)	165884.39	0.02			21.264	7.8701	
$D^{12}COOH$	16(2,14) - 16(1,15)	166168.22	0.05			103.824	0.3870	
$H^{12}COOD$	4(3, 2) - 5(2, 3)	166176.02	1.96			18.289	0.0106	
$H^{12}COOH$	13(1,12) - 13(0,13)	166263.79	0.02			66.968	0.2549	
$H^{12}COOH$	13(2,11) - 13(1,12)	166336.96	0.01			72.514	0.3731	
$H^{12}COOH$	12(2,10) - 12(1,11)	166399.28	0.01			62.526	0.3366	
$D^{12}COOH$	8(1, 8) - 7(1, 7)	166441.28	0.02			21.073	7.8663	
$H^{12}COOH$	5(1, 5) - 4(0, 4)	166586.53	0.01			7.480	0.1089	
$D^{12}COOH$	27(9,19) - 28(8,20)	166598.59	1.76			398.730	0.1178	
$D^{12}COOH$	27(9,18) - 28(8,21)	166606.76	1.76			398.730	0.1178	
$H^{12}COOD$	9(4, 6) - 10(3, 7)	166749.75	4.99			56.570	0.0368	
$H^{12}COOD$	14(5,10) - 15(4,11)	166842.94	9.66			116.719	0.0637	
$H^{12}COOH$	37(4,33) - 37(4,34)	166860.44	0.07			564.658	0.5813	
$H^{13}COOH$	15(2,13) - 15(1,14)	166947.58	0.08			94.516	0.4383	
$H^{12}COOH$	12(4, 9) - 13(3,10)	166956.82	0.03			88.332	0.0599	
$H^{13}COOH$	9(2, 7) - 9(1, 8)	167039.83	0.08			36.983	0.2283	
$H^{13}COOH$	13(1,12) - 12(2,11)	167051.52	0.12			66.784	0.1312	
$D^{12}COOH$	30(5,26) - 29(6,23)	167378.00	1.54			377.652	0.1501	
$H^{13}COOH$	13(1,12) - 13(0,13)	167396.78	0.12			66.772	0.2475	
$H^{12}COOD$	14(5, 9) - 15(4,12)	167464.84	9.67			116.698	0.0637	
$H^{12}COOH$	14(2,12) - 14(1,13)	167613.11	0.01			83.248	0.4074	
$H^{12}COOH$	11(2, 9) - 11(1,10)	167627.74	0.01			53.288	0.2991	
$H^{12}COOD$	6(1, 6) - 5(0, 5)	167694.66	0.05			10.823	0.1322	
$H^{12}COOD$	4(3, 1) - 5(2, 4)	167697.06	1.96			18.238	0.0106	
$H^{12}COOH$	14(1,13) - 14(1,14)	167704.22	0.02			77.653	0.1516	
$H^{12}COOD$	9(4, 5) - 10(3, 8)	167878.99	4.99			56.532	0.0368	
$D^{12}COOH$	49(7,42) - 49(7,43)	168282.05	3.58			985.167	1.1857	
$H^{13}COOD$	2(2, 1) - 2(1, 2)	168374.83	0.45			3.927	0.0292	
$H^{12}COOD$	41(5,36) - 41(5,37)	168377.93	1.20			674.581	0.7705	
$H^{13}COOH$	17(5,13) - 18(4,14)	169159.60	4.25			162.674	0.0869	
$H^{13}COOH$	38(5,34) - 37(6,31)	169202.53	8.51			605.531	0.2090	
$D^{12}COOH$	33(6,27) - 32(7,26)	169260.29	1.98			466.158	0.1706	
$H^{12}COOD$	13(1,12) - 13(0,13)	169412.44	0.23			64.299	0.2162	
$H^{12}COOH$	21(2,19) - 21(2,20)	169660.93	0.02			180.536	0.2932	
$D^{12}COOH$	46(9,38) - 45(10,35)	169678.25	6.90			919.041	0.2357	
$D^{12}COOH$	31(10,22) - 32(9,23)	169737.33	2.70			515.012	0.1370	
$D^{12}COOH$	31(10,21) - 32(9,24)	169740.29	2.70			515.012	0.1370	
$H^{12}COOH$	12(4, 8) - 13(3,11)	169741.00	0.03			88.241	0.0598	
$H^{13}COOH$	24(2,22) - 25(1,25)	169771.41	1.61			233.252	0.0079	
$H^{12}COOH$	10(2, 8) - 10(1, 9)	169828.91	0.01			44.807	0.2618	
$H^{12}COOH$	35(8,28) - 36(7,29)	170169.41	0.06			608.663	0.1906	
$D^{12}COOH$	7(2, 6) - 7(1, 7)	170261.23	0.03			21.073	0.1106	
$H^{12}COOH$	35(8,27) - 36(7,30)	170302.92	0.06			608.659	0.1906	
$H^{12}COOD$	8(0, 8) - 7(0, 7)	170377.99	0.03			20.117	7.9716	
$H^{12}COOH$	15(2,13) - 15(1,14)	170379.62	0.01			94.721	0.4383	
$H^{13}COOH$	17(5,12) - 18(4,15)	170418.78	4.24			162.633	0.0869	
$H^{13}COOH$	8(2, 6) - 8(1, 7)	170421.24	0.08			30.033	0.1935	
$D^{12}COOH$	8(0, 8) - 7(0, 7)	170705.42	0.02			20.272	7.9517	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOD$	17(2,15) - 17(1,16)	170728.28	0.45			115.524	0.4530	
$H^{12}COOH$	31(4,27) - 30(5,26)	170882.48	0.04			405.099	0.1793	
$H^{13}COOH$	14(1,13) - 14(1,14)	170905.12	0.13			77.367	0.1530	
$H^{12}COOH$	6(3, 4) - 7(2, 5)	171023.53	0.02			29.940	0.0251	
$D^{12}COOH$	9(0, 9) - 8(1, 8)	171026.71	0.04			26.625	0.2119	
$H^{12}COOD$	3(2, 2) - 3(1, 3)	171091.22	0.45			6.012	0.0504	
$D^{12}COOH$	46(9,37) - 45(10,36)	171372.35	6.96			919.038	0.2358	
$D^{12}COOH$	15(2,13) - 14(3,12)	171423.76	0.18			91.420	0.1062	
$D^{12}COOH$	6(4, 3) - 7(3, 4)	171616.32	0.15			34.629	0.0153	
$D^{12}COOH$	6(4, 2) - 7(3, 5)	171928.37	0.15			34.619	0.0153	
$H^{12}COOD$	17(2,15) - 16(3,14)	172017.96	2.01			115.481	0.1203	
$H^{13}COOH$	16(2,14) - 16(1,15)	172019.70	0.08			106.692	0.4631	
$H^{13}COOH$	8(1, 8) - 7(1, 7)	172144.46	0.03	172144.39	0.12	22.287	7.8718	
$H^{12}COOH$	39(5,35) - 38(6,32)	172379.29	0.05			637.235	0.2159	
$H^{12}COOH$	8(1, 8) - 7(1, 7)	172635.72	0.01	172635.70	0.12	22.405	7.8720	
$H^{12}COOH$	9(2, 7) - 9(1, 8)	172790.43	0.01	172790.38	0.12	37.084	0.2256	
$D^{12}COOH$	35(11,25) - 36(10,26)	172829.86	4.02			646.142	0.1561	
$D^{12}COOH$	35(11,24) - 36(10,27)	172830.91	4.02			646.142	0.1561	
$H^{13}COOH$	45(5,40) - 45(5,41)	173182.03	0.57			832.696	0.7223	
$H^{12}COOD$	8(2, 7) - 7(2, 6)	173312.23	0.02			27.644	7.4970	
$H^{12}COOD$	49(6,43) - 49(6,44)	173323.85	3.85			961.060	0.9104	
$D^{12}COOH$	42(8,35) - 41(9,32)	173341.28	4.82			761.437	0.2159	
$H^{12}COOH$	55(6,49) - 55(6,50)	173544.04	0.12			1240.636	0.8461	
$H^{12}COOH$	46(5,41) - 46(5,42)	173805.64	0.12			870.087	0.7107	
$D^{12}COOH$	24(4,20) - 23(5,19)	173928.06	0.70			242.801	0.1284	
$H^{12}COOD$	8(7, 2) - 7(7, 1)	174020.44	0.03			110.509	1.8751	
$H^{12}COOD$	8(7, 1) - 7(7, 0)	174020.44	0.03			110.509	1.8751	
$H^{12}COOD$	8(6, 3) - 7(6, 2)	174037.30	0.03			86.592	3.5002	
$H^{12}COOD$	8(6, 2) - 7(6, 1)	174037.30	0.03			86.592	3.5002	
$H^{12}COOD$	8(5, 4) - 7(5, 3)	174075.91	0.02			66.350	4.8753	
$H^{12}COOD$	8(5, 3) - 7(5, 2)	174075.93	0.02			66.350	4.8753	
$H^{12}COOD$	8(4, 5) - 7(4, 4)	174159.40	0.02			49.785	6.0003	
$H^{12}COOD$	8(4, 4) - 7(4, 3)	174162.15	0.02			49.785	6.0003	
$H^{13}COOH$	7(2, 5) - 7(1, 6)	174164.40	0.08	174164.39	0.12	23.847	0.1610	
$D^{12}COOH$	34(4,31) - 33(5,28)	174181.19	3.06			457.909	0.0756	
$H^{12}COOD$	8(3, 6) - 7(3, 5)	174290.40	0.02			36.903	6.8750	
$D^{12}COOH$	7(1, 7) - 6(0, 6)	174379.30	0.03			15.257	0.1621	
$H^{12}COOD$	8(3, 5) - 7(3, 4)	174455.87	0.02	174455.89	0.12	36.908	6.8750	
$H^{12}COOD$	4(2, 3) - 4(1, 4)	174728.27	0.45			8.789	0.0689	
$D^{12}COOH$	28(4,25) - 27(5,22)	174732.35	1.37			319.248	0.1178	
$D^{12}COOH$	34(6,29) - 33(7,26)	174737.63	2.27			490.711	0.1741	
$H^{12}COOH$	16(2,14) - 16(1,15)	174769.96	0.01			106.927	0.4651	
$H^{12}COOH$	6(3, 3) - 7(2, 6)	174830.31	0.02			29.814	0.0249	
$H^{12}COOH$	29(3,26) - 29(3,27)	174857.76	0.04			346.292	0.4308	
$D^{12}COOH$	8(2, 7) - 7(2, 6)	175215.32	0.02	175215.31	0.12	26.753	7.4943	
$D^{12}COOH$	38(7,32) - 37(8,29)	175627.82	3.32			618.652	0.1956	
$H^{12}COOH$	29(7,23) - 30(6,24)	175663.96	0.05			428.992	0.1562	
$H^{13}COOH$	34(4,31) - 33(5,28)	175680.27	4.73			475.866	0.1707	
$D^{12}COOH$	10(5, 6) - 11(4, 7)	175756.02	0.28			73.514	0.0338	
$D^{12}COOH$	39(12,28) - 40(11,29)	175890.88	5.84			792.101	0.1752	
$D^{12}COOH$	39(12,27) - 40(11,30)	175891.25	5.84			792.101	0.1752	
$D^{12}COOH$	10(5, 5) - 11(4, 8)	175922.37	0.28			73.509	0.0338	
$H^{12}COOH$	29(7,22) - 30(6,25)	175945.96	0.05			428.983	0.1562	
$H^{12}COOH$	8(2, 6) - 8(1, 7)	176286.59	0.01	176286.59	0.12	30.125	0.1913	
$D^{12}COOH$	8(7, 2) - 7(7, 1)	176323.61	0.03	176323.68	0.12	96.839	1.8752	
$D^{12}COOH$	8(7, 1) - 7(7, 0)	176323.61	0.03	176323.68	0.12	96.839	1.8752	
$D^{12}COOH$	8(6, 3) - 7(6, 2)	176362.59	0.02	176362.61	0.12	76.619	3.5004	
$D^{12}COOH$	8(6, 2) - 7(6, 1)	176362.59	0.02	176362.61	0.12	76.619	3.5004	
$D^{12}COOH$	8(5, 4) - 7(5, 3)	176435.12	0.02	176435.17	0.12	59.506	4.8755	
$D^{12}COOH$	8(5, 3) - 7(5, 2)	176435.21	0.02	176435.17	0.12	59.506	4.8755	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{12}COOH$	8(4, 5) - 7(4, 4)	176576.97	0.02	176576.97	0.12	45.505	6.0005	
$D^{12}COOH$	8(4, 4) - 7(4, 3)	176585.53	0.02	176585.55	0.12	45.505	6.0005	
$D^{12}COOH$	8(3, 6) - 7(3, 5)	176750.14	0.02			34.619	6.8749	
$H^{12}COOD$	8(2, 6) - 7(2, 5)	176770.70	0.02			27.823	7.4989	
$H^{13}COOH$	8(0, 8) - 7(0, 7)	176797.98	0.03	176797.95	0.12	20.815	7.9808	
$D^{12}COOH$	8(3, 5) - 7(3, 4)	177119.51	0.02	177119.51	0.12	34.629	6.8750	
$H^{13}COOH$	21(2,19) - 21(2,20)	177204.65	0.14			179.884	0.2925	
$H^{12}COOH$	8(0, 8) - 7(0, 7)	177282.79	0.01	177282.80	0.12	20.861	7.9825	
$D^{12}COOH$	36(5,31) - 36(5,32)	177522.16	0.64			532.333	0.8354	
$H^{13}COOH$	11(4, 8) - 12(3, 9)	177530.21	1.85			77.864	0.0521	
$D^{12}COOH$	42(8,34) - 41(9,33)	177731.54	4.89			761.430	0.2161	
$D^{12}COOH$	17(3,14) - 17(2,15)	177939.85	0.13			122.338	0.4723	
$H^{13}COOH$	6(2, 4) - 6(1, 5)	178030.63	0.08	178030.51	0.12	18.430	0.1311	
$D^{12}COOH$	18(3,15) - 18(2,16)	178046.41	0.14			136.040	0.5098	
$H^{13}COOH$	17(2,15) - 17(1,16)	178915.70	0.08	178915.84	0.12	119.590	0.4827	
$D^{12}COOH$	43(13,31) - 44(12,32)	178931.59	8.26			952.869	0.1943	
$D^{12}COOH$	43(13,30) - 44(12,33)	178931.71	8.26			952.869	0.1943	
$D^{12}COOH$	8(2, 7) - 8(1, 8)	179035.26	0.03			26.625	0.1213	
$H^{13}COOH$	8(2, 7) - 7(2, 6)	179047.82	0.02	179047.82	0.12	29.522	7.4981	
$H^{12}COOD$	5(2, 4) - 5(1, 5)	179297.07	0.44			12.258	0.0856	
$H^{12}COOH$	8(2, 7) - 7(2, 6)	179384.69	0.01	179384.66	0.12	29.814	7.4983	
$H^{13}COOH$	11(4, 7) - 12(3,10)	179503.64	1.84			77.799	0.0521	
$D^{12}COOH$	14(6, 9) - 15(5,10)	179547.49	0.48			127.306	0.0528	
$H^{13}COOH$	8(7, 2) - 7(7, 1)	179607.31	0.04	179607.31	0.12	126.029	1.8751	
$H^{13}COOH$	8(7, 1) - 7(7, 0)	179607.31	0.04	179607.31	0.12	126.029	1.8751	
$H^{13}COOH$	8(6, 3) - 7(6, 2)	179611.64	0.03	179611.62	0.12	98.180	3.5001	
$H^{13}COOH$	8(6, 2) - 7(6, 1)	179611.64	0.03	179611.62	0.12	98.180	3.5001	
$D^{12}COOH$	14(6, 8) - 15(5,11)	179622.38	0.48			127.303	0.0528	
$H^{13}COOH$	8(5, 4) - 7(5, 3)	179633.51	0.02	179633.53	0.12	74.602	4.8752	
$H^{13}COOH$	8(5, 3) - 7(5, 2)	179633.52	0.02	179633.53	0.12	74.602	4.8752	
$H^{13}COOH$	8(4, 5) - 7(4, 4)	179690.58	0.02			55.303	6.0002	
$H^{13}COOH$	8(4, 4) - 7(4, 3)	179691.90	0.02	179691.93	0.12	55.303	6.0002	
$H^{13}COOH$	8(3, 6) - 7(3, 5)	179795.46	0.02	179795.49	0.12	40.290	6.8750	
$D^{12}COOH$	18(2,16) - 18(2,17)	179894.42	0.09			130.039	0.3431	
$H^{13}COOH$	8(3, 5) - 7(3, 4)	179895.11	0.02	179895.07	0.12	40.293	6.8750	
$H^{12}COOH$	8(7, 2) - 7(7, 1)	179910.48	0.01			129.187	1.8751	
$H^{12}COOH$	8(7, 1) - 7(7, 0)	179910.48	0.01			129.187	1.8751	
$H^{12}COOH$	8(6, 3) - 7(6, 2)	179913.00	0.01	179912.96	0.12	100.510	3.5001	
$H^{12}COOH$	8(6, 2) - 7(6, 1)	179913.00	0.01	179912.96	0.12	100.510	3.5001	
$H^{12}COOH$	8(5, 4) - 7(5, 3)	179932.07	0.01	179932.15	0.12	76.231	4.8752	
$H^{12}COOH$	8(5, 3) - 7(5, 2)	179932.07	0.01	179932.15	0.12	76.231	4.8752	
$D^{12}COOH$	16(3,13) - 16(2,14)	179969.89	0.11			109.367	0.4308	
$H^{12}COOH$	8(4, 5) - 7(4, 4)	179984.16	0.01	179984.04	0.12	56.358	6.0002	
$H^{12}COOH$	8(4, 4) - 7(4, 3)	179985.27	0.01	179985.34	0.12	56.358	6.0002	
$D^{12}COOH$	13(1,12) - 13(1,13)	180037.19	0.10			64.573	0.1823	
$H^{12}COOD$	8(1, 7) - 7(1, 6)	180049.47	0.02	180049.47	0.12	22.933	7.8681	
$H^{12}COOH$	8(3, 6) - 7(3, 5)	180083.04	0.01	180083.03	0.12	40.899	6.8750	
$H^{12}COOH$	7(2, 5) - 7(1, 6)	180086.63	0.01	180086.71	0.12	23.933	0.1594	
$H^{12}COOH$	8(3, 5) - 7(3, 4)	180171.21	0.01	180171.19	0.12	40.902	6.8750	
$H^{12}COOD$	14(1,13) - 14(1,14)	180301.37	0.33			74.290	0.1607	
$D^{12}COOH$	8(2, 6) - 7(2, 5)	180574.71	0.02	180574.72	0.12	27.038	7.5000	
$D^{12}COOH$	19(3,16) - 19(2,17)	180579.10	0.16			150.458	0.5412	
$H^{12}COOH$	35(4,32) - 34(5,29)	180800.65	0.06			503.749	0.1761	
$H^{12}COOH$	17(2,15) - 17(1,16)	180900.63	0.01	180900.61	0.12	119.859	0.4869	
$H^{12}COOH$	23(6,18) - 24(5,19)	181053.94	0.05			280.718	0.1217	
$H^{12}COOD$	20(2,18) - 20(2,19)	181153.71	0.36			157.925	0.3068	
$H^{12}COOD$	23(2,21) - 24(1,24)	181463.55	2.15			207.154	0.0058	
$H^{12}COOH$	25(3,22) - 24(4,21)	181464.35	0.03			261.061	0.1527	
$H^{12}COOH$	23(6,17) - 24(5,20)	181621.05	0.05			280.699	0.1216	
$H^{13}COOH$	8(2, 6) - 7(2, 5)	181688.73	0.03	181688.71	0.12	29.657	7.4989	
$H^{13}COOH$	5(2, 3) - 5(1, 4)	181794.59	0.08	181794.51	0.12	13.782	0.1038	
$H^{12}COOH$	8(2, 6) - 7(2, 5)	181850.08	0.01	181850.06	0.12	29.940	7.4989	
$H^{13}COOH$	6(1, 6) - 5(0, 5)	182040.75	0.06			11.186	0.1303	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOH$	19(2,17) - 18(3,16)	182802.11	0.02	182802.13	0.12	148.405	0.1355	
$D^{12}COOH$	8(1, 7) - 7(1, 6)	182864.46	0.02	182864.45	0.12	23.024	7.8610	
$D^{12}COOH$	17(2,15) - 17(1,16)	182923.04	0.06			116.237	0.3820	
$H^{12}COOD$	34(4,30) - 34(4,31)	182991.42	0.53			463.046	0.5998	
$D^{12}COOH$	2(2, 1) - 1(1, 0)	183072.49	0.04			2.327	0.0525	
$H^{12}COOH$	10(0,10) - 9(1, 9)	183090.25	0.01	183090.22	0.12	34.636	0.2159	
$D^{12}COOH$	18(7,12) - 19(6,13)	183095.45	0.79			195.998	0.0720	
$D^{12}COOH$	18(7,11) - 19(6,14)	183126.38	0.79			195.997	0.0720	
$H^{12}COOH$	46(10,37) - 47(9,38)	183190.69	0.14			1025.879	0.2518	
$H^{12}COOH$	46(10,36) - 47(9,39)	183209.34	0.14			1025.878	0.2518	
$H^{12}COOH$	46(10,36) - 47(9,39)	183209.34	0.14			1025.878	0.2518	
$H^{12}COOD$	18(2,16) - 18(1,17)	183236.49	0.45			128.621	0.4562	
$D^{12}COOH$	29(4,26) - 28(5,23)	183741.37	1.58			340.312	0.1137	
$D^{12}COOH$	15(3,12) - 15(2,13)	183783.16	0.09			97.138	0.3876	
$H^{12}COOH$	6(2, 4) - 6(1, 5)	183964.55	0.01	183964.51	0.12	18.509	0.1300	
$H^{13}COOH$	22(6,17) - 23(5,18)	184000.20	8.06			260.734	0.1139	
$D^{12}COOH$	33(4,30) - 32(5,27)	184077.52	2.68			432.745	0.0843	
$H^{12}COOD$	7(1, 7) - 6(0, 6)	184118.98	0.05			15.122	0.1564	
$H^{12}COOH$	50(7,43) - 49(8,42)	184260.36	0.07			1062.127	0.2848	
$H^{12}COOH$	14(1,13) - 14(0,14)	184360.34	0.02	184360.37	0.12	77.098	0.2514	
$H^{13}COOH$	22(6,16) - 23(5,19)	184466.70	8.05			260.718	0.1139	
$H^{12}COOH$	6(1, 6) - 5(0, 5)	184511.57	0.01	184511.57	0.12	11.208	0.1300	
$H^{13}COOH$	10(0,10) - 9(1, 9)	184568.48	0.06			34.483	0.2184	
$H^{12}COOH$	25(2,23) - 26(1,26)	184762.76	0.19			252.471	0.0079	
$H^{12}COOD$	6(2, 5) - 6(1, 6)	184809.16	0.44			16.417	0.1009	
$D^{12}COOH$	2(2, 0) - 1(1, 1)	185243.48	0.04			2.257	0.0513	
$H^{13}COOH$	4(2, 2) - 4(1, 3)	185253.32	0.08			9.906	0.0785	
$H^{13}COOH$	5(3, 3) - 6(2, 4)	185306.80	0.55			24.368	0.0176	
$H^{13}COOH$	8(1, 7) - 7(1, 6)	185431.89	0.03	185431.89	0.12	23.847	7.8707	
$H^{12}COOD$	10(0,10) - 9(1, 9)	185451.36	0.05			33.014	0.2299	
$H^{13}COOH$	37(4,33) - 37(4,34)	185485.29	0.22			562.770	0.5665	
$D^{12}COOH$	13(1,12) - 13(0,13)	185526.65	0.09			64.390	0.1753	
$H^{12}COOH$	8(1, 7) - 7(1, 6)	185650.12	0.01	185650.12	0.12	23.933	7.8712	
$D^{12}COOH$	20(3,17) - 20(2,18)	185764.74	0.17			165.581	0.5649	
$H^{13}COOH$	14(1,13) - 14(0,14)	185973.33	0.13			76.864	0.2437	
$H^{12}COOH$	17(5,13) - 18(4,14)	186151.37	0.04			163.885	0.0870	
$H^{12}COOD$	9(1, 9) - 8(1, 8)	186393.02	0.03	186393.10	0.12	26.797	8.8822	
$D^{12}COOH$	29(5,24) - 28(6,23)	186442.13	1.32			355.970	0.1516	
$D^{12}COOH$	22(8,15) - 23(7,16)	186475.41	1.29			279.582	0.0911	
$D^{12}COOH$	22(8,14) - 23(7,17)	186487.52	1.29			279.581	0.0911	
$D^{12}COOH$	38(7,31) - 37(8,30)	186507.59	3.39			618.631	0.1963	
$H^{12}COOH$	44(6,38) - 43(7,37)	186526.46	0.05			819.644	0.2506	
$D^{12}COOH$	9(1, 9) - 8(1, 8)	186912.04	0.03	186912.04	0.12	26.625	8.8770	
$D^{12}COOH$	3(2, 2) - 3(0, 3)	187156.83	0.05			4.394	0.0044	
$H^{12}COOH$	17(5,12) - 18(4,15)	187212.13	0.04			163.850	0.0869	
$D^{12}COOH$	31(5,27) - 30(6,24)	187563.13	1.79			400.013	0.1528	
$H^{13}COOH$	5(3, 2) - 6(2, 5)	187584.96	0.55			24.292	0.0176	
$H^{12}COOD$	13(1,12) - 12(2,11)	187674.91	0.48			63.689	0.1438	
$H^{12}COOH$	5(2, 3) - 5(1, 4)	187708.49	0.02			13.857	0.1031	
$H^{13}COOH$	18(2,16) - 18(1,17)	187730.82	0.08	187730.98	0.12	133.202	0.4967	
$D^{12}COOH$	4(2, 3) - 4(0, 4)	187806.12	0.04			7.307	0.0101	
$D^{12}COOH$	30(4,26) - 30(4,27)	187813.67	0.25			368.510	0.6566	
$H^{13}COOH$	29(3,26) - 29(3,27)	187928.55	0.21			345.095	0.4248	
$H^{13}COOH$	3(2, 1) - 3(1, 2)	188232.68	0.08			6.803	0.0545	
$H^{12}COOD$	27(3,24) - 27(3,25)	188307.51	0.48			290.776	0.4474	
$D^{12}COOH$	29(3,26) - 30(2,29)	188458.14	2.49			336.989	0.0096	
$H^{12}COOH$	45(6,40) - 44(7,37)	188503.66	0.06			852.893	0.2536	
$H^{12}COOH$	40(9,32) - 41(8,33)	188505.69	0.09			788.074	0.2175	
$H^{12}COOH$	40(9,31) - 41(8,34)	188547.51	0.09			788.072	0.2175	
$H^{12}COOD$	3(3, 1) - 4(2, 2)	188586.28	1.96			14.639	0.0044	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{13}COOH$	37(5,32) - 36(6,31)	188736.00	8.72			577.510	0.2099	
$H^{12}COOH$	18(2,16) - 18(1,17)	188870.78	0.01			133.510	0.5035	
$D^{12}COOH$	9(2, 8) - 9(1, 9)	188939.06	0.04			32.860	0.1305	
$D^{12}COOH$	14(3,11) - 14(2,12)	188967.20	0.08			85.662	0.3449	
$D^{12}COOH$	5(2, 4) - 5(0, 5)	189042.38	0.04			10.931	0.0188	
$H^{12}COOD$	3(3, 0) - 4(2, 3)	189239.24	1.96			14.617	0.0044	
$H^{12}COOD$	8(4, 5) - 9(3, 6)	189295.84	4.99			49.280	0.0293	
$D^{12}COOH$	24(3,21) - 24(3,22)	189378.19	0.11			234.377	0.4952	
$H^{12}COOD$	14(1,13) - 14(0,14)	189433.14	0.30			73.985	0.2117	
$D^{12}COOH$	30(4,27) - 29(5,24)	189479.51	1.81			362.189	0.1080	
$H^{12}COOD$	13(5, 9) - 14(4,10)	189494.86	9.65			105.786	0.0561	
$D^{12}COOH$	21(2,19) - 22(1,22)	189600.45	1.14			175.070	0.0040	
$D^{12}COOH$	26(9,18) - 27(8,19)	189736.85	2.04			378.046	0.1103	
$D^{12}COOH$	26(9,17) - 27(8,20)	189741.42	2.04			378.046	0.1103	
$H^{12}COOD$	13(5, 8) - 14(4,11)	189856.42	9.65			105.774	0.0561	
$D^{12}COOH$	32(4,29) - 31(5,26)	189866.10	2.35			408.403	0.0929	
$H^{12}COOD$	8(4, 4) - 9(3, 7)	189905.66	4.99			49.260	0.0293	
$H^{12}COOH$	15(1,14) - 15(1,15)	190204.00	0.02			88.376	0.1456	
$D^{12}COOH$	8(1, 8) - 7(0, 7)	190475.44	0.03			20.272	0.1910	
$H^{13}COOH$	35(4,32) - 34(5,29)	190485.68	4.85			501.656	0.1699	
$H^{13}COOH$	2(2, 0) - 2(1, 1)	190591.39	0.08			4.476	0.0303	
$D^{12}COOH$	48(6,37) - 48(6,38)	190596.67	1.97			757.682	0.9748	
$H^{12}COOH$	11(4, 8) - 12(3, 9)	190746.79	0.03			78.524	0.0522	
$H^{12}COOD$	9(0, 9) - 8(0, 8)	190768.08	0.03			25.801	8.9626	
$H^{13}COOH$	39(5,35) - 38(6,32)	190794.72	8.60			634.225	0.2125	
$D^{12}COOH$	9(0, 9) - 8(0, 8)	190796.73	0.03			25.966	8.9397	
$D^{12}COOH$	6(2, 5) - 6(0, 6)	191118.90	0.04			15.257	0.0306	
$H^{12}COOH$	4(2, 2) - 4(1, 3)	191128.53	0.02			9.977	0.0781	
$H^{12}COOD$	7(2, 6) - 7(1, 7)	191275.10	0.43			21.264	0.1147	
$D^{12}COOH$	31(4,28) - 30(5,25)	191609.67	2.06			384.885	0.1009	
$H^{12}COOH$	38(4,34) - 38(4,35)	191823.50	0.09			593.192	0.5514	
$H^{12}COOH$	14(1,13) - 13(2,12)	192265.22	0.01			76.834	0.1483	
$D^{12}COOH$	12(1,11) - 11(2,10)	192486.67	0.10			54.440	0.1424	
$H^{12}COOH$	11(4, 7) - 12(3,10)	192494.17	0.03			78.466	0.0521	
$H^{13}COOH$	16(5,12) - 17(4,13)	192794.56	4.25			149.129	0.0792	
$D^{12}COOH$	30(10,21) - 31(9,22)	192912.61	3.14			491.377	0.1295	
$D^{12}COOH$	30(10,20) - 31(9,23)	192914.28	3.14			491.377	0.1295	
$H^{12}COOH$	22(2,20) - 22(2,21)	193139.38	0.03	193139.37	0.12	196.741	0.2794	
$H^{13}COOH$	9(1, 9) - 8(1, 8)	193483.72	0.03	193483.67	0.12	28.029	8.8844	
$H^{12}COOH$	38(5,33) - 37(6,32)	193519.64	0.05			608.416	0.2171	
$H^{13}COOH$	16(5,11) - 17(4,14)	193599.84	4.24			149.103	0.0792	
$H^{13}COOH$	15(1,14) - 15(1,15)	193689.04	0.16			88.055	0.1472	
$D^{12}COOH$	21(3,18) - 21(2,19)	193767.77	0.18			181.394	0.5802	
$H^{12}COOH$	34(8,27) - 35(7,28)	193941.81	0.07			581.559	0.1831	
$H^{12}COOH$	40(5,36) - 39(6,33)	193974.21	0.06			666.724	0.2193	
$H^{12}COOH$	34(8,26) - 35(7,29)	194032.60	0.07			581.556	0.1831	
$H^{12}COOH$	9(1, 9) - 8(1, 8)	194046.98	0.01	194046.93	0.12	28.164	8.8848	
$H^{12}COOH$	3(2, 1) - 3(1, 2)	194062.26	0.02			6.871	0.0544	
$D^{12}COOH$	5(4, 2) - 6(3, 3)	194064.34	0.16			29.467	0.0089	
$D^{12}COOH$	5(4, 1) - 6(3, 4)	194189.38	0.16			29.463	0.0089	
$D^{12}COOH$	7(2, 6) - 7(0, 7)	194295.38	0.04			20.272	0.0453	
$H^{13}COOH$	31(4,27) - 30(5,26)	194701.60	4.64			403.014	0.1790	
$D^{12}COOH$	44(5,40) - 43(6,37)	194750.41	9.92			764.039	0.0713	
$H^{12}COOH$	5(3, 3) - 6(2, 4)	194758.69	0.02			24.646	0.0176	
$H^{12}COOD$	9(2, 8) - 8(2, 7)	194786.73	0.02			33.425	8.5511	
$D^{12}COOH$	10(0,10) - 9(1, 9)	194802.22	0.05			32.860	0.2479	
$H^{12}COOD$	33(3,30) - 34(2,33)	194915.13	3.07			427.432	0.0129	
$D^{12}COOH$	13(3,10) - 13(2,11)	195066.23	0.07			74.949	0.3043	
$H^{13}COOH$	25(2,23) - 26(1,26)	195163.55	1.89			251.586	0.0072	
$D^{12}COOH$	47(9,39) - 46(10,36)	195244.79	7.85			953.116	0.2419	
$H^{13}COOH$	19(2,17) - 18(3,16)	195355.41	0.65			147.626	0.1378	
$H^{12}COOH$	36(4,33) - 35(5,30)	195404.32	0.06			530.334	0.1751	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stan. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOD$	42(5,37) - 42(5,38)	195485.83	1.72			705.205	0.7292	
$H^{13}COOH$	2(2, 1) - 2(1, 2)	195581.79	0.08			4.308	0.0292	
$D^{12}COOH$	20(3,17) - 19(4,16)	195774.94	0.43			165.247	0.1188	
$H^{12}COOD$	9(8, 2) - 8(8, 1)	195779.12	0.04			143.900	1.8890	
$H^{12}COOD$	9(8, 1) - 8(8, 0)	195779.12	0.04			143.900	1.8890	
$H^{12}COOD$	9(7, 3) - 8(7, 2)	195789.97	0.03			116.814	3.5558	
$H^{12}COOD$	9(7, 2) - 8(7, 1)	195789.97	0.03			116.314	3.5558	
$H^{12}COOD$	9(6, 4) - 8(6, 3)	195817.55	0.03			92.398	5.0003	
$H^{12}COOD$	9(6, 3) - 8(6, 2)	195817.55	0.03			92.398	5.0003	
$H^{12}COOD$	9(5, 5) - 8(5, 4)	195875.55	0.03			72.156	6.2226	
$H^{12}COOD$	9(5, 4) - 8(5, 3)	195875.62	0.03			72.156	6.2226	
$H^{12}COOD$	9(4, 6) - 8(4, 5)	195995.72	0.02			55.594	7.2225	
$H^{12}COOD$	9(4, 5) - 8(4, 4)	196002.31	0.02			55.594	7.2225	
$D^{12}COOH$	34(11,24) - 35(10,25)	196025.50	4.69			619.559	0.1486	
$D^{12}COOH$	34(11,23) - 35(10,26)	196026.10	4.69			619.559	0.1486	
$H^{12}COOD$	9(3, 7) - 8(3, 6)	196153.99	0.02			42.717	7.9998	
$H^{12}COOH$	2(2, 0) - 2(1, 1)	196378.11	0.02			4.541	0.0303	
$H^{12}COOD$	9(3, 6) - 8(3, 5)	196455.59	0.02			42.727	7.9998	
$D^{12}COOH$	9(2, 8) - 8(2, 7)	196815.84	0.03			32.597	8.5471	
$H^{12}COOH$	5(3, 2) - 6(2, 5)	196879.21	0.02			24.575	0.0176	
$D^{12}COOH$	47(9,38) - 46(10,37)	197676.82	7.93			953.112	0.2420	
$H^{12}COOD$	19(2,17) - 19(1,18)	197917.89	0.46			142.383	0.4547	
$H^{13}COOH$	3(2, 2) - 3(1, 3)	198114.90	0.08			6.468	0.0505	
$H^{13}COOH$	9(0, 9) - 8(0, 8)	198167.74	0.03	198167.68	0.12	26.713	8.9740	
$D^{12}COOH$	35(6,30) - 34(7,27)	198173.58	2.62			515.992	0.1787	
$D^{12}COOH$	9(8, 2) - 8(8, 1)	198363.46	0.06	198363.46	0.12	126.040	1.8891	
$D^{12}COOH$	9(8, 1) - 8(8, 0)	198363.46	0.06	198363.46	0.12	126.040	1.8891	
$D^{12}COOH$	9(5, 5) - 10(4, 6)	198366.70	0.30			65.398	0.0266	
$D^{12}COOH$	9(7, 3) - 8(7, 2)	198396.04	0.03	198396.05	0.12	102.720	3.5560	
$D^{12}COOH$	9(7, 2) - 8(7, 1)	198396.04	0.03	198396.05	0.12	102.720	3.5560	
$D^{12}COOH$	9(5, 4) - 10(4, 7)	198444.56	0.30			65.395	0.0266	
$D^{12}COOH$	9(6, 4) - 8(6, 3)	198453.86	0.03	198453.85	0.12	82.502	5.0006	
$D^{12}COOH$	9(6, 3) - 8(6, 2)	198453.86	0.03	198453.85	0.12	82.502	5.0006	
$H^{13}COOH$	14(1,13) - 13(2,12)	198509.04	0.15			76.446	0.1514	
$H^{13}COOH$	19(2,17) - 19(1,18)	198535.94	0.09			147.520	0.5054	
$D^{12}COOH$	9(5, 5) - 8(5, 4)	198559.08	0.03	198559.21	0.12	65.392	6.2229	
$D^{12}COOH$	9(5, 4) - 8(5, 3)	198559.37	0.03	198559.21	0.12	65.392	6.2229	
$H^{12}COOD$	8(2, 7) - 8(1, 8)	198702.93	0.42			26.797	0.1271	
$H^{12}COOH$	9(0, 9) - 8(0, 8)	198754.98	0.01	198754.96	0.12	26.774	8.9762	
$D^{12}COOH$	9(4, 6) - 8(4, 5)	198759.07	0.03	198759.07	0.12	51.395	7.2228	
$H^{13}COOH$	19(2,17) - 19(1,18)	198759.12	0.01			147.873	0.5146	
$D^{12}COOH$	9(4, 5) - 8(4, 4)	198779.53	0.03	98779.52	0.12	51.395	7.2228	
$D^{12}COOH$	8(2, 7) - 8(0, 8)	198805.27	0.04			25.966	0.0621	
$D^{12}COOH$	43(8,36) - 42(9,33)	198850.21	5.50			792.582	0.2218	
$D^{12}COOH$	9(3, 7) - 8(3, 6)	198943.09	0.03	98943.07	0.12	40.514	7.9996	
$D^{12}COOH$	38(12,27) - 39(11,28)	199092.26	6.80			762.574	0.1678	
$D^{12}COOH$	38(12,26) - 39(11,29)	199092.47	6.80			762.574	0.1678	
$H^{13}COOH$	7(1, 7) - 6(0, 6)	199337.13	0.05			15.637	0.1533	
$D^{12}COOH$	50(7,43) - 50(7,44)	199381.38	4.91			1022.359	1.1166	
$H^{12}COOH$	28(7,22) - 29(6,23)	199389.43	0.06			406.397	0.1487	
$H^{13}COOH$	46(5,41) - 46(5,42)	199502.03	0.61			867.289	0.6859	
$H^{12}COOD$	9(2, 7) - 8(2, 6)	199574.95	0.02	99575.06	0.12	33.720	8.5549	
$H^{12}COOH$	28(7,21) - 29(6,24)	199578.74	0.06			406.391	0.1487	
$D^{12}COOH$	9(3, 6) - 8(3, 5)	199612.84	0.03	99612.82	0.12	40.537	7.9997	
$H^{12}COOH$	30(3,27) - 30(3,28)	199615.36	0.05			368.671	0.4094	
$H^{12}COOH$	47(5,42) - 47(5,43)	199817.48	0.14			905.483	0.6755	
$H^{12}COOH$	56(6,50) - 56(6,51)	199842.23	0.14			1282.866	0.8058	
$D^{12}COOH$	10(2, 9) - 10(1,10)	199955.15	0.04			39.775	0.1381	
$D^{12}COOH$	34(6,28) - 33(7,27)	200057.12	2.31			490.656	0.1766	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$-$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOD$	8(1, 8) - 7(0, 7)	200249.72	0.05			20.117	0.1827	
$H^{13}COOH$	25(3,22) - 24(4,21)	200415.57	2.04			259.711	0.1538	
$H^{12}COOD$	23(3,20) - 22(4,19)	200439.58	5.17			213.735	0.1401	
$D^{12}COOH$	39(7,33) - 38(8,30)	200593.62	3.81			646.863	0.2011	
$H^{13}COOH$	10(4, 7) - 11(3, 8)	201040.43	1.85			68.831	0.0444	
$H^{12}COOH$	2(2, 1) - 2(1, 2)	201264.05	0.02			4.377	0.0292	
$H^{13}COOH$	9(2, 8) - 8(2, 7)	201285.07	0.03			35.494	8.5527	
$H^{13}COOH$	22(2,20) - 22(2,21)	201293.95	0.19			196.042	0.2794	
$H^{12}COOD$	50(6,44) - 50(6,45)	201406.52	5.16			997.594	0.8626	
$H^{13}COOH$	4(2, 3) - 4(1, 4)	201503.96	0.08			9.347	0.0693	
$D^{12}COOH$	12(3, 9) - 12(2,10)	201608.05	0.06			65.007	0.2670	
$H^{12}COOH$	9(2, 8) - 8(2, 7)	201673.55	0.01	201673.72	0.12	35.798	8.5530	[25A]
$H^{12}COOH$	7(1, 7) - 6(0, 6)	201920.63	0.01	201920.76	0.12	15.670	0.1526	
$D^{12}COOH$	18(2,16) - 18(1,17)	201981.98	0.08			129.302	0.3743	
$H^{13}COOH$	9(7, 3) - 8(7, 2)	202069.56	0.04			132.020	3.5557	
$H^{13}COOH$	9(7, 2) - 8(7, 1)	202069.56	0.04			132.020	3.5557	
$H^{13}COOH$	9(8, 2) - 8(8, 1)	202072.17	0.05			164.131	1.8890	
$H^{13}COOH$	9(8, 1) - 8(8, 0)	202072.17	0.05			164.131	1.8890	
$H^{13}COOH$	9(6, 4) - 8(6, 3)	202080.88	0.03	202081.11	0.12	104.171	5.0002	
$H^{13}COOH$	9(6, 3) - 8(6, 2)	202080.88	0.03	202081.11	0.12	104.171	5.0002	
$H^{13}COOH$	9(5, 5) - 8(5, 4)	202116.38	0.02			80.594	6.2224	
$H^{13}COOH$	9(5, 4) - 8(5, 3)	202116.40	0.02			80.594	6.2224	
$D^{12}COOH$	42(13,30) - 43(12,31)	202125.77	9.60			920.403	0.1869	
$D^{12}COOH$	42(13,29) - 43(12,32)	202125.85	9.60			920.403	0.1869	
$H^{13}COOH$	9(4, 6) - 8(4, 5)	202200.63	0.02	202200.35	0.12	61.297	7.2224	
$H^{13}COOH$	9(4, 5) - 8(4, 4)	202203.80	0.02			61.297	7.2224	
$H^{12}COOD$	9(1, 8) - 8(1, 7)	202210.61	0.03			28.939	8.8785	
$H^{13}COOH$	10(4, 6) - 11(3, 9)	202228.53	1.85			68.792	0.0444	
$H^{13}COOH$	45(4,42) - 44(5,39)	202231.82	7.36			803.802	0.1025	
$D^{12}COOH$	13(6, 8) - 14(5, 9)	202299.31	0.52			116.233	0.0454	
$H^{13}COOH$	9(3, 7) - 8(3, 6)	202334.07	0.02	202334.15	0.12	46.288	7.9999	
$D^{12}COOH$	13(6, 7) - 14(5,10)	202336.90	0.52			116.232	0.0454	
$H^{12}COOH$	9(7, 3) - 8(7, 2)	202409.38	0.01	202409.17	0.12	135.188	3.5557	[25A]
$H^{12}COOH$	9(7, 2) - 8(7, 1)	202409.38	0.01	202409.17	0.12	135.188	3.5557	[25A]
$H^{12}COOH$	9(8, 2) - 8(8, 1)	202413.77	0.01	202413.65	0.12	168.253	1.8890	[25A]
$H^{12}COOH$	9(8, 1) - 8(8, 0)	202413.77	0.01	202413.65	0.12	168.253	1.8890	[25A]
$H^{12}COOH$	9(6, 4) - 8(6, 3)	202418.21	0.01	202418.30	0.12	106.511	5.0002	[25A]
$H^{12}COOH$	9(6, 3) - 8(6, 2)	202418.21	0.01	202418.30	0.12	106.511	5.0002	[25A]
$H^{12}COOH$	9(5, 5) - 8(5, 4)	202449.79	0.01	202450.01	0.12	82.233	6.2224	[25A]
$H^{12}COOH$	9(5, 4) - 8(5, 3)	202449.81	0.01	202450.01	0.12	82.233	6.2224	[25A]
$H^{13}COOH$	9(3, 6) - 8(3, 5)	202516.07	0.02	202515.95	0.12	46.294	7.9999	
$H^{12}COOH$	9(4, 6) - 8(4, 5)	202527.11	0.01	202527.30	0.12	62.362	7.2224	[25A]
$H^{12}COOH$	9(4, 5) - 8(4, 4)	202529.78	0.01	202529.76	0.12	62.362	7.2224	[25A]
$H^{12}COOH$	9(3, 7) - 8(3, 6)	202654.13	0.01	202654.46	0.12	46.906	7.9999	[25A]
$H^{12}COOH$	9(3, 6) - 8(3, 5)	202815.20	0.01	202815.16	0.12	46.911	7.9999	[25A]
$D^{12}COOH$	3(2, 2) - 2(1, 1)	202984.00	0.04			3.866	0.0583	
$H^{13}COOH$	36(4,33) - 35(5,30)	203432.73	4.98			528.240	0.1678	
$H^{12}COOD$	15(1,14) - 15(1,15)	203496.86	0.42			84.569	0.1564	
$H^{12}COOH$	3(2, 2) - 3(1, 3)	203742.43	0.02			6.543	0.0506	
$H^{12}COOH$	15(1,14) - 15(0,15)	203937.27	0.02			87.918	0.2472	
$D^{12}COOH$	14(1,13) - 14(1,14)	203938.47	0.13			74.183	0.1790	
$D^{12}COOH$	9(2, 7) - 8(2, 6)	204075.44	0.03			33.062	8.5578	
$D^{12}COOH$	22(3,19) - 22(2,20)	204684.18	0.19			197.884	0.5871	
$H^{12}COOH$	22(6,17) - 23(5,18)	204707.25	0.05			262.638	0.1141	
$D^{12}COOH$	9(2, 8) - 9(0, 9)	204824.39	0.04			32.330	0.0798	
$H^{13}COOH$	9(2, 7) - 8(2, 6)	204978.34	0.03	204978.32	0.12	35.717	8.5545	
$D^{12}COOH$	43(8,35) - 42(9,34)	205064.57	5.60			792.570	0.2222	
$H^{12}COOH$	22(6,16) - 23(5,19)	205080.93	0.05			262.625	0.1140	
$H^{12}COOH$	9(2, 7) - 8(2, 6)	205127.74	0.01	205127.82	0.12	36.006	8.5544	[25A]
$D^{12}COOH$	9(1, 8) - 8(1, 7)	205130.98	0.03	205130.95	0.12	29.124	8.8677	
$H^{12}COOH$	32(4,28) - 31(5,27)	205663.02	0.04			428.495	0.1862	
$H^{13}COOH$	5(2, 4) - 5(1, 5)	205757.69	0.08			12.944	0.0864	
$D^{12}COOH$	19(2,17) - 19(2,18)	205777.10	0.12			143.594	0.3316	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOD$	21(2,19) - 21(2,20)	205825.13	0.45			172.806	0.2948	
$D^{12}COOH$	17(7,11) - 18(6,12)	205963.21	0.88			181.969	0.0645	
$D^{12}COOH$	17(7,10) - 18(6,13)	205979.37	0.88			181.969	0.0645	
$H^{13}COOH$	15(1,14) - 15(0,15)	206006.45	0.16			87.644	0.2393	
$D^{12}COOH$	32(5,28) - 31(6,25)	206323.56	2.06			423.154	0.1543	
$H^{12}COOD$	18(2,16) - 17(3,15)	206372.62	2.01			127.849	0.1349	
$D^{12}COOH$	16(2,14) - 15(3,13)	206422.69	0.23			102.482	0.1223	
$D^{12}COOH$	9(1, 9) - 8(0, 8)	206682.06	0.03			25.966	0.2222	
$H^{12}COOD$	10(1,10) - 9(1, 9)	206837.53	0.03			33.014	9.8911	
$H^{12}COOH$	45(10,36) - 46(9,37)	206882.58	0.15			990.540	0.2444	
$H^{12}COOH$	45(10,35) - 46(9,38)	206895.37	0.15			990.540	0.2444	
$H^{12}COOH$	4(2, 3) - 4(1, 4)	207057.72	0.02			9.430	0.0694	
$H^{12}COOD$	9(2, 8) - 9(1, 9)	207096.64	0.41			33.014	0.1382	
$D^{12}COOH$	10(1,10) - 9(1, 9)	207297.38	0.04			32.860	9.8847	
$H^{12}COOD$	24(2,22) - 25(1,25)	207327.09	2.52			224.103	0.0054	
$H^{13}COOH$	21(6,16) - 22(5,17)	207553.24	8.06			243.437	0.1063	
$D^{12}COOH$	37(5,32) - 37(5,33)	207760.01	0.96			559.688	0.7890	
$H^{12}COOH$	46(4,43) - 45(5,40)	207816.51	0.26			840.422	0.1070	
$H^{13}COOH$	21(6,15) - 22(5,18)	207854.78	8.05			243.427	0.1063	
$D^{12}COOH$	14(1,13) - 14(0,14)	208003.67	0.13			74.048	0.1719	
$D^{12}COOH$	11(3, 8) - 11(2, 9)	208138.10	0.05			55.843	0.2332	
$H^{12}COOH$	37(4,34) - 36(5,31)	208168.57	0.07			557.714	0.1728	
$H^{12}COOD$	2(2, 1) - 1(1, 0)	208255.01	0.45			2.597	0.0525	
$H^{13}COOH$	9(1, 8) - 8(1, 7)	208359.74	0.03			30.033	8.8825	
$H^{13}COOH$	4(3, 2) - 5(2, 3)	208606.25	0.55			19.846	0.0106	
$H^{12}COOH$	9(1, 8) - 8(1, 7)	208623.90	0.01	208623.86	0.12	30.125	8.8832	[25A]
$H^{12}COOH$	11(0,11) - 10(1,10)	208828.61	0.01			41.822	0.2488	
$D^{12}COOH$	21(8,14) - 22(7,15)	209433.68	1.45			262.597	0.0836	
$D^{12}COOH$	21(8,13) - 22(7,16)	209440.18	1.45			262.597	0.0836	
$H^{12}COOD$	11(0,11) - 10(1,10)	209569.65	0.05			39.914	0.2649	
$D^{12}COOH$	3(2, 1) - 2(1, 2)	209637.92	0.04			3.655	0.0544	
$H^{12}COOH$	16(5,12) - 17(4,13)	209713.69	0.04			150.323	0.0793	
$H^{13}COOH$	4(3, 1) - 5(2, 4)	209747.22	0.55			19.808	0.0106	
$H^{12}COOD$	2(2, 0) - 1(1, 1)	210091.02	0.45			2.537	0.0516	
$H^{13}COOH$	11(0,11) - 10(1,10)	210137.20	0.06			41.647	0.2518	
$D^{12}COOH$	25(4,21) - 24(5,20)	210272.86	0.85			260.617	0.1363	
$H^{12}COOD$	35(4,31) - 35(4,32)	210301.94	0.73			488.441	0.5697	
$H^{12}COOH$	16(5,11) - 17(4,14)	210391.70	0.04			150.301	0.0793	
$H^{12}COOD$	21(3,18) - 21(2,19)	210523.00	1.83			179.672	0.5907	
$H^{12}COOH$	26(2,24) - 27(1,27)	210609.92	0.23			271.564	0.0072	
$H^{12}COOH$	20(2,18) - 20(1,19)	210618.42	0.02			162.941	0.5207	
$H^{12}COOD$	15(1,14) - 15(0,15)	210665.78	0.39			84.330	0.2074	
$D^{12}COOH$	10(0,10) - 9(0, 9)	210687.55	0.04			32.330	9.9293	
$H^{12}COOD$	20(3,17) - 20(2,18)	210754.74	1.86			163.968	0.5526	
$H^{13}COOH$	6(2, 5) - 6(1, 6)	210885.61	0.08			17.258	0.1023	
$H^{12}COOD$	10(0,10) - 9(0, 9)	210948.03	0.03	210948.03	0.12	32.164	9.9536	[16A]
$H^{12}COOH$	5(2, 4) - 5(1, 5)	211218.14	0.02			13.037	0.0866	
$H^{13}COOH$	20(2,18) - 20(1,19)	211370.62	0.10			162.537	0.5090	
$H^{13}COOH$	40(5,36) - 39(6,33)	211570.12	8.70			663.696	0.2151	
$H^{12}COOD$	7(4, 4) - 8(3, 5)	211592.08	4.98			42.727	0.0221	
$H^{12}COOD$	7(4, 3) - 8(3, 6)	211897.50	4.98			42.717	0.0221	
$H^{12}COOD$	12(5, 8) - 13(4, 9)	211954.58	9.64			95.589	0.0485	
$D^{12}COOH$	11(2,10) - 11(1,11)	212052.65	0.05			47.367	0.1444	
$H^{13}COOH$	38(4,34) - 38(4,35)	212083.23	0.31			591.238	0.5385	
$H^{12}COOD$	12(5, 7) - 13(4,10)	212156.10	9.64			95.582	0.0485	
$H^{12}COOH$	39(9,31) - 40(8,32)	212196.44	0.10			757.227	0.2101	
$H^{12}COOH$	39(9,30) - 40(8,33)	212224.85	0.10			757.226	0.2101	
$H^{12}COOD$	22(3,19) - 22(2,20)	212304.51	1.80			196.088	0.6239	
$H^{12}COOH$	46(6,41) - 45(7,38)	212416.94	0.07			886.861	0.2582	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'\ (K'_{-1}, K'_{+1})\ J\ (K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{12}COOH$	10(2, 9) - 10(0,10)	212450.31	0.05			39.358	0.0972	
$D^{12}COOH$	25(9,17) - 26(8,18)	212762.37	2.31			358.108	0.1028	
$D^{12}COOH$	25(9,16) - 26(8,19)	212764.87	2.31			358.108	0.1028	
$H^{12}COOD$	19(3,16) - 19(2,17)	212784.37	1.89			148.985	0.5113	
$H^{12}COOH$	16(1,15) - 16(1,16)	213609.91	0.03			99.801	0.1409	
$H^{13}COOH$	30(3,27) - 30(3,28)	213728.70	0.29			367.416	0.4048	
$H^{12}COOH$	10(4, 7) - 11(3, 8)	214199.88	0.03			69.480	0.0444	
$D^{12}COOH$	10(3, 7) - 10(2, 8)	214255.60	0.05			47.463	0.2029	
$H^{13}COOH$	37(4,34) - 36(5,31)	214285.98	5.13			555.622	0.1643	
$H^{13}COOH$	44(4,41) - 43(5,38)	214523.40	6.95			769.937	0.1115	
$H^{12}COOD$	20(2,18) - 20(1,19)	214706.11	0.48			156.806	0.4496	
$H^{12}COOD$	28(3,25) - 28(3,26)	214731.75	0.59			310.921	0.4273	
$H^{13}COOH$	10(1,10) - 9(1, 9)	214769.91	0.03			34.483	9.8940	
$H^{12}COOH$	41(5,37) - 40(6,34)	214771.09	0.07			696.988	0.2219	
$H^{12}COOH$	10(4, 6) - 11(3, 9)	215251.42	0.03			69.446	0.0444	
$H^{12}COOH$	10(1,10) - 9(1, 9)	215407.84	0.01	215407.90	0.12	34.636	9.8945	
$D^{12}COOH$	39(7,32) - 38(8,31)	215708.70	3.89			646.832	0.2022	
$D^{12}COOH$	29(10,20) - 30(9,21)	215984.94	3.56			468.487	0.1220	
$D^{12}COOH$	29(10,19) - 30(9,22)	215985.87	3.56			468.487	0.1220	
$H^{12}COOD$	10(2, 9) - 9(2, 8)	216195.56	0.03	216195.58	0.12	39.922	9.5937	[16A]
$H^{13}COOH$	15(5,11) - 16(4,12)	216202.83	4.25			136.346	0.0715	
$H^{12}COOH$	6(2, 5) - 6(1, 6)	216232.70	0.02			17.362	0.1026	
$D^{12}COOH$	22(2,20) - 23(1,23)	216240.69	1.32			190.671	0.0037	
$H^{13}COOH$	8(1, 8) - 7(0, 7)	216255.40	0.05			20.815	0.1781	
$H^{12}COOD$	9(1, 9) - 8(0, 8)	216264.75	0.05			25.801	0.2112	
$H^{12}COOD$	23(3,20) - 23(2,21)	216275.70	1.76			213.207	0.6511	
$D^{12}COOH$	4(4, 1) - 5(3, 2)	216345.13	0.16			25.047	0.0036	
$H^{12}COOD$	18(3,15) - 18(2,16)	216356.98	1.91			134.733	0.4685	
$D^{12}COOH$	4(4, 0) - 5(3, 3)	216386.86	0.16			25.046	0.0036	
$H^{12}COOD$	10(2, 9) - 10(1,10)	216454.67	0.40			39.914	0.1480	
$H^{13}COOH$	15(5,10) - 16(4,13)	216703.34	4.24			136.329	0.0715	
$H^{12}COOH$	45(6,39) - 44(7,38)	216769.07	0.06			852.829	0.2563	
$H^{13}COOH$	7(2, 6) - 7(1, 7)	216897.11	0.08			22.287	0.1169	
$H^{13}COOH$	16(1,15) - 16(1,16)	217333.46	0.20			99.443	0.1429	
$D^{12}COOH$	43(5,39) - 42(6,36)	217376.75	8.47			731.121	0.0801	
$D^{12}COOH$	31(4,27) - 31(4,28)	217442.39	0.39			391.277	0.6244	
$D^{12}COOH$	25(3,22) - 25(3,23)	217474.32	0.15			252.543	0.4748	
$H^{12}COOD$	10(9, 2) - 9(9, 1)	217541.41	0.07	217541.42	0.12	181.685	1.9001	[16A]
$H^{12}COOD$	10(9, 1) - 9(9, 0)	217541.41	0.07	217541.42	0.12	181.685	1.9001	[16A]
$H^{12}COOD$	10(8, 3) - 9(8, 2)	217546.56	0.04	217546.55	0.12	150.431	3.6002	[16A]
$H^{12}COOD$	10(8, 2) - 9(8, 1)	217546.56	0.04	217546.55	0.12	150.431	3.6002	[16A]
$H^{12}COOD$	10(7, 4) - 9(7, 3)	217565.48	0.04	217565.45	0.12	122.845	5.1003	[16A]
$H^{12}COOD$	10(7, 3) - 9(7, 2)	217565.48	0.04	217565.45	0.12	122.845	5.1003	[16A]
$H^{12}COOH$	33(8,26) - 34(7,27)	217599.72	0.08			555.214	0.1756	
$H^{12}COOD$	10(6, 5) - 9(6, 4)	217606.83	0.04	217606.89	0.12	98.929	6.4004	[16A]
$H^{12}COOD$	10(6, 4) - 9(6, 3)	217606.83	0.04	217606.89	0.12	98.929	6.4004	[16A]
$H^{12}COOH$	33(8,25) - 34(7,28)	217660.71	0.08			555.212	0.1756	
$H^{12}COOD$	10(5, 6) - 9(5, 5)	217689.34	0.03	217689.54	0.12	78.690	7.5004	[16A]
$H^{12}COOD$	10(5, 5) - 9(5, 4)	217689.53	0.03	217689.54	0.12	78.690	7.5004	[16A]
$H^{12}COOH$	23(2,21) - 23(2,22)	217824.48	0.03			213.658	0.2679	
$H^{12}COOD$	10(4, 7) - 9(4, 6)	217854.34	0.03	217854.44	0.12	62.132	8.4003	
$H^{12}COOD$	10(4, 6) - 9(4, 5)	217868.57	0.02	217868.60	0.12	62.132	8.4003	
$H^{12}COOH$	26(3,23) - 25(4,22)	217932.49	0.03			279.914	0.1621	
$D^{12}COOH$	11(0,11) - 10(1,10)	217956.29	0.07			39.775	0.2844	
$H^{12}COOD$	10(3, 8) - 9(3, 7)	218028.98	0.02	218028.88	0.12	49.260	9.0996	
$H^{12}COOH$	4(3, 2) - 5(2, 3)	218036.82	0.02			20.118	0.0106	
$H^{12}COOD$	14(1,13) - 13(2,12)	218116.69	0.49			73.028	0.1675	
$H^{12}COOH$	20(2,18) - 19(3,17)	218132.10	0.02			162.690	0.1492	
$D^{12}COOH$	30(3,27) - 31(2,30)	218165.43	2.91			358.561	0.0089	
$D^{12}COOH$	10(2, 9) - 9(2, 8)	218313.48	0.04			39.162	9.5880	
$D^{12}COOH$	23(3,20) - 23(2,21)	218528.62	0.21			215.038	0.5867	
$H^{12}COOH$	39(4,35) - 39(4,36)	218539.39	0.11			622.453	0.5249	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOD$	10(3, 7) - 9(3, 6)	218541.82	0.02			49.280	9.0996	
$H^{12}COOH$	38(4,35) - 37(5,32)	218869.24	0.08			585.891	0.1692	
$H^{12}COOH$	8(1, 8) - 7(0, 7)	218938.51	0.01			20.861	0.1771	
$H^{12}COOH$	4(3, 1) - 5(2, 4)	219098.57	0.02			20.082	0.0106	
$D^{12}COOH$	33(11,23) - 34(10,24)	219126.93	5.32			593.721	0.1411	
$D^{12}COOH$	33(11,22) - 34(10,25)	219127.27	5.32			593.721	0.1411	
$H^{13}COOH$	10(0,10) - 9(0, 9)	219341.88	0.03	219341.85	0.12	33.323	9.9668	
$D^{12}COOH$	9(3, 6) - 9(2, 7)	219646.64	0.05			39.869	0.1754	
$H^{12}COOH$	45(4,42) - 44(5,39)	219724.73	0.22			805.765	0.1161	
$H^{12}COOH$	10(0,10) - 9(0, 9)	220037.96	0.01	220037.90	0.12	33.404	9.9694	[25A]
$D^{12}COOH$	10(9, 2) - 9(9, 1)	220405.31	0.13			159.073	1.9002	
$D^{12}COOH$	10(9, 1) - 9(9, 0)	220405.31	0.13			159.073	1.9002	
$D^{12}COOH$	10(8, 3) - 9(8, 2)	220432.42	0.07			132.657	3.6004	
$D^{12}COOH$	10(8, 2) - 9(8, 1)	220432.42	0.07			132.657	3.6004	
$D^{12}COOH$	10(7, 4) - 9(7, 3)	220479.74	0.04			109.338	5.1006	
$D^{12}COOH$	10(7, 3) - 9(7, 2)	220479.74	0.04			109.338	5.1006	
$D^{12}COOH$	10(6, 5) - 9(6, 4)	220561.35	0.04			89.122	6.4007	
$D^{12}COOH$	10(6, 4) - 9(6, 3)	220561.36	0.04			89.122	6.4007	
$D^{12}COOH$	10(5, 6) - 9(5, 5)	220707.54	0.04			72.015	7.5008	
$D^{12}COOH$	10(5, 5) - 9(5, 4)	220708.36	0.04			72.015	7.5008	
$D^{12}COOH$	8(5, 4) - 9(4, 5)	220828.32	0.32			58.026	0.0198	
$D^{12}COOH$	8(5, 3) - 9(4, 6)	220861.76	0.32			58.024	0.0198	
$D^{12}COOH$	36(6,31) - 35(7,28)	220969.49	2.99			542.043	0.1826	
$D^{12}COOH$	10(4, 7) - 9(4, 6)	220976.57	0.04			58.024	8.4006	
$D^{12}COOH$	48(9,40) - 47(10,37)	220983.44	8.83			987.947	0.2479	
$D^{12}COOH$	10(4, 6) - 9(4, 5)	221020.70	0.04			58.026	8.4006	
$D^{12}COOH$	30(5,25) - 29(6,24)	221067.52	1.55			377.511	0.1581	
$H^{12}COOD$	3(2, 2) - 3(0, 3)	221138.25	0.48			4.342	0.0023	
$D^{12}COOH$	10(3, 8) - 9(3, 7)	221138.56	0.04			47.150	9.0990	
$H^{12}COOD$	17(3,14) - 17(2,15)	221180.55	1.93			121.219	0.4257	
$H^{13}COOH$	26(2,24) - 27(1,27)	221520.74	2.21			270.612	0.0066	
$H^{12}COOD$	4(2, 3) - 4(0, 4)	221540.73	0.47			7.227	0.0053	
$D^{12}COOH$	11(2,10) - 11(0,11)	221698.56	0.06			47.045	0.1132	
$H^{13}COOH$	38(5,33) - 37(6,32)	221834.56	8.84			605.397	0.2159	
$D^{12}COOH$	4(2, 3) - 3(1, 2)	221835.10	0.04			6.172	0.0660	
$H^{12}COOH$	7(2, 6) - 7(1, 7)	222110.39	0.02			22.405	0.1173	
$D^{12}COOH$	37(12,26) - 38(11,27)	222207.36	7.72			733.792	0.1603	
$D^{12}COOH$	37(12,25) - 38(11,28)	222207.48	7.72			733.792	0.1603	
$D^{12}COOH$	10(3, 7) - 9(3, 6)	222268.94	0.04			47.195	9.0993	
$H^{12}COOD$	5(2, 4) - 5(0, 5)	222310.53	0.47			10.823	0.0099	
$H^{12}COOD$	10(2, 8) - 9(2, 7)	222517.65	0.03			40.377	9.6006	
$H^{12}COOD$	24(3,21) - 24(2,22)	222574.96	1.72			231.018	0.6714	
$H^{13}COOH$	38(4,35) - 37(5,32)	222812.16	5.30			583.806	0.1595	
$D^{12}COOH$	44(6,38) - 44(6,39)	222835.65	2.76			790.317	0.9214	
$D^{12}COOH$	13(1,12) - 12(2,11)	222849.38	0.12			63.145	0.1694	
$H^{12}COOH$	27(7,21) - 28(6,22)	222981.17	0.07			384.562	0.1411	
$D^{12}COOH$	19(2,17) - 19(1,18)	223058.98	0.10			143.018	0.3657	
$H^{12}COOH$	27(7,20) - 28(6,23)	223106.36	0.07			384.558	0.1411	
$D^{12}COOH$	10(1,10) - 9(0, 9)	223182.71	0.04			32.330	0.2552	
$D^{12}COOH$	33(5,29) - 32(6,26)	223318.99	2.35			447.082	0.1543	
$H^{13}COOH$	10(2, 9) - 9(2, 8)	223472.23	0.03	223471.93	0.12	42.208	9.5959	
$H^{12}COOD$	6(2, 5) - 6(0, 6)	223615.33	0.47			15.122	0.0165	
$H^{13}COOH$	43(4,40) - 42(5,37)	223631.18	6.59			736.882	0.1207	
$H^{13}COOH$	8(2, 7) - 8(1, 8)	223800.46	0.09			28.029	0.1303	
$H^{13}COOH$	15(1,14) - 14(2,13)	223893.78	0.02			87.252	0.1698	
$H^{12}COOH$	10(2, 9) - 9(2, 8)	223915.56	0.01	223915.53	0.12	42.525	9.5963	[25A]
$D^{12}COOH$	8(3, 5) - 8(2, 6)	224109.24	0.05			33.062	0.1502	
$H^{12}COOD$	10(1, 9) - 9(1, 8)	224231.51	0.03			35.684	9.8850	
$H^{13}COOH$	9(4, 6) - 10(3, 7)	224259.60	1.85			60.561	0.0368	
$D^{12}COOH$	44(8,37) - 43(9,34)	224434.00	6.21			824.484	0.2276	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'\ (K'_{-1}, K'_{+1})$–$J\ (K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{12}COOH$	48(9,39) - 47(10,38)	224439.31	8.94			987.940	0.2481	
$H^{12}COOH$	21(2,19) - 21(1,20)	224468.57	0.02	224468.94	0.12	178.708	0.5222	[25A]
$H^{13}COOH$	10(8, 3) - 9(8, 2)	224533.58	0.05	224533.60	0.12	170.872	3.6001	
$H^{13}COOH$	10(8, 2) - 9(8, 1)	224533.58	0.05	224533.60	0.12	170.872	3.6001	
$H^{13}COOH$	10(7, 4) - 9(7, 3)	224535.80	0.04	224533.60	0.12	138.760	5.1002	
$H^{13}COOH$	10(7, 3) - 9(7, 2)	224535.80	0.04	224533.60	0.12	138.760	5.1002	
$H^{13}COOH$	10(9, 1) - 9(9, 0)	224543.18	0.07	224543.09	0.12	207.236	1.9001	
$H^{13}COOH$	10(9, 2) - 9(9, 1)	224543.18	0.07	224543.09	0.12	207.236	1.9001	
$H^{13}COOH$	10(6, 5) - 9(6, 4)	224556.37	0.03	224556.39	0.12	110.912	6.4002	
$H^{13}COOH$	10(6, 4) - 9(6, 3)	224556.37	0.03	224556.39	0.12	110.912	6.4002	
$H^{12}COOD$	43(5,38) - 43(5,39)	224584.88	2.37			736.530	0.6928	
$H^{13}COOH$	10(5, 6) - 9(5, 5)	224609.35	0.02	224609.31	0.12	87.336	7.5003	
$H^{13}COOH$	10(5, 5) - 9(5, 4)	224609.42	0.02	224609.31	0.12	87.336	7.5003	
$H^{13}COOH$	10(4, 7) - 9(4, 6)	224727.30	0.02	224727.26	0.12	68.041	8.4002	
$H^{13}COOH$	10(4, 6) - 9(4, 5)	224734.17	0.02	224734.16	0.12	68.042	8.4002	
$H^{12}COOH$	16(1,15) - 16(0,16)	224833.81	0.03	224834.25	0.12	99.427	0.2426	
$H^{13}COOH$	10(3, 8) - 9(3, 7)	224885.35	0.03	224885.35	0.12	53.037	9.0997	
$H^{12}COOH$	10(7, 4) - 9(7, 3)	224911.84	0.01	224912.44	0.12	141.939	5.1002	[28A]
$H^{12}COOH$	10(7, 3) - 9(7, 2)	224911.84	0.01	224912.44	0.12	141.939	5.1002	[28A]
$H^{12}COOH$	10(8, 3) - 9(8, 2)	224911.95	0.01	224912.44	0.12	175.005	3.6001	[28A]
$H^{12}COOH$	10(8, 2) - 9(8, 1)	224911.95	0.01	224912.44	0.12	175.005	3.6001	[28A]
$D^{12}COOH$	12(6, 7) - 13(5, 8)	224916.91	0.57			105.906	0.0382	
$H^{12}COOH$	10(9, 1) - 9(9, 0)	224923.34	0.02	224923.30	0.12	212.450	1.9001	
$H^{12}COOH$	10(9, 2) - 9(9, 1)	224923.34	0.02	224923.30	0.12	212.450	1.9001	
$H^{12}COOH$	10(6, 5) - 9(6, 4)	224929.09	0.01	224929.17	0.12	113.263	6.4002	
$H^{12}COOH$	10(6, 4) - 9(6, 3)	224929.09	0.01	224929.17	0.12	113.263	6.4002	
$D^{12}COOH$	12(6, 6) - 13(5, 9)	224934.77	0.57			105.905	0.0382	
$H^{13}COOH$	9(4, 5) - 10(3, 8)	224940.10	1.85			60.538	0.0368	
$H^{12}COOH$	10(5, 6) - 9(5, 5)	224976.76	0.01	224976.74	0.12	88.986	7.5002	
$H^{12}COOH$	10(5, 5) - 9(5, 4)	224976.82	0.01	224976.74	0.12	88.986	7.5002	
$H^{12}COOH$	10(4, 7) - 9(4, 6)	225085.44	0.01	225085.40	0.12	69.117	8.4002	
$H^{12}COOH$	10(4, 6) - 9(4, 5)	225091.21	0.01	225091.22	0.12	69.118	8.4002	
$D^{12}COOH$	12(2,11) - 12(1,12)	225186.80	0.07			55.634	0.1495	
$H^{13}COOH$	10(3, 7) - 9(3, 6)	225195.70	0.03	225195.69	0.12	53.049	9.0998	
$H^{12}COOH$	10(3, 8) - 9(3, 7)	225237.75	0.01	225237.62	0.12	53.666	9.0998	
$D^{12}COOH$	40(7,34) - 39(8,31)	225393.64	4.32			675.837	0.2062	
$H^{12}COOH$	10(3, 7) - 9(3, 6)	225512.54	0.01	225512.50	0.12	53.677	9.0998	
$H^{12}COOD$	7(2, 6) - 7(0, 7)	225640.43	0.46			20.117	0.0250	
$H^{12}COOH$	31(3,28) - 31(3,29)	225824.33	0.06			391.770	0.3910	
$H^{13}COOH$	21(2,19) - 21(1,20)	226235.29	0.12			178.249	0.5083	
$H^{13}COOH$	23(2,21) - 23(2,22)	226535.50	0.25			212.910	0.2688	
$H^{12}COOH$	39(5,34) - 38(6,33)	226689.91	0.06			637.096	0.2230	
$H^{12}COOD$	11(2,10) - 11(1,11)	226768.62	0.38			47.493	0.1564	
$H^{12}COOD$	16(3,13) - 16(2,14)	226933.18	1.95			108.450	0.3842	
$D^{12}COOH$	10(1, 9) - 9(1, 8)	227150.58	0.04			35.966	9.8690	
$H^{12}COOD$	11(1,11) - 10(1,10)	227218.46	0.03			39.914	10.8979	
$H^{12}COOD$	16(1,15) - 16(1,16)	227261.27	0.52			95.519	0.1535	
$H^{12}COOH$	39(4,36) - 38(5,33)	227284.76	0.09			614.871	0.1643	
$H^{13}COOH$	16(1,15) - 16(0,16)	227313.46	0.19			99.110	0.2348	
$D^{12}COOH$	7(3, 4) - 7(2, 5)	227564.44	0.05			27.038	0.1264	
$D^{12}COOH$	11(1,11) - 10(1,10)	227602.20	0.06			39.775	10.8901	
$D^{12}COOH$	10(2, 8) - 9(2, 7)	227659.98	0.04			39.869	9.6056	
$H^{12}COOH$	48(5,43) - 48(5,44)	227782.36	0.16			941.607	0.6436	
$H^{13}COOH$	47(5,42) - 47(5,43)	227798.67	0.68			902.609	0.6531	
$D^{12}COOH$	15(1,14) - 15(1,15)	228104.16	0.18			84.463	0.1775	
$H^{12}COOD$	3(2, 2) - 2(1, 1)	228195.59	0.45			4.107	0.0583	
$H^{12}COOH$	21(6,16) - 22(5,17)	228199.19	0.06			245.318	0.1064	
$H^{13}COOH$	10(2, 8) - 9(2, 7)	228409.47	0.03	228409.36	0.12	42.555	9.5993	
$H^{12}COOH$	21(6,15) - 22(5,18)	228440.61	0.06			245.310	0.1064	
$H^{12}COOH$	44(4,41) - 43(5,38)	228520.86	0.19			771.917	0.1253	
$H^{12}COOH$	10(2, 8) - 9(2, 7)	228544.07	0.01	228544.05	0.12	42.848	9.5992	
$H^{12}COOD$	8(2, 7) - 8(0, 8)	228574.66	0.45			25.801	0.0352	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{12}COOH$	16(7,10) – 17(6,11)	228708.35	0.96			168.685	0.0571	
$D^{12}COOH$	16(7, 9) – 17(6,12)	228716.46	0.96			168.685	0.0571	
$H^{13}COOH$	39(4,36) – 38(5,33)	228788.51	5.50			612.797	0.1535	
$H^{12}COOH$	8(2, 7) – 8(1, 8)	228859.36	0.02			28.164	0.1310	
$H^{13}COOH$	42(4,39) – 41(5,36)	229546.25	6.27			704.639	0.1297	
$D^{12}COOH$	6(3, 3) – 6(2, 4)	230048.76	0.06			21.793	0.1035	
$H^{13}COOH$	15(1,14) – 14(2,13)	230081.08	0.18			86.841	0.1737	
$D^{12}COOH$	11(0,11) – 10(0,10)	230451.45	0.06			39.358	10.9210	
$H^{12}COOH$	44(10,35) – 45(9,36)	230491.04	0.16			955.957	0.2370	
$H^{12}COOH$	44(10,34) – 45(9,37)	230499.72	0.16			955.957	0.2370	
$H^{13}COOH$	32(4,28) – 31(5,27)	230599.28	4.72			426.381	0.1861	
$H^{13}COOH$	20(2,18) – 19(3,17)	230887.79	0.69			161.886	0.1521	
$H^{13}COOH$	20(6,15) – 21(5,16)	230949.85	8.05			226.899	0.0986	
$H^{12}COOD$	11(0,11) – 10(0,10)	230955.82	0.04			39.200	10.9453	
$D^{12}COOH$	15(1,14) – 15(0,15)	231085.09	0.17			84.363	0.1694	
$H^{13}COOH$	20(6,14) – 21(5,17)	231140.61	8.05			226.892	0.0986	
$H^{13}COOH$	10(1, 9) – 9(1, 8)	231187.65	0.03	231188.74	0.12	36.983	9.8908	
$H^{12}COOD$	25(3,22) – 25(2,23)	231301.26	1.68			249.512	0.6846	
$H^{13}COOH$	41(5,37) – 40(6,34)	231359.62	8.82			693.944	0.2169	
$H^{12}COOD$	22(2,20) – 22(2,21)	231471.64	0.55			188.367	0.2856	
$H^{12}COOH$	10(1, 9) – 9(1, 8)	231505.59	0.01	231505.39	0.12	37.084	9.8918	
$H^{13}COOH$	3(3, 1) – 4(2, 2)	231546.32	0.55			16.085	0.0044	
$H^{13}COOH$	9(2, 8) – 9(1, 9)	231601.82	0.09			34.483	0.1425	
$D^{12}COOH$	5(3, 2) – 5(2, 3)	231688.27	0.06			17.319	0.0807	
$H^{13}COOH$	40(4,37) – 39(5,34)	232012.19	5.73			642.597	0.1464	
$H^{13}COOH$	3(3, 0) – 4(2, 3)	232035.70	0.55			16.069	0.0044	
$D^{12}COOH$	20(8,13) – 21(7,14)	232279.10	1.59			246.358	0.0762	
$D^{12}COOH$	20(8,12) – 21(7,15)	232282.48	1.59			246.358	0.0762	
$H^{13}COOH$	41(4,38) – 40(5,35)	232309.84	5.98			673.211	0.1384	
$H^{12}COOD$	10(1,10) – 9(0, 9)	232334.20	0.05			32.164	0.2418	
$D^{12}COOH$	20(2,18) – 20(2,19)	232435.18	0.16			157.828	0.3240	
$D^{12}COOH$	35(6,29) – 34(7,28)	232447.79	2.67			515.911	0.1824	
$D^{12}COOH$	12(2,11) – 12(0,12)	232513.75	0.07			55.389	0.1274	
$H^{12}COOD$	9(2, 8) – 9(0, 9)	232593.32	0.44			32.164	0.0469	
$D^{12}COOH$	4(3, 1) – 4(2, 2)	232661.52	0.06			13.607	0.0572	
$H^{12}COOD$	16(1,15) – 16(0,16)	232839.81	0.50			95.333	0.2037	
$H^{13}COOH$	9(1, 9) – 8(0, 8)	232941.14	0.05			26.713	0.2048	
$H^{12}COOH$	15(5,11) – 16(4,12)	233072.92	0.04			137.522	0.0716	
$D^{12}COOH$	44(8,36) – 43(9,35)	233130.90	6.33			824.467	0.2281	
$D^{12}COOH$	3(3, 0) – 3(2, 1)	233161.84	0.07			10.648	0.0315	
$H^{12}COOD$	12(0,12) – 11(1,11)	233187.75	0.06			47.493	0.3009	
$H^{12}COOH$	40(4,37) – 39(5,34)	233203.79	0.10			644.657	0.1582	
$H^{12}COOD$	15(3,12) – 15(2,13)	233275.59	1.96			96.433	0.3451	
$D^{12}COOH$	21(3,18) – 20(4,17)	233454.39	0.52			180.070	0.1306	
$H^{12}COOD$	21(2,19) – 21(1,20)	233468.19	0.51			171.884	0.4423	
$H^{12}COOH$	15(5,10) – 16(4,13)	233494.14	0.04			137.508	0.0716	
$D^{12}COOH$	3(3, 1) – 3(2, 2)	233513.78	0.07			10.636	0.0315	
$H^{12}COOD$	6(4, 3) – 7(3, 4)	233704.44	4.98			36.908	0.0152	
$D^{12}COOH$	4(3, 2) – 4(2, 3)	233707.54	0.07			13.571	0.0570	
$H^{12}COOD$	25(2,23) – 26(1,26)	233748.09	2.93			241.715	0.0050	
$H^{13}COOD$	3(2, 1) – 2(1, 2)	233790.55	0.45			3.927	0.0555	
$H^{12}COOD$	6(4, 2) – 7(3, 5)	233843.45	4.98			36.903	0.0152	
$D^{12}COOH$	5(3, 3) – 5(2, 4)	234094.63	0.06			17.237	0.0801	
$H^{12}COOH$	43(4,40) – 42(5,37)	234201.47	0.16			738.882	0.1344	
$H^{12}COOH$	12(0,12) – 11(1,11)	234214.89	0.01			49.718	0.2831	
$H^{12}COOD$	11(5, 7) – 12(4, 8)	234258.72	9.63			86.127	0.0410	
$H^{12}COOD$	11(5, 6) – 12(4, 9)	234365.67	9.63			86.123	0.0410	
$H^{12}COOH$	42(5,38) – 41(6,35)	234609.32	0.08			728.031	0.2237	
$D^{12}COOH$	6(3, 4) – 6(2, 5)	234763.63	0.06			21.632	0.1021	
$D^{12}COOH$	25(4,21) – 25(3,22)	234852.91	0.49			259.797	0.6922	
$D^{12}COOH$	24(3,21) – 24(2,22)	235219.07	0.23			232.848	0.5805	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'\ (K'_{-1},\ K'_{+1})$–$J\ (K_{-1},\ K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1},\ K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{12}COOH$	26(4,22) - 26(3,23)	235287.96	0.53			279.621	0.7291	
$H^{13}COOH$	12(0,12) - 11(1,11)	235320.77	0.08			49.519	0.2864	
$D^{12}COOH$	4(2, 2) - 3(1, 3)	235490.73	0.04			5.752	0.0571	
$D^{12}COOH$	24(9,16) - 25(8,17)	235683.76	2.55			338.915	0.0953	
$D^{12}COOH$	24(9,15) - 25(8,18)	235685.09	2.55			338.915	0.0953	
$H^{12}COOH$	9(1, 9) - 8(0, 8)	235702.70	0.01			26.774	0.2035	
$H^{12}COOH$	38(9,30) - 39(8,31)	235793.47	0.11			727.137	0.2026	
$H^{12}COOH$	38(9,29) - 39(8,32)	235812.57	0.11			727.137	0.2026	
$D^{12}COOH$	7(3, 5) - 7(2, 6)	235813.13	0.06			26.753	0.1234	
$H^{12}COOH$	47(6,42) - 46(7,39)	235964.47	0.09			921.598	0.2623	
$H^{13}COOH$	11(1,11) - 10(1,10)	236002.16	0.05	236002.08	0.12	41.647	10.9014	
$D^{12}COOH$	42(5,38) - 41(6,35)	236046.70	7.27			699.009	0.0897	
$H^{12}COOH$	41(4,38) - 40(5,35)	236433.80	0.12			675.253	0.1511	
$H^{12}COOH$	9(2, 8) - 9(1, 9)	236485.93	0.02			34.636	0.1434	
$H^{12}COOH$	11(1,11) - 10(1,10)	236717.20	0.01	236717.22	0.12	41.822	10.9020	
$H^{12}COOH$	42(4,39) - 41(5,36)	236809.65	0.14			706.661	0.1430	
$D^{12}COOH$	24(4,20) - 24(3,21)	237083.88	0.45			240.694	0.6493	
$H^{13}COOH$	2(2, 1) - 1(1, 0)	237098.22	0.08			2.923	0.0525	
$H^{12}COOD$	24(3,21) - 23(4,20)	237104.00	5.18			230.534	0.1509	
$H^{12}COOH$	27(2,25) - 28(1,28)	237321.05	0.26			291.350	0.0067	
$D^{12}COOH$	8(3, 6) - 8(2, 7)	237347.96	0.05			32.597	0.1442	
$H^{12}COOH$	9(4, 6) - 10(3, 7)	237388.92	0.03			61.199	0.0368	
$H^{12}COOD$	11(2,10) - 10(2, 9)	237532.41	0.04	237532.34	0.12	47.134	10.6278	[16A]
$H^{13}COOH$	26(3,23) - 25(4,22)	237532.60	2.09			278.538	0.1637	
$H^{12}COOH$	17(1,16) - 17(1,17)	237755.49	0.03			111.928	0.1374	
$H^{12}COOD$	10(2, 9) - 10(0,10)	237840.85	0.43			39.200	0.0595	
$H^{12}COOH$	9(4, 5) - 10(3, 8)	237991.02	0.03			61.179	0.0368	
$H^{12}COOD$	12(2,11) - 12(1,12)	238022.28	0.37			55.750	0.1637	
$D^{12}COOH$	34(5,30) - 33(6,27)	238176.27	2.66			471.805	0.1528	
$D^{12}COOH$	27(4,23) - 27(3,24)	238658.94	0.57			300.153	0.7579	
$H^{13}COOH$	2(2, 0) - 1(1, 1)	238805.26	0.08			2.867	0.0518	
$D^{12}COOH$	28(10,19) - 29(9,20)	238961.20	3.96			446.343	0.1145	
$D^{12}COOH$	28(10,18) - 29(9,21)	238961.70	3.96			446.343	0.1145	
$H^{12}COOD$	36(4,32) - 36(4,33)	239213.30	0.98			514.530	0.5442	
$D^{12}COOH$	13(2,12) - 13(1,13)	239299.53	0.10			64.573	0.1535	
$H^{12}COOD$	11(9, 2) - 10(9, 1)	239307.12	0.07			188.942	3.6366	
$H^{12}COOD$	11(9, 3) - 10(9, 2)	239307.12	0.07			188.942	3.6366	
$H^{12}COOD$	11(10, 1) - 10(10, 0)	239307.61	0.14			223.862	1.9092	
$H^{12}COOD$	11(10, 2) - 10(10, 1)	239307.61	0.14			223.862	1.9092	
$H^{12}COOD$	11(8, 4) - 10(8, 3)	239318.47	0.05			157.688	5.1821	
$H^{12}COOD$	11(8, 3) - 10(8, 2)	239318.47	0.05			157.688	5.1821	
$H^{12}COOD$	11(7, 5) - 10(7, 4)	239347.62	0.04			130.102	6.5459	
$H^{12}COOD$	11(7, 4) - 10(7, 3)	239347.62	0.04			130.102	6.5459	
$H^{12}COOD$	11(6, 6) - 10(6, 5)	239406.12	0.04			106.188	7.7277	
$H^{12}COOD$	11(6, 5) - 10(6, 4)	239406.12	0.04			106.188	7.7277	
$H^{13}COOH$	14(5,10) - 15(4,11)	239424.18	4.25			124.321	0.0638	
$D^{12}COOH$	9(3, 7) - 9(2, 8)	239475.20	0.05			39.162	0.1645	
$H^{12}COOD$	11(5, 7) - 10(5, 6)	239518.83	0.04			85.951	8.7277	
$H^{12}COOD$	11(5, 6) - 10(5, 5)	239519.31	0.04			85.951	8.7277	
$D^{12}COOH$	5(2, 4) - 4(1, 3)	239634.76	0.04			9.244	0.0748	
$D^{12}COOH$	11(2,10) - 10(2, 9)	239699.70	0.06			46.444	10.6202	
$H^{13}COOH$	14(5, 9) - 15(4,12)	239725.44	4.24			124.311	0.0638	
$H^{12}COOD$	11(4, 8) - 10(4, 7)	239736.76	0.03			69.399	9.5457	
$H^{12}COOD$	11(4, 7) - 10(4, 6)	239765.11	0.03			69.400	9.5457	
$H^{12}COOD$	14(3,11) - 14(2,12)	239867.68	1.97			85.175	0.3090	
$H^{12}COOD$	11(3, 9) - 10(3, 8)	239909.01	0.03			56.532	10.1810	
$D^{12}COOH$	38(5,33) - 38(5,34)	239968.45	1.38			587.744	0.7506	
$D^{12}COOH$	11(1,11) - 10(0,10)	240097.36	0.06			39.358	0.2895	
$H^{12}COOH$	22(2,20) - 22(1,21)	240289.87	0.02	240289.88	0.12	195.168	0.5198	
$H^{13}COOH$	10(2, 9) - 10(1,10)	240304.13	0.09			41.647	0.1536	
$H^{13}COOH$	11(0,11) - 10(0,10)	240338.63	0.05	240338.70	0.12	40.639	10.9596	
$H^{13}COOH$	39(4,35) - 39(4,36)	240345.71	0.45			620.428	0.5140	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{12}COOH$	12(0,12) - 11(1,11)	240506.40	0.09			47.367	0.3212	
$H^{12}COOD$	11(3, 8) - 10(3, 7)	240733.25	0.03			56.570	10.1812	
$H^{13}COOH$	31(3,28) - 31(3,29)	240903.90	0.40			390.453	0.3879	
$H^{12}COOH$	3(3, 1) - 4(2, 2)	240980.05	0.02			16.352	0.0044	
$H^{12}COOH$	11(0,11) - 10(0,10)	241146.20	0.01	241146.22	1.00	40.744	10.9625	[28A]
$H^{12}COOH$	32(8,25) - 33(7,26)	241151.90	0.09			529.628	0.1681	
$H^{12}COOH$	32(8,24) - 33(7,27)	241192.35	0.09			529.626	0.1681	
$H^{12}COOD$	19(2,17) - 18(3,16)	241206.53	2.00			140.939	0.1512	
$H^{12}COOH$	3(3, 0) - 4(2, 3)	241435.39	0.02			16.337	0.0044	
$D^{12}COOH$	23(4,19) - 23(3,20)	241634.54	0.41			222.328	0.6026	
$H^{13}COOH$	17(1,16) - 17(1,17)	241658.62	0.25			111.529	0.1397	
$D^{12}COOH$	17(2,15) - 16(3,14)	241792.86	0.29			114.273	0.1407	
$H^{12}COOH$	33(4,29) - 32(5,28)	241877.06	0.05			452.651	0.1934	
$D^{12}COOH$	32(11,22) - 33(10,23)	242139.77	5.93			568.628	0.1336	
$D^{12}COOH$	32(11,21) - 33(10,24)	242139.96	5.93			568.628	0.1336	
$D^{12}COOH$	10(3, 8) - 10(2, 9)	242300.29	0.05			46.444	0.1841	
$H^{12}COOD$	29(3,26) - 29(3,27)	242405.99	0.71			331.753	0.4111	
$D^{12}COOH$	11(10, 1) - 10(10, 0)	242449.26	0.26			195.932	1.9093	
$D^{12}COOH$	11(10, 2) - 10(10, 1)	242449.26	0.26			195.932	1.9093	
$D^{12}COOH$	11(9, 3) - 10(9, 2)	242471.38	0.15			166.424	3.6368	
$D^{12}COOH$	11(9, 2) - 10(9, 1)	242471.38	0.15			166.424	3.6368	
$H^{12}COOD$	26(3,23) - 26(2,24)	242509.52	1.64			268.679	0.6908	
$D^{12}COOH$	11(8, 4) - 10(8, 3)	242510.39	0.08			140.009	5.1825	
$D^{12}COOH$	11(8, 3) - 10(8, 2)	242510.39	0.08			140.009	5.1825	
$D^{12}COOH$	11(7, 5) - 10(7, 4)	242575.96	0.06			116.692	6.5462	
$D^{12}COOH$	11(7, 4) - 10(7, 3)	242575.96	0.06			116.692	6.5462	
$D^{12}COOH$	11(6, 6) - 10(6, 5)	242686.87	0.06			96.479	7.7282	
$D^{12}COOH$	11(6, 5) - 10(6, 4)	242686.89	0.06			96.479	7.7282	
$D^{12}COOH$	11(5, 7) - 10(5, 6)	242883.14	0.06			79.377	8.7281	
$D^{12}COOH$	11(5, 6) - 10(5, 5)	242885.18	0.06			79.377	8.7281	
$D^{12}COOH$	37(6,32) - 36(7,29)	242900.09	3.38			568.866	0.1856	
$H^{12}COOH$	2(2, 1) - 1(1, 0)	242928.95	0.02			2.988	0.0525	
$H^{13}COOH$	22(2,20) - 22(1,21)	243084.67	0.15			194.648	0.5042	
$D^{12}COOH$	7(5, 3) - 8(4, 4)	243172.74	0.33			51.395	0.0134	
$D^{12}COOH$	7(5, 2) - 8(4, 5)	243185.62	0.33			51.395	0.0134	
$D^{12}COOH$	11(4, 8) - 10(4, 7)	243230.54	0.06			65.395	9.5460	
$D^{12}COOH$	11(4, 7) - 10(4, 6)	243318.22	0.06			65.398	9.5460	
$D^{12}COOH$	11(3, 9) - 10(3, 8)	243322.59	0.06			54.527	10.1800	
$H^{12}COOH$	24(2,22) - 24(2,23)	243574.46	0.04			231.285	0.2586	
$H^{12}COOD$	11(2,10) - 11(0,11)	244417.43	0.41			46.904	0.0723	
$H^{12}COOH$	2(2, 0) - 1(1, 1)	244598.14	0.02			2.933	0.0518	
$D^{12}COOH$	13(2,12) - 13(0,13)	244789.00	0.09			64.390	0.1393	
$H^{12}COOH$	10(2, 9) - 10(1,10)	244993.65	0.02			41.822	0.1547	
$D^{12}COOH$	11(3, 8) - 10(3, 7)	245120.36	0.06			54.609	10.1807	
$D^{12}COOH$	28(4,24) - 28(3,25)	245158.91	0.62			321.375	0.7774	
$D^{12}COOH$	36(12,25) - 37(11,26)	245240.86	0.61			705.753	0.1528	
$D^{12}COOH$	36(12,24) - 37(11,27)	245240.92	8.61			705.753	0.1528	
$H^{13}COOH$	23(3,20) - 23(2,21)	245319.58	0.49			220.466	0.6410	
$H^{12}COOD$	11(2, 9) - 10(2, 8)	245551.60	0.04			47.799	10.6390	
$H^{13}COOH$	11(2,10) - 10(2, 9)	245604.22	0.04			49.662	10.6308	
$D^{12}COOH$	20(2,18) - 20(1,19)	245784.89	0.14			157.383	0.3575	
$D^{12}COOH$	11(3, 9) - 11(2,10)	245923.18	0.05			54.440	0.2029	
$H^{12}COOD$	11(1,10) - 10(1, 9)	246087.49	0.04			43.163	10.8881	
$H^{13}COOH$	24(3,21) - 24(2,22)	246091.31	0.49			238.915	0.6767	
$H^{12}COOH$	11(2,10) - 10(2, 9)	246105.97	0.01	246106.52	1.00	49.994	10.6314	[28A]
$D^{12}COOH$	40(7,33) - 39(8,32)	246120.10	4.42			675.791	0.2079	
$H^{13}COOH$	22(3,19) - 22(2,20)	246338.19	0.50			202.757	0.6016	
$H^{12}COOD$	13(3,10) - 13(2,11)	246387.25	1.98			74.679	0.2758	
$H^{12}COOH$	26(7,20) - 27(6,21)	246452.24	0.07	246456.16	1.00	363.486	0.1335	[28A]
$H^{12}COOH$	26(7,19) - 27(6,22)	246533.70	0.07			363.483	0.1335	
$D^{12}COOH$	26(3,23) - 26(3,24)	246657.74	0.21			271.394	0.4599	
$H^{12}COOH$	17(1,16) - 17(0,17)	246857.09	0.03	246857.42	0.16	111.624	0.2383	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
D^{12}COOH	49(9,41) - 48(10,38)	246873.99	9.84			1023.532	0.2538	
H^{12}COOH	40(4,36) - 40(4,37)	246880.80	0.13			652.436	0.5016	
H^{13}COOH	11(8, 4) - 10(8, 3)	246997.80	0.06			178.361	5.1820	
H^{13}COOH	11(8, 3) - 10(8, 2)	246997.80	0.06			178.361	5.1820	
H^{13}COOH	11(9, 3) - 10(9, 2)	247004.13	0.08			214.726	3.6365	
H^{13}COOH	11(9, 2) - 10(9, 1)	247004.13	0.08			214.726	3.6365	
H^{13}COOH	11(7, 5) - 10(7, 4)	247006.48	0.05			146.250	6.5457	
H^{13}COOH	11(7, 4) - 10(7, 3)	247006.48	0.05			146.250	6.5457	
H^{13}COOH	11(10, 2) - 10(10, 1)	247020.98	0.10			255.332	1.9092	
H^{13}COOH	11(10, 1) - 10(10, 0)	247020.98	0.10			255.332	1.9092	
H^{13}COOH	11(6, 6) - 10(6, 5)	247038.83	0.04			118.402	7.7276	
H^{13}COOH	11(6, 5) - 10(6, 4)	247038.83	0.04			118.402	7.7276	
H^{13}COOH	11(5, 7) - 10(5, 6)	247113.53	0.03			94.828	8.7276	
H^{13}COOH	11(5, 6) - 10(5, 5)	247113.71	0.03			94.828	8.7276	
H^{12}COOD	4(2, 3) - 3(1, 2)	247233.45	0.46			6.370	0.0659	
H^{13}COOH	8(4, 5) - 9(3, 6)	247254.67	1.85			53.049	0.0293	
H^{13}COOH	11(4, 8) - 10(4, 7)	247271.97	0.04			75.537	9.5456	
H^{13}COOH	11(4, 7) - 10(4, 6)	247285.66	0.04			75.538	9.5456	
H^{12}COOH	11(8, 4) - 10(8, 3)	247412.57	0.02			182.508	5.1820	
H^{12}COOH	11(8, 3) - 10(8, 2)	247412.57	0.02			182.508	5.1820	
H^{12}COOH	11(7, 5) - 10(7, 4)	247418.25	0.01	247418.09	1.00	149.442	6.5457	[28A]
H^{12}COOH	11(7, 4) - 10(7, 3)	247418.25	0.01	247418.09	1.00	149.442	6.5457	[28A]
D^{12}COOH	11(6, 6) - 12(5, 7)	247420.30	0.60			96.321	0.0311	
H^{12}COOH	11(9, 3) - 10(9, 2)	247421.16	0.02	247418.09	1.00	219.953	3.6365	[28A]
H^{12}COOH	11(9, 2) - 10(9, 1)	247421.16	0.02	247418.09	1.00	219.953	3.6365	[28A]
D^{12}COOH	11(6, 5) - 12(5, 8)	247428.26	0.60			96.321	0.0311	
H^{12}COOH	11(10, 1) - 10(10, 0)	247439.85	0.02			261.766	1.9092	
H^{12}COOH	11(10, 2) - 10(10, 1)	247439.85	0.02			261.766	1.9092	
H^{13}COOH	11(3, 9) - 10(3, 8)	247445.74	0.04			60.538	10.1814	
H^{12}COOH	11(6, 6) - 10(6, 5)	247446.25	0.01	247445.68	1.00	120.766	7.7275	[28A]
H^{12}COOH	11(6, 5) - 10(6, 4)	247446.25	0.01	247445.68	1.00	120.766	7.7275	[28A]
H^{12}COOH	11(5, 7) - 10(5, 6)	247513.97	0.01	247514.13	1.00	96.490	8.7275	[28A]
H^{12}COOH	11(5, 6) - 10(5, 5)	247514.12	0.01	247514.13	1.00	96.490	8.7275	[28A]
H^{12}COOD	12(1,12) - 11(1,11)	247537.88	0.04			47.493	11.9029	
D^{12}COOH	31(3,28) - 32(2,31)	247555.44	3.41			380.795	0.0084	
H^{13}COOH	8(4, 4) - 9(3, 7)	247621.65	1.85			53.037	0.0293	
H^{12}COOH	11(4, 8) - 10(4, 7)	247660.45	0.01	247661.36	1.00	76.625	9.5456	[28A]
H^{12}COOH	11(4, 7) - 10(4, 6)	247671.96	0.01	247670.76	1.00	76.626	9.5456	[28A]
H^{12}COOH	11(3, 9) - 10(3, 8)	247830.81	0.01	247830.62	1.00	61.179	10.1814	[28A]
D^{12}COOH	12(1,12) - 11(1,11)	247833.35	0.09			47.367	11.8939	
H^{13}COOH	11(3, 8) - 10(3, 7)	247946.47	0.04			60.561	10.1814	
D^{12}COOH	22(4,18) - 22(3,19)	248085.90	0.36			204.711	0.5548	
H^{12}COOH	46(6,40) - 45(7,39)	248086.74	0.07			886.775	0.2618	
H^{12}COOH	11(3, 8) - 10(3, 7)	248274.48	0.01			61.199	10.1814	
D^{12}COOH	26(4,22) - 25(5,21)	248399.55	1.01			279.184	0.1449	
H^{12}COOD	15(1,14) - 14(2,13)	248419.70	0.49			83.070	0.1937	
D^{12}COOH	32(4,28) - 32(4,29)	248564.69	0.58			414.737	0.5992	
H^{13}COOH	27(2,25) - 28(1,28)	248601.28	2.56			290.328	0.0061	
H^{12}COOD	11(1,11) - 10(0,10)	248604.64	0.06			39.200	0.2740	
H^{13}COOH	25(3,22) - 25(2,23)	248816.46	0.49			258.096	0.7077	
D^{12}COOH	11(1,10) - 10(1, 9)	248881.11	0.06			43.543	10.8656	
H^{13}COOH	21(3,18) - 21(2,19)	248954.50	0.50			185.795	0.5598	
H^{13}COOH	10(1,10) - 9(0, 9)	249543.31	0.05			33.323	0.2336	
H^{13}COOH	17(1,16) - 17(0,17)	249681.83	0.24			111.261	0.2306	
D^{12}COOH	41(7,35) - 40(8,32)	249901.90	4.85			705.575	0.2108	
H^{13}COOH	11(2,10) - 11(1,11)	249906.19	0.09			49.519	0.1634	
H^{13}COOH	42(5,38) - 41(6,35)	249977.11	8.96			724.975	0.2177	
D^{12}COOH	45(8,38) - 44(9,35)	250034.16	6.94			857.146	0.2330	
D^{12}COOH	12(0,12) - 11(0,11)	250152.31	0.09			47.045	11.9150	
H^{12}COOD	13(2,12) - 13(1,13)	250191.07	0.36			64.683	0.1698	
D^{12}COOH	12(3,10) - 12(2,11)	250435.01	0.05			63.145	0.2207	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{12}COOH$	35(5,31) - 34(6,28)	250498.11	3.00			497.329	0.1496	
$D^{12}COOH$	41(5,37) - 40(6,34)	250536.12	6.30			667.714	0.0998	
$H^{12}COOD$	12(0,12) - 11(0,11)	250836.56	0.04			46.904	11.9382	
$D^{12}COOH$	11(2, 9) - 10(2, 8)	251237.86	0.06			47.463	10.6457	
$D^{12}COOH$	15(7, 9) - 16(6,10)	251344.66	1.03			156.146	0.0497	
$D^{12}COOH$	15(7, 8) - 16(6,11)	251348.56	1.03			156.146	0.0497	
$H^{12}COOD$	17(1,16) - 17(1,17)	251369.07	0.64			107.139	0.1518	
$H^{12}COOH$	20(6,15) - 21(5,16)	251550.55	0.06			228.758	0.0987	
$H^{12}COOH$	20(6,14) - 21(5,17)	251703.21	0.06			228.753	0.0987	
$D^{12}COOH$	49(9,40) - 48(10,39)	251735.67	9.98			1023.523	0.2540	
$H^{13}COOH$	11(2, 9) - 10(2, 8)	251957.32	0.04	251957.28	0.16	50.174	10.6366	
$H^{12}COOH$	11(2, 9) - 10(2, 8)	252078.49	0.01	252078.45	0.16	50.471	10.6363	
$D^{12}COOH$	16(1,15) - 16(1,16)	252261.14	0.22			95.410	0.1771	
$H^{12}COOH$	10(1,10) - 9(0, 9)	252355.55	0.01			33.404	0.2318	
$H^{12}COOD$	12(2,11) - 12(0,12)	252372.41	0.38			55.271	0.0847	
$H^{12}COOD$	12(3, 9) - 12(2,10)	252548.81	1.98			64.950	0.2457	
$H^{12}COOH$	24(3,21) - 24(2,22)	252715.93	0.03			239.410	0.6722	
$D^{12}COOH$	14(1,13) - 13(2,12)	252746.78	0.16			72.555	0.1994	
$H^{13}COOH$	24(2,22) - 24(2,23)	252770.89	0.33			230.484	0.2603	
$H^{13}COOH$	20(3,17) - 20(2,18)	252946.46	0.51			169.588	0.5169	
$H^{12}COOH$	23(3,20) - 23(2,21)	253042.06	0.03			220.924	0.6341	
$D^{12}COOH$	3(2, 1) - 2(0, 2)	253261.35	0.05			2.200	0.0025	
$H^{12}COOH$	43(5,39) - 42(6,36)	253312.47	0.09			759.856	0.2246	
$H^{12}COOH$	32(3,29) - 32(3,30)	253346.32	0.08			415.585	0.3755	
$H^{13}COOH$	26(3,23) - 26(2,24)	253629.36	0.49			278.001	0.7329	
$H^{13}COOH$	11(1,10) - 10(1, 9)	253898.56	0.04	253898.46	0.16	44.694	10.8963	
$H^{12}COOH$	21(2,19) - 20(3,18)	253991.96	0.03			177.723	0.1642	
$H^{12}COOD$	22(2,20) - 22(1,21)	254007.10	0.57			187.615	0.4339	
$H^{12}COOH$	43(10,34) - 44(9,35)	254020.48	0.18			922.129	0.2295	
$H^{12}COOH$	43(10,33) - 44(9,36)	254026.32	0.18			922.129	0.2295	
$H^{12}COOH$	25(3,22) - 25(2,23)	254206.16	0.03			258.634	0.7062	
$H^{13}COOH$	19(6,14) - 20(5,15)	254210.33	8.05			211.119	0.0909	
$H^{12}COOH$	11(1,10) - 10(1, 9)	254279.65	0.01	254279.59	0.16	44.807	10.8976	
$)^{12}COOH$	14(2,13) - 14(1,14)	254321.06	0.13			74.183	0.1567	
$d^{13}COOH$	19(6,13) - 20(5,16)	254328.20	8.05			211.115	0.0909	
$H^{12}COOH$	11(2,10) - 11(1,11)	254382.42	0.02			49.718	0.1649	
$D^{12}COOH$	16(1,15) - 16(0,16)	254428.72	0.22			95.338	0.1677	
$D^{12}COOH$	25(3,22) - 25(2,23)	254566.37	0.26			251.305	0.5704	
$D^{12}COOH$	29(4,25) - 29(3,26)	254901.33	0.68			343.275	0.7875	
$H^{12}COOH$	22(3,19) - 22(2,20)	255012.29	0.03			203.183	0.5932	
$D^{12}COOH$	19(8,12) - 20(7,13)	255021.91	1.72			230.864	0.0687	
$D^{12}COOH$	19(8,11) - 20(7,14)	255023.61	1.72			230.864	0.0687	
$H^{12}COOH$	27(3,24) - 26(4,23)	255472.13	0.04			299.524	0.1723	
$H^{12}COOD$	44(5,39) - 44(5,40)	255485.32	3.18			768.551	0.6615	
$H^{12}COOH$	16(1,15) - 15(2,14)	255555.11	0.02			98.402	0.1934	
$H^{12}COOD$	17(1,16) - 17(0,17)	255676.96	0.62			106.995	0.2007	
$H^{12}COOD$	5(4, 2) - 6(3, 3)	255684.67	4.97			31.820	0.0089	
$H^{12}COOD$	5(4, 1) - 6(3, 4)	255740.31	4.97			31.818	0.0089	
$D^{12}COOH$	13(3,11) - 13(2,12)	255915.06	0.06			72.555	0.2373	
$D^{12}COOH$	21(4,17) - 21(3,18)	255958.70	0.32			187.857	0.5078	
$H^{12}COOD$	27(3,24) - 27(2,25)	256203.30	1.61			288.511	0.6907	
$H^{12}COOH$	14(5,10) - 15(4,11)	256263.96	0.05			125.481	0.0638	
$H^{12}COOD$	13(0,13) - 12(1,12)	256284.75	0.06			55.750	0.3373	
$H^{13}COOH$	39(5,34) - 38(6,33)	256388.23	8.98			634.045	0.2219	
$D^{12}COOH$	6(2, 5) - 5(1, 4)	256402.58	0.04			13.079	0.0846	
$H^{12}COOD$	10(5, 6) - 11(4, 7)	256436.75	9.62			77.397	0.0337	
$H^{12}COOD$	10(5, 5) - 11(4, 8)	256490.32	9.62			77.396	0.0337	
$H^{12}COOH$	14(5, 9) - 15(4,12)	256517.41	0.05			125.473	0.0638	
$H^{13}COOH$	12(1,12) - 11(1,11)	257180.71	0.06			49.519	11.9071	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'\ (K'_{-1}, K'_{+1})$–$J\ (K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{12}COOH$	45(6,39) - 45(6,40)	257253.80	3.75			823.656	0.8765	
$D^{12}COOH$	12(1,12) - 11(0,11)	257479.26	0.09			47.045	0.3247	
$H^{12}COOH$	49(5,44) - 49(5,45)	257578.99	0.19			978.456	0.6150	
$H^{13}COOH$	3(2, 2) - 3(0, 3)	257598.87	0.12			4.484	0.0015	
$H^{12}COOH$	26(3,23) - 26(2,24)	257657.79	0.03			278.589	0.7353	
$D^{12}COOH$	31(5,26) - 30(6,25)	257699.66	1.80			399.808	0.1647	
$H^{13}COOH$	3(2, 2) - 2(1, 1)	257857.39	0.09			4.476	0.0583	
$H^{12}COOD$	23(2,21) - 23(2,22)	257875.16	0.66			204.605	0.2789	
$H^{13}COOH$	4(2, 3) - 4(0, 4)	257901.99	0.12			7.466	0.0034	
$H^{13}COOH$	48(5,43) - 48(5,44)	257939.12	0.81			938.652	0.6239	
$H^{12}COOH$	12(1,12) - 11(1,11)	257975.01	0.01			49.718	11.9079	
$H^{12}COOH$	23(2,21) - 23(1,22)	258018.03	0.03			212.317	0.5146	
$H^{13}COOH$	19(3,16) - 19(2,17)	258065.04	0.52			154.142	0.4743	
$H^{12}COOD$	11(3, 8) - 11(2, 9)	258120.81	1.98			55.990	0.2180	
$D^{12}COOH$	14(2,13) - 14(0,14)	258386.26	0.12			74.048	0.1492	
$H^{12}COOH$	21(3,18) - 21(2,19)	258426.71	0.02			186.195	0.5507	
$H^{13}COOH$	5(2, 4) - 5(0, 5)	258482.15	0.12			11.186	0.0064	
$D^{12}COOH$	23(9,15) - 24(8,16)	258509.05	2.78			320.467	0.0878	
$D^{12}COOH$	23(9,14) - 24(8,17)	258509.74	2.78			320.467	0.0878	
$H^{12}COOD$	4(2, 2) - 3(1, 3)	258638.98	0.45			6.012	0.0595	
$H^{12}COOD$	12(2,11) - 11(2,10)	258791.54	0.05			55.057	11.6555	
$H^{12}COOH$	48(6,43) - 47(7,40)	259041.38	0.10			957.106	0.2659	
$H^{12}COOH$	13(0,13) - 12(1,12)	259179.63	0.01			58.323	0.3185	
$H^{12}COOH$	37(9,29) - 38(8,30)	259302.55	0.12			697.804	0.1950	
$H^{12}COOH$	37(9,28) - 38(8,31)	259315.24	0.12			697.804	0.1950	
$H^{13}COOH$	6(2, 5) - 6(0, 6)	259468.52	0.12			15.637	0.0107	
$D^{12}COOH$	21(2,19) - 21(2,20)	259542.86	0.19			172.737	0.3196	
$D^{12}COOH$	36(5,32) - 35(6,29)	259877.28	3.38			523.664	0.1446	
$H^{13}COOH$	13(0,13) - 12(1,12)	260056.49	0.10			58.097	0.3220	
$H^{12}COOH$	8(4, 5) - 9(3, 6)	260374.36	0.03			53.677	0.0293	
$H^{13}COOH$	12(2,11) - 12(1,12)	260401.76	0.10			58.097	0.1721	
$H^{12}COOD$	26(2,24) - 27(1,27)	260450.55	3.37			259.992	0.0046	
$H^{13}COOH$	27(3,24) - 27(2,25)	260635.81	0.49			298.621	0.7519	
$H^{12}COOH$	8(4, 4) - 9(3, 7)	260698.99	0.03			53.666	0.0293	
$D^{12}COOH$	40(5,36) - 39(6,33)	260722.09	5.50			637.244	0.1102	
$D^{12}COOH$	12(2,11) - 11(2,10)	260967.50	0.08			54.440	11.6456	
$H^{13}COOH$	7(2, 6) - 7(0, 7)	261008.05	0.12			20.815	0.0164	
$H^{12}COOD$	12(10, 3) - 11(10, 2)	261071.80	0.16			231.844	3.6669	
$H^{12}COOD$	12(10, 2) - 11(10, 1)	261071.80	0.16			231.844	3.6669	
$H^{12}COOD$	12(9, 4) - 11(9, 3)	261076.12	0.08			196.924	5.2503	
$H^{12}COOD$	12(9, 3) - 11(9, 2)	261076.12	0.08			196.924	5.2503	
$H^{12}COOD$	12(11, 1) - 11(11, 0)	261078.03	0.28			270.429	1.9168	
$H^{12}COOD$	12(11, 2) - 11(11, 1)	261078.03	0.28			270.429	1.9168	
$H^{12}COOD$	12(8, 5) - 11(8, 4)	261095.29	0.06			165.670	6.6671	
$H^{12}COOD$	12(8, 4) - 11(8, 3)	261095.29	0.06			165.670	6.6671	
$H^{12}COOD$	12(7, 6) - 11(7, 5)	261137.06	0.05			138.086	7.9172	
$H^{12}COOD$	12(7, 5) - 11(7, 4)	261137.06	0.05			138.086	7.9172	
$H^{13}COOH$	12(0,12) - 11(0,11)	261185.72	0.06			48.656	11.9528	
$H^{12}COOD$	12(6, 7) - 11(6, 6)	261216.43	0.05			114.174	9.0005	
$H^{12}COOD$	12(6, 6) - 11(6, 5)	261216.44	0.05			114.174	9.0005	
$H^{12}COOH$	40(5,35) - 39(6,34)	261281.80	0.07			666.538	0.2289	
$H^{12}COOD$	12(5, 8) - 11(5, 7)	261365.55	0.05			93.941	9.9172	
$H^{12}COOD$	12(5, 7) - 11(5, 6)	261366.63	0.05			93.941	9.9172	
$H^{13}COOH$	16(1,15) - 15(2,14)	261630.86	0.22			97.965	0.1982	
$H^{12}COOD$	12(4, 9) - 11(4, 8)	261643.95	0.05			77.396	10.6669	
$H^{12}COOD$	12(4, 8) - 11(4, 7)	261696.86	0.05			77.397	10.6669	
$H^{12}COOD$	13(2,12) - 13(0,13)	261705.41	0.36			64.299	0.0962	
$H^{12}COOD$	12(3,10) - 11(3, 9)	261786.26	0.05			64.535	11.2487	
$H^{13}COOH$	23(2,21) - 23(1,22)	261823.97	0.20			211.733	0.4977	
$D^{12}COOH$	27(10,18) - 28(9,19)	261847.85	4.33			424.943	0.1070	
$D^{12}COOH$	27(10,17) - 28(9,20)	261848.12	4.33			424.943	0.1070	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{12}COOH$	45(8,37) - 44(9,36)	262069.23	7.09			857.120	0.2338	
$H^{12}COOH$	12(0,12) - 11(0,11)	262103.48	0.01			48.787	11.9559	
$D^{12}COOH$	14(3,12) - 14(2,13)	262428.38	0.07			82.666	0.2525	
$H^{12}COOH$	18(1,17) - 18(1,18)	262463.68	0.04			124.755	0.1349	
$H^{13}COOH$	13(5, 9) - 14(4,10)	262491.31	4.25			113.054	0.0561	
$D^{12}COOH$	13(0,13) - 12(1,12)	262509.52	0.12			55.634	0.3580	
$H^{13}COOH$	13(5, 8) - 14(4,11)	262666.17	4.25			113.048	0.0561	
$H^{12}COOD$	10(3, 7) - 10(2, 8)	262939.16	1.98			47.799	0.1925	
$H^{13}COOH$	3(2, 1) - 2(1, 2)	263043.65	0.09			4.308	0.0560	
$H^{12}COOD$	12(3, 9) - 11(3, 8)	263049.77	0.04			64.600	11.2490	
$H^{12}COOH$	20(3,17) - 20(2,18)	263058.99	0.02			169.966	0.5078	
$D^{12}COOH$	5(2, 3) - 4(1, 4)	263072.76	0.05			8.544	0.0584	
$H^{12}COOH$	27(3,24) - 27(2,25)	263189.30	0.04			299.267	0.7585	
$H^{12}COOD$	14(2,13) - 14(1,14)	263241.88	0.35			74.290	0.1749	
$H^{13}COOH$	8(2, 7) - 8(0, 8)	263257.88	0.12			26.713	0.0235	
$D^{12}COOH$	38(6,33) - 37(7,30)	263702.66	3.80			596.467	0.1876	
$H^{12}COOH$	3(2, 2) - 2(1, 1)	263762.38	0.02			4.541	0.0583	
$H^{13}COOH$	18(3,15) - 18(2,16)	264039.77	0.52			139.464	0.4330	
$D^{12}COOH$	12(11, 1) - 11(11, 0)	264495.46	0.47			236.612	1.9169	
$D^{12}COOH$	12(11, 2) - 11(11, 1)	264495.46	0.47			236.612	1.9169	
$D^{12}COOH$	12(10, 3) - 11(10, 2)	264512.80	0.28			204.019	3.6671	
$D^{12}COOH$	12(10, 2) - 11(10, 1)	264512.80	0.28			204.019	3.6671	
$D^{12}COOH$	12(9, 4) - 11(9, 3)	264544.73	0.16			174.512	5.2506	
$D^{12}COOH$	12(9, 3) - 11(9, 2)	264544.73	0.16			174.512	5.2506	
$D^{12}COOH$	12(8, 5) - 11(8, 4)	264598.27	0.10			148.099	6.6675	
$D^{12}COOH$	12(8, 4) - 11(8, 3)	264598.27	0.10			148.099	6.6675	
$H^{12}COOH$	31(8,24) - 32(7,25)	264606.23	0.09			504.798	0.1605	
$H^{12}COOH$	31(8,23) - 32(7,26)	264632.69	0.09			504.798	0.1605	
$H^{12}COOH$	12(2,11) - 12(1,12)	264647.63	0.02			58.323	0.1739	
$H^{12}COOH$	28(2,26) - 29(1,29)	264665.59	0.31			311.830	0.0062	
$D^{12}COOH$	12(7, 6) - 11(7, 5)	264685.96	0.08			124.784	7.9176	
$D^{12}COOH$	12(7, 5) - 11(7, 4)	264685.96	0.08			124.784	7.9176	
$D^{12}COOH$	20(4,16) - 20(3,17)	264736.67	0.27			171.778	0.4635	
$D^{12}COOH$	12(6, 7) - 11(6, 6)	264832.23	0.08			104.574	9.0010	
$D^{12}COOH$	12(6, 6) - 11(6, 5)	264832.31	0.08			104.574	9.0010	
$D^{12}COOH$	31(11,21) - 32(10,22)	265069.36	6.51			544.279	0.1261	
$D^{12}COOH$	31(11,20) - 32(10,23)	265069.46	6.51			544.279	0.1261	
$D^{12}COOH$	12(5, 8) - 11(5, 7)	265088.43	0.08			87.479	9.9176	
$D^{12}COOH$	12(5, 7) - 11(5, 6)	265093.08	0.08			87.479	9.9176	
$H^{12}COOD$	12(1,12) - 11(0,11)	265186.69	0.06			46.904	0.3077	
$H^{12}COOH$	3(2, 2) - 3(0, 3)	265235.23	0.02			4.492	0.0013	
$H^{12}COOD$	5(2, 4) - 4(1, 3)	265373.52	0.46			9.386	0.0744	
$D^{12}COOH$	6(5, 2) - 7(4, 3)	265425.30	0.34			45.505	0.0077	
$D^{12}COOH$	6(5, 1) - 7(4, 4)	265429.60	0.34			45.505	0.0077	
$D^{12}COOH$	12(3,10) - 11(3, 9)	265479.32	0.08			62.643	11.2470	
$H^{12}COOH$	4(2, 3) - 4(0, 4)	265517.54	0.02			7.480	0.0031	
$D^{12}COOH$	12(4, 9) - 11(4, 8)	265520.52	0.08			73.509	10.6671	
$D^{12}COOH$	12(4, 8) - 11(4, 7)	265683.53	0.08			73.514	10.6671	
$D^{12}COOH$	37(5,33) - 36(6,30)	265916.83	3.80			550.818	0.1379	
$H^{12}COOH$	5(2, 4) - 5(0, 5)	266057.90	0.02			11.208	0.0058	
$H^{13}COOH$	11(1,11) - 10(0,10)	266203.58	0.06			40.639	0.2641	
$H^{13}COOH$	9(2, 8) - 9(0, 9)	266375.22	0.12			33.323	0.0318	
$H^{13}COOH$	18(1,17) - 18(1,18)	266476.32	0.30			124.313	0.1375	
$D^{12}COOH$	39(5,35) - 38(6,32)	266593.82	4.84			607.604	0.1203	
$D^{12}COOH$	36(6,30) - 35(7,29)	266653.97	3.04			541.923	0.1882	
$H^{13}COOH$	21(2,19) - 20(3,18)	266893.65	0.74			176.893	0.1681	
$H^{12}COOD$	9(3, 6) - 9(2, 7)	266915.00	1.97			40.377	0.1685	
$H^{12}COOH$	6(2, 5) - 6(0, 6)	266977.09	0.02			15.670	0.0097	
$H^{13}COOH$	43(5,39) - 42(6,36)	267220.25	9.11			756.792	0.2175	
$H^{13}COOH$	12(2,11) - 11(2,10)	267676.27	0.06			57.855	11.6594	
$H^{12}COOD$	12(1,11) - 11(1,10)	267752.62	0.06			51.372	11.8881	
$H^{12}COOD$	13(1,13) - 12(1,12)	267799.09	0.06			55.750	12.9067	
$D^{12}COOH$	30(4,26) - 30(3,27)	267912.25	0.75			365.838	0.7888	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	J' (K'_{-1}, K'_{+1})–J (K_{-1}, K_{+1})	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{13}COOH$	33(4,29) - 32(5,28)	267952.84	4.80			450.508	0.1937	
$D^{12}COOH$	13(1,13) - 12(1,12)	267998.99	0.12			55.634	12.8965	
$D^{12}COOH$	12(3, 9) - 11(3, 8)	268196.01	0.08			62.786	11.2486	
$D^{12}COOH$	35(12,24) - 36(11,25)	268197.21	9.46			678.458	0.1453	
$D^{12}COOH$	35(12,23) - 36(11,26)	268197.24	9.46			678.458	0.1453	
$H^{12}COOH$	12(2,11) - 11(2,10)	268240.23	0.01			58.203	11.6601	
$D^{12}COOH$	38(5,34) - 37(6,31)	268255.23	4.28			578.796	0.1296	
$H^{12}COOH$	7(2, 6) - 7(0, 7)	268413.18	0.02			20.861	0.0149	
$H^{12}COOD$	12(2,10) - 11(2, 9)	268621.76	0.05			55.990	11.6719	
$H^{12}COOH$	19(3,16) - 19(2,17)	268660.05	0.02			154.503	0.4658	
$H^{12}COOH$	3(2, 1) - 2(1, 2)	268830.53	0.02			4.377	0.0562	
$H^{12}COOH$	11(1,11) - 10(0,10)	269034.79	0.02			40.744	0.2619	
$H^{13}COOH$	32(3,29) - 32(3,30)	269296.41	0.53			414.202	0.3738	
$H^{13}COOH$	12(8, 5) - 11(8, 4)	269465.11	0.07			186.600	6.6669	
$H^{13}COOH$	12(8, 4) - 11(8, 3)	269465.11	0.07			186.600	6.6669	
$H^{13}COOH$	12(9, 4) - 11(9, 3)	269466.95	0.09			222.965	5.2502	
$H^{13}COOH$	12(9, 3) - 11(9, 2)	269466.95	0.09			222.965	5.2502	
$H^{13}COOH$	12(10, 2) - 11(10, 1)	269481.74	0.11			263.572	3.6668	
$H^{13}COOH$	12(10, 3) - 11(10, 2)	269481.74	0.11			263.572	3.6668	
$H^{13}COOH$	12(7, 6) - 11(7, 5)	269482.02	0.06			154.489	7.9170	
$H^{13}COOH$	12(7, 5) - 11(7, 4)	269482.02	0.06			154.489	7.9170	
$H^{13}COOH$	12(11, 1) - 11(11, 0)	269506.19	0.13			308.409	1.9167	
$H^{13}COOH$	12(11, 2) - 11(11, 1)	269506.19	0.13			308.409	1.9167	
$H^{12}COOD$	37(4,33) - 37(4,34)	269516.78	1.29			541.309	0.5232	
$H^{13}COOH$	12(6, 7) - 11(6, 6)	269528.92	0.05	269529.07	0.16	126.643	9.0003	
$H^{13}COOH$	12(6, 6) - 11(6, 5)	269528.93	0.05	269529.07	0.16	126.643	9.0003	
$H^{13}COOH$	12(5, 8) - 11(5, 7)	269630.02	0.05	269630.11	0.16	103.071	9.9170	
$H^{13}COOH$	12(5, 7) - 11(5, 6)	269630.44	0.05	269630.11	0.16	103.071	9.9170	
$D^{12}COOH$	21(2,19) - 21(1,20)	269739.41	0.18			172.396	0.3503	
$H^{12}COOH$	18(1,17) - 18(0,18)	269793.50	0.04			124.510	0.2345	
$H^{12}COOH$	25(7,19) - 26(6,20)	269814.05	0.08			343.168	0.1258	
$D^{12}COOH$	10(6, 5) - 11(5, 6)	269826.52	0.63			87.479	0.0243	
$D^{12}COOH$	10(6, 4) - 11(5, 7)	269829.80	0.63			87.479	0.0243	
$H^{13}COOH$	12(4, 9) - 11(4, 8)	269835.73	0.05	269835.79	0.16	83.786	10.6668	
$D^{12}COOH$	13(0,13) - 12(0,12)	269836.47	0.12			55.389	12.9107	
$H^{13}COOH$	12(4, 8) - 11(4, 7)	269861.32	0.05			83.786	10.6668	
$H^{12}COOH$	25(7,18) - 26(6,21)	269866.15	0.08			343.166	0.1258	
$H^{13}COOH$	28(3,25) - 28(2,26)	269911.64	0.49			319.948	0.7646	
$H^{12}COOH$	12(8, 5) - 11(8, 4)	269915.87	0.02	269915.85	0.16	190.760	6.6669	
$H^{12}COOH$	12(8, 4) - 11(8, 3)	269915.87	0.02	269915.85	0.16	190.760	6.6669	
$H^{12}COOH$	12(9, 3) - 11(9, 2)	269920.54	0.02	269920.52	0.16	228.206	5.2502	
$H^{12}COOH$	12(9, 4) - 11(9, 3)	269920.54	0.02	269920.52	0.16	228.206	5.2502	
$H^{12}COOH$	12(7, 6) - 11(7, 5)	269928.98	0.02	269928.91	0.16	157.695	7.9170	
$H^{12}COOH$	12(7, 5) - 11(7, 4)	269928.98	0.02	269928.91	0.16	157.695	7.9170	
$H^{12}COOH$	12(10, 3) - 11(10, 2)	269937.59	0.02	269937.45	0.16	270.020	3.6668	
$H^{12}COOH$	12(10, 2) - 11(10, 1)	269937.59	0.02	269937.45	0.16	270.020	3.6668	
$H^{12}COOH$	12(11, 1) - 11(11, 0)	269963.95	0.03	269963.87	0.16	316.189	1.9167	
$H^{12}COOH$	12(11, 2) - 11(11, 1)	269963.95	0.03	269963.87	0.16	316.189	1.9167	
$H^{12}COOH$	12(6, 7) - 11(6, 6)	269970.33	0.01	269970.26	0.16	129.020	9.0003	
$H^{12}COOH$	12(6, 6) - 11(6, 5)	269970.33	0.01	269970.26	0.16	129.020	9.0003	
$H^{13}COOH$	12(3,10) - 11(3, 9)	270010.55	0.06			68.792	11.2493	
$D^{12}COOH$	15(3,13) - 15(2,14)	270023.77	0.08			93.475	0.2663	
$H^{12}COOD$	8(3, 5) - 8(2, 6)	270034.36	1.97			33.720	0.1457	
$H^{12}COOH$	12(5, 8) - 11(5, 7)	270062.45	0.01	270062.56	0.16	104.747	9.9170	
$H^{12}COOH$	12(5, 7) - 11(5, 6)	270062.78	0.01	270062.56	0.16	104.747	9.9170	
$H^{13}COOH$	7(4, 4) - 8(3, 5)	270080.16	1.85			46.294	0.0220	
$H^{13}COOH$	40(4,36) - 40(4,37)	270119.91	0.62			650.337	0.4929	
$D^{12}COOH$	15(2,14) - 15(1,15)	270172.32	0.16			84.463	0.1591	
$H^{12}COOH$	25(2,23) - 25(2,24)	270231.90	0.05			249.620	0.2513	
$H^{12}COOH$	12(4, 9) - 11(4, 8)	270253.20	0.01	270253.19	0.16	84.886	10.6668	
$H^{13}COOH$	7(4, 3) - 8(3, 6)	270263.82	1.85			46.288	0.0220	
$H^{12}COOH$	12(4, 8) - 11(4, 7)	270274.73	0.01	270274.63	0.16	84.887	10.6668	
$D^{12}COOH$	12(1,11) - 11(1,10)	270283.88	0.08			51.845	11.8576	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOH$	12(3,10) - 11(3, 9)	270429.21	0.01	270429.20	0.16	69.446	11.2493	
$H^{13}COOH$	10(2, 9) - 10(0,10)	270505.56	0.12			40.639	0.0411	
$H^{12}COOH$	8(2, 7) - 8(0, 8)	270515.08	0.02			26.774	0.0213	
$H^{13}COOH$	17(3,14) - 17(2,15)	270587.41	0.53			125.558	0.3937	
$H^{12}COOD$	13(0,13) - 12(0,12)	270634.87	0.06			55.271	12.9325	
$H^{12}COOH$	44(5,40) - 43(6,37)	270689.08	0.10			792.466	0.2244	
$H^{13}COOH$	12(3, 9) - 11(3, 8)	270782.19	0.06			68.831	11.2494	
$H^{12}COOH$	28(3,25) - 28(2,26)	270892.45	0.04			320.658	0.7756	
$H^{12}COOH$	12(3, 9) - 11(3, 8)	271113.54	0.01	271113.98	0.16	69.480	11.2494	
$H^{12}COOD$	30(3,27) - 30(3,28)	271115.58	0.83			353.269	0.3983	
$H^{13}COOH$	13(2,12) - 13(1,13)	271778.86	0.11			67.381	0.1797	
$D^{12}COOH$	22(3,19) - 21(4,18)	272098.53	0.63			195.635	0.1442	
$D^{12}COOH$	7(2, 6) - 6(1, 5)	272172.19	0.04			17.674	0.0955	
$H^{12}COOD$	28(3,25) - 28(2,26)	272326.84	1.59			309.000	0.6856	
$H^{12}COOD$	7(3, 4) - 7(2, 5)	272349.18	1.97			27.823	0.1236	
$H^{12}COOD$	14(2,13) - 14(0,14)	272373.66	0.35			73.985	0.1065	
$H^{13}COOH$	18(1,17) - 18(0,18)	272882.25	0.29			124.099	0.2270	
$D^{12}COOH$	15(2,14) - 15(0,15)	273153.24	0.16			84.363	0.1571	
$H^{12}COOH$	9(2, 8) - 9(0, 9)	273433.64	0.02			33.404	0.0290	
$D^{12}COOH$	39(5,34) - 39(5,35)	273820.42	1.92			616.497	0.7200	
$D^{12}COOH$	14(7, 8) - 15(6, 9)	273884.48	1.10			144.349	0.0426	
$D^{12}COOH$	14(7, 7) - 15(6,10)	273886.26	1.10			144.349	0.0426	
$D^{12}COOH$	19(4,15) - 19(3,16)	273898.91	0.23			156.482	0.4227	
$H^{12}COOD$	6(3, 3) - 6(2, 4)	273960.93	1.97			22.682	0.1017	
$D^{12}COOH$	42(7,36) - 41(8,33)	273963.71	5.41			736.081	0.2148	
$D^{12}COOH$	12(2,10) - 11(2, 9)	274726.07	0.08			55.843	11.6791	
$H^{12}COOD$	25(3,22) - 24(4,21)	274734.62	5.17			248.063	0.1630	
$H^{12}COOH$	19(6,14) - 20(5,15)	274778.92	0.06			212.957	0.0910	
$H^{12}COOH$	19(6,13) - 20(5,16)	274873.21	0.06			212.954	0.0910	
$H^{12}COOH$	18(3,15) - 18(2,16)	274964.66	0.02			139.810	0.4254	
$H^{12}COOD$	5(3, 2) - 5(2, 3)	275000.38	1.96			18.289	0.0796	
$D^{12}COOH$	13(1,13) - 12(0,12)	275325.94	0.12			55.389	0.3603	
$D^{12}COOH$	46(8,39) - 45(9,36)	275574.02	7.70			890.568	0.2380	
$H^{13}COOH$	12(2,10) - 11(2, 9)	275587.21	0.06			58.578	11.6684	
$H^{12}COOD$	18(1,17) - 18(1,18)	275606.87	0.78			119.427	0.1510	
$H^{12}COOD$	4(3, 1) - 4(2, 2)	275607.84	1.96			14.639	0.0566	
$H^{13}COOH$	27(3,24) - 26(4,23)	275666.40	2.15			290.119	0.1747	
$H^{12}COOH$	12(2,10) - 11(2, 9)	275700.81	0.01			58.880	11.6679	
$H^{13}COOH$	11(2,10) - 11(0,11)	275771.15	0.12			48.656	0.0511	
$H^{12}COOH$	13(2,12) - 13(1,13)	275779.54	0.02			67.635	0.1818	
$H^{12}COOD$	3(3, 0) - 3(2, 1)	275916.84	1.96			11.726	0.0313	
$H^{12}COOD$	23(2,21) - 23(1,22)	276071.24	0.65			203.998	0.4255	
$H^{12}COOD$	3(3, 1) - 3(2, 2)	276134.04	1.96			11.719	0.0312	
$H^{13}COOH$	28(2,26) - 29(1,29)	276165.75	2.95			310.736	0.0057	
$D^{12}COOH$	17(1,16) - 17(1,17)	276192.47	0.28			107.024	0.1776	
$D^{12}COOH$	4(2, 2) - 3(0, 3)	276203.44	0.06			4.394	0.0055	
$H^{12}COOD$	4(3, 2) - 4(2, 3)	276255.50	1.96			14.617	0.0565	
$D^{12}COOH$	26(3,23) - 26(2,24)	276274.91	0.32			270.406	0.5584	
$H^{12}COOD$	20(2,18) - 19(3,17)	276352.36	1.99			154.750	0.1696	
$H^{13}COOH$	12(1,11) - 11(1,10)	276474.08	0.06			53.163	11.8993	
$H^{12}COOD$	5(3, 3) - 5(2, 4)	276498.23	1.96			18.238	0.0793	
$D^{12}COOH$	27(3,24) - 27(3,25)	276593.60	0.29			290.927	0.4498	
$H^{12}COOH$	41(4,37) - 41(4,38)	276702.13	0.15			683.140	0.4814	
$H^{12}COOD$	6(3, 4) - 6(2, 5)	276919.23	1.97			22.581	0.1010	
$H^{12}COOH$	12(1,11) - 11(1,10)	276929.27	0.01	276929.25	0.16	53.288	11.9011	
$H^{12}COOD$	15(2,14) - 15(1,15)	277133.45	0.37			84.569	0.1791	
$D^{12}COOH$	18(2,16) - 17(3,15)	277285.93	0.35			126.790	0.1618	
$H^{12}COOH$	10(2, 9) - 10(0,10)	277311.24	0.02			40.744	0.0377	
$H^{13}COOH$	18(6,13) - 19(5,14)	277351.86	8.05			196.096	0.0832	
$H^{13}COOH$	18(6,12) - 19(5,15)	277422.83	8.05			196.094	0.0832	
$H^{13}COOH$	16(3,13) - 16(2,14)	277423.06	0.54			112.430	0.3570	
$H^{12}COOH$	42(10,33) - 43(9,34)	277475.07	0.19			889.056	0.2220	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOH$	42(10,32) – 43(9,35)	277478.96	0.19			889.055	0.2220	
$H^{12}COOH$	24(2,22) – 24(1,23)	277542.39	0.04			230.152	0.5074	
$H^{12}COOD$	4(4, 1) – 5(3, 2)	277572.26	4.97			27.462	0.0036	
$H^{12}COOD$	7(3, 5) – 7(2, 6)	277583.35	1.97			27.644	0.1221	
$H^{12}COOD$	4(4, 0) – 5(3, 3)	277590.82	4.97			27.461	0.0036	
$D^{12}COOH$	18(8,11) – 19(7,12)	277671.56	1.85			216.113	0.0614	
$D^{12}COOH$	18(8,10) – 19(7,13)	277672.38	1.85			216.113	0.0614	
$D^{12}COOH$	17(1,16) – 17(0,17)	277757.30	0.27			106.972	0.1667	
$H^{13}COOH$	4(2, 3) – 3(1, 2)	277774.54	0.09			6.803	0.0658	
$H^{12}COOD$	30(4,26) – 30(3,27)	277915.25	4.35			362.313	0.8339	
$D^{12}COOH$	41(7,34) – 40(8,33)	277953.85	4.96			705.508	0.2134	
$H^{13}COOH$	13(1,13) – 12(1,12)	278306.85	0.09			58.097	12.9115	
$H^{12}COOD$	16(1,15) – 15(2,14)	278407.15	0.49			93.813	0.2224	
$H^{12}COOD$	9(5, 5) – 10(4, 6)	278512.52	9.61			69.400	0.0265	
$H^{12}COOD$	9(5, 4) – 10(4, 7)	278537.55	9.61			69.399	0.0265	
$H^{12}COOD$	8(3, 6) – 8(2, 7)	278561.53	1.97			33.425	0.1427	
$D^{12}COOH$	16(3,14) – 16(2,15)	278732.40	0.10			104.975	0.2784	
$H^{12}COOD$	14(0,14) – 13(1,13)	278874.62	0.08			64.683	0.3740	
$H^{12}COOD$	29(4,25) – 29(3,26)	278886.28	4.46			339.839	0.7939	
$H^{12}COOD$	18(1,17) – 18(0,18)	278911.49	0.76			119.317	0.1985	
$H^{12}COOH$	13(1,13) – 12(1,12)	279182.20	0.01	279182.10	0.16	58.323	12.9124	[25A]
$H^{12}COOD$	31(4,27) – 31(3,28)	279307.88	4.23			385.493	0.8681	
$H^{12}COOH$	13(5, 9) – 14(4,10)	279315.60	0.05			114.199	0.0562	
$H^{12}COOH$	13(5, 8) – 14(4,11)	279462.66	0.05			114.194	0.0561	
$H^{12}COOH$	34(4,30) – 33(5,29)	279509.23	0.06			477.568	0.2010	
$H^{13}COOH$	25(2,23) – 25(2,24)	279825.77	0.42			248.762	0.2537	
$H^{12}COOD$	9(3, 7) – 9(2, 8)	279928.79	1.97			39.922	0.1631	
$H^{12}COOD$	13(2,12) – 12(2,11)	279967.88	0.07			63.689	12.6780	
$H^{12}COOH$	47(6,41) – 46(7,40)	280603.02	0.09			921.483	0.2672	
$H^{12}COOH$	29(3,26) – 29(2,27)	280830.29	0.05			342.757	0.7865	
$D^{12}COOH$	33(4,29) – 33(4,30)	280844.45	0.83			438.886	0.5803	
$D^{12}COOH$	22(9,14) – 23(8,15)	281245.74	3.00			302.763	0.0804	
$D^{12}COOH$	22(9,13) – 23(8,16)	281246.09	3.00			302.763	0.0804	
$H^{13}COOH$	29(3,26) – 29(2,27)	281499.25	0.50			341.974	0.7710	
$H^{12}COOH$	49(6,44) – 48(7,41)	281528.51	0.12			993.386	0.2689	
$H^{12}COOH$	17(3,14) – 17(2,15)	281700.45	0.02			125.893	0.3872	
$H^{12}COOD$	10(3, 8) – 10(2, 9)	281762.21	1.98			47.134	0.1831	
$H^{13}COOH$	13(0,13) – 12(0,12)	281916.43	0.09			57.368	12.9468	
$D^{12}COOH$	15(1,14) – 14(2,13)	281951.69	0.20			82.666	0.2321	
$H^{12}COOD$	28(4,24) – 28(3,25)	281999.63	4.57			318.084	0.7496	
$H^{12}COOH$	33(3,30) – 33(3,31)	282027.90	0.09			440.115	0.3626	
$D^{12}COOH$	13(2,12) – 12(2,11)	282111.72	0.11			63.145	12.6657	
$H^{12}COOD$	13(1,13) – 12(0,12)	282149.22	0.07			55.271	0.3424	
$H^{13}COOH$	12(2,11) – 12(0,12)	282261.70	0.12			57.368	0.0614	
$H^{12}COOH$	11(2,10) – 11(0,11)	282271.01	0.02			48.787	0.0470	
$H^{13}COOH$	24(2,22) – 24(1,23)	282309.23	0.27			229.498	0.4897	
$H^{12}COOD$	6(2, 5) – 5(1, 4)	282626.48	0.46			13.154	0.0838	
$H^{12}COOH$	36(9,28) – 37(8,29)	282729.04	0.13			669.227	0.1875	
$H^{12}COOH$	36(9,27) – 37(8,30)	282737.39	0.13			669.226	0.1875	
$H^{12}COOD$	13(10, 4) – 12(10, 3)	282838.32	0.17			240.553	5.3080	
$H^{12}COOD$	13(10, 3) – 12(10, 2)	282838.32	0.17			240.553	5.3080	
$H^{12}COOD$	13(11, 3) – 12(11, 2)	282840.84	0.30			279.138	3.6925	
$H^{12}COOD$	13(11, 2) – 12(11, 1)	282840.84	0.30			279.138	3.6925	
$H^{12}COOD$	13(9, 5) – 12(9, 4)	282848.70	0.10			205.633	6.7697	
$H^{12}COOD$	13(9, 4) – 12(9, 3)	282848.70	0.10			205.633	6.7697	
$H^{12}COOD$	13(12, 2) – 12(12, 1)	282852.97	0.49			321.389	1.9232	
$H^{12}COOD$	13(12, 1) – 12(12, 0)	282852.97	0.49			321.389	1.9232	
$H^{13}COOH$	44(5,40) – 43(6,37)	282872.22	9.28			789.398	0.2160	
$H^{12}COOD$	13(8, 6) – 12(8, 5)	282877.47	0.07			174.380	8.0774	
$H^{12}COOD$	13(8, 5) – 12(8, 4)	282877.47	0.07			174.380	8.0774	
$H^{12}COOD$	13(7, 7) – 12(7, 6)	282934.46	0.07			146.796	9.2313	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$-$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOD$	13(7, 6) - 12(7, 5)	282934.46	0.07			146.796	9.2313	
$H^{12}COOH$	13(0,13) - 12(0,12)	282939.75	0.01	282939.80	0.16	57.530	12.9499	[25A]
$D^{12}COOH$	18(4,14) - 18(3,15)	282957.06	0.20			141.979	0.3857	
$H^{12}COOD$	13(6, 8) - 12(6, 7)	283038.76	0.07			122.887	10.2314	
$H^{12}COOD$	13(6, 7) - 12(6, 6)	283038.79	0.07			122.887	10.2314	
$H^{13}COOH$	12(1,12) - 11(0,11)	283045.66	0.07			48.656	0.2962	
$D^{12}COOH$	39(6,34) - 38(7,31)	283076.14	4.25			624.852	0.1884	
$H^{12}COOH$	7(4, 4) - 8(3, 5)	283205.41	0.03			46.911	0.0220	
$H^{12}COOD$	13(5, 9) - 12(5, 8)	283230.99	0.07			102.659	11.0774	
$H^{12}COOD$	13(5, 8) - 12(5, 7)	283233.27	0.07			102.659	11.0774	
$H^{12}COOD$	32(4,28) - 32(3,29)	283238.47	4.10			409.371	0.8952	
$H^{12}COOH$	7(4, 3) - 8(3, 6)	283367.85	0.03			46.906	0.0220	
$H^{12}COOD$	13(4,10) - 12(4, 9)	283576.20	0.06			86.123	11.7694	
$H^{12}COOD$	13(3,11) - 12(3,10)	283651.67	0.06			73.267	12.3058	
$H^{12}COOD$	13(4, 9) - 12(4, 8)	283669.69	0.06			86.127	11.7694	
$H^{12}COOH$	14(0,14) - 13(1,13)	283684.42	0.01			67.635	0.3545	
$H^{12}COOH$	4(2, 3) - 3(1, 2)	283771.90	0.02			6.871	0.0658	
$H^{13}COOH$	14(2,13) - 14(1,14)	284019.36	0.13			77.367	0.1863	
$D^{12}COOH$	14(0,14) - 13(1,13)	284042.64	0.15			64.573	0.3945	
$D^{12}COOH$	31(4,27) - 31(3,28)	284118.95	0.86			389.052	0.7827	
$H^{12}COOD$	11(3, 9) - 11(2,10)	284138.80	1.98			55.057	0.2027	
$H^{13}COOH$	15(3,12) - 15(2,13)	284272.61	0.54			100.084	0.3230	
$H^{12}COOD$	15(2,14) - 15(0,15)	284302.37	0.36			84.330	0.1156	
$H^{13}COOH$	14(0,14) - 13(1,13)	284314.56	0.12			67.381	0.3582	
$D^{12}COOH$	26(10,17) - 27(9,18)	284651.03	4.68			404.287	0.0995	
$D^{12}COOH$	26(10,16) - 27(9,19)	284651.17	4.68			404.287	0.0995	
$H^{12}COOD$	24(2,22) - 24(2,23)	284803.82	0.78			221.518	0.2744	
$H^{12}COOD$	5(2, 3) - 4(1, 4)	284807.75	0.45			8.789	0.0625	
$H^{13}COOH$	12(5, 8) - 13(4, 9)	285431.11	4.25			102.544	0.0485	
$H^{12}COOD$	13(3,10) - 12(3, 9)	285511.02	0.06			73.374	12.3064	
$H^{13}COOH$	12(5, 7) - 13(4,10)	285528.44	4.25			102.540	0.0485	
$H^{12}COOH$	12(1,12) - 11(0,11)	285863.61	0.02			48.787	0.2936	
$H^{12}COOD$	3(2, 1) - 2(0, 2)	286378.28	0.48			2.173	0.0013	
$H^{12}COOH$	45(5,41) - 44(6,38)	286534.13	0.11			825.866	0.2230	
$D^{12}COOH$	13(12, 2) - 12(12, 1)	286544.07	0.79			281.107	1.9233	
$D^{12}COOH$	13(12, 1) - 12(12, 0)	286544.07	0.79			281.107	1.9233	
$D^{12}COOH$	13(11, 3) - 12(11, 2)	286556.69	0.51			245.435	3.6928	
$D^{12}COOH$	13(11, 2) - 12(11, 1)	286556.69	0.51			245.435	3.6928	
$D^{12}COOH$	13(10, 3) - 12(10, 2)	286582.24	0.31			212.842	5.3083	
$D^{12}COOH$	13(10, 4) - 12(10, 3)	286582.24	0.31			212.842	5.3083	
$D^{12}COOH$	13(9, 5) - 12(9, 4)	286626.01	0.18			183.337	6.7701	
$D^{12}COOH$	13(9, 4) - 12(9, 3)	286626.01	0.18			183.337	6.7701	
$D^{12}COOH$	13(8, 6) - 12(8, 5)	286696.94	0.12			156.925	8.0779	
$D^{12}COOH$	13(8, 5) - 12(8, 4)	286696.94	0.12			156.925	8.0779	
$D^{12}COOH$	16(2,15) - 16(1,16)	286767.88	0.21			95.410	0.1609	
$D^{12}COOH$	22(2,20) - 22(2,21)	286777.80	0.23			188.318	0.3179	
$D^{13}COOH$	13(7, 7) - 12(7, 6)	286810.99	0.11			133.613	9.2319	
$D^{12}COOH$	13(7, 6) - 12(7, 5)	286810.99	0.11			133.613	9.2319	
$H^{12}COOD$	27(4,23) - 27(3,24)	286987.43	4.67			297.057	0.7027	
$D^{12}COOH$	8(2, 7) - 7(1, 6)	286995.32	0.04			23.024	0.1077	
$D^{12}COOH$	13(6, 8) - 12(6, 7)	286999.28	0.11			113.408	10.2319	
$D^{12}COOH$	13(6, 7) - 12(6, 6)	286999.47	0.11			113.408	10.2319	
$H^{12}COOH$	17(1,16) - 16(2,15)	287113.33	0.02			110.282	0.2191	
$H^{12}COOD$	12(3,10) - 12(2,11)	287133.52	1.98			63.689	0.2218	
$H^{12}COOD$	27(2,25) - 28(1,28)	287183.87	3.85			278.932	0.0043	
$D^{12}COOH$	13(5, 9) - 12(5, 8)	287325.79	0.11			96.321	11.0779	
$D^{12}COOH$	13(5, 8) - 12(5, 7)	287335.62	0.11			96.321	11.0779	
$H^{12}COOH$	19(1,18) - 19(1,19)	287553.91	0.05			138.281	0.1333	
$D^{12}COOH$	13(3,11) - 12(3,10)	287591.78	0.11			71.499	12.3031	
$D^{12}COOH$	5(5, 1) - 6(4, 2)	287606.55	0.35			40.354	0.0030	
$D^{12}COOH$	5(5, 0) - 6(4, 3)	287607.72	0.35			40.353	0.0030	
$H^{12}COOH$	14(2,13) - 14(1,14)	287762.75	0.02			77.653	0.1888	
$D^{12}COOH$	13(4,10) - 12(4, 9)	287844.19	0.11			82.366	11.7695	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$D^{12}COOH$	30(11,20) - 31(10,21)	287920.78	7.05			520.674	0.1186	
$D^{12}COOH$	30(11,19) - 31(10,22)	287920.83	7.05			520.674	0.1186	
$H^{12}COOH$	30(8,23) - 31(7,24)	287969.89	0.10			480.726	0.1528	
$H^{12}COOD$	45(5,40) - 45(5,41)	287970.68	4.17			801.265	0.6350	
$H^{12}COOH$	30(8,22) - 31(7,25)	287986.95	0.10			480.726	0.1528	
$H^{12}COOD$	14(1,14) - 13(1,13)	288006.39	0.07			64.683	13.9094	
$D^{12}COOH$	14(1,14) - 13(1,13)	288107.84	0.15			64.573	13.8982	
$D^{12}COOH$	13(4, 9) - 12(4, 8)	288130.82	0.11			82.377	11.7695	
$D^{12}COOH$	27(4,23) - 26(5,22)	288156.99	1.18			298.502	0.1547	
$H^{13}COOH$	4(2, 2) - 3(1, 3)	288308.95	0.09			6.468	0.0607	
$H^{12}COOH$	12(2,11) - 12(0,12)	288407.75	0.02			57.530	0.0567	
$D^{12}COOH$	17(3,15) - 17(2,16)	288567.02	0.11			117.165	0.2890	
$H^{12}COOH$	16(3,13) - 16(2,14)	288598.77	0.02			112.756	0.3517	
$D^{12}COOH$	16(2,15) - 16(0,16)	288935.46	0.20			95.338	0.1635	
$H^{12}COOH$	50(5,45) - 50(5,46)	289063.48	0.23			1016.028	0.5898	
$H^{12}COOD$	13(1,12) - 12(1,11)	289201.14	0.07			60.303	12.8852	
$D^{12}COOH$	33(5,28) - 33(4,29)	289451.55	1.45			448.254	0.9140	
$D^{12}COOH$	14(0,14) - 13(0,13)	289532.11	0.15			64.390	13.9077	
$H^{13}COOH$	13(2,12) - 12(2,11)	289683.95	0.09			66.784	12.6830	
$H^{13}COOH$	49(5,44) - 49(5,45)	289767.02	0.99			975.416	0.5982	
$H^{12}COOD$	33(4,29) - 33(3,30)	289834.18	3.98			433.933	0.9144	
$H^{13}COOH$	13(2,12) - 13(0,13)	290029.22	0.13			66.772	0.0715	
$H^{12}COOH$	22(2,20) - 21(3,19)	290255.00	0.03			193.501	0.1809	
$H^{12}COOH$	13(2,12) - 12(2,11)	290314.11	0.01	290314.10	0.16	67.150	12.6839	[25A]
$H^{12}COOD$	14(0,14) - 13(0,13)	290388.96	0.07			64.299	13.9281	
$D^{12}COOH$	34(5,29) - 34(4,30)	290724.19	1.56			474.190	0.9485	
$H^{12}COOD$	29(3,26) - 29(2,27)	290759.25	1.57			330.140	0.6768	
$H^{12}COOD$	13(3,11) - 13(2,12)	290817.32	1.99			73.028	0.2403	
$H^{13}COOH$	14(3,11) - 14(2,12)	290885.52	0.54			88.524	0.2918	
$D^{12}COOH$	32(5,27) - 32(4,28)	291321.15	1.35			423.028	0.8715	
$D^{12}COOH$	13(1,12) - 12(1,11)	291330.20	0.11			60.861	12.8456	
$D^{12}COOH$	17(4,13) - 17(3,14)	291491.72	0.17			128.274	0.3524	
$D^{12}COOH$	13(3,10) - 12(3, 9)	291514.50	0.11			71.732	12.3064	
$H^{13}COOH$	19(1,18) - 19(1,19)	291598.57	0.37			137.793	0.1361	
$H^{12}COOD$	13(2,11) - 12(2,10)	291672.59	0.07			64.950	12.7002	
$H^{12}COOD$	16(2,15) - 16(1,16)	291817.11	0.41			95.519	0.1826	
$H^{13}COOH$	13(9, 5) - 12(9, 4)	291931.82	0.11			231.954	6.7695	
$H^{13}COOH$	13(9, 4) - 12(9, 3)	291931.82	0.11			231.954	6.7695	
$H^{13}COOH$	13(8, 6) - 12(8, 5)	291935.78	0.09			195.589	8.0773	
$H^{13}COOH$	13(8, 5) - 12(8, 4)	291935.78	0.09			195.589	8.0773	
$H^{13}COOH$	13(10, 4) - 12(10, 3)	291943.60	0.13			272.561	5.3079	
$H^{13}COOH$	13(10, 3) - 12(10, 2)	291943.60	0.13			272.561	5.3079	
$H^{13}COOH$	13(7, 7) - 12(7, 6)	291962.86	0.08			163.478	9.2311	
$H^{13}COOH$	13(7, 6) - 12(7, 5)	291962.86	0.08			163.478	9.2311	
$H^{13}COOH$	13(11, 3) - 12(11, 2)	291966.97	0.15			317.398	3.6925	
$H^{13}COOH$	13(11, 2) - 12(11, 1)	291966.97	0.15			317.398	3.6925	
$H^{13}COOH$	13(12, 2) - 12(12, 1)	291999.42	0.18			366.452	1.9232	
$H^{13}COOH$	13(12, 1) - 12(12, 0)	291999.42	0.18			366.452	1.9232	
$H^{13}COOH$	13(6, 8) - 12(6, 7)	292027.35	0.08			135.633	10.2311	
$H^{13}COOH$	13(6, 7) - 12(6, 6)	292027.36	0.08			135.633	10.2311	
$D^{12}COOH$	46(8,38) - 45(9,37)	292043.22	7.87			890.531	0.2392	
$D^{12}COOH$	9(6, 4) - 10(5, 5)	292150.35	0.66			79.377	0.0178	
$D^{12}COOH$	9(6, 3) - 10(5, 6)	292151.58	0.66			79.377	0.0178	
$H^{13}COOH$	13(5, 9) - 12(5, 8)	292159.92	0.08			112.065	11.0773	
$H^{13}COOH$	13(5, 8) - 12(5, 7)	292160.81	0.08			112.065	11.0773	
$H^{12}COOH$	29(2,27) - 30(1,30)	292417.37	0.35			333.003	0.0058	
$H^{13}COOH$	13(4,10) - 12(4, 9)	292419.33	0.08			92.786	11.7694	
$H^{12}COOH$	13(9, 5) - 12(9, 4)	292421.62	0.02	292421.90	0.16	237.209	6.7695	[25A]
$H^{12}COOH$	13(9, 4) - 12(9, 3)	292421.62	0.02	292421.90	0.16	237.209	6.7695	[25A]
$H^{12}COOH$	13(8, 6) - 12(8, 5)	292422.09	0.02	292421.90	0.16	199.764	8.0772	[25A]
$H^{12}COOH$	13(8, 5) - 12(8, 4)	292422.09	0.02	292421.90	0.16	199.764	8.0772	[25A]

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOH$	13(10, 4) – 12(10, 3)	292436.14	0.02	292436.10	0.16	279.024	5.3079	[25A]
$H^{12}COOH$	13(10, 3) – 12(10, 2)	292436.14	0.02	292436.10	0.16	279.024	5.3079	[25A]
$H^{12}COOH$	13(7, 7) – 12(7, 6)	292444.43	0.02	292444.40	0.16	166.699	9.2311	[25A]
$H^{12}COOH$	13(7, 6) – 12(7, 5)	292444.43	0.02	292444.40	0.16	166.699	9.2311	[25A]
$H^{12}COOH$	13(11, 3) – 12(11, 2)	292461.80	0.03	292461.70	0.16	325.194	3.6924	[25A]
$H^{12}COOH$	13(11, 2) – 12(11, 1)	292461.80	0.03	292461.70	0.16	325.194	3.6924	[25A]
$H^{13}COOH$	13(4, 9) – 12(4, 8)	292464.63	0.08			92.788	11.7694	
$H^{13}COOH$	40(5,35) – 39(6,34)	292477.37	9.13			663.455	0.2279	
$H^{12}COOH$	13(12, 1) – 12(12, 0)	292496.26	0.04	292496.10	0.16	375.706	1.9231	[25A]
$H^{12}COOH$	13(12, 2) – 12(12, 1)	292496.26	0.04	292496.10	0.16	375.706	1.9231	[25A]
$H^{12}COOH$	13(6, 8) – 12(6, 7)	292501.95	0.02	292501.89	0.16	138.025	10.2311	[25A]
$H^{12}COOH$	13(6, 7) – 12(6, 6)	292501.95	0.02	292501.89	0.16	138.025	10.2311	[25A]
$H^{13}COOH$	13(3,11) – 12(3,10)	292574.07	0.08			77.799	12.3066	
$H^{12}COOH$	13(5, 9) – 12(5, 8)	292623.19	0.01	292623.00	0.16	113.755	11.0772	[25A]
$H^{12}COOH$	13(5, 8) – 12(5, 7)	292623.90	0.01	292623.00	0.16	113.755	11.0772	[25A]
$D^{12}COOH$	6(2, 4) – 5(1, 5)	292699.81	0.05			12.030	0.0578	
$H^{13}COOH$	6(4, 3) – 7(3, 4)	292779.67	1.85			40.298	0.0151	
$H^{13}COOH$	6(4, 2) – 7(3, 5)	292863.20	1.85			40.290	0.0151	
$H^{12}COOH$	13(4,10) – 12(4, 9)	292864.49	0.01	292864.50	0.16	93.901	11.7693	[25A]
$H^{12}COOH$	13(4, 9) – 12(4, 8)	292902.61	0.01	292902.60	0.16	93.903	11.7693	[25A]
$H^{13}COOH$	17(1,16) – 16(2,15)	293013.16	0.27			109.816	0.2249	
$H^{12}COOH$	13(3,11) – 12(3,10)	293027.89	0.01	293027.70	0.16	78.466	12.3067	[25A]
$H^{12}COOH$	30(3,27) – 30(2,28)	293033.62	0.05			365.555	0.7915	
$H^{12}COOH$	24(7,18) – 25(6,19)	293076.68	0.08			323.608	0.1181	
$H^{12}COOH$	24(7,17) – 25(6,20)	293109.39	0.08	293109.30	0.16	323.606	0.1181	[25A]
$H^{12}COOH$	19(1,18) – 19(0,19)	293421.02	0.05	293421.62	0.16	138.085	0.2312	[25A]
$D^{12}COOH$	46(6,40) – 46(6,41)	293509.18	4.95			857.694	0.8397	
$H^{12}COOD$	26(4,22) – 26(3,23)	293538.46	4.76			276.769	0.6551	
$D^{12}COOH$	14(1,14) – 13(0,13)	293597.31	0.15			64.390	0.3961	
$H^{13}COOH$	13(3,10) – 12(3, 9)	293717.57	0.08			77.864	12.3068	
$H^{12}COOH$	28(3,25) – 27(4,24)	293967.86	0.05	293968.65	0.16	319.889	0.1836	[25A]
$H^{12}COOH$	13(3,10) – 12(3, 9)	294043.18	0.01	294043.20	0.16	78.524	12.3069	[25A]
$H^{12}COOH$	4(2, 2) – 3(1, 3)	294058.89	0.02			6.543	0.0609	
$D^{12}COOH$	22(2,20) – 22(1,21)	294489.40	0.22			188.061	0.3446	
$H^{12}COOD$	14(3,12) – 14(2,13)	295255.42	1.99			83.070	0.2579	
$D^{12}COOH$	35(5,30) – 35(4,31)	295375.01	1.70			500.821	0.9734	
$H^{13}COOH$	30(3,27) – 30(2,28)	295402.61	0.52			364.692	0.7718	
$H^{12}COOH$	15(3,12) – 15(2,13)	295406.20	0.02			100.404	0.3188	
$H^{12}COOH$	47(11,37) – 48(10,38)	295694.63	0.33			1103.343	0.2489	
$H^{12}COOH$	47(11,36) – 48(10,39)	295695.80	0.33			1103.343	0.2489	
$H^{12}COOH$	13(2,12) – 13(0,13)	295782.11	0.02			66.968	0.0664	
$D^{12}COOH$	31(5,26) – 31(4,27)	296009.47	1.26			390.530	0.8232	
$D^{12}COOH$	13(7, 7) – 14(6, 8)	296338.96	1.16			133.295	0.0355	
$D^{12}COOH$	13(7, 6) – 14(6, 9)	296339.72	1.16			133.295	0.0355	
$D^{12}COOH$	32(5,27) – 31(6,26)	296373.57	2.05			422.859	0.1719	
$H^{13}COOH$	19(1,18) – 19(0,19)	296682.40	0.36			137.623	0.2241	
$H^{13}COOH$	45(5,41) – 44(6,38)	296704.55	9.47			822.799	0.2133	
$H^{13}COOH$	5(2, 4) – 4(1, 3)	296853.13	0.09			9.906	0.0742	
$H^{13}COOH$	13(3,10) – 13(2,11)	297046.87	0.55			77.753	0.2630	
$H^{13}COOH$	15(2,14) – 15(1,15)	297098.76	0.15			88.055	0.1919	
$H^{12}COOH$	41(5,36) – 40(6,35)	297371.99	0.08			696.742	0.2350	
$D^{12}COOH$	43(7,37) – 42(8,34)	297392.62	6.00			767.358	0.2182	
$H^{12}COOD$	16(2,15) – 16(0,16)	297395.65	0.39			95.333	0.1233	
$H^{12}COOH$	26(2,24) – 26(2,25)	297625.45	0.06			268.662	0.2457	
$H^{12}COOH$	18(6,13) – 19(5,14)	297899.33	0.07			197.913	0.0832	
$H^{12}COOH$	18(6,12) – 19(5,15)	297956.09	0.07			197.911	0.0832	
$D^{12}COOH$	13(2,11) – 12(2,10)	298056.32	0.11			65.007	12.7061	
$H^{12}COOH$	25(2,23) – 25(1,24)	298707.83	0.05			248.671	0.4992	
$H^{13}COOH$	33(3,30) – 33(3,31)	298732.94	0.67			438.662	0.3624	
$H^{13}COOH$	13(1,12) – 12(1,11)	298894.89	0.09			62.386	12.9000	

TABLE 11. Microwave transitions in order of frequency (MHz).—Continued

Isotopic species	$J'(K'_{-1}, K'_{+1})$–$J(K_{-1}, K_{+1})$	Calculated frequency	Stand. dev.	Observed frequency	Exp. unc.	$J(K_{-1}, K_{+1})$ Energy level (Cm^{-1})	S	Ref.
$H^{12}COOD$	7(2, 6) - 6(1, 5)	299010.24	0.46			17.670	0.0939	
$H^{13}COOH$	14(2,13) - 14(0,14)	299087.58	0.14			76.864	0.0811	
$H^{12}COOD$	34(4,30) - 34(3,31)	299173.28	3.87			459.171	0.9256	
$D^{12}COOH$	16(4,12) - 16(3,13)	299182.38	0.15			115.370	0.3222	
$H^{13}COOH$	13(2,11) - 12(2,10)	299258.42	0.09			67.771	12.6960	
$H^{12}COOD$	24(2,22) - 24(1,23)	299369.68	0.75			221.032	0.4176	
$H^{12}COOH$	13(2,11) - 12(2,10)	299374.30	0.01			68.076	12.6952	
$H^{13}COOH$	14(1,14) - 13(1,13)	299382.78	0.12			67.381	13.9149	
$H^{12}COOH$	13(1,12) - 12(1,11)	299436.63	0.01			62.526	12.9025	
$D^{12}COOH$	3(3, 1) - 2(2, 0)	299477.66	0.07			8.436	0.0870	
$H^{12}COOD$	14(1,14) - 13(0,13)	299520.73	0.08			64.299	0.3776	
$D^{12}COOH$	18(3,16) - 18(2,17)	299521.70	0.13			130.039	0.2980	
$D^{12}COOH$	3(3, 0) - 2(2, 1)	299549.95	0.07			8.434	0.0870	
$D^{12}COOH$	18(1,17) - 18(1,18)	299750.58	0.34			119.304	0.1785	
$H^{12}COOD$	19(1,18) - 19(1,19)	299787.48	0.94			132.383	0.1508	
$D^{12}COOH$	27(3,24) - 27(2,25)	299957.44	0.39			290.147	0.5463	

2.1. Formic Acid References

a. Laboratory References

[1A] Pietenpol, W. J., Rogers, J. D., and Williams, D., "Microwave Spectra of Asymmetric Top Molecules", Phys. Rev. **78,** 480 (1950)

[2A] Kislik, P., and Townes, C. H., Nat. Bur. Stand. Cinc. 518 (1952)

[3A] Rogers, J. D., and Williams, D., Phys. Rev. **83,** 210 (1951)

[4A] Erlandsson, G., "Preliminary Analysis of the Microwave Spectrum of Formic Acid", Arkiv. Fysik. **6,** 491 (1953)

[5A] Erlandsson, G., J. Chem. Phys. **25,** 379 (1956)

[6A] Erlandsson, G., "Millimetre Wave Spectrum of Formic Acid", J. Chem. Phys. **28,** 71 (1958)

[7A] Trambarulo, R., and Moser, P. M., J. Chem. Phys. **22,** 1622 (1954)

[8A] Lerner, R. G., Friend, J. P., and Dailey, B. P., J. Chem. Phys. **23,** 210 (1955)

[9A] Lerner, R. G., Friend, J. P., and Dailey, B. P., "Microwave Spectrum and Structure of Formic Acid", J. Chem. Phys. **26,** 680 (1957)

[10A] Wertheimer R., "Etude du spectre de rotation et des constantes d'inertie de la molécule d'acide formique", C.R. Acad. Sci. Paris **242,** 1591 (1956)

[11A] Wertheimer, R., C.R. Acad. Sci. Paris **242,** 243 (1956)

[12A] Wertheimer, R., "Constantes moléculaires de l'acide formique déduites du spectre de rotation", Arch. Sciences, **10,** 184 (1957)

[13A] Wertheimer, R., Thesis University of Paris (1956)

[14A] Erlandsson, G., and Selen, H., Arkiv. Fysik. **14,** 61 (1958)

[15A] Trambarulo, R., Clerk, A., and Hearns, C., "Planarity of the Formic Acid Monomer", J. Chem. Phys. **28,** 736 (1958)

[16A] Mirri, A. M., "Millimetre Wave Spectrum of Deutero-Derivatives of Formic Acid", Nuovo Cimento **18,** 849 (1960)

[17A] Kwei, G. H., and Curl, R. F., "Microwave Spectrum of ^{18}O Formic acid and Structure of Formic Acid" J. Chem. Phys. **32,** 1592 (1960)

[18A] Kim, H., Keller, R., and Gwinn, W. D., "Dipole Moment of Formic Acid, HCOOH and HCOOD", J. Chem. Phys. **37,** 2748 (1962)

[19A] Bellet, J., Samson, C., and Wertheimer, R., "Constantes de distorsion de l'acide formique", C.R. Acad. Sci. Paris **262,** 1333 (1966)

[20A] Willemot, E., Dangoisse, D., and Bellet, J., "Microwave Spectrum of Formic Acid and Its Isotopic Species in D, ^{13}C and ^{18}O. Study of Coriolis Resonances between υ_7 and υ_8 Vibrational Excited States", J. Mol. Spectrosc. **73,** 96 (1978)

[21A] Takami, M., "K-type Doubling Lines of H_2CO and HCOOH in the HF Region" J. Phys. Soc. Japan **24,** 372 (1968)

[22A] Bellet, J., Deldalle, A., Samson, C., and Steenbeckeliers, G., "Identification du spectre de l'acide formique dideutéré à l'aide des théories de Kivelson et de Watson appliquées au rotateur plan déformable", C.R. Acad. Sci. Paris, **268,** 560 (1969)

[23A] Deldalle, A., "Etude des spectres de rotation des isotopes deutérés de la molécule d'acide formique", Thesis University of Lille (1969)

[24A] Samson, C., and Willemot, E., 'Utilisation de l'effet Stark pour la mise en evidence de transitions interdites", C.R. Acad. Sci. Paris **271,** 1204 (1970)

[25A] Bellet, J., Samson, C., Steenbeckeliers, G., and Wertheimer, R., "Etude du spectre de rotation de la molécule d'acide formique. A) Etude de la molécule $H^{12}COOH$ dans l'état fondamental", J. Mol. Struct. **9,** 49 (1971)

[26A] Bellet, J., Deldalle, A., Samson, C., Steenbeckeliers, G., and Wertheimer, R., "Etude du spectre de rotation de la molecule d'acide formique. B) Etude de quelques substitutions isotopiques. Application à la détermination de la structure de la molécule". J. Mol. Struct. **9,** 65 (1971)

[27A] Samson, C., "Etude des spectres de rotation pure de la molécule d'acide formique—Cas d'une résonance de Coriolis entre états vibrationnels excités", Thesis University of Lille (1971)

[28A] Belov, S. P., Buranin, A. V., Kazarov, V. P., Karyakin, E. N., and Krupnov, A. F., "Microwave Gas Spectroscopy in the 200–870 GHz Range", J.E.T.P. Letters **18,** 167 (1973)

[29A] Chardon, J. C., Genty, C., Guichon, D., and Théobald, J. G., "R.F. Spectrum and Hyperfine Structure of Formic Acid", J. Chem. Phys. **64,** 1437 (1976)

b. Interstellar References

[1B] Zuckerman, B., Ball, J. A., and Gottlieb, A., "Microwave Detection of Interstellar Formic Acid", Astrophys. J. **163,** 141 (1971)

[2B] Winnewisser, G., Churchwell, E., "Detection of Formic Acid in Sagittarius B2 by its 2_{11}–2_{12}", Astrophys. J. Letters **200,** 33 (1975)

c. Other References

[1C] Watson, J. K. G., "Determination of Centrifugal Distortion Coefficients of Asymmetric-Top Molecules-III Sextic Coefficients", J. Chem. Phys. **48,** 4517 (1968)

[2C] King, G. W., Hainer, R. M., and Cross, P. C., "The Asymmetric Rotor. II Calculation of Dipole Intensities and Lines Classification", J. Chem. Phys. **12,** 210 (1944)

[3C] Maillard, B., "Etude de l'absorption des rayonnements hertziens et infrarouges par les molecules du type toupie asymétrique", Thesis University of Lille (1972)