Microwave Spectra of Formaldehyde -d_1, -d_2

By Hiromasa Hirakawa, Takeshi Oka
and Koichi Shimoda

*Department of Physics, Faculty of Science,
University of Tokyo*

(Received September 20, 1956)

Microwave spectra of formaldehyde-d_1, -d_2 molecules have been observed. To date 15 lines of HDC^{12}O^{16}, one line of HDC^{13}O^{16} and 13 lines of D$_2$C^{12}O^{16} have been measured and assigned as shown in Table I. Lawrance and Strandberg[1] used a semi-classical approach to handle the centrifugal distortion effect of H$_2$CO molecule, and there seems to be some discrepancy between their results and the calculation based on the analysis given by Nielsen[2]. Further investigation to reinterpret all the spectra of formaldehyde and its available isotopic substitutions found in microwave[1,3] and infrared[4,5] region is now in progress.

References

1) R. B. Lawrance and M.W.P. Strandberg: Phys. Rev. **83** (1951) 363.
2) H. H. Nielsen: Revs. Mod. Phys. **23** (1951) 90.
3) H. Hirakawa, A. Miyahara and K. Shimoda: J. Phys. Soc. Japan **11** (1956) 334.
4) G. Herzberg: *Infrared and Raman Spectra of Polyatomic Molecules* (1949) p. 300.
5) D. W. Davidson, B. P. Stoicheff and H. J. Bernstein: J. Chem. Phys. **22** (1954) 289.

Table I. Observed frequencies for formaldehyde -d_1, -d_2.

Transition $J_{K_{-1}, K_{+1}} \rightarrow J_{K_{-1}, K'_{+1}}$	Observed frequency (Mc/sec)	Intensity
1) HDC^{12}O^{16}		
$1_{1, 1} \rightarrow 1_{1, 0}$	5346.64±0.03	S
$2_{1, 2} \rightarrow 2_{1, 1}$	16038.06	S
$5_{2, 4} \rightarrow 5_{2, 3}$	4489.08±0.03	S
$6_{2, 5} \rightarrow 6_{2, 4}$	8922.59	S
$7_{2, 6} \rightarrow 7_{2, 5}$	15907.38	S
$10_{3, 8} \rightarrow 10_{3, 7}$	3283.09±0.03	MS
$11_{3, 9} \rightarrow 11_{3, 8}$	5702.6*	MS
$12_{3, 10} \rightarrow 12_{3, 9}$	9412.51	MS
$13_{3, 11} \rightarrow 13_{3, 10}$	14873.02	MS
$16_{4, 13} \rightarrow 16_{4, 12}$	2946.67±0.03	MW
$17_{4, 14} \rightarrow 17_{4, 13}$	4713.90	MW
$18_{4, 15} \rightarrow 18_{4, 14}$	7322.35	M
$19_{4, 16} \rightarrow 19_{4, 15}$	11074.30	M
$23_{5, 19} \rightarrow 23_{5, 18}$	3330.66±0.04	W
$24_{5, 20} \rightarrow 24_{5, 19}$	5018.25	W
2) HDC^{13}O^{16}		
$1_{1, 1} \rightarrow 1_{1, 0}$	5156.19±0.10	WW
3) D$_2$C^{12}O^{16}		
$1_{1, 1} \rightarrow 1_{1, 0}$	6096.10±0.02	S
$2_{1, 2} \rightarrow 2_{1, 1}$	18287.90	S
$4_{2, 3} \rightarrow 4_{2, 2}$	3687.28±0.04	S
$5_{2, 4} \rightarrow 5_{2, 3}$	8519.10	S
$6_{2, 5} \rightarrow 6_{2, 4}$	16759.64	S
$8_{3, 6} \rightarrow 8_{3, 5}$	2850.62±0.03	M
$9_{3, 7} \rightarrow 9_{3, 6}$	5536.98	MS
$10_{3, 8} \rightarrow 10_{3, 7}$	10304.64	MS
$13_{4, 10} \rightarrow 13_{4, 9}$	3079.48±0.03	MW
$14_{4, 11} \rightarrow 14_{4, 10}$	5461.54	M
$15_{4, 12} \rightarrow 15_{4, 11}$	9259.88	M
$16_{4, 13} \rightarrow 16_{4, 12}$	15080.34	M
$19_{5, 15} \rightarrow 19_{5, 14}$	4508.39±0.04	W

*   The measurement of this line was difficult because it comes very near the strong HDO $4_{3, 2} \rightarrow 4_{3, 1}$ line.