The $\nu_1-\nu_2$, $\nu_3-\nu_2$, ν_1, and ν_3 bands of $H_2{}^{16}O$: line positions and strengths

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Tables 9

ABSTRACT

High-resolution spectra of $H_2{}^{16}O$ were recorded with a Fourier-transform spectrometer covering transitions in the (100)-(010), (001)-(010), (100)-(000), and (001)-(000) bands. The measured line frequencies were used to determine high accuracy values of rotational energy levels in the (100) and (001) vibrational states. Measurements of the line strengths were fitted to a model in which 19 transition moment parameters were determined for the B-type bands and 8 parameters for the A-type bands. The fitting technique did not consider interactions between the (020), (100), and (001) vibrational states. The experimental results provide a more accurate representation of the line positions and strengths than those presently available for these bands.

1. INTRODUCTION

This is the second of three papers involving the (020), (100), and (003) vibrational states of H_2O. The first paper[1] covered high resolution measurements and analysis of the (02.0)-(010) and (020)-(000) bands of $H_2{}^{16}O$, $H_2{}^{17}O$, and $H_2{}^{18}O$. The present study includes measurements of the (100)-(010), (001)-(010), (]()())-((()()()), and (001)-(000) bands of $H_2{}^{16}O$. This study (as well as the previous report [1]) does not include a perturbation treatment of the data. Instead, the measured line strengths for each band were analyzed using a one band fit and the computed results represent unperturbed values.

Several reports[2-14] have been published which include measurements and/or calculations of line positions and strengths for some or all of the bands of $H_2{}^{16}O$ noted above. In addition Pearson et al.,[15] measured a few rotational transitions in excited vibrational states using millimeter and submillimeter laboratory techniques and observed frequencies in the (000)-(000), (030)-(010), (020)-(020), (100)-(100), and (001)-(001) bands of $H_2{}^{16}O$.

2. EXPERIMENT

The experimental details are the same as those discussed in the first report[1] on the $2\nu_2-\nu_2$ and $2\nu_2$ bands of H_2O. The experimental conditions used in the present study are given in Table 1. It was noted in the previous paper and an earlier report[16] that a small amount of formamine was found to be absorbed onto the cell walls on the 6-m base transversal cell (runs with path lengths

> 2.39m) and this was always present in the recorded spectra. Although the presence was minute, certain regions were inaccessible for measurements of H_2O: namely, the 1711-1800 cm^{-1} region and several areas between 3500 and 3600 cm^{-1}.

Impurities were not observed in the spectra obtained with the 2.39 m long absorption cell. Nevertheless, medium to strong absorptions of $H_2{}^{16}O$ contained added contributions due to a combination of narrow, low-pressure absorptions as a result of a small amount of water vapor (50 to 200 μm total pressure) in the vacuum tank which enclosed the FTS and air-broadened $H_2{}^{16}O$ absorptions due to the $H_2{}^{16}O$ content in the open spaces between the IR source and vacuum tank. These added contributions were very useful in the analysis of the stronger lines from the scans obtained when the 2.39 m cell was evacuated.

The line centers were measured with two computer programs. One, labeled LINEFINDER, determines line center positions and relative absorption peaks, and the other uses the technique of nonlinear least-squares (NLLS) in which absorption line positions, strengths, line widths and continuum parameters are fitted simultaneously in an interactive mode. The latter technique was used to determine experimental values of line strengths and the majority of line center values. These computer algorithins have been used in several previous studies[1,16-21]. In the present study the majority of line center values used in the analysis were determined using the NLLS program with unapodized spectra. In the majority of cases two line positions for a given $H_2{}^{16}O$ absorption

were input to the NLLS program: one representing the slightly shifted, pressure broadened contribution and the other for the desired low-pressure feature. For the strongest lines, three line positions were input to the NLLS program: the two noted above and the contribution representing the low-pressure H_2O content in the vacuum tank. The optical density of $H_2^{16}O$ in the vacuum tank was established from empty cell (2.39m path length) runs obtained in the 2.7//fro region as well as comparable results in the 6.2μm region[16]. The measure'c] line positions were calibrated ant] corrected by reference to known $H_2^{16}O^{16}$ ant] N_2O^{17} frequencies and these standards were used in the previous study' .

3. ANALYSIS

The quantum assignments of the measured $H_2^{16}O$ transitions in the ν_1-ν_2, ν_3-ν_2, v, , and ν_3 bands were determined with the sic] of the }1,0 compilation by Flaud et al. '3 which is also included in the HITRAN database[14]. The rotational energy levels in the (100) and (001) vibrational states were derived by the addition to each measured transition frequency of the (100)-(010), (100)-(000), (001)-(010), and (003)-(000) bands, the appropriate lower state level given in Ref. 16. These results were weighted and then averaged for each level. ~'able' 2 lists value's of the rotat.ions] energy levels and estimations of the uncertainties for the (100) and (001) states obtained in this study.

The experimental strengths were analyzed by the method used in the first. paper[1]. This method is based on fitting the measured

line strengths by least-squares to models in which the dipole moment matrix elements are represented by expansion coefficients; 19 terms for B-type transitions and 8 terms for A-type transitions. The B-type analysis was used in my previous studies[1,16,19-21] and the A-type transitions of the ν_2 bands of $HD^{16}O$ and $HD^{18}O$[20] were tested with the 8 coefficient fit. Both types of dipole expansions were developed and described by Flaud and Carey-Peyret[9] with 8 coefficients for each. The extra 11 coefficients used here were found to be necessary for the analysis of the ν_2 bands of $H_2{}^{16}O^{16}$ and $H_2{}^{17}O$ and $H_2{}^{18}O$[19] and also applied in my work on the B-type ν_2 bands of $HD^{16}O$ and $HD^{18}O$[20] and $D_2{}^{16}O$ and $D_2{}^{18}O$[21]. The B-type matrix elements are given in Table 3 and the A-type elements are listed in Table 4. The first 8 elements given in Table 3 and all 8 elements given in Table 4 are the same as those given by Flaud and Carey-Peyret[9] although they are given here in a somewhat different format from that presented in Ref. 9. Additional terms found necessary for B-type bands of H_2O, HDO, and D_2O were not needed in the analysis of HDO A-type transitions in the ν_2 bands[20]. In the present study, it could not be determined if additional terms were needed in the analysis of the ν_3 and $\nu_3-\nu_2$ bands due to perturbation effects and therefore the 8 terms presented in Table 4 and in Ref. 9 were used.

The measured line strengths were least-squares fitted by using the dipole moment expansion coefficients listed in Tables 3 and 4 and Eqs. (1)-(3) given in Ref. 3. The matrix elements of the direction cosines were computed from the vibration-rotation parameters given by Toth[16] for the (000) and (010) states and from

Flaud and Camy-Peyret[7] for the (1 00) and (001) states. Va] ues and associ ated estimated uncertaint ies of the matrix elements of the expa nded dipol e moments derived from the f its are given i n Tabl e 5. The 1 ower porti ons for the entri es f or each band 1 i st s the? number of 1 ines fitted, the values of the standard deviation in percent, 0%, of the 1 i ne strength fit s anti the frequency extent of the 1 i nes used in the fits. Measured 1 i ne strengths of transit ions strong] y af fected by resonance ef f ect s were not incl uded i n the anal yses. Nevertheless, it was very difficult to fit the v, band mainly due to int eracti ons wit h the st ronger ν_3 band. The fit of the v, band r equi reel separa i ng t he measurements into 3 sets with each set represent i ng a frequency interval . This met-hod was used in the anal ysis of the ν_2 band of $H_2^{16}O^{16}$. However, in the present case, the fits were overal l not good as exempl i f i ed by the rather large values of o% given in ~'able 5 especially o% for the high frequency set of the (1 00) - (000) band.

Included in 'Table 5 are values of matrix elements derived in other studies: The (100)-(010) and (001)-(010) bands by Flaud et al .[10] and the (100)-(000) and (00))-(000) bands by Flaud and Carey - Peyret[9]. Those .studies[9,10] took into account the interact-ions between the three vi brational states (020) , (100) , and (001) and to Compare those results to the pres ent values for the (100) -- (01 0) and (300)-(000) bands involves uncoupl i ng the Fermi -t ype, far interact ions between the (020) and (100) states. The method used in the f i rst. paper[1] and used here was to apply the foil owing expressi ons:

$$C_{32} = h_{32}/(E_3 - E_2)$$

$$C_{23} = h_{32}/(E_2 - E_3)$$

$$C_{22} = C_{33} = (1 - C_{23}^2)^{1/2}$$

$$\mu_2^\circ(j) = C_{22}\mu_2(j) + C_{23}\mu_3(j)$$

$$\mu_3^\circ(j) = C_{33}\mu_3(j) + C_{32}\mu_2(j), \qquad (1)$$

where h_{32} is the first order coupling constants between the (100) state (labeled 3) and (020) state (labeled 2). E_3 and E_2 are the observed rotationless energy levels for the (100) and (020) vibrational states and $\mu_n(j)$ are the matrix elements obtained in the other studies[9-10]. $\mu_n^\circ(j)$ are the uncoupled constants representing the other studies and the computed values are included in Table 5. The computed values of $\mu_n^\circ(j)$ were derived from Eq. (3) using the coupling constant, h_{32}, given in Ref. 7 and the matrix elements, $\mu_n(j)$, given in Refs. 9,10. These computed values represent a first approximation to the uncoupled constants. Higher order terms, h_{32}, etc., and more involved expressions than those given in Eq. (1) are involved in obtaining a higher order approximation of $\mu_n^\circ(j)$. However, the first order results given in Table 5 are good approximations.

4. RESULTS

Table 6 lists lines of the transitions observed in the (100)-(010) and (001)-(010) bands of $H_2{}^{16}O$. Entries for the table include the observed line position, the observed minus the computed line position (o-c), rotational quantum assignments, the observed

strength, the estimated uncertainty in the measured strength (%s), the observed minus the computed line strength in percent [(o-C) %], and the ratio R of the observed line strength to that given for $H_2^{16}O$ in the tabulation by Flaud et al.[10] (and in the 1992 edition of the HITRAN database[14] and Ref. 13). The computed line strength values are given in place of the percent differences in the column for (o-c) % if the magnitude of (o-c)% is 12% or greater. The majority of these entries are of transit-ions which are moderately to strongly perturbed. The values for the line strengths are in units of inverse square centimeters per atmosphere (1 atm=760 Torr) whereas the values given in Refs. 10,14-15 are given in $cm^{-1}/(mol\ cm^{-2})$. Therefore values from Refs. 10, 14-15 were converted to inverse centimeters squared per atmosphere by applying the factor 2.48×10^{19} (at 296K) to determine the values of R given in ~'able? 6. The experimental line strengths are presented in the table for a temperature of 296K whereas the sample temperatures of several of the spectra from which the strengths were determined were? slightly different than 296K. These values were converted to those for T= 296K with the use of the equations given in Eq. (1) in Ref. 1 and the ν_2 rotat.ions] levels given in Refs. 16.

The observed positions are given to three, four, or five decimal places in Table 6 which indicates the accuracy of these measurements. Obviously, the most accurate estimates are given with five significant figures past the decimal, and as was reported in Ref. 1 the absolute uncertainty for these measurements is ± 6 x 30-5 cm^{-1}. The computed line positions were derived from the

rotational energies given in Table 2 for the (100) and (003) states and the levels given for the (010) states given in Ref. 16. An asterisk next to the line position value denotes a doubled absorption involving two transitions which were not adequately resolved in the spectra. The quantum assignments given for these features are for the stronger of the two and the values of the observed and computed strengths represent the sum of the strengths of the two comparable transitions.

The computed line strengths were derived from the dipole moment expansion coefficients given in Table 5 and Eqs. (1)--(3) given in Ref. 1. Not. all of the line strength measurements given in Table 6 were included in the least-squares analyses. Entries with %s=15% were not. included because these transitions resulted in averaged values with uncertainties of as much as 60% to possibly less than 10%. This range of uncertainty for each of these transitions arises from one or more of the following reasons: (a) blending (b) weakness of transition intensity and (c) poor agreement between values derived from the various spectra. Other entries not included in the line strength analyses were transitions strongly perturbed due to resonance interactions and the computed strengths derived for these transitions in Table 6 represent the unperturbed values.

Table 7 is a listing comparable in content to that of Table 6. This table lists the measurements and computations for the (100) - (000) band of $H_2^{16}O$. Also included in Table 7 are a few transitions of which the computed strengths given by Flaud et al .13 (and

included in the HITRAN listing[14]) were much larger than estimated in this study. These lines are denoted with an "UL" in place of a value for the %s entry. In fact, there were no apparent absorption features in any of the spectra within ± 0.015 cm^{-1} of the listed frequencies for these lines and the observed line strength values represent upper limit values.

Values of R given in Table 7 were derived from computed line strength values given in Refs. 33 and 14. It should be noted that the computed values derived by Flaud and Camy-Peyret[9] severs] years ago differ somewhat from those reported in Refs. 13 and 14. The computed strengths given in Ref. 13 were derived from an analysis of unreported measurements obtained, for the most part, with a grating spectrometer with a spectral resolution of 0.03-0.05 cm^{-1} and these same values were incorporated in the HITRAN database[14].

Table 8 is a listing for the (001)-(000) band and is similar in content to that of Table 7. The previous computed values of line strengths used to determine values of R are also given in the HITRAN database[14].

The high accuracy measurements of $H_2{}^{16}O$ pure-rotational frequencies obtained by Pearson et al.15 are presented in Table 9 for their observations in the (100)-(100) and (003)-(001) bands. Included in this table are computed frequencies derived from rotational energy levels given in this study and listed in Table 2. The table lists the rotational quantum assignments, band, measured frequency given by Pearson et al.[15] (converted from megahertz to inverse centimeters with the speed of light as 2.99792458 x 1010

cm/s) , the computed frequencies from my work, the uncertainty, un, of the computed frequency, and the difference, A, between the measured and computed frequencies. The values of un are based on the estimated uncertainties of the two rotational level energies involved in a transition and computed from the expression,

$$un = (un_1^2 + un_2^2)^{1/2}, \qquad (2)$$

where un_1 and un_2 are the uncertainties of the two involved rotational energies. Inspection of the values of un and A shows that t.here is good agreement, on the average, between the measured and computed frequencies within the limits placed on the computed values .

5. DISCUSSION AND CONCLUSION

More than 2000 transitions frequencies measured in this study were determined to an absolute accuracy of 0. 0001 cm^{-1} (3 MHz) or better for the majority of the lines. 'l'he experimental line strengths were fitted by least- squares to a model which included 19 dipole moment. expansion coefficients for B-type transitions and 8 terms for A-type transitiens. The fitting technique did not take into account the interactions between the vibrational states (020) , (1 00) , and (001) and therefore the computed *strengths* derived in this study represent unperturbed values. These results, including those? of the previous study[1], will be fitted to a theoretical model which includes interactions between the three interacting

vibrational states.

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REF ERENCES

3. R. A. Toth , "The $2\nu_2 - \nu_2$ and $2\nu_2$ bands of $H_2{}^{16}O$, $H_2{}^{17}O$, 'ant] $H_2{}^{18}O$: 1 ine positi ons and strengths, " J . Opt.Soc.Am.B (in press) .

2. D. M. Gat es, R. F. Cal fee, I). W. Hansen,andW.S.Benedict, "Lineparametersand computed spectra f or wat er vapor bands at 2. 7μ, " U. S. Dept . of Commerce, Nati onal Bureau of St andards Monograph 71 Aug. 3, (1964) .

3. L. A. Pugh and K. Narahari Rae, "Spect rum of water vapor in the 1.9 and 2.7μ regions, " J. Mol . Spectrosc. 47, 403-408 (1973) .

4. L. A. Pugh, Ph. D. di ssert at ion, The Ohio State University, 1972; Microfilm #72-21 ,0 05, Universit y Mi crof i lms, Ann Arbor Michigan.

5. C. Camy-Peyret, J . -M. Fl aud,G.Guel achvil i , and C. Amiot, "High resol uti on Fouri er transf orm spect rum of water between 2930 arid 4255 cm^{-1}," Mol . Phy s. 26, 825-855 (1973) .

6. J. --M. Flaud and C. Camy-Peyret, "The $2\nu_2$, ν_1, and ν_3 bands of $H_2{}^{16}O$ rotational study of the (000) and (020) stat. es, " Mol . Phys. 4, 8)1-823 (19″/ 3).

7. J. -M. Fl aud and C. Camy-Peyret, "The i nteracting states (020) , (300), and (001) of $H_2^{16}O$, " J. Mol . Spectrosc. 51, 142-150 (19″/ 4).

8. R. A. Toth," Strengt hs and ai r-broadened widths of H_2O l ines in the 2950-3400 Cm-l region, " J . Quant . Spectrosc. Radi at.. Transfer 13, 132-/-1142 (19-/3).

Tab] e 6. Line positions (cm-') and strengths (cm^{-2}/atm. at. 296K) observed in the (100)-(010) and (001)-(010) bands of $H_2{}^{16}O$.

observed position	o-c	upper J	upper K_a	upper K_c	lower J	lower K_a	lower K_c	observed strength	%s	(o-c)%	? R
					(100)-(010) bard						
1820.8?03	-42	4	2	3	5	3	2	1.35E -05	10	9.36E -06	1.41
1852.9587	2?	3	2	2	4	3	1	6.22E-06	4	-3.4	0.91
1859.9482	2	3	2	1	4	3	2	2.30E-05	5	11.6	1.0[
1862.8786	126	7	2	6	8	1	7	1.12E-06	10	1.73E-06	1.0S
1871 .7?24	24	6	1	5	7	?	6	5.32E -06	10	2.94E-06	2.6(
1874 .780.4	35	8	1	8	9	0	9	4.82E -06	10	6.42E-06	1.2(
1881.07856	-6	2	2	1	3	3	0	3.42E-05	3	-0.2	0.92
1882.5180	0	2	2	0	3	3	1	1.00[-05	5	-14.2	0.8(
1894.9216	68	7	1	7	8	0	8	2.41E-06	10	4.30E-06	0.87
1895.7(07	-75	8	2	7	8	3	6	2.33E-06	10	1.63E-06	1.33
1898.593	111	5	3	3	5	4	2	2.20E-06	5	2.95E-06	0.87
1900.31814	85	6	3	4	7	2	5	2.1 OE-06	10	3.64E-06	1.0E
1901.24010	42	4	3	2	4	4	1	6.66E-06	3	9.33E-06	0.84
1902.0755	-10	5	3	2	5	4	1	6.32E-06	4	8.77E-06	1.07
1912.851	-197	7	3	4	7	4	3	2.63E-06	10	3.11 E-06	0.8(
1914 .?2568	30	6	0	6	7	1	7	1.33E -05	3	7.69E -06	2.45
1915.16015	-18	6	1	6	7	0	7	2.17E-05	3	2.31E-05	1.33
1915.56192	15	2	1	2	3	2	1	2.09E-05	3	-1.5	0.9?
1918.8679	-27	5	2	4	6	1	5	3.00E -06	10	4.27E-06	0.94
1919.37633	5	3	1	2	4	2	3	2.78E-05	2	0 . 8	1.0E
1919.9370	9	5	1	4	4	4	1	5.50E -06	10	9.28E -08	1.45
1927.67898	28	6	2	5	6	3	4	7.63E-06	3	-1.2	0.87
1931.5891	7	6	4	3	7	3	4	2.68E-06	5	3.33E-06	0.74
1933.5549	18	5	0	5	6	1	6	3.88E-05	3	5.2	1.37
1934.5176	19	6	1	6	6	2	5	8.40E-06	5	2 . 8	0.9E
1935.6759	-1	5	1	5	6	0	6	1.18E-05	5	-4.0	1.2(
1936.67672	-2	2	1	1	3	2	2	1.33E-05	4	7.1	1.0S
1938.7240	-13	5	2	4	5	3	3	4.23E-06	10	-4.4	0.84
1939.0968	1 8	5	3	3	6	2	4	1.00E-06	10	1.55E-06	0.93
1946.49941	8	4	2	3	4	3	2	1.78E-05	3	- 1 . 3	0.8(
1947.40?66	-13	8	0	8	7	3	5	1.04E-05	2	4.51E-08	0.7(
1949.0511	-48	6	0	6	6	1	5	3.93E-06	10	2.81E-06	1.25
1949.8074	23	1	1	1	2	2	0	1.44 E-05	4	5.7	1.03
1950.45205	6	4	2	3	5	1	4	1.50E-05	4	-1.8	1.2(
1951.4?39	-25	3	2	2	3	3	1	5.95E -06	3	7.5	0.95
195?.1159	-57	8	2	6	8	3	5	7.36E-07	10	-8.3	0.8E
1952.18796	. 7	4	0	4	5	1	5	1.78E-05	4	3.0	1.24
1953.30328	-48	5	1	5	5	2	4	5.27E-06	10	3.9	0.9E
1955.8218	-29	7	1	6	7	2	5	5.1 OE-06	3	0.0	0.85
1956.18567	14	1	1	0	2	2	1	4.95E-05	3	2.2	1.0(
1956.80864	-1	4	1	4	5	0	5	5.33[-05	2	3 . 9	1.2(
1957.14807	-5	3	2	1	3	3	0	1.73E-05	3	0.4	0.9C
1960.6418	-33	4	2	2	4	3	1	5.20E-06	3	6.77E-06	0.74
1961.986	-151	6	4	2	7	3	5	3.54E-07	10	1.20[-06	1.05
1963.1912	19	7	2	5	7	3	4	5.77E-06	4	-1.1	0.91
1965.4258	16	5	2	3	5	3	2	1.73E-05	4	1 . 9	0.9C
1969.55888	2	4	1	4	4	2	3	2.37E-05	3	-2.9	0.91
1969.7{537	3	3	0	3	4	1	4	6.60E-05	3	3.8	1.17
1975.198	84	5	4	2	6	3	3	1.30[-06	5	0 . 0	0.7(
1975.44505	-1	5	0	5	5	1	4	1.76E-05	2	0.3	0.93
1976.87042	26	4	3	2	5	2	3	4.80E-06	3	1.2	1.12
1979.0714	-9	6	1	5	6	2	4	5.70E-06	5	4.41E-06	1.12
1979.0886	20	3	1	3	4	0	4	1.98E-05	2	-1.2	1.12
1982.7519	-13	3	1	3	3	2	2	1.03E-05	4	-2.7	0.9C
1983.4058	-7	3	2	2	4	1	3	4.46E-06	3	-5.2	1.0(
1984 .5?8?	-79	5	4	1	6	3	4	1.14E -06	8	4.08E-06	0.5$
1986.45821	- 2	2	0	2	3	1	3	2.35E-05	3	3.8	1.1C
1995.56746	7	5	1	4	5	2	3	2.84E-05	3	- 1 . 3	0.8E
1999.54729	-lo	4	0	4	4	1	3	1.08E-05	3	-6.7	0.87
2003.00029	9	2	1	2	3	0	3	5.47E-05	3	-0.7	1.0(
2003.39230	-1	1	0	1	2	1	2	6.40E-05	4	-0.4	1.00
2004.5237	38	4	4	1	5	3	2	1.57E-06	10	2.76E-06	0.59
2004.90168	2	4	1	3	4	2	2	1.58E-05	5	-0.3	0.9C
2006.9780	3	2	1	1	2	2	0	1.36E-05	4	0.4	0.91
2008.05759	8	3	1	2	3	2	1	5.38E-05	3	-3.0	0.8E
?01?.310	-12	3	3	1	4	2	2	1.03E-06	6	-0.6	0.84
2016.28086	-2	2	2	1	3	1	2	8.05E-06	4	-3.3	1.00
2018.95876	12	3	0	3	3	1	2	6.02E-05	2	-1.5	0.92
2022 .0862	6	0	0	0	1	1	1	1.76E-05	3	-0.7	0.95
2024.3390	8	5	3	2	4	4	1	6.81[-07	5	2.30E-06	0,65
2027.3283	-3	3	3	0	4	2	3	4.25E-06	10	2.80E-06	1.04
2028.32897	2	1	1	1	2	0	2	1.05E -05	5	-4.1	0.95
2032.2923	30	2	0	2	2	1	1	2.76[-05	3	-2.5	0.90
2039.94793	7	1	0	1	1	1	0	7.55E-05	3	-4.5	0.88
2043.1667	-38	3	2	1	4	1	4	3.40E-06	10	2.82E-06	0.93
2053.0533	4	3	1	3	2	2	0	1.73E-06	5	1.44E-06	0.97
2058.24035	26	4	1	4	3	2	1	4.4EJE-06	4	1.1	0.80
2059.1083	50	4	2	2	3	3	1	6.00E-07	10	1.10[-06	0.49
2059.2151	31	5	2	4	4	3	1	1.26E-06	10	1.39E-06	0.75
2063.0890	21	8	2	7	7	3	4	1.12E-06	10	8.85E-07	1.32
2068.8967	0	6	2	5	5	3	2	2.25E-06	10	3.39[-06	0.57
2070.6418	1	7	2	6	6	3	3	3.32E-07	10	6.48E-07	0.47
2072.4888	18	9	4	5	8	5	4	1.56[-06	4	2.86E-06	0.51
2079.9340	-1	1	1	0	1	0	1	8.63[-05	3	4.3	0.93
2085.0869	-10	3	1	2	2	2	1	1.03E-05	7	-2.1	0.76
2085.4998	5	2	1	1	2	0	2	3.20[-05	3	2.7	0.91
2086.6105	-16	7	3	4	6	4	3	1.29E-06	10	3.39E-06	0.63
2090.9749	3	2	0	2	1	1	1	1.35E -05	4	-1.4	0.81
2091.08952	0	4	2	2	4	1	3	2.28E-05	8	7.7	0.88
2091.1042	-5	5	2	3	4	3	2	5.00E-06	10	5.65E-06	0.68
2092.35041	3	3	2	1	3	1	2	7.42E-05	3	5.0	0.90
2092.3998	22	7	3	4	7	2	5	7.45E-06	3	9.901-06	0.89
2093.5158	7	8	3	5	8	2	6	1.10E-06	8	1.361:-06	0.87
2095.05705	14	5	2	3	5	1	4	3.55E -05	3	4.131-05	0.88
2095.49603	9	3	1	2	3	0	3	7.50E-05	3	2.2	0.91
2096.31947	0	2	2	0	2	1	1	1.69E-05	2	1.8	0.88
2097.0206	- 5	6	3	3	6	2	4	2.50E-06	10	6.3?[-06	0.88
2098.2484	-55	8	4	4	8	3	5	3.59E-07	10	8.85[-07	0.72
2098.5471	-10	1	1	1	0	0	0	2.01E-05	3	-1.2	0.82
20 99.8365	-27	9	3	6	9	2	7	1.18[-06	3	1.37E -06	0.87
2099.96941	1	5	3	2	5	2	3	3.61E -05	3	2.82[-05	0.92
2108.9525	1	4	3	1	4	2	2	1.34E-05	2	1.09E -05	0,91
2109.5712	21	7	4	3	7	3	4	1.54E-06	10	5.83E -06	0.86
2110.3518	22	4	1	3	4	0	4	1.52E-05	3	-1.5	0.88
2111.63302	4	2	2	1	2	1	2	3.18E-05	5	-9.4	0.79
2114.0151	-11	4	1	3	3	2	2	6.00E-06	10	-11.8	0.64
2114.31070	-4	3	0	3	2	1	2	7.48[-05	2	-2.5	0.75
2116.00972	16	3	3	0	3	2	1	3.40E -05	8	2.62E -05	0.94
2119.353	65	6	4	2	6	3	3	3.04E-07	10	3.60E -06	0.75
2119.3919	5	3	2	2	3	1	3	1.45E-05	6	5.6	0.94
2121.4239	23	3	3	1	3	2	2	9.30E-06	10	8.33E -06	0.88
2122.75215	6	6	4	3	6	3	4	1.33E -05	6	1.06E -05	0.90
2122. 82261	5	4	3	2	4	2	3	2.97E -05	3	3.1	0.89
2123.1167	3	6	2	4	5	3	3	1.62E-06	4	2.09E -06	0,58
2124.0358	54	7	4	4	7	3	5	1.99[-06	10	7.0	0.99
?125.7466	-39	5	4	1	5	3	2	3.56E-07	10	1.61E -05	0.96
2126.1348	21	5	3	3	5	2	4	7.70E-06	6	2 . 5	0.96
2126.2013	-10	8	4	5	8	3	6	2.50E-06	10	4.0	1.02
2128.3402	180	6	5	2	6	4	3	1.20E-06	10	1.34E-05	1.07
2128.76952	-6	5	1	4	5	0	5	2.80E-05	3	6.5	0.97
2129.71820	-3	4	2	3	4	1	4	3.43E-05	3	0.3	0.92
2130.0419	32	5	5	0	5	4	1	1.21E-06	10	1.80E-05	1.03
2130.2082	-60	5	5	1	5	4	2	6.08E-07	10	6. 01E-06	1.57
2131.57505	1	3	1	3	2	0	2	3.12E-05	3	0.7	0.75
2131.6239	5	6	3	4	6	2	5	1.52E-05	10	8.6	1.06
2132.5519	-16	8	2	6	8	1	7	1.26E-06	10	9.7	0.99
2135.0758	9	10	4	7	10	3	8	3.07E-07	10	2.44E-07	13.98
2135.5335	13	4	0	4	3	1	3	3.50E-05	5	3.04E-05	0.84
2141.5199	1 1	5	1	4	4	2	3	2.47E -05	3	1.3	0.69
2142.3026	-22	5	2	4	5	1	5	7.40E -06	4	-5.1	0.89
2145.67858	6	4	1	4	3	0	3	9.45[-05	3	0.4	0.72
2148.18859	6	2	2	1	1	1	0	7.25E-05	3	6.4	0.79
2148.4817	9	6	1	5	6	0	6	4.42E-06	10	-5.4	0.86
2148.8334	12	8	3	6	8	2	7	3.10[-06	2	0.7	0.97
2149.6193	-38	9	2	7	9	1	8	1.12E-06	5	-1.4	0.81
2153.538	61	93		6	84		5	6.39[.-07	10	1.74E-06	0.70
2154.3536	-47	7	2	5	6	3	4	4.50E-06	10	5.48E-06	0.61
2154.71135	5	5	0	5	4	1	4	8.07E -05	3	-3.9	0.67
2155.00240	6	2	2	0	1	1	1	1.9?[-05	4	2.3	0.7/

Table 6 continued

observed position	o-c	upper J	upper K_a	upper Kc	lower J	lower K_a	lower Kc	observed strength	%s	(o-c)%[a]	R
2156.6376	-3	6	2	5	6	1	6	1.35E-05	6	-1.9	0.94
2159.845	-274	9	3	7	9	2	8	3.92E -07	10	6.7	0.93
2160.0053	6	5	1	5	4	0	4	2.77E-05	4	-0.?	0.68
?165. ??56	-2	3	2	2	2	1	1	1.96E -05	4	3.8	0.72
2166.1096	14	6	1	5	5	2	4	7.70E -06	10	5.7	0.66
2167.7/185	8	7	1	6	7	0	7	7.11 E-06	4	2.4	0.92
?172.1414	-13	7	2	6	7	1	7	2.601-06	10	9.4	1.05
2172.4862	-3	6	0	6	5	1	5	2.11E -05	4	-2.3	0.65
217>.0367	-4	6	1	6	5	0	5	6.46E-05	3	1.0	0.65
2178.90166	13	4	2	3	3	1	2	4.? 7E-05	3	6.6	0.69
2182.9521	43	8	2	6	7	3	5	1.36E-06	6	3.1	0.76
2187.1?90	35	7	1	6	6	2	5	1.96E-05	6	1.54E-05	0.75
2187.70?42	-6	3	2	1	2	1	2	2.84E-05	4	-7.0	0.7-0
2189.4310	-15	7	0	7	6	1	6	4.80E-05	7	10.1	0.69
2189.6620	-18	5	2	4	4	1	3	1.30E-05	7	1.11[-05	0.70
2190.6037	-6	7	1	7	6	0	6	1.48E-05	4	3.3	0.64
2191.72488	-2	3	3	1	2	2	0	2.00[-05	3	-2.4	0.70
2193.03905	0	3	3	0	2	2	1	5.42E-05	3	6.05E -05	0.69
?198.52783	-14	6	2	5	5	1	4	2.45E-05	8	5.9	0.59
2206.2671	-27	8	0	8	7	1	7	5.66E-06	8	8.53E -06	0.52
2206.41995	-5	8	1	8	7	0	7	2.43E-05	4	-4.5	0.56
2206.9677	-3	7	2	6	6	1	5	4.80E-06	10	-2.6	0.51
2211.50372	-7	4	3	2	3	2	1	3.71E-05	4	-5.0	0.64
2216.2335	-38	8	2	7	7	1	6	9.50E-06	10	8.40E-06	0.55
2218.0661	6	4	3	1	3	2	2	7.70E-06	10	1.19E-05	0.6?
2220.80075	-31	9	1	8	8	2	7	5.05E-06	6	4.32E-06	0.55
2222.0410	16	9	0	9	8	1	8	1.39E -05	4	4.5	0.57
22?2.2888	5	9	1	9	8	0	8	4.50E-06	6	2.0	0.55
22?6.7504	-8	9	2	8	8	1	7	1.51E-06	10	9.8	0.49
2???.3469	-18	4	4	0	3	3	1	2.51E-05	4	1.7/E-05	0.69
2227.40191	4	4	4	1	3	3	0	8.42E -05	3	5.32E -05	0.75
2233.17?	41	5	3	2	5	0	5	2.10E-06	10	5.92E-07	0.75
2?37.9864	-lo	10	0	10	9	1	9	2.70E-06	5	2.02E-06	0.65
2238.1048	-18	10	1	10	9	0	9	7.00E-06	6	6.04E -06	0.56
2238.2671	11	10	2	9	9	1	8	2.60E-06	10	1.68E-06	0.58
2?38.941?7	8	6	3	4	5	2	3	1.26E-05	4	-3.1	0.55
2246.6288	73	7	3	5	6	2	4	2.1 0E-06	10	2.38E-06	0.48
2251.4065	-7	8	3	6	7	2	5	4.10E-06	10	6.2	0.57
2251.42561	1	5	4	1	4	3	2	6.62E-05	3	2.95E-05	0.?4
2251.86970	-2	5	4	2	4	3	1	2.57E-05	3	9.93E -06	0.77
2?52.28515	-36	5	5	1	4	4	0	8.77E-06	3	3.21E-05	0.65
2252.3049	0	5	5	0	4	4	1	2.50E-05	10	9.64E-05	0.62
2254.6?81	-36	9	3	7	8	2	6	1.? 0E-06	10	6.70E-07	0.99
2257.8478	-21	10	3	8	9	2	7	6.87E-07	10	9.76E-07	0.40
2?68.860?	19	1	2	1	1	2	1	1 0 1 1		9.30E-07	4
*2271.734	69	6	6	1	5	5	0	1.03E-05	10	3.40E-04	0.58
2274.3?30	-15	5	2	3	4	1	4	1.92E -05	4	3.93E-06	0.75
2274.8573	-12	6	5	2	5	4	1	1.7X-05	3	4.94E-05	0.63
2275.0251	-5	6	5	1	5	4	2	6.00[-06	8	1.65E-05	0.67
2275.5340	-25	6	4	2	5	3	3	1.38E-05	6	5.05E-06	0.72
2?84.0588	18	6	3	3	5	2	4	1.32E -05	4	2.13E-06	0.65
2293.9192	59	7	6	1	6	5	2	5.90E-06	4	1.19E-04	0.76
2296.6711	15	7	5	3	6	4	2	3.40E-06	10	8.17E-06	0.63
2297.45465	-9	7	5	2	6	4	3	9.1 0E-06	5	2.46E-05	0.58
2372.1436	22	6	3	4	5	0	5	1.33E-06	10	2.80E-07	0.41
2393.6016	24	6	4	3	5	1	4	4.02E-06	4	2.83E -07	0.82
(001)-(010) band											
1919.2303	-26	6	4	2	7	4	3	2.56E-06	10	3.03[-06	0.60
1932.1368	43	7	2	5	8	2	6	1.40E-06	10	9.7	0.81
1935.3430	-29	8	2	7	9	2	8	1.21E-06	10	9.53E -07	0.96
1946.8907	21	5	4	2	6	4	3	6.67E-06	3	5.27E-06	0.93
1947.2798	-51	6	3	4	7	3	5	2.41E-06	10	4.7	0.84
1956.3085	-46	9	1	9	10	1	10	3.00E-06	8	-7.3	0.74
1956.3295	2	9	0	9	10	0	10	1.07E-06	8	0.0	0.79
1957.1668?	-3	7	2	6	8	2	7	6.86E-06	3	1.7	0.78
1958.1069	19	6	2	4	7	2	5	1. 01E-05	4	7.7	0.82
1958.6166	-11	7	1	6	8	1	7	2.31E-06	10	-0.1	0.7/
1965.56?9	3	5	3	?	6	3	3	3.15E-06	3	4.10E-06	0.79
1972.59248	7	5	3	3	6	3	4	1.25E-05	3	-3,9	0.80
1975.7/05	52	8	1	8	9	1	9	2.53E -06	4	-0.5	0.79
1975.8079	23	8	0	8	9	0	9	7.66E-06	3	0.4	0.80
1978.0235	4	6	2	5	7	2	6	4.42E-06	3	-6.7	0.79
1981.0268	4	6	1	5	?	1	6	1.56E-05	4	3.6	0.80
'1983.664	25	8	7	1	8	7	2	5.36E-07	10	4.05E-07	1.42
1984.7804	10	5	2	3	6	2	4	6.40E-06	3	-4.3	0.75
1995.24550	4	7	1	7	8	1	8	1.63E-05	2	-0.3	0.80
1995.3105	-1	7	0	7	8	0	8	5.74E-06	4	5.3	0.85
1995.96918	7	4	3	1	5	3	2	1.93[-05	3	-0.5	0.84
1998.7407	-24	4	3	2	5	3	3	5.67E-06	10	6.60E-06	0.71
2001.8855	-19	6	3	3	5	5	0	1.01E-05	3	9.33E-09	0.70
2003.6354	-15	5	1	4	6	1	5	9.50E-06	5	-3.6	0.75
2004.18769	0	5	2	4	6	2	5	2.00E-05	3	2.65E-05	0.7/'
2005.87/9	6	2	0	2	3	2	1	1.74E-06	5	1.3 BE-06	0.79
2012.15395	14	4	2	2	5	?	3	3.55E -05	3	-2.0	0.78
2014.235	110	7	0	7	7	2	6	4.44E-07	10	3.40[-07	0.84
2014.72825	8	6	1	6	7	1	7	9.87E-06	2	-6.0	0.7/
2014.8343S	4	6	0	6	7	0	7	3.06E-05	3	-3.2	0.79
2021.2698	57	8	6	2	8	6	3	5.62E-07	10	-4.3	0.97
2022.9878	-48	4	1	3	4	3	2	1.48E-06	3	1.32E-06	0.'70
2023.4912	-31	5	1	4	5	3	3	5.21E-07	10	-9.0	0.59
2023.6?91	78	7	6	2	7	6	1	1.75E-06	4	2.5	1.01
2023.639	82	7	6	1	7	6	2	5.98E-07	4	2.8	1.04
2024.38907	1	3	3	0	4	3	1	7.05E -06	3	3.2	0.82
2025.25419	2	3	3	1	4	3	2	2.08E-05	3	0.9	0.81
'2025.8900	-41	6	6	0	6	6	1	6.35E-06	6	1.6	1.02
2025.8995	0	4	2	3	5	2	4	1.37E-05	6	-3.5	0.84
2026.94094	0	4	1	3	5	1	4	5.00E -05	5	-3.6	0.7/
2034.14258	5	5	1	5	6	1	6	5.35E -05	3	-1.5	0.81
2034.1916	41	6	0	6	6	2	5	2.76[-06	4	2.191.-06	0.83
2034.3628	6	5	0	5	6	0	6	1.90E-05	4	4.2	0.85
2035.8746	5	5	2	4	4	4	1	3.10E-07	10	3.761-08	0.76
2036.0070	27	1	0	1	2	2	0	3.66E-07	10	-0.8	0.67
2040.0166	-10	3	2	1	4	2	2	1.65E-05	4	-4.9	0.7/
2044.3329	36	9	3	7	9	3	6	2.53E-07	10	2.041:-07	0.61
2048.64951	7	3	2	2	4	2	3	5.48E -05	3	-2.4	0.82
?051.3925?	3	3	1	2	4	1	3	?.56[-05	3	-2.6	0.79
2051. 9905	-9	5	0	5	5	2	4	1.70E-06	10	1.351" -06	0.85
2052.4114	-20	9	5	5	9	5	4	4.88E-07	10	2.79E-07	1.55
2053.86439	5	4	0	4	5	0	5	8.34E-05	4	-1.2	0.8?
2054.43251	10	4	1	4	5	1	5	2.60E-05	3	-6.0	0.83
2058.49488	-11	7	5	3	7	5	2	2.78E-06	10	-1.8	0.92
2059.7608	66	7	2	6	7	2	5	2.91E -06	10	1.53[-06	0.89
2060.6467	8	6	5	2	6	5	1	2.37E-06	10	-7,0	0.88
2060.7159	-8	6	5	1	6	5	2	7.60E-06	4	-0.6	0.95
2062.5500	-18	5	5	1	5	5	0	1.73E-05	3	-7,5	0.90
2062.5559	-87	5	5	0	5	5	1	5.78E -06	3	-7.3	0.90
2066.6147/	22	4	0	4	4	2	3	7.55[-06	4	5.99E-06	0.87
2067.7/915	8	2	2	0	3	2	1	5.16E-05	2	2,3	0.83
2070.2777	2 5	8	3	6	8	3	5	4.16[-07	10	2.59E-07	0.75
2071.95014	0	2	2	1	3	2	2	1.66E-05	2	-3.8	0.79
2075.3784	30	3	0	3	4	0	4	3.75E-05	3	-2.2	0.81
2075.99128	9	3	1	3	4	1	4	1.08E-04	3	-1.8	0.83
2076.03278	-9	5	1	5	5	1	4	1. 01E-05	10	5.31E -06	0.89
2076.97193	15	2	1	1	3	1	2	1.00E-04	2	1.9	0.83
2079.850	232	8	4	5	8	4	4	3.63E-07	10	-2.0	0.70
2082.9078	47	2	0	?	2	2	1	3.50E-06	10	10.6	0.83
2085.3729	11	6	2	5	6	2	4	4.20E-06	6	1.47E-06	0.84
2086.8355	-5	7	4	4	7	4	3	5.00E-06	10	3.55E-06	1.11
2090.3980	-20	7	3	5	7	3	4	5.02E-06	6	2.73E-06	0.87
2090.8986	17	6	4	3	6	4	2	3.39E-06	2	2.7	0.87
2092.9884	1 5	6	4	2	6	4	3	1.15E -05	3	9.90E -06	0.98
2093.31639	12	2	0	2	3	0	3	1.36E-04	2	0.1	0.84
2093.4095	-1	5	4	2	5	4	1	2.58E-05	4	4.8	0.94
2093. 643	3 3	7	4	3	7	4	4	1.40[-06	10	1.19[-06	0.92
2093.8639	11	5	4	1	5	4	2	8.24E-06	3	0.4	0.90
2094.0929	1	2	1	2	3	1	3	3.96E-05	3	-1.9	0.83
2095.19841	19	4	4	1	4	4	0	1.92[-05	5	3.6	0.97
2095.25175	-3	4	4	0	4	4	1	5.36E-05	3	-3.6	0.90
2097.1057	1	8	4	4	8	4	5	1.49[-06	10	1.13E -06	0.89
2101.7923	53	4	1	4	4	1	3	1.08E-06	10	3.75E -06	0.71

Table 6 continued

observed position	o-c	upper J	upper K_a	upper K_c	lower J	lower K_a	lower K_c	observed strength	%s	(o-c)%[a]	R
2103.3318	16	1	1	0	2	1	1	2.86E-05	3	-0.1	0.83
2104.6452	5	6	3	4	6	3	3	4.64E-06	4	2.84E-06	0.89
?113.81038	-3	5	3	3	5	3	2	3.33E-05	3	2.31E-05	0.95
2114.5? 841	-10	1	0	1	2	0	2	4.48E-05	2	1.8	0.86
2114.63947	-1	1	1	1	2	1	2	9.55E-05	2	-0.6	0.85
2119.2316	0	4	3	2	4	3	1	2.27E-05	4	1.83E-05	0.98
21?0.185	-322	4	1	3	3	3	0	4.68E-07	10	3.90E-07	0.99
2121 .647[{	5	4	3	1	4	3	2	6.42E-05	3	5.50E-05	0.93
2121.7448	3	5	3	2	5	3	3	9.91E-06	2	7.81E-06	0.87
2122.45415	4	3	3	1	3	3	0	1.17E-04	3	-0.9	0.91
2122.8546	-13	3	3	0	3	3	1	4. 01E-05	4	1.9	0.93
2123.1747	21	3	1	3	3	1	2	1.98E-05	3	2.37E-05	0.84
2127.1511	4	4	2	3	4	2	2	6.75E-06	10	1.05E-05	0.88
?137.33071	4	3	2	2	3	2	1	6.33E-05	5	7.45E-05	0.87
2137.37154	2	0	0	0	1	0	1	8.90E-05	3	1.6	0.87
2139.9268	14	2	1	2	2	1	1	1.58E-05	4	-6.4	0.84
2142.25143	6	2	2	1	2	2	0	5.60E-05	3	2.5	0.92
2143.981	-117	5	1	4	4	3	1	3. 01E-07	10	3.68E-07	0.75
2144.80859	3	2	2	0	2	2	1	1.64E-04	2	-0.5	0.89
2146.7291	36	7	3	4	7	3	5	3.66E-07	10	1.07E-06	0.94
2149.1295	-75	3	2	1	3	2	2	3.04E-05	7	2.57E-05	1.19
2151.19505	2	1	1	1	1	1	0	1.24E-04	3	1.9	0.89
2153.241	-115	5	0	5	4	2	2	4.25[-07	10	4.95E-07	0.91
2158.1062	-1	4	2	2	4	2	3	2.81E-05	3	3.52E-05	0.89
2160.262	-75	6	1	5	5	3	2	1.30E-06	10	-4.7	0.94
2162.0144	-11	1	1	0	1	1	1	4.33E-05	6	0.8	0.89
2171.8187	43	5	2	3	5	2	4	4.1 OE-06	10	5.27E-06	0.94
2172.3240	12	2	1	1	2	1	2	6.00E-05	4	-0.2	0.94
2184.74681	5	1	0	1	0	0	0	3.62E-05	3	1.3	0.90
2187.3785	3	3	1	2	3	1	3	1.08E-05	3	-2.9	0.97
2198.60957	4	2	1	2	1	1	1	4.81E-05	4	6.0	0.92
2?06.20715	-3	4	1	3	4	1	4	1.56E-05	4	1.94[-05	0.85
2206.6561	29	2	0	2	1	0	1	2.15E-04	10	10.8	1.00
2207.3853	-13	6	5	2	5	5	1	1.49E-06	10	-7.3	1.38
2207.4303	12	6	5	1	5	5	0	4.41E-06	10	-8.5	1.36
2208.87956	13	2	1	1	1	1	0	1.42E-04	3	4.1	0.93
2214.36025	9	3	2	2	2	2	1	1.09E-04	3	9.51E-05	0.89
2215.67500	17	5	4	2	4	4	1	1.12E-05	10	1.73E-05	1.00
2?18.5?666	7	3	1	3	2	1	2	2.14E-04	4	5.8	0.92
2?18.847[5	7	4	3	1	3	3	0	8.30E-06	3	4.70E-05	1.26
2219.43136	-12	3	2	1	2	2	0	3.57E-05	4	3.17E-05	0.92
2220.7/50	-15	2	2	1	2	0	2	1.36E-06	10	-10.8	0.87
2224.7695	40	3	2	2	3	0	3	8.30E-06	10	9.90E-06	0.87
2225.8648	6	3	0	3	2	0	2	7.83E-05	3		0.92
22?9.8050	14	7	5	3	6	5	?	3.1 OE-06	10	4.5%[a]06	1.09
2?29.8963	-13	8	2	6	8	?	7	8.25E-07	10	1.38E-06	0.84
2?30.0397	-64	7	5	2	6	5	1	9.35E-07	8	1.52E-06	0.98
2232.6012	22	4	2	3	4	0	4	3.16E-06	10	3.86E-06	0.94
2233.21228	4	3	1	2	2	1	1	6.50E-05	6	0.5	0.92
2236.26465	4	4	2	3	3	2	?	4.85E-05	5	4.16E-05	0.90

observed position	o-c	upper J	upper K_a	upper K_c	lower J	lower K_a	lower K_c	observed strength	%s	(o-c)%[a]	R
2237.7(?8	5	4	1	4	3	1	3	7.74E-05	3	7.17E-05	0.91
2239.48898	-4	533		4	3		2	1.45E-05	5	5.55E-05	1.23
2239.50713	-14	6	4	2	5	4	1	1.16E-05	3	1.82[-05	1.10
2242.75432	11	4	0	4	3	0	3	2.31E-04	4	1.6	0.93
2243.4420	32	5	3	3	5	1	4	3.06E-06	10	-3.2	1.12
2?44.7075	28	5	2	4	5	0	5	6.20E-06	10	9.58[-06	0.96
2246.78749	5	4		22	32		1	1.34E-04	3	1.24[-04	0.93
2252.8710	-3	8	5	3	7	5	2	1.80[-06	5	2.90E-06	1.08
2255.29913	2	5	1	5	4	1	4	1.83E-04	3	-3.1	0.95
2255.39053	5	4	1	3	3	1	2	1.91E-04	3	0.6	0.94
2257.45751	8	5	2	4	4	2	3	1.38E-04	3	1.13[-04	0.90
2258.69213	6	5	0	5	4	0	4	6.60[-05	3	2.6	0.95
??60.5935	26	7	4	4	6	4	3	8.22E-06	3	1.31E-05	1.16
2260.8266	-45	6	3	4	5	3	3	4.30[-06	10	1.49E-05	1.08
2263.9853	14	74		3	64		2	2.78E-06	10	4.31E-06	1.30
2267.8815	60	7	1	6	7	1	7	9.68E-07	10	1.26E-06	0.96
2272.4111	34	6	2	5	5	2	4	1.60[-05	5	2.78E-05	1.12
?272.98905	3	6	1	6	5	1	5	4.60E-05	3	-4.0	0.90
2273.06990	7	5	2	3	4	2	2	3.68E-05	4	0.0	0.90
2274.42948	-8	5	1	4	4	1	3	4.85E-05	4	-1.6	0.93
2?74.7108	8	6	0	6	5	0	5	1.51E-04	3	4.2	0.97
2277.53452	0	6	3	3	5	3	2	5.10E-05	4	4.39[-05	0.85
2281.5613	4	7	3	5	6	3	4	1.19E-05	10	2.871-05	1.01
2286.6352	-75	8	1	7	8	1	8	1.36E-06	10	1.911-06	0.94
2289.89402	2	6	1	5	5	1	4	1.00E-04	5	2.6	0.99
2290.15895	-1	71		7	61		6	9.53[-05	3	-1.4	0.93
2291.0672	50	7	2	6	6	2	5	5.00E-05	10	-5.2	1.06
2?96.73060	-1	6	2	4	5	2	3	7.57E-05	4	-1.2	0.93
2373.2777	2	1	2	0	1	2	1	3.48E-06	10	2.721" -06	1.21
2389.5324	27	13	1	13	12	1	12	1.30E-06	5	-1.7	0.92
2405.5160	13	4	4	0	3	2	1	1.66E-06	6	1.371. -06	1.19
2407.1661	31	6	3	3	5	1	4	4.22E-06	4	8.89E-06	1.02
2411.0301	78	4	4	1	3	2	2	3.94E-07	10	-10.4	0.88
2422.659	95	5	4	1	4	2	2	4.55E-07	10	8.23E-07	0.54
2429.9333	50	6	2	4	5	0	5	4.76E-06	6	-3.7	1.09
2437.2560	29	54		2	4		23	2.00E-06	10	-8.4	0.90
2437.402	93	6	4	2	5	2	3	2.82E-06	10	-6.3	0.92
2440.4196	8	734		6		1	5	1.16E-06	10	1.861-06	0.91
?451.9604	35	7	4	3	6	2	4	9.64E-07	10	0.8	0.99
?464.4057	-4	634		5		1	5	7.92[-07	10	-10,3	0.99
2465.9108	-49	6	4	3	5	2	4	8.60E-07	7	7.64[-07	1.12
2469.2111	49	8	4	4	7	2	5	2.00E-06	10	-5.1	0.94
2482.6101	2	83		5	7	1	6	2.05E-06	10	2.57[-06	1.06
2497.6885	-22	7	4	4	6	2	5	1.82E-06	6	1.5	1.02
2510.5194	-79	7	3	5	6	1	6	1.38E-06	10	1.74[-06	0.86
2510.9503	41	75		3	63		4	9.19E-07	10	5.0	1.01
2514.168	-87	8	5	3	7	3	4	7.25[-07	10	5.4	1.03
2530.6797	-65	7	6	2	6	4	3	3.36E-07	10	12.0	1.04
2544.4191	-30	8	2	6	7	0	7	8.28E-07	10	1.16E-06	0.82
2571.9099	-106	9	4	4	8	2	?	5.02E-07	10	-13.0	0.89

* asterisk denotes a doubted absorption with the quantum assignment given for the stronger transition. The strength given represents the sum of the strengths of the two comparable transitions.

o-c are observed minus computed line positions in $cm^{-1} \times 10^5$. Computed values derived from energy levels given in table 2 and lower state, (010), levels given in ref. 16

%s are estimated uncertainties in the measured line strengths given in percent

a.(o-c)% is the percent difference between the observed and computed line strength or the value of the computed strength if the difference between the observed and computed values is ≈±12% or larger in magnitude.

R is the ratio of the observed line strength derived in this study to the computed value given in ref. 14

Table 7. Line positions (cm^{-1}) and strengths (cm^{-2}/atm. at 296K) observed in the (100) - (000) band of $H_2{}^{16}O$.

observed position	o-c	upper J	upper K_a	upper K_c	lower J	lower K_a	lower Kc	observed strength	%s	(o-c)%[a]	R
?912.3760	-30	8	0	8	9	5	5	2.10[-05	10	8.46[-08	1.15
2937.7756	-69	9	4	5	1	0	7	4 1.58E -05	5	5.37E -07	1.11
2937.8494	2	1	2	1	1	2	1	3 2 1 1 6.26E-06	10	3.31E-06	1.11
?981 .7558	-2?	7	4	3	8	7	2	8.22 E-015	6	5.02E-07	1.00
2984.608	88	1	2	2	1	1	3	3 1 0 1.80E-06	10	4.45E -06	0.98
2996.39445	28	1	1	0	1	1	1	2 3 1 0 1.15E -05	8	-6.7	1.06
2998.7293	-?7	1	1	1	1	1	1	2 2 1 0 4.30E-06	10	3.4	1.25
2999.651	93	6	4	3	7	7	0	3.30E-06	10	2.77E-07	0.96
3004.47/6	-48	5	1	4	6	6	1	1.79E-05	6	1.83E-08	0.84
3005.2555	-43	1	1	3	8	1	2	6 7 2.50E-06	4	3.05E-06	0.93
3007.127	-70	6	4	2	7	7	1	2.50E -06	10	9.45E-08	1.00
3026.440	-154	1	0	3	7	1	1	6 6 1.67E-06	10	-12.6	0.95
30?6.8?74	-6	8	1	8	9	4	5	8.61E-06	10	6.80[-06	1.13
3028.23704	0	1	1	1	1	0	1	2 4 9 1.62E-05	3	0.2	1.07
3041.4315	13	1	1	2	9	1	2	5 8 1.23E-05	5	3.5	1.10
3043. ?618	7	9	3	6	1	0	6	5 8.30E-06	4	-0.5	1.03
3045.6966	15	1	2	3	1	0	1	3 4 9 5.92E-06	3	5.3	1.08
3046.1765	-20	7	3	5	8	6	2	3.80E -06	15	2.24E-06	1.21
3047.6670	52	1	1	2	1	0	1	2 3 9 5.50E-06	10	-12.7	1.01
3055 .?935	6	1	0	0	1	0	1	1 3 9 1.55E-05	5	8.2	1.16
3059.7233	-3	1	0	1	1	0	1	1 2 9 4.50E-05	4	2.2	1.11
3073.38063	-1	7	3	4	8	6	3	9.80E-06	4	0.9	1.10
3076.7153	0	6	3	4	7	6	1	1.05E-05	4	6.26E-06	1.15
3082.7571	-16	1	0	1	9	1	1	4 8 1.90E-05	4	-1.1	1.03
3083.30336	0	1	0	2	9	1	1	5 7 1.23E-05	5	4.7	1.09
3087.709	-29	5	0	5	6	5	2	1.95E-06	10	1.33E-06	1.04
3093.5698	32	1	2	7	6	1	3	8 5 1.86[-06	10	2.98E-06	1.05
*309 7.2935	-17	1	1	8	3	1	2	9 4 3.92E-06	3	7.12E-06	0.91
3097.3197	-7	7	2	6	8	5	3	1.43E-05	2	1.20E -05	1.05
3100.6083	-38	7	1	7	8	4	4	1.14E-05	5	9.65E-06	1.14
3105.2?87	-11	5	3	3	6	6	0	1.82E-06	10	1.12E-06	1.10'
*3107 .1508	0	1	0	9	2	1	1	1 0 1 5.00E-06	10	1.54E-05	0.91
3108.880?	11	5	3	2	6	6	1	6.60E-06	5	3.57E-06	1.02
3112.7019	-62	1	2	4	9	1	3	5 8 8.60E-06	6	-2.2	1.00
3113.12352	2	1	0	2	9	1	1	3 8 7.35E-05	2	-2.8	1.05
3113.57933	3	9	E	I	9	1	0	3 8 1.43E-04	3	4.4	1.09
3115.2361	-4	1	1	3	9	1	?	4 8 7.63E-06	2	9.44E-06	0.94
3118.9806	-14	9	2	7	1	0	5	6 9.1 OE-05	5	8.07E-05	1.17
3120.892	-316	1	1	7	5	1	2	8 4 2.80E-06	10	3.66E-06	1.08
3120.9659	64	1	1	7	4	1	2	8 5 8.60E-06	4	1.10E-06	1.09
3121.7835	0	9	1	9	1	0	2	8 5.05E-05	4	4.6	1.12
3121.909	171	1	2	6	7	1	3	7 6 3.12E-06	10	5.98E-06	1.27
3124.1963	-131	1	2	6	6	1	3	7 7 1.84E-06	10	-7.4	1.52
'3125.1835	39	1	0	8	3	1	1	9 2 1.65E-05	5	2.40E -05	0.99
3131.35017	-26	1	2	5	8	1	3	6 7 1.00E-05	4	4.3	0.99
3131.4458	19	8	0	8	8	5	3	4.36[-05	2	1.09E-09	1.02
3134.63075	-1	9	1	8	1	0	4	7 1.78E-04	3	-1.6	1.02
*3135.0965	-9	9	9	0	1	0	1	0 1 1.95E-05	4	5.37E -05	1.01
3139.55545	-1	6	2	5	7	5	2	6.22E-05	2	5.34E-05	1.06
3147.9? 533	15	8	2	6	9	5	5	4.50E-05	3	-0.1	1.04
3148.2980	18	1	1	6	6	1	2	7 5 4.23E-06	10	7.75E-06	0.91
3148.3504	33	1	0	7	4	1	1	8 3 3.04E-05	3	3.69E-05	0.99
3148.36880	17	1	0	7	3	1	1	8 4 9.11[-06	4	1.23E-05	0.89
3149.2600	-30	1	1	6	5	1	2	7 6 1.52E-05	5	2.32E-05	0.96
*3153.1325	50	9	8	1	1	0	9	2 5.35E-05	4	7.58E-05	0.93
3156.6946	0	1	3	5	8	1	4	6 9 1.80E-06	15	2.11 E-06	1.14
3164.0294	2?	1	1	5	7	1	2	6 6 1.55E-05	3	1.38E-05	0.96
3164.368?7	4	1	1	4	8	1	2	5 7 1.57E-05	3	2.6	1.00
3164.56604	-3	6	1	6	7	4	3	9.05E-05	3	8.31E-05	1.11
3165.7035	-2?	8	4	5	8	7	2	1.33E-06	10	1.66E-09	0.99
3170.89958	2	7	2	5	8	5	4	1.64E-04	3	1.2	1.06
3171.12587	0	8	0	8	9	3	7	2.54E -05	3	1.32E-04	1.19
3175.07484	15	1	0	6	5	1	1	7 4 6.05E -05	3	8.12E -05	1.01
3175.4015	-81	1	0	6	4	1	1	7 5 2.30E-05	6	2.70E-05	1.11
'3175.8992	-60	9	7	2	1	0	8	3 1.41E-04	3	-6.9	0.99
3176.49895	-17	5	2	4	6	5	1	2.05E -05	3	1.71E-05	1.11
3177.25813	24	1	0	3	8	1	1	4 7 1.33E-04	3	-2.8	1.03
3171.633	97	7	4	3	7	7	0	2.46E-06	15	1.10E-08	1.18
3178.3480	21	8	4	4	8	7	1	2.1 OE-06	15	1.44E-09	1.35
3178.95503	9	9	2	8	1	0	3	7 9.65E -05	2	-1.4	1.05
*3181.0800	16	8	8	1	9	9	0	1.68[-04	5	2.27E-04	0.94
3181.533%	-46	9	4	5	9	7	2	1.16E-05	5	8.66[-10	0.89
3182.70395	-3	8	1	7	9	4	6	1.59E-04	3	-0.1	1.04
3185.14148	13	8	1	8	9	2	7	4.41E-04	3	-0.4	1.07
3187.53393	-9	11	5	6	126		7	2.84E-05	3	4.15E-05	0.97
3189.87758	-7	6	2	4	7	5	3	4.65E-05	3	-1.1	1.06
3190.94189	-7	10	5	6	11		65	1.77E-04	2	1.5('[-04	0.97
3202.01296	27	9	6	4	1	0	7	3 7.23E -05	3	8.50E-05	1.01
3202.10341	12	9	6	3	1	0	7	4 2.18[-04	5	2.55E -04	1.00
'3203.4644	21	8	7	2	9	8	1	4.13E -04	3	-3.1	0.95
3207.629	95	10	2	9	10	5	6	1.38E-06	10	4.91E-07	1.01
3209.2385	-18	4	2	3	5	5	0	3. 01E-05	3	2.62E-05	1.09
3219.67618	-1	5	1	5	6	4	2	5.18E -05	2	1.5	1.07
3224.4857	-40	4	2	2	5	5	1	1.35E -05	8	1.12E-05	1.08
3225.70612	1	7	1	6	8	4	5	1.00E-03	2	1.0	1.06
3?26.0685	-2	7	0	7	8	3	6	1.03E-03	2	1.3	1.11
3229.0395	8	8	6	3	9	7	2	6.70E-04	3	-7.1	0.99
3229.0587	-3	8	6	2	9	7	3	2.40[-04	3	0.1	1.06
'3?30.9833	24	7	7	0	8	8	1	1.14E -03	3	2.7	0.97
3232.3884	7/	8	3	6	8	6	3	2.73E-06	15	3.05E -07	1.40
3232.75604	1	9	5	4	1	0	6	5 3.50E-04	5	5.17E-04	0.98
3232.88751	1	9	5	5	1	0	6	4 6.04E -05	3	1.73E-04	0.99
3233.98827	-1	9	3	7	1	0	4	6 2.06E-04	2	1.7	1.05
3239.6046	18	124		8	13	5	9	4.18E -06	3	5.05E-06	0.95
3242.697	0	15	3	12	16	4	13	4.40E-07	15	-6.6	1.35
3243.04507	13	8	2	7	9	3	6	1.09[-03	2	-0.4	1.06
3246.55500	-18	9	4	6	1	0	5	5 2.89E-04	3	2.60E-04	1.02
3247.853	112	6	3	4	6	6	1	1.24E-06	10	3.17E-07	1.17
3249.196??	-16	11	4	7	12	5	8	5.24E-05	3	6.16E-05	1.04
3249.47258	2	7	1	7	8	2	6	4.25E -04	2	0.3	1.08
'3256.085?	-46	7	6	1	8	7	2	2.48E-03	4	1.7	1.00
3258.07400	-5	8	5	4	9	6	3	9.75E-04	3	1.51E-03	1.03
3258.15855	0	8	5	3	9	6	4	3.78E-04	3	5.03E-04	1.02
3261.0154	9	104		6	11	5	7	5.38E -05	3	7.79[-05	1.00
'3261.8306	0	17	0	17	18	1	18	1.27E -06	10	2.15E -06	0.86
3262.5181	-7	6	1	5	7	4	4	4.94E-04	2	0.6	1.07
3264.3538	-54	8	1	8	8	4	5	1.05E-05	10	6.66E-06	1.07
3267.2337(	-16	4	1	4	5	4	1	1.68E-04	3	-1.9	1.06
3268.796	-159	7	3	4	7	6	1	1.50E-06	15	8.32E-07	0.93
3270.7973	-4	8	2	7	8	5	4	1. 02E-05	4	4.36[-06	1.03
3271.6763	20	1	4	4	1	1	1	5 3 1 2 1.28E -06	10	1.83E-06	0.88
3273.4026	-13	9	4	5	1	0	5	6 4.50[-04	6	8.09E -04	0.99
3?76.7889	40	9	0	9	9	3	6	6.60E-06	10	-7.6	0.97
3278.6209	-4	6	0	6	7	3	5	7.40[-04	3	-1.1	1.09
3279.09667	3	8	4	5	9	5	4	2.81E-03	3	2.49E -03	1.01
3282.8354	29	1	3	3	1	0	1	4 4 1 1 7.28E-06	4	8. 11E-06	0.96
'3283.0621	-2	6	6	1	7	7	0	6.20[-03	2	5.59[-03	1.03
3283.7637>	4	8	3	6	9	4	5	2.40E-03	2	1.6	1.03
3284.1944	-7	7	5	3	8	6	2	1.03E-03	2	1.30[-03	1.02
3284.22476	4	7	5	2	8	6	3	3.18E-03	3	3.89E-03	1.02
'3285.6723	0	16	1	16	17	0	17	6.90E-06	10	9.37E-06	1.01
'3285.821	0	15	1	14	16	2	15	5.1 OE-06	10	8.83E-06	0.80
3286.8510	-78	93		6	96		3	3.60E -06	15	1.14E-06	1.27
3288.0991	60	14	3	12	15	2	13	5.30E -06	10	6.50E -06	0.98
3294.05764	-2	8	4	4	9	5	5	5.62E-04	3	8.34E -04	1.06
3295.009	-106	11		38	11	6	5	9.55E -07	5	6. 01E-07	0.72
3299.8656	-43	1	2	3	9	1	3	4 1 0 1.00E-05	10	-3.4	0.97
3303.07565	-5	7	2	6	8	3	5	1.30E-03	5	1.5	1.07
3304.6399	-42	7	1	7	7	4	4	8.40E -06	10	6.00E-06	1.05
3308.07815	7	7	4	4	8	5	3	2.60E-03	3	2.25E-03	1.02
3308.40508	-28	3	1	3	4	4	0	3.00E-05	4	-4.2	1.06
3309.3335	-39	10		1	9	104	6	2.50E-06	15	-12.2	0.75
3309.36834	-5	1	4	2	1	3	1	5 1 1 4 1.90E -05	5	2.56E-05	0.95
I3310.526	67	6	5	2	7	6	1	1.03E -02	5	1.19E-02	0.99
3310.7923	10	6	2	5	6	5	2	1.68E -05	3	9.50E-06	1.04
3310.8554	17	1	3	2	1	1	1	4 3 1 2 2.15E -05	7	2.48E-05	0.99
3311.5845	8	13	3	11	14	2	12	7.30E-06	10	-10.8	1.01
3313.39347	7	6	1	6	7	2	5	3.53E-03	3	1.4	1.10
3314.10505	8	11		3	8	124	9	1.16[-04	4	3.8	1.02
3317.27950	-4	7	4	3	8	5	4	3.63E -03	4	6.76E-03	1.04
3317.68822	-9	4	1	3	5	4	2	2.58E -04	2	-7.8	1.04
3317.809	12	11		29	11	5	6	4.50[-06	6	3.221-06	0.98
3326.0096	-3	103		7	11	4	8	1.30E-04	5	4.1	1.04
3326.04304	-7	7	3	5	8	4	4	2.63[-03	2	2.9	1.04

Table 7 continued

observed position	o-c	upper J	K_a	Kc	lower J	K_a	K_c	observed strength	%s	(o-c)%*	R
332 7.32931	-7	5	0	5	6	3	4	3.90E-03	2	-3.4	1.06
3327.7106	9	8	0	8	7	5	3	6.60[-06	10	1.47E -09	0.85
3332.52024	0	1	3	2	1	2	1	4 1 1 3		2.48E-05	3
*3332.57(5	-81	1	4	1	1	4	1	5 0 1 5		1.21E-04	3
333?.6045	-2?	1	?	3	1	0	1	3 2 1 1		5.42E-05	3
3333.0451	23	1	?	2	1	0	1	3 3 1 1		2.60E-05	10
3334.5614	46	1	3	1	1	2	1	4 2 1 3		5.1 OE-05	8
3334 .6?89	5	6	4	3	7	5	2	1.69E-02	3	6.4	0.98
*3336.8461	3	5	5	0	6	6	1	2.32E-02	4	-4.0	1.01
3336.89866	-6	9	3	6	1	0	4	7		1.1 BE-03	2
3337.19955	1	8	0	8	8	3	5	1.43E-04	2	1.21E -05	1.06
*3338.931	o	1	5	0	1	5	1	5 1 1 4		2.70E-06	5
3339.0784	-2	6	1	6	6	4	3	4.88E-05	3	3.58E-05	1.12
3339.2847	-15	3	1	2	4	4	1	2.33E-04	3	2.53E-04	1.05
3342. ?9522	-1	6	4	2	7	5	3	2.46E-03	2	5.29E-03	1.02
3344.382	-82	1	0	2	8	1	0	5 5		5.80E-06	10
3348.4436	-9	8	3	5	9	4	6	1.05E-03	2	-6.0	1.05
3353.8437	10	5	2	3	5	5	0	1.06E-05	3	3.7	1.00
3354.29753	4	1	1	2	9	1	2	3 1 0		2.94E-04	3
*3355.605	216	1	3	0	1	3	1	4 1 1 4		3.95E -04	4
3355.752	51	9	1	8	9	4	5	5.05E-05	10	4.34E-05	1.03
3355.8764	0	12	1	11	13	2	12	9.1 OE-05	6	9.99E-05	1.07
3357.0195	-47	12	2	11	13	1	12	2.20E-04	10	2.99E-04	1.02
3357.034?	-15	6	2	5	7	3	4	1.25E-02	4	1.8	1.07
3359.1855	-15	11	4	8	12	3	9	1.53E-05	4	2.11E-05	1.00
3360.40?36	10	9	2	7	9	5	4	3.69[-05	3	2.79E-05	0.98
3360.6817	-7	1	1	3	9	1	2	2 1 0		8.28E-05	3
3361.67262	-9	6	3	4	7	4	3	2.09E-02	3	2.6	1.05
3362.28353	-7	7	3	4	8	4	5	7.11 E-03	3	8.85[-03	1.02
3362.9657	0	1	4	1	1	4	1	4 2 1 3		7.20E-06	4
336? .9945	0	1	4	0	1	4	1	4 1 1 3		2.82[-06	10
3366.2314	57	7	2	5	7	5	2	5.50E-05	6	4.34E-05	1.01
3366.99478	29	8	2	6	8	5	3	1.92E-05	5	1.44E-05	1.02
3367.342?	23	5	1	5	5	4	2	1.79[-05	5	1.54E-05	1.04
3367.64255	6	5	4	1	6	5	2	1.68E-02	2	3.29E-02	1.03
3369.1540	-5	5	4	?	6	5	1	2.83E-03	3	1.09E-02	1.05
3371.04885	-7	4	0	4	5	3	3	1.71E -03	3	-3.9	1.07
3374.0196?	o	10	2	8	11		39	3.00E-04	2	6.0	1.07
3374.68305	7	5	1	5	6	2	4	3.07E-03	2	0.1	1.08
3378.06426	3	12	1	12	13	0	13	9.80E-04	4	1.07E-03	1.10
3378.43755	0	11	1	10	12	2	11	8.70E-04	4	-3.5	1.09
3378.918?	4	11	2	10	12	1	11	2.83E-04	3	-5.6	1.08
3379.66578	3	12	0	12	13	1	13	2.20E-04	2	3.57E-04	1.09
3380.46727	-6	6	3	3	7	4	4	3.42E -03	2	7.07E-03	1.08
3385.6016	-3	10	3	8	11	2	9	7.1 OE-04	3	-4.7	1.05
3386.7540	0	13	1	13	13	2	12	1.03E-05	6	3.2	0.96
3386.80781	0	13	0	13	13	1	12	3.00E-05	4	0.3	0.94
3389.1544	71	1	4	2	1	3	1	4 3 1 2		4.60E-06	7
3389.4675	-13	4	1	4	4	4	1	3.35E-05	3	2.96E-05	1.09
3389.660	0	1	4	1	1	3	1	4 2 1 2		1.60E-06	10
3389.82792	5	7	0	7	7	3	4	1.87E-04	2	1.65E-04	1.05
3391.57133	2	9	2	7	1	0	3	8		2.42E -03	2
3391.8133	-7	8	1	7	8	4	4	6.20E-05	3	5.36E-05	1.09
3392.50712	10	5	3	3	6	4	2	1.50[-02	2	0.8	1.03
3392.72536	-2	4	4	0	5	5	1	1.33E-02	4	1.96E-02	1.03
3392.94133	5	4	4	1	5	5	0	3.65E-02	3	5.89E-02	1.04
3394.5786	-12	10	4	7	11	3	8	7.63E -05	3	1.49E-04	1.08
3395.8783	-31	11	5	7	12	4	8	1.60E-05	3	1.85E-06	0.96
3397.21331	4	5	3	2	6	4	3	5.13[-02	3	4.49E-02	1.04
3400.65088	o	10	1	9	11	2	10	8.38E-04	2	1.8	1.12
3401.05340	0	11	0	11	12	1	12	2.80E-03	5	-6.9	1.08
3401.09236	7	11	1	11	12	0	12	9.69E-04	3	-3.2	1.12
3401.49902	0	10	2	9	11	1	10	2.40E-03	4	-2.1	1.09
3403.58283	-11	5	2	4	6	3	3	1.07E-02	3	-5.1	1.00
3406.6747	-5	8	2	6	9	3	7	2.02E-03	2	5.5	1.06
3408.85528	0	3	0	3	4	3	2	4.13E -03	2	-4.3	1.08
3409.9832	6	12	1	12	12	2	11	9.25[-05	3	1.06E-04	1.01
3411.7209	-13	12	0	1?	12	1	11	3.57E -05	3	1.1	0.88
341?.341	153	1	3	2	1	2	1	3 3 1 1		6.90[-06	10
3412.47282	2	9	3	7	1	0	2	8		5.75E-04	2
3415.5897	-45	13	1	12	13	2	11	2.30E-05	7	1.95E -05	1.02
3417.1715	-1	7	1	6	7	4	3	3.95E -04	2	1.9	1.03

observed position	o-c	upper J	K_a	Kc	lower J	K_a	Kc	observed strength	%s	(o-c)%*	R
3419.9504	3	7	2	5	8	3	6	1.30E-02	6	0.6	1.04
3420.49755	-8	4	3	2	5	4	1	8.41E -02	4	1.4	1.06
3421.7s90	-14	4	3	1	5	4	2	2.84E-02	3	2.6	1.03
3422.3329	7	9	1	8	1	0	2	9		5.88E-03	3
3423.24453	2	10	0	10	11	1	11			2.50E -03	4
3423.27 {(9	2	10	1	10	11	0	11			7.50E -03	5
3424.08631	0	9	2	8	1	0	1	9		2.00E-03	2
'3424.2266	51	8	7	2	8	8	1			3.50E-05	3
3431. 0645	-4	4	1	4	5	2	3			2.30E-02	5
3432.4820	11	6	1	5	6	4	2			1.79[-04	3
3432.83008	1	6	2	4	7	3	5			8.55E-03	2
3433.7660	-35	6	0	6	6	3	3			2.14E -04	2
3633.8008	8	1	1	1	1	1	1	2 1 0		1.25E -04	7
3434.05321	-1	11	0	11	11	1	10			3.42E -04	3
3435.98025	7	10	5	6	11	4	7			1.21E -03	2
3436.8243	67	12	2	11	12	3	10			8.65E -05	4
3438.041	-221	12	1	11	1?	2	10			3.00E-05	10
3439.1947	-16	5	1	4	5	4	1			3.04E-04	3
3439.6684	-14	4	1	3	4	4	0			4.60[-05	10
3440.72258	-1	2	0	2	3	3	1			4.78E-04	3
3442.07{60	0	8	3	6	9	2	7			3.16[-03	2
3442.50290	-4	4	2	3	5	3	2			7.67E-02	3
3443.20353	2	8	1	7	9	2	8			4.44E-03	2
3445.157[5	3	9	0	9	10	110				1.7/t-02	3
3445.21970	-4	9	1	9	10	010				5.70E-03	5
3(,(,5.798?	12	9	6	4	9	7	3			1.81[-05	5
3445.859	-166	9	6	3	9	7	2			6.13E-05	2
3446.8845	-2	8	2	7	9	1	8			1.30[-02	8
34 46.94124	1	5	2	3	6	3	4			4.51E -02	3
3447.07690	-10	3	3	1	4	4	0			4.32[-02	3
3447.23680	-10	3	3	0	4	4	1			1.30E -01	5
34 48.9366	-59	8	6	3	8	7	2			1.28[-04	6
3448.9511	-30	8	6	2	8	7	1			4.25E -05	6
'3451.9612	-42	7	6	1	7	7	0			2.40E-04	2
3456.7537{	4	1	0	1	1	0	1	0 2 9		1.04E-03	3
3457.3460	0	1	0	0	1	0	1	0 1 9		3.55E -04	3
3458.4657	-9	1	1	2	1	0	1	1 3 9		8.80E-05	3
3460.0151	-16	10	5	6	10	6	5			1.60E-04	4
3460.7171	-2	11		66	12	5	7			4.02[-05	10
3462.5243	21	1	1	1	1	0	1	1 2 9		2.71E -04	3
3462.59086	-19	4	2	2	5	3	3			3.27E-02	3
3462.81448	4	7	1	6	8	2	7			2.81E -02	2
3464.7434	33	12		66	13	5	9			7.60E -06	10
3465.0151	-100	12	7	6	13	6	7			7.89E-06	10
3466.89443	-6	8	1	8	9	0	9			3.90E-02	4
3467.1470	-14	8	0	8	9	1	9			7.33[-03	3
3467.49559	-42	5	0	5	5	3	2			1.45[-03	2
3470.3411	10	7	2	6	8	1	7			8.24E -03	3
3475.47486	-3	8	4	5	9	3	6			2.17E-04	3
3474.90700	1	7	3	5	8	2	6			1.42E-03	4
3475. 03302	-4	3	2	2	4	3	1			4.47E-02	3
3475.9464	-44	10	5	5	10	6	4			1.59[-05	10
3476.3459	-18	9	5	4	9	6	3			1.23E-04	2
3477.101	-282	9	5	5	9	6	4			1.33E-05	10
3477.7619	-22	8	5	3	8	6	2			1.07E-04	2
3477.8451	-54	8	5	4	8	6	3			2.60E -04	5
347 7.8586	-70	11		39	11	4	8			6.70E-05	10
3479.6429	123	7	5	2	7	6	1			8.90E-04	3
3480.21855	-7	10	2	9	10	3	8			8.26E -04	3
3480.6281	2	9	0	9	9	1	8			2.68E -03	3
3480.6538	-14	6	1	5	7	2	6			1.71E-02	4
3480.7602	13	3	1	3	4	2	2			1.7/k-02	2
3481.6620	9	6	5	2	6	6	1			1.28E-03	2
34822.2469	-12	3	2	1	4	3	2			1.40E-01	3
348-6.6874	13	11		65	12	5	8			9.22[-05	2
3487.8183	-11	10	1	9	10	2	8			2.70E-04	2
3488.0? 182	0	7	0	7	8	1	8			6.95E -02	2
3488.32053	-6	7	1	7	8	0	8			2.30E-02	2
3(,89.0832	-7	10	4	7	10	5	6			2.52E-04	2
3491.1745	-8	4	0	4	4	3	1			6.35E -04	2
3494.92992	-4	10	3	8	104		7			5.26E-04	3
3495.17695	?	6	2	5	7	1	6			3.97E-02	2

observed strength	%s	(o-c)%*	R
5.36E -05	2	5.061-02	1.06
3.28E -02	2	-3.2	1.04
1.30E -01	5	-2.9	1.04
1.28[-04	6	5.?	1.02
4.25E -05	6	4.8	1.01
2.40E-04	2	-5.2	0.96
1.04E-03	3	4.1	1.00
3.55E -04	3	6.4	1.02
8.80E-05	3	2.0	0.93
1.60E-04	4	7.931--05	0.94
4.02[-05	10	6.051" -08	0.99
2.71E -04	3	3.8	0.97
3.27E-02	3	2.95E-02	1.07
2.81E -02	2	1.1	1.06
7.60E -06	10	1.12[-07	0.99
7.89E-06	10	1.42[-07	0.92
3.90E-02	4	6.1	1.15
7.33[-03	3	1.23E -02	1.04
1.45[-03	2	1.1	1.06
8.24E -03	3	-3.3	1.06
2.17E-04	3	4.36[-04	1.02
1.42E-03	4	2. 01E -03	1.07
4.47E-02	3	-1.2	1.07
2.63[-05	0.93		
2.14E -04	0.90		
7.16[-05	0.99		
1.64E -04	0.95		
4.93E -04	1.00		
5.13E -05	1.11		
1.22[-03	0.96		
1.3	0.96		
0.6	0.99		
2.9	1.07		
-1.5	1.05		
1.55E-03	1.00		
-1.0	1.04		
-3.1	0.92		
0.9	1.07		
0.5	1.07		
5.5	0.92		
-2.1	1.07		
4.0	0.93		
-5.2	1.05		

Tabl e 7 conti nued

observed position	o-c	upper J	upper K_a	upper Kc	lower J	lower K_a	lower Kc	observed strength	%s	(o-c)%*R
3496.27971	-6	9	4	6	9	5	5	2.45E-04	4	2.22E-04 0.95
3496.38?9	-16	1 1	5	6	1 2	4	9	1.57E-04	2	2.14E-06 1.09
3496.62467	-4	5	1	4	6	2	5	8.00E-02	4	0.8 1.05
3496.9172	5	1 1	7	5	1 2	6	6	9.76E-06	10	3.33E-07 1.08
3497.98505	- 19	1 0	6	5	1 1	5	6	3.22[-04	2	2.65E-06 1.06
3500.67/22	0	1 1	7	4	1 2	6	7	2.75E-05	3	1.16E-06 1.04
3500.87307	-10	9	2	8	9	3	7	7.61E-04	2	-1.7 0.95
3501.2?725	-4	8	4	5	8	5	4	1.86E-03	2	1.60E-03 0.97
3501.46267	0	8	1	8	8	2	7	6.80E-03	2	5.7 1.06
3503.2757	-14	?	2	1	3	3	0	1.92E -01	4	-4.6 1.05
3503.58072	-10	1 1	2	9	1 1	3	8	1.71E-04	2	-2.6 0.87
3504.34299	1	7	4	4	7	5	3	1.33E-03	4	1.07E-03 0.98
3504.46687	3	8	0	8	8	1	7	1.68E-03	3	2.16E -03 0.98
3504.7501	4	2	2	0	3	3	1	6.30E-02	5	-6.7 1.02
3505.86556	-3	6	4	3	6	5	2	6.30E-03	5	5.20E -03 0.95
3505.9535	-lo	3	0	3	3	3	0	1.03E-03	5	-5. ? 1.07
3508.37903	5	1 0	5	5	1 1	4	8	2.34E-04	2	1.33E-06 1.05
3508.83606	-5	6	0	6	7	1	7	3.90E -02	4	1.3 1.06
3509.55958	-11	6	1	6	7	0	7	1.13E-01	2	-1.5 1.04
3510.50011	7	6	3	4	7	2	5	3.72E -03	3	7.93E-03 1.09
3511.4304	-3	1 0	6	4	1 1	5	7	9.30E-05	2	1.92E-06 1.04
3511.59395	-11	4	1	3	5	2	4	3.96E-02	2	4.6 1.08
3512.61083	2	7	4	3	7	5	2	9.91E-04	2	3.21E-03 0.99
3513.1269	-7	8	4	4	8	5	3	1.95E-04	2	5.28E-04 0.98
3513.83?02	1	7	4	4	8	3	5	2.29E-03	2	1.79E-04 1.08
3514.04553	15	9	1	8	9	2	7	2.55E-03	5	3.6 1.00
3574.16499	4	5	4	1	5	5	0	2.28E-03	3	5.71E-03 1.02
3515.71368	-1	5	4	2	5	5	1	2.83E-04	2	1.91E-03 1.00
3519.84813	-2	8	2	7	8	3	6	5.72E-03	3	-3.5 0.95
3520.4096	11	1 2	3	9	1 2	4	8	7.20E-06	10	9.93[-06 0.59
3521.29060	1	8	3	6	8	4	5	3.78E-03	2	2.1 0.96
3522.0952	43	1 0	4	6	1 0	5	5	6.45E-05	3	7.78E-05 0.86
352?.2?609	0	5	2	4	6	1	5	1.73E-02	3	-7.1 1.06
3522.7403	-27	2	1	2	3	2	1	1.00E-01	3	-6.4 1.00
352?.7761	1	7	1	7	7	2	6	4.55E-03	2	-3.0 0.99
3526.39309	7	9	5	4	1 0	4	7	2.38E-03	3	6.81E-06 1.05
3526.56902	6	1 0	7	4	1 1	6	5	7.55E-05	2	4.05E-06 1.04
3527.03033	-1	3	1	2	4	2	3	1.44E-01	3	-2.6 1.01
3527.97044	-1	7	0	7	7	1	6	1.36E-02	2	-5.3 0.95
3529.05576	0	5	0	5	6	1	6	1.70E-01	5	-1.2 1.02
3529.2? 175	3	8	5	4	9	4	5	8.48E-03	2	3. 01E-07 0.99
3530.07475	0	7	3	5	7	4	4	2.74E-03	3	2.7 1.00
3530.75983	-8	5	1	5	6	0	6	5.50E-02	8	-2.3 1.02
3530.938?	-61	1 0	2	8	1 0	3	7	2.40E-04	6	2.16E-04 1.02
3531.67595	-2	9	6	4	1 0	5	5	2.47E -04	3	4.26E-06 1.07
3536.18511	5	6	3	4	6	4	3	1.63E -02	3	1.45E-02 1.12
3540.04810	-18	1 1	3	8	1 1	4	7	1.29E-04	2	-1.6 0.85
3540.17271	-9	5	3	3	5	4	2	7.1 OE-03	2	2.3 1.05
3540.67725	0	8	1	7	8	2	6	2.26E -03	2	0.9 0.99
3542.7512	7	4	3	2	4	4	1	2.02E-02	3	-0.6 1.06
3542.89188	1	6	1	6	6	2	5	2.76E-02	3	-0.5 1.02
3543.59693	6	5	3	2	5	4	1	2.55E -02	3	2.08E-02 1.04
3543.7194	3	4	3	1	4	4	0	7.10E-03	3	4.7 1.05
3544.16297	6	2	1	1	3	2	2	5.93E-02	3	0.5 1.06
3545.99337	7	9	4	5	1 0	3	8	1.42E-03	2	1.22E-05 1.12
3547.51392	11	5	3	3	6	2	4	4.26E-04	3	2.75E-03 1.10
3548.39164	3	4	0	4	5	1	5	7.27E-02	10	-3.1 0.99
3548.51915	1	8	5	3	9	4	6	1.97E-03	2	3.92E-06 1.05
3550.412?8	-1	6	2	5	6	3	4	2.72E-02	2	3.5 1.07
3550.43108	3	6	3	3	6	4	2	1.70E-03	6	4.86E-03 1.01
3551.75146	-11	1 0	4	6	1 1	3	9	1.11E-04	3	4.86E-06 1.04
3551.85754	0	4	2	3	5	1	4	4.95E-02	3	5.75E-02 1.03
3552.10775	-1	6	4	3	7	3	4	7.47E-02	2	5.22E-04 1.10
3552.22751	1	4	1	4	5	0	5	2.22E -01	4	3.3 1.07,
3552.40954	4	6	0	6	6	1	5	1.00E-02	5	2.7 1.04
3552.5866	34	1 0	3	7	1 0	4	6	1.56E-04	3	-5.3 0.87
3552.807?2	-1	8	4	4	9	3	7	3.95[-03	2	2.91E-07 1.09
3553.7553	30	7	3	4	7	4	3	5.75E-03	4	8.25E -03 0.93
3554.7191	10	9	7	3	1 0	6	4	5.22E-05	2	3.63E -06 1.00
3554.78054	3	9	2	7	9	3	6	2.23E-03	3	1.8 0.95
3557.1? 963	-2	1	1	1	2	2	0	5.51E-02	2	-1.5 1.06
"3557.7137	100	1 0	9	2	1 1	8	3	3.70E-06	10	2.33E-07 1.00
3557.99948	3	9	3	6	9	4	5	1.46[-03	2	-5.1 0.95
3561.16374	3	5	2	4	5	3	3	1.41E -02	3	-2.6 1.03
3561. ?476	-12	5	1	5	5	2	4	1.63E-02	2	01.6 1.05
3561.42842	6	5	1	4	4	4	1	1.25E -04	2	1.24E-05 0.83
3562.06225	-5	1 1	4	7	1 2	3	1 0	5.80E-05	3	9. 01E-06 1.04
3563.58962	5	1	1	0	2	2	1	1.98[-01	4	0.6 1.08
3564.06086	-2	75		3	84		4	4.19[-03	2	1.19E-06 1.06
3566.00486	2	7	1	6	7	2	5	1.7/E-02	4	3.0 1.02
3566.33036	1	7	4	3	8	3	6	5.11 E-02	2	1.55E-05 1.10
3566.5336	-20	3	0	3	4	1	4	2.67E-01	2	4.5 1.07
3568.79811	-6	4	2	3	4	3	2	5.51[-02	3	-3.7 1.04
3570.022	399	9	8	2	1 0	7	3	1.1 OE-05	4	3.90E-07 1.10
3570.0418	-3	98		1	10	7	4	3.20E -05	3	1.17E-06 1.07
3572.74835	-7	8	2	6	8	3	5	2.23E-03	3	2.1 0.98
3575.1?7{1	3	7	5	2	8	4	5	1.07[-02	2	1.96E-05 1.05
3575.656?1	0	3	2	2	3	3	1	1.57E-02	2	-8.2 1.03
3574.48688	0	3	1	3	4		04	7.22E-02	5	-4.6 0.99
3576.85061	0	5	0	5	5	1	4	5.92E -02	3	6.8 1.09
357 7.21288	-4	4	1	4	4	2	3	7.13E-02	2	-3.6 1.0?
3579.3445	-84	3	2	1	3	3	0	5.50E-02	10	4.8 1.15
3581.88623	0	8	7	2	9	6	3	2.66E-04	3	1.95E-05 1.06
358?.02334	-8	8	7	1	9	6	4	8.40E -05	3	6.51E-06 1.00
3582.71676	5	4		22	43		1	2.20E -02	2	2.07E-02 1.03
3583.37857	3	322		4	1		3	1.25E -02	4	1.46E-02 1.09
3583.66351	1	2	0	2	3	1	3	8.90[-0?	3	6.9 1.08
3583.70962	-10	7	2	5	7	3	4	1.60E-02	3	-2.4 0.98
3584.3290	76	4	3	2	5	2	3	3.85E -05	4	6.57E-03 1.02
3585.24793	28	6	4	2	7	3	5	4.30E -02	3	2.97E-05 1.04
3587.1078	-6	5	2	3	5	3	2	4.33E-02	2	5.12[-02 1.02
3587.48869	1	6	1	5	6	?	4	1.32E-02	4	-1.8 0.98
3587.97548	0	6	2	4	6	3	3	1. 01E-02	3	-7.8 0.98
3589.7973	-43	4	0	4	3	3	1	3.38[-05	3	-2.6 1.19
3590.23826	6	3		1	3		322	3.05E-02	2	-0.9 1.07
3590.86206	1	76		2	85		3	6.40E-04	4	2. 01E-05 1.06
3591.3473	18	6	0	6	5	3	3	2.28E-05	6	0.5 1.07
3591.60916	3	7	6	1	8	5	4	1.98[-03	2	6.2?[-05 1.09
3591.68990	4	7	1	6	64		3	4.16E-05	3	1.82[-05 1.49
3593.79124	0	5	0	5	4	3	2	1.31E-04	3	4.5 1.22
3595.4827	-4	6	5	2	7	4	3	1.50E-02	10	1.65E-05 1.09
3595.962	67	8	8	1	9	7	2	3.30E -05	10	1.17E-06 1.01
3596.23775	-12	5	4	2	6	3	3	1.35E-01	3	1.32E -04 1.05
3598.13526	-1	2	1	2	3	0	3	1.97E-01	3	4.8 1.11
3598.60312	2	6	3	3	7	2	6	6.55[-02	2	6.55E-05 1.10
3598.97647	-9	6	5	1	7	4	4	4.70E -03	5	4.80E-05 1.07
3599.3919	-3	7	3	4	8	2	7	1.70E-02	6	4.00E-06 1.16
3599.52010	4	4	0	4	4	1	3	3.35E-02	3	-0.1 1.05
3599.9953	0	21		2	22		1	7.50E -02	10	-5.6 1.01
3600.9572	-20	1	0	1	2	1	2	2.23E -01	3	3.7 1.07
3601.0267	-2	5		3	2		625	1.40E-01	6	1.50[-03 1.04
3603.02545	-2	5	1	4	5	2	3	8.30E-02	3	0.5 1.04
3604.6530	-7	8	1	8	7	2	5	1.95[-05	3	5.14E-07 1.55
3607. ?625	-8	5	4	1	6	3	4	2.18E-01	3	1.141-03 1.06
3608.38421	0	7	7	1	8	6	2	8.70E-05	3	9.97E-06 1.08
3608.4148?	3	7	7	0	8	6	3	2.61E-04	2	2.99E-05 1.08
3612.02330	5	4	1		3		422	4.55E -0?	2	4.3 1.07
3614.30042	-3	2	1	1	2	2	0	3.6X-02	2	-2.1 1.05
3615.23625	-6	3	1	2	3	2	1	1.63E-01	4	7.6 1.13
3615.3284	-23	2	2	1	3	1	2	1.68E-02	3	2.281-02 1.07
3615.64478	-11	4	3	1	5	2	4	1.03E-02	3	1.25E-03 1.08
3618.0062	-19	303		3	1		2	1.63E-01	3	2.1 1.04
3618.0402	-70	6	6	1	7	5	2	1.47E -03	5	6.371-06 0.96
3618.2297	-4	6	6	0	7	5	3	5.23E-04	5	2.08E-06 1.02
3619.4312	-51	3	3	1	4	2	2	3.84E-04	10	1.78E-03 0.87
3619.91611	-2	0	0	0	1	1	1	5.56E -02	6	9.4 1.13
3623.20275	1	1	1	1	2	0	2	3.20E-02	3	-0.2 1.05
3624.12387	-6	5	5	1	6	4	2	3.62E-03	2	8.781.-05 1.08
3624.60074	-5	93		6	10	2	9	5.17E-04	2	8.64E-05 1.13
3625.17928	3	5	5	0	6	4	3	1.12E -02	4	2.62[. -04 1.13
36?6.2056	6	4	4	1	5	3	2	2.59E-01	2	1.361.-03 1.08
3630.76611	6	2	0	2	2	1	1	7.40E-02	4	6.0 1.08
3630.83037	4	4	4	0	5	3	3	6.77E-02	3	4.32["-04 1.09
3634.98243	4	3	3	0	4	2	3	7.72E-03	2	3.98E-03 1.06

Tabl e 7 cont i nued

observed position	o-c	upper J	upper K_a	upper Kc	lower J	lower K_a	lower Kc	observed strength	%s	(o-c)%	R
3638.08202	0	1	0	1	1	1	0	1.90E-01	2	6.1	1.02
3639.9335	-24	4	2	2	5	1	5	2.80E-02	6	3.16E-04	1.01
3643.90321	-4	1	0	3	7	1	2	1.88E-05	3	2. 01E-05	1.15
3644.32395	3	1	0	5	6	1	1	5.55E-05	4	3.00E-05	1.06
3648.66751	-lo	5	2	3	6	1	6	4.98E-02	3	3.58E-05	1.07
3652.38805	0	6	4	3	5	5	0	2.02E-04	3	1.76E-04	1.06
3660.37585	11	3	1	3	2	2	0	1.69E-03	2	1.1	1.11
3661 .67712	21	5	1	5	4	2	2	4.21E-04	2	3.32E-04	1.20
3662.15295	-8	5	3	3	4	4	0	1.75E-04	2	2.92E-04	1.16
3663.0452?	-2	6	2	4	7	1	7	2.15E-03	2	1.76[-05	1.16
3664.3052	-8	1	1	3	8	1	2	2.78E-05	3	3.20E-05	1.16
3665.41892	3	4	1	4	3	2	1	3.51E-03	2	3.22E-03	1.15
3665.83030	-7	5	3	2	4	4	1	8.65E-04	2	-4.0	1.14
3665.89647	-2	4	2	3	3	3	0	2.31E-03	3	2.74E-03	1.14
3674.69680	-4	1	1	0	1	0	1	1.83E-01	2	4.9	1.07
3678.24251	-3	9	4	6	1	0	1	7.80E-05	2	2.75E-05	1.14
3680.37349	-5	2	1	1	2	0	2	6.68E-02	4	7.5	1.10
3681.09930	-1	7	4	4	8	1	7	2.67E-04	2	1.33E-05	1.10
3681.28942	5	5	2	4	4	3	1	7.03E-04	3	8.32E-04	1.15
3681.33985	-1	4	2	2	3	3	1	1.09E-03	2	-2.3	1.13
3681.90366	-1	7	2	5	8	1	8	1.60E-03	2	1.58E-04	1.16
3682.56867	1	6	3	4	5	4	1	4.78E-04	2	8.27E-04	1.24
3682.95425	1	1	0	4	7	1	1	7.90E-05	3	5.86E-05	1.13
3683.6077	20	8	2	7	7	3	4	6.30 E-05	3	2.44E-05	1.49
3683.7572	2	1	0	6	5	1	1	7.00 E-06	8	1.33E-05	1.38
3683.8483	75	7	4	3	6	5	2	1.35E-05	7	1.45E-04	0.99
3687.536?	59	8	5	4	9	2	7	1.49E-04	5	2.25E-05	1.14
3690.63101	0	3	1	2	3	0	3	1.46E-01	10	8.8	1.11
3691.06230	11	4	2	2	4	1	3	1.57E-02	5	3.7/E-02	1.16
3691.39775	-38	3	2	1	3	1	2	1.05E-01	4	1.33E-01	1.11
3692.4910	-4	3	1	2	2	2	1	1.34E -02	7	-5.9	1.10
3693.2934	-15	1	1	1	0	0	0	4.02E-02	2	4.0	1.05
3694.79355	3	2	2	0	2	1	1	2.55E-02	4	3.24E -02	1.06
3696.4624	-6	5	2	3	5	1	4	1.07E-01	3	6.87E -02	1.05
3700.0384	-7	7	3	5	6	4	2	7.1 OE-05	7	1.36E-04	1.23
370?.58?2	-13	7	3	4	7	2	5	2.56E-02	10	1.45E-02	1.01
3703.5908	6	5	3	3	6	0	6	1.00E-03	10	3.94 E-07	1.12
3705.43792	8	6	3	3	6	2	4	4.00E-02	4	9.63E-03	1.07
3705.49098	-2	4	3	2	5	0	5	3.07E-03	6	3.86E-05	1.14
3705.75013	7	4	1	3	4	0	4	2.77E-02	3	9.0	1.11
3706.41703	7	8	3	5	8	2	6	2.67E-03	3	1.92E-03	1.02
3706.61870	7	6	2	4	6	1	5	1.27E-02	6	1.08E-02	0.99
3706.6664	7	6	3	4	7	0	7	2.20E-03	4	6.49E-05	1.31
3707.42748	0	5	3	2	5	2	3	4.31E-03	2	4.53E-02	1.09
3708.65082	6	1	0	4	6	1	0	3.14E-04	6	1.69E-04	0.93
3709.19805	-?	?	2	1	2	1	?	5.35E-02	3	6.52E-02	1.11
3711.10?44	-13	2	1	2	1	0	1	1.47E -01	3	8.0	1.10
3711.8755	-33	3	0	3	2	1	2	1.1 OE-01	5	2.6	1.10
3713.15863	11	3	3	1	4	0	4	3.88E-04	?	2.59E -05	1.14
3713.75500	-2	7	3	5	8	0	8	3.17E-04	2	4.92E-05	1.16
3714.8810	-2	5	4	2	6	1	5	1.1 OE-03	10	3.11E-06	1.18
3715.3492	6	9	4	6	8	5	3	5.46E-06	5	3.45E-06	1.43
3716.07409	1	4	3	1	4	2	2	2.57E-04	2	1.88E-02	1.16
3716.3133	-4	9	3	6	9	2	7	2.24E -03	3	1.89E-03	0.97
3716.59711	-1	3	2	2	3	1	3	1.97E-02	2	2.33E-02	1.09
3718.8805	-40	8	4	4	8	3	5	3.74E-03	10	1.26E-03	1.02
3721.8520	-30	7	2	5	7	1	6	1.37E-02	10	7.5	0.96
37?3.1497	-3	9	2	7	1	0	1	1.50E-04	10	3.5	1.10
3723.18843	7	3	3	0	3	2	1	1.15E-03	3	4.99E-02	1.?4
3723.83070	-4	8	3	6	9	0	9	4.04E-04	2	1.72E-04	1.19
3724.1883	7	5	1	4	5	0	5	3.89E-02	4	1.7	1.05
3726.4488	-3	3	1	3	2	0	2	4.75E-02	2	5.4	1.09
3726.4767	1	4	2	3	4	1	4	4.44E-02	3	5.18E -02	1.05
3728. ?674?	7	7	3	4	6	4	3	5.63E -05	3	5.90E-04	1.51
3728.9097(	-7	3	3	1	3	2	2	2.09E-03	4	1.60E-02	1.12
3730.08970	0	7	4	3	7	3	4	4.24E-02	3	8.35E -03	1.02
3750.47667	5	4	3	2	4	2	3	1.64E-02	3	4.97E-02	1.09
3731.0707	-8	1	0	3	7	1	0	1.86E-04	3	?.8	0.93
3752.73869	5	4	0	4	3	1	3	3.42E-02	2	-4.0	1.05
3754.0782	-35	5	3	3	5	2	4	5.90E-03	7	1.15E-02	1.03
3740.3931	4	6	4	2	6	3	3	4.41E-02	3	5.43E-03	1.04
3740.81353	-6	4	1	4	3	0	3	1.21E -01	?	4.5	1.11

observed position	o-c	upper J	upper K_a	upper Kc	lower J	lower K_a	lower K_c	observed strength	%s	(o-c)%	R
3743.56562	1	*6*	*1*	*5*	6	0	6	6.10[-03	8	3.9	1.07
3745.48568	0	6	4	3	6	3	4	3.00E-02	5	1.62E-02	1.03
3746.3228	11	2	2	1	1	1	0	1.19E-01	2	-3.3	1.11
3747.42919	-2	5	4	1	5	3	2	3.1 OE-01	2	2.65E-02	1.08
3747.4939	15	9	5	4	9	4	5	2.75E-03	10	9.59E-04	0.96
3748.21051	-1	7	3	5	7	2	6	2.31E-03	3	2.89E-03	1.03
3748.3917	-32	11	38	11	2	9		1.35E-04	10	-5.1	0.96
3750.27813	3	8	4	5	8	3	6	5.12E -04	4	3.24E-03	0.98
3750.9559	-9	4	4	0	4	3	1	1.50E-01	3	9.87E-03	1.09
3751.4697	-6	5	0	5	4	1	4	8.00E-02	3	-1.3	1.09
3752.138	-67	6	2	5	6	1	6	1.53E-02	10	-1.0	1.10
375?.50069	-8	4	4	1	4	3	2	5.50[-01	3	2.97E-02	1.07
3752.83227	-6	2	2	0	1	1	1	3.1 OE-02	6	3.48E-02	0.95
3753.6523	5	10	5	6	10	4	7	3.77E-04	3	3.24E-04	1.03
3753.8186?	-2	5	4	2	5	3	3	1.74E-01	3	8.94E-03	1.05
3755.02946	6	9	4	6	9	3	7	1.53E-04	2	3.86E-04	0.93
3755.40372	0	5	1	5	4	0	4	2.70E-02	2	-3.2	1.06
37>7,62852	-1	8	5	3	8	4	4	2.78E -03	4	9.06E-04	1.02
37>8.39891	-1	8	3	6	8	2	7	3.00E -03	3	3.38E -03	1.02
3758.62003	-6	9	2	7	9	1	8	1.48E-03	3	5.7	0.99
3761.58471	-1	8	3	5	7	4	4	7.02[-06	3	9.86E -05	1.72
3761.67585	1	10	4	7	10	3	8	2.05[-04	2	3.69E-04	0.93
3762.1713	17	7	1	6	7	0	7	7.25E-03	2	0.5	1.00
376?.8142	-11	12	5	8	12	4	9	2.80E-06	2	2.571,-05	0.77
3763.69972	5	3	2	2	2	1	1	3.13[-02	3	0.9	1.10
3764.59916	8	7	5	2	7	4	3	2.02E -02	2	6.651" -03	1.09
3767.46440	-1	95	5	94	6			2.05E -03	2	3.39["-04	1.00
3768.09248	-4	7	5	3	7	4	4	7.56E -03	4	2.27[. -03	1.07
3768.6898	-1	606	5	1	5			1.63E -02	4	-2.6	1.09
3768.94027	-1	6	5	1	6	4	2	1.11E-02	2	4.32[-03	1.04
3710.45539	0	6	1	6	5	0	5	5.30E-02	5	4.0	1.16
37{1.56285	0	5	5	0	5	4	1	4.02E-02	6	1.67[-02	1.10
3771.76962	-9	5	5	1	5	4	?	1.32[-02	3	5.59E-03	1.07
37{2.50993	4	10	64	10	5	5		1.52E-04	2	9.01E-05	0.99
3774.05338	-4	6	1	5	5	2	4	4.68E-03	2	-4.6	1.14
37{4.4378	-6	12	2	10	13	1	13	1.64E-06	10	6.80E -06	1.21
37(4.47589	2	126	7	12	5	8		5.16E -05	2	2.18[-05	0.91
37/6. 07016	-2	10	28	10	1	9		1.33E -04	2	1,8	0.93
37{/.94925	-3	4	2	3	3	1	2	6.45E-02	2	1.0	1.08
3778.26175	0	10	6	5	10	5	6	5.16E-04	2	2.84E -04	0.99
37{9.15124	-1	9	6	3	9	5	4	1.40E-03	5	8.64E -04	1.04
3781.40069	7	9	6	4	9	5	5	4.67E-04	2	2.94E -04	1.00
3781.80144	-1	8	?	7	8	1	8	2.59E-03	2	7.9	1.00
378?.6320	-3	103	8	10	2	9		3.26E-04	2	-2.7	0.94
3783.73063	5	8	6	2	8	5	3	1.11E-03	2	7.79E -04	1.06
3784.4602	-46	8	6	3	8	5	4	3.23E-03	10	2.36E -03	1.00
3784.93216	-3	707	6	1	6			2.70E-02	3	3.4	1.18
3785.26758	1	3	2	1	2	1	2	9.41E-02	2	5.72E -02	1.1?
3785.68771	-5	7	1	7	606			8.78[-03	2	0.1	1.14
3787.12693	-?	7	6	2	7	5	3	2.09E-03	2	1.68E -03	1.06
3789.24375	0	6	6	0	6	5	1	2.74E-03	2	2.40E -03	1.11
3789.27142	-2?	6	6	1	6	5	2	8.13E-03	2	7.19E -03	1.10
3789.63483	-?	5	2	4	4	1	3	1.30E-02	2	0.3	1.07
3790.4312	-15	11	74	11	6	5		5.68E-05	2	-0.4	0.97
3791.8?18	15	11	7	5	11	6	6	1.89E-05	4	-2.0	0.95
3791.95625	-9	1	1	2	9	1	1	1.01E-04	2	4.5	0.90
3793.4907	-lo	1	0	1	0	1	1	3.52E-06	4	7.99E -05	1.09
3795.16811	0	10	7	3	10	6	4	6.28[-05	4	1.4	1.03
3795.50326	-5	7	1	6	6	2	5	7.42[-03	3	0.4	1.10
3795.64228	2	10	74	10	6	5		1.80E-04	2	-3.7	0.97
3795.79848	-4	9	1	8	9	0	9	9.55E-04	3	7.53E -04	0.98
3796.89442	-2	9	2	8	9	1	9	2.93E-04	3	2.39E -04	0.94
3798.58304	-2	3	3	0	3	0	3	9.27E-04	2	1.1 OE-03	1.02
3798.80066	0	9	7	2	9	6	3	4.89E-04	2	-6.1	1.01
3798.93532	0	9	7	3	9	6	4	1.53E -04	6	1.74E-04	0.95
3799.04741	3	3	3	1	2	2	0	4.25E-02	3	5.24E-02	1.11
3799.93351	-1	6	2	5	5	1	4	2.10E-02	2	2.5	1.09
3800.44303	-6	3	3	0	2	2	1	1.64E-01	2	4.2	1.13
3800.81936	0	8	1	8	7	0	7	1.18[-02	3	2.2	1.18
3800.8780?	-8	8	0	8	7	1	7	2.33E-03	3	3.83E-03	1.15
3803.833	126	7	7	0	7	6	1	2. 01E-03	2	2.37E-03	1.06
3804.2006	0	12	8	4	12	7	5	2.05E-06	10	4.0	1.06

Table '/ Cent-ihued

observed position	o-c	upper J	upper K_a	upper K_c	lower J	lower K_a	lower K_c	observed strength	%s	(o-c)%	R
3804.4962	-16	1	2	8	5	1	2	7 6	5.45E-06	3	-8.3	0.94
3804.7s85	2	1	2	3	1	0	1	2 2 1 1	1.55E-05	6	1.91E-05	0.85
3808.0779	7	1	1	8	3	1	1	7 4	2.09E-05	2	1.74E-05	1.02
3808.167	-120	1	1	8	4	1	1	7 5	7. 10E-06	10	5.81E-06	1.04
3808.17?8	-22	4	4	0	5	1	5		3.62E-05	10	1.72E-06	1.17
3808.989.?	24	5	4	1	6	1	6		8.23E-05	4	1.76E-06	1.25
3810.2363	29	7	5	2	8	?	7		1.83E-05	3	6.96E-07	1.44
3810.32570	5	7	2	6	6	1	5		3.30E-03	2	2.97E-03	1.12
3811 .?36	-61	1	0	8	2	1	0	7 3	2.20E-05	5	1.48[-05	1.0E
3811.7971	6	1	0	2	9	1	0	1 1 0	2.70E-04	2	1.70E-04	0.8$
3813.7991	-10	9	8	1	9	7	2		1.51E-04	2	9.19E-05	1.05
3813.8034	0	9	8	2	9	7	3		5.06E-05	2	3.06 E-05	1.05
3813.98079	1	8	1	7	7	2	6		1.09E-03	2	8.86E-04	1.12
3815.54495	-6	9	0	9	8	1	8		4.17E-03	3	-2.2	1.15
3815.6885	8	9	1	9	8	0	8		1.40E-03	10	-1.8	1.16
3818.68263	4	4	3	2	3	2	1		9.66E-02	2	1.0	1.14
*3823.844	48	1	1	9	2	1	1	8 3	7.90E-06	7	4.88E-07	1.04
3824.28073	-4	4	2	2	3	1	3		9.85E-02	2	8.93E-03	1.09
38?5.55220	-1	4	3	1	3	2	2		7.88E-02	?	3.19E-02	1.14
*3825.6941	2	1	0	9	2	1	0	8 3	2.18E-05	2	5.42E-06	1.05
3826,07851	-2	1	1	1	1	0	1	1 0 1 1	7.25E-05	2	2.92E-05	0.81
3826.4163	-56	1	1	2	1	0	1	1 1 1 1	2.68E-05	10	9.41E-06	0.91
"38?7.1806	-10	9	9	0	9	8	1		3.82E-05	4	2.16E-05	1.01
3828.59021	-3	5	3	2	5	0	5		2.22E-02	3	1.21E-03	1.05
3828.9926	-10	5	5	0	6	2	5		1.58E-05	4	3.58E-06	1.30
3830.15211	-2	10	0	10	9	1	9		4.22E-04	2	-3.8	1.17
3830.21929	-13	10	1	10	9	0	9		1.29E-03	2	-2.1	1.18
3830.36670	0	9	1	8	8	2	7		1.14E-03	2	6.33[-04	1.14
3834.21419	5	9	2	8	8	1	7		4.02E-04	2	2.31E-04	1.10
3834.5081	36	5	3	3	4	2	2		1.62E-02	6	-3.6	1.08
3841.48?7	-16	12	2	11	12	1	12		1.65E-05	10	2.32E-06	0.89
3844.3517	46	1	1	0	1	1	1	0 1 1 0	2.95E-04	6	-10.4	1.17
3844.4042	-?9	11	1	11	1	00	10		1.03E-04	2	-5.9	1.23
3845.40158	2	1	0	1	9	9	2	8	1.00E-04	2	2.38E-05	1.12
3846.39921	-6	6	3	4	5	2	3		2.04E-02	3	2.31E-02	1.06
3847.26742	2	1	0	2	9	9	1	8	3.15E-04	2	7.81E-05	1.11
3849.5793	16	4	4	0	3	3	1		3.32E-02	3	6.66E -0?	1.05
3849,59904	-5	4	4	1	3	3	0		1.47E-01	5	1.99E-01	1.06
3853.57572	-14	5	3	2	4	2	3		4.95E-01	3	4.97E-02	1.08
3855.0453	4	7	3	5	6	2	4		2.44E-03	2	3.09E-03	1.07
3856.78385	4	5	4	1	5	1	4		2. 02E-02	4	1.14E-03	1.06
3857.6?422	-10	12	1	12	11	0	11		4.87E-05	4	6.24E-05	1.16
3859.03617	-4	6	4	2	6	1	5		6.39E -03	2	3.96E-04	1.07
3859.30147	0	4	4	0	4	1	3		3.28E-03	2	1.69E-04	1.09
3860.5168	45	1	1	2	1	0	1	0 1 9	1.68E-05	10	1.07E-05	0.97
3861.5147	-7	6	3	3	6	0	6		8.95E-03	10	1.04E -03	1.05
3867.5295	-19	9	3	7	8	2	6		1.83 E-04	2	2.09E-05	1.05
3868.23225	-3	7	4	3	7	1	6		9.36E-03	3	3.12E-03	1.08
3871.08168	7	5	2	3	4	1	4		4.68E-02	2	8.90E-03	1.08
3875.72440	-4	5	4	1	4	3	2		2.40E-01	4	6.41E-02	1.02
387.3.94422	-8	5	4	2	4	3	1		1.88E-01	3	2.11E-02	1.05
3888.8?	-522	1	2	3	1	0	1	1 2 9	4.60E-07	UL.	5.36E-06	0.27
3892.00?51	-7	6	3	3	5	2	4		1.09[-01	2	4.36E-03	1.06
3893.77003	9	5	5	1	4	4	0		5.1 0E-04	2	2.49E-02	0.87
3893.79629	-6	5	5	0	4	4	1		1.39E-03	4	7.46E-02	0.81
3897.97582	-1	6	4	2	5	3	3		7.29E-02	2	9.05E -03	1.08
3898.7491	48	7	3	4	7	0	7		2.1 0E-03	6	1.88E-03	1.13
3902.44078	.3	7	4	4	6	3	3		1.75E-02	2	2.68E-03	1.05
3905.80763	-1	9	5	4	9	2	7		4.07E-04	2	6.84E-04	1.05
3906.49242	1	8	5	3	8	2	6		2.42E-04	2	3.29E-04	1.11
3910.17943	14	4	4	1	4	1	4		2.24E-03	3	4.32 E-04	1.09
3913.0413	-78	9	4	5	9	1	8		3.45E-04	4	9.88E-04	1.33
3913.42639	-2	7	5	2	7	2	5		7.85E-04	2	1.04E-03	1.11
3913.4401	-3	10	5	5	10		28		6.00E-05	10	1.23E-04	1.25
3914.03749	4	8	4	5	7	3	4		8.95E-03	3	1.90E-03	1.00
3916.3792	51	6	5	2	5	4	1		1.50E-02	8	3.33E-02	1.14
3916.60601	-5	6	5	1	5	4	2		4.11E-03	3	1.12E -02	1.00
3921.10308	1	9	4	6	8	3	5		4.95E-04	2	1.04E-04	0.98
3922.89902	8	6	?	4	5	1	5		1.88E-03	2	1.20[-03	1.09
39?3.46764	0	7	4	3	6	3	4		9.95E-02	2	9.70E -03	1.05
3923.94709	2	6	5	1	6	2	4		1.82E-04	2	2.58E-04	1.12
39?4.88295	-9	1	0	4	7	9	3	6	2.00E-04	10	2.85E-05	0.88

observed position	o-c	upper J	upper K_a	upper K_c	lower J	lower K_a	lower KC	observed strength	%s	(o-c)%	R
3926.9044	25	11	4	8	10	3	7"	7.00E-06	3	2.35E-07	0.79
3928.8135	-13	12	4	9	11		38	8.00E -07	10	1.42E-11	0.47
3931.16133	0	5	4	2	5	1	5	9.53E-04	3	3.27E-04	1.07
3932.0805	-30	7	3	4	6	2	5	2.62[-02	2	4.31E-03	1.09
3935.39346	0	5	5	0	5	?	3	2.09E -04	2	3.26E -04	1.14
●3935.800	-lo	6	6	1	5	5	0	9.7A-04	2	3.45E-02	0.81
3938.05622	-2	7	5	3	6	4	2	7.18E-03	2	4.30E -03	1.04
3939.11133	-lo	7	5	2	6	4	3	1.69E-02	3	1.32E-02	0.99
3945.2648	-19	8	3	5	8	0	8	9.45E-05	?	3.64E -04	1.16
3945.4041	-80	12	6	6	12	3	9	2.06E-06	10	9.72E-06	1.44
3948.83689	17	11	6	5	11	3	8	1.33E-05	6	6.44E-05	1.14
3952.34433	4	8	4	4	7	3	5	9.33E-03	2	1. 01E-03	1.07
3953.7820	-13	104	6	10	1	9		2.30[-05	10	1.50E-04	1.19
3958.14097	1	7	6	2	6	5	1	9.80E-04	3	3.50E-03	0.99
3958.17712	-2	7	6	1	6	5	2	2.93E-03	2	1.05E-02	0.99
3958.21998	-2	8	5	4	7	4	3	2.34E-02	3	4.25E-03	1.04
3965.69558	12	5	5	1	5	2	4	4.25E-05	3	1.07E -04	1.12
3967.56207	4	6	3	4	5	0	5	3.50E-03	2	4.26E-03	1.09
3975.5297	20	9	6	3	9	3	6	3.64E-05	6	1.80E-04	1.11
3973.8088	26	6	5	2	6	2	5	2.06E-04	10	6.99E -04	1.00
3974.75301	3	1	0	5	6	9	4	5	7.50E-03	4	2.66E-04	0.93
●3974.9680	-32	7	7	0	6	6	1		6.57E-04	2	6.43E-03	0.85
3976.57377	-3	9	5	5	8	4	4		7.21E -03	2	3.89E-04	0.96
3978.81409	5	7	2	5	6	1	6		2.41E-03	2	1.71E-03	1.15
3979.72046	-3	8	3	5	7	2	6		1.78E -03	2	4.98E -04	1.11
3979.79188	-5	8	6	3	7	5	2		3.12E-03	4	3.97E -03	0.95
3979.99545	-3	8	6	2	7	5	3		1.08E-03	3	1.33E-03	1.00
3982.28982	4	5	4	2	4	1	3		1.67E-02	5	8.25E-04	1.08
3985.02062	-1	9	5	4	8	4	5		7.24E -03	2	1.45E-03	1.01
3985.07838	-2	11	5	7	10	4	6		2.02E-04	2	1.80E-05	0.93
3986.00571	0	9	4	5	8	3	6		3.92E-03	3	9.04E-04	1.12
3986.22833	4	7	5	3	7	2	6		7.24E-05	2	2.82E-04	1.15
3988.75786	24	125	8	11	4	7			4.24E-05	2	1.17E-05	0.91
3992.52001	-4	4	4	0	3	1	3		1.66E-03	2	1.91E-04	1.06
3995.0068	-11	6	4	3	5	1	4		3.33E-02	3	3.52E -03	0.99
3997.0745	-27	8	7	2	7	6	1		8.70E-04	2	1.83E-03	0.97
3997.0803	118	8	7	1	7	6	2		2.90E-04	2	6.1 0E-04	0.97
3998.06658	10	9	3	6	9	0	9		4.70E-05	3	6.32E-04	1.18
4000.46993	0	9	6	4	8	5	3		8.25E-04	2	4.74E-04	1.02
4001.28186	-4	9	6	3	8	5	4		2.37E-03	2	1.45E-03	1.03
4003.85666	-27	8	5	4	8	2	7		1.45E-04	2	7.39E-04	1.29
4004.4195	21	7	6	1	7	3	4		3.44E-05	3	2.09E-04	1.17
4010.5237?	-3	1	0	5	5	9	4	6	9.52E-04	2	1.51E -04	1.05
4011.12236	17	7	3	5	6	0	6		7.95E -04	3	8.93E-04	1.11
*4011.7549	-16	8	8	1	7	7	0		2.91E -04	3	6.051-04	0.88
4012.23136	-4	8	4	5	8	1	8		3.77E-05	5	9.121-04	1.35
4016.3279	33	6	6	0	6	3	3		5.38E-06	7	3.7/l-05	1.15
4018.5392	31	9	7	3	8	6	2		2.36E-04	3	-5.0	0.98
4018.5723	5	9	7	2	8	6	3		7.22E-04	3	-3.1	1.00
4019.68314	-11	1	0	6	5	9	5	4	1.42E-03	2	4.94E-04	1.01
4021.08398	2	7	4	4	6	1	5		3.68E-03	3	1.101" -03	1.03
4022.23450	-4	1	0	6	4	9	5	5	4.28E-04	2	1.74E-04	1.06
4027.9645	56	9	5	5	9	2	8		1.65E-05	3	1.72["-04	1.13
4028.89812	39	6	6	1	6	3	4		1.65E -05	3	1.22[-04	1.33
4030.0795	13	7	6	2	7	3	5		9.60E-06	7	7.77E -05	1.30
4030.5690	1	1	0	4	6	9	3	7	4.57E-04	2	1.03[-04	1.04
4031.4032	24	5	4	1	4	1	4		6.25E-03	2	1.18[-03	1.01
4032.6345	-16	9	3	6	8	2	7		1.69E-03	4	6.34E -04	1.16
4033.5116	13	8	6	3	8	3	6		2.63E -05	5	2.53[-04	1.27
'4033.6971	13	9	8	1	8	7	2		2.98E-04	3	2.48E -04	0.96
4035.4702	63	11	74	11	4	7			1.33E-06	10	1.54E -05	1.53
4036.4? 697	-1	8	2	6	7	1	7		4.53E-04	3	3.24E -04	1.16
4036.69705	0	11	66	10	5	5			2.35E-04	2	5.57E -05	1.00
4039.23224	-7	1	0	7	4	9	6	3	4.28E-04	3	3.27E -04	1.02
'4039.2766	9	10	10	1	9	9	0		3.50E-06	10	4.32E -05	2.94
4039.3842	-23	1	0	7	3	9	6	4	1.42E-04	2	1.09E -04	1.02
4039.99866	2?	11	5	6	10	4	7		7.92E-04	2	1.54E -04	1.06
4040.7501	-9	96	4	93	7				5.05E-06	4	6.71E-05	1.18
4043.34121	-6	11	6	5	10	5	6		5.06E-04	?	1.94E -04	1.01
4047.1352	-1	14	69	13	5	8			9.30E-06	5	5.49E-06	0.72
*4047 .9429	30	9	9	0	8	8	1		8. 01E-05	2	5.88E-05	0.82
4050.85335	-3	12	6	7	11	5	6		3.40E-04	3	5.50E-05	0.99

Table 7 continued

observed position	o-c	upper J	upper K_a	upper Kc	lower J	lower K_a	lower Kc	observed strength	%s	(o-c)%*	R
4051.0512	53	9	4	6	9	1	9	6.00E-06	4	2.05E-04	1.40
4052.18013	10	8	4	5	7	1	6	4.1 0E-03	2	2.27E -03	1.08
4055.0160	0	1	0	8	3	9	7	2 1.38E-04	3	1.07E-04	0.97
4055.0220	0	10	8	2	9	7	3	4.60E-05	3	3.57E-05	0.97
4056.556?	-2	5	5	0	5	0	5	3.90E-06	4	4.1 0E-05	1.34
4057.75572	11	8	3	6	7	0	7	1.51E-03	2	-2.1	1.14
4058.9574	-20	1	1	7	5	1	0	6 4		6.67E-05	4
4059.5045	-15	1	1	7	4	1	0	6 5		1.93E-04	3
4062.882?	-8	1	3	6	8	1	2	5 7		5.37E-05	2
*406? .9210	0	11	10	1	10	9	2	3.27E-06	4	2.28E-05	2.30
4065.48795	0	12	6	6	11	5	7	5.59E-05	2	2.50E-05	1.02
4066.1247	5	5	5	1	4	2	2	8.11 E-05	2	1.60E-04	0.99
*4070. 1729	0	1	0	9	2	9	8	1 5.52E-05	2	3.55E-05	0.87
4075.31655	3	6	4	2	5	1	5	1.32E-03	2	4.47E-04	1.01
4075.6125	0	1	1	8	4	1	0	7 3		2.29E-05	2
407>.6384	-3	1	1	8	3	1	0	7 4		6.86E-05	2
4077.38507	0	12	7	6	11	6	5	7.57E-05	2	6.79E -05	1.04
4078.44116	21	11	4	7	10	3	8	3.56E-04	2	1.34E-04	1.09
4079.02548	0	12	7	5	11	6	6	2.31E-05	4	-0.9	1.00
4080.0247	70	6	5	1	6	0	6	2.11E-06	10	3.63E-05	1.46
4080.20947	17	6	5	2	5	2	3	5.276-04	2	9.74E-04	0.99
4081.54208	24	5	5	0	4	2	3	2.17E-04	2	4.92E-04	1.03
'4083.711	0	1	1	1	0	1	0	1 0 1		1.91E-06	10
*4085.478	0	1	2	1	0	3	1	1 9 2		1.50E-06	10
4088.37048	11	9	4	6	8	1	7	5		.57E-04	2
408$.65397	4	10	3	7	9	2	8	2. 01E-04	2	1.15E-04	1.15
4088.7895	35	7	7	0	7	4	3	1.19E-06	10	3.12E-05	1.09
4089.277	-225	10	7	4	10	4	7	1.40E-06	10	3.31E-05	1.56
4089.2955	-41	9	7	3	9	4	6	8.80E-07	10	1.57E-05	1.77
4090.00641	0	13	6	7	12	5	8	4.40E-05	3	2.95E-05	1.04
4090.5613	52	8	7	2	8	4	5	2.1 0E-06	10	5.07E-05	1.24
'4091.8249	0	1	1	9	2	1	0	8 3		2.86E-05	2
4093.06305	?	7	5	3	6	2	4	2.39E-04	2	4.02E-04	0.96
4093.2526	34	1	0	4	7	1	0	1 1 0		5.90E-06	10
4093.53688	-14	9	2	7	8	1	8	7.97E-04	2	6.24E-04	1.20
4093.9766	0	13	7	7	12	6	6	7.65E-06	5	9.48E-06	0.95
4095.3904	11	1	?	8	5	1	1	7 4		2.71E -05	2
4098. ??00	0	1	3	7	6	1	2	6 7		2.25E-05	4
4106.37//2	0	9	3	7	8	0	8	2.95E-04	3	1.1	1.19
4107.04756	3	8	5	4	7	2	5	8.83E-04	2	1.13E-03	0.92
4107.9798	0	14	7	8	13	6	7	7.20E-06	8	1.06E -05	1.01
4110.51187	6	6	5	1	5	2	4	1.20E-04	3	3.20E -04	0.99
4111.9465	4	1	1	3	8	1	1	0 1 1		2.02E-06	4
4112,844	1	1	2	9	4	1	1	8 3		8.32E-06	3
4112.848	-1	1	2	9	3	1	1	8 4		2.78E -06	3
4114.2139	0	1	3	8	6	1	2	7 5		2.70E-06	8
4714.5584	0	1	3	8	5	1	2	7 6		7.74E-06	3
4117.628	0	1	4	7	7	1	3	6 8		1.80E -06	10
4118.5162	0	14	6	8	13	5	9	3.30E -06	10	3.83E-06	1.15
4125.19408	6	7	4	3	6	1	6	1.28E -03	3	1.09E-03	0.96
4125.437(1	3	9	5	5	8	2	6	3.91E-04	2	2.84E-04	0.87
41?8.72?65	3	10	4	7	9	1	8	6.68E-04	4	-4.2	1.12
4131.06550	-6	12	4	8	11	3	9	3.07E -05	2	2.40E-05	1.12
4131.871	0	1	4	8	7	1	3	7 6		3.08E-06	10
4133.06681	-6	10	5	6	9	2	7	2.34E-03	2	5.37E-04	0.97
4133.172	0	1	3	9	5	1	2	8 4		9.77E-07	8
.4133.189	0	13	9	4	12	8	5	2.93E-06	8	1.24E-05	1.07
4138.126	0	15	7	8	14		69	1.30E-06	10	4.31E-06	1.07
4142.92491	3	7	5	2	6	2	5	3.1 0E-04	3	1.09E-03	0.90
4145.42242	0	11	3	8	10	2	9	2.38E-04	3	2.19E-04	1.20
4148.87833	2	1	0	2	8	9	1	9 1.43E-04	2	3.2	1.23
4156.097{4	2	103	8	9	0	9		4.56E -04	3	5.09E-04	1.22
4159.8514	-6	5	5	1	4	0	4	2.66E-06	10	1.43E-05	1.12
4163.5631	18	11	5	7	10	2	8	1.59E-04	3	1.00E-04	1.03
4169.0644	4	6	6	1	5	3	2	2.43E-05	3	1.76E -04	0.92
4172.03550	-2	11	4	8	10	1	9	9.22E-05	2	1.24E-04	1.20
4175.9081	-24	6	6	0	5	3	3	7.70E -06	10	6.04E-05	0.89
4179.7960	6	8	5	3	7	2	6	5.88E-05	4	3.08[-04	0.82
4182.5595	4	8	4	4	7	1	7	6.83E-05	5	2.34E-04	0.89
4197.1014	4	12	5	8	11	2	9	1.15E-04	3	1.56E-04	1.07
4197.2715	68	8	6	3	7	3	4	2.75E-05	2	3.18E-04	0.74
4197.7976	37	7	6	1	6	3	4	3.35E-05	3	3.19E-04	0.85
4200.92627	0	1	2	3	9	1	1	2 1 0		2.82E-05	2
4?01.37193	-13	6	5	2	5	0	5	1.48E-05	5	1.23E-04	0.90
4202.2544	4	11	2	9	10	1	10	2.00E-04	3	2.75E-04	1.22
4206.3569	21	1	1	3	9	1	0	0 1 0		6.98E-05	3
4214.06182	32	1	0	6	5	9	3	6		8.30E-06	7
4217.1892	5	12	4	9	11	1	10			9.70E-05	2
4222.1291	14	9	5	4	8	2	7	6.84E-05	2	6.32E-04	0.76
4222.9480	10	8	6	2	7	3	5	8.70E -06	5	1.17E-04	0.76
4223.254	96	11	66	10	3	7		1.70E-06	10	4.57E-05	0.47
4234.0959	0	1	3	5	9	1	2	2 1 0		7.90E-06	5
4236.6253	-2	12	6	7	11	3	8	4.7/L-06	4	8.31E -05	0.51
4247.9592	19	9	4	5	8	1	8	1.00[-05	5	3.83E-04	0.60
4249.1394	-56	7	5	3	6	0	6	4.50E-06	6	5.841-05	0.73
4250.3335	79	9	6	3	8	3	6	1.54E-05	3	3.04E-04	0.72
4252.3799	24	1	2	3	1	0	1	1 0 1 1		4.80E-05	5
4253.9918	-4	1	2	2	1	0	1	1 1 1 1		2.86E-05	6
4254.1075	-24	13	3	10	12	?	11			3.16E-05	2
4257.7004	20	13	6	8	12	3	9			1.93E -06	4
4261.7463	2	1	4	6	9	1	3	3 1 0		1.12E-05	4
4263.3011	-40	7	7	0	6	4	3	2.20E-06	8	2.76E-05	0.58
4271.0236	32	1	0	5	5	9	2	8 4.83E-06	4	1.22E-04	0.61
42?5.7222	0	1	4	5	1	0	1	3 2 1 1		8. 06E-06	3
4282.0317	-48	8	7	2	7	4	3			3.18E-06	10
4285.525	-4	8	7	1	7	4	4	9.00E-07	10	1.55E-05	0.52
4295.077	0	15	4	11	14	3	12			1.40 E-07	UL
4298.4058	50	9	7	3	8	4	4			5.30E -07	10
4303.2140	38	8	5	4	7	0	7			1. 01E-05	2
4304.4911	-6	13	2	11	12	1	12	3.28E -05	2	1.07E-04	1.27
4304.6223	-5	1	3	3	1	1	1	2 0 1 2		1.06E-05	2
4307.4751	-11	9	7	2	8	4	5			1.41E-06	10
4327.699	-151	11	5	6	10	2	9			1.02E-06	10
4329.748	298	1	0	7	3	9	4	6		1.65E -07	UL
4335.416	260	8	6	3	7	1	6	1.15E -06	10	5.64E-05	0.46
4353.145	336	11	74	10	4	7		1.60E-07	UL	4.77E-05	0.05
4353.7025	-10	1	4	3	1	2	1	3 0 1 3		1.13E-05	10
4354.4615	0	1	4	2	1	2	1	3 1 1 3		3.03E -06	8
4388.31	341	1	0	8	3	9	5	4		3.50E-08	UL
4401.1886	0	1	5	2	1	3	1	4 1 1 4		3.00E-06	10
4411.270	513	11	83	10	5	6				2.10E-07	U1
4414.8199	-11	10	5	6	9	0	9	3.74E -06	10	9.28E-05	0.87
4468.70	613	10	7	4	9	2	7	7.1 OE-08	UL.	6.20["-06	0.07

* asterisk denotes a doubled absorption with the quantum assignment '-given for the stronger transition. The strength given represents the sum of the strengths of the two comparable transitions.

o-c are observed minus computed line positions in $cm^{-1} \times 10^5$. Computed values derived from energy levels *given* in table 2 and ground state levels given in ref. 16

%s are estimated uncertainties in the measured line strengths given in percent

a. (o-c)% is the percent difference between the observed and computed line strength or the value of the computed strength if the difference between the observed and computed values is ≈±12% or larger in magnitude.

R is the ratio of the observed line strength derived in this study to the computed value given in ref. 14

UL. upper limit. There were no apparent absorption features in any of the spectra within ±0.015 cm^{-1} of the listed frequency. The observed strength given represents the maximum strength the transition can have taking into consideration nearby absorption features of other transitions and also the signal-to-noise ratio of the spectra.

Table 8. Line positions (cm^{-1}) and strengths (cm^{-2}/atm. at 296K) observed in the (001) - (000) band of $H_2{}^{16}O$.

observed position	o - c	upper J	upper K_a	upper Kc	lower J	lower K_a	lower Kc	observed strength	%s	(o-c)	%R
‘2992.1605	16-4	9	8	2	1	0	1	1.57E-06	10	6.20E-07	1.03
3008.277/	-4	1	0	7	3	1	1	2.33E-06	10	1.14E-06	0.90
3013.162	-277	8	1	8	9	5	5	1.17E-06	10	8.57E-07	0.89
3013.21442	-8	6	3	3	7	7	0	4.53E-05	2	2.71E-07	0.75
3027.0140	47	1	0	2	8	1	1	6	5	4.95E-06	2
3028.2616	30	1	0	1	9	1	1	5	6	5.60E-06	4
*3036 .2214	169	9	7	3	1	0	9	2		8.47E-06	10
3040.7415	30	7	2	6	8	6	3	7.18E-06	3	3.36E-06	1.02
3041.0884	21	1	2	1	1	2	1	3	3	1.32E-06	10
3054.1929	13	1	3	4	1	0	1	4	6	8.37E-07	10
3059.2586	-97	1	0	6	4	1	1	8	3	1.30E-05	6
3074.7196	15	1	2	2	1	1	1	3	4	2.10E-06	10
3077.7453	-22	7	1	7	8	5	4	9.00E-06	4	6.04E-06	0.96
3080.3735	-5	6	2	5	7	6	2	3.40E-06	3	1.10E-06	0.97
3085.35744	3	9	6	4	1	0	8	3		2.33E-05	2
3085.5065	1	1	2	5	7	1	3	7	6	3.37E-06	4
3085.55892	3	9	6	3	1	0	8	2		7.52E-06	2
3085.68966	0	1	1	5	7	1	2	7	6	9.10E-06	3
3086.1330	-14	1	2	1	1	1	3	3	1	5.41E-06	3
3092.28571	33	9	1	8	1	0	5	5		7.62E-06	3
3101.803?	-23	1	1	0	1	1	2	2	1	5.65E-06	3
3112.5424	-15	8	6	3	9	8	2	1.66E-05	6	7.37E-06	1.00
3112.5879	0	8	6	2	9	8	1	4.70E-05	4	2.21E-05	0.95
3112.67092	3	1	0	5	6	1	1	7	5	1.06E-05	4
3116.3069	-41	7	2	5	8	6	2	4.80E-06	4	4.17E-06	0.83
3120.1920	11	1	0	5	5	1	1	7	4	3.22E-05	2
31?9.59935	5	1	1	4	8	1	2	6	7	1.93E-05	2
3136.1715	19	6	1	6	7	5	3	5.19E-06	3	3.41E-06	0.93
3139.112?9	1	9	5	5	1	0	7	4		8.43E-05	2
*3140.021	240	7	6	2	8	8	1	8.60E-05	3	3.99E-05	0.97
3142.13175	3	9	5	4	1	0	7	3		2.78E-05	3
3145.89477	2	1	1	3	9	1	2	5	8	2.28E-05	7
3147.0055	14	8	1	7	9	5	4	7.24E-05	2	5.16E-05	0.99
3149.3375	29	1	1	1	0	1	2	3	9	7.80E-06	4
3157.68655	0	1	0	1	1	0	1	1	3	9	2.23E-05
3162.0846	-1	1	0	0	1	0	1	1	2	9	7.30E-05
3162.12989	3	1	0	4	7	1	1	6	6	2.55E-05	3
3165.45995	4	8	5	4	9	7	3	6.22E-05	2	2.78E-05	0.96
3166.45616	-2	8	5	3	9	7	2	1.88E-04	3	8.33E-05	0.96
3177.1313	17	1	2	4	8	1	3	6	7	1.50E-06	10
3184.5299	6	1	0	2	9	1	1	4	8	2.76E-05	3
3186.35?5	-18	9	2	8	9	6	3	1.50E-06	10	1.00E-06	0.91
3188.29715	5	5	1	5	6	5	2	2.41E-05	6	1.14E-05	1.03
3190.1700	-18	1	0	3	8	1	1	5	7	3.15E-05	2
3191.97194	3	7	5	3	8	7	2	3.37E-04	3	1.49E-04	1.00
3192.10360	-7	94	6	10	6	5		2.57E-04	2	1.05E-04	1.00
3192.22926	-6	7	5	2	8	7	1	1.12E-04	3	4.96E-05	0.99
3193.05916	2	7	1	6	8	5	3	4.87E-05	2	3.48E-05	0.99
3?00.925?	53	123	9	13	5	8		5.67E-06	4	6.62E-06	0.94
3?00.99837	10	7	0	7	8	4	4	3.78E-05	2	2.81E-05	1.02
3211.2165	-5	10	4	6	11	6	5	4.70E-06	7	3.90E-05	0.99
3211.55527	-1	9	4	5	1	0	6	4		1.42E-04	2
3214.0333	6	10	1	9	11		38	9.60E-05	6	-2.5	0.96
3215.3? 035	13	9	1	9	1	0	3	8		2.22E-04	3
3218.71203	-12	6	5	2	7	7	1	1.31E-04	3	5.87E-05	1.00
3218.75912	13	6	5	1	7	7	0	3.76E-04	4	1.76E-04	0.96
3??0.29233	-1	8	4	5	9	6	4	2.16E-04	2	8.54E-05	0.98
3223.45795	8	9	0	9	1	0	2	8		7.48E-05	2
3230.28416	6	9	3	7	1	0	5	6		3.85E-04	3
3230.42005	-3	8	4	4	9	6	3	8.27E-04	2	2.56E-04	1.01
3?30.92145	-4	6	1	5	7	5	2	1.93E-04	2	1.33E-04	1.02
3?36.155	-315	7	2	6	7	6	1	2.97E-06	4	1.71E-06	1.04
3?36.39957	-5	9	2	8	104		7	3.33E-04	2	2.95E-04	0.98
3242.9512	-9	11	38	12	5		7	8.70E-06	4	1.06E-05	0.96
3247.36325	3	7	4	4	8	6	3	1.35E-03	3	5.14E-04	1.01
3251.50867	-1	7	4	3	8	6	?	4.92E-04	3	1.71E-04	1.02
3261.2665	0	5	1	4	6	5	1	4.44E-05	2	3.14E-05	1.01
3264.24009	4	6	0	6	7	4	3	3.29E-04	2	2.34E-04	1.07
3266.086?	4	8	3	6	9	5	5	5.00E-04	10	2.04E-04	1.08
3271.4129	-4	1	0	0	1	0	1	0	4	7	8.05E-06
3271.9143	-4	8	1	8	9	3	7	2.44E-04	3	2.16E-04	1.08
3272.05174	-1	10	2	8	11	4	7	1.34E-04	2	1.45E-04	0.99
3275.07[5	51	7	1	7	752			6.90E-06	3	4.96E-06	1.01

observed position	o-c	upper J	upper K_a	upper K_c	lower J	lower K_a	lower Kc	observed strength	%s	(o-c)	%R
327.$.87408	0	6	4	3	7	6	2	7.06E-04	2	2.68E-04	1.02
327>.17>13	-5	6	4	2	7	6	1	2.1 OE-03	2	8.04E-04	0.99
3278.84136	-1	9	1	8	1	0	3	7		1.25E-04	2
‘3282.009	358	9	7	3	9	9	0	1.27E-06	10	9.29E-07	0.81
3285.0520	3	8	2	7	9	4	6	3.78E-04	3	2.98E-04	1.02
3285.7274	-23	4	1	3	5	5	0	3.87E-05	3	2.91E-05	0.99
3286.16913	16	8	0	8	9	2	7	7.03E-04	2	2.1	1.02
3296.0868	-3	10	2	8	10	6	5	7.45E-06	10	5.90E-06	0.96
3297.57573	-2	9	3	6	1	0	5	5		7.15E-05	2
3298.10676	1	7	3	5	8	5	4	4.28E-03	3	1.38E-03	1.00
3300.21398	-2	5	4	2	6	6	1	2.1 OE-03	2	8.33E-04	1.00
3300.50072	1	5	4	1	6	6	0	7.12E-04	2	2.78E-04	1.01
3311.7594	-4	7	2	5	7	6	2	2.60E-06	10	13.0	0.89
3313.449	-178	8	2	6	8	6	3	1.39[-05	10	1.1 OE-05	0.98
3314.6057	-4	1	0	1	1	0	1	0	3	7	5.20E-06
3315.04288	-1	8	3	5	9	5	4	3.46E-04	2	7.951-04	1.00
3318.3628	-22	5	0	5	6	4	2	2.1 OE-04	2	1.47E-04	1.04
33?0.485	0	14	7	7	15	7	8	1.41E-06	15	2.6	1.21
3320.5417	21	9	0	9	9	4	6	9.50E-06	10	8.00E-06	1.00
‘3322.126	0	18	1	17	19	1	18	3.00E-07	10	3.91E-07	0.83
3323.3414	24	9	2	7	1	0	4	6		1.86E-04	?
3323.387	-110	11	6	6	11	8	3	2.55E-06	10	1.73E-06	0.90
3325.375	-202	12	66	12	8	5		7.40E-07	15	16.0	0.71
3325.841	-12	14	68	15	6	9		2.11 E-06	15	3.561”-06	0.74
3326.79630	-3	7	1	7	8	3	6	1.98E-03	2	1.79E-03	1.04
3327.5880	-3	6	3	4	7	5	3	3.45E-03	4	8.30[”-04	1.02
3328.424	0	1	5	4	1	1	1	6	4	1	2
3329.64418	2	72	6	84	5			3.66E-03	2	2.34} -03	1.03
3329.8365	27	9	6	4	9	8	1	9.50E-06	6	6.13[. -06	0.92
3330. 0386	25	9	6	3	9	8	2	3.20E-06	10	2.05E-06	0.94
3330.77150	-6	7	3	4	8	5	3	6.60E -05	2	5.181’ -04	0.94
3341.38362	1	8	1	7	9	3	6	1.46E-03	3	-2.1	1.03
3342.0102	17	9	1	8	9	5	5	1.40E-05	6	1.181-05	0.96
3344.9932	4	1	4	5	9	1	5	5	1	0	5.80E-06
3345.3935	0	16	2	14	17	2	15	2.36E-06	5	-6.9	1.05
‘3346.7976	0	12	9	3	13	94		3.05E-06	10	-3.8	1.09
3347.3814	-2	15	4	12	16	4	13	3.77E-06	6	-10,4	0.94
3347.4300	0	1	5	3	1	2	1	6	3	1	3
3348.1933	2	6	3	3	7	5	2	2.30E-04	4	2.59[-03	1.21
3349.86205	-10	7	0	7	8	2	6	6.92E-04	2	1,0	1.03
3351.6215	6	14	4	10	15	4	11	1.06E-05	2	-6.7	0.95
3352.640	-28	13	5	8	14	5	9	6.1 OE-06	4	1.26E -05	1.04
3355.70595	4	5	3	3	6	5	2	1.87E-02	4	3.46E-03	1.06
3356.3388	40	11	2	10	11	4	7	1.17E-05	5	-0.6	0.85
‘3356.9082	5	11	10	2	12	10	3	2.40E-06	10	8.2	1.19
3359.51985	9	5	3	2	6	5	1	8.76E-03	4	1.16E -03	1.02
3359.7996	124	13	6	8	14	69		1.40E-05	4	1.84E-05	0.91
3364.2895	-12	4	0	4	5	4	1	7.40E -04	3	4.73E -04	1.07
3364.8?691	5	8	2	6	9	4	5	1.85E -03	3	2.1 OE-03	1.02
3365.3822	24	8	0	8	8	4	5	8.30E -05	3	7.25E -05	0.97
3367.8139	0	15	2	13	16	2	14	2.96E-06	10	4.14E -06	0.91
‘3368.2975	0	16	1	15	17	1	16	1.15E-05	6	-2.0	1.05
3368.5275	9	15	3	13	16	3	14	1.27E-05	4	2.5	1.08
3368.81952	5	6	2	5	7	4	4	5.18[-03	5	1.69E -03	1.04
3369.1361	9	8	1	7	8	5	4	1.1 OE-04	10	7.53E -05	1.17
3370.9025	-1	14	3	11	15	3	12	2.12E-05	3	-7.0	1.01
‘3372.8272	-21	11	93	12	9	4		1.02E -05	5	-5.9	1.05
3373.87454	3	1	3	5	9	1	4	5	1	0	3.94E-05
3373.9321	24	12	7	5	13	76		2.30E-05	3	2.91E-05	0.91
3374.3321	5	12	76	13	7	7		8.41E -06	4	9.70E-06	1.00
3375.1870	-7	1	3	4	9	1	4	4	1	0	1.97E -05
3378.5297	28	9	1	9	9	3	6	6.1 OE-05	3	5.27E-05	1.06
3379.12374	1	6	1	6	7	3	5	1.75E-03	3	1.47E-03	1.05
3380.1152	1	10	5	6	10	73		7.57E-06	5	6.02E-06	0.76
3382.4747	56	12	66	13	6	7		8.40E -05	2	3.2	1.22
3382.86970	5	9	5	5	9	7	2	5.21E-05	2	3.52E-05	0.88
‘3382.9069	-311	10	10	0	11	10	1	4.16E-06	7	-10.4	0.98
3383.07556	-1	4	3	2	5	5	1	6.76E-03	3	1.04E-03	1.04
3384.11345	4	12	5	7	13	5	8	1.22E -04	4	1.82E-04	0.95
3384.38710	3	4	3	1	5	5	0	2.42E -02	4	3.14E-03	1.05
3385.9171	-1	9	5	4	9	7	3	1.97E-05	2	1.17E-05	0.99
3386.35361	-34	8	5	3	8	7	2	8.47E -05	3	5.07[-05	0.98
3387.8479	3	7	5	3	7	7	0	6.93E -05	2	4.34E-05	0.93

Table 8 conti nued

observed position	o-c	upper J	upper K_a	upper Kc	lower J	lower K_a	lower Kc	observed strength	%s	(o-c)%[a]	R
3388.10595	8	7	5	2	7	7	1	2.37E-05	3	1.45E-05	0.95
3389.3?416	12	7	1	6	7	5	3	4.40E-05	5	3.61E -05	0.96
3390.1336	-3	1	5	2	1	4	1	6.2E-05	2	4.25E-05	1.08
3391.0472	35	1	5	1	1	4	1	6.1E-05	1	1.42E-05	3 0.2 1.08
3393.0055	-49	1	3	4	1	0	1	4.4E-05	1	1.10E-04	3 1.03[-04 1.16
3393.2158	0	1	3	3	1	0	1	4.3E-05	1	3.80E-05	5 3.70E-05 1.07
*3393.6894	o	16	0	16	17	0	17	5.66E-05	2	5.17E-05	1.19
3396.17572	0	7	2	5	8	4	4	1.47E-03	3	1.72E-03	1.04
3398.1454	-5	12	5	8	13	5	9	5.50E-05	2	6.57E-05	1.01
3398.81305	-2	7	1	6	8	3	5	1.73E-03	3	-3.7	1.04
'3398.9028	-31	10	9	1	11	9	2	3.04E-05	2	2.7	1.13
3399.75333	4	12	4	8	13	4	9	3.04E-04	3	-0.8	1.01
3400.40585	0	11	7	4	12	7	5	3.50E-05	5	-4.3	1.09
3400.5661	3	11	7	5	12	7	6	1.06E-04	3	-3.4	1.10
3402.15828	5	6	1	5	6	5	2	1.15E-04	3	8.96[-05	1.00
3402.6950	-6	3	0	3	4	4	0	1.21E-04	2	7.30E-05	1.08
3405.0296	-31	7	0	7	7	4	4	6.98E-05	3	5.87E-05	1.00
3407.8?61	-4	5	1	4	5	5	1	1.30E-05	10	1.05E-05	0.98
3408.7488	-10	5	2	4	6	4	3	5.80E-05	5	8.77E-03	0.80
3410.2045	-5	11	6	5	12	6	6	9.30E-05	4	1.06E-04	1.03
3411.1056	-87	10	2	9	10	4	6	3.12E-05	5	2.28E-05	0.98
3411.8524	-46	11	6	6	12	6	7	2.88E-04	4	3.16E-04	1.07
3413.0677	32	6	0	6	7	2	5	5. 86E-03	3	-2.7	1.02
*3413.5675	44	10	8	2	11	8	3	1.19E-04	4	1.32E-04	1.00
3413.8468	22	11	5	6	12	5	7	2.02E-04	5	2.51E-04	1.02
3413.857	-51	1	4	2	1	3	1	5.2E-04	1	6.26E-05	7 0.1 1.07
3413.90?9	1	1	4	1	1	3	1	5.1E-04	1	1.88E-04	2 0.1 1.07
3413.99131	0	13	3	11	14	3	12	2.65E-04	4	1.8	1.08
3414.0302	2	1	3	2	1	1	4	2.1E-02	2	8.60E-05	4 -1.6 1.04
3415.53568	-6	1	2	3	9	1	3	3.1E-04	0	5.02E -04	2 0.4 1.04
3415.66631	-7	1	2	4	9	1	3	4.1E-04	0	1.32E-04	2 1.47E-04 1.00
*3416.1589	-17	15	1	15	16	1	16	2.35E-04	3	2.5	1.12
3419.3540	57	11	4	8	11	6	5	3.25E -05	4	2.40E -05	0.92
3419.46218	5	6	2	4	7	4	3	6.83E-03	4	9.14E-03	0.98
3422.2727	44	11	3	9	11	5	6	3.86E-05	10	12.9	0.94
3423.1166	-3	11	5	7	1?	5	8	6.51E-04	3	7.78E-04	1.01
*3425.0171	-20	9	9	1	1	0	9	5.23E-05	4	-4.1	1.03
3426.1866	15	11	4	7	12	4	8	4.24E-04	6	-5.4	1.02
3426.7927	4	10	7	3	11	7	4	3.14E-04	3	3.56E-04	0.99
3426.8484	12	10	7	4	11	7	5	1.03E-04	3	1.19E-04	0.98
3427.91718	-1	5	1	5	6	3	4	1.44E-02	3	9.47E-03	1.04
3435.6936	-12	9	4	6	9	6	3	2.53E-04	2	1.54E-04	0.96
*3436.291	66	13	2	12	14	2	13	1.02E-03	3	1.2	1.08
3436.4472	-52	1	2	2	1	0	1	3.2E-04	1	1.05E-03	7 -0.4 1.05
3437.4785	4	10	6	4	11	6	5	9.47E-04	2	1.07E-03	1.02
3437.7685	-21	11	3	8	12	3	9	6.95E-04	2	0.6	1.04
3437.9884	39	8	1	8	8	3	5	8.98E-05	2	7.6	0.99
3438.19075	5	5	2	3	6	4	2	2.92E-03	3	4.12E-03	1.04
3438.2206	4	10	6	5	11	6	6	3.31E-04	4	-7.6	1.07
3638.44826	-8	11	4	8	12	4	9	1.48E-03	2	1.71E -03	1.01
3438.58459	0	14	1	14	15	1	15	2.28E-04	4	-1.6	1.08
3438.6411	21	1	4	0	1	4	1	5.0E-04	1	7.48E -04	2 7.6 1.20
3438.7523	-10	6	0	6	6	4	3	4.06E-04	2	3.18E-04	1.00
'3439.7642	5	9	8	2	1	0	8	2.95E-04	3	-8.4	1.00
3439.8958	-11	8	4	5	8	6	2	1.51E-04	3	9.04E-05	0.93
3439.93765	-6	4	2	3	5	4	2	8.80E-04	3	3.76E-03	1.00
3442.7803	13	7	4	4	7	6	1	6.42E-04	3	3.49E-04	0.99
3443.10243	-1	10	5	5	11	5	6	2.15E-03	4	2.68E -03	0.96
3445.0055	-1	6	4	3	6	6	0	1.70E -04	3	8.85E-05	1.02
3446.31117	-59	6	4	2	6	6	1	5.52E-04	2	2.65E-04	1.08
3448.40040	2	6	1	5	7	3	4	1.57E-02	4	-5.6	1.05
3448.6991	9	10	5	6	11	5	7	7.95E-04	3	9. 01E-04	1.05
3450.1917	3	8	4	4	8	6	3	5.58E -04	3	2.78E-04	0.98
3453.1137	-2	9	7	2	10	7	3	3.07E-04	3	-5.3	1.05
3453.1297	16	9	7	3	1	0	7	4.9.02E-04	3	-7,2	1.03
3456. ?5478	1	10	4	6	11	4	7	3.70E-03	2	5.16E-03	0.99
3457.5003	-5	9	2	8	9	4	5	3.80E-04	4	3.35E -04	1.01
*3458.5451	-89	12	1	11	13	1	12	3.78E-03	2	2.2	1.09'
3458.59614	-6	1	1	2	9	1	2	2.1E-03	0	1.25E-03	2 -3.2 1.02
3458.7606	-7	1	1	3	9	1	2	3.1E-03	0	3.56E-03	3 -5.5 1.02
3460.40922	3	10	3	7	11	3	8	7.55E-03	2	-3.6	1.00
*3460.5953	0	1	3	1	1	3	1	4.1E-04	1	3.50E -03	2 2.4 1.1W
3461.6979	-5	10	4	7	11	4	8	1.70E -03	4	1.97E-03	1.04

observed position	o-c	upper J	upper K_a	upper KC	lower J	lower K_a	lower KC	observed strength	%s	(o-c)%[a]	R
3464.38142	-7	9	6	3	1	0	6	4.4E-04	1	9.38E -04	3 1.04E-03 1.03
3464.66833	11	9	6	4	1	0	6	5.5E-04	1	2.75E -03	3 3.11E-03 0.99
'3465.9503	0	8	8	0	9	8	1	5.09E-04	3	-3.9	1.03
3466.0292	40	5	0	5	5	4	2	1.60[-04	4	1.23E-04	1.05
3468.55815	14	3	2	2	4	4	1	3.1 0E-03	3	9.16E-03	1.00
3469.004	120	1	4	1	1	4	1	4.1E-04	1	9.00E -06	5 1.20E-05 0.89
3469.0286	12	1	4	0	1	4	1	4.2E-04	1	2.70E-05	5 3.59E-05 0.92
3470.5641	5	9	4	5	1	0	4	6.3.40E -03	4	5.66E-03	1.02
3471.7055	-12	9	3	7	9	5	4	6.14E-04	2	4.24E-04	1.03
3471.79498	-2	9	5	4	1	0	5	5.5E-04	1	2.37E-03	3 2.7x-03 1.02
3475.2934	10	4	1	4	5	3	3	1.63E-03	2	5.56E-03	1.06
3473.36978	-3	5	0	5	6	2	4	5.71E-03	3	-1.9	1.05
3474.7388	8	9	5	5	1	0	5	6.6.90E-03	3	8.19E-03	0.99
3474.7836	2	3	2	1	4	4	0	1.58E-03	2	3.19E-03	1.05
'3479.3708	-17	8	7	1	9	7	2	2.80E -03	10	-0.9	1.09
3480.39544	-5	10	2	8	11	2	9	1.28E-02	2	-1.9	1.04
'3480.594	-140	11	2	10	12	2	11	1.34E-02	10	8.6	1.17
3480.88642	-2	103	8	11	3	9		3.95E-03	3	-4.2	1.05
3482.4817	-20	1	2	0	1	2	1	3.0E-04	1	1.27E-02	4 10.6 1.21
3484.13180	6	9	3	6	1	0	3	7.7E-04	1	8.80E -03	4 -0.6 1.03
3485.15550	3	8	3	6	8	5	3	5.39E-04	3	3.22E-04	1.00
3485.74075	9	9	4	6	1	0	4	7.1.49E-02	2	1.81E-02	1.01
3486.5230	-12	4	0	4	4	4	1	2.67E-04	2	2. 01E-04	1.02
3488.3504	8	5	1	4	6	3	3	1.20E-02	6	-4.2	1.08
3490.55569	1	7	1	7	7	3	4	1.26E-03	2	1.071,-03	1.06
3491. 0098	-14	8	6	2	9	6	3	7.03E -03	10	-7.5	1.03
3491.10201	0	8	6	3	9	6	4	2.24E-03	3	-11.5	0.99
3491.7372	0	13	0	13	13	2	12	4.35E-05	2	-5.5	1.08
3491.8002	-7	13	1	13	13	1	12	1.33E-04	5	-3"7	1.10
3493.43806	4	7	3	5	7	5	2	3.28E -03	2	1.63E-03	0.97
3493.6880	-19	1	4	1	1	3	1	4.3E-04	1	1.66E -05	6 2.09E-05 0.90
3494.16159	23	8	2	7	8	4	4	5.42E-04	2	4.21[-04	1.08
3494.260	9	14	2	13	14	2	12	6.25E-06	10	-10.4	1.00
3498.60202	-2	6	3	4	6	5	1	1.67E-03	2	6.4?['-04	1.01
3499.74675	-2	8	5	3	9	5	4	1.81E-02	10	2.13["-02	0.97
3501. 06252	7	8	5	4	9	5	5	6.33[-03	2	7.10[-03	1.02
3501.5679	15	8	4	4	9	4	5	3.74E-02	2	4.76[-02	1.03
3501.82565	-3	9	2	7	1	0	2	8.1.34E-02	5	-0.1	1.06
3502.22836	-1	5	3	3	5	5	0	4.42E-03	3	1.32[-03	1.04
3502.4092	44	10	1	9	11	1	10	2.93E -02	4	4.0	1.11
3502.424	54	1	0	2	9	1	1	2.1.0	9.75E -03	4	4,3 1.16
3502.87468	1	9	3	7	1	0	3	8.3.38E-02	3	3.66[-02	1.05
3504.1645	-97	11	1	11	12	1	12	3.80E-02	3	8.3	1.18
'3505.5551	-1	7	7	1	8	7	2	3.90E-03	2	-6,1	1.01
3506.07942	2	5	3	2	5	5	1	1.97E-03	3	4.48E -04	1.05
3509.42112	-2	8	3	5	9	3	6	8.04E-02	3	1.4	1.07
3510.65301	8	8	4	5	9	4	6	1.34E-02	3	1.62[-02	1.01
3513.0708	-33	3	1	3	4	3	2	1.65E-02	10	2.20[-02	1.10
3514.40081	0	12	0	12	12	2	11	4.28E-04	2	4.87E-04	1.00
3514.53642	-4	12	1	12	12	1	11	1.45E-04	2	1.62E -04	1.01
3516.12058	-10	13	1	12	13	3	11	2.40E-05	2	2.90E -05	0.93
3517.3195	-5	13	2	12	13	2	11	7.77E-05	4	8.73E -05	0.99
3517.4269	-1	7	6	1	8	6	2	4.68E-03	3	-5.1	1.04
3517.4502	-13	7	6	2	8	6	3	1.40E-02	3	-5.4	1.04
3517.675	-61	1	4	2	1	2	1	4.4.11 E-06	1	8.11 E-06	4 1.02E -05 0.89
3518.99193	4	4	1	3	5	3	2	4.95E-02	4	5.51E-02	1.03
3521.1157	14	7	2	6	7	4	3	4.70E-03	10	3.42E -03	1.00
3523.14073	-2	8	2	6	9	2	7	I.10E-01	4	-3.0	1.03
3523.9728	6	9	1	8	1	0	1	9.2.45E-02	5	-5.4	1.02
3524.10175	4	9	2	8	1	0	2	9.7.10E-0?	10	-7.9	0.99
3524.83572	-1	8	3	6	9	3	7	2.97E-02	2	3.23E-02	1.13
3525.6388	-25	10	0	10	11	0	11	1.06E-01	5	8.8	1.18
3527.0081	-40	7	5	2	8	5	3	1.41E-02	5	-9.2	1.02
3527.49531	-7	7	5	3	8	5	4	4.49E-02	3	-3.5	1.08
3528.12027	4	4	0	4	5	2	3	4.75E-02	2	-0.5	1.08
3529.65	-88	9	0	9	8	4	4	7.70E-08	UL.	1.18E-06	0.07
3531.37515	6	7	4	3	8	4	4	3.24E-02	2	3.75E-02	1.04
3532.8361	-10	1	4	3	1	1	4	5.1.0	3.56E-06	10	4.45E-06 0.98
3534.26927	13	6	1	6	6	3	3	1.55E-03	2	1.27E-03	1.05
3536.26616	-2	7	4	4	8	4	5	9.60E-02	6	1.13E-01	1.01
3536.5256	11	7	3	4	8	3	5	6.60E-02	5	-3.0	1.07
3536.8746S	7	1	1	0	1	1	1	?.1.0	4.76E-04	2	-8.9 1.03
3537.1655	21	1	1	1	1	1	1	1.1.0	1.50E-03	7	-4.4 1.08

Table 8 continued

observed position	o-c	upper J	upper K_a	upper K_c	lower J	lower K_a	lower K_c	observed strength	%s	(o-c)%[a]	R
3538.34971	6	1	2	1	1	1	2	2.92E-04	2	3.31E-04	0.98
3538.7164	10	13	?	11	13	4	10	1.20E-05	3	1.50E-05	0.88
3538.78321	2	6	2	5	6	4	2	4.76E-03	2	2.12E-03	1.0?
3540.7083	-?4	12	2	11	12	2	10	9.46E-05	2	1.11E-04	0.95
3543.01971	3	3	1	2	4	3	1	1.42 E-02	5	1.70E-02	0.9S
*3543.659	44	6	6	0	7	6	1	2.30E-02	5	2.59E-02	0.95
3545.03745	-15	7	2	5	8	2	6	9.40E-02	5	-2.4	1.03
3545.22318	-1	8	1	7	9	1	8	1.77E-01	6	-9.1	0.98
3545.55151	1	8	2	7	9	2	8	6.21E-02	4	-2.6	1.06
*3546.897	-164	9	1	9	10		110	2.70E-01	10	10.1	1.15
3547.75753	-3	7	3	5	8	3	6	1.85E-01	5	2.27E -01	1.13
3547.30041	1	9	3	6	9	5	5	2.20E-04	4	3.11E-04	0.95
3548.35729	4	2	1	2	3	3	1	4.82E-03	?	5.90E-03	1.07
3553.7381	33	6	5	1	7	5	2	8.00E-02	5	-1.4	1.09
3553.87967	-1	6	5	2	7	5	3	2.51E-02	2	-7.2	1.02
3554.8867	37	12	3	9	12	5	8	5.60E-05	5	6.94E-05	0.91
3554.91372	-2	103	7	10	5		6	3.92E-04	2	4.85E-04	0.98
3556.8538	44	8	0	8	7	4	3	8.32E-06	10	1.41E-05	0.66
3557.85217	41	11	38		11	5	7	6.03E-05	5	6.83E-05	1.02
3558.3811	-7	1	2	2	1	0	1	1.57E-04	3	1.79E-04	0.97
3559.1151	9	1	0	0	1	0	1	4.32E-03	4	4.62E-03	1.06
3559.73710	-1	1	0	1	1	0	1	1.37E-03	2	1.54E-03	1.00
3560.13247	-12	6	4	2	7	4	3	2. 01E-01	2	2.21E-01	1.05
3561.91794	0	4	23		4	4	0	6.84E-04	2	1.70E-03	1.07
356?.32008	8	64	3		74		4	7.02E-02	3	-4.6	1.10
3563.96676	2	2	1	1	3	3	0	2.41E-02	2	2.79E-02	1.04
3565.67221	4	6	3	3	7	3	4	3.20E-01	4	4.44E-01	1.05
3566.08033	-4	71	6		81		7	1.43E-01	4	-3.0	1.04
3566.7524	-9	7	2	6	8	2	7	4.04E-01	4	-5.3	1.06
3567.92?	-11	8	0		8		909	4.27E-01	4	1.8	1.10
3567.935	-61	8	1	8	9	1	9	1.43E-01	4	2.3	1.11
3568.0838	-2	5	1	5	5	3	2	1.44E-02	6	9.68E-03	1.04
3568.28936	-10	6	2	4	7	2	5	6.67E-01	3	2.2	1.08
3570.54048	3	6	3	4	7	3	5	1.06E-01	2	1.54E-01	1.04
3575.04985	8	3	03		4		22	3.45E-02	3	-2.0	1.08
3575.7[560	-13	11	29		11	4	8	2.00E-04	3	-4.6	1.05
3578.01480	2	4	2	2	4	4	1	4.31E-03	2	6.1 OE-03	1.05
3580.0648	-23	5	5	0	6	5	1	3.20E-02	2	0.5	1.08
3580.0944	-11	5	5	1	6	5	2	9.42E-02	3	-1.4	1.06
3581.04100	-2	9	0	9	9	2	8	3.80E-03	2	4.13E-03	1.04
3581.12846	10	10	1	9	103		8	3.33E-03	3	-7.3	1.03
3582.3690	0	91	9		91		8	1.15E-02	10	-7.7	1.04
3585.85649	1	5	23		54		2	3.20E-03	2	3.98E-03	1.07
3586.54285	-11	6	1	5	7	1	6	9.00E-01	3	-1.0	1.06
3586.60354	-4	5	3		2		633	1.18E-01	3	2.63E-01	1.01
3586.95527	3	6	2	5	7	2	6	2.18E-01	4	2.82E-01	1.07
3587.71888	-4	5	4	1	6	4	2	1.1 OE-01	8	-4.3	1.07
3588.54721	3	54	2		64		3	3.23E-01	4	-6.3	1.04
3588.71011	-7	7	0	7	8	0	8	2.83E-01	3	-1.6	1.07
3588.74955	-8	7	1	7	8	1	8	8.47E-01	3	-1.7	1.07
3589.59105	6	10	2	9	10		28	1.12E-03	2	1.24E-03	1.02
3589.7238	-2	10	2	8	104		7	1.72E-03	4	1.90E-03	1.01
3593.1973	-19	5	23		6		24	4.11E-01	3	-3.1	1.04
3593.4188	-16	4	1	4	4	3	1	1.80E-03	4	5.05E-03	1.05
3593.97453	5	6	24		64		3	1.23E-02	3	1.46E-02	1.03
3595.32593	-7	5	3	3	6	3	4	5.50E-01	2	8. 01E-01	1.03
3598.90941	11	92	7		94		6	1.43E-03	2	-9.1	1.02
3600.20538	2	7	2	5	7	4	4	3.96E-03	2	4.40E-03	1.04
3600.7596	0	9	1		8		937	3.13E-03	4	-6.9	1.03
3602.35380	6	8	2	6	8	4	5	8.25E-03	2	-9.6	1.03
3602.49027	-2	8	0	8	8	2	7	2.77E-02	4	-9,4	1.03
3605.2554	9	8	1	8	8	1	7	9.50E-03	10	-6.9	1.05
3606.9933	-17	5	1	4	6	1	5	5.60E-01	3	-0.5	1.07
3609.23363	-4	6	0	6	7	0	7	1.59E-00	2	-0.5	1.08
3609.33879	-11	6	1	6	7	1	7	5.21E-01	2	-1.8	1.07
3610.16944	-1	3	1		3		330	8.90E-03	4	1.18E-02	1.04
3612.56227	-8	5	2	4	6	2	5	1.33E-00	2	1.48E-00	1.07
3613.0566	-4	2	0	2	3	2	1	1.41E-01	3	-?.1	1.08
3614.50965	-6	4	4	0	5	4	1	3.66E-01	4	0.4	1.09
3614.70244	2	4	4	1	5	4	2	1.17E-01	3	-3.7	1.04
3615.81432	8	9	2	8	9	2	7	1.01E-02	3	-8.9	1.05
3617.65130	-3	4	3	1	5	3	2	8.46E-01	4	1. 11E-00	1.07
3618. 1868	- 2	8	1		7		836	2.33E-02	3	-6.2	1.04
3619.61182	-7	4	2	2	5	2	3	2.05E-00	3	-1.2	1.06
3621.18047	-5	4	3	2	5	3	3	3.03E-01	3	3.72E-01	1.07
3623.16565	-3	7	0	7	7	2	6	2.05E-02	3	-8.8	1.03
3628.3463	-19	4	1	3	5	1	4	2.75E-00	2	-1.1	1.07
3628.69824	-2	7	1	7	7	1	6	6.33E-02	3	-8.7	1.04
3629.4465	-24	5	0	5	6	0	6	8.69E-01	4	-1.5	1.07
3629.6434	-17	5	1	5	6	1	6	2.53[-00	2	-3.6	1.06
3632.2758	-66	7	1	6	7	3	5	1.68[-02	2	-1.8	1.09
3633.84343	-3	4	?	3	5	2	4	7.11[-01	2	-4.1	1.05
‘3635 .97s7	0	1	1	1	1	1	1	1.17E-06	?	6.9	0.88
3636.2100	16	12	4	9	124		8	4.11 E-05	3	4.72E-05	1.03
3636.5239	-7	10	1	10	9	3	7	8.20E-06	10	1.35E-05	0.77
3637.8057	7	10	3	8	10	3	7	8.64[-04	3	-8.6	1.09
3641.64288	5	31	2		33		1	9.23E-03	2	1.031.-02	1.04
3641.77836	4	6	1	5	6	3	4	7.83E-02	?	-6.0	1.05
3642.56579	-6	6	0	6	6	2	5	1.29E-01	2	-2.1	1.09
3643.02526	2	8	2	7	8	2	6	8.84E-03	3	9.99[-03	1.04
3643.32933	12	1	0	1	2	2	0	2.71E-02	3	-6.6	1.04
3645.28710	-2	4	1		3		432	6.65E-02	2	7.31E -02	1.03
3645.6086	-2	8	4	4	7	6	1	3.22E-05	2	-5,9	0.98
3645.93118	9	5	1	4	5	3	3	3.00E-02	3	-7,0	1.04
3646.46362	-2	3	3	0	4	3	1	3.42E-01	3	-3.6	1.05
3647.13830	1	3	2	1	4	2	2	8.74E-01	3	-1.7	1.06
3647.55293	-8	3	3	1	4	3	2	1.07E-00	5	0 . 6	1.09
3649.28298	-1	4	0	4	5	0	5	3.95E-00	2	1.2	1.10
3650.63601	2	4	1	4	5	1	5	1.27E-00	3	-0.3	1.10
3651.36505	-11	3	1	2	4	1	3	1.33E-00	2	1.7	1.09
3652.91230	1	6	1	6	6	1	5	4.7?[-02	5	-0.2	1.15
‘3653.8480	0	10	10	0	10	10	1	1.15E-04	2	7.7	0.93
3655.3325	-13	9	1	9	8	3	6	1.13E-04	2	1.41E-04	0.88
3655.4660	69	9	4	6	8	6	3	2.50E-05	6	-6.4	1.05
3656.30351	1	3	2	2	4	2	3	2.69E-00	3	-1.4	1.08
3659.93455	0	5	0	5	5	2	4	7.00E-02	3	-6.7	1.04
3661.8892	29	12	93		12	9	4	1.51E-05	4	-7.4	0.84
3662.78511	-6	13	5	9	13	5	8	2.07E-05	2	2.48E-05	0.96
3664.3916?	-3	11	4	8	11	4	7	5.55E-04	2	6.69 E-04	1.01
3664.5988	29	10	4	6	11	2	9	4.00E-06	10	2.80E-06	1.88
3664.674?7	1	7	3	5	6	5	2	2.84E-04	3	2.47E-04	1.05
‘3665.0972	55	11	93		11	9	2	7.93E-05	2	8.2	0.98
3665.95254	6	6	3	3	5	5	0	3.95E-04	2	1.66E-04	0.66
3666.08389	2	9	3	7	9	3	6	8.15E-03	2	9.95E-03	1.03
‘3668.0688	o	10	9	1	10	9	2	3.08E-04	2	4.0	0.95
3668.7/652	-6	3	0	3	4	0	4	1.68E-00	2	-0.6	1.08
3669.94288	-1	7	2	6	7	2	5	6.33E-02	?	7.81E-02	1.03
3670.74961	-4	3	1	3	4	1	4	4.84E-00	2	0.5	1.09
3671.4515	10	8	1	8	7	3	5	1.24E-04	2	-10.2	0.97
367?.0953	9	13	86		13	8	5	5.40[-06	10	-10.5	0.85
3673.4819	-23	1	0	4	7	9	6	3.30E-06	3	5.08E-06	0.80
3674. 26857	-4	4	0	4	4	2	3	3.00[-01	3	-3.6	1.07
3674.9578	-7	2	2	0	3	2	1	2.30[-00	2	-1. [)	1.07
3676.01950	-3	2	1	1	3	1	2	4.49E-00	2	0.1	1.08
3677.43838	-4	5	1	5	5	1	4	2.37E-01	2	2.74E-01	1.09
3678.6268	-3	11	84		11	8	3	1.34E -04	2	-1.7	0.93
3678.6367	-24	11	B	3	11	8	4	4.48E-05	2	-1.4	0.94
3679.43622	-9	2	2	1	3	2	2	7.81E-01	?	0.5	1.09
3681.42043	6	8	3	6	7	5	3	6.88E-05	2	-4.8	0.98
3681.5483	-14	10	8	2	10	8	3	7.37E-04	2	0.5	0.95
3683.93374	12	7	1		7		634	1.03E-03	2	-2. ?	1.02
3683.99024	38	12	5	8	12	5	7	3.93E -05	4	4.63E-05	0.97
3684.2431	13	9	8	2	9	8	1	2.73E-03	2	2.7	0.98
3684.52780	-10	3	0	3	3	2	2	9.90E-02	2	-1.6	1.09
3686.44890	-7	6	2	5	5	4	2	5.06E-04	2	4.14E-04	1.05
3688.45126	-8	2	0	2	3	0	3	5.65E -00	2	-0.8	1.07
3689.07537	-lo	12	7	5	12		76	6.11E-05	3	-5.0	0.93
3690.31136	-1	2	0	2	2	2	1	1.50E-01	3	-1.6	1.08
3690.90936	-4	8	3	6	8	3	5	8.78E -03	4	1.13E-02	1.08
3691.29811	-5	2	1	2	3	1	3	1.68E-00	2	0.3	1.08
3691.84993	2	6	1	6	5	3	3	6.85E-04	2	0.0	1.00
3692.04209	-2	4	1	4	3	3	1	3.87E-04	3	6.67E-04	1.02
3693.78999	1	6	2	5	6	2	4	3.40E -02	10	6.60E-02	1.01
3693.8365	23	9	3	7	8	5	4	1.17E-04	10	-7.9	1.01
3694.29272	14	10	7	4	10	7	3	4.83[-04	2	3.96E -04	1.20
3694.3531	-16	10	73		10	7	4	1.35E -03	7	1.19E-03	1.1?

Table 8 continued

observed position	o-c	upper J	upper K_a	upper K_c	lower J	lower K_a	lower K_c	observed strength	%s	(o-c)X*	R
3694.3787	-35	5	1	5	4	3	2	3.35E-03	10	2.78E-03	1.06
3695.02731	8	9	2	8	8	4	5	2.08E-04	2	2.36E-04	0.94
3695.62787	-4	7	2	6	6	4	3	1.09E-03	2	4.6	1.03
3696.272?	-2	12	6	7	12		66	3.11E-05	10	3.71E-05	0.88
3696.8872	29	9	7	3	9	7	2	4.58E-03	4	6.0	1.04
3696.8993	19	9	7	2	9	7	3	1.53E-03	4	6.3	1.04
3698.1929	-10	8	2	7	7	4	4	1.74E-04	5	1.94E-04	0.94
*3699.2685	-24	8	7	1	8	7	2	2.11E-02	3	1.88E-02	1.10
3699.4937	-44	11	5	7	11		56	6.09E-04	2	6.95E-04	0.99
3700.9759	-39	1	0	3	8	9	5	1.55E-05	5	1.81E -05	0.97
*3701.4309	-17	7	7	1	7	7	0	5.90E-02	10	6.9	1.04
3701.76440	-4	4	1	4	4	1	3	1.95E-01	3	1.72E-01	1.07
3701.80563	-6	1	10		21		1	1.15E-00	2	-3.6	1.05
3703.8147?	2	6	3	3	7	1	6	1.39E-03	3	9.33E-04	1.18
3705.1089	-15	11	6	5	11		66	1.63E-04	10	-5.2	0.99
3705.35657	6	10	6	5	10		64	7.11E-04	2	-1.0	1.02
3705.68071	2	80		8	72		5	6.42E-04	3	-6.9	1.01
3706.55178	2	10	64		10	6	5	1.98E-03	3	-7.8	0.95
3706.84138	-1	9	4	6	9	4	5	9.50E-03	6	1.21E-02	0.97
3707.83663	-8	5	2	3	4	4	0	3.59E-04	2	4.06E-04	1.02
3708.25824	-3	9	6	4	9	6	3	7.71E-03	2	-2.9	0.99
3708.59779	-2	9	6	3	9	6	4	2.60E-03	3	-1.6	1.01
3708.95995	3	64		2	72		5	9.00E-05	10	2.45E-04	1.08
3709.40224	-7	1	0	1	2	0	2	1.76[-00	3	1.1	1.09
3709.77840	-7	10	5	6	105		5	9.11E-04	4	1.02E-03	1.00
3710.7057	12	8	6	3	8	6	2	8.37E-03	2	-3.8	0.98
3710.78162	9	8	6	2	8	6	3	2.75E-02	4	5.4	1.08
371 0.91681	-10	7	3	5			734	7.43E-02	2	1.09E-01	1.06
3712.2045	-7	1	1	1	2	1	2	3.71E-00	2	-1.3	1.07
3712.867	-28	76		2	76		1	8.32E-02	6	8.0	1.09
3712.880	96	7	6	1	7	6	2	2.78E-02	6	8.3	1.10
3713.8815	-78	14	6	8	14		69	1.65E-06	5	3.19E-06	0.58
*3714.7948	-34	6	6	0	6	6	1	2.81E-01	5	2.1	1.03
3716.16017	-7	95		5	9	5	4	1.09E-02	2	-7.3	1.02
3718.96313	2	5	2	4	5	2	3	5.18E-01	2	5.0	1.03
3719.7621	-22	8	4	5	8	4	4	1.32E-02	7	-10.1	1.08
3720.13167	-9	8	5	4	8	5	3	1.23E-02	3	-7.3	1.00
3720.7017	-20	11	6	6	12	4	9	3.20E-06	10	2.49E-06	0.69
3721.8773	-12	8		5	3		854	3.72E-02	2	-5.6	1.01
3722.222?1	-3	3	1	3	3	1	2	1. 01E-00	2	3.9	1.08
3722.82650	-15	75		3	75		2	1.16E-01	8	-2.1	1.03
3723.27342	2	7	5	2	7	5	3	3.78E-02	3	-4.2	1.01
37?3.37897	4	105		5	10	5	6	2.57E-03	2	2.96E-03	0.99
3723.8792	-70	10	4	6	96		3	1.13E-05	2	2.09[-05	0.70
3724.89368	-1	6	5	2	6	5	1	1. 01E-01	3	-4.9	0.99
3724.97444	-7	6	5	1	6	5	2	3.18E-01	3	-0.2	1.04
3725.68587	1	6	3	4	6	3	3	6.71E-02	2	1.08E -01	1.02
3726.616	-97	5	5	1	5	5	0	7.70E-01	4	-0.5	1.02
3726.623	-167	5	5	0	5	5	1	2.57E-01	4	-0.4	1.03
3727.00609	16	4	3	1	5	1	4	2.43E-03	3	4.64E -03	1.03
3727.73751	-7	74		4	74		3	1.25E-01	7	1.40E-01	1.03
3750.00041	-1	7	0	7	6	2	4	8.19E-04	2	-0.7	1.05
3732.13433	-2	0	0	0	1	0	1	3.25E-00	3	0.5	1.08
3732.2834	-32	6	4	3	6	4	2	1.20E-01	10	-8.3	1.03
3752.5048	-1	8	3	5	7	5	2	2.95E-04	4	3.63E-04	0.84
3754.27265	0	4	23		4	2	2	4.00E-01	2	1.7	1.04
37s,.64486	-8	6	4	2	6	4	3	3.56E-01	2	-9.0	1.03'
3734.93076	-2	5	4	2	5	4	1	9.60E-01	4	-0.8	1.07,
3755.4065	-23	74		3	74		4	4.10[-02	10	4.59E-02	1.05
3735.44471	1	5	4	1	5	4	2	3.18E-01	2	-1.3	1.06
3735.49264	1	5	3	3	5	3	2	6.10E-01	4	8.66E-01	1.10
3756.68263	-2	4	4	1	4	4	0	7.31E-01	2	0.8	1.05
3756.74320	-1	4	4	0	4	4	1	2.17E-00	2	-0.3	1.04
3738.40066	-5	2	1	2	2	1	1	6.69E-01	4	5.3	1.12
3739.09454	-9	8	4	4	8	4	5	3.32E-02	2	4.25E-02	1.04
3740.35815	7	6	2	4	5	4	1	2.72E-03	3	-8.8	1.01
3740.7745	-15	4	2	2	5	0	5	4.50E-03	4	-2.5	1.09
3740.8652	10	3	2	1	4	0	4	4.75E-03	2	-1.1	1.11
3741.30612	-6	4	32		43		1	5.64E-01	4	6.81E-01	1.09
374?.3854	-4	4	1	3	3	3	0	9.13E-03	4	-2.0	1.06
3742.7860	29	5	4	1	6	2	4	5.26E-05	2	8.56E-05	1.23
3743.94635	-21	4	3	1	4	3	2	1.52E-00	4	2.03E-00	1.06
3744,18430	-5	5	3	2	5	3	3	1.13E -01	2	2. 84E-01	1.01
3744.50953	6	3	2	2	3	2	1	2.84E-00	5	5.6	1.11
3744.6511	-23	3	3	1	3	3	0	4.46E-00	4	1.9	1.08
3745.08665	-14	3	3	0	3	3	1	1.48E-00	4	1.5	1.07
3746.1322?	3	9	4	5	9	4	6	2.03E-03	3	3.80E-03	1.02
3748.96668	7	6	0	6	5	2	3	8.39E-03	4	1.1	1.06
3?49.32918	-1	1	1	1	1	1	0	4.30E-00	2	-0.4	1.07
3749.57387	2	2	2	1	2	?	0	1.95E-00	2	0.3	1.07
3750.35256	-1	2	2	0	3	0	3	1.60E-02	5	-5.8	1.05
37>2. ?1253	-7	2	2	0	2	2	1	5.85E-00	2	0.7	1.08
3754.66548	4	3	0	3	2	2	0	1.36E-02	2	3.1	1.09
37>4.80912	0	3	3	0	4	1	3	7.71E -04	2	8.64["-04	1.07
3756.61637	-5	3	2	1	3	2	2	9.23E-01	2	4.2	1.09
3759.05008	-3	6	3	3	6	3	4	2.676-01	3	3.15[-01	1.06
3759.84453	3	1	1	0	1	1	1	1.40E-00	3	- 2.8	1.04
3760.36371	-3	5	0	5	4	2	2	7.74E-03	5	-2.4	1.02
3762.47461	3	4	0	4	3	2	1	4.66E-02	2	0.5	1.05
3764.4558	5	6	2	4	7	0	7	2.88E-05	4	4.13E -05	1.56
3765.76026	-1	4	2	2	4	2	3	1.18E-00	2	2.2	1.05
3766.05675	0	5	1	4	4	3	1	7.05E -03	2	-2.8	1.03
3766.36970	-1	9	3	6	8	5	3	9.75E-05	2	-5.6	0.96
3769.88901	4	2	1	1	2	1	2	1.90E-00	2	-0.4	1.06
37X1.15237	-9	8	4	5	9	2	8	2.26E-05	2	8.19E-06	0.93
3771.2164	-26	6	5	1	7	3	4	3.60E-06	10	9.34E-08	0.74
3773.44271	-2	9	4	6	1	0	2	9	5.35E-06	3	2.54E-05	0.96
377.3.92682	-2	104		6	10	4	7	2.76E-03	5	0.8	1.04
3776.54619	0	7	5	3	8	3	6	3.08E-05	2	8.61E-06	0.92
37 78.34031	-1	4	4	0	5	2	3	9.34E-05	2	1.42E-04	1.08
3779.49311	0	1	0	1	0	0	0	1.11E-00	4	-1.7	1.06
3779.76218	-5	5	2	3	5	2	4	1.71E-01	3	7.1	1.08
3780.455	-77	6	4	3	7	2	6	4.80E-06	3	2.90E-07	0.93
3781.4621	-50	8	6	3	9	4	6	7.20E-06	10	3.14E-06	1.05
3784.58370	-4	3	1	2	3	1	3	3.33E-01	3	2.6	1.08
3787.42186	-1	7	1		6		633	3.78E-03	10	0.5	1.04
3787.9488	21	1	2	3	9	1	3	1	1	2	4.1 OE-06	8	3.45E-06	0.89
3788.64855	-10	1	1	4	8	1	2	2	1	1	1.35E-05	4	8.78E-06	0.95
3788.80963	2	11	4	7	11	4	8	2.31E-04	2	2. 01E-04	1.00
3789.5001	0	12	4	8	11	6	5	4.96E-06	5	5.55E-06	0.86
3793.82515	1	8	2	6	7	4	3	3.12[-03	2	-3.2	1.01
3796.43955	3	2	1	2	1	1	1	1.37[-00	2	-0.4	1.08
3797.78793	0	6	2	4	6	2	5	2. 01E-01	3	4.5	1.05
3798.5235	29	4	3	2	5	1	5	2.84E-05	3	8.56E-05	1.07
3801.41875	11	2	0	2	1	0	1	5.75E-00	2	0.5	1.08
3802.35062	26	11	2	9	10	4	6	3.08E-05	5	3.65E-05	0.89
3802.96564	0	4	1	3	4	1	4	5.22E-01	2	1.2	1.06
3804.8939	1	82		6	9		09	4.83E-05	2	3.17E-05	0.92
3805.23162	9	3	3	1	4	1	4	2.94E-04	2	3.69E-04	1.12
3806.05000	3	9	3	6	9	3	7	3.31E-03	2	*6.6*	*1.00*
3806.3531	-19	76		2	84		5	1.79E -05	2	7.53E-06	0.99
3807.01355	-4	2	1	1	1	1	0	3.92E-00	2	-0.2	1.07
3808.01870	1	92		7	84		4	5.24E-04	2	-3.3	1.00
3808.59505	4	12	4	8	12	4	9	1.44E-04	3	1.24E -04	0.98
3809.1108	-6	7	3	5	8	1	8	9.51E-05	3	2.54E-05	1.02
3810.8246	5	1	0	2	8	9	4	5	4.86E-04	3	-4.9	0.99
3815.64696	2	2	2	1	2	0	2	4.78E-02	2	7.7	1.16
3816.09162	-6	3	1	3	2	1	2	5.78E-00	2	0.2	1.08
3818.34118	5	7	2	5	7	2	6	2.63[-02	2	4.6	1.04
3818.9312	-2	11	38		10	5	5	2.80E-05	8	-5.9	0.93
3819.90390	-27	3	2	2	3	0	3	2.78[-01	3	3.2	1.10
38?0.75857	4	3	0	3	2	0	2	2.17E-00	2	0.2	1.07
38?1.76403	-17	3	2	2	?	2	1	2.65E-00	2	-1.0	1.09
38?3.27580	2	5	1	4	5	1	5	9.44[-02	2	3.6	1.07
3825.2618	-12	9	2	7	10		010	1.64E-05	3	1.08[-05	1.01
38?6.75401	5	3	2	1	2	2	0	8.45E-01	2	-4.0	1.04
3827.50433	2	10	3	7	10	3	8	2.90E-03	4	2.57E-03	1.04
3827.99955	9	4	2	3	4	0	4	9.50E -02	2	-0.6	1.07
3831.2640	16	12	3	9	11	5	6	2.74E-05	4	-1.4	1.00
3831.68608	-21	3	1	2	2	1	1	1.71E -00	2	-0.5	1.06
3834.98299	-3	4	1	4	3	1	3	1.84E-00	3	-4.6	1.07
3837.86922	-6	4	0	4	3	0	3	6.13E-00	2	1.4	1.08
3839.46?03	-4	8	2	6	8	2	7	3.07E-02	3	7.2	1.06
3839.92933	0	4	32		33		1	3.85E-01	3	4.24E-01	1.01
3840.12611	24	5	2	4	5	0	5	1.86E-01	2	2.12E-01	1.03
3841.04480	-8	4	3	1	3	3	0	1.14E-00	2	1.27E-00	1.05

Table 8 continued

observed position	o-c	upper J	upper K_a	upper K_c	lower J	lower K_a	lower KC	observed strength	%s	(o-c)	%R
3843.50462	-8	6	1	5	6	1	6	1.42E-01	3	1.3	1.04
3843.75074	-4	4	2	3	3	2	2	1.03E -00	3	-5.8	1.05
3844.8472	-3	5	3	3	5	1	4	5.50E-02	3	7.56E-02	1.05
3848.8375	-21	1	0	3 8	11	1	11	1.14E-05	3	7.49E-06	1.02
3849.05949	0	7	3	5	7	1	6	3.62E-02	3	4.37E-02	1.07
384'9.6520	34	4	3	2	4	1	3	1.53E-02	6	1.85E-02	1.07
3849.86689	-2	6	2	5	6	0	6	3.45E-02	4	4.19E-02	1.09
3850.1992	49	14	4	10	14	4	11	5.00E-06	10	11.7	0.93
3852.05752	-5	5	1	5	4	1	4	4.75E-00	3	-1.0	1.07
3853.96617	-7	4	2	2	3	2	1	3.06[-00	2	-3,4	1.03
3854.09054	-1	5	0	5	4	0	4	1.65E-00	3	1.5	1.08
3854 .43822	-1	4	1	3	3	1	2	4.80E-00	3	2.1	1.08
3856.70411	-1	3	3	1	3	1	2	2.24E-02	3	-2.1	1.06
3857.16419	-9	5	4	2	4	4	1	4.60E-01	3	1.5	1.04
3857.42489	-4	5	4	1	4	4	0	1.53E-01	3	1.4	1.03
3858.17675	5	8	3	6	8	1	7	6.60E-03	2	-9.4	1.04
3859.40888	5	9	?	7	9	2	8	3.60E-03	3	5.7	1.04
3861.78775	-11	5	3	3	4	3	2	1.16E-00	2	1.39E-00	1.04
3862.49151	-12	7	1	6	7	1	7	2.40E-02	2	7.3	1.10
3863.31982	-5	2	2	0	1	0	1	1.13E-01	2	0.1	1.07
3864,30996	-5	5	3	2	4	3	1	2.81E-01	2	4.58E-01	.05
3865.11147	-2	5	2	4	4	2	3	2.32E-00	3	2.79E-00	.05
3866.10922	4	7	2	6	7	0	7	6.30E-02	5	-1.5	.04
3866.75920	10	1	0	4 7	1	0	2 8	4.50E-04	3	-7.6	.01
:5848.62621	1	8	4	5	8	2	6	1.83E-03	2	2.1 0E-03	.00
:5869.19255	-5	6	1	6	5	1	5	1.16E-00	3	1.0	.07
:5870.12933	-4	6	0	6	5	0	5	3.55E-00	3	2.4	.09
3871.45334	1	6	5	2	5	5	1	4.26E-02	2	4.1	.04
3871.49690	-7	6	5	1	5	5	0	1.25E-01	3	1.8	.02
3872.75552	13	1	1	4 8	1	1	2 9	4.88E-04	2	-1.1	.01
3874.40219	-4	5	1	4	4	1	3	1.17E-00	2	1.4	1.06
3876.56499	8	7	4	4	7	2	5	7.67E-03	2	8.73E-03	1.00
3877.42595	6	1	0	2 8	1	0	2 9	3.65E-03	3	7.1	1.04
3877.8592	30	1	2	3 1	0	1	3 1 3	2.30E-06	10	1.62E-06	1.04
3878.8077	42	1	2	5 8	1	2	3 9	1.34E-05	3	-8.2	0.96
3879.94944	-6	6	4	3	5	4	2	1.43E-01	2	-3.8	1.00
3880.1401	-2	8	1	7	8	1	8	3.24E-02	3	9.0	1.11
3880.19146	4	5	2	3	4	2	2	8.75E-01	3	1.8	1.07
3880.35470	-2	6	2	5	5	2	4	5.41E-01	2	6.47E-01	1.04
3881.02852	-2	6	4	2	5	4	1	4.42E-01	3	-0.5	1.04
3881,6554	-7	1	2	4 9 1 2 2 1 0				4.84E-05	2	2.9	1.00
3881.87529	2	8	2	7	8	0	8	9.83E-03	2	2.2	1.05
3882.93702	2	1	0	3 8	1	0	1 9	1.11E-03	2	5.3	1.05
3883.26659	-4	6	3	4	5	3	3	2.83E-01	3	3.48E-01	1.04
3884.0037	-16	7	6	2	6	6	1	2.85E-02	5	9.8	1.10
3884.011	53	7	6	1	6	6	0	9.50E-03	5	9.9	1.09
3885.2659	-18	1	1	5 7	1	1	3 8	1.05E-04	4	1.21E-04	0.94
3886.07711	-24	7	0	7	6	0	6	7.30E-01	2	-0.0	1.06
3807.29052	1	6	4	3	6	2	4	2.78E-03	2	3.07E-03	1.03
3888.02770	0	3	3	0	3	1	3	2.50E-03	3	-2.8	1.07
3891.29955	0	6	1	5	5	1	4	2.20E-00	2	0.7	1.05
3892.1447	4	1	3	4 1 0 1 3 2 1 1				3.50E-05	4	-0.4	0.92
3892.82703	-2	3	2	1	2	0	2	7.30E-02	4	-2.9	1.03
3893.66732	-3	1	1	2 9 1 1	2	1	0	3.72E-04	3	7.2	1.03
3894.06345	6	7	5	3	6	5	2	9.70E-02	6	-10.5	0.91
3894.2872	-21	7	5	2	6	5	1	3.45E-02	3	-4.4	0.97
*3895.1447	0	8	7	1	7	7	0	5.63E-03	2	0.8	0.97
3896.41966	-6	1	1	3 9 1 1	1	1	0	1.06E-03	3	5.8	1.03
3896.78093	6	9	1	8	9	1	9	4.07E-03	4	3.0	1.04
3897.56755	-3	9	2	8	9	0	9	1.24E-02	3	5.7	1.07
3898.7616	21	5	4	2	5	2	3	6.39E-03	2	7.22E-03	1.00
3899.21671	-3	6	3	3	5	3	2	6.85E-01	2	1. 01E-00	1.05
3899.44135	-1	7	2	6	6	2	5	1.14E-00	2	-1.6	1.04
3901.6664	-17	8	1	8	7	1	7	4.20E-01	3	2.0	1.08
3901.84695	-3	8	0	8	7	0	7	1.26E-00	2	1.9	1.08
3902.24993	0	7	4	4	6	4	3	2.86E-01	2	-3.8	1.02
3904.18862	-7	6	2	4	5	2	3	1.62E-00	4	-2.1	1.01
3904.29472	-13	7	3	5	6	3	4	5.24E-01	2	6.29[-01	1.00
*3905.0054	53	9	8	2	8	8	1	7.18E-04	2	0.2	0.93
3905.1263	9	6	4	2	7	0	7	2.63E -05	4	1.15E-05	1.10
3905.37036	-9	7	4	3	6	4	2	9.30E-02	4	-5.1	1.02
3906.0647	-32	7	1	6	6	1	5	4.1 0E-01	5	0.1	1.04
3906.1574	-31	8	6	3	7	6	2	6.90E-03	3	2.3	1.01
3906.1983	-18	8	6	2	7	6	1	2.08E-02	2	2.8	1.01
3908.58147	-1	12	2	10	12	2	11	3.04E-04	2	5.4	1.00
3909.03739	3	4	4	1	4	2	2	1.08E-03	2	-8.6	1.03
3909.91418	0	12	3	10	12	1	11	1. 01E-04	4	7.0	1.02
3910.5387	21	9	5	5	9	3	6	4.21[-04	2	4.75E-04	1.00
3912.70679	1	1	0	1 9 1	0	1	1 0	4.34E-03	2	6.7	1.00
3913.02713	-10	1	0	2 9 1	0	0	1 0	1.48E-03	2	2.8	1.06
'3913.8546	9	1	0	9 1	9	9	0	7.44E-05	4	2.1	0.91
3914.4141	6	15	4	12	15	2	13	1.85E-06	10	1.55E-06	1.03
3916.32875	-4	8	2	7	7	2	6	2.1 0E-01	3	3.6	1.07
3916.7847	2	9	7	3	8	7	2	2.95E-03	2	0.3	0.97
3916.7926	82	9	7	2	8	7	1	9.83E-04	2	0.3	0.96
3917.2086	-9	8	5	3	7	5	2	6.00E-02	3	-7.2	0.95
3917.28587	-6	91		9	81		8	6.50E-01	4	3.7	1.09
3917.36263	-16	9	0	9	8	0	8	2.18E-01	3	4.3	1.10
3920.0886	-15	8	1	7	7	1	6	6.50E -01	3	3.9	1.07
3921.52710	6	5	3	2	5	1	5	5.84E-04	3	1.62[-03	1.01
'3921 .7830	1	11	10	2	10	10	1	6.1 0E-06	2	3.3	0.88
3922.5387	12	13	2	11	13	2	12	2.65E-05	2	8.3	1.01
3923. 16440	5	13	3	11	13	1	12	8.00E-05	2	10. 0	1.02
3923,7937	-26	8	4	5	7	4	4	4.99E-02	3	-5.4	1.02
3924.3727	-9	8	3	6	7	3	5	9.80E-02	3	-9.2	1.01
3924.48877	7	4	4	0	4	2	3	2.38E-03	3	2.69E -03	1.01
3925.13435	6	7	3	4	6	3	3	1.86E-01	5	-5.6	1.04
3925.17576	-11	7	2	5	6	2	4	2.99E-01	2	1.6	1.04
3925.8857	1	8	5	4	8	3	5	2.02E-04	2	2.33E-04	1.00
'3926.027	-26	1	0	8 2	9	8	1	4.60E-04	5	2.8	0.95
3928.02987	1	9	6	4	8	6	3	1.06E-02	2	-1.4	0.98
3928.08758	-1	1	1	1 1 0	1	1	1 1	5.12E-04	4	6.1	1.04
3928.20142	4	9	6	3	8	6	2	3.58E-03	2	-2.3	0.99
3929.36088	-6	4	2	2	3	0	3	1.96E-01	3	-0.9	1.04
3930.56606	3	8	4	4	7	4	3	1.38E-01	2	1.54E-01	1.03
3932.13541	-15	9	?		8	8	2 7	2.90E-01	3	2.1	1.04
3932.5454	16	10	1	10	9	1	9	9.80 E-02	5	2.5	1.08
3932.58070	0	10	0	10	9	0	9	2.80E-01	6	-2.4	1.03
3934.10055	-2	9	1	8	8	1	7	9. 10E-02	5	-5.2	0.97
'3934.2620	-34	11	9	3	10	9	2	3.50E-05	5	4.04E-05	0.7/
3935.13027	2	3	3	0	2	1	1	1.33E-02	4	0.1	1.05
3935.762	-307	1	4	2 1 2 1	4	2	1 3	1.80E-05	10	5.5	0.96
3936.0358	-30	1	4	3 1 2 1	4	1	1 3	6.22E-06	4	9.9	1.00
3938.07778	-19	1	0	7 4	9	7	3	4.77E-04	2	2.9	1.00
3938.11055	-8	10	7	3	9	7	2	1.33E-03	2	-4.4	0.92
3938.2908	-9	9	5	5	8	5	4	2.98E-02	3	-2.6	1.00
3938.45846	7	64		2	62		5	2.35[-03	3	2.92E-03	0.99
3940.30553	-1	7	5	3	7	3	4	7.12E -04	2	8.50E-04	0.98
3940.58899	3	9	5	4	8	5	3	9.80[-03	4	-3.2	1.00
'3941.5300	-1oo	12	10	2	11	10	1	3.06E-06	4	5.3	0.90
3941.6351	32	8	4	4	9	0	9	1.73E-05	3	8.97E -06	1.20
3942.65235	-12	8	?		6	7	2 5	4.21E-01	4	3.9	1.05
3942.88695	-13	9	3	7	8	3	6	1.33E-01	3	-7.5	0.97
3943.0087	-18	12	1	11	12	1	12	4.40E-04	6	-0.1	0.97
3943.0715	24	12	2	11	12	0	12	1.40E-04	5	-4.5	0.93
3944.36797	-30	9	4	6	8	4	5	6.61E-02	2	-7.4	1.01
3946.6083	9	11	8	4	10	8	3	1.37E-04	4	-2.8	0.90
3946.613	-82	11	83		10	8	2	4.58E -05	4	-2.5	0.91
3947.1742	6	10	2	9	92		8	4.00E-02	10	0.7	1.06
3947.4631	-21	11	1	11	10	1	10	1.32E-01	4	1.19E-01	1.17
3947.477	-135	1	1	0 1 1 1	0	0	1 0	4.43E-02	4	3.95E-02	1.18
3948.17703	-11	1	0	1 9	9	1	8	1.24E-01	5	3.3	1.05
3948.4713	-1	15	3	13	15	1	14	3.27E-06	4	-9.4	0.81
3949.57283	0	1	0	6 5	9	6	4	1.46E-03	3	-3.6	0.96
3949.9837	0	8	3	5	7	3	4	2.95E-01	2	3.6	1.06
3950.1417[	-4	1	0	6 4	9	6	3	4.22E-03	3	-7.0	0.93
3950.57352	-4	3	3	1	2	1	2	2.41[-02	3	-0.8	1.03
3951.97760	9	6	5	2	6	3	3	2.19E-04	2	2.73E-04	0.96
3953.09761	-6	4	3	1	3	1	2	7.50E -02	2	9.02E-02	1.02
3953.5424	-10	7	4	3	7	2	6	3.33E -04	2	4.44E-04	1.01
3954.158	-15	12	93		11	9	2	1.33[-05	10	-11.6	0.79
3955.24158	0	9	4	5	8	4	4	1.59E-02	2	2.25E-02	1.01
3956.88258	1	9	2	7	8	2	6	5.80E -02	4	5.6	1.05
3957.5144	73	13	1	12	13	1	13	4.48E-05	2	9.2	1.06
3957.5344	0	1	3	2 1 2 1	3	0	1 3	1.34E-04	2	9.0	1.06
3959.02056	-4	11	7	5	10		74	4.93E-04	2	-5.9	0.91

Table 8 continued

observed position	o-c	upper J	upper K_a	upper Kc	lower J	lower K_a	lower Kc	observed strength	%s	(o-c)%ᵃR
3959.14182	2	1	1	7	4	1	0	7	3	1.62E-04 2 -7.2 0.9(
3959.50315	3	1	0	5	6	9	5	5		3.81E-03 2 -6.6 0.97
3959.72385	-1	1	0	3	8	9	3	7		1.86E-02 3 -0.5 1.01
3959.88126	3	5	5	1		5	3	2		3.88E-04 2 4.97E-04 0.95
*3960.701	99	13	10	4		12	10	3		9.60E-07 10 0.5 0.85
3960.77651	2	6	3	3		6	1	6		1.26E-03 2 1.45E-03 1.1 C
3961.71241	-13	11	2	10		1	0	2	9	4.98E-02 3 9.4 1.12
*3962.040	-199	12	0	12		11	0	11		6.60E-02 4 5.92E-02 1.16
3962.18706	-2	11	1	10		1	0	1	9	1.65E-02 4 8.5 1.11
3963.84268	-4	1	0	4	7	9	4	6		8.51E-03 2 -7.4 0.95
3964.3656	32	1	0	6	5	1	0	4	6	5.83E-06 4 7.46E-06 0.93
3964.59460	0	6	5	1		6	3	4		5.1 0E-04 2 6.70E-04 0.94
3964.72956	-6	5	5	0		5	3	3		1.21E-04 4 1.54E-04 0.97
3964.80043	-2	1	0	5	5	9	5	4		1.11 E-02 2 -8.1 0.97
3966.2257	-12	7	5	2		7	3	5		1.37E-04 2 1.82E-04 0.94
3966.7496	-18	1	2	8	5	1	1	8	4	1.54E-05 2 -2.2 0.91
3966.7758	-22	1	2	8	4	1	1	8	3	4.62E-05 2 -2.2 0.91
3969.1385	6	1	0	2	8	9	2	7		6.48E-02 6 6.5 1.05
3970.68035	6	1	1	6	6	1	0	6	5	1.54E-03 2 -4.5 0.96
3970.92830	7	8	5	3		8	3	6		2.15E-04 2 2.94E-04 0.92
3971.6275	11	14	2	13		14	0	14		1.07E-05 2 4.0 0.98
3971.6563	4	14	1	13		14	1	14		3.15E-05 3 2.1 0.97
3972.1234	-24	9	3	6		8	3	5		3.70E-02 8 -3.8 0.95
3972.24483	-17	1	1	6	5	1	0	6	4	4.96[-04 3 -8.1 0.93
3972.65547	-2	5	3	2		4	1	3		2.40E-02 2 3.97E-02 0.9S
3973.91817	-6	5	2	3		4	0	4		3.52E-02 4 -0.6 1.03
3975.13933	1	1	1	3	9	1	0	3	8	2.12E-02 2 7.8 1.07
3975.7795	-19	12	2	11		11	2	10		5.40E-03 4 4.8 1.05
3976.00866	-4	12	1	11		11	1	10		1.66E-02 2 7.2 1.08
3976.2031	14	8	4	4		8	2	7		2.06E-04 2 3.66E-04 0.95
*3976.2639	74	13	1	13		12	1	12		2.40E-02 4 2. 01E-02 1.24
3979.4062	26	9	6	4		9	4	5		2.63E-05 4 3.76E-05 0.90
3979.5942	-7	12	7	6		1	1	7	5	5.03E-05 2 -10.0 0.85
3979.77063	0	1	1	5	7	1	0	5	6	3.94E-03 4 -5.6 0.98
3979.96762	22	1	2	7	5	11	7	4		1.63E-04 4 -1.6 0.96
3980.2692	-2	9	5	4		9	3	7		2.52E-05 2 3.64E-05 0.92
3980.83483	-5	1	1	2	9	1	0	2	8	7.11E-03 4 3.7 1.02
3982.0636	-12	1	1	4	8	1	0	4	7	8.88E-03 2 -4.4 0.98
3982.87038	14	4	3	2		3	1	3		1.05E-02 4 1.22E -02 1.01
3984.2262	21	15	2	14		15	0	15		5.40E-06 4 7. 11E-06 1.01
3985.1324	75	15	1	14		15	1	15		2.74E-06 10 2.37E-06 1.08
3986.4447	-1	1	3	8	6	1	2	8	5	1.21E-05 2 -9.9 0.85
3986.5267	0	1	3	8	5	1	2	8	4	4.20E-06 5 -5.7 0.88
3989.56902	7	13	1	12		12	1	11		1.62E-03 2 1.1 1.01
3989.82645	-6	1	1	5	6	1	0	5	5	1.15E-03 2 1.34E-03 0.93
3990.2724	-14	14	0	14		13	0	13		4.70E-03 10 0.9 1.07
3990.572?	21	8	6	3		8	4	4		1.20E-05 10 1.79E-05 0.92
3990.71351	0	1	0	3	7	9	3	6		4.00E-02 3 -0.2 0.97
3991.17670	-?	1	2	6	7	1	1	6	6	1.49E-04 2 1.64E-04 0.91
3992.66825	3	12	2	10		1	1	2	9	6.70E-03 3 5.3 1.02
3994.84305	-6	12	6	6		1	1	6	5	4.30E-04 3 4.87E-04 0.89
3995.0273	-27	1	0	4	6	9	4	5		1.82E-02 4 2.52E-02 0.98
3995.96945	-5	1	0	5	5	1	0	3	8	1.55E-05 3 2.62E-05 0.89
3997.82504	35	7	6	2		7	4	3		3.22E-05 2 6.05E-05 0.78
3998.83305	5	1	2	4	9	1	1	4	8	9.12E-04 2 -1.5 0.97
3998.89018	-15	1	2	5	8	1	1	5	7	3.67E-04 2 4.13E-04 0.91
3998.9587	30	9	6	3		9	4	6		3.60E-06 10 7.96E-06 0.64
3999.6846?	13	8	6	2		8	4	5		2.40E-05 3 4.33E-05 0.81
3999.74858	7	1	3	7	7	1	2	7	6	3.95E-05 3 4.51E-05 0.87
4000.2042	15	7	3	4		7	1	7		8.90E-05 2 3.2 1.02
4000.7509	10	1	3	7	6	1	2	7	5	1.30E-05 10 1.50E-05 0.86
4002.0724	-1	6	6	1		6	4	2		6.85E-06 3 1.43E-05 0.75
4002.7682	-11	14	2	13		13	2	12		4.62E-04 3 2.3 1.01
4002.8612	-3	14	1	13		13	1	12		1.38E-03 2 1.8 1.01
4002.96797	-4	13	3	11		12	3	10		1.83E-03 2 3.2 0.99
4003.1?85	18	6	6	0		6	4	3		2.09E-05 3 4.23E-05 0.77
*4003.5893	28	15	1	15		14	1	14		1.81E-03 4 3.9 1.07
4004.70534	-5	13	2	11		12	2	10		6.29E-04 2 5.1 1.01
4005.48730	9	1	1	3	8	1	0	3	7	4.21E-03 2 3.5 0.99
4005.6792	0	14	8	7		1	3	8	6	8. 86E-07 10 1.08E-06 0.76
4005.9188	0	1	4	8	6	1	3	8	5	2.60E-06 7 3.23E-06 0.74
4006.6311	-62	9	4	5		9	2	8		3.51E-06 10 1.91E-05 0.78
4008.57135	1	6	3	3		5	1	4		6.26E-02 3 9.77E-02 1.06
4010.83459	-7	13	68	12	6	7				1.18E-04 2 1.31E-04 0.91
4012.69465	-1	4	4	0	3	2	1			1.47E -02 5 1.4 1.02
4014. 07811	o	1	3	4	1	0	1	2	4	9 7.42E-04 2 -0.2 0.96
4014.45252	-6	12	5	7	11	5	6			9.12E-04 2 1.17E-03 0.94
4014.6134	-18	1	5	2	1	4	1	4	2	1 3 2.52E -04 2 3.48[-04 1.06
4015.38622	-2	11	4	7	10	4	6			2.62E-03 2 -1.4 1.00
4015.54974	-12	1	5	1	1	4	1	4	1	1 3 1.19E-04 2 2.6 1.02
4015.85533	0	1	4	3	1	2	1	3	3	1 1 1.57E-04 2 2.5 0.98
4016.81427	-1	14	2	12	13	2	11			4.63E-04 2 0.1 0.95
4017.03585	7	12	3	9	11	3	8			3.39[-03 3 1.7 0.95
4018.2400	6	13	6	7	12	6	6			3.82E-05 2 4.27E -05 0.91
4018.51545	-4	4	4	1	3	2	2			4.44E-03 4 -1.8 0.99
4019.46646	8	5	3	3	4	1	4			3.00E-02 4 3.36E-02 1.09
4019.9?42	5	5	4	2	5	0	5			3.41E-05 4 6.02E-05 0.87
40?1.6387	5	14	7	7	13	76				8.60E-06 10 1.07E-05 0.80
4024.4186	0	15	88	14	8	7				6. 11E-07 10 -10.7 0.82
4025.3513	-15	6	2	4	5	0	5			4.60E-02 5 0.3 1.02
4026.7762	4	1	3	3	1	0	1	2	3	9 2.87E-04 3 3.4 0.96
4027.9372	16	14	4	11	13	4	10			6.05E-05 3 1.3 0.95
4027.9877	0	15	2	13	14	2	12			3.21E-05 3 3.62E-05 1.05
4028.1788	0	1	6	1	1	5	1	5	1	1 4 7.90E-05 6 -2.9 0.95
4028.25661	0	15	3	13	14	3	12			1.14E-04 2 5.3 0.99
4029.4284	9	14	6	9	13	6	8			1.05E-05 10 3.7 1.03
'4029.5240	0	17	1	17	16	1	16			1.07E-04 2 3.2 1.06
4029.77970	6	5	4	1	4	2	2			8.38E-03 3 -0.5 0.98
4033.2590	-11	1	4	5	1	0	1	3	5	9 2.37E-05 2 -5.7 0.91
4034.53824	-8	124	8	11	4	7				2.22E-03 2 2.7 0.95
4035.35121	8	135	8	12	5	7				5.15[. -05 3 9.80E-05 0.91
4036.35793	0	1	4	3	1	1	1	3	3	1 0 1.81["-04 2 -6.1 0.90
4038.3814	0	15	7	9	14	7	8			1.77E-06 4 2.23E-06 0.82
4040.368	0	17	2	16	16	2	15			1.75E-05 2 0.9 0.98
4040.375	0	17	1	16	16	1	15			5.83E -06 2 0.9 0.97
4040.6646	-2	1	5	4	1	2	1	4	4	1 1 3.95E-05 3 1.1 0.92
'4041 .9231	0	1	8	0	1	8	1	7	0	1 7 2.24E -05 3 1.6 1.04
4042.3 0390	16	14	68	13	6	7				2.46E -05 2 2.94E-05 0.87
4043.77745	1	7	3	4	6	1	5			1.49E-02 6 1.72E-02 1.01
4044.85916	1	6	4	2	5	2	3			3.03E -02 2 1.4 0.99
4044.90985	8	5	4	2	4	2	3			2.00E-02 2 -3.6 0.95
4045.2764	0	1	5	3	1	2	1	4	3	1 1 1.34E -05 5 -1.0 0.91
4048.17{6	-5	8	3	5	8	1	8			2.55E-05 3 -2.8 0.99
4048.33872	0	15	5	11	14	5	10			1.46E-05 2 -6.7 0.86
4050.3682	11	13	4	9	12	4	8			1.78[-04 3 4.9 0.94
4051.5660	0	17	3	15	16	3	14			4.80E-06 10 5.4 0.97
4051.7434	0	17	2	15	16	2	14			1.55E-06 10 2.1 0.94
4052.522	0	16	4	13	15	4	12			2.70E-06 7 4.7 0.94
'4053.9412	0	19	1	19	18	1	18			4.40E-06 4 2.8 1.05
4055.1422	0	16	3	13	15	3	12			8.20E -06 8 3.6 0.92
4060.37727	3	7	4	3	6	2	4			9.29E-03 4 2.3 0.98
4060.6094	8	6	3	4	5	1	5			6.95E-03 10 7.66E-03 1.05
4062.4290	-11	1	4	4	1	0	1	3	4	9 1. 11E-04 2 4.8 0.92
4063.765	0	17	4	14	16	4	13			1.33E-06 10 -4.8 0.84
4071.3550	0	1	5	4	1	1	1	4	4	1 0 7.60E-06 10 6.62E-06 0.99
4072.75	-120	7	4	4	7	0	7			9.00E-08 UL. 6.76E-06 0.06
4075.85523	-2	6	4	3	5	2	4			6.70E-03 5 1.2 0.98
4076.2589	-28	14	5	9	13	5	8			5.64E -05 2 6.41E-05 0.90
4078.5091	0	1	6	4	1	2	1	5	4	1 1 3.27E-06 5 -4.3 0.81
4079.39345	9	8	4	4	7	2	5			1.91E-02 2 2.6 0.97
4081.25281	1	7	2	5	6	0	6			6.18E-03 4 -0.4 0.99
4084.85534	6	5	5	0	4	3	1			1.60E-03 2 -3.2 0.91
4085.6-345	0	9	9	1	9	7	2			8.47E-07 10 5.77E-07 1.06
4086.17644	-2	5	5	1	4	3	2			4.69E-03 3 -4.5 0.91
4086.5085	0	1	6	6	1	0	1	5	6	9 7.90E-07 10 1.04E-06 1.03
4088.0895	13	4	4	0	3	0	3			1.92E -04 4 -0.8 1.00
4088.12631	3	8	3	5	7	1	6			1.83E-02 2 -8.2 0.98
4103.8846	0	16	5	11	15	5	10			2.00E-06 10 1.6 0.82
4104.10542	-4	9	4	5	8	2	6			2.93E-03 2 -2.9 0.95
4104.76123	0	6	5	1	5	3	2			7. 01E-03 3 -1.7 0.90
4106.02127	4	7	3	5	6	1	6			1.19E-02 2 -8.4 0.96
4106.06338	0	7	4	4	6	2	5			1.39[-02 2 -1.0 0.93
4109.55832	4	6	5	2	5	3	3			2.26E -03 2 -1.9 0.90
4114.3785	43	9	5	5	9	1	8			2.60E-06 7 3.63E-07 1.69
4121.37112	-11	7	5	2	6	3	3			2.37E-03 3 4.6 0.94
4123.5067	25	5	4	1	4	0	4			1.66E-04 2 -7.8 0.90

Table 8 continued

observed position	o - c	upper J	upper K_a	upper Kc	lower J	lower K_a	lower K_c	observed strength	%s	(o-c)%[a]	R
4133.68342	-6	7	5	3	6	3	4	6.30E-03	2	0.6	0.89
4134.68756	-2	8	5	3	7	3	4	5.37E-03	2	4.0	0.90
4138.81884	8	8	2	6	7	0	7	7.56E-03	4	0.6	0.97
4139.39092	-2	9	3	6	8	1	7	2.06E-03	2	-5.3	0.95
4141.92974	1	8	4	5	?	2	6	2.71E-03	2	3.4	0.94
4146.34287	-2	9	5	4	8	3	5	1.20E-03	2	1.1 0E-03	0.92
4147.9082	-22	9	4	6	9	0	9	4.80E-06	7	9.88E-07	1.94
4149.51192	0	6	6	0	5	4	1	1.29E-03	2	-5.6	0.81
4149.7582	1	6	6	1	5	4	2	4.39E-04	2	-3.6	0.83
4153.34148	2	1	0	4	6	9	2	7	1.36E-03	2	3.21E-03	0.88
4154.58785	-11	8	3	6	7	1	7	2.12E-03	2	1.1	0.96
4154.991	205	11	6	6	11	2	9	1.73E-06	10	6.54E-07	1.84
4159.17875	5	1	0	5	5	9	3	6	1.89E-03	2	7.9	0.89
4159.34906	-2	8	5	4	7	3	5	1.46E-03	2	1.7	0.87
4166.02205	14	6	4	2	5	0	5	5.75E-04	2	-3.7	0.90
4166.3218	82	6	5	1	6	1	6	3.00E-06	3	9.70E-07	1.81
4171.28862	-6	7	6	1	6	4	2	5.64E-04	2	-2.8	0.81
4172.33693	-11	7	6	2	6	4	3	1.68E-03	2	-2.8	0.80
4173.642	40	11	5	7	11	1	10	2.20E-06	10	9.50E-07	1.57
4176.38253	3	11	5	6	10	3	7	2.73E-04	3	2.24E-04	0.89
4181.47663	3	9	4	6	8	2	7	3.81E-03	2	4.5	0.91
4187.34171	1	9	5	5	8	3	6	2.48E-03	2	4.8	0.87
4191.15575	-14	8	6	2	7	4	3	1.46E-03	3	0.6	0.81
4193.2018	104	5	5	0	4	1	3	4.36E-06	6	5.79E-06	0.69
4193.87075	-1	11	4	7	10	2	8	2.11E-04	2	2.99E-04	0.86
4194.55305	-4	1	0	3	7	9	1	8	1.93E-03	2	-4.6	0.91
4194.60363	0	8	6	3	7	4	4	4.83E -04	2	1.4	0.81
4195.75054	-6	9	2	7	8	0	8	1.02E-03	2	2.0	0.94
4200.22452	0	12	5	7	11	38		2.64E-04	3	2.34E-04	0.87
4204. 84040	2	9	3	7	8	1	8	2.84E-03	2	3.0	0.93
42 07.6130	?9	7	7	0	6	5	1	8.98E-05	2	9.99E-05	0.68
4207.6466	1	7	7	1	6	5	2	2.64E-04	2	3.00E -04	0.66
4208.0678	1	9	6	3	8	4	4	3.20E-04	3	2.2	0.80
4214.1161	?7	6	5	1	5	1	4	7.09E-05	3	8.20E-05	0.74
4216.4547	53	7	4	3	6	0	6	1.13E-04	2	-8.0	0.83
4216.93279	-3	9	6	4	8	4	5	9.46E-04	2	4.1	0.81
4218.2527	1	1	0	5	6	9	3	7	3.83E-04	3	7.1	0.86
4221.2894	- 8	1	0	6	4	9	4	5	5.18E-04	3	2.9	0.78
4224.342?4	-1	10	4	7	9	2	8	5.05E-04	2	3.6	0.87
4230.12354	6	8	7	1	7	5	2	3.23E-04	2	-6.7	0.67
4230.1679	-65	13	5	8	123	9		2.40E-05	3	1.94E-05	0.99
4230.3114	0	8	7	2	7	5	3	1.08E-04	3	-6.4	0.68
4231.2539	13	11	6	5	10	4	6	8.05E-05	3	4.6	0.78
4232.8820	47	8	5	3	8	1	8	4.80E-06	7	2.33E-06	1.57
4236.7925	-32	8	6	2	8	2	7	4.05E-06	3	2.11E-06	1.41
4239.8814	7	12	66		11	4	7	1.00E-04	2	8.4	0.80
4239.93337	-5	1	0	6	5	9	4	6	1.59E-04	3	1.8	0.76
4240.01445	7	752		6	1		5	4.93E-05	2	-9.5	0.74
4242.88?06	0	124	8		11	2	9	1.89E-04	3	2.21E-04	0.86
4243.8558	82	5	5	1	4	1	4	1.36E-06	3	1.88E-06	0.54
4250.0893	-7	13	6	7	12	4	8	1.13E-05	7	8.9	0.78
4250.61852	-6	11	38		10	1	9	1.99E-04	3	-3.3	0.87
4250.89157	-1	1	0	2	8	9	0	9	1.17E-03	3	0.9	0.91
4251.5708	-16	9	7	2	8	5	3	8.47E-05	2	-2.1	0.69
4252.30815	0	9	7	3	8	5	4	2.48E-04	2	-4.1	0.67
4252.36122	2	11	5	7	10	3	8	4.24E-04	2	4.4	0.81
4255.74514	1	1	0	3	8	9	1	9	3.77E-04	3	1.8	0.88
4259.459	107	9	6	3	9	2	8	1.27E-06	10	6.64E-07	1.52
*4259.562	112	8	8	0	7	6	1	6.12E-05	2	7.08E -05	0.54
4264.31728	0	11	6	6	10	4	7	2.09E-04	3	3.9	0.76
4264.9259	0	14	6	8	13	4	9	9.40E-06	5	8.6	0.76
4269.76579	0	11	4	8	10	29		5.61E-04	2	7.3	0.87
4271.40125	3	1	0	7	3	9	5	4	1.45E-04	2	-3.9	0.66
4272.8302	4	8	5	3	7	1	6	2.	.2 1.0E-04	2	1.70E-04	0.95

observed position	o-c	upper J	upper K_a	upper Kc	lower J	lower K_a	lower Kc	observed strength	%s	(o-c)%[a]	R
4275.68045	- 6	1	0	7	4	9	5	5	5.08E -05	3	1.7	0.70
4275.5598	15	8	4	4	7	0	7	1.31E-04	2	-6.9	0.81
4282.4365	-10	9	8	2	8	6	3	4.97E-05	2	5.64E-05	0.54
4287.8919	108	10	6	4	10	2	9	1.98E-06	3	1.31E-06	1.24
4288.8047	-38	1	1	7	4	1	0	5	5	2.58E -05	6	7.7	0.73
4289.6067	11	1	2	5	8	1	1	3	9	4.78E-05	2	6.9	0.80
4290.7450	19	12	6	7	11	4	8	2.95E-05	3	2.43E-05	0.86
4290.8706	35	1	4	5	9	1	3	3	1	0	4.20E -06	4	1.21E-05	0.61
4294.6472	16	11	7	5	10	5	6	6.92E-05	3	-2.1	0.65
4295.8137	-2	1	3	4	9	1	2	2	1	0	1.48E-05	4	1.73E-05	0.78
4302.8779	-5	12	7	5	11	5	6	2.84E-05	2	-1.2	0.66
4304.27122	10	1	1	2	9	1	0	0	1	0	1.45E-04	4	2.4	0.89
4304.4493	0	10	8	2	9	6	3	3.41E-05	2	3.87E-05	0.54
4304.5859	0	1	0	8	3	9	6	4	1.18E-05	5	-9.3	0.56
4305.41132	2	1	2	3	9	1	1	1	1	0	1.70E-04	3	-8.2	0.80
*4305 .5824	13	9	9	1	8	7	2	7.50E-06	6	1.03E-05	0.37
4306.71776	2	11	3	9	10	1	10	4.15E-04	3	-0.4	0.85
4313.1500	-lo	13	7	6	12	5	7	2.95E-06	6	-10.6	0.59
4313.6104	21	9	5	4	8	1	7	3.47E-05	4	-2.0	0.72
4315.6224	1	12	7	6	11	5	7	9.10E-06	10	-3"1	0.64
4316.7269	28	12	4	9	11	2	10	5.88E-05	3	4.3	0.83
4319.6840	30	13	6	8	12	4	9	2.27E-05	4	0.6	0.69
4320.2455	-7	14	7	7	13	5	8	2.90E-06	10	-2.4	0.65
4325.4367	28	11	8	3	10	6	4	5.92E-06	4	6.82[-060.52
4325.9190	-2	11	84		10	6	5	1.88E-05	3	-9.2	0.55
4327.5482	28	1	0	5	5	1	0	1	1	0	1.50E-06	10	9.38E -07	1.40
*4328.736	0	1	0	9	1	9	7	2	8.16E-06	3	1.02E -05	0.41
4329.6129	15	1	3	5	9	1	2	3	1	0	4.05E-05	2	4.3	0.76
4337.1753	-18	13	7	7	12	5	8	9.70E-06	4	1.9	0.66
4339.9836	38	8	6	2	7	2	5	7.60E-06	7	1.03E-05	0.45
4342.9537	21	9	4	5	8	0	8	1.04E-05	2	1.25E-05	0.78
4344.9933	39	12	8	4	11	6	5	9. 10E-06	10	2.8	0.61
*4345.933	89	10	10	0	9	8	1	1.00E-06	10	1.25E-06	0.32
4346.4135	19	12	8	5	11	6	6	2.90E-06	10	-1.5	0.59
4349.3375	12	14	4	10	13	2	11	1.07E-05	4	1.19E-05	0.76
4351.149	0	11	9	2	10	73		1.34E-06	3	1.62E-06	0.52
4351.172	-17	11	9	3	10	74		4.03E-06	3	4.86E-06	0.51
4351.3318	-10	14	6	9	13	4	10	2.10E-06	10	3.5	0.69
4356.2227	4	12	2	10	11	0	11	1.42E-04	2	-3.2	1.0?
4356.9320	3	9	6	3	8	2	6	5.15E-06	3	-9.9	1.21
4357.4127	-18	12	3	10	11	1	11	4.76E-05	2	-2.1	1.02
4358.0278	-4	13	3	10	12	1	11	1.68E-05	2	-4.0	0.91
4359.933	0	14	7	8	13	5	9	9.00E-07	10	-2.5	0.69
4363.0185	22	1	0	5	5	9	1	8	4.33E-05	3	1.3	1.10
4364.2786	18	13	4	10	12	2	11	5.25E-05	3	4.1	0.92
4366.1566	-7	13	86		12	6	7	3.30E-06	1	0	2.7	0.62
*4369.3864	-188	1	1	1	0	2	1	0	8	3	1.14E-06	10	-4.1	0.52
4371.7245	15	1	4	5	1	0	1	3	3	1	1	3.60E-06	10	6.2	0.80
4372.6730	-7	12	93		11	7	4	1.86E-06	10	2.36E-06	0.45
4379.6035	13	1	0	6	4	9	2	7	1.61E-05	10	-4.8	1.05
4385.6069	0	1	5	6	1	0	1	4	4	1	1	1.60E-06	10	10.8	0.72
4407.0689	79	13	2	11	1	2	0	1	2	1.53E 05	3	-3.7	1.01
4407.6275	6	13	3	11	12	1	12	4.56E-05	2	-4.0	1.00
4408.7710	22	1	4	3	1	1	1	3	1	1	2	1.26E-05	4	1.43E-05	0.89
4409.7392	91	11	6	5	10	2	8	3.30E -06	10	-5.1	0.92
4411.760	68	14	4	11	13	2	12	4.50E-06	10	-3.4	0.87
4415.099	-126	1	5	5	1	1	1	4	3	1	2	2.80E-06	10	2.44E-06	0.87
4421.513	-87	11	5	6	10	1	9	3.80E-06	10	-3.2	1.02
4448.227	193	12	6	6	11	2	9	4.07E-06	4	-5.6	0.86
4457.0292	7	1	4	2	1	2	1	3	0	1	3	1.25E-05	6	1.44E-05	0.91
4457.2486	28	14	3	12	13	1	13	4.40E-06	4	-9.3	0.95
4458.714	-8	1	5	4	1	2	1	4	2	1	3	3.40E-06	10	-5.6	0.85
4488.6002	16	1	2	5	7	1	1	1	1	0	1.85E-06	6	2.43E-06	0.80
4506.2?47	2	1	5	3	.1	3	14	1	14	4.10E -06	10	0.5	1.03

* asterisk denotes a doubled absorption with the quantum assignment given for the stronger transition. The strength given represents the sum of the strengths of the two comparable transitions.

o-c are observed minus computed line positions in $cm^{-1} \times 10^5$. Computed values derived from energy levels given in table 2 and ground state levels given in ref.16. %s are estimated uncertainties in the measured line strengths given in percent

a. (o-c)% is the percent difference between the observed and computed line strength or the value of the computed strength if the difference between the observed and computed values is ≈±12% or larger in magnitude.

R is the ratio of the observed line strength derived in this study to the computed value given in ref.

UL. upper limit. There were no apparent absorption features in any of the spectra within ±0.015 cm^{-1} of the listed frequency. The observed strength given represents the maximum strength the transition can have taking into consideration nearby absorption features of other transitions and also the signal-to-noise ratio of the spectra.

Tabl e 9. Observed[1] and computed frequencies of transitions in the (300)-(100), and (001)-(001) bands of $H_2{}^{16}O$. Values in cm-[1].

J	K_a	K_c	J	K_a	K_c	band	observed	computed[2]	un	A
1	1	0	1	0	1	(100)-(100)	18.037618	18.03743	9	19
3	1	3	2	2	0	(100)-(100)	6.570344	6.57019	8	15
4	1	4	3	2	1	(100)-(100)	12.811429	12.81131	6	12
4	2	3	3	3	0	(100)-(100)	15.970345	15.97037	7	-2
5	1	5	4	?	2	(100)-(100)	10.897115	10.89723	9	-11
1	1	0	1	0	1	(001)-(001)	17.4885?8	17.48851	10	2
5	1	5	4	2	2	(001)-(001)	10.7{5288	10.71537	8	-8

1. taken from Ref. 15

2. computed values were calculated from levels given in Table 2 of the present study

un uncertainty of computed frequencies derived from estimated uncertainties given in this study, Values x 10^5

A observed minus computed frequencies x 10^5

9. J . -M. F] aud and C. Camy-Peyret, "Vibrat ion-rotation intensities in H_2O-type mol ecul es appl i cat i on to the $2\nu_2$, V,, and ν_3 bands of $H_2{}^{16}O$," J. Mol. Spectrosc. 55, 278-310 (1975) .

10. J . -M. Fl aud, C. Camy-Peyret, J . -Y. Mandin and G. Guelachvi 1 i , "$H_2{}^{16}O$ hot bands i n the 6.3 μm regi on," Mol . Phys. 2, 413-426 (39-/7).

11. P. E. Fral ey and K. Narahari Rae, "High resolution spectra of water vapor v, and ν_3 bands of $11_2{}^{16}0$, " J . Mo] . Spect.rose. 29, 348-364 (1969) .

12. J.-M. Fl aud, C. Camy-Peyret , and J . P. Mai 11 ard, "Higher ro-vibrational levels of H_2O deduced from high resoluti on oxygen-hydrogen flame spectra between 2800-6200 Cm-l, " Mol . Phys . 32, 499-521 (1976).

13. J.-M. Flaud, C. Camy-Peyret and R. A. Toth, Water vapour line parameters from microwave to medium infrared (an atlas of }1$_2$'60, $H_2{}^{17}O$ and $H_2{}^{18}O$ line positions and intensities between 0 and 4350 cm^{-1}) Pergamon Press, London (1981) .

14. L. S. Rothman, R. R. Gamache, R. H. Tipping C. P. Rinsl and, M. A. H. Smith, D. C. Benner, V. M. Devi, J.-M. Flaud, C. Camy - Peyret, A. Perrin, A. Goldman, S. T. Massie, L. R. Brown, and R. A. Toth, "The HITRAN molecular database: editions of 1991 and 1992, t' J. Quant. Spectrosc. Rad. Transfer 48, 469-507(1993) .

15. J. C. Pearson, T. Anderson, l?. Herbst , F'. C. De Luci a, and P. Helminger, " Millimeter - and submi 11 imeter-wave spectrum of highly excited states of water, " The Ast rophys. J . 379, L41-L43 (1993).

16. R. A. Toth, "ν_2 band of $H_2{}^{16}O$: 1 ine strengths and t ransit ion frequencies," Opt. Soc. Am. B 8, 2236--2255 (1991) .

1-/. R. A. Toth, l'I,ine-frequency measurements and analysis of N_2O between 900 and 4700 cm^{-1}," Appl. Opt. 30, 5289-5315 (1991).

18. R. A. Toth, "Line strengths (900-3600 cm-l) , self-broadened linewidths and frequency shifts (1800-2630 cm^{-1}) of N_2O," Appl. Opt. (in press)

19. R. A. Toth, "Transition frequencies and absolute strengths of $H_2{}^{17}O$ and $H_2{}^{18}O$ in the 6.2-μm region," Opt. Soc Am. B 9, 462-482 (1992).

20. R. A. Toth, "$HD^{16}O$, $HD^{18}O$, and $HD^{17}O$ transition frequencies and strengths in the ν_2 bands," J. Mol. Spectrosc. (in press).

21. R. A. Toth, "$D_2{}^{16}O$ and $D_2{}^{18}O$ transition frequencies and strengths in the ν_2 bands," J. Mol. Spectrosc. (in press) .

Tabl e 1. Experimental conditions and extent of measurements

spectral range (cm^{-1})	unanodized resolution (cm^{-1})	path length (m)	sampl e pressure (1'err)	percent abundance of isotopic species $H_2{}^{16}O$	$H_2{}^{17}O$	$H_2{}^{18}O$
1300-2300	0.0052	25.	0.92	99.6	0.04	0.2
1300-2300	0.0052	97.	0.86	99.6	0.04	0.2
1300-2300	0.0052	193.	0.92	99.6	0.04	0.2
1300-2300	0.0052	433.	0.87	99.6	0.04	0.2
1900-4506	0.011	433.	7.10	99.6	0.04	0.2
1900-4506	0.011.	433.	13.1	99.6	0.04	0.?,
2900-4200	0.01.1	2.39	0.34	99.6	0.04	0.2
2900-4200	0.013	2.39	2.25	99.6	0.04	0.2
2819-4356	0.013	25.	1.18	99.6	0.04	0.2
2732-4364	0.011	25.	3.86	99.6	0.04	().2
2693-4364	0.031	76.	3.86	99.6	0.04	0.2
2622-4457	0.031	193.	3.98	99.6	0.04	0.2
2622-4506	0.011	433,	4.0 Q	99.6	o.04	0.2

Table 2. Rotational energy levels (cm^{-1}) of the (001) and (100) vibrational states of $H_2{}^{16}O$. Estimated uncertainties given in $cm^{-1} \times 10^5$

J	K_a	K_c	(001)		(100)	
0	0	0	3755.92870	3	3657.05325	4
1	0	1	3779.49311	8	3680.45376	4
1	1	1	3791.70093	2	3693.29355	3
1	1	0	3796.98162	6	3698.49119	8
2	0	2	3825.21299	6	3725.94198	3
2	1	2	3833.57664	4	3754.89692	11
2	1	1	3849.38533	4	3750.46435	5
2	2	1	3885.75775	6	3788.69443	5
2	2	0	3887.11422	6	3789.96945	5
3	0	3	3890.82934	7	3791.37219	8
3	1	3	3895.58804	6	3796.53964	6
3	1	2	3926.86222	6	3827.39266	8
3	2	2	3956.66582	6	3858.87560	4
3	2	1	3962.91786	4	3864.76393	4
3	3	1	4030.06992	6	3935.21128	8
3	3	0	4030.30618	2	3935.34471	6
4	0	4	3974.63093	5	3875.01712	7
4	1	4	3977.26150	4	3877.57524	4
4	1	3	4027.80403	3	3927.80282	5
4	2	3	4050.05?22	5	3951.31508	4
4	2	2	4066.12259	7	3966.55925	6
4	3	2	4125.14872	8	4030.83894	6
4	3	1	4126.46347	8	4031.85365	5
4	4	1	4224.81693	3	4135.01768	7
4	4	0	4224.85102	5	4134.79853	5
5	0	5	4076.14331	4	3976.30815	4
5	1	5	4076.89596	4	3977.45648	7
5	1	4	4149.89929	6	4049.53617	8
5	2	4	4165.47381	6	4065.13191	6
5	2	3	4195.97099	6	4095.92000	6
5	3	3	4244.30477	5	4150.28751	10
5	3	2	4248.15255	6	4153.93818	5
5	4	2	4345.27209	6	4257.78684	4
5	4	1	4345.55921	4	4256.24135	4
5	5	1	4468.69337	4	4381.90422	8
5	5	0	4468.69782	6	4381.90416	4
6	0	6	4195.47731	5	4095.31532	7
6	1	6	4195.81813	4	4095.80333	6
6	1	5	4290.75709	5	4190.26218	4
6	2	5	4296.56348	4	4199.39106	3
6	2	4	4350.69939	6	4249.52445	4
6	3	4	4387.23483	3	4292.90997	6
6	3	3	4408.02888	4	4308.21134	6
6	4	3	4490.0(401	5	4394.46445	3
6	4	2	4491.36985	8	4401.94203	4
6	5	2	4613.52648	7	4526.72000	13
6	5	1	4613.57337	8	4526.72057	5
6	6	1	4759.85270	6	4677.87650	25
6	6	0	4759.85323	15	4677.87654	15
7	0	7	4332.7?392	8	4232.18458	3
7	1	7	4332.91239	6	4?32.38433	6
7	1	6	4448.97084	7	4348.41477	4
7	2	6	4452.35282	3	4353.23147	6
7	2	5	4527.94937	6	4426.06643	5
7	3	5	4553.27562	5	4457.81876	3
7	3	4	4586.68326	6	4484.99226	8
7	4	4	4658.97484	5	4563.98978	4
7	4	3	4663.15074	7	4572,44641	2
7	5	3	4782.66225	7	4695.83653	3
7	5	2	4782.92020	7	4695.83634	7
7	6	2	4929.06195	15	4846.77375	3
7	6	1	4929.06897	15	4846.77600	5
7	7	1	5096.24545	10	5020.02627	10
7	7	0	5096.24550	30	5020.02641	10
8	0	8	4488.09062	4	4387.35751	4
8	1	8	4488.14578	11	4387.06300	5
8	1	7	4624.30288	4	4523.58902	4
8	2	7	4625.93701	3	4525.964?1	6
8	2	6	4725.06240	7	46?2.90619	9
8	3	6	4741.06717	5	4643.99925	3
8	3	5	4792.34041	3	4689.32875	6
8	4	5	4851.53797	6	4756.39416	4
8	4	4	4861.80329	6	4769.03867	4
8	5	4	4976.04346	6	4889.45726	4
8	5	3	4977.04429	5	4889.40418	2
8	6	3	5122.34764	5	5039.62753	12
8	6	2	512?.39315	12	5039.64228	7
8	7	2	5289.95820	30	5213.26944	10
8	7	1	5289.95908	11	5213.26905	10
8	8	1	5475.75555	60	5406.54944	20
8	8	0	5475.75555	60	5406.54944	20
9	0	9	4661.42653	12	4559.70777	6
9	1	9	4661.44869	12	4559.75216	4
9	1	8	4816.99104	6	4715.96703	5
9	2	8	4817.7s589	9	4717.10461	6
9	2	7	4939.79434	4	4837.69978	6
9	3	7	4949.00314	7	4850.44146	3
9	3	6	5022.28141	2	4918.23499	7
9	4	6	5067.07693	6	4971.26084	5
9	4	5	5087.01723	3	4992.12177	7
9	5	5	5193.45776	5	5108.34945	3
9	5	4	5196.50066	3	5107.72929	4
9	6	4	5339.64148	3	5256.38163	8
9	6	3	5339.84344	5	5256.44877	5
9	7	3	5507.47502	7	5430.18095	10
9	7	2	5507.48?66	30	5430.18387	8
9	8	2	5694.04822	15	5624.38695	30
9	8	1	5694.04822	15	5624.38751	10
9	9	1	5896.27261	12	5836.98595	30
9	9	0	5896.27261	12	5836.98595	30
10	0	10	4852.74921	6	4750.36230	4
10	1	10	4852.75541	6	4750.38793	6
1	0	1 9	5027.25683	9	4925.78707	5
1	0	2 9	5027.55965	11	4926.34709	3
1	0	2 8	5171.06009	5	5069.08848	2
1	0	3 8	5175.95530	2	5076.26623	3
1	0	3 7	5275.63278	3	5169.03944	4
1	0	4 7	5304.72776	4	5207.80231	5
1	0	4 6	5355.26311	4	5246.80043	7
1	0	5 6	5434.48413	6	5334.98852	6
1	0	5 5	5442.09797	4	5351.40879	5
1	0	6 5	5580.81846	6	5496.98077	7
1	0	6 4	5581.52502	5	5497.21555	5
1	0	7 4	5748.66152	14	5670.61552	6
1	0	7 3	5748.69874	8	5670.63006	12
1	0	8 3	5935.83153	50	5865.60411	40
1	0	8 2	5935.83251	40	5865.60555	50
1	0	9 2	6139.32411	25	6079.97815	20
1	0	9 1	6139.32411	25	6079.97815	20
10	10	1	6355.73736	100	6264.74611	30
10	10	0	6355.73756	100	6264.74611	30
11	0	11	5062.01077	15	4958.90129	3
11	1	11	5062.01336	20	4958.93691	15
11	1	10	5255.20538	6	5153.18869	3
11	2	10	5255.34674	20	5153.53465	15
1 1	2 9		5418.80354	7	5316.80441	7
1 1	3 9		5421.267{9	3	5320.88911	25
1 1	3 8		5543.63688	12	5439.05662	8

Tabl e 2 cent.i.nued

J	K_a	KC	(001)	(loo)
1	1	4 8	5563.39999 8	5465.05382 7
1	1	4 7	5631.83942 3	5524.56942 16
1	1	5 7 '	5698.48967 5	5601.53158 8
1	1	5 6	5714.53217 10	5621.33471 30
1	1	6 6	5845.65355 7	5761.40271 10
1	1	6 5	5847.70695 20	5762.06031 12
1	1	7 5	6013.36608 8	5934.41955 20
1	1	7 4	6013.51074 6	5934.47791 10
1	1	8 4	6200.89228 10	6129.98144 40
1	1	8 3	6200.89837 25	6129.98391 10
1	1	9 3	6405.51765 48	6346.10897 60
1	1	9 2	6405.51794 200	6346.10897 60
11	10	2	6623.67235 60	6534.17631 60
11	10	1	6623.67235 60	6534.17631 60
11	11	1	6852.16788 100	6785.60036300
11	11	0	6852.16788 100	6785.60036300
12	0	12	5289.15215 10	5186.33752 8
12	1	12	5289.15295 15	5184.73448 6
12	1	11	5500.85677 8	5398.25055 40
12	2	11	5500.91588 24	5399.33075 50
12	2	10	5683.33282 7	5581.10963 11
12	3	10	5684.53067 17	5579.48982 18
1	2	3 9	5830.25937 7	5726.06246 7
1	2	4 9	5841.86281 8	5742.03722 15
1	2	4 8	5933.54666 7	5826.13442 8
1	2	5 8	5984.67545 25	5887.76596 21
1	2	5 7	6013.44811 6	5918.17321 80
1	2	6 7	6133.77462 9	6049.84891 6
1	2	6 6	6138.88967 15	6051.27307 10
1	2	7 6	6301.40751 8	6221.43163 10
1	2	7 5	6301.87s48 22	6221.62338 10
1	2	8 5	6489.01121 20	6417.29637 15
12	8	4	6489.03947 30	6417.30549 50
1	2	9 4	6694.57864 60	6635.10944 300
1	2	9 3	6694.57915 30	6635.10944 300
12	10	3	6914.35?55 80	6825.8WO0 300
12	10	2	6914.35835 80	6825.89900 300
13	0	13	5534.11135 60	5429.11859 10
13	1	13	5534.11105 30	5429.12815 10
13	1	12	5764.18544 10	5662.47525 45
13	2	12	5764.20465 8	5660.40423 10
13	2	11	5964.91273 9	5862.33905 17
13	3	11	5965.47513 6	5862.46697 10
13	3	10	6132.64433 6	6028.85888 30
13	4	10	6139.02976 6	6037.87366 50
1	3	4 9	6256.02106 11	6148.68295 190
1	3	5 9	6292.11987 7	6194.30324 50
1	3	5 8	6336.03672 15	6241.53159 60
1	3	6 8	6444.63535 9	6363.56837 19
1	3	6 7	6455.74234 9	6365.37945 10
1	3	7 7	6612.54852 12	6531.47900 50
1	3	7 6	6613.83569 15	6532.02069 40
1	3	8 6	6799.95736 13	6727.31879 50
1	3	8 5	6800.05109 60	6727.35841 40
1	3	9 5	7006.35900 500	6946.69639400
1	3	9 4	7006.35900 500	6946.70165 400
13	10	4	7227.46421 300	
13	10	3	7227.46421 300	
14	0	14	5796.94279 22	5690.87849 50
14	1	14	5796.88679 10	5690.88001 40
14	1	13	6045.17201 12	5940.54255 300
14	2	13	6045.14246 12	5940.63751 10
14		212	6263.69938 8	6161.13327 50

J	K_a	K_c	(001)	(loo)
14	3	12	6?63.92009 25	6160.37285 40
14	3	11	6451.08156 9	6347.16860400
14	4	11	6454.13347 25	6351.85515 20
14	4	10	6596.2? 248 13	6489.20200 500
14	5	10	6619.78911 15	6520.60730 40
1	4	5 9	6705.59388 30	6589.74543 300
1	4	6 9	67(7.52833 15	6676.46991 15
14	6	8	6798.71927 15	6705.04620 50
1	4	7 8	6946.46300300	6864.39533 40
1	4	7 7	6949.58027 15	6865.72802 300
1	4	8 7	7133.48509 60	7059.81262 50
14	8	6	7133.78095 40	7059.93346300
1	4	9 6	?340.18230 400	7280.59215 300
1	4	9 5	7340.19980400	
15	0	15	6077.10477 50	5970.20012300
15	1	15	6077.10477 50	5970.20012300
15	1	14	6343.43385 20	6238.21526300
15	2	14	6342.52789 20	6238.22050300
15	2	13	6578.87025 10	6474.70435 50
15	3	13	6579.74043 6	6475.43940 400
15	3	12	6784.72742 15	6682.00397300
15	4	12	6786.68839 10	6683.52400 500
15	4	11	6952.18899 20	6846.56082 300
15	5	11	6966.58408 15	6865.69900 500
15	5	10	7074.30900600	6960.3867/ 300
15	6	10	7131.63067 50	
1	5	6 9	7167.34800600	7070.63936400
1	5	7 9	7302.71938 50	7220.23000 500
1	5	7 8	7.$09.49260300	7222.96299300
1	5	8 8	7489.30484 60	
1	5	8 7	7490.10000 600	
16	0	16	6375.05260 60	6267.03550 25
16	1	16	6375.05260 60	6267.03550 25
16	1	15	6659.44792 100	6553.22400300
16	2	15	6659.44792 100	6553.22400 300
16	2	14	6912.56935 60	
16	3	14	6913.06460 60	
16	3	13	7135.32125 50	
16	4	13	7136.37600300	
16	4	12	7323.11014 50	
16	5	12	7331.48610 300	
16	5	11	7464.48532 50	
16	6	11	7506.01800 600	
16	6	10	7559.38665 70	
17	0	17	6690.46970 60	6581.27750 50
17	1	17	6690.46970 60	6581.27750 50
17	1	16	6992.76200 150	
17	2	16	6992.76226 150	
17	2	15	7262.79975 50	
17	3	15	7262.77922 150	
17	3	14	7502.38500 600	
17	4	14	7503.07197300	
18	0	18	7023.28630 50	
18	1	18	7023.28630 50	
18	1	17	7343.34370300	
18	2	17	7343.34370 300	
18	2	16	7630.01370300	
18	3	16	7630.00700600	
19	0	19	7375.38810 60	
19	1	19	7.$73.38810 60	
20		020	7{40.68900 300	
20	1	20	7740.68900 300	

Tab] e 3. Matrix elements used in the expansion of the dipol e moment for B-type transitions o-f water vapor.

j	n	$\langle J\ K\|A'(j)\|J'K'\rangle/\langle J\ K\|\Phi(x)\|J'\ K+\Delta K\rangle$	$\Delta K = \pm 1$
2	3	$J'(J'+1) + J(J+1)$	(a)
3	1	$K'^2 + K^2$	(a)
4	1	$K'^2 - K^2$	(a)
5	1	$K'^2 - K^2 - 2m$	(a)
6	3	$(K'^2-K^2)(K'^2-K^2-2m)$	(a)
7	1	$J(J+1) - 2m(m-1)+(2m-1)K\Delta K - K^2 - 1$	(a)
8	3	$[(J'-K\Delta K-1)(J'-K\Delta K-2)(J'+K\Delta K+2)(J'+K\Delta K+3)]^{1/2}$	(a)
9	1	$K'^2J'(J'+1) - K^2J(J+1)$	
30	1	$K'^4 - K^4$	
11	1	$(K'^2-K^2)[J'(J'+1) + J(J+1)]$	
12	1	$K'^2(J'^2+J')^2$	
13	1	K'^6	
14	1	K'^4	
15	1	$K'^2J'(J'+1)$	
16	1	$K'^6 \cdot \cdot K^6$	
17	3	$J'(J'+1)$ if $m=0$ and $J=K_c$ or $J'=K_c'$, otherwise = 0	
18	1	$J'(J'+1)$ if $m=0$ and $J=K_c$ or $J'=K_c'-1$, otherwise = 0	
19	3	$J'(J'+1)$ if $m\neq 0$ and $J=K_c$ and $J'=K_c'$, otherwi se = o	

(a) taken from Flaud and Camy-Peyret, ref. 9

$$J'-J = 0, \pm 1$$

$$m = [J'(J'+1) - J(J+1)]/2$$

$$K'-K = n\Delta K$$

Tab] e 4. Matrix elements used in the expansion of' the dipole moment for A-type transit tions of water vapor. [a]

j	n	$\langle J\ K \| A'(j) \| J'K' \rangle / \langle J\ K \| \Phi(z) \| J'K \rangle$ $\Delta K = \pm 1$
2	0	$J'(J'+1) + J(J+1)$
3	0	$2K^2$
4	0	m
5	0	$2J(J+1) - 2m(m-1) - 2K^2 - 1$
6	2	$AK[(J'-K\Delta K-1)(J'+K\Delta K+2)]^{1/2} \times F$
7	2	$2(K+\Delta K)[(J'-K\Delta K-1)(J'+K\Delta K+2)]^{1/2} \times F$
8	2	$2\{K-t\ \Delta K(1-m)\}[(J'-K\Delta K-1)(J'+K\Delta K+2)]^{1/2} \times F$

a. taken from Fl aud and Camy-Peyret, ref. 9

$$J'-J = 0, \pm 1$$

$$m = [J'(J'+1) - J(J+1)]/2$$

$$K'-K = nAK$$

$$F = \langle J\ K \| \Phi(z) \| J'K \rangle / \langle J\ K \| \Phi(x) \| J'K+\Delta K \rangle$$

Tab] e 5. Dipole **moment expansion coefficients derived** from least-squares fits of $H_2{}^{16}O$ measured lines strengths in the (100)-(010), (100)-(000), (001)-(010), and **(001)-(000')** bands. Results derived without Fermi and /or Coriolis interactions included in the analyses. Values in Debyes.

	(100) "(010) band		(100)-(000) band			
j	this work	Flaud et a la	this work			Flaud et al.[b]
1	2.000 (25)E-02	2.20(40)E-02	I.48(10)E-02	1.47(7)E-02	1.51(3)E-02	1.469 (75)E-02
2	-3.67(369)E-06		-1.79 (569)E-06	-6.7(573)E-06	-2.41 (89)E-05	
3	8.4(141)E-05	7.48(500)E-04	1.8(193)E-05	2.46(275)E-04	3.50(120)E-04	
4	-4.78 (55)E-04	.1.1 0(4I)E-03	-1.45 (68)E-03	-1.26 (34)E-03	-1.26 (80)E-03	-1.35 (9)E-03
5	3.76(165)E-05		4.84(142)E-04	5.58(261)E-04	4.53(41)E-04	5.09(62)E-04
6	6.42(24)E-05	1.64(145)E-05	-7.48 (544)E-05	-1.13 (60)E-04	-6.68 (107)E-05	4.90(231)E-07
7	9.42(286)E-06		-4.32 (219)E-05	2.2(108)E-05	2.82(149)E-05	3.60(135)E-07
8	1.66(82)E-05		5.26(188)E-06	-7.5(432)E-06	-2.17 (66)E-05	
9	-1.95 (58)E-05		1.43(172)E-05	5.(123)E-06	-3.88 (65)E-05	
10	7.00(239)E-05		-1.12 (74)E-05	1.2(117)E-05	6.32(181)E -05	
11	8.88(270)E-06		-7.98 (784)E-06	-5.2(570)E-06	1.49(37)E-05	
12	-9.25 (426)E-08		1.06(134)E-08	2.02(279)E-08	2.30(134) E-08	
13	6.21(183)E-06		1.9(676)E-07	-5.4(138)E-07	4.23(143)E-07	
14	-8.64 (466)E-05		-8.4(116)E-06	2.97(868)E-05	-1.91 (145)E-05	
15	1.09(35)E-05		-1.74 (124)E-06	-6.70(710)E-06	2.03(316)E-06	
16	-4.1I(10I)E-06		9.3(165)E-08	3.2(178)E-07	-9.52 (191)E-07	
17	2.04(191)E-05		6.5(421)E-06	1.1(719)E-06	-3.46 (144)E-05	
18	-5.48 (945)E-06		1.3(189)E-06	-1.3(320)E-06	-1.95 (66)E-05	
19	2.50(115)E-05		-1.03 (146)E-05	3.2(215)E-05	3.64(337)E-05	
UC	80	11	124	73	107	
$\sigma\%^{d}$	4.1	11.1	3.8	7.1	15.3	
min v	1852.959	2002.999	3028.237	3598.135	3500.873	
max v	2238.941	2193.038	3593.791	3844.404	4106.378	

	(001)-(010) band		(001)-(000) band	
j	this work	Flaud et al.[a]	this work	Flaud et al.[b]
1	2.497 (3)E-02	2.670 (72)E-02	7.257(74)E-02	6.869 (130)E-02
2	-7.69 (656)E-07		7.61(32)E-06	
3	1.99(14)E-05		-8.49 (7)E-05	
4	4.063 (39)E-04	1.86(170)E-04	-1.478 (4)E-03	-1.146(210)E-03
5	1.92(187)E-06		6.38(435)E-07	
6	-1.59(8)E-04		5.05(1)E-04	5. 00(110)E-04
7	-6.72 (206)E-06		-1.23 (3)E-05	
8	1.9(715)E-08		1.35(2)E-05	3.8 I(110)E-05
UC	67	24	159	
$\sigma\%^{d}$	3.1	8.3	4.4	
min v	1957.187	2026.939	3223.458	
max v	2497.689	2274.708	4407.627	

a. Taken from Flaud et al., ref. 10. Values given above differ from those given in ref. 10 for the (100)-(010) band in which the Fermi interaction between the (020) and (100) states was removed.

b. Taken from Flaud et al., ref. 9. Values given above differ from those given in ref. 9 for the (100)-(000) band in which the Fermi interaction between the (020) and (100) states was removed.

c. N represent the number of line strengths used in the least-squares fit

d. $\sigma\%$ is the standard deviation resulting

$u\% = \{\Sigma[(S_{obs}-S_{cal})/S_{obs}]^2/N\}^{1/2}\times 100$ "O"' 'he 'east-squares f i t in percent.

rnin and max v are given in cm-1 and pertain to the minimum and maximum frequency range of transitions used the [east-squares fits.

values given within parenthesis are estimated uncertainties in the last digit(s).