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The High-Resolution Rotational and Torsional Spectra of HSSH

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High-resolution spectroscopic measurements on both the torsional and the rotational spectra of disulfane (HSSH) are reported. The infrared torsional spectrum has been measured using a high-resolution Fourier transform spectrometer in the range 300–550 cm^{-1}. Approximately 2000 torsional–rotational spectral lines belonging to the band systems $v_t = 1 \leftarrow 0$, $2 \leftarrow 1$, and $3 \leftarrow 2$ have been analyzed and fitted. In addition, new rotational transitions are reported, especially involving the second excited ($v_t = 2$) torsional state. The torsional potential function of Herbst and Winnewisser (*Chem. Phys. Lett.* 155, 572–575 (1989)) has been refined.

I. INTRODUCTION

Disulfane (HSSH), a nearly accidental prolate symmetric top, exhibits a number of interesting spectroscopic effects that can be measured, disentangled, and studied to a high level of clarity. The nearly right-angle chain structure and the high barrier toward internal rotation are in the main responsible for these effects, which are detected by high-resolution spectroscopy.

First and foremost, HSSH and all of its presently known isotopically substituted forms are nearly perfect accidental prolate symmetric tops with asymmetry parameter κ varying between −0.9996 for HSSH and −0.9999993 for DSSD (*1–3*). The r_0 structure of the molecule is such that the dihedral angle χ is only slightly greater than 90° (the *gauche* configuration) with potential barriers at both the *trans* ($\chi = 180°$) and *cis* ($\chi = 0°$) configurations. In addition, the HSS bond angle is approximately 99°, so that this angle is nearly perpendicular as well. The dipole moment of HSSH lies perpendicular to the S–S axis, which results in *c*-type transitions if the dihedral angle exceeds about 90° (*1*). The rotational and rovibrational spectra consist of regularly

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spaced compact Q-branches and easily discernable P- and R-branches. The K-type doubling in molecules with small asymmetry is caused by two effects: splitting due to the $\Delta K = \pm 2$ asymmetric top matrix elements ("asymmetry splitting") and centrifugal distortion splitting due to the matrix elements of the quartic, sextic, and higher-order distortion terms. The K-type doubling induced by centrifugal distortion was first observed in the millimeter-wave spectra of HSSH and DSSD (*2, 3*).

Second, significant differences occur between the various isotopic species that are symmetric to exchange (e.g., HSSH, DSSD) and those that are not (e.g., $HS^{34}SH$, HSSD). The symmetric isotopes show an alternation in intensity due to nuclear spin statistics which is missing in the nonsymmetric isotopes. These latter isotopes can exhibit both b- and c-type transitions due to a rotation of the principal axes. This effect is most marked for HSSD (*2*) and $DS^{34}SD$ (manuscript in preparation).

Third, the torsional splittings in disulfane are fairly small and not very dependent on rotational quantum numbers. They can therefore be used to test theoretical aspects of internal motion and to obtain the potential energy for torsional motion to a high degree of accuracy. The effects of differing *cis* and *trans* barriers can be seen in the spectra, although they are not as dominant as in HOOH, due to the higher barriers in HSSH. Although torsional motion is almost always treated as an effective one-dimensional motion, the relative simplicity of the HSSH torsional spectrum caused by the high barriers to internal rotation and the small number of normal modes allows a determination of the coupling of the torsional motion to other modes of motion, in particular the low-frequency S–S stretch.

Finally, the structure of HSSH as well as its torsional barriers are an excellent testing ground for ab initio quantum chemical treatments. Indeed, presently available torsional barriers and equilibrium structures from a variety of ab initio calculations are in excellent agreement with the experimentally determined r_0 structure and torsional potential, as shall be discussed later.

These interesting features have made disulfane a topic for a significant amount of spectroscopic investigation. A large body of data in both the millimeter-wave and infrared regions of the spectrum as well as Raman and electron diffraction work has been published (*1–11*). Recently, Herbst and Winnewisser (*11*) have derived a potential function for the torsional motion of HSSH based on a limited amount of experimental data, including torsional splittings in the ground ($v_t = 0$) and first excited ($v_t = 1$) torsional states. Since then we have greatly expanded the experimental data base of disulfane with the particular aims of deriving a more precise potential function and a full substitution structure. Measurements of the pure rotational spectrum of HSSH in the millimeter-wave region have been extended to include many more transitions in the first excited torsional state ($v_t = 1$) and, for the first time, transitions in the second excited ($v_t = 2$) torsional state; in particular we have measured $K = 1 \leftarrow 0$ P-, Q-, and R-branch transitions and $K = 2 \leftarrow 1$ Q-branch transitions in $v_t = 1$ and $K = 1 \leftarrow 0$ Q-branch transitions in $v_t = 2$. Details of much of this work along with isotopic studies will be published in a forthcoming paper concerning the substitution structure of disulfane, with the SSH bond angle determined for the first time from millimeter-wave data.

In addition to the newly measured pure rotational transitions, we have recently measured the infrared torsional–rotational spectrum of HSSH to high resolution on

the Fourier transform instrument at Giessen. Previous measurements of the torsional spectrum of HSSH were reported at low resolution, which was insufficient for an accurate determination of the torsional potential function (*5–7*). It is one purpose of this paper to present our new infrared results, which comprise several thousand rotationally analyzed lines involving the torsional transitions $v_t = 1 \leftarrow 0$, $2 \leftarrow 1$, and $3 \leftarrow 2$. The new high-resolution infrared data led to the assignment of the $v_t = 2$ $K = 1 \leftarrow 0$ Q-branch rotational transitions, the band center of which lies in the millimeter region near 138.4 GHz.

The infrared transition wavenumbers have been fitted using a simple asymmetric top model in which different rotational and centrifugal distortion constants are determined for the torsional substates and the torsional splittings in the limit of zero rotation are treated as adjustable parameters. Such a treatment is viable because of the small interaction between overall rotational and torsional motions. The analyzed infrared lines are listed in Table I. Table II contains the vibrational energies and torsional splittings of the first four torsional states of HSSH. Torsional splittings for $v_t = 2$ and 3 and vibrational energies of all states through $v_t = 3$ have been determined from our analysis of the IR data whereas splittings for $v_t = 0$, 1, and 2 are from millimeter-wave data (*1, 11*). The newly assigned $v_t = 2$ $K = 1 \leftarrow 0$ Q-branch rotational transitions are listed in Table III.

The torsional splittings in $v_t = 0$, 1, 2 and the band centers of the torsional transitions $v_t = 1 \leftarrow 0$ and $2 \leftarrow 1$ have been used to determine a refined torsional potential, shown in Fig. 1. The applicability of this potential has been tested by predicting the torsional splitting and energy of the $v_t = 3$ state and has been found to be satisfactory.

TABLE II

Energies of Torsional States in HSSH

Torsional State v_t	Energy (cm^{-1})[a]		Torsional Splittings (MHz)			
			1/2 [Δ(4-1) + Δ(3-2)][c]		1/2[Δ(4-1) - Δ(3-2)]	
	Expt	Fit[b]	Expt.	Fit[b]	Expt.	Fit[b]
0	0	0	0.058(4)[d]	0.069	---	0.006
1	417.476765(7)	416.7	7.995(25)[d]	7.642	---	0.359
2	808.019808(12)	808.0	376.14(05)[e] 379.91(81)	376.360	≤ 9	9.592
3	1171.406195(56)	1170.6	10642.7(3.3)	10602	135(18)	152.

[a] Energies relative to ground state; calculated zero-point energy of 214.6 cm^{-1}

[b] Torsional splittings averaged. See text for discussion of analysis. Based on torsional potential derived from $v_t = 0,1,2$ data.

[c] See theory section for discussion of the meaning of Δ

[d] Previously taken millimeter-wave data - see references (1,11)

[e] Millimeter-wave data; present work.

TABLE III

Measured Line Frequencies of the Second Excited ($v_t = 2$) Torsional State of HSSH

J	lower component (MHz)	upper component (MHz)
1	138095.629	
2	138073.778	138825.514
3	138041.238	138793.068
4	137997.752	138749.828
5	137943.386	
6	137878.190	138630.928
7		138555.326
8	137715.280	
9		138371.803
10	137509.130	138263.982
11	137389.818	138145.432
12	137259.807	138016.195
13	137119.149	137876.393
14	136967.700	137725.844
15	136805.557	137564.682
16	136632.769	137392.910
17	136449.357	137210.606
18	136255.353	137017.768
19	136050.779	136814.439
20	135835.675	136600.658
21	135610.104	136376.445
22	135374.053	136141.848
23	135127.608	135896.917
24		135641.709

The remainder of this paper is organized as follows: in Section II, some experimental details and new spectra are presented. In Section III, the details of the theory of the torsional splittings in HSSH are reviewed and our analysis procedure detailed. Our results and conclusions are discussed in Section IV.

II. EXPERIMENTAL DETAILS

The infrared and millimeter-wave data presented in this paper have been obtained with two spectrometers. The Bruker IFS 120 HR vacuum Michelson interferometer in Giessen was used to record the torsional–rotational bands of HSSH with an unapodized resolution of 0.0018 cm^{-1} (50 MHz). The bands encompass a spectral region from 300 to 550 cm^{-1}. The spectrum was calibrated using lines of the OCS ν_2 band reported by Jolma *et al.* (*12*). Experimental details of the interferometer have been discussed by Plummer *et al.* (*10*). There are several minor differences in the present measurement because of the different wavenumber region probed. The detector employed was a Ge–Cu type, the radiation source was a globar, the beam splitter was mylar of 2.5 μm thickness, and the windows were of cesium iodide (CsI). The cell length was 2.80 m.

In Fig. 2 we present a small part of the torsional–rotational spectrum of HSSH. The selected region shows particularly clearly the torsional doubling associated with the $v_t = 2 \leftarrow 1$ transitions. It may be pointed out that the assignment of these hot-band transitions led finally to the location of the $^rQ_0$-branch of the pure rotational

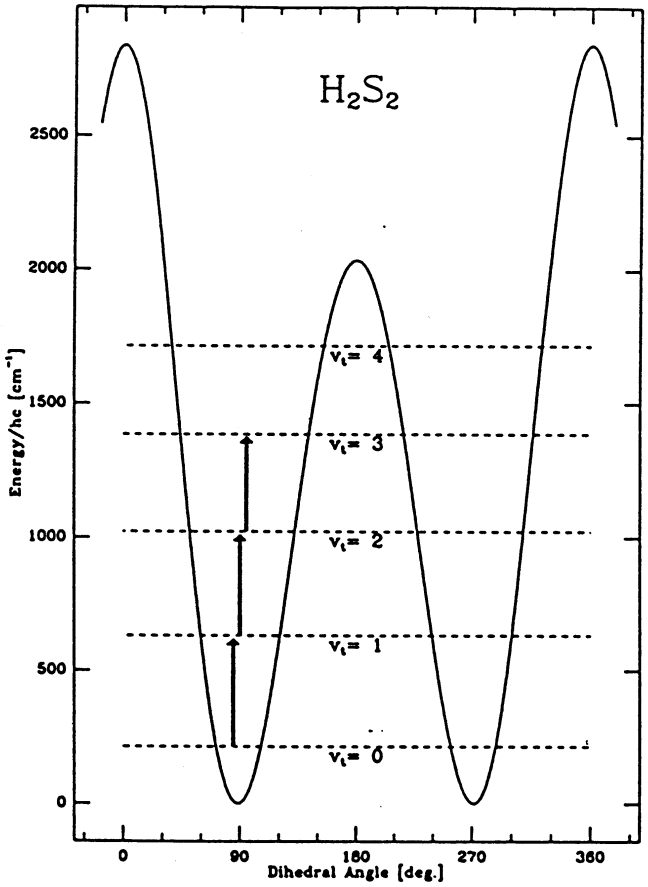

FIG. 1. The potential function $V(\chi)$ is plotted as a function of the dihedral (torsional) angle χ. The function is derived from the torsional splittings and band centers for $v_t \leq 2$. The torsional energy levels have been superimposed on the potential; torsional splittings are too small to be depicted. Bold arrows show the observed transitions.

transitions in the $v_t = 2$ excited state. These transitions had not been seen in earlier Q-branch analyses (*1–3*) due to their relative weakness and the large size of the torsional splitting. Figure 3 illustrates some low J pure rotational ${}^rQ_0$-branch transitions and their splittings for both the $v_t = 1$ and 2 torsional states of HSSH.

The millimeter-wave data were recorded with the computer-controlled millimeter-wave spectrometer in Cologne which employs a digital phase-sensitive detector; details of this spectrometer have been reported recently (*13*).

III. THEORY AND ANALYSIS

In the internal axis method (IAM) pioneered by Hunt *et al.* (*14*) for molecules of the HSSH/HOOH class, the torsional motion can be separated from the rigid body rotational motion to a large extent. In this approach, the torsional levels are obtained by solution of the eigenvalue equation

$$\{F_T P_\chi^2 + V(\chi)\}\psi(\chi) = E\psi(\chi), \tag{1}$$

where χ is the dihedral angle between the H–S groups, P_χ is the torsional angular momentum, $V(\chi)$ is the torsional potential, and F_T is the reduced rotational "constant" for torsional motion which, in reality, contains a small dependence on χ. The P_χ

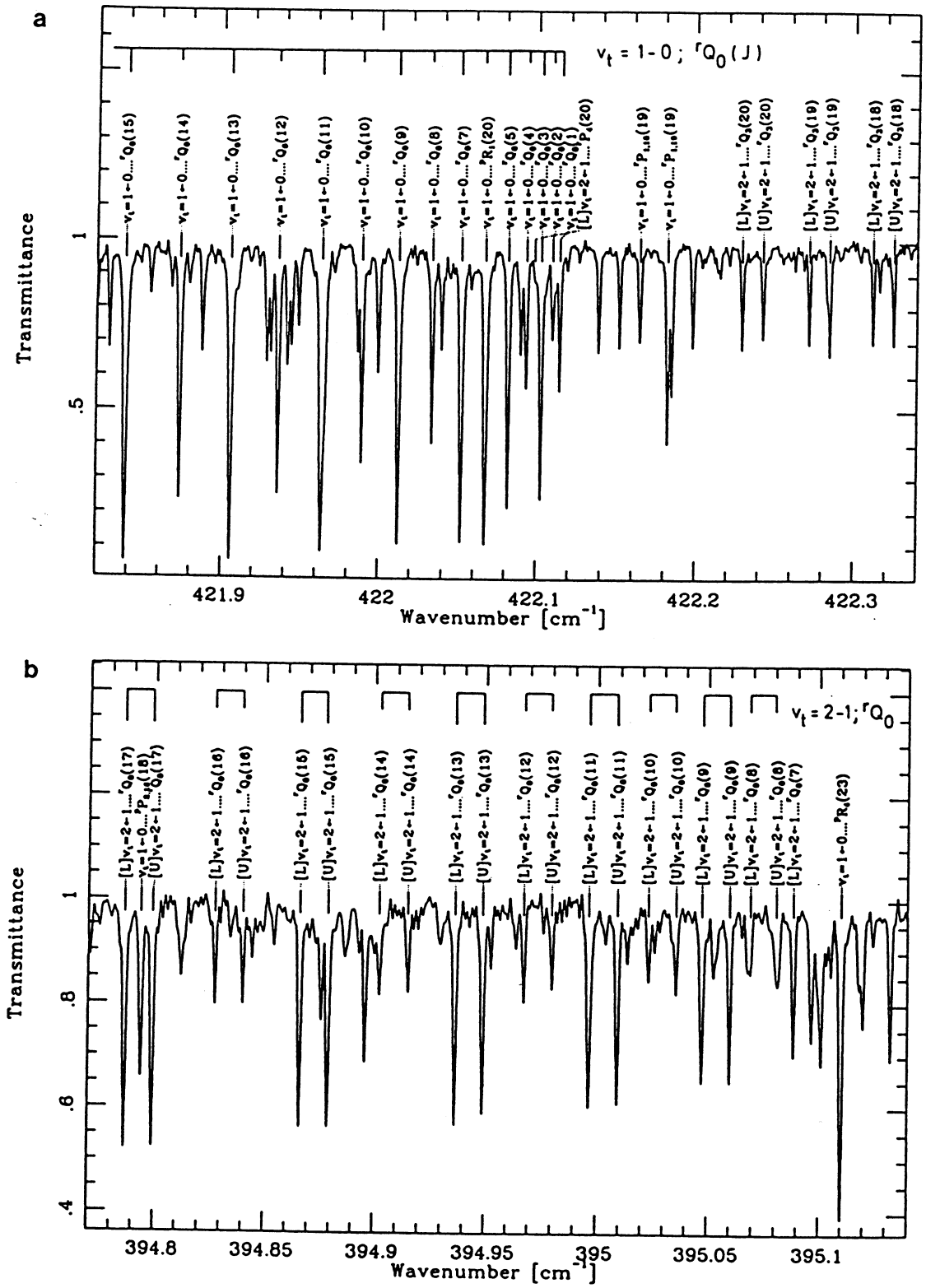

FIG. 2. (a) The torsional–rotational infrared spectrum near the band origin of the $v_t = 1 \leftarrow 0$ band is depicted. The dominant features belong to the $^rQ_0$ branch. (b) The torsional–rotational infrared spectrum near the band origin of the $v_t = 2 \leftarrow 1$ band is depicted. The torsionally split lines are denoted by [L] and [U] for lower and upper, respectively. (c) The torsional–rotational infrared spectrum near the band origin of the $v_t = 3 \leftarrow 2$ band is depicted. The torsionally split lines are once again denoted by [L] and [U].

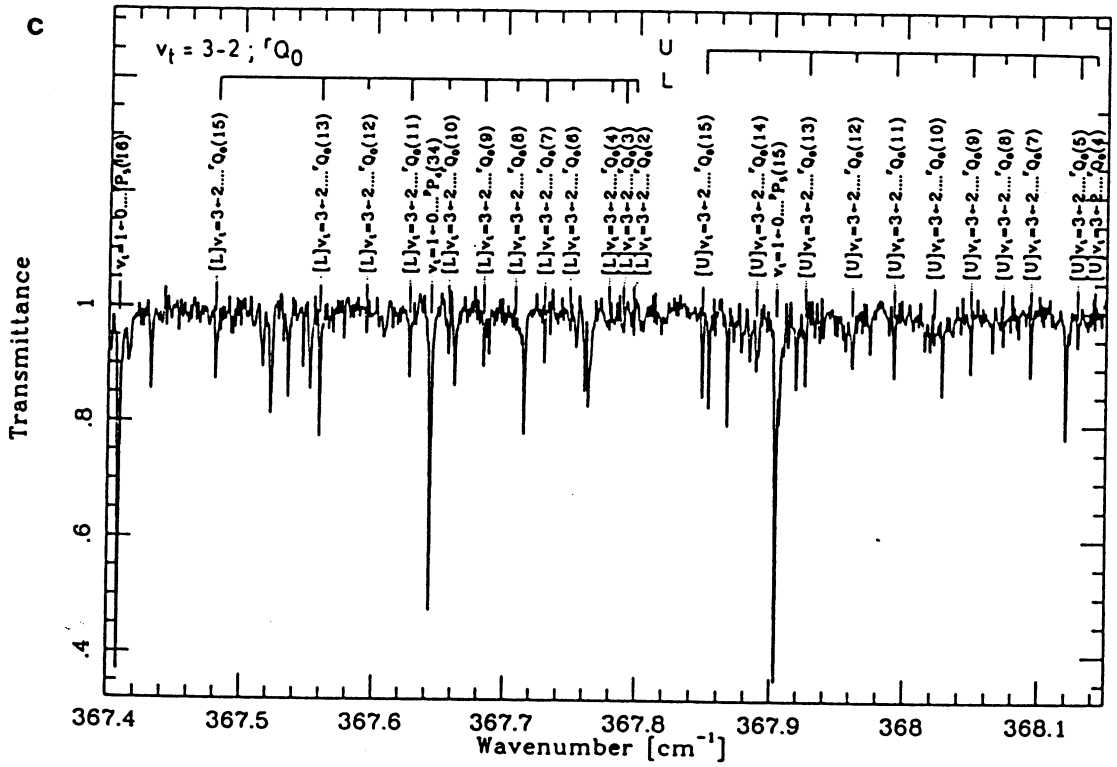

FIG. 2—*Continued*

operator used in (1) is only an approximate form of an operator which contains a small K dependence (*14*). The coordinate χ is so chosen that angular motion of the two H–S groups preserves the direction of the axis that bisects the torsional angle. This axis is both an inertial axis of the molecule (either the b axis or the c axis depending upon the value of χ) and the axis along which the dipole moment points. With this definition for torsional motion, it is easily seen that one complete torsional period requires a range for χ of $0 \leqslant \chi \leqslant 4\pi$ rather than the more customary $0 \leqslant \chi \leqslant 2\pi$.

The torsional potential energy $V(\chi)$ can be represented by a trigonometric expansion of the type

$$V(\chi) = V_0 + \sum_i V_i \cos(i\chi), \tag{2}$$

where V_0 is defined so as to make the potential minima zero. For HSSH (as well as HOOH), where the minimum energy is neither at the *cis* position ($\chi = 0, 2\pi, 4\pi, \ldots$) nor at the *trans* position ($\chi = \pi, 3\pi, \ldots$) but close to the *gauche* form ($\chi = \pi/2, 3\pi/2, \ldots$), it is convenient to retain only the first three terms (V_1, V_2, and V_3) in the cosine expansion. These terms are sufficient to reproduce the main features of the torsional potential, including barrier heights at the *cis* and *trans* positions which can differ from one another. Solution for Eq. (1) leads to torsional energy levels which are functions of F_T and the potential parameters.

The torsional energy levels are conveniently obtained with the use of orthonormal free-rotor basis functions $(4\pi)^{-1/2}\exp(is\chi)$, where s is any integer *or* half-integer due

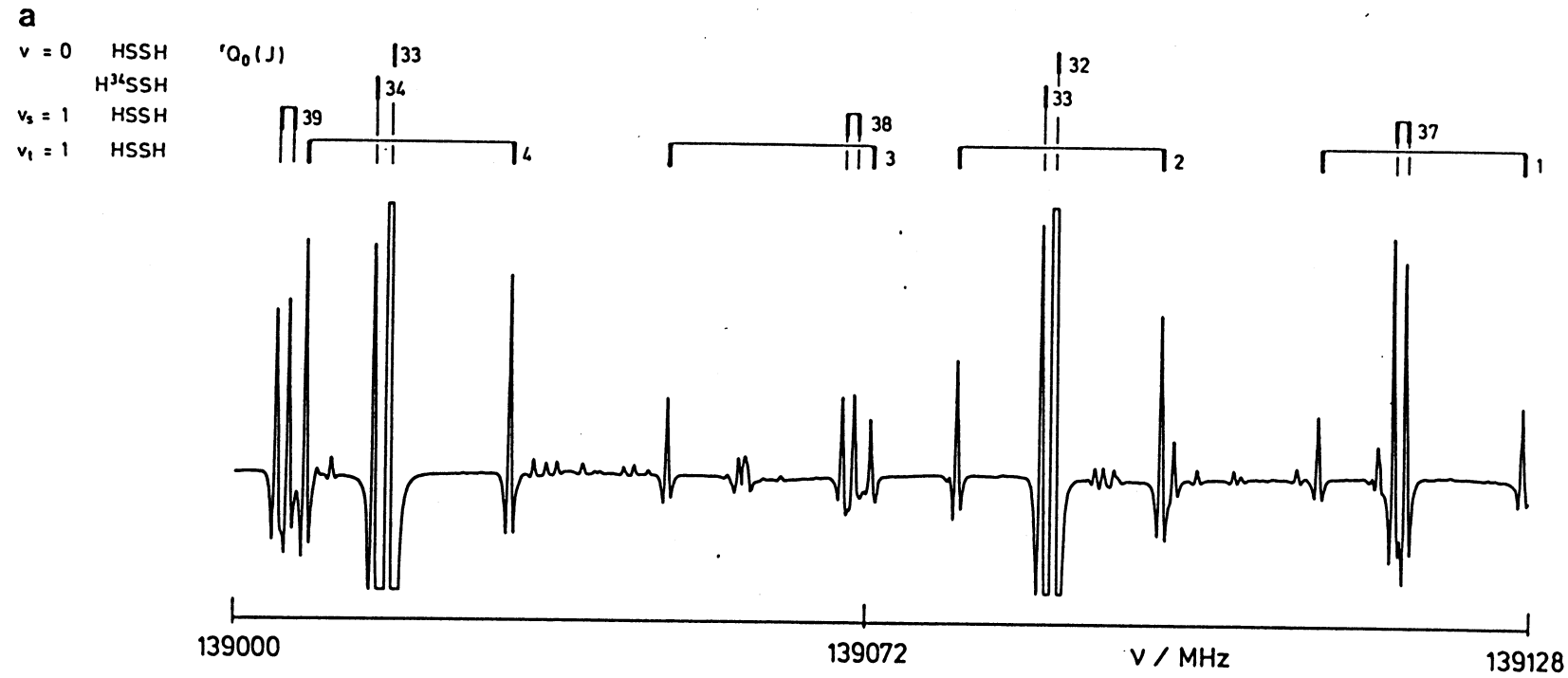

FIG. 3. (a) The four pure rotational $'Q_0$-branch transitions of lowest J for the $v_t = 1$ torsional state are depicted with the characteristic splitting of 16 MHz. Other assignments are also indicated. (b) The four pure rotational $'Q_0$-branch transitions of lowest J for the $v_t = 2$ torsional state are depicted. The characteristic torsional splitting of 752 MHz can be seen. Other assignments are also indicated. The inset shows for comparison the positions of the $'Q_0$ subband origins for $v_t = 0$, 1, and 2.

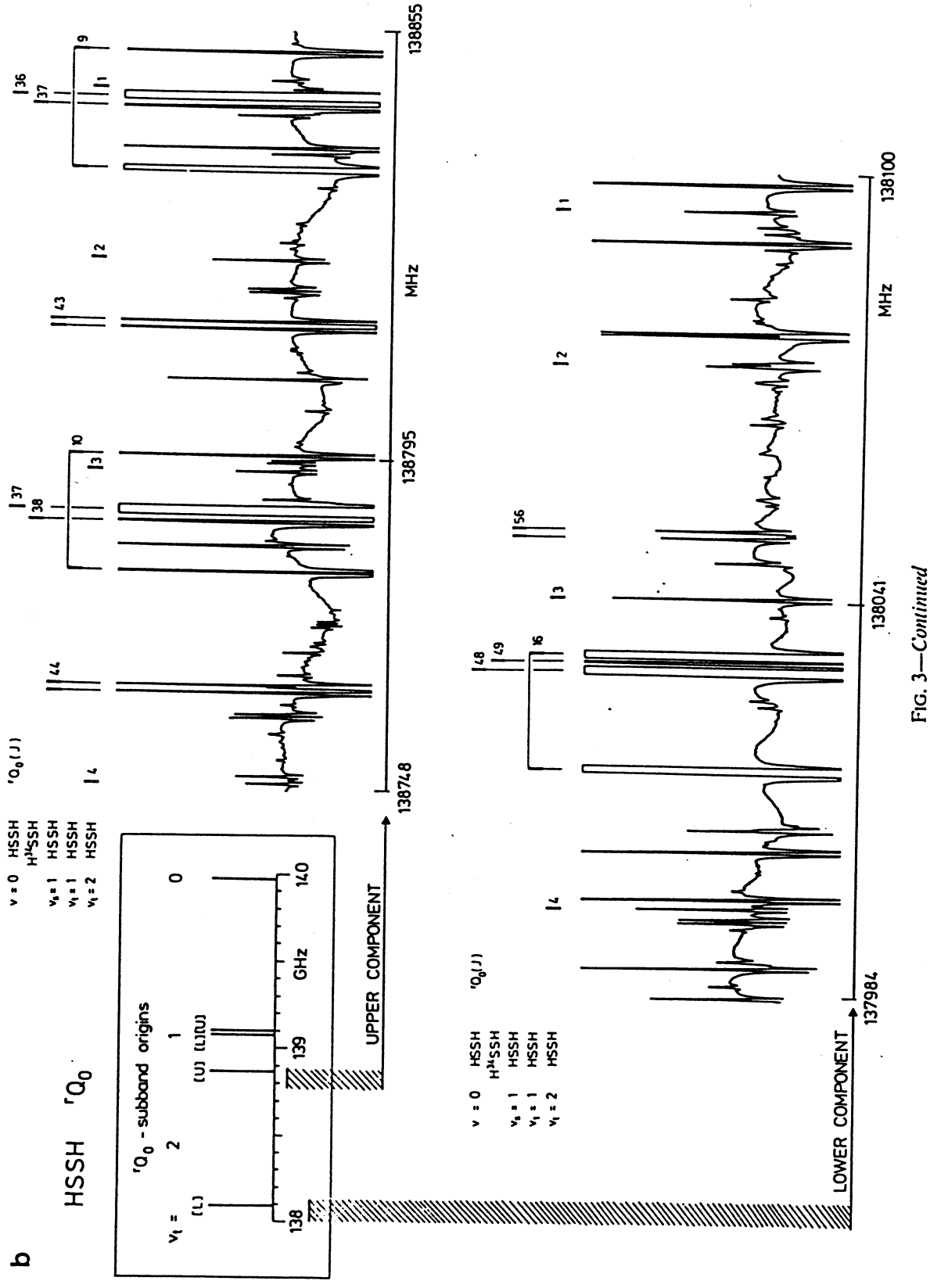

FIG. 3—*Continued*

to the range of χ. Since the Hamiltonian operator connects only those basis functions with $\Delta s = 0, \pm 1, \pm 2, \pm 3$, the basis functions can be separated into two classes of the type $(4\pi)^{-1/2}\exp[i(n+\sigma)\chi]$, where n is an integer and $\sigma = 0$ or $\frac{1}{2}$. In the calculations performed here the range of n has been limited to $-20 \leq n \leq 20$. Upon performance of the two distinct matrix diagonalizations, it is found that for $\sigma = 0$, the energy level pattern consists of closely spaced doublets which can be characterized by a joint quantum number $v_t = 0, 1, 2, 3, \ldots$. The doublet splitting increases rapidly with increasing v_t. A similar pattern holds for the $\sigma = \frac{1}{2}$ case, the only difference being a smaller doublet splitting than for the $\sigma = 0$ case for each value of v_t. For states significantly below the potential barriers, the $\sigma = 0$ and $\sigma = \frac{1}{2}$ doublets have essentially the same center of gravity. Hunt *et al.* (*14*) have characterized the quartet of levels for each v_t by the additional quantum number $\tau = 1, 2, 3, 4$ in the order of ascending energy so that $\tau = 1$ and 4 refer to the $\sigma = 0$ levels and $\tau = 2$ and 3 refer to the $\sigma = \frac{1}{2}$ levels. We maintain this convention throughout this paper. The eigenvectors $\psi_{v_t,\tau}(\chi)$ corresponding to these four levels are symmetric and antisymmetric linear combinations of the exponential basis functions, so they can be expanded in trigonometric (cos or sin) series with terms of the type $\cos(n\chi)$, $\sin[(n+\frac{1}{2})\chi]$, $\cos[(n+\frac{1}{2})\chi]$, and $\sin(n\chi)$ for $\tau = 1, 2, 3, 4$, respectively. The torsional wave functions $\psi_{v_t,\tau}(\chi)$ can be characterized by the irreducible representations of the symmetry group of the torsional Hamiltonian (*15, 16*). In the approach of Dreizler (*15*), four symmetry elements are used to characterize this group, which is isomorphic with the well-known C_{2v} group. The symmetry elements are E ($\chi \rightarrow \chi$ or $\chi \rightarrow \chi + 4\pi$), T ($\chi \rightarrow \chi + 2\pi$), σ_{trans} ($\chi \rightarrow 2\pi - \chi$), and σ_{cis} ($\chi \rightarrow 4\pi - \chi$). The character table is shown in Table IV. The four torsional wave functions for each v_t have the irreducible representations A_1 ($\tau = 1$), B_1 ($\tau = 2$), B_2 ($\tau = 3$), and A_2 ($\tau = 4$). To characterize the overall rotational–torsional wave functions in the approach of Dreizler (*15*) requires use of a direct product group of 16 elements made up of the torsional group and the well-known four-group $V(a, b, c)$ for rigid asymmetric tops (*17*). In the extended permutation–inversion group approach utilized by Hougen (*16*) and Bunker (*18*), only eight elements are needed to characterize the torsional and rotational wave functions using a group designated $G_4^\dagger$ or $G_4(EM)$. With Bunker's notation, the torsional wavefunctions have the irreducible representations A_{1s} ($\tau = 1$), A_{2d} ($\tau = 2$), A_{1d} ($\tau = 3$), and A_{2s} ($\tau = 4$), where the subscripts s and d refer to the single- or double-group representations. The character table for this extended group is contained in Table V.

TABLE IV

Character Table for Dreizler's Torsional Group L

L	E	T	σ_t	σ_c	
A_1	1	1	1	1	cos nχ (τ = 1)
A_2	1	1	-1	-1	sin nχ (τ = 4)
B_1	1	-1	1	-1	sin (n+1/2)χ (τ = 2)
B_2	1	-1	-1	1	cos (n+1/2)χ (τ = 3)

TABLE V

Character Table for Extended Permutation–Inversion Group

G_4^*	E	P	P*	E*	T	PT	PT*	T*		K_aK_c
A_{1s}	1	1	1	1	1	1	1	1	cos nχ (τ = 1)	e e
A_{2s}	1	1	−1	−1	1	1	−1	−1	sin nχ (τ = 4)	
B_{1s}	1	−1	1	−1	1	−1	1	−1		e o
B_{2s}	1	−1	−1	1	1	−1	−1	1		
A_{1d}	1	1	1	1	−1	−1	−1	−1	cos (n+1/2)χ (τ = 3)	
A_{2d}	1	1	−1	−1	−1	−1	1	1	sin (n+1/2)χ (τ = 2)	o e
B_{1d}	1	−1	1	−1	−1	1	−1	1		
B_{2d}	1	−1	−1	1	−1	1	1	−1		o o

Definition of operations: E - identity, P - permutation (12)(ab) where molecular framework is $H_1S_aS_bH_2$, (E)* - inversion, T - increase torsional angle by 2π

The spacings among the quartet of levels for each v_t are quite sensitive to the *cis* and *trans* barrier heights. A simple treatment of the torsional eigenvalue problem using harmonic oscillator-like (localized) basis functions rather than the free-rotor functions utilized in our treatment shows this effect nicely (*16*). For the case of HSSH, in which the *cis* barrier height (V_{cis}) is significantly greater than the *trans* barrier height (V_{trans}), the energy level pattern is such that the $\tau = 1$ and 2 levels are very closely spaced, as are the $\tau = 3$ and 4 levels. Indeed, as V_{cis} becomes much larger than V_{trans}, the two pairs of levels become degenerate and the $\sigma = 0$ doublet spacing $\Delta(4 - 1)$ equals the $\sigma = \frac{1}{2}$ doublet spacing $\Delta(3 - 2)$. On the other hand, as V_{cis} is reduced in size to approach V_{trans}, $\Delta(3 - 2)$ becomes significantly smaller than $\Delta(4 - 1)$. Thus the difference in splittings $\frac{1}{2}[\Delta(4 - 1) - \Delta(3 - 2)]$ is mainly a measure of V_{cis}. If V_{cis} is fixed and V_{trans} varied, then both $\Delta(4 - 1)$ and $\Delta(3 - 2)$ vary dramatically although their difference is fairly constant. Thus, the average splitting $\frac{1}{2}[\Delta(4 - 1) + \Delta(3 - 2)]$ is mainly a measure of V_{trans}.

Although the discussion up to this point has given the impression that torsional motion produces a quartet of closely spaced levels for each state characterized by v_t, the proper inclusion of rigid-body rotational motion reduces the number of states by a factor of two (*14–16*). This reduction stems from the fact that the overall rotational–torsional wave functions must be characterized by single-group representations in the $G_4(EM)$ group. The asymmetric rotor eigenfunctions $|J, K_a, K_c\rangle$ transform as single-group representations if K_a is even and as double-group representations if K_a is odd. Thus if K_a is even, the only allowed torsional states are those with single-group representations ($\tau = 1, 4$), whereas if K_a is odd, the only allowed torsional states are those with double-group representations ($\tau = 2, 3$). Both the allowed torsional levels (regular lines) and the unallowed levels (dotted lines) are shown in Fig. 4 for low values of K_a (referred to as K in the figure).

The torsional selection rules for spectroscopic transitions are also easily obtained via group theory. The dipole moment of the molecule can be written as

$$\mu = \mu_i \cos(\chi/2), \tag{3}$$

where i stands for the inertial axis, which for HSSH is the c-axis. Since $\cos(\chi/2)$ transforms as A_{1d} in the $G_4(EM)$ group, the allowed torsional transitions are $A_{1s} \Leftrightarrow A_{1d}$ ($\tau = 1 \Leftrightarrow 3$) and $A_{2s} \Leftrightarrow A_{2d}$ ($\tau = 4 \Leftrightarrow 2$). In the approach of Dreizler (*15*), $\cos(\chi/2)$ transforms as B_2, and the allowed torsional transitions are $A_1 \Leftrightarrow B_2$ ($\tau = 1 \Leftrightarrow 3$) and $A_2 \Leftrightarrow B_1$ ($\tau = 4 \Leftrightarrow 2$). Group theory yields no limiting selection rules for Δv_t; however, the large *cis* and *trans* barriers for HSSH and the resultant small splittings caused by torsional motion indicate that harmonic oscillator selection rules ($\Delta v_t = \pm 1$) are applicable, a result we have confirmed by intensity calculations. For example, we calculate that the $v_t = 2 \leftarrow 0$, $\tau = 3 \leftarrow 1$ transition has a transition dipole only $\approx 10\%$ of that of the fundamental transition.

The rotational transitions are c-type ($\Delta J = 0, \pm 1$; ΔK_a = odd). Figure 4 shows some strongly allowed ($\Delta K_a = 1$) transitions for both millimeter-wave ($\Delta v_t = 0$) and far-infrared ($\Delta v_t = 1$) radiation. It can be seen that the torsional splittings $\Delta\nu$ in the millimeter-wave lines are given by the sum of $\Delta(4-1)$ and $\Delta(3-2)$. The millimeter-

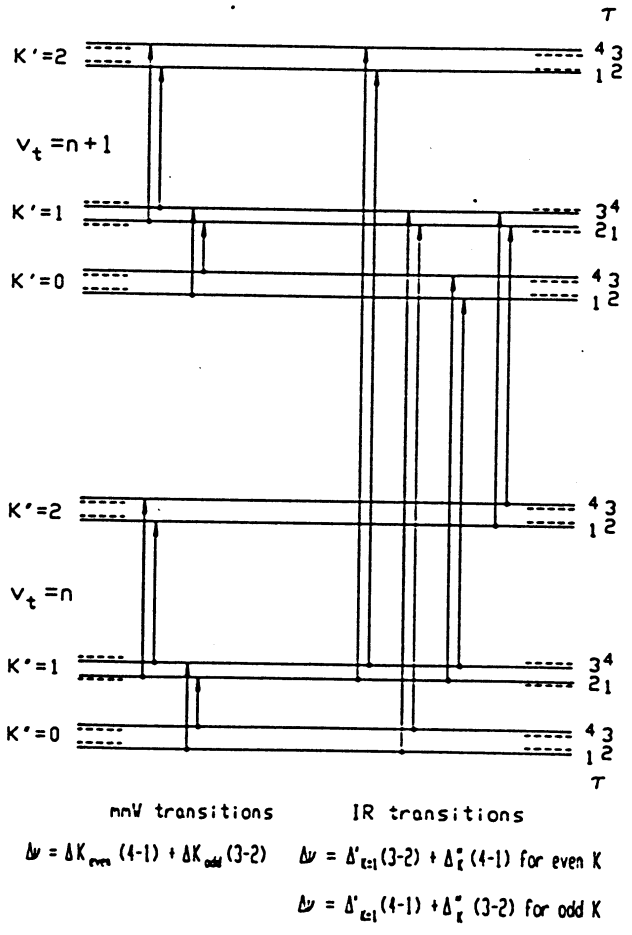

FIG. 4. The allowed torsional–rotational levels and transitions are shown for low K values. Single and double primes in the expressions for the torsional splittings $\Delta\nu$ refer to the upper and lower torsional levels, respectively. Note that the torsional splittings seen in the pure rotational, millimeter-wave (mmW) spectrum only determine the sum of the $\tau = 4$–1 and $\tau = 3$–2 splittings in a given torsional state.

wave splittings therefore cannot be used to decouple $\Delta(4-1)$ from $\Delta(3-2)$ if they do not depend on K_a; these splittings yield information concerning V_{trans} but not V_{cis}, as discussed above. For the IR data, on the other hand, the splittings are given by $\Delta''(4-1)+\Delta'(3-2)$ and $\Delta''(3-2)+\Delta'(4-1)$, where $'$ refers to the upper v_t state and $''$ to the lower v_t state and the two expressions refer to K_a'' even and odd (K_a' odd and even), respectively. Since the splitting of the upper state is much larger than that of the lower state and since $\Delta(4-1)$ exceeds $\Delta(3-2)$ by an amount related to the size of the *cis* barrier, any small alternation in torsional splitting observed in the IR as K_a'' varies between even and odd values is sensitive to the difference between $\Delta'(4-1)$ and $\Delta'(3-2)$ and yields direct information on V_{cis} (*16*). Such alternation is large enough to be seen in the $v_t = 3 \leftarrow 2$ IR spectrum.

In a previous communication on HSSH (*11*), we utilized a weighted nonlinear least-squares fit to the millimeter-wave data on the lowest J torsional splittings in $v_t = 0$ and 1, preliminary IR data on the band centers for $v_t = 1 \leftarrow 0$ and $2 \leftarrow 1$, and the IR-determined torsional splitting in $v_t = 2$ to obtain a potential function for torsional motion of the type shown in Eq. (2) with terms through V_3. We then determined V_{cis} and V_{trans} to be $(2800 \pm 90)\ cm^{-1}$ and $(1990 \pm 15)\ cm^{-1}$, respectively, with the major uncertainty caused by a lack of knowledge of F_T. (Without the IR band centers, V_{cis} could not have been determined, since the millimeter-wave torsional splittings by themselves are not sensitive to this barrier.) The values for V_{cis} and V_{trans} are in excellent agreement with the results of previous ab initio quantum chemical calculations (*19, 20*) which show, however, that as the torsional motion occurs, other changes occur in the skeletal framework of the molecule, particularly in the S–S bond length and the SSH angle. The reduced rotational "constant" F_T could not be obtained in our least-squares fit and had to be calculated based on an oversimplified model in which the skeletal framework of the molecule remains rigid except for the torsional motion (*14*). Although there is a dependence of F_T on χ to consider in this model, a larger problem was a discrepancy between the previous experimental (*1, 8*) and ab initio theoretical (*19, 20*) values for the SSH bond angle. This discrepancy has now been resolved in favor of the theoretically determined angle (see Section IV). Using our new r_0 structure (to be presented and refined in a forthcoming paper), we have recalculated the χ-independent part of F_T to be $19.61\ cm^{-1}$. It makes little sense to include the small χ-dependent terms in F_T in a solution of the torsional problem because the model on which they are based (a rigid skeleton) is not valid. Using the value of F_T newly obtained, including the new $v_t = 2$ low J torsional splitting measured accurately in our millimeter-wave apparatus, and changing the weights of our previous fit slightly to emphasize the torsional splittings over the IR band centers (see below), we have refitted the torsional data. The results of the fit can be seen in Table II. They are discussed in the next section along with the potential function determined. Figure 1 contains the torsional potential function and the torsional levels.

The success of the IAM treatment in understanding the torsional splittings in the torsional–rotational spectrum of HSSH suggests that this approach should be used to fit all of the measured transition frequencies. Such an approach has been utilized for methanol and similar three-fold internal rotors (*21*). In this treatment, the torsional wave functions and symmetric or asymmetric top rotational functions are multiplied together and used as basis functions to diagonalize a Hamiltonian matrix containing torsional, rotational, and rotational–torsional interaction terms. Although this method

is indispensable for methanol, in which the rotational–torsional interaction is large even with the IAM Hamiltonian specifically designed to reduce it, the small rotational–torsional interaction seen in HSSH suggests a more empirical and simpler approach used previously to study the millimeter-wave spectrum of HOOH (*22*) as well as in earlier papers on HSSH (*1–3, 10*). In this approach, the torsional–rotational spectrum is fitted to a Watson-type *S*-reduced asymmetric top Hamiltonian in which all v_t, τ states are accorded their own sets of rotational constants (if necessary) and the torsional energies and splittings in the absence of rotation are treated as adjustable parameters. Any small torsional–rotational interaction is absorbed in the differing rotational and centrifugal distortion constants. The reason rotational–torsional interaction is so much larger in methanol than in HOOH or HSSH has to do with the different symmetries of the molecules and has been discussed by Hunt *et al.* (*14*).

IV. DISCUSSION OF RESULTS

As discussed in Section III, the transition wavenumbers in Table I have not been analyzed by the IAM approach with the inclusion of torsional–rotational interaction (*14*) but by a simpler method in which different rotational and centrifugal distortion constants are utilized for the different torsional substates. The torsional energies and $v_t = 2, 3$ torsional splittings determined by this method are contained in the "experimental" columns of Table II. The $v_t = 2$ "symmetric" torsional splitting ($\frac{1}{2}[\Delta(4-1) + \Delta(3-2)]$) so deduced of 379.91 ± 0.81 MHz compares well with the millimeter-wave value of 376.14 ± 0.05 MHz. The spectroscopic parameters determined by this approach are shown in Table VI. Not all of the infrared data could be analyzed by our procedure; higher J and K_a states are significantly affected by Coriolis coupling (see below) and are excluded from the current data set.

Although the substitution structure for disulfane will be reported in a future publication, the HSS bond angle merits special discussion here due to a previous substantial discrepancy between experimental and theoretical values. The experimentally determined value for ∠SSH was originally reported to be 91–92° (*1, 8*) based partially on electron diffraction work. More recent ab initio treatments have obtained a value of 98.4° (*19, 20*). Our current r_0 structure is in substantial agreement with the theoretical treatments; we obtain 99.4° for ∠SSH.

Our new fit to the torsional data for $v_t \leqslant 2$ results in refined values for V_{cis} and V_{trans} of 2843 ± 9 cm^{-1} and 2037 ± 12 cm^{-1} based on the directly determined parameters V_1 = 274 ± 5 cm^{-1}, V_2 = 1219 ± 5 cm^{-1}, and V_3 = 129 ± 12 cm^{-1}. The errors are 1σ deviations obtained under the assumption that F_T is known exactly. True uncertainties are clearly larger. The potential function minimizes at a torsional angle χ of 89° which is reasonably close to the experimental r_0 angle of 90.54°. The results in Table II show that the torsional splittings of HSSH are well determined by a simple potential of the type shown in Eq. (2). Using just three potential parameters (V_1, V_2, and V_3), we have been able to fit the highly accurate low J torsional splittings for $v_t = 0, 1, 2$ determined from the pure rotational spectrum of HSSH with residuals (observed − calculated) of −0.11, 0.35, and −0.12 MHz for $v_t = 0, 1, 2$, respectively, as well as the band centers for the $v_t = 1 \leftarrow 0$ and $2 \leftarrow 1$ transitions. Somewhat larger than the experimental precision, the residuals for the torsional splittings reflect the simplicity of the potential function and the one-dimensional treatment. In the fit

TABLE VI

Effective Spectroscopic Parameters[a]

Constant	Ground state[b]	v_t=1
A /MHz	146858.1473(46)	146038.013(61)
B /MHz	6970.42953(62)	6942.6302(29)
C /MHz	6967.68832(61)	6931.6476(29)
D_J /kHz	5.39762(44)	5.38755(152)
D_{JK} /kHz	85.4059(70)	87.551(112)
D_K /MHz	2.427270(54)	2.3165(55)
d_1 /Hz	9.015(22)	-0.08339(27)
d_2 /Hz	-27.2244(72)	-30.16(73)
H_J /Hz	-0.001517(104)	0.0(fixed)
H_{JK} /Hz	-0.0549(24)	0.0(fixed)
H_{KJ} /Hz	1.629(23)	-57.4(43)
H_K /kHz	0.100986(118)	0.172(142)
$E(v)-E(v-1)$ /cm^{-1}	—	417.4767646(66)

Constant	v_t=2 (lower)	v_t=2 (upper)
A /MHz	145392.321(146)	145388.606(149)
B /MHz	6917.0241(78)	6916.9684(81)
C /MHz	6895.6815(80)	6895.7727(81)
D_J /kHz	5.3726(36)	5.3804(36)
D_{JK} /kHz	103.99(24)	103.23(27)
D_K /MHz	2.4342(126)	2.0216(127)
d_1 /Hz	-21.8(71)	36.0(80)
d_2 /Hz	-50.55(174)	-45.33(155)
H_{KJ} /Hz	-283.3(93)	-321.6(98)
H_K /kHz	4.72(31)	-6.89(32)
$E(v)-E(v-1)$ /cm^{-1}	390.5365737(183)	390.5495127(197)

Constant	v_t=3 (lower)	v_t=3 (upper)
A /MHz	144783.26(87)	144779.37(100)
B /MHz	6892.362(26)	6892.191(28)
C /MHz	6857.083(25)	6857.848(29)
D_J /kHz	5.396(21)	5.393(24)
D_{JK} /kHz	84.8(26)	89.9(25)
D_K /MHz	0.0(fixed)	0.0(fixed)
d_1 /Hz	-6.3(217)	-4.6(226)
d_2 /Hz	-78.1(88)	-65.8(61)
$E(v)-E(v-1)$ /cm^{-1}	363.202549(66)	363.570224(87)
$\lvert E_{cis}\rvert$ /MHz[c]	72.7(130)	62.4(130)

[a] Numbers in parentheses are one standard deviations.
[b] Revised constants. See also Ref.(10).
[c] The value of $[\Delta(4-1) - \Delta(3-2)]/2$ in Table II is obtained by adding these values of upper and lower component. Errors for this constant were estimated by manual adjustments.

reported here (but not in the preliminary version of Ref. (*11*)), the band centers have been assigned a weight corresponding to an uncertainty of 0.05 cm^{-1}, significantly greater than their deduced uncertainties, because it is clear that the band centers are influenced to some degree by Fermi-type (potential) coupling involving the low-lying (510-cm^{-1}) first excited S–S stretching state (v_s = 1). A strong Coriolis coupling has

already been detected involving the $v_t = 1$ and $v_s = 1$ states in the high K_a FIR pure rotational spectrum. The potential coupling, to be discussed and analyzed in a future paper in which ab initio theory is used to determine its magnitude (*23*), involves mainly the $v_t = 2$ state despite the fact that the energy for this state of 808 cm^{-1} places it farther from the first excited S–S stretching state ($v_s = 1$) than the $v_t = 1$ state, at 417 cm^{-1}, which is also connected to the $v_s = 1$ state due to the large-amplitude nature of the torsional motion. The most obvious manifestation of the coupling is an abnormally large torsional splitting ($\frac{1}{2}[\Delta(4 - 1) + \Delta(3 - 2] \approx 0.5$ MHz) in the $v_s = 1$ state, seen many years ago but only recently explained (*23*). It can be seen in Table II that the fit to the torsional band centers results in vibrational energies that are only good to ≈ 0.5 cm^{-1}. A more accurate determination of the energy levels would require solution of at least a two-dimensional Schroedinger equation with coordinates for torsional motion and the S–S stretch, and possibly a multi-dimensional equation involving other low frequency motions as well. The low J, K torsional splittings in the $v_t = 0, 1, 2, 3$ states, on the other hand, are not affected as greatly by the potential coupling.

The utility of the torsional potential determined from the data involving the $v_t = 0$, 1, and 2 states in predicting the $v_t = 3$ state data is also shown in Table II. The symmetric rotationless torsional splitting $\frac{1}{2}[\Delta(4 - 1) + \Delta(3 - 2)]$ is determined to be 10 642.7 ± 3.3 MHz from IR data whereas it is predicted to be 10 602 MHz from the fit to the lower state data. This splitting is associated with the potential barrier V_{trans}. The asymmetric torsional splitting $\frac{1}{2}[\Delta(4 - 1) - \Delta(3 - 2]$ is measured to be 135 ± 18 MHz and predicted to be 152 MHz. This latter splitting is associated with V_{cis}. That the predicted splittings differ somewhat from those measured is not too surprising given the large size of the $v_t = 3$ splittings. Note that the splitting associated with V_{cis} was too small in the $v_t \leq 2$ states to be seen in the IR torsional spectrum and cannot be detected at all in the pure rotational spectrum due to the selection rules. Yet the potential determined from the $v_t \leq 2$ data was able to predict this splitting and determine the value of V_{cis} based primarily on the positions of the band centers for the $v_t = 1 \leftarrow 0$ and $2 \leftarrow 1$ transitions. Clearly the energies of the excited torsional states are sensitive to the entire potential function $V(\chi)$.

Although a full IAM treatment of the pure rotational and torsional–rotational spectra of HSSH is not needed to analyze the data set presented here, it might prove useful in further refining the torsional potential. In the case of methanol, a full IAM treatment did permit an accurate determination of the reduced rotational constant F_T. Were this parameter to be determined for HSSH, there would be even less uncertainty in the deduced torsional potential function.

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TABLE I

Observed IR Transitions (in cm^{-1}) of HSSH

J	Ka	Kc	-	J	Ka	Kc	Observed	O-C
a				ν_t = 1 - 0 Band				
25	1	24	-	26	0	26	409.40684	0.00001
24	1	23	-	25	0	25	409.91917	0.00003
23	1	22	-	24	0	24	410.42961	0.00000
22	1	21	-	23	0	23	410.93809	-0.00013
21	1	20	-	22	0	22	411.44499	0.00000
20	1	19	-	21	0	21	411.94991	-0.00001
19	1	18	-	20	0	20	412.45309	0.00012
18	1	17	-	19	0	19	412.95416	0.00000
17	1	16	-	18	0	18	413.45342	-0.00006
16	1	15	-	17	0	17	413.95092	0.00000
15	1	14	-	16	0	16	414.44647	-0.00002
14	1	13	-	15	0	15	414.94018	0.00001
13	1	12	-	14	0	14	415.43197	0.00000
12	1	11	-	13	0	13	415.92184	-0.00004
11	1	10	-	12	0	12	416.40994	0.00005
9	1	8	-	10	0	10	417.38024	0.00003
8	1	7	-	9	0	9	417.86252	0.00000
7	1	6	-	8	0	8	418.34296	0.00006
6	1	5	-	7	0	7	418.82135	-0.00002
5	1	4	-	6	0	6	419.29792	0.00000
4	1	3	-	5	0	5	419.77259	0.00005
3	1	2	-	4	0	4	420.24527	0.00005
2	1	1	-	3	0	3	420.71598	0.00000
25	1	25	-	25	0	25	421.36313	-0.00004
23	1	23	-	23	0	23	421.47672	-0.00003
22	1	22	-	22	0	22	421.53009	0.00003
21	1	21	-	21	0	21	421.58106	0.00000
20	1	20	-	20	0	20	421.62962	0.00008
19	1	19	-	19	0	19	421.67609	-0.00002
18	1	18	-	18	0	18	421.72019	0.00004
17	1	17	-	17	0	17	421.76187	-0.00001
16	1	16	-	16	0	16	421.80127	-0.00002
15	1	15	-	15	0	15	421.83838	0.00000
14	1	14	-	14	0	14	421.87332	0.00016
13	1	13	-	13	0	13	421.90561	0.00000
12	1	12	-	12	0	12	421.93586	0.00011
11	1	11	-	11	0	11	421.96360	0.00003
10	1	10	-	10	0	10	421.98908	0.00000
9	1	9	-	9	0	9	422.01227	0.00001
8	1	8	-	8	0	8	422.03315	0.00002
7	1	7	-	7	0	7	422.05173	0.00006
5	1	5	-	5	0	5	422.08185	0.00004
4	1	4	-	4	0	4	422.09342	0.00001
3	1	3	-	3	0	3	422.10273	0.00005
2	1	2	-	2	0	2	422.10977	0.00013
1	1	1	-	1	0	1	422.11426	-0.00001
2	1	1	-	1	0	1	423.04044	-0.00014
3	1	2	-	2	0	2	423.48961	-0.00002
4	1	3	-	3	0	3	423.93674	0.00001
5	1	4	-	4	0	4	424.41185	0.00000
6	1	5	-	5	0	5	424.86503	0.00003
7	1	6	-	6	0	6	425.31621	0.00004
8	1	7	-	7	0	7	425.76536	0.00001
9	1	8	-	8	0	8	426.21263	0.00008
10	1	9	-	9	0	9	426.65779	0.00003
11	1	10	-	10	0	10	427.10103	0.00005
12	1	11	-	11	0	11	427.54222	0.00003
13	1	12	-	12	0	12	427.98137	-0.00003
14	1	13	-	13	0	13	428.41859	-0.00001
15	1	14	-	14	0	14	428.85380	0.00001
16	1	15	-	15	0	15	429.28697	0.00000
17	1	16	-	16	0	16	429.71813	0.00000
18	1	17	-	17	0	17	430.14721	-0.00005
20	1	19	-	19	0	19	430.99941	-0.00002
21	1	20	-	20	0	20	431.42245	0.00000
22	1	21	-	21	0	21	431.84344	0.00000
23	1	22	-	22	0	22	432.26241	0.00003
24	1	23	-	23	0	23	432.67928	0.00001
25	1	24	-	24	0	24	433.09414	0.00003
25	2	24	-	26	1	26	418.61280	0.00014
25	2	23	-	26	1	25	418.57975	-0.00006
24	2	23	-	25	1	25	419.12860	0.00003
24	2	22	-	25	1	24	419.09821	0.00001
23	2	22	-	24	1	24	419.64256	0.00009
23	2	21	-	24	1	23	419.61447	-0.00004
22	2	21	-	23	1	23	420.15445	0.00002
22	2	20	-	23	1	22	420.12867	-0.00005
21	2	19	-	22	1	21	420.64087	0.00002
20	2	19	-	21	1	21	421.17243	0.00011
20	2	18	-	21	1	20	421.15091	0.00004
19	2	17	-	20	1	19	421.65879	0.00000
18	2	17	-	19	1	19	422.18222	0.00002
18	2	16	-	19	1	18	422.16449	-0.00012
17	2	16	-	18	1	18	422.68418	0.00006
17	2	15	-	18	1	17	422.66828	-0.00003
16	2	15	-	17	1	17	423.18402	-0.00001
16	2	14	-	17	1	16	423.16986	-0.00004
15	2	14	-	16	1	16	423.68189	-0.00002
15	2	13	-	16	1	15	423.66938	0.00001
14	2	13	-	15	1	15	424.17775	-0.00002
14	2	12	-	15	1	14	424.16670	-0.00002
13	2	12	-	14	1	14	424.67170	0.00010
13	2	11	-	14	1	13	424.66200	0.00007
12	2	11	-	13	1	13	425.16340	0.00002
12	2	10	-	13	1	12	425.15510	0.00009
11	2	10	-	12	1	12	425.65324	0.00012
11	2	9	-	12	1	11	425.64595	-0.00001
10	2	9	-	11	1	11	426.14052	0.00000
10	2	8	-	11	1	10	426.13478	0.00002
9	2	8	-	10	1	10	426.62626	-0.00020
9	2	7	-	10	1	9	426.62141	-0.00001
8	2	7	-	9	1	9	427.11009	0.00004
8	2	6	-	9	1	8	427.10591	-0.00001
7	2	6	-	8	1	8	427.59154	-0.00003
7	2	5	-	8	1	7	427.58830	0.00003
5	2	3	-	6	1	5	428.54658	0.00008
3	2	1	-	4	1	3	429.49609	0.00002
2	2	1	-	3	1	3	429.96813	0.00000
25	2	23	-	25	1	25	430.68615	-0.00009
25	2	24	-	25	1	24	430.65682	0.00008
24	2	22	-	24	1	24	430.73867	-0.00008
24	2	23	-	24	1	23	430.71160	0.00010
23	2	21	-	23	1	23	430.78912	-0.00004
23	2	22	-	23	1	22	430.76412	0.00004
22	2	20	-	22	1	22	430.83743	-0.00004
22	2	21	-	22	1	21	430.81448	0.00001
21	2	19	-	21	1	21	430.88369	0.00000
20	2	18	-	20	1	20	430.92779	-0.00001
20	2	19	-	20	1	19	430.90871	0.00002
19	2	17	-	19	1	19	430.96978	-0.00004
19	2	18	-	19	1	18	430.95251	-0.00001
18	2	16	-	18	1	18	431.00987	-0.00006
18	2	17	-	18	1	17	430.99419	0.00003
17	2	15	-	17	1	17	431.04751	-0.00004
17	2	16	-	17	1	16	431.03362	0.00001
16	2	14	-	16	1	16	431.08318	-0.00009
16	2	15	-	16	1	15	431.07082	-0.00005
15	2	13	-	15	1	15	431.11687	-0.00001
15	2	14	-	15	1	14	431.10589	-0.00005
14	2	12	-	14	1	14	431.14843	0.00003
14	2	13	-	14	1	13	431.13882	0.00000
13	2	11	-	13	1	13	431.17779	-0.00003
13	2	12	-	13	1	12	431.16949	-0.00002
12	2	10	-	12	1	12	431.20513	0.00000
12	2	11	-	12	1	11	431.19802	0.00001
11	2	9	-	11	1	11	431.23034	-0.00001
11	2	10	-	11	1	10	431.22439	0.00007
10	2	8	-	10	1	10	431.25347	0.00001
10	2	9	-	10	1	9	431.24847	0.00003
9	2	7	-	9	1	9	431.27447	0.00000
8	2	6	-	8	1	8	431.29327	-0.00012
8	2	7	-	8	1	7	431.29009	-0.00001
7	2	5	-	7	1	7	431.31020	0.00000
7	2	6	-	7	1	6	431.30770	0.00006
6	2	4	-	6	1	6	431.32494	0.00003
6	2	5	-	6	1	5	431.32302	0.00003
5	2	3	-	5	1	5	431.33743	-0.00008
4	2	3	-	4	1	3	431.34719	0.00008
3	2	1	-	3	1	3	431.35625	-0.00018
2	2	1	-	2	1	1	431.36231	0.00005
2	2	1	-	1	1	1	432.29247	0.00000
2	2	0	-	1	1	0	432.29247	0.00009
3	2	2	-	2	1	2	432.75082	-0.00021
3	2	1	-	2	1	1	432.75082	0.00007
4	2	3	-	3	1	3	433.20733	-0.00014
5	2	3	-	4	1	3	433.66100	0.00012
6	2	5	-	5	1	5	434.11391	-0.00008
7	2	5	-	6	1	5	434.56228	0.00014
8	2	7	-	7	1	7	435.01199	-0.00002
8	2	6	-	7	1	6	435.00954	0.00010
9	2	8	-	8	1	8	435.45777	-0.00006
9	2	7	-	8	1	7	435.45452	0.00001
10	2	9	-	9	1	9	435.90152	0.00002
10	2	8	-	9	1	8	435.89731	0.00016
11	2	9	-	10	1	9	436.33814	0.00017
12	2	11	-	11	1	11	436.78241	0.00001
12	2	10	-	11	1	10	436.77631	-0.00002
13	2	12	-	12	1	12	437.21967	0.00004
13	2	11	-	12	1	11	437.21244	-0.00001
14	2	13	-	13	1	13	437.65470	-0.00001
14	2	12	-	13	1	12	437.64630	-0.00002
15	2	14	-	14	1	14	438.08762	0.00000
15	2	13	-	14	1	13	438.07791	-0.00002
16	2	15	-	15	1	15	438.51840	0.00002
16	2	14	-	15	1	14	438.50720	-0.00009
17	2	16	-	16	1	16	438.94699	0.00002
17	2	15	-	16	1	15	438.93439	0.00001
18	2	17	-	17	1	17	439.37342	0.00003
18	2	16	-	17	1	16	439.35907	-0.00014
19	2	17	-	18	1	17	439.78174	-0.00003
19	2	18	-	18	1	18	439.79767	0.00004
20	2	19	-	19	1	19	440.21967	-0.00003
20	2	18	-	19	1	18	440.20197	-0.00008
21	2	20	-	20	1	20	440.63962	0.00003
21	2	19	-	20	1	19	440.62003	-0.00002
22	2	21	-	21	1	21	441.05735	0.00005
22	2	20	-	21	1	20	441.03571	-0.00005
23	2	22	-	22	1	22	441.47288	0.00006
23	2	21	-	22	1	21	441.44911	-0.00009
24	2	23	-	23	1	23	441.88620	0.00006
24	2	22	-	23	1	22	441.86030	-0.00004
25	2	24	-	24	1	24	442.29731	0.00002
25	2	23	-	24	1	23	442.26909	-0.00008
25	3	23	-	26	2	25	427.78941	0.00015
24	3	21	-	25	2	23	428.30736	-0.00016
23	3	21	-	24	2	23	428.82234	0.00010

TABLE I—*Continued*

J	Ka	Kc	-	J	Ka	Kc	Observed	O-C	J	Ka	Kc	-	J	Ka	Kc	Observed	O-C
22	3	19	-	23	2	21	429.33604	-0.00014	23	3	21	-	22	2	21	450.65414	0.00010
21	3	19	-	22	2	21	429.84707	0.00008	24	3	21	-	23	2	21	451.06628	-0.00016
20	3	17	-	21	2	19	430.35659	-0.00005	25	5	21	-	26	4	23	446.00419	-0.00002
18	3	16	-	19	2	18	431.36877	0.00017	25	3	23	-	24	2	23	451.47561	0.00011
18	3	15	-	19	2	17	431.36877	-0.00008									
17	3	15	-	18	2	17	431.87170	0.00006	25	4	•	-	26	3	•	436.92627	-0.00002
17	3	14	-	18	2	16	431.87170	-0.00015	24	4	•	-	25	3	•	437.44403	-0.00001
16	3	14	-	17	2	16	432.37270	0.00009	23	4	•	-	24	3	•	437.95969	-0.00005
16	3	13	-	17	2	15	432.37270	-0.00007	22	4	•	-	23	3	•	438.47336	0.00000
15	3	13	-	16	2	15	432.87154	0.00005	21	4	•	-	22	3	•	438.98493	0.00001
15	3	12	-	16	2	14	432.87154	-0.00007	20	4	•	-	21	3	•	439.49454	0.00013
14	3	12	-	15	2	14	433.36834	0.00007	19	4	•	-	20	3	•	440.00183	0.00002
14	3	11	-	15	2	13	433.36834	-0.00003	17	4	•	-	18	3	•	441.01032	-0.00004
13	3	11	-	14	2	13	433.86297	0.00001	16	4	•	-	17	3	•	441.51152	0.00001
13	3	10	-	14	2	12	433.86297	-0.00006	15	4	•	-	16	3	•	442.01057	0.00002
12	3	10	-	13	2	12	434.35555	0.00001	14	4	•	-	15	3	•	442.50749	0.00000
12	3	9	-	13	2	11	434.35555	-0.00005	13	4	•	-	14	3	•	443.00227	-0.00005
11	3	9	-	12	2	11	434.84603	0.00000	12	4	•	-	13	3	•	443.49501	-0.00003
11	3	8	-	12	2	10	434.84603	-0.00004	11	4	•	-	12	3	•	443.98567	0.00003
10	3	8	-	11	2	10	435.33437	-0.00003	10	4	•	-	11	3	•	444.47413	0.00000
10	3	7	-	11	2	9	435.33437	-0.00006	8	4	•	-	9	3	•	445.44468	-0.00004
9	3	7	-	10	2	9	435.82082	0.00015	7	4	•	-	8	3	•	445.92686	0.00005
9	3	6	-	10	2	8	435.82082	0.00013	6	4	•	-	7	3	•	446.40678	0.00001
8	3	6	-	9	2	8	436.30478	-0.00004									
8	3	5	-	9	2	7	436.30478	-0.00005	25	4	•	-	25	3	•	449.00036	0.00000
7	3	5	-	8	2	7	436.78687	0.00003	24	4	•	-	24	3	•	449.05453	-0.00011
7	3	4	-	8	2	6	436.78687	0.00002	23	4	•	-	23	3	•	449.10677	0.00001
6	3	4	-	7	2	6	437.26676	0.00002	22	4	•	-	22	3	•	449.15667	-0.00004
6	3	3	-	7	2	5	437.26676	0.00001	21	4	•	-	21	3	•	449.20446	-0.00003
5	3	3	-	6	2	5	437.74448	-0.00003	20	4	•	-	20	3	•	449.25011	0.00001
5	3	2	-	6	2	4	437.74448	-0.00003	19	4	•	-	19	3	•	449.29351	-0.00003
4	3	2	-	5	2	4	438.22010	-0.00005	18	4	•	-	18	3	•	449.33477	-0.00003
4	3	1	-	5	2	3	438.22010	-0.00005	17	4	•	-	17	3	•	449.37389	-0.00001
									16	4	•	-	16	3	•	449.41082	-0.00001
24	3	21	-	24	2	23	439.91828	0.00013	15	4	•	-	15	3	•	449.44555	-0.00003
23	3	21	-	23	2	21	439.97037	-0.00016	14	4	•	-	14	3	•	449.47814	-0.00003
22	3	19	-	22	2	21	440.01984	0.00015	13	4	•	-	13	3	•	449.50857	-0.00001
21	3	19	-	21	2	19	440.06748	-0.00011	12	4	•	-	12	3	•	449.53680	-0.00002
20	3	17	-	20	2	19	440.11264	0.00006	11	4	•	-	11	3	•	449.56292	0.00003
19	3	16	-	19	2	18	440.15595	0.00016	10	4	•	-	10	3	•	449.58688	0.00009
19	3	17	-	19	2	17	440.15595	-0.00009	9	4	•	-	9	3	•	449.60848	-0.00003
18	3	15	-	18	2	17	440.19684	0.00001	8	4	•	-	8	3	•	449.62804	-0.00002
18	3	16	-	18	2	16	440.19684	-0.00019	7	4	•	-	7	3	•	449.64538	-0.00006
17	3	14	-	17	2	16	440.23584	0.00013	6	4	•	-	6	3	•	449.66064	-0.00001
17	3	15	-	17	2	15	440.23584	-0.00003	5	4	•	-	5	3	•	449.67367	-0.00002
16	3	13	-	16	2	15	440.27243	0.00000	4	4	•	-	4	3	•	449.68453	-0.00002
16	3	14	-	16	2	14	440.27243	-0.00013									
15	3	12	-	15	2	14	440.30707	0.00008	4	4	•	-	3	3	•	451.54397	-0.00003
15	3	13	-	15	2	13	440.30707	-0.00002	5	4	•	-	4	3	•	451.99795	-0.00001
14	3	11	-	14	2	13	440.33945	0.00006	6	4	•	-	5	3	•	452.44973	-0.00001
14	3	12	-	14	2	12	440.33945	-0.00002	7	4	•	-	6	3	•	452.89928	-0.00003
13	3	10	-	13	2	12	440.36969	0.00006	8	4	•	-	7	3	•	453.34665	-0.00004
13	3	11	-	13	2	11	440.36969	0.00000	9	4	•	-	8	3	•	453.79184	-0.00002
12	3	9	-	12	2	11	440.39771	0.00000	10	4	•	-	9	3	•	454.23477	-0.00004
12	3	10	-	12	2	10	440.39771	-0.00004	11	4	•	-	10	3	•	454.67554	-0.00001
11	3	8	-	11	2	10	440.42368	0.00006	12	4	•	-	11	3	•	455.11405	-0.00002
11	3	9	-	11	2	9	440.42368	0.00003	13	4	•	-	12	3	•	455.55033	-0.00003
10	3	7	-	10	2	9	440.44736	-0.00002	14	4	•	-	13	3	•	455.98441	-0.00002
10	3	8	-	10	2	8	440.44736	-0.00004	15	4	•	-	14	3	•	456.41626	-0.00001
9	3	6	-	9	2	8	440.46897	-0.00001	16	4	•	-	15	3	•	456.84586	0.00000
9	3	7	-	9	2	7	440.46897	-0.00002	17	4	•	-	16	3	•	457.27320	-0.00002
8	3	5	-	8	2	7	440.48847	0.00005	18	4	•	-	17	3	•	457.69834	0.00000
8	3	6	-	8	2	6	440.48847	0.00004	19	4	•	-	18	3	•	458.12116	-0.00004
7	3	4	-	7	2	6	440.50586	0.00017	20	4	•	-	19	3	•	458.54184	0.00002
7	3	5	-	7	2	5	440.50586	0.00016	21	4	•	-	20	3	•	458.96018	0.00001
6	3	3	-	6	2	5	440.52082	0.00001	22	4	•	-	21	3	•	459.37622	-0.00005
6	3	4	-	6	2	4	440.52082	0.00001	23	4	•	-	22	3	•	459.79011	0.00000
5	3	2	-	5	2	4	440.53382	0.00005	24	4	•	-	23	3	•	460.20161	-0.00006
5	3	3	-	5	2	3	440.53382	0.00005	25	4	•	-	24	3	•	460.61091	-0.00005
4	3	1	-	4	2	3	440.54456	-0.00001									
4	3	2	-	4	2	2	440.54456	-0.00001	25	5	•	-	26	4	•	446.00419	-0.00002
									24	5	•	-	25	4	•	446.52223	-0.00004
3	3	0	-	2	2	0	441.94792	0.00002	23	5	•	-	24	4	•	447.03825	-0.00002
3	3	1	-	2	2	1	441.94792	0.00002	22	5	•	-	23	4	•	447.55221	0.00002
4	3	1	-	3	2	1	442.40413	-0.00001	21	5	•	-	22	4	•	448.06399	-0.00003
4	3	2	-	3	2	2	442.40413	-0.00001	20	5	•	-	21	4	•	448.57364	0.00008
5	3	2	-	4	2	2	442.85820	0.00000	19	5	•	-	20	4	•	449.08141	0.00000
5	3	3	-	4	2	3	442.85820	0.00000	18	5	•	-	19	4	•	449.58688	-0.00007
6	3	3	-	5	2	3	443.31007	-0.00001	17	5	•	-	18	4	•	450.09039	-0.00001
6	3	4	-	5	2	4	443.31007	-0.00001	16	5	•	-	17	4	•	450.59173	-0.00001
7	3	4	-	6	2	4	443.75978	0.00001	15	5	•	-	16	4	•	451.09096	0.00000
7	3	5	-	6	2	5	443.75978	0.00001	14	5	•	-	15	4	•	451.58807	0.00000
8	3	5	-	7	2	5	444.20729	0.00001	13	5	•	-	14	4	•	452.08306	0.00000
8	3	6	-	7	2	6	444.20729	0.00001	12	5	•	-	13	4	•	452.57592	-0.00001
9	3	6	-	8	2	6	444.65257	-0.00002	11	5	•	-	12	4	•	453.06667	0.00001
9	3	7	-	8	2	7	444.65257	-0.00001	10	5	•	-	11	4	•	453.55524	-0.00003
10	3	7	-	9	2	7	445.09572	0.00001	9	5	•	-	10	4	•	454.04169	-0.00004
10	3	8	-	9	2	8	445.09572	0.00003	8	5	•	-	9	4	•	454.52603	-0.00002
11	3	8	-	10	2	8	445.53660	-0.00002	7	5	•	-	8	4	•	455.00833	0.00011
11	3	9	-	10	2	9	445.53660	0.00000									
12	3	9	-	11	2	9	445.97529	-0.00004	25	5	•	-	25	4	•	458.07721	-0.00003
12	3	10	-	11	2	10	445.97529	-0.00001	24	5	•	-	24	4	•	458.13187	-0.00001
13	3	10	-	12	2	10	446.41179	-0.00004	23	5	•	-	23	4	•	458.18430	-0.00004
13	3	11	-	12	2	11	446.41179	0.00000	22	5	•	-	22	4	•	458.23459	-0.00002
14	3	11	-	13	2	11	446.84608	-0.00004	21	5	•	-	21	4	•	458.28266	-0.00004
14	3	12	-	13	2	12	446.84608	0.00002	20	5	•	-	20	4	•	458.32858	-0.00002
15	3	12	-	14	2	12	447.27810	-0.00010	19	5	•	-	19	4	•	458.37232	-0.00001
15	3	13	-	14	2	13	447.27810	-0.00002	18	5	•	-	18	4	•	458.41385	-0.00001
16	3	13	-	15	2	13	447.70802	-0.00002	17	5	•	-	17	4	•	458.45319	-0.00002
16	3	14	-	15	2	14	447.70802	0.00008	16	5	•	-	16	4	•	458.49036	-0.00002
17	3	14	-	16	2	14	448.13555	-0.00012	15	5	•	-	15	4	•	458.52536	0.00000
17	3	15	-	16	2	15	448.13555	0.00001	14	5	•	-	14	4	•	458.55817	0.00001
19	3	17	-	18	2	17	448.98400	-0.00003	13	5	•	-	13	4	•	458.58872	-0.00005
20	3	17	-	19	2	17	449.40508	-0.00008	12	5	•	-	12	4	•	458.61716	-0.00003
20	3	18	-	19	2	18	449.40508	0.00017	11	5	•	-	11	4	•	458.64343	0.00000
21	3	19	-	20	2	19	449.82360	0.00006	10	5	•	-	10	4	•	458.66748	0.00000
22	3	19	-	21	2	19	450.24017	-0.00012	9	5	•	-	9	4	•	458.68933	-0.00002

TABLE I—*Continued*

J	Ka	Kc	-	J	Ka	Kc	Observed	O-C
8	5	*	-	8	4	*	458.70899	-0.00004
7	5	*	-	7	4	*	458.72653	0.00001
6	5	*	-	6	4	*	458.74182	-0.00001
5	5	*	-	5	4	*	458.75498	0.00003
5	5	*	-	4	4	*	461.07902	-0.00001
6	5	*	-	5	4	*	461.53065	-0.00003
7	5	*	-	6	4	*	461.98011	-0.00001
8	5	*	-	7	4	*	462.42732	-0.00002
9	5	*	-	8	4	*	462.87230	-0.00003
10	5	*	-	9	4	*	463.31508	-0.00003
11	5	*	-	10	4	*	463.75560	-0.00005
12	5	*	-	11	4	*	464.19395	-0.00001
13	5	*	-	12	4	*	464.63002	-0.00001
14	5	*	-	13	4	*	465.06383	-0.00004
15	5	*	-	14	4	*	465.49544	-0.00002
16	5	*	-	15	4	*	465.92477	-0.00002
17	5	*	-	16	4	*	466.35183	-0.00004
18	5	*	-	17	4	*	466.77666	-0.00003
19	5	*	-	18	4	*	467.19927	0.00003
20	5	*	-	19	4	*	467.61950	-0.00003
21	5	*	-	20	4	*	468.03753	-0.00002
22	5	*	-	21	4	*	468.45327	-0.00003
23	5	*	-	22	4	*	468.86672	-0.00004
24	5	*	-	23	4	*	469.27792	-0.00003
25	5	*	-	24	4	*	469.68682	-0.00002
25	0	25	-	26	1	25	400.02878	0.00002
24	0	24	-	25	1	24	400.54657	-0.00004
23	0	23	-	24	1	23	401.06238	-0.00001
22	0	22	-	23	1	22	401.57605	-0.00005
21	0	21	-	22	1	21	402.08786	0.00013
20	0	20	-	21	1	20	402.59732	0.00003
19	0	19	-	20	1	19	403.10474	-0.00003
18	0	18	-	19	1	18	403.61017	0.00002
17	0	17	-	18	1	17	404.11347	0.00002
16	0	16	-	17	1	16	404.61469	0.00004
15	0	15	-	16	1	15	405.11374	-0.00001
14	0	14	-	15	1	14	405.61075	0.00000
13	0	13	-	14	1	13	406.10567	0.00001
12	0	12	-	13	1	12	406.59837	-0.00007
11	0	11	-	12	1	11	407.08912	0.00001
10	0	10	-	11	1	10	407.57765	0.00000
9	0	9	-	10	1	9	408.06407	-0.00001
8	0	8	-	9	1	8	408.54835	-0.00003
7	0	7	-	8	1	7	409.03053	-0.00001
6	0	6	-	7	1	6	409.51057	0.00000
5	0	5	-	6	1	5	409.98848	0.00002
2	0	2	-	3	1	2	411.40925	-0.00001
1	0	1	-	2	1	1	411.87859	0.00003
25	0	25	-	25	1	25	412.13518	0.00000
24	0	24	-	24	1	24	412.18715	0.00000
23	0	23	-	23	1	23	412.23698	-0.00005
22	0	22	-	22	1	22	412.28475	-0.00010
21	0	21	-	21	1	21	412.33056	-0.00001
20	0	20	-	20	1	20	412.37417	-0.00005
19	0	19	-	19	1	19	412.41580	0.00001
18	0	18	-	18	1	18	412.45528	0.00000
17	0	17	-	17	1	17	412.49267	-0.00002
16	0	16	-	16	1	16	412.52801	-0.00001
15	0	15	-	15	1	15	412.56127	0.00000
14	0	14	-	14	1	14	412.59243	-0.00002
13	0	13	-	13	1	13	412.62154	0.00000
12	0	12	-	12	1	12	412.64861	0.00005
11	0	11	-	11	1	11	412.67349	-0.00001
10	0	10	-	10	1	10	412.69628	-0.00008
9	0	9	-	9	1	9	412.71713	-0.00001
8	0	8	-	8	1	8	412.73580	-0.00004
7	0	7	-	7	1	7	412.75250	0.00003
6	0	6	-	6	1	6	412.76717	0.00016
5	0	5	-	5	1	5	412.77947	-0.00001
4	0	4	-	4	1	4	412.78988	0.00001
3	0	3	-	3	1	3	412.79818	0.00000
2	0	2	-	2	1	2	412.80447	0.00005
3	0	3	-	2	1	1	414.19253	0.00002
4	0	4	-	3	1	2	414.64871	-0.00006
5	0	5	-	4	1	3	415.10284	0.00000
6	0	6	-	5	1	4	415.55468	-0.00004
8	0	8	-	7	1	6	416.45187	-0.00003
10	0	10	-	9	1	8	417.34023	-0.00002
11	0	11	-	10	1	9	417.78110	-0.00002
12	0	12	-	11	1	10	418.21976	0.00000
13	0	13	-	12	1	11	418.65616	-0.00001
14	0	14	-	13	1	12	419.09040	0.00004
15	0	15	-	14	1	13	419.52234	0.00002
16	0	16	-	15	1	14	419.95203	-0.00001
17	0	17	-	16	1	15	420.37949	-0.00003
18	0	18	-	17	1	16	420.80478	0.00003
19	0	19	-	18	1	17	421.22769	-0.00005
20	0	20	-	19	1	18	421.64850	0.00004
21	0	21	-	20	1	19	422.06711	0.00018
22	0	22	-	21	1	20	422.48319	0.00005
23	0	23	-	22	1	21	422.89707	0.00000
24	0	24	-	23	1	22	423.30872	-0.00001
25	0	25	-	24	1	23	423.71811	0.00000
25	1	24	-	26	2	24	390.75160	-0.00013
25	1	25	-	26	2	25	390.63179	-0.00002
24	1	23	-	25	2	23	391.26338	-0.00001
24	1	24	-	25	2	24	391.15279	0.00004
23	1	23	-	24	2	23	391.67152	0.00002
22	1	21	-	23	2	21	392.28129	0.00002
22	1	22	-	23	2	22	392.18812	0.00007
21	1	20	-	22	2	20	392.78746	-0.00001
21	1	21	-	22	2	21	392.70244	0.00004
20	1	19	-	21	2	19	393.29185	0.00000
20	1	20	-	21	2	20	393.21455	0.00001
19	1	19	-	20	2	19	393.72441	-0.00007
18	1	17	-	19	2	17	394.29510	-0.00001
17	1	16	-	18	2	16	394.79391	-0.00006
17	1	17	-	18	2	17	394.73754	-0.00018
16	1	15	-	17	2	15	395.29098	-0.00001
16	1	16	-	17	2	16	395.24102	0.00002
15	1	14	-	16	2	14	395.78613	-0.00002
15	1	15	-	16	2	15	395.74209	0.00003
14	1	13	-	15	2	13	396.27947	0.00001
14	1	14	-	15	2	14	396.24090	0.00001
13	1	12	-	14	2	12	396.77067	-0.00004
13	1	13	-	14	2	13	396.73748	-0.00001
12	1	11	-	13	2	11	397.26046	-0.00002
12	1	12	-	13	2	12	397.23184	-0.00001
11	1	10	-	12	2	10	397.74822	0.00003
11	1	11	-	12	2	11	397.72399	0.00002
10	1	9	-	11	2	9	398.23397	-0.00005
10	1	10	-	11	2	10	398.21368	-0.00017
9	1	8	-	10	2	8	398.71798	0.00000
9	1	9	-	10	2	9	398.70147	0.00000
8	1	7	-	9	2	7	399.20001	-0.00003
8	1	8	-	9	2	8	399.18688	0.00004
7	1	6	-	8	2	6	399.68011	-0.00011
7	1	7	-	8	2	7	399.66998	0.00002
6	1	5	-	7	2	5	400.15857	0.00005
6	1	6	-	7	2	6	400.15075	-0.00006
5	1	4	-	6	2	4	400.63486	-0.00004
5	1	5	-	6	2	5	400.62943	0.00003
4	1	3	-	5	2	3	401.10932	-0.00006
3	1	2	-	4	2	2	401.58188	-0.00008
3	1	3	-	4	2	3	401.57981	0.00005
2	1	1	-	3	2	1	402.05255	-0.00007
1	1	0	-	2	2	0	402.52140	0.00003
25	1	25	-	25	2	23	402.70746	0.00004
25	1	24	-	25	2	24	402.82375	0.00001
24	1	24	-	24	2	22	402.76484	0.00009
24	1	23	-	24	2	23	402.87397	-0.00005
23	1	23	-	23	2	21	402.81980	0.00001
23	1	22	-	23	2	22	402.92044	0.00007
22	1	21	-	22	2	21	402.96479	0.00001
21	1	21	-	21	2	19	402.92298	-0.00002
21	1	20	-	21	2	20	403.00733	0.00008
20	1	20	-	20	2	18	402.97120	0.00002
20	1	19	-	20	2	19	403.04779	-0.00001
19	1	19	-	19	2	17	403.01706	0.00000
19	1	18	-	19	2	18	403.08632	0.00011
18	1	18	-	18	2	16	403.06052	-0.00013
18	1	17	-	18	2	17	403.12308	-0.00001
17	1	17	-	17	2	15	403.10199	0.00004
17	1	16	-	17	2	16	403.15784	0.00001
16	1	16	-	16	2	14	403.14099	0.00003
16	1	15	-	16	2	15	403.19065	0.00000
15	1	15	-	15	2	13	403.17768	0.00001
15	1	14	-	15	2	14	403.22153	0.00000
14	1	14	-	14	2	12	403.21207	-0.00002
14	1	13	-	14	2	13	403.25043	-0.00005
13	1	13	-	13	2	11	403.24424	0.00002
13	1	12	-	13	2	12	403.27744	-0.00006
12	1	12	-	12	2	10	403.27402	-0.00004
10	1	9	-	10	2	9	403.34699	0.00002
9	1	9	-	9	2	7	403.34977	-0.00003
9	1	8	-	9	2	8	403.36625	-0.00002
8	1	8	-	8	2	6	403.37049	0.00003
8	1	7	-	8	2	7	403.38364	0.00000
7	1	7	-	7	2	5	403.38486	0.00004
7	1	6	-	7	2	6	403.39905	-0.00002
6	1	6	-	6	2	4	403.40485	-0.00004
6	1	5	-	6	2	5	403.41257	-0.00001
5	1	5	-	5	2	3	403.41867	0.00001
5	1	4	-	5	2	4	403.42417	0.00001
4	1	4	-	4	2	2	403.43018	0.00004
4	1	3	-	4	2	3	403.43381	0.00001
3	1	3	-	3	2	1	403.43937	0.00005
3	1	2	-	3	2	2	403.44159	0.00007
2	1	1	-	2	2	1	403.44718	-0.00013
6	1	6	-	5	2	4	406.19406	-0.00008
6	1	5	-	5	2	3	406.20188	0.00004
7	1	7	-	6	2	5	406.64290	0.00001
8	1	8	-	7	2	6	407.08912	-0.00019
8	1	7	-	7	2	5	407.10255	0.00005
9	1	9	-	8	2	7	407.53340	0.00001
9	1	8	-	8	2	6	407.55006	0.00018
10	1	10	-	9	2	8	407.97311	-0.00003
10	1	9	-	9	2	7	407.99525	-0.00005
11	1	11	-	10	2	9	408.41459	0.00004
12	1	12	-	11	2	10	408.85158	-0.00003
12	1	11	-	11	2	9	408.88020	-0.00001
13	1	13	-	12	2	11	409.28633	0.00000
13	1	12	-	12	2	10	409.31953	-0.00017
14	1	14	-	13	2	12	409.71873	0.00004
14	1	13	-	13	2	11	409.75722	0.00001
15	1	15	-	14	2	13	410.14870	0.00001
15	1	14	-	14	2	12	410.19279	0.00006
16	1	16	-	15	2	14	410.57628	-0.00005
16	1	15	-	15	2	13	410.62623	-0.00002
17	1	17	-	16	2	15	411.00160	-0.00001
18	1	17	-	17	2	15	411.48732	0.00000
20	1	20	-	19	2	18	412.26329	0.00011
20	1	19	-	19	2	17	412.34036	-0.00002
21	1	21	-	20	2	19	412.67895	0.00000
21	1	20	-	20	2	18	412.76394	0.00005
22	1	22	-	21	2	20	413.09225	-0.00008
22	1	21	-	21	2	19	413.18542	0.00004

TABLE I—*Continued*

J	Ka	Kc	-	J	Ka	Kc	Observed	O-C	J	Ka	Kc	-	J	Ka	Kc	Observed	O-C
23	1	23	-	22	2	21	413.50320	-0.00010	15	2	14	-	14	3	12	400.76441	-0.00008
23	1	22	-	22	2	20	413.60491	0.00005	15	2	13	-	14	3	11	400.76441	-0.00002
24	1	24	-	23	2	22	413.91186	-0.00002	16	2	15	-	15	3	13	401.19519	-0.00005
24	1	23	-	23	2	21	414.02233	0.00002	16	2	14	-	15	3	12	401.19519	0.00003
25	1	25	-	24	2	23	414.31805	0.00000	17	2	16	-	16	3	14	401.62372	-0.00010
25	1	24	-	24	2	22	414.43774	0.00000	17	2	15	-	16	3	13	401.62372	0.00000
									18	2	17	-	17	3	15	402.05027	0.00004
24	2	23	-	23	3	23	381.80514	-0.00014	18	2	16	-	17	3	14	402.05027	0.00017
22	2	21	-	23	3	21	382.83115	-0.00004	19	2	18	-	18	3	16	402.47434	-0.00013
21	2	20	-	22	3	20	383.34104	-0.00011	19	2	17	-	18	3	15	402.47434	0.00003
21	2	19	-	22	3	19	383.34104	0.00012	20	2	19	-	19	3	17	402.89655	0.00003
20	2	19	-	21	3	19	383.84909	-0.00002	20	2	18	-	19	3	16	402.89655	0.00022
20	2	18	-	21	3	18	383.84909	0.00017	21	2	20	-	20	3	18	403.31617	-0.00023
19	2	18	-	20	3	18	384.35492	-0.00015	21	2	19	-	20	3	17	403.31617	0.00000
19	2	17	-	20	3	17	384.35492	0.00001	22	2	21	-	21	3	19	403.73407	-0.00002
18	2	17	-	19	3	17	384.85895	-0.00007	23	2	21	-	22	3	19	404.14923	-0.00003
18	2	16	-	19	3	16	384.85895	0.00006	24	2	23	-	23	3	21	404.56284	-0.00006
17	2	16	-	18	3	16	385.36081	-0.00015	25	2	23	-	24	3	21	404.97354	-0.00001
17	2	15	-	18	3	15	385.36081	-0.00004									
16	2	15	-	17	3	15	385.86087	0.00000	25	3	•	-	26	4	•	371.83873	-0.00002
16	2	14	-	17	3	14	385.86087	0.00008	24	3	•	-	25	4	•	372.35445	0.00002
15	2	14	-	16	3	14	386.35862	-0.00014	23	3	•	-	24	4	•	372.86809	-0.00003
15	2	13	-	16	3	13	386.35862	-0.00008	22	3	•	-	23	4	•	373.37984	0.00001
14	2	13	-	15	3	13	386.85459	-0.00003	21	3	•	-	22	4	•	373.88957	0.00001
14	2	12	-	15	3	12	386.85459	0.00001	20	3	•	-	21	4	•	374.39732	0.00003
13	2	12	-	14	3	12	387.34842	-0.00003	18	3	•	-	19	4	•	375.40678	0.00003
13	2	11	-	14	3	11	387.34842	0.00000	17	3	•	-	18	4	•	375.90849	0.00001
12	2	11	-	13	3	11	387.84024	0.00000	16	3	•	-	17	4	•	376.40819	0.00000
12	2	10	-	13	3	10	387.84024	0.00002	15	3	•	-	16	4	•	376.90591	0.00001
11	2	10	-	12	3	10	388.32990	-0.00009	14	3	•	-	15	4	•	377.40161	0.00004
11	2	9	-	12	3	9	388.32990	-0.00007	13	3	•	-	14	4	•	377.89520	-0.00002
10	2	9	-	11	3	9	388.81773	0.00003	12	3	•	-	13	4	•	378.38683	-0.00001
10	2	8	-	11	3	8	388.81773	0.00005	11	3	•	-	12	4	•	378.87646	0.00003
9	2	8	-	10	3	8	389.30330	-0.00004	10	3	•	-	11	4	•	379.36401	0.00003
9	2	7	-	10	3	7	389.30330	-0.00004	9	3	•	-	10	4	•	379.84945	-0.00004
8	2	7	-	9	3	7	389.78694	0.00001	8	3	•	-	9	4	•	380.33297	0.00003
8	2	6	-	9	3	6	389.78694	0.00001	7	3	•	-	8	4	•	380.81439	0.00004
7	2	6	-	8	3	6	390.26848	0.00002	6	3	•	-	7	4	•	381.29370	0.00000
7	2	5	-	8	3	5	390.26848	0.00002	5	3	•	-	6	4	•	381.77096	-0.00003
6	2	5	-	7	3	5	390.74791	-0.00001	4	3	•	-	5	4	•	382.24623	0.00003
6	2	4	-	7	3	4	390.74791	-0.00001	3	3	•	-	4	4	•	382.71936	-0.00002
5	2	4	-	6	3	4	391.22529	-0.00002									
5	2	3	-	6	3	3	391.22529	-0.00002	25	3	•	-	25	4	•	383.91178	0.00000
4	2	3	-	5	3	3	391.70058	-0.00005	24	3	•	-	24	4	•	383.98399	-0.00004
4	2	2	-	5	3	2	391.70058	-0.00005	23	3	•	-	23	4	•	384.01416	-0.00003
3	2	2	-	4	3	2	392.17387	0.00001	22	3	•	-	22	4	•	384.06226	0.00000
3	2	1	-	4	3	1	392.17387	0.00001	21	3	•	-	21	4	•	384.10825	0.00000
2	2	1	-	3	3	1	392.64506	0.00004	20	3	•	-	20	4	•	384.15216	0.00001
2	2	0	-	3	3	0	392.64506	0.00004	19	3	•	-	19	4	•	384.19394	-0.00001
									18	3	•	-	18	4	•	384.23371	0.00004
25	2	23	-	25	3	23	393.36305	0.00010	17	3	•	-	17	4	•	384.27134	0.00004
24	2	23	-	24	3	21	393.41585	-0.00003	16	3	•	-	16	4	•	384.30689	0.00005
23	2	21	-	23	3	21	393.46596	0.00005	15	3	•	-	15	4	•	384.34028	-0.00002
22	2	21	-	22	3	19	393.51448	-0.00005	14	3	•	-	14	4	•	384.37165	-0.00001
21	2	20	-	21	3	18	393.56056	-0.00015	13	3	•	-	13	4	•	384.40088	-0.00005
21	2	19	-	21	3	19	393.56056	0.00009	12	3	•	-	12	4	•	384.42810	-0.00001
20	2	19	-	20	3	17	393.60472	-0.00008	11	3	•	-	11	4	•	384.45322	0.00002
20	2	18	-	20	3	18	393.60472	0.00012	10	3	•	-	10	4	•	384.47623	0.00003
19	2	18	-	19	3	16	393.64677	-0.00002	9	3	•	-	9	4	•	384.49710	-0.00001
19	2	17	-	19	3	17	393.64677	0.00014	8	3	•	-	8	4	•	384.51590	-0.00003
18	2	17	-	18	3	15	393.68666	-0.00003	7	3	•	-	7	4	•	384.53272	0.00006
18	2	16	-	18	3	16	393.68666	0.00010	6	3	•	-	6	4	•	384.54725	-0.00005
17	2	16	-	17	3	14	393.72441	-0.00008	5	3	•	-	5	4	•	384.55973	-0.00011
17	2	15	-	17	3	15	393.72441	0.00002	4	3	•	-	4	4	•	384.57032	0.00002
16	2	15	-	16	3	13	393.76018	-0.00001									
16	2	14	-	16	3	14	393.76018	0.00007	7	3	•	-	6	4	•	387.78635	0.00010
15	2	14	-	15	3	12	393.79384	0.00004	8	3	•	-	7	4	•	388.23427	0.00003
15	2	13	-	15	3	13	393.79384	0.00011	9	3	•	-	8	4	•	388.68001	-0.00009
14	2	13	-	14	3	11	393.82530	-0.00001	10	3	•	-	9	4	•	389.12373	-0.00010
14	2	12	-	14	3	12	393.82530	0.00004	11	3	•	-	10	4	•	389.56547	0.00005
13	2	12	-	13	3	10	393.85469	-0.00003	12	3	•	-	11	4	•	390.00490	0.00002
13	2	11	-	13	3	11	393.85469	0.00001	13	3	•	-	12	4	•	390.44212	-0.00007
12	2	11	-	12	3	9	393.88197	-0.00006	14	3	•	-	13	4	•	390.87739	0.00003
12	2	10	-	12	3	10	393.88197	-0.00003	15	3	•	-	14	4	•	391.31035	-0.00003
11	2	10	-	11	3	8	393.90722	-0.00003	16	3	•	-	15	4	•	391.74132	0.00008
11	2	9	-	11	3	9	393.90722	-0.00001	17	3	•	-	16	4	•	392.16991	-0.00004
10	2	9	-	10	3	7	393.93035	-0.00001	18	3	•	-	17	4	•	392.59648	-0.00001
10	2	8	-	10	3	8	393.93035	0.00001	19	3	•	-	18	4	•	393.02063	-0.00003
9	2	8	-	9	3	6	393.95137	0.00001	20	3	•	-	19	4	•	393.44307	0.00000
9	2	7	-	9	3	7	393.95137	0.00002	21	3	•	-	20	4	•	393.86314	0.00005
7	2	6	-	7	3	4	393.96712	0.00003	22	3	•	-	21	4	•	394.28093	-0.00001
7	2	5	-	7	3	5	393.96712	0.00003	23	3	•	-	22	4	•	394.69683	0.00021
6	2	5	-	6	3	3	394.00181	0.00002	24	3	•	-	23	4	•	395.11004	-0.00006
6	2	4	-	6	3	4	394.00181	0.00002	25	3	•	-	24	4	•	395.52148	0.00009
5	2	4	-	5	3	2	394.01445	0.00005									
5	2	3	-	5	3	3	394.01445	0.00005	25	4	•	-	26	5	•	362.34313	0.00002
4	2	3	-	4	3	1	394.02499	0.00007	24	4	•	-	25	5	•	362.85852	0.00003
4	2	2	-	4	3	2	394.02499	0.00007	23	4	•	-	24	5	•	363.37184	0.00003
3	2	2	-	3	3	0	394.03323	-0.00009	22	4	•	-	23	5	•	363.88333	-0.00002
3	2	1	-	3	3	1	394.03323	-0.00009	21	4	•	-	22	5	•	364.39285	0.00004
									20	4	•	-	21	5	•	364.90030	0.00001
7	2	6	-	6	3	4	397.24099	0.00003	19	4	•	-	20	5	•	365.40577	-0.00001
7	2	5	-	6	3	3	397.24099	0.00003	18	4	•	-	19	5	•	365.90937	0.00009
8	2	7	-	7	3	5	397.68874	-0.00016	17	4	•	-	18	5	•	366.41080	0.00002
8	2	6	-	7	3	4	397.68874	-0.00015	16	4	•	-	17	5	•	366.91041	0.00013
9	2	8	-	8	3	6	398.13473	0.00002	15	4	•	-	16	5	•	367.40775	-0.00002
9	2	7	-	8	3	5	398.13477	0.00007	14	4	•	-	15	5	•	367.90329	0.00004
10	2	9	-	9	3	7	398.57836	-0.00001	13	4	•	-	14	5	•	368.39670	-0.00001
10	2	8	-	9	3	6	398.57837	0.00001	12	4	•	-	13	5	•	368.88819	0.00003
11	2	10	-	10	3	8	399.01986	-0.00004	11	4	•	-	12	5	•	369.37757	-0.00001
11	2	9	-	10	3	7	399.01986	-0.00002	10	4	•	-	11	5	•	369.86499	0.00002
12	2	11	-	11	3	9	399.45928	0.00001	9	4	•	-	10	5	•	370.35036	0.00003
12	2	10	-	11	3	8	399.45928	0.00003	8	4	•	-	9	5	•	370.83369	0.00004
13	2	12	-	12	3	10	399.89646	-0.00005	7	4	•	-	8	5	•	371.31496	0.00003
13	2	11	-	12	3	9	399.89646	-0.00001	6	4	•	-	7	5	•	371.79414	-0.00002
14	2	13	-	13	3	11	400.33149	-0.00009	5	4	•	-	6	5	•	372.27138	0.00004
14	2	12	-	13	3	10	400.33149	-0.00004									

TABLE I—*Continued*

J	Ka	Kc	J	Ka	Kc	Observed	O-C
25	4	•	25	5	•	374.41484	0.00003
24	4	•	24	5	•	374.46684	0.00003
23	4	•	23	5	•	374.51674	0.00000
22	4	•	22	5	•	374.56459	0.00000
21	4	•	21	5	•	374.61034	-0.00003
20	4	•	20	5	•	374.65413	0.00007
19	4	•	19	5	•	374.69569	0.00001
18	4	•	18	5	•	374.73524	0.00003
17	4	•	17	5	•	374.77266	-0.00001
16	4	•	16	5	•	374.80809	0.00004
15	4	•	15	5	•	374.84135	0.00000
14	4	•	14	5	•	374.87251	-0.00005
12	4	•	12	5	•	374.92879	0.00004
11	4	•	11	5	•	374.95372	-0.00001
10	4	•	10	5	•	374.97661	-0.00001
9	4	•	9	5	•	374.99745	0.00001
8	4	•	8	5	•	375.01625	0.00008
7	4	•	7	5	•	375.03288	0.00006
6	4	•	6	5	•	375.04741	0.00002
5	4	•	5	5	•	375.05989	0.00001
9	4	•	8	5	•	379.17980	-0.00016
11	4	•	10	5	•	380.06542	0.00003
12	4	•	11	5	•	380.50503	0.00012
13	4	•	12	5	•	380.94225	-0.00005
14	4	•	13	5	•	381.37741	-0.00014
15	4	•	14	5	•	381.81069	0.00003
16	4	•	15	5	•	382.24166	0.00003
17	4	•	16	5	•	382.67041	-0.00004
19	4	•	18	5	•	383.52161	-0.00001
20	4	•	19	5	•	383.94391	-0.00006
21	4	•	20	5	•	384.36405	-0.00010
22	4	•	21	5	•	384.78229	0.00013
23	4	•	22	5	•	385.19797	-0.00002
25	4	•	24	5	•	386.02317	0.00004
25	5	•	26	6	•	352.80439	0.00010
24	5	•	25	6	•	353.31938	-0.00002
23	5	•	24	6	•	353.83269	0.00014
22	5	•	23	6	•	354.34377	0.00004
21	5	•	22	6	•	354.85298	0.00005
20	5	•	21	6	•	355.36018	0.00001
19	5	•	20	6	•	355.86543	0.00001
18	5	•	19	6	•	356.36873	0.00004
17	5	•	18	6	•	356.87004	0.00007
16	5	•	17	6	•	357.36928	0.00002
15	5	•	16	6	•	357.86650	-0.00005
14	5	•	15	6	•	358.36189	0.00005
13	5	•	14	6	•	358.85515	0.00003
12	5	•	13	6	•	359.34646	0.00006
11	5	•	12	6	•	359.83569	0.00004
10	5	•	11	6	•	360.32293	0.00004
9	5	•	10	6	•	360.80810	0.00000
8	5	•	9	6	•	361.29128	0.00000
7	5	•	8	6	•	361.77249	0.00007
6	5	•	7	6	•	362.25155	0.00002
5	5	•	6	6	•	362.72863	0.00004
25	5	•	25	6	•	364.87442	0.00006
24	5	•	24	6	•	364.92615	-0.00001
23	5	•	23	6	•	364.97590	0.00002
22	5	•	22	6	•	365.02359	0.00006
21	5	•	21	6	•	365.06916	0.00004
20	5	•	20	6	•	365.11261	-0.00002
19	5	•	19	6	•	365.15412	0.00005
18	5	•	18	6	•	365.19346	0.00001
17	5	•	17	6	•	365.23081	0.00006
16	5	•	16	6	•	365.26600	0.00002
15	5	•	15	6	•	365.29914	0.00000
14	5	•	14	6	•	365.33020	-0.00003
13	5	•	13	6	•	365.35929	0.00005
12	5	•	12	6	•	365.38624	0.00005
11	5	•	11	6	•	365.41108	0.00002
10	5	•	10	6	•	365.43384	-0.00002
9	5	•	9	6	•	365.45459	0.00001
8	5	•	8	6	•	365.47324	0.00000
7	5	•	7	6	•	365.48966	-0.00016
6	5	•	6	6	•	365.50428	-0.00005
10	5	•	9	6	•	370.08039	0.00006
11	5	•	10	6	•	370.52195	-0.00007
12	5	•	11	6	•	370.96165	0.00006
13	5	•	12	6	•	371.39906	0.00003
14	5	•	13	6	•	371.83421	-0.00013
15	5	•	14	6	•	372.26753	0.00002
16	5	•	15	6	•	372.69859	0.00004
17	5	•	16	6	•	373.12761	0.00015
18	5	•	17	6	•	373.55412	-0.00009
19	5	•	18	6	•	373.97884	0.00002
20	5	•	19	6	•	374.40132	0.00005
21	5	•	20	6	•	374.82167	0.00010
22	5	•	21	6	•	375.23964	-0.00007
23	5	•	22	6	•	375.65562	-0.00006
24	5	•	23	6	•	376.06947	-0.00001
25	5	•	24	6	•	376.48098	-0.00014

b ν_t-2-1 Band - High Freq. Comp.

J	Ka	Kc	J	Ka	Kc	Observed	O-C
23	1	22	24	0	24	383.60102	-0.00017
22	1	21	23	0	23	384.10181	-0.00014
19	1	18	20	0	20	385.59458	-0.00006
18	1	17	19	0	19	386.08881	-0.00018
16	1	15	17	0	17	387.07267	-0.00015
14	1	13	15	0	15	388.05002	-0.00012
12	1	11	13	0	13	389.02086	-0.00006
10	1	9	11	0	11	389.98512	0.00001
8	1	7	9	0	9	390.94252	-0.00015
25	1	25	25	0	25	394.38403	-0.00006
24	1	24	24	0	24	394.44441	-0.00006
23	1	23	23	0	23	394.50228	-0.00016
22	1	22	22	0	22	394.55782	-0.00016
21	1	21	21	0	21	394.61096	-0.00015
20	1	20	20	0	20	394.66177	-0.00005
19	1	19	19	0	19	394.70992	-0.00019
18	1	18	18	0	18	394.75586	-0.00010
17	1	17	17	0	17	394.79925	-0.00019
16	1	16	16	0	16	394.84030	-0.00018
14	1	14	14	0	14	394.91512	-0.00019
13	1	13	13	0	13	394.94891	-0.00019
11	1	11	11	0	11	395.00930	-0.00014
9	1	9	9	0	9	395.05990	-0.00022
7	1	7	7	0	7	395.10098	-0.00017
8	1	7	7	0	7	398.80917	-0.00013
10	1	9	9	0	9	399.70205	-0.00009
11	1	10	10	0	10	400.14587	-0.00006
12	1	11	11	0	11	400.58783	-0.00016
14	1	13	13	0	13	401.46668	-0.00013
16	1	15	15	0	15	402.33844	-0.00014
17	1	16	16	0	16	402.77167	-0.00015
18	1	17	17	0	17	403.20316	-0.00011
19	1	18	18	0	18	403.63294	-0.00001
20	1	19	19	0	19	404.06070	-0.00015
22	1	21	21	0	21	404.91104	-0.00025
25	2	24	26	1	26	391.75645	0.00006
25	2	23	26	1	25	391.62807	0.00010
24	2	23	25	1	25	392.26497	0.00018
23	2	22	24	1	24	392.77156	0.00014
23	2	21	24	1	23	392.66176	0.00012
22	2	21	23	1	23	393.27644	0.00017
22	2	20	23	1	22	393.17546	0.00020
19	2	17	20	1	19	394.70327	0.00004
18	2	17	19	1	19	395.27798	0.00019
18	2	16	19	1	18	395.20837	0.00014
17	2	16	18	1	18	395.77368	0.00000
17	2	15	18	1	17	395.71127	0.00020
16	2	15	17	1	17	396.26797	0.00022
16	2	14	17	1	16	396.21188	0.00015
15	2	13	16	1	15	396.71035	0.00014
14	2	13	15	1	15	397.25067	0.00022
12	2	11	13	1	13	398.22607	0.00021
12	2	10	13	1	12	398.19265	0.00012
10	2	8	11	1	10	399.16985	0.00009
8	2	7	9	1	9	400.15478	0.00014
25	2	23	25	1	25	403.77182	0.00013
24	2	22	24	1	24	403.81903	0.00017
22	2	21	22	1	21	403.81491	0.00011
21	2	19	21	1	21	403.94931	0.00020
21	2	20	21	1	20	403.86438	-0.00003
20	2	18	20	1	20	403.98877	0.00000
20	2	19	20	1	19	403.91184	0.00007
17	2	15	17	1	17	404.09659	0.00016
17	2	16	17	1	16	404.04056	0.00021
15	2	13	15	1	15	404.15897	0.00018
14	2	12	14	1	14	404.18723	0.00009
13	2	12	13	1	12	404.18033	0.00008
12	2	10	12	1	12	404.23835	0.00018
12	2	11	12	1	11	404.20978	0.00019
10	2	9	10	1	9	404.26136	-0.00014
4	2	3	3	1	3	406.21730	0.00016
6	2	5	5	1	5	407.12147	0.00003
6	2	4	5	1	4	407.11589	-0.00006
8	2	7	7	1	7	408.01829	0.00022
8	2	6	7	1	6	408.00798	0.00016
11	2	9	10	1	9	409.32847	0.00004
12	2	11	11	1	11	409.78837	0.00016
12	2	10	11	1	10	409.76399	-0.00005
13	2	12	12	1	12	410.22600	0.00010
16	2	15	15	1	15	411.52739	0.00010
19	2	18	18	1	18	412.81118	0.00009
20	2	19	19	1	19	413.23528	0.00019
20	2	18	19	1	18	413.16570	0.00015
21	2	20	20	1	20	413.65710	-0.00002
22	2	21	21	1	21	414.07720	0.00003
23	2	22	22	1	22	414.49538	0.00013
24	2	23	23	1	23	414.91149	0.00014
24	2	22	23	1	22	414.81051	0.00013
25	2	24	24	1	24	415.32540	-0.00006
25	2	23	24	1	23	415.21590	0.00018
24	3	22	25	2	24	401.37302	0.00017
23	3	21	24	2	23	401.88456	-0.00001
22	3	20	23	2	22	402.39441	0.00011
20	3	18	21	2	20	403.40766	-0.00012
19	3	16	20	2	18	403.91184	0.00013
18	3	16	19	2	18	404.41330	0.00006
18	3	15	19	2	17	404.41330	-0.00010
17	3	15	18	2	17	404.91294	-0.00001
17	3	14	18	2	16	404.91294	-0.00014
16	3	14	17	2	16	405.41088	0.00021
16	3	13	17	2	15	405.41088	0.00011
15	3	13	16	2	15	405.90644	0.00011
15	3	12	16	2	14	405.90644	0.00003
14	3	12	15	2	14	406.40007	0.00008
14	3	11	15	2	13	406.40007	0.00002
13	3	11	14	2	13	406.89143	-0.00018
11	3	9	12	2	11	407.86857	-0.00019
25	3	22	25	2	24	412.87875	0.00010
24	3	21	24	2	23	412.93081	-0.00017
23	3	21	23	2	21	412.98135	-0.00021

TABLE I—*Continued*

J	Ka	Kc	-	J	Ka	Kc	Observed	O-C	J	Ka	Kc	-	J	Ka	Kc	Observed	O-C
22	3	19	-	22	2	21	413.02920	-0.00017	26	5	*	-	27	4	*	418.53556	-0.00013
21	3	18	-	21	2	20	413.07546	0.00004	25	5	*	-	26	4	*	419.05262	0.00003
21	3	19	-	21	2	19	413.07546	-0.00020	24	5	*	-	25	4	*	419.56742	-0.00005
20	3	17	-	20	2	19	413.11932	-0.00006	23	5	*	-	24	4	*	420.08051	0.00020
19	3	16	-	19	2	18	413.16116	-0.00009	22	5	*	-	23	4	*	420.59110	-0.00001
18	3	15	-	18	2	17	413.20089	-0.00013	21	5	*	-	22	4	*	421.10001	0.00014
17	3	14	-	17	2	16	413.23861	-0.00008	20	5	*	-	21	4	*	421.60660	0.00002
16	3	13	-	16	2	15	413.27413	-0.00015	17	5	*	-	18	4	*	423.11429	-0.00009
15	3	12	-	15	2	14	413.30770	-0.00007	16	5	*	-	17	4	*	423.61280	-0.00006
15	3	13	-	15	2	13	413.30770	-0.00013	13	5	*	-	14	4	*	425.09581	-0.00006
13	3	10	-	13	2	12	413.36834	-0.00013	11	5	*	-	12	4	*	426.07411	-0.00002
13	3	11	-	13	2	11	413.36834	-0.00018	10	5	*	-	11	4	*	426.56010	-0.00003
12	3	9	-	12	2	11	413.39562	-0.00006									
12	3	10	-	12	2	10	413.39562	-0.00008	24	5	*	-	24	4	*	431.12383	0.00005
11	3	8	-	11	2	10	413.42068	-0.00011	22	5	*	-	22	4	*	431.22442	-0.00008
11	3	9	-	11	2	9	413.42068	-0.00013	20	5	*	-	20	4	*	431.31661	-0.00005
10	3	*	-	10	2	*	413.44375	-0.00007	18	5	*	-	18	4	*	431.40014	-0.00011
9	3	*	-	9	2	*	413.46468	-0.00007	17	5	*	-	17	4	*	431.43871	-0.00012
8	3	*	-	8	2	*	413.48351	-0.00007	16	5	*	-	16	4	*	431.47521	-0.00006
7	3	*	-	7	2	*	413.50024	-0.00009	15	5	*	-	15	4	*	431.50951	-0.00005
6	3	*	-	6	2	*	413.51498	0.00000	14	5	*	-	14	4	*	431.54171	0.00000
5	3	*	-	5	2	*	413.52740	-0.00014	13	5	*	-	13	4	*	431.57174	0.00002
									12	5	*	-	12	4	*	431.59963	0.00004
3	3	*	-	2	2	*	414.93453	-0.00014	11	5	*	-	11	4	*	431.62533	0.00002
4	3	*	-	3	2	*	415.38909	0.00005	10	5	*	-	10	4	*	431.64892	0.00003
5	3	*	-	4	2	*	415.84115	-0.00016	9	5	*	-	9	4	*	431.67031	-0.00002
6	3	*	-	5	2	*	416.29144	-0.00002	8	5	*	-	8	4	*	431.68972	0.00010
7	3	*	-	6	2	*	416.73937	-0.00012	7	5	*	-	7	4	*	431.70681	0.00004
8	3	*	-	7	2	*	417.18536	-0.00003	6	5	*	-	6	4	*	431.72152	-0.00012
9	3	*	-	8	2	*	417.62906	-0.00012									
10	3	*	-	9	2	*	418.07073	-0.00009	5	5	*	-	4	4	*	434.04812	0.00007
11	3	8	-	10	2	8	418.51026	-0.00010	6	5	*	-	5	4	*	434.49783	0.00000
11	3	9	-	10	2	9	418.51026	-0.00008	7	5	*	-	6	4	*	434.94543	0.00000
12	3	10	-	11	2	10	418.94782	0.00011	8	5	*	-	7	4	*	435.39092	0.00006
12	3	9	-	11	2	9	418.94782	0.00009	9	5	*	-	8	4	*	435.83405	-0.00007
13	3	11	-	12	2	11	419.38279	-0.00015	10	5	*	-	9	4	*	436.27515	-0.00004
13	3	10	-	12	2	10	419.38279	-0.00018	11	5	*	-	10	4	*	436.71402	-0.00006
15	3	13	-	14	2	13	420.24686	-0.00008	12	5	*	-	11	4	*	437.15073	-0.00004
15	3	12	-	14	2	12	420.24686	-0.00013	13	5	*	-	12	4	*	437.58542	0.00015
16	3	14	-	15	2	14	420.67563	-0.00008	14	5	*	-	13	4	*	438.01755	-0.00002
16	3	13	-	15	2	13	420.67563	-0.00014	15	5	*	-	14	4	*	438.44783	-0.00003
17	3	15	-	16	2	15	421.10224	-0.00007	16	5	*	-	15	4	*	438.87564	0.00009
17	3	14	-	16	2	14	421.10224	-0.00015	17	5	*	-	16	4	*	439.30115	-0.00007
18	3	16	-	17	2	16	421.52658	-0.00017	18	5	*	-	17	4	*	439.72473	0.00005
19	3	17	-	18	2	17	421.94886	-0.00016	19	5	*	-	18	4	*	440.14585	-0.00007
20	3	18	-	19	2	18	422.36908	-0.00003	20	5	*	-	19	4	*	440.56482	-0.00012
20	3	17	-	19	2	17	422.36908	-0.00018	21	5	*	-	20	4	*	440.98172	-0.00001
21	3	19	-	20	2	19	422.78693	-0.00009	22	5	*	-	21	4	*	441.39619	-0.00010
23	3	21	-	22	2	21	423.61619	-0.00011	23	5	*	-	22	4	*	441.80855	-0.00006
24	3	21	-	23	2	21	424.02785	-0.00012	24	5	*	-	23	4	*	442.21873	0.00004
25	3	23	-	24	2	23	424.43660	-0.00019	25	5	*	-	24	4	*	442.62654	0.00002
25	4	*	-	26	3	*	409.98073	0.00006	25	0	25	-	26	1	25	373.15892	-0.00012
23	4	*	-	24	3	*	411.00709	0.00002	23	0	23	-	24	1	23	374.19194	0.00003
22	4	*	-	23	3	*	411.51720	-0.00006	21	0	21	-	22	1	21	375.21632	0.00014
20	4	*	-	21	3	*	412.53149	-0.00012	20	0	20	-	21	1	20	375.72493	-0.00016
19	4	*	-	20	3	*	413.03588	0.00014	19	0	19	-	20	1	19	376.23173	-0.00012
18	4	*	-	19	3	*	413.53780	-0.00004	18	0	18	-	19	1	18	376.73654	0.00007
17	4	*	-	18	3	*	414.03790	-0.00002	17	0	17	-	18	1	17	377.23895	0.00004
16	4	*	-	17	3	*	414.53579	-0.00017	16	0	16	-	17	1	16	377.73901	-0.00017
15	4	*	-	16	3	*	415.03201	0.00006	15	0	15	-	16	1	15	378.23742	0.00012
14	4	*	-	15	3	*	415.52599	0.00009	13	0	13	-	14	1	13	379.22714	0.00013
12	4	*	-	13	3	*	416.50781	0.00016	12	0	12	-	13	1	12	379.71874	0.00014
11	4	*	-	12	3	*	416.99538	-0.00006	11	0	11	-	12	1	11	380.20812	0.00010
9	4	*	-	10	3	*	417.96469	-0.00014	9	0	9	-	10	1	9	381.18032	0.00003
									8	0	8	-	9	1	8	381.66332	0.00017
25	4	*	-	25	3	*	421.99936	-0.00001	7	0	7	-	8	1	7	382.14395	0.00014
22	4	*	-	22	3	*	422.15155	-0.00007	3	0	3	-	4	1	3	384.04456	0.00010
21	4	*	-	21	3	*	422.19821	0.00007									
20	4	*	-	20	3	*	422.24256	0.00001	25	0	25	-	25	1	25	385.30252	-0.00024
19	4	*	-	19	3	*	422.28462	-0.00003	24	0	24	-	24	1	24	385.34946	-0.00008
18	4	*	-	18	3	*	422.32508	0.00005	23	0	23	-	23	1	23	385.39454	0.00011
17	4	*	-	17	3	*	422.36304	-0.00006	22	0	22	-	22	1	22	385.43753	0.00010
16	4	*	-	16	3	*	422.39902	-0.00004	21	0	21	-	21	1	21	385.47855	-0.00001
15	4	*	-	15	3	*	422.43286	-0.00004	20	0	20	-	20	1	20	385.51780	-0.00001
14	4	*	-	14	3	*	422.46469	0.00006	19	0	19	-	19	1	19	385.55524	0.00007
13	4	*	-	13	3	*	422.49424	0.00000	18	0	18	-	18	1	18	385.59076	0.00010
12	4	*	-	12	3	*	422.52179	0.00005	17	0	17	-	17	1	17	385.62439	0.00012
11	4	*	-	11	3	*	422.54715	0.00003	16	0	16	-	16	1	16	385.65607	0.00006
10	4	*	-	10	3	*	422.57047	0.00008	15	0	15	-	15	1	15	385.68595	0.00007
9	4	*	-	9	3	*	422.59153	-0.00001	14	0	14	-	14	1	14	385.71393	0.00006
8	4	*	-	8	3	*	422.61054	-0.00004	13	0	13	-	13	1	13	385.74012	0.00012
7	4	*	-	7	3	*	422.62769	0.00019	12	0	12	-	12	1	12	385.76432	0.00007
6	4	*	-	6	3	*	422.64225	-0.00006	11	0	11	-	11	1	11	385.78669	0.00006
5	4	*	-	5	3	*	422.65500	0.00000	9	0	9	-	9	1	9	385.82578	-0.00002
									8	0	8	-	8	1	8	385.84256	-0.00002
4	4	*	-	3	3	*	424.51658	0.00007	7	0	7	-	7	1	7	385.85736	-0.00013
5	4	*	-	4	3	*	424.96858	-0.00005	6	0	6	-	6	1	6	385.87067	0.00013
6	4	*	-	5	3	*	425.41871	0.00009	5	0	5	-	5	1	5	385.88172	-0.00001
7	4	*	-	6	3	*	425.86647	0.00001									
9	4	*	-	8	3	*	426.75369	-0.00002	5	0	5	-	4	1	3	388.19095	-0.00006
10	4	*	-	9	3	*	427.19703	-0.00007	7	0	7	-	6	1	5	389.08766	-0.00015
11	4	*	-	10	3	*	427.63640	0.00006	9	0	9	-	8	1	7	389.97566	0.00011
12	4	*	-	11	3	*	428.07339	0.00018	11	0	11	-	10	1	9	390.85414	-0.00007
13	4	*	-	12	3	*	428.50831	-0.00001	13	0	13	-	12	1	11	391.72386	0.00013
15	4	*	-	14	3	*	429.37189	0.00007	15	0	15	-	14	1	13	392.58415	0.00006
16	4	*	-	15	3	*	429.80000	0.00000	16	0	16	-	15	1	14	393.01085	0.00003
17	4	*	-	16	3	*	430.22616	-0.00005	19	0	19	-	18	1	17	394.27728	0.00015
18	4	*	-	17	3	*	430.65023	0.00000	23	0	23	-	22	1	21	395.93298	0.00003
20	4	*	-	19	3	*	431.49163	-0.00004	25	0	25	-	24	1	23	396.74685	0.00006
21	4	*	-	20	3	*	431.90914	0.00004									
22	4	*	-	21	3	*	432.32436	0.00004	24	1	23	-	25	2	23	364.54760	-0.00018
23	4	*	-	22	3	*	432.73739	0.00006	22	1	21	-	23	2	21	365.54972	-0.00011
24	4	*	-	23	3	*	433.14812	-0.00002	21	1	21	-	22	2	21	365.88422	-0.00016
25	4	*	-	24	3	*	433.55662	0.00010	20	1	19	-	21	2	19	366.54531	-0.00006
									19	1	19	-	20	2	19	366.90610	-0.00009
27	5	*	-	26	4	*	418.01664	-0.00012	18	1	17	-	19	2	17	367.53483	-0.00013

TABLE I—*Continued*

J	Ka	Kc	-	J	Ka	Kc	Observed	O-C
17	1	16	-	18	2	16	368.02723	-0.00003
16	1	15	-	17	2	15	368.51783	-0.00013
15	1	14	-	16	2	14	369.00690	-0.00015
14	1	13	-	15	2	13	369.49451	-0.00002
13	1	13	-	14	2	13	369.91572	-0.00021
13	1	12	-	14	2	12	369.98041	0.00002
12	1	11	-	13	2	11	370.46460	-0.00004
11	1	11	-	12	2	11	370.90044	-0.00010
10	1	10	-	11	2	10	371.38933	0.00001
8	1	7	-	9	2	7	372.38524	-0.00009
6	1	5	-	7	2	5	373.33583	0.00000
25	1	25	-	25	2	23	375.83299	-0.00004
23	1	23	-	23	2	21	375.95027	-0.00004
21	1	21	-	21	2	19	376.05781	-0.00018
20	1	19	-	20	2	19	376.25679	-0.00014
20	1	20	-	20	2	18	376.10802	-0.00021
14	1	13	-	14	2	13	376.43346	-0.00018
13	1	13	-	13	2	11	376.39269	-0.00014
10	1	10	-	10	2	8	376.47877	-0.00010
5	1	4	-	4	2	2	378.89874	-0.00012
10	1	9	-	9	2	7	381.14474	-0.00006
11	1	10	-	10	2	8	381.58883	0.00000
13	1	13	-	12	2	11	382.40722	-0.00003
14	1	13	-	13	2	11	382.91056	0.00002
15	1	15	-	14	2	13	383.26246	-0.00014
15	1	14	-	14	2	12	383.34763	0.00000
17	1	17	-	16	2	15	384.10825	0.00016
18	1	18	-	17	2	16	384.52704	-0.00009
18	1	17	-	17	2	15	384.64853	0.00012
19	1	19	-	18	2	17	384.94355	-0.00014
19	1	18	-	18	2	16	385.07843	-0.00007
21	1	21	-	20	2	19	385.76935	-0.00001
25	1	25	-	24	2	23	387.39075	0.00005
25	2	24	-	26	3	24	354.59538	0.00001
25	2	23	-	26	3	23	354.59538	-0.00016
21	2	20	-	22	3	20	356.63188	0.00014
21	2	19	-	22	3	19	356.63188	0.00006
19	2	18	-	20	3	18	357.63860	0.00022
19	2	17	-	20	3	17	357.63860	0.00016
17	2	16	-	18	3	16	358.63750	0.00022
17	2	15	-	18	3	15	358.63750	0.00018
16	2	15	-	17	3	15	359.13399	0.00018
16	2	14	-	17	3	14	359.13399	0.00015
13	2	12	-	14	3	12	360.61181	0.00012
13	2	11	-	14	3	11	360.61181	0.00011
12	2	*	-	13	3	*	361.10031	-0.00008
11	2	*	-	12	3	*	361.58731	0.00019
25	2	23	-	25	3	23	366.61429	0.00006
24	2	22	-	24	3	22	366.66486	0.00003
24	2	23	-	24	3	21	366.66486	0.00016
23	2	21	-	23	3	21	366.71360	0.00018
22	2	20	-	22	3	20	366.76008	0.00010
22	2	21	-	22	3	19	366.76008	0.00020
21	2	19	-	21	3	19	366.80472	0.00019
20	2	18	-	20	3	18	366.84720	0.00015
20	2	19	-	20	3	17	366.84720	0.00021
19	2	17	-	19	3	17	366.88764	0.00008
19	2	18	-	19	3	16	366.88764	0.00013
18	2	16	-	18	3	16	366.92615	0.00010
18	2	17	-	18	3	15	366.92615	0.00015
17	2	15	-	17	3	15	366.96256	0.00005
17	2	16	-	17	3	14	366.96256	0.00009
15	2	13	-	15	3	13	367.02942	0.00005
15	2	14	-	15	3	12	367.02942	0.00007
12	2	10	-	12	3	10	367.11463	0.00015
12	2	11	-	12	3	9	367.11463	0.00016
9	2	*	-	9	3	*	367.18143	0.00006
4	2	*	-	3	3	*	369.10312	-0.00013
5	2	*	-	4	3	*	369.55573	-0.00008
6	2	*	-	5	3	*	370.00841	0.00009
7	2	*	-	6	3	*	370.45481	0.00003
9	2	*	-	8	3	*	371.34572	0.00018
10	2	*	-	9	3	*	371.78804	0.00023
13	2	12	-	12	3	10	373.10243	0.00022
13	2	11	-	12	3	9	373.10243	0.00021
15	2	14	-	14	3	12	373.96822	0.00015
15	2	13	-	14	3	11	373.96822	0.00013
17	2	16	-	16	3	14	374.82552	-0.00006
17	2	15	-	16	3	13	374.82552	-0.00009
19	2	18	-	18	3	16	375.67491	0.00021
19	2	17	-	18	3	15	375.67491	0.00016
23	2	22	-	22	3	20	377.34774	0.00008
23	2	21	-	22	3	19	377.34774	-0.00003
24	2	23	-	23	3	21	377.76064	0.00004
24	2	22	-	23	3	20	377.76064	-0.00010
25	2	23	-	24	3	21	378.17175	0.00016
25	3	*	-	26	4	*	345.22383	-0.00017
24	3	*	-	25	4	*	345.73390	-0.00001
23	3	*	-	24	4	*	346.24578	-0.00003
20	3	*	-	21	4	*	347.76395	-0.00006
13	3	*	-	14	4	*	351.23871	-0.00004
12	3	*	-	13	4	*	351.72721	-0.00013
11	3	*	-	12	4	*	352.21418	0.00022
10	3	*	-	11	4	*	352.69844	-0.00019
9	3	*	-	10	4	*	353.18120	-0.00011
8	3	*	-	9	4	*	353.66191	-0.00010
6	3	*	-	7	4	*	354.61742	-0.00004
5	3	*	-	6	4	*	355.09236	0.00016
4	3	*	-	5	4	*	355.56514	0.00020
25	3	*	-	25	4	*	357.24159	-0.00012
24	3	*	-	24	4	*	357.29201	-0.00021
23	3	*	-	23	4	*	357.34068	-0.00004
21	3	*	-	21	4	*	357.43150	-0.00015
20	3	*	-	20	4	*	357.47389	-0.00019
19	3	*	-	19	4	*	357.51448	-0.00002
18	3	*	-	18	4	*	357.55290	0.00000
16	3	*	-	16	4	*	357.62370	0.00006
15	3	*	-	15	4	*	357.65590	-0.00008
13	3	*	-	13	4	*	357.71449	-0.00011
12	3	*	-	12	4	*	357.74071	-0.00017
10	3	*	-	10	4	*	357.78740	0.00002
9	3	*	-	9	4	*	357.80760	0.00000
8	3	*	-	8	4	*	357.82561	-0.00018
7	3	*	-	7	4	*	357.84178	-0.00019
21	3	*	-	20	4	*	367.14179	0.00006
22	3	*	-	21	4	*	367.55884	-0.00014
25	3	*	-	24	4	*	368.79798	-0.00005
25	4	*	-	26	5	*	335.81767	-0.00003
23	4	*	-	24	5	*	336.83928	0.00006
22	4	*	-	23	5	*	337.34715	0.00003
21	4	*	-	22	5	*	337.85317	0.00008
20	4	*	-	21	5	*	338.35725	0.00011
19	4	*	-	20	5	*	338.85918	-0.00009
18	4	*	-	19	5	*	339.35936	-0.00010
17	4	*	-	18	5	*	339.85765	-0.00007
16	4	*	-	17	5	*	340.35405	0.00002
15	4	*	-	16	5	*	340.84837	-0.00004
14	4	*	-	15	5	*	341.34096	0.00013
13	4	*	-	14	5	*	341.83126	-0.00004
12	4	*	-	13	5	*	342.31988	0.00007
11	4	*	-	12	5	*	342.80627	-0.00009
10	4	*	-	11	5	*	343.29089	-0.00005
9	4	*	-	10	5	*	343.77368	0.00014
8	4	*	-	7	5	*	343.20956	0.00007
25	4	*	-	25	5	*	347.83390	-0.00001
24	4	*	-	24	5	*	347.88450	0.00012
23	4	*	-	23	5	*	347.93290	0.00006
22	4	*	-	22	5	*	347.97928	0.00001
21	4	*	-	21	5	*	348.02372	0.00003
20	4	*	-	20	5	*	348.06598	-0.00011
19	4	*	-	19	5	*	348.10639	-0.00009
18	4	*	-	18	5	*	348.14478	-0.00006
17	4	*	-	17	5	*	348.18128	0.00009
16	4	*	-	16	5	*	348.21567	0.00015
15	4	*	-	15	5	*	348.24790	0.00007
14	4	*	-	14	5	*	348.27808	-0.00005
13	4	*	-	13	5	*	348.30619	-0.00021
12	4	*	-	12	5	*	348.33280	0.00015
11	4	*	-	11	5	*	348.35709	0.00020
9	4	*	-	9	5	*	348.39948	0.00018
8	4	*	-	8	5	*	348.41749	0.00001
18	4	*	-	17	5	*	356.46819	-0.00012
21	4	*	-	20	5	*	357.73259	-0.00004
22	4	*	-	21	5	*	358.14970	-0.00016
23	4	*	-	22	5	*	358.56511	0.00013
24	4	*	-	23	5	*	358.97780	-0.00018
25	4	*	-	24	5	*	359.38891	0.00004

C ν_t-2-1 Band - Low Freq. Comp.

J	Ka	Kc	-	J	Ka	Kc	Observed	O-C
24	1	23	-	25	0	25	383.08578	-0.00001
22	1	21	-	23	0	23	384.08912	0.00011
21	1	20	-	22	0	22	384.38429	0.00007
20	1	19	-	21	0	21	385.08585	0.00003
16	1	15	-	17	0	17	387.06009	0.00006
14	1	13	-	15	0	15	388.03754	0.00017
10	1	9	-	11	0	11	389.97240	0.00007
25	1	25	-	25	0	25	394.37100	0.00001
24	1	24	-	24	0	24	394.43142	0.00009
23	1	23	-	23	0	23	394.48943	0.00017
22	1	22	-	22	0	22	394.54501	0.00023
21	1	21	-	21	0	21	394.59811	0.00021
20	1	20	-	20	0	20	394.64877	0.00017
19	1	19	-	19	0	19	394.69683	-0.00007
16	1	16	-	16	0	16	394.82731	0.00020
15	1	15	-	15	0	15	394.86617	0.00021
14	1	14	-	14	0	14	394.90222	0.00003
11	1	11	-	11	0	11	394.99651	0.00010
10	1	10	-	10	0	10	395.02316	0.00017
7	1	7	-	7	0	7	395.08831	0.00008
6	1	5	-	5	0	5	397.89687	0.00016
8	1	7	-	7	0	7	398.79662	0.00011
10	1	9	-	9	0	9	399.68954	0.00019
12	1	11	-	11	0	11	400.57533	0.00013
14	1	13	-	13	0	13	401.45398	-0.00006
15	1	14	-	14	0	14	401.89078	-0.00002
16	1	15	-	15	0	15	402.32590	0.00010
17	1	16	-	16	0	16	402.75873	-0.00029
18	1	17	-	17	0	17	403.19065	0.00019
20	1	19	-	19	0	19	404.04816	0.00017
21	1	20	-	20	0	20	404.47409	0.00003
22	1	21	-	21	0	21	404.89847	0.00013
23	1	22	-	22	0	22	405.32093	0.00011
25	1	24	-	24	0	24	406.16047	0.00011
24	2	23	-	25	1	25	392.25175	-0.00016
21	2	20	-	22	1	22	393.76834	-0.00014
21	2	19	-	22	1	21	393.67375	-0.00006
19	2	17	-	20	1	19	394.69026	-0.00009
18	2	17	-	19	1	19	395.26498	0.00000
18	2	16	-	19	1	18	395.19537	-0.00001

TABLE I—*Continued*

J	Ka	Kc	-	J	Ka	Kc	Observed	O-C
17	2	15	-	16	1	17	395.69817	-0.00006
16	2	15	-	17	1	17	396.25488	-0.00008
16	2	14	-	17	1	16	396.19688	-0.00003
15	2	13	-	16	1	15	396.69735	-0.00006
14	2	13	-	15	1	15	397.23757	-0.00012
11	2	9	-	12	1	11	398.66946	-0.00006
10	2	9	-	11	1	11	399.18105	-0.00018
9	2	7	-	10	1	9	399.64218	-0.00019
7	2	6	-	8	1	8	400.61959	-0.00017
6	2	5	-	7	1	7	401.09507	-0.00022
25	2	23	-	25	1	25	403.75849	-0.00016
23	2	21	-	23	1	23	403.85111	-0.00007
22	2	20	-	22	1	22	403.89457	-0.00005
21	2	19	-	21	1	21	403.93604	-0.00015
19	2	17	-	19	1	19	404.01349	-0.00017
18	2	17	-	18	1	17	403.98662	-0.00011
17	2	15	-	17	1	17	404.08341	-0.00019
15	2	14	-	15	1	14	404.10205	0.00001
13	2	12	-	13	1	12	404.16736	-0.00015
12	2	11	-	12	1	11	404.19678	-0.00008
3	2	1	-	2	1	1	405.74826	-0.00012
4	2	3	-	3	1	3	406.20430	-0.00019
6	2	5	-	5	1	5	407.10860	-0.00018
7	2	6	-	6	1	6	407.53787	-0.00018
11	2	10	-	10	1	10	409.33580	-0.00006
11	2	9	-	10	1	9	409.31560	-0.00011
12	2	11	-	11	1	11	409.77528	-0.00020
13	2	11	-	12	1	11	410.18449	-0.00009
14	2	12	-	13	1	12	410.61537	-0.00018
15	2	13	-	14	1	13	411.04408	-0.00013
16	2	15	-	15	1	15	411.51430	-0.00020
17	2	16	-	16	1	16	411.94429	-0.00009
17	2	15	-	16	1	15	411.89448	-0.00008
19	2	18	-	18	1	18	412.79818	-0.00008
19	2	17	-	18	1	17	412.73580	0.00018
20	2	18	-	19	1	18	413.13249	-0.00016
21	2	19	-	20	1	19	413.56728	-0.00006
22	2	20	-	21	1	20	413.97979	0.00009
23	2	21	-	22	1	21	414.38958	-0.00012
24	2	23	-	23	1	23	414.89831	-0.00015
24	2	22	-	23	1	22	414.79739	0.00002
25	2	24	-	24	1	24	415.31240	-0.00017
24	3	21	-	25	2	23	401.36042	0.00010
23	3	21	-	24	2	23	401.87174	0.00013
22	3	19	-	23	2	21	402.38166	-0.00003
21	3	19	-	22	2	21	402.88922	0.00010
21	3	18	-	22	2	20	402.88922	-0.00018
20	3	17	-	21	2	19	403.39521	0.00010
19	3	17	-	20	2	19	403.89869	0.00006
19	3	16	-	20	2	18	403.89869	-0.00013
18	3	15	-	19	2	17	404.40064	0.00011
17	3	15	-	18	2	17	404.90024	0.00013
17	3	14	-	18	2	16	404.90024	0.00000
16	3	13	-	17	2	15	405.39804	0.00011
15	3	13	-	16	2	15	405.89372	0.00019
15	3	12	-	16	2	14	405.89372	0.00011
14	3	12	-	15	2	14	406.38722	0.00002
14	3	11	-	15	2	13	406.38722	-0.00004
13	3	10	-	14	2	12	406.87907	0.00018
12	3	10	-	13	2	12	407.36857	0.00012
12	3	9	-	13	2	11	407.36857	0.00009
9	3	7	-	10	2	9	408.82518	0.00016
9	3	6	-	10	2	8	408.82518	0.00015
24	3	21	-	24	2	23	412.91814	0.00015
22	3	19	-	22	2	21	413.01653	0.00011
22	3	20	-	22	2	20	413.01653	-0.00018
21	3	19	-	21	2	19	413.06283	0.00010
20	3	17	-	20	2	19	413.10653	0.00005
20	3	18	-	20	2	18	413.10653	-0.00014
19	3	16	-	19	2	18	413.14855	0.00019
19	3	17	-	19	2	17	413.14855	0.00003
18	3	15	-	18	2	17	413.18826	0.00011
18	3	16	-	18	2	16	413.18826	-0.00002
17	3	15	-	17	2	15	413.22607	0.00012
16	3	13	-	16	2	15	413.26196	0.00011
16	3	14	-	16	2	14	413.26196	0.00003
15	3	12	-	15	2	14	413.29510	0.00014
15	3	13	-	15	2	13	413.29510	0.00008
14	3	11	-	14	2	13	413.32650	0.00013
14	3	12	-	14	2	12	413.32650	0.00008
13	3	10	-	13	2	12	413.35586	0.00016
13	3	11	-	13	2	11	413.35586	0.00013
12	3	9	-	12	2	11	413.38308	0.00016
12	3	10	-	12	2	10	413.38308	0.00013
11	3	8	-	11	2	10	413.40820	0.00015
11	3	9	-	11	2	9	413.40820	0.00013
10	3	7	-	10	2	9	413.43118	0.00009
10	3	8	-	10	2	8	413.43118	0.00008
8	3	5	-	8	2	7	413.47103	0.00015
8	3	6	-	8	2	6	413.47103	0.00014
7	3	*	-	7	2	*	413.48783	-0.00001
3	3	*	-	2	2	*	414.92193	-0.00008
4	3	*	-	3	2	*	415.37640	0.00002
5	3	*	-	4	2	*	415.82861	-0.00002
6	3	*	-	5	2	*	416.27874	-0.00003
8	3	*	-	7	2	*	417.17257	-0.00012
9	3	*	-	8	2	*	417.61666	0.00020
12	3	10	-	11	2	10	418.93506	0.00010
12	3	9	-	11	2	9	418.93506	0.00008
13	3	11	-	12	2	11	419.37030	0.00013
13	3	10	-	12	2	10	419.37030	0.00011
14	3	12	-	13	2	12	419.80332	0.00009
14	3	11	-	13	2	11	419.80332	0.00006
15	3	12	-	14	2	12	420.23435	0.00017
17	3	15	-	16	2	15	421.08960	0.00013
17	3	14	-	16	2	14	421.08960	0.00005
18	3	16	-	17	2	16	421.51401	0.00013
18	3	15	-	17	2	15	421.51401	0.00002
20	3	18	-	19	2	18	422.35636	0.00016
20	3	17	-	19	2	17	422.35636	0.00000
21	3	19	-	20	2	19	422.77423	0.00014
21	3	18	-	20	2	18	422.77423	-0.00006
22	3	19	-	21	2	19	423.19007	0.00004
23	3	21	-	22	2	21	423.60337	0.00005
24	3	21	-	23	2	21	424.01508	0.00010
25	3	23	-	24	2	23	424.42399	0.00020
25	3	22	-	24	2	22	424.42399	-0.00019
25	4	*	-	26	3	*	409.98739	-0.00007
24	4	*	-	25	3	*	410.48167	-0.00001
23	4	*	-	24	3	*	410.99379	-0.00011
20	4	*	-	21	3	*	412.51861	0.00013
19	4	*	-	20	3	*	413.02270	0.00006
17	4	*	-	18	3	*	414.02474	-0.00011
16	4	*	-	17	3	*	414.52288	-0.00003
15	4	*	-	16	3	*	415.01888	-0.00004
14	4	*	-	15	3	*	415.51278	-0.00011
12	4	*	-	13	3	*	416.49450	-0.00017
10	4	*	-	11	3	*	417.46841	0.00020
9	4	*	-	10	3	*	417.95182	-0.00007
25	4	*	-	25	3	*	421.98630	0.00015
24	4	*	-	24	3	*	422.03900	-0.00003
23	4	*	-	23	3	*	422.08972	-0.00008
22	4	*	-	22	3	*	422.13840	-0.00006
21	4	*	-	21	3	*	422.18491	-0.00009
20	4	*	-	20	3	*	422.22937	-0.00006
19	4	*	-	19	3	*	422.27176	0.00001
18	4	*	-	18	3	*	422.31192	-0.00003
17	4	*	-	17	3	*	422.35010	0.00006
16	4	*	-	16	3	*	422.38599	-0.00002
15	4	*	-	15	3	*	422.41971	-0.00016
14	4	*	-	14	3	*	422.45163	0.00002
13	4	*	-	13	3	*	422.48136	0.00012
12	4	*	-	12	3	*	422.50867	-0.00008
11	4	*	-	11	3	*	422.53406	-0.00009
10	4	*	-	10	3	*	422.55736	-0.00005
9	4	*	-	9	3	*	422.57877	0.00017
8	4	*	-	8	3	*	422.59737	-0.00008
6	4	*	-	6	3	*	422.62921	-0.00019
4	4	*	-	3	3	*	424.50346	-0.00015
5	4	*	-	4	3	*	424.95573	0.00000
6	4	*	-	5	3	*	425.40571	0.00001
7	4	*	-	6	3	*	425.85350	-0.00004
8	4	*	-	7	3	*	426.29918	-0.00005
9	4	*	-	8	3	*	426.74260	-0.00017
10	4	*	-	9	3	*	427.18410	-0.00005
11	4	*	-	10	3	*	427.62318	-0.00019
12	4	*	-	11	3	*	428.06053	0.00010
13	4	*	-	12	3	*	428.49528	-0.00004
14	4	*	-	13	3	*	428.92796	-0.00009
15	4	*	-	14	3	*	429.35859	0.00000
16	4	*	-	15	3	*	429.78688	-0.00008
18	4	*	-	17	3	*	430.63735	0.00020
20	4	*	-	19	3	*	431.47854	-0.00001
21	4	*	-	20	3	*	431.89584	-0.00012
22	4	*	-	21	3	*	432.31112	-0.00005
23	4	*	-	22	3	*	432.72414	-0.00002
24	4	*	-	23	3	*	433.13491	-0.00003
25	4	*	-	24	3	*	433.54351	0.00000
25	5	*	-	26	4	*	419.04019	0.00014
24	5	*	-	25	4	*	419.55481	-0.00012
23	5	*	-	24	4	*	420.06781	0.00004
22	5	*	-	23	4	*	420.57862	0.00004
21	5	*	-	22	4	*	421.08741	0.00006
18	5	*	-	19	4	*	422.60141	0.00006
17	5	*	-	18	4	*	423.10190	0.00000
16	5	*	-	17	4	*	423.60031	-0.00008
15	5	*	-	16	4	*	424.09672	-0.00010
14	5	*	-	15	4	*	424.59111	-0.00005
12	5	*	-	13	4	*	425.57371	0.00010
11	5	*	-	12	4	*	426.06172	0.00001
9	5	*	-	10	4	*	427.03172	0.00010
7	5	*	-	8	4	*	427.99321	0.00009
24	5	*	-	24	4	*	431.11132	0.00008
23	5	*	-	23	4	*	431.16262	-0.00006
22	5	*	-	22	4	*	431.21194	-0.00004
21	5	*	-	21	4	*	431.25912	-0.00001
20	5	*	-	20	4	*	431.30422	0.00007
19	5	*	-	19	4	*	431.34722	0.00020
18	5	*	-	18	4	*	431.38781	0.00005
17	5	*	-	17	4	*	431.42623	-0.00012
16	5	*	-	16	4	*	431.46273	-0.00006
15	5	*	-	15	4	*	431.49703	-0.00007
14	5	*	-	14	4	*	431.52923	-0.00003
13	5	*	-	13	4	*	431.55932	0.00004
12	5	*	-	12	4	*	431.58712	-0.00003
11	5	*	-	11	4	*	431.61294	0.00006
10	5	*	-	10	4	*	431.63644	-0.00003
9	5	*	-	9	4	*	431.65792	0.00000
8	5	*	-	8	4	*	431.67733	0.00011
7	5	*	-	7	4	*	431.69424	-0.00013
6	5	*	-	6	4	*	431.70931	-0.00007
5	5	*	-	5	4	*	431.72204	-0.00021
5	5	*	-	4	4	*	434.03564	-0.00003

TABLE I—*Continued*

J	Ka	Kc	-	J	Ka	Kc	Observed	O-C	J	Ka	Kc	-	J	Ka	Kc	Observed	O-C
6	5	*	-	5	4	*	434.48553	0.00010	10	1	10	-	9	2	8	381.09283	-0.00004
7	5	*	-	6	4	*	434.93304	0.00001	10	1	9	-	9	2	7	381.13223	0.00021
8	5	*	-	7	4	*	435.37853	0.00007	11	1	11	-	10	2	9	381.52914	0.00006
10	5	*	-	9	4	*	436.26282	0.00005	11	1	10	-	10	2	8	381.57614	0.00009
11	5	*	-	10	4	*	436.70163	-0.00002	12	1	11	-	11	2	9	382.01843	0.00007
12	5	*	-	11	4	*	437.13834	0.00001	14	1	14	-	13	2	12	382.82325	0.00021
13	5	*	-	12	4	*	437.57263	-0.00019	14	1	13	-	13	2	11	382.89773	-0.00002
14	5	*	-	13	4	*	438.00513	0.00002	15	1	15	-	14	2	13	383.24955	0.00009
16	5	*	-	15	4	*	438.86322	0.00015	16	1	15	-	15	2	13	383.77036	0.00017
17	5	*	-	16	4	*	439.28873	-0.00001	18	1	17	-	17	2	15	384.63375	0.00015
18	5	*	-	17	4	*	439.71213	-0.00006	20	1	19	-	19	2	17	385.49393	-0.00003
21	5	*	-	20	4	*	440.98915	-0.00006	22	1	21	-	21	2	19	386.34543	0.00020
22	5	*	-	21	4	*	441.38373	-0.00003	23	1	23	-	22	2	21	386.57206	0.00019
23	5	*	-	22	4	*	441.79603	-0.00005	23	1	22	-	22	2	20	386.76835	0.00015
24	5	*	-	23	4	*	442.20616	0.00001	24	1	23	-	23	2	21	387.18955	0.00017
25	5	*	-	24	4	*	442.61393	-0.00004	25	1	25	-	24	2	23	387.37766	0.00005
									25	1	24	-	24	2	22	387.60856	-0.00021
25	0	25	-	26	1	25	373.14574	-0.00009									
24	0	24	-	25	1	24	373.66353	0.00018	25	2	24	-	26	3	24	354.58260	0.00012
23	0	23	-	24	1	23	374.17863	-0.00009	25	2	23	-	26	3	23	354.58260	0.00010
21	0	21	-	22	1	21	375.20302	0.00000	22	2	21	-	23	3	21	356.11250	-0.00016
20	0	20	-	21	1	20	375.71184	-0.00011	22	2	20	-	23	3	20	356.11250	-0.00018
18	0	18	-	19	1	18	376.72331	-0.00003	21	2	20	-	22	3	20	356.61879	-0.00010
17	0	17	-	18	1	17	377.22582	0.00001	21	2	19	-	22	3	19	356.61879	-0.00011
16	0	16	-	17	1	16	377.72613	0.00003	18	2	17	-	19	3	17	358.12599	0.00000
15	0	15	-	16	1	15	378.22415	-0.00008	18	2	16	-	19	3	16	358.12599	0.00000
14	0	14	-	15	1	14	378.72003	-0.00016	16	2	15	-	17	3	15	359.12100	-0.00003
13	0	13	-	14	1	13	379.21392	-0.00005	16	2	14	-	17	3	14	359.12100	-0.00004
12	0	12	-	13	1	12	379.70562	0.00004	15	2	*	-	16	3	*	359.61560	-0.00003
11	0	11	-	12	1	11	380.19488	-0.00012	14	2	*	-	15	3	*	360.10830	0.00003
10	0	10	-	11	1	10	380.68225	0.00000	13	2	*	-	14	3	*	360.59890	-0.00005
9	0	9	-	10	1	9	381.16723	-0.00007	11	2	*	-	12	3	*	361.57430	-0.00010
8	0	8	-	9	1	8	381.65023	0.00006	10	2	*	-	11	3	*	362.05911	-0.00006
7	0	7	-	8	1	7	382.13082	-0.00002	9	2	*	-	10	3	*	362.54202	0.00006
6	0	6	-	7	1	6	382.60912	-0.00019									
5	0	5	-	6	1	5	383.08576	0.00017	25	2	23	-	25	3	23	366.60102	-0.00018
4	0	4	-	5	1	4	383.55976	0.00010	25	2	24	-	25	3	22	366.60102	-0.00016
3	0	3	-	4	1	3	384.03144	-0.00007	23	2	21	-	23	3	21	366.70032	-0.00012
									23	2	22	-	23	3	20	366.70032	-0.00010
25	0	25	-	25	1	25	385.28943	-0.00012	21	2	19	-	21	3	19	366.79148	-0.00012
23	0	23	-	23	1	23	385.36117	-0.00007	21	2	20	-	21	3	18	366.79148	-0.00011
22	0	22	-	22	1	22	385.42432	0.00006	20	2	18	-	20	3	18	366.83396	-0.00019
21	0	21	-	21	1	21	385.48543	0.00003	20	2	19	-	20	3	17	366.83396	-0.00018
19	0	19	-	19	1	19	385.54194	-0.00010	19	2	*	-	19	3	*	366.87455	-0.00013
18	0	18	-	18	1	18	385.57737	-0.00018	17	2	*	-	17	3	*	366.94953	-0.00015
17	0	17	-	17	1	17	385.61133	0.00015	16	2	*	-	16	3	*	366.98410	-0.00004
16	0	16	-	16	1	16	385.64286	-0.00007	15	2	*	-	15	3	*	367.01639	-0.00019
15	0	15	-	15	1	15	385.67273	-0.00008	14	2	*	-	14	3	*	367.04682	-0.00017
14	0	14	-	14	1	14	385.70069	-0.00013	13	2	*	-	13	3	*	367.07520	-0.00018
13	0	13	-	13	1	13	385.72687	-0.00009	12	2	*	-	12	3	*	367.10172	-0.00002
12	0	12	-	12	1	12	385.75104	-0.00018	11	2	*	-	11	3	*	367.12589	-0.00019
11	0	11	-	11	1	11	385.77359	-0.00003	9	2	*	-	9	3	*	367.16852	-0.00016
9	0	9	-	9	1	9	385.81275	-0.00006	8	2	*	-	8	3	*	367.18696	0.00003
8	0	8	-	8	1	8	385.82962	0.00002									
5	0	5	-	5	1	5	385.86884	0.00007	7	2	*	-	6	3	*	370.44193	-0.00018
3	0	3	-	3	1	3	385.88553	-0.00003	9	2	*	-	8	3	*	371.33272	-0.00012
									12	2	*	-	11	3	*	372.65333	-0.00009
5	0	5	-	4	1	3	388.17795	-0.00010	14	2	*	-	13	3	*	373.52333	-0.00009
6	0	6	-	5	1	4	388.62754	-0.00003	15	2	*	-	14	3	*	373.95534	0.00004
7	0	7	-	6	1	5	389.07497	0.00013	19	2	*	-	18	3	*	375.66173	-0.00014
9	0	9	-	8	1	7	389.96275	0.00019	20	2	19	-	19	3	17	376.08311	-0.00015
11	0	11	-	10	1	9	390.84105	-0.00014	20	2	18	-	19	3	16	376.08311	-0.00016
13	0	13	-	12	1	11	391.71065	-0.00005	21	2	20	-	20	3	18	376.50252	-0.00002
14	0	14	-	13	1	12	392.14217	0.00016	21	2	19	-	20	3	17	376.50252	-0.00003
15	0	15	-	14	1	13	392.57115	0.00013	25	2	24	-	24	3	22	378.15844	-0.00010
16	0	16	-	15	1	14	392.99754	-0.00020	25	2	23	-	24	3	21	378.15844	-0.00012
18	0	18	-	17	1	16	393.84425	0.00002									
19	0	19	-	18	1	17	394.26396	-0.00003	25	3	*	-	26	4	*	345.21118	0.00009
20	0	20	-	19	1	18	394.68136	-0.00009	24	3	*	-	25	4	*	345.72280	-0.00002
21	0	21	-	20	1	19	395.09655	-0.00001	23	3	*	-	24	4	*	346.23291	0.00007
22	0	22	-	21	1	20	395.50927	-0.00006	21	3	*	-	22	4	*	347.24701	0.00007
23	0	23	-	22	1	21	395.91976	-0.00001	18	3	*	-	19	4	*	348.75370	0.00006
24	0	24	-	23	1	22	396.32787	0.00002	17	3	*	-	18	4	*	349.25199	-0.00001
25	0	25	-	24	1	23	396.73358	0.00000	12	3	*	-	13	4	*	351.71464	0.00006
									11	3	*	-	12	4	*	352.20133	0.00011
25	1	25	-	26	2	25	363.79869	-0.00006	9	3	*	-	10	4	*	353.16878	0.00019
24	1	24	-	25	2	24	364.32110	-0.00009	8	3	*	-	9	4	*	353.64949	0.00018
23	1	23	-	24	2	23	364.84020	0.00006	6	3	*	-	7	4	*	354.60497	0.00019
22	1	21	-	23	2	21	365.53702	0.00013									
21	1	21	-	22	2	21	365.87131	0.00014	25	3	*	-	25	4	*	357.22890	0.00020
20	1	20	-	21	2	20	366.38331	0.00009	24	3	*	-	24	4	*	357.27919	-0.00004
19	1	19	-	20	2	19	366.89310	0.00013	23	3	*	-	23	4	*	357.32768	-0.00006
17	1	17	-	18	2	17	367.90571	0.00017	22	3	*	-	22	4	*	357.37419	-0.00005
17	1	16	-	18	2	16	368.01450	0.00004	20	3	*	-	20	4	*	357.46138	0.00020
16	1	15	-	17	2	15	368.50522	0.00005	19	3	*	-	19	4	*	357.50160	-0.00001
13	1	13	-	14	2	13	369.90302	0.00018	18	3	*	-	18	4	*	357.54021	0.00018
13	1	12	-	14	2	12	369.98781	0.00019	17	3	*	-	17	4	*	357.57649	0.00005
11	1	10	-	12	2	10	370.83462	0.00013	16	3	*	-	16	4	*	357.61101	0.00019
8	1	8	-	9	2	8	372.34703	0.00012	15	3	*	-	15	4	*	357.64320	0.00003
8	1	7	-	9	2	7	372.37242	-0.00012	14	3	*	-	14	4	*	357.67360	0.00009
									13	3	*	-	13	4	*	357.70189	0.00006
25	1	25	-	25	2	23	375.82002	0.00009	9	3	*	-	9	4	*	357.79500	0.00012
24	1	23	-	24	2	23	376.09245	0.00007									
22	1	21	-	22	2	21	376.17171	0.00010	22	3	*	-	21	4	*	367.54599	-0.00004
21	1	20	-	21	2	20	376.20875	0.00007	23	3	*	-	22	4	*	367.96103	-0.00011
21	1	21	-	21	2	19	376.04491	0.00013	22	3	*	-	21	4	*	367.54599	-0.00004
20	1	19	-	20	2	19	376.24417	0.00010									
16	1	15	-	16	2	15	376.36865	-0.00004	25	4	*	-	26	5	*	335.80455	0.00006
15	1	15	-	15	2	13	376.31016	-0.00017	24	4	*	-	25	5	*	336.31636	0.00013
12	1	12	-	12	2	10	376.41072	-0.00011	23	4	*	-	24	5	*	336.82616	0.00011
11	1	11	-	11	2	9	376.43968	0.00013	22	4	*	-	23	5	*	337.33388	-0.00008
9	1	9	-	9	2	7	376.48989	0.00008	21	4	*	-	22	5	*	337.84016	0.00021
									20	4	*	-	21	5	*	338.34398	-0.00004
6	1	6	-	5	2	4	379.32385	0.00013	19	4	*	-	20	5	*	338.84627	0.00010
6	1	5	-	5	2	3	379.33883	0.00016	17	4	*	-	18	5	*	339.84477	0.00012
8	1	8	-	7	2	6	380.21334	0.00019	16	4	*	-	17	5	*	340.34087	-0.00012
9	1	9	-	8	2	7	380.65423	0.00000	15	4	*	-	16	5	*	340.83546	0.00008

TABLE I—*Continued*

J	Ka	Kc	-	J	Ka	Kc	Observed	O-C
14	4	*	-	13	5	*	341.32766	-0.00016
13	4	*	-	14	5	*	341.81826	-0.00005
12	4	*	-	13	5	*	342.30667	-0.00016
11	4	*	-	12	5	*	342.79336	-0.00003
10	4	*	-	11	5	*	343.27807	0.00009
9	4	*	-	10	5	*	343.76068	0.00008
8	4	*	-	9	5	*	344.24118	-0.00006
7	4	*	-	8	5	*	344.71967	-0.00003
6	4	*	-	7	5	*	345.19677	0.00019
5	4	*	-	6	5	*	345.67136	0.00012
4	4	*	-	5	5	*	346.14407	0.00012
25	4	*	-	25	5	*	347.82090	0.00020
24	4	*	-	24	5	*	347.87110	-0.00009
23	4	*	-	23	5	*	347.91959	-0.00007
22	4	*	-	22	5	*	347.96619	0.00008
21	4	*	-	21	5	*	348.01047	-0.00008
20	4	*	-	20	5	*	348.05308	0.00011
19	4	*	-	19	5	*	348.09339	0.00001
18	4	*	-	18	5	*	348.13178	0.00002
17	4	*	-	17	5	*	348.16810	-0.00003
16	4	*	-	16	5	*	348.20249	0.00002
15	4	*	-	15	5	*	348.23478	-0.00002
13	4	*	-	13	5	*	348.29337	-0.00003
12	4	*	-	12	5	*	348.31980	0.00013
11	4	*	-	11	5	*	348.34400	0.00008
10	4	*	-	10	5	*	348.36619	0.00004
9	4	*	-	9	5	*	348.38639	0.00003
8	4	*	-	8	5	*	348.40439	-0.00016
20	4	*	-	19	5	*	357.30000	-0.00017
22	4	*	-	21	5	*	358.13658	-0.00012
23	4	*	-	22	5	*	358.55180	0.00000
24	4	*	-	23	5	*	358.96480	0.00001
25	4	*	-	24	5	*	359.37570	0.00004
d			ν_t-3-2 Band - High Freq. Comp.					
25	1	25	-	25	0	25	367.30091	-0.00004
24	1	24	-	24	0	24	367.36753	-0.00011
23	1	23	-	23	0	23	367.43152	-0.00014
22	1	22	-	22	0	22	367.49311	0.00009
21	1	21	-	21	0	21	367.55161	-0.00010
19	1	19	-	19	0	19	367.66102	-0.00008
17	1	17	-	17	0	17	367.75971	-0.00012
15	1	15	-	15	0	15	367.84781	-0.00007
14	1	14	-	14	0	14	367.88791	0.00000
13	1	13	-	13	0	13	367.92521	-0.00006
11	1	11	-	11	0	11	367.99201	0.00002
10	1	10	-	10	0	10	368.02143	0.00008
9	1	9	-	9	0	9	368.04801	-0.00002
7	1	7	-	7	0	7	368.09333	-0.00008
5	1	5	-	5	0	5	368.12803	-0.00007
17	1	16	-	16	0	16	375.76411	0.00001
18	1	17	-	17	0	17	376.19664	-0.00011
20	1	19	-	19	0	19	377.05725	-0.00001
21	1	20	-	20	0	20	377.48483	-0.00027
22	1	21	-	21	0	21	377.91125	-0.00008
24	1	23	-	23	0	23	378.75884	-0.00008
25	2	23	-	25	1	25	376.78581	0.00008
24	2	23	-	24	1	23	376.61444	-0.00011
23	2	21	-	23	1	23	376.87115	0.00014
22	2	21	-	22	1	21	376.73024	0.00009
21	2	19	-	21	1	21	376.94911	-0.00027
20	2	19	-	20	1	19	376.83615	0.00019
19	2	17	-	19	1	19	377.02102	0.00014
17	2	15	-	17	1	17	377.08553	0.00009
16	2	15	-	16	1	15	377.01824	0.00016
15	2	13	-	15	1	15	377.14285	-0.00022
14	2	12	-	14	1	14	377.16912	-0.00016
12	2	11	-	12	1	11	377.16104	0.00017
10	2	9	-	10	1	9	377.21752	0.00001
7	0	7	-	6	1	5	362.11199	-0.00007
9	0	9	-	8	1	7	362.99261	0.00016
11	0	11	-	10	1	9	363.86270	-0.00019
12	0	12	-	11	1	10	364.29440	0.00003
13	0	13	-	12	1	11	364.72342	0.00007
14	0	14	-	13	1	12	365.14991	0.00010
15	0	15	-	14	1	13	365.57401	0.00027
17	0	17	-	16	1	15	366.41391	-0.00011
18	0	18	-	17	1	16	366.83060	0.00024
21	0	21	-	20	1	19	368.06421	0.00020
22	0	22	-	21	1	20	368.46991	-0.00019
23	0	23	-	22	1	21	368.87381	0.00022
25	0	25	-	24	1	23	369.67301	0.00021
e			ν_t-3-2 Band - Low Freq. Comp.					
25	1	25	-	25	0	25	366.92621	0.00004
24	1	24	-	24	0	24	366.99363	-0.00013
19	1	19	-	19	0	19	367.29111	-0.00008
18	1	18	-	18	0	18	367.34290	0.00033
17	1	17	-	17	0	17	367.39121	-0.00004
15	1	15	-	15	0	15	367.48023	-0.00028
13	1	13	-	13	0	13	367.55872	-0.00022
11	1	11	-	11	0	11	367.62650	-0.00007
10	1	10	-	10	0	10	367.65610	-0.00022
9	1	9	-	9	0	9	367.68320	-0.00017
7	1	7	-	7	0	7	367.72922	-0.00014
6	1	6	-	6	0	6	367.74642	0.00012
4	1	4	-	4	0	4	367.77820	0.00015
3	1	3	-	3	0	3	367.78913	0.00025
2	1	2	-	2	0	2	367.79700	0.00001
6	1	5	-	5	0	5	370.53712	-0.00020
7	1	6	-	6	0	6	370.98723	-0.00004
8	1	7	-	7	0	7	371.43553	-0.00013
10	1	9	-	9	0	9	372.32744	-0.00030
15	1	14	-	14	0	14	374.53023	-0.00015
16	1	15	-	15	0	15	374.96593	-0.00021
18	1	17	-	17	0	17	375.83293	0.00006
19	1	18	-	18	0	18	376.26393	0.00010
20	1	19	-	19	0	19	376.69322	0.00005
22	1	21	-	21	0	21	377.54693	-0.00010
24	1	23	-	23	0	23	378.39434	-0.00004
24	2	23	-	24	1	23	376.23741	0.00006
23	2	21	-	23	1	23	376.49403	0.00002
20	2	18	-	20	1	20	376.61021	0.00001
20	2	19	-	20	1	19	376.46052	-0.00004
19	2	17	-	19	1	19	376.64543	-0.00002
17	2	15	-	17	1	17	376.71075	0.00001
16	2	15	-	16	1	15	376.64422	0.00010
15	2	13	-	15	1	15	376.76933	0.00032
14	2	12	-	14	1	14	376.79543	-0.00011
14	2	13	-	14	1	13	376.72084	-0.00016
13	2	11	-	13	1	13	376.82002	-0.00026
12	2	11	-	12	1	11	376.78784	-0.00014
11	2	9	-	11	1	11	376.86465	0.00013
10	2	8	-	10	1	10	376.88423	0.00024
10	2	9	-	10	1	9	376.84324	0.00021
25	0	25	-	25	1	25	358.00859	0.00004
24	0	24	-	24	1	24	358.05278	-0.00003
23	0	23	-	23	1	23	358.09520	-0.00007
21	0	21	-	21	1	21	358.17470	-0.00008
19	0	19	-	19	1	19	358.24721	0.00010
18	0	18	-	18	1	18	358.28059	0.00000
17	0	17	-	17	1	17	358.31230	0.00001
16	0	16	-	16	1	16	358.34221	0.00000
15	0	15	-	15	1	15	358.37028	-0.00007
13	0	13	-	13	1	13	358.42158	0.00026
12	0	12	-	12	1	12	358.44438	0.00023
11	0	11	-	11	1	11	358.46529	0.00007
9	0	9	-	9	1	9	358.50209	0.00003
7	0	7	-	7	1	7	358.53200	0.00013
9	0	9	-	8	1	7	362.61941	-0.00011
11	0	11	-	10	1	9	363.48971	0.00016
13	0	13	-	12	1	11	364.34960	0.00010
18	0	18	-	17	1	16	366.45481	-0.00005
19	0	19	-	18	1	17	366.86811	-0.00012
20	0	20	-	19	1	18	367.27942	0.00041
21	0	21	-	20	1	19	367.68741	0.00021
23	0	23	-	22	1	21	368.49561	-0.00014

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