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A LINE SURVEY OF ORION-KL FROM 607 TO 725 GHz

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ABSTRACT

With the Caltech Submillimeter Telescope, we have performed an unbiased line survey of Orion-KL in the frequency range 607–725 GHz. We were able to identify lines down to a threshold of 1–2 K in main beam brightness temperature units, and we found 1064 spectral features consisting of 2032 lines, partially blended. Apart from the abundant diatomic rotors such as CO, CS, SO, the spectrum is dominated by CH_3OH and SO_2, both in terms of numbers of lines and integrated flux. The number of unidentified lines is 155 or 14%. We also report the tentative identification of the new molecule SiH in our data. For some complex organic molecules, we find rotation temperatures and column densities which are much higher than those found in earlier studies. It is likely the cause of this is a significant contribution from a very compact, hot component of the Orion molecular cloud core which was not visible in lower frequency surveys.

Subject headings: ISM: individual (Orion Kleinmann-Low) — ISM: molecules — line: identification — radio lines: ISM — surveys

On-line material: machine-readable tables

1. INTRODUCTION

It is now well known that the interstellar medium contains regions of high density [$n(H_2) = 10^3$–10^8 cm^{-3}], known as molecular clouds, in which star formation takes place. In these regions, a complex chemistry gives rise to a set of abundant molecular species. Each molecule generates a set of spectral lines, resulting in a "line forest." As the sensitivity of telescopes and receivers has improved, it has become possible to reach the line confusion limit toward some of these regions, which are particularly prolific line sources. To determine the presence and measure the abundance of any given molecule requires the observations of many lines. The best way to do this is by means of a line survey. In fact, unbiased spectral line surveys are necessary to obtain an unbiased view of the chemistry of a specific region. Line surveys so far have concentrated on two objects: IRC +10216 as a representative of an evolved star, and Orion-KL as a representative of star-forming hot cores (Groesbeck, Phillips, & Blake 1994; Schilke et al. 1997 and references therein). A few surveys have been performed for other objects of these two classes (e.g., Sutton et al. 1991 in Sgr B2, Bell, Avery, & Watson 1993 in W51, Macdonald et al. 1996 in G34.3, and Helmich & van Dishoeck 1997 in W3) and some work for dark clouds (Kaifu et al. 1987), but nothing approaching the extent of data toward these two sources. The data presented so far cover only the spectral range up to 360 GHz, with the exception of Harris et al. (1995), who surveyed a small frequency range around from 685–692 GHz in Orion-KL. Some spectral regions are inaccessible to ground based observations because of atmospheric absorption, but two large windows in the submillimeter, at 450 μm (corresponding to $\approx$600–725 GHz) and at 350 μm (corresponding to $\approx$780–960 GHz), remain largely unobserved.

In this paper we complete the study of the 450 μm window for Orion-KL, while a survey in the 350 μm range has been started. It might be thought that observations of these bands would produce only redundant information, because most molecules have been covered well by lower frequency surveys. This is not so, because for almost all species the transitions emitting in the submillimeter region originate from higher energy levels than at lower frequencies, thereby tracing gas with higher densities and temperatures. This trend is further enhanced by the smaller beam sizes at higher frequencies (for a given telescope) which allow a more efficient coupling to very small, high-density, hot sources. It also is interesting to investigate the interaction of gas with dust continuum radiation, which starts to have significant optical depths in these frequency ranges. Once the database on Orion is complete, one can begin to compare other sources with Orion from a chemical point of view. The basic collected data set of Orion spectra, as observed from ground-based telescopes, will be useful to many current observers and particularly to spectroscopic studies carried out with future instruments such as the SMA, ALMA, and FIRST.

2. OBSERVATIONS AND DATA PROCESSING

Using the Caltech Submillimeter Observatory (CSO), we performed a line survey of the Orion-KL region in the frequency range 607–725 GHz (Fig. 1). This spectral range covers almost the entire 450 μm atmospheric window bracketed by very broad, strong atmospheric H_2O absorption lines at 556.9 and 752.0 GHz. Two gaps are present in the band: one at 620.7 GHz, caused by atmospheric H_2O, and one, less deep, at 715.4 GHz, caused by atmospheric O_2. The line at 620.7 GHz prohibits observations between 620 and 623 GHz. Additionally, O_3 lines around 656 GHz worsen the transmission in this range. Any spectral lines close to these frequencies have a much higher calibration uncertainty. The part of the atmospheric window between 600 and 607 GHz could not be observed due to local oscillator power constraints.

The data were taken between 1994 November and 1995 January, using the 650 GHz facility SIS receiver (Kooi et al.

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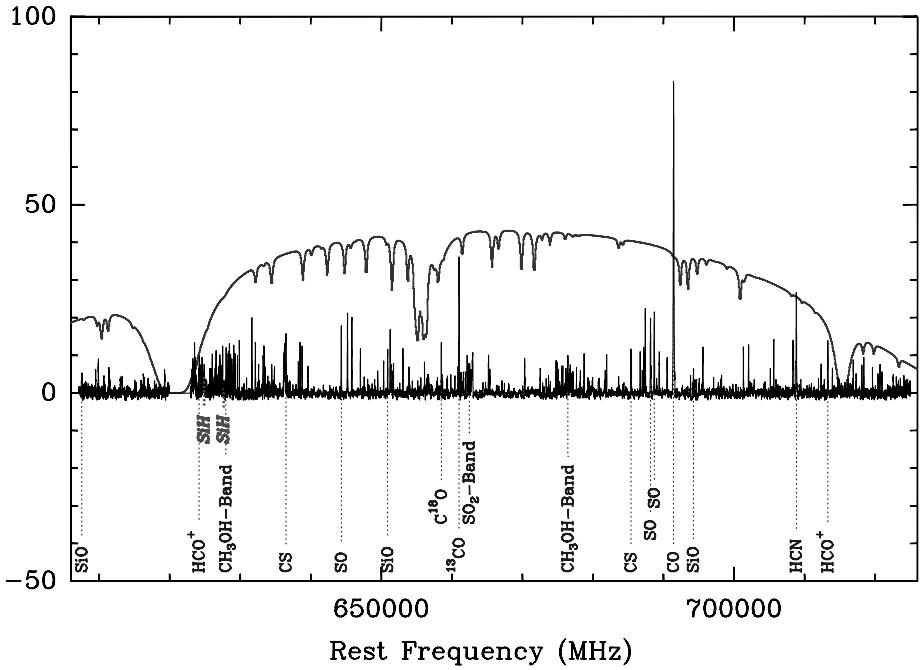

FIG. 1.—Spectrum of Orion-KL from 607 to 725 GHz. The strongest lines and frequencies of the possible newly detected molecule SiH are marked. Overlaid is a plot of the zenith atmospheric transmission for 1 mm of precipitable water vapor at Mauna Kea. The ordinate is valid for the spectrum in T_A^* units, and for the atmospheric transmission in percent.

1994). The two facility CSO 500 MHz AOS with 1024 channels each were used in a serial mode to cover approximately 1 GHz at each tuning. The observations consisted of two complete coverages of the band: the first coverage was done with a spacing of 800 MHz to ensure overlap, the second coverage was done with the same spacing, but offset by 400 MHz to the first coverage. Since the weather conditions were excellent, eight nights were sufficient to cover the whole spectrum twice. The single sideband system temperatures were in the range 1500–3000 K, and the spectral resolution obtained is 1 MHz. The beam efficiency was measured to be 0.55 on Jupiter, and the line intensities (T_a^*) were corrected by that factor to give T_R^*-values. In the case of Orion, observing the KL region with the present resolution (10″–12″ depending on the frequency) breaks it up into distinct subsources (see, e.g., Sutton et al. 1994),

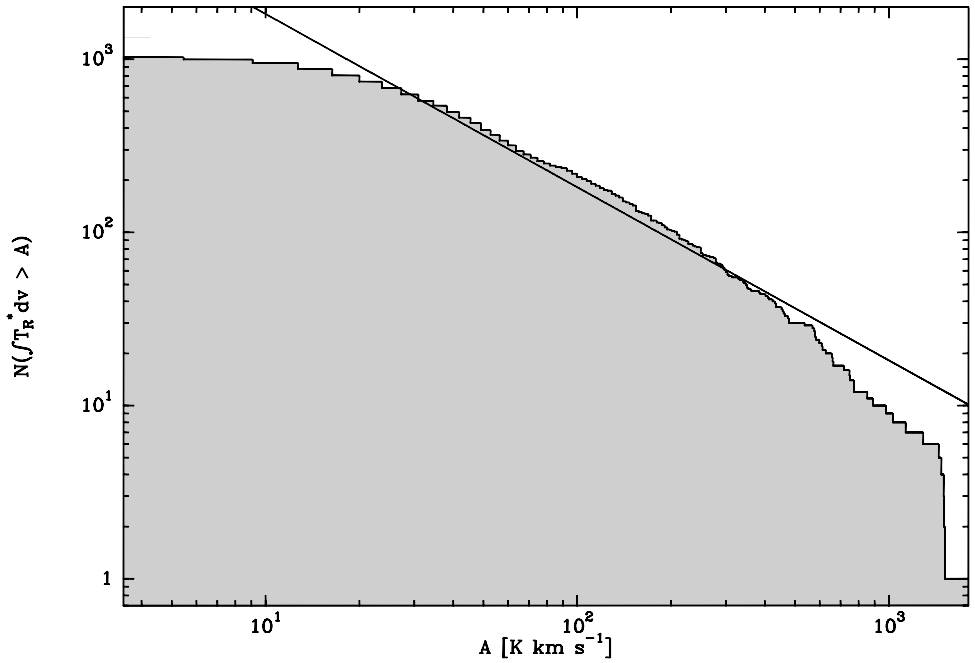

FIG. 2.—Number of lines with integrated main-beam brightness temperatures, $\int T_R^* dv > A$, larger than a value A. The power-law fit obviously does not provide a good fit to the very intense or very weak lines.

TABLE 1

LTE Rotation Temperatures and Beam-Averaged Column Densities, Determined Using a Boltzmann Plot

Line	T_{rot} (K)	σ (K)	N (cm^{-2})	σ (cm^{-2})	Notes
CO	100	0	6.0(19)	...	From $C^{18}O$, T_{rot} fixed
CS	127	...	1.0(15)	...	Two lines only
SiO	110	50	5.4(14)	6.5(14)	
HCl	150	0	1.0(14)	...	T_{rot} fixed
SiH	100	0	9.1(15)	...	T_{rot} fixed
SO	64	5	2.3(17)	0.7(17)	Corrected for optical depth
NO	90	14	1.5(17)	0.6(17)	
HCN	100	0	2.6(16)	...	From $HC^{15}N$, T_{rot} fixed
SO_2	187	4	6.0(16)	0.3(16)	
$^{34}SO_2$	192	12	8.2(15)	1.1(15)	
H_2S	129	10	1.2(16)	0.3(16)	
NH_2D	75	11	9.7(15)	3.8(15)	
CH_3OH	303	6	5.0(16)	0.2(16)	Optically thick?
$^{13}CH_3OH$	229	14	9.6(15)	1.1(15)	
H_2CO	190	9	3.2(15)	0.5(15)	
HNCO	240	13	3.1(15)	0.5(15)	
$HCOOCH_3$	316	9	1.3(17)	0.1(17)	Optically thick?
CH_3OCH_3	360	26	2.8(16)	0.4(16)	Optically thick?
CH_3CH_2CN	239	4	3.1(16)	0.2(16)	Optically thick?

Notes.—The column densities are determined using the main beam brightness line temperature scale. For species where only one line was available, a rotation temperature of 100 K was used, except in the case of HCl, where a temperature of 150 K was used for consistency with Schilke et al. 1995.

notably the hot core (near IRc2), where the sulphur-bearing molecules and the continuum peak, and the compact ridge, 10″ southeast of it, where organic oxygen-bearing molecules have their maximum. We always were pointed toward the hot core position $\alpha_{1950} = 5^h32^m47^s.0$, $\delta_{1950} = -5°24'24''$. The pointing was checked by observing planets and by observing lines of molecules which are known to peak in the vicinity of the hot core. We estimate an overall accuracy of 3″. The calibration was affected by occasional slight sideband imbalances (typically in the 20% range, occasionally reaching 50%). However, since each line was observed four times with different tunings, this was not a serious problem. We estimate the overall calibration accuracy to be 30%, except close to the deep atmospheric absorptions, where it is worse. The observations were performed using symmetric position switching to positions 5′ away in azimuth. Since the OMC-1 ridge runs north-south and the data were not taken at very low elevations, this setup excludes off-source contamination for all species with the possible exception of $^{12}CO(6–5)$.

A zero order baseline (i.e., a constant offset) was subtracted from the DSB data, the offset being defined by the line free part of the spectrum, or, in case of spectra without obvious line free parts, by the lowest points of the spectrum. In very crowded spectra these lowest points were defined by a few channels only. The double sideband data were subsequently deconvolved using a maximum entropy deconvolution method (similar to the one used and described by Sutton et al. 1994), to produce a single sideband spectrum. One advantage compared to CLEAN type deconvolution methods, which had been used for earlier Caltech surveys (Sutton et al. 1985; Blake et al. 1986; Schilke et al. 1997) is

TABLE 2

Integrated Line Intensities for Each Species

Line	$\int T_R^* dv$ (K km s^{-1})	Line	$\int T_R^* dv$ (K km s^{-1})	Line	$\int T_R^* dv$ (K km s^{-1})
CO	11476.7	SO	10055.6	SO_2	27889.0
CS	1321.4	NO	611.8	CH_3OH	27463.6
SiO	913.7	NS	306.2	H_2CO	3934.3
SiH	319.9	CN	85.4	H_2CS	234.2
HCl	785.8	CCH	88.8	HNCO	1196.5
HCN	2730.3	CH_3CN	2830.2	$HCOOCH_3$	2466.0
HNC	319.2	H_2O	82.7	CH_3OCH_3	3466.0
HCO^+	839.4	H_2S	1556.4	CH_3CH_2CN	2939.3
HCS^+	8.3	NH_2D	78.2	U	7130.1

Note.—The numbers are integrals over all transitions (including torsionally or vibrationally excited ones) and all isotopomers.

that it permits fitting the sideband gain ratios, while these ratios had to be provided for CLEAN. The achieved sensitivity is sufficiently high to securely identify 1 K lines over most of the band.

The main difficulty facing all sideband deconvolution methods is that pointing errors result in line shape and strength changes for the separate measurements of the same line (due to the structured source), which may result in spurious features in the synthesized SSB spectrum. The MEM method seems to produce fewer of these than the CLEAN deconvolution. Using a model spectrum helps suppressing the spurious features. In questionable cases, inspections of the original DSB spectra were performed. Some of the unidentified lines could be spurious features and if so, they are marked in the tables as questionable assignments.

Line blending also makes secure identifications difficult in some cases, this time independent of the observing method. Here line strength predictions based on other lines of the same species provide one way to disentangle features and make reliable assignments. Obviously, some iteration is required to derive a self-consistent result. Still, since one expects the presence of many weak lines just at the detection threshold, the likelihood of significant contamination by these lines is very high for weak lines. This renders their intensities rather uncertain, but not in an easily quantifiable way. Another problem, connected to blending, is the difficulty in determining a reliable baseline, which particularly affects the estimation of the line parameters of weak lines.

3. RESULTS

The intention of this paper is to present the data and some basic results. The full analysis of both physical and chemical parameters will be presented elsewhere (P. Schilke & T. G. Phillips 2001, in preparation), as discussed further below. The analysis of the survey reveals 1064 spectral features consisting of 2032 lines, partially blended (see Fig. 1). The number of *U* lines is 155 or about 14%. This number is presumably due to the sparseness of laboratory data in this wavelength range and will hopefully be reduced in the future. The spectrum is dominated by CO, CS, SO, SiO, HCN, HCO^+, H_2CO, SO_2, and CH_3OH, with many lines from very highly excited states. The sensitivity to these highly excited lines is partly due to the small beam size (about 12″), which is well matched to the hot core. Contrary to the findings of Harris et al. (1995), we have no lack of weak or intermediate strength features in our spectrum (see also Fig. 2).

The line identification was mainly performed on the basis of the JPL line catalog[4] (Pickett et al. 1998) and by the help of various papers by E. Herbst and collaborators (e.g., Anderson, Herbst, & De Lucia 1992, 1993; Pearson et al. 1994, 1995). For SiO, the frequencies from Mollaaghabada et al. (1991) were used. The paper by Xu & Lovas (1997) on methanol allowed the assignment of 23 previously unidentified lines to methanol. For $C^{33}S$, the frequencies were calculated using the constants in Bogey, Demuynck, & Destombes (1981).

Classically, one distinguishes four velocity components in Orion spectra (Blake et al. 1987): extended ($v_{LSR} \approx 9$ km s^{-1}, $\Delta v \approx 4$ km s^{-1}) and compact ridge ($v_{LSR} \approx 8$ km s^{-1}, $\Delta v \approx 3$ km s^{-1}), plateau ($v_{LSR} \approx 6$–10 km s^{-1}, $\Delta v \gtrsim 20$ km s^{-1}), and hot core ($v_{LSR} \approx 3$–6 km s^{-1}, $\Delta v \approx 5$–10km s^{-1}). These components are emitted from regions with differing physical and chemical conditions, which are described by (Blake et al. 1987). Here we have made no attempt to make multicomponent fits to disentangle the contributions of the various components, but we note if one or several components dominate the spectra of the various species.

It has been predicted that the number of lines per frequency interval should drop as one goes toward higher frequencies, mostly because of the high critical densities required to excite the levels. Indeed, some molecules familiar from lower frequency work are not seen any more, notably the heavier linear rotors like HC_3N, OCS, and symmetric tops like CH_3CCH. Even CH_3CN gets weaker, although many lines are still detectable. As predicted, the detectable molecules include the simple di- and triatomic rotors, but also asymmetric molecules such as H_2CO, CH_3OH, and SO_2. However, even some heavy asymmetric rotors such as CH_3CH_2CN, $HCOOCH_3$, and CH_3OCH_3 are still seen. The complex spectra of these species results in a line density per frequency interval which is not much different from that at lower frequencies. New molecules, which do not contribute significantly to lower frequency surveys are the light hydrides, such as SiH, HCl, H_2CO, and H_2S, which begin to become prominent.

One goal in analyzing the data is to determine molecular parameters, such as rotation temperatures, column densities etc. Traditionally, the approach here has been by-hand fitting of lines, possibly with multiple velocity components, and the production of rotation diagrams. For surveys with a large number of lines (such as the present one or future FIRST surveys), by-hand fitting is impractical. Furthermore, one often suffers from line blending problems, which makes determining line parameters difficult. A serious drawback of rotation diagram methods is that they may give erroneous results if the lines fitted happen to be optically thick. This can be amended by using isotopomeric lines to determine optical depths and correcting for that, but again this is a time-consuming process, impractical for large amounts of data. Here we give only results from the traditional rotation-diagram technique (Table 1). No optical depth correction has been attempted, except in the case of SO. High optical depths can falsify both column density and rotation temperature. In most cases, high optical depth tends to equalize the brightness temperatures of all lines of a molecule, which results in a flattening of the Boltzmann-plot and to apparent rotation temperatures which are too high. In some cases, notably for SO, where the low-excitation lines have low line strengths, high optical depths can lead to a steepening of the Boltzmann-plot and thus to a lower rotation temperature (Serabyn & Weisstein 1995). In the discussion of the individual molecules we will point out suspected high optical depth effects.

In the future it will be better to approach the problem of uniform analysis in a novel way. Using a molecular line catalog, the complete spectrum of a line survey can be fitted at once, yielding directly the molecular parameters one is interested in. The application of this technique to the present data and the data from Schilke et al. (1997) will be described in Schilke & Phillips (2001, in preparation).

The CO molecule, as expected, is the most abundant species with a total column density of 6×10^{19} cm^{-2}.

[4] http://spec.jpl.nasa.gov.

TABLE 3

TABLE OF ALL OBSERVED FEATURES

ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule
607175.1.....	$H^{13}CO^+$	611264.9.....	CCH	613678.0.....	CH_3OCH_3	615288.6.....	CH_3OCHO *E*
607215.3.....	CH_3OH *E*	611265.4.....	CCH	613678.0.....	CH_3OCH_3	615628.7.....	SO_2
607608.0.....	SiO	611327.2.....	CCH	613849.9.....	CH_3OCH_3	615985.5.....	$^{33}SO_2$
608021.3.....	C_2H_5CN	611327.6.....	CCH	613849.9.....	CH_3OCH_3	616226.3.....	*U*
608021.3.....	C_2H_5CN	611441.6.....	H_2S	613852.6.....	CH_3OCH_3	616322.2.....	CH_3OH *E*
608093.5.....	CH_3OCH_3	611552.5.....	SO	613852.7.....	CH_3OCH_3	616347.3.....	$SO_2(v_2)$
608096.1.....	CH_3OCH_3	611580.0.....	CH_3OH *A*	613855.4.....	CH_3OCH_3	616472.4.....	SO_2
608097.5.....	CH_3OCH_3	612125.1.....	$^{13}CH_3OH$ *E*	613855.5.....	CH_3OCH_3	616603.6.....	*U*
608097.5.....	CH_3OCH_3	612227.4.....	C_2H_5CN	613855.5.....	CH_3OCH_3	616637.3.....	$H_2^{13}CO$
608098.7.....	CH_3OCH_3	612280.7.....	CH_3OCH_3	613855.6.....	CH_3OCH_3	616980.0.....	CH_3OH *E*
608098.7.....	CH_3OCH_3	612280.8.....	CH_3OCH_3	613904.8.....	$^{13}CH_3OH$ *E*	617097.0.....	*U*
608100.1.....	CH_3OCH_3	612280.8.....	CH_3OCH_3	613959.0.....	CH_3OCH_3	617149.4.....	*U*
608101.5.....	CH_3OCH_3	612280.8.....	CH_3OCH_3	613962.3.....	CH_3OCH_3	617180.3.....	C_2H_5CN
608196.0.....	CH_3CN	612281.2.....	CH_3OCH_3	613962.4.....	CH_3OCH_3	617180.5.....	C_2H_5CN
608196.0.....	CH_3CN	612281.3.....	CH_3OCH_3	613965.6.....	CH_3OCH_3	617234.3.....	C_2H_5CN
608196.0.....	CH_3CN	612281.3.....	CH_3OCH_3	613965.7.....	CH_3OCH_3	617234.4.....	C_2H_5CN
608269.3.....	*U*	612281.8.....	CH_3OCH_3	613965.7.....	CH_3OCH_3	617346.6.....	HNCO
608287.2.....	CH_3CN	612442.7.....	$SO_2(v_2)$	613965.8.....	CH_3OCH_3	617617.7.....	C_2H_5CN
608287.2.....	CH_3CN	612479.8.....	$^{13}CH_3OH$ *A*	613970.7.....	CH_3OCH_3	617618.8.....	C_2H_5CN
608287.2.....	CH_3CN	612867.6.....	HNCO	613970.7.....	CH_3OCH_3	617627.4.....	CH_3OH *E*
608389.1.....	CH_3CN	612891.5.....	$^{13}CH_3OH$ *A*	613974.1.....	CH_3OCH_3	617919.0.....	C_2H_5CN
608389.1.....	CH_3CN	612891.5.....	$^{13}CH_3OH$ *A*	613974.2.....	CH_3OCH_3	618152.0.....	SO_2
608389.1.....	CH_3CN	612929.9.....	CH_3OCH_3	613977.5.....	CH_3OCH_3	618592.2.....	CH_3OCHO *E*
608980.0.....	CH_3CN	612929.9.....	CH_3OCH_3	613977.6.....	CH_3OCH_3	619156.9.....	*U*
608980.0.....	CH_3CN	612930.8.....	CH_3OCH_3	613977.6.....	CH_3OCH_3	619251.1.....	$SO_2(v_2)$
608980.0.....	CH_3CN	612931.0.....	CH_3OCH_3	613977.8.....	CH_3OCH_3	619318.7.....	*U*
609131.2.....	*U*	612931.6.....	CH_3OCH_3	613978.0.....	CH_3OCH_3	619340.5.....	C_2H_5CN
609163.9.....	$SO_2(v_2)$	612931.9.....	CH_3OCH_3	613978.0.....	CH_3OCH_3	619365.1.....	*U*
609164.8.....	C_2H_5CN	612931.9.....	CH_3OCH_3	613990.0.....	CH_3OH *E*	623071.7.....	CH_3OH *A*
609164.8.....	C_2H_5CN	612932.1.....	CH_3OCH_3	614019.0.....	CH_3OCHO *A*	623145.7.....	CH_3OH *E*
609506.2.....	$HN^{13}C$	612934.1.....	$^{13}CH_3OH$ *A*	614090.0.....	$^{13}CH_3OH$ *E*	623193.2.....	CH_3OH *E*
609558.4.....	SO_2	613076.2.....	SO_2	614113.6.....	SO_2	623262.1.....	CH_3OH *E*
609703.6.....	CH_3OCH_3	613303.9.....	$^{13}CH_3OH$ *A*	614303.1.....	CH_3OCH_3	623296.4.....	*U*
609704.8.....	CH_3OCH_3	613334.0.....	$^{13}CH_3OH$ *A*	614303.1.....	CH_3OCH_3	623316.9.....	*U*
609706.0.....	CH_3OCH_3	613335.0.....	$^{13}CH_3OH$ *A*	614303.1.....	CH_3OCH_3	623340.9.....	CH_3OH *E*
609706.0.....	CH_3OCH_3	613338.1.....	$^{33}SO_2$	614303.1.....	CH_3OCH_3	623363.4.....	$HCN(v_2)$
609707.8.....	CH_3OCH_3	613350.9.....	$^{13}CH_3OH$ *A*	614360.6.....	$^{13}CH_3OH$ *E*	623487.1.....	*U*
609707.8.....	CH_3OCH_3	613522.6.....	$^{13}CH_3OH$ *E*	614628.4.....	CH_3CHO *E*	623516.7.....	$SO_2(v_2)$
609709.1.....	CH_3OCH_3	613590.3.....	CH_3OCH_3	614741.5.....	CH_3CHO *E*	623570.6.....	*U*
609712.1.....	CH_3OCH_3	613590.3.....	CH_3OCH_3	614741.6.....	CH_3CHO *E*	623613.5.....	SO_2
609959.6.....	SO	613592.3.....	CH_3OCH_3	614756.6.....	CH_3CHO *E*	623644.1.....	*U*
610692.6.....	$^{13}CH_3OH$ *A*	613592.3.....	CH_3OCH_3	614758.3.....	CH_3CHO *E*	623693.1.....	$^{33}SO_2$
610692.6.....	$^{13}CH_3OH$ *A*	613594.5.....	CH_3OCH_3	614780.0.....	HNCO	623737.7.....	CH_3OH *E*
610721.8.....	$^{13}CH_3OH$ *E*	613594.5.....	CH_3OCH_3	614780.2.....	HNCO	623779.8.....	C_2H_5CN
610768.0.....	$^{13}CH_3OH$ *E*	613594.5.....	CH_3OCH_3	614976.3.....	HNCO	623784.7.....	C_2H_5CN
610844.3.....	CH_3OCH_3	613594.5.....	CH_3OCH_3	615052.0.....	HNCO	623848.6.....	*U*
610844.3.....	CH_3OCH_3	613612.0.....	$^{13}CH_3OH$ *E*	615098.9.....	HNCO	623964.8.....	CH_3CN
610847.6.....	CH_3OCH_3	613676.4.....	SO_2	615248.6.....	C_2H_5CN	623964.8.....	CH_3CN
610850.8.....	CH_3OCH_3	613678.0.....	CH_3OCH_3	615249.3.....	C_2H_5CN	623964.8.....	CH_3CN
610890.4.....	$^{13}CH_3OH$ *E*	613678.0.....	CH_3OCH_3	615276.7.....	*U*	624023.9.....	CH_3OCHO *E*

TABLE 3

Continued

ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule
624031.4.....	CH_3OCHO *A*	624901.3.....	CH_3OCH_3	626007.7.....	$^{13}CH_3OH$ *E*	626989.0.....	CH_3OCH_3
624031.5.....	CH_3OCHO *A*	624905.4.....	CH_3OCH_3	626041.1.....	CH_3OH *A*	627004.6.....	CH_3OH *A*
624072.8.....	*U*	624905.6.....	CH_3OCH_3	626041.2.....	CH_3OH *A*	627013.0.....	CH_3OH *E*
624102.0.....	C_2H_5CN	624907.8.....	CH_3OCH_3	626043.5.....	$^{33}SO_2$	627015.6.....	CH_3OCH_3
624103.1.....	C_2H_5CN	624908.8.....	CH_3OCH_3	626073.6.....	CH_3OH *A*	627018.1.....	CH_3OCH_3
624108.1.....	SO_2	624909.0.....	CH_3OCH_3	626073.6.....	CH_3OH *A*	627019.4.....	CH_3OCH_3
624166.1.....	CH_3CN	624914.5.....	CH_3CN	626075.4.....	CH_3OH *E*	627019.5.....	CH_3OCH_3
624166.2.....	CH_3CN	624914.5.....	CH_3CN	626087.3.....	SO_2	627020.6.....	CH_3OCH_3
624166.2.....	CH_3CN	624914.5.....	CH_3CN	626103.1.....	CH_3OH *A*	627020.6.....	CH_3OCH_3
624208.7.....	HCO^+	624914.5.....	CH_3CN	626111.2.....	CH_3OH *E*	627022.0.....	CH_3OCH_3
624235.1.....	CH_3OH *A*	624914.5.....	CH_3CN	626112.2.....	CH_3OH *E*	627023.3.....	CH_3OCH_3
624254.5.....	$^{33}SO_2$	624920.1.....	SiH	626137.5.....	CH_3OH *E*	627057.4.....	NS
624263.6.....	*U*	624924.6.....	SiH	626156.8.....	CH_3OH *E*	627057.8.....	CH_3CN
624344.1.....	CH_3CN	624926.4.....	CH_3CN	626185.8.....	$^{33}SO_2$	627057.8.....	CH_3CN
624344.1.....	CH_3CN	624926.5.....	CH_3CN	626191.9.....	$^{33}SO_2$	627057.8.....	CH_3CN
624344.1.....	CH_3CN	624926.4.....	CH_3CN	626196.5.....	CH_3OH *E*	627058.1.....	NS
624344.4.....	SO_2	624932.0.....	CH_3OCH_3	626306.2.....	CH_3CN	627058.4.....	NS
624365.4.....	CH_3OH *E*	624932.3.....	CH_3OCH_3	626306.2.....	CH_3CN	627058.6.....	NS
624460.9.....	*U*	624935.5.....	CH_3OCH_3	626306.2.....	CH_3CN	627059.0.....	NS
624498.4.....	CH_3CN	624935.7.....	CH_3OCH_3	626349.2.....	$C^{34}S$	627059.6.....	NS
624498.4.....	CH_3CN	624935.8.....	SiH	626374.8.....	CH_3OH *E*	627082.5.....	$^{33}SO_2$
624498.4.....	CH_3CN	624936.4.....	CH_3OCH_3	626376.4.....	CH_3OH *E*	627138.6.....	$^{13}CH_3OH$ *A*
624551.6.....	CH_3OCHO *A*	624964.3.....	$H^{37}Cl$	626397.8.....	CH_3OH *E*	627170.6.....	CH_3OH *E*
624551.9.....	CH_3OCHO *A*	624977.8.....	$H^{37}Cl$	626451.9.....	CH_3OH *E*	627209.3.....	CH_3OH *A*
624552.1.....	CH_3OCHO *A*	624988.3.....	$H^{37}Cl$	626474.6.....	H_2S	627331.1.....	SO_2
624552.3.....	CH_3OCHO *A*	625024.6.....	C_2H_5CN	626476.7.....	CH_3OH *A*	627335.1.....	$^{33}SO_2$
624582.7.....	CH_3OCHO *E*	625155.7.....	CH_3OH *E*	626476.7.....	CH_3OH *A*	627398.1.....	CH_3CN
624583.0.....	CH_3OCHO *E*	625207.6.....	CH_3OH *E*	626482.6.....	H_2CS	627398.1.....	CH_3CN
624583.1.....	CH_3OCHO *E*	625063.3.....	*U*	626489.9.....	CH_3OH *E*	627398.1.....	CH_3CN
624583.3.....	CH_3OCHO *E*	625072.7.....	CH_3OH *A*	626511.9.....	CH_3OH *A*	627444.1.....	CH_3OH *A*
624626.0.....	$^{13}CH_3OH$ *E*	625072.7.....	CH_3OH *A*	626511.9.....	CH_3OH *A*	627444.1.....	CH_3OH *A*
624629.1.....	CH_3CN	625294.0.....	CH_3OCHO *E*	626555.0.....	CH_3OH *E*	627476.0.....	*U*
624629.1.....	CH_3CN	625294.0.....	CH_3OCHO *E*	626555.9.....	CH_3OH *E*	627528.6.....	CH_3OH *E*
624629.1.....	CH_3CN	625294.0.....	CH_3OCHO *E*	626608.7.....	CH_3OH *E*	627558.5.....	CH_3OH *A*
624670.3.....	CH_3OCHO *E*	625294.0.....	CH_3OCHO *E*	626609.0.....	CH_3OH *A*	627618.1.....	CH_3OCHO *A*
624680.3.....	CH_3OCHO *A*	625335.0.....	*U*	626626.3.....	CH_3OH *A*	627618.1.....	CH_3OCHO *A*
624680.3.....	CH_3OCHO *A*	625352.5.....	CH_3OH *A*	626640.0.....	CH_3OH *E*	627650.6.....	CH_3OH *E*
624736.1.....	CH_3CN	625352.5.....	CH_3OH *A*	626654.1.....	CH_3OH *E*	627672.7.....	SiH
624736.1.....	CH_3CN	625383.1.....	CH_3OH *A*	626673.8.....	CH_3OH *A*	627689.9.....	SiH
624736.1.....	CH_3CN	625383.1.....	CH_3OH *A*	626724.7.....	*U*	627707.6.....	SiH
624744.3.....	$^{13}CH_3OH$ *A*	625434.0.....	CH_3OH *E*	626803.8.....	CH_3OH *E*	627713.0.....	CH_3OH *A*
624778.0.....	*U*	625510.2.....	CH_3OH *A*	626809.5.....	SO_2	627713.0.....	CH_3OH *A*
624819.3.....	CH_3CN	625510.2.....	CH_3OH *A*	626864.9.....	CH_3OH *A*	627715.3.....	SO_2
624819.3.....	CH_3CN	625668.1.....	*U*	626865.8.....	CH_3OH *A*	627750.8.....	CH_3OH *E*
624819.3.....	CH_3CN	625749.5.....	CH_3OH *E*	626880.7.....	CH_3OH *E*	627807.8.....	CH_3OH *E*
624838.0.....	CH_3OH *A*	625781.3.....	CH_3OH *E*	626930.5.....	CH_3OH *E*	627816.6.....	CH_3OH *E*
624878.8.....	CH_3CN	625901.6.....	HCl	626945.2.....	CH_3OH *E*	627908.1.....	CH_3OH *A*
624878.8.....	CH_3CN	625918.7.....	HCl	626989.0.....	CH_3OCH_3	627908.1.....	CH_3OH *A*
624878.8.....	CH_3CN	625932.0.....	HCl	626989.0.....	CH_3OCH_3	627921.8.....	CH_3OH *E*
624887.4.....	SO_2	625971.5.....	CH_3OH *A*	626989.0.....	CH_3OCH_3	627971.4.....	CH_3OH *A*

TABLE 3

Continued

ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule
627971.4.....	CH_3OH *A*	630952.4.....	CH_3OH *A*	634766.6.....	C_2H_5CN	636274.1.....	CH_3OH *A*
628021.4.....	CH_3OH *E*	630952.4.....	CH_3OH *A*	634782.4.....	SO_2	636279.3.....	CH_3OH *A*
628039.0.....	CH_3OH *A*	631280.5.....	$C^{33}S$	634878.8.....	*U*	636280.5.....	CH_3OH *A*
628039.0.....	CH_3OH *A*	631705.7.....	H_2CO	634898.4.....	SO_2	636291.1.....	CH_3OH *A*
628051.8.....	CH_3OH *A*	631751.8.....	^{34}SO	635027.5.....	CH_3OCHO *A*	636299.3.....	CH_3OH *A*
628093.3.....	*U*	632193.3.....	SO_2	635027.7.....	CH_3OCHO *A*	636303.3.....	CH_3OH *A*
628114.1.....	CH_3OH *E*	632286.6.....	CH_3OCH_3	635027.8.....	CH_3OCHO *A*	636311.6.....	CH_3OH *A*
628115.4.....	CH_3OH *E*	632286.6.....	CH_3OCH_3	635027.9.....	CH_3OCHO *A*	636333.5.....	CH_3OH *A*
628167.6.....	CH_3OH *E*	632289.5.....	CH_3OCH_3	635051.0.....	$^{33}SO_2$	636337.4.....	CH_3OH *A*
628187.7.....	CH_3OH *A*	632292.4.....	CH_3OCH_3	635085.0.....	*U*	636341.6.....	CH_3OH *A*
628187.7.....	CH_3OH *A*	632401.4.....	CH_3OCHO *A*	635121.0.....	C_2H_5CN	636363.8.....	CH_3OH *A*
628237.8.....	CH_3OH *E*	632474.6.....	$^{33}SO_2$	635144.2.....	$^{33}SO_2$	636365.6.....	CH_3OH *A*
628251.3.....	CH_3OH *E*	632505.4.....	$^{13}CH_3OH$ *A*	635216.9.....	^{30}SiO	636393.3.....	CH_3OH *A*
628318.2.....	CH_3OH *E*	632571.6.....	HNCO	635295.3.....	*U*	636393.8.....	CH_3OH *A*
628330.0.....	CH_3OH *E*	632659.7.....	^{34}SO	635324.8.....	SO_2	636413.7.....	CH_3OH *A*
628338.1.....	CH_3OH *A*	632771.4.....	$^{13}CH_3OH$ *A*	635389.8.....	CH_3OH *E*	636419.9.....	CH_3OH *A*
628338.1.....	CH_3OH *A*	632852.2.....	*U*	635414.4.....	C_2H_5CN	636420.0.....	CH_3OH *A*
628341.1.....	$^{33}SO_2$	633023.5.....	*U*	635414.4.....	C_2H_5CN	636468.7.....	CH_3OCH_3
628408.9.....	CH_3OH *E*	633114.5.....	*U*	635567.3.....	$^{13}CH_3OH$ *E*	636468.8.....	CH_3OCH_3
628445.3.....	CH_3OH *E*	633147.7.....	$^{33}SO_2$	635672.6.....	CH_3OH *A*	636470.7.....	CH_3OCH_3
628469.9.....	CH_3OH *A*	633156.9.....	CH_3OH *E*	635697.1.....	C_2H_5CN	636472.6.....	CH_3OCH_3
628512.1.....	CH_3OH *A*	633302.5.....	^{34}SO	635697.1.....	C_2H_5CN	636522.9.....	CH_3OH *A*
628513.3.....	CH_3OH *A*	633423.0.....	CH_3OH *A*	635749.3.....	CH_3OCHO *E*	636531.8.....	CS
628525.0.....	CH_3OH *A*	633571.9.....	CH_3OH *E*	635750.4.....	CH_3OCHO *A*	636677.6.....	CH_3OH *A*
628657.8.....	CH_3OCH_3	633674.3.....	*U*	635750.8.....	CH_3OCHO *A*	636714.0.....	HNCO
628659.0.....	CH_3OCH_3	633791.4.....	SO_2	635750.8.....	CH_3OCHO *A*	636714.3.....	HNCO
628660.1.....	CH_3OCH_3	633802.5.....	*U*	635750.8.....	CH_3OCHO *A*	636887.0.....	CH_3OH *A*
628660.1.....	CH_3OCH_3	633832.7.....	*U*	635750.8.....	CH_3OCHO *A*	636946.2.....	CH_3OCHO *E*
628662.0.....	CH_3OCH_3	633860.1.....	*U*	635751.1.....	CH_3OCHO *A*	636954.6.....	CH_3OCHO *A*
628662.0.....	CH_3OCH_3	633891.1.....	*U*	635754.6.....	CH_3OCHO *E*	636954.6.....	CH_3OCHO *A*
628663.1.....	CH_3OCH_3	633898.3.....	*U*	635874.1.....	CH_3OH *A*	636999.8.....	HNCO
628666.1.....	CH_3OCH_3	633906.0.....	CH_3OCHO *E*	635904.9.....	*U*	637003.2.....	C_2H_5CN
628696.5.....	CH_3OH *E*	633926.9.....	*U*	635940.9.....	CH_3OH *E*	637003.2.....	C_2H_5CN
628775.7.....	CH_3OCH_3	633950.0.....	CH_3OCHO *E*	636013.8.....	CH_3OH *A*	637037.7.....	HNCO
628775.7.....	CH_3OCH_3	633960.3.....	CH_3OCHO *A*	636053.0.....	$^{33}SO_2$	637056.6.....	$SO_2(v_2)$
628776.5.....	CH_3OCH_3	633960.3.....	CH_3OCHO *A*	636073.6.....	CH_3OCHO *A*	637161.5.....	CH_3OH *A*
628777.3.....	CH_3OCH_3	634005.9.....	CH_3OCHO *E*	636073.7.....	CH_3OCHO *A*	637307.3.....	$^{33}SO_2$
628816.1.....	CH_3OH *E*	634081.1.....	*U*	636105.5.....	CH_3OH *A*	637512.3.....	CH_3OH *A*
628869.0.....	CH_3OH *A*	634118.9.....	$SO_2(v_2)$	636161.0.....	CH_3OH *A*	637684.0.....	$^{13}CH_3OH$ *A*
628889.6.....	*U*	634276.3.....	SO_2	636190.1.....	CH_3OH *A*	637685.0.....	$^{13}CH_3OH$ *A*
629140.5.....	CH_3OH *A*	634317.5.....	CH_3OCHO *E*	636190.3.....	CH_3OH *A*	637723.3.....	C_2H_5CN
629321.5.....	CH_3OH *E*	634373.6.....	CH_3OCHO *E*	636190.9.....	CH_3OH *A*	637797.4.....	$^{33}SO_2$
629363.8.....	CH_3OH *E*	634454.2.....	$^{33}SO_2$	636193.4.....	CH_3OH *A*	637843.3.....	CH_3OCH_3
629651.8.....	CH_3OH *E*	634470.0.....	CH_3OH *E*	636196.9.....	CH_3OH *A*	637843.6.....	CH_3OCH_3
629695.9.....	*U*	634508.1.....	HNC	636198.6.....	CH_3OH *A*	637844.0.....	CH_3OCH_3
629790.6.....	C_2H_5CN	634584.6.....	*U*	636202.0.....	CH_3OH *A*	637844.0.....	CH_3OCH_3
629825.3.....	CH_3OD *E*	634634.0.....	*U*	636202.9.....	CH_3OH *A*	637863.7.....	*U*
629921.3.....	CH_3OH *A*	634692.0.....	$SO_2(v_2)$	636208.6.....	CH_3OH *A*	637952.1.....	CH_3OH *A*
630375.9.....	*U*	634731.6.....	HNCO	636225.8.....	CH_3OH *A*	638084.3.....	*U*
630583.0.....	CH_3OH *E*	634766.6.....	C_2H_5CN	636248.0.....	CH_3OH *A*	638119.3.....	C_2H_5CN

TABLE 3

Continued

ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule
638220.4.....	*U*	641056.7.....	NH_2D	643159.6.....	CH_3CN	646216.9.....	CH_3OCHO *A*
638279.5.....	CH_3OH *E*	641057.6.....	NH_2D	643220.8.....	CH_3CN	646216.9.....	CH_3OCHO *A*
638494.3.....	CH_3OH *A*	641117.7.....	$^{13}CH_3OH$ *A*	643220.8.....	CH_3CN	646708.8.....	C_2H_5CN
638523.5.....	CH_3OH *A*	641206.5.....	SO_2	643220.8.....	CH_3CN	646708.8.....	C_2H_5CN
638585.5.....	$^{13}CH_3OH$ *E*	641224.7.....	*U*	643257.5.....	CH_3CN	646742.0.....	*U*
638635.2.....	$^{33}SO_2$	641324.5.....	$^{33}SO_2$	643257.5.....	CH_3CN	646766.6.....	CH_3OCH_3
638770.3.....	SO_2	641361.9.....	CH_3OCH_3	643257.5.....	CH_3CN	646768.2.....	CH_3OCH_3
638817.8.....	CH_3OH *A*	641362.0.....	CH_3OCH_3	643257.5.....	CH_3CN	646769.8.....	CH_3OCH_3
639153.6.....	CH_3OH *A*	641363.8.....	CH_3OCH_3	643257.5.....	CH_3CN	646769.8.....	CH_3OCH_3
639646.1.....	$^{33}SO_2$	641365.8.....	CH_3OCH_3	643269.8.....	CH_3CN	646871.6.....	C_2H_5CN
639650.9.....	SO_2	641421.4.....	H_2CS	643269.8.....	CH_3CN	646927.8.....	*U*
639764.7.....	$H_2^{13}CO$	641825.5.....	SO_2	643269.8.....	CH_3CN	647084.6.....	H_2CO
639795.1.....	$^{33}SO_2$	641914.5.....	SO_2	643277.6.....	CH_3OCHO *E*	647196.2.....	CH_3OCH_3
639945.4.....	CH_3OH *A*	641918.1.....	CH_3OH *E*	643281.8.....	CH_3OCHO *A*	647196.2.....	CH_3OCH_3
640002.2.....	$^{33}SO_2$	641993.9.....	CH_3OH *A*	643412.6.....	CH_3OCH_3	647199.6.....	CH_3OCH_3
640116.7.....	$^{33}SO_2$	642136.1.....	*U*	643413.6.....	C_2H_5CN	647203.0.....	CH_3OCH_3
640148.3.....	$^{33}SO_2$	642231.9.....	SO_2	643417.8.....	CH_3OCH_3	647319.8.....	*U*
640159.1.....	$^{13}CH_3OH$ *A*	642280.6.....	CH_3CN	643423.0.....	CH_3OCH_3	647395.6.....	CH_3OH *E*
640167.1.....	$^{33}SO_2$	642280.6.....	CH_3CN	643423.0.....	CH_3OCH_3	647418.4.....	*U*
640167.3.....	$^{13}CH_3OH$ *E*	642280.6.....	CH_3CN	643643.0.....	CH_3OCH_3	647448.5.....	SO_2
640175.9.....	$^{33}SO_2$	642289.1.....	CH_3OCH_3	643643.7.....	CH_3OCH_3	647455.1.....	CH_3OCH_3
640177.3.....	$^{33}SO_2$	642294.8.....	CH_3OCH_3	643646.2.....	CH_3OCH_3	647456.0.....	CH_3OCH_3
640289.6.....	$^{13}CH_3OH$ *A*	642300.6.....	CH_3OCH_3	643646.8.....	CH_3OCH_3	647456.0.....	CH_3OCH_3
640297.0.....	$^{13}CH_3OH$ *A*	642300.6.....	CH_3OCH_3	643647.6.....	CH_3OCH_3	647456.8.....	CH_3OCH_3
640298.1.....	$^{13}CH_3OH$ *A*	642552.6.....	*U*	643658.3.....	SO_2	647457.5.....	CH_3OCH_3
640298.2.....	$^{13}CH_3OH$ *A*	642670.8.....	CH_3CN	643690.6.....	CH_3OCH_3	647546.6.....	$^{33}SO_2$
640298.6.....	$^{13}CH_3OH$ *A*	642670.8.....	CH_3CN	643693.0.....	CH_3OCH_3	647608.3.....	CH_3OCH_3
640299.6.....	$^{13}CH_3OH$ *A*	642670.8.....	CH_3CN	643694.4.....	CH_3OCH_3	647609.5.....	CH_3OCH_3
640304.4.....	$^{13}CH_3OH$ *A*	642739.0.....	*U*	643696.8.....	CH_3OCH_3	647610.6.....	CH_3OCH_3
640376.8.....	$^{13}CH_3OH$ *A*	642762.0.....	*U*	643697.1.....	CH_3OCH_3	647610.6.....	CH_3OCH_3
640398.5.....	$^{13}CH_3OH$ *A*	642799.8.....	^{29}SiO	643697.5.....	CH_3OCH_3	647612.4.....	CH_3OCH_3
640403.3.....	$^{13}CH_3OH$ *A*	642806.2.....	SO_2	643728.3.....	*U*	647612.4.....	CH_3OCH_3
640404.9.....	$^{13}CH_3OH$ *A*	642829.5.....	CH_3CN	644185.8.....	*U*	647613.5.....	CH_3OCH_3
640408.5.....	$^{13}CH_3OH$ *A*	642829.5.....	CH_3CN	644377.8.....	SO	647616.5.....	CH_3OCH_3
640419.4.....	$^{13}CH_3OH$ *A*	642829.5.....	CH_3CN	645198.0.....	SO_2	647717.2.....	$SO_2(v_2)$
640435.0.....	$^{13}CH_3OH$ *A*	642829.8.....	$^{13}CH_3OH$ *A*	645254.0.....	SO	648119.7.....	*U*
640438.7.....	$^{13}CH_3OH$ *A*	642837.7.....	$^{13}CH_3OH$ *E*	645875.3.....	SO	648134.0.....	*U*
640442.3.....	$^{13}CH_3OH$ *A*	642934.7.....	CH_3OCH_3	645923.7.....	CH_3OCH_3	648193.0.....	DCO^+
640466.3.....	$^{13}CH_3OH$ *A*	642934.7.....	CH_3OCH_3	645926.1.....	CH_3OCH_3	648324.2.....	CH_3OCHO *A*
640469.5.....	$^{13}CH_3OH$ *A*	642940.3.....	CH_3OCH_3	645927.5.....	CH_3OCH_3	648333.3.....	CH_3OCHO *E*
640494.6.....	$^{13}CH_3OH$ *A*	642946.0.....	CH_3OCH_3	645927.5.....	CH_3OCH_3	648381.4.....	SO_2
640497.1.....	$^{13}CH_3OH$ *A*	642964.0.....	CH_3CN	645928.6.....	CH_3OCH_3	648737.6.....	$^{33}SO_2$
640498.4.....	$^{13}CH_3OH$ *A*	642964.0.....	CH_3CN	645928.6.....	CH_3OCH_3	648787.4.....	*U*
640526.1.....	$^{13}CH_3OH$ *A*	642964.0.....	CH_3CN	645930.0.....	CH_3OCH_3	648824.7.....	C_2H_5CN
640526.6.....	$^{13}CH_3OH$ *A*	643074.0.....	CH_3CN	645931.3.....	CH_3OCH_3	648827.3.....	C_2H_5CN
640552.4.....	$^{13}CH_3OH$ *A*	643074.0.....	CH_3CN	646088.7.....	CH_3OCH_3	648827.4.....	H_2CS
640552.5.....	$^{13}CH_3OH$ *A*	643074.0.....	CH_3CN	646088.7.....	CH_3OCH_3	649052.1.....	SO_2
640886.3.....	CH_3OH *A*	643089.7.....	CH_3OCHO *E*	646090.8.....	CH_3OCH_3	649104.5.....	*U*
640942.1.....	CH_3OCHO *E*	643159.6.....	CH_3CN	646093.0.....	CH_3OCH_3	649168.0.....	CH_3OCHO *E*
640981.1.....	*U*	643159.6.....	CH_3CN	646208.5.....	CH_3OCHO *E*	649219.8.....	CH_3OCHO *E*

TABLE 3

Continued

ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule
649226.6.....	CH_3OCHO *A*	652940.1.....	CH_3OH *A*	656760.4.....	SO_2	659885.9.....	SO_2
649226.6.....	CH_3OCHO *A*	652940.1.....	CH_3OH *A*	656900.6.....	$^{33}SO_2$	659898.5.....	SO_2
649236.3.....	SO_2	653045.3.....	$^{13}CH_3OH$ *E*	657167.1.....	C_2H_5CN	659941.8.....	$^{13}CH_3OH$ *E*
649541.5.....	CH_3OH *E*	653109.7.....	SO_2	657169.2.....	C_2H_5CN	659944.6.....	$^{13}CH_3OH$ *A*
649912.8.....	$^{13}CH_3OH$ *E*	653244.9.....	CH_3OCH_3	657170.8.....	CH_3OH *E*	659989.2.....	C_2H_5CN
649915.2.....	NH_2D	653244.9.....	CH_3OCH_3	657222.6.....	SO_2	660009.5.....	CH_3OCHO *E*
649916.3.....	NH_2D	653246.6.....	CH_3OCH_3	657331.5.....	$^{33}SO_2$	660039.2.....	$^{13}CH_3OH$ *E*
649916.6.....	NH_2D	653248.3.....	CH_3OCH_3	657331.5.....	$^{33}SO_2$	660044.0.....	$^{13}CH_3OH$ *E*
649916.7.....	NH_2D	653323.8.....	C_2H_5CN	657331.6.....	$^{33}SO_2$	660115.1.....	$^{13}CH_3OH$ *A*
649917.2.....	NH_2D	653535.3.....	*U*	657331.6.....	$^{33}SO_2$	660115.1.....	$^{13}CH_3OH$ *A*
649954.6.....	NH_2D	653572.1.....	*U*	657406.5.....	$^{13}CH_3OH$ *E*	660458.7.....	CH_3OCH_3
649955.1.....	NH_2D	653598.0.....	*U*	657452.7.....	$^{13}CH_3OH$ *A*	660458.7.....	CH_3OCH_3
649955.7.....	NH_2D	653711.0.....	*U*	657452.7.....	$^{13}CH_3OH$ *A*	660460.4.....	CH_3OCH_3
649956.0.....	NH_2D	653882.9.....	SO_2	657721.8.....	*U*	660462.1.....	CH_3OCH_3
649956.1.....	NH_2D	653931.4.....	*U*	657663.5.....	$H_2^{13}CO$	660472.7.....	SO_2
649956.6.....	NH_2D	653973.0.....	H_2CO	657868.9.....	CH_3OCHO *A*	660593.4.....	CH_3CN
650374.1.....	H_2S	654030.7.....	C_2H_5CN	657869.8.....	CH_3OCHO *A*	660593.5.....	CH_3CN
650534.0.....	*U*	654069.8.....	$^{33}SO_2$	657885.3.....	SO_2	660593.5.....	CH_3CN
650569.3.....	C_2H_5CN	654131.0.....	*U*	657933.8.....	*U*	660673.9.....	$^{13}CH_3OH$ *E*
650573.5.....	C_2H_5CN	654341.8.....	CH_3OH *E*	658005.2.....	$H_2O(v_2)$	660785.2.....	*U*
650594.6.....	C_2H_5CN	654396.8.....	*U*	658031.5.....	*U*	660806.3.....	CH_3CN
650594.6.....	C_2H_5CN	654420.1.....	$^{13}CH_3OH$ *A*	658102.2.....	CH_3OH *A*	660806.3.....	CH_3CN
650680.9.....	C_2H_5CN	654437.6.....	SO_2	658191.6.....	CH_3OH *E*	660806.3.....	CH_3CN
650742.4.....	$^{33}SO_2$	654457.5.....	H_2CO	658217.3.....	$^{33}SO_2$	660811.6.....	$^{13}CH_3OH$ *E*
650742.5.....	$^{33}SO_2$	654457.5.....	H_2CO	658218.5.....	$SO_2(v_2)$	660866.6.....	$^{13}CH_3OH$ *A*
650742.6.....	$^{33}SO_2$	654519.5.....	C_2H_5CN	658226.8.....	SO_2	660918.3.....	SO_2
650742.6.....	$^{33}SO_2$	654533.3.....	*U*	658411.0.....	$SO_2(v_2)$	661068.0.....	^{13}CO
650956.6.....	SiO	654836.5.....	H_2CO	658466.3.....	CH_3OCHO *A*	661157.5.....	CH_3CN
651299.8.....	SO_2	654836.5.....	H_2CO	658466.3.....	CH_3OCHO *A*	661157.5.....	CH_3CN
651306.2.....	SO_2	654969.0.....	C_2H_5CN	658541.6.....	SO_2	661157.5.....	CH_3CN
651410.1.....	SO_2	654969.0.....	C_2H_5CN	658553.6.....	$C^{18}O$	661190.7.....	$^{13}CH_3OH$ *E*
651432.6.....	NO	654993.4.....	*U*	658631.7.....	SO_2	661295.6.....	CH_3CN
651433.0.....	NO	655212.9.....	H_2CO	658714.6.....	*U*	661295.6.....	CH_3CN
651433.5.....	NO	655212.9.....	H_2CO	658742.7.....	$^{33}SO_2$	661295.7.....	CH_3CN
651493.4.....	SO	655387.3.....	CH_3OCHO *A*	658742.7.....	$^{33}SO_2$	661314.4.....	$^{13}CH_3OH$ *E*
651511.2.....	H_2CS	655388.9.....	CH_3OCHO *A*	658743.0.....	$^{33}SO_2$	661332.4.....	SO_2
651535.9.....	*U*	655390.0.....	CH_3OCHO *A*	658743.0.....	$^{33}SO_2$	661389.9.....	HNCO
651570.9.....	DCN	655391.5.....	CH_3OCHO *A*	658749.3.....	$SO_2(v_2)$	661408.8.....	CH_3CN
651617.4.....	CH_3OH *E*	655444.5.....	HNCO	658928.3.....	*U*	661408.8.....	CH_3CN
651771.4.....	NO	655641.9.....	H_2CO	658945.7.....	HNCO	661408.8.....	CH_3CN
651772.9.....	NO	655645.8.....	H_2CO	658953.1.....	$^{13}CH_3OH$ *E*	661496.8.....	CH_3CN
651773.1.....	NO	656075.3.....	SO_2	658973.5.....	HNCO	661496.8.....	CH_3CN
651868.0.....	^{13}CN	656167.4.....	H_2CO	659064.0.....	$^{13}CH_3OH$ *A*	661496.8.....	CH_3CN
651868.4.....	^{13}CN	656168.1.....	CH_3OH *E*	659188.7.....	*U*	661510.8.....	SO_2
651868.5.....	^{13}CN	656224.1.....	CH_3OCHO *E*	659338.3.....	SO_2	661559.7.....	CH_3CN
652531.0.....	C_2H_5CN	656467.3.....	H_2CO	659372.7.....	$^{13}CH_3OH$ *A*	661559.7.....	CH_3CN
652531.0.....	C_2H_5CN	656549.5.....	$^{33}SO_2$	659372.7.....	$^{13}CH_3OH$ *A*	661559.7.....	CH_3CN
652534.2.....	C_2H_5CN	656593.1.....	HNCO	659390.3.....	$^{13}CH_3OH$ *A*	661597.4.....	CH_3CN
652534.2.....	C_2H_5CN	656656.2.....	SO_2	659421.0.....	SO_2	661597.4.....	CH_3CN
652652.8.....	$^{33}SO_2$	656724.0.....	*U*	659495.2.....	*U*	661597.4.....	CH_3CN

TABLE 3

Continued

ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule
661597.4.....	CH_3CN	663890.9.....	CH_3CN	666441.8.....	CH_3OCHO *A*	669485.2.....	CH_3OCH_3
661597.4.....	CH_3CN	663890.9.....	CH_3CN	666518.3.....	C_2H_5CN	669485.6.....	CH_3OCH_3
661610.0.....	CH_3CN	663951.1.....	C_2H_5CN	666518.3.....	C_2H_5CN	669486.8.....	CH_3OCH_3
661610.0.....	CH_3CN	663951.1.....	C_2H_5CN	666553.8.....	CH_3OCH_3	669487.2.....	CH_3OCH_3
661610.0.....	CH_3CN	664404.6.....	SO_2	666554.8.....	CH_3OCH_3	669488.8.....	CH_3OCH_3
661668.2.....	SO_2	664445.5.....	CH_3OCHO *E*	666555.9.....	CH_3OCH_3	669488.8.....	CH_3OCH_3
661715.1.....	$SO_2(v_2)$	664449.2.....	CH_3OCHO *A*	666555.9.....	CH_3OCH_3	670011.2.....	*U*
661760.8.....	$^{13}CH_3OH$ *E*	664449.2.....	CH_3OCHO *A*	666557.7.....	CH_3OCH_3	670073.3.....	NO
661961.0.....	$^{33}SO_2$	664475.6.....	$^{33}SO_2$	666557.7.....	CH_3OCH_3	670073.8.....	C_2H_5CN
661961.0.....	$^{33}SO_2$	664682.8.....	C_2H_5CN	666558.8.....	CH_3OCH_3	670073.8.....	C_2H_5CN
661961.1.....	$^{33}SO_2$	664682.8.....	C_2H_5CN	666561.7.....	CH_3OCH_3	670076.3.....	NO
661961.1.....	$^{33}SO_2$	664760.3.....	SO_2	666624.8.....	C_2H_5CN	670088.2.....	NO
661962.2.....	SO_2	664780.9.....	*U*	666624.8.....	C_2H_5CN	670088.8.....	CH_3OCH_3
661970.5.....	$^{33}SO_2$	664814.9.....	CH_3OCH_3	666706.0.....	$^{13}CH_3OH$ *A*	670089.2.....	CH_3OCH_3
662087.2.....	*U*	664817.2.....	CH_3OCH_3	666821.2.....	*U*	670089.2.....	CH_3OCH_3
662202.7.....	SO_2	664818.5.....	CH_3OCH_3	666908.7.....	C_2H_5CN	670089.6.....	CH_3OCH_3
662212.0.....	H_2CO	664818.6.....	CH_3OCH_3	666908.7.....	C_2H_5CN	670090.1.....	CH_3OCH_3
662295.8.....	CH_3OH *E*	664819.4.....	CH_3OCH_3	667026.8.....	C_2H_5CN	670090.5.....	CH_3OCH_3
662319.1.....	CH_3OCH_3	664819.6.....	CH_3OCH_3	667026.8.....	C_2H_5CN	670091.4.....	CH_3OCH_3
662320.6.....	CH_3OCH_3	664820.9.....	CH_3OCH_3	667147.5.....	CH_3OH *A*	670091.4.....	CH_3OCH_3
662321.6.....	CH_3OCH_3	664822.2.....	CH_3OCH_3	667148.1.....	CH_3OH *A*	670091.7.....	NO
662323.6.....	CH_3OCH_3	665203.6.....	SO_2	667470.6.....	CH_3OCHO *E*	670094.6.....	NO
662404.2.....	SO_2	665246.8.....	SO_2	667497.6.....	CH_3OH *E*	670365.9.....	SO_2
662414.5.....	CH_3OCH_3	665393.7.....	H_2S	667718.9.....	C_2H_5CN	670422.6.....	CH_3OH *A*
662416.1.....	CH_3OCH_3	665442.4.....	CH_3OH *E*	667718.9.....	C_2H_5CN	670499.6.....	C_2H_5CN
662416.4.....	CH_3OCH_3	665506.5.....	C_2H_5CN	667817.3.....	C_2H_5CN	670499.6.....	C_2H_5CN
662417.5.....	CH_3OCH_3	665508.2.....	C_2H_5CN	667817.3.....	C_2H_5CN	670756.5.....	$^{13}CH_3OH$ *A*
662566.9.....	SO_2	665509.0.....	CH_3OCHO *A*	667949.3.....	C_2H_5CN	670852.2.....	*U*
662697.6.....	SO_2	665560.6.....	CH_3OCHO *E*	667949.3.....	C_2H_5CN	670894.4.....	*U*
662799.4.....	SO_2	665568.6.....	CH_3OCHO *A*	668073.0.....	CH_3OCH_3	671161.3.....	CH_3OCH_3
662876.9.....	SO_2	665618.5.....	CH_3OCHO *E*	668073.0.....	CH_3OCH_3	671161.3.....	CH_3OCH_3
662933.5.....	SO_2	665705.8.....	CH_3OCHO *E*	668073.6.....	CH_3OCH_3	671161.4.....	CH_3OCH_3
662972.8.....	SO_2	665710.5.....	CH_3OCH_3	668074.4.....	CH_3OCH_3	671161.5.....	CH_3OCH_3
662997.7.....	SO_2	665711.2.....	CH_3OCH_3	668077.1.....	CH_3OCH_3	671162.0.....	CH_3OCH_3
663011.2.....	SO_2	665711.7.....	CH_3OCH_3	668077.8.....	CH_3OCH_3	671162.0.....	CH_3OCH_3
663014.3.....	SO_2	665712.4.....	CH_3OCH_3	668077.8.....	CH_3OCH_3	671162.0.....	CH_3OCH_3
663016.0.....	SO_2	665716.0.....	CH_3OCH_3	668081.2.....	CH_3OCH_3	671162.6.....	CH_3OCH_3
663362.7.....	CH_3CN	665717.0.....	CH_3OCH_3	668118.1.....	CH_3OH *E*	671191.9.....	$SO_2(v_2)$
663362.7.....	CH_3CN	665721.3.....	CH_3OCH_3	668457.8.....	NS	671208.8.....	CH_3OCH_3
663362.7.....	CH_3CN	665721.8.....	CH_3OCH_3	668457.9.....	NS	671209.0.....	CH_3OCH_3
663599.0.....	CH_3CN	665814.4.....	*U*	668457.9.....	NS	671209.3.....	CH_3OCH_3
663599.0.....	CH_3CN	666371.3.....	C_2H_5CN	668850.6.....	NS	671209.3.....	CH_3OCH_3
663599.0.....	CH_3CN	666371.3.....	C_2H_5CN	668850.7.....	NS	671312.7.....	CH_3OCH_3
663639.0.....	*U*	666382.0.....	$^{33}SO_2$	668850.8.....	NS	671312.7.....	CH_3OCH_3
663715.3.....	CH_3CN	666382.0.....	$^{33}SO_2$	668854.9.....	CH_3OH *E*	671313.0.....	CH_3OCH_3
663715.3.....	CH_3CN	666382.0.....	$^{33}SO_2$	669407.5.....	CH_3OCH_3	671313.3.....	CH_3OCH_3
663715.3.....	CH_3CN	666382.0.....	$^{33}SO_2$	669407.5.....	CH_3OCH_3	671313.7.....	CH_3OCH_3
663715.3.....	CH_3CN	666418.3.....	C_2H_5CN	669409.0.....	CH_3OCH_3	671314.0.....	CH_3OCH_3
663842.8.....	C_2H_5CN	666418.3.....	C_2H_5CN	669410.5.....	CH_3OCH_3	671314.0.....	CH_3OCH_3
663890.9.....	CH_3CN	666441.8.....	CH_3OCHO *A*	669485.2.....	CH_3OCH_3	671314.6.....	CH_3OCH_3

TABLE 3

Continued

ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule
671408.3.....	*U*	674597.5.....	CH_3OH *A*	676205.5.....	CH_3OH *A*	678357.9.....	*U*
671480.7.....	CH_3OH *A*	674618.4.....	CH_3OH *A*	676205.5.....	CH_3OH *A*	678417.7.....	*U*
671480.7.....	CH_3OH *A*	674618.4.....	CH_3OH *A*	676215.0.....	CH_3OH *A*	678451.9.....	HNCO
671716.8.....	*U*	674658.9.....	CH_3OH *E*	676250.6.....	CH_3OH *E*	678546.9.....	*U*
671912.5.....	CH_3OH *E*	674667.8.....	$^{33}SO_2$	676269.5.....	CH_3OH *A*	678675.6.....	CH_3OH *E*
672184.4.....	$^{13}CH_3OH$ *E*	674710.4.....	CH_3OH *A*	676269.5.....	CH_3OH *A*	678710.3.....	*U*
672360.8.....	CH_3OH *A*	674716.7.....	CH_3OH *E*	676349.3.....	CH_3OH *E*	678785.4.....	CH_3OH *A*
672447.3.....	*U*	674743.0.....	CH_3OH *E*	676362.3.....	CH_3OH *E*	679121.6.....	CH_3CN
672459.4.....	CH_3OCHO *A*	674762.2.....	CH_3OH *E*	676408.5.....	CH_3OCHO *A*	679121.6.....	CH_3CN
672564.5.....	SO_2	674774.0.....	^{34}SO	676416.1.....	CH_3OH *E*	679121.6.....	CH_3CN
672903.4.....	CH_3OCH_3	674791.5.....	CH_3OH *A*	676425.5.....	CH_3OH *A*	679314.7.....	CH_3CN
672903.4.....	CH_3OCH_3	674812.7.....	H_2CO	676425.5.....	CH_3OH *A*	679314.7.....	CH_3CN
672903.6.....	CH_3OH *E*	674990.4.....	CH_3OH *A*	676484.3.....	SO_2	679314.7.....	CH_3CN
672905.5.....	CH_3OCH_3	675034.5.....	CH_3OH *A*	676494.6.....	CH_3OH *E*	679342.4.....	CH_3OH *A*
672907.5.....	CH_3OCH_3	675035.7.....	CH_3OH *A*	676496.8.....	CH_3OH *E*	679342.4.....	CH_3OH *A*
672999.0.....	$SO_2(v_2)$	675038.9.....	H_2CS	676503.2.....	CH_3OH *A*	679393.0.....	C_2H_5CN
673072.1.....	*U*	675044.0.....	CH_3OH *E*	676504.3.....	CH_3OH *E*	679393.0.....	C_2H_5CN
673101.5.....	$^{33}SO_2$	675047.8.....	CH_3OH *E*	676585.4.....	CH_3OH *E*	679482.3.....	CH_3CN
673229.9.....	$SO_2(v_2)$	675097.2.....	CH_3OH *E*	676591.4.....	CH_3OH *E*	679482.3.....	CH_3CN
673416.1.....	CH_3OH *E*	675134.8.....	CH_3OH *E*	676604.2.....	CH_3OH *A*	679482.3.....	CH_3CN
673559.8.....	*U*	675135.1.....	$^{13}CH_3OH$ *E*	676604.2.....	CH_3OH *A*	679554.5.....	$^{13}CH_3OH$ *A*
673657.8.....	$SO_2(v_2)$	675144.1.....	CH_3OH *E*	676677.7.....	CH_3OH *E*	679504.0.....	CH_3CN
673671.1.....	C_2H_5CN	675176.7.....	CH_3OH *A*	676712.5.....	CH_3OH *E*	679504.0.....	CH_3CN
673671.1.....	C_2H_5CN	675231.6.....	CH_3OH *E*	676749.5.....	CH_3OH *A*	679504.0.....	CH_3CN
673675.0.....	CH_3OH *E*	675324.6.....	^{34}SO	676823.5.....	CH_3OH *A*	679653.1.....	CH_3OCHO *E*
673676.3.....	CH_3OH *A*	675347.7.....	CH_3OH *A*	676829.5.....	CH_3OH *A*	679682.0.....	CH_3OCHO *E*
673676.3.....	CH_3OH *A*	675555.3.....	$^{13}CH_3OH$ *A*	676926.5.....	SO_2	679683.6.....	CH_3OCHO *A*
673708.6.....	CH_3OCHO *E*	675566.1.....	CH_3OCHO *A*	677013.0.....	CH_3OH *E*	679683.6.....	CH_3OCHO *A*
673745.9.....	CH_3OH *A*	675566.1.....	CH_3OCHO *A*	677058.0.....	$SO_2(v_2)$	679740.3.....	CH_3CN
673969.5.....	CH_3OH *E*	675612.8.....	CH_3OH *A*	677112.4.....	*U*	679740.3.....	CH_3CN
673991.7.....	$^{33}SO_2$	675654.3.....	CH_3OCHO *A*	677190.6.....	CH_3OH *E*	679740.3.....	CH_3CN
673997.0.....	$^{33}SO_2$	675678.1.....	CH_3OCHO *E*	677233.3.....	CH_3OH *A*	679760.7.....	*U*
673998.0.....	^{34}SO	675710.6.....	CH_3OCHO *E*	677273.0.....	*U*	679781.0.....	$C^{33}S$
674009.2.....	$C^{17}O$	675773.6.....	CH_3OH *E*	677296.5.....	$SO_2(v_2)$	679791.2.....	CH_3OCH_3
674017.3.....	CH_3OH *A*	675777.8.....	CH_3OH *A*	677380.9.....	SO_2	679791.2.....	CH_3OCH_3
674129.1.....	CH_3OH *E*	675777.8.....	CH_3OH *A*	677417.5.....	CH_3OH *E*	679792.7.....	CH_3OCH_3
674129.2.....	CH_3OH *A*	675887.8.....	CH_3OH *E*	677508.3.....	^{30}SiO	679794.2.....	CH_3OCH_3
674129.2.....	CH_3OH *A*	675963.5.....	CH_3OH *E*	677567.5.....	*U*	679830.6.....	CH_3CN
674147.8.....	CH_3OH *E*	675983.9.....	*U*	677656.8.....	$SO_2(v_2)$	679830.6.....	CH_3CN
674162.1.....	CH_3OH *E*	675997.1.....	CH_3OCHO *A*	677709.6.....	CH_3OH *E*	679830.6.....	CH_3CN
674162.4.....	CH_3OH *A*	675997.1.....	CH_3OCHO *A*	677857.1.....	$^{13}CH_3OH$ *E*	679895.3.....	CH_3CN
674162.4.....	CH_3OH *A*	676010.8.....	$^{33}SO_2$	677885.8.....	$SO_2(v_2)$	679895.3.....	CH_3CN
674196.5.....	CH_3OH *A*	676013.7.....	CH_3OH *E*	677919.9.....	*U*	679895.3.....	CH_3CN
674201.7.....	CH_3OH *E*	676021.4.....	$SO_2(v_2)$	677961.7.....	$SO_2(v_2)$	679934.0.....	CH_3CN
674254.3.....	CH_3OH *E*	676034.6.....	CH_3OH *E*	677984.8.....	SO_2	679934.0.....	CH_3CN
674284.5.....	*U*	676111.8.....	CH_3OCHO *A*	678005.7.....	CH_3OCHO *A*	679934.0.....	CH_3CN
674447.7.....	$SO_2(v_2)$	676111.8.....	CH_3OCHO *A*	678054.6.....	$SO_2(v_2)$	679934.0.....	CH_3CN
674469.8.....	$C^{34}S$	676130.6.....	CH_3OH *A*	678128.2.....	SO_2	679934.0.....	CH_3CN
674512.5.....	CH_3OH *E*	676130.6.....	CH_3OH *A*	678237.4.....	HNCO	679947.0.....	CH_3CN
674597.5.....	CH_3OH *A*	676138.6.....	CH_3OH *E*	678252.6.....	CH_3OH *E*	679947.0.....	CH_3CN

TABLE 3

Continued

ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule
679947.0.....	CH_3CN	681631.8.....	CH_3CN	684257.3.....	CH_3OH *E*	687696.6.....	*U*
679998.1.....	$SO_2(v_2)$	681631.8.....	CH_3CN	684296.0.....	*U*	687718.2.....	*U*
680000.1.....	$^{13}CH_3OH$ *A*	681631.8.....	CH_3CN	684325.2.....	CH_3OCH_3	687871.1.....	CH_3OCHO *E*
680027.2.....	CN	681631.8.....	CH_3CN	684327.6.....	CH_3OCH_3	688113.0.....	CH_3OCHO *E*
680039.1.....	CH_3OCH_3	681668.6.....	CH_3CN	684330.0.....	CH_3OCH_3	688203.5.....	SO
680039.1.....	CH_3OCH_3	681668.6.....	CH_3CN	684330.0.....	CH_3OCH_3	688275.7.....	$HC^{13}N$
680039.1.....	CH_3OCH_3	681668.6.....	CH_3CN	684381.5.....	SO_2	688611.6.....	$^{13}CH_3OH$ *E*
680039.1.....	CH_3OCH_3	681674.0.....	SO_2	684429.9.....	*U*	688734.9.....	SO
680041.9.....	CH_3OCH_3	681789.6.....	CH_3OH *E*	684675.6.....	$H_2{}^{13}CO$	688887.1.....	CH_3OD *E*
680041.9.....	CH_3OCH_3	681913.1.....	C_2H_5CN	684840.8.....	CH_3OCH_3	688995.3.....	CH_3OCHO *A*
680042.0.....	CH_3OCH_3	681913.1.....	C_2H_5CN	684840.8.....	CH_3OCH_3	688995.3.....	CH_3OCHO *A*
680042.0.....	CH_3OCH_3	681946.1.....	C_2H_5CN	684842.1.....	CH_3OCH_3	688997.2.....	CH_3OCHO *E*
680047.3.....	CN	681989.8.....	CH_3OH *A*	684843.3.....	CH_3OCH_3	688997.4.....	CH_3OCHO *E*
680047.9.....	CN	682092.2.....	*U*	684929.0.....	SO_2	688999.1.....	CH_3OCHO *A*
680047.9.....	CN	682271.9.....	CH_3OH *E*	685336.5.....	CH_3OCH_3	688999.1.....	CH_3OCHO *A*
680087.3.....	C_2H_5CN	682303.3.....	CH_3CN	685336.5.....	CH_3OCH_3	689006.5.....	CH_3OCHO *A*
680094.5.....	C_2H_5CN	682303.3.....	CH_3CN	685340.1.....	CH_3OCH_3	689007.6.....	C_2H_5CN
680169.8.....	CH_3OCHO *A*	682303.3.....	CH_3CN	685343.8.....	CH_3OCH_3	689070.1.....	CH_3OCHO *E*
680247.8.....	*U*	682370.9.....	$^{13}CH_3OH$ *E*	685434.7.....	CS	689120.1.....	H_2S
680264.4.....	CN	682440.6.....	HCS^+	685492.5.....	CH_3OCH_3	689233.7.....	$SO_2(v_2)$
680264.5.....	CN	682583.7.....	C_2H_5CN	685493.5.....	CH_3OCH_3	689289.5.....	*U*
680264.7.....	CN	682660.0.....	C_2H_5CN	685494.5.....	CH_3OCH_3	689438.7.....	SO_2
680481.0.....	C_2H_5CN	682660.0.....	C_2H_5CN	685494.5.....	CH_3OCH_3	689522.6.....	SO_2
680507.1.....	C_2H_5CN	682899.3.....	CH_3OCHO *E*	685496.3.....	CH_3OCH_3	690294.3.....	CH_3OH *E*
680575.0.....	HNCO	682935.6.....	CH_3OCHO *E*	685496.3.....	CH_3OCH_3	690465.2.....	SO_2
680632.0.....	$SO_2(v_2)$	682938.3.....	CH_3OCHO *A*	685497.4.....	CH_3OCH_3	690551.4.....	$H^{13}CN$
680769.0.....	$SO_2(v_2)$	682938.3.....	CH_3OCHO *A*	685500.2.....	CH_3OCH_3	690629.5.....	$^{13}CH_3OH$ *E*
680786.9.....	HNCO	683170.7.....	*U*	685505.1.....	CH_3OH *E*	690672.9.....	*U*
680804.4.....	CH_3OH *A*	683407.5.....	HNCO	685594.4.....	^{29}SiO	691472.9.....	CO
680841.3.....	C_2H_5CN	683425.2.....	CH_3OH *A*	685611.1.....	C_2H_5CN	691649.4.....	C_2H_5CN
680889.6.....	HNCO	683425.2.....	CH_3OH *A*	685971.8.....	CH_3OCHO *E*	691649.4.....	C_2H_5CN
680906.1.....	HNCO	683476.7.....	*U*	686016.9.....	CH_3OCHO *E*	691815.7.....	CH_3OCHO *E*
680923.8.....	CH_3OCH_3	683510.6.....	*U*	686019.4.....	CH_3OCHO *A*	691841.9.....	CH_3OCHO *A*
680924.6.....	CH_3OCH_3	683571.6.....	CH_3OCHO *A*	686019.4.....	CH_3OCHO *A*	691841.9.....	CH_3OCHO *A*
680925.7.....	CH_3OCH_3	683685.7.....	CH_3OCH_3	686373.6.....	CH_3OCHO *A*	691842.6.....	CH_3OCHO *E*
680927.2.....	CH_3OCH_3	683687.9.....	CH_3OCH_3	686678.9.....	$^{33}SO_2$	691991.8.....	$^{33}SO_2$
680967.3.....	CH_3OCHO *A*	683689.0.....	CH_3OCH_3	686731.3.....	CH_3OH *A*	692079.1.....	$H_2{}^{18}O$
681012.7.....	$^{33}SO_2$	683689.5.....	CH_3OCH_3	687030.5.....	CH_3OCH_3	692200.9.....	C_2H_5CN
681012.7.....	$^{33}SO_2$	683689.8.....	CH_3OCH_3	687030.5.....	CH_3OCH_3	692200.9.....	C_2H_5CN
681012.7.....	$^{33}SO_2$	683690.4.....	CH_3OCH_3	687031.2.....	CH_3OCH_3	692204.0.....	CH_3OCHO *A*
681012.7.....	$^{33}SO_2$	683691.5.....	CH_3OCH_3	687032.0.....	CH_3OCH_3	692204.0.....	CH_3OCHO *A*
681090.0.....	CH_3OCH_3	683692.7.....	CH_3OCH_3	687034.5.....	CH_3OCH_3	692674.3.....	*U*
681090.8.....	CH_3OCH_3	683749.8.....	CH_3OH *E*	687035.3.....	CH_3OCH_3	692726.2.....	*U*
681091.5.....	CH_3OCH_3	683751.0.....	$^{13}CH_3OH$ *A*	687035.3.....	CH_3OCH_3	693269.4.....	SO
681092.6.....	CH_3OCH_3	683762.5.....	CH_3OCHO *E*	687038.6.....	CH_3OCH_3	693420.5.....	$SO_2(v_2)$
681275.8.....	CH_3CN	683770.5.....	CH_3OCHO *A*	687224.5.....	CH_3OH *A*	693469.0.....	$^{33}SO_2$
681275.8.....	CH_3CN	683773.4.....	CH_3OCHO *A*	687303.4.....	H_2S	693790.2.....	*U*
681275.8.....	CH_3CN	683780.8.....	CH_3OCHO *E*	687456.3.....	SO	693876.8.....	$H^{13}CO^+$
681631.8.....	CH_3CN	683960.3.....	C_2H_5CN	687544.7.....	*U*	694138.2.....	SO_2
681631.8.....	CH_3CN	683960.3.....	C_2H_5CN	687580.7.....	*U*	694294.5.....	SiO

TABLE 3

Continued

ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule
694494.0.....	SO_2	698161.1.....	CH_3CN	701375.9.....	H_2CO	705726.9.....	$^{13}CH_3OH$ *E*
694726.2.....	*U*	698227.4.....	CH_3CN	702072.6.....	$^{13}CH_3OH$ *E*	705985.8.....	CH_3OCH_3
695067.0.....	*U*	698227.4.....	CH_3CN	702103.7.....	SO_2	705985.8.....	CH_3OCH_3
695119.3.....	$^{33}SO_2$	698227.4.....	CH_3CN	702293.3.....	SO_2	705986.5.....	CH_3OCH_3
695122.8.....	CH_3OCHO *E*	698267.2.....	CH_3CN	702417.3.....	CH_3OH *E*	705987.3.....	CH_3OCH_3
695156.8.....	CH_3OCHO *E*	698267.2.....	CH_3CN	702479.5.....	NH_2D	705989.8.....	CH_3OCH_3
695157.7.....	CH_3OCHO *A*	698267.2.....	CH_3CN	702479.9.....	NH_2D	705990.5.....	CH_3OCH_3
695157.7.....	CH_3OCHO *A*	698267.2.....	CH_3CN	702480.3.....	NH_2D	705990.5.....	CH_3OCH_3
695432.5.....	CH_3OCH_3	698267.2.....	CH_3CN	702480.7.....	NH_2D	705993.7.....	CH_3OCH_3
695435.0.....	CH_3OCH_3	698280.5.....	CH_3CN	702481.2.....	NH_2D	706082.9.....	CH_3OH *E*
695437.5.....	CH_3OCH_3	698280.5.....	CH_3CN	702501.7.....	HNCO	706234.8.....	SO_2
695437.5.....	CH_3OCH_3	698280.5.....	CH_3CN	702502.1.....	$^{33}SO_2$	706256.8.....	$^{13}CH_3OH$ *A*
695525.3.....	*U*	698347.5.....	CH_3OCH_3	702532.5.....	CH_3OCH_3	706411.6.....	SO_2
695632.5.....	SO_2	698354.6.....	CH_3OCH_3	702534.5.....	CH_3OCH_3	706631.7.....	*U*
695773.7.....	*U*	698494.8.....	CH_3OH *E*	702535.2.....	CH_3OCH_3	706924.5.....	$^{13}CH_3OH$ *A*
695821.7.....	$^{13}CH_3CN$	698541.5.....	CCH	702536.0.....	CH_3OCH_3	707113.2.....	$^{13}CH_3OH$ *E*
695821.7.....	$^{13}CH_3CN$	698541.8.....	CCH	702536.5.....	CH_3OCH_3	707167.2.....	$^{13}CH_3OH$ *E*
695821.7.....	$^{13}CH_3CN$	698603.8.....	CCH	702537.2.....	CH_3OCH_3	707173.4.....	$^{13}CH_3OH$ *A*
696257.5.....	CH_3OH *E*	698604.2.....	CCH	702538.0.....	CH_3OCH_3	707173.4.....	$^{13}CH_3OH$ *A*
696527.0.....	SO_2	698787.6.....	C_2H_5CN	702539.3.....	CH_3OCH_3	707244.2.....	$^{13}CH_3OH$ *E*
696532.2.....	$HN^{13}C$	698787.6.....	C_2H_5CN	702718.5.....	HNCO	707335.1.....	CH_3OCH_3
696958.7.....	CH_3CN	698930.9.....	CH_3OH *A*	702831.4.....	HNCO	707337.6.....	CH_3OCH_3
696958.8.....	CH_3CN	699071.6.....	*U*	702835.4.....	HNCO	707340.0.....	CH_3OCH_3
696958.8.....	CH_3CN	699432.6.....	CH_3OCH_3	702895.7.....	SO_2	707340.0.....	CH_3OCH_3
697061.3.....	*U*	699432.6.....	CH_3OCH_3	703891.9.....	$^{13}CH_3OH$ *E*	707342.2.....	$^{13}CH_3OH$ *E*
697147.8.....	CH_3OH *E*	699433.5.....	CH_3OCH_3	704192.6.....	CH_3OCHO *E*	707368.0.....	$^{13}CH_3OH$ *A*
697209.2.....	CH_3CN	699434.5.....	CH_3OCH_3	704193.5.....	CH_3OCHO *A*	707368.0.....	$^{13}CH_3OH$ *A*
697209.2.....	CH_3CN	699437.3.....	CH_3OCH_3	704193.5.....	CH_3OCHO *A*	707442.9.....	$^{13}CH_3OH$ *E*
697209.2.....	CH_3CN	699437.6.....	CH_3OCH_3	704195.2.....	$^{13}CH_3OH$ *A*	707477.5.....	$^{13}CH_3OH$ *E*
697297.4.....	*U*	699438.7.....	CH_3OCH_3	704270.3.....	SO_2	707518.2.....	$^{13}CH_3OH$ *A*
697433.5.....	CH_3CN	699440.0.....	CH_3OCH_3	704289.2.....	CH_3OH *A*	707606.3.....	$^{13}CH_3OH$ *A*
697433.5.....	CH_3CN	699453.1.....	CH_3OCH_3	704422.8.....	CH_3OCH_3	707609.0.....	$^{13}CH_3OH$ *A*
697433.6.....	CH_3CN	699453.1.....	CH_3OCH_3	704423.8.....	CH_3OCH_3	707614.7.....	$^{13}CH_3OH$ *A*
697500.5.....	*U*	699454.4.....	CH_3OCH_3	704424.7.....	CH_3OCH_3	707727.9.....	C_2H_5CN
697631.7.....	CH_3CN	699455.7.....	CH_3OCH_3	704424.8.....	CH_3OCH_3	707727.9.....	C_2H_5CN
697631.7.....	CH_3CN	699719.8.....	CH_3OCH_3	704426.6.....	CH_3OCH_3	707812.7.....	$^{13}CH_3OH$ *E*
697631.7.....	CH_3CN	699720.2.....	CH_3OCH_3	704426.6.....	CH_3OCH_3	708010.5.....	$^{13}CH_3OH$ *E*
697660.6.....	*U*	699721.1.....	CH_3OCH_3	704427.5.....	CH_3OCH_3	708055.2.....	$^{13}CH_3OH$ *A*
697761.4.....	*U*	699828.9.....	$SO_2(v_2)$	704430.3.....	CH_3OCH_3	708216.1.....	*U*
697803.6.....	CH_3CN	699873.9.....	$H_2^{13}CO$	704638.0.....	$^{33}SO_2$	708266.5.....	$H_2^{13}CO$
697803.6.....	CH_3CN	699941.5.....	CH_3CN	704638.0.....	$^{33}SO_2$	708392.5.....	SO_2
697803.6.....	CH_3CN	699941.5.....	CH_3CN	704638.1.....	$^{33}SO_2$	708470.4.....	H_2S
697949.2.....	CH_3CN	699941.5.....	CH_3CN	704638.1.....	$^{33}SO_2$	708546.1.....	$^{13}CH_3OH$ *E*
697949.2.....	CH_3CN	700308.1.....	HNCO	704919.6.....	$^{13}CH_3OH$ *E*	708654.2.....	*U*
697949.2.....	CH_3CN	700312.9.....	SO_2	705181.3.....	CH_3OH *E*	708785.6.....	$HCN(v_2)$
698068.4.....	CH_3CN	700639.0.....	C_2H_5CN	705422.3.....	HNCO	708813.1.....	CH_3OH *E*
698068.4.....	CH_3CN	700639.0.....	C_2H_5CN	705457.7.....	C_2H_5CN	708877.2.....	HCN
698068.4.....	CH_3CN	700950.3.....	HNCO	705464.4.....	$^{13}CH_3OH$ *A*	708951.1.....	C_2H_5CN
698161.1.....	CH_3CN	701022.3.....	$^{13}CH_3OH$ *A*	705467.5.....	CH_3OH *E*	708951.1.....	C_2H_5CN
698161.1.....	CH_3CN	701366.7.....	CH_3OH *E*	705672.1.....	SO_2	708979.3.....	SO_2

TABLE 3

Continued

ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule
709006.3.....	*U*	714747.0.....	NH_2D	716943.8.....	H_2CO	721353.8.....	CH_3OCH_3
709200.6.....	$^{13}CH_3OH$ *E*	714747.2.....	NH_2D	717124.3.....	CH_3OCHO *A*	721355.7.....	CH_3OCH_3
709308.2.....	*U*	714748.4.....	NH_2D	717128.9.....	CH_3OCHO *A*	721356.3.....	CH_3OCH_3
709466.2.....	*U*	714749.1.....	NH_2D	717168.5.....	CH_3OCHO *E*	721356.8.....	CH_3OCH_3
709510.6.....	SO_2	714779.5.....	SO_2	717177.9.....	CH_3OCHO *E*	721357.9.....	CH_3OCH_3
709628.6.....	C_2H_5CN	714897.5.....	NS	717308.2.....	*U*	721519.8.....	CH_3OH *E*
709628.6.....	C_2H_5CN	714897.6.....	NS	717348.8.....	^{34}SO	721542.6.....	CH_3OH *A*
709817.8.....	C_2H_5CN	714897.6.....	NS	717466.9.....	CH_3OD *A*	721542.6.....	CH_3OH *A*
710177.6.....	$SO_2(v_2)$	714971.8.....	*U*	717818.9.....	C_2H_5CN	721723.7.....	CH_3OH *E*
710184.8.....	C_2H_5CN	715195.9.....	*U*	717818.9.....	C_2H_5CN	721793.0.....	CH_3OH *A*
710184.8.....	C_2H_5CN	714983.9.....	*U*	717837.8.....	CH_3OCH_3	721998.1.....	CH_3OH *E*
710385.8.....	$^{13}CH_3OH$ *A*	715237.9.....	CH_3OH *E*	717837.9.....	CH_3OCH_3	722039.5.....	CH_3OH *A*
710386.5.....	$H_2^{13}CO$	715314.6.....	CH_3OCHO *A*	717838.9.....	CH_3OCH_3	722075.4.....	CH_3OH *E*
710393.4.....	$H_2^{13}CO$	715407.1.....	*U*	717840.0.....	CH_3OCH_3	722161.5.....	HNCO
710517.6.....	CH_3OCHO *A*	715446.0.....	*U*	718158.8.....	CH_3OH *A*	722316.5.....	$^{13}CH_3OH$ *E*
710517.6.....	CH_3OCHO *A*	715767.2.....	*U*	718209.3.....	$^{13}CH_3OH$ *E*	722544.6.....	CH_3OH *E*
710517.8.....	CH_3OCHO *E*	716121.4.....	CH_3CN	718305.4.....	CH_3OCH_3	722575.1.....	CH_3OCH_3
710572.6.....	$^{33}SO_2$	716121.4.....	CH_3CN	718305.5.....	CH_3OCH_3	722575.3.....	CH_3OCH_3
710729.4.....	$H^{13}NC$	716121.4.....	CH_3CN	718306.4.....	CH_3OCH_3	722575.4.....	CH_3OCH_3
710918.7.....	SO_2	716167.4.....	*U*	718307.4.....	CH_3OCH_3	722575.4.....	CH_3OCH_3
711021.0.....	$^{33}SO_2$	716208.9.....	^{34}SO	718436.1.....	CH_3OH *E*	722576.7.....	$C^{34}S$
711304.5.....	C_2H_5CN	716270.8.....	CH_3CN	718474.6.....	CH_3CN	722592.0.....	CH_3OH *E*
711304.5.....	C_2H_5CN	716270.8.....	CH_3CN	718474.6.....	CH_3CN	722615.8.....	SO_2
711316.9.....	*U*	716270.8.....	CH_3CN	718474.6.....	CH_3CN	722704.8.....	SO_2
711415.1.....	$H_2^{13}CO$	716393.1.....	CH_3CN	718477.3.....	CH_3CN	722705.7.....	CH_3OH *A*
712010.5.....	SO_2	716393.1.....	CH_3CN	718477.3.....	CH_3CN	722705.7.....	CH_3OH *A*
712371.8.....	$HCN(v_2)$	716393.1.....	CH_3CN	718477.3.....	CH_3CN	722742.3.....	CH_3OH *E*
712527.5.....	C_2H_5CN	716488.1.....	CH_3CN	718618.0.....	C_2H_5CN	722789.8.....	CH_3OH *A*
712527.5.....	C_2H_5CN	716488.1.....	CH_3CN	718618.0.....	C_2H_5CN	722804.1.....	CH_3OH *E*
712673.8.....	C_2H_5CN	716488.1.....	CH_3CN	718765.6.....	$^{33}SO_2$	722823.7.....	CH_3OH *E*
712673.8.....	C_2H_5CN	716556.1.....	CH_3CN	718765.9.....	$^{33}SO_2$	722849.0.....	CH_3OH *E*
712723.8.....	CH_3OCH_3	716556.1.....	CH_3CN	718771.4.....	$SO_2(v_2)$	722889.6.....	CH_3OH *A*
712723.8.....	CH_3OCH_3	716556.1.....	CH_3CN	718830.5.....	$^{33}SO_2$	723040.8.....	CH_3OH *E*
712746.8.....	C_2H_5CN	716596.9.....	CH_3CN	719178.6.....	C_2H_5CN	723192.6.....	CH_3OH *A*
712746.8.....	C_2H_5CN	716596.9.....	CH_3CN	719178.6.....	C_2H_5CN	723194.4.....	CH_3OH *A*
712808.4.....	$^{13}CH_3OH$ *A*	716596.9.....	CH_3CN	719462.5.....	SO_2	723202.7.....	CH_3OH *E*
712825.6.....	SO_2	716596.9.....	CH_3CN	719557.6.....	CH_3OCH_3	723250.8.....	CH_3OH *E*
713341.7.....	HCO^+	716596.9.....	CH_3CN	719557.6.....	CH_3OCH_3	723281.4.....	CH_3OH *E*
713409.5.....	*U*	716610.1.....	CH_3CN	719558.6.....	CH_3OCH_3	723336.7.....	CH_3OH *E*
713588.3.....	$SO_2(v_2)$	716610.1.....	CH_3CN	719559.7.....	CH_3OCH_3	723342.8.....	CH_3OCH_3
713982.4.....	CH_3OH	716610.1.....	CH_3CN	719664.8.....	CH_3OH *A*	723343.7.....	CH_3OCH_3
714223.6.....	$^{33}SO_2$	716662.4.....	C_2H_5CN	719788.7.....	^{30}SiO	723344.6.....	CH_3OCH_3
714375.2.....	*U*	716662.4.....	C_2H_5CN	719947.9.....	*U*	723344.6.....	CH_3OCH_3
714455.9.....	*U*	716859.9.....	NH_2D	720069.2.....	CH_3OH *E*	723346.4.....	CH_3OCH_3
714505.5.....	NS	716860.6.....	NH_2D	720441.3.....	CH_3OH *A*	723346.4.....	CH_3OCH_3
714505.5.....	NS	716861.3.....	NH_2D	720723.6.....	SO_2	723350.0.....	CH_3OCH_3
714505.5.....	NS	716861.6.....	NH_2D	720812.0.....	CH_3OH *A*	723582.7.....	HNCO
714617.4.....	*U*	716861.8.....	NH_2D	721011.1.....	CH_3OH *E*	723619.6.....	CH_3OH *A*
714746.2.....	NH_2D	716862.8.....	NH_2D	721352.7.....	CH_3OCH_3	723761.6.....	$^{33}SO_2$
714746.6.....	NH_2D	716876.1.....	^{34}SO	721353.1.....	CH_3OCH_3	723761.6.....	$^{33}SO_2$

TABLE 3

Continued

ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule	ν (MHz)	Molecule
723761.7.....	$^{33}SO_2$	724506.2.....	SO_2	724740.8.....	CH_3OH *E*	724938.6.....	CH_3OCH_3
723761.7.....	$^{33}SO_2$	724565.0.....	CH_3OH *E*	724761.4.....	HNCO	724939.3.....	CH_3OCH_3
723866.6.....	*U*	724595.5.....	CH_3OH *E*	724823.6.....	CH_3OH *E*	724941.7.....	CH_3OCH_3
724121.5.....	CH_3OH *E*	724644.6.....	CH_3OH *A*	724851.5.....	CH_3OH *E*	724942.5.....	CH_3OCH_3
724345.4.....	CH_3OH *A*	724644.6.....	CH_3OH *A*	724855.1.....	CH_3OH *A*	724942.5.....	CH_3OCH_3
724153.9.....	CH_3OH *E*	724647.3.....	HNCO	724855.2.....	CH_3OH *A*	724945.6.....	CH_3OCH_3
724482.1.....	CH_3OH *A*	724648.5.....	CH_3OH *E*	724937.8.....	CH_3OCH_3	724963.0.....	CH_3OH *E*
724482.1.....	CH_3OH *A*	724719.3.....	CH_3OH *E*	724937.8.....	CH_3OCH_3	725013.1.....	CH_3OH *A*

NOTE.—This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal.*

Unexpectedly, the molecule with the next highest column density is SO, with 2.3×10^{17} cm^{-2}. The strongest lines of this molecule are very optically thick and it is only through the isotopomer ^{34}SO and by weak transitions of the main isotopomer that the high column density is established. Other surprises are the very high apparent column density of $HCOOCH_3$ and very high rotation temperatures of $HCOOCH_3$, CH_3OCH_3, and CH_3CH_2CN. While apparent high rotation temperatures could be faked by high optical depths, high optical depths would lower the column densities, while we determine higher, or in the case of $HCOOCH_3$ much higher column densities. This together with the fact that we do indeed observe very highly excited lines of all three species (up to 1000 K for $HCOOCH_3$, 800 K for CH_3OCH_3, and 1600 K for CH_3CH_2CN) point at the interpretation that we do see a probably compact and hot component which has been missed by lower frequency surveys.

The interpretation of the rotation diagrams is not easy, because in particular the very high excitation lines are rather weak and consequently suffer very much from blending. The assignment of each individual feature to the highly excited transitions of $HCOOCH_3$, CH_3OCH_3, or CH_3CH_2CN would be questionable. Only the large number of detected lines gives confidence in the assignments and the resulting high column densities and temperatures.

As in the 345 GHz survey (Schilke et al. 1997), CO is *not* the dominant coolant of the gas (see Table 2). The combined integrated line intensities in SO_2 and CH_3OH are each more than 2.5 times that of CO, which is very comparable to the value of SO. Other molecules, such as HCN, CH_3CN, H_2CO, $HCOOCH_3$, CH_3OCH_3, and CH_3CH_2CN also contribute significantly to the cooling. One important coolant, H_2O in the vibrational ground state, is of course unobserved, but it is evident that any models of the thermal balance of Orion-KL have to take as many species as possible into account.

Plotting the number of molecules with $\int T_R^* dv > A$ (Fig. 2) shows that the number of lines with integrated intensities between $\approx$20 and 1000 K km s^{-1} can be fitted roughly by a power law with a slope of -1. Using this power law in a calculation of the integrated flux would result in an infinite contribution from weak lines. Clearly, the power law is not a good approximation for low flux values and cannot be used to estimate the flux contribution from weak, unresolved lines.

Using the continuum offset of the chopped observations in the line free parts of the DSB spectra, we obtain an offset of 7.3 K = 237 Jy at the CSO, taking the DSB calibration for the continuum offset into account. The average line emission over the range of the survey is 1.3 K or 41 Jy, giving a total flux of 278 Jy. Wright et al. (1992) measure a peak flux of 375 Jy with the JCMT. Considering the different beam sizes, these two values are comparable to each other for a source size of about 10″. Hence, the integrated line emission contributes about 15% to the total emission at this frequency. This value is in agreement with a prediction by Groesbeck (1994), who finds that the line contribution to the total flux in Orion drops from 50% at 800 μm to 10% at 450 μm. This estimate takes only the identifiable features into account, including the *U* lines (see Table 3 for all observed features). A forest of low-level lines and line wings could contribute a pseudo-continuum of unknown strength. Models using Gaussian line shapes and the information available in the JPL catalog (Groesbeck 1994) predict that the contribution of this pseudo-continuum is low, but the existence of non-Gaussian wings could alter the contribution significantly. However, it seems implausible that the relative contribution of the pseudo-continuum to the identifiable line emission changes very much with frequency. Thus, although the absolute values of the line contribution to the apparent continuum will be a lower limit, it seems safe to conclude that the relative importance of line contribution to the continuum drops with frequency between 350 and 650 GHz.

4. COMMENTS ON INDIVIDUAL SPECIES

4.1. *Diatomic Molecules without Electronic Angular Momentum* (Table 4)

CO.—The carbon monoxide (6–5) lines of ^{12}CO, ^{13}CO, $C^{18}O$, and $C^{17}O$ are detected in this survey. The line wings of ^{12}CO(6–5) range from ≈ -80 km s^{-1} to 100 km s^{-1}. The peak temperature of the ^{12}CO(6–5) line is about 150 K, although calibration using the beam efficiency on Jupiter may not be appropriate for the extended component of the emission. The line shows a little dip at the very top,[5] most likely due to self-absorption, although contamination from emission at the OFF-position, while improbable, cannot be ruled out completely. ^{13}CO(6–5) is also very strong and shows line wings, but not quite as wide. The $C^{18}O$(6–5) line is partially blended with an SO_2 line and other lines, so that the line wing contribution is difficult to determine. It is noteworthy that neither the $C^{18}O$ nor the ^{13}CO line shows

[5] The CO line is plotted with a reduced intensity in Fig. 4 to show this dip.

TABLE 4

TABLE OF DIATOMIC MOLECULES

Molecule	ν (MHz)	$J_{(F)}$	T_R^{*a} (K)	$\int T_R^* dv^a$ (K km s^{-1})	Notes
CO.....	691473.0	6–5	153.8	9811.6	
^{13}CO	661068.1	6–5	70.1	1445.9	
C^{18}O	658553.6	6–5	25.0	409.7	1
C^{17}O	674009.3	6–5	6.6	109.5	2
CS	636531.8	13–12	29.9	598.3	3
	685434.8	14–13	23.1	535.7	
C^{34}S	626349.3	13–12	8.8	108.2	
	674469.9	14–13	3.9	30.7	
	722576.8	15–14	8.1	48.5	4
SiO	607608.0	14–13	10.6	325.6	5
	650956.7	15–14	21.8	609.8	
	694294.6	16–15	13.0	424.4	
^{29}SiO	642799.8	15–14	2.9	28.5	6
	685594.4	16–15	2.5	19.6	
^{30}SiO	635217.0	15–14	3.5	66.6	
	677508.3	16–15	2.1	12.5	
	719788.8	17–16	2.5	29.5	
SiH	624920.1	$(3/2)_2$–$(1/2)_1$	16.9	278.6	7
	624924.6	$(3/2)_1$–$(1/2)_1$	—	—	
	624935.8	$(3/2)_1$–$(1/2)_0$	—	—	
	627672.7	$(3/2)_1$–$(1/2)_1$	5.3	37.2	
	627689.9	$(3/2)_2$–$(1/2)_1$	—	—	
	627707.6	$(3/2)_1$–$(1/2)_0$	2.4	14.1	8
HCl	625901.6	1_2–0_2	15.2	612.7	
	625918.8	1_3–0_2	15.2	612.7	
	625932.0	1_1–0_2	15.2	612.7	
H^{37}Cl.....	624964.4	1_2–0_2	9.6	173.1	
	624977.8	1_3–0_2	—	—	
	624988.3	1_1–0_2	—	—	

NOTES.—(1) Blend with SO_2 at 658541.6. (2) Blend with $^{34}SO_2$ at 673997.1, ^{34}SO at 673998.1 and CH_3OH at 674017.3. (3) Blend with CH_3OH at 636522.9. (4) Blend with CH_3OCH_3 at 722576 and CH_3OH at 722566.7. (5) Uncertain calibration. (6) Blend with SO_2 at 642806.2. (7) Blend with CH_3CN at 624914.6 and 624926.4 and CH_3OCH_3 between 624932.0 and 624936.4. (8) Blend with CH_3OH at 627713.1 and SO_2 at 627715.3. This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal*.

[a] Dashes indicate that the line is part of a blend, and intensity and area are given by the values preceding it.

any contribution from the hot core velocity component. The C^{17}O line is blended with $^{34}SO_2$ and CH_3OH lines and cannot be used to determine column densities.

CS.—Carbon monosulfide is detected in the C^{32}S(13–12) and (14–13) lines, in C^{34}S(13–12), (14–13) and (15–14) and in C^{33}S(13–12) and (14–13). ^{13}CS lines could not be found, but one of the two possible lines is buried under a H_2CO line while the other is in a noisy part of the spectrum. The main isotopomer lines display wings, while lines from the ^{34}S and ^{33}S isotopomers show mostly a contribution from the hot core. In spite of that, the rotation temperature determined by C^{34}S is anomalously low, only 32 K. However, it is based on only three lines, two of which are situated at the edges of the band, where the atmosphere has a low transmission and the calibration is not reliable. The line ratios of the C^{32}S/C^{34}S (13–12) and (14–13) can be used to determine optical depths of the main isotope. Assuming a ^{32}S/^{34}S ratio of 23 and equal excitation temperatures, one determines C^{32}S optical depths of 5 and 0.5, respectively. The latter value is more trustworthy, since the calibration of the C^{34}S(14–13) is better than for (13–12). This means that C^{32}S has an optical depth close to unity and that the rotation temperature and column density determined from the two C^{32}S lines, $T_{\rm rot} = 127$ K and $N(\rm CS) = 1 \times 10^{15}$ cm^{-2}, have physical meanings.

SiO.—Silicon monosulfide is found in the (14–13), (15–14), and (16–15) lines of the main isotopomer ^{28}SiO, in the (15–14) and (16–15) lines of the ^{29}SiO and in the (15–14), (16–15), and (17–16) lines of the ^{30}SiO isotopomer. The lines are broad, and all of them, including the isotopomeric lines, only show the plateau component. The isotopomeric ratios suggest that the ^{28}SiO lines also have $\tau \approx 1$. The SiO rotation temperature and column density, determined by the main isotopomer, are $T_{\rm rot} = 110 \pm 50$ K and $N(\rm SiO) = (5.4 \pm 6.5) \times 10^{14}$ cm^{-2}, respectively, which is consistent with the isotopomeric results.

SiS.—SiS is not found in this survey. It has previously been identified by Ziurys (1991) in a couple of sources, including Orion. Based on her results, the lines in our frequency range would be too weak to be detectable.

HCl.—The ground state lines of HCl and H^{37}Cl are found. The HCl line has previously been investigated by Schilke, Phillips, & Wang (1995), and H^{37}Cl toward a different position in Orion has been observed by Salez et al. (1996). The line ratio of H^{37}Cl/H^{35}Cl in this survey supports the conclusion that the H^{35}Cl emission is optically thin, as determined by Schilke et al. by analysis of the hyperfine components. A weak feature is present at the frequency of the DCl(2–1) line. Using the working hypothesis that it is indeed DCl and using the same parameters as for HCl ($T_{\rm rot} = 150$ K), one determines a column density of 1×10^{14} cm^{-2}, corresponding to a DCl/HCl ratio of 0.2, which is outside the range of deuterium enhancement usually observed. A lower rotation temperature could only lower this ratio by a factor of 2, which is still much too high. The most probable conclusion is that the feature we observe is not DCl.

SiH.—SiH has two groups of three hyperfine transitions from the $^2\Pi_{1/2}$ state within our band: one at 624.9 and the other at 627.7 GHz (Brown, Curl, & Evenson 1985). We see evidence for both of them (Fig. 3). At 624.9 GHz, the SiH line is blended with the $CH_3CN(34_0$–$33_0)$ and $(34_1$–$33_1)$ lines, and with CH_3OCH_3(16–15) lines. The combined estimated line intensity of these blends accounts for most of the line intensity but does not exclude a contribution of SiH with a strength similar to the 627.7 GHz line. The latter is blended in one hyperfine component with two CH_3OH lines of a line strength similar to the adjacent CH_3OH lines (at $v_{\rm LSR} = -30$ and 30 in Fig. 3), and with a highly excited SO_2 line. The resulting line strength is *lower* than each of the CH_3OH lines individually, which is a puzzle. But the strongest hyperfine component is not blended with any known line, and a trace of the weakest hyperfine component is present. Due to these uncertainties, we regard the identification as only tentative. The only hope of confirming or rejecting the detection in this source are interferometric observations, in case the SiH molecule shows a different spatial distribution than the others. The further discussion adopts the working hypothesis that at least the main hyperfine component of the 627.7 GHz transition is indeed due to SiH and derives the column density and abundances.

The line velocity is 4.7 km s^{-1}, which points to the hot core as the origin. Based on the integrated intensity of the $(J' - J''; \ F' - F'' = 3/2 - 1/2; \ 2^+ - 1^-)$ transition at 627.6869 GHz and using a dipole moment of 0.124 D (Lewerenz et al. 1983), one derives a column density in the

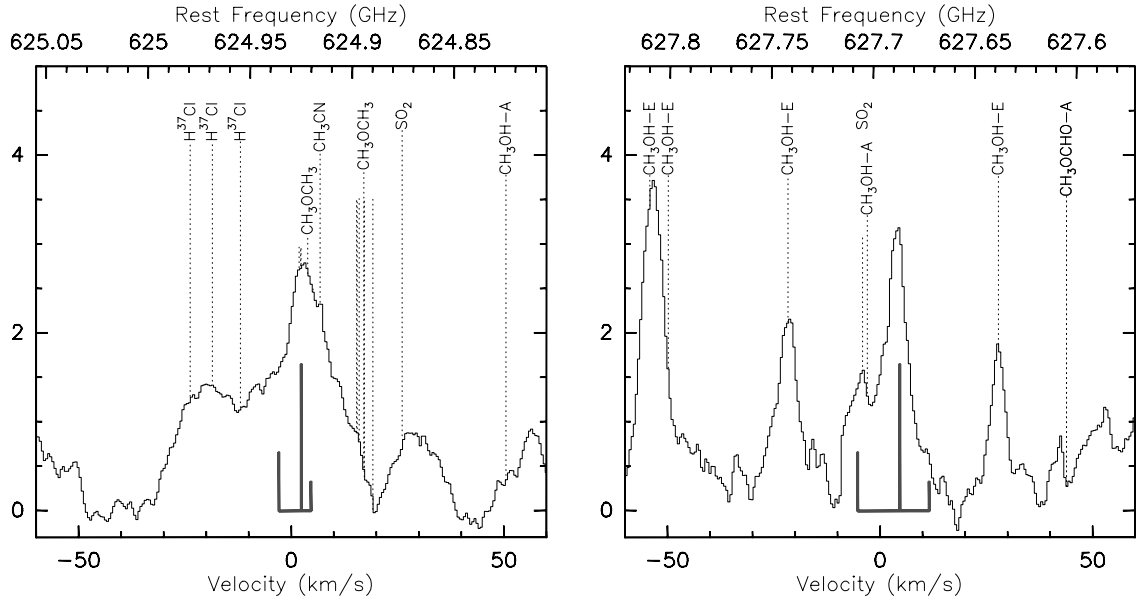

FIG. 3.—Spectra of SiH at 624.9 and 627.7 GHz. The positions and strengths of the hyperfine components are indicated.

upper level of 4.2×10^{15} cm^{-2}, which translates to a total column density of 9.1×10^{15} cm^{-2} for SiH. Here we assumed an excitation temperature of 100 K and we neglected the population in the $^2\Pi_{3/2}$ state (200 K above ground). Using a H_2 column density of 3×10^{24} cm^{-2} for the hot core (Schilke et al. 1992), the resulting abundance of SiH in the hot core is 3×10^{-9}. In a study of silicon chemistry in hot cores, MacKay (1995) assumes that silicon comes off grains in the form of SiH_4, which is then converted by hydrogen abstraction reactions with atomic hydrogen to SiH_3, SiH_2, SiH, and finally Si. Both Si and SiH can react with molecular oxygen to form SiO. He finds that the relative abundances of the silicon hydrides and SiO depend much on the initial abundance of molecular oxygen in the gas phase. If molecular oxygen is absent, he predicts peak SiH abundances of a few times 10^{-10}, not too far from what we observe. In this model, SiO is absent in the hot core. Indeed, recent interferometer observations of SiO in Orion-KL (Chandler & De Pree 1995; Wright et al. 1995) as well as the 345 GHz survey of Schilke et al. (1997) and the present paper find SiO exclusively in the plateau or outflow component, but not in the hot core.

DF.—We find a feature at the frequency of the DF(1–0) transition. In earlier conference reports of this survey (Schilke 1996) we suggested this as a very tentative detection of the molecule. However, recent measurements failed to reproduce it (D. M. Mehringer & D. C. Lis 1998, private communication).

4.2. *Polyatomic Linear Molecules and Ions without Electronic Angular Momentum* (Table 5)

HCN *and* HNC.—The (8–7) lines of HCN, $H^{13}CN$ and $HC^{15}N$ are detected, along with DCN(9–8) and three lines of vibrationally excited HCN in the $v_2 = 1$ state. The $v_2 = 2$ transitions have been searched for, but not conclusively found. Although the HCN(7–6) line is in the range of this survey, it unfortunately is placed at a frequency where absorption by the 620.7 GHz H_2O line causes the atmosphere to be completely opaque. The HNC(7–6) and $HN^{13}C$(7–6) and (8–7) lines are also observed.

HC_3N *and* OCS.—No lines of cyanoacetylene or carbonyl sulfide are detected. This is not surprising, since in this frequency range the levels would have J quantum numbers in the 70s or 50s range, respectively, and level energies of $\approx$1000 K.

HCO^+.—The (7–6) and (8–7) lines are found in the main isotopomer, and also, tentatively, in the ^{13}C isotopomers. The calibration of all four lines is not very reliable, since the main isotopomeric lines are situated close to the two aforementioned gaps in the band, the $H^{13}CO^+$(7–6) lines at the very edge of our observing band and the (8–7) line in a region of the spectrum with line contaminations from both sidebands. Therefore, not much can be said about optical depths or excitation of the lines.

TABLE 5

TABLE OF POLYATOMIC MOLECULES

Molecule	ν (MHz)	$J_{(F)}$	T_R^* (K)	$\int T_R^* dv$ (K km s^{-1})	Notes
HCN	708877.2	8–7	48.7	1501.8	
$H^{13}CN$.....	690551.5	8–7	17.5	456.3	
$HC^{15}N$.....	688275.8	8–7	11.5	166.9	
HCN-$v_2 = 1$...	623363.5	7_1–6_1	15.7	218.1	
	708785.7	8_1–7_1	13.4	146.6	1
	712371.8	8_1–7_1	11.6	170.3	
DCN	651570.9	9–8	5.5	70.3	
HNC	634508.2	7–6	14.8	248.6	
$HN^{13}C$.....	609506.3	7–6	3.6	17.2	2
	696532.3	8–7	2.8	53.3	3
HCO^+	624208.7	7–6	14.3	142.8	
	713341.8	8–7	24.7	577.2	
$H^{13}CO^+$	607175.1	7–6	2.9	19.8	4
	693876.9	8–7	14.0	99.6	
HCS^+	682440.7	16–15	0.9	8.3	5

NOTES.—(1) Blend with HCN at 708877.2. (2) Questionable assignment. (3) Blend with SO_2 at 696527.1. (4) Uncertain calibration. (5) Questionable assignment. This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal*.

TABLE 6

TABLE OF SO MOLECULES

Molecule	ν (MHz)	N_J	T_R^* (K)	$\int T_R^* dv$ (K km s^{-1})	Notes
SO	609959.7	10_{10}–9_{10}	17.2	476.4	
	611552.6	5_4–2_3	3.7	67.2	
	644377.8	15_{14}–14_{13}	33.9	980.7	
	645254.1	15_{15}–14_{14}	39.6	1289.7	1
	645875.4	15_{16}–14_{15}	39.0	1134.0	
	651493.5	11_{11}–10_{11}	4.7	49.5	2
	693269.4	12_{12}–11_{12}	3.2	54.8	
^{34}SO.....	631751.8	15_{14}–14_{13}	14.8	189.9	3
	632659.8	15_{15}–14_{14}	15.0	305.7	4
	633302.6	15_{16}–14_{15}	17.1	412.7	
	675324.6	16_{17}–15_{16}	6.6	136.2	
	716209.0	17_{16}–16_{15}	4.7	75.5	
	717348.9	17_{18}–16_{17}	9.7	145.5	

NOTES.—(1) Blend with SO_2 at 645198.0. (2) Blend with H_2CS at 651511.3. (3) Large frequency error. (4) Large frequency error. This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal.*

4.3. *Linear Molecules with Electronic Angular Momentum*

SO.—Nine lines of SO and nine of ^{34}SO were found in this survey (see Table 6). The lines with high transition strengths from the main isotopomer are very broad and, judged from the isotopomeric ratio, are optically thick. The ^{34}SO lines give a rotation temperature of 39 ± 4 K and a column density for ^{32}SO (assuming a ^{32}S/^{34}S ratio of 23) of $(1.4 \pm 1.1) \times 10^{18}$ cm^{-2}. This column density seems excessively high. Combining the ^{34}SO lines with the main isotopomer lines and iteratively correcting those for high optical depths lead to much lower column densities and higher rotation temperatures, 64 ± 5 K and $(2.3 \pm 0.5) \times 10^{17}$ cm^{-2}. These values are similar to earlier surveys (Serabyn & Weisstein 1995; Sutton et al. 1994). In the rotation plot it is evident that the ^{34}SO line group at 631–633 GHz has line intensities which are too high and are the cause of the low temperature and high column density of the ^{34}SO data. This frequency range is at the edge of the deep 620.7 GHz O_2 absorption line, which may be the cause of a calibration problem.

NO.—Four hyperfine triplets of NO lines are found in this survey (see Table 7). The triplets are blended, so that they cannot be used to determine optical depths based on hyperfine ratios reliably. A rotation diagram gives a rotation temperature of 122 ± 25 K and a column density of $(1.5 \pm 0.6) \times 10^{17}$ cm^{-2}.

NS.—Four hyperfine multiplets of NS are found, from $J = (27/2)$–$(25/2)$ to $J = (31/2)$–$(29/2)$, partly blended with other lines (see Table 7). The line velocities and widths point to a hot core origin. Due to the blends, the data cannot be used for rotation diagram analyses. This molecule has been extensively studied by McGonagle & Irvine (1997) in Orion and other sources, it also was detected in Orion by Schilke et al. (1997) at 345 GHz.

CN.—Three hyperfine groups of the CN(6–5) line are detected, although the lines are weak (see Table 8). Line widths and velocities are consistent with an extended ridge origin, so the excitation temperature is probably too low to produce strong emission in this frequency range.

CCH.—The (7–6) and (8–7) lines of CCH are found but are very weak (see Table 8). The narrow line width and the line velocity point to an extended ridge origin, similar to CN. The weakness of the lines prohibits a useful rotation diagram analysis.

4.4. *Symmetric Rotors*

CH_3CN.—Methyl cyanide CH_3CN is found in a plethora of lines, ranging from the ($J = 34$–33) lines to the ($J = 39$–38) lines in the ground vibrational state and the $v_8 = 1$ and $v_8 = 2$ lines (see Table 9). The level energies reach from 500 to 1500 K. No reliable lines of the ^{13}C isotopomers were found. The rotation diagram shows a large scatter, possibly because of blending or misidentification of some lines. Another possibility is that this molecule cannot be described properly by a single temperature LTE distribution, particularly if one takes the vibrationally excited lines into account. At 345 GHz the CH_3CN lines were found to be optically thick.

CH_3CCH.—Lines from methyl acetylene are not detected in this survey. This molecule has been found in earlier surveys to trace the extended ridge, so that it is not surprising that the lines in this band, which have lower levels of more than 650 K above ground, are not seen.

4.5. *Inorganic Asymmetric Rotors*

SO_2.—Sulphur dioxide is observed in the ^{32}S, ^{34}S, and ^{33}S isotopomers, including some vibrationally excited levels (see Table 10). Even ground state levels reaching up to 1400 K above ground are observed. Including all levels, the rotation temperature is 187 ± 4 K with a column density of $(6.0 \pm 0.3) \times 10^{16}$ cm^{-2}. The $^{34}SO_2$ data give a rotation temperature of 192 ± 12 K with a column density of

TABLE 7

TABLE OF NO AND NS MOLECULES

Molecule	ν (MHz)	N_J	T_R^{*a} (K)	$\int T_R^* dv^a$ (K km s^{-1})	Notes
NO.....	651432.7	13/2, 13/2–11/2, 11/2*e*	15.5	236.7	
	651433.0	13/2, 15/2–11/2, 13/2*e*	—	—	
	651433.6	13/2, 11/2–11/2, 9/2*e*	—	—	
NS	714505.5	31/2, 31/2–29/2, 29/2*e*	2.8	23.5	1
	714505.6	31/2, 29/2–29/2, 25/2*e*	—	—	
	714505.6	31/2, 33/2–29/2, 31/2*e*	—	—	
	714897.7	31/2, 31/2–29/2, 29/2*f*	—	—	

NOTE.—(1) Questionable assignment. This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal.*

[a] Dashes indicate that the line is part of a blend, and intensity and area are given by the values preceding it.

TABLE 8

TABLE OF CN AND C_2H MOLECULES

Molecule	ν (MHz)	N, J, F	T_R^{*a} (K)	$\int T_R^* dv^a$ (K km s^{-1})	Notes
CN.....	680027.2	6, 11/2, 11/2–5, 9/2, 11/2	4.1	19.6	
	680264.5	6, 13/2, 13/2–5, 11/2, 11/2	4.1	34.8	
	680264.5	6, 13/2, 13/2–5, 11/2, 11/2	—	—	
	680264.8	6, 13/2, 13/2–5, 11/2, 11/2	—	—	
CCH.....	611265.0	7, 15/2, 15/2–6, 13/2, 13/2	2.2	29.0	
	611265.4	7, 15/2, 15/2–6, 13/2, 13/2	—	—	
	611327.2	7, 13/2, 13/2–6, 11/2, 11/2	3.8	10.6	
	611327.7	7, 13/2, 13/2–6, 11/2, 11/2	—	—	
	698541.6	8, 17/2, 17/2–7, 15/2, 15/2	2.2	22.1	
	698541.9	8, 17/2, 17/2–7, 15/2, 15/2	—	—	
	698603.9	8, 15/2, 15/2–7, 13/2, 13/2	3.1	27.1	
	698604.2	8, 15/2, 15/2–7, 13/2, 13/2	—	—	

NOTE.—This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal.*

[a] Dashes indicate that the line is part of a blend, and intensity and area are given by the values preceding it.

$(8.2 \pm 1.1) \times 10^{15}$ cm^{-2}. The line ratio between $^{32}SO_2$ and $^{34}SO_2$ indicates that the strongest lines of the main isotopomer are moderately optically thick.

H_2O.—The $(1_{1,0}–1_{0,1})$ line of vibrationally excited water in the $v_2 = 1$ state, 2330 K above ground, is found (see Table 11). This is the vibrationally excited equivalent of the ortho-H_2O ground state line at 556.9 GHz and has been found to show strong maser action in various oxygen-rich red giant and supergiant stars (Menten & Young 1995). A calculation shows that the line strength is consistent with thermal excitation at 200 K, if a water abundance of 10^{-5} in the hot core (Gensheimer et al. 1996) is assumed, i.e., a column density of 3×10^{19} cm^{-2}. A weak line at the frequency of the highly excited $H_2^{18}O(5_{3,2}–4_{4,1})$ line (the $H_2^{18}O$ equivalent of the atmospheric H_2O line at 620.7 GHz) is found. It is weaker than predicted by the above parameters, but it is close to the CO line and has an SO_2 line in the other sideband, so the calibration may be somewhat uncertain. The corresponding $H_2^{17}O$ line is buried under $C^{18}O$, so nothing can be said about its strength. No strong HDO lines are expected in our band.

H_2S.—Six lines of H_2S are found in the survey. The line shapes indicate a plateau component (see Table 11). From the rotation diagram we derive a rotation temperature of 129 ± 10 K and a column density of $(1.2 \pm 0.3) \times 10^{16}$ cm^{-2}. No frequencies for $H_2^{34}S$ lines in this frequency range are known, but the stronger ones should be detectable. No HDS lines are found in our band.

NH_2D.—Five hyperfine groups of NH_2D were found (see Table 11). The rotation diagram gives a rotation temperature of 75 ± 11 K and a column density of $(9.7 \pm 3.8) \times 10^{15}$ cm^{-2}. The rotation temperature agrees, within the error bars, with the one determined by Walmsley et al. (1987), but our column density is much larger, even taking different beam filling factors into account. However, most of the lines we observe are blended, so that we could have easily overestimated the integrated area.

4.6. *Organic Asymmetric Rotors*

CH_3OH.—Methanol is one of the strongest contributors to the spectrum, displaying 351 lines, including lines in the $v_t = 1$ and $v_t = 2$ torsionally excited states; additionally one observes 126 lines of $^{13}CH_3OH$ also including lines in the $v_t = 1$ and $v_t = 2$ torsionally excited states (see Table 12). Using all CH_3OH data, a rotation temperature of 303 ± 6 K and a column density of $(5.0 \pm 0.2) \times 10^{16}$ cm^{-2} are derived. Using $^{13}CH_3OH$, one determines a rotation temperature of 229 ± 14 K and a column density of $(9.6 \pm 1.1) \times 10^{15}$ cm^{-2}. This indicates that many $^{12}CH_3OH$ lines are optically thick and that the rotation diagram results may need corrections. Some lines at frequencies of deuterated methanol (CH_3OD) have been found, but the lines could not be fitted by a rotation diagram, hence the assignment is questionable.

C_2H_5OH.—Ethanol has been found in Orion-KL by Sutton et al. (1994), Ohishi et al. (1995), and Schilke et al. (1997). Since currently published frequencies only reach up to 600 GHz, nothing can be said about the existence of C_2H_5OH in this frequency range, but it could well take account of a few unidentified lines.

H_2CO.—Formaldehyde has 14 lines in the main isotopomer and seven in the $H_2^{13}CO$ isotopomer (see Table 13). The main isotopomer gives a rotation temperature of 190 ± 9 K and a column density of $(3.2 \pm 0.5) \times 10^{15}$ cm^{-2}. The isotopomeric lines are too weak to give a useful rotation diagram, but the line ratios suggest that the stronger $H_2^{12}CO$ lines are optically thick.

H_2CS.—Thioformaldehyde is tentatively found with five transitions. The lines are very weak, which in this frequency range is to be expected on the basis of earlier surveys, so they cannot be used to determine physical parameters of this molecule.

HNCO.—Isocyanic acid is found in 29 line groups consisting of 79 lines, mostly a-type transitions ($\Delta K_a = 0$) of $J = 28$–27 to $J = 33$–32 with $K_a = 0 \ldots 3$, but also a few b-type ($\Delta K_a = 1$) transitions of lower level energies and lower strengths (see Table 14). The rotation diagram yields a rotation temperature of 240 ± 13 K and a column density of $(3.1 \pm 0.5) \times 10^{15}$ cm^{-2}. As already discussed by Churchwell et al. (1986) and Schilke et al. (1997), the $K_a > 0$ ladders are populated by FIR pumping, so that the rotation temperature is a measure of the dust temperature.

HCOOH.—We find six features at frequencies of formic acid lines, but the detections are rather tentative and the lines are weak, so we do not consider this molecule detected in this survey and produce no table.

TABLE 9

TABLE OF CH_3CN MOLECULES

Molecule	ν (MHz)	J_K	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes
CH_3CN	623964.8	34_9–33_9	4.0	30.9	
	624166.2	34_8–33_8	8.4	72.9	1
	624344.1	34_7–33_7	16.4	203.8	2
	624498.4	34_6–33_6	9.7	154.6	
	624629.1	34_5–33_5	16.7	186.7	3
	624736.1	34_4–33_4	9.7	120.2	4
	624819.3	34_3–33_3	6.7	98.1	5
	624878.9	34_2–33_2	6.7	96.6	
	624914.6	34_1–33_1	—	—	
	624914.6	34_1–33_1	16.9	278.6	
	624926.4	34_0–33_0	—	—	
	642280.7	35_9–34_9	2.0	26.3	7
	642670.9	35_7–34_7	3.7	18.5	
	642829.6	35_6–34_6	2.6	24.7	8
	642964.0	35_5–34_5	2.0	16.9	
	643074.1	35_4–34_4	2.4	30.4	9
	643159.7	35_3–34_3	1.9	18.1	
	643220.9	35_2–34_2	1.8	20.6	
	643257.6	35_1–34_1	4.3	59.8	10
	643269.9	35_0–34_0	4.3	59.8	
	660593.4	36_9–35_9	0.9	3.2	
	660806.4	36_8–35_8	2.2	26.5	11
	661157.6	36_6–35_6	4.7	35.4	
	661295.7	36_5–35_5	6.2	51.0	
	661408.8	36_4–35_4	2.8	22.4	
	661496.8	36_3–35_3	6.4	132.6	12
	661559.8	36_2–35_2	5.7	68.1	
	661597.4	36_1–35_1	7.3	128.3	
	661610.1	36_0–35_0	—	—	
	679121.6	37_8–36_8	2.7	16.7	
	679314.8	37_7–36_7	2.0	8.9	
	679482.4	37_6–36_6	3.6	21.4	
	679740.3	37_4–36_4	4.5	49.5	
	679830.7	37_3–36_3	4.7	60.9	
	679895.3	37_2–36_2	5.7	77.1	
	679934.1	37_1–36_1	7.7	140.1	
	679947.0	37_0–36_0	—	—	
	696958.8	38_{10}–37_{10}	2.1	22.9	
	697209.2	38_9–37_9	1.5	11.7	
	697433.6	38_8–37_8	1.5	9.7	
	697631.8	38_7–37_7	2.5	18.2	
	697803.7	38_6–37_6	5.6	58.8	
	697949.2	38_5–37_5	2.9	20.2	
	698068.4	38_4–37_4	3.7	26.2	
	698161.2	38_3–37_3	6.6	59.8	
	698227.4	38_2–37_2	5.7	45.4	
	698267.2	38_1–37_1	7.5	57.9	
	698280.5	38_0–37_0	6.0	42.6	
	716121.4	39_6–38_6	3.7	19.4	
	716270.9	39_5–38_5	4.0	35.3	
	716393.1	39_4–38_4	3.1	7.5	
	716488.2	39_3–38_3	5.2	22.0	
	716556.2	39_2–38_2	1.7	11.3	
	716596.9	39_1–38_1	4.4	33.8	
	716610.2	39_0–38_0	3.6	27.7	
$CH_3CN(v_8 = 1)$...	608196.1	33_2–32_2	3.3	28.5	
	626306.2	34_5–33_5	3.9	44.1	
	663362.8	36_1–35_1	2.9	32.9	
	681275.8	37_6–36_6	2.1	35.1	
	681631.8	37_0–36_0	2.8	33.0	
	681668.6	37_3–36_3	7.8	209.5	13
	699941.6	38_4–37_4	2.0	17.5	
	718474.6	39_2–38_2	4.2	42.8	
	718477.3	39_1–38_1	—	—	
$CH_3CN(v_8 = 2)$...	608287.2	33_5–32_5	5.9	76.5	
	608389.2	33_4–32_4	3.3	30.4	
	627057.8	34_2–33_2	5.7	47.3	14
	627398.1	34_1–33_4	2.7	17.9	
	663599.1	36_4–35_4	1.8	19.2	
	663715.4	36_3–35_3	1.4	8.6	
	663715.4	36_3–35_3	1.4	8.6	
	663890.9	36_2–35_2	1.5	14.2	
	679504.0	37_{15}–36_{15}	2.9	18.9	
	682303.3	37_2–36_2	3.7	51.2	

NOTES.—(1) Blend with HCO^+ at 624208.7. (2) Blend with SO_2 at 624344.5. and CH_3OH at 624365.4. (3) Blend with $^{13}CH_3OH$ at 624626.1. (4) Blend with $^{13}CH_3OH$ at 624744.3. 5. Blend with CH_3OH at 624838.0. (6) Blend with SiH at 624920.1, 624926.4 and 624935.8; and CH_3OCH_3 between 624929.9 and 624936.4. (7) Blend with CH_3OCH_3 at 642289.2. (8) Blend with $^{13}CH_3OH$ at 642829.9. (9) Blend with $HCOOCH_3$ at 643089.8. (10) Blend with $HCOOCH_3$ at 643277.7. (11) Blend with $^{13}CH_3OH$ at 660811.6. (12) Blend with SO_2 at 661510.8. (13) Blend with SO_2 at 681674.3. (14) Blend with NS at 627057.4. This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal*.

[a] Dashes indicate that the line is part of a blend, and intensity and area are given by the values preceding it.

$HCOOCH_3$.—Methyl formate is found in this survey with 75 line groups (see Table 15). In contrast to the 345 GHz survey (Schilke et al. 1997), where this species was the dominating molecule in terms of number of lines, it shows far fewer lines in this survey than, e.g., CH_3OH. The excitation energies are clustered in two groups, one ranging from 300–500 K, the other from 800–1500 K. The identifications of lines in the latter cluster is difficult. This is both because the errors of the catalog frequencies are large, and because the high excitation lines are rather weak, so that contamination by other weak lines is probable. This would raise the intensity of the high excitation lines, making the Boltzmann-Plot flatter and producing a rotation temperature which is too high.

Using all data, one gets a rotation temperature of 316 ± 9 K and a column density of $(1.3 \pm 0.1) \times 10^{17}$ cm^{-2}. Both values are much higher than found in earlier surveys (e.g., Schilke et al. 1997 find a rotation temperature of 89 ± 3 K and column density of $(1.5 \pm 0.1) \times 10^{16}$ cm^{-2}). That many lines with excitation energies around 1000 K are found suggests the existence of a second component, a compact source either with high temperatures or with very high optical depths. Because of the above mentioned frequency uncertainty, the velocity of this component cannot be determined. Note that chemically related molecules like CH_3OH or CH_3OCH_3 also display rather high rotation temperatures. For CH_3OH, the isotopomer $^{13}CH_3OH$ gives a lower temperature, indicating that optical depth effects are the cause of the high rotation temperatures. For $HCOOCH_3$ and CH_3OCH_3, there are no isotopomeric frequencies known and the isotopomeric lines would be too weak anyway. Hence, the question cannot be settled with the current data set.

CH_3OCH_3.—Dimethyl ether, like $HCOOCH_3$, has fewer lines than in the 345 GHz survey (see Table 16). A rotation temperature of 360 ± 26 K and a column density of

TABLE 10

TABLE OF SO_2 MOLECULES

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* dv^a$ (K km s^{-1})	Notes
SO_2	609558.4	$33_{2,32}$–$32_{1,31}$	11.7	215.0	
	613076.2	$8_{5,3}$–$7_{4,4}$	7.8	283.3	
	613676.5	$41_{3,39}$–$41_{2,40}$	2.6	27.6	1
	614113.7	$42_{7,35}$–$42_{6,36}$	2.9	30.0	
	615628.7	$12_{9,3}$–$13_{8,6}$	1.7	19.9	
	616472.4	$29_{3,27}$–$28_{2,26}$	5.6	138.3	
	618152.1	$34_{2,32}$–$33_{3,31}$	2.4	42.6	
	623613.5	$22_{11,11}$–$23_{10,14}$	4.6	32.6	
	624108.1	$38_{1,37}$–$38_{0,38}$	3.9	28.9	2
	624344.5	$35_{1,35}$–$34_{0,34}$	16.4	203.8	3
	624887.5	$42_{4,38}$–$41_{5,37}$	6.7	89.1	4
	626087.3	$14_{4,10}$–$13_{3,11}$	21.1	716.6	5
	626809.5	$27_{12,16}$–$28_{11,17}$	5.9	99.8	6
	627331.1	$16_{2,14}$–$15_{1,15}$	14.7	248.6	7
	627715.3	$42_{2,40}$–$42_{1,41}$	2.4	14.1	8
	632193.4	$9_{5,5}$–$8_{4,4}$	25.6	774.4	
	633791.5	$47_{7,41}$–$47_{6,42}$	3.2	25.3	
	634276.4	$45_{7,39}$–$45_{6,40}$	2.6	18.9	
	634782.4	$11_{9,3}$–$12_{8,4}$	3.3	44.5	
	634898.5	$31_{3,29}$–$30_{2,28}$	12.9	210.4	
	635324.8	$38_{7,31}$–$38_{6,32}$	1.4	11.9	
	638770.4	$41_{7,35}$–$41_{6,36}$	2.7	32.5	
	639651.0	$15_{4,12}$–$14_{3,11}$	13.8	362.2	9
	641206.6	$9_{3,7}$–$8_{0,8}$	1.6	16.8	
	641825.5	$36_{0,36}$–$35_{1,35}$	4.5	75.5	
	641914.5	$39_{7,33}$–$39_{6,34}$	1.6	19.3	10
	642232.0	$36_{7,29}$–$36_{6,30}$	1.7	18.7	
	642806.2	$21_{11,11}$–$22_{10,12}$	2.9	28.5	11
	643658.3	$35_{2,34}$–$34_{1,33}$	4.0	45.1	
	645198.0	$37_{7,31}$–$37_{6,32}$	39.6	1289.7	12
	647448.5	$34_{7,27}$–$34_{6,28}$	5.8	73.1	13
	648381.5	$35_{7,29}$–$35_{6,30}$	4.7	48.7	
	649052.1	$38_{3,35}$–$37_{4,34}$	1.7	3.1	
	649236.4	$43_{3,41}$–$43_{2,42}$	2.7	14.4	
	651299.9	$10_{5,5}$–$9_{4,6}$	32.0	888.1	
	651306.3	$33_{7,27}$–$33_{6,28}$	—	—	
	651410.1	$32_{7,25}$–$32_{6,26}$	11.3	118.5	
	653109.7	$18_{3,15}$–$17_{2,16}$	20.7	475.6	
	653882.9	$31_{7,25}$–$31_{6,26}$	5.5	63.5	
	654437.6	$30_{7,23}$–$30_{6,24}$	6.6	64.0	
	656075.4	$29_{7,23}$–$29_{6,24}$	4.0	55.4	
	656656.3	$33_{3,31}$–$32_{2,30}$	9.9	144.1	
	656760.5	$28_{7,21}$–$28_{6,22}$	7.2	124.8	
	657222.7	$48_{3,45}$–$48_{2,46}$	3.8	69.3	14
	657885.4	$27_{7,21}$–$27_{6,22}$	5.4	49.5	
	658226.8	$15_{10,6}$–$16_{9,7}$	5.2	76.2	15
	658541.6	$26_{7,19}$–$26_{6,20}$	25.0	409.7	16
	658631.7	$36_{1,35}$–$35_{2,34}$	10.2	115.5	
	659338.3	$25_{7,19}$–$25_{6,20}$	8.5	115.5	
	659421.0	$37_{1,37}$–$36_{0,36}$	9.9	154.3	
	659886.0	$40_{1,39}$–$40_{0,40}$	10.1	227.8	
	659898.6	$24_{7,17}$–$24_{6,18}$	—	—	
	660472.7	$23_{7,17}$–$23_{6,18}$	8.6	87.6	
	660918.3	$22_{7,15}$–$22_{6,16}$	14.0	334.2	
	661332.5	$21_{7,15}$–$21_{6,16}$	11.5	181.0	
	661510.8	$36_{2,34}$–$35_{3,33}$	6.4	132.6	17
	661668.3	$20_{7,13}$–$20_{6,14}$	11.9	294.8	
	661962.2	$19_{7,13}$–$19_{6,14}$	11.2	287.9	18
	662202.7	$18_{7,11}$–$18_{6,12}$	20.1	431.3	19
	662404.3	$17_{7,11}$–$17_{6,12}$	15.7	459.7	20
	662566.9	$16_{7,9}$–$16_{6,10}$	17.0	479.3	
	662697.6	$15_{7,9}$–$15_{6,10}$	12.7	354.5	
	662799.5	$14_{7,7}$–$14_{6,8}$	12.5	300.0	
	662877.0	$13_{7,7}$–$13_{6,8}$	14.1	346.2	
	662933.6	$12_{7,5}$–$12_{6,6}$	17.2	328.4	
	662972.8	$11_{7,5}$–$11_{6,6}$	20.8	313.1	
	662997.7	$10_{7,3}$–$10_{6,4}$	20.9	454.1	
	663011.3	$9_{7,3}$–$9_{6,4}$	—	—	
	663014.4	$7_{7,1}$–$7_{6,2}$	—	—	
	663016.0	$8_{7,1}$–$8_{6,2}$	—	—	
	664404.6	$20_{3,17}$–$20_{0,20}$	4.8	71.5	
	664760.4	$44_{2,42}$–$44_{1,43}$	2.6	20.4	
	665203.7	$25_{12,14}$–$26_{11,15}$	20.4	747.2	
	665246.9	$16_{4,12}$–$15_{3,13}$	—	—	
	670365.9	$11_{5,7}$–$10_{4,6}$	17.8	569.3	
	672564.5	$17_{4,14}$–$16_{3,13}$	13.5	436.0	
	676484.4	$6_{6,0}$–$5_{5,1}$	20.0	578.6	21
	676926.6	$38_{0,38}$–$37_{1,37}$	7.7	203.4	
	677381.0	$14_{10,4}$–$15_{9,7}$	3.3	25.7	
	677984.9	$41_{2,40}$–$41_{1,41}$	3.4	52.0	22
	678128.3	$37_{2,36}$–$36_{1,35}$	6.7	172.1	
	681674.1	$35_{3,33}$–$34_{2,32}$	7.8	209.5	23
	684381.5	$24_{12,12}$–$25_{11,15}$	2.8	46.5	
	684929.1	$45_{3,43}$–$45_{2,44}$	3.7	49.4	
	689438.7	$12_{5,7}$–$11_{4,8}$	19.3	665.0	
	689522.6	$11_{3,9}$–$10_{0,10}$	2.7	41.6	
	690465.2	$52_{8,44}$–$52_{7,45}$	1.7	13.5	
	694138.2	$38_{1,37}$–$37_{2,36}$	5.3	87.3	
	694494.0	$39_{1,39}$–$38_{0,38}$	6.8	111.3	
	695632.6	$7_{6,2}$–$6_{5,1}$	22.8	771.3	
	696527.1	$13_{10,4}$–$14_{9,5}$	2.8	53.3	24
	700313.0	$18_{11,7}$–$19_{10,10}$	3.1	27.5	25
	702103.8	$19_{4,16}$–$18_{3,15}$	23.7	659.0	26
	702293.4	$38_{2,36}$–$37_{3,35}$	5.2	63.4	
	702895.7	$18_{4,14}$–$18_{1,17}$	5.8	75.6	
	704270.4	$16_{4,12}$–$16_{1,15}$	3.5	28.6	
	705672.1	$18_{4,14}$–$17_{3,15}$	25.3	628.1	
	706234.8	$28_{13,15}$–$29_{12,18}$	1.7	11.4	
	706411.7	$40_{3,37}$–$39_{4,36}$	3.2	25.4	
	708392.5	$13_{5,9}$–$12_{4,8}$	26.6	851.5	
	708979.4	$20_{4,16}$–$20_{1,19}$	4.5	47.7	
	709510.7	$37_{3,35}$–$36_{2,34}$	5.7	68.2	
	710918.7	$14_{4,10}$–$14_{1,13}$	3.4	27.9	
	712010.6	$40_{0,40}$–$39_{1,39}$	7.2	90.5	
	712825.7	$39_{2,38}$–$38_{1,37}$	6.3	64.4	
	714779.6	$8_{6,2}$–$7_{5,3}$	7.9	102.6	
	719462.6	$17_{11,7}$–$18_{10,8}$	1.7	7.2	
	720723.7	$20_{3,17}$–$19_{2,18}$	13.2	462.8	
	722615.9	$18_{2,16}$–$17_{1,17}$	9.4	139.2	
	722704.9	$22_{12,10}$–$23_{11,13}$	2.7	11.9	27
	724506.2	$22_{4,18}$–$22_{1,21}$	4.5	29.7	
$^{34}SO_2$ ...	613338.1	$14_{4,10}$–$13_{3,11}$	5.1	38.1	28
	615985.5	$9_{5,5}$–$8_{4,4}$	4.3	104.2	
	623693.1	$46_{3,43}$–$46_{2,44}$	10.3	173.7	29
	624254.5	$35_{7,29}$–$35_{6,30}$	19.7	234.5	30
	626043.6	$15_{4,12}$–$14_{3,11}$	21.1	716.6	31
	626185.8	$25_{12,14}$–$26_{11,15}$	5.4	36.8	32
	626191.9	$20_{11,9}$–$21_{10,12}$	—	—	
	627082.6	$32_{7,25}$–$32_{6,26}$	1.4	9.6	
	627335.2	$33_{7,27}$–$33_{6,28}$	14.7	248.6	33
	628341.2	$16_{2,14}$–$15_{1,15}$	17.1	293.3	34
	632474.6	$29_{7,23}$–$29_{6,24}$	3.0	34.5	
	633147.8	$28_{7,21}$–$28_{6,22}$	4.1	29.3	
	634454.2	$27_{7,21}$–$27_{6,22}$	5.4	64.5	
	635051.1	$10_{5,5}$–$9_{4,6}$	5.5	70.3	
	635144.2	$26_{7,19}$–$26_{6,20}$	1.9	17.9	
	636053.0	$25_{7,19}$–$25_{6,20}$	1.1	5.1	
	637307.3	$23_{7,17}$–$23_{6,18}$	1.1	9.8	
	637797.4	$22_{7,15}$–$22_{6,16}$	2.3	44.9	
	638635.2	$20_{7,13}$–$20_{6,14}$	1.2	7.4	
	639646.1	$16_{7,9}$–$16_{6,10}$	13.8	362.2	35
	639795.1	$15_{7,9}$–$15_{6,10}$	1.4	12.0	
	640002.2	$13_{7,7}$–$13_{6,8}$	1.1	6.4	
	640116.8	$11_{7,5}$–$11_{6,6}$	2.5	22.3	
	640148.4	$10_{7,3}$–$10_{6,4}$	2.1	47.0	36

TABLE 10—*Continued*

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* dv^a$ (K km s^{-1})	Notes
$^{34}SO_2$ ...	640167.1	$9_{7,3}$–$9_{6,4}$	—	—	
	640175.9	$8_{7,1}$–$8_{6,2}$	—	—	
	640177.3	$7_{7,1}$–$7_{6,2}$	—	—	
	641324.6	$39_{2,38}$–$39_{1,39}$	1.6	28.7	
	647546.7	$33_{3,31}$–$32_{2,30}$	2.7	37.9	
	648737.6	$18_{3,15}$–$17_{2,16}$	4.8	89.5	
	652652.9	$16_{4,12}$–$15_{3,13}$	6.0	91.4	
	654069.9	$11_{5,7}$–$10_{4,6}$	4.9	55.4	
	656549.5	$37_{1,37}$–$36_{0,36}$	1.5	9.7	
	656900.7	$6_{6,0}$–$5_{5,1}$	4.2	49.2	
	658217.4	$17_{4,14}$–$16_{3,13}$	5.2	76.2	37
	661970.5	$38_{3,35}$–$37_{4,34}$	11.2	287.9	38
	664475.7	$18_{11,7}$–$19_{10,10}$	3.4	22.3	
	673101.5	$12_{5,7}$–$11_{4,8}$	5.0	104.8	
	673991.8	$38_{0,38}$–$37_{1,37}$	6.6	109.5	39
	673997.1	$35_{3,33}$–$34_{2,32}$	—	—	
	674667.9	$11_{3,9}$–$10_{0,10}$	3.8	50.0	40
	676010.8	$7_{6,2}$–$6_{5,1}$	5.5	47.8	41
	686678.9	$19_{4,16}$–$18_{3,15}$	3.6	43.9	
	691991.8	$13_{5,9}$–$12_{4,8}$	2.3	37.5	
	693469.0	$18_{4,14}$–$17_{3,15}$	5.6	135.3	
	695119.3	$8_{6,2}$–$7_{5,3}$	7.1	111.1	42
	702502.1	$46_{2,44}$–$46_{1,45}$	2.6	26.6	43
	710572.6	$21_{4,18}$–$20_{3,17}$	3.8	57.7	
	711021.1	$14_{5,9}$–$13_{4,10}$	5.2	57.4	
	714223.7	$9_{6,4}$–$8_{5,3}$	2.7	27.0	
	718830.6	$20_{3,17}$–$19_{2,18}$	1.9	21.8	
$^{33}SO_2$ ...	650742.4	$16_{7,9}$–$16_{6,10}$	4.0	71.4	
	657331.6	$36_{1,35}$–$35_{2,34}$	3.4	46.1	44
	658742.8	$16_{4,12}$–$15_{3,13}$	6.9	92.5	45
	661961.0	$11_{5,7}$–$10_{4,6}$	11.2	287.9	46
	666382.0	$6_{6,0}$–$5_{5,1}$	5.3	173.7	47
	681012.8	$12_{5,7}$–$11_{4,8}$	2.8	24.9	
	704638.1	$8_{6,2}$–$7_{5,3}$	1.9	29.9	
	718765.7	$21_{4,18}$–$20_{3,17}$	3.0	35.0	48
	723761.6	$9_{6,4}$–$8_{5,3}$	3.8	54.8	

NOTES.—(1) Blend with CH_3OCH_3 at 613678.0. (2) Blend with CH_3CH_2CN at 624102.1. (3) Blend with CH_3CN at 624344.1 and CH_3OH at 624365.4. (4) Blend with CH_3CN at 624878.9 and CH_3OCH_3 between 624901.3 and 624909.1. (5) Blend with CH_3OH at 626041.2 and $^{34}SO_2$ at 626043.6. (6) Blend with CH_3OH at 626803.9. (7) Blend with $^{34}SO_2$ at 627335.2. (8) Blend with SiH at 627689.9 and CH_3OH at 627713.1. (9) Blend with $^{34}SO_2$ at 639646.1. (10) Blend with CH_3OH at 641918.1. (11) Blend with ^{29}SiO at 642799.8. (12) Blend with SO at 645254.1. (13) Blend with CH_3OCH_3 at 647455.2. (14) Too strong, possible blend with *U* line. (15) Blend with $^{34}SO_2$ at 658217.4. (16) Blend with $C^{18}O$ at 658553.6. (17) Blend with CH_3CN at 661496.8. (18) Blend with SO_2 at 661970.5 and $^{33}SO_2$ at 662962.0. (19) Blend with H_2CO at 662212.1. (20) Blend with CH_3OCH_3 at 662414.6. (21) Blend with CH_3OH at 676494.7. (22) Blend with SO_2-$v_2 = 1$ at 677961.8. (23) Blend with CH_3CN at 681668.6. (24) Blend with $HN^{13}C$ at 696532.3. (25) Blend with HNCO at 700308.1. (26) Blend with $^{13}CH_3OH$ at 702072.6. (27) Blend with CH_3OH at 722705.8. (28) Blend with $^{13}CH_3OH$ at 613334.1 and 613335.0. (29) Questionable assignment. (30) Blend with CH_3OH at 624235.2. (31) Blend with CH_3OH at 626041.2 and SO_2 at 626087.3. (32) Blend with CH_3OH at 626196.5 (33) Blend with SO_2 at 627331.1. (34) Blend with CH_3OH at 628338.2. (35) Blend with SO_2 at 649651.0. (36) Blend with $^{13}CH_3OH$ at 640159.1 and 640167.3. (37) Blend with SO_2 at 658226.8. (38) Blend with $^{34}SO_2$ at 661962.2 and $^{33}SO_2$ at 662962.0. (39) Blend with ^{34}SO at 673998.1. (40) Blend with CH_3OH at 647658.9. (41) Blend with CH_3OH at 676013.8 and SO_2-$v_2 = 1$ at 676021.4. (42) Blend with $HCOOCH_3$ at 695122.9. (43) Blend with HNCO at 705502.2. (44) Too strong, possible blend with *U* line. (45) Blend with SO_2-$v_2 = 1$ at 658749.4. (46) Blend with SO_2 at 661970.5 and $^{34}SO_2$ at 661962.2. (47) Blend with CH_3CH_2CN at 666371.4. (48) Blend with SO_2-$v_2 = 2$ at 718771.4. This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal*.

[a] Dashes indicate that the line is part of a blend, and intensity and area are given by the values preceding it.

$(2.8 \pm 0.4) \times 10^{16}$ cm^{-2} are found. Like $HCOOCH_3$, it also shows a much higher rotation temperature than found in previous surveys, but unlike $HCOOCH_3$, the column density derived here is consistent with earlier work [e.g., Schilke et al. 1997 find a rotation temperature of 89 ± 5 K and column density of $(1.8 \pm 0.2) \times 10^{16}$ cm^{-2}]. See the discussion for $HCOOCH_3$ for the possible causes of these high rotation temperatures.

CH_2CHCN.—Vinyl cyanide is not observed in this survey. Extrapolations using the results of Schilke et al. (1997) predict maximum line intensities of about 1–2 K in the present band, which are at our detection limit.

CH_3CH_2CN.—Ethyl cyanide shows 81 line groups up to almost 1600 K above ground (see Table 17). The rotation diagram fit gives a rotation temperature of 239 ± 4 K and a column density of $(3.1 \pm 0.2) \times 10^{16}$ cm^{-2}. As for the complex organics, the rotation temperature is significantly higher than in previous surveys, while the column density is only slightly higher [as compared to Schilke et al. 1997, who find a rotation temperature of 99 ± 3 K and column density of $(1.3 \pm 0.2) \times 10^{16}$ cm^{-2}].

4.7. *Unidentified Lines*

We find 155 unidentified lines in the survey, some of them questionable (see Table 18). Those are marked as "Questionable assignment" in the table. The strongest reliable lines reach 10–14 K; most are in the 2–8 K range.

4.8. *Conclusions*

In this line survey of the Orion hot core we find 1064 spectral features consisting of 2032 lines, partially blended (see Figs. 1 and 4). The number of *U* lines is 155 or about 14%. This number is due to the sparseness of laboratory data in this wavelength range and will hopefully be reduced in the future. The spectrum is dominated by CO, CS, SO, SiO, HCN, HCO^+, H_2CO, SO_2, and CH_3OH, with many lines from very highly excited states. The sensitivity to these highly excited lines is partly due to the small beam size (about 12″), well matched to the hot core. Contrary to the findings of Harris et al. (1995), we have no lack of weak or intermediate strength features in our spectrum (see also Fig. 2). For some molecules, a rotation diagram analysis yields very high rotation temperatures, above 300 K. It seems possible that these are not real but are due to optically thick emission from hot (150 to 200 K) compact regions rich in complex molecules. This hot component does not show up in lower frequency surveys, due to its compactness. The dominant coolants in this frequency range are SO_2 and CH_3OH, which outperform CO by a large factor. Finally, the line contribution to the apparent continuum, as measured in a broadband experiment, is only about 15% as compared to about 50% in lower frequency surveys.

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TABLE 11

TABLE OF H_2O, H_2S AND NH_2D MOLECULES

	ν (MHz)	$J_{K_p,K_m}(, v_F)$	T_R^* (K)	$\int T_R^* dv$ (K km s^{-1})	Notes
H_2O-$v_2 = 1$.....	658005.3	$1_{1,0}$–$1_{0,1}$	8.9	150.4	
$H^{18}{}_2O$.....	692079.1	$5_{3,2}$–$4_{4,1}$	1.3	6.0	
H_2S.....	611441.6	$5_{3,2}$–$5_{2,3}$	13.2	235.0	
	626474.6	$7_{6,1}$–$7_{5,2}$	13.1	97.4	1
	650374.2	$4_{4,1}$–$4_{3,2}$	15.9	343.9	
	665393.8	$4_{2,2}$–$4_{1,3}$	8.6	178.6	
	687303.4	$2_{0,2}$–$1_{1,1}$	20.3	581.2	
	689120.2	$9_{7,2}$–$9_{6,3}$	5.9	107.6	
	708470.4	$3_{1,2}$–$3_{0,3}$	23.9	656.7	
NH_2D.....	641056.7	$3_{3,0},1_3$–$3_{2,2},0_3$	1.3	12.2	
	649915.2	$2_{0,2},1_1$–$1_{0,1},1_1$	2.8	51.0	2
	702479.6	$4_{2,3},1_3$–$3_{3,1},0_2$	1.7	10.0	
	714746.2	$3_{0,3},0_2$–$2_{1,1},1_1$	3.1	40.4	
	716859.9	$2_{1,1},1_1$–$1_{1,0},1_0$	3.5	28.5	3

NOTES.—(1) Blend with CH_3OH at 626476.8. (2) Blend with $^{13}CH_3OH$ at 649912.8. (3) Blend with ^{34}SO at 716876.1. This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal*.

TABLE 12

TABLE OF CH_3OH MOLECULES

Molecule	ν (MHz)	J_K	T_R^*[a] (K)	$\int T_R^* dv$[a] (K km s^{-1})	Notes[a]
CH_3OH.....	607215.3	12_2E–11_1E	3.5	43.9	1
	611580.1	18_2A^-–17_3A^-	4.2	35.1	
	613990.1	$17_{-7}E$–$18_{-6}E$	2.8	15.8	
	616980.0	$4_{-2}E$–$3_{-1}E$	5.7	81.4	
	623071.8	18_2A^+–17_3A^+	5.9	62.2	
	624235.2	21_1A^-–20_2A^-	19.7	234.5	2
	624365.4	24_2E–23_3E	16.4	203.8	3
	625352.5	$24_{10}A^+$–25_0A^+	4.6	45.5	
	625352.5	$24_{10}A^-$–25_0A^-	—	—	
	625749.6	13_0E–12_0E	18.1	179.0	
	626489.9	$21_{-1}E$–20_2E	8.5	57.3	
	626626.3	3_2A^-–2_1A^-	26.2	280.1	
	626640.0	13_0E–12_0E	—	—	
	627170.7	$13_{-1}E$–$12_{-1}E$	19.7	206.2	
	627558.6	13_0A^+–12_0A^+	23.4	224.2	
	627650.7	$13_{10}E$–$12_{10}E$	3.0	12.2	
	627713.1	$13_{10}A^-$–$12_{10}A^-$	2.4	14.1	4
	627713.1	$13_{10}A^+$–$12_{10}A^+$	—	—	
	627750.9	$13_{-10}E$–$12_{-10}E$	3.5	22.4	
	627807.9	13_9E–12_9E	6.3	41.7	
	627816.6	$13_{-9}E$–$12_{-9}E$	—	—	
	627908.2	13_9A^+–12_9A^+	4.7	30.6	
	627908.2	13_9A^-–12_9A^-	—	—	
	627921.9	$13_{-8}E$–$12_{-8}E$	6.1	40.5	
	627971.4	13_8A^+–12_8A^+	6.7	48.4	
	627971.4	13_8A^-–12_8A^-	—	—	
	628021.4	13_8E–12_8E	—	—	
	628039.1	13_7A^-–12_7A^-	7.5	52.3	
	628039.1	13_7A^+–12_7A^+	—	—	
	628051.9	13_2A^-–12_2A^-	22.0	279.4	
	628114.1	13_7E–12_7E	7.8	52.9	
	628115.4	$13_{-7}E$–$12_{-7}E$	—	—	
	628167.7	13_6E–12_6E	10.5	79.1	
	628187.8	13_6A^-–12_6A^-	12.2	103.8	
	628187.8	13_6A^+–12_6A^+	—	—	
	628237.8	$13_{-6}E$–$12_{-6}E$	11.7	84.4	
	628251.4	13_5E–12_5E	13.0	111.7	
	628318.2	$13_{-5}E$–$12_{-5}E$	17.1	293.3	5

TABLE 12—*Continued*

Molecule	ν (MHz)	J_K	T_R^*[a] (K)	$\int T_R^* d\nu$[a] (K km s^{-1})	Notes[a]
CH_3OH.....	628330.0	$13_{-4}E$–$12_{-4}E$	17.1	293.3	5
	628338.2	13_5A^+–12_5A^+	—	—	—
	628338.2	13_5A^-–12_5A^-	—	—	—
	628408.9	13_4E–12_4E	16.3	153.6	
	628445.4	$13_{-3}E$–$12_{-3}E$	17.3	149.0	
	628469.9	13_3A^+–12_3A^+	19.9	212.1	
	628512.2	13_4A^-–12_4A^-	25.1	384.1	
	628513.4	13_4A^+–12_4A^+	—	—	
	628525.0	13_3A^-–12_3A^-	—	—	
	628696.6	13_1E–12_1E	18.8	192.5	
	628816.1	13_3E–12_3E	16.3	154.4	
	628869.1	13_2A^+–12_2A^+	16.3	156.1	
	629140.5	3_2A^+–2_1A^+	21.1	155.4	
	629321.6	13_2E–12_2E	19.2	182.1	
	629651.9	$13_{-2}E$–$12_{-2}E$	17.4	159.1	
	629921.3	7_1A^+–6_0A^+	25.7	212.9	
	630952.4	10_6A^+–11_5A^+	8.4	57.0	
	630952.4	10_6A^-–11_5A^-	—	—	
	633423.1	13_1A^-–12_1A^-	23.2	247.5	
	634470.1	$21_{-9}E$–$22_{-8}E$	6.4	42.9	
	635389.9	26_4E–26_3E	2.5	35.5	
	635672.7	25_4A^+–25_3A^+	5.1	58.0	
	635874.1	24_4A^+–24_3A^+	3.8	36.2	
	635940.9	$24_{-3}E$–$23_{-4}E$	1.3	11.0	
	636013.9	23_4A^+–23_3A^+	3.5	21.5	
	636105.6	22_4A^+–22_3A^+	5.6	56.3	
	636161.0	21_4A^+–21_3A^+	7.6	60.7	
	636190.2	15_4A^+–15_3A^+	16.5	193.3	
	636190.3	20_4A^+–20_3A^+	—	—	
	636190.9	14_4A^+–14_3A^+	—	—	
	636193.4	16_4A^+–16_3A^+	—	—	
	636196.9	13_4A^+–13_3A^+	—	—	
	636198.7	17_4A^+–17_3A^+	—	—	
	636202.0	19_4A^+–19_3A^+	—	—	
	636202.9	18_4A^+–18_3A^+	—	—	
	636208.6	12_4A^+–12_3A^+	17.2	109.9	
	636225.9	11_4A^+–11_3A^+	16.2	141.4	
	636248.0	10_4A^+–10_3A^+	15.8	140.2	
	636274.2	9_4A^+–9_3A^+	21.2	192.5	
	636279.3	10_4A^-–10_3A^-	—	—	
	636280.5	11_4A^-–11_3A^-	—	—	
	636299.4	12_4A^-–12_3A^-	20.7	113.7	
	636303.4	8_4A^+–8_3A^+	—	—	
	636311.7	8_4A^-–8_3A^-	19.8	130.5	
	636333.5	7_4A^+–7_3A^+	21.3	235.3	
	636337.4	7_4A^-–7_3A^-	—	—	
	636341.6	13_4A^-–13_3A^-	—	—	
	636363.8	6_4A^+–6_3A^+	20.6	172.7	
	636365.7	6_4A^-–6_3A^-	—	—	
	636393.3	5_4A^+–5_3A^+	20.6	171.6	
	636393.8	5_4A^-–5_3A^-	—	—	
	636413.8	14_4A^-–14_3A^-	19.8	214.6	
	636419.9	4_4A^+–4_3A^+	—	—	
	636420.1	4_4A^-–4_3A^-	—	—	
	636522.9	15_4A^-–15_3A^-	29.9	598.3	6
	636677.6	16_4A^-–16_3A^-	10.2	102.9	
	636887.0	17_4A^-–17_3A^-	6.7	61.2	
	637161.5	18_4A^-–18_3A^-	5.6	49.8	
	637512.4	19_4A^-–19_3A^-	5.1	55.6	
	637952.2	20_4A^-–20_3A^-	4.1	38.6	
	638279.6	10_0E–$9_{-1}E$	16.1	150.2	
	638494.4	21_4A^-–21_3A^-	2.5	17.3	
	638523.5	8_3A^+–7_2A^+	29.0	189.0	
	638817.8	8_3A^-–7_2A^-	25.9	180.5	

TABLE 12—*Continued*

Molecule	ν (MHz)	J_K	T_R^{*a} (K)	$\int T_R^* dv^a$ (K km s^{-1})	Notes[a]
CH_3OH.....	639153.6	$22_4A^- - 22_3A^-$	2.9	26.1	
	639945.4	$23_4A^- - 23_3A^-$	1.3	12.4	
	640886.4	$24_4A^- - 24_3A^-$	0.9	4.1	
	641993.9	$25_4A^- - 25_3A^-$	1.4	15.4	
	647395.7	$12_{-8}E - 13_{-7}E$	3.4	23.7	
	649541.5	$14_1E - 13_2E$	10.6	129.1	
	651617.4	$10_1E - 9_0E$	12.0	122.9	
	656168.1	$13_2E - 12_1E$	16.6	298.5	7
	658102.2	$19_2A^- - 18_3A^-$	3.7	39.9	
	658191.6	$16_7E - 17_6E$	2.9	40.2	
	662295.8	$16_{-7}E - 17_{-6}E$	2.2	16.0	
	665442.4	$5_{-2}E - 4_{-1}E$	19.6	204.2	
	667147.5	$10_5A^+ - 11_4A^+$	7.5	95.1	
	667148.1	$10_5A^- - 11_4A^-$	—	—	
	667497.7	$6_4E - 7_3E$	6.7	67.8	
	668118.2	$18_0E - 17_1E$	4.8	49.0	
	668854.9	$25_2E - 24_3E$	4.1	56.5	8
	670422.7	$14_1A^+ - 13_1A^+$	9.7	124.6	
	671480.8	$18_8A^+ - 19_7A^+$	4.1	46.4	
	671480.8	$18_8A^- - 19_7A^-$	—	—	
	672360.9	$19_2A^+ - 18_3A^+$	2.9	33.8	
	672903.7	$17_{-1}E - 16_0E$	6.2	62.3	9
	673416.2	$14_0E - 13_0E$	8.8	85.4	
	673745.9	$4_2A^- - 3_1A^-$	9.9	94.2	
	674990.4	$8_1A^+ - 7_0A^+$	17.1	172.3	
	675134.8	$14_{-1}E - 13_{-1}E$	12.9	140.7	10
	675144.2	$14_{-4}E - 13_{-4}E$	—	—	—
	675612.9	$14_0A^+ - 13_0A^+$	14.1	151.3	
	675773.7	$3_3E - 2_2E$	15.9	209.5	
	675777.9	$14_4A^- - 13_4A^-$	—	—	
	675777.9	$14_4A^+ - 13_4A^+$	—	—	
	675963.6	$14_{-10}E - 13_{-10}E$	3.7	30.1	
	676013.8	$14_9E - 13_9E$	5.5	47.8	11
	676034.6	$14_{-9}E - 13_{-9}E$	4.8	46.6	
	676130.7	$14_9A^- - 13_9A^-$	3.1	13.2	
	676130.7	$14_9A^+ - 13_9A^+$	—	—	
	676138.7	$14_{-8}E - 13_{-8}E$	4.5	39.6	
	676205.6	$14_8A^- - 13_8A^-$	14.5	197.4	
	676205.6	$14_8A^+ - 13_8A^+$	—	—	
	676215.1	$14_2A^- - 13_2A^-$	—	—	
	676250.7	$14_8E - 13_8E$	4.7	36.6	
	676269.5	$14_7A^+ - 13_7A^+$	7.3	69.9	
	676269.5	$14_7A^- - 13_7A^-$	—	—	
	676349.4	$14_{-7}E - 13_{-7}E$	6.6	53.6	
	676362.4	$14_7E - 13_7E$	6.9	54.1	
	676416.1	$14_6E - 13_6E$	10.6	155.9	
	676425.6	$14_6A^+ - 13_6A^+$	—	—	
	676425.6	$14_6A^- - 13_6A^-$	—	—	
	676494.7	$14_5E - 13_5E$	20.0	578.6	12
	676496.8	$14_{-6}E - 13_{-6}E$	—	—	—
	676503.2	$19_0A^+ - 18_1A^+$	—	—	—
	676504.3	$13_{-6}E - 14_{-5}E$	—	—	—
	676585.4	$14_{-4}E - 13_{-4}E$	11.1	225.6	
	676591.4	$14_{-5}E - 13_{-5}E$	—	—	
	676604.2	$14_5A^+ - 13_5A^+$	—	—	
	676604.2	$14_5A^- - 13_5A^-$	—	—	
	676677.8	$14_4E - 13_4E$	9.1	110.7	
	676712.5	$14_{-3}E - 13_{-3}E$	10.0	139.0	
	676749.5	$14_3A^+ - 13_3A^+$	13.2	195.1	
	676823.6	$14_4A^+ - 13_4A^+$	14.9	259.8	
	676829.6	$14_3A^- - 13_3A^-$	—	—	
	677013.1	$14_1E - 13_1E$	12.2	138.3	
	677190.6	$14_3E - 13_3E$	12.1	136.3	
	677233.3	$14_2A^+ - 13_2A^+$	12.1	148.0	

TABLE 12—*Continued*

Molecule	ν (MHz)	J_K	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes[a]
CH_3OH.....	677709.7	14_2E–13_2E	14.1	212.8	
	678252.7	$14_{-2}E$–$13_{-2}E$	12.5	152.9	13
	678785.4	4_2A^+–3_1A^+	21.8	248.8	
	679342.4	9_6A^+–10_5A^+	9.5	93.9	
	679342.4	9_6A^-–10_5A^-	—	—	
	680804.4	22_1A^-–21_2A^-	8.1	131.7	14
	681989.9	14_1A^-–13_1A^-	20.2	213.3	
	683749.8	$12_{-2}E$–11_1E	6.2	50.9	15
	684257.3	$25_{-3}E$–$24_{-4}E$	6.1	49.4	
	685505.1	11_0E–$10_{-1}E$	19.8	250.0	16
	686731.3	9_3A^+–8_2A^+	21.9	208.4	
	687224.6	9_3A^-–8_2A^-	23.9	253.6	
	697147.9	15_1E–14_2E	9.5	127.4	
	701366.8	11_1E–10_0E	22.6	478.2	17
	704289.2	20_2A^-–19_3A^-	5.2	39.0	
	705181.3	14_2E–13_1E	12.4	101.5	
	705467.5	$25_{-3}E$–$25_{-2}E$	—	—	
	706083.0	15_7E–16_6E	2.4	10.6	
	708813.2	19_0E–18_1E	16.3	119.8	18
	718158.8	15_1A^+–14_1A^+	16.3	251.1	
	718436.2	$4_{-4}E$–$3_{-3}E$	17.5	170.6	
	719664.9	9_1A^+–8_0A^+	12.7	117.4	
	720441.3	5_2A^-–4_1A^-	6.5	70.8	
	721011.1	15_0E–14_0E	11.0	97.7	
	721793.0	20_2A^+–19_3A^+	2.6	16.7	
	721998.2	$23_{-3}E$–$23_{-2}E$	1.6	11.0	19
	723040.8	$15_{-1}E$–$14_{-1}E$	8.0	84.1	
	723281.4	$18_{-1}E$–17_0E	5.3	33.7	
	723619.6	15_0A^+–14_0A^+	7.5	63.3	
	724121.6	4_3E–3_2E	8.9	85.9	
	724345.4	15_2A^-–14_2A^-	2.6	20.6	
	724153.9	$15_{-10}E$–$14_{-10}E$	1.9	12.6	
	724482.2	15_7A^+–14_7A^+	4.7	35.7	
	724482.2	15_7A^-–14_7A^-	—	—	
	724565.0	$15_{-7}E$–$14_{-7}E$	7.0	53.1	
	724595.5	15_7E–14_7E	4.5	29.5	
	724644.6	15_6A^-–14_6A^-	6.5	52.2	20
	724644.6	15_6A^+–14_6A^+	—	—	—
	724648.6	15_6E–14_6E	—	—	—
	724719.4	15_5E–14_5E	4.6	37.7	
	724740.9	$15_{-6}E$–$14_{-6}E$	3.9	28.2	
	724823.7	$15_{-4}E$–$14_{-4}E$	4.9	39.4	
	724851.5	$15_{-5}E$–$14_{-5}E$	5.7	50.0	
	724855.2	15_5A^+–14_5A^+	—	—	
	724855.2	15_5A^-–14_5A^-	—	—	
	724963.0	$15_{-3}E$–$14_{-3}E$	5.8	58.7	
	725013.2	15_3A^+–14_3A^+	6.2	46.0	
$CH_3OH(v_t$–1)	616322.2	20_2E–19_3E	9.7	160.5	
	623145.8	$10_{-7}E$–$10_{-6}E$	6.3	64.4	
	623193.3	$14_{-7}E$–$14_{-6}E$	9.2	117.4	
	623262.2	$9_{-7}E$–$9_{-6}E$	4.8	59.4	21
	623340.9	$8_{-7}E$–$8_{-6}E$	17.3	126.7	
	623737.8	9_0E–8_1E	6.6	58.5	
	625510.2	13_8A^+–12_8A^+	5.7	53.2	
	625781.4	13_3E–12_3E	6.1	35.3	
	625971.6	13_1A^+–12_1A^+	5.5	39.3	
	626196.5	13_7E–12_7E	3.1	16.7	22
	626374.8	$13_{-8}E$–$12_{-8}E$	2.5	17.3	
	626376.4	$13_{-9}E$–$12_{-9}E$	—	—	
	626397.8	$13_{-6}E$–$12_{-6}E$	4.2	25.4	
	626451.9	$13_{-2}E$–$12_{-2}E$	6.8	58.1	
	626476.8	13_7A^+–12_7A^+	13.1	97.4	23
	626511.9	13_5A^+–12_5A^+	9.4	82.1	

TABLE 12—*Continued*

Molecule	ν (MHz)	J_K	T_R^{*a} (K)	$\int T_R^* dv^a$ (K km s^{-1})	Notes[a]
$CH_3OH(v_t = 1)$.....	626555.1	13_4E–12_4E	13.8	123.4	
	626555.9	17_0E–16_1E	—	—	
	626608.8	$13_{-3}E$–$12_{-3}E$	14.2	100.2	
	626609.0	13_2A^+–12_2A^+	—	—	
	626654.1	13_1E–12_1E	18.2	143.7	
	626673.9	13_2A^-–12_2A^-	15.3	169.4	
	626803.9	13_8E–12_8E	5.9	99.8	24
	626864.9	13_3A^+–12_3A^+	8.6	58.5	
	626880.8	13_2E–12_2E	9.0	76.8	
	626930.5	$13_{-1}E$–$12_{-1}E$	9.8	68.5	
	626945.2	$13_{-4}E$–$12_{-4}E$	12.0	92.5	
	627004.6	13_0A^+–12_0A^+	8.8	52.9	
	627013.0	$13_{-5}E$–$12_{-5}E$	14.6	107.7	25
	627209.4	13_1A^-–12_1A^-	8.7	68.3	
	627444.1	13_4A^+–12_4A^+	7.4	62.7	
	627528.7	13_5E–12_5E	6.5	47.3	
	630583.0	$7_{-1}E$–$8_{-2}E$	4.0	20.5	
	633156.9	$4_{-2}E$–$5_{-3}E$	3.9	32.4	
	633572.0	$4_{-2}E$–$5_{-3}E$	12.9	99.7	
	641918.1	9_3E–10_4E	1.6	19.3	26
	652940.1	13_9A^+–12_8A^+	3.4	59.5	
	654341.9	6_3E–5_2E	2.1	18.5	
	657170.8	$8_{-5}E$–$9_{-6}E$	6.0	84.2	27
	671912.5	10_0E–9_1E	2.2	11.8	
	673675.0	14_3E–13_3E	4.3	54.6	28
	673676.4	14_6A^-–13_6A^-	—	—	—
	674017.3	14_1A^+–13_1A^+	6.6	109.5	29
	674129.2	$14_{-7}E$–$13_{-7}E$	2.1	16.9	
	674129.2	14_3A^-–13_3A^-	—	—	
	674147.9	14_6E–13_6E	1.8	13.0	
	674512.5	$14_{-2}E$–$13_{-2}E$	3.2	29.0	
	674597.6	14_7A^+–13_7A^+	1.4	6.9	
	674618.4	14_5A^-–13_5A^-	2.5	22.6	
	674658.9	14_4E–13_4E	3.8	50.0	30
	674710.4	14_2A^+–13_2A^+	4.0	39.6	
	674716.8	$14_{-3}E$–$13_{-3}E$	—	—	
	674743.0	14_0E–13_0E	6.4	66.2	
	674762.2	14_1E–13_1E	7.5	105.8	31
	674791.5	14_2A^-–13_2A^-	6.6	41.8	32
	675034.5	14_3A^+–13_3A^+	3.5	18.5	33
	675044.0	14_8E–13_8E	3.7	43.0	34
	675047.9	14_2E–13_2E	—	—	—
	675097.2	$14_{-1}E$–$13_{-1}E$	4.5	34.4	
	675176.8	14_0A^+–13_0A^+	4.3	33.6	
	675231.6	$14_{-5}E$–$13_{-5}E$	2.9	24.6	
	675347.8	14_1A^-–13_1A^-	4.6	47.1	
	675887.9	14_5E–13_5E	5.6	71.0	
	678675.6	8_8E–7_7E	6.1	47.6	
	681789.7	$3_{-2}E$–$4_{-3}E$	14.2	161.0	
	682271.9	$16_{11}E$–$15_{10}E$	2.4	22.4	
	683425.2	11_4A^-–12_5A^-	3.6	34.6	
	690294.3	8_3E–9_4E	2.9	27.3	35
	696257.5	13_5E–14_4E	1.4	11.7	
	698494.9	13_5E–14_4E	1.9	14.3	
	698930.9	3_1A^-–2_2A^-	2.6	11.1	
	702417.4	7_3E–6_2E	3.3	25.0	
	715237.9	$9_{-1}E$–8_2E	5.2	40.7	
	720069.2	11_0E–10_1E	2.5	11.4	
	721519.8	15_3E–14_3E	1.2	3.4	
	721542.7	15_6A^-–14_6A^-	2.5	15.7	
	721723.8	$15_{-10}E$–$14_{-10}E$	2.7	20.9	
	722039.6	15_1A^+–14_1A^+	1.5	7.8	36
	722544.7	$15_{-2}E$–$14_{-2}E$	2.7	25.3	
	722592.1	$15_{-8}E$–$14_{-8}E$	7.7	53.2	
	722705.8	15_5A^+–14_5A^+	2.7	11.9	37

TABLE 12—*Continued*

Molecule	ν (MHz)	J_K	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes[a]
$CH_3OH(v_t = 1)$.....	722742.3	15_4E–14_4E	1.7	4.5	
	722789.8	15_2A^+–14_2A^+	2.3	9.7	
	722804.1	$15_{-3}E$–$14_{-3}E$	3.8	16.5	
	722823.8	15_0E–14_0E	2.7	15.3	
	722849.1	15_1E–14_1E	3.2	10.1	
	722889.6	15_2A^-–14_2A^-	2.1	6.9	
	723192.7	15_3A^+–14_3A^+	5.0	45.2	
	723202.8	15_2E–14_2E	—	—	
	723250.8	$15_{-1}E$–$14_{-1}E$	1.9	4.3	
	723336.8	$15_{-4}E$–$14_{-4}E$	6.1	52.7	38
$CH_3OH(v_t = 2)$.....	617627.4	$20_{-7}E$–$20_{-6}E$	3.3	10.4	39
	624838.0	13_1A^+–12_1A^+	6.7	98.1	40
	625155.8	$13_{11}E$–$12_{11}E$	8.1	60.3	
	625207.6	$13_{-10}E$–$12_{-10}E$	5.7	66.4	
	625072.8	13_9A^+–12_9A^+	6.0	36.7	
	625383.1	$13_{10}A^+$–$12_{10}A^+$	4.6	35.6	
	625434.0	$13_{10}E$–$12_{10}E$	2.2	6.8	
	626041.2	13_3A^-–12_3A^-	21.1	716.6	41
	626073.7	13_4A^+–12_4A^+	—	—	—
	626075.4	$13_{-2}E$–$12_{-2}E$	—	—	—
	626103.2	13_0A^+–12_0A^+	—	—	—
	626111.2	13_3E–12_3E	—	—	—
	626112.2	$13_{-7}E$–$12_{-7}E$	—	—	—
	626137.5	13_2E–12_2E	—	—	—
	626156.8	$13_{-1}E$–$12_{-1}E$	6.2	31.8	
	629363.8	17_1E–16_0E	5.3	37.9	
	673969.6	$14_{-4}E$–$13_{-4}E$	3.8	28.7	42
	674162.1	$14_{-2}E$–$13_{-2}E$	1.7	17.6	
	674162.4	14_4A^-–13_4A^-	—	—	
	674196.5	14_0A^+–13_0A^+	1.4	12.1	
	674201.8	14_3E–13_3E	—	—	
	674254.4	$14_{-1}E$–$13_{-1}E$	1.2	6.2	
	677417.5	18_1E–17_0E	3.5	30.0	
	720812.0	15_1A^+–14_1A^+	2.1	17.8	
	722075.4	15_6E–14_6E	0.9	5.9	43
$^{13}CH_3OH$.....	612125.2	$13_{-1}E$–$12_{-1}E$	2.5	32.6	
	612479.8	13_0A^+–12_0A^+	1.9	8.8	
	612891.6	13_7A^+–12_7A^+	1.7	12.6	
	612891.6	13_7A^-–12_7A^-	—	—	
	612934.2	13_2A^-–12_2A^-	1.8	21.8	44
	613303.9	13_3A^+–12_3A^+	7.5	127.3	
	613334.1	13_4A^-–12_4A^-	5.1	38.1	45
	613335.0	13_4A^+–12_4A^+	—	—	—
	613350.9	13_3A^-–12_3A^-	4.1	23.2	
	613522.6	13_1E–12_1E	1.9	13.4	
	613612.1	13_3E–12_3E	2.4	14.3	
	613904.9	$4_{-2}E$–$3_{-1}E$	1.5	9.2	
	614090.1	13_2E–12_2E	2.7	24.4	
	614360.7	$13_{-2}E$–$12_{-2}E$	3.1	40.4	
	624626.1	$13_{-8}E$–$14_{-7}E$	16.7	186.7	46
	624744.3	3_2A^-–2_1A^-	9.7	120.2	47
	626007.8	10_0E–$9_{-1}E$	5.0	30.7	
	627138.7	3_2A^+–2_1A^+	6.9	44.9	
	632505.4	8_3A^+–7_2A^+	5.2	31.5	
	632771.4	8_3A^-–7_2A^-	6.7	61.4	
	637684.0	11_5A^+–12_4A^+	1.5	18.1	
	637685.1	11_5A^-–12_4A^-	—	—	
	638585.6	17_7E–18_6E	1.2	3.3	48
	640159.1	23_4A^+–23_3A^+	2.1	47.0	49
	640167.3	10_1E–9_0E	—	—	—
	640289.7	20_4A^+–20_3A^+	3.8	64.2	
	640297.1	16_4A^+–16_3A^+	—	—	
	640298.1	17_4A^+–17_3A^+	—	—	
	640298.2	19_4A^+–19_3A^+	—	—	

TABLE 12—*Continued*

Molecule	ν (MHz)	J_K	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes[a]
$^{13}CH_3OH$.....	640298.7	15_4A^+–15_3A^+	—	—	
	640299.6	18_4A^+–18_3A^+	—	—	
	640304.4	14_4A^+–14_3A^+	—	—	
	640376.8	10_4A^+–10_3A^+	1.1	4.9	
	640398.5	11_4A^-–11_3A^-	2.0	14.4	
	640403.4	10_4A^-–10_3A^-	—	—	
	640404.9	9_4A^+–9_3A^+	—	—	
	640408.6	12_4A^-–12_3A^-	—	—	
	640419.4	9_4A^-–9_3A^-	2.1	13.9	
	640435.0	8_4A^+–8_3A^+ & 2.6	2.6	20.8	
	640438.8	13_4A^-–13_3A^-	—	—	
	640442.4	8_4A^-–8_3A^-	—	—	
	640466.3	7_4A^+–7_3A^+	2.4	24.9	
	640469.6	7_4A^-–7_3A^-	—	—	
	640494.6	14_4A^-–14_3A^-	3.4	23.7	
	640497.1	6_4A^+–6_3A^+	—	—	
	640498.4	6_4A^-–6_3A^-	—	—	
	640526.2	5_4A^+–5_3A^+	2.6	14.9	
	640526.6	5_4A^-–5_3A^-	—	—	
	640552.4	4_4A^+–4_3A^+	2.0	12.2	
	640552.6	4_4A^-–4_3A^-	—	—	
	641117.8	18_4A^-–18_3A^-	1.9	49.7	50
	642829.9	22_4A^-–22_3A^-	2.6	24.7	51
	642837.8	13_2E–12_1E	—	—	—
	649912.8	18_0E–17_1E	2.8	51.0	52
	653045.4	$17_{-1}E$–16_0E	2.4	18.4	
	654420.2	14_1A^+–13_1A^+	3.7	29.8	
	657406.5	14_0E–13_0E	1.8	12.0	
	658953.1	$14_{-1}E$–$13_{-1}E$	1.7	10.5	53
	659372.8	$14_{11}A^+$–$13_{11}A^+$	3.3	25.1	
	659372.8	$14_{11}A^-$–$13_{11}A^-$	—	—	
	659390.4	14_0A^+–13_0A^+	5.4	38.1	
	659941.9	14_8E–13_8E	2.8	15.3	
	659944.6	14_2A^-–13_2A^-	—	—	
	660039.2	$14_{-7}E$–$13_{-7}E$	3.5	41.4	54
	660044.0	14_7E–13_7E	—	—	—
	660115.2	14_6A^-–13_6A^-	3.0	27.4	
	660115.2	14_6A^+–13_6A^+	—	—	
	660673.9	14_1E–13_1E	3.2	31.1	
	660811.6	14_3E–13_3E	2.2	26.5	55
	660866.7	14_2A^+–13_2A^+	2.7	46.2	
	661190.8	$5_{-2}E$–$4_{-1}E$	2.8	10.2	
	661314.4	14_2E–13_2E	7.1	32.2	56
	661760.9	$14_{-2}E$–$13_{-2}E$	2.8	29.5	
	666706.1	8_1A^+–7_0A^+	4.7	55.7	
	670756.6	4_2A^-–3_1A^-	3.1	25.0	
	672184.4	11_0E–$10_{-1}E$	1.7	14.4	
	675135.1	3_3E–2_2E	12.9	140.7	57
	675555.3	4_2A^+–3_1A^+	4.6	36.4	58
	677857.1	15_1E–14_2E	1.7	8.6	
	679554.5	9_3A^+–8_2A^+	6.6	45.0	
	680000.2	9_3A^-–8_2A^-	9.2	111.4	59
	682370.9	26_2E–25_3E	4.4	117.5	
	688611.6	11_1E–10_0E	2.5	20.1	
	690629.6	14_2E–13_1E	3.7	33.3	
	701022.4	15_1A^+–14_1A^+	1.5	5.9	
	702072.6	$18_{-1}E$–17_0E	23.7	659.0	60
	703891.9	15_0E–14_0E	1.9	10.0	
	704195.2	20_0A^+–19_1A^+	1.9	12.7	61
	705726.9	$15_{-1}E$–$14_{-1}E$	2.9	10.5	
	706256.9	15_0A^+–14_0A^+	4.3	37.5	
	706924.5	15_2A^-–14_2A^-	2.6	17.2	
	707113.2	15_7E–14_7E	1.2	4.2	
	707167.2	15_6E–14_6E	2.0	14.3	

TABLE 12—*Continued*

Molecule	ν (MHz)	J_K	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes[a]
$^{13}CH_3OH$.....	707173.4	$15_6A^- - 14_6A^-$	—	—	
	707173.4	$15_6A^+ - 14_6A^+$	—	—	
	707244.2	$15_5E - 14_5E$	1.3	3.3	
	707342.2	$15_{-4}E - 14_{-4}E$	1.9	11.2	62
	707368.0	$15_5A^+ - 14_5A^+$	3.6	31.7	
	707368.0	$15_5A^- - 14_5A^-$	—	—	
	707442.9	$15_4E - 14_4E$	1.7	7.9	
	707477.5	$15_{-3}E - 14_{-3}E$	1.9	10.3	
	707518.2	$15_3A^+ - 14_3A^+$	1.9	10.9	
	707606.4	$15_4A^- - 14_4A^-$	3.8	29.1	
	707609.0	$15_4A^+ - 14_4A^+$	—	—	
	707614.8	$15_3A^- - 14_3A^-$	—	—	
	707812.8	$15_1E - 14_1E$	2.6	14.7	
	708010.6	$15_3E - 14_3E$	2.4	16.8	
	708055.2	$15_2A^+ - 14_2A^+$	2.3	15.3	
	708546.2	$6_{-2}E - 5_{-1}E$	4.1	23.7	
	709200.7	$15_{-2}E - 14_{-2}E$	1.9	6.1	
	710385.8	$9_1A^+ - 8_0A^+$	4.5	23.7	63
	712808.4	$15_1A^- - 14_1A^-$	2.9	20.8	
	718209.4	$4_{-4}E - 3_{-3}E$	2.7	10.6	
	722316.5	$4_3E - 3_2E$	2.7	11.2	
	610692.7	$13_6A^+ - 12_6A^+$	8.0	33.2	
	610721.9	$13_{-12}E - 12_{-12}E$	8.8	76.1	
	610768.1	$13_{-10}E - 12_{-10}E$	6.9	59.3	
$^{13}CH_3OH(v_t{=}1)$.....	610890.4	$13_{-11}E - 12_{-11}E$	4.3	44.7	
	635567.3	$4_{-2}E - 5_{-3}E$	1.4	5.9	
	657452.8	$14_6A^+ - 13_6A^+$	2.1	17.3	
	659064.0	$14_1A^- - 13_1A^-$	1.5	11.2	
	683751.0	$26_2A^+ - 25_1A^+$	6.2	50.9	64
	704919.7	$15_7E - 14_7E$	2.7	22.0	
	705464.4	$15_2A^- - 14_2A^-$	—	—	
$^{13}CH_3OH(v_t{=}2)$.....	657452.8	$14_2A^- - 13_2A^-$	1.7	11.7	
CH_3OD	629825.3	$5_3E - 4_2E$	1.5	2.2	
	688887.2	$4_{-3}E - 3_{-2}E$	0.7	1.5	65
	717466.9	$7_3A^+ - 6_2A^+$	1.1	7.1	66

NOTES.—(1) Uncertain calibration. (2) Blend with $^{34}SO_2$ at 624254.5. (3) Blend with CH_3CN at 624344.1 and SO_2 at 624344.5. (4) Blend with SiH at 627689.9 and SO_2 at 627715.3. (5) Blend with $^{34}SO_2$ at 628341.2. (6) Blend with CS at 636431.8. (7) Blend with H_2CO at 656167.4. (8) Blend with NS at 668859.8. (9) Blend with CH_3OCH_3 at 672903.4. (10) Blend with $^{13}CH_3OH$ at 675135.1. (11) Blend with $^{34}SO_2$ at 676010.8 and SO_2-$v_2 = 1$ at 676021.4. (12) Blend with SO_2 at 676484.4. (13) Blend with HNCO at 678237.6. (14) Blend with HNCO at 680787.0. (15) Blend with $^{13}CH_3OH$ at 683751.1. (16) Blend with CH_3OCH_3 at 685500.3. (17) Blend with H_2CO at 701376.0. (18) Blend with HCN at 708877.2. (19) Questionable assignment. (20) Blend with HNCO at 724647.4. (21) Large frequency error. (22) Blend with $^{34}SO_2$ at 626191.9. (23) Blend with H_2S at 626474.5. (24) Blend with SO_2 at 626809.5. (25) Blend with CH_3OCH_3 at 627015.6. (26) Blend with SO_2 at 641914.5. (27) Blend, large error in frequency. (28) Blend with CH_3CH_2CN at 674671.2. (29) Blend with $C^{17}O$ at 674009.3. (30) Blend with $^{34}SO_2$ at 674667.9. (31) Blend with ^{34}SO at 674774.1. (32) Blend with H_2CO at 674791.5. (33) Blend with H_2CS at 675039.0. (34) Blend with H_2CS at 675039.0. (35) Large frequency error, found at 690357.7. (36) Questionable assignment. (37) Blend with SO_2 at 722704.9. (38) Blend with CH_3OCH_3 at 723336.8. (39) Large frequency error. (40) Blend with CH_3CN at 624819.3. (41) Blend with $^{34}SO_2$ at 626043.6 and SO_2 at 626087.3. (42) Blend with $^{34}SO_2$ at 673991.8. (43) Questionable assignment. (44) Blend with CH_3OCH_3 group at 612931.9. (45) Blend with $^{34}SO_2$ at 613338.1. (46) Blend with CH_3CN at 624629.1. (47) Blend with CH_3CN at 624736.1. (48) Large frequency error. (49) Blend with $^{34}SO_2$ at 640148.4 and 640167.1. (50) Too strong, possible blend with *U* line. (51) Blend with CH_3CN at 642829.6. (52) Blend with NH_2D at 639915.2. (53) Blend with HNCO at 658945.8. (54) Blend with $^{13}CH_3OH$ at 660043.9. (55) Blend with CH_3CN at 660806.4. (56) Blend with SO_2 at 661332.5. (57) Blend with CH_3OH at 675134.8. (58) Blend with $HCOOCH_3$ at 675566.2. (59) Blend with SO_2-$v_2 = 1$. (60) Blend with SO_2 at 702104.8. (61) Blend with $HCOOCH_3$ at 704193.5. (62) Blend with CH_3OCH_3 at 707340.1. (63) Blend with $H_2^{13}CO$ at 710386.6. (64) Blend with CH_3OH at 683749.8. (65) Questionable assignment. (66) Questionable assignment. This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal*.

[a] Dashes indicate that the line is part of a blend, and intensity and area are given by the values preceding it.

TABLE 13

TABLE OF H_2CO AND H_2CS MOLECULES

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes[a]
H_2CO	631705.8	$9_{1,9}$–$8_{1,8}$	37.1	749.4	
	647084.7	$9_{0,9}$–$8_{0,8}$	21.9	339.2	
	653973.1	$9_{2,8}$–$8_{2,7}$	13.5	213.5	
	654457.5	$9_{7,3}$–$8_{7,2}$	3.7	30.0	
	654457.5	$9_{7,2}$–$8_{7,1}$	—	—	
	654836.6	$9_{6,4}$–$8_{6,3}$	3.2	33.4	
	654836.6	$9_{6,3}$–$8_{6,2}$	—	—	
	655212.9	$9_{5,5}$–$8_{5,4}$	7.0	115.1	
	655212.9	$9_{5,4}$–$8_{5,3}$	—	—	
	655641.9	$9_{4,6}$–$8_{4,5}$	7.8	107.4	
	655645.8	$9_{4,5}$–$8_{4,4}$	—	—	
	656167.4	$9_{3,7}$–$8_{3,6}$	16.6	298.5	1
	656467.3	$9_{3,6}$–$8_{3,5}$	8.5	170.8	
	662212.1	$9_{2,7}$–$8_{2,6}$	20.1	431.3	2
	674812.7	$9_{1,8}$–$8_{1,7}$	16.2	242.0	
	701376.0	$10_{1,10}$–$9_{1,9}$	22.6	478.2	3
	716943.9	$10_{0,10}$–$9_{0,9}$	18.1	400.9	
$H^{13}{}_2CO$...	616637.3	$9_{1,9}$–$8_{1,8}$	2.7	38.6	
	639764.8	$9_{3,7}$–$8_{3,6}$	1.6	15.2	
	657663.6	$9_{1,8}$–$8_{1,7}$	3.0	23.5	
	684675.7	$10_{1,10}$–$9_{1,9}$	4.9	94.5	
	699873.9	$10_{0,10}$–$9_{0,9}$	3.4	63.4	
	708266.5	$10_{2,9}$–$9_{2,8}$	4.1	24.0	
	710386.6	$10_{4,7}$–$9_{4,6}$	4.5	23.7	4
	710393.4	$10_{4,6}$–$9_{4,5}$	—	—	—
	711415.2	$10_{3,7}$–$9_{3,6}$	3.6	64.2	
H_2CS.....	626482.7	$18_{1,17}$–$17_{1,16}$	13.1	97.4	5
	641421.4	$19_{1,19}$–$18_{1,18}$	2.1	19.1	6
	648827.4	$19_{0,19}$–$18_{0,18}$	2.1	27.2	
	651511.3	$19_{2,18}$–$18_{2,17}$	4.7	49.5	7
	675039.0	$20_{1,20}$–$19_{1,19}$	3.5	18.5	8

NOTES.—(1) Blend with CH_3OH at 656168.1. (2) Blend with SO_2 at 662202.7. (3) Blend with CH_3OH at 701366.8. (4) Blend with $^{13}CH_3OH$ at 710385.8. (5) Blend with H_2S at 626474.5 and CH_3OH at 626476.8. (6) Large frequency error. (7) Blend with SO at 651493.5. (8) Blend with CH_3OH at 675035.8 and CH_3OH at 675044.0. This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal*.

[a] Dashes indicate that the line is part of a blend, and intensity and area are given by the values preceding it.

TABLE 14

TABLE OF HNCO MOLECULES

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes
HNCO...	612867.6	$28_{1,28}$–$27_{1,27}$	2.6	28.0	
	614780.0	$28_{3,26}$–$27_{3,25}$	2.9	28.8	
	614780.2	$28_{3,25}$–$27_{3,24}$	—	—	
	614976.4	$28_{2,27}$–$27_{2,26}$	1.7	7.1	
	615052.1	$28_{2,26}$–$27_{2,25}$	2.5	17.5	
	615098.9	$28_{0,28}$–$27_{0,27}$	4.5	42.3	
	617346.7	$28_{1,27}$–$27_{1,26}$	3.3	23.0	
	632571.7	$11_{1,11}$–$12_{0,12}$	6.2	77.8	
	634731.7	$29_{1,29}$–$28_{1,28}$	4.8	40.1	
	636714.1	$29_{3,27}$–$28_{3,26}$	2.2	23.9	
	636714.3	$29_{3,26}$–$28_{3,25}$	—	—	
	636999.9	$29_{2,27}$–$28_{2,26}$	2.3	14.2	1
	637037.8	$29_{0,29}$–$28_{0,28}$	7.7	74.8	
	655444.5	$10_{1,10}$–$11_{0,11}$	3.9	31.4	
	656593.1	$30_{1,30}$–$29_{1,29}$	2.5	18.8	
	658945.8	$30_{2,28}$–$29_{2,27}$	1.7	10.5	2
	658973.5	$30_{0,30}$–$29_{0,29}$	2.2	10.7	
	661390.0	$30_{1,29}$–$29_{1,28}$	2.3	18.5	
	678237.5	$9_{1,9}$–$10_{0,10}$	12.5	152.9	3
	678452.0	$31_{1,31}$–$30_{1,30}$	1.7	11.2	
	680575.0	$31_{3,29}$–$30_{3,28}$	1.0	9.6	
	680787.0	$31_{2,30}$–$30_{2,29}$	8.1	131.7	4
	680889.6	$31_{2,29}$–$30_{2,28}$	4.2	35.8	
	680906.1	$31_{0,31}$–$30_{0,30}$	7.9	62.2	
	683407.6	$31_{1,30}$–$30_{1,29}$	3.6	34.6	
	700308.1	$32_{1,32}$–$31_{1,31}$	3.1	27.5	5
	700950.3	$8_{1,8}$–$9_{0,9}$	2.4	7.9	
	702501.8	$32_{3,30}$–$31_{3,29}$	2.6	26.6	6
	702718.6	$32_{2,31}$–$31_{2,30}$	3.0	18.5	
	702831.5	$32_{2,30}$–$31_{2,29}$	4.9	65.0	
	702835.5	$32_{0,32}$–$31_{0,31}$	—	—	
	705422.4	$32_{1,31}$–$31_{1,30}$	2.4	19.3	
	722161.5	$33_{1,33}$–$32_{1,32}$	3.4	35.8	
	723582.7	$7_{1,7}$–$8_{0,8}$	1.7	16.0	
	724647.4	$33_{2,32}$–$32_{2,31}$	6.5	52.2	7
	724761.4	$33_{0,33}$–$32_{0,32}$	4.3	22.3	

NOTES.—(1) Blend with CH_3CH_2CN at 637003.5. (2) Blend with $^{13}CH_3OH$ at 658953.1. (3) Blend with CH_3OH at 678252.7. (4) Blend with CH_3OH at 680804.4. (5) Blend with SO_2 at 700312.9. (6) Blend with $^{34}SO_2$ at 702502.1. (7) Blend with CH_3OH at 724644.6. This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal*.

[a] Dashes indicate that the line is part of a blend, and intensity and area are given by the values preceding it.

TABLE 15

TABLE OF $HCOOCH_3$ MOLECULES

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes[a]
$HCOOCH_3$.....	614019.0	$34_{9,26}A$–$33_{8,25}A$	4.0	28.4	
	615288.6	$50_{14,37}E$–$49_{0,49}E$	6.1	96.7	
	618592.2	$50_{20,31}E$–$49_{20,30}E$	2.1	33.0	1
	624023.9	$25_{12,14}E$–$24_{11,14}E$	2.4	22.6	
	624031.4	$25_{12,14}A$–$24_{11,13}A$	—	—	
	624031.5	$25_{12,13}A$–$24_{11,14}A$	—	—	
	624551.7	$54_{5,49}A$–$53_{6,48}A$	4.5	63.0	
	624551.9	$54_{6,49}A$–$53_{6,48}A$	—	—	
	624552.1	$54_{5,49}A$–$53_{5,48}A$	—	—	
	624552.4	$54_{6,49}A$–$53_{5,48}A$	—	—	
	624582.8	$54_{11,44}E$–$53_{2,51}E$	6.5	68.8	
	624583.0	$54_{12,43}E$–$53_{2,51}E$	—	—	
	624583.1	$54_{11,44}E$–$53_{11,43}E$	—	—	
	624583.4	$54_{12,43}E$–$53_{11,43}E$	—	—	
	624670.4	$16_{16,1}E$–$15_{15,1}E$	4.1	24.1	
	624680.4	$16_{16,0}A$–$15_{15,1}A$	3.1	20.9	
	624680.4	$16_{16,1}A$–$15_{15,0}A$	—	—	
	625294.0	$55_{10,46}E$–$54_{9,45}E$	7.3	101.8	
	625294.0	$55_{9,46}E$–$54_{9,45}E$	—	—	
	625294.1	$55_{10,46}E$–$54_{10,45}E$	—	—	
	625294.1	$55_{9,46}E$–$54_{10,45}E$	—	—	
	627618.2	$23_{13,11}A$–$22_{12,10}A$	1.1	2.3	
	627618.2	$23_{13,10}A$–$22_{12,11}A$	—	—	
	632401.4	$51_{17,35}A$–$50_{17,34}A$	3.6	39.0	2
	633906.0	$19_{15,4}E$–$18_{14,4}E$	5.2	23.4	
	633950.0	$19_{15,5}E$–$18_{14,5}E$	7.9	80.1	
	633960.4	$19_{15,4}A$–$18_{14,5}A$	—	—	
	633960.4	$19_{15,5}A$–$18_{14,4}A$	—	—	
	634005.9	$51_{14,37}E$–$50_{14,36}E$	3.9	41.3	3
	634317.6	$53_{12,41}E$–$52_{12,40}E$	3.9	31.4	4
	634373.7	$53_{13,41}E$–$52_{13,40}E$	4.1	48.1	5
	635027.6	$55_{5,50}A$–$54_{6,49}A$	3.6	42.0	
	635027.8	$55_{6,50}A$–$54_{6,49}A$	—	—	
	635027.8	$55_{5,50}A$–$54_{5,49}A$	—	—	
	635027.9	$55_{6,50}A$–$54_{5,49}A$	—	—	
	635749.3	$51_{17,35}E$–$50_{17,34}E$	1.5	12.3	
	635750.4	$31_{10,22}A$–$30_{9,21}A$	—	—	
	635750.8	$56_{4,52}A$–$55_{5,51}A$	—	—	
	635750.8	$56_{5,52}A$–$55_{5,51}A$	—	—	
	635750.8	$56_{4,52}A$–$55_{4,51}A$	—	—	
	635750.8	$56_{5,52}A$–$55_{4,51}A$	—	—	
	635751.2	$51_{15,37}A$–$50_{15,36}A$	—	—	
	635754.6	$31_{10,22}E$–$30_{7,23}E$	—	—	
	636073.6	$26_{12,15}A$–$25_{11,14}A$	1.2	2.8	
	636073.8	$26_{12,14}A$–$25_{11,15}A$	—	—	
	636946.2	$17_{16,2}E$–$16_{15,2}E$	2.7	19.3	
	636954.7	$17_{16,1}A$–$16_{15,2}A$	—	—	
	636954.7	$17_{16,2}A$–$16_{15,1}A$	—	—	
	640942.1	$51_{15,37}E$–$50_{15,36}E$	1.1	3.7	
	643089.8	$22_{14,9}E$–$21_{13,9}E$	2.4	30.4	6
	643277.7	$29_{11,18}E$–$28_{10,18}E$	4.3	59.8	7
	643281.8	$29_{11,19}A$–$28_{10,18}A$	—	—	—
	646208.6	$20_{15,6}E$–$19_{14,6}E$	2.3	19.3	
	646216.9	$20_{15,5}A$–$19_{14,6}A$	—	—	
	646216.9	$20_{15,6}A$–$19_{14,5}A$	—	—	
	648324.2	$32_{10,22}A$–$31_{9,23}A$	5.8	91.0	
	648333.4	$32_{8,24}E$–$31_{7,25}E$	—	—	
	649168.1	$18_{16,2}E$–$17_{15,2}E$	3.6	51.9	
	649219.8	$18_{16,3}E$–$17_{15,3}E$	3.2	15.5	
	649226.7	$18_{16,2}A$–$17_{15,3}A$	—	—	
	649226.7	$18_{16,3}A$–$17_{15,2}A$	—	—	
	655387.4	$56_{6,50}A$–$55_{7,49}A$	2.7	30.1	
	655388.9	$56_{7,50}A$–$55_{7,49}A$	—	—	
	655390.0	$56_{6,50}A$–$55_{6,49}A$	—	—	

TABLE 15—*Continued*

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes[a]
$HCOOCH_3$.....	655391.6	$56_{7,50}A$–$55_{6,49}A$	—	—	
	656224.1	$33_{8,26}E$–$32_{7,25}E$	1.7	11.7	
	657868.9	$53_{17,37}A$–$52_{17,36}A$	3.7	33.1	
	657869.8	$53_{17,36}A$–$52_{17,35}A$	3.7	33.1	
	658466.4	$21_{15,6}A$–$20_{14,7}A$	3.8	23.8	
	658466.4	$21_{15,7}A$–$20_{14,6}A$	—	—	
	660009.6	$28_{12,16}E$–$27_{11,16}E$	3.1	17.6	
	664445.5	$17_{17,1}E$–$16_{16,1}E$	6.5	77.1	
	664449.2	$17_{17,0}A$–$16_{16,1}A$	—	—	
	664449.2	$17_{17,1}A$–$16_{16,0}A$	—	—	
	665509.0	$56_{7,49}A$–$55_{7,48}A$	2.3	28.0	8
	665560.7	$56_{13,43}E$–$55_{13,42}E$	3.0	26.7	
	665568.7	$55_{9,47}A$–$54_{9,46}A$	—	—	
	665618.6	$55_{3,53}E$–$54_{3,52}E$	1.9	20.2	
	665705.8	$54_{20,34}E$–$53_{20,33}E$	3.3	36.5	9
	666441.8	$58_{6,53}A$–$57_{6,52}A$	5.5	94.0	
	666441.9	$58_{5,53}A$–$57_{5,52}A$	—	—	
	667470.7	$24_{14,10}E$–$23_{13,10}E$	4.8	95.7	
	672459.4	$54_{16,39}A$–$53_{16,38}A$	1.5	8.4	
	673708.7	$20_{16,4}E$–$19_{15,4}E$	2.7	20.2	
	675566.2	$55_{29,26}A$–$54_{29,25}A$	4.6	36.4	10
	675566.2	$55_{29,27}A$–$54_{29,26}A$	—	—	—
	675654.3	$56_{8,48}A$–$55_{9,47}A$	2.3	14.9	
	675678.1	$55_{29,26}E$–$54_{29,25}E$	0.9	6.9	11
	675710.7	$56_{14,43}E$–$55_{3,53}E$	0.7	2.1	
	675997.2	$55_{27,28}A$–$54_{27,27}A$	3.6	16.6	
	675997.2	$55_{27,29}A$–$54_{27,28}A$	—	—	
	676111.8	$27_{13,15}A$–$26_{12,14}A$	4.2	38.8	
	676111.8	$27_{13,14}A$–$26_{12,15}A$	—	—	
	676408.5	$52_{11,41}A$–$51_{11,40}A$	5.4	52.9	
	678005.8	$32_{11,21}A$–$31_{10,22}A$	2.9	18.0	
	679653.1	$25_{14,11}E$–$24_{13,11}E$	1.1	5.0	
	679682.0	$25_{14,12}E$–$24_{13,12}E$	2.2	10.6	
	679683.6	$25_{14,11}A$–$24_{13,12}A$	—	—	
	679683.6	$25_{14,12}A$–$24_{13,11}A$	—	—	
	680169.9	$54_{13,42}A$–$53_{13,41}A$	4.3	39.7	
	680967.4	$36_{10,27}A$–$35_{9,26}A$	3.5	40.7	
	682899.4	$23_{15,8}E$–$22_{14,8}E$	1.7	11.1	
	682935.7	$23_{15,9}E$–$22_{14,9}E$	2.2	23.1	
	682938.4	$23_{15,8}A$–$22_{14,9}A$	—	—	
	682938.4	$23_{15,9}A$–$22_{14,8}A$	—	—	
	683571.6	$53_{12,41}A$–$52_{12,40}A$	3.9	120.2	
	683762.5	$30_{2,28}E$–$29_{11,18}E$	3.9	44.9	
	683770.6	$30_{12,19}A$–$29_{11,18}A$	—	—	
	683773.4	$30_{12,18}A$–$29_{11,19}A$	—	—	
	685971.8	$21_{16,5}E$–$20_{15,5}E$	3.8	32.4	
	686016.9	$21_{16,6}E$–$20_{15,6}E$	3.1	19.6	
	686019.4	$21_{16,5}A$–$20_{15,6}A$	—	—	
	686019.4	$21_{16,6}A$–$20_{15,5}A$	—	—	
	686373.6	$57_{8,49}A$–$56_{8,48}A$	3.1	31.9	
	687871.1	$56_{15,42}E$–$55_{15,41}E$	2.5	36.7	
	688113.0	$56_{28,29}E$–$55_{28,28}E$	2.3	21.5	
	688995.4	$56_{25,31}A$–$55_{25,30}A$	1.6	13.9	12
	688995.4	$56_{25,32}A$–$55_{25,31}A$	—	—	—
	688997.2	$56_{23,33}E$–$55_{25,31}E$	—	—	—
	688997.4	$19_{17,3}E$–$18_{16,3}E$	—	—	—
	688999.1	$19_{17,2}A$–$18_{16,3}A$	—	—	—
	688999.1	$19_{17,3}A$–$18_{16,2}A$	—	—	—
	689006.5	$53_{11,42}A$–$52_{11,41}A$	—	—	—
	689070.1	$56_{25,31}E$–$55_{25,30}E$	7.1	75.5	13
	691815.8	$26_{14,12}E$–$25_{13,12}E$	1.6	11.9	
	691841.9	$26_{14,13}A$–$25_{13,12}A$	2.8	12.1	
	691841.9	$26_{14,12}A$–$25_{13,13}A$	—	—	
	691842.6	$26_{14,13}E$–$25_{13,13}E$	—	—	
	692204.0	$56_{20,37}A$–$55_{20,36}A$	1.1	2.7	14

TABLE 15—*Continued*

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes[a]
$HCOOCH_3$.....	692204.0	$56_{20,36}A$–$55_{20,35}A$	—	—	14
	695122.9	$24_{15,9}E$–$23_{14,9}E$	7.1	111.1	15
	695156.9	$24_{15,10}E$–$23_{14,10}E$	2.4	19.9	
	695157.8	$24_{15,9}A$–$23_{14,10}A$	—	—	
	695157.8	$24_{15,10}A$–$23_{14,9}A$	—	—	
	704192.7	$18_{18,1}E$–$17_{17,1}E$	1.9	12.7	16
	704193.5	$18_{18,0}A$–$17_{17,1}A$	—	—	—
	704193.5	$18_{18,1}A$–$17_{17,0}A$	—	—	—
	710517.7	$23_{16,7}A$–$22_{15,8}A$	0.8	1.0	
	710517.7	$23_{16,8}A$–$22_{15,7}A$	—	—	
	710517.9	$23_{16,8}E$–$22_{15,8}E$	—	—	
	715314.6	$57_{12,46}A$–$56_{12,45}A$	2.9	25.4	
	717124.3	$56_{13,43}A$–$55_{13,42}A$	2.3	5.0	
	717128.9	$57_{14,44}A$–$56_{14,43}A$	—	—	
	717168.6	$56_{7,49}E$–$55_{7,48}E$	1.9	1.8	
	717177.9	$57_{10,47}E$–$56_{10,46}E$	—	—	

NOTES.—(1) Large frequency error. (2) Questionable assignment. (3) Large frequency error. (4) Large frequency error. (5) Large frequency error. (6) Blend with CH_3CN at 643074.1. (7) Blend with CH_3CN at 643269.9. (8) Blend with CH_3CH_2CN at 665506.6. (9) Blend with CH_3OCH_3 at 665710.6. (10) Blend with $^{13}CH_3OH$ at 675555.3, large frequency error. (11) Large frequency error. (12) Blend with CH_3CH_2CN at 689007.7. (13) Large frequency error. (14) Blend CH_3CH_2CN at 692200.9. (15) Blend with $^{34}SO_2$ at 691119.3. (16) Blend with $^{13}CH_3OH$ at 704195.3. This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal*.

[a] Dashes indicate that the line is part of a blend, and intensity and area are given by the values preceding it.

TABLE 16

TABLE OF CH_3OCH_3 MOLECULES

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes[a]
CH_3OCH_3.....	608093.5	$12_{7,5}EA$–$11_{6,5}EA$	5.8	116.1	
	608096.1	$12_{7,5}EE$–$11_{6,5}EE$	—	—	
	608097.5	$12_{7,6}AE$–$11_{6,5}AE$	—	—	
	608097.5	$12_{7,5}AE$–$11_{6,6}AE$	—	—	
	608098.8	$12_{7,6}AA$–$11_{6,5}AA$	—	—	
	608098.8	$12_{7,5}AA$–$11_{6,6}AA$	—	—	
	608100.1	$12_{7,6}EE$–$11_{6,6}EE$	—	—	
	608101.5	$12_{7,6}EA$–$11_{6,6}EA$	—	—	
	609703.6	$9_{8,2}EA$–$8_{7,1}EA$	1.2	6.8	
	609704.9	$9_{8,2}EE$–$8_{7,1}EE$	—	—	
	609706.1	$9_{8,1}AA$–$8_{7,2}AA$	—	—	
	609706.1	$9_{8,2}AA$–$8_{7,1}AA$	—	—	
	609707.9	$9_{8,1}AE$–$8_{7,2}AE$	—	—	
	609707.9	$9_{8,2}AE$–$8_{7,1}AE$	—	—	
	609709.1	$9_{8,1}EE$–$8_{7,2}EE$	—	—	
	609712.1	$9_{8,1}EA$–$8_{7,2}EA$	—	—	
	610844.4	$20_{3,17}AE$–$19_{2,18}AE$	4.7	52.7	1
	610844.4	$20_{3,17}EA$–$19_{2,18}EA$	—	—	—
	610847.6	$20_{3,17}EE$–$19_{2,18}EE$	—	—	—
	610850.9	$20_{3,17}AA$–$19_{2,18}AA$	—	—	—
	612280.8	$30_{11,19}EA$–$30_{10,20}EA$	2.7	22.3	2
	612280.8	$30_{11,19}EE$–$30_{10,20}EE$	—	—	—
	612280.9	$30_{11,19}AA$–$30_{10,20}AA$	—	—	—
	612280.9	$30_{11,20}AA$–$30_{10,21}AA$	—	—	—
	612281.2	$30_{11,19}AE$–$30_{10,20}AE$	—	—	—
	612281.3	$30_{11,20}AE$–$30_{10,21}AE$	—	—	—
	612281.3	$30_{11,20}EE$–$30_{10,21}EE$	—	—	—
	612281.8	$30_{11,20}EA$–$30_{10,21}EA$	—	—	—
	612929.9	$27_{11,16}AA$–$27_{10,17}AA$	1.8	21.8	3
	612929.9	$27_{11,17}AA$–$27_{10,18}AA$	—	—	—
	612930.8	$27_{11,16}EE$–$27_{10,17}EE$	—	—	—
	612931.1	$27_{11,17}EE$–$27_{10,18}EE$	—	—	—
	612931.6	$27_{11,16}EA$–$27_{10,17}EA$	—	—	—
	612931.9	$27_{11,16}AE$–$27_{10,17}AE$	—	—	—
	612931.9	$27_{11,17}AE$–$27_{10,18}AE$	—	—	—
	612932.2	$27_{11,17}EA$–$27_{10,18}EA$	—	—	—
	613590.3	$22_{11,12}AA$–$22_{10,13}AA$	1.9	12.5	
	613590.3	$22_{11,11}AA$–$22_{10,12}AA$	—	—	
	613592.4	$22_{11,11}EE$–$22_{10,12}EE$	—	—	
	613592.4	$22_{11,12}EE$–$22_{10,13}EE$	—	—	
	613594.5	$22_{11,11}EA$–$22_{10,12}EA$	—	—	
	613594.5	$22_{11,12}AE$–$22_{10,13}AE$	—	—	
	613594.5	$22_{11,11}AE$–$22_{10,12}AE$	—	—	
	613594.5	$22_{11,12}EA$–$22_{10,13}EA$	—	—	
	613678.0	$21_{11,11}EA$–$21_{10,12}EA$	2.6	27.6	4
	613678.0	$21_{11,10}AE$–$21_{10,11}AE$	—	—	—
	613678.0	$21_{11,11}AE$–$21_{10,12}AE$	—	—	—
	613678.1	$21_{11,10}EA$–$21_{10,11}EA$	—	—	—
	613849.9	$18_{11,8}AA$–$18_{10,9}AA$	2.4	37.1	
	613849.9	$18_{11,7}AA$–$18_{10,8}AA$	—	—	
	613852.7	$18_{11,8}EE$–$18_{10,9}EE$	—	—	
	613852.8	$18_{11,7}EE$–$18_{10,8}EE$	—	—	
	613855.4	$18_{11,8}EA$–$18_{10,9}EA$	—	—	
	613855.5	$18_{11,8}AE$–$18_{10,9}AE$	—	—	
	613855.5	$18_{11,7}AE$–$18_{10,8}AE$	—	—	
	613855.6	$18_{11,7}EA$–$18_{10,8}EA$	—	—	
	613959.1	$14_{11,4}AA$–$14_{10,5}AA$	3.2	40.9	
	613962.3	$14_{11,4}EE$–$14_{10,5}EE$	—	—	
	613962.4	$14_{11,3}EE$–$14_{10,4}EE$	—	—	
	613965.6	$14_{11,4}EA$–$14_{10,5}EA$	—	—	
	613965.8	$14_{11,4}AE$–$14_{10,5}AE$	—	—	
	613965.8	$14_{11,3}AE$–$14_{10,4}AE$	—	—	
	613965.9	$14_{11,3}EA$–$14_{10,4}EA$	—	—	
	613970.8	$13_{11,2}AA$–$13_{10,3}AA$	—	—	

TABLE 16—*Continued*

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* dv^a$ (K km s^{-1})	Notes[a]
CH_3OCH_3.....	613970.8	$13_{11,3}AA$–$13_{10,4}AA$	—	—	
	613974.1	$13_{11,3}EE$–$13_{10,4}EE$	—	—	
	613974.2	$13_{11,2}EE$–$13_{10,3}EE$	—	—	
	613977.5	$13_{11,3}EA$–$13_{10,4}EA$	—	—	
	613977.7	$13_{11,2}AE$–$13_{10,3}AE$	—	—	
	613977.7	$13_{11,3}AE$–$13_{10,4}AE$	—	—	
	613977.8	$13_{11,2}EA$–$13_{10,3}EA$	—	—	
	613978.0	$12_{11,2}AA$–$12_{10,3}AA$	—	—	
	613978.0	$12_{11,1}AA$–$12_{10,2}AA$	—	—	
	614303.1	$26_{4,23}AA$–$25_{1,24}AA$	2.4	23.3	
	614303.2	$26_{4,23}EE$–$25_{1,24}EE$	—	—	
	614303.2	$26_{4,23}AE$–$25_{1,24}AE$	—	—	
	614303.2	$26_{4,23}EA$–$25_{1,24}EA$	—	—	
	624901.3	$16_{6,11}EA$–$15_{5,10}EA$	6.7	89.1	5
	624905.4	$16_{6,11}AE$–$15_{5,10}AE$	—	—	—
	624905.6	$16_{6,11}EE$–$15_{5,10}EE$	—	—	—
	624907.9	$16_{6,10}EA$–$15_{5,10}EA$	—	—	—
	624908.8	$16_{6,11}AA$–$15_{5,10}AA$	—	—	—
	624909.1	$16_{6,10}EE$–$15_{5,10}EE$	—	—	—
	624932.1	$16_{6,11}EE$–$15_{5,11}EE$	16.9	278.6	6
	624932.4	$16_{6,10}AE$–$15_{5,11}AE$	—	—	—
	624935.5	$16_{6,10}EE$–$15_{5,11}EE$	—	—	—
	624935.8	$16_{6,10}AA$–$15_{5,11}AA$	—	—	—
	624936.4	$16_{6,10}EA$–$15_{5,11}EA$	—	—	—
	626989.0	$35_{2,33}AE$–$34_{1,34}AE$	4.3	36.7	
	626989.0	$35_{2,34}EA$–$34_{1,34}EA$	—	—	
	626989.0	$35_{2,34}EE$–$34_{1,34}EE$	—	—	
	626989.1	$35_{2,33}AA$–$34_{1,34}AA$	—	—	
	627015.6	$13_{7,6}EA$–$12_{6,6}EA$	14.6	107.7	7
	627018.1	$13_{7,6}EE$–$12_{6,6}EE$	—	—	—
	627019.4	$13_{7,7}AE$–$12_{6,6}AE$	—	—	—
	627019.5	$13_{7,6}AE$–$12_{6,7}AE$	—	—	—
	627020.7	$13_{7,7}AA$–$12_{6,6}AA$	—	—	—
	627020.7	$13_{7,6}AA$–$12_{6,7}AA$	—	—	—
	627022.0	$13_{7,7}EE$–$12_{6,7}EE$	—	—	—
	627023.4	$13_{7,7}EA$–$12_{6,7}EA$	—	—	—
	628657.9	$10_{8,3}EA$–$9_{7,2}EA$	12.9	86.2	
	628659.0	$10_{8,3}EE$–$9_{7,2}EE$	—	—	
	628660.2	$10_{8,3}AA$–$9_{7,2}AA$	—	—	
	628660.2	$10_{8,2}AA$–$9_{7,3}AA$	—	—	
	628662.0	$10_{8,3}AE$–$9_{7,2}AE$	—	—	
	628662.0	$10_{8,2}AE$–$9_{7,3}AE$	—	—	
	628663.2	$10_{8,2}EE$–$9_{7,3}EE$	—	—	
	628666.2	$10_{8,2}EA$–$9_{7,3}EA$	—	—	
	628775.8	$34_{4,30}AE$–$33_{3,31}AE$	1.9	16.4	
	628775.8	$34_{4,31}EA$–$33_{3,30}EA$	—	—	
	628776.6	$34_{4,31}EE$–$33_{3,30}EE$	—	—	
	628777.3	$34_{4,30}AA$–$33_{3,31}AA$	—	—	
	632286.6	$35_{1,34}AE$–$34_{4,31}AE$	2.3	9.1	
	632286.6	$35_{1,34}EA$–$34_{4,30}EA$	—	—	
	632289.5	$35_{1,34}EE$–$34_{4,30}EE$	—	—	
	632292.4	$35_{1,34}AA$–$34_{4,31}AA$	—	—	
	636468.8	$20_{5,16}EA$–$19_{4,15}EA$	6.4	42.4	
	636468.8	$20_{5,16}AE$–$19_{4,15}AE$	—	—	
	636470.8	$20_{5,16}EE$–$19_{4,15}EE$	—	—	
	636472.7	$20_{5,16}AA$–$19_{4,15}AA$	—	—	
	637843.4	$34_{3,32}AA$–$33_{4,29}AA$	2.9	29.8	
	637843.7	$34_{3,31}EE$–$33_{4,30}EE$	—	—	
	637844.0	$34_{3,31}EA$–$33_{4,30}EA$	—	—	
	637844.1	$34_{3,32}AE$–$33_{4,29}AE$	—	—	
	641361.9	$20_{5,15}AE$–$19_{4,16}AE$	2.2	19.4	
	641362.0	$20_{5,15}EA$–$19_{4,16}EA$	—	—	
	641363.9	$20_{5,15}EE$–$19_{4,16}EE$	—	—	
	641365.8	$20_{5,15}AA$–$19_{4,16}AA$	—	—	
	642289.2	$33_{6,27}AA$–$33_{1,32}AA$	2.0	26.3	8

TABLE 16—*Continued*

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes[a]
CH_3OCH_3.....	642294.9	$33_{6,27}EE$–$33_{1,32}EE$	—	—	—
	642300.6	$33_{6,27}AE$–$33_{1,32}AE$	—	—	—
	642300.6	$33_{6,27}EA$–$33_{1,32}EA$	—	—	—
	642934.8	$30_{2,28}EA$–$30_{3,28}EA$	2.5	48.0	
	642934.8	$30_{2,28}AE$–$30_{3,27}AE$	—	—	
	642940.4	$30_{2,28}EE$–$30_{3,28}EE$	—	—	
	642946.0	$30_{2,28}AA$–$30_{3,27}AA$	—	—	
	643412.7	$32_{6,26}AA$–$32_{1,31}AA$	1.2	8.5	9
	643417.8	$32_{6,26}EE$–$32_{1,31}EE$	—	—	—
	643423.0	$32_{6,26}AE$–$32_{1,31}AE$	—	—	—
	643423.0	$32_{6,26}EA$–$32_{1,31}EA$	—	—	—
	643643.1	$17_{6,12}AE$–$16_{5,11}AE$	3.3	41.5	
	643643.8	$17_{6,12}EE$–$16_{5,11}EE$	—	—	
	643646.2	$17_{6,12}AA$–$16_{5,11}AA$	—	—	
	643646.9	$17_{6,11}EA$–$16_{5,11}EA$	—	—	
	643647.7	$17_{6,11}EE$–$16_{5,11}EE$	—	—	
	643690.6	$17_{6,12}EA$–$16_{5,12}EA$	3.1	24.1	
	643693.0	$17_{6,12}EE$–$16_{5,12}EE$	—	—	
	643694.4	$17_{6,11}AE$–$16_{5,12}AE$	—	—	
	643696.9	$17_{6,11}EE$–$16_{5,12}EE$	—	—	
	643697.1	$17_{6,11}EA$–$16_{5,12}EA$	—	—	
	643697.6	$17_{6,11}AA$–$16_{5,12}AA$	—	—	
	645923.8	$14_{7,7}EA$–$13_{6,7}EA$	10.5	98.0	
	645926.2	$14_{7,7}EE$–$13_{6,7}EE$	—	—	
	645927.5	$14_{7,8}AE$–$13_{6,7}AE$	—	—	
	645927.6	$14_{7,7}AE$–$13_{6,8}AE$	—	—	
	645928.6	$14_{7,8}AA$–$13_{6,7}AA$	—	—	
	645928.7	$14_{7,7}AA$–$13_{6,8}AA$	—	—	
	645930.0	$14_{7,8}EE$–$13_{6,8}EE$	—	—	
	645931.3	$14_{7,8}EA$–$13_{6,8}EA$	—	—	
	646088.8	$22_{4,18}AE$–$21_{3,19}AE$	2.5	18.2	
	646088.8	$22_{4,18}EA$–$21_{3,19}EA$	—	—	
	646090.9	$22_{4,18}EE$–$21_{3,19}EE$	—	—	
	646093.0	$22_{4,18}AA$–$21_{3,19}AA$	—	—	
	646766.7	$30_{4,27}AA$–$29_{1,28}AA$	1.9	12.8	
	646768.2	$30_{4,26}EE$–$29_{1,28}EE$	—	—	
	646769.8	$30_{4,26}EA$–$29_{1,28}EA$	—	—	
	646769.8	$30_{4,27}AE$–$29_{1,28}AE$	—	—	
	647196.2	$21_{3,18}EA$–$20_{2,19}EA$	2.1	16.4	
	647196.2	$21_{3,18}AE$–$20_{2,19}AE$	—	—	
	647199.7	$21_{3,18}EE$–$20_{2,19}EE$	—	—	
	647203.1	$21_{3,18}AA$–$20_{2,19}AA$	—	—	
	647455.2	$35_{6,29}AA$–$35_{1,34}AA$	5.8	73.1	10
	647456.1	$35_{4,31}AE$–$34_{3,32}AE$	—	—	—
	647456.1	$35_{4,32}EA$–$34_{3,31}EA$	—	—	—
	647456.8	$35_{4,32}EE$–$34_{3,31}EE$	—	—	—
	647457.5	$35_{4,31}AA$–$34_{3,32}AA$	—	—	—
	647608.4	$11_{8,4}EA$–$10_{7,3}EA$	8.7	74.5	
	647609.5	$11_{8,4}EE$–$10_{7,3}EE$	—	—	
	647610.6	$11_{8,4}AA$–$10_{7,3}AA$	—	—	
	647610.6	$11_{8,3}AA$–$10_{7,4}AA$	—	—	
	647612.4	$11_{8,3}AE$–$10_{7,4}AE$	—	—	
	647612.4	$11_{8,4}AE$–$10_{7,3}AE$	—	—	
	647613.6	$11_{8,3}EE$–$10_{7,4}EE$	—	—	
	647616.5	$11_{8,3}EA$–$10_{7,4}EA$	—	—	
	653244.9	$21_{5,17}EA$–$20_{4,16}EA$	1.1	2.1	
	653244.9	$21_{5,17}AE$–$20_{4,16}AE$	—	—	
	653246.6	$21_{5,17}EE$–$20_{4,16}EE$	—	—	
	653248.4	$21_{5,17}AA$–$20_{4,16}AA$	—	—	
	660458.8	$21_{5,16}AE$–$20_{4,17}AE$	3.6	30.6	11
	660458.8	$21_{5,16}EA$–$20_{4,17}EA$	—	—	—
	660460.4	$21_{5,16}EE$–$20_{4,17}EE$	—	—	—
	660462.2	$21_{5,16}AA$–$20_{4,17}AA$	—	—	—
	662319.1	$18_{6,13}EA$–$17_{5,12}EA$	4.5	27.1	
	662320.7	$18_{6,13}AE$–$17_{5,12}AE$	—	—	

TABLE 16—*Continued*

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* dv^a$ (K km s^{-1})	Notes[a]
CH_3OCH_3.....	662321.7	$18_{6,13}EE$–$17_{5,12}EE$	—	—	
	662323.6	$18_{6,13}AA$–$17_{5,12}AA$	—	—	
	662414.6	$18_{6,12}AE$–$17_{5,13}AE$	15.7	459.7	12
	662416.1	$18_{6,12}EA$–$17_{5,13}EA$	—	—	—
	662416.4	$18_{6,12}EE$–$17_{5,13}EE$	—	—	—
	662417.5	$18_{6,12}AA$–$17_{5,13}AA$	—	—	—
	664814.9	$15_{7,9}EA$–$14_{6,8}EA$	6.7	59.6	
	664817.2	$15_{7,9}EE$–$14_{6,8}EE$	—	—	
	664818.5	$15_{7,9}AE$–$14_{6,8}AE$	—	—	
	664818.7	$15_{7,8}AE$–$14_{6,9}AE$	—	—	
	664819.4	$15_{7,9}AA$–$14_{6,8}AA$	—	—	
	664819.7	$15_{7,8}AA$–$14_{6,9}AA$	—	—	
	664820.9	$15_{7,8}EE$–$14_{6,9}EE$	—	—	
	664822.2	$15_{7,8}EA$–$14_{6,9}EA$	—	—	
	665710.6	$44_{12,33}EA$–$44_{11,34}EA$	3.3	36.5	13
	665711.2	$44_{12,32}AE$–$44_{11,33}AE$	—	—	—
	665711.8	$44_{12,33}AE$–$44_{11,34}AE$	—	—	—
	665712.4	$44_{12,32}EA$–$44_{11,33}EA$	—	—	—
	665716.1	$44_{12,33}EE$–$44_{11,34}EE$	—	—	—
	665717.0	$44_{12,32}EE$–$44_{11,33}EE$	—	—	—
	665721.4	$44_{12,32}AA$–$44_{11,33}AA$	—	—	—
	665721.8	$44_{12,33}AA$–$44_{11,34}AA$	—	—	—
	666553.8	$12_{8,5}EA$–$11_{7,4}EA$	5.3	47.6	
	666554.9	$12_{8,5}EE$–$11_{7,4}EE$	—	—	
	666555.9	$12_{8,5}AA$–$11_{7,4}AA$	—	—	
	666555.9	$12_{8,4}AA$–$11_{7,5}AA$	—	—	
	666557.8	$12_{8,5}AE$–$11_{7,4}AE$	—	—	
	666557.8	$12_{8,4}AE$–$11_{7,5}AE$	—	—	
	666558.8	$12_{8,4}EE$–$11_{7,5}EE$	—	—	
	666561.8	$12_{8,4}EA$–$11_{7,5}EA$	—	—	
	668073.0	$9_{9,0}AA$–$8_{8,1}AA$	5.8	66.0	
	668073.0	$9_{9,1}AA$–$8_{8,0}AA$	—	—	
	668073.7	$9_{9,1}EE$–$8_{8,1}EE$	—	—	
	668074.4	$9_{9,1}EA$–$8_{8,1}EA$	—	—	
	668077.1	$9_{9,0}EE$–$8_{8,0}EE$	—	—	
	668077.9	$9_{9,0}AE$–$8_{8,1}AE$	—	—	
	668077.9	$9_{9,1}AE$–$8_{8,0}AE$	—	—	
	668081.2	$9_{9,0}EA$–$8_{8,0}EA$	—	—	
	669407.6	$22_{5,18}EA$–$21_{4,17}EA$	2.1	12.0	
	669407.6	$22_{5,18}AE$–$21_{4,17}AE$	—	—	
	669409.0	$22_{5,18}EE$–$21_{4,17}EE$	—	—	
	669410.5	$22_{5,18}AA$–$21_{4,17}AA$	—	—	
	669485.2	$36_{12,24}AE$–$36_{11,25}AE$	2.7	26.5	
	669485.2	$36_{12,25}AE$–$36_{11,26}AE$	—	—	
	669485.6	$36_{12,24}EA$–$36_{11,25}EA$	—	—	
	669486.9	$36_{12,25}EE$–$36_{11,26}EE$	—	—	
	669487.2	$36_{12,24}EE$–$36_{11,25}EE$	—	—	
	669488.9	$36_{12,24}AA$–$36_{11,25}AA$	—	—	
	669488.9	$36_{12,25}AA$–$36_{11,26}AA$	—	—	
	670088.8	$34_{12,23}EA$–$34_{11,24}EA$	5.5	39.1	14
	670089.2	$34_{12,22}AE$–$34_{11,23}AE$	—	—	—
	670089.2	$34_{12,23}AE$–$34_{11,24}AE$	—	—	—
	670089.6	$34_{12,22}EA$–$34_{11,23}EA$	—	—	—
	670090.1	$34_{12,23}EE$–$34_{11,24}EE$	—	—	—
	670090.6	$34_{12,22}EE$–$34_{11,23}EE$	—	—	—
	670091.4	$34_{12,22}AA$–$34_{11,23}AA$	—	—	—
	670091.4	$34_{12,23}AA$–$34_{11,24}AA$	—	—	—
	671161.4	$29_{12,17}AA$–$29_{11,18}AA$	3.2	35.4	
	671161.4	$29_{12,18}AA$–$29_{11,19}AA$	—	—	
	671161.4	$29_{12,17}EE$–$29_{11,18}EE$	—	—	
	671161.5	$29_{12,17}EA$–$29_{11,18}EA$	—	—	
	671162.0	$29_{12,18}EE$–$29_{11,19}EE$	—	—	
	671162.1	$29_{12,17}AE$–$29_{11,18}AE$	—	—	
	671162.1	$29_{12,18}AE$–$29_{11,19}AE$	—	—	
	671162.7	$29_{12,18}EA$–$29_{11,19}EA$	—	—	

TABLE 16—*Continued*

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes[a]
CH_3OCH_3.....	671208.9	$36_{3,34}AA$–$35_{4,31}AA$	1.9	13.3	
	671209.1	$36_{3,33}EE$–$35_{4,32}EE$	—	—	
	671209.3	$36_{3,33}EA$–$35_{4,32}EA$	—	—	
	671209.3	$36_{3,34}AE$–$35_{4,31}AE$	—	—	
	671312.8	$28_{12,17}AA$–$28_{11,18}AA$	2.2	49.9	
	671312.8	$28_{12,16}AA$–$28_{11,17}AA$	—	—	
	671313.1	$28_{12,16}EE$–$28_{11,17}EE$	—	—	
	671313.4	$28_{12,16}EA$–$28_{11,17}EA$	—	—	
	671313.8	$28_{12,17}EE$–$28_{11,18}EE$	—	—	
	671314.1	$28_{12,17}AE$–$28_{11,18}AE$	—	—	
	671314.1	$28_{12,16}AE$–$28_{11,17}AE$	—	—	
	671314.7	$28_{12,17}EA$–$28_{11,18}EA$	—	—	
	672903.4	$23_{4,19}AE$–$22_{3,20}AE$	6.2	62.3	15
	672903.4	$23_{4,19}EA$–$22_{3,20}EA$	—	—	—
	672905.5	$23_{4,19}EE$–$22_{3,20}EE$	—	—	—
	672907.5	$23_{4,19}AA$–$22_{3,20}AA$	—	—	—
	679791.2	$22_{5,17}AE$–$21_{4,18}AE$	4.4	46.9	
	679791.2	$22_{5,17}EA$–$21_{4,18}EA$	—	—	
	679792.8	$22_{5,17}EE$–$21_{4,18}EE$	—	—	
	679794.2	$22_{5,17}AA$–$21_{4,18}AA$	—	—	
	680039.1	$38_{2,37}EA$–$37_{1,37}EA$	3.8	31.0	16
	680039.1	$38_{2,36}AE$–$37_{1,37}AE$	—	—	—
	680039.2	$38_{2,37}EE$–$37_{1,37}EE$	—	—	—
	680039.2	$38_{2,36}AA$–$37_{1,37}AA$	—	—	—
	680041.9	$38_{1,38}AE$–$37_{2,35}AE$	—	—	—
	680041.9	$38_{1,38}EA$–$37_{2,36}EA$	—	—	—
	680042.0	$38_{1,38}EE$–$37_{2,36}EE$	—	—	—
	680042.0	$38_{1,38}AA$–$37_{2,35}AA$	—	—	—
	680923.9	$19_{6,14}EA$–$18_{5,13}EA$	7.2	52.4	
	680924.6	$19_{6,14}AE$–$18_{5,13}AE$	—	—	
	680925.8	$19_{6,14}EE$–$18_{5,13}EE$	—	—	
	680927.2	$19_{6,14}AA$–$18_{5,13}AA$	—	—	
	681090.1	$19_{6,13}AE$–$18_{5,14}AE$	5.5	29.2	
	681090.9	$19_{6,13}EA$–$18_{5,14}EA$	—	—	
	681091.6	$19_{6,13}EE$–$18_{5,14}EE$	—	—	
	681092.7	$19_{6,13}AA$–$18_{5,14}AA$	—	—	
	683685.8	$16_{7,10}EA$–$15_{6,9}EA$	11.1	81.1	
	683687.9	$16_{7,10}EE$–$15_{6,9}EE$	—	—	
	683689.0	$16_{7,10}AE$–$15_{6,9}AE$	—	—	
	683689.6	$16_{7,9}AE$–$15_{6,10}AE$	—	—	
	683689.9	$16_{7,10}AA$–$15_{6,9}AA$	—	—	
	683690.4	$16_{7,9}AA$–$15_{6,10}AA$	—	—	
	683691.5	$16_{7,9}EE$–$15_{6,10}EE$	—	—	
	683692.8	$16_{7,9}EA$–$15_{6,10}EA$	—	—	
	684325.2	$34_{4,31}AA$–$33_{1,32}AA$	4.7	48.3	
	684327.6	$34_{4,30}EE$–$33_{1,32}EE$	—	—	
	684330.1	$34_{4,30}EA$–$33_{1,32}EA$	—	—	
	684330.1	$34_{4,31}AE$–$33_{1,32}AE$	—	—	
	684840.9	$23_{5,19}EA$–$22_{4,18}EA$	4.4	27.0	
	684840.9	$23_{5,19}AE$–$22_{4,18}AE$	—	—	
	684842.1	$23_{5,19}EE$–$22_{4,18}EE$	—	—	
	684843.3	$23_{5,19}AA$–$22_{4,18}AA$	—	—	
	685336.6	$22_{3,19}EA$–$21_{2,20}EA$	1.9	16.4	
	685336.6	$22_{3,19}AE$–$21_{2,20}AE$	—	—	
	685340.2	$22_{3,19}EE$–$21_{2,20}EE$	—	—	
	685343.8	$22_{3,19}AA$–$21_{2,20}AA$	—	—	
	685492.6	$13_{8,6}EA$–$12_{7,5}EA$	19.8	250.0	17
	685493.6	$13_{8,6}EE$–$12_{7,5}EE$	—	—	—
	685494.6	$13_{8,6}AA$–$12_{7,5}AA$	—	—	—
	685494.6	$13_{8,5}AA$–$12_{7,6}AA$	—	—	—
	685496.4	$13_{8,6}AE$–$12_{7,5}AE$	—	—	—
	685496.4	$13_{8,5}AE$–$12_{7,6}AE$	—	—	—
	685497.4	$13_{8,5}EE$–$12_{7,6}EE$	—	—	—
	685500.2	$13_{8,5}EA$–$12_{7,6}EA$	—	—	—
	687030.6	$10_{9,2}AA$–$9_{8,1}AA$	12.4	187.2	

TABLE 16—*Continued*

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* dv^a$ (K km s^{-1})	Notes[a]
CH_3OCH_3.....	687030.6	$10_{9,1}AA$–$9_{8,2}AA$	—	—	
	687031.2	$10_{9,2}EE$–$9_{8,2}EE$	—	—	
	687032.0	$10_{9,2}EA$–$9_{8,2}EA$	—	—	
	687034.6	$10_{9,1}EE$–$9_{8,1}EE$	—	—	
	687035.3	$10_{9,2}AE$–$9_{8,1}AE$	—	—	
	687035.3	$10_{9,1}AE$–$9_{8,2}AE$	—	—	
	687038.6	$10_{9,1}EA$–$9_{8,1}EA$	—	—	
	695432.6	$35_{4,32}AA$–$34_{1,33}AA$	4.8	49.6	
	695435.1	$35_{4,31}EE$–$34_{1,33}EE$	—	—	
	695437.5	$35_{4,31}EA$–$34_{1,33}EA$	—	—	
	695437.5	$35_{4,32}AE$–$34_{1,33}AE$	—	—	
	698347.5	$40_{6,34}EE$–$39_{3,36}EE$	1.3	2.1	
	698354.6	$40_{6,34}AA$–$39_{3,37}AA$	—	—	
	699432.7	$24_{5,20}EA$–$23_{4,19}EA$	3.3	22.0	
	699432.7	$24_{5,20}AE$–$23_{4,19}AE$	—	—	
	699433.6	$24_{5,20}EE$–$23_{4,19}EE$	—	—	
	699434.5	$24_{5,20}AA$–$23_{4,19}AA$	—	—	
	699437.3	$20_{6,15}EA$–$19_{5,14}EA$	—	—	
	699437.6	$20_{6,15}AE$–$19_{5,14}AE$	—	—	
	699438.8	$20_{6,15}EE$–$19_{5,14}EE$	—	—	
	699440.0	$20_{6,15}AA$–$19_{5,14}AA$	—	—	
	699453.1	$23_{5,18}AE$–$22_{4,19}AE$	2.5	16.0	
	699453.2	$23_{5,18}EA$–$22_{4,19}EA$	—	—	
	699454.4	$23_{5,18}EE$–$22_{4,19}EE$	—	—	
	699455.8	$23_{5,18}AA$–$22_{4,19}AA$	—	—	
	699719.9	$20_{6,14}AE$–$19_{5,15}AE$	1.7	7.3	
	699720.2	$20_{6,14}EA$–$19_{5,15}EA$	—	—	
	699721.1	$20_{6,14}EE$–$19_{5,15}EE$	—	—	
	702532.5	$17_{7,11}EA$–$16_{6,10}EA$	5.2	45.6	
	702534.5	$17_{7,11}EE$–$16_{6,10}EE$	—	—	
	702535.2	$17_{7,11}AE$–$16_{6,10}AE$	—	—	
	702536.1	$17_{7,11}AA$–$16_{6,10}AA$	—	—	
	702536.5	$17_{7,10}AE$–$16_{6,11}AE$	—	—	
	702537.2	$17_{7,10}AA$–$16_{6,11}AA$	—	—	
	702538.1	$17_{7,10}EE$–$16_{6,11}EE$	—	—	
	702539.3	$17_{7,10}EA$–$16_{6,11}EA$	—	—	
	704422.9	$14_{8,7}EA$–$13_{7,6}EA$	5.9	50.1	
	704423.8	$14_{8,7}EE$–$13_{7,6}EE$	—	—	
	704424.8	$14_{8,7}AA$–$13_{7,6}AA$	—	—	
	704424.8	$14_{8,6}AA$–$13_{7,7}AA$	—	—	
	704426.6	$14_{8,7}AE$–$13_{7,6}AE$	—	—	
	704426.6	$14_{8,6}AE$–$13_{7,7}AE$	—	—	
	704427.6	$14_{8,6}EE$–$13_{7,7}EE$	—	—	
	704430.3	$14_{8,6}EA$–$13_{7,7}EA$	—	—	
	705985.8	$11_{9,2}AA$–$10_{8,3}AA$	7.4	45.8	
	705985.8	$11_{9,3}AA$–$10_{8,2}AA$	—	—	
	705986.6	$11_{9,3}EE$–$10_{8,3}EE$	—	—	
	705987.3	$11_{9,3}EA$–$10_{8,3}EA$	—	—	
	705989.8	$11_{9,2}EE$–$10_{8,2}EE$	—	—	
	705990.5	$11_{9,2}AE$–$10_{8,3}AE$	—	—	
	705990.5	$11_{9,3}AE$–$10_{8,2}AE$	—	—	
	705993.8	$11_{9,2}EA$–$10_{8,2}EA$	—	—	
	707335.2	$36_{4,33}AA$–$35_{1,34}AA$	1.9	11.2	18
	707337.6	$36_{4,32}EE$–$35_{1,34}EE$	—	—	—
	707340.1	$36_{4,32}EA$–$35_{1,34}EA$	—	—	—
	707340.1	$36_{4,33}AE$–$35_{1,34}AE$	—	—	—
	712723.8	$44_{1,43}AE$–$43_{4,40}AE$	2.0	11.0	
	712723.8	$44_{1,43}EA$–$43_{4,39}EA$	—	—	
	717837.8	$21_{6,16}EA$–$20_{5,15}EA$	1.8	9.4	
	717837.9	$21_{6,16}AE$–$20_{5,15}AE$	—	—	
	717838.9	$21_{6,16}EE$–$20_{5,15}EE$	—	—	
	717840.0	$21_{6,16}AA$–$20_{5,15}AA$	—	—	
	718305.4	$21_{6,15}AE$–$20_{5,16}AE$	4.9	24.8	
	718305.6	$21_{6,15}EA$–$20_{5,16}EA$	—	—	
	718306.4	$21_{6,15}EE$–$20_{5,16}EE$	—	—	

TABLE 16—*Continued*

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes[a]
CH_3OCH_3.....	718307.4	$21_{6,15}AA$–$20_{5,16}AA$	—	—	
	719557.6	$24_{5,19}AE$–$23_{4,20}AE$	1.1	1.9	19
	719557.6	$24_{5,19}EA$–$23_{4,20}EA$	—	—	—
	719558.7	$24_{5,19}EE$–$23_{4,20}EE$	—	—	—
	719559.8	$24_{5,19}AA$–$23_{4,20}AA$	—	—	—
	721352.8	$18_{7,12}EE$–$17_{6,11}EE$	2.3	17.5	
	721353.2	$18_{7,12}AE$–$17_{6,11}AE$	—	—	
	721353.8	$18_{7,12}AA$–$17_{6,11}AA$	—	—	
	721355.8	$18_{7,11}AE$–$17_{6,12}AE$	—	—	
	721356.4	$18_{7,11}AA$–$17_{6,12}AA$	—	—	
	721356.9	$18_{7,11}EE$–$17_{6,12}EE$	—	—	
	721357.9	$18_{7,11}EA$–$17_{6,12}EA$	—	—	
	722575.2	$39_{5,35}AA$–$38_{4,34}AA$	8.1	48.5	20
	722575.3	$39_{5,35}EE$–$38_{4,35}EE$	—	—	—
	722575.4	$39_{5,35}EA$–$38_{4,35}EA$	—	—	—
	722575.4	$39_{5,35}AE$–$38_{4,34}AE$	—	—	—
	723342.9	$15_{8,8}EA$–$14_{7,7}EA$	6.1	52.7	21
	723343.8	$15_{8,8}EE$–$14_{7,7}EE$	—	—	—
	723344.6	$15_{8,8}AA$–$14_{7,7}AA$	—	—	—
	723344.6	$15_{8,7}AA$–$14_{7,8}AA$	—	—	—
	723346.4	$15_{8,8}AE$–$14_{7,7}AE$	—	—	—
	723346.4	$15_{8,7}AE$–$14_{7,8}AE$	—	—	—
	723350.0	$15_{8,7}EA$–$14_{7,8}EA$	—	—	—
	724937.9	$12_{9,4}AA$–$11_{8,3}AA$	5.9	52.7	
	724937.9	$12_{9,3}AA$–$11_{8,4}AA$	—	—	
	724938.6	$12_{9,4}EE$–$11_{8,4}EE$	—	—	
	724939.4	$12_{9,4}EA$–$11_{8,4}EA$	—	—	
	724941.8	$12_{9,3}EE$–$11_{8,3}EE$	—	—	
	724942.5	$12_{9,4}AE$–$11_{8,3}AE$	—	—	
	724942.5	$12_{9,3}AE$–$11_{8,4}AE$	—	—	
	724945.7	$12_{9,3}EA$–$11_{8,3}EA$	—	—	

NOTES.—(1) Too strong, possible blend with *U* line. (2) Too strong, possible Blend with *U* line. (3) Blend with $^{13}CH_3OH$ at 612934.2. (4) Blend with SO_2 at 613676.5. (5) Blend with CH_3CN at 624878.9 and SO_2 at 624887.5. (6) Blend with SiH at 624920.1, 624926.4 and 624935.8; and CH_3CN at 624914.6 and 624926.4. (7) Blend with CH_3OH at 627013.0. (8) Blend with CH_3CN at 642280.7. (9) Blend with CH_3CH_2CN at 643412.7. (10) Blend with SO_2 at 647455.2. (11) Blend with SO_2 at 660472.7. (12) Blend with SO_2 at 662414.6. (13) Blend with $HCOOCH_3$ at 665705.8. (14) Blend with NO at 670091.7. (15) Blend with CH_3OH at 672903.7. (16) Blend with CN at 680947.4. (17) Blend with CH_3OH at 685505.1. (18) Blend with $^{13}CH_3OH$ at 707342.3. (19) Questionable assignment. (20) Blend with CH_3OH at 722566.7 and $C^{34}S$ at 722576.8. (21) Blend CH_3OH at 723336.8. This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal*.

[a] Dashes indicate that the line is part of a blend, and intensity and area are given by the values preceding it.

TABLE 17

TABLE OF C_2H_5CN MOLECULES

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* d\nu^a$ (K km s^{-1})	Notes[a]
C_2H_5CN.....	608021.4	$24_{9,15}-23_{8,16}$	5.9	34.2	
	612227.4	$35_{7,28}-34_{6,29}$	5.1	68.7	
	615248.7	$30_{8,23}-29_{7,22}$	2.5	20.5	
	617180.3	$72_{2,71}-71_{2,70}$	2.9	3.6	
	617180.5	$72_{1,71}-71_{1,70}$	—	—	
	617234.4	$69_{12,58}-68_{12,57}$	4.9	24.9	
	617234.4	$69_{12,57}-68_{12,56}$	—	—	
	617618.8	$69_{11,58}-68_{11,57}$	—	—	
	617919.0	$41_{6,35}-40_{5,36}$	6.1	108.4	1
	619340.6	$43_{6,38}-42_{5,37}$	8.0	62.2	2
	623779.8	$72_{3,70}-71_{3,69}$	4.8	19.0	
	625024.7	$44_{6,39}-43_{5,38}$	1.7	5.7	
	629790.6	$71_{4,67}-70_{4,66}$	2.0	10.1	
	634766.7	$71_{13,59}-70_{13,58}$	2.9	19.7	
	634766.7	$71_{13,58}-70_{13,57}$	—	—	
	635414.4	$71_{23,48}-70_{23,47}$	1.8	11.1	
	635414.4	$71_{23,49}-70_{23,48}$	—	—	
	635697.2	$75_{1,75}-74_{1,74}$	3.3	39.2	
	635697.2	$75_{0,75}-74_{0,74}$	—	—	
	637723.4	$12_{12,1}-11_{11,0}$	1.7	9.0	
	638119.4	$38_{7,31}-37_{6,32}$	2.1	17.4	
	646708.8	$13_{12,2}-12_{11,1}$	—	—	
	650569.4	$34_{8,27}-33_{7,26}$	2.1	26.9	
	650594.7	$76_{1,75}-75_{1,74}$	—	—	
	650680.9	$42_{4,38}-41_{3,39}$	—	—	
	652534.2	$73_{13,61}-72_{13,60}$	—	—	
	653323.8	$73_{11,62}-72_{11,61}$	1.9	19.9	
	654030.8	$73_{10,64}-72_{10,63}$	2.0	18.2	
	654519.6	$40_{7,34}-39_{6,33}$	2.1	20.2	
	659989.2	$56_{6,51}-55_{5,50}$	2.7	14.4	
	663842.8	$74_{7,68}-73_{7,67}$	1.7	12.5	
	663951.2	$20_{11,9}-19_{10,10}$	2.5	18.7	
	663951.2	$20_{11,10}-19_{10,9}$	—	—	
	664682.9	$15_{12,3}-14_{11,4}$	3.3	39.6	
	664682.9	$15_{12,4}-14_{11,3}$	—	—	
	666418.4	$20_{15,5}-20_{14,6}$	—	—	
	666518.4	$22_{15,7}-22_{14,8}$	—	—	
	666624.8	$24_{15,10}-24_{14,11}$	—	—	
	666908.8	$29_{15,14}-29_{14,15}$	3.0	57.4	
	666908.8	$29_{15,15}-29_{14,16}$	—	—	
	667026.8	$31_{15,17}-31_{14,18}$	3.5	46.0	
	667026.8	$31_{15,16}-31_{14,17}$	—	—	
	667718.9	$43_{15,28}-43_{14,29}$	2.0	19.4	
	667718.9	$43_{15,29}-43_{14,30}$	—	—	
	667817.3	$45_{15,31}-45_{14,32}$	2.2	38.4	
	667817.3	$45_{15,30}-45_{14,31}$	—	—	
	667949.4	$48_{15,33}-48_{14,34}$	2.7	14.8	
	667949.4	$48_{15,34}-48_{14,35}$	—	—	
	670499.6	$31_{9,23}-30_{8,22}$	2.6	26.1	
	670499.6	$31_{9,22}-30_{8,23}$	—	—	
	679393.0	$32_{9,24}-31_{8,23}$	3.4	26.6	
	679393.0	$32_{9,23}-31_{8,24}$	—	—	
	680094.6	$76_{11,65}-75_{11,64}$ $32_{9,23}-31_{8,24}$	—	—	
	680481.1	$78_{4,75}-77_{4,74}$	2.9	31.9	
	680507.1	$78_{3,75}-77_{3,74}$	2.4	26.5	
	680841.3	$43_{7,36}-42_{6,37}$	2.4	28.9	
	681913.1	$22_{11,11}-21_{10,12}$	1.5	2.7	
	681913.1	$22_{11,12}-21_{10,11}$	—	—	
	681946.1	$76_{9,68}-75_{9,67}$	3.5	28.2	
	682583.8	$76_{8,69}-75_{8,68}$	3.5	40.8	
	682660.1	$17_{12,5}-16_{11,6}$	4.4	43.1	
	682660.1	$17_{12,6}-16_{11,5}$	—	—	
	683960.4	$80_{1,79}-79_{1,78}$	—	—	
	685611.2	$38_{8,30}-37_{7,31}$	3.0	40.3	

TABLE 17—*Continued*

Molecule	ν (MHz)	J_{K_p,K_m}	T_R^{*a} (K)	$\int T_R^* dv^a$ (K km s^{-1})	Notes[a]
C_2H_5CN.....	691649.4	$18_{12,7}-17_{11,6}$	—	—	
	698787.6	$29_{10,19}-28_{9,20}$	0.8	2.9	3
	698787.6	$29_{10,20}-28_{9,19}$	—	—	—
	700639.0	$19_{12,7}-18_{11,8}$	1.9	14.9	
	700639.0	$19_{12,8}-18_{11,7}$	—	—	
	707727.9	$30_{10,20}-29_{9,21}$	1.8	30.8	
	707727.9	$30_{10,21}-29_{9,20}$	—	—	
	708951.2	$83_{2,82}-82_{2,81}$	2.9	24.4	
	708951.2	$83_{1,82}-82_{1,81}$	—	—	
	709628.6	$20_{12,8}-19_{11,9}$	1.7	9.2	
	709628.6	$20_{12,9}-19_{11,8}$	—	—	
	711304.5	$18_{16,2}-18_{15,3}$	1.7	19.2	
	711304.5	$18_{16,3}-18_{15,4}$	—	—	
	712527.6	$37_{16,22}-37_{15,23}$	2.6	25.4	
	712527.6	$37_{16,21}-37_{15,22}$	—	—	
	712673.9	$39_{16,24}-39_{15,25}$	1.7	11.9	
	712673.9	$39_{16,23}-39_{15,24}$	—	—	
	712746.9	$40_{16,25}-40_{15,26}$	4.0	22.7	
	712746.9	$40_{16,24}-40_{15,25}$	—	—	
	716662.4	$31_{10,21}-30_{9,22}$	—	—	
	718618.1	$21_{12,10}-20_{11,9}$	—	—	
	719178.6	$16_{13,3}-15_{12,4}$	2.3	5.5	
	719178.6	$16_{13,4}-15_{12,3}$	—	—	

NOTES.—(1) Too strong, possible blend with *U* line. (2) Too strong, possible blend with *U* line. (3) Questionable assignment. This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal.*

[a] Dashes indicate that the line is part of a blend, and intensity and area are given by the values preceding it.

TABLE 18

TABLE OF *U* LINES

Molecule	ν (MHz)	T_R^* (K)	$\int T_R^* dv$ (K km s^{-1})	Notes
U	608269.3	5.2	72.3	
	609131.2	2.1	9.7	1
	615276.7	6.1	96.7	
	616226.3	3.7	57.7	
	616603.6	3.2	34.1	
	617097.1	6.8	61.3	
	617149.5	7.0	87.5	
	619157.0	5.5	58.3	
	619318.7	11.7	158.6	
	619365.2	9.8	87.6	
	623296.5	11.7	67.1	
	623316.9	9.6	77.7	
	623487.1	10.4	114.5	
	623570.7	19.9	388.4	
	623644.1	13.4	162.4	
	623848.6	5.8	99.6	
	624072.8	4.7	30.2	
	624263.6	4.9	34.9	
	624460.9	8.5	147.2	
	624778.0	5.9	61.2	
	625063.4	4.8	44.3	
	625335.0	4.6	49.0	
	625668.1	4.9	22.7	
	626724.8	3.7	26.2	
	627476.1	6.1	38.8	
	628093.4	2.7	15.1	
	628889.7	5.4	35.2	
	629696.0	2.3	7.3	
	630376.0	3.4	24.3	
	632852.2	1.9	17.7	
	633023.5	3.7	37.0	
	633114.6	3.4	18.0	
	633674.4	3.9	55.9	
	633802.5	3.2	24.0	
	633832.8	7.2	61.3	
	633860.1	5.0	50.7	
	633891.1	4.6	27.4	
	633898.3	4.6	27.6	
	633926.9	5.2	25.9	
	634081.2	5.4	51.3	
	634584.6	6.7	0.0	
	634634.0	2.8	24.2	
	634878.9	9.1	107.6	
	635085.0	4.2	36.5	
	635295.3	1.3	3.2	
	635904.9	2.5	32.7	
	637863.7	4.1	44.4	
	638084.3	2.6	46.7	
	638220.4	2.0	27.5	
	640981.1	1.6	1.7	
	641224.8	1.4	16.3	
	642136.2	2.0	37.7	
	642552.7	1.5	11.9	
	642739.0	6.6	107.1	
	642762.1	2.2	14.0	
	643728.4	2.3	34.3	
	644185.9	3.5	18.3	
	646742.0	1.9	30.1	
	646927.8	1.8	23.6	
	647319.8	1.9	19.8	
	647418.5	2.8	23.9	
	648119.8	6.4	72.8	
	648134.0	5.2	41.6	
	648787.4	2.7	39.7	

TABLE 18—*Continued*

Molecule	ν (MHz)	T_R^* (K)	$\int T_R^* dv$ (K km s^{-1})	Notes
U	649104.5	7.1	134.7	
	650534.1	3.0	22.6	
	651535.9	5.7	73.0	
	653535.4	1.3	12.2	
	653572.1	1.2	12.7	
	653598.0	0.9	6.3	
	653711.0	2.7	39.3	
	653931.4	3.2	35.6	
	654131.1	2.3	37.1	
	654396.9	1.9	22.5	
	654533.4	2.0	16.9	
	654993.4	3.1	17.2	
	656724.0	4.1	35.1	
	657721.9	2.9	41.1	
	657933.8	6.4	61.1	
	658031.5	3.2	20.0	
	658714.7	6.7	100.4	
	658928.3	2.6	8.3	
	659188.8	3.2	39.8	
	659495.2	9.9	198.8	
	660785.2	2.8	26.4	
	662087.2	1.6	11.8	
	663639.1	2.2	33.8	
	664780.9	3.5	34.4	
	665814.5	3.4	39.5	
	666821.3	2.5	16.9	
	670011.3	2.4	20.2	
	670852.2	5.3	43.6	
	670894.5	3.3	39.4	
	671408.4	3.1	124.0	
	671716.8	1.7	12.6	
	672447.3	1.9	11.2	
	673072.1	4.0	56.9	
	673559.9	2.5	72.1	
	674284.5	2.0	13.0	
	675984.0	3.7	24.6	
	677112.4	2.8	37.8	
	677273.0	3.6	28.9	
	677567.6	3.6	42.9	
	677919.9	2.9	16.8	
	678358.0	2.0	20.4	
	678417.7	4.3	55.5	
	678546.9	3.6	37.0	
	678710.4	3.3	21.7	
	679760.8	3.7	18.1	
	680247.8	4.4	52.5	
	682092.3	3.0	28.5	
	683170.8	2.8	39.7	
	683476.8	4.4	25.3	
	683510.6	4.6	63.7	
	684296.1	3.9	44.3	
	684430.0	6.6	52.8	
	687544.7	5.1	51.6	2
	687580.7	4.8	98.7	3
	687696.7	3.0	34.9	
	687718.3	3.1	16.8	
	689289.6	2.3	15.0	
	690672.9	4.3	35.5	4
	692674.4	2.5	14.9	
	692726.2	4.0	59.1	
	693790.3	3.1	43.8	
	694726.2	6.8	42.1	
	695067.1	4.7	87.2	
	695525.3	2.1	11.5	

TABLE 18—*Continued*

Molecule	ν (MHz)	T_R^* (K)	$\int T_R^* dv$ (K km s^{-1})	Notes
U	695773.7	2.1	18.5	
	697061.3	3.5	41.4	
	697297.5	1.9	11.2	
	697500.6	2.1	21.9	
	697660.7	1.7	12.6	
	697761.5	2.6	22.0	
	699071.6	3.5	37.7	
	706631.8	5.7	133.8	
	708216.1	2.8	21.9	
	708654.2	3.7	28.3	
	709006.3	4.1	35.7	
	709308.3	6.7	195.9	
	709466.2	5.1	53.4	
	711316.9	1.7	19.2	
	713409.6	3.6	30.7	
	714375.3	2.0	16.2	
	714455.9	3.2	40.8	5
	714617.5	2.8	41.5	
	714971.8	4.4	28.6	
	715195.9	3.9	60.8	
	714984.0	5.2	41.3	
	715407.1	2.9	25.4	
	715446.0	3.7	47.1	
	715767.2	3.3	64.7	
	716167.5	5.1	69.5	
	717308.3	3.1	25.6	
	719948.0	2.7	22.9	
	723866.6	1.5	3.9	

NOTES.—(1) Questionable assignment. (2) Questionable assignment. (3) Questionable assignment. (4) Questionable assignment. (5) Questionable assignment. This table is available in machine-readable form in the electronic edition of *The Astrophysical Journal.*

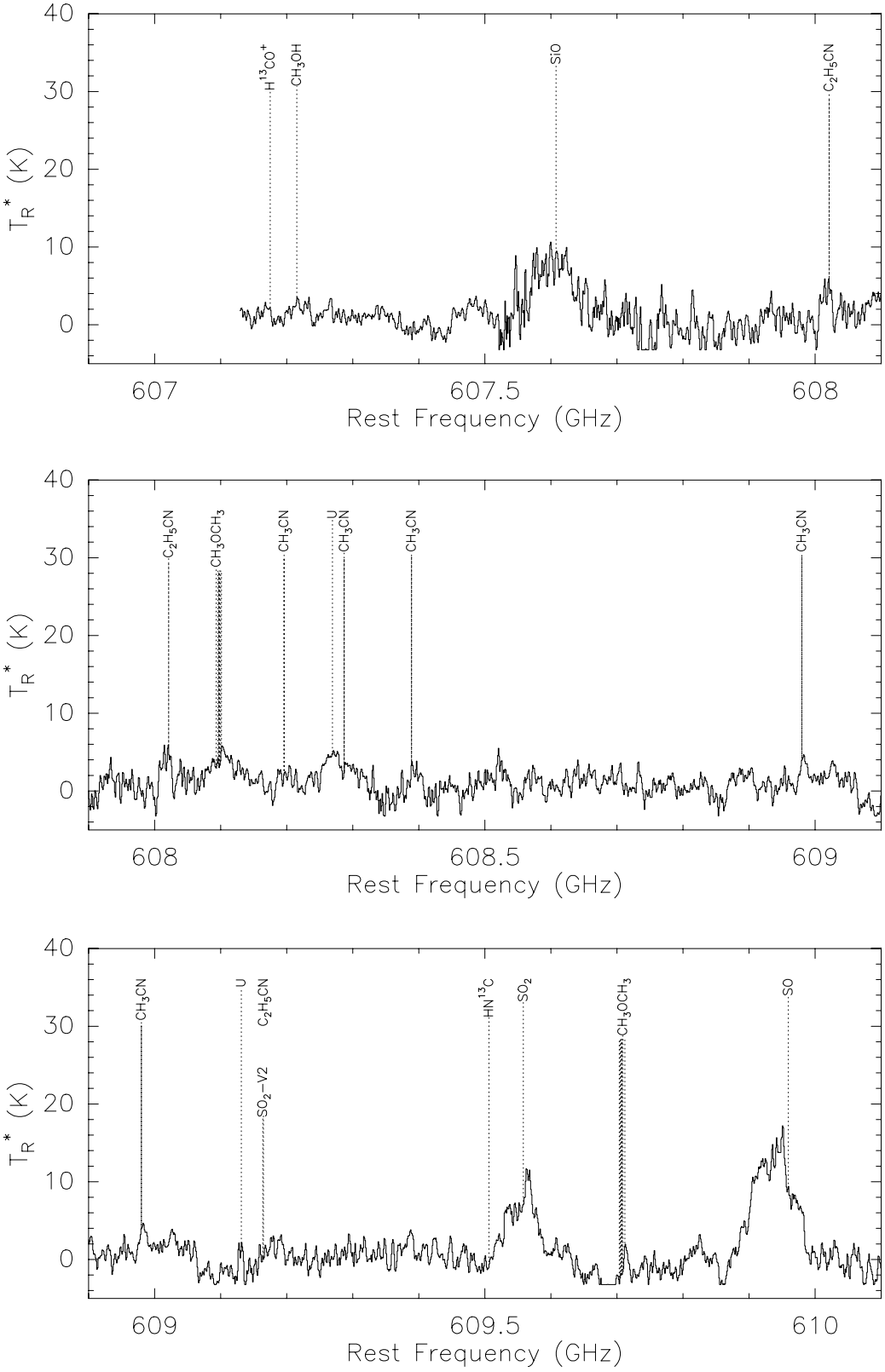


FIG. 4.—Line survey from 607–725 GHz. All observed lines are marked. The adopted source velocity is 9 km s^{-1}, and the spectra are plotted with 1 MHz resolution. Notice the gap between 620 and 623 GHz.

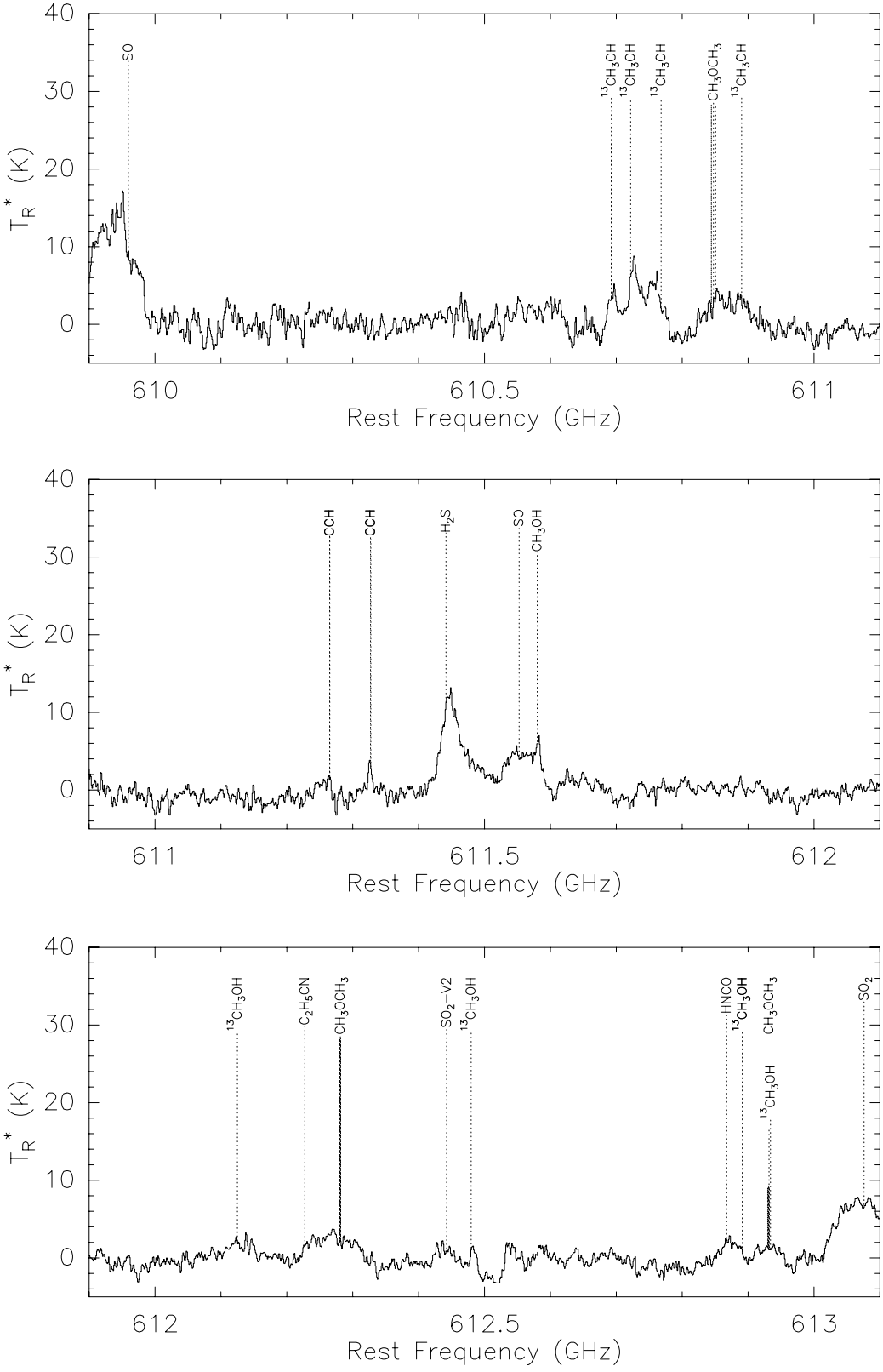


FIG. 4.—*Continued*

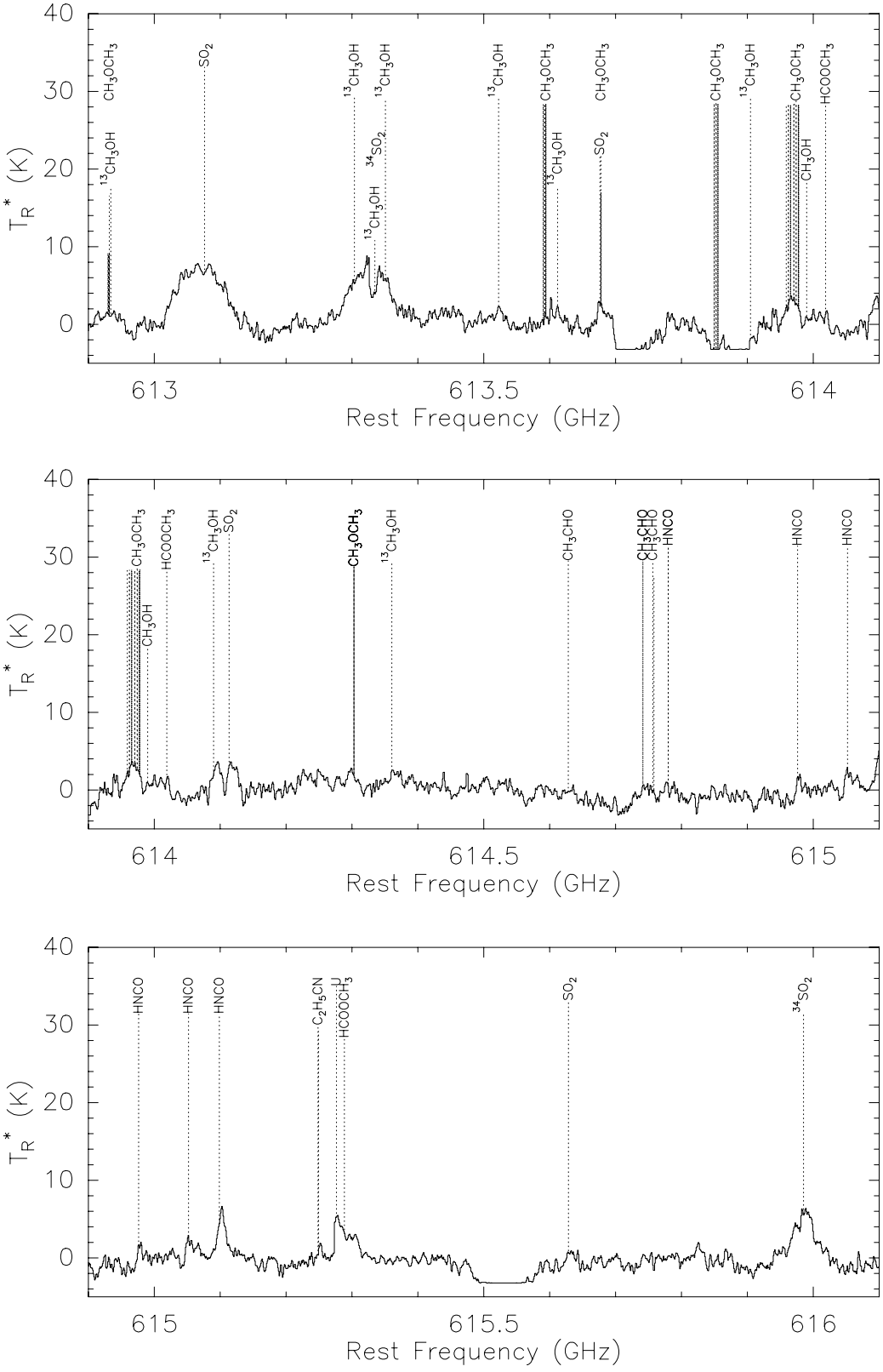


FIG. 4.—*Continued*

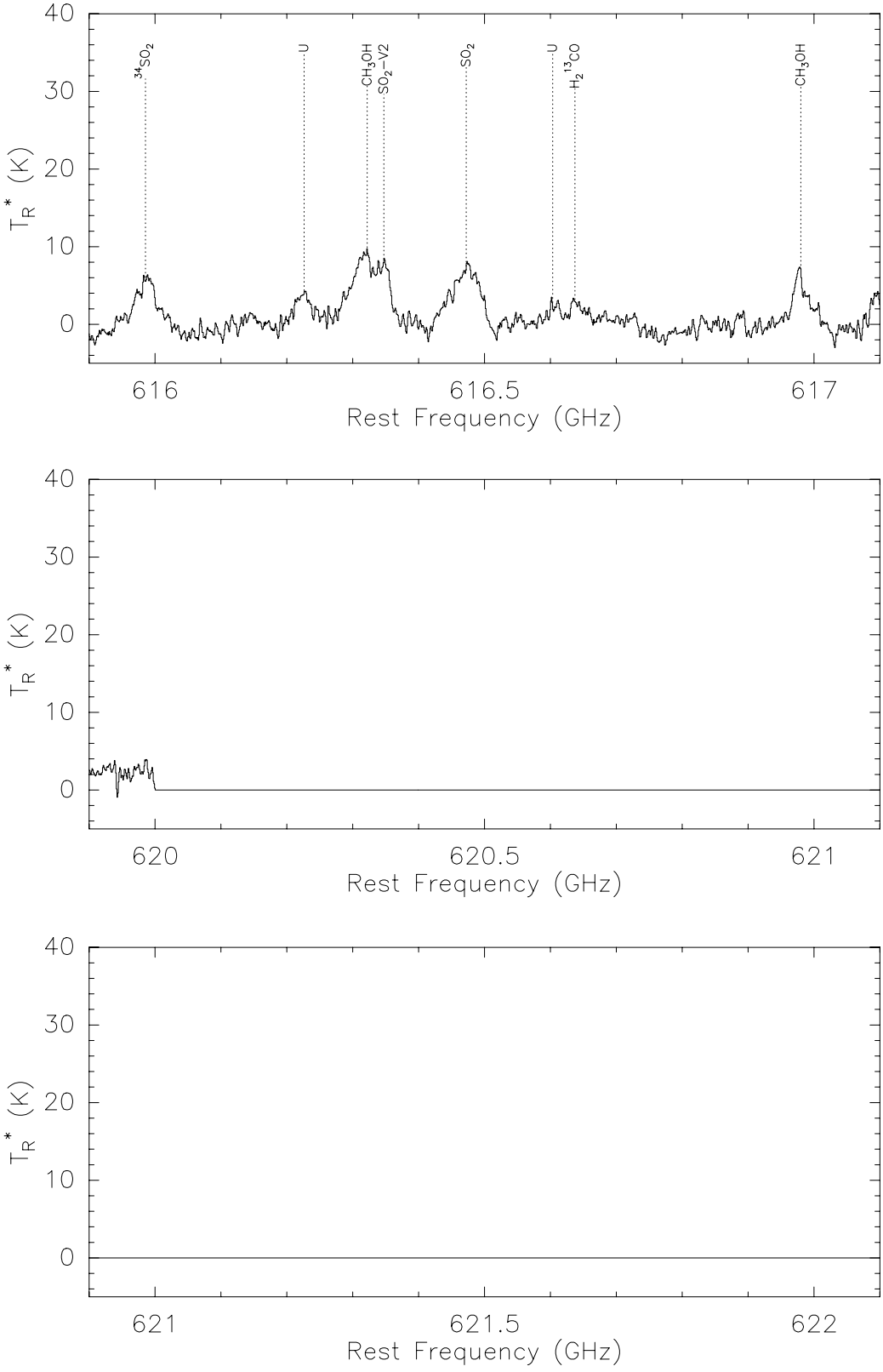
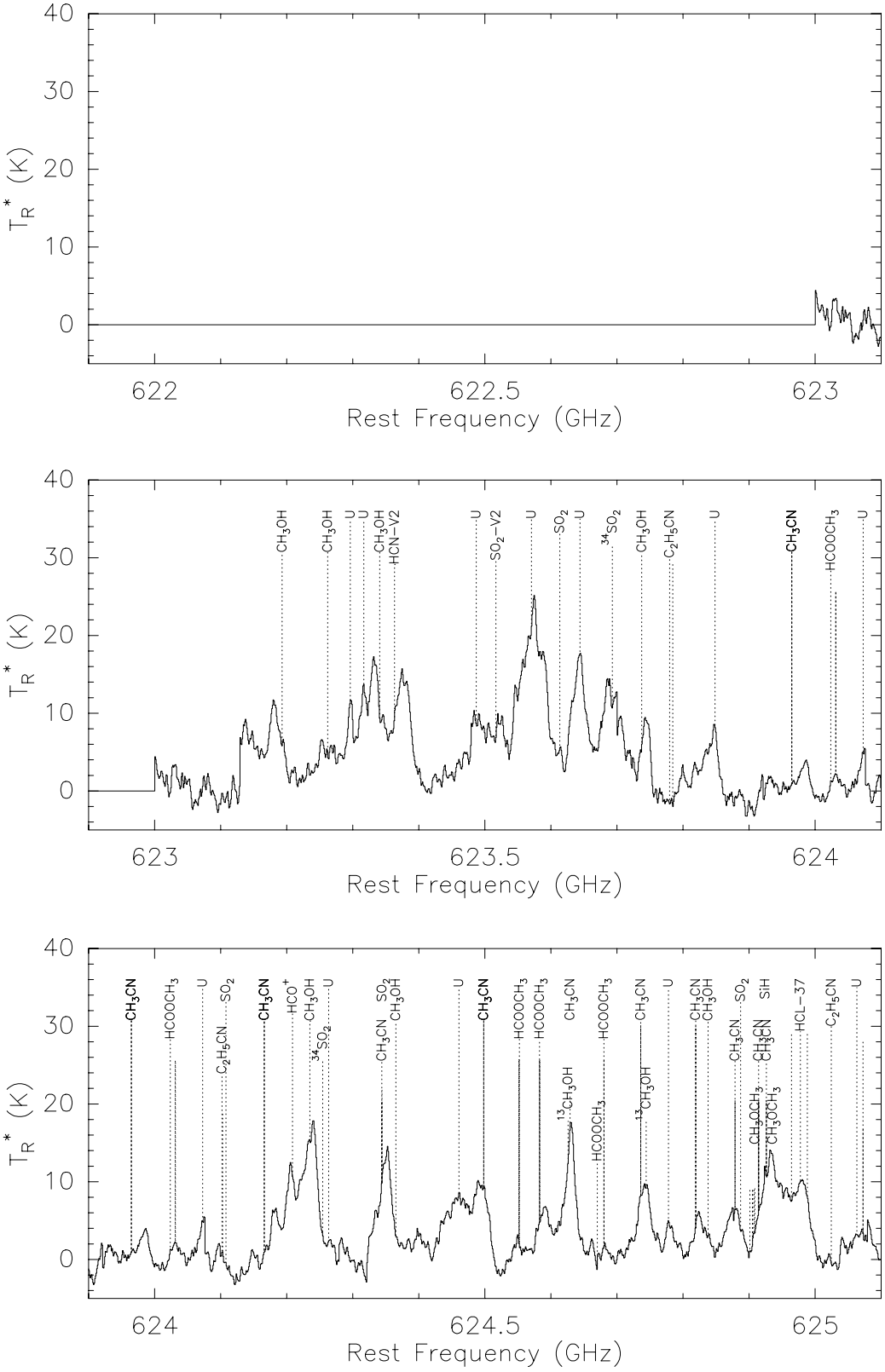


FIG. 4.—*Continued*



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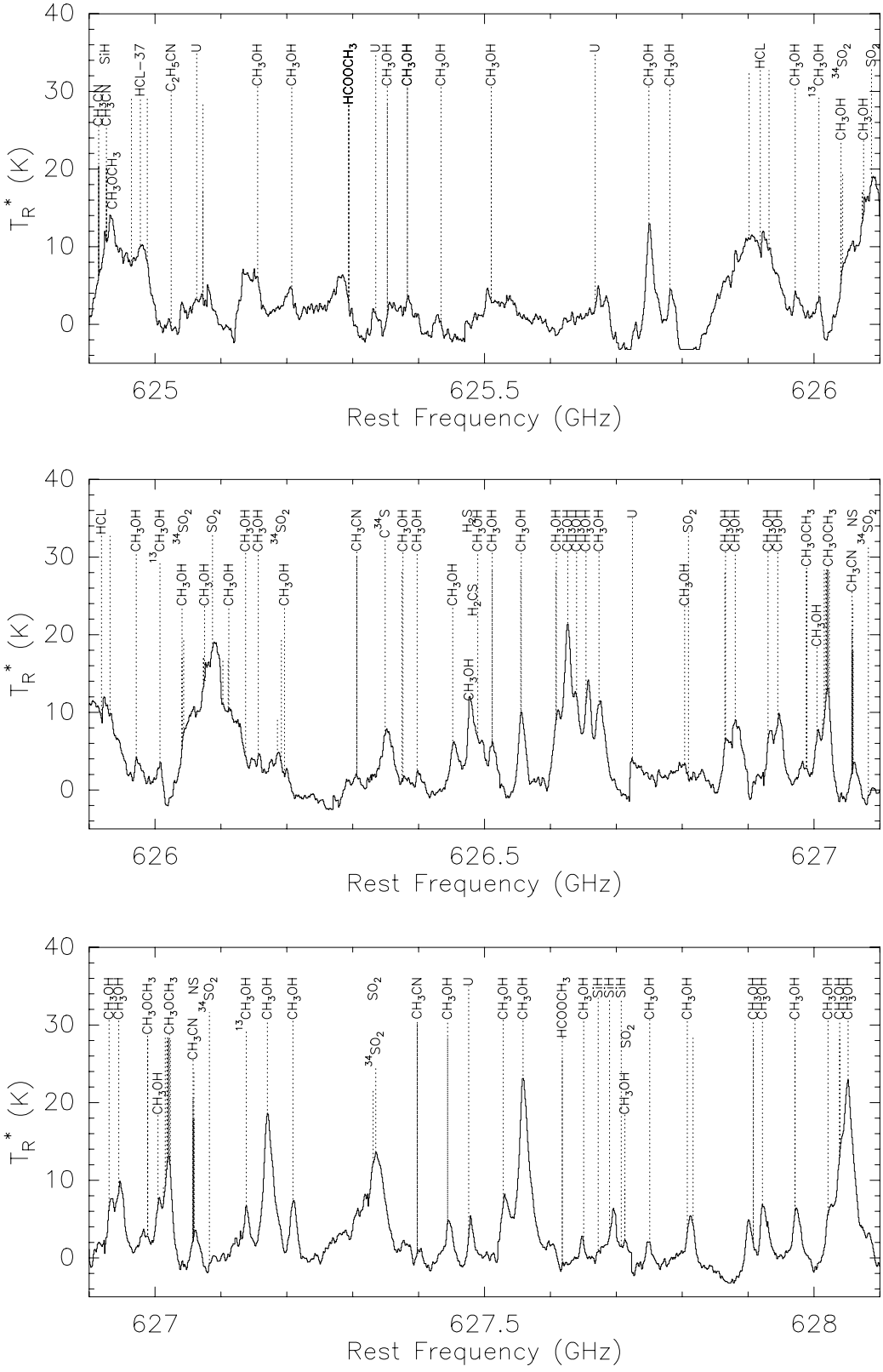

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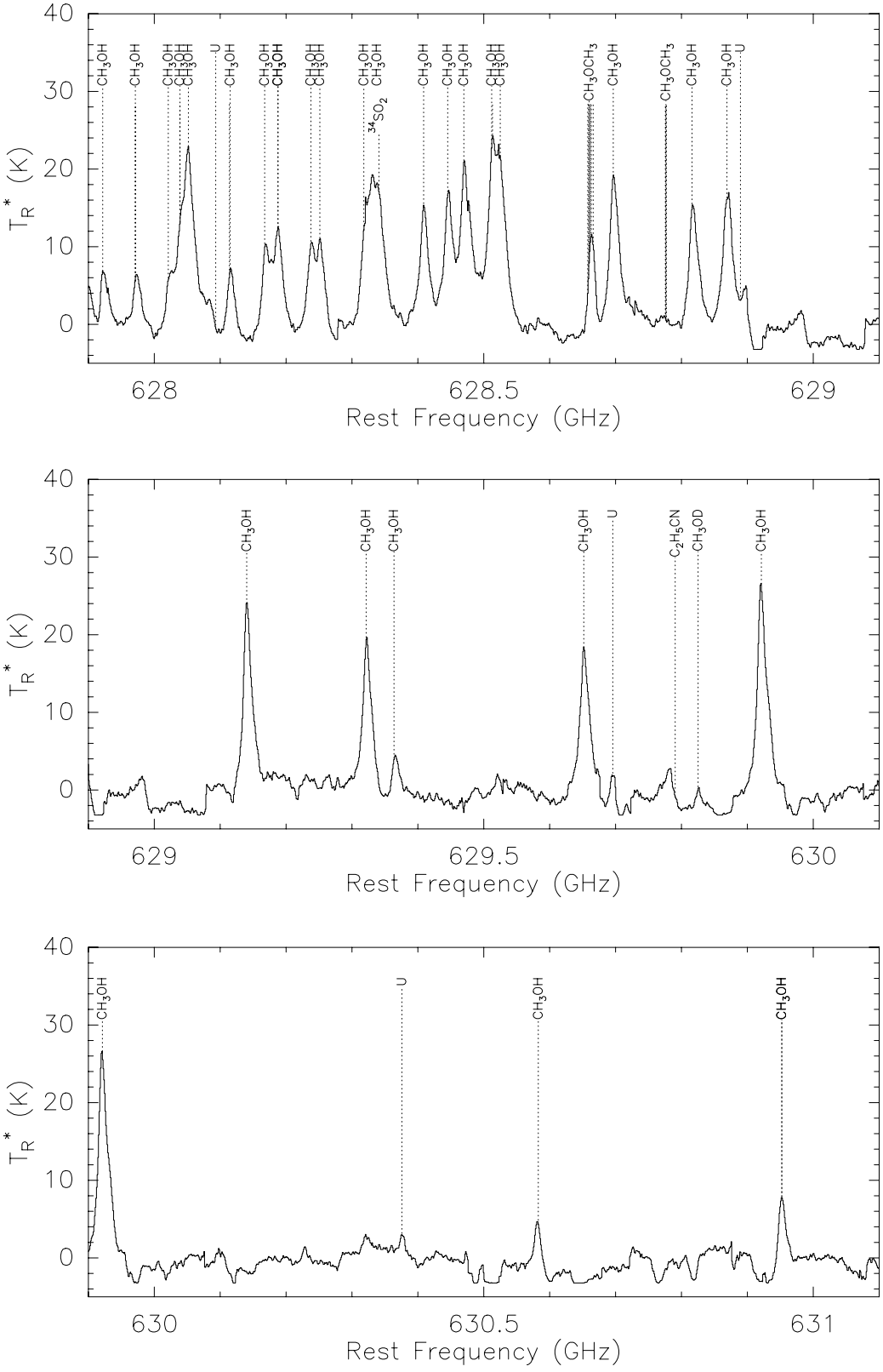

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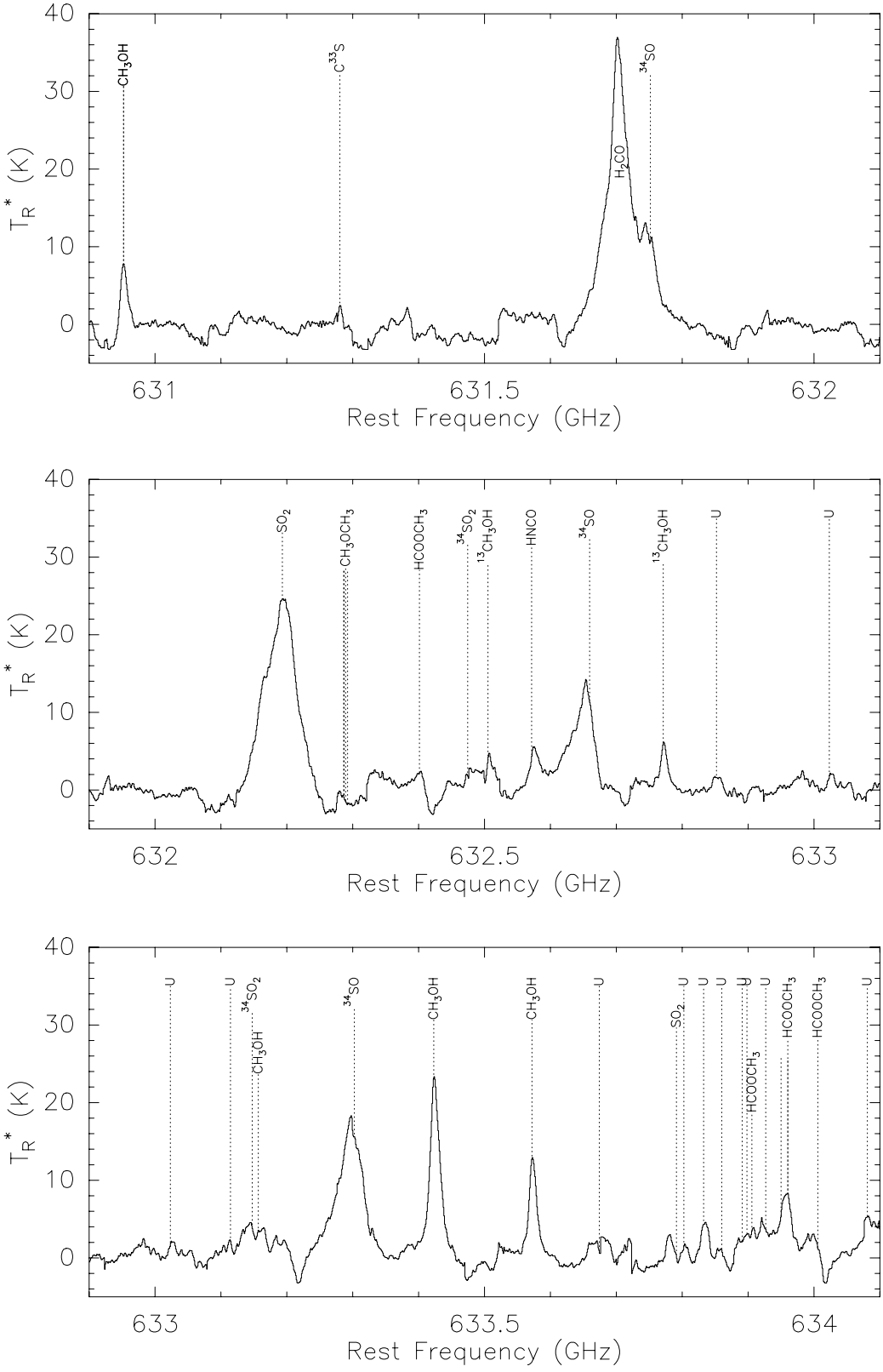

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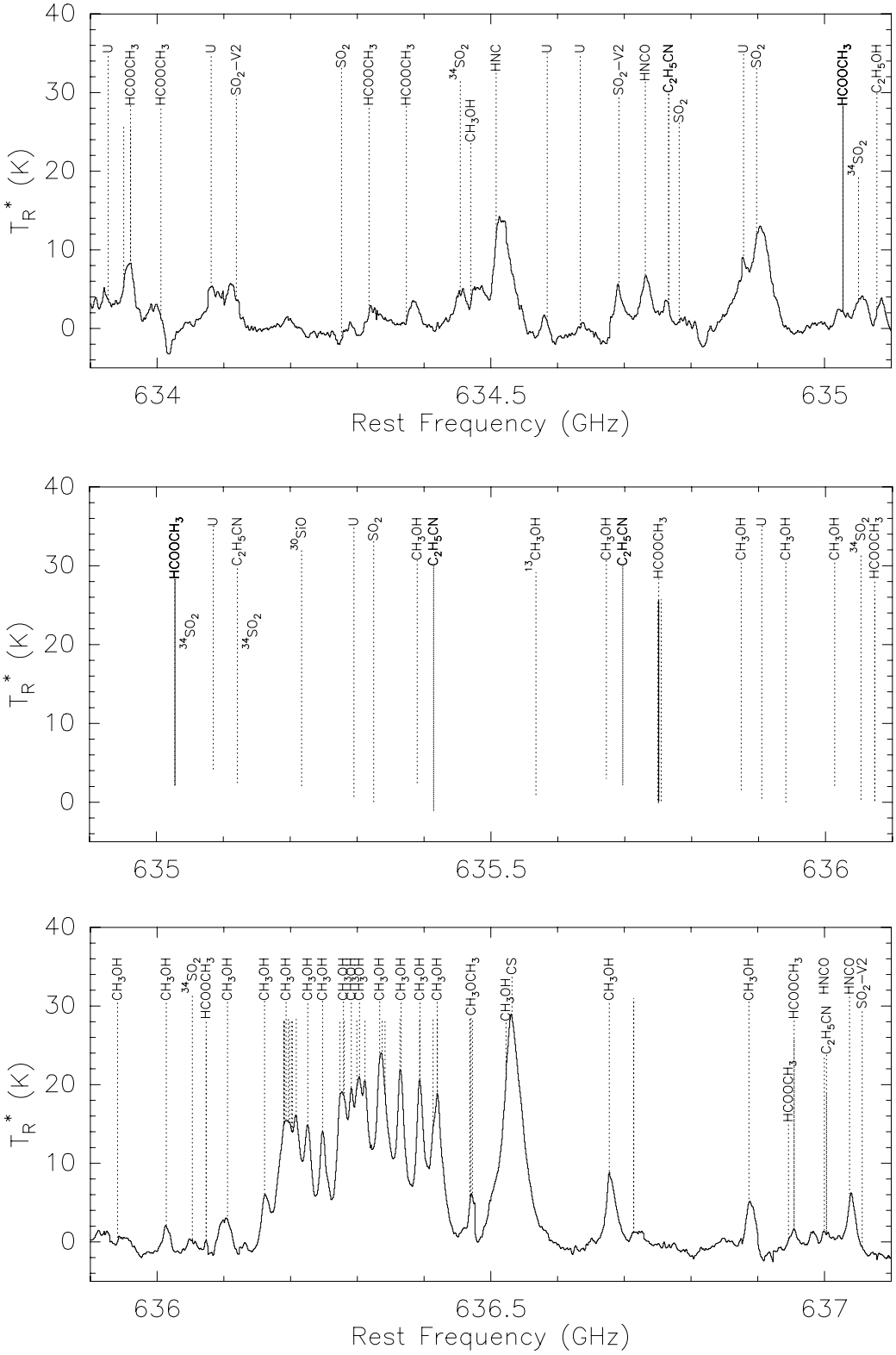

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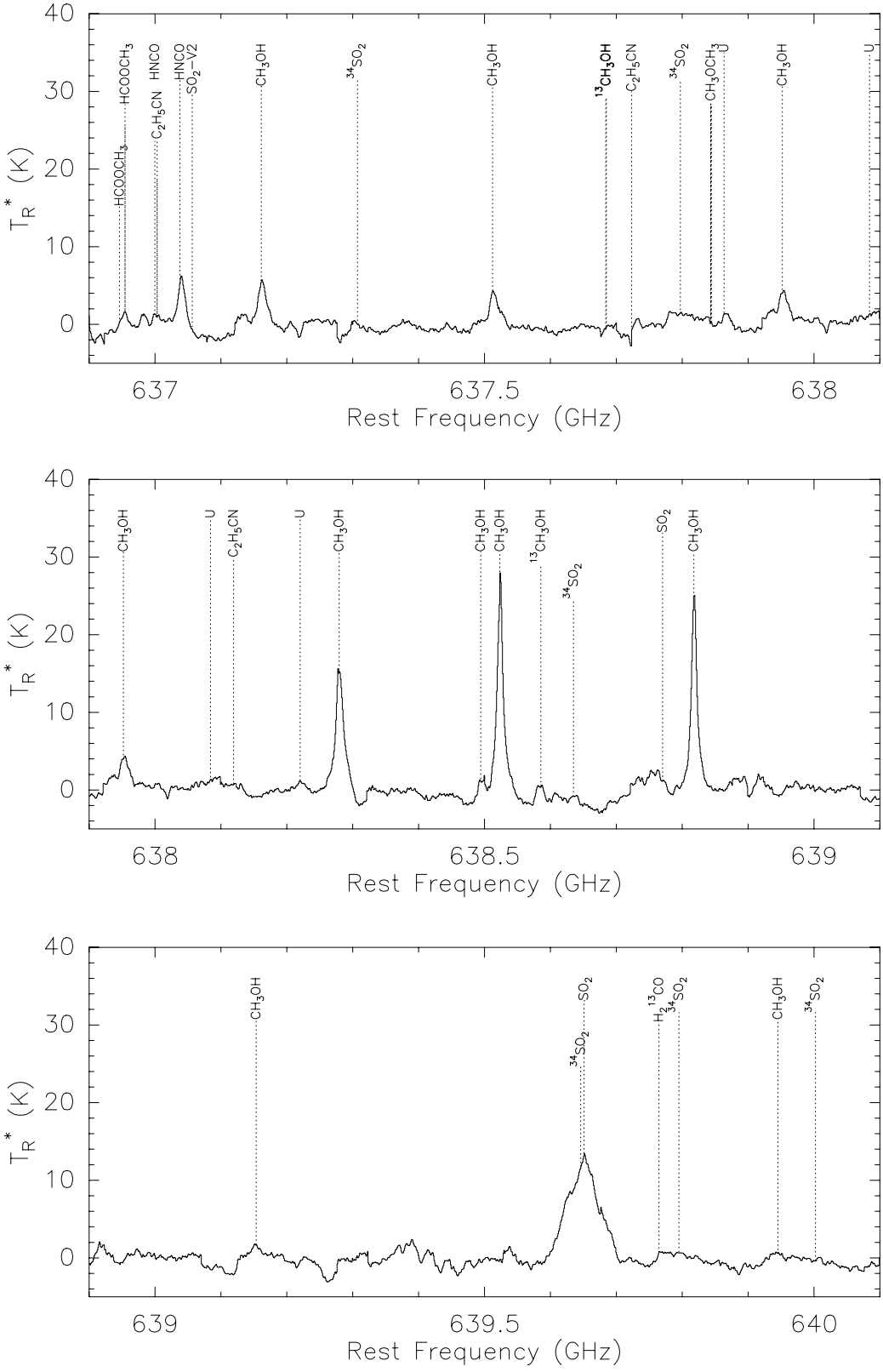

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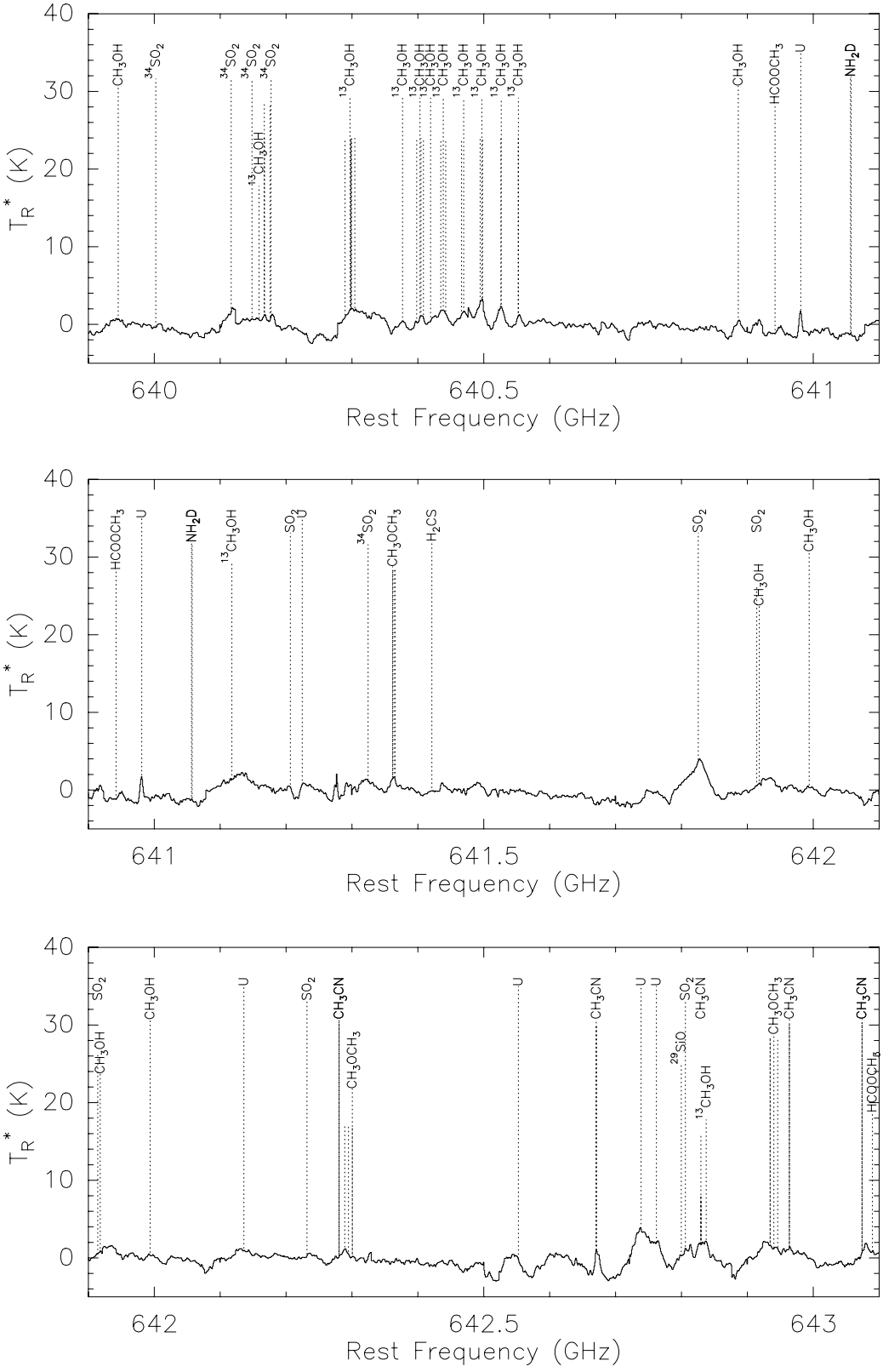

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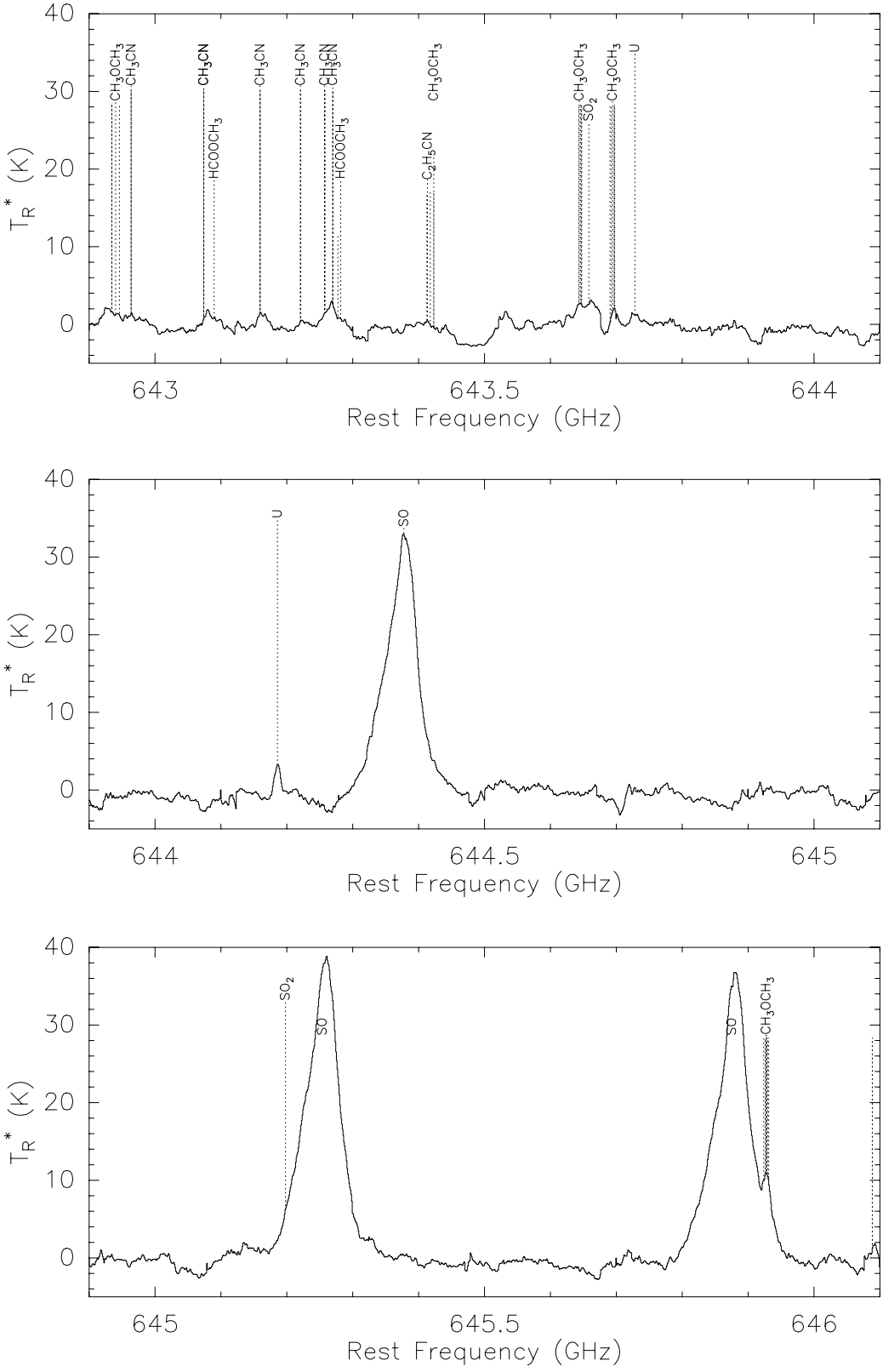

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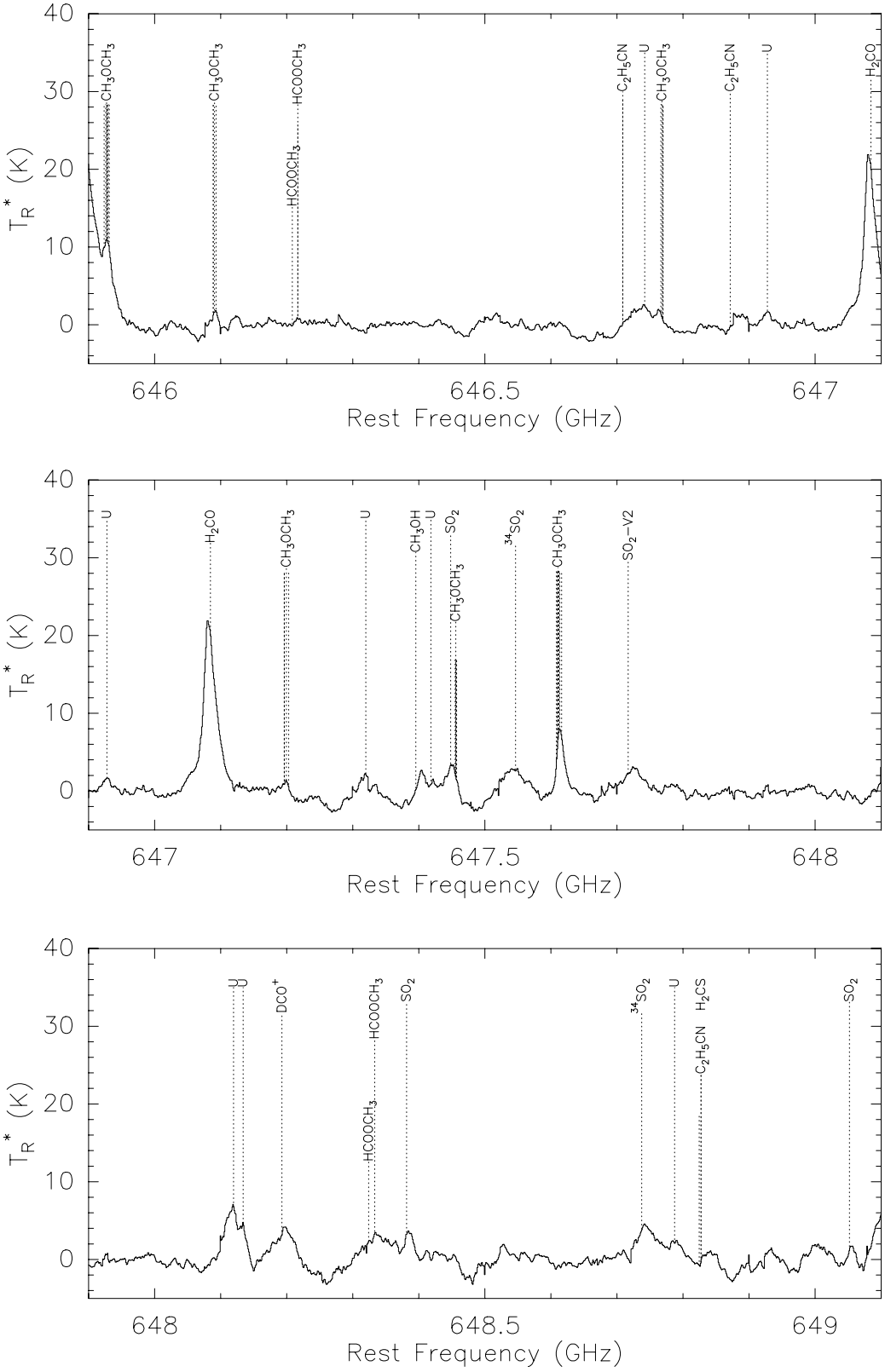

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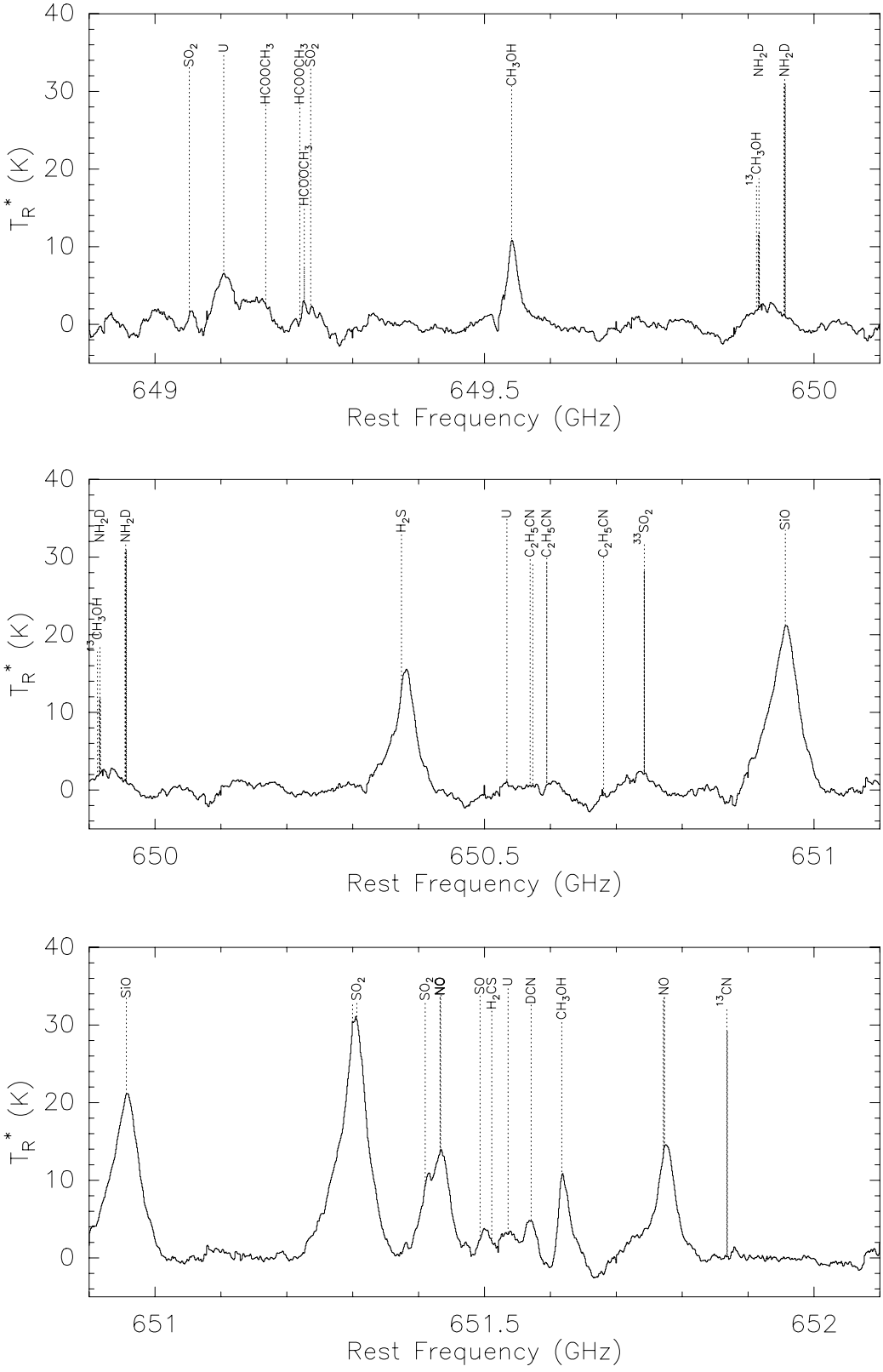

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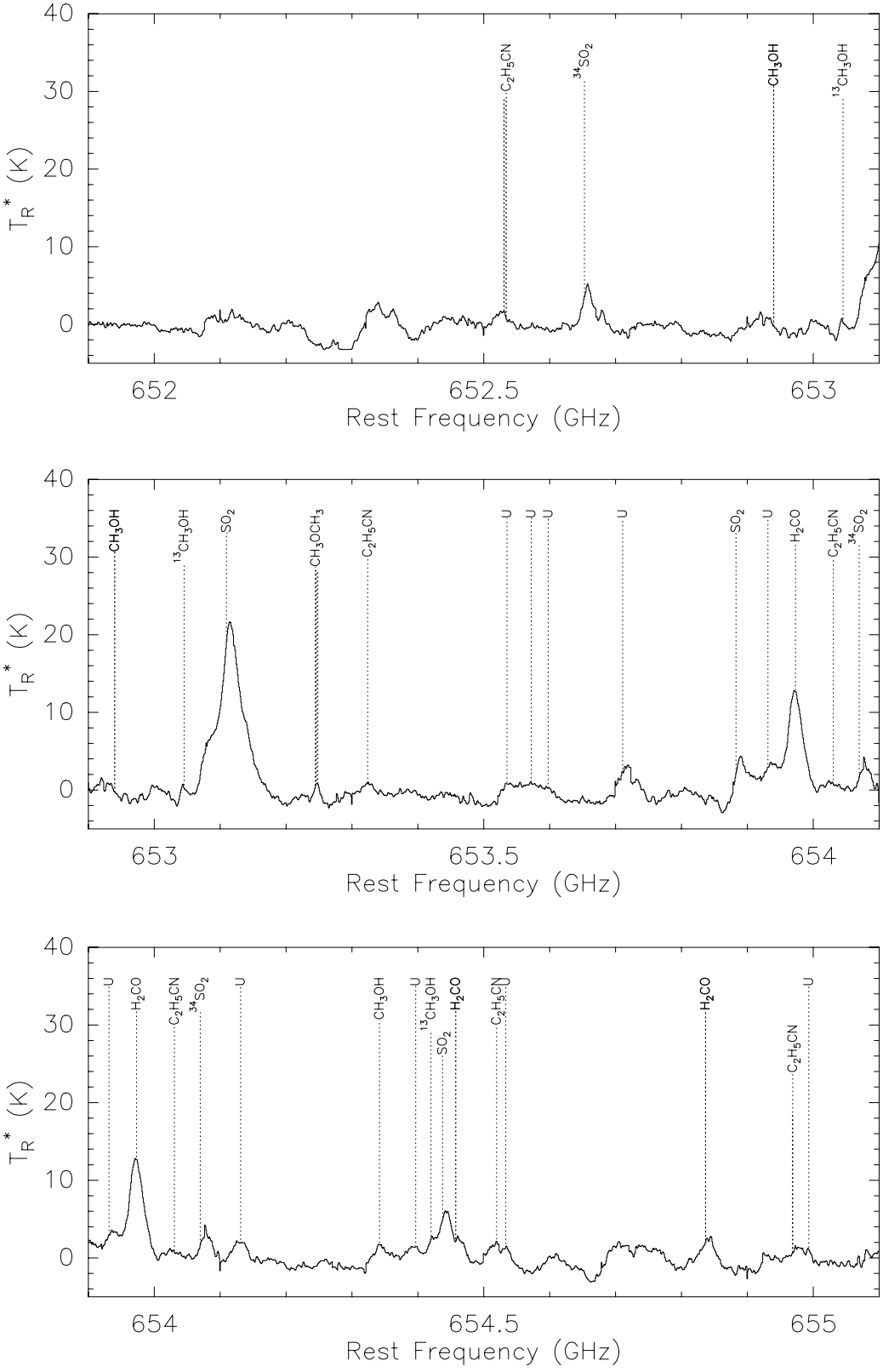

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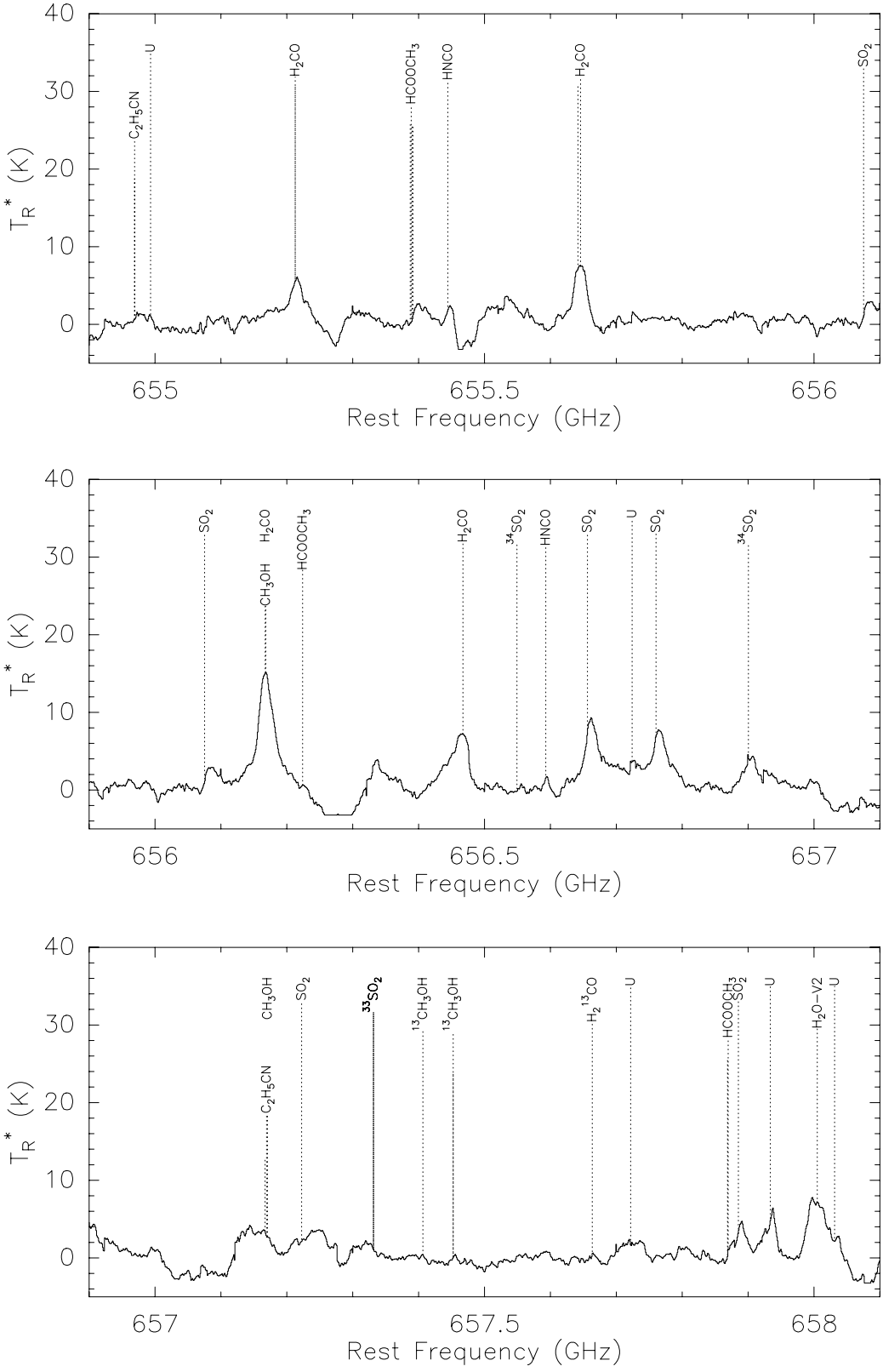

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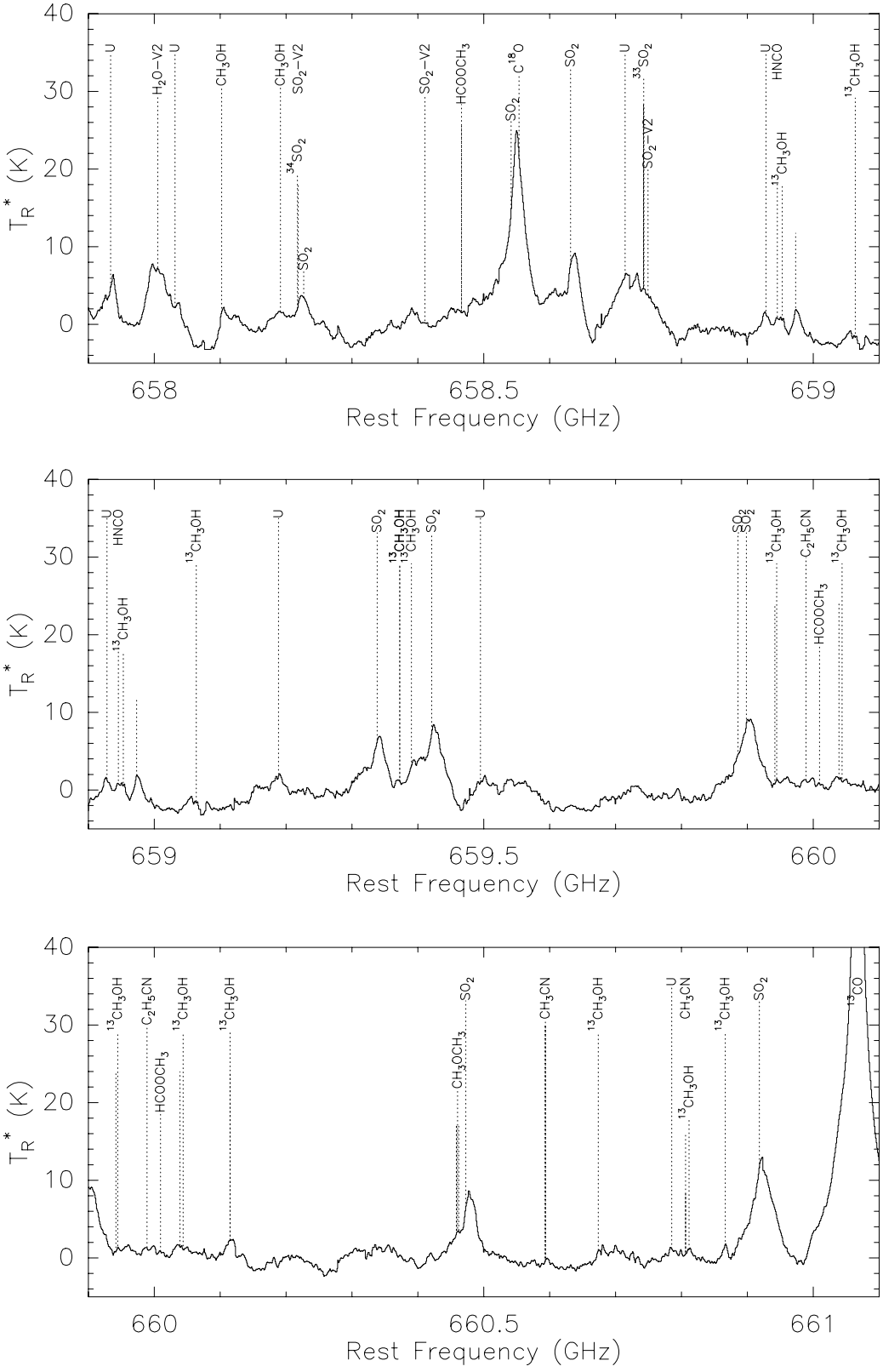

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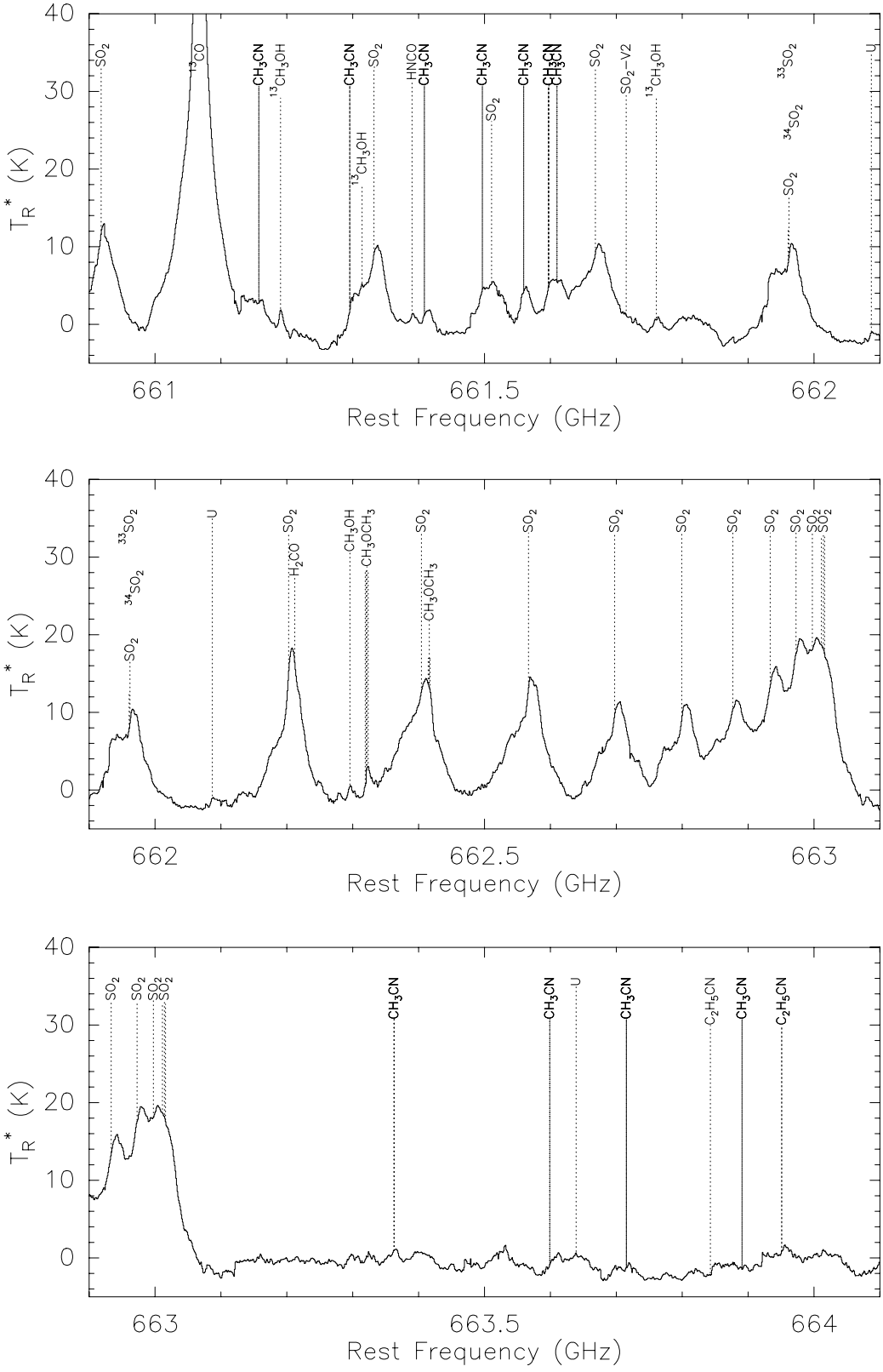

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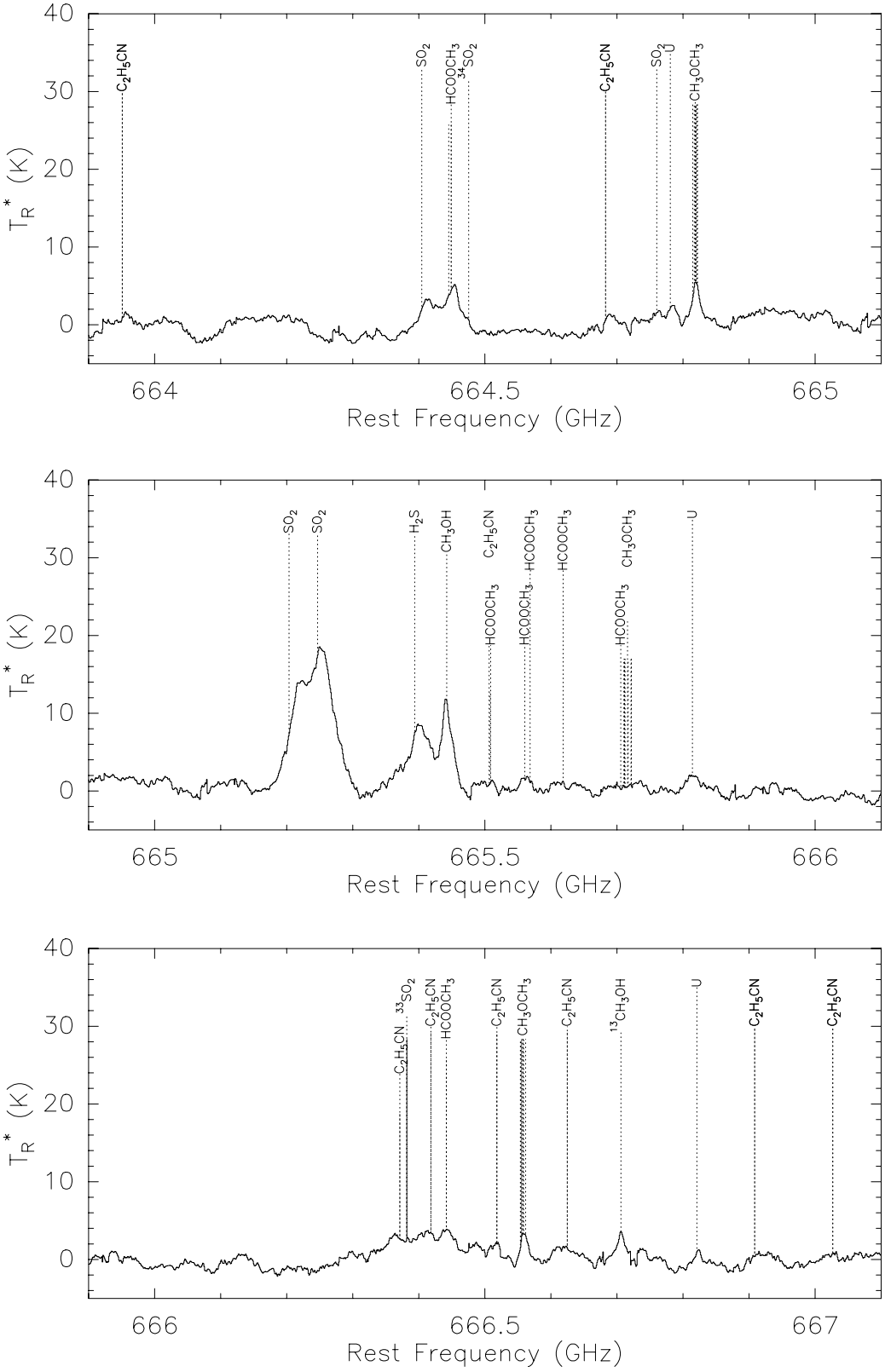

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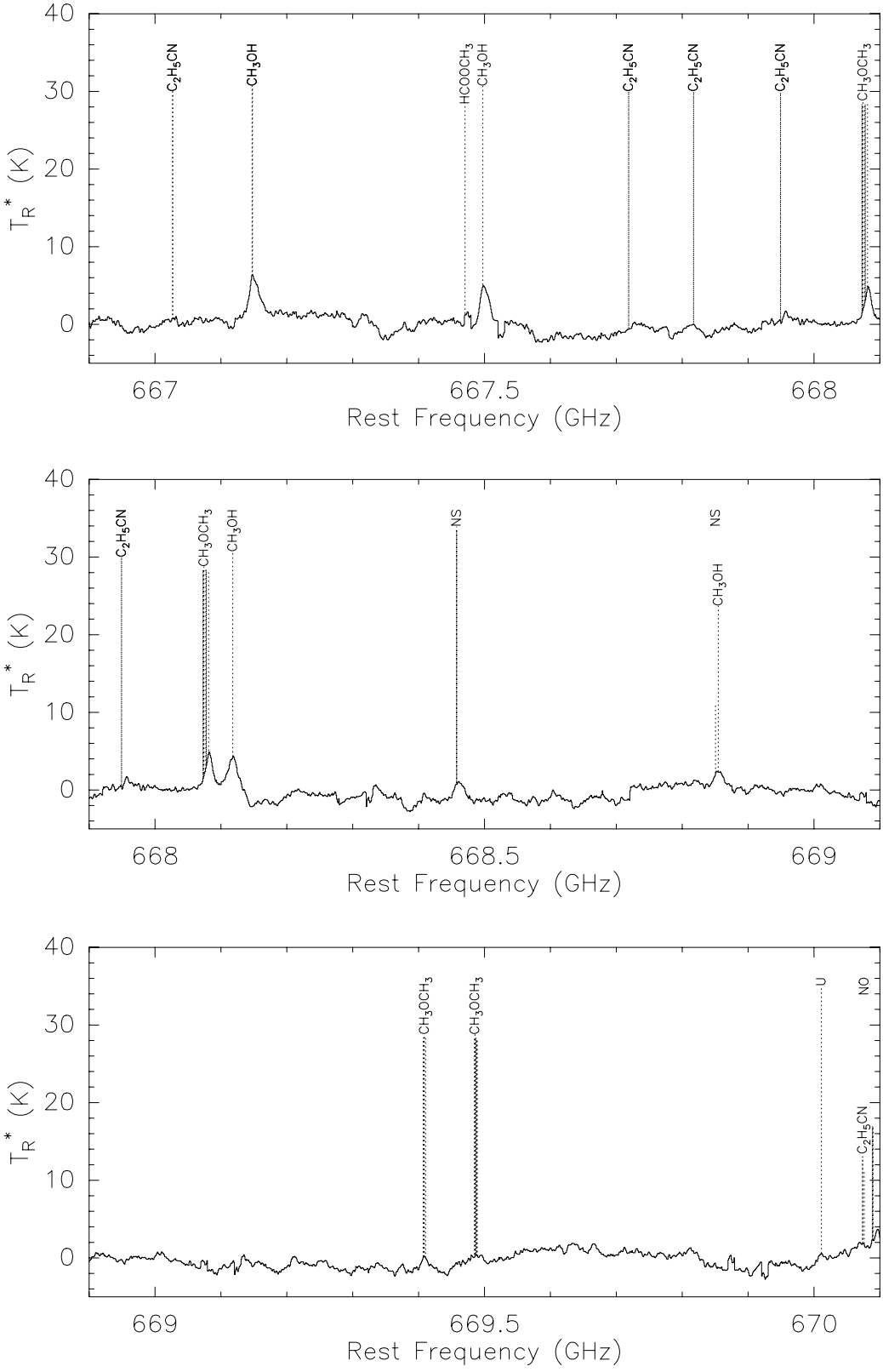

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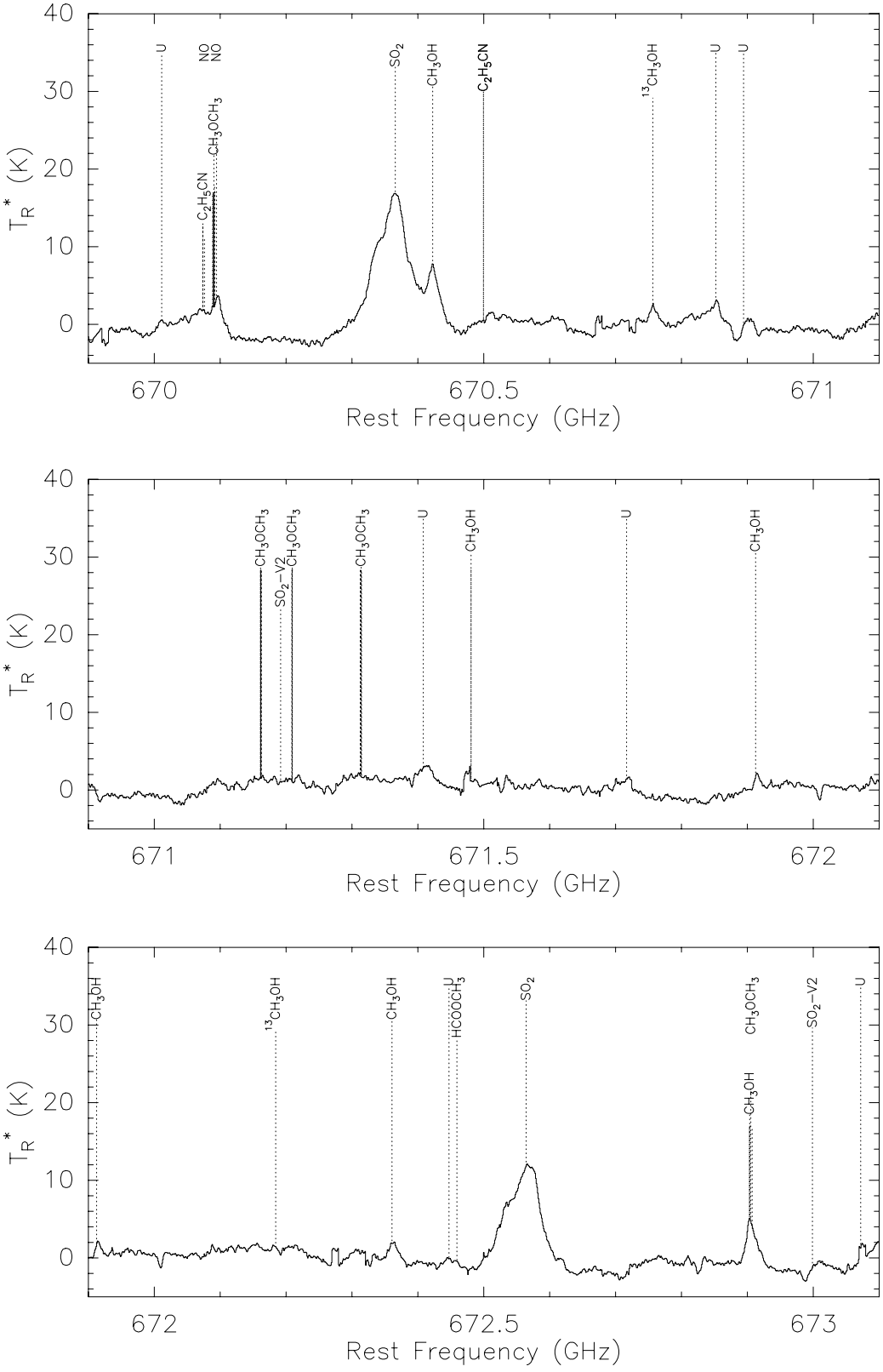

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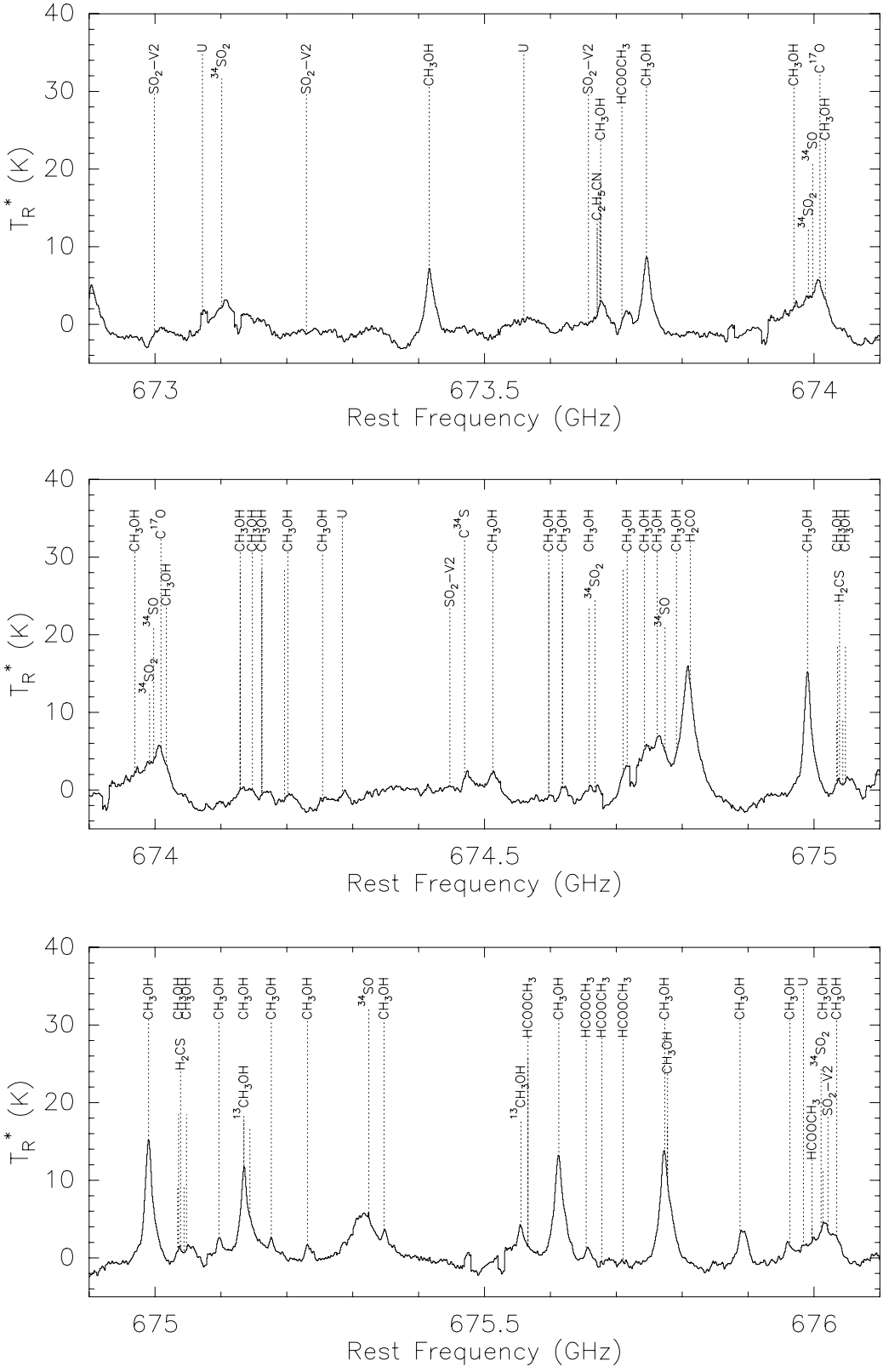

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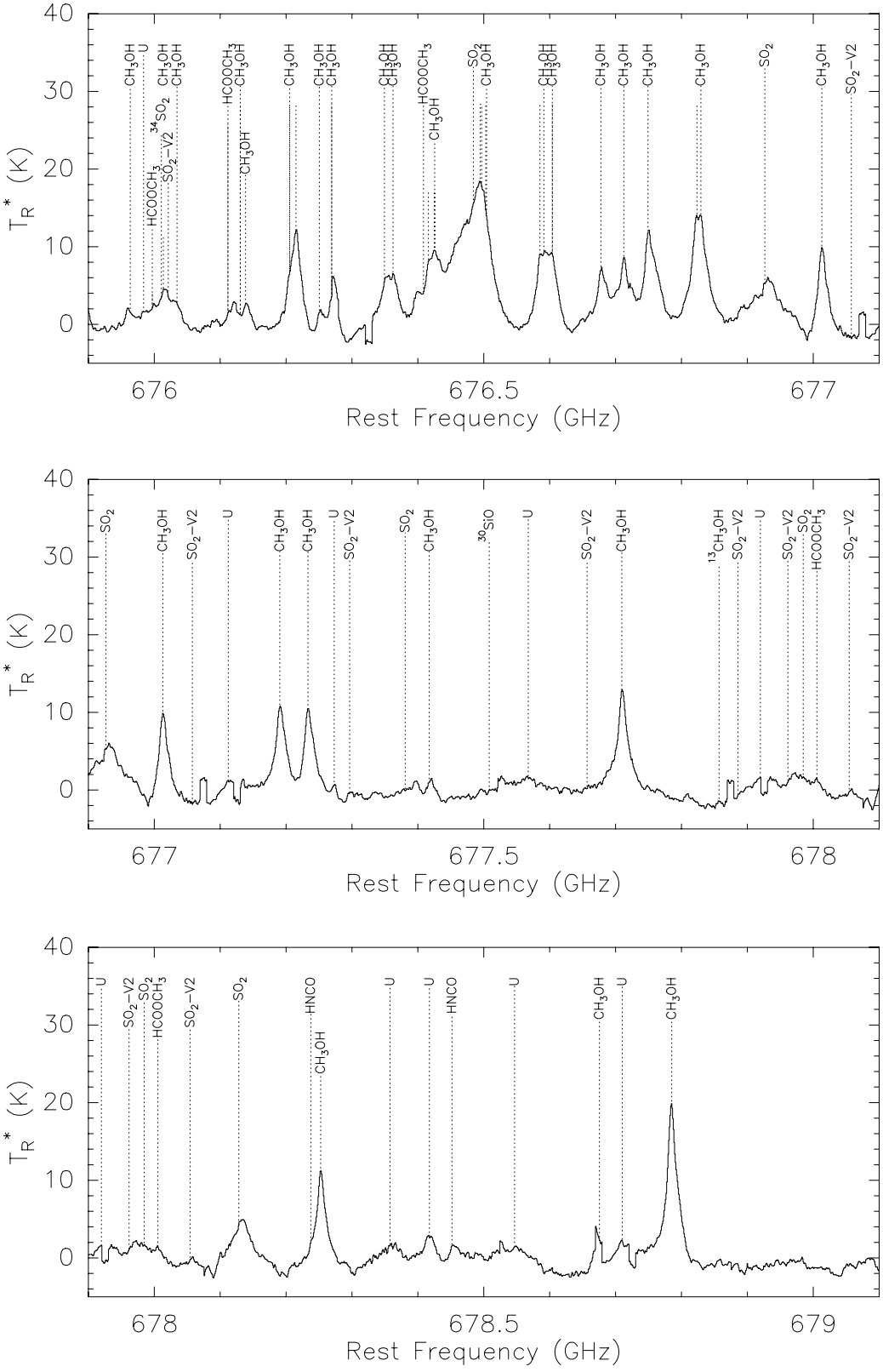

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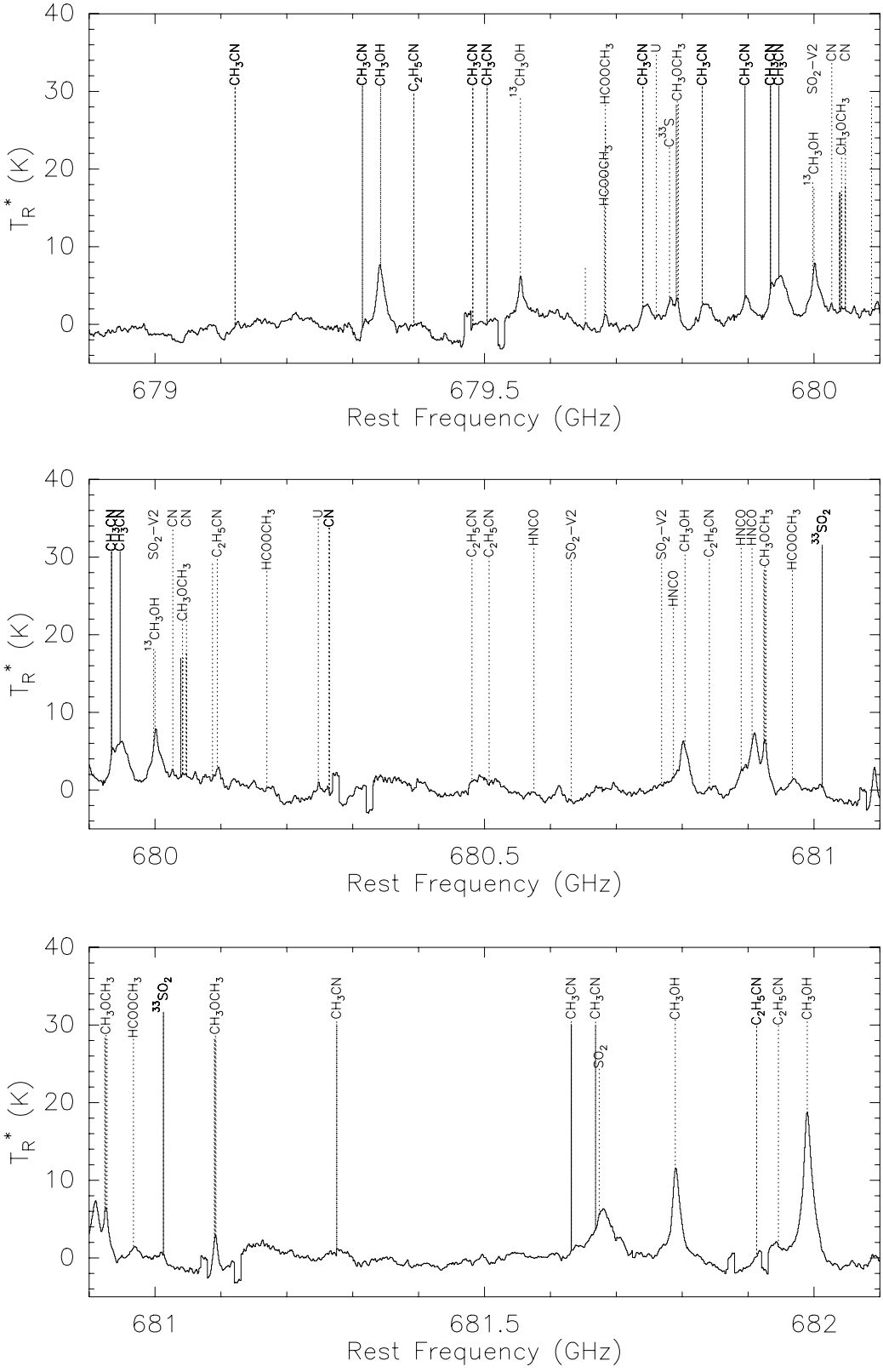

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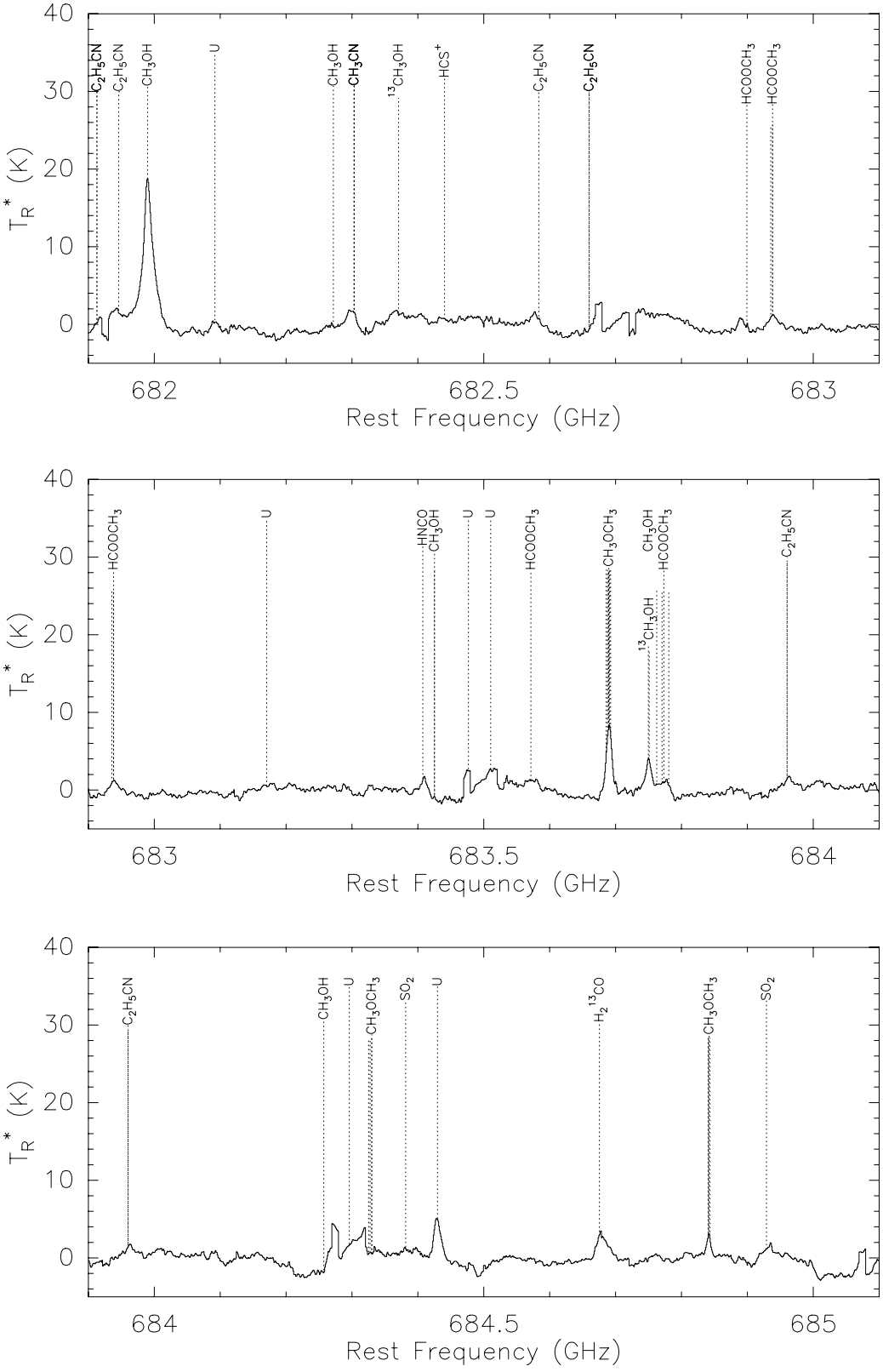

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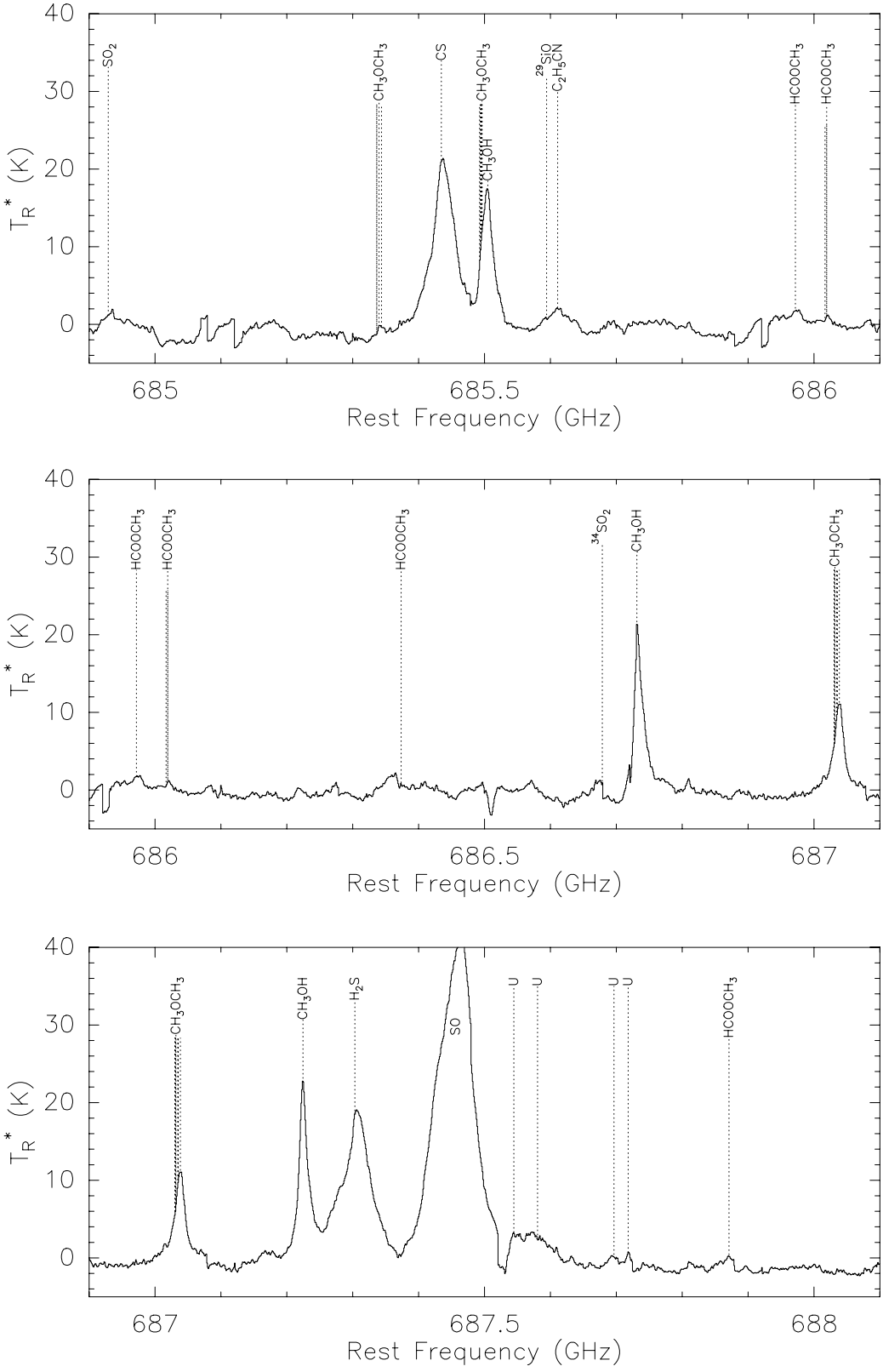

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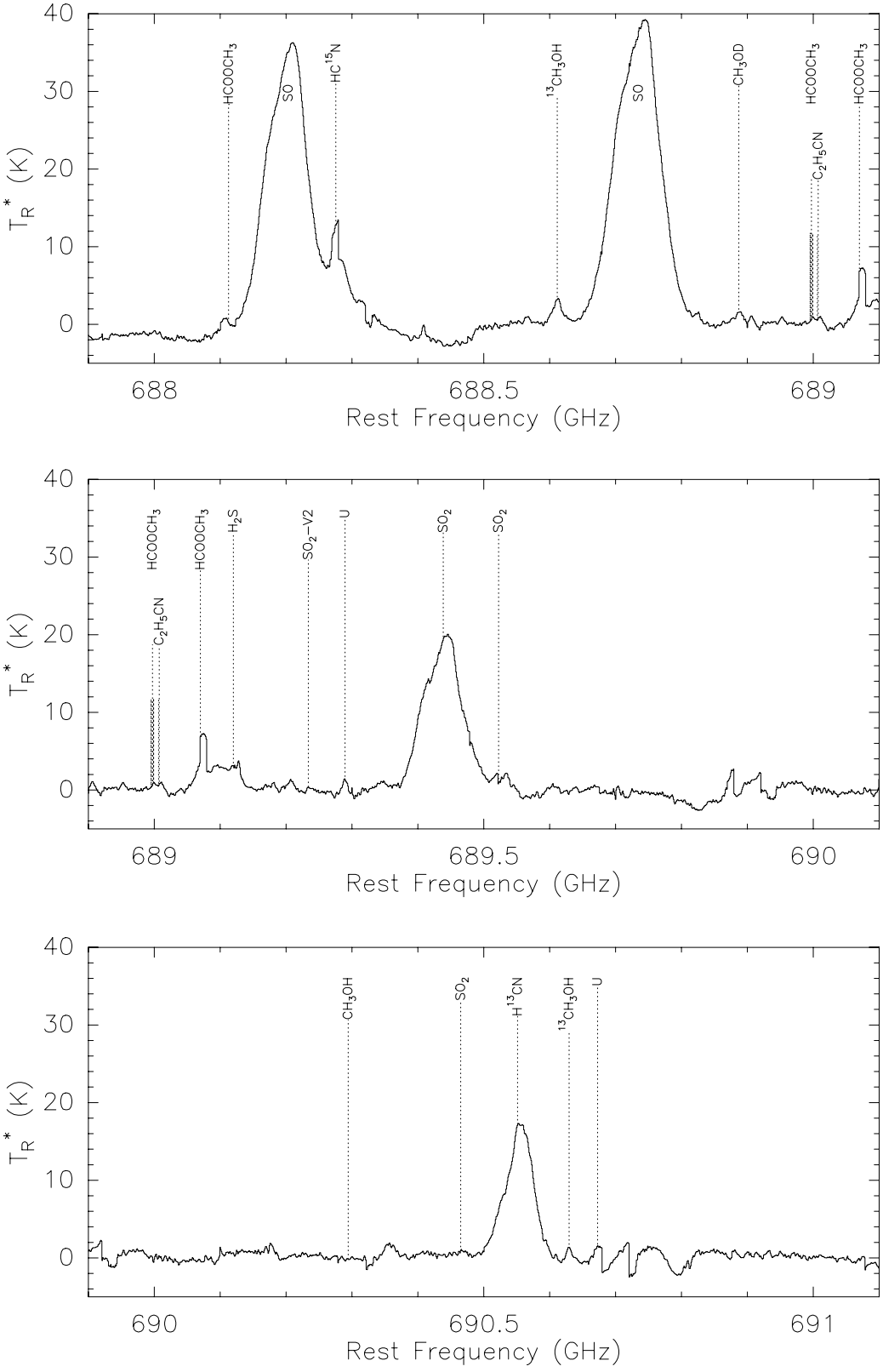

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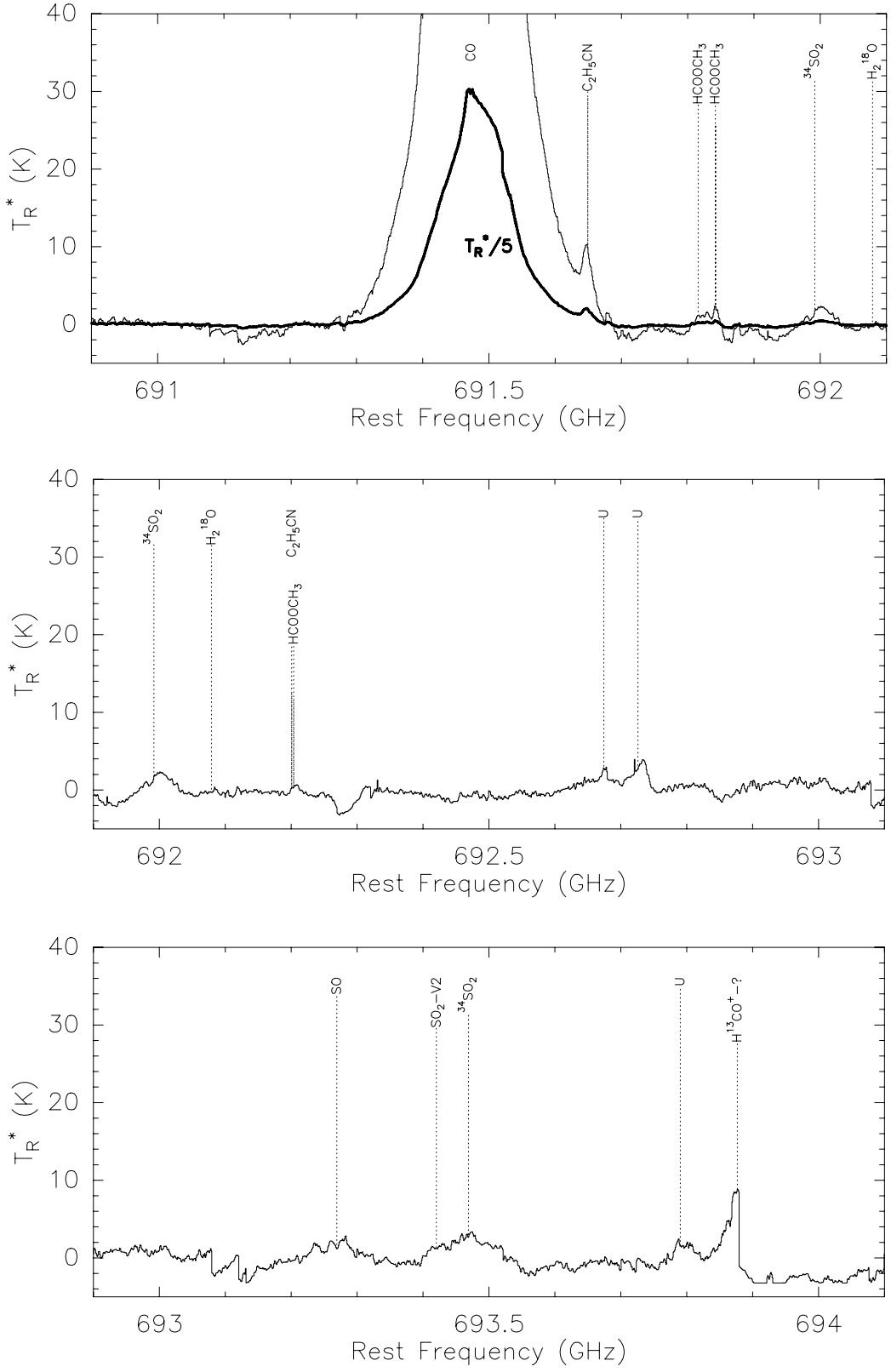

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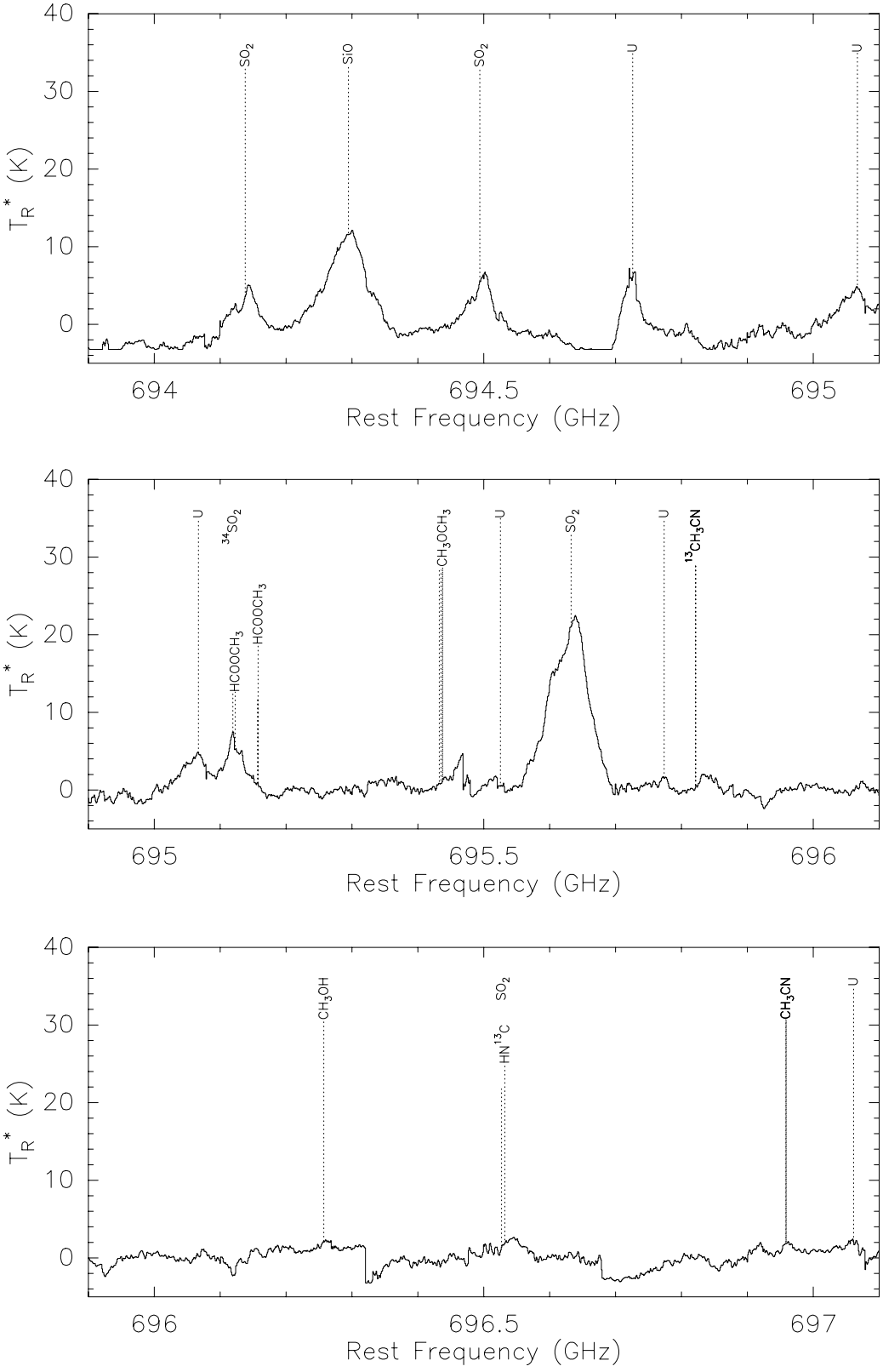

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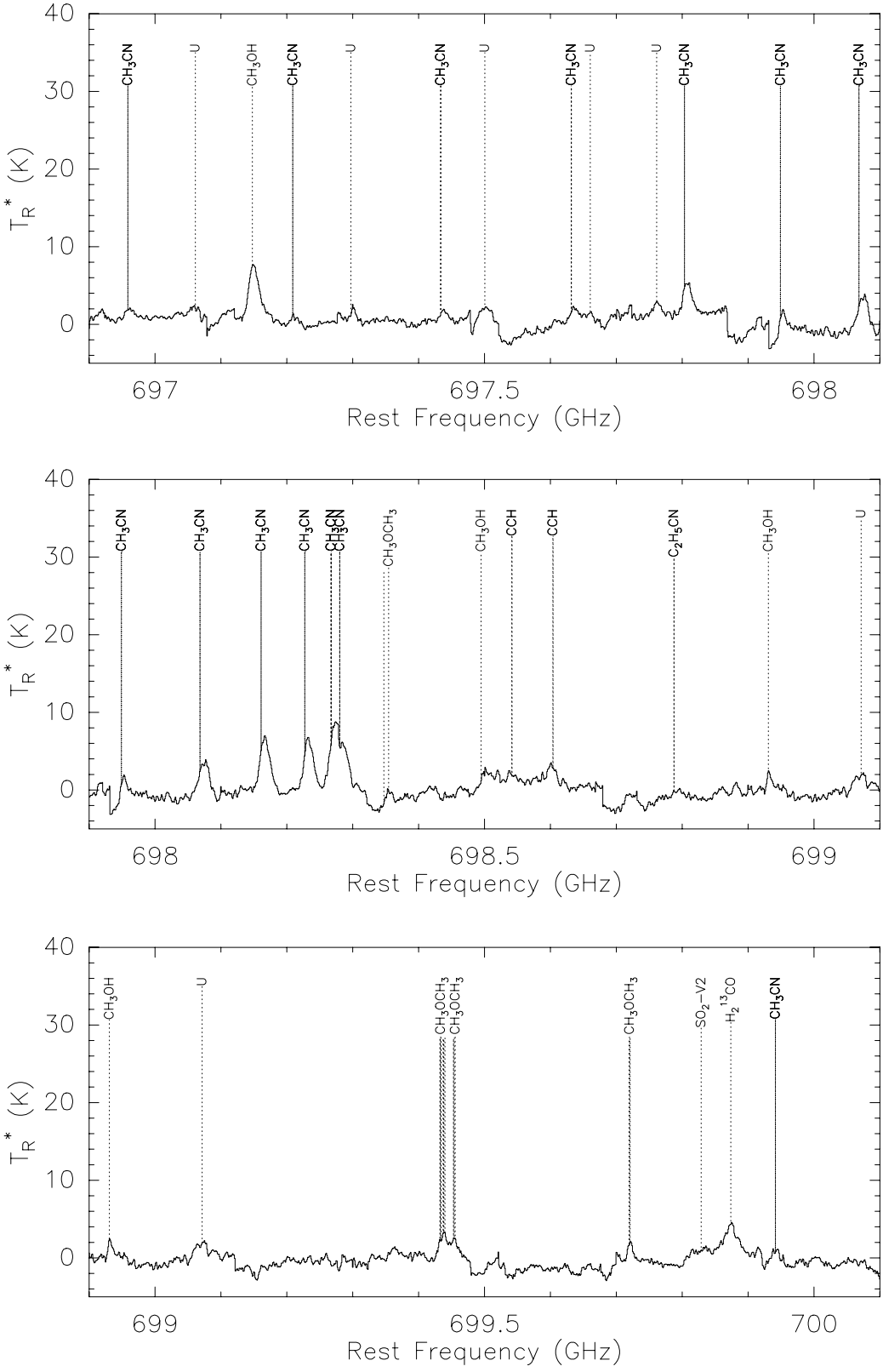

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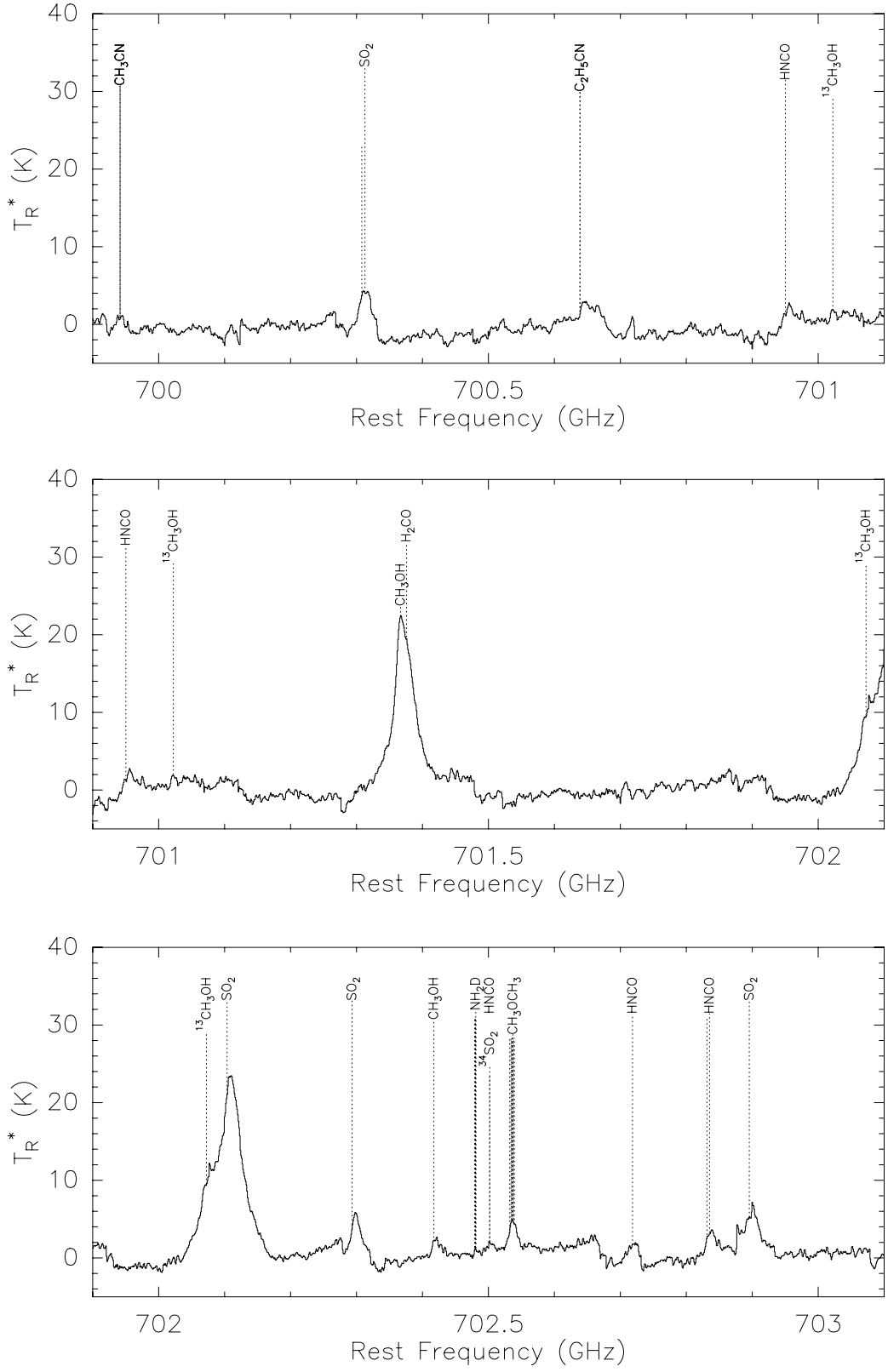

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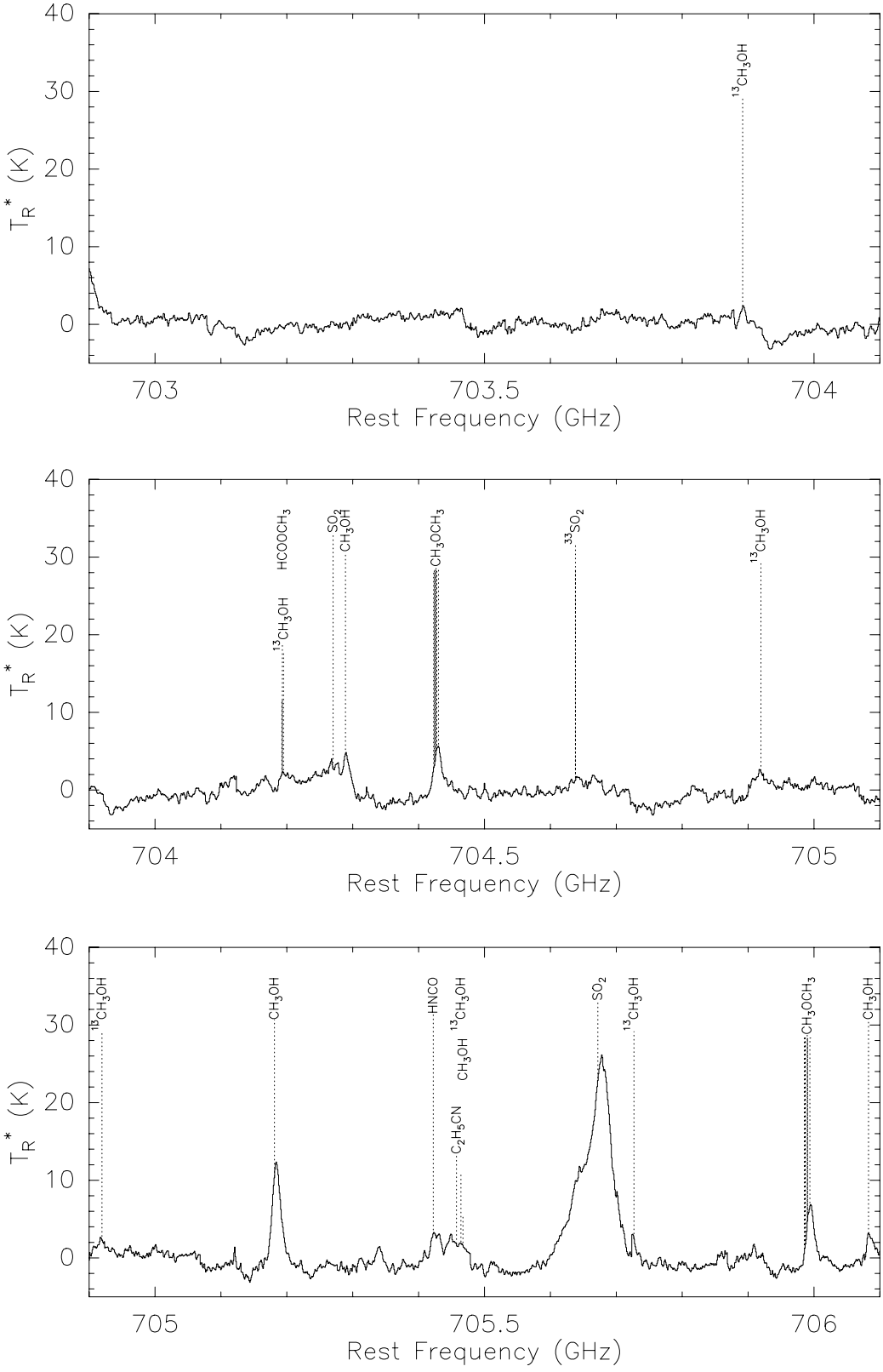

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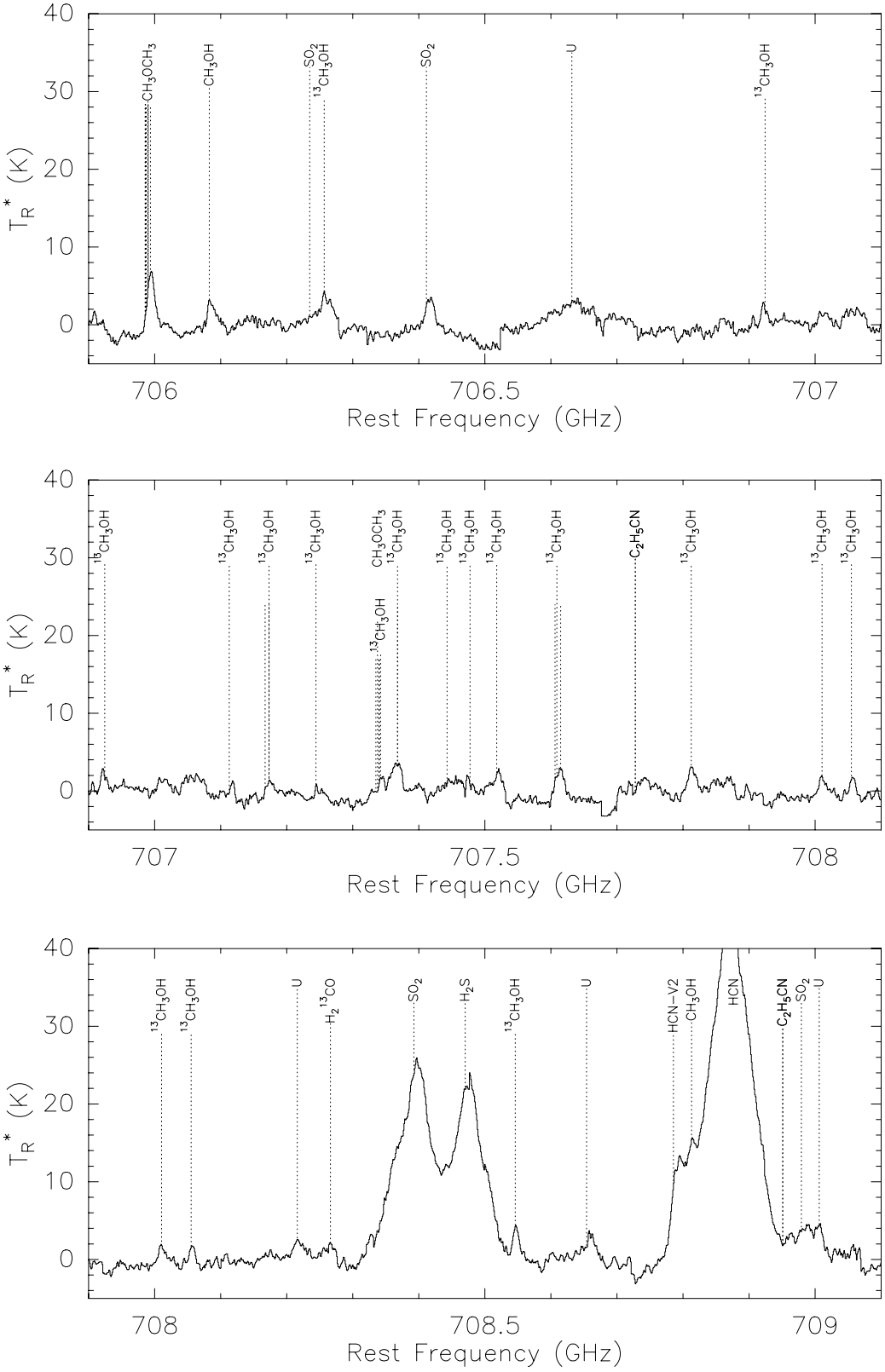

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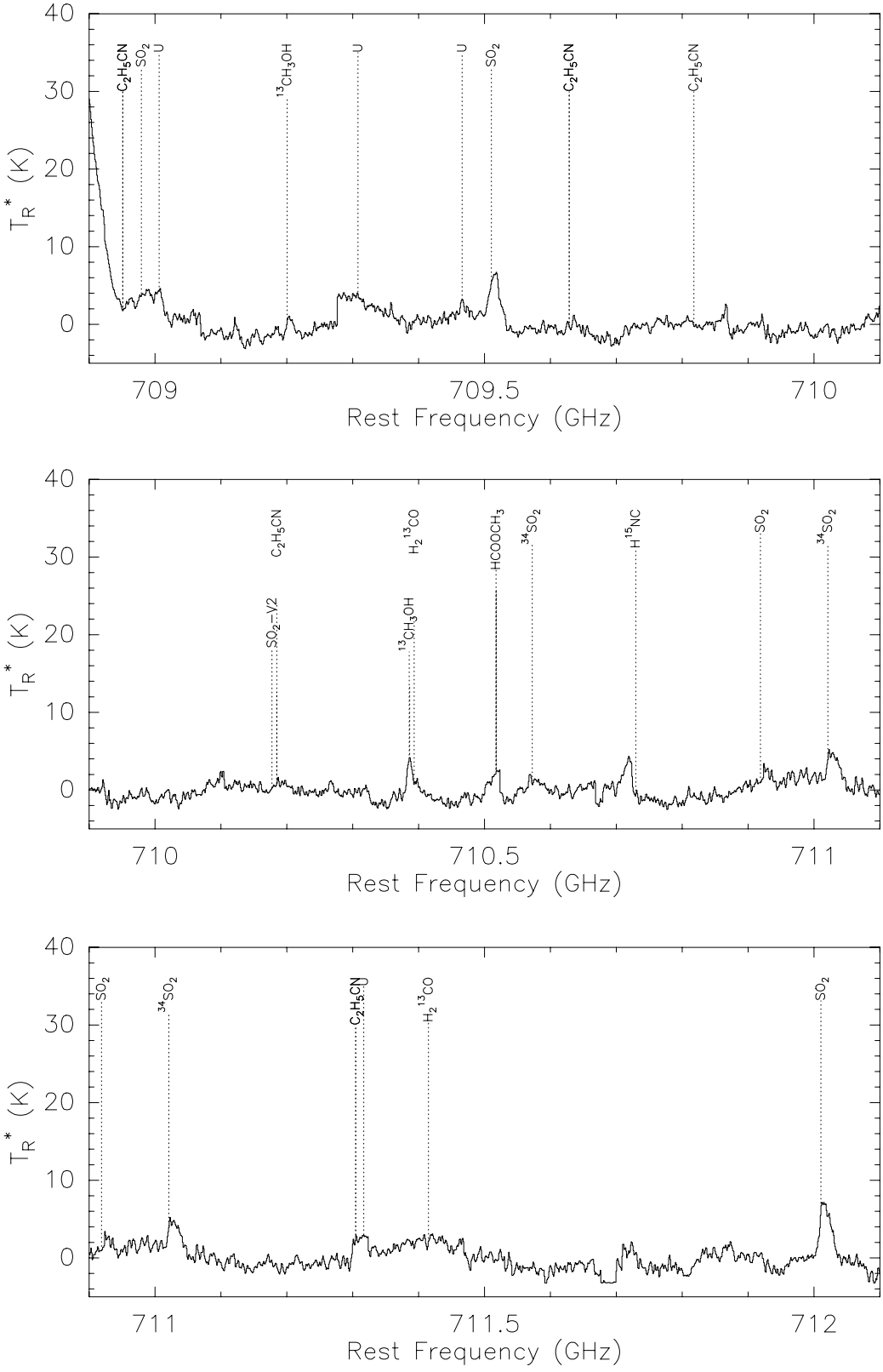

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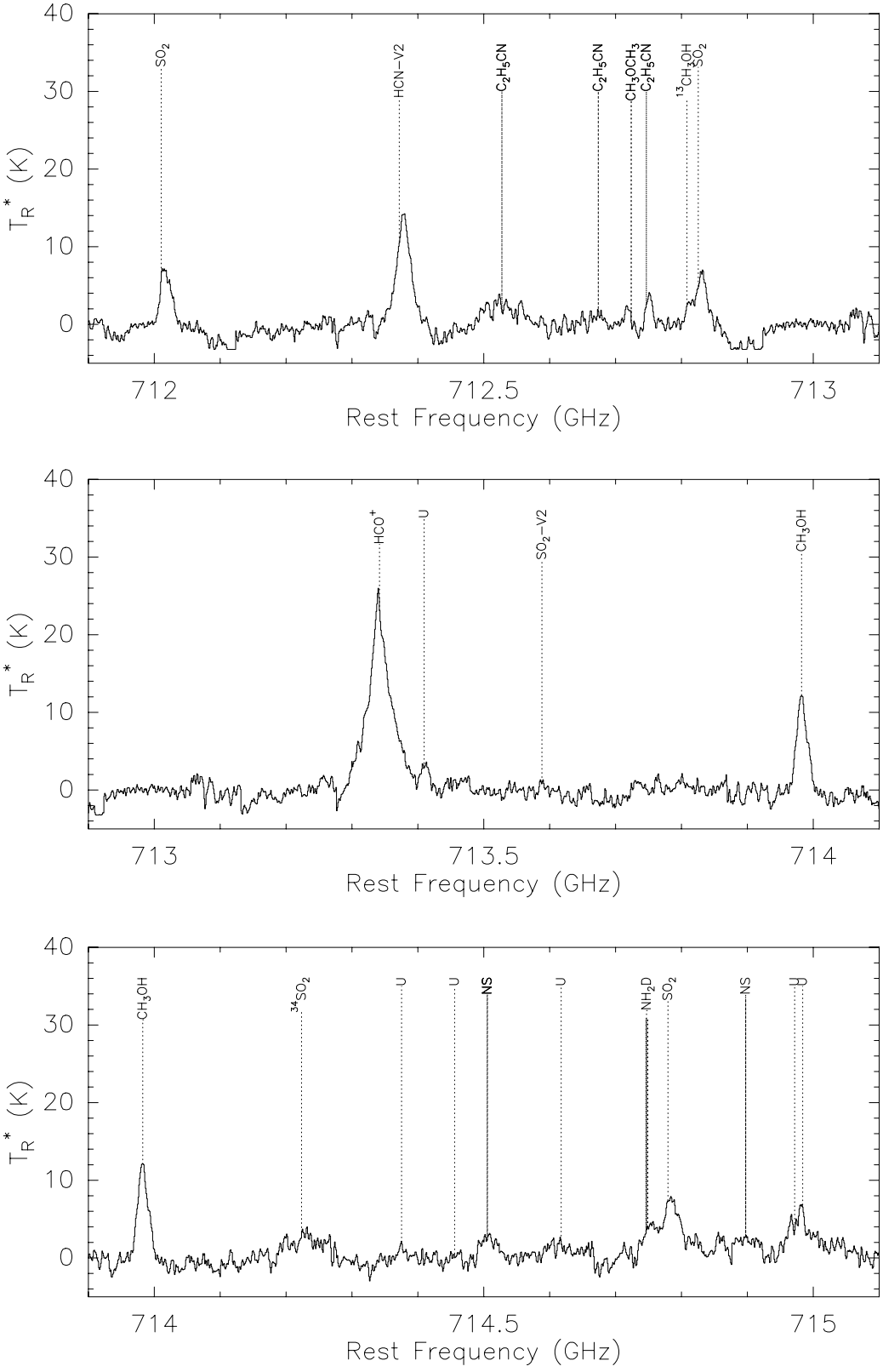

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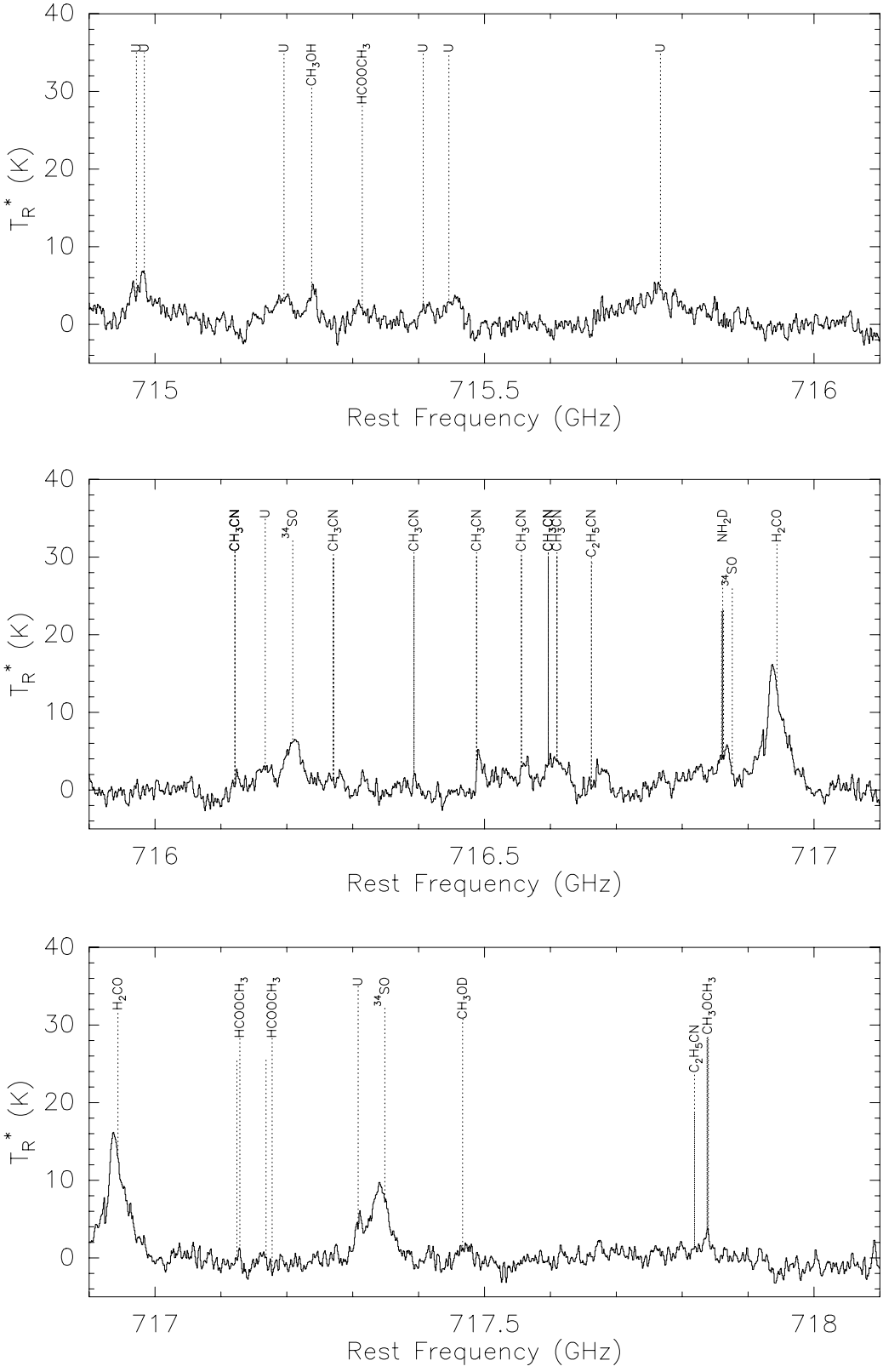

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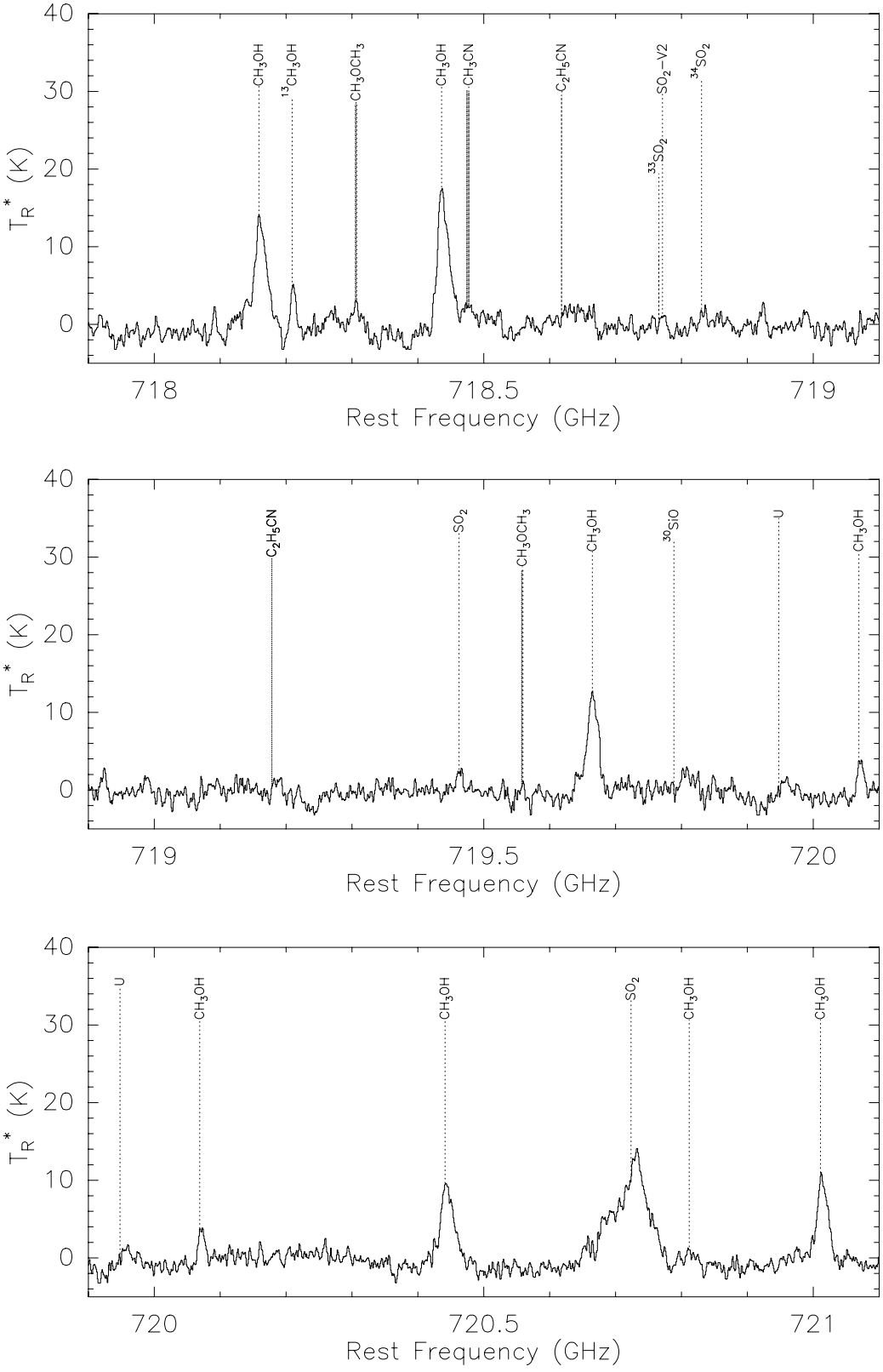

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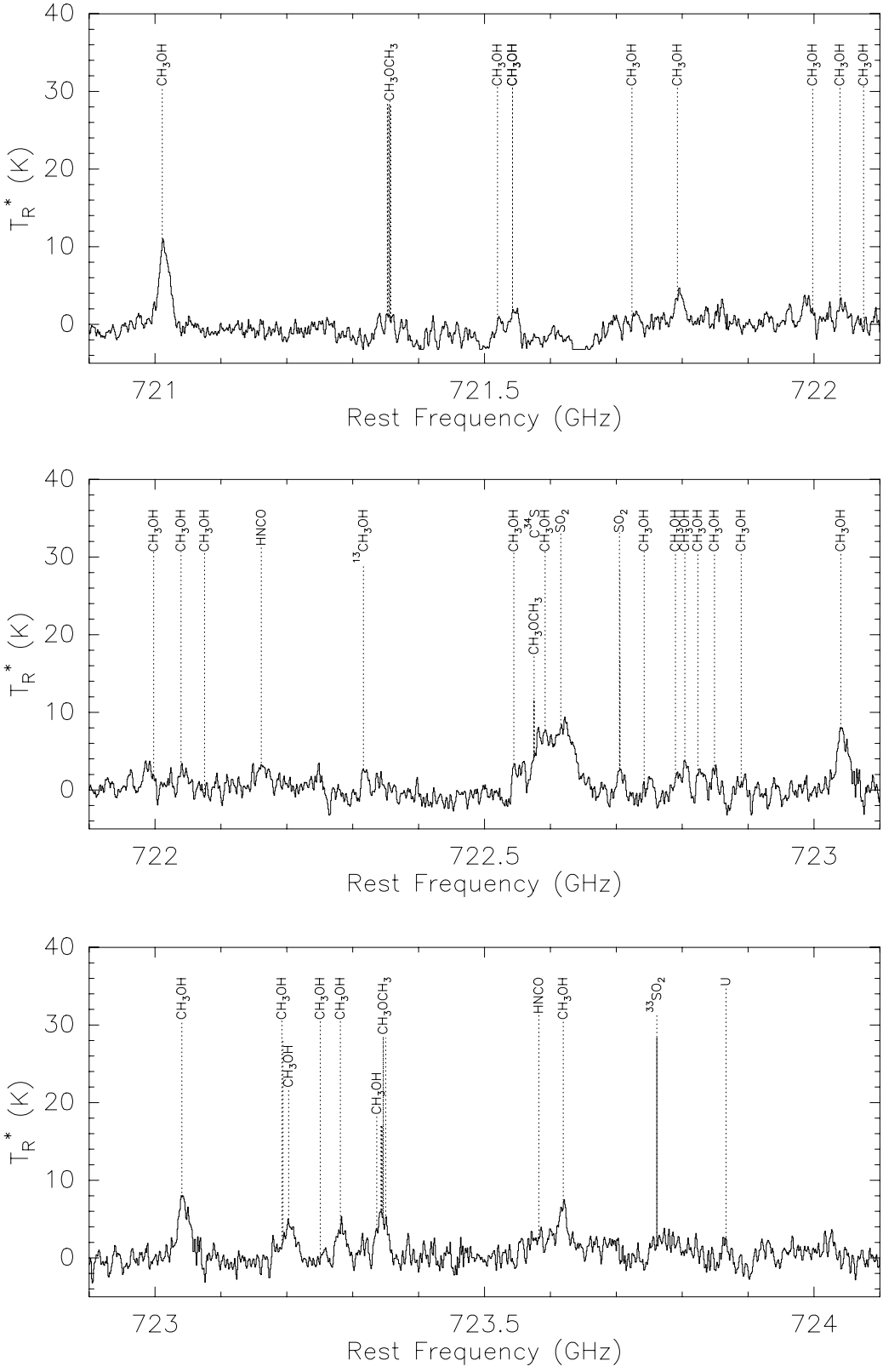

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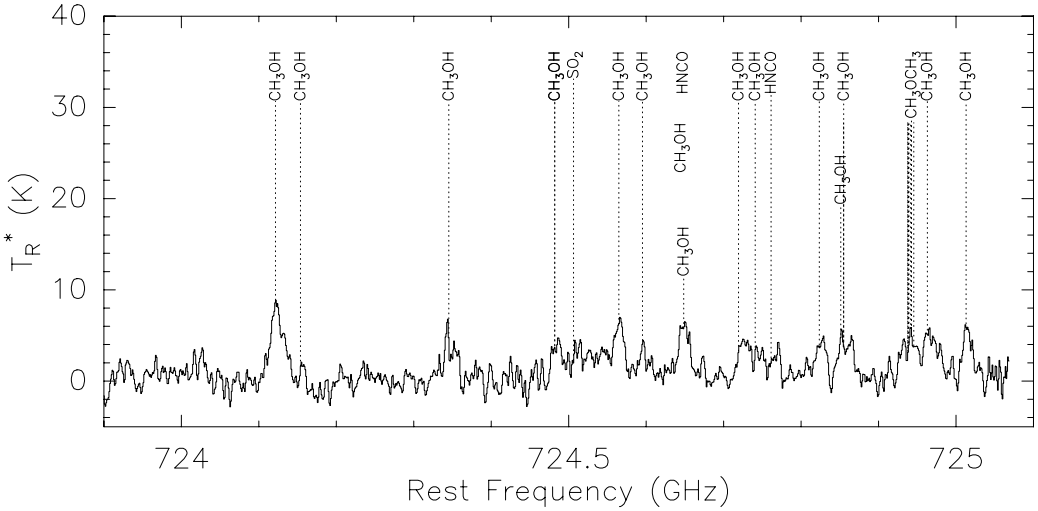

FIG. 4.—*Continued*

REFERENCES

Anderson, T., Herbst, E., & De Lucia, F. C. 1992, ApJS, 82, 405
———. 1993, J. Mol. Spectrosc., 159, 410
Bell, M. B., Avery, L. W., & Watson, K. G. 1993, ApJS, 86, 211
Blake, G. A., Sutton, E. C., Masson, C. R., & Phillips, T. G. 1986, ApJS, 60, 257
———. 1987, ApJ, 315, 621
Bogey, M., Demuynck, C., & Destombes, J. L. 1981, Chem. Phys. Lett., 81, 256
Brown, J. M., Curl, R. F., & Evenson, K. M. 1985, ApJ, 292, 188
Chandler, C. J., & De Pree, C. G. 1995, ApJ, 455, L67
Churchwell, E., Wood, D., Myers, P. C., & Myers, R. V. 1986, ApJ, 305, 405
Gensheimer, P. D., Mauersberger, R., & Wilson, T. L. 1996, A&A, 314, 281
Groesbeck, T. D. 1994, Ph.D. thesis, Caltech
Groesbeck, T. D., Phillips, T. G., & Blake, G. A. 1994, ApJS, 94, 147
Harris, A. I., Avery, L. W., Schuster, K.-F., Tacconi, L. J., & Genzel, R. 1995, ApJ, 446, L85
Helmich, F. P., & van Dishoeck, E. F. 1997, A&AS, 124, 205
Kaifu, N., et al. 1987, ApJ, 317, L111
Kooi, J. W., Walker, C. K., LeDuc, H. G., Schaffer, P. L., Hunter, T. R., Benford, D. J., & Phillips, T. G. 1994, Int. J. Infrared Millimeter Waves, 15, 477
Lewerenz, M., Bruna, P. J., Peyerimhoff, S. D., & Brienker, R. J. 1983, Mol. Phys., 49, 1
Macdonald, G. H., Gibb, A. G., Habing, R. J., & Millar, T. J. 1996, A&AS, 119, 333
MacKay, D. D. S. 1995, MNRAS, 274, 694
McGonagle, D., & Irvine, W. M. 1997, ApJ, 477, 711
Menten, K. M., & Young, K. 1995, ApJ, 450, L67
Mollaaghabada, R., Gottlieb, C. A., Vritilek, J. M., & Thaddeus, P. 1991, ApJ, 368, L19
Ohishi, M., Ishikawa, S.-I., Yamamoto, S., Saito, S., & Amano, T. 1995, ApJ, 446, L43
Pearson, J. C., Sastry, K. V. L. N., Herbst, E., & De Lucia, F. C. 1994, ApJS, 93, 589
Pearson, J. C., Sastry, K. V. L. N., Winnewisser, M., Herbst, E., & De Lucia, F. C. 1995, J. Phys. Chem. Ref. Data, 24, 1
Pickett, H. M., Poynter, R. L., Cohen, E. A., Delitsky, M. L., Pearson, J. C., & Müller, H. S. P. 1998, J. Quant. Spectrosc. Radiat. Transfer, 60, 883. 1995,
Salez, M., Frerking, M. A., & Langer, W. D. 1996, ApJ, 467, 708
Schilke, P. 1996, in IAU Symp. 178, Molecules in Astrophysics: Probes and Processes, ed. E. F. van Dishoeck (Dordrecht: Kluwer), 137
Schilke, P., Groesbeck, T. D., Blake, G. A., & Phillips, T. G. 1997, ApJS, 108, 301
Schilke, P., Phillips, T. G., & Wang, N. 1995, ApJ, 441, 334
Schilke, P., Walmsley, C. M., Pineau des Forêts, G., Roueff, E., Flower, D. R., & Guilloteau, S. 1992, A&A, 256, 595
Serabyn, E., & Weisstein, E. W. 1995, ApJ, 451, 238
Sutton, E. C., Blake, G. A., Masson, C. R., & Phillips, T. G. 1985, ApJS, 58, 341
Sutton, E. C., Jaminet, P. A., Danchi, W. C., & Blake, G. A. 1991, ApJS, 77, 255
Sutton, E. C., Peng, R., Danchi, W. C., Jaminet, P. A., Sandell, G., & Russell, A. P. G. 1994, ApJS, 97, 455
Walmsley, C. M., Hermsen, W., Henkel, C., Mauersberger, R., & Wilson, T. L. 1987, A&A, 172, 311
Wright, M. C. H., Plambeck, R. L., Mundy, L. G., & Looney, L. W. 1995, ApJ, 455, L185
Wright, M. C. H., Sandell, G. Wilner, D. J., & Plambeck, R. L. 1992, ApJ, 393, 225
Xu, L.-H., & Lovas, F. J. 1997, J. Phys. Chem. Ref. Data, 26, 17
Ziurys, L. M. 1991, ApJ, 379, 260