The Submillimeter-wave Spectra of Interstellar Molecules

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Although gaseous organic molecules in cold interstellar clouds are mainly unsaturated in nature, saturated and near-saturated molecules can be detected in regions of star formation and young stellar objects. The latter molecules are probes of rather complex physical conditions and of an unusual chemistry that most likely occurs at least partially on the surfaces of interstellar grains. Many of these hydrogen-rich molecules have complex rotational spectra because of the phenomenon of internal rotation, sometimes known as torsion. With our new fast-scan spectrometer that operates in the millimeter-wave and submillimeter-wave region (Petkie *et al.,* 1997), and with powerful theoretical methods, we have measured and analyzed many rotational-torsional lines of saturated organic molecules that are both known and likely interstellar species. In our most recent work, we have studied the species glycolaldehyde (CH_2OHCHO), acetone (CH_3COCH_3), methyl ethyl ether ($CH_3OC_2H_5$), and methyl carbamate ($H_2NCOOCH_3$.) Based on our analysis of these species, we are able to predict accurate frequencies for many lines unmeasured in the laboratory (see, e.g., Butler *et al.,* 2001). The first two species are known interstellar molecules while the latter two are likely candidates for detection, especially in hot core-like sources such as the Orion Hot Core and Sgr B2(N-LMH). We are also beginning to study the spectra of doubly deuterated species such as CHD_2OH, because the recent detection of the doubly deuterated molecule D_2CO has shown that chemical fractionation of deuterium is even more efficient than previously suspected.

References:

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