INTERSTELLAR AND COMETARY ICES: MOLECULAR EMISSION FROM COMET 1996 B2

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Observation of the pure rotational spectra of molecular species at the shortest radio wavelengths provides a powerful means of probing the physics and chemistry of cometary comae (e.g., Crovisier, 1994). One of the goals of such research is the determination of the chemical composition of cometary nuclei, as deduced from the emission of molecules which have sublimed into the coma. Since comets are generally believed to be the least processed material surviving from the origin of the solar system, the nature of cometary volatiles can in principal provide unique information on the origin and evolution of the planets. Since, moreover, comets may well have provided a substantial portion of the volatile budgets of the terrestrial planets, their origin and composition may be closely related to the origin of life on Earth (e.g., Delsemme, 1992; Owen et al., 1991). An important aspect of these questions is the relationship between comets and the interstellar medium, since one viable model of cometary nuclei considers them to be an agglomeration of interstellar grains (Greenberg, 1993).
The present apparition of Comet Hyakutake 1996 B2, which passed closer to the Earth than all but a handful of bright comets over the last 400 years, and the availability of both new radio telescopes and more sensitive receivers, has provided an unusual opportunity to investigate these issues. We have observed molecular emission from C/1996 B2 with the James Clark Maxwell Telescope in Hawaii at submillimeter wavelengths and at the Five College Radio Astronomy Observatory in Massachusetts in the 3mm wavelength band. The results include the first map of the emission from HCN in a cometary coma, obtained with the 15 element focal plane array camera at FCRAO, and the first detection of cometary HNC observed at the JCMT (Matthews et al.,1996). Additional observations are underway or planned for low energy rotational transitions of the CN radical (a possible daughter of HCN), of methanol (CH3OH), and of cyanoacetylene (HC3N). The HCN mapping data are being analyzed to determine the absolute abundance of this species and

its relation to the abundance of the CN radical which has long been observed in comets. The apparent relatively high abundance ratio of HNC to HCN, of order 7%, is strikingly reminiscent of the ratio in quiescent interstellar molecular clouds. In the latter environment this extreme departure from chemical equilibrium is a consequence of low temperature ion-molecule chemistry in the gas phase (e.g., Irvine et al., 1987), which raises the question of whether the cometary data indicate the survival of interstellar molecular material that froze onto interstellar grains and was then incorporated into a comet.

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