37.13-P

**Detection of Abundant Ethane in Comet C/1996 B2 (Hyakutake) and Comet C/1995 01 (Hale-Bopp): Evidence for Modified Interstellar Ice**

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Abundant ethane ($C_2H_6$) was detected in Comet C/1996 B2 and in Comet C/1995 01 with the use of high-resolution infrared spectroscopy at the NASA Infrared Telescope Facility on Mauna Kea. Ro-vibrational lines of the $\nu_7$ band were used to derive production rates and rotational temperatures for ethane in these two comets. It was found that the ratio of $C_2H_6/H_2O$ was higher in Comet C/1996 B2 by about a factor of two. A high abundance of ethane is consistent with production of $C_2H_6$ in modified icy grain mantles in the natal cloud. Ethane could form either by photolysis of methane rich ice or by hydrogen- addition reactions to condensed acetylene. The lower abundance of ethane relative to water in C/1995 01 suggests that processing of pre-cometary ices varied for these two comets.

37.14-P

**Searches for Heavy Molecules in Comet C/1995 O1 Hale-Bopp**

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We present results of line searches carried out at 7 mm and 1.3 cm wavelength, using the Haystack Observatory 37-m antenna. The focus of this observing campaign was on searches for heavy molecules, with large moments of inertia, where the partition function of the molecule may favor observations at low frequencies. A successful detection was made of the $CH_3OH$ 7(0)-6(1) A+ transition at 44 GHz, with peak antenna temperature of approximately 70 mK km/s on March 28, 1997. However, other searches were unsuccessful, and only upper limits were obtained for $C_3H_2$ 3(2,1)-3(1,2), CS 1-0, CCS 4,3-3,2, $HC_3N$ 5-4, $HC_5N$ 18-17, $NH_3$ 1(1)-1(1), and $NH_3$ 3(3)-3(3). Three-sigma limits are 13 mK km/s for $C_3H_2$, 8 mK km/s for CCS, 9 mK km/s for $HC_3N$, 15 mK km/s for $HC_5N$, and 18 mK km/s for $NH_3$ 3(3)-3(3). Assuming a rotational temperature of 70 K, the production rate for $HC_3N$ is log $Q[HC_3N] < 27.5$, consistent with the detection reported by Lis et al. on IAUC 6566. For $CH_3OH$, assuming thermal equilibrium at 100 K, log $Q[CH_3OH] = 29.5$.

37.15-P

**Molecular Line Imaging of Comet Hale-Bopp**

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We present images of comet C/1995 O1 Hale-Bopp in the millimeter-wave emission of the neutral gases HCN and CS. The data were obtained between October, 1996, and June, 1997, using the 15-element QUARRY focal plane array on the Five College Radio Astronomy Observatory (FCRAO) 14-m telescope. This observing campaign represents the first long-term cometary molecular mapping program, and concentrates on the HCN J=1-0 rotational transition, along with CS J=2-1 during the months surrounding the comet's perihelion passage. Significant, time-variable asymmetries are visible in the maps, and when both HCN and CS were mapped close in time to one another, asymmetries and elongations are correlated in the two molecular line images. Preliminary modelling suggests the observed asymmetries can be accounted for by anisotropic emission of gas from the nucleus, with perhaps 25-50% of the emission occuring in "jets."

37.16-P

**Collisional Quenching of OH Radio Emission from Comet Hale-Bopp**

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OH radio emission arises from the molecule's ground state lambda doublet. In comets, the excitation of these energy levels is usually dominated by a process involving absorption of solar UV photons followed by a radiative cascade back to the ground state which leads to a population inversion or anti-inversion and results in strong emission. However, when the coma density is high enough, as in a high production rate comet like C/1995 O1 (Hale-Bopp), collisions between the OH molecule and other species can "quench" the population inversion and shut down the strong radio emission from the molecule. We present observations of this quenching effect in Comet Hale-Bopp. The comet has been monitored in the 18-cm OH emission during the time period from August, 1996, through June, 1997, using the NRAO 140-foot antenna in Green Bank, West Virginia. The observed lines were frequently strong enough to permit "mapping" of the coma with the 18-arcmin antenna beam, and maps were made using a hexagonal ring pattern 9 and 18 arcminutes from the nucleus position. The radio OH brightness distribution and line intensity indicate that considerable quenching of the OH radio emission occurs within the inner coma. Comparison of the observations to quenching models suggests that, near perihelion, radio emission from all OH molecules within a few hundred thousand kilometers of the nucleus was effectively shut off by collisional quenching of the OH excitation and that only a few percent of the total number of OH molecules in the coma were sensed at radio wavelengths. This derived quenching scale is generally consistent with previous observations of the effect in lower production rate comets when the high production rate of Hale-Bopp is considered.

37.17-P

**On the Production and Kinematics of Sodium Atoms in the Head of Comet Hale-Bopp**

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FRIDAY

The interpretation of the presence and extent of the atomic sodium observed in comet Hale-Bopp raises a number of questions related to the production, motion, and lifetime of these Na atoms under the action of the solar radiation near 1 AU. Here we report on data which pertain to the study of sodium in the head of the comet, yielding information on the Na emission in the coma out to $\sim 0.15 \times 10^6$ km on the sunward side, to $\sim 0.2 \times 10^6$ km tailwards.

The observations were carried out at the Observatoire de Haute-Provence, with the 1.93 m telescope and the ELODIE spectrometer, which is fed by a pair of optical fibers with 2-arcsec apertures separated by 1.8 arcmin. In particular, spectra were obtained on 15-17 April, 1997, near the discovery date of the sodium tail at the La Palma Observatory. These spectra (resolution $\sim$ 7 km/s) were used to determine Na D line profiles, as well as the relative intensities of the emissions corresponding to the two positions observed simultaneously. The main outcome of our first analysis concerns the profiles recorded some distance away from the optical centre, which all show velocity shifts and asymmetric line broadening in the direction of anti-sunward velocities. Some evidence is found to suggest the existence of an extended or multi-source production of sodium atoms, at least in the coma.

Another series of spectra secured just before perihelion, 25-27 March, was analysed in the same way as the April spectra. Comparison between the two sets of data provides a nice illustration of the marked influence of the heliocentric radial velocity, not only upon the strength of the fluorescence ("Swings effect"), but also upon the motion of the emitting atoms, which are accelerated by the radiation pressure to widely different degrees as their excitation wavelengths fall at different places within the Fraunhofer Na D line profiles.