Abstract IT-3c-1

SODIUM IN COMETS

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The discovery of the sodium tail on comet Hale-Bopp raised several questions on the presence of the neutral sodium atoms in comets and at the same time open new horizons on cometary physics. The analysis of the third tail revealed the resonant fluorescence as the mechanism source and allowed to confirm the theoretical value of the photoionization lifetime for a sodium atom in the space. Such value is three times larger than that assumed in the last 25 years of studies of planetary atmospheres where the sodium is present.

Since the sodium has a very high efficiency on interaction with the solar photons it is well visible even if the density is very low and it could be used as a tracer of some processes working on the cometary coma, as already occurs on planetary atmospheres. A further point stressing the important role it could play is the sodium observed on the dust tail, that it was likely released in situ by the dust particles.

The observation of sodium in some long period and new comets has been claimed by other authors in the past and the possible evidence of a sodium tail has been reported for the comets 1910 A1 and Mrkos (1957).

In this work we report the analysis of old observations of comets, where it has been seen the sodium, trying to get new insights and common points on the sources and the mechanisms working on the sodium and the coma, that we still have to understand well even on Hale-Bopp.

Abstract CT-3c-1

COMET HALE-BOPP'S DIFFUSE SODIUM TAIL

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We have imaged a diffuse sodium tail of comet Hale-Bopp using large, 8-degree field-of-view observations from the McDonald Observatory in March 1997. We subtracted off-band images from sodium-filter images to obtain the atomic sodium tail. The sodium tail was broader than the dust or ion tails, and the central axis of the tail was located within the dust tail, near the anti-sunward edge. Its radially integrated brightness increased with distance from the nucleus for at least 8 million km, suggesting an extended source for the sodium gas. Smaller, 0.5-degree field-of-view observations of the coma region support this theory. We find dust to be the most likely source of the sodium gas.

Abstract CT-3c-2

HIGH-DISPERSION LINE PROFILES OF THE SODIUM (Na) EMISSION WITHIN THE INNER COMA OF HALE-BOPP (C/1995 O1)

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We obtained high-dispersion spectra of Hale-Bopp with the 2DCoude cross-dispersed echelle spectrograph at the f/33 focus of the 2.7-m telescope at McDonald Observatory. On February 27, March 1 and April 5, 1997 UT, the Na D-line spectral region was observed at a spectral resolution of ~180,000 (1.7 km/s) at spatially resolved locations within ~40,000 km of the optocenter. Using computer driven offsets and TV guiding, different regions of the inner coma were sampled by a ~350 x 9,000 km slit.

The conclusions presented here are based on line profiles extracted from the full slit length. Future analysis will concentrate on extracting several spatially resolved profiles along the slit length.

The cometary Na emission lines (intrinsic FWHM = 2-5 km/sec) centered on the "optocenter" are consistent with a source coming from the thermal release of Na atoms from the nucleus. At all sampled positions on March 1 and April 5 the observed cometary Na D_2 line at 5890Å had an asymmetric red shoulder implying an extended source of Na atoms along a line-of-sight through the inner coma defined by the spectrograph slit.

Velocity dispersions of 2.5 to 12.0 km/sec were measured at the ~10% intensity level on the full slit profiles. The velocity dispersion of the extended source increases with distance from the nucleus and appears to be smaller in "dusty" regions of the inner coma.

The echelle bandpass on April 5 also contained the Na D_1 line at 5896Å , which was also asymmetric on the red wing. The ratio of D line strengths was consistent with an optically thin coma.

Abstract CT-3c-3

NEUTRAL SODIUM IN THE INNER COMA OF COMET HALE-BOPP (C/1995O1): HELIOCENTRIC DEPENDENCE AND SPATIAL DISTRIBUTION

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Neutral sodium observations in Comet Hale-Bopp (C/1995 O1) were carried out with a low-dispersion and high-dispersion spectrograph, as well as a narrow-band imaging of the inner coma.

We have performed a sequential monitoring by the low-dispersion spectrograph from September 1996 to May 1997. After the positive detection of the neutral sodium emission in early February 1997, we have confirmed by high-dispersion spectroscopic observations (Kawabata et al. 1997, IAU Circ. 6575). The high-dispersion spectroscopic observations were made from February to April 1997.

Furthermore, we started the imaging observations of the inner coma using the filter set for neutral sodium emission at that time, and continued to April 1997.

Results of our observations are as follows.

First, from our spectroscopic monitoring a ratio of the intensity of neutral sodium emission to that of the continuum varied with r^{-4} after the Swings effect was corrected, where r denotes a heliocentric distance of Comet Hale-Bopp, Secondly, "neutral sodium jet" structure was detected from our imaging observations of the inner coma. This structure is similar to the arc structure of continuum emission but slightly shifted to the anti-solar direction (Sakamoto et al. 1997, IAU Circ. 6686).

We will also show the result of random walk simulation for the neutral sodium atoms to compare with our observations.