VOLATILE DISTRIBUTIONS IN THE COMAE OF COMET 73P/SCHWASSMANN-WACHMANN 3 DERIVED FROM HIGH-RESOLUTION IR SPECTROSCOPIC OBSERVATIONS. R. J. Vervack, Jr.[1], N. Dello Russo[1], H. A. Weaver[1], N. Biver[2], D. Bockelée-Morvan[2], J. Crovisier[2], and C. M. Lisse[1], [1]JHU/Applied Physics Laboratory, [2]Observatoire de Paris-Meudon

Introduction: Comet 73P/Schwassmann-Wachmann 3 is a Jupiter-family comet based on its short period (5.34 years) and low orbital inclination (11.4°). During its 1995 apparition, the comet split into at least five fragments [1], increasing the overall gas production rate by more than an order of magnitude from the previous apparition [2]. Observations obtained during the 2006 apparition confirm the disintegration of 73P: 68 named fragments were identified and at least two of the larger fragments were shedding boulder-sized pieces [3]. Radar observations confirm that the largest fragments (C and B) are of significant size [4], strongly suggesting that material from different depths (including the deep interior of 73P) is exposed on the surfaces of these bodies.

Measurements of the spatial distributions of volatile species in the coma of a comet can provide important clues about how these species are released from the nucleus and the subsequent chemistry that occurs in the coma. This study reports the spatial distributions of volatile species in the comae of fragments 73P-B and 73P-C on UT May 14 and 15, 2006, derived from high-resolution infrared observations obtained with the NIRSPEC spectrometer [5] at the 10-m W. M. Keck Observatory on Mauna Kea, Hawaii.

Results: The combination of 73P's close passage to Earth and the spectral/spatial capabilities of NIRSPEC has yielded unprecedented spatial information on SW3-B and SW3-C. As seen in Figure 1, spatial distributions averaged over many lines show that the gas outflow is more extended than the dust in the sunward direction and that the gas outflow appears more symmetric than the dust. However, such averages can mask important underlying differences. When examined on a line-by-line basis, the spatial profiles of individual lines with different energies suggest that there are rotational temperature variations in the coma and that the rotational temperature decreases with distance from the nucleus. Interestingly, the observed variations are not the same for all species. For example, H_2O decreases in both directions while HCN decreases in the sunward direction only. The peak column density of the "cold" lines also appears to be slightly shifted sunward with respect to the "hot" lines.

The spatial distributions shown here were determined from a single stacked image covering a significant time span (on the order of 60 minutes). Comparisons of the spatial distributions determined from single (A-B) frames separated in time by approximately one hour suggest not only that the "cold" and "hot" relationships are observable on small time scales (~2 minutes) but also that they are relatively stable over the longer time scales. Furthermore, the "cold" and "hot" components of H_2O and HCN behave similarly in both fragments on both dates.

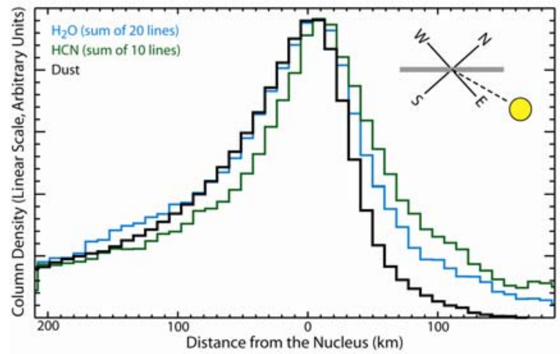

Figure 1. Average spatial distributions for H_2O and HCN compared to the distribution of dust in 73P-B on May 14.6.

We will report on the observed spatial distributions of the volatile species in 73P-B and 73P-C, including a detailed examination of their temporal variability. Distributions will be presented for not only H_2O and HCN but for the additional species observed in 73P [6]. The spatial distributions of several unidentified spectral lines will also be examined in an effort to identify the unknown sources of the emissions.

The volatile species distributions measured in 73P-B and 73P-C can provide valuable tests of and constraints on models of inner gaseous coma processes [7,8] owing to the high spatial resolution and large number of energy levels sampled. We will investigate the observed spatial distributions in the context of these models to infer information about the physical processes occurring in the coma of 73P-B and 73P-C.

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