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Understanding Measured Rotational Temperatures in the Very Inner Coma of Comet 73P/Schwassmann-Wachmann 3

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Abstract

Direct sublimation of a comet nucleus surface is usually considered to be the main source of gas in the coma of a comet. However, evidence from a number of comets including the recent spectacular images of comet 103P/Hartley 2 by the EPOXI mission indicates that the nucleus alone may not be responsible for all, or possibly at times even most, of the total amount of gas seen in the coma. Indeed, the sublimation of icy grains, which have been injected into the coma appears to constitute an important source. We use the fully-kinetic Direct Simulation Monte Carlo model discussed in [2] and [3] in order to reproduce the measurements of column density and rotational temperature of the comet 73P-B/Schwassmann-Wachmann 3 made with a very high spatial resolution of $\sim$30 km with IRCS/Subaru in May 2006 [1]. The gas models with production from the nucleus alone predict rotational temperatures of about 110K near the nucleus at heliocentric distance of about 1 AU, but they then decrease to only several tens of degrees by 10-20 nucleus radii. The decay of both the rotational temperature and the column density with the distance from the nucleus is too fast on that range for models that only include direct sublimation from the nucleus. The addition of a substantial source of gas from icy grains in the model slows down this decay in rotational temperature and provides a more gradual drop in column density profiles, which corresponds better to the observations.

Acknowledgements

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