Geophysical Research Abstracts
Vol. 17, EGU2015-4528-1, 2015
EGU General Assembly 2015

DSMC Simulations of Ceres' Water Plumes and Exosphere

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In April, 2015, the NASA Dawn spacecraft will arrive at the closest dwarf planet, Ceres, that is also the largest asteroid orbiting between Mars and Jupiter. An important task, not planned before, is to investigate the dynamics and origin of the newly discovered water plumes emitted from the northern hemisphere of Ceres [1]. It is not clear what the source mechanism of the gas plumes is. They could be produced by surface sublimation at some spots with exposed ice or shallowly buried ice bed. On the other hand, an Enceladus-like water vapor emission could take place. The second possibility is turns out to be the case will have tremendous impact on our view on Ceres as a potential habitable world. We follow up our previous study on the existence of a surface-bound exosphere of Ceres [2] by making advanced DSMC simulations [3-4] of the escaping water cloud surrounding Ceres and the associated exosphere maintained by the infall /recycle of a small fraction of the gas outflow. Ballistic transport of the water molecules across the surface to the polar regions would also lead to the formation of ice caps in the cold trap regions as will be tested by the Dawn observations.

References:
1. Küppers, M., O'Rourke, L., Bockelee-Morvan. D., Zakharov, V., et al., "Localized sources of water vapor on the dwarf planet (1) Ceres", Nature, 505. pp. 525-527, 2014.
2. Tu, L., W.-H. Ip, Y.-C. Wang, 2014. "A sublimation-driven exospheric model of Ceres". Planetary and Space Science 104. pp. 157-162, 2014.
3. Wu, J.-S., Tseng, K.-C. and Wu, F.-Y., "Parallel three-dimensional DSMC method using mesh refinement and variable time-step scheme", Comput. Phys. Comm., 162, pp. 166-187, 2004.
4. Su, C.-C., Tseng, K.-C., Cave, H.M., Wu, J.-S., Lian, Y.-Y., Kuo, T.-C. and Jermy, M.C., "Implementation of a Transient Adaptive Sub-Cell Module for the Parallel DSMC Code Using Unstructured Grids," Computers & Fluids, Vol. 39, pp. 1136-1145, 2010.