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DSMC Simulations of Gas Outflow and Photochemical Processes in the Coma of Comet 67P/Churyumov-Gerasimenko

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The expansion of sublimating gas from cometary nucleus surface is a complex physical process. It involves the diurnal temperature effect of the outgassing rate, the gas drag to the dust, the irregular shape of the nucleus at different scale lengths, transition from the collisional flow regime to the free-molecular flow regime, and the direct gas flow over or into regions in the shadow. Most of these effects which have been discussed before can now be tested by imaging observations and in-situ measurements at comet 67P/Churyumov-Gerasimenko (67P/C-G). We produce the surface temperature distribution and its diurnal variation by a geometrical thermal model of comet 67P/C-G. And we use a parallel 3D Direct Simulation Monte Carlo (DSMC) code, named PDSC++ [1, 2], from Wu's group at NCTU to calculate the gas flow near the cometary nucleus. In the presentation, we will show the results and basic characteristics of the gas coma pattern of comet 67P by including non-uniform gas composition (i.e. H_2O-rich vs. CO_2/CO) from different regions (i.e. neck vs. head/body). In addition, preliminary results on the photochemical effects of a distributed source will be described.

Reference:
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2. 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.