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The distribution of electrically charged dust and its effect on the plasma flow in the coma of comet 67P/Churyumov-Gerasimenko

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Abstract

Being the target of the Rosetta mission, comet 67P/Churyumov-Gerasimenko is the object of both theoretical and practical interest. With the lack of detailed knowledge of every aspect of the comet and its coma, some predictions of their properties need to be estimated and done by means of numerical modeling.

Sublimation of volatiles contained in the nucleus results in injection of the gas and dust into the cometary environment. Originally neutral, the dust grains can accumulate electric charge on their surfaces. Such grains will contribute to the local electric charge and current densities and, as a result, can cause a perturbation of the local electric and magnetic fields. In turn, these fields will affect the motions of the smallest charged dust particles in significant ways. The potential effect of dust charging on the distribution of the fields is the subject of this work.

The most important process [1] that causes a grain charging is the interaction with the surrounding plasma (mainly plasma of the solar wind). Other processes that determine the distribution of dust in the coma include gravity of the nucleus, drag force by the gas and the Lorentz force. At large cometocentric distances, the combined effect of solar gravity and solar radiation pressure defines the direction of the dust tail.

The dust has no significant effect on the neutral gas for the rather low mass production rates in the coma of comet 67P/Churyumov-Gerasimenko. This allows us to apply the results of our previous simulation of the neutral gas coma [2] to calculate the drag force that act upon the dust grains.

In this first attempt to quantitively evaluate the effect of the charged dust on the cometary environment we have used the distribution of the plasma flow and the electric and magnetic fields obtained from MHD simulation [3] of the interaction of the comet with solar wind.

For simulation of the dust we have used our Monte-Carlo model [4], where dust grains are represented by a set of model particles acted upon by the forces and physical processes listed above. Accounting for these, our kinetic model is applicable in the whole range of grain sizes.

In this work we present a detailed analysis of the neutral/charged dust distribution in the coma of comet 67P/Churyumov-Gerasimenko at heliocentric distances relevant to the Rosetta mission. The charge density associated with the dust grains and its potential effect on the electric and magnetic fields in the vicinity of the nucleus are also studied.

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References

[1] M. Horányi, “Charged dust dynamics in the solar system,” *Annual review of astronomy and astrophysics*, vol. 34, pp. 383–418, 1996.

[2] V. Tenishev, M. Combi, and B. Davidsson, “A global kinetic model for cometary comae. The evolution of the coma of the Rosetta target comet Churyumov-Gerasimenko throughout the mission,” *Astrophysical Journal*, vol. 685, pp. 659–677, 2008.

[3] K. C. Hansen, T. Bagdonat, U. Motschmann, C. Alexander, M. R. Combi, T. E. Cravens, T. I. Gombosi, Y.-D. Jia, and I. P. Robertson, “The

plasma environment of comet 67P/Churyumov-Gerasimenko throughout the Rosetta main mission," *Space Science Reviews*, vol. 128, no. 1-4, pp. 133–166, 2007.

[4] V. Tenishev, M. R. Combi, and M. Rubin, "Numerical simulation of dust in a cometary coma: Application to comet 67P/Churyumov-Gerasimenko," *Astrophysical Journal*, vol. 732, no. 2, 2011.