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# Effect of dust on the ionosphere of 67P/Churyumov-Gerasimenko

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## Abstract

The ESA *Rosetta* mission is a unique cometary mission consisting both of an orbiter and a lander. The orbiter will follow comet 67P/Churyumov-Gerasimenko (67P) closely from August 2014 to the end of the nominal mission in December 2015. The comet passes perihelion in August 2015, at a heliocentric distance of ~1.3 AU. At that stage 67P is expected to be actively outgassing. The gas, dominated by $H_2O$, carries with it dust particles to the coma and for 67P, near perihelion, the dust-to-gas mass emission ratio is anticipated to exceed 1. The well-developed coma/ionosphere, will be probed *in situ* e.g. by the dual Langmuir probe (LAP) [1] and the Mutual Impedance Probe (MIP) [2], which are parts of the Rosetta Plasma Consortium (RPC) [3], and by the Rosetta Orbiter Spectrometer for Ion and Neutral Analysis (ROSINA) [4], providing e.g., electron and ion number densities down to cometocentric distances of ~5-20 km.

We present a model of the ionization balance in the diamagnetic cavity of 67P near perihelion. The model builds upon an earlier presented pure gas-phase model [5]. The updated model takes into account gas-dust interactions. We aim in particular to *qualitatively* address the potential role of grains in the ionization balance and discuss the possibility of a significant level of electron depletion due to electron attachment to grains of different sizes. The study is in part motivated by the discovery of a pronounced level of electron depletion in the plume of Enceladus, which has been attributed to nanograin charging [6,7].

On the one hand we argue that grains with radii of ~ 100 nm and more are unlikely to significantly affect the overall ionospheric particle balance of 67P at least for cometocentric distances >10 km. On the other hand, our simulations suggest that *if* nanograins with radii in the 1-3 nm range are as ubiquitous (~1% with respect to the gas in terms of mass) in the coma of 67P as in the Enceladus plume a pronounced level of electron depletion can prevail up to cometocentric distances of several tens of km, possibly throughout the diamagnetic cavity.

The results of our simulations may prove useful in the interpretation of scientific data returned from individual instruments of the *Rosetta* orbiter as well as in inter-instrumental data comparisons. At the same time, *in situ* measurements will be used for driving the model after which model-observation comparisons will serve as a good test of our understanding of the key processes affecting the ionospheric particle balance of 67P in the near nucleus surrounding.

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