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Recent advances in the model of aspherical dust dynamics for GIADA experiment in the coma of 67P/Churyumov-Gerasimenko

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Introduction. We report the latest improvements of the model of aspherical dust grain dynamics [1] in the cometary atmosphere of 67P/Churyumov- Gerasimenko(67P/C-G). The model is aimed to support the scien- tific objectives of GIADA (Grain Impact Analyzer and Dust Accumulator) in-situ experiment [2] on board of the ESA ROSETTA spacecraft. The instrument will measure individual dust grain mass, number density and velocity in the immediate vicinity of the cometary nucleus. In this report we discuss the distinctions in the dy- namics of the aspherical dust in comparison with the spherical approximation developed in the currently used 3D+t spherical dust models [3,4].

Model. We assume that dust grains are homogeneous, isothermal polygonal convex bodies (close to ellip- soid of revolution with different aspect ratios of axes). The grains are moving under influence of three forces: aero- dynamic , gravitational and torque. The gas distribution (density, velocity, temperature) in the coma is taken from the Euler solution for spherical expansion. The aerodynamic force we estimate from expressions for free molecular interaction. On the comet surface we postulate the distribution function of ejection velocity and the distribution function of initial orientation of the grains. From the same origin on the surface we trace a number of grain trajectories with different initial conditions. Then we derive an average trajectory with mean parameters and the dispersion around it. We evaluate the goodness of spherical grain approximation through the deviation of the spherical grain trajectory from the averaged trajectory.

Results. We have studied various distribution functions of initial orientation of aspherical rotating grains. The results of our simulations show that the dynamics of aspherical grains is very sensitive to the initial parameters (orientation and ejection velocity). Therefore, we see that the velocity along the trajectory of the identical aspherical grains could change significantly increasing up to 40 % when the torque is considered. This also affects on the radial distribution of the averaged parameters: the volume density and the mean velocity. Our first results show that the region of the high variation of the dynamical dust parameters is about ten kilometers outward of the surface of the nucleus for grain sizes of less or equal of a micron.

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