MONTE-CARLO MODELLING OF THE CIRCUMNUCLEAR DUST COMA: BENCHMARK ASPHERICAL-HOMOGENEOUS AND SPHERICAL-INHOMOGENEOUS NUCLEI. V. V. Zakharov[1], J.-F. Crifo[2], G. A. Lukianov[3] and A. V. Rodionov[4], [1]LESIA, Observatoire de Paris, 5, Place Jules Janssen, F-92195 Meudon Cedex, France, vladimir.zakharov@obspm.fr, [2]Service d'Aéronomie du CNRS, BP 3, F-91371 Verrières le Buisson Cedex, France, crifo@aerov.jussieu.fr, [3]Center for Advanced Studies, St.-Petersburg State Technical University, Polytechnichestkaya str., 29, 195251, St.-Petersburg, Russia, [4]Central Research Institute on Machine Building (TsNIIMASH), Pionerskaya str., 4, Korolev, Moscow Region, 141070, Russia.

The preparation of cometary missions in which dust samplings will be possible down to the nucleus surface led us to develop a dust dynamical model suitable to forecast the near-nucleus environment prior to the measurements, and to interprete them.

Our modeling method (the so-called Dust Monte-Carlo (DMC) technique [1]) consists in monitoring the motion of a large number of grains distributed over the full range of ejectable masses, taking into account all applied forces. The aerodynamic force is computed on the basis of a gasdynamical computation of the gas coma, and the true gravitational force (asymmetrical if the nucleus is aspherical) is used.

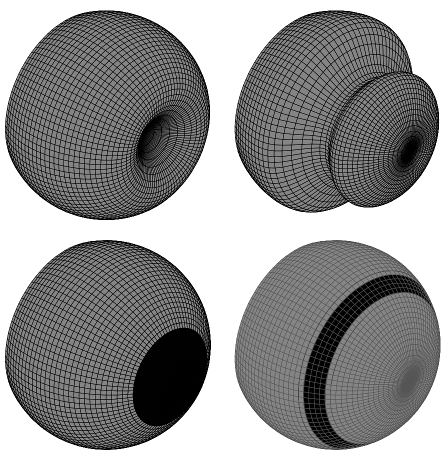

Fig. 1 Model nuclei used in this study. The region of low activity is in dark.

In the present, interim development phase, the grains are assumed spherical, and only three applied forces are taken into account: the nucleus gravitational force, the gas coma aerodynamic force, and the solar radiation pressure. Also, simple benchmark nuclei are considered. Here, we report results concerning the four axially symmetric dusty ice nuclei shown on Figure 1: (a) homogeneous nucleus with a large subsolar cavity (top left); (b) homogeneous nucleus with a midlatitude valley (top right); (c) spherical nucleus with a spherical cap of reduced activity (low left); (d) spherical nucleus with a ring of reduced activity (low right). In all cases, the Sun is assumed to be on the axis of symmetry. For each nucleus, two different sizes and heliocentric distances are considered. The gas comae around these eight nuclei have been extensively described in [2] and [3].

The small subset from the existing results presented here shows that (a) in large parts of the dust coma, trajectory crossings occur and thus the dust distribution cannot be characterized by unique velocity vector; (b) a wealth of trajectories ending in surface impacts are found (see example in Fig. 2), producing sizable fluxes of grains of a large range of sizes; (c) the dust coma at any size is structured, but the structures are not similar to the gas coma structures, nor simply related to the surface activity – in particular, there is no evident way to decide whether a coma dust structure is due to nucleus asphericity or to nucleus inhomogeneity; (d) when computing the dust coma at any size, it is not acceptable to neglect any of the three forces considered here; (e) even, the asphericity of the gravity field (when existing) must be taken into account

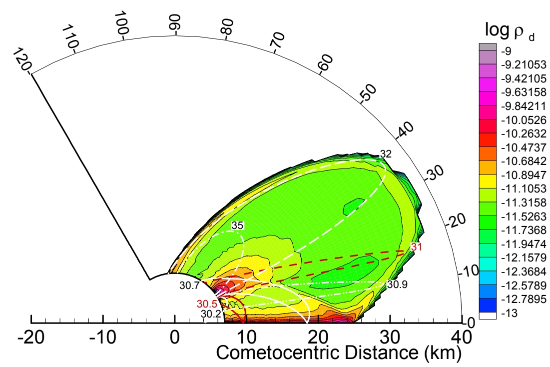

Fig. 2 Isocontours of $\log_{10}$(dust density) and trajectories of dust grains (9.1 micron radius) for the nucleus with weakly active cap at 3 AU from the Sun.

References: [1] Crifo J.-F. et al. (2005) *Icarus*, *176*, 192-219. [2] Crifo J.-F. et al. (2003) *Icarus*, *163*, 479-503. [3] Zakharov V.V. et al. (2008) *Icarus*, *194*, 327-346.