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Compacted aggregates from numerical simulations compared to Rosetta collected particles

Isabelle Maroger (1), Jérémie Lasue (1), Robert Botet (2), Philippe Garnier (1), Sihane Merouane (3), Thurid Mannel (4,5), Anny-Chantal Levasseur-Regourd (6), and Mark Bentley (7)

(1) IRAP, Universite Toulouse 3, IRAP, Toulouse, France (philippe.garnier@irap.omp.eu), (2) Universite Paris-Sud/CNRS, UMR 8502, LPS, Orsay, France, (3) Max Planck Institute, Göttingen, Germany, (4) Space Research Institute of the Austrian Academy of Sciences, Graz, Austria, (5) University of Graz, Graz, Austria, (6) UPMC (Sorbonne Univ.); CNRS/INSU; LATMOS-IPSL, Paris, France, (7) European Space Astronomy Centre, Madrid, Spain

The Rosetta space mission includes three main instruments for solid dust particles analysis. The combined microscope and mass spectrometer COSIMA (Cometary Secondary Ion Mass Analyser) [1], the atomic force microscope MIDAS (Micro-Imaging Dust Analysis System) [2], and the impact detector GIADA (Grain Impact Analyser and Dust Accumulator) [3]. These three instruments provide complementary insights into the dust particles properties thanks to their different approaches and resolution ranges (10nm to 1mm). GIADA and MIDAS observed a major contribution from compact dust aggregates together with a population of porous particles with a low fractal dimension (Df ∼1.7 for MIDAS [4]) [5, 6]. Such a fractal dust component of the nucleus and its properties give constraints on the formation of comets in the early solar system [5].
In this work, we analyse results from a simple numerical model of dust aggregates compaction and compare them with COSIMA images of collected aggregates to assess the initial physical properties of the dust populations. We consider 4 different kinds of fractal aggregates presenting different initial fractal dimensions (Df ∼1.8/2.1/2.5/3) based on their aggregation processes (diffusion limited or reaction limited aggregations, depending on the surface sticking probabilities of the monomers, and particle-cluster or cluster-cluster aggregations).
We find that the aspect ratio distribution observed by COSIMA may be explained either by compacting two different initial families with low and high fractal dimensions and the same cohesive strength between monomers, or by compacting a single type of particles (with an aggregation process like DLPA) however with a large range of internal cohesive strengths or collection velocities.

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