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209.06 – Three-dimensional kinetic modeling of the near coma of comet 67P/Churyumov-Gerasimenko

Rosetta is the first mission that escorts a comet along its way through the Solar system for an extended amount of time. As a result, the target of the mission, comet 67P/Churyumov-Gerasimenko, becomes an object of the increased scientific interest. Interpretation of the already obtained observations as well as planning of the new measurements requires detailed modeling of the coma constrained by physical quantities measured by the instruments onboard the spacecraft.

The primary difficulties of such modeling are the kinetic nature of the dusty gas flow in the coma as well as the complexity of the nucleus shape as shown by the recent Rosetta images.

Here we present the first results of the fully three-dimensional simulation of the near coma of comet 67P/Churyumov-Gerasimenko performed with our Adaptive Mesh Particle Simulator (AMPS) code. The simulation is performed using a realistic nucleus shape model based on Rosetta observations for modeling the coma and calculation of the synthetic images.

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209.07 – The Comet Radar Explorer Mission

Missions to cometary nuclei have revealed major geological surprises: (1) Global scale layers – do these persist through to the interior? Are they a record of primary accretion? (2) Smooth regions – are they landslides originating on the surface? Are they cryovolcanic? (3) Pits – are they impact craters or sublimation pits, or rooted in the interior? Unambiguous answers to these and other questions can be obtained by high definition 3D radar reflection imaging (RRI) of internal structure. RRI can answer many of the great unknowns in planetary science: How do primitive bodies accrete? Are cometary nuclei mostly ice? What drives their spectacular activity and evolution? The Comet Radar Explorer (CORE) mission will image the detailed internal structure of the nucleus of 10P/Tempel 2. This ~16 x 8 x 7 km Jupiter Family Comet (JFC), or its parent body, originated in the outer planets region possibly millions of years before planet formation. CORE arrives post-perihelion and observes the comet's waning activity from safe distance. Once the nucleus is largely dormant, the spacecraft enters a ~20-km dedicated Radar Mapping Orbit (RMO). The exacting design of the RRI experiment and the precise navigation of RMO will achieve a highly focused 3D radar reflection image of internal structure, to tens of meters resolution, and tomographic images of velocity and attenuation to hundreds of meters resolution, tied to the gravity model and shape. Visible imagers will produce maps of the surface morphology, albedo, color, texture, and photometric response, and images for navigation and shape determination. The cameras will also monitor the structure and dynamics of the coma, and its dusty jets, allowing their correlation in 3D with deep interior structures and surface features. Repeated global high-resolution thermal images will probe the near-surface layers heated by the Sun. Derived maps of thermal inertia will be correlated with the radar boundary response, and photometry and texture, probing surface materials attainable by future robotic excavation missions. Thermal images will reveal areas of sublimation cooling around vents and pits, and the secular response of the outer meters as the nucleus moves farther from the Sun.

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209.08 – Results from the Worldwide Coma Morphology Campaign for Comet ISON (C/2012 S1)

Comet ISON (C/2012 S1) was predicted to be a bright comet in late 2013 because of its extremely small perihelion distance of 2.7 solar radii. In anticipation of the likely bonanza of scientific results, we coordinated a worldwide campaign (http://www.psi.edu/ison) to obtain both dust and gas images of the comet. During the campaign, we have received many hundreds of images primarily from amateur astronomers but also from a number of professionals. Comet ISON showed dust structure in its coma at large heliocentric distances before water became the primary sublimating gas. The Hubble Space Telescope (HST) observed a dust feature in the coma at a heliocentric distance of