Geophysical Research Abstracts
Vol. 16, EGU2014-6993, 2014
EGU General Assembly 2014

Constraints on the subsurface structure and density of the nucleus of Comet 67P/Churyumov–Gerasimenko from radar observations

Philippe Lamy (1), Paul Kamoun (2), Imre Toth (3), and Alain Herique (4)

(1) Laboratoire d'Astrophysique de Marseille, Marseille cedex 13, France (philippe.lamy@lam.fr), (2) Université de Nice Sophia Antipolis and Thales Alenia Space, Cannes, France, (3) Konkoly Observatory, MTA CSFK, Budapest, Hungary, (4) Institut de Planétologie et d'Astrophysique de Grenoble, Grenoble, France

We performed an in-depth analysis of the observations carried with the radar system of the Arecibo Observatory in November 1982 when comet 67P/Churyumov-Gerasimenko had a close encounter with Earth at a geocentric distance of 0.4 AU taking into account our present knowledge of the properties of its nucleus (size, rotational state). In the absence of a detectable radar echo, we determined a maximum radar cross section of 0.7 km^2 leading to a maximum radar albedo of 0.05. This low albedo probably results from a combination of a low radar reflectivity material and a lightly packed upper layer of the nucleus with substantial roughness (rms slope of $\approx 55^\circ$), consistent with its low thermal inertia. Based on radar observations of other cometary nuclei and asteroids, it is unlikely that the albedo can be lower than 0.04 so that we were able to constrain the dielectric permittivity of the subsurface layer to a narrow range of 1.9 to 2.1. Laboratory measurements and our modeling of mixtures of ice and dust led to a porosity in the range of approximately 55 to 65% and a density in the range of $\approx$600 to $\approx$1000 kg m^{-3} for the top $\approx$2.5 m layer of the nucleus. This would be the bulk density range for an homogeneous nucleus and would place the success of the landing at risk but an inhomogeneous nucleus with an overall density below this range remains a possibility.