

Imaging and Polarimetry of the Nucleus of Comet 2P/Encke. H. Boehnhardt, G. P. Tozzi, S. Bagnulo, K. Muinonen, A. Nathues, L. Kolokolova

Comet 2P/Encke is a short-periodic comet and is a favorable object for studies of the light scattering of bare cometary nuclei. Such studies enable the assessment of the nucleus size, of the surface porosity and of the material albedo. New observations of 2P/Encke were performed during October to December 2006 when the comet approached the Sun from 2.7 to 2.0 AU. Broadband imaging photometry as well as broadband and narrow band linear polarimetry is measured for the nucleus of 2P/Encke over the phase angle range from 4 to 28 deg. An analysis of the point spread function of the comet in combined photometric and polarimetric images does not reveal significant coma activity in 2P/Encke, though a very low level coma was detected comparing to a dust production of approximately 0.05 kg/s. Over the measured phase angle range the nucleus displays a widely color independent photometric phase function with linear slope of $0.048(\pm 0.003)$ mag/deg. The absolute R filter magnitude at zero phase angle is $15.05(\pm 0.05)$ mag and corresponds to an equivalent radius for the nucleus of $2.52(\pm 0.05)$ km (assumed albedo of 0.047). The nucleus color V-R was measured to be $0.50(\pm 0.07)$ mag, suggesting a spectral reddening of $14.5(\pm 7.0)$ %/100nm. The phase function of linear polarimetry in Bessel V and R filter shows a widely color independent linear increase with phase angle of $0.123(\pm 0.02)$ %/deg. The test of the asteroid albedo-polarization relationship reveals unreasonably high albedo values for the nucleus suggesting that either this relationship is not applicable for comets, possibly because the surface is too dark or that different so far undetermined fitting parameters are to be used. The linear polarimetric phase function of 2P/Encke presented here is the first ever measured of a cometary nucleus. It is unique compared to other solar system objects, in particular there is no good agreement with any polarization phase function known from the asteroid population, although individual similarities are noted. It suggests to measure further cometary nuclei in order to put the light scattering behavior of comets on better empirical grounds and to verify or disprove the existence of a polarization-albedo relationship in comets as for asteroids.