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NEO Characterization

Physical characterization and shape model of 1998 OR2 shows its surface is heterogeneous

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ABSTRACT

On April 29th 2020, the near Earth object (52768) 1998 OR2 experienced a close approach to the Earth at a distance of 16.4 lunar distances (LD). 1998 OR2 is a potentially hazardous asteroid of absolute magnitude H = 16 that can currently come as close to the Earth as 3.4 lunar distances.

We report here observations of this object in polarimetry, photometry and radar. The photometric observations obtained with 20 different telescope over the world confirm the previously reported synodic rotation period of 4.11h. The polarimetric observations were obtained with the Torino Polarimeter at the Calern

station in South of France (MPC 010). They display a consistent variation of the polarimetric response as a function of the rotational phase. These variation can be linked to variation of the surface properties of 1998 OR2 as polarimetric observation are independent on shape and to a first order correlated with albedo. Analysis of the variation of the polarization as a function of the phase angle provides an albedo determination of pv = 0.226 +- 0.03. The radar observations were obtained with the planetary radar system from 305m Arecibo telescope. The Doppler observations provide a circular polarization ratio of 0.282 +- 0.015 and the delay-Doppler images show that the surface of 1998 OR2 is a top-shape asteroid with large scale structures such as large craters and concavities that can potentially be correlated with the variations observed in polarimetry. Combining radar and photometric observation, we obtained 1998 OR2 shape model showing the presence of concavities and craters. The shape model display a volume of 2.9 +- 0.5 cube kilometer corresponding to an equivalent diameter of 1.8 +- 0.1 kilometer. The shape model display a sidereal rotation period of 4.10872 +- 0.00001 hours and a spin axis orientation of (332.3°, 20.7°).

1998 OR2 is one of the largest asteroid that can perform fly-by closer to 4 lunar distances. Its heterogeneous surfaces and its peculiar surface properties showing evidence of shock darkening/impact melts (Battle et al., 2022, The PSJ, 3, 226) makes it one of the best target for future space mission.

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