Non-convex model of the binary asteroid (809) Lundia and its density estimation

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Introduction: (809) Lundia was classified as a V-type asteroid in the Flora family (Florczak et.al. 2002). The binary nature of (809) Lundia was discovered in September 2005 based on photometric observations. The first modeling of the Lundia synchronous binary system was based on 22 lightcurves obtained at Borowiec and Pic du Midi Observatories during two oppositions in 2005/2006 and 2006/2007. Two methods of modeling — modified Roche ellipsoids and kinematic — gave similar parameters for the system (Kryszczynska et al. 2009). The poles of the orbit in ecliptic coordinates were: longitude 118° and latitude 28° in the modified Roche model and 120°, 18°, respectively, in the kinematic model. The orbital period obtained from the lightcurve analysis as well as from modeling was 15.418 h. The obtained bulk density of both components was 1.64 or 1.71 g/ccm.

Observations: We observed (809) Lundia in the 2008, 2009/2010, 2011, and 2012 oppositions at the Borowiec, Pic du Midi, Prompt, and Rozhen Observatories. As predicted, the visible eclipses/occultation events were observed only in 2011. Currently, our dataset consists of 45 individual lightcurves and they were all used in the new modeling.

Method: We used new method of modeling based on a genetic algorithm that is able to create a non-convex asteroid shape model, rotational period, and spin-axis orientation of a single or binary asteroid, using only photometric observations. The details of the method are presented in the poster by Bartczak et al., at this conference.

Results: The new non-convex model of (809) Lundia is presented in the figure. The parameters of the system in the ecliptic coordinates are: longitude 122°, latitude 22°, and sidereal period 15.41574 h. They are very similar to the values obtained before. However, assuming an equivalent diameter of a single body of 9.1 km from the Spitzer observations (Marchis et al. 2012) and the volume of the two modeled bodies, the separation of the components is 17.2 km, the sizes of the components are 7.7 km and 6.7 km, and the size ratio is 0.87. The obtained density of 2.5 g/ccm is much higher than that determined before. In comparison to the density of HED meteorites, this value implies a macroporosity of only 13–23 %.

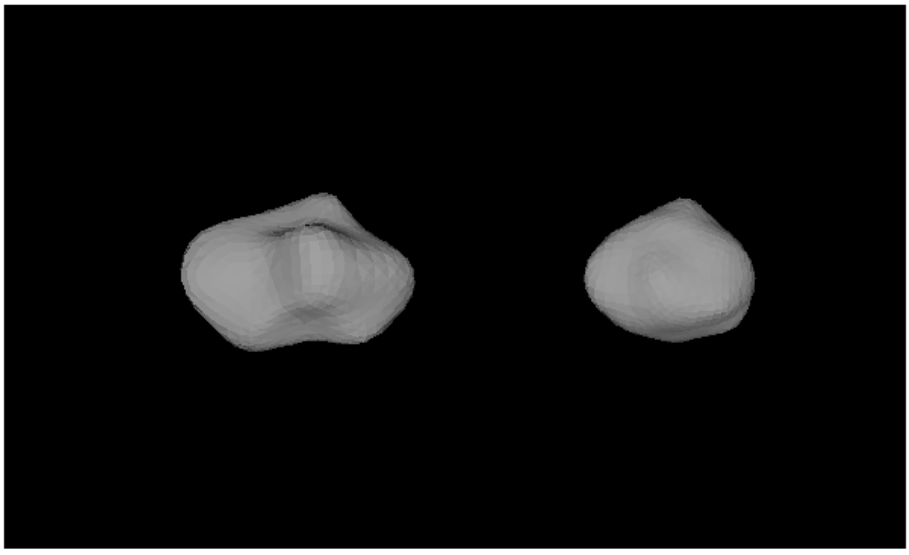

Figure: Side view of the (809) Lundia system.

References: Florczak M. et al. (2002) Icarus 159, 178; Kryszczynska A. et al. (2009) Astronomy & Astrophysics 501, 769; Marchis F. et al. (2012) Icarus 221, 1130.