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Shape and spin of asteroid 967 Helionape

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Abstract. Knowledge of the spin and shape parameters of the asteroids is very important for understanding of the conditions during the creation of our planetary system and formation of asteroid populations. The main belt asteroid and Flora family member 967 Helionape was observed during five apparitions. The observations were made at the Bulgarian National Astronomical Observatory (BNAO) Rozhen, since March 2006 to March 2016. Lihtcurve inversion method (Kaasalainen *et al.* (2001)), applied on 12 relative lightcurves obtained at various geometric conditions of the asteroid, reveals the spin vector, the sense of rotation and the preliminary shape model of the asteroid. Our aim is to contribute in increasing the set of asteroids with known spin and shape parameters. This could be done with dense lightcurves, obtained during small number of apparitions, in combination with sparse data produced by photometric asteroid surveys such as the Gaia satellite (Hanush (2011)).

Keywords. Minor planets, asteroids, photometric-Asteroids: individual: 967 Helionape

1. Observations and data Reduction

The observations were made by 50/70 cm Schmidt telescope equipped with FLI PL16803 CCD camera and 60 cm Cassegrain telescope with FLI PL9000 CCD camera. Aperture photometry of the asteroids and the comparison stars was performed using the software program CCDPHOT (Buie (1998)). For lightcurve analysis, we used the software package MPO Canopus v10.4 (Warner (2011)). The first observations of 967 Helionape were part of studies of the interrelations among Flora family asteroids (Apostolovska *et al.* (2009), Kryszczyńska *et al.* (2012)). According to NEOWISE, Helionape has a diameter of 10.216 km and albedo of 0.178 (Mainzer *et al.* (2016)).

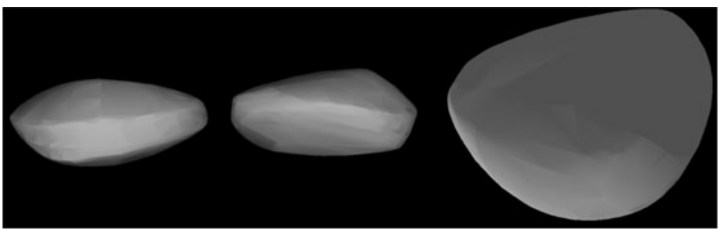

Figure 1. Shape model of 967 Helionape, shown at equatorial viewing illumination geometry, with rotational phases 90 apart (two pictures on the left) and the pole-on view on the right.

The table 1 gives the sidereal rotational period, sense of rotation, ecliptic coordinates λ and β of the pole solution and rough relative shape dimensions. Pole 2 is corresponding mirror solution to Pole 1.

Table 1. Parameters of the model

Asteroid 967 Helionape	Sidereal period (h)	Sence of rotation	Pole $\lambda(^\circ)$	Pole $\beta(^\circ)$	a/b	b/c
Pole 1	3.2339400	P	180.4	43.0	1.07	1.77
Pole 2	3.2339403	P	359.5	30.0	1.05	1.71
Pole 3	3.2339362	P	162.8	35.0	1.08	1.78

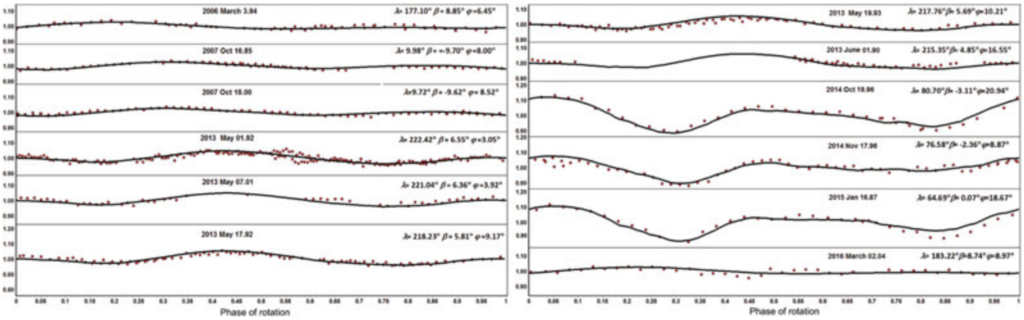

Figure 2. Lightcurves (points) obtained from observations for 967 Helionape superimposed on the lightcurves created by a model (solid line). In the graph are given, the phase angle (φ), the ecliptic longitude (λ) and latitude (β) of the asteroid referred to the date of the observation referring to the midtime of the lightcurve observed.

2. Conclusions

Using convex lightcurve inversion method we obtained three possible spin axes solutions with prograde sense of rotation and preliminary shape of 967 Helionape. One of the solutions, Pole 2 is corresponding mirror solution to Pole 1. Next opportunities for observing this asteroid through Schmidt telescope at BNAO Rozhen will be since August to December 2017 which could improve the calculated spin axes solutions and the obtained shape model. A search of the Asteroid Lightcurve Database (Warner *et al.* (2009)) and DAMIT (Ďurech *et al.* (2010)) has been shown that prior to the present paper there have been no reported results for the pole and shape of 967 Helionape.

Acknowledgments

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