Laboratory Astrophysics: from Observations to Interpretation
Proceedings IAU Symposium No. 350, 2019
F. Salama & H. Linnartz, eds.
doi:10.1017/S1743921319009426

Asteroid collisions as origin of debris disks: Asteroid shape reconstruction from BNAO Rozhen photometry

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Abstract. As a result of collisions during their lifetimes, asteroids have a large variety of different shapes. It is believed that high velocity collisions or rotational spin-up of asteroids continuously replenish the Sun's zodiacal cloud and debris disks around extrasolar planets (Jewitt (2010)). Knowledge of the spin and shape parameters of the asteroids is very important for understanding collision asteroid processes. Lately photometric observations of asteroids showed that variations in brightness are not accompanied by variations in colour index which indicate that the shape of the lightcurve is caused by varying illuminations of the asteroid surface rather than albedo variations over the surface. This conclusion became possible when photometric investigations were combined with laboratory experiments (Dunlap (1971)). In this article using the convex lightcurve inversion method we obtained the sense of rotation, pole solutions and preliminary shape of 901 Brunsia.

Keywords. Minor planets, asteroids, debris disks: individual: 901 Brunsia

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Observations and Results

The lightcurve inversion technique (Kaasalainen *et al.* (2001)) provide a shape model represented by a convex polyhedron which approximates the real non-convex shape of an asteroid. In order to reconstruct the asteroid's shape and spin axis direction using a lightcurve inversion technique we need a set of dense lightcurves obtained at different geometric conditions during several oppositions. The observations of 901 Brunsia (Figure 1) were performed at the Bulgarian National Astronomical Observatory (BNAO) Rozhen with 2m RCC, 50/70cm Schmidt and 60cm Cassegrain telescopes, and the first ones were part of studies of the interrelations among Flora family asteroids (Kryszczyńska *et al.* (2012)). 901 Brunsia has a diameter of 13.21 km and albedo of 0.234 and is a stony asteroid with Tholen classification as a S-type. For lightcurve analysis, we used the software package MPO Canopus v10.4 (Warner (2011)). Based on nine relative lightcurves obtained over six apparitions (from Dec 2011 to Dec 2018), and assuming asteroid as triaxial ellipsoid, rotating about the shortest axis c=1 ($a > b > c$), we derived relative shape dimensions a/b=1.25, b/c=1.28. The calculated sidereal period for the asteroid which has a prograde motion is 3.13574h, and ecliptic coordinates for the Pole 1 are $\lambda = 329.7°$, $\beta = 26.7°$ and for the Pole 2 (mirror solution) are $\lambda = 152.4°$, $\beta = 20.9°$.

Up to now, in the Asteroid Lightcurve Database (Warner *et al.* (2009), Ďurech *et al.* (2010)) we found no published results for the pole and shape of 901 Brunsia. Knowing

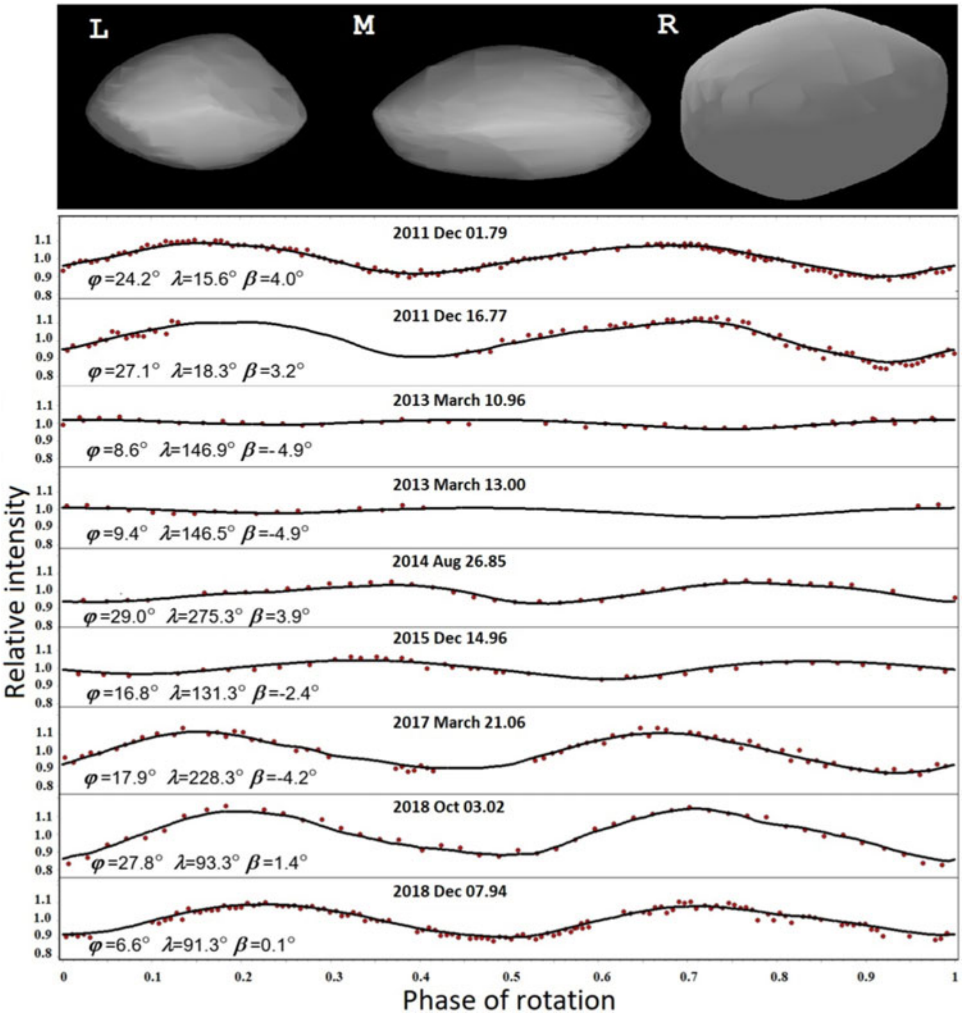

Figure 1. Top: Shape model of 901 Brunsia, shown at equatorial viewing illumination geometry, with rotational phases 90° apart (L, M) and the pole-on view (R). Bottom: Observations (dots) superimposed on the lightcurves (solid line) generated by a model. The phase angle (φ), the ecliptic longitude (λ) and latitude (β) of the asteroid corresponds to the date of the observation.

the asteroid's shape, especially of the active ones, which eject dust and particles, could give better insight of asteroid destruction and production of interplanetary debris.

Acknowledgment

This research was partially supported by the BNSF grants DN 08-1/2016 and DN 18/13-12.12.2017. The grant for participation at the IAU S350: Laboratory Astrophysics: from Observations to Interpretation is sponsored by IAU and EUROPLANET.

References

Ďurech, J., Sidorin, V., & Kaasalainen, M. 2010, *A&A*, 513, 46
Dunlap, J. 1971, in: T. Gehrels (eds.), Physical Studies of Minor Planets, *NASSP*, 267, p. 147
Jewitt, D., Weaver, H., Agarwal, J., Mutchler, M., & Drahus, M. 2010, *Nature*, 467, 817

Kaasalainen, M., Torppa, J., & Muinonen, K. 2001, *Icarus*, 153, 37
Kryszczyńska, A., Colas, F., Polińska, M., *et al.* 2012, *A&A*, 546, 72
Warner, B., Harris, A., Pravec, P. 2009, *Icarus*, 202, 134
Warner, B. 2011, MPO Canopus Software. http://www.MinorPlanetObserver.com

https://doi.org/10.1017/S1743921319009426 Published online by Cambridge University Press