Period and shape analysis for some slowly rotating asteroids

G. Fedorets[1], M. Granvik[1,2], and J. Masiero[3]

[1]Department of Physics, University of Helsinki, Finland
[2]Finnish Geodetic Institute, Finland
[3]NASA Jet Propulsion Laboratory, USA

We conduct observations of several slowly rotating asteroids as a follow-up to the Thousand Asteroid Lightcurve Survey. We perform the rotation period, pole orientation, and convex shape model calculations. We also aim to perform statistical testing on this subset and assess the population properties of slowly rotating asteroids.

The majority of rotation periods of asteroids estimated from photometric lightcurves belong to fast rotators. The time required for obtaining an accurate period estimate is substantially longer for a slowly rotating asteroid than a for a rapidly rotating asteroid. The quality of period estimates based on lightcurve surveys with a constant time allocation for all asteroids will degrade with increasing rotation period.

The Thousand Asteroid Lightcurve Survey (TALCS) [1] carried out with the Canada-France-Hawaii Telescope was one of the first systematic asteroid lightcurve surveys. The main outcome of TALCS was a debiased rotation-period distribution for the main-belt asteroids but, the accuracy of the period distribution is poor for long periods. In order to determine more accurate periods for slow rotators and, thus, assess the validity of the debiased rotation-period distribution at the long-period end, we have obtained photometric follow-up observations of a selected sample of TALCS slow rotators with the University of Hawaii 2.2-m telescope.

We used the methods presented in [2] and [3] to estimate the rotation period, pole orientation and convex shape model of selected asteroids. The analysis performed with data from TALCS and follow-up observations for one of these objects, a Hungaria asteroid (39420) Elizabethgaskell, did not allow an unambiguous solution for these values. To turn down the possibility of a methodologic failure in the analysis, we simulated a lightcurve of an elongated object, selected points with the same cadence as in the real observations and added random noise. The same period, pole and shape analysis was then successfully performed for the simulated object, producing the shape model resembling the original one. Thus, we could confirm that (39420) Elizabethgaskell is either a binary, or, which is more likely, a non-primary-axis rotator.

We perform a similar analysis for two other slow rotators, (20571) Tiamorrison and (134527) 1999 RY_{30}, and attempt to improve the initial period solutions as well as define the pole orientation and convex shape models for the asteroids, or, alternatively, search for binary and/or non-primary-axis rotation signatures from the lightcurves.

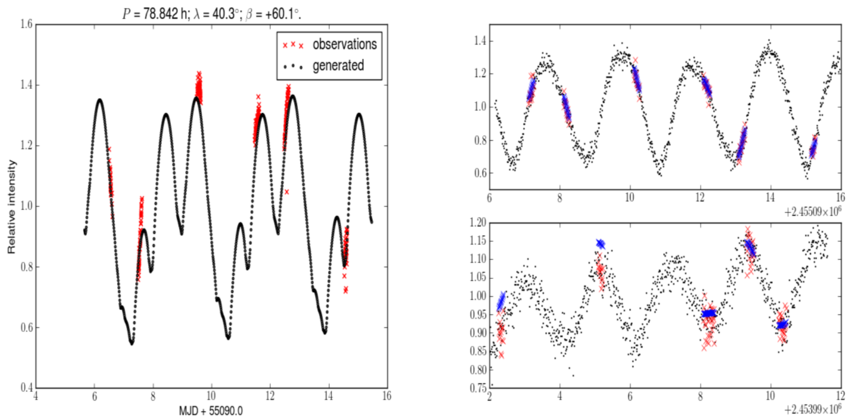

Figure: Left: best fit for a single-body, primary-axis model of (39420) Elizabethgaskell. Right: fit for a synthetic body with the same observation cadence as in the original observations.

References: [1] Masiero et al. 2009, Icarus 204, 145–171. [2] Kaasalainen & Torppa, 2001, Icarus, 153, 24–36. [3] Kaasalainen et al. 2001, Icarus, 153, 37–51.