MODELLING ASTEROIDS' SHAPES BASED ON THEIR LIGHTCURVES. Anna Marciniak[1], T. Michałowski[1], T. Kwiatkowski[1], K. Kamiński[1], and R. Hirsch[1], [1]Astronomical Observatory, Adam Mickiewicz University, Słoneczna 36, 60-286 Poznań, Poland (aniab@lab.astro.amu.edu.pl)

Introduction: Traditional methods of determining asteroids' spin and shape parameters assume its shape as a triaxial ellipsoid. However, after a few space missions to asteroids and detailed radar studies it is now clear, that most asteroids have rather irregular shapes. They manifest themselves in the asteroids' lightcurves in a form of flat minima, changing number of extrema, or different heights and shapes of extrema. All such features that were an obstacle to the EAM methods, are an advantage in lightcurve inversion method [2], [3]. They contain much information on the body shape, allowing to obtain quite good approximation of the convex hull of the body. The method uses all the data points directly, without the necessity to approximate data with some function. That reduces the possible sources of errors.

Modelling: Lightcurve inversion models the asteroid's shape and spin parameters, that produces lightcurves which fit best the observed ones. In practice, obtaining an unique model from lightcurve inversion requires data from slightly more apparitions than in the traditional methods. However, when the phase angle coverage is large it may suffice for an unique solution, even if the apparition number itself is small. Precise period determination is crucial for this method, then obtaining a shape model with a pole solution is straightforward.

Results: We combined the data collected in our database over years with the lightcurves from the literature and obtained a few new asteroid models. As an example the shape model of 984 Gretia is shown below. There were three apparitions taken from the literature [1], [4], [5]. To this set we added six new apparitions to obtain the model. The period we found is very well established due to the very long observing time span. Resulting spin parameters are:
P $= 5.778026$ h
Pole 1: $\lambda_p = \ \ 92°\ \beta_p = 67°$
Pole 2: $\lambda_p = 247°\ \beta_p = 48°$
The period is accurate to the last unit digit, while the pole position error is about 5° on the celestial sphere.

Conclusions: Having such efficient tool for obtaining full models of asteroids requires big datasets of photometric observations of these minor bodies. Observational campaigns should be focused on repeated observations of the same objects during different apparitions, to obtain brightness measurements at the largest possible span of longitudes and phase angles.

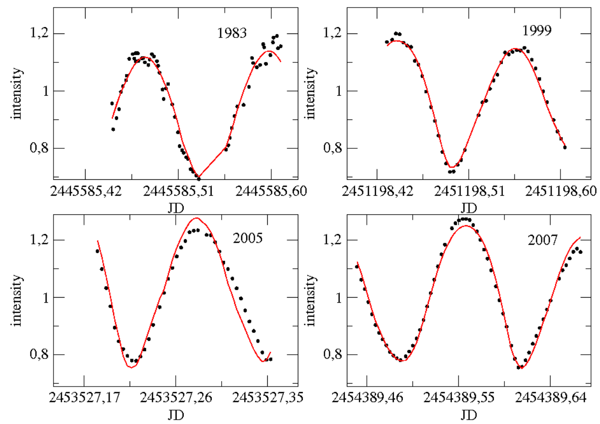

Figure 1: Example lightcurves with the model fit for asteroid 984 Gretia for four different apparitions. Data for the first curve come from [1].

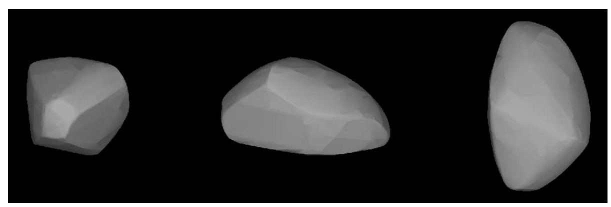

Figure 2: Shape model of asteroid 984 Gretia in equatorial view, rotated 90°, and viewed from above.

References

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