



Modeling asteroid shapes using BNAO Rozhen photometric data in combination with sparse data

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Our work aims to demonstrate how the use of our dense lightcurves in combination with sparse data from diverse sources will affect the results for obtaining the sidereal period, shape models, and ecliptic pole solution for a chosen asteroid.

Photometric observations of minor planets are traditional at the Bulgarian National Astronomical observatory (BNAO) Rozhen. They started with photoelectric observations in 1991, and later have been continued as CCD photometric observations on all three telescopes: 2m Ritchey-Chretien-Coudé, 50cm/70cm, and 60cm Cassegrain. We hope that the new 1.5 m robotic telescope planned to be operational next year will be also partly devoted to the study of minor planets.

Our target, 339 Dorothea, is a main-belt asteroid, a large member of the Eos dynamical family. For the last 8 years, between 2013 and 2021, the asteroid 339 Dorothea was observed at BNAO Rozhen during six apparitions and several dense lightcurve were obtained. We used these dense photometric data in lightcurve inversion method and reconstruct the model of the asteroid, determining its sidereal period, shape, and pole orientation. Afterward, using sparse data from the AstDys database with an accuracy of 0.01 mag in combination with the obtained dense data, new trials for calculating and improving the physical characteristics of the asteroid 339 Dorothea were made.

Unlike very low photometric accuracy in ground-based sparse photometry, space missions have provided astronomers with sparse photometry with extremely high accuracy, for example, the ESA GAIA mission. The NEOWISE mission has observations only for a limited number of asteroids. Fortunately, we were able to find some sparse data for our target and use this accurate photometry in combination with our dense lightcurves for the reconstruction of the asteroid spin state and shape model.

Due to bad weather conditions and limited allocation of observing time at the BNAO Rozhen dedicated to our project, we have at our disposal full and partial dense lightcurves obtained for several more asteroids in few different apparitions. Combining these dense data with ground-based or space mission sparse data will contribute to enlarging the database of asteroids with known physical characteristics. Enriching the number of asteroids with known physical parameters would provide more data for future statistical analysis and could help in answering the questions for the evolution of our Solar System.

