

NEO Characterization

SPIN AND SHAPE MODELS OF 16 NEAR-EARTH ASTEROIDS OBSERVED WITHIN THE NEOROCKS PROJECT

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Keywords: *asteroids, photometry, physical characterization, asteroid rotational state, asteroid shape*

ABSTRACT

The “NEO Rapid Observation, Characterization and Key Simulations” (NEOROCKS) project is a European Union’s Horizon 2020 research and innovation programme running from the year 2020. One of its several goals is a physical characterization of near-Earth asteroids through photometric observations performed by large and small ground-based telescopes.

Our task is to plan and carry out photometric observations of asteroids for which enough data can be collected in order to have a chance of determining their rotational state (period and rotational axis direction) and shape. This requires observations in several in time-distant asteroid apparitions, therefore, data collection for several years is typically needed. We take advantage of already published data and complete the dataset with our targeted measurements. From February 2020 to December 2022, we observed 16 NEAs with the Danish 1.54-m telescope (La Silla, Chile) or the Mayer 0.65-m telescope (Ondřejov, Czechia), namely (5189) 1990 UQ, (6569) Ondaatje, (7482) 1994 PC1, (8566) 1996 EN, (22099) 2000 EX106, (66251) 1999 GJ2, (86450) 2000 CK33, (98943) 2001 CC21, (137199) 1999 KX4, (170891) 2004 TY16, (310842) 2003 AK18, (329437) 2002 OA22, (495615) 2015 PQ291, (506459) 2002 AL14, (512245) 2016 AU8 and 2013 BO76. We will present the results achieved by employing the light-curve inversion method described in Kaasalainen & Torppa (2001) and Kaasalainen et al. (2001), whose methods were rewritten into user-friendly programs by Josef Ďurech. In addition, we performed visible spectra measurements for asteroids (98943) 2001 CC21 and (495615) 2015 PQ291. Photometric observation in four photometric filters (*griz*) was performed for six of the asteroids mentioned above, allowing taxonomical classification and thus extending the amount of information available for some NEAs.

As a by-product of the spin and shape estimates of these 16 asteroids, we look into the sensitivity of the light-curve inversion method on various factors. The number of observations does not necessarily reflect the quality of the resulting rotational state and shape estimate. For example, the distribution of the photometry data in time, observation frequency in the individual asteroid's apparition, density of light-curve coverage, and range of phase angle coverage may all influence the quality of the best model solutions. Understanding these factors will help us to plan future photometric observations of near-Earth asteroids most efficiently.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870403.

Kaasalainen M. and Torppa J., *Optimization Methods for Asteroid Lightcurve Inversion: I. Shape Determination*, Icarus (2001), vol. 153, p. 24-36

Kaasalainen M., Torppa J., and Muinonen K., *Optimization Methods for Asteroid Lightcurve Inversion: II. The Complete Inverse Problem*, Icarus (2001), vol. 153, p. 37-51.

Comments:

Oral presentation preferred.

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