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Prevalence of Fast Rotators in Small Near-Earth Asteroids: An Ongoing Survey from the Canary Island Observatories

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Near-Earth asteroids (NEAs) provide valuable opportunities to study the physical and structural properties of small bodies. While most asteroids have rotation periods longer than the ”cohesionless spin barrier”—a 2.2-hour limit beyond which rubble-pile asteroids would break apart due to centrifugal forces—some rotate much faster, challenging current understanding of the internal structure of these objects [1][2].

Detecting short rotation periods in NEAs is particularly challenging because of the difficulty of obtaining continuous, high-cadence observations of multiple targets over several hours. Large-scale surveys are not typically designed to capture the dense temporal sampling needed to fully resolve the light curves of fast rotators. These limitations highlight the importance of follow-up observations with dedicated telescopes to obtain high temporal resolution photometric data.

In this work we present the current status of an ongoing survey designed to expand the sample of NEAs with well-determined rotation periods, focusing on asteroids with absolute magnitudes H>22.5. The survey uses four newly installed robotic telescopes at the Teide Observatory in Tenerife, Canary Islands. These include a pair of 80-cm telescopes (TTT1-2), a 1-m wide-field telescope (TST) with a field of view of 4.1 deg^2, and a newly installed 2-m telescope (TTT-3). All are equipped with sCMOS

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imaging sensors that provide the high temporal resolution required for photometric observations, making them ideal for detecting and studying fast rotators.

Our survey targets recently discovered small NEAs with unknown rotation periods. By studying their rotational states, we aim to gain deeper insights into the forces and mechanisms that allow these bodies to maintain their structural integrity at high rotation rates, with important implications for planetary defense strategies and future research on asteroid composition and the physical processes driving their internal evolution.

To date, over fifty NEAs have been observed in the days following their discovery to identify and analyze short rotation periods. We will present preliminary results, highlighting several objects for which we have clearly determined rotation periods, including examples of fast rotators (see Fig. 1).

In addition, we will present GPUPHOT, a new photometry software package optimized for fast and efficient image processing. GPUPHOT integrates a novel set of convolution-based algorithms that significantly improve the performance of point source photometry. Designed to support the large data requirements of robotic telescopes, the software will be made publicly available later this year, providing valuable resources to the planetary science community.

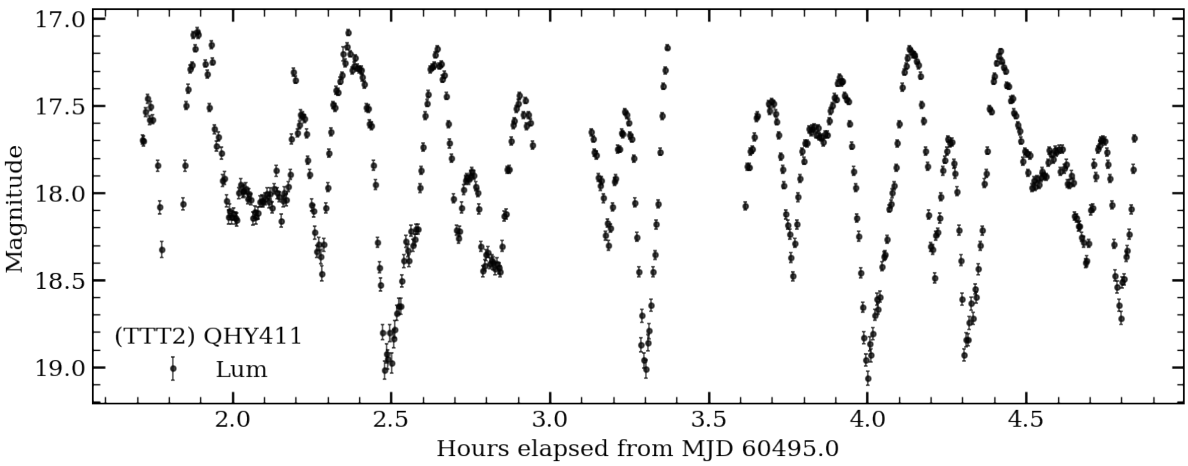

Figure 1: Light curve of the asteroid 2024 MK, obtained using the TTT2 telescope on the night of July 4, 2024. The data span about 3 hours and show large brightness variations with an amplitude of nearly 2 magnitudes, consistent with an elongated shape. The rapid variations suggest a non-principal axis rotation. This object was also observed by telescopes in the LCO network and the Goldstone radar.

References

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