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Towards angular and rotation tracking of Apophis with Meade telescope in 2029: Citizen science tracking ISS and presenting on public education site

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ABSTRACT

The Apophis asteroid 99942 will make a close approach with Earth on 13 April 2029 (1) and can be followed from central Europe and Africa (2). Its trajectory influenced by Earth’s gravity is well predicted. However, there are uncertainties concerning its rotational behavior and the long-term influence on its path (3–6). Changes to its rotation period of at least 27 hours, are predicted, but their magnitude is unclear due to uncertainty of non-homogeneous mass distribution. Gravity interaction with Earth during the flyby may change these rotations and the strength of the semimajor axis drift rate due to Yarkovsky acceleration (4,7). It is therefore of interest to measure Apophis’ rotation combined with its trajectory during the flyby.

The MEADE LX200GPS telescope is primarily designed for astronomical observing and is used to observe celestial and deep-space objects where, after lock-on, tracking is mainly achieved by adjustment of Earth rotation (8,9). Additional adjustments must be made to track an artificial satellite or the Apophis asteroid during the close approach to Earth (10). The tracking data are initially based on open loop calculations. During actual observation, real-time corrections are made through optical tracking with a camera. In addition, the camera will be used to measure rotational changes through Fourier analysis on the apparent brightness (11,12).

A first experiment is planned in 2024-2025 to track the International Space Station (ISS) using the adapted telescope and estimate the tracking measurement precision. The adaptation includes the integration of a camera and software development to calculate the offset from the nominal path. Through the creation of inserted offset-errors from the nominal known path, precision of the optical calculated offset will be derived. In addition, an on-line site will be developed to share information for public education and will present real-time calculations of tracking ISS and Apophis in 2029. The adaptations and the results of the experiment will be presented, as well as suggestions for further upgrade of the system in order to retrieve significant data from the actual Apophis flyby.

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