Photometric analysis of Near-Earth Asteroids using TRAPPIST telescopes

Science Photo Library - ANDRZEJ WOJCICKI // Getty Images

SUMMARY.
Near-Earth Asteroids (NEAs) constitute a complex dynamical population whose proximity to Earth ($\leq$ 1.3 au) necessitates rigorous characterization for both solar system evolution studies and impact hazard assessment. This METEOR explores the rotational physics and morphology of NEAs using time-series photometry from the TRAPPIST telescope network. The student will master CCD signal processing and differential photometry to quantify periodic flux variations caused by the rotation of non-spherical bodies. By applying rotational dynamics and mathematical light-curve inversion, the aim will be to derive fundamental physical parameters including rotation periods, 3D shape models, and spin-axis orientations.

— OBJECTIVES

- **Knowledge**, Observe and analyze light curves using the TRAPPIST telescopes, derive fundamental physical parameters including rotation periods, 3D shape models, and spin-axis orientations of NEAs.
- **Skills** Preparing observations, data calibration, how to analyse them, and how to interpret them.

— INSTITUTE

The work will be done at the STAR Institute of the University of Liège and the TRAPPIST team.

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— APPLICATIONS

by Emmanuel Jehin

The TRAPPIST 0.6m telescopes installed at the la Silla observatory in Chile in 2010 and in Morocco in 2016 by our team are dedicated to the research and the study of exoplanets in transit and the study of the small bodies of the Solar System (comets and asteroids) (Jehin et al. 2011). The main goal of this METEOR is the physical characterization of NEAs through the analysis of new and/or archived observations obtained with the TRAPPIST telescopes.

NEAs are asteroids that possess a semi-major axis smaller than 1.3 astronomical units. This means that these objects can potentially come close to the Earth, cross its orbit and even impact it. As of today, more than 35,000 NEAs have been discovered and about 2,000 new NEAs are discovered each year. Among those about 2500 are considered as potentially dangerous for the Earth. Their study is then important to better understand their population, their formation and their physical properties (size, albedo, composition, and rotation period, densities) to develop mitigation strategies in the case of the discovery of an NEA on an Earth impact trajectory.

During the METEOR, the student will familiarize with the observations with TRAPPIST telescopes, schedule new observations and then reduce and analyze the new data. The main datasets will be photometric observations that will allow to derive light curves and derive the rotation period of the asteroids, get information on its shape. A rotation light curve of an asteroid is indeed produced by the fact that an asteroid is an irregularly shaped object that is spinning around a rotation axis. As the asteroid rotates, the total surface area visible from Earth is changing, producing the variation of its intensity. Analysis of asteroid light curves provides information about its rotation period, its spin axis orientation and shape.

— EVALUATION

- Theory grade [30%]
  - Student will be asked to write a report and prepare an oral presentation, followed with questions.
- Practice grade [30%]
- Defense grade [40%]
  - Oral and slides quality
  - Context
  - Project / Personal work
  - Answers to questions

— BIBLIOGRAPHY & RESOURCES

- Jehin et al. (2011)
- https://www.cometa.uliege.be/
- https://www.trappist.uliege.be/

— CONTACT

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