

**PDC2025**  
**Stellenbosch, Cape Town, South Africa**

**□ NEO Characterization**

**Astrometry, orbit determination, and thermal inertia of the Tianwen-2 target asteroid (469219) Kamo`oalewa**

**Marco Fenucci<sup>(1,2)</sup>, Bojan Novaković<sup>(3)</sup>, Pengfei Zhang<sup>(4)</sup>, Albino Carbognani<sup>(5)</sup>,  
Marco Micheli<sup>(1,6)</sup>, Laura Faggioli<sup>(1,6)</sup>, Francesco Gianotto<sup>(1,6)</sup>, Francisco  
Ocaña<sup>(7,8)</sup>, Dora Föhning<sup>(1,6)</sup>, Juan Luis Cano<sup>(9)</sup>, Luca Conversi<sup>(1)</sup>, Richard  
Moissl<sup>(1)</sup>**

- (1) *ESA ESRIN / PDO / NEO Coordination Centre, neocc@esa.int, Largo Galileo Galilei 1, 00044, Frascati, RM, Italy*
- (2) *Deimos Italia S.R.L., Via Alcide De Gasperi 24, 28060, San Pietro Mosezzo, NO, Italy*
- (3) *Department of Astronomy, Faculty of Mathematics, University of Belgrade, Studentski trg 16, Belgrade, 11000, Serbia*
- (4) *Center for Lunar and Planetary Sciences, Institute of Geochemistry, Chinese Academy of Sciences, Guiyang (Guizhou), PR China*
- (5) *INAF – Osservatorio di Astrofisica e Scienza dello Spazio, Via Gobetti 93/3, 40129, Bologna, Italy*
- (6) *Starion Italia, Via di Grotte Portella 28, 00044, Frascati, RM, Italy*
- (7) *ESA ESAC / PDO, Bajo del Castillo s/n, 28692 Villafranca del Castillo, Madrid, Spain*
- (8) *Deimos Space S.L.U., Ronda de Poniente, 19, 28760 Tres Cantos Madrid, Spain*
- (9) *ESA ESOC / PDO, Robert-Bosch-Straße 5, 64293 Darmstadt, Germany*

**Keywords:** *astrometry, orbit determination, thermal inertia, Kamo`oalewa*

(469219) Kamo`oalewa is a small near-Earth asteroid, which is currently a quasi-satellite of Earth. Lightcurve measurements revealed a rotation period of about 30 minutes, while the spectrum is compatible with that of S-type asteroids. This object has been selected as the target of the sample-return Tianwen-2 mission of the China National Space Administration.

In early 2024, we performed an observational campaign to better determine the orbit of Kamo`oalewa. Astrometric measurements were taken from the Loiano Astronomical Station and from the Calar Alto Observatory. We also accurately re-measured two precovery detections from the Sloan Digital Sky Survey from 2004. This new astrometry was used in a 7-dimensional orbit determination, aimed at determining both the orbital elements and the Yarkovsky effect. This process was performed with the Aegis software [1] of the ESA NEO Coordination Centre. We detected a semi-major axis drift due to the Yarkovsky effect of  $-68.96 \pm 3.9$  au/My, with a high signal-to-noise of 17.5. The new orbit solution also significantly reduced the position uncertainty at the time of arrival of the Tianwen-2 spacecraft.

Thermal inertia is then studied by using ASTERIA [2], a new method suitable to estimate the thermal properties of small asteroids affected by the Yarkovsky effect. By using different models for the physical parameters of Kamo`oalewa, the ASTERIA model estimated the thermal inertia at  $155^{+90}_{-45} \text{ J m}^{-2} \text{ K}^{-1} \text{ s}^{-1/2}$  or at  $181^{+99}_{-60} \text{ J m}^{-2} \text{ K}^{-1} \text{ s}^{-1/2}$ . Assuming that the low thermal inertia is given by the presence of a regolith layer on the surface, thermal conductivity models [3] predict a grain size of the order of 0.1 – 3 mm.

[1] Fenucci et al. (2024), *The Aegis orbit determination and impact monitoring system and services of the NEOCC web portal*, CMDA, 136, 58

[2] Novaković et al. (2024), *ASTERIA – Asteroid Thermal Inertia Analyzer*, PSJ, 5, 1

[3] Gundlach and Blum (2013), *A new method to determine the grain size of planetary regolith*, Icarus, 223, 1

\*\*\*\*\*

**Comments:**

*Poster presentation preferred.*