

Surface thermal inertia of near-Earth asteroid (469219) Kamo'oalewa: Statistical estimation and implications

*Lu Liu¹, Jianguo Yan¹, Liangliang Yu², Marco Fenucci³, Mao Ye¹, Zhen Zhong⁴, Yihao Chen¹, Xi Guo¹, Denggao Qiu¹, Jean-Pierre Barriot⁵

1. State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing, Wuhan University, 2. State Key Laboratory of Lunar and Planetary Science, Macau University of Science and Technology, 3. ESA NEO Coordination Centre, 4. School of Physics and Electronic Science, Guizhou Normal University, 5. Geodesy Observatory of Tahiti, University of French Polynesia

The Chinese small body exploration mission Tianwen-2 is aimed at sampling the near-Earth, fast-rotating asteroid (469219) Kamo'oalewa and returning the samples to Earth. Characterisation of the currently unknown physical properties of Kamo'oalewa in the pre-mission phase would support mission implementation. In this study, we preliminarily estimate the surface thermal inertia of Kamo'oalewa using a statistical method, based on the Yarkovsky-related orbital drift of $(-6.155 \pm 1.758) \times 10^{-3}$ au/Myr for Kamo'oalewa obtained in our previous work. A reasonable estimate of the surface thermal inertia obtained is $402.05_{-194.37}^{+376.29}$ J K⁻¹ m⁻² s^{-1/2}. This low value suggests the presence of coarse regolith on the surface of Kamo'oalewa or its nature as a porous rock. The regolith potentially present on the surface of Kamo'oalewa may have millimetre- to decimetre-sized grains with cohesive strengths varying from ~0.76 Pa to 0.045 Pa. If Kamo'oalewa is a porous rock, its porosity is expected to range from ~20% to 50%, corresponding to tensile strengths of ~1.3 to 11.5 MPa. This study provides preliminary insights into the surface thermal inertia of Kamo'oalewa from a statistical viewpoint, which may facilitate the Tianwen-2 mission.

Keywords: Thermal inertia, Kamo'oalewa, Yarkovsky effect, Chinese Small Body Exploration Mission