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ASTERIA - Asteroid Thermal Inertia Analyzer

Bojan Novaković[1], Marco Fenucci[1,2], Dušan Marčeta[1] & Debora Pavela[1]

[1] University of Belgrade, Faculty of Mathematics, Department of Astronomy, Belgrade, Serbia

[2] ESA Near-Earth Objects Coordination Centre, Frascati (Roma), Italy

- ASTERIA (Asteroid Thermal Inertia Analyzer) is a novel model and corresponding publicly available software for determining the surface thermal inertia (TI) of asteroids **(Novaković et al. 2024)**
- It is based on the model-to-measurement comparison of the Yarkovsky effect-induced orbital drift.
- A general advantage of the ASTERIA model is that it may be applied to smaller asteroids than TPM.
- ASTERIA provides a robust benchmark for independently verifying thermal inertia estimates derived from traditional methods

Application to 38 Near-Earth asteroids

Novaković et al. (PSJ, 2024)

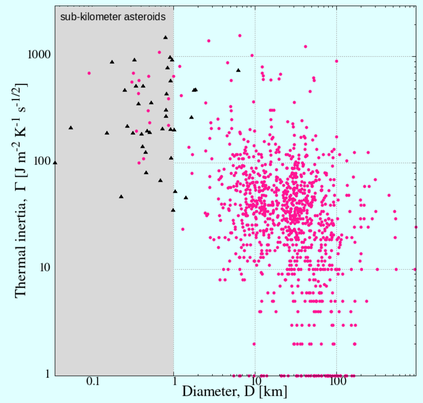
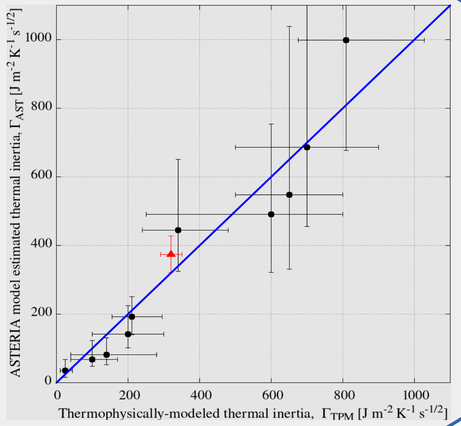


Figure 2: TI vs. diameter values for objects with available TI estimates. Our TI results for 38 NEAs are denote with black triangles. The thermophysically derived literature values from MacLennan & Emery (2021, PSJ, 2, 161) and Hung et al. (2022, PSJ, 3, 56) are shown as pink circles.

Model Validation

- The model has been validated using data from Bennu and ten other well-characterized NEAs. The results agree well, demonstrating the model's reliability for TI analysis.

Figure 1: TI values derived from TPM listed in the literature compared to values derived from the ASTERIA model. The blue line is the line of equality where the same results should appear.



Application to Asteroid Didymos

Novaković & Fenucci (Icarus, 2024)

$258\ ^{+94}_{-63}$ J m^{-2} K^{-1} s$^{-1/2}$

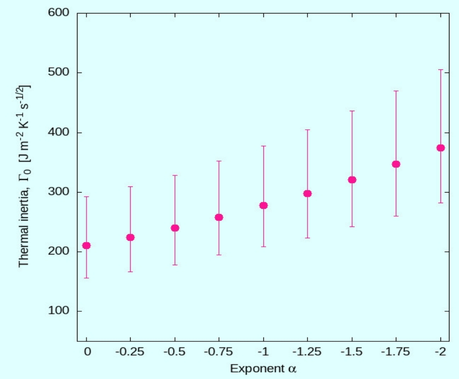


Figure 3: Thermal inertia estimates for asteroid Didymos with the model assuming thermal inertia variable with heliocentric distance. The results for different values of scaling exponent α are shown.
Note that the α = 0 case corresponds to the constant thermal inertia model.

- We have identified a set of 38 near-Earth asteroids (NEAs) for which all the input parameters critical for the ASTERIA model to work reliably are available and presented the new TI for those objects.
- Among these 38 NEAs, 29 are classified as PHAs. It makes our results highly relevant from the planetary defense point of view.
- Our sample of new TI estimates also includes 31 sub-kilometer-sized asteroids. At the same time, there are only 17 other literature values in this size range, highlighting the importance of the ASTERIA model for determining the surface TI of small asteroids (see Figure 2).
- We have also estimated the thermal inertia of asteroid Didymos at $258\ ^{+94}_{-63}$ J m^{-2} K^{-1} s$^{-1/2}$

For more information please check our papers:

- Novaković, B., Fenucci, M., Marčeta, D., and Pavela, D., 2024, PSJ, 5, 11
- Novaković, B., Fenucci, M., 2024, Icarus, 421, id.116225

The ASTERIA software is publicly available at:
https://zenodo.org/records/8365840

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