CONTROL ID: 2554227

TITLE: Discovery of Spin-Rate-Dependent Asteroid Thermal Inertia

ABSTRACT BODY:

Abstract (2,250 Maximum Characters): Knowledge of the surface thermal inertia of an asteroid can provide insight into surface structure: porous material has a lower thermal inertia than rock. Using WISE/NEOWISE data and our new asteroid thermal-inertia estimator we show that the thermal inertia of main-belt asteroids (MBAs) appears to increase with spin period. Similar behavior is found in the case of thermophysically-modeled thermal inertia values of near-Earth objects (NEOs). We interpret our results in terms of rapidly increasing material density and thermal conductivity with depth, and provide evidence that thermal inertia increases by factors of 10 (MBAs) to 20 (NEOs) within a depth of just 10 cm. On the basis of a picture of depth-dependent thermal inertia our results suggest that, in general, thermal inertia values representative of solid rock are reached some tens of centimeters to meters below the surface in the case of MBAs (the median diameter in our dataset = 24 km). In the case of the much smaller (km-sized) NEOs a thinner porous surface layer is indicated, with large pieces of solid rock possibly existing just a meter or less below the surface. These conclusions are consistent with our understanding from in-situ measurements of the surfaces of the Moon, and a few asteroids, and suggest a very general picture of rapidly changing material properties in the topmost regolith layers of asteroids. Our results have important implications for calculations of the Yarkovsky effect, including its perturbation of the orbits of potentially hazardous objects and those of asteroid family members after the break-up event. Evidence of a rapid increase of thermal inertia with depth is also an important result for studies of the ejecta-enhanced momentum transfer of impacting vehicles ("kinetic impactors") in planetary defense.

CURRENT CATEGORY: Asteroid Physical Characteristics: Surfaces

CURRENT : None

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