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Thermal modeling of the binary asteroid Didymos

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The target of the ESA's HERA mission is asteroid 65803 Didymos (1996 GT), an Apollo-type near-Earth object (NEO). Didymos is a binary asteroid; the primary body has a diameter of around 775 m and a rotation period of 2.26 hours, whereas the secondary body (informally called Didymoon) has a diameter of around 165 m and rotates around the primary at a distance of around 1.2 km in around 12 hours.

Thermophysical properties of the uppermost surface govern the exchange of radiative energy between the asteroid and its environment, hence determine surface and subsurface temperatures. These thermophysical properties are characterized by grain size, porosity, or packing of the surface materials. Diurnal change in surface temperature show large variations in fine soils like sand and highly porous rock with low thermal inertia, and much smaller variations in in dense rock with high thermal inertia. Here we present a thermophysical model of Didymoon based on known, assumed and derived range of physical properties. A parameter study has been carried out for surface temperatures assuming possible thermal inertia ranges.

Results from this study are used to investigate performance for Thermal Infrared instrument TIRA onboard HERA spacecraft. Hera is the European contribution to an international double-spacecraft collaboration. Due to launch in 2024, Hera would travel to the binary asteroid system. TIRA onboard HERA will be operating in the 8-14 μm wavelength range. It will be used for scientific analysis and to demonstrate the feasibility of using a TIR camera for GNC (Guidance, navigation and control). The main scientific output for TIRA is to determine the thermal inertia and thus the properties of the surface material.