Ceres' Thermal Inertia from Dawn Data

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Thermal inertia is a fundamental parameter that controls surface temperature variations of airless body, and his value is sensitive to the presence of dust, regolith or rock; so this is an indicator of history and type of the surface material. Ceres and Vesta, the two largest bodies of the main asteroid belt, are important to understand the early stages of solar system and the formation of terrestrial planets; the Visible and InfraRed mapping spectrometer (VIR) [1] onboard the NASA DAWN mission has allowed to measure the surface temperatures of these bodies (the instrument is sensitive to temperatures higher than 180 K [2]), and a thermal analysis has been done for Vesta's surface, obtaining a map of its thermal inertia [3]. A similar analysis has been done for Ceres [4].

The thermal inertia is derived by comparing the observed temperatures with the theoretical temperatures calculated with a thermophysical model; local illumination and observing geometry have been derived from the detailed shape model of Ceres. The surface temperature strongly depends on the thermal conductivity of the soil; the code can simulate different types of material from the moondust to the bedrock, in ascending order of thermal conductivity. Ceres' surface has been divided into sectors and for each of them the theoretical temperature curve (temperature as function of the local solar time) has been calculated, varying the parameters of conductivity and roughness (that is a measure of topography on the sub-pixel scale) until observed temperatures were reproduced.

Our analysis indicates a low value of the average thermal inertia (up to about 20 $Jm^{-2}K^{-1}s^{-1/2}$) for areas with no special features, according to previous independent estimates [5]; moreover, there are no significant variations with the latitude. In general, this could confirm the inversely proportional trend of the thermal inertia as a function of the diameter, observed for several asteroids of the main belt [6]. The analysis was extended to the faculae of the Occator crater [7] and to the Haulani crater, and we have found higher thermal inertia with respect to the Ceres' average, probably related to higher grain sizes.

References :

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