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Ceres surface temperatures: comparison between observation and theory

E. Rognini, M. T. Capria, F. Tosi, A. Frigeri, M. C. De Sanctis, E. Palomba, A. Longobardo, S. Fonte, M. Giardino, F. G. Carrozzo, A. Raponi, M. Ciarniello, E. Ammannito
INAF-IAPS, Rome, Italy

Abstract

Theoretical and observed temperatures on Ceres surface are compared. We calculate surface temperatures with a termophysical code that provides the temperature as a function of thermal conductivity and roughness. Preliminary results suggest low values for the thermal inertia.

1. Introduction

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 largest bodies in the main asteroid belt, are important to understand the early stages of solar system and the formation of terrestrial planets. The VIR instrument [1] onboard the NASA mission Dawn has allowed to measure the surface temperatures of these bodies, and a thermal analysis has been done for Vesta's surface, obtaining a map of its thermal inertia [2]. A similar kind of analysis is now being applied to Ceres.

2. The method

The VIR instrument is acquiring the spectra of Ceres in the range $0.25 - 5.1$ μm; the part of spectrum at $\lambda > 3.1$ μm is dominated by thermal emission so can be used to derive the temperatures (VIR is sensitive at temperatures above 180 K [3]). A termophysical model is used to compute theoretical temperatures. In order to obtain these temperatures we have to take into account the topography with the varying illumination angles. Ceres has an irregular shape, so a shape model is necessary. Surface temperature strongly depends on thermal conductivity. Different classes of thermal conductivity, corresponding to different kind of material (from lunar dust to regolith, in ascending order of thermal inertia) are considered. Ceres surface is divided into quadrangles and average temperatures are calculated iteratively by varying the values of roughness (a term characterizing topography at subpixel scale) and thermal conductivity class, until observed average temperatures are reproduced.

3. Summary and Conclusions

Preliminary analysis was made, restricted to a partial set of data that covers a limited portion of surface; this analysis suggest that Ceres' thermal inertia is low. We are now extending the analysis to the whole VIR data set: we are increasing surface under study, in order to obtain a thermal map as extended as possible.

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