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Local thermal inertia on the surface of Vesta

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Abstract

From the data obtained by VIR, a visible and infrared mapping spectrometer onboard the Dawn spacecraft, the surface temperature of Vesta can be determined. The retrieved temperatures, together with a termophysical model, can be used to derive thermal inertia values. The procedure has been applied to derive the thermal inertia of several unusual features that have been observed on the surface of Vesta.

1. Introduction

Launched in 2007, the Dawn spacecraft is now orbiting Vesta[1]. One of the onboard instruments is VIR, a visible and infrared mapping spectrometer devoted to the study of the mineralogical composition and thermophysical properties of Vesta's surface [2]. The instrument performs imaging spectroscopy in the range from the near-UV through the IR (0.25-5 micron). From VIR infrared spectra surface temperatures can be retrieved by means of temperature-retrieval algorithms.

The temperature of a surface, and in particular its variation with respect to illumination conditions, contain information on the thermal inertia (and other thermal properties) of the materials composing this surface. The VIR spectrometer is sensitive only to temperatures greater than 170-180 K. While the derivation of thermal inertia would optimally involve the measurement of nighttime temperatures and as many local solar times as possible, VIR observations can constrain this property with the help of a thermophysical model.

2. Analysis of local features

A theoretical code computing surface and subsurface temperatures on a shape model under a range of different assumptions and conditions is used. When the theoretical temperature is matching the one retrieved directly from VIR spectra, the assumptions on the thermal properties used in the code are assumed to correspond to reality.

The code is solving the heat transport equation in a multi-layered shell with density increasing towards the center. The code depends on various input parameters, of which the most important are Bond albedo, emissivity, thermal conductivity. Bond albedo, that is derived from geometrical albedo, is assumed to be known.

The subpixel roughness is taken into account and is numerically estimated. When running the code at a given time and given location on the surface of Vesta, thermal conductivity and sub-pixel roughness are varied till the retrieved temperature is matched. A thermal inertia value is then computed. The thermal properties (sub-pixel roughness and thermal inertia) derived in this way, together with compositional information, allow us to estimate the nature and physical status of the different regions of Vesta's surface.

Strong albedo variations have been observed on the surface of Vesta. Bright features have been identified corresponding to regions where temperature is lower than the average ones. Dark features are also visible, showing an opposite behavior. A first catalog of these features has been compiled and is being used to test the sensitivity of the thermophysical code to its input parameters in deriving local thermal inertia values.

6. Summary and Conclusions

The preliminary conclusions derived from this analysis of bright and dark features on the surface of Vesta are:

1- in order to match the temperatures of dark features, an albedo lower than the average one and a sub-pixel roughness from moderate to low have to be assumed.

2- in order to match the temperature of bright zones, an albedo higher than the average one and a sub-pixel roughness from moderate to high have to be assumed. On these zones, thermal inertia tends to assume values higher than the average one.

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References

[1] Russell C.T et al., Science, 336, 684 2012.

[2] De Sanctis, M. C. et al., Science 336, 697–700 (2012).