Local thermal properties of the surface of Vesta

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Temperature information has been obtained from the Dawn/VIR (Visible InfraRed imaging spectrometer) spectra acquired during the Vesta campaign. When combined with a thermophysical model, these temperatures can be used to derive surface thermal properties. Thermal properties are sensitive to several physical characteristics of the surface that are not all spatially resolved. Thus, the derivation of surface temperatures and thermal inertia can lead to the characterization of surface and sub-surface properties of Vesta and the determination of regolith properties. The model we are using solves the heat conduction equation and provide the temperature as a function of thermal conductivity, albedo, emissivity, density and specific heat. The model is applied to the actual shape of Vesta: for any given location, characterized by a well-defined illumination condition and a given UTC time to compute the thermal inertia that results in model temperatures providing a best-fit to surface temperatures as retrieved by VIR. The model has been already applied to the first Vesta full-disk data to derive the global average thermal inertia of Vesta. The values obtained are typical of fine-grained, unconsolidated materials (i.e. dust) and suggest a surface in which a dust layer is wide-spread on coarser regolith.

The model is now being applied on small regions of the surface of Vesta. Specific regions are selected because they are interesting for some reason or appear different from the surroundings, such as, for example, dark and bright spots and other peculiar features. Given a location, the thermophysical code is applied until the obtained temperatures are matching (best-fit techniques are used) the temperatures derived from the VIR spectra. The thermal inertia, thermal conductivity, albedo and roughness values are then assumed to be characterizing the location under analysis. The results of the model must be carefully checked and interpreted by taking into account the context (from high-resolution images acquired by the framing camera) and in general all the available information. Particularly important is, to this end, the "local time" information. A given spot on Vesta's surface has been typically observed more than once, at different local solar angles and scales. This can greatly improve the reliability of the results. To date, the code is being applied to an initial list of small regions with bright or dark materials, corresponding to areas with higher or lower temperatures compared to the surrounding average temperatures. This initial analysis is already highlighting local differences, (with respect to the average value) in the value of the thermal inertia. This is a clear indication of differences in the local physical proper-ties of the surface layer, namely a different thermal conductivity due to different levels of soil roughness and compactness.

Future analyses will lead to a classification of the surface of Vesta in terms of albedo and thermal inertia, and qualitative indications of the local roughness (or smoothness) of the surface. This information, coupled with the mineralogical information, will help to characterize the materials of the surface of Vesta and will complement analyses of the regolith properties from high-resolution images.