Rough-surface model for surface temperature calculations on Vesta

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We model observations by the Dawn Visual and Infrared spectrometer (VIR) [1] to reproduce the observed surface temperature of Vesta. The VIR instrument has collected over 3,700 spectral cubes of Vesta out to 5.1 microns. The observed surface temperature is derived by matching the irradiance near 5 microns with a grey body, the Planck function after removing a reflected-light component per previous procedures [2–5] with similar results.

We noted that the observed surface temperatures are significantly hotter than what simple theoretical models would predict [2]. To better understand this, we used a high-resolution topographic model of Vesta [6] that provided exact phase, incidence, and emission angles for every VIR pixel. We assume an emissivity of 0.9, Bond albedo of between 0.16 and 0.22 [5], and a variety of thermal inertia values for a low-contrast, highly degraded, homogenous crater. We have created a "rough-surface" thermal model that takes into account how irregular grains create sub-pixel variations in the thermal spectrum and describe the effect it has on the observed surface temperatures of Vesta. We have applied this method to the VIR observations of Vesta, which produced a high level of agreement with the observed surface temperatures.

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