Lunar Thermal Models: New Insights from the Diviner Lunar Radiometer Experiment

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The Moon is a cornerstone for understanding airless planetary bodies throughout the Solar System. Thermal modeling studies of asteroids and other small bodies have benefitted from knowledge of the Moon's thermophysical properties acquired through decades of remote sensing, in situ measurements, and sample analysis. Recently, NASA's Lunar Reconnaissance Orbiter has acquired detailed thermal infrared and solar reflectance measurements over the entire Moon with the Diviner Lunar Radiometer instrument [1]. Diviner's global measurements in multiple IR spectral bands at a resolution of ~250 m have led to new insights into the heat transfer and thermophysical properties of planetary materials.

Here, we report on several key insights and model innovations obtained through analysis of the Diviner data relevant to the development of thermal models for a variety of airless bodies. In particular, we describe: 1) the temperature-dependent thermal conductivity of regolith [2], 2) small-scale roughness effects on temperatures and thermal emission phase behavior [3], 3) variability in regolith density/porosity caused by geologic processes [2,4,5], 4) small and large rocks/boulders [6], 5) polar shadowing and heat flow measurements [7]. In addition to these key features, we will also show recent Diviner observations that demonstrate the importance of thermal modeling and infrared remote sensing for planetary missions throughout the Solar System.

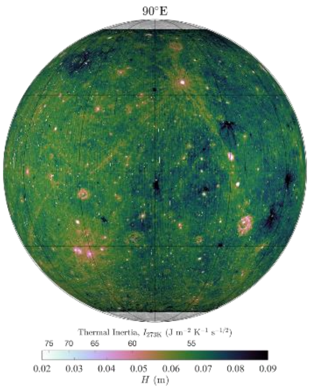

Figure (above right): A new view of the Moon from Diviner thermal measurements and models. This global map of thermal inertia (or equivalent 'H-parameter' [2]) was derived from Diviner nighttime regolith temperatures and model fitting, using depth- and temperature-dependent thermophysical properties.

References:

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