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Thermal Inertia and Surface Roughness of Comet 9P/Tempel 1 Derived from Recalibrated Deep Impact NIR Spectroscopy

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Abstract

On July 4, 2005, the HRI-IR instrument onboard the Deep Impact spacecraft (NASA/Univ. of Maryland) acquired the first ever near-infrared spectra of a fully resolved comet nucleus, 9P/Tempel 1. Early attempts to estimate the thermal inertia of the surface material were inconclusive, due to negligence of small-scale surface roughness in the thermophysical models used to analyze the spectra. Following a substantial recalibration of the original dataset, we now reconsider the 9P/Tempel 1 spectra, using more realistic thermophysical models. In addition to large-scale nucleus irregularity, these models now explicitly consider small-scale roughness and related phenomena such as shadowing and IR self heating. Furthermore, 3D heat conduction can be utilized when topographic features are similar in size to the thermal skin depth, or smaller. Estimates of the thermal inertia, degree of small-scale roughness and their levels of variation across the nucleus are presented.