Planetary Regolith in Vacuum: Thermal Conductivity Models, Thermal Inertia.
Uncertainties and Possible Ways of Improvement

*Jens Biele[1], Matthias Grott[2], Naoya Sakatani[3], Kazunori Ogawa[4]

1. German Aerospace Center, DLR RB MSC, 51147 Cologne, Germany, 2. German Aerospace Center, DLR PF, 12489 Berlin, Germany, 3. Department of Physics, School of Science and Technology, Meiji University, Kawasaki, Kanagawa 214 8571, Japan, 4. Department of Planetology, Graduate School of Science, Kobe University, Kobe, Hyogo 657 8501, Japan

We analyse current models of thermal conductivity for planetary regoliths under vacuum conditions and compare two recent models of thermal conductivity (the Gundlach&Blum[1] and the Sakatani&Ogawa[2] model) to discuss trends in observed parameters for solid and radiative conduction. Potential extensions and improvements of the models in terms of a different treatment of the radiative conduction term will be presented. Furthermore, we correlate thermal skin depth vs. grain size and explore the limits of applicability of using thermal inertia to estimate the "typical" grain size of granular material. The most important issue related to the application of current thermal conductivity models to remote sensing data is how well we can constrain the unknown material parameters like grain thermal conductivity, contact area, surface energy, surface roughness, and shape. Further uncertainties involve the temperature-dependence of thermal inertia and we conclude that detailed analysis of remote sensing data will likely require abandoning the concept of a fixed thermal inertia and analyzing the relevant quantities like heat capacity and thermal conductivity directly.

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[2] Sakatani, N., K. Ogawa, Y.-i. Iijima, M. Arakawa and S. Tanaka (2016). "Compressional stress effect on thermal conductivity of powdered materials: Measurements and their implication to lunar regolith." Icarus . **267**: 1-11, Sakatani, N., K. Ogawa, Y. Iijima, M. Arakawa, R. Honda and S. Tanaka (2017). "Thermal conductivity model for powdered materials under vacuum based on experimental studies." AIP Advances **7**(1): 015310.

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