Thermal Environments of Airless Planetary Surfaces

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Description: There now exists, or will soon exist, extensive resolved infrared flux/temperature data of Ceres and Vesta from NASA’s Dawn mission, of Comet 67P/C-G from ESA’s Rosetta mission, of the Moon from NASA’s LRO mission, of Mercury from NASA’s Messenger mission, and of icy satellites from NASA’s Cassini mission that will be publicly available. By interpreting these observations for a range of airless planetary bodies with a suitable computational thermal model, allows the physical nature, formation, and evolution of planetary regolith (i.e. soil) to be investigated.

The observed temperature of a planetary surface depends on the physical properties of its regolith, as well as the illumination and observation conditions involved. Two important physical properties of the regolith that govern the observed temperature are the thermal inertia and surface roughness. Thermal inertia is a measure of a material’s resistance to temperature change, and can give an indication of the presence or absence of loose regolith material. Roughness is a measure of surface irregularity at scales greater than the thermal penetration depth (i.e. “1 cm), and it has the tendency to direct emitted thermal radiation back towards the Sun (i.e. an effect known as “beaming”). These two regolith properties can be computationally determined by fitting observed infrared fluxes/temperatures with a rough surface thermophysical model.

This computational project will use the Advanced Thermophysical Model (ATPM) [1,2,3] with the above data, and may investigate any of the following:

- How do thermal properties derived from infrared flux/temperature measurements relate to the geology seen in optical images?
- Can these thermal properties tell us how granular systems work in different gravitational environments (e.g. regolith movement)?
- Can they tell us about any mechanical properties of the surface (e.g. cohesion)?
- How stable can volatile materials be on planetary surfaces (e.g. within permanently shadowed craters)?

The project may also include obtaining new observations of fast rotating near-Earth asteroids with the VLT telescope in Chile, and application of the ATPM to the newly acquired and previously published data.

References:

Qualifications required: Degree in Physics, Astrophysics or related subject (1st or upper second class). Competent programming skills.