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New Concepts for Thermal Measurements on Airless Bodies

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Thermal properties control to a high extent the energy balance of planetary near surface layers. To measure these properties *in situ*, in particular the thermal conductivity, in the laboratory and in a terrestrial field experiment, various methods can be used. One which appears most suitable to be applied also on a planetary surface (because it is conceptionally simple and causes a minimal disturbance of the soil) is the so-called "heated thin wire" method, which ideally allows (due to its specific geometry) to derive the thermal conductivity of the surrounding medium directly by measuring the temperature increase of the heated sensor. It is not necessary to have independent measurements of the two other parameters determining thermal diffusivity, namely density and heat capacity.

Both "thin wire" sensors and similar designs (e.g. the MUPUS penetrator mounted on the comet lander PHILAE) encounter two particular problems when applied in the regolith layers of airless bodies: (i) The conductivities to be measured can be very low ($< 10^{-3}$ W/m/K). This is much smaller than the conductivity of the materials out of which the sensor is usually composed. Therefore, there is always the danger that the sensor itself acts as a heat pipe and disturbs the measurement. (ii) If measurements in boreholes are performed in an airless environment, the contact problem between the sensor and the surrounding medium can become serious. In terrestrial applications this problem is usually circumvented by using grease or similar substances to ensure a good thermal contact. However, for space applications (particularly if the same sensor should be used repeatedly and at different locations) this is not a suitable method. We present some ideas and concepts how thermal sensors could be optimized to perform measurements in porous and low conducting regolith layers. Possible applications on the moon and for asteroids are discussed.