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The Heat flow and Physical Properties Package (HP3) an integrated sensor suite for planetary subsurface investigations

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Regoliths store in their physical properties a record of the physical and chemical processes that have taken place during and after their deposition. The study of these properties, especially below the surface, allows the exploration of the bodiesąę past for periods of up to billions of years (i.e. Lunar of Hermean regoliths). At present there is a whole host of missions, analyzing the planetary surfaces from orbit. A few of them plan a landing, with only minor investigations of the subsurface (i.e. Rosetta). Access to depths up to a few meters still remains to be accomplished and is a relevant scientific objective, especially if complementary to the recovery of samples. To reach these goals, many efforts have been spent in the last decade to create and enhance a new class of investigative tools, able to self-penetrate the regolith: the Moles, an example of which is PLUTO, the subsurface soil sampling systems placed on board the Beagle 2 Lander. With funding from the ESA scientific development programme, and with the aim of creating the first prototype of an ą§instrumented Moleą́, our team is developing the Heat flow and Physical Properties Package (HP3), a combination of sensors whose final purpose is the measurement of the intrinsic heat flow of a planetary body. HP3 is an integrated instrument, designed to be attached to, and deployed by, a dedicated Mole. Once in place, it will perform in-situ measurements of the regolith status and properties. Weighing only ˜300g (of which only 200 attached to the Mole), it is com-

posed by three different sensor sets. A cluster of thermometers and heaters measures the thermal status at different depths and the thermal properties; a set of accelerometers and tiltmeters derives the mechanical characteristics and the precise position of the tool, while a ČŒ-ray Compton backscattering densitometer measures the density. All these data can be used by themselves or, combined to derive the heat flow, providing then data on the internal structure and thermal evolution of the target body. HP3 is housed in a trailed compartment, connected to the deployment Mole (the ąsłtractorąĺ) and, by a flat Copper-Kapton tether, to the surface element. Most of the sensors and the electronics are accommodated into the trailed body, while thermometers and heaters are integrated in the tether.