New Carriers and Sensors for Robotic Planetary Exploration

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The robotic element of planetary exploration missions does play a crucial role for a successful mission completion. The development of reliable and rugged systems with at the same time low resource requirements and a generous acceptance of harsh environmental conditions is an important constituent of supportive research and development programs.

This paper introduces a selection of new technologies developed by ESA support programs to foster the European scientific community and industry. Presented is a focused selection of potential scientific payload carrier modules and its highly integrated scientific instruments designed for in-situ exploration missions to planets and small bodies of our solar system. These developments could serve surface modules with very low resource availability. Low resource requirements and a highly integrated character is an important technology driver of all development plans.

The Nanokhod micro-rover is a mobile element capable to explore the surrounding of a stationary lander unit within a radius of 50 meter. Via a tether connection the provision of all communication and power distribution is ensured. The Nanokhod concepts merges the idea of the design of an “as small as possible” mobile element yet keeping the capability to carry a substantial scientific payload suite to analyse the near-by landing site. The engineering model has been build and will undergo a challenging test campaign in the near future.

The development of the Geochemistry Instrument Package Facility (GIPF), the payload suite designed for the Nanokhod rover, has been finalized and delivered to ESA. It consists of an Alpha Particle X-ray Spectrometer (APXS), a Mössbauer spectrometer (MIMOS2) and a micro camera (MIROCAM). The instrument front ends have already been thermally qualified at cryogenic temperatures. Beyond a partial heritage from existing flight models all instruments were modified towards an accommodation in the rover’s payload cabin and an increased performance.

An alternative payload element for the payload cabin is an extremely small Laser Mass Spectrometer (LMS). A breadboard of this instrument is currently part of an extensive

test and evaluation campaign. Also this instrument will be re-designed to fit into the Nanokhod modular payload suite.

The Instrumented Mole System (IMS) is based on a device that penetrates regolith down to a depth of 5 meter. The Heat Flow and Physical Properties Package (HP^3) demonstrates that a scientifically meaningful payload can be integrated into the payload compartment. This package comprises an active temperature measurement module, a densitometer to determine the density of the penetrated regolith and a device to determine the precise location of the mole.

An alternative instrument is based on an Attenuated Total Reflection (ATR) infrared spectrometer. It will observe and analyse through a window all material adjacent to the hull of the payload compartment within the penetration hole.

A newly implemented project is the design and fabrication of a melting probe. This probe enables the subsurface exploration of icy layers. It will be capable to carry scientific instrumentation into depth and decipher the stratigraphy of ice and dust deposition on planetary bodies.

The overall goal of all support activities is to analyse, design and built all critical components of a technologies which has no space application so far. Once all technical hurdles have been overcome by the breadboard development, a given instrumentation can rapidly be inserted into a flight model programme.