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# Current status of the development of payload carriers and instrumentation for in-situ planetary exploration

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Scientific instruments on planetary lander have to deal with very limited resources. Usually the allocated mass, volume and energy are extremely restricted. Certainly miniaturization, combination of different instruments and sharing of common resources is a top requirement for a successful design. In order to promote initial steps towards small and integrated payloads a large number of technology studies and developments have been initiated by ESA over the past years. This presentation will give an overview of the achievements and status of these activities.

Two contracts resulting in the development of a breadboard/engineering model for instrument carriers are close to finalization. This is the Nanokhod micro-rover and the Instrumented Mole System (IMS). While the Nanokhod is capable to explore the surrounding of a lander unit within a radius of 50 meter, the mole can penetrate soil down to 5 meter. Both vehicles are subject to intensive functional and environmental test campaigns upon completion of integration. A newly implemented project is the analysis, 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 development of the Geochemistry Instrument Package Facility (GIPF), a payload suite designed for the Nanokhod rover, is also close to its finalization. It consists of an APXS, a Mössbauer spectrometer and a micro camera. The instrument front ends have already been thermally qualified at cryogenic temperatures. Beyond the existing strong heritage from existing flight models all instruments were modified towards an increased performance. This package will also undergo a subsequent test phase under cold environmental conditions. In a follow-on activity all rover and payload electronics will be combined and miniaturized.

An alternative payload element is an extremely small Laser Mass Spectrometer (LMS). A breadboard version of this instrument is currently part of an extensive test and evaluation campaign.

In a similar approach like for the Nanokhod rover a payload suite has been built for the IMS. The Heat Flow and Physical Properties Package ($HP^3$) shall demonstrate that a meaningful scientific 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 currently in the process of being assigned. This is the breadboard development of an Attenuated Total Reflection (ATR) infrared spectrometer. The design goal is to fit this instrument also into the small payload compartment. The ATR will be capable to detect monolayers of water and will give information on the substrate material.

In an early phase of scientific and technical evaluation is a technique called Optically Stimulated Luminescence (OSL) dating. OSL is used to measure absolute ages of sedimentary deposits up to 1 Ma. This implies an obvious application to Mars exploration. The outcome of this evaluation will decide on the possible implementation of a bread boarding activity.