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GEP-ExoMars: a Geophysics and Environment Observatory on Mars

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Scientific objective:

The goal of the Long-Lived Geoscience Observatory on Mars, GEP (Geophysics Package) is to initiate the setup of a permanent network of fixed stations on the planet, with the objective to operate for several ($\geq$6) years. These stations will monitor with high resolution the seismic activity and the rotation of the planet, the magnetic field and its variations. They will measure the heat flux and monitor and study the environmental conditions (meteorology and atmospheric electric fields) and subsurface (ice/water table, subsurface porosity and volatiles). By providing new geophysical models of Mars´ interior as well as the actual geologic activity of the surface (heat flow, seismic activity), GEP will provide a major step in our understanding of the geological evolution of the planet and the habitability conditions during the first billion years. In addition, GEP will monitor the present Martian climate and meteorology, will provide a unique data set on potential hazards for future human exploration missions (radiation, atmospheric electricity, dust storms) and will perform high resolution characterization of the Martian surface.

Payload

The payload is composed of the following instrument suite (All model payload characteristics are based on state of the art instruments in Europe)

• Network/geophysical : Core payload is based on network instruments with phase B+

maturity. They include a seismic suite (2 VBB, 1 SP), a heat flux probe carried up to 5 m deep by a mole, a tri-axial magnetic field sensor, an atmospheric electricity probe and a meteorological suite (ATM).

• Geophysical : Full payload includes experiments working in conjunction with the Aurora Rover or drilling system, or experiments needing some lander elements or significant R&D activities. Includes a bistatic GPR and a radio science experiment based on an X band transponder (capable of direct link to Earth) as well as two more SP seimic sensors.

• Environmental AURORA payload : ESA recommended the inclusion of the Pasteur environment suite (ATM and UV-VIS already listed in the Network payload plus a Dust analyzer and Ionising Radiation Monitor) for a total of 1.9 kg of environmental instruments, excluding the boom.

System

Two system options are considered depending on deployment: a 'Semihard' option that can be deployed before landing or jettisoned from the landing module, and a 'Soft' option (same g loads as the lander). For ExoMairs, 'Soft' option is currently favoured. The full payload mass (including margins) is about 7$\sim$kg including the 4.5 kg core payload. The full mass (with margin) of the autonomous package including the full original and the "inherited" AURORA payload elements and bus subsystems is around 25$\sim$kg.

Power concept

Although the mean power consumption of GEP is in the order of only about 4 W, a solar generator is not feasible under the given constraints ($\pm 45^{\circ}$ latitude, all seasons including global dust storms, > 6 a operational life). An RTG solution is foreseen with off-shelf heater elements from Russia (tbc) and a highly efficient European thermoelectric generator. A 40 Wh Li-Ion secondary battery is used to buffer peak power demands (mainly for telecommunications)

Programmatics

The GEP is currently onboard the baseline EXOMARS 2011 mission of ESA's AURORA program. Other opportunities might be considered for the deployment of GEP package, such as the 2016 AURORA mission, NASA 2011 SCOUT and possibly all other NASA mission later than 2011. The GEP stations are a unique contribution to the International Mars exploration in the next decade and will complement the Pasteur-EXOMARS and MSL payloads, which are more focused on exobiology, surface mineralogy and atmospheric composition.