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Planetary Radio Interferometry and Doppler Experiment with the Phobos-Grunt mission

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Phobos-Grunt is an international mission led by the Space Research Institute of the Russian Academy of Sciences and the Russian Space Agency for studying Phobos and the Martian system. Its programme includes return to Earth of a soil sample from Phobos. The Phobos landing vehicle will remain on the surface of the Martian satellite after departure of the return vehicle for extended in situ studies (Fig. 1).

The Planetary Radio Interferometric and Doppler Experiment with the Phobos-Grunt mission (PRIDE-Phobos) will be conducted with the Phobos landing vehicle and a network of Earth-based radio telescopes in the interests of multidisciplinary studies requiring precise estimates of the lander's state vector which in turn enables estimates of the orbital parameters of Phobos. The experiment will exploit the technique demonstrated recently in the Huygens VLBI Experiment (Pogrebenko et al., this conference and [1]) and proposed for a number of planetary experiments presented at EPSC2009 (e.g. Cimò et al and Coustenis et al., this conference). Among the science goals of PRIDE-Phobos are:

- Precise estimates of the celestial mechanics parameters and their evolution for Phobos and Mars;
- Study of the internal mass distribution of Phobos;
- Estimates of the parameters of the Areocentric dynamical system in ICRF;
- Gravitational physics experiments.

The Phobos lander on-board instrumentation involved in PRIDE measurements include an X-band (8.4 GHz) transmitter, Ultra-Stable Oscillator (USO) and medium-gain antenna. The Earth-based segment of PRIDE-Phobos includes deep space tracking station, VLBI radio telescopes and data processing centres. The data measurements obtained with PRIDE-Phobos will be analysed in concurrence with data obtained with other on-board instruments, e.g. gravimeters and seismometers. PRIDE-Phobos will conduct three types of measurements: radial distance using methods employed by deep space navigation network, radial velocity using both a standard service two-way link radio system and a one-way (down-only) system based on the on-board USO, and angular position relative to background radio sources using the VLBI technique.

The quality of addressing the above goals of the experiment depends critically of the position of the lander on the surface of Phobos and duration of the experiment. As shown by simulations, to reach its goals the experiment must last for at least one year.

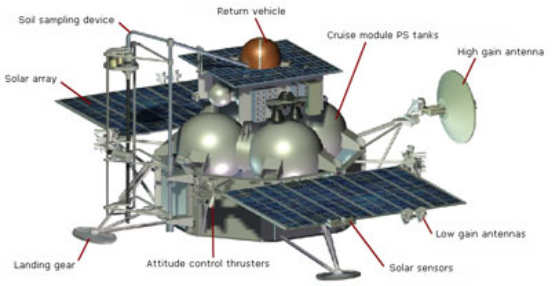

Figure 1: Phobos-Grunt spacecraft. Its landing stage (below the level of solar cell batteries) will remain on the surface of Phobos for extended in situ studies, including PRIDE-Phobos.

References

[1] Huygens VLBI tracking experiment (2008), *JIVE Research Note* 0011.