

Geophysical experiments on Phobos proposed for JAXA Mars Moon Exploration mission

*Kazunori Ogawa¹, Satoshi Tanaka², Naoya Sakatani², Munetaka Ueno^{1,2}, Takeshi Hoshino², Kazutoshi Sakamoto², Taichi Kawamura³, Yoshiaki Ishihara², Nozomu Takeuchi⁴, Philippe Lognonné³, Akito Araya⁴, Ryuhei Yamada⁵, Takeshi Tsuji⁶, Taizo Kobayashi⁷, Kei Shirai⁸, Matthias Grott⁹, Jerzy Grygorczuk¹⁰, Axel Hagermann¹¹, Jörg Knollenberg⁹, Tilman Spohn⁹, Hideaki Miyamoto⁴, Hiroaki Katsuragi¹², Sin-iti Shirono¹², Tomokatsu Morota¹², Masahiko Arakawa¹

1.Kobe University, 2.Japan Aerospace Exploration Agency, 3.Institut de Physique du Globe de Paris, 4.University of Tokyo, 5.National Astronomical Observatory of Japan, 6.Kyushu University, 7.University of Fukui, 8.The Graduate University for Advanced Studies, 9.German Aerospace Center, 10.Polish Academy of Sciences, 11.Open University, 12.Nagoya University

Scientific instruments and their support devices are being proposed for geophysical experiments on Phobos as potential instruments for the Mars Moon Exploration mission (MMX). JAXA is currently planning a sample return mission to the martian moons. The spacecraft will stay in a quasi-orbit around Phobos for months or 1-2 years, and make scientific observations including remote sensing, landings on Phobos for sampling, and several flybys of Deimos. Scientific goals of MMX were defined as in the following two categories: (1) To reveal the origin of the Mars moons, and then to make a progress in our understanding of planetary system formation and of primordial material transport around the border between the inner- and the outer-part of the early solar system. (2) To observe processes that have impact on the evolution of the Mars system from the new vantage point and to advance our understanding of Mars surface environment transition. While a landing site for sampling is still under consideration, in a current plan the main spacecraft lands twice, on the "red" and "blue" areas on Phobos for example.

We proposed five scientific instruments for this mission. SEIS: a three-axes short-period seismometer and an active seismic vibration source, SSXT: a penetration probe of several tens cm length with temperature and thermal conductivity sensors, miniRAD: a miniaturized thermal infrared radiometer, a muon detector, and SUMIRE: a mechanical insertion resistance probe of 5 cm length. All these instruments basically aim at investigating the geophysical properties of the surface, sub-surface, and interior of Phobos, and their combined observations can provide integrated models of mechanical and thermal properties of the subsurface which has not been studied so far. The scientific objectives of these instruments are connected to the following mission objectives corresponding to the mission goals above: (a) To obtain indirect information on the Phobos internal structure in order to constrain the origin of Phobos independent of the sample analysis results. (b) To characterize the space environment and the surface features of Phobos, with the intention of comparison with asteroids.

Because the first four of the above scientific instruments require a long observation time at a fixed location, a long-lived landing package (MSM) is also proposed. SUMIRE is planned to be mounted on the feet of the mothership (main lander). Objectives of MSM are providing electric power, command/telemetry interfaces, and an operable environment for the scientific instruments throughout a period of our observations over a Mars year. MSM has the following specifications and functions: (i) Operates independently from the mothership and survives at a fixed point of area. (ii) Controls internal temperature in an operable range of the scientific instruments for their continuous observations. (iii) Provides wired interfaces of telemetry/command and power to the scientific instruments. (iv) Communicates over a radio link with the mothership in orbits and with ground-based stations on the Earth. MSM will be placed on Phobos' surface during the landing sequence of the main spacecraft, and stay there over its entire lifetime.

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