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Mars Landing System for Surface Science in MELOS Mission

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Mars landing exploration system is being studied in MELOS, a Japanese Mars mission under study, including deployment from orbiter, entry into martian atmosphere, descending with aerodynamical control by heat shield, followed by parashute decelaration, landing with hazard aboidance, navigation and control, deployment of rover, and long-term operation on the Mars. Landing system and the following scientific observation as a long-lived station. Such landing and surface exloration system is briefly reported in this presentation.

Mars is among the extremely attractive planets to be explored in its nature: inner structure, surface processes, weather and climate system, and atmospheric escape. Furthermore, there are planned a sample return of dusts floating in the air and an exploration of life in the habitable zone showing aquifer or methane gas. In the MELOS mission, all of these aspects are studied and some of them will be selected as a united Mars mission to be proposed as a MELOS series.

Entry, descent and landing (EDL) as well as surface long-lived technology and surface rover technology are yet to be developed in Japan but essential for the missions of inner structure, surface processes, and life on Mars. Thus the EDL of a probe from Mars orbiter and the surface long-lived technology on the Mars are investigated in this study to clarify the techinical problems and estimate the feasibility.

Three kinds of entry probes are assumed: A) a 700kg class probe to land a 500kg class lander with a 100kg class rover with 20 to 25 kg science payloads carried. B) two 350kg class probes to land 300kg class lander with 20 to 25 kg science payloads. C) 450kg and 250kg probes to land a 400kg and a 200kg landers, with 30kg class rover on the large one, and with 20 to 25 kg science payloads.

To start this study, we assumed that the launcher is H-2A-204, with 1.8t wet mass of the orbiter and landing system. The orbit of the orbiter is 300km x 10 Mars radius. The probe should survive during cruise using a internal heater.

The lander is a legged lander with aerodynamically decrease by heat shield and parashute, and controls its attitude for soft and smart landing by RCS (Reaction Control system) and reaction wheel (RW). The lander is expected to survive in the winter season for a long-lived station to investigate inner structure.

The lander instruments include seismometry, mass spectrometer, X-ray analyzer, landscape and macro imagers, magnetometer, space VLBI, meteorological package, atmospheric radio sounding in 25 kg. Rover is mounted on the lander. Communication system has X-band for direct link to the terrestrial station and UHF band for link to the orbiter. Battery and solar paddle for energy and thermal control are prepared for survivability even in the winter.

The feasibility of such EDL and long-lived technology has been examined to find a solution for a mission success as well as low cost in the spacecraft system.

Keywords: Mars, Landing, Geological Survey, Inner structure, Atmosphere Observation, Rover