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IAF SPACE EXPLORATION SYMPOSIUM (A3)
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MARS MOONS' EXPLORER (MMX) INFRARED SPECTROMETER (MIRS) OPERATIONS CONCEPTS, OBSERVATION STRATEGIES AND EXPECTED MISSION PERFORMANCES

Abstract

The Japanese Martian Moons eXplorer (MMX) mission, scheduled for launch in 2026, aims to elucidate the origin of Phobos and Deimos, return Phobos samples and characterize Mars' atmospheric system. The French contribution to this mission consists of an infrared spectrometer (MIRS), a Rover (Idefix) developed with the German space agency (DLR) and a Flight dynamics cooperation between the French Space Agency (CNES) and the Japan Aerospace Exploration Agency (JAXA).

After four years of intensive and fruitful cooperation between the French Laboratory of Space Studies and Astrophysics Instrumentation (LESIA) of the Observatoire de Paris – PSL and CNES, MIRS is now ready to be delivered for its integration to MMX.

The observation strategies have contributed to MIRS design from the very start, from the choice of the field of view to the definition of the observation modes in the flight software, including estimating budgets for the limited lifetime items. As a result, and in synergy with MMX, MIRS is a versatile instrument that will provide detailed composition maps of Phobos and Deimos from various altitudes as well as Mars atmosphere monitoring.

With one year of cruise, three years of observations of the Martian system and several critical phases, MIRS operations concept and ground control segment will combine a high level of automation with a certain degree of flexibility in order to both foolproof MIRS commanding and allow for unexpected observation opportunities.

Translating the scientific requirements into practical MMX and MIRS observations sequences requires a close and iterative cooperation between all teams in order to ensure a good mutual understanding and a proper consideration of all the constraints. The optimization of the target areas coverage and of the necessary time to retrieve the associated scientific telemetry are crucial to the scientific return.

MIRS performances will also be optimized by seeking the best Signal to Noise Ratio while avoiding the detector's saturation. It will be achieved through the fine characterization of MIRS response in flight thanks to dedicated absolute, relative and flat-field calibrations, the resulting fine setting of MIRS parameters and the use of a ground radiometric model to select the best observation opportunities and adjust MIRS exposure time.

This paper will address mission performances and describe and illustrate the optimization performed for MIRS observation strategies, which are expected to improve significantly the scientific return with respect to the MMX mission allocations.