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# MISSION ANALYSIS FOR THE MARTIAN MOONS EXPLORER (MMX) MISSION

**Abstract**

The Mars system has been the target of many space exploration missions, yet the origin of the moons Phobos and Deimos is still not understood. The three prevailing hypothesis are: 1) the moons are type C or D asteroids, 2) the moons are remnants of Mars formation, or 3) the moons were formed by accretion of ejecta from a planetesimal impact on Mars. Unraveling the mystery of the origins of Deimos and Phobos would impact our understanding of the origin and formation of the solar system, and of the nature of the matter that was incorporated. For this reason, in the last decade several space agencies have studied mission options dedicated to the exploration of the moons of Mars. In 2011 the Russian Space Agency launched the sample return Phobos-Grun], but the spacecraft has failed to escape the Earth orbit. More recently, several mission scenarios were proposed by ESA and NASA (Phootprint, PANDORA, PADME, and MERLIN), including flyby missions, orbiters, landers, and sample return missions. Because of the scientific importance of such a mission, and building on the experience of asteroid sample return missions Hayabusa and Hayabusa2, the Japanese space agency is now planning a new sample return mission to be launch in the early 2020s. The mission is currently the main candidate for the next Japanese large-class spacecraft, following Hayabusa 2 (currently flying) and the space observatory ASTRO-H (launch in 2016). This paper presents the mission analysis work carried for the mission, with focus on the transfers from the launch to the moons, and from the moons back to the Earth. Several architectures are considered, depending on the propulsion system used and on the moon or moons chosen for the landing. An analytical formulation is also presented for quick estimate of the three-maneuver orbit insertion strategy.