Orbit Design for Martian Moons Explorer

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The Martian Moons Explorer (MMX) mission is now under study in Japan Aerospace Exploration Agency. Its scope includes the world's-first landing on one of the Martian moons, collecting samples from the surface and return to the Earth. This paper describes orbit design for MMX.

Launch window candidates in early 2020's are reported and interplanetary trajectory is shown. A sample-return mission from the inside of the Mars sphere of influence requires large delta-V compared to past missions achieved in Japan. Trade-off study between chemical and electric propulsion is described, and a possible plan using only chemical propulsion is presented.

Mars Orbit Insertion (MOI) and Mars Orbit Escape (MOE) are critical events in this mission. We show a 3-impulse maneuver sequence plan for the MMX probe to reach the Phobos quasi-satellite orbit (QSO) from the interplanetary space. Some preliminary results of mission analysis for MOI and MOE including power and communication analysis are shown.

In the past planetary missions in Japan, several failures and accidents have occurred especially in orbit insertion. For the mission success of MMX, it is essential to decrease insertion risks, and enhance robustness and tolerance of MOI. We propose a novel method to utilize interplanetary parking orbits for those requirements. Even if the probe fails to be inserted into the Mars orbit and fly away from the Mars, the proposed orbit guarantees the probe to re-encounter the Mars after just one Martian year. Conditions, trajectory design methods on the B-plane, impacts for the resources and capability in the MMX mission are discussed.

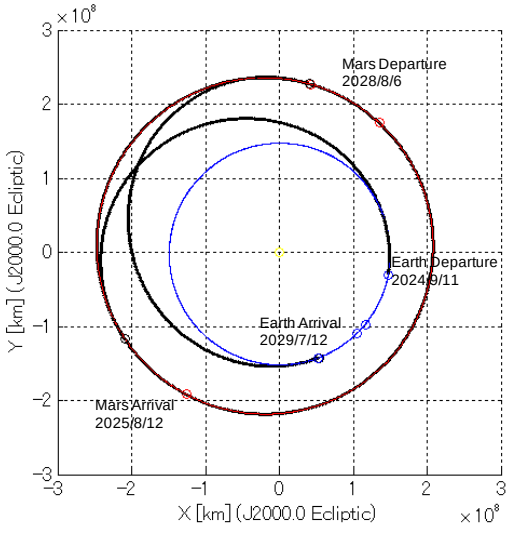

Fig.1 Nominal Orbit Plan.