

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (Part 1) (4A)

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LAUNCH OF A PHOBOS AND DEIMOS SAMPLE RETURN SPACECRAFT AS A CO-MANIFESTED
PAYLOAD OF THE NASA SLS LAUNCHER

Abstract

A combined Phobos and Deimos sample return mission spacecraft concept is presented as a mission that would fly as a secondary, co-manifested payload on the NASA Space Launch System (SLS) launcher in the mid to late 2020s. After the SLS boosts its primary payload to its prescribed injection velocity, the SLS's upper stage is fired again to inject the Phobos/Deimos spacecraft to Trans-Mars Injection (TMI). The spacecraft travels to Mars and does a series of aerobraking maneuvers to place itself in a Mars parking orbit. After aeroshell jettison, the spacecraft does a propulsive burn to intercept and land on Phobos. Once on Phobos, a 250 kg science package is deployed, which includes a rover. In addition to exploration, a sample is obtained and placed in a sample canister held within the Earth Return Capsule (ERC) element. Once the mission on Phobos is completed, the vehicle fires its descent stage engines again to transfer to the higher orbit of Deimos; after rendezvous and landing, it deploys its second science package for investigation and also obtains a sample. As at Phobos, the Deimos sample is deposited in the ERC. After Deimos operations, the spacecraft's Ascent Stage/Earth Departure Stage ascends back to Mars parking orbit. From there it departs Mars for its journey back to Earth. Later, at Earth arrival, the ERC element separates from the Ascent Stage/Earth Departure Stage and reenters Earth atmosphere, for a later parachute landing. In addition to injecting its primary payload (the Orion capsule) to Trans-Lunar Injection (TLI), the SLS Block 2 launcher (with the EUS upper stage) can boost 5.3 metric tons (mt) of payload to TMI velocity (a mass sufficient for a Phobos/Deimos exploration and sample return mission) while retaining a sufficient launch margin. In this paper the engineering details of the Phobos/Deimos craft are presented along with a diagram of its Earth-Mars trajectory. Also included are CAD illustrations of the spacecraft, the mission delta-velocity (Δv) budget for the mission, and the mass budget. Science objectives are also presented, as are summaries of the unique features of both Phobos and Deimos. Of all the Moons in the Solar System, Phobos is located closest to its host planet (Mars). This mission will be presented with summary information of the upgraded Block 2 SLS and its new Exploration Upper Stage. This report comes from ongoing research at the Boeing's Exploration Launch Systems division Space Systems division.