IAF SPACE EXPLORATION SYMPOSIUM (A3)
Mars Exploration – missions current and future (3A)

Author: Dr. Alison Gibbings
OHB System AG, Germany

Mr. Ingo Gerth
OHB System AG, Germany
Prof. Jürgen Oberst
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany
Mr. Kai Wickhusen
German Aerospace Center (DLR), Berlin, Germany
Dr. Konrad Willner
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Institute for Planetary Research, Germany

DEPHINE MISSION – EXPLORING THE MARTIAN MOONS OF DEIMOS AND PHOBOS – IN ESA'S COSMIC VISION PROGRAMME

Abstract

The Deimos and Phobos Interior Explorer (DePhine) mission will explore the origins and evolution of the Martian satellite system. It is a candidate for the next (M)edium class mission call of ESA's Cosmic Vision Programme. A spacecraft, launched on an Ariane 6.2, will be directly injected into a Mars transfer orbit. Detailed and comprehensive comparative studies of both Deimos and Phobos will be performed, focusing on their interior structure and diversity. Understanding the origins of both satellites is key to unlocking the evolution of the Martian system and the overarching processes in the formation of the solar system. Are Phobos and Deimos true siblings, originating from the same source and sharing the same formation scenario? Are the satellites rubble piles or solid bodies? Do they possess hidden deposits of water ice in their interiors? These questions will be addressed as the spacecraft first enters a quasi-satellite orbit about Deimos, performing global surface mapping and a series of very close flybys at less than 5 km distance. The spacecraft will then enter into a 2:1 resonance orbit with Phobos, performing multiple close flybys and similar remote sensing measurements (for comparative analysis). A suite of instruments – a camera system, radio science, high-frequency radar, magnetometer, gamma ray/neutron spectrometer, dust detectors and a solar wind sensor - will perform detailed mapping of the local space environment, surface, structure and interior of both satellites. Simultaneous radio tracking and remote sensing observations (which is not possible for Mars Express) is achievable with a steerable on-board antenna.

The paper will report on the scientific justification, mission architecture and focus on the (sub)system design of implementing the DePhine mission. Different architecture designs and system options are included (i.e. Deimos lander), with additional mass and cost-saving opportunities. DePhine is proposed as an ESA-led mission, but within the context of international collaboration. The spacecraft will arrive in 2031, approximately six years after the Mars Moon Exploration mission (JAXA, Phobos Sample Return Mission). The M-class mission opportunity requires a high TRL-level spacecraft, ready for launch within the 2029/32 timeframe, on either a Vega-C or Ariane 6 class launch vehicle. The programmatic constraints of mission cost, risks, schedule and the use of critical technologies are therefore also included. The mission and system design for DePhine was developed by a consortium of OHB System AG, DLR and scientists from international institutes and organisations. Concurrent engineering techniques were also used throughout.