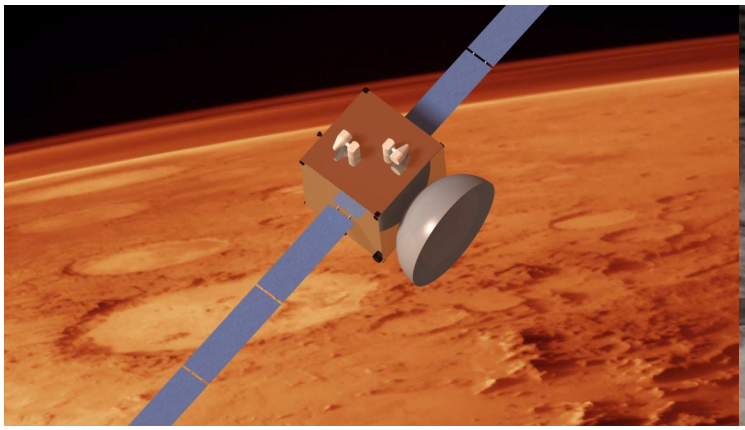
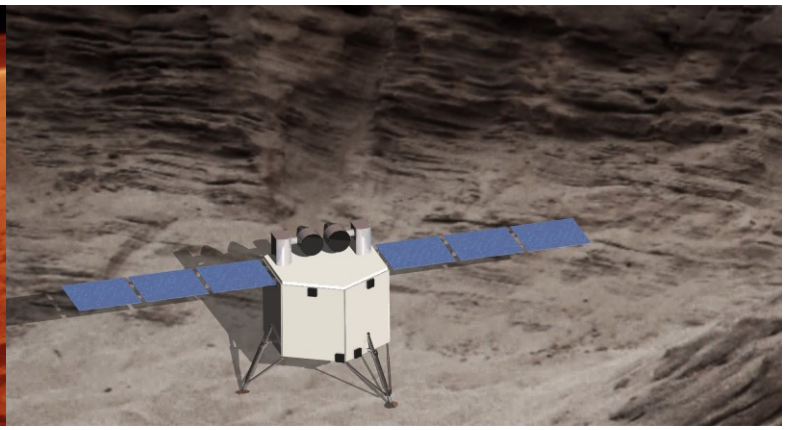
APHRODITE

Revolutionising solar system dynamics

By DSE group 11





Jury Summary

For centuries, mankind has been trying to characterise the processes governing the solar system by combining Earth and space observations. The objective of the Aphrodite mission is to perform accurate ranging between Mars, Phobos, Deimos, and Earth for eight years. Doing so will give detailed insight into the characteristics of moons in the Martian system. With the accurate positions of all bodies within the Martian system, the fundamental forces acting in the solar system can be studied.

Aphrodite consists of three main elements: two landers, one on Phobos and one on Deimos, and an orbiter around Mars. The distance to the bodies will be determined with an accuracy of 0.5 metres with the use of two-way laser ranging. The laser system is also used to communicate with Earth, however a redundant radio system is present in case of failure. The other subsystems are designed to support this communication and ranging system.

Landing on Phobos has been attempted before, but never successfully. Nobody has ever attempted to land on Deimos. Combining this with Aphrodite's relatively long mission lifetime, the mission is risky. An important aspect of the mission design is therefore based on risk mitigation. For example, since little is known about the landing surfaces of the moons, the harpoons anchoring the landers to the surface are designed to work for a big range of surface toughnesses. The lasers are equipped with their own actuators, this means they can point over a wide range without the orbiter having to make complicated turns. Next to that, redundancy of components is integrated in the complete design.

The total project cost is set at one billion euros, which is low for such a complex system bringing three elements into the Martian system. This challenge was tackled by choosing off-the-shell products when possible for the subsystem components to minimise development and production costs. In addition to its main objective, the orbiter can be used as a communication relay during and after the mission, which will help future missions reduce their own communication requirements.

Sustainability is also a main point of attention in the mission. This mission, by choosing for a revolutionary green propellant and using life cycle assessments, brings sustainability of spacecraft to new heights.

Mission Characteristics

Launch mass: 3874 kg

Launcher: Falcon 9

Launch date: 26/02/2031

Orbiter

Dry mass: 714 kg

Wet mass: 3089 kg

Solar array size: 12 m^2

Phobos lander:

Dry mass: 275 kg

Wet mass: 372 kg

Solar array size: 2.81 m^2

Deimos lander:

Dry mass: 290 kg

Wet mass: 413 kg

Solar array size: 2.81 m^2

Total cost: M$ 930