ESMO - The European Student Moon Orbiter

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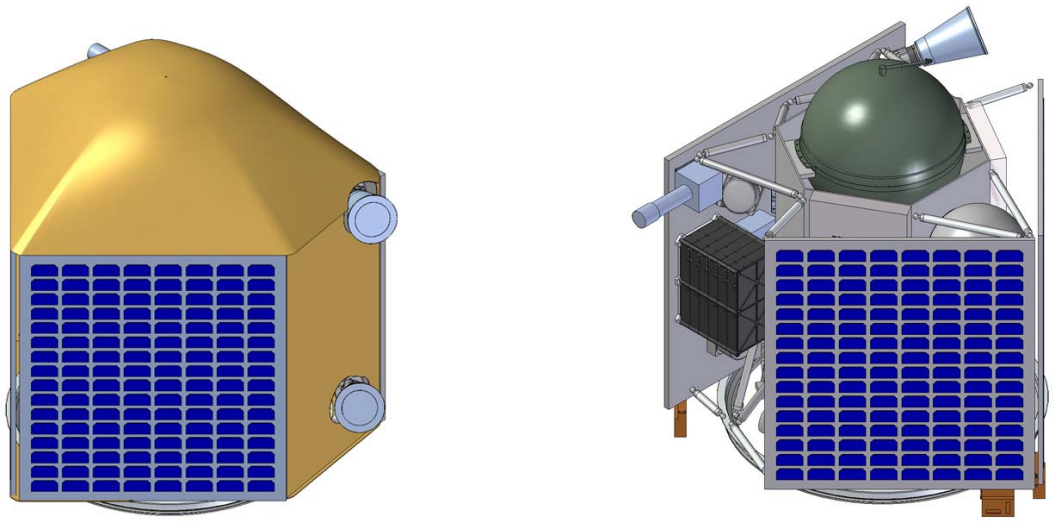

The ESMO spacecraft as seen from above. The external view shows the solar panels and thermal blankets. The internal view shows the solar panels only. Images credits: Surrey Satellite Technology Ltd.

Mission statement

The European Student Moon Orbiter (ESMO) is planned to be the first European student mission to the Moon. ESMO represents a unique and inspirational opportunity for university students, providing them with valuable and challenging hands-on space project experience in order to fully prepare a well qualified workforce for future ESA missions in the next decades. In addition, ESMO has a powerful education outreach aspect and strong attraction for younger students studying in high schools across Europe, by lowering the entry-level for lunar exploration to attainable university project activities. ESMO also represents an opportunity for students to contribute to the scientific knowledge and future exploration of the Moon by returning new data and testing new technologies.

Mission objectives

- To launch the first lunar spacecraft to be designed, built and operated by students across ESA Member States and ESA Cooperating States.
- To place and operate the spacecraft in a lunar orbit.
  » An on-board chemical propulsion system will be used to transfer the spacecraft from its initial Earth orbit to a polar orbit around the Moon via the Sun-Earth L1 Lagrange point over a period of 3 months; this is done to reduce propellant consumption.
- To acquire images of the Moon from a stable lunar orbit and transmit them back to Earth for education outreach purposes.
  » A 2.5 kg narrow angle camera will be used for providing medium-resolution images of the lunar surface at specific locations upon request from schools. This will be operated from a highly eccentric lunar orbit.
- To perform new measurements relevant to advanced technology demonstration, lunar science and exploration.
  » Payloads being studied are a small radar payload, a radiation monitor, a 2.5 kg passive microwave radiometer (temperature of the regolith a few metres below the surface), and a telecommunication experiment to test a lunar internet protocol. All may be operated from the same orbit as the camera.

Brief description of ESMO

ESMO is the fourth mission within ESA's Education Satellite Programme and builds upon the experience gained with SSETI Express satellite (launched into LEO in 2005), YES2 tether/re-entry capsule experiment (launched into LEO on the Foton-M3 mission in September 2007) and ESEO satellite (the European Student Earth Orbiter planned for launch into LEO in 2013). Some 200 students from 20 Universities in 11 countries are currently participating in the ESMO project, which has successfully completed a Phase A Feasibility Study and is proceeding well with preliminary design activities in Phase B.

The ESMO spacecraft is designed to be launched into Geostationary Transfer Orbit (GTO) as a secondary/auxiliary payload in the 2014 timeframe. The exact launch opportunity has yet to be confirmed, but the spacecraft is to be compatible with a number of launchers.

Surrey Satellite Technology Limited (SSTL), as System Prime Contractor, is managing the ESMO project for the ESA Education Office and providing considerable system-level and specialist technical support to the university student teams during the implementation of the project until launch and early operations. The participating universities have been finalised at the System Design Review in June 2010.

The students are expected to provide most of the spacecraft subsystems, payload and ground support systems under supervision by their universities and the prime contractor as part of their academic studies. The students obtain hands-on training and knowledge transfer by technical experts during internships, in addition to using facilities at SSTL for spacecraft assembly, integration and testing. Flight spare hardware is also donated by ESA where justified to lower project cost and risk.

Technical facts (to be confirmed)

Dimensions	120 x 110 x 100 cm
Mass	265 kg (incl. 93 kg propellant)
Expected lifetime	11 months (6 months lunar operations)
Lunar orbit	Periapsis altitude 280 km; apoapsis altitude 16400 km; inclination 56°
Attitude and Orbit Control System	3-axis stabilised: 2 star trackers, 4 sun sensors, 2 IMUs, 4 reaction wheels, 4 cold gas thrusters
On-board data handling	2 ESA LEON2 processors (dual redundant) running data handling software (command timeline and simple FDIR) and AOCS software; 32MB Serial Flash for payload data storage; CANbus data interfaces
Communications	Low Gain Antennas for omni-directional coverage; S-band transponder with PSK-PM modulation and range & range rate capability for radio-navigation; 8 kbps downlink / 4 kbps uplink between Moon and Earth stations
Electrical power system	2 body-mounted 3J GaAs solar panels for 170W BOL power & 122W EOL power; 24-29 V unregulated bus; 15 Ah capacity Li-ion batteries
Propulsion	4 liquid MON/MMH bipropellant thrusters: 22 N thrust each, 285 s specific impulse (modulated by AOCS software during burns for reaction control); Delta-V of 1150 m/s
Structure	Al honeycomb central thrust tube with load bearing struts for launch adapter mating
Thermal control	Passive: MLI & surface coatings Active: local heaters for eclipse (e.g. propellant tanks)
Ground segment	Ground stations: Villafranca 15m S-band dish for TT&C; Raisting 30m S-band dish for payload downlink; Perth/Kourou for LEOP/manoeuvres