THE EUROPEAN STUDENT MOON ORBITER (ESMO): A SMALL MISSION FOR EDUCATION, OUTREACH AND LUNAR SCIENCE

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Abstract: The paper will present the programmatic and technical status of the ESMO project, provide a description of the payload and its measurements, the spacecraft and mission design, and how the project is structured to provide maximum education/outreach benefits to prepare the space science/exploration workforce of the future.

Introduction: 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, particularly those planned by the Exploration and Science programmes 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: The primary objectives of the ESMO mission are (1) to launch the first lunar spacecraft to be designed, built and operated by students across ESA Member and Cooperating States; (2) to place the spacecraft in a lunar orbit; (3) to acquire images of the Moon from a stable lunar orbit and transmit them back to Earth for education outreach purposes; (4) to transfer to a science orbit, and perform niche measurements of interest to lunar science and exploration.

Payload description: A miniaturised payload would perform measurements in order to achieve these objectives over a period of 6 months in lunar orbit. The core payload is a Narrow Angle Camera for optical imaging of specific locations on the lunar surface upon request from schools, and presently a nanosat subsatellite for global gravity field mapping to 10-20 mGal precision via accurate ranging of the subsatellite from the main spacecraft. Such a nanosat, called Lunette, would be deployed in a low altitude near-circular polar orbit at 100 km altitude. Alternative scientific payload under consideration includes a Biological Experiment (BioLEx) characterizing lunar environment effects on living cells, and a passive microwave radiometer measuring the temperature of the lunar regolith at a few metres below the surface. Furthermore, it is planned to demonstrate a lunar internet communications protocol in lunar in order to enable future data delay between lunar surface elements, orbiters and Earth ground stations.

Mission/system design: The 250 kg ESMO minispacecraft is designed to be launched into Geostationary Transfer Orbit (GTO) as a secondary payload in the 2012/2013 timeframe. The exact launch opportunity has yet to be established, although design work to date has assumed the use of the ASAP adaptor on the Ariane 5 or Soyuz launchers from Kourou. However, the design is adaptable to other launch vehicles. An on-board liquid bipropellant propulsion system will be used to transfer the spacecraft from its initial GTO to the operational lunar orbit via the Sun-Earth L1 Lagrange point over a period of 3 months. The spacecraft would then perform outreach and science operations in the operational lunar polar orbit for a period of 3-6 months.

Programmatics: ESMO is the third mission within ESA's Education Satellite Programme and builds upon the experience gained with SSETI Express (launched into LEO in 2005), the YES2 experiment (launched on the Foton-M3 mission into LEO in 2007) and ESEO (the European Student Earth Orbiter planned for launch into GTO in 2011). Some 200 students from 17 Universities in 10 countries are currently participating in the project, which has successfully completed a Phase A Feasibility Study and is proceeding into preliminary design activities in Phase B. The ESMO project has a high potential for international cooperation involving various elements that could be provided by international partners and their respective universities.