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# SELMA mission: revealing the origin of lunar water

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We propose a very low cost lunar mission to cover a poorly investigated inter-disciplinary area in the lunar science. The mission SELMA (Surface, Environment, and Lunar Magnetic Anomalies) investigates the interaction of the neutral and plasma environment with the lunar surface and the impact of this interaction on the surface composition, in the first hand, on the presence of water. The mission focuses on the fundamental question: What is the origin of the water in the lunar soil? The mission also addresses the questions: What are the lunar exosphere content and composition and how does the exosphere interact with the surface? How do the lunar magnetic anomalies interact with the solar wind and affect the surface?
SELMA investigates the origin of the water in the lunar soil via simultaneous measurements of the OH/$H_2O$ abundance in the soil, the proton flux deposited to the surface, and transient changes in the exospheric gas content and composition. The water content in the surface is mapped via measurements of the 2700 – 3300 nm OH/$H_2O$/ice absorption lines. The proton flux at the surface is measured remotely via backscattered hydrogen flux (energetic neutral atoms, ENAs). The exospheric gas content and composition and possible transient changes due to micrometeoroid influx or outgassing are monitored by a neutral gas mass spectrometer.
Little is known about the tenuous lunar exosphere, its composition, structure, and relation to the plasma environment. The reasons for the present poor knowledge of the lunar exosphere is the difficulty of observations due to the low number densities, and the complexity of models due to the multiplicity of the mechanisms responsible for the input and loss of exospheric species. To investigate the lunar exosphere SELMA is equipped with state-of-the-art time-of-flight neutral gas mass spectrometer with unprecedented sensitivity and mass resolution.
The Moon does not have a global magnetic field but possesses local magnetizations. The magnetizations interact with the solar wind plasma creating highly variable mini-magnetospheres affecting, through an as yet unknown mechanism, the surface visible albedo. The electrodynamical interaction is very complex being one of the fundamental solar wind interactions in the solar system. SELMA studies how the magnetic anomaly interact with the solar wind and surface via simultaneous measurements of 3D ion and electron distribution functions, the local magnetic field, solar wind flux variations on the surface through ENA imaging of the backscattered hydrogen flux, imaging in the visible range, and measuring the surface IR spectrum.
The SELMA results will be of critical importance for the interpretation of data from Mercury to be collected by the ESA BepiColombo mission in 2020 – 2022.
To address its scientific objectives SELMA carries a highly focused suite of instruments including an IR spectrometer, an ENA telescope, an ion and electron spectrometer, a neutral gas mass spectrometer, a magnetometer, and a visible camera. SELMA is a spinning platform to be inserted on a low maintenance quasi-frozen polar orbit of 30 km x 216 km by a dedicated launch and a solid state fuel kick stage. SELMA was proposed to ESA as a candidate for the S-class mission.