Lunar Exploration and Science Orbiter (LExSO) MISSION: BUILDING ON THE LEGACY OF THE LUNAR RECONNASSIANCE ORBITER IN SUPPORT OF FUTURE LUNAR SCIENCE AND SURFACE EXPLORATION. M. Amato (Michael.Amato@nasa.gov), N. Petro, C. Baker, B. Cohen, E. Mazarico, E. Park, J. Staren, C. Achilles,[1], S. Lawrence[2], [1]NASA Goddard Space Flight Center, [2]NASA Johnson Space Flight Center

Introduction: The Lunar Exploration and Science Orbiter (LExSO) mission concept is being actively developed to serve critical future lunar exploration and science measurement needs. LExSO is a lunar orbiter capable of accommodating a payload suite of highly capable instruments. The mission will contribute to answering science questions about: surface geology; volatiles; and in addition to science, support exploration needs. A preliminary science team is working to define the science needs for a next generation orbital mission based on previous community input reports. Important science questions have been defined by the broader science community in the recent Lunar Exploration Analysis Group Continuous Lunar Orbital Capabilities Specific Action Team (LEAG CLOC SAT) Report, the Artemis III Science Definition Team and the 2023 - 2032 Planetary Science and Astrobiology Decadal Survey Report. The LExSO mission will significantly contribute to our understanding of the Moon with new science and improved measurements over the existing wealth of data on hand.

The mission concept is in pre-Phase A study with a science and engineering team based out of NASA GSFC who developed and currently operate LRO. The core team developing LExSO has experience with lunar missions in low lunar orbit such as LRO and LADEE.

The Need for LExSO: LEAG's CLOC-SAT report clearly articulates the scientific need for continued orbital presence at the Moon. LRO is beyond its design lifetime and may not operational past the first few Human Artemis landing missions (fuel is expected to run out as soon as 2027,). Foreseeing a gap and new needs in orbital science, LExSO has started the first study step in formulation and to enable timely progress into development. LRO continues to be one of the most critical contributors to lunar science. LRO continues to be one of the most critical contributors to lunar science measuring anthropogenic as well as natural changes to the surface that can critically impact human exploration planning and safety needs. LExSO will address science and exploration drivers with increased measurement capabilities and has significantly more orbital adjustment flexibility. LExSO will fill Artemis situational awareness, planning, and science gaps and with enhanced capability, enabling improvements to the LRO imagery and localized topography.

LExSO Concept Development: LExSO is in pre-Phase A in FY 23 and will advance to Phase A in FY24. NASA Science Mission Directorate, Artemis and Exploration Systems Development Mission Directorate and the lunar science community are the key stakeholders in LExSO. As the concept matures, we expect opportunities to evolve the science team and eagerly anticipate additional community engagement sessions.

LExSO goals: LExSO science goals are largely driven by the anticipated CLOC SAT report as well as exploration/Artemis needs that the team has distilled into an initial set of mission objectives. A LExSO 'pre science team' has been organized in three major working groups: Surface Geology, Resources/Volatiles. and Exploration. These science working groups are working together with stakeholders, engineering, management to prioritize the goals and measurements. The goals, derived from CLOC SAT and exploration/Artemis inputs are being worked to derive a cohesive mission that advances lunar science on its own by addressing a swath of the highest priority measurements, while simultaneously supporting exploration. Examples areas include improved surface imaging and mapping, volatile and resource cycle characterization, topography, temporal changes, navigation along with other science and Artemis exploration areas.

LExSO Mission: LExSO is envisioned to be a NASA Discovery class-like mission, reflecting the need for higher capability instruments and orbit adjustment flexibility. A 50 km polar orbit, like LRO, constrains the possible measurement types but ensures global coverage. These constraints are driving the team to a cohesive set of goals and measurements that improve our understanding of the Moon, but will inevitably leave some investigations in place for subsequent missions. LExSO goals and measurements are being carefully worked to provide a comprehensive suite including global measurement capabilities as well as high resolution volatile/resource assessments, imagery, and topography of select regions. A goal of the suite is to resolve both sunlit and permanently shadowed regions allowing investigation of anywhere on the lunar surface. The global imagery capability allows detection of temporal changes and therefore assistance in knowing where to target the regional higher resolution measurements. LExSO uniquely fulfils these two important capabilities (global and targeted mapping) that cannot be performed adequately from other orbits. The LExSO mission team is leveraging knowledge and lessons learned gained from LRO to formulate a mission

that will serve lunar science and exploration to fundamentally change our understanding of the Moon and its processes.

Goal and Requirements work: The pre-Phase A team will include community input and involvement in these measurement goal decisions that drive the instrument suite. GSFC is working directly with NASA HQ to enable this key mission input. The mission architecture is focused on the needs of stakeholders (science an exploration). In this pre-phase A effort, the LExSO team is seeking input for mission and instrument trades to work through to drive LExSO's mission architecture. Acquisition strategies will be worked later in pre-Phase A with our stakeholders. Notional spacecraft and mission decisions are early and changeable at this stage. An early conceptual design is shown below (Figure 1). The team is excited to work with the community on what will be a critical and important science and exploration mission.

Figure 1 – Early conceptual LExSO spacecraft, drawing heavily on the wildly successful LRO design.

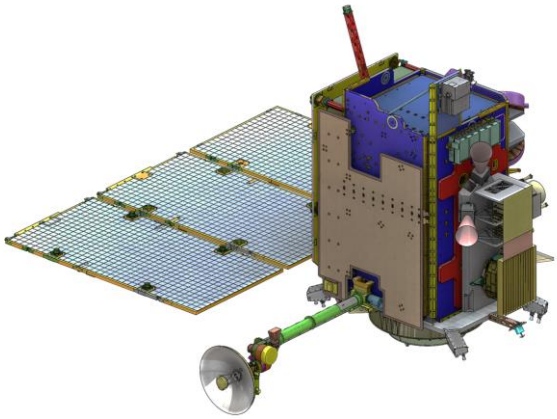

Figure 1 – Early conceptual LExSO example.

Acknowledgments: The LExSO team, NASA SMD ESSIO and ESDMD.

Additional Information: If you have any questions or need additional information please contact Michael Amato, Noah Petro or Betsy Park at NASA GSFC