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Ex Luna Scientia! Nuclear Astrophysics Enabled by the Lunar Occultation eXplorer (LOX)¹

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LOX is a focused science mission that will, for the first time, perform systematic population studies of thermonuclear, or type-Ia, supernova (SNeIa) using their emergent nuclear radiation. LOX will achieve this by probing the fundamental nuclear processes that govern these “beacons of the Cosmos”. LOX measurements of the radioactivity left behind in the wake of nuclear burning will reveal characteristic trends via population studies that individual detections cannot, further our understanding of the matter–energy life cycles within galaxies, and provide critical diagnostic evidence for the multiple evolutionary pathways responsible this class of supernovae. LOX will directly test the assumption of SNeIa homogeneity. Open questions in cosmology (e.g., cosmic expansion history, dark energy) and astrophysics (e.g., the details of the nucleosynthetic yields) requires us to understand the fundamental nature of these objects and their progenitors. LOX will achieve its science goals with a simple, low-cost, cross-cutting implementation. LOX employs a single-instrument payload consisting of an array of identical gamma-ray sensor modules. The instrument design and its single mode of operation leverage decades of heritage derived from planetary exploration endeavors. The LOX implementation approach mitigates the challenges associated with increasingly complex space-based instrumentation. LOX leverages the power of continuous all-sky monitoring to meet its science goals. Therefore, LOX fills a long-standing astrophysical capability gap. In fact, as the first high-sensitivity MeV astrophysics mission in a generation, it has a significant capacity for discovery beyond our primary SNeIa science goals. LOX is currently being prepared for submission to NASA’s astrophysics MIDEX program, and with it NASA will establish the Moon as a platform for science and once again pry open a new window on the Cosmos.

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