Paper ID: 103366
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IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 1 (2A)

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LUNAR REY: DEVELOPMENT OF AN AUTOMATED INSTRUMENT TO STUDY ENGINEERED ORGANISMS AND CROP PRODUCTION ON THE MOON

Abstract

To gain greater independence from Earth, future long-duration missions to the Moon and beyond will likely use a combination of crop plants and engineered organisms to produce food and countermeasures for astronauts. Lunar REY (Radiation Effects on photosynthetic organisms and Yeast) will deploy an automated culturing system and a multiparticle radiation detector on the lunar surface to compare how cyanobacteria, plants, and yeast – space-relevant organisms from across the tree of life – function in the context of lunar surface radiation and gravity. Lunar REY's central hypothesis is that lunar surface radiation and gravity will negatively impact cell growth, metabolic activity, and bioproduction.

Lunar REY includes several components with extensive flight heritage. At its core is the BioSensor, a microfluidic and spectroscopy system for monitoring the growth and physiological responses of organisms to beyond low Earth orbit (LEO) conditions originally developed for the BioSentinel CubeSat mission and currently being adapted for the Lunar Explorer Instrument for space biology Applications (LEIA) mission, scheduled to launch in 2027. Unique among biological instruments, the BioSensor accommodates hundreds of samples in a versatile microwell format. While benefiting from the BioSensor's flight heritage, Lunar REY advances its design to accommodate unprecedented diversity in both biology and assay type, while including large numbers of replicates for statistical confidence. Lunar REY also features a Multiparticle Radiation Detector suite (MRD) using Timepix technology. As with the BioSensor, the MRD is based on technology with extensive flight heritage and promises to extend the boundaries of lunar knowledge by measuring several forms of particle radiation (charged particles, fast neutrons, and thermal neutrons) in a compact, low-cost detector suite.