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PLANTS ON THE MOON: THE CUBESAT SHAPED PLANT GROWTH EXPERIMENT MODULE ON THE LUNAR SURFACE

Abstract

In 2014, Lithuania launched its first CubeSats LituanicaSAT-1 and LitSAT-1 into low Earth orbit. Building onto the success of our first CubeSat mission, we are launching a project to develop the first biological Lunar payload and land it on the Moon at the end of 2017.

The module will be taken to the Moon by a Lunar lander of one of the companies currently competing for the Google Lunar XPRIZE. The module will be tethered on the surface of the lander with access to passive thermal control, electrical energy and data transmissions.

This scientific project is based on an open-source concept by a planetary scientist Dr. Christopher McKay and will explore Lunar surface as an environment for plant seed germination and plant growth. Seeds of three strains of two plant species - *Arabidopsis thaliana* Columbia wild type, *Arabidopsis thaliana* radiation-sensitive mutant and a Lithuanian strain of a flowering plant - will be grown inside a 2U size CubeSat shaped module for the duration of a Lunar day (14 Earth days). The module will have an integrated 3D-printed plastic platform for seed immobilization and liquid delivery system. Temperature inside the module will be held in a narrow interval using a closed loop control system with an on-board computer. Phototropism and gravitropism of stems and roots will be imaged using high definition cameras every 6 hours for the duration of the experiment. Plant metabolism will be characterized measuring CO_2 concentration in the module.

Solar optical spectra, CO_2 concentration, temperature and radiation data will be collected and sent back to Earth. A control for the experiment will be performed in an identical module in lab environment. Temperature, illuminance data from the Lunar module will be used for creating identical conditions in the Earth module. Data from imagery (total leaf area, leaf coloring, stem and root length and curvature) and sensors (CO_2 concentration, radiation dose) will be analysed and compared to control and results from *Arabidopsis thaliana* experiments on the ISS[1].

The project was initiated by the Lithuanian Aerospace Association and has received support from Vilnius University, Kaunas University of Technology, Vilnius Gediminas Technical University, Vytautas Magnus University, Lithuanian government and commercial partners.

[1]Kiss, J. Z.; Millar, K. D. L. Edelmann, R. E. Phototropism of Arabidopsis thaliana in microgravity and fractional gravity on the International Space Station. Planta, 2012, 236, 635-645