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DESIGN OF A MICROECOSYSTEM TO SUSTAIN FLUORESCENT TARDIGRADES IN SPACE FOR
NANOSATELLITE PAYLOAD EXPERIMENT

Abstract

The University of Manitoba Space Applications and Technology Society (UMSATS) is preparing a nanosatellite that will carry a biological experiment containing a micro-ecosystem consisting of tardigrades, rotifers, and lichen into low earth orbit. Tardigrades have been exposed to space in a desiccated state and successfully revived upon return to Earth. We propose to assess the survival and behavior

of active, rehydrated tardigrades, as they hunt and feed. The micro-ecosystem will be housed within aluminum chambers, and will be exposed to vacuum for time periods of two weeks to one year, depending on the compartment. Each micro-ecosystem is to be sustained by lichens as the primary producer that will generate oxygen by photosynthesis. Bdelloid rotifers will serve as the primary food source for the tardigrades. The tardigrades will be launched into space in a cryptobiotic state (anhydrbiotic). After the pre-defined time periods of vacuum, the chambers will be flooded with water to rehydrate the tardigrades. Their survival and activity will be evaluated by an onboard camera and image processing system that will be able to send images back to Earth for further analysis. The tardigrades have been genetically modified to express the enhanced green fluorescent protein (EGFP). When exposed to blue light (470 nm) they will emit a green/yellow fluorescence (507 nm), that will be detected via a camera equipped with a filter that allows only light of 500 to 510 nm. An image-processing algorithm will be used to determine whether or not the tardigrades are alive by examining their movement patterns. Based on whether or not the images and statistics demonstrate that the tardigrades can survive and reproduce, conclusions can be drawn regarding the possibility of artificially introducing life to other planets. Given that past papers have illustrated the incredible hardiness of the tardigrade, it is expected that the tardigrades will be capable of persisting even when rehydrated in space.