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EXAMINING EFFECTS OF COSMIC RADIATION ON THE ACTIVITY OF HIV-1 LATENCY REVERSAL USING CUBESAT PAYLOADS

Abstract

Highly Active Antiretroviral Therapy (HAART) can suppress HIV replication but does not act on latent viral reservoirs. "Shock and kill" therapeutic approaches aim to re-awaken viral expression in HIV reservoir-containing cells and target those cells for elimination. Latency Reversal Agents (LRAs) that effectively stimulate virus production, when coupled with HAART to prevent new reservoir seeding, could potentially reduce viral persistence in people living with HIV. Through previous experiments, we and others have determined that several LRAs reverse latency in a non-infectious cell culture model of HIV (J-Lat 9.2). However, no LRA to date can activate all viral reservoirs, and LRAs with the highest activities also show the most toxicity. External factors, combined with low-dose LRAs, may improve latency reversal while minimizing toxicities. Aerospace technologies could help support development of ground-based therapies for human diseases but have been historically limited by cost and accessibility to the public. This experiment is therefore designed to determine the effect of exposure to cosmic radiation on the activity of LRAs using Cubesat technology. In initial laboratory studies, J-Lat cells expressing green fluorescent protein (GFP) upon latency reversal will be treated with established LRAs, placed inside a vacuum chamber, and irradiated with ionizing radiation ranging from 0 to 80 Gy in 1.8-2 Gy fractions. Cell cultures will then be examined by flow cytometry for additive changes in GFP expression. A modified version of the J-Lat experiment will then be conducted as a payload of a 3U Cubesat developed by the SFU Satellite Design team. The projected launch date for this payload into the lower Earth orbit is summer 2021. The proposed on-orbit experiment consists of cells monitored with a dedicated absorption spectrophotometer. The cells are sandwiched by resistive heaters to maintain temperature stability. A multiple experimental well array, spectrophotometer, and environmental control assemblies will be stacked to increase sample size and maximize available space in the CubeSat. The findings from this experiment will inform drug responsiveness of the designated cell line under exposure to radiation, and contribute to development of a more accessible and economical approach to manage and potentially find a cure for HIV using emerging aerospace technologies.