ABSTRACT
Engineering and Spaceflight Operations students collaborated to design, build, and fly an experimental scientific research payload to quantify radiation levels at a cruising altitude of 60,000 feet, and studied the effects on in-vitro biological agents all while simultaneously investigating communication pathways utilising an Automatic Dependent Surveillance-Broadcast system (ADS-B) for the future of suborbital spaceflights.

INTRODUCTION
The purpose of the first experiment is to study the position of the aircraft using an ADS-B for subsonic or supersonic flights through triangulation from communication nodes. The goal of the second experiment is to test the effects of radiation using the Timepix on in-vitro T-Cells in a cytokine solution, as well as cells with medicinal plants and extracts.

MISSION OBJECTIVES
• Design and develop a reusable scientific payload rig capable of being operated at high altitudes
• Analyze the radiation dosage and Linear Energy Transfer Spectrum received at stratospheric altitudes as high as 63,600 feet.
• Identify changes in murine cells treated with cytokines, and bombarded with ionizing radiation and secondary particles (protons, electrons, neutrons, Gamma Rays and X-rays).
• Receive ADS-B pings from communication towers to triangulate position, state vector, and intended trajectory information.

RESULTS
• Radiation data information collected over the duration of the flight showed an average dose of 2.877 micro gray per minute, with a maximum dose received of 48 micro gray per minute.
• First observations indicated one third of the vials had been exposed to a temperature shock, these vials had not been placed directly on the silicone heating pads and correlated with our temperature control vials placed outside the labs.
• ADS-B results received from firsthand account of our subject matter expert/pilot indicate that we were receiving steady pings up until the commercially regulated altitude of 50,000 feet, where the instrument was effectively locked out of communications with the system.

LEARNING OUTCOMES
The major learning outcomes of this project were related to the design, fabrication and operation of the payload and the instruments utilized. There was a significant learning curve which had to bridge to understand the intricacies of developing an Environment Control Life Support System (ECLSS) and working with In-Vitro Biological agents. The team gained crucial experience in developing an airworthy payload and working with the mechanical and electrical subsystems.

FUTURE RECOMMENDATIONS
Future changes to the experiment would include a new iteration design for the 6U NanoLabs which allow for better accessibility in placing the components of the ECLSS and the instruments inside. An improvised thermal control system to sustain an optimized temperature range. A key change to the payload would be the cable management for the instruments. Testing of instruments under all circumstances including temporary loss of power, sensor and hardware related faults would also help to plan for contingencies so all the data can be recovered.

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