Overview

The Space Survivability Test Chamber (SST) provides an extensive, versatile, and cost-effective system for pre-launch verification and assessment of small satellites, system components, and spacecraft materials. A UNSGC Faculty Research Infrastructure Grant was awarded for the purpose of making improvements to enhance and extend the capabilities of the SST. Since the SST was brought online in August 2016, several externally funded projects have been completed and collaborative projects with The University of Texas at Austin (JPL) and Logan High School (Utah). Many more projects are forthcoming and the capabilities of the SST continue to be improved and developed for the future.

Space Environment Effects

The harsh space environment can modify materials and cause detrimental effects to satellites. To predict and mitigate these deleterious effects, ideally a full spacecraft would be tested in all applicable space environments [1]. Because this is not practical, the ability to accurately simulate space environment effects through long-duration, well-characterized testing in an accelerated, versatile laboratory environment becomes key.

Simulated Space Environments

The SST chamber simulates several critical characteristics of the space environment: electron flux, ionizing radiation, photon flux, temperature and neutral gas environment. Fig. 3 shows representative electron spectral fluxes for several common environments and the solar UV/Vis/NIR. The energy range of electron, ionizing radiation, and photon sources are shown above these graphs.

SST Space Environmental Effects Projects

Telecommunications Component Viability

High frequency RF antenna dielectric components used on telecommunications satellites were tested in orbital conditions. Electrostatic discharge events induce transient RF radiation were monitored and characterized using both video and current monitoring to identify the frequency, location, and magnitude of discharges. Effect of temperature (-10 °C to 60 °C) on discharge characteristics was tested over a full orbital cycles of several days. Funded by VoSat.

Mission Lifetime Survivability of Space Grade Electronic Components

High performance RF communications cabling underwent accelerated testing simulating the duration of a full multi-year mission. In-Situ penetrability characterization was performed to understand the long-term cumulative effects of radiation on cable properties including frequency response and power loss. Additionally, electrostatic discharge was monitored and characterized using video and current monitoring. This provided understanding of charge accumulation and discharge induced by radiation within the samples. Funded by Times Microwave.

Viability of Plant Growth in Space

Radish seeds flown on the Russian BION-M1 mission were observed by Logan High School students to have faster germination rates than control, ground based radish seeds. Seeds were tested in the SST to test if radiation was the cause of this change in germination rate. A biological test chamber, designed by University of Toledo students, housed the seeds in a controlled atmosphere for safe testing in the SST vacuum. Partial funding through the USEIStars Gear Up Program.

Space Environment Effects on Muscle and Skeletal Cells

In-Vitro tests of muscles cells irradiated in the SST and biological test chamber have been. The effects of radiation on muscle cells will progress in cardiovascular disease and degenerative tissue risks from space radiation. A collaborative follow-on 2017 UNSGC Infrastructure award will support further development of the physiological effects of ionizing radiation.

Projects On The Horizon

Future proposed projects cover a wide array of scientific fields; these include:

- Communications Satellite Component Testing
- Materials Testing: Radiation induced conductivity (RIC) of p•erovskite dielectric materials by total ionizing dose (TID). Funding pending from Sandia National Labs.
- Radiation Damage of Spaceflight Electronic Components
- Testing of New Spacecraft Propulsion Technologies

Acknowledgments and References