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Abstract:
Electrodynamic Dust Shield (EDS) Preparation for MISSE-11 Launch

The dusty surfaces of the Moon, Mars, and various asteroids present a significant challenge to NASA's manned and unmanned space exploration efforts. The fine, electrostatically charged dust is difficult to remove and has resulted in vision obscuration, false instrument readings, contamination, elevated temperatures, performance reduction, and equipment failure. To alleviate these problems, NASA KSC's Electrostatics and Surface Physics Laboratory (ESPL) is developing active dust mitigation systems for solar system exploration and *in situ* resource utilization (ISRU). Part of KSC's Swamp Works system, the lab emphasizes fast-paced, hands-on, cost-effective, and collaborative innovation.

The Electrodynamic Dust Shield (EDS) is an ESPL technology being developed to prevent dust accumulation on space components. It consists of a dielectric substrate embedded with parallel electrodes which, when applied with high voltage out-of-phase waveforms, produce a traveling electric field wave that scatters dust particles from its surface via dielectrophoretic and electrostatic forces. The EDS is currently fully functional and has been tested for scalability and endurance in reduced gravity/pressure flight. Next, it will be part of the May 2019 Materials International Space Station Experiment-11 (MISSE-11) payload, which will test small shield samples for performance durability with exposure to the harsh space environment.

The summer objective was to test EDS functionality before active and passive dust shield samples launch on MISSE-11, in order to screen for good flight/control samples as well as to compare pre-flight and post-flight clearing efficiencies. I imaged glass and Kapton shields of 2-phase and 3-phase electrode configurations with the Keyence VHX-5000 digital microscope to check for damage before and after all testing for a qualitative pre-flight baseline; helped with vacuum testing of high-voltage shield breakdown; assembled shields and wires using Electrobond 004 silver epoxy; and helped with vacuum and cryogenic dust clearance testing of assembled EDS systems. I learned CAD (computer-aided design) and 3D printing skills to create parts for a shaker table/motor assembly, which will allow for repeatable experiments by evening out EDS dust distribution in a consistent manner prior to dust scattering testing. I will also be improving the interfacing with Alpha Space's prototype Data Communications Unit (DCU), a payload component to control power to the EDS and store data, by mapping the DCU structure upon power-up and writing shell scripts to improve various processes. Finally, I also CADed and 3D-printed plastic supports for three different geometries of the Electrostatic Precipitator (ESP), a project that aims to use high voltage electrodes to charge and filter out dust from the Martian atmosphere drawn for ISRU devices.

This work on dust mitigation technologies will help to support future robotic and human space exploration missions, including NASA's Journey to Mars; the EDS has especially significant applications to spacecraft solar panels, thermal radiators, viewports, and astronaut visors. This opportunity has also allowed me to become more familiar with various lab equipment and hardware testing, develop key modeling skills in SolidWorks, explore past and present components critical to America's space program, work with inspiring peers and mentors, and ascertain my dream of working permanently for NASA.