



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Andrew Wang	Project Number S1718
Project Title Dusty Spacesuit Charging and Arcing: Implications for Human Exploration of the Lunar Terminator and Far-Side	
<p style="text-align: center;">Abstract</p> <p>Objectives The Moon is devoid of a global magnetic field and atmosphere and is thus directly exposed to space plasma and solar radiation. Due to the emission of photoelectrons and collection of ions and electrons from the plasma, the lunar surface and any objects on it become electrically charged. Charging combined with the lunar dust environment raises concerns of electrostatic discharge hazards that would imperil astronauts on future lunar exploration missions.</p> <p>Methods In order to investigate charging and discharge behaviors and interactions with the dusty plasma environment, experiments were conducted in a vacuum chamber at USC to simulate lunar surface conditions. A plasma with properties similar to the average solar wind conditions was generated by an electron bombardment gridded ion thruster. The first experiment tested the effects of lunar regolith dust on spacesuit material GoreTex and the second experiment quantified charging dangers on a simulated astronaut arm.</p> <p>Results The results show that while a clean spacesuit would not typically experience electrostatic discharge in plasma, the combination of lunar dust deposition and high voltage charging significantly increases discharge and arcing occurrences, which could lead to spacesuit breakdown, equipment failure, and endangerment of astronauts lives.</p> <p>Conclusions Experimentation and analysis suggest that charging will pose a severe risk to astronauts at the lunar terminator or lunar far-side. This experimentation provides further insight into not only lunar exploration hazards but also other extraterrestrial operations. Under certain conditions, satellite repair to future asteroid mining could also be hindered by the dynamic space plasma charging environment.</p>	
Summary Statement Through laboratory experimentation and further analysis of data, I showed that the dusty plasma charging environment on the lunar surface would be dangerous towards astronauts during future lunar exploration missions.	
Help Received Experimentation was independently conducted using vacuum chamber facilities located at the University of Southern California's Department of Astronautical Engineering.	