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MITIGATING LUNAR DUST ON SPACECRAFT SURFACES USING ELECTROMAGNETIC FIELDS

Abstract

The Wolverine CubeSat Development Team (WCDT) program has been the only middle school nationwide to develop, build, test, and launch a cube satellite (also known as a CubeSat), and numerous other missions are being developed. Aside from satellites, this program is focused on the future of space and lunar exploration as a whole. The goal of the AMARIS Lunar Rover mission is to see how dust on the moon's surface can be repelled to prevent future issues.This repulsion was observed during the Apollo era missions. Brian O'Brien, the principal investigator for the Dust Detector Experiment on several Apollo lunar landing missions, stated that lunar dust is the number one environmental problem on the moon and can cause unexpected difficulties and hazards. When melted soil freezes again, almost instantaneously, it now becomes razor sharp and extremely fine. These glassy fragments are called agglutinates, believed to have toxic properties. In an environment without oxygen and humidity, but exposed to large amounts of radiation, scientists believe that effects caused by lunar dust toxicity may possibly be significantly greater than what is currently expected based on simulants made from Earth materials. Not only does lunar dust pose threats to the health of astronauts because of its toxicity and its ability to become a major respiratory irritant, the dust has been proven to repeatedly cause hardware failures, according to NASA. Energetically charged particles charge regolith on the moon's surface by ejecting secondary electrons from atoms, forming positively charged regions, thus it could be possible to use electric and magnetic fields to repel the dust. In 2019-2020, student researchers tested this theory by attempting to create a magnetic field using magnets, and an electric field using Indium Tin Oxide (ITO) plates. Due to difficulty ionizing the simulated dust, student researchers were unable to repel the simulated dust. This experiment is a continuation of a previous experiment: "Lunar Dust Mitigation on Spacecraft in Low Gravity Free-fall Environment". In contrast to the previous experiment, this experiment will focus solely on the electric field, due to difficulties with the lunar simulant. A Van de Graaff generator will also be used to ionize the dust - while ITO plates will be used to repel it. With success, this procedure could have real world applications on a variety of spacecraft surfaces to reduce damage and increase efficiency.The knowledge gained from this experiment will be used in designing a team lunar rover in the near future, which will utilize CubeSat technology. Overall, this proposal uses electromagnetic and vacuum theories as a framework and seeks to further advance student understanding of the lunar environment.