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Moon Exploration – Part 1 (2A)

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AMARIS: MITIGATING DUST ACCUMULATION USING ELECTROSTATIC FORCES AND A LITHIUM ION NANOFOIL SHIELD WITH APPLICATIONS TO LUNAR MISSIONS

Abstract

The Wolverine CubeSat Development Team is internationally recognized for creative excellence in aerospace, biotechnology, engineering, and entrepreneurship. It began in August 2015 with the goal of launching a CubeSat into space. The team has since launched numerous high altitude BalloonSats, WeissSat-1, and are developing their second CubeSat, CapSat-1. Additionally, students and alumni have begun developing the AMARIS lunar rover, demonstrating the importance of engaging students in space-based scientific research within the academic pipeline while utilizing commercial off-the-shelf and CubeSat technology.

According to Apollo 17 astronaut Gene Cernan, “Dust is probably one of our greatest inhibitors to a nominal operation on the moon.” Bombardment of micrometeoroids form glassy fragments called agglutinates, which cause hardware failures and are toxic to astronauts. There is still no effective method of protecting against this abrasive and adhesive dust. Energetic charged particles charge the surface regolith by ejecting secondary electrons from atoms, thus forming positively charged regions. Forces of attraction between these dust particles are mainly horizontal, while the repulsive forces are mainly vertical, creating a dust cloud from the rise of particles. The team proposes that ionizing particles have the ability to also charge surfaces comprised of atoms with low ionization energy. The AMARIS mission will evaluate the potential to repel dust using an ultra thin lithium nanofoil coating positively charged through ionization for use on instruments and suits.

AMARIS' landing site will be Lacus Mortis. The regolith depth is expected to be one to two inches, and slopes on the surface will be less than 12 with rocks a maximum height of 0.35m. AMARIS will be 1U until deployed from Astrobotic's Peregrine Lander onto the lunar surface using a Nitinol hinge, forming a 2U footprint. Its batteries will be fully charged by Peregrine-provided power, and necessary system diagnostic checks will be performed by BLUECUBE to verify internal power sources and wireless communication. Once deployed, AMARIS will transition to surface mode, and Peregrine-provided power and wired communication will be discontinued. The rover will traverse through remote operation approximately 100m from the landing site and transmit experimental data through the lander and back to Earth using a USB port. Total mission life will be eight Earth days. In March 2019, students conducted a Preliminary Design Review, and students have since conducted a proof-of-concept experiment of the payload and continue to move forward in the development of AMARIS for launch in 2021.