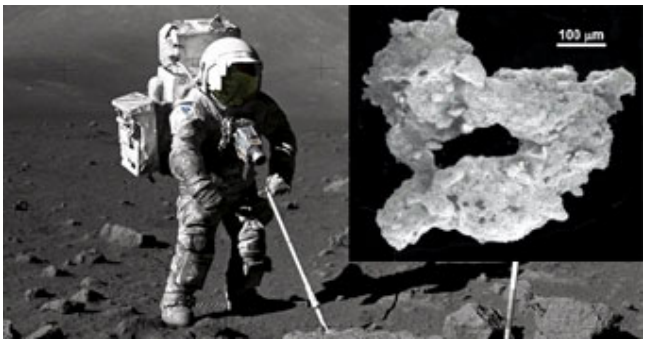
Keep Astronauts and Spacecraft Safe By Filtering Out Lunar Dust



Apollo 17 astronaut Harrison Schmitt collects soil from the moon in 1972 (left). Microscopic view of lunar dust (right)

Name of Technology: Lunar Dust Management Technology for Spacecraft Atmospheres Spacesuits

Participating NASA Centers: Glenn Research Center (lead) and Johnson Space Center, Marshall Spaceflight Center

Technological Area: TA6 – Human Health, Life Support and Habitation Systems

Vision for the Technology: A major inhibitor to operations on the moon is dust. Lunar dust particles are fine in size and very abrasive. They can damage spacecraft equipment and present health hazards to astronauts if inhaled. With regards to spacecraft, NASA is seeking innovation in the areas of particle filtration / separation, barrier techniques, and monitoring instruments. With regards to spacesuits, NASA is seeking innovation for covers, that will be capable of preventing intrusion of dust into Life Support Systems.

Challenges: In spacecraft NASA requires filtration that is compact, low power, with high flow rates. The current state of the art is HEPA filters. There are currently no airborne particle sensors for pressurized and low gravity environments. Also, there are no particle sensors that can distinguish between lunar dust and generic cabin dust.

Overview of Student Project: NASA seeks innovative ideas from students that focus on Innovations related to ONE of the following areas: Filtration for Spacecraft, or Dust Monitoring Sensors, or Filtration for Spacesuits.

Ultimately, NASA Seeks to Achieve the Following Specs in the Following Areas:

Filtration and Particle Separation for Spacecraft

- Flow rates of 11.3m^3/minute and minimized pressure drop, typically <125 Pa
- Permissible levels of suspended particulate matter to be maintained at <3mg/m^3
- Filtration performance sought is 99.97% collection efficiency for particles greater than .3 micron in diameter and larger.

Barrier Techniques

- Systems designed to collect and remove dust from airlocks that provide a >99.5% effective barrier

Monitoring Instruments

- Instruments that measure particle sizes in real time and require low power and minimal maintenance and be capable of functioning in microgravity and reduced pressure environments (26.2 kPA < pressure 103 kPA)

Vented / Non-Vented Portable Life Support Systems (PLSS)

- There are several spacesuit components that require access to the environment for gas flow. The components require special covers that prevent dust and intrusion and allow for sufficient gas flow.
- Covers are needed for PLSS Shell Vent Ports, PLSS Rapid Cycle Amine System Vent Quick Disconnect, Suit Purge Valves, Positive and Negative Pressure Relief Valves, Battery Charge Connector, and Spacesuit Common Connector

2020 SBIR / STTR Solicitation on this Topic:
H3.03 Lunar Dust Management Technology for Spacecraft Atmospheres and Spacesuits

Research Funded by NASA on this Topic:

Proposal Number - **18-1- H1.01-1095**
Gas Inlet Sensor for Measuring Dust Particle Size Distribution and Concentration

Proposal Number - **16-1 - H4.01-7953**
Dust Tolerant, High Pressure Oxygen Quick Disconnect for Advanced Spacesuit and Airlock Applications

Proposal Number - **15-1 H3.03-8782**
Multifunctional Dust Filters for Crew Cabin Air Purification

Proposal Number - **14-1 H1.01-9274**
Dust Separation and Measurement System for Mars ISRU Applications

References:

Lunar Sourcebook, edited by Grant H. Heiken, David T. Vaniman, Bevan M. French, 1991, Cambridge University Press

Agui, Juan, R. Vijayakumar, and Jay Perry. "Particulate Filtration Design Considerations for Crewed Spacecraft Life Support Systems." 46th International Conference on Environmental Systems, 2016.

Apollo 17 Technical Crew Debrief, Page 20-12, NASA Manned Spacecraft Center, January 4, 1973, MSC-07631