Unique NASA Science Lab Tackles 'Sticky' Issue of Lunar Dust

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In the safety-conscious, science-driven business of aerospace research, where laboratories routinely are set up as "clean rooms," in which sterility is paramount, Dr. Mian Abbas' lab is something of an anomaly. The word "dust" is even in its name.

Not that the "Dusty Plasma Lab," part of the National Space Science and Technology Center in Huntsville, Ala., is any less well maintained than any other professional research facility. The dust found here is unique for another reason. It comes from Earth's Moon.

That dust -- currently a single vial's worth, barely a teaspoon full -- is the focus of a vital study to help NASA send explorers back to the Moon in coming decades. Since April, Abbas, a space scientist at NASA's Marshall Space Flight Center in Huntsville, has been using a volleyball-sized vacuum chamber in the Dusty Plasma Lab to simulate the Moon's airless environment. With his partners, Marshall Center astrophysicist Dr. Paul Craven and Dragana Tankosic, a doctoral student in physics at the University of Alabama in Huntsville, Abbas is suspending grains of lunar dust, one at a time, in a vacuum in the chamber.

The team bombards each grain -- part of a sample scooped up in 1972 by astronauts during the Apollo 17 Moon mission -- with ultraviolet radiation. This gives each particle an electrostatic charge, similar to the charge a person acquires when walking across a heavy carpet in wool socks. Abbas and his partners study how dust grains in the lunar environment charge and discharge, shedding their electrostatic charge

the way touching a metal door in a carpeted room can give a person a brief, tingling shock.

The goal for Abbas and his team is to log the physical characteristics and behavior of dust grains ranging in size from 2 microns to 20 microns -- the particle sizes most likely to cause problems during long-term Moon missions. How big is 20 microns? Look at the period at the end of this sentence -- it's just shy of 400 microns in diameter.

"Working with such tiny particles is a test of patience," Abbas acknowledges, smiling. "But we have much to learn about the properties and behavior of lunar dust if we hope to conduct long-term or even permanent science-oriented operations on the Moon."

That powdery dust, the by-product of fearsome meteor storms that pounded the Moon for eons, coats much of the lunar surface. A build-up of this dust could damage or destroy sensitive machinery and mechanical equipment without proper protection. As the Apollo astronauts discovered, lunar dust clings to everything, from gloves and boots to vehicles.

Scientists theorize that lunar dust must be electrostatically charged by incidents of high ultraviolet solar radiation and by the solar wind -- charged particles constantly flowing from the Sun. When ultraviolet radiation hits the Moon's "day side," the half that perpetually faces the Sun, it knocks electrons out of atoms in the lunar soil. This creates a positive charge in countless dust specks, which repel one another the way identically charged magnets react in close proximity. Charged dust, scientists theorize, is pushed upward, often rising hundreds of feet in a phenomenon dubbed "fountaining." The particles then discharge, sink to the surface and the cycle repeats. On the Moon's night side, the solar wind has the same effect, but instead of positively charging atoms, it creates negatively charged ones. The dust behaves identically there,

however, fountaining until the particles discharge and fall back.

To date, no lunar landing mission has stayed on the surface long enough for the dust to pose a real concern. "But for future long-duration missions, we obviously need to pursue dust abatement and mitigation strategies," Abbas said. "We need to ensure sensitive equipment, vehicles and spacesuits are protected."

There's more at risk than machinery. Earlier this year, astrobiologists at NASA's Ames Research Center in Moffett Field, Calif., conducted laboratory studies that suggest lunar dust could pose human health threats. The dust motes aren't poisonous, but unlike dust on Earth, buffed by atmospheric friction and interaction with the elements, lunar dust remains coarse and jagged. If inhaled -- when astronauts track the dust back into their pressurized landers or flight vehicles -- particles can embed themselves in the lungs like burrs, and cannot be easily expelled. The potential result? Long-term ailments similar to silicosis, a respiratory illness typically contracted by stonecutters and others exposed to ground-up or blasted rock.

Lunar dust research is expected to continue into 2007 and beyond, Abbas said, noting that the work is vital to overcoming problems associated with lunar dust -- a critical step in realizing the Vision for Space Exploration, NASA's mission to return human explorers to the Moon and enable human exploration of the Solar System.

"We are making unprecedented observations and developing mathematical models for the behavior of these dust particles," he says. "Not only will this research enable NASA to learn to efficiently remove accumulated dust, but in time it could lead to advances such as dust-repellent clothing, hardware and building materials."

Advances, no doubt, that will leave those pesky lunar particles in the

dust.

Source: NASA