MOON DUST PARTICULATE MATTER ANALYZER.

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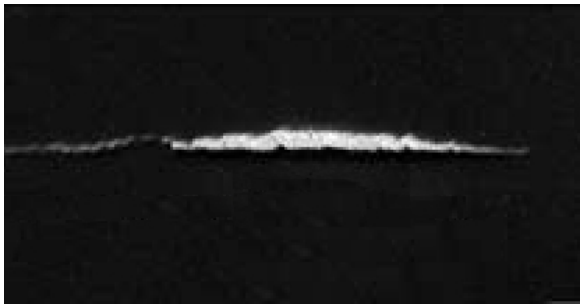

Figure 1. Surveyor 7 image of lunar horizon glow. Positively charged dust particles (5-10 μm) may hop 3 to 30 cm over to the night side terminator, where photoelectrons accumulate.

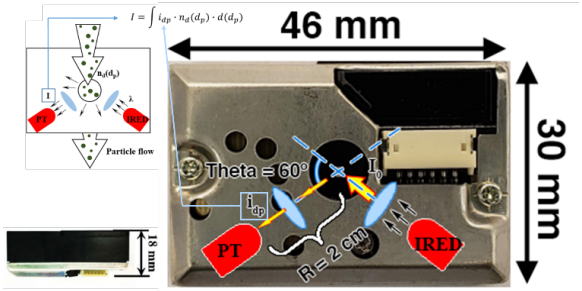

Figure 3. The particulate matter sensor based device uses principles of optical scattering. It consists of a near-Infrared (940nm) LED light source (IRED), and a scattering photo-intensity detector (PT). As particles move through the optical view volume—hole through the center of the body—either falling or lofted (Fig. 4), the scattered intensity is measured. A robust inversion algorithm based on Mie scattering converts the scattering intensity into particulate concentration and particle size distributions.

Dust is a major risk management factor for lunar exploration. Knowledge of exospheric dust lifetimes, particle size, charge, and cloud density is critical to develop methodologies and tools to manage and mitigate dust movement and transient environments caused by natural (e.g., impacts and electrostatic levitation, Fig. 1) and human activity (e.g., rocket exhaust, roving (Fig. 2), and mining). The Moon dust particulate matter analyzer (Figs. 3 & 4) is a low mass, power, and cost method for characterizing dust.

Moon dust particulate matter analyzer will:

1. Acquire measurements of particle size distributions, charge, composition, trajectories, and velocities.
2. Estimate dust cloud density and height.
3. Be suitable for small- to Artemis-class landers and robotic/crewed rovers.
4. Yield a network of distributed data critical for comprehending the regional and/or global dust transport.
5. Characterize the lunar exosphere's current state and provide data for predicting its future state.

Exosphere-bound surfaces that exhibit dust mobilization, lofting, and transport of particulate matter (aerosol, dust) are common in our Solar System. Hence. what we learn from examining the Moon's exosphere can also be applied to optimizing the risk management of expeditions to these other nearly airless places.

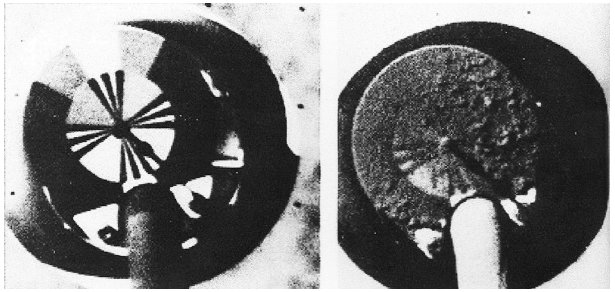

Figure 2. Before-and-after images of a calibration target mounted on the end of Surveyor VI omnidirectional antenna B. Dust was kicked up during a post-landing hop. The after image shows a coherent mass of lunar soil adhering to the vertical surface of the calibration target.

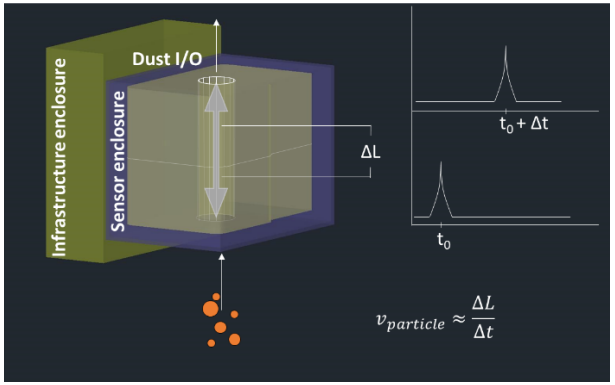

Figure 4. Two sequential sensors will be assembled to get a time of flight measurement in addition to the scattering signal. From the time of flight measurement and known spacing, we will estimate the particle velocity and use it in determining the concentration and size distribution. Multiple instrument orientations will resolve particle trajectories.