Investigate the dynamics of dust particles under the airless bodies' conditions to study the lunar horizon glow. M. E. Abdelaal[1], I. A. Shashkova[2], A. Y. Poroykov[3], I. A. Kuznetsov[2], G. G. Dolnikov[2], A. A. Kartasheva[2], A. Shekhovtsova[2], A. N. Lyash[2], A. E. Dubov[2] and A. V. Zakharov[2], [1]Moscow Institute of Physics and Technology (Institutskiy Pereulok, 9, Dolgoprudny, Moscow Oblast, 141701, Russia, mohamad.essam@phystech.edu), [2]Space Research Institute of the Russian Academy of Sciences (Profsoyuznaya 84/32, Moscow 117997, Russia, zakharov@iki.rssi.ru).

Introduction: The Moon is one of the most important airless bodies in our solar system since it reflects the Earth's nearest natural plasma climate. Dust grains on the lunar surface are exposed to UV radiation and solar wind plasma, which can cause them to gather electrical charges, allowing them to lift off and travel in the presence of near-surface electric fields.

The moon's "horizontal glow," as seen by Apollo astronauts, is a thin, luminous crescent barely above the lunar surface. This phenomenon is believed to be caused by light scattering lunar dust particles. The new research expands on prior findings, demonstrating that "nearby dust particles can generate unexpectedly huge electrical charges and intense particle-particle repulsive forces," which lift particles of various sizes off the lunar surface.

The experimental setup for employing a vacuum chamber to simulate dusty plasma levitation is defined. To visualize the dust particle trajectory, a stereo system comprising two cameras with a laser as a source of illumination is used. For calculating the particle trajectory in three-dimensional coordinates, image processing approaches and examples of processing outcomes are shown.

Digital Formats:

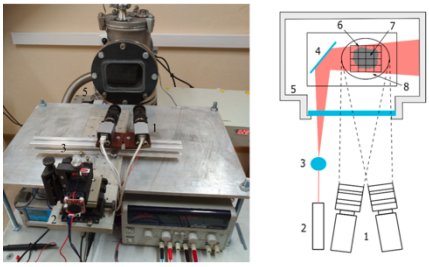

Figure 1. Picture and scheme (top view) of the experimental setup for investigating the dust particles trajectories (1 – CMOS cameras, 2 – laser, 3 – beam expander, 4 – mirror, 5 – vacuum chamber, 6 – steel mesh, 7 – dust particles, 8 – conductive substrate).

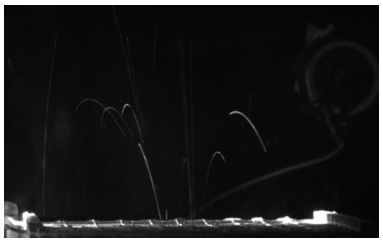

Figure 2. Visualization of the levitation of Mica particles (the thin parabolic lines in the photograph) with noticeable steel mesh and particles on the substrate.

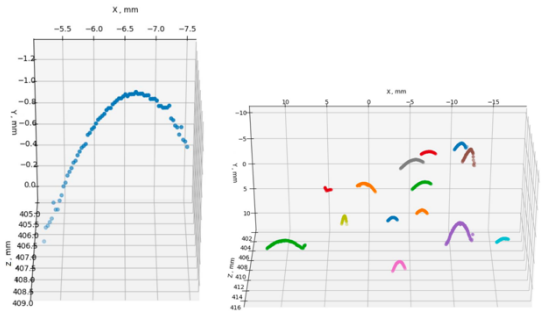

Figure 3. Particle trajectory obtained after the image processing.

Results: The proposed approach and image processing technology not only enable for the visualization and quantification of dust particle levitation properties. These factors are useful in practical tests on modeling dusty plasma levitation, and they improve the chances of future lunar landing missions succeeding.

References:

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