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SPACE EXPLORATION SYMPOSIUM (A3)
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SUNRISE-DRIVEN DUST STORMS ON THE MOON EXPLAIN 50-YEAR-OLD & 2014 LUNAR MYSTERIES: GROUND-TRUTH MEASUREMENTS BY APOLLO 12 DUST DETECTOR EXPERIMENT

Abstract

Activities by Apollo astronauts landing or leaving the Moon and walking on its surface caused movements of fine lunar dust which inescapably blackened white spacesuits and caused many operational problems and failures in hardware. Gene Cernan, last man on the Moon, reported: "We can overcome other physiological or physical or mechanical problems except dust" which adhered "to everything, no matter what kind of material" with a "restrictive, friction-like action". For future expeditions, humans can be trained and hardware tested before launch with simulations for every major environmental problem on the Moon except movements of fine dust in daytime dusty plasmas. Current planning must rely on qualitative knowledge from 12 Apollo astronauts and quantitative knowledge from 14 discoveries to date from measurements by four 270g Apollo Dust Detector Experiments we invented in 1966, deployed by Apollo 11, 12, 14 and 15. Here we show 2015 discoveries from Apollo 12 Dust Detector of dust storms after the first few sunrises and explain them with our measurement-based 5-step model of naturally-occurring transport of dust. Rocket exhausts free particles from cohesive forces of other particles, then sunrise causes photoelectric effects which positively-charge dust particles and surface so that Coulomb forces of repulsion mobilise freed dust, visually like eddying ground mist at dawn on Earth. These discoveries at 100cm height are important operationally and also solve 50-year-old mysteries of levitation of fine dust and Horizon Glow, major objectives of lunar orbiter LADEE in 2014 which did not measure fine dust predicted for altitudes of 2.5 to 250km. Our model also explains how lunar surfaces are made smooth despite craters caused by meteorites, and predicts that naturally-occurring processes will mitigate over about a year impacts of human and robotic mining on the lunar surface. Further, the sunrise discoveries are consistent with causing January 2014 immobilisation of the first lunar rover for 40 years, Chang'e-3 Yutu. In 2016, seemingly supporting this suggestion, scientific priorities for Chang'e-4 lunar rover in 2018 were changed to be the first of some 20 lunar-landed spacecraft with top priority of studying lunar surface floating dust. This challenges or breaks the 50-year pre-Apollo management mindset dismissing importance of fine dust. We suggest again that human and robotic lunar expeditions for purposes of staging stations to Mars or large, airless asteroids, a Moon Village and lunar rovers competing for Google LunarX Medals, must give fine lunar dust high priority in risk-management plans.