

ABSTRACT

“Dust on the Moon: from Apollo to Chang’e-4”

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Official policies and actions about dust on the Moon for the successful Apollo program of landing 12 astronauts on the Moon, as summarised by us at DEP-10, were in stark contrast to those articulated for the Chang’e-4 lunar Rover planned for 2018 as the next methodical step towards landing humans on the Moon in 2025-30. Here we track how this contrast developed over the past three years, with continuity coming from the sequence of our measurement-based discoveries with the minimalist Apollo 12 Dust Detector Experiment, the only one of four DDEs with a vertical solar cell facing East, as in our invention in 1966. In 2015, the sophisticated dust detector on the LADEE lunar orbiter did not measure the fine dust at altitudes between about 3 km and 250 km predicted from Apollo. Nor did LADEE measure the levitated fine dust long believed to cause the sunset Horizon Glow photographed by Surveyors. In December 2015 we published and explained with a simple model the discovery of dust storms after the first two sunrises over the Apollo 12 landing area. These are also the first measurements of dust levitated to 100cm above the lunar surface and the cause of brightening of the dawn horizon. We published our suggestion that such dust storms may have caused the Chang’e-3 lunar rover Yutu to become immobilised on and since its second lunar day, even though the electronics continued operating for the next two years. In May 2016 the announcement was made that the scientific priorities of Chang’e-4 lunar rover, scheduled for 2018, had been revised because of information provided by Chang’e-3. We congratulate the Chang’e scientists and engineers for making their next mission the long overdue first spacecraft to give priority to measurements of lunar surface floating dust. We recommend that these latest developments justify an increased priority for dust measurements and mitigation in international developments of concepts such as a Village on the Moon and competitions for the Google lunar X prize. We have also drawn attention to the combined roles of (i) Sunrise driven dust storms and (ii) the long forgotten discovery by Tommy Gold of cohesive forces of lunar dust, in making lunar surfaces smooth despite pockmarked by craters. This combination also serves the important promise of mitigation by natural causes of dust contamination from mining and local resources utilisation on the Moon.