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MOVIDA, A MICROBALANCE SYSTEM TO DETECT VOLATILES AND MONITOR CHARGING PROCESSES OF LUNAR DUST

Abstract

In the context of the NASA-led Artemis and the ESA lunar programs, in recent years the world's space agencies and several private companies are planning to return to the Moon. The Moon is a privileged location for space observations and investigation of fundamental questions related to the origin and evolution of our Solar System. Nevertheless, the Lunar environment can compromise instrument performance and cause important issues for human crews: it is thus extremely important to study and characterize it in terms of physical properties, granulometry and electric charge. The Moon surface is exposed to solar radiation as well as to solar wind, charged particles, galactic cosmic rays and high-speed micrometeorites, leading to different processes of dust charging [1]. The interaction of the lunar surface with UV radiation and plasma results in the emission and re-absorption of photoelectrons and/or secondary electrons at the walls of microcavities formed between neighboring dust particles below the surface, resulting in unexpectedly large negative charges and strong particle repulsion forces sufficient to mobilize and lift off dust particles [1, 2]. In this framework, we propose MOVIDA (Moon Volatile Investigator and Dust Analyser), an innovative instrument based on PCMs (Piezoelectric Crystal Microbalances) whose main scientific objectives are: 1) measure properties of lunar dust and processes of charging and levitation; 2) identify potential resources, which might be exploited in future exploration missions, such as water or organic-rich materials. MOVIDA is composed by two units: 1) based on quartz crystals equipped with built-in heaters and Resistance Temperature Detectors (RTDs), to measure volatiles and dust abundance; 2) DEC (Dust Electrostatic Collector), based on quartz crystals equipped with a capacitor to determine the properties of the lunar levitating dust. The instrument is under development by an Italian Consor-

tium composed by INAF-IAPS, Politecnico di Milano and CNR-IIA and led by INAF-IAPS, which has a strong heritage concerning PCM-based instrumentation. MOVIDA concept derives from the heritage of VISTA (Volatile In Situ Thermogravimeter Analyser), developed for ESA Hera mission (TRL 8), while DEC concept is under validation . MOVIDA has been chosen as a potential payload of interest for two ESA AOs: "Announcement of Opportunity for Lunar Payloads Delivery Service" (2018) and "Reserve Pool of science activities for the moon: a SciSpacE Announcement of opportunity" (2022). References [1] X. Wang and al., Geophysical Research Letters 43.12, 2016. [2] N. C. Orger and al., Advances in Space Research 63.10, 2019.