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LUMIO: A CUBESAT TO DETECT METEOROID IMPACTS ON THE LUNAR FARSIDE

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ABSTRACT

A large number of meteoroids and micrometeoroids enter the Earth–Moon system continuously, constituting a potential threat to our planet. Lunar meteoroid impacts have caused in the past a substantial change in the lunar surface and its properties. With no atmospheric shield, the Moon is subject to a large number of impacts from meteoroids, typically ranging from a few tens of grams to a few kilograms every day. The high impact rate on the lunar surface has important implications for future human and robotic assets that will inhabit the Moon for significant periods of time. Therefore, a better understanding of the meteoroid population in the cislunar environment is required for future exploration of the Moon. Moreover, refining current meteoroid models is of paramount importance for many applications, including planetary science investigations. For instance, since meteoroids may travel dispersed along the orbit of their parent body, understanding meteoroids and associated phenomena can be valuable for the study of asteroids and comets themselves, and their dynamical paths. Studying meteoroid impacts can help deepening the understanding of the spatial distribution of near-Earth objects in the Solar System. The study of dust particles is also relevant to the topic of space weather. The ability to predict impacts is therefore critical to many applications, both related to engineering aspects of space exploration, and to more scientific investigations regarding evolutional processes in the Solar System. Also, accurate impact flux models would be crucial to support planetary defense actions, as large meteoroids can cause severe damage to our communities.

In this context, the Lunar Meteoroid Impacts Observer (LUMIO) is a CubeSat mission to observe, quantify, and characterise lunar meteoroid impacts, by detecting their impact flashes on the far-side of the Moon. This complements the information available from Earth-based observatories, which are bounded to the lunar near-side, with the goal of synthesising a global recognition of the lunar meteoroid environment. LUMIO envisages a 12U CubeSat form-factor placed in a halo orbit at Earth-Moon L2. The detections are performed using the LUMIO-Cam, an optical instrument capable of detecting light flashes in the visible spectrum (450-950 nm). LUMIO is one of the two winners of ESA's LUCE (Lunar CubeSat for Exploration) SysNova competition, and is currently in Phase B development.
In this work, we present the latest results on the modelling of the meteoroid environment in the Earth-Moon system, including an estimate of LUMIO's potential impact on our existing knowledge of meteoroids, supported by high-fidelity simulation data [1,2]. An overview of the present-day LUMIO CubeSat design is also given, with a focus on the latest developments involving both the ongoing/planned scientific activities and the development of the payload.

References: [1] Merisio et al., 2022, Icarus. [2] Topputo et al., 2022, Icarus.

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Comments: *Oral presentation preferred, will be attending in person*