THE LUMIO CUBESAT: DETECTING METEOROID IMPACTS ON THE LUNAR FARSIDE.

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Introduction: 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 substantial changes in the morphology of the lunar surface and its properties. The Moon has no atmospheric shield, and therefore 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. A better understanding of the meteoroid population in the cislunar environment is required for future exploration of the Moon. The refinemement of current meteoroid models is of paramount importance for many applications, including planetary science investigations. For instance, understanding meteoroids and associated phenomena is extremely important for the study of asteroids and comets and their dynamical paths, as meteoroids carry valuable information about their parent body and its evolution. 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 in the Earth proximity. 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.

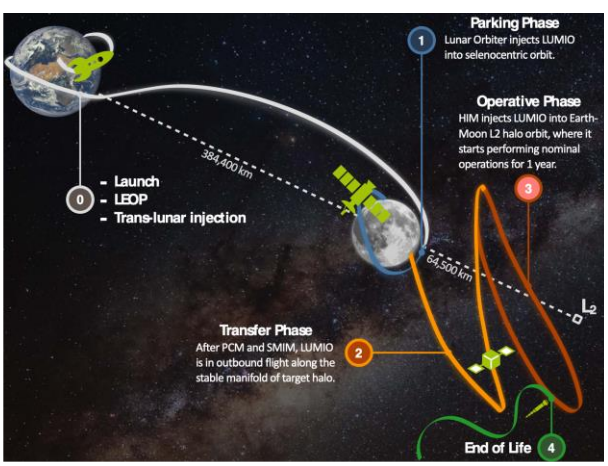

Fig.1: LUMIO Concept of Operations

The LUMIO Mission: 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 farside of the Moon. This complements the information available from Earth-based observatories, which are bounded to the lunar nearside, 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. In particular, we present results of high-fidelity simulations [1,2], which reproduce datasets to be acquired from LUMIO, as well as their scientific post-processing, exploitation, and interpretation.

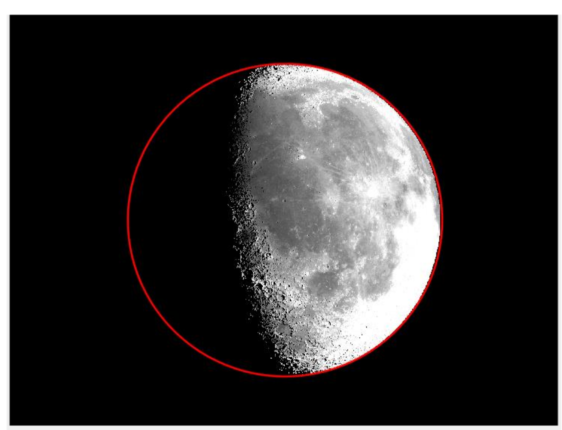

Fig.2: LUMIO-Cam Synthetic Image Generation

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. In this context, we present opportunities to join the LUMIO Scientific Team and collaborate on LUMIO-related topics.

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