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LUMIO: a CubeSat to monitor the lunar farside

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Vast amounts of meteoroids and micrometeoroids continuously enter the Earth–Moon system and consequently become a potential threat. Lunar meteoroid impacts have caused a substantial change in the lunar surface and its properties. The Moon having no atmospheric blanket to protect itself, it is subjected to impacts from meteoroids ranging from a few kilograms to 10's of grams each 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 greater 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. 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. 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 can be also of interest because, together with the solar wind, they determine the space weather. Finally, it is critical to be able to predict impacts by relying on accurate impact flux models. That because the impact of small asteroids with Earth, even slightly larger than meteoroids, can cause severe damage.

In this context, the Lunar Meteoroid Impacts Observer (LUMIO) is a CubeSat mission to observe, quantify, and characterise the meteoroid impacts by detecting their flashes on the lunar far-side. This complements the knowledge gathered by Earth-based observations of the lunar nearside, thus synthesising a global information on the lunar meteoroid environment. LUMIO envisages a 12U CubeSat form-factor placed in a halo orbit at Earth-Moon L2. The mission employs the LUMIO-Cam, an optical instrument capable of detecting light flashes in the visible spectrum. LUMIO is one of the two winner of ESA's LUCE (Lunar CubeSat for Exploration) SysNova competition, and as such it is being considered by ESA for implementation in the near future. The Phase A study has been conducted in 2020 under ESA's General Support Technology Programme (GSTP) and successfully completed at the beginning of 2021, after an independent mission assessment performed by ESA's

CDF team.

In this work, the latest results of the Phase A study of the LUMIO lunar CubeSat will be shown. An overview of the present-day LUMIO CubeSat A design will be given, with a focus on the latest developments. An overview on how LUMIO will impact the currently existing knowledge of meteoroid models will be given supported by high-fidelity simulated data.