DIMORPHOS PLUME PROFILES AFTER DART IMPACT: AN EXPERIMENTAL ANALYSIS

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Introduction: NASA Double Asteroid Redirection Test (DART) mission impacted the surface of Dimorphos, the secondary asteroid of Didymos binary system on 26 September 2022. The Light Italian Cubesat for Imaging of Asteroids (LICIACube) [1], provided by the Italian Space Agency (ASI) was released 15 days before the impact to acquire high-resolution images of its effects. The primary objective of LICIACube was to observe the impact of DART (Double Asteroid Redirection Test [2]) on Dimorphos, the natural satellite of the asteroid 65803 Didymos. The cubesat was equipped with two cameras: LEIA (LICIACube Explorer Imaging for Asteroid), a narrow-field panchromatic camera designed for high-resolution imaging over long distances, and LUKE (LICIACube Unit Key Explorer) [3], a wide-field bayer filter RGB camera for a comprehensive multicolor analysis of the asteroidal environment. Our understanding of Didymos' composition was established as an S-class asteroid using ground observations with best analog meteorites identified in L/LL type ordinary chondrites. Utilizing images captured by LUKE, coupled with experimental work conducted in the laboratory on samples of material compatible with the hypothetical composition of Dimorphos, this work aims to provide further insight to the interpretation of the asteroid composition. In line with the extensive efforts of the LICIACube team on the NASA DART mission, our objectives were twofold. Firstly, we conducted a profile study on the plume generated by the impact of DART with Dimorphos, as captured by LUKE. We then assembled an experimental apparatus for the reflection analysis of materials compatible with the possible composition of the material ejected from Dimorphos. These results will be compared with the plume RGB data to determine the composition of Dimorphos.

Methods: To study the plume profiles, we developed a MATLAB image processing program developed by our team. Our approach started with an initial cropping phase to ensure optimal visibility of the region of interest, followed by the removal of saturated pixels, which are particularly prevalent in long exposure images. We then selected pixel vectors along the plume to perform a thorough analysis of its spectral behavior. Regarding the experimental work, we assembled a system of two goniometers, each equipped with arms for precise adjustment of the incidence and reflection angles on the material under study. A spectrometer was used to accurately measure the reflected light acquired at different phase angles.

We will present the results of the analysis of the plume profiles, showing the different possible explanations for the observed features and the conclusions we have drawn. In addition, the results of the experimental work carried out in the laboratory will be presented, obtaining details of Dimorphos plume composition.

References:

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