



## DART and LICIAcube: Documenting Kinetic Impact

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The NASA Double Asteroid Redirection Test (DART) mission will demonstrate asteroid deflection by a kinetic impactor. DART will impact Dimorphos, the secondary member of the (65803) Didymos system, in late September to early October, 2022 in order to change the binary orbit period. DART will carry a 6U CubeSat called LICIAcube, contributed by the Italian Space Agency, to document the DART impact and to observe the impact ejecta. LICIAcube will be released by DART 10 days prior to Didymos encounter, and LICIAcube will fly by Dimorphos at closest approach distance of about 51 km and with a closest approach time delay of about 167 s after the DART impact. LICIAcube will observe the structure and evolution of the DART impact ejecta plume and will obtain images of the surfaces of both bodies at best ground sampling about 1.4 m per pixel. LICIAcube imaging importantly includes the non-impact hemisphere of the target body, the side not imaged by DART.

The LICIAcube flyby trajectory, notably the closest approach distance and the time delay of closest approach, are designed to optimize the study of ejecta plume evolution without exposing the satellite to impact hazard. LICIAcube imaging will determine the direction of the ejecta plume and the ejection angles, and will further help to determine the ejecta momentum transfer efficiency  $\beta$ . The ejecta plume structure, as it evolves over time, is determined by the amount of ejecta that has reached a given altitude at a given time. The LICIAcube plume images enable characterization of the ejecta mass versus velocity distribution, which is strongly dependent on target properties like strength and porosity and is therefore a powerful diagnostic of the DART impact, complementary to measurements of the DART impact crater by the ESA Hera mission which will arrive at Didymos in 2026. Hera will measure crater radius and crater volume to determine the total volume of ejecta, which together with a ejecta mass-velocity distribution gives a full characterization of the DART impact.

Models of the ejecta plume evolution as imaged by LICIAcube show how LICIAcube images can discriminate between different target physical properties (mainly strength and porosity), thereby allowing inferences of the magnitude of the ejecta momentum. Measured ejecta plume optical depth profiles can distinguish between gravity-controlled and strength-controlled impact cases and help determine target physical properties. LICIAcube ejecta plume images further provide information on the direction of the ejecta momentum as well as the magnitude, requiring full 2-D simulations of the plume images. We will present new simulation model optical depth profiles across the plume at arbitrary positions.

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