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**DUST DYNAMICS SIMULATIONS USING LICIAcube OBSERVATIONS IN
PREPARATION FOR THE HERA MISSION SCIENCE**

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After the successful launch of the ESA/HERA mission [1] on 7 October 2024 it is timely to recall what we have learned from The NASA Double Asteroid Redirection Test (DART) impact [2] and ASI/Light Italian Cubesat for Imaging of Asteroids (LICIAcube) [3] mission. DART was the first space mission that successfully demonstrated the kinetic impactor technique for planetary defense. It was at the same instant, on 26th September 2022, when LICIAcube [3] evidenced the impact and became the first Cubesat to image the plume coming from Dimorphos. Among the scientific objectives of the HERA mission is to determine the physical properties of Dimorphos, including its internal structure and to constrain binary formation scenarios. Here we present how dust dynamics simulations with LICIAcube observations can help constraining the physical properties of the dust in the binary system.

The scientific objectives: The estimation of the size distribution and velocity distribution of the plume in close vicinity to Dimorphos, captured in the LICIACube images is still an unanswered question. We attempt to constrain the particle sizes within the collimated plume structures and address questions such as: what is the effect of motion of the dust clumps with different dust composition of different fragments? What are the optical properties of the dust with different dust composition of different fragments?

The model: We apply the 3D+t model – LIMARDE [4,5] constrained with laboratory observations [6], impact simulations and near- field observations such as the LICIACube [7] images and simulates the long-lived ejecta. The model computes single particle trajectories, the dust rotational frequencies and velocity as well as the particle orientation at any time and distance. We compute the dust velocity distribution based on the physical properties (size, mass and shape) derived from the LICIACube observations. The results are useful to check what is the role of the fragmentation of the particles and to constrain the physical properties based on the dynamical properties of the ejected dust in the near- and mid- environment.

Discussion: The LICIACube observations suggest that we have the locations of accumulation of different particles along the collimated plume streamers. The latter may contain particles of the same density and shape but with different velocity and rotation due to the initial ejected position and form not-linear motion within the collimated filament – like structures. Our LIMARDE simulations with particles of different shapes show that result with different velocities suggest a scenario where the dusty clumps could occur at the same location due to motion of particles with different shapes. We address what is the effect of non-sphericity on the dust deposition distribution of the ejecta plume and the influence of the dust temperature, initial orientation, and initial rotational energy on the ejecta evolution.

References: [1] Michel, P. et al. 2022 PSJ 160 [2] Rivkin, A.S. et al. 2021, PSJ, 2, 24pp; [3] Dotto, E. et al. 2021, PSS 199, [4] Ivanovski et al. 2023, u.rev.; [5] Fahnestock et al. 2022, PSJ; [6] Ormo et al. 2022, *E&PSL* [7] Dotto et al. 2024, Nature

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