Ejecta from the DART-produced active asteroid Dimorphos

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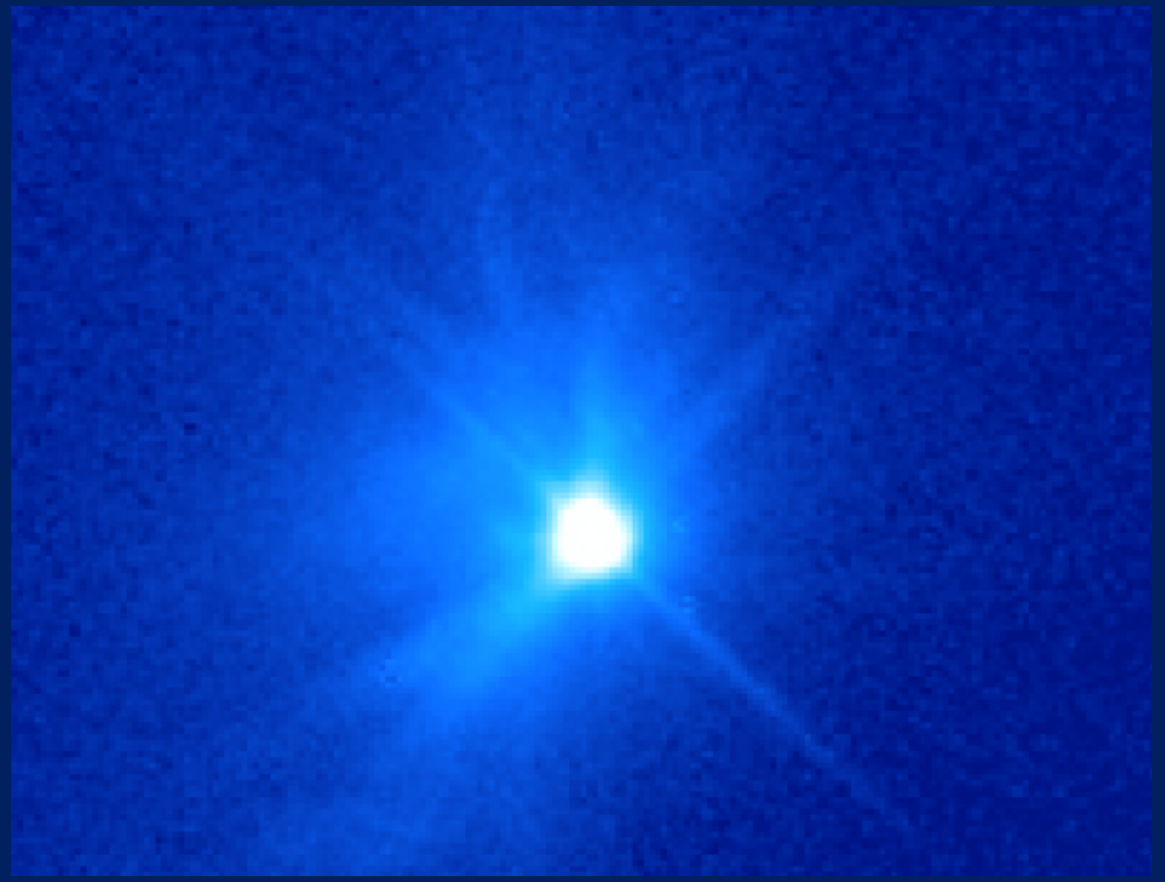

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The researchers from CAB, Jens Ormö and Isabel Herreros, take part in the study led by J.-Y. Li (Planetary Science Institute, Tucson, USA), analyzing the Hubble Space Telescope observations of the ejecta plume (debris) created by the DART impact. The speed and evolution of this ejected material may explain the momentum change caused by the impact.

Some active asteroids have been proposed to be the result of impact events. Because active asteroids are generally discovered serendipitously only after their tail formation, the process of the impact ejecta evolving into a tail has never been directly observed. NASA's Double Asteroid Redirection Test (DART) mission, apart from having successfully changed the orbital period of Dimorphos, demonstrated the activation process of an asteroid from an impact under precisely known impact conditions. Here the observations of the DART impact ejecta with the Hubble Space Telescope (HST) from impact time T+15 minutes to T+18.5 days at spatial resolutions of ~2.1 km per pixel are reported. The observations reveal a complex evolution of ejecta, which is first dominated by the gravitational interaction between the Didymos binary system and the ejected dust and later by solar radiation pressure. The lowest-speed ejecta dispersed via a sustained tail that displayed a consistent morphology with previously observed asteroid tails thought to be produced by impact. The ejecta evolution following DART's controlled impact experiment thus provides a framework for understanding the fundamental mechanisms acting on asteroids disrupted by natural impact.

The research team at CAB conducted several experiments with impact velocities of about 400 meters per second with different target configurations to understand how boulders in the target material (i.e., "rubble-pile") affect the material ejection, the shape of the crater and lowers momentum transfer (i.e. the effective "push" of the asteroid).

These results assisted in the validation of the numerical models used by the DART Investigation Team to predict and interpretate the outcomes of the mission.

J.-Y. LI ET AL., NATURE, 2023; HTTPS://DOI.ORG/10.1038/S41586-023-05811-4