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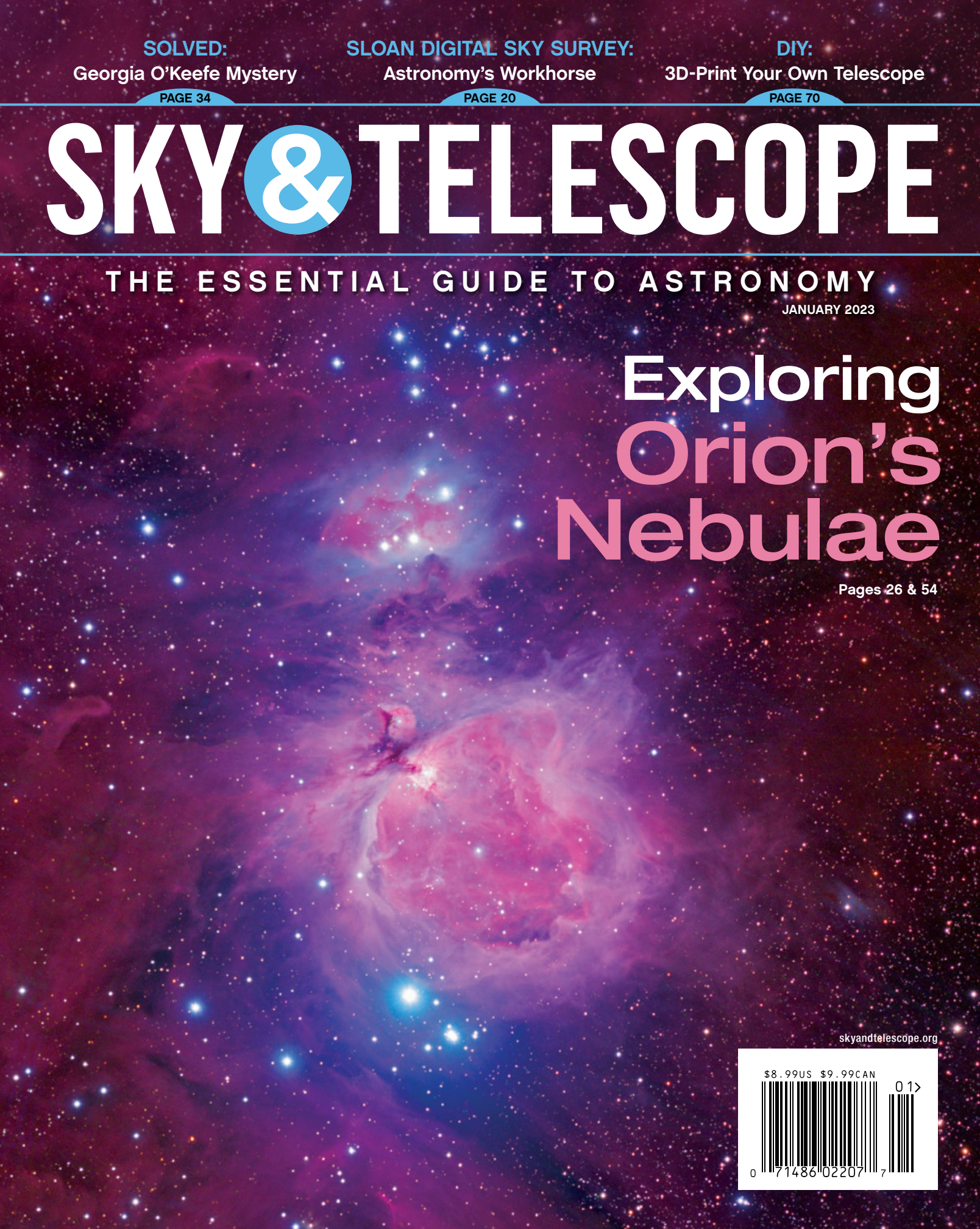

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◀ The ATLAS project captured stills of the DART mission's impact on Dimorphos. (See the animation at **https://is.gd/DARTphotos**.)

SOLAR SYSTEM

NASA's DART Mission Successfully Impacts Asteroid

AS EARTH BARRELS along its orbit around the Sun, it's peppered by impacts from near-Earth objects. While large collisions are rare, the fossil record demonstrates that once in a while, large asteroids have dug out craters, spawned tsunamis, caused climate changes, and wiped out life.

But with enough warning, a small change in an asteroid's orbital velocity could turn a certain future impact into a certain miss. The first test of such a mechanism happened on September 26th, when NASA's Double Asteroid Redirection Test (DART) smashed nearly head-on into Dimorphos, the satellite of asteroid 65803 Didymos. If the crash changes the velocity of Dimorphos' orbit by a detectable amount, the mission will validate the notion that we can use a kinetic impactor to nudge a hazardous asteroid's path, keeping Earth out of harm's way.

DART streamed photos from its Didymos Reconnaissance and Asteroid Camera for Optical navigation (DRACO) down to Earth in real time, about one per second. Fed into an onboard computer with software descended from anti-missile technology, those images helped DART autonomously guide itself to impact. On its approach, it resolved Dimorphos and its larger companion Didymos into worlds with fascinating surfaces covered with gullies and angular blocks. DART initially targeted the binary system, then it differentiated the larger and smaller member of the binary pair, and finally it steered toward the smaller Dimorphos.

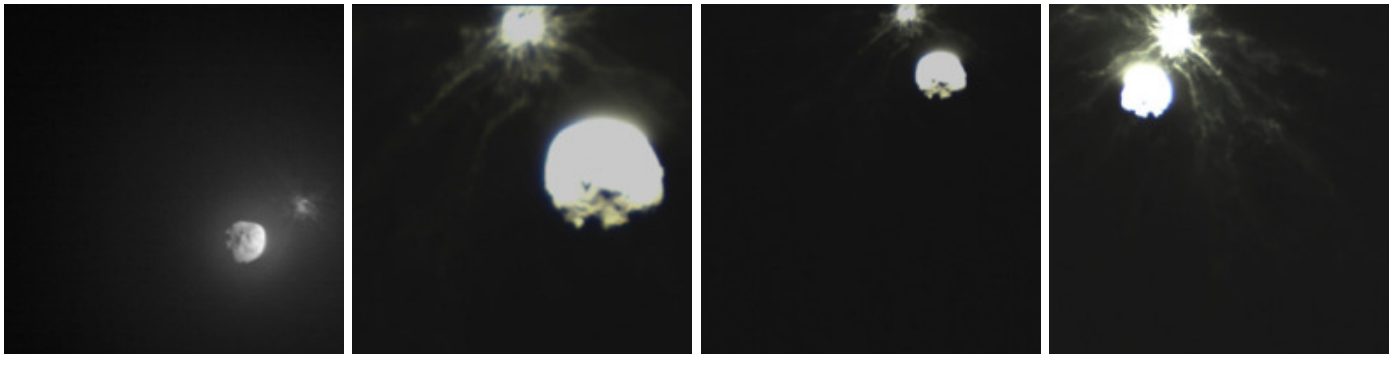
While the DRACO camera feed ended upon impact, the Italian-built minisatellite LICIACube (pronounced "lee-chee-ah kyoob"), separated from DART on September 11th to establish a viewpoint on the carnage. LICIACube used two cameras (the high-resolution, monochrome LEIA and wider-angle, color LUKE) to shoot photos of Dimorphos throughout the approach, impact, and afterward. It passed about 55 kilometers (34 miles) away from the moon 165 seconds after the impact.

Meanwhile, observers throughout space and across Earth watched the immediate and long-term effects of the crash. Other in-space observers include the Lucy spacecraft, currently cruising toward its Jupiter Trojan asteroid mission, as well as the Hubble and James Webb Space Telescopes. Along with Earth-based observers, the telescopes saw the plumes of dust that rose off the surface of Dimorphos in response to the crash. At least two separate plumes were visible: One, crescent-shaped, spread out in the direction opposite the impact, while another, fainter one jetted at an angle behind Didymos' apparent motion across the sky.

The key result from the mission — detecting a significant decrease in Dimorphos' orbital period — will take days to weeks to achieve. Observers across Earth will look for the telltale dimming of the Didymos system's light as the asteroid pair mutually eclipse each other throughout the rest of 2021. The period will need to decrease by at least 70 seconds for the change to be detectable above the uncertainty in the orbit. Didymos is fainter than 14th magnitude, out of reach of typical backyard scopes, so the mission organized no formal amateur observing campaign.

■ EMILY LAKDAWALLA

See more impact follow-up observations at https://is.gd/DARTphotos.



▲ The CubeSat LICIACube separated from DART on Sept. 11th to photograph the impact on Sept. 26th from a safe distance. The spacecraft swung closest to the asteroid 165 seconds after impact (second frame) and captured asymmetric plumes of dust coming from Dimorphos.

DART IMPACT FROM GROUND-BASED TELESCOPE: IMAGES: ATLAS PROJECT (UNIVERSITY OF HAWAII / NASA); IMAGE PROCESSING: EMILY LAKDAWALLA; LICIA CUBESAT PHOTOS OF IMPACT: ASI / NASA (4)