ANSEL ADAMS:
Moons Over the High Sierra
PAGE 26

COSMOLOGY:
The Big Bang Gold Rush
PAGE 34

TEST REPORT:
A Smart Telescope
PAGE 66

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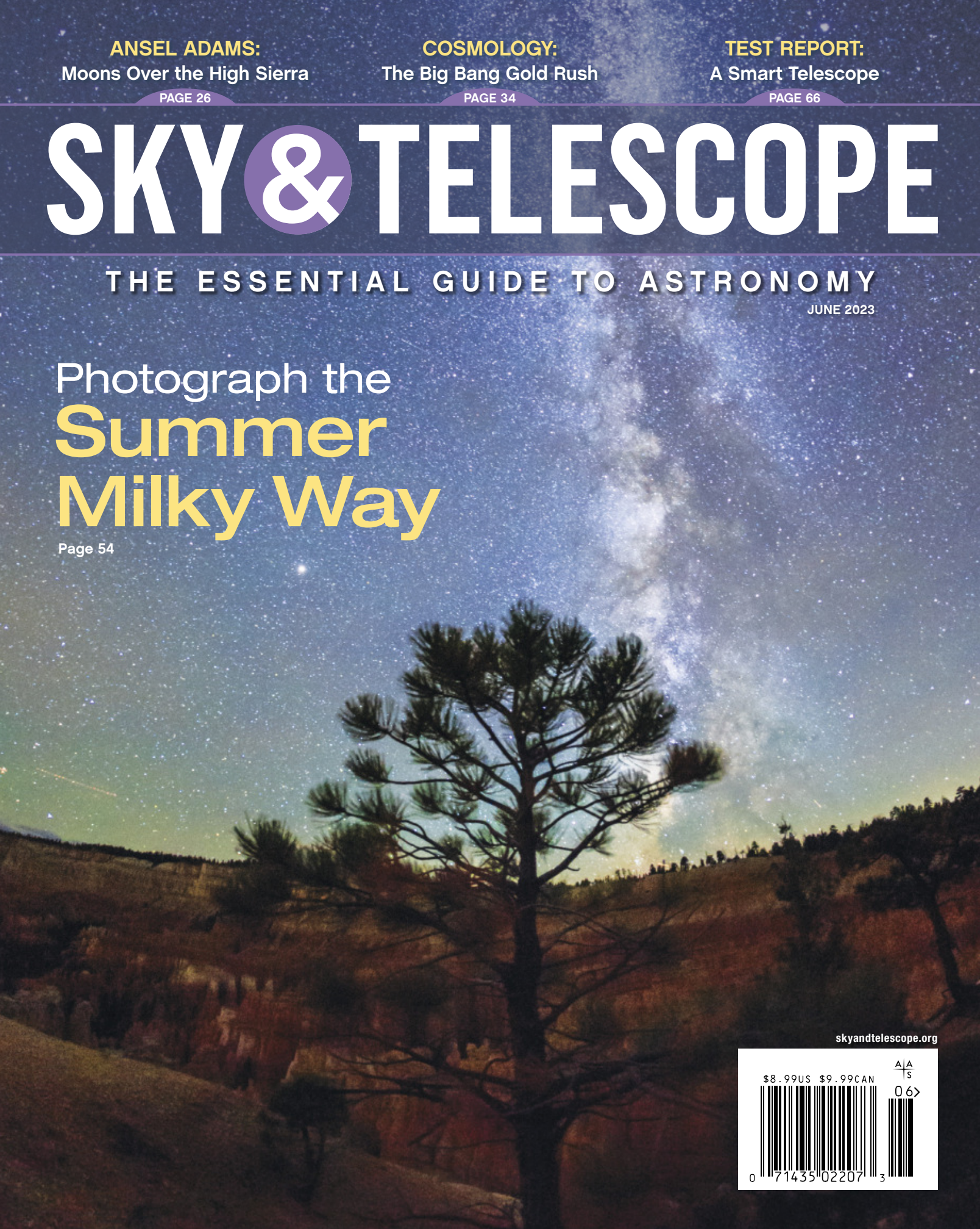
Page 54



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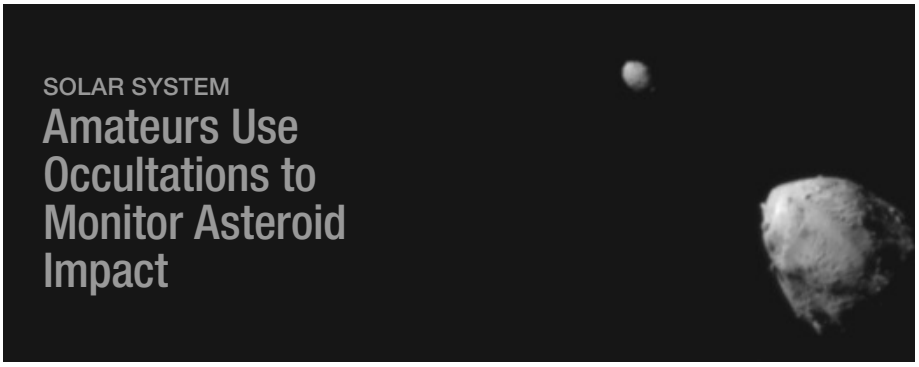

SOLAR SYSTEM

Amateurs Use Occultations to Monitor Asteroid Impact

AMATEUR ASTRONOMERS around the globe have chased down the shadows of the Didymos-Dimorphos asteroid system as it passed in front of, or *occulted*, distant stars, thereby helping scientists evaluate the effects of NASA's Double Asteroid Redirection Test.

The DART mission intentionally ran into Dimorphos, the moon of near-Earth asteroid 65803 Didymos, on September 26, 2022 (*S&T:* Jan. 2023, p. 8). The collision was designed to test planetary-defense strategies by changing the moonlet's orbit.

The DART team has measured the change in Dimorphos' orbit around Didymos using ground- and space-based telescopes. But stellar occultations enable measurements not yet possible by other means.

One of the groups following up on the impact is a French-Greek collaboration known as the Asteroid Collaborative Research via Occultation Systematic Survey (ACROSS), initiated with the support of the European Space Agency (ESA). ACROSS ties together the professional and amateur communities in the hunt for stellar occultations by the Didymos system. While professionals predict when and where to observe, volunteers across continents conduct most of the observations. Every time this asteroid system blocks a background star, observers gather to watch — sometimes traveling hundreds of kilometers to the narrow path of the pair's shadow. Their data help trace the shadow and pin down the asteroids' orbits.

▲ This image, taken from 920 km (570 mi) away, shows the asteroid Didymos (bottom right) and its moonlet, Dimorphos, about 2.5 minutes before the impact of NASA's DART spacecraft.

Calculating the path along which the asteroids' shadow falls can be tricky. Sometimes amateurs see nothing at all. Bad weather and orbital uncertainties plagued early attempts, starting in mid-June last year. Such misses can serve to rework the orbital model.

Soon after the DART impact, Didymos began crossing the Milky Way's galactic plane, which meant it was passing in front of many brighter stars. Observers used mobile stations to successfully record 19 occultations between October 15, 2022, and January 21, 2023, with multiple detections for most of these events. In three of these, observers even detected Dimorphos, which spans only 160 meters (520 feet), making it the smallest object observed during an occultation.

The background stars involved ranged from magnitude 9 to 13.5, visible to telescopes between 4.5 and 14 inches in aperture. In each case, the background star blinked out for less than half a second; observers used high-speed cameras and GPS to accurately time the disappearances.

ACROSS observations have enabled a measurement of the impact's effect on the system's orbit around the Sun, a valuable constraint for ESA's Hera mission, which will rendezvous with the asteroid system in 2026. The team found that the impact changed Didymos' velocity by 1 to 3 meters per day.

As the first occultation season has come to an end, the ACROSS team, led by Paolo Tanga (Observatory of Côte d'Azur, France) and Kleomenis Tsiganis (Aristotle University of Thessaloniki, Greece), is now preparing for the next one, which starts in April 2024.

■ DAMYA SOUAMI

SOLAR SYSTEM

A Dozen More Moons for Jupiter

THE BIGGEST PLANET in the solar system now has the largest family of moons. The International Astronomical Union's Minor Planet Center has published orbits for 12 previously unreported moons of Jupiter, based on observations from Scott Sheppard (Carnegie Institution for Science).

The newest additions bring the list of Jovian moons to 92, a hefty 15% increase from the previous tally of 80. The new finds put Jupiter's lunar family well ahead of Saturn's 83 confirmed moons, at least for now.

All the new moons are small and far out, taking more than 250 days to orbit Jupiter. Nine of the 12 are among the 71 outermost Jovian moons. Jupiter probably captured these moons, as evidenced by their *retrograde* orbits.

Three of the new moons are among 13 others that orbit Jupiter in a *prograde* direction, between the orbits of the large, close-in Galilean moons and the far-out retrograde moons. The new discoveries add to two known prograde groups: Two additions go to the Himalia group between 11 and 12 million km from Jupiter, and one to the more distant Carpo group at 17 million km.

But searches for prograde moons outside these groups turned up nothing. In the yawning gap between the Galilean moons and the Himalia group, there's only one moon, and it's already known: the 9-kilometer Themisto. "We have searched very deeply for objects near Themisto and have found nothing else to date," says Sheppard. He says glare from Jupiter is strong enough to hide anything smaller than 3 km across.

Stay tuned for more, as Sheppard still has observations awaiting approval.

■ JEFF HECHT

DIDYMOS ASTEROID SYSTEM: NASA / JOHNS HOPKINS APL