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SEEKING HAZARDOUS NEAR-EARTH OBJECTS

New cameras put Tucson sky hunters on top again

By Tom Beal Arizona Daily Star Jan 22, 2017 Updated Jan 22, 2017

Photos Courtesy of Catalina Sky Survey

The G96 60-inch telescope on Mt. Lemmon has helped the Catalina Sky Survey regain its lead in near-Earth discoveries.

MORE INFORMATION

Sun setting on solar telescope at Kitt Peak, southwest of Tucson

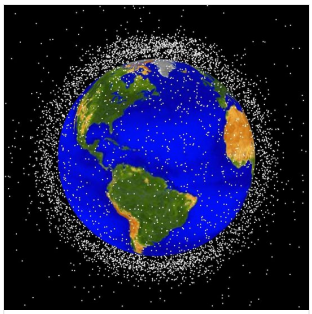
Tucson astronomers, students readying for August's solar eclipse

Asteroid hunters with the Catalina Sky Survey were very excited on a recent Saturday when they discovered an orbiting object that would whiz by Earth two days later.

The discovery generated headlines about a “surprise” asteroid coming very close to Earth at half the distance to the moon, but that was not the exciting part for observers at the sky survey.

The asteroid itself “was a fairly ordinary object making a fairly ordinary close approach,” said Eric Christensen, principal investigator for the survey, which is run by the University of Arizona’s Lunar and Planetary Laboratory.

But it was the first asteroid discovered by a custom-made camera on the survey’s 0.9-meter Schmidt telescope near Mount Bigelow in the Santa Catalina Mountains.



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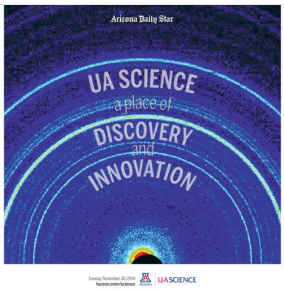

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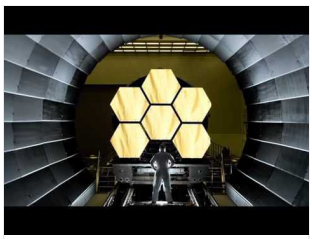

Focus on Optics and Astronomy

A similar camera upgrade on the survey's 1.6-meter telescope atop Mount Lemmon, completed in September, had already tripled the rate at which the telescope finds potentially hazardous near-Earth objects. Catalina Sky Survey has now reclaimed its status as world leader in such discoveries after lagging slightly behind the University of Hawaii's Pan-STARRS Survey for two years.

The new cameras, each with a 111-megapixel CCD chip, were designed by Steve Larson, co-investigator for the sky survey, and built in Tucson.

The optics were designed by Richard Buchroeder and fabricated at the Tucson Optical Research Group. The cameras were made by Spectral Instruments of Tucson, and the other parts were fabricated in the machine shops of the UA's Steward Observatory and the Department of Physics.

The digital camera's CCD chips were manufactured by Semiconductor Technology Associates of San Juan Capistrano, California.

BIGGEST DISCOVERY YEAR

Larson said he knew the cameras would make a difference, but said he was surprised at how well everything worked when the first one was commissioned. "It tripled our average rate of discoveries. It was startling to us that it worked so well."

In addition to upgrading both cameras, the survey has refurbished a third 1-meter telescope on Mount Lemmon that can be operated remotely from a control room at the UA's Lunar and Planetary Lab. It is used for immediate followup of the most interesting objects found each night. It frees more time for the discovery telescopes.

As a result of the upgrade, Catalina Sky Survey discovered 924 near-Earth objects in 2016, its biggest yearly total and the most ever discovered by any survey, said Lindley Johnson, head of NASA's Planetary Defense Coordination Office.

Johnson's office is charged with fulfilling NASA's congressional mandate to find and plot the paths of potentially hazardous near-Earth objects.

NASA has already found 93.5 percent of the estimated population of near-Earth asteroids larger than 1 kilometer in diameter, Johnson told the NASA Small Bodies Assessment Group in Tucson recently.

If an object that large slammed into Earth, it "would have serious consequences on the global climate and the global ecosystem," said Christensen.

It would cause “millions if not billions of fatalities and would set the human race back centuries if not more.”

The one suspected of wiping out the dinosaurs and 75 percent of other species by generating clouds of dust that changed Earth’s climate is estimated to have been about 10 kilometers in diameter.

Christensen said those collisions happen “on the time scale of tens of millions, if not hundreds of millions, of years.”

He views his work as insurance against the improbable.

FINDING LARGE OBJECTS

Johnson’s NASA office is working on the updated congressional task of finding at least 90 percent of near-Earth objects 140 meters or larger.

Those objects could cause significant regional damage, said Christensen, but not long-term global effects.

Christensen said the Catalina Sky Survey will find a bunch of them. Pan-STARRS, meanwhile, is putting a second telescope into operation later this year.

That means more work for folks like Bob McMillan of the Lunar and Planetary Lab, who runs the SpaceWatch program from two dedicated Steward Observatory telescopes atop Kitt Peak, southwest of Tucson.

When McMillan and the late Tom Gehrels started the program in 1980, it, too, was an asteroid-discovery program, but over time it began to concentrate on the follow-up studies needed to plot the objects’ paths and predict if they might be a problem in the future.

It’s critical to follow up interesting objects immediately, McMillan said. Survey telescopes take four 30-second images, 10 minutes apart, allowing astronomers to plot “a tiny arc” of an object’s orbit and determine how fast it is moving.

It takes more observations than that to fully predict its orbit and to have any hope of finding it the next time it comes around years or decades later, he said.

NASA pays McMillan and his crew of six astronomers to follow the “high-priority stuff,” such as potentially hazardous objects, asteroids that could be visited by spacecraft, any that have been identified as a target or already measured by radio telescopes and those that are being continuously studied for the effect of subtle forces on their orbits.

SpaceWatch also has agreements with larger telescopes for “target of opportunity” observations of especially critical targets.

With two fairly large telescopes capable of seeing faint objects, SpaceWatch finds itself in constant demand, McMillan said. “There aren’t many who go as faint as we do as often as we do,” he said.

McMillan and his colleagues are astronomers who specialize in astrometry — the measurement of the position and motion of objects in space. Knowing that the objects exist is one thing, he said. “If you can’t find this stuff again, nothing else matters.”

Finding them, and predicting where they are headed, has become a specialty at the Lunar and Planetary Lab.

SCANNING THE NIGHT SKIES

In the Catalinas, survey astronomers take turns watching the skies each night the clouds and the moon are not interfering with their “seeing.” The survey employs 11 people with a NASA budget of about $1.7 million per year, said Christensen.

The observers watch a bank of computer screens, on which they choose their targets for the evening. Each piece of the night sky visible to the camera — a field that just grew nearly fivefold with the new $500,000 cameras — is imaged four times, 10 minutes apart, to look for things that move in the sky.

The computer weeds out all the known objects — stars, planets, satellites, previously discovered asteroids, the space station.

Operators then have to figure out which of the moving objects are “false positives” and which are candidates for forwarding to the Minor Planet Center at the Smithsonian Astrophysical Observatory, which verifies the genuine targets and issues alerts for followups by professional and amateur astronomers.

The Minor Planet Center also keeps a list of potentially hazardous asteroids and when they will make an approach to Earth that is too close for comfort.

Johnson’s Planetary Defense Coordination Office is responsible for identifying those threats and figuring out what to do about them.

On its webpage, Johnson says “no known NEO currently poses a risk of impact with Earth over the next 100 years.”

But plenty have yet to be found.

At the Tucson meeting earlier this month, Johnson said the pace of discovery is accelerating, with Catalina Sky Survey and Pan-STARRS leading the way. He said 93.5 percent of the largest asteroids (1-kilometer and larger) have been found and half of the asteroids 140-meters in diameter and larger have also been discovered. Proposed space telescopes and larger ground-based surveys will also be enlisted in the hunt.

NASA is also planning two missions, one with the European Space Agency, to test strategies for moving asteroids into different orbits, Johnson said.

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