Astronomer finds multiple ways to get a fix on near-Earth asteroids

March 27 2015

The United Kingdom InfraRed Telescope, located near the summit of Mauna Kea in Hawaii, is just one of several being used by NAU's David Trilling. Credit: University of Arizona

For eons, ancient objects have slipped stealthily past Earth, their anonymity assured in the vastness of space. But now the clumps, chunks and misshapen islands of rock are being observed and measured within hours of their discovery, thanks to ingenuity, technology and the curiosity of David Trilling.

The rapid generation of data from asteroids is just one item in the field of view of the Northern Arizona University astronomer and his close collaborator, post-doctoral researcher Michael Mommert.

Trilling, on sabbatical in South Africa, has recently added three new NASA-funded funded projects to a constellation of research aimed at adding to our body of knowledge about the number and types of asteroids with orbits anywhere near Earth.

Using the Spitzer Space Telescope—one of NASA's Great Observatories and a familiar tool from earlier research—as well as telescopes in Hawaii, Mexico, and South Africa, Trilling and Mommert are chasing down the hidden details of the solar system's most common and least understood objects.

Finding the unexpected

The Spitzer project, with about $400,000 in funding, will target 597 asteroids over 710 hours of telescope time. Observations began in February.

"We're focusing on asteroids that are too faint to be seen any other way," Trilling said. "Spitzer occupies a special niche because it really is the most sensitive telescope." The infrared capabilities of the orbiting Spitzer allow him to measure diameter and albedo (reflectivity), which reveals valuable information about an asteroid's composition.

The findings of this project, when combined with Trilling's previous work and all other asteroid observations, will result in about 15 percent of all near Earth asteroids having been characterized. "That's a pretty big sample when just a few years ago it was much less than 1 percent," Trilling said.

But with the knowledge comes questions.

"Every good science experiment I've ever been in ends up with a question like, 'What are we looking at?' " Trilling said. "You never get the answer you expect. The compositions of these asteroids, especially the smaller ones, are all over the map. But I think that's what's exciting about what we're doing. There's a puzzle there we need to solve."

Doing so will offer a clearer picture of what's out there and whether we should be concerned.

"We want to know how many near Earth asteroids are about 50 meters in size," Trilling said. "That's about the size of the one that made Meteor Crater, so we'd like to know how many are out there and how much risk there is."

Discovery-driven data

Another NASA project that began in February, with more than $160,000 in funding, features a cross-border collaboration using telescopes in Hawaii and Mexico that allows a rapid response—an unusual attribute in the slow-moving world of astronomy.

"What we're observing are asteroids that were very recently discovered and are flying past Earth," Trilling said. "There is only a short amount of time when they are bright enough to be seen by telescopes on Earth."

That time could be a week, or a few days, or even just a few hours.

Trilling explained that when an asteroid is discovered, the information is entered into a database maintained by the International Astronomical Union. A custom software program written by Mommert queries the database for recent discoveries that meet certain criteria—a bright enough asteroid in the right part of the sky—so that Trilling can study them.

"Sometimes we can observe an asteroid the very same night it was discovered," Trilling said.

That's where one element of the collaboration comes into play. Trilling has nightly access to the United Kingdom InfraRed Telescope in Hawaii (of which the University of Arizona is a managing partner) and he doesn't have to be there to use it. Instead, the telescope is operated by astronomers who use a queue system to direct the telescope to prioritized targets: essentially, as requests flow in, they are assigned a place in line. The system allows Trilling up to 150 observations per year.

"We were able to capitalize on that by proposing that every night, or every other night, they spend a little bit of time observing an asteroid," Trilling said. "The person operating the queue can switch from my program to someone else's in the middle of the night, so it works out very well."

The second part of the collaboration involves the National Astronomical Observatory telescope in San Pedro Martir, Baja California, Mexico, mounted with an optical and infrared camera built by an astronomer from Arizona State University. With recently gained access to that telescope, Trilling and Mommert have added 150 more observations to their list.

"The telescope in Mexico is fully robotic," Trilling said. "We just send in our request and a computer does all the scheduling. We'll get an email in the morning that says our asteroid has been observed and includes a web link to our data. It even automatically reprocesses the data to generate a picture. It's just amazing."

Recently, Trilling has added three telescopes in South Africa to the growing list of asteroid-observing facilities. These three also can respond within a day, or even a few hours, to asteroids that are particularly interesting to observe. One of these three is the Southern African Large Telescope: its 11-meter mirror makes it the largest optical telescope in the Southern Hemisphere.

Plug and play

A third project, with nearly $390,000 in funding, involves refurbishing the Mid InfraRed Spectrometer and Imager, then using it on NASA's InfraRed Telescope Facility in Hawaii to measure the diameter and albedo of asteroids with brief observation windows.

Trilling said that at present the infrared camera on this telescope uses liquid helium and is difficult to operate, limiting its use to only three nights every six months. Trilling's collaborators, hardware experts from the Smithsonian Astrophysical Observatory, will convert the camera to an electrical cooling system.

"Basically, you can just plug it into the wall like a refrigerator and it stays cold," Trilling said. "It will stay on the telescope all the time, so in the middle of the night I can get an hour to observe."

The observations, which will include about 750 near earth asteroids that are not being studied through any other telescopes, will take place through February 2019.

Provided by Northern Arizona University