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Bigger Telescopes Seek Killer Asteroids

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An Earth-bound asteroid or comet could still kill us but thanks to powerful telescopes slated for addition to the worldwide detection effort, we may be able to actually see it coming.

In Japan, a telescope at the Bisei Spaceguard Center (BSGC) came online in February. Its mirror is only 20 inches (a half meter) in diameter, but scientists plan to upgrade to a larger 40-inch (1-meter) diameter scope in September. And a couple months ago, the long-running Near-Earth Asteroid (NEA) Tracking project at NASA's Jet Propulsion Laboratory upgraded to a larger telescope that also makes monthly observations three times more often than before.

Also, in terms of sheer mirror width, the Spacewatch asteroid-seeking team at Kitt Peak in Arizona is about to bring down the house. Later this year the team hopes to start using a 6-foot (1.8-meter) telescope, along with a 0.9-meter telescope already in use. The bigger telescope will help scientists search for fainter objects and cover greater areas of sky.

Thanks to those changes, scientists soon will be one scope away from a "magic number" total of six telescopes with mirrors at least 1 meter across in use for detecting asteroids. In 1992, the "Spaceguard Report" recommended that six telescopes with mirrors 2.5 meters across be built to discover within 10 years about 90 percent of large asteroids with orbits approaching Earth. Bisei will bring the total to five.

Efforts were falling quite short of that goal, while movies such as *Deep Impact* and *Armageddon* publicized the threat of "killer" asteroids and comets.

But two years ago, NASA scientist Alan Harris said the 90 percent in 10 years goal could be achieved with six scopes as small as 1 meter across. So now a decent shot at forecasting our demise is on the horizon, though how fast we'll find all those rocks and what we'd do about it both remain unclear.

Busy at Bisei

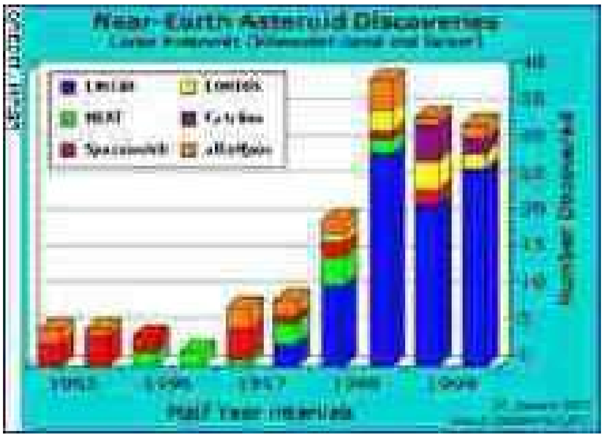
Syuzo Isobe of the Japan Spaceguard Association (JSA) described to *SPACE.com* the $7 million Bisei Center, operated by the JSA and funded by the Japanese Space and Technology Agency (STA).

"It will have two telescopes and six full-time staff," Isobe said. "The running cost this fiscal year is about $600,000. The center also would find space debris that could pose a hazard to Japan's STA's science satellites currently orbiting Earth."

Bisei Spaceguard Center in Japan. Credit: Syuzo Isobe

The Bisei Spaceguard Center's second telescope will have similar capabilities to the Lincoln Near-Earth Asteroid Research (LINEAR) asteroid-detecting telescopes in New Mexico.

LINEAR, which also uses two 1-meter telescopes, is by far the most successful asteroid search program to date. According to NASA, during 1999 LINEAR accounted for more than 70 percent of the discoveries of large asteroids.



Discovery of large asteroids by the major observatories Credit: NASA

LINEAR now faces tougher competition from Bisei, Spacewatch and NEAT (Near Earth Asteroid Tracking), which upgraded from a 1-meter telescope to a 4-foot (1.2-meter) telescope at the Maui Space Surveillance Site in Hawaii. (NEAT temporarily closed during 1999 and this boosted LINEAR's proportion of discoveries).

Japan bonus

The entry of Japan into the search for killer rocks helps geographically, said Don Yeomans, manager of NASA's Near-Earth Asteroid (NEA) program office.

"The entry of the Japanese search effort is a very welcome one for a couple of reasons," Yeomans said. "It will add longitude diversity for the ongoing search efforts so that weather problems in the U.S. Southwest (where most U.S. search programs are based) will not be such a problem.

"Also, a discovery of a near-Earth object (NEO) [from] the [continental] U.S. or in Hawaii could be followed up easily by the Japanese site, which is several hours to the west," he said. "A very close, fast moving object can be quickly lost unless followed up immediately."

Follow-up observations are needed to track an asteroid over several days or weeks. They enable the orbit to be calculated. In 1998 a "potentially hazard asteroid" called 1998 OX-4 was detected by the Spacewatch team, but was lost due to the lack of follow-up observations.

Another benefit of a non-U.S. search team is "political diversity," Yeomans added. "NEOs are an international problem and they require an international solution. The more international partners that are involved, the less the entire effort need depend upon NASA-supported programs."

Project Spaceguard

In his 1973 novel *Rendezvous with Rama*, Arthur C. Clarke describes a fictitious asteroid impact in Europe in 2077. This event forces Earthlings to create a "Spaceguard" system to detect and deflect Earth-threatening asteroids and comets. So far, most scientists and politicians, not to mention the public, have embraced such an approach.

For now, NASA has embraced the recommendations of the Spaceguard Report, named for Clarke's vision, and is aiming to find most of the large rocks.

The report identified asteroids 1 kilometer or larger as the main risk to civilization. The group acknowledged that comets and small asteroids also posed a threat but felt that less priority should be given these objects.

Debate continues over the risk from these other objects but there is general agreement that the large rocks, at least, should be found. For now, there is no international commitment or cooperation to achieve the Spaceguard goal.

Recent downward revisions to the estimated number of large near-Earth asteroids will not make much difference to the required survey effort. The odds of a collision with the Earth might be reduced but the same amount of sky still needs to be searched each month -- there will simply be fewer large asteroids to find because they will be spread more thinly across the sky.

There is an unexpected benefit with a scheme to detect large asteroids. Harris's calculations suggest that an ongoing search using six telescopes will also detect many of the most threatening smaller NEOs because, before hitting us, they are likely to buzz the Earth during several orbits of the sun. Being close to the Earth means they are likely to be picked up by a vigilant Spaceguard program.

International efforts

Spaceguard efforts have had ups and downs in other countries. Jin Zhu runs the Schmidt CCD Asteroid Program (SCAP) asteroid search project at Beijing Observatory in China. He told *SPACE.com* that the time allocated to asteroid detection at the observatory had reduced considerably during 1999.

In Australia Rob McNaught reports that he plans to have the 0.6-meter Uppsala telescope operational early in 2001. McNaught runs the only professional search program in the southern hemisphere and this is regarded as particularly important for follow-up observations.

The project is mostly funded under NASA's NEO Observations Program and is associated with the Catalina Sky Survey in Arizona. Between 1990 and 1996 McNaught was part of the "Spaceguard Australia" team looking for NEOs from the Anglo-Australian Observatory in Australia. That search effort found 30 percent of all new NEOs up to 1996, when the Australian government withdrew funding.

Taking the Search to Space

A couple groups advocate searching for asteroids with space-based telescopes to solve the trouble of astmospheric glare. Want to learn more?

The news from Europe is not good. The OCA-DLR Asteroid Survey (ODAS) asteroid tracking project, located near Nice in France, stopped observing in April 1999 so it could be refurbished. Alain Maury, ODAS' technical project manager, told *SPACE.com* that, following management changes the telescope had closed down. "I am currently looking for a new job," Maury said. "I don't think the Schmidt telescope will reopen anytime soon."

Still, assuming that the latest systems can be configured to detect sufficiently faint objects, only one more dedicated telescope with a diameter of 1 meter or larger would be required to achieve the Spaceguard goal within a decade.

However, given the uncertainties with near-Earth asteroid search programs in recent years, perhaps it would be wise to have a few more telescopes spread around the world. Arthur C. Clarke may prefer to be known as a visionary rather than a prophet of doom.

Major Programs Searching for Near Earth Asteroids and Comets

Name and location	Equipment	Status
Bisei Spaceguard Center (BSGC) http://noewg.mtk.nao.ac.jp/ Okayama, Japan	1-meter telescope & 0.5-meter telescope, both used for detecting NEOs and space debris	0.5-meter telescope commissioned in February 2000. 1-meter should be ready September 2000.
Catalina Sky Survey (CSS) http://www.lpl.arizona.edu/css/ Mt Bigelow, Arizona	0.7-meter telescope, dedicated to NEO work Magnitude 19.2	Pays greater attention to objects high in the northern sky than other surveys. Plans to upgrade a 1.5-meter telescope at Mt. Lemmon.
Lincoln Near-Earth Asteroid Research (LINEAR) http://llwww.mit.edu/LINEAR/ White Sands, New Mexico	1-meter telescope originally developed for tracking satellites. Two are now mainly doing NEO work. Magnitude 19 (maybe 20.5)	Responsible for 70 percent of large near-Earth asteroid discoveries in 1999. Second telescope began in October 1999..
Lowell Observatory Near Earth Object Search (LONEOS) http://www.lowell.edu/users/elgb/loneos_disc.html Flagstaff, Arizona	0.6-meter telescope dedicated to NEO work Magnitude 18.5.	Concentrating on detecting large NEOs.
Near Earth Asteroid Tracking (NEAT) http://huey.jpl.nasa.gov/%7Espravdo/neatintr.html Maui, Hawaii	1.2-meter telescope dedicated to NEO work.	Recently upgraded from a 1-meter GEODSS telescope, magnitude 19.
OCA-DLR Asteroid Survey (ODAS) http://earn.dlr.de/odas/odas.htm Nice, France	0.9-meter telescope	Closed down in April 1999.
Schmidt CCD Asteroid Program (SCAP) http://vega.bac.pku.edu.cn/%7Ezj/scap/scap.html Beijing Astronomical Observatory, China	0.6-meter telescope. NEO work is secondary.	Telescope time reduced during 1999 due to other demands for the telescope.
Southern Hemisphere Survey	0.6-meter Uppsala	Plans for commissioning early

http://www.lpl.arizona.edu/css/csssouth.html Siding Spring, Australia	telescope will be dedicated to NEO work	in 2001. The only professional search in the southern hemisphere.
Spacewatch http://www.lpl.arizona.edu/spacewatch/ Kitt Peak, Arizona	0.9-meter telescope dedicated to NEO work Magnitude 21.5	A 1.8-meter telescope is under construction

Notes:

Magnitude is essentially a measure of the faintness of an object. The higher the magnitude, the fainter the object. Magnitude 21, which is a typical upper limit for the above surveys, is exceedingly faint. Background light such as the Milky Way or moonlight will swamp any objects of this magnitude. A typical 1-kilometer asteroid would have a magnitude of 18 when observed about 100 million miles (160.9 million kilometers) from Earth, in the opposite direction to the sun. Spaceguard scientists need to detect these objects at larger distances and at less favorable angles, where they will appear fainter. Magnitude 20.5 has been suggested as an appropriate limit for reaching the Spaceguard goal of detecting 90 percent of these large asteroids within a decade.

All the above systems use CCD detectors for recording the images. These are similar to the devices used in camcorders to collect light digitally. To eliminate the effects of random bright spots in the images (mostly caused by cosmic rays) the usual procedure is to take between three and five shots of the same portion of sky. Sophisticated computer programs have been developed to scan the resulting images for signs of NEOs.

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