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mission control

Watching for wanderers

Woken from the deep sleep of a hibernated spacecraft, NEOWISE now monitors the population of near-Earth objects for science and Earth protection purposes, explains Principal Investigator **Amy Mainzer**.

Our Solar System brims with asteroids and comets: rocky and icy fragments left over from its formation billions of years ago. These stony travellers mostly stay in their orbital lanes as they circle the Sun in the region between Mars and Jupiter. Others keep to the frozen outer reaches of the Solar System and rarely stray inwards. However, sometimes an object, perturbed by the influence of a planet's gravity or slowly pushed by the very weak force of sunlight falling on its surface, makes its way towards Earth. At this point, it becomes a near-Earth object (NEO): asteroids or comets in Earth's vicinity. Most of the time, NEOs glide harmlessly by, but sometimes they impact the Earth.

The average frequency of NEO impacts is relatively well known on timescales that are short astronomically but rather long compared with a human lifespan. To better determine if a significant impact is likely to occur over the next century, astronomers monitor NEO orbits and survey the skies to discover more. The good news is that about 95% of NEOs capable of having a global effect have already been found. However, only about a quarter of the objects large enough to cause severe regional damage have been found[1,2].

The NEO Observations Program, an element of NASA's Planetary Defense Coordination Office, funds surveys to locate and track more of the NEO population. These surveys consist of 1–2-metre ground-based telescopes using visible light, which discover most of the NEOs being found today. NASA also has a space-based observatory in low-Earth orbit called the near-Earth Object Wide-field Infrared Survey Explorer[3] (NEOWISE, pictured). This telescope uses infrared instead of visible light to detect NEOs, sensing the heat they emit as they are warmed by the Sun.

NEOWISE did not begin its life as an asteroid and comet surveyor. It is carrying out an extended mission beyond its original goals. The spacecraft began life as the Wide-field Infrared Survey Explorer (WISE), led by Principal Investigator Ned Wright of UCLA. WISE's scientific objective was to carry out an all-sky survey at four infrared wavelengths[4]. The WISE primary mission was a success, and its cryogenic system (which kept the two longest wavelength detectors at their operating temperature of approximately 8 K) exceeded its planned lifetime of seven months.

An artist's impression of the NEOWISE spacecraft in Earth orbit, watching for near-Earth objects. Image courtesy of NASA/JPL-Caltech.

WISE proved to be effective at discovering asteroids and comets using its heat-sensing detectors, which allow measurements of objects' diameters and reflectivities (a clue to an object's composition) to be made. During the original mission, more than 158,000 Solar System objects were detected, including hundreds of NEOs.

After the cryogen ran out, NASA provided funding to continue operating WISE for a few months longer to complete a full year using its two shorter-wavelength infrared channels. Although warmer, these channels were still operational because the telescope is well insulated. On 1 February 2011, the mission was put into hibernation, with no specific plans for reuse. However, in 2013 NASA requested the spacecraft be revived to resume the search for NEOs. Renamed NEOWISE, it has been surveying since December of that year[5].

By virtue of the infrared measurements it makes and the fact that it scans the sky perpendicularly to the Earth–Sun line, most of the NEOWISE-discovered NEOs are large and dark. This offers a complementary look at the population detected by the ground-based visible light surveys. NEOWISE has measured sizes and reflectivities of about 25,250 objects, including 664 NEOs, since its 2013 reactivation.

As expected, natural and irreversible changes to NEOWISE's orbit mean that, at some point, earthshine on the telescope will make it impossible to continue observations. Nevertheless, we are learning much about Earth's nearest neighbours from NEOWISE; its measurements set limits on the numbers, sizes and reflectivities of asteroid and comet populations throughout the Solar System. NEOWISE also discovered the first and so far only known Earth Trojan, an object that shares Earth's orbit around the Sun[6]. In addition, NEOWISE has taught us how to discover NEOs in large numbers with an infrared space telescope, paving the way for future investigations.

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