

► the light, which strongly suggested that it came from the first generation of stars.

CR7 also hosts second-generation stars, made from material spat out by dying first-generation stars, which means that it is not the sort of galaxy in which astronomers had imagined that they would make such a discovery. Sobral and his colleagues suggest that the primordial stars may be late developers, formed from a cloud of pristine and uncontaminated gas that was prevented from cooling and coalescing by the heat of strong radiation from earlier-blooming stars. This later formation

date would also explain why the stars were visible to Subaru.

That primordial stars should turn up in a large and evolved galaxy presents a challenge to the group's interpretation of CR7's light signal, but is probably the least exotic of the possible explanations, says Naoki Yoshida, an astrophysicist at the University of Tokyo. One alternative, that the emission comes from a supermassive black hole that formed directly from the collapse of a pristine cloud of gas, would actually be "even more spectacular", adds Sobral.

Until now, many astronomers believed that seeing the first generation of stars would take an instrument such as NASA's James Webb Space Telescope, which is projected to cost nearly US\$9 billion, is scheduled to launch in 2018 and should have the power to look further back in time than any previous instrument. But if Sobral and his colleagues are right, it may be possible to see primordial stars with existing telescopes. Indeed, similar bright galaxies have already been identified as potential candidates, adds Sobral. "We may already be looking at them." ■



An object estimated at 20 metres across exploded over Chelyabinsk, Russia, in 2013.

PLANETARY SCIENCE

Private asteroid hunt lacks cash

Foundation fails to raise funds it needs for a space telescope to catalogue near-Earth objects.

BY TRACI WATSON

Astronomy and science organizations have declared 30 June as Asteroid Day, with plans to talk up the danger of asteroids that might be on a collision course with Earth. One partner in the effort, the Sentinel mission, has an especially urgent need to drum up public support: it is struggling to raise the US\$450 million it needs to launch a space telescope dedicated to finding hundreds of thousands of near-Earth objects.

Astronomers have long sought a spacecraft that would hunt for near-Earth objects

full-time, but public funding for such a programme has never materialized. Ground-based surveys have identified nearly all of the largest asteroids, but many of the space rocks that measure between 50 and a few hundred metres in diameter — big enough to wipe out a city with a direct hit — remain uncharted.

"Without space-based assets, progress is going to stall," says physicist Mark Boslough of Sandia National Laboratories in Albuquerque, New Mexico.

Sentinel, announced in 2012 by the B612 Foundation of Mill Valley, California, was supposed to provide that eye in the sky,

and NASA had hoped that the privately run effort would supplement the agency's own asteroid-hunting programme. NASA is considering funding an alternative mission, the Near-Earth Object Camera (NEOCam), initially proposed to the agency in 2006. But some scientists fear that Sentinel could spoil the chances of NASA supporting NEOCam. If Sentinel cannot fly, "then it's just a distraction from getting a job done that needs to get done," says planetary scientist Timothy Swindle of the University of Arizona in Tucson.

Ground-based surveys have located roughly 90% of the large asteroids that might be a concern — these are all bigger than one kilometre in diameter and pass by Earth's orbit at a distance of 45 million kilometres or less. An impact by one of these behemoths would have global consequences; fortunately, such immense objects plummet to Earth on average only once every 700,000 years or so, and none of those known is heading this way any time soon.

The statistics are less reassuring for smaller objects. As of August 2014, according to data in a recent paper, surveys had spotted only 565 near-Earth asteroids ranging from roughly 45 to 55 metres across — out of an estimated total of up to 520,000 (A. W. Harris and G. D'Abamo *Icarus* 257, 302–312; 2015). An asteroid no larger than that damaged trees across 2,000 square kilometres of Siberian forest in 1908, in what is known as the Tunguska event (see 'Direct hit'). Tunguska-sized bodies strike Earth once every 500 years or so, Boslough says. An object that exploded over Chelyabinsk, Russia, in February 2013 was estimated to have been about 20 metres in diameter.

PLANETARY PROTECTION

Sentinel aims to ensure that a similar fate does not unexpectedly befall a place the size of Lagos or London. Mission director Harold Reitsem, who helped to design instruments on the Hubble Space Telescope, says that Sentinel will use an infrared detector to find 90% of near-Earth objects larger than 140 metres across, and will also spot a good number of objects measuring 30 metres or more. If an asteroid were found to be headed for Earth long enough before impact, authorities could try to knock it off course.

AP PHOTO/AP VIDEO

Or they could plan to evacuate the target area.

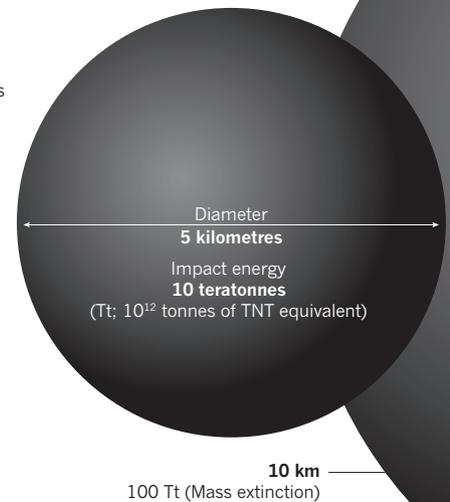
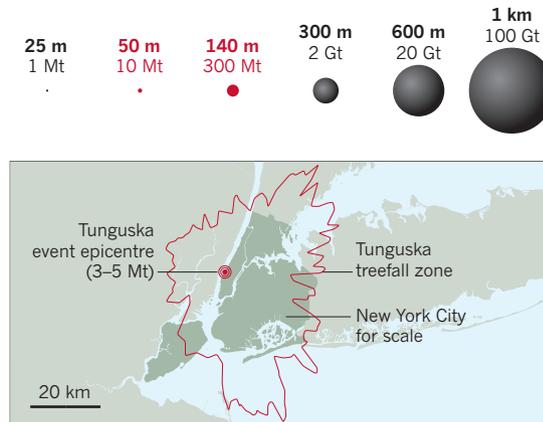
To help Sentinel along, in 2012 NASA signed an agreement with the B612 Foundation to provide analytical support and, once the spacecraft is in orbit, a data downlink. The space agency has an interest in Sentinel's success; it is under orders from Congress to find 90% of all near-Earth objects 140 metres or bigger by 2020. NASA will miss that target whether Sentinel launches or not, but a good space telescope could help to build a catalogue more quickly than ground-based surveys alone, which would need perhaps several decades.

"I don't want anybody to think that B612 is going to save the planet, but they are doing what we need to do," NASA administrator Charles Bolden said in 2013 when Congress pressed him on asteroid-detection efforts.

Yet progress has been slow. The B612 Foundation raised donations of roughly \$1.2 million in 2012 and \$1.6 million in 2013 — far short of its annual goal of \$30 million to \$40 million. NASA says that Sentinel has also missed every development milestone laid out in the 2012 agreement. In a January statement to an advisory panel, NASA said that its "reliance on the private sector for a space-based NEO survey ... is being re-examined". NASA's Lindley Johnson, director of the near-earth object programme, declined to speak to

DIRECT HIT

In the 1908 Tunguska event, an object exploded over Siberia, damaging trees across 2,000 square kilometres. If a similar event occurred above New York City, the damage would hit all five boroughs and beyond. Impact energies for different sized objects are shown.



Nature, citing the ongoing discussions between the B612 Foundation and the agency.

NEOCam, meanwhile, would use an infrared telescope to search for asteroids from a vantage point between Earth and the Sun. In September, NASA will decide whether it is a finalist out of more than two dozen proposals being considered for launch by 2022 through the Discovery programme, which caps each

mission's cost at \$450 million.

If Sentinel receives substantial funding soon, it could launch by late 2019, says B612 Foundation chief executive and former astronaut Edward Lu. Even if NASA terminates its agreement with the foundation, he vows to keep the project going. "Believe me, I could do a lot of other things," he says. "But I feel this is extremely important." ■

ETHICS

Earth science wrestles with conflict-of-interest policies

Industry-funding controversies highlight lack of standards among field's journals.

BY JEFF TOLLEFSON

The undisclosed industry ties of some authors of Earth-science papers have raised ethical questions about how the field handles conflicts of interest. The cases of global-warming sceptic Willie Soon and hydrologist Donald Siegel have inspired calls for a uniform policy on reporting funding from entities that have an interest in the outcome of research.

"The Earth-science community doesn't really have a coherent set of policies for dealing with this," says Naomi Oreskes, a science historian at Harvard University in Cambridge, Massachusetts, who co-authored a 12 June commentary¹ in *Environmental Science & Technology* calling for stronger disclosure rules.

Soon, a solar physicist at the Harvard-Smithsonian Center for Astrophysics co-authored a 2010 paper² on climate-change policy in *Ecology Law Currents*, but he did not disclose funding from Southern Company, an electricity

provider in Atlanta, Georgia. The company has lobbied against stronger regulations to limit greenhouse-gas emissions.

The journal's editors told the Climate Investigations Center (CIC), a watchdog group in Alexandria, Virginia, that they do not have a conflict-of-interest policy, but are "exploring the possibility".

Soon also published a study³ in March in *Nature Geoscience* on atmospheric conditions during the Little Ice Age — a 500-year cool period that began around the 1400s — without reporting his funding. Nature Publishing Group (which also publishes *Nature*) says that Soon complied with its policies, which require the disclosure of financial ties that are relevant to the research in question.

But even if the study had little relevance to climate policy, Oreskes says Soon's funders benefit from any paper in a peer-reviewed journal. Such funding relationships can create an unconscious bias and should be reported, she says.

Still, having disclosure policies does not guarantee that scientists will abide by them, as the CIC found when it examined other publications that Soon listed as "deliverables" in reports to Southern Company.

In 2009, Soon and others published a study⁴ in the *Journal of Climate* on the variability of monsoons. The journal requires authors to disclose all funding sources and "any financial arrangement with a research sponsor that could give the appearance of a conflict of interest." Soon's co-authors acknowledged support from conventional granting agencies. But Soon did not report his funding from Southern Company. After the CIC released documents in February revealing Soon's industry ties, the journal amended the study to clarify his funding.

In another case, hydrologist Donald Siegel of Syracuse University in New York came under fire for a study⁵ that concluded that fracking — which uses pressurized fluids to shatter rock and release trapped natural gas ▶