

EARTH SCIENCE

Iconic Antarctic lab gets the boot

Homeless sediment collection dates back to 1960s.

BY ALEXANDRA WITZE

Free to a good home: more than 23 kilometres of skinny tubes of dirt. With them comes half a century of Antarctic geological history.

The US National Science Foundation (NSF) is looking for a new place to store its Antarctic marine-sediment cores, the world's biggest collection of environmental records from the Southern Ocean. The cores have lain on shelves at Florida State University in Tallahassee since 1963. But last year, the university told the NSF that it no longer wanted to host the collection. Ideas for where the Antarctic Marine Geology Research Facility might move to are due by 3 August.

"This area of research is not a priority for the current faculty," says Gary Ostrander, vice-president for research at Florida State. "It doesn't make sense to continue to support that size facility."

The NSF contributes roughly US\$280,000 per year, but the university has to pay for overhead costs such as air conditioning for the 930-square-metre building.

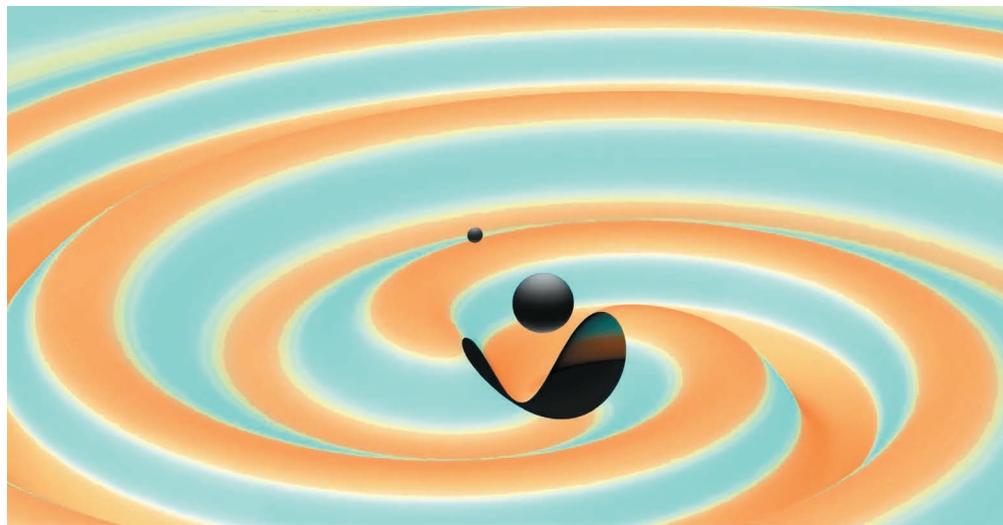
The invaluable collection includes cores gathered in the 2000s by the international ANDRILL programme, which revealed the history of the West Antarctic Ice Sheet over the past 17 million years.

The transfer is a blow for Sherwood Wise, a geologist at Florida State and the facility's principal investigator. "It'll be a sad day for me," he says. "This has been a marvellous resource for the university." Dozens of researchers from around the world visit the collection every year to study palaeoclimate clues and other evidence buried within the sediments.

Over the years, more and more cores have accumulated, from more than 90 research cruises. Studies of the samples have triggered hundreds of publications on all aspects of Southern Ocean and Antarctic history.

Curating these older materials is vital because Antarctic samples are so expensive and difficult to gather, says Philip Bart, a marine geologist at Louisiana State University in Baton Rouge. "The facility is critical to ongoing research," he says.

Wherever and whenever the Florida cores move, Wise estimates that it will take around \$2 million just to pack them up and ship them. ■



A computer simulation of the black-hole merger detected on 26 December 2015.

PHYSICS

LIGO sees second black-hole crash

First gravitational-wave detection was not a fluke.

BY DAVIDE CASTELVECCHI

Just before 4 a.m. on 26 December, B. S. Sathyaprakash woke up to some good news: gravitational waves had been detected for the second time in history.

The theoretical physicist from Cardiff University, UK, had his laptop next to his bed, set up to alert him when he received automated e-mail notices from computers at the Advanced Laser Interferometer Gravitational-Wave Observatory (LIGO).

"I got up and I went and checked the computer. Lo and behold, there was an event from just two minutes before," he says. At 3:38:53 UTC (Coordinated Universal Time), LIGO's twin detectors in Louisiana and Washington state had both picked up the signature ripples of two massive objects — probably two black holes — in the final stages of spiralling into each other.

At the time, the international LIGO collaboration and its colleagues at Virgo, a European observatory near Pisa, Italy, were busy analysing LIGO's first discovery: the event that they had detected on 14 September. The scientists would announce that finding in February, to great global fanfare. They did not run a full analysis of the second event until weeks later, says LIGO physicist Bruce Allen, managing director of the Max Planck Institute for Gravitational Physics in Hanover, Germany.

"It was absolutely mind-boggling how, within a few months of the first event, we had a second one," Sathyaprakash says.

SECOND SUCCESS

The second detection "shows that this whole business is not a fluke", says Clifford Will, a theoretical physicist at the University of Florida in Gainesville, who is not a member of either the LIGO or Virgo teams. In principle, the September discovery could have been a huge stroke of luck, but the second event suggests that there is a large population of black-hole pairs out there that will produce frequent mergers. LIGO and Virgo can look forward to regular detections, says Will, who studies gravitational waves and other predictions of Albert Einstein's general theory of relativity. "This is going to be a new kind of astronomy."

Einstein predicted that any accelerating or rotating bodies should produce ripples in the fabric of space, which are vaguely similar to sound waves but move at the speed of light and can propagate in a vacuum.

Detailed analysis of the second detection confirmed that the signature had to be the ripples from a pair of black holes (see video at go.nature.com/28lwdkf). This time, the signal from the gravitational waves lasted for one full second, instead of one-fifth of a second as in the first event. The second event encompassed

NUMERICAL-RELATIVISTIC SIMULATION: S. OSSOKINE/A. BUONANNO (MAX PLANCK INST. GRAV. PHYS.)/SIMULATING EXTREME-SPACE-TIME PROJECT; SCIENTIFIC VISUALIZATION: T. DIETRICH/R. HAAS (MAX PLANCK INST. GRAV. PHYS.)



the objects' last 27 orbits around each other, compared with just 5 or so from the first detection. This enabled the researchers to get a test of general relativity that was in some respects twice as precise as their test during the first detection.

This was true even though the September event was 'louder' than the December event. The first two black holes weighed as much as 36 and 29 times the mass of the Sun, respectively, whereas the holes in the second pair were relatively lightweight, at 14 and 8 solar masses, and radiated one-third as much gravitational energy. (In both cases, the black-hole pairs might have been orbiting each other for millions or billions of years, but LIGO captured only the finale, when the orbits and the gravitational waves that they produced had frequencies within the observatory's window of sensitivity.)

WELL-TIMED GIFT

The LIGO and Virgo scientists estimate that both collisions occurred more than 400 megaparsecs (1.3 billion light years) from Earth, although the distances could not be measured precisely. The teams presented their latest results on 15 June at a meeting of the American Astronomical Society in San Diego, California, and published them in *Physical Review Letters* (B. P. Abbott *et al. Phys. Rev. Lett.* **116**, 241103; 2016).

The latest discovery was especially

exciting for physicist Chad Hanna, a LIGO collaborator at Pennsylvania State University in University Park. When Hanna got the alert by text message, it was still Christmas Day in the United States, and he was with family. The collaboration requires members to keep data completely confidential, so Hanna hopped out of his chair, got his laptop and went upstairs to an empty room. At first, he was sceptical, he says: "I just didn't think the Universe had such a sense of humour to send a real event on Christmas."

But he soon realized that although the signal was relatively quiet, it was genuine. It was a crucial test for the software that combs the data from the two observatories in real time, which he helped to design. The system could catch events even if they were half-buried in noise, but didn't produce too many false positives.

RESET

Ultimately, the automated alerts from LIGO will notify dozens of teams of astronomers as well. The researchers will then reposition their telescopes in the hope of detecting visible light, or other electromagnetic waves, that originate from the same events that produce the gravitational waves.

After its first four-month science run between September 2015 and January 2016,

the US\$620-million Advanced LIGO has shut down for an upgrade. It is scheduled to start another run this September, accompanied by an upgraded Virgo.

The results released last week complete the search for black-hole mergers in LIGO's autumn run, but the collaboration is still sifting through its data for other types of event — and may yet announce further discoveries even before the next run begins. In particular, the international Einstein@Home project is looking for signals with the help of computers belonging to volunteers around the world. ■

CORRECTIONS

It costs the United Kingdom £161 million per week to be in the EU, not £250 million, as stated in the Editorial 'Turning point' (*Nature* **534**, 295; 2016). The News story 'Gene therapies pose million-dollar conundrum' (*Nature* **534**, 305–306; 2016) should have said that cancer drugs that unleash the power of the immune system cost up to \$40,000 per month, not per year. And the News Feature 'The secret history of ancient toilets' (*Nature* **533**, 456–458; 2016) incorrectly said that roundworms and whipworms cause dysentery — they cause problems such as malnutrition.