WEDNESDAY 15 JUNE 2016

EMBARGOED UNTIL 3.15AM AEST THURSDAY 16 JUNE 2016

BLACK HOLE COLLISION – MORE GRAVITATIONAL WAVES FOUND

Scientists have detected gravitational waves for a second time, caused by the collision of two black holes 14 and eight times the size of the sun.

The team, including scientists from The Australian National University (ANU), glimpsed the black holes orbiting each other 27 times in their last second before coalescing. The signal was 10 times longer than that of the first gravitational wave, which was announced in February this year.

The signal was detected by the two Laser Interferometer Gravitational-Wave Observatory (LIGO) detectors in the United States, said LIGO researcher Professor Susan Scott, from the ANU Research School of Physics and Engineering (RSPE).

“This has cemented the age of gravitational wave astronomy,” she said

“This shows data is going to flow, that will enable us to map a lot more of the Universe than we’ve seen before.”

The violent collision happened approximately 1.4 billion years ago in a distant galaxy. During the journey to Earth, the gravitational waves died down so much that they stretched the LIGO detectors only a tiny fraction of the width of a proton.

Gravitational waves are caused by violent cosmic events such as collisions between stars or black holes, or explosions such as supernovae. They were predicted by Albert Einstein in 1916, but he thought they would be too small for humans to ever detect.

Until gravitational waves were detected, nearly all astronomy had relied on electromagnetic observations – visible light, radio waves, X-rays and so on – said Dr Rob Ward, a LIGO researcher from the ANU RSPE.

“I'd always imagined there would be electromagnetic counterparts in our first discoveries, but instead we found these invisible collisions of black holes purely through the gravitational waves they emitted with no counterparts at all,” Dr Ward said.

“Gravitational wave astronomy is going to revolutionise our understanding of the Universe.”

Gravitational waves promise major insights into the puzzles of dark energy and dark matter. The latest gravitational wave was detected on December 26, 2015.

The ripples reached the LIGO detector in Louisiana in the United States, and 1.1 milliseconds later the identical LIGO detector in Washington state.

The tiny signal was too small to be immediately seen amongst the background noise, but seventy seconds later the super-computer driven data processing systems found a match between the two detectors and alerted researchers of the find.

The chair of the Australian Consortium for Interferometric Gravitational Astronomy, Dr Bram Slagmolen, said he was proud of the contribution Australian scientists had made to the detection.

“There’s massive enthusiasm among Australian scientists, we’ve come up with lots of innovative technology and ideas,” said Dr Slagmolen, from ANU RSPE.

“Advanced LIGO is such a massive machine and it’s fantastic to see it operate in the way we intended,”

Professor David McClelland, from ANU RSPE and Leader of Australia’s Partnership in Advanced LIGO, said that Australian scientists were already working on projects which would enhance the sensitivity of the LIGO detectors.

“Our world-leading quantum optical devices will triple the searchable volume of our universe,” Professor McClelland said.

“We’ll see many more discoveries announced over the next few years.”

The research is published in Physical Review Letters.

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ABOUT LASER INTERFEROMETER GRAVITATIONAL–WAVE OBSERVATORY (LIGO)

The LIGO Observatories are funded by the National Science Foundation (NSF), and were conceived, built, and are operated by Caltech and MIT. The discovery, accepted for publication in the journal *Physical Review Letters*, was made by the LIGO Scientific Collaboration (which includes the GEO Collaboration and the Australian Consortium for Interferometric Gravitational Astronomy) and the Virgo Collaboration using data from the two LIGO detectors.

LIGO research is carried out by the LIGO Scientific Collaboration (LSC), a group of more than 1,000 scientists from universities around the United States and in 14 other countries. More than 90 universities and research institutes in the LSC develop detector technology and analyse data; approximately 250 students are strong contributing members of the collaboration. The LSC detector network includes the LIGO interferometers and the GEO600 detector.

Virgo research is carried out by the Virgo Collaboration, consisting of more than 250 physicists and engineers belonging to 19 different European research groups: 6 from Centre National de la Recherche Scientifique (CNRS) in France; 8 from the Istituto Nazionale di Fisica Nucleare (INFN) in Italy; 2 in The Netherlands with Nikhef; the Wigner RCP in Hungary; the POLGRAW group in Poland and the European Gravitational Observatory (EGO), the laboratory hosting the Virgo detector near Pisa in Italy.

The NSF leads in financial support for Advanced LIGO. Funding organisations in Germany (Max Planck Society), the U.K. (Science and Technology Facilities Council, STFC) and Australia (Australian Research Council) also have made significant commitments to the project.