New gravitational wave hits Earth
For the first time, three detectors zoom in on its location

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UNIVERSITY PARK, Pa. — For the first time, three detectors have tracked the gravitational waves emitted by a merger of two black holes — a critical new capability that allows scientists to more closely locate a gravitational wave’s birthplace in space. Gravitational waves are ripples in space and time created when two massive, compact objects such as black holes merge. A paper about the new gravitational wave — known as GW170814 — has been accepted for publication in the journal Physical Review Letters.

https://news.psu.edu/story/484944/2017/09/27/research/new-gravitational-wave-hits-earth
The new detections were made on Aug. 14 by the LIGO Scientific Collaboration's two gravitational-wave detectors in the United States and by the Virgo Gravitational-Wave Observatory in Italy. It is the first joint detection of gravitational waves by the LIGO and Virgo detectors. It also is the fourth announced detection of a binary black-hole system and the first significant gravitational-wave signal recorded by the Virgo detector.

The detection is especially important because it highlights the scientific potential of a three-detector network of gravitational-wave detectors. "The Virgo Gravitational-Wave Observatory joining forces with LIGO is a huge moment in astronomy," said Chad Hanna, assistant professor of physics and of astronomy & astrophysics and Freed Early Career Professor at Penn State, who has served as co-chair of LIGO's Compact Binary Coalescence Group, which has detected all the gravitational waves discovered thus far.

"It is our hope to one day detect gravitational waves and to simultaneously observe the source of the gravitational waves with conventional telescopes so that we might learn even more about what causes the gravitational waves. In order to do that, we need to know where to look. LIGO and Virgo together allow us to pinpoint the gravitational wave source in the sky far better than before, which will dramatically improve our chances of capturing the gravitational wave source with other telescopes."

The new ability to observe gravitational waves with three detectors — two at LIGO plus one at Virgo — opens the door to additional scientific knowledge.

"Virgo adds new capability to the LIGO network. Thanks to Virgo we can now test a key prediction of Einstein's general relativity, namely the polarization property of the wave," said B.S. Sathyaprakash, the Elsbach Professor of Physics and professor of astronomy and astrophysics at Penn State. "The two LIGO detectors alone are not able to infer the polarization property of gravitational waves because they alone could not fix the position of the source in the sky. The addition of Virgo as a third detector helps in localizing the source and hence allows us to infer the wave's polarization. As far as we can tell, Einstein is still right."

France Córdova, director of the U.S. National Science Foundation (NSF) and a former head of the Penn State Department of Astronomy and Astrophysics, said, "Little more than a year and a half ago, NSF announced that its Laser Gravitational-Wave Observatory had made the first-ever detection of gravitational waves resulting from the collision of two black holes in a galaxy a billion light-years away. Today, we are delighted to announce the first discovery made in partnership between the Virgo Gravitational-Wave Observatory and the LIGO Scientific Collaboration, the first time a gravitational-wave detection was observed by these observatories, located..."
thousands of miles apart. This is an exciting milestone in the growing international scientific effort to unlock the extraordinary mysteries of our Universe."

LIGO is funded by NSF and operated by Caltech and MIT, which conceived and built the project. Financial support for the Advanced LIGO project was led by NSF with Germany (Max Planck Society), the U.K. (Science and Technology Facilities Council) and Australia (Australian Research Council) making significant commitments and contributions to the project. More than 1,200 scientists from around the world participate in the effort through the LIGO Scientific Collaboration, which includes the GEO Collaboration. Additional partners are listed at http://ligo.org/partners.php.

The Virgo detector, located near Pisa, Italy, consists of more than 280 physicists and engineers belonging to 20 different European research groups: six from Centre National de la Recherche Scientifique (CNRS) in France; eight from the Istituto Nazionale di Fisica Nucleare (INFN) in Italy; two in The Netherlands with Nikhef; the MTA Wigner RCP in Hungary; the POLGRAW group in Poland; Spain with the University of Valencia; and EGO, the laboratory hosting the Virgo detector near Pisa in Italy. Chad Hanna's work is supported by the National Science Foundation and the Charles E. Kaufman Foundation of The Pittsburgh Foundation. B.S. Sathyaprakash's work is supported by the National Science Foundation and the Indo-US Science and Technology Forum.

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