CGWA press release

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LIGO and Virgo Announce Four New Gravitational-Wave Detections

The LIGO-VIRGO collaborations (integrated by CGWA scientists) are also releasing their first catalog of gravitational-wave events

On Saturday, December 1, scientists attending the Gravitational Wave Physics and Astronomy Workshop in College Park, Maryland, presented new results from the National Science Foundation's LIGO (Laser Interferometer Gravitational-Wave Observatory) and the European-based VIRGO gravitational-wave detector regarding their searches for coalescing cosmic objects, such as pairs of black holes and pairs of neutron stars. The LIGO and Virgo collaborations have now confidently detected gravitational waves from a total of 10 stellar-mass binary black hole mergers and one merger of neutron stars, which are the dense, spherical remains of stellar explosions. Six of the black hole merger events had been reported before, while four are newly announced.

From September 12, 2015, to January 19, 2016, during the first LIGO observing run since undergoing upgrades in a program called Advanced LIGO, gravitational waves from three binary black hole mergers were detected. The second observing run, which lasted from November 30, 2016, to August 25, 2017, yielded one binary neutron star merger and seven additional binary black hole mergers, including the four new gravitational-wave events being reported now. The new events are known as GW170729, GW170809, GW170818, and GW170823, in reference to the dates they were detected.

All of the events are included in a new catalog, also released Saturday, with some of the events breaking records. For instance, the new event GW170729, detected in the second observing run on July 29, 2017, is the most massive and distant gravitational-wave source ever observed. In this coalescence, which happened roughly 5 billion years ago, an equivalent energy of almost five solar masses was converted into gravitational radiation.

GW170814 was the first binary black hole merger measured by the three-detector network, and allowed for the first tests of gravitational-wave polarization (analogous to light polarization). The event GW170817, detected three days after GW170814, represented the first time that gravitational waves were ever observed from the merger of a binary neutron star system. What's more, this collision was seen in gravitational waves and light, marking an exciting new chapter in multi-messenger astronomy, in which cosmic objects are observed simultaneously in different forms of radiation.

This catalog documents the beginning of a new era in Astronomy started just three years ago: Gravitational Wave Astronomy and Multi-Messenger Astronomy.

In a few more months the third scientific observational campaign (O3) fo the LIGO and VIRGO detectors is scheduled to start and run for a full year of data taking. This will be the last stage before the instruments obtain design sensitivity, which is scheduled to happen in 2021. At that time the detectors will be able to explore a volume of our universe 60 times larger than the region of the universe observed during the last two scientific runs.

The laser interferometers are producing ground breaking scientific results not only proving the correctness of Einstein's theory of General Relativity but also paving the ground to understand better long standing mysteries of our universe.

Mysteries like the current expansion rate and the future of our universe, the nature of matter at regimes not encountered on earth and the abundance of heavy elements like gold and platinum.

Several CGWA-UTRGV scientists participated in the meeting and presented results related to the TOROS observations during the LIGO VIRGO observational campaigns.

The work of the UTRGV led TOROS Scientific Collaboration was presented at the time that construction is ongoing for a new astronomical facility made possible by National Science Foundation's award to the CGWA-UTRGV.

This new UTRGV astronomical observatory will be located in Cordon Macon in the Northwest of Argentina. The site located in the Atacama region is the driest dessert in the planet. Located at a heigh of more than 15,000 ft above sea level this site has one the best conditions for astronomical observation in the world. The instrumentation at the observatory will be dedicated to follow-up gravitational wave events to capture the possible electromagnetic radiation associated with gravitational wave events, in a manner similar to what happened on August 17 of last year when the collision of two neutron stars was simultaneous observed in gravitational and electromagnetic waves.

The **Center for Gravitational Wave Astronomy** is a member of the LIGO Scientific Collaboration since 1998.
The University of Texas Rio Grande Valley houses the Center for Gravitational Wave Astronomy, which was founded in 2003 with grants from the National Aeronautic Space Administration and the National Science Foundation. The CGWA has the largest group of gravitational- wave researchers in Texas and one of the largest in the USA involved in LIGO Scientific Collaboration global research effort. Its scientists and student researchers were key participants in the first direct detection of gravitational waves on September 14, 2015.

The Collaborations
LIGO is funded by NSF and operated by Caltech and MIT, which conceived of LIGO and led the Initial and Advanced LIGO projects. Financial support for the Advanced LIGO project was led by the NSF with Germany (Max Planck Society), the U.K. (Science and Technology Facilities Council) and Australia (Australian Research Council-OzGrav) 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. A list of additional partners is available at https://my.ligo.org/census.php.
The Virgo collaboration consists of more than 300 physicists and engineers belonging to 28 different European research groups: six from Centre National de la Recherche Scientifique (CNRS) in France; 11 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 IFAE and the Universities of Valencia and Barcelona; two in Belgium with the Universities of Liege and Louvain; Jena University in Germany; and the European Gravitational Observatory (EGO), the laboratory hosting the Virgo detector near Pisa in Italy, funded by CNRS, INFN, and Nikhef. A list of the Virgo Collaboration can be found at http://public.virgo-gw.eu/the- virgo-collaboration/. More information is available on the Virgo website at www.virgo-gw.eu.