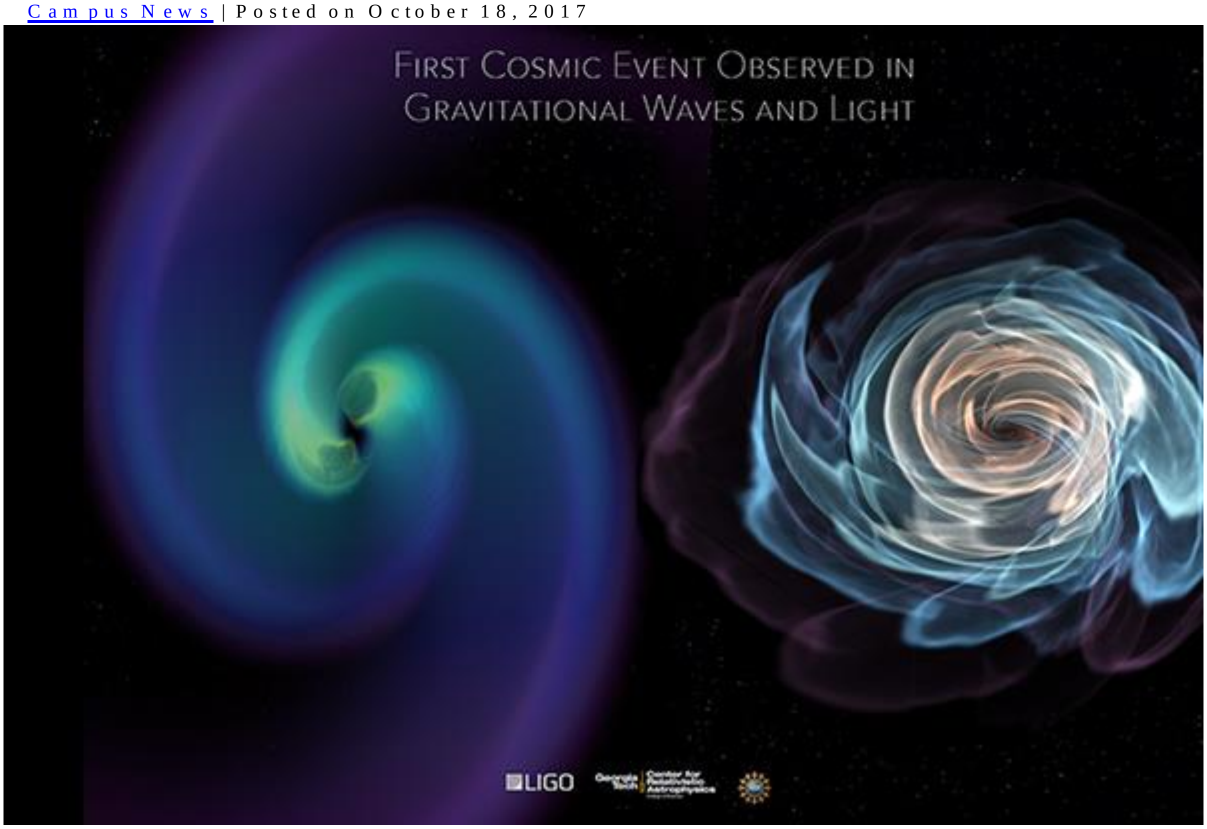
Tiffany Summerscales Part of Scientific Discovery

Both gravitational waves and light measured from the same source

Campus News | Posted on October 18, 2017



Neutron star merger seen in gravity and matter. This still image from an animated visualization shows the coalescence of two orbiting neutron stars. The right panel contains a visualization of the matter of the neutron stars. The left panel shows how space-time is distorted near the collisions. (Photo by Karan Jani/Georgia Tech)

By: Adapted from the LIGO press release, ligo.org/detections/GW170817/press-release/pr-english.pdf; Gillian Sanner, Media Communications Manager

On Monday, Oct. 16, 2017, the LIGO and Virgo collaborations announced the first-ever detection of gravitational waves from the collision of a pair of neutron stars. Andrews University professor of physics Tiffany Summerscales, along with her students, represented Andrews University in the work of the Laser Interferometer Gravitational-Wave Observatory (LIGO) Scientific Collaboration. Previous detections of gravitational waves (faint ripples in the fabric of spacetime predicted by Einstein's theory of general relativity) from pairs of colliding black holes resulted in this year's Nobel Prize in physics being awarded to three senior members of the LIGO collaboration.

Summerscales says, "The LIGO and Virgo Collaborations, along with a large number of astronomy partners, announced both the discovery of gravitational waves from a pair of neutron stars that collided and merged and the light emitted by the same event. This is a very exciting detection because it is the first time we have measured both gravitational waves and light from the same source. The more cosmic messengers there are, the more information they bring us and the more complete the picture that can be painted."

The discovery was made using the U.S.-based LIGO, the Europe-based Virgo detector and some 70 ground- and space-based observatories.

Neutron stars are the smallest, densest stars known to exist and are formed when massive stars explode in supernovas. As these neutron stars spiraled together, they emitted gravitational waves that were detectable for about 100 seconds; when they collided, a flash of light in the form of gamma rays was emitted and seen on Earth about two seconds after the gravitational waves. In the days and weeks following the smashup, other forms of light, or electromagnetic radiation—including X-ray, ultraviolet, optical, infrared and radio waves— were detected.

The observations have given astronomers an unprecedented opportunity to probe a collision of two neutron stars. For example, observations made by the U.S. Gemini Observatory, the European Very Large Telescope and NASA's Hubble Space Telescope reveal signatures of recently synthesized material, solving a decades-long mystery of where about half of all elements heavier than iron are produced.

"By having light astronomers and gravitational wave astronomers working together, we were able to even more than measure the properties of the neutron stars and their collision," says Summerscales. "We showed that some of the bursts of the highest energy light, called gamma rays, come from colliding neutron stars. We found that the collision produced many heavy elements like gold, platinum and uranium. We were able to use a new method to measure the expansion of the universe."

LIGO is funded by the 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) making significant commitments and contributions to the project.

More than 1,200 scientists and some 100 institutions from around the world participate in the effort through the LIGO Scientific Collaboration, which includes the GEO Collaboration and the Australian collaboration OzGrav. Additional partners are listed at http://ligo.org/partners.php.

The Virgo collaboration 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 the European Gravitational Observatory, EGO, the laboratory hosting the Virgo detector near Pisa in Italy, funded by CNRS, INFN and Nikhef.

To learn more about the Andrews University Department of Physics, visit andrews.edu/cas/physics/.

Related link: ligo.org/detections/GW170817.php

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