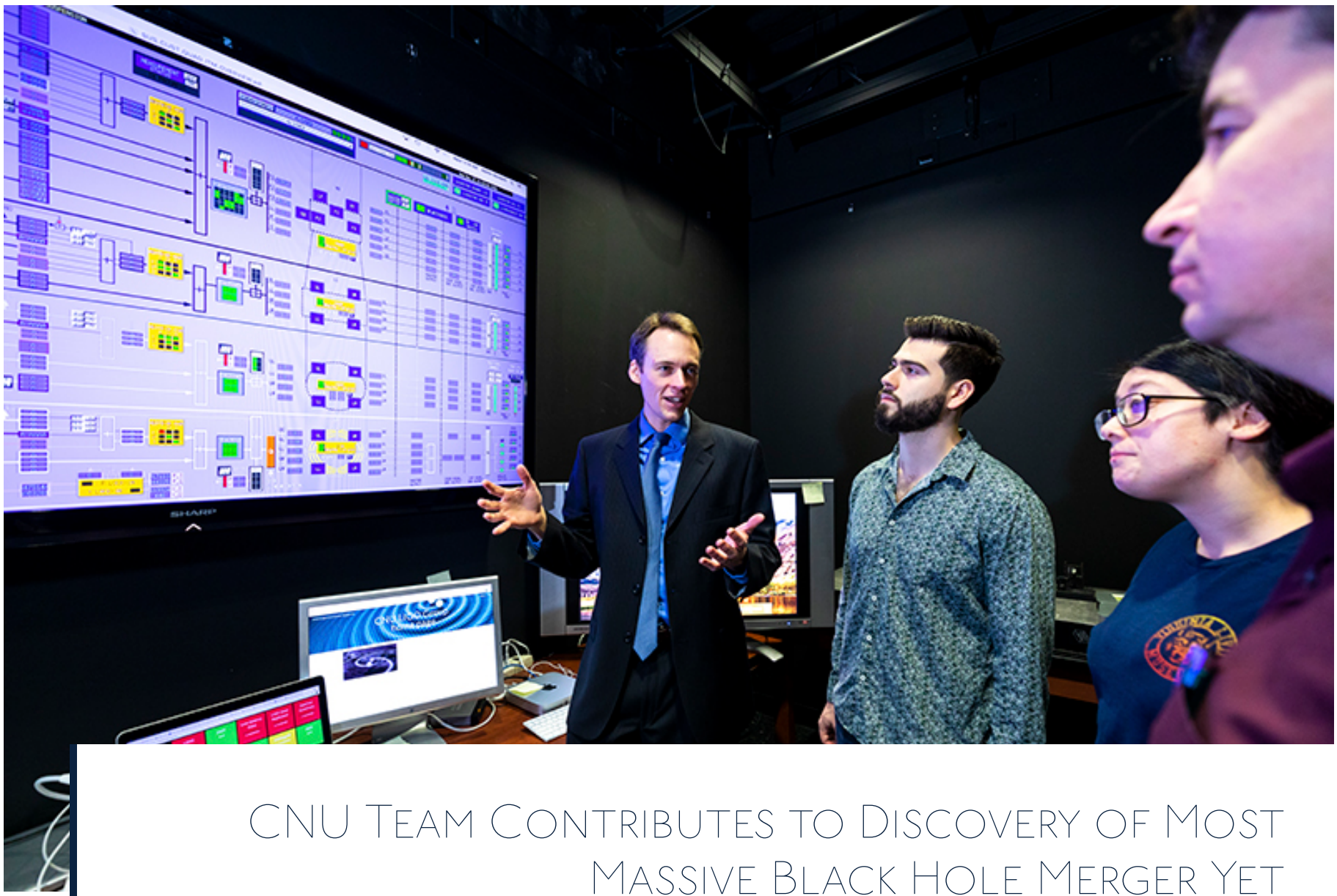

CNU TEAM CONTRIBUTES TO DISCOVERY OF MOST MASSIVE BLACK HOLE MERGER YET

FISHER, WALKER LEAD TEAM THAT INCLUDES STUDENTS, ALUMNI.

by Jim Hanchett | September 4, 2020

Above: Ryan Fisher, left, with students

Read time: about 2 min

For all its vast emptiness, the universe is humming with activity in the form of gravitational waves. Produced by extreme astrophysical phenomena, these reverberations ripple forth and shake the fabric of space-time, like the clang of a cosmic bell.

Christopher Newport University scientists and students are contributing to a research team that has detected a signal from what may be the most massive black hole merger yet observed via gravitational waves. The product of the merger is the first clear detection of an “intermediate-mass” black hole, with a mass between 100 and 1,000 times that of the sun.

"We are very excited to be a part of these new discoveries in astrophysics enabled by gravitational wave astronomy,” said Dr. Ryan Fisher of the Department of Physics, Computer Science and Engineering. “This discovery is a great example of how much we still have to learn about the strange objects like black holes that make up our universe."

The Christopher Newport research group includes Fisher, physics professor Dr. Marissa Walker, Associate Scientist Robert Bruntz, master's alumni Anne Baer '20 and Alexander Balsamo '20, master's student Michael Patel, undergraduates Grace Johns, Nathan Ormsby, Jack Lynam, Nii-Boi Quartey and Scott Reid.

Their contributions were added to those made by nearly 2,000 other researchers in the Laser Interferometer Gravitational-wave Observatory (LIGO) Scientific Collaboration (which contributed to this story) and the Virgo Collaboration. “The result demonstrates how powerful we can be when we work toward a common goal together with people who have different talents and backgrounds,” Walker said.

The researchers detected the signal, which they have labeled GW190521, with the National Science Foundation’s LIGO, a pair of identical, 4-kilometer-long interferometers in the United States; and Virgo, a 3-kilometer-long detector in Italy. They first discovered the signal in May, 2019 and this week published their analysis of the discovery in two academic papers that earned international media attention.

The signal, resembling about four short wiggles, is extremely brief in duration, lasting less than one-tenth of a second. From what the researchers can tell, GW190521 was generated by a source that is roughly 5 gigaparsecs away, when the universe was about half its age, making it one of the most distant gravitational-wave sources detected so far.

As for what produced this signal, based on a powerful suite of state-of-the-art computational and modeling tools, scientists think that GW190521 was most likely generated by a binary black hole merger with unusual properties.

Almost every confirmed gravitational-wave signal to date has been from a binary merger, either between two black holes or two neutron stars. This newest merger appears to be the most massive yet, involving two inspiraling black holes with masses about 85 and 66 times the mass of the sun.

The LIGO-Virgo team has also measured each black hole’s spin and discovered that as the black holes were circling ever closer together, they could have been spinning about their own axes, at angles that were out of alignment with the axis of their orbit. The black holes’ misaligned spins likely caused their orbits to wobble, or “precess,” as the two Goliaths spiraled toward each other.

The new signal likely represents the instant that the two black holes merged. The merger created an even more massive black hole, of about 142 solar masses, and released an enormous amount of energy, equivalent to around 8 solar masses, spread across the universe in the form of gravitational waves.

Fisher, Walker, Bruntz, Baer, Balsamo and Johns are co-authors of two newly published papers. One, appearing in *Physical Review Letters*, details the discovery, and the other, in *The Astrophysical Journal Letters*, discusses the signal’s physical properties and astrophysical implications. Fisher and Walker are 2016 recipients of the Special Breakthrough Prize in Fundamenetal Physics. This prestigious award recognizes individuals who have made profound contributions to human knowledge.