West Virginia University. NEWS

WVU astrophysicist part of research team that proves Einstein was right

Father of relativity theories 'would be proud'

Relatively speaking, Einstein was right.

Thatís the finding of West Virginia University astrophysicist Maura McLaughlin and colleagues, who were able to confirm a long-held prediction of Albert Einsteinís theory of general relativity. Their research appears today (July 3) in the journal Science.

ìIíd like to think Einstein would be proud of the teamís work and excited that we were able to confirm his theory,î McLaughlin said.

McLaughlin and her husband, Duncan Lorimer, physics professors in WVUís Eberly College of Arts and Sciences, were part of a team that discovered pulsar PSR J0737-3039A/B. It is the only known double-pulsar system: two pulsars locked into close orbit around one another. The two pulsars are so close to each other, in fact, that the entire binary could fit within the sun.

Pulsars are small, dense stellar objects left behind after massive stars die and explode as supernovae. They typically have a mass greater than that of the sun, but compressed to the size of a city like Washington, D.C. They spin at staggering speeds, generate huge gravity fields and emit powerful beams of radio waves along their magnetic poles. These illuminate Earth-based radio telescopes like rotating lighthouse beacons as the pulsar spins.

More than 1,700 pulsars have been discovered in Earthís galaxy, but the pulsar discovered in 2003 by McLaughlin, Lorimer and colleagues is the only known double-pulsar system.

This new test of Einsteinís theory using the double pulsar was led by McGill University astrophysics doctoral candidate RenÈ Breton. Breton worked with McLaughlin and fellow scientists in Canada, the United Kingdom, United States, France and Italy to study the twin pulsar. They used the 100-meter Robert C. Byrd Green Bank Radio Telescope at the National Radio Astronomy Observatory in Green Bank. The WVU Department of Physics has a partnership with the Green Bank Observatory and frequently conducts research there.

Einsteinís theory of general relativity predicted that in a strong gravitational field, like that of a pulsar, an objectís spin axis should slowly change direction as the pulsar orbits around its companion. This change in direction is called precession.

The team of researchers discovered that one of the two pulsars is indeed precessing -- just as Einsteinís 1915 theory predicts. If Einstein had been wrong, the pulsar wouldnít be precessing or would precess in some other way.

Pulsars are too small and too distant to observe their orientation directly. However, the researchers realized they could make such measurements using the eclipses visible when one of the twin pulsars passes in front of its companion. When this occurs, the magnetosphere of the first pulsar partly absorbs the radio ìlightî being emitted from the other, which allows the researchers to determine its spatial orientation. After four years of observations, the team determined that its spin axis moves just as Einstein predicted.

ìMany people have worked very hard to confirm these results, and I am thrilled to be a part of a chapter in the history of this important scientific theory,î McLaughlin said.

Currently McLaughlin is working with Benetge Perera, a WVU doctoral candidate at the Green Bank Observatory. They are modeling the double-pulsar system to make important measurements about the systemís geometry and about the highly magnetized environments of pulsars called magnetospheres.

PROVING EINSTEIN ó WVU astrophysicist Maura McLaughlin is one of a group of researchers whose work confirms a long-held prediction of Albert Einstein's theory of general relativity. Their research appears today (July 3) in the journal Science.

Photo by: Ted Webb

BIG RED ó This graphic shows a star that has evolved into its red giant phase and is fusing material on its companion pulsar, spinning it up to millisecond periods. This is how the double-pulsar system evolved. The red giant will soon undergo a supernova explosion and leave behind a pulsar, resulting in the system we know today of an old, fast-spinning pulsar and a young, slowly spinning pulsar.

Photo by: John Rowe Animations

STAR WARS ó This

iThere is so much more we can learn about the double pulsar,î McLaughlin said. iUnlocking its mysteries is going to keep me and many others busy for a long time. Itís an exciting time to be a physicist and a great opportunity for the students of WVU. West Virginia is one of the best places on Earth to do this work.î

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(MEDIA: Additional images are available at http://www.physics.mcgill.ca/~bretonr/doublepulsar/ and http://www.nrao.edu/imagegallery/php/level1.php.)

illustration portrays a "present-day" view of the two pulsars in the system, both with their rotating lighthouse beams of radio emission.

Photo by: John Rowe Animations

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