New EINSTEIN@HOME effort launched: home computers to search Arecibo data for new pulsars

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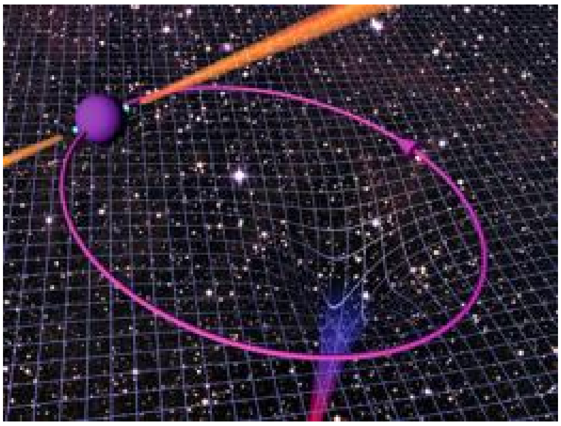

Depiction of a pulsar orbiting a companion neutron star or black hole, shown as the curved spacetime associated with the companion's mass. By measuring the pulsar's orbit to high precision, scientists can measure the accuracy of General Relativity and determine the companion's mass.

Einstein@Home, based at the University of Wisconsin--Milwaukee (UWM) and the Albert Einstein Institute (AEI) in Germany, is one of the world's largest public volunteer distributed computing projects. More than 200,000 people have signed up for the project and donated time on their computers to search gravitational wave data for signals from unknown pulsars.

Today, Prof. Bruce Allen, Director of the Einstein@Home project, and Prof. Jim Cordes, of Cornell University and Chair of the Arecibo PALFA Consortium, announced that the Einstein@Home project is beginning to analyze data taken by the PALFA Consortium at the Arecibo Observatory in Puerto Rico. The Arecibo Observatory is the largest single-aperture radio telescope on the planet and is used for studies of pulsars, galaxies, solar system objects, and the Earth's atmosphere.

Using new methods developed at the AEI, Einstein@Home will search Arecibo radio data to find binary systems consisting of the most extreme objects in the universe: a spinning neutron star orbiting another neutron star or a black hole. Current searches of radio data lose sensitivity for orbital periods shorter than about 50 minutes. But the enormous computational capabilities of the Einstein@Home project (equivalent to tens of thousands of computers) make it possible to detect pulsars in binary systems with orbital periods as short as 11 minutes.

"Discovery of a pulsar orbiting a neutron star or black hole, with a sub-hour orbital period, would provide tremendous opportunities to test General Relativity and to estimate how often such binaries merge," said Cordes. The mergers of such systems are among the rarest and most spectacular events in the universe. They emit bursts of gravitational waves that current detectors might be able to detect, and they are also thought to emit bursts of gamma rays just before the merged stars collapse to form a black hole. Cordes added: "The Einstein@Home computing resources are a perfect complement to the data management systems at the Cornell Center for Advanced Computing and the other PALFA institutions."

"While our long-term goal is to detect gravitational waves, in the shorter-term we hope to discover at least a few new radio pulsars per year, which should be a lot of fun for Einstein@Home participants and should also be very interesting for astronomers. We expect that most of the project's participants will be eager to do both types of searches," said Allen. Einstein@Home participants will automatically receive work for both the radio and gravitational-wave searches.

The large data sets from the Arecibo survey are archived and processed initially at Cornell and other PALFA institutions. For the Einstein@Home project, data are sent to the Albert Einstein Institute in Hannover via high-bandwidth internet links, pre-processed and then distributed to computers around the world. The results are returned to AEI, Cornell, and UWM for further investigation.

Gravitational waves were first predicted by Einstein in 1916 as a consequence of his general theory of relativity, but have not yet been directly detected. For the past four years, Einstein@Home has been searching for gravitational waves in data from the US LIGO detector.

Radio pulsars, first discovered in the 1960s, are rapidly spinning neutron stars that emit a lighthouse-like beam of radio waves that sweeps past the earth as frequently as 600 times per second. Radio pulsars in short-period binary systems are especially interesting because the effects of general relativity can be very strong. Systems that have already been discovered have been used to verify that Einstein's predictions about gravitational wave emission are correct to better than 1%.

The discovery of new pulsars in much shorter-period binaries would improve estimates of the rates at which binary star systems form and disappear in our Galaxy, and also provide new targets to search for with gravitational wave detectors.

The Arecibo Observatory is the largest single-aperture radio telescope on the planet and is used for studies of pulsars, galaxies, solar system objects, and the Earth's atmosphere. The first binary pulsar was discovered at Arecibo in 1974 and led to Hulse and Taylor's 1993 Nobel Prize in Physics, because of its stringent test of general relativity. The new pulsar survey uses a specialized radio camera, the Arecibo L-band Feed Array, and is conducted by the PALFA Consortium.

The Max Planck Institute for Gravitational Physics (Albert Einstein Institute) is the largest research institute in the world devoted to the study of general relativity. Its two branches in Potsdam and Hannover support research in astrophysics, theoretical physics, mathematics, and experimental physics. It operates the GEO600 gravitational wave detector near Hannover, Germany, is a partner in the American LIGO project, and plays a major role in the analysis of the data from all existing gravitational wave detectors, including the VIRGO detector in Italy. The software that will be used in the Einstein@Home radio searches was developed by the AEI in Hannover.

The University of Wisconsin - Milwaukee hosts the Einstein@Home project and plays a major role in the data analysis activities of the LIGO Scientific Collaboration. It also carries out Arecibo radio observations as an Arecibo Remote Control Center (ARCC).

More information: Einstein@Home: einstein.phys.uwm.edu/

Source: Cornell University (news : web)