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Press Release

Hannover, 12th August 2010

Einstein@Home 'citizen scientists' in the U.S.A. and Germany discover a new pulsar in Arecibo telescope data

(*Science* Express, Aug. 12, 2010.)

Idle computers are the astronomers' playground: Three citizen scientists – a German and an American couple – have discovered a new radio pulsar hidden in data gathered by the Arecibo Observatory. This is the first deep-space discovery by Einstein@Home, which uses donated time from the home and office computers of 250,000 volunteers from 192 different countries. (Science Express, Aug. 12, 2010.)

The citizens credited with the discovery are Chris and Helen Colvin, of Ames, Iowa and Daniel Gebhardt, of Universität Mainz, Musikinformatik, Germany. Their computers, along with 500,000 others from around the world, analyze data for Einstein@Home (on average, donors contribute about two computers each).

The new pulsar – called PSR J2007+2722 – is a neutron star that rotates 41 times per second. It is in the Milky Way, approximately 17,000 light years from Earth in the constellation Vulpecula. Unlike most pulsars that spin as quickly and steadily, PSR J2007+2722 sits alone in space, and has no orbiting companion star. Astronomers consider it especially interesting since it is likely a recycled pulsar that lost its companion. However they can not rule out that it may be a young pulsar born with an lower-than-usual magnetic field.

Einstein@Home, based at the Center for Gravitation and Cosmology at the University of Wisconsin -- Milwaukee, and at the Max Planck Institute for Gravitational Physics (Albert Einstein Institute, Hannover), has been searching for gravitational waves in data from the US LIGO Observatory since 2005. Starting in March 2009, Einstein@Home also began searching for signals from radio pulsars in astronomical observations from the Arecibo Observatory in Puerto Rico. Arecibo is the world's largest and most sensitive radio telescope, and is managed by Cornell University. About one-third of Einstein@Home's computing capacity is used to search Arecibo data.

"This is a thrilling moment for Einstein@Home and our volunteers. It proves that public participation can discover new things in our universe. I hope it inspires more people to join us to help find other secrets hidden in the data," says Bruce Allen, leader of the Einstein@Home project, Director at the Max Planck

Institute for Gravitational Physics (Albert Einstein Institute), and Adjunct Professor of Physics at the University of Wisconsin – Milwaukee.

The paper, "Pulsar Discovery by Global Volunteer Computing," is authored by Allen's graduate student Benjamin Knispel, from the Albert Einstein Institute, Germany; Bruce Allen; James M. Cordes, Cornell professor of astronomy and chair of the Pulsar ALFA Consortium, and a team of collaborators. It announces the first genuine astronomical discovery by a public volunteer distributed computing project.

"No matter what else we find out about it, this pulsar is bound to be extremely interesting for understanding the basic physics of neutron stars and how they form. Its discovery has required a complex system that includes the Arecibo Telescope and computing resources at the Albert Einstein Institute, at the Cornell Center for Advanced Computing, and at the U. of Wisconsin – Milwaukee to be able to send data out worldwide to Einstein@Home volunteers," Cordes said.

The Arecibo Observatory is funded by the National Science Foundation, which collaborates with the Max Planck Gesellschaft to support Einstein@Home.

Einstein@Home web site: http://einstein.phys.uwm.edu/

Material additional to publication:
http://www.aei.mpg.de/english/contemporaryIssues/akt_news/pressinfo/index.html

Additional Background Material

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. Einstein@Home was developed as part of the World Year of Physics 2005 activities of the American Physical Society. For the past five years, Einstein@Home has been searching for gravitational waves in data from the U.S. LIGO detectors.

Radio pulsars are rapidly spinning neutron stars that emit lighthouse-like beams of radio waves that can sweep past the Earth as often as 716 times per second. They were discovered in 1967 by Jocelyn Bell and Antony Hewish. (Coincidentally, the first one to be discovered was also in the constellation of Vulpecula.) Pulsars that have orbiting companions are called binary pulsars. They have been used to verify Einstein's theory of general relativity to very high precision.

Disrupted Recycled Pulsar: When two massive stars are born close together from the same cloud of gas, they can form a binary system and orbit each other from birth. If those two stars are at least a few times as massive as our Sun, their lives will both end in supernova explosions. The more massive star explodes first leaving behind a neutron star. If the explosion does not kick the second star away, the binary system survives. The neutron star can now be visible as a radio pulsar, and slowly loses energy and spins down. Later, the second star can swell up, allowing the neutron star to suck up its matter. The matter falling onto the neutron star spins it up and reduces its magnetic field. This is called "recycling" because it returns the neutron star to a quickly-spinning state. Finally, the second star also explodes in a supernova, producing another neutron star. If this second explosion also fails to disrupt the binary, a double neutron star binary is formed. Otherwise, the spun-up neutron star is left with no companion and becomes a "**disrupted recycled pulsar**", spinning between a few and 50 times per second.

Arecibo Observatory is the largest single-dish 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 Pulsar ALFA (PALFA) survey now being conducted at Arecibo uses a specialized radio camera, the Arecibo L-band Feed Array, and is conducted by the PALFA Consortium of astronomers. 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 from the Cornell Center for Advanced Computing 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 and Cornell for further investigation.

The Pulsar ALFA (PALFA) Consortium was formed in 2003 to conduct a large scale pulsar survey with the Arecibo telescope. It includes astronomers at twenty universities, institutes and observatories worldwide.

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. The AEI Hannover is a joint undertaking of the Max Planck Society and the Leibniz Universität Hannover. Together with British partners 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 is used in the Einstein@Home radio searches was developed by the AEI in Hannover.

The Center for Gravitation and Cosmology at 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).

BOINC is the Berkeley Open Infrastructure for Network Computing used by Einstein@Home and many other volunteer computing projects like SETI@Home. It was developed at the University of California at Berkeley's Space Sciences Laboratory,
in an effort led by Dr. David Anderson.

Funding
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Useful links

Max Planck Institute for Gravitational Physics (Albert Einstein Institute): http://www.aei.mpg.de/

Material additional to publication:
http://www.aei.mpg.de/english/contemporaryIssues/akt_news/pressinfo/index.html

Arecibo Observatory: http://www.naic.edu/
Einstein@Home: http://einstein.phys.uwm.edu/
Einstein@Home Arecibo Radio Pulsar search: http://einstein.phys.uwm.edu/radiopulsar/html/index.php
BOINC: http://boinc.berkeley.edu/
Cornell Center for Advanced Computing: http://www.cac.cornell.edu/
LIGO Scientific Collaboration: http://www.ligo.org/
Pulsar Arecibo L-band Feed Array (PALFA) Consortium: http://arecibo.tc.cornell.edu/PALFA/
LIGO Group, University of Wisconsin - Milwaukee: http://www.lsc-group.phys.uwm.edu/
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