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Jodrell Bank Centre for Astrophysics

Pulsar Astronomers win the European Union Descartes Prize for Research

2nd December 2005

A collaboration of European research teams (The Pulsar Science in Europe - PULSE - collaboration) led by Professor Andrew Lyne of the University of Manchester, have been awarded the European Commission's prestigious 2005 Descartes Prize for Research.

The Descartes Prize is awarded to teams of researchers who have achieved outstanding scientific and technological results through collaborative research. PULSE's award was for their continuing research into the use of pulsars to study some of the most extreme physical conditions in the universe and test its most fundamental laws.

A pulsar is a small, rapidly spinning and highly magnetised neutron star that results from the violent collapse of a massive star in a supernova explosion. The giant star's core, weighing nearly a million times the mass of the Earth, is condensed into an incredibly dense body typically some 20km across. As they rotate, they emit powerful beams of radio waves from above their magnetic poles and which sweep across the Galaxy like a light-house beam. Should the beams cross the Earth, radio telescopes will detect pulses of emission which are, in effect, the ticks of a highly accurate clock. Their period is set by the rotation speed of the pulsar and ranges from a just over a millisecond up to a few seconds.

The PULSE collaboration is between the pulsar groups at the University of Manchester's Jodrell Bank Observatory, the Max Planck Institute for Radioastronomy in Germany, ASTRON in the Netherlands, the INAF Astronomical Observatory of Cagliari in Italy and the University of Thessalonika in Greece.

The success of PULSE was only possible because of the unique position of Europe having the largest number of 100m-class radiotelescopes required to observe the weak pulsars. The collaboration used the telescopes at Jodrell Bank, Effelsberg, Westerbork and Bologna.

PULSE was initiated in 1995 with a grant from the European Union with the aim of creating a team who could undertake large scale research projects that were otherwise too big for the individual groups on their own. The work of the Manchester group, the largest in the collaboration, is largely funded the United Kingdom's Particle Physics and Astronomy Research Council.

The group's crowning achievement has been the discovery and follow-up observations, made in collaboration with Australian astronomers, of the first known double pulsar. Studies of the double pulsar have enabled them to make the most accurate confirmation yet of Albert Einstein's general theory of relativity - the theory of gravity which supplanted that of Isaac Newton. "Rarely does a single class of object lend itself to high-precision experiments in so many domains of modern and

fundamental physics," enthuses Dr Michael Kramer of the University of Manchester.

The importance of the collaboration was emphasised by Professor John Seiradakis of the University of Thessalonika: "The bringing together of groups across Europe has enabled us to benefit from collaborative instrumentation and software effort, the sharing of expertise and training opportunities and the co-ordination of observing programmes."

PULSE has enabled the setting up of a unified data format for the easy exchange of pulsar data and has designed and performed unique experiments to understand pulsars. Ten years on, the team are world leaders and their research achievements cover a wide field, not only in studying the extreme physics of the pulsars themselves, but also in using them as probes of the galaxy through which their signals pass.

Professor Lyne underlines the importance of the collaboration: "Our work increases mankind's knowledge of some of the fundamental laws that govern the universe. These results are not only of interest to today's scientific professionals. They also help to interest young people in astronomy, physics and basic research, forming an important foundation for a society increasingly based on science and technology."

Additional Information:

Discovery of the double pulsar

Whilst the 100m class European instruments were ideal for developing for developing and testing new techniques, the best chance of detecting new pulsars comes from observing the central regions of our disc-like galaxy. Professor Nichi D'Amico from INAF explains: "This is not seen well from the northern hemisphere and so we sought the collaboration of the Australian Telescope National Facility (ATNF), which operates the 64-m Parkes Telescope in New South Wales".

The Parkes Telescope was equipped with a 13-beam receiver system jointly developed by Jodrell Bank Observatory, the ATNF and the INAF group. Then followed a massive 5-year experiment that enabled them to discover over 750 pulsars, more than had been discovered in the previous 30 years, amongst which was one of the holy grails of pulsar astronomy - the double pulsar.

Einstein's theory of General Relativity predicts that two objects in orbit around each other would emit gravitational waves causing them to gradually spiral in towards each other until they coalesce in a gigantic explosion. The current separation of the two pulsars is nearly a million kilometres, about the size of the Sun, and the group have measured a reduction in their separation of just 7mm per day - precisely what has been predicted.

Joint efforts to understand pulsars

PULSE is using the European telescopes to observe the double pulsar also to understand the working of pulsars and hence physics under extreme conditions with magnetic and gravitational fields many billion times stronger than those encountered anywhere on Earth. Ben Stappers from ASTRON explains: "The results obtained from studying the double pulsar can be compared to the results of the many other experiments that we have done jointly in the past on other sources. Such a

comparison would be almost impossible without the common data format." Hardware and software developed by PULSE has enabled simultaneous observations of weak pulses to be made by telescopes across Europe. Axel Jessner from the Max Planck Institute comments: "The experiments are very difficult and require the largest telescopes on Earth. The energy that would be collected with our telescopes from a pulsar during the lifetime of the whole Universe would light up a torch for only one second."

Further information and images relating to this press release can be found at: http://www.jb.man.ac.uk/descartes/

Further Information about the Descartes Prize may be found at: http://europa.eu.int/comm/research/descartes/index_en.htm

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(Note: Andrew Lyne, Michael Kramer, John Seiradakis, Axel Jessner and Ben Stappers will be receiving the prize in London on Friday 2nd December so contacts on that day are Duncan Lorimer and Ian Morison below.)

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