The Large European Array for Pulsars

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EPTA

In Europe, five 100-m class telescopes are being used to form the European Pulsar Timing Array (EPTA). A pulsar timing array (PTA) uses an array of millisecond pulsars (MSPs) as the endpoints of a galaxy-scale gravitational wave (GW) detector. Two other PTAs are the Parkes Pulsar Timing Array and the North American Nanohertz Observatory for Gravitational Waves. The EPTA benefits from having five telescopes in terms of sensitivity, sky coverage and flexibility. The telescopes are: the *Westerbork Synthesis Radio Telescope,* the *Effelsberg Radio Telescope,* the *Lovell Radio Telescope,* the *Nançay Radio Telescope* and the *Sardinia Radio Telescope (see right column).*

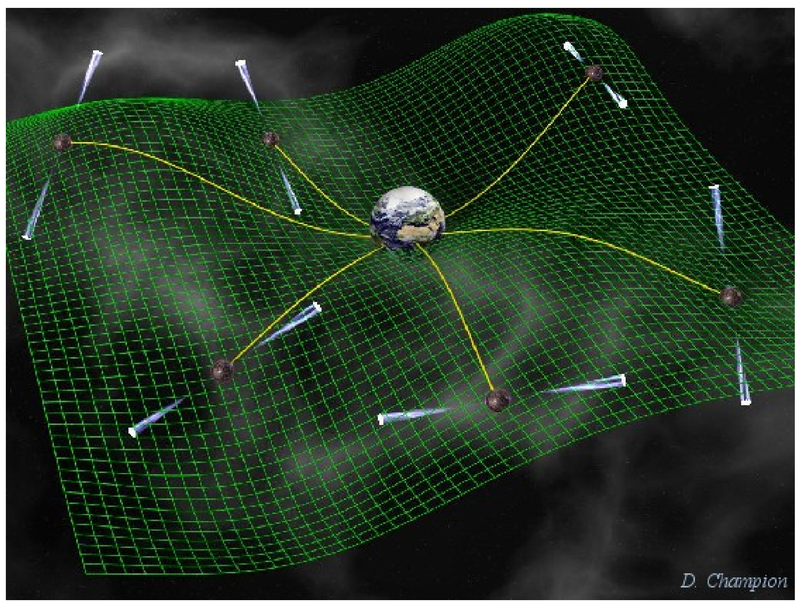
LEAP

Recently the EPTA has made a giant `leap' forward thanks to European funding of the Large European Array for Pulsars (LEAP). This prestigious project involves coherently combining the five EPTA-telescopes to make the equivalent of a fully steerable 194-m dish. This will improve the TOAs by an order of magnitude, possibly leading to a first detection of GWs within five years. LEAP is also an important demonstrator for the SKA where baselines up to thousands of kilometres will need to be coherently combined to create a phased array for pulsar timing.

LEAP summary:

- **Tied array telescope, equivalent of *194-m steerable dish*.**
- **Declination capability: *-30^o to 90^o*.**
- **Funded by EU, 2.5 MEuro grant to M. Kramer.**
- **5 full-time postdocs for development / observations / analysis.**
- **Aimed at a detection of GW by timing 20 pulsars to 100 ns for 5 years (Jenet et al. 2005).**

Gravitational Waves



A pulsar timing array, detecting the stochastic gravitational wave background.

GWs are small disturbances in space-time, caused by the motion of masses. These waves are so weak that only the strongest waves, such as caused by the coalescence of supermassive black holes (SMBHs) in the early universe or cosmic string oscillations, have a chance of being detected. In a PTA, accurate observations of the arrival times of the radio-pulses from millisecond pulsars act as a galaxy-scale GW detector. It is sensitive to GWs with a frequency in the nano-Hertz regime, which corresponds to the regime of the stochastic GW background caused by the coalescence of SMBHs in the early universe. This makes PTAs complimentary to other GW detectors such as LIGO, VIRGO and LISA.

Telescopes used by LEAP

Left column from top to bottom: Sardinia Radio Telescope, Nançay Radio Telescope, Effelsberg Radio Telescope. Right column from top to bottom: Westerbork Synthesis Radio Telescope, Lovell Radio Telescope.

Progress

- Pipeline created to correlate raw data using correlation package DiFX.
- A FPGA based hardware backend has been developed for Jodrell Bank, Effelsberg and Nançay, providing baseband signals up to 512 MHz delivered as 16 MHz subbands, which are recorded on a dedicated storage node.
- Fringes have been detected between WSRT and Effelsberg.
- A pipeline for phased summation of all LEAP-telescopes is near completion.

References

Ferdman et al. 2010, CQGra, 27, 8
Jenet et al. 2005, ApJ, 625,L123
Deller, Tingay, Bailes & West 2007, PASP, 119, 318

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