



# Report from the event supported by RadioNet

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**TITLE** *EUROPEAN PULSAR TIMING ARRAY COLLABORATION MEETING*

**DATE:** *18-20 APRIL 2018*

**LOCATION:** *NORWICH, UNITED KINGDOM*

**MEETING WEBPAGE:** *<https://rferdman.wixsite.com/epta>*

**HOST INSTITUTE:** *UNIVERSITY OF EAST ANGLIA (UEA)*

**RADIONET  
BENEFICIARY / NO:** *OSO / 7*

# Report:

## 1 SCIENTIFIC SUMMARY

The European Pulsar Timing Array (EPTA) is a collaboration that seeks to detect gravitational waves (GWs) from interacting supermassive black holes in distant, merging galaxies, using long-term observations of pulsars. It has membership based in several European countries: The United Kingdom, France, Germany, The Netherlands, and Italy. It is based around the five 100 metre-class based in those countries.

Every meeting of the EPTA includes discussion of discussion on the topic of this goal of GW detection, as well as the vast amount of ancillary science that can be performed using the voluminous data sets that arise as a direct result of this collaboration. In what follows, I describe some of the highlights of this meeting.

The first day of the meeting overlapped with the last day of the SPINS-UK meeting, a UK neutron-star science network, which was holding its first meeting in Norwich. We combined both meetings together to present a varied programme. It began with a session on future telescope science, from the MeerKAT array and the Square Kilometre Array – of great relevance to the EPTA, as future pulsar work will reach new heights with these telescopes. The following two sessions had EPTA members giving summary talks on the diverse science that EPTA work has and will continue to perform: this not only includes pulsar timing arrays and GW detection, but also astrophysics on a wide range of scales, from solar system dynamics to galaxy formation rates and mechanisms. The final session switched back to non-radio neutron star observations, in the X-ray as well as in GWs, with the latter discussing the recent multi-messenger double neutron star binary merger, GW170817. It was a very informative and interesting day, and allowed the EPTA to demonstrate the impact and breadth of its science.

The second day began the EPTA in earnest, with updates on the operations and data collection from each of the five EPTA telescopes: **The Lovell telescope** (UK); **Effelsberg** (Germany); **Nançay** (France); **Westerbork** (The Netherlands); and the **Sardinia Radio Telescope** (Italy). The meeting was generally divided into working group-led sessions. This format began with the timing working group, which included updates on the GW-centred work, and also included several secondary science projects, including precision tests of general relativity with PSR J2222–0137 and PSR J1012+5307. The final science session involved talks about work on the Large European Array for Pulsars (LEAP), a coherent array of all EPTA telescopes, giving a boost in collecting area and therefore sensitivity, comparable to the Arecibo radio telescope. This session demonstrating the kind of science in which LEAP is particularly and uniquely strong: giant pulse detection in millisecond pulsars; targeted pulsar searches in globular clusters; and precision astrometry of millisecond pulsars.

The third and final day of presentations began with a session from the data analysis working group, which work specifically on the GW detection and characterisation from the resulting pulsar timing analysis. This included talks on novel techniques (e.g. null-stream and spherical-harmonic analysis), and theoretical *lower* limits on the GW amplitude at nanohertz frequencies. The session concluded with a practical demonstration of the software package named *Enterprise*, which aims to provide the tools with which GW data analysis can be done with pulsar-derived data sets. The final session of the meeting concerned itself with the interstellar medium (ISM), and its characterisation on a number of fronts. This included telescope and sources that are not currently used by the EPTA for GW detection efforts, but that provide valuable input into our understanding of how to deal with the ISM in our data analysis. This included a summary of studies of millisecond pulsars and the Solar Wind using the **LOFAR array**, and of dispersion measure variations seen in the Crab pulsar.

Since this was a collaboration meeting, there was also ample time set aside in the meeting schedule for discussion about data releases and data sharing with other pulsar timing array collaborations around the world, and the International Pulsar Timing Array (IPTA) collaboration, a consortium of the North American, Australian, and European collaborations. We also discussed current and upcoming EPTA projects. We will not discuss further the content of these internal (and often political) collaboration discussions, but they were extremely useful and some very good progress was made on several points.

Overall, this meeting was very much a success, and has given us a great deal of work to look forward to in preparation for the upcoming IPTA meeting in the US this June, as well as the following EPTA meeting in Bielefeld, Germany in October.

This meeting had several impacts on the community. Firstly, it allowed our science to be more widely demonstrated beyond collaboration members, during the first “overlap” day with the SPINS-UK consortium meeting. Additionally, there was a large student representation at the meeting, not only in attendance, but in presenting their work. It showed just how vital students are to the success of the EPTA and European science in general. Finally, work using Radionet telescopes and facilities was highlighted throughout the meeting, including the Effelsberg radio telescope, and the LOFAR array — including the German GLOW consortium.

Event webpage: <https://rferdman.wixsite.com/epta/programme>



**Left:** Alberto Sesana speaking about Pulsar Timing Array theory; **Right:** Caterina Tiburzi discusses using pulsar observations to study the Solar Wind.

## 2 AGENDA OF THE EVENT

### Wednesday, 18 April 2018

10:00 – 10:15: **Introduction and welcome**, Robert Ferdman (UEA, UK)

10:15 – 11:00: **Session: Next-Generation observatories**

- *Neutron star science with the Square Kilometre Array*, Evan Keane (SKA Organisation, UK)
- *MeerTRAP: A real-time survey for fast radio transients and pulsars with MeerKAT*, Sotiris Sanidas (University of Manchester, UK)

11:00 – 11:30: **Coffee/Tea**

11:30 – 12:30: **Session: Pulsar Timing Arrays I**

- *The European Pulsar Timing Array: experimental design, observation strategy and a LEAP to the future*, Kuo Liu (MPIfR, Germany)
- *Pulsar Timing Arrays in theory*, Alberto Sesana (University of Birmingham, UK)

12:30 – 14:00: **Lunch**

14:00 – 15:00: **Session: Pulsar Timing Arrays II**

- *Probing Solar System kinematics with IPTA data*, Nicolas Caballero (MPIfR, Germany)
- *Constraining galaxy merger rates with PTAs*, Siyuan Chen (University of Birmingham, UK)

15:00 – 15:30: **Coffee/Tea**

15:30 – 16:30: **Session: Neutron stars: multi-wavelength and multi-messenger**

- *Neutron Stars and MAGNETARSs with IXPE, eXTP, and more*, Silvia Zane (MSSL/UCL, UK)
- *GW170817 and beyond: Inferring the properties of coalescing neutron stars with gravitational waves*, Christopher Berry (University of Birmingham, UK)

### **Thursday, 19 April 2018**

09:30 – 10:00: **Session: Telescope updates**

- *Effelsberg*, James McKee (MPIfR, Germany)
- *Jodrell Bank*, Benjamin Stappers (University of Manchester, UK)
- *Nançay (+NenuFAR)*, Gilles Theureau (Obs. de Paris/CNRS, France)
- *WSRT (+LOFAR)*, Gemma Janssen (ASTRON, The Netherlands)
- *Sardinia*, Delphine Perrodin (INAF – OAC, Italy)

10:00 – 11:00: **Session: Timing Working Group I**

- *Update on the Timing Working Group*, Ben Perera (University of Manchester, UK)
- *GW Limits with PSR J1713+0747 High-Cadence Timing*, Ben Perera (University of Manchester, UK)
- *Scalar-Tensor Gravity Limits with PSR J2222-0137*, Lorenz Haase (MPIfR, Germany)

11:00 – 11:30: **Coffee/Tea**

11:30 – 12:30: **Session: Timing Working Group II**

- *Update on Pulsar Timing at Nançay*, Lucas Guillemot (LPC2E/Université d'Orléans, France)
- *PSR J1012+5307 Timing Update*, Madhuri Gaikwad (MPIfR, Germany)
- *Status of NANOGrav Data Releases*, Tim Pennucci (ELTE, Hungary)

12:30 – 14:00: **Lunch**

14:00 – 15:00: **Discussion: EPTA data release 2.0**

15:00 – 15:30: **Coffee/Tea**

15:30 – 16:30: **Session: LEAP Working Group**

- *Update on the LEAP Working Group*, Kuo Liu (MPIfR, Germany)
- *PSR B1937+21 Giant Pulses Using LEAP*, James McKee (MPIfR, Germany)
- *GC M28 Pulsar Search and PSR B1821-24A Giant Pulses*, Lin Wang (University of Manchester, UK)
- *MSP Positions using LEAP*, Madhuri Gaikwad (MPIfR, Germany)

16:30 – 17:30: **Discussion: EPTA/IPTA politics**

### **Friday, 20 April 2018**

09:00 – 10:45: **Session: Data analysis working group**

- *Update on the Data Analysis Working Group*, Siyuan Chen (University of Birmingham, UK)
- *Analyzing Resolvable PTA Sources with Null Streams*, Janna Goldstein (University of Birmingham, UK)
- *Spherical Harmonic Analysis of PTA Timing Residuals*, Elinore Roebber (University of Birmingham, UK)
- *Robust Lower Limit to the nHz Stochastic GWB*, Enrico Barausse (IAP/CNRS, France)

10:45 – 11:00: *Enterprise Demonstration*, Janna Goldstein (University of Birmingham, UK)

11:00 – 11:30: **Coffee/Tea**

11:30 – 12:30: **Discussion: EPTA projects**

12:30 – 14:00: **Lunch**

14:00 – 15:00: **Session: Interstellar medium working group**

- *Update on the ISM Working Group*, James McKee (MPIfR, Germany)
  - *Updates on the Solar Wind with GLOW, LOFAR, and WSRT*, Caterina Tiburzi (University of Bielefeld, Germany) and Golam Shaifullah (ASTRON, The Netherlands)
  - *MSP DM Variations with LOFAR and GLOW*, Julian Donner (MPIfR, Germany)
- Scattering and DM Variations in the Crab Pulsar*, James McKee (MPIfR, Germany)

15:00 – 15:30: **Coffee/Tea**

15:30 – 16:30: **Informal discussion/end of meeting**

### **3 PARTICIPANTS**

**Number of participants: 30**

**Geographical distribution:**

- France: 3
- Germany: 8
- Hungary: 1
- Italy: 3
- The Netherlands: 2
- UK: 11

**Number of young researchers and students:**

- Students: 10
- Postdocs: 7

**Gender:**

- Female: 7
- Male: 23

**Conference photo:**



#### 4 RADIO NET FINANCIAL CONTRIBUTION

Approximately one-third of the RadioNet financial support (3000€) was used to pay for conference expenses (catering, room hire), and two-thirds is to be used for 6 delegate expense claims (presenters of results from RadioNet infrastructures).

#### 5 CONFIRMATION:

Following the Regulation (EU) 2016/679 - General Data Protection Regulation-, we ask you to confirm that RadioNet is allowed to publish this report, incl. participants lists, statistic's details, pictures, etc.

***I CONFIRM THAT RADIO NET IS ALLOWED TO PUBLISH THIS REPORT, INCLUDING THE PARTICIPANT LIST, STATISTICS, DETAILS, AND PICTURES.***

A handwritten signature in blue ink, appearing to read "Robert", written in a cursive style.