Report from event supported by RadioNet

TITLE	*EPTA 2019 AUTUMN WORKSHOP*
DATE:	*OCTOBER 7-9TH, 2019*
LOCATION:	*MARCOUX, FRANCE*
MEETING WEBPAGE:	*https://epta2019b.sciencesconf.org/*
HOST INSTITUTE:	*STATION DE RADIOASTRONOMIE, CNRS, FRANCE*
RADIONET BENEFICIARY / NO:	*OBSPARIS / 10*

RadioNet has received funding from the EU's Horizon 2020 research and innovation programme under the grant agreement No 730562

Report:

1. SCIENTIFIC SUMMARY

The European Pulsar Timing Array (EPTA) is a consortium of European radio observatories and research teams created in 2006. Its main science objective is the detection of gravitational waves in the nHz-μHz domain. This is a long term project that requires the collection of data time series over decades, advances in the theoretical understanding of the gravitational sky and the development of new generations of algorithms to separate the multiple sources of noise superimposed on the signal of interest. The collaboration is structured in methodological working groups (instrumental development, timing data acquisition, data analysis, simulations and data challenges) interacting monthly through teleconferences. It also meets twice a year in face-to-face workshops, in spring and autumn.

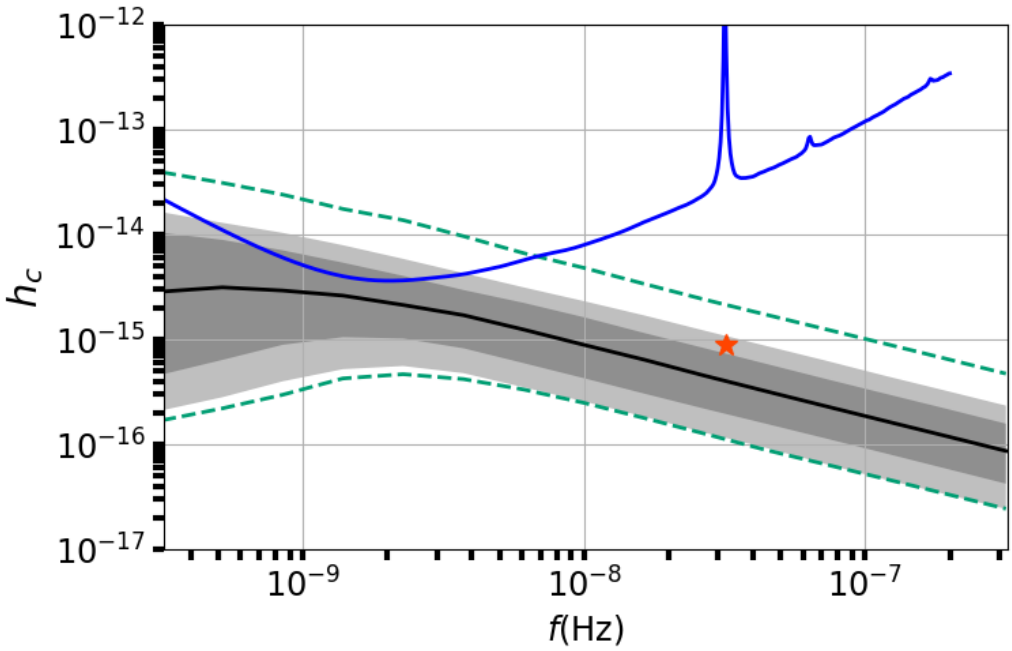

Figure : (From *Chen et al 2019).* First constraints of Pulsar Timing Arrays (PTA) on the population of Super Massive Black Holes Binaries (SMBHB). One can directly compare astrophysical observations of galaxy mergers + black hole/galaxy relations with PTA data. The gravitational wave spectrum is presented as strain (h_c) vs frequency. The green line show the prior distribution from astrophysical models. The analysis uses all pulsar parameters and gravitational wave parameters and is based on IPTA DR2 data (Perera et al 2019). The shadow area show the posterior distribution of the population, while the blue line is the gravitational wave upper limit from the last PTA analysis and the red stars is the limit at frequency 1 yr^{-1} assuming circular SMBHB orbits. We can see that PTA upper limits are starting to probe astrophysically interesting parameter space. Constraints are consistent with current observations.

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RADIONET RELEVANCE

Five European radio telescopes participate in the collection of millisecond pulsar times of arrival, using state of the art dedicated backends designed to coherently dedisperse the signal after its travel through the ionised interstellar medium (ISM). At each telescope, the observing time dedicated to high precision pulsar timing goes from a few hundred to a couple thousand hours per semester. The instrument involved are the Lovell telescope (Manchester, UK), Effelsberg (Bonn, Germany), WSRT (Westerbork, NL), SRT (Cagliari, Italy) and NRT (Nançay, France). In parallel to the high cadence observations conducted at each individual telescope, the LEAP experiment provides once a month, in 25 hours sessions, coherently added beamformed data from the five instruments. This provides us with additional high sensitivity data from a 200-m equivalent dish. Furthermore, LOFAR also contributes to e.g. second order monitoring of the ISM dispersion measure and there is an ongoing project to involve e-Merlin, just as for LEAP, through the coherent addition of a subset of its antennas.

IMPACT

The EPTA acts as a school to form young pulsar radio astronomers, and coordinates multiple short term scientific projects that are led by European students and post-docs. EPTA bi-annual workshops are both a place of scientific exchanges about the last developments within the different working groups and projects, and a place of debate and management of the collaboration. This is where we collectively elaborate the guidelines of the collaboration, write down or update the various policies (authorships, membership, structure), define and set-up student/post-doc projects, and where we discuss the interface of the European group with the rest of the world.

In the Autumn 2019 edition, we focused the discussion on the scientific roadmap of the collaboration and we organised tutorials for the main part of the data analysis process, from data reduction, through pulsar and noise modelisation, up to gravitational wave analysis techniques. The first session was dedicated to student and workshop projects.

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2 AGENDA OF THE EVENT

7.10.2019, Monday Morning

Executive Committee Summary (Kuo Liu, Lucas Guillemot) 10'

Data Analysis (40')
Overview of the DA group activity, Siyuan Chen
Analysing PTA correlations in the fourier domain: a piece of PTACAKE, Janna Goldstein & Elinore Roebber
Impact of planetary ephemerides on PTA, Aurélien Chalumeau
Multiple GW sources PTA algorithms, Mikel Falxa

Timing/ISM (40')
Overview of the Timing Group Activity, Golam Shaifullah
IA applied to RFI mitigation in NRT pulsar timing pipeline, Anaïs Berthereau
Constraining DM variations with GLOW, Julian Donner
Timing B1937+21 with 2D template, Emma van der Wateren

LEAP (30')
Update from the LEAP working group, Kuo Liu
Scintillation studies with LEAP, Robert Main
Giant pulse studies in PSRB1821+24A, Lin Wang

Telescopes updates (40')
JBO – Benjamin Shaw
WSRT/LOFAR – Golam Shaifullah
SRT – Delphine Perrodin
NRT – Ismaël Cognard
Effelsberg – Kuo Liu

Monday Afternoon - Tutorials

1) TOA creation (including 2D template matching) (60') (Kuo Liu)

2) Data combination (60') (Golam Shaifullah)

3) pulsar & noise models / TempoNest analysis (60')
(Gregory Desvignes, Antoine Petiteau)

4) GW analysis ENTERPRISE analysis (60')
(Siyuan Chen, Stanislav Babak)

8.10.2019, Tuesday (full day workshop parallel sessions)

Preliminary discussion: *agreement on the data format of the par+tim files (30')*

parallel session 1: *from archives to combined TOAs (chair: Delphine Perrodin)*

parallel session 2: *noise and gravitational wave analysis (chair: Siyuan Chen)*

9.10.2019 Wednesday Morning

restitution of parallel sessions (chair: Kuo Liu, Antoine Petiteau) (40')

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discussion about protocols and formats (chair: Delphine Perrodin) (40')
discussion about the Scientific Roadmap (chair: Lucas Guillemot) (60')
conclusions and futures actions (Gilles Theureau) (20')

3. PARTICIPANTS

Participants came from all over Europe, from the Institutes participating to the EPTA collaboration (MPIfR, Paris Observatory, Orléans University, Manchester University, Birmingham University, Bielefeld University, Cagliari Observatory, Milano University, ASTRON). There were 26 actually attending participants, among them: 8 women and 19 men, 8 students, 7 post docs and 12 faculty staff members. A few people (5-8) participated remotely to the Monday and Wednesday sessions.

We had three last minute cancellations, due to personal reason or travel problems.

RADIONET FINANCIAL CONTRIBUTION

The RadioNet funding of 1500€ was used to cover entirely the accommodation, meals and coffee breaks for six of the participating PhD students.

PUBLICATIONS

- *In case of future publication - please provide additional information: place & date. Remember to insert the acknowledgment of the RadioNet support:*

The project leading to this publication has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730562 [RadioNet]

CONFIRMATION

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