Report from the event supported by RadioNet

TITLE	*INTERNATIONAL PULSAR TIMING ARRAY ANNUAL CONFERENCE*
DATE:	*JUNE 26TH – JULY 7TH, 2017*
LOCATION:	*PARIS (SÈVRES), FRANCE*
MEETING WEBPAGE:	*http://ipta.phys.wvu.edu/index.html*
HOST INSTITUTE:	*PARIS OBSERVATORY*
RADIONET BENEFICIARY / NO:	*TO BE FILLED BY MANAGEMENT*

accepted on 13.7.2017

Isabelle Pott

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 International Pulsar Timing Array collaboration is made of the contributions of three continental consortia: EPTA in Europe, PPTA in Australia and NanoGRAV in North America. Its primary goal is to detect gravitational waves in the Nanohertz regime using radio pulsar timing observations.

This year the annual IPTA conference took place in Sèvres, France. As usual, it has started with a Student Workshop preparing the new generations of scientists to both the technics of pulsar timing and gravitational wave analysis.

The student week was organized mainly in lectures in the morning and practice exercises in data analysis and statistical methods, using the tools provided by the community (Tempo2, TempoNest, PSRCHIVE, PINT). This program was completed by invited seminars with local expert in e.g. Reference Time Scale (G.Petit), Planetary Ephemerides (A.Fienga), General Relativity (A.LeTiec, E.Gourgoulhon), Plasma Physics (J.M.Griessmeier). 25 students from graduate to Post-doc level participated to this school, surrounded by 10 lecturers from the IPTA collaboration.

The Science Meeting followed the week after, gathering 78 participants (19 women) from all over the world. The agenda was organized in coherent sessions, with series of 15 minutes talks and a long discussion session closing the day. The defining moment of the meeting was the open day about multi-messenger gravitational wave astronomy on Wednesday July 5th, that gathered invited speakers from connected fields, and covered the last results from LIGO/Virgo, LISA collaboration, CMB polarization B-modes, gravitational antenna MIGA, GRAVITY experiment at VLT, and of courses the Pulsar Timing Array across the world. The other days were devoted to data gathering and radio telescopes updates, to gravitational wave analysis techniques, to the methods for characterizing the various forefronts (intrinsic pulsar noise, interstellar medium imprints, planetary ephemerides systematics etc...) and to the ongoing collaborative projects. The discussions addressed questions such as general organization, publication and communication policy, data homogenization issues between telescopes and backends and prospective plans for the future of the consortium, including the rising weight of South African and Chinese contributions.

Kuo Liu (MPIfR, Bonn) introducing the topic to a group of 30 students and post-docs on Monday June 26th.

Li Di, project scientist of FAST, presenting the last news from the newborn giant radio telescope in China on Monday July 3rd.

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Radionet supports the European Pulsar Timing Array program since its foundation in 2006. The Transnational Access funding also supports most of the European facilities involved in this PTA world wide program: Effelsberg, GR; Jodrell Bank, UK; Westerbork, NL; Nançay, FR; Sardinia Radio Telescope, IT; Parkes, AU, Green Bank and Arecibo telescopes, US. The European radio telescopes are all allocating an important part of their observing time to the PTA program, providing high precision homogenized pulsar Times of Arrival (TOAs) as well as new millisecond pulsar targets through dedicated search surveys. This annual meeting is a unique showcase for sharing our high quality European timing data, in particular those produced with multi-telescope phased array (LEAP experiment). These is also a unique environment to form our European students to the new algorithms and technics to analyze these data. Furthermore, most of the lecturers for the student week were part of the Radionet institutes, and this participates to their influence on the international scene.

2. AGENDA OF THE EVENT

IPTA 2017 Student Week Schedule

Monday, June 26
09:00 – 09:10 Welcome/Bienvenue à Paris [Gilles Theureau]
09:10 – 10:10 [Lecture]: Introduction to pulsar timing [Kuo Liu]
10:10 - 10:30 Overview of student presentations [Delphine Perrodin]
10:30 – 11:00 Coffee break / Undergraduate student meeting [Jeffrey Hazboun]
11:00 – 12:30 [Lecture] Introduction to reference time scales [Gérard Petit, BIPM]
12:30 – 13:30 Lunch
13:30 – 15:00 [Lecture] The INPOP planetary ephemeris [Agnès Fienga, OCA, Nice]
15:00 – 15:30 [Activity] Pulsar timing I: TOA extraction with PSRCHIVE [Kuo Liu, Stefan Oslowski, James McKee]
15:30 – 16:00 Coffee break
16:00 - 17:30 [Activity] Pulsar timing I: TOA extraction with PSRCHIVE

Tuesday, June 27
09:00 -10:30 [Lecture] Post-Keplerian effects in binary systems [Alexandre Le Tiec, LUTh]
10:30 - 11:00 Coffee break
11:00 – 11:30 [Lecture + Demo]: Introduction to TEMPO2 [James McKee]
11:30 – 12:30 [Activity] Pulsar timing II: Familiarization with TEMPO2 [James McKee, Lucas Guillemot, Kuo Liu, Stefan Oslowski]
12:30 – 14:00 Lunch
12:30 – 13:30 Women's lunch (CIEP cafeteria)
14:00 – 14:30 [Activity] Pulsar timing II – TEMPO2
14:30 – 15:30 [Lecture+Demo] Introduction to PINT [Luo Jing]
15:30 – 16:00 Coffee break
16:00 – 17:30 [Activity] Pulsar timing III: Familiarization with PINT [Luo Jing]
20:30 Babyfoot (foosball) tournament

Wednesday, June 28
09:00 – 10:00 [Lecture] Introduction to gravitational wave science [Jeffrey Hazboun]
10:00 – 11:00 [Lecture] Astrophysical sources of GW [Alberto Sesana]
11:00 – 11:30 Coffee break
11:30 – 12:30 [Lecture] Detection of GWs with PTAs [Delphine Perrodin]
12:30 – 14:00 Lunch
14:00 – 15:00 Sources of noise in PTA datasets; Bayesian methods [Lindley Lentati]
15:00 – 15:30 [Activity] Pulsar timing noise [Lindley Lentati, Jeffrey Hazboun]

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15:30 – 16:00 Coffee break
16:00 – 17:30 [Activity] Pulsar timing noise

Thursday, June 29
09:00 – 09:45 [Lecture] Data analysis techniques for GW detection [Antoine Petiteau, Paul Baker]
09:45 – 10:30 [Lecture] Interstellar medium, dispersion and scattering effects [Jean-Mathias Griessmeier]
10:30 – 11:00 Coffee break
11:00 – 12:30 [Lecture] the Galactic central BH and the no hair theorem [Eric Gourgoulhon, LUTh]
12:30 – 14:00 Lunch
14:00 – 15:30 [Activity] Running GW detection pipelines [Paul Baker, Antoine Petiteau]
15:30 – 16:00 Coffee break
16:00 – 17:00 [Activity] Running GW detection pipelines
17:00 – 17:30 Student presentation preparation and Q&A [everyone]

Friday, June 30
09:00 – 10:00 [Lecture] Pulsar searches, discovery, confirmation and timing [Peter Gentile]
10:00 – 10:30 Student presentations I
10:30 – 11:00 Coffee break
11:00 - 12:00 [Lecture] Developing PSRCHIVE tools [Stefan Oslowski]
12:00 – 12:30: Student presentations II
12:30 – 14:00 Lunch
14:00 – 15:30 Student presentations III
15:30 – 16:00 Coffee break
16:00 – 17:00 Career panel

IPTA 2017 Science Meeting Program

Monday

I. Radio telescopes (09:50 – 12:30) *(chair : Ismaël Cognard)*

Gilles Theureau, *Welcome address (10')*

Delphine Perrodin, *Pulsar science at the Sardinia Radio Telescope (15+5')*

Fronefield Crawford, *The Arecibo remote command center network (15+5')*

Renée Spiewak, *Secondary Science with the GBT North Celestial Cap Survey (15+5')*

11:00 – 11:30 coffee break

Xinping Deng, *Observing with a phased array feed at the Parkes Telescope (15+5')*

Li Di, *A Pulsar-Galaxies-MW-FRB Commensal Survey Plan for the Five-hundred-meter Aperture Spherical radio Telescope (15+5')*

Jingbo Wang, *New radio telescope -- QTT 110 meter and Tianma 65 meter radio telescope and Pulsar Timing Array in China (15+5')*

12:30 – 14:20 lunch break

II. Timing data (14:20 - 15:40) *(chair : Gregory Desvignes)*

Richard Manchester, *PPTA project (15+5')*

Kuo Liu, *Overview and update on the LEAP (15+5')*

James Mc Kee, *new backend generation EPTA data set (15+5')*

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David Nice, *NANOGrav overview (15+5')*

15:40 – 16:10 coffee break

Andrea Lommen, *Precision timing with NICER (15+5')*

Peter Gentile, *Polarization calibration of NANOGrav's Arecibo data set (15+5')*

Discussions (16:50-18:00): *(chair : Stefan Oslowski)*

DR2 and future datasets, including new PTA contributions (FAST, GMRT, MeerKAT...)

Cyber-i discussions and a demo (R. Ferdman)

Tuesday

I. Updates from PTA's analysis groups (09:30-11:40) *(chair : Antoine Petiteau)*

Steve Taylor, *Update on NANOGrav Data Analysis Methods (20+5')*

Chiara Mingarelli, *EPTA data analysis overview. (20+5')*

Ryan Shannon, *Update on PPTA data analysis. (20+5')*

10:45 – 11:15 coffee break

II. PTA vs ephemeris (11:15-12:15) (chair : Nicolas Caballero)

Stephen Taylor, *Gravitational-wave constraints in the presence of solar-system ephemeris uncertainties. (15+5')*

Joseph Lazio, *Solar System Ephemerides, Pulsar Timing, and Navigation. (15+5')*

Abhinav Jindal, *Constraints on Planet Nine and distant solar system objects using Pulsar Timing (15+5')*

12:15 – 14:20 lunch break

III. Search methods and algorithms (14:20-16:00) *(chair : Steve Taylor)*

Siyuan Chen, *Implications on Astrophysical model selection from the PPTA upper limit. (15+5')*

Janna Goldstein, *Sky localisation of monochromatic GW sources in pulsar timing array data using the null stream method. (15+5')*

Chiara Mingarelli, *Detection Prospects of Local Continuous Nanohertz Gravitational-Wave Sources with Pulsar Timing Arrays. (15+5')*

Naoyuki Yonemaru, *New detection method for ultra-low frequency gravitational waves with pulsar spin-down rate statistics. (15+5')*

Paul Baker, *Enterprise: a new PTA data analysis suite. (15+5')*

16:00 – 16:30 coffee break

Discussions (16:30-17:30): *(chair : Alberto Sesana):* *Scientific requirements for a detection protocol; Publication and communication policy*

Wednesday [external attendees, invited reviews]

I. Theory *(chair : Gilles Theureau)*

09:00 Alexandre Le Tiec, *General relativistic dynamics of binary black holes*

09:35 Luc Blanchet, *Gravitational waves and the problem of motion in GR.*

10:10 Eric Gourgoulhon, *Black Hole observations and the no-hair theorem*

10:45 – 11:15 coffee break

II. experimentations *(chair : Stanislas Babak)*

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11:15 Matteo Barsuglia, *LIGO and Virgo: status and next steps*

11:45 Antoine Petiteau, *The LISA mission*

12:20 – 14:00 lunch break

14:00 Bess Fang, *Low Frequency Gravitational Wave Detection with Ground Based Atom Interferometer Arrays*

14:35 Guillaume Patanchon, *B-mode measurements with Planck and future missions*

15:10 Guy Perrin, *The GRAVITY VLT experiment and the central BH*

15:45 – 16:15 coffee break

III. PTAs : the low frequency end *(chair : Andrea Lommen)*

16:15 Megan De Cesar, *The Second IPTA Data Release and Considerations for Future Releases*

16:50 Michele Vallisneri, *Current limits from PTAs and current modeling approaches*

17:25 Irina Dvorkin, *Measuring the stochastic gravitational-wave background from stalling massive black-hole binaries with pulsar-timing arrays*

Discussions (18:00-18:45) : *multi-messenger information (chair : Andrea Lommen)*

19:15 Cocktail-dinner

Thursday

I. Sources of noise (9:30-10:30) *(chair : Caterina Tiburzi)*

Paul Brook, *Pulse profile variability in the NANOGrav 11-years data set (15+5')*

Aditya Parthasarathy Madapusi, *Profile variability studies for the PPTA pulsars (15+5')*

Michael Lam, *The NANOGrav 9-year Data Set : excess noise in MSP arrival times (15+5')*

10:30 – 11:00 coffee break

II. ISM effects (11:00-12:00) *(chair : Lindley Lentati)*

Caterina Tiburzi, *The effect of the Solar wind in low-frequency observations of pulsars (15+5')*

Megan Jones, *Analysis of DM variations in the NANOGrav 9-years data set (15+5')*

Stefan Oslowski, *Probing the extremes of ISM with LOFAR (15+5')*

12:00 – 14:00 lunch break

III. Consortium projects (14:00-15:00) *(chair : Kuo Liu)*

Li Guo, *A pulsar-based time standard with International Pulsar Timing Array (15+5')*

Tim Dolch, *Analyzing Single Pulses in the J1713 24-hr Global Campaign (15+5')*

Nicolas Caballero, *Planetary ephemeris (IPTA project) (15+5')*

IV. Other projects using PTA data (15:00-15:40) *(chair : Kuo Liu)*

Jiang Dong, *Build advanced national frequency standard by Pdot of pulsar (15+5')*

Jingbo Wang, *Comparison of pulsar position from timing and Very Long Baseline Astrometry (15+5')*

15:40 – 16:10 coffee break

Xiaojin Liu, *Measuring the second derivative of the spin frequency in precise pulsar timing (15+5')*

Golam Shaifullah, *Spectral indices of MSPs (15+5')*

Mallory Roberts, *X-ray luminosity of pulsars with accurate distances (15+5')*

Discussions (17:10-18:00): *(chair : Dan Stinebring)*: *New IPTA consortium projects*

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Friday

I. New instrumental/numerical/algorithmic developments (9:30-10:30) *(chair : Lucas Guillemot)*

Lindley Lentati, Cobra : *Bayesian approach to pulsar searching (15+5')*

Keeisi Caballero, *The Centre for Advanced Radio Astronomy (15+5')*

Jing Luo, *PINT a new generation of high precision timing package (15+5')*

10:30 – 11:00 coffee break

Di Li, *A database-based pulsar-pulse search pipeline (15+5')*

Jeffrey Hazboun, *The NANOGrav pulsar signal simulator (15+5')*

II. The IPTA Diversity Committee (11:40-12:30) *(chair : Delphine Perrodin and Chiara Mingarelli)*

IPTA Code of Conduct / anti-harassment policy

Development of interactive sessions promoting diversity-related issues

Accessibility of future IPTA meetings

12:30 – 14:20 lunch break

Discussions (14:20-15:20) *(chair : Gemma Janssen): PTA observations in the SKA era; Future instrumentation and future analysis tools*

3. PARTICIPANTS

Among the 78 participants, 39 were from a European Institute, 19 were women. Most of the others came from either North America, Australia or China. We had another regular 6 remote participants following the talks and discussions through a youtube channel (from South Africa and US mainly). The student fraction was about a third of the audience of the second week.

Insert the attendance list (including name, affiliation and country) – signed by the participants or signed by the organisers (in case of heavy burden with collecting all participant signatures).

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Stanislav	**Babak**	AEI and APC, Université Paris-Diderot
Paul	**Baker**	West Virginia University
Matteo	**Barsugila**	APC, Université Paris-Diderot
Luc	**Blanchet**	Institut d'Astrophysique de Paris
Paul	**Brook**	West Virginia University
R. Nicolas	**Caballero**	Max-Planck-Institut fuer Radioastronomie
Keeisi	**Caballero**	University of Texas Rio Grande Valley
Siyuan	**Chen**	University of Birmingham
Ismaël	**Cognard**	LPC2E / CNRS, Université d'Orléans
James	**Cordes**	Cornell University
Fronefield	**Crawford**	Franklin and Marshall College
Megan	**DeCesar**	Lafayette College
Xinping	**Deng**	Max-Planck-Institute for Radio Astronomy
Grégory	**Desvignes**	Max-Planck-Institute for Radio Astronomy
Timothy	**Dolch**	Hillsdale College
Jiang	**Dong**	YunNan Astronomical Observatory
Julian	**Donner**	Universität Bielefeld
Irina	**Dvorkin**	Institut d'Astrophysique de Paris
Bess	**Fang-Sortais**	SYRTE, Observatoire de Paris
Robert	**Ferdman**	University of East Anglia
Agnès	**Fienga**	Observatoire de la Côte d'Azur
Madhuri	**Gaikwad**	Max Planck Institute for Radioastronomy
Nathaniel	**Garver-Daniels**	West Virginia University
Pete	**Gentile**	West Virginia University
Ben	**Gillen**	Oberlin College
Janna	**Goldstein**	University of Birmingham
Eric	**Gourgoulhon**	LUTH, CNRS, Observatoire de Paris, PSL
Jean-Mathias	**Griessmeier**	LPC2E and Univ. of Orleans
Lucas	**Guillemot**	LPC2E and Univ. of Orleans
Lorenz	**Haase**	Universität Bielefeld
Henryk	**Haniewicz**	University of East Anglia
Jeffrey	**Hazboun**	University of Texas Rio Grande Valley
Gemma	**Janssen**	ASTRON/Radboud University
Abhinav	**Jindal**	University of Toronto
Megan	**Jones**	West Virginia University
Michael	**Keith**	University of Manchester, JBCA
Lars	**Künkel**	Universität Bielefeld
Michael	**Lam**	West Virginia University
Joseph	**Lazio**	Jet Propulsion Laboratory, California Institute of Technology
Alexandre	**Le Tiec**	Observatoire de Paris
Lindley	**Lentati**	Cambridge University
Di	**Li**	National Astronomical Observatories of China
Xiaojin	**Liu**	The University of Manchester
Kuo	**Liu**	Max Planck Institute for Radio Astronomy
Andrea	**Lommen**	Haverford College
Jing	**Luo**	University of Texas Rio Grande Valley/UTSA
Dustin	**Madison**	National Radio Astronomy Observatory
Richard	**Manchester**	CSIRO Astronomy and Space Science
James	**McKee**	Max Planck Institute for Radio Astronomy
Chiara	**Mingarelli**	Max Planck Institute for Radio Astronomy
David	**Nice**	Lafayette College
Antonia	**Orsini**	West Virginia University
Stefan	**Oslowski**	Swinburne University of Technology
Aditya	**Parthasarathy Mad**	Swinburne University of Technology
Guillaume	**Patanchon**	APC, Université Paris-Diderot
Timothy	**Pennucci**	ELTE
Benetge	**Perera**	The University of Manchester
Guy	**Perrin**	LESIA, Observatoire de Paris
Delphine	**Perrodin**	INAF - Osservatorio Astronomico di Cagliari
Gérard	**Petit**	Bureau International des Poids et Mesures
Antoine	**Petiteau**	APC, Université Paris-Diderot
Mallory	**Roberts**	New York University Abu Dhabi
Anika	**Rowe**	West Virginia University
Alberto	**Sesana**	University of Birmingham
Golam	**Shaifullah**	ASTRON
Ryan	**Shannon**	CSIRO/ICRAR-Curtin University
Brent	**Shapiro-Albert**	West Virginia University
Renée	**Spiewak**	Swinburne University
Dan	**Stinebring**	Oberlin University
Shanghai Astro	**Taylor**	Jet Propulsion Laboratory / California Institute of Technology
Gilles	**Theureau**	Paris Observatory, CNRS and Université d'Orléans
Caterina	**Tiburzi**	Max Planck Institute for Radio Astronomy/Bielefeld University
Michele	**Vallisneri**	Jet Propulsion Laboratory, California Institute of Technology
Haley	**Wahl**	West Virginia University
Jingbo	**Wang**	Xinjiang astronomical observatory,CAS
Lin	**Wang**	National Astronomical Observatories of China
Caitlin	**Witt**	West Virginia University
Naoyuki	**Yonemaru**	Kumamoto University

Gilles Theureau

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4. RadioNet financial contribution

The IPTA Student Workshop is traditionally free of charge for attending students and lecturer, accommodation and daytime expenses being covered by collected grants from various institutions. Radionet contributed (4.0 k€) to this support together with Region Île de France (5.5 k€), CNRS (12.5 k€) and Paris Observatory (4.5 k€). All participants to the Student Week stayed at the Centre International d'Études Pédagogiques (CIEP), which provides hotel rooms, coffee breaks and lunches, as well as seminar and conference rooms with full equipment.

List of supported participants:

Henryk Haniewicz, UK
Siyuan Chen, UK
Julian Donner, GER
Lorenz Haase, GER
Ben Gillen, US
Naoyuki Yonemaru, Jap
Xiaojin Liu, UK
Jiang Dong, China
Jing Luo, US
Keeisi Caballero, US
Lin Wang, China & UK
Brent Shapiro-Albert, US
Caitlin Witt, US
Janna Goldstein, UK
Renée Spiewak, AU
Paul Baker, US
Haley Wahl, US
Lars Künkel, GER
Antonia Orsini, US
Megan Jones, US
Aditya Parthasarathy Madapusi, AU
Paul Brook, US
Abhinav Jindal, CA
Madhuri Gaikwad, GER
Anika Rowe, US

5. Publications

High-precision timing of 42 millisecond pulsars with the European Pulsar Timing Array. Desvignes, G. et al 2016, MNRAS 458, 3341

From spin noise to systematics: stochastic processes in the first International Pulsar Timing Array data release. Lentati, L. et al 2016, MNRAS 458, 2161

The International Pulsar Timing Array: First data release. Verbiest, J., 2016, MNRAS 458, 1267

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Single-Source Gravitational Wave Limits From the J1713+0747 24-hr Global Campaign. Dolch et al 2016, Journal of Physics: Conference Series, Volume 716, Issue 1, article id. 012014

The noise properties of 42 millisecond pulsars from the European Pulsar Timing Array and their impact on gravitational-wave searches. Caballero, N. et al 2016, MNRAS 457, 4421

European Pulsar Timing Array limits on continuous gravitational waves from individual supermassive black hole binaries. Babak, S. et al 2016, MNRAS 455, 1665

European Pulsar Timing Array limits on an isotropic stochastic gravitational-wave background. Lentati L, et al. MNRAS, 453, 2576 (2015)

Limits on Anisotropy in the Nanohertz Stochastic Gravitational Wave Background. Taylor S, et al., PhRvL, 115, 041101 (2015)

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