

# Stephen Taylor | Curriculum Vitae

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## Education

### Institute of Astronomy, University of Cambridge

Cambridge, UK

*PhD (Astronomy)*

2010–2014

**Advisor:** Dr. Jonathan R. Gair; **Thesis Title:** *Exploring The Cosmos With Gravitational Waves*

**Description:** A new Bayesian hierarchical modeling scheme is introduced to use compact-binary gravitational-wave standard sirens to infer the mass-distribution of the binary population, the progenitor star-formation rate, and cosmological parameters. Advanced pulsar-timing array techniques are developed to map the nanohertz gravitational-wave sky through a parametrized overlap-reduction function, and large accelerations to the Bayesian searches for single supermassive black-hole binaries are proposed.

### University of Oxford

Oxford, UK

*MPhys (1<sup>st</sup> Class), [ranked 1<sup>st</sup> in Jesus College, 4<sup>th</sup> across University]*

2006–2010

**Advisor:** Prof. Steven Rawlings; **Thesis Title:** *The Cosmic Evolution Of Black-hole Accretion*

## Professional Experience

### CALIFORNIA INSTITUTE OF TECHNOLOGY

Pasadena, USA

*Caltech Postdoctoral Scholar (TAPIR group)*

2016–Present

*Visiting scholar (TAPIR group)*

2014–2016

### NASA JET PROPULSION LABORATORY

Pasadena, USA

*NASA Postdoctoral Fellow*

2014–2016

### INSTITUTE OF ASTRONOMY, UNIVERSITY OF CAMBRIDGE

Cambridge, UK

*PhD candidate*

2010–2014

## Research Interests

**Primary interests:** gravitational-wave astronomy • theoretical astrophysics • massive black-hole binaries • stellar-mass compact objects • pulsar timing • statistical inference

**Secondary interests:** galaxy formation and evolution • cosmology • pulsar physics and demographics • ionized interstellar medium

**Specific interests:** pulsar-timing data-analysis for nanohertz gravitational-wave searches • pulsar-timing noise characterization and mitigation • waveform modeling for supermassive black-hole binary searches • modeling final-parsec dynamics of supermassive black-hole binaries • stochastic signal analysis strategies • compact-binary demographics and population inference • Bayesian hierarchical modeling

## Grants & Funding

### Jun 2016: “New Directions and New Opportunities for NANOGrav Astrophysics”

Awarded \$11k by the NANOGrav Physics Frontier Center for a proposal on behalf of the collaboration’s Astrophysics Working Group. Funding will ensure undergraduate/graduate students and outside experts can attend a sprint week in March 2017 to advance several key areas of interest, and to achieve rapid progress on collaboration projects.

## Honors & Awards

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**2015:** International Pulsar Timing Array (IPTA) Steering Committee Prize — “Honorable Mention”  
**2015:** Gravitational Wave International Committee (GWIC) Thesis Prize — “Honorable Mention”  
**2014:** NASA Postdoctoral Fellowship (JPL)  
**2014:** Royal Astronomical Society Travel Award — £750  
**2013:** Royal Astronomical Society Travel Award — £700  
**2012–2014:** Christ’s College (Cambridge) Travel Grants [various; total exceeds £1k]  
**2010:** Science and Technology Facilities Council (STFC) — full PhD studentship award  
**2008:** Examiner’s Prize, Oxford Physics Speaking Competition  
**2007:** Oxford Physics department prize for laboratory work  
**2007–2010:** Undergraduate Scholar of Jesus College, Oxford  
**2006–2010:** Regularly awarded Oxford undergraduate departmental and college examination prizes

## Teaching Experience

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**Jun–Aug 2016:** Co-supervisor of Caltech summer undergraduate student (Maya Fuller)  
**May 2016:** Guest Lecturer for Caltech Ph237 class “Gravitational Waves”  
**Mar 2016:** Co-organizer of student workshop at NANOGrav Spring meeting  
**Sep 2015:** Lecturer for NANOGrav detection-group workshop at Caltech  
**Jun 2015:** Lecturer at “CSI PTA” Aspen summer workshop  
**2011–2013:** Supervisor for Cambridge Part II undergraduate students in RELATIVITY  
**2011:** Prepared computing coursework for Cambridge Part II undergraduate students

## Professional Service

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### Reviewer for international journals.....

Monthly Notices of the Royal Astronomical Society (MNRAS), Physical Review D (PRD)

### Conference organization.....

**Oct 2016:** Chair of SOC for NANOGrav Fall meeting at University of Illinois Urbana-Champaign  
**Mar 2016:** SOC and LOC member for NANOGrav Spring meeting at Caltech  
**Mar 2016:** Co-organizer of NANOGrav student workshop at Caltech  
**Mar 2014:** SOC and LOC member for British Gravity meeting (BritGrav) at Cambridge, UK

### Seminar organization.....

**2015–2016:** Caltech TAPIR and LIGO postdoctoral lunch seminar series

### Professional affiliations.....

- North American Nanohertz Observatory for Gravitational-waves (NANOGrav), *Full member*
- European Pulsar Timing Array (EPTA), *Member*
- International Pulsar Timing Array (IPTA), *Member*
- American Physical Society (DGRAV), *Member*
- American Astronomical Society, *Member*
- Royal Astronomical Society, *Fellow*

## Outreach & Media Engagement

### Outreach.....

**2016:** Featured gravitational-wave expert at NASA's "Ticket to Explore JPL" event

**2013:** Interactive presentation at Cambridge's Institute of Astronomy Open Day

**2012–2014:** Presentation to prospective students (Institute of Astronomy graduate interviews)

**2012:** Outreach talk at Institute of Astronomy public-observing evening: "The Space Race"

**2011:** Interactive presentation at Cambridge's Institute of Astronomy Open Day

### Press releases.....

**Feb 2016:** First-author research: "[Pulsar Web Could Detect Low-Frequency Gravitational Waves](#)" (JPL press release)

**Apr 2016:** Collaboration research: "[Gravitational Wave Search Provides Insights into Galaxy Evolution and Mergers](#)" (NRAO press release)

### Media coverage.....

- Interviewed and quoted by *Science* magazine: "[In Search of Spacetime Megawaves](#)" by Daniel Clery, *Science* 11 Mar 2016: Vol. 351, Issue 6278, pp. 1124–1125
- Quoted, with research featured in [Gizmodo](#), [Engadget](#), [Phys.org](#), [Astronomy magazine](#), [Universe Today](#)
- Collaboration research featured in [Science Daily](#), [Astronomy Now](#) (online)

## Publications

- 22 **peer-reviewed publications (of which 8 are first-author) with 317 citations, h-index 10.**
- Metrics available at <https://scholar.google.com/citations?user=iN2djBMAAAAJ&hl=en>.
- 5 key publications are indicated below with preceding asterisks.

### Submitted & In Preparation.....

**S. R. Taylor**, L. Lentati, S. Babak, P. Brem, J. R. Gair, A. Sesana, A. Vecchio. "*All correlations must die: Assessing the significance of a stochastic gravitational-wave background in pulsar-timing arrays*". Submitted to Physical Review D. arXiv:1606.09180.

**S. R. Taylor**, R. van Haasteren. "*Optimized anisotropic modelling of the nanohertz gravitational-wave sky with pulsar-timing arrays*". (In Prep.)

**S. R. Taylor**, J. Simon, L. Sampson. "*Bayesian model emulation of stochastic gravitational-wave spectra for final-parsec probes with pulsar-timing arrays*". (In Prep.)

### Publications In Peer-reviewed International Journals.....

**May 2016:** G. Desvignes, R. N. Caballero, L. Lentati, [and 40 others, including **S. R. Taylor**]. "*High-precision timing of 42 millisecond pulsars with the European Pulsar Timing Array*". *MNRAS*, 458:3341–3380.

**May 2016:** L. Lentati, R. M. Shannon, W. A. Coles, [and 80 others, including **S. R. Taylor**]. "*From spin noise to systematics: stochastic processes in the first International Pulsar Timing Array data release*". *MNRAS*, 458:2161–2187.

**May 2016 :** J. P. W. Verbiest, L. Lentati, G. Hobbs, [and 89 others, including **S. R. Taylor**]. "*The International Pulsar Timing Array: First data release*". *MNRAS*, 458:1267–1288.

**Apr 2016 :** Z. Arzoumanian, A. Brazier, S. Burke-Spolaor, [and 48 others, including **S. R. Taylor**]. "*The NANOGrav Nine-year Data Set: Limits on the Isotropic Stochastic Gravitational Wave Background*". *Astrophys. J.*, 821:13.

**Apr 2016 :** R. N. Caballero, K. J. Lee, L. Lentati, [and 36 others, including **S. R. Taylor**]. "*The noise properties*

of 42 millisecond pulsars from the European Pulsar Timing Array and their impact on gravitational-wave searches". [MNRAS, 457:4421–4440](#).

**\*Mar 2016 : S. R. Taylor**, M. Vallisneri, J. A. Ellis, C. M. F. Mingarelli, T. J. W. Lazio, and R. van Haasteren. "Are We There Yet? Time to Detection of Nanohertz Gravitational Waves Based on Pulsar-timing Array Limits". [Astrophys. J. Lett, 819:L6](#).

**Jan 2016 : S. R. Taylor**, E. A. Huerta, J. R. Gair, and S. T. McWilliams. "Detecting Eccentric Supermassive Black Hole Binaries with Pulsar Timing Arrays: Resolvable Source Strategies". [Astrophys. J., 817:70](#).

**Jan 2016 : S. Babak**, A. Petiteau, A. Sesana, P. Brem, P. A. Rosado, **S. R. Taylor**, [and 30 others]. "European Pulsar Timing Array limits on continuous gravitational waves from individual supermassive black hole binaries". [MNRAS, 455:1665–1679](#).

**Nov 2015 : J. R. Gair**, J. D. Romano, and **S. R. Taylor**. "Mapping gravitational-wave backgrounds of arbitrary polarisation using pulsar timing arrays". [Phys. Rev. D, 92\(10\):102003](#).

**\*Nov 2015 : L. Lentati**, **S. R. Taylor**, C. M. F. Mingarelli, [and 33 others]. "European Pulsar Timing Array limits on an isotropic stochastic gravitational-wave background". [MNRAS, 453:2576–2598](#).

**Sep 2015 : E. A. Huerta**, S. T. McWilliams, J. R. Gair, and **S. R. Taylor**. "Detection of eccentric supermassive black hole binaries with pulsar timing arrays: Signal-to-noise ratio calculations". [Phys. Rev. D, 92\(6\):063010](#).

**Aug 2015 : J. D. Romano**, **S. R. Taylor**, N. J. Cornish, J. Gair, C. M. F. Mingarelli, and R. van Haasteren. "Phase-coherent mapping of gravitational-wave backgrounds using ground-based laser interferometers", [Phys. Rev. D, 92\(4\):042003](#).

**\*Jul 2015: S. R. Taylor**, C. M. F. Mingarelli, J. R. Gair, [and 32 others]. "Limits on Anisotropy in the Nanohertz Stochastic Gravitational Wave Background". [Phys.Rev. Lett, 115\(4\):041101](#).

**Mar 2015: C. J. Moore**, **S. R. Taylor**, and J. R. Gair. "Estimating the sensitivity of pulsar timing arrays", [Classical and Quantum Gravity, 32\(5\):055004](#).

**Nov 2014: S. R. Taylor**, J. Ellis, and J. Gair. "Accelerated Bayesian model-selection and parameter-estimation in continuous gravitational-wave searches with pulsar-timing arrays". [Phys. Rev. D, 90\(10\):104028](#).

**Oct 2014: J. Gair**, J. D. Romano, **S. R. Taylor**, and C. M. F. Mingarelli. "Mapping gravitational-wave backgrounds using methods from CMB analysis: Application to pulsar timing arrays". [Phys. Rev. D, 90\(8\):082001](#).

**Aug 2014: R. M. Shannon**, S. Chamberlin, N. J. Cornish, J. A. Ellis, C. M. F. Mingarelli, D. Perrodin, P. Rosado, A. Sesana, **S. R. Taylor**, [and 14 others]. "Summary of Session C1: pulsar timing arrays". [General Relativity and Gravitation, 46:1765](#).

**\*Oct 2013: S. R. Taylor** and J. R. Gair. "Searching for anisotropic gravitational-wave backgrounds using pulsar timing arrays". [Phys. Rev. D, 88\(8\):084001](#).

**May 2013: L. Lentati**, P. Alexander, M. P. Hobson, **S. R. Taylor**, J. Gair, S. T. Balan, and R. van Haasteren. "Hyper-efficient model-independent Bayesian method for the analysis of pulsar timing data". [Phys. Rev. D, 87\(10\):104021](#).

**Feb 2013 : S. R. Taylor**, J. R. Gair, and L. Lentati. "Weighing the evidence for a gravitational-wave background in the first International Pulsar Timing Array data challenge". [Phys. Rev. D, 87\(4\):044035](#).

**Jul 2012: S. R. Taylor** and J. R. Gair. "Cosmology with the lights off: Standard sirens in the Einstein Telescope era". [Phys. Rev. D, 86\(2\):023502](#).

**\*Jan 2012: S. R. Taylor**, J. R. Gair, and I. Mandel. "Cosmology using advanced gravitational-wave detectors alone". [Phys. Rev. D, 85\(2\):023535](#).

## Presentations

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- 29 oral presentations (of which 10 were invited), with 4 conference leadership roles.
- Recent presentations are available to view at <https://speakerdeck.com/stevertaylor>.

### Invited Talks.....

**Oct 2016:** *New data-analysis approaches for gravitational-wave searches with pulsar-timing arrays*, Montana State University seminar, Bozeman MT, USA

**Jul 2016:** *New horizons in gravitational-wave astronomy with pulsar-timing arrays*, Armagh Observatory seminar, Armagh, UK

**Jul 2016:** *Probing the final-parsec problem with pulsar-timing arrays*, Anton Pannekoek Instituut seminar, University of Amsterdam, Amsterdam, Netherlands

**Jul 2016:** *Probing the final-parsec problem with pulsar-timing arrays*, Radboud University astrophysics seminar, Radboud, Netherlands

**Jun 2016:** *Gravitational-wave data-analysis techniques for pulsar-timing arrays*, IPTA conference, Stellenbosch, South Africa

**Mar 2016:** *Sources of nanohertz gravitational-waves for pulsar-timing array searches*, NANOGrav student workshop, Caltech, Pasadena CA, USA

**Dec 2015:** *Prospects for near future detection and astrophysical inference with PTAs*, Gravitational-wave group seminar, University of Birmingham, UK

**Dec 2015:** *Prospects for near future detection and astrophysical inference with PTAs*, Statistics group seminar (School of Mathematics), University of Edinburgh, UK

**Dec 2015:** *Prospects for near future detection and astrophysical inference with PTAs*, CaJAGWR seminar, California Institute of Technology

**May 2013:** *Searching For Anisotropic Gravitational-wave Backgrounds Using Pulsar Timing Arrays*, Albert Einstein Institute (AEI) GW seminar, Hanover

**Dec 2012:** *Weighing the evidence for a gravitational-wave background*, Gravitational-wave group seminar, University of Birmingham, UK

### Contributed Presentations.....

**May 2016:** *Carrying the physics of supermassive black-hole binary evolution into pulsar-timing array searches*, EPTA meeting, Bielefeld, Germany

**Apr 2016:** *Are we there yet? Time to detection of nanohertz gravitational waves*, American Physical Society meeting, Salt Lake City UT, USA

**Mar 2016:** *Carrying the physics of supermassive black-hole binary evolution into pulsar-timing array searches*, NANOGrav meeting, Caltech, Pasadena CA, USA

**Oct 2015:** *Are we there yet? Time to detection of nanohertz gravitational waves*, NANOGrav meeting, McGill University, Montreal, Canada

**Jun 2015:** *Eccentric supermassive black-hole binary signals in pulsar-timing data*, European Pulsar Timing Array meeting, Bonn, Germany

**Apr 2015:** *Eccentric supermassive black-hole binary signals in pulsar-timing data*, American Physical Society meeting, Baltimore MD, USA

**Feb 2015:** *Eccentric supermassive black-hole binary signals in pulsar-timing data*, NANOGrav meeting, Arecibo, Puerto Rico

**Jan 2015:** *Exploring the cosmos with gravitational waves*, American Astronomical Society meeting, Seattle WA, USA

**Nov 2014:** *EPTA constraints on gravitational-wave anisotropy*, European Pulsar Timing Array meeting, Cambridge, UK

**Jun 2014:** *EPTA and IPTA searches for gravitational-wave background anisotropy*, International Pulsar Timing Array meeting, Banff, Canada

**May 2014:** *EPTA limits on gravitational-wave anisotropy*, European Pulsar Timing Array meeting, Astron, Netherlands

**Oct 2013:** *The pulsar-term in PTA continuous-wave searches: a blessing and a curse*, European Pulsar Timing Array meeting, Pula, Sardinia

**Jul 2013:** *Probing anisotropy of the GW background with pulsar timing arrays*, 20th International Conference on General Relativity and Gravitation and 10th Amaldi Conference on Gravitational Waves, Warsaw

**Jun 2013:** *The first PTA search pipeline for anisotropy in the GW background*, International Pulsar Timing Array meeting, Krabi, Thailand

**Apr 2013:** *Searching For Anisotropic Gravitational-wave Backgrounds Using Pulsar Timing Arrays*, European Pulsar Timing Array meeting, l'Observatoire de Paris, Paris

**Feb 2013:** *Weighing the evidence for a gravitational-wave background*, Institute of Astronomy seminar, University of Cambridge

**Nov 2012:** *Weighing the evidence for a gravitational-wave background*, European Pulsar Timing Array meeting, Albert Einstein Institute (AEI), Potsdam, Germany

**Jun 2012:** *Milestones in Spacetime: Double Neutron-Star Binaries as Gravitational-Wave Standard Sirens*, Institute of Astronomy seminar, University of Cambridge, UK

**Feb 2012:** *Hubble without the Hubble: Cosmology using advanced gravitational-wave detectors alone*, Gravitational-Wave Meeting, Institut de Ciències de l'Espai, Barcelona, Spain

#### Posters.....

**Aug 2015:** *Galactic environment effects on gravitational wave signals in pulsar timing arrays*, Postdoc Research Day, NASA Jet Propulsion Laboratory

**Aug 2012:** *Cosmology without EM counterparts: Standard sirens in the advanced era and beyond*, Rattle and Shine, KITP Santa Barbara

**Dec 2011:** *Cosmology using advanced gravitational-wave detectors alone*, Graduate Student Conference 2011, Cavendish Laboratory, University of Cambridge

## Computing Skills

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- **OS:** Linux/UNIX, Windows
- **Programming:** C/C++, PYTHON, UNIX shell scripting, HTML, GPU programming (CUDA C, PyCUDA)
- **Typography:**  $\text{\LaTeX}$ , Bibtex, Microsoft Office, Pages, OpenOffice
- **Scientific:** Mathematica, Matlab, PYTHON



## References

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**Dr Jonathan R. Gair [*PhD advisor*]**

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