Jeffrey S. Hazboun — Curriculum Vitae

Department of Physics, Oregon State University
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Professional Experience

Oregon State University **Corvallis, OR**
- *Assistant Professor of Physics* *September 2022–Present*

University of Washington Bothell **Bothell, WA**
- *NANOGrav Physics Frontiers Center Senior Postdoctoral Fellow* *August 2018–September 2022*

University of Texas Rio Grande Valley **Brownsville, TX**
- *NANOGrav Physics Frontiers Center Postdoctoral Fellow* *August 2016–July 2018*

Hendrix College **Conway, AR**
- *Visiting Assistant Professor* *August 2015–July 2016*

Utah State University **Logan, UT**
- *Postdoctoral Teaching Position/ Head Online Class Developer* *September 2014 - August 2015*

Georgia Institute of Technology **Atlanta, GA**
- *Visiting Scholar, Center for Relativistic Astrophysics* *June 2012 - May 2013*

Education

PhD in Physics **December 2014**
Utah State University *Logan, Utah*
Advisor: Dr. James T. Wheeler
Dissertation Title: *Conformal gravity and time*

MS Physics (Mathematics Minor) **June 2008**
Oregon State University *Corvallis, Oregon*
Advisor: Dr. Tevian Dray
Thesis Title: *The effects of negative-energy shells on Schwarzschild spacetime*

BS Biology **December 1999**
State University of New York, College of Environmental Science and Forestry *Syracuse, New York*

Grants & Funding

Faculty Early Career Development Program (CAREER): Grad RA Supplement *2024*
- *CAREER: Multimessenger Astrophysics with Pulsar Timing Arrays in the Detection Era*
- PI Jeffrey Hazboun: Total award: $\$60,961$

Faculty Early Career Development Program (CAREER) *2023*
- *CAREER: Multimessenger Astrophysics with Pulsar Timing Arrays in the Detection Era*
- PI Jeffrey Hazboun: Total award: $\$400,000$

Amazon Web Services Machine Learning Research Award *2019*
- PI Jeffrey Hazboun: Total award: $\$50,000$ in AWS Promotional Credits

Awards

2024 ICBS Frontiers of Science Award in Theoretical Physics *2024*

- *Awarded by:* The International Congress of Basic Science
- *Awarded for:* "Reporting first evidence for the existence of a gravitational wave background from merging supermassive black holes"

Observing Proposals

Co-I: **"Monitoring pulse-shape changes in the IPTA pulsar sample"** *May 2021*

- Giant Metrewave Radio Telescope, Target of Opportunity proposal
- Status: awarded 10.0 hours

Co-I: **"Tracking Rapid and Unexpected Pulse Shape Changes in the MSP J1713+0747"** *May 2021*

- Very Large Array, Director's discretionary time proposal VLA/$21A-426$
- Status: awarded 14.0 hours

Co-I: **"Monitoring pulse shape changes in the International Pulsar Timing Array"** *June 2021*

- Parkes Observatory, Non A-priori Assignable Proposal
- Status: awarded 10.0 hours

Co-I: **"High Cadence Observations of MSPs for Gravitational Wave Detection"** *March 2020*

- Arecibo Radio Telescope, proposal P2945
- Status: awarded 32.5 hours

Co-I: **"High Time Resolution Observations of a Bright Millisecond Pulsar"** *November 2018*

- Greenbank Telescope, Project ID GBT$18B-355$
- Status: awarded 5 hours

Publications

• **Metrics** available at InspireHEP or Google Scholar.

Submitted

5. *Galaxy Tomography with the Gravitational Wave Background from Supermassive Black Hole Binaries*.
   Yifan Chen, [...], **J. S. Hazboun**, et al. [92 Authors]
   Arxiv:2411.05906
4. *The NANOGrav 15 yr Data Set: Harmonic Analysis of the Pulsar Angular Correlations*.
   Gabriella Agazie, [...], **J. S. Hazboun**, et al. [89 Authors]
   Arxiv:2411.13472
3. *The NANOGrav 15 year Data Set: Removing pulsars one by one from the pulsar timing array*.
   Gabriella Agazie, [...], **J. S. Hazboun**, et al. [105 Authors]
   Arxiv:2411.14846
2. *CMB and energy conservation limits on nanohertz gravitational waves*.
   David Wright, John T. Giblin, Jeffrey Hazboun
   Arxiv:2409.15572
1. *Tuning a PTA in the detection era*.
   Jeremy G. Baier, Jeffrey S. Hazboun, Joseph D. Romano
   Arxiv:2409.00336

Accepted

3. *The NANOGrav 15 yr Data Set: Running of the Spectral Index*.
   Gabriella Agazie, [...], **J. S. Hazboun**, et al. [105 Authors]
   The Astrophysical Journal, -, -, (2024)

2. *The NANOGrav 15 yr data set: Posterior predictive checks for gravitational-wave detection with pulsar timing arrays*.
Gabriella Agazie, [...], **J. S. Hazboun**, et al. [102 Authors]
The Astrophysical Journal Letters, -, -, (2024)

1. *The NANOGrav 15 yr Data Set: Looking for Signs of Discreteness in the Gravitational-wave Background*.
Gabriella Agazie, [...], **J. S. Hazboun**, et al. [100 Authors]
The Astrophysical Journal Letters, -, -, (2024)

Published

52. *Exploring the time variability of the solar wind using LOFAR pulsar data*.
S. C. Susarla, [...], **J. S. Hazboun**, et al. [25 Authors]
Astronomy and Astrophysics, **692**, 0, (2024)

51. *An unusual pulse shape change event in PSR J1713+0747 observed with the Green Bank Telescope and CHIME*.
R. J. Jennings, [...], **J. S. Hazboun**, et al. [44 Authors]
The Astrophysical Journal, **964**, 2, (2024)

50. *NANOGrav 15-year gravitational-wave background methods*.
Aaron D. Johnson, [...], **J. S. Hazboun**, et al. [98 Authors]
Physical Review D, **109**, 10, (2024)

49. *Comparing recent PTA results on the nanohertz stochastic gravitational wave background*.
G. Agazie, [...], **J. S. Hazboun**, et al. [244 Authors]
The Astrophysical Journal, **966**, 1, (2024)

48. *The NANOGrav 12.5 yr Data Set: A Computationally Efficient Eccentric Binary Search Pipeline and Constraints on an Eccentric Supermassive Binary Candidate in 3C 66B*.
G. Agazie, [...], **J. S. Hazboun**, et al. [89 Authors]
The Astrophysical Journal, **963**, 2, (2024)

47. *The NANOGrav 12.5 yr Data Set: Search for Gravitational Wave Memory*.
G. Agazie, [...], **J. S. Hazboun**, et al. [91 Authors]
The Astrophysical Journal, **963**, 1, (2024)

46. *The NANOGrav 15-year data set: Search for Transverse Polarization Modes in the Gravitational-Wave Background*.
G. Agazie, [...], **J. S. Hazboun**, et al. [99 Authors]
The Astrophysical Journal Letters, **964**, 1, (2024)

45. *How to Detect an Astrophysical Nanohertz Gravitational Wave Background*.
B. Bécsy, [...], **J. S. Hazboun**, et al. [96 Authors]
The Astrophysical Journal, **959**, 1, (2023)

44. *Analytic distribution of the optimal cross-correlation statistic for stochastic gravitational-wave-background searches using pulsar timing arrays*.
J. S. Hazboun, P. M. Meyers, J. D. Romano, X. Siemens, A. M. Archibald
Physical Review D, **108**, 10, (2023)

43. *The NANOGrav 15-year Data Set: Search for Anisotropy in the Gravitational-Wave Background*.
G. Agazie, [...], **J. S. Hazboun**, et al. [93 Authors]
The Astrophysical Journal Letters, **956**, 1, (2023)

42. *The NANOGrav 15-year Data Set: Constraints on Supermassive Black Hole Binaries from the Gravitational Wave Background*.
G. Agazie, [...], **J. S. Hazboun**, et al. [114 Authors]
The Astrophysical Journal Letters, **952**, 2, (2023)

41. *The NANOGrav 15 yr Data Set: Evidence for a Gravitational-wave Background*.
G. Agazie, [...], **J. S. Hazboun**, et al. [115 Authors]
The Astrophysical Journal Letters, **951**, 1, (2023)

40. *The NANOGrav 12.5-year Data Set: Bayesian Limits on Gravitational Waves from Individual Supermassive Black Hole Binaries*.
Z. Arzoumanian, [...], **J. S. Hazboun**, et al. [78 Authors]
The Astrophysical Journal Letters, **951**, 2, (2023)

39. *The NANOGrav 15 yr Data Set: Observations and Timing of 68 Millisecond Pulsars*.
G. Agazie, [...], **J. S. Hazboun**, et al. [101 Authors]
The Astrophysical Journal Letters, **951**, 1, (2023)

38. *The NANOGrav 15 yr Data Set: Detector Characterization and Noise Budget*.
G. Agazie, [...], **J. S. Hazboun**, et al. [92 Authors]
The Astrophysical Journal Letters, **951**, 1, (2023)

37. *The NANOGrav 15 yr Data Set: Search for Signals from New Physics*.
A. Afzal, [...], **J. S. Hazboun**, et al. [124 Authors]
The Astrophysical Journal Letters, **951**, 1, (2023)

36. *The NANOGrav 15-year Data Set: Bayesian Limits on Gravitational Waves from Individual Supermassive Black Hole Binaries*.
G. Agazie, [...], **J. S. Hazboun**, et al. [99 Authors]
The Astrophysical Journal Letters, **951**, 2, (2023)

35. *Disentangling Multiple Stochastic Gravitational Wave Background Sources in PTA Datasets*.
A. R. Kaiser, [...], **J. S. Hazboun**, et al. [10 Authors]
The Astrophysical Journal, **938**, 2, (2022)

34. *Bayesian Solar Wind Modeling with Pulsar Timing Arrays*.
J. S. Hazboun, et al. [30 Authors]
The Astrophysical Journal, **929**, 1, (2022)

33. *A Detection of Red Noise in PSR J1824−2452A and Projections for PSR B1937+21 using NICER X-ray Timing Data*.
J. S. Hazboun, et al. [20 Authors]
The Astrophysical Journal, **928**, 1, (2022)

32. *The International Pulsar Timing Array second data release: Search for an isotropic Gravitational Wave Background*.
J. Antoniadis, [...], **J. S. Hazboun**, et al. [70 Authors]
Monthly Notices of the Royal Astronomical Society, **510**, 4, (2022)

31. *The NANOGrav 12.5-year data set: Search for Non-Einsteinian Polarization Modes in the Gravitational-Wave Background*.
Z. Arzoumanian, [...], **J. S. Hazboun**, et al. [71 Authors]
The Astrophysical Journal Letters, **923**, 2, (2021)

30. *Searching For Gravitational Waves From Cosmological Phase Transitions With The NANOGrav 12.5-year dataset*.
Z. Arzoumanian, [...], **J. S. Hazboun**, et al. [65 Authors]
Physical Review Letters, **127**, 25, (2021)

29. *Multimessenger pulsar timing array constraints on supermassive black hole binaries traced by periodic light curves*.
Chengcheng Xin, Chiara M. F. Mingarelli, **J. S. Hazboun**
The Astrophysical Journal, **915**, 2, (2021)

28. *The NANOGrav 11yr Data Set: Limits on Supermassive Black Hole Binaries in Galaxies within 500Mpc*.

Z. Arzoumanian, [...], **J. S. Hazboun**, et al. [57 Authors]
The Astrophysical Journal, **914**, 2, (2021)

27. *Astrophysics Milestones For Pulsar Timing Array Gravitational Wave Detection*.
N. S. Pol, [...], **J. S. Hazboun**, et al. [51 Authors]
The Astrophysical Journal Letters, **911**, 2, (2021)

26. *Precision Timing of PSR J0437-4715 with the IAR Observatory and Implications for Low-Frequency Gravitational Wave Source Sensitivity*.
M. T. Lam, **J. S. Hazboun**
The Astrophysical Journal, **911**, 2, (2021)

25. *A Study in Frequency-Dependent Effects on Precision Pulsar Timing Parameters with the Pulsar Signal Simulator*.
B. J. Shapiro-Albert, **J. S. Hazboun**, M. A. McLaughlin, M. T. Lam
The Astrophysical Journal, **909**, 2, (2021)

24. *Common-spectrum process versus cross-correlation for gravitational-wave searches using pulsar timing arrays*.
J. D. Romano, **J. S. Hazboun**, X. Siemens, A. M. Archibald
Physical Review D, **103**, 6, (2021)

23. *The Pulsar Signal Simulator: A Python package for simulating radio signal data from pulsars*.
J. S. Hazboun, et al. [10 Authors]
Journal of Open Software Science, **6**, 58, (2021)

22. *The NANOGrav 12.5-year Data Set: Search For An Isotropic Stochastic Gravitational-Wave Background*.
Z. Arzoumanian, [...], **J. S. Hazboun**, et al. [61 Authors]
The Astrophysical Journal Letters, **905**, 2, (2020)

21. *Model Dependence of Bayesian Gravitational-Wave Background Statistics for Pulsar Timing Arrays*.
J. S. Hazboun, J. Simon, X. Siemens, J. D. Romano
The Astrophysical Journal Letters, **905**, 1, (2020)

20. *The NANOGrav 12.5-year Data Set: Observations and Narrowband Timing of 47 Millisecond Pulsars*.
Md F. Alam, [...], **J. S. Hazboun**, et al. [70 Authors]
The Astrophysical Journal Supplements, **252**, 4, (2020)

19. *Multi-Messenger Gravitational Wave Searches with Pulsar Timing Arrays: Application to 3C66B Using the NANOGrav 11-year Data Set*.
Z. Arzoumanian, [...], **J. S. Hazboun**, et al. [59 Authors]
The Astrophysical Journal, **900**, 2, (2020)

18. *The NANOGrav 12.5-year Data Set: Wideband Timing of 47 Millisecond Pulsars*.
Md F. Alam, [...], **J. S. Hazboun**, et al. [70 Authors]
The Astrophysical Journal Supplements, **252**, 1, (2020)

17. *Modeling the Uncertainties of Solar System Ephemerides for Robust Gravitational-wave Searches with Pulsar-timing Arrays*.
M. Vallisneri, [...], **J. S. Hazboun**, et al. [64 Authors]
The Astrophysical Journal, **893**, 2, (2020)

16. *The NANOGrav 11 yr Data Set: Evolution of Gravitational-wave Background Statistics*.
J. S. Hazboun, et al. [63 Authors]
The Astrophysical Journal, **890**, 2, (2020)

15. *The NANOGrav 11 yr Data Set: Limits on Gravitational Wave Memory*.
K. Aggarwal, [...], **J. S. Hazboun**, et al. [61 Authors]
The Astrophysical Journal, **889**, 1, (2020)

14. *The International Pulsar Timing Array: second data release*.
B. B. P. Perera, [...], **J. S. Hazboun**, et al. [75 Authors]
Monthly Notices of the Royal Astronomical Society, **490**, 4, (2019)
13. *The NANOGrav 11 yr Data Set:*
Limits on Gravitational Waves from Individual Supermassive Black Hole Binaries.
K. Aggarwal, [...], **J. S. Hazboun**, et al. [64 Authors]
The Astrophysical Journal, **880**, 2, (2019)
12. *The astrophysics of nanohertz gravitational waves*.
S. Burke-Spolaor, [...], **J. S. Hazboun**, et al. [15 Authors]
The Astronomy and Astrophysics Review, **27**, 1, (2019)
11. *Hasasia: A Python package for Pulsar Timing Array Sensitivity Curves*.
J. S. Hazboun, J. D. Romano, T. L. Smith
Journal of Open Software Science, **4**, 42, (2019)
10. *Realistic sensitivity curves for pulsar timing arrays*.
J. S. Hazboun, J. D. Romano, T. L. Smith
Physical Review D, **100**, 10, (2019)
9. *An acoustical analogue of a galactic-scale gravitational-wave detector*.
M. T. Lam, J. D. Romano, J. S. Key, M. Normandin, **J. S. Hazboun**
American Journal of Physics, **86**, 10, (2018)
8. *A Second Chromatic Timing Event of Interstellar Origin toward PSR J1713+0747*.
M. T. Lam, [...], **J. S. Hazboun**, et al. [37 Authors]
The Astrophysical Journal, **861**, 2, (2018)
7. *The NANOGrav 11-year Data Set: Pulsar-timing Constraints on the Stochastic Gravitational-wave Background*.
Z. Arzoumanian, [...], **J. S. Hazboun**, et al. [62 Authors]
The Astrophysical Journal, **859**, 1, (2018)
6. *Constructing an explicit AdS/CFT correspondence with Cartan geometry*.
J. S. Hazboun
Nuclear Physics B, **929**, pp. 254-265, (2018)
5. *Power radiated by a binary system in a de Sitter universe*.
B. Bonga, **J. S. Hazboun**
Physical Review D, **96**, 6, (2017)
4. *C7 multi-messenger astronomy of GW sources*.
M. Branchesi, [...], **J. S. Hazboun**, et al. [45 Authors]
General Relativity and Gravitation, **46**, 9, (2014)
3. *Time and dark matter from the conformal symmetries of Euclidean space*.
J. S. Hazboun, J. T. Wheeler
Classical and Quantum Gravity, **31**, 21, (2014)
2. *A systematic construction of curved phase space: A gravitational gauge theory with symplectic form*.
J. S. Hazboun, J. T. Wheeler
Journal of Physics: Conference Series, **360**, 012013, (2012)
1. *The Effect of Negative-Energy Shells on the Schwarzschild Black Hole*.
J. S. Hazboun, T. Dray
General Relativity and Gravitation, **42**, pp. 1457-1467, (2010)

Technical and White Papers

9. *Heliosphere Meets Interstellar Medium, in a Galactic Context*.
Stella Ocker, [...], **J. S. Hazboun**, et al. [11 Authors]
Bulletin of American Astronomical Society, **55**, 3, (2023)

8. *Pulsar Timing Arrays: Gravitational Waves from Supermassive Black Holes and More*.
I. Stairs, [...], **J. S. Hazboun**, et al. [32 Authors]
Canadian Long Range Plan for Astronony and Astrophysics White Papers, **2020**, pp. 16, (2019)
7. *The NANOGrav Program for Gravitational Waves and Fundamental Physics*.
S. Ransom, [...], **J. S. Hazboun**, et al. [15 Authors]
Bulletin of American Astronomical Society, **51**, pp. 195, (2019)
6. *NANOGrav Education and Outreach: Growing a Diverse and Inclusive Collaboration for Low-Frequency Gravitational Wave Astronomy*.
Timothy Dolch, [...], **J. S. Hazboun**, et al. [27 Authors]
Bulletin of American Astronomical Society, **51**, pp. 254, (2019)
5. *The Gravitational View of Massive Black Hole Mergers*.
Monica Colpi, [...], **J. S. Hazboun**, et al. [19 Authors]
Bulletin of American Astronomical Society, **51**, 3, (2019)
4. *Physics Beyond the Standard Model With Pulsar Timing Arrays*.
Xavier Siemens, **J. S. Hazboun**, et al. [8 Authors]
Bulletin of American Astronomical Society, **51**, 3, (2019)
3. *The Second International Pulsar Timing Array Mock Data Challenge*.
J. S. Hazboun, C. M. F. Mingarelli, K. J. Lee
Arxiv:1810.10527
2. *Null-stream pointing with pulsar timing arrays*.
J. S. Hazboun, S. L. Larson
Arxiv:1607.03459
1. *Limiting alternative theories of gravity using gravitational wave observations across the spectrum*.
J. S. Hazboun, M. P. Marcano, S. L. Larson
Arxiv:1311.3153

Teaching & Mentoring

Teaching Positions

- **Assistant Professor of Physics**, Oregon State University, Fall 2022 - Present
Electromagnetism and General Physics I
- **Visiting Assistant Professor**, Hendrix College, Fall 2015 - Spring 2016
Astronomy, Cosmology, Quantum Mechanics, and General Physics I
Mentored 4 undergraduate researchers.
- **Physics Instructor**, Utah State University, Spring 2015
General Physics II: Physics for the Life Sciences class.
Instructor of Record for 165 students.
Supervised nine teaching assistants.
- **Astronomy Instructor**, Utah State University, Fall 2014
Instructor of record for a 300+ person astronomy class.
Supervised two teaching assistants.
- **Online Physics Course Developer & Instructor**, Utah State University, 2012-2014
The Universe: Proposed, developed and taught an online cosmology class.
Aimed at non-science majors.
Continuously offered for the last 7 semesters.
Over 2000 students have taken this class.
- **Physics Instructor**, Utah State University, Summer 2011
General Physics I: Instructor of Record

- **MCAT Physics Instructor** Princeton Review, Portland, Oregon, Summer 2007
  Developed curriculum to help students review for physics portion of the MCAT exam.
  Taught students test-taking strategies to prepare for a stressful and fast-paced exam.

Courses

Courses Instructed, *Textbook* (Students × Credit Hours) [cumulative]

- **Data Analysis,** *Ivezić* (87 hrs)
- **Astrophysics,** *Maoz* (97 hrs)
- **Wave & Oscillations,** *Georgi* (99 hrs)
- **Electromagnetism,** *Griffiths* (111 hrs)
- **Quantum Mechanics,** *Griffiths* (39 hrs)
- **Cosmology,** *Ryden* (27 hrs)
- **Astronomy,** *Bennett, et al.* (1300 hrs)
- **The Universe,** *Ratcliffe* (1200 hrs)
- **Physics for the Life Sciences 1,** *Cutnell & Johnson* (75 hrs)
- **Physics for the Life Sciences 2,** *Cutnell & Johnson* (450 hrs)
- **Physics for Engineers 1,** *Halliday & Resnick* (75 hrs)

Graduate Student Research Mentoring

- *David Wright*, Oregon State University 2023-Present
  "Arbitrating the source of Nanohertz Gravitational Waves"
- *Kalista Wayt*, Oregon State University 2023-Present
  "Red Noise in Pulsars"
- *Alberto Diaz Hernandez*, Oregon State University 2022-Present
  "Time-series Analysis of Active Galactic Nuclei"
- *Jeremy Baier*, Oregon State University 2022-Present
  "Sensitivity of PTAs and Noise Mitigation"
- *Ian Díaz*, Oregon State University 2022-2024
  "Red Noise in X-ray Pulsars Times of Arrival"
- *Brent Shapiro-Albert*, West Virginia University 2018-2020
  "Chromatic Covariances with the Pulsar Signal Simulator"
- *Andrew Kaiser*, West Virginia University 2018-2020
  "Bayesian Non-Linear Timing with Gravitational Wave PTA Software"

Undergraduate Student Research Mentoring

- *Kyle Gourlie*, Oregon State University 2023-Present
  "Variance of PTA Sensitivity Curves"
- *Peter Orndoff*, Oregon State University 2022-2024
  "Visualizing the Gravitational Wave Background"
- *Kalista Wayt*, University of Washington Bothell 2022-2023
  "IPTA Quick Optimal Statistic"
- *Christine Ye*, University of Washington Bothell 2020-2022
  "PTA False Alarm Studies"
- *Min Young Kim*, University of Washington Seattle 2018-2019
  "Bayesian Pulsar Timing"
- *Kyle Gersbach*, University of Washington Bothell 2018-2020
  "Teaching with the Pulsar Signal Simulator"
- *Jacob Hesse*, University of Washington Bothell 2017-2018
  "Efficiently Simulating NANOGrav Pulsars"
- *Amelia Henkel*, REU UT Rio Grande Valley Summer 2017
  "Dispersing Simulated Baseband Pulsar Signals"
- *Cassidy Wagner*, REU UT Rio Grande Valley Summer 2017

"Simulating Interstellar Medium Effects with Convolution"

- *Chris Griffin*, Hendrix College 2015-2016
  "Conformal Diagrams of Crossing Spherical Shells in Schwarzschild Spacetime"
- *Devon Roell*, Hendrix College 2015-2016
  "The Quantum Exchange Force and Gravity"
- *Eric Mullins*, Hendrix College 2015-2016
  "Localizing Gravitational Wave Sources with Noisy Null Signals"
- *Connor Nelson*, Hendrix College 2015-2016
  "Localizing Multiple Gravitational Wave Sources with Null Signals"
- *Manuel Pichardo Marcano*, Utah State University 2012-2013
  "Multi-messenger Pulsar Timing Array Sources and Propagation Tests"

Teaching assistant

- Utah State University Fall 2009-Spring 2012
  General Physics I: Recitation Leader and Lab Instructor
  General Physics II: Recitation Leader and Lab Instructor
- Oregon State University Fall 2006-Spring 2009
  Paradigms in Physics TA: NSF funded higher division class reform project. Facilitated group work and took part in curriculum meetings.
  Physics for the Life Sciences: Recitation Leader and Lab Instructor
  General Physics II: Lab Instructor

Leadership & Professional Service

Research leadership

- **Co-chair**, NANOGrav Detection Working Group *April 2024–Present*
- **Lead**, NANOGrav 15-year Detector Characterization Analysis *Mar 2021–June 2023*
- **Co-chair**, IPTA Gravitational Wave Analysis Group *Jan 2019–Dec 2021*
- **Co-chair**, IGRAV Diversity, Equity & Inclusion Working Group *Jan 2019–July 2021*
- **Co-chair**, IPTA Data Challenge Group *Mar 2018–Jan 2022*

Reviewer for Research Proposals

- National Science Foundation (US)
- National Science Foundation (Switzerland)

Reviewer for international journals

- The Astrophysical Journal
- Classical and Quantum Gravity
- Physical Review D
- General Relativity & Gravitation
- Monthly Notices of the Royal Astronomical Society
- Physical Review Letters
- European Journal of Physics

Conference organization

- Chair, Scientific Organizing Committee, IPTA Meeting, Caltech, Pasadena, CA June, 2025
- Local Organizing Committee, NANOGrav Spring Meeting, Oregon State University 2023
- Local Organizing Committee, Conferences for Undergraduate Women in Physics, UW Seattle 2019
- Local Organizing Committee Chair, NANOGrav Spring Meeting, UW Bothell 2019
- LISA Data Analysis Workshop, AAS233 2019
- Scientific Organizing Committee, LISA Symposium, Chicago 2018
- Scientific Organizing Committee, NANOGrav Spring Meeting, University of Virginia 2018
- Scientific Organizing Committee, NANOGrav Spring Student Workshop, University of Virginia 2018
- Student Workshop Organizer, IPTA Meeting, Paris, France 2017
- Session Chair, *Black Holes*, AAS235 2020
- Session Chair, LISA Symposium 2018

Code & data sharing

- Jupyter Notebook examples for `pta_forecasts`. Based on `arxiv.org/abs/2009.11865` *2020*
  `https://github.com/Hazboun6/pta_forecasts`
- Introductory data analysis tutorial. *2019*
  `https://github.com/Hazboun6/data_analysis_tutorial`
- Developer of open-source Python GW analysis software `enterprise` *2017–*
  `https://github.com/nanograv/enterprise`

Media Engagement, Outreach & Diversity

Media Coverage & Engagement

- *"NSF Career Award helps physicist unravel the mysteries of the universe"* *Feb 2023*
  OSU College of Science
- *"Physicist Answers Physics Questions From Twitter — Tech Support — WIRED"* *Nov 2023*
  WIRED Magazine
- *"Scientists have found signs of a new kind of gravitational wave. It's really big"* *June 2023*
  National Public Radio, Morning Edition
- *"Gravitational wave discovery leads to greater understanding of the fabric of our universe"* *June 2023*
  PBS News Hour
- *"Scientists discover that universe is awash in gravitational waves"* *June 2023*
  Reuters Wire Service
- *"Astrophysicists report solid evidence for a background hum of gravitational waves"* *June 2023*
  GeekWire
- *"Astrophysics collaboration led by Oregon State finds 'chorus' of gravitational waves"* *June 2023*
  OSU press release

Outreach Projects

- *Astronomy on Tap Corvallis Lecture Series* *Fall 2023 – Present*
  Bombs Away Cafe, First Tuesday of the Month
  300+ Attendees and counting

Outreach Talks

- Astronomy on Tap Speaker, *"Black Holes"* *2024*
- Academy for Lifelong Learning, *"Whispers of Behemoth Black Holes"* *2024*
- Science Pub, *" The Search for Lumbering Giants: Whispers of Behemoth Black Holes"* *2024*
- North City Tech Meetup, *"Searching for Gravitational Waves with a Galactic-Scale Detector"* *2021*
- Gravitational Wave Astronomy, Eastside Preparatory *"How are gravitational waves detected?"* *2020*
- Science Wednesday Panel Discussion, King's Live Music *"The Science of Time Travel"* *2015*
- Science Fiction Club Talk, Hendrix College *"Black Holes and Wormholes"* *2015*
- Science Unwrapped (500 person public lecture), Utah State University *"Explore to Conserve"* *2013*
- Conservation Club Talk, Weber State *"A Scientist's Role in Conservation"* *2012*
- Science Unwrapped, Swaner Ecocenter *"A Scientist's Role in Modern Exploration"* *2012*
- Cache Valley Stargazers Talk, Logan, UT *"Black Holes: Ninjas of the Night Sky"* *2009*

Diversity & Equity

- Member, College of Science Equity, Access and Inclusion Leadership Council, 2023 – Present
- Appointee, NANOGrav Equity and Climate Committee, 2023 – Present
- Member APS Climate Site Visit Committee, 2024
- Chair/Member, Diversity, Inclusion, Culture & Equity Committee, OSU Physics Depart, 2022 – 2024
- Founding Co-chair, DEI Working Group, International Gravitational Outreach Group, 2018– 2021
- Member of the NANOGrav chapter of the APS Inclusion, Diversity, & Equity Alliance, 2020– 2022
- Local Organizing Committee, UW, Seattle (2019) Conferences for Undergraduate Women in Physics

Professional affiliations

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

Software Development

Lead Developer

`Hasasia`
- *Python package for calculating pulsar timing array sensitivity curves and signal-to-noise ratios.*
- https://pypi.org/project/hasasia/

`Pulsar Signal Simulator`
- *Python package for simulating pulsar observation data.*
- https://github.com/PsrSigSim/PsrSigSim

`La Forge`
- *Python package for processing data from Bayesian analyses of PTA data.*
- https://pypi.org/project/la-forge/

`Pulsar Data Toolbox`
- *Python package for accessing pulsar data files.*
- https://pypi.org/project/pdat/

Development Team

`Enterprise`
- *Python package for bayesian PTA data analysis.*
- https://github.com/nanograv/enterprise

`enterprise_extensions`
- *Python package for building bayesian analysis models.*
- https://github.com/nanograv/enterprise_extensions

`gwent`
- *Python package calculating gravitational wave sensitivities across the spectrum*
- https://pypi.org/project/gwent/

`Tabletop PTA`
- *Python package for an acoustical PTA demonstration.*
- https://pypi.org/project/tabletop_pta/

Full Presentation List

Invited talks

35. University of Michigan Physics Seminar, October, 2024
"Calibrating a galactic-scale gravitational wave detector: PTA noise modeling and characterization"

34. Pacific Northwest Assoc for College Physics Plenary, May, 2024
"The Search for Lumbering Giants: Listening to the Whispers of Behemoth Black Holes"

33. Yale Gravitational Wave Symposium Plenary, November, 2023
"Calibrating a galactic-scale gravitational wave detector: PTA noise modeling and characterization"

32. Amaldi 15 Plenary, July, 2023
"Calibrating a galactic-scale gravitational wave detector: PTA noise modeling and characterization"

31. International Pulsar Timing Array Meeting Special Session, June, 2023
"The NANOGrav 15-year Detector Characterization"

30. University of Michigan Astronomy Colloquium, October, 2022
"Lumbering Giants & Nanohertz Unicorns"

29. Oregon State University Colloquium, March, 2022
"Lumbering Giants & Nanohertz Unicorns"

28. **State University of New York Oswego Seminar**, February, 2022
"Searching for Lumbering Giants"
27. **Gravitational Wave Physics and Astronomy Workshop Plenary**, December, 2021
"Current Status of Pulsar Timing Array Gravitational Wave Astronomy"
26. **University of South Carolina Colloquium**, December, 2021
"The Search for Lumbering Giants"
25. **Idaho State University Colloquium**, October, 2021
"The Search for Lumbering Giants"
24. **Gravitational Wave Astronomy Northwest**, July, 2021
"Pulsar Timing Array Gravitational Wave Astronomy Update"
23. **Los Alamos National Lab**, April, 2021
"Searching for Nanohertz Gravitational Waves with a Galactic-Scale Detector"
22. **University of Missouri**, March, 2021
"Searching for Nanohertz Gravitational Waves with a Galactic-Scale Detector"
21. **Univ. of Wisc. Milwaukee, Center for Grav., Cosmo. and Astroph. Seminar**, February, 2021
"Doubling Down on Single Source Sensitivity"
20. **CERN Theory Colloquium**, January, 2021
"Highlights from the Search for Gravitational Waves in NANOGrav Datasets"
19. **Gravitational Wave Astronomy Northwest**, June, 2020
"Update on the search for gravitational waves in NANOGrav and IPTA datasets"
18. **LIGO Hanford Seminar**, March, 2020
"The Search for Lumbering Giants"
17. **American Astronomical Society 235th Meeting, NANOGrav Special Session**, January, 2020
"Highlights from the search for gravitational waves in NANOGrav datasets"
16. **Montana State University, Physics Colloquium**, November, 2019
"Exploring the discovery space of pulsar timing arrays with realistic sensitivity curves"
15. **Whitman College, Physics Colloquium**, October, 2019
"The Search for Lumbering Giants:
Observing the Nanohertz Gravitational-Wave Sky with Pulsar Timing Arrays"
14. **22nd International Conference on General Relativity and Gravitation (GR22) & 13th Edoardo Amaldi Conference on Gravitational Waves (Amaldi13)**, July, 2019
"Education and Public Outreach Efforts by Pulsar Timing Array Collaborations"
13. **Northwest APS Meeting**, May, 2019
"The Search for Lumbering Giants:
Observing the Nanohertz Gravitational-Wave Sky with Pulsar Timing Arrays"
12. **Gravitational Wave Physics and Astronomy Workshop**, December, 2019
"Current Status of Pulsar Timing Array Gravitational Wave Astronomy"
11. **University of Washington Bothell Physical Sciences Division Seminar**, December, 2018
"Observing the Nanohertz Gravitational-Wave Sky with Pulsar Timing Arrays"
10. **University of Washington Seattle AstroLunch Talk**, February, 2018
"A Galactic Scale Gravitational Wave Detector: The NANOGrav 11yr Limits"
9. **University of Washington Bothell Physical Sciences Division Seminar Seminar**, November, 2017
"The NANOGrav Pulsar Timing Array:
Using simulations to characterize our galactic gravitational wave detector."
8. **University of Texas Rio Grande Valley Arecibo Remote Command Center Meeting**, February, 2017
"Simulating Pulsar Signals for Noise Characterization of PTAs"
7. **University of Arkansas Physics Colloquium**, February, 2016
"Gravitational Wave Astronomy in the 2nd Century of GR"
6. **Western Washington University Physics Colloquium**, May, 2015
"A New Window into the Cosmos"
5. **Brigham Young University Physics Theory Seminar**, February, 2015
"Gravitational Gauge Theory and the Dark Cosmological Constituents"

4. **Georgia Tech Center for Relativistic Astrophysics, Departmental Colloquium**, March, 2013
   "Biconformal Space & Testing Alternative Theories of Gravity using Multi-Messenger Astronomy"
3. **Utah State University Physics Colloquium**, February, 2013
   "Best Practices for the Online Classroom"
2. **Utah State University Physics Colloquium**, September 2010
   "Curved Phase Space from conformal symmetry"
1. **Oregon State Physics Colloquium**, March 2009
   "Spherical Shells in a Schwarzschild Background"

Contributed presentations

49. *Update on the NANOGrav 12.5-year Custom Noise Project*
NANOGrav Fall Meeting, Vancouver, BC, October, 2023

48. *NANOGrav 15-year Detector Characterization Update*
International PTA Meeting, Queensland, Australia, June, 2023

47. *Analytic distribution of the optimal cross-correlation statistic for pulsar timing arrays*
American Physical Society April Meeting, Minneapolis, MN, April, 2023

46. *NANOGrav 15-year Detector Characterization Update*
NANOGrav Spring Meeting, Corvallis, OR, March, 2023

45. *Tuning PTAs for Single Source Sensitivity*
Caltech DSA2000 Science Meeting, Pasadena, CA, March, 2023

44. *NANOGrav 15-year Detector Characterization Analysis*
NANOGrav Fall Meeting, Milwaukee, WI,October, 2022

43. *Noise Budget for the NANOGrav Pulsar Timing Array*
American Physical Society April Meeting, New York City, NY, April, 2022

42. *NANOGrav 15-year Dataset Noise Update*
NANOGrav Spring Meeting, New York City, March, 2022

41. *Full PTA Advanced Noise Modeling Update*
NANOGrav Fall Meeting, Virtual/Nashville TN, October, 2021

40. *Comparing Single-Source Statistics for PTA Observing Strategies*
American Physical Society April Meeting, Virtual, April, 2021

39. *Doubling Down on Single Source Sensitivity*
American Astronomical Society Meeting, Virtual, January, 2021

38. *Model Dependence of Bayesian Gravitational Wave Background Statistics in PTAs*
International Pulsar Timing Array Meeting, Virtual, September, 2020

37. *Predicting NANOGrav's Sensitivity into the future with* `hasasia`
American Physical Society April Meeting, Virtual, April, 2020

36. *Exploring the Nanohertz Gravitational-Wave Discovery Space with Sensitivity Curves and* `hasasia`
American Astronomical Society Meeting, Honolulu, HI, January, 2020

35. *Gravitational Wave Astronomy with the NANOGrav Pulsar Timing Array*
Texas Symposium on Relativistic Astrophysics, Portsmouth, UK, December, 2019

34. *Modeling Astrophysical Noise Sources in PTAs*
Fall NANOGrav Meeting, Ithaca, NY, October, 2019

33. *Realistic Pulsar Timing Array Sensitivity Curves*
GR22/Amaldi13, Valencia, Spain, July, 2019

32. *Pulsar Timing Array Sensitivity Curves*
American Physical Society April Meeting, Denver, Colorado, April, 2019

31. *Characterizing the Sensitivity of the NANOGrav 11-year Data Set*
Spring NANOGrav Meeting, Bothell, Washington, March, 2019

30. *Bayesian Monitoring of Solar Electron Density Using NANOGrav Data sets*
American Astronomical Society Meeting, Seattle, Washington, January, 2019

29. *Bayesian Monitoring of the Solar Wind with Pulsar Timing Arrays*
AstroNWxSW, Vancouver, British Columbia, November, 2018

28. *Spurious Gravitational Wave Detections in the NANOGrav 11 Year Data Set*
Fall NANOGrav Meeting, Green Bank, West Virginia, October, 2018

27. *The International Pulsar Timing Array Mock Data Challenge*
LISA Symposium, Chicago, Illinois, July, 2018

26. *Evolution of the Detection Statistics in the NANOGrav Dataset*
International Pulsar Timing Array Meeting, Albuquerque, New Mexico, June, 2018

25. *Noise Evolution in the NANOGrav 11 Year Data Set*
Northwest Section APS Meeting, Tacoma, Washington, June, 2018

24. *Publishing a Gravitational Wave Stochastic Background Analysis*
Python in Astronomy, New York, New York, May, 2018

23. *Slicing the NANOGrav 11 Year Data Set*
American Physical Society April Meeting, Columbus, Ohio, April, 2018

22. *Evolution of the NANOGrav 11 Year Data Set*
Spring NANOGrav Meeting, Charlottesville, Virginia, March, 2018

21. *Slicing the NANOGrav 11 Year Data Set*
Fall NANOGrav Meeting, Easton, Pennsylvania, October, 2017

20. *The NANOGrav pulsar signal simulator*
International Pulsar Timing Array, Sèvres, France, July, 2017

19. *Late-time quadrupolar gravitational wave power in de Sitter space*
American Physical Society April Meeting, Washington, DC, January, 2017

18. *Null Stream Approach with PTAs: Noise Characterization and Excess Power*
American Astronomical Society 227th Meeting, Grapevine, Texas, January, 2017

17. *Assessing the null stream approach for source localization in PTAs*
Fall NANOGrav Meeting, Urbana, Illinois, October, 2016

16. *Comparing transverse-traceless decompositions of symmetric tensors*
Int. Soc. for General Relativity and Gravitation 21st Meeting, New York City, New York, July, 2016

15. *Null Stream Approach for finding Sky Position of Pulsar Timing Array sources*
American Physical Society April Meeting, Salt Lake City, Utah, April, 2016

14. *A Cartan Geometry approach to the AdS/CFT*
Midwest Gravity Meeting, Evanston, Illinois, October, 2015

13. *Tracing the AdS/CFT Degrees of Freedom using Cartan Geometry*
American Physical Society April Meeting, Baltimore, Maryland, April 2015

12. *Conformal gravity, dark matter and time*
Midwest Gravity Meeting, Rochester, MI, November, 2014

11. *Conformal gravity, dark matter and time*
APS Four Corners Meeting, Orem, Utah, October 2014

10. *Time from the conformal symmetries of a Euclidean space*
Midwest Gravity Meeting, Milwaukee, Wisconsin, October 2013

9. *Lorentzian geometry from the conformal symmetries of a Euclidean space*
Loops 13: International Conference on Quantum Gravity, Waterloo, Canada, July 2013

8. *Testing Bimetric and Massive Gravity Theories using Multi-Messenger Astronomy*
GR20/AMALDI 10, Warsaw, Poland, July 2013

7. *Lorentzian spin connection from the conformal symmetries of a Euclidean space*
   53rd Cracow School of Theoretical Physics, Zakopane, Poland, June 2013
6. *General relativity in signature changing phase space*
   Pacific Coast Gravity Meeting, Davis, California, March 2013
5. *General relativity in phase space with a natural notion of time*
   Pacific Coast Gravity Meeting, Santa Barbara, California, March 2012
4. *A systematic construction of curved phase space: A gravitational gauge theory with symplectic form*
   Loops 11: International Conference on Quantum Gravity, Madrid, Spain, May 2011
3. *Quantum gravity in relativistic phase space*
   Intermountain Graduate Research Symposium, Logan, Utah, March 2010
2. *Multiple Spherical Shells in Schwarzschild Spacetime*
   12th Marcel Grossman Gravity Meeting, Paris, France, July 2009
1. *Single Spherical Shells in Schwarzschild Spacetime*
   Pacific Coast Gravity Meeting, Eugene, Oregon, March 2009

Posters

3. *The NANOGrav Pulsar Signal Simulator*
   American Astronomical Society Meeting, Honolulu, HI, January, 2020
2. *Pulsar Timing Array Source Location Using the Null Signal Approach*
   American Astronomical Society 225th Meeting, Seattle, Washington, January 2015
1. *Multiple Spherical Shells in Schwarzschild Spacetime*
   TEXAS Symposium on Relativistic Astrophysics, Vancouver, Canada, December 2008