

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

ICBS Frontiers of Science Award in Theoretical Physics 2024

- *Awarded by:* The International Congress of Basic Science
- *Awarded for:* “Papers in the top one per cent of the most-cited articles recently published in our journals”

IOP Publishing North America: Top Cited Paper Award 2024

- *Awarded by:* Institute of Physics Publishing
- *Awarded for:* “Reporting first evidence for the existence of a gravitational wave background from merging supermassive black holes”

Observing Proposals

Co-I: “The North American Nanohertz Observatory for Gravitational Waves” May 2024

- Greenbank Telescope, Project ID GBT24B–427
- Status: awarded 1723.50 hours

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 GBT18B–355
- Status: awarded 5 hours

Publications

- **Metrics** available at [InspireHEP](#) or [Google Scholar](#).

Submitted.....

1. *The NANOGrav 15-year Data Set: Search for Gravitational Wave Memory.*
Rand Burnette, [...], **J. S. Hazboun**, et al. [105 Authors]
[Arxiv:2502.18599](#)
2. *Pulse Profile Variability of PSR J1022+1001 in NANOGrav Data.*
William Fiore, [...], **J. S. Hazboun**, et al. [49 Authors]
[Arxiv:2412.05452](#)
3. *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](#)

5. *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](#)
6. *CMB and energy conservation limits on nanohertz gravitational waves.*
David Wright, John T. Giblin, **J. S. Hazboun**
[Arxiv:2409.15572](#)
7. *The Anomalous Acceleration of PSR J2043+1711: Long-Period Orbital Companion or Stellar Flyby?*
Thomas H Donlon, [...], **J. S. Hazboun**, et al. [56 Authors]
[Arxiv:2407.06482](#)

Accepted.....

1. *Tuning a PTA in the detection era.*
Jeremy G. Baier, **J. S. Hazboun**, Joseph D. Romano
[The Astrophysical Journal](#), -, -, (2025)

Published.....

1. *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)
2. *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)
3. *NANOGrav 15-year gravitational-wave background methods.*
Aaron D. Johnson, [...], **J. S. Hazboun**, et al. [98 Authors]
[Physical Review D](#), **109**, 10, (2024)
4. *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)
5. *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)
6. *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)
7. *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)
8. *How to Detect an Astrophysical Nanohertz Gravitational Wave Background.*
B. B csy, [...], **J. S. Hazboun**, et al. [96 Authors]
[The Astrophysical Journal](#), **959**, 1, (2023)
9. *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)

10. *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)
11. *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)
12. *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)
13. *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)
14. *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)
15. *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)
16. *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)
17. *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)
18. *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)
19. *Bayesian Solar Wind Modeling with Pulsar Timing Arrays.*
J. S. Hazboun, et al. [30 Authors]
[The Astrophysical Journal](#), **929**, 1, (2022)
20. *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)
21. *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)
22. *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)
23. *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)

24. *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)
25. *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)
26. *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)
27. *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)
28. *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)
29. *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)
30. *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)
31. *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)
32. *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)
33. *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)
34. *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)
35. *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)
36. *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)

37. *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)
38. *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)
39. *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)
40. *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)
41. *The astrophysics of nanohertz gravitational waves.*
 S. Burke-Spolaor, [...], **J. S. Hazboun**, et al. [15 Authors]
[The Astronomy and Astrophysics Review](#), **27**, 1, (2019)
42. *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)
43. *Realistic sensitivity curves for pulsar timing arrays.*
J. S. Hazboun, J. D. Romano, T. L. Smith
[Physical Review D](#), **100**, 10, (2019)
44. *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)
45. *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)
46. *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)
47. *Constructing an explicit AdS/CFT correspondence with Cartan geometry.*
J. S. Hazboun
[Nuclear Physics B](#), **929**, pp. 254-265, (2018)
48. *Power radiated by a binary system in a de Sitter universe.*
 B. Bonga, **J. S. Hazboun**
[Physical Review D](#), **96**, 6, (2017)
49. *C7 multi-messenger astronomy of GW sources.*
 M. Branchesi, [...], **J. S. Hazboun**, et al. [45 Authors]
[General Relativity and Gravitation](#), **46**, 9, (2014)
50. *Time and dark matter from the conformal symmetries of Euclidean space.*
J. S. Hazboun, J. T. Wheeler
[Classical and Quantum Gravity](#), **31**, 21, (2014)
51. *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)

52. *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.....

1. *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)
2. *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 Astronomy and Astrophysics White Papers](#), **2020**, pp. 16, (2019)
3. *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)
4. *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)
6. *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)
7. *The Second International Pulsar Timing Array Mock Data Challenge.*
J. S. Hazboun, C. M. F. Mingarelli, K. J. Lee
[Arxiv:1810.10527](#)
8. *Null-stream pointing with pulsar timing arrays.*
J. S. Hazboun, S. L. Larson
[Arxiv:1607.03459](#)
9. *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.....

1. **University of Michigan Physics Seminar,** October, 2024
"Calibrating a galactic-scale gravitational wave detector: PTA noise modeling and characterization"
2. **Pacific Northwest Assoc for College Physics Plenary,** May, 2024
"The Search for Lumbering Giants: Listening to the Whispers of Behemoth Black Holes"
3. **Yale Gravitational Wave Symposium Plenary,** November, 2023
"Calibrating a galactic-scale gravitational wave detector: PTA noise modeling and characterization"
4. **Amaldi 15 Plenary,** July, 2023
"Calibrating a galactic-scale gravitational wave detector: PTA noise modeling and characterization"
5. **International Pulsar Timing Array Meeting Special Session,** June, 2023
"The NANOGrav 15-year Detector Characterization"

6. **University of Michigan Astronomy Colloquium,** October, 2022
"Lumbering Giants & Nanohertz Unicorns"
7. **Oregon State University Colloquium,** March, 2022
"Lumbering Giants & Nanohertz Unicorns"
8. **State University of New York Oswego Seminar,** February, 2022
"Searching for Lumbering Giants"
9. **Gravitational Wave Physics and Astronomy Workshop Plenary,** December, 2021
"Current Status of Pulsar Timing Array Gravitational Wave Astronomy"
10. **University of South Carolina Colloquium,** December, 2021
"The Search for Lumbering Giants"
11. **Idaho State University Colloquium,** October, 2021
"The Search for Lumbering Giants"
12. **Gravitational Wave Astronomy Northwest,** July, 2021
"Pulsar Timing Array Gravitational Wave Astronomy Update"
13. **Los Alamos National Lab,** April, 2021
"Searching for Nanohertz Gravitational Waves with a Galactic-Scale Detector"
14. **University of Missouri,** March, 2021
"Searching for Nanohertz Gravitational Waves with a Galactic-Scale Detector"
15. **Univ. of Wisc. Milwaukee, Center for Grav., Cosmo. and Astroph. Seminar,** February, 2021
"Doubling Down on Single Source Sensitivity"
16. **CERN Theory Colloquium,** January, 2021
"Highlights from the Search for Gravitational Waves in NANOGrav Datasets"
17. **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"
19. **American Astronomical Society 235th Meeting, NANOGrav Special Session,** January, 2020
"Highlights from the search for gravitational waves in NANOGrav datasets"
20. **Montana State University, Physics Colloquium,** November, 2019
"Exploring the discovery space of pulsar timing arrays with realistic sensitivity curves"
21. **Whitman College, Physics Colloquium,** October, 2019
*"The Search for Lumbering Giants:
Observing the Nanohertz Gravitational-Wave Sky with Pulsar Timing Arrays"*
22. **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"
23. **Northwest APS Meeting,** May, 2019
*"The Search for Lumbering Giants:
Observing the Nanohertz Gravitational-Wave Sky with Pulsar Timing Arrays"*
24. **Gravitational Wave Physics and Astronomy Workshop,** December, 2019
"Current Status of Pulsar Timing Array Gravitational Wave Astronomy"
25. **University of Washington Bothell Physical Sciences Division Seminar,** December, 2018
"Observing the Nanohertz Gravitational-Wave Sky with Pulsar Timing Arrays"
26. **University of Washington Seattle AstroLunch Talk,** February, 2018
"A Galactic Scale Gravitational Wave Detector: The NANOGrav 11yr Limits"
27. **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."*
28. **University of Texas Rio Grande Valley Arecibo Remote Command Center Meeting,** February, 2017
"Simulating Pulsar Signals for Noise Characterization of PTAs"
29. **University of Arkansas Physics Colloquium,** February, 2016
"Gravitational Wave Astronomy in the 2nd Century of GR"

30. **Western Washington University Physics Colloquium,** May, 2015
"A New Window into the Cosmos"
31. **Brigham Young University Physics Theory Seminar,** February, 2015
"Gravitational Gauge Theory and the Dark Cosmological Constituents"
32. **Georgia Tech Center for Relativistic Astrophysics, Departmental Colloquium,** March, 2013
"Biconformal Space & Testing Alternative Theories of Gravity using Multi-Messenger Astronomy"
33. **Utah State University Physics Colloquium,** February, 2013
"Best Practices for the Online Classroom"
34. **Utah State University Physics Colloquium,** September 2010
"Curved Phase Space from conformal symmetry"
35. **Oregon State Physics Colloquium,** March 2009
"Spherical Shells in a Schwarzschild Background"

Contributed presentations.....

1. *Update on the NANOGrav 12.5-year Custom Noise Project*
NANOGrav Fall Meeting, Vancouver, BC, October, 2023
2. *NANOGrav 15-year Detector Characterization Update*
International PTA Meeting, Queensland, Australia, June, 2023
3. *Analytic distribution of the optimal cross-correlation statistic for pulsar timing arrays*
American Physical Society April Meeting, Minneapolis, MN, April, 2023
4. *NANOGrav 15-year Detector Characterization Update*
NANOGrav Spring Meeting, Corvallis, OR, March, 2023
5. *Tuning PTAs for Single Source Sensitivity*
Caltech DSA2000 Science Meeting, Pasadena, CA, March, 2023
6. *NANOGrav 15-year Detector Characterization Analysis*
NANOGrav Fall Meeting, Milwaukee, WI, October, 2022
7. *Noise Budget for the NANOGrav Pulsar Timing Array*
American Physical Society April Meeting, New York City, NY, April, 2022
8. *NANOGrav 15-year Dataset Noise Update*
NANOGrav Spring Meeting, New York City, March, 2022
9. *Full PTA Advanced Noise Modeling Update*
NANOGrav Fall Meeting, Virtual/Nashville TN, October, 2021
10. *Comparing Single-Source Statistics for PTA Observing Strategies*
American Physical Society April Meeting, Virtual, April, 2021
11. *Doubling Down on Single Source Sensitivity*
American Astronomical Society Meeting, Virtual, January, 2021
12. *Model Dependence of Bayesian Gravitational Wave Background Statistics in PTAs*
International Pulsar Timing Array Meeting, Virtual, September, 2020
13. *Predicting NANOGrav's Sensitivity into the future with *hasasia**
American Physical Society April Meeting, Virtual, April, 2020
14. *Exploring the Nanohertz Gravitational-Wave Discovery Space with Sensitivity Curves and *hasasia**
American Astronomical Society Meeting, Honolulu, HI, January, 2020
15. *Gravitational Wave Astronomy with the NANOGrav Pulsar Timing Array*
Texas Symposium on Relativistic Astrophysics, Portsmouth, UK, December, 2019
16. *Modeling Astrophysical Noise Sources in PTAs*
Fall NANOGrav Meeting, Ithaca, NY, October, 2019
17. *Realistic Pulsar Timing Array Sensitivity Curves*
GR22/Amaldi13, Valencia, Spain, July, 2019

18. *Pulsar Timing Array Sensitivity Curves*
American Physical Society April Meeting, Denver, Colorado, April, 2019
19. *Characterizing the Sensitivity of the NANOGrav 11-year Data Set*
Spring NANOGrav Meeting, Bothell, Washington, March, 2019
20. *Bayesian Monitoring of Solar Electron Density Using NANOGrav Data sets*
American Astronomical Society Meeting, Seattle, Washington, January, 2019
21. *Bayesian Monitoring of the Solar Wind with Pulsar Timing Arrays*
AstroNWxSW, Vancouver, British Columbia, November, 2018
22. *Spurious Gravitational Wave Detections in the NANOGrav 11 Year Data Set*
Fall NANOGrav Meeting, Green Bank, West Virginia, October, 2018
23. *The International Pulsar Timing Array Mock Data Challenge*
LISA Symposium, Chicago, Illinois, July, 2018
24. *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
26. *Publishing a Gravitational Wave Stochastic Background Analysis*
Python in Astronomy, New York, New York, May, 2018
27. *Slicing the NANOGrav 11 Year Data Set*
American Physical Society April Meeting, Columbus, Ohio, April, 2018
28. *Evolution of the NANOGrav 11 Year Data Set*
Spring NANOGrav Meeting, Charlottesville, Virginia, March, 2018
29. *Slicing the NANOGrav 11 Year Data Set*
Fall NANOGrav Meeting, Easton, Pennsylvania, October, 2017
30. *The NANOGrav pulsar signal simulator*
International Pulsar Timing Array, Sèvres, France, July, 2017
31. *Late-time quadrupolar gravitational wave power in de Sitter space*
American Physical Society April Meeting, Washington, DC, January, 2017
32. *Null Stream Approach with PTAs: Noise Characterization and Excess Power*
American Astronomical Society 227th Meeting, Grapevine, Texas, January, 2017
33. *Assessing the null stream approach for source localization in PTAs*
Fall NANOGrav Meeting, Urbana, Illinois, October, 2016
34. *Comparing transverse-traceless decompositions of symmetric tensors*
Int. Soc. for General Relativity and Gravitation 21st Meeting, New York City, New York, July, 2016
35. *Null Stream Approach for finding Sky Position of Pulsar Timing Array sources*
American Physical Society April Meeting, Salt Lake City, Utah, April, 2016
36. *A Cartan Geometry approach to the AdS/CFT*
Midwest Gravity Meeting, Evanston, Illinois, October, 2015
37. *Tracing the AdS/CFT Degrees of Freedom using Cartan Geometry*
American Physical Society April Meeting, Baltimore, Maryland, April 2015
38. *Conformal gravity, dark matter and time*
Midwest Gravity Meeting, Rochester, MI, November, 2014
39. *Conformal gravity, dark matter and time*
APS Four Corners Meeting, Orem, Utah, October 2014
40. *Time from the conformal symmetries of a Euclidean space*
Midwest Gravity Meeting, Milwaukee, Wisconsin, October 2013

41. *Lorentzian geometry from the conformal symmetries of a Euclidean space*
Loops 13: International Conference on Quantum Gravity, Waterloo, Canada, July 2013
42. *Testing Bimetric and Massive Gravity Theories using Multi-Messenger Astronomy*
GR20/AMALDI 10, Warsaw, Poland, July 2013
43. *Lorentzian spin connection from the conformal symmetries of a Euclidean space*
53rd Cracow School of Theoretical Physics, Zakopane, Poland, June 2013
44. *General relativity in signature changing phase space*
Pacific Coast Gravity Meeting, Davis, California, March 2013
45. *General relativity in phase space with a natural notion of time*
Pacific Coast Gravity Meeting, Santa Barbara, California, March 2012
46. *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
47. *Quantum gravity in relativistic phase space*
Intermountain Graduate Research Symposium, Logan, Utah, March 2010
48. *Multiple Spherical Shells in Schwarzschild Spacetime*
12th Marcel Grossman Gravity Meeting, Paris, France, July 2009
49. *Single Spherical Shells in Schwarzschild Spacetime*
Pacific Coast Gravity Meeting, Eugene, Oregon, March 2009

Posters.....

1. *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
3. *Multiple Spherical Shells in Schwarzschild Spacetime*
TEXAS Symposium on Relativistic Astrophysics, Vancouver, Canada, December 2008