

SHANIA NICHOLS

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Current Position

NanoGrav PFC Postdoctoral Researcher

September 2024 - Present

Working on Noise Budget and Pulsar Timing

Education

Louisiana State University

June 2018 - August 2024

Ph.D in Physics, Expected August 2024

State University of New York at Oswego

August 2014 - May 2018

Bachelors of Science in Meteorology, Astronomy Minor

Technical Skills

Languages: Python, Mathematica, MatLab, Bash, L^AT_EX

Data Analysis Tools: Pandas, NumPy, SciPy, Astropy, Matplotlib, Machine Learning Algorithms (t-SNE), Time Series Analysis, Digital Signal Processing

Developer Tools: Linux, GitLab, Jupyter Notebooks

Work Experience

Graduate Research Assistant

May 2020 – August 2024

- * Identified and analyzed loud transient noise, known as "loud glitches", within the Advanced Laser Interferometer Gravitational Wave Observatory (aLIGO) instruments, investigating their origins. Utilizing a machine learning algorithm (t-SNE) on the time series data of these loud glitches, unveiled their characteristic duration. This led to the conclusion that residual gas molecules and dust transiting the laser beam are not the source of loud glitches.
- * Performed noise injections to produce transient noise in aLIGO detector. This experiment proved the control loop used to detect gravitational waves was not the source of loud transient noise. It also revealed an energy spectrum between loud glitches and other transient noise types identified by the Gravity Spy machine learning tool.
- * Investigated detector auxiliary channel data to determine correlations between loud glitches in the gravitational wave data and various detector subsystems, including research which ruled out the voltage monitors as a source of loud glitches. This work has been published to the journal of Classical and Quantum Gravity. DOI:10.1088/1361-6382/abfd85
- * Co-led the noise mitigation review team for gravitational wave candidates in the fourth observing run, overseeing the evaluation of data quality surrounding gravitational wave signals. This involved determining analysis windows for gravitational wave searches and recommending various parameter estimation (PE) investigations in cases where noise coincided with a signal. Once PE investigations are completed, the event is finalized to be included in the gravitational wave catalog.
- * Served as the detector characterization expert for the GW230529 Discovery paper editorial team, contributing to the description of the LIGO Livingston detector status and data quality during the detection of the gravitational wave signal. Discussed the detector upgrades implemented for the fourth observing run. This paper was submitted to the Astrophysical Journal Letters. Member of the editorial team for the detector characterization publication dedicated to the first part of the fourth observing run, which is currently in preparation.

Graduate Teaching Assistant

August 2018 – May 2020

- * Provided instruction and mentorship to undergraduate students in physics and astronomy labs, cultivating their understanding of fundamental concepts.
- * Participated in assessing student performance by grading lab reports and homework assignments, providing constructive feedback to enhance their progress.
- * Introduced new astronomy lab curriculum to promote increased student engagement.

Mentorship

May 2022 – Present

- * Provided mentorship to undergraduates and a master's student, assisting with aLIGO research projects.
- * Delivered support navigating research methodologies, experimental techniques, and data analysis, enabling them to acquire essential skills vital for their advancement in academic research.

Selected Conferences and Lectures

The Dirty Laundry of Gravitational Wave Detection

November 2023

Invited Lecture for Brown University's Theoretical Physics Research Group

Providence, RI

Exploring the Origins of Loud Glitches in aLIGO Detector Data

September 2023

LVK Conference Poster

Toyama, Japan

Investigation of Loud Transient Noise Sources in aLIGO Detectors

April 2023

American Physical Society Conference Research Presentation

Minneapolis, MN

LIGO Detector Characterization for Instrument Scientists

March 2022

LVK Conference Talk on behalf of the Detector Characterization Group (co-speaker)

Remote

Leadership

Diversity, Equity, Inclusion and Accessibility Committee

July 2020 – August 2023

- * Acted as a Graduate Student Representative on the Diversity, Equity, Inclusion, and Accessibility (DEIA) Committee, practicing shared leadership principles to foster collaboration and inclusivity.
- * Contributed to the development of the departmental climate survey aimed at assessing the department environment for different stakeholders, and presented the survey results during departmental all-hands meetings to initiate constructive discussions and awareness.
- * Played a key role in developing a departmental website hosting resources on safety, support services across campus, and reporting mechanisms for incidents, fostering a safer and more inclusive environment.
- * Completed Safe Space training, acquiring knowledge and skills in promoting inclusivity and providing support for members of the LGBTQ+ community, contributing to a more inclusive and supportive departmental environment.

Physics and Astronomy Graduate Student Organization Executive Board

May 2021 – May 2022

- * Interfaced with faculty members in the physics and astronomy department to advocate for graduate student concerns, including but not limited to wages, mental health, teaching approaches, and curriculum standards.
- * Coordinated prospective student visits, conducted fundraising initiatives, and oversaw fund management for events involving both prospective and current graduate students.

Selected Publications

- [1] A. G. Abac et al. “Observation of Gravitational Waves from the Coalescence of a 2.5–4.5 M_{\odot} Compact Object and a Neutron Star”. In: *Astrophys. J. Lett.* 970.2 (2024), p. L34. DOI: 10.3847/2041-8213/ad5beb. arXiv: 2404.04248 [astro-ph.HE].
- [2] B. P. Abbott et al. “A Gravitational-wave Measurement of the Hubble Constant Following the Second Observing Run of Advanced LIGO and Virgo”. In: *Astrophys. J.* 909.2 (2021), p. 218. DOI: 10.3847/1538-4357/abdc7. arXiv: 1908.06060 [astro-ph.CO].
- [3] B.P. Abbott et al. “GW190425: Observation of a Compact Binary Coalescence with Total Mass $\sim 3.4M_{\odot}$ ”. In: *Astrophys. J. Lett.* 892 (2020), p. L3. DOI: 10.3847/2041-8213/ab75f5. arXiv: 2001.01761 [astro-ph.HE].
- [4] R. Abbott et al. “GW190412: Observation of a Binary-Black-Hole Coalescence with Asymmetric Masses”. In: *Phys. Rev. D* 102.4 (2020), p. 043015. DOI: 10.1103/PhysRevD.102.043015. arXiv: 2004.08342 [astro-ph.HE].
- [5] R. Abbott et al. “GW190521: A Binary Black Hole Merger with a Total Mass of 150 M_{\odot} ”. In: *Phys. Rev. Lett.* 125 (2020), p. 101102. DOI: 10.1103/PhysRevLett.125.101102. arXiv: 2009.01075 [gr-qc].
- [6] R. Abbott et al. “GW190814: Gravitational Waves from the Coalescence of a 23 Solar Mass Black Hole with a 2.6 Solar Mass Compact Object”. In: *Astrophys. J.* 896.2 (2020), p. L44. DOI: 10.3847/2041-8213/ab960f. arXiv: 2006.12611 [astro-ph.HE].
- [7] R. Abbott et al. “GWTC-2: Compact Binary Coalescences Observed by LIGO and Virgo During the First Half of the Third Observing Run”. In: *Phys. Rev. X* 11 (2021), p. 021053. DOI: 10.1103/PhysRevX.11.021053. arXiv: 2010.14527 [gr-qc].
- [8] R. Abbott et al. “GWTC-2.1: Deep extended catalog of compact binary coalescences observed by LIGO and Virgo during the first half of the third observing run”. In: *Phys. Rev. D* 109.2 (2024), p. 022001. DOI: 10.1103/PhysRevD.109.022001. arXiv: 2108.01045 [gr-qc].
- [9] R. Abbott et al. “GWTC-3: Compact Binary Coalescences Observed by LIGO and Virgo during the Second Part of the Third Observing Run”. In: *Phys. Rev. X* 13.4 (2023), p. 041039. DOI: 10.1103/PhysRevX.13.041039. arXiv: 2111.03606 [gr-qc].
- [10] R. Abbott et al. “Observation of gravitational waves from two neutron star-black hole coalescences”. In: *Astrophys. J. Lett.* 915 (2021), p. L5. DOI: 10.3847/2041-8213/ac082e. arXiv: 2106.15163 [astro-ph.HE].
- [11] R. Abbott et al. “Tests of General Relativity with GWTC-3”. In: (Dec. 2021). arXiv: 2112.06861 [gr-qc].
- [12] Rich Abbott et al. “Search for intermediate mass black hole binaries in the third observing run of Advanced LIGO and Advanced Virgo”. In: *Astron. Astrophys.* 659 (2022), A84. DOI: 10.1051/0004-6361/202141452. arXiv: 2105.15120 [astro-ph.HE].
- [13] Derek Davis et al. “LIGO detector characterization in the second and third observing runs”. In: *Class. Quant. Grav.* 38.13 (2021), p. 135014. DOI: 10.1088/1361-6382/abfd85. arXiv: 2101.11673 [astro-ph.IM].