

Pinchen Fan

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Research Interests

Search for extraterrestrial life, technosignatures (SETI), biosignatures, exoplanets, astrobiology

Gravitational waves, tests of general relativity, multi-messenger astronomy

Education

The Pennsylvania State University, University Park, PA
Ph.D., Dual-Title in Astronomy & Astrophysics and Astrobiology Expected 2027
Thesis advisor: Jason Wright
M.S. in Astronomy & Astrophysics Expected 2024

Carleton College, Northfield, MN
B.A. in Physics, Minor in Mathematics, *magna cum laude* 2018-2022

Appointments

Graduate Research Assistant, Penn State University 2023-Present
Co-instructor of Astro 476 SETI, Penn State University Fall 2023
Graduate Teaching Assistant, Penn State University Fall 2022
Undergraduate Research Assistant, Massachusetts Institute of Technology 2021-2022
Undergraduate Teaching Assistant, Carleton College 2020-2022
Undergraduate Research Assistant, Carleton College 2019-2022

Honors, Awards, and Fellowships

CPEST Travel Grant, Penn State University 2024
Zaccheus Daniel Fellowship, Penn State University 2023
PATHS STEAM Educational Grant, LGBT Tech 2023
Homer F. Braddock/Nellie H. and Oscar L. Roberts Fellowship, Penn State University 2022
Phi Beta Kappa Society Member 2022
Sigma Xi The Scientific Research Honors Society Member 2022
Dean's List 2020-2021, Carleton College 2021
Parents Fund for Academic Excellence (Summer Research Fellowship), Carleton College 2021

Publications

[Google Scholar](#), h-index 10, 600 citations 3/2024

Leading Author

1. Anarya Ray, **Pinchen Fan**, Vincent F. He, Malachy Bloom, Suyu Michael Yang, Jay D. Tasson, and Jolien D. E. Creighton, *Measuring Gravitational Wave Speed and Lorentz Violation with the First Three Gravitational-Wave Catalogs*, 2023, [arXiv:2307.13099 \[gr-qc\]](#)

Co-Author

1. Muhammed Saleem and 19 other authors (incl. **Pinchen Fan**), *Demonstration of Machine Learning-assisted real-time noise regression in gravitational wave detectors*, 2023, [arXiv:2306.11366 \[gr-qc\]](#)

Collaboration Author (P. C. Fan)

In these papers, I am listed as an author because of my research as a LIGO-Virgo-KAGRA collaboration member.

15. C. Fletcher et al., *A Joint Fermi-GBM and Swift-BAT Analysis of Gravitational-Wave Candidates from the Third Gravitational-wave Observing Run*, 2023, [arXiv:2308.13666 \[astro-ph.HE\]](#)
14. A. G. Abac et al., *Search for Eccentric Black Hole Coalescences during the Third Observing Run of LIGO and Virgo*, 2023, [arXiv:2308.03822 \[astro-ph.HE\]](#)
13. R. Abbott et al., “Constraints on the Cosmic Expansion History from GWTC-3”, *The Astrophysical Journal* **949**, 76 (2023)
12. R. Abbott et al., *Search for gravitational-lensing signatures in the full third observing run of the LIGO-Virgo network*, 2023, [arXiv:2304.08393 \[gr-qc\]](#)
11. R. Abbott et al., “Search for subsolar-mass black hole binaries in the second part of Advanced LIGO’s and Advanced Virgo’s third observing run”, *Monthly Notices of the Royal Astronomical Society*, [stad588](#) (2023)
10. R. Abbott et al., *Open data from the third observing run of LIGO, Virgo, KAGRA and GEO*, 2023, [arXiv:2302.03676 \[gr-qc\]](#)
9. R. Abbott et al., “Model-based Cross-correlation Search for Gravitational Waves from the Low-mass X-Ray Binary Scorpius X-1 in LIGO O3 Data”, *The Astrophysical Journal Letters* **941**, L30 (2022)
8. R. Abbott et al. (LIGO Scientific Collaboration, Virgo Collaboration, and KAGRA Collaboration), “All-sky search for continuous gravitational waves from isolated neutron stars using Advanced LIGO and Advanced Virgo O3 data”, *Phys. Rev. D* **106**, 102008 (2022)
7. R. Abbott et al. (LIGO Scientific Collaboration, Virgo Collaboration, and KAGRA Collaboration), “Search for gravitational waves from Scorpius X-1 with a hidden Markov model in O3 LIGO data”, *Phys. Rev. D* **106**, 062002 (2022)
6. R. Abbott et al. (LIGO Scientific Collaboration, Virgo Collaboration, and KAGRA Collaboration), “Search for continuous gravitational wave emission from the Milky Way center in O3 LIGO-Virgo data”, *Phys. Rev. D* **106**, 042003 (2022)
5. R. Abbott et al., “Searches for Gravitational Waves from Known Pulsars at Two Harmonics in the Second and Third LIGO-Virgo Observing Runs”, *The Astrophysical Journal* **935**, 1 (2022)

4. R. Abbott et al. (The LIGO Scientific Collaboration, the Virgo Collaboration, and the KAGRA Collaboration), “All-sky search for gravitational wave emission from scalar boson clouds around spinning black holes in LIGO O3 data”, *Phys. Rev. D* **105**, 102001 (2022)
3. R. Abbott et al., “First joint observation by the underground gravitational-wave detector KAGRA with GEO 600”, *Progress of Theoretical and Experimental Physics* **2022**, 063F01 (2022)
2. R. Abbott et al., *Search for gravitational-wave transients associated with magnetar bursts in Advanced LIGO and Advanced Virgo data from the third observing run*, 2022, [arXiv:2210.10931 \[astro-ph.HE\]](#)
1. R. Abbott et al., *Tests of General Relativity with GWTC-3*, 2021, [arXiv:2112.06861 \[gr-qc\]](#)

Research Experience

Pennsylvania State University, University Park, PA

Graduate Research Assistant, Department of Astronomy and Astrophysics

A Search for Extraterrestrial Laser Emissions 2022-Present
 Advisor: Jason T. Wright

- Analyze near-infrared 1D stellar spectra taken with the Hobby-Eberly Telescope
- Set statistical thresholds to discriminate possible extraterrestrial laser signal from noise
- Develop machine-learning algorithms to analyze 2D stellar image to find possible

Massachusetts Institute of Technology, Cambridge, MA

Undergraduate Research Assistant, MIT Kavli Institute for Astrophysics and Space Research

Analyzing DeepClean Performance with GstLAL 2022
 Advisor: Erik Katsavounidis

- Analyzed the real-time machine-learning DeepClean algorithm on gravitational-wave detectors
- Ran a gravitational-wave analysis pipeline to determine the performance of the algorithm
- Quantified the earlier detections and warnings of compact binary mergers

Comparison of Gravitational-Wave Skymaps 2021-2022
 Advisor: Erik Katsavounidis

- Compared skymaps generated by different low-latency algorithms with ones generated by Bayesian inference using LIGO-Virgo data
- Quantified and analyzed the relatedness of low-latency skymaps for real signals detected by LIGO-Virgo and for simulated gravitational-wave events
- Developed possible methods for identifying noise in signals using the relatedness of low-latency skymaps

Carleton College, Northfield, MN

Undergraduate Research Assistant, Department of Physics and Astronomy

Measuring the Speed of Gravitational Waves and Testing Lorentz Symmetry 2020-2022
 Advisor: Jay Tasson

- Measure the speed of gravitational waves using LIGO Bayesian inference nested sampling algorithms and Markov Chain Monte Carlo (MCMC) methods with LIGO-Virgo data
- Compute the constraints of the coefficients for Lorentz Violation in the nonbirefringent, nondispersive limit using the measurements of the speed of gravitational waves
- Test Lorentz violation with respect to dispersion

Emission Line Survey of M33 Galaxy

2019-2020

Advisor: Cindy Blaha

- Created continuum-subtracted images to measure the ionized hydrogen regions in M33 galaxy
- Studied the star-forming regions of M33 by analyzing the hydrogen emission regions
- Developed and implemented IRAF codes to further identify the H-II, O-III, and S-II regions
- Compared these regions to understand M33's chemical composition, thus its possible age

Teaching Experience

Pennsylvania State University, University Park, PA

Co-instructor, Astro 476 Search for Extraterrestrial Intelligence

Fall 2023

Teaching Assistant, Astro 420W Planets and Planetary System Formation

Fall 2022

Carleton College, Northfield, MN

Lab Assistant & Grader, Astro 110 Introduction to Astronomy

Winter 2021 & Winter 2022

Lab Assistant, Astro 113 Observational and Laboratory Astronomy

Fall 2021

Grader, Physics 235 Electricity and Magnetism

Spring 2021

Lab Assistant, Physics 228 Atomic and Nuclear Physics and Lab

Fall 2020

Talks

Invited

CU Boulder Department of Astrophysical and Planetary Sciences Seminar

2024

When to Search for Transmissions from Earth-level Civilizations

Other

AAS 243rd Meeting SETI/Technosignatures Session

2024

A Search for Infrared Laser Emission with the Hobby-Eberly Telescope

Penn State Department of Astronomy & Astrophysics Lunch Talk

2023

A Search for Infrared Laser Emission with the Hobby-Eberly Telescope

LIGO-Virgo-KAGRA TestingGR Group Telecon

2022

Measuring GW Speed and Lorentz Violation with the First Three GW Catalogs

Summer MKI Undergraduate Research Forum, Massachusetts Institute of Technology

2021

Comparison of Skymaps from Multiple Gravitational-Wave Event-Finding Methods

LIGO-Virgo-KAGRA Compact Binary Coalescences Low-Latency Telecon

2021

Comparison of Skymaps from cWB, GstLAL, PyCBC, and LALInference from O3 Data/Alerts

Poster Presentations

Penn State SETI Symposium, State College, PA A Search for Infrared Laser Emission with the Hobby-Eberly Telescope	2023
Undergraduate Research and Internship Symposium, Carleton College Comparison of Skymaps from Multiple Gravitational-Wave Event-Finding Methods	2021
Carleton College/St. Olaf College Physics Dept. Poster Session, Carleton College Comparison of Skymaps from Multiple Gravitational-Wave Event-Finding Methods	2021
LIGO-Virgo-KAGRA Collaboration Meeting Comparison of Skymaps from cWB, GstLAL, PyCBC, and LALInference from O3 Data/Alerts	2021
LIGO-Virgo-KAGRA Collaboration Meeting Measuring the Speed of Gravitational Waves and Testing Lorentz Symmetry with O3a Data	2021
LIGO-Virgo-KAGRA Collaboration Meeting Tests of Lorentz Symmetry with Speed of Gravity Measurements	2021

Undergraduate Mentorship

<i>Pedro A. Gabriel</i> , Penn State Department of Aerospace Engineering '26 - Laser SETI, HPF telluric mask improvement	2022-
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Service & Outreach

<i>Member</i> , AAS Committee for Sexual-Orientation and Gender Minorities in Astronomy - Promote equality for sexual-orientation and gender minorities within astronomy	2023-2026
<i>Chair</i> , Assembly of the Order of the Octopus Science Organizing Committee - A conference for early-career SETI researchers at Green Bank Observatory, August 9-11, 2024	2024-Present
<i>Co-chair</i> , Assembly of the Order of the Octopus Local Organizing Committee - A conference for early-career SETI researchers at Green Bank Observatory, August 9-11, 2024	2024-Present
<i>Student Manager</i> , Penn State Extraterrestrial Intelligence (PSETI) Center - Invite speakers to the weekly PSETI seminars - Manage the PSETI Center website	2023-Present
<i>Member</i> , Penn State Astronomy Colloquia & Department Talks Committee - Select and invite speakers for the weekly departmental colloquia and talks - Organize lunches between the speakers and graduate students	2023-Present
<i>Member</i> , Penn State SETI Symposium Local Organizing Committee	2023
<i>Member</i> , Penn State Astronomy Outreach Group - Give planetarium shows, telescope tours, and astronomy talks to the general public	2022-Present
<i>Member</i> , Penn State Towards a More Inclusive Astronomy Working Group	2022-Present
<i>Alumni Interviewer</i> , Carleton College Admissions Office	2022-Present

Skills

- Programming: Python, \LaTeX , Unix, Java, R, Julia
- Software: HEALPix, HTML, Mathematica, IRAF, OriginLab, SAOImage DS9, Stellarium, Voyager, Logger Pro, R Studio, Premier Pro, Photoshop, Zoom, Microsoft Office Products
- Languages: English, Mandarin