

Zachary Gelles

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Papers: [arXiv](#)

EDUCATION

Princeton University, Princeton, New Jersey September 2022 – Present
Ph.D. in Physics (expected June 2027); M.A. in Physics (awarded May 2024)

- Advisors: Eliot Quataert & Frans Pretorius
- Research interests: black holes, strong gravity, accretion physics, numerical relativity
- Member of Event Horizon Telescope (EHT) and Black Hole Explorer (BHEX) Collaborations

Harvard University, Cambridge, Massachusetts September 2017 – May 2022
A.B., Physics and Mathematics with Citation in Chinese – *Summa Cum Laude*, Phi Beta Kappa, Highest Departmental Honors

GRANTS & AWARDS

Kusaka Memorial Prize (Princeton Physics Department)	June 2026
NSF Graduate Research Fellowship	September 2023 – Present
Princeton University Centennial Fellowship	September 2022 – September 2023
John Harvard Scholarship (top 5% of class GPA)	May 2018 – June 2022
Harvard PRISE Fellowship (EHT research)	June 2020 – August 2020
David Rockefeller International Experience Grant (CERN research)	June 2019 – August 2019
Detur Book Prize (academic achievement)	May 2018

TEACHING

Princeton Astrophysics Department – Assistant Instructor September 2025 – April 2026
Hosted office hours and graded problem sets in “Astro 301: General Relativity” (Fall) and “Astro 206: Black Holes” (Spring)

EHT Collaboration – GR Crash Course Instructor July 2020 – October 2020
Designed a seven-lecture crash course in general relativity for EHT Collaboration members.

Harvard Physics Department – Course Assistant September 2019 – December 2019
Hosted office hours, held review sessions, and graded problem sets in “Physics 19: Intro to Theoretical Physics.”

Loomis-Michael Observatory – Telescope Instructor January 2019 – May 2019
Telescope instructor for Student Astronomers at Harvard-Radcliffe (STahr).

MENTORSHIP, OUTREACH, & SERVICE

Referee

- Physical Review D
- Astronomy & Astrophysics

Princeton Physics Department – Mentor and Coordinator September 2022 – Present

- Mentor undergraduate students through ReMatch program and first-year graduate students through TiPOTS (Toward an Inclusive Physics Community in Graduate Students)
- Help organize annual Spring into Science event for local elementary schoolers.
- Organize welcome meetings for new graduate students and lead discussions on prelim exam preparation.
- Captain of physics department softball team (The Big Bangers). Organize department-wide practices and games to build community.

Harvard Physics Department – Mentor and Coordinator September 2020 – May 2022

- Worked with Society of Physics Students to develop “Polaris,” a mentorship program focused on inclusion for new physics students.
- Helped underclassmen navigate the department and organized regular meetups over Zoom.

- Operated a 110-seat, 12-meter full-dome planetarium with Megastar-IIA projector; led 2–3 (45-minute) shows each Saturday.
- Developed and introduced Spanish planetarium programming to increase accessibility for local community.

PUBLICATIONS

First-Author

7. [Z. Gelles](#) and F. Pretorius, “Nonlinear Endpoint of Charged Horizon Instabilities”, [Physical Review D](#) **113**, 124067, 124067 (2026)
6. [Z. Gelles](#), A. Chael, and E. Quataert, “Signatures of Black Hole Spin and Plasma Acceleration in Jet Polarimetry. II. Off-axis Jets”, [The Astrophysical Journal](#) **1001**, 206, 206 (2026)
5. [Z. Gelles](#) and F. Pretorius, “Accumulation of charge on an extremal black hole’s event horizon”, [Physical Review D](#) **112**, 064003 (2025)
4. [Z. Gelles](#), A. Chael, and E. Quataert, “Signatures of Black Hole Spin and Plasma Acceleration in Jet Polarimetry”, [The Astrophysical Journal](#) **981**, 204 (2025)
 - *Featured in AAS Nova: [A new way to measure black hole spin](#) (Apr 30, 2025)*
3. [Z. Gelles](#), K. Chatterjee, M. Johnson, B. Ripperda, and M. Liska, “Relativistic Signatures of Flux Eruption Events near Black Holes”, [Galaxies](#) **10**, 107 (2022)
2. [Z. Gelles](#), E. Himwich, M. D. Johnson, and D. C. M. Palumbo, “Polarized image of equatorial emission in the Kerr geometry”, [Physical Review D](#) **104**, 044060 (2021)
1. [Z. Gelles](#), B. S. Prather, D. C. M. Palumbo, M. D. Johnson, G. N. Wong, and B. Georgiev, “The Role of Adaptive Ray Tracing in Analyzing Black Hole Structure”, [The Astrophysical Journal](#) **912**, 39 (2021)

Co-Author

5. A. Chael, A. Lupsasca, G. N. Wong, [Z. Gelles](#), and E. Quataert, “Black Hole Polarimetry III: Universal Polarization of Synchrotron Radiation at the Horizon”, [arXiv e-prints](#), [arXiv:2606.12518](#), [arXiv:2606.12518](#) (2026)
4. Y. Tsunetoe, D. W. Pesce, R. Narayan, A. Chael, [Z. Gelles](#), C. Gammie, E. Quataert, and D. Palumbo, “Limb-brightened Jet in M87 from Anisotropic Nonthermal Electrons”, [The Astrophysical Journal](#) **984**, 35 (2025)
3. M. Wielgus, M. Moscibrodzka, J. Vos, [Z. Gelles](#), I. Martí-Vidal, J. Farah, N. Marchili, C. Goddi, and H. Messias, “Orbital motion near Sagittarius A^{*}. Constraints from polarimetric ALMA observations”, [Astronomy & Astrophysics](#) **665**, L6 (2022)
2. D. C. M. Palumbo, [Z. Gelles](#), P. Tiede, D. O. Chang, D. W. Pesce, A. Chael, and M. D. Johnson, “Bayesian Accretion Modeling: Axisymmetric Equatorial Emission in the Kerr Spacetime”, [The Astrophysical Journal](#) **939**, 107 (2022)
1. R. Narayan, D. C. M. Palumbo, M. D. Johnson, [Z. Gelles](#), et al., “The Polarized Image of a Synchrotron-emitting Ring of Gas Orbiting a Black Hole”, [The Astrophysical Journal](#) **912**, 35 (2021)

Collaboration and White Papers

4. Gravity Collaboration, R. Abuter, N. Aimar, P. Amaro Seoane, et al., “Polarimetry and astrometry of NIR flares as event horizon scale, dynamical probes for the mass of Sgr A^{*}”, [Astronomy & Astrophysics](#) **677**, L10 (2023)
3. M. D. Johnson, K. Akiyama, R. Baturin, B. Bilyeu, et al., “The Black Hole Explorer: Motivation and Vision”, in [Space telescopes and instrumentation 2024: optical, infrared, and millimeter wave](#), Vol. 13092, edited by L. E. Coyle, S. Matsuura, and M. D. Perrin, Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series (Aug. 2024)

2. E. Peretz, P. Kurczynski, M. D. Johnson, J. Houston, et al., “The Black Hole Explorer: Astrophysics Mission Concept Engineering Study Report”, in [Space telescopes and instrumentation 2024: optical, infrared, and millimeter wave](#), Vol. 13092, edited by L. E. Coyle, S. Matsuura, and M. D. Perrin, Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series (Aug. 2024)
1. Event Horizon Telescope Collaboration, K. Akiyama, J. C. Algaba, A. Alberdi, et al., “First M87 Event Horizon Telescope Results. VIII. Magnetic Field Structure near The Event Horizon”, [The Astrophysical Journal Letters](#) **910**, L13 (2021)

SEMINARS AND PRESENTATIONS

Invited Seminars

- **Simons Collaboration on Extreme Electrodynamics of Compact Sources**, Weekly Seminar. “Signatures of Black Hole Spin and Plasma Acceleration in Jet Polarimetry.” Virtual. April 2026
- **Cambridge University**, DAMTP General Relativity Seminar. “A Nonlinear Endpoint of Charged Horizon Instabilities.” Cambridge, UK. March 2026
- **Brown University**, ICERM Workshop on Extremal Black Holes. “The Nonlinear Development of Charged Horizon Instabilities.” Providence, RI. January 2026
- **The Black Hole Initiative**, Event Horizon Telescope Group Seminar. “Measuring Black Hole Spin from Jet Polarimetry.” Cambridge, MA. November 2025
- **Columbia University**, Joint Math/Physics Seminar. “Charged Instabilities of Extremal Black Holes.” New York, NY. October 2025
- **Los Alamos National Laboratory**, Center for Nonlinear Studies Seminar. “Charged Instabilities of Extremal Black Holes.” Los Alamos, NM. June 2025
- **Northwestern University**, CIERA Seminar. “Measuring Black Hole Spin from Polarized Images of Jets.” Evanston, IL. May 2025
- **Goethe University**, Institute for Theoretical Physics Astrocoffee Seminar. “Measuring Black Hole Spin from Polarized Images of Jets.” Frankfurt, Germany (virtual). December 2024
- **Columbia University**, Theoretical High Energy Astrophysics (THEA) Seminar. “Measuring Black Hole Spin from Polarized Images of Jets.” New York, NY. November 2024
- **The Black Hole Initiative**, Event Horizon Telescope Group Seminar. “Signatures of Plasma Acceleration and Black Hole Spin in Jet Polarimetry.” Cambridge, MA. October 2024
- **Nicolaus Copernicus Astronomical Center**, Colloquium. “Gravitational Lensing in Simulated Images of Black Holes.” Warsaw, Poland (virtual). June 2021

Public Talks

- “Black Hole Jets,” Planetarium Lecture, New Jersey State Museum, Trenton, NJ. July 2025
- “Black Hole Jets,” Astronomy on Tap, Trenton, NJ. March 2025
- “How to Take a Picture of a Black Hole,” Astronomy on Tap, Trenton, NJ. October 2024
- “What We Can Learn From Images of Black Holes,” Planetarium Lecture, New Jersey State Museum, Trenton, NJ. July 2024

Contributed Talks

- “Measuring Black Hole Spin from Jet Polarimetry,” Black Hole Explorer Jets Group (virtual). January 2026
- “Measuring Black Hole Spin from Jet Polarimetry,” EHT Collaboration Meeting, Max Planck Institute for Radio Astronomy, Berlin, Germany. July 2025
- “Accumulation of Charge on an Extremal Black Hole’s Event Horizon,” GR24, Glasgow, UK. July 2025
- “Accumulation of Charge on an Extremal Black Hole’s Event Horizon,” APS Joint March & April Meeting, Anaheim, CA. March 2025
- “Signatures of Black Hole Spin and Plasma Acceleration in Jet Polarimetry,” AAS Winter Meeting, Washington, DC. January 2025

- “Charged Instabilities of Extremal Black Holes” (e-poster), Black Holes Inside and Out, Copenhagen, Denmark. July 2024
- “Measuring Black Hole Spin from Polarized Images of Jets,” EHT Collaboration Meeting, Mexico City, Mexico. June 2024
- “Polarization Signatures of Relativistic Aberration in Black Hole Jets,” APS April Meeting, Sacramento, CA. April 2024
- “A Numerical Investigation of Perturbations to Charged Black Holes,” Taking it to the Extreme Workshop, Princeton Center for Theoretical Science, Princeton, NJ. March 2024
- “Polarization of Blandford–Znajek Jets,” EHT-IAS Workshop, Institute for Advanced Study, Princeton, NJ. November 2023
- “Relativistic Signatures of Flux Eruption Events Near Black Holes,” Phenomenology Symposium, University of Pittsburgh, Pittsburgh, PA. May 2023
- “Effects of Opacity on Variability in Black Hole Images,” Next Generation EHT Conference, Granada, Spain. June 2022
- “The Polarized Image of Fluid Orbiting a Kerr Black Hole,” APS April Meeting (virtual). April 2021
- “Identifying Small Scale Features in High Resolution Images of Black Holes,” Next Generation EHT Conference (virtual). February 2021
- “Understanding Trigger Efficiencies for Long-Lived Staus,” CERN dE/dx Analysis Group, Geneva, Switzerland. July 2019

OTHER SKILLS AND INTERESTS

Programming	Python, C, C++, Mathematica
Languages	Proficient in Spanish, French, and Mandarin
Hobbies	Playing softball, scuba diving, hiking, riding roller coasters