Simona J. Miller

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I am a fourth-year Ph.D candidate in the Laser Interferometer Gravitational-wave Observatory (LIGO) Data Analysis group at the California Institute of Technology studying the measurability of the spins of black holes through their gravitational-wave emission on an individual-event and population level.

Education

Sept. 2021 – Present Ph.D in Physics (Expected 2026)
California Institute of Technology, Pasadena, CA, USA

Sept. 2016 – May 2020 B.A. in Physics, Minor in Mathematics
Smith College Northampton, MA, USA

Thesis: *Using Gravitational-wave Signals to Model the Distribution of Spin Across the Binary Black Hole Population*

Honors:
Summa Cum Laude
Highest Honors in Physics
STRIDE Research Scholar

Honors, Awards, & Fellowships

2024 James A. Cullen Memorial Fellowship (California Institute of Technology)
2021-22 Named first-year Graduate Fellowship (California Institute of Technology)
2021 Fulbright Research Award – to conduct physics research in Germany for one year
2020 Graduated Summa Cum Laude (Smith College)
2020 Highest Honors on Undergraduate Honors Thesis in Physics (Smith College)
2020 The Adelaide Wilcox Bull Paganelli Prize for exceptional achievement and service to the Smith College Department of Physics
2020 The Frank A. Waterman Prize for a senior who has done excellent work in the Smith College Department of Physics
2020 Elected to Phi Beta Kappa, National Academic Honor Society for Liberal Arts and Sciences
2020 Elected to Sigma Xi, National Scientific Research Honor Society
2019 International Research Experience for Undergraduates in Physics (University of Florida)
2018 LIGO Summer Undergraduate Research Fellowship (California Institute of Technology)

Research Experience

Sept. 2021 – Present LIGO Laboratory, California Institute of Technology, Pasadena, CA, USA
Graduate Research Assistant
Advised by Katerina Chatziioannou

Sept. 2023 Center for Computational Astrophysics, Flatiron Institute, New York, NY, USA
Dec. 2023 *Guest Researcher*

Advised by Will Farr & Maximiliano Isi

Jan. 2021 Max Planck Institute for Gravitational Physics, Hannover, Lower Saxony, Germany
Aug. 2021 *Fulbright Award*

Advised by Maria Alessandra Papa & Reinhard Prix

June. 2020 Center for Computational Astrophysics, Flatiron Institute, New York, NY, USA
Dec. 2020 *Postbaccalaureate Visiting Scholar*

Advised by Will Farr & Thomas Callister

Sept. 2019 Smith College, Northampton MA & LIGO Laboratory, Pasadena CA, USA
May 2020 *Senior Honors Thesis in Physics*

Advised by Thomas Callister & Travis Norsen

May 2019 GEO 600, Albert Einstein Institute, Hannover, NI, Germany
Aug. 2019 *Participant in University of Florida's International REU Program*

Advised by James Lough & Nikhil Mukund

Sept. 2018 LIGO Laboratory, California Institute of Technology, Pasadena, CA, USA (remotely)
Sept. 2019 *Undergraduate Research Assistant*

Advised by Thomas Callister

June 2018 LIGO Laboratory, California Institute of Technology, Pasadena, CA, USA
Aug. 2018 *Summer Undergraduate Research Fellow*

Advised by Alan Weinstein, Jonah Kanner, & Thomas Callister

Feb. 2018 Theoretical Condensed Matter Physics Lab, Smith College, Northampton, MA, USA
Feb. 2019 *Undergraduate Research Assistant*

Advised by Courtney Lannert

Publications

Short author publications (5 total):

- *The anti-aligned spin of GW191109: glitch mitigation and its implications.*
  R. Udall, S. Hourihane, **S. Miller**, D. Davis, K. Chatziioannou, M. Isi, & H. Deshong
  With Physical Review D. reviewers ArXiv:2409.03912

- *Gravitational wave signals carry information beyond effective spin parameters.*
  S. J. Miller, Z. Ko, T. A. Callister, & K. Chatziioannou
  Physical Review D. May 2024 ArXiv:2401.05613

- *GW190521: tracing imprints of spin-precession on the most massive black hole binary.*
  S. J. Miller, M. Isi, K. Chatziioannou, V. Varma, & I. Mandel
  Physical Review D. Jan. 2024 ArXiv:2310.01544

- *No evidence that the majority of black holes in binaries have zero spin.*
  T. A. Callister, **S. J. Miller**, K. Chatziioannou, & W. Farr.
  The Astrophysical Journal Letters. Sept. 2022 ArXiv:2205.08574

- *The Low Effective Spin of Binary Black Holes and Implications for Individual Gravitational-wave Events.*
  S. Miller, T. A. Callister, & W. Farr.
  The Astrophysical Journal. June 2020 ArXiv:2001.06051

LIGO-Virgo-KAGRA collaboration papers to which I have made a significant contribution (2 total):

- *Population Properties of Compact Objects from the Second LIGO–Virgo Gravitational-Wave Transient Catalog*
  The LIGO-Virgo-KAGRA Collaboration (I contributed analysis)
  Astrophysical Journal Letters. May 2021 ArXiv:2004.08342

- *GW190412: Observation of a binary-black-hole coalescence with asymmetric masses*
  The LIGO-Virgo-KAGRA Collaboration (I contributed analysis)
  Physical Review D. Aug 2020 ArXiv:2004.08342

Invited Presentations

- *S. Miller. Measuring the Spins of Binary Black Holes Using Gravitational Waves*
  (**Invited** Colloquium)
  Amherst College Physics and Astronomy Colloquium, Amherst, MA, USA. November 2023.

- *S. Miller. Mind the systematics: How is the assumed population model affecting our measurements of the binary black hole population?*
  (**Invited** Talk + Panel Discussion)
  GWPopulations What's Next Conference, Milan, Italy. July 2023.

Notable Contributed Presentations

- *S. Miller. Improving Posterior Predictive Checks for Binary Black Hole Populations*
  (Talk)
  American Physical Society (APS) Global Summit, Anaheim, CA, US. March 2025.

- *S. Miller. Dissecting Gravitational Waves from Precessing Heavy Binary Black Holes in the Time Domain*
  (Talk)
  April 2024 Meeting of the American Physical Society (APS), Sacramento, CA, US. April 2024.

- *S. Miller. How can we measure spin precession for heavy binary black holes using gravitational waves?*
  (Talk)
  April 2023 Meeting of the American Physical Society (APS), Minneapolis, MN, US. April 2023.

- *S. Miller. No evidence that the majority of black holes in binaries have zero spin: Population measurements of the BBH spin after LIGO/Virgo's O3 observing run*
  (Talk)
  April 2022 Meeting of the American Physical Society (APS), New York, NY, US. April 2022.

- *S. Miller. The Natal Spins of Binary Black Holes After LIGO/Virgo's O3a Observing Run.*
  (Talk)
  237th Meeting of the American Astronomical Society (AAS), virtual. Jan. 2021.

- *S. Miller. Using Gravitational-waves to Model the Distribution of Spin Across the Binary Black Hole Population.*
  (Talk)
  Smith College Physics Senior Honors Thesis Symposium. Northampton, MA, USA (virtually). May 2020.

- *S.Miller. The Low Effective Spin of BBHs and Implications for Individual GW Events.*
  (Poster Presentation)
  Conference for Undergraduate Women in Physics. Hartford, CT. Jan. 2020.

- *S. Miller. Improved Whitening of the Readout Signal for GEO 600.*
  (Talk)
  Smith College Physics Students' Summer Research Symposium. Northampton, MA, USA. Sept. 2019.

- *S. Miller. Measuring Eccentricity in Binary Black Hole Inspirals Through Gravitational-wave Emission.*
  (Talk)
  Smith College Pfabe Symposium for Student Research in Physics. Northampton, MA, USA. May 2019.

- *S. Miller. Modeling and Measuring Eccentricity in Binary Black Hole Inspirals.*
  (Poster Presentation)
  Conference for Undergraduate Women in Physics. Amherst, MA, USA. Jan. 2019.

- *S. Miller, R. Ahmad, & B. Laurenceau. Creating an Arduino-Based Faraday Motor.*
  (Poster Presentation)
  Celebrating Collaborations at Smith College. Northampton, MA, USA. April 2018.

- *S. Miller & R. Ahmad. Making the Invisible Visible Using Arduino Microcontrollers.*
  (Poster Presentation)
  Celebrating Collaborations at Smith College. Northampton, MA, USA. April 2017.

Teaching & Outreach

Mentoring

June 2024 – present Sophia Winney (University of Chicago)
Mentor for Caltech LIGO SURF program 2024

Project: *Developing Better Posterior Predictive Checks for Gravitational-wave Population Analyses*; Continued work remotely for the 2024-25 academic year to prepare results for publication

June 2023 – present Karen Kang (Amherst College)
Mentor for Caltech LIGO SURF program 2023

Project: *Mapping Parameter Correlations in Spinning Binary Black Hole Mergers*; Continued work remotely for the 2023-24 and 2024-25 academic years to prepare results for publication

June 2022 – May 2023 Zoe Ko (University of California Berkeley)
Mentor for Caltech LIGO SURF program 2022

Project: *Studying Effective and Component Spin Distributions of Binary Black Hole Mergers*; Continued work remotely for the 2022-23 academic year to prepare results for publication

Outreach Presentations

- *S. Miller. Gravitational-wave Population Inference*
  (**Invited** Talk)
  Caltech LIGO Undergraduate Study Group, Pasadena, CA, USA. Feb. 2024.

- *S. Miller. Measuring the distribution of spin across the black hole population.*
  (**Invited** Talk)
  Graduate student research presentation at FUTURE Conference, Pasadena, CA, USA. Sept. 2022.

- *S. Miller. My Journey into Gravitational-wave Physics.*
  (**Invited** Talk)
  Presentation to Medford High School honors physics classes. Medford, MA, USA (virtually). June 2021.

- *S. Miller. Introduction to Gravitational Radiation.*
  (**Invited** Talk)
  Guest Lecture to Smith College's Advanced Introductory Physics class. Northampton, MA, USA. Nov. 2019.

Teaching and Tutoring Experience

April 2024 – **June 2024** California Institute of Technology, Pasadena, CA, USA
Teaching Assistant – Undergraduate Computational Physics Laboratory
Advised by Rana Adhikari and Lee McCuller

Jan. 2024 – **Mar. 2024** California Institute of Technology, Pasadena, CA, USA
Teaching Assistant – Graduate Level General Relativity II
Advised by Saul Teukolsky

Sept. 2018 – **May 2020** Spinelli Center for Quantitative Learning, Northampton, MA, USA
Physics Master Tutor – Introductory Physics II, Math. Methods of Physics & Engineering
Advised by Travis Norsen & Kat McCune

Sept. 2018 – **May 2020** Smith College Physics Department, Northampton, MA, USA
Teaching Assistant – Introductory Physics II, Advanced Introductory Physics
Advised by Travis Norsen & Joyce Palmer-Fortune

Volunteer Work

May 2024 – **present** Caltech Graduate Student Workers and Postdocs United, UAW
Elected Collective Bargaining Team Member for Graduate Student Union

Sept. 2023 – **Sept. 2025** California Institute of Technology
Volunteer at FUTURE conferences; 2023, 2024
Invited panelist for FUTURE conference; see entry below

Sept. 2022 California Institute of Technology
Graduate student Co-Chair of FUTURE conference

Played major role (60+ hours) in organizing the FUTURE conference for undergraduate women and gender minorities in physics, including serving on the admissions panel, moderating several panels at the conference, giving talks and tours, being in charge of 30+ graduate student volunteers, and lots of administrative work; Advised by David Hsieh

Sept. 2022 California Institute of Technology
Sept. 2024 *Respect is a Part of Research Facilitator; 2022, 2023, 2024*

Facilitator for workshop about preventing sexual assault and creating a culture of respect in graduate school, as part of the physics, math, & astronomy Caltech graduate student orientation

Jan. 2022 California Institute of Technology
June 2023 *Member of Physics, Math, & Astronomy Graduate Student Advisory Board*

Liased between graduate students and administration, organized social activities; Advised by Nam Ung and Mika Walton

Misc. Employment

Jan. 2019 Smith College Physics Department, Northampton, MA, USA
May 2019 *Grader – Introductory Physics I*

Advised by Travis Norsen

Sept. 2016 Educational Outreach Physics Lab, Smith College, Northampton, MA, USA
May 2018 *Designed and constructed demonstrations to use in Introductory Physics classrooms*

STRIDE research project, Advised by Joyce Palmer-Fortune

Jan. 2014 Tufts University Center for Engineering Education & Outreach, Somerville, MA, USA
Aug. 2016 *Elementary Curriculum Development Intern; LEGO Robotics Summer Camp Instructor*