

Sarah Hoback

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Education

Harvard University, PhD Candidate in Theoretical Physics

August 2022 - 2028

Intro to String Theory, Quantum Field Theory I, Quantum Field Theory II, Statistical Mechanics, Quantum Black holes, Quantum Phases of Matter, Radiative Processes in Astrophysics, Modern Atomic and Optical Physics I

Pomona College, Bachelors in Physics

August 2019 - May 2021

Quantum Mechanics, Research in Physics: Quantum Field Theory I, Statistical Mechanics, Research in Physics: Quantum Field Theory II, Mechanics, Elementary Particle Physics, Abstract Algebra, E&M, Classical Field Theory (audited, and graded)

American University

August 2017- May 2019

Modern Physics, Waves and Optics, Complex Analysis, Linear Algebra, Calculus III, Differential Equations, Computational Math and Physics, General Relativity Computation, Curvature and Tensors

Research Experience

Harvard University | Semi-Classical Excitations in JT Gravity, Von Neumann Algebras

Nov 2022- Present

- Working with my advisor, Professor. Daniel Jafferis on evaluating semi-classical excitations in the bulk in JT gravity in (1,1)-dimensions from the Lorenzian and Euclidean Perspective. I also am working on using operator Algebras to compute the entropy of an observer in the bulk of dS-spacetime via type I factor approximations.

Caltech | Conformal Field Theory Research

December 2019- November 2022

- Worked with Dr. Sarthak Parikh to develop a conjecture diagrammatic method for explicitly writing down any conformal block with scalar exchange. We subsequently proved this conjecture.

Cal State Fullerton | Simulating Binary Black Hole Mergers

May 2019- August 2019

- Contributed to new Spectral Einstein Code Base to simulate Binary Black Hole Mergers as part of the Cal Fullerton SpeCTRE team.

Stanford University | LIGO

June 2018 – September 2018

- Refined command-based scripts for X-Ray diffraction data reduction, and worked with post-docs to create Python code to generate atomic structures of amorphous solids.

American University | LIGO

May 2017- May 2019

- AU physics is partnered with LIGO, where I used COMSOL Finite Element Modeling software to create simulations of our experiments that calculated the quality factor of substrates coatings.

Research Grant Awards

2023 Wallace-Noyes Fellowship Award(\$3000)

May 2022

- Research grants award to Harvard physics graduate students with connections to armed forces.

Pomona College RAISE Grant(\$2500)

April 2020

- Awarded research grants for proposals to study conformal blocks.

LSC Summer Research Grant for Undergraduates(\$1300)

March 2019

- Awarded by Stanford LIGO to fund my research for SpeCTRE.

NASA Space Grant (\$2500), Robyn Mathias Scholarship (\$2000)

February 2018

- Awarded two summer research grants for proposal to study optical coatings at Stanford LIGO.

Scholarship Awards

Two Sigma PhD Fellowship Finalist

December 2023

- Selected as 1/16 of the Two Sigma fellowship finalists with over 300 applicants.

Two Sigma Fellowship Nominee

October 2023

- One of three student selected by the Physics Department to be nominated for the Two Sigma PhD Fellowship

NSF GRFP Fellowship

May 2021

- Accepted NSF GRFP Fellowship which provides The GRF provides financial support for three years within a five-year fellowship period comprising a \$34,000 stipend per twelve-month Fellowship Year.

MIT Dean of Science Fellowship (declined)

May 2021

- Selected as one of about 10 MIT graduate applications to be awarded 3 years of full funding to attend MIT for theoretical physics. I declined this award as I will be attending Harvard

Churchill Scholar Nominee

October 2020

- Received Pomona College's nomination for the Churchill Scholarship. Pomona College only selects two seniors each year for the scholarship.

Pomona Scholarship, Simon Plas Memorial Fund, B Heartwell Scholarship, Annual Fund Scholarship

- Pomona College scholarships that consider both merit and financial need for the year of 2020.

Caltech Visiting Undergraduate Research Program

May 2020

- Due to Covid-19 the Caltech VURP program was going to be officially shut down. However, my work during the school year with Dr. Parikh, resulted in the administration making an exception, and admitting me as the only student to be accepted in the VURP program for the summer of 2020.

SVC General Fund International Scholarship (\$3500)

January 2019

- Material science scholarship awarded to 5 students internationally, only undergraduate awardee and one of 2 USA recipients.

Publications

- Fortin, J. F., Hoback, S., Ma, W. J., Parikh, S., & Skiba, W. (2022). Feynman Rules for Scalar Conformal Blocks. *arXiv preprint arXiv:2204.08909*. Accepted to JHEP
- Hoback, S., & Parikh, S. (2021). Dimensional reduction of higher-point conformal blocks. *Journal of High Energy Physics*, 2021(3), 1-36.
- Hoback, S., & Parikh, S. (2021). Towards Feynman rules for conformal blocks. *Journal of High Energy Physics*, 2021(1), 1-70.
- Prasai, K., Jiang, J., Mishkin, A., Shyam, B., Angelova, S., Birney, R., ... & Hoback, S. (2019). High precision detection of change in intermediate range order of amorphous zirconia-doped antala thin films due to annealing. *Physical review letters*, 123(4), 045501.
- Abbott, R., Abbott, T. D., Abraham, S., Acernese, F., Ackley, K., Adams, C., ... & Bruno, G. (2021). Search for gravitational waves associated with gamma-ray bursts detected by Fermi and Swift during the LIGO–Virgo run O3a. *The Astrophysical Journal*, 915(2), 86.
- Abbott, R., Abbott, T. D., Abraham, S., Acernese, F., Ackley, K., Adams, C., ... & Bruno, G. (2020). Properties and astrophysical implications of the 150 M_{\odot} binary black hole merger GW190521. *The Astrophysical Journal Letters*, 900(1), L13.
- Abbott, R., Abbott, T. D., Abraham, S., Acernese, F., Ackley, K., Adams, C., ... & Bruno, G. (2020). GW190521: a binary black hole merger with a total mass of 150 M_{\odot} . *Physical review letters*, 125(10), 101102.
- Abbott, R., Abbott, T. D., Abraham, S., Acernese, F., Ackley, K., Adams, C., ... & Brown, D. D. (2020). GW190814: gravitational waves from the coalescence of a 23 solar mass black hole with a 2.6 solar mass compact object. *The Astrophysical Journal Letters*, 896(2), L44.
- Abbott, R., Abbott, T. D., Abraham, S., Acernese, F., Ackley, K., Adams, C., ... & Brown, D. D. (2020). GW190412: Observation of a binary-black-hole coalescence with asymmetric masses. *Physical Review D*, 102(4), 043015.
- Hamburg, R., Fletcher, C., Burns, E., Goldstein, A., Bissaldi, E., Briggs, M. S., ... & Bouffanais, Y. (2020). A joint Fermi-GBM and LIGO/Virgo analysis of compact binary mergers from the first and second gravitational-wave observing runs. *The Astrophysical Journal*, 893(2), 100.
- Abbott, R., Abbott, T. D., Abraham, S., Acernese, F., Ackley, K., Adams, C., ... & Buikema, A. (2021). Open data from the first and second observing runs of Advanced LIGO and Advanced Virgo. *SoftwareX*, 13, 100658.
- Thanked for useful conversations in: Fortin, J. F., Ma, W. J., & Skiba, W. (2020). All global one-and two-dimensional higher-point conformal blocks. *arXiv preprint arXiv:2009.07674*.

Presentations

December 2017- Present

- Talks given at: Stanford University LIGO, American University Colloquia, Robyn Mathias Scholars Conference, Cal State Fullerton SpecTRE, Caltech, Pomona College Senior Thesis Presentation
- Won best talk in the Natural Sciences at the Robyn Mathias Scholars Conference

Conferences

Grad School- Present

- Workshop on Spacetime and Quantum Information (December 2023)
- Kickoff Workshop for the Simons Collaboration on Celestial Holography (October 2023)
- A Quantum Al-Khwarizmi for Spacetime: A Workshop on von Neumann Algebras in Quantum Field Theory & Gravity (August 2023)
- Advanced Summer School in Quantum Field Theory and Quantum Gravity, invited (Did not attend)
- Emergent Geometries and Strings from Quantum Fields (June 2023), invitation required
- Symposium on Quantum Information, Complexity, and the Physical World (December 2022)
- Conference Joint BHI/CMSA Conference on Flat Holography (June 2022)
- New Frontiers: Interactions between Quantum Physics and Mathematics (June 2022)

Relevant Work Experience

CEO & Co-founder - Thaeles Inc.

May 2020 - Present

- I co-founded, Thaeles Inc., a nationwide site acquisition company that brings reliable internet and cell service to underserved communities. At first we started as a los angeles based company, and now grown to be a nationwide site acquisition services provider.

Classical Field Theory Grader

January 2020- May 2020

- Graded and audited Classical Field Theory, at neighboring university, Harvey Mudd College

Outreach

Harvard Committee of Graduate Education

August 2023- Present

- One of the five students selected to be on the Harvard Committee of Graduate Education. The committee consists of Deans from each of Harvard's Graduate Programs as well as 5 student representatives. The committee determines new initiatives for the graduate programs to improve graduate student education, outcomes, and well-being

Graduate School of Arts and Science Student Council, Chair of Research

May 2023- Present

- Elected as the Chair of Research for the entire GSAS student body. Duties include gathering and analyzing data to promote student advocacy, and working with the Dean's to acquire funding for various professional development funds for graduate students.

Graduate School of Arts and Science Student Council, Physics Representative

Jan 2023-Present

- The only Physics Representative for the 254 physics graduate students to the Graduate School of Arts and Sciences Student Council.

Petey Green Program, Science Tutor

June 2022-August 2022

- Tutored students in a Boston juvenile detention center for 4 hours weekly during the summer of 2022 in math and science. .

AU Optics Olympiad, AU Thin-Sat

May 2017- May 2019

- Studies have shown that by the time students reach high school they have already determined if they have a future in STEM fields, thus our aim in both projects is to target students as early as possible and create a fun environment where they learn about exciting fields in physics.
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