Samuel **Alipour-fard**

Graduate Student in Theoretical Nuclear and Particle Physics

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Education

Massachusetts Institute of Technology

Cambridge, MA

Anticipated Ph.D. in Theoretical Nuclear and Particle Physics

Aug. 2019 - Present

- Cumulative GPA: 4.0
- Recieved a 2019 MIT graduate research fellowship.
- Research Advisor: Jesse Thaler

College of Creative Studies (CCS), University of California, Santa Barbara

Santa Barbara, CA

B.S. in Physics

Sep. 2015 - Jun. 2019

- Cumulative GPA: 4.0
- Recieved the UCSB Regents Scholarship for all 4 years of undergraduate education.
- Graduated with highest academic honors and with distinction in the major
- Recieved the Arnold Nordsieck Award, awarded to a graduating senior showing exceptional research promise
- Academic Advisor: Tengiz Bibilashvili. Research Advisor: Nathaniel Craig

Research Experience

Graduate Research, High Energy Physics (Advised by Dr. Jesse Thaler)

Massachusetts Institute of Technology

Researcher

Aug. 2019 - Present

- Explored the geometric ability of the Energy Mover's Distance (EMD) to reproduce common collider physics observables such as thrust.
- With collaborators, used the EMD to design new methods for jet grooming in collider physics
- Explored the analytic behavior of correlation functions of groomed jets, using grooming methods motivated by the EMD.
- Characterized EMD groomed jets using correlation functions at leading order, leading logarithmic order, and next-to-leading logarithmic order in perturbative Quantum Chromodynamics. Performed calculations in the presence of fixed, perturbatively running, and non-perturbatively frozen couplings.
- Working on manuscript for the above work. Anticipated pre-print and publication within the year.

Undergraduate Research, High Energy Physics (Advised by Dr. Nathaniel Craig)

University of California, Santa Barbara

Researcher

Jan. 2017 - July 2019

- Modified technology such as Madgraph, Pythia8, and Delphes in order to accurately simulate displaced decays and Long-Lived Particles (LLPs) in high energy particle collisions.
- Contributed to work presented at a Nov. 2017 talk to extol the properties of the hypothetical Circular Electron-Positron Collider (CEPC), by Nathaniel Craig
- Contributed to work published in *The CLIC Potential for New Physics* in 2018, see below.
- Studied the properties of hypothetical future colliders including CEPC, the International Linear Collider (ILC), and the Future Circular Collider (FCC-ee) to develop a faithful study of the abilities of future colliders to detect LLPs, published in *Long Live the Higgs Factory: Higgs Decays to Long-Lived Particles at Future Lepton Colliders* in 2019, see below.
- Studied the properties of the Large Hadron Collider (LHC) to develop a faithful study of the abilities of current and future experiments at the LHC to detect LLPs, in *The Second Higgs at the Lifetime Frontier* in 2020, see below.
- Contributed to work presented at a Nov. 2018 talk to extol the hypothetical properties of CEPC, by Seth Koren.
- Summer Undergraduate Research Fellowship (SURF) Roig Fellow: work funded in part by the SURF Roig Fellowship, during the Summer of 2018.
- Granted the Arnold Nordsieck Award in 2019, given to a graduating senior showing great research promise.

Undergraduate Research, Biophysics (Advised by Dr. Greg Huber)

University of California, Santa Barbara

Researcher

Apr. 2016 - Jun. 2018

- Worked with Dr. Greg Huber to investigate properties of diffusion on parking garage or Terasaki Ramp topologies
- Designed code to simulate random walks on the Terasaki Ramp
- Investigated diffusion across membranes with similar topologies recently discovered in the rough endoplasmic reticulum in cells

Teaching

Massachusetts Institute of Technology *Cambridge, MA*

Teaching Assistant *August. 2020 - Present*

- Teaching Assistant for Physics 8.02, an undergraduate electromagnetism course at MIT, with Professor Nuh Gedik.
- Teaching Assistant for Physics 8.251, an undergraduate string theory course at MIT, with Professor Hong Liu. Designed problems for students to solve with TA help during recitations. Received perfect TA course evaluations.
- Teaching Assistant for Physics 8.851, a graduate effective field theory course at MIT, with Professor Iain Stewart. Designed problems for students to solve with TA help during recitations and trained an undergraduate TA to help with the graduate course. Also helped design, streamline, and debug the course website, and helped put the course onto the MITx database of online courses for people to access internationally.

Learning Assistant Program, University of California at Santa Barbara *Santa Barbara, CA*

Learning Assistant *Sep. 2017 - July 2019*

- Learning Assistant (LA) for upper division Quantum Mechanics, Sep. 2017 - Dec. 2017 and Sep. 2018 - Present. This work contributed to earning Prof. Nathaniel Craig the 2018 Cottrell Scholar Award, and spurring interest in the Learning Assistant Program at UCSB.
- LA for upper division Classical Mechanics, Apr. 2018 - Jun. 2018 and Sep. 2018 - Dec. 2018.
- LA for upper division Thermodynamics and Statistical Mechanics, Jul. 2018 - Sep. 2018.
- LA for lower division Electrodynamics, Sep. 2018 - Dec. 2018

Teaching Assistant, Calclulus III, Boulder High School *Boulder, CO*

Teaching Assistant *Aug. 2014 - Jan. 2015*

- Helped students at Boulder High School learn multivariable calculus, under teacher Akili Obeka.

Outreach

USA Physics Olympiad

Grader and Coaching Team Member *April 2022*

- Served as a grader with the coaching team for the 2022 USA Physics Olympiad. Graded and discussed problems with the rest of the US coaches.

MIT Summer Research Program (MSRP) Admissions Committee *MIT*

Admissions Committee Member *January 2022*

- Served on the admissions committee for the MSRP, whose goal is to bring students from underrepresented and underserved communities to MIT.
- Looked through and graded applications, and worked in small teams and larger committees to find the most suitable applicants for the MSRP's goals of diversity and inclusion at MIT.

Graduates Advising Graduate Admissions Committee *MIT*

Founding Member *July 2020 - Present*

- Involved in several projects ranging from data collection and analysis to reworking the MIT graduate application and essay prompts to foster greater inclusivity and diversity, with a special eye towards prospective women and under-represented minority applicants.

United States Association of Young Physicists' Tournaments (USAYPT)

2020-2022 Tournament Judge *February*

- Judged for the 2020 USAYPT Tournament, an international physics tournament with competing middle- and high-schools from the United States, China, Georgia, and Tunisia; USAYPT 2020 took place in Exeter, New Hampshire.
- Judged for the 2021 USAYPT Tournament, which took place over Zoom.
- Judged for the 2022 USAYPT Tournament, which took place in Raleigh, North Carolina.

Feynman Club, University of California at Santa Barbara *Santa Barbara, CA*

Founder *Jun. 2018 - Sep. 2018*

- Ran a club with the support of Professor Tengiz Bibilashvili, with the intent of teaching undergraduate students quantum mechanics directly from the path integral approach, relying on the book Quantum Mechanics and Path Integrals by R. Feynman and A. Hibbs.
- Taught in a conversational style in which students worked together to solve problems and build intuition.

Skills

Programming Python, C++, Mathematica, LaTeX, Bash, Fish shell
Software `MadGraph 5, Pythia 8, Delphes, ROOT`
Languages English, Spanish

Honors, Awards, and Scholarships

2020 **Finalist**, Paul and Daisy Soros Fellowships for New Americans *New York, NY*
2019-2020 **Recipient**, MIT Graduate Fellowship *Cambridge, MA*
2019 **Bachelor of Science**, graduated from UCSB with highest academic honors, and distinction in the major *Santa Barbara, CA*
2019 **Recipient**, Arnold Nordsieck Award, granted to a graduating senior with exceptional research promise *Santa Barbara, CA*
2017 **Recipient**, Roig Summer Undergraduate Research Fellowship *Santa Barbara, CA*
2017-2019 **Recipient**, Regents Scholarship *Santa Barbara, CA*

Presentations and Talks

Safely Eating Junk: Pileup and Infrared Radiation Annihilation (PIRANHA)

Talks on my research on continuous jet grooming at MIT — *2021-2022*

- Gave talks on ongoing research regarding novel techniques for continuous jet grooming at:
- Boost 2021, an annual conference for boosted object phenomenology, over zoom on August 2, 2021;
- Invited talk for Jet Definitions subgroup of the ATLAS collaboration at CERN over zoom on September 28th, 2021;
- Invited talk for LHCP 2022, a conference for LHC and collider physics, over zoom on May 16, 2022;
- Invited talk at the Stony Brook Center for Frontiers in Nuclear Science workshop titled "Jet Physics: From RHIC/LHC to EIC" on July 1, 2022;
- Boost 2022 in Hamburg, Germany on August 18th, 2022.

Seminar on Supersymmetric Quantum Mechanics — *Santa Barbara, CA*

Independent Seminar — *May 2018*

- Organized and presented an interactive seminar utilizing original teaching techniques to teach students about supersymmetric quantum mechanics

Seminar on Generalized Functions — *Santa Barbara, CA*

Independent Seminar — *Dec. 2018*

- Organized and presented an interactive seminar utilizing original teaching techniques to teach students about generalized functions

Future Colliders and Why to Fund Them — *Santa Barbara, CA*

Undergraduate Research Symposium and CCS RACA-CON (Conference) — *Sep. 2018 and Nov. 2018*

- Gave a talk presenting research of long-lived particles at the proposed Compact Linear Collider.
- A recording of this talk is available at http://online.kitp.ucsb.edu/online/undergrad18/alipourfard/.
- Gave a talk and presented a poster regarding the same research at the CCS RACA-CON conference.

Seeing the Invisible — *Santa Barbara, CA*

CCS RACA-CON — *Nov. 2017*

- Presented a poster regarding research of long-lived particles at the LHC.

Dijets and Displaced Decays — *Santa Barbara, CA*

Undergraduate Research Symposium, University of California at Santa Barbara — *Sep. 2017*

- Gave a talk to physics undergraduates presenting research of long-lived particles at the LHC.
- A recording of this talk is available at http://online.kitp.ucsb.edu/online/undergrad17/alipourfard/.

Publications and e-Prints

[3] *The Second Higgs at the Lifetime Frontier*, S. Alipour-fard, N. Craig, S. Gori, S. Koren, D. Redigolo. J. High Energ. Phys. 2020, 29 (2020).

Published 6 July 2020

[2] *Long Live the Higgs Factory: Higgs Decays to Long-Lived Particles at Future Lepton Colliders*, S. Alipour-fard, N. Craig, M. Jiang, S. Koren. Chin. Phys. C, 43: 053101 (2019).

Published 19 Mar. 2019

[1] *The CLIC Potential for New Physics*, J. de Blas, et al, CERN Yellow Reports: Monographs, CERN-2018-009-M (2018).

Published 21 Dec. 2018