# Seth W. Musser

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## Statement of Purpose

My goal as a physicist is to develop a clearer understanding of quantum phases of matter and their transitions. Using inspiration from classical physics to probe quantum phenomena is especially exciting to me. I am also passionate about helping students to think about physics pictorially and to appreciate and take advantage of symmetry in their work.

## Education

2018 - Present — PhD student in Physics
**Massachusetts Institute of Technology**: Cambridge, MA

2017-2018 — MASt (MSc equivalent) with Distinction in Applied Mathematics
**The University of Cambridge**: Cambridge, UK

2013-2017 — BA with Honors in Physics
BS with Honors in Mathematics
**The University of Chicago**: Chicago, IL
Cumulative GPA: 3.97/4.00

## Honors and Awards

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|---|---|
| 2019-2022 | NSF Graduate Fellow |
| 2017-2018 | Churchill Scholar |
| Summer 2017 | Enrico Fermi Institute Undergraduate Research Award |
| Summer 2017 | James Franck Institute Undergraduate Research Award |
| May 2017 | John H Lewis Prize for best graduating physics student |
| Summer 2016 | Selove Prize for Summer Research |
| May 2016 | Phi Beta Kappa (3rd year) |
| March 2016 | Goldwater Scholar |

## Publications and Presentations

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|---|---|
| Talk at APS DFD 2019: | "Flying in a superfluid: starting flow past an airfoil" |
| Superfluid flight paper: | "Starting Flow Past an Airfoil and its Acquired Lift in a Superfluid" S. Musser, D. Proment, M. Onorato, W.T.M. Irvine, Phys. Rev. Lett. **123**, 154502 (2019) |
| Talk for ChuSOARS: | "Vortex Nucleation in Superfluids" |
| Paper for 2016 REU: | "Weyl's Law on Riemannian Manifolds" |
| Paper for 2015 REU: | "From Hamiltonian Systems to Poisson Geometry" |
| Talk for 2015 REU: | "Poisson Geometry with Applications to the Hamiltonian Formulation of Inviscid Fluid Mechanics" |
| Paper for 2014 REU: | "Weakly Nonlinear Oscillations with Analytic Forcing" |

## Research Experience

Mar. 2019 - Present — Massachusetts Institute of Technology Department of Physics
Condensed Matter Theory Researcher
PI: Professor Senthil Todadri

- Working to understand experiments done on cuprate superconductors by simple modeling and comparison to classical/soft matter phase transitions
- Calculating the behavior of physical quantities across a continuous metal insulator transition

Apr. 2016 - Oct. 2019 | University of Chicago Department of Physics
Superfluids Researcher
PI: Professor William Irvine

- Built from scratch simulation of dragging hydrofoil through a 2D superfluid governed by Gross–Pitaevskii equation (GPE); later independently ported to GPU
- Used simulation to understand the role circulation plays in vortex nucleation, and similarities between superfluid and ideal fluid flow
- Published a paper detailing controlled nucleation of vortices in a superfluid, using a hydrofoil potential

Summer 2016, '15, '14 | University of Chicago Department of Mathematics
REU Student
Mentors: Sean Howe and Yun Cheng, Clark Butler, and Ben Seeger

- 2016 - Studied Riemannian geometry and the spectrum of the geometric Laplacian to understand Weyl's law and DeWitt expansion
- 2015 - Studied Poisson manifolds to develop a rigorous background for understanding the Hamiltonian formulation of inviscid fluid mechanics
- 2014 - Studied the failure of regular perturbation theory to address the weakly nonlinear oscillator and demonstrated two-timing as an alternative approach

Jan. 2015 - Mar. 2016 | University of Chicago Department of Mathematics
Mathematical Fluid Dynamics Researcher
Mentor: Professor Norman Lebovitz

- Studied turbulence through seminal papers and texts
- Studied the application of Hamiltonian formulation of inviscid fluid mechanics to stability results for Riemann ellipsoids
- Numerically and analytically evaluated various methods to probe stability within this context

## Work Experience

July 2019 | West Wing Writers
Math Consultant

- Performed calculations used as part of an environmental campaign

Sep. 2014 - June 2017 | University of Chicago Department of Mathematics
Junior Tutor for MATH 13000s

- Lead 80-minute tutorial sessions twice a week to solidify students' understanding
- Gave quizzes and other formative assessments, and graded homework

Aug. 2014 - Oct. 2014 | University of Chicago College Programming Office
Orientation Leader

- Helped set up and organize events for the Class of 2018's Orientation Week
- Led a group of 30 members of the Class of 2018 in discussions about drugs, alcohol, sexuality, race, and privilege at the college
- Conveyed the college's expectations for behavior while facilitating discussions

## Programming Languages

Fluent: LaTeX, python, Mathematica, Fortran, OpenCL
Some Experience: CUDA, C, LabVIEW