Seth W. Musser

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Statement of Purpose

My goal as a physicist is to probe the role that topology plays in fundamental physics phenomena from the quantum Hall effect to vortex dynamics in a superfluid. As such, in graduate school I plan to study the role of topology in hard condensed matter. 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

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

In preparation with Prof. Irvine: "Tunable Nucleation of Superfluid Vortices from Hydrofoil"
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

Apr. 2016 - Present — 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
- Using simulation to understand the role circulation plays in vortex nucleation, and similarities between superfluid and ideal fluid flow
- Working on 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

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