

Casey E. Berger

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Education

The University of North Carolina

Chapel Hill, NC

Ph.D. in Physics, May 2020

Royster Society of Fellows

Department of Energy Computational Science Graduate Fellow

Dissertation: "Circumventing the sign problem in rotating quantum matter."

The Ohio State University

Columbus, OH

B.S. in Physics *summa cum laude* and with research distinction, May 2015

Cumulative GPA: 3.93

Boston University

Boston, MA

B.A. in Philosophy *summa cum laude*, B.S. in Film Production *summa cum laude*, May 2010

Minor in Spanish

Cumulative GPA: 3.80, *Phi Beta Kappa*, *College Scholar*

Research Interests

Research Interests:

High performance scientific computing

Quantum many-body systems

Condensed matter theory

Nuclear theory

Lattice QCD

Quantum information and quantum computing

Research Experience

Postdoctoral Research Associate

May 2020-present

Lattice field theory: models for complex phase diagrams of disordered quantum materials, applying complex Langevin to circumvent the sign problem in rotating superfluids, and quantum finite elements techniques.

Boston University, Department of Physics and Hariri Institute for Computing

Graduate Researcher

May 2015-May 2020

Advisor: Dr. Joaquín E. Drut

Quantum many-body physics: lattice and Monte Carlo methods. Applying the complex Langevin method to circumvent the sign problem in non-relativistic bosonic fields with finite chemical potential and angular momentum.

The University of North Carolina at Chapel Hill

Research Experience, Cont'd

DOE CSGF Practicum

May-August 2017

Advisor: Dr. André Walker-Loud

Properties of scattering of charged pions via Lattice QCD. Bayesian fitting of correlation functions and error analysis using Python.

Lawrence Berkeley National Laboratory

Undergraduate Researcher

Aug 2014-May 2015

Advisors: Dr. Joaquín E. Drut, Dr. Richard J. Furnstahl, Dr. Robert J. Perry

Quantum many-body physics: enhancing and expanding computational methods developed during a summer REU for Fermi gases.

Low Energy Nuclear Theory Group, Department of Physics, The Ohio State University
The University of North Carolina at Chapel Hill

Computational Astronomy and Physics Summer REU Student

May 2014 - Aug 2014

Advisors: Dr. Joaquín E. Drut, Dr. Eric R. Anderson

Quantum many-body physics: focusing on novel computational methods for Fermi gases. Implementing Monte Carlo methods to calculate the ground-state energy for interacting fermions in a lattice of harmonic oscillator traps.

The University of North Carolina at Chapel Hill

Undergraduate Researcher

Feb 2013-Feb 2014

Advisor: Dr. Christopher S. Hill

Programming Monte Carlo simulations and modeling collisions using C++ and ROOT. Designing and creating a website to organize and display images of CMS collision data using python and HTML.

CMS Group, Department of Physics
The Ohio State University

Publications and Preprints

Complex Langevin and other approaches to the sign problem in quantum many-body physics, C. E. Berger, L. Rammelmüller, A. C. Loheac, F. Ehmman, J. Braun, and J. E. Drut, *preprint*

Thermodynamics of rotating quantum matter in the virial expansion, C. E. Berger, K.J. Morrell, and J. E. Drut, *Phys. Rev. A* **102**, 023309 - (2020)

Third- and fourth-order virial coefficients of harmonically trapped fermions in a semiclassical approximation, K. J. Morrell, C. E. Berger, and J. E. Drut, *Phys. Rev. A* **100**, 063626 - (2019)

Interacting Bosons at Finite Angular Momentum Via Complex Langevin, C. E. Berger and J. E. Drut, *Proceedings of the 36th Annual International Symposium on Lattice Field Theory* (2019)

Hard-wall and non-uniform lattice Monte Carlo approaches to one-dimensional Fermi gases in a harmonic trap, C. E. Berger, J. E. Drut, and W. J. Porter, *Computer Physics Communications* **208**, pp. 103-108 (2016)

Harmonically trapped fermions in two dimensions: ground-state energy and contact of SU(2) and SU(4) systems via nonuniform lattice Monte Carlo, Z-H. Luo, C. E. Berger, and J. E. Drut, *Phys. Rev. A* **93**, 033604 - (2016)

Energy, contact, and density profiles of one-dimensional fermions in a harmonic trap via nonuniform-lattice Monte Carlo calculations, C. E. Berger, E. R. Anderson, and J. E. Drut, *Phys. Rev. A* **91**, 053618 - (2015)

Talks and Presentations

Invited Talks

- Circumventing the sign problem with complex Langevin in lattice field theory*
FermiLab Theory Seminar July 2020
- Circumventing the sign problem with complex Langevin in lattice field theory*
MIT Virtual Lattice Field Theory Colloquium Series June 2020
- Circumventing the sign problem with complex Langevin in lattice field theory*
RPI Advanced Cyberinfrastructure Training for Modeling Physical Systems June 2020
- Complex Langevin: a method for overcoming the sign problem in lattice field theory*
Harvey Mudd College February 2020
- The complex Langevin approach to the sign problem in lattice field theory*
Boston University High Energy Theory Seminar January 2020
- Complex Langevin: a method for overcoming the sign problem in lattice field theory*
Denison University February 2020
- Complex Langevin: a method for overcoming the sign problem in lattice field theory*
Oxford College of Emory University November 2019
- Rotating Superfluids via Complex Langevin*
The University of Glasgow October 2019
- Rotating Superfluids via Complex Langevin*
Lawrence Berkeley National Laboratory October 2019
- Rotating Superfluids via Complex Langevin*
Jefferson Laboratory September 2019
- Complex Langevin in Nonrelativistic Rotating Bosonic Systems*
Nuclear Theory Seminar: University of Maryland, College Park October 2018

Conference Talks and Poster Presentations

- Complex Langevin in Nonrelativistic Rotating Bosonic Systems*
20th Conference on Recent Progress in Many Body Theories: Toulouse, France September 2019
- Complex Langevin in Nonrelativistic Rotating Bosonic Systems*
DOE CSGF Annual Program Review: Arlington, VA July 2019
- Strongly interacting rotating bosons via complex stochastic quantization*
Lattice 2018: East Lansing, MI July 2018
- Strongly interacting rotating bosons via complex stochastic quantization*
The American Physical Society March Meeting: Los Angeles, CA March 2018

Conference Talks and Poster Presentations, Cont'd

<i>Equation of state of strongly coupled 1D fermions in harmonic traps</i> The American Physical Society March Meeting: San Antonio, TX	March 2015
<i>Equation of state of strongly coupled 1D fermions in harmonic traps</i> Conference for Undergraduate Women in Physics: Ann Arbor, MI	January 2015
<i>Ground-state energy of interacting one-dimensional fermions in a harmonic trap: a new approach</i> Computational Astronomy and Physics REU: Chapel Hill, NC	August 2014
<i>Understanding rotating superfluids through statistical methods</i> UNC Women in Computing Research Symposium: Chapel Hill, NC	March 2019
<i>Strongly interacting rotating bosons via complex stochastic quantization</i> DOE CSGF Annual Program Review Fellows' Poster Session: Arlington, VA	July 2018
<i>Charged Pion Scattering with Massive QED</i> DOE CSGF Annual Program Review Fellows' Poster Session: Arlington, VA	July 2017
<i>Harmonically-trapped fermions in three dimensions: a hard-wall approach</i> DOE CSGF Annual Program Review Fellows' Poster Session: Arlington, VA	July 2016
<i>New quantum Monte Carlo method for determining the equation of state of one-dimensional fermions in harmonic traps</i> Denman Undergraduate Research Forum: The Ohio State University, Columbus, OH	March 2015
<i>The ground-state energy of interacting one-dimensional fermions in a harmonic trap: a new approach</i> Grace Hopper Celebration of Women in Computing REU Site Poster Session: Phoenix, AZ	October 2014
<i>The equation of state of one-dimensional fermions in a harmonic trap</i> Computational Astronomy and Physics REU poster session: Chapel Hill, NC	July 2014

Conferences and Workshops: Organized

Third Annual Royster Global Conference: Chapel Hill, NC	May 2019
SciREN Triangle, 2015 - 2019	Sept. 2015, 2016, 2017, 2018, and 2019
SciREN Triangle Lesson Planning Workshop 2015-2019	Aug. 2015, 2016, 2017, 2018, and 2019

Conferences and Workshops: Attended/Attending

American Association of Physics Teachers North Carolina Section Fall Meeting	November 2019
20th Conference on Recent Progress in Many Body Theories: Toulouse, France	September 2019
Argonne Training Program on Extreme-Scale Computing (ATPESC): St. Charles, IL	July 2019
DOE CSGF Annual Program Review: Arlington, VA	annually, 2016-2019
UNC Course Development Institute for Graduate Students: Chapel Hill, NC	December 2017
STAQ Quantum Ideas Summer School: Duke University, Durham, NC	June 2019
Lattice 2018: East Lansing, MI	July 2018
American Physical Society March Meeting: Los Angeles, CA	March 2018
DOE CSGF Annual Program Review: Arlington, VA	July 2015
American Physical Society March Meeting: San Antonio, TX	March 2015
American Physical Society Conference for Undergraduate Women in Physics: Ann Arbor, MI	January 2015
Grace Hopper Celebration of Women in Computing: Phoenix, AZ	October 2014

Teaching Experience

<i>Mathematical Methods of Theoretical Physics, Co-Instructor:</i> co-instructor for a graduate course on mathematical methods for physics at UNC. Developed hands-on labs and exercises using simple coding tools.	Fall 2019
<i>UNC First Year Seminar Instructor:</i> developed and taught a 3 credit course on science literacy and communication to undergraduate students at UNC	Spring 2018
<i>Senior Graduate Student Pre-Candidacy Mentoring Team:</i> held instructional sessions on content and test-taking strategies to help first year graduate students prepare for their qualifying exams	Spring 2017-present
<i>SciREN Triangle 2015:</i> developed a lesson plan for grades 6-12 based on statistical physics for use in local classrooms	Fall 2015
<i>Private Tutor:</i> high school and college physics, calculus, SAT prep, and Spanish	Fall 2012-present
<i>Teaching Assistant:</i> Differential Equations for Scientists and Engineers	Fall 2013-Spring 2014

Professional Service and University Activities

Meetings and Seminar Development Chair Allies for Minorities and Women in Science and Engineering: UNC Chapel Hill	Spring 2019- present
Organizational Team Member SciREN (The Scientific Research and Education Network) Triangle	Summer 2015- present
Senior Graduate Student Pre-Candidacy Mentoring Team UNC Department of Physics and Astronomy	Spring 2017-present
Graduate Representative Graduate Studies and Affairs Committee: UNC Department of Physics and Astronomy	Spring 2017
Panelist, "Outreach Networking Lunch" ComSciCon Triangle 2017	Spring 2017
Undergraduate Co-Chair Society for Women in Physics: The Ohio State University	Summer 2013-Spring 2015
Undergraduate Representative Undergraduate Studies Committee: The Ohio State University	Fall 2013-Spring 2015
Student Guest Speaker Arts and Sciences Dean's Alumni Advisory Committee Lunch: The Ohio State University	Fall 2013
Panelist, "Undergraduate Research and Internships" Physics Department Seminar: The Ohio State University	Fall 2013

Selected Honors and Awards

<i>William Neal Reynolds Fellow, Royster Society of Fellows</i> The University of North Carolina at Chapel Hill	Fall 2015 - Spring 2020
<i>Computational Science Graduate Fellow</i> The United States Department of Energy	Fall 2015 - Summer 2019
<i>NSF Graduate Research Fellowship Program - Honorable Mention</i> The National Science Foundation	Spring 2015
<i>Smith Awards</i> Department of Physics, The Ohio State University	Spring 2015, 2014, & 2013
<i>Arts and Sciences Undergraduate Research Scholarship</i> The Ohio State University	Spring 2015
<i>Blue Chip Award</i> Boston University College of Communications	Spring 2010
<i>Matchette Prize for Excellence in Philosophy</i> Department of Philosophy, Boston University College of Arts and Sciences	Spring 2010

Professional and Academic Society Memberships

<i>The American Association for Physics Teachers</i>	since Summer 2019
<i>Sigma Xi, the Scientific Research Honor Society</i>	since Summer 2019
<i>The American Physical Society</i>	since Fall 2014
<i>Sigma Pi Sigma Physics Honor Society</i>	since Spring 2014
<i>Mortar Board National Senior Honorary</i>	since Spring 2014

Skills

Programming Languages: C++, python, Mathematica, LaTeX, R
Programming Packages and Libraries: OpenMP, Jupyter, lsqfit, pandas
General Computer: Microsoft Office, Evernote, Adobe Photoshop, Mac, Linux, Windows
Language: English (fluent), Spanish (fluent), French (conversational)

Related Coursework

Professional Development

An Introduction to Evidence-Based Undergraduate Teaching in STEM (CIRTL online course)

Graduate

Classical Mechanics
 Quantum Mechanics (1 year)
 Electrodynamics (1 year)
 Statistical Mechanics
 Scientific Computation
 Parallel and Distributed Computing
 Algorithms and Analysis
 Seminar in Theoretical Physics: Non-Perturbative Quantum Many-Body Theory
 Bayesian Methods and Modern Statistics

Non-academic Employment

Management 360

Beverly Hills, CA

Assistant to literary manager, October 2010-February 2012

Working busy desks, dealing with high-profile clients: sending out submissions, handling client and manager calendars, answering phones and rolling calls, organizing travel.

Script analysis and project work: reading scripts and writing coverage, developing director and casting ideas lists for projects.