

Casey E. Berger

Assistant Professor

Bates College
Physics and Astronomy
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Professional and Academic Positions

Assistant Professor

Bates College Department of Physics and Astronomy

August 2024-present

Assistant Professor

Smith College Departments of Physics and Statistical and Data Sciences

July 2023-June 2024

Visiting Assistant Professor

Smith College Department of Physics

July 2021- July 2023

Postdoctoral Research Associate

Boston University, Department of Physics and Hariri Institute for Computing

May 2020-May 2021

Graduate Researcher

Advisor: Dr. Joaquín E. Drut
The University of North Carolina at Chapel Hill

May 2015-May 2020

DOE CSGF Practicum

Advisor: Dr. André Walker-Loud
Lawrence Berkeley National Laboratory

May-August 2017

Undergraduate Researcher

Advisors: Dr. Joaquín E. Drut, Dr. Richard J. Furnstahl, Dr. Robert J. Perry
The University of North Carolina at Chapel Hill and The Ohio State University

Aug 2014-May 2015

Computational Astronomy and Physics Summer REU Student

Advisors: Dr. Joaquín E. Drut, Dr. Eric R. Anderson
The University of North Carolina at Chapel Hill

May 2014 - Aug 2014

Undergraduate Researcher

Advisor: Dr. Christopher S. Hill
The Ohio State University

Feb 2013-Feb 2014

Education

The University of North Carolina

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."

Chapel Hill, NC

The Ohio State University

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

Cumulative GPA: 3.93

Columbus, OH

Boston University

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

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

Minor in Spanish

Cumulative GPA: 3.80, *Phi Beta Kappa*

Boston, MA

Research Grants as Principal Investigator

DOE ERCAP <i>Rotating superfluids via Complex Langevin</i>	2022
Department of Energy's Energy Research Computing Allocations Program grant. ERCAP0021439. Awarded resources: 3K CPU node hours, 100 GPU node hours, 1TB storage. Co-Investigator: Don Willcox.	
NSF XSEDE <i>Properties of rotating superfluids via the complex Langevin method</i>	2021
National Science Foundation Extreme Science and Engineering Discovery Environment grant. PHY200099. Awarded resources: 2k GPU hours, 50k core-hours, and 500GB storage on Bridges-2. Estimated value of awarded resources: \$25,105.70. Co-Investigator: Don Willcox.	
DOE ERCAP <i>Rotating superfluids via Complex Langevin</i>	2021
Department of Energy's Energy Research Computing Allocations Program grant. ERCAP0017942. Awarded resources: 17M NERSC hours, 270TB storage. Co-Investigators: Richard Brower, Don Willcox.	

Publications and Preprints

<i>Quantum technologies for climate change: Preliminary assessment</i> , Q4Climate executive committee, white paper (2021)	
<i>Complex Langevin and other approaches to the sign problem in quantum many-body physics</i> , C. E. Berger, L. Rammelmüller, A. C. Loheac, F. Ehmman, J. Braun, and J. E. Drut, <i>Physics Reports</i> , (2020)	
<i>Thermodynamics of rotating quantum matter in the virial expansion</i> , C. E. Berger, K. J. Morrell, and J. E. Drut, <i>Phys. Rev. A</i> 102 , 023309 - (2020)	
<i>Third- and fourth-order virial coefficients of harmonically trapped fermions in a semiclassical approximation</i> , K. J. Morrell, C. E. Berger, and J. E. Drut, <i>Phys. Rev. A</i> 100 , 063626 - (2019)	
<i>Interacting Bosons at Finite Angular Momentum Via Complex Langevin</i> , C. E. Berger and J. E. Drut, <i>Proceedings of the 36th Annual International Symposium on Lattice Field Theory</i> (2019)	
<i>Hard-wall and non-uniform lattice Monte Carlo approaches to one-dimensional Fermi gases in a harmonic trap</i> , C. E. Berger, J. E. Drut, and W. J. Porter, <i>Computer Physics Communications</i> 208 , pp. 103-108 (2016)	
<i>Harmonically trapped fermions in two dimensions: ground-state energy and contact of SU(2) and SU(4) systems via nonuniform lattice Monte Carlo</i> , Z-H. Luo, C. E. Berger, and J. E. Drut, <i>Phys. Rev. A</i> 93 , 033604 - (2016)	
<i>Energy, contact, and density profiles of one-dimensional fermions in a harmonic trap via nonuniform-lattice Monte Carlo calculations</i> , C. E. Berger, E. R. Anderson, and J. E. Drut, <i>Phys. Rev. A</i> 91 , 053618 - (2015)	

Conference Proceedings

<i>Quantum Counter-Terms for Lattice Field Theory on Curved Manifolds</i> , E. Owen, C. E. Berger, R. Brower, G. Fleming, Andrew D. Gasbarro, and Timothy G. Raben, <i>Proceedings of Science LATTICE 2021</i> , (2021)	
<i>Interacting Bosons at Finite Angular Momentum Via Complex Langevin</i> , C. E. Berger and J. E. Drut, <i>Proceedings of Science LATTICE 2018</i> , (2018)	

Students Mentored - Current

Andy Esseln	Comparative methods for quantum phase transitions <i>Smith College Class of 2025</i>
Noah Edmonds-Estes	Machine learning for atomic spectroscopy data <i>Bates College Class of 2025</i>

Students Mentored - Previous

Bridget Duah	Machine learning for atomic spectroscopy data <i>Smith College Class of 2024</i>
Xinyun Guo	Monte Carlo approaches to atomic spectroscopy <i>Smith College Class of 2025</i>
Meiqi Ma	Data science for quantum materials <i>Smith College Class of 2027, AEMES program</i>
Libby Morningstar	Investigating Weyl semimetal and magnetized phases in quantum materials using stochastic and machine learning methods. <i>Smith College Class of 2023, Senior thesis</i>
Jessica Jiang	Comparing approaches to the Ising Model. <i>Smith College Class of 2023</i>
Zoe Roumeliotis	Quantum data analysis <i>Smith College Class of 2024</i>
Allison Brand	Exploring Quantum mechanics through statistical models <i>Smith College Class of 2024</i>
Kyara Soto Villareal	Quantum data analysis <i>Smith College Class of 2026</i>
AC Manning	Applying machine learning to determine thermalization of stochastic simulations. <i>Smith College Class of 2025, STRIDE program</i>
Jourbienthia Paul	Applying machine learning to determine thermalization of stochastic simulations. <i>Smith College Class of 2025, AEMES program</i>
Eloise Yang	Applications of the AMReX framework to improve computational efficiency in lattice algorithms. <i>Post-undergraduate researcher, Lawrence Berkeley National Laboratory</i>
Yasmine Zefri	Critical properties of nonequilibrium Ising models. <i>UNC Chapel Hill, Class of 2020</i>

Teaching Experience - Current

Newtonian Physics, instructor of record

A rigorous study of Newtonian mechanics. Beginning with Newton's laws, the concepts of energy, momentum, and angular momentum are developed and applied to gravitational, harmonic, and rigid-body motions.

Fall 2024

Introductory Quantum Mechanics, instructor of record

An investigation of the basic principles of quantum mechanics in the Schrödinger representation and the application of these principles to tunneling, the harmonic oscillator, and the hydrogen atom.

Fall 2024

Quantum Theory, instructor of record

A formal treatment of quantum theory using Dirac notation, including an introduction to approximation methods and their applications. The general theory of angular momentum and time-independent perturbation theory are developed and used to derive the fine and hyperfine structures of hydrogen.

Winter 2025

Mathematical Methods of Physics, instructor of record

A study of selected mathematical techniques necessary for advanced work in physics and other sciences. The interpretation of functions as vectors in Hilbert space provides a unifying theme for developing Fourier analysis, special functions, methods for solving ordinary and partial differential equations, and techniques of vector calculus.

Winter 2025

Teaching Experience - Previous

Introductory Physics I, instructor of record

First course in the calculus-based introductory physics series at Smith College. Studio-style with combined lecture and lab. Newtonian mechanics, with an emphasis on problem-solving skills and critical reasoning about physics scenarios.

Fall 2021, Spring 2022,
Spring 2024

Programming for Data Science in Python, instructor of record

Deep dive into data science packages in Python, including Numpy, Pandas, Seaborn, and Matplotlib. Object-oriented programming in Python and developing good practices for Python package development, with an emphasis on data wrangling, analysis, and visualization.

Fall 2023

Reproducible Scientific Computing with Data, instructor of record

Lab-based course to teach good programming practices for data with R. Basic data wrangling and visualization, use of R studio and Markdown, implications and ethics of data use and access.

Fall 2023

Mathematical Methods of Physical Sciences and Engineering, instructor of record

Overview of mathematical methods and their applications in Physics and Engineering. Recognizing, understanding, and applying mathematics to questions about the physical world, with hands-on work in Mathematica to develop numerical skills.

Fall 2022, Spring 2023

Computational Methods for the Physical Sciences, instructor of record

Proposed and developed course in computational methods using Python, with no prior coding experience needed. From Python basics to error analysis, data management and visualization with pandas, numpy, and seaborn to implementing numerical algorithms for differentiation, integration, and stochastic systems.

Fall 2022

Advanced Data Structures, postdoctoral teaching assistant

Assisted in online instruction for a computer engineering course at Boston University. Course covered searching and sorting, analysis of algorithms, trees and data structures, and 2D graphs and networks.

Fall 2020

Mathematical Methods of Theoretical Physics, Co-Instructor

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

UNC First Year Seminar, instructor of record

Developed and taught a 3 credit course on science literacy and communication to undergraduate students at UNC

Spring 2018

Senior Graduate Student Pre-Candidacy Mentoring Team:

Held instructional sessions on content and test-taking strategies to help first year graduate students prepare for their qualifying exams

2017-2020

Teaching Experience, cont'd

SciREN Triangle 2015:

Developed a lesson plan for grades 6-12 based on statistical physics for use in local classrooms

Fall 2015

Private Tutor:

High school and college physics, calculus, SAT prep, and Spanish

2012-2019

Teaching Assistant:

Differential Equations for Scientists and Engineers

2013-2014

Talks and Presentations

Invited Talks and Panels

Science Communication Alumni Panel

DOE CSGF Annual Program Review, Washington D.C.

July 2024

What can a computer teach us about quantum physics?

St Mary's College of Maryland

January 2024

What can a computer teach us about quantum physics?

Bates College

January 2024

Academic Careers in Physics: the Secret Menu to Design Your Own Path

CUWiP 2024, Boston College

January 2024

What can a computer teach us about quantum physics?

Haverford College

November 2023

Interdisciplinary methods for quantum materials

Sigma Xi, Smith College

March 2023

Teaching quantum physics to computers: the infinite improbability drive, statistical physics, and harnessing the questionable intelligence of machines

SciTech Café

March 2023

Careers in Physics Panel Discussion

CUWiP 2023, Boston University

January 2023

What can a computer teach us about quantum physics?

Hamilton College

December 2022

What can a computer teach us about quantum physics?

Smith College

November 2022

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

Invited Talks, cont'd

<i>Complex Langevin: a method for overcoming the sign problem in lattice field theory</i> Harvey Mudd College	February 2020
<i>The complex Langevin approach to the sign problem in lattice field theory</i> Boston University High Energy Theory Seminar	January 2020
<i>Complex Langevin: a method for overcoming the sign problem in lattice field theory</i> Denison University	February 2020
<i>Complex Langevin: a method for overcoming the sign problem in lattice field theory</i> Oxford College of Emory University	November 2019
<i>Rotating Superfluids via Complex Langevin</i> The University of Glasgow	October 2019
<i>Rotating Superfluids via Complex Langevin</i> Lawrence Berkeley National Laboratory	October 2019
<i>Rotating Superfluids via Complex Langevin</i> Jefferson Laboratory	September 2019
<i>Complex Langevin in Nonrelativistic Rotating Bosonic Systems</i> Nuclear Theory Seminar: University of Maryland, College Park	October 2018

Conference Talks

<i>Complex Langevin and machine learning approaches to the non-linear sigma model with a topological term</i> APS March Meeting 2024: Minneapolis, MN	March 2024
<i>Complex Langevin in Nonrelativistic Rotating Bosonic Systems</i> 20th Conference on Recent Progress in Many Body Theories: Toulouse, France	September 2019
<i>Complex Langevin in Nonrelativistic Rotating Bosonic Systems</i> DOE CSGF Annual Program Review: Arlington, VA	July 2019
<i>Strongly interacting rotating bosons via complex stochastic quantization</i> Lattice 2018: East Lansing, MI	July 2018
<i>Strongly interacting rotating bosons via complex stochastic quantization</i> The American Physical Society March Meeting: Los Angeles, CA	March 2018
<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

Poster Presentations

<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

Bridging the Gap: Data Science Applications in Modern Physics Education, AAPT Summer Meeting, Boston	
Science Communication workshop for CUWiP 2023, Boston University	Jan
Work-Life Balance workshop for CUWiP 2023, Boston University	Jan
Quantum for Climate Workshop: virtual	Febr
Third Annual Royster Global Conference: Chapel Hill, NC	
SciREN Triangle, 2015 - 2019	Every Sept.
SciREN Triangle Lesson Planning Workshop 2015-2019	Every Aug.

Conferences and Workshops: Attended/Attending

American Physical Society March Meeting: Minneapolis, MN	March 2024
Data Science Education Community of Practice (DSECOP) Workshop	June 2023
NERSC/Nvidia AI for Science Bootcamp	August 2022
American Association of Physics Teachers New Faculty Workshop	July 2021
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

Conferences and Workshops: Attended/Attending, Cont'd

Argonne Training Program on Extreme-Scale Computing (ATPESC): St. Charles, IL	July 2019
DOE CSGF Annual Program Review: Arlington, VA	annually, 2016-present
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

Professional Service

Fellowship screening committee The Department of Energy Computational Science Graduate Fellowship	2024-present
Executive Committee Member-at-Large American Physical Society's Topical Group on Data Science	2023-present
Advisory Board Member Qubit x Qubit	2021-present
Creator and facilitator: Building Balance Webinar MIT Women+ in Chemistry	2021
Creator and facilitator: Resiliency and Work-Life Balance Webinar Allies for Minorities and Women in Science and Engineering: UNC Chapel Hill	2020-2021
Meetings and Seminar Development Chair Allies for Minorities and Women in Science and Engineering: UNC Chapel Hill	2019-2020
Organizational Team Member SciREN (The Scientific Research and Education Network) Triangle	2015-2019
Senior Graduate Student Pre-Candidacy Mentoring Team UNC Department of Physics and Astronomy	2017- 2020
Graduate Representative Graduate Studies and Affairs Committee: UNC Department of Physics and Astronomy	Spring 2017

Professional Service, cont'd

Undergraduate Co-Chair Society for Women in Physics: The Ohio State University	2013-2015
Undergraduate Representative Undergraduate Studies Committee: The Ohio State University	2013-2015

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>Fulbright Award Finalist</i> The United States Department of State, Fulbright Commission	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

Selected Honors and Awards, cont'd

<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

The American Association for Physics Teachers (AAPT)
 The American Physical Society (APS)
 Sigma Pi Sigma Physics Honor Society
 Mortar Board National Senior Honorary

Reviewer for

Physical Review A
Foundations of Physics

Skills

Programming Languages: C++, Python, Mathematica, LaTeX, R

Programming Packages and Libraries: OpenMP, Jupyter, Numpy, Pandas, Seaborn, PyTorch

Programming Skills and Competencies: SLURM job submission, HPC, cloud computing, version control with git

General Computer: Microsoft Office suite; Google Docs suite; Notion; Evernote; Mac, Linux, and Windows operating systems

Languages: English (fluent), Spanish (fluent), French (conversational)

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.