Andrew C. Loheac

andrewloheac.com
Github: aloheac

Education

University of North Carolina at Chapel Hill May 2019
Doctor of Philosophy in Physics Chapel Hill, NC

University of North Carolina at Chapel Hill December 2017
Master of Science in Physics Chapel Hill, NC

Rochester Institute of Technology May 2014
Bachelor of Science in Physics, *summa cum laude* (GPA: 4.00) Rochester, NY
Minor in Computer Science

Technology Skills

Programming Languages: C++, Python, Matlab, Mathematica; familiarity with Java and Fortran.
Libraries and Frameworks: SciPy, NumPy, wxPython, Armadillo, FFTW, ACML/BLAS, OpenMP, OpenACC, Keras, GNU Scientific Library, Boost, HDF5, CUDA.
Development Environments: JetBrains CLion, JetBrains PyCharm, git, Eclipse; familiarity with Visual Studio.

Development Projects

Improving Quantum Monte Carlo Efficiency with Convolutional Neural Networks July 2018 - present

- Currently investigating the application of convolutional neural networks toward improving the efficiency and robustness of quantum Monte Carlo algorithms.
- Implemented machine learning algorithms using Keras and TensorFlow. Dataset is managed using the HDF5 format.

High-Order Perturbation Theory: Software for Symbolic and Numerical Evaluation December 2015 - June 2017

- Developed an object-oriented software package in C++ to symbolically compute analytic expressions of the perturbative expansion for interacting quantum gases. Utilized features provided by the Boost C++ and GNU Scientific libraries.
- Accelerated numerical and symbolic evaluations using OpenMP and OpenACC with the GNU and PGI compilers.

Scimitar: A Visual Driver for Parameter Space Exploration December 2014 - May 2015

- Led the development of an application developed in Python using wxPython designed for the management of large numerical simulation jobs which explore vast parameter spaces on cluster computing resources.
- *Scimitar* drastically improved the efficiency of the group's research tasks and the output of scientific results.

Equations of State from Quantum Monte Carlo Algorithms August 2014 - present

- Numerically investigated equations of state of quantum gases using a variety of Monte Carlo algorithms developed by our research group and implemented in C++ and Fortran. Depended on FFTW, ACML, and Armadillo libraries.
- Performed data analysis of Monte Carlo results in Python (using SciPy and NumPy libraries) and Mathematica.

Professional Experience

Graduate Research Assistant July 2014 - present
Department of Physics and Astronomy, University of North Carolina, Chapel Hill, NC

- Numerically and analytically investigated thermodynamics of strongly-interacting Fermi gases across dimensions and temperature scales. Developed custom quantum Monte Carlo techniques and other computational methods.
- Published multiple scientific results in journals including Physical Review A and Physical Review D.

Graduate Teaching Assistant January 2016 - May 2017
Department of Physics and Astronomy, University of North Carolina, Chapel Hill, NC

- Led lab sections for beginning- and intermediate-level undergraduate courses in numerical techniques for physics.
- Helped students with programming assignments and graded homework submissions.

Undergraduate Researcher April 2013 - June 2014
X-Ray and Surface Science Laboratory
School of Physics and Astronomy, Rochester Institute of Technology, Rochester, NY

- Studied carbon monoxide and oxygen interactions with surface reconstructions on gold single crystals using X-ray diffraction techniques. Studied numerical models of these interactions using MATLAB.
- Published results from experiments conducted at the Advanced Photon Source at Argonne National Laboratory.

Undergraduate Researcher January 2011 - January 2013
Complex Systems and Granular Materials Laboratory
School of Physics and Astronomy, Rochester Institute of Technology, Rochester NY

- Developed parallelized molecular dynamics simulations for modeling the rheology of geometrically cohesive granular materials using Nvidia's CUDA C++ platform.

Publications and Presentations

- Published 7 articles in peer-reviewed journals including Physical Review A, Physical Review D, and the Journal of Physical Chemistry C. Additional article accepted at Physical Review Letters. Full CV is available at andrewloheac.com.
- Topics include studies of the equation of state of spin-polarized and unpolarized fermions, development of numerical methods including complex Langevin, hybrid Monte Carlo under an analytic continuation, automated high-order perturbation theory, and the virial expansion. Undergraduate study in gold single crystals is also published.
- Research results have been presented at national and international conferences.

Selected publications:

- **Andrew C. Loheac**, Jens Braun, and Joaquín E. Drut, *Polarized fermions in one dimension: density and polarization from complex Langevin calculations, perturbation theory, and the virial expansion.* Physical Review D **98**, 054507 (2018).
- **Andrew C. Loheac** and Joaquín E. Drut, *Third-order perturbative lattice and complex Langevin analyses of the finite-temperature equation of state of non-relativistic fermions in one dimension.* Physical Review D **95**, 094502 (2017).
- **Andrew C. Loheac**, Jens Braun, Joaquín E. Drut, and Dietrich Roscher, *Thermal equation of state of polarized fermions in one dimension via complex chemical potentials.* Physical Review A **92**, 063609 (2015).

Selected presentations:

- SAS Institute Deep Learning Symposium (Cary, NC; September 2018). *"Deep learning quantum matter"*, co-presented with Joaquín E. Drut.
- University of Washington Institute for Nuclear Theory Workshop (Seattle, WA; August 2018). *"Thermodynamics of non-relativistic matter from complex Langevin in one and two dimensions"*.
- 35th International Symposium on Lattice Field Theory (Granada, Spain; June 2017). *"Equation of state of non-relativistic matter from automated perturbation theory and complex Langevin"*.

Fellowships and Honors

- UNC Dissertation Completion Fellowship *($18,000 + tuition)* April 2018
- National Science Foundation Graduate Research Fellowship *($34,000 + tuition per year, for 3 years)* June 2014
- RIT School of Physics and Astronomy Research Scholar May 2014
- RIT Outstanding Undergraduate Scholar Award December 2013
- RIT Physics Faculty and Alumni Endowed Scholarship *($1,500)* May 2013

Personal Projects

Training Neural Networks to Play *2048* Using Q-Learning September 2017 - June 2018

- Developed a Python application to generate training data for a deep neural network which predicts optimal game moves using reinforcement learning. Resulting algorithm matched average human-level performance.
- Gained experience in using Keras (running on TensorFlow) and designing neural networks for a custom data set.

Credentials

- CompTIA A+ IT Technician Certification September 2008