Christopher Moore

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Profile

Theoretical Condensed Matter Physicist interested in using high performance parallel computing to numerically model topological materials such as Dirac and Weyl semimetals as well as superconductor-semiconductor heterostructures. Currently conducting research into quasi-particle excitations arising in these materials and the application to topological quantum computing. An effective oral and written communicator with publications in major scientific journals along with presentations on original research at multiple scientific conferences. Independent and collaborative work skills gained through joining multiple scientific groups and managing processes in a manufacturing engineering setting.

Skills

Programming

- Computer programming using Python (sklearn, numpy, pandas), Bash, Mathmatica, Matlab, C, R, CUDA, and LabView.
- Member of Clemson Makerspace, familiar with 3D printing, microcontrollers, and Raspberry pi.
- Implemented high-performance parallelization techniques to run numerical models on Linux-based supercomputing cluster.

Professional Certificates

- Python Data Science - Professional Certificate - IBM *edX* (2020), *Credential Id:* c95ffbfae0c646aa81dbbd42babdeb8e
- Google IT Support Professional Certificate Specialization *Coursera* (2019), *Credential Id:* YRA2J8DZ5MQJ
- TUM Lean Six Sigma Yellow Belt *TUM School of Management Executive Education* (2019), *Credential Id:* EEC_2019001545

Professional Activities

- *Referee: Physical Review B*

Research

Atom-Surface Interactions and Quantum Electrodynamics

Missouri University of Science and Technology – Rolla, MO (2020-Current)

- Analytically and numerically modeled temperature dependent atom-surface interactions between helium atoms and silicon (111). Studied effects on quantum reflection, in coordination with spin-echo experiments carried out in Heidelberg, Germany. Results to be published in the near future.

Topological Condensed Matter

Clemson University – Clemson, SC (2014-2019)

- Showed that partially separated Andreev bound states (ps-ABSs) arise as generic low energy modes in superconductor-semiconductor heterostructures. When separated by a distance of the order of the characteristic Majorana decay length, these ps-ABSs give an identical signal to "garden variety" Majorana Zero Modes (MZMs) for a large range of control parameters in localized charge tunneling experiments.
- Outlined a two-terminal charge tunneling experiment capable of differentiating between ps-ABSs and MZMs. This research is valuable to researchers attempting to create topological quantum computers because the braiding calculations used in these computations rely on MZMs which are localized to the ends of the semiconducting nanowire. Without running the proposed experiment or one similar to it, there is no way to be certain that the system is in a topological phase supporting true MZMs.
- Computed the Nernst coefficient (conventional as well as anomalous) for the recently discovered Dirac Semi Metal Cd3As2 using Boltzmann dynamics within the relaxation time approximation. Showed that the spin degeneracy in the two four-fold degenerate Dirac points can be lifted by a magnetic field, producing four doubly-degenerate Weyl points with a non-vanishing Chern number. Showed that the Nernst response in this material is dominated by the anomalous Nernst effect and hence can be used as a direct probe of the Berry curvature.

Jammed Granular Matter

University of Rhode Island – Kingston, RI (2013-2014) - Used configurational statistics to show profiles of pressure, mass density, and entropy of disks in narrow channels jammed by gravity and centrifuge. Calculations led to publication, with applications to granular matter under conditions which create heterogeneous

mass distributions. Created a mathematical model in Mathematica to simulate the system.

Materials and Nanotechnology

North Dakota State University – Fargo, ND (May–July, 2010-2012)

- Worked with a team to create a method of purifying colloidal nanoparticle samples into monodisperse layers using density-gradient-ultracentrifugation. Dry nanocrystal films were created and characterized using highly monodisperse silicon nanocrystals, leading to a significant enhancement in photoluminecence over polydisperse samples.
- Assisted in the creation of a cryogenic system which measured temperature dependent photoluminecence in silicon nanoparticles using optical microscopy as well as spectroscopy.
- Set up a system to capture video microscopy of phase separation in polymer-nanocrystal mixtures. Constructed a program using Matlab which tracks particles in a solution.

Nuclear Magnetic Resonance Data Analysis

Minnesota State University Moorhead – Moorhead, MN (2010 - 2011)

- Data from a published study was modeled to measure proton-proton interactions. Separations were found to be unusually small, results were presented at Student Academic Conference.
- Developed system to record and control temperature of a sample in a student built NMR machine. Program was written in LabView to provide a user interface used to monitor and control temperature of the NMR probe via temperature controller.

Industry Experience

Material Requirements Planning / Manufacturing Engineering Intern

Case New Holland – Fargo, ND (2007-2012)

- Managed nesting process on oxy-fuel computer numeric controlled sheet-metal cutters. Focused on continuous process improvement within the cutting process.
- Programmed laser sheet-metal cutters and plasma punches.

- Promoted to material requirements planning. Managed inventory quantities, start times, and due dates of parts according to lean manufacturing standards.

Teaching Experience

Assistant Professor of Mathematics and Physics

William Peace University – Raleigh, NC (2019)

- Taught introductory physics and math courses.
- Managed physics lab, which involved writing all physics labs, maintenance and inventory of all lab equipment, as well as supervising courses.
- Served on the teaching and learning committee.

Mathematics Tutor

Tri-County Technical College – Pendelton, SC (2019-current) - Tutor for Calculus, Statistics, Differential Equations, Physics, and Programming Courses.

Graduate Teacher of Record

Clemson University – Clemson, SC (2018)

- Course leader for calculus-based electrodynamics labs.
- Managed teaching assistants for 10 lab sections.
- Entered students' final grades and responsible for all grade disputes.

Teaching Assistant

Clemson University – Clemson, SC (2014-2017) - Course leader for calculus-based waves, optics, and modern physics labs.

- Instructed students proper experimental lab techniques and data analysis.
- Grader for algebra-based physics lecture course.
- Worked in the Learning Center. Assisted students of all levels with physics homework.

Teaching Assistant

University of Rhode Island – Kingston, RI (2012-2014)

- Lab instructor for calculus and algebra-based physics labs.
- Instructed electronics based physics labs for science and engineering students.
- Taught regression techniques using Excel and LoggerPro.

Teaching Assistant / Tutor

Minnesota State University Moorhead – Moorhead, MN (2010-2011)

- Lab assistant for algebra-based physics labs.

Education

Clemson University, Clemson, SC

PhD Physics, (2018)

University of Rhode Island, Kingston, RI

M.S. Physics, (2014)

Minnesota State University Moorhead, Moorhead, MN

B.S. Physics, (2012) *B.S. Operations Management,* (2007)

Publications

- C Zeng, C Moore, AM Rao, TD Stanescu, and S Tewari "Analytical solution of the finite length Kitaev chain coupled to a quantum dot," *Physical Review B* (accepted) (2019).
- C Moore, TD Stanescu, S Tewari "Two terminal charge tunneling: Disentangling Majorana zero modes from partially separated Andreev bound states in semiconductor-superconductor heterostructures," *Physical Review B* 96 (16), 165302 (2018).
- C Moore, C Zeng, TD Stanescu, S Tewari "Quantized zero bias conductance plateau in semiconductor-superconductor heterostructures without non-Abelian Majorana zero modes," *Physical Review B* 98 (15), 155314 (2018).

- G Sharma, C Moore, S Saha, S Tewari "Nernst effect in Dirac and inversion-asymmetric Weyl semimetals," *Physical Review B* 96 (19), 195119 (2017).
- C Moore, D Liu, B Ballnus, M Karbach, and G Müller "Disks in narrow channel jammed by gravity and centrifuge: profiles of pressure, mass density, and entropy density," *Journal of Statistical Mechanics: Theory and Experiment* (4), P04008 (2014).
- A R Van Sickle, J B Miller, C Moore, R J Anthony, U R Kortshagen and E K Hobbie "Temperature dependent photoluminescence of size purified silicon nanocrystals," *ACS Applied Materials and Interfaces* 5, 4233 (2013).

Talks / Presentations

Invited

- "Quasi-Majorana Bound States in Semiconductor-Superconductor Heterostructures," University of Missouri (2019).
- "Tunneling Transport Phenomena in Topological Systems," Los Alamos National Lab (2018).

Contributed

- Presented research results at American Physical Society March Meeting (2019).
- Presented research results at Michigan State University Quantum Information Science Workshop (2018).
- Presented research results at American Physical Society March Meeting (2018).
- Presented research at Clemson University's Symposium for the Introduction to Research in Physics and Astronomy (2018) & (2016).
- Presented research results at Minnesota State University Moorhead Student Academic Conference (2011) & (2010).

Awards

- Clemson University PEGAS travel grant (2018).
- CSNS Student Research Grant (2010/2011).
- Hart-Sipson Endowed Scholarship (2010/2011) & (2011/2012).
- Walt Wesley Memorial Scholarship (2010/2011) & (2011/2012).