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Application Review

Return to Student Overview

*Your session will automatically time out at **8:25:26pm** Central Time if no action is taken. Any action (saving information or choosing a new page) will reset this timer.*

Your application data has been submitted. No changes to your application can be made, however, you can update profile information at any time from the Student Overview screen.

Recommenders

HongWen Jiang
Michalis Bachtis
Rahul Roy

The recommender's list is currently locked. The submission window is closed.

This application requires 3 recommendations.

Making a change to the list of recommenders: Student applicants cannot make changes to the list of recommenders. Changes to the list must be made by the Campus Representative. For guidance on how to remove and replace a recommender, please see FAQ questions **"One of my recommenders needs to be replaced. How do I make this change?"**

Application Questions & Answers

Legal Residence Information

*** Citizenship**

U.S. Citizen

Career Goals/Professional Aspirations

*** What is the highest degree you plan to obtain?**

Ph.D.

*** In one or two sentences, describe your career goals and professional aspirations (see example below). This statement will be used in publications if you are selected as a scholar or honorable mention.**

Ph.D. in physics, specializing in condensed matter physics, with a focus on topological materials and quantum computation. Conduct research in these areas and teach at the university level.

*** What are your career goals and professional aspirations? Indicate which area(s) of mathematics, science or engineering you are considering pursuing in your research career and specify how your current academic program and your overall educational plans will assist you in achieving your career goals and professional aspirations.**

I intend to become a professor of physics at a public research institution. In particular, I am eager to conduct research in condensed matter physics, a field that has revolutionized our understanding of nature with discoveries such as superconductivity and quasiparticle excitations, and transformed modern life with inventions such as transistors, camera sensors, and blue LEDs. In addition, I look forward to teaching and sharing science as a way of understanding nature, and of motivating

individual purpose. I believe that in addition to being elegant and useful, science can be a source of inspiration, vocation, and purpose.

Currently, I am pursuing an educational program comprised of coursework, research, and teaching. For coursework, I have completed the core of the physics major and a mathematics minor. These and other courses have given me a broad-based scientific knowledge that is foundational for research and teaching. I am now pursuing graduate coursework in physics and additional courses in mathematics with the intention of developing the research skills required to contribute to condensed matter physics.

For research, I am studying phase transitions between quantized phases of conductivity in the Quantum Hall Effect. These studies are immediately rewarding for their results, and valuable in the long term as my skills in quantum mechanics and statistical mechanics are maturing. In addition, this past summer, I conducted research in quantum computation, and found that the experimentally based research gave me a stronger physical intuition.

For teaching, I have always helped friends and peers informally, and I am now a Peer Learning Facilitator for the introductory electromagnetism course at UCLA. In this role, I create worksheets of problems, compile review notes, and lead students in problem solving sessions. Next year, I plan to become a Teaching Assistant. I enjoy teaching, and have enjoyed learning how to teach. I believe these experience will improve my teaching in the future.

Following UCLA, I will go to graduate school for physics. To begin this process, I have met professors and graduate students from other institutions and conducted informational interviews. Their perspectives, thoughts and advice has given me some insights into how to realize a research career in condensed matter physics. In graduate school, I want to expand my research on electronic phases and phase transitions to include topological phases and driven systems, with potential applications to superconducting qubits for quantum computation. I am especially excited to learn about many-body physics and behaviors that can only be explained using interacting Hamiltonians. After graduate school, I will seek a postdoctoral appointment before pursuing a faculty position.

*** Describe an activity or experience that has been important in helping shape or reinforce your desire to pursue a research career in science, mathematics or engineering.**

"We cannot know the exact value of any quantity in a stochastic system," a friend recently asserted to me. While this is typically true, there are some disordered systems in condensed matter where we can, in fact know quantities exactly. For example, disorder in the Integer Quantum Hall Effect localizes all electronic states except those at the center of Landau Levels, leading to a conductivity quantized in exact proportion to the number of Landau Levels filled. Condensed matter theory studies the collective behavior of dense matter where quantum effects are important. I'm curious to understand and explain the behaviors that arise in condensed matter systems.

My first experience with condensed matter was at my community college where we learned about the crystalline properties of solids and electronic band structures. I remember a thrill as I calculated Bragg scattering angles and as I read about depletion regions in pn junctions. When I came to UCLA,I wanted to learn more, so in my first year, I took a course in electronic materials science and then approached Professor Rahul Roy.

Rahul told me that I needed to learn quantum mechanics to conduct research with him. I spent much of the summer studying, and in the fall I joined his group. Since then, my fascination with condensed matter has grown as I've learned more about the field and approached research

problems. I am eager to continue my research, and look forward to pursuing a career in condensed matter physics research.

(Optional question, answering the question below will depend on your personal experience.)

Goldwater Scholars will be representative of the diverse economic, ethnic and occupational backgrounds of families in the United States. Describe any social and/or economic impacts you have encountered that influenced your education - either positively or negatively - and how you have dealt with them.

I grew up in a small family in a small town. My family is my mother and sister, and my high school had limited science and math classes that I finished by the end of my first year. Balancing family commitments during the day with my interest in learning more science, I enrolled at the local community college. At College of Marin, I learned the fundamentals of chemistry, physics, and mathematics, and, with the generosity of Professor Erik Dunmire, I was introduced to materials science and solid state physics. This coursework launched my pursuit of science for its beauty and utility.

My small family and community have motivated me seek larger opportunities. For me, this means becoming an active member of the research community, and nurturing others through teaching. At UCLA, between classes and working, I have actualized this motivation by conducting research in condensed matter physics, attending colloquia/conferences, and presenting my work. In addition, I have mentored new transfer students in their transition to UCLA, and currently lead problem solving sessions for the introductory electromagnetism course. As I continue to develop professionally, I aspire to both conduct significant research in condensed matter physics, and to teach, mentor, and motivate students of all backgrounds.

Research Projects

Research Project #1

Electronic Localization

Starting Month

04

Starting Year

2018

Ongoing

Yes

Average Hours/Week (Academic Year)

25

Average Hours/Week (Summer)

35

Name of Project Mentor

Rahul Roy

Title of Project Mentor

Professor

Name of Project Mentor

Title of Project Mentor

Name of Project Mentor

Title of Project Mentor

Description of research, including your involvement in AND contribution to the project.
A central concept in physics is the 'characteristic length,' or scale of a system: what is 'big' and what is 'small'? Ideally, this length comes from a model, as the Bohr radius for hydrogen does, but the length may be empirical. When the characteristic length is infinite, as the localization length of a traveling wave is, something miraculous occurs: the physics at all scales---atomic, mesoscopic, and macroscopic---realize the same quantitative behavior.

I am working independently with Professor Rahul Roy's guidance to numerically determine the critical exponent (how fast the localization length diverges at a critical point) for the delocalization transitions of the IQHE. We are approaching this problem by determining the localization length in an atomic tight-binding model, and a macroscopic wave function based model. Our study is the first to explore the delocalization transition in systems large enough to produce statistically reliable results for higher Landau Levels.

Do you have Papers/Publications associated with this research project?
Yes

*** If yes, how many publications are associated with this work?**
1

*** Citation**
Talkington S, and Roy R. 2019. Numerical determination of Chern numbers and critical exponents for Anderson localization in tight-binding and related models. UC eScholarship.

*** Status**
Published

*** How are you listed in the publication?**
First author

*** Type of Publication**
Campus Publication

Do you have Presentations associated with this research project?
Yes

*** If yes, how many presentations are associated with this work?**
1

*** Citation**
Talkington S, and Roy R. Chern Numbers and Critical Exponents in Tight-Binding and Related Models. Poster session presented at: UCLA Undergraduate Research Week; 2019 May 20-24; Los Angeles, CA.

*** Campus, Regional, National or International**
Campus

*** Presentation type**
Poster

*** How are you listed on the presentation?**
Presenter

Research Projects
Research Project #2
Driven Qubit Systems
Starting Month
06
Starting Year
2019
Ongoing
Yes
Average Hours/Week (Academic Year)
5
Average Hours/Week (Summer)
50
Name of Project Mentor
HongWen Jiang
Title of Project Mentor
Professor
Name of Project Mentor

Title of Project Mentor

Name of Project Mentor

Title of Project Mentor

Description of research, including your involvement in AND contribution to the project.
Reliable and scalable quantum computing will be a transformative technology. Yet before we can realize such large-scale quantum computing, we must first understand how to encode information, how the encoded information evolves while stored, and how to readout the information. Professor HongWen Jiang's group creates charge-based semiconductor quantum dot qubits, which are a scalable, but as-yet unreliable method to realize quantum computing.

Working with HongWen's guidance, and consulting graduate students Nick Penthorn, John Rooney, and Tim Wilson for experimental details, I developed a computational method to determine the time-evolution of driven qubit systems 500x faster than methods in the literature. This additional speed can be used to predict results of varying experimental parameters, and to explain experimental results through parameter space explorations.

I have submitted a paper to Physical Review B describing this method, and am moving it through the peer-review process.
Do you have Papers/Publications associated with this research project?
Yes
*** If yes, how many publications are associated with this work?**
1
*** Citation**
Talkington S, and Jiang HW. 2019. Efficient unitary method for simulation of driven quantum systems. Submitted to Phys. Rev. B. arXiv:1909.02532.

*** Status**
Submitted

*** How are you listed in the publication?**
First author

*** Type of Publication**
National Professional Society Journal

Do you have Presentations associated with this research project?
Yes

*** If yes, how many presentations are associated with this work?**
1

*** Citation**
Talkington S, and Jiang H. Efficient Unitary Method for Simulation of Driven Quantum Systems. Oral session presented at: 2019 Annual Meeting of the APS Far West Section; 2019 November 1-2; Stanford, CA.

*** Campus, Regional, National or International**
Regional

*** Presentation type**
Oral

*** How are you listed on the presentation?**
Presenter

Research Projects

Research Project #3

Starting Month

Starting Year

Ongoing

Average Hours/Week (Academic Year)

Average Hours/Week (Summer)

Name of Project Mentor

Title of Project Mentor

Name of Project Mentor

Title of Project Mentor

Name of Project Mentor

Title of Project Mentor

Description of research, including your involvement in AND contribution to the project.

Do you have Papers/Publications associated with this research project?

Do you have Presentations associated with this research project?

Research Projects
Research Project #4

Starting Month

Starting Year

Ongoing

Average Hours/Week (Academic Year)

Average Hours/Week (Summer)

Name of Project Mentor

Title of Project Mentor

Name of Project Mentor

Title of Project Mentor

Name of Project Mentor

Title of Project Mentor

Description of research, including your involvement in AND contribution to the project.

Do you have Papers/Publications associated with this research project?

Do you have Presentations associated with this research project?

Research Projects
Research Project #5

Starting Month

Starting Year

Ongoing

Average Hours/Week (Academic Year)

Average Hours/Week (Summer)

Name of Project Mentor

Title of Project Mentor

Name of Project Mentor

Title of Project Mentor

Name of Project Mentor

Title of Project Mentor

Description of research, including your involvement in AND contribution to the project.

Do you have Papers/Publications associated with this research project?

Do you have Presentations associated with this research project?

Mentor Recognition Information

*** Mentor Name**
Rahul Roy

*** Mentor Title**
Professor

Mentor Name
HongWen Jiang

Mentor Title
Professor

Mentor Name
Michalis Bachtis

Mentor Title
Professor

Research Skills

Skill Description #1
I have acquired a broad-based scientific knowledge through my coursework, conversations with peers, readings, and by attending colloquia. I believe that this wide knowledge will be pivotal to my success in condensed matter where physics, mathematics, chemistry, and materials science are united.

Research Skills
Skill Description #2
I am experienced at programming for scientific computations using Python/Matlab/C++, and I perform exact calculations in Mathematica. In addition, I am an expert at document preparation in LaTeX, and I am adept at visualizing data and creating graphics using Matplotlib/Inkscape/TikZ.

Research Skills
Skill Description #3
I know how to use statistical methods in experimental design and in drawing appropriate conclusions from data. In particular, I make sure to run multiple independent trials in order to determine the variance of measurements, and I understand the propagation of errors and effect of systematic errors.

Research Skills
Skill Description #4
I have developed the ability to critically evaluate the scientific literature, compare works, and perform literature surveys. This has been a guide in my research so far: determining what is known so that I can build upon it, learn the existing content and methods, and attribute credit where due.

Research Skills
Skill Description #5
I have developed my verbal communication skills as a team member, with colleagues, and to broader audiences. In addition to research experiences, working in Residential Life taught me to negotiate and resolve social conflicts, while leading physics seminars taught me to distill and connect ideas.

Other Activities and Accomplishments
Activity/Accomplishment
Running
Organization (if applicable)
UCLA BruinRunners
Scope of Activity/Accomplishment

College/University
Role/Involvement
I like long distance running. It's a way for me to feel good, relax, and chat with others. I've run over a dozen ultramarathons (26+ miles), including a 70 mile race.
Leadership Position
Member
Length of Involvement
More than one academic year

Other Activities and Accomplishments
Activity/Accomplishment
Teaching
Organization (if applicable)
UCLA Academic Advancement Program
Scope of Activity/Accomplishment
College/University
Role/Involvement
I lead problem solving sessions for the introductory electromagnetism course. Each week, I create ~20 problems to supplement course materials, and lead four 90 minute sessions of ~10 students.
Leadership Position
Peer Learning Facilitator
Length of Involvement
Academic Year

Other Activities and Accomplishments
Activity/Accomplishment
Academic advising
Organization (if applicable)
UCLA Transfer Student Center
Scope of Activity/Accomplishment
College/University
Role/Involvement
I guided a group of students majoring in mathematics through their transition from community college to UCLA. In particular, I shared my knowledge on "how to be successful" in the mathematics major and prepared an assortment of written materials.
Leadership Position
Transfer Student Mentor
Length of Involvement
Semester

Other Activities and Accomplishments
Activity/Accomplishment
Community development

Organization (if applicable)
UCLA Residential Life
Scope of Activity/Accomplishment
College/University
Role/Involvement
I was responsible for 90 students' welfare through advising, mediation, event planning, and the resolution of dangerous situations. (2018-19) I led an 800-person building in addressing issues, coordinating events, and implementing policies. (2017-18)
Leadership Position
Resident Assistant; Building President
Length of Involvement
More than one academic year

Other Activities and Accomplishments
Activity/Accomplishment
Creating formula sheets
Organization (if applicable)
N/A
Scope of Activity/Accomplishment
Other
Role/Involvement
This isn't formal or part of a group, but its something that I think is interesting, and others have told me they liked. For my physics classes at UCLA, I created formula sheets (typeset in LaTeX). Please see http://spenser.science/formula-sheets/
Leadership Position
N/A
Length of Involvement
More than one academic year

Recognitions
Recognition
Helen Quinn Award
Type
National
Award Description
Awarded by the American Physical Society "each year to a student from California, Nevada or Hawaii for the outstanding work performed by the recipient" in theoretical physics. Awarded for research completed with Professor HongWen Jiang on qubits.
Award Year
2019

Recognitions
Recognition

UCLA Library Prize
Type
College/University
Award Description
Awarded the UCLA Library Prize for best research paper, for research I completed on electronic conductivity with Professor Rahul Roy. "The Library Prize for Undergraduate Research recognizes and honors excellence in undergraduate research at UCLA."
Award Year
2019

Recognitions
Recognition
UCLA Undergraduate Research Fellowship
Type
College/University
Award Description
One of 30 UCLA students selected from over 200 applicants to receive a fellowship to support research during my Sophomore year (2018-2019).
Award Year
2018

Recognitions
Recognition
UCLA Summer REU Program
Type
College/University
Award Description
One of 15 students selected to participate in UCLA's paid Summer REU Program in Physics.
Award Year
2019

Current College/University

*** Institution type:**
4-year institution

*** Field of study**
Physics and Astronomy
Physics and Astronomy areas of specialization
Condensed Matter Physics

*** Official cumulative unweighted GPA**

*** How many credit hours does your school require for graduation?**

180

*** How many credit hours will you achieve as of January 1, 2020?**

148

*** How many credit hours do you plan to achieve for graduation?**

208

*** Expected baccalaureate graduation month**

06

*** Expected baccalaureate graduation year**

2021

*** According to the definition provided above, indicate whether you are a sophomore or junior.**

Junior

*** Matriculation status at the institution you will be attending during the 2020-2021 academic year**

Currently Enrolled

*** Have you been involved in or do you plan to Study Abroad?**

No

Coursework

Current Course 1

Statistical Physics (Graduate)

Current Course 2

Solid State Physics Laboratory

Current Course 3

Electronics for Measurement Laboratory

Current Course 4

Discrete Mathematics

Current Course 5

Current Course 6

Future Course (In Major) 1

Quantum Mechanics II (Graduate)

Future Course (In Major) 2

Classical Mechanics (Graduate)

Future Course (In Major) 3

Electromagnetic Theory I (Graduate)

Future Course (In Major) 4

Electromagnetic Theory II (Graduate)

Future Course (In Major) 5

Particle Physics

Future Course (In Major) 6

General Relativity

Future Course (Outside Major) 1

Complex Analysis
Future Course (Outside Major) 2
Differential Geometry
Future Course (Outside Major) 3
Topology
Future Course (Outside Major) 4
Abstract Algebra I: Rings and Fields
Future Course (Outside Major) 5
Abstract Algebra II: Group Theory
Future Course (Outside Major) 6
Enumerative Combinatorics

Previous Schools Attended

School Name
College of Marin
City
Kentfield
State/Territory
CA
Institution type:
2-year institution
Dates attended
Jan 2014 - May 2017
Unweighted GPA on a 4.00 scale

Will you be providing a transcript from this school to your Goldwater Campus Representative?
Yes

Future Academic Plans

*** Is the institution you will be attending for the 2020-2021 academic year the same as your current academic institution?**
Yes

Certification and Release

*** Applicant's Signature**
Spenser M. Talkington

Supporting Documentation

Essay
Research Essay

Send to Printer