Non-GPS applications, accurate clocks

NSF Personal Statement

My experiences as an undergraduate at the University of Colorado at Boulder have ignited my passion for research and have convinced me of my ability to contribute to the scientific community and to society through research (GOOD IDEAS, BUT TRY TO MAKE THE SECOND PART OF THIS SENTENCE FLOW BETTER / SEXIER). It is my ambition to enter graduate school next year as part of a nuclear and quantum theory group, and later to pursue a faculty position at a leading research university.

**Motivation**

What do you like about physics?

What do you like about theoretical / computational physics?

I am fascinated by the boundary between

What do you like about nuclear and quantum theory in particular? (FIND SOME REL-WORLD PROBLEMS THESE DISCIPLINES WILL SOLVE!)

**Research**

The large and vibrant research community at the University of Colorado has given me the freedom to explore my interests, develop research skills, and gain confidence in many fields. For 2 years I have worked with Asst. Prof. Paul Romatschke in the Nuclear Theory group. I have developed a set of hydrodynamic simulations of cold atomic gases expanding from optical traps, which are studied with great interest by experimental groups at the University of Colorado for THESE REASONS. In the process, I have learned a great deal both about the theory underlying cold quantum fluids and the numerical techniques necessary to simulate and understand a physical system on a computer. I also had the opportunity to collaborate closely with a researcher from ETH Zurich, Switzerland, which further excited me about the opportunity to extend my research internationally in the future (AWKWARD PLACEMENT!). This project is the subject of my honors thesis, and has culminated in a publication to be submitted within the next few months, on which I am the primary author.

Excited about the hydrodynamics of exotic fluids and curious about alternative applications (AWKWARDLY LONG PREAMBLE FOR SENTENCE), I took a brief hiatus from nuclear theory to spend 9 weeks of the summer of 2014 on an NSF REU studying theoretical magneto-hydrodynamics with Prof. Dana Longcope at Montana State University. During this time, I implemented a clever parameter-space search which allowed us to constrain a set of unobservable parameters for a solar flare, which I then used to successfully demonstrate that our simulated solar flare matched closely experimental observations (THIS COULD BE TWO SENTENCES, MAYBE 3? USE PARAMETER, OBSERVABLE TOO MANY TIMES). I am presenting this work at the 2014 LWS / Hinode / IRIS meeting in Portland, OR. We will publish a paper on this work within the year, on which I will be a co-author. **Broader Impacts:** Energy release in solar flares remains poorly understood, and is centrally important to space weather predictions that seek to protect astronauts and instruments in space.

During my sophomore year at the University of Colorado, I spent a year working with Asst. Prof. Ivan Smalyukh doing experimental liquid crystal materials research. ~~For the majority of this duration~~ I worked independently to determine the strength and range of interactions between micrometer-sized particles in liquid crystal materials under different conditions. I presented this work at the 2013 Materials Science and Engineering seminar in Boulder, CO. This work has also been published in Physical Review E.[[1]](#footnote-1) **Broader Impacts:** Self-assembly of particles in liquid crystal is on the forefront of micro- and nano-fabrication techniques, and may allow for electronics to be fabricated with significantly less expense. This would have drastic impacts on the technological economy. (PARTICULARLY THE LAST SENTENCE SCREAM “I AM LOOKING FOR SOMETHING TO TALK ABOUT! EITHER TAKE IT OUT OR EXPAND ON IT.)

I also spent two summers working with Prof. Joseph Shaw in the Optical Remote Sensing laboratory at Montana State University. I spent the summer of 2013 working independently to develop and implement a new set of algorithms to automate data analysis for an airborne imager, which is part of a publication being prepared for submission on which I will be a co-author. During the summer of 2012 I designed and built an optoelectronic system to detect the aurora borealis. I presented this work at the 2012 Optical Technology Center conference in Bozeman, MT. **Broader Impacts:** Airborne imagers are being explored as a method for optically monitoring CO2 sequestration sites from the air and detecting leaks.

**Community Involvement and Outreach**

While at the University of Colorado, I have demonstrated leadership potential, initiative, and a strong commitment to improving education for underrepresented groups. For 1.5 years I have been closely involved with a graduate student-led organization, CU-Prime, that was conceived in the CU Boulder physics department in 2013. CU-Prime aims to improve retention of underrepresented students in STEM fields by strengthening community in the sciences through mentorship, research talks for undergraduates, and special coursework. Alongside other members of CU-Prime I co-designed the first CU-Prime class, *Fundamentals of Scientific Inquiry* (PHYS 1400) (? SHOULD LIST COURSE NUMBER?), to expose entering students to research and to the physics community and to strengthen the confidence of minority students and women in physics (TOO MANY “ANDS”). I am currently co-instructing the inaugural CU-Prime class along with 3 graduate students. I am also an active member of the CU-Prime research committee and have enabled CU-Prime to understand and improve the representation of minorities and women at our talks and events by generating quantitative analyses of data from our first year. I see the CU-Prime vision, which was inspired by a similar organization at UC Berkeley, as a national standard of the future, and look forward to the opportunity to initiate a similar organization at another university when I enter graduate school (TOO MANY PARENTHESES IN THIS PARAGRAPH!).

I have also tutored physics and mathematics at the University of Colorado and have been involved in engineering outreach activities for dominantly-Hispanic elementary school students through the Colorado Space Grant Consortium.

**Future Plans**

**Intellectual Merit**

My diverse experiences and coursework in theoretical and experimental physics, engineering, mathematics, and computer science provide the leverage I will need to creatively solve difficult interdisciplinary problems. My experience solving research problems independently makes me well-qualified to take on the individual research responsibilities of a graduate student, while my time spent in CU-Prime working effectively as part of a large group united under a common vision demonstrates my abilities as part of a team.

**Broader Impacts**

My knowledge of a diverse set of research areas will allow me to forge connections between academic disciplines that will result in improved applications of physical principles, and will cause overflowing economic prosperity (!). My commitment to mentorship and inclusion of underrepresented groups will continue to flourish when I enter graduate school, and by promoting community among women and minority groups I hope to give them the confidence they need to become an integral part of a globally-competitive STEM workforce.

Community Involvement section too overflowingly politically-correct for Devin’s taste.

**Research section:** Flesh out all of the broader impacts sections!!! Cut out the fluff in the rest: this is what I was working on, with whom, where, and here are the results (e.g. paper). More similar to the section about Joe.

Get rid of the broader impacts at the bottom. Maybe put the broader impacts of your work with CU-Prime in the CU-Prime section.

You skipped everything about motivation and about what you want to do in grad school!

Motivation: describe what you like about physics – like the physical applications / realization of pure mathematics, puzzles.

1. M.B. Pandey, T. Porenta, J. Brewer, A. Burkhart, S. Copar, S. Zumer, and Ivan I. Smalyukh. “Self-assembly of skyrmion-dressed chiral nematic colloids with tangential anchoring.” *Phys. Rev. E 89,* *060502* (2014). [↑](#footnote-ref-1)