Shuhan Zheng

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Physics and Astronomy Undergraduate

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Education

University of Toronto, Toronto ON, Canada.

HBSc., Major in Physics, University of Toronto, 2020 to 2024 (expc.).

HBSc., Major in Astronomy and Astrophysics, University of Toronto, 2020 to 2024 (expc.).

Marianopolis College, Montreal QC, Canada.

Pure & Applied Science DEC, 2018 to 2020.

Research Experiences

In the summer of 2023, I worked as a research intern in Dr. Xin Tong's Polarized Neutron group at China Spallation Neutron Source (CSNS), a research facility operated by China Academy of Sciences, Institute of High Energy Physics. During this time, I collaborated with Dr. Xin Tong's [1] Polarized Neutron Group. Specifically, I worked with Dr. Tianhao ("Radian") Wang[2] and Dr. Ahmad Salman to develop a polarized neutron imager that can directly observe the magnetic field of a given sample in 3D. I was solely responsible for the design and implementation of various neutron-optical simulations and data analysis programs, including a novel raytracing-based finite element simulation for simulating the detector's output when taking a snapshot of the sample with a diffusive neutron source. Compared to other existing methods, it is faster and can accommodate non-adiabatic transitions and non-coherent neutron beams.

Since September 2021, I have been a member of the Data Processing subsystem of the University of Toronto Aerospace Team Space Systems (UTAT-SS). I was at first in a team that develops, implements, and tests an algorithm that removes smile distortion, then I became the project lead of another team that does the same for keystone distortion. Until UTAT-SS settled on a scientific objective, I was also a member of the Mission Science system, which was scoping for alternative missions for the team's CubeSat project FINCH. The team's design paper of which I am a coauthor has been published in the Smal Satellite Conference 2022[3].

Rewards

- Team lead and first author of one of the top 10 finalist submissions in The Moon Society's Moon Base Design Contest[4], 2021 (the smallest, and the only undergraduate team to be selected as a finalist). The goal was to design a lunar base that sustainably supports the survival and well-being of a crew of 30 for 10 years, and then evaluate its cultural and economic significance. The contest welcomed submissions from all levels of education, including engineering graduate students and professionals.
- Provincial top 15 rank in Quebec, Canadian Association of Physicists (CAP) Exam, 2019.

Leadership Experiences

- **University of Toronto Physics Student Union (UofT PhySU)**
  - Vice-President of Internal and External Affairs, 2023 to 2024 academic year. My role is to organize and coordinate PhySU's collaboration with external partners, as well as with the Department of Physics itself.
- **Marianopolis Propulsion Laboratory**, a student rocketry society at Marianopolis College, Montreal
  - Co-executive, 2019 to 2020 academic years;
  - Outreach director, 2018 to 2020.

Notable Skills

Python programming and LaTeX typesetting, analog and digital electronics design and prototyping, technical drawing, scientific and technical writing.

[1] Dr. Tong is a **lead scientist** in the field of polarized neutron science at Oak Ridge National Laboratory and CSNS.
See more info about Dr. Tong's Google Scholar page: https://scholar.google.com/citations?user=Iy4X3WAAAAAJ

[2] Dr. Wang is one of the Ph.D. supervisors and researchers at Oak Ridge National Laboratory and CSNS.
See more info at Dr. Wang's ResearchGate page: https://www.researchgate.net/profile/Tianhao-Wang-14

[3] Miles, A. (n.d.). FINCH: A blueprint for accessible and scientifically valuable remote sensing satellite missions. DigitalCommons@USU. https://digitalcommons.usu.edu/smallsat/2022/all2022/88/

[4] The Moon Society's announcement for contest winners: https://www.moonsociety.org/news/2021/03/10/announcement-of-winners-for-the-moon-societys-first-moon-base-design-contest/

Course Projects

Computational Physics - Comparison between Fast Mutlipole Method (FMM) and Particle Mesh Method (PM) *Fall 2021*

For the course's final project, I did the research for and implemented the FMM and PM algorithms in Python, and compared their performances in terms of accuracy and speed. I also implemented a direct sum method (DSM) for comparison. At the end of the report, I discussed each algorithm's advantages and disadvantages in various situations, such as when the particles are clumped together or when there is a large ensemble of particles. I was rewarded an 85.42% (A) for this project.

Electronics Labs - A Serial Photonic Communication Device *Winter 2023*

For the course's final project, my project partner and I designed and built a laser-based device that transmits 1s and 0s serially, based on the polarization of each laser pulse. Initially, the design consisted of a laser diode, two polarizers, two photodetectors, a liquid crystal film, a microcontroller, and a beam-splitter. However, due to budgetary and logistics concerns, it was reduced to one polarizer-photodetector pair, a laser diode, a polarizer film attached to a step motor, and a microcontroller. The device was able to transmit with high fidelity, and I was rewarded an 8/10 for this project.