W. Callum Wareham

callum_wareham@sfu.ca · CV

Education

PhD, Physics - Simon Fraser University (Ongoing) 2023 – 2027

BSc, Physics - University of Guelph (GPA 93.2%) 2018 – 2022

Research Experience

Stochastic Thermodynamics of Molecular Rotary Motors **Simon Fraser University**

Graduate Student Beginning September 2023
Research Assistant June 2023 – Present

- Interested in the theoretical properties (efficiency, design principles, etc.) of molecular machines such as $F_O F_1$–ATPase, a biological rotary motor. Current work is focused on the theory of *in vitro* experiments which will allow us to further understand the optimal control of F_1, i.e. understanding the driving strategies that its partner motor F_O might use.
- Supervisor: David A. Sivak

Low-Energy Optical Properties of Dirac Materials **University of Guelph**

Full-Time Research Assistant September 2022 – April 2023
NSERC Undergraduate Student Research Award Summer 2022

- Used a combination of pen-and-paper and computational techniques (Python) to compute the low-energy optical properties of 2-and-3-dimensional Dirac and Weyl Materials. Further developed my knowledge of condensed matter physics, quantum mechanics, and mathematical techniques (linear response theory, Green's functions methods).
- Supervisor: Elisabeth J. Nicol

Kilonova Modelling with Python **University of Guelph**

Senior Undergraduate Research Project September 2021 – May 2022
Departmental Summer Research Award Summer 2021

- Implemented and developed numerical model in Python with the goal of predicting the effect of a central remnant on kilonovae (astronomical transients from neutron star mergers). Model combines the macrophysics (relativistic mechanics, thermodynamics, radiative transfer) with the microphysics (modelled ejecta opacity.)
- Supervisor: Daniel M. Siegel

Infrared Spectroscopy of PEX-a Pipes **University of Guelph**

Student Research Assistant September 2020 – May 2021
NSERC Undergraduate Student Research Award Summer 2020

- Independently planned, built, documented and maintained a Python script for processing over 14,000 infrared spectra on cross-linked polyethylene (PEX) pipes alongside categorical information on the scans. Group is using resulting database to streamline new analyses and visualizations, including those leading to publications.
- Communicated with group effectively, including group meeting presentations, to determine project requirements and develop effective solutions. Recognized by supervisor & other group members for excellent clarity and attention to detail when presenting.
- Supervisor: John R. Dutcher

Research Awards

- NSERC Canada Graduate Scholarship – Doctoral 2025 – 2027
  - Simon Fraser University
- NSERC Michael Smith Foreign Study Supplement 2025
  - Simon Fraser University/Tohoku University, Sendai, Japan
- NSERC Canada Graduate Scholarship – Master's 2023
  - Simon Fraser University
- NSERC Undergraduate Student Research Award 2022
  - Low-Energy Optical Properties of Dirac Materials, University of Guelph
- Departmental Summer Research Award 2021
  - Kilonova Modelling with Python, University of Guelph
- NSERC Undergraduate Student Research Award 2020
  - Infrared Spectroscopy of PEX-a Pipes, University of Guelph

Scholarships & Recognitions

- J.B Reynolds Graduation Medal in Physics 2022
- College of Engineering and Physical Sciences Society of Excellence 2022
- Marie Curie Scholarship in Physics 2022
- James L. Hunt Scholarship in Physics 2021
- Copernicus Scholarship in Physics 2020
- College of Biological Sciences Dean's Scholarship 2020
- University of Guelph Retiree Association Scholarship 2020
- Puslinch Optimist Club Scholarship 2019
- University of Guelph Entrance Scholarship 2019

All awards held at University of Guelph.

Publications

4. **W. Callum Wareham**, David A. Sivak. "Multi-parameter Optimal Control of F_1-ATPase." arxiv: 2410.24122. Submitted to *Phys. Rev. E.*

3. **W. Callum Wareham**, Elisabeth J. Nicol. "Optical conductivity of tilted higher pseudospin Dirac-Weyl cones." *Phys. Rev. B* **108**, 085424 (2023). DOI: 10.1103/PhysRevB.108.085424. arxiv: 2308.09700.

2. Michael Grossutti, Joseph D'Amico, Jonathan Quintal, Hugh MacFarlane, **W. Callum Wareham**, Amanda Quirk, John R. Dutcher. "Deep Generative Modeling of Infrared Images Provides Signature of Cracking in Cross-Linked Polyethylene Pipe." *ACS Appl. Mater. Interfaces* **15**, 18, 22532-22542 (2023). DOI: 10.1021/acsami.3c02564.

1. Michael Grossutti, Melanie Hiles, Joseph D'Amico, **W. Callum Wareham**, Benjamin Morling, Scott Graham, John R. Dutcher. "Quantifying stabilizing additive hydrolysis and kinetics through principal component analysis of infrared spectra of cross-linked polyethylene pipe." *Polymer Degradation and Stability* **200**, 109963 (2022). DOI: 10.1016/j.polymdegradstab.2022.109963.

Presentations

3. *Tipsy Cones: Optical Conductivity of Tilted Dirac Cones with Varying Pseudospin.* **W. Callum Wareham***, Elijah T. Kent*, Elisabeth J. Nicol. (Poster)
   - 2^{nd} place at CEPS Undergraduate Poster Session, University of Guelph, Aug. 2022.
   - Presented at 2022 Canadian Undergraduate Physics Conference, Oct. 2022.
2. *Turbo Kilonovae: Wavelength-Dependent Central Engine Heating in Kilonovae.* **W. Callum Wareham***, Michael Müller, Daniel M. Siegel. (Contributed Presentation)
   - Presented at 2022 Canadian Undergraduate Physics Conference, Oct. 2022.

1. *Identifying Accelerated Ageing Pathways for Cross-Linked Polyethylene Pipes Through Machine Learning.* Joseph D'Amico*, Melanie Hiles, Michael Grossutti, **W. Callum Wareham**, John R. Dutcher. (Contributed Presentation)
    - Presented at 2021 American Physical Society March Meeting.

*Denotes presenting author.

Skills

- Numerical modelling, analysis of large data sets, pen & paper calculations.
- Exceptional communication (both written and presentation) skills, and experience with a wide audience range (scientific peers, industry collaborators, general public, elementary school students). Consistent instructor/supervisor recognition for quality of both written and presented work.
- Extensive experience with Python, Git(+Hub/Lab), LaTeX, command line interfaces.
- Novice use of Linux & high-performance (cluster) computing (Digital Research Alliance, formerly Compute Canada). Past experience with C, R, Java, JavaScript.
- Scientific documentation with attention to detail for both simulations and in the lab.
- Lab experience (exceptional performance in three courses) and analysis of real-world data.

Volunteer Experience

Organizing Committee – Frontiers in Biophysics 2024 **2023 – 2024**

VP External – University of Guelph Physics and Astronomy Club **2020 – 2021**

University of Guelph Physics Curriculum Committee – Student Rep. **2019 – 2021**

References

David A. Sivak
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Professor, Department of Physics, University of Guelph
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Daniel M. Siegel
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Professor, Institute for Physics, University of Greifswald
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