

W. Callum Wareham

callum.wareham@sfu.ca · CV

EDUCATION

MSc, Physics - Simon Fraser University (Ongoing) 2023 – 2025

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

RESEARCH EXPERIENCE

Stochastic Thermodynamics of Molecular Rotary Motors Simon Fraser University

MSc Student

Beginning September 2023

Research Assistant

June 2023 – Present

- Interested in the theoretical properties (efficiency, design principles, etc.) of molecular machines such as F_0F_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_0 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
 - Starting January 2025, Simon Fraser University
- 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 F₁-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. 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)
 - 2nd 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), L^AT_EX, 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 dsivak@sfu.ca	<i>Associate Professor, Department of Physics, Simon Fraser University</i> 8888 University Dr W, Burnaby, BC V5A 1S6
Elisabeth J. Nicol enicol@uoguelph.ca	<i>Professor, Department of Physics, University of Guelph</i> 50 Stone Rd E, Guelph, ON, Canada N1G 2W1
Daniel M. Siegel daniel.siegel@uni-greifswald.de	<i>Professor, Institute for Physics, University of Greifswald</i> Felix-Hausdorff-Straße 6, 17489 Greifswald, Germany