

# W. Callum Wareham

calwareham99@gmail.com · CV

## EDUCATION

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**MSc, Physics** - Simon Fraser University (Accepted)

Beginning Sept. 2023

**BSc, Physics** - University of Guelph (GPA 93.2%)

2018–2022

## RESEARCH EXPERIENCE

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### 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

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- NSERC Canada Graduate Scholarship - Master's (awarded, beginning Sept. 2023) 2023
  - Simon Fraser University
- NSERC Undergraduate Student Research Award 2022
  - Low-Energy Optical Properties of Dirac Materials
- Departmental Summer Research Award 2021
  - Kilonova Modelling with Python
- NSERC Undergraduate Student Research Award 2020
  - Infrared Spectroscopy of PEX-a Pipes

All awards held at University of Guelph unless otherwise listed.

## SCHOLARSHIPS & RECOGNITIONS

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- 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

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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

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3. *Tipsy Cones: Optical Conductivity of Tilted Dirac Cones with Varying Pseudospin.* **W. Callum Wareham\***, Elijah T. Kent\*, Elisabeth J. Nicol. (Poster)
  - 2<sup>nd</sup> 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

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- Extensive experience with Python, Git(+Hub/Lab), L<sup>A</sup>T<sub>E</sub>X, command line interfaces.
- Basic use of Linux & high-performance (cluster) computing (Digital Research Alliance, formerly Compute Canada). Past experience with C, R, Java, JavaScript.
- 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.
- 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

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

- Attended CEPS Student Council Executive Committee meetings and assisted with event planning for undergraduate students and outreach.
- Developed short Hallowe'en program to be presented to elementary school students at Royal Astronomical Society of Canada event.
- Guest host on podcast Gryphons and Gluons (Episodes 4 & 6)

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

- Gathered, interpreted and communicated student feedback on courses and program to improve future curriculum.

## REFERENCES

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Elisabeth J. Nicol  
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