W. Callum Wareham

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Education

MSc, Physics – Simon Fraser University (Accepted) *Beginning Sept. 2023*

BSc, Honours Physics – University of Guelph (93 GPA) *2018-2022*

Awards and Scholarships

- 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 – Supervised by Elisabeth J. Nicol.
- J. B. Reynolds Graduation Medal in Physics *2022*
  - For obtaining highest cumulative average in the required physics courses in the program.
- College of Engineering and Physical Sciences Society of Excellence *2022*
  - For demonstrating excellent academic achievement and contributing to the University of Guelph community and beyond throughout career.
- Marie Curie Scholarship in Physics *2022*
  - Highest cumulative average in fourth-year physics.
- Departmental Summer Research Award *2021*
  - Kilonova Modelling with Python – Supervised by Daniel M. Siegel.
- James L. Hunt Scholarship in Physics *2021*
  - Highest cumulative average in third-year physics.
- NSERC Undergraduate Student Research Award *2020*
  - Infrared Spectroscopy of PEX-a Pipes – Supervised by John R. Dutcher.
- Copernicus Scholarship in Physics *2020*
  - Awarded to the three students achieving the highest combined average in second-year physics courses.
- College of Biological Sciences Dean's Scholarship *2020*
  - For demonstrating a high level of academic achievement. When considered for this award, I was enrolled in the College of Biological Sciences.
- University of Guelph Retiree Association Scholarship *2020*
  - For the highest average as a child, grand-child, or great grand-child of a retiree of the University of Guelph.
- Puslinch Optimist Club Scholarship *2018, 2019*

Research Experience

- **NSERC Undergraduate Student Research Award** – *Summer 2022*
  Full-Time Research Assistant – *September 2022 – Present*
  Low-Energy Optical Properties of Dirac Materials – Elisabeth J. Nicol University of Guelph
  - Using 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.
  - Preparing a manuscript with supervisor for submission to Physical Review B.

- **Departmental Summer Research Award** – *Summer 2021*
  Senior Undergraduate Research Project – *September 2021 – May 2022*
  Kilonova Modelling with Python – Daniel M. Siegel University of Guelph
  - 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 (material opacity).
  - Collaborated with supervisor and graduate students to extend model in wake of recent transient observations; group is currently seeking to use model to help predict the lightcurves from merger events leaving behind a remnant.

- **NSERC Undergraduate Student Research Award** – *Summer 2020*
  Student Research Assistant – *September 2020 – May 2021*
  Infrared Spectroscopy of PEX-a Pipes – John R. Dutcher University of Guelph
  - 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 (publication 2 below).
  - 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.

Publications

1. *Optical conductivity of tilted higher pseudospin Dirac-Weyl cones*. W. Callum Wareham, Elisabeth J. Nicol. In preparation for submission to *Physical Review B*.
2. *Deep Generative Modeling of Infrared Images Provides Signature of Cracking in Cross-Linked Polyethylene Pipe.* Michael Grossutti, Joseph D'Amico, Jonathan Quintal, Hugh MacFarlane, W. Callum Wareham, Amanda Quirk, John R. Dutcher. *ACS Applied Materials & Interfaces*, published online (to be printed) DOI:10.1021/acsami.3c02564.
3. *Quantifying Stabilizing Additive Hydrolysis and Kinetics Through Principal Component Analysis of Infrared Spectra of Cross-Linked Polyethylene Pipe*. Michael Grossutti, Melanie Hiles, Joseph D'Amico, W. Callum Wareham, Benjamin Morling, Scott Graham, John R. Dutcher. *Polymer Degradation and Stability* **200**, 109963 (2022). DOI:10.1016/j.polymdegradstab.2022.109963.

Presentations

1. *Tipsy Cones: Optical Conductivity of Tilted Dirac Cones with Varying Pseudospin*. W. Callum Wareham*, Elijah T. Kent*, Elisabeth J. Nicol. (Poster)
   - 2nd place at 2022 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.
3. *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

- Extensive experience with Python, Git(+Hub/Lab), LaTeX, command line interfaces.
- Developing experience with C, Linux; previous experience with R, Java, JavaScript.
- Problem solving in physics & mathematics, learned from research and coursework experiences.
- 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

- **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)

- **Student Representative** - Undergraduate Physics Curriculum Committee *2019 - 2021*
   - Gathered, interpreted and communicated student feedback on courses and program to improve future curriculum.

References

- Elisabeth J. Nicol
  enicol@uoguelph.ca
  Professor, Department of Physics, University of Guelph
  50 Stone Rd E, Guelph, ON, Canada N1G 2W1

- Daniel M. Siegel
  daniel.siegel@uni-greifswald.de
  Professor, Institute for Physics, University of Greifswald
  Felix-Hausdorff-Straße 6, 17489 Greifswald, Germany

- John R. Dutcher
  dutcher@uoguelph.ca
  Professor, Department of Physics, University of Guelph
  50 Stone Rd E, Guelph, ON, Canada N1G 2W1