Jack Hollis Farrell

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Objective

Innovative science research and meaningful science communication.

Education

Halifax Grammar School, International Baccalaureate (IB) Diploma **2017**

- IB Score: 43/45
- Academic Average: 97%
- Valedictorian, Class of 2017

University of Toronto, Honours Bachelor of Science **(Expected) 2017-2021**

- 4th year Physics Specialist with Minors in Mathematics and English
- Cumulative GPA 3.97

Awards and Honours

- University of Toronto National Scholarship (Full scholarship: Tuition and Living fees for four years of undergraduate study)
- NSERC Undergraduate Summer Research Award (2019)
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- Bryan Wayne Statt-George Luste Prize in Experimental Physics
- University of Toronto Scholar (Entrance Award)
- Mary Mounfield Scholarship
- E Murray Cleland Scholarship
- Joseph Alfred Whealy In-Course Scholarship
- Northrop Frye Center Undergraduate Research Fellowship (with Thomas Fraser)
- NSERC *Science: Action!* Video Competition Finalist

Research

Research Student, *University of Toronto* (NSERC USRA) **May 2020 – Sep 2020**

- Project: *Computational Electron Hydrodynamics*
- Supervisors: Prof. Nicolas Grisouard & Prof. Thomas Scaffidi

I implemented a finite volume method to model the compressible flow of viscous electrons in a device called a "Field Effect Transistor". With certain boundary conditions, this setup is unstable, and the instability can lead to coherent oscillations at frequencies in the "TeraHertz" range. These devices could have great applications because, currently, there do not exist good sources of radiation with these frequencies. This was an important project for me since it confirmed my interest in Condensed Matter Physics, specifically on the theoretical side – and the field of electron hydrodynamics is hugely exciting to me.

Research Student, *University of Toronto* (NSERC USRA) **May 2019 – Sep 2019**

- Project: *Testing and Development of Instruments for a Balloon-Borne Spectrometer Mission*
- Supervisor: Prof. Kaley A. Walker

Laboratory work included systems programming, machining, and electronics, which were all new to me at the time, so I learned a lot. I also performed some theoretical work involving image processing. The project ended with a ten-day field campaign in Timmins, Ontario, during which the stratospheric balloon was launched – this challenging, engaging, and ultimately incomparable experience matured me as a researcher. I presented a poster at the U of T Physics Department's 2019 Undergraduate Research Fair.

Videographer and Research Student, *Dalhousie University* **May 2018 – Sep 2018**

- Project: *Water Quality Research Outreach Videos*
- Supervisor: Dr. Graham Gagnon & Dr. Amina Stoddart

I produced outreach videos with Dalhousie University's Centre for Water Resources Studies under Dr. Graham Gagnon, now Associate Vice President Research at Dalhousie. The movies featured interviews with the various undergraduates, graduate students, and postdoctoral fellows at the lab in which they described their projects. I feel that, especially since the group's research on water quality issues directly affects the general public, it is crucial to make sure the work is understandable for non-scientific audiences. I also assisted with laboratory work.

- https://www.youtube.com/channel/UCcrrD4jos8wIMS4hqaVmUAg

Research Student, *Canadian Light Source "Students on the Beamlines"* **2015 – 2018**

- Project: *Identification of Toxic Metals Absorbed by Microplastic Fibers on Nova Scotian Beaches*

I participated in a group high school research project that used the Canadian Light Source (CLS) synchrotron in Saskatoon, Saskatchewan, Canada. We identified toxic metals attached to microplastic fibers in Nova Scotia's seawater. The project included planning, testing, and presenting the preliminary results to the staff scientists at the CLS.

Relevant Coursework

The following upper-year undergraduate physics courses are especially relevant for my field of interest, Condensed Matter Physics. Courses that are in progress or scheduled are in **bold.** My transcript gives a fuller picture of my background in physics and mathematics.

- **PHY 487 *Condensed Matter Physics***
- **PHY 452 *Statistical Mechanics***
- PHY 358 *Atoms, Molecules, and Solids*
- **PHY 456 *Quantum Mechanics II***
- PHY 356 *Quantum Mechanics I*
- **PHY 407 *Computational Physics***
- PHY 354 *Advanced Classical Mechanics*
- PHY 350 *Electromagnetic Theory*
- PHY 252 *Thermal Physics*

Work Experience

Teaching Assistant, *University of Toronto* **Sep 2020 – Current**

Recently, the physics department has been incorporating computer programming into early undergraduate courses – computing forms a major component of modern physics research, so it is important training for undergraduates. I help students in a variety of first and second year courses with the basics of *Python*, the programming 'language' preferred by the physics department.

Physics Tutor, *Victoria College* **Sep 2019 – Current**

Trained by learning specialist, I ran weekly drop-in hours for undergraduate physics students at the University of Toronto as part of the "Victoria College Peer Tutors" organization.

Peer Mentor, *Vic One Program* **Sep 2018 – Apr 2019**

Peer mentor for the Arthur Schawlow Stream (physical sciences) of the Vic One program at Victoria College. Attended weekly post-lecture receptions to advise students and responded to email questions about the program.

Audience Coordinator, *Canadian Broadcasting Corporation (CBC)* **2018**

Directed audience members during live tapings of CBC's *The Rick Mercer Report*.

Freelance / Independent Filmmaker **2016 – Current**

Clients include the Victoria College Registrar's Office and a freelance agency called "The Halifax Collective". Some independently produced films shown at Atlantic Youth Film Festival.

Organizer / Instructor, *Short Cuts Film Camp* **2015 – 2018**

I helped organize and run a day camp to teach students in Halifax aged 8-14 the techniques of film writing, production, and editing. Designed several exercises and activities.

Publications and Presentations

Director / Producer, *Indefensible* **Apr 2017 – Oct 2017**

Directed and produced *Indefensible: The Troubling Legacy of Edward Cornwallis*, a documentary funded by the Northrop Frye Centre at Victoria College in the University of Toronto. The film was screened to a crowded house at Victoria College on 24 November 2017. Working on this project gave me some first-hand nonfiction filmmaking experience that I have, more recently, applied to science communication films and videos.

- https://www.youtube.com/watch?v=5czbjc4iVMA

Farrell, J.H.*, Saunders, J., Panas, M., Knee-Walden, W., Cassidy, N., Cho, Y., Fogal, A., Hon, J., Knuckey, E., Fogal, P., Jaeger, W., Murphy, J., & Walker, K. A.. (2) 2019 *Developing Components for a Balloon Borne Spectrometer*. University of Toronto Physics Department Undergraduate Research Fair. (NSERC USRA)

Saunders, J.*, Panas, M., Knee-Walden, W., Cassidy, N., Cho, Y., **Farrell, J.H.**, Fogal, A., Hon, J., Knuckey, E., Fogal, P., Jaeger, W., Murphy, J., & Walker, K. A.. (2020) *Canadian Atmospheric Laser Absorption Spectrometer Experiment Test-bed (CALASET): Field Measurements of CO_2 and N_2O with a Stratospheric Balloon-Borne Laser Spectrometer*. American Geophysical Union Fall Meeting. (NSERC USRA)

Saunders, J.*, Panas, M., Knee-Walden, W., Cassidy, N., Cho, Y., **Farrell, J.H.**, … , Kaley Walker. *Canadian Atmospheric Laser Absorption Spectrometer Experiment Test-bed: Data Processing and Modelling of Absorption by Trace Gases.* Canadian Chemistry Conference and Exhibition (CCCE). (NSERC USRA)

Saunders, J.*, Panas, M., Knee-Walden, W., Cassidy, N., Cho, Y., **Farrell, J.H.**,, … , Kaley Walker. *Canadian Atmospheric Laser Absorption Spectrometer Experiment Test-bed (CALASET): The Development and Testing of a Balloon-Borne Laser Spectrometer for Field Measurements of Gases in the Atmosphere.* CCCE (NSERC USRA)

Contributor, *Eau Canada: Toward a National Water Strategy* **2019**
A report, directly to the Prime Minister of Canada, from the Prime Minister's Youth Council directed by François Lépine-Cossette. I contributed a section summarizing the importance of water quality research.

Extracurricular

Founder, *Victoria College Jazz Ensemble* **2018-2019**
I founded an amateur Jazz group as an outlet for students, like me, who wanted to keep up their musical hobby but could not commit (for reasons of time, or, in my case, skill level) to the larger groups at the University of Toronto. We have seen a changing, interdisciplinary roster of students ranging from physics, philosophy, genetics, kinesiology, and music. We played background music for various on-campus charity groups during the 2018-2019 school year.

Founding Member, *University of Toronto Canadian Politics Society* **2018-2019**
I participated in three years of a *First Minister's Conference Simulation*, a version of model UN focusing on Canadian politics. The club has been a great way to keep up with politics news and develop public speaking skills. The club also runs lectures, panels, screenings, and more events.

Debating **2013 – Current**
Debating is a terrific activity for keeping up communication and public speaking skills. I was selected for Canada's national debate team in 2017, and I competed with the team at the 2017 Pan-American Championships in Buenos Aires, Argentina. I also won the 2017 Canadian National Debating Championship. As part of U of T's debate team called "Hart House", I have competed in several Canadian tournaments, including making it to the finals of the *Chancellor's Cup* hosted at Queen's University.

Skills

Scientific / Technical
Familiar with techniques useful for science research including data analysis and visualization in Python and R, general programming in Python, Numerical Solutions to PDEs in Python and *Dedalus*, symbolic computing with *Mathematica*, image processing, design work in *AutoCAD*, machining, and some electronics and systems programming.

Public Speaking / Communication
Confident speaking persuasively in front of large groups thanks to a long debating career.

Film Production
Can produce and edit professional quality films in a variety of styles. Familiar with the equipment and software used for production including Adobe Premiere Pro.