

Education

- 2019–2024 **PhD. Biological Physics**, *University of Toronto*, *Advised by Andreas Hilfinger.*
Thesis title: Utilizing stochastic fluctuations to decipher biochemical reaction networks in cells
- 2018–2019 **MSc. Biological Physics**, *University of Toronto*
Thesis title: Characteristic variability of co-regulated genes
- 2012–2017 **BSc. Honours Physics and Mathematics**, *McGill University*

Positions

- March 1 **Postdoctoral Researcher**, *van Oudenaarden group at the Hubrecht Institute*
- 2024–present Developing mathematical and computational frameworks to extract quantitative biological information from single-cell and single-molecule sequencing data to uncover hidden cellular states and investigate the organization and dynamics of translation, ribosomes, and chromatin.
- 2018–2023 **PhD Candidate**, *Hilfinger Group at the University of Toronto*
Developed approaches to exploit naturally occurring fluctuations in cells to probe cellular systems. This entails developing *general* mathematical theories of stochastic processes, computational models with simulations, and experiments with techniques from molecular biology.
- 2021 – 2023 **Visiting Researcher**, *Centre for Applied Synthetic Biology at Concordia University*
Engineered and cloned many synthetic gene regulatory circuits in *E. coli*. Used microfluidic devices ([mother machine](#)) with time-lapse fluorescence microscopy to follow single cells. Adapted a machine learning image processing [pipeline](#) in order to segment cells in the mother machine using brightfield images. Developed a novel analysis pipeline for quantitative variability measurements from mother machine datasets.
- 2018–present **Teaching Assistant**, *University of Toronto*
For the following courses: Classical Mechanics, Electricity and Magnetism, Introduction to Biological Physics, and first year physics for engineers.
- 2018–2019 **Departmental Steward**, *Departmental Steward CUPE Local 3902*
Represented contract workers from the Department of Physics (i.e. teaching assistants, postdocs) at monthly steward council meetings, and kept the department up to date on the state of collective bargaining. This year was the start of the COVID19 pandemic: I hosted meetings with contract workers of the department and shared their concerns in meetings with the chairs of the department.
- 2018 **Research Fellow**, *University of Toronto Mississauga*
Pre-doctoral research fellowship in theoretical biophysics. Explored how stochastic fluctuations are propagated in Feed-Forward motifs in biochemical reaction networks.
- 2016 **Research Assistant**, *Kushner group at the University of Toronto*
Analyzed data generated from the Community Earth System Model (CESM) to explore how planetary waves and weather systems are affected by sea ice loss in the coupled climate system.
- 2015 **Summer Research Intern**, *National Research Council Canada*
Through the NRC summer employment program, I worked under the supervision of Dr. Khabat Heshami in the Quantum Photonics group. Theoretical development of novel multi-mode quantum memory scheme.
- 2015 **Research Assistant**, *McGill Quantum Defects Lab*
Development of compact diffraction laser wavemeter with sub-picometer accuracy and picowatt sensitivity. Developed a real-time interface for the wavemeter using python.
- 2015 – 2016 **Student Assistant**, *McGill University department of Mathematics and Statistics*
Graded assignments for courses: Introduction to Partial Differential Equations, Honours Advanced Calculus, and Honours Complex Variables.

Scholarly Works

Preprints

1. **Joly-Smith E***, VanInsberghe M*, Sarieva K*, Marinelli E*, van Es RM, Sobrevals Alcaraz P, Vos HR, Andersson-Rolf A, Clevers H, and van Oudenaarden A. Global translation states revealed at single-cell resolution, *bioRxiv* (2026)

*Equal contribution

Publications

2. **Joly-Smith E**, Talpur MM, Allard P, Papazotos F, Potvin-Trottier L, and Hilfinger A. Exploiting fluctuations in gene expression to detect causal interactions between genes, *eLife* (2025)
3. Jager K, Orozco-Hidalgo MT, Springstein BL, **Joly-Smith E**, Papazotos F, McDonough EK, Fleming E, McGallum G, Yuan AH, Hilfinger A, Hochschild A, and Potvin-Trottier L. Measuring prion propagation in single bacteria elucidates a mechanism of loss, *Proc. Natl. Acad. Sci. USA* 120 (39) e2221539120 (2023)
4. **Joly-Smith E**, Wang ZJ, and Hilfinger A. Inferring gene regulation dynamics from static snapshots of gene expression variability, *Phys. Rev. E* 104, 044406 (2021)

Presentations

- 2026 **Single Cell Genomics 2026**, SCISSOR: Single-Cell Inference of Structural States Of Ribosomes. *Poster presentation.*
- 2025 **Advances in Single-Cell Technologies**, Global translation states revealed at single-cell resolution. *Poster presentation.*
- 2025 **Single Cell Genomics 2025**, Quantifying ribosomal states in single cells with scRibo-seq. *Poster presentation.*
- 2025 **EMBL Conference – The Expanding World of RBPs: From Posttranscriptional Control to Riboregulation**, Quantifying ribosomal states in single cells with scRibo-seq. *Poster presentation.*
- 2024 **University of Manchester Developmental Biology Seminar**, Exploiting fluctuation in gene expression to detect causal interactions between genes. *Invited talk.*
- 2023 **APS March Meeting**, Exploiting stochastic fluctuations in gene expression to infer interactions between genes. *Contributed talk.*
- 2022 **Biophysique Québec 2nd Annual Symposium**, Exploiting stochastic fluctuations in gene expression to infer interactions between genes. *Contributed talk.*
- 2022 **Canadian Association of Physicists Congress**, Inferring causality in gene regulation from static snapshots of gene expression variability. *Contributed talk.*
- 2022 **Annual Meeting of the Biophysical Society of Canada**, Inferring gene regulation dynamics from static snapshots of gene expression reporters. *Contributed poster presentation and talk at student symposium.*
- 2022 **Annual Conference on Quantitative Approaches in Biology at Northwestern University**, Fluorescence maturation time: a nuisance or a feature? *Contributed lightning talk and poster presentation.*
- 2022 **APS March Meeting**, Inferring gene regulation from static snapshots of gene expression variability. *Contributed talk.*
- 2022 **Winter q-bio meeting**, Inferring gene regulation from static snapshots of gene expression variability. *Contributed talk.*
- 2021 **BiophysiQ Québec Molecular and Cellular Biophysics Virtual Mini-Symposium**, Fluorescent maturation time: is it a bug or a feature? *Contributed talk.*

- 2021 **BactoMontréal meeting**, Inferring gene regulation dynamics from static snapshots of gene expression variability. *Poster presentation.*
- 2021 **Presented for the Nancy Papalopulu Lab and the Cerys Manning Lab at the University of Manchester**, Inferring gene regulation dynamics from static snapshots of gene expression reporters. *Invited talk.*
- 2021 **EMBO workshop on Physics of Living Systems: From Molecules to Tissues**, Inferring gene regulation dynamics from static snapshots of gene expression reporters. *Contributed talk.*
- 2021 **Annual Meeting of the Biophysical Society of Canada**, Inferring gene regulation dynamics from static snapshots of gene expression variability. *Poster presentation.*
- 2021 **RIP Seminar in the CPS department at University of Toronto Mississauga**, Inferring gene regulation dynamics from static snapshots of gene expression reporters. *Invited talk.*
- 2020 **Canadian Association of Physicists Virtual Congress**, Characteristic variability of co-regulated genes. *Contributed talk.*
- 2019 **Annual Meeting of the Biophysical Society of Canada**, Characteristic variability of co-regulated genes. *Poster presentation.*

Computational Skills

Programming and scientific computing: Python, C++, MATLAB, Mathematica, Linux, LaTeX.

Single-cell genomics: Processing and analysis of single-cell sequencing data, including read alignment, quality control, feature quantification, dimensionality reduction, clustering, differential analysis, and integration of multimodal genomic measurements.

Long-read genomics: Analysis of Oxford Nanopore sequencing data, including long-read alignment, per-read DNA modification analysis, and quantitative analysis of single-molecule chromatin organization.

Quantitative modelling and inference: Development and application of mathematical, statistical, and machine-learning approaches to infer biological states and parameters from high-dimensional genomic data.

High-performance computing: Development and execution of large-scale genomic analysis pipelines on HPC clusters, including parallel computing and job scheduling.

Laboratory Skills

Molecular biology: Primer design, PCR, Gibson Assembly, bacterial transformation by heat shock and electroporation, plasmid construction, and bacterial culture.

Microfluidics and microscopy: Fabrication of PDMS microfluidic devices and long-term time-lapse fluorescence microscopy of single cells.

General laboratory techniques: Preparation of media and agar plates, sterile technique, and standard microbiology laboratory practices.

Awards & Grants

- 2023 **American Physical Society DBIO Travel Award.** An award intended to support travel to the APS March Meeting, see [here](#) for details.
- 2022 **CPS Graduate spotlight.** Featured on the University of Toronto department of Chemical and Physical Sciences website. See [here](#) for the interview.

- 2022 **Best poster award.** At the 7th Annual Biophysical Society of Canada Meeting. See [here](#) for the list of poster awardees.
- 2022 **Travel Grant from the University of Toronto Mississauga.**
- 2022 **Conference Grant.** From the University of Toronto School of Graduate Studies.
- 2022 **Conference Travel Grant.** From the department of Physics at the University of Toronto.
- 2021 **Travel Grant.** From the department of Chemical and Physical Sciences at the University of Toronto Mississauga.
- 2021 **CPS Graduate Research Visit Program.** A competitive program from the department of Chemical and Physical Sciences at the University of Toronto Mississauga.
- 2018 **Pre-doctoral Summer Research Fellowship.** Research stipend for the months leading up to graduate studies in the Department of Physics at the University of Toronto.
- 2015 **Richard and Mary Shaw Scholarship,** "Awarded to outstanding undergraduate students who have completed at least one year of a B.Sc. program on the basis of high academic standing".
- 2015 **Deans Honour List,** Awarded to top 10% of all undergraduate students based on cumulative GPA for two consecutive semesters.

Other Experience

- 2021 **Theoretical Biophysics Blog.** Co-creator of the following [blog](#). Contributed this [blog post](#).
- 2022 **Reviewer.** Peer review (with PhD advisor) of manuscripts submitted for publication at PLOS Computational Biology and PLOS Biology.
- 2022-2023 **Mentored gifted undergraduate student.** Research project involving simulations of biochemical reaction networks in growing and dividing cells. Work submitted for publication.
- Fluent in French and English.