

# Matthew Leighton

## Curriculum Vitae

### Education

- 2020–Present **Ph.D. in Physics**, *Simon Fraser University*, Burnaby, Canada
- 2016–2020 **B.Sc. Honours in Physics and Mathematics**, *Dalhousie University*, Halifax, Canada
- **Honours Thesis:** *Modelling the Formation of Cross-Linked Collagen Fibrils*, supervised by Prof. Andrew Rutenberg.
  - Middle-Distance Runner with the Varsity Track Team (2016-2018)
  - Choral Scholar with the University of King's College Chapel Choir (2016-2020)
- 2019 **Exchange Program, Mathematics, Statistics, and Finance**, *Chalmers University of Technology*, Göteborg, Sweden

### Experience

#### Research

- 2020–Present **Graduate Researcher**, *Sivak Group*, Simon Fraser University
- Working under the supervision of professor David Sivak, analyzing biological molecular machines using the theory of nonequilibrium statistical mechanics. Projects include exploring performance trade-offs in collective motor-driven transport, and investigating internal energy and information transduction in multi-component stochastic systems.
- 2018–2020 **Undergraduate Researcher**, *Rutenberg Group*, Dalhousie University
- Worked with professor Andrew Rutenberg on various research projects in theoretical biophysics using computational and mathematical methods. Projects included modelling stochastic effects in the process of host cell invasion by *S. Typhimurium* bacteria, developing a theoretical model for the thermodynamics of *in vivo* Collagen fibril growth, and studying the mechanics of double-twist liquid crystal elastomer systems under deformation.

#### Teaching and Outreach

- Fall 2022 **Teaching Assistant**, *PHYS 801: Grad Student Seminar*, Simon Fraser University
- Responsibilities included running peer review sessions and providing feedback on graduate student research presentations.
- Spring 2022 **Organizer**, *Frontiers in Biophysics 2022*, Vancouver, Canada
- Member of the organizing committee for Frontiers in Biophysics 2022, a conference run by and for graduate students in biophysics and related areas in the Pacific Northwest.
  - Conference was held in person in downtown Vancouver, with 85 attendees.
- Fall 2021 **Teaching Assistant**, *PHYS 132: Physics Laboratory I*, Simon Fraser University
- Responsibilities included helping to run the lab sessions and grading lab reports.
  - Received the Fall 2021 Physics TA Teaching Award for outstanding teaching efforts.
- Fall 2021 **Teaching Assistant**, *PHYS 344: Thermal Physics*, Simon Fraser University
- Responsibilities included leading tutorials and grading assignments.

Summer 2018,2019 **Science Outreach**, *Dalhousie University*, Halifax, Canada  
○ Led interactive physics experiment demonstrations as part of the Discovery Days outreach program for elementary and high school students.

### Other

2017–2018 **Business Analyst**, *Inetco Systems LTD*, Vancouver, Canada  
○ Led the planning process for the release of a major new cloud SaaS product; wrote and presented the business plan at a quarterly board meeting for board approval.  
○ Performed financial modelling and analysis, managed marketing campaigns, and communicated requirements to the software team.  
○ Started as a summer co-op student, hired to stay on as a part-time consultant over the next year.

Summer 2015,2016 **Bicycle Instructor**, *Pedalheads*, Vancouver, Canada  
○ Taught children aged 4-13 beginner to advanced biking skills.

### Volunteer Coach

- Head coach for a Vancouver Hawks youth field hockey team (Spring 2015/16/17)
- Assistant coach for Kitsilano Secondary School's junior ice hockey team (2015-2016)

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## Publications and Manuscripts

peer reviewed: 5, first author: 5, h-index: 3, total citations: 20 **[Google Scholar]**

5. **M.P. Leighton**, D.A. Sivak, "Dynamic and Thermodynamic Bounds for Collective Motor-Driven Transport", *Physical Review Letters*, **129**:118102, 2022.
4. **M.P. Leighton**, D.A. Sivak, "Performance Scaling and Trade-offs in Collective Motor-Driven Transport", *New Journal of Physics*, **24**:013009, 2022.
3. **M.P. Leighton**, A.D. Rutenberg, and L. Kreplak, "D-Band Strain Underestimates Fibril Strain for Twisted Collagen Fibrils at Low Strains", *Journal of the Mechanical Behavior of Biomedical Materials*, **124**:104854, 2021.
2. **M.P. Leighton**, L. Kreplak, and A.D. Rutenberg, "Chiral Phase-Coexistence in Compressed Double-Twist Elastomers", *Soft Matter*, **17**:5018, 2021.
1. **M.P. Leighton**, L. Kreplak, and A.D. Rutenberg, "Nonequilibrium Growth and Twist of Cross-Linked Collagen Fibrils", *Soft Matter*, **17**:1415, 2021.

### Under Review

**M.P. Leighton**, D.A. Sivak, "Inferring Subsystem Efficiencies in Bipartite Molecular Machines", *arXiv:2209.12084*, 2022.

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## Selected Talks and Posters

### Talks

March 2023 **Inferring Subsystem Efficiencies in Bipartite Molecular Machines**, *American Physical Society March Meeting*

November 2022 **A Guided Tour of the Nanoscale Machines that keep Us Alive**, *Invited Guest Lecture for SFU PHYS344*

November 2022 **Dynamic and Thermodynamic Bounds on the Performance of Multi-Component Molecular Machines**, *Physics of Life: Students and Postdocs Edition Symposium at the Center for the Physics of Biological Function*

June 2022 **Dynamic and Thermodynamic Bounds for Collective Motor-Driven Transport**, *Frontiers in Biophysics 2022*

- May 2022 **Dynamic and Thermodynamic Bounds for Collective Motor-Driven Transport**, *Workshop on Stochastic Thermodynamics III*
- June 2021 **Scaling Laws and Performance Trade-offs for Collective Transport**, *Frontiers in Biophysics 2021*
- November 2020 **Structural Phase Transitions in Double-Twist Elastomers**, *Collagen Cafe II*
- July 2020 **Nonequilibrium Growth of Cross-Linked Collagen Fibrils**, *Collagen Cafe I*
- June 2020 **Elastomeric Properties of Double-Twist Collagen Fibrils**, *Soft Matter Canada Symposium*
- March 2020 **Modelling Cross-Linking in Collagen Fibrils**, *APS March Meeting (via DSOF Virtual Meeting)*
- January 2020 **Coarse-Grained Structure of Double-Twist Liquid Crystals**, *Atlantic Undergraduate Physics Conference*  
Selected for award – top theory talk.
- November 2019 **Modelling Cross-Linking in Collagen Fibrils**, *Canadian Undergraduate Physics Conference*
- August 2018 **Stochastic Modelling of Cellular *Salmonella* Infection**, *Dalhousie Bioblast Symposium*
- Posters**
- January 2023 **Dynamic and Thermodynamic Performance Bounds for Multi-Component Molecular Machines**, *Gordon Research Conference on Stochastic Physics in Biology*
- January 2023 **Dynamic and Thermodynamic Performance Bounds for Multi-Component Molecular Machines**, *Berkeley Stat Mech Meeting*
- April 2022 **Dynamic and Thermodynamic Bounds for Collective Motor-Driven Transport**, *SFU Physics Department Poster Session*
- May 2021 **Scaling Laws and Performance Trade-offs for Collective Transport**, *Biophysical Society of Canada Annual Meeting*  
Selected for poster award.
- February 2021 **Performance Trade-offs in Cooperative Intracellular Transport**, *SFU Physics Department Poster Session*

## Selected Awards

- 2022 **Travel and Research Award**, *Simon Fraser University*
- 2022 **Hargreaves Scholarship**, *Simon Fraser University*
- 2022 **Howard Malm Graduate Scholarship**, *Simon Fraser University*
- 2022-2025 **NSERC CGS-D**, *Simon Fraser University*
- 2021 **TA Teaching Award (PHYS 132)**, *SFU Physics*
- 2021 **Kirk H. Michaelian Graduate Scholarship**, *Simon Fraser University*
- 2021 **Poster Award**, *Canadian Biophysical Society*
- 2020-2021 **NSERC CGS-M**, *Simon Fraser University*
- 2020-2021 **BC Graduate Scholarship**, *Simon Fraser University*
- 2020 **NSERC USRA**, *Dalhousie University*
- 2020 **Top Theory Talk**, *Atlantic Undergraduate Physics Conference*

2018 **NSERC USRA**, *Dalhousie University*  
2016–2020 **Chancellor's Scholarship**, *Dalhousie University*  
2016–2020 **Helen Roby Choral Scholarship**, *University of King's College*  
2017–2018 **USports Academic All-Canadian**, *Dalhousie University*  
2016–2017 **USports Academic All-Canadian**, *Dalhousie University*  
2016–2020 **Dean's List**, *Dalhousie University*

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## Languages and Technical Skills

- **Languages:** English (Native), French (Fluent)
- Extensive experience with scientific programming and numerical optimization in Python
- Experienced in the use of Compute Canada computing clusters
- Working knowledge of MATLAB, Mathematica, and HTML

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## Miscellaneous Qualifications

**Grade 8 Piano, Advanced Music Theory**, *Royal Conservatory of Music*  
**DELF B2**, *French language Certification*  
**CSIA Level 1 Ski Instructor**, *Canadian Ski Instructors Alliance*  
**AST 1 Avalanche Skills**, *Avalanche Canada*  
**Emergency First Aid, CPR-C, and Bronze Cross**, *Canadian Lifesaving Society*  
**Cansail 4**, *Sail Canada*