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 invation 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.

Vancouver – BC – Canada
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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)

Publications and Manuscripts

M.P. Leighton, D.A. Sivak, "Dynamic and Thermodynamic Bounds for Collective Motor-Driven Transport", *Physical Review Letters,* **129**:118102, 2022.

M.P. Leighton, D.A. Sivak, "Performance Scaling and Trade-offs in Collective Motor-Driven Transport", *New Journal of Physics*, **24**:013009, 2022.

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.

M.P. Leighton, L. Kreplak, and A.D. Rutenberg, "Chiral Phase-Coexistence in Compressed Double-Twist Elastomers", *Soft Matter*, **17**:5018, 2021.

M.P. Leighton, L. Kreplak, and A.D. Rutenberg, "Nonequilibrium Growth and Twist of Cross-Linked Collagen Fibrils", *Soft Matter*, **17**:1415, 2021.

Submitted

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

Selected Talks and Posters

Talks

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 DSOFT 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

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 **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*

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

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*