Keck Science Bldg.
Stanford, CA
94305, USA
jlucero@stanford.edu
jnelucero.com
JosephNLucero
jnlucero96
jnlucero96

# Joseph N. E. Lucero

## *Curriculum Vitae*

*"No one undertakes research with the intention of winning a prize. It is the joy of discovering something no one knew before."*

*- Stephen Hawking*

## Research Statement

*My research interests center on the application of computational methods to simulate the dynamics of mesoscale stochastic systems. I am particularly interested in using these simulations to guide the development of theoretical models that elucidate both, the far-from-equilibrium response of biophysical systems, as well as the optimal design principles that allow for these systems to operate in an efficient way. I am also interested in the development of such optimal principles for computation (biological or artificial) that take into account the costs ascribed by information thermodynamics.*

## Education

**Ph.D. in Chemistry**, **2021 – Present**
*Stanford University*,
Stanford, California, USA.

**M.Sc. in Physics**, **2019 – 2021**
*Simon Fraser University*,
Burnaby, British Columbia, Canada,
*GPA – 4.15/4.33.*
Thesis: "Stochastic Thermodynamics of Gaussian Information Engines"

**B.Sc. (Hons. with Distinction) in Physics – Biological Physics**, **2014 – 2019**
*Simon Fraser University*,
Burnaby, British Columbia, Canada,
*CGPA – 3.93/4.33; UDGPA – 4.00/4.33.*
Thesis: "Energy and Information Transduction In Strongly-Coupled Systems"

## Peer-Reviewed Publications

**Joseph N. E. Lucero**, Jannik Ehrich, John Bechhoefer, and David A. Sivak. "Maximal fluctuation exploitation in Gaussian information engines." *Phys. Rev. E*, **104**, 044122. (2021).

Tushar K. Saha, **Joseph N. E. Lucero**, Jannik Ehrich, David A. Sivak, and John Bechhoefer. "Maximizing power and velocity of an information ratchet." *Proc. Natl. Acad. Sci. USA*, **118**(20), e2023356118. (2021). SFU News Press Release. PNAS Commentary.

Emma Lathouwers, **Joseph N. E. Lucero**, and David A. Sivak. "Nonequilibrium response of stochastic strongly-coupled rotary motors." *J. Phys. Chem. Lett.*, **11**, 5273-5378. (2020). SFU News Press Release.

**Joseph N. E. Lucero**, Aliakbar Mehdizadeh, and David A. Sivak. "Optimal control of rotary motors." *Phys. Rev. E.*, **99**, 012119. (2019).

## Manuscripts

Tushar K. Saha, Jannik Ehrich, **Joseph N. E. Lucero**, David A. Sivak, and John Bechhoefer. "Inference-driven Gaussian information engines." (*In prep.*)

**Joseph N. E. Lucero**, Chun-Yen Chen, Audrey Huang, Benjamin Sheldan, David A. Sivak, and Matt Thomson. "Physically Optimizing Inference." (*In prep.*)

## Current Active Projects

**Optimal Control of Pattern-Forming Systems**
(Feb 2022 - present)
Supervised by: Dr. **Grant M. Rotskoff**

**Physically Optimizing Inference**
(Feb 2020 - present)
Supervised by: Dr. **David A. Sivak**

**Optimal Fluctuation Exploitation in Information Engines**
with **Jannik Ehrich** and **Tushar K. Saha**
(May 2019 - present)
Supervised by: Dr. **David A. Sivak** and Dr. **John Bechhoefer**

## Technical Skills

- Extensive experience in:
  - Scientific Python, Cython, & FORTRAN programming
  - Data analysis and presentation
  - Utilization of ComputeCanada computer clusters
  - Handling and processing large data outputs from numerical simulations
  - OpenMP parallelization
- Experienced in shell (zsh and bash) scripting
- Proficient in C/C++, MATLAB, and Mathematica programming

## PG Awards & Scholarships

**NSERC PGS D**
(2021 – 2024)
Value: $63,000 CAD/3 years
Location of tenure: Stanford University

**NSERC CGS M in Physics**
(2020 – 2021)
Value: $17,500 CAD
Location of tenure: Simon Fraser University

**BC Graduate Scholarship**
(2019 – 2020)
Value: $15,000 CAD
Location of tenure: Simon Fraser University

## UG Research Experience

**Undergraduate Research Assistant**
(Spring 2015 - Summer 2019)
Location: Simon Fraser University – Dept. of Physics
Topic: Nonequilibrium Response of Rotary Mechanochemical Machines

**Undergraduate Research Assistant**
(Summer 2018)
Location: Carleton University – Dept. of Physics
Topic: Monte Carlo Simulations of GYN-Applicator Radiation Transport & Deposition

**Undergraduate Research Assistant**
(Summer 2017)
Location: Simon Fraser University – Dept. of Computer Science
Topic: Inferring Maximum Likelihood Phylogenies from MIRU-VNTR data

## UG Awards & Scholarships

**SFU Physics Charter Faculty Prize**
(Summer 2019)

**NSERC USRA in Computational Biophysics**
(Summer 2019)
Value: $4,500 CAD
PI: Dr. David A. Sivak

**NSERC USRA in Computational Medical Physics**
(Summer 2018)
Value: $5,315 CAD
PI: Dr. Rowan M. Thomson

**SFU Undergraduate Open Scholarship**
(Summer 2016; Spring 2016, 2017, 2018; Fall 2015, 2016, 2017, 2018)

**NSERC USRA in Computational Biology**
(Summer 2017)
Value: $4,500 CAD
PI: Dr. Leonid Chindelevitch

**SFU President's Honor Roll**
(Spring 2017, Spring 2019)

**SFU Dean's Honour Roll**
(Summer 2015; Fall 2015; Spring 2016, 2017, 2019)

**SFU Academic Excellence Entrance Scholarship**
(Fall 2014)

## Offered Awards

**FAST Doctoral Fellowship in Chemistry**
(2021 - 2025)
Value: $96,000 CAD/4 years
Location of tenure: University of Toronto

**QEII Graduate Scholarship in Science and Technology (Physics)**
(2021 - 2022)
Value: $15,000 CAD
Location of tenure: York University

**Chair's Fellowship in Chemistry**
(2021 - 2022)
Value: $7,500 USD
Location of tenure: Northwestern University

**NSERC CGS M in Chemistry**
(2019 - 2020)
Value: $17,500 CAD
Location of tenure: Western University

## Presentations

**Maximizing fluctuation exploitation in a simple information ratchet**
(March 2021)
American Physical Society March Meeting – Virtual

**Optimal Control of Rotary Motors**
(August 2018)
Canadian Undergraduate Physics Conference – University of Alberta

## Posters

**Performance Limits of a Gaussian Information Engine**
(February 2021)
Annual Physics Department Poster Competition – Simon Fraser University

**Thermodynamics of Information-Driven Feedback**
(February 2020)
Annual Physics Department Poster Competition – Simon Fraser University

**Optimal Fluctuation Exploitation in Information Ratchets**
(August 2019)
Physics Summer Student Poster Competition – Simon Fraser University

**Modelling of GYN-applicators in egs_brachy**
(August 2018)
Canadian Undergraduate Physics Conference – University of Alberta

**Inferring Maximum Likelihood Phylogenies from MIRU-VNTR Data**
(*Top Undergraduate Poster Prize*)
(August 2017)
Symposium on Mathematics and Computation – Simon Fraser University

**Optimal Driving of a Nonequilibrium Mechanochemical Motor**
(*Top Poster Prize*)
(August 2016)
Physics Summer Student Research Day – Simon Fraser University

**Optimal Driving of Rotatory Mechanochemical Motors**
(April 2016)
Annual Physics Department Poster Competition – Simon Fraser University

## Conferences Attended

**Frontiers in Biophysics**
(June 2016, June 2017, June 2019, June 2021)
Simon Fraser University/University of British Columbia

**Workshop on Stochastic Thermodynamics II**
(May 2021)
Santa Fe Institute (Virtual)

**Canadian Association of Physicists Congress**
(June 2019)
Simon Fraser University

**Undergraduate Research Opportunities Conference**
(September 2017)
University of Waterloo

## Class Projects

**(Numerical PDEs) Pseudospectral Solutions to 2D Advection-Diffusion Equations**
(Sept 2019 - Dec 2019)
Supervised by: Dr. **Ralf Wittenberg**

**(Control Theory) Robust Control and Emergent Oscillations**
(Jan 2019 - Apr 2019)
Instructor: Dr. **John Bechhoefer**

**(Machine Learning) Making Trustworthy Classifiers**
(Oct 2018 - Dec 2018)
Instructor: Dr. **Greg Mori**

**(Biophysics Laboratory) *Saccharomyces Cerevisiae* and Statistical Indicators of Population Health**
(Oct 2017 - Dec 2017)
Supervised by: Dr. **Nancy R. Forde** and Dr. **David Lee**

**(Computational Biology) Nuclear and Mitochondrial Genes Shed Light on the Evolution of Salmon**
with **Aniket Mane**, **Alice Yue**, and **Zahra Zohrevand**
(Nov 2016 - Dec 2016)
Supervised by: Dr. **Leonid Chindelevitch** and Dr. **Bernard Crespi**

## PG Courses

- Nonequilibrium Statistical Physics & Stochastic Processes
- Equilibrium Statistical Mechanics
- Introduction to Biophysics
- Numerical PDEs
- Physical Chemistry
- Machine Learning

## UG Courses

- Control Theory
- Computational Physics
- Mathematical Physics
- Classical Mechanics
- Quantum Mechanics
- Intro. to Particle Physics
- Electromagnetic Theory
- Computational Biology
- Molecular Biology & Physiology
- Protein Structure & Function

## Mentoring Experience

Brad Friesen
(Sept 2019 - April 2020)
"Optimal Driving of a Semi-Classical Electron Junction"

Shakul Pathak
(May 2019 - July 2019)
"Optimal Driving of a Flashing Rotary Brownian Ratchet"
Now: ChemE. PhD student, MIT

Kristopher Samant
(May 2018 - Aug 2018)
"An Investigation Into the Properties and Modelling of the CivaDot in egs_brachy"
Now: Physics B.Sc. student, Carleton University

## Teaching Experience

**Graduate Student Teaching Assistant**
(Sept 2021 - present)
Description: Stanford University: Physical Chemistry Series (CHEM 171, 173, & 175).
10 upper-class Chemistry majors

**Simon Fraser University Peer Educator**
(Jan 2017 - Dec 2017)
Description: Served as a volunteer peer educator for first year Physics courses for the Life Sciences, holding open lab hours, helping students in the Life Sciences that are confused with concepts taught in class. Coordinated with the professors teaching these classes to ensure cohesiveness in explanations between lectures and open labs.

## Volunteer Experience

**Secretary**
(Sept 2020 - Sept 2021)
Organization: Simon Fraser University - Physics Graduate Caucus
Description: Responsible for attending all Physics Graduate Caucus meetings and taking minutes. Elected position.

**Alternative Representative to the Graduate Student Society**
(Sept 2019 - Sept 2021)
Organization: Simon Fraser University - Physics Graduate Caucus
Description: Responsible for attending Graduate Student Society meetings in the event of the Executive representative is unable to do so. Elected position.

**Science Rendezvous Volunteer**
(May 2016, May 2017)
Organization: Simon Fraser University
Description: Day volunteer, ran physics demonstrations illustrating the concepts of electrostatics, electromagnetism, and optics.

## References


**David A. Sivak**
Department of Physics
Simon Fraser University
8888 University Dr, Burnaby
BC V5A 1S6, Canada

**John Bechhoefer**
Department of Physics
Simon Fraser University
8888 University Dr, Burnaby
BC V5A 1S6, Canada

**Rowan M. Thomson**
Department of Physics
Carleton University
1125 Colonel By Dr, Ottawa
ON, Canada K1S 5B6


*Last updated: October 29, 2021*