

CURRICULUM VITAE

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Education

University of Ottawa 2010-2014

Ph.D. Physics (Biological Physics, Supervisor: Prof. Mads Kærn)

- Thesis: Computational Investigations of Noise-Mediated Cell Population Dynamics (nominated for a thesis prize)

University of Ottawa 2008-2010

M.Sc. Physics (Biological Physics, Supervisor: Prof. Mads Kærn)

- Thesis: An Algorithm for the Stochastic Simulation of Gene Expression and Cell Population Dynamics

University of Calgary 2002-2008

B.Sc. Physics with Applied Mathematics Minor and

B.Sc. Biological Sciences

- Supervisor for honors stream projects: Prof. Stuart A. Kauffman, M.D.

Publications

Under Review

1. "Phenotypic heterogeneity facilitates survival while hindering the evolution of drug resistance". Joshua Guthrie, Daniel A. Charlebois. Preprint posted on the *bioRxiv*, doi: <https://doi.org/10.1101/2021.09.20.460867>.

Accepted/Published

26. "Lattice-based Monte Carlo simulation of the effects of nutrient concentration and magnetic field exposure on yeast colony growth and morphology". Rebekah Hall and Daniel A. Charlebois. (2021) *In Silico Biology*, accepted.
25. "Synthetic Gene Circuits for Antimicrobial Resistance and Cancer Research". *Kevin S. Farquhar, *Michael Tyler Guinn, Gábor Balázsi and **Daniel A. Charlebois**. (2021) *Synthetic Genomics – From Natural to Synthetic Genomes*. Michael Fernandez-Nino (Editor), doi: 10.5772/intechopen.99329, ISBN 978-1-83969-639-8.
24. "Does Transcriptional Heterogeneity Facilitate the Development of Genetic Drug Resistance?", Kevin S. Farquhar, Samira Rasouli Koochi, **Daniel A. Charlebois**. (2021) *BioEssays*, 43: 2100043.
23. "Advancing Antimicrobial Resistance Through Quantitative Modeling and Synthetic Biology", Kevin S. Farquhar, Harold Flohr, **Daniel A. Charlebois**. (2020) *Frontiers in Bioengineering and Biotechnology*, 8: 583415.

22. Rebekah Hall, **Daniel A. Charlebois**, Book review on “A World Beyond Physics: The Emergence and Evolution of Life” by Stuart A. Kauffman. (2020) *The Quarterly Review of Biology*, 95: 133.
21. “Engineered Gene Networks Enable Non-Genetic Drug Resistance and Enhanced Cellular Robustness”, Brendan Camellato, Ian J. Roney, Afnan Aziz, **Daniel A. Charlebois**, Mads Kærn. (2019) *Engineering Biology*, doi: 10.1049/enb.2019.0009.
20. “Role of Network-Mediated Stochasticity in Mammalian Drug Resistance”, Kevin Farquhar, **Daniel A. Charlebois**, Mariola Szenk, Joseph Cohen, Dmitry Nevozhay, Gábor Balázsi. (2019) *Nature Communications*, 10: 2766.
19. “Modeling Cell Population Dynamics”, **Daniel A. Charlebois**, Gábor Balázsi. (2019) *In Silico Biology*, 13: 21. (Among “Most read ISB articles in 2019”).
18. “Multiscale Effects of Heating and Cooling on Genes and Gene Networks”, **Daniel A. Charlebois**, Kevin Hauser, Sylvia Marshall, Gábor Balázsi. (2018) *Proceeding of the National Academy of Sciences of the United States of America*, doi: 10.1073/pnas.1810858115.
17. “Negative Regulation Gene Circuits with Efflux Pump Control”, ***Daniel A. Charlebois**, *Junchen Diao, Dmitry Nevozhay, Gábor Balázsi. (2018) *Methods in Molecular Biology*, 1772: 25.
16. “Backward Evolution from Gene Network Dynamics”. *Merzu Belete, ***Daniel A. Charlebois**, Gábor Balázsi. (2018) *bioRxiv*, doi: 10.1101/369371.
15. “Frequency-Dependent Selection: A Diversifying Force in Microbial Populations”, **Daniel A. Charlebois**, Gábor Balázsi. (2016) *Molecular Systems Biology*, 12: 880.
14. “Efflux Pump Control Alters Synthetic Gene Circuit Function”, Junchen Diao, **Daniel A. Charlebois**, Dmitry Nevozhay, Zoltán Bódy, Csaba Pál, Gábor Balázsi. (2016) *ACS Synthetic Biology*, doi: 10.1021/acssynbio.5b00154.
13. “Effect and Evolution of Gene Expression Noise on the Fitness Landscape”, **Daniel A. Charlebois**. (2015) *Physical Review E*, 92: 022713.
12. “Coherent Feedforward Transcriptional Regulatory Motifs Enhance Drug Resistance”, **Daniel A. Charlebois**, Gábor Balázsi, Mads Kærn. (2014) *Physical Review E*, 89: 052708.
11. “An Accelerated Method for Simulating Population Dynamics”, **Daniel A. Charlebois**, Mads Kærn. (2013) *Communications in Computational Physics*, 14: 461.
10. **Daniel A. Charlebois**. Book review on “Number-Crunching” by Paul J. Nahin. (2013) *Physics in Canada*, 69: 72.

9. "What all the Noise is About: The Physical Basis of Cellular Individuality". **Daniel A. Charlebois**, Mads Kærn. (2012) *Canadian Journal of Physics*, 90: 919.
8. "Gene Expression Noise Facilitates Adaptation and Drug Resistance Independently of Mutation". **Daniel A. Charlebois**, Nezar Abdennur, Mads Kærn. (2011) *Physical Review Letters*, 117: 218101.
7. "An Algorithm for the Stochastic Simulation of Gene Expression and Heterogeneous Population Dynamics". **Daniel A. Charlebois**, Dawn Fraser, Jukka Intosalmi, Mads Kærn. (2011) *Communications in Computational Physics*, 9: 89.
6. "Stochastic Gene Expression and the Processing and Propagation of Noisy Signals in Genetic Networks". **Daniel A. Charlebois**, Theodore J. Perkins, Mads Kærn. (2011) *Information Processing and Biological Systems*. A.S. Ribeiro and S. Niiranen (Editors). Springer-Verlag, pg. 89-112, ISBN: 978-3-642-19620-1.
5. "Dynamics of Stochastic Gene Rings". **Daniel A. Charlebois**. (2010) *Canadian Undergraduate Physics Journal*, 8: 13.
4. "A Biophysicist Ponders the Application of Hidden Metric Spaces to Genetic Networks". **Daniel Charlebois**. (2009) *Nature*, 458: 811.
3. **Daniel Charlebois**, Book review on "The Human Side of Einstein" by Walter Isaacson. (2008) *Canadian Undergraduate Physics Journal*, 8: 37.
2. "*CellLine*, a Stochastic Cell Lineage Simulator". Andre S. Ribeiro, **Daniel A. Charlebois**, Jason Lloyd-Price. (2007) *Bioinformatics*, 23: 3409.
1. "Effects of Microarray Noise on Inference Efficiency of a Stochastic Model of Gene Networks". **Daniel A. Charlebois**, Andre S. Ribeiro, Antti Lehmussola, Jason Lloyd-Price, Olli Yli-Harja, Stuart A. Kauffman. (2007) *WSEAS Transactions on Biology and Biomedicine*, Vol. 4: 15.

*Equal contribution. Underline denotes trainee.

Research Experience

Assistant Professor of Biophysics

Department of Physics, University of Alberta 2019-Present

Adjunct Professor

Department of Biological Sciences, University of Alberta 2021-Present

Affiliate Faculty Member

Collaborative Mathematical Biology Group, University of Alberta 2020-Present

Natural Sciences and Engineering Research Council Postdoctoral Fellow/Associate

Laufer Center for Physical and Quantitative Biology, Stony Brook University 2014-2019
• Supervisor: Prof. Gábor Balázsi

Research Assistant

Ottawa Institute of Systems Biology, University of Ottawa 2008-2014

Institute for Biocomplexity and Informatics, University of Calgary 2005-2007

Canadian Blood Services, National Epidemiology and Surveillance Division 2005

Teaching Experience

Teaching

Instructor, University of Alberta Winter 2021
Course: BIOPH401/501 – Advanced Biophysics

Instructor/Supervisor, University of Alberta Fall 2020
Course: PHYS499 – Undergraduate Research Project
Students: Joshua Guthrie and Samiha Ali

Instructor, University of Alberta Winter 2020
Course: PHYS495/595 – Intro to Biophysics

Guest Lecturer, Stony Brook University Winter 2018
Course: Genetic Engineering

Guest Lecturer, Stony Brook University Winter 2018
Women in Science and Engineering Course:
Opportunities in STEM and Beyond

Co-Instructor, Stony Brook University Winter 2017 & Fall 2018
WISE Course: Women in the Laboratory:
Introduction to Science, Engineering, and Mathematics Research

Laboratory Guest Instructor, Stony Brook University Fall 2016
Physical and Quantitative Biology

Guest Lecturer, Stony Brook University
Course: Introduction to Biomedical Engineering

Summer 2016

Teaching Assistant, Department of Physics, University of Ottawa
Courses: Statistical Thermodynamics, Mechanics, Theoretical Physics,
Fundamentals of Physics I, II, & III

2008-2012

Trainees

Postdoctoral Fellows:

Dr. Shamanth Shankarnarayan (2021-Present)

PhD Students:

- Akila Bandara, Department of Physics, University of Alberta (2020-Present)

MSc Students:

- Samira Rasouli Koohi, Department of Physics, University of Alberta (2021-Present)
- Harold Flohr, Department of Physics, University of Alberta (2020-Present)

Undergraduate Students:

- Samiha Ali, Departments of Mathematical and Statistical Sciences & Physics, University of Alberta [PHYS499 and Research Supervisor] (2020-Present)
- Joshua Guthrie, Departments of Physics & Computing Science, University of Alberta [PHYS499 and Research Supervisor] (2020-Present)
- Rebekah Hall, Department of Mathematical and Statistical Sciences, University of Alberta [Research Supervisor] (2019-Present)
- Sylvia Marshall, BSc Chemistry (Hons.), Laufer Center for Physical and Quantitative Biology at Stony Brook University [Undergraduate Thesis Co-Supervisor with Prof. Gábor Balázsi] (2015- 2016)

Trainee Awards

- Rebekah Hall: NSERC Undergraduate Student Research Award (2021)
- Joshua Guthrie, NSERC Undergraduate Student Research Award (2021)
- Samiha Ali, U of A URI Support Fund (2021)
- Rebekah Hall, Alberta Innovates Summer Research Studentship (2020)

Mentoring

Mentor
University of Alberta-Women in Science and Engineering (UA-WISE)/
Women in Scholarship, Engineering, Science, and Technology (WiSEST)
Mentorship Program

2019-Present

Advisor Stony Brook University Senior Design Project in Biomedical Engineering	2016-2018
International Genetically Engineered Machine (iGEM) Competition Advisor Stony Brook University Model of a Synthetic <i>E. Coli</i> System for Programmed Melittin Formation (bronze medal awarded at championship)	2014
iGEM Advisor University of Ottawa Modeling a synthetic fold-change molecule detector network in budding yeast (gold medal awarded at championship)	2013
Assisted Prof. Kærn and Prof. Balázsi with training and supervising undergraduate and graduate students (theoretical and experimental projects)	2010-2019

Grants & Fellowships

AI4Society Seed Grant <ul style="list-style-type: none"> AI4Society, University of Alberta, \$10,000 “Machine learning to rapidly detect drug-resistant human fungal pathogens” 	2021
Discovery Grant (Primary Investigator) <ul style="list-style-type: none"> Natural Sciences and Engineering Research Council of Canada, \$145,000 “Biophysical models of the effect of the physico-chemical environment on genetic networks” 	2020-2025
Discovery Launch Supplement (Primary Investigator) <ul style="list-style-type: none"> Natural Sciences and Engineering Research Council of Canada, \$12,500 “Biophysical models of the effect of the physico-chemical environment on genetic networks” 	2020-2021
Discovery COVID-19 Supplement (Primary Investigator) <ul style="list-style-type: none"> Natural Sciences and Engineering Research Council of Canada, \$4,640 “Biophysical models of the effect of the physico-chemical environment on genetic networks” 	2020-2021
New Frontiers in Research Fund – Exploration (Primary Investigator) <ul style="list-style-type: none"> Government of Canada, \$250,000 “Understanding and mitigating drug resistance: Quantitative models and synthetic gene networks” 	2020-2023

- *John R. Evans Leaders Fund (Primary Investigator) 2019-2022
 - Canada Foundation for Innovation, \$98,969
 - “Mitigation of Drug Resistance in Bacteria and Pathogenic Yeasts”

- Research Capacity Program - Small Equipment Grant (Primary Investigator) 2019-2022
 - Government of Alberta, Ministry of Jobs, Economy and Innovation, \$98,969
 - “Mitigation of Drug Resistance in Bacteria and Pathogenic Yeasts”
 - *Matching funds for CFI-JELF

- Start-Up Funds 2019-2022
 - Faculty of Science, University of Alberta

- GPU Grant (Primary Investigator) 2018
 - NVIDIA Corporation, 2 Titan X Pascal GPUs valued at \$3,000

- Postdoctoral Fellowship 2014-2016
 - Natural Sciences and Engineering Research Council of Canada, \$90,000

- GPU Grant (Primary Investigator) 2014
 - NVIDIA Corporation, 2 Tesla K40 GPU Accelerators valued at \$15,000

Awards & Scholarships

- Audrey & Randy Lomnes Early Career Endowment Award in Physics 2020-2022
 - Department of Physics, University of Alberta and Audrey & Randy Lomnes, \$90,000
 - “Identification and Mitigation of Drug Resistance in the Yeast Pathogen *Candida auris*”

- Faculty of Graduate and Postdoctoral Studies Dean’s Scholarship 2014
(University of Ottawa, for doctorate, \$3,000)

- Queen Elizabeth II Scholarship in Science and Technology 2012-2014
(Government of Ontario, \$30,000)

- Excellence Scholarship 2012-2014
(University of Ottawa, \$16,000)

- Faculty of Graduate and Postdoctoral Studies Dean’s Scholarship 2010
(University of Ottawa, for master’s with a thesis, \$1,500)

- Jason Lang Scholarship 2008
(Government of Alberta, \$1,000)

Laurence Decore Award for Student Leadership (Government of Alberta, \$500)	2006
Computer Science Undergraduate Society Schlumberger Calgary Technology Centre Award (CSUS and Schlumberger Information Systems, \$1,000)	2005
ExxonMobil Higher Education Award (ExxonMobil, \$15,000)	2002-2005

Scientific Talks

26. "Lattice-Based Simulations of Yeast Colony Growth Under Low-Nutrient Conditions and Magnetic Field Exposure" online seminar hosted by Quantitative Biophysics in Canada (QBIOC), June 24, 2021 (Invited).
25. "Quantifying the Transition from Non-Genetic to Genetic Drug Resistance" online seminar hosted by the Department of Physics, Simon Fraser University, Canada, April 14, 2021 (Invited).
24. "Quantifying the Transition from Non-Genetic to Genetic Drug Resistance" online seminar hosted by the Department of Physics, Concordia University, Canada, April 7, 2021 (Invited).
23. "Effects of Temperature and Drugs on the Function, Dynamics, and Evolution of Gene Regulatory Networks and Antimicrobial Resistance" online seminar hosted by the Department of Biological Sciences, University of Alberta, Canada, November 19, 2020 (Invited).
22. "Drug Resistance: Noise, Networks, and Evolution" online seminar hosted by the Department of Physics and Astronomy, University of Calgary, Canada, October 29, 2020. (Invited)
21. "Investigations on Drug Resistance: Mathematical and Engineered Model Systems", Mathematical Biology Seminar Series, online seminar hosted by the Collaborative Mathematical Biology Group & Department of Mathematics and Statistics, University of Alberta, Canada, April 6, 2020. (Invited)
20. "Gene Network-Mediated Heterogeneity in Mammalian Drug Resistance", Advances in Theoretical and Experimental Methods for Analyzing Complex Regulatory Networks, BIRS, Banff, Canada, February 20, 2020. (Invited)
19. "The Role of Gene Network-Mediated Stochasticity in Mammalian Drug Resistance", LBD 2019 Webinar on Biosystems/Laboratory of Biosystem Dynamics, hosted by Tampere University, Finland, December 10, 2019. (Invited)

18. "Non-genetic to Genetic Antimicrobial Resistance: Mechanisms from Mathematical and Fungal Model Systems", Biochemistry 623 Molecular and Cellular Biology Seminar Series, Biochemistry Department, University of Alberta, Edmonton, Canada, November 5, 2019. (Invited)
17. "Gene Networks and Drug Resistance: Breakthroughs Using Novel Model Systems", Biological & Biomedical Engineering Research Symposium, McGill University, Montreal, Canada, March 22, 2019. (Invited keynote)
16. "Multiscale Effects of Temperature on Synthetic Gene Circuits", American Physical Society March Meeting, Boston, USA, March 4, 2019.
15. "Heterogeneity in Mammalian Drug Resistance", Gordon Research Conference on Drug Resistance, Bryant University, Smithfield, USA, July 25, 2018.
14. "Stochasticity in Mammalian Drug Resistance", American Physical Society March Meeting, Los Angeles, USA, March 7, 2018.
13. "Functional Effects of Heating and Cooling Gene Networks", LBD 2017 Webinar on Biosystems, online conference hosted by the Tampere University of Technology, Finland, December 11, 2017. (Invited)
12. "Effect of Temperature on Synthetic Positive and Negative Feedback Gene Circuits", APS March Meeting, New Orleans, USA, March 16, 2017.
11. "Evolving Drug Resistance: Quantitative Models and Synthetic Gene Networks", Mini-Workshop: Cellular Heterogeneity and Evolution, Stony Brook University, Stony Brook, USA, August 25, 2016. (Invited)
10. "Gene Expression Noise, Fitness Landscapes, and Evolution", APS March Meeting, Baltimore, USA, March 16, 2016.
9. "Theoretical Investigations on the Development of Drug Resistance", Laufer Center Retreat, Old Field Club, Stony Brook, USA, April 20, 2015.
8. "From Mathematical Models to the Laboratory: Shedding New Light on Drug Resistance", SBU Postdoc Spotlight, Stony Brook University, Stony Brook, USA, September 18, 2014.
7. "Modelling & Simulation of Cellular Population Dynamics: The Case for Noise-Mediated Drug Resistance", Mathematical Tools for Evolutionary Systems Biology, BIRS, Banff, Canada, May 29, 2013. (Invited)
6. "Gene Expression Noise Facilitates Adaptation and Drug Resistance Independently of Mutation", Ottawa-Carleton Institute for Physics, University of Carleton, Ottawa, Canada, April 30, 2013.

5. "Simulating Heterogeneous Cell Populations and the Development of Noise Induced Drug Resistance", University of Texas MD Anderson Cancer Center, Houston, USA, August 20, 2012.
4. "Modelling Drug Resistance in Cell Populations", 2011 OISB Symposium, Montebello, Canada, June 8, 2011.
3. "Stochastic Simulation of Gene Expression and Heterogeneous Population Dynamics", Ottawa-Carleton Institute for Physics, University of Carleton, Ottawa, Canada, December 15, 2009.
2. "*P53Sim*, Multiple Cells and Cell Lineage P53-Mdm2 Feedback Loop Delayed Stochastic Simulator", Department of Physics and Astronomy, University of Calgary, Calgary, Canada, April 25, 2007.
1. "Inference Algorithms, Threshold Test for Gene Regulatory Networks", Department of Biological Sciences, University of Calgary, Calgary, Canada, April 6, 2006.

Service & Public Outreach

External Reviewer (Evaluation Group: 1505 – Physics), National Science and Engineering Research Council of Canada (2021)

Scientific Program Committee, CanFunNet 2022, Canadian Fungal Network (2021 – Present)

External Examiner, Doctoral Candidacy Exams (Shubhadeep Patra & Charles E. Jensen), Department of Physics, University of Alberta (2021)

External Grant Reviewer, New Frontiers in Research Fund – Exploration (2020)

Judge, Best Student Oral Presentation, Division of Physics in Medicine and Biology, 2020 Canadian Association of Physicists Virtual Congress (2020)

Pint of Science Festival Talk, "Physics + Biology = Weapons Against Drug Resistance", Pint of Science Canada, online (2020)

Judge, Nat Rutter "Outstanding Technician of the Year" Award, Sigma Xi, University of Alberta Chapter (2020)

Member, Undergraduate Biophysics Degree Program Development Committee, Department of Physics, University of Alberta (2019-Present)

Member, Graduate Admissions Committee, Department of Physics, University of Alberta (2019-Present)

Member, Thesis Committee (Aaron Lyons and Furkan Altincicek), Department of Physics, University of Alberta (2019-Present)

S⁴ Humans of Physics Talk, “Daniel Charlebois = Human Biophysicist”, Department of Physics, University of Alberta (2019)

APS March Meeting Focus Session Co-Organizer and Chair, Single-Cell Variability and Dynamics, and Evolutionary Systems Biology I & II, Los Angeles (2018)

Moderator, SBU Postdoc Spotlight, Stony Brook University (2017)
Judge, Three Minute Thesis Competition, Stony Brook University (2017)

Editorial Board Member, *In Silico Biology* (2016-Present)
TEDx Talk, “Drug Resistance: A New Paradigm”, Stony Brook University (2016)

Member, Postdoc Advisory Committee, Stony Brook University (2016-2019)

Panel Participant, NSF Graduate Research Fellowship Program information session, Stony Brook University (2016)

Grant Review Panelist, National Science Foundation (2016)

SBU Postdoc Spotlight Presentation, “From Mathematical Models to the Laboratory: Shedding New Light on Drug Resistance”, Stony Brook University (2014)

Journal Reviewer: *Advances in Difference Equations*, *BioEssays*, *DNA Research*, *Earth Systems and Environment Science*, *FEBS Letters*, *In Silico Biology*, *Molecular Biosystems*, *Physical Review E*, *Physical Review Letters*, *PLOS Biology*, *PLOS Computational Biology*, *PLOS ONE*

Languages & Computational/Experimental Skills

Languages: Fluent in English and French;

Operating Systems: Windows, Mac, Linux

Software: MATLAB, Mathematica, XPPAUT, MatCont, LaTeX, OpenMP, FCS Express

Programming Languages: Fortran, Python, C++, Pascal

Experimental Skills: bacterial, fungal, and mammalian cell culture, flow cytometry, microscopy and microfluidics, cell counter, plate reader, gel electrophoresis, yeast transformation, drug resistance/evolution experiments

Professional Memberships

American Association for the Advancement of Science (member since 2017)

Biophysical Society (member since 2021)

Biophysical Society of Canada (member since 2019)

Canadian Association of Physicists (member since 2008, Professional Physicist, P.Phys., since 2011)

Engineers Without Borders (member since 2004)

National Postdoctoral Association (affiliate member 2014-2019)

New York Academy of Sciences (member 2015-2019)

Sigma Xi (elected, full member since 2010)