

# GUILLAUME ST-ONGE

## Research Assistant Professor

Network Science Institute & Roux Institute  
Northeastern University, Portland, ME 04101, USA

✉ [g.st-onge@northeastern.edu](mailto:g.st-onge@northeastern.edu)

🌐 [www.gstonge.ca](http://www.gstonge.ca)

Mathematical & Computational Modeling | Complex Networks | Data Science | Epidemiology

## ACADEMIC POSITIONS

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**Research Assistant Professor** | Department of Physics, Northeastern University 2024–present

- Core faculty at the [Network Science Institute & Roux Institute](#)
- Member of [EPISTORM—Center for Advanced Epidemic Analytics and Predictive Modeling Technology](#)

**Postdoctoral Research Associate** | Department of Physics, Northeastern University 2022–2024

- Advisor: Alessandro Vespignani
- FRQNT: Postdoctoral Fellow

## EDUCATION

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**Ph.D. in Physics** | Université Laval | [Honour List of the Faculty of Graduate and Postdoctoral Studies](#) 2018–2022

- Advisors: Antoine Allard and Laurent Hébert-Dufresne (co-advisor)
- Thesis title: *Contagion process on complex networks beyond pairwise interactions*

**M.Sc. in Physics** | Université Laval | [Honour List of the Faculty of Graduate and Postdoctoral Studies](#) 2015–2017

- Advisor: Louis J. Dubé
- Thesis title: *Propagation dynamics on random networks: characterization of the phase transition*

**B.Sc. in Physics** | Université Laval | [Governor General's Academic Medal for Highest Academic Standing](#) 2012–2015

## FUNDING AND AWARDS

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### Postdoctoral research

- [FRQNT: Postdoctoral Research Fellowship](#) (\$110 000) June 2022–June 2024

### Graduate research

- [NSERC: Doctoral Scholarship – Alexander Graham Bell Canada](#) (\$105 000) Jan. 2018–Dec. 2020
- [FRQNT: Doctoral Scholarship\\*](#) (\$60 000) Jan. 2018–Dec. 2020
- [NSERC: Master Scholarship – Alexander Graham Bell Canada](#) (\$17 500) Sept. 2015–Aug. 2016
- [FRQNT: Master Scholarship](#) (\$30 000) Sept. 2015–Aug. 2017
- [Desjardins Foundation: Master Scholarship\\*](#) (\$3 000) Oct. 2015

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\*Awarded but declined

## Internship research

- [FRQNT: International Internship Program](#) (\$7 500) 2020
- [NSERC: Michael Smith Foreign Study Supplements](#) (\$6 000) 2019
- [NSERC: Undergraduate Student Research Award](#) (\$4 500, Awarded 3 times) 2013, 2014, 2015

## Awards

- Best presentation, [Fourth Northeast Regional Conference on Complex Systems](#) 2021
- [Concours d'expression scientifique Pierre Amiot](#) (science popularization, 3rd place), Université Laval 2017
- Student merit award, Physics Department, Université Laval 2015
- Pedagogue of the year, Physics Students Association, Université Laval 2014

## TEACHING

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- *Dynamical Processes in Complex Networks*, guest lecturer 2022–2025  
Presentation title: Branching process and probability generating functions in network science
- Teaching assistant:
  - *Statistical Physics*, teaching assistant 2016–2018, 2020
  - *Computational Physics*, teaching assistant 2016, 2018
  - *Mathematical Physics III*, teaching assistant 2014
  - *Mathematical Physics I, II*, teaching assistant 2013
- Book in preparation: [CoSMOS: Complex Systems Modeling Open Sourcebooks](#)

## PUBLICATIONS AND PATENTS

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### Articles published or accepted in a peer-reviewed journal

24. [A vision for estimation of the instantaneous reproductive number](#)  
C. W. Milando, G. G. Vega Yon, K. Johnson, A. Urbinati, **G. St-Onge**, B. Klein, A. Cori, L. F. White, Rt Collabathon participants 2026  
*Epidemics*. 54, 100885
23. [Pandemic monitoring with global aircraft-based wastewater surveillance networks](#)  
**G. St-Onge**, J. T. Davis, L. Hébert-Dufresne, A. Allard, A. Urbinati, S. V. Scarpino, M. Chinazzi, A. Vespignani 2025  
*Nature Medicine*. 31, 788–796
22. [Characteristic scales and adaptation in higher-order contagions](#)  
G. Burgio, **G. St-Onge**, L. Hébert-Dufresne 2025  
*Nature Communications*. 16, 4589
21. [One pathogen does not an epidemic make: A review of interacting contagions, diseases, beliefs, and stories](#)  
L. Hébert-Dufresne, Y.-Y. Ahn, V. Colizza, A. Allard, J. W. Crothers, P. Sheridan Dodds, M. Galesic, F. Ghanbarnejad, D. Gravel, R. A. Hammond, K. Lerman, J. Lovato, J. J. Openshaw, S. Redner, S. V. Scarpino, **G. St-Onge**, T. R. Tangherlini, J.-G. Young 2025  
*npj Complexity*. 2, 26
20. [Ensemble<sup>2</sup>: scenarios ensembling for communication and performance analysis](#)  
C. Bay, **G. St-Onge**, J. T. Davis, M. Chinazzi, E. Howerton, J. Lessler, M. C. Runge, K. Shea, S. Truelove, C. Viboud, A. Vespignani 2024  
*Epidemics*. 46, 100748
19. [Nonlinear bias toward complex contagion in uncertain transmission settings](#)  
**G. St-Onge**, L. Hébert-Dufresne, A. Allard 2024  
*Proceedings of the National Academy of Sciences of the United States of America*. 121, e2312202121

18. [Hierarchical team structure and multidimensional localization \(or siloing\) on networks](#)  
L. Hébert-Dufresne, **G. St-Onge**, J. Meluso, J. Bagrow, A. Allard  
*Journal of Physics: Complexity*. 4, 035002 2023
17. [Source-sink behavioural dynamics limit institutional evolution in a group-structured society](#)  
L. Hébert-Dufresne, T. M. Waring, **G. St-Onge**, M. T. Niles, L. K. Corlew, M. P. Dube, S. J. Miller,  
N. J. Gotelli, B. J. McGill  
*Royal Society Open Science*. 9, 211743 2022
16. [Influential groups for seeding and sustaining nonlinear contagion in heterogeneous hypergraphs](#)  
**G. St-Onge**, I. Iacopini, V. Latora, A. Barrat, G. Petri, A. Allard, L. Hébert-Dufresne  
*Communications Physics*. 5, 25 2022
15. [Universal Nonlinear Infection Kernel from Heterogeneous Exposure on Higher-Order Networks](#)  
**G. St-Onge**, H. Sun, A. Allard, L. Hébert-Dufresne, G. Bianconi  
*Physical Review Letters*. 127, 158301 2021
14. [Social Confinement and Mesoscopic Localization of Epidemics on Networks](#)  
**G. St-Onge**, V. Thibeault, A. Allard, L. J. Dubé, L. Hébert-Dufresne  
*Physical Review Letters*. 126, 098301 2021
13. [Inference, Model Selection, and the Combinatorics of Growing Trees](#)  
G. T. Cantwell, **G. St-Onge**, J.-G. Young  
*Physical Review Letters*. 126, 038301 2021
12. [Master equation analysis of mesoscopic localization in contagion dynamics on higher-order networks](#)  
**G. St-Onge**, V. Thibeault, A. Allard, L. J. Dubé, L. Hébert-Dufresne  
*Physical Review E*. 103, 032301 2021
11. [Localization, epidemic transitions, and unpredictability of multistrain epidemics with an underlying genotype network](#)  
B. J. M. Blake, **G. St-Onge**, L. Hébert-Dufresne  
*PLOS Computational Biology*. 17, e1008606 2021
10. [Threefold way to the dimension reduction of dynamics on networks: an application to synchronization](#)  
V. Thibeault, **G. St-Onge**, L. J. Dubé, P. Desrosiers  
*Physical Review Research*. 2, 043215 2020
9. [Network comparison and the within-ensemble graph distance](#)  
H. Hartle, B. Klein, S. McCabe, A. Daniels, **G. St-Onge**, C. Murphy, L. Hébert-Dufresne  
*Proceedings of the Royal Society A*. 476, 20190744 2020
8. [Thresholding normally distributed data creates complex networks](#)  
G. T. Cantwell, Y. Liu, B. F. Maier, A. C. Schwarze, C. A. Serván, J. Snyder, **G. St-Onge**  
*Physical Review E*. 101, 062302 2020
7. [Phase transition in the recoverability of network history](#)  
J.-G. Young, **G. St-Onge**, E. Laurence, C. Murphy, L. Hébert-Dufresne, P. Desrosiers  
*Physical Review X*. 9, 041056 2019
6. [Efficient sampling of spreading processes on complex networks using a composition and rejection algorithm](#)  
**G. St-Onge**, J.-G. Young, L. Hébert-Dufresne, L. J. Dubé  
*Computer Physics Communications*. 240, 30 2019
5. [Universality of the stochastic block model](#)  
J.-G. Young, **G. St-Onge**, P. Desrosiers, L. J. Dubé  
*Physical Review E*. 98, 032309 2018
4. [Phase transition of the susceptible-infected-susceptible dynamics on time-varying configuration model networks](#)  
**G. St-Onge**, J.-G. Young, E. Laurence, C. Murphy, L. J. Dubé  
*Physical Review E*. 97, 022305 2018
3. [Geometric evolution of complex networks with degree correlations](#)  
C. Murphy, A. Allard, E. Laurence, **G. St-Onge**, L. J. Dubé  
*Physical Review E*. 97, 032309 2018
2. [Exact vectorial model for nonparaxial focusing by arbitrary axisymmetric surfaces](#)  
D. Panneton, **G. St-Onge**, M. Piché, S. Thibault  
*Journal of the Optical Society of America A*. 33, 801 2016

1. *Needles of light produced with a spherical mirror*

D. Panneton, **G. St-Onge**, M. Piché, S. Thibault  
*Optics Letters*. 4, 419

2015

## Preprints and submitted manuscripts

- *The impact of behavioral homophily and conformity on epidemic spreading in networks with large groups*  
O. Ribordy, C. Granell, **G. St-Onge**, L. Hébert-Dufresne, A. Arenas, A. Allard  
*arXiv:2605.25875*.
- *Simpson's paradox explains the ubiquity of nonlinear, threshold, and complex contagions*  
L. Hébert-Dufresne, A. Allard, J.-G. Young, W. H. W. Thompson, **G. St-Onge**  
*arXiv:2605.00791*.
- *Group dynamics shape contagion onsets and multistable active phases under collective reinforcement*  
S. Lamata-Otín, F. Malizia, L. A. Keating, **G. St-Onge**, V. Latora, J. Gómez-Gardeñes, L. Hébert-Dufresne  
*arXiv:2603.28566*.
- *A multi-scale model to evaluate airport wastewater surveillance and ICU genomic monitoring for pandemic preparedness*  
B. K. Reddy, J. L.-H. Tsui, K. O. Drake, **G. St-Onge**, J. T. Davis, C. Mills, J. Dunning, I. I. Bogoch,  
S. V. Scarpino, S. Bhatt, O. G. Pybus, A. Rambaut, M. J. Wade, T. Ward, M. Chand, E. M. Volz, A. Vespignani,  
M. U. G. Kraemer  
*medRxiv 2026.02.27.26347250*.
- *Evaluation of stochastic trajectory-based epidemic models using the energy score*  
C. Bay, K. Mu, **G. St-Onge**, M. Chinazzi, J. T. Davis, A. Vespignani  
*medRxiv 2025.01.13.25320493*.
- *Detecting structural perturbations from time series with deep learning*  
E. Laurence, C. Murphy, **G. St-Onge**, X. Roy-Pomerleau, V. Thibeault  
*arXiv:2006.05232*.

## Patents

- *Hybrid nanocomposite materials, laser scanning system and use thereof in volumetric image projection*,  
C. Allen, S. Thibault, A. Talbot-Lanciault, P. Blais, **G. St-Onge**, P. Desaulniers  
CA Patent No. 2983656  
2017

## TALKS AND INVITED PRESENTATIONS

- 
- *Modeling Platform for Travel-Based Genomic and Wastewater Outbreak Surveillance* 2025
    - *InsightNet Annual Meeting*, Salt Lake City (UT), USA
    - *Epistorm Annual Meeting*, Boston (MA), USA
  - *The Unreasonable Effectiveness of Branching Processes for Outbreak Analytics* 2025  
Network Science Research Symposium (keynote presentation), Boston (MA), USA
  - *L'efficacité hors norme des fonctions génératrices pour modéliser les épidémies* 2025  
*Centre Interdisciplinaire en Modélisation Mathématique de l'Université Laval*, Québec (QC), Canada
  - *Statistical physics of epidemics with applications to global biosurveillance* 2025  
*PHYS 7210 - Introduction to Research in Physics (seminar)*, Northeastern University, Boston (MA), USA
  - *Generating function methodology for metapopulation epidemics with applications to global biosurveillance* 2024  
*Quantitative Methods for Dynamics on Networks*, Los Alamos (NM), USA
  - *Optimization of a global wastewater surveillance network at airports for emerging pathogens* 2024  
*International School and Conference on Network Science*, Québec (QC), Canada
  - *Establishing a wastewater global surveillance network at airports for early detection of emerging pathogens: A modeling study* 2023  
*Epidemics: 9th International Conference on Infectious Disease Dynamics*, Bologna, Italy

- *Wastewater environmental Surveillance for Pandemic Preparedness (Roundtable discussion)* 2023  
Grand Challenges Annual Meeting, Dakar, Senegal
- *Probability generating functions for epidemics on metapopulation networks* 2023
  - *Contagion on Complex Social Systems (CCSS)*, Burlington (VT), USA
  - *International School and Conference on Network Science*, Vienna, Austria
- *Quantifying population dynamics of complex contagions* 2023  
*International School and Conference on Network Science*, Vienna, Austria
- *Navigating wastewater surveillance at airports with probability generating functions* 2023  
*NetPLACE*, (virtual)
- *Indistinguishability of simple and complex contagions when transmission settings matter* 2023  
*Mathematical Institute, University of Oxford*, Oxford, UK (virtual)
- *Confounders of interacting diseases* 2023  
*Dynamics of Interacting Contagions*, Santa Fe (NM), USA
- *Reconstruction Of Product-Diffusion Cascades* 2022  
*Workshop on Network Dynamics and Choice Theory*, Burlington (VT), USA
- *Nonlinear infection rate to compress mechanistic epidemic models* 2022  
*Fourth Northeast Regional Conference on Complex Systems*, Buffalo (NY), USA
- *Influential groups in hypergraph contagions* 2022  
*Max Planck Institute for Mathematics in the Sciences*, Leipzig, Germany
- *Bursty exposure on higher-order networks leads to nonlinear infection kernels* 2021
  - *Networks 2021: A Joint Sunbelt and NetSci Conference*, Bloomington (IN), USA
  - *SIAM Conference on Applications of Dynamical Systems (DS21)*, Portland (OR), USA
  - *Fourth Northeast Regional Conference on Complex Systems*, Buffalo (NY), USA 🏆 (best talk)
- *Influence maximization in simplicial contagion* 2020  
*International School and Conference on Network Science*, Rome, Italy
- *Localization, bistability and optimal seeding of contagions on higher-order networks* 2020  
*Artificial Life Conference*, Montreal (QC), Canada
- *Mesosopic localization of spreading processes on networks* 2019  
*International School and Conference on Network Science*, Burlington (VT), USA
- *SIS dynamics on time-varying random networks* 2017  
*Institute for Disease Modeling*, Seattle (WA), USA
- *Susceptible-infected-susceptible dynamics on the rewired configuration model* 2017  
*International School and Conference on Network Science*, Indianapolis (IN), USA
- *Co-evolution of Growth and Dynamics on Network* 2016  
*International School and Conference on Network Science*, Seoul, Republic of Korea
- *Modeling ultra-sharp needles of light using vector diffraction theory* 2014  
*50th Canadian Undergraduate Physics Conference*, Kingston (ON), Canada

## OTHER RELEVANT EXPERIENCES

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### Internships

Vermont Complex System Center, Burlington (VT), USA

- Visiting graduate student | group of Prof. Laurent Hébert-Dufresne 2019-2020  
Project: *Temporal reconstruction of networks with message-passing*

Université Laval, Québec (QC), Canada

- Undergraduate research assistant | group of Prof. Louis J. Dubé  
Project: *Statistical physics of complex networks* 2015
- Undergraduate research assistant | group of Prof. Michel Piché  
Project: *Highly focused laser beam modeling* 2014
- Undergraduate research assistant | group of Prof. Claudine Allen  
Project: *Development of an optical system for biodetection* 2013

### Summer and winter schools

- [Summer Institute in Statistics and Modeling in Infectious Diseases](#), (virtual) 2022
- [Complex Systems Summer School](#), Santa Fe (NM), USA 2018
- [Complex Networks Winter Workshop](#), Québec (QC), Canada 2018

## LEADERSHIP AND SERVICE

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### Conferences and workshops

- Co-organizer: [The Art of Epidemics: Data Storytelling through Effective Visualizations](#) 2025
  - Special session at [Epidemics 10: 10th International Conference on Infectious Disease Dynamics](#)
- School & Satellite chair: [International School and Conference on Network Science \(NetSci\)](#) 2024
  - Flagship conference of the [Network Science Society](#)
  - Elected *Scientific Event of the Year* by the [Cercle des ambassadeurs de Québec](#) 🏆
- Co-organizer: [Epistorm Rt-Collabathon](#) 2024
  - Collaborative event to build community around real-time estimation of the effective reproduction number
  - Supported by the [CDC's Center for Forecasting and Outbreak Analytics Insight Net initiative](#)
- Program committees:
  - [Conference on Complex Systems \(CCS\)](#) 2024-2025
  - [Northeast Regional Conference on Complex Systems \(NERCCS\)](#) 2022
- Session chair:
  - [Networks 2021: A Joint Sunbelt and NetSci Conference, S14 – Epidemiology](#) 2021
  - [SIAM Conference on Applications of Dynamical Systems \(DS21\), CP4 – Dynamics](#) 2021
- Projects liaison: [Complex Networks Winter Workshop](#) 2019

### Faculty committee

- Member: Full Time Non-Tenure Track Faculty Committee, College of Science, Northeastern University 2024–present
- Member: PhD Admission Committee, Network Science, Northeastern University 2025

### Reviewer

- Journals (17): [Science Advances](#), [Nature Communications](#), [Physical Review Letters](#), [Physical Review X](#), [Physical Review E](#), [PLOS Computational Biology](#), [npj Complexity](#), [PNAS Nexus](#), [Journal of The Royal Society Interface](#), [Journal of Complex Networks](#), [Communications Physics](#), [Scientific Reports](#), [Chaos: An Interdisciplinary Journal of Nonlinear Science](#), [New Journal of Physics](#), [IMA Journal of Applied Mathematics](#), [Advances in Complex Systems](#), [PLOS One](#)
- Triage grading for [The Interdisciplinary Contest in Modeling \(ICM\)](#) 2022

## MEDIA COVERAGE

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- Selection of media coverage on our *Nature Medicine* article about aircraft wastewater surveillance: 2025
  - [Thinking globally for pandemic early warning systems](#), *Nature News and Views*
  - [Wastewater sampling could be key to early warning of new disease outbreaks](#), *The Guardian*
  - [Waste surveillance at just 20 airports could spot the next pandemic](#), *NewScientist*
  - [How monitoring wastewater from international flights can serve as an early warning system for the next pandemic](#), *Northeastern Global News*
- Other media coverage of my research:
  - [Mathematical model offers new insights into spread of epidemics](#), *phys.org* 2021
  - [To find the right network model, compare all possible histories](#), *phys.org* 2021
  - [How large a gathering is too large during the coronavirus pandemic?](#), *Science News* 2020

## SELECTED OPEN-SOURCE SOFTWARE

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- **pgfgleam**: efficient solution of stochastic metapopulation epidemics for global biosurveillance (Python)
- **SamplableSet**: implementation of sets which can be randomly sampled efficiently (C++/Python)
- **fasttr**: uniform sampler for the temporal reconstruction of growing trees (C++/Python)
- **spreading\_CR**: stochastic simulation algorithm for contagion processes (C++/Python)