

Antoine Allard

Curriculum Vitæ

Assistant Professor
Département de physique, de génie physique et d'optique
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ACADEMIC POSITIONS

Université Laval Assistant Professor ★ Sentinelle Nord Research Chair on Applications and Theory of Network Analysis ○ Co-leader of the Dynamica Research Group on complex systems ○ Member of the Centre Interdisciplinaire en Modélisation Mathématique de l'Université Laval (CIMMUL)	Québec, Canada 2018–present
Universitat de Barcelona Postdoctoral Fellow ★ Awarded the Juan de la Cierva – Incorporación postdoctoral fellowship	Barcelona, Spain 2018
Centre de Recerca Matemàtica Senior Research Fellow	Bellaterra, Spain 2017
Universitat de Barcelona Postdoctoral Fellow ★ Awarded the Fonds de recherche du Québec – Nature et Technologies postdoctoral fellowship	Barcelona, Spain 2014–2016
University of British Columbia Centre for Disease Control Research Assistant	Vancouver, Canada 2006–2007
Université Laval Undergraduate Research Assistant ○ Supervisor: Louis J. Dubé, Nonlinear Dynamics Group ★ Natural Sciences and Engineering Research Council of Canada Undergraduate Student Research Award	Québec, Canada 2006
Centre de Recherche de l'Hôtel-Dieu de Québec Undergraduate Research Assistant ○ Supervisor: Luc Beaulieu, Radio Oncology Department ★ Natural Sciences and Engineering Research Council of Canada Undergraduate Student Research Award	Québec, Canada 2005
Université Laval Undergraduate Research Assistant ○ Supervisor: Gilles Joncas, Astrophysics Group	Québec, Canada 2004

EDUCATION

Université Laval Ph.D. in Physics ○ Thesis Title: <i>Percolation sur graphes aléatoires: Modélisation et description analytique</i> ¹ ○ Advisor: Louis J. Dubé ★ Awarded the CIHR Frederick Banting and Charles Best Canada Graduate Scholarship ★ Thesis added to the Board of Honour for receiving the highest overall mark	Québec, Canada 2009–2014
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¹Percolation on random graphs: Modelling and analytical description

Université Laval

Québec, Canada
2006–2008

M.Sc. in Physics

- Thesis Title: *Modélisation Mathématique en Épidémiologie par Réseaux de Contacts: Introduction de l'Hétérogénéité dans la Transmissibilité*²
- Advisor: Louis J. Dubé
- ★ Thesis added to the Board of Honour for receiving the highest overall mark

Université Laval

Québec, Canada
2003–2006

B.Sc. in Physics (Theoretical Physics option)

- ★ Rouge et Or Distinction for excellence in academic undergraduate results
- ★ Nominated 2003 AESGUL Prize for “Student of the year” (chosen by the peers)

FUNDING AND AWARDS

Grants

- Discovery Grant, *Natural Sciences and Engineering Research Council of Canada* (NSERC), 2019–2024
- Sentinelle Nord Research Chair on Applications and Theory of Network Analysis, *Université Laval*. 2018–2023

Fellowships

- Juan de la Cierva – Incorporación (postdoctoral fellowship), *Ministerio de Economía, Industria y Competitividad de España*, 2017–2019
- Postdoctoral Fellowship, *Fonds de recherche du Québec – Nature et Technologies* (FRQNT), 2014–2016
- Frederick Banting and Charles Best Canada Graduate Scholarships - Doctoral Awards, *Canadian Institutes of Health Research* (CIHR), 2009–2012
- Doctoral Research Scholarship, *Fonds de recherche du Québec – Nature et Technologies* (FRQ-NT), 2008 (declined)
- Doctoral Research Scholarship, *Fondation de l'Université Laval*, 2008 (declined)
- Undergraduate Student Research Award, *Natural Sciences and Engineering Research Council of Canada* (NSERC), 2006
- Undergraduate Student Research Award, *Natural Sciences and Engineering Research Council of Canada* (NSERC), 2005

Other Recognitions

- 2019 AESGUL Prize for “Teacher of the year” (elected by the undergraduate students), 2019
- Board of Honour for a Ph.D.'s Thesis (highest distinction), Faculty of Graduate Studies, Université Laval, 2014
- Nominated 2013 AESGUL Prize for “Staff member of the year” as the Teaching Assistant of PHY-3000 Statistical Physics (elected by the undergraduate students), 2014
- Board of Honour for a Master's Thesis (highest distinction), Faculty of Graduate Studies, Université Laval, 2009
- Third Place at the Student Competition (Poster Presentation), Congress of the Canadian Association of Physicists, Quebec City, 2008
- 2006 AESGUL Prize for “Staff member of the year” as the Teaching Assistant of PHY-1002 Mathematical Physics II (elected by the undergraduate students), 2007
- Rouge et Or Distinction for excellence in academic undergraduate results, 2006
- Nominated 2003 AESGUL Prize for “Student of the year” (chosen by the peers), 2004

²Mathematical modelling in contact networks for epidemiology: Introduction of heterogeneity in transmissibility.

TEACHING

Université Laval

Québec, Canada

Teacher

- PHY-7053 Theory of Complex Systems and Networks Winter 2020
- PHY-3500 Numerical Physics (partial task) Winter 2020
- PHY-3000 Statistical Physics Fall 2019
- PHY-2502 Nonlinear Dynamics, Chaos and Complexity Winter 2019
- PHY-7008 B Special Subjects Deep Learning: Theory and applications Winter 2019
- PHY-3000 Statistical Physics Fall 2018
- ★ Awarded 2019 AESGUL Prize for “Teacher of the year” (elected by the undergraduate students)

Université Laval

Québec, Canada

Teaching Assistant

- PHY-3000 Statistical Physics Fall 2013
- ★ Nominated 2013 AESGUL Prize for “Staff member of the year” (elected by the undergraduate students)
- PHY-2502 Nonlinear Dynamics, Chaos and Complexity Fall 2012
- PHY-3000 Statistical Physics Fall 2010
- PHY-3000 Statistical Physics Fall 2009
- PHY-1002 Mathematical Physics II Fall 2007
- PHY-2502 Nonlinear Dynamics, Chaos and Complexity Winter 2007
- PHY-1002 Mathematical Physics II Fall 2006
- ★ Awarded 2006 AESGUL Prize for “Staff member of the year” (elected by the undergraduate students)

St. Anthony’s RC Girls School/Hetton School

Sunderland, United Kingdom

Foreign Language Assistant

2008–2009

MENTORING

Ph.D. students

- Charles Murphy, *Université Laval*, 2018–present
- Vincent Thibeault, *Université Laval*, Fall 2019

M.Sc. students

- Béatrice Désy, *Université Laval*, Fall 2019
- Francis Normand³, *Université Laval*, 2019–present
- Charles Murphy³, *Université Laval*, 2016–2017

Summer interns

- Olivier Ribordy, *Université Laval*, 2019
- François Thibault, *Université Laval*, 2019

Bachelor’s thesis

- Marta Caveró Lázaro³, *Universitat Autònoma de Barcelona*, 2018

ORGANIZING ACTIVITIES

Complex Networks Winter Workshop (CNWW)

Québec, Canada

Co-director

December 2019

- In collaboration with [Sentinelle Nord](#) and the [Vermont Complex Systems Center](#)

³Acting/acted as co-advisor.

International School and Conference on Network Science (NetSci 2019)

Burlington VT, USA

School, Poster Session, and Satellite Co-chair

May 2019

- Organized by the [Vermont Complex Systems Center](#)

Complex Networks Winter Workshop (CNWW)

Québec, Canada

Co-director

December 2018

- In collaboration with [Sentinelle Nord](#), the [Vermont Complex Systems Center](#) and the [Network Science Institute](#)

Contagion & Networks (ContNet2018)

Paris, France

Co-organizer

June 2018

- Satellite symposium of the International School and Conference on Network Science (NetSci 2018)
- In collaboration with B. M. Althouse, L. Hébert-Dufresne and S. V. Scarpino

Contagion & Networks (ContNet2017)

Indianapolis IN, USA

Co-organizer

June 2017

- Satellite symposium of the International School and Conference on Network Science (NetSci 2017)
- In collaboration with B. M. Althouse, L. Hébert-Dufresne and S. V. Scarpino

REVIEWING ACTIVITIES

Program committee

- 8th International Conference on Complex Networks and their Applications (Complex Networks 2019)
- 10th Conference on Network Modeling and Analysis (MARAMI 2019)
- International School and Conference on Network Science (NetSci 2019)
- 7th International Conference on Complex Networks and their Applications (Complex Networks 2018)
- International School and Conference on Network Science (NetSci 2018)
- 6th International Conference on Complex Networks and their Applications (Complex Networks 2017)
- Mapping Complexity: Foundations and Applications of Network Geometry workshop (MACFANG-17)
- 5th International Workshop on Complex Networks and their Applications (Complex Networks 2016)

Jury

- Xavier Roy-Pomerleau (Master's thesis, *Université Laval*, 2019)
- Vincent Thibeault (Master's thesis, *Université Laval*, 2019)
- Guillaume St-Onge (PhD exam, *Université Laval*, 2019)
- Edward Laurence (PhD seminar, *Université Laval*, 2018)
- Edward Laurence (PhD exam, *Université Laval*, 2017)
- Jaume Palmer Real (Master's thesis, *Universitat Autònoma de Barcelona*, 2017)

Scholarships

- Larkin Kerwin undergraduate scholarship, *Université Laval*, 2019

Scientific journals

- Applied Network Science
- Bioinformatics
- Discrete Dynamics in Nature and Society
- Europhysics Letters
- IEEE's Transactions on Network Science and Engineering
- Nature Communications
- Physica A

- Physical Review E
- Physical Review Letters
- Physical Review X
- PLOS ONE
- Scientific Reports

ADMINISTRATIVE ACTIVITIES

Student Investment Fund Board member	Université Laval 2012–2013
Physics Graduate Student Union Treasurer	Université Laval 2011–2012
Physics Graduate Program Committee Member	Université Laval 2011–2012
Physics Professoral Assembly Student representative	Université Laval 2010–2012
Physics Undergraduate Student Union Treasurer	Université Laval 2004–2006

PUBLICATIONS AND PRESENTATIONS

Submitted manuscripts

- *On the accuracy of message-passing approaches to percolation in complex networks*, **A. Allard** and L. Hébert-Dufresne, [arXiv:1906.10377](#) (2019)
- *Geometric renormalization unravels self-similarity of the multiscale human connectome*, M. Zheng, **A. Allard**, Patric Hagmann and M. Á. Serrano, [arXiv:1904.11793](#) (2019)
- *Mercator: uncovering faithful hyperbolic embeddings of complex networks*, G. García-Pérez⁴, **A. Allard**⁴, M. Á. Serrano and M. Boguñá, [arXiv:1904.10814](#) (2019)
- *Smeared phase transitions in percolation on real complex networks*, L. Hébert-Dufresne and **A. Allard**, [arXiv:1810.00735](#) (2018)
- *Navigable maps of structural brain networks across species*, **A. Allard** and M. Á. Serrano, [arXiv:1801.06079](#) (2018)

Research publications⁵ (refereed)

- *Percolation and the effective structure of complex networks*, **A. Allard** and L. Hébert-Dufresne, [Phys. Rev. X 9, 011023](#) (2019) [1]
- *Geometric evolution of complex networks with degree correlations*, C. Murphy, **A. Allard**, E. Laurence, G. St-Onge, and L. J. Dubé, [Phys. Rev. E 97, 032309](#) (2018) [2]
- *The risk of sustained sexual transmission of Zika is underestimated*, **A. Allard**⁴, B. M. Althouse⁴, L. Hébert-Dufresne⁴, and S. V. Scarpino⁴, [PLoS Pathog. 13, e1006633](#) (2017) [27]

⁴Equal contribution.

⁵Known number of citations in brackets (according to [Google Scholar](#)).

- *Asymmetric percolation drives a double transition in sexual contact networks*, **A. Allard**, B. M. Althouse, S. V. Scarpino, and L. Hébert-Dufresne, *Proc. Natl. Acad. Sci. USA* **114**, 8969–8973 (2017) [17]
- *Strategic tradeoffs in competitor dynamics on adaptive networks*, L. Hébert-Dufresne, **A. Allard**, P.-A. Noël, J.-G. Young, and E. Libby, *Sci. Rep.* **7**, 7576 (2017) [4]
- *The geometric nature of weights in real complex networks*, **A. Allard**, M. Á. Serrano, G. García-Pérez, and M. Boguñá, *Nat. Commun.* **8**, 14103 (2017) [38]
 - ★ Featured in [Nature Physics' Research highlights](#).
 - ★ Featured in [Nature Communications' Web collection on complex systems](#).
- *The effect of a prudent adaptive behaviour on disease transmission*, S. V. Scarpino, **A. Allard**, and L. Hébert-Dufresne, *Nature Phys.* **12**, 1042–1046 (2016) [28]
 - ★ Featured in [Nature Physics' News & Views](#).
 - ★ In the top 5% of all research outputs scored by [Altmetric](#) (media coverage).
- *The hidden hyperbolic geometry of international trade: World Trade Atlas 1870–2013*, G. García-Pérez, M. Boguñá, **A. Allard**, and M. Á. Serrano, *Sci. Rep.* **6**, 33441 (2016) [34]
 - ★ Featured in the section *Economía* of the newspaper *El Periódico*.
- *Growing networks of overlapping communities with internal structure*, J.-G. Young, L. Hébert-Dufresne, **A. Allard**, and L. J. Dubé, *Phys. Rev. E* **94**, 022317 (2016) [7]
- *Multi-scale structure and topological anomaly detection via a new network statistic: The onion decomposition*, L. Hébert-Dufresne, J. Grochow, and **A. Allard**, *Sci. Rep.* **6**, 31708 (2016) [9]
- *Constrained growth of complex scale-independent systems*, L. Hébert-Dufresne, **A. Allard**, J.-G. Young, and L. J. Dubé, *Phys. Rev. E* **93**, 032304 (2016) [10]
 - ★ Featured in the *Editors' Suggestions* section of *Phys. Rev. E*.
- *Complex networks as an emerging property of hierarchical preferential attachment*, L. Hébert-Dufresne, E. Laurence, **A. Allard**, J.-G. Young, and L. J. Dubé, *Phys. Rev. E* **92**, 062809 (2015) [9]
- *General and exact approach to percolation on random graphs*, **A. Allard**, L. Hébert-Dufresne, J.-G. Young, and L. J. Dubé, *Phys. Rev. E* **92**, 062807 (2015) [15]
- *A shadowing problem in the detection of overlapping communities: Lifting the resolution limit through a cascading procedure*, J.-G. Young, **A. Allard**, L. Hébert-Dufresne, and L. J. Dubé, *PLOS ONE* **10**, e0140133 (2015) [10]
- *Spreading dynamics on complex networks: a general stochastic approach*, P.-A. Noël, **A. Allard**, L. Hébert-Dufresne, V. Marceau, and L. J. Dubé, *J. Math. Biol.* **69**, 1627–1660 (2014) [10]
- *A system-level model for the microbial regulatory genome*, A. N. Brooks, D. J. Reiss, **A. Allard**, W.-J. Wu, D. M. Salvanha, C. L. Plaisier, S. Chandrasekaran, M. Pan, A. Kaur, and N. S. Baliga, *Mol. Syst. Biol.* **10**, 740 (2014) [38]
- *Coexistence of phases and the observability of random graphs*, **A. Allard**, L. Hébert-Dufresne, J.-G. Young, and L. J. Dubé, *Phys. Rev. E* **89**, 022801 (2014) [4]
 - ★ Featured in the *Editors' Suggestions* section of *Phys. Rev. E*.
- *Percolation on random networks with arbitrary k -core structure*, L. Hébert-Dufresne⁴, **A. Allard**⁴, J.-G. Young, and L. J. Dubé, *Phys. Rev. E* **88**, 062820 (2013) [21]
- *Global efficiency of local immunization of complex networks*, L. Hébert-Dufresne⁴, **A. Allard**⁴, J.-G. Young⁴, and L. J. Dubé, *Sci. Rep.* **3**, 2171 (2013) [79]
- *Bond percolation on a class of correlated and clustered random graphs*, **A. Allard**, L. Hébert-Dufresne, P.-A. Noël, V. Marceau, and L. J. Dubé, *J. Phys. A* **45**, 405005 (2012) [23]

- *Exact solution of bond percolation on small arbitrary graphs*, **A. Allard**, L. Hébert-Dufresne, P.-A. Noël, V. Marceau, and L. J. Dubé, [EPL 98, 16001 \(2012\)](#) [8]
- *Propagation on networks: An exact alternative perspective*, P.-A. Noël, **A. Allard**, L. Hébert-Dufresne, V. Marceau, and L. J. Dubé, [Phys. Rev. E 85, 031118 \(2012\)](#) [22]
- *Structural preferential attachment: Stochastic process for the growth of scale-free, modular and self-similar systems*, L. Hébert-Dufresne, **A. Allard**, V. Marceau, P.-A. Noël, and L. J. Dubé, [Phys. Rev. E 85, 026108 \(2012\)](#) [13]
- *Structural preferential attachment: Network organization beyond the link*, L. Hébert-Dufresne, **A. Allard**, V. Marceau, P.-A. Noël, and L. J. Dubé, [Phys. Rev. Lett. 107, 158702 \(2011\)](#) [35]
- *Modeling the dynamical interaction between epidemics on overlay networks*, V. Marceau, P.-A. Noël, L. Hébert-Dufresne, **A. Allard**, and L. J. Dubé, [Phys. Rev. E 84, 026105 \(2011\)](#) [109]
- *Propagation dynamics on networks featuring complex topologies*, L. Hébert-Dufresne, P.-A. Noël, V. Marceau, **A. Allard**, and L. J. Dubé, [Phys. Rev. E 82, 036115 \(2010\)](#) [38]
 ★ Also in the *Virtual Journal of Biological Physics Research*, issue 7, vol. 20 (2010).
- *Adaptive networks: Coevolution of disease and topology*, V. Marceau, P.-A. Noël, L. Hébert-Dufresne, **A. Allard**, and L. J. Dubé, [Phys. Rev. E 82, 036116 \(2010\)](#) [179]
 ★ Also in the *Virtual Journal of Biological Physics Research*, issue 7, vol. 20 (2010).
- *Heterogeneous bond percolation on multitype networks with an application to epidemic dynamics*, **A. Allard**, P.-A. Noël, L. J. Dubé, and B. Pourbohloul, [Phys. Rev. E 79, 036113 \(2009\)](#) [96]
 ★ Also in the *Virtual Journal of Biological Physics Research*, issue 7, vol. 17 (2009).

Book chapters

- *A new approach to international trade from Network Geometry: The World Trade Atlas 1870-2013*, G. García-Pérez, M. Boguñá, **A. Allard**, and M. Á. Serrano, in [Networks of International Trade and Investment: Understanding globalization through the lens of network analysis](#), S. Gorgoni, A. Amighini, and M. Smith (Eds.), Vernon Press, pp. 71–112 (2018) ISBN:978-1-62273-065-0
- *The Social Zombie: Modelling undead outbreaks on social networks*, L. Hébert-Dufresne, P.-A. Noël, V. Marceau, **A. Allard**, and L. J. Dubé, in [Mathematical Modelling of Zombies](#), R. Smith? (Ed.), University of Ottawa Press, pp. 149–170 (2014) ISBN:978-0-77662-210-1

Scientific outreach

- *Des ponts d'Euler à la grippe aviaire: De l'abstraction mathématique à la réalité sociale des épidémies*⁶, **A. Allard**, P.-A. Noël, and L. J. Dubé, [Accromath 4 \(winter-spring 2009\)](#)

Selected presentations⁷

- *An introduction to the methodologies for studying complex networks* (oral), Scientific Retreat of the thematic project 1 (TP1) – Sentinelle Nord, Forêt Montmorency, Québec, 2019
- *Three tales about percolation on real complex networks* (oral), International Conference on Complex Networks, Tarragona, Spain, 2019
- *Modeling with Random Networks* (oral, Joint talk with L. Hébert-Dufresne), Complex Networks Winter Workshop, Québec, Québec, 2018
- *Les réseaux complexes: un paradigme unificateur et transformateur pour comprendre la relation dynamique/structure des systèmes complexes* (oral), Centre de recherche CERVO, Québec, Québec, 2018

⁶From Euler bridges to avian flu: From mathematical abstraction to the social reality of epidemics.

⁷Invited presentations are denoted with a filled circle.

- *Les réseaux complexes: un paradigme unificateur et transformateur pour comprendre la relation dynamique/structure des systèmes complexes* (oral), Institut de biologie intégrative et des systèmes, Université Laval, Québec, Québec, 2018
- *The hyperbolic brain: A geometric approach to network neuroscience* (oral), Sentinelle Nord Annual Meeting, Québec, Québec, 2018
- *Double epidemic threshold and the potential of the Zika virus as a sustained STI* (oral), BIFI International Conference, Zaragoza, Spain, 2018
- *The effective navigable geometry of the brain* (oral), Mapping Complexity: Foundations and Applications of Network Geometry workshop (MACFANG-17), Barcelona, Spain, 2017
- *The effective navigable geometry of the brain* (oral), International School and Conference on Network Science, Indianapolis, Indiana, 2017
- *Towards an effective structure of complex networks and its contributions to epidemiology and neuroscience* (oral), Network Science Institute, Boston, Massachusetts, 2017
- *The geometric nature of weights in real complex networks* (oral), Conference on Complex Systems (CCS 2016), Amsterdam, The Netherlands, 2016
- *The hidden geometry of complex weighted networks* (oral), 8th International Conference on Discrete Models of Complex Systems (Summer Solstice 2016), Aveiro, Portugal, 2016
- *Unveiling the hidden geometry of weighted networks* (oral), International School and Conference on Network Science (TOPONETS15), Zaragoza, Spain, 2015
- *Exploring the hidden metric space of complex networks* (oral), Santa Fe Institute, Santa Fe, New Mexico, 2015
- *Percolation on clustered and correlated random graphs: General formalism and applications* (poster), International School and Conference on Network Science, Copenhagen, Denmark, 2013
- *Bond and site percolation on clustered and correlated random graphs* (oral), Joint CRM-Imperial College School and Workshop in Complex Systems, Barcelona, Spain, 2013
- *Unveiling hidden communities through cascading detection on network structures* (oral), 2nd International Conference on Complex Sciences, Santa Fe, New Mexico, 2012
- *Exact solution of bond percolation on small arbitrary graphs* (oral), International School and Conference on Network Science, Evanston, Illinois, 2012
- *Using network organization to hinder propagation in structured populations* (poster), International School and Conference on Network Science, Evanston, Illinois, 2012
- *Multitype modular networks as a model of clustered social networks* (poster), International School and Conference on Network Science, Boston & Cambridge, Massachusetts, 2010
- *Heterogeneous Bond Percolation on Complex Networks: Application to Epidemiology* (poster), Canadian Association of Physicists Congress, Québec City, 2008
- ★ Third place at the student competition.