(Max)imilian Puelma Touzel, Canadian/Chilean citizen

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Mila, #200, 6666 rue St. Urbain, Montreal, Quebec H2S 3H1, Canada

Languages spoken: ***English*** (native), ***Spanish*** (fluent), ***French*** (intermediate), ***German*** (intermediate)

Education

2011-2015 **PhD – Physics**
Physics of Biological and Complex Systems (International Max Planck Research School)
University of Goettingen, Germany
Dissertation: *Cellular dynamics and stable chaos in balanced networks* (link)
Committee: Fred Wolf, Robert Guetig, Joerg Enderlein

2008-2009 **Master of Science – Physics**
Department of Physics, University of Toronto, Canada

2001-2006 **Honours Bachelor of Science – Mathematics & Physics (Double Specialist)**
Department of Physics, University of Toronto, Canada

Research Experience

2020-present **Research Associate - Canadian Excellence Research Chair funded** Montréal, Canada
Mila*, Université de Montréal*
- decision-making tasks as psychometric diagnostics using inverse reinforcement learning
- Dynamics of continual reinforcement learning
- Topic Modelling in NLP applications

2018-2020 **Post-Doctoral Fellow - IVADO PDF award** Montréal, Canada
Mila*, Université de Montréal*
Advisors: Yoshua Bengio & Guillaume Lajoie
- Improving training for recurrent neural network models using dynamical systems
- Normative analyses and neural implementations of human and primate decision-making

2015-2018 **Post-Doctoral Fellow - ERC-funded** Paris, France
Laboratoire de physique théorique*, Ecole Normale Supérieure*
Advisors: Aleksandra Walczak & Thierry Mora
- statistical inference of probabilistic models of genetic recombination and selection processes
- model-based inference of repertoire dynamics using high-throughput sequencing

2010-2015 **Doctoral Researcher - IMPRS Excellence stipend award** Goettingen, Germany
Theoretical Neurophysics Group*, Max Planck Institute for Dynamics and Self-Organization*
Advisor: Fred Wolf
- statistical physics of cortical circuit attractor dynamics, response theory for neural ensembles, neural classifiers for sequence discrimination

2009-2010 **Master's Researcher** Toronto, Canada
Systems Biophysics Lab, *Department of Physics, University of Toronto*
Advisor: William Ryu
- thermotaxis assay development and imaging experiments for *C. elegans*

2004-2005 **Undergraduate Researcher** Toronto, Canada
Centre for Quantum Information and Quantum Control, *University of Toronto*
Advisor: Aephraim Steinberg
- optimal measurement theory in quantum state discrimination

Scholary Awards & Grants

2021 **FRQNT Team grant award** (co-written; 180k/3 years)
2019 **Montreal AI & Neuroscience conference Poster Award**
2018 **IVADO Post-doctoral fellowship award** ($140k over 2 years)
2015 **Sloan-Swartz Travel Fellowship** (1 of 2)
Swartz Foundation Meeting 2015, HHMI Janelia Farms
2014 **Summer School Start-up Program grant** (€20k)
University of Goettingen (principal writer and coordinator)
2012 **ACCN Award (sole recipient,** €2k)
Advanced Course in Computational Neuroscience, Organization for Computational Neuroscience
2012 **CNS 2012 Conference Poster Award**
2011 **Excellence Fellowship, IMPRS PhD** (2 yrs.)
International Max Planck Research School *Physics of Biological and Complex Systems*
2009 **Travel grant, Neural Dynamics Summer School**
MITACS (Mathematics of Information Technology and Complex Systems)
2001 **90th Percentile**, Leonardo da Vinci Competition
Faculty of Applied Science and Engineering, University of Toronto

Work (10 journal; 3 AI workshop/conference; 8 first-author; h-index=8; *equal contr.; ■ AI conf.; ○ pre-print)

■ **Puelma Touzel M***, Memarian A*, Riemer M, Bhuti R, Rish I. Summarizing societies: Agent abstraction. ICLR Workshop From Cells to Societies (2022).
■ Riemer M, Chandra Raparthy S, Cases I, Subbaraj G, **Puelma Touzel M**, Rish I. Continual Learning In Environments With Polynomial Mixing Times. NeurIPS Workshop on ecological theory of RL (2021)
○ **Puelma Touzel M**, Cisek P, Lajoie G. Deliberation gated by opportunity cost adapts to context with urgency. Bioarxiv: 2021.07.31.452742 (in revision)
○ Koraichi MB, **Puelma Touzel M**, Mora T, Walczak AM. NoisET: Noise learning and Expansion detection of T-cell receptors with Python. arxiv: 2102.03568 (submitted)
• **Puelma Touzel M***, Vogt R*, Schlizerman E, Lajoie, G. On Lyapunov Exponents for RNNs: Understanding Information Propagation Using Dynamical Systems Tools. Frontier is Applied Mathematics (2022)
■ **Puelma Touzel M**, Cisek P, Lajoie G (2020). Urgency as the opportunity cost of commitment (workshop, NeurIPS).
• **Puelma Touzel M**, Mora T, Walczak A (2019). Inferring the immune response from repertoire sequencing. PLOS Comp Bio 16(4): e1007873.
■ Goyette K*, Kerg GC*, **Puelma Touzel M**, Gidel G, Vorontsov E, Bengio Y, Lajoie G (2019). "Non-normal Recurrent Neural Network (nnRNN): learning long time dependencies while improving expressivity with transient dynamics" NeurIPS Proc. 32
• **Puelma Touzel M**, Wolf F (2019). "The statistical mechanics of phase-space partitioning in large-scale spiking neuron circuits." Phys. Rev. E (99)5. 1-16.
• Pogorelyy M, Minervina A, **Puelma Touzel M**, Sycheva A, Komech E, Kovalenko E, Karganova G, Egorov E, Komkov A, Chudakov D, Mamedov I, Mora T, Walczak A, Lebedev Y (2018). Precise tracking of vaccine-responding T-cell clones reveals convergent and personalized response in identical twins. PNAS, 115 (50) 12704-12709.
• Magadan S, Jouneau L, **Puelma Touzel M**, Marillet S, Chara W, Six A, Quillet E, Mora T, Walczak A, Cazals F, Sunyer O, Fillatreau S, Boudinot P (2018). "Origin of Public Memory B Cell Clones in Fish After Antiviral Vaccination". Front. Immuno. (9) 2115.
• Murall CL, Abbate JL, **Puelma Touzel M**, Allen-Vercoe E, Alizon S, Froissart R, McCann K (2016). "Invasions of Host-Associated Microbiome Networks". vol. 56 Networks of Invasion. Editors: Bohane D, Dumbrell A & Massol F. Advances in Ecological Research.
• **Puelma Touzel M**, Wolf F (2015). "Complete Firing-Rate Response of Neurons with Complex Intrinsic Dynamics." PLoS Comput Biol 11(12): e1004636.
• Wolf F, Engelken R, **Touzel MP**, Weidinger JDF, Neef A (2014). "Dynamical models of cortical circuits," *Current Opinion in Neurobiology* (25) 228-36. (Invited article for special issue in computational neuroscience)
• **Touzel MP**, Adamson RBA, Steinberg AM (2007). "Optimal bounded-error strategies for projective measurements in non-orthogonal state discrimination," *Phys. Rev. A*, 76(6), 062314.

Society membership, Institutional/Research community service

- DBIO member, **American Physical Society**
- Reviewer, **Physical Review X** (Editor's remark: "You clearly put a lot of effort in thinking about the paper and preparing your review. Your help is much appreciated.")
- Reviewer, **COSYNE, NeurIPS**
- Member, **Society for Computational Neuroscience**,
- DPMB member, **Canadian Association of Physicists**
- W2 Professorship hiring committee, **Max Planck Institute for Dynamics and Self-Organization** (2015)
- Board member (Student Representative), **Institute of Nonlinear Dynamics**, Goettingen, Germany (2014-2015)

Organization of Science Conferences, Workshops, Schools, Reading Groups, Courses

2022 **Workshop Co-organizer** Providence, USA
Social alignment in humans and machines (*ICLR Workshop*)

2021 **Symposium Co-organizer** Montréal, Canada
Symposium on Explanation in Neuroscience & Artificial Intelligence (SENAI)

2020-2022 **Reading group Co-organizer** Montréal, Canada
Mila NeuroAI reading group

2020 **Discussion session facilitator** Montréal, Canada
Higher-order cognition *session (UNIQUE Student Symposium 2020)*

2019 **Workshop co-organizer** Montréal, Canada
Real neurons & hidden units Workshop (NeurIPS NeuroAI Workshop)
Comprehensive 1-day event, e.g. >50 double-blind review processed papers, live video feed, panel, etc.

Workshop group discussion activity organizer Toronto, Canada
Mathematics of Vision Workshop, Fields Institute

Conference co-organizer Montréal, Canada
Montreal Physics and AI Workshop
>200 participants, lectures, and beginner and advanced workshops

2017 **Symposium co-organizer** Paris, France
- *Paris Biological Physics Community Day*

2012-2015 **Summer school lead organizer** Goettingen, Germany
Goettingen Advanced Course in Computational Neuroscience
- Managed team, facilitated the event.

Initiated, acquired funding for, and oversaw a transition to a novel, advanced-content format

2011-2015 **Course co-coordinator/content manager** Goettingen, Germany
- Seminar in Biophysics, Seminar in Theoretical Neuroscience

2014 **Summer school co-coordinator (Week 2: Network Neurodynamics)** Valparaiso, Chile
Latin American Summer School in Computational Neuroscience held at Instituto de Sistemas Complejos Valparaiso

Selected Talks

2022 **(Invited) BIRS Workshop on Dynamical Principles of Bio. & Artificial Neural Nets** Banff, Canada

2021 **Neural Scaling Laws Workshop** Tremblant, Canada

2021 **Reinforcement learning Reading Group (Mila)** Virtual

2020 **Ross Otto Lab (McGill Psychology)** Virtual
Urgency as the opportunity cost of time

Neural AI Reading Group (Mila) Montreal, Canada
Inverse Rational Control

2019 ***Soft Matter & Biophysics Seminar*, Simon Fraser University** (invited) Vancouver, Canada
An inference take on urgency in decision-making

***Computational Neuroscience Seminar*, University of Ottawa** (invited) Ottawa, Canada

An inference take on urgency in decision-making
Quantitative & Computational Biology Seminar, UdeM (invited) Montreal, Canada
Inferring repertoire dynamics from repertoire sequencing
2018 *Spotlight talk*, Rice University, q-bio Conference Houston, USA
Ensemble response of immune repertoires to vaccination
2018 *Friday seminar,* UCL, Gatsby Theoretical Neuroscience Unit (invited) London, UK
Understanding the shape of high-dimensional activity in cortex-inspired neural circuits
Biophysics seminar, Emory University, Dept. Physics (invited) Atlanta, USA
APS March Meeting Los Angeles, USA
Repertoire-based approach to identifying sequence motifs specific to an effective vaccine
Biophysics seminar, McGill University, Dept. Physics (invited) Montréal, Canada
Inferring contributions of recombination and selection to singly-perturbed repertoires
Tea talk, Montreal Institute for Learning Algorithms (invited) Montréal, Canada
Don't paint the box black: Using dynamical systems to explain complex phase space geometry
2017 *Systems Immunology and Vaccine Design Workshop* Heidelberg, Germany
Repertoire-based approach to identifying sequence motifs specific to an effective vaccine
Biophysics Seminar, U of T Dept. Physics Toronto, Canada
Inferring contributions of recombination and selection to singly-perturbed repertoires
2016 *PhD & PostDoc Seminar,* ENS Dept. Physics Paris, France
The statistical mechanics of phase space partitioning in large scale neuronal circuits
2015 *Swartz Foundation Meeting* Janelia Research Campus, USA
A theory for the balanced state that keeps track of each and every spike
Neuronal Circuits and Computations Group Seminar, Friedrich Miescher Institute Basel, Switzerland
A theory of precise spike timing in cortical circuits
American Physical Society March Meeting San Antonio, USA
2015 Elements of a finite-size ergodic theory for stable chaos
ENS Theoretical Neuroscience Seminar Paris, France
A theory of precise spike timing in cortical circuits
2014 *American Physical Society March Meeting* Denver, USA
Microstate description of stable chaos in networks of spiking neurons
Tutorial Lecture, Summer School in Computational Neuroscience Valparaiso, Chile
Theory and modelling methodology in biophysics through case studies in computational neuroscience

Selected Poster Presentations

2022 *RLDM* Rhode Island, USA
2022 *COSYNE* Lisbon, Portugal
2021 *NeurIPS EcoRL Workshop* Virtual
2021 *MAIS* Virtual
2021 *COSYNE* Virtual
Urgency as the opportunity cost of commitment
2020 *Biological and Artificial Reinforcement Learning Workshop NeurIPS* Virtual
Urgency as the opportunity cost of commitment
2020 *Neuroscience and Artificial Intelligent Systems (Cold Spring Harbor Labs)* Virtual
Urgency as the opportunity cost of commitment
2020 *COSYNE* Denver, USA
An inference perspective on urgency in decision-making
2019 *Montréal AI & Neuroscience Conference* (***Poster Prize Winner***) Montréal, Canada
An inference take on urgency in decision-making
2019 *Physics & AI Workshop* Montréal, Canada
Stochastic thermodynamics of aggregate-label learning
2018 *Montréal AI & Neuroscience Conference* Montréal, Canada
Transfer properties of multi-spike tempotrons
q-bio Conference Houston, USA

Ensemble response of immune repertoires to vaccination
Curie-Weizmann Meeting Paris, France
Inferring perturbations to immune repertoires using clone size statistics

2017 ***Beg Rohu Summer School on Statistical Physics*** Beg Rohu, France
Inferring perturbations to immune repertoire dynamics

2016 ***Statistical physics methods in biology and computer science*** Paris, France
Antibody repertoires in fish

2016 ***Dynamics and Information in Cells and Tissues Workshop*** Les Houches, France
Inferring antibody generation: VDJ recombination in multiply infected fish

2015 ***International Conference in Mathematical Neuroscience*** Antibes, France
How entropy-producing networks can have precise spike times

2015 ***COSYNE*** Salt Lake City, USA
How entropy-producing networks can have precise spike times

2014 ***Bernstein Conference*** Goettingen, Germany
Stable chaos in balanced networks of spiking neurons with synaptic filtering

2013 ***German Neuroscience Society*** Goettingen, Germany
Instability and partial synchrony in a balanced network of resonator neurons
COSYNE Salt Lake City, USA
Controlling the trade-off between categorization and separation via resonance
Bernstein Conference Tuebingen, Germany
Microstate description of stable chaos in balanced spiking networks
Computational Neuroscience Society meeting Paris, France
Olfactory bulb network dynamics as a pattern reservoir for adaptive cortical representations
Mathematical Challenges in Neural Network Dynamics Columbus, USA
Stability properties of a balanced network of Type II neuronal oscillators

2012 ***Bernstein Conference*** Munich, Germany
Analyzing chaotic activity in a balanced network of Type II neuronal oscillators
Computational Neuroscience Society meeting (***Poster Prize Winner***) Decatur, USA
Features of Chaotic Activity in a balanced network of Type II neuronal oscillators

2007 ***International Conference on Quantum Information*** Rochester, U.S.A.
Optimal bounded-error strategies for projective measurements in non-orthogonal state discrimination

2006 ***Conference on Quantum Information and Quantum Control*** Toronto, Ontario
Non-orthogonal state discrimination in the presence of error using projective strategies

Participation in Schools

2017 ***Beg Rohu Summer School on Statistical Physics*** Beg Rohu, France
Out of Equilibrium Dynamics, Evolution and Genetics
Cargese Summer School *Theoretical Biophysics* Cargese, France

2016 ***Course on Multiscale Integration in Biological Systems,*** Curie Institute Paris, France
Physical description of biological systems, from single molecule to organisms
L'Ecole de Physique des Houches Les Houches, France
Dynamics and Information in Cells and Tissues
Kavli Institute for Theoretical Physics Santa Barbara, USA
Quantitative Immunology

2015 ***Kavli Institute for Theoretical Physics*** Santa Barbara, USA
Olfaction

2014 ***Latin American Summer School in Computational Neuroscience*** Valparaiso, Chile

2013 ***Mathematical Biosciences Institute*** Columbus, USA
Mathematical Challenges in Neural Network Dynamics

2012 ***Computational Neuroscience Society*** Bedlewo, Poland
Advanced Course in Computational Neuroscience (ACCN)

2009 ***Latin American Summer School in Computational Neuroscience*** Valparaiso, Chile
Center for Neural Dynamics Ottawa, Canada

Computational Neuroscience Summer School

2008 ***Instituto de Sistemas Complejos*** Valparaiso, Chile
Complex Systems Summer School

Universidad de Chile Santiago, Chile
Mathematical Modeling of Biological Systems using Matlab

2007 ***Institute of Physics*** Manchester, England
Conference and Training Course in Emergent Themes in Biophysics

Teaching/Supervision Experience

2020-present **Graduate-level dynamical systems lectures (substitute lecturer)** Montreal, Canada

2020-present **2 PhD students co-supervision (with Dr. Irina Rish)** Montreal, Canada

2021-present **2 PhD student co-supervision (with Guillaume Lajoie)** Montreal, Canada

2019 **Physics and AI Workshop tutor** Montreal, Canada

2018 **Master's student supervision (with Drs. Aleks Walczak & Thierry Mora)** Paris, France

2015 **Master's student supervision (with Dr. Fred Wolf)** Goettingen, Germany

2014 **Summer school tutor** Valparaiso, Chile
- Supervised group projects
- Lectured on modelling methodology in neuroscience

2012-2015 **Summer school group work tutor** Goettingen, Germany
Goettingen School for Computational Neuroscience,
Latin American Summer School in Computational Neuroscience
- Group work supervision; designed and implemented literature review activity

2008-2009 **Teaching assistant** Toronto, Canada
Department of Physics, *University of Toronto*
- designed and delivered inquiry-based tutorials.

2006-2007 **Science educator and content programmer** Toronto, Canada
Ontario Science Centre
- developed and performed demonstrations on astronomy, robotics, and resonance

2006 **Science camp co-ordinator** Toronto, Canada
Activity Science Camp With Hispanic Youth
- conceived, designed, and implemented activity-focused summer science camp for at-risk youth supported by the *Centre for Spanish-Speaking People*

2005 **Professional academic tutor** Toronto, Canada
- academic (math & science) and language support to newly immigrated youth

Communications Experience

- **Scientific writing and editing**:
  - 2 years professional manuscript and thesis editing for Max Planck Institute (MPIDS)
  - Scientific Advisory Board Report editing 2016, Max Planck Institute for Dynamics and Self-Organization
  - Successful grant/fellowship-writing
- **Effective communication**: completed graduate-level course, *Effective Communication for Physicists*
- **Public-speaking/Event facilitation**: theatre; television interview; conference chair; summer school facilitator
- **Science communication**: talks; course/camp/school teaching; public science center communicator

Computational Skills

- High-performance computing experience:
  - Regular use of >100 cores for distributed calculations on MPIDS 10,000 core cluster (2012-2015).
  - Use of ENS physics cluster multi-threaded program on 48 core machine (2015-2018)
  - Active cloud computing, *Compute Canada* user (2019-present)
- Multi-language proficient (matlab, python, C++, mathematica).
- Extensive version control and notebook-based prototyping
- **Data science/machine learning stack (python: scipy, scikit-learn, PyTorch, pandas, etc.)**

Selected Outreach/Media

2021	**Mila blog article,** Recap of NeuroAI reading group	Montreal, Canada
2019	**ELife Ambassador**	Montreal, Canada
	• Contributor to the Statistical Literacy Initiative	
2011	**History of science journal article**	Goettingen, Germany
	"*Joseph Rotblat is Dead: Who will Save the World Now?*", *Peace* magazine vol.24 iss.1	
2007	**Canadian Broadcasting Company live on-set, on-air interview**	Toronto, Canada