Giorgio Nicoletti

Contacts

ECHO Laboratory
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giorgionicoletti

Skills

Programming

Advanced Knowledge

Python | Wolfram Mathematica

Basic Knowledge

C++ | Matlab | Julia | R | Bash

Tools

Latex | Powerpoint & MS Office | HTML | CSS | Inkscape

Languages

native: Italian

fluent: English

intermediate: French

beginner: German, Japanese

Research experience

École Polytechnique Fédérale de Lausanne — *Lausanne, Switzerland*
Postdoctoral researcher — 2023 - present
Laboratory of Ecohydrology, with prof. Andrea Rinaldo

Tübingen University — *Tübingen, Germany*
Visiting Ph.D. student — Sept 2022 - Dec 2022
"Self-organization of neuronal networks" group, with prof. Anna Levina

Max Planck Institute for the Physics of Complex Systems — *Dresden, Germany*
Visiting Ph.D. student — June 2022 - July 2022
Division of Biological Physics, with Dr. Daniel M. Busiello

Education

Ph.D. in Physics *cum laude* — *University of Padova*
Thesis: *Information and Criticality in Complex Stochastic Systems* — 2019 - 2023
Supervisors: prof. Amos Maritan and prof. Samir Suweis

Master's Degree in Physics *cum laude* — *University of Padova*
Thesis: *Scaling and Renormalization Group for models of neural activity* — 2017 - 2019
Final grade: 110/110, GPA: 29.93/30

Erasmus+ scolarship — *Paris-Sud University*
International Master in Physics of Complex System, ECTS GPA: A/A — 2018 - 2019

Bachelor's Degree in Physics *cum laude* — *University of Padova*
Thesis: *A Bayesian interpretation of quantum probability* — 2014 - 2017
Final grade: 110/110, GPA: 29.19/30

Invited talks

Information propagation across timescales — *Trieste, Italy*
International Center for Theoretical Physics — *4th Apr 2024*

Tuning transduction from hidden observables to optimize information harvesting — *Trieste, Italy*
"Information processing and decision-making in biology" workshop, ICTP — *11th Mar 2024*

Survival and coexistence in spatially explicit metapopulation models — *Padova, Italy*
"Emergent dynamical patterns of disordered systems with applications to natural communities" workshop — *18th Dec 2023*

Information theory in stochastic processes and complex systems — *Dresden, Germany*
Max Planck Institute for the Physics of Complex Systems — *13th Jul 2022*

What can phase transitions and criticality teach us about brain dynamics? — *Stockholm, Sweden*
BrainNet workshop, KTH Royal Institute of Technology — *23rd - 24th May 2022*

Unfolding complex systems with information theory — *Online*
Young Seminars of the Italian Society of Statistical Physics — *10th Mar 2022*

Publications and preprints

Unveiling gene perturbation effects through Gene Regulatory Networks inference from single-cell transcriptomic data — bioRxiv *2024.05.10.593314 (2024)*
C. Corridori, M. Romeike, G. Nicoletti, C. Buecker, S. Suweis, S. Azaele, G. Martello

Information propagation in Gaussian processes on multilayer networks — arXiv *arXiv:2405.01363 (2024)*
G. Nicoletti, D. M. Busiello

Spatially disordered environments stabilize competitive metacommunities — arXiv *arXiv:2404.09908 (2024)*
P. Padmanabha*, G. Nicoletti*, D. Bernardi*, S. Suweis, S. Azaele, A. Rinaldo, A. Maritan (*equal contribution)

Information propagation in multilayer systems with higher-order interactions across timescales
G. Nicoletti, D. M. Busiello
Phys. Rev. X
14 (2) 021007 (2024)

Tuning transduction from hidden observables to optimize information harvesting
G. Nicoletti, D. M. Busiello
arXiv
arXiv:2403.04709 (2024)

Prenatal experience with language shapes the brain
B. Mariani, G. Nicoletti, G. Barzon, M. C. O. Barajas, M. Shukla, R. Guevara, S. Suweis, J. Gervain
Science Advances
9 (47), eadj3524 (2023)

Emergent encoding of dispersal network topologies in spatial metapopulation models
G. Nicoletti*, P. Padmanabha*, S. Azaele, S. Suweis, A. Rinaldo, A. Maritan (*equal contribution)
PNAS
120 e2311548120 (2023)

A network-based method for extracting the organization of brain-wide circuits from reconstructed connectome datasets
K. K. H. Manjunatha, M. Bruzzone, G. Nicoletti, S. Suweis, M. Dal Maschio
bioRxiv
2023.05.21.541471 (2023)

The emergence of scale-free fire outbreaks in Australia
G. Nicoletti, L. Saravia, F. Momo, A. Maritan, S. Suweis
iScience
26 (3) 106181 (2023)
Best poster award at the conference "Stochastic Models and Experiments in Ecology and Biology 2021" Venice, Italy

The architecture of information processing in biological systems
G. Nicoletti, M. Bruzzone, S. Suweis, M. Dal Maschio, D. M. Busiello
arXiv
2301.12812 (2023)

Mutual information in changing environments: Nonlinear interactions, out-of-equilibrium systems, and continuously varying diffusivities
G. Nicoletti, D. M. Busiello
Phys. Rev. E
106, 014153 (2022)

Information-driven transitions in projections of underdamped dynamics
G. Nicoletti, A. Maritan, D. M. Busiello
Phys. Rev. E
106, 014118 (2022)

Criticality and network structure drive emergent oscillations in a stochastic whole-brain model
G. Nicoletti*, G. Barzon*, B. Mariani, M. Formentin, S. Suweis (*equal contribution)
J. Phys. Complex.
3, 025010 (2022)

Disentangling the critical signatures of neural activity
B. Mariani, G. Nicoletti, M. Bisio, M. Maschietto, S. Vassanelli, S. Suweis
Sci. Rep.
12, 10770 (2022)
Featured in the "Top 100 papers in Neuroscience" published by Scientific Reports in 2022

Mutual information disentangles interactions from changing environments
G. Nicoletti, D. M. Busiello
Phys. Rev. Lett.
127, 228301 (2021)
Physical Review Letters Editors' Suggestion, viewpoint in the APS "Physics" magazine and highlight in PRL's weekly tip sheet for reporters

Neuronal avalanches across the rat somatosensory barrel cortex and the effect of single whisker stimulation
B. Mariani, G. Nicoletti, M. Bisio, M. Maschietto, R. Oboe, A. Leparulo, S. Suweis, S. Vassanelli
Front. Syst. Neur.
15:709677 (2021)

Scaling and criticality in a phenomenological renormalization group
G. Nicoletti, S. Suweis, A. Maritan
Phys. Rev. Res.
2, 023144 (2020)

Contributed talks and posters

Information Processing, Noise, and Adaptation in Living Systems (SIGNAL24)
Dresden, Germany
Talk: Information propagation across timescales in multiscale systems
15^{th} - 19^{th} Apr 2024

Italian Conference on Complex Systems 2023
Naples, Italy
Poster: Emergent encoding of dispersal network topologies in spatial metapopulation models
9^{th} - 11^{th} Oct 2023

28th International Conference on Statistical Physics
Tokyo, Japan
Talk: The architecture of information processing in biological systems
7^{th} - 11^{th} Aug 2023

Brain Criticality Meeting 2022
Online
Poster: Criticality and network structure drive emergent oscillations in a stochastic whole-brain model
7^{th} - 9^{th} Nov 2022

Conference on Complex Systems 2022
Palma de Mallorca, Spain
Talk: Criticality and network structure drive emergent oscillations in a stochastic whole-brain model
Talk: Information-driven transitions in optimal projections of underdamped dynamics
17^{th} - 21^{st} Oct 2022

Bernstein Conference 2022
Berlin, Germany
Poster: Disentangling the critical signatures of neural activity: avalanches, spatial correlations and information
14^{th} - 16^{th} Sept 2022

Conference on Complex Systems 2021 — *Lyon, France*, *25th - 29th Oct 2021*
Talk: Disentangling the role of external and intrinsic dynamics on the critical signatures of neural activity
Talk: Modeling the emergence of scale-free fire outbreaks in Australia
Poster: Disentangling internal interactions from noisy environments through mutual information

Stochastic Models and Experiments in Ecology and Biology 2021 — *Venice, Italy*, *22nd - 25th June 2021*
Poster: Modeling the emergence of scale-free fire outbreaks in Australia

Brain Criticality Virtual Meeting — *Online*, *6th - 9th Oct 2020*
Poster: What can a phenomenological Renormalization Group teach us about criticality in a network of neurons?

Bernstein Conference 2020 — *Online*, *29th Sept - 1st Oct 2020*
Poster: Scaling and criticality in a phenomenological renormalization group

Italian Conference on Complex Systems — *Trento, Italy*, *1st - 3rd July 2019*
Poster: Scaling and Renormalization Group for the activity of neurons

Attended Schools and Workshops

Winter Workshop on Complex Systems 2022 — *Arc-et-Senans, France*, *24th - 28th Jan 2022*
Workshop

Beg Rohu Summer School on "Statistical Mechanics and Emergent Phenomena in Biology" — *St. P. Quiberon, France*, *30th May - 12th June 2021*
School

Computational and Theoretical Models in Neuroscience — *Venice, Italy*, *9th - 16th Sept 2019*
School

Organized Conferences

Robustness, Adaptability and Critical Transitions in Living Systems — *Lyon, France*, *27th Oct 2021*
Main organizer
Satellite of the Conference on Complex Systems 2021

Teaching Experience and Supervision

2023 - 24 **Fundamental of Information Systems**, Master's Degree in Data Science, University of Padova — *Teaching assistant*
2022 - 23 **Advanced Statistical Mechanics**, PhD course in Physics, University of Padova — *Invited lecturer*
2022 - 23 **Physics with applications to biological systems**, Bachelor's Degree in Biology of Human and Environmental Health, University of Padova — *Teaching assistant*
2021 - 23 **Co-supervision of two Master's thesis and two Bachelor's thesis**, Department of Physics and Astronomy, University of Padova — *Co-supervision*
2021 - 22 **Models of Theoretical Physics**, Master's Degree in Physics of Data, University of Padova — *Teaching assistant*
2020 - 22 **IT and Bioinformatics**, Bachelor's Degree in Biology and Molecular Biology, University of Padova — *Teaching assistant*

Honors and Awards

12th Mar 2023 **Featuring in the "Top 100 papers in Neuroscience" published by Scientific Reports in 2022** for the article *Disentangling the critical signatures of neural activity*, Sci. Rep. 127, 12, 10770 (2022)
29th Nov 2022 **Graduate Alumni Award** awarded to the best graduate student of the School of Science, University of Padova
22nd Nov 2021 **Physical Review Letters Editors' Suggestion, viewpoint in "Physics" magazine and highlight in PRL's weekly tip sheet for reporters** for the article *Mutual information disentangles interactions from changing environments*, Phys. Rev. Lett. 127, 228301 (2021)
25th Jun 2021 **Best Poster Award** for "Modeling the emergence of scale-free fire outbreaks in Australia" at *Stochastic Models and Experiments in Ecology and Biology 2021*, ECLT, Venice, Italy. Sponsored by MDPI
Feb 2017 **Student grant** for the best students enrolled in scientific degrees, granted by University of Padova
10th Oct 2014 **Best student award** for the best high school students in Italy, awarded by the Italian Ministry for Education

Service and Memberships

I have reviewed for **PNAS**, **Physical Review X**, **Physical Review Letters**, **Physical Review Research**, **Physical Review E**, and **PLOS Computational Biology**.
2021 - present Member of the **Complex Systems Society**
2021 - 2023 Member of the **Italian Society of Physics**
2021 - 2023 **Elected representative** in the PhD Program Committee and the Academic Board of the PhD program, Department of Physics and Astronomy, University of Padova