Giorgio **Nicoletti**

CONTACTS

Room 232, Quantitative Life Sciences
ICTP, Trieste, Italy

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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

International Center for Theoretical Physics — *Trieste, Italy*
POSTDOCTORAL RESEARCHER — 2024 - PRESENT
Quantitative Life Sciences section, with prof. Antonio Celani

École Polytechnique Fédérale de Lausanne — *Lausanne, Switzerland*
POSTDOCTORAL RESEARCHER — 2023 - 2024
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 *cum laude*, 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 *cum laude*, 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

Finite size scaling of survival statistics in metapopulation models — **PHYS. REV. E**
A. DOIMO, G. NICOLETTI, D. BERNARDI, P. PADMANABHA — *111 (6), 064415 (2025)*

Excitation-inhibition balance controls information encoding in neural populations — **PHYS. REV. LETT.**
G. BARZON, D. M. BUSIELLO, G. NICOLETTI — *134 (6), 068403 (2025)*

Information interference driven by environmental activity — **PHYS. REV. RESEARCH**
G. NICOLETTI, D. M. BUSIELLO — *6 (4), 043275 (2024)*

Landscape and environmental heterogeneity support coexistence in competitive metacommunities

P. Padmanabha*, G. Nicoletti*, D. Bernardi*, S. Suweis, S. Azaele, A. Rinaldo, A. Maritan (*equal contribution)

Information propagation in Gaussian processes on multilayer networks

G. Nicoletti, D. M. Busiello

Tuning transduction from hidden observables to optimize information harvesting

G. Nicoletti, D. M. Busiello

Physical Review Letters Editors' Suggestion and viewpoint in the APS "Physics" magazine

Information propagation in multilayer systems with higher-order interactions across timescales

G. Nicoletti, D. M. Busiello

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

Emergent encoding of dispersal network topologies in spatial metapopulation models

G. Nicoletti*, P. Padmanabha*, S. Azaele, S. Suweis, A. Rinaldo, A. Maritan (*equal contribution)

The emergence of scale-free fire outbreaks in Australia

G. Nicoletti, L. Saravia, F. Momo, A. Maritan, S. Suweis

Best poster award at the conference "Stochastic Models and Experiments in Ecology and Biology 2021" Venice, Italy

Mutual information in changing environments: Nonlinear interactions, out-of-equilibrium systems, and continuously varying diffusivities

G. Nicoletti, D. M. Busiello

Information-driven transitions in projections of underdamped dynamics

G. Nicoletti, A. Maritan, D. M. Busiello

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)

Disentangling the critical signatures of neural activity

B. Mariani, G. Nicoletti, M. Bisio, M. Maschietto, S. Vassanelli, S. Suweis

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

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

Scaling and criticality in a phenomenological renormalization group

G. Nicoletti, S. Suweis, A. Maritan

Preprints

The somatosensory barrel cortex controls the spindle thalamocortical oscillation by frequency locking

R. Guevara, M. Tambaro, M. Maschietto, A. Leparulo, C. Checchetto, G. Nicoletti, B. Mariani, S. Suweis, S. Vassanelli

A novel metric for species vulnerability and coexistence in spatially-extended ecosystems

D. Bernardi, G. Nicoletti, P. Padmanabha, S. Suweis, S. Azaele, A. Rinaldo, A. Maritan

Optimal information gain at the onset of habituation to repeated stimuli

G. Nicoletti, M. Bruzzone, S. Suweis, M. Dal Maschio, D. M. Busiello

Multiscale nonlinear integration drives accurate encoding of input information

G. Nicoletti, D. M. Busiello

Unveiling gene perturbation effects through Gene Regulatory Networks inference from single-cell transcriptomic data

C. Corridori, M. Romeike, G. Nicoletti, C. Buecker, S. Suweis, S. Azaele, G. Martello

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

CONTRIBUTED TALKS AND POSTERS

International Physics of Living Systems (PoLS) Annual Meeting *Urbana-Champaign, USA*
TALK: TUNING TRANSDUCTION FROM HIDDEN OBSERVABLES TO OPTIMIZE INFORMATION HARVESTING WITH A LIMITED ENERGY BUDGET *28th Jul - 1st Aug 2025*

29th International Conference on Statistical Physics *Firenze, Italy*
TALK: TUNING TRANSDUCTION FROM HIDDEN OBSERVABLES TO OPTIMIZE INFORMATION HARVESTING WITH A LIMITED ENERGY BUDGET *13th - 18th Jul 2025*

ENAC Research Day 2024 *Lausanne, Switzerland*
POSTER: LANDSCAPE AND HABITAT HETEROGENEITY DRIVE NICHE COEXISTENCE IN DISPERSING ECOLOGICAL METACOMMUNITIES *9th Sept 2024*

Stochastic Models and Experiments in Ecology and Biology 2024 *L'Aquila, Italy*
TALK: SPATIALLY DISORDERED ENVIRONMENTS STABILIZE COMPETITIVE METACOMMUNITIES *28th - 31st May 2024*

SIGNAL24: Information Processing, Noise, and Adaptation in Living Systems *Dresden, Germany*
TALK: INFORMATION PROPAGATION ACROSS TIMESCALES IN MULTISCALE SYSTEMS *15th - 19th Apr 2024*

Italian Conference on Complex Systems 2023 *Naples, Italy*
POSTER: EMERGENT ENCODING OF DISPERSAL NETWORK TOPOLOGIES IN SPATIAL METAPOPULATION MODELS *9th - 11th Oct 2023*

28th International Conference on Statistical Physics *Tokyo, Japan*
TALK: THE ARCHITECTURE OF INFORMATION PROCESSING IN BIOLOGICAL SYSTEMS *7th - 11th Aug 2023*

Brain Criticality Meeting 2022 *Online*
POSTER: CRITICALITY AND NETWORK STRUCTURE DRIVE EMERGENT OSCILLATIONS IN A STOCHASTIC WHOLE-BRAIN MODEL *7th - 9th 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 *17th - 21st Oct 2022*
TALK: INFORMATION-DRIVEN TRANSITIONS IN OPTIMAL PROJECTIONS OF UNDERDAMPED DYNAMICS

Bernstein Conference 2022 *Berlin, Germany*
POSTER: DISENTANGLING THE CRITICAL SIGNATURES OF NEURAL ACTIVITY: AVALANCHES, SPATIAL CORRELATIONS AND INFORMATION *14th - 16th Sept 2022*

Conference on Complex Systems 2021 *Lyon, France*
TALK: DISENTANGLING THE ROLE OF EXTERNAL AND INTRINSIC DYNAMICS ON THE CRITICAL SIGNATURES OF NEURAL ACTIVITY *25th - 29th Oct 2021*
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*
POSTER: MODELING THE EMERGENCE OF SCALE-FREE FIRE OUTBREAKS IN AUSTRALIA *22nd - 25th June 2021*

Brain Criticality Virtual Meeting *Online*
POSTER: WHAT CAN A PHENOMENOLOGICAL RENORMALIZATION GROUP TEACH US ABOUT CRITICALITY IN A NETWORK OF NEURONS? *6th - 9th Oct 2020*

Bernstein Conference 2020 *Online*
POSTER: SCALING AND CRITICALITY IN A PHENOMENOLOGICAL RENORMALIZATION GROUP *29th Sept - 1st Oct 2020*

Italian Conference on Complex Systems *Trento, Italy*
POSTER: SCALING AND RENORMALIZATION GROUP FOR THE ACTIVITY OF NEURONS *1st - 3rd July 2019*

ATTENDED SCHOOLS AND WORKSHOPS

Emergence of Information in Molecular Systems (MOLINFO) *Munich, Germany*
WORKSHOP *22nd Jul - 2nd Aug 2024*

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

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

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

ORGANIZED CONFERENCES

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

AWARDS, HONORS AND MEDIA COVERAGE

13th Jul 2025   **"Giovanni Paladin" prize** for the best PhD thesis on topics in statistical physics and complex systems for the years 2022-2024. Awarded at the inaugural ceremony of the 29th International Conference on Statistical Physics by the Italian Association for Statistical Physics (SIFS)

3rd Apr 2025   *Entropy* **Outstanding Reviewer Award** awarded to five outstanding reviewers of the journal *Entropy* in 2024

9th Mar 2025   **Phys.org feature article** for the paper *Excitation-Inhibition balance controls information encoding in neural populations*, Phys. Rev. Lett. 134, 068403 (2025)

7th Oct 2024   **Physical Review Letters Editors' Suggestion, viewpoint in the magazine "Physics", and Phys.org feature article** for the paper *Tuning transduction from hidden observables to optimize information harvesting*, Phys. Rev. Lett. 133, 158401 (2024)

22nd Nov 2023   **Press release by the American Association for the Advancement of Science, coverage by several international news outlets (The Times, Daily Mail, El Pais, Le Figaro, Corriere della Sera, and more), and several popular science publications (New Scientists, Nature Italy, PsyPost, Science Alert, and more)** for the paper *Prenatal experience with language shapes the brain*, Science Advances 9 (47), eadj3524 (2023)

12th Mar 2023   **Featuring in the "Top 100 papers in Neuroscience" published by Scientific Reports in 2022** for the paper *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 of the University of Padova

Dec 2021   **Winner of the SECS travel grant** funded by the *Young Researchers in Complex Systems Society*

22nd Nov 2021   **Physical Review Letters Editors' Suggestion, viewpoint in "Physics" magazine and highlight in PRL's weekly tip sheet for reporters** for the paper *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

TEACHING EXPERIENCE AND SUPERVISION

2025   **An introduction to information theory for stochastic biological systems**, PhD course in Physics, University of Padova — *Main lecturer*

2025   **Co-supervision of one Master's thesis**, EPFL-ICTP — *Co-supervision*

2023   **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*

SERVICE AND MEMBERSHIPS

I have reviewed for **Nature Communications**, **PNAS**, **Physical Review X**, **Physical Review Letters**, **Physical Review Research**, **Physical Review E**, **iScience**, **Entropy**, and **PLOS Computational Biology**.

2024 - present   Organizer of **Quantitative Life Sciences Journal Club** at ICTP

2024 - present   Member of the **Italian Society of Statistical Physics**

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