

Giorgio Nicoletti

CONTACTS

Room 232, Quantitative Life Sciences
ICTP, Trieste, Italy
✉ gnicolet@ictp.it
🏠 giorgionicoletti.github.io
📧 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+ scholarship** 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

- Landscape and environmental heterogeneity support coexistence in competitive metacommunities** PNAS
P. PADMANABHA*, G. NICOLETTI*, D. BERNARDI*, S. SUWEIS, S. AZAELE, A. RINALDO, A. MARITAN (*EQUAL CONTRIBUTION) 121 (44) e2410932121 (2024)
- Information propagation in Gaussian processes on multilayer networks** J. PHYS. COMPLEX.
G. NICOLETTI, D. M. BUSIELLO 5, 045004 (2024)

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

PHYS. REV. LETT.
133, 158401 (2024)

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

G. NICOLETTI, D. M. BUSIELLO

PHYS. REV. X
14 (2) 021007 (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 (46) e2311548120
(2023)

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

I SCIENCE
26 (3) 106181 (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

Featured in the "Top 100 papers in Neuroscience" published by Scientific Reports in 2022

SCI. REP.
12, 10770 (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

PHYS. REV. LETT.
127, 228301 (2021)

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. RESEARCH
2, 023144 (2020)

PREPRINTS

Maximal information at the edge of stability in excitatory-inhibitory neural populations

G. BARZON, D. M. BUSIELLO, G. NICOLETTI

ARXIV
arXiv:2406.03380 (2024)

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

C. CORRADORI, M. ROMEIKE, G. NICOLETTI, C. BUECKER, S. SUWEIS, S. AZAELE, G. MARTELLO

BIORXIV
2024.05.10.593314 (2024)

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)

Information gain at the onset of habituation to repeated stimuli

G. NICOLETTI, M. BRUZZONE, S. SUWEIS, M. DAL MASCHIO, D. M. BUSIELLO

ARXIV
2301.12812 (2023)

CONTRIBUTED TALKS AND POSTERS

ENAC Research Day 2024

POSTER: LANDSCAPE AND HABITAT HETEROGENEITY DRIVE NICHE COEXISTENCE IN DISPERSING ECOLOGICAL METACOMMUNITIES

Lausanne, Switzerland
9th Sept 2024

Stochastic Models and Experiments in Ecology and Biology 2024

TALK: SPATIALLY DISORDERED ENVIRONMENTS STABILIZE COMPETITIVE METACOMMUNITIES

L'Aquila, Italy
28th - 31st May 2024

SIGNAL24: Information Processing, Noise, and Adaptation in Living Systems

TALK: INFORMATION PROPAGATION ACROSS TIMESCALES IN MULTISCALE SYSTEMS

Dresden, Germany
15th - 19th Apr 2024

Italian Conference on Complex Systems 2023

POSTER: EMERGENT ENCODING OF DISPERSAL NETWORK TOPOLOGIES IN SPATIAL METAPOPOPULATION MODELS

Naples, Italy
9th - 11th Oct 2023

28th International Conference on Statistical Physics

TALK: THE ARCHITECTURE OF INFORMATION PROCESSING IN BIOLOGICAL SYSTEMS

Tokyo, Japan
7th - 11th Aug 2023

Brain Criticality Meeting 2022

POSTER: CRITICALITY AND NETWORK STRUCTURE DRIVE EMERGENT OSCILLATIONS IN A STOCHASTIC WHOLE-BRAIN MODEL

Online
7th - 9th Nov 2022

Conference on Complex Systems 2022

TALK: CRITICALITY AND NETWORK STRUCTURE DRIVE EMERGENT OSCILLATIONS IN A STOCHASTIC WHOLE-BRAIN MODEL

TALK: INFORMATION-DRIVEN TRANSITIONS IN OPTIMAL PROJECTIONS OF UNDERDAMPED DYNAMICS

Palma de Mallorca, Spain
17th - 21st Oct 2022

Bernstein Conference 2022

POSTER: DISENTANGLING THE CRITICAL SIGNATURES OF NEURAL ACTIVITY: AVALANCHES, SPATIAL CORRELATIONS AND INFORMATION

Berlin, Germany
14th - 16th Sept 2022

Conference on Complex Systems 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

Lyon, France
25th - 29th Oct 2021

Stochastic Models and Experiments in Ecology and Biology 2021

POSTER: MODELING THE EMERGENCE OF SCALE-FREE FIRE OUTBREAKS IN AUSTRALIA

Venice, Italy
22nd - 25th June 2021

Brain Criticality Virtual Meeting

POSTER: WHAT CAN A PHENOMENOLOGICAL RENORMALIZATION GROUP TEACH US ABOUT CRITICALITY IN A NETWORK OF NEURONS?

Online
6th - 9th Oct 2020

Bernstein Conference 2020

POSTER: SCALING AND CRITICALITY IN A PHENOMENOLOGICAL RENORMALIZATION GROUP

Online
29th Sept - 1st Oct 2020

Italian Conference on Complex Systems

POSTER: SCALING AND RENORMALIZATION GROUP FOR THE ACTIVITY OF NEURONS

Trento, Italy
1st - 3rd July 2019

ATTENDED SCHOOLS AND WORKSHOPS

Emergence of Information in Molecular Systems (MOLINFO)

WORKSHOP

Munich, Germany
22nd Jul - 2nd Aug 2024

Winter Workshop on Complex Systems 2022

WORKSHOP

Arc-et-Senans, France
24th - 28th Jan 2022

Beg Rohu Summer School on "Statistical Mechanics and Emergent Phenomena in Biology"

SCHOOL

St. P. Quiberon, France
30th May - 12th June 2021

Computational and Theoretical Models in Neuroscience

SCHOOL

Venice, Italy
9th - 16th Sept 2019

ORGANIZED CONFERENCES

Robustness, Adaptability and Critical Transitions in Living Systems

MAIN ORGANIZER

Satellite of the Conference on Complex Systems 2021

Lyon, France
27th Oct 2021

TEACHING EXPERIENCE AND SUPERVISION

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| 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 |

HONORS AND AWARDS

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| 7 th Oct 2024 | Physical Review Letters Editors' Suggestion and viewpoint in "Physics" magazine for the article <i>Tuning transduction from hidden observables to optimize information harvesting</i> , Phys. Rev. Lett. 133, 158401 (2024) |
| 12 th Mar 2023 | Featuring in the "Top 100 papers in Neuroscience" published by Scientific Reports in 2022 for the article <i>Disentangling the critical signatures of neural activity</i> , Sci. Rep. 127, 12, 10770 (2022) |
| 29 th 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 <i>Young Researchers in Complex Systems Society</i> |

- 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, iScience, Entropy**, and **PLOS Computational Biology**.

- 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