# CURRICULUM VITAE

## ELENA AGLIARI

### GENERAL INFORMATION

| | |
|---|---|
| Date and Place of Birth | 05 JULY 1980, PARMA (IITALY) |
| Citizenship | Italian |
| E-mail | agliari@mat.uniroma1.it; elena.agliari@uniroma1.it |
| Certified E-mail | elena.agliari@pec.it |
| Current position | Associate Professor<br>Department of Mathematics, Sapienza University, Rome, Italy |
| Web-Page | http://www.mat.uniroma1.it/people/agliari |
| Orcid-ID | 0000-0002-5121-3511 |

### EDUCATION AND QUALIFICATION

- October 2022: **National Scientific Qualification** in **Mathematical Physics** (01/A4) as Full Professor (unanimous decision of the Committee)
- July 2018: **National Scientific Qualification** in **Theoretical Physics of Fundamental Interactions** (02/A2) as Associate Professor (unanimous decision of the Committee)
- December 2016: **Qualification** as **Researcher** (ricercatore III livello a tempo indeterminato) in **Applied Mathematics** at CNR (Centro Nazionale delle Ricerche), prot. 368.15
- December 2013; September 2019: **National Scientific Qualification** in **Mathematical Physics** (01/A4) as Associate Professor (unanimous decision of the Committee)
- December 2013: **National Scientific Qualification** in **Theoretical Physics of Matter** (02/B2) as Associate Professor (unanimous decision of the Committee)
- March 2007: **Ph.D. diploma in Physics** at Department of Physics, University of Parma
- March 2004: **Master Degree in Physics** at Department of Physics, University of Parma (final grade: 110/110 lode)
- July 1999: **High School Diploma** at Liceo Scientifico Statale "G. Ulivi" in Parma (final grade 100/100 lode)

### ACCADEMIC APPOINTMENTS

- July 2022 - present: **Associate Professor** (**SSD MAT/07**) at Mathematics Department, **Sapienza University**, Rome (Italy)
- December 2023: **Visiting Professor** at **Nanyang Technological University**, Singapore
- October 2022: **Research guest** at **Isaac Newton for Mathematical Sciences**, Cambridge (United Kingdom)
- July 2019 - July 2022: **Assistant Professor** (RTD-B, **SSD MAT/07**) at Mathematics Department, **Sapienza University**, Rome, Italy
- June 2015 - July 2019: **Research Fellow** (RTD-A, **SSD MAT/07**) at Mathematics Department, **Sapienza University**, Rome (Italy) [3 year contract extended 2 more years]
- March 2015 - May 2015: **Assistant Professor** at Engineering Department, **University Campus Bio-Medico**, Rome (Italy)
- November 2014: **Research guest** at Mathematics Department, **University of São Paulo** (Brazil)
- March 2014 - September 2014: **Research fellowship** at Physics Department, **Sapienza University of Rome** (Italy)
- December 2010 - November 2013: **Researcher Associate** and **local Coordinator** for the project "Dynamics and statistical mechanics of lymphocyte networks below the percolation threshold", within the MIUR program **FIRB** (Futuro In Ricerca) prot. RBFR08EKEV [National Coordinator A. Barra (Sapienza University of Rome)], at Physics Department, University of **Parma** (Italy)
- 2010-2011: several periods spent as **Research Guest** at Laboratoire de Physique Théorique de la Matière Condensée, Université Pierre et Marie Curie, **Paris** (France) for collaboration with the research group led by O. Bénichou

- 2009-2013: several periods spent as **Researcher Guest** at **Sapienza University of Rome** (Italy) for collaboration with the research group "Complex Statistical Mechanics" led by F. Guerra
- 2009-2011: several periods spent as **Researcher Guest** at Albert-Ludwigs-Universität, **Freiburg** (Germany) for collaboration with the research group "Theoretical Polymer Physics" led by A. Blumen
- December 2008 – November 2010: **Post-doc** position (**Assegno di Ricerca**) for researches on *"Transport and Diffusion on complex structures"*, at Physics Department, University of **Parma** (Italy)
- February 2008 – November 2008: **Post-doc** fellowship from **"Fondazione Angelo della Riccia"** for investigations on *"Coherent and incoherent dynamics on discrete structures"*, at Albert-Ludwigs-Universität, **Freiburg** (Germany)
- January 2007 – January 2008: **Post-Doc** position (Borsa di Studio) for researches on *"Transport models for spin systems on complex topologies"*, at Physics Department, University of **Parma** (Italy)

### MAIN RESEARCH TOPICS

- Mathematical methods for neural networks and artificial intelligence
  Rigorous investigations on paradigmatic models of neural networks like the Hopfield network and the Boltzmann machine via statistical-mechanics techniques (e.g., smooth cavity field, multiple stochastic stability, random overlap structures, non-linear PDE approaches, replica symmetry breaking). Development of a fluctuation theory for the order parameters to control analytically phase transitions. Extensions to more sophisticated embeddings (non-mean-field topologies and multi-species models) toward a rationale for deep learning.
- Statistical mechanics of complex systems and their applications
  Rigorous investigations on the role of disorder and of topology in the emerging properties of statistical-mechanics models (e.g., spin models, biochemical networks, social systems). To this task the development of mathematical models and methods is required, possibly combining standard techniques of statistical mechanics with tools stemming from different fields such as cybernetics (e.g., transfer functions theory, Laplace transforms, Fourier analysis) and graph theory (e.g., percolation and rewiring processes, centrality and clustering measures).
- Inference on biological experimental data
  Development of inferential tools to deal with big-data stemming from biological high-resolution imaging meant to unveil the temporal response of the cells (e.g., storage and loss moduli frequency analysis, viscoelastic quantitative comparisons, fluctuation-dissipation ratio) and to outline an effective model for the system under investigation.

### TEACHING ACTIVITY

- A.Y. 2019/20, 2020/21, 2021/22, 2022/23, 2023/24, **"Mathematical Models for Neural Networks"** at University Sapienza of Rome (Italy) - **Lecturer**
- A.Y. 2020/21, 2021/22, 2023/24, **"Calculus and Biostatistics"** at University Sapienza of Rome (Italy) - **Co-Lecturer**
- A.Y. 2015/16, 2023/24, **"Mathematical and Numerical Methods in Biology"** at University Sapienza of Rome (Italy) - **Lecturer**
- A.Y. 2019/20, 2022/23 **"Calculus and Biostatistics"** at University Sapienza of Rome (Italy) - **Lecturer**
- A.Y. 2021/22, **"An introduction to statistical learning"** dedicated to under-graduate students enrolled in the Honours Program (Percorso d'Eccellenza) in Mathematics, at University Sapienza of Rome (Italy) - **Lecturer**
- July 2021, **"Mathematical Models and Methods for Neural Networks"** for the summer school on "Mathematical Methods in Computational Neuroscience", at the Fred Kavli Science Center, Eresfjord (Norway) - **Invited Lecturer**
- A.Y. 2017/18, **"Mathematics for Artificial Intelligence"** Reading course for the PhD programme in Mathematics at University Sapienza of Rome (Italy) - **Lecturer**
- A.Y. 2016/17, 2017/18, 2018/19, **"Mathematical Methods and Models for the Environment"** at University Sapienza of Rome (Italy) - **Lecturer**
- A.Y. 2014/15, **"Mechanics and Thermodynamics"** at University Campus Bio-Medico of Rome (Italy) - **Co-Lecturer**
- January 2015, **"Random Walks, diffusion and statistical mechanics"** at CIRM school for the Institut Henri Poincaré trimester on "Disordered Systems, Random Spatial Processes and their Applications", Marseille (France) - **Invited Lecturer**
- December 2014, **"Modelling the complexity of the adaptive immune response"** for researchers and PhD students at Institut d'Études Avancées IMERA, Marseille (France) - **Invited Lecturer**
- A.Y. 2012/13, **"Physics of Complex Systems"**, University of Parma (Italy) - **Lecturer**
- A.Y. 2010/11, **"Mathematical Methods for Arts II"**, Politecnico "Scientia et Ars" (Italy) - **Lecturer**
- A.Y. 2010/11, *"Dynamical Systems"*, University of Parma (Italy) - **Teaching Assistant**

• A.Y. 2007/08, 2008/09, 2009/10, *"Physics I"*, Telematic University "San Raffaele" (Italy) - **Lecturer**
• A.Y. 2006/07: *"Complements of Quantum Physics"*, University of Parma (Italy) - **Teaching Assistant**
• A.Y. 2005/06, 2006/07: *"Statistical Physics I"*, University of Parma (Italy) - **Teaching Assistant**
• A.Y. 2004/05, 2006/07: *"Calculus III"*, University of Parma (Italy) - **Teaching Assistant**

### SUPERVISION OF STUDENTS

Since 2010 I have (co)-supervised:
8 PhD students
42 students for the Master Thesis
9 students for the Bachelor Thesis
4 undergraduate students for Honours Program

### GRANTS AS PRINCIPAL INVESTIGATOR

• 2022 - **PNRR grant PE1 spoke 5** - *"Foundations of High-Quality AI"* (prot. PE1221852F8F23A5) - 5 M€ (thereof 256 k€ for the research line "Theory of information-processing in (deep) Neural Networks" for which I am PI)
• 2022 - **Award grants for researchers** from Fondo sociale Europe plus (FSE+) - 2 k€
• 2021 - **Fondi Ateneo Sapienza** to lead investigations on *"Rigorous approaches to the study of collective behaviors"* (prot. RM12117A8590B3FA) - 14.3 k€
• 2020 - **Fondi Ateneo Sapienza** to lead investigations on *"Mathematical methods and models for complex systems"* (prot. RM120172B8066CB0) - 39 k€
• 2018 - **Progetto Giovani GNFM** (Gruppo Nazionale di Fisica Matematica) to lead investigations on *"Approcci rigorosi al Deep Learning"* - 1.5 k€
• 2016 - **Progetto Giovani GNFM** (Gruppo Nazionale di Fisica Matematica) to lead investigations on *"Statistical Mechanics of Deep Learning"* - 2 k€
• 2014 - **Progetto Giovani** from GNFM (Gruppo Nazionale di Fisica Matematica) to lead investigations on *"Molecular Parallel Processing: Rigorous results from Disordered Statistical Mechanics and Theory of Underpercolated Graphs"* - 2 k€
• 2012 - **Fondi Ateneo University of Parma** (academic scientific fundings - maximum rank) - 2 k€
• 2010/11 - **Angelo della Riccia** grant to lead investigations on *"Reaction-Diffusion processes with applications to immune networks"* - 4 k€
• 2010/13 - **FIRB** (prot. RBFR08EKEV) for the project *"Dynamics and statistical mechanics of lymphocyte networks below the percolation threshold"* in collaboration with Sapienza University of Rome - 480 k€
• 2007/8 - **Angelo della Riccia** grant to lead investigations on *"Coherent and Incoherent Dynamics on discrete structures"* - 11 k€

### GRANTS AS PARTICIPANT

• 2023 - **Fondi Ateneo Sapienza** on "Complex random systems and statistical mechanics" (prot. RM123188F3CD7763); coordinator: Vittoria Silvestri (Sapienza University of Rome).
• 2022 - **PNRR grant CN1 spoke 6** - *"Multiscale modelling & Engineering applications"* (for which I am Scientific Responsabile of one work-package and one PhD fellowship)
• 2022 - **Fondi Ateneo Sapienza** on *"High-throughput multiscale imaging of fixed and live biological samples"* (prot. GA122181AFEB4283); coordinator: Andrea Mele (Sapienza University of Rome).
• 2022 - **Fondi Ateneo Sapienza** on *"Large scale multicomponent random systems"* (prot. RM12218169691087); coordinator: Vittoria Silvestri (Sapienza University of Rome).
• 2019 - **Fondi Ateneo Sapienza** on *"Mathematical problems in kinetic theories and out-of-equilibrium statistical mechanics"* (prot. RM11916B7AD5678D); coordinator: Emanuele Caglioti (Sapienza University of Rome).
• 2019 - **National Natural Science Foundation of China (NNSFC)** on *"First-passage problems in stochastic search with mobile target"* (Grant No. 60171009); coordinator: Junhao Peng (Guangzhou University).
• 2018 - **Fondi Ateneo Sapienza** on *"Problems in out-of-equilibrium statistical mechanics"* (prot. RM118164368D6841); coordinator: Giada Basile (Sapienza University of Rome).
• 2017 - **Fondi Ateneo Sapienza** on *"Modelling complex systems in the digital era"* (prot. RG11715C7CC31E3D); coordinator: Vittorio Loreto (Sapienza University of Rome).

- 2016 - **Fondi Ateneo Sapienza** on *"Mathematical-physics methods for evolution problems"* (prot. RM116154CD9961A3); coordinator: Dario Benedetto (Sapienza University of Rome).
- 2013 - **Progetto Giovani GNFM** (Gruppo Nazionale di Fisica Matematica) on *"Statistical mechanics for molecular parallel processing"*; coordinator: Adriano Barra (Sapienza University of Rome).
- 2013 - **Spinner project** on *"Applications of inverse problems in bio-medical and public-health contexts"* supported by regione Emilia-Romagna; coordinator: Luca Zanni (University of Modena and Reggio).
- 2012 - **Fondi Ateneo Sapienza** on *"Application of statistical mechanics of complex systems to biological phenomena"*; coordinator: Adriano Barra (Sapienza University of Rome).
- 2011 - **Fondi Ateneo Sapienza** on *"Comparison between theory and experiment for complex statistical mechanics applied to the immune system"*; coordinator: Adriano Barra (Sapienza University of Rome).
- 2010, 2011, 2012 - participation to "**iniziativa specifica TO61**" on *"Biological applications of theoretical physics methods"* supported by Commissione IV of INFN; national coordinator: Michele Caselle (University of Torino).
- 2008 - **PRIN** (Progetti di Ricerca di interesse Nazionale) on *"Disorder and non-linearity in classical and quantum transport"*; national coordinator: Roberto Livi (University of Florence).

## EDITORIAL BOARD MEMBERSHIP

Since 2022 **Main Editor** for "**Physica A: Statistical Mechanics and its Applications**" (Section: Deep learning, genetic algorithms and other methods of AI)

2019-2023 Member of the **Divisional Associate Editor** for "**Physical Review Letters**"

2018-2022 Member of the **Editorial Board** for "**Frontiers in Physics**"

2017-2022 Member of the **Advisory Panel** for the "**Journal of Physics A: Mathematical and Theoretical**"

2019 Invited **Guest Editor** (with A. Barra, M.A. Javarone, and A. Pizzoferrato) for "**Frontiers in Physics**" special issue on "**Social Spreading: Opinions, Behaviours and Strategies**"

2018 Invited **Guest Editor** (with A. Barra, P. Sollich, and L. Zdeborová) for the "**Journal of Physics A: Mathematical and Theoretical**" special issue on "**Machine Learning and Statistical Physics: Theory, Inspiration, Application**"

2016-2018 Member of the **Scientific Committee** of "**Scienze & Ricerche**" (Mathematics section)

2018-2019 Member of the **Editorial Board** for "**Heliyon**" (Mathematics section)

2015 **Editor** (with B. Tirozzi, G. Montani, A. Barra, and N. Carlevaro) for the volume **"Theory and Applications in Mathematical Physics"**, World Scientific Publishing

## SOCIETY MEMBERSHIPS, AWARDS AND HONORS

- March 2020 "**Outstanding Referee Award**" from the *American Physical Society,* in recognition of "reports and advice [that] have helped us to advance and diffuse the knowledge of physics, while creating a resource that is invaluable to authors, researchers, students, and readers.*"*
- January 2019 - December 2019: member of **UMI** (Unione Matematica Italiana) and of **EWM** (European Women in Mathematics)
- Selected as "**EPS invited speaker**" at the workshop "Venice meeting on fluctuations in complex small systems" (2018)
- "**Outstanding Reviewers Award**" from the *Journal of Physics A: Mathematical and Theoretical,* "in recognition of the high quality and timeliness of your reviews" (2016)
- From January 2013: member of **INdAM** (Istituto Nazionale di Alta Matematica)
- October 2009 - November 2013: member of **INFN** (Istituto Nazionale Fisica Nucleare)
- Best student of the A.Y. 2002/03, Department of Physics, University of Parma
- Several papers that I (co-)authored have been awarded by journal's Editors and inserted in special collections. In particular,
    - E. Agliari, et al*., Retrieving infinite numbers of patterns in a spin-glass model of immune networks* (Europhys. Lett., 2017), selected for **Editor's Choice** (2017) - Ref[68] in the full list of publications
    - E. Agliari, et al*., Retrieval Capabilities of Hierarchical Networks: From Dyson to Hopfield* (Phys. Rev. Lett., 2015), selected for **Europhysicsnews** (46/2, 2015) - Ref[54] in the full list of publications
    - E. Agliari, et al., *Meta-stable states in the hierarchical Dyson model drive parallel processing in the hierarchical Hopfield network*, selected by IOP for "**Highlights - A collection of outstanding research published in 2015**" and chosen for cover image by J. Phys. A (2015) - Ref[53] in the full list of publications

## ACADEMIC DUTIES

- A.Y. 2022/23, 2023/24: Member of the PhD Board for the PhD course in Mathematics, Sapienza University of Rome
- A.Y. 2019/20, 2020/21, 2021/22, 2022/23: Member of the Committee for Placement for the courses "Mathematics" and "Mathematics for Applications", Sapienza University of Rome
- A.Y. 2018/19, 2019/20, 2020/21: Member of the Committee for Placement for the Faculty of "Sciences", Sapienza University of Rome
- A.Y. 2018/19: Member of the Teaching Committee for the course "Environmental Monitoring and Recovery", Sapienza University of Rome
- A.Y. 2017/18, 2018/19: Member of the Committee for Orientation and Placement for the courses "Mathematics" and "Mathematics for Applications", Sapienza University of Rome
- A.Y. 2016/17, 2017/18, 2018/19: Member of the Committee for Quality Managing and Assurance (Gestione dell'Assicurazione Qualità) for the course "Environmental Monitoring and Recovery", Sapienza University of Rome
- September 2016: Room President for the admission test (Science), Sapienza University of Rome

## POPULARISATION OF SCIENCE

- Invited talk "Origins ML", Festival della Scienza, Macro, Roma, April 2024
- E. Agliari, A. Barra, "La lezione mancata: La meccanica statistica dei sistemi complessi", Ithaca 16, 209-223 (2020)
- E. Agliari, A. Barra, "L'elaborazione d'informazione nelle reti neurali", Ithaca 16, 25-38 (2020)
- Invited talk "La matematica per l'intelligenza artificiale" within the event "La notte dei ricercatori" at Sapienza University of Roma, 27 November 2020
- Invited talk "Mathematicians and artificial intelligence" within the event "Lauree Scientifiche" for high school students, at Sapienza University of Roma, 8 May 2020
- Invited talk "La matematica per l'intelligenza artificiale" within the event "La notte dei ricercatori" at Sapienza University of Roma, 27 September 2019
- E. Agliari, A. Barra, "Elementi di processazione di informazione nei sistemi biologici ed artificiali", Scienze&Ricerca 50, 28-35 (2017)
- Collaboration to the project "Lauree Scientifiche" for high school students, at Sapienza University of Roma, Edition 2017
- A. Barra, E. Agliari, "Le reti del sistema immunitario da una prospettiva di meccanica statistica", Scienze&Ricerca 34, 59-66 (2016)
- Collaboration to the project "La notte dei ricercatori" at University of Parma, 27 September 2013
- Invited talk "Scientific Careers" for high school students, Liceo Scientifico Statale "Giacomo Ulivi", Parma, Editions 2007, 2010
- Invited talk "The role of a scientist" for undergraduate and high-school students, Centro S. Elisabetta, Parma 2007
- Collaboration to the project "Lauree Scientifiche" for high school students, at University of Parma, Editions 2006, 2007, 2010-12
- Laboratory "Meraviglie della Scienza. La cucina scientifica" at Festival della Scienza, Genova, 26 October – 7 November 2004

## INTERACTION WITH COMPANIES

- **Mat/Lav24**: 7 February 2024, Department of Mathematics, Sapienza University of Rome, Italy (co-organized with P. Buttà, D. Benedetto, G. Puppo, D. Monaco, M. Sciandrone)
- **AI for Women**: 20 October 2023, Department of Mathematics, Sapienza University of Rome, Italy (invited participant at the round table)
- Since 2019: supervision of 7 undergraduate/graduate students for Stage in companies
- **Roma Math Career Day 2023**: 22 September 2023, CNR Roma, Italy (co-organized with R. Natalini, M. Cesari, G. Puppo, C. Manni, D. Marinucci, M. Procesi, M. Pedicini)
- **STEM Career Day 2023**: 18 May 2023, Sapienza University of Rome, Italy (moderator for the session dedicated to Mathematics and Physics careers)
- **Roma Math Career Day 2022**: 14 September 2022, CNR Roma, Italy (co-organized with R. Natalini, M. Cesari, G. Puppo, C. Manni, D. Marinucci, M. Procesi, M. Pedicini)

- **Mat/Lav22**: 19 May 2022, Department of Mathematics, Sapienza University of Rome, Italy (co-organized with A. Malusa, D. Benedetto, G. Puppo, D. Monaco)
- **Mat/Lav21**: 27 May 2021, Department of Mathematics, Sapienza University of Rome, Italy (co-organized with A. Malusa, D. Benedetto, G. Puppo)

### ORGANIZED WORKSHOPS AND EVENTS

- Winter school "**Mathematical methods for machine learning**", 2025, Department of Mathematics, Sapienza University of Roma (co-organized with …..)
- Workshop "**Mathematical methods for machine learning**", 2025, Department of Mathematics, Sapienza University of Roma (co-organized with …..)
- Workshop "**Physics-Informed machine learning**", 9 October 2023, The Alan Turing Institute, London (co-organized with A. Barra, M. Bazzi, A. Pizzoferrato)
- Workshop "**Φ-ML: rigorous techniques**", 16-27 January 2023, The Alan Turing Institute, London (co-organized with A. Barra, M. Bazzi, A. Pizzoferrato)
- Workshop "**Guerra80: Interpolating maxima of rugged landscapes**" to celebrate the eightieth birthday of Francesco Guerra, 2 December 2022, Department of Mathematics, Sapienza University of Rome (co-organized with A. Barra, E. Marinari, G. Parisi, F. Ricci-Tersenghi)
- Since 2019: Member of the Organizing Committee of "**MOMA Colloquia**", Sapienza University of Rome, Italy
- Workshop "**Women of Mathematics**", 07-21 December 2016, Sapienza University of Rome, Italy (co-organized with G. Basile, D. Benedetto, A. D'Orazio, A. Garroni, C. Malvenuto et al.)
- Workshop "**Mathematical Physics: Theory and Applications**", 15-17 September 2014, Sapienza University of Rome, Italy (co-organized with A. Barra)
- ECCS satellite meeting "**Modeling the complexity of the immune system**", 19 September 2013, Barcelona, Spain (co-organized with A. Annibale, A. Barra and A.C.C. Coolen)
- **XVIII Convegno Nazionale di Fisica Statistica e dei Sistemi Complessi,** 24-26 June 2013, University of Parma, Italy (co-organized with P. Buonsante, R. Burioni, D. Cassi, A. Vezzani)
- Workshop "**Physicists' investigations in immunology**", 15 November 2012, Sapienza University of Rome, Italy (co-organized with A. Barra)
- **XVII Convegno Nazionale di Fisica Statistica e dei Sistemi Complessi**, 20-22 June 2012, University of Parma, Italy (co-organized with P. Buonsante, R. Burioni, D. Cassi, A. Vezzani)

### INVITED SEMINARS AND INVITED CONTRIBUTIONS IN WORKSHOPS

- 25-26 July 2024: "Joint Meeting of the American Mathematical Society and the Unione Matematica Italiana", University of Palermo, Palarmo (Italy) invited talk **"TBA"**
- 22-24 May 2024: "From Machine-Learning Theory to Driven Complex Systems and back" CECAM-HQ-EPFL, Lausanne (Switzerland) invited talk **"TBA"**
- 15 February 2024: "FAIR-Meeting Spoke 5" Department of Computer, Control and Management Engineering (DIAG), Sapienza University of Roma (Italy) invited talk **"Associative neural networks beyond retrieval: learning and generalization on structured data sets"**
- 31 January 2024: "Dialogs on Neuronal Networks: Theoretical and Biological Perspectives" Istituto Superiore di Sanità, Roma (Italy) invited talk **"Biological inspired Machine Learning"**
- 4 December 2023: Invited Colloquium *"A statistical-mechanics approach to (shallow) neural networks"*, School of Physical and Mathematical Sciences, Nanyang Technology University (Singapore)
- 15 September 2023: "RoMaDS: A day on Statistical Physics for Machine Learning", Department fo Mathematics, University of Roma Tor Vergata (Italy) invited talk **"*The early bird regularises better"*
- 11-16 June 2023: "Mathematical Physics of Complex Systems", Palazzone di Cortona (Italy) invited talk **"*The early bird regularises better"*
- 30 May 2023: "Hard sciences for machine learning", Auditorium dell'Area della Ricerca del CNR, Pisa (Italy) invited talk **"*The emergence of concepts in shallow neural-networks"*
- 9 May 2023: Invited seminar *"Numerical methods for Boltzmann machines"*, University of Modena and Reggio Emilia (Italy)

- 3 May 2023: Invited seminar *"Mathematical methods for Boltzmann machines"*, University of Salento (Italy)
- 26-31 March 2023: "DPG-Frühjahrstagung (DPG Spring Meeting) - DPG Focus Session: Physics meets ML", Technical University of Dresden (Germany) invited talk *"The emergence of concepts in shallow neural-networks"*
- 12 January 2023: Invited seminar **"Dense neural networks that learn, store and retrieve"**, Istituto Superiore di Sanità (Italian National Institute of Health), Roma (Itay)
- 2 December 2022: "Guerra80: Interpolating maxima of rugged landscapes", Sapienza University of Rome (Italy) invited talk *"Recurrent neural networks that generalize from examples and improve by dreaming"*
- 24 October 2022: "From Dispersive Hydrodynamics to Forecasting, Machine Learning and Back", Isaac Newton Institute, Cambridge (UK) invited talk **"A Crossroad between Statistical Mechanics, PDE-Theory, Neural networks and Machine learning"**
- September 2022: Invited talk at "Venice Meeting on Fluctuations in small complex systems X", Palazzo Franchetti, Venice (Italy) [cancelled]
- 13-14 June 2022: "Random graphs and Networks Workshop", Mathematics Department of the University of South Wales (UK) invited talk **"Complex (neural) networks for complex tasks"**
- 12 May 2022 Invited seminar *"Numerical methods for Boltzmann machines"*, University of Modena and Reggio Emilia (Italy)
- 25 January 2022: Invited seminar *"The emergence of concepts in shallow neural-networks"*, Mathematical Institute, University of Oxford (UK)
- 19 November 2021: Invited seminar *"Some rigorous results on Boltzmann machines"*, University of South Wales, Pontypridd (UK)
- 5 August 2021: Invited talk at the Sci-ML webinar series *"Learning from Storing"*, Carnegie Mellon University, Pittsburgh (US)
- 22 July 2021: Invited panelist at the workshop *"Physical Review Referee Orientation Session"*, organised by the American Physical Society
- 14 May 2021: Invited seminar *"Numerical methods for Boltzmann machines"*, University of Modena and Reggio Emilia (Italy)
- 10 May 2021: Invited seminar *"From Memory to Learning and backward"*, University of Salento (Italy)
- 15,18 March 2021: "Machine Learning and Statistical Physics", Lagrange Mathematics and Computation Research Center , Paris (France), invited talk *"Learning from Storing"*
- 25 November 2020: Invited seminar *"Complexity in neural networks: the good with the bad"*, Institute for Cross-Disciplinary Physics & Complex Systems, Palma de Mallorca (Spain)
- 1 July 2020: Invited seminar *"Machine Learning from a Mathematical perspective"*, ISMAR-CNR, Roma (Italy)
- 24-26 February 2020: "International Max-Planck Research School - Physics of Biological and Complex Systems", Göttingen (Germany), invited talk *"Complexity in neural networks: the good with the bad"*
- 23-25 September 2019: "II Bad Wildbad meeting on random processes & applications", Koenig Karls Bad (Germany), invited talk *"Encounters on Combs"*
- 1-26 July 2019: "Predictability and control of evolution", Nordita, Stockholm (Sweden), invited talk *"A statistical-inference approach to assess an 'interaction' pattern among migrating cells."*
- 27 February 2019: Invited talk at the CANES Cross-Disciplinary Approaches to Non-Equilibrium Systems) seminar series series *"Hopfield networks beyond the Hebbian paradigma"*, King's College London
- 7 December 2018: Invited seminar *"Dreaming Neural Networks"* at Kavli Institute for Systems Neuroscience, Trondheim (Norway)
- 26 November 2018: Invited seminar *"Rigorous Approaches to Neural Networks"* at Department of Mathematics, University of Bologna (Italy)
- 13-18 October 2018: "Venice Meeting on Fluctuations in small complex systems IV", Palazzo Franchetti, Venice (Italy), invited talk *"Collective features in biochemical reactions"*
- 25-27 June 2018: "CONES2018: Frontiers of Non-Equilibriums Science", King's College, London [declined]
- 20 June 2018: Invited seminar "*Statistical inference tools to assess leukocyte migratory ability*", CNR Nanotec, Lecce (Italy)
- 28 May - 01 June 2018: "Search and problem solving by random walks: drunkards vs quantum computers", Physikzentrum Bad-Honnef (Germany), invited talk *"Search and Diffusion of Leucocytes on Lab-On-Chip"*
- 25 April 2018: "AI days in Northumbria", Northumbria University, Newcastle (United Kingdom), invited talk *"Neural Networks from a stochastic dynamics perspective"*
- 20 February 2018: "Statistical Mechanics and Applications VIII", Department of Mathematics, University of Bologna (Italy), invited talk *"Dreaming and Unlearning in Neural Networks"*

- 4-6 May 2017: Invited talk *"Statistical Mechanics of learning and retrieval"*, Assemblea GNFM, Montecatini (Italy)
- 18-21 April 2017: "Critical Transitions in Complex Systems", University of Salento (Italy), invited talk *"Criticality in Graphs"*
- 7 April 2017: Invited seminar for Mathematical Models for Applications (MoMA) "**Neural Networks from a Statistical Mechanics perspective**", Department of Mathematics, Sapienza University of Rome (Italy)
- 13 December 2016: Invited seminar for Numerical Analysis *"Analytical and Numerical Approaches to study Free-energy Minima of Associative Recurrent Neural Networks"*, Department of Mathematics, Sapienza University of Rome (Italy)
- 17-18 November 2016: "Mathematical Models for Quantum and Classical Mechanics", Mathematic Department, University of Florence (Italy), invited talk *"Absorption and collision in branched structures"*
- 11 March 2016: Invited seminar *"Topological and Statistical-Mechanics properties of Dyson hierarchical systems"*, Institut Non Linéaire de Nice, Sophia-Antipolis (France)
- 17 December 2015: Invited seminar *"Information processing in biochemical networks"*, Computational Neuroscience Laboratory, École Polytechnique Fédérale de Lousanne, Lousanne (Switzerland)
- 3-8 August 2015: "XIX Brazilian School of Probability", São Sebastião-SP, (Brazil), invited talk *"Statistical mechanics of hierarchical networks"*
- 11 March 2015: "Workshop on Fractional Calculus and its Applications", Mathematic Department, University of Roma Tre, Roma (Italy), Invited talk *"Lévy flights with absorption and collisione in combs"*
- 9 January 2015: Invited seminar *"Biological information processing on hierarchical and scale free networks"*, at Institut de Neurosciences des Systèmes, Aix-Marseille Université, Marseille (France)
- 5-7 November 2014: "4th Workshop in Stochastic Modeling", Mathematic Department, University of São Paulo, São Carlos (Brazil), Invited talk *"Epidemic spreading in inhomogeneous structures"*
- 4 April 2014: Invited seminar *"The infinite collision property on finite, random combs"*, Department of Mathematics, Sapienza University of Rome (Italy)
- 16-20 September 2013: *"European Conference on Complex Systems"*, Barcelona (Spain), invited talk *"Anergy and parallel processing in spin glass models of immune networks"*
- 29 July - 1 August 2013: *"Classical and Quantum transport in Complex Networks"*, Bad-Honnef (Germany), invited talk *"First-passage phenomena in branched structures"*
- 3-8 June 2013: *"Search and Exploration III"*, Cargèse (France), Invited talk *"Collisions and absorption on branched structures"*
- 21 February 2013: Invited seminar *"A Statistical mechanics perspective on Immune Networks"*, at NORDITA, Stockholm (Sweden)
- 3 December 2012: Invited seminar *"The statistical mechanics of collective behaviours in chemical kinetics"*, at Albert-Ludwigs-Universitaet, Freiburg (Germany)
- 21 February 2012: Invited seminar *"A Statistical mechanics perspective on Immune Networks"*, at SISSA, Trieste (Italy)
- 1 December 2010: Invited seminar *"A Hebbian approach to complex network generation and applications in theoretical immunology"*, Physics Department, University of Pisa (Italy)
- 13 July 2010: Invited seminar *"Statistical physics approach to Immune Idiotypic Networks"*, at Soft Matter and Biophysics Department, Ludwig-Maximilians-Universitaet München, (Germany).
- 2-5 June 2010: *"3rd Black Forest Focus on Soft Matter"*, Breisach (Germany), invited talk: *"Effects of Inhomogeneity on classical and quantum transport"*
- 15-20 November 2009: *"Statistical Mechanics on Random Structures"*, Banff International Research Station, Banff (Canada), invited talk: *"The autopoietic immune system: a statistical physics perspective"*
- 5-6 March 2009: *"Workshop on Statistical Mechanics and Applications III"*, Mathematics Department, University of Bologna, invited talk *"Diffusive Strategies in Group Competition"*
- 16-28 July 2008: *"Workshop on Statistical Mechanics and Applications II"*, Eurandom, Eindhoven (The Netherlands), invited talk *"Non-canonical Dynamics for the Ising model on random structures"*
- 10-14 March 2008: "YEP (Young European Probabilists) V", Eurandom, Eindhoven (The Netherlands), invited talk *"Diffusive Thermal Dynamics for the Ising model on the Erdös-Rényi random graph"*
- 15 March 2007: Invited seminar "**Autocatalytic Reaction in Restricted Geometries: Extended Mean-Field Treatment and applications to Social Systems**", at Brunel University, London (UK)
- 14-15 December 2006: *"Informal Meeting on Statistical Physics"*, SISSA, Trieste (Italy), invited talk "**Statistical models of binary reactions among Diffusing particles**"
- 21-23 June 2006: *"XI Convegno Nazionale Fisica Statistica"*, Physics Department, University of Parma (Italy), invited talk *"Efficiency of Information Spreading in a population of diffusing agents"*

## OTHER CONTRIBUTIONS IN WORKSHOPS

- 2-7 September 2019: "XXI Workshop Unione Matematica Italiana (UMI)", University of Pavia (Italy), invited talk *"Learning, Reinforcement and Remotion"*
- 5-7 October 2018: "Assemblea Scientifica del Gruppo Nazionale di Fisica Matematica", at Montecatini Terme (Italy), talk: *"Apprendimento, Consolidamento e Rimozione"*
- 26-28 June 2017: "Bio-Math Modelling Workshop (MOBI-2017)", at Istituto Nazionale di Alta Matematica, Rome (Italy), talk: *"The (biochemical) molecular interactions from a cybernetic perspective"*
- 01-02 October 2015: "Mathematical Models in Social Dynamics", at Politecnico di Torino (Italy), talk: *"The role of migration is economic complexity"*
- 22-23 May 2014: "Biophysics@Rome2014", at CNR Tor Vergata (Italy), talk: *"Statistical mechanics unveils collective behaviours in biochemistry"*
- 15-17 May 2014: "Assemblea Scientifica del Gruppo Nazionale di Fisica Matematica", at Montecatini Terme (Italy), talk: *"Collective behaviours: from biochemical kinetics to cybernetics"*
- 21-23 September 2011: "XV Workshop on Statistical Mechanics and non-perturbative Field Theory", at Physics Department, University of Bari (Italy), talk: *"Performance and breakdown of the immune system from a statistical mechanics perspective"*
- 9-11 September 2010: "BioPhys 2010", at Arcidosso (Italy), sponsored talk *"Statistical physics approach to Immune Idiotypic Networks"*
- 28-30 May 2009: *"NET 2009 Evolution and Complexity"*, Sapienza University of Rome (Italy), poster contribution: *"Group Competition and Consensus Spreading"*
- 26-29 August 2007: *"Diffusion Fundamentals II"*, organized by University of L'Aquila, UCL (University College London) and University of Leipzig in L'Aquila (Italy), poster contribution *"Autocatalytic reaction-diffusion process in restricted geometries"*
- 16-18 July 2007: *"Fluctuation and Dissipation Phenomena in Driven Systems far from Equilibrium"*, Max Planck Institute, Dresden (Germany), poster contribution *"Heat conduction in a two-dimensional Ising model"*
- 17-20 September 2006: *"XXIV Convegno di Fisica Teorica e Struttura della Materia"*, organized by University of Trento, Levico Terme (Italy), poster contribution *"Universal Features of Information Spreading"*


## SCHOOLS ATTENDED

- **Two-year training course on educational innovation**, September 2020- July 2022, organised by Sapienza University of Rome
- **"XLI Summer School on Mathematical Physics"**, 05-10 September 2016, Ravello (Italy)
- **"XXXIX Summer School on Mathematical Physics"**, 15-27 September 2014, Ravello (Italy)
- "**Boulder school for condensed matter and material physics**" on "Non-equilibrium Statistical Mechanics: Fundamental Problems and Applications", 6-24 July 2009, Boulder University, Colorado (USA)
- "**École d'Été de Physique Théorique**" - session 85: *"Complex Systems"*, 3-28 July 2006, Université Joseph Fourier, Les Houches (France)
- "**International Summer School**" on *"Fundamental Problems in Statistical Physics XI"*, 4-17 September 2005, Katholieke Universiteit Leuven, European Centre La Foresta, Leuven (Belgium)
- "**Condensed Matter Summer School**", organized by INFM and ISI Foundation on *"Single molecule Biophysics"* and *"Non-Equilibrium systems: the problem of turbulence in fluids and plasma"* , 3-28 September 2004, Villa Gualino, Torino (Italy)
- "**International School of Theoretical Physics**", organized by INFN, 31 August - 4 September 2004, Centro S. Elisabetta, Parma (Italy)


## SCIENTIFIC COMMITTES, REVIEWER ACTIVITY

Reviewer for the following project founding Institutions:
2023: Serrapilheira Institute (Brazil)
2023: External jury member for the "Machine Learning track" at the Radboud science faculty (The Netherlands)
2021: Agencia Nacional de Investigación y Desarrollo (Gobierno de Chile)
2021: University of Insubria
2020: Polish National Science Center

2020: Alexander von Humboldt Foundation
2020: IMéRA: Institut d'études avancées d'Aix-Marseille (Foundation of Université d'Aix-Marseille)
2020: Swiss National Science Foundation
2019: Deutsche Forschungsgemeinschaft (German Research Foundation)
2017, 2018: Czech Science Foundation
2017: Romanian Research Programme
2017: United Arab Emirates University Research Office

Member of the following workshop program committees:
2021: First International Conference on Artificial Intelligence and Sustainable Computing for Smart Cities (AIS2C2)
2014: CompleNet 2014 (5th Workshop on Complex Networks)
2014: Socio-Economic Dynamics: Physics-based Agent Models to go beyond the representative agent paradigm (Satellite Meeting of ECCS'14)

Member of the following evaluation committees:
2024: Member of the Selection Committee for a tenure-track position on "Statistical Physics and Machine Learning" at Ecole Normale Supérieure, Paris (France)
2024: Member of the Assessment Committee for the PhD programme in Mathematics at the Goethe-Universität Frankfurt (Germany)
2024: Member of the Selection Committee for an Assistant/Associate Professor level in Theoretical Biophysics at Radboud University, Nijmegen (The Netherlands)
2024: Member of the Selection Committee for a Tenure Track position (RTT) in Mathematical Physics at University of Modena and Reggio Emilia (Italy)
2024: Member of the Assessment Committee for the PhD programme in Mathematics at University of Bologna (Italy)
2023: Member of the Selection Committee for a Teaching assignment in the Faculty of Science at the University Sapienza of Roma (Italy)
2023: Member of the Assessment Committee for the PhD programme in Physics at University Tor Vergata, Roma (Italy)
2022-2023: Member of the monitoring panel for the AI National Ph.D. program
2022: Member of the Selection Committee for a one-year Fellowship in the field of Mathematical Physics and Probability and Mathematical Statistics at the University Sapienza of Roma (Italy)
2022: Member of the Selection Committee for Tutoring fellowships in the Faculty of Science at the University Sapienza of Roma (Italy) [twice]
2021: Member of the Selection Committee for a one-year Fellowship in the field of Mathematical Physics and Probability and Mathematical Statistics at the University Sapienza of Roma (Italy)
2020: Member of the Selection Committee for a two-year Fellowship in the field of Mathematical and its applications at the University Sapienza of Roma (Italy)
2020: Member of the Assessment Committee for the PhD programme in Physics at the Laboratories de Physique de l'École Normale Supérieure, Paris (France)
2019: Member of the Selection Committee for a one-year Fellowship in the field of Mathematical Physics at the University of Salento (Italy)
2018: Member of the Assessment Committee for the PhD programme in Neuroscience (Faculty of Medicine) at the Norwegian University of Science and Technology, Trondheim (Norway)

Reviewer for international scientific journals:
Since 2006 I have served as reviewer for more than 40 different international scientific journals (ISI) in the area of applied mathematics, mathematical physics and theoretical physics.

### FULL LIST OF PUBLICATIONS (ISI)

115.　E. A., et al, *Place cells*, in preparation (2024).
114.　E. A., et al, *TAM networks*, in preparation (2024).
113.　E. A., Aquaro, A. Fachechi, *Regularization, early stopping and algebraic properties*, in preparation (2024).
112.　E. A., M. Aquaro, A.A.A. Coolen, A. Fachechi, *Replica analysis for RBM*, in preparation (2023).
111.　E. A., A. Fachechi, D. Luongo, *Algebraic properties for Hebbian-like kernels*, Apple. Math. Comp. (2024).

110. E. A., F. Alemanno, A. Barra, M. Castellana, D. Lotito, M. Piel, *Inverse modelling of time-delayed interactions via the Dynamic Entropy formalism* , submitted to Phys. Rev. Lett. (2024).

**2024**

109. E. A., A. Fachechi, D. Luongo, *Algebraic properties for Hebbian-like kernels*, Apple. Math. Comp. (2024).
108. E. A., F. Alemanno, Aquaro, A. Fachechi, *Regularization, early stopping and dreaming*, submitted Neur. Netw. (2023).
107. M. Aquaro, F. Alemanno, I. Kanter, F. Durante, A. Barra, E. Agliari, *Hebbian dreaming for small datasets*, Neur. Netw. (2024)

**2023**

106. E. A., A. Alessandrelli, A. Barra, F. Ricci-Tersenghi, *Parallel learning by multitasking neural networks*, J. Stat. 113401 (2023).
105. E. A., F. Alemanno, Aquaro, A. Barra, *Ultrametric identities in glassy models of Natural Evolution*, J. Phys. A 56, 385001 (2023).
104. E. A., L. Albanese, F. Alemanno, A. Alessandrelli, A. Barra, F. Giannotti, D. Lotito, and D. Pedreschi. Dense Hebbian neural networks: a replica symmetric picture of unsupervised learning, Physica A 627, 129143 (2023).
103. E. A., L. Albanese, F. Alemanno, A. Alessandrelli, A. Barra, F. Giannotti, D. Lotito, and D. Pedreschi, Dense Hebbian neural networks: a replica symmetric picture of supervised learning, Physica A 626, 129076 (2023).
102. E. A., F. Alemanno, Aquaro, A. Barra, C. Marullo, *From Pavlov Condition to Hebb Learning*, Neural Comput. 35, 930 (2023)
101. F. Alemanno, M. Aquaro, I. Kanter, A. Barra, E.A., *Supervised Hebbian learning*, Europhys. Lett. Perspective, 141, 11001 (2023)

**2022**

100. E.A., A. Fachechi, C. Marullo, *Non-linear PDEs approach to statistical mechanics of dense associative memories*, J. Math. Phys. (2022)
99. A. Fachechi, F. Alemanno, A. Barra, E.A., *Outperforming RBM Feature-Extraction Capabilities by "Dreaming" Mechanism*, IEEE Trans. Neur. Netw. (2022)
98. E.A., F. Alemanno, A. Barra, G. De Marzo, *Unsupervised learning: the emergence of a concepts in associative neural networks*, Neur. Netw. 148, 232 (2022)

**2021**

97. E.A., F.E. Leonelli, C. Marullo, *Storing, learning and retrieving biased patterns*, Applied Mathematics and Computation 415, 126716 (2021)
96. E.A., G. Sebastiani, *Learning and retrieval operational modes for three-layer restricted Boltzmann Machines*, J. Stat. Phys. 185, 10 (2021)
95. E.A., F. Alemanno, L. Albanese, A. Fachechi, *A transport equation approach for deep neural networks with quenched random weights,* J. Phys. A 54, 505004 (2021)
94. F.E. Leonelli, E.A., L. Albanese, A. Barra, *On the effective initialisation for restricted Boltzmann machines via duality with Hopfield model*, Neur. Net. 143, 314-326 (2021)
93. C. Marullo, E.A., *Boltzmann machines as generalised Hopfield networks: a review on recent results and outlooks*, Entropy 23, 34 (2021)

**2020**

92. E.A., A. Barra, P. Sollich, L. Zdeborová, *Machine learning and statistical physics: preface*, J. Phys. A 53, 500401 (2020)
91. E.A., G. De Marzo, *Tolerance versus synaptic noise in dense associative memories*, Europ. Phys. J. Plus 135, 883 (2020)
90. E.A., A. Fachechi, C. Marullo, *The relativistic Hopfield model with correlated patterns*, J. Math. Phys. (2020)
89. E.A., L. Albanese, A. Barra, G. Ottaviani, *Replica symmetry breaking in neural networks: a few steps toward rigorous results*, J. Phys. A 53, 415005 (2020)
88. E.A., F. Alemanno, A. Barra, A.O. Barra, A. Fachechi, L. Moretti, L. Franceschi-Vento, *Analysis of temporal correlation in heart rate variability through maximum entropy principle in a minimal pairwise glassy model*, Sci. Rep. 10, 15353 (2020)
87. E.A., A. Barra, A.O. Barra, A. Fachechi, L. Moretti, L. Franceschi-Vento, *Detecting heart pathologies via machine learning on clinical markers*, Sci. Rep. 10, 8845 (2020)
86. E.A., F. Alemanno, A. Barra, A. Fachechi, *Generalized Guerra's interpolazione techniques for dense associative networks*, Neur. Net. 128, 254 (2020)
85. E.A., P. Saez, A. Barra, M. Piel, P. Vargas, M. Castellana, *A statistical inference approach to reconstruct intercellular interactions in cell migration experiments*, Science Adv. 6, eaay2103 (2020)
84. E.A., F. Alemanno, A. Barra, M. Centonze, A. Fachechi, *Neural networks with Redundant Representation: Detecting the Undetectable*, Phys. Rev. Lett. 124, 028301 (2020)

**2019**

83. E.A., F. Alemanno, A. Barra, A. Fachechi, *Dreaming neural networks: rigorsous results,* J. Stat. 083503 (2019)
82. J. Peng, E. A., *First encounters on combs*, Phys. Rev. E 100, 062310 (2019)
81. E.A., F. Alemanno, A. Barra, A. Fachechi, *A novel derivation of the Marchenko-Pastur law through analog bipartite spin-glasses,* J. Phys. A 52, 254002 (2019)
80. E.A., A. Barra, M. Notarnicola, *The relativistic Hopfield model: rigorous results,* J. Math. Phys. 60, 033302 (2019)
79. J. Peng, E. A., *Exact results for the first-first-passare properties in a class of fratta networks*, Chaos 29, 023105 (2019)
78. A. Fachechi, E. A., A. Barra, *Dreaming neural networks: forgetting spurious memories and reinforcing pure ones*, Neur. Net. 12, 24 (2019)
77. E. A., A. Barra, B. Tirozzi, *Free energies of Boltzmann Machines: self-averaging properties, annealed and replica simmetric approximations in the thermodynamic limit*, J. Stat. 033301 (2019)

**2018**
76. E. A., D. Migliozzi, D. Tantari, *Non-Convex Multi-species Hopfield models,* J. Stat. Phys.172, 1247 (2018)
75. E. A., A. Barra, P. Contucci, A. Pizzoferrato, C. Vernia, *Alienation and fragmentation from collective data,* Palgrave Communications 4, 55 (2018)
74. E. Agliari, A. Barra, G. Landolfi, S. Murciano, S. Perrone, *Complex Reaction Kinetics in Chemistry: A Unified Picture Suggested by Mechanics in Physics*, Complexity 2018, 7423297 (2018)

**2017**
73. E. A., A. Pachon, P. Rodrigues, F. Tavani, *Phase Transition for the Maki–Thompson Rumour Model on a Small-World Network*, J. Stat. Phys. 169, 846 (2017)
72. L. Fusaro, S. Mereu, E. Salvatori, E. Agliari, S. Fares, F. Manes, *Modeling ozone uptake by urban and peri-urban forest: a case study in the Metropolitan City of Rome,* Environ. Sci. Pollut. Res. (2017)
71. E. Agliari, A. A. Barra, D. Tantari, C. Longo, *Neural Networks Retrieving Boolean Patterns in a Sea of Gaussian Ones*, J. Stat. Phys. 168, 1085 (2017)
70. J. Peng, E. A., *Scaling laws for diffusion on (trans)fractal scale-free networks*, Chaos 27, 083108 (2017)
69. E. Biselli, E.A., A. Barra, F. R. Bertani, A. Gerardino, A. De Ninno, A. Mencattini, F. Mattei, G. Schiavoni, V. Lucarini, E. Vecchelli, G. Kromer, C. Di Natale, E. Martinelli, L Businaro, *A novel protocol to evaluate the efficacy of chemotherapy induced human anticancer immunity in a microfluidic environment*, Sci. Rep. (2017)
68. E. A., A. Annibale, A. Barra, ACC Coolen, D. Tantari, *Retrieving infinite numbers of patterns in a spin-glass model of immune networks*, Europhys. Lett. 117, 28003 (2017); selected by IOP
67. E. A., F. Tavani, *The exact Laplacian spectrum for the Dyson hierarchical network,* Sci. Rep. 7, 39962 (2017)

**2016**
66. E. A., A. Barra, L. Dello Schiavo, A. Moro, *Complete integrability of information processing by biochemical reactions,* Sci. Rep. 6, 36314 (2016)
65. E. A., A. Barra, A. Galluzzi, F. Rovira, D. Tantari, *Insights in Economical Complexity in Spain: the hidden boost of migrants,* Palgrave Communications 2, 16021 (2016)
64. E. A., D. Cassi, L. Cattivelli, F. Sartori, *Two-particle problem in comblike structures*, Phys. Rev. E 93, 052111 (2016)
63. F. Tavani, E. A., *First-passage phenomena in hierarchical networks*, Phys. Rev. E 93, 022133 (2016)

**2015**
62. E. A., A. Barra, A. Galluzzi, M. Javarone, A. Pizzoferrato, D. Tantari, *Emerging heterogeneities in Italian customs and comparison with nearby countries,* PLoS One 0144643 (2015)
61. L. Cattivelli, E. A., F. Sartori, D. Cassi, *Lévy Flights with power law absorption*, Phys. Rev. E 92, 042156 (2015)
60. J. Peng, E. A., Z. Zhang, *Exact calculations of first-passage properties on the pseudofractal scale-free web*, Chaos 25, 073118 (2015)
59. E. A., A. Barra, A. Galluzzi, D. Tantari, F. Tavani, *Topological properties of hierarchical networks*, Phys. Rev. E 91, 062807 (2015)
58. M. Bellingeri, E. A., D. Cassi, *Optimization strategies with resource scarcity: From immunization of networks to the traveling salesman problems*, Mod. Phys. Lett. B 1550180 (2015)
57. E. A., F. Sartori, L. Cattivelli, D. Cassi, *Hitting and trapping times on branched structures*, Phys. Rev. E 91, 052132 (2015)
56. E. A., M. Altavilla, A. Barra, L. Dello Schiavo, E. Katz, *Notes on stochastic (bio)-logic gates: the role of allosteric cooperativity*, Sci. Rep. 5, 9415 (2015)
55. E. A., A. Barra, A. Galluzzi, F. Guerra. D. Tantari, F. Tavani, *Hierarchical neural networks perform both serial and parallel processing*, Neur. Net. 66, 22 (2015)
54. E. A., A. Barra, A. Galluzzi, F. Guerra, D. Tantari, F. Tavani, *Retrieval capabilities of hierarchical networks: From Dyson to Hopfield*, Phys. Rev. Lett. 114, 028103 (2015)

53. E. A., A. Barra, A. Galluzzi, F. Guerra, D. Tantari, F. Tavani, *Meta-stable states in the hierarchical Dyson model drive parallel processing in the hierarchical Hopfield network*, J. Phys. A 48, 015001 (2015); selected for cover image for the printed issue of J. Phys. A: Math. Theor. (volume 48 issue 1); selected by IOP

52. P. Sgrignoli, E. A., R. Burioni, A. Schianchi, *Instability and Network Effects in Innovative Markets*, Mathematics and Computers in Simulation 108, 260-271 (2015)

51. E. A., A. Barra, G. Del Ferraro, F. Guerra, D. Tantari, *Anergy in self-directed B lymphocytes: A statistical mechanics perspective*, J. Theor. Biol. 375, 21-31 (2015)

**2014**

50. E. A., E. Biselli, A. De Ninno, G. Schiavoni, L. Gabriele, A. Gerardino, F. Mattei, A. Barra, L. Businaro, *Cancer-driven dynamics of immune cells in a microfluidic environment*, Sci. Rep. 4, 6639 (2014)

49. E. A., A. Barra, P. Contucci, R. Sandell, C. Vernia, *A stochastic approach for quantifying immigrant integration: the Spanish test case*, New J. Phys. 16, 103034 (2014)

48. E. A., A. Blumen, D. Cassi, *Slow encounters of particle pairs in branched structures*, Phys. Rev. E 89, 052147 (2014)

47. E. A., A. Barra, A. Galluzzi, M. Isopi, *Multitsking associative networks with neuronal threshold noise*, Neur. Net. 49, 19 (2014)

**2013**

46. E. A., A. Annibale, A. Barra, A.C.C. Coolen, D. Tantari, *Immune networks: multi-tasking capabilities near saturation*, J. Phys. A 46, 415003 (2013); selected by IOP

45. E. A., A. Barra, R. Burioni, A. Di Biasio, G. Uguzzoni, *Collective behaviours: from biochemical kinetics to electronic circuits*, Sc. Rep. 3, 3458 (2013)

44. E. A., A. Annibale, A. Barra, A.C.C. Coolen, D. Tantari, *Immune networks: multi-tasking capabilities at medium load*, J. Phys. A 46, 335101 (2013)

43. E. A., A. Barra, S. Bartolucci, A. Galluzzi, F. Guerra, F. Moauro, *Parallel processing in immune networks*, Phys. Rev. E 87, 042701 (2013); selected for Kaleidoscope April 2013

42. E. A., A. Barra, A. D'Antoni, A. Galluzzi, *Parallel retrieval of correlated patterns: from Hopfield networks to Boltzmann machines*, Neur. Net. 38, 52 (2013)

41. E. A., L. Asti, A. Barra, R. Scrivo, R. Valesini, R.S. Wallis, *Application of Stochastic Modelling to Assess the Evolution of Tuberculous and Non-Tuberculus Mycobacterial Infection in Patients Treated with Tumor Necrosis Factor Inhibitors*, PLoS One 8, e55017 (2013)

**2012**

40. E. A., A. Barra, A. Galluzzi, F. Guerra, F. Moauro, *Multitasking Associative Networks*, Phys. Rev. Lett. 109, 268101 (2012)

39. E. A., L. Asti, A. Barra, R. Burioni, G. Uguzzoni, *Analogue neural networks on correlated random graph*s, J. Phys. A 45, 365001 (2012)

38. E. A., A. Barra, F. Guerra, K. Gervasi-Vidal, *Can persistent Epstein-Barr virus infection induce chronic fatigue syndrome as a Pavlov reflex of the immune response?*, J. Biol. Dyn. 6, 740 (2012)

37. E. A., R. Burioni, G. Uguzzoni, *The true reinforced random walk with bias*, New J. Phys. 14, 063027 (2012)

36. E. A., A. Barra, R. Burioni, A. Di Biasio, *Notes on the p-spin glass studied via Hamilton-Jacobi and smooth cavity techniques*, J. Math. Phys. 53, 063304 (2012)

35. E. A., L. Asti, A. Barra, L. Ferrucci, *Organization and evolution of synthetic idiotypic networks*, Phys. Rev. E 85, 051909, (2012)

34. B. Meyer, E. A., O. Bénichou, R. Voiturez, *Exact calculations of first-passage quantities on recursive networks*, Phys. Rev. E 85, 026113 (2012)

33. A. Di Biasio, E. A., A. Barra, R. Burioni, *Mean-field cooperativity in chemical kinetics*, Theor. Chem. Acc. 131, 1104 (2012)

32. A. Barra, E. A., *A statistical mechanics approach to Granovetter theory*, Physica A 391, 3017 (2012)

**2011**

31. E. A., M. Casartelli, A. Vezzani, *Slow relaxation in microcanonical warming of a Ising lattice*, Eur. Phys. J. B 84, 317 (2011)

30. E. A., A. Barra, F. Guerra, F. Moauro, *A thermodynamic perspective on immune capabilities*, J. Theor. Biol. 287, 48 (2011)

29. E. A., C. Cioli, E. Guadagnini, *Percolation on correlated random network*s, Phys. Rev. E 84, 031120 (2011)

28. E. A., A. Barra, *A Hebbian approach to complex-network generation*, Europhys. Lett. 94 10002 (2011)

27. E. A., *Trapping of continuous-time quantum walks on Erdös-Rényi graphs*, Physica A 390 1853 (2011)

26. E. A., A. Barra, F. Camboni, *Notes on ferromagnetic diluted p-spin mode*l, Rep. on Math. Phys. 68, 1 (2011)

25. A. Barra, E. A., *Equilibrium statistical mechanics on correlated random graphs*, J. Stat. Mech. P02027 (2011)

**2010**

24. E. A., M. Casartelli, A. Vezzani, *Microscopic energy flows in disordered Ising spin systems*, J. Stat. Mech. P10021 (2010)
23. A. Barra, E. A., *Stochastic dynamics for idiotypic immune networks*, Physica A 389, 5903 (2010)
22. E. A., M. Casartelli, E. Vivo, *Metric characterization of cluster dynamics on the Sierpinski gasket*, J. Stat. Mech. P09002 (2010)
21. E. A., R. Burioni, P. Sgrignoli, *A two-populations Ising model on diluted random graphs*, J. Stat. Mech. P07021 (2010)
20. E. A., R. Burioni, A. Manzotti, *Effective target arrangement in a deterministic scale-free graph*, Phys. Rev. E 82, 011118 (2010)
19. A. Barra, E. A., *A Statistical mechanics approach to autopoietic immune networks*, J.Stat. Mech. P07004 (2010)
18. E. A., A. Blumen, O. Mülken, *Quantum-walk approach to searching on fractal structures*, Phys. Rev. A 82, 012305 (2010); selected for Vir. J. Quantum Inf./ Vol. 10/ Issue 7/ Algorithms and Computation and for Kaleidoscope July 2010
17. E. A., R. Burioni, P.L. Contucci, *A Diffusive Strategic Dynamics for Social Systems*, J. Stat. Phys. 139, 478 (2010)
16. E. A., A. Blumen, O. Mülken, *Continuous-Time quantum walks and trapping*, Int. J. Bif. Chaos, 20, 271 (2010)
15. E. A., R. Burioni, D. Cassi, F.M. Neri, *Word-of-Mouth and dynamical inhomogeneous markets: an efficiency measure and optimal sampling policies for the pre-launch stage*, IMA J. Manage. Math. 21, 67 (2010)

**2009**

14. E. A., R. Burioni, *Random walks on deterministic scale-free networks: exact results*, Phys. Rev. E, 80, 031125 (2009)
13. E. A., M. Casartelli, A. Vezzani, *Energy transport in an Ising disordered model*, J. Stat. Mech. 07041 (2009)

**2008**

12. E. A., A. Barra, F. Camboni, *Criticality in diluted ferromagnet*, J. Stat. Mech., 10003 (2008)
11. E. A., A. Blumen, O. Mülken, *Dynamics of continuous-time quantum walks in restricted geometries*, J. Phys. A, 41, 445301 (2008)
10. E. A., M. Casartelli, A. Vezzani, *Interacting random walkers and non-equilibrium fluctuations*, Eur. Phys. J. B, 65, 257 (2008)
9. E. A., *Exact mean first-passage time on the T-grap*h, Phys. Rev. E, 77, 011128 (2008)
8. E. A., R. Burioni, D. Cassi, F.M. Neri, *Random walk on a population of random walkers*, J. Phys. A, 41, 015001 (2008)

**2007**

7. E. A., M. Casartelli, A. Vezzani, *Configurations and observables in an Ising model with heat flow*, Eur. Phys. J. B, 60, 499 (2007)
6. E. A., R. Burioni, D. Cassi and F.M. Neri, *Autocatalytic reactions on low-dimensional substrates*, Theor. Chem. Acc. 118, 855 (2007)
5. E. A., R. Burioni, D. Cassi, F.M. Neri, *Universal features of information spreading efficiency on d-dimensional lattices*, Phys. Rev. E, 75, 021119 (2007); selected by Vir. J. Bio. Phys. Res./ Vol. 13/ Issue 5/ Information Transfer in Biological Systems

**2006**

4. E. A., R. Burioni, D. Cassi, F.M. Neri, *Efficiency of information spreading in a population of diffusing agents*, Phys. Rev. E 73, 046138 (2006); selected by Vir. J. Bio. Phys. Res./ Vol. 11/ Issue 9/ Information Transfer in Biological Systems
3. E. A., R. Burioni, D. Cassi, A. Vezzani, *Fractal geometry of Ising magnetic patterns: signatures of criticality and diffusive dynamics*, Eur. Phys. J. B, 49, 119 (2006)

**2005**

2. E. A., R. Burioni, D. Cassi, A. Vezzani, *Random walks interacting with evolving energy landscapes*, Eur. Phys. J. B, 48, 529 (2005)
1. E. A., R. Burioni, D. Cassi, A. Vezzani, *Diffusive thermal dynamics for the spin-S Ising ferromagnet*, Eur. Phys. J. B, 46, 109 (2005)

### BOOKS

4. E. A., "A Random Walk in diffusion processes and statistical mechanics", book chapter in "Lecture Notes for Henri Poincare trimester", Cambridge University Press (2016)
3. E. A., D. Cassi, "First-passage phenomena on finite inhomogeneous networks", book chapter in "First-Passage Phenomena and Their Applications", R. Metzler, G. Oshanin, and S. Redner Eds., World Scientific Publishing, Singapore (2014)
2. E. A., *Diffusion with reaction and interaction: from condensed matter to social systems*, LAP LAMBERT Academic Publishing GmbH & Co. KG. Saarbrücken, Germany (2011)

1. E. A., A. Barra, R. Burioni, P. Contucci, *New perspectives in the equilibrium statistical mechanics approach to social and economic sciences*, book chapter in "Mathematical Modeling of Collective Behavior in Socio-Economic and Life-Sciences", G. Naldi, L. Pareschi, G. Toscani Eds., Birkhäuser Mathematics, Springer (2010)

### PROCEEDINGS

8. E. A., A. Barra, F. Tavani, B. Tirozzi, Motifs stability in hierarchical modular networks, in "Theory and Applications in Mathematical Physics", World Scientific Publishing (2016)
7. E. A., A. Barra, A. Galluzzi, D. Tantari, F. Tavani, *A walk in the statistical mechanics formulation of neural networks. Alternative routes to Hebb prescription*, in "Proceedings of the International Conference on Neural Computation Theory and Applications (NCTA-2014)"**,** SCITEPRESS (Science and Technology Publications, Lda) (2014)
6. R. Burioni, E. A., D. Cassi, *Excitations Transfer and Random Walks on Dynamic Contacts Networks*, in "Nonlinear Phenomena in Complex Systems: From Nano to Macro Scale", D. Matrasulov and H.E. Stanley Eds., Springer Series (NATO Science for Peace and Security Series C: Environmental Security) (2014)
5. E. A., A. Barra, A. Galluzzi, A. Pizzoferrato, D. Tantari, *Ferromagnetic Models for Cooperative Behavior: Revisiting Universality in Complex Phenomena*, in "Mathematical Models and Methods for Planet Earth", A. Celletti, U. Locatelli, T. Ruggeri and E. Strickland Eds., Springer INdAM Series (2014)
4. E. A., A. Barra, S. Franz, T. Sabetta, *Some Thoughts on the Ontogenesis in B-cell Immune Networks*, in "Managing complexity reducing perplexity. Mathematical modelling of biological system", G. Ajmone Marsan and M. Delitala Eds., Springer Heidelberg (2014)
3. E. A., A. Barra, R. Burioni, F. Camboni, P. Contucci, *Effective interactions in group competition with strategic diffusive dynamics*, Intellectual Archive Bulletin, 09/12 (2012)
2. E. A., A. Barra, R. Burioni, P. Contucci, Acquaintance role for decision making and exchanges in social networks, J. Dyses **2**, no. 1, 34 (2009)
1. E. A., R. Burioni, D. Cassi, F.M. Neri, *Autocatalytic reaction-diffusion processes in restricted geometries*, Diffusion Fundamentals, **7**, 1.1 (2007)

### SUMMARY OF SCIENTIFIC PRODUCTION

Google Scholar
Items: 134; Citations: 2767; h-index: 29
Scopus
Items: 116; Citations: 1983; h-index: 23

Roma, 15 February 2024