

CURRICULUM VITAE

ELENA AGLIARI

GENERAL INFORMATION

Date and Place of Birth	05 JULY 1980, PARMA (ITALY)
Citizenship	Italian
E-mail	agliari@mat.uniroma1.it ; elena.agliari@uniroma1.it
Certified E-mail	elena.agliari@pec.it
Current position	Associate Professor 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)

ACADEMIC 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. RBF08EKEV [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. 2024/25, 2025/26, “**Mathematics for Machine Learning**” at University Sapienza of Rome (Italy) - **Lecturer**
- A.Y. 2019/20, 2020/21, 2021/22, 2022/23, 2023/24, 2024/25, 2025/26, “**Mathematical Models for Neural Networks**” at University Sapienza of Rome (Italy) - **Lecturer**
- A.Y. 2025/26, “**Mathematics**” for Geological Sciences and Technologies for Conservation and Restoration of Cultural Heritage at University Sapienza of Rome (Italy) - **Co-lecturer**
- A.Y. 2015/16, 2023/24, 2024/25, “**Mathematical and Numerical Methods in Biology**” 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. 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**
- 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**
- 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:

10 PhD students

43 students for the Master Thesis

11 students for the Bachelor Thesis

4 undergraduate students for Honours Program

GRANTS AS PRINCIPAL INVESTIGATOR

- 2026 - **Excellence Grant - Visiting professor** to invite Prof. Pierpaolo Vivo (King's College London) for two weeks - 2.5 k€
- 2025 - **Excellence Grant - Visiting professor** to invite Prof. Alessandro Ingrassia (Radboud University) for two weeks - 2.5 k€
- 2025 - **Excellence Grant - Visiting professor** to invite Prof. Jean Barbier (ICTP Trieste) for two weeks - 2.5 k€
- 2025 - **Grant Sapienza - Visiting professor** to invite Prof. Alessia Annibale (King's College London) for one month - 5 k€
- 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. RBF08EKEV) 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 FOR OTHER ACTIVITIES

- 2025 - **GNFM-INDAM** - contribution of the organization of the workshop "Statistical mechanics of learning machines and neural networks" - 4 k€

GRANTS AS PARTICIPANT

- 2024 - **Fondi Ateneo Sapienza** on "Probabilistic Models in Statistical Physics and Data Science" (prot. RM124190CB1269EB); coordinator: Lorenzo Taggi (Sapienza University of Rome).
- 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)

2025-2026 **Editor** (with J. Indekeu) for the Physics A special issue on “**Statistical Mechanics for Artificial Learning**”

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

- From January 2025: member of **INFN** (Istituto Nazionale Fisica Nucleare)
- 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, 2024/25: 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, 2023/24: 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

- E. Agliari, A. Barra, “Cogito Ergo \Sum”, *Asimmetrie* (2025)
- E. Agliari, A. Barra, “L’Intelligenza Artificiale nell’ultimo secolo”, *Nuova Lettera Matematica* (2025)
- Invited talk “Sostenibilità dell’Intelligenza Artificiale” within the event “Libero arbitrio e Intelligenza Artificiale” at Sapienza University of Roma, 11 October 2024
- Invited talk at “Origins: Interdisciplinary Dialogue on the Genesis of Complexity”, Festival delle Scienze, Auditorium del Macro, Roma, 20 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

- Since 2019: supervision of 10 undergraduate/graduate students for Stage in companies including Banca d’Italia, TIM, Leonardo, ITA Airways.
- **Roma Math Career Day 2025**: 18 September 2025, CNR Roma, Italy (co-organized with R. Natalini, M. Cesari, G. Puppo, C. Manni, D. Marinucci, M. Procesi, M. Pedicini)

- **Roma Math Career Day 2024**: 11 September 2024, CNR Roma, Italy (co-organized with R. Natalini, M. Cesari, G. Puppo, C. Manni, D. Marinucci, M. Procesi, M. Pedicini)
- **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)
- **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

- UMI Workshop "**Mathematics for Artificial Intelligence and Machine Learning**", 21-23 January 2026, Department of Mathematics, Sapienza University of Rome (co-organized with A. Barra, A. Fachechi, G. Visconti and UMI board)
- Workshop "**From statistical mechanics of disordered systems to high-dimensional statistical inference**", 19-20 January 2026, Department of Mathematics, Sapienza University of Rome (co-organized with A. Barra)
- Summer school "**Mathematical methods for high-dimensional data**", 8-12 September 2025, Department of Mathematics, Sapienza University of Rome (co-organized with E. Caglioti, A. Fachechi, L. Taggi)
- 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 LECTURER FOR SUMMER/WINTER SCHOOLS

- 16-20 June 2025, "**Hebbian neural networks**", for the Hausdorff School of Mathematics on "Statistical Mechanics of Spin Glasses, Neural Networks and Learning", Lipschitz-Saal, University of Bonn (Germany)
- 2-14 June 2025, "**Information processing in Hebbian networks**", for the Summer School on "Concepts and Methods of Statistical Physics", Beg Rhou, Saint Pierre Quiberon (France)
- 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)
- 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)

- December 2014, “**Modelling the complexity of the adaptive immune response**” for researchers and PhD students at Institut d’Études Avancées IMERA, Marseille (France)

INVITED CONTRIBUTIONS IN WORKSHOPS

- 14-19 June 2026: INdAM workshop “Probability Models in Mathematical Physics” invited talk **TBA**, Rome
- 18-22 May 2026: “Deep Patterns” invited talk **TBA**, Eurandom, Eindhoven (The Netherlands)
- 28-29 October 2025: “Chalmers AI Research Center Workshop for Structured Learning” invited talk **TBA**, Chalmers, Gothenburg (Sweden) .
- 9 October 2025: “Hard Science for AI” invited talk “**The Hopfield model: Looking Forward, Looking Backward**”, Bologna University, Bologna (Italy) .
- 14-17 September 2025: “38th Marian Smoluchowski Symposium on Statistical Physics” invited talk “**Networks of Hebbian networks: more is different**”, Faculty of Physics Astronomy and Advanced Computer Science of the Jagiellonian University in Kraków, Poland.
- 26 April 2025: “New Frontiers in Associative Memories” ICLR workshop, invited plenary speaker, Singapore [declined]
- 20 February 2025: Panelist at the FAIR-Meeting Spoke 5, Department of Computer, Control and Management Engineering (DIAG), Sapienza University of Roma (Italy)
- 6 December 2024: Meeting SinDEM Lazio 2024 “Intelligenza artificiale e demenza: nuova opportunità o una sfida impari?”, Facoltà di Medicina e Chirurgia, Università Tor Vergata, Roma (Italy) invited talk “**IA un cervello non umano che sa autorigenerarsi**”
- 30 October - 4 November 2024: “Mathematical aspects in non equilibrium systems: from micro to macro”, Center for Scientific Culture Ettore Majorana, Erice (Italy) invited talk “**The Hopfield model: Looking Backward, Looking Forward**”
- 23-25 September 2024: “1st conference of the Italian Network for Computational Neuroscience”, Istituto Superiore di Sanità, Roma (Italy) invited talk “**Networks of neural networks: the more is different**”
- 2-6 September 2024: “ROccella Conference on Inference and AI – ROC(K)IN' AI”, Roccella Jonica, (Italy) invited talk “**Networks of neural networks: more is different**”
- 22-24 May 2024: “From Machine-Learning Theory to Driven Complex Systems and back” CECAM-HQ-EPFL, Lausanne (Switzerland) invited talk “**Information processing from classical-conditioning to contrastive-divergence**”
- 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**”
- 15 September 2023: “RoMaDS: A day on Statistical Physics for Machine Learning”, Department of 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**”
- 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**”
- 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**”
- 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**”
- 22 July 2021: Invited panelist at the workshop “**Physical Review Referee Orientation Session**”, organised by the American Physical Society
- 15-18 March 2021: “Machine Learning and Statistical Physics”, Lagrange Mathematics and Computation Research Center , Paris (France), invited talk “**Learning from Storing**”
- 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: “Il Bad Wildbad meeting on random processes & applications”, Koenig Karls Bad (Germany), invited

- talk **“Encounters on Combs”**
- 2-7 September 2019: “XXI Workshop Unione Matematica Italiana (UMI)”, University of Pavia (Italy), invited talk **“Learning, Reinforcement and Remotion”**
 - 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.”**
 - 13-18 October 2018: “Venice Meeting on Fluctuations in small complex systems IV”, Palazzo Franchetti, Venice (Italy), invited talk **“Collective features in biochemical reactions”**
 - 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: Assemblea GNFM, Montecatini (Italy), invited talk **“Statistical Mechanics of learning and retrieval”**
 - 18-21 April 2017: “Critical Transitions in Complex Systems”, University of Salento (Italy), invited talk **“Criticality in Graphs”**
 - 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”**
 - 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”**
 - 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”**
 - 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”**
 - 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 Erdős-Rényi random graph”**
 - 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”**

INVITED SEMINARS AND COLLOQUIA

- 8 May 2026: Invited Mark Kac seminar **“TBA”**, Utrecht (The Netherlands)
- 24 April 2026: Invited seminar **“TBA”**, Instituto Superior Técnico, Lisbon (Portugal)
- 26 March 2026: Invited Froum Numerica seminar **“The many lives of the Hopfield model: from dreams to generalization”**, Sophia-Antipolis (France)
- 12 November 2025: Volterra seminar **“The Hopfield model: Looking Backward, Looking Forward”**, CNR, Roma
- 14 January 2025: Invited seminar **“Dreaming Neural Networks”**, Basque Center for Applied Mathematics, Bilbao (Spain)
- 29 July 2024: Invited seminar **“Dreaming Neural Networks”**, Riken Center for Brain Science, Tokyo (Japan)
- 28 May 2024: Invited seminar **“Complexity and Machine Learning”**, Department of Mathematics, Goethe-Universität Frankfurt (Germany)

- 16 May 2024: Invited Colloquium **“Machine Learning: from mammal's brain to statistical mechanics”**, Frascati National Laboratories (“Spring School 'Bruno Touschek' in Nuclear, Subnuclear and Astroparticle Physics”), (Italy)
- 24 April 2024: Invited seminar **“A statistical mechanics approach to shallow Boltzmann machines”**, University of Modena and Reggio Emilia (Italy)
- 4 December 2023: Invited Colloquium **“A statistical-mechanics approach to (shallow) neural networks”**, School of Physical and Mathematical Sciences, Nanyang Technology University (Singapore)
- 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)
- 12 January 2023: Invited seminar **“Dense neural networks that learn, store and retrieve”**, Istituto Superiore di Sanità (Italian National Institute of Health), Roma (Italy)
- 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 seminar **“Learning from Storing”** for the Sci-ML webinar series, Carnegie Mellon University, Pittsburgh (US)
- 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)
- 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)
- 27 February 2019: Invited talk at the CANES Cross-Disciplinary Approaches to Non-Equilibrium Systems) seminar series **“Hopfield networks beyond the Hebbian paradigm”**, King's College London
- 27 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)
- 20 June 2018: Invited seminar **“Statistical inference tools to assess leukocyte migratory ability”**, CNR Nanotec, Lecce (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)
- 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)
- 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)
- 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)
- 4 April 2014: Invited seminar **“The infinite collision property on finite, random combs”**, Department of Mathematics, Sapienza University of Rome (Italy)
- 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).
- 15 March 2007: Invited seminar **“Autocatalytic Reaction in Restricted Geometries: Extended Mean-Field Treatment**

and applications to Social Systems”, at Brunel University, London (UK)

OTHER CONTRIBUTIONS IN WORKSHOPS

- 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 COMMITTEES, REVIEWER ACTIVITY

Reviewer for the following project founding Institutions:

2025: External reviewer for the 2020-2024 VQR (Italy)

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 evaluation committees:

2025: Member of the Committee for the PhD defence in Neuroscience at the Norwegian University of Science and Technology, Trondheim (Norway)
2025: Member of the Assessment Committee for the upgrade from Tenure Track position (RTD-B) to Associate Professor in Mathematical Physics at University of Sapienza, Roma (Italy)
2025: Member of the Assessment Committee for an associate professor in the Department of Computing Sciences, University Bocconi, Milano (Italy)
2025: Member of the Committee for the PhD defence in Mathematics at the University of the Basque Country, Bilbao (Spain)
2025: Member of the Assessment Committee for the PhD programme in Mathematics at University of Bologna (Italy)
2024: Member of the Selection Committee for the appointment of a tenure-track professorship (W2TT) at Center for Critical Computational Studies (Germany)
2024: Member of the Assessment Committee for the upgrade from Tenure Track position (RTD-B) to Associate Professor in Mathematical Physics at University of L'Aquila (Italy)
2024: Member of the Selection Committee for a tenure-track position on "Statistical Physics and Machine Learning" at École Normale Supérieure, Paris (France)
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 Committee for the PhD defence in Physics at University Tor Vergata, Roma (Italy)
2022-2023: Member of the monitoring panel for the AI National Ph.D. program
2023: Member of the Selection Committee for a Junior Researcher position (RTD-A) in Mathematical Physics at University of Sapienza of Roma (Italy)
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 Laboratoires 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 xd (Faculty of Medicine) at the Norwegian University of Science and Technology, Trondheim (Norway)

Member of the following workshop program committees:

2025: XXIII International Conference on Image Analysis and Processing (ICIAP25) [Area Chair for the session *AI for Science*]
2025: 29th International Conference on Statistical Physics (STATPHYS29) [Chair of the Topic 1 Committee "General and Mathematical Aspects"]
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)

Reviewer for international scientific journals:

Since 2006 I have served as reviewer for more than 45 different international scientific journals (ISI) in the area of applied mathematics, mathematical physics and theoretical physics.

FULL LIST OF PUBLICATIONS

121. E.A., A. Barra, A. Ladiana, A. Lepre, *Thermodynamic Binding: Freezing Chimeric States in Multi-Modal Associative Memories*, New Frontiers in Associative Memory workshop at ICLR (2026).
120. E.A., A. Barra, P. Bianco, A. Fachechi, D. Pallara, *The thermodynamic limit in mean field neural networks*, submitted (2025).
119. E.A., A. Alessandrelli, S. Akter, A. Fachechi, *Pattern disentanglement and reconstruction by modular Hebbian networks*, BUMI (2026)
118. E.A., P Duarte Mourão, A Fachechi, P Vivo, *Spectral criteria for generalization in noisy Hebbian neural networks* (2026)
117. E.A., A. Fachechi, D. Luongo, *The importance of being empty*, Neurocomp. (2026)
116. E.A., P. Duarte Mourão, A. Fachechi, *The beneficial role of noise for disentanglement tasks in modular Hebbian networks*, Physica A 682, 131134 (2016)
115. E.A., A. Alessandrelli, A. Barra, M.S. Centonze, F. Ricci-Tersenghi, *Networks of neural networks: more is different*, Neur. Netw. 194, 108181 (2026).
- 2025**
114. E.A., A. Alessandrelli, P. Duarte Mourao, A. Fachechi, *Multi-channel pattern reconstruction through L-directional associative memories*, New Frontiers in Associative Memory workshop at ICLR (2025).
113. M.S. Centonze, A. Treves, E.A., A. Barra, *Analytical methods for continuous attractor neural networks*, J. Stat. Phys. 192, 67 (2025).
112. E.A., A. Alessandrelli, A. Barra, M.S. Centonze, F. Ricci-Tersenghi, *Generalized hetero-associative neural networks*, J. Stat. 013302 (2025).
111. E.A., M. Aquaro, A.A.A. Coolen, A. Fachechi, M. Mulder, *Fundamental operating regimes, hyper-parameter fine-tuning and glassiness: towards an interpretable replica-theory for trained restricted Boltzmann machines*, J. Phys. A 58, 065004 (2025).
- 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*, Phys. Rev. E 110, 024301 (2024).
109. E.A., A. Fachechi, D. Luongo, *Algebraic properties for Hebbian-like kernels*, Appl. Math. Comp. 474, 128689 (2024).
108. E.A., F. Alemanno, Aquaro, A. Fachechi, *Regularization, early stopping and dreaming: A Hopfield-like setup to address generalization and overfitting*, Neur. Netw. 177, 106389 (2024).
107. M. Aquaro, F. Alemanno, I. Kanter, F. Durante, A. Barra, E. Agliari, *Hebbian dreaming for small datasets*, Neur. Netw. 173, 106174 (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: rigorous 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-passage properties in a class of fractal 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 symmetric approximations in the thermodynamic limit*, *J. Stat.* 033301 (2019)
- 2018**
76. E. A., D. Migliozi, 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)

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