

UNIVERSITÀ DEGLI STUDI DI MILANO

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Pietro Rotondo

Curriculum Vitae

• PERSONAL INFORMATION

<u>Name</u>	Pietro Rotondo
<u>Date of birth</u>	July 29 th 1986
<u>Place of birth</u>	Lecce, Italy
<u>Citizenship</u>	Italian
<u>Languages</u>	Italian (mother tongue), English (fluent)
<u>Electronic address</u>	pietro.rotondo@unipr.it
<u>Google Scholar</u>	https://scholar.google.com/citations?user=XCWbt2EAAAAJ&hl=it
<u>Scopus</u>	https://www.scopus.com/authid/detail.uri?authorId=56483204600
<u>Orcid</u>	https://orcid.org/0000-0001-6745-6166

• EDUCATION

01/01/2012 – 16/01/2016	Qualification held Institution Thesis title Advisor Thesis Referees Grade	PhD in Physics University of Milan, Unimi, Italy <i>Emergent collective phenomena in quantum many- body systems</i> Sergio Caracciolo Rosario Fazio (ICTP, Trieste) Luca Tagliacozzo (Strathclyde, Glasgow) Excellent (<i>best grade possible</i>)
16/12/2008 – 09/07/2011	Qualification held Institution Thesis title Advisor External Advisor Grade	Master in Physics University of Milan, Unimi, Italy <i>Statistical mechanics modeling of a random laser</i> Bruno Bassetti Luca Leuzzi (University of Rome, La Sapienza) 110 <i>cum laude (best grade possible)</i>
01/10/2005 – 16/12/2008	Qualification held Institution Thesis title Advisor Grade	Bachelor in Physics University of Milan, Unimi, Italy <i>Swimmers at low Reynolds number</i> Bruno Bassetti 110 <i>cum laude (best grade possible)</i>

• CURRENT POSITION

16/01/2023	RTDA (PNRR), UNIPR Parma
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• PREVIOUS POSITIONS

03/02/2020–15/01/2023	Fellini Fellow (Marie Curie Cofund), INFN Milan Research Project: “ <i>Statistical Physics of Machine Learning with geometrically structured data</i> ”. Grant Agreement: 754496
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- 03/11/2017 – 03/11/2019 Marie Curie Fellow (MCIF), University of Nottingham
Research Project: “*Hopfield neural network dynamics in open quantum systems*”
Grant Agreement: 766442
- 19/05/2016 – 02/11/2017 Research Fellow, University of Nottingham, School of Physics and Astronomy
Supervisors: Igor Lesanovsky, Juan P. Garrahan
- 01/10/2015 – 01/05/2016 Research Assistant, University of Milan, Unimi
(*integration of the PhD scholarship*)
Project title: “Statistical Mechanics of disordered and complex systems”
Supervisor: Sergio Caracciolo

• GRANTS AWARDED

- 2023 Bando Fil2 Unipr, awarded as Principal Investigator (PI) of the project (**12,000€**)
(*Project topic: Statistical Physics of Deep learning*)
- 2023 PRIN project (PNRR) awarded as Co-PI, PI Manlio De Domenico (~**220,000€**)
(*formally declined the role of Co-PI for incompatibility with my current position*)
- 2023 PRIN project awarded as Co-PI, PI Michele Allegra (~**220,000€**)
(*formally declined the role of Co-PI for incompatibility with my current position*)

• FELLOWSHIPS, SCHOLARSHIPS AND AWARDS

- 2024 Abilitazione Scientifica Nazionale (ASN) a Professore di II fascia. Settore concorsuale 02/A2
(*expiration date 02/07/2035*)
- 2020 Fellini Fellowship, INFN/Marie Curie Cofund (~**200,000€**)
(*ranked 1st out of 214 candidates*)
- 2020 Unimi Postdoc Fellowship (declined)
- 2017 Marie Curie Individual Fellowship (**183,454.80€**)
- 2012 PhD Scholarship, University of Milan, Unimi
(*ranked 2nd out of more than 40 candidates*)
- 2008 Unimi Ateneo Scholarship (**4100€**)
(*awarded to the 10 best students in the whole scientific area*)
- 2007 Unimi Ateneo Scholarship (**4100€**)
- 2006 Unimi Ateneo Scholarship (**4100€**)

- **REFeree** for Nature, Nature Communications, Physical Review X, Physical Review Letters, Physical Review E, European Physics Journal; Quantum Science and Technology, Physical Review Research

Note on author order. Please note that in all my **first and last** author manuscripts I was the leading contributor (or one of the leading contributors) to the project, I conceived the original idea (sometimes in collaboration with one or more co-authors) and coordinated the research activity (e.g. mentoring junior collaborators).

• PREPRINTS (MANUSCRIPTS UNDER REVIEW)

- [29] *Statistical mechanics of transfer learning in fully-connected networks in the proportional limit.*
A. Ingrosso, R. Pacelli, **P. Rotondo**, F. Gerace.
arXiv: 2407.07168 (2024).
- [28] *Feature learning in finite-width Bayesian deep linear networks with multiple outputs and convolutional layers.* F. Bassetti, M. Gherardi, A. Ingrosso, M. Pastore, **P. Rotondo**.
arXiv:2406.03260 (2024).

- [27] *Local kernel renormalization as a mechanism for feature learning in overparametrized convolutional neural networks.*
R. Aiudi, R. Pacelli, A. Vezzani, R. Burioni, **P. Rotondo**.
arXiv:2307.11807 (2023).

• PUBLICATIONS

- [26] *Predictive power of a Bayesian effective action for one hidden layer neural networks.*
P. Baglioni, R. Pacelli, R. Aiudi, F. Di Renzo, A. Vezzani, R. Burioni, **P. Rotondo**.
Physical Review Letters 133, 027301 (2024).
DOI: <https://doi.org/10.1103/PhysRevLett.133.027301>
- [25] *Resolution of similar patterns in a solvable model of unsupervised deep learning with structured data.*
A. Baroffio, **P. Rotondo**, M. Gherardi.
Chaos, Solitons and Fractals, Vol. 182, 114848 (2024).
DOI: <https://doi.org/10.1016/j.chaos.2024.114848>
- [24] *Inversion dynamics of class manifolds in deep learning reveals tradeoffs underlying generalization.*
S. Ciceri, L. Cassani, M. Osella, **P. Rotondo**, F. Valle, M. Gherardi.
Nature Machine Intelligence, Vol. 6, 40-47 (2024). Selected for the cover of the Journal.
DOI: 10.1038/s42256-023-00772-9
- [23] *A statistical mechanics framework for Bayesian deep neural networks beyond the infinite-width limit.*
S. Ariosto, R. Pacelli, M. Pastore, F. Ginelli, M. Gherardi, **P. Rotondo**.
Nature Machine Intelligence, Vol. 5, 1497-1507 (2023).
DOI: 10.1038/s42256-023-00767-6
- [22] *Universal mean field upper bound for the generalization gap of deep neural networks.*
S. Ariosto, R. Pacelli, F. Ginelli, M. Gherardi, **P. Rotondo**.
Physical Review E 105, 064309 (2022).
arXiv:2201.11022 (2022).
DOI: <https://doi.org/10.1103/PhysRevE.105.064309>
- [21] *Self-induced glassy phase in multimodal cavity quantum electrodynamics.*
V. Erba, M. Pastore, **P. Rotondo**.
Physical Review Letters 126, 183601 (2021).
arXiv:2101.03754 (2021).
DOI: <https://doi.org/10.1103/PhysRevLett.126.183601>
- [20] *Beyond the storage capacity: data driven satisfiability transition.*
P. Rotondo, M. Pastore, M. Gherardi.
Physical Review Letters 125, 120601 (2020).
arXiv:2005.09992 (2020).
DOI: <https://doi.org/10.1103/PhysRevLett.125.120601>
- [19] *Statistical Learning Theory of structured data.*
M. Pastore, **P. Rotondo**, V. Erba, M. Gherardi.
Physical Review E 102, 032119 (2020). Selected as Editor's suggestion.
arXiv:2005.10002 (2020).
DOI: <https://doi.org/10.1103/PhysRevE.102.032119>
- [18] *Signatures of associative memory behavior in a multi-mode spin-boson model.*
E. Fiorelli, M. Marcuzzi, **P. Rotondo**, F. Carollo, I. Lesanovsky.
Physical Review Letters 125, 070604 (2020).
arXiv:2003.01004 (2020).
DOI: <https://doi.org/10.1103/PhysRevLett.125.070604>

- [17] *Random Geometric graphs in high dimension.*
V. Erba, S. Ariosto, M. Gherardi, **P. Rotondo**.
Physical Review E 102, 012306 (2020).
arXiv:2002.12272 (2020).
DOI: <https://doi.org/10.1103/PhysRevE.102.012306>
- [16] *Large deviations of the free-energy in the p-spin glass model.*
M. Pastore, A. Di Gioacchino, **P. Rotondo**.
Physical Review Research 1, 033116 (2019).
arXiv:1909.06196 (2019).
DOI: <https://doi.org/10.1103/PhysRevResearch.1.033116>
- [15] *Dynamics of strongly coupled disordered dissipative spin-bosons systems.*
E. Fiorelli, **P. Rotondo**, F. Carollo, M. Marcuzzi, I. Lesanovsky.
Physical Review Research 2, 013198 (2020).
arXiv:1904.13181 (2020).
DOI: <https://doi.org/10.1103/PhysRevResearch.2.013198>
- [14] *Intrinsic dimension estimation for locally undersampled data.*
V. Erba, M. Gherardi, **P. Rotondo**.
Scientific Reports 9, 17133 (2019).
arXiv:1906.07670 (2019).
DOI: <https://doi.org/10.1038/s41598-019-53549-9>
- [13] *Counting the learnable functions of geometrically structured data.*
P. Rotondo, M. Cosentino Lagomarsino, M. Gherardi.
Physical Review Research 2, 023169 (2020). Selected as “Editor’s suggestion”.
arXiv:1903.12021 (2020).
DOI: <https://doi.org/10.1103/PhysRevResearch.2.023169>
- [12] *Generalization from correlated sets of patterns in the perceptron model.*
F. Borra, **P. Rotondo**, M. Cosentino Lagomarsino, M. Gherardi.
Journal of Physics A, Vol. 52, 38 (2019).
arXiv:1903.06818 (2019).
DOI: [10.1088/1751-8121/ab3709](https://doi.org/10.1088/1751-8121/ab3709)
- [11] *Quantum accelerated approach to the thermal state of classical spin systems with application to pattern-retrieval in the Hopfield neural network.*
E. Fiorelli, **P. Rotondo**, M. Marcuzzi, J. P. Garrahan, I. Lesanovsky,
Phys. Rev. A 99, 032126 (2019).
DOI: <https://doi.org/10.1103/PhysRevA.99.032126>
- [10] *Singularities in large deviations of work in quantum quenches.*
P. Rotondo, J. Minar, J. P. Garrahan, I. Lesanovsky, M. Marcuzzi.
Phys. Rev. B 98, 184303 (2018).
DOI: <https://doi.org/10.1103/PhysRevB.98.184303>
- [9] *Open quantum generalization of Hopfield neural networks.*
P. Rotondo, M. Marcuzzi, J. P. Garrahan, I. Lesanovsky, M. Muller,
J. Phys. A: Math. Theor. **51** 115301 (2018). On the Cover and selected as 2018 highlight by IoP.
DOI: [10.1088/1751-8121/aaabcb](https://doi.org/10.1088/1751-8121/aaabcb)
- [8] *Current quantization and fractal hierarchy in a driven repulsive lattice gas.*
P. Rotondo, A. Sellaio, M. Cosentino Lagomarsino, S. Caracciolo, M. Gherardi,
Phys. Rev. E 96, 052141 (2017).
DOI: <https://doi.org/10.1103/PhysRevE.96.052141>
- [7] *Unified Fock space representation of fractional quantum Hall states.*
A. Di Gioacchino, L. G. Molinari, V. Erba, **P. Rotondo**,
Phys. Rev. B 95, 245123 (2017).
DOI: <https://doi.org/10.1103/PhysRevB.95.245123>
- [6] *Effective spin physics in two-dimensional cavity QED arrays.*

J. Minar, S. Gunes Soyler, **P. Rotondo**, I. Lesanovsky,
 New Journ. Phys., Vol. 19 (2017).
 arXiv:1702.02979 (2017).
 DOI: 10.1088/1367-2630/aa753c

[5] *Measuring logic complexity can guide pattern discovery in empirical systems.*

M. Gherardi, **P. Rotondo**,
 Complexity 1099-0526, (2016).
 DOI: 10.1002/cplx.21819

[4] *Emergent collective phenomena in quantum many-body systems.*

P. Rotondo,
 PhD Thesis (2016). See here for the online version: <http://pcteserver.mi.infn.it/~caraccio/PhD/Rotondo.pdf>

[3] *Devil's staircase phase diagram of the fractional quantum Hall effect in the thin torus limit.*

P. Rotondo, L. G. Molinari, P. Ratti, M. Gherardi,
 Phys. Rev. Lett. 116, 256803 (2016).
 DOI: <https://doi.org/10.1103/PhysRevLett.116.256803>

[2] *Dicke simulators with emergent collective quantum computational abilities.*

P. Rotondo, M. Cosentino Lagomarsino, G. Viola,
 Phys. Rev. Lett. 114, 143601 (2015).
 DOI: <https://doi.org/10.1103/PhysRevLett.114.143601>

[1] *Replica Symmetry breaking in cold atoms and spin glasses.*

P. Rotondo, E. Tesio, S. Caracciolo,
 Phys.Rev. B 91(1), 014415 (2015).
 DOI: <https://doi.org/10.1103/PhysRevB.91.014415>

• PROCEEDINGS

[1] *Jack on a Devil's staircase. Toward a Science campus in Milan.* Edited by Springer (2018). In Press.

A. Di Gioacchino, M. Gherardi, L. G. Molinari, **P. Rotondo**.

• SUPERVISION OF POSTDOCS

2024 Dr Paolo Baglioni (*funded by PRIN PNRR*)

2024 Dr Rosalba Pacelli (*funded by PRIN*)

• SUPERVISION & CO-SUPERVISION OF GRADUATE STUDENTS

2023	Sebastiano Ariosto	PhD	Insubria	Advisor: F. Ginelli
	<i>(now post-doc at UniBocconi, Milano)</i>			
2021	Vittorio Erba	PhD	Unimi	Advisor: S. Caracciolo
	<i>(now post-doc at EPFL, Lausanne)</i>			
2020	Mauro Pastore	PhD	Unimi	Advisor: S. Caracciolo
	<i>(now post-doc at Paris Ecole Normale Supérieure)</i>			

• SUPERVISION & CO-SUPERVISION OF UNDERGRADUATE STUDENTS

2024	Andrea Corti	Msc Degree	Unimi	Advisor: M. Gherardi
2020	Luca Zilli	Bsc Degree	Unimi	Advisor: M. Gherardi
2020	Mirko Rossini	Msc Degree	Unimi	Advisor: M. Gherardi
	<i>(now PhD student at Ulm University)</i>			
2020	Sebastiano Ariosto	Msc Degree	Unimi	Advisor: M. Gherardi
2020	Simone Ciceri	Bsc Degree	Unimi	Advisor: M. Gherardi
2019	Rosalba Pacelli	Msc Degree	Unimi	Advisor: M. Gherardi
2019	Alessandro Tamaro	Bsc Degree	Unimi	Advisor: S. Caracciolo
2018	Davide Maria Tagliabue	Bsc Degree	Unimi	Advisor: S. Caracciolo
	<i>(now PhD student at Unimi)</i>			
2018	Francesco Borra	Msc Degree	Unimi	Advisor: S. Caracciolo

	<i>(now Post-doc at ENS in Paris)</i>			
2017	Daniel Walker	3 rd year project	Nottingham	Advisor: I. Lesanovsky
2016	Andrea Di Gioacchino	Msc degree	Unimi	Advisor: S. Caracciolo
	<i>(now Marie Curie Fellow at ENS in Paris)</i>			
2016	Vittorio Erba	Bsc degree	Unimi	Advisor: L. G. Molinari
2015	Andrea Papale	Msc degree	Unimi	Advisor: S. Caracciolo
	<i>(now Post-doc at ENS in Paris)</i>			
2015	Piergiorgio Ratti	Bsc degree	Unimi	Advisor: L. G. Molinari
2015	Jacopo Cattaneo	Bsc degree	Unimi	Advisor: B. Bassetti
2014	Andrea Di Gioacchino	Bsc degree	Unimi	Advisor: S. Caracciolo
	<i>(now Marie Curie Fellow at ENS, Paris)</i>			
2013	Carlo Minotti	Bsc degree	Unimi	Advisor: B. Bassetti
2012	Federica Balistreri	Bsc degree	Unimi	Advisor: B. Bassetti

• TEACHING ACTIVITIES

Summer 2024	Teaching position	Lecturer
	Course	PhD Course: Physics of Machine Learning
	Hours	32
	Institution	Unipr, Parma
Spring 2024	Teaching position	Lecturer
	Course	Istituzione di Fisica per Geologia
	Hours	72
	Institution	Unipr, Parma (Dipartimento SCVSA)
Summer 2023	Teaching position	Lecturer
	Course	PhD Course: Physics of Machine Learning
	Hours	32
	Institution	Unipr, Parma
Summer 2022	Teaching position	Lecturer
	Course	PhD Course: Physics of Machine Learning
	Hours	32
	Institution	Insubria University, Como
Spring 2020	Teaching position	Invited Lecturer (Intro on Machine Learning)
	Course	Advanced Statistical Mechanics
	Hours	3
	Institution	University of Milan, Unimi
Spring 2018	Teaching position	Invited Lecturer (Intro on Machine Learning)
	Course	Advanced Statistical Mechanics
	Hours	10
	Institution	University of Milan, Unimi
Spring-Autumn 2015	Teaching position	Teaching assistant
	Course	Quantum Mechanics (Bachelor)
	Hours	40
	Institution	University of Milan, Unimi
Winter 2015	Teaching position	Teaching assistant
	Course	Quantitative methods for social sciences (Bachelor) <i>(course of the political sciences department)</i>
	Hours	20
	Institution	University of Milan, Unimi

Spring 2015	Teaching position	Invited lecturer
Spring 2014	Course	Statistical Mechanics (Master)
Spring 2013	Hours	4
	Institution	University of Milan, Unimi
Spring 2012	Teaching position	Lecturer
		<i>(in place of Prof. B. Bassetti sick)</i>
	Course	Statistical Mechanics (Master)
	Hours	20
	Institution	University of Milan, Unimi

• INVITED/CONTRIBUTED TALKS

09/2024	“Roc(k)in’ AI: Roccella Conference on Inference and Artificial Intelligence”, Roccella Jonica. Invited Speaker.
05/2024	CECAM Workshop “From machine-learning theory to driven complex systems and back”, EPFL Lausanne. Contributed Talk: <i>Feature learning in Bayesian one-hidden layer networks</i> .
06/2023	“Machine Learning for Lattice field theory and beyond”, Trento. Invited Speaker: <i>Statistical mechanics of deep learning beyond the infinite-width limit</i>
05/2023	“Youth in High-Dimensions”, ICTP Trieste. Invited Speaker: <i>Statistical mechanics of deep learning beyond the infinite-width limit</i>
09/2022	Asiago Workshop: Physics of Machine Learning. Invited Speaker: <i>Statistical mechanics of deep learning beyond the infinite-width limit</i>
06/2022	Parma: SIFS Workshop. Contributed Talk: <i>Universal mean field upper bound for the generalization gap of deep neural networks</i>
06/2022	Como: School on “Statistical Physics of Deep Learning”. Invited Speaker: <i>Universal mean field upper bound for the generalization gap of deep neural networks</i>
05/2022	Paris Saclay <i>(invited by Valentina Ros)</i> Talk: <i>Universal mean field upper bound for the generalization gap of deep neural networks</i>
03/2022	EPFL Lausanne: Applied Machine Learning Days (AMLD) 2022. Contributed Talk: <i>Universal mean field upper bound for the generalization gap of deep neural networks</i> .
04/2021	GSSI Institute (L’Aquila): Artificial Intelligence 2021 (Spring session) Invited Speaker: <i>Statistical Learning Theory of geometrically structured data</i>
07/2020	Trieste ICTP <i>(invited by Jacopo Grilli)</i> Talk: <i>Statistical Learning Theory of geometrically structured data</i>
07/2019	Buenos Aires: <i>StatPhys27</i> . Contributed Talk: <i>Machine Learning with geometrically structured data</i>
11/2018	Protea Hotel Edward Durban: <i>Quantum techniques in Machine Learning Workshop. (invited by F. Petruccione)</i> . Invited Speaker: <i>Open quantum generalization of Hopfield neural networks</i>

- 03/2018 Technische Universitat Berlin: *DPG & EPS Spring meeting condensed matter*.
Contributed talk: *Singularities in large deviations of work in quantum quenches*
- 05/2017 King's College London. *Workshop on Stat. Phys. of Complex, Glassy and Non-Equilib. systems*.
Contributed talk: *Open quantum generalization of Hopfield neural networks*
- 05/2017 University of Leeds, Leeds (*invited by Zlatko Papić*)
Talk: *Open quantum generalization of Hopfield neural networks*
- 05/2017 ENS, Paris (*invited by Francesco Zamponi*)
Talk: *Statistical mechanics approach to multimodal cavity QED with disorder*
- 02/2017 Unimi, Milan. *Workshop on Complex systems*
Invited Talk: *Anomalous transport in driven lattice gases with long-range repulsive interactions*
- 01/2016 Unimi, Milan. *Workshop on Complex Systems*
Invited Talk: *Devil's staircase phase diagram of the fractional quantum Hall effect in the thin-torus limit*
- 09/2015 MPI for Complex systems, Dresden. *Synthetic quantum magnetism workshop*
Poster: *Dicke simulators with emergent collective quantum computational abilities*
- 06/2015 ICFO, Barcelona. (*invited by Maciej Lewenstein*)
Talk: *Dicke simulators with emergent collective quantum computational abilities*
- 01/2015 Unimi, Milan. *Workshop on Complex Systems*
Instant Talk: *Dicke simulators with emergent collective quantum computational abilities*

• SCHOOLS, CONFERENCES AND WORKSHOPS ATTENDED

- 02/09/2019 – 06/09/2019 *Model-guided Data Science*. Como Lake Summer School. Como (Italy)
- 24/06/2018 – 07/07/2018 *Deep Learning and Statistical Physics*. Summer School. Beg Rohu (France).
- 07/07/2014 – 15/07/2014 *Quantum matter at ultralow temperatures*. SIF School. Varenna (Italy).
- 03/02/2014 – 14/02/2014 *Lectures on Statistical Field Theory*. School. Galileo Institute, Florence (Italy).
- 01/07/2013 – 05/07/2013 *Geometrical aspects of quantum states in condensed matter*. Workshop and conference. ICTP, Trieste (Italy).
- 11/03/2013 – 16/03/2013 *Advanced topics in conformal field theory*. School. ICTP, Trieste (Italy).

• OTHER ACADEMIC ACTIVITIES

- 06/2024 Co-organizer of the SIFS workshop in Parma “Convegno SIFS 2024”.
(*This is the largest Italian conference in the field of statistical physics*)
- 06/2023 Co-organizer of the SIFS workshop in Parma “Convegno SIFS 2023”.
- 10/2022 Co-organizer of the conference “The many facets of Statistical Field Theory” in honor of the 70th birthday of S. Caracciolo
- 05/2008 – 07/2011 Member of the governing body (*Consiglio di dipartimento, CCD*) of the Physics department, representing students in teaching and administrative issues.

Milano 13/07/2024