Vittorio Erba

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Research positions

Main research interest: Statistical physics of inference, learning and optimization

01/2023 ↦ 12/2024 | **SNSF Postdoctoral Fellow**, École polytechnique fédérale de Lausanne
Independent researcher working with the groups of Lenka Zdeborová and Florent Krzakala

11/2021 ↦ 12/2022 | **Postdoctoral Researcher**, École polytechnique fédérale de Lausanne
Working in the groups of Lenka Zdeborová and Florent Krzakala

Education

10/2018 ↦ 10/2021 | **PhD in Theoretical Physics**, Università degli Studi di Milano
Thesis supervisor: Sergio Caracciolo | Full marks cum laude

10/2016 ↦ 10/2018 | **M. Sc. in Theoretical Physics**, Università degli Studi di Milano
Thesis supervisor: Sergio Caracciolo | 110 cum laude/110

10/2013 ↦ 07/2016 | **B. Sc. in Physics**, Università degli Studi di Milano
Thesis supervisor: Luca Molinari | 110 cum laude/110

Scientific service

Reviewer for ICLR 2023, NeurIPS 2022 & 2023, Physica A: Statistical Mechanics and its Applications

Organiser of:

- 08/2023 | "Statistical physics & machine learning back together again": 2-weeks workshop at the Cargese Institute of Scientific Studies
- 06/2022 | AI4Science Day: 1-day workshop for EPFL groups working on ML applied to natural sciences
- 03/2022 | AI&Physics Track, AMLD22: conference track on theoretical and applied machine learning
- 10/2016 | Particle and Astroparticle Physics Autumn Programme: visit to INFN and Gran Sasso labs

Volunteering for the Italian Association of Physics Students (2015 ↦ 2017)

- Secretary and IT contributor for the association
- Managed an outreach program for high-schools

Visits, Conferences & Schools

Talk	08/2023 | Statistical physics & machine learning back together again, Cargese Research Institute
Talk	06/2023 | High Dimensional Statistics and Random Matrices, Porquerolles
Poster	05/2023 | Youth in High-Dimensions, ICTP Trieste
Talk	04/2023 | Visit to Riccardo Zecchina's group, Bocconi University, Milan
Poster	02/2023 | Towards a theory of artificial and biological neural networks, Les Houches School
-	10/2022 | The many facets of Statistical Field Theory, SISSA Trieste
Talk	08/2022 | Mathematical and Scientific Machine Learning, Virtual
Poster	07/2022 | Summer school on Statistical Physics & Machine learning, Les Houches School
Poster	06/2022 | Youth in High-Dimensions, ICTP Trieste
-	03/2022 | Applied Machine Learning Days 2022, EPFL Lausanne
-	02/2022 | Loss Landscape of Neural Networks, EPFL Lausanne
-	12/2021 | EPFL NeurIPS 2021 Mirror Event, EPFL Lausanne
-	09/2021 | Rigorous Evidence for Information-Computation Trade-offs, Virtual
-	07/2021 | Glassy Systems and Inter-Disciplinary Applications, Cargese Research Institute
-	02/2021 | Symposium on Explanation in Neuroscience and Artificial Intelligence, Virtual
Talk	12/2020 | Talk to Lenka Zdevorová's group, EPFL Lausanne
-	10/2020 | Brain Criticality 2020, Virtual

Talk	10/2020 | Visit to Michele Parrinello's group, Univesità della Svizzera Italiana, Lugano
Talk	10/2019 | Complex Systems Meeting, Unimi Milan
-	10/2019 | Mathematical and Computational Aspects of Machine Learning, SNS Pisa
Poster	06/2019 | XXIV Convegno Nazionale di Fisica Statistica e dei Sistemi Complessi, Parma
-	02/2019 | Lectures on Statistical Field Theories, GGI Firenze
-	09/2018 | Disordered serendipity: a glassy path to discovery, Sapienza University, Rome
-	08/2017 | International Conference of physics students, Unito Torino
-	05/2017 | Conferenza Italiana Studenti di Fisica, Uniba Bari
Talk	08/2016 | International Conference of physics students, Malta
-	05/2016 | Conferenza Italiana Studenti di Fisica, Unito Torino
-	05/2015 | Conferenza Italiana Studenti di Fisica, Unito Torino

Funding

- 2023 | SNSF Postdoctoral Fellowship (2 years) | 10% success rate, total budget ~221000 CHF
- 2018 | Ph.D. Scholarship (3 years) | Awarded by Unimi, Milan. Ranked 10th/53 candidates
- 2015 | Excellence Scholarship (3 years) | Awarded by Unimi, Milan, to the best students

Teaching & Supervision

Main teacher

- UNIMI, Fall 2020: Precourse of mathematics for freshmen in physics (basic maths)
- Academic year 2016/17: Substitute physics teacher the "L. Einaudi" secondary public school, Varese
- 2013 $\mapsto$ 2018: Private lectures in math, physics, chemistry, latin

Teaching assistant

- EPFL, Fall 2022: Scientific Machine Learning
- UNIMI, Spring 2021: Mathematical methods in physics (complex and functional analysis)
- UNIMI, Fall 2020: Numerical treatment of experimental data (C++, OOP and numerical methods)
- UNIMI, Spring 2020: Mathematical methods in physics (complex and functional analysis)
- UNIMI, Fall 2019: Support course of mathematics for freshman in natural sciences (basic maths)
- UNIMI, Spring 2019: Mathematical methods in physics (complex and functional analysis)

Student supervision

- 2023, EPFL, Hamza Meel, Semester project, Main supervisor: Lenka Zdeborová
- 2023, EPFL, Rodrigo Emilio Pérez Ortiz, M.Sc. thesis, Main supervisor: Lenka Zdeborová
- 2022, EPFL, Odilon Duranthon, Semester project, Main supervisor: Lenka Zdeborová
- 2022, EPFL, Matteo Vilucchio, Semester project, Main supervisor: Florent Krzakala
- 2022, EPFL, Borja Mateos, Semester project, Main supervisor: Lenka Zdeborová
- 2020, UNIMI, Sebastiano Ariosto, M.Sc. Thesis, Main supervisor: Marco Gherardi
- 2020, UNIMI, Mirko Rossini, M.Sc. Thesis, Main supervisor: Marco Gherardi

UNIMI: Università degli Studi di Milano
EPFL: École polytechnique fédérale de Lausanne

Publications

1. **Asymptotic Characterisation of Robust Empirical Risk Minimisation Performance in the Presence of Outliers.** Vilucchio, Troiani, Erba, Krazkala. Preprint Arxiv (2023)
2. **Statistical mechanics of the maximum-average submatrix problem.** Erba†, Krzakala, Perez, Zdeborová. Preprint Arxiv (2023)
3. **Optimal denoising of rotationally invariant rectangular matrices.** Troiani, Erba†, Krzakala, Maillard, Zdeborová. Mathematical and Scientific Machine Learning (2022)
4. **Self-induced quenched disorder in multimodal cavity quantum electrodynamics.** Erba†, Pastore, Rotondo. Physical Review Letters (2021)

5. **The number of optimal matchings in the Euclidean assignment problem on the line.** Caracciolo, Erba†, Sportiello. Journal of Statistical Physics (2021)
6. **The p-Airy distribution.** Caracciolo, Erba†, Sportiello. Preprint Arxiv (2020)
7. **Statistical learning theory of structured data.** Pastore, Rotondo, Erba, Gherardi. Physical Review E (2020, Editor's suggestion)
8. **Random geometric graphs in high dimension.** Erba†, Ariosto, Gherardi, Rotondo. Physical Review E (2020)
9. **The Dyck bound in the concave 1-dimensional random assignment model.** Caracciolo, D'Achille, Erba†, Sportiello. Journal of Physics A (2020)
10. **Intrinsic dimension estimation for locally undersampled data.** Erba†, Gherardi, Rotondo. Scientific Reports (2019)
11. **Unified Fock space representation of fractional quantum Hall states.** Di Gioacchino, Molinari, Erba, Rotondo. Physical Review B (2017)

†: denotes first authorship: I had a primary role in the research and writing related to these papers.

Skills

- **Computer programming**: proficient in Julia, Python, Wolfram Mathematica, LaTeX. Have experience with C++, Bash
- **Web design**: knowledge of HTML, CSS and creation of static websites
- **Graphics**: have experience with Inkscape

Languages

- **Italian**: mothertongue
- **English**: Fluent, CEFR C1. Certifications: Cambridge BULATS C1 (2019), Cambridge FCE B2 (2012)
- **French**: Intermediate