Curriculum Vitae et Studiorum

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Personal Data

Last Name:	Zamparo
First Name:	Marco
Birth:	14 January 1979, Turin, Italy
Nationality:	Italian
Work Address:	Department of Physics, University of Bari Aldo Moro, via Amendola 173, I-70126 Bari - Italy
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Current Position

Fixed-term research assistant (RTDA) at University of Bari Aldo Moro
Sector 02/A2 - Theoretical Physics of Fundamental Interactions
28 December 2020 - 27 December 2023

Research and Teaching Profile

I graduated in nuclear engineering with honours at the Polytechnic University of Turin in 2005, where I received a European PhD in Physics in 2009 and I was awarded for the most outstanding doctoral research in 2008. My research interests lie in the fields of statistical physics, mathematical physics, probability theory, and mathematical modelling of biological systems. I have authored 32 publications on ISI-indexed international journals, with a total of 435/467 (WOS/SCOPUS) citations and an h-index of 10. My publications, together with preprints and manuscripts in preparation, can be divided as detailed below in physical and multidisciplinary works and in mathematical works. I have been lecturer in *Continuum Mechanics and Fluid Dynamics* in the International (Paris-Turin-Trieste) Master's programme in Physics of Complex Systems at the Polytechnic University of Turin from 2015 to 2017. Now I am lecturer in *Large Fluctuations in Probability and Statistical Mechanics* in the Master's programme in Theoretical Physics and Complex Systems at the University of Bari Aldo Moro, and in *Large Deviation Theory and Applications* in the PhD programme in Computer Science and Mathematics at the same university. I am also co-lecturer in *Mathematical and Numerical Methods for Geophysics* in the Master's programme in Geological and Geophysical Sciences at the University of Bari Aldo Moro, and in *Analytical Mechanics* in the Bachelor's programme in Physics at the same university. In 2019 I obtained the Italian National Scientific Qualification as Associated Professor in Mathematical Physics.

Physics and multidisciplinary applications. During the PhD and afterwards I have worked on the statistical physics modelling of protein folding [1 - 4,9,10] and mechanical protein unfolding [5,6,8,12]. Subsequently, I contributed to devise a mathematical model for prediction of intra-protein residue-residue contacts [15] and for identification of interacting proteins in multiprotein systems [18]. Parallel to this, I contributed to a statistical physics description of protein sorting processes in living cells [17,24,30]. On a different research line, I collaborated to develop a mathematical model for financial asset dynamics based on observed scaling symmetries of assets' returns [13,14]. The model was later used to tackle an option pricing problem [16]. I also proposed an extension of factor analysis to time series with latent Gaussian processes [11]. Recently, I have been involved in the study of dynamical phase transitions in generalisations of the totally asymmetric simple exclusion process [21,23,25], and in the study of large fluctuations in simplified active-particle systems [34].

Mathematics and its methods. Stimulated by the mathematical problems of physics, I have undertaken an independent activity in mathematics and rigorous physics, which is now my main activity. During the PhD I managed to solve a statistical mechanical model of protein folding

with disorder, computing its quenched free energy rigorously [7]. Subsequently, I have provided a description of the apparent multifractality of self-similar Lévy processes [19]. In the framework of stochastic interacting particle systems, I have discover that a formula exists for the mean time that the particles spend in a lattice [20]. In the context of binary time series, I have proposed a new model for dependent binary sequences, which relies on a renewal structure [28]. Recently, I have established large deviation principles for renewal-reward processes under optimal hypotheses [26,31]. I have used these results to investigate the renewal models of statistical physics [22], such as the homogeneous pinning model of polymers and the Poland-Scheraga model of DNA denaturation, and stochastic processes with restart [32]. For the renewal models of statistical physics I have also characterised the precise asymptotics of probabilities at criticality [27]. I am currently investigating quenched large deviation principles in polymer pinning models with disorder [35], and trying to elucidate the singularities of rate functions by assessing the presence of big-jumps in exponential fluctuations [36]. Parallel to this, I have probed the quenched and annealed transport properties of the Lévy-Lorentz gas, which basically is a random walk in a long-tailed random environment [29]. Finally, I have established large deviation principles for quadratic functionals of Gauss-Markov chains with application to the entropy production rate [33].

Education and Qualifications

- Italian National Scientific Qualification (ASN) as Associated Professor
  Sector 01/A4 - Mathematical Physics
  9 September 2019 - 9 September 2028
- European PhD in Physics
  Polytechnic University of Turin, Department of Physics, 5 February 2009
  Thesis title: *Wako-Saitô-Muñoz-Eaton model: protein folding kinetics and stretching*
  Advisor: Prof. Alessandro Pelizzola
- Master of Science in Nuclear Engineering
  Polytechnic University of Turin, 18 July 2005
  Thesis title: *Metodi meccanico-statistici per il ripiegamento delle proteine*
  Advisor: Prof. Alessandro Pelizzola
  Marks: 110/110 *cum laude*

Awards

2008 Quality Award for the most outstanding doctoral research of the Polytechnic University of Turin

Publications

[1] **M. Zamparo** and A. Pelizzola, *Kinetics of the Wako-Saitô-Muñoz-Eaton model of protein folding*, Phys. Rev. Lett. **97** 068106 (2006)

[2] **M. Zamparo** and A. Pelizzola, *Rigorous results on the local equilibrium kinetics of a protein folding model*, J. Stat. Mech. P 12009 (2006)

[3] P. Bruscolini, A. Pelizzola, and **M. Zamparo**, *Downhill versus two-state protein folding in a statistical mechanical model*, J. Chem. Phys. **126** 215103 (2007)

[4] P. Bruscolini, A. Pelizzola, and **M. Zamparo**, *Rate determining factors in protein model structures*, Phys. Rev. Lett. **99** 038103 (2007)

[5] A. Imparato, A. Pelizzola, and **M. Zamparo**, *Ising-like model for protein mechanical unfolding*, Phys. Rev. Lett. **98** 148102 (2007)

[6] A. Imparato, A. Pelizzola, and **M. Zamparo**, *Protein mechanical unfolding: a model with binary variables*, J. Chem. Phys. **127** 145105 (2007)

[7] **M. Zamparo**, *An exactly solvable model for a β-hairpin with random interactions*, J. Stat. Mech. P 10013 (2008)

[8] A. Imparato, A. Pelizzola, and **M. Zamparo**, *Equilibrium properties and force-driven unfolding pathways of RNA molecules*, Phys. Rev. Lett. **103** 188102 (2009)

[9] **M. Zamparo** and A. Pelizzola, *Nearly symmetrical proteins: folding pathways and transition states*, J. Chem. Phys. **131** 035101 (2009)

[10] **M. Zamparo**, A. Trovato, and A. Maritan, *Simplified exactly solvable model for β-amyloid aggregation*, Phys. Rev. Lett. **105** 108102 (2010)

[11] **M. Zamparo**, S. Stramaglia, J.R. Banavar, and A. Maritan, *Inverse problem for multivariate time series using dynamical latent variables*, Phys. A **391** 3159-3169 (2012)

[12] A. Pelizzola and **M. Zamparo**, *Nonequilibrium dynamics of an exactly solvable Ising-like model and protein translocation*, Europhys. Lett. **102** 10001 (2013)

[13] F. Baldovin, F. Camana, M. Caraglio, A.L. Stella, and **M. Zamparo**, *Aftershock prediction for high-frequency financial markets' dynamics*, in F. Abergel, B.K. Chakrabarti, A. Chakraborti, A. Ghosh, eds., *Econophysics of Systemic Risk and Network Dynamics* (New Economic Windows, Springer 2013), pp. 49-58

[14] **M. Zamparo**, F. Baldovin, M. Caraglio, and A.L. Stella, *Scaling symmetry, renormalization, and time series modeling: The case of financial assets dynamics*, Phys. Rev. E **88** 062808 (2013)

[15] C. Baldassi, **M. Zamparo**, C. Feinauer, A. Procaccini, R. Zecchina, M. Weigt, and A. Pagnani, *Fast and accurate multivariate Gaussian modeling of protein families: Predicting residue contacts and protein-interaction partners*, PLOS ONE **9** e92721 (2014)

[16] F. Baldovin, M. Caporin, M. Caraglio, A.L. Stella, and **M. Zamparo**, *Option pricing with non-Gaussian scaling and infinite-state switching volatility*, J. Econometrics **187** 486-497 (2015)

[17] **M. Zamparo**, F. Chianale, C. Tebaldi, M. Cosentino-Lagomarsino, M. Nicodemi, and A. Gamba, *Dynamic membrane patterning, signal localization and polarity in living cells*, Soft Matter **11** 838-849 (2015)

[18] T. Gueudre, C. Baldassi, **M. Zamparo**, M. Weigt, and A. Pagnani, *Simultaneous identification of specifically interacting paralogs and interprotein contacts by direct coupling analysis*, Proc. Natl. Acad. Sci. U.S.A. **113** 12186-12191 (2016)

[19] **M. Zamparo**, *Apparent multifractality of self-similar Lévy processes*, Nonlinearity **30** 2592-2611 (2017)

[20] **M. Zamparo**, L. Dall'Asta, and A. Gamba, *On the mean residence time in stochastic lattice-gas models*, J. Stat. Phys. **30** 120-134 (2019)

[21] D. Botto, A. Pelizzola, M. Pretti, and **M. Zamparo**, *Dynamical transition in the TASEP with Langmuir kinetics: mean-field theory*, J. Phys. A: Math. Theor. **52** 045001 (2019)

[22] **M. Zamparo**, *Large deviations in renewal models of statistical mechanics*, J. Phys. A: Math. Theor. **52** 495004 (2019)

[23] D. Botto, A. Pelizzola, M. Pretti, and **M. Zamparo**, *Unbalanced Langmuir kinetics affects TASEP dynamical transitions: mean-field theory*, J. Phys. A: Math. Theor. **53** 345001 (2020)

[24] **M. Zamparo**, D. Valdembri, G. Serini, I.V. Kolokolov, V.V. Lebedev, L. Dall'Asta, and A. Gamba, *Optimality in self-organized molecular sorting*, Phys. Rev. Lett. **126** 088101 (2021)

[25] A. Pelizzola, M. Pretti, and **M. Zamparo**, *Simple exclusion processes with local resetting*, Europhys. Lett. **133** 60003 (2021)

[26] **M. Zamparo**, *Large deviations in discrete-time renewal theory*, Stoch. Process. Their Appl. **139** 80-109 (2021)

[27] **M. Zamparo**, *Critical fluctuations in renewal models of statistical mechanics*, J. Math. Phys. **62** 113301 (2021)

[28] **M. Zamparo**, *Renewal model for dependent binary sequences*, J. Stat. Phys. **187** 5 (2022)

[29] **M. Zamparo**, *Large fluctuations and transport properties of the Lévy-Lorentz gas*, to appear in Ann. Inst. H. Poincaré Probab. Statist. (arXiv:2010.09083)

[30] E. Floris, A. Piras, F.S. Pezzicoli, **M. Zamparo**, L. Dall'Asta, and A. Gamba, *Phase separation and critical size in molecular sorting*, Phys. Rev. E **106** 044412 (2022)

[31] **M. Zamparo**, *Large deviation principles for renewal-reward processes*, Stoch. Process. Their Appl. **156** 226-245 (2023)

[32] **M. Zamparo**, *Statistical fluctuations under resetting: rigorous results*, J. Phys. A: Math. Theor. **55** 484001 (2022)

[33] **M. Zamparo** and M. Semeraro, *Large deviations for quadratic functionals of stable Gauss-Markov chains and entropy production*, J. Math. Phys. **64** 023302 (2023)

Submitted

[34] M. Semeraro, G. Gonnella, A. Suma, and **M. Zamparo**, *Work fluctuations for a harmonically confined active Ornstein-Uhlenbeck particle*, under review in Phys. Rev. Lett.

In Preparation

[35] **M. Zamparo** and F. den Hollander, *Quenched large deviations and cocycles in renewal theory*

[36] **M. Zamparo** and G. Giacomin, *Big jumps in exponential fluctuations of the pinning model and the effect of disorder*

Research Fellowships

- Fellow in Statistical Mechanics in the group of Prof. Alessandro Pelizzola. Polytechnic University of Turin, Department of Applied Science and Technology, 16 January 2020 - 27 December 2020
- Postdoc in Mathematical Physics in the group of Prof. Andrea Gamba. Polytechnic University of Turin, Department of Applied Science and Technology, 16 January 2018 - 15 January 2020
- Postdoc in Statistical Inference in the group of Prof. Alfredo Braunstein. Polytechnic University of Turin, Department of Applied Science and Technology, 16 July 2016 - 15 January 2018
- Postdoc in Statistical Physics in the group of Prof. Riccardo Zecchina. Polytechnic University of Turin, Department of Applied Science and Technology, 1 December 2013 - 31 May 2016
- Researcher in Statistical Physics in the group of Prof. Riccardo Zecchina. Human Genetics Foundation - Torino, 1 January 2012 - 30 November 2013
- Postdoc in Econophysics in the group of Prof. Attilio Stella. University of Padua, Department of Physics and Astronomy, 1 May 2010 - 31 December 2011
- Postdoc in Protein Physics in the group of Prof. Amos Maritan. University of Padua, Department of Physics and Astronomy, 1 January 2009 - 30 April 2010
- PhD fellow in Physics. Polytechnic University of Turin, Department of Physics, 1 January 2006 - 31 December 2008
- Fellow in Statistical Mechanics in the group of Prof. Alessandro Pelizzola. Polytechnic University of Turin, Department of Physics, 1 September 2005 - 31 December 2005

Project Participation

- Progetto Lagrange-Fondazione CRT 2006-2008 "Statistical mechanics of heterogeneous models of biological systems" (3 years). Coordinator: Prof. Alessandro Pelizzola
- PRIN 2007 - Progetti di Ricerca di Interesse Nazionale "Amiloidi e ripiegamento di proteine: un approccio teorico-sperimentale" (2 years). Coordinator: Prof. Amos Maritan
- Progetto di Eccellenza 2008-2009 Fondazione Cassa di Risparmio di Padova e Rovigo "Anomalous scaling in physics and finance" (2 years). Coordinator: Prof. Attilio Stella

- PRIN 2010-2011 - Progetti di Ricerca di Interesse Nazionale "Statistical mechanics of disordered and complex systems" (3 years). Coordinator: Prof. Giorgio Parisi
- MSCA-RISE-2016 - Marie Skłodowska-Curie Research and Innovation Staff Exchange "New algorithms for inference and optimization of large scale biological data" (4 years). Coordinator: Prof. Andrea Pagnani
- REFIN 2020 - Research for Innovation "Analisi della risposta emodinamica da segnali di risonanza magnetica funzionale per il monitoraggio della capacità cognitiva" (3 years). Coordinator: Prof. Sebastiano Stramaglia
- Horizon Europe Seeds 2021 "Optogenetica per lo sviluppo di organs-on-chip: nuove piattaforme per lo studio di terapie avanzate in malattie rare neuromuscolari e oncologiche" (1.5 years). Coordinator: Prof. Annamaria De Luca

Conferences and Seminars

- University of Leiden, Department of Mathematics, 2 March 2023. Invited seminar: *Large deviation principles for renewal-reward processes*
- Workshop "The Lorentz Gas". Leiden, 19 - 23 December 2022. Invited talk: *Large fluctuations and transport properties of the Lévy-Lorentz gas*
- University of North Texas, Department of Physics, 26 November 2022. Invited seminar: *Renewal model for dependent binary sequences*
- XXVI Italian national conference on Statistical Physics and Complex Systems. Parma, 20 - 22 June 2022
- University of Paris, UFR de Mathématiques, 16 June 2022. Invited seminar: *Large deviation principles for renewal-reward processes*
- University of Bari, Department of Mathematics, 02 March 2022. Invited seminar: *Large deviation principles for renewal-reward processes*
- Polytechnic University of Bari, Department of Mechanical Engineering, Mathematics and Management, 23 November 2021. Invited seminar: *Large fluctuations and transport properties of the Lévy-Lorentz gas*
- XXV Italian national conference on Statistical Physics and Complex Systems. Parma, 23 - 25 June 2022
- University of Paris, UFR de Mathématiques, 19 November 2020. Invited seminar: *Large fluctuations and transport properties of the Lévy-Lorentz gas*
- University of Bologna, Department of Mathematics, 5 November 2020. Invited seminar: *Large fluctuations and transport properties of the Lévy-Lorentz gas*
- Workshop "Interdisciplinary Topics in Statistical Physics: a meeting in honor of Attilio Stella". Padova, 19 - 20 September 2019. Invited talk: *Apparent multifractality of self-similar Lévy processes*
- XXIV Italian national conference on Statistical Physics and Complex Systems. Parma, 24 - 26 June 2019
- Workshop "Statistical Physics Approaches to Systems Biology". Havana, 14 - 15 February 2019. Talk: *Large deviation principles in renewal theory*
- XXIII Italian national conference on Statistical Physics and Complex Systems. Parma, 20 - 22 June 2018. Invited talk: *On the mean residence time in stochastic lattice-gas models*
- University of Zaragoza, Institute for Biocomputation and Physics of Complex Systems, 4 May 2018. Invited seminar: *Residence time and optimality in self-organized molecular sorting*
- Polytechnic University of Turin, Department of Mathematics, 19 April 2018. Invited seminar: *Large deviation principles in renewal theory*

- University of Padua, Department of Mathematics, 23 March 2018. Invited seminar: *Large deviation principles in renewal theory*
- SM&FT 2017. Bari, 13 - 15 December 2017. Invited talk: *Large deviations in renewal models of statistical mechanics*
- Biophys 2017. Pisa, 25 - 26 September 2017. Talk: *Optimality in self-organizing molecular sorting*
- Assemblea Scientifica GNFM. Montecatini Terme (Pistoia), 4 - 6 May 2017. Talk: *Apparent multifractality of self-similar Lévy processes*
- XX Italian national conference on Statistical Physics and Complex Systems. Parma, 29 June - 1 July 2015. Invited talk: *A solvable example of non-strictly-convex large deviation principle in statistical mechanics*
- Conference "Regulation and inference in biological systems". Bardonecchia (Turin), 2 - 6 February 2015
- Workshop "Protein physics: structure, dynamics and function". Brixen (Bolzano), 6 - 8 February 2014. Invited talk: *Nonequilibrium dynamics of an exactly solvable Ising-like model and protein translocation*
- Workshop "Statistical modeling, financial data analysis and applications". Venice, 11 - 14 September 2013. Invited talk: *Scaling symmetry and financial time series modeling*
- XVIII Italian national conference on Statistical Physics and Complex Systems. Parma, 24 - 26 June 2013
- XVI Italian national conference on Statistical Physics and Complex Systems. Parma, 22 - 24 June 2011
- Workshop "Quantitative finance". Padua, 27 - 28 January 2011
- Workshop "Physics of protein folding and aggregation". Brixen (Bolzano), 11 - 12 February 2010
- Workshop "Interdisciplinary topics in statistical mechanics". Venice, 16 - 18 April 2009
- Biophys 2008. Arcidosso (Grosseto), 10 - 12 September 2008. Talk: *Pathways and transition states in protein folding*
- XIII Italian national conference on Statistical Physics and Complex Systems. Parma, 23 - 25 June 2008. Poster: *Application of spectral coarse-graining to a protein folding model*
- Statphys 23. Genova, 9 - 13 July 2007. Poster: *Wako-Saitô-Muñoz-Eaton Model and protein folding kinetics*
- XII Italian national conference on Statistical Physics and Complex Systems. Parma, 20 - 21 June 2007. Talk: *Wako-Saitô-Muñoz-Eaton model and protein folding kinetics*

Attended Schools and Training Visits

- International School on Statistical Physics Approaches to Systems Biology. Havana, 4 - 13 February 2019
- 2-month visit in the group of Prof. Roberto Mulet. University of Havana, Department of Theoretical Physics, 18 December 2018 - 18 February 2019
- International School on Multidisciplinary Approaches to Economic and Social Complex Systems. Siena, 27 June - 3 July 2010
- 3-month visit in the group of Prof. Paolo De Los Rios. Ecole Polytechnique Fédérale de Lausanne, Laboratory of Statistical Biophysics, 1 May - 31 July 2007
- International School of Physics "Enrico Fermi" on Protein Folding and Drug Design. Varenna (Lecco), 4 - 14 July 2006

- Séminaire Transalpin de Physique on Non-Equilibrium Statistical Mechanics. Champex-Lac (Entremont District), 5 - 11 March 2006

Institutional Responsibilities

PhD student representative. Polytechnic University of Turin, Department of Physics, January 2006 - December 2008

Positions of Trust

Reviewer for Physical Review E, Europhysics Letters, Journal of Statistical Mechanics: Theory and Experiment, Journal of Physics A: Mathematical and Theoretical, Stochastic Processes and their Applications

Supervision Activity

- Co-Supervisor of PhD student Massimiliano Semeraro. University of Bari Aldo Moro, November 2020 - October 2023. Thesis title: *Out of equilibrium systems and active matter*
- Co-Supervisor of PhD student Davide Botto. Polytechnic University of Turin, January 2017 - December 2019. Thesis title: *Dynamical transitions in driven diffusive models*
- Co-Supervisor of Master's student Luca Pertile. University of Padua, October 2011 - April 2012. Thesis title: *Calibration of self-similar strongly correlated stochastic processes on the basis of a single time series*
- Co-Supervisor of Master's student Stefano Ruzza. University of Turin, January 2015 - October 2015. Thesis title: *Inferenza statistica e criticità*

Teaching

- Lecturer in *Large Deviation Theory and Applications* in the PhD programme in Computer Science and Mathematics at the University of Bari Aldo Moro. University of Bari Aldo Moro, October 2022 - December 2023
- Lecturer in *Large Fluctuations in Probability and Statistical Mechanics* in the Master's programme in Theoretical Physics and Complex Systems at the University of Bari Aldo Moro. University of Bari Aldo Moro, October 2022 - December 2023
- Co-Lecturer in *Analytical Mechanics* in the Bachelor's programme in Physics at the University of Bari Aldo Moro. University of Bari Aldo Moro, October 2022 - December 2023
- Co-Lecturer in *Mathematical and Numerical Methods for Geophysics* in the Master's programme in Geological and Geophysical Sciences at the University of Bari Aldo Moro. University of Bari Aldo Moro, October 2021 - December 2023
- Tutor in Classical Electromagnetism. University of Bari Aldo Moro, February 2022 - December 2023
- Lecturer in *Continuum Mechanics and Fluid Dynamics* in the International (Paris-Turin-Trieste) Master's programme in Physics of Complex Systems at the Polytechnic University of Turin. Polytechnic University of Turin, May 2015 - May 2017
- Tutor in Classical Mechanics. Polytechnic University of Turin, January 2006 - December 2008

Software Skills

Confident user of Linux, Fortran, Matlab, and Latex

Language Skills

Italian (native) and English (fluent)