

Curriculum Vitae - Stefano Marcantoni

2 December 2024

	Personal Information
First Name	Stefano
Last Name	Marcantoni

	Education
1 Nov 2014 - 6 Feb 2018	PhD in Theoretical Physics, University of Trieste Thesis: On the non-equilibrium thermodynamics of quantum systems Supervisor: Prof. Fabio Benatti <u>Keywords:</u> <i>Open quantum systems, entropy production, quantum non-Markovianity</i>
1 Oct 2012 - 17 Oct 2014	Master's degree in Theoretical Physics, University of Trieste (full marks with honors)
1 Oct 2009 - 30 Oct 2012	Bachelor's degree in Physics, University of Camerino (full marks with honors)

	Work Experience
1 Aug 2023 - present	Marie Curie Postdoctoral Fellow, Université Côte d'Azur, Nice (FR), Laboratoire Dieudonné (Mathematics) - Probability and Statistics section -Working with Dr. Raphaël Chetrite on the MSCA project ConNEqtions <u>Keywords:</u> <i>Diffusion processes, Large deviations, Quantum trajectories</i>
1 Aug 2022 - 31 Jul 2023	Assegnista di Ricerca (postdoc), SISSA Trieste (IT), Mathematics Area - Mathematical Physics group lead by Prof. Marcello Porta -Working on the ERC-funded project MaMBoQ <u>Keywords:</u> <i>Interacting fermions, Rigorous derivation of effective equations</i>
1 Oct 2019 - 31 Jul 2022	Research Fellow, University of Nottingham (UK), Condensed matter theory group lead by Prof. Juan Garrahan <u>Keywords:</u> <i>Classical Markov chains, Fluctuation relations, Large deviations</i>
1 Feb 2018 - 30 Sep 2019	Assegnista di Ricerca (postdoc), University of Trieste (IT), -Theorist in the experimental group of Prof. Daniele Fausti (time-resolved spectroscopy) -Working on the ERC-funded project INCEPT <u>Keywords:</u> <i>Pump-probe experiments, Models for complex quantum systems</i>

	Awards and Distinctions
July 2022	Winner of MSCA Postdoctoral Fellowship 2021 with the project "ConNEqtions" (score 91.6%)
March 2021	IOP Trusted Reviewer status
February 2021	Seal of Excellence for the High Quality Project "ConNEqtions" (score 91.2%), MSCA-IF-EF-ST-2020

	List of Publications
	<i>Preprint</i>
[16]	S. Marcantoni , M. Merkli, “Ultrastrong coupling, nonselective measurement and quantum Zeno dynamics”, <i>arXiv:2411.06817</i>
	<i>Peer-reviewed journal articles</i>
[15]	S. Marcantoni , M. Porta, and J. Sabin, “Dynamics of mean-field Fermi systems with nonzero pairing”, <i>Ann. Henri Poincaré</i> (2024). https://doi.org/10.1007/s00023-024-01473-8
[14]	E. Fiorelli, S. Gherardini, and S. Marcantoni , “Stochastic entropy production: Fluctuation relation and irreversibility mitigation in non-unital quantum dynamics”, <i>J. Stat. Phys.</i> 190 , 111 (2023).
[13]	S. Marcantoni , F. Carollo, F. M. Gambetta, I. Lesanovsky, U. Schneider, and J. P. Garrahan, “Anderson and many-body localization in the presence of spatially correlated classical noise”, <i>Phys. Rev. B</i> 106 , 134211 (2022).
[12]	S. Marcantoni , C. Pérez-Espigares, and J. P. Garrahan, “Symmetry-induced fluctuation relations in open quantum systems”, <i>Phys. Rev. E</i> 104 , 014108 (2021).
[11]	V. Carnevali, S. Marcantoni , and M. Peressi, “Moiré patterns generated by stacked 2D lattices: a general algorithm to identify primitive coincidence cells”, <i>Computational Materials Science</i> 196 , 110516 (2021).
[10]	A. Marciniak, S. Marcantoni , F. Giusti, F. Glerean, G. Sparapassi, T. Nova, A. Cartella, S. Latini, F. Valiera, A. Rubio, J. van den Brink, F. Benatti, and D. Fausti, “Vibrational coherent control of localized dd electronic excitation”, <i>Nat. Phys.</i> 17 , 368 (2021).
[9]	S. Gherardini, S. Marcantoni , and F. Caruso, “Irreversibility mitigation in unital non-Markovian quantum evolutions”, <i>Phys. Rev. Research</i> 2 , 033250 (2020).
[8]	S. Marcantoni , C. Pérez-Espigares, and J. P. Garrahan, “Symmetry-induced fluctuation relations for dynamical observables irrespective of their behaviour under time-reversal”, <i>Phys. Rev. E</i> 101 , 062142 (2020).
[7]	M. Ramezani, S. Marcantoni , F. Benatti, R. Floreanini, F. Petiziol, A. T. Rezakhani, and M. Golshani, “Impact of nonideal cycles on the efficiency of quantum heat engines”, <i>Eur. Phys. J. D</i> 73 , 144 (2019).
[6]	F. Glerean, S. Marcantoni , G. Sparapassi, A. Blason, M. Esposito, F. Benatti and D. Fausti, “Quantum model for Impulsive Stimulated Raman Scattering”, <i>J. Phys. B</i> 52 , 145502 (2019).
[5]	F. Benatti, L. Ferialdi, and S. Marcantoni , “Qubit Entanglement generation by Gaussian non-Markovian dynamics”, <i>J. Phys. A: Math. Theo.</i> 52 , 035305 (2019).
[4]	M. Ramezani, F. Benatti, R. Floreanini, S. Marcantoni , M. Golshani, and A. T. Rezakhani, “Quantum detailed balance conditions and fluctuation relations for thermalizing quantum dynamics”, <i>Phys. Rev. E</i> 98 , 052104 (2018).
[3]	F. Benatti, R. Floreanini, S. Marcantoni , P. Pinotti, and K. Zimmermann, “Bound on dissipative effects from semileptonic neutral <i>B</i> -meson decays”, <i>Eur. Phys. J. C</i> 77 , 651 (2017).
[2]	S. Marcantoni , S. Alipour, F. Benatti, R. Floreanini, and A. T. Rezakhani, “Entropy production and non-Markovian dynamical maps”, <i>Sci. Rep.</i> 7 , 12447 (2017).
[1]	S. Alipour, F. Benatti, F. Bakhshinezhad, M. Afsary, S. Marcantoni , and A. T. Rezakhani, “Correlations in quantum thermodynamics: Heat, Work and Entropy production”, <i>Sci. Rep.</i> 6 , 35568 (2016).
	<i>Peer-reviewed conference proceedings</i>
[1p]	S. Marcantoni , “Thermodynamics of a qubit undergoing dephasing”, <i>Journal of Physics: Conference Series</i> 841 , 012019 (2017).

	Research Activity (numbers in parenthesis refer to the list of publications)
Non-equilibrium thermodynamics and statistical mechanics	<p>The main line of research I pursued since the starting of my PhD is the application of the theory of open quantum systems to problems in non-equilibrium thermodynamics. In particular, as a first topic I studied a general formulation of the first and second law of thermodynamics in strongly interacting and correlated systems [1,1p]. Afterwards, I investigated the behavior of the entropy production rate in open quantum systems undergoing non-Markovian time-evolutions, showing that it can be negative for physically legitimate dynamics [2]. In a couple of follow-up works, the variance of the stochastic entropy production has been shown to transiently decrease along with the average for some choices of the dynamical parameters in unital [9] and non-unital [14] non-Markovian evolutions.</p> <p>Right after my PhD I also studied the connection between quantum fluctuation relations and quantum detailed balance [4], and investigated the effect of interactions in the working medium of quantum heat engines [7]. More recently, I have been working on symmetry-induced fluctuation relations, firstly in the context of classical Markov chains [8] and later in open quantum systems [12], unifying and generalizing previously known results. Together with Dr. Raphaël Chetrite, I am now exploring similar problems in diffusion processes, resorting to mathematically rigorous techniques and looking for the minimal mathematical structure behind these results.</p>
Derivation of effective dynamics	<p>More recently, I have started working on the rigorous derivation of effective evolution equations in complex systems. In particular, together with Prof. Marco Merkli, I am currently investigating the rigorous derivation of effective (possibly non-Markovian) dynamics for open quantum systems. Preliminary results have been obtained in the ultrastrong coupling limit [16]. Also, together with Prof. Marcello Porta and collaborators, I have studied the dynamics of interacting fermions, focusing on the derivation of the Hartree-Fock-Bogoliubov equations for BCS states in the fermionic mean-field limit [15].</p>
Other topics in the theory of open quantum systems and condensed matter	<p>Other projects I have been working on are the analysis of entanglement generation in open quantum systems through a non-Markovian environment [5] and the estimate of dissipative effects in neutral B mesons [3]. Also, I contributed in the development of an algorithm to detect Moiré patterns in 2D materials [11] and I have studied numerically the fate of Anderson and Many-Body Localization in presence of correlated dephasing [13]. Moreover, in the group of Daniele Fausti, I contributed to the development of theoretical models to describe pump-probe experiments [6],[10].</p>

	Scientific visits
	<i>Long visits (one month or more)</i>
26 Aug - 26 Oct 2024	Visit to Prof. Marco Merkli, Memorial University of Newfoundland, St. John's, Canada
1 - 30 October 2021	Visit to Dr. Raphaël Chetrite, Université Côte d'Azur, Nice, France
1 Oct 2018 - 31 Dec 2018	Visiting Scientist at the Max Planck Institute for the Structure and Dynamics of Matter, Theory Section, Hamburg, Germany
	<i>Short visits</i>
10 - 22 December 2023	Visit to the group of Dr. Serena Cenatiempo, GSSI L'Aquila, Italy
9 - 15 January 2022	Visit to Dr. Ugo Marzolino, INFN - Trieste Section, Trieste, Italy
13 - 17 May 2019	Visit to the group of Prof. Filippo Caruso, LENS, Firenze, Italy
10 - 13 December 2018	Visit to the group of Prof. Martin Plenio, University of Ulm, Germany
5 - 12 June 2016	Visit to Dr. Sahar Alipour and Prof. Ali T. Rezakhani, IPM, Tehran, Iran

	Invited Communications
20 January - 7 February 2025	ICTS Program “Quantum Trajectories”, Bengaluru, India Invited talk: TBA
15 - 19 July 2024	9th European Congress of Mathematics (ECM2024), Sevilla, Spain Mini-symposium “Collective phenomena of fermionic systems” Invited talk: “Mean-field dynamics of interacting fermions with nonzero pairing”
13 December 2023	Mathematical Challenges in Quantum Mechanics (MCQM) PhD Lecture: “Introduction to the theory of open quantum systems” (online)
11 December 2023	SMAQ Seminar: “Mean-field dynamics of interacting fermions with nonzero pairing” GSSI L’Aquila, Italy
30 April 2023	Seminar: “Fluctuation relations in open quantum systems”, SISSA Trieste, Italy
12 - 17 February 2023	BIRS Workshop “Non-Markovianity in Open Quantum Systems”, Banff, Canada Invited talk: “Irreversibility mitigation under non-Markovian thermalizing dynamics”
28 September - 2 October 2020	YIQIS 2020 - Young Italian Quantum Information Science Conference, (online) Invited Talk: “Vibrational modulation of electronic transitions in Copper Germanate: a theoretical model”
13 May 2020	Foundations Reading Group at University College London, UK Seminar (online): “Fluctuation relations for time-symmetric observables”
14 May 2019	Seminar: “Quantum model for Impulsive Stimulated Raman Scattering”, LENS, Firenze, Italy
12 December 2018	Seminar: “Detailed Balance and Fluctuation Relations in Open Quantum Systems” University of Ulm, Germany
8 June 2016	Seminar: “Quantum thermodynamics of a bipartite system” IPM, Tehran, Iran

	Other Conferences/Workshops/Schools
	<i>Contributed talk</i>
1 - 6 July 2024	XXI International Congress of Mathematical Physics ICMP2024, Strasbourg, France Thematic session: Many-body Quantum Systems & Condensed Matter Physics Talk: “Mean-field dynamics of interacting fermions with nonzero pairing”
22 - 26 March 2021	Gran Sasso Quantum Meeting: From equilibrium phenomena towards open quantum systems, (online) Talk: “Irreversibility mitigation in unital non-Markovian dynamical maps”
9 - 12 September 2019	IQIS 2019, Milano, Italy 12th Italian Quantum Information Science Conference Talk: “Fluctuation Relation and Quantum Detailed Balance in open quantum systems”
29 July - 1 August 2019	Conference on Taming Non-Equilibrium Systems: from Quantum Fluctuation to Decoherence, ICTP, Trieste, Italy Talk: “Fluctuation Relation and Detailed Balance in open quantum systems”
11 and 18 May 2018	Trieste Junior Quantum Days 2018, Trieste, Italy Talk: “Quantum model for Impulsive Stimulated Raman Scattering”
12 and 19 May 2017	Junior Trieste Quantum Days, Trieste, Italy Talk: “Thermodynamics of non-Markovian open quantum systems”

	Other Conferences/Workshops/Schools
7 - 9 April 2017	Workshop PAFT2017, Vietri sul Mare, Italy “Current Problems in Theoretical Physics” Talk: “Thermodynamics of a bipartite quantum system”
24 - 26 October 2016	7th Young Researcher Meeting, Torino, Italy Talk: “Heat, work and entropy production in a bipartite quantum system”
3 - 4 September 2014	BaBar Physics Jamboree, SLAC (by phone) Talk: “Dissipative effects in neutral B meson decays”
	<i>Poster</i>
24 - 26 July 2019	Trieste Junior Quantum Days 2019, Trieste, Italy Poster: “Detailed Balance and Fluctuation Relations in Open Quantum Systems”
23 - 28 June 2019	QTD2019 Quantum Thermodynamics Conference, Espoo, Finland Poster: “Detailed Balance and Fluctuation Relations in Open Quantum Systems”
26 - 31 May 2019	Workshop Quantum 2019, Torino, Italy Poster: “Quantum model for Impulsive Stimulated Raman Scattering”
17 - 20 September 2018	IQIS 2018, Catania, Italy 11th Italian Quantum Information Science Conference Poster: “Quantum model for Impulsive Stimulated Raman Scattering”
11 - 12 December 2017	Royal Society meeting, London, UK “Foundations of quantum mechanics and their impact on contemporary society” Poster: “Dissipative effects in neutral B-meson decays”
12 - 15 September 2017	IQIS 2017, Firenze, Italy 10th Italian Quantum Information Science Conference Poster: “Entropy production under non-Markovian dynamical maps”
10 - 13 April 2017	640 WE-Heraeus-Seminar, Bad Honnef, Germany “Non-Markovianity and Strong Coupling Effects in Thermodynamics” Poster: “Entropy production under non-Markovian dynamical maps”
13 - 17 March 2017	5th Quantum Thermodynamics Conference, Oxford, UK Poster: “Thermodynamics of a bipartite quantum system”
3 - 8 July 2016	QDev/NBIA Summer School, Copenhagen, Denmark “Quantum Information in Condensed Matter Physics” Poster: “Correlations in quantum thermodynamics”
	<i>Participant</i>
28 - 29 June 2024	Young Researcher Symposium YRS, Strasbourg, France (Satellite event of ICMP 2024)
11 - 15 March 2024	Conference “Open Quantum Systems”, Toulouse, France Part of the thematic semester “Mathematical Aspects of Quantum Mechanics” (Satellite event of ICMP 2024)
26 - 30 June 2023	Hausdorff School “Recent Advances in Quantum and Statistical Mechanics”, Bonn, Germany
18 - 23 June 2023	SwissMAP Workshop “Effective theories in classical and quantum particle systems”, Les Diablerets, Switzerland
27 - 31 March 2023	School “Scaling limits and generalized hydrodynamics”, GSSI L’Aquila, Italy (online)
8 - 10 February 2023	Conference “Trails in Quantum Mechanics and Surroundings”, Trieste, Italy (For the 90th birthday of Gianfausto Dell’Antonio)
6 - 9 September 2022	Solid Math 2022, Trieste, Italy

	Other Conferences/Workshops/Schools
7 - 16 March 2022	Indam Quantum Meetings - IQM22, Milano, Italy Workshop I “Many-Body Quantum Mechanics, Quantum Statistical Mechanics, Open Quantum Systems” + short visit
31 January - 4 February 2022	International workshop - MPIPKS Dresden, Germany (online) “Openness as a resource: accessing new quantum states with dissipation”
20 - 23 September 2021	GSSI Workshop, L’Aquila, Italy (online) “Statistical and Quantum Mechanics: reconsidering their foundations in the light of new cutting edge experiments and theoretical models”
14 - 17 June 2021	52 Symposium on Mathematical Physics, University of Torun, Poland (online) “Channel, Maps and all that”
7 - 11 June 2021	17th Granada Seminar (online) “New Frontiers in Nonequilibrium Statistical Physics: from fundamentals, fluctuations and hydrodynamics to biology and quantum nonequilibrium”
8 - 11 February 2021	Royal Society meeting, (online) “New perspectives on quantum many-body chaos”
23 June - 10 July 2020	SISSA - GSSI joint lecture series (online) “Mathematical Methods in Field Theory and Quantum Mechanics”
18 Feb. - 1 Mar. 2019	Advanced School and Workshop, Trieste, Italy “Ubiquitous Quantum Physics: the New Quantum Revolution”
1 - 4 November 2016	Autumn School, Munich, Germany “Mathematical Foundations of Physics”
19 - 24 September 2016	Training School, Cambridge, UK “Thermodynamics and non-equilibrium phenomena for quantum interfaces of light and matter”
10 - 12 September 2015	IQIS 2015, Monopoli, Italy 8th Italian Quantum Information Science Conference
9 - 14 February 2015	51 Winter School of Theoretical Physics, Ladek Zdroj, Poland “Irreversible dynamics: nonlinear, nonlocal and non-Markovian manifestation”

	Mentoring activities
Mar 2019 - Sep 2019	Francesco Valiera (co-supervision of a bachelor thesis in physics) Article published together: [10]
Mar 2018 - Aug 2018	Mehdi Ramezani (mentoring of a visiting PhD student) Articles published together: [4],[7]
Jun 2016 - Mar 2017	Pietro Pinotti (co-supervision of a bachelor thesis in physics) Article published together: [3]

	Reviewer activity
October 2019 - ongoing	Referee for the following journals: Journal of Physics A, Physical Review A, Physical Review E, Physical Review Letters, PRXQuantum, Journal of Statistical Mechanics: Theory and Experiment

	Organization of Seminars
Feb 2023 - June 2023	Seminar Series “Mathematics of Many-Body Systems”, SISSA Trieste (together with Matteo Gallone and Marcello Porta)

	Computer skills
Programming	Fortran, C++/Root, Java, Python
Editing	LaTex, Emacs, Microsoft Office
Scientific software	Mathematica, Matlab, Octopus, Quantum Espresso, gnuplot

	Outreach activities
19 February 2018	3h class for high school students “The wave theory of light” (in Italian), open day at the University of Trieste
5 September 2017	Seminar for high school students “Theory and Experiments about the diffraction of light” (in Italian), open day at the University of Trieste

	Languages
Mother tongue	Italian
Working knowledge	English
Basic	French