

Francesco MATTIOTTI

Curriculum vitae et studiorum

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Education

- 2017–2021 **Ph.D. in Physics**, *University of Notre Dame*, Notre Dame (USA), *cum laude*
Thesis: “Cooperative effects in quantum systems: superradiance and long-range interactions”.
Advisors: Prof. Fausto Borgonovi, Prof. Giuseppe Luca Celardo and Prof. Boldizsár Jankó.
- 2017–2021 **Ph.D. in Science**, *Università Cattolica del Sacro Cuore*, Brescia (Italy), *cum laude*
Thesis: “Cooperative effects in quantum systems: superradiance and long-range interactions”.
Advisors: Prof. Fausto Borgonovi, Prof. Giuseppe Luca Celardo and Prof. Boldizsár Jankó.
- 2013–2016 **Master’s degree in Physics**, *Università Cattolica del Sacro Cuore*, Brescia (Italy), *cum laude*
Thesis: “Interplay of cooperativity and noise, from light-harvesting complexes to quantum transport”.
Advisor: Prof. Giuseppe Luca Celardo. Co-advisor: Prof. Fausto Borgonovi.
- 2010–2013 **Bachelor’s degree in Physics**, *Università Cattolica del Sacro Cuore*, Brescia (Italy), *cum laude*
Thesis: “Non-Hermitian Hamiltonian approach to quantum transport”.
Advisor: Prof. Giuseppe Luca Celardo. Co-advisor: Prof. Giulio Giuseppe Giusteri.

Positions

- 2021–now **Post-doc**, *University of Strasbourg*, Strasbourg (France)
Quantum Matter Theory group at CESQ - Institut de Science et d’Ingénierie Supramoléculaires.
Group leader: Prof. Guido Pupillo.
- 2017–2021 **Ph.D. Student with scholarship**, *International Ph.D. in Science*, Brescia (Italy) and Notre Dame (USA)
Joint research project between *Università Cattolica del Sacro Cuore* and *University of Notre Dame* (double degree): “Cooperative Effects in quantum systems”.
Advisors: Prof. Fausto Borgonovi, Prof. Giuseppe Luca Celardo and Prof. Boldizsár Jankó.
- 2016 **Research Assistant**, *Università Cattolica del Sacro Cuore*, Brescia (Italy)
Project: “Quantum transport in nanostructured systems with applications to biosystems”.
Coordinator: Prof. Fausto Borgonovi.
Funding: Fondazione EULO.

Visiting Positions

- 02/12/2022 – **USACH visiting researcher**, *Universidad de Santiago de Chile*, Santiago
18/12/2022 (Chile)
Scientific collaboration with Prof. Felipe Herrera.
- 06/10/2019 – **UC/Sandia visit**, *University of California, Berkeley and Sandia National
13/10/2019 Laboratories*, Berkeley and Livermore (USA)
Scientific collaboration with Dr. Mohan Sarovar.
- 24/09/2018 – **UND visiting Ph.D. student**, *University of Notre Dame*, Notre Dame (USA)
20/12/2019 In the framework of the International Doctoral Program in Science.
Scientific collaboration with Prof. Boldizsár Jankó and Prof. Masaru Kuno.
- 02/05/2018 – **BUAP visiting position**, *Benemérita Universidad Autónoma de Puebla*,
04/09/2018 Puebla (Mexico)
At Instituto de Física.
Scientific collaboration with Prof. Felix M. Izrailev and Prof. G. Luca Celardo.
- 16/04/2018 – **INFN scientific mission**, *Heriot-Watt University*, Edinburgh (United
19/04/2018 Kingdom)
Scientific collaboration with Prof. Erik Gauger.
- 02/08/2017 – **BUAP visiting position**, *Benemérita Universidad Autónoma de Puebla*,
03/11/2017 Puebla (Mexico)
At Instituto de Física.
Scientific collaboration with Prof. Felix M. Izrailev and Prof. G. Luca Celardo.

Grants

- 01/06/2020 – **National Science Foundation (NSF), USA**, *NSF DMR1952841*
31/05/2023 Title: “Realizing robust superfluorescence from nanocrystal superlattices”.
My role: collaborator.
PI: Prof. Masaru Kuno, Co-PI: Prof. Boldizsár Jankó (University of Notre Dame, USA).
Financial Support: 500,877 USD.
- 2016 – 2020 **Istituto Nazionale di Fisica Nucleare (INFN), Italy**, *Affiliation with
travel grant, DynSysMath project*
Title: “Cooperative effects in quantum systems: superradiance and long-range interactions”
My role: Ph.D. student.
PI: Prof. Fausto Borgonovi (Università Cattolica del Sacro Cuore, Italy).
Financial Support: 6,000 EUR.
- 22/06/2016 **Fondazione EULO, Italy**, *Title: “Quantum transport in nanostructures
devices with application to bio-systems”*
My role: collaborator.
PI: Prof. G. Luca Celardo, Co-PI: Prof. Fausto Borgonovi (Università Cattolica del Sacro Cuore, Italy).
Financial Support: 12,000 EUR.

Awards

- 13/09/2019 **University of Notre Dame, USA, Graduate School Professional Development Award**
Downes Memorial Fund to support a travel to Benemérita Universidad Autónoma de Puebla (Puebla, Mexico) to participate to the QuEBS conference and “Non-Hermitian Quantum Systems” workshop.
Financial Support: 650 USD.
- 28/05/2019 **University of Notre Dame, USA, Graduate School Professional Development Award**
Zahm Research Travel Grant Fund to support a travel to Sandia National Laboratories (Livermore, California) for a scientific collaboration with Mohan Sarovar.
Financial Support: 2,100 USD.
- 11/07/2013 **Istituto G. Toniolo, Italy, Master scholarship**
Financial Support: 3,500 EUR.

Teaching experience

- 2017 **Teaching Assistant, Quantum Mechanics (Bachelor in Physics)**, Università Cattolica del Sacro Cuore, Brescia (Italy)
Teaching duties: 20 hours, exercises.

Transferable skills

- Group work and tutoring I had international collaborations with experienced researchers and with other Ph.D. students. I trained and tutored 5 undergraduate and 7 graduate students.
- Communication skills I have given 19 oral presentations, 5 of which invited, and 11 of which to international conferences/gatherings. I have contributed to write 18 scientific papers, 16 of which have been published on peer-reviewed journals. I have been a referee for 8 scientific papers, as certified by [Web of Science](#).

Language skills

- Italian native speaker.
- English professional working proficiency; *IELTS - Academic score: 7.0/9 (CEFR lev.: C1)*.
- Spanish basic proficiency.
- French basic proficiency.

Technical skills

- Operating systems Good knowledge of GNU/Linux and Microsoft Windows environments.
- Programming I use Julia, Python and FORTRAN for scientific computing. I’m familiar with the following libraries: LAPACK, BLAS, Numpy, Matplotlib, Julia QuantumOptics.
- Software I use LaTeX for scientific typing, Grace and Gnuplot for data visualization.

Publications and preprints

- [18] S. Kumar, S. Biswas, U. Rashid, K. S. Mony, G. Chandrasekharan, F. Mattiotti, R. M. A. Vergauwe, D. Hagenmuller, V. Kaliginedi, and A. Thomas, Extraordinary electrical conductance through amorphous nonconducting polymers under vibrational strong coupling, [J. Am. Chem. Soc.](#) (2024).
- [17] F. S. Lozano-Negro, E. Alvarez Navarro, N. C. Chávez, F. Mattiotti, F. Borgonovi, H. M. Pastawski, and G. L. Celardo, Universal stability of coherently diffusive one-dimensional systems with respect to decoherence, [Phys. Rev. A](#) **109**, 042213 (2024).
- [16] A. Valzelli, A. Boschetti, F. Mattiotti, A. Kargol, C. Green, F. Borgonovi, and G. L. Celardo, Large scale simulations of photosynthetic antenna systems: Interplay of cooperativity and disorder (2024), [arXiv:2404.08542 \[cond-mat\]](#) .
- [15] L. G. Celardo, M. Angeli, F. Mattiotti, and R. Kaiser, Localization of light in three dimensions: A mobility edge in the imaginary axis in non-Hermitian Hamiltonians, [EPL](#) **145**, 35002 (2024).
- [14] F. Mattiotti, J. Dubail, D. Hagenmüller, J. Schachenmayer, J.-P. Brantut, and G. Pupillo, Multifractality in the interacting disordered Tavis-Cummings model, [Phys. Rev. B](#) **109**, 064202 (2024).
- [13] T. Gupta, G. Masella, F. Mattiotti, N. V. Prokof'ev, and G. Pupillo, Scale-invariant phase transition of disordered bosons in one dimension (2023), [arXiv:2310.17682 \[cond-mat, physics:quant-ph\]](#) .
- [12] N. Sauerwein, F. Orsi, P. Urich, S. Bandyopadhyay, F. Mattiotti, T. Cantat-Moltrecht, G. Pupillo, P. Hauke, and J.-P. Brantut, Engineering random spin models with atoms in a high-finesse cavity, [Nat. Phys.](#) **19**, 1128–1134 (2023).
- [11] A. G. Catalano, F. Mattiotti, J. Dubail, D. Hagenmüller, T. Prosen, F. Franchini, and G. Pupillo, Anomalous Diffusion in the Long-Range Haken-Strobl-Reineker Model, [Phys. Rev. Lett.](#) **131**, 053401 (2023).
- [10] S. Ghonge, D. Engel, F. Mattiotti, G. L. Celardo, M. Kuno, and B. Jankó, Enhanced robustness and dimensional crossover of superradiance in cuboidal nanocrystal superlattices, [Phys. Rev. Res.](#) **5**, 023068 (2023).
- [9] F. Mattiotti, M. Sarovar, G. G. Giusteri, F. Borgonovi, and G. L. Celardo, Efficient light harvesting and photon sensing via engineered cooperative effects, [New J. Phys.](#) **24**, 013027 (2022).
- [8] F. Mattiotti, W. M. Brown, N. Piovella, S. Olivares, E. M. Gauger, and G. L. Celardo, Bio-inspired natural sunlight-pumped lasers, [New J. Phys.](#) **23**, 103015 (2021).
- [7] N. C. Chávez, F. Mattiotti, J. A. Méndez-Bermúdez, F. Borgonovi, and G. L. Celardo, Disorder-enhanced and disorder-independent transport with long-range hopping: Application to molecular chains in optical cavities, [Phys. Rev. Lett.](#) **126**, 153201 (2021).

- [6] F. Mattiotti, M. Kuno, F. Borgonovi, B. Jankó, and G. L. Celardo, Thermal decoherence of superradiance in lead halide perovskite nanocrystal superlattices, [Nano Lett.](#) **20**, 7382–7388 (2020).
- [5] N. C. Chávez, F. Mattiotti, J. A. Méndez-Bermúdez, F. Borgonovi, and G. L. Celardo, Real and imaginary energy gaps: a comparison between single excitation superradiance and superconductivity and robustness to disorder, [Eur. Phys. J. B](#) **92**, 144 (2019).
- [4] M. Gullì, A. Valzelli, F. Mattiotti, M. Angeli, F. Borgonovi, and G. L. Celardo, Macroscopic coherence as an emergent property in molecular nanotubes, [New J. Phys.](#) **21**, 013019 (2019).
- [3] F. Borgonovi, F. Mattiotti, and F. M. Izrailev, Temperature of a single chaotic eigenstate, [Phys. Rev. E](#) **95**, 042135 (2017).
- [2] G. G. Giusteri, F. Mattiotti, and G. L. Celardo, Non-hermitian hamiltonian approach to quantum transport in disordered networks with sinks: Validity and effectiveness, [Phys. Rev. B](#) **91**, 094301 (2015).
- [1] G. L. Celardo, A. Biella, G. G. Giusteri, F. Mattiotti, Y. Zhang, and L. Kaplan, Superradiance, disorder, and the non-hermitian hamiltonian in open quantum systems, [AIP Conf. Proc.](#) **1619**, 64–72 (2014).

Scientific communications

I have given 19 talks, 5 of which invited. I have presented 11 posters at conferences.

- 27/05/2024 **Poster**, “*E-MRS*” conference, Strasbourg (France)
Title: “Multifractality in the interacting disordered Tavis-Cummings model”
- 21/05/2024 **Talk**, “*CAFQA*” conference, Ottawa (Canada)
Title: “Strong light-matter coupling in disordered systems: multifractality and protected transport”
- 07/03/2024 **Talk**, “*APS March Meeting 2024*” conference, Minneapolis (USA)
Title: “Multifractality in the interacting disordered Tavis-Cummings model”
- 19/01/2024 **Invited Talk**, *Laboratoire de Physique Théorique et Modèles Statistiques – Université Paris-Saclay*, Paris (France)
Title: “Strong light-matter coupling in disordered systems: multifractality and protected transport”
- 11/01/2024 **Invited Talk**, *Società Italiana di Fisica Statistica Young Seminars*, online
Title: “Strong light-matter coupling in disordered systems: multifractality and protected transport”
- 16/11/2023 **Invited Talk**, *Laboratoire de Physique des Solides – Université Paris-Saclay*, Paris (France)
Title: “Strong light-matter coupling in disordered systems: multifractality and protected transport”
- 07/09/2023 **Talk**, “*CMD30 FisMat*” conference, Milan (Italy)
Title: “Multifractality in the interacting disordered Tavis-Cummings model”
- 06/09/2023 **Invited Talk**, “*CMD30 FisMat*” conference, Milan (Italy)
Title: “Strong light-matter coupling in disordered systems: multifractality and protected transport”

- 18/07/2023 **Poster**, “*Quantum localization and Glassy physics*” school, Cargèse (France)
Title: “Multifractality in the interacting disordered Tavis-Cummings model”
- 21/06/2023 **Poster**, “EGAS 54” conference, Strasbourg (France)
Title: “Multifractality in the interacting disordered Tavis-Cummings model”
- 08/03/2023 **Poster**, “*Out-of-equilibrium physics with photons and atoms*” school, Les Houches (France)
Title: “Multifractality in the interacting disordered Tavis-Cummings model”
- 13/12/2022 **Poster**, “*2nd Workshop on Molecular Quantum Technology - MQT 2022*” conference, Puerto Natales (Chile)
Title: “Multifractality and localization in the disordered interacting Tavis-Cummings model”
- 13/10/2022 **Talk**, *Institut de Science et d’Ingénierie Supramoléculaires – University of Strasbourg*, Strasbourg (France)
Title: “Cooperativity in strongly-coupled quantum systems: superradiance, robust transport and multifractality”
- 16/06/2022 **Invited Talk**, *Laboratoire de Physique et Chimie Théoriques – Université de Lorraine*, Nancy (France)
Title: “Cooperative effects in quantum systems: robustness to disorder and long-range interactions”
- 25/08/2021 **Talk**, “*17èmes journées de la matière condensée*” conference, online
Title: “Disorder-Enhanced and Disorder-Independent Transport with long range hopping: application to molecular chains in optical cavities”
- 01/07/2021 **Poster**, “*Wave International Networking Event*” conference, online
Title: “Disorder-Enhanced and Disorder-Independent Transport with Long-Range Hopping: Application to Molecular Chains in Optical Cavities”
- 25/06/2021 **Poster**, “*I Conference of the Italian Society of Statistical Physics - SIFS*” conference, online
Title: “Disorder-Enhanced and Disorder-Independent Transport with Long-Range Hopping: Application to Molecular Chains in Optical Cavities”
- 12/03/2021 **Talk**, “*nanoGe Spring Meeting*” conference, online
Title: “Thermal decoherence of superradiance in lead halide perovskite nanocrystal superlattices”
- 04/09/2020 **Talk**, “*CMD2020GEFES*” conference, online
Title: “Disorder-Enhanced and Disorder-Independent Transport with long range hopping: application to molecular chains in optical cavities”
- 07/11/2019 **Talk**, “*Non-Hermitian Quantum Systems*” conference, Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
Title: “Interplay of cooperativity and functionality: from light-harvesting nanotubes to efficient photon-sensors”
- 29/10/2019 **Poster**, “*Quantum Effects in Biological Systems (QuEBS)*” conference, Benemérita Universidad Autónoma de Puebla (Puebla, Mexico)
Title: “Efficient photo-detection and light harvesting via engineered cooperative effects”
- 29/10/2019 **Talk**, “*Quantum Effects in Biological Systems (QuEBS)*” conference, Benemérita Universidad Autónoma de Puebla (Puebla, Mexico)
Title: “Macroscopic coherence as an emergent property in molecular nanotubes”

- 23/10/2018 **Talk**, “*Quantum Biology*” conference, Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
Title: “Non-Hermitian Hamiltonian approach to quantum transport in disordered networks with sinks: Validity and effectiveness”
- 12/06/2018 **Poster**, “*Chaos, quantum chaos and more*” conference, Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
Title: “Temperature of a single chaotic eigenstate”
- 27/03/2018 **Talk**, *Facoltà di Scienze Matematiche, Fisiche e Naturali – Università Cattolica del Sacro Cuore*, Brescia (Italy)
Title: “Superabsorption of light: from Dicke to quantum engineering”
- 12/12/2017 **Talk**, *Facoltà di Scienze Matematiche, Fisiche e Naturali – Università Cattolica del Sacro Cuore*, Brescia (Italy)
Title: “Cooperative effects in light-harvesting systems”
- 27/09/2017 **Poster**, “*Transport at the Nanoscale: Molecules, Graphene and more*” conference, Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
Title: “Cooperativity and scalability of light-harvesting devices by separating absorption from transmission”
- 21/09/2017 **Talk**, “*Transport at the Nanoscale: Molecules, Graphene and more*” conference, Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
Title: “Cooperativity and scalability of light-harvesting devices by separating absorption from transmission”
- 12/09/2017 **Talk**, *Instituto de Física – Benemérita Universidad Autónoma de Puebla*, Puebla (Mexico)
Title: “Cooperativity and scalability of light-harvesting devices by separating absorption from transmission”
- 29/06/2017 **Poster**, “*XXII National Conference on Statistical Physics and Complex Systems*” conference, Università degli Studi di Parma (Parma, Italy)
Title: “Decoupling absorption from transmission in light-harvesting devices”

Attended Scientific Workshops, Schools and Courses

I have attended 19 international scientific workshops, 3 training schools and 5 PhD-level courses.

- 17/06/2024 – **Workshop**, *Challenges and perspectives in resonator-mediated quantum many-body physics: From atoms to solid state*, Zurich (Switzerland)
- 18/06/2024
- 27/05/2024 – **Workshop**, *E-MRS*, Strasbourg (France)
- 31/05/2024
- 21/05/2024 – **Workshop**, *CAFQA*, Ottawa (Canada)
- 23/05/2024
- 03/03/2024 – **Workshop**, *APS March Meeting 2024*, Minneapolis (USA)
- 08/03/2024
- 04/09/2023 – **Workshop**, *CMD30 FisMat*, Milan (Italy)
- 08/09/2023
- 18/07/2023 – **School**, *Quantum localization and Glassy physics*, Cargèse (France)
- 28/07/2023

- 18/06/2023 – **Workshop**, *EGAS 54*, Strasbourg (France)
22/06/2023
- 05/03/2023 – **School**, *Out-of-equilibrium physics with photons and atoms*, Les Houches
10/03/2023 (France)
- 12/12/2022 – **Workshop**, *2nd Workshop on Molecular Quantum Technology - MQT 2022*,
16/12/2022 Puerto Natales (Chile)
Organized by Universidad de Santiago de Chile (Santiago, Chile)
- 24/08/2021 – **Workshop**, *17èmes journées de la matière condensée*, online
27/08/2021 Organized by Société Française de Physique (France)
- 01/07/2021 – **Workshop**, *Wave International Networking Event*, online
02/07/2021 Organized by Université Côte d’Azur (Nice, France)
- 23/06/2021 – **Workshop**, *I Conference of the Italian Society of Statistical Physics - SIFS*,
25/06/2021 online
Organized by Università degli Studi di Parma (Parma, Italy)
- 08/03/2021 – **Workshop**, *nanoGe*, online
12/03/2021 Organized by Fundació Scito
- 02/09/2020 – **Workshop**, *CMD2020GEFES*, online
04/09/2020 Organized by European Physical Society
- 04/11/2019 – **Workshop**, *Non-Hermitian Quantum Systems*, Centro Internacional de Ciencias
08/11/2019 (Cuernavaca, Morelos, Mexico)
- 27/10/2019 – **Workshop**, *Quantum Effects in Biological Systems (QuEBS)*, Benemérita
31/10/2019 Universidad Autónoma de Puebla (Puebla, Mexico)
- 22/10/2018 – **Workshop**, *Quantum Biology*, Centro Internacional de Ciencias (Cuernavaca,
26/10/2018 Morelos, Mexico)
- 04/06/2018 – **Workshop**, *Chaos, quantum chaos and more*, Centro Internacional de Ciencias
22/06/2018 (Cuernavaca, Morelos, Mexico)
- 13/02/2018 **PhD Course**, *Materials and technologies for high-efficiency solar cells: from standards to nanostructures*, Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)
By Prof. Antonio Terrasi (Università degli Studi di Catania, Catania, Italy)
- 05/02/2018 – **PhD Course**, *Methods of numerical resolution of ODE systems: theory, implementation and applications*, Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)
08/02/2018 By Prof. Adolfo Avella (Università degli Studi di Salerno, Salerno, Italy)
- 11/01/2018 – **PhD Course**, *Understanding materials by molecular dynamics simulations*,
12/01/2018 Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)
By Dr. Claudia Caddeo (IOM-CNR, Cagliari, Italy)
- 18/09/2017 – **Workshop**, *Transport at the Nanoscale: Molecules, Graphene and more*, Centro
07/10/2017 Internacional de Ciencias (Cuernavaca, Morelos, Mexico)

- 07/08/2017 – **PhD Course**, *Introduction to Classical and Quantum Chaos*, Instituto de
30/10/2017 Física, Benemérita Universidad Autónoma de Puebla (Puebla, Mexico)
By Prof. Felix M. Izrailev
- 28/06/2017 – **Workshop**, *XXII National Conference on Statistical Physics and Complex
30/06/2017 Systems*, Università degli Studi di Parma (Parma, Italy)
- 08/06/2017 – **PhD Course**, *Wave processes in random media: physical principles, mathe-
22/06/2017 matical methods, and applications*, Facoltà di Scienze Matematiche, Fisiche e
Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)
By Prof. Valentin Freilikher (Bar-Ilan University Ramat-Gan, Israel)
- 27/06/2016 – **Workshop**, *IWDS10 - International Workshop on Disordered Systems*, Facoltà
01/07/2016 di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro
Cuore (Brescia, Italy)
- 20/06/2016 – **School**, *2nd School on Scientific Data Analytics and Visualization*, CINECA
24/06/2016 (Bologna, Italy)