



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

- 2025–now ○ **Post-doc**, *University of Saarland*, Saarbrücken (Germany)
Theoretical Quantum Physics group at the Faculty of Physics.
Group leader: Prof. Giovanna Morigi.
- 2021–2025 ○ **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

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

| Grants

- 06/2020–05/2023 ○ **National Science Foundation (NSF), USA, NSF DMR1952841**
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

- Team work and tutoring I had international collaborations and worked in team 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 published on peer-reviewed journals. I have been a referee for 13 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 or have used Julia, Python, MATLAB, Mathematica and FORTRAN for scientific computing. I have a basic knowledge of C. I'm familiar with the following libraries: LAPACK, BLAS, Numpy, Matplotlib, Julia QuantumOptics. I do regression testing in my code development.
- Software I use Git for version control. I use LaTeX for scientific typing. I use Microsoft Word/Excel/PowerPoint and LibreOffice. I have used Grace and Gnuplot for data visualization.

References

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- [17] 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, *J. Phys. Chem. B* **128**, 9643–9655 (2024).
- [16] S. Kumar, S. Biswas, U. Rashid, K. S. Mony, G. Chandrasekharan, F. Mattiotti, R. M. A. Vergauwe, D. Hagenmüller, V. Kaliginedi, and A. Thomas, Extraordinary Electrical Conductance through Amorphous Nonconducting Polymers under Vibrational Strong Coupling, *J. Am. Chem. Soc.* **146**, 18999–19008 (2024).
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- [14] 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).
- [13] 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).
- [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).

I Scientific communications

I have given 19 talks, 5 of which invited. I have presented 12 posters at conferences.

- 28/10/2024 • **Poster**, “JMC 2024” conference, Marseille (France)
Title: “Multifractality in the interacting disordered Tavis-Cummings model”
- 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”

I Attended Scientific Workshops, Schools and Courses

I have attended 20 international scientific workshops, 3 training schools and 5 PhD-level courses.

- 28–31/10/2024 • **Workshop**, *JMC 2024*, Marseille (France)
- 17–18/06/2024 • **Workshop**, *Challenges and perspectives in resonator-mediated quantum many-body physics: From atoms to solid state*, Zurich (Switzerland)
- 27–31/05/2024 • **Workshop**, *E-MRS*, Strasbourg (France)
- 21–23/05/2024 • **Workshop**, *CAFQA*, Ottawa (Canada)
- 03–08/03/2024 • **Workshop**, *APS March Meeting 2024*, Minneapolis (USA)
- 04–08/09/2023 • **Workshop**, *CMD30 FisMat*, Milan (Italy)
- 18–28/07/2023 • **School**, *Quantum localization and Glassy physics*, Cargèse (France)
- 18–22/06/2023 • **Workshop**, *EGAS 54*, Strasbourg (France)
- 05–10/03/2023 • **School**, *Out-of-equilibrium physics with photons and atoms*, Les Houches (France)
- 12–16/12/2022 • **Workshop**, *2nd Workshop on Molecular Quantum Technology - MQT 2022*, Puerto Natales (Chile)
Organized by Universidad de Santiago de Chile (Santiago, Chile)
- 24–27/08/2021 • **Workshop**, *17èmes journées de la matière condensée*, online
Organized by Société Française de Physique (France)
- 01–02/07/2021 • **Workshop**, *Wave International Networking Event*, online
Organized by Université Côte d'Azur (Nice, France)
- 23–25/06/2021 • **Workshop**, *I Conference of the Italian Society of Statistical Physics - SIFS*, online
Organized by Università degli Studi di Parma (Parma, Italy)
- 08–12/03/2021 • **Workshop**, *nanoGe*, online
Organized by Fundació Scito
- 02–04/09/2020 • **Workshop**, *CMD2020GEFES*, online
Organized by European Physical Society
- 04–08/11/2019 • **Workshop**, *Non-Hermitian Quantum Systems*, Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)

- 27–31/10/2019 • **Workshop**, *Quantum Effects in Biological Systems (QuEBS)*, Benemérita Universidad Autónoma de Puebla (Puebla, Mexico)
- 22–26/10/2018 • **Workshop**, *Quantum Biology*, Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
- 04–22/06/2018 • **Workshop**, *Chaos, quantum chaos and more*, Centro Internacional de Ciencias (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)
- 05–08/02/2018 • **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)
By Prof. Adolfo Avella (Università degli Studi di Salerno, Salerno, Italy)
- 11–12/01/2018 • **PhD Course**, *Understanding materials by molecular dynamics simulations*, Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)
By Dr. Claudia Caddeo (IOM-CNR, Cagliari, Italy)
- 18/09–07/10/2017 • **Workshop**, *Transport at the Nanoscale: Molecules, Graphene and more*, Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
- 07/08–30/10/2017 • **PhD Course**, *Introduction to Classical and Quantum Chaos*, Instituto de Física, Benemérita Universidad Autónoma de Puebla (Puebla, Mexico)
By Prof. Felix M. Izrailev
- 28–30/06/2017 • **Workshop**, *XXII National Conference on Statistical Physics and Complex Systems*, Università degli Studi di Parma (Parma, Italy)
- 08–22/06/2017 • **PhD Course**, *Wave processes in random media: physical principles, mathematical 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)
- 27/06–01/07/2016 • **Workshop**, *IWDS10 - International Workshop on Disordered Systems*, Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)
- 20–24/06/2016 • **School**, *2nd School on Scientific Data Analytics and Visualization*, CINECA (Bologna, Italy)