

# Francesco Mattiotti

## *Curriculum vitae et studiorum*

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### Education

- 2021 **Ph.D. in Physics**, *cum laude*, February 25<sup>th</sup>, 2021, at Department of Physics - University of Notre Dame (USA)  
With a thesis on Cooperative effects in quantum systems: superradiance and long-range interactions. Advisors: Fausto Borgonovi, Giuseppe Luca Celardo and Boldizsár Jankó.
- 2021 **Ph.D. in Science**, *cum laude*, February 25<sup>th</sup>, 2021, at Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)  
With a thesis on Cooperative effects in quantum systems: superradiance and long-range interactions. Advisors: Fausto Borgonovi, Giuseppe Luca Celardo and Boldizsár Jankó.
- 2016 **Master's degree in Physics**, *cum laude*, February 16<sup>th</sup>, 2016, at Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)  
With a thesis on the interplay of cooperativity and noise, from light-harvesting complexes to quantum transport. Advisor: Giuseppe Luca Celardo. Co-advisor: Fausto Borgonovi.
- 2013 **Bachelor's degree in Physics**, *cum laude*, December 16<sup>th</sup>, 2013, at Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)  
With a thesis on the non-Hermitian Hamiltonian approach to quantum transport. Advisor: Giuseppe Luca Celardo. Co-advisor: Giulio Giuseppe Giusteri.

### Positions

- 2021-now **Post-doc**, *University of Strasbourg*, in the Quantum Matter Theory group led by Guido Pupillo at CESQ - Institut de Science et d'Ingénierie Supramoléculaires
- 2017-2021 **Ph.D. Student with scholarship**, *International PhD in Science*, on a joint research project between Università Cattolica del Sacro Cuore and University of Notre Dame  
The research project was about Cooperative Effects in quantum systems, supervised by Prof. Fausto Borgonovi, Prof. Giuseppe Luca Celardo and Prof. Boldizsár Jankó.
- 2016 **Research Assistant**, at Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)  
On a project about quantum transport in nanostructured systems with applications to biosystems, coordinated by Prof. Fausto Borgonovi. The project is financed by Fondazione EULO.

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## Visiting Positions

- December 2<sup>nd</sup> - 18<sup>th</sup>, 2022 **USACH visiting researcher**, *Universidad de Santiago de Chile (Santiago, Chile)*, for a scientific collaboration with Prof. Felipe Herrera.
- September 24<sup>th</sup>, 2018 - December 20<sup>th</sup>, 2019 **UND visiting Ph.D. student**, *University of Notre Dame (Indiana, USA)*, at Faculty of Physics, in the framework of the International Doctoral Program in Science, for a scientific collaboration with Prof. Boldizsár Jankó and Prof. Masaru Kuno.
- May 2<sup>nd</sup> - September 4<sup>th</sup>, 2018 **BUAP visiting position**, *Benemérita Universidad Autónoma de Puebla (Puebla, Mexico)*, at Instituto de Física, for a scientific collaboration with Prof. Felix M. Izrailev and Prof. G. Luca Celardo.
- April 16<sup>th</sup> - 19<sup>th</sup>, 2018 **INFN scientific mission**, *Heriot-Watt University (Edinburgh, United Kingdom)*, for a scientific collaboration with Prof. Erik Gauger.
- August 2<sup>nd</sup> - November 3<sup>rd</sup>, 2017 **BUAP visiting position**, *Benemérita Universidad Autónoma de Puebla (Puebla, Mexico)*, at Instituto de Física, for a scientific collaboration with Prof. Felix M. Izrailev and Prof. G. Luca Celardo.

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## Grants

- June 1<sup>st</sup>, 2020 - May 31<sup>st</sup>, 2023 **National Science Foundation (NSF), USA**, *NSF DMR1952841 (Title: realizing robust superfluorescence from nanocrystal superlattices)*, 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*, Role: Ph.D. student. PI: Prof. Fausto Borgonovi (Università Cattolica del Sacro Cuore, Italy), Financial Support: 6,000 EUR.
- June 22<sup>nd</sup>, 2016 **Fondazione EULO, Italy**, *Title: Quantum transport in nanostructures devices with application to bio-systems*, Role: collaborator. PI: Prof. G. Luca Celardo, Co-PI: Prof. Fausto Borgonovi (Università Cattolica del Sacro Cuore, Italy), Financial Support: 12,000 EUR.

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## Awards

- September 13<sup>th</sup>, 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.
- May 28<sup>th</sup>, 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.
- July 11<sup>th</sup>, 2013 **Istituto G. Toniolo, Italy**, *Master scholarship*, Financial Support: 3,500 EUR.

## Teaching experience

2017 **Teaching Assistant**, *Quantum Mechanics*, 20 hours of exercises at Università Cattolica del Sacro Cuore (Brescia, Italy)

## Transferable skills

**Group work and tutoring** I had international collaborations with experienced researchers and with other PhD students. I also trained and tutored undergraduate and graduate students.

**Communication skills** I have given various oral presentations to international conferences/gatherings. I have written papers that were published on peer-reviewed journals.

## Language skills

Italian native speaker.

English professional working proficiency; *IELTS - Academic score: 7.0/9 (CEFR level: 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

- [14] Nick Sauerwein, Francesca Orsi, Philipp Uhrich, Soumik Bandyopadhyay, Francesco Mattiotti, Tigrane Cantat-Moltrecht, Guido Pupillo, Philipp Hauke, and Jean-Philippe Brantut. Engineering random spin models with atoms in a high-finesse cavity. *Nat. Phys.*, 19(8):1128–1134, August 2023.
- [13] 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(5):053401, August 2023.
- [12] Fabricio S. Lozano-Negro, Emilio Alvarez Navarro, Nahum C. Chávez, Francesco Mattiotti, Fausto Borgonovi, Horacio M. Pastawski, and G. Luca Celardo. Universal stability towards decoherence in quantum diffusive 1D chains. *arXiv:2307.05656*, 2023.
- [11] Sushrut Ghonge, David Engel, Francesco Mattiotti, G. Luca Celardo, Masaru Kuno, and Boldizsár Jankó. Enhanced robustness and dimensional crossover of superradiance in cuboidal nanocrystal superlattices. *Phys. Rev. Res.*, 5(2):023068, April 2023.
- [10] Francesco Mattiotti, Jérôme Dubail, David Hagenmüller, Johannes Schachenmayer, Jean-Philippe Brantut, and Guido Pupillo. Multifractality in the interacting disordered Tavis-Cummings model. *arXiv:2302.14718*, 2023.

- [9] Francesco Mattiotti, Mohan Sarovar, Giulio Giuseppe Giusteri, Fausto Borgonovi, and Giuseppe L Celardo. Efficient light harvesting and photon sensing via engineered cooperative effects. *New J. Phys.*, 24(1):013027, jan 2022.
- [8] Francesco Mattiotti, William M Brown, Nicola Piovella, Stefano Olivares, Erik M Gauger, and G. Luca Celardo. Bio-inspired natural sunlight-pumped lasers. *New J. Phys.*, 23(10):103015, oct 2021.
- [7] Nahum C. Chávez, Francesco Mattiotti, J. A. Méndez-Bermúdez, Fausto Borgonovi, and G. Luca Celardo. Disorder-enhanced and disorder-independent transport with long-range hopping: Application to molecular chains in optical cavities. *Phys. Rev. Lett.*, 126:153201, Apr 2021.
- [6] Francesco Mattiotti, Masaru Kuno, Fausto Borgonovi, Boldizsár Jankó, and G. Luca Celardo. Thermal decoherence of superradiance in lead halide perovskite nanocrystal superlattices. *Nano Lett.*, 20(10):7382–7388, 2020.
- [5] Nahum C. Chávez, Francesco Mattiotti, J. A. Méndez-Bermúdez, Fausto Borgonovi, and G. Luca Celardo. Real and imaginary energy gaps: a comparison between single excitation superradiance and superconductivity and robustness to disorder. *Eur. Phys. J. B*, 92(7):144, Jul 2019.
- [4] Marco Gullì, Alessia Valzelli, Francesco Mattiotti, Mattia Angeli, Fausto Borgonovi, and Giuseppe Luca Celardo. Macroscopic coherence as an emergent property in molecular nanotubes. *New J. Phys.*, 21(1):013019, 2019.
- [3] Fausto Borgonovi, Francesco Mattiotti, and Felix M. Izrailev. Temperature of a single chaotic eigenstate. *Phys. Rev. E*, 95:042135, Apr 2017.
- [2] Giulio G. Giusteri, Francesco Mattiotti, and G. Luca Celardo. Non-hermitian hamiltonian approach to quantum transport in disordered networks with sinks: Validity and effectiveness. *Phys. Rev. B*, 91:094301, Mar 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(1):64–72, 2014.

## Scientific communications

- September 7<sup>th</sup>, 2023 **Talk**, titled “Multifractality in the interacting disordered Tavis-Cummings model” at the conference “CMD30 FisMat”, at Milan (Italy)
- September 6<sup>th</sup>, 2023 **Invited Talk**, titled “Strong light-matter coupling in disordered systems: multifractality and protected transport” at the conference “CMD30 FisMat”, at Milan (Italy)
- July 18<sup>th</sup>, 2023 **Poster**, titled “Multifractality in the interacting disordered Tavis-Cummings model” at the school “Quantum localization and Glassy physics”, at Cargèse (France)
- June 21<sup>st</sup>, 2023 **Poster**, titled “Multifractality in the interacting disordered Tavis-Cummings model” at the conference “EGAS 54”, at Strasbourg (France)

- March 8<sup>th</sup>, 2023 **Poster**, titled "Multifractality in the interacting disordered Tavis-Cummings model" at the school "Out-of-equilibrium physics with photons and atoms", at Les Houches (France)
- December 13<sup>th</sup>, 2022 **Poster**, titled "Multifractality and localization in the disordered interacting Tavis-Cummings model" at the conference "2nd Workshop on Molecular Quantum Technology - MQT 2022", at Puerto Natales (Chile)
- October 13<sup>th</sup>, 2022 **Talk**, titled "Cooperativity in strongly-coupled quantum systems: superradiance, robust transport and multifractality" at Institut de Science et d'Ingénierie Supramoléculaires, University of Strasbourg (Strasbourg, France)
- June 16<sup>th</sup>, 2022 **Invited Talk**, titled "Cooperative effects in quantum systems: robustness to disorder and long-range interactions" at Laboratoire de Physique et Chimie Théoriques - Université de Lorraine (Nancy, France)
- August 25<sup>th</sup>, 2021 **Talk**, titled "Disorder-Enhanced and Disorder-Independent Transport with long range hopping: application to molecular chains in optical cavities" at the conference "17èmes journées de la matière condensée", online
- July 1<sup>st</sup>, 2021 **Poster**, titled "Disorder-Enhanced and Disorder-Independent Transport with Long-Range Hopping: Application to Molecular Chains in Optical Cavities" at the conference "Wave International Networking Event", online
- June 25<sup>th</sup>, 2021 **Poster**, titled "Disorder-Enhanced and Disorder-Independent Transport with Long-Range Hopping: Application to Molecular Chains in Optical Cavities" at the conference "I Conference of the Italian Society of Statistical Physics - SIFS", online
- March 12<sup>th</sup>, 2021 **Talk**, titled "Thermal decoherence of superradiance in lead halide perovskite nanocrystal superlattices" at the conference "nanoGe Spring Meeting", online
- September 4<sup>th</sup>, 2020 **Talk**, titled "Disorder-Enhanced and Disorder-Independent Transport with long range hopping: application to molecular chains in optical cavities" at the conference "CMD2020GEFES", online
- November 7<sup>th</sup>, 2019 **Talk**, titled "Interplay of cooperativity and functionality: from light-harvesting nanotubes to efficient photon-sensors" at the conference "Non-Hermitian Quantum Systems", at Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
- October 29<sup>th</sup>, 2019 **Poster**, titled "Efficient photo-detection and light harvesting via engineered cooperative effects" at the conference "Quantum Effects in Biological Systems (QuEBS)", at Benemérita Universidad Autónoma de Puebla (Puebla, Mexico)
- October 29<sup>th</sup>, 2019 **Talk**, titled "Macroscopic coherence as an emergent property in molecular nanotubes" at the conference "Quantum Effects in Biological Systems (QuEBS)", at Benemérita Universidad Autónoma de Puebla (Puebla, Mexico)
- October 23<sup>rd</sup>, 2018 **Talk**, titled "Non-Hermitian Hamiltonian approach to quantum transport in disordered networks with sinks: Validity and effectiveness" at the conference "Quantum Biology", at Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
- June 12<sup>th</sup>, 2018 **Poster**, titled "Temperature of a single chaotic eigenstate" at the conference "Chaos, quantum chaos and more", at Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)

- March 27<sup>th</sup>, 2018 **Talk**, titled “Superabsorption of light: from Dicke to quantum engineering” at Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)
- December 12<sup>th</sup>, 2017 **Talk**, titled “Cooperative effects in light-harvesting systems” at Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)
- September 27<sup>th</sup>, 2017 **Poster**, titled “Cooperativity and scalability of light-harvesting devices by separating absorption from transmission” at the conference “Transport at the Nanoscale: Molecules, Graphene and more”, at Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
- September 21<sup>th</sup>, 2017 **Talk**, titled “Cooperativity and scalability of light-harvesting devices by separating absorption from transmission” at the conference “Transport at the Nanoscale: Molecules, Graphene and more”, at Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
- September 12<sup>th</sup>, 2017 **Talk**, titled “Cooperativity and scalability of light-harvesting devices by separating absorption from transmission” at Instituto de Física, Benemérita Universidad Autónoma de Puebla (Puebla, Mexico)
- June 29<sup>th</sup>, 2017 **Poster**, titled “Decoupling absorption from transmission in light-harvesting devices” at the conference “XXII National Conference on Statistical Physics and Complex Systems”, at Università degli Studi di Parma (Parma, Italy)

## Attended Scientific Workshops, Schools and Courses

- September 4<sup>th</sup> - 8<sup>th</sup>, 2023 **Workshop**, CMD30 FisMat, at Milan (Italy)
- July 18<sup>th</sup> - 28<sup>th</sup>, 2023 **School**, Quantum localization and Glassy physics, at Cargèse (France)
- June 18<sup>th</sup> - 22<sup>nd</sup>, 2023 **Workshop**, EGAS 54, at Strasbourg (France)
- March 5<sup>th</sup> - 10<sup>th</sup>, 2023 **School**, Out-of-equilibrium physics with photons and atoms, at Les Houches (France)
- December 12<sup>th</sup> - 16<sup>th</sup>, 2022 **Workshop**, 2nd Workshop on Molecular Quantum Technology - MQT 2022, at Puerto Natales (Chile), organized by Universidad de Santiago de Chile (Santiago, Chile)
- August 24<sup>th</sup> - 27<sup>th</sup>, 2021 **Workshop**, 17èmes journées de la matière condensée, online, organized by Société Française de Physique (France)
- July 1<sup>st</sup> - 2<sup>nd</sup>, 2021 **Workshop**, Wave International Networking Event, online, organized by Université Côte d'Azur (Nice, France)
- June 23<sup>rd</sup> - 25<sup>th</sup>, 2021 **Workshop**, I Conference of the Italian Society of Statistical Physics - SIFS, online, organized by Università degli Studi di Parma (Parma, Italy)
- March 8<sup>th</sup> - 12<sup>th</sup>, 2021 **Workshop**, nanoGe, online, organized by Fundació Scito

- September 2<sup>nd</sup> - 4<sup>th</sup>, 2020 **Workshop**, CMD2020GEFES, online, organized by European Physical Society
- November 4<sup>th</sup> - 8<sup>th</sup>, 2019 **Workshop**, Non-Hermitian Quantum Systems, at Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
- October 27<sup>th</sup> - 31<sup>st</sup>, 2019 **Workshop**, Quantum Effects in Biological Systems (QuEBS), at Benemérita Universidad Autónoma de Puebla (Puebla, Mexico)
- October 22<sup>nd</sup> - 26<sup>th</sup>, 2018 **Workshop**, Quantum Biology, at Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
- June 4<sup>th</sup> - 22<sup>nd</sup>, 2018 **Workshop**, Chaos, quantum chaos and more, at Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
- February 13<sup>th</sup>, 2018 **PhD Course**, Materials and technologies for high-efficiency solar cells: from standards to nanostructures. Course held by Prof. Antonio Terrasi (from Università degli Studi di Catania, Catania, Italy) at Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)
- February 5<sup>th</sup> - 8<sup>th</sup>, 2018 **PhD Course**, Methods of numerical resolution of ODE systems: theory, implementation and applications. Course held by Prof. Adolfo Avella (from Università degli Studi di Salerno, Salerno, Italy) at Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)
- January 11<sup>th</sup> - 12<sup>th</sup>, 2018 **PhD Course**, Understanding materials by molecular dynamics simulations. Course held by Claudia Caddeo, PhD (from IOM-CNR, Cagliari, Italy) at Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)
- September 18<sup>th</sup> - October 7<sup>th</sup>, 2017 **Workshop**, Transport at the Nanoscale: Molecules, Graphene and more, at Centro Internacional de Ciencias (Cuernavaca, Morelos, Mexico)
- August 7<sup>th</sup> - October 30<sup>th</sup>, 2017 **PhD Course**, Introduction to Classical and Quantum Chaos. Course held by Prof. Felix M. Izrailev at Instituto de Física, Benemérita Universidad Autónoma de Puebla (Puebla, Mexico)
- June 28<sup>th</sup> - 30<sup>th</sup>, 2017 **Workshop**, XXII National Conference on Statistical Physics and Complex Systems at Università degli Studi di Parma (Parma, Italy)
- June 8<sup>th</sup> - 22<sup>nd</sup>, 2017 **PhD Course**, Wave processes in random media: physical principles, mathematical methods, and applications. Course held by Prof. Valentin Freilikher (from Bar-Ilan University Ramat-Gan, Israel) at Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)
- June 27<sup>th</sup> - July 1<sup>st</sup>, 2016 **Workshop**, IWDS10 - International Workshop on Disordered Systems, at Facoltà di Scienze Matematiche, Fisiche e Naturali - Università Cattolica del Sacro Cuore (Brescia, Italy)
- June 20<sup>th</sup> - 24<sup>th</sup>, 2016 **School**, 2nd School on Scientific Data Analytics and Visualization, at CINECA (Bologna, Italy)