Curriculum Vitae

Personal data

Name:	Dario Gerace
Date and place of birth:	October 5, 1977, in Napoli (Italy)
Nationality:	Italian
Spoken languages:	Italian (mother language), English (fluent understanding, fluent speaking, fluent writing), French (good understanding, medium speaking, medium writing), Spanish (medium understanding, basic speaking, basic writing), German (basic understanding)
Work address:	Dipartimento di Fisica, Università degli Studi di Pavia, via Bassi 6, I-27100 Pavia (Italy)
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Education and professional experience

May 2022 - present: Professor in theoretical condensed matter physics at the Dipartimento di Fisica, Università degli Studi di Pavia, Italy.

April 2015 - April 2022: Associate Professor in theoretical condensed matter physics at the Dipartimento di Fisica, Università degli Studi di Pavia, Italy.

August 2014 - September 2017: Special Visiting Fellow at Departamento de Fisica, Universidade Federal de Minas Gerais, Belo Horizonte, and Departamento de Fisica, Universidade Federal do Rio de Janeiro (Brazil), in the group of Prof. Marcelo F. Santos.

October-December 2013: Visiting researcher at Ecole Polytechnique Fédérale de Lausanne (EPFL), Institute of Theoretical Physics, in the group of V. Savona, with a Swiss National Science Foundation (SNSF) International Visits award.

August-September 2010: Visiting researcher at Centre for Quantum Technologies, National University of Singapore. One month stay in the group of Kwek Leong Chuan, carrying out research on few atom lasers and effects of pure dephasing.

December 2008 - April 2015: Researcher (assistant professor in condensed matter physics, with tenure) at the Dipartimento di Fisica, Università degli Studi di Pavia, Italy.

January 2008 - December 2008: Research associate (assistant professor level, tenure track position) at CNISM (Consorzio Interuniversitario per le Scienze Fisiche della Materia), c/o Dipartimento di Fisica "A. Volta," Università degli Studi di Pavia, Italy.

January 2006 - December 2007: Post-Doc Researcher and Teaching Assistant in the Quantum Photonics group of Prof. A. Imamoğlu, at Institute of Quantum Electronics, ETH Zürich, Switzerland.

November 2004 - December 2005: Fellowship for research activity on the theme "*Theory of photonic crystals*" with Prof. L. C. Andreani at the Department of Physics, University of Pavia.

November 2001 - October 2004: University of Pavia. Ph.D. in Physics with a thesis on "*Photonic Modes and Radiation-Matter Interaction in Photonic Crystal Slabs*" under the supervision of Prof. L. C. Andreani.

Curriculum in brief

Dario Gerace currently holds a permanent position as Full Professor in theoretical condensed matter physics at the University of Pavia, where he has obtained both his Master (Italian "Laurea", in 2001) and PhD (in 2005) degrees in Physics, working under the supervision of Prof. Lucio Claudio Andreani. After that, he has been post-doctoral researcher in the Quantum Photonics group of Atac Imamoglu at ETH Zurich. Then, in 2009 he got a tenured researcher position (Assistant Professor level) at the University of Pavia, before being promoted to Associate Professorship in 2015. In 2014, he was awarded a national Italian qualification to Full Professorship (call ASN-2013), a position that he holds since 2022. In the past few years, he has been developing a number of national and international collaborations on several topics related to condensed matter theory and quantum photonics. Although he has been mainly working as a theorist, he has always interacted with leading experimental groups worldwide yielding several scientific publications in the leading journals of the field, such as Nature, Nature Physics, Science Advances, Nano Letters, Physical Review Letters, with over 7500 citations and an H-factor of 48 as of June 2024 (updated data from Scopus, H-factor of 56 and over 10000 citations according to Google Scholar). He has co-edited a book entitled "Strong Light-Matter Coupling: From Atoms to Solid State Systems" (World Scientific, Singapore, 2014), he has written or contributed to various chapters in edited books, and he is an Editorial Board Member of Scientific Reports, an online journal of the Springer Nature publishing group. A summary of the early career achievements and track records is given in the following.

BIBLIOGRAPHIC IDENTIFIERS
ORCID: 0000-0002-7442-125X
Researcher ID: L-4405-2013
Scopus ID: 56216966800

Main research interests

1. Theory and numerical methods for the calculation of optical properties in nanostructured materials, with emphasis on artificial materials with periodic refractive index (photonic crystals), effects of dispersion, intrinsic diffraction losses, disorder. Quantum theory of radiation-matter interaction in photonic crystals, strong coupling and modification of spontaneous emission rate.
2. Classical nonlinear optics and quantum optics based on semiconductor nanostructures, with emphasis on all-optical switching, harmonic generation, optical bistability, single-photon sources, single-atom lasers, generation of entangled photons, strongly correlated *photonic* systems, circuit quantum electrodynamics with superconducting qubits.
3. Theory and numerical methods for the calculation of transport properties in strongly correlated electronic systems, manybody theory in semiconductor nanostructures, such as quantum wells and dots, with emphasis on the Landauer formalism and the Kondo effect in quantum dots.
4. Quantum phase transitions in interacting bosonic systems including the effects of dissipation, quantum optics of nonlinear open systems, effects of entanglement on manybody coherence.
5. Quantum vacuum effects in analog models: Dynamical Casimir emission, Hawking radiation and Unruh effect in out-of-equilibrium cavity QED systems.
6. Quantum simulations with near-term quantum computers, quantum machine learning, quantum computing, quantum nanostructures as quantum simulators.

Other professional services

1. Editorial Board Member of the condensed matter section of Scientific Reports, an online and open access journal of the Nature Publishing Group (NPG).

2. Regular reviewer for the Nature Publishing Group (NPG) journals (Nature Materials, Nature Nanotechnology, Nature Photonics, Nature Communications, Scientific Reports), the American Physical Society (APS) journals (Physical Review Letters, Physical Review A, Physical Review B, Physical Review E, Physical Review X), the American Institute of Physics (AIP) journals (Applied Physics Letters, Journal of Applied Physics), the Institute of Physics (IOP) journals (New Journal of Physics, Europhysics Letters), the Optical Society of America (OSA) journals (Optica, Optics Letters, Optics Express, Journal of the Optical Society of America), and others.

Teaching experience

2022 - current: University of Pavia, Department of Physics. Bachelor in Physics: Professor of Electromagnetism.

2020 - current: University of Pavia, Department of Physics. Master course in Physics: Professor of Quantum Nanostructures.

2015 - current: University of Pavia, Department of Pharmaceutical Sciences, course in Chemistry and Pharmaceutical Technologies: Professor of Physics.

2009 - 2019: University of Pavia, Department of Physics. Master course in Physics: Professor of Semiconductor Physics and Semiconductor Nanostructures.

2008: University of Pavia, Faculty of Sciences. PhD course in Physics: Assistant Professor of Semiconductor Physics and Semiconductor Nanostructures, has held a class on Advanced Solid State Physics for the PhD school in Physics.
Master course in Physics: Teaching assistant for Semiconductor Physics, Semiconductor Nanostructures, Solid State Physics, Photonics.

2007: ETH Zurich, Institute of Quantum Electronics. Responsible for linear optics experiments held by 3rd year students for the bachelor degree in Physics. Teaching load: 4 hrs. per week

2006-2007: ETH Zurich, Faculty of Engineering. Teaching assistant (exercise classes) on classical mechanics and electromagnetism for Physics I and Physics II students. Teaching load: 2 hrs. per week.

2004-2005: University of Pavia, Faculty of Chemistry. Teaching assistant for the General Physics class, giving lectures (10 hrs.) on Optics and Photonics at the bachelor degree in Chemistry, 2nd year students.

2002-2004: University of Pavia, Faculty of Chemistry. Teaching assistant, in charge of exercise classes, preparation and correction of examinations for the General Physics course at the bachelor degree in Chemistry and Pharmaceutical Technologies, 1st year students.

Main oral contributions: workshops, conferences, schools

1. "Quantum polariton interferometry", **invited talk** at the "Excitonics and Polaritonics International Conference" (EPIC 2023), November 27 - December 1, 2023, Singapore (SG).
2. "Quantum Neural Network Models and Case Studies on NISQ devices", **invited talk** at the workshop on "Quantum Machine Learning - Integrating Hardware and Software Developments", February 15, 2023, Erlangen (DE).
3. "Comparing Quantum and Classical Machine Learning for Vector Boson Scattering Background Reduction at the Large Hadron Collider", **invited talk** at the 5th workshop on "High Performance Computing and Quantum Computing", Dec. 15, 2022, Bologna (IT).

4. "Illusion Optics and Photonics," **keynote lecture** at the workshop "Enlightening Mind," May 24, 2022, Firenze (IT).
5. "Nonlinear and quantum optics in confined photonic systems," **invited seminar** at the Condensed Matter section of the 107^{th} Congress of the Italian Physical Society, September 13 - 17, 2021, online event.
6. "Quantum machine learning on NISQ hardware," **invited online seminar** at the online workshop on *Scientific quantum computing and simulation on near term devices*, October 05-November 13, 2020, organized from the Institute for Nuclear Theory (INT), University of Washington Seattle (US).
7. "Photonic crystal cavities for enhanced nonlinear and quantum photonics," **invited talk** at the Winter School on *New Developments in Solid State Physics*, February 23 - 28, 2020, Mauterndorf (AU).
8. "Photonic crystal cavities for enhanced nonlinear and quantum optics," **invited talk** at the workshop on *Complex Materials for Nonlinear Optics*, January 29 - 31, 2020, ETH Zurich (CH).
9. "An artificial neural network implemented on noisy intermediate-scale quantum hardware," **long talk** at the conference on *Quantum Techniques in Machine Learning (QTML)*, October 20-24, 2019, KAIST Daejeon (South Korea).
10. "Slow Light to Reduce the Energy Dissipation of Mach-Zehnder Modulators in Silicon Photonics," **invited talk** at the international conference on *Energy, Materials, and Nanotechnology (EMN) - Meeting on Photonics*, September 10-13, 2019, Milano (IT).
11. "Quantum simulations," **invited talk** at the workshop on *Computational Mathematics, Statistics, and Machine Learning*, May 7-9, 2019, Pavia (IT).
12. "A quantum information based artificial neuron model," **invited talk** at the conference and workshop on *Quantum Information and Thermodynamics*, March 11-22, 2019, Natal (BR).
13. "An artificial neuron model implemented on the IBM quantum processor," **invited talk** at the workshop on *Quantum Computing and High Performance Computing*, Dec. 18, 2018, CINECA, Bologna (IT).
14. "Quantum simulators in hybrid nano-circuits," at the XI *Italian Quantum Information Science* Conference (IQIS2018), Sept. 17-20, 2018, Catania (IT).
15. "Quantum simulators in hybrid nano-circuits," **invited talk** at the XIX *Trends in Nanotechnology* Conference (TNT2018), Sept. 3-7, 2018, Lecce (IT).
16. "Photon rectification in waveguide QED," **invited talk** at the 1st workshop on *Waveguide quantum electrodynamics* (WQED18), June 4 - 8, 2018, Mazara del Vallo (IT).
17. "Steady state entanglement of spatially separated solid state qubits," **invited talk** at the *VI Quantum Information School and Workshop*, August 21 -25, 2017, Paraty (BR).
18. "Digital quantum simulators with hybrid spin-photon qubits in superconducting resonator arrays," **invited talk** at the *Ctrl-Q Workshop on "Semiconductor cavity quantum electrodynamics*, June 14, 2017, Saarland University, Saarbrücken (DE).
19. "Digital quantum simulation of condensed matter models with hybrid qubits," **invited talk** at the *Quantum Simulations and Manybody Physics with Light*, June 4 - 11, 2016, Chania, Crete (GR).
20. "Enhanced nonlinearities of silicon photonic crystal cavities," **invited talk** at the *InfraRed Optical Nanostructures* symposium 2015, October 22 - 23, 2015, Vienna (AU).
21. "Quantum information processing and simulation with hybrid spin-photon qubits," **invited talk** at the *V Quantum Information School and Workshop*, August 11 -15, 2015, Paraty (BR).
22. "Enhanced nonlinear properties of photonic crystal nanocavities," **invited talk** at the XX OptoElectronics and Communications Conference (OECC 2015), symposium on *Hybrid nanophotonics*, June 28 - July 2, 2015, Shanghai (CH).
23. "Theory of acoustic black holes in flowing microcavity polariton fluids," **invited talk** at the International Winter School and Workshop *Strongly correlated fluids of light and matter*, 12-23 January 2015, ECT* Trento (IT).
24. "Single-photon nonlinear optics in passive photonic integrated circuits," **invited talk** at Photonics North, symposium on *Nonlinear Optics, Nanophotonics and Quantum Optics*, 28-30 May 2014, Montreal (CA).
25. "Optimization of polarization diversity couplers for silicon photonics: Reaching the -1dB coupling efficiency threshold," contributed talk at Photonics North, symposium on *Photonic Theory, Simulation and Design*, 28-30 May 2014, Montreal (CA).

26. "Single-photon sources without quantum emitters," **invited talk** at Photonics West, SPIE symposium on *Advances in Photonics of Quantum Computing, Memory, and Communication VI*, 1-6 February 2014, San Francisco (USA).
27. "Solid-state single-photon sources without quantum emitters?" **invited talk** at the workshop *Quantum Future: the shift in the communication paradigm*, 18-19 October 2013, Padova (IT).
28. "Solid-state single-photon sources without quantum emitters?", VI *Italian Quantum Information Science* (IQIS) conference, 24-26 September 2013, Como (IT).
29. "Exciton-photon coupling in confined photonic structures: from strongly correlated photons to novel quantum devices," **invited talk** at the XIII conference on *Optics of Excitons in Confined Systems*, 9-13 September 2013, Roma (IT).
30. "Analog Hawking radiation from a step-like event horizon in an out-of-equilibrium superfluid," **invited talk** at the Workshop on Effective Gravity in Fluids and Superfluids, July 2012, Abdus Salam ICTP, Trieste (IT).
31. "Photonic Crystals: molding the propagation and confinement of light for advanced nonlinear and quantum optics," **invited lecture** at the V International School on Nanophotonics and Photovoltaics, April 2012, Pukhet (Thailand).
32. "Photonic crystal polaritons for the generation of entangled photons," *Workshop on entanglement in solid state systems*, September 2011, Lecce (Italy).
33. "Low-power continuous wave frequency conversion in far-field optimized silicon photonic crystal nanocavities," *CLEO Europe conference 2011*, May 2011, Munich (Germany).
34. "Photon correlations in multi-cavity nonlinear systems," *CLEO USA conference 2011*, May 2011, Baltimore (USA).
35. "Bloch surface wave polaritons," XI conference on *Physics of Light Matter Coupling in Nanostructures*, April 2011, Berlin (Germany).
36. "Photon correlations in photonic crystal cavity QED," **invited talk**, XI conference on *Physics of Electromagnetic Crystal Structures*, September 2010, Granada (Spain).
37. "The quantum optical Josephson interferometer," XI conference on *Optics of Excitons in Confined Systems*, 7-11 September 2009, Madrid (Spain).
38. "Fermionized photons in an array of photonic crystal cavities," IX conference on *Physics of Light Matter Coupling in Nanostructures*, April 2009, Lecce (IT).
39. "Quantum optics with semiconductor quantum dots and photonic crystal cavities," **invited talk**, IV *National Congress of the Italian Physical Society*, September 2008, Genova (IT).
40. "Light propagation and light-matter interaction in Silicon photonic crystals," **invited lecture** al IV *Graduated Student Meeting on Electronic Engineering*, June 2008, Univesitat Rovira i Virgili, Tarragona (Spain).
41. "Theory of photonic crystal slabs by the Guided-Mode Expansion method," **invited talk** at *Workshop on Numerical Methods for Optical Nanostructures*, July 2007, ETH Zurich (Switzerland).
42. "Enhanced light emission in active silicon-on-insulator photonic crystal slabs and slot waveguides," **invited talk** at *International Conference on Transparent Optical Networks*, July 2007, Rome (IT).
43. "Cavity-QED with photonic crystal nanocavities and semiconductor quantum dots," conference on *Synergy between computation and experiment in nanoscale science*, NNIN Harvard, June 2006, Boston (Massachusetts, USA).
44. "Theory and measurements of photonic crystal slabs," **invited talk** seminar on *Optics of Photonics Band-Gap Materials*, Indian Institute of Technology, October 2005, Kharagpur (India).
45. "Disorder effects on out-of-plane propagation losses in linear photonic crystal waveguides," Photonics West, SPIE Symposium on *Nanotechnologies in Photonics – Photonic Crystal Materials and Devices*, January 2005, San Josè (California, USA).
46. "Polaritons and nanocavities in photonic crystal slabs," 4th Conference on *Physics of Light-Matter Coupling in Nanostructures*, July 2004, St. Petersburg (Russia).
47. "Diffraction losses, cavity modes and exciton polaritons in photonic crystal slabs," 12th Conference *Optical Waveguide Theory and Numerical Modeling*, March 2004, Gent (Belgium).
48. "Quantum theory of photonic crystal polaritons," 8th Conference on *Optics of Excitons in Confined Systems*, September 2003, Lecce (IT).

Invited seminars

1. "Photonic crystal cavities for enhanced nonlinear effects," invited seminar at the Institut des Nanotechnologies de Lyon (INL), Ecole Centrale de Lyon (ECL), September 13, 2022, Lyon (FR).
2. "Universal quantum simulators," *Physics Colloquium*, Dipartimento di Scienza e Alta Tecnologia, Università dell'Insubria, January 27, 2020, Como (IT).
3. "Universal quantum simulators in hybrid superconducting platforms," QuEng Seminar at the *PhD school on quantum engineering*, April 25, 2018, Grenoble (FR).
4. "Digital quantum simulators in superconducting-based hybrid platforms," IQST Seminar at the *Center for Integrated Quantum Science and Technologies*, Ferbuary 22, 2018, University of Ulm (DE).
5. "An acoustic black hole in a quantum fluid of light," Microphotonics seminar at the European Laboratory for Nonlinear Spectroscopy (LENS), May 2015, Firenze (IT).
6. "Integrated single photon sources without quantum emitters," Physics Colloquium at Departamento de Física, Universidade Federal de Minas Gerais, August 2014, Belo Horizonte (BR).
7. "Analog models in condensed matter: an acoustic black hole in a flowing polariton superfluid," invited seminar at Ecole Polytechnique Fédérale de Lausanne (EPFL), November 2013, Lausanne (CH).
8. "Light emission in silicon photonic crystal nanocavities," invited seminar at Istituto Italiano di Tecnologia (IIT) - CNR, February 2013, Lecce (IT).
9. "Cosmological models in condensed matter: analog Hawking radiation in a semiconductor microcavity," Department seminar at Departamento de Física, Universidade Federal de Minas Gerais, November 2012, Belo Horizonte (BR).
10. "Cosmological models in condensed matter: analog Hawking radiation in a semiconductor microcavity," Colloquium at Institute Neel, CNRS Grenoble, October 2012, Grenoble (FR).
11. "Analog Hawking radiation in out-of-equilibrium superfluids," seminar at INO-CNR BEC center, January 2012, Trento (IT).
12. "Photonic crystal platforms: applications to enhanced nonlinear effects in Silicon photonics," Colloquium at Deparment of Electronic engineering, Princeton University, May 2011, Princeton (US).
13. "Time-dependent phenomena in cavity QED with superconducting qubits and microwave resonators," Scuola Normale Superiore, November 4, 2010, Pisa (IT).
14. "Photon correlations in multi-cavity open systems," Centre for Quantum Technologies, National University of Singapore, September 6, 2010, Singapore.
15. "Photonic crystal platforms: applications to Silicon photonics," Colloquium at Nanyang Technological University, August 24, 2010, Singapore.
16. "Silicon photonics," CEA-LETI Grenoble, invited by J.-M. Gérard, May 4, 2010, Grenoble (FR).
17. "Photon correlations in nonlinear multi-cavity systems," Institute Neel, CNRS Grenoble, April 28, 2010, Grenoble (FR).
18. "Controlling the dynamics of a coupled atom-cavity system by pure dephasing," ETH seminar invited by H. Tureci, March 9, 2010, Zurich (CH).
19. "Photon correlations in nonlinear multi-cavity systems," European Laboratory for Nonlinear Spectroscopy (LENS), January 17, 2010, Firenze (IT).
20. "Single photon nonlinearity in solid state cavity QED," Physics Colloquium at Dipartimento di Fisica "A. Volta," February 3, 2009, Pavia (IT).
21. "Light propagation and light-matter interaction in Silicon photonic crystals," Italian Institute of Technology, September 23, 2008, Genova (IT).
22. "Out-of-equilibrium Tonks-Girardeau gas in an array of coupled cavities," CNR-BEC center, April 17, 2008, Trento (IT).
23. "Quantum nature of a single QD strongly coupled to a photonic crystal cavity mode," LPN Marcoussis, March 15, 2007, Paris (FR).
24. "Quantum nature of a single QD strongly coupled to a photonic crystal cavity mode," Univ. Paris VII, March 13, 2007, Paris (FR).

25. "Quantum nonlinear regime in solid-state cavity-QED," Max Planck Institute for Quantum Optics, October 9, 2006, Munich (DE).
26. "Realizing an effective Bose-Hubbard model with polariton superlattices," Quantum Optics meeting, September 25-27, 2005, Villa Garbald (Castasegna, CH).
27. "Photonic crystal slabs for the control of light propagation and light-matter interaction," invited by A. Imamoglu June 6, 2005, ETH Zurich (CH).
