

# LORENZO MACCONE'S CURRICULUM VITÆ

with a statement of research interest and a list of publications

Lorenzo Maccone, born in Ivrea (TO) –Italy– on April 21, 1972 (Italian citizen).

## CONTACT INFORMATION

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## ACADEMIA (reverse chronological order)

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### Present<sup>1</sup>

**Associate professor** from October 2010 at the Dipartimento di Fisica (formerly dip. Fisica “A. Volta”) of the University of Pavia, Italy. He has received the scientific habilitation to full professor: December 2013, scientific habilitation for Theoretical Structure of Matter (02/B2); January 2014, scientific habilitation for Theoretical Physics of Fundamental Interactions (02/A2).

He currently teaches the courses of “Classical Electrodynamics and special relativity” (i.e. fisica generale 2), an undergraduate course for Mathematicians; “Quantum Optics” (i.e. ottica quantistica), an undergraduate and master course for physicists; “Open quantum systems” a graduate course for physics PhD students. He is the international exchange coordinator for the Physics department of the university of Pavia (Erasmus program and other international programs).

His main current research lines refer to **theoretical quantum mechanics and its applications**, primarily: Quantum Information, Quantum Optics, Quantum Computation, and Foundations of Quantum Mechanics.

### Past<sup>1</sup>

June 2010-September 2010: **Official Faculty Guest at the Los Alamos National Laboratories** in the group of W.H. Zurek, working on Foundations of Quantum Mechanics and Quantum Metrology.

June 2009-May 2010: **Visiting Scientist at the Massachusetts Institute of Technology (MIT)** in the xQIT, “Center for Extreme Quantum Information theory” (funded by the W. M. Keck foundation).

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<sup>1</sup>Present and past according to a reference system connected to the surface of Earth!

February 2009-May 2009: **Research associate at ISI** (Institute for Scientific Interchange Foundation) in Torino, Italy.

December 2004- December 2008: **Contract Professor** at the University of Pavia (contract of 4 years).

March 2004-December 2004: **Postdoctoral Associate (UNIPV)** in the Quantum Information theory group of the University of Pavia.

November 2000-February 2004: **Postdoctoral Associate (MIT)** in the Research Laboratory of Electronics of the Massachusetts Institute of Technology (MIT) in the groups of Prof. J. H. Shapiro and Prof. S. Lloyd. This position was renewed three times: in November 2001, November 2002, and November 2003.

January 2000-November 2000: **Postdoctoral fellowship (UNIPV)** at the University of Pavia.

## CURRICULUM STUDIORUM

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September 1996-December 13, 1999: **Ph.D. in theoretical Physics** in Pavia under the supervision of Prof. G. M. D'Ariano. Thesis “Quantum tomography: methods and applications”, in which the theory and various applications of quantum state reconstruction techniques are analyzed.

September 1992-June 7, 1996: **Master in Physics** obtained with full marks (110 on 110) *cum laude* and an average mark of 29.77 on 30 for the eighteen required exams.

High School: Liceo Classico (Liceo “C. Botta”, Ivrea), where literary and humanistic subjects are emphasized. Final score: 60 on 60 (full marks).

## SKILLS

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### **Scientific research:**

Numerous publications on peer-reviewed international scientific journals— Nature, Science, Nature Photonics, Nature Physics, Physical Review Letters, and IEEE Transactions on Information Theory among others (see full list of publications below).

Presentation of his research in numerous conferences and workshops, and in invited seminars (see full list below).

Active in the divulgation of Physics, Quantum Mechanics in particular.

Referee for the journals Science, Nature, Nature Physics, Nature Photonics, Nature Communications, Proceedings of the National Academy of Sciences (PNAS), IEEE Photonics Technology Letters, Scientific reports, Foundations of Physics, Phys. Rev. Lett., Phys. Rev. A, Phys. Rev. X, Quantum, Annalen der Physik, Quantum Information and Computation, Physics Letters, New Journal of Physics, Journal of Physics A: Mathematical and General, Journal of Physics B: Atomic, Molecular & Optical Physics, European Physical Journal D, European Physical Journal Plus, Journal of the Optical Society of America B, Journal of Mathematical Physics, Complexity, Theoretical Computer Science, Physics essays, International Journal of Quantum Information, Quantum Information Processing, Symmetry, Inverse Problems, Proceedings of the Royal Society A, Entropy, Information Sciences, Quantum Measurements and Quantum Metrology, Journal of Physics Communications, American Journal of Physics, Advances in Space Research.

Referee for multiple national and international grant proposals, including European projects. Recognition for “Outstanding Referee” from the American Physical Society in 2012.

**Foreign languages:** Fluent English, basic French.

**Computer abilities:** excellent skills in information technologies; started programming in 1981; programming languages: C, Fortran, Assembler 8086, and Basic; Latex typesetting language; Operating systems: Linux (since 1995), MS-DOS, and Windows (from 2.0 to XP); system administrator for Linux and mixed Linux-Windows computer clusters, web servers, mail servers, FTP servers, samba servers, and a domain name server; architectures: IBM compatibles, Apple computer architectures, Sun Sparc, and DEC Alpha; applications: Mathematica, emacs, Open Office, Microsoft Office, etc.

**Scholarships:** three scholarships from the private institution INPDAI for study achievements.

#### MISCELLANEA:

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Sports: mountain sports (alpine ski, trekking, free climbing, *piolet traction*, mountain biking), sailing (provisional rating and experience on a 38-foot vessel), long distance bicycle trips, swimming.

Hobbies: computers and electronics (radio amateur license I-Z2ZYY), reading.

Civil service: EMT-trained ambulance technician with “Croce Verde Fornovese” in Fornovo, PR (he has also volunteered on the Italian Red Cross ambulances, at the Red Cross in Pavia). He has thus fulfilled the mandatory military requirements for his country.

#### STATEMENT OF RESEARCH INTEREST AND RESEARCH ACTIVITIES

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The day I was born people were landing on the moon. Explore, discover, invent: reading the book of nature is my dream. I am a theoretical physicist, mainly interested in the study of fundamental aspects and of practical applications of Quantum Mechanics. My research activity has been chiefly devoted to quantum optics, quantum theory of measurement, quantum information theory, and foundations of quantum mechanics. A schematic list of the research topics I pursued, or I am currently pursuing, follows. The references refer to the publications in the subsequent list. The research has been performed in collaboration with numerous coauthors.

- **Quantum parameter estimation:** quantum positioning [17], quantum metrology [51, 41, 75, 82, 80, 86, 90, 96, 102], interferometric tunability of the absorption [53], quantum imaging [66,107], quantum illumination [64,60].
- **Quantum foundations:** interpretation of entanglement [92,95,100], quantum time [94,89,103,101], information-disturbance tradeoffs [52,56], quantum thermodynamics [68], quantum descriptions of closed timelike curves [72], quantum reference frames [83], uncertainty relations [91].
- **Quantum computation:** quantum Random Access Memory [59,63], quantum solution to the Ulam problem [50], quantum optical computation [9], blind quantum computation [87].

- **Quantum cryptography:** secure database interrogation: the QPQ cryptographic primitive [61,67,69,87], quantum cryptographic ranging [22], quantum cryptographic protocol for the communication of reference frames [57].
- **Quantum state reconstruction:** weak-value tomography [88], theoretical analysis and proposal of tomographic procedures for optical systems [3,5] and systems with SU(1,1) and SU(2) symmetries [16,25], contribution to generalized tomography [14,15], application of quantum tomography to classical imaging [46].
- **Experimental proposals:** Liouvillian superoperator measurement [3,4], optical Schrödinger cat [5], optical Fock state synthesis-measurement [12,13].
- **Entanglement, uses:** quantum clock synchronization with dispersion cancellation [18], dynamical evolution of composite systems [27,28], conversion between speakable and unspeakable information [83].
- **Entanglement, new sources:** difference-beam state [20,24].
- **Quantum-channel capacities:** minimum output entropy conjecture [70], entanglement assisted capacity of bosonic channels [29,31], classical capacity of bosonic and Gaussian channels [32,105,85], waveguide capacity [35], ultimate limits to channel capacity [39], decoding schemes for achieving the classical capacity [77,79].
- **Numerical simulations:** Monte-Carlo simulations of laser master and Fokker Plank equations [1], Monte-Carlo simulations of numerous tomographic schemes.
- **Clock synchronization:** conveyor belt clock synchronization protocol [40], limits to synchronization in the presence of decoherence [21].

In addition to the above research, I have also devoted some effort to the divulgation of Quantum Physics [54,62,73,84,98].

## PATENTS

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- “Method for ensuring privacy while querying a database by using quantum superposition and multiple responses”. US Patent 8126830 B2. Filed on June 24, 2008, serial number 12/145,050. Internationally (PCT) filed on July 2, 2008, serial number PCT/US08/68995. [Provisional patent filed on July 3, 2007, serial number 60/947,720.]
- “Bucket Brigade Address Decoding Architecture for Classical and Quantum Random Access Memories”. US Patent 7764568. Internationally (PCT) filed on July 2, 2008, serial number PCT/US08/68993. [Provisional patent filed on July 3, 2007, serial number 60/947,719.]

## PUBLICATIONS

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1. G. M. D'Ariano, C. Macchiavello, L. Maccone, "Noise, errors and information in quantum amplification", *Int. J. Mod. Phys. B* **11**, 3385 (1997).
2. G. M. D'Ariano and L. Maccone, "Quantum Tomography of Optical Devices", in *5th International Conference on Squeezed States and Uncertainty Relations*, ed. by J. Janszky, Y. S. Kim, and V. I. Man'ko, p. 529 (1997).
3. G. M. D'Ariano, L. Maccone, "Measuring Quantum Optical Hamiltonians", *Phys. Rev. Lett.* **80**, 5465 (1998).
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5. G. M. D'Ariano, C. Macchiavello, and L. Maccone, "Quantum tomography of mesoscopic superpositions of radiation states", *Phys. Rev. A* **59**, 1816 (1999).
6. G. M. D'Ariano, P. Kumar, C. Macchiavello, L. Maccone, and N. Sterpi, "A Test of the State Reduction Rule", *Phys. Rev. Lett.* **83**, 2490 (1999).
7. G. M. D'Ariano, A. Garuccio, L. Maccone, and M. F. Sacchi, "Tomographic test of Bell's inequality", *J. Opt. B*, **1**, 576 (1999).
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9. G. M. D'Ariano, C. Macchiavello, and L. Maccone, "Quantum Computation with Polarized Photons", *Fortschr. Phys.* **48**, 573 (2000).
10. G. M. D'Ariano, L. Maccone, M. F. Sacchi and A. Garuccio, "Homodyning Bell's inequality", in '4<sup>th</sup> Int. Conf. on Quantum Communication, Measurement, and Computing', Kluwer/Plenum, pg. 163 (2000).
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14. G. M. D'Ariano, L. Maccone and M. G. A. Paris, "Orthogonality relations in Quantum Tomography", *Phys. Lett. A* **276**, 25 (2000).
15. G. M. D'Ariano, L. Maccone, M. G. A. Paris "Quorum of observables for universal quantum estimation", *Journ. of Phys. A* **34**, 93 (2001).
16. G. M. D'Ariano, E. De Vito, and L. Maccone, "SU(1,1) tomography", *Phys. Rev. A* **64**, 033805 (2001).

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93. E. Moreva, G. Brida, M. Gramegna, V. Giovannetti, L. Maccone and M. Genovese, “The time as an emergent property quantum mechanics, a synthetic description of a first experimental approach”, invited papers at DICE 2014, Journ. of Phys. Conf. series **626**, 012019 (2015).
94. V. Giovannetti, S. Lloyd, L. Maccone, “*Quantum time*”, Phys. Rev. D **92**, 045033 (2015).
95. Z. Huang, L. Maccone, A. Karim, C. Macchiavello, R. Chapman, A. Peruzzo, “*High-dimensional entanglement certification*”, Sci. Rep. **6**, 27637 (2016).
96. Z. Huang, C. Macchiavello, L. Maccone, “*Entanglement-assisted quantum metrology*”, Phys. Rev. A **94**, 012101 (2016).
97. M. Menotti, L. Maccone, J. E. Sipe, and M. Liscidini “*Generation of energy-entangled  $W$  states via parametric fluorescence in integrated devices*”, Phys. Rev. A **94**, 013845 (2016).

98. L. Maccone, “*Computer quantistici: status e prospettive*”, presented at the Istituto Lombardo Accademia di Scienze e Lettere, on November 24, 2016. Accepted for publication on the “Rendiconti dell’Istituto”.
99. A. Riccardi, C. Macchiavello, L. Maccone, “*Tight entropic uncertainty relations for systems with dimension three to five*”, Phys. Rev. A **95**, 032109 (2017).
100. D. Sauerwein, C. Macchiavello, L. Maccone, B. Kraus, “*Multipartite correlations in mutually unbiased bases*”, Phys. Rev. A **95**, 042315 (2017).
101. J. Leon, L. Maccone, “*The Pauli Objection*”, Found. Phys. **47**(12), 1597 (2017).
102. M. Hassani, C. Macchiavello, L. Maccone, “*Digital quantum metrology*”, Phys. Rev. Lett. **119**, 200502 (2017).
103. E. Moreva, G. Brida, M. Gramegna, L. Maccone, M. Genovese, “*Quantum time: experimental multi-time correlations*”, Phys. Rev. D, **96**, 102005 (2017).

— Papers in progress (NOT YET PUBLISHED): —

104. S.Lloyd, L.Maccone, R.Garcia-Patron, V.Giovannetti, Y.Shikano, S.Pirandola, L.A. Rozema, A.Darabi, Y.Soudagar, L.K.Shalm, A.M.Steinberg, “*A reply to ”Problems with modelling closed timelike curves as post-selected teleportation”*”, arXiv:1108.0153 (2011).
105. S. Lloyd, V. Giovannetti, L. Maccone, N.J. Cerf, S. Guha, R. Garcia-Patron, S. Mitter, S. Pirandola, M.B. Ruskai, J.H. Shapiro, H. Yuan, “*The bosonic minimum output entropy conjecture and Lagrangian minimization*”, arXiv:0906.2758 [quant-ph] (2009).
106. V. Giovannetti, S. Lloyd, L. Maccone, “*Quantum internet routers*”, in progress (2009).
107. V. Giovannetti, S. Lloyd, L. Maccone, “*Sub-Rayleigh Ghost Imaging*”, in progress (2009).
108. V. Giovannetti, S. Lloyd, L. Maccone, and J. H. Shapiro, “*Improved resolution in imaging through quantum post-selection*” (*Paper P1-1*), proceedings for the QCM&C 2008 conference.
109. F. Guerrieri, L. Maccone, F. N. C. Wong, J. H. Shapiro, S. Tisa, F. Zappa, “*Imaging Beyond the Rayleigh Bound*” (*Paper MON-6*), proceedings for the QCM&C 2010 conference (Brisbane, Australia).

SEMINARS, CONFERENCES AND WORKSHOPS

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International scientific conferences with presentation of research in oral or poster form:

- 2017: MEDiT Health Innovation (Vicenza, 17-18 November) (**invited oral presentation**); Cose Cosmiche, dialoghi sul tempo (Palazzo Archinto, Milano, 9/11) (**public outreach seminar, 30/40 ppl.**); Applied Quantum group Milan meeting, AQM17 (Varazze, 25-27 September) (**invited oral presentation**); IQIS17 (Firenze, 12-15 September) (**oral presentation**); 6th International Conference on New Frontiers in Physics ICNFP (Kolymbari, Crete, Greece, 19-26 August) (**invited oral presentation**); Benasque workshop on quantum information (Benasque, Spain, 9-15 July); Micro-workshop to discuss future projects, Ulm university (Ulm, Germany, 22-23 June) (**oral presentation**); “Il cielo di Roma 2017” (Parco Appia antica, Roma, 2 June) (**public outreach seminar**); Grup d’Informaci/ó Quántica, Universitat Autònoma Barcelona (Barcelona, Spain, 29 May) (**invited oral presentation**); Quantum 2017 (Torino, May 7-12) (**invited oral presentation**); “Non e’ la classica fisica” IV Convegno Marveggio (Sondrio, April 22) (**public outreach seminar, 300 people**); Collegio Borromeo (Pavia, March 30) (**public outreach seminar**); QuProCS II (Palma de Mallorca, April 6-7) (**invited oral presentation**).
- 2016: Istituto Lombardo, Accademia di scienze e lettere (Milano, 24 November) (**public outreach seminar**); Quantum measurement: a dialog of big and small (Warwick, UK, 28 September) (**invited oral presentation**); IQIS 2016 9th Italian Quantum Information Science Conference (Roma, Italy, 20-23 September) (**invited oral presentation**); Taming quantum noise TQN16 (Mazara del Vallo, Italy, September 5-9—) (**invited oral presentation**); FQXI 2016 ‘If A Tree Falls: the Physics of What Happens and Who is Listening’ (Banff, Canada, August 17-22) (**invited 5-minute presentation**); 3rd Seefeld workshop on Quantum Information (Seefeld, Austria, June 26 - July 1) (**invited oral presentation**); 619th WE-Heraeus-Seminar: Quantum Speed Limits (Bad Honnef, Germany, June 8-10) (**invited oral presentation**); 4th International Conference on the Nature and Ontology of Spacetime (Varna, Bulgaria, May 30-June 2) (**oral presentation**); Testing Quantum Gravity (TQC) (Torino, May 26-27) (**invited oral presentation**); Pint of Science (Pavia, May 24) (**public outreach**); Symposium on quantum information and foundations of physics KCIK (Sopot, Poland, 19-21 May) (**invited oral presentation**); Mini-course at the University of Jordan in the Erasmus Plus “staff mobility for teaching” program (Amman, Jordan, 15-21 April) (**international school**); Recent advances in quantum metrology, RAQM16 (Warsaw, Poland, March 2-4) (**invited oral presentation**); Winter school in Signagi, Erasmus Plus “staff mobility for teaching” program (Signagi, Georgia, 2-9 February) (**international school**).
- 2015: Quantum Information Processing and Applications (QIPA-2015) (Allahabad, India, 3-11 December) (**invited oral presentation**); International Conference on Quantum Foundations ICQF15 (Patna, India, 1-4 December) (**invited keynote presentation**); Ciclo di conferenze “Seramente” (Grugliasco, 12 November) (**invited public outreach seminar**); MEDiT Health innovation (Vicenza, 28-29 October) (**invited oral presentation via teleconference**), shared with Prof. D’Ariano and Dr. Stopazzolo M.D.); Time Machine Factory 2015 TM2015 (Torino, 25-28 October) (**invited oral presentation plus invited public outreach talk**); Quantum UnConference QUC15 (Menesjärvi, Finland, 15-18 October) (**invitation to the meeting**); Notte Europea dei ricercatori (Pavia, September 21) (**public outreach seminar**); Workshop on Time in Physics (ETH Zurich,

September 7-11) (**invited oral presentation**); 1 month research visit to MIT, thanks to the “Progetto Pavia-Boston” of the University of Pavia (Cambridge MA, USA, August 10-September 4); Second Bucharest School on Quantum Technologies, SpaceTech (Bucharest, Romania, June 30- July 3) (**invited lecture series**); Q+ hangout seminar (internet-distributed seminar based on Google Hangouts organized by D. Burgarth and M. Leifer, June 9) (**invited oral presentation**); 589 WE-Heraeus-Seminar: Continuous Variable Entanglement in Atomic Systems: Fundamentals and Applications (Bad Honnef, Germany, May 11-15) (**invited oral presentation**); Quantum Physics Of Nature, QUPON 2015 (Vienna, May 18-22).

- 2014: Workshop on Quantum Metrology, Interaction, and Causal Structure, (Tsinghua University, Beijing, China, December 1-5) (**invited oral presentation**); Public outreach seminar (> 300 attendees) at the “Festival della Scienza di Genova”, (Palazzo Ducale, Sala del Maggior Consiglio, Genova, Oct. 27) (**invited public outreach seminar**); one-day workshop on Quantum Technology – Quantum Expo 14/15 (Milano, Oct. 3) (**invited oral presentation**); 7th Italian Quantum Information Science Conference (IQIS-2014) (Salerno, Sep. 15-19) (**invited oral presentation**); Sharif University (Tehran, Iran, September 2) (**Invited oral presentation**); International Iran Conference on Quantum Information, IICQI14 (Esfahan, Iran, September 5-11) (**invited keynote speaker**); Advances in Foundations of Quantum Mechanics and Quantum Information with atoms and photons (Torino, May 26-30) (**invited oral presentation**); Institut für Theoretische Physik, Universität Innsbruck, (Innsbruck, August 4) (**invited oral presentation**).
- 2013: 6th Italian Quantum Information Science Conference (IQIS-2013) (Como, September 24-29) (**invited oral presentation and public outreach talk**); Quantum information seminar in Hiroshima (Hiroshima University, August 10-14) (**invited oral presentation**); International workshop on New Science and Technologies using Entangled Photons (NSTEP) (Osaka, Japan, 8-9 August) (**invited oral presentation**); *Quantum Information Benasque workshop* (Benasque, Spain, June 29-August 6); Twin Workshop on Complex Quantum Systems (Ackergill Tower, Wick, Scotland 27-30 May) (**invited oral presentation**); Seminar at the Quantum Information Group of the Universitat Autònoma de Barcelona (UAB), (Bellaterra, Spain, May 21) (**invited oral presentation**); Multiweek invitation for the “Control of Complex Quantum Systems” program at the Kavli Institute for Theoretical Physics (Santa Barbara, CA, USA, Jan 26-Feb 22) (**invited oral presentation**).
- 2012: First NASA Quantum Future Technologies Conference (Mountain View, CA, USA, Jan 17-21) (**invited oral presentation**); Quantum 2012, *Advances in Foundations of Quantum Mechanics and Quantum Information with atoms and photons* at INRIM (Torino, May 21-25) (**invited oral presentation**); *Central European Workshop on Quantum Optics 2012 (CEWQO12)* (Sinaia, Romania, July 2-6) (**oral presentation**); Quantum Communication, Measurement and Computing 2012 (QCMC12) (Vienna, Austria, July 30-August 3); 3rd COQUIT Workshop (ISI, Torino, Sep. 11-12) (**invited oral presentation**); Sources and signatures of quantum enhancements in technology at the Royal Society at Chicheley Hall (Chicheley, Sep. 13-14) (**invited oral presentation**); Sixth International Workshop DICE2012 (Castiglione, Italy, Sep. 17-21) (**oral presenta-**

- tion); 5th Italian Quantum Information Science Conference (IQIS-2012) (Padova, Sep. 26-28) (**invited oral presentation**); TM2012 (Torino, Oct. 14-20) (**invited oral presentation and public outreach seminar**).
- 2011: Seminar at INRIM (Torino, May 12) (**invited oral presentation**); *Difficult Problems in Quantum Information Theory (2011 xQIT conference)* (Cambridge MA, May 3-4) (**invited oral presentation**); Entanglement, Quantum information and the Quantum-to-classical transition (Accademia dei Lincei, Roma, May 5-7); PhD cycle of lectures on quantum information and computation (Padova, Italy, April-May) (**invited oral presentation**); International Conference on Quantum Optics and Quantum Computing IC-QOQC11 (Noida, India, March 22-26) (**invited oral presentation**); First International Workshop on High Dimensional Entanglement (Como, June 20-24) (**oral presentation**).
- 2010: Quantum Coherence and Decoherence workshop (Benasque, Spain, September 6-17) (**oral presentation**); CQuIC Seminar at UNM (Albuquerque, September 2) (**invited oral presentation**); PIQuDos seminar at the Perimeter Institute for Theoretical Physics (Waterloo, Canada, April 28) (**invited oral presentation**); BBN Technologies Corporation (Cambridge, MA, April 20) (**invited oral presentation**); Chalmers University of Technology, Linnaeus Colloquium (Göteborg, Sweden, March 4) (**invited oral presentation**); Nagoya Winter Workshop on Quantum Information, Measurement, and Foundations (Nagoya, Japan, February 18-24) (**invited oral presentation**); Los Alamos National Laboratory, quantum lunch seminar series (Los Alamos, NM, February 3) (**invited oral presentation**); Los Alamos National Laboratory, quantum lunch seminar series (Los Alamos, NM, January 27) (**invited oral presentation**).
- 2009: Amherst College Physics Colloquium (Amherst, MA, December 3) (**invited oral presentation**); Aspuru-Guzik Group meeting seminar, Harvard university (Cambridge, MA, October 14) (**invited oral presentation**); Seminar at IFISC (Palma de Mallorca, Spain, October 1) (**invited oral presentation**); *Intern. Conf. on Quantum Information Processing and Communication (QIPC09)* (Roma, September 21-25); *Quantum Information Benasque workshop* (Benasque, Spain, June 7-17); *Central European Workshop on Quantum Optics 2009 (CEWQO09)* (Turku, Finland, May 23-26) (**oral presentation**); Seminar at ETH in the group of Stefan Wolf, Zürich (Zürich, Switzerland, May 19) (**invited oral presentation**); *Quantum Information and Many body Quantum Systems, QUROPE09 International school* (Cortona, Italy, May 3-8) (**oral presentation**); Seminar at INRIM (Torino, April 2) (**invited oral presentation**); Seminar at Scuola Normale Superiore (Pisa, April 16) (**invited oral presentation**).
- 2008: three weeks invitation at the Massachusetts Institute of Technology for a research project (Cambridge MA, January 6-February 1); *IV workshop ad memoriam of Carlo Novero Advances in Foundations of QM and QI with atoms and photons* (Torino, May 19-23) (**oral presentation**); *Quantum Information and Control In Queensland QICIQ* and *Asia Pacific Conference on Quantum Information Science, APCQIS* (Cairns, Australia, June 30 - July 5) (**oral presentation**); *Joint 5th QPL and 4th DCM Workshops: Quantum Physics and Logic*, satellite workshop of ICALP2008 (Reykjavik, Iceland, July 12-13) (**oral presentation**); *Quantum Communication Measurement and Computing (QCMC) 2008* (Calgary, August, 19-24); *Italian Quantum Information Science Conference 2008 (IQIS08)*

- (Camerino, October, 24-29) (**oral presentation**); *Difficult Problems in Quantum Information Theory (2008 xQIT conference)* (Cambridge MA, November 19-20) (**invited oral presentation**); *Theorie Kolloquium at the ITP* (Innsbruck, December 3) (**invited oral presentation**).
- 2007: three weeks invitation at the Massachusetts Institute of Technology for a research project (Cambridge MA, January 7-February 2); *Quantum Information and Many-Body Quantum Systems* (Pisa, March 26-31) (**oral presentation**); *first Quantumbionet Workshop* (Pavia University, May 25) (**invited oral presentation**); *Vienna Symposium on the Foundations of Modern Physics* (Vienna, Austria, June 7-10); *Quantum Information Benasque workshop* (Benasque, Spain, June 11-20); *Photons, Atoms and Qubits 2007 – PAQ07* (Royal Society, London, United Kingdom, September 2-5); *International Iran Conference on Quantum Information – IICQI* (Kish, Iran, September 7-10) (**invited oral presentation**); *Noise Information & Complexity @ Quantum Scale* (Centro Ettore Majorana, Erice, Italy, November 4-10) (**oral presentation**).
- 2006: *Advances in Foundations of Quantum Mechanics and Quantum Information with atoms and photons*, (Torino, May 2-5) (**oral presentation**); *XI International Conference on Quantum Optics ICQO'2006*, (Minsk, Belarus, May 26-31) (**invited oral presentation**); *Foundations of Probability and Physics-4* (Växjö, Sweden, June 4-9) (**oral presentation**); *QUPREST 2006, Focus meeting: quantum process estimation*, (Budmerice, Slovakia, September 27-October 1) (**invited oral presentation**); *QCM&C 2006* (Tsukuba, Japan, November 28- December 3); Quantum information seminar in Hiroshima (Hiroshima University, December 8) (**invited oral presentation**).
- 2005: *Frisno8, 8th French-Israeli symposium on nonlinear optics* (Ein Bokek, Israel, February 20-25) (**oral presentation**); *Quantum Information Benasque workshop* (Benasque, Spain, June 12-25); *Seminari di Quantum Information* (Milano, October 28) (**invited oral presentation**).
- 2004: *International DFG Workshop on Quantum Entanglement - from Error Correction to Secure Key Distribution* (Hirschegg, Austria, March 30 - April 2) (**invited oral presentation**); *Foundations of Quantum Information* (Camerino, April 16-19); 2nd Workshop ad memoriam of Carlo Novero “Advances in Foundations of Quantum Mechanics and Quantum Information with atoms and photons” (Torino, April 26); *X International Conference on Quantum Optics* (Minsk, Belarus, May 30-June 3) (**invited oral presentation**); *5th European QIPC Workshop* (Roma, September 20-22); *Mini workshop on Quantum Open Systems* (Pavia, Italy, October 25-26). Cambridge, Pisa.
- 2003: *Advances in Quantum Information Processing: from theory to experiment* (Erice, Italy, March 15-22); *8<sup>th</sup> International Conference on Squeezed States and Uncertainty Relations* (Puebla, Mexico, June 9-13); *Third annual MIT/NU MURI workshop* (Cambridge MA, USA, July 10-11); *QIT-EQIS ERATO conference on quantum information science* (Kyoto, Japan, September 2-6) (**oral presentation**); *3<sup>rd</sup> Annual MIT-Cambridge Quantum Information Workshop* (Cambridge MA, USA, October 2-3).



- 2002: *Quantum Information Quantum Entanglement – Euroconference* (San Feliu de Guixols, Spain, March 23-28); *Second annual MIT/NU MURI workshop* (Northwestern University, Evanston IL, USA, 11 April); *IX international conference on quantum optics 2002* (Raubichi, Belarus, May 14-17) (**invited oral presentation**); *II Cambridge-MIT Quantum Information Workshop* (Cambridge, UK, June 13-14) (**oral presentation**); *Progress in Electromagnetics Research Symposium: Quantum computation session* (Cambridge MA, USA, July 5); *QCM&C 2002* (Cambridge MA, USA, July 22-26); *MIT/NU MURI review workshop* (Cambridge MA, USA, October 23); *NASA-DoD workshop on quantum Imaging and Metrology* (Pasadena CA, USA November 14-15) (**invited oral presentation**).
- 2001: *7th International Conference on Squeezed States and Uncertainty Relations ICSSUR2001* (Boston MA USA, June 4-8); *CQO8: 8<sup>th</sup> Rochester Conference on Coherence & Quantum Optics* and *ICQI2001: International Conference on Quantum Information* (Rochester NY USA, June 10-16) (**oral presentation**); *Mysteries, Puzzles and Paradoxes in Quantum Mechanics* (Gargnano Italy, August 27-September 1); *Quantum Optics – EuroConference* (San Feliu de Guixols, Spain, October 06-11).
- 2000: *Seventh central-european workshop on quantum optics* (Balatonfured Hungary, April 28 - May 1); *QCM&C Y2K* (Capri Italy, 3-8 July); *Mysteries, puzzles and paradoxes in Quantum Mechanics* (Gargnano Italy, September 17-23); *Quantum Optics XI – EuroConference* (Palma Spain, October 14-19).
- 1999: *III Adriatico research conference on quantum interferometry* (Trieste Italy, March 1-5); *Fundamental Problems in Quantum Theory Workshop* (Baltimore MD USA, August 9-13).
- 1997: *II Working Party on Quantum Optics and Quantum Computation* (at the Scuola Normale di Pisa, Pisa, June 26-28); *LXXXIII congresso nazionale Società Italiana di Fisica, Congresso del Centenario* (Villa Olmo Como Italy, October 27-31).

## DIDACTICS

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University Courses held:

- Classical electrodynamics and special relativity (“Fisica Generale 2” da 9 CFU), bachelor’s course in the math department.
- Quantum Optics (“Ottica quantistica” da 6 CFU), master course in the physics department.
- Open quantum systems, graduate course for the PhD program in Physics.
- Foundations of quantum mechanics, modulus of the Foundations of Physics bachelor’s course in the physics department.

Thesis advisor:

- Phd: G. D. C. “Non classical states in interferometry” (2008).
- Masters: C. C. R. “Quantum state estimation: direct state measurement vs tomography” (2013).
- Masters: A. A. “Quantum Private Queries in the Presence of Noise” (2015).
- Bachelor: F. P. “Envariance and the emergence of probabilities in quantum mechanics” (2012).

## PROJECTS

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Participation in many research projects. The list of projects financed as a PI (Principal Investigator) follows:

- 2017: Bando per fondo di ricerca Ateneo “Blue Sky Research” for a two-year foundational ‘curiosity driven’ proposal. Funding of 60,000 \$.
- 2015: FQXi’s Physics of What Happens program grant, from the Foundational Questions Institute (a private foundation from the US). Funding of 44,965 \$ for the project “Quantum Spacetime from Events” (<http://fqxi.org/grants/large/awardees/list>); funding for a month-long exchange program at MIT (internal funding competition from the University of Pavia).
- 2014: Fondazione Banca del Monte di Lombardia. Project “A quantum digital universe”: financing of 22.268 Euros for buying hardware (for a theoretical research project!).