

Curriculum Vitae – Filippo Caruso

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Education

- November 1, 2009, Postdoc (EU Marie Curie Fellow),
in Institute of Theoretical Physics,
University of Ulm, Germany
Supervisor: Martin B. Plenio.
- October 1, 2008, Research Associate in Quantum Information Theory,
in Quantum Optics and Laser Science Group,
Department of Physics and Institute for Mathematical Sciences,
Imperial College London, London SW7 2PG, UK.
Supervisor: Martin B. Plenio.
- July 1, 2008, Ph.D. in Physics, Scuola Normale Superiore - Pisa,
with full marks and honours (70/70 cum laude).
Ph.D. Thesis: “Quantum Information transfer over Quantum Channels”.
Supervisors: V. Giovannetti and R. Fazio.
- April 21, 2005, Degree in Physics, Dept. of Physics, Univ. of Catania,
with full marks and honours (110/110 cum Laude).
Thesis: “Optimal Eavesdropping in Quantum Cryptography”,
after a semester in Quantum Information Theory group (Pavia, Italy).
Supervisors: C. Macchiavello, R. Fazio, G. Piccitto.
- July 15, 2005, Diploma of Licenza, Scuola Superiore of Catania
(University School of Excellence for Higher Education),
with full marks and honours (70/70 cum Laude); GPA: 30/30 cum Laude.
Thesis: “Storing Quantum Information via Atomic Dark Resonances”.
Supervisors: F.S. Cataliotti and M. Inguscio.
- July 2000, Diploma di Maturità Scientifica
(high school degree of Scientific studies),
with full marks and honours (100/100 cum Laude); GPA: 30/30 cum Laude.

Research activities

- **Research Interests:** Quantum Information Theory, Quantum Communication and Quantum Optics, Biophysics, Critical Quantum Systems, Quantum Cryptography, Chaos and Complex Systems, Networks, Geophysics, Statistical Mechanics. Referee for American Physical Society (APS), New Journal of Physics (NJP), European Physical Journal (EPJ), Europhysics Letters (EPL), International Journal of Quantum Information, and Physica A (Elsevier).
- In 2008-2009, research activity, as postdoctoral researcher at Imperial College London (UK) in the Quantum Information Science group of M.B. Plenio, on correlated noise and memory effects arising in space and/or in time in quantum information processing and communication. Particularly, we are studying also transport phenomena in biological quantum networks, assisted by noise, in collaboration with A. Chin, A. Datta, S.F. Huelga, and M.B. Plenio. Indeed, we have investigated noise-assisted transport and entanglement dynamics on complex networks to describe the remarkable efficiency (99%) and robustness of excitation energy transfer from the light-harvesting chlorosomes to the bacterial reaction center in biological photosynthetic complexes. These results strongly suggest the possibility for achieving robust and efficient information/energy transfer, assisted by noise, by designing optimized artificial nano-structures for transport, for instance, in solar cells and in quantum information processing.
- In 2005-2008, research activity for my Ph.D. at Quantum Transport & Information (QTI) group, Scuola Normale Superiore (Pisa, Italy), on Quantum Communication and Quantum Information theory, particularly on open quantum systems, quantum (memoryless and memory) channels, quantum capacity issues for Bosonic and qubit channels and related topics. Supervisors: V. Giovannetti and R. Fazio. Moreover, I have worked also about quantum spin chains, critical Bosonic systems and quantum phase transitions, applying the tools of the so-called Nonextensive Statistical Mechanics, in collaboration with C. Tsallis (Rio de Janeiro, Brazil).
- In 2004-2005, research activity for my degree thesis at Quantum Information Theory group (University of Pavia, Italy) on Quantum Cryptography, in collaboration with C. Macchiavello and H. Bechmann-Pasquinucci. We studied the robustness of various quantum key distribution protocols (e.g., which use two mutually unbiased bases of qudits) and we derived analytically the optimal eavesdropping strategies and the security thresholds.
- In 2002-2005, research activity for my Diploma of Licenza, at Quantum Information Laboratory, Scuola Superiore of Catania (Catania, Italy), centered to the theoretical and experimental realization of a quantum state transfer and of a quantum cloning machine based on a realistic atomic three-level scheme, in collaboration with F.S. Cataliotti.
- In 2001-2005, research activity at Chaos And Complexity Theoretical University Study (CACTUS) group, Dept. of Physics (Catania, Italy), with a particular attention to those interdisciplinary aspects of Chaos and Statistical Mechanics related to Complex Systems (e.g., self-organized criticality phenomena and complex networks), in collaboration with A. Rapisarda, V. Latora, A. Pluchino, S. Vinciguerra, B. Tadic, and P. Castorina.

Awards and Memberships

- 2009-2011 EU Marie Curie Fellowship in Inst. of Theo. Phys., University of Ulm, Germany.
- Award (2006) as the best young researcher in Physics in an Italian University by Italian Physical Society.
- “Ettore Majorana” Award (2006) as the best young researcher in Theoretical Physics, in order to commemorate the centennial of the birth of the great Italian physicist E. Majorana.
- PhD Fellowship of Scuola Normale Superiore, Pisa, Italy (2005-2008).
- Member of Italian Physical Society, since 2005.
- University Scholarship of Scuola Superiore of Catania, Italy (2000-2005).

Teaching activity

- In 2008-2009, Interferometry and Holography 2nd Year Laboratory Experiment, Department of Physics at Imperial College London (UK).

Conferences/ Schools/ Visits

- Workshop on Complex Quantum Systems, October 14-15 2010, Palma de Mallorca, Spain - **Invited Talk**.
- Workshop on Quantum Mechanics of biosystems, July 8-9 2010, at the Villa Gualino in Torino, Italy - **Invited Talk**.
- Workshop on Transport in Complex Quantum Systems, July 5-7 2010, Novara, Italy - **Invited Talk**.
- CAMEL6, Workshop on Control of Quantum Dynamics of Atoms, Molecules and Ensembles by Light, June 2010, Varna, Bulgaria - **Invited Talk**.
- Visit to Department of Chemistry and Chemical Biology in Harvard University (Prof. A. Aspuru-Guzik), June 2010, Cambridge, MA, USA.
- Visit to Center for Extreme Quantum Information Theory (Prof. S. Lloyd) and to ENI-MIT Solar Frontiers Center, Massachusetts Institute of Technology (MIT), June 2010, Cambridge, MA, USA.
- QuEBS 2010, Workshop on Quantum Effects in Biological Systems, 17-20 June 2010, at Harvard University in Cambridge, MA, USA - **Talk**.
- Quantum 2010, V Workshop ad memoriam of Carlo Novero, Advances in Foundations of Quantum Mechanics and Quantum Information with atoms and photons, and 3rd Italian Quantum Information Science Conference IQIS 2010, May 2010, Torino, Italy - **Talk**.
- Workshop on Quantum Information Theory and Complex Systems, May 2010, Reims, Germany - **Invited Talk**.

- Invited visit to the European Laboratory for Non-linear Spectroscopy (LENS) for a scientific collaboration with Prof. M. Inguscio, December 2009, Florence, Italy - **Invited Talk**.
- QIPC 2009, International Conference on Quantum Information Processing and Communication, September 2009, Rome, Italy - Poster.
- QuEBS 2009, Workshop on Quantum Effects in Biological Systems, July 2009, Lisbon, Portugal - Poster.
- 4th Feynman Festival and 11th International Conference on Squeezed States and Uncertainty Relations, International conference, June 2009, Olomouc, Czech Republic - Talk.
- QUROPE09 International School on Quantum Information and Many-Body Systems, May 2009, Cortona, Italy - Talk.
- Invited visit to Dept. of Physics, Univ. of Catania, April 2009, Catania, Italy - **Invited Talk**.
- IMA conference on Quantum Computing and Complexity of Quantum Simulation, Institute for Mathematical Sciences, Imperial College London, April 2009, London, UK.
- Workshop on Quantum Information and Graph Theory, University of Hertfordshire, March 2009, Hertfordshire, UK - **Invited Talk**.
- Invited visit to Centre for Quantum Technology (Prof. F. Petruccione), University of KwaZulu-Natal, February 2009, Durban, South Africa - **3 Invited Talks**.
- QUOXIC (QUantum OXford Imperial College) meeting, Oxford University Computing Lab, December 2008, Oxford, UK.
- Italian Quantum Information Science Conference (IQIS2008), October 24-29, 2008, Camerino (Macerata), Italy - Poster.
- Invited visit to Center for Extreme Quantum Information Theory (Profs. S. Lloyd, J.H. Shapiro), Massachusetts Institute of Technology (MIT), April 2008, Cambridge, MA, USA - **Invited Talk**.
- Invited visit to Quantum Information Theory group (Prof. M.B. Plenio), Imperial College London, March 2008, London, UK - **Invited Talk**.
- International Conference on Noise, Complexity & Information @ Quantum Scale, November 4-10, 2007, Erice (Trapani), Italy - Poster.
- Oral Communication, "Bosonic and Qubit Gaussian channels", XCIII Congress of Italian Physical Society, September 24-29, 2007, Pisa, Italy.
- Summer School 2007, Scuola Superiore di Catania, August 27 - September 1, 2007, Catania, Italy - Expository Talk.
- XXIII IUPAP International Conference on Statistical Physics Statphys23, July 9-13, 2007, Genova, Italy - 2 Posters.
- International Conference on Complexity, Metastability and Nonextensivity, satellite conference of StatPhys23, July 1-5, 2007, Catania, Italy - **Invited Talk**.

- Taming the Quantum World conference: the 7th Canadian Summer School on Quantum Information, 4th Canadian Quantum Information Students' Conference, Theory and Realization of Practical Quantum Key Distribution, May 27 - June 14, 2007, Institute for Quantum Computing (IQC) and Perimeter Institute for Theoretical Physics (PI), Waterloo (Ontario, Canada) - Talk (<http://pirsa.org/07060004>) and Poster.
- Workshop on Quantum Information and Many-Body Quantum Systems, March 26-31, 2007, Centro di Ricerca Matematica Ennio de Giorgi di Scuola Normale Superiore, Pisa, Italy - Poster.
- Invited visit to the Centro Brasileiro de Pesquisas Fisicas (CBPF) for a scientific collaboration with Prof. C. Tsallis, February 2007, Rio de Janeiro, Brazil - **Invited Talk**.
- Summer School on Scalable Quantum Information Processing and Computing (FP6 Integrated Project SCALA) and Workshop on Quantum-Classical Transition and Quantum Information (organized by Los Alamos National Laboratory), June 11-30, 2006, Benasque Center for Science, Benasque, Spain - Poster.
- Invited visit to Dept. of Physics, Univ. of Catania, May 2006, Catania, Italy - **Invited Talk**.
- Oral Communication, "Quantum state transfer in a non-inverted gain medium", XCI Congress of Italian Physical Society, September 26 - October 1, 2005, Catania, Italy.
- 3rd NEXT International Conference: News Expectations and Trends in Statistical Physics, August 13-18, 2005, Kolimbari (Crete), Greece - Talk and Poster.
- International School of Physics "Enrico Fermi", Quantum Computers, Algorithms and Chaos, July 5-15, 2005, Varenna, Italy - Talk.
- Workshop on Quantum entanglement in physical and information sciences, December 14-18, 2004, Scuola Normale Superiore, Pisa, Italy.
- 31st Workshop of International School of Solid State Physics on Complexity, Metastability and Nonextensivity, July 20-26, 2004, Erice (Trapani), Italy - Poster.
- NEXT 2003 - Second Sardinian International Conference, News and Expectations in Thermostatistics NEXT03, September 21-28, 2003, Villasimius (Cagliari), Italy.
- EGS Conference on Nonlinear Processes in Geophysics, April 6-11, 2003, Nice, France - Poster.

Cultural competitions

- National Mathematics Olympiad - Scuola Normale Superiore (Pisa, Italy) and Unione Matematica Italiana; "VI Etneade Matematica" - MATHESES (Catania, Italy), 1999-2000.
- National Physics Olympiad: regional winning participation, in 1996-1997, 1997-1998, 1998-1999. Participation at "Summer School of Physics" (Physics Olympiad Project, Sassoferato, Italy, 1999) and at "XIV Gara Nazionale" (Senigallia, Italy, 2000).
- Chemistry Olympiad (Palermo, Italy, 2000).

Miscellaneous

- Programming languages: Fortran, Java, Pascal, Basic.
- Software: Mathematica, MatLab, OriginPro, MikTeX, Microsoft Office XP.
- Operating system Platforms: Linux, Windows.

Languages: Italian (native speaker), English, French (basic), German (SD1 Goethe level).

List of Publications

1. F. Caruso, N. Spagnolo, C. Vitelli, F. Sciarrino, and M.B. Plenio, “*Experimental simulation of noise-assisted transport in optical cavity networks*”, Eprint arXiv:1008.3398 (2010).
2. F. Caruso, J. Eisert, V. Giovannetti, and A.S. Holevo, “*The optimal unitary dilation for bosonic Gaussian channels*”, Eprint arXiv:1009.1108 (2010).
3. F. Caruso, S.F. Huelga, and M.B. Plenio, “*Noise-enhanced classical and quantum capacities in communication networks*”, Phys. Rev. Lett. (in press), Eprint arXiv:1003.5877 (2010).
4. F. Caruso and H. Kantz, “*Prediction of extreme events in the OFC model on a small world network*”, Eprint arXiv:1004.4774 (2010).
5. F. Caruso, A.W. Chin, A. Datta, S.F. Huelga, and M.B. Plenio, “*Entanglement and entangling power of the dynamics in light-harvesting complexes*”, Phys. Rev. A **81**, 062346 (2010), Eprint arXiv:0912.0122 (2009).
6. A.W. Chin, A. Datta, F. Caruso, S.F. Huelga, M.B. Plenio, “*Noise-assisted energy transfer in quantum networks and light-harvesting complexes*, New J. Phys. **12**, 065002 (2010), Eprint arXiv:0910.4163 (2009).
7. F. Caruso, V. Giovannetti, and M. Palma, “*Teleportation-Induced Correlated Quantum Channels*”, Phys. Rev. Lett. **104**, 020503 (2010), Eprint arXiv:0906.0506.
8. F. Caruso, A.W. Chin, A. Datta, S.F. Huelga, and M.B. Plenio, “*Highly efficient energy excitation transfer in light-harvesting complexes: The fundamental role of noise-assisted transport*”, The Journal of Chemical Physics, **131**, 105106 (2009), Eprint arXiv:0901.4454.
9. F. Caruso, J. Eisert, V. Giovannetti, and A.S. Holevo, “*Multi-mode bosonic Gaussian channels*”, New. J. Phys. **10**, 083030 (33pp) (2008), Eprint arXiv:0804.0511.
10. F. Caruso, V. Giovannetti, C. Macchiavello, and M.B. Ruskai, “*Qubit channels with small correlations*”, Phys. Rev. A **77**, 052323 (2008), Eprint arXiv:0803.3172 (2008).
11. F. Caruso and V. Giovannetti, “*Qubit quantum channel: A characteristic function approach*”, Phys. Rev. A **76**, 042331 (2007), Eprint arXiv:0707.4443.

12. F. Caruso and C. Tsallis, “*Nonadditive entropy reconciles the area law in quantum systems with classical thermodynamics*”, Phys. Rev. E **78**, 021102 (2008), Eprint arXiv:cond-mat/0612032.
13. F. Caruso, V. Giovannetti, and A.S. Holevo, “*One-mode bosonic Gaussian channels: a full weak-degradability classification*”, New J. Phys. **8**, 310 (2006), Eprint arXiv:quant-ph/0609013.
14. F. Caruso and V. Giovannetti, “*Degradability of Bosonic Gaussian Channels*”, Phys. Rev. A **74**, 062307 (2006), Eprint arXiv:quant-ph/0603257.
15. F. Caruso, H. Bechmann-Pasquinucci, and C. Macchiavello, “*Robustness of quantum key distribution with two and three mutually unbiased bases*”, Phys. Rev. A **72**, 032340 (2005), Eprint arXiv:quant-ph/0505146.
16. F. Caruso, I. Herrera, S. Bartalini and F. S. Cataliotti, “*Slow Light amplification in a non-inverted gain medium*”, Europhys. Lett. **69**, 938-944 (2005), Eprint arXiv:quant-ph/0504045.
17. F. Caruso, A. Pluchino, V. Latora, S. Vinciguerra, and A. Rapisarda, “*Analysis of Self-Organized Criticality in the Olami-Feder-Christensen model and in real earthquakes*”, Phys. Rev. E, Rapid Communications **75**, 055101(R) (2007), Eprint arXiv:cond-mat/0606118.
18. F. Caruso, V. Latora, A. Pluchino, A. Rapisarda, and B. Tadic, “*Olami-Feder-Christensen Model on different Networks*”, Eur. Phys. J. B **50**, 243-247 (2006), Eprint arXiv:cond-mat/0509808.
19. F. Caruso and P. Castorina, “*Opinion dynamics and decision of vote in bipolar political systems*”, Int. J. Modern Phys. C Vol. **16**, No. 9, 1473 (2005), Eprint arXiv:physics/0503199.
20. F. Caruso, S. Vinciguerra, V. Latora, A. Rapisarda, and S. Malone, “*Multifractal Analysis of Mt. St. Helens Seismicity as a tool for identifying eruptive activity*”, Fractals Vol. **14**, No. 3, 179-186 (2006), Eprint arXiv:physics/0311049.

Conference Proceedings

21. F. Caruso, A.W. Chin, A. Datta, S.F. Huelga, and M.B. Plenio, “*Noise-assisted transport in biological quantum networks*”, in Proceedings of 4th Feynman Festival and 11th International Conference on Squeezed States and Uncertainty Relations, International conference, June 2009, Olomouc, Czech Republic.
22. F. Caruso and V. Giovannetti, “*A new approach to characterize qubit channels*”, International Journal of Quantum Information **6**, 621 (2008), Eprint arXiv:0802.2822.
23. F. Caruso and C. Tsallis, “*Extensive nonadditive entropy in quantum spin chains*”, as **invited paper** in Proceedings of the Conference CTNEXT07, Complexity, Metastability and Nonextensivity, Catania, Italy, 1-5 July 2007, eds. S. Abe, H.J. Herrmann, P. Quarati, A. Rapisarda and C. Tsallis, American Institute of Physics Conference Proceedings 965 (New York, 2007), p. 51, Eprint arXiv:0711.2641.
24. F. Caruso and V. Giovannetti, “*Bosonic and Qubit Gaussian channels*”, Proceedings of XCIII Italian Physical Society Congress, Pisa, Italy (2007).

25. F. Caruso, A. Pluchino, V. Latora, S. Vinciguerra, and A. Rapisarda, “*Self-Organized Criticality and Earthquakes*”, Proceedings of the Conference CTNEXT07, Complexity, Metastability and Nonextensivity, Catania, Italy, 1-5 July 2007, eds. S. Abe, H.J. Herrmann, P. Quarati, A. Rapisarda and C. Tsallis, American Institute of Physics Conference Proceedings 965 (New York, 2007), p. 281, Eprint arXiv:0711.1750.
26. F. Caruso, I. Herrera, and F.S. Cataliotti, “*Quantum state transfer in a non-inverted gain medium*”, Proceedings of XCI Italian Physical Society Congress, Catania, Italy (2005).
27. F. Caruso, V. Latora, A. Rapisarda, and B. Tadic, “*The Olami-Feder-Christensen Model on a Small World topology*”, Proceedings of 31st Workshop of International School of Solid State Physics: Complexity, Metastability and Nonextensivity (Erice, Italy), eds. C. Beck, G. Benedek, A. Rapisarda, C. Tsallis, The Science and Culture Series Physics (World Scientific, 2005), Eprint arXiv:cond-mat/0507643.