

Biographical Sketch: Giacomo Mauro D'Ariano

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Education Laurea in Physics (Solid State) (1978), University of Pavia, Italy (Advisor: F. Borsa)
Scuola di Perfezionamento in Polymer Science, Politecnico di Milano, 1979 (Advisor: A. Pavan).
Research training: NMR, Phase transitions and Magnetic Systems, 1980-1982 (Advisor: A. Rigamonti); Statistical Mechanics, Group Theory, Integrable Systems, 1982-84 (Advisor: M. Rasetti)

Employment

2000-present Leader, *QUIT* (Quantum Information Theory Group) of the University of Pavia, Italy

2000-present Full professor, Dipartimento di Fisica “A. Volta”, University of Pavia, Italy

1992-2000 Associate professor, Dipartimento di Fisica “A. Volta”, University of Pavia, Italy

1984-1992 University Researcher, Dipartimento di Fisica “A. Volta”, University of Pavia, Italy

Other Institutional activities

2000-present Member of Center for Photonic Communication and Computing, ECE Department, Northwestern University, Evanston, IL

Honors, fellowships and awards

Corresponding Member of the Lombard Academy of Sciences and Letters; Alumnus Almo Collegio Borromeo of Pavia (1974-80); Fellowship in *Polymer Science* Politecnico di Milano (1978-79); Research fellowship, Pavia University (1979-80). Two INFN Excellences 1998; INFN Highlight 2000-01. Fellow, Optical Society of America.

Main accomplishments

He started Quantum Optics and Quantum Information at Pavia University, where he founded the *Quantum Information Theory Group* (QUIT). He contributed to the advancement of Quantum Mechanics, conceiving and developing the popular tomography method for quantum states for general quantum systems, and ideating the first feasible method for experimental characterization of quantum devices. With his young school he introduced the method of quantum combs, along with many optimal quantum protocols and measurement setups (including the optimal quantum broadcasting and the optimal phase estimation for mixed states). He derived the mathematical structure of Quantum Mechanics from five operational axioms, and, recently, in collaboration with his disciples G. Chiribella and P. Perinotti, he closed his axiomatization program with a first derivation of Quantum Theory from information-theoretic principles.

Invited stages, visiting scholar, and visiting professor

[m=month, w=week] Institut des Hautes Études Scientifiques of Bur sur Ivette, Paris (1984 3m: L. Michel); Center for Nonlinear Studies, Los Alamos, New Mexico (1987 1w: M. M. Nieto and D. Campbell); Arbeitsgruppe “Nichtklassische Strahlung” der Max-Planck-Gesellschaft an der Humboldt-Universität zu Berlin (1994 1m: H. Paul); Department of Electrical and Computer Engineering, Northwestern University, Evanston IL (1994 2m, 1995 4m, 1996 4m: H. P. Yuen; 1997 3m, 1998 2m: P. Kumar; 2000 3m, 2001 5m, 2002 4m, 2003 4m, 2004 4m, 2005 2m, 2006 1m: H. P. Yuen: since then rvisiting professor regularly for one up to three monts every year). Department of Physics and Astronomy, University of Missouri-Columbia (1991 2w: B. DeFacio); Department for Physics and Astronomy, University of New Mexico (1993 1w: C. Caves); Graduate School of Human Informatics, Nagoya University, Japan (1993 1w: M. Ozawa); Abteilung für Quantenphysik, Universität Ulm (1994 1w W. Schleich); Max-Planck, Munich (1995 1w: H. Walther); Friedrich Schiller University di Jena, Theoretical Physics Institute (1997 1w: D. Welsch); University of Oxford (1998 1w: A. Ekert); Department of Physics, University of Maryland at Baltimore County, (1998 1w, 1999 1w, 2000 1w: Y. Shih, M. Rubin); Department of Mathematics, University of Stuttgart (2001 1w: B. Kummerer) EURANDOM, Oberwolfach 2001 1w, Benasque (2000 3w, 2003 3w, 2005 3w), Eindhoven (2003 1w: R. Gill), Oberwolfach 2005 1w, School of Mathematical Sciences University of Nottingham (2003 1w: S. Belavkin), Tohoku University Sendai Japan (2005 1w: M. Ozawa) ERATO Tokyo (2006 1w: M. Hayashi).

Funded Research Projects

INFN Advanced Research Projects (PRA): (1997-00) *Generation and detection of quantum mesoscopic surpositions in parametric media (CAT)*; (2002-) *Quantum Teleportation and Quantum Cloning by the Optical Parametric Squeezing Process (CLON)*; INFN PAIS Projects: (1999-00) *Study of correlations and state reduction in cw and pulsed parametric devices by self homodyne techniques (TWIN)*; Italian Ministry of University and Research Projects: (1997-98) *Amplification and Detection of Quantum Information*, (1999-00) *Quantum Information Transmission and Processing: Quantum Teleportation and Error Correction* (2001-) *Entanglement Assisted High Precision Measurements* (2002-2003) *New Generation of Quantum Measuring Devices for Photon Quantum Information Technology* (2003-2005) *Novel quantum measurements by parametric processes*. (2005-2006) *Broadcasting of Quantum Information and Cryptography*. (2008-) *Quantum Circuits Architecture*. European Community: (2002-) *Active Teleportation and Entangled State Information Technology*, (2009-) *Collective quantum operations for information technologies*.

Institutional and Professional Service

Member of the Steering Committee of *Quantum Information Theory and Quantum Computation* of the European Science Foundation (1999-2002); Member of the Network of Excellence *QUIPROCON* (Quantum Information Processing and Communication) (2000-); **Vice President** of the Steering Committee of the International Conference on Quantum Communication, Measurement and Computing (QCM& C) (1010-); **Co-Chair** of the 2nd International ICST Conference on Quantum Communication and Quantum Networking (2010-); **Principal Organizer**: Working Conference on Quantum Measurements and Open Quantum Systems, Torino, Institute of Scientific Interchanges, 1997; II Working Party on Quantum Optics and Quantum Computation, Scuola Normale di Pisa 1997; Workshop on: Quantum Information Processing and Quantum Communications, Pavia 2004. **Member of the Organizing Committee**: 6th International Conference on Quantum Communication, Measurement, and Computing, MIT, Cambridge, MA, 2002; 5th International Conference on Quantum Communication, Computing and Measurement, Chicago, 1998. **Member of the Advisory Committee**: Foundations of Probability and Physics-6, Vaxjo 2011; Quantum Probability, Information and Control Symposium, Nottingham 2006; 9th ICSSUR, Besançon France 2005; Wigner Centennial Conference, Pecs Hungary 2002; 7th International Conference on Squeezed States and Uncertainty Relations, Boston, MA, 2001; 6-th International Conference on "Squeezed States and Uncertainty Relations" Naples 1999; 5th International Conference on Quantum Communication, Measurement, and Computing, Capri, Italy, 2000. 7th International Conference on Quantum Communication, Measurement, and Computing, Glasgow, UK, 2004. Quantum Optics II, Cozumel in the Mexican Caribbean, 6-9 December 2004. ICSSUR Besançon, France, May 2 to 6, 2005. **Member of Program Committee**: subcommittee "Quantum Optics", EQEC Munich, 2003; Topical meeting on: Quantum Information and Communication, Laser Munich 2001; Topic area: Quantum Optics, CLEO/EUROPE-IQEC Nice 2000. **Editorial Board Member**: Open Systems & Information Dynamics, Journal of Quantum and Semiclassical Optics, (2000-2006). **National Research Project Coordinator**: (1997-98) *Amplification and Detection of Quantum Information*, (1999-00) *Quantum Information Transmission and Processing: Quantum Teleportation and Error Correction* (2001-2002) *Entanglement Assisted High Precision Measurements* (2003-2005) *Novel quantum measurements by parametric processes*. (2005-2006) *Broadcasting of Quantum Information and Cryptography*. (2008-) *Quantum Circuits Architecture*.

Research Interests

Quantum Information and Quantum Mechanics of Measurements and Open Systems. New types of quantum devices: programmable quantum devices. New kinds of quantum measurements. Quantum tomography of states and quantum devices. Quantum communications. Exploiting the quantum entanglement for improving quantum measurements. Logical Foundations of Quantum Mechanics. Foundations of Relativity and Quantum Field Theory. **Additional expertise**: Quantum Mechanics in general, Quantum Optics, Group Theory, Lie algebras, Monte Carlo simulation methods, Statistical Mechanics, Phase transitions, NMR.

Publications: Over 292 papers, including 213 on peer-reviewed journals, 44 articles in hardbound volumes, one highlight, four memories for academy, one coauthored book, one co-edited book, one teaching book (in Italian), one computer book (in Italian), 17 conference papers, 9 preprints

Invited Talks: More than 150 invited talks, seminars, and lectures. Chairman of numerous conference sessions.

Principal Publications in the Past Five Years:

- G. Chiribella, G. M. D'Ariano, P. Perinotti, *Informational derivation of Quantum Theory* (1011.6451 accepted for publication on Phys. Rev. A)
 Giacomo Mauro D'Ariano, Stefano Facchini, Paolo Perinotti, *No-signaling, entanglement-breaking, and localizability in bipartite channels*, Phys. Rev. Lett. **106** 010501 (2011)
 G. M. D'Ariano, *Probabilistic Theories: What is Special about Quantum Mechanics?* in *Philosophy of Quantum Information and Entanglement*, Eds A. Bokulich and G. Jaeger (Cambridge University Press, Cambridge UK 2010) 85-126 (also arXiv:0807.4383)
 G. Chiribella, G. M. D'Ariano, P. Perinotti, *Probabilistic Theories with Purification* Phys. Rev. A **81** 062348 (2010)
 A. Bisio, G. Chiribella, G. M. D'Ariano, S. Facchini, P. Perinotti, *Optimal quantum tomography for states, measurements, and transformations* Phys. Rev. Lett. **102** 010404 (2009)
 G. Chiribella, G. M. D'Ariano, P. Perinotti, *Optimal Cloning of Unitary Transformation* Phys. Rev. Lett. **101** 180504 (2008)
 Giulio Chiribella, Giacomo M. D'Ariano, Paolo Perinotti, *Memory effects in quantum channel discrimination* Phys. Rev. Lett. **101** 180501 (2008)

Other Collaborators

Current: A. Hamma, F. Markopoulou, H. P. Yuen, P. Kumar, F. De Martini, B. Valiron, P. Mataloni, F. Sciarrino, R. Werner, D. Schlingemann, M. Keyl, D. Kretschmann, **Past**: M. Raginski, V. P. Belavkin, R. Demkowicz-Dobrzanski, G. Cassinelli, E. De Vito, R. Gill, N. Cerf, M. Roetteler, L. Kauffman, A. Ekert, M. Mosca, W. van Dam, B. Kummerer, D. Bruß, M. Lewenstein, J. Kahn, A. Andreoni, M. Bondani, A. Levero, A. Porzio, S. Solimeno, P. Tombesi, S. Mancini, M. Fortunato, S. L. Braunstein, G. J. Milburn, M. Rubin, Y. Shih, A. Garuccio, K. Banaszek, M. Vasilyev, V. I. Man'ko, U. Leonhardt, H. Paul, R. Schack, C. M. Caves, S. Moroni, L. R. Evangelista, M. Saraceno, B. DeFacio, R. Bonifacio, M. Rasetti, A. Montorsi, M. Vadamchino, J. Katriel, A. Solomon, L. Michel **Occasional**: G. A. Barbosa, C. Agnes, C. Buzano, L. Benni, C. Marchetti, S. Aldovrandi. **Only coauthors**: A. Sen(De), U. Sen, S.-K. Choi, M. B. Plenio, S. Bose, D. Jonathan, M. De Laurentis, H. Maassen, E. Corndorf, G. Di Giuseppe, A. Mazzei, M. Ricci, T.-G. Noh, P. Voss, A. P. Bonoldi, E. Castellaro, R. Ciapparelli, E. Cima, D. Colombo, M. Maffezzini, R. Dionigi. **Continuing discussion**: M. Ozawa,

Laurea, PhD, and Postdoctoral Supervision, Contract Sponsor

Laurea Thesis: L. Bertolini (1981/82), A. Cavalli (1984/85), G. Onida (1986-87), N. Sterpi (1986/87), R. Paoletti (1987/88), R. Simonelli (1991/92), R. Seno (1991/92), A. Zucchetti (1993/94), G. Orfino (1993/94), M. Sacchi (1994/95), L. Maccone (1995/96), M. Painsi (1997/98), M. Cinchetti (1998/99), P. Perinotti (1998/99), P. Scudo (1999/00), P. Lo Presti (1999/00), B. Falabretti (2001/02), R. Mecozzi (2001/02), F. Buscemi (2001/02), G. Chiribella (2002/03), P. Albini (2003/2004), D. Magnani (2005/2006), S. Bronzin (2004-), S. Facchini (2006/07), A. Bisio (2006/07), A. Tosini (2008/9) **PhD Thesis**: C. Macchiavello (1992-94), M. Paris (1992-94), R. Seno (1994-96), M. Sacchi (1996-98), L. Maccone (1997-99), P. Lo Presti (2001-03), F. Buscemi

(2003-05), G. Chiribella (2004-06), G. De Cillis (2005-2004), D. Magnani (2006-2008), M. Dall'Arno (2009-) A. Tosini (2010-) M. Zaopo (2010-) **Postdoctoral Fellows:** N. Sterpi (1994-95,97-98), M. Paris (1996-01), C. Macchiavello (1997-98), M. Sacchi (1998-01), L. Maccone (2000-01), P. Perinotti (2002-), G. Chiribella (2006-2010), A. Bisio (2010-), S. Facchini (2010-), M. Sedlak (209-). **Long-term contract Sponsor:** M. Sacchi (2001-2009), O. Rudolph (2001-2004), M. Keyl (2004-2005), L. Maccone (2004). **Monthly contracts :** K. Banaszek (1999), Th. Richter (2000), D. Schlingeman (2006)

Teaching Activities

Foundations of Quantum Mechanics (2006-, II level Phys.), *Physical Theory of Information* (2004-, II level Phys.), *Quantum Optics* (2004-, I and II levels Phys.), *Quantum Systems and Information* (2000-2003, Laurea, Phys.), *Quantum Optics* (1992-1999, Laurea, Phys.), *Structure of Matter* (1997-98, Laurea, Phys.), *Solid State Theory* (1991-92, Laurea, Phys.), *Seminars in Statistical Mechanics* (1984-99, Laurea, Phys.), *Quantum Stochastic Methods in Quantum Optics* (1990-91, PhD, Phys.), *Structure of Matter: lecturer* (1984-94, Laurea, Phys.), *General Physics: lecturer* (1983-84, Laurea, Biology) *Physics Lab: lecturer* (1979-80, Laurea, Medicine), *Polymer Science: seminars on Creep Fracture* (1978-79, Laurea, Engineering)

International Schools

College on Representation Theory of Lie Groups, Trieste ICTP. 1985; *Summer School attributed to the Memory of Prof. A. O. Barut*, Ankara 1995 (two series of lectures); *6th Volterra-CIRM International School on Quantum Information: Filtering and Control*, Levico terme 2004

Professional Societies:

Società Italiana di Fisica, Optical Society of America