

Curriculum vitae – Irene Marzoli

CONTACTS

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EDUCATION

- Ph.D. in Physics, University of Milano (Italy), October 1996.
Thesis: “Quantum spatial effects in non-linear optical cavities with spherical mirrors” (*Effetti quantistici spaziali in cavità ottiche non-lineari a specchi sferici*). Advisor: Prof. Luigi A. Lugiato.
- M.S. in Physics (*Laurea Summa cum Laude*), University of Camerino (Italy), July 1992.
Thesis: “Quantum non-demolition measurements in a Penning trap” (*Misure quantistiche non-distruttive in una trappola di Penning*). Advisor: Prof. Paolo Tombesi.

PROFESSIONAL EXPERIENCE

From 11/1998 to present Assistant professor (*Ricercatore universitario*) at the University of Camerino (Italy), Department of Physics.

From 06/1996 to 10/1998 Postdoctoral fellow (*Wissenschaftliche Angestellte BAT/IIa*), University of Ulm (Germany), Abteilung für Quantenphysik. Research advisor: Prof. Wolfgang Schleich.

09/1998 Visiting scientist, The Johns Hopkins University (Baltimore, USA), Electrical and Computer Engineering Department. Collaboration with Prof. Alexander Kaplan.

09/1997 Visiting scientist, Weizmann Institute of Science (Rehovot, Israel), Chemical Physics Department. Collaboration with Prof. Gershon Kurizki.

From 02/1993 to 09/1993 Graduate research assistant, Joint Institute for Laboratory Astrophysics at Boulder (Colorado, USA). Research Advisor: Prof. Peter Zoller.

From 11/1992 to 05/1996 Graduate research assistant, University of Milano (Italy), Department of Physics.

RESEARCH INTERESTS

- Quantum information processing with trapped electrons;
- Quantum information channels with long-range interacting spin chains;
- Wavepacket dynamics;
- Quantum and non-linear optics;
- Laser cooling of trapped ions;
- Quantum non-demolition measurements.

INVITED SEMINARS

16/12/2005 University of Bari (Italy), Department of Physics, “Towards a quantum computer with trapped electrons.”

29/11/2005 University of Ulm (Germany), Institut für Quanteninformationsverarbeitung, “Quantum computing with trapped electrons.”

17/06/2004 Johannes-Gutenberg-University, Mainz (Germany), Atomic, Molecular and Optical Physics Colloquium “Trapped electrons in vacuum for a scalable quantum computer.”

30/04/2004 University of Ulm (Germany), Abteilung für Quantenphysik, “Trapped electrons in vacuum for quantum computation”.

24/01/2001 Max-Planck-Institut für Quantenoptik, Garching (Germany), “Realization of a quantum algorithm using a trapped electron.”

INVITED TALKS AT INTERNATIONAL CONFERENCES, WORKSHOPS, AND SCHOOLS

- 1) Italian Quantum Information Science Conference (IQIS 2008), Camerino (Italy), 24-29 October 2008;
- 2) École de Physique Les Houches “*Modern applications of trapped ions*”, Les Houches (France), 19-23 May 2008;
- 3) Workshop on “*Open problems in quantum mechanics*”, Bertinoro (Italy), 3-6 December 2007;
- 4) “*Quantum Mechanics: from fundamental problems to applications*”, Bertinoro (Italy), 4-7 December 2006;
- 5) 3rd Workshop *ad memoriam* of Carlo Novero on “*Advances in Foundations of Quantum Mechanics and Quantum Information with atoms and photons*”, Torino (Italy), 2-5 May 2006;
- 6) AMOP – Frühjahrstagung der Deutschen Physikalischen Gesellschaft, Frankfurt am Main (Germany), 13-17 March 2006;
- 7) MMD - Meeting 2005 “*Matter, Materials and Devices*”, Genova (Italy), 22-25 June 2005;

- 8) Final meeting of the European RTN QUEST on “*Quantum Information with Ions, Atoms, and Photons*”, La Thuile (Italy), 6-12 March 2004;
- 9) Seminar on “*Fundamentals of Quantum Optics V*”, Kühtai (Austria), 16 - 21 January 2000;
- 10) International conference on “*Nonlinear Dynamics and Computational Physics*”, Ahmedabad (India) 18-22 November 1997.

PARTICIPATION TO CONFERENCES AND WORKSHOPS

- 11) QUROPE Workshop “*Quantum/Classical Control in Quantum Information: Theory and Experiments*”, Otranto (Italy), 13-20 September 2008 (contributed talk);
- 12) SCALA “*Scalable Quantum Computing with Light and Atoms*” annual meeting, Paris (France), 22-23 January 2007 (poster);
- 13) SCALA “*Scalable Quantum Computing with Light and Atoms*” Kick Off Meeting, Paris (France), 12-13 January 2006 (poster);
- 14) International Conference on “*New Trends in Quantum Mechanics: Fundamental Aspects and Applications*”, Palermo (Italy), 11-13 November 2005 (poster);
- 15) 5th Quantum Information Processing and Communication Workshop, Roma (Italy), 20-22 September 2004 (poster);
- 16) Quantum Optics EuroConference 2001, San Feliu de Guixols (Spain), 6 -11 October 2001 (poster);
- 17) The Second ESF QIT Conference “*Quantum Information: Theory, Experiment and Perspectives*”, Gdansk (Poland), 10 -18 July 2001 (poster);
- 18) CLEO/EUROPE-EQEC Focus Meetings 2001, Munich (Germany), 18 - 22 June 2001 (contributed talk);
- 19) ACQUIRE meeting, Trento (Italy), 7 - 9 February 2001 (talk);
- 20) Third Annual Meeting of the TMR Research Network on Microlasers and Cavity QED, Schloß Reisenburg (Germany), 13 - 17 October 1999 (talk);
- 21) *Joint Symposium on Quantum Optics*, Innsbruck (Austria) 17-19 March 1997 (talk);
- 22) *Frühjahrstagung der Deutschen Physikalischen Gesellschaft*, Mainz (Germany) 3-6 March 1997 (poster);
- 23) *European Research Conference on Quantum Optics*, Castelvecchio Pascoli (Italy) 21-26 September 1996 (poster);
- 24) *European Research Conference on Quantum Optics*, Davos (Switzerland) 23-28 September 1995 (poster);
- 25) Workshop on “*Dissipation in mesoscopic systems*”, Firenze (Italy) 26-27 March 1992 (talk).

PROFESSIONAL AND ORGANIZATIONAL SERVICE

- Member of the Optical Society of America (OSA).
- Member of the Organizing Committee of the conference on *Scalable Quantum Computing with Light and Atoms*, Cortina d’Ampezzo (Italy), 15-22 February 2009.
- Chair of the University Committee for admission to Ph.D. School (University of Camerino, October 2008).
- Member of the Organizing Committee of the QUROPE Workshop *Quantum/Classical Control in Quantum Information: Theory and Experiments*, Otranto (Italy), 13-20 September 2008.
- From April 2008 to present, Co-ordinator of the University Research Committee (University of Camerino).
- Member of the Physics Committee for Graduate admission (University of Camerino, November 2007).
- Member of the Selection Committee for a position of Technical Staff (University of Camerino, April 2007).
- From January 2006 to present, Member of the Dissemination Committee of Integrated Project FP6 IST Priority *Scalable Quantum Computing with Light and Atoms*
- Expert (proposal evaluator) for the 6th Framework Programma of the European Union, *Information Society Technologies* (IST), *Future and Emerging Technologies* (FET).
- Member of the Organizing Committee of the workshop on *Recent Challenges in Novel Quantum Systems*, Camerino (Italy), 6-8 July 2005.
- Member of the panel for the implementation of *The European Charter for Researchers* and *The Code of conduct for the Recruitment of Researchers* (Commission Recommendation 2005/251/CE) University of Camerino (April - July 2005).
- Member of the Organizing Committee of the Fifth International Conference on *Quantum Communication Measurement & Computing*, Capri (Italy), 3 - 8 July 2000.
- Referee for Physical Review Letters, Physical Review A, The European Physical Journal D, Optics Communications, Proceedings Royal Society London, New Journal of Physics, and Il Nuovo Cimento.

TEACHING EXPERIENCE

Courses taught at the University of Camerino (Italy):

A.Y. 2008/2009 **Classical Mechanics** (90 hours), lower level undergraduate course, requirement for Physics Major (Fisica Generale 1, Corso di laurea in Fisica, classe 25).

A.Y. 2007/2008 **Classical Mechanics** (90 hours) lower level undergraduate course, requirement for Physics Major

(Fisica Generale 1, Corso di laurea in Fisica, classe 25).

A.Y. 2006/2007 **Classical Mechanics** (90 hours), lower level undergraduate course, requirement for Physics Major (Fisica Generale 1, Corso di laurea in Fisica, classe 25).

A.Y. 2005/2006 **General physics with applications to fitness** (60 hours), lower level undergraduate course (Fisica generale ed applicazioni alle metodologie del fitness, Corso di Laurea in Scienze e Tecnologie del Fitness e dei Prodotti della Salute, classe 24).

A.Y. 2005/2006 **Classical Mechanics** (80 hours), lower level undergraduate course, requirement for Physics Major (Meccanica del Punto e Meccanica dei Sistemi, Corso di laurea in Fisica, classe 25).

A.Y. 2004/2005 **Classical Mechanics** (80 hours), lower level undergraduate course, requirement for Physics Major (Meccanica del Punto e Meccanica dei Sistemi, Corso di laurea in Fisica, classe 25).

A.Y. 2003/2004 **Classical Mechanics** (80 hours), lower level undergraduate course, requirement for Physics Major (Meccanica del Punto e Meccanica dei Sistemi, Corso di laurea in Fisica, classe 25).

A.Y. 2002/2003 **Classical Mechanics** (80 hours), lower level undergraduate course, requirement for Physics Major (Meccanica del Punto e Meccanica dei Sistemi, Corso di laurea in Fisica, classe 25).

A.Y. 2001/2002 **Quantum Optics** (40 hours), upper level undergraduate course (secondo modulo di Ottica Quantistica per il Corso di Laurea in Fisica).

A.Y. 2001/2002 **General Physics 1** (60 hours), lower level undergraduate course, requirement for Mathematics Major (Fisica Sperimentale 1 per il Corso di Laurea in Matematica ed Applicazioni).

A.Y. 2000/2001 **Quantum Optics** (40 hours), upper level undergraduate course (secondo modulo di Ottica Quantistica per il Corso di Laurea in Fisica).

A.Y. 2000/2001 **General Physics 1** (60 hours), lower level undergraduate course, requirement for Mathematics Major (Fisica Sperimentale 1 per il Corso di Laurea in Matematica ed Applicazioni).

A.Y. 1999/2000 **Quantum Optics** (40 hours), upper level undergraduate course (secondo modulo di Ottica Quantistica per il Corso di Laurea in Fisica).

A.Y. 1998/1999 **General Physics 2** (60 hours), lower level undergraduate course, requirement for Geology Major (Fisica sperimentale II e Laboratorio di Fisica per il Diploma Universitario di Geologo Tecnico per il Monitoraggio Geoambientale).

Instructor of the following courses held at the University of Camerino:

A.Y. 1999/2000 **General Physics 1**, lower level undergraduate course, requirement for Physics and Mathematics Major (Esercitazioni di Fisica Generale 1 per i Corsi di Laurea in Fisica ed in Matematica).

A.Y. 1998/1999 **General Physics 1**, lower level undergraduate course, requirement for Physics Major (Esercitazioni di Fisica Generale 1 per il Corso di Laurea in Fisica).

SUPERVISION ACTIVITY AND TUTORING

Graduate Students:

- Giulia Gualdi, Ph.D. in Physics at the University of Camerino (April 2008). Co-advised jointly with Paolo Tombesi. Thesis: "Optimal state transfer in long-range interacting spin chains."
- Giacomo Ciaramicoli, Ph.D. in Physics at the University of Rome "La Sapienza" (October 2004). Co-advised jointly with Paolo Tombesi. Thesis: "Quantum Computation with trapped electrons."

Undergraduate Students:

- Paolo Pierangeli, Bachelor in Physics at the University of Camerino (September 2007).
- Antonello Petrucciani, Bachelor in Physics at the University of Camerino (April 2004).
- Silvia Stortini, Master in Physics at the University of Camerino (September 2003). Thesis: "Computazione quantistica con elettroni intrappolati."
- Mauro Fantuzi, Master in Physics at the University of Camerino (April 2002). Thesis: "Moto quantistico di due elettroni in una trappola di Penning."

- Oliver M. Friesch, Master in Physics at the University of Ulm, Abteilung für Quantenphysik (June 1998). Co-advised jointly with Wolfgang Schleich. Thesis: “Raum-Zeit-Strukturen in der Quantenmechanik.”
- First-year Physics student advisor at the University of Camerino (from March 2001 to July 2005).

RESEARCH PROJECTS AND GRANTS

- 07/2008 Italian Ministry for Education, University, and Research, €33.000,00
Progetto Lauree Scientifiche – Orientamento e formazione insegnanti. One-year award, local co-ordinator.
- 07/2005 Italian Ministry for Education, University, and Research, €40.678,00
Progetto Lauree Scientifiche – Orientamento e formazione insegnanti. Two-year award, local co-ordinator.
- 11/2005 European Commission, FP6 IST Priority, Integrated Project, contract no. 015714
 SCALA - *Scalable Quantum Computing with Light and Atoms*. Four-year award, member of the group coordinated by Paolo Tombesi.
- 11/2005 European Commission, FP6 IST Priority, Integrated Project, contract no. 015848
 QAP - *Qubit Applications* Four-year award, member of the group coordinated by Paolo Tombesi.
- 03/2005 Italian Ministry for Education, University, and Research, PRIN (Cofin) 2005
Quantum computation with neutral or charged trapped particles. Two-year award, member of the group coordinated by Paolo Tombesi (national co-ordinator Ennio Arimondo, University of Pisa)
- 09/2004 European Commission, FP6 IST Priority, STREP Project, contract no. 003772 €370.000,00
 QUELE - *Quantum Computing with trapped electrons* Four-year award, member of the group coordinated by Paolo Tombesi.
- 03/2004 European Commission, FP6 IST Priority, Research Training Network
 CONQUEST - *Controlled quantum coherence and entanglement in sets of trapped particles*. Four-year award, member of the group coordinated by Paolo Tombesi.

PUBLICATIONS IN PEER-REVIEWED JOURNALS

1. I. Marzoli, P. Tombesi, G. Ciaramicoli, G. Werth, P. Bushev, S. Stahl, F. Schmidt-Kaler, M. Hellwig, C. Henkel, G. Marx, I. Jex, E. Stachowska, G. Szawiola, and A. Walaszyk, “Experimental and theoretical challenges for the trapped electron quantum computer”, *Quantum Information and Computation* (submitted).
2. I. Marzoli, A. E. Kaplan, F. Saif, and W. P. Schleich, “Quantum carpets of a slightly relativistic particle”, *Fortschr. Phys.* **56**, 967 (2008).
3. G. Gualdi, V. Kostak, I. Marzoli, and P. Tombesi, “Optimal state transfer in long-range interacting spin chains”, *Phys. Rev. A* **78**, 022325 (2008).
4. G. Ciaramicoli, I. Marzoli, and P. Tombesi, “Quantum spin models with electrons in Penning traps”, *Phys. Rev. A* **78**, 012338 (2008).
5. G. Ciaramicoli, I. Marzoli, and P. Tombesi, “Spin chains with electrons in Penning traps”, *Phys. Rev. A* **75**, 032348 (2007).
6. G. Ciaramicoli, I. Marzoli, and P. Tombesi, “Qubit decoherence in a nuclear magnetic resonance-like quantum processor with trapped particles”, *Int. J. Mod. Phys. B* **20**, 1699 (2006).
7. G. Ciaramicoli, F. Galve, I. Marzoli, and P. Tombesi, “Array of planar Penning traps as a nuclear magnetic resonance molecule for quantum computation”, *Phys. Rev. A* **72**, 042323 (2005).
8. S. Stortini and I. Marzoli, “Composite pulses for quantum computation with trapped electrons”, *Eur. Phys. J. D* **32**, 209 (2005).
9. G. Ciaramicoli, I. Marzoli, and P. Tombesi, “Trapped electrons in vacuum for a scalable quantum processor”, *Phys. Rev. A* **70**, 032301 (2004).
10. G. Ciaramicoli, I. Marzoli, and P. Tombesi, “Scalable quantum processor with trapped electrons”, *Phys. Rev. Lett.* **91**, 017901 (2003).
11. G. Ciaramicoli, I. Marzoli, and P. Tombesi, “Three-qubit network with a single trapped electron”, *J. Mod. Opt.* **49**, 1307 (2002).
12. M. Berry, I. Marzoli, and W. Schleich, “Quantum carpets, carpets of light”, *Physics World* **14**, 39 (2001).
13. G. Ciaramicoli, I. Marzoli, and P. Tombesi, “Realization of a quantum algorithm using a trapped electron”, *Phys. Rev. A* **63**, 052307 (2001).
14. R. Bonifacio, I. Marzoli, and W.P. Schleich, “Non-dissipative decoherence for quantum carpets”, *J. Mod. Opt.* **47**, 2891 (2000).
15. A. Gatti, K. I. Petsas, I. Marzoli, and L. A. Lugiato, “Investigation of spatial Einstein-Podolski-Rosen aspects in the degenerate optical parametric oscillator”, *Opt. Commun.* **179**, 591 (2000).

16. O. M. Friesch, I. Marzoli, and W. P. Schleich, “Quantum carpets woven by Wigner functions”, *New J. Phys.* **2**, 4 (2000).
17. A. E. Kaplan, I. Marzoli, W.E. Lamb, Jr., and W.P. Schleich, “Multi-mode interference: highly regular pattern formation in quantum wave packet evolution”, *Phys. Rev. A* **61**, 032101 (2000).
18. D. Bouwmeester, I. Marzoli, G.P. Karman, W. Schleich, and J. P. Woerdman, “Optical Galton board”, *Phys. Rev. A* **61**, 013410 (2000).
19. A. Gatti, L.A. Lugiato, K.I. Petsas, and I. Marzoli, “Spatial Einstein-Podolsky-Rosen aspects in the optical parametric oscillator below threshold”, *Europhys. Lett.* **46**, 461 (1999).
20. I. Marzoli, F. Saif, I. Bialynicki-Birula, O.M. Friesch, A.E. Kaplan, and W.P. Schleich, “Quantum carpets made simple”, *acta physica slovacica* **48**, 323 (1998).
21. L.A. Lugiato, A. Gatti, H. Ritsch, I. Marzoli, and G.L. Oppo, “Quantum images in nonlinear optics”, *J. Mod. Opt.* **44**, 1899 (1997).
22. A. Gatti, H. Wiedemann, L.A. Lugiato, I. Marzoli, G.L. Oppo, and S.M. Barnett, “Langevin treatment of quantum fluctuations and optical patterns in optical parametric oscillators below threshold”, *Phys. Rev. A* **56**, 877 (1997).
23. I. Marzoli, A. Gatti, and L.A. Lugiato, “Spatial quantum signatures in parametric down-conversion”, *Phys. Rev. Lett.* **78**, 2092 (1997).
24. L.A. Lugiato, S. M. Barnett, A. Gatti, I. Marzoli, G.L. Oppo, and H. Wiedemann, “Quantum Images”, *Journal of Nonlinear Optical Physics and Materials* **5**, 809 (1996).
25. L.A. Lugiato, S.M. Barnett, M. Brambilla, A. Gatti, I. Marzoli, G.L. Oppo, F. Prati, M. Stefani, M. Travagnin, and H. Wiedemann, “Nonlinear optical patterns: classical and quantum effects, perspectives for applications”, *Phil. Tran. R. Soc. Lond. A* **354**, 767 (1996).
26. L.A. Lugiato and I. Marzoli, “Quantum spatial correlations in the optical parametric oscillator with spherical mirrors”, *Phys. Rev. A* **52**, 4886 (1995).
27. I. Marzoli, J.I. Cirac, R. Blatt, and P. Zoller, “Laser cooling of trapped three-level ions: designing two-level systems for sideband cooling”, *Phys. Rev. A* **49**, 2771 (1994).
28. I. Marzoli and P. Tombesi, “Quantum non-demolition measurement of cyclotron excitations and wave function collapse”, *Europhys. Lett.* **24**, 515 (1993).

CONTRIBUTIONS TO CONFERENCE PROCEEDINGS AND EDITED VOLUMES

29. G. Gualdi, I. Marzoli, and P. Tombesi, “Spin chains as quantum channels for qubit state transfer”, accepted for *IARIA Proceedings* (2009).
30. I. Marzoli, G. Ciaramicoli, and P. Tombesi, “Spin chains with trapped electrons,” in *Photon Counting Applications, Quantum Optics, and Quantum Cryptography*, edited by Ivan Prochazka, Alan L. Migdall, Alexandre Pauchard, Miloslav Dusek, Mark S. Hillery, Wolfgang P. Schleich, *Proceedings of SPIE Vol. 6583* (SPIE, Bellingham, WA, 2007) 65830X.
31. P. Tombesi and I. Marzoli, “QIP with trapped electrons in vacuum,” in *Quantum Information Processing and Communication in Europe*, eds. T. Van der Pyl and A. Karlson (European Communities, 2005).
32. D. Vitali, G. Ciaramicoli, I. Marzoli, and P. Tombesi, “Quantum computation with electrons in a Penning trap”, (Rochester, NY, 2003).
33. G. Ciaramicoli, I. Marzoli, P. Tombesi, and D. Vitali, “Simple quantum algorithms with an electron in a Penning trap”, in *Proc. of the 1st International Conference on Experimental Implementations of Quantum Computation*, ed. R.G. Clark (Rinton Press, Princeton USA, 2001).
34. A. Gatti, L.A. Lugiato, G.-L. Oppo, S.M. Barnett, and I. Marzoli, “Macroscopic Quantum Effects in Nonlinear Optical Patterns”, in *Proceedings of the International Conference on Macroscopic Quantum Coherence*, eds. E. Sassaroli, Y. Srivastava, J. Swain and A. Widom (World Scientific, Singapore, 1999).
35. I. Marzoli, I. Bialynicki-Birula, O. M. Friesch, A.E. Kaplan, and W.P. Schleich, “The particle in the box: Intermode traces in the propagator”, in *Nonlinear Dynamics and Computational Physics*, ed. V.B. Sheorey (Narosa Publishing House, New Delhi, 1999) pp.135-146.
36. I. Marzoli, O.M. Friesch, and W.P. Schleich, “Quantum carpets and Wigner functions”, in *Proceedings of the Fifth Wigner Symposium*, eds. P. Kasperkovitz and D. Grau (World Scientific, Singapore, 1998) pp. 323-329.
37. A. Gatti, L.A. Lugiato, and I. Marzoli, “Squeezing and EPR paradox in nonlinear optical patterns”, in *Proceedings of the 5th International Conference on Squeezed States and Uncertainty Relations*, eds. D. Han, J. Janszky, Y.S. Kim and V.I. Man'ko (NASA Conference Publication Series NASA/CP--1998--206855, 1998) pp. 169--174.
38. H. Wiedemann, S.M. Barnett, A. Gatti, L.A. Lugiato, I. Marzoli, and G.-L. Oppo, “Numerical simulations of quantum patterns”, in *Quantum Interferometry*, eds. F. De Martini, G. Denardo and Y. Shih (VCH, Weinheim, 1996).
39. L.A. Lugiato, S.M. Barnett, A. Gatti, I. Marzoli, G.-L. Oppo, and H. Wiedemann, “Quantum aspects of nonlinear optical patterns”, in *Coherence and Quantum Optics VII*, eds. J. Eberly, L. Mandel and E. Wolf (Plenum Press, New York, 1996) pp. 5 -14.

40. I. Marzoli and P. Tombesi, “Phase-sensitive backaction measurements in Penning traps: Squeezing the thermal noise”, in *Quantum Interferometry*, eds. F. De Martini, G. Denardo and A. Zeilinger (World Scientific, Singapore, 1994).