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Scuola di Scienze e Tecnologie
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Curriculum Vitae

Irene Marzoli

(last update on February 12, 2015)

Education

10/1996 **Ph.D. in Physics, Università degli Studi di Milano (Italy).**
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.

07/1992 **M.S. in Physics (Laurea Summa cum Laude), Università degli Studi di Camerino (Italy).**
Thesis: "Quantum non-demolition measurements in a Penning trap" *(Misure quantistiche non-distruttive in una trappola di Penning).*
Advisor: Prof. Paolo Tombesi.

Professional experience

11/1998–present **Assistant professor** *(Ricercatore universitario)*, University of Camerino (Italy), School of Science and Technology, Physics Division.

06/1996–10/1998 **Postdoctoral fellow** *(Wissenschaftliche Angestellte BAT/IIa)*, Universität 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, Istrael), Chemical Physics Department. Collaboration with Prof. Gershon Kurizki.

12/1995–05/1996 **Graduate research assistant**, University of Milano (Italy), Department of Physics.

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

Research interests

- **Quantum communication:** quantum channels with long-range interacting spin chains. Entanglement generation and perfect state transfer in ferromagnetic systems.
- **Quantum computation and information:** proposal for a scalable quantum processor with trapped electrons; composite pulses for quantum computation. Design of an effective spin-spin interaction in arrays of trapped electrons; simulation of quantum spin models.
- **Wavepacket dynamics:** Multimode interference and pattern formation in matter wave evolution. The Talbot effect: revivals, fractional revivals, and **quantum carpets**.
- **Quantum and nonlinear optics:** realistic model of a degenerate optical parametric oscillator with spherical mirrors; spatial correlations in the field quadratures and in the intensity fluctuations below threshold. Nonlinear optical patterns: spatial solitons and quantum images. Langevin treatment of quantum fluctuations.
- **Laser cooling:** sideband cooling of trapped particles, design of an effective two-level system suitable for ground-state cooling.
- **Quantum theory of measurement:** methods to counteract the effects of the observation on a quantum mechanical system, quantum non-demolition measurements and back-action evasion schemes. Application of quantum non-demolition measurements to the detection of a single trapped electron.

Invited talks and seminars

2014 *La didattica della Fisica*, Convegno Internazionale "Le vie della pedagogia tra linguaggi, ambienti e tecnologie", Macerata (Italy), 14–15 November 2014;
Dal gatto di Schrödinger al computer quantistico, Scuola Nazionale di Fisica Moderna per Insegnanti di Scuola Secondaria di Secondo Grado, Udine (Italy), 8–11 September 2014;

2013 *Quantum information processing with trapped electrons*, Course on *Ion Traps for Tomorrow's Applications*, International School of Physics "Enrico Fermi", Varenna (Italy), 21-30 July 2013;

2011 *A trapped electron quantum computer?*, Fourth Italian Quantum Information Science Conference 2011, Vietri sul Mare (Italy), 18–20 April 2011;

2008 *Quantum computation with trapped electrons*, Italian Quantum Information Science Conference (IQIS 2008), Camerino (Italy), 24–29 October 2008;
Quantum computation with electrons, École de Physique Les Houches *Modern applications of trapped ions*, Les Houches (France), 19–23 May 2008;

2007 *Spin chains with electrons in Penning traps*, Workshop on *Open problems in quantum mechanics*, Bertinoro (Italy), 3–6 December 2007;
Spin chains with trapped electrons, SPIE Europe *Optics and Optoelectronics*, Prague (Czech Republic), 16–19 April 2007;

2006 *Quantum information processing with electrons in Penning traps*, Workshop on *Quantum Mechanics: from fundamental problems to applications*, Bertinoro (Italy), 4–7 December 2006;
Towards a quantum computer with trapped electrons, 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;
Towards a quantum computer with trapped electrons, AMOP Frühjahrstagung der Deutschen Physikalischen Gesellschaft, Frankfurt am Main (Germany), 13–17 March 2006;

Invited talks and seminars (continued)

2005 *Towards a quantum computer with trapped electrons*, University of Bari (Italy), Department of Physics, December 2005;
Quantum computing with trapped electrons, Universität Ulm (Germany), Institut für Quanteninformationsverarbeitung, November 2005;
Towards a quantum computer with trapped electrons, MMD - Meeting 2005 *Matter, Materials and Devices*, Genova (Italy), 22–25 June 2005;

2004 *Trapped electrons in vacuum for a scalable quantum computer*, Atomic, Molecular and Optical Physics Colloquium, Johannes-Gutenberg-Universität, Mainz (Germany), June 2004;
Trapped electrons in vacuum for quantum computation, Universität Ulm (Germany), Abteilung für Quantenphysik, April 2004;
Trapped electrons in vacuum for a scalable quantum computer, Final meeting of the European RTN QUEST on *Quantum Information with Ions, Atoms, and Photons*, La Thuile (Italy), 6–12 March 2004;

2001 *Quantum computing with trapped electrons*, Max-Plack-Institut für Quantenoptik, Garching (Germany), *Realization of a quantum algorithm using a trapped electron*, January 2001;

2000 *Quantum carpets: muultimode interference in wave packet dynamics*, Seminar on *Fundamentals of Quantum Optics V*, Kühtai (Austria), 16–21 January 2000;

1997 *The particle in the box: Intermode traces in the propagator*, International conference on *Nonlinear Dynamics and Computational Physics*, Ahmedabad (India) 18–22 November 1997.

Participation to conferences and workshops

2013 *Convegno Scientifico sul Piano nazionale per le Lauree Scientifiche*, Città della Scienza (Napoli), 12–13 December 2013 (contributed talk);
3rd Scientific Day of the School of Science and Technology, Camerino (Italy), 12 June 2013 (poster);

2012 ECTI *European Conference on Trapped Ions*, Universitätszentrum Obergurgl (Austria), 9–14 September 2012 (poster);

2011 *1st Scientific Day of the School of Science and Technology*, Camerino (Italy), 8 June 2011 (poster); COST Action *Ion Traps for Tomorrow's Applications*, scientific kick-off meeting, Internationales Wissenschaftsforum Heidelberg (Germany), 23-25 March 2011 (contributed talk);

2009 Italian Quantum Information Science Conference 2009, Scuola Normale Superiore, Pisa (Italy), 5–8 November 2009 (contributed talk);
International Conference on *Scalable Quantum Computing with Light and Atoms*, Cortina d'Ampezzo (Italy), 15–22 February 2009 (poster);

2008 QUROPE Workshop *Quantum/Classical Control in Quantum Information: Theory and Experiments*, Otranto (Italy), 13–20 September 2008 (contributed talk);

2007 SCALA *Scalable Quantum Computing with Light and Atoms* annual meeting, Paris (France), 22–23 January 2007 (poster);

2006 SCALA *Scalable Quantum Computing with Light and Atoms* Kick Off Meeting, Paris (France), 12–13 January 2006 (poster);

2005 International Conference on *New Trends in Quantum Mechanics: Fundamental Aspects and Applications*, Palermo (Italy), 11–13 November 2005 (poster);

Participation to conferences and workshops (continued)

2004 5th *Quantum Information Processing and Communication* Workshop, Roma (Italy), 20–22 September 2004 (poster);

2001 Quantum Optics EuroConference 2001, San Feliu de Guixols (Spain), 6–11 October 2001 (poster);
The Second ESF QIT Conference *Quantum Information: Theory, Experiment and Perspectives*, Gdansk (Poland), 10–18 July 2001 (poster);
CLEO/EUROPE-EQEC Focus Meetings 2001, Munich (Germany), 18–22 June 2001 (contributed talk);
ACQUIRE meeting, Trento (Italy), 7–9 February 2001 (talk);

1999 Third Annual Meeting of the TMR Research Network on *Microlasers and Cavity QED*, SchloßReisensburg (Germany), 13–17 October 1999 (talk);

1997 Joint Symposium on Quantum Optics, Innsbruck (Austria), 17–19 March 1997 (talk);
AMOP Frühjahrstagung der Deutschen Physikalischen Gesellschaft, Mainz (Germany), 3–6 March 1997 (poster);

1996 European Research Conference on *Quantum Optics*, Castelvecchio Pascoli (Italy), 21–26 September 1996 (poster);

1995 European Research Conference on *Quantum Optics*, Davos (Switzerland), 23–28 September 1995 (poster);

1992 Workshop on *Dissipation in mesoscopic systems*, Firenze (Italy), 26–27 March 1992 (contributed talk).

Teaching experience

Courses taught at the University of Macerata (Italy):

A.Y. 2014/2015 **Elements of Physics (58 hours)** – in Italian – undergraduate course *(Elementi di Fisica, Corso di laurea magistrale in Scienze della Formazione Primaria, classe LM-85bis).*

Courses taught at the University of Camerino (Italy):

A.Y. 2014/2015 **Atomic Physics (51 hours)** – in English – upper level undergraduate course *(Corso di laurea magistrale in Fisica, classe LM-17).*

A.Y. 2013/2014 **Electromagnetism (52 hours)** – in English – upper level undergraduate course *(Corso di laurea magistrale in Fisica, classe LM-17).*
Atomic Physics (52 hours) – in English – upper level undergraduate course *(Corso di laurea magistrale in Fisica, classe LM-17).*
Metodi innovativi per la didattica delle scienze (20 hours) – in Italian – graduate course for perspective high school teachers *(Percorso Abilitante Speciale per le classi di concorso A038 Fisica e A049 Matematica e Fisica).*

A.Y. 2012/2013 **Electromagnetism (51 hours)** – in English – upper level undergraduate course *(Corso di laurea magistrale in Fisica, classe LM-17).*
Atomic Physics (52 hours) – in English – upper level undergraduate course *(Corso di laurea magistrale in Fisica, classe LM-17).*

A.Y. 2011/2012 **Electromagnetism (51 hours)** – in English – upper level undergraduate course *(Corso di laurea magistrale in Fisica, classe LM-17).*
Atomic Physics (45) – in English – upper level undergraduate course *(Corso di laurea magistrale in Fisica, classe LM-17).*

Teaching experience (continued)

A.Y. 2010/2011	**Electromagnetism (47 hours)** – in English – upper level undergraduate course *(Corso di laurea magistrale in Fisica, classe LM-17).* **Atomic Physics (42 hours)** – in English – upper level undergraduate course *(Corso di laurea magistrale in Fisica, classe LM-17).*
A.Y. 2009/2010	**Electromagnetism (50 hours)** – in English – upper level undergraduate course *(Corso di laurea magistrale in Fisica, classe LM-17).*
A.Y. 2008/2009	**Newtonian Mechanics (90 hours)**, undergraduate course, requirement for Physics Major *(Fisica Generale 1, Corso di laurea in Fisica, classe 25).*
A.Y. 2007/2008	**Newtonian Mechanics (90 hours)**, undergraduate course, requirement for Physics Major *(Fisica Generale 1, Corso di laurea in Fisica, classe 25).*
A.Y. 2006/2007	**Newtonian Mechanics (90 hours)**, 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).* **Newtonian Mechanics (80 hours)**, undergraduate course, requirement for Physics Major *(Meccanica del Punto e Meccanica dei Sistemi, Corso di laurea in Fisica, classe 25).*
A.Y. 2004/2005	**Newtonian Mechanics (80 hours)**, undergraduate course, requirement for Physics Major *(Meccanica del Punto e Meccanica dei Sistemi, Corso di laurea in Fisica, classe 25).*
A.Y. 2003/2004	**Newtonian Mechanics (80 hours)**, undergraduate course, requirement for Physics Major *(Meccanica del Punto e Meccanica dei Sistemi, Corso di laurea in Fisica, classe 25).*
A.Y. 2002/2003	**Newtonian Mechanics (80 hours)**, 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).* **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).* **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).*

Teaching experience (continued)

Instructor of the following courses:

A.Y. 1999/2000 **General Physics 1**, 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**, undergraduate course, requirement for Physics Major *(Esercitazioni di Fisica Generale 1 per il Corso di Laurea in Fisica).*

Supervision activity and mentoring

Graduate Students:

- Aarouj, Ph.D. candidate in Physics at the University of Camerino.
- Giulia Gualdi, Ph.D. in Physics at the University of Camerino (April 2008). Thesis: *Optimal state transfer in long-range interacting spin chains.* Co-advised jointly with Paolo Tombesi.
- Giacomo Ciaramicoli, Ph.D. in Physics at the University of Rome "La Sapienza" (2002). Thesis: *Quantum computing with trapped electrons.* Co-advised jointly with Paolo Tombesi.

Undergraduate Students:

- Sara Conti, Bachelor in Physics at the University of Camerino (October 2012).
- 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, M.S. in Physics at the University of Camerino (September 2003). Thesis: *Computazione quantistica con elettroni intrappolati.*
- Mauro Fantuzi, M.S. in Physics at the University of Camerino (April 2002). Thesis: *Moto quantistico di due elettroni in una trappola di Penning.*
- Oliver M. Friesch, M.S. in Physics (Diplom) at the University of Ulm, Abteilung fr Quantenphysik (June 1998). Thesis: *Raum-Zeit-Strukturen in der Quantenmechanik.* Co-advised jointly with Wolfgang Schleich.

03/2001–07/2005 • Coordinator of the academic coaching and tutoring for Physics students at the University of Camerino.

Professional and organizational service

01/2011–12/2014 **Vice-Chair** and Italian member of the Management Committee of the COST Action MP1001 *Ion Traps for Tomorrow's Applications* (www.cost-iota.org).

2014 **Reviewer** for the European Commission DG for Communications Networks, Content and Technology of the integrated project *Simulators and Interfaces with Quantum Systems* (grant agreement ICT-FP7-600645-SIQS).

External reviewer of the Ph.D. thesis by Manzoor Ali, submitted at the Department of Electronics, Quaid-i-Azam University (Islamabad, Pakistan).

Professional and organizational service (continued)

2013	**External reviewer** of the Ph.D. thesis by Khalid Naseer, submitted at the Department of Electronics, Quaid-i-Azam University (Islamabad, Pakistan).
	Scientific Director together with Martina Knoop and Giovanna Morigi of the Course on *Ion Traps for Tomorrow's Applications* of the International School of Physics "Enrico Fermi", 21–30 July 2013, Varenna (Italy).
	Evaluator of two short research proposals participating to the call PRIN 2012, funded by the Italian Ministry for Education, University and Research.
	Evaluator of a short research proposal participating to the call "FIRB - Futuro in Ricerca 2010", funded by the Italian Ministry for Education, University and Research.
2012	**External reviewer** for the Italian research assessment exercise (VQR 2004–2010).
	Evaluator of two full proposals for the European Commission's Future and Emerging Technologies Scheme (FET) - Open (FP7-ICT-2011-C).
2011	**Evaluator** of a full proposal for the European Commission's Future and Emerging Technologies Scheme (FET) - Open (FP7-ICT-2011-C).
	Evaluator of two research proposals participating to the call "FIRB - Futuro in Ricerca 2010", funded by the Italian Ministry for Education, University and Research.
	Evaluator of an application for a Post-Doctoral fellowship at the University of Calabria (Italy), in the framework of POR Calabria FSE 2007-2013.
	External reviewer of the Ph.D. thesis by Shahid Iqbal, submitted at the Department of Electronics, Quaid-i-Azam University (Islamabad, Pakistan).
2009	**External reviewer** of the Ph.D. thesis by Rameez-ul-Islam, submitted at the Department of Electronics, Quaid-i-Azam University (Islamabad, Pakistan).
	Guest editor of the special issue of Fortschritte der Physik on *Quanta of Light, Matter, and Information: A Festschrift in honour of Paolo Tombesi*.
	Member of the Organizing Committee of the conference on *Scalable Quantum Computing with Light and Atoms*, Cortina dAmpezzo (Italy), 15–22 February 2009.
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.
01/2006–01/2010	**Member of the Dissemination Committee** of the Integrated Project FP6 IST Priority *Scalable Quantum Computing with Light and Atoms* (SCALA).
01/2005–12/2006	**Expert** (proposal evaluator) for the 6th Framework Programme of the European Union, Information Society Technologies (IST), Future and Emerging Technologies (FET).
2005	**Member of the Organizing Committee** of the workshop on *Recent Challenges in Novel Quantum Systems*, Camerino (Italy), 6–8 July 2005.
2002–	**Member** of the Optical Society of America (OSA).
2000	**Member of the Organizing Committee** of the Fifth International Conference on *Quantum Communication Measurement & Computing*, Capri (Italy), 3–8 July 2000.
1996–	**Referee** for the following international scientific journals: Physical Review Letters, Physical Review A, Physical Review E, New Journal of Physics, The European Physical Journal D, Optics Communications, Proceedings Royal Society London, Journal of Physics B: Atomic, Molecular & Optical Physics, Journal of Mathematical Physics, International Journal of Theoretical Physics, Physics Letters A, and Il Nuovo Cimento.

University service

2014	**Member of the Selection Committee** for the admission to one-year internship (Tirocinio Formativo Attivo) for teaching physics (classe di abilitazione A038 – Fisica) and mathematics and physics (classe di abilitazione A049 – Matematica e Fisica) in Italian high schools.
2013	**Member of the Scientific Committee** for the selection of the five best posters presented during the *3rd Scientific Day of the School of Science and Technology*, 12 June 2013, Camerino (Italy).
2012	**Member of the University Committee** for the selection of a post-doctoral fellow in opto-mechanical systems (School of Science and Technologies, Physics division, University of Camerino). **Member of the Selection Committee** for the admission to one-year internship (Tirocinio Formativo Attivo) for teaching mathematics and physics (classe di abilitazione A049 – Matematica e Fisica) in Italian high schools.
2011	**Member of the University Committee** for the establishment of the Master degree for teaching mathematics, chemistry, physics, and natural sciences in Italian middle schools (Laurea Magistrale classe LM-95 per l'insegnamento di scienze matematiche, chimiche, fisiche e naturali nella scuola secondaria di primo grado).
2010	**Member of the University Committee** for the award of five graduate scholarships to carry on research abroad (University of Camerino).
2009	**Evaluator** of applicants seeking admission to the School of Advanced Studies (University of Camerino). **Member of the University Committee** for the selection of two Post-doctoral fellows (University of Camerino).
2008	**Chair of the University Committee** for admission to Ph.D. School (University of Camerino).
04/2008–10/2011	**Coordinator of the University Research Committee** (University of Camerino).
2007	**Member of the Physics Committee** for admission to Ph.D. School (University of Camerino). **Member of the Selection Committee** for a position of Technical Staff (University of Camerino).
2005–	**Local coordinator** of the national program *Progetto Lauree Scientifiche* to strengthen Physics education programs in Italy, to improve teacher training, encourage more students to pursue science careers and modernize science laboratory classrooms in schools.
2005	**Member** of the working group of the University of Camerino for the implementation of The European Charter for Researchers and The Code of Conduct for the Recruitment of Researchers (Commission Recommendation 2005/251/CE).
03/2001–07/2005	**Coordinator** of tutorship and mentoring service for Physics students at the University of Camerino.

Dissemination, education and public outreach

10/2011–present	**Co-editor** of the monthly Newsletter of the COST Action MP1001 *Ion Traps for Tomorrow's Applications*.
01/2006–12/2010	**Member of the Dissemination Committee** of the FP6-IST Integrated Project SCALA, contract no. 015714, *Scalable Quantum Computing with Light and Atoms*.

Dissemination, education and public outreach (continued)

06/2006 **Participation** to Luciano Onder's scientific talk-show *Explora – La TV delle Scienze*, dedicated to "Light, matter and radiation," produced by RAI Educational and sponsored by the Italian Ministry for Education, University and Research (12 June 2006, RaiEdu2).

01/2005–present **Local coordinator** of Physics outreach activities funded in the framework of *Piano nazionale per le Lauree Scientifiche*, an initiative of the Italian Ministry for Education, University and Research to spread and promote science (chemistry, mathematics, physics and material science) among secondary school students and teachers. Examples of such activities are: public talks and lectures, visiting secondary schools, workshops for students and/or teachers, supporting science exhibits and similar events in collaboration with the Science Museum of Camerino University.