

Marco Bellini

Curriculum vitae et studiorum

1992	M. Sc. degree in Physics at the University of Firenze (110/110 <i>cum laude</i>)
1996	Ph.D. degree in Physics at the University of Firenze
1997-1999	Part of the technical/scientific staff at LENS, Firenze, Italy
1999-2004	Researcher at the INO, Firenze, Italy
2004-2010	Senior Researcher at INO- CNR
2010-now	Research Director at INO-CNR

Currently coordinating two experimental research groups in a collaboration among the Istituto Nazionale di Ottica (INO-CNR), the European Laboratory for Non Linear Spectroscopy (LENS), and the Department of Physics of the University of Firenze. The main focus is quantum optics and laser/matter interactions at very high intensities:

- “VUV-XUV Spectroscopy and Frontier Coherent Sources” group & laboratory;
- “Experimental Quantum Optics” group & laboratory.

Group web page: http://research.ino.it/Groups/extreme_light/

Publications

Co-author of >**150** publications in refereed international scientific journals (2 *Science*, 1 *Nature*, 3 *Nature Photonics*, 15 *Phys. Rev. Lett.*, etc.), in books, and in refereed proceedings and of >**140** conference presentations (**57** invited ones). His papers have been cited about **3000** times and score an **h-index** of **27** according to Scopus and ISI –Web of Science, May 2017 (*total citations >4200 and h-index=32 according to Google Scholar*).

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WoS Researcher ID: J-4990-2013
Google Scholar ID: epMTMUQAAAAJ

Main scientific interests:

- High-precision atomic and molecular spectroscopy and development of novel coherent sources in the far infrared (FIR-THz)
 - Spectroscopy with ultrashort laser pulses and development of novel techniques for high-resolution atomic spectroscopy
 - Development, characterization, and applications of novel coherent sources in the extreme ultraviolet (XUV) based on high-order laser harmonics
 - High-intensity laser-matter interactions and generation of supercontinuum
 - Optical coherence tomography for advanced diagnostics in medicine and for the cultural heritage
 - Quantum Optics: generation, engineering, and characterization of nonclassical states of light for novel quantum technologies
 - Tests of fundamental principles in quantum mechanics: non-classicality, entanglement, nonlocality, commutation rules, etc.
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Main scientific achievements:

During his research activity, Marco Bellini achieved several important results in the above fields. Some of the main ones are reported below:

- 1997 **Demonstration of phase coherence in supercontinuum generation**: fundamental discovery for the generation of trains of phase-locked supercontinuum pulses. It led to the development of frequency combs, later awarded of the 2005 Nobel prize in Physics to Theodor W. Hänsch, co-author of the research.
- 1998 **Demonstration of phase coherence in high-order harmonic generation**: it proved the role of the different electron trajectories in the harmonic generation process and led to the development of attosecond pulses and to the birth of attophysics.
- 2000-2002 **Demonstration of XUV interferometry and high-resolution XUV spectroscopy with high-order harmonics**: it opened the field to the now widespread use of laser harmonic sources for applications in the XUV and soft X-ray regions.
- 2004 **Experimental realization of the photon creation operator**: first implementation of a fundamental quantum process for advanced state engineering and first exploration of the quantum-to-classical transition for light states.
- 2006 **First application of Optical Coherence Tomography to artwork diagnostics**: after this pioneering demonstration in ancient painting analysis, OCT has now become a widespread and privileged tool for cultural heritage diagnostics.
- 2007 **Direct verification of non-commutativity of quantum operators**: the first realization of arbitrary sequences and superpositions of simple quantum operators was a breakthrough for the fundamental understanding of quantum physics and as a new tool for quantum technologies.
- 2011 **Realization of high-fidelity quantum noiseless amplification**: using a non-deterministic scheme for avoiding the addition of quantum noise to the amplification process, it promises more efficient methods for quantum information processing and communication.
- 2012 **Shaping of ultrashort single photons**: thanks to an innovative merge of the fields of ultrafast and quantum optics, it demonstrated the possibility of encoding quantum information in the spectrotemporal mode of quantum light states.
- 2013 **Femtosecond laser writing of graphitic electrodes in diamond**: this new technique holds promise of leading to the realization of 3D diamond detectors for high-energy physics and biomedical applications.
- 2014 **First hybrid quantum/classical entangled states of light**: experimental realization of the optical version of Schrodinger's cat paradox. A fundamental scientific breakthrough and a possible main ingredient of future heterogeneous quantum networks.
- 2015 **Noise-assisted transport in an optical network**: a simple, scalable, and controllable optical fiber cavity network to simulate quantum transport phenomena.
- 2015 **First arbitrary state orthogonalizer and qubit generator**: a "Schrödinger's pet" machine, able to turn a whole zoo of input states into coherent superpositions for innovative quantum technologies and measurement tasks.
- 2016 **Demonstration of zero-area single-photon pulses**: a single broadband photon of extremely short duration can be strongly modulated by interacting with resonant atoms.

Other recent significant achievements and awards:

- 2016-2017 OSA Elected Fellow Member, *“for pioneering contributions in ultrafast, highly nonlinear, and quantum optics. In particular, for his seminal experiments on the coherence of supercontinuum and high-order harmonics and for innovative methods of quantum light state engineering”*
- 2012-2015 Special Visiting Researcher, Brazilian Science Without Borders programme: *“Coherent manipulation of the spectrottemporal mode of quantum light”*
- 2013 Habilitation for First Grade Professorship (Professore di Prima Fascia: Ordinario), in Sector 02/B1 (Experimental Physics of Matter), with a global score of: Excellent (A)
- 2013 Organizer and Chair of the Quantum Information Processing and Communication (QIPC 2013) Conference, 30/06-05/07/2013, Florence, Italy
- 2014 Co-author of a Taylor&Francis handbook on laser-based time and frequency measurements (ISBN 9781439841518)

Main international scientific collaborations:

- Max-Planck-Institut für Quantenoptik, Garching, GERMANY (T. W. Hänsch)
- Lund Institute of Technology, SWEDEN (A. L’Huillier, C.G. Wahlström)
- Centre d’Etudes de Saclay, Gif-sur-Yvette, FRANCE (P. Salières)
- Queen’s University, Belfast, UK (M. S. Kim)
- Universidad Complutense, Madrid, SPAIN (L. Vazquez)
- University of Rostock, GERMANY (W. Vogel)
- Lebedev Physical Institute, Russian Academy of Sciences, Moscow, RUSSIA (V.I. Man’ko)
- Imperial College, London, UK (M.S. Kim)
- University of Olomouc, Czech Republic (J. Fiurasek)
- Université libre de Bruxelles, Brussels, BELGIUM (N. Cerf)
- Seoul National University, Seoul, KOREA (H. Jeong)
- University of Queensland, AUSTRALIA (T.C. Ralph)
- Universidade Federal de Pernambuco, BRAZIL (K. Cassemiro, D. Felinto)

Collaborations with international scientific journals:

As a Topical Editor

- ❖ Optics Letters

As a Referee

- ❖ Science
- ❖ Nature, Nature Physics, Nature Photonics, Nature Communications
- ❖ Physical Review Letters, Physical Review A
- ❖ Optics Letters, Optics Express, JOSA B
- ❖ New Journal of Physics
- ❖ + several others...

Collaborations with industries:

- CSO (Costruzione Strumenti Oftalmici) Firenze: development of an ocular biometer using Optical Coherence Tomography (OCT);
- ENI (Istituto Donegani) Novara: optical simulators of quantum transport in photosynthetic systems

Refereeing and evaluating activities:

- Evaluator for national and international scientific projects (ERC 2017; DFG 2017, Germany; ANR 2012 and 2013, France; Vici NWO 2012, Netherland; Padua University, etc.)
- External referee for national and international PhD theses and scientific grants (Universities of Tel Aviv, Swinburne, Padua, Pisa, Torino, Pierre et Marie Curie - Paris, etc.)
- Member of the selection committee for several research contracts (LENS and INO-CNR) and for permanent researcher positions (CNR call 364.92)

Responsibility in national and international research projects

As a coordinator:

- 2008 CNR RSTL “Sorgenti di fotoni entangled con cristalli nonlineari strutturati per la comunicazione e la crittografia quantistica”
- 2008 Ente Cassa di Risparmio di Firenze “Pettini di luce quantistici”
- 2010 Ente Cassa di Risparmio di Firenze 2010 “Sorgenti di radiazione innovative per regioni spettrali estreme”

As a local responsible:

- 2004-2008 Joint Research Activity JRA-FOSCIL “Frontiers of Optical Science: Controlling Intense Light” within EU-FP6 “LASERLAB-Europe” network
- 2009-2012 Joint Research Activity JRA-ALADIN “Attosecond Laser sources and Applications; Design and Innovation” within EU-FP7 “LASERLAB-Europe-II” network
- 2010-2013 Regione Toscana POR-FESR project “Capacità Tecnologica e Operativa della Toscana per l’Utilizzo dello Spazio - CTOTUS”
- 2010-2014 EU ERA-Net CHIST-ERA project “QSCALE - Quantum technologies for extending the range of quantum communications”
- 2012-2015 Joint Research Activities “INREX” and “EURO-LITE” within EU-FP7 “LASERLAB-Europe-III” network

Conference Organization and Committees:

The Second International Conference on Quantum, Nano, and Micro Technologies (ICQNM 2008)

10-15/02/2008 - Sainte Lucie, Martinique

Technical Program Committee

XVI International Conference on Ultrafast Phenomena (UP2008)

09-13/06/2008 Stresa (Lago Maggiore), Italy

Local Organizing Committee

The Third International Conference on Quantum, Nano and Micro Technologies (ICQNM 2009)

01-06/2/2009 - Cancun, Mexico

Technical Program Committee

11th International Conference on Squeezed States and Uncertainty Relations (ICSSUR) and 4th Feynman Festival (FEYNFEST)

22-26/06/2009, Olomouc, Czech Republic

Program and Advisory committee

The Fourth International Conference on Quantum, Nano and Micro Technologies (ICQNM 2010)

10-16/02/2010 - St. Maarten, Netherlands Antilles

Technical Program Committee

SPIE Optics + Optoelectronics
Quantum Optics and Quantum Information Transfer and Processing
18-21/04/2011, Prague Congress Centre, Prague, Czech Republic
Program Committee

12th International Conference on Squeezed States and Uncertainty Relations (ICSSUR) and 5th Feynman Festival (FEYNFEST)
02-06/05/2011, Foz do Iguaçu, Brazil
International Advisory Board

Fotonica 2012, 14° Convegno Nazionale delle Tecnologie Fotoniche
15-17/05/2012, Florence, Italy
Technical Program Committee

SPIE Optics + Optoelectronics
Quantum Optics and Quantum Information Transfer and Processing
15-18/04/2013, Clarion Congress Hotel, Prague, Czech Republic
Program Committee

Quantum Information Processing and Communication (QIPC 2013)
30/06-05/07/2013, Florence, Italy
Organizer + Chair

Fotonica 2014, 16° Convegno Nazionale delle Tecnologie Fotoniche
12-14/05/2014, Napoli, Italy
Technical Program Committee

SPIE Optics + Optoelectronics 2015
Quantum Optics and Quantum Information Transfer and Processing
13-16/04/2015, Prague, Czech Republic
Program Committee

14th International Conference on Squeezed States and Uncertainty Relations (ICSSUR 2015)
29/06-03/07/2015, Gdańsk, Poland
International Program Committee

Fotonica 2015, 17° Convegno Nazionale delle Tecnologie Fotoniche
06-08/05/2015, Torino, Italy
Technical Program Committee

Top 10 publications:

1) "Quantum-to-classical transition with single-photon-added coherent states of light"

A. Zavatta, S. Viciani and M. Bellini, *Science*, 306, 660-662 (2004)

Cit.#=355 IF= 29.747

2) "Temporal coherence of ultrashort high-order harmonic pulses"

M. Bellini, C. Lyngå, A. Tozzi, M. B. Gaarde, T. W. Hänsch, A. L'Huillier and C. G. Wahlström, *Physical Review Letters*, 81, 297-300 (1998)

Cit.#=257 IF= 7.943

3) "Probing Quantum Commutation Rules by Addition and Subtraction of Single Photons to/from a Light Field"

V. Parigi, A. Zavatta, M.S. Kim, and M. Bellini, *Science*, 317, 1890-1893 (2007)

Cit.#=222 IF= 29.747

4) "Phase-locked white-light continuum pulses: towards a universal optical frequency comb synthesizer"

M. Bellini and T. W. Hänsch, *Optics Letters*, 25, 1049-1051 (2000)

Cit.#=126 IF=3.39

5) "A high-fidelity noiseless amplifier for quantum light states"

A. Zavatta, J. Fiurasek, and M. Bellini, *Nature Photonics*, 5, 52-56 (2011)

Cit.#=105 IF= 29.278

6) "Generation of hybrid entanglement of light"

H. Jeong, A. Zavatta, M. Kang, S. Lee, L.S. Costanzo, S. Grandi, T.C. Ralph, and M. Bellini, *Nature Photonics*, 8, 564-569 (2014)

Cit.#=43 IF=29.278

7) "Adaptive detection of arbitrarily-shaped ultrashort quantum light states"

C. Polycarpou, K. N. Cassemiro, G. Venturi, A. Zavatta, and M. Bellini, *Physical Review Letters*, 109, 053602 (2012)

Cit.#=28 IF=7.328

8) "Experimental demonstration of the bosonic commutation relation via superpositions of quantum operations on thermal light fields"

A. Zavatta, V. Parigi, M.S. Kim, H. Jeong, and M. Bellini, *Physical Review Letters*, 103, 140406 (2009)

Cit.#=78 IF= 7.328

9) "Ramsey-type spectroscopy with high-order harmonics"

S. Cavalieri, R. Eramo, M. Materazzi, C. Corsi and M. Bellini, *Physical Review Letters*, 89, 133002 (2002)

Cit.#=52 IF=7.328

10) "Extreme ultraviolet interferometry measurements with high-order harmonics"

D. Descamps, C. Lyngå, J. Norin, A. L'Huillier, C.-G. Wahlström, J.-F. Hergott, H. Merdji, P. Salières, M. Bellini, and T. W. Hänsch, *Optics Letters*, 25, 135-137 (2000)

Cit.#=74 IF=3.39