Marco Bellini

Curriculum vitae et studiorum

1992	M. Sc. degree in Physics at the University of Firenze (110/110 *cum laude*)
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 Istituto Nazionale di Ottica (INO), Firenze, Italy
2004-2010	Senior Researcher at CNR-INO
2010-now	Research Director at CNR-INO

Leader of an experimental research group of the Istituto Nazionale di Ottica (CNR-INO), in a close collaboration with the European Laboratory for Non Linear Spectroscopy (LENS) and the Department of Physics and Astronomy of the University of Firenze.

Group web page: https://quantumlight.ino.cnr.it

2010-2017 Elected member of the Council of CNR-INO
2017-2023 Head of the Sesto Fiorentino Unit of CNR-INO, the largest unit of the Institute, with about 50 permanent staff and 60 grants and associates.

Publications

Co-author of >**180** publications in refereed international scientific journals (2 *Science*, 1 *Nature*, 3 *Nature Photonics*, 20 *Phys. Rev. Lett.*, etc.), in books, and in refereed proceedings, and of **160** conference presentations (**69** invited + **1** plenary). His papers have been cited about **5100** times and score an **h-index** of **35** (40) according to Scopus (Google Scholar), July 2023.

Scopus Author ID:	7102557978
Orcid ID:	0000-0001-7352-1366
WoS Researcher ID:	J-4990-2013
Google Scholar ID:	epMTMUQAAAAJ

Main scientific interests:

Although the main current interests are in the field of Quantum Optics, in the course of his scientific career MB has been involved in very different experimental activities, ranging from high-precision atomic and molecular spectroscopy in the far infrared, to coherent sources in the extreme ultraviolet. He is an expert in frontier experimental research with ultrashort laser pulses, both in the regime of high-intensity laser-matter interactions, and in that of quantum effects with single-photon-level light intensities.

- Quantum Optics: generation, engineering, and characterization of nonclassical states of light for novel quantum technologies
- Quantum information processing and communication: development of experimental tools and procedures for continuous-variable protocols and field tests of quantum key distribution
- Tests of fundamental principles in quantum mechanics: non-classicality, entanglement, nonlocality, commutation rules, etc.
- 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
- Spectroscopy with ultrashort laser pulses and development of novel techniques for high-resolution atomic spectroscopy

- High-precision atomic and molecular spectroscopy and development of novel coherent sources in the far infrared (FIR-THz)
- Optical coherence tomography for advanced diagnostics in medicine and for the cultural heritage

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Main scientific achievements:

- 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**.

- 1997-1998 **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, for which **Anne L'Huillier, co-author of the research, was awarded the 2023 Nobel prize in Physics**.

- 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.

- 2020 **Entanglement of macroscopic light pulses**: the delocalized addition of a single photon can entangle two separate laser pulses containing an average of up to 60 photons each.

Other 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 spectrotemporal 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
- 2008-now Member of numerous advisory boards and program committees of international scientific conferences
- 2006-now **16** Invited seminars and Colloquia at prestigious international research Institutes
- 2003-now **69** Invited oral presentations + **1** Plenary presentation at international conferences
- 2003-now Numerous popular scientific articles and interviews in the national and international press
- 1997-2005 Key role (explicitly recognized during the Nobel lecture in Stockholm and in numerous interviews in the following years) in the researches that led to the **2005 Nobel Prize in Physics to T. W. Hänsch**
- 1997-2000 Involvement in the researches leading to the **2023 Nobel Prize in Physics to A. L'Huillier**

Collaborations with international scientific journals:

As a Topical/Associate Editor

- Optics Letters (2012-2018)
- IEEE Photonics Journal (2021-)

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

Didactical, refereeing, and evaluating activities:

- Member of the academic board of the joint PhD Program on Quantum Technologies (QT) held by the University of Napoli Federico II, the National Council of Research (CNR) in Florence and the University of Camerino.
- Involved in didactical activities for the PhD courses of LENS, UNIFI, and QT;
- Supervisor of 8 graduate and 6 PhD theses;
- 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 committees for several CNR research contracts and permanent positions