

Gianluca Galzerano (GG) short Curriculum Vitae

PRESENT POSITION

- Since 01/2023 **Research Director** - Institute of Photonics and Nanotechnology of the Italian National Research Council (IFN–CNR)
- Since 2002 **Adjunct professor** in Experimental Physics and Absolute Optical Frequency Measurements - Politecnico di Milano (Faculty of Engineering and PhD school)

PAST POSITIONS

- 01/2006-12/2022 **Senior Research** - Institute of Photonics and Nanotechnology of the Italian National Research Council (IFN–CNR)
- 04/2010-11/2013 **Director at interim** of the Institute of Photonics and Nanotechnology of the Italian National Research Council (IFN–CNR)
- 12/2001-12/2005 **Researcher** - Institute of Photonics and Nanotechnology of the Italian National Research Council (IFN–CNR)
- 06/2001-12/2001 **Post-Doc** - Centro di Studio per le Telecomunicazioni Spaziali Italian National Research Council (CSTS), Milano
- 06/2000-06/2001 **Post-Doc** - Italian National Institute of Matter Physics (INFM) Milano section
- 06/1999-06/2000 **Post-Doc** - Department of Electronic and Information Science, Politecnico di Milano

EDUCATION

- February 1999 **PhD in Metrology: science of the measurements** from the Politecnico di Torino
- July 1994 **Laurea** (master university degree) in **Electronics Engineering** (optoelectronics specialization) from Politecnico di Milano

PROFESSIONAL ACHIEVEMENTS

- Since 2022 **Member of the Governing Board of the National Infrastructure I-PHOQS**, Integrated Infrastructure Initiative in Photonic and Quantum Sciences
- 2020 **National Habilitation for Full Professor in Measurements:** Electronic and electrical measurements (sector 09/E4)
- Since 2018 **Associated Reasearcher at the Istituto Nazionale di Fisica Nucleare (INFN)**, Milan section
- 2017 - 2021 **Member of the Scientific Board** of the “Centro Internazionale di Fotonica per l’Energia” - CIFE foundation, Milan
- Since 2017 **Associated Reasearcher at the Istituto Nazionale di Astrofisica (INAF)**, Catania section
- 2017 **National Habilitation for Full Professor in Experimental Physics of Matter** (sector 02/B1)

PROFESSIONAL ACTIVITIES

RESEARCH PROJECTS (LAST 10 YEARS)

- 2023/2025 MUR - PRIN2022 “Advanced room-Temperature THz hyperspectral Imaging based on novel ultrafast fiber Lasers - ATTILA” (total budget 290 k€) – **Principal Investigator**
- 2023/2025 MUR – PNRR Infrastructure, “Integrated Infrastructure Initiative in Photonic and Quantum Sciences I-PHOQS” (IFN-Milano total budget 4025 k€) – **Scientific Coordinator of the IFN-Milano research unit**
- 2023/2025 MUR – PNRR Infrastructure, “STILES” (astrocomb activity total budget 500 k€) – **Scientific Coordinator of the astrocomb activity Observatory of Catania & Telescopio Nazionale Galileo**
- 2022/2025 Industrial PhD CNR/Confindustria/Cambridge Raman Imaging: “Ultra-fast fiber lasers in the near- and mid-IR spectral regions for vibrational hyperspectral microscopy” – **Principal Investigator**
- 2022/2024 Esperimento Gruppo V, Istituto Nazionale di Fisica Nucleare – INFN Milano, “EHIOPIA: Efficient THz generation fOr hypersPectral ImAging and broad-band spectroscopy” (total funds: 150 k€) – **Principal Investigator**
- 2022/2023 Research contract Huawei/Politecnico di Milano “Design, realization, and characterization of a medium range free-space optical communication link at 10 μm ” (total funds: 34 k€+VAT) – **Principal Investigator**
- 2018/2021 Industrial PhD CNR/Confindustria/Brighthsolutions “Advanced laser sensor technologies for the identification of black plastics -ASPIRE” – **Principal Investigator**
- 2018/2020 Industrial research project BIOS Srl: “Development of a laser platform based on 532/1064 nm Nd:YAG lasers for vascular and dermatological surgery” (total funds 30 k€+VAT) – **Principal Investigator**
- 2017/2018 Accordo Quadro Regione Lombardia – CNR “Cyber-Sort” (total budget CNR-IFN 178 k€) – **Scientific Coordinator of the CNR-IFN research unit**
- 2013/2015 Accordo-Quadro Regione Lombardia CNR “Technologies and materials for the efficient use of solar energy” (total funds: 1192 k€) – **Principal Investigator**
- 2014 MUR – CNR Progetto Premiale “Sincronizzazione in fibra ottica di laboratori distribuiti con standard di tempo e frequenza” (total funds: 326 k€) – **Principal Investigator**
- 2014 Research contract Quanta System SpA “Support to the design of an enrichment cavity for the generation of entangled photon pairs” (total funds 15 k€+VAT) – **Principal Investigator**
- 2013 Research contract - SELEX GALILEO S.P.A. “Development, realization and characterization of a heterodyne measurement instrument for the frequency characterization of single-frequency Q-Switched Nd:YAG laser” (total funds 50.8 k€+VAT) – **Principal Investigator**
- 2013 MUR – INRIM Progetto Premiale “LIFT-LInk ottico nazionale per il Tempo e la Frequenza” (total budget CNR-IFN 260 k€) – **Scientific Coordinator of the CNR-IFN research unit**

CONFERENCE PROGRAM COMMITTEES

- 2023 Member of the Program Committee of the European Optical Society Annual Meeting (EOSAM) Topical Meeting 7- Optical frequency combs, Dijon, France, 11-15 September 2023

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| 2023 | Member of the Scientific Program Committee of the D-PHOTON 2023 Dielectric Photonic Devices and Systems Beyond Visible, Bari, Italy 11-13 July 2023 |
| 2022 | Member of the Local Organizing Committee of the 25th International Conference on Spectral Lineshape, San Leucio (CE), Italy, 22-26 June 2022 |
| 2020 | Member of the Local Organizing Committee of the INO Annual Symposium 2020, Naples Napoli http://www.inosymposium.cnr.it |
| 2018 | Member of the Scientific Program Committee of the D-PHOTON 2023 Dielectric Photonic Devices and Systems Beyond Visible, Bari, Italy 1-3 October 2018 |
| 2018 | Member of the Local Organizing Committee of the 30th European Frequency and Time Forum, Torino, Italy, 10-12 April 2018 |

EDITORIAL BOARD

- Since 2023 Associate editor of Frontier in Photonics, Light Sources and Luminescent Materials
- Since 2021 Associate editor of Metrology, MDPI

EVALUATION PANEL

GG is serving as a reviewer and scientific expert for the following National and International Funding Agencies: MIUR, French National Research Agency, Polish National Research Agency, Swiss Research Agency.

GG has served as scientific expert of MIUR for the ANVUR (VQR 2004-2010 and VQR 2011-2014)

GG has served as referee for the most important international journals in the area of physics and optics such as: Nature Photonics, Nature Communications, Light Science&Application, Laser and Photonics Review, Optica, Optics Letters, Optics Express, Applied Optics, Physical Review A, Physical Review E, Applied Physics Letters, Review of Scientific Instruments, Journal of Chemical Physics, Journal of Quantum Electronics, IEEE Transactions, Applied Physics B.

TEACHING, ACADEMIC SUPERVISION AND OUTREACHING ACTIVITIES

Since Academic Year 2001/2002 GG has a broad teaching experience in university courses at undergraduate, graduate and PhD levels including: General Physics, Electromagnetism and Optics, and Optical frequency measurements (PhD course).

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| 2014/15 to 2019/20 | Member of the Bachelor's and Master's Degree Commissions for the Study Course of Physical Engineering at the School of Industrial and Information Engineering of the Politecnico di Milano |
| 2008/09-2017/18 | Member of the Bachelor's and Master's Degree Commissions for the Study Course in Environmental and Territorial Engineering at the School of Civil, Environmental and Territorial Engineering of the Milan Polytechnic |

GG has been Supervisor ("relatore") of more than 40 MSc and 8 PhD thesis in Laser Physics, Optics and Photonics, Optical Measurements, and Physics of Matter.

GG is coauthor of several scientific reviews and dissemination contributions, including a few articles for Materials Science and Materials Engineering Handbook (Elsevier) and for the Encyclopedia of Analytical Chemistry (Wiley).

GG is coauthor of the college textbook: “Misure elettroniche di laboratorio,” E. Bava, G. Galzerano, M. Norgia, R. Ottoboni, C. Svelto, Pitagora Editrice, Bologna 2005 – ISBN 88-371-1592-X.

SYNTHESIS OF THE RESEARCH ACTIVITY

The research activity of GG is focused on the development of solid-state lasers and amplifiers, based on innovative materials and techniques, widely tunable in the near and mid-infrared spectral region (from 1 μm to 4 μm), the synthesis of optical frequency comb sources from visible to far infrared spectral regions, novel precision and broad-band spectroscopy methods, frequency metrology and precision optical measurements/sensors, optical remote sensing, and free-space optical communications in the near and mid-infrared spectral regions. In particular, the main contributors are:

- i) development of high-spectral purity continuous-wave and mode-locked rare-earth and transition metal solid-state lasers in different settings and operational regimes for applications to optical communications, optical radar for remote sensing of atmosphere (coherent Doppler lidar and DIAL systems), and high-resolution spectroscopy. Major results: demonstration and characterization of new laser materials in the 1- μm , 2- μm , 3- μm region, such as Yb-, Tm-, Ho-, and Dy-doped fluoride materials; demonstration of few-optical cycle pulses at 2.4 μm , based on Cr-doped ZnSe/S crystals, at 3.1 μm using Dy-doped active fluoride fiber, and at 1.04 μm using all Yb-fiber fs system (master oscillator and power amplification);
- ii) optical frequency comb synthesizers in the near and mid-ir based on innovative fiber lasers and amplifiers specifically developed for high-power and high-repetition rate pulses. Major results: synthesis of an optical frequency comb at 2-3 μm with average output power of 1 W; synthesis of a broadly tunable difference frequency generation comb in the mid-ir spectrum from 8 to 14 μm ;
- iii) precision and broadband molecular spectroscopy in the near and mid-ir using high-spectral purity frequency-stabilized lasers (solid-state, fiber, semiconductor, quantum-cascade-lasers) and optical frequency combs. Novel spectroscopic systems and techniques based on infrared frequency comb have been proposed and demonstrated. Major results: spectroscopic determination of the Boltzmann constant by Doppler broadening thermometry; comb-assisted high-precision molecular spectroscopy in the mid-ir using quantum cascade lasers; novel ultrabroad-band and fast acquisition time spectroscopy methods based on the direct use of optical frequency combs;
- iv) development of optical frequency standards based of frequency stabilized lasers against atomic and molecular absorption lines. Major results: frequency standard at 532 nm with a fractional stability of 10^{-14} based on a Nd:YAG laser stabilized respect to saturated absorption lines of iodine; frequency standard in the near-IR with 10^{-13} stability based on semiconductor laser stabilized against acetylene and water sub-Doppler lines; frequency standard in the mid-ir range with 10^{-12} stability based on quantum cascade laser stabilized against fluoroform sub-Doppler lines.

Main scientific collaborations

- N. Picqué and T. Udem, Max Plank Institute fur Quantenoptik, Garching (D)
- Kar, Heriot Watt University, Institute of Photonics and Quantum Sciences, Edinburgh (UK)
- R. Vallée, Université Laval, Centre d'Optique, Photonique et Laser (COPL), Québec, Canada
- S. Jackson, MacQuarie University, School of Engineering, MQ Photonics Research Centre Sidney (Australia)

- L. Gianfrani and A. Castrillo, Seconda Università di Napoli, Dipartimento di Fisica
- M. Tonelli and A. Di Lieto, Università di Pisa, Dipartimento di Fisica
- Agnesi and F. Pirzio, Università di Pavia, Dipartimento di Ingegneria Industriale e dell'Informazione
- S. Cialdi, Università degli Studi di Milano, Dipartimento di Fisica
- F. Prudeniano, Politecnico di Bari, Dipartimento di Ingegneria Elettrica e dell'Informazione
- L. Serafini, Istituto Nazionale Fisica Nucleare, sez. Milano
- F. Levi and D. Calonico, Istituto Nazionale di Ricerca Metrologica di Torino
- P. De Natale, P. Cancio and P. Maddaloni, Istituto Nazionale di Ottica-CNR

PUBLICATIONS AND BIBLIOMETRICS

The research activity by GG and his personal contributions are documented by:

- 141 papers published in high-impact peer-refereed ISI-indexed international journals;
- 140 proceedings in international conferences and contributions to scientific books;
- 71 contributions to international conferences (14 invited talks).

Scopus: H-index: 30 - Sum of total citations 3008 (July 2023)

Google Scholar: H-index 35 - Sum of total citations 3744 (July 2023)

SELECTED PUBLICATIONS

- [1] Y. Wang, F. Jobin, S. Duval, V. Fortin, P. Laporta, M. Bernier, G. Galzerano, and R. Vallée, "Ultrafast Dy³⁺:fluoride fiber laser beyond 3 μm ," *Optics Letters* **44**, n. 2, 395-398 (2019)
- [2] N. Coluccelli, M. Cassinerio, B. Redding, H. Cao, P. Laporta, and G. Galzerano, "The optical frequency comb fiber spectrometer," *Nature Communication* **7**, 12995, (2016)
- [3] M. Cassinerio, A. Gambetta, N. Coluccelli, P. Laporta, and G. Galzerano "Absolute dual-comb spectroscopy at 1.55 μm by free-running Er: fiber lasers," *Applied Physics Letters* **104**, pp. 231102-1-4 (2014)
- [4] L. Moretti, A. Castrillo, E. Fasci, M. D. De Vizia, G. Casa, G. Galzerano, A. Merlone, P. Laporta, and L. Gianfrani "Determination of the Boltzmann constant by means of precision measurements of H₂¹⁸O line shapes at 1.39 μm ," *Physical Review Letters* **111**, n. 6, 060803-1-5 (2013)
- [5] A. Gambetta, N. Coluccelli, M. Cassinerio, D. Gatti, P. Laporta, G. Galzerano, and M. Marangoni "Milliwatt-level frequency combs in the 8–14 μm range via difference frequency generation from an Er: fiber oscillator," *Optics Letters*, vol. **38**, n. 7, 1155-1157 (2013)
- [6] D. Gatti, G. Galzerano, D. Janner, S. Longhi, and P. Laporta, "Fiber strain sensor based on a π -phase-shifted Bragg grating and the Pound-Drever-Hall technique," *Optics Express* **16**, n. 3, pp. 1945-1950 (2008)
- [7] N. Coluccelli, G. Galzerano, F. Cornacchia, D. Parisi, M. Tonelli, and P. Laporta, "Novel Tm-doped LiLuF₄ crystal for efficient laser action in the wavelength range from 1.8 to 2 μm ," *Optics Letters* **32**, n. 14, pp. 2040-2042 (2007)
- [8] G. Della Valle, R. Osellame, G. Galzerano, N. Chiodo, G. Cerullo, P. Laporta, O. Svelto, U. Morgner, A. G. Rozhin, V. Scardaci, and A. C. Ferrari, "Passive mode-locking by carbon nanotubes in a femtosecond laser written waveguide laser," *Applied Physics Letters* **89**, pp. 231115-231117 (2006)
- [9] F. Bertinetto, P. Cordiale, G. Galzerano, and E. Bava, "Frequency stabilization of DBR diode laser against Cs absorption lines at 852 nm using the modulation transfer method," *IEEE Transaction on Instrum. and Meas.* **50**, n. 2, pp. 490-493 (2001)
- [10] P. Cordiale, G. Galzerano, and H. Schnatz, "International comparison of two iodine-stabilised frequency-doubled Nd:YAG lasers at $\lambda = 532 \text{ nm}$," *Metrologia* **37**, n. 2, pp. 177-182 (2000)

Le informazioni contenute nel presente curriculum vitae sono rilasciate ai sensi degli artt. 46 e 47 del D.P.R. 445/2000 e s.m.i.

Autorizzo il trattamento dei dati personali ai sensi del Regolamento Europeo (G.D.P.R. 2016/679).

Autorizzo il trattamento dei miei dati personali presenti nel CV ai sensi dell'art. 13 d. lgs. 30 giugno 2003 n. 196 - "Codice in materia di protezione dei dati personali" e dell'art. 13 GDPR 679/16 - "Regolamento europeo sulla protezione dei dati personali".

In fede,
Gianluca Galzerano

Milano