Davide Gatti

Associate Professor

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Education

2005 - 2008 | **Physics Department, Politecnico di Milano**
Ph.D. in Physics
*Thesis title:*Fiber Bragg gratings for telecommunications and sensing applications
Tutor: Prof. Paolo Laporta
Supervisor: Prof. Stefano Longhi

1996 – 2004 | **Physics Department, Politecnico di Milano**
Bachelor in Electronic Engineering
*Thesis title:*Active mode-locking of wide wavelength tunability Tm:Ho-doped laser sources emitting at 2 µm
Tutor: Prof. Paolo Laporta
Supervisor: Dr. Gianluca Galzerano

Teaching experience

2024 – present | **Professor**
Industrial Production Engineering
*E*xperimental Physics

2017 – 2024 | **Professor**
Civil Engineer for Risk Mitigation
*E*xperimental Physics I and II

2012 – 2017 | **Professor**
Building Engineering/Architecture
*G*eneral Physics

2005 – 2012 | **Assistant Professor**
Electronic Engineering, Civil Engineering, Management and Production Engineering,
*G*eneral Physics, experimental Physics, Optics and Electromagnetism

Supervisor of:

- 2 PhD Student (Riccardo Gotti 2015-2017; Marta Tonini 2024-present)
- 7 Master's Student Matteo Beretta (Menlo Systems 2021-2022) ; Niccolò Salvatore Barberio (2022-2023);Marco Mazza (Gilardoni Spa 2022-2023); Alice Ferreri (Gilardoni Spa 2022-2023); Luca Melesi (2023-2024); Giulio Mattoni (2023-2024); Ivan Gianfranco de Pisapia (Azcom Technology 2023-2024)
- 8 undergraduate student
- 15 PCTO students

Research experience

2019 – Ongoing

Physics Department, Politecnico di Milano
Associate professor

- Development of comb-assisted laser systems for very high accuracy and precision spectroscopy

2014 – 2019

Physics Department, Politecnico di Milano
Assistant Professor

- NIR and MIR ultra-short pulse laser system development
- Design and realization of a precision spectrometer based on optical frequency combs and cavity ring-down spectroscopy technique

2013 – 2014

Physics Department, Politecnico di Milano
Research fellow

- Development of a coherent Raman microscopy system based on spectral compression of femtosecond pulses

2010 – 2013

Institute of photonics and nanotechnologies IFN-CNR
Research fellow

- Phase stabilized pulses synthesis in the mid infrared region for precision optical spectroscopy.

2008 – 2010

Physics Department, Politecnico di Milano
Postdoctoral fellow

- Design of a LIDAR system for methane detection to be mounted on an helicopter platform starting from *in situ* measurements performed with a portable spectrometer
- Design, realization and characterization of optical fiber Bragg gratings for telecommunication and sensing
- Development of solid state laser sources both in continuous and pulsed regime with emission around 2 µm based on fluoride crystals doped with thulium or co-doped with thulium and holmium ions.

Publications

2024
1. Moretti, L. *et al.* Fast rate dual-comb spectrometer in the water-transparent 7.5–11.5 µm region. *Optics Letters* **49,** 1844–1847 (2024).

2023
2. Bernasconi, R. *et al.* Printing MEMS: Application of Inkjet Techniques to the Manufacturing of Inertial Accelerometers. *Micromachines* **14** (2023).
3. Elkhazraji, A. *et al.* High-resolution molecular fingerprinting in the 11.6-15 µm range by a quasi-CW difference-frequency-generation laser source. *Optics Express* **31,** 4164–4178 (2023).
4. Lamperti, M. *et al.* A stimulated Raman loss spectrometer for metrological studies of quadrupole lines of hydrogen isotopologues. *Molecular Physics,* e2196353 (2023).
5. Lamperti, M. *et al.* Stimulated Raman scattering metrology of molecular hydrogen. *Communications Physics* **6** (2023).

2022
6. **Gatti, D.** *et al.* Standoff CARS spectroscopy and imaging using an ytterbium-based laser system. *Optics Express* **30,** 15376–15387 (2022).

2021
7. Gotti, R., Lamperti, M., **Gatti, D.** & Marangoni, M. Laser-Based Primary Thermometry: A Review. *Journal of Physical and Chemical Reference Data* **50** (2021).

2020
8. Gotti, R. *et al.* Comb-locked frequency-swept synthesizer for high precision broadband spectroscopy. *Scientific Reports* **10** (2020).
9. Gotti, R. *et al.* Multispectrum rotational states distribution thermometry: Application to the $3\nu_1 + \nu_3$ band of carbon dioxide. *New Journal of Physics* **22** (2020).
10. Lamperti, M. *et al.* Optical frequency metrology in the bending modes region. *Communications Physics* **3** (2020).
11. Vicentini, E. *et al.* Nonlinear pulse compression to 22 fs at 15.6 µJ by an all-solid-state multipass approach. *Optics Express* **28,** 4541–4549 (2020).
12. Wójtewicz, S. *et al.* Accurate deuterium spectroscopy and comparison with ab initio calculations. *Physical Review A* **101** (2020).

2019
13. Alsaif, B. *et al.* Comb-calibrated sub-Doppler spectroscopy with an external-cavity quantum cascade laser at 7.7 μm. *Optics Express* **27,** 23785–23790 (2019).

2018
14. AlSaif, B. *et al.* High accuracy line positions of the ν_1 fundamental band of $^{14}N_2^{16}O$. *Journal of Quantitative Spectroscopy and Radiative Transfer* **211,** 172–178 (2018).
15. Gotti, R. *et al.* Cavity-ring-down Doppler-broadening primary thermometry. *Physical Review A* **97** (2018).
16. Lamperti, M. *et al.* Absolute spectroscopy near 7.8 μm with a comb-locked extended-cavity quantum-cascade-laser. *Scientific Reports* **8** (2018).

2017
17. Gotti, R. *et al.* Conjugating precision and acquisition time in a Doppler broadening regime by interleaved frequency-agile rapid-scanning cavity ring-down spectroscopy. *Journal of Chemical Physics* **147** (2017).

2016
18. Gambetta, A., Cassinerio, M., **Gatti, D.**, Laporta, P. & Galzerano, G. Scanning micro-resonator direct-comb absolute spectroscopy. *Scientific Reports* **6** (2016).
19. **Gatti, D.** *et al.* Comb-locked Lamb-dip spectrometer. *Scientific Reports* **6** (2016).
20. Mondelain, D. *et al.* Sub-MHz accuracy measurement of the S(2) 2–0 transition frequency of D_2 by Comb-Assisted Cavity Ring Down spectroscopy. *Journal of Molecular Spectroscopy* **326,** 5–8 (2016).

2015

21. Della Valle, G., **Gatti, D.** & Longhi, S. Friedmann-Robertson-Walker transformational technique in paraxial wave optics. *Journal of the Optical Society of America B: Optical Physics* **32,** 1834–1842 (2015).
22. Gambetta, A. *et al.* Frequency-comb-assisted precision laser spectroscopy of CHF−3 around 8.6 μm. *Journal of Chemical Physics* **143** (2015).
23. **Gatti, D.** *et al.* Comb-locked cavity ring-down spectrometer. *Journal of Chemical Physics* **142** (2015).
24. **Gatti, D.** *et al.* Wide-bandwidth Pound-Drever-Hall locking through a single-sideband modulator. *Optics Letters* **40,** 5176–5179 (2015).
25. Longhi, S., **Gatti, D.** & Della Valle, G. Non-Hermitian transparency and one-way transport in low-dimensional lattices by an imaginary gauge field. *Physical Review B - Condensed Matter and Materials Physics* **92** (2015).
26. Longhi, S., **Gatti, D.** & Della Valle, G. Robust light transport in non-Hermitian photonic lattices. *Scientific Reports* **5** (2015).

2013

27. Gambetta, A. *et al.* Milliwatt-level frequency combs in the 8-14 μm range via difference frequency generation from an Er:fiber oscillator. *Optics Letters* **38,** 1155–1157 (2013).
28. **Gatti, D.** *et al.* Frequency-comb-calibrated Doppler broadening thermometry. *Physical Review A - Atomic, Molecular, and Optical Physics* **88** (2013).

2012

29. Coluccelli, N. *et al.* 250-MHz synchronously pumped optical parametric oscillator at 2.25-2.6 μm and 4.1-4.9 μm. *Optics Express* **20,** 22042–22047 (2012).
30. Coluccelli, N. *et al.* Frequency-stabilized 1 W optical comb at 2.2-2.6 μm by Cr^{2+}:ZnSe multipass amplification. *Optics Letters* **37,** 4440–4442 (2012).
31. **Gatti, D.** *et al.* Analysis of the feed-forward method for the referencing of a CW laser to a frequency comb. *Optics Express* **20,** 24880–24885 (2012).
32. Kumar, V. *et al.* Balanced-detection Raman-induced Kerr-effect spectroscopy. *Physical Review A - Atomic, Molecular, and Optical Physics* **86** (2012).
33. Mills, A. *et al.* Coherent phase lock of a 9 μm quantum cascade laser to a 2 μm thulium optical frequency comb. *Optics Letters* **37,** 4083–4085 (2012).
34. Sala, T. *et al.* Wide-bandwidth phase lock between a CW laser and a frequency comb based on a feed-forward configuration. *Optics Letters* **37,** 2592–2594 (2012).

2011

35. Coluccelli, N. *et al.* 1.6-W self-referenced frequency comb at 2.06 μm using a Ho:YLF multipass amplifier. *Optics Letters* **36,** 2299–2301 (2011).
36. Gambetta, A. *et al.* Mid-infrared quantitative spectroscopy by comb-referencing of a quantum-cascade-laser: Application to the CO_2 spectrum at 4.3 μm. *Applied Physics Letters* **99** (2011).
37. **Gatti, D.** *et al.* Absolute frequency spectroscopy of CO_2 lines at around 2.09 μm by combined use of an Er:fiber comb and a Ho:YLF amplifier. *Optics Letters* **36,** 3921–3923 (2011).
38. **Gatti, D.** *et al.* High-precision molecular interrogation by direct referencing of a quantum-cascade-laser to a near-infrared frequency comb. *Optics Express* **19,** 17520–17527 (2011).
39. Marazzi, L. *et al.* Structured FBG filters for 10-Gb/s DPSK signal demodulation in single ended applications. *Optical Fiber Technology* **17,** 156–159 (2011).

2010

40. Coluccelli, N. *et al.* Passive mode-locking of a diode-pumped Tm:$GdLiF_4$ laser. *Applied Physics B: Lasers and Optics* **101,** 75–78 (2010).
41. Galzerano, G. *et al.* CW and femtosecond operation of a diode-pumped Yb:BaY_2F_8 laser. *Optics Express* **18,** 6255–6261 (2010).
42. **Gatti, D.**, Fernandez, T., Longhi, S. & Laporta, P. Temporal differentiators based on highly-structured fibre Bragg gratings. *Electronics Letters* **46,** 943–945 (2010).

2008 | 43. **Gatti, D.** *et al.* Demonstration of differential phase-shift keying demodulation at 10 Gbit/s optimal fiber Bragg grating filters. *Optics Letters* **33,** 1512–1514 (2008).

44. Longhi, S., **Gatti, D.**, Laporta, P. & Belmonte, M. Synthesis of fiber Bragg grating filters for optimal DPSK demodulation. *Optical Fiber Technology* **14,** 259–261 (2008).

2007 | 45. **Gatti, D.**, Galzerano, G., Toncelli, A., Tonelli, M. & Laporta, P. Actively mode-locked Tm-Ho:$LiYF_4$ and Tm-Ho:BaY_2F_8 lasers. *Applied Physics B: Lasers and Optics* **86,** 269–273 (2007).

46. Ornigotti, M., Valle, G., **Gatti, D.** & Longhi, S. Topological suppression of optical tunneling in a twisted annular fiber. *Physical Review A - Atomic, Molecular, and Optical Physics* **76** (2007).

2006 | 47. Coluccelli, N. *et al.* Tunability range of 245 nm in a diode-pumped Tm:BaY_2F_8 laser at 1.9 μm: A theoretical and experimental investigation. *Applied Physics B: Lasers and Optics* **85,** 553–555 (2006).

2005 | 48. Longhi, S. *et al.* Optical buffering in phase-shifted fibre gratings. *Electronics Letters* **41,** 1075–1077 (2005).

Research Projects

2025 – present | **Galileo 2025**
COLD kinetics of radical reactions using dual Comb Absorption Spectroscopy based on Electro-optic modulation (COLD-CASE)
Principal Investigator

2022 – present | **Collaborative project with KAUST (Saudi Arabia) and Laval University**
Mid-infrared dual comb spectroscopy for chemical kinetics of combustion processes
Investigator

2018 | **Research contract between Politecnico di Milano – Polo di Lecco and VDGLAB**
Design di un illuminatore basato su molecole fluorescenti eccitate da radiazione laser (Illuminator desing based on fluorescent molecules excited by laser radiation)
Principal Investigator

2018 – 2019 | **Collaborative project with KAUST (Saudi Arabia)**
Development of two new sensors for industries
Investigator

2017 – 2019 | **Progetto Emblematico, Regione Lombardia – Fondazione Cariplo**
EMpowerment del PAzienTe in cAsa (EMPATIA)
Investigator

2017 – 2018 | **Accordo quadro Regione Lombardia – CNR**
Future Home for Future Communities (FHfFC)
Investigator

2016 – 2019 | **Collaborative project with KAUST (Saudi Arabia)**
Frequency-comb-calibrated cavity-Enhanced Absorption Spectroscopy at high Temperatures for combustion-relevant gases (FEAST)
Investigator

2014 – 2015 | **Research contract between Politecnico di Milano – Polo di Lecco and Combustion and Energy**
Studio di fattibilità di un sensore ottico per il monitoraggio di una fiamma posta sulla sommità di un camino (Feasibility study of an optical sensor for monitoring a flame on the top of a chimney)
Principal Investigator

2013 – 2015 | **Progetto regionale Fondazione Cariplo**
Surface enhanced coherent antistokes Raman scattering for label-free ultra-sensitive detection
Investigator

2012 – 2014 | **National Project FIRB**
Cold fluoromethane molecules for ultra-high resolution ro-vibrational spectroscopy assisted by optical frequency comb synthesizers: A laboratory test of the constancy of the proton-to-electron mass ratio
Investigator

2010 – 2013 | **European project FET-Open**
Coherently-enhanced Raman One-beam Standoff Spectroscopic TRacing of Airborne Pollutants (CROSS-TRAP)
Investigator

2009 – 2010 | **ENI project S.p.a**
001-OE-TGeoscienza
Investigator

2008 | **Research Contract between Physics and Selex Galileo Avionica**
ATLID-MO (ATmospheric LIDar-Master Oscillator)
Investigator

2005 – 2008 | **National Project PRIN**
Sviluppo di sorgenti laser a singola frequenza in fibra nel vicino infrarosso per applicazioni avanzate alla sensoristica" (prot. 2005099872) (Development single-frequency fiber laser sources in the near infrared for advanced sensor applications)
Investigator

National and International Collaborations

- Lucile Rutkowski Institut de Physique de Rennes (IPR), University of Rennes, France
- Dr. Aamir Farooq, Clean Combustion Research Center, King Abdullah University of Science and Technology (KAUST), Thuwal, Arabia Saudita.
- Dr. Jérôme Genest Centre d'optique, photonique et laser, Université Laval, Québec, Canada
- TOPTICA Photonics, Monaco, Germania.
- Dr. Alain Campargue, LIPhy laboratoire,Grenoble , Francia.
- Dr. Luca Poletto, IFN-CNR Padova.
- Dr. Mauro Marzorati, IBFM-CNR, Segrate (MI)
- PhD Piotr Masłowski, Nicolaus Copernicus University, Toruń, Polonia.
- Dr. Martin E. Fermann, IMRA Inc., Ann Arbor, Michigan, USA.
- PhD Ingmar Hartl, Head of Laser Science & Research, DESY, Amburgo, Germania.
- Magnus Haakestadt, FFI – Norwegian Defence Research Establishment, Kjeller, Norvegia.
- Prof. Daniele Romanini, CNRS Director, Grenoble, Francia.
- Prof. Livio Gianfrani, Dipartimento di Scienze Ambientali, Seconda Università di Napoli, Caserta, Italia.
- Prof. Marco Prevedelli, Dipartimento di Fisica e Astronomia, Università di Bologna, Bologna, Italia.
- Prof. Mauro Tonelli, National Enterprise for Nanoscience and Nanotechnology–CNR e Dipartimento di Fisica, Università di Pisa, Italia.
- Prof. Mario Martinelli, Policom, Milano, Italia.
- Dr. Davide Janner, ICFO – Institut de Ciencies Fotoniques, Mediterranean Technology Parc, Castelldefels, Spagna.
- PhD Gualtiero Nunzi Conti, Istituto di Fisica Applicata "Nello Carrara", CNR-IFAC, Sesto Fiorentino (FI), Italia.
- Ing. Michele Belmonte, Avanex Corporation, San Donato Milanese, Milano, Italia.
- Ing. Vincenzo di Giovine, Combustion&Energy S.r.l, Oggiono (Lecco), Italia.

Journal Peer Review

- Nature Photonics
- Nature Communications
- Optics Letters
- Optics Express
- Photonics Technology Letter
- Photonics Journal
- Optical Fiber Technologies
- Optical Engineering.

Summer schools

2007 **Optical Supercontinua and Frequency Combs**
International School of Physics *Wilhelm and Helse Heraeus* Wittenberg, Germany

2006 **Metrology and Fundamental Constants**
International School of Physics Enrico Fermi Varenna (Lecco), Italy

Training courses

2012 LabView Real-Time 1 e 2
2013 High-throughput LabView FPGA
2018 LabView Performance
2018 Advanced Architecture in LabView
2019 Managing SW Engineering in LabView