



# Davide Gatti


Associate Professor

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## Education

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|-------------|---|
| 2005 - 2008 | <b>Physics Department, Politecnico di Milano</b><br><i>Ph.D. in Physics</i><br><i>Thesis title:</i> Fiber Bragg gratings for telecommunications and sensing applications<br><i>Tutor:</i> Prof. Paolo Laporta<br><i>Supervisor:</i> Prof. Stefano Longhi  |
| 1996 - 2004 | <b>Physics Department, Politecnico di Milano</b><br><i>Bachelor in Electronic Engineering</i><br><i>Thesis title:</i> Active mode-locking of wide wavelength tunability Tm:Ho-doped laser sources emitting at 2 $\mu\text{m}$<br><i>Tutor:</i> Prof. Paolo Laporta<br><i>Supervisor:</i> Dr. Gianluca Galzerano |

## Research experience

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|----------------|---|
| 2019 - Ongoing | <b>Physics Department, Politecnico di Milano</b><br><i>Associate professor</i> <ul style="list-style-type: none"><li>Development of comb-assisted laser systems for very high accuracy and precision spectroscopy</li></ul>   |
| 2014 - 2019    | <b>Physics Department, Politecnico di Milano</b><br><i>Assistant Professor</i> <ul style="list-style-type: none"><li>NIR and MIR ultra-short pulse laser system development</li><li>Design and realization of a precision spectrometer based on optical frequency combs and cavity ring-down spectroscopy technique</li></ul> |
| 2013 - 2014    | <b>Physics Department, Politecnico di Milano</b><br><i>Research fellow</i> <ul style="list-style-type: none"><li>Development of a coherent Raman microscopy system based on spectral compression of femtosecond pulses</li></ul>  |
| 2010 - 2013    | <b>Institute of photonics and nanotechnologies IFN-CNR</b><br><i>Research fellow</i> <ul style="list-style-type: none"><li>Phase stabilized pulses synthesis in the mid infrared region for precision optical spectroscopy.</li></ul>   |

- 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  $\mu\text{m}$  based on fluoride crystals doped with thulium or co-doped with thulium and holmium ions.

## Publications

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| 2023 | <ol style="list-style-type: none"> <li>1. Elkhazraji, A. <i>et al.</i> High-resolution molecular fingerprinting in the 11.6-15 <math>\mu\text{m}</math> range by a quasi-CW difference-frequency-generation laser source. <i>Optics Express</i> <b>31</b>, 4164–4178 (2023).</li> <li>2. Lamperti, M. <i>et al.</i> A stimulated Raman loss spectrometer for metrological studies of quadrupole lines of hydrogen isotopologues. <i>Molecular Physics</i>, e2196353 (2023).</li> <li>3. Lamperti, M. <i>et al.</i> Stimulated Raman scattering metrology of molecular hydrogen. <i>Communications Physics</i> <b>6</b> (2023).</li> </ol>   |
| 2022 | <ol style="list-style-type: none"> <li>4. <b>Gatti, D.</b> <i>et al.</i> Standoff CARS spectroscopy and imaging using an ytterbium-based laser system. <i>Optics Express</i> <b>30</b>, 15376–15387 (2022).</li> </ol>  |
| 2021 | <ol style="list-style-type: none"> <li>5. Gotti, R., Lamperti, M., <b>Gatti, D.</b> &amp; Marangoni, M. Laser-Based Primary Thermometry: A Review. <i>Journal of Physical and Chemical Reference Data</i> <b>50</b> (2021).</li> </ol>  |
| 2020 | <ol style="list-style-type: none"> <li>6. Gotti, R. <i>et al.</i> Comb-locked frequency-swept synthesizer for high precision broadband spectroscopy. <i>Scientific Reports</i> <b>10</b> (2020).</li> <li>7. Gotti, R. <i>et al.</i> Multispectrum rotational states distribution thermometry: Application to the <math>3\nu_1 + \nu_3</math> band of carbon dioxide. <i>New Journal of Physics</i> <b>22</b> (2020).</li> <li>8. Lamperti, M. <i>et al.</i> Optical frequency metrology in the bending modes region. <i>Communications Physics</i> <b>3</b> (2020).</li> <li>9. Vicentini, E. <i>et al.</i> Nonlinear pulse compression to 22 fs at 15.6 <math>\mu\text{J}</math> by an all-solid-state multipass approach. <i>Optics Express</i> <b>28</b>, 4541–4549 (2020).</li> <li>10. Wójtewicz, S. <i>et al.</i> Accurate deuterium spectroscopy and comparison with ab initio calculations. <i>Physical Review A</i> <b>101</b> (2020).</li> </ol> |
| 2019 | <ol style="list-style-type: none"> <li>11. Alsaif, B. <i>et al.</i> Comb-calibrated sub-Doppler spectroscopy with an external-cavity quantum cascade laser at 7.7 <math>\mu\text{m}</math>. <i>Optics Express</i> <b>27</b>, 23785–23790 (2019).</li> </ol>   |
| 2018 | <ol style="list-style-type: none"> <li>12. AlSaif, B. <i>et al.</i> High accuracy line positions of the <math>\nu_1</math> fundamental band of <math>^{14}\text{N}_2^{16}\text{O}</math>. <i>Journal of Quantitative Spectroscopy and Radiative Transfer</i> <b>211</b>, 172–178 (2018).</li> <li>13. Gotti, R. <i>et al.</i> Cavity-ring-down Doppler-broadening primary thermometry. <i>Physical Review A</i> <b>97</b> (2018).</li> <li>14. Lamperti, M. <i>et al.</i> Absolute spectroscopy near 7.8 <math>\mu\text{m}</math> with a comb-locked extended-cavity quantum-cascade-laser. <i>Scientific Reports</i> <b>8</b> (2018).</li> </ol>   |
| 2017 | <ol style="list-style-type: none"> <li>15. Gotti, R. <i>et al.</i> Conjugating precision and acquisition time in a Doppler broadening regime by interleaved frequency-agile rapid-scanning cavity ring-down spectroscopy. <i>Journal of Chemical Physics</i> <b>147</b> (2017).</li> </ol>  |

- 2016 | 16. Gambetta, A., Cassinerio, M., **Gatti, D.**, Laporta, P. & Galzerano, G. Scanning micro-resonator direct-comb absolute spectroscopy. *Scientific Reports* **6** (2016).
17. **Gatti, D. et al.** Comb-locked Lamb-dip spectrometer. *Scientific Reports* **6** (2016).
18. Mondelain, D. *et al.* Sub-MHz accuracy measurement of the S(2) 2–0 transition frequency of D<sub>2</sub> by Comb-Assisted Cavity Ring Down spectroscopy. *Journal of Molecular Spectroscopy* **326**, 5–8 (2016).
- 2015 | 19. 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).
20. Gambetta, A. *et al.* Frequency-comb-assisted precision laser spectroscopy of CHF–3 around 8.6  $\mu\text{m}$ . *Journal of Chemical Physics* **143** (2015).
21. **Gatti, D. et al.** Comb-locked cavity ring-down spectrometer. *Journal of Chemical Physics* **142** (2015).
22. **Gatti, D. et al.** Wide-bandwidth Pound-Drever-Hall locking through a single-sideband modulator. *Optics Letters* **40**, 5176–5179 (2015).
23. 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).
24. Longhi, S., **Gatti, D.** & Della Valle, G. Robust light transport in non-Hermitian photonic lattices. *Scientific Reports* **5** (2015).
- 2013 | 25. Gambetta, A. *et al.* Milliwatt-level frequency combs in the 8–14  $\mu\text{m}$  range via difference frequency generation from an Er: fiber oscillator. *Optics Letters* **38**, 1155–1157 (2013).
26. **Gatti, D. et al.** Frequency-comb-calibrated Doppler broadening thermometry. *Physical Review A - Atomic, Molecular, and Optical Physics* **88** (2013).
- 2012 | 27. Coluccelli, N. *et al.* 250-MHz synchronously pumped optical parametric oscillator at 2.25–2.6  $\mu\text{m}$  and 4.1–4.9  $\mu\text{m}$ . *Optics Express* **20**, 22042–22047 (2012).
28. Coluccelli, N. *et al.* Frequency-stabilized 1 W optical comb at 2.2–2.6  $\mu\text{m}$  by Cr<sup>2+</sup>:ZnSe multipass amplification. *Optics Letters* **37**, 4440–4442 (2012).
29. **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).
30. Kumar, V. *et al.* Balanced-detection Raman-induced Kerr-effect spectroscopy. *Physical Review A - Atomic, Molecular, and Optical Physics* **86** (2012).
31. Mills, A. *et al.* Coherent phase lock of a 9  $\mu\text{m}$  quantum cascade laser to a 2  $\mu\text{m}$  thulium optical frequency comb. *Optics Letters* **37**, 4083–4085 (2012).
32. 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 | 33. Coluccelli, N. *et al.* 1.6-W self-referenced frequency comb at 2.06  $\mu\text{m}$  using a Ho:YLF multipass amplifier. *Optics Letters* **36**, 2299–2301 (2011).
34. Gambetta, A. *et al.* Mid-infrared quantitative spectroscopy by comb-referencing of a quantum-cascade-laser: Application to the CO<sub>2</sub> spectrum at 4.3  $\mu\text{m}$ . *Applied Physics Letters* **99** (2011).
35. **Gatti, D. et al.** Absolute frequency spectroscopy of CO<sub>2</sub> lines at around 2.09  $\mu\text{m}$  by combined use of an Er: fiber comb and a Ho:YLF amplifier. *Optics Letters* **36**, 3921–3923 (2011).
36. **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).
37. 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 | 38. Coluccelli, N. *et al.* Passive mode-locking of a diode-pumped Tm:GdLiF<sub>4</sub> laser. *Applied Physics B: Lasers and Optics* **101**, 75–78 (2010).
39. Galzerano, G. *et al.* CW and femtosecond operation of a diode-pumped Yb:BaY<sub>2</sub>F<sub>8</sub> laser. *Optics Express* **18**, 6255–6261 (2010).
40. **Gatti, D.**, Fernandez, T., Longhi, S. & Laporta, P. Temporal differentiators based on highly-structured fibre Bragg gratings. *Electronics Letters* **46**, 943–945 (2010).
- 2008 | 41. **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).
42. 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 | 43. **Gatti, D.**, Galzerano, G., Toncelli, A., Tonelli, M. & Laporta, P. Actively mode-locked Tm-Ho:LiYF<sub>4</sub> and Tm-Ho:BaY<sub>2</sub>F<sub>8</sub> lasers. *Applied Physics B: Lasers and Optics* **86**, 269–273 (2007).
44. 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 | 45. Coluccelli, N. *et al.* Tunability range of 245 nm in a diode-pumped Tm:BaY<sub>2</sub>F<sub>8</sub> laser at 1.9 μm: A theoretical and experimental investigation. *Applied Physics B: Lasers and Optics* **85**, 553–555 (2006).
- 2005 | 46. Longhi, S. *et al.* Optical buffering in phase-shifted fibre gratings. *Electronics Letters* **41**, 1075–1077 (2005).

## Research Projects

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- 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	<b>Progetto regionale Fondazione Cariplo</b> Surface enhanced coherent antistokes Raman scattering for label-free ultra-sensitive detection <i>Investigator</i>
2012 – 2014	<b>National Project FIRB</b> 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 <i>Investigator</i>
2010 – 2013	<b>European project FET-Open</b> Coherently-enhanced Raman One-beam Standoff Spectroscopic TRacing of Airborne Pollutants (CROSS-TRAP) <i>Investigator</i>
2009 – 2010	<b>ENI project S.p.a</b> ooi-OE-TGeoscienza <i>Investigator</i>
2008	<b>Research Contract between Physics and Selex Galileo Avionica</b> ATLID-MO (ATmospheric LIDar-Master Oscillator) <i>Investigator</i>
2005 – 2008	<b>National Project PRIN</b> 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) <i>Investigator</i>

## Teaching experience

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2017 – present	<b>Professor</b> <i>Civil Engineer for Risk Mitigation</i> Experimental Physics I and II
2012 – 2017	<b>Professor</b> <i>Building Engineering/Architecture</i> General Physics
2005 – 2012	<b>Assistant Professor</b> <i>Electronic Engineering, Civil Engineering, Management and Production Engineering,</i> General Physics, experimental Physics, Optics and Electromagnetism

## Journal Peer Review

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

## National and International Collaborations

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- 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 Maślowski, 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 Haakestad, 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 Ciències 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.

## Summer schools

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2007	<b>Optical Supercontinua and Frequency Combs</b> International School of Physics <i>Wilhelm and Helse Heraeus</i> Wittenberg, Germany
2006	<b>Metrology and Fundamental Constants</b> International School of Physics <i>Enrico Fermi Varenna (Lecco)</i> , Italy

## Training courses

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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