

## **Livio Gianfrani – Short Curriculum Vitae**

Livio Gianfrani received the degree in Physics (cum laude) on 1989 at the University of Naples "Federico II" and the PhD in Physics on 1993. In 1994 he got a stable position as researcher in Physics, at the Environmental Sciences Faculty of the Second University of Naples (UniNA2). Since November 2000 to October 2016, he has been Associate Professor of Experimental Physics at UniNA2. Since the 1st November 2016, he is Full Professor of Matter Physics at Università degli Studi della Campania "Luigi Vanvitelli" (UniCampania) in Caserta.

He coordinates the Molecules and Precision Measurements Research Group, being responsible for the Laser Spectroscopy Laboratories at the Department of Mathematics and Physics.

Since November 2015, he is the President of the Board of the Bachelor Program in Physics.

Since November 2005, for about TEN years, he was the Coordinator of the International PhD Program in Novel Physics Methodologies for Environmental Research at UniNA2. Presently, he is member of the Board of the PhD Program in Mathematics, Physics and applications to Engineering at UniCampania.

Gianfrani teaches Electromagnetism (for Bachelor students in Physics and Mathematics), Atomic Quantum Physics (for Bachelor students in Physics) and Molecular Physics (for the Master of Science in Physics).

He has performed and, in many cases, headed a variety of experiments in collaboration with national and international Institutes and Universities.

### **• Summary of Scientific Activity**

Livio Gianfrani has a long-standing experience of experimental research in: atomic, molecular and optical physics; laser spectroscopy and light-matter interaction; precision measurements and test of theories; spectral line shapes; fundamental metrology; development of spectroscopic instrumentation for chemical and isotope analysis; metrology for the environment.

His most important achievements include: spectroscopic determination of the Boltzmann constant; experimental tests of line shape theories; observation of the intrinsic linewidth of a quantum cascade laser; development of laser spectroscopy for stable isotope ratio analysis; first extension of NICE-OHMS to the Doppler-limited regime; experimental test of the symmetrization postulate for spin-0 particles.

So far, Gianfrani has published more than 100 papers on peer-reviewed scientific journals (including 4 Physical Review Letters, 15 Physical Review A, 10 Optics Letters, 2 Philosophical Transactions of the Royal Society A).

The bibliometric indicators are reported hereafter (Source: Scopus, 04/04/2018).  
Documents: 120

**h-index: 26**

Total number of citations: 1997

Citing articles: 1161

### **• Research Experiences in Foreign Universities and Institutes (selection)**

In the period 1996/1997, he was guest researcher at the National Institute of Standards and Technology (NIST) in Boulder - Colorado (USA), working with Leo Hollberg in the Time & Frequency Division.

In 2002, he was guest scientist at the Centre for Isotope Research (CIO), Dept. of Physics, University of Groningen (Holland), being awarded of a NATO-NWO fellowship for senior scientists.

In the period January/February 2012, he was Visiting Professor at the Institute of Physics, Nicolaus Copernicus University, Torun, Poland.

Finally, during the summer of 2012, he was visiting scientist at IMRA America Inc., Ann Arbor (Michigan, USA).

#### • Invited talks

An important indicator of success is given by the large number of seminars (around 30) in foreign universities and invited talks at national and international conferences (27).

Recent invited talks include:

- i) "Highly-Accurate Line Shape Studies in the Near-IR Spectrum of Water", 21st International Conference on Spectral Line Shapes, Saint Petersburg, 5 July 2012;
- ii) "Advances in laser-based isotope ratio measurements", 23rd International Conference on High Resolution Molecular Spectroscopy, Budapest, 26 August 2013;
- iii) "Precision measurements of the shape of water lines in the near-IR: Investigation of narrowing effects in the Doppler regime", International Meeting on Water Line Profiles, The Royal Society, Chicheley Hall, London, 8 October 2013;
- iv) "The Boltzmann constant from the shape of a molecular spectral line", PSAS2014, International Conference on Precision Physics of Simple Atomic Systems, Rio de Janeiro, 26 May 2014.
- v) "Spectroscopic determination of the Boltzmann constant", IUPAP Fundamental Constants Meeting 2015, Eltville, 4 February 2015;
- vi) "The use of Doppler-broadened laser absorption spectroscopy in primary gas thermometry", Theo Murphy Scientific Meeting on "Towards Implementing the New Kelvin", The Royal Society, Chicheley Hall, London, 19 May 2015;
- vii) "The Boltzmann constant from the shape of a vibration-rotation transition", ICOLS 2015, 22nd International Conference on Laser Spectroscopy, Singapore, 2 July 2015.
- viii) "Precision measurements of spectroscopic parameters in atmospheric relevant molecules", ASA Meeting, 13th Conference on Atmospheric Spectroscopy Applications, Reims, 25 August 2016.
- ix) "Advances in Doppler broadening thermometry for the spectroscopic determination of the Boltzmann constant", FFK-2017, International Conference on Precision Physics and Fundamental Physics Constants, Warsaw, 18 May 2017.

#### • Research projects

Gianfrani has shown excellent skills in managing research projects. In total, he has been involved (either as Principal Investigator or Responsible of the Research Unit) in a large variety of projects, at the European, National and Regional levels. A few of them will be highlighted hereafter.

Since February 2017: National Coordinator of the PRIN Project entitled: "A new primary method of gas thermometry based upon Doppler-broadened mercury spectroscopy in the UV region", duration: 3 years.

Since June 2016: Responsible of the Research Unit of the EMPIR-EURAMET Project entitled InK#2 - Implementing the New Kelvin (<http://www.vtt.fi/sites/InK2/the-project>), duration: 3 years; amount of funding: 100000 Euro.

2013 – 2015: Principal Investigator of the Researcher Excellence Grant (SIB01 REG4 InK, project title: Comb-calibrated Doppler Broadening Thermometry, EMRP Call SI 2013) within the EURAMET Joint Research Project entitled "InK - Implementing the new Kelvin", duration: 2 years; amount of funding: 77071.80 Euro.

2012 – 2014: Principal Investigator of the Researcher Excellence Grant (SIB01 REG3 InK, project title: Development, optimization and application of Doppler Broadening Thermometry for the implementation of the new Kelvin, EMRP Call SI 2012) within the EURAMET Joint Research Project

entitled "InK - Implementing the new Kelvin", duration: 2 years; amount of funding: 77071.80 Euro.

2007 – 2008: Responsible of the UniNA2 research unit within the PRIN2006 Project entitled "Spectroscopic determination of the Boltzmann constant", funded by the Italian Ministry for University and Research, duration: 2 years; total amount of funding: 217500 Euro.

2005 – 2008: Principal Investigator of the European Project ALICE, awarded by the European Commission, 6th FP, within the program "Marie-Curie Host Fellowship for Transfer of Knowledge", duration: 4 years; contract number MTKD-CT-2004-014532, from 04.04.2005 to 03.04.2009; amount of funding: 202588.61 Euro.

2000 – 2003: Responsible of the UniNA2 research unit within a research project funded by INGV (National Institute for Geophysics and Vulcanology) FP 2000-2002 entitled "Development of a spectroscopic integrated system for remote and continuous monitoring of volcanic gases", duration: 3 years; total amount of funding 900 ML.

#### • **National and international reputation and professional activity for the scientific community**

- Guest Editor for the Elsevier Journal "Optics & Lasers in Engineering" - Special Issue: "Optical Methods in Earth Sciences", Vol. 37, 2002.

- Guest Editor for the Taylor & Francis Journal "Isotopes in Environmental and Health Studies", Special Issue: "Stable Isotope Ratio Infrared Spectrometry", Vol. 41, 2005, and Vol. 42, 2006.

- Reviewer ex-post for the FIRB Program of the MIUR (Italian Ministry for Education and Research), July 2017.

- Referee for the NWO (Netherlands Organisation for Scientific Research) funding agency, Program on Innovational Research, November 2016.

- Grant Reviewer for the Swiss National Science Foundation (November 2015).

- Grant Reviewer for the National Science Center (NCN panel ST2), Poland, SONATA Program (<http://www.ncn.gov.pl/>), April 2015.

- Referee for the STAR Program, Mobility of Young Researchers, University "Federico II" of Naples, February/March 2015.

- Referee for the University Ca' Foscari Venezia, Young Researchers' Awards (Premi alla Ricerca 2014), March 2014.

- Reviewer of projects within the EMRP call 2013 – Energy and Environment, for the EURAMET organization, November 2013.

- Reviewer for ANVUR (National Agency for the Evaluation of University and Research), VQR 2004-2010; total number of examined products: 13.

- Referee for the University Ca' Foscari Venezia, Young Researchers' Awards (Premi alla Ricerca 2011).

- Referee for the NWO (Netherlands Organisation for Scientific Research) funding agency, Program on Earth and Life Sciences, April 2011.

- Reviewer of projects within the EMRP call 2010 – Industry and Environment, for the EURAMET organization, November 2010.

- Reviewer of SBIR (Small Business Innovation Research) projects for the US DOE - Dept. of Energy, March 2008.

- Reviewer of SBIR (Small Business Innovation Research) projects for the US DOE - Dept. of Energy, 2005.

- Member of the Scientific Committee of the 6th International Conference on Field Laser Application in Industry and Research (FLAIR 2018), Assisi, Italy, 2018 (<http://www.ino.it/flair/>).

- Member of the Scientific Committee of the 5th International Conference on Field Laser Application in Industry and Research (FLAIR 2016), Aix-les-Bains, France, 2016 (<http://flair2016.sciencesconf.org/>).

- Member of the Programme Committee of the CLEO-Europe/EQEC 2015, Section Precision Metrology and Frequency Combs, Munich, 21-25 June 2015.
- Member of the Scientific Committee of the 4th International Conference on Field Laser Application in Industry and Research (FLAIR 2014), Pratolino, Firenze, 2014 (<http://www.ino.it/flair/>).
- Chair of the ID-1 Session: "Frequency Standards and Spectroscopy", at the conference CLEO-Europe/IQEC 2013, Munich, 13 May 2013.
- Member of the Programme Committee of the CLEO-Europe/IQEC 2013, Section Precision Metrology and Frequency Combs, Munich, 12-16 May 2013 (<http://2013.cleoeurope.org/committees#eqec-2011-programme-committees>).
- Member of the Scientific Committee of the 3rd International Conference on Field Laser Application in Industry and Research (FLAIR 2011), Murnau, Germany.
- Member of the Programme Committee of the CLEO/EUROPE Conference 2011, Section EE – Precision Metrology and Fundamental Limits, Munich, 22-26 May 2011 (<http://2011.cleoeurope.org/conference/committees#eqec-2011-programme-committees>).
- Member of the Scientific Committee of the 4th International Workshop on Progress in Determining the Boltzmann Constant, Torino, 22-24 September 2009.
- Member of the Scientific Committee of the 2nd International Conference on Field Laser Application in Industry and Research (FLAIR 2009), Grainau, Germany, 2009.
- Chairman and co-organizer (with Erik Kerstel) of the 2nd International Workshop on "Stable Isotope Ratio Infrared Spectrometry", SIRIS 2007, Pratolino, Firenze, 7-8 September 2007.
- Member of the Scientific Committee of the FLAIR (Field Laser Application in Industry and Research) conference (Pratolino, Firenze), September 2007.
- Chairman and co-organizer (with Erik Kerstel) of the International Workshop on "Stable Isotope Ratio Infrared Spectrometry", SIRIS 2004, IAEA Building, Vienna, 6-8 September 2004.
- Co-chair of the International Workshop on "Optical Methods in Earth Sciences", OMES 2001, Bacoli, Napoli, 21-24 March 2001;
- Member of the organizing committee of the International Conference on "Spin-Statistics Connection and Commutation Relations", SPIN 2000, Capri, 31 May – 3 June 2000.
  
- External examiner for the final dissertations of many PhD programs of Italian and European universities.
- Regular referee for several international scientific journals, including: J. Chemical Physics, J. Quantitative Spectroscopy & Radiative Transfer, J. Optical Society of America B, Optics Express, Optics Letters, Physical Review A, Physical Review Letters; Applied Physics Letters.

#### • Awards

- Awarded by a NATO-NWO (Nederlandse Organisatie voor Wetenschappelijk Onderzoek) fellowship for senior scientists; title of the research program: "Accurate isotopic measurements in water by means of diode laser spectroscopy in the near infrared" (June 2002).
- Awarded by a CNR (National Research Council) fellowship for short-term mobility (Communication n. 055050, 18 June 1997).

- 99) Eugenio Fasci, Antonio Castrillo, Hemanth Dinesan, Stefania Gravina, Luigi Moretti, and **Livio Gianfrani**, "Precision spectroscopy of HD at 1.38  $\mu\text{m}$ ", submitted to *Phys. Rev. Lett.* (2018).
- 98) E. Fasci, H. Dinesan, L. Moretti, A. Merlone, A. Castrillo, and **L. Gianfrani**, "Dual-laser Frequency-Stabilized Cavity Ring-Down Spectroscopy for water vapor density measurements", *Metrologia*, in press (2018).
- 97) Edoardo Vicentini, Alessio Gambetta, Nicola Coluccelli, Eugenio Fasci, Antonio Castrillo, **Livio Gianfrani**, Valentina Di Sarno, Pasquale Maddaloni, Adina Ceausu-Velcescu, Paolo De Natale, Yuchen Wang, Toney T. Fernandez, Paolo Laporta, and Gianluca Galzerano, "Rovibrational fine structure and transition dipole moment of  $\text{CF}_3\text{H}$  by frequency-comb-assisted saturated spectroscopy at 8.6  $\mu\text{m}$ ", *J. Quant. Spectr. Rad. Transf.* **217**, 373-379 (2018).
- 96) A. Gambetta, E. Vicentini, N. Coluccelli, Y. Wang, T.T. Fernandez, P. Maddaloni, P. De Natale, A. Castrillo, **L. Gianfrani**, P. Laporta, and G. Galzerano, "Versatile Mid-Infrared Frequency-Comb referenced sub-Doppler spectrometer" *Applied Physics Letters Photonics* **3**, 046103 (2018).
- 95) J.-M. Hartmann, H. Tran, R. Armante, C. Boulet, A. Campargue, F. Forget, **L. Gianfrani**, I. Gordon, S. Guerlet, M. Gustafsson, J.T. Hodges, S. Kassi, D. Lisak, F. Thibault, G.C. Toon, "Recent advances in collisional effects on spectra of molecular gases and their practical consequences", *J. Quant. Spectr. Rad. Transf.* **213**, 178-227 (2018).
- 94) J. Fischer, B. Fellmuth, C. Gaiser, T. Zandt, L. Pitre, F. Sparasci, M. D. Plimmer, M. de Podesta, R. Underwood, G. Sutton, G. Machin, R. M. Gavioso, D. Madonna Ripa, P. P. M. Steur, J. Qu, X. J. Feng, J. Zhang, M. R. Moldover, S. P. Benz, D. R. White, **L. Gianfrani**, A. Castrillo, L. Moretti, B. Darquié, E. Moufarej, C. Daussy, S. Briaudeau, O. Kozlova, L. Risegari, J. J. Segovia, M. C. Martín and D. del Campo, "The Boltzmann project", *Metrologia* **55**, R1-R20 (2018).
- 93) R. Gotti, L. Moretti, D. Gatti, A. Castrillo, G. Galzerano, P. Laporta, **L. Gianfrani**, and M. Marangoni, "Cavity-ring-down Doppler-broadening primary thermometry", *Phys. Rev. A* **97**, 012512 1-5 (2018).
- 92) A. Gambetta, E. Vicentini, Y. Wang, N. Coluccelli, E. Fasci, **L. Gianfrani**, A. Castrillo, V. Di Sarno, L. Santamaria, P. Maddaloni, P. De Natale, P. Laporta, and G. Galzerano, "Absolute frequency measurements of  $\text{CHF}_3$  Doppler-free ro-vibrational transitions at 8.6  $\mu\text{m}$ ", *Opt. Lett.* **42**, 1911-1914 (2017).
- 91) T. A. Odintsova, E. Fasci, L. Moretti, E. J. Zak, O. L. Polyansky, J. Tennyson, **L. Gianfrani**, and A. Castrillo, "Highly accurate intensity factors of pure  $\text{CO}_2$  lines near 2  $\mu\text{m}$ ", *J. Chem. Phys.* **146**, 244309 1-9 (2017).
- 90) S. Wójtewicz, P. Wcislo, P. Amodio, **L. Gianfrani**, D. Lisak and R. Ciurylo, "Dispersion and relativistic corrections to the spectral line-shape models", *J. Physics: Conference Series* **810**, 012062 1-3 (2017).
- 89) E. Fasci, T. Odintsova, A. Castrillo, M.D. De Vizia, A. Merlone, F. Bertiglia, L. Moretti and **L. Gianfrani**, "Dual-laser absorption spectroscopy of  $\text{C}_2\text{H}_2$  at 1.4  $\mu\text{m}$ ", *Phys. Rev. A* **93**, 042513 1-9 (2016).
- 88) M.D. De Vizia, T. Odintsova, and **L. Gianfrani**, "Hyperfine structure effects in Doppler-broadening thermometry on water vapor at 1.4  $\mu\text{m}$ ", *Metrologia* **53**, 800-804 (2016).
- 87) R. M. Gavioso, D. Madonna Ripa, P.P.M. Steur, C. Gaiser, T. Zandt, B. Fellmuth, M. de Podesta, R. Underwood, G. Sutton, L. Pitre, F. Sparasci, L. Risegari, **L. Gianfrani**, A. Castrillo and G. Machin, "Progress towards the determination of thermodynamic temperature with ultra-low uncertainty", *Phil. Trans. R. Soc. A.* **374**: 20150046 1-12 (2016).

- 86)** L. Gianfrani, "Linking the thermodynamic temperature to an optical frequency: Recent advances in Doppler Broadening Thermometry", *Phil. Trans. R. Soc. A.* **374**: 20150047 1-23 (2016).
- 85)** A. Gambetta, N. Coluccelli, M. Cassinero, T. T. Fernandez, D. Gatti, A. Castrillo, A. Ceausu-Velcescu, E. Fasci, L. Gianfrani, L. Santamaria, V. Di Sarno, P. Maddaloni, P. De Natale, P. Laporta, and G. Galzerano "Frequency-comb-assisted precision laser spectroscopy of CHF<sub>3</sub> around 8.6 μm", *J. Chem. Phys.* **143**, 234202 1-6 (2015).
- 84)** P. Amodio, M.D. De Vizia, L. Moretti, and L. Gianfrani, "Investigating the ultimate accuracy of Doppler Broadening Thermometry by means of a global fitting procedure", *Physical Review A* **92**, 032506 1-8 (2015).
- 83)** E. Fasci, M.D. De Vizia, A. Merlone, L. Moretti, A. Castrillo, and L. Gianfrani, "The Boltzmann constant from the H<sub>2</sub><sup>18</sup>O vibration-rotation spectrum: Complementary tests and revised uncertainty budget", *S233-S241 Metrologia* **52** (2015).
- 82)** P. Wcislo, P. Amodio, R. Ciurylo, and L. Gianfrani, "Relativistic formulation of the Voigt profile", *Physical Review A* **91**, 022508 1-6 (2015).
- 81)** H. Dinesan, E. Fasci, A. D'Addio, A. Castrillo, and L. Gianfrani, "Characterization of the frequency stability of an optical frequency standard at 1.39 μm based upon noise-immune cavity-enhanced optical heterodyne molecular spectroscopy", *Optics Express* **23**, 1757-1766 (2015).
- 80)** A. Gambetta, M. Cassinero, N. Coluccelli, E. Fasci, A. Castrillo, L. Gianfrani, D. Gatti, M. Marangoni, P. Laporta, and G. Galzerano, "Direct phase-locking of a 8.6-μm quantum cascade laser to a mid-IR optical frequency comb: application to precision spectroscopy of N<sub>2</sub>O", *Optics Letters* **40**, 304-307 (2015).
- 79)** E. Fasci, N. Coluccelli, M. Cassinero, A. Gambetta, L. Hilico, L. Gianfrani, P. Laporta, A. Castrillo, and G. Galzerano, "Narrow-linewidth quantum cascade laser at 8.6 μm", *Optics Letters* **39**, 4946 (2014).
- 78)** H. Dinesan, E. Fasci, A. Castrillo, and L. Gianfrani, "Absolute frequency stabilization of an extended-cavity diode laser by Noise-Immune Cavity-Enhanced Optical Heterodyne Molecular Spectroscopy", *Optics Letters* **39**, 2198-2201 (2014).
- 77)** A. Castrillo, L. Moretti, E. Fasci, M. D. De Vizia, G. Casa, and L. Gianfrani, "The Boltzmann constant from the shape of a molecular spectral line", *J. Molecular Spectroscopy*, Special Issue "Molecular spectroscopy tests of Fundamental Physics", vol. **300**, 131-138 (2014).
- 76)** F. Rohart, S. Mejri, P.L.T. Sow, S.K.Tokunaga, C. Chardonnet, B. Darquié, H. Dinesan, E. Fasci, A. Castrillo, L. Gianfrani, and C. Daussy, "Absorption line shape recovery beyond the detection bandwidth limit: application to the Boltzmann constant determination", *Physical Review A* **90**, 042506, 1-12 (2014).
- 75)** J. Tennyson, P. F. Bernath, A. Campargue, A. G. Csaszar, L. Daumont, R. R. Gamache, J. T. Hodges, D. Lisak, O. V. Naumenko, L. S. Rothman, H. Tran, N.F. Zobov, J. Buldyreva, C.D. Boone, M.D. De Vizia, L. Gianfrani, J. M. Hartmann, R. McPheat, D. Weidmann, J. Murray, N.H. Ngo, O.L. Polyansky, "Recommended isolated-line profile for representing high-resolution spectroscopic transitions", *Pure and Applied Chemistry* **86**, 1931-1943 (2014).
- 74)** M. D. De Vizia, A. Castrillo, E. Fasci, P. Amodio, L. Moretti, and L. Gianfrani, "Experimental test of the quadratic approximation in the partially correlated speed-dependent hard-collision profile", *Physical Review A* **90**, 022503 (2014).
- 73)** P. Amodio, L. Moretti, A. Castrillo, and L. Gianfrani, "Line-narrowing effects in the near-infrared spectrum of water and precision determination of spectroscopic parameters", *J. Chemical Physics* **140**, 044310, 1-7 (2014);

- 72)** Gatti D, Mills A A, De Vizia M D, Mohr C, Hartl I, Marangoni M, Fermann M, **Gianfrani L**, "Frequency-comb-calibrated Doppler broadening thermometry", *Physical Review A*, vol. **88**, 012514, 1-5 (2013).
- 71)** Moretti L, Castrillo A, Fasci E, De Vizia M D, Casa G, Galzerano G, Merlone A, Laporta P, **Gianfrani L**, "Determination of the Boltzmann Constant by Means of Precision Measurements of H<sub>2</sub><sup>18</sup>O Line Shapes at 1.39 μm", *Physical Review Letters*, vol. **111**, 060803, 1-5 (2013).
- 70)** R. Fedele, A. Mannan, F. Tanjia, S. De Nicola, D. Jovanovia, and **L. Gianfrani**, "Modulational instability analysis of the cylindrical nonlinear von Neumann equation", *J. Plasma Physics* **79**, 443-446 (2013)
- 69)** J.-M. Hartmann, H. Tran, N.H. Ngo, X. Landsheere, P. Chelin, Y. Lu, A.-W. Liu, S.-M. Hu, **L. Gianfrani**, G. Casa, A. Castrillo, M. Lepere, Q. Deliere, M. Dhyne, L. Fissiaux, "Ab initio calculations of the spectral shapes of CO<sub>2</sub> isolated lines including non-Voigt effects and comparisons with experiments", *Physical Review A* **87**, 013403 1-11 (2013).
- 68)** H. Tran, N. H. Ngo, J.-M. Hartmann, R. R. Gamache, D. Mondelain, S. Kassi, A. Campargue, **L. Gianfrani**, A. Castrillo, E. Fasci, and F. Rohart, *J. Chemical Physics* **138**, 034302 1-8 (2013).
- 67)** A. Castrillo, A. Gambetta, D. Gatti, G. Galzerano, P. Laporta, M. Marangoni, **L. Gianfrani**, "Absolute molecular density determinations by direct referencing of a quantum cascade laser to an optical frequency comb", *Applied Physics B* **110**, 155-162, DOI 10.1007/s00340-012-5013-x (2013).
- 66)** **L. Gianfrani**, "Highly-accurate line shape studies in the near-IR spectrum of H<sub>2</sub><sup>18</sup>O: Implications for the spectroscopic determination of the Boltzmann constant", *J. Physics: Conference Series* **397**, 012029 1-8 (2012).
- 65)** A. Castrillo, H. Dinesan, G. Casa, G. Galzerano, P. Laporta, and **L. Gianfrani**, "Amount-ratio determinations of water isotopologues by dual-laser absorption spectrometry", *Physical Review A* **86**, 052515 1-8 (2012).
- 64)** A. Mills, D. Gatti, J. Jiang, C. Mohr, W. Mefford, I. Hartl, M. Fermann, **L. Gianfrani**, and M. Marangoni, "Coherent phase lock of a 9 μm quantum cascade laser to a 2 μm Thulium optical frequency comb", *Optics Letters* **37**, 4083 (2012).
- 63)** A. Gambetta, D. Gatti, A. Castrillo, N. Coluccelli, G. Galzerano, P. Laporta, **L. Gianfrani**, M. Marangoni, "Comb-assisted spectroscopy of CO<sub>2</sub> absorption profiles in the near- and mid-infrared regions", *Applied Physics B* **109**, 385-390, DOI 10.1007/s00340-012-4947-3 (2012).
- 62)** M.D. De Vizia, A. Castrillo, E. Fasci, L. Moretti, F. Rohart, and L. Gianfrani, "Speed dependence of collision parameters in the H<sub>2</sub><sup>18</sup>O near-IR spectrum: Experimental test of the quadratic approximation", *Physical Review A* **85**, 062512 1-8 (2012).
- 61)** A. Gambetta, D. Gatti, A. Castrillo, G. Galzerano, P. Laporta, **L. Gianfrani**, and M. Marangoni, "Mid-infrared quantitative spectroscopy by comb-referencing of a quantum-cascade-laser: Application to the CO<sub>2</sub> spectrum at 4.3 μm", *Applied Physics Letters* **99**, 251107 (2011)
- 60)** M.D. De Vizia, L. Moretti, A. Castrillo, E. Fasci, **L. Gianfrani**, "The lineshape problem in Doppler-width thermometry", *Mol. Phys.* **109**, 2291 (2011).
- 59)** A. Castrillo, M.D. De Vizia, L. Moretti, G. Galzerano, P. Laporta, A. Merlone, **L. Gianfrani**, "Doppler-width thermodynamic thermometry based upon line-absorbance analysis", *Physical Review A* **84**, 032510 (2011).
- 58)** D. Gatti, A. Gambetta, A. Castrillo, G. Galzerano, P. Laporta, **L. Gianfrani**, M. Marangoni: "High-precision molecular interrogation by direct referencing of a quantum-cascade-laser to a near-infrared frequency comb", *Optics Express* **19**, 17520-17527 (2011).

- 57) M. De Vizia, F. Rohart, A. Castrillo, E. Fasci, L. Moretti, and **L. Gianfrani**: "Investigation on speed-dependent effects in the near-IR spectrum of self-colliding  $\text{H}_2^{18}\text{O}$  molecules", *Physical Review A* **83**, 052506 (2011).
- 56) G. Galzerano, A. Gambetta, E. Fasci, A. Castrillo, M. Marangoni, P. Laporta, and **L. Gianfrani**: "Absolute frequency measurement of a water stabilized diode laser at  $1.384\ \mu\text{m}$  by means of a fiber frequency comb", *Applied Physics B* **102**, 725–729 (2011).
- 55) A. Castrillo, E. Fasci, G. Galzerano, G. Casa, P. Laporta, and **L. Gianfrani**: "Offset-frequency locking of extended-cavity diode lasers for precision spectroscopy of water at  $1.38\ \mu\text{m}$ ", *Optics Express* **18**, 21851-21860 (2010).
- 54) A. Gambetta, E. Fasci, A. Castrillo, M. Marangoni, G. Galzerano, G. Casa, P. Laporta, and **L. Gianfrani**: "Frequency metrology in the near-infrared spectrum of  $\text{H}_2^{17}\text{O}$  and  $\text{H}_2^{18}\text{O}$  molecules: testing a new inversion method for energy levels retrieval", *New Journal of Physics* **12**, 103006 (2010).
- 53) A. Merlone, F. Moro, A. Castrillo, and **L. Gianfrani**: "Design and capabilities of a temperature control system for the Italian experiment based upon precision laser spectroscopy for a new determination of the Boltzmann constant", *Int. J. of Thermophysics* **31**, 1360-1370 (2010).
- 52) S. Bartalini, S. Borri, P. Cancio, A. Castrillo, I. Galli, G. Giusfredi, D. Mazzotti, **L. Gianfrani**, and P. De Natale: "Observing the intrinsic linewidth of a quantum-cascade laser: beyond the Schawlow-Townes limit", *Physical Review Letters* **104**, 083904 (2010).
- 51) A. Castrillo, G. Casa, A. Merlone, G. Galzerano, P. Laporta, and **L. Gianfrani**: "On the determination of the Boltzmann constant by means of precision molecular spectroscopy in the near-infrared", *Comptes Rendus Physique* **10**, 894-906 (2009).
- 50) G. Galzerano, E. Fasci, A. Castrillo, N. Colluccelli, **L. Gianfrani**, and P. Laporta: "Absolute frequency stabilization of an extended-cavity diode laser against Doppler-free  $\text{H}_2^{17}\text{O}$  absorption lines at  $1.384\ \mu\text{m}$ ", *Optics Letters* **34**, 3107-3109 (2009).
- 49) G. Casa, R. Wehr, A. Castrillo, E. Fasci, and **L. Gianfrani**: "The line shape problem in the near-infrared spectrum of self-colliding  $\text{CO}_2$  molecules: experimental investigation and test of semiclassical models", *J. Chemical Physics* **130**, 184306 (2009).
- 48) S. Borri, S. Bartalini, I. Galli, P. Cancio, G. Giusfredi, D. Mazzotti, A. Castrillo, **L. Gianfrani**, and P. De Natale: "Lamb-dip-locked quantum-cascade laser for comb-referenced IR absolute frequency measurements", *Optics Express* **16**, 11637-11646 (2008).
- 47) E. Kerstel and **L. Gianfrani**: "Advances in Laser-based isotope ratio measurements: Selected applications", **Review Article**, *Applied Physics B* **92**, 439-449 (2008).
- 46) R. Wehr, S. Kassi, D. Romanini and **L. Gianfrani**: "Optical feedback cavity-enhanced absorption spectroscopy for *in situ* measurements of the ratio  $^{13}\text{C}:^{12}\text{C}$  in  $\text{CO}_2$ ", *Applied Physics B* **92**, 459-465 (2008).
- 45) G. Casa, A. Castrillo, G. Galzerano, R. Wehr, A. Merlone, D. Di Serafino, P. Laporta, and **L. Gianfrani**: "Primary gas thermometry by means of laser absorption spectroscopy: Determination of the Boltzmann constant", *Physical Review Letters* **100**, 200801 (2008).
- 44) E. De Tommasi, G. Casa, A. Castrillo, and **L. Gianfrani**: "An Efficient Approximation for a Wavelength-Modulated 2nd Harmonic Lineshape from a Voigt Absorption Profile", *J. Quant. Spectr. Rad. Transf.* **109**, 168-175 (2008).
- 43) A. Castrillo, G. Casa and **L. Gianfrani**: "Oxygen isotope ratio measurements in  $\text{CO}_2$  by means of a continuous-wave quantum cascade laser at  $4.3\ \mu\text{m}$ ", *Optics Letters* **32**, 3047-3049 (2007).
- 42) G. Casa, D.A. Parretta, A. Castrillo, R. Wehr, and **L. Gianfrani**: "Highly accurate determinations of  $\text{CO}_2$  line strengths using intensity-stabilized diode laser absorption spectrometry", *J. Chemical Physics* **127**, 084311 (2007).



- 41) S. Bartalini, P. Cancio, G. Giusfredi, D. Mazzotti, P. De Natale, S. Borri, I. Galli, T. Leveque, and **L. Gianfrani**: "Frequency-comb-referenced quantum-cascade laser at 4.4  $\mu\text{m}$ ", *Optics Letters* **32**, 988-990 (2007).
- 40) E. De Tommasi, G. Casa, and **L. Gianfrani**: "An intensity stabilised diode laser spectrometer for sensitive detection of  $\text{NH}_3$ ", *IEEE Trans. of Instrum. Meas.* **56**, 309-312 (2007).
- 39) S. Kassi, M. Chenevier, **L. Gianfrani**, A. Salhi, Y. Rouillard, A. Ouvrard, and D. Romanini: "Looking into the volcano with a mid-IR diode laser and cavity enhanced absorption spectroscopy", *Optics Express* **14**, 11442-11452 (2006).
- 38) E. De Tommasi, G. Casa, and **L. Gianfrani**: "High precision determinations of  $\text{NH}_3$  concentration by means of diode laser spectrometry at 2.005 micron", *Applied Physics B* **85**, 257-263 (2006).
- 37) A. Castrillo, E. De Tommasi, L. Sirigu, J. Faist and **L. Gianfrani**: "Doppler-free saturated-absorption spectroscopy of  $\text{CO}_2$  at 4.3 micron by means of a distributed feedback quantum cascade laser", *Optics Letters* **31**, 3040-3042 (2006).
- 36) A. Castrillo, G. Casa, A. Palmieri, and **L. Gianfrani**: "Measuring the  $^{13}\text{C}/^{12}\text{C}$  isotope ratio in atmospheric  $\text{CO}_2$  by means of laser absorption spectrometry: A new perspective based on a 2.05- $\mu\text{m}$  diode laser", *Isotopes in Environmental & Health Studies* **42**, 47-56 (2006).
- 35) P. De Natale, G. De Natale, G. Gagliardi, **L. Gianfrani**, A. Rocco, "Novel laser-based techniques for monitoring of volcanoes", *Annals of Geophysics* **48**, 767-773 (2005).
- 34) A. Castrillo, G. Casa, E. Kerstel, and **L. Gianfrani**: "Diode laser absorption spectrometry for  $^{13}\text{CO}_2/^{12}\text{CO}_2$  isotope ratio analysis: Investigation on precision and accuracy levels", *Applied Physics B*, **81**, 863-869 (2005).
- 33) A. Castrillo, G. Casa, M. van Burgel, D. Tedesco, and **L. Gianfrani**: "First field determination of the  $^{13}\text{C}/^{12}\text{C}$  isotope ratio in volcanic  $\text{CO}_2$  by diode-laser spectrometry", *Optics Express*, **12**, 6515-6523 (2004).
- 32) **L. Gianfrani**, A. Rocco, G. Battipaglia, A. Castrillo, G. Gagliardi, A. Peressotti, M.F. Cotrufo: "Assessing soil respiration by means of diode laser spectroscopy", *Appl. Spectr.*, **58**, 1051-1056 (2004).
- 31) A. Rocco, G. De Natale, P. De Natale, G. Gagliardi, and **L. Gianfrani**: "A diode-laser based spectrometer for in-situ measurements of volcanic gases", *Applied Physics B* **78**, 235-240 (2004).
- 30) **L. Gianfrani**, G. Gagliardi, M. van Burgel, and E.R.Th. Kerstel "Isotope analysis of water by means of near-infrared dual-wavelength diode laser spectroscopy", *Optics Express* **11**, 1566-1576 (2003).
- 29) A. Castrillo, G. Gagliardi, G. Casa, and **L. Gianfrani**: "Combined interferometric and absorption-spectroscopic technique for determining molecular line strengths: Applications to  $\text{CO}_2$ ", *Physical Review A* **67**, 062503 (2003).
- 28) G. Gagliardi, A. Castrillo, R.Q. Iannone, E. Kerstel, and **L. Gianfrani**: "High-precision determination of the  $^{13}\text{CO}_2/^{12}\text{CO}_2$  isotope ratio using a portable 2.008-micron diode-laser spectrometer", *Applied Physics B* **77**, 119-124 (2003).
- 27) E.R.Th. Kerstel, G. Gagliardi, **L. Gianfrani**, H.A.J. Meijer, R. van Trigt, and R. Ramaker: "Determination of the  $^2\text{H}/^1\text{H}$ ,  $^{17}\text{O}/^{16}\text{O}$ , and  $^{18}\text{O}/^{16}\text{O}$  isotope ratios in water by means of tunable diode laser spectroscopy at 1.39  $\mu\text{m}$ ", *Spectr. Acta A* **58**, 2389-2396 (2002).
- 26) G. Gagliardi, R. Restieri, G. Casa, and **L. Gianfrani**: "Chemical and isotopic analysis using diode laser spectroscopy: applications to volcanic gas monitoring", *Opt. Las. Eng.* **37**, 131-142 (2002).
- 25) G. Gagliardi and **L. Gianfrani**: "Trace-gas analysis using diode lasers in the near-IR and long-path techniques", *Opt. Las. Eng.* **37**, 509 (2002).

- 24) G. Gagliardi, R. Restieri, G. De Biasio, P. De Natale, F. Cotrufo, and **L. Gianfrani**: "Quantitative diode-laser absorption spectroscopy near 2  $\mu\text{m}$  with high precision measurements of  $\text{CO}_2$  concentration", *Rev. Sci. Instr.* 72, 4228-4233 (2001).
- 23) P. De Natale, **L. Gianfrani**, and G. De Natale: "Optical methods for monitoring of volcanoes: techniques and new perspectives", *J. Volc. Geotherm. Res.* 109, 235-245 (2001).
- 22) L. Moretti, A. Sasso, **L. Gianfrani**, and R. Ciurylo: "Collisional-broadened and Dicke-narrowed line shapes of  $\text{H}_2^{16}\text{O}$  and  $\text{H}_2^{18}\text{O}$  transitions at 1.39  $\mu\text{m}$ ", *J. Mol. Spectroscopy* 205, 20-27 (2001).
- 21) G. Gagliardi, G. Rusciano, and **L. Gianfrani**: "Ultra-narrow  $\text{H}_2^{18}\text{O}$  lines and new absolute frequency references in the near-IR", *J. Opt. A* 2, 310-313 (2000).
- 20) G. Gagliardi, G. Rusciano, and **L. Gianfrani**: "Sub-Doppler spectroscopy of  $\text{H}_2^{18}\text{O}$  at 1.4  $\mu\text{m}$ ", *Applied Physics B* 70, 883-888 (2000).
- 19) **L. Gianfrani**, P. De Natale and G. De Natale: "Remote sensing of volcanic gases with a DFB-laser based spectrometer", *Applied Physics B* 70, 467-470 (2000).
- 18) **L. Gianfrani**, R.W. Fox, and L. Hollberg: "Cavity enhanced absorption spectroscopy of molecular oxygen", *J. Optical Society of America B* 16, 2247-2254 (1999).
- 17) S. Viciani, **L. Gianfrani**, M. Inguscio and P. De Natale: "Magnetic fields effects on molecular transitions in the far infrared region: prospects for more sensitive spectrometers", *J. Optical Society of America B* 16, 301 (1999).
- 16) P. De Natale, **L. Gianfrani**, S. Viciani, and M. Inguscio: "First spectroscopic observation of the faraday effect in far infrared region", *Optics Letters*, 22, 1896 (1997).
- 15) **L. Gianfrani**, M. Gabrysch, C. Corsi, and P. De Natale: "Detection of  $\text{H}_2\text{O}$  and  $\text{CO}_2$  using DFB diode lasers: measurement of broadening coefficients and assessment of the accuracy levels for volcanic monitoring", *Appl. Opt.*, 36, 9481 (1997).
- 14) **L. Gianfrani**, M.R. Santovito, and A. Sasso: "Pressure broadening investigation of  $\text{NO}_2$  spectrum in the near IR", *J. Mol. Spect.*, 186, 207 (1997).
- 13) G. Gagliardi, **L. Gianfrani**, and G.M. Tino: "Investigation of the  $b^1\Sigma_g^+ (v=0) \leftarrow X^3\Sigma_g^- (v=0)$  magnetic dipole transitions in  $^{18}\text{O}_2$ ", *Physical Review A* 55, 4597 (1997).
- 12) **L. Gianfrani**, G. Gagliardi, G. Pesce, and A. Sasso: "High sensitivity detection of  $\text{NO}_2$  by using a 740 nm semiconductor diode laser", *Applied Physics B* 64, 487 (1997).
- 11) **L. Gianfrani**, A. Sasso, and G.M. Tino: "Monitoring of  $\text{O}_2$  and  $\text{NO}_2$  using tunable diode lasers in the near-infrared region", *Sensors and Actuators B* 39, 283 (1997).
- 10) M. de Angelis, **L. Gianfrani**, F. Pavone, A. Sasso, G.M. Tino: "Temperature dependence of self-broadening in molecular oxygen spectrum", *Il Nuovo Cimento D* 18, 557 (1996).
- 9) M. de Angelis, G. Gagliardi, **L. Gianfrani**, and G.M. Tino: "Test of the symmetrization postulate for spin 0-particles", *Physical Review Letters* 76, 2840 (1996).
- 8) P. Cangiano, M. de Angelis, **L. Gianfrani**, G. Pesce and A. Sasso: "Hyperfine structure and isotope shift investigations of atomic nitrogen by saturation spectroscopy"; *Phys. Rev A* 50, 1082 (1994).
- 7) **L. Gianfrani**, and G.M. Tino: "High resolution spectroscopy of iridium in a hollow cathode discharge"; *Z. Phys. D* 25, 113 (1993).
- 6) G.M. Tino, M. Barsanti, M. de Angelis, **L. Gianfrani**, and M. Inguscio: "Spectroscopy of the 689 nm intercombination line of strontium using an extended-cavity InGaP/InGaAlP diode laser"; *Applied Physics B* 55, 397 (1992).
- 5) M. Barsanti, **L. Gianfrani**, F. Pavone, A. Sasso, C. Silvestrini, and G.M. Tino: "Isotope Shifts and Hyperfine Structures Investigation of Doubly Excited Levels in SrI"; *Z. Phys. D* 23, 145 (1992).

- 4) **L. Gianfrani**, A. Sasso, G.M. Tino, and F. Marin: "Polarization spectroscopy of atomic oxygen by dye and semiconductor diode lasers"; *Il Nuovo Cimento D13*, 1221 (1991).
- 3) **L. Gianfrani**, O. Monda, A. Sasso, M.I. Schisano, G.M. Tino, and M. Inguscio: "Visible and ultraviolet high resolution spectroscopy of TiI and TiII"; *Opt. Comm.* 83, 300 (1991).
- 2) M. Francesconi, **L. Gianfrani**, M. Inguscio, P. Minutolo, A. Sasso, and G.M. Tino: "A new approach to impedance spectroscopy"; *Applied Physics B51*, 87-90 (1990).
- 1) **L. Gianfrani**, A. Sasso, G.M. Tino, and M. Inguscio: "Experimental indication of a nuclear volume contribution to the isotope shift of atomic oxygen"; *Opt. Comm.* 78, 2, 158-162 (1990).

#### TUTORIAL PUBLICATIONS

---

- 1) D. Gatti, T. Sala, M. Marangoni, G. Galzerano, and **L. Gianfrani**, "Precision Molecular Spectroscopy with Frequency Combs", *Encyclopedia of Analytical Chemistry*, John Wiley & Sons, Ltd., pp. 1-20, 2012. DOI: 10.1002/9780470027318.a9249.

#### PUBLICATIONS ON INTERNATIONAL MAGAZINES

---

- 1) **L. Gianfrani**, P. De Natale: "Remote measurements of volcanic gases with a diode-laser-based spectrometer", *Optics and Photonics News* **11**, 44 (2000).
- 2) D. Tedesco, A. Castrillo, G. Casa, O. Vaselli, and **L. Gianfrani**: "Field Carbon Isotope analysis of Volcanic Gases: A New Frontier in Isotope Geochemistry", *Eos Trans. AGU*, **86**, 510 (2005).
- 3) F. K. Tittel, D. Weidmann, C. Oppenheimer and **L. Gianfrani**: "Laser Absorption Spectroscopy for Volcano Monitoring", *Optics & Photonics News* **17**, 5, 24-31 (2006).
- 4) S. Bartalini, S. Borri, P. Cancio, A. Castrillo, I. Galli, G. Giusfredi, D. Mazzotti, **L. Gianfrani** and P. De Natale: "Quiet cascade: Measuring QCL intrinsic linewidth", *Optics & Photonics News* **12**, 32 (2010).

#### EDITORIALS FOR SPECIAL ISSUES

---

- 1) P. Ferraro, G. De Natale, P. De Natale, and **L. Gianfrani**: "Optical Methods in Earth Sciences", Editorial to a special issue, *Opt. Las. Eng.* **37**, 87-89 (2002).
- 2) E. Kerstel and **L. Gianfrani**: "Stable Isotope Ratio Infrared Spectrometry: New Developments and Applications", Editorial to a special issue, *Isotopes in Environmental & Health Studies* 41, 289-291 (2005).