Mariangela Gioannini

Dipartimento di Elettronica e Telecomunicazioni,
Politecnico di Torino, Torino, Italy
Email: mariangela.gioannini@polito.it

PERSONAL PROFILE

Associate Professor at the Department of Electronics and Telecommunication at Politecnico di Torino, Italy. My research field is on modelling of optoelectronic devices with focus on semiconductor laser sources and non-linear laser dynamics for optical communications, optical interconnect and sensing. As an Electronic Engineer, I'm interested in bringing modelling of semiconductor lasers as close as possible to the device design, experimental characterization, and final application. I see modelling as a tool that helps scientists and engineers in guiding experiments, understanding deeply their experimental findings and envision new device applications. Most of my modelling work is carried on in close contact with experimental research laboratories and industrial partners.

Personal links: MGioannini_Profile
MGioanini_Scopus
MGioannini_GScholar

EDUCATION

01/1999 – 02/2002 PhD in Electronics and Communication Engineering,
Politecnico di Torino, Italy
Thesis: Analysis and design of multi-section semiconductor lasers for applications to DWDM and OTDM optical transmission systems.

10/1992 – 12/1998 Master Degree (5 years curriculum) in Electronic Engineering
Politecnico di Torino, Italy
Thesis: Design and realization of fiber Bragg gratings
Honors: summa cum laude

PROFESSIONAL APPOINTMENTS

11/2014 – Present Associate Professor
Department of Electronics and Telecommunication, Politecnico di Torino Italy

- Professor of the course *Optoelectronics* of Master Degree in Electronic Engineering and of the Course Applied Electronics of the Bachelor Degree in Computer Engineering
- I'm currently coordinating a small research group of students and post-docs.
- Member of the *Microwave and Optoelectronics Research Group* of the Department
- Member of the management committee of the *Interdepartmental Centre for Applied Photonics* (Photonext) of Politecnico di Torino

11/2017 National Scientific Qualification for Full Professor Position (discipline Electronics)

01/2005 – 10/2014 Assistant Professor
Department of Electronics and Telecommunication, Politecnico di Torino Italy

- Professor in undergraduate courses of Applied Electronics and Electronics for Telecommunication
- Research activity in the frame of EU projects for development of InAs/GaAs quantum dot based optoelectronics (laser diodes for telecom, semiconductor optical amplifiers, SLDs). I developed

the modelling of quantum dot SLDs for optical coherent tomography, the model for quantum dot DFB lasers and the model of intermediate band solar cells based on quantum dots.

03/2002 – 12/2004 Post-Doc Fellowship

Department of Electronics and Telecommunication, Politecnico di Torino Italy

- Research position funded by the EU Project "BigBand" "Ultra Wide band InP based quantum dot devices and applications covering the 1.4-1.65 μm wavelength range". Development of a model to study the optical gain properties of inhomogeneously broadened quantum dash material Theoretical study of the linewidth enhancement factor in inhomogeneously broadened quantum dot lasers.

02/2001-05/2001 Visiting Researcher

Centre for Communications Research, Dept of Electrical and Electronic Engineering, University of Bristol

- Investigation of 2-D-lattice distributed reflector lasers

2001 and 2002 Short Term Research Visits

Fraunhofer Institut für Nachrichtentechnik, Heinrich-Hertz-Institut, Berlin, Germany

- Experimental characterization of gain and saturable absorber session of QW passive mode-locked lasers

RESEARCH EXPERIENCE AND PROJECTS

01/2016 – present <u>Modelling, design and experimental characterization of lasers for silicon photonics platform:</u>

- Design of III-V/Si lasers for narrow linewidth, high tolerance to external optical feedback and isolator free operation
- Experimental characterization and modelling of non-linear effects in silicon photonic mirrors based on silicon micro-rings
- Physics-based modelling of InAs/GaAs quantum dot lasers epitaxially grown on silicon including electrical model of carrier transport

Fundings: Principal Investigator of several Sponsored Research Agreements supported by CISCO Systems (San Josè, US)

11/2016-present <u>Development of a simulator for the study of the self-generation of optical frequency combs is semiconductor lasers in both ring and Fabry Perot configurations and in various semiconductor platforms:</u>

- InAs/GaAs Quantum Dot lasers at 1.3 μm
- Quantum Cascade Lasers in the Mid-IR.

Fundings: Principal Investigator of Italian National Project funded by Fondazione CRT; Principal Investigator of industry sponsored research contracts (Ranovus, Ottawa, Canada)

06/2017-11/2020 <u>Modelling of Photonic Cristal Microcavity Lasers</u> to assess the impact of Photonic Cristal waveguide dispersion (slow light) on laser performance
Collaboration with Technical University of Denmark (Prof. Jesper Mork's group)

01/2013-12/2015 <u>Modelling and design of GaAs Intermediate Band Solar Cells based on InAs Quantum Dot Material</u>
Funding: co-Principal Investigator of research contract supported by US Army Research Laboratory

03/2002-01/2015 <u>Modelling and design of photonics devices based on InAs/GaAs Quantum Dot devices:</u>

- Superluminescent Light Emitting Diodes for Optical Coherent Tomography
- InAs/GaAs Quantum Dot lasers for optical communication
- InAs/GaAs Quantum Dot lasers for self-mixing velocimetry

Funding: participation to 4 EU Research Projects (BigBand, NanoUB, FastDot, Delight) under frameworks FP5, FP6 and FP7. Collaborations with Prof. Reithmeir's group, Prof. Eiseinstein's group, III-V Lab and Thales, Prof. Elsasser's group.

Research Collaborations with International Research Institutes and Industries:
With Academy: University Wurzburg, Germany (2002-2005); Technion Haifa, Israel (2002-2005); Technical University of Darmstadt, Germany (2009-2020); CNRS-INSA Rennes and Telecom ParisTech, France (2006-2009); Technical University of Denmark, Denmark (2017-2020)
With Industry:
CISCO Systems San José US and CISCO Optical Nuremberg, Germany (2016-present); Ranovus, Canada (2017-2019); Thales and III-V Lab (2003-2009); Innolume GmbH (2009-2012)

SERVICES

2013-2019	Member of the Technical Programme Committee of European Conference on Lasers and Electro-Optics (CLEO Europe), sub-committee: Semiconductor Lasers. In 2019 I have been sub-committee chair
2020-present	Member of the Europe Advisory Committee for the conferences “IEEE International Semiconductor Laser Conference (ISLC)” and “European Semiconductor Laser Workshop”
2019	Guest Editor of the IEEE Journal Selected Topics in Quantum Electronics, special issue “Semiconductor Lasers”
2020-2021	Guest Editor of MDPI Applied Science Special Issue “Quantum Dot Lasers and Laser Dynamics”
2018	Organization of the 2018 Edition of the European Semiconductor Laser Workshop, 21-22 September, Bari, Italy
2017	Organization of the International Workshop “Self-generation of optical frequency combs in semiconductor lasers”, 26-17 October, Torino, Italy
2002-present	Reviewer for the major journals in the field of optics and photonics: IEEE J. Quantum Electron; IEEE J. Select. Topics Quantum Electron., IEEE J. Lightwave Tech., Optics Express, Optics Letters, Applied Physics Letters,

INVITED TALKS

- M. Gioannini, "*FDTW Approach for Simulation of QD lasers and SOAs*", ISPALD-2013 "International Symposium on Physics and Applications of Laser Dynamics 2013", Parigi (FR), 29 -31 October 2013
  Organizers: Profs. F. Grillot and M. Sciamanna
- M. Gioannini, "*Numerical simulation and analysis of single section quantum dot lasers for optical comb generation*" ICTON 2016 "International Conference on Transparent Optical Network ICTON 2016", 12 July 2016, Trento, Italy
- M. Gioannini, "*Self-generation of optical frequency combs in single section quantum dot lasers: theory and numerical modelling*" SPIE Photonics Europe 2018, Strasburg (FR), 24 April 2018
- M. Gioannini "*Modelling self-pulsing and self-generation of optical frequency combs in QD lasers*" SPIE Photonics West, San Francisco (US), 1 February 2019
- M. Gioannini *"Modelling Self-generation of optical frequency combs in quantum dot lasers"*,"International Symposium on Physics and Applications of Laser Dynamics 2019", Metz (FR), 19 November 2019
  Organizers: Profs. F. Grillot and M. Sciamanna

PUBBLICATIONS

Publication index (Scopus database. February 2022):

- 112 conference and journal papers
- Citations (since 2000): 1126 (Scopus); 1355 (Google Scholar)
- H-index: 18 (Scopus); 20 (Google Scholar)

Entire list of publications is available at:
https://www.scopus.com/authid/detail.uri?authorId=6602360453

MOST RELEVANT JOURNAL PAPERS

Laser diodes for silicon photonic platform (2020-present)

- Marco Novarese, Sebastian Romero Garcia, Stefania Cucco, Don Adams, Jock Bovington, and **Mariangela Gioannini**, "Study of nonlinear effects and self-heating in a silicon microring resonator including a Shockley-Read-Hall model for carrier recombination," Opt. Express, 30, 14341-14357 (2022)
- Cristina Rimoldi, Lorenzo Luigi Columbo, Jock Bovington, Sebastian Romero-García, and **Mariangela Gioannini**, "Damping of relaxation oscillations, photon-photon resonance, and tolerance to external optical feedback of III-V/SiN hybrid lasers with a dispersive narrow band mirror," Opt. Express, 30, 11090-11109 (2022)
- Saldutti, M., Tibaldi, A., Cappelluti, F., **Gioannini, M.** *Impact of carrier transport on the performance of QD lasers on silicon: a drift-diffusion approach***,** (2020) Photonics Research, 8 (8), pp. 1388-1397.
- Columbo, L., Bovington, J., Romero-Garcia, S., Siriani, D.F., **Gioannini, M.** *Efficient and Optical Feedback Tolerant Hybrid Laser Design for Silicon Photonics Applications* (2020) IEEE Journal of Selected Topics in Quantum Electronics, 26 (2), art. no. 8861363

Self-generation of optical frequency combs in quantum dot laser diodes and quantum cascade lasers (2015-present)

- **Gioannini, M.,** Bardella, P., Montrosset, I. *Time-domain traveling-wave analysis of the multimode dynamics of quantum dot Fabry-Perot lasers,* (2015) IEEE Journal of Selected Topics in Quantum Electronics, 21 (6)
- Bardella, P., Columbo, L.L., **Gioannini, M.** *Self-generation of optical frequency comb in single section quantum dot Fabry-Perot lasers: A theoretical study* (2017) Optics Express, 25 (21)
- Columbo, L.L., Bardella, P., **Gioannini, M.** *Self-pulsing in single section ring lasers based on quantum dot materials: Theory and simulations* (2018) Optics Express, 26 (15)
- Pawlus, R., Columbo, L.L., Bardella, P., Breuer, S., **Gioannini, M.** *Intensity noise behavior of an InAs/InGaAs quantum dot laser emitting on ground states and excited states* (2018) Optics Letters, 43 (4), pp. 867-870
- Weber, C., Columbo, L.L., **Gioannini, M**., Breuer, S., Bardella, P. *Threshold behavior of optical frequency comb self-generation in an InAs/InGaAs quantum dot laser* (2019) Optics Letters, 44 (14), pp. 3478-3481
- Silvestri, C., Columbo, L.L., Brambilla, M., **Gioannini, M.** *Coherent multi-mode dynamics in a quantum cascade laser: Amplitude- A nd frequency-modulated optical frequency combs* (2020) Optics Express, 28 (16), pp. 23846-23861
- Prati, F., Lugiato, L.A., Gatti, A., Columbo, L., Silvestri, C., **Gioannini, M.,** Brambilla, M., Piccardo, M., Capasso, F. *Global and localised temporal structures in driven ring quantum cascade lasers* (2021) Chaos, Solitons and Fractals, 153, art. no. 111537
- Columbo, L., Piccardo, M., Prati, F., Lugiato, L.A., Brambilla, M., Gatti, A., Silvestri, C., **Gioannini, M**., Opačak, N., Schwarz, B., Capasso, F. *Unifying Frequency Combs in Active and Passive Cavities: Temporal Solitons in Externally Driven Ring Lasers*(2021) Physical Review Letters, 126 (17), art. no. 173903
- Prati, F., Brambilla, M., Piccardo, M., Columbo, L.L., Silvestri, C., **Gioannini, M.,** Gatti, A., Lugiato, L.A., Capasso, F. *Soliton dynamics of ring quantum cascade lasers with injected signal* (2021) Nanophotonics, 10 (1), pp. 195-207

Photonic Crystal Microcavity Lasers (2019-present)

- Saldutti, M., Bardella, P., Mork, J., **Gioannini, M.** *A simple coupled-Bloch-mode approach to study active photonic crystal waveguides and lasers* (2019) IEEE Journal of Selected Topics in Quantum Electronics, 25 (6), art. no. 8735893
- Saldutti, M., Rasmussen, T.S., **Gioannini, M.,** Mørk, J. *Theory of slow-light semiconductor optical amplifiers* (2020) Optics Letters, 45 (21), pp. 6022-6025

Semiconductor Quantum Dot and Quantum Dash materials and lasers (2004-2014)

- **Gioannini, M.** *Numerical modeling of the emission characteristics of semiconductor quantum dash materials for lasers and optical amplifiers* (2004) IEEE Journal of Quantum Electronics, 40 (4), pp. 364-373
- Reithmaier, J.P., Somers, A., Deubert, S., Schwertberger, R., Kaiser, W., Forchel, A., Calligaro, M., Resneau, P., Parillaud, O., Bansropun, S., Krakowski, M., Alizon, R., Hadass, D., Bilenca, A., Dery, H., Mikhelashvili, V., Eisenstein, G., **Gioannini, M.,** Montrosset, I., Berg, T.W., Van Der Poel, M., Mørk, J., Tromborg, B. *InP based lasers and optical amplifiers with wire-/dot-like active regions* (2005) Journal of Physics D: Applied Physics, 38 (13), pp. 2088-2102

- Somers, A., Kaiser, W., Reithmaier, J.P., Forchel, A., **Gioaninni, M.,** Montrosset, I. *Optical gain properties of InAs/InAlGaAs/InP quantum dash structures with a spectral gain bandwidth of more than 300 nm* (2006) Applied Physics Letters, 89 (6)
- **Gioannini, M.,** Montrosset, I. *Numerical analysis of the frequency chirp in quantum-dot semiconductor lasers* (2007) IEEE Journal of Quantum Electronics, 43 (10), pp. 941-949
- Blazek, M., Wolfgang Elsäßer, Hopkinson, M., Resneau, P., Krakowski, M., Rossetti, M., Bardella, P., **Gioannini, M.,** Montrosset, I. *Coherence function control of Quantum Dot Superluminescent Light Emitting Diodes by frequency selective optical feedback* (2009) Optics Express, 17 (16), pp. 13365-13372
- Grillot, F., Veselinov, K., **Gioannini, M.,** Montrosset, I., Even, J., Piron, R., Homeyer, E., Loualiche, S. *Spectral analysis of 1.55-μm InAs-InP(113)B quantum-dot lasers based on a multipopulation rate equations model* (2009) IEEE Journal of Quantum Electronics, 45 (7), pp. 872-878.
- **Gioannini, M**., Rossetti, M. *Time-domain traveling wave model of quantum dot DFB lasers* (2011) IEEE Journal on Selected Topics in Quantum Electronics, 17 (5), art. no. 27, pp. 1318-1326
- **Gioannini, M.** *Ground-state power quenching in two-state lasing quantum dot lasers* (2012) Journal of Applied Physics, 111 (4), art. no. 043108
- Gready, D., Eisenstein, G., **Gioannini, M.,** Montrosset, I., Arsenijevic, D., Schmeckebier, H., Stubenrauch, M., Bimberg, D. *On the relationship between small and large signal modulation capabilities in highly nonlinear quantum dot lasers* (2013) Applied Physics Letters, 102 (10), art. no. 101107
- **Gioannini, M.,** Dommermuth, M., Drzewietzki, L., Krestnikov, I., Livshits, D., Krakowski, M., Breuer, S. *Two-state semiconductor laser self-mixing velocimetry exploiting coupled quantum-dot emission-states: Experiment, simulation and theory* (2014) Optics Express, 22 (19), pp. 23402-23414

Third generation of solar cells based on quantum dot material (2013-2016)

- **Gioannini, M.,** Cedola, A.P., Di Santo, N., Bertazzi, F., Cappelluti, F. *Simulation of quantum dot solar cells including carrier intersubband dynamics and transport* (2013) IEEE Journal of Photovoltaics, 3 (4), art. no. 6556978, pp. 1271-1278
- Cappelluti, F., **Gioannini, M.,** Khalili, A. *Impact of doping on InAs/GaAs quantum-dot solar cells: A numerical study on photovoltaic and photoluminescence behavior* (2016) Solar Energy Materials and Solar Cells, 157, pp. 209-220