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Massimo Borghi

Date of birth: 07/05/1988 | **Nationality:** Italian | **Gender:** Male | **Phone number:** (+39) 3473892392 (Mobile) | **Email address:** massimo.borghi@unipv.it | **LinkedIn:** https://www.linkedin.com/in/massimo-borghi-9b6a2820a/ | **ORCID:** https://orcid.org/0000-0003-4137-0852 | **Skype:** massimo.borghi |

Address: Via per Novi, 7A, 41033, Concordia sulla Secchia (MO), Italy (Home) |

Address: Via Agostino Bassi, 6, Department of Physics, 27100, Pavia, Italy (Work)

EDUCATION AND TRAINING

01/01/2002 – 01/01/2007 Mirandola, Italy

DIPLOMA DI MATURITÀ SCIENTIFICA Liceo scientifico G.Galilei

Final grade 100

01/01/2007 – 24/09/2010 Modena, Italy

DIPLOMA DI LAUREA TRIENNALE IN FISCA Università degli Studi di Modena e Reggio Emilia

Final grade 110L

24/09/2010 – 26/09/2012 Trento, Italy

DIPLOMA DI LAUREA MAGISTRALE IN FISICA Università degli Studi di Trento

Final grade 110L | **Thesis** Disorder and optical nonlinearities in silicon on insulator microrings

01/11/2012 – 21/03/2016 Trento, Italy

PHD IN PHYSICS University of Trento

- Modeling and design of Silicon Photonics integrated components
- Experimental test of integrated Silicon Photonics devices
- Experience in modeling, design and validation of integrated photonic devices for linear, non linear and quantum optics
- Design and validation of experimental setups for quantum optics
- Supervision of master students
- Tutoring activities

Thesis Linear, nonlinear and quantum optics in silicon photonics

Link http://eprints-phd.biblio.unitn.it/1693/

WORK EXPERIENCE

01/04/2016 – 31/12/2017 Trento, Italy

POST DOCTORAL FELLOW NANOSCIENCE LABORATORY, UNIVERSITY OF TRENTO

1. Modeling, design and experimental validation of integrated photonic devices for nonlinear quantum optics applications
2. Setup of a laboratory for integrated quantum optics experiments
3. Work package leader of the provincial research project SIQURO (On silicon chip quantum optics for quantum compurting and secure communications)

Department Nanoscience Laboratory, Department of Physics | **Address** Via Sommarive 14, 38123, Trento, Italy

08/01/2018 – 22/03/2019 Bristol, United Kingdom

RESEARCH ASSOCIATE QUANTUM ENGINEERING AND TECHNOLOGY LAB, UNIVERSITY OF BRISTOL

1. Work package leader in European project SQUARE (Silicon Photonics for Quantum Fibre Newtorks)
2. Theory of new probabilitstic sources of photonic qubits based on multimode waveguides, single and coupled resonators
3. Experimental source characterization by both stimulated emission and quantum state tomography
4. Supervision of PhD students

Address H.H.Wills physics laboratory, BS8 1TL, Bristol, United Kingdom |

Website http://www.bristol.ac.uk/physics/research/quantum/

01/04/2019 – 03/04/2020 Vimercate, Italy

R&D WDM OPTICAL DEVELOPER SM OPTICS

1. Transmission tests on Wavelength Division Multiplexed optical networks
2. Impact of nonlinearities and non-idealities in the performance of Intensity Modulated and Coherent receivers
3. Supervision of master students of Politecnico Milano

Address Via John Fitzgerald Kennedy 2, 20871, Vimercate, Italy | **Website** https://www.sm-optics.com

01/05/2020 – 31/10/2021 Trento, Italy

POST DOCTORAL FELLOW NANOSCIENCE LABORATORY, UNIVERSITY OF TRENTO

1. Developement of models and innovative software for the description of hybrid photonic-biological neural networks
2. Photonic implementation of reservoir computing concepts using silicon microresonator nonlinearities
3. Supervision of PhD and master students
4. Work package leader of the H2020-EU.1.2.1 - FET (EPIQUS) Electronic Photonic Quantum Simulator Platform

Address Via Sommarive 14, 38123, Trento, Italy | **Website** http://nanolab.physics.unitn.it/

01/11/2021 – CURRENT Pavia, Italy

RTDA RESEARCHER DEPARTMENT OF PHYSICS, UNIVERSITY OF PAVIA

1. Design and experimental characterization of integrated photonic circuits for quantum applications
2. Supervision of PhD and master students
3. Lecturer and teaching support

LANGUAGE SKILLS

Mother tongue(s): **ITALIAN**

Other language(s):

	UNDERSTANDING		**SPEAKING**		**WRITING**
	Listening	Reading	Spoken production	Spoken interaction	
ENGLISH	C1	C1	C1	C1	C1

Levels: A1 and A2: Basic user; B1 and B2: Independent user; C1 and C2: Proficient user

DIGITAL SKILLS

Office tools | Comsol multiphysics | Lumerical FDTD | Matlab | Lab View | Python

Scientific output summary

I started to work on integrated optics during my master thesis in 2012, at the University of Trento. Here I developed a theoretical and experimental background in integrated silicon photonics, focusing on devices made by single and coupled ring resonators. In particular, I studied the impact of nonlinear losses caused by two photon absorption and free carrier absorption on the temporal dynamics of single and coupled resonators.

During my PhD I've delved into the nonlinear optics of integrated silicon devices, studying both second order and third order nonlinear optical processes. I have investigated the origin of electro-optic modulation in strained silicon. One of the major results was the demonstration that what was believed in literature to be attributed to electro-optic modulation was indeed due to free carrier dispersion. This work allowed us to set an upper limit to the magnitude of the strain-induced second order nonlinearity [1,2]. I have also extensively worked on multimodal Four Wave Mixing (FWM) for generating conjugate light beams bridging the near infrared to the mid-infrared. At the time of publication, this was the first demonstration on a chip [3]. Related works on FWM include the engineering of photonic molecules for enhanced light matter interaction [4] and a subject review on the topic of nonlinear silicon photonics [5].

During the last year of my PhD I have been the work package leader of a project on silicon quantum optics (SIQURO). Here I focused on the design and characterization of parametric photon pair sources based on spontaneous four wave mixing (SFWM), and in the development of passive photonic circuitry for multiphoton interference.

My growing interests in silicon quantum photonics led me to move at the Quantum Engineering and Technology Laboratories of the University of Bristol. Here I developed a strategy to measure the phase resolved joint spectral amplitude (JSA) of a photon pair source by exploiting a fully integrated approach [6], which allowed for the first time to measure complex JSA from an on-chip microresonator. Beside photon pair source characterization, I have conceived, designed and characterized a source based on multimodal SFWM that produces spectrally uncorrelated pairs (highly pure), with simultaneously high indistinguishability and heralding efficiency [7]. This invention was later patented in 2020. I have been also awork package leader in European project SQUARE (Silicon Photonics for Quantum Fibre Networks).

In 2020 I moved back to the University of Trento as a post-doctoral researcher, where I was involved in two projects. The first (EPIQUS), of which I was a work package leader, aimed to develop an integrated processor for implementing a variational quantum eigensolver on the silicon oxynitride platform. I extensively worked on the design and test of the active and passive optical components of the processor, and I have collaborated with external partners for the co-integration of the electronics driving the photonic circuitry. The second project (BACKUP) was aimed to develop a silicon chip for photonic neuromorphic computing. In this context, I have developed and tested new strategies for modeling the dynamics of silicon resonators under the simultaneous influence of nonlinear loss and nonlinear resonance frequency shifts [8], and applied these methodologies to give the first experimental demonstration of photonic reservoir computing using integrated silicon microresonators as network nodes [9].

SInce 2021 I am working as a RTDa researcher at the University of Pavia. Here I have contributed to the characterization and development of structured photon pair sources, i.e, sources incorporating multiple components for increased and extended performance metrics. Examples include the observation of the superradiant effect in arrays of silicon ring resonators [10] and the coherent combination of the photon pair emission from multiple rings to generate frequency encoded qubits [11] and qudits [12].

Recently I am investigating the properties of parametric sources beyond the single pair emission, focusing on the measurement of squeezing and of the related photon number distribution. I am also working on applications of frequency bin encoding for high dimensional quantum key distribution and multi-photon interference.

Selected publications

1. M.Borghi, M.Mancinelli, F.Merget, J.Witzens, M.Bernard, M.Ghulinyan, G.Pucker and L.Pavesi, “High-frequency electro-optic measurement of strained silicon racetrack resonators”, Opt. Lett., Vol. 40, pp.5287-5290, 2015.
2. M.Borghi, M.Mancinelli, M.Bernard, M.Ghulinyan, G.Pucker and L.Pavesi, “Homo-dyne detection of free carrier induced electro-optic modulation in strained silicon resonators”, J. Light. Technol., Vol. 34, no.24, pp. 5657-5668, 2016.
3. S.Signorini, M. Mancinelli, M.Borghi, M. Bernard, M. Ghulinyan, G. Pucker and L. Pavesi, “Intermodal four-wave mixing in silicon waveguides”, Phot. Research, Vol. 6, no. 8, pp. 805-814, 2018.
4. M.Borghi, A.Trenti and L.Pavesi, “Four Wave Mixing control in a photonic molecule made by Silicon microring resonators”, Sci. Rep., 9(1), 1-14, 2020.
5. M.Borghi, C.Castellan, S.Signorini, A.Trenti and L.Pavesi, “Nonlinear Silicon Photonics”, J. Opt., Vol. 19, No. 9, 2017.
6. M. Borghi, “Phase resolved joint spectra tomography of a ring resonator photon pair source using a silicon nanophotonic chip”, Opt. Express, Vol. 28, Issue 5, pp. 7442-7462, 2020.
7. S.Paesani*, M.Borghi*, S.Signorini*, A.Mainos, L.Pavesi and A.Laing, “Near ideal spontaneous photon sources in silicon quantum photonics, Nat. Commun., 11(1), 1-6, 2020.
8. M. Borghi, D. Bazzanella, M. Mancinelli and L. Pavesi, “On the modeling of thermal and free carrier nonlinearities in silicon-on-insulator microring resonators”, Opt. Express, 29(3), 4363-4377, 2021.
9. M. Borghi, S.Biasi and Lorenzo Pavesi. "Reservoir computing based on a silicon microring and time multiplexing for binary and analog operations." Sci. Rep. 11.1, 15642, 2021.
10. M.Borghi, F.A. Sabattoli, H. El Dirani, L.Youssef, C.Petit-Etienne, E.Pargon, J.E.Sipe, A. Mataji-Kojouri, M.Liscidini, C.Sciancalepore, M.Galli and D.Bajoni, "Superspontaneous four-wave mixing in an array of silicon microresonators." Phys. Rev. Appl., 18.3, 034007, 2022.

11. M. Clementi, F. A. Sabattoli, M. Borghi, L. Gianini, N.Tagliavacche, H. El Dirani, L. Youssef, N.Bergamasco, C.Petit-Etienne, E.Pargon, J. E. Sipe, M. Liscidini, C. Sciancalepore, M. Galli and D.Bajoni, “Programmable frequency-bin quantum states in a nano-engineered silicon device”, Nat. Commun., 14(1), 176, 2023.
12. M.Borghi, N.Tagliavacche, F.A.Sabattoli, H. El Dirani, L.Youssef, C.Petit-Etienne, E.Pargon, J.E.Sipe, M.Liscidini, C.Sciancalepore, M.Galli and D.Bajoni, "Reconfigurable Silicon Photonic Chip for the Generation Of Frequency-Bin-Entangled Qudits", Phys. Rev. Appl. 19.6, 064026, 2023.

* Equally contributing authors

Full list of publications

1. M.Mancinelli, M.Borghi, P.Bettotti, J.M. Fedeli and L.Pavesi, “An All Optical Method for Fabrication Error Measurements in Integrated Photonic Circuits”, J. Light. Technol., Vol. 31, pp. 2340-2346, 2013.
2. M.Mancinelli, M.Borghi, F.Ramiro Manzano, J.M. Fedeli and L.Pavesi, “Chaotic dynamics in coupled resonator sequences”, Opt. Express, Vol.22, pp.14505-14516, 2014.
3. M.Borghi, M.Mancinelli, F.Merget, J.Witzens, M.Bernard, M.Ghulinyan, G.Pucker and L.Pavesi, “High-frequency electro-optic measurement of strained silicon racetrack resonators”, Opt. Lett., Vol. 40, pp.5287-5290, 2015.
4. M.Borghi, M.Mancinelli, F.Merget, J.Witzens, M.Bernard, M.Ghulinyan, G.Pucker and L.Pavesi, “High-frequency electro-optic measurement of strained silicon racetrack resonators”, Proc. SPIE. 9891, Silicon Photonics and Photonic Integrated Circuits V, 98910D., 2016.
5. A. Trenti, M.Borghi, M.Mancinelli, G.Fontana and L.Pavesi, “One and two photon quantum interference in a Mach Zehnder interferometer”, Proc. SPIE. 9894, Nonlinear Optics and its Applications IV, 98940W, 2016.
6. A. Trenti, M. Borghi, M. Mancinelli, H.M. Price, G. Fontana, and L. Pavesi, “Quantum interference in an asymmetric Mach-Zehnder interferometer”, J. Opt., vol. 18, no. 085201, 2016.
7. M.Borghi, M.Mancinelli, M.Bernard, M.Ghulinyan, G.Pucker and L.Pavesi, “Homo-dyne detection of free carrier induced electro-optic modulation in strained silicon resonators”, J. Light. Technol., vol.34, no.24, pp. 5657-5668, 2016.
8. F. Ramiro-Manzano, S. Biasi, M. Bernard, M., Mancinelli, T. Chalyan, F. Turri, M. Ghulinyan, M. Borghi, A. Samusenko, D. Gandofi, R. Guider, A. Trenti, P.E. Larrè, L. Pasquardini, N. Prltjaga, S. Mana, I. Carusotto, G. Pucker and L. Pavesi, “Microring resonators and silicon photonics. MRS Adv., 1(48), 3281-3293, 2016.

9. M.Borghi, C.Castellan, S.Signorini, A.Trenti and L.Pavesi, “Nonlinear Silicon Photonics”, J. Opt., Vol. 19, No. 9, 2017.

10. S.Signorini, M.Borghi, M.Mancinelli, M.Bernard, M.Ghulinyan, G.Pucker and L.Pavesi, “Oblique beams interference for mode selection in multimode silicon waveguides”, J. Appl. Phys., Vol. 122, no. 11., 2017.

11. S. Signorini, M. Mancinelli, M.Borghi, M. Bernard, M. Ghulinyan, G. Pucker and L. Pavesi, “Intermodal four-wave mixing in silicon waveguides”, Phot. Research, Vol. 6 no. (8), 805-814, 2018.

12. A. Trenti, M. Borghi, S. Biasi, M. Ghulinyan, F. Ramiro-Manzano, G. Pucker, and L. Pavesi, “Thermo-optic coefficient and nonlinear refractive index of silicon oxynitride waveguides”, AIP Advances, vol. 8, no. (2), 025311, 2018.

13. C. Castellan, A. Chalyan, M. Mancinelli, P. Guilleme, M. Borghi, F. Bosia and L. Pavesi, “Tuning the strain-induced resonance shift in silicon racetrack resonators by their orientation”, Opt. Express, 26(4), 4204-4218, 2018.

14. M. Borghi, A. Trenti and L.Pavesi, “Four Wave Mixing control in a photonic molecule made by Silicon microring resonators”, Sci. Rep., 9(1), 1-14, 2020.

15. M. Borghi, “Phase resolved joint spectra tomography of a ring resonator photon pair source using a silicon nanophotonic chip”, Opt. Express, Vol. 28, Issue 5, pp. 7442-7462, 2020.

16. S. Paesani*, M. Borghi*, S. Signorini*, A. Mainos, L. Pavesi and A. Laing, “Near ideal spontaneous photon sources in silicon quantum photonics, Nat. Commun., 11(1), 1-6, 2020.

17. M. Borghi, D. Bazzanella, M. Mancinelli and L. Pavesi, “On the modeling of thermal and free carrier nonlinearities in silicon-on-insulator microring resonators”, Opt. Express, 29(3), 4363-4377, 2021.

18. M. Borghi, S. Biasi and Lorenzo Pavesi. "Reservoir computing based on a silicon microring and time multiplexing for binary and analog operations." Sci. Rep., 11.1, 15642, 2021.

19. D. Bazzanella, M. Mancinelli, M. Borghi, P. Bettotti and L. Pavesi, "PRECISE Photonic Hybrid Electromagnetic Solver.", IEEE Photonics J., 14.3, 1-10. 2022.

20. G. Piccoli, M. Sanna, M. Borghi, L. Pavesi and M. Ghulinyan, “Silicon oxynitride platform for linear and nonlinear photonics at NIR wavelengths”, Opt. Mat. Express, 12(9), 3551-3562, 2022.

21. M. Borghi and L. Pavesi. "Mitigating indistinguishability issues in photon pair sources by delayed-pump intermodal four wave mixing." Opt. Express 30.8, 12964-12981, 2022.

22. M.Borghi, F.A. Sabattoli, H. El Dirani, L.Youssef, C.Petit-Etienne, E.Pargon, J.E.Sipe, A. Mataji-Kojouri, M.Liscidini, C.Sciancalepore, M.Galli and D.Bajoni, "Superspontaneous four-wave mixing in an array of silicon microresonators." Phys. Rev. Appl., 18.3, 034007, 2022.

23. M. Clementi, F. A. Sabattoli, M. Borghi, L. Gianini, N. Tagliavacche, H. El Dirani, L. Youssef, N. Bergamasco, C. Petit-Etienne, E. Pargon, J. E. Sipe, M. Liscidini, C. Sciancalepore, M. Galli and D. Bajoni, Programmable frequency-bin quantum states in a nano-engineered silicon device, Nat. Commun., 14(1), 176, 2023.

24. M.Borghi, N. Tagliavacche, F.A.Sabattoli, H. El Dirani, L.Youssef, C.Petit-Etienne, E.Pargon, J.E.Sipe, M.Liscidini, C.Sciancalepore, M.Galli and D.Bajoni , "Reconfigurable Silicon Photonic Chip for the Generation Of Frequency-Bin-Entangled Qudits.", Phys. Rev. Appl. 19.6, 064026, 2023.

25. N. Leone, S. Azzini, S. Mazzucchi, V. Moretti, M. Sanna, M. Borghi, G. Piccoli, M. Bernard, M. Ghulinyan and L. Pavesi, "Generation of quantum-certified random numbers using on-chip path-entangled single photons from an LED", Phot. Research, Vol. 11, Issue 9, 2023.

26. I. Faruque, B. M. Burridge, M. Banic, M. Borghi, J. E. Sipe, J.G. Rarity and J. Barreto, "Quantum-referenced spontaneous emission tomography", Quantum Sci. Technol., Vol. 8, N. 4, 2023.

*Equally contributing authors

Books and book chapters

1. M. Borghi, D. Gandolfi, M. Ghulinyan, R. Guider, M. Mancinelli, G. Pucker, F. Ramiro Manzano, F. Turri, L. Pavesi, "Silicon microresonators: how to give a new twist to silicon photonics", book chapter in *Plenary Lectures on Nanoscience and Engineering,* ISBN: 9781628417951, 2015.

Invited talks at international conferences

1. M. Borghi, D. Gandolfi, M. Ghulinyan, R. Guider, M. Mancinelli, G. Pucker, F. Ramiro-Manzano, F. Turri and L.Pavesi, "Silicon microresonators: how to give a new twist to silicon photonics", ROMOpto 2015, 1-4 Settembre 2015, Bucharest, Romania.

2. M. Borghi and L.Pavesi, "Classical and Quantum Silicon Photonics", FisMat 2017, 5th October 2017, Trieste (Italy).

3. M. Borghi, "Integrated quantum photonics", 6th international symposium on Optics and its applications, 14th February 2018, Trento, Italy.

4. M. Borghi, "Integrated quantum photonics", 4th June 2018, ICPYS 2018, Kharkiv, Ukraine

5. M. Borghi, "Structured photon pair sources for on chip quantum state engineering", ICQP 2022, International Conference on Integrated Quantum Photonics, 5-7 October 2022, DTU Copenhagen (Denmark)

6. M. Borghi, N. Tagliavacche, M. Clementi, F. A. Sabattoli, L. Gianini, H. El Dirani, L. Youssef, N. Bergamasco, C. Petit-Etienne, E. Pargon, J.E. Sipe, M. Liscidini, C. Sciancalepore, M. Galli, and D. Bajoni, "Programmable silicon photonic sources of frequency bin entangled qubits and qudits", ICTON 2023, Bucharest, 2-6 July.

Invited talks in external institutions

1. M. Borghi, “Shaping and measuring quantum states of light with silicon photonic chips”, OSA YSU & NAS Student Chapter, IPR Armenia OSA Student Chapter, SPIE YSU Student Chapter, 2020
2. M. Borghi, D. Roberts, A. Jones, L. Pavesi and A. Laing, “Variational Quantum simulation on a silicon photonic chip”, Kick-off meeting of Nanoscience Laboratory at Department of Physics, 3 December 2021, University of Trento, Italy

Contributions to conferences

1. M.Borghi, M.Mancinelli, F.Ramiro Manzano, J.M.Fedeli and L.Pavesi, “Chaotic dynamics in coupled resonator sequences”, IEEE Group IV Photonics, 27th -29th August 2014, Paris, France. [**Oral contribution**] - **Awarded as “Best student oral presentation” by Nature Photonics.**

2. M.Borghi, M.Mancinelli, F.Ramiro Manzano, J.M.Fedeli and L.Pavesi, “Self pulsation and chaos in sequence of ring resonators”, SPIE Photonics Europe 2015, 14th -17th April 2014, Bruxelles, Belgium. **[Oral contribution]**
3. M.Borghi, M.Mancinelli, F.Merget, J.Witzens, M.Bernard, M.Ghulinyan, G.Pucker and L.Pavesi, “High-frequency electro-optic measurement of strained silicon racetrack resonators”, SPIE Photonics Europe 2016, 01st -08th April 2016, Bruxelles, Belgium. **[Oral contribution]**
4. M.Borghi, M.Mancinelli, F.Merget, J.Witzens, M.Bernard, M.Ghulinyan, G.Pucker and L.Pavesi, “Time resolved electro-optic measurements of straines silicon racetrack resonators”, ICTON 2016, 10th -14th July 2016, Trento, Italy. **[Oral contribution]**
5. M. Borghi, A.Trenti and L.Pavesi, “Controlling stimulated and spontaneous Four Wave Mixing in coupled microring resonators”, SPIE Photonics Europe, 23rd April 2018, Strasbourg, France. **[Oral contribution]**
6. M. Borghi, “Measuring the Joint Spectral Amplitude of photon pairs with a compact silicon chip”, IEEE Group IV Photonics, 7-10 December 2021, Malaga, Spain **[Oral contribution]**
7. M. Borghi, “Experimental demonstration of reservoir computing with a silicon microring and time multiplexing”, IEEE Group IV Photonics, 7-10 December 2021, Malaga, Spain **[Oral contribution]**
8. M. Borghi, A. M-Kojouri, F. A. Sabattoli, H. El Dirani, L. Youssef, C. Petit-Etienne, E. Pargon, J. E. Sipe, M. Liscidini, C. Sciancalepore, M. Galli, and D. Bajoni, “Cooperative spontaneous four-wave mixing in single-channel and dual-channel sequences of side-coupled ring resonators”, EOSAM 2022, 12-16 September 20222, Porto (Portugal) **[Oral contribution]**
9. M. Borghi, N. Tagliavacche, M. Clementi, F. A. Sabattoli, L. Gianini, H. El Dirani, L. Youssef, N. Bergamasco, C. Petit-Etienne, E. Pargon, J.E. Sipe, M. Liscidini, C. Sciancalepore, M. Galli, and D. Bajoni, “Generation of frequency bin entangled ququarts in

a programmable silicon photonics chip", CLEO 2023, San Jose CA, 7-12 May 2023. **[Oral contribution]**

Posters in conferences

1. M.Borghi, M.Mancinelli, P.Bettotti, J.M.Fedeli and L.Pavesi, "On chip test structure based on Coupled Resonator Induced Transparency for disorder measurements", Fotonica 2013, 21-13 Maggio 2013, Milano, Italia.
2. M.Bernard, M.Borghi, M.Ghulinyan, S.Manna, M.Mancinelli, G.Pucker, F.Ramiro Manzano, A.Trenti, and Lorenzo Pavesi, "Nonlinear Silicon Photonics", Frontiers in Optics, 18-22 Ottobre 2015, San Jose, California, Stati Uniti.
3. A.Trenti, M.Borghi, M.Mancinelli, G.Fontana and L.Pavesi, "Quantum interference effects in a Mach Zehnder interferometer", Fotonica 2015, 6-8 Maggio 2015, Torino, Italia
4. M. Borghi, F. A. Sabattoli, H. El Dirani, L. Youssef, C. Petit-Etienne, E. Pargon, C. Sciancalepore, J.E. Sipe, A. Mataji-Kojouri, M. Liscidini, M. Galli, and D. Bajoni, "Towards superradiant spontaneous four wave mixing in an array of silicon microresonators", CLEO 2023, San Jose CA, 7-12 May 2023

Roles in international projects

1. **Work package leader** of the provincial research project SIQURO (On silicon chip quantum optics for quantum computing and secure communications), 2017, Department of Physics, University of Trento, Italy.
2. **Work package leader** in European project SQUARE (Silicon Photonics for Quantum Fibre Networks), 2018, Quantum Engineering and Technology Labs, University of Bristol, UK.
3. **Work package leader** of the H2020-EU.1.2.1 - FET (EPIQUS) Electronic Photonic Quantum Simulator Platform, 2020-2021, Department of Physics, University of Trento, Italy.
4. **Work package referent** for sub-activity 4.3.2 "Development of integrated squeezed light sources for CV quantum experiments" of NQSTI PE4 F13C22001250007

Lectures at schools

1. Series of lectures "Coupled Mode Theory and applications in microresonators", in master degree course of "Integrated Photonic devices", 2012/2013 (Department of Physics, University of Trento)
2. Series of lectures "Coupled Mode Theory and applications in microresonators" in master degree course "Integrated Photonic devices", 2013/2014 (Department of Physics, University of Trento)
3. Series of invited lectures, "Design, simulation, and challenges in the realization of Silicon On Insulator quantum integrated circuits", 9th Optoelectronics and Photonics Winter School, IQP-Integrated Quantum Photonics, 26th -1st April 2017, Folgaria, Trento (Italy).
4. Series of invited lectures on "Probabilistic photon pair sources", invited talks at PIQP 2023-Photonic Quantum Information Processing 2023, 21-27 January 2023, M. Bondone, Trento, Italy.

Teaching activities

1. Co-lecturer of Fisica Sperimentale 1, academic year 2021/2022, 64 hours. Bachelor degree in Physics, University of Pavia, Italy.
2. Co-lecturer of Fisica Sperimentale 1, academic year 2022/2023, 54 hours. Bachelor degree in Physics, University of Pavia, Italy.
3. Co-lecturer of Fisica Sperimentale 1, academic year 2023/2024, 32 hours (planned). Bachelor degree in Physics, University of Pavia, Italy.
4. Lecturer of Scienze Matematiche e Fisiche – academic year 2023/2024, 32 hours. Degree in Pharmacy, University of Pavia, Italy.

Tutoring activities

1. Tutor in “Laboratorio di Fisica 2”, academic year 2016/2017, 70 hours of laboratory support activity. Bachelor degree in Physics, Department of Physics, University of Trento, Italy.
2. Tutor in “Fisica generale 2”, academic year 2016/2017, 30 hours frontal lectures. Bachelor degree in Mathematics, Department of Mathematics, University of Trento, Italy.
3. Tutor in “Fisica generale 2”, academic year 2017/2018, 22 hours frontal lectures. Bachelor degree in mathematics, Department of Mathematics, University of Trento, Italy.

Outreach activities

1. Partecipation to “Notte dei Ricercatori 2013 (Researcher’s night)” with the stand “Nanocanali di luce (Nano-channels of light), 27 September 2013, Trento, Italy. Contribution type: Interactive event in which the public is invited to take part to scientific demonstrations which have photonics as central topic. A poster support gives a more comprehensive insight both on the physics and on the applications of the presented devices. Covered topics: integrated waveguides, Fiber Bragg Grating sensors, lasers, optical fibers.
2. Partecipation to “Notte dei Ricercatori (Researcher’s night) 2015” with the stands “L’elettronica della luce: la nanofotonica al silicio (Silicon nanophotonics: the electronics of light)” and “La nanofotonica come strumento d’indagine microscopico (Nanophotonics as a microscopic tool of investigation”, 25 September 2015, Trento, Italy. Contribution type: Interactive event in which the public is invited to take part to scientific demonstrations which have photonics as central topic. A poster support gives a more comprehensive insight both on the physics and on the applications of the presented devices. Covered topics: integrated waveguides, optical cloaking, diffraction, speckle patterns, integrated platforms for biosensing.
3. Partecipation to Industrial Problem Solving with Physics 2015. Contribution type: This is a one-week event in which groups of ten people has to face with an industrial problem. This can be approached from both a theoretical and an experimental point of view using the tools offered by the laboratories of the University or by the R&D staff of the industry itself. The problem which I faced concerned the optimization of the geometry of the spray pattern of a high pressure can, filled with oil or water. This has been done using fluid dynamics Finite Element Methods.

4. Partecipation to Industrial Problem Solving with Physics 2016. Contribution type: This is a one-week event in which groups of ten people has to face with an industrial problem. This can be approached from both a theoretical and an experimental point of view using the tools offered by the laboratories of University or by the R&D staff of the industry itself. The problem which I faced concerned the prediction of the cooling times of refractory bricks used to build high temperature ovens. This has been accomplished used the Heat Transfer and Thermal Stress module of a finite element solver. My group won the event.
5. Active participation at SPIE Chapter of the University of Trento with frontal lectures to both specialized and not specialized audience.
6. Open public seminar “Fotonica: l’arte di manipolare la luce”, 2016, as a part of the participation at SPIE Chapter of the University of Trento.

Supervision of PhD students

1. Supervisor of PhD student Noemi Tagliavacche (XXXVIII cycle, 2022/2023, Department of Physics, University of Pavia)
2. Supervisor of PhD student Marcello Bacchi (XXXVIII cycle, 2022/2023, Department of Physics, University of Pavia)
3. Supervisor of PhD student Emanuele Brusaschi (XXXIX cycle, 2023/2024, Department of Physics, University of Pavia)

Supervision of bachelor and master students

1. Supervision of the master thesis of Mr. Alessandro Trenti at Department of Physics of University of Trento. Thesis title: A setup for the generation of entangled photons via second order parametric processes (2014).
2. Supervision of the master thesis of Mr. Stefano Signorini at Department of Physics of University of Trento. Thesis title: Mode selection and Stimulated Four Wave Mixing in a multimode Silicon Waveguide (2015).
3. Supervision of the master student Mattia Cominelli at Department of Physics of University of Trento. Thesis title: Mode selection and Four Wave Mixing in multimodal Silicon Photonics (2016).
4. Supervision of the bachelor student Marco Canteri at Department of Physics of University of Trento. Thesis title: Generation and Manipulation of entangled photon pairs in coupled resonators (2017).
5. Master thesis supervisor of student Noemi Tagliavacche, Department of Physics of University of Pavia. Thesis title: Generation of frequency bin entangled states on a silicon photonic chip (2022)
6. Master thesis supervisor of student Emanuele Brusaschi, Department of Physics of University of Pavia. Thesis title: Squeezed light photon number statistics without counting photons (2023)
7. Master thesis supervisor of student Federica Moroni, Department of Physics of University of

Pavia. Thesis title: to be defined (planned 2024)

Commissions of trust

1. Deputy member in the scientific committee of the PhD candidate Daniel Balado Souto (supervisors Jesús Liñares Beiras and Xesús Prieto Blanco), Universidade de Santiago de Compostela. Thesis title “High dimensional auto-compensating quantum cryptography in optical fibers implemented with discrete and integrated photonic devices”. Thesis discussion 7/5/2021
2. Deputy member of the commission for the Bachelor and Master degree in Physics, Department of Physics, University of Pavia, 25/03/2022.
3. Board member of Test Online Cisia (TOLC), 13/4/2022, Department of Physics, University of Pavia.
4. Deputy member of the commission for the Bachelor and Master degree in Physics, Department of Physics, University of Pavia, 15/07/2022.
5. Member of the examining board for an individual position of occasional or professional service at the Department of Industrial engineering and Information of University of Pavia, for the PhD. Paula Lujan Pagano, project “Experimental study of frequency- encoded multipartite entangled states”, main advisor prof. Daniele Bajoni (08/03/2023)
6. Board member of Test Online Cisia (TOLC), 6/9/2023, Department of Physics, University of Pavia.
7. Member of the examining board for an individual position of occasional or professional service at the Department of Industrial engineering and Information of University of Pavia, for the PhD. Paula Lujan Pagano, project “Study of coupled resonators for the generation of squeezed light”, main advisor prof. Daniele Bajoni (28/09/2023)
8. Member of the commission for the Bachelor and Master degree in Physics, Department of Physics, University of Pavia, 20/10/2023

International patents

UK Patent GB2005827.7, Scalable single photon source, major inventor (66.5% intellectual property)

Editorial activities

Member of the editorial board of Frontiers in Photonics (www.frontiersin.org/journals/photonics#)

Regular referee of Science Advances, Optics Express, Optics Letters, Photonic Research, Applied Physics Letter, Physical Review Applied, Physical Review A.

Indices (updated at 16/12/2023)

Iris

Total number of publications: 28

Total number of citations: 425

10 year H-index: 10

Scopus

Total number of publications: 28

Total number of citations: 431

10 year H-index: 10

Web of science

Total number of publications: 32

Total number of citations: 360

10 year H-index: 10

Google scholar

Total number of publications: 24

Total number of citations: 640

10 year H-index: 12

Job related skills

- Strong theoretical background in linear, nonlinear and quantum optics.
- Strong background in classical and quantum integrated photonics on multiple material platforms (silicon, silicon nitride, silicon oxynitride, AlGaAs)
- Strong expertise in the modeling, simulation and design of integrated optical devices
- Ability to organize and realize optical experimental setups.
- Ability to manage light propagation, light shaping and light coupling in bulk, fiber and integrated optical devices.
- Ability to manage and connect different instruments (lasers, photodetectors, oscilloscopes, voltage/current sources, VNAs, etc...)
- Ability in realizing experimental setups with high degree of remote control using LabView/Python/Matlab/Octave
- Ability in managing techniques for laser locking through optical phase loops, active stabilization of high Q optical cavities through PID controllers

SIMULAZIONE ASN 2023-2025
per
MASSIMO BORGHI

Report generato il:16/12/23 12.27

Aggiornamento dati reportistica IRIS:16/12/2023 12:16:50

Aggiornamento dati Classi A:16/11/2023

Versione dei dati utilizzata:più validati: ultimi dati inseriti e approvati (esclusi ritirati e bozze)

2008/2013/2018-2023

Disclaimer

Il report seguente simula gli indicatori relativi alla propria produzione scientifica in relazione alle soglie ASN 2023-2025 del proprio SC/SSD. Si ricorda che il superamento dei valori soglia (almeno 2 su 3) è requisito necessario ma non sufficiente al conseguimento dell'abilitazione.
La simulazione si basa sui dati IRIS e sugli indicatori bibliometrici alla data indicata e non tiene conto di eventuali periodi di congedo obbligatorio, che in sede di domanda ASN danno diritto a incrementi percentuali dei valori. La simulazione può differire dall'esito di un'eventuale domanda ASN sia per errori di catalogazione e/o dati mancanti in IRIS, sia per la variabilità dei dati bibliometrici nel tempo. Si consideri che Anvur calcola i valori degli indicatori all'ultima data utile per la presentazione delle domande.

La presente simulazione è stata realizzata sulla base delle specifiche raccolte sul tavolo ER del Focus Group IRIS coordinato dall'Università di Modena e Reggio Emilia e delle regole riportate nel DM 589/2018 e allegata Tabella A. Cineca, l'Università di Modena e Reggio Emilia e il Focus Group IRIS non si assumono alcuna responsabilità in merito all'uso che il diretto interessato o terzi faranno della simulazione. Si specifica inoltre che la simulazione contiene calcoli effettuati con dati e algoritmi di pubblico dominio e deve quindi essere considerata come un mero ausilio al calcolo svolgibile manualmente o con strumenti equivalenti.

MASSIMO BORGHI

Inquadramento

Struttura	DIPARTIMENTO DI FISICA
Qualifica	Ricercatori Legge 240/10 - t.det
Area	AREA MIN. 02 - Scienze fisiche
SSD	Settore FIS/03 - Fisica della Materia
SC	02/B1 - FISICA SPERIMENTALE DELLA MATERIA

Identificativi

ORCID ID	Publons/Researcher ID	SCOPUS AUTHOR-ID
0000-0003-4137-0852		

Copertura IRIS ultimi 15 anni

Presenti in IRIS	Con identificativo WOS	Con identificativo SCOPUS
28	24	28

ASN 2023-2025

SECONDA FASCIA	Valore	INDICATORE	Soglia	Stato
	16	Numero articoli ultimi 5 anni	13	✓
	425	Numero citazioni ultimi 10 anni	337	✓
	10	H index ultimi 10 anni	11	✗
	La simulazione ASN per il ruolo di docente di Seconda Fascia ha esito positivo?			**SI**

PRIMA FASCIA	Valore	INDICATORE	Soglia	Stato
	24	Numero articoli ultimi 10 anni	27	✗
	425	Numero citazioni ultimi 15 anni	607	✗
	10	H index ultimi 15 anni	14	✗
	La simulazione ASN per il ruolo di docente di Prima Fascia ha esito positivo?			**NO**

COMMISSARIO	Valore	INDICATORE	Soglia	Stato
	24	Numero articoli ultimi 10 anni	50	✗
	425	Numero citazioni ultimi 15 anni	1280	✗
	10	H index ultimi 15 anni	21	✗
	La simulazione ASN per il ruolo di Commissario ha esito positivo?			**NO**

NOTE
Indicatore 1. Articoli su riviste presenti su Scopus e/o WoS, limitatamente alle tipologie Scopus article, article in press, review, letter, note, short survey e alle tipologie WoS article, letter, note, review
Indicatore 2. Citazioni ricevute dalle pubblicazioni indicizzate da Scopus o da WoS (si considera la banca dati con il valore di citazioni più alto), nessuna tipologia esclusa.
Indicatore 3. H Index calcolato sulla base della produzione scientifica e delle citazioni di cui al punto 2

ELENCO PUBBLICAZIONI CONSIDERATE AI FINI DEGLI INDICATORI ASN

1pa, 2pa, 3pa: indicatori ASN II fascia; 1po, 2po, 3po: indicatori ASN I fascia e commissari

*: l'identificativo risulta errato, controllare qualità dell'archivio/identificativi; ** tipologia mancante; *** recupero dei dati non ancora effettuato; **** numero di citazioni aggiornato a più di 15 giorni fa. Negli ultimi tre casi l'errore dovrebbe venire risolto automaticamente entro pochi giorni. Se cosi non avviene, contattare l'help desk di ateneo.

Handle/Anno	Tipo MIUR/Titolo	Type	Codice	Cit.	Indicatore
11571/1486863	Articolo in rivista (262)	Article	**2-s2.0-85169917913**	0	1,2,3pa
2023	**Generation of quantum-certified ran...**				1,2,3po
11571/1477051	Articolo in rivista (262)	Article	**2-s2.0-85146195299**	6	1,2,3pa
2023	**Programmable frequency-bin quantum**	Article	WOS:000955726400005	4	1,2,3po
11571/1486864	Articolo in rivista (262)	Article	**2-s2.0-85173069376**	0	1,2,3pa
2023	**Quantum-referenced spontaneous**				1,2,3po
11571/1482323	Articolo in rivista (262)	Article	**2-s2.0-85161811290**	0	1,2,3pa
2023	**Reconfigurable Silicon Photonic Chi...**	Article	WOS:001015603900005	0	1,2,3po
11571/1482337	Articolo in rivista (262)	Article	**2-s2.0-85128150492**	5	1,2,3pa
2022	**Mitigating indistinguishability iss...**	Article	WOS:000781729800062	3	1,2,3po
11571/1482336	Articolo in rivista (262)	Article	**2-s2.0-85129129744**	0	1,2,3pa
2022	**PRECISE Photonic Hybrid**	Article	WOS:000790812100007	0	1,2,3po
11571/1482335	Articolo in rivista (262)	Article	**2-s2.0-85137656552**	6	1,2,3pa
2022	**Silicon oxynitride platform for lin...**	Article	WOS:000859033500009	5	1,2,3po
11571/1477111	Articolo in rivista (262)	Article	**2-s2.0-85138449885**	2	1,2,3pa
2022	**Superspontaneous Four-Wave Mixing**	Article	WOS:000852221100001	2	1,2,3po
11571/1482396	Articolo in rivista (262)	Article	**2-s2.0-85101242123******	21	1,2,3pa
2021	**On the modeling of thermal and free...**	Article	WOS:000614617700113	16	1,2,3po
11571/1482395	Articolo in rivista (262)	Article	**2-s2.0-85111727975**	25	1,2,3pa
2021	**Reservoir computing based on a sili...**	Article	WOS:000685200300002	24	1,2,3po
11571/1482399	Contributo in Atti di convegno (273)	Conference Paper	**2-s2.0-85091640708**	1	2,3pa
2020	**Chromatically Coupled Silicon Photo...**				2,3po
11571/1482397	Articolo in rivista (262)	Article	**2-s2.0-85084961902**	78	1,2,3pa
2020	**Near-ideal spontaneous photon**	Article	WOS:000537282700009	69	1,2,3po
11571/1482398	Contributo in Atti di convegno (273)	Conference Paper	**2-s2.0-85106059382**	2	2,3pa
2020	**Near-optimal spontaneous photon**				2,3po
11571/1482400	Articolo in rivista (262)	Article	**2-s2.0-85080900821**	14	1,2,3pa
2020	**Phase-resolved joint spectra tomogr...**	Article	WOS:000518435600123	10	1,2,3po
11571/1482401	Articolo in rivista (262)	Article	**2-s2.0-85060373974**	10	1,2,3pa
2019	**Four Wave Mixing control in a photo...**	Article	WOS:000456392400089	8	1,2,3po
11571/1486860	Articolo in rivista (262)	Article	**2-s2.0-85051062549**	48	1,2,3pa
2018	**Intermodal four-wave mixing in sili...**	Article	WOS:000440380100010	37	1,2,3po
11571/1486861	Articolo in rivista (262)	Article	**2-s2.0-85042236983**	28	1,2,3pa
2018	**Thermo-optic coefficient and nonlin...**	Article	WOS:000426580900083	25	1,2,3po
11571/1486862	Articolo in rivista (262)	Article	**2-s2.0-85042089146**	7	1,2,3pa
2018	**Tuning the strain-induced resonance...**	Article	WOS:000426268500043	6	1,2,3po
11571/1486858	Articolo in rivista (262)	Review	**2-s2.0-85028771337**	84	2,3pa
2017	**Nonlinear silicon photonics**	Review	WOS:000408191300001	73	1,2,3po
11571/1486859	Articolo in rivista (262)	Article	**2-s2.0-85029827832**	1	2,3pa
2017	**Oblique beams interference for**	Article	WOS:000411459800006	1	1,2,3po
11571/1486815	Contributo in volume (Capitolo o Saggio) (268)	Conference Paper	**2-s2.0-84982282544**	0	2,3pa
2016	**High frequency electro-optic measur...**	Proceedings Paper	WOS:000391521900010	0	2,3po
11571/1486857	Articolo in rivista (262)	Article	**2-s2.0-85006940223**	13	2,3pa
2016	**Homodyne Detection of Free Carrier ...**	Article	WOS:000391019400010	13	1,2,3po
11571/1486865	Recensione in rivista (263)	Conference Paper	**2-s2.0-85041288258**	3	2,3pa
2016	**Microring Resonators and Silicon Ph...**	Article	WOS:000412665900006	2	1,2,3po
11571/1486855	Abstract in Atti di convegno (274)	Conference Paper	**2-s2.0-84985995087**	1	2,3pa
2016	**One and two photon quantum**	Proceedings Paper	WOS:000381694500019	1	2,3po

Handle/Anno	Tipo MIUR/Titolo	Type	Codice	Cit.	Indicatore
11571/1486856	Articolo in rivista (262)	Article	**2-s2.0-84980398251**	5	2,3pa
2016	**Quantum interference in an**	Article	WOS:000390218900001	5	1,2,3po
11571/1485019	Articolo in rivista (262)	Article	**2-s2.0-84957591378**	41	2,3pa
2015	**High-frequency electro-optic measur...**	Article	WOS:000366133400040	38	1,2,3po
11571/1485018	Articolo in rivista (262)	Article	**2-s2.0-84902952950**	15	2,3pa
2014	**Chaotic dynamics in coupled resonat...**	Article	WOS:000338044300044	12	1,2,3po
11571/1482755	Articolo in rivista (262)	Article	**2-s2.0-84879894808**	9	2,3pa
2013	**An All Optical Method for Fabricati...**	Article	WOS:000320868700001	6	1,2,3po

H-index sui 10 anni: 10

Ranking	# Citazioni
1	84
2	78
3	48
4	41
5	28
6	25
7	21
8	15
9	14
10	**13**
11	10
12	9
13	7
14	6
15	6
16	5
17	5
18	3
19	2
20	2
21	1
22	1
23	1
24	0
25	0
26	0
27	0
28	0

H-index sui 15 anni: 10

Ranking	# Citazioni
1	84
2	78
3	48
4	41
5	28
6	25
7	21
8	15
9	14
10	**13**
11	10
12	9
13	7
14	6
15	6
16	5
17	5
18	3
19	2
20	2
21	1
22	1
23	1
24	0
25	0
26	0
27	0
28	0

Criteri adottati per la simulazione

Criteri di calcolo degli indicatori - Settori Bibliometrici

1) # articoli ultimi X anni: contiamo i prodotti IRIS con identificativo Scopus (limitatamente ai document type: article, article in press, review, letter, note, short survey) e/o WoS (limitatamente ai document type: WoS article, letter, note, review), conteggiando solo una volta i prodotti con entrambi i codici.
2) # citazioni ultimi X anni: sommiamo le citazioni ricevute dai prodotti IRIS con identificativo Scopus e/o WoS, senza filtri sulla tipologia, usando per ogni prodotto con entrambi i codici il valore di citazioni più alto tra quello Scopus e quello Wos.
3) h index a X anni: calcoliamo il valore in base alle citazioni dei prodotti IRIS con identificativo Scopus e/o WoS, senza filtri sulla tipologia, usando per ogni prodotto con entrambi i codici il valore di citazioni più alto tra quello Scopus e quello WoS.

Criteri di calcolo degli indicatori - Settori NON Bibliometrici

1) # articoli e contributi ultimi X anni: sommiamo i prodotti IRIS delle tipologie Articolo su Rivista e Nota a Sentenza pubblicati su riviste scientifiche con ISSN in base agli ultimi elenchi ANVUR ai prodotti IRIS delle tipologie Contributo in Volume (Capitolo o Saggio), Prefazione/Postfazione, Voce (in Dizionario o Enciclopedia), Contributo in Atto di convegno pubblicati su volumi con ISBN (o ISMN).
2) # articoli classe A ultimi X anni: sommiamo i prodotti IRIS delle tipologie Articolo su Rivista e Nota a Sentenza pubblicati su riviste di classe A in base agli ultimi elenchi ANVUR.
3) # libri ultimi X anni: sommiamo i prodotti IRIS con ISBN (o ISMN) delle tipologie Monografia o Trattato scientifico, Concordanza, Edizione critica di testi/di scavo, Pubblicazioni di fonti inedite, Commento scientifico, Traduzione di libro.

Criteri di definizione settori bibliometrico/non bibliometrico

Settori bibliometrici: i settori concorsuali afferenti alle aree disciplinari 1-9, ad eccezione dei settori concorsuali 08/C1 Design e progettazione tecnologica dell'architettura, 08/D1 Progettazione architettonica, 08/E1 Disegno, 08/E2 Restauro e storia dell'architettura, 08/F1 Pianificazione e progettazione urbanistica e territoriale, i settori del macrosettore 11/E Psicologia.
Settori non bibliometrici: i settori concorsuali afferenti alle aree disciplinari 10-14, con l'eccezione di tutti i settori concorsuali del macrosettore 11/E Psicologia, e i settori concorsuali 08/C1 Design e progettazione tecnologica dell'architettura, 08/D1 Progettazione architettonica, 08/E1 Disegno, 08/E2 Restauro e storia dell'architettura, 08/F1 Pianificazione e progettazione urbanistica e territoriale.

Calcolo H-index

"Uno scienziato ha indice h se h delle sue pubblicazioni sono state citate almeno h volte ciascuna".
(versione originale: "A scientist has index h if h of his or her Np papers have at least h citations each
and the other (Np – h) papers have h citations each")
credits: Hirsch JE. An index to quantify an individual's scientific research output.