

SCIENTIFIC PRODUCTION IN BRIEF

1 book, 46 articles in international peer-reviewed journals (1 Nature, 1 Nature Physics, 1 Science, 6 Physical Review Letters, 2 Nature Communications, 1 Optica, 1 Science Advances, 1 Light: Science & Applications), co-author of **182 contributions at international conferences** (79 among invited, post-deadline and plenary talks, of which 18 personally presented), **h-index: 29** (Google Scholar, ~6800 citations).

AWARDS IN BRIEF

“Emiliano Sali” award, Italian Physical Society (2012); Insubria University Press award (2010); “Galluzzi’s award for Physics 2006”, University of Rome “Roma Tre” (2006).
Habilitation to Professore Ordinario (Full Professor), disciplinary field 02/B1 - Experimental physics of matter (12/2023-12/2034).

FUNDING TRACK RECORD IN BRIEF

>€4M as principal investigator since starting as an independent researcher in 2018, including a recently awarded ERC Consolidator; >€250k in direct Knowledge Exchange grants with industries; >€250k in competitively awarded postdoctoral fellowships.

MANAGEMENT ACTIVITIES IN BRIEF

2012-2014: Senior postdoc at INRS-EMT, Canada, with the responsibility to define and start a novel research line in Integrated Quantum Optics, including grant writing, recruitment and management.

2017-2018: Research Fellow at the Institute of Photonics, taking some of the responsibilities concerning the administration and management of the group.

2018-2021: Chancellor’s Fellow and Lecturer at the University of Strathclyde, building and developing my independent research activities and group. Supported by the Fraunhofer Centre for Applied Photonics (FhCAP), developing common research projects in quantum photonics.

2021-2024: Senior Lecturer at the University of Strathclyde, continuing my independent research efforts and collaboration with FhCAP.

From 2024: Professor at Insubria University (Como, Italy), leading a research group in experimental quantum photonics.

SUPERVISION ACTIVITIES IN BRIEF

Current: 2 PhD students as 1st supervisor (University of Strathclyde). Past: 4 PDRAs; 1 PhD as first supervisor; 4 PhDs as second supervisor; co-supervision of 3 PhD and 7 undergraduate students.

RESEARCH EXPERIENCE IN BRIEF

14 years from PhD. Research topics: quantum optics, integrated photonics, nonlinear optics.

RESEARCH EXPERIENCE

- 05/2024 – Associate Professor**
Università degli studi dell'Insubria, Como, Italy. PI of the research group 'Quantum Photonics' (QuP) – currently recruiting.
- 05/2024 – Visiting Researcher**
Institute of Photonics, University of Strathclyde, Glasgow, UK.
- 12/2021 – 04/2024 Senior Lecturer (Associate Professor)**
Institute of Photonics, University of Strathclyde, Glasgow, UK. PI of the research group 'Quantum Photonics' (QuP) – 4 people.
- 06/2018 – 11/2021 Chancellor's Fellow and Lecturer (Lecturer B, Assistant Professor)**
University of Strathclyde & Fraunhofer Centre for Applied Photonics, Glasgow, UK. PI of the research group 'Quantum Photonics' (QuP).
- 02/2017 – 05/2018 Fraunhofer Fellow in Quantum Technologies**
University of Strathclyde & Fraunhofer Centre for Applied Photonics, Glasgow, UK.
- 07/2014 – 01/2017 International Incoming Marie Curie Fellow**
Heriot-Watt University, Edinburgh, UK.
- 05/2011 – 05/2014 Postdoctoral Fellow, 2 externally funded postdoctoral fellowships**
INRS-EMT, Varennes, Canada.
- 01/2011 – 04/2011 Visiting Scientist**
INRS-EMT, Varennes, Canada.
- 10/2009 – 09/2010 Assegnista di ricerca (Equivalent to Postdoctoral research fellow)**
Università degli Studi dell'Insubria, Como, Italy.

EDUCATION

- 10/2006 – 03/2010 Research Doctorate in Physics (PhD)**
Spatiotemporal structure of entanglement in Parametric Down Conversion
March 18th, 2010 – Università degli studi dell'Insubria, Como, Italy.
Supervisor: Dr Alessandra Gatti.
PhD thesis selected for publication as a book by the Insubria University Press (IUP) among the PhD theses of the Faculty of Chemical, Physical and Mathematical Sciences of the Insubria University (2010).
- 10/2003 – 07/2006 Magistral Laurea degree in physics (MSc), 110/110 cum laude**
Imaging techniques by means of quantum correlated optical beams
July 6th, 2006 – Università degli studi dell'Insubria, Como.
Supervisor: Prof. Luigi Lugiato.
Master thesis awarded with the "Galluzzi's prize for Physics 2006" by the University of Rome "Roma Tre".
- 10/2000 – 10/2003 Laurea degree in Physics (BSc), 110/110 cum laude**
Error correction techniques in quantum computing
October 23rd, 2003 – Università degli studi dell'Insubria, Como.
Supervisor: Dr Giuliano Benenti.
Awarded with 2 scholarships for the high average marks achieved.

ACTIVE RESEARCH GRANTS

- **05/2024 – 04/2029** ERC Consolidator Grant 2023, 5 years, "Quantum-enhanced nonlinear imaging (QuNIm)", GAP 101125923, €2M, PI.

- **03/2024 – 02/2027** EPSRC Standard Grant, **co-I**, £1M, “Silicon Core Fibres: Extending the reach of nonlinear fibre systems”.
- **10/2023 – 09/2027** Scottish Funding Council, Alliance for Research Challenge in Quantum Technologies, **co-I**, £600k.
- **09/2023 – 08/2025** Innovate UK-Canada, **co-I**, £500k, “Generation of Entanglement for Quantum Secure Multiparty Computation”.
- **10/2022 – 03/2026** Industrial PhD scholarship (AWE and QuantIC), **PI**, £185k, “Quantum entanglement-based tamper indication techniques”.
- **11/2022 – 05/2024** Innovate UK ISCF Commercialising Quantum Technologies, Feasibility Study, **PI**, £460k, “A PACKaged source of Multiplexed Entangled photons (PADME)”, PN 10031438. Lead industrial partner: Bay Photonics Ltd (UK).

DISTINCTIONS AND AWARDS

- **2023 – 2034** Habilitation to “Professore Ordinario”, 02/B1 “Fisica sperimentale della materia”, Italy.
- **2018 – 2027** Habilitation to “Professore Associato”, 02/B1 “Fisica sperimentale della materia”, Italy.
- **2018 – 2027** Habilitation to “Professore Associato”, 02/B2 “Fisica teorica della materia”, Italy.
- **2013 – 2017** Habilitation to “Maître de conférences” (Lecturer Equivalent), France.
- **2012** “Emiliano Sali” award, Italian Physical Society: awarded to the best PhD laureate submitting a thesis in Atomic, Molecular or Optical Physics at an Italian University after January 2009.
- **2010** Insubria University Press award: PhD thesis selected for publication among the theses of the Faculty of Chemical, Physical and Mathematical Sciences of Insubria University.
- **2006** “Galluzzi’s award for Physics 2006”, University of Rome “Roma Tre”: best Master thesis in Physics submitted at an Italian University.

TEACHING EXPERIENCE

- 2024 –** Lecturer for the “Quantum Physics II” class, 3rd year, Università dell’Insubria, Italy.
- 2024 –** Lecturer for the “Physics II” class (Chemistry and Mathematics degrees), 2nd year, Università dell’Insubria, Italy.
- 2020 – 2024** Lecturer for the PH260 “Physical Electronics” class, Level 2, 10 credits. Department of Physics class for Engineering students.
- 2018 – 2024** Lecturer for the “Quantum Wells and Quantum Dots” module of the PH963 class “Advanced Photonics Devices”, Level 5, 20 credits, master program.

RESEARCH ACTIVITIES

- **Quantum-enhanced multiphoton fluorescence microscopy.** Many pioneering advances in medicine and biology require observation of the microscopic world with high resolution and without damaging the specimen. One of the most successful and widespread techniques is multiphoton fluorescence microscopy, which allows full 3D imaging via optical sectioning, i.e., imaging of planes within the sample without physical slicing. However, multiphoton microscopy requires intense ultrashort pulsed lasers, and the depth of operation is limited to a few hundred microns by the low signal-to-noise ratio. In addition, there are still concerns over the possibility that the high laser powers required to excite the fluorescence could modify the sample under investigation.

I want to address these limitations by exploiting the unique properties of entanglement, a quantum mechanical superposition of two or more photons that behave like single particles. The proposed quantum-enhanced technique will maintain the strengths of standard multiphoton fluorescence microscopy (high 3D resolution and molecular specificity), yet with an increased signal-to-noise ratio. We expect this microscope to require illumination powers ~ 1000 times lower than the classical counterpart, enabling 3D imaging of even the most fragile and delicate specimens. On the other hand, the concept also applies to 3- and 4-photon absorption processes and the increased signal-to-noise ratio will allow an enhanced penetration depth. This could enable deeper imaging at low illumination levels, giving access to sub-cortical brain regions fundamental for studies into learning, memory, and degenerative neural conditions such as Alzheimer’s disease.

- **Integrated Quantum Photonics.** Quantum computing is one of the most exciting contemporary challenges. The rapid progress of these past few years is reinforcing the vision of a quantum computer to become operative in the not-too-far future. However, no definite and favourite platform has emerged so far, and the community is still scouting all available options (superconducting circuits, trapped ions, neutral or cold atoms, etc.). In this framework, photons play a relevant role due to their high resilience to decoherence (loss of the quantum states information via interaction with the environment) and the direct link with quantum communication. In all these approaches, the challenge ahead is scalability: the current quantum machines can only process a limited number of quantum bits, limiting their application to the solution of proof-of-concept problems.

I am investigating a novel approach for generating highly complex quantum states, called cluster states, that underpin a scalable approach to photonic quantum computing. Such states, to be useful, must live on miniaturised components fabricated by a mature technology that supports scalability with increased complexity and commercial viability. Integrated photonics satisfies both these requirements. It can count on many tools and devices developed during the last forty years for telecommunications and data processing. I am developing a novel way to realise large-scale cluster states combining integrated photonics – a mature technology that has proven affordable and agile – and frequency combs. A suitable integration of frequency combs will allow entanglement to be shared among all the comb lines, effectively generating a large-scale integrated cluster state.

REVIEWING ACTIVITIES

- **Journals:** Nature, Science, Sciences Advances, Nature Photonics, npj Quantum Information, Communications Physics, Scientific Reports, ACS Photonics, Optics Express, Optics Letters, Applied Physics Letters, Journal of the Optical Society of America B, Progress in Quantum Electronics, Applied Physics Express, and Optics & Laser Technology.
- **Councils:** ERC; Israel Science Foundation; EPSRC, UK; MITACS (Elevate & Accelerate programs) and NSERC, Canada; PRIN, Italy; NCSTE, Kazakhstan; Czech Science Foundation.

OTHER SCIENTIFIC ACTIVITIES and INSTITUTIONAL RESPONSIBILITIES

- Track co-chair for Quantum Photonics at the IEEE International Conference on Quantum Computing and Engineering 2024.
- Committee member for the Optica CLEO US Conference, FS3: Quantum Photonics, 2024.
- Member of the University of Strathclyde Senate from September 2022 to April 2024.
- Lecturer at the UK MetaMaterials Network Summer school (August 2022), University of St Andrews, UK.
- Editor for Scientific Reports (since March 2020).
- External Examiner for 8 PhD vivae (Heriot-Watt University, August 2024; University of Exeter, October 2023; University of Pavia, Italy, June 2023; KTH, Sweden, June 2022; University of Rome La Sapienza, Italy, February 2022; University of Pavia, Italy, March 2021; Aarhus University, Denmark, October 2020; University of Sussex, September 2020)
- Program chair for the OSA conference Integrated Photonics Research, Silicon, and Nano-Photonics, Montreal, Canada, July 26-29, 2021 (virtual).
- Committee member for the OSA Nonlinear Optics Topical Meeting 2021, Topic: Quantum Effects Enabled by Nonlinear Optics, August 9-13, 2021 (virtual).
- Topic co-chair for Quantum Communications, Institute of Physics conference Photon2020, Nottingham, UK, September 1-4, 2020 (virtual).
- General chair for the OSA conference Integrated Photonics Research, Silicon, and Nano-Photonics, Montreal, Canada, July 13-16, 2020 (virtual).
- Lecturer at the “Quantum devices for non-classical light generation and manipulation” Summer School (10/2019), Erice, Italy.
- Program chair for the OSA conference Integrated Photonics Research, Silicon, and Nano-Photonics, Burlingame, US, July 29-August 1, 2019.

- Lecturer at the 10th Optoelectronics and Photonics Winter school organised by the University of Trento, the Nanoscience Laboratory, and The University of Rome La Sapienza, Andalo, Italy, 20-26 January, 2019. Lecture topic: “Nonlinear optics for quantum science”.
- Member of the Institute of Photonics (Strath) management group since 2018.
- Organiser for the Institute of Photonics (Strath) seminars since 2018.
- 2018-2020, committee member for the OSA Pacific Rim Conference on Lasers and Electro-Optics (CLEO Pacific Rim), C7. Quantum Optics, Atomic Physics and Quantum Information.
- Sub-committee chair for the OSA conference Integrated Photonics Research, Silicon, and Nano-Photonics, Zurich, Switzerland, July 2-5, 2018.
- Organizer of the special session “Towards integrated quantum photonics: materials, designs, technologies and applications” at the international conference *META'17, the 8th International Conference on Metamaterials, Photonic Crystals and Plasmonics*, Incheon - Seoul, South Korea, July 25-28, 2017.
- Committee member for the conference Photonics North 2014 (Optical Society of America), May 28-30, 2014, Montreal, Canada.