



# Fulvio Flamini

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## Professional experience

- 2020-2021 **Marie-Curie Research Fellow.**  
University of Innsbruck – Advisor: Prof. Hans J Briegel.  
Roles PI in the MSCA-IF research project MAZINGER  
(*Mach-Zehnder and Interference Get Enhanced by Reinforcement Learning*)
- 2019-2020 **ESQ Postdoctoral Research Fellow.**  
University of Innsbruck – Advisor: Prof. Hans J Briegel.  
Roles PI in the ESQ project *Investigating the interplay between AI and quantum technologies.* .  
Co-PI in the SFB-BeyondC project: *Models of quantum learning and computation.*  
Co-PI in the outreach project: *Seeker: a trading card game for outreach in science.*
- 2016-2018 **Postdoctoral Research Fellow.**  
Sapienza University of Rome – Advisor: Prof. Fabio Sciarrino.  
Project: Development of validation protocols for multi-photon quantum interference.

## Education

- 2013-2016 **Ph.D. in Physics, with Honours.**  
Sapienza University of Rome – Advisor: Prof. Fabio Sciarrino.  
Thesis: *Implementation of integrated photonic experiments towards quantum technologies.*  
Roles Member of board of the Department of Physics.
- 2013 **Master's in Physics, with Honours.**  
Sapienza University of Rome – Advisor: Prof. Fabio Sciarrino.  
Thesis: *Implementation and characterization of Boson Sampling with integrated photonics.*
- 2011 Bachelor's in Physics, *101/110.*  
Sapienza University of Rome – Advisor: Prof. Francesco Petrarca.  
Thesis: *Teleportation and quantum computing.*
- 2007 Diploma of scientific high school, with Honours.

## Awards and Achievements

- 2016 **Piero Brovotto Prize**, awarded by the Italian Physical Society *for the theoretical and experimental contributions to the development of thermo-reconfigurable photonic devices.*
- 2016 Highlight in: *Horiuchi N, Reconfigurable circuits, Nature Photonics 10, 73 (2016).*
- 2015 Collaboration in the project *Gamma: monitoring and registration of the environmental storage parameters* for the Finmeccanica industrial innovation prize. The project was judged *among the most valuable presented.*
- 2007 Inclusion in the national register for high school students graduated with Honours.

## Funding and Grants

### Research grants and Fellowships

- 2021-2022 Marie Skłodowska-Curie Individual Fellowship (**MSCA-IF**), grant agreement no. 885567.
- 2021 **ESQ Discovery Grant**, granted by the *Erwin-Schrödinger Center for Quantum Science and Technology* (ESQ). Project: *Projective simulation with optical frequency combs: a continuous-variable approach on graph states*. Amount granted: 78k €.
- 2019-2020 ESQ PostDoc Fellowship (**MSCA-COFUND**), grant agreement no. 801110, granted by the *Erwin-Schrödinger Center for Quantum Science and Technology* (ESQ).
- 2015 Funding of a *Young Researcher Project*, granted by MIUR. Project: *Optimization of quantum sources at telecom wavelength*. Amount granted: 2k €.
- 2013-2016 Ph.D. scholarship, granted by Sapienza University of Rome upon public competition.

### Selected grants for Science Communication and Outreach

#### Seeker: the Game

- 2021-2022 Funding of a *Seeker* expansion set on quantum technologies and AI:  
by *FWF Austrian Science Fund* as Science Communication Programme (49k €)
- 2020-2021 Funding of a *Seeker* core set on general physics (28k €):  
by *Förderkreis 1669 - Wissenschaft Gesellschaft* (20k €), by *Doktoratskolleg Atoms, Light and Molecules* (5k €) and by *Department of Physics at University of Innsbruck* (3k €).

#### RAYS

- 2016 *SPIE education outreach Grant*. (4k \$)
- 2016 *SPIE FOCUS conference Grant*. (4k \$)
- 2016 *OSA centennial special event Grant*. (2k \$)

## Outreach activities

### Seeker: the Game

- 2020-2021 Conception, design and development of *Seeker*, a game for **science communication**.

### RAYS

- 2015-2017 **Co-founder of RAYS** (Rome Association of Young Scientists), aimed at promoting activities of science communication and professional development in Optics. Member of the **Local Organizing Committee** for the Young Italian Quantum Information Science conference (2016), supported by RAYS. Contribution to *Futuro Remoto* (Naples, 2015) and to *European Makers Faire* (Rome, 2016) with educational optics experiments for the general public. Organizing 10+ outreach events in high schools in Rome.
- Roles Co-founder and President of La Sapienza SPIE Student Chapter; Co-founder and Treasurer of La Sapienza OSA Student Chapter.

### Others

- 2020 Contribution to a Sci.Comm. blog with "*Chasing Quantum Advantage at Light Speed*".
- 2019 Participation to the Fest der Wissenschaft (Festival of Science) in Innsbruck, with fun and didactic demonstrations on artificial intelligence.

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## Expertise

### Soft skills

- Supervision Co-supervision of 4 PhD students and 6 Master's students during experiments, data analyses and thesis preparation from 2014 to 2018 (off-the-record).
- Management Promoting outreach initiatives, applying for funding, organizing conferences (see above).
- Teamwork – Strong co-operative abilities, developed both with theorists and experimentalists.  
– Expertise in the coordination of small teams in separate projects. Ability to manage small-size projects, converting high-level requirements in low-level tasks.

### Hard skills

- Coding Expertise in data analysis and numerical simulations.  
Softwares: Mathematica (fluent). Languages: Python (fluent); CUDA-Python (basic).
- Experimental Integrated quantum photonics, Femtosecond laser writing, Optical experiments design.
- Presentation Proficient in PowerPoint. Expertise in **science communication** (e.g. papers, presentations and graphics), strengthened with seminars by world-class instructor Jean-luc Doumont.
- Languages Italian (mother tongue), English.

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## Scientific community

### Reviewer

- Journals Nature Physics, PRX Quantum, Physical Review Letters, Physical Review A, Physical Review Applied, Quantum Science & Technology, Journal of Optics, Scientific Reports, Entropy, New Journal of Physics, Applied Sciences, International Journal of Quantum Information, Energies, IEEE Journal of Selected Topics in Quantum Electronics.
- Board – Member of the Reviewer Board for Photonics.  
– Guest Editor for a Special Issue in Photonics.

### Conference chair

- 2021 SFB BeyondC winter workshop  
2021 MLQ2021

### Main collaborators

- Theory Prof. Dr. Andreas Buchleitner (Freiburg Institute for Advanced Studies, Freiburg, Germany)  
Assoc. Prof. Ernesto F. Galvão (Universidade Federal Fluminense, Niterói, Brazil)  
Assoc. Prof. Nathan Wiebe (University of Washington, Seattle, United States)  
Dr. Mattia Walschaers (Laboratoire Kastler Brossel, Paris, France)
- Exp Prof. Markus Aspelmeyer (IQOQI, Austrian Academy of Sciences, Vienna, Austria)  
Prof. Fabio Sciarrino (Sapienza University of Rome, Rome, Italy - Ph.D. advisor)  
Dr. Roberto Osellame (Consiglio Nazionale delle Ricerche, Milan, Italy)

## Dissemination at international conferences

### Talks

- 2021 – (Invited) Cargese School of Quantum Information and Quantum Technology 2021 (online).  
*Seminar on Boson Sampling*
- 2021 – Photonics North 2021 (online).  
*Emergence of biased errors in imperfect photonic circuits*
- 2020 – (Invited) Photonics North 2020 (online).  
*Photonic architecture for reinforcement learning*
- 2019 – MSCA Falling Walls Lab contest (Brussels, Belgium).  
*Breaking the wall of Wall-E*
  - 1st DPG Fall Meeting on Quantum Science and Information Technologies (Freiburg, Germany).  
*Photonic architecture for reinforcement learning*
- 2018 – (Invited) Kick-off Meeting Freiburg-Nagoya project (Freiburg, Germany).  
*Validating multi-photon quantum interference with pattern recognition*
  - Visiting seminar (Innsbruck, Austria).  
*Learning to distinguish quantum indistinguishability*
- 2015 – Workshop on quantum simulation and quantum walks (Yokohama, Japan).  
*Quantum suppression law in a 3D photonic circuit implementing the Fast Fourier Transform*
- 2015 – PICQUE scientific school in integrated quantum photonics applications (Rome, Italy).  
*Thermally-reconfigurable laser written photonic circuit for applications at telecom wavelength*
- 2014 – 100<sup>o</sup> National Conference SIF (Pisa, Italy).  
*Experimental validation of photonic Boson Sampling*

### Posters

- 2020 – Quantum Optics 2020 (Oberurgl, Austria).
- 2019 – Austrian Quantum Information Conference 2019 (Vienna, Austria).
  - Graduate Conference on Complex Quantum Systems (Vienna, Austria).
  - Quantum Computing - From Algorithms to Applications (Oberurgl, Austria).  
*Photonic architecture for reinforcement learning*
  - Quantum Information and Measurement (QIM) V: Quantum Technologies (Rome, Italy).  
*Visual assessment of multi-photon interference*
- 2016 – Workshop on quantum simulation and quantum walks (Prague, Czech Republic).  
*Validating multi-photon interference on three-dimensional laser-written quantum circuits*
  - Italian Quantum Information Science Conference (Rome, Italy).  
*Thermally-reconfigurable laser written photonic circuit for applications at telecom wavelength*
  - SPIE Optics + Photonics (San Diego, California).  
*Outreach activities with RAYS and Sapienza SPIE Student Chapter*
- 2015 – QUTE-EUROPE summer school (Goteborg, Sweden).  
*Thermally-reconfigurable photonic circuit at telecom wavelength by femtosecond laser writing*
- 2014 – Italian Quantum Information Science Conference (Salerno, Italy).  
*Experimental validation of Boson Sampling on a photonic integrated circuit*
  - PICQUE school: integrated photonic manipulation for quantum applications (Varenna, Italy).  
*Non-monotonic trend of bosonic coalescence within Boson Sampling architecture*
  - School on quantum physics and quantum information (Olomouc, Czech Republic).  
*Experimental realization of Boson Sampling and validation against uniform distribution*

## Publications

### Summary

Citations Google Scholar: 1229 (h-index: 13); Web of Science: 754

1<sup>st</sup> author in 8 peer-reviewed papers, 1 preprint, 1 conference proceedings.

### Peer-reviewed publications

1. [Flamini E](#), Walschaers M, Spagnolo N, Wiebe N, Buchleitner A, Sciarrino F, Validating multi-photon interference with finite data, *Quantum Science and Technology* **5**, 045005 (2020).
2. [Flamini E](#), Hamann A, Jerbi S, Trenkwalder L M, Poulsen Nautrup H, Briegel H J, Photonic architecture for reinforcement learning, *New Journal of Physics* **22**, 045002 (2020).
3. Giordani T, Brod D J, Esposito C, Viggianiello N, Romano M, [Flamini E](#), Carvacho G, Spagnolo N, Galvão E F, Sciarrino F, Experimental quantification of genuine four-photon indistinguishability, *New Journal of Physics* **22**, 043001 (2020).
4. [Flamini E](#), Spagnolo N, Sciarrino F, Visual assessment of multi-photon interference, *Quantum Science and Technology* **4**, 2 (2019).
5. Agresti I, Viggianiello N, [Flamini E](#), Spagnolo N, Crespi A, Osellame R, Wiebe N, Sciarrino F, Pattern recognition techniques for Boson Sampling validation, *Physical Review X* **9**, 011013 (2019).
6. Brod D J, Galvão E F, Viggianiello N, [Flamini E](#), Spagnolo N, Sciarrino F, Witnessing genuine multiphoton indistinguishability, *Physical Review Letters* **122**, 063602 (2019).
7. Giordani T, [Flamini E](#), Pompili M, Viggianiello N, Spagnolo N, Crespi A, Osellame R, Wiebe N, Walschaers M, Buchleitner A, Sciarrino F, Experimental statistical signature of many-body quantum interference, *Nature Photonics* **12** (3), 173-178 (2018).
8. Viggianiello N, [Flamini E](#), Bentivegna M, Spagnolo N, Crespi A, Brod D J, Galvão E F, Osellame R, Sciarrino F, Optimal photonic indistinguishability tests in multimode networks, *Science Bulletin* **63** (22), 1470-1478 (2018).
9. [Flamini E](#), Viggianiello N, Giordani T, Bentivegna M, Spagnolo N, Crespi A, Corrielli G, Osellame R, Martin-Delgado M A, Sciarrino F, Observation of photonic states dynamics in 3-D integrated Fourier circuits, *Journal of Optics* **20**, 7 (2018).
10. [Flamini E](#), Spagnolo N, Sciarrino F, Photonic quantum information processing: a review, *Reports on Progress in Physics* **82**, 1 (2018).
11. Viggianiello N, [Flamini E](#), Innocenti L, Cozzolino D, Bentivegna M, Spagnolo N, Crespi A, Brod D J, Galvão E F, Osellame R, Sciarrino F, Experimental generalized quantum suppression law in Sylvester interferometers, *New Journal of Physics* **20**, 033017 (2018).
12. [Flamini E](#), Spagnolo N, Viggianiello N, Crespi A, Osellame R, Sciarrino F, Benchmarking integrated linear-optical architectures for quantum information processing, *Scientific Reports* **7**, 15133 (2017).
13. [Flamini E](#), Viggianiello N, Bentivegna M, Spagnolo N, Mataloni P, Crespi A, Ramponi R, Osellame R, Sciarrino F, Generalized quantum fast transformations via femtosecond laser writing technique,

*Interdisciplinary Information Sciences* **23**, 115-118 (2017).

14. Crespi A, Osellame R, Ramponi R, Bentivegna M, Flamini F, Spagnolo N, Viggianiello N, Innocenti L, Mataloni P, Sciarrino F, Suppression law of quantum states in a 3D photonic fast Fourier transform chip, *Nature Communications* **7**, 10469 (2016).
15. Flamini F, Magrini L, Rab A S, Spagnolo N, D'Ambrosio V, Mataloni P, Sciarrino F, Zandrini T, Crespi A, Ramponi R, Osellame R, Thermally reconfigurable quantum photonic circuits at telecom wavelength by femtosecond laser micromachining, *Light: Science & Applications* **4**, e354 (2015).
16. Bentivegna M, Spagnolo N, Vitelli C, Brod D J, Crespi A, Flamini F, Ramponi R, Mataloni P, Osellame R, Galvão E F, Sciarrino F, Bayesian approach to boson sampling validation, *International Journal of Quantum Information* **12**, 1560028 (2015).
17. Bentivegna M, Spagnolo N, Vitelli C, Flamini F, Viggianiello N, Latmiral L, Mataloni P, Brod D J, Galvão E F, Crespi A, Ramponi R, Osellame R, Sciarrino F, Experimental scattershot boson sampling, *Science Advances* **1**, e1400255 (2015).
18. Spagnolo N, Vitelli C, Bentivegna M, Brod D J, Crespi A, Flamini F, Giacomini S, Milani G, Ramponi R, Mataloni P, Osellame R, Galvão E F, Sciarrino F, Experimental validation of photonic boson sampling, *Nature Photonics* **8**, 615–620 (2014).

### Preprints

1. Flamini F, Emergence of biased errors in imperfect photonic circuits, preprint at arXiv:2106.06717v1.

### Conference proceedings

1. Flamini F, and Sciarrino F, Implementation and validation of photonic Boson Sampling, *Proceedings of the International School of Physics Enrico Fermi* **198**, pp.111-130 (2018).
2. Spagnolo N, Vitelli C, Bentivegna M, Flamini F, Mataloni P, Sciarrino F, Brod D J, Galvão E F, Crespi A, Ramponi R, Osellame R, Experimental boson sampling with integrated photonics, *Research in Optical Sciences*, QTh1A.3 (2014).

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### Books

2020 Self-published the novel "*Entangled*". This fiction is intended for the general public.