# Francesco Arzani

Researcher in quantum information and quantum optics

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🌐 frzani.github.io/

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## Academic and professional experience

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| 09/2023–current | **Junior professor**, *INRIA Paris and École Normale Supérieure – Paris, France*, QAT team |
| 05/2021–current | **Consultant**, *Xanadu Quantum Technologies – Toronto, Ontario, Canada (remote)* |
| 09/2020–08/2023 | **Post-doctoral researcher**, *Freie Universiät Berlin – Quantum information theory, quantum many-body theory, and quantum optics group,* <br> Supervisor: Prof. Jens Eisert |
| 10/2018–10/2019 | **Post-doctoral researcher**, *MOCQUA team – Loria, Nancy & Quantum Information group – Laboratory of Informatics of Paris 6,* <br> Supervisors: Dr. Damian Markham, Dr. Simon Perdrix |
| 04/2018–9/2018 | **Post-doctoral researcher**, *Université Paris Diderot & Paris center for quantum computing,* <br> Supervisors: Dr. Damian Markham, Dr. Iordanis Kerenidis |

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## Education

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| 01/2015–03/2018 | **PhD in Physics**, *École Normale Supérieure, Paris; Kastler Brossel Laboratory,* <br> Thesis: "Measurement-based quantum information with optical frequency combs", <br> Supervisors: Prof. Nicolas Treps & Prof. Claude Fabre <br> Funding: Paris Sciences Lettres Research University |
| 10/2012–12/2014 | **Master's degree in Theoretical Physics**, *Università degli Studi di Pavia,* <br> Master's thesis: "Measurement-based quantum information with optical frequency combs", <br> Supervisor: Prof. Chiara Macchiavello; Co-supervisors Prof. Nicolas Treps & Dr. Giulia Ferrini <br> Grade: 110/110 cum laude (with honours) |
| 02/2014–08/2014 | **Master's internship**, *Quantum Optics group – Kastler Brossel Laboratory, Université Paris 6 Pierre et Marie Curie* |
| 09/2013–07/2014 | **ERASMUS exchange period**, *Université Paris 6 Pierre et Marie Curie* |
| 09/2009–10/2012 | **Bachelor's Degree in Physics**, *Università degli Studi di Pavia,* <br> Bachelor's thesis: "An informational approach to quantum thermodynamics beyond the von Neumann Regime", <br> Supervisor: Dr. Paolo Perinotti <br> Grade: 110/110 |
| 2009 | **High school diploma**, *Liceo scientifico tecnologico, IIS "Guglielmo Marconi"*, Tortona <br> Grade: 100/100 cum Laude (with honours) |

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## Grants, awards, fellowships

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| 03/2025–02/2028 | **ANR-PRCI**, *Franco-German collaborative research grant on Bosonic Lattice Codes (BoLaCo),* French coordinator, partnered with Freie Universität Berlin |
| 09/2020–08/2022 | **Humboldt postdoctoral fellowship**, *Freie Universität Berlin* |
| 09/2009–07/2015 | **Student at IUSS**, *Istituto Universitario di Studi Superiori, Pavia* |
| 09/2009–07/2014 | **Student at Collegio Ghislieri**, *Pavia*, Residence for university students with merit based admission |

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## Teaching and outreach

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| 10/2024–02/2025 | **Instructor**, *École Normale Supérieure – Paris Sciences Lettres ,* <br> Quantum computing (M2), Quantum engineering master |

| 10/2023–02/2024 | **Instructor**, *École Normale Supérieure – Paris Sciences Lettres*, Quantum programming (M2), Quantum engineering master |
| 11/2021–03/2022 | **Teaching assistant**, *Freie Universitat Berlin*, Quantum information (Master's level) |
| 11/2019 | **Fête de la Science**, *Sorbonne Univérsité*, Presentation of quantum information to high school students |
| 09/2018–12/2018 | **Teaching assistant and lab demonstrator (Vacataire)**, *Univérsité d'Évry val d'Essonne*, Introduction to experimental physics (Bachelor's level) |

## Academic reviewing

**Phys. Rev. Lett., Phys. Rev. A, Quantum Journal, JOSA B, Eur. Phys. J. D, Optics Express, QIP (conference)**

## Languages

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| Native | Italian |
| Fluent | English, French |
| Basic | German |

## Computer Skills

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| Operating systems | Unix/Linux, Windows |
| Programming languages | Mathematica, Python, Julia, C++ |

## Publications

### Preprints

- *Towards fault-tolerant quantum computation with universal continuous-variable gates*
  S. Blair, **F. Arzani**, G. Ferrini, A. Ferraro(arxiv:2506.13643).
- *Can effective descriptions of bosonic systems be considered complete?*
  **F. Arzani**, R. I. Booth, U. Chabaud (arxiv:2501.13857).

### Journal articles (peer reviewed)

- *Exploiting symmetry in variational quantum machine learning.*
  J. J. Meyer, M. Mularski, E. Gil-Fuster, A. A. Mele, **F. Arzani**, A. Wilms, J. Eisert
  Physical Review X Quantum 4, 010328 (2023). (arxiv:2205.06217).

- *Gottesman-Kitaev-Preskill codes: A lattice perspective.*
  J. Conrad, J. Eisert, **F. Arzani**
  Quantum 6, 648 (2022). (arxiv:2109.14645)

- *Random coding for sharing bosonic quantum secrets.*
  **F. Arzani**, G. Ferrini, F. Grosshans, D. Markham
  Physical Review A 100 (2), 022303 (2019). (arXiv:1808.06870)

- *Bloch-Messiah reduction for twin beams of light.*
  D. B. Horoshko, L. La Volpe, **F. Arzani**, N. Treps, C. Fabre, M. I. Kolobov
  Physical Review A 100 (1), 013837(2019). (arXiv:1903.06578)

- *High-dimensional quantum encoding via photon-subtracted squeezed states.*
  **F. Arzani**, A. Ferraro, V. Parigi
  Physical Review A 99 (2), 022342 (2019). (arXiv:1811.09263)

- *Violating Bell inequalities with entangled optical frequency combs and multi-pixel homodyne detection.*
  W. N. Plick, **F. Arzani**, N. Treps, E. Diamanti, D. Markham
  Physical Review A 98 (6), 062101 (2018). (arXiv:1805.06059)

- *Reconfigurable optical implementation of quantum complex networks.*
  J. Nokkala, **F. Arzani**, F. Galve, R. Zambrini, S. Maniscalco, J. Piilo, N. Treps, V. Parigi.
  New Journal of Physics 20 (5), 053024 (2018). (arXiv:1708.08726)

- *Versatile engineering of multimode squeezed states by optimizing the pump spectral profile in spontaneous parametric down-conversion.*
  **F. Arzani**, C. Fabre, N. Treps.
  Physical Review A 97 (3), 033808 (2018). (arXiv:1709.10055)

- *Polynomial approximation of non-Gaussian unitaries by counting one photon at a time.*
  **F. Arzani**, N. Treps, G. Ferrini
  Physical Review A 95 (5), 052352 (2017). (arXiv:1703.06693)

- *Multimode entanglement in reconfigurable graph states using optical frequency combs.*
  Y. Cai, J. Roslund, G. Ferrini, **F. Arzani**, X. Xu, C. Fabre, N. Treps.
  Nature Communications 8, 15645 (2017). (arXiv:1605.02303)

- *A direct approach to Gaussian measurement based quantum computation.*
  G. Ferrini, J. Roslund, **F. Arzani**, C. Fabre, N. Treps.
  Physical Review A 94 (6), 062332 (2016). ( arXiv:1605.03350)

- *Optimization of networks for measurement-based quantum computation.*
  G. Ferrini, J. Roslund, **F. Arzani**, Y. Cai, C. Fabre, N. Treps.
  Physical Review A 91 (3), 032314 (2015). (arXiv:1407.5318)

### Other

- *Harmonizing continuous noise to build a modular photonic quantum computer.*
  **F. Arzani**
  Quantum Views 5, 51 (2021).
- *Measurement based quantum information with optical frequency combs.*
  **F. Arzani**
  PhD Thesis, Paris Sciences Lettres and École Normale Supérieure de Paris (2018)

## Talks, conferences, workshops, schools

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|---|---|---|
| 05/2025 Guest seminar | **QUEST Lab**, *(Online) North Carolina State University, Raleigh (NC), USA* , "Can effective descriptions of bosonic systems be considered complete?" | |
| 04/2025 Poster | **QCTIP**, *Conference on quantum computing theory in practice, Freie Universität Berlin, Berlin, Germany*, "Can effective descriptions of bosonic systems be considered complete?" | |
| 10/2024 Contributed talk | **INRIA and ENS Paris-Saclay**, *Workshop of the Défi Eqip project, ENS Saclay, Saclay, France*, "Bosonic quantum error correction meets lattice theory" | |
| 07/2024 Tutorial talk | **IFISC**, *Mini workshop on Non-Gaussian Quantum Reservoir Computing, Palma de Mallorca, Spain*, "Gaussian and non-Gaussian resources in quantum optics" | |
| 02/2024 Guest seminar | **MC2**, *Wallenberg Centre for Quantum Technologies, Gothenburg, Sweden* , "Springs and crystals: Bosonic quantum error correction meets lattice theory" | |
| 09/2022 Contributed talk | **CQIQC IX**, *Conference on quantum information and quantum control, Fields Institute, Toronto, Canada*, "Gottesman-Kitaev-Preskill bosonic error correcting codes: a lattice perspective" | |
| 09/2021 Invited talk | **Xanadu**, *Xanadu Quantum Technologies, Toronto ON, Canada*, "Gottesman-Kitaev-Preskill bosonic error correcting codes: a lattice perspective" | |
| 09/2021 Invited talk | **IPP**, *Télécom Paris - Institut Polytechnique de Paris, Palaiseau, France*, "Continuous-variable quantum information, multi-mode quantum optics and bosonic error correcting codes " | |
| 09/2021 Contributed talk | **SAMOP21**, *Virtual DPG-Meeting of the Atomic, Molecular, Plasma Physics and Quantum Optics Section (SAMOP)*, "Gottesman-Kitaev-Preskill bosonic error correcting codes: a lattice perspective" | |

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| 08/2019 | **CQIQC VIII**, |
| Contributed talk | *Conference on quantum information and quantunm control, Fields Institute, Toronto, Canada*, |
| | "Random coding for sharing bosonic quantum secrets" |
| 11/2018 | **Q-Turn 2018**, |
| Contributed talk | *Workshop on changing paradigms in quantum science, Universidade Federal de Santa Catarina, Florianópolis, Brazil*, |
| | "Quantum secret sharing using squeezing and almost any passive interferometer" |
| 11/2018 | **JIQ 2018**, |
| Contributed talk | *Journées d'Informatique Quantique, Laboratoire Lorrain de rechèrce en informatique et ses applications, Nancy, France*, |
| | "Quantum secret sharing using squeezing and almost any passive interferometer" |
| 09/2018 | **QuTech 2018**, |
| Contributed talk | *Quantum technology international conference, 1st edition, Kastler Brossel laboratory, Paris, France*, |
| | "Versatile engineering of multimode squeezed states by optimizing the pump spectral profile in spontaneous parametric down-conversion" |
| 09/2017 | **Workshop on quantum science and technologies**, |
| Contributed talk | *International Center for Theoretical Physics, Trieste, Italy*, |
| | "Polynomial approximation of non-Gaussian unitaries by counting one photon at a time" |
| 05/2017 | **Photons beyond qubits 2017**, |
| Invited talk | *Palacký University, Olomouc, Czech Republic*, |
| | "Measurement-based quantum information protocols with optical frequency combs" |
| 04/2017 | **Quantum information and measurement 2017**, |
| Contributed talk | *4th edition, Université Pierre et Marie Curie, Paris, France*, |
| | "Shaping the Pump of a Synchronously Pumped Optical Parametric Oscillator for Continous - Variable Quantum Information" |
| 11/2016 | **GDR Quantum Information 2016**, |
| Poster | *7th colloquium of the CNRS research network on Quantum information, foundations and applications, Télécom ParisTech, Paris, France*, |
| | "Shaping the Pump of a Synchronously Pumped Optical Parametric Oscillator for Continous - Variable Quantum Information" |
| 06/2016 | **CEWQO 2016**, |
| Poster | *23rd central european workshop on quantum optics,Orthodox Academy of Crete, in Kolymbari, Crete, Greece*, |
| | "Quantum Computing with Optical Frequency Combs" |
| 04/2015 | **International School on Parametric Nonlinear Optics**, |
| Attendance | *Les Houches School of Physics, Les Houches, France* |