



# Francesco Albarelli, PhD

Quantum physicist

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I am a postdoctoral researcher in quantum information theory, with a particular interest in multiparameter quantum estimation theory and metrology, continuously monitored quantum systems and nonclassicality of continuous variable quantum systems.

## Experience

**Research assistant**, Faculty of Physics, University of Warsaw, Poland 2019–Present  
Postdoc position (Polish: *adiunkt badawczy*) in the theoretical quantum metrology group led by [Rafał Demkowicz-Dobrzański](#). Main themes of research: noisy multiparameter quantum metrology and spatially correlated noise in quantum interferometry.

**Research fellow**, Dept. of Physics, University of Warwick, Coventry, United Kingdom 2018–2019  
Postdoc position in the [Quantum Information Science group](#) led by [Animesh Datta](#), funded by the Networked Quantum Information Technologies Hub (NQIT). Main themes of research: multiparameter quantum estimation theory and metrology.

**Visiting research student**, Dept. of Physics, University College London, UK 2018  
Conducted research in collaboration with [Alessio Serafini](#) on quantum control for continuous variable systems.

**Traineeship Erasmus+**, Centre for Theoretical AMO Physics, Queen's University Belfast, UK 2017  
Visited the [Quantum Technology group](#) to collaborate with [Alessandro Ferraro](#) on resource theories of non-classicality and non-Gaussianity.

**Teaching assistant**, University of Milan, Italy 2015–2018  
General physics, C++ programming and mathematics, see [Teaching](#) below.

## Education

**Philosophiae Doctor (Ph.D.)**, Dept. of Physics, University of Milan, Italy 2015–2018  
Dissertation: [Continuous measurements and nonclassicality as resources for quantum technologies](#).  
Supervisor: [Matteo G. A. Paris](#). External Referees: [Alessio Serafini](#) and [Rajiah Simon](#).  
International schools attended

- **Quantum Complex Systems Out of Equilibrium**, [Lake Como School of Advanced Studies](#), Como, Italy, 29 Jul–3 Aug 2018
- **Quantum Machine Learning**, [28th Chris Engelbrecht Summer School](#), Drakensberg mountains, South Africa, 23 Jan–1 Feb 2017
- **Quantum Simulators**, [International School of Physics "Enrico Fermi" Course 198](#), Varenna, Italy, 22–27 Jul 2016; admitted with scholarship

**Master of Science (M.Sc.)**, Dept. of Physics, University of Bologna, Italy 2012–2015  
Final grade: *Summa cum laude*. Specialized curriculum in theoretical physics. Dissertation: [Nonlinearity as a resource for nonclassicality](#). Supervisors: [Matteo G. A. Paris](#) and [Cristian Degli Esposti Boschi](#).

**Bachelor of Science (B.Sc.)**, Dept. of Physics, University of Bologna, Italy 2009–2012  
Final grade: *Summa cum laude*. General curriculum in physics. Dissertation: [The role of entropy in Gibbs paradox](#) (in Italian). Supervisors: [Alessandro Pesci](#) and [Elisa Ercolessi](#).

**High school diploma**, Scientific Lyceum "Georges Lemaître", Rimini, Italy 2004–2009  
State exam mark: *100/100 cum laude*.

## Teaching

**Teaching assistant**, General physics (in Italian) 2015–2018  
Bachelor course in chemistry L-27, University of Milan (3 academic years)

**Teaching assistant**, C++ programming (in Italian) 2016–2018  
Bachelor course in physics L-30, University of Milan (2 academic years)

**Teaching assistant**, Fundamentals of Mathematics (in Italian) 2015–2016  
Bachelor course in chemistry L-27, University of Milan

## Supervision

**Giacomo Piscia**, Master student in Physics, Università degli Studi di Milano, co-supervisor with **M. G. Genoni** and **M. G. A Paris**. Project: Multi-parameter quantum metrology with time-continuous measurements

2021

## Languages

Mother tongue

**Italian**

Other languages<sup>1</sup>

**English<sup>2</sup>**

Understanding				Speaking				Writing	
Listening		Reading		Interaction		Production			
C2	Fluent	C2	Fluent	C1	Fluent	C1	Fluent	C1	Fluent

<sup>1</sup>Common European Framework of Reference for Languages (CEFR)

<sup>2</sup>IELTS - British Council, 12/07/2014 (Overall Score: 8.0/9.0)

## Personal interests

Music, Rationality, Science, Sustainability, Food, Books

## Publications

### Web of Science/Publons metrics

publications	total times cited	h-index	verified reviews
17	188	8	41

### International peer-reviewed journals

- [18] Experimental Quantum-Enhanced Response Function Estimation  
Ilaria Gianani, Francesco Albarelli, Valeria Cimini, Marco Barbieri  
[Phys. Rev. A](#), to appear (2021), [arXiv:2007.15564](#)
- [17] Noisy Quantum Metrology Enhanced by Continuous Nondemolition Measurement  
Matteo A. C. Rossi, Francesco Albarelli, Dario Tamascelli, Marco G. Genoni  
[Phys. Rev. Lett.](#) **125**, 200505 (2020), [arXiv:2006.08974](#)
- [16] Quantum Semiparametric Estimation  
Mankei Tsang, Francesco Albarelli, Animesh Datta  
[Phys. Rev. X](#) **10**, 031023 (2020), [arXiv:1906.09871](#)
- [15] Time-Local Optimal Control for Parameter Estimation in the Gaussian Regime  
Alexander Predko, Francesco Albarelli, Alessio Serafini  
[Phys. Lett. A](#) **384**, 126268 (2020), [arXiv:2001.03551](#)
- [14] A Perspective on Multiparameter Quantum Metrology: From Theoretical Tools to Applications in Quantum Imaging  
Francesco Albarelli, Marco Barbieri, Marco G. Genoni, Ilaria Gianani  
[Phys. Lett. A](#) **384**, 126311 (2020), [arXiv:1911.12067](#)
- [13] On the Discontinuity of the Quantum Fisher Information for Quantum Statistical Models with Parameter Dependent Rank  
Luigi Seveso, Francesco Albarelli, Marco G. Genoni, Matteo G. A. Paris  
[J. Phys. A](#) **53**, 02LT01 (2020), [arXiv:1906.06185](#)
- [12] Characterizing Non-Deterministic Noiseless Linear Amplifiers at the Quantum Limit  
Hamza Adnane, Francesco Albarelli, Abdelhakim Gharbi, Matteo G. A. Paris  
[J. Phys. A](#) **52**, 495302 (2019), [arXiv:1901.07480](#)
- [11] Evaluating the Holevo Cramér-Rao Bound for Multiparameter Quantum Metrology  
Francesco Albarelli, Jamie F. Friel, Animesh Datta  
[Phys. Rev. Lett.](#) **123**, 200503 (2019), [arXiv:1906.05724](#)
- [10] Quantum State Engineering by Nondeterministic Noiseless Linear Amplification  
Hamza Adnane, Matteo Bina, Francesco Albarelli, Abdelhakim Gharbi, Matteo G. A. Paris  
[Phys. Rev. A](#) **99**, 063823 (2019), [arXiv:1901.10509](#)

- [9] Quantum Frequency Estimation with Conditional States of Continuously Monitored Independent Dephasing Channels  
 Francesco Albarelli, Matteo A. C. Rossi, Marco G. Genoni  
[Int. J. Quantum Inf. \*\*17\*\*, 1941013 \(2019\)](#), [arXiv:1910.12549](#)
- [8] Locally Optimal Control of Continuous-Variable Entanglement  
 Francesco Albarelli, Uther Shackerley-Bennett, Alessio Serafini  
[Phys. Rev. A \*\*98\*\*, 062312 \(2018\)](#), [arXiv:1711.11400](#)
- [7] Restoring Heisenberg Scaling in Noisy Quantum Metrology by Monitoring the Environment  
 Francesco Albarelli, Matteo A. C. Rossi, Dario Tamascelli, Marco G. Genoni  
[Quantum \*\*2\*\*, 110 \(2018\)](#), [arXiv:1803.05891](#)
- [6] Resource Theory of Quantum Non-Gaussianity and Wigner Negativity  
 Francesco Albarelli, Marco G. Genoni, Matteo G. A. Paris, Alessandro Ferraro  
[Phys. Rev. A \*\*98\*\*, 052350 \(2018\)](#), [arXiv:1804.05763](#)
- [5] Ultimate Limits for Quantum Magnetometry via Time-Continuous Measurements  
 Francesco Albarelli, Matteo A. C. Rossi, Matteo G. A. Paris, Marco G. Genoni  
[New J. Phys. \*\*19\*\*, 123011 \(2017\)](#), [arXiv:1706.00485](#)
- [4] Generation of Coherence via Gaussian Measurements  
 Francesco Albarelli, Marco G. Genoni, Matteo G. A. Paris  
[Phys. Rev. A \*\*96\*\*, 012337 \(2017\)](#), [arXiv:1705.04997](#)
- [3] Quantum Backflow Effect and Nonclassicality  
 Francesco Albarelli, Tommaso Guaita, Matteo G. A. Paris  
[Int. J. Quantum Inf. \*\*14\*\*, 1650032 \(2016\)](#), [arXiv:1604.07141](#)
- [2] Enhanced Estimation of Loss in the Presence of Kerr Nonlinearity  
 Matteo A. C. Rossi, Francesco Albarelli, Matteo G. A. Paris  
[Phys. Rev. A \*\*93\*\*, 053805 \(2016\)](#), [arXiv:1602.07626](#)
- [1] Nonlinearity as a Resource for Nonclassicality in Anharmonic Systems  
 Francesco Albarelli, Alessandro Ferraro, Mauro Paternostro, Matteo G. A. Paris  
[Phys. Rev. A \*\*93\*\*, 032112 \(2016\)](#), [arXiv:1507.07840](#)

## Conference proceedings

- [2] Continuous Measurements for Advanced Quantum Metrology  
 Francesco Albarelli, Matteo A. C. Rossi, Dario Tamascelli, Marco G. Genoni  
[Proceedings \*\*12\*\*, 47 \(2019\)](#)
- [1] The Role of Monitoring Time and Detectors Efficiencies in Time-Continuous Quantum Magnetometry  
 Francesco Albarelli, Matteo A. C. Rossi, Matteo G. A. Paris, Marco G. Genoni  
[Toward a Science Campus in Milan, \(2018\)](#), Springer International Publishing

## Preprints

- [1] Attainability of the Holevo-Cramér-Rao Bound for Two-Qubit 3D Magnetometry  
 Jamie Friel, Pantita Palittapongarnpim, Francesco Albarelli, Animesh Datta  
[arXiv:2008.01502 \(2020\)](#)

## Presentations

### Contributed talks

- [4] Recent advances in multiparameter quantum estimation  
 4th AQM meeting, Milan, Italy, 20 Dec 2019
- [3] Evaluating the Holevo Cramér-Rao bound for multi-parameter quantum metrology  
 IQIS 2019 (12th Italian Quantum Information Science Conference), Milan, Italy, 9–12 Sep 2019
- [2] Restoring Heisenberg scaling in noisy quantum metrology by monitoring the environment  
 Quantum Roundabout 2018, Nottingham, United Kingdom, 11–13 Jul 2018
- [1] Ultimate limits for quantum magnetometry via time-continuous measurements  
 YQIS 2017 (3rd International Conference for Young Quantum Information Scientists), Erlangen, Germany, 3–6 Oct 2017

## Posters

- [10] Noisy Quantum Metrology Enhanced by Continuous Nondemolition Measurement  
CTP Quantum Information Days 2020(+1), Warsaw, 22–24 Feb 2021
- [9] Evaluating and upper bounding the Holevo Cramér-Rao bound  
QQQ Workshop (Quantum open systems, Quantum thermodynamics, Quantum probability), Milan, Italy, 18–21 Feb 2020)
- [8] The Holevo Cramér-Rao bound for multi-parameter quantum metrology  
CEWQO2019 (26th Central European Workshop on Quantum Optics), Paderborn, Germany, 3–7 June, 2019
- [7] The Holevo Cramér-Rao bound for multi-parameter quantum metrology  
Quantum Measurement: Fundamentals, Twists, and Applications, Trieste, Italy, 29 Apr–4 May 2019
- [6] Locally optimal control of continuous variable entanglement  
IQIS 2018 (11th Italian Quantum Information Science Conference), Catania, Italy, 17–20 Sep 2018
- [5] Restoring Heisenberg scaling in noisy quantum metrology by monitoring the environment  
PRACQSYS 2018 (Principles and Applications of Control in Quantum Systems), Paris, France, 2–6 Jul 2018)
- [4] Generation of coherence via Gaussian measurements  
IQIS 2017 (10th Italian Quantum Information Science Conference), Florence, Italy, 12–15 September 2017
- [3] Nonlinearity as a resource for quantum technologies  
636 WE-Heraeus-Seminar: Quantum-Limited Metrology and Sensing, Bad Honnef, Germany, 6–9 Feb 2017)
- [2] Nonlinearity as a resource for quantum technologies  
IQIS 2016 (9th Italian Quantum Information Science Conference), Rome, Italy, 20–23 Sep 2016
- [1] Nonlinearity as a resource for quantum technologies  
Quantum Roundabout 2016, Nottingham, United Kingdom, 6–8 Jul 2016