

Europass Curriculum Vitae

Updated: March 18, 2024

Personal information

Surname / First name

Nationality

Civil status

Working address 1

Working address 2

Email

Webpage

Pastorello Davide

Italian

Married, 2 daughters

Piazza di Porta San Donato 5, Bologna

Via dei Mille 39, Rimini

davide.pastorello3@unibo.it

<https://sites.google.com/view/pastorello-unibo>

Current position

2023-present

Assistant Professor (RTD-a, s.s.d. MAT/07)

Department of Mathematics

Alma Mater Studiorum - Università di Bologna, Italy

Qualifications

ASN

Habilitation for Associate Professor in Mathematical Physics

(*Abilitazione Scientifica Nazionale* Professore II Fascia, s.c. A1/04)

Research interests

- Mathematical foundations of quantum mechanics;
- Quantum information and computation;
- Quantum and quantum-inspired machine learning;
- Hybrid quantum-classical algorithms;
- Optimization;
- Quantum communication and cryptography;
- Quantum logic;
- Information geometry.

Previous positions

2020-2023

Assistant Professor (RTD-a, s.s.d. MAT/07)

Group of Quantum Information, Dept. of Information Engineering and Computer Science, University of Trento (Italy)

2015-2019

Postdoc

Mathematical Physics group, Department of Mathematics, University of Trento.

Jan. - June 2015

Coordinator of a project, involving the laboratory of cryptography *CryptolabTN* and the company *IKS*, focused on applications of anomaly detection models and machine learning to biometric recognition for users of mobile devices.

2011-2014

PhD candidate at Department of Mathematics, University of Trento.

Education

Ph.D in Mathematics

Institution: University of Trento
Date: 13 November 2014
Evaluation: Excellent
Dissertation: *Geometric Hamiltonian formulation of Quantum Mechanics*

M.Sc. in Physics

Institution: University of Trento
Date: 30 March 2011
Final Mark: 110/110 cum laude
Thesis: *Gleason's theorem: An approach based on Measurability and Harmonic Analysis*

Publications

Books:

- [30] D. Pastorello ***Concise Guide to Quantum Machine Learning*** Springer Singapore 2023, pages 148, ISBN 978-981-19-6897-9

Published/accepted papers:

- [29] D. Pastorello, E. Blanzieri ***Scalable quantum neural networks by few quantum resources*** accepted for publication in International Journal of Quantum Information (arXiv: 2307.01017)
- [28] E. Zardini, E. Blanzieri, D. Pastorello. ***A quantum k-nearest neighbors algorithm based on the Euclidean distance estimation*** accepted for publication in Quantum Machine Intelligence (arXiv: 2305.04287)
- [27] L. Schmid, E. Zardini, D. Pastorello ***A general learning scheme for classical and quantum Ising machines*** Scipost Physics Core 7, 013 (2024)
- [26] E. Tolotti, E. Zardini, E. Blanzieri, D. Pastorello ***Ensembles of quantum classifiers*** Quantum Information & Computation Vol.24 No.3&4 (2024)
- [25] E. Zardini, E. Blanzieri, D. Pastorello. ***Implementation and Empirical Evaluation of a Quantum Machine Learning Pipeline for Local Classification.*** PLoS ONE 18(11): e0287869 (2023)
- [24] E. Blanzieri, D. Pastorello, V. Cavecchia, A. Romyantsev, M. Maltseva. ***Evaluating the convergence of tabu enhanced hybrid quantum optimization.*** Quantum Information Processing 22, 205 (2023)
- [23] E. Blanzieri, R. Leporini, D. Pastorello ***Local Approach to Quantum-inspired Classification*** International Journal of Theoretical Physics 62, 4 (2023)
- [22] E. Zardini, M. Rizzoli, S. Dissegna, E. Blanzieri, D. Pastorello ***Reconstructing Bayesian Networks on a Quantum Annealer*** Quantum Information and Computation, Vol. 22, No. 15&16, 1320–1350 (2022)
- [20] R. Leporini, D. Pastorello. ***An efficient geometric approach to quantum-inspired classifications.*** Scientific Reports vol. 12 (1), (2022)
- [21] R. Leporini, D. Pastorello ***Quantum-inspired classification based on Voronoi tessellation and pretty-good measurements*** Quantum Reports 4(4), 434-441 (2022)

- [19] A. Romyantsev, D. Pastorello, E. Blanzieri, V. Cavecchia. **On convergence of tabu-enhanced quantum annealing algorithm** Communications in Computer and Information Science, vol 1552. Springer, Cham. (2022)
- [18] A. Bonomi, T. De Min, E. Zardini, E. Blanzieri, V. Cavecchia, D. Pastorello **Quantum annealing learning search implementations** Quantum Information & Computation, v. 22, n. 3&4, p. 181-208 (2022)
- [17] R. Leporini, D. Pastorello. **Support Vector Machines with Quantum State Discrimination** in Quantum Reports, v. 2021, 3, n. 3 (2021)
- [16] D. Pastorello, E. Blanzieri **A Quantum Binary Classifier based on Cosine Similarity** Proceedings of: IEEE International Conference on Quantum Computing and Engineering QCE 21, Broomfield, CO, USA, October 17 - 22 (2021)
- [15] D. Pastorello, E. Blanzieri, V. Cavecchia. **Learning adiabatic quantum algorithms over optimization problems** Quantum Machine Intelligence vol. 3, n. 2 (2021)
- [14] M. Pasini, N. Leone, S. Mazzucchi, V. Moretti, D. Pastorello, L. Pavesi. **Bell inequality violation by entangled single photon states generated from a LASER, a LED, or a halogen lamp.** Physical Review A, v. 2020, n. 102 (2020)
- [13] S. Azzini, S. Mazzucchi, V. Moretti, D. Pastorello, L. Pavesi. **Single-particle entanglement.** Advanced Quantum Technologies v. 2020 vol 3, n. 10 (2020)
- [12] D. Pastorello. **Geometric viewpoint on the quantization of a fuzzy logic.** International Journal of Geometric Methods in Modern Physics Volume 17, Issue 13 (2020)
- [11] D. Pastorello, E. Blanzieri. **Quantum Annealing Learning Search for solving QUBO problems.** Quantum Information Processing 18: 303 (2019)
DOI: 10.1007/s11128-019-2418-z
- [10] D. Pastorello. **Entanglement, CP-maps and quantum communications.** UMI Springer Lecture Notes vol. 25 "Quantum Physics and Geometry" (Springer International Publishing 2019)
- [9] D. Pastorello. **A geometrization of quantum mutual information.** International Journal of Quantum Information Vol. 17, No. 02, 1950011 (2019)
- [8] D. Pastorello. **A quantum key distribution scheme based on tripartite entanglement and violation of CHSH inequality.** International Journal of Quantum Information Vol. 15, No. 05, 1750040 (2017)
- [7] D. Pastorello. **A geometric approach to quantum control in projective Hilbert spaces.** Reports on Mathematical Physics Vol. 79, No. 1 (2017)
- [6] D. Pastorello. **Open-loop quantum control as a resource for secure communications.** International Journal of Quantum Information. Vol. 14, No. 02, 1650010 (2016)
- [5] D. Pastorello. **Geometric Quantum Mechanics and applications.** International Journal of Geometric Methods in Modern Physics. Vol. 13, No. Supp. 1, 1630017 (2016)
- [4] V. Moretti and D. Pastorello: **Frame functions in finite-dimensional quantum mechanics and its hamiltonian formulation on complex projective spaces.** International Journal of Geometric Methods in Modern Physics Vol. 13, No. 02, 1650013 (2016)

- [3] D. Pastorello. **A geometric hamiltonian description of composite quantum systems and quantum entanglement.** International Journal of Geometric Methods in Modern Physics v. 12, n. 7, 1550069 (2015)
- [2] D.Pastorello. **Geometric hamiltonian formulation of quantum mechanics on complex projective spaces.** International Journal of Geometric Methods in Modern Physics Vol. 12, No. 08, 1560015 (2015)
- [1] V. Moretti and D. Pastorello. **Generalized spherical harmonics, frame functions and Gleason theorem** Annales Henri Poincaré v. 2013, 14, n.5, p. 1435-1443 (2013)

Submitted papers:

- G. De Palma, T. Klein, D. Pastorello **Classical shadows meet quantum optimal mass transport** (arXiv: 2309.08426)

Selected conferences, workshops, and seminars

The symbol * means Invited Speaker

Winter 2023	*Lecture "Quantum Machine Learning" as <i>Springer Nature Video</i> . (invited by Springer Nature)
Trento, 4 Dec 2023	*Invited lecture "On the learning capability of Ising machines" for the Master in Computer Science, University of Trento
Torino, 11-15 Sept. 2023	Workshop <i>Quantum 2023</i> organized by University of Torino and INRiM .
Verona, 6 June 2023	* <i>Quilab Workshop</i> , University of Verona
Bologna, 29 Nov. 2022	*Guest at Dept. of Mathematics, University of Bologna
On-line event, 15-18 Aug. 2022	<i>Conference on Modern Management based on Big Data</i> organized by Keimyung University, South Korea
Tropea, 27 June-2 July 2022	*International Quantum Structures Association Conference 2022
Lugano, 20-21 June 2022	*International Workshop on <i>Quantum & Biomedical Applications, Technologies, and Sensors</i> q-BATS 2022
On-line event, 17-22 Oct 2021	IEEE International Conference on <i>Quantum Computing and Engineering (QCE21)</i> , Broomfield, CO, USA.
On-line event, 22-30 July 2021	*Conference <i>Information Engines at the Frontiers of Nanoscale Thermodynamics</i> organized by Telluride Science Research Center and University of California, Davis
On-line event, 10 June 2021	*Workshop <i>Quantum Computing</i> organized by the IT company ATOS
On-line event, 24 Nov. 2020	*SPIE quantum computing workshop <i>Photonics as a key enabling technology</i>
Bologna, 19 Dec. 2019	*Workshop <i>Quantum Computing and High Performance Computing</i> at CINECA
Verona, Apr. 2019	*Guest at Dept. of Computer Science, University of Verona
Grenoble, 18 - 22 Feb. 2019	<i>European Quantum Technology Conference 2019</i> (International conference of the QT Flagship)

Trento, 19 Nov. 2018	*Scientific outreach conference <i>La frontiera delle tecnologie quantistiche</i> (at Fondazione Caritro, Trento)
Verona, 25 Oct. 2018	*Quantum Computing Workshop <i>Quantum@Univr</i> at University of Verona
Trieste, 18 May 2018	*Workshop <i>Trieste Junior Quantum Days 2018. A glance in research: where we stand and the future challenges</i> (awarded as best talk)
Heidelberg, 19 - 21 Mar. 2018	Workshop <i>Beyond digital computing</i> at University of Heidelberg
Bologna, 23 - 25 Nov. 2017	*Workshop <i>Physics and Geometry</i> at University of Bologna
Levico Terme (Trento), 4 - 6 July 2017	Workshop <i>Geometry and Quantum Physics</i>
Vietri sul Mare (Salerno), 6 - 10 Apr. 2017	Workshop <i>Current Problems in Theoretical Physics</i>
Bremen, 12 - 17 Mar. 2017	Deutsche Physikalische Gesellschaft conference.
Trento, 1-2 Sept. 2016	*Workshop <i>Siquro</i> where I gave a <i>Short course on quantum cryptography</i> .
Munich, June 2016	*Guest at Dept. of Mathematics, Technische Universität München.
Brixen, 8-13 Feb. 2016	Workshop <i>Mathematical Challenges in Quantum Mechanics</i> .
Zaragoza, 30 Aug. - 4 Sept., 2015	XXIV International Fall Workshop on Geometry and Physics.
Rome, Oct. 2014	*Guest at Department of Mathematics and Physics, University of Roma Tre.
Levico Terme (Trento), 15-19 Sept. 2014	Workshop <i>Operator and Geometric Analysis on Quantum Theory</i> (member of local committee).
Granada, 2-5 Sept. 2014	XXIII International Fall Workshop on Geometry and Physics.
Bari, 29 June - 4 July 2014	*Workshop <i>Quantum Mechanics and applications</i> .
Vienna, 19-23 May 2014	*AQFT14 workshop <i>Algebraic Quantum Field Theory: Its status and its future</i>
Trento, 26 Feb. 2014	*Opening of the Academic Year of doctoral schools in Mathematics and Biomolecular Science, University of Trento
Trento, 3 Feb. 2014	*Math-Physics joint seminar organized by BEC center (Unitn).
Napoli, Jan. 2014	*Guest at Department of Physics of University of Naples <i>Federico II</i> .
Hamburg, Apr. 2012	*Guest at DESY (Deutsches Elektronen Synchrotron).
Trieste, 13-18 Feb. 2012	Workshop <i>Quantum Geometry and Matter</i> , SISSA.

Awards and Grants

- 2020-present See section **Projects** below.
- 2018 **Award for best talk** at Trieste Junior Quantum Days 2018.
- 2017 **Grant** of Fondazione Caritro for the project *Research and development of quantum algorithms and quantum cryptographic protocols*.
- 2016 **Award for best PhD thesis in Mathematics** at University of Trento a.y. 2013/2014. Awarded by Rector Paolo Collini on 14 May 2016.

Projects

- 2021-present P.I. of the project "Testing the learning performances of quantum machines" funded by Q@TN consortium, INFN and CINECA.
- 2023-present Team member of the project SERICS (PE00000014) under the MUR National Recovery and Resilience Plan funded by the European Union - NextGenerationEU.
- 2020-2023 P.I. of the project "Implementation of Quantum Annealing Learning Search to solve optimization problems" (DISI, CNR-IMEM, German Aerospace Center) with access to the quantum annealer installed at Forschungszentrum Jülich.
- 2017-2019 P.I. of the project "Research and development of quantum algorithms and quantum cryptographic protocols" funded by Fondazione Caritro, involving Dept. of Mathematics, DISI, and INFN.
- Jan.-June 2015 Coordinator of a project, involving the laboratory of cryptography *CryptolabTN* and the company *IKS*, focused on applications of anomaly detection models and machine learning to biometric recognition for users of mobile devices.

Patents

- 2020 (filed) - 2022 (granted)
2023 (US patent)
- Incoherent source for intraparticle entanglement** (Inventors: S. Mazzucchi, V. Moretti, M. Pasini, D. Pastorello, L. Pavesi. Number: 102020000005521).
The invention is a compact source of single-photon entangled states for applications to **quantum information processing, cryptography** and **certified random number generation**.

Active collaborations at:

- University of Trento
Dept. of Mathematics
Dept. of Physics
Dept. of Information Engineering and Computer Science
- Tech. Universität München
Dept. of Physics
Forschungszentrum Jülich
Simulation and Data Lab (SDL)
- University of Verona
Dept. of Computer Science
- University of Bergamo
Dept. of Economics
- German Aerospace Center
Institute for Software Technology
- CNR
Institute of Materials for Electronics and Magnetism
- Almaviva S.p.a.
Frontier Technology Lab

Teaching activity

14-16 Sept 2022

Summer/Winter Schools

TQT-Q@TN School on Quantum Science and Technology

organized by Trieste Institute for Theoretical Quantum Technologies (TQT) and Quantum Science and Technology LAB in Trento (Q@TN).

2 Sept 2016

Siquro. Summer school on Quantum Cryptography.

organized by University of Trento and Bruno Kessler Foundation.

Academic Year 2023/2024

Lecturing

Mathematical methods of Quantum Mechanics,
Master in *Mathematics*.

Linear Algebra,

undergrad. in *Chemistry and Technologies for the Environment and Materials*.

A. Y. 2022/2023
2021/2022
2020/2021

Quantum Machine Learning,

Master in *Computer Science*.

A.Y. 2017/2018

PhD course **Introduction to Quantum Information,**

Doctoral School in *Information and Communication Technology*.

A. Y. 2015/2016

PhD course **Foundations of Quantum Information and Quantum Cryptography,**
Doctoral School in *Mathematics*.

A.Y. 2014/2015

Additional course of **Mathematical Analysis,**

undergrad. in *Environmental and Civil Engineering*.

Teaching support

A.Y. 2018/2019
2016/2017
2015/2016
2014/2015

Mathematical Foundations for Computer Science, undergrad. in *Computer Science*.

A.Y. 2018/2019
2017/2018

Geometry B (General topology), undergrad. in *Mathematics*.

A.Y. 2017/2018

Mathematical Analysis I, undergrad. in *Mathematics* and *Physics*.

A.Y. 2016/2017

Mathematical Analysis II, undergrad. in *Industrial Engineering*.

A.Y. 2016/2017
2015/2016
2014/2015

Mathematical Analysis II, undergrad. in *Physics*.

A.Y. 2014/2015

Mathematical Analysis I, undergrad. in *Environmental and Civil Engineering*.

A.Y. 2013/2014

Discrete Mathematics II, undergrad. in *Computer Science*.

A.Y. 2012/2013

Geometry III (Algebraic topology), undergrad. in *Mathematics*.

A.Y. 2012/2013

Geometry I, undergrad. in *Mathematics* and *Physics*.

PhD supervision

2023-present Co-advisor of a PhD student at the doctoral program in **Information and Communication Technology** (University of Trento) on topics of quantum computing and quantum machine learning.

2020-present Co-advisor of a PhD student at the doctoral program in **Information and Communication Technology** (University of Trento) on topics of quantum computing and quantum machine learning.

Thesis supervision

A.Y. 2023/2024 Advisor for a Master thesis in **Computer science** on quantum genetic algorithms.

A.Y. 2023/2024 Advisor for a Master thesis in **Artificial Intelligence Systems** on modified Hopfield networks.

A.Y. 2023/2024 Co-Advisor for a Master thesis in **Mathematics** on security of complex networks.

A.Y. 2022/2023 Advisor for a Master thesis in **Physics** on formulation of nearest neighbors algorithms with different metrics for quantum annealing platforms.

A.Y. 2022/2023 Advisor for a Master thesis in **Computer Science** on quantum bootstrap classification.

A.Y. 2021/2022 Advisor for a Master thesis in **Physics** on design and characterization of a parametric learning model for quantum annealing platforms.

A.Y. 2021/2022 Advisor for a Bachelor thesis in **Physics** on test and validation of a QML algorithm on a IBM quantum processor.

A.Y. 2021/2022 Co-advisor for a Bachelor thesis in **Computer Science** on feature selection by quantum annealing.

A.Y. 2021/2022 Co-advisor for a Bachelor thesis in **Computer Science** on a quantum algorithm to solve a financial problem.

A.Y. 2020/2021 Co-advisor for 2 Bachelor theses in **Computer Science** on reconstruction of Bayesian network learning structures using quantum annealing.

A.Y. 2019/2020 Co-advisor for a Bachelor thesis in **Computer Science** on the implementation of a hybrid quantum-classical algorithm for optimization.

Service activity

2020-2023 Member of the outreach and communication board.
Dept. of Information Engineering and Computer Science, University of Trento

2017-2019 Coordinator of the Mathematical Physics seminars.
Dept. of Mathematics, University of Trento.

Memberships

INdAM *Istituto Nazionale di Alta Matematica*
INFN *Istituto Nazionale di Fisica Nucleare*
QUILAB *Quantum Informatics Laboratory (University of Verona)*
IQSA *International Quantum Structures Association*

Peer-reviewing

Journal Reviewer

Journals by: Springer Nature, Elsevier, World Scientific.

Conference Reviewer

Mathematical Foundations of Computer Science (MFCS); Quantum Physics and Logic (QPL); Italian Conference on CyberSecurity (ITASEC)

Other peer-rev. activities

Reviewer of the project proposals for the *Jülich UNified Infrastructure for Quantum computing (JUNIQ)* at Forschungszentrum Jülich, Germany.

Dissemination activity

Trento, 21 Sep. 2023

Talk *Machine learning with quantum computers*. Meetup Speck&Tech.

Trento, 3 Mar. 2022

Lecture *Machine learning with quantum computers*. ICT Days, University of Trento.

Trento, 24 Sept. 2021

Lecture *Computer Quantistici: cosa sono e a cosa servono i calcolatori basati sulla fisica quantistica*. European Researchers' Night 2021.

Trento, 18 Nov. 2019

Seminar *Macchine quantistiche: stato dell'arte e sfide future* organized by Fondazione Caritro.

Trento, 19 Nov. 2018

Seminar *La frontiera delle tecnologie quantistiche*, organized by Fondazione Caritro

Under italian law: Le informazioni contenute nel presente documento vengono rese ai sensi e per gli effetti degli artt. 46 e 47 del DPR 445/2000.