Francesco Pio **Barone**

University of Padua | PhD candidate in Quantum Physics

Random walker between mountain biking, piano playing, and quantum physics.

Date of birth: 22 July 1999 **Nationality**: Italian
Now in Padua, Italy
Area of interest: quantum algorithms | quantum error correction | tensor networks

An updated version of this CV can be downloaded at baronefr.github.io/cv/.

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Education

PhD candidate in Quantum Physics

University of Padua (IT) · 2024 - 2027

My research is focused on quantum error correction protocols, their simulation through optimized numerical techniques, and their application in digital quantum algorithms.

- **Supervisor**: Prof. Simone Montangero.

MSc in Physics of Data

University of Padua (IT) · 2021 - 2024

The curriculum is focused on computational physics and quantum computing.

- resident of **University Merit College Don Nicola Mazza**
- **Final grade**: 110/110 summa cum laude. **GPA**: 29.8/30. 78/90 ECTS with honors.
- **Erasmus** period in Universität Innsbruck (Sept. 2023 - Feb. 2024)
- **Thesis** @Universität Innsbruck: **"Floquet counterdiabatic protocols for Quantum Annealing on Parity architecture"**. Characterization of Floquet protocols for Quantum Annealing: hyper-parameter tuning for optimal convergence and cost analysis of the algorithm. Derivation of new protocols with improved convergence accuracy. (take a look!)

BSc in Physics

University of Catania (IT) · 2018 - 2021

- **Final grade**: 110/110 magna cum laude
- **Thesis**: **"A new framework for real time gravitational wave detection"**. Built a machine-learning model based on fuzzy logic to perform transient detection in noisy artificial signal segments of a gravitational wave interferometer. The project involved the use of genetic feature selection and spectral signal processing techniques.

Research experience

Università Innsbruck, Institute of Theoretical Physics // Visiting student

Innsbruck (AT) · Sept. 2023 - Feb. 2024

Master thesis at the University of Innsbruck, in the Quantum Optimization group, supervised by Prof. Wolfgang Lechner. I have worked on quantum annealing optimization on the Parity architecture.

CERN Quantum Technology Initiative // Full-time Quantum Computing Intern

Genève (CH) · June - Sept. 2023

CERN openlab program. I have worked on quantum annealing simulation and optimization, applying quantum optimal control and counterdiabatic driving to the preparation of spin systems in non-trivial phases.

Publications

2024	F.P. Barone - **Floquet counterdiabatic protocols for Quantum Annealing on Parity architecture** (thesis.unipd.it)
2023	F.P. Barone et al. - **Counterdiabatic optimized driving in quantum phase sensitive models** (DOI:10.1088/1367-2630/ad313e)
2023	F.P. Barone et al. - **A Novel Multi-Layer Modular Approach for Real-Time Fuzzy-Identification of Gravitational-Wave Signals** (DOI:10.1088/2632-2153/ad1200)
2018	(collaboration) **How does cosmic ray flux vary with altitude? Let's ask it to EEE project students** (DOI:10.1393/gdf/i2018-10306-2)

Partecipations, achievements and honors

2023	**Conference** partecipation: INQA (International Network on Quantum Annealing) 2023.	University of Innsbruck
2023	**Poster** at the Quantum Error Correction & Mitigation Workshop (16-18 October).	University of Trento
2022	**PennyLane Code Camp 2023.** My team earned 7th place out of 500+ participants.	
2019	**Merit scholarship** (2019-2021) for being among the top 5 students in my degree course.	University of Catania
2018	**Olifis Italy finalist.** Finalist of the national Olympiad of Physics.	Senigallia (IT)

Extracurricular activities

Lecturer of Linux course — Padova (IT) · 2024

Lecturer of an introductory course about Linux OS for the university students of Collegio di merito Don Nicola Mazza.

Senior Tutor for Physics — Scuola Superiore di Catania (IT) · Aug. - Sept. 2019

Tutor for Physics students at the European Olympiad of Experimental Science (eoes.it) summer school, in charge of supervising analysis of laboratory data and lecturing on 4th and 5th year high-school topics.

Extreme Energy Events project — Erice (IT) · 2017-2018

Student member of EEE project, a research activity by Centro Fermi & INFN which involves students actively using and analyzing data of MRPC particle detectors.

Skills

</> Computer stuff

Actively coding in	C, C++, Python, Fortran
In love with	Bash, LaTeX
Figuring out	Julia, Rust
Experience in	C#, ROOT, R, Matlab, Visual Basic, HTML5, CSS, JS
Hardware	Arduino, Raspberry Pi, FPGA (VHDL design)
Quantum SDK	Qiskit, PennyLane, Qibo, QuTiP
Machine learning	PyTorch, Keras, Tensorflow, Scikit-learn
Distributed computing	Apache Spark, Dask, Kafka
Database	MySQL, Mongo
Operative systems	Fedora, Debian, Kali, Windows (if requested)

Language

	Understanding	Speaking	Writing
Italian	Native	Native	Native
English	C1	C1	C1
French	A1	A1	A1

Others

Volunteering	volunteer for Italian Red Cross (2018-2022)
Driving licence	B

Portfolio

Most of my projects are published in GitHub. Here I list only the main ones (i.e. my favourites).

› Counterdiabatic Optimized Local Driving annealER — CERN-IT-INNOVATION/colder · 2023

Optimization of Quantum Annealing schedules with hybrid counterdiabatic driving and quantum optimal control methods.

› Digitized Quantum Annealing via Tensor Network simulations — perceptron-dqa · 2023

Quantum Annealing simulation via Tensor Networks for a binary perceptron Hamiltonian.

› Neural Style Transfer — neural-style-transfer · 2023

Deep CNN-based method to perform Image2Image arbitrary style transfer given two input pictures.

› HAVOK and Reservoir computing for chaotic dynamics forecast — rhavok-analysis · 2022

Forecasting and controlling chaotic behavior through the HAVOK technique (by S. Brunton et al) and modern developments in Reservoir Computing. Eventually, a simple Reinforcement Learning demo model is used to control a Lorenz system.

› Streaming processing of cosmic rays — streaming-cosmic-rays · 2022

Live analysis of events detected by cosmic rays telescopes in Legnaro INFN laboratories. The data is analyzed in a distributed fashion through Apache Spark, producing a live data quality dashboard.

Mean-timer technique in drift tubes detectors mean-timer-technique-... · 2022

An implementation of the mean-timer technique in drift tube detectors.

Reprogrammable FIR filter on FPGA mapd_7taps_fir · 2021

VHDL design of FPGA FIR filter, whose coefficients can be re-configured runtime using the UART interface.