Saverio **Monaco**

Computational Physics MSc graduate · AI enthusiast · Quantum Computing enthusiast

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Education

RWTH Aachen & DESY

Hamburg, Germany

PhD in Quantum Generative models for High Energy Physics - ENGAGE Marie Skłodowska-Curie PhD — *Mar. 2024 - Now*

- **Thesis: Detector Simulation and Jet Clustering for HL LHC with Quantum Computing**

University of Padua

Padua, Italy

M.Sc. in Computational Physics — *Sep. 2020 - Sep. 2023*

- **Grade:** 110/110 with honors
- **Thesis: Study of quantum correlations in LHCb simulated heavy flavour jets**
  Explored applications of Quantum Machine Learning in High Energy Physics, focusing on b— vs c—jets classification. Investigated entanglement production in Parametrized Quantum Circuits during training process. Analyzed entanglement evolution to enhance jet identification training procedure and gain new insights of the data. I presented and provided updates to the LHCb collaboration on a regular basis.

University of Catania

Catania, Italy

B.Sc. in Physics — *Sep. 2016 - Jul. 2020*

- **Thesis: Phase-Space Formulation of Quantum Mechanics.**
  A concise guide to an alternative and equivalent formulation of Quantum Mechanics in which position and momentum variables are expressed through Wigner quasi-probability distributions.

Exchange Year in Germany

Rahden, Germany

11th Grade - Junior Year in Gymnasium der Stadt Rahden — *Sep. 2014 - Jul. 2015*

Hosted for a year by a volunteer German family. I attended a German "Gymnasium" during the 11th grade year, where I adjusted to a different lifestyle and immersed myself in learning the language, reaching a high B2 proficiency level.

Research Experience

Internship at CERN

Geneva, Switzerland

Full-time Quantum Machine Learning Intern — *Apr. 2022 - OCt. 2022*

Explored **Quantum Machine Learning models** such as Variational quantum eigensolvers, Quantum Convolutional Neural Networks and Quantum Autoencoders for the task of phase recognition of spin models. The research at the Internship further lead to an official Python package and a paper published on Physical Review B: "*Quantum phase detection generalisation from marginal quantum neural network models*".

Supervisors: Oriel Kiss, Antonio Mandarino, Sofia Vallecorsa, Michele Grossi.

Poster presentation at QIP

Ghent, Belgium

Poster presentation at Quantum Information Processing 2023 (4-10 February 2023) — *Feb. 2023*

Presented "*Quantum phase detection generalisation from marginal quantum neural network models*" as a poster in Ghent at the 26th Conference on Quantum Information Processing.

Poster presentation at IFAE

Catania, Italy

Poster presentation at Incontri di Fisica delle Alte Energie 2023 (12-14 April 2023) — *Apr. 2023*

Presented a poster on behalf of Padua LHCb research group containing my Master's Thesis results in Catania at the High Energy Physics conference.

Languages

- Mother tongue: Italian
- Other languages:

	Understanding	Speaking	Writing	Certificate
English:	C1	C1	C1	**IELTS Academic: score 7**
German:	C1	B2	B2	**Goethe-Zertifikat B2**
French:	B2	B1	B2	**EsaBac diploma**

Programming Skills

Programming Languages	Python, R, C, Bash, Fortran, VHDL, Agda, SQL
Machine Learning libraries	Jax, Pytorch, Scipy, scikit-learn, Pennylane
Other libraries	Numpy, Pandas, Seaborn, Matplotlib, Plotly
Other skills	Linux, Git, Arduino, Sphinx, ReadTheDocs, LaTeX

Projects

Generative Modeling through Matrix Product States (Tensor network) *Group (2) Project*

Final project for "Quantum Information and Computing" *Feb. 2022 - Apr. 2022*

Developed a Matrix Product State (MPS) designed for generative tasks named Born Machine. The efficacy of this model was evaluated using the MNIST digits dataset to produce and reconstruct black and white images.

Processing of streaming data using Apache Spark and Kafka *Group (3) Project*

Final project for "Management and Analysis of Physics Datasets" *Jun. 2021 - Sep. 2021*

Analysis through Parallel Computing of simulated streaming processing of cosmic rays in Drift Tubes detectors. Implementation of a live dashboard using Plotly Dash.

Implementation of two Convolutional Neural Networks for MAGIC Telescopes *Group (4) Project*

Final project for "Laboratory of Computational Physics" *Apr. 2021 - Jul. 2021*

Implementation in Python and CTLearn of two distinct Convolutional Neural Networks for Gamma-ray/Cosmic-ray classifier and direction-energy reconstruction using simulated and real data from MAGIC Cherenkov Telescopes.

4-Taps Finite Impulse Response Filter in VHDL *Solo Project*

Project for " Management and Analysis of Physics Datasets" *Dec. 2020 - Gen. 2021*

Implementation of a UART and Low-Pass filter in a FPGA using VHDL.

Learning the topology of a Bayesian Network using the K2 algorithm *Group (2) Project*

Final project for "Advanced statistics" *May. 2021 - Jul. 2021*

The K2 algorithm was implemented in R from scratch to learn the topology of a Bayesian Network from input event data.

Extracurricular Activities

PennyLane Code Camp 2023

Participated in a coding challenge related to the Pennylane library for Quantum Machine Learning. *Nov. 2022*

- My team arrived 7th place over more than 500 other teams.
- Enhanced my skills of the Pennylane library.
- Honed my teamwork skills.

Lecturer of "LaTeX course" *Padua, Italy*

Computer science commitee - "College of Merit Don Nicola Mazza" *A.Y. 2020-21, 2021-22, 2022-2023*

Courses were held in three lessons spanning from the fundamental principles of the markup language to delve into more advanced subjects, encompassing the utilization of particular libraries (like TikZ) and advanced commands.

Publications

2024 Exploring the Phase Diagram of the quantum one-dimensional ANNNI model
M. Cea, M. Grossi, **S. Monaco**, E. Rico, L. Tagliacozzo, S. Vallecorsa
arXiv pre-print

2023 Quantum phase detection generalization from marginal quantum neural network models
S. Monaco, O. Kiss, A. Mandarino, S. Vallecorsa, M. Grossi
Phys. Rev. B 107 (8) p. L081105. American Physical Society

2023 Study of quantum correlations in LHCb simulated heavy flavour jets
S. Monaco, D. Lucchesi, D. Zuliani, L. Sestini and
thesis.unipd.it