Antonio Anna Mele

Curriculum Vitae

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Birth date: 22/08/1997
Nationality: Italian

Short Profile

Current status: PhD student at Freie Universität Berlin.

Research interests: Theory of Quantum Information and Computation. Artificial Intelligence and Machine Learning.

Education

2021 – Now **PhD in Quantum Information**, Freie Universität Berlin.
Advisor: Jens Eisert

2019 – 2021 **Master degree in Physics**, Joint programme (UNITN-SISSA).
University of Trento, Trento.
SISSA/ISAS - International School for Advanced Studies, Trieste.
Exams average: 30/30.
Thesis: Quantum Approximate Optimization Algorithm for Quantum Many-Body States Preparation.
Advisors: Mario Collura & Philipp H.J. Hauke
Final Grade: 110/110 cum Laude, 20/10/2021

2016 – 2019 **Bachelor degree in Physics**, *University of Pisa*, Pisa.
Thesis: How to break down quantum noise in a gravitational waves detector.
Advisor: Giancarlo Cella.
Final grade: 110/110 cum Laude, 27/06/2019.

2011 – 2016 **Secondary School**, *Liceo Scientifico delle Scienze Applicate E.Fermi*, Policoro(MT).
Final grade: 100/100.

Academic papers

- **A.A. Mele**, G.B. Mbeng, G.E. Santoro, M. Collura, P. Torta. Avoiding barren plateaus via transferability of smooth solutions in Hamiltonian Variational Ansatz. ArXiv preprint, arXiv:2206.01982, 2022.
- J.J. Meyer, M. Mularski, E. Gil-Fuster, **A.A. Mele**, F. Arzani, A. Wilms, J. Eisert. Exploiting symmetry in variational quantum machine learning. ArXiv preprint, arXiv:2206.01982, 2022.

Master courses

During my master degree, I had the opportunity to attend various PhD courses in SISSA, in addition to the master courses in University of Trento, including:

UNITN:

- Statistical mechanics (30L/30) - R. Potestio
- Experimental methods (30/30) - S. Vitale
- Quantum Field Theory I (30/30) - A. Perego
- Quantum Mechanics, fields and symmetries (30/30) - W. Leidemann
- Nuclear and subnuclear physics (30L/30) - W. Leidemann
- Solid state physics I (30L/30) - G. Baldi
- Computational physics (30/30) - F. Pederiva

- Quantum computing (30L/30) - P. Hauke
- Quantum Machine Learning (30/30) - D. Pastorello
- General relativity and Cosmology (Attended course) - M. Rinaldi

SISSA:

- Many-Body Simulations I. Stochastic methods: from Langevin dynamics to Quantum Monte Carlo (30/30) - S. Sorella
- Many-Body Simulations II. Exact and Renormalisation methods: from Lanczos to Tensor Networks (28/30) - M. Collura
- Electronic bands and phonon dispersions: theory and applications (30L/30) - A. Dal Corso
- Quantum Many Body Systems and Strongly Correlated Electrons I (30L/30) - M. Capone
- Quantum Many Body Systems and Strongly Correlated Electrons II (30L/30) - M. Fabrizio
- The quantum Ising chain for beginners (30L/30) - G. Santoro
- Hubbard model dynamical correlation function via Lanczos Techniques (30L/30) - M. Collura
- Application of basic quantum Monte Carlo methods to a toy model on a lattice (30/30) - S. Sorella
- Entanglement Entropy and Quantum Field Theories (30/30) - P. Calabrese
- Algorithmic differentiation for electronic simulations (Attended course) - S. Sorella
- Introduction to Quantum Information and Computation (30L/30) - G. Santoro, R. Fazio
- Machine Learning for Material Science (30/30) - S. De Gironcoli

Master thesis abstract

In the *Variational Quantum Algorithms* setting, I have analyzed the preparation of ground states of quantum many-body models finding strategies to speed-up the procedure and also to deal with the so-called *Barren Plateaus* phenomena, a crucial problem in Quantum Machine Learning. The results of my master's research led to the paper arXiv:2206.01982.

Computer Skills

Languages and Softwares: Python, C/C++, Fortran, Mathematica, LaTeX, HTML, CSS.

Frameworks for Quantum Computing e.g. *QisKit*, *Pennylane*, *CirQ*.

Good Arduino skills (plus, implemented a robotic hand as project for high school thesis).

Video-editing: Final Cut Pro.

Partecipation in Schools and Workshops

08/2022 QMATH Masterclass on Entropy Inequalities in Quantum Information Science, University of Copenhagen.

Talks and Poster

Sep. 8, 2022 Avoiding barren plateaus via transferability of smooth solutions in Hamiltonian Variational Ansatz, DPG Meeting, Quantum Information.

Sep. 8, 2021 Exploiting symmetry in variational quantum machine learning, DPG Meeting, Quantum Information.

Languages

Italian: Native.

English: Fluent, written and spoken. Master and PhD programme in English. FCE certificate.

Experiences and Awards

2020 **Deep Learning Day**: The day course organized by *AI Student Society* consisted in a Neural Networks course and a seminar on Adversarial Attacks.

2020 **Samsung innovation Camp**: 25 hours of online training and a Project Work on the main digital disciplines: marketing, communication, business, data analytics, innovative use of technologies, privacy and online security.

2019 **UNITN-SISSA**: Scholarship for admission to Master Programme. Selected through a competition based on a physics written and oral exam.

2019 **Laude Bachelor Ceremony**: Partecipation at ceremony for awarding diplomas to graduates *cum Laude*.

2018-2019 **Lead The Future**: Selected as Mentee in *LeadTheFuture*. With the acceptance rate below 20 %, it is an organization that empowers top-performing students to achieve their goals by providing prestigious mentorship coming from the world's leading STEM innovation hubs such as Silicon Valley and CERN.

2015 **Physics, Chemistry and Informatics Olympiad**: Partecipation at the national finals of the National Informatics Olympiad and at both the regional phases of Physics and Chemistry olympiads.

2015-2016 **IoStudio**: Competition of MIUR and SAMSUNG. Winner for programming an Android App for my high school.

Other Experiences

- *Safety in lab* Course (2020).
- Representative of high school student body for two years (2014-15 and 2015-16).
- Organizer of *Global Climate March* in Policoro (MT) (2015/11).
- FIGC football referee (2014-15).
- Math, physics and programming mentor for students.
- EIPASS (Computer Science certification)