Antonio Anna Mele

Curriculum Vitae

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Short profile

Current status	PhD student at Freie Universität Berlin, Jens Eisert group.
Research interests	Theory of Quantum Information and Computing. AI and Machine Learning.
	https://antonioannamele.com

Education

2021 – Now	**PhD in Quantum Information**, Freie Universität Berlin. *Advisor*: Jens Eisert
2019 – 2021	**Master degree in Physics**, Double degree UNITN-SISSA. *University of Trento*, Trento. *SISSA/ISAS - International School for Advanced Studies*, Trieste. *Final grade*: 110/110 cum Laude, 20/10/2021. *Exams average*: 30/30 (maximum).
2016 – 2019	**Bachelor degree in Physics**, *University of Pisa*, Pisa. *Final grade*: 110/110 cum Laude, 27/06/2019.

Academic papers

- Learning fermionic correlations by evolving with random translationally invariant Hamiltonians. J. Denzler, **A.A. Mele**, E. Derbyshire, T. Guaita, J. Eisert. ArXiv preprint arXiv:2309.12933, 2023.
- Introduction to Haar Measure Tools in Quantum Information: A Beginner's Tutorial. **A.A. Mele**. ArXiv preprint arXiv:2307.08956, 2023.
- J.J. Meyer, M. Mularski, E. Gil-Fuster, **A.A. Mele**, F. Arzani, A. Wilms, J. Eisert. Exploiting symmetry in variational quantum machine learning. PRX Quantum 4 (1), 010328, 2023.
- Avoiding barren plateaus via transferability of smooth solutions in Hamiltonian Variational Ansatz. **A.A. Mele**, G.B. Mbeng, G.E. Santoro, M. Collura, P. Torta. Physical Review A 106 (6), L060401, 2022
- Stochastic noise can help to avoid saddle points in variational quantum algorithms. J. Liu, F. Wilde, **A.A. Mele**, L. Jiang, J. Eisert. ArXiv preprint, arXiv:2210.06723, 2022.

Teaching

2022 – 2023	Quantum information theory (tutorials). https://antonioannamele.com/teaching/

Talks and Poster

02/2023	Avoiding barren plateaus via transferability of smooth solutions in Hamiltonian Variational Ansatz, QIP 2023 (poster).
09/2022	Avoiding barren plateaus via transferability of smooth solutions in Hamiltonian Variational Ansatz, DPG conference (talk).
09/2021	Exploiting symmetry in variational quantum machine learning, DPG conference (talk).
11/2022	Avoiding barren plateaus via transferability of smooth solutions in Hamiltonian Variational Ansatz, QTML 2022 (Extendend talk).

Partecipation in Schools and Workshops

08/2023   QMATH Masterclass on Quantum Learning Theory, University of Copenhagen.

07/2023   PCMI 2023 Graduate Summer School in Quantum Computation. IAS/Park City Mathematics Institute.

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

Current research interests

My current research focuses on **Quantum Learning Theory**, **Random Quantum Circuits**, and **Quantum Computation with Fermions**. I am deeply interested in the interplay between **Classical Simulability vs Learnability** of quantum state classes. I am actively exploring the impact of a more realistic noise model in Quantum Algorithms, tied to a project in preparation (I proved that even small amount of non-unital noise eliminates Barren Plateaus). I like to integrate mathematical-theoretical tools from Theoretical Computer Science with numerical analysis, including Machine Learning, for a cohesive approach in my research.

Review activity

Journals   Quantum

npj Quantum Information

Conferences   27th Conference on Quantum Information Processing (QIP 2024)

17th Conference on Theory of Quantum Computation, Communication and Cryptography (TQC 2023)

26th Conference on Quantum Information Processing (QIP 2023)

Quantum Techniques in Machine Learning 2022 (QTML 2022)

Bachelor and Master thesis

Master   Title: Quantum Approximate Optimization Algorithm for Quantum Many-Body States Preparation.

Advisors: Mario Collura & Philipp H.J. Hauke.

Bachelor   Title: How to break down quantum noise in a gravitational waves detector.

Advisor: Giancarlo Cella.

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

Computer Skills

Languages and Softwares
Python, C/C++, Fortran, Mathematica, 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.

Languages

Italian
Native.

English
Advanced. Master and PhD programme in English. FCE certificate.

German
Basic knowledge.

Experiences and Awards

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.

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.

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

Other Experiences

- Representative of high school student body for two years (2014-15 and 2015-16).
- FIGC football referee (2014-15).
- Math, physics and programming mentor for students.