

Francesco Slongo

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EDUCATION

Ph.D. in Physics and Chemistry of Biological Systems - cum Laude

Scuola Internazionale Superiore di Studi Avanzati, SISSA, Trieste, Italy

Sept. 2021 → 29th Sept. 2025

SUPERVISOR: prof. C. Micheletti

TOPIC: *Quantum-inspired algorithms for sampling lattice polymers in dense phases*

DESCRIPTION: My Ph.D. project focused on developing models and algorithms inspired by, or amenable to, quantum computing to study polymer systems under conditions that are challenging to simulate using traditional techniques, particularly at high densities. The algorithms were tested using both classical and quantum computers. A key aspect of the project was investigating topological entanglement in these systems, with a special emphasis on the linking probability, a topological observable that has been largely unexplored in this context due to the complexity of the required simulations. I have also reviewed articles for Physical Review and Scientific Reports.

Master's degree in Theoretical Physics - 110 cum Laude/110

Joint programme UniTn-SISSA, University of Trento-SISSA, Trento/Trieste, Italy

Sept. 2019 → Oct. 2021

SUPERVISOR: prof. P. Faccioli

THESIS: *Variational Estimate of the Reaction Coordinate in Macromolecular Transitions*

DESCRIPTION: My Master's thesis focused on developing a novel method to compute the committor—a key quantity in transition path theory that enables the calculation of all relevant observables. The method, inspired by variational Monte Carlo, helps transition path sampling approaches used to study rare events, such as protein folding, and was validated using both toy models and the realistic case of alanine dipeptide.

Erasmus+ Exchange at University of Oslo

Aug. 2018 → June 2019

DESCRIPTION: During the third year of my Bachelor's degree, I participated in an Erasmus exchange program at the University of Oslo. This experience allowed me to take advanced courses not available at my home university and significantly improve my English proficiency.

Bachelor's degree in Physics - 110 cum Laude/110

University of Trento, Trento, Italy

Sept. 2016 → Sept. 2019

SUPERVISOR: Prof. M. Rinaldi

THESIS: *The first image of a black hole: shadows in Schwarzschild and Kerr metrics*

DESCRIPTION: My Bachelor's thesis work focused on calculating analytically the shape of black hole shadows in Schwarzschild and Kerr spacetimes using the Hamilton-Jacobi formalism, providing an alternative to traditional optics-based approaches.

EXPERIENCE

Consultant

d-fine s.r.l., Milano, Italy

June 2026 → Today

DESCRIPTION: As a consultant at d-fine, my daily work centers on Monte Carlo simulations for risk management, applying the statistical and computational methods from my physics background to financial risk problems.

High School Mathematics and Physics Teacher

I.I.S. Galilei-Tiziano, Belluno, Italy

Nov. 2025 → May 2026

DESCRIPTION: I taught mathematics and physics and prepared laboratory experiences for 4 classes of students aged 15 to 18 at high school level.

RESEARCH INTERESTS

Self-Assembly and Topological Organization in Soft Matter: I am interested in how dense polymer systems organize themselves, from the emergence of giant components in self-assembling melts and the scaling of their properties, to the inter- and intra-chain topological entanglement that arises in these phases.

Rare Events and Macromolecular Transitions: I am interested in the sampling of rare events and transitions in macromolecular systems, in particular using the formalism of Transition Path Theory.

Method Development for Hard Sampling Problems: I develop algorithms and simulation techniques based on statistical mechanics for regimes where conventional approaches struggle, such as quantum-based optimization applied to spin-based Hamiltonians for dense polymer melts. I am interested in extending this to new classes of problems and methodologies.

ON-GOING PROJECTS

Monte Carlo methods for self-assembled melts of rings

COLLABORATORS: E. Fornasa, C. Micheletti

In this work we use a formulation inspired by quantum annealers to devise efficient Monte Carlo moves for melts of rings.

Quantum computing for cyclomatic polymers in a melt of polymer rings

COLLABORATORS: S. Whittington, C. Micheletti

In this work we use the tools devised in previous articles to study branched polymers with cyclomatic complexity equal to two and three. EXPECTED SUBMISSION: Oct. 2026

Variational estimation of the committor function in macromolecular transitions

COLLABORATORS: F. De Matteis, P. Faccioli

In this work we extend the method that I developed during my Master's thesis, studying rare macromolecular transitions.

TALKS & POSTERS

1. CECAM Workshop - Invited talk

TITLE: Quantum annealing for hard soft-matter problems

Sept. 2025; Trieste, Italy

2. StatPoly in Venice Statistical Mechanics of polymers and biopolymers - Contributed Talk & Poster

TITLE: Efficient sampling of lattice polymer melts inspired by quantum computing

July 2025; Venice, Italy

3. National Conference of ICSC Spoke 7 - Poster

TITLE: Thermodynamic reweighting for QUBO models of physical systems

May 2025; Trieste, Italy

4. APS March Meeting - Contributed talk & Poster

TITLE: Quantum-inspired Encoding Enhances Stochastic Sampling of Soft Matter Systems

March 2025; Anaheim, United States

5. 11th International Conference on Multiscale Material Methods - Contributed talk & Poster

TITLE: Quantum-inspired Encoding Enhances Stochastic Sampling of Soft Matter Systems

Sept. 2024; Prague, Czech Republic

6. Annual Meeting of the Physics of Living Systems (PoLS) - Contributed talk & Poster

TITLE: Quantum-inspired Encoding Enhances Stochastic Sampling of Soft Matter Systems

June 2024; Trieste, Italy

7. III Conference of the Italian Society of Statistical Physics – SIFS - Poster

TITLE: Solving hard Monte-Carlo sampling problems using quantum encoding

June 2023; Parma, Italy

8. Christmas workshop: XBW 2022 - Contributed talk

TITLE: A QUBO model for melts of self-assembling ring polymers

Dec 2022; Brdo, Slovenia

WORKSHOPS & SUMMER SCHOOLS

Ph.D. for innovation

A programme aimed to match the best Ph.D. skills with companies.

June 2025; Trieste, Italy

Farewell workshop for Pietro Faccioli

Workshop about the research of Prof. Pietro Faccioli

March 2023; Trento, Italy

TQT-Q@TN School on Quantum Science and Technology

Summer school about quantum technology, quantum computing and quantum machine learning

Sept. 2022; Trento, Italy

ICTP-SISSA-CECAM Workshop on Molecular Dynamics and its Applications to Biological Systems

Summer school about quantum technology, quantum computing and quantum machine learning

Sept. 2021; Virtual Meeting

AWARDS & GRANTS

DSOFT FIT Award(2025)

United States

International Travel Award to participate in the APS March Meeting.

Winner of ICTP - Quantinuum Quantum Hackathon (2023)

Trieste, Italy

Best Team Project Award. Project from Merck KGaA.

Joint program UniTn-SISSA (Sept. 2019 → Oct. 2021)

Trento/Trieste, Italy

Scholarship for the Joint Program with Admission through Public Competition.

Collegio Bernardo Clesio (x2) (2016 → 2019/2019 → 2021)

Trento, Italy

College for meritorious students with Admission through Public Competition.

SKILLS

Programming: C/C++, Python, Java, MATLAB, Mathematica, bash, awk, SQL (basic)

Technologies: Git, Github, Gitlab, Docker, Pytorch, TensorFlow, vmd

Languages: Italian (native), English (professional)

Conceptual skills: Statistics, modeling, optimization, Monte Carlo sampling, ML, quantum computing

Soft-skills: Analysis, Problem-Solving, Critical Thinking, Interpersonal Skills, Project Management, Written & Oral Communication

PUBLICATIONS

Fornasa. E., **Slongo, F.**, & Micheletti, C. (2026). Self-assembly Monte Carlo reveals localized entanglement in giant polymer melts, Nature Communications.

Slongo, F., & Micheletti, C. (2025). Computing canonical averages with quantum and classical optimizers: Thermodynamic reweighting for QUBO models of physical systems. Physical Review Research, 7(2), 023116.

Slongo, F., Hauke, P., Faccioli, P., & Micheletti, C. (2023). Quantum-inspired encoding enhances stochastic sampling of soft matter systems. Science Advances, 9(43), eadi0204.

REFERENCE LETTERS MAY BE REQUESTED TO

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Prof. Pietro Faccioli

Dipartimento di Fisica "Giuseppe Occhialini", Milano, Italy

EMAIL: pietro.faccioli@unimib.it