

Giovanni Cemin

Dresden, Germany

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Research Interests

- Computational quantum many-body physics
- Tensor-network methods: MPS, DMRG, TEBD
- Equilibrium and non-equilibrium many-body quantum dynamics
- Machine learning and reinforcement learning for physics
- Critical phenomena and phase transitions
- Quantum information and computation: quantum circuits, stabilizer circuits, and quantum magic

Experience

PhD Researcher

Dresden, Germany

Max Planck Institute for the Physics of Complex Systems

Oct 2023 - Present

- Implemented Reinforcement Learning framework in JAX (Proximal Policy Optimization algorithm), to achieve optimal control of stochastic quantum circuits.
- Built a modular, documented stabilizer-circuit simulator from scratch in Python/JAX with full GPU acceleration, enabling large-scale ($>10^3$ qubits) studies of quantum dynamics and statistical behavior (10^3 - 10^4 parallel trajectories).
- Performed large-scale quantum-dynamics and machine-learning experiments on HPC SLURM-based GPU clusters: multi-node (1-4), multi-GPU (up to 16 GPUs).
- Optimized and parallelized simulation and ML pipelines for quantum many-body systems, achieving up to 300x speedup.
- Applied best practices software development lifecycles, including version control with Git, and coding standards to ensure reproducible research.
- Organizer of the [quantum computing journal club](#), running weekly and discussing state-of-the-art research.

Internship - Business Functional Analyst

Frankfurt am Main, Germany

Deutsche Bank

Jul 2023 - Sep 2023

- Designed and deployed Python tools for automated data quality checks and documentation automation, increasing process efficiency by 10x.
- Wrote comprehensive Python testing suites for internal data reporting packages to ensure reliability and code quality.
- Developed an internal Python package to automate documentation processes, reducing manual maintenance by 90%.
- Bridged business and technical teams through communication and collaborative development within a corporate environment.
- Represented Deutsche Bank at the "Bank on Tech" event, presenting two innovative projects resulting in highly positive feedback.

Scientific publications and preprints

G. Cemin, M. Schmitt, M. Bukov

2025

Learning to stabilize nonequilibrium phases of matter with active feedback using partial information, [arXiv:2508.06612](#)

G. Cemin, M. Cech, E. Weiss, S. Soltan, D. Braun, I. Lesanovsky, F. Carollo

2024

Machine learning of reduced quantum channels on noisy intermediate-scale quantum devices, [Phys. Rev. A 110, 052418](#)

G. Cemin, F. Carnazza, S. Andergassen, G. Martius, F. Carollo, I. Lesanovsky

2023

Inferring dynamical generators of local quantum observables from projective measurements through machine learning, [Phys. Rev. Applied 21, L041001](#)

Honors and Awards

- Academic Excellence Award (Master's), FPB Cassa | 650€ 2024
Recognized for graduating with the highest possible grade (Summa Cum Laude equivalent) in the Master's program.
- Double Degree Merit Scholarship, University of Tübingen-Trento | 5.000€ 2023
Awarded for academic excellence to support the dual-degree program between the University of Trento and the University of Tübingen.
- Microsoft Vendor Prize, Deutsche Bank "The Year of AI" Hackathon 2023
Developed a GPT-powered chatbot during a Deutsche Bank internship.

Projects

Qtetrix

Dresden, Germany

MPI-PKS

Jan 2024 - Present

- Developed an RL framework to prevent entanglement growth in large stochastic stabilizer circuits, enabling optimal control of system sizes up to 128 qubits. The obtained policy outperforms established baselines and carefully designed heuristic strategies, revealing nontrivial control patterns unattainable with deterministic protocols, [arXiv:2508.06612 \(2025\)](#)
- Performed scalable GPU-accelerated simulations on HPC clusters to explore the entanglement phase diagram under RL-optimized control.
- Investigated generalizations to higher-dimensional circuits, magic-doped dynamics, and measurement-induced settings.
- *Collaborators:* Marin Bukov (MPI-PKS) and Markus Schmitt (University Regensburg)

LoRaC - Long-Range interacting Circuits

Dresden, Germany

MPI-PKS

Jun 2025 - present

- Investigated phase transition in the steady-state of Floquet dynamics in stabilizer circuits with long-range interactions.
- Developed a GPU-accelerated stabilizer-circuit simulator in Python/JAX from scratch, enabling large-scale simulations of $>10^3$ qubits across 10^3 – 10^4 parallel trajectories.
- Characterized critical behavior, extracted critical exponents, and mapped the transition to the long-range site percolation universality class, providing quantitative insights into non-equilibrium phase transitions.
- Explored generalizations to arbitrary graph topologies, magic doping, and measurement-induced dynamics, extending the framework beyond 1D chains
- *Collaborators:* Marin Bukov (MPI-PKS) and Andrea Solfanelli (MPI-PKS)

CHILL - Calibrating Heat In Large-scale Lattices

Dresden, Germany

MPI-PKS

Jan 2026 - present

- Investigated temperature fluctuations in quantum annealers; designed and optimized spin chains (“quantum thermometers”) to probe QPU temperatures online.
- Applied quantum thermometers to improve hardware calibration and post-processing, enhancing the precision of quantum annealer experiments.
- *Collaborators:* Gianluca Teza (MPI-PKS)

Master thesis

Tübingen, Germany

University of Tübingen

Oct 2022- Jun 2023

- Implemented tensor-network simulations of spin-chain dynamics using TEBD to generate training data for open-quantum-systems modeling.
- Trained interpretable ML models to learn an effective Lindblad master equation, extract dynamical laws, and successfully extrapolate to unseen time scales, [Phys. Rev. Appl. \(2024\)](#)
- Extended the framework to learn general quantum channels via Stinespring-dilation theorem. Applied the method to IBM superconducting-qubit hardware, fitting open-system dynamics from real device data and inferring gate-level decoherences, [Phys. Rev. A \(2024\)](#).

Coarse-Graining model for small molecules

Trento, Italy

University of Trento

Jul 2022

Implemented an autoencoder in Python/PyTorch to learn coarse-grained molecular representations from molecular-dynamics trajectories, reproducing results from [Sci. Rep. \(2019\)](#). Extended and validated the approach on three additional molecular systems, demonstrating robustness and generalizability of the learned representations.

Relation between Energy consumption and weather, ML model

Trento, Italy

University of Trento

Jul 2021

Developed two predictive machine-learning models using scikit-learn:

- A classifier that distinguishes between rural, industrial, and urban regions of Trentino based on energy-consumption profiles.
- A regression model that predicts energy demand from weather variables (temperature, wind, etc.) and day-of-week features.

Both models achieved $\leq 10\%$ relative error, demonstrating strong performance on real-world time-series data.

Education

Max Planck Institute for the Physics of Complex Systems

Dresden, Germany

Ph.D. in Physics

Oct 2023 - Present

- Ph.D. in Physics studying out-of-equilibrium dynamics of many-body systems through Reinforcement Learning.
- Part of **International Max Planck Research School for Quantum Dynamics and Control (IMPRS-QDC)**
- Relevant coursework: Numerical tools for quantum many-body physics, Stochastic processes, Quantum many-body dynamics.
- Supervisors: **Marin Bukov**, **Markus Schmitt**

University of Tübingen

Tübingen, Germany

Master's degree in Physics

Oct 2022 - Aug 2023

- Final evaluation: **very good (1.0)**
- Double degree program with University of Trento.
- Master Thesis' project: Developed tensor-network simulations (TEBD) for large 1D spin systems and generated dynamical datasets. Learned effective Lindblad generators via machine-learning models trained on projective measurements. Extended the model to a time-dependent, non-Markovian setting and analysed the resulting dynamical features. Supervisors: Prof. **Igor Lesanovsky** and Prof. **Raffaello Potestio**.

University of Trento

Trento, Italy

Master's degree in Physics

Sep 2021 - Oct 2023

- Final evaluation: **110/110 cum Laude**
- Relevant coursework: Statistical Mechanics, Quantum Field Theory, Computational Physics, Quantum Computing, Large Deviations Methods and Multi-scale Methods in Soft Matter Physics, and Condensed Matter Physics.

University of Trento

Trento, Italy

Bachelor's degree in Physics

Sep 2018 - Sep 2021

- Final evaluation: 99/110
- Thesis: Derivation and measurement of the equation of state of a weakly interacting 3D Bose gas. Supervisor: Prof. **Franco Dalfovo**.

Talks

- Learning to stabilize nonequilibrium phases of matter using partial information**
Condensed Matter Theory Seminar *MPI-PKS, Dresden, Germany – Nov 2025*
- Learning to stabilize nonequilibrium phases of matter using partial information**
Condensed Matter Theory Seminar *TUM Munich, Germany – Oct 2025*
- Learning to stabilize nonequilibrium phases of matter using partial information**
Computational Quantum Science group Seminar *University of Regensburg, Germany – Oct 2025*
- Reinforcement learning to stabilize nonequilibrium phases of matter with active feedback**
School for Master Students *MPI-PKS, Dresden, Germany – Sep 2025*
- Entanglement transitions in quantum games through reinforcement learning**
Deutsche Physikalische Gesellschaft (DPG) *University of Regensburg, Germany – Mar 2025*
- Entanglement transitions in quantum games through reinforcement learning**
Deutsche Physikalische Gesellschaft (DPG) *TUB Berlin, Germany – Mar 2024*

Poster presentation

- Quantum Games: learning to disentangle**
Machine Learning & Quantum Physics Workshop *Universitätszentrum Obergurgl, Austria – Apr 2025*
- Phase Transitions in Quantum Games**
Machine Learning for Quantum Matter *MPI-PKS, Dresden, Germany – Feb 2025*
- Phase Transitions in Quantum Games**
Machine Learning for Quantum Technologies Workshop *MPI for the Science of Light, Nürnberg, Germany – Nov 2024*

Schools & Workshops

- Machine Learning & Quantum Physics Workshop**
Workshop *Universitätszentrum Obergurgl, Austria – Apr 2025*
- Machine Learning for Quantum Matter**
Workshop *MPI-PKS, Dresden, Germany – Feb 2025*
- Machine Learning for Quantum Technologies**
Workshop *MPI for the Science of Light, Nürnberg, Germany – Nov 2024*
- Frontiers at the Intersection of Quantum Simulation and Machine Learning**
Summer school *ICTP, Trieste, Italy – Apr 2024*

Extracurricular Activities

- Tutoring** *Primiero, Italy*
Physics and math *Jun 2022- Aug 2022*
- Provided one-on-one tutoring to a high school student to prepare for physics and math exams, resulting in a successful passing grade.
- Saxophon study** *Primiero, Italy*
Primiero's school of music *Sep 2008 - Jul 2018*
- Developed strong time management and organisational skills through 10 years of saxophone study, balancing practice and performance commitments with academic responsibilities.

Reference Senior Scientists

- [Marin Bukov](#), Max Planck Institute for the Physics of Complex Systems, Dresden, Germany
- [Markus Schmitt](#), Regensburg University / FZ Jülich, Regensburg, Germany
- [Igor Lesanovsky](#), Eberhard Karls Universität, Tübingen, Germany
- [Federico Carollo](#), Coventry University, Coventry, England