MATIJA MEDVIDOVIĆ

ETH Zürich | mmedvidovic@ethz.ch
Phone: +41 77 2387621 | LinkedIn: Matija Medvidović | GitHub: Matematija

EMPLOYMENT AND EDUCATION

Postdoctoral researcher 09/2024 - present
ETH, Zürich, Switzerland

· Postdoc in computational quantum physiscs in Juan Carrasquilla's group

PhD in Physics 08/2019 - 06/2024
Center for Computational Quantum Physics, Flatiron Institute & Columbia University, New York, USA

· Flatiron CCQ Graduate Scholar Award (Simons Foundation) – full support for 6 years of graduate study
· Dissertation: *Neural-network compression methods for computational quantum many-body physics*
· Supervisor: Dries Sels (New York University)

Perimeter Scholars International 08/2018 - 06/2019
Perimeter Institute for Theoretical Physics & University of Waterloo, Ontario, Canada

· Published research and thesis: *Adversarial learning of efficient Markov Chain Monte Carlo kernels*
· Supervisor: Juan Carrasquilla (Vector Institute Toronto → ETH Zürich)

Master of Science 10/2012 - 09/2017
University of Zagreb, Croatia

· Research and thesis: *Phase transition analysis in complex networks*
· Supervisor: Davor Horvatic (PMF Zagreb)

SELECTED PUBLICATIONS

Variational Quantum Dynamics of Two-Dimensional Rotor Models
***Matija Medvidović** & Dries Sels (2023), PRX Quantum, 4(4), 040302*

· Simulation of unitary dynamics for large quantum systems using neural-network states – available on GitHub
· Presented at APS March Meeting 2023 (Transport and Dynamics in Quantum Devices) and ICML 2023

Classical variational simulation of the Quantum Approximate Optimization Algorithm
***Matija Medvidović** & Giuseppe Carleo (2021), npj Quantum Information, 7(1), 1–7*

· A machine learning method for simulation of large variational quantum circuits – available on GitHub.
· Presented at: APS March Meeting 2021 (Quantum ML), Quantum Techniques in ML 2021, Harnessing Quantum Matter Data Revolution 2021 (best poster award), ML in Science and Engineering 2020, NeurIPS 2021.

Deep Learning the Functional Renormalization Group
*Domenico di Sante, **Matija Medvidović**, Alessandro Toschi, Giorgio Sangiovanni, Cesare Franchini, Anirvan Sengupta, Andrew Millis (2022), Physical Review Letters 129, 136402*

· A machine learning method for deep learning large many-body vertex functions – available on GitHub.
· Presented at: APS March Meeting 2022 (Machine Learning for Quantum Matter), NeurIPS 2022.

Neural-Network Quantum States for Many-Body Physics
***Matija Medvidović** and Javier Robledo Moreno, arXiv:2402.11014*

· A comprehensive review of variational techniques for neural-network parametrizations of many-body states

Generative models for sampling of lattice field theories
***Matija Medvidović**, Juan Carrasquilla, Lauren E. Hayward, & Bohdan Kulchytskyy (2020), arXiv:2012.01442*

· A deep learning method for speeding up Markov Chain Monte Carlo sampling of physical field theories.
· Peer-reviewed and poster presented at NeurIPS 2020 (ML and the Physical Sciences).

Fast quantum circuit cutting with randomized measurements
*Angus Lowe, **Matija Medvidović**, Anthony Hayes, Lee J. O'Riordan, Thomas R. Bromley, Juan Miguel Arrazola, Nathan Killoran (2023), Quantum, 7, 934.*

- A novel approach to combining quantum circuits into a larger one, with a quadratically reduced overhead.
- Work done during the summer residency at *Xanadu Quantum Technologies* – available on Github.

Grad DFT: a software library for machine learning enhanced density functional theory
*Pablo A. M. Casares, Jack S. Baker, **Matija Medvidović**, Roberto dos Reis, Juan Miguel Arrazola (2024), J. Chem. Phys., 160 (6): 062501*

- A software library for neural networks in density functional theory – available on Github

HONORS & AWARDS

Graduate Scholar Award 2019 - 2025
Center for Computational Quantum Physics, Flatiron Institute, New York

- Full support from the Simons Foundation for the duration of the PhD program at Columbia University

Perimeter Scholars International Award 2018

- Full support from the Perimeter Institute for Theoretical Physics during the Perimeter Scholars International master's program

WORK EXPERIENCE

Research Assistant 09/2020 - 07/2024
Flatiron Institute & Columbia University *New York, USA*

- Research in numerical condensed matter physics and quantum computing at the Flatiron Institute in New York

Resident 05/2022 - 08/2022
Xanadu Quantum Technologies *Toronto, Ontario, Canada*

- Selected as one of graduate student residents to research practical near-term quantum computing applications on modern quantum hardware

Teaching Assistant 09/2020 - 01/2022
Columbia University *New York, USA*

- In person recitations and grading for the *Scientific Computing* course at Columbia
- Compiling assignments and challenges for students on a wide array of numerical techniques
- Taught weekly sessions preparing first-year graduate students for Qualifying Exams at Coulmbia during the pandemic

SKILLS & INTERESTS

Numerical Methods for Many-Body quantum systems

- Classical and Quantum Monte Carlo Methods: Metropolis, Hamiltonian Monte Carlo
- Tensor Network Methods – Matrix Product States (MPS) for Density Matrix Renormalization Group (DMRG) and real-time evolution calculations
- Density functional theory (DFT) – functional design and large-scale mulecular calculations

Machine learning / Artificial intelligence

- Four years of experience in domain-specific applications of deep learning methods in condensed matter physics and quantum computing
- Peer-reviewed publications in using AI methods for simulation of variational quantum circuits, renormalization group calculations and sampling classical field theories
- Experience working with modern models (MLPs, CNNs, Normalizing Flows, Neural ODEs, GANs...), optimizers (SGD, Adam, Natural Gradient...) and software libraries (Jax, PyTorch)
- Experience with modern Quantum simulation software packages – PennyLane, Qiskit and Cirq

Languages and Tools

· Proficient: Python, C/C++, Julia; Git, LaTeX

TEACHING & LEADERSHIP

President September 2021 - June 2022
Physics Graduate Council @ Columbia

· Heading the student body in charge of fostering communication between the department and grad students
· Started *Alumni chats*, a series of informal talks with Columbia physics alumni
· Work on improving department climate, inclusion and social life

Graduate lecturer 2020
Democracy Prep Coding Club

· Volunteered to participate in an outreach program and teach coding basics to high school students during the COVID-19 pandemic at the Democracy Prep School in Harlem, New York City

Student teaching assistant 2014 - 2017
University of Zagreb, Faculty of Science

· Experience in teaching recitations by being selected to TA undergraduate students in "Quantum physics" and "General Physics" courses
· Author of 120-page formal lecture notes "Basics of Quantum Mechanics" for undergraduate students

Member, debate coach and judge 2007 - present
Croatian Debate Society and Zagreb Student Debate Forum NGOs

· British Parliamentary (Chief debate coach 2016-2018) and World Schools formats
· Competed in and judged over 30 debate tournaments across the world, including judging the 2015 World Universities Debate Championship in Kuala Lumpur, Malaysia and the 2018 World Schools Debating Championship in Zagreb, Croatia
· Volunteer coach of advanced college-level debaters in English and contestants at world and European championships in English. Mentored students won world championship and other prestigious tournaments.