

GENERATION QI

**Next generation of quantum information scientists.
Series of international schools for students in Gdansk**

11-22.07.2022



For whom?

- The whole school is dedicated to students who wish learn basics of quantum computation and simulation.
- We mostly welcome **undergraduate students** who wish to develop his further academic/industrial career in vibrating quantum technologies area.
- In particular, we encourage for applying students interested in our master program **Quantum Information Technologies** at the University of Gdańsk.
- Of course, everyone is welcome and every application will be considered individually!

By whom?

- **Prof. Michał Horodecki (ICTQT, University of Gdańsk)**
(Quantum teleportation, quantum cloning, superdense coding)
- **Prof. Marcin Marciniak (University of Gdańsk)**
(Classical and quantum complexity theory)
- **Dr. Sergii Strelchuk (University of Cambridge)**
(Modern trends in quantum computing)
- **Dr. Paweł Mazurek (ICTQT, University of Gdańsk)**
(Quantum error correction)
- **Dr. Michał Studziński (University of Gdańsk)**
(Circuit model of quantum computation)
- and many others...

The structure of the school

The whole school is divided into **three** subsequent steps:

- **Beginner:** Introduction to Quantum Mechanics and Information Theory (2 days)
- **Intermediate:** Introduction to quantum computing and error correcting codes (5 days)
- **Advanced:** topics in quantum computing and quantum simulation (3 days)

Among many interesting 'classical' topics, we would like to focus on modern aspects of quantum computing and simulation:

- The quantum phase estimation algorithm with applications
- Amplitude amplification with applications
- The Harrow-Hassidim-Lloyd quantum algorithm for systems of linear equations
- Hybrid Quantum-Classical computational models (Pauli-based Computation and Variational Quantum Eigensolver)
- Quantum simulation for local hamiltonians and its importance

Selected textbooks:

- 1 M.A. Nielsen, I.L. Chuang, *Quantum Computation and Quantum Information*
- 2 M. Le Bellac, *A short Introduction to Quantum Information and Quantum Computation*
- 3 N.D. Mermin, *Quantum Computer Science. An Introduction*
- 4 D.A. Lidar, T.A. Brun, *Quantum Error Correction*
- 5 W-H. Steeb, Y. Hardy, *Problems and Solutions in Quantum Computing and Quantum Information*
- 6 J. Preskill, *Lecture Notes for Physics 229: Quantum Information and Computation*

Selected research and review papers:

- 1 B. Bauer, S. Bravyi, M. Motta, G. K-L. Chan, *Quantum Algorithms for Quantum Chemistry and Quantum Materials Science*, Chem. Rev. 2020, 120, 22, 12685–12717 + references within in
- 2 A. W. Harrow, A. Hassidim, S. Lloyd, *Quantum algorithm for solving linear systems of equations*, Phys. Rev. Lett. vol. 15, no. 103, pp. 150502 (2009)
- 3 J. Tilly, H. Chen, S. Cao et al., *The Variational Quantum Eigensolver: a review of methods and best practices*, <https://arxiv.org/abs/2111.05176>