**Quantum Computing**

**Savona Vincenzo**

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**Cursus**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Sem.</th>
<th>Type</th>
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<tr>
<td>Ing.-phys</td>
<td>MA1, MA3</td>
<td>Opt.</td>
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<td>Physics</td>
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<tr>
<td>Quantum Science and Engineering</td>
<td>MA1, MA3</td>
<td>Opt.</td>
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**Contact**

- Language: English
- Credits: 4
- Session: Winter
- Semester: Fall
- Exam: Oral
- Workload: 120h
- Weeks: 14
- Hours: 4 weekly
- Lecture: 2 weekly
- Exercises: 2 weekly
- Number of positions: 20

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**Frequency**

Every year

**Remark**

Next time: Fall

**Summary**

After introducing the foundations of classical and quantum information theory, and quantum measurement, the course will address the theory and practice of digital quantum computing, covering fundamental and advanced topics such as recent quantum algorithms and the theory of quantum error correction.

**Content**

**Introduction**

- Crash course on quantum mechanics
- Quantum measurement and interaction with the environment
- Foundations of classical and quantum information theory

**Quantum computing**

- The quantum circuit model
- Universal quantum gates
- Quantum advantage and the Deutsch-Jozsa algorithm

**Overview of quantum algorithms**

- The quantum Fourier transform and Shor's factoring algorithm
- The quantum state amplification and Grover's database search algorithm
- The quantum phase estimation and linear system solving
- Digital quantum simulation and unitary time evolution
- The variational quantum eigensolver

**Noise in quantum hardware and the digital noise model**

**Quantum error correction**

- The Shor quantum error correction code
• Stabilizer codes
• Fault-tolerant quantum computing

Overview of recent advances in quantum hardware and software

Learning Prerequisites

Required courses
Quantum Physics I, Quantum Physics II

Resources

Bibliography
John Preskill, Lecture Notes on Quantum Information and Computation

Moodle Link
• https://go.epfl.ch/PHYS-641