

**Modulbezeichnung:** Quantum Computing (PW-QC) **5 ECTS**  
(Quantum Computing)

Modulverantwortliche/r: Michael J. Hartmann  
Lehrende: Michael J. Hartmann

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|-----------------------------|-----------------------|----------------------|
| Startsemester: WS 2021/2022 | Dauer: 1 Semester     | Turnus: unregelmäßig |
| Präsenzzeit: 60 Std.        | Eigenstudium: 90 Std. | Sprache: Englisch    |

**Lehrveranstaltungen:**

Quantum Computing (WS 2021/2022, Hauptseminar, 2 SWS, Michael J. Hartmann)  
Quantum Computing - Übung (WS 2021/2022, Übung, Michael J. Hartmann)

**Inhalt:**

**Contents:**

The course provides an introduction to quantum computing. The development of quantum hardware has progressed substantially in recent years and has now reached a level of maturity where first industrial applications are being explored. This course will introduce the fundamental ingredients of quantum algorithms, quantum bits and quantum gates, the most important hardware implementations and in particular algorithms that can run on near term hardware implementations of so called Noisy Intermediate Scale Quantum (NISQ) devices. The course will be completed with introductions to the basic concepts of error correction, which is needed in the next stage of development to fully exploit the potential of this emerging computing technology. Prerequisites: the main concepts of quantum theory, including quantum states, the Schrödinger equation, unitary evolution and measurements.

**Lernziele und Kompetenzen:**

**Learning goals and competences:**

Students

- explain the relevant topics of the lecture
- apply the methods to specific examples

**Literatur:**

The course will present all the relevant material. Useful additional reading contains "Quantum Computation and Quantum Information" by Nielsen and Chuang (Cambridge Univ. Press), "Quantum Computing: A Gentle Introduction" by Rieffel and Polak (MIT Press) as well as lecture notes by John Preskill available at <http://theory.caltech.edu/preskill/ph229/> and Ronald de Wolf available at <https://homepages.cwi.nl/~rdewolf/qc19.html>.

**Verwendbarkeit des Moduls / Einpassung in den Musterstudienplan:**

Das Modul ist im Kontext der folgenden Studienfächer/Vertiefungsrichtungen verwendbar:

**[1] Data Science (Bachelor of Science)**

(Po-Vers. 2020w | Anwendungsfach | Physik | Quantum Computing)

Dieses Modul ist daneben auch in den Studienfächern "Data Science (Master of Science)", "Physics (Master of Science)", "Physik (Bachelor of Science)", "Physik (Master of Science)", "Physik mit integriertem Doktorandenkolleg (Master of Science)" verwendbar.

**Studien-/Prüfungsleistungen:**

Quantum Computing (Prüfungsnummer: 71561)

(englische Bezeichnung: Quantum Computing)

Prüfungsleistung, Klausur, Dauer (in Minuten): 90

Anteil an der Berechnung der Modulnote: 100% Prüfungssprache: Englisch

Erstablesung: WS 2021/2022, 1. Wdh.: WS 2021/2022 (nur für Wiederholer)

1. Prüfer: Michael J. Hartmann