Module title			Abbreviation
Introduction to Quantum Computing and Quantum Information			11-QUI-202-m01
Module coordinator		**Module offered by**	
Managing Director of the Institute of Theoretical Physics and Astrophysics		Faculty of Physics and Astronomy	
ECTS	**Method of grading**	**Only after succ. compl. of module(s)**	
6	numerical grade	--	
Duration	**Module level**	**Other prerequisites**	
1 semester	undergraduate	--	

Contents

Basic concepts of quantum theory and statistics. Qubits and the representation of quantum-mechanical states by density operators. Theory of the measurement process. Von Neumann entropy, bipartite systems, entanglement, and entanglement measures. Quantum channels, Kraus operators and Stinespring theorem. Decoherence of quantum states. Introduction to quantum teleportation and quantum cryptography. First steps in the theory of quantum computation and error correction.

Intended learning outcomes

Knowledge of the basic principles of quantum information theory and its application. Deepened understanding of specific properties of quantum systems such as entanglement. Overview of the most important theorems and possible applications of quantum information theory. The aim is to perpare the students for further elective courses on this subject in the Master's study program.

Courses (type, number of weekly contact hours, language — if other than German)

V (3) + R (1)
Module taught in: German or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 120 minutes) or
b) oral examination of one candidate each (approx. 30 minutes) or
c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
d) project report (approx. 8 to 10 pages) or
e) presentation/talk (approx. 30 minutes).
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.
Language of assessment: German and/or English
Assessment offered: In the semester in which the course is offered and in the subsequent semester

Allocation of places

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Additional information

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Workload

180 h

Teaching cycle

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Referred to in LPO I (examination regulations for teaching-degree programmes)

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Module appears in

Bachelor's degree (1 major) Physics (2020)
Bachelor's degree (1 major) Nanostructure Technology (2020)
Bachelor's degree (1 major) Mathematical Physics (2020)
Bachelor's degree (1 major) Quantum Technology (2021)
exchange program Physics (2023)
Bachelor's degree (1 major) Mathematical Physics (2024)