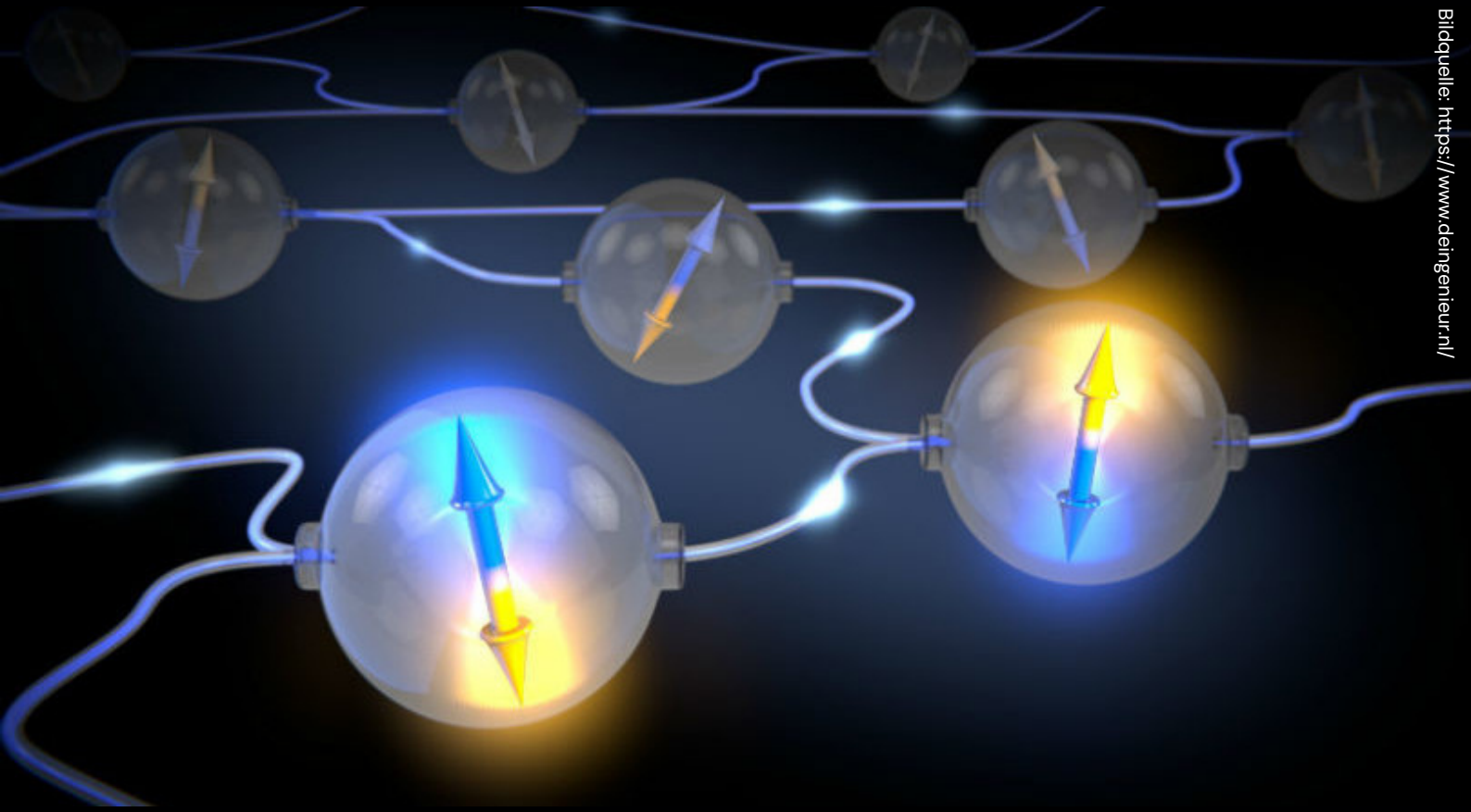
UNIVERSITÄT LEIPZIG

QUANTUM COMMUNICATION

Lecture & exercise with discussion



Bildquelle: https://www.deingenieur.nl/

Learn more about Quantum Communication protocols and how a Quantum Internet could be realized.

Prof. Dr. Nabeel Aslam, Felix Bloch Institute for Solid State Physics

For students enrolled in Physics Bachelor and Master programs.

Thursdays 13:15 - 14:45, SR 218 Linnéstr. 5

FIRST LECTURE ON OCTOBER 17TH

WS 24/25

SCAN FOR MORE INFORMATION

Quantum Communication

Module type	Recommended for	Module availability	Module number and ECTS
elective	5/6/7/8th semester	once a year	**12-PHY-BMWQC1** **5 CP**
Workload	Tutorial hours	Private study hours	
150 h	45 h	105 h	

Responsibility

Head of the department “Solid-State Based Quantum Information”

Teaching units (SWS / tutorial hours / private study hours)

- Lecture “Quantum Communication” (2 SWS / 30 h / 70 h)
- Seminar “Quantum Communication” (1 SWS / 15 h / 35 h)

Participation requirements

None

Examinations (duration; weighting) and pre-examination requirements

Oral exam (30 min; ×1)

Pre-examination requirements: Solution of weekly exercises on the module content, for which points will be awarded. Prerequisite for admission to the exam is 1) the achievement of 50% of the possible points of the semester and 2) one presentation of a solution to an exercise.

Objectives

The students
- know the advantages that quantum communication can offer compared to classical communication
- are able to describe quantum mechanical processes in quantum communication physically and mathematically
- understand the advantages and disadvantages of different hardware platforms and experimental techniques for the realization and optimization of quantum communication processes
- have studied current literature on quantum communication and thus gained an overview of the current state of the art and open questions

Content

- introduction to quantum mechanics and optics topics relevant to quantum communication
- description, generation and use of quantum entanglement in quantum communication
- discussion of basic quantum communication protocols
- problems with quantum communication over long distances and approaches for quantum repeaters
- promising hardware platforms for the realization of quantum communication (photons, solid-state spins, quantum dots, trapped atoms)

References

- Nielsen, M. und Chuang, I.Einführung in die Quantum Informationsverarbeitung: “Quantum Computation and Quantum Information”
- Bassoli, R. et. al., “Quantum Communication Networks”
- Peter Rohde, “The Quantum Internet”
- Azuma, K. et al., “Quantum repeaters: From quantum networks to the quantum internet”, arxiv.org (2022)
- Ruf, M. et al., “Quantum networks based on color centers in diamond” Journal of Applied Physics 130, 070901 (2021)