



Mini-course

IIP's AUDITORIUM

NOVEMBER
18 to 22

3:00 pm

TITLE:

Theory of quantum communication

Abstract:

This course is an introduction to the theory of quantum communication. We will start with a brief overview of quantum information theory. We will then explore the current state of knowledge in quantum and private communication, including one-shot and asymptotic communication capacities. Finally, we will discuss some topics at the frontiers of quantum communications research, such as second-order asymptotic results for secure key rates in quantum key distribution, and the design of quantum repeater networks for a global-scale quantum internet.

Lecturers:

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Lecture 1: Introduction to quantum information and quantum communication

- Quantum states: density operators, entanglement
- Measurements: POVM formalism
- Quantum channels: definition and examples
- Quantum hypothesis testing
- Quantum entropies

Lecture 2: Classical communication over quantum channels

- Description of the protocol with and without entanglement assistance
- Quantum super-dense coding
- One-shot upper and lower bounds
- Proof of the classical capacity and entanglement-assisted classical capacity of a quantum channel

Lecture 3: Quantum communication

- Description of the protocol with and without feedback assistance
- Example: Teleportation and entanglement distillation
- One-shot upper and lower bounds
- Proof of the quantum capacity of a quantum channel without feedback assistance
- Bounds on the quantum capacity of a quantum channel with feedback assistance

Lecture 4: Private communication

- Description of the protocol with and without feedback assistance
- Example: Secret key distillation; quantum key distribution
- One-shot upper and lower bounds
- Proof of the private capacity of a quantum channel without feedback assistance
- Bounds on the private capacity of a quantum channel with feedback assistance

Lecture 5: Network quantum communication and the quantum internet

- Broadcast and multiple-access channels
- Quantum repeaters, with example protocols
- General bounds on repeater-assisted quantum communication