

Title: **Entanglement and nonlocality**

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Description: Often a shared entangled state can be used as a resource to improve outcomes beyond what is possible classically. In this course, we will look at various topics where entanglement is used as a resource, including zero-error capacity and various nonlocal games. We will also study quantum conditional probabilities and their representations.

Topics covered include:

Theory of CP maps

- Choi-Kraus representation
- Non-uniqueness of Choi-Kraus

Zero Error Capacity

- The binary case
- Concepts from graph theory
- Zero error capacity for quantum channels
- Entanglement assisted zero-error capacity
- Introduction to operator systems

Quantum Correlations

- Classical vs Quantum conditional probabilities
- State purification and POVM's vs PVM's
- Some C*-algebra basics
- Conjectures of Connes and Tsirelson

Applications to Finite input-output games

- Binary constraint systems
- Games based on graphs
- Values of games