Introduction
(Lecture of the Quantum Information class of the Master in Quantum Science and Technology)

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Outline

What is quantum information?

Interdisciplinary field based on

- Quantum mechanics (typically nonrelativistic)

  - Schrödinger equation, derived in 1924

  - John von Neumann, E. P. Wigner

- Quantum optics,

  - Photodetection and the statistics of light, coherent states, etc., George Sudarshan, Roy J. Glauber, and Leonard Mandel, 1950's, 1960's

  - Roy Glauber, Nobel Prize 2005

- Computer science

  - Computational complexity theory, analysis of algorithms and computability theory.

What is quantum information? II

- Unlike many areas of physics, it has a constructive side.

- Very often the goal is to create quantum states of very many particles experimentally, or to make a quantum computer.

- The theory is trying to help this development.

Subfields of quantum information science

- Theory of nonlocality, Bell inequalities, 1964

- Theory of quantum entanglement, Werner, 1989

- Quantum metrology (measuring some quantity using a quantum system), many experiments from 2000

- Quantum computer, quantum algorithms (Shor, 1994 and Grover, 1996)

- Quantum communication, quantum cryptography

- Quantum error correction

- Quantum simulation (one can simulate so large quantum systems that could not fit into a classical computer)