

Introduction

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

Géza Tóth

Theoretical Physics, University of the Basque Country (UPV/EHU), Bilbao, Spain
Donostia International Physics Center (DIPC), San Sebastián, Spain
IKERBASQUE, Basque Foundation for Science, Bilbao, Spain
Wigner Research Centre for Physics, Budapest, Hungary

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Introduction

- Motivation to study quantum information science

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)