Q3 OVERVIEW

URL

Quantum Information Systems with Q3

DATED IN 13.1

See also the Quantum Workbook (Springer, 2022) .

This compilation of tutorial documents is intended as an introductory text on quantum computation and as a self-learning guide. It is an attempt to collect some fundamental principles and elementary methods in the field of quantum computation and quantum information and then reorganize them in a compact and integrated form. Through tutorial documents in this compilation, the usage of Q3 is also demonstrated.

The Postulates of Quantum Mechanics

It summarizes the fundamental postulates of quantum mechanics and effectively provides a brief review of basic concepts and fundamental principles of quantum mechanics.

Quantum States

Time Evolution of Quantum States

Measurements on Quantum States

Quantum Computation: Overview

It presents and describes elementary quantum gates for universal quantum computation. These are the building blocks of quantum algorithms and quantum communication protocols.

Single–Qubit Gates

Two–Qubit Gates

Multi–Control NOT Gate

Multi–Control Unitary Gates

Universal Quantum Computation

Computational Model of Measurement

Quantum Computation Models

It explains physical methods and principles to implement elementary quantum gates and introduces different quantum computation schemes.

Quantum Bits

Dynamical Scheme

Geometrical and Topological Schemes

Quantum Adiabatic Scheme

Measurement–Based Scheme

Quantum Algorithms

It introduces some widely known quantum algorithms to help grasp the idea of the so-called quantum supremacy of quantum algorithms over their classical counterparts.

Quantum Decision Algorithms

Quantum Fourier Transform

Quantum Phase Estimation

Order–Finding and Factorization

Quantum Search Algorithm

Quantum Noise and Decoherence

It introduces mathematical methods including quantum operation and quantum master equation to describe quantum noise and decoherence effects. It also discusses the distance measures for quantum states.

How Quantum Decoherence Occurs

Quantum Operations

Quantum Master Equation

Distance Measures Between Quantum States

Quantum Error–Correction Codes

It is devoted to quantum error-correction codes through a discussion of the basic principles, procedures, and examples.

The Nine–Qubit Code

Quantum Error–Correction Theorems

Stabilizer Formalism

Stabilizer Codes

Surface Codes

Quantum Information Theory

It introduces quantum information theory. It discusses the entropies of quantum information content and the measures for quantum entanglement degree focusing on quantum entanglement as a valuable physical resource for quantum information processing and quantum communication.

Shannon Entropy

Von Neumann Entropy

Entanglement and Entropy

Appendix

Quantum Teleportation

Distance Measures between Quantum States

The Pauli and Clifford Groups

Related Guides

- Quantum Information Systems
- Quantum Many–Body Systems
- Quantum Spin Systems

Related Tech Notes

- Quantum Computation: Quick Start with Q3
- Quantum Many–Body Systems with Q3
- Quantum Spin Systems with Q3
- Staying Up To Date with Q3

Related Links

- M. Nielsen and I. L. Chuang (2022) , Quantum Computation and Quantum Information (Cambridge University Press, 2011).
- Mahn–Soo Choi (2022) , A Quantum Computation Workbook (Springer, 2022).
- `About Q3`