Quantum Computation and Quantum Information

**Introduction to the Tenth Anniversary Edition**

**Afterword to the Tenth Anniversary Edition**

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How to Use This Book

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* 1. **Global Perspectives**

Quantum computation and quantum information (QCQI) is the study of the information processing tasks that can be accomplished using quantum mechanical systems.

The turn of the 20th century witnessed a tumultuous time in “classical physics”. The stormy times were quelled starting in the 1920s with the genesis of the modern theory of quantum mechanics.

Quantum mechanics became entrenched in science because it found solid applications in many areas including atomic structure, nuclear fusion in stars, superconductors, DNA structure, and elementary particles of Nature.

Quantum mechanics is a mathematical framework that sets certain basic parameters and modes of operation for the construction of physical theories like quantum electrodynamics.

QCQI seeks to develop tools which sharpen our intuition about quantum mechanics and also to make its predictions more transparent to the human mind. Examples of these pursuits include:

* The discovery of the no-cloning theorem in the early 1980s – one of the earliest results stemming from QCQI,
* controlling single quantum systems – dating back to the 1970s - in order to probe many different aspects of the system’s behavior with incredible precision.

The modern incarnation of computer science was announced Alan Turin in his 1936 paper. Turing along with Alonzo Church laid the foundations for computational theory while John von Neumann developed a simple theoretical model for interconnecting components capable of functioning as a Universal Turing Machine.

Hardware development accelerated starting in 1947 with the development of the transistor by Bardeen, Brattain, and Shockley. The rate of growth in computing power was subsequently codified by Gordon Moore in 1965. As Moore’s Law flattens various efforts to reignite the growth trajectory have been implemented or researched including multi-core processing and using quantum mechanics to perform computation instead of classical physics based computational paradigms.

* 1. **Quantum Bits (pp 13 – 17)**

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