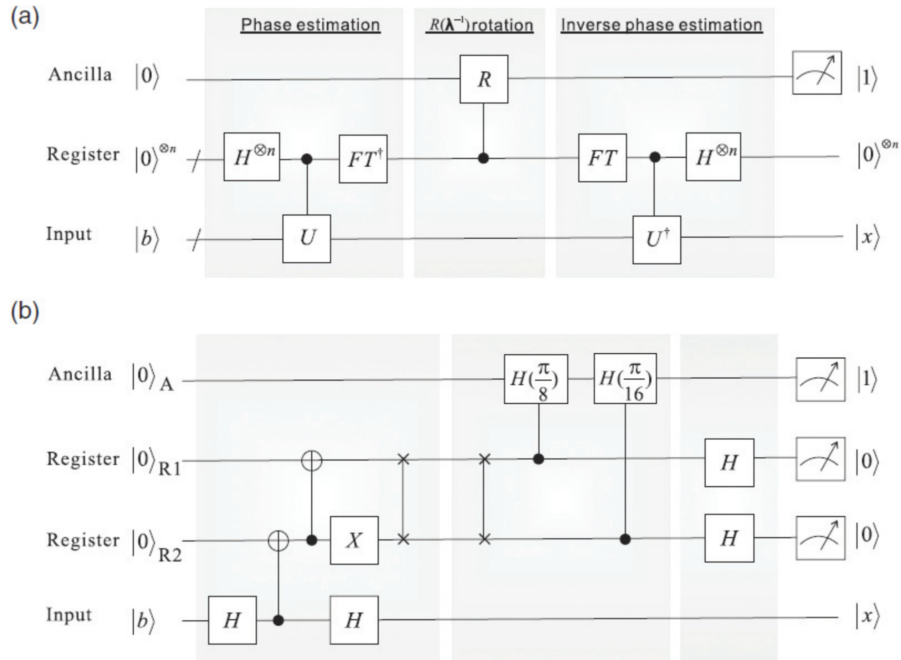
Experimental Demonstration of a Quantum Algorithm for a Set of Linear Equations



Quantum computers exploit the properties of quantum physics, such as, the quantum superposition principle, quantum entanglement and so on, to process information. These computer offer significant speedup compared to their classical counterpart, for instance in factorizing a large integer [1], or finding a target in an unsorted database [2]. These quantum algorithms are not only important mathematically, but also important in practice because they pose a deadly threat to existing cryptography.

The development of quantum algorithms follows three directions. One develops from the Shor algorithm, and grows into the phase estimation and related algorithms. Another follows from the Grover algorithm, which develops into the quantum amplitude amplification and related quantum algorithms. The third direction is the quantum simulation in which a quantum system is simulated efficiently in a quantum computer, which is exponentially faster than classical computers [3].

Using quantum phase estimation, a novel quantum algorithm was designed that solves a set of linear equations exponentially faster than its classical counterpart [4]. Now this quantum algorithm has been successfully demonstrated by a group of physicists led by Prof. Jianwei Pan, from the University of Science and Technology, in Hefei, China [5]. They have used 4 photonic qubits and demonstrated a set of two linear equations. They used lasers to prepare two pairs of entangled photons, which they spatially separated and sent down four different paths. The photons passed through a series of logic gates that corresponded to the steps of solving two linear equations. Their experiment has shown the feasibility of the algorithm.

References

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