A Hybrid Quantum Computer Architecture

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In the last couple of decades, numerous schemes to build quantum computers have been proposed. Fundamental building blocks and essential processes have been realized in various kinds of qubits [1]. Recently, it has been recognized that scalability – concretely, operating millions of qubits – is a prerequisite to perform fault-tolerant computation [2]. Here, we propose a scalable quantum computer architecture which combines the advantages of different types of solid-state qubits. Spin qubits, having extremely long coherence times, serve as quantum memory, and qubits based on superconducting circuits, particularly transmon qubits, serve as quantum processor. In addition, superconducting flux qubits may be used to provide strong coupling with spin qubits. The transmon and flux qubits can be coupled through a common superconducting resonator bus. Scalability and operation principles of this scheme will be discussed.

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