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Quantum simulations and algorithms with ion trap systems

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Abstract

Laser-cooled trapped atomic ions are well-established as possessing the highest performance of any platform for quantum computing. But as importantly, the path to scaling trapped ion quantum computers involves well-defined architectural plans, from shuttling ions between quantum processor unit (QPU) cores and modular photonic interconnects between multiple QPUs to gradual error-correction strategies. Full-stack ion trap quantum computers have thus moved away from the physics of qubits and gates and toward the engineering of optical control signals, quantum gate compilation for algorithms, and high level system design considerations. I will summarize the state-of-the-art in these quantum computers, covering recent algorithms and quantum simulations of physical processes, and speculate on how they might be used in the future.