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Quantum simulations using phonons in trapped ions

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Abstract

Trapped ions enable the preparation of a reliable platform that can be used to quantum computation and quantum simulations. In addition to qubits comprising of internal states in ions, the quanta of the ion crystal's vibrational motion, or phonons, which offer higher information capacity per physical degree of freedom than qubits, are considered to be alternative computational resources. Phonons in trapped ions can be used to certain applications, including the simulation of strongly interacting particles, quantum walks, and analog quantum computation using bosonic degrees of freedom. In this talk, I review the application of phonons in trapped ions to quantum simulations, and explain our recent progress regarding the system of polaritons in the Jaynes-Cummings-Hubbard model and quantum walks.