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Dynamic Simulation of the Jaynes-Cummings model using the hybrid quantum-classical algorithm

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Abstract

The Jaynes-Cummings model is the canonical model for atom-light interactions, describing a single confined bosonic mode interacting with a two-level system (qubit). This is sufficient to describe a wide range of phenomena in quantum optics and quantum computing. We simulate the dynamics of this model using the hybrid quantum-classical algorithm (HQCA) consisting of quantum and classical computers. The parametric quantum state preparations and quantum measurements are performed on the quantum computer and parameters optimization employ on the classic computer. For implement of hybrid quantum-classical algorithms, the Noisy Intermediate Scale Quantum (NISQ) computer is used. In Noisy Intermediate Scale Quantum computers, we don't need to error correction. For this purpose, we transform Hamiltonian to qubit form and using an algorithm to obtain the dynamic of the Jaynes-Cummings model. We obtain occupation probability and transition probability in the Jaynes-Cummings model using the hybrid quantum-classical algorithm. The output of the algorithm is compatible with the exact calculation.

Keywords: Jaynes-Cummings model, quantum dynamics, hybrid quantum-classical algorithm

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