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Analog superconducting quantum simulator for Holstein polarons

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We propose an analog quantum simulator for the Holstein molecular-crystal model based on a superconducting circuit QED system in the dispersive regime. By varying the driving field on the superconducting resonators, one can access both the adiabatic and antiadiabatic regimes of this model, and the strong electron-phonon coupling required for small-polaron formation can be readily reached. We show that a small-polaron state of arbitrary quasimomentum can be generated by applying a microwave pulse to the resonators. We also show that significant squeezing in the resonator modes can be achieved in the polaron-crossover regime through a measurement-based scheme.

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