Abstract Submitted
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Exploring dynamical phases of a BCS superconductor in a cavity-QED quantum simulator[1] ROBERT LEWIS-SWAN, DIEGO BARBERENA, JILA, NIST, CTQM and Dept. of Physics, University of Colorado, JUAN MUNIZ, DYLAN YOUNG, JULIA CLINE, JILA, NIST and Dept. of Physics, University of Colorado, ANA MARIA REY, JILA, NIST, CTQM and Dept. of Physics, University of Colorado, JAMES THOMPSON, JILA, NIST and Dept. of Physics, University of Colorado — Atom-light interactions in optical cavities have been proposed as emulators of quantum spin models with long-range interactions. Building on our recent experimental observation of collective spin-exchange interactions, generated by coupling a far-detuned optical cavity mode to a narrow optical transition in Sr-88 [arXiv:1910.00439 (2019)], we report progress towards the simulation of the iconic BCS Hamiltonian which describes s-wave superconductors. Theoretical studies of this model have predicted novel dynamical phases of matter including one in which the superconducting order parameter exhibits persistent and robust coherent oscillations. Leveraging the internal structure of the 1S0-3P1 optical transition we discuss protocols to realize the dynamical phases in our cavity-QED simulator. The interplay between the cavity-mediated interactions and tunable inhomogeneous energy shifts generated via Stark and magnetic Zeeman shifts allow us to explore the dynamical phase diagram. We discuss the feasibility of observing the dynamical phases under current experimental conditions, including robustness to typical sources of decoherence and experimental noise.

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