Abstract Submitted for the DAMOP19 Meeting of The American Physical Society

Quantum Collective Spin Dynamics of Strontium in Cavity QED DIEGO BARBERENA, ROBERT LEWIS-SWAN, JAMES THOMPSON, ANA MARIA REY, University of Colorado Boulder — Recently, a new regime of cavity QED has become amenable to experimental explorations, enabled by the recent developments in implementations with alkaline earth atoms that take advantage of the long lifetimes of their clock transitions and their rich internal structure. In this regime, the atoms are subject to strong exchange interactions and collective superradiant decay, both of them mediated by a single optical cavity mode. Here we report results when the clock transition is also coherently driven by an external field. By computing the time evolution of different spin observables, we show that, in the limit of a large number of particles, the system shows three markedly different dynamical behaviors as a function of the drive strength. We also compute the time evolution of spin squeezing to assess the metrological usefulness of the system. We then report new investigations when a shorter lived but stronger transition is used. Here we analyze the new effects that arise because the cavity photons cannot be adiabatically eliminated and play a dynamically important role. We study how those effects can be used for sensing.

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Date submitted: 06 Feb 2019

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