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Dissipative Preparation of Squeezing of a Collective Atomic Spin in a Cavity JOHANNES OTTERBACH, EMANUELE DALLA TORRE, Harvard University, VLADAN VULETIC, Massachusetts Institute of Technology, MIKHAIL LUKIN, Harvard University — Spin squeezed states have attracted substantial interest over the last decades from fundamental and application points of view to study many-body entanglement and improve high-precision spectroscopy. One limiting factor for squeezing is the coupling to the environment which usually has detrimental effects on the generation and entanglement fidelity of these states. Here we present a scheme for the deterministic generation of spin squeezed states in coherently driven atomic ensemble of effective spin-1/2 particles collectively interacting with a strongly decaying cavity mode, thus turning dissipation into a resource for entanglement. We show that there exists a dark-state of the cavity dissipation exhibiting squeezing bounded only by the Heisenberg limit and calculate the timescale to reach this state. Upon taking spontaneous atomic scattering into account we determine the general scaling of the squeezing as a function of the collective atom-photon coupling and the cavity and atomic decay rates observing an improvement compared to the preparation schemes based on unitary time evolution.

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