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Imaging Protection of Spin Coherence in a Tunable Heisenberg Model[1] ERIC S. COOPER, EMILY J. DAVIS, AVIKAR PERIWAL, Stanford University, GREGORY BENTSEN, Princeton University, SIMON J. EVERED, KATHERINE VAN KIRK, MONIKA H. SCHLEIER-SMITH, Stanford University
— Optical cavities can be used to engineer long-range interactions between atomic spins, with diverse applications in metrology and quantum simulation. I will present our recent implementation of a family of Heisenberg spin models, where controlled optical and magnetic fields tune between XY (spin-exchange) and Ising interactions. By directly imaging atomic spin states, we characterize the atoms interactions and explore the transition between regimes of theoretical interest where inhomogeneities lead to complex many-body states and regimes of metrological interest where the system can be described using a collective spin model. In particular, we show that XY interactions protect the collective spin against inhomogeneous fields that completely dephase the non-interacting system. In future work such interactions can be used to enhance spin squeezing protocols.

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