Abstract Submitted
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Cavity-mediated collective spin-exchange interactions on a millihertz linewidth optical transition[1] JULIA CLINE, MATTHEW NORCIA, ROBERT LEWIS-SWAN, BIHUI ZHU, ANA REY, JAMES THOMPSON, JILA, Univ of Colorado - Boulder — A key challenge in using laser cooled atoms for metrology or quantum simulation is understanding and controlling coherent interactions between the atoms. In this talk, we report the observation of spin-exchange interactions mediated by the emission and reabsorption of photons inside an optical cavity [Norcia *et. al.* arXiv:1711.03673]. The interactions are tunable and infinite range. The effective spin degree of freedom is encoded in the clock states of ^{87}Sr with radiative decay lifetime of 150 seconds. We observe one-axis twisting dynamics, the emergence of a many-body energy gap, and signatures of gap protection of the optical coherence against dephasing. The spin exchange interactions in our system are of particular interest since they occur in the ultra-narrow optical clock transition which contains up to ten different nuclear spin levels. These features may enable future applications for entanglement-enhanced metrology and for explorations of rich quantum many-body dynamics in a high-spin system.

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