Twists, gaps, and superradiant emission on a millihertz linewidth optical transition.

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I will describe superradiant pulses of light generated from an optical transition that does not like to radiate light: the millihertz linewidth optical transition in strontium [1]. This new source of light may allow us to overcome thermal and technical limitations on laser frequency stability [2,3]. The pulses of light are generated by laser cooling and trapping an ensemble of 10^5 strontium atoms inside a high finesse optical cavity to achieve a collective enhancement in the radiation rate.

We observe that cavity-mediated spin-exchange interactions emerge when the cavity is tuned away from resonance with the atomic transition frequency [4]. The spin exchange interactions manifest in the experiment as a many-body energy gap and as one-axis twisting dynamics. The energy gap may prove useful for enhancing atomic coherence times, while the one-axis twisting dynamics may prove useful for creating entanglement [5].

If time permits, I will also discuss the creation of highly spin squeezed states [6] and efforts to apply these states in a proof-of-principle matter wave interferometer [7].

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