Abstract Submitted
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Thermalization and Bose-condensation of photons via laser cooling of cold atoms[1] CHIAO-HSUAN WANG, JQI, QuICS, University of Maryland, MICHAEL GULLANS, JQI, QuICS, Princeton University, J. V. PORTO, WILLIAM PHILLIPS, JQI, University of Maryland, NIST, ALEXEY GORSHKOV, JACOB TAYLOR, JQI, QuICS, University of Maryland, NIST — In high optical depth atomic ensembles, we show that photons reemitted during the laser cooling process can equilibrate with the atomic motion and reach a steady state. We separate a set of long-lived (optically thick) photonic modes and study the atomic photon re-emission and absorption on top of the free-space cooling mechanism. In this regime, we find that a grand canonical ensemble of photons can arise directly via atomic laser cooling in an experimentally accessible regime [1], with a chemical potential controlled by the laser frequency following the general framework of "Floquet thermalization". Moreover, by placing the atoms in a curved cavity, the transverse modes in the cavity can be mapped into 2D massive bosons inside a parabolic well and can lead to 2D Bose-Einstein condensate of light. We consider realization of this regime using two-level atoms in Doppler cooling, and construct a phase diagram in the laser frequency and intensity parameter space showing the gain, condensate, thermal and quasi-thermal regimes for cavity photons with simulated values appropriate for the Yb intercombination transition. Looking forward, our approach will admit various applications such as Rydberg-polariton thermalization with laser-cooled Rydberg atoms. [1] arXiv:1712.08643.

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