ID de Contribution: **11** Type: **Invited talk**

Collective atom counting and first lasing on a millihertz linewidth optical transition

lundi 22 février 2016 15:00 (30 minutes)

Is it possible to exploit atom-atom correlations and entanglement to advance the field of precision measurement beyond the current independent-atom paradigm? We have explored this question along two fronts that will be discussed: superradiant or bad-cavity lasers that could be 10,000 times less sensitive to thermal motion of the optical cavity's mirrors [1], and spin-squeezed states that can greatly surpass the standard quantum limit on phase estimation [2]. Our experimental system consists of laser cooled strontium atoms held inside of a finesse 30,000 cavity by a magic-wavelength lattice. My talk will describe strong collective coupling between the atoms and cavity, non-destructive atom counting [3], prospects for entangled clocks that surpass the standard quantum limit, lasing in the superradiant crossover regime on the 7.5 kHz linewidth transition $^1S_0$ to $^3P_1$ [4], and the first observation of pulsed lasing deep into the superradiant regime on the 1 mHz linewidth transition $^1S_0$ to $^3P_0$.

[1] "A steady-state superradiant laser with less than one intracavity photon,"
J. G. Bohnet, Z. Chen, J. M. Weiner, D.Meiser, M. J. Holland, J. K. Thompson, *Nature* **484**, 78-81 (2012)

[2] "Deterministic Squeezed States with Joint Measurements and Feedback,"
K. C. Cox, G. P. Greve, J. M. Weiner, J. K. Thompson, arXiv:1512.02150 (2015)

[3] "Strong Coupling on a Forbidden Transition in Strontium and Nondestructive Atom Counting,"
M. A. Norcia, J.K. Thompson, arXiv:1506.02297 (2015)

[4] "A Cold-Strontium Laser in the Superradiant Crossover Regime,"M. A. Norcia, J. K. Thompson, arXiv:1510.06733 (2015)

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