Toward a spin-squeezed optical clock

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Optical atomic clocks are the world's most precise and accurate quantum sensors. The most advanced clock comparisons are limited in their precision by the standard quantum limit [1,2], giving rise to considerable interest in employing spin squeezing to demonstrate a quantum advantage in frequency metrology. To date, clocks employing spin squeezing have been demonstrated in the microwave domain [3], or at the 10^{-13} level for optical clocks [4]. In this talk, we will present a new apparatus at JILA capable of producing spin-squeezed states for quantum metrology. We employ a cavity quantum electrodynamics architecture by loading 1000's of strontium atoms into a high-finesse optical cavity. We use this cavity to perform quantum non-demolition measurements of the collective atomic ensemble. Progress in generating metrologically useful squeezed states will be presented, and we will discuss using these states for the operation of a high performance optical clock to achieve stability below the standard quantum limit for the first time.

References

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