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Quantum metrology frontiers with highly squeezed quantum states of atomic ensembles ONUR HOSTEN, NILS J. ENGELSEN, RAJIV KRISHNAKUMAR, MARK A. KASEVICH, Stanford University — Production of spin-squeezed atomic ensembles could greatly enhance the performance of existing atom-based sensors by overcoming the atomic shot-noise that limits these sensors. At the time of writing, our preliminary results with an ensemble of $25\text{x}10^3$ ^{87}Rb atoms (prepared in magnetically insensitive states) suggest a noise reduction that is 17dB below shot-noise with 90% coherence indicating a metrologically relevant squeezing parameter of 16.5dB. With our currently known experimental inefficiencies the theoretical maximum we expect to observe lies around 23dB for $100\text{x}10^3$ atoms. We employ a measurement based squeezing method inside of a high-finesse ($>10^5$) dual-wavelength cavity, resonant at both 780 nm (probe) and 1560 nm (trap). The commensurate wavelength relationship allows identical coupling of the probe light to all atoms, generating symmetric squeezed states, opening up the future possibility of releasing the generated states into free-space for fluorescence detection, compatible with atomic fountain based sensors.

Onur Hosten
Stanford University

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