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Enhanced Spin Squeezing via Collective and Individual Atomic Control[1] LEIGH NORRIS, COLLIN TRAIL, IVAN DEUTSCH, University of New Mexico — Spin squeezed states have generated considerable interest for their possible applications in metrology and quantum information processing. While recent years have witnessed great advances in producing spin squeezed states and understanding their properties, most spin squeezing research to date has focused on ensembles of qubit spins. We explore squeezed state production in an ensemble of spin-f alkali atoms. Collective interactions are achieved through coherent quantum feedback of a laser probe, interacting with the ensemble through the Faraday interaction. We study the enhancement of this process through further control of the atomic qudits. We control the internal atomic state both before and after the collective interaction. Initial preparation increases the collective squeezing parameter through enhancement of resolvable quantum fluctuations. Final control squeezes the individual atoms, further enhancing the total squeezing in a multiplicative manner. We show how decoherence is further suppressed in this system when compared to qubits.

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