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**Apparatus to study matter-wave quantum optics in spin space in a sodium spinor Bose-Einstein condensate** DELARAM NEMATOLLAHI, QIMIN ZHANG, JOSEPH ALTERMATT, SHAN ZHONG, MATTHEW GOODMAN, ANITA BHAGAT, ARNE SCHWETTMANN, University of Oklahoma —
We present our apparatus designed to study matter-wave quantum optics in spin space, including our recently finished vacuum system and laser systems. Microwave-dressed spin-exchange collisions in a sodium spinor Bose-Einstein condensate provide a precisely controllable nonlinear interaction that generates squeezing and acts as a source of entanglement. As a consequence of this entanglement between atoms with magnetic quantum numbers m=+1 and m=-1, the noise of population measurements can be reduced below the shot noise. Versatile microwave pulse sequences will be used to implement an interferometer, a phase-sensitive amplifier and other devices. With an added ion detector to detect Rydberg atoms via pulsed-field ionization, we plan to study the effect of Rydberg excitations on the spin evolution of the ultracold gas.

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