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Nonlinear matter-wave amplification in a ^{23}Na spinor Bose-Einstein condensate JONATHAN WRUBEL, PAUL GRIFFIN, HYEWON PECHKIS, JIANING HAN, RYAN BARNETT, EITE TIESINGA, PAUL LETT, JQI, NIST and Univ. of Maryland — An $F = 1$, ^{23}Na Bose-Einstein condensate (BEC) in a far off-resonant optical trap has a spinor order parameter for the hyperfine sublevels $m_F = +1, 0, -1$. At low magnetic fields pairs of atoms may undergo spin-changing collisions between the $|m_{F_A}, m_{F_B} >= |0, 0>$ and $|+1, -1>$ states. The ground state is a BEC in the $m_F = 0$ state. However, by dressing the $F = 1$ energy levels with a microwave field off-resonant from the $F = 2$ state, the sign of the effective quadratic Zeeman energy is reversed and the $m_F = 0$ BEC becomes metastable. Vacuum fluctuations in the initially empty $m_F = +1, -1$ states drive nonlinear amplification of $|+1, -1>$ atom pairs. When the energy difference is equal to an interaction energy, then the rate of emission of $|+1, -1>$ pairs is maximal. This realizes a phase-insensitive parametric amplifier for matter waves and is characterized by sub-shot-noise spin correlations between the $m_F = +1$ and $m_F = -1$ BECs. We discuss progress in realizing this amplifier in a Na BEC as well as possibilities for building a nonlinear matter-wave interferometer.

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