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Bose-Einstein S=1 Spinor Condensates, Dynamics, Noise Statistics and Scaling GEORGE I. MIAS, STEVEN M. GIRVIN, Yale University — We examine Bose-Einstein spinor condensates in the short-time non-linear regime for S=1 atoms in the context of ^{87}Rb studied experimentally by the Stamper-Kurn group [L. Sadler et al, Nature **443**, p193, 2006]. We will describe the quantum dynamics of a sample that starts as a condensate of N atoms in a pure $S = 1$, $m_f = 0$ state. Our approach seeks to improve the mean-field description of such systems by including the contributions of quantum fluctuations that seed the eventual formation of ferromagnetic domains. We will give a simple quantum description of the system for the short-time regime in analogy with "two-mode squeezing" of quantum optics, treating the initial $m_f = 0$ condensate as a source for the conversion to pairs of $m_f = 1, -1$ states. Even though the system as a whole is described by a pure state with zero entropy, the reduced density matrix for the $m_f = +1$ degree of freedom, obtained by tracing out the $m_f = -1, 0$ degrees of freedom, is a thermal state. We propose to observe the large fluctuations associated with this thermal state using Hanbury-Brown-Twiss noise correlation measurements in the density and momentum distributions of the individual m_f species. Finally, we will discuss the effect of excitations in connection to the seeding and ultimate formation of domains of ferromagnetically aligned spins. (Supported by NSF DMR-0603369).

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