Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Spin dynamics beyond the single mode approximation in a sodium spinor BEC[1] SHAN ZHONG, JIEJIAN WEN, QINGZE GUAN, QIMIN ZHANG, ISAIAH MORGENSTERN, HIO G. OOI, ANITA BHAGAT, DELARAM NEMATOLLAHI, HYOYEON LEE, D. BLUME, ARNE SCHWETTMANN, University of Oklahoma — We use a sodium spin-1 Bose-Einstein condensate to experimentally demonstrate that physics beyond the single-mode approximation can be relevant during the short-time non-equilibrium dynamics. Our experiments rely on microwave dressing of the F=1 hyperfine states, where F denotes the total angular momentum of the Na atoms. The observed spin population dynamics are compared to theoretical predictions that are derived by solving a set of coupled mean-field Gross-Pitaevskii equations. The fact that beyond single-mode approximation physics can, in certain parameter regimes, have a pronounced effect on the dynamics when the spin healing length is comparable to or larger than the size of the Bose-Einstein condensate has implications for using Bose-Einstein condensates as models for quantum phase transitions and spin squeezing studies as well as nonlinear SU(1,1) interferometers. Our work opens the door for devising time-dependent coupling schemes between spin and spatial degrees of freedom.

[1]We gratefully acknowledge support by the National Science Foundation under Grant No. PHY-1846965 (CAREER; QZ, SZ, IM, HO, AS) and PHY-1806259 (JJ, QG, DB). Some of the computing for this project was performed at the OU Supercomputing Center for Education Research (OSCER) at the University of Oklahoma.

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Date submitted: 31 Jan 2020 Electronic form version 1.4