Abstract Submitted
for the DAMOP14 Meeting of
The American Physical Society

Atomic Einstein-Podolsky-Rosen entanglement: How much thermal noise can it tolerate? KAREN KHERUNTSYAN, ROBERT LEWIS-SWAN, University of Queensland — We examine the prospect of demonstrating EPR entanglement for massive particles using spin-changing collisions in a spinor Bose condensate. Specifically, we address the question of sensitivity of EPR quadrature entanglement to the initial thermal population of the hyperfine states $m_F = \pm 1$, for the condensate initially prepared in the $m_F = 0$ state. In the photonic analog of this process – optical parametric downconversion – this question is irrelevant as at optical frequencies and room temperatures the thermal population of the signal and idler modes is negligible, allowing us to approximate them as vacuum states. These considerations are, however, inapplicable to ultracold atomic gases and motivate our study of the spinor dynamics in the presence of a small thermal population $\bar{n}_{th}$ in the $m_F = \pm 1$ states [1]. For condensates containing 150 to 200 atoms in the $m_F = 0$ state, we predict an upper bound of $\bar{n}_{th} \simeq 1$ that can be tolerated for observing EPR quadrature entanglement during spin-changing collisions. For $\bar{n}_{th} \gtrsim 1$, EPR entanglement is lost, even though other (less restrictive) entanglement criteria, such as inseparability, can still be satisfied.

[1] R. J. Lewis-Swan & K. V . Kheruntsyan, PRA 87, 063635 (2013).

Karen Kheruntsyan
University of Queensland

Date submitted: 28 Jan 2014 Electronic form version 1.4