



Joint Quantum Sciences Seminar

Wednesday, October 3, 4:00 pm
Jefferson 250

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“Mesoscopic Einstein-Podolsky-Rosen states of massive systems”

The demonstration of long-lived entanglement between two separated massive systems opens up the possibility of new tests of quantum mechanics and decoherence theories. For example, the intriguing idea of spatially dependent decoherence was put forward by Furry [1] in response to Einstein-Podolsky-Rosen’s (EPR) paradox paper [2], which highlighted the inconsistency of quantum mechanics with the classical premise of local realism. Furry’s hypothesis is not a part of conventional quantum mechanics. It could occur in a modified quantum mechanics. In the EPR paradox, a measurement made by an observer at one location can seemingly instantaneously affect the quantum state at another. States that demonstrate the correlations of an EPR paradox were thus called “steerable” by Schrodinger. Here, we will present evidence for EPR steerable entangled states of 40,000 atoms generated in a Bose-Einstein condensate [3]. The structure of the correlations can be further analysed, to deduce miniature cat-type paradoxes with atoms. In order to investigate EPR steerable states with spatial separations, we present a protocol for creating, storing and retrieving EPR steerable states of an opto-mechanical oscillator [4]. This leads us to consider the possibility of generating mechanical Schrodinger cat-states, and to test macroscopic realism for massive systems using Leggett-Garg and Bell inequalities in time.

[1] W. H. Furry, Phys. Rev. **49**, 393 (1936). [2] A. Einstein, B. Podolsky, and N. Rosen, Phys. Rev. **47**, 777 (1935). [3] M. Egorov et. al, Phys. Rev. A **84**, 021605 (2011). [4] S. Kiesewetter, R. Y. Teh, P. Drummond and M. Reid, Phys. Rev. Lett. **119**, 023601 (2017). [5] S. Coleman, Phys. Rev. D **15**, 2929 (1977). [6] O. Fialko et. al., J. Phys. B **50** 024003 (2017).

Refreshments will be provided at 4:00 PM