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Interferometry with ultra-cold few-atom states

EITE TIESINGA, Joint Quantum Institute

I will explain some of our recent modeling of experiments that loaded an atomic Bose-Einstein condensate into a three-dimensional optical lattice. In an optical lattice, a periodic trap for atoms, the condensate can be divided into millions of independent atomic coherent states. These states are superpositions of different atom number and the analogue of coherent states of light or photons. As in the case of coherent laser light these atomic states can be made to interfere. In fact, the time-evolution of the states leads to collapse and revivals in interference patterns observed in the atomic momentum distribution. I show that long-period revivals are associated to effective three-body interactions that are due to virtual excitations to higher vibrational states within a site of an optical lattice. This work has been published as P. R. Johnson, E. Tiesinga, J. V. Porto, and C. J. Williams, New Journal of Physics **11**, 093022 (2009).