DAMOP16-2016-020083

Abstract for an Invited Paper
for the DAMOP16 Meeting of
the American Physical Society

Manipulation of quantum noise for precision measurements with cold atoms

ONUR HOSTEN, Stanford University

I will focus on our experiments with cold atoms highlighting some of the most recent developments in the prospect of using quantum entanglement to improve the precision of atomic and optical sensors. The first part of the talk will describe the generation of 20dB spin-squeezed states of half a million ^{87}Rb atoms inside of an optical cavity. The second part will describe the experimental demonstration of a new concept we call quantum phase magnification. The demonstrated 20 dB squeezing enables a 100-fold reduction in averaging time or a 100-fold reduction in atom numbers to achieve a given sensing precision. As part of this work we show an atomic clock operating 10 dB beyond the classical limit. Some of the states prepared in these experiments possess in excess of 680 atom entanglement. The quantum phase magnification experiment shows that detection noise levels below the standard quantum limit is in fact not a requirement to realize the benefits of the intrinsic sensitivity provided by exotic quantum states. Here, optical cavity-aided effective interactions between atoms magnify signals to-be-measured to levels that can easily be detected with a rather inefficient fluorescence imaging system. The method relaxes stringent detection requirements which have been the main bottleneck in quantum metrology experiments, and can also be implemented in physical platforms other than cold atom-cavity systems.