High Visibility Gravimetry With a Bose Einstein Condensate

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In this talk, we discuss Bose Einstein condensate based gravimetry exploiting large momentum transfer beam splitters realized with both Bragg and Bloch processes [1].

We report on the operation of a cold atom gravimeter exploiting an expanded Bose Einstein condensate (BEC) as the source of atoms, achieving fringe visibility as high as 85%. The density of the condensate after expansion is sufficiently low that we observe no detrimental mean field effects in the measurement. We compare the performance of the gravimeter using cold thermal atomic clouds just below BEC phase space density to the performance achieved using a BEC and find an increase in visibility using the condensed source.

Bose Einstein condensates and atom lasers are the matter wave analog of optical lasers, the preferred source for optical precision measurements. The use of BECs in precision atom interferometry is not widespread because of density related shifts and dephasing due to mean field effects or atom interactions and due to the comparatively low flux. To our knowledge, thermal atomic clouds have been used in all previous gravimeters realized to date.

In the experiments we describe here, the freely falling condensates undergo expansion to low density before entering the interferometer pulse sequence. The advantage of the BEC source is that it exhibits a narrow momentum both parallel and transverse to the direction of propagation of the probe lasers increasing the efficacy of large momentum transfer beam splitting. We discuss and compare the flux for state of the art BEC experiments to that of state selected thermal sources and discuss the implications for the sensitivity of future precision measurements of gravity exploiting freely falling condensates and atom lasers [2].