Coherent control of matter: a multiple-photon atom interferometer to measure h/M_{Cs}, and strongly correlated (Laughlin) states in rotating Bose Condensates

Steven Chu

Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA

This talk will summarize the current progress of two experiments. (1) A new measurement of h/M_{Cs} using multiple-photon beam splitters in an atom interferometer. Mach Zender and Ramsey-Borde atom interferometers using coherent beam splitters of up to 20 photon momenta have been recently reported by our group. Using this wide-area interferometer, progress in an improved measurement of the fine structure constant, with the goal of measuring the 2 kHz photon recoil frequency shift to an absolute accuracy of less than 2 micro Hertz will be presented.

In the second half of the talk, our studies of rotating Bose gases will be presented. The correlated motions of rotating atoms are directly analogous to the Fractional Quantum Hall effects of 2-D electrons in a magnetic field in that both systems exhibit a new quantum ground state where a motionally-correlated ground state arises from single particle degeneracy. I will discuss our experimental efforts to populate strongly correlated, higher angular momentum states in micro-Bose condensates.