CU Physics Department Colloquium

Monday, February 26, 2007
4:10 PM - 428 Pupin Hall

Experiments with a "Particle in a Box":
Bose Einstein condensates, and Maxwell's Demon

The "particle in a box" is at the heart of quantum mechanics and is a paradigm for many problems in physics. In this talk, I will describe recent experiments conducted by my group which confine a Bose-Einstein condensate to a one-dimensional optical box. These conditions have enabled the experimental realization of atomic number squeezing, toward the production of number states. These states will be used for the controlled study of quantum entanglement and for fundamental precision tests. More generally, we have demonstrated the ability to measure atom statistics by single-atom counting, paving the way for the new field of quantum atom optics.

The concept of a "particle in a box" is also widely used in thermodynamics. The historic paradox of Maxwell's demon suggested a way to cause particles to accumulate in one side of the box, in an apparent violation of the Second Law. Motivated by these ideas we have developed a method to form an optical "one-way" barrier for atoms. This device would allow atoms coming from one side of the barrier to pass through, but those coming from the other side to be reflected. I will show how this idea can be used for phase space compression and cooling, as an optical realization of Maxwell's demon.

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