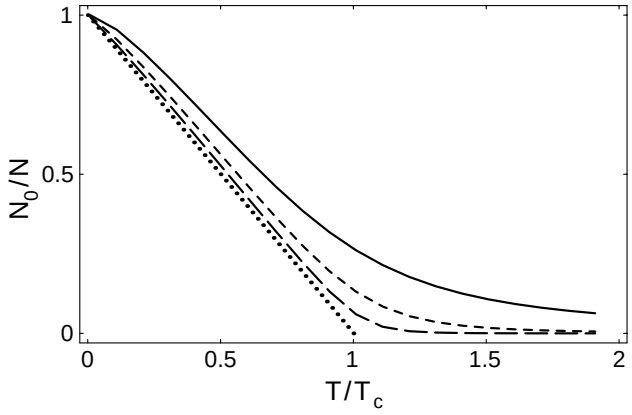
Bose-Einstein condensation of a finite number of particles trapped in one or three dimensions

Bose-Einstein condensation (BEC) of an ideal gas was theoretically investigated for a finite number of particles [1]. This was done by considering the discrete quantum states in a harmonic oscillator potential.

In three dimensions, we found a transition temperature which is lower than in the thermodynamic limit and calculated the corrections. Lowering the dimension increases the transition temperature and is therefore favorable for BEC. This is in contrast to the standard result obtained in the thermodynamic limit which states that BEC is not possible in, e.g., a one-dimensional (1D) harmonic potential. As a result, 1D atom traps, such as radially tightly confining magnetic traps or optical dipole traps, are promising for studying BEC.



The condensate fraction for a finite number N of atoms in a one-dimensional harmonic potential versus temperature. Plots are shown for N=100 (solid line), 10^4, 10^8 and infinite (dotted).

1. W. Ketterle and N.J. van Druten, Phys. Rev. A **54**, 656 (1996).