

Tutorial 9: Modern Physics

1. Consider a gas of bosons (Helium atoms) of mass m . This gas is inside a $3D$ infinite well of size 1 cm on each side. To what temperature do I need to cool the gas so that all bosons go into the ground state?
2. In fact I can achieve a Bose-Einstein condensate at a temperature much higher than what I determined in *Q1*. Let's work with Cornell and Wieman's setup using ^{87}Rb atoms. Almost 2000 atoms were confined to a volume of 10^{-15} m^3 . What is the temperature at which the wavefunctions coalesce to form a Bose-Einstein condensation?
3. Free electrons in a metal behave like a quantum gas. At what minimum temperature, would these electrons behave like a classical gas? The density of electrons is 1 per atom and atoms are roughly 0.3 nm apart.