

PHY 410

HW# 10

Assigned: April 15, 2009: Due April 22, 2005

- 10.1 In the first observation of Bose-Einstein condensation with atomic hydrogen a gas of approximately 2×10^{10} atoms was trapped in a region and cooled until its density was 1.8×10^{14} atoms/cm³.
- (i) Why can we treat the Hydrogen atom as a boson?
 - (ii) What is the average distance between the hydrogen atoms at the above density
 - (iii) Calculate the condensation temperature T_E and compare to the measured value of 50 μ K.
- 10.2 Calculate the condensation temperature for liquid helium-4 ⁴He assuming that the atoms in the liquid can be treated as an ideal gas. (A physical justification for this is the large zero-point motion of the light He atoms). The mass density you can use is 0.145 g/cm³. Compare this with the experimental value of 2.17K.
- 10.3 Find an expression for the entropy of a 3-dimensional ideal bose gas (mass m) confined in a volume V as a function of temperature τ in the region $0 < \tau < \tau_E$.
- 10.4 Problem 7.14 of the text. (Kittel and Kroemer)
- 10.5 Problem 8.1 of the text. (Kittel and Kroemer)