

## Physics 540: Statistical Mechanics I

**Read:** LL 57-58, 62-63, K 4.5

**Problems to study:** K.4 pr 20

“LL 1” means section 1 from Landau and Lifshitz book

“K.1 pr 2” means problem 2 from section 1 of Kubo’s book.

### Homework 11

#### Exercise 1

Study the problem Kubo 4.20 (semiconductor). Derive expressions for  $\mu(T)$  at low and high  $T$ .

#### Exercise 2

Consider an ideal three-dimensional Bose gas made of particles with dispersion law  $\epsilon_p \sim p^\alpha$ .

- For which values of power  $\alpha$  is Bose condensation possible?
- What is the behavior of the heat capacity at small  $T$  for those  $\alpha$ ?
- What happens with ordinary particles ( $\alpha = 2$ ) moving in  $d = 2$  spatial dimensions?

#### Exercise 3

Hydrogen with density  $n = 10^{18} \text{ cm}^{-3}$  is heated to such a degree that pressure of the blackbody radiation becomes equal to that of particles.

- Calculate this temperature  $T_b$ . What is the state of matter at this point?
- Calculate the ratio of blackbody and particle specific heats at this  $T_b$ .