

# Homework 3

Due 1/27/2011

1. [10 points] Show that the reciprocal of a fcc BL is a bcc BL by using the structure factor argument.
    - a) Specifically, consider the fcc BL as 4 identical-"atom" basis + sc BL. [Physically, that "atom" may be in fact a many atom basis, but it is OK to consider that basis as an atom for this problem.] Note that the reciprocal of a sc BL with lattice constant  $a$  is another sc BL with lattice constant  $2\pi/a$ . For  $\vec{G}$  of the reciprocal sc BL, calculate the structure factor  $S_{\vec{G}}$  for the 4 "atom" basis. Then, show that  $S_{\vec{G}}$  vanishes for certain  $\vec{G}$  vectors, and is a constant value for other  $\vec{G}$  vectors, in such a way that the those  $\vec{G}$  vectors with non-vanishing  $S_{\vec{G}}$  make a bcc BL.
    - b) Examine the volumes of *primitive* cells of the BL and the reciprocal BL of (a), and show that they indeed satisfy  $VV^* = (2\pi)^3$ .
- sc = simple cubic, fcc = face centered cubic, bcc = body centered cubic.

2. [10 points] Kittel 2.6

3. [10 points] Kittel 2.7

4. [10 points] Kittel 4.1

5. [10 points] Kittel 4.2