6.730 PHYSICS FOR SOLID STATE APPLICATIONS

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PROBLEM SET 3

Issued: 2-23-04 Due:2-27-04, at the beginning of class.

Readings: PSSA Chapter 4 and 5

Problem 3.1 *2D Crystal Structure Former Quiz Problem*

There is a two-dimensional array of idenitical atoms (see plot on the last page). Using various sections of the drawing on the last page, indicate the following:

(a) The primitive translations of the lattice.

(b) The basis for the periodic structure.

(c) The Wigner-Seitz unit cell.

(d) The primitive translations of the reciprocal lattice.

(e) The first Brillouin Zone.

Turn in the attached page with your homework.

Problem 3.2 *X-Ray Diffraction of FCC Crystals*

Problem 5.5 in PSSA.

Problem 3.3 *Two-Dimensional Crystals*

Consider a 2D lattice of discrete points in a the plane which have some finite minimum separation and that the lattice has both translational symmetry (for translation by a lattice constant) and rotational symmetry.

(a) Show that the repeating set of points can only have n = 1, 2, 3, 4, or 6-fold rotational symmetry.

Hint: Consider a point at the origin that is on the 2D lattice and one of its nearest neighbors that is the point on the lattice with the minimal distance from the origin. Show that rotations of 360/n never result in points that are separated further than the original two lattice points only so long as n= 1,2, 3, 4, or 6.

(b)Visit the web site http://www.lassp.cornell.edu/lifshitz/quasicrystals.html or http://www.cmp.caltech.edu/ lifshitz/quasicrystals.html which shows a diffraction pattern of a material, known as a quasicrystal, which has n = 5; that is, five-fold symmetry. Does this violate what you have proven above? Why or why not?