PROBLEM SET 3   Due Thursday February 7

Physics 140A– WINTER 2013

[1.] Sidebottom Problem 6.6.

[2.] Sidebottom Problem 6.7.

[3.] Sidebottom Problem 6.9.

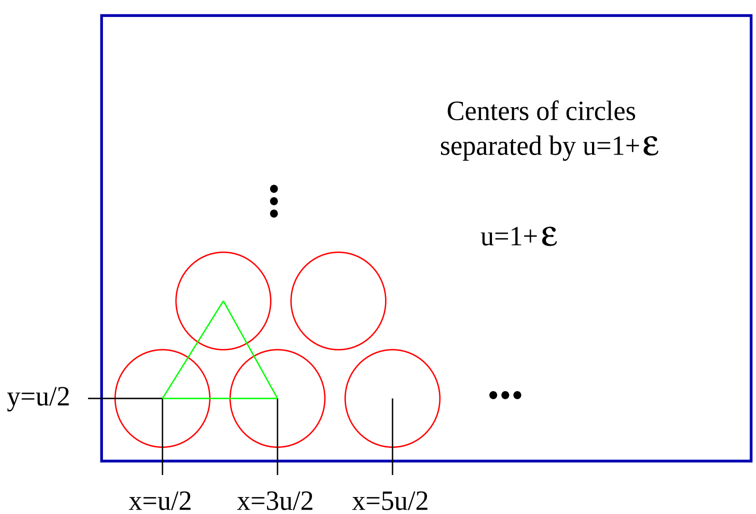
[4.] In class we determined the missing reflections arising from the basis for a bcc structure. Do the same for the fcc lattice. If you have the energy, try Sidebottom Problem 6.13, which asks what the additional effects of the diamond lattice (which attachs a further atom at $(1/4, 1/4, 1/4)$ to each of the fcc sites).

[5.] Suppose a matrix M has a degenerate eivenvalue, that is, there are two distinct vectors $\vec{v}_1 \neq \vec{v}_2$ with $M\vec{v}_1 = \lambda\vec{v}_1$, $M\vec{v}_2 = \lambda\vec{v}_2$ for the same λ. What is true of linear combinations of $\vec{v}_1$ and $\vec{v}_2$?

[6.] Consider a collection of eight masses m connected by springs of spring constant k with periodic boundary conditions.
a) What are the eight normal mode frequencies?
b) What are the eight normal mode vectors?
c) What is the physical interpretation of the mode (1 1 1 1 1 1 1 1)? How would you justify the fact the excitation energy is zero?
d) Some of the normal mode frequencies are degenerate. The normal modes that we wrote in class for those frequencies have entries which are complex numbers. Yet we expect the positions of the masses to be real. Is this a difficulty? (Hint: Think about the result of Problem [5.].)

The problem(s) below is(are) *numeric*. I will be available in the computer lab, room 106, Wednesday 10:00 am - noon to help with these problems, or with general background on writing C programs, compiling them, etc.

[7.] Write a code which can set up the initial positions of N disks of diameter $a = 1$ so that the spacing between their centers in $a + \epsilon$. See Figure.



The disks are in a box $0 < x < L$ and $0 < y < L$. They have diameter $a = 1$ but we do not pack them as closely as possible, but instead separate their centers by $1 + \epsilon$. Of course N must not be too large if all the disks are to fit in the box. If N is small, just put the disks in the lower left corner, as shown.

(We will use this code in a succeeding assignment as an ingredient in a larger code to evaluate the density correlation function $g(r)$ for a hard disk system.)