Homework #3, Due by email, Monday, November 4th

1) Show that the spherical wave Green's function conserves intensity on the surface of a sphere.

2) The small angle approximation for the phase shift u2z/(2k) where k is the wavevector, u the reciprocal space co-ordinate and z the slice thickness is often used in multislice calculations. Using typical conditions, estimate the validity of this approximation. Does it depend upon the number of slices (be careful)?

3) Show that if you have weak scatterers randomly placed in a sample (e.g. point defects) then the resulting 2nd-order diffraction (i.e. double-diffraction) contributions are going to be much smaller than for a crystal. (Hint: consider what random positions do to the phases.)

4) Using the Ewald spheres for electrons of slightly different energy and considering an inelastic event which excites an electron in the solid with a small energy:

a) Draw Ewald spheres for the incident electron and the electron which has lost a small fraction of its energy.

b) By superimposing on this the sphere for the low energy electron excited in the solid, show that momentum conservation forces the inelastic excitations to have wavevectors almost normal to the incident beam direction.

5) Using the two-beam dispersion surface, show qualitatively that two-beam lattice fringes from a wedge crystal can be either have a larger or smaller spacing than the 'true' lattice fringe spacing in the crystal depending upon which side of the exact Bragg condition the crystal is oriented. (Hint: remember to match boundary conditions normal to the exit/entrance surfaces).