020130 Quiz 3 XRD

1) **Describe** and **give the relative advantages** of the following detectors:
   a) Scintillation Detector (Bicron, the detector used in lab)
   b) Proportional Counter (2D)
   e) Image Plate (Fluorescent plate detector)

2) What do the following mean:
   a) (111)
   b) <111>
   c) [111]
   d) {111}

3) What is the relationship between (111) and [111] for a cubic lattice?

4) How are the components of the vector $\mathbf{H}_{hkl} = h\,\mathbf{b}_1 + k\,\mathbf{b}_2 + i\mathbf{b}_3$ related to the real space lattice parameters $\mathbf{a}_1$, $\mathbf{a}_2$, $\mathbf{a}_3$, where h, k and l are the Miller indicies of a plane?

Answers 020130 Quiz 3 XRD

1) a) Scintillation detector is a single channel detector with a scintillation crystal and a PMT or solid state optical detector. It is an inexpensive detector ($10,000) common on diffractometers

b) Proportional counter is a gas filled detector with a wire or wires that detect gas ionization. PC's operate at about 2KV bias which allows for proportionality between the number of photons incident and the detector current or voltage. Generally costs $15K for a 1-d detector and $100K for a 2D detector. PC's can be energy sensitive allowing for some monochromatization in the detector. Disadvantage is cost and somewhat maintenance. Advantage is 2D resolution and real time display of data.

c) Image plate is a flourescent screen detector that is read in a separate step. The screen can be cut to any shape and size and placed at any point in the x-ray camera. Cost for reader is about $100K. Allows for 2D detection and high degree of flexibility. No real time is possible. Extremely high angle resolution which is useful for protein crystallography.

2) (111) describes the 111 plane (Miller indicies, hkl), <111> is the family of directions [111], [111] is the 111 direction [uvw], {111} is the family of planes (111).

3) For a cubic lattice (hkl) is normal to [uvw] if h=u, k=v and l=w.

4) $\mathbf{b}_i = (\mathbf{a}_{i+1} \text{ x } \mathbf{a}_{i+2})/V$, where V is the volume of the unit cell, $V = a_1a_2a_3$