$S_G = 2f$ (maximum) if $\frac{4}{3}h + \frac{2}{3}k + l$ = even integer
$\Rightarrow (h+k) + \frac{1}{3}(h-k) + l$ = " "
$= 0$ (zero) if $\frac{4}{3}h + \frac{2}{3}k + l$ = odd integer

} one or the other iff $h-k = 3p$ ← integer.

So we have max. intensity when $(h,k,l) = (1,1,0), (0,0,2) \ldots$ etc.

and no peaks at $(h,k,l) = (0,0,1), (1,1,1) \ldots$ etc.

4.

(a) $E = \hbar\omega = \frac{hc}{\lambda}$

$$\Rightarrow \lambda = \frac{hc}{E} = \frac{1240\ \text{eV}\cdot\text{nm}}{8028\ \text{eV}} \doteq 1.54\ \text{Å}$$

comparable to lattice constants (or interatomic separations)!

$$|\vec{k}| = \frac{2\pi}{\lambda} = \frac{2\pi}{1.54\times10^{-10}\,\text{m}} \doteq 4.08\times10^{10}\,\text{m}^{-1} = 4.08\ \text{Å}^{-1}.$$

(b)

The distance between two adjacent (hkl) planes $d(hkl)$:

$$d^2(hkl) = a^2/(h^2+k^2+l^2)$$

$$\Rightarrow d^2(111) = 5^2/(1^2+1^2+1^2) = \frac{25}{3}, \quad d(1,1,1) \sim 2.89\ \text{Å}$$

Bragg's law: $2d\sin\theta \sim \lambda$

$$\Rightarrow \theta = \sin^{-1}\left(\frac{\lambda}{2d}\right) = \sin^{-1}\left(\frac{1.54}{5.78}\right) \sim 15.5^\circ$$

The angle between $\vec{k}$ and $\vec{k}'$ $= 2\theta \sim 31^\circ$