Glazer & Clark

8.4. Outline the steps leading to $n(\omega)\,d\omega = 2 \times \frac{V}{2\pi^2 c^3}\,\omega^2 d\omega \times \frac{d\omega}{\exp(\hbar\omega/k_BT)-1}$,

for the # of photons with frequencies between $\omega$ and $d\omega$.

$\frac{1}{\exp(\hbar\omega/k_BT)-1}$ is the occupation # for Bose-Einstein Distribution,

$2$ accounts for the two independent polarizations.

$\frac{V}{2\pi^2 c^3}\omega^2 d\omega$ is the degeneracy. To see this, recall the density of state ~~is equal~~ in k-space is equal to the surface area of a sphere's 1/8 of radius $r = \sqrt{n_x^2+n_y^2+n_z^2} = \sqrt{k_x^2+k_y^2+k_z^2}\left(\frac{a}{\pi}\right)$. $\Rightarrow$ degeneracy in k space is

given by $g(k)\,dk = \left(\frac{V}{\pi^3}\right)\frac{4\pi k^2\,dk}{8} = \frac{Vk^2}{2\pi^2}\,dk$.

From QM: $\varepsilon = \hbar\omega$, from relativity, $\varepsilon = pc = \hbar kc$.

$\Rightarrow \quad \hbar\omega = \hbar kc \Rightarrow k = \frac{\omega}{c}$, going to $\omega$ space gives

$$g(\omega)\,d\omega = g(k)\frac{dk}{d\omega}\,d\omega = g\left(\frac{\omega}{c}\right)\frac{1}{c}\,d\omega$$

$$= \frac{V\omega^2}{2\pi^2 c^2}\frac{1}{c}\,d\omega$$