Population Factor in Interband Transition in QW

Eq. (9.4.1.a)

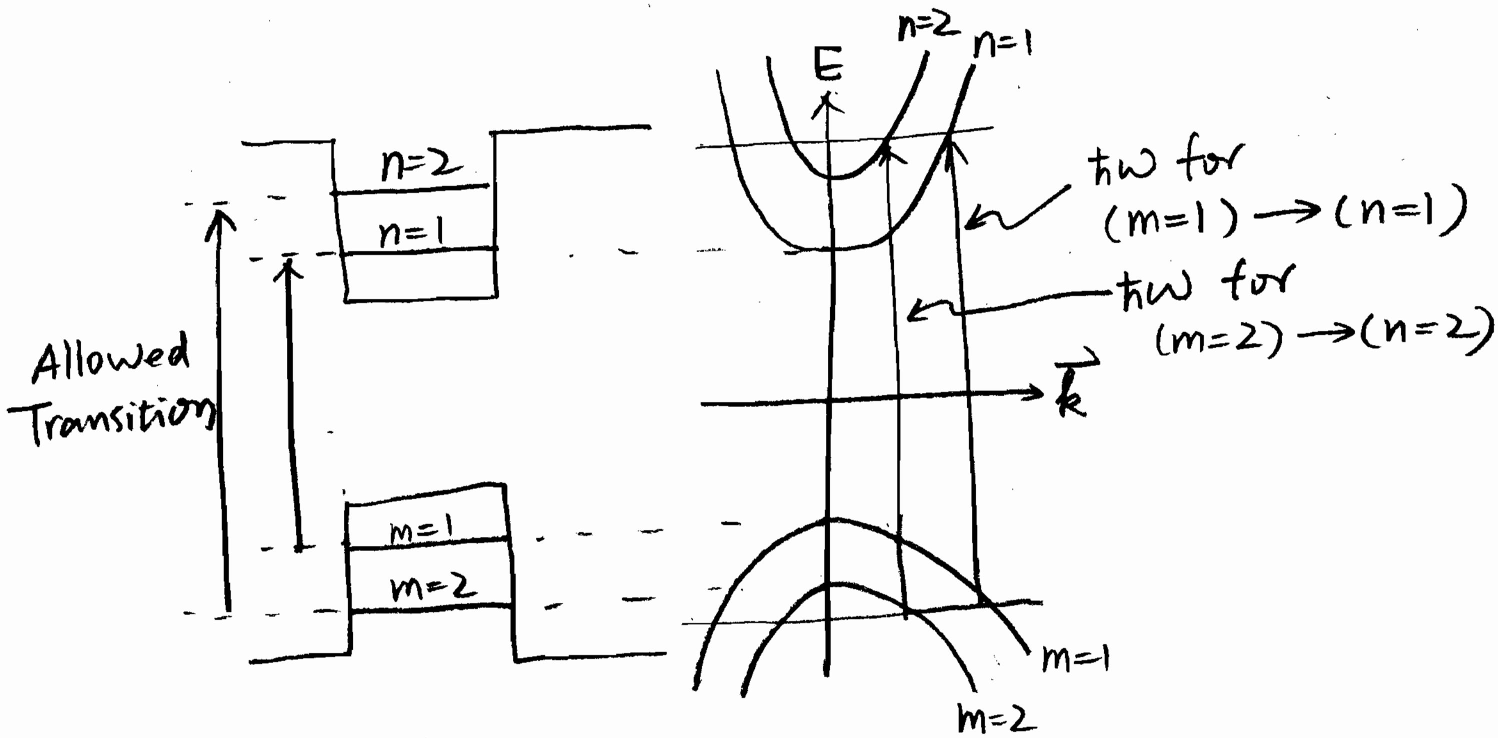
$$\alpha(\hbar\omega) = C_0 \frac{2}{V} \sum_{k_a} \sum_{k_b} |\hat{e}\cdot\vec{P}_{ba}|^2 \cdot \delta(E_{ba}-\hbar\omega)\cdot(f_v(E_a)-f_c(E_b))$$

$$= C_0 \frac{2}{V} \sum_{m,n} I_{hm}^{en} \sum_{k} |\hat{e}\cdot\vec{P}_{cv}|^2 \delta(E_{ba}-\hbar\omega)(f_v(E_a)-f_c(E_b))$$

$$= C_0 \sum_{m,n} I_{hm}^{en} \cdot \int dE_{ba} \cdot \rho_r^{2D} |\hat{e}\cdot\vec{P}_{cv}|^2 \cdot \delta(E_{ba}-\hbar\omega)(f_v(E_a)-f_c(E_b))$$

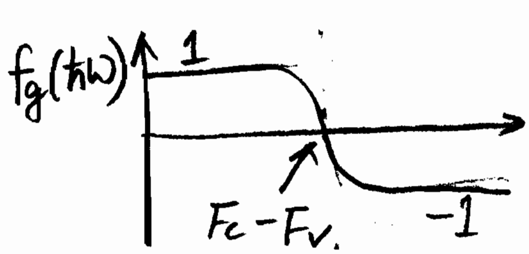
Note that $I_{hm}^{en} = \delta_{mn}$ in infinite well

($I_{hm}^{en} \approx \delta_{mn}$ in finite potential well)



For a given photon energy ($\hbar\omega$), E_a and E_b are independent of $\vec{k}_t$

$f_v(E_a) - f_c(E_b) = -\underbrace{f_g(\hbar\omega)}_{\text{Fermi-Inversion factor}}$ is only a function of $\hbar\omega$



$$\Rightarrow \alpha(\hbar\omega) = \alpha_0(\hbar\omega)\,[-f_g(\hbar\omega)]$$