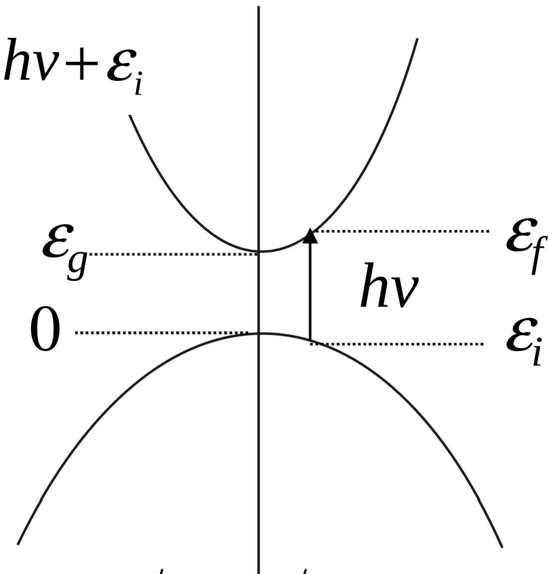
Allowed direct transitions: Absorption

- *i.e.* every initial state is connected with a final state: $\varepsilon_f = h\nu + \varepsilon_i$



- In parabolic bands: $\varepsilon_f - \varepsilon_g = \dfrac{\hbar^2 k^2}{2m_e^*}$ and $\varepsilon_i = -\dfrac{\hbar^2 k^2}{2m_h^*}$

- Therefore $h\nu - \varepsilon_g = \dfrac{\hbar^2 k^2}{2}\left(\dfrac{1}{m_e^*} + \dfrac{1}{m_h^*}\right)$

  $= \dfrac{\hbar^2 k^2}{2}\left(\dfrac{1}{m_r}\right)$ where m_r is reduced mass, $1/m_r = 1/m_e^* + 1/m_h^*$

- Density of <u>directly associated states</u>, $g(h\nu) = \dfrac{4\pi(2m_r)^{3/2}}{h^3}(h\nu - \varepsilon_g)^{1/2}$ (slide 2.6)

- Hence $$\alpha(h\nu) = A^*(h\nu - \varepsilon_g)^{1/2}$$

- *Summary:* Photon ensures energy is conserved; $k_f = k_i$

For an index of refraction of 4, and assuming $m_e^* = m_h^* = m_0$, then

$\alpha(h\nu) \approx 2\times10^4 (h\nu - \varepsilon_g)^{1/2}$ cm^{-1}

(with $h\nu$ and ε_g in eV)