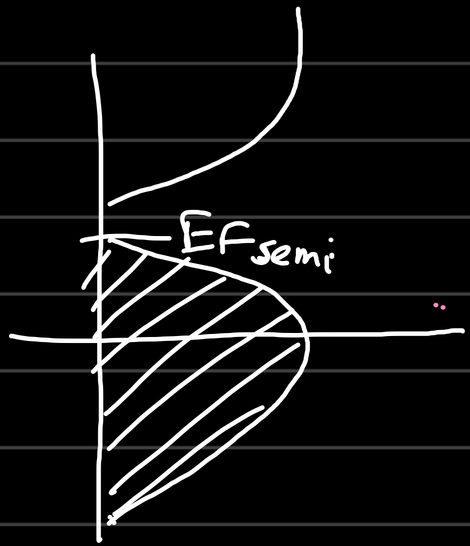
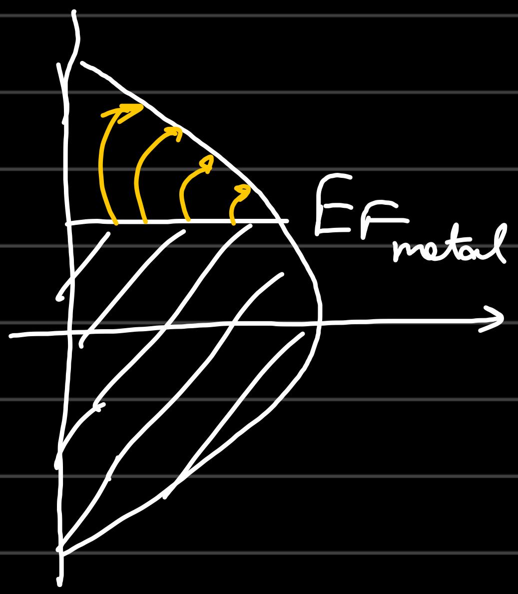
Lecture 25





→ Metals are transparent for $E > E_\beta$

Electronic Transitions.

i) Inter-band transitions: (Valence → Conduction)

↳ in semiconductors

↳ in metals at very high frequencies

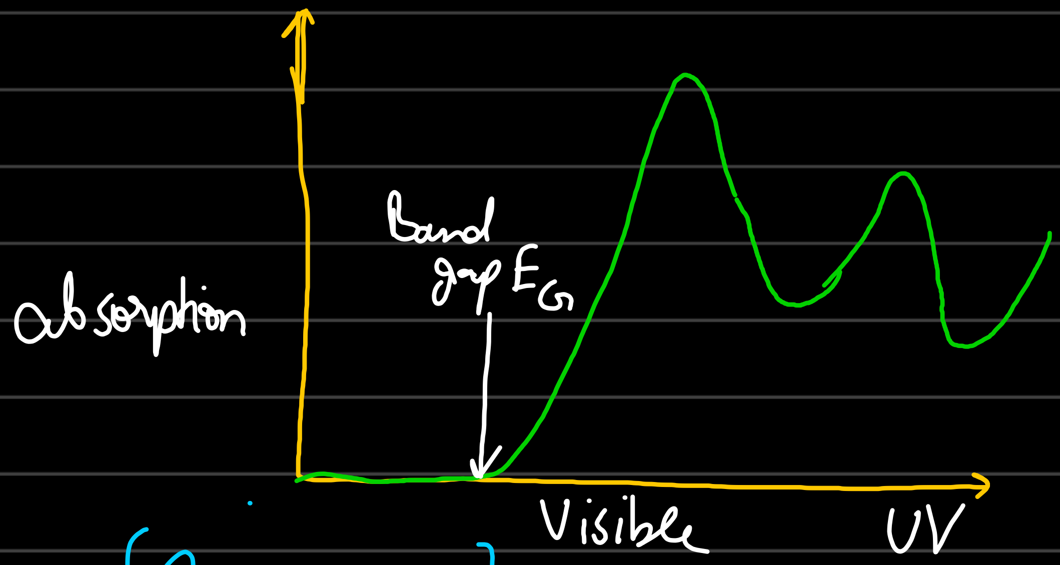
ii) Intra-band transitions

↳ in metals at low frequencies

↳ {metals are opaque}

→ valence band is completely filled

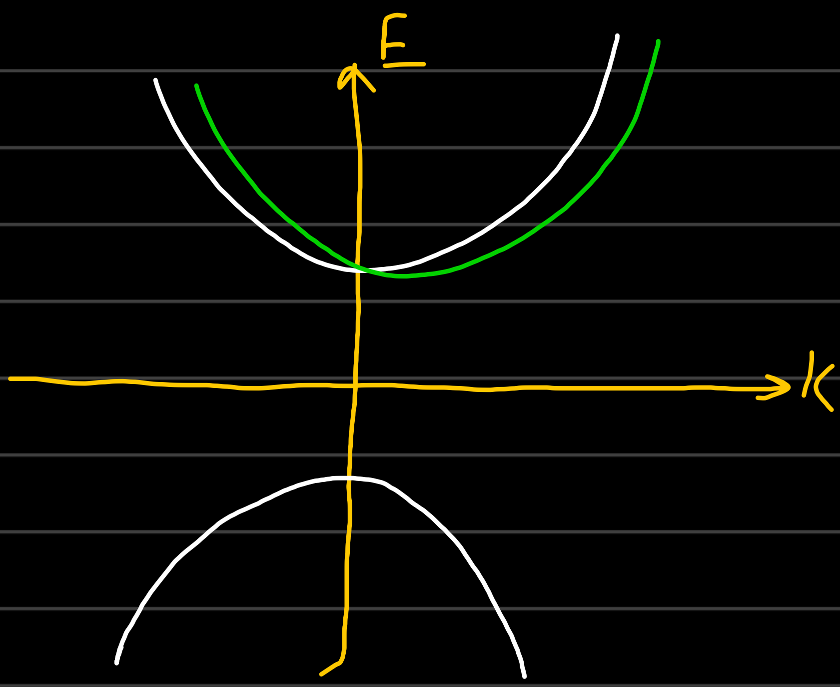
no intra-band transitions.



{Band edge}

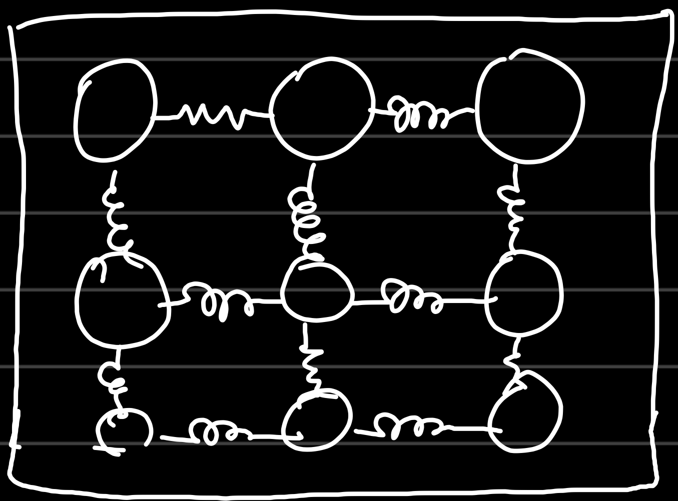
Direct and Indirect Semiconductor

i) $E_{f_i} - E_i = h\nu$ ii) $\underbrace{\hbar k_f - \hbar k_i = \hbar k_{photon}}_{\text{conservation of momentum.}}$



→ top of valence band & bottom of conduction band on same k value → direct band gap

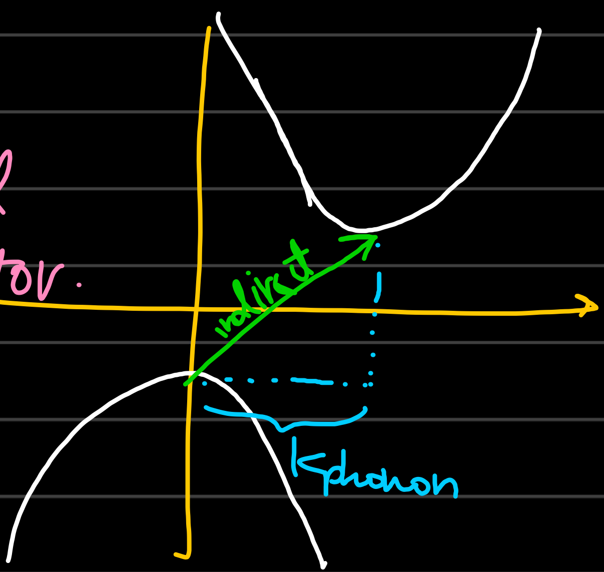
Phonons: lattice vibrations.



→ Oscillations at any $T \neq 0$ are called phonons.

Indirect band gap semiconductor.

↳ eg: Silicon



↳ requires help of phonon for band transition.

* Photon have large energy, small momentum (k)
* Phonon have low energy, large momentum (k)

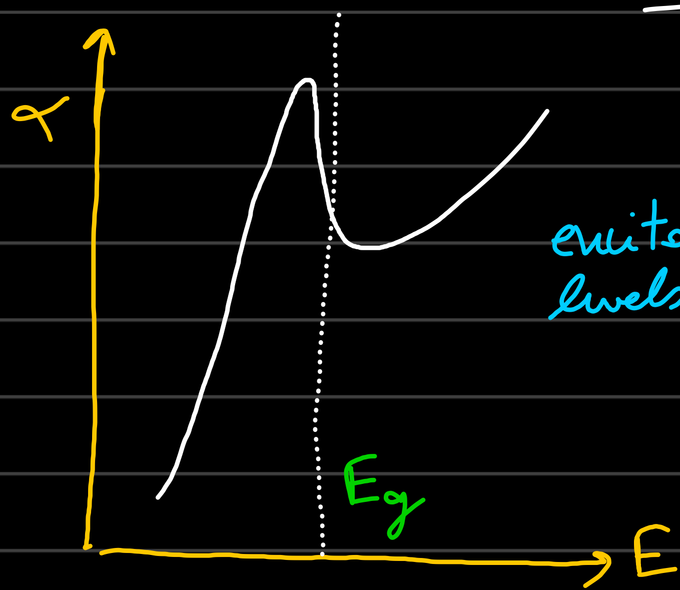
↳ Indirect semiconductor require aid of phonons hence probability of transitions is also reduced.

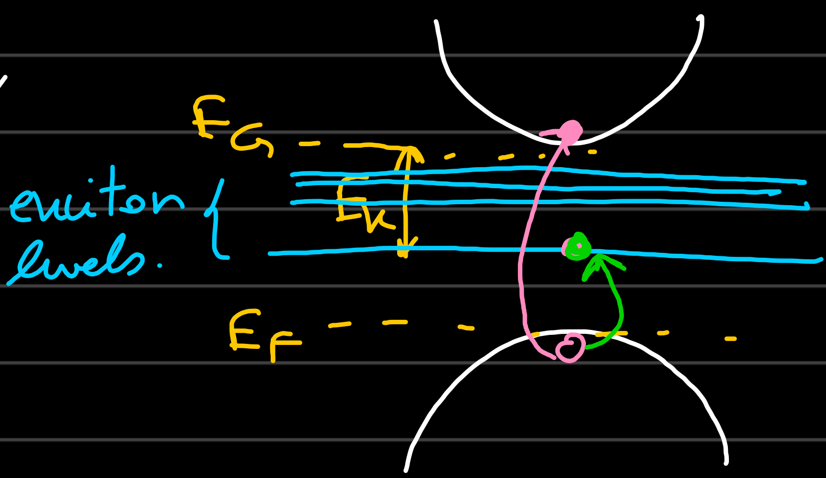
→ Optical transitions in Indirect SC's are weaker than Direct SC's.

↳ Hence most efficient photodetectors, transistors are all direct band gap SC.

Absorption from Exciton:-

↳ Electron-hole pair ⇒ exciton.





→ Electron apriory knows an existence of a bound state {exciton levels} below the

Band gap. $\longrightarrow$ electron does not go into conduction band.

$\rightarrow$ absorption peak found below E_G.