

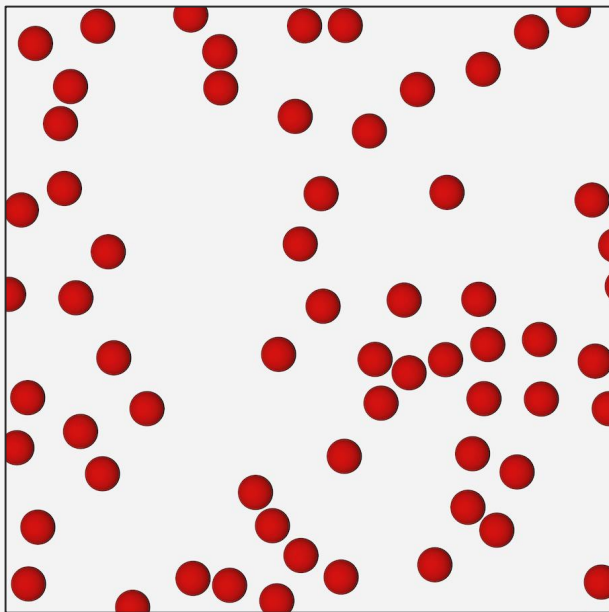
Working Principle of a Semiconductor Based Solar Cell

Transport of Charge Carriers

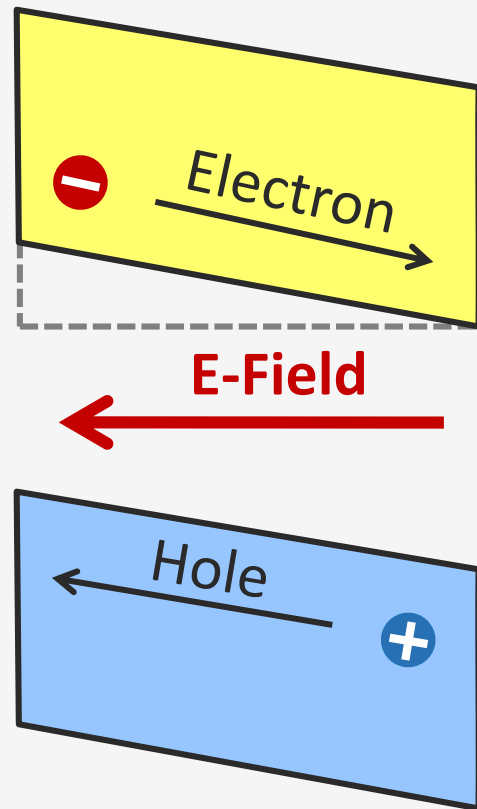
Week 2.3.3

Arno Smets

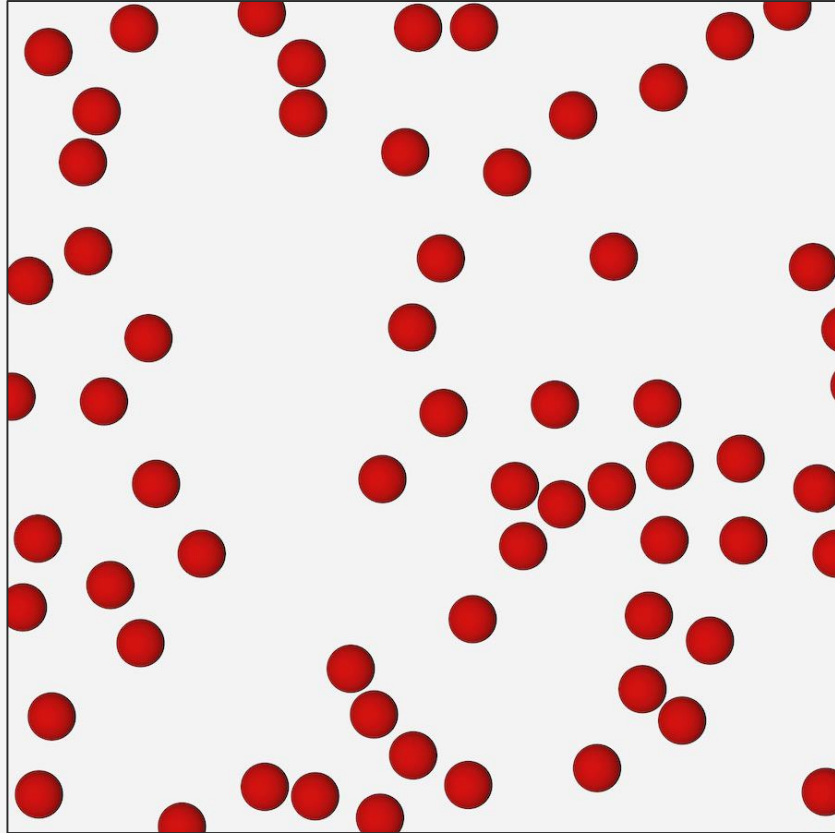
Diffusion



Drift

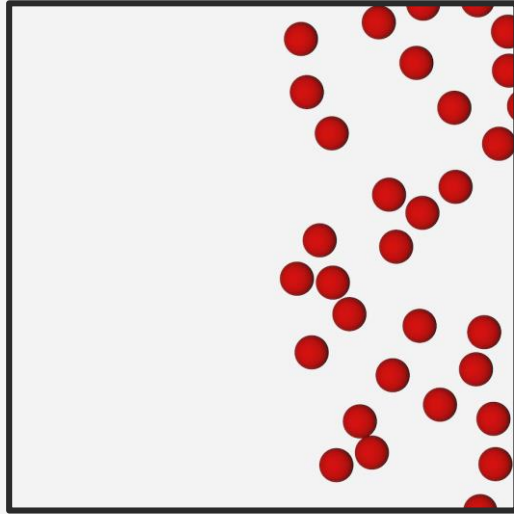


Random movement = no net movement

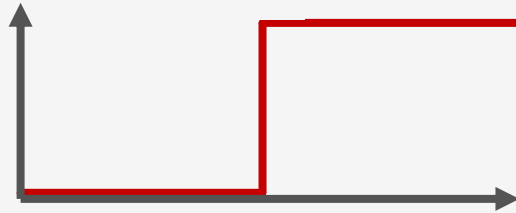


Diffusion

$$J_e = qD_e \frac{dn}{dx}$$



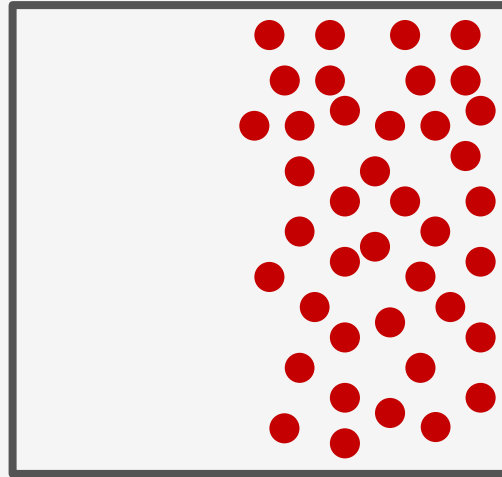
density



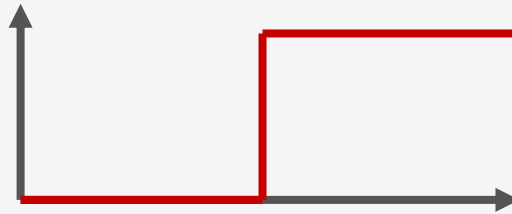
Diffusion



$$J_e = qD_e \frac{dn}{dx}$$



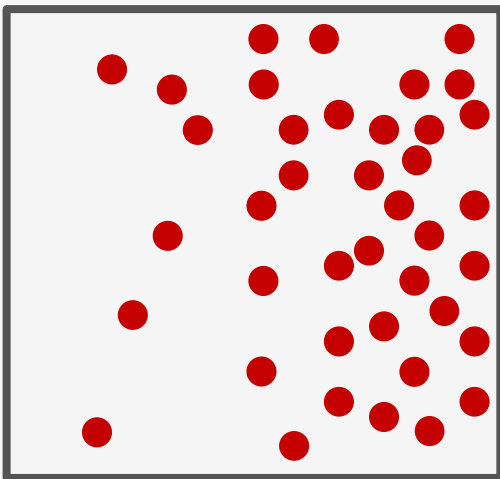
density



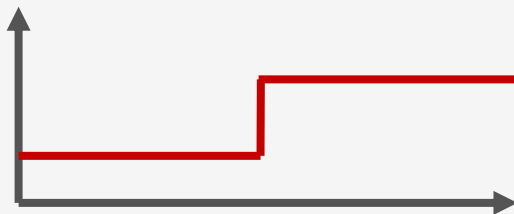
Diffusion



$$J_e = qD_e \frac{dn}{dx}$$

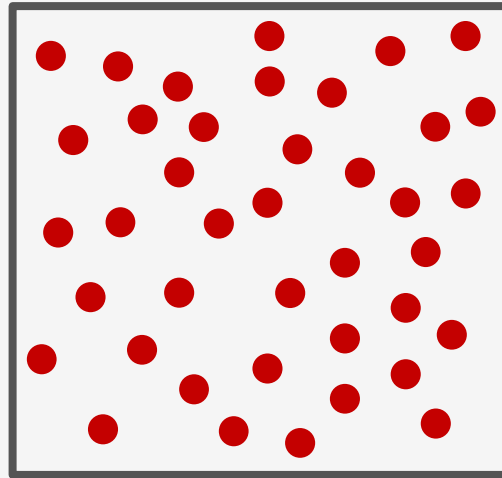


density

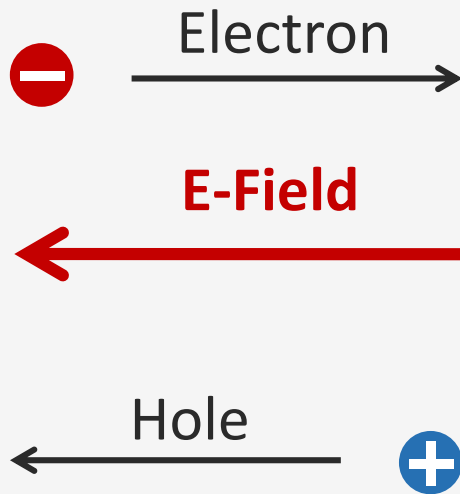


Diffusion

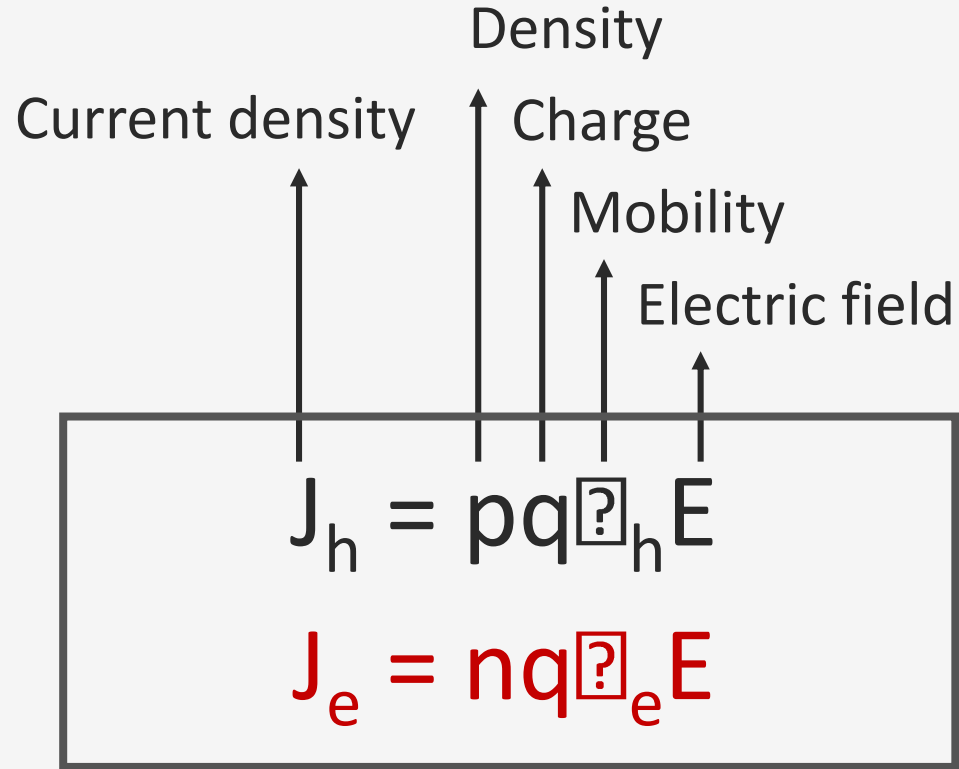
$$\frac{dn}{dx}=0 \quad J=0$$



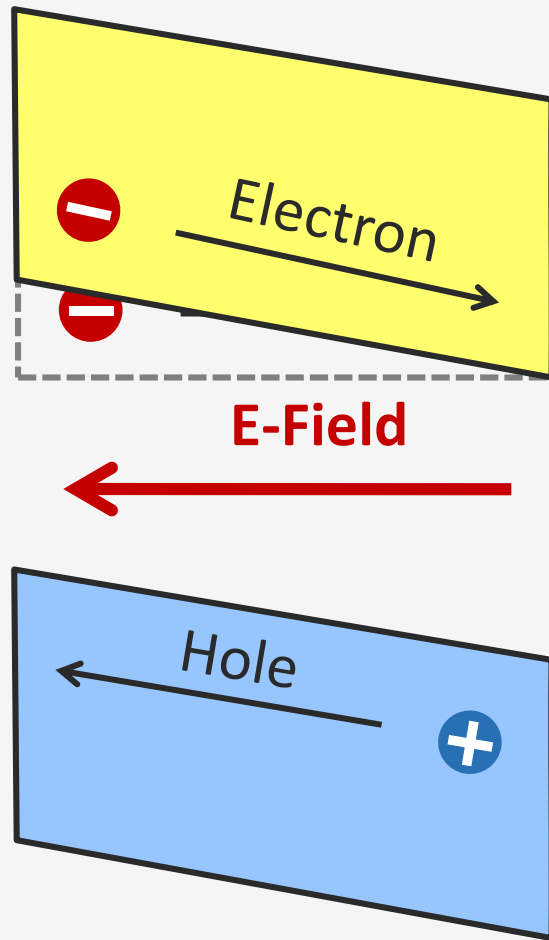
Drift



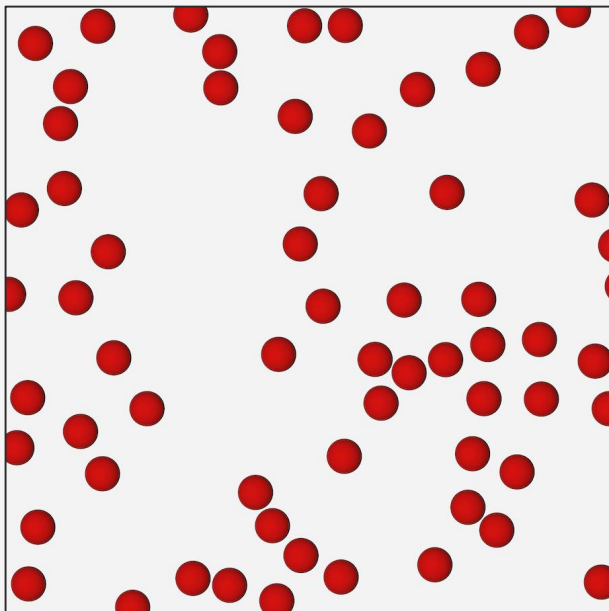
Drift



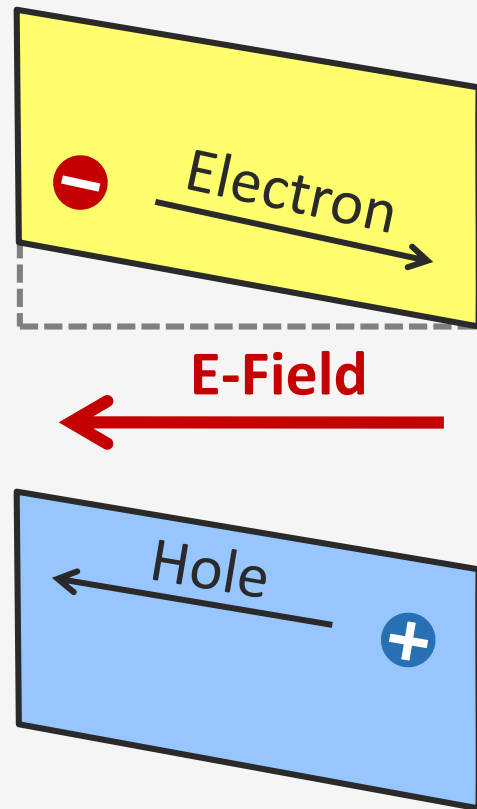
Drift



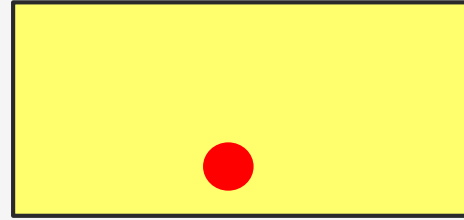
Diffusion



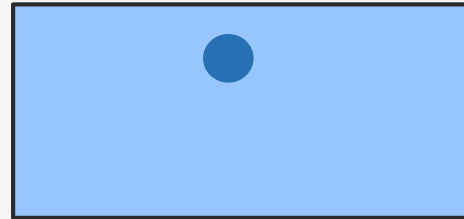
Drift



Charge Carrier Recombination

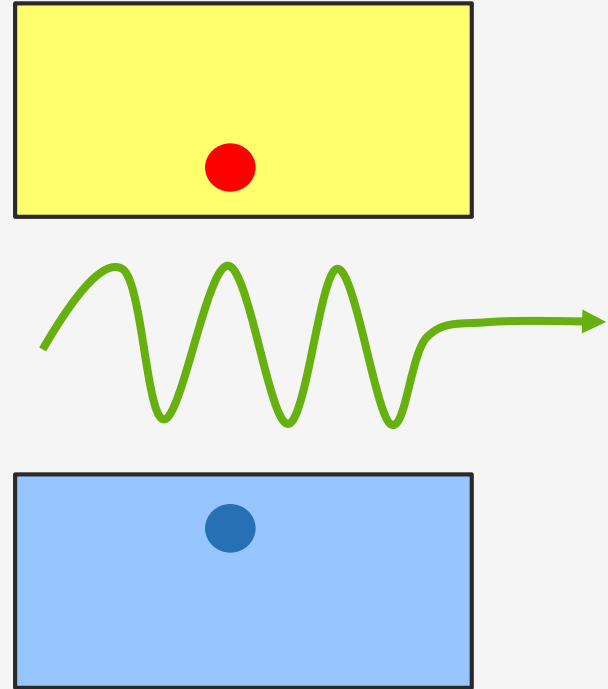


Recombination

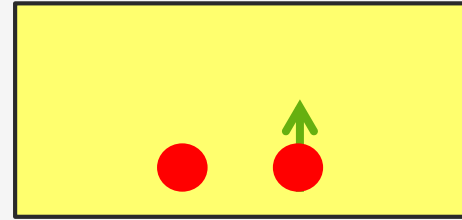


Charge Carrier Recombination

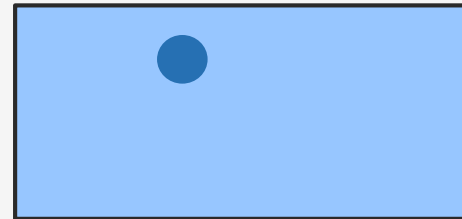
Radiative recombination



Charge Carrier Recombination

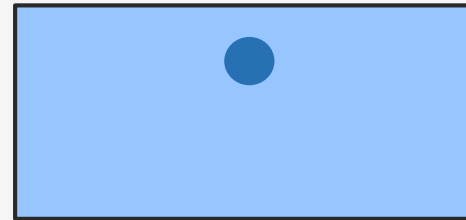
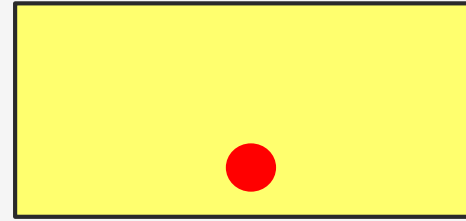


Auger recombination

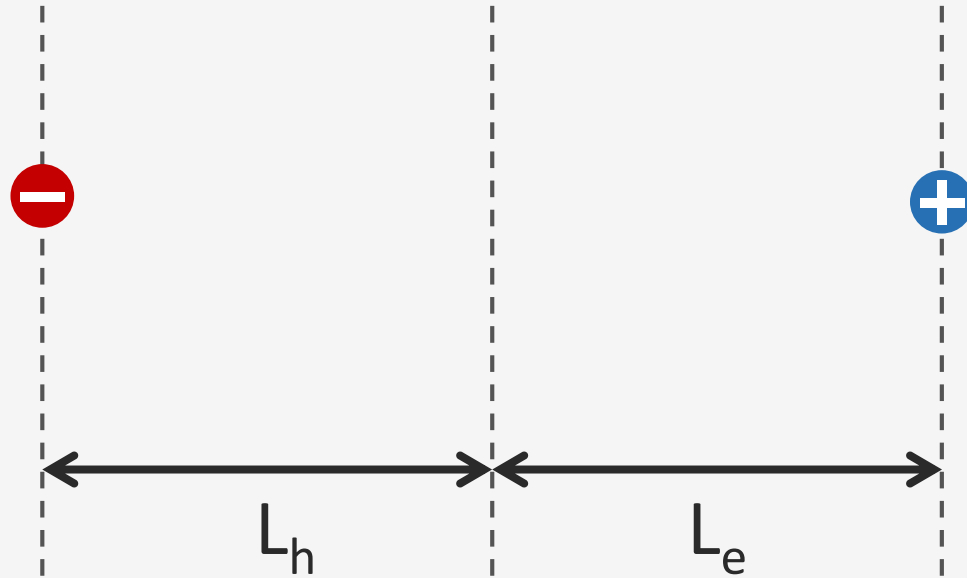


Charge Carrier Recombination

**Shockley-Read-Hall (SRH)
recombination**

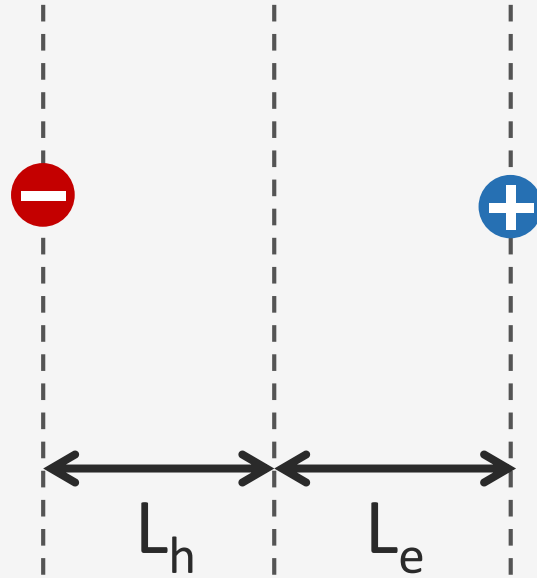


Diffusion Length



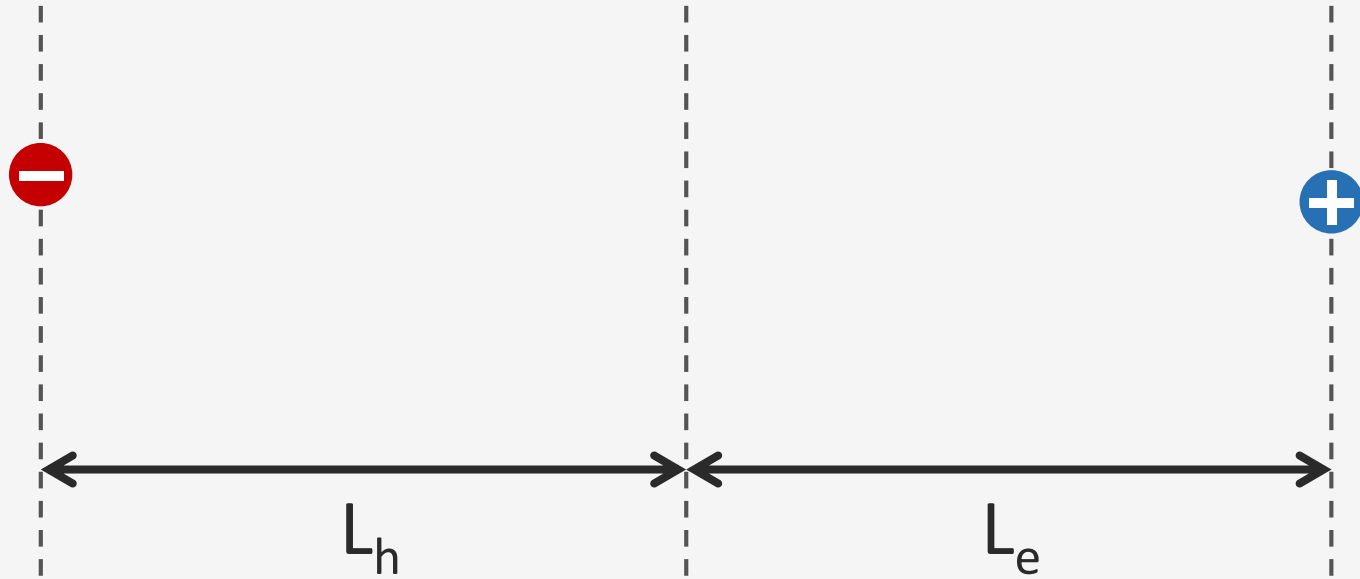
$$L = \sqrt{D t}$$

Diffusion Length



$$L = \sqrt{D t}$$

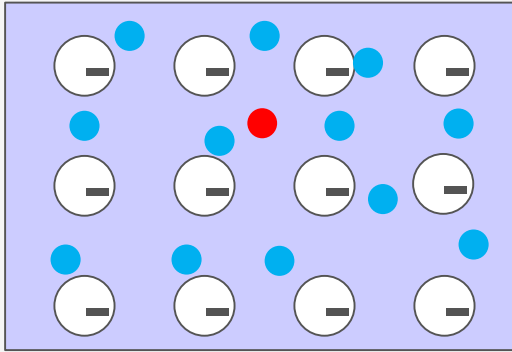
Diffusion Length



$$L = \sqrt{D t}$$

Diffusion Length

Transport by diffusion limited by minority carriers



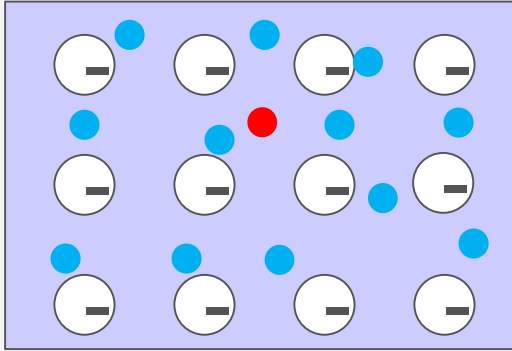
p-doped

Diffusion length:

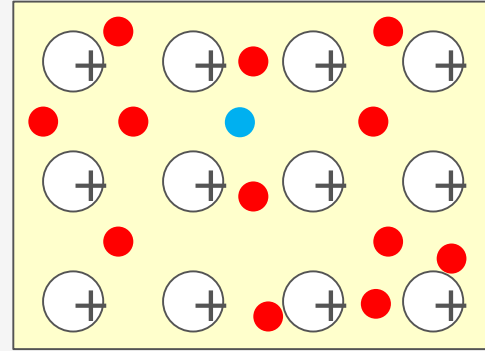
$$L_e = \sqrt{D_e t_e} < L_n$$

Diffusion Length

Transport by diffusion limited by minority carriers



p-doped



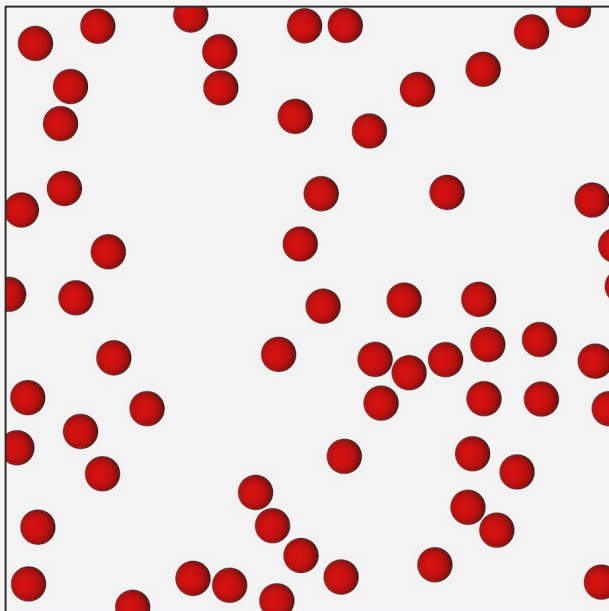
n-doped

Diffusion length:

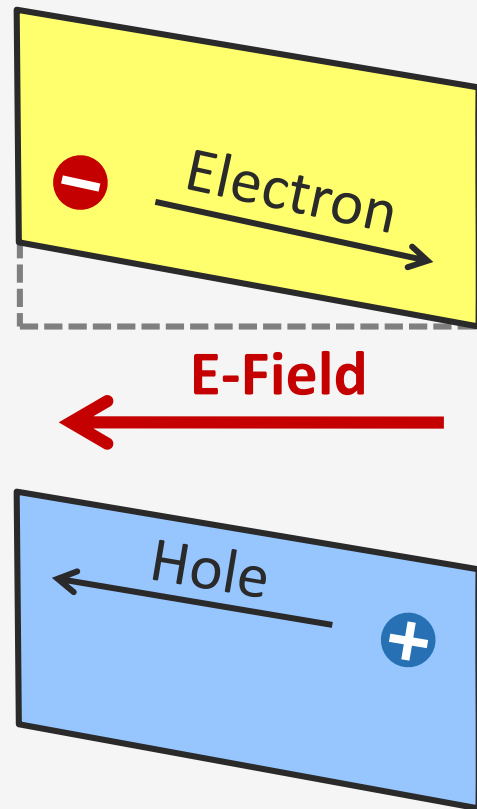
$$L_e = \sqrt{D_e t_e} < L_h$$

$$L_h = \sqrt{D_h \tau_h} < L_e$$

Diffusion



Drift



Thank you for your attention!

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