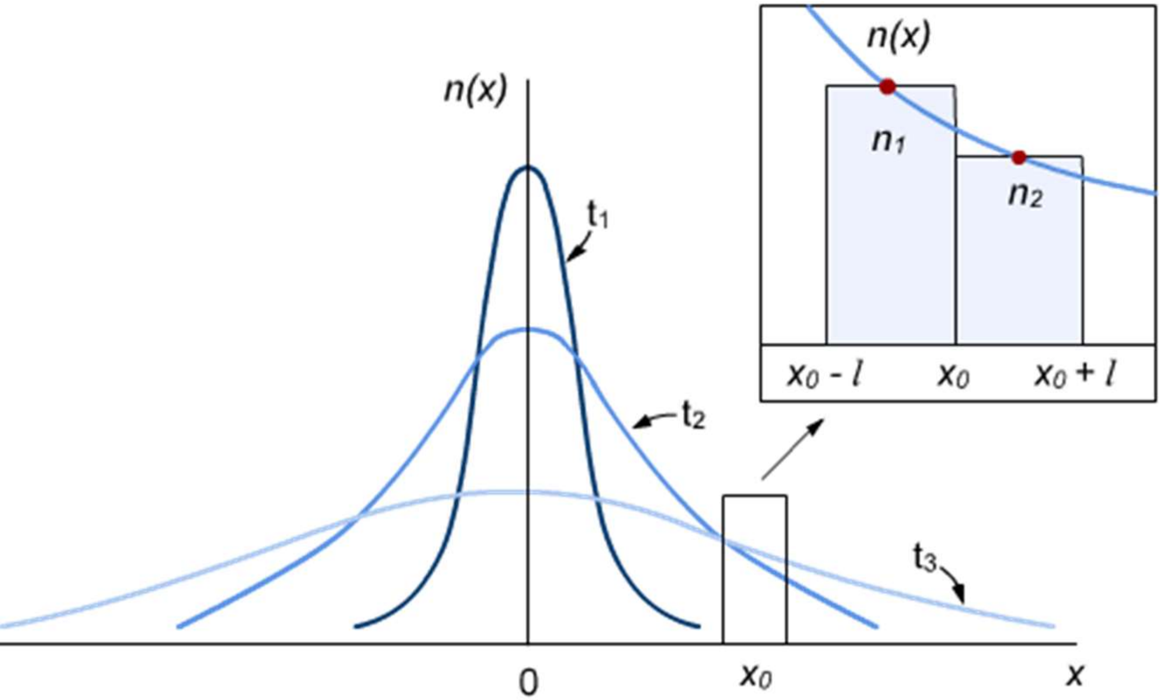
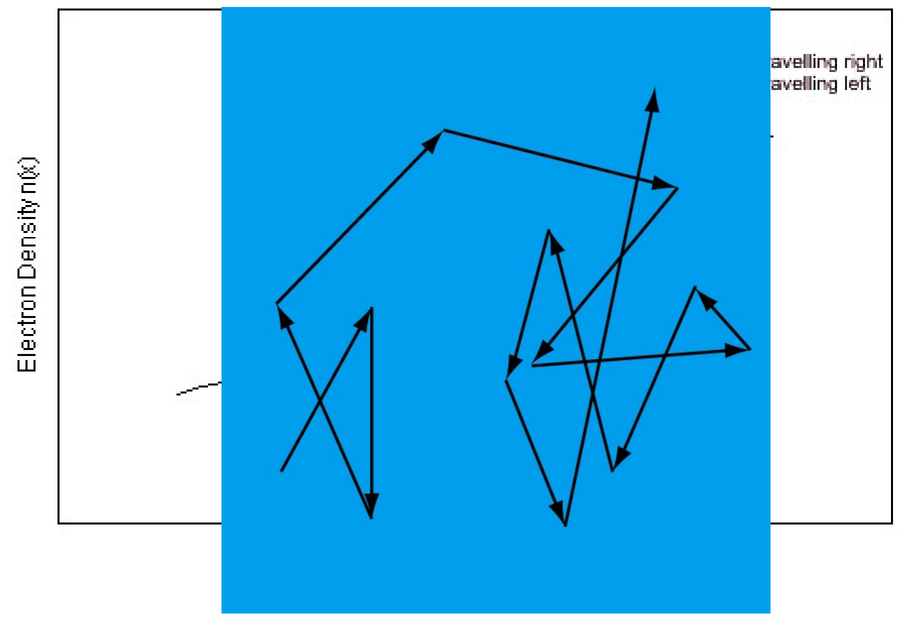
Diffusion



Thermal energy

$$\frac{1}{2}m^* v_{th}^2 = \frac{3k_B T}{2}$$

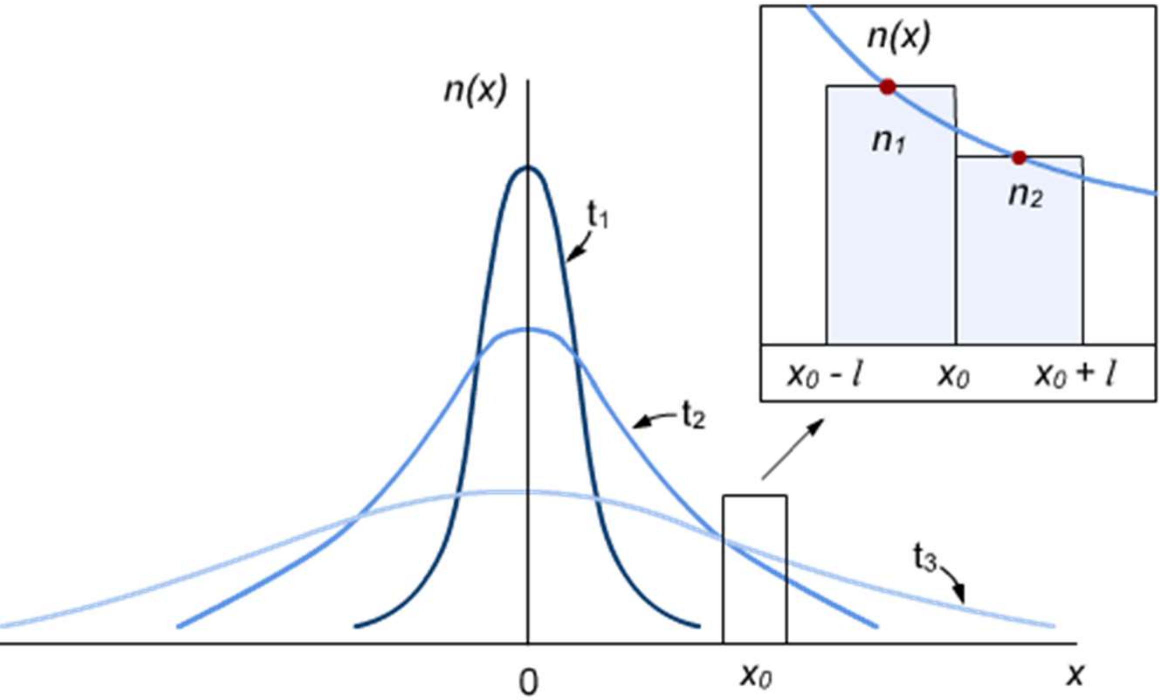


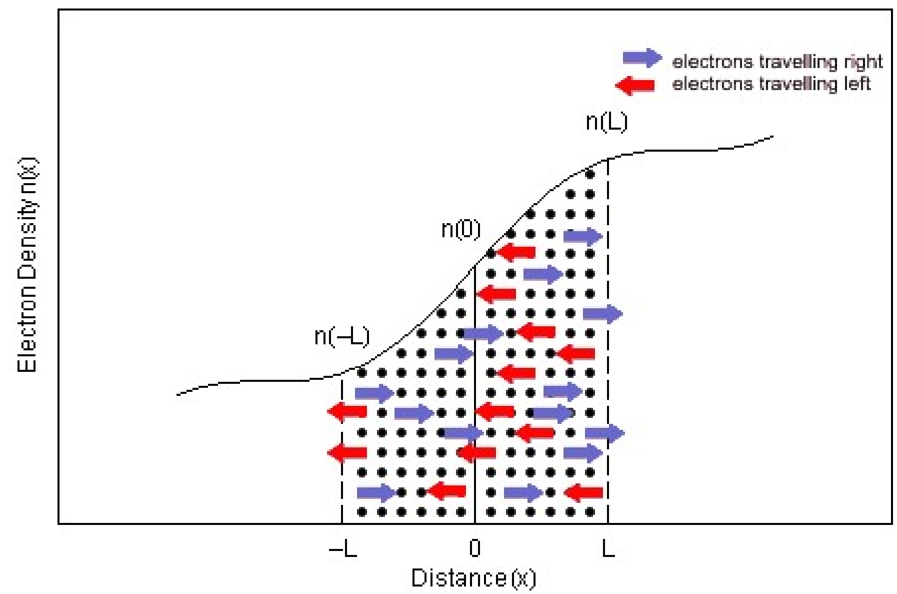
Transport of particles (electrons here) due to a concentration gradient

Driven by thermal motion of particles (electrons)

Flux (particle current) is proportional to concentration gradient

Diffusion current





Flux to the right $\frac{1}{2}v_{th}\cdot n(-l/2)$

$\frac{1}{2}v_{th}\cdot n(+l/2)$ **Flux to the left**

$$\Phi = \frac{1}{2}v_{th}\cdot n\left(-\frac{l}{2}\right) - \frac{1}{2}v_{th}\cdot n\left(+\frac{l}{2}\right)$$

Net flux

Diffusion coefficient $D = \frac{l v_{th}}{2} = \frac{l^2}{2\tau}$

$$\Phi = \frac{l v_{th}}{2}\frac{n\left(-\frac{l}{2}\right) - n\left(+\frac{l}{2}\right)}{l} \simeq -D\frac{dn}{dx}$$

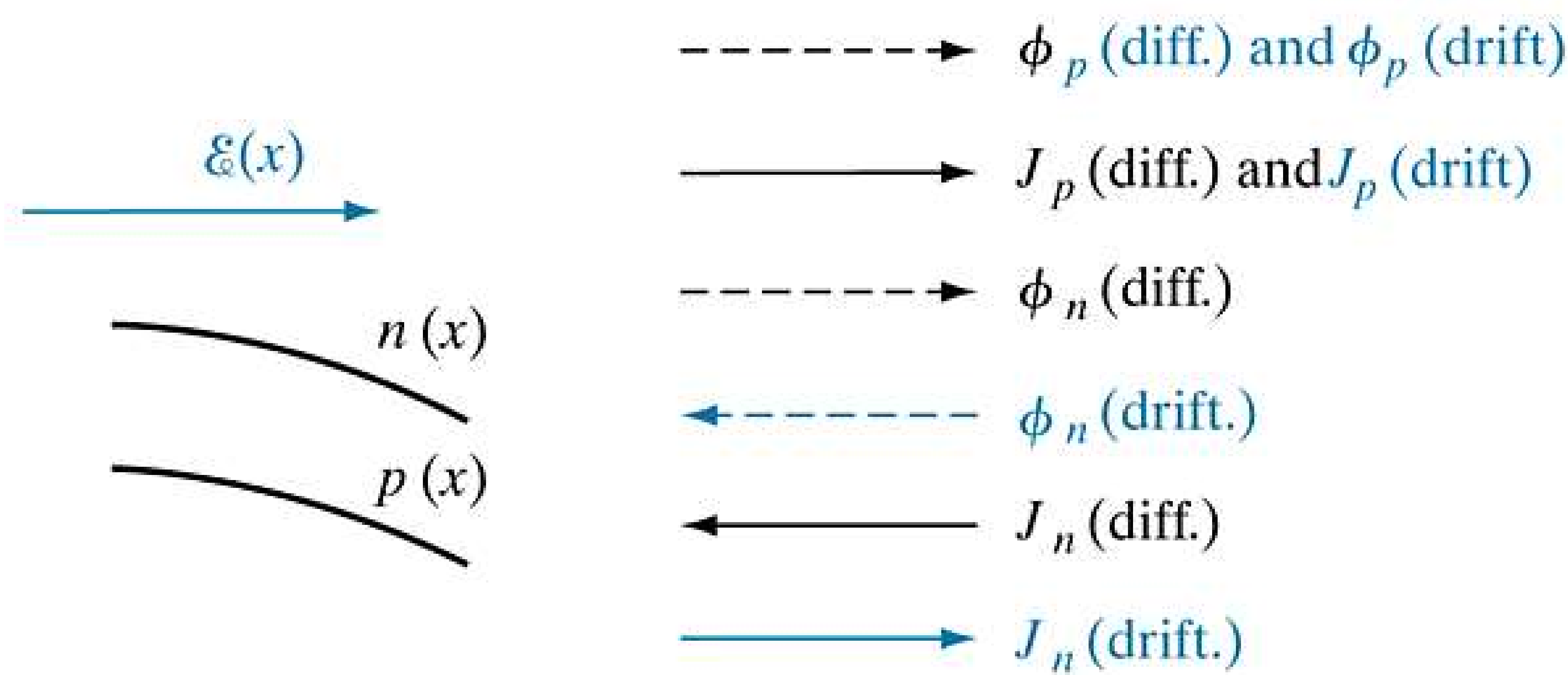
$J = eD\frac{dn}{dx}$ **Diffusion current**

Drift and diffusion currents

$$J_n = ne\mu_n\mathcal{E} + eD_n\frac{dn}{dx}$$

Drift-diffusion

$$J_p = pe\mu_p\mathcal{E} - eD_p\frac{dp}{dx}$$



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Artwork Sources:

1. Prof. Sanjay Banerjee
2. www.pveducation.org
3. britneyspears.ac