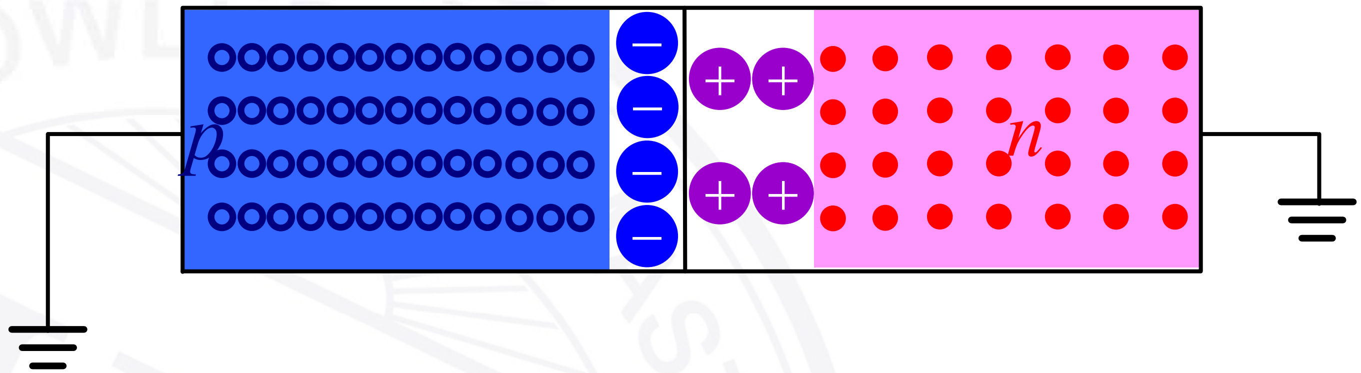
Lecture
PN Junction: Minority Carrier Distributions

Vincent Chang

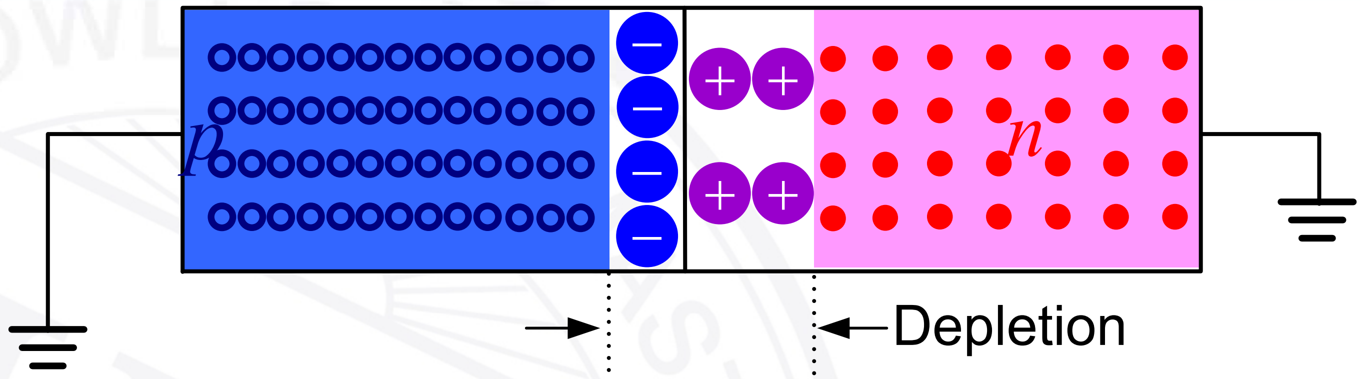
Outline

Zero Bias	Forward Bias	Reverse Bias
• Thermal equilibrium	• Physical meaning • Distribution	• Distribution • Saturation current

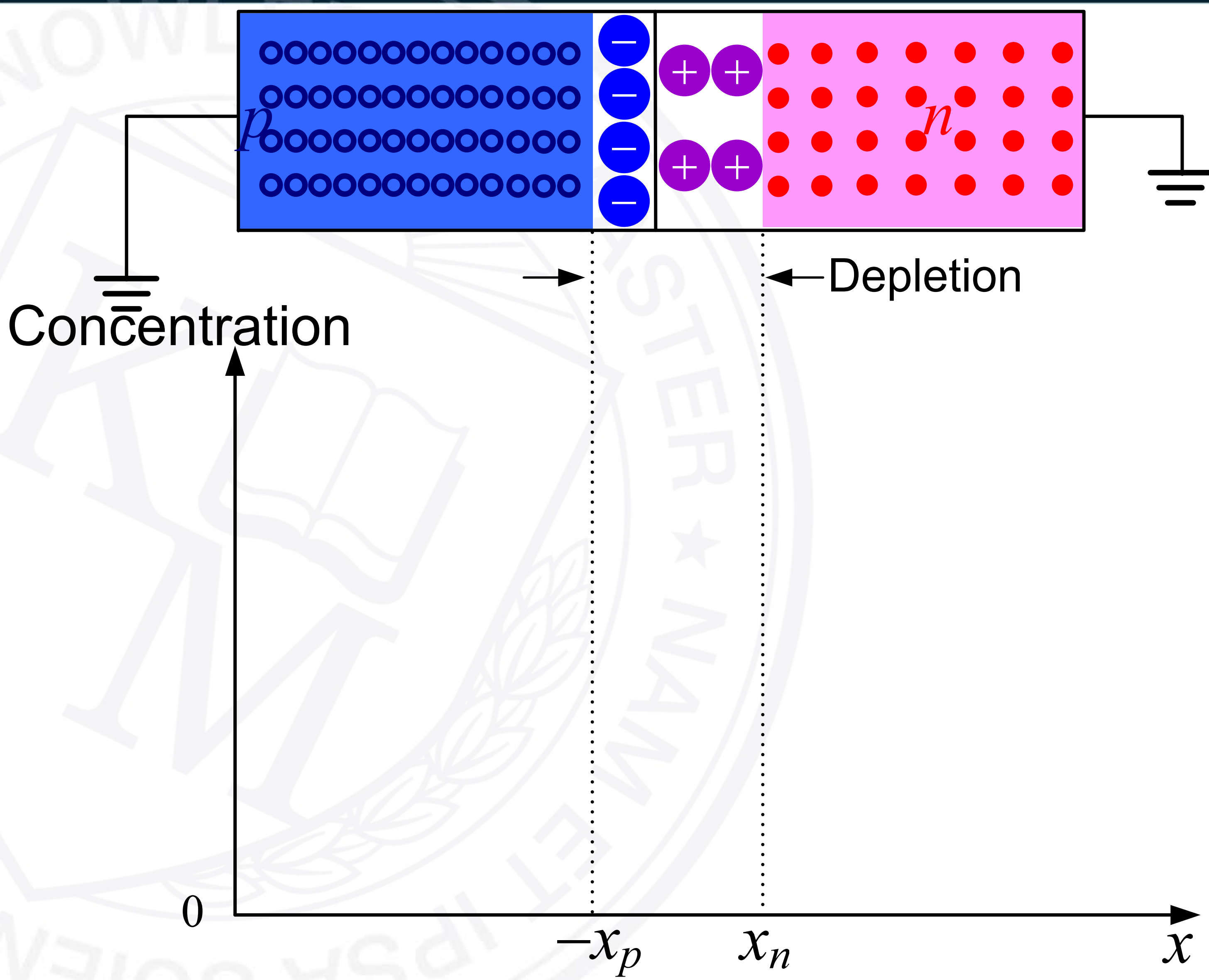
Minority Carrier Distribution—Zero Bias



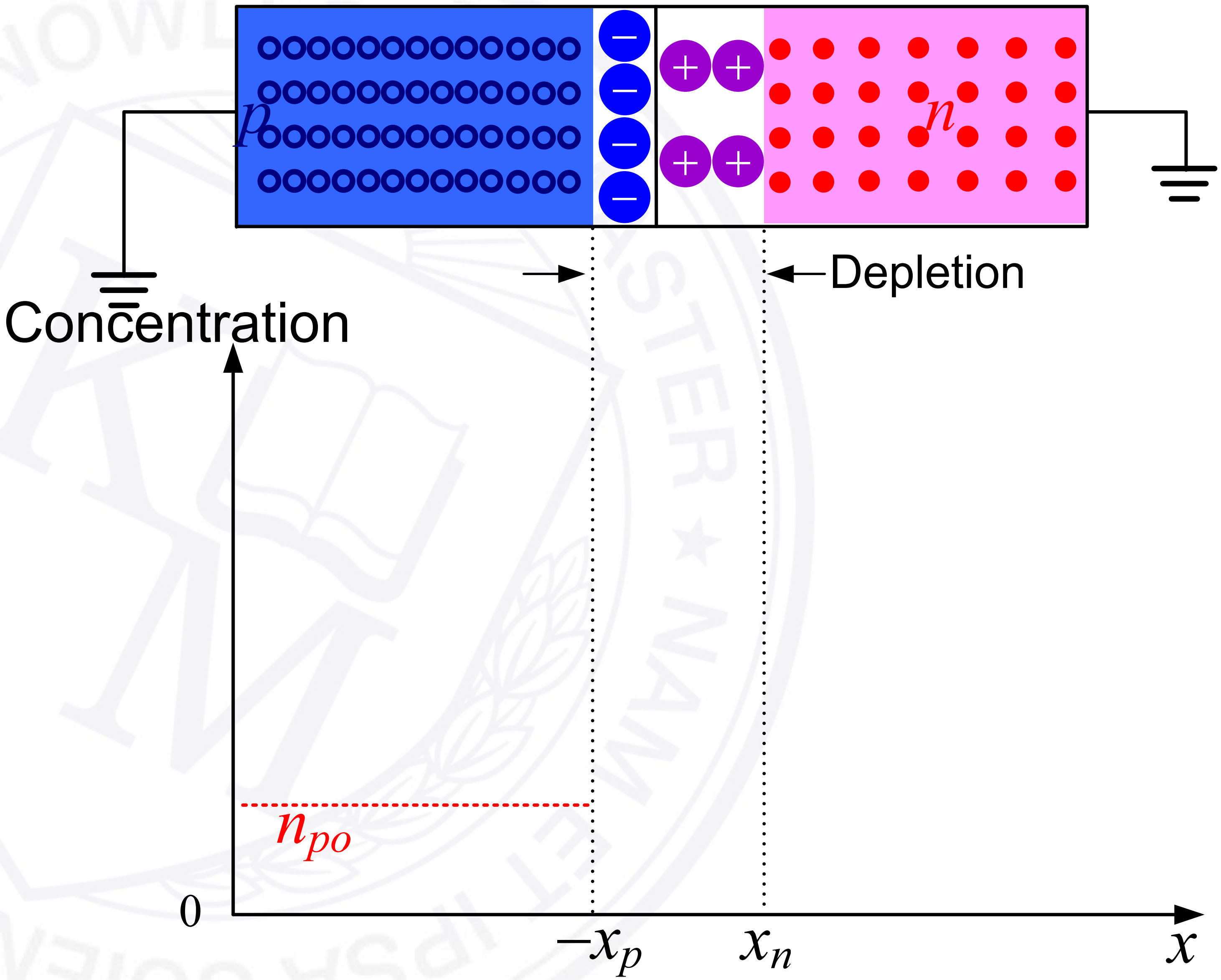
Minority Carrier Distribution—Zero Bias



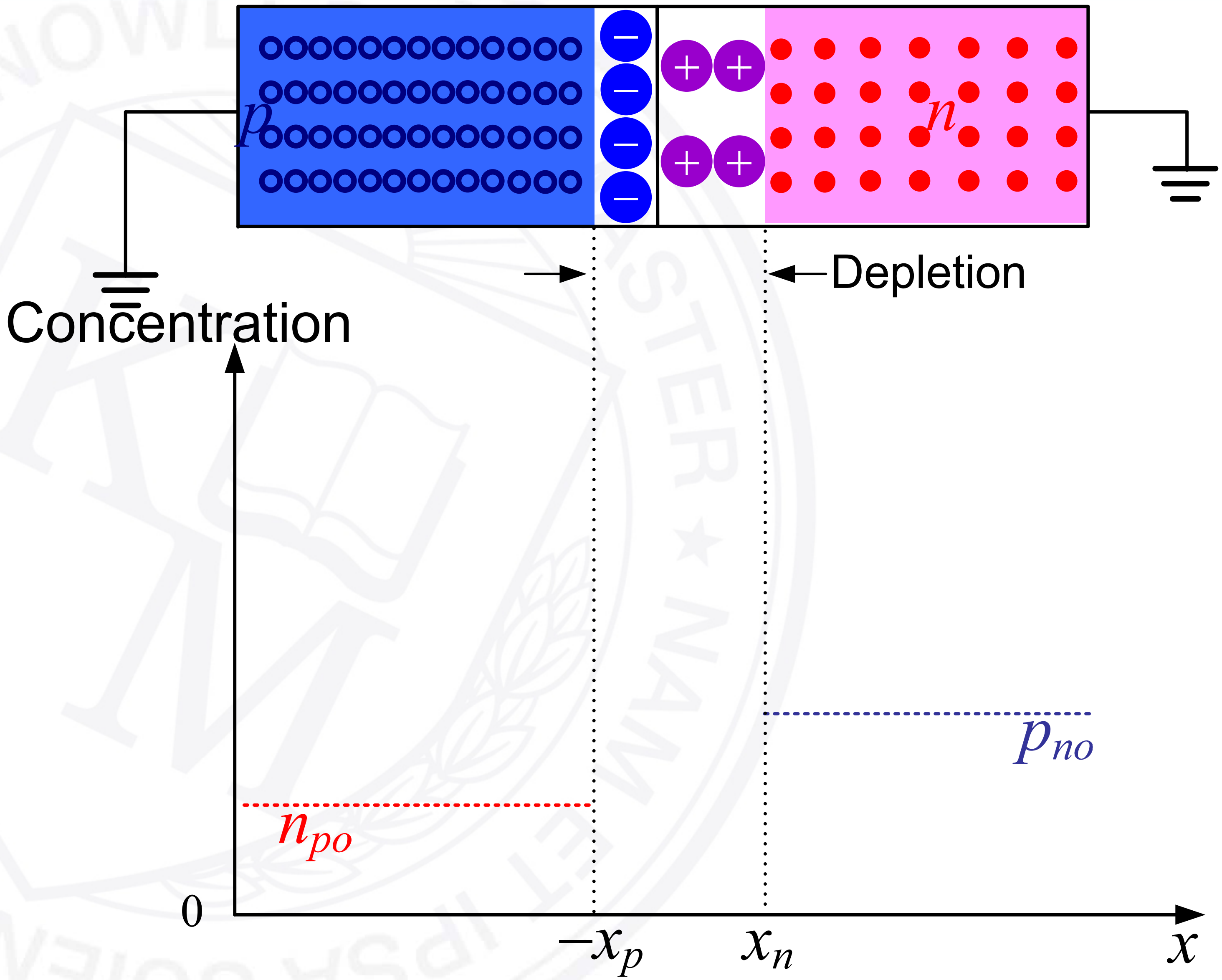
Minority Carrier Distribution—Zero Bias



Minority Carrier Distribution—Zero Bias



Minority Carrier Distribution—Zero Bias



Outline

Zero Bias

- Thermal equilibrium

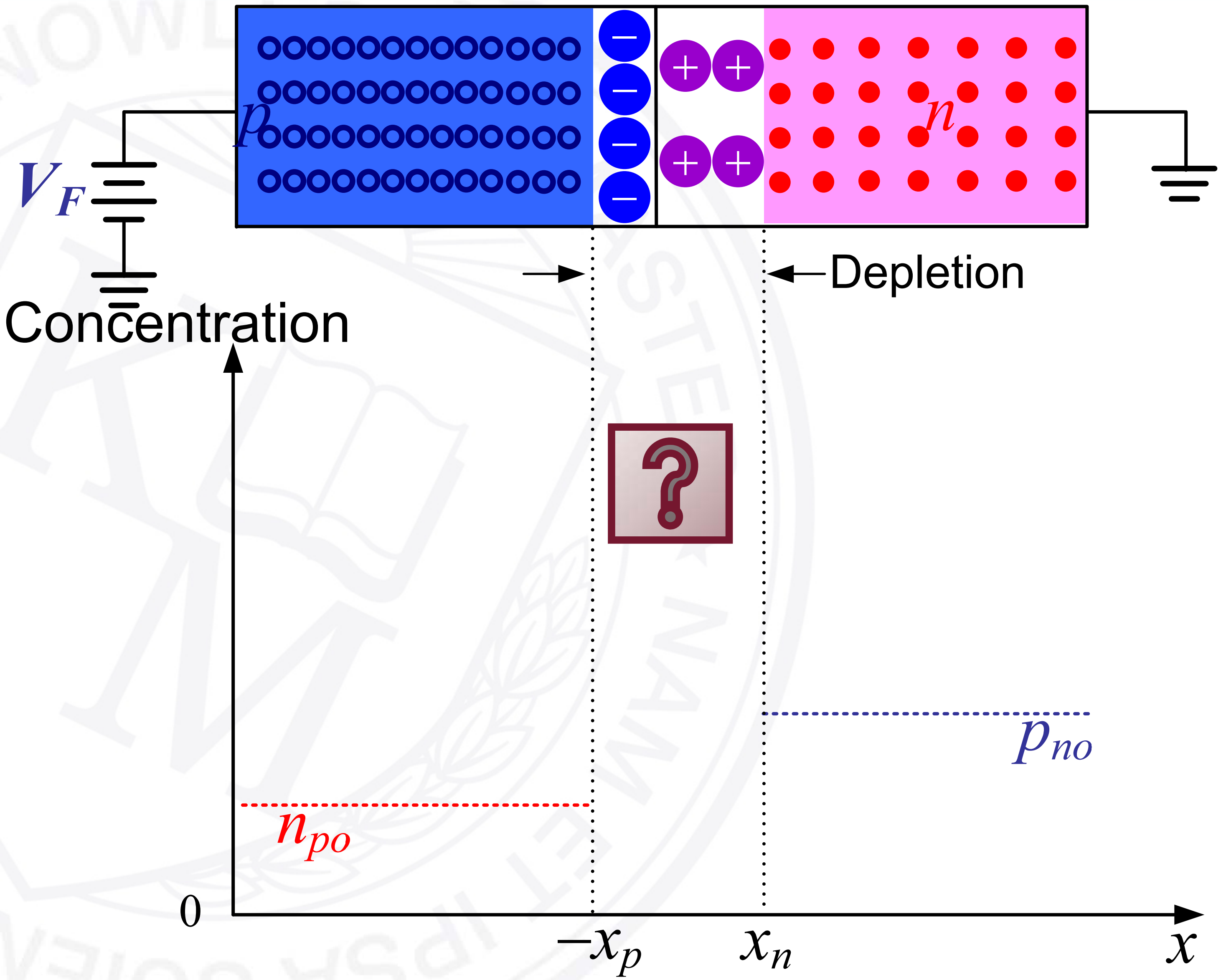
Forward Bias

- Physical meaning
- Distribution

Reverse Bias

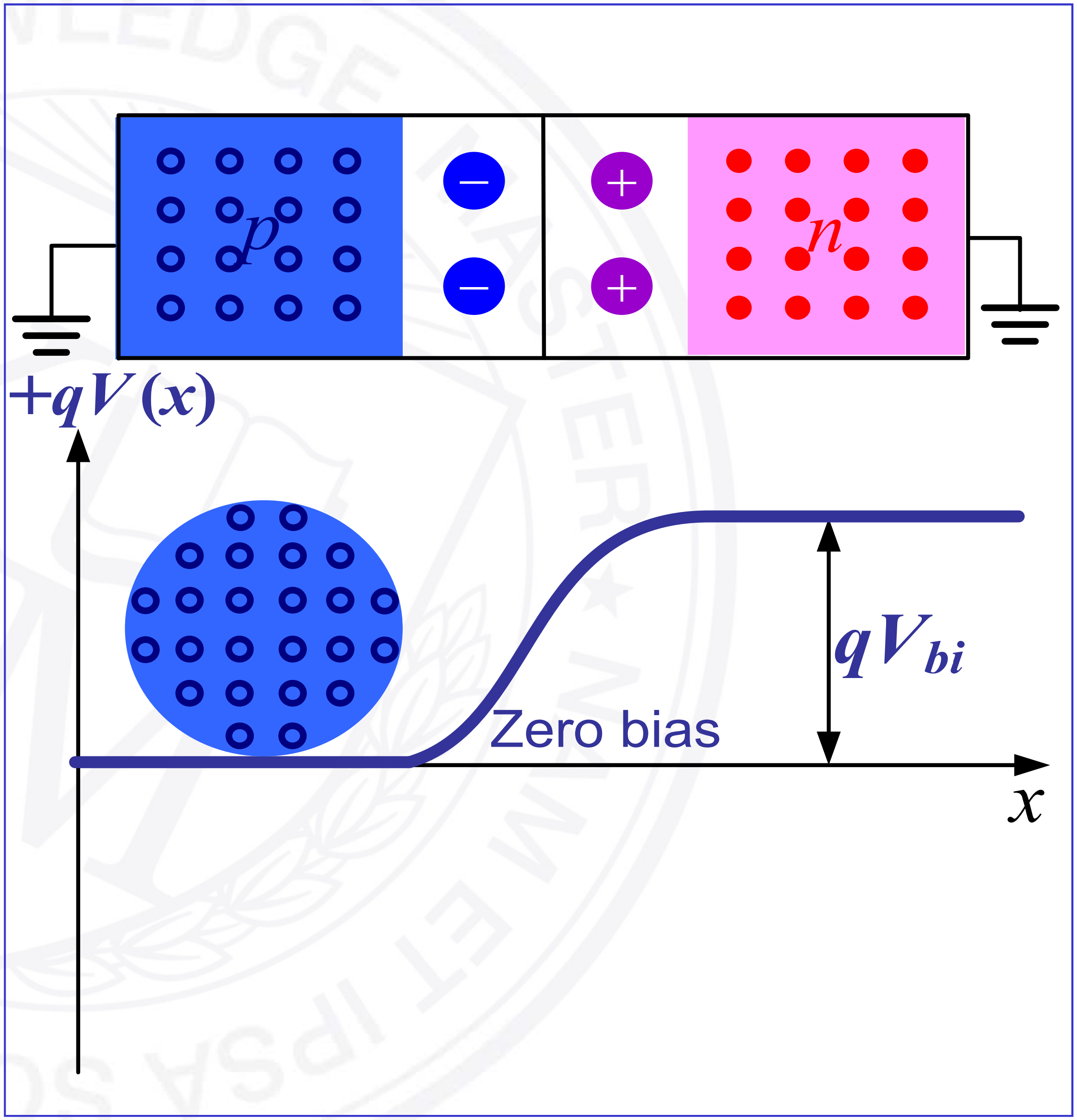
- Distribution
- Saturation current

Minority Carrier Distribution—Forward

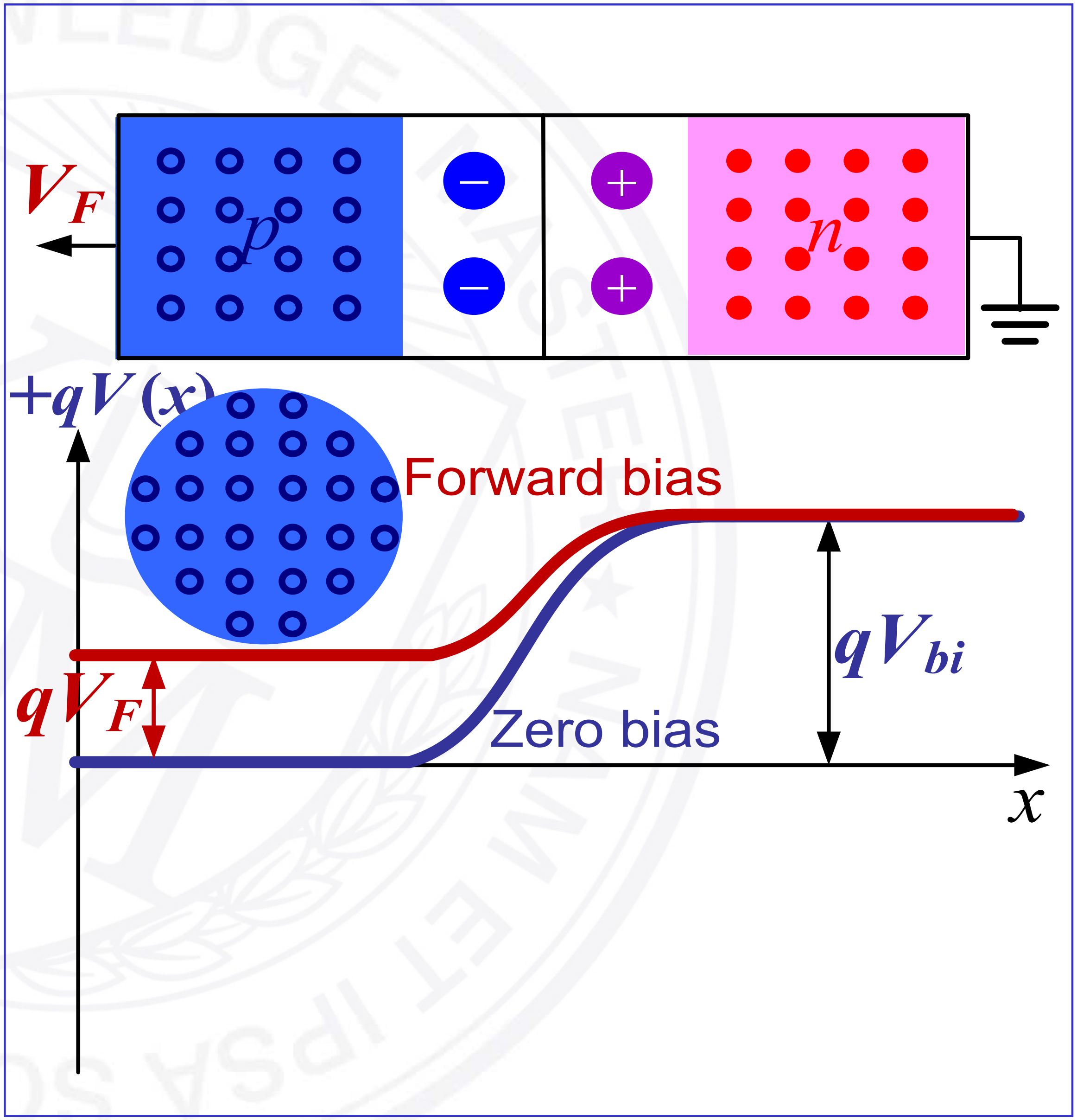


Independence Hall, Philadelphia

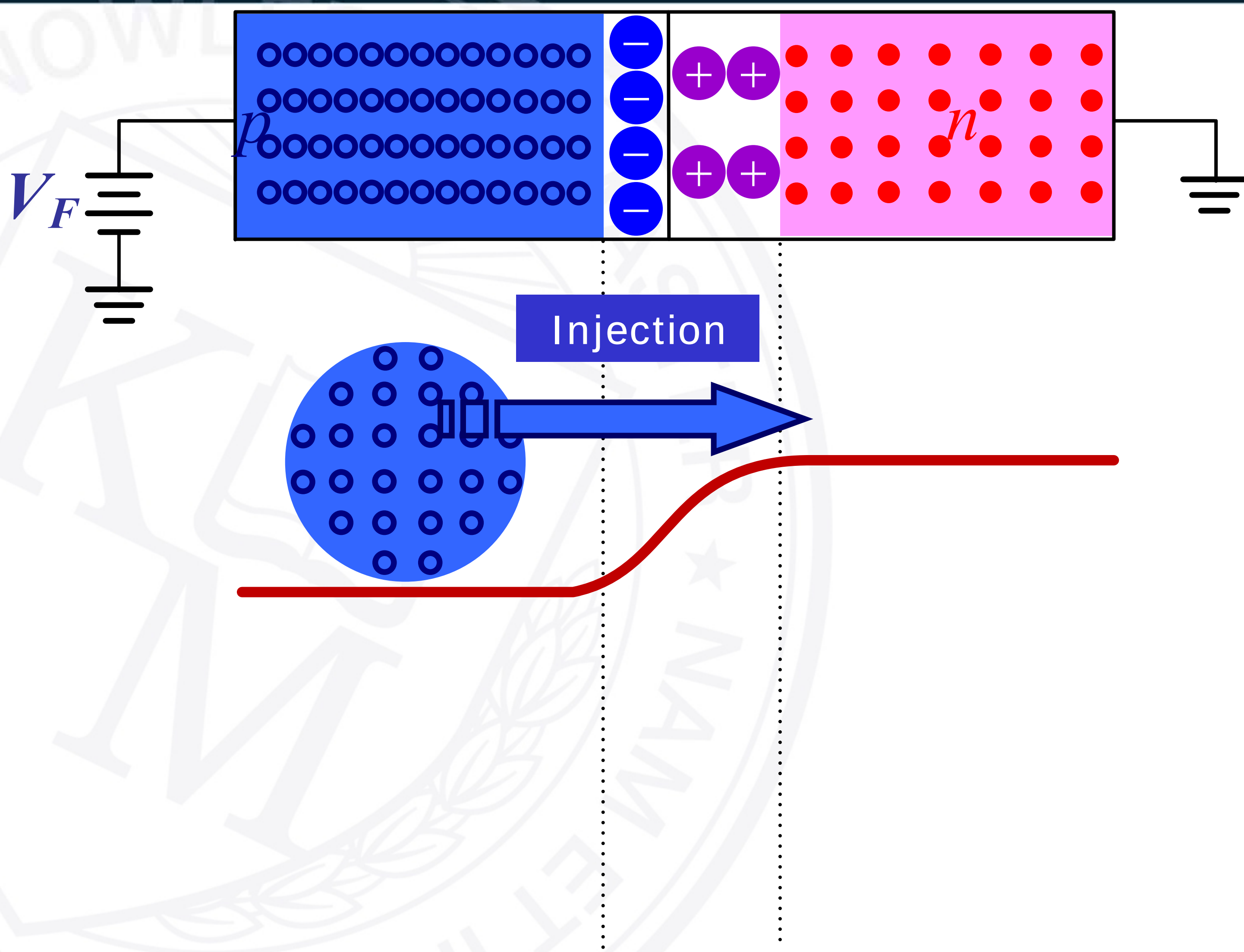
Zero Bias



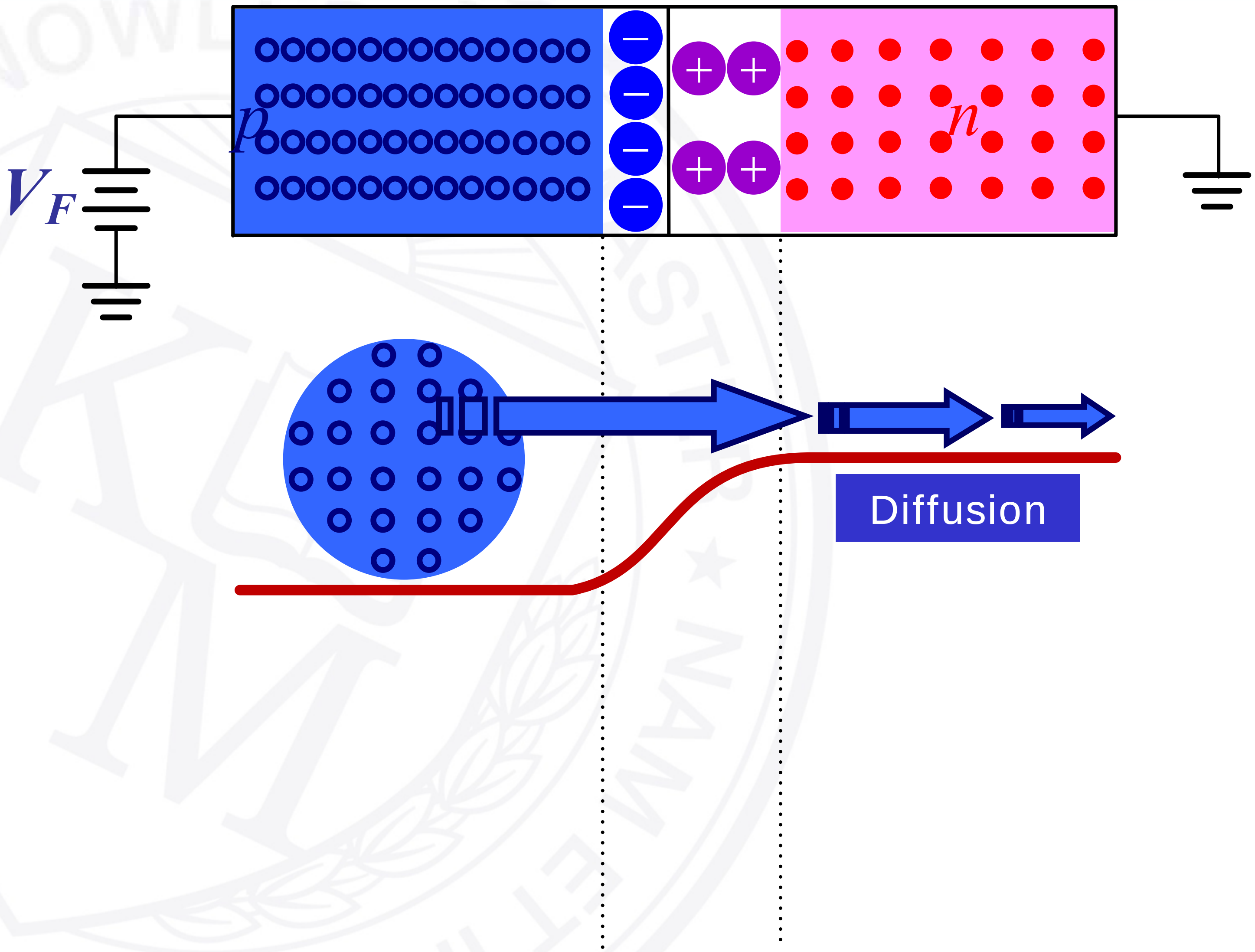
Forward Bias



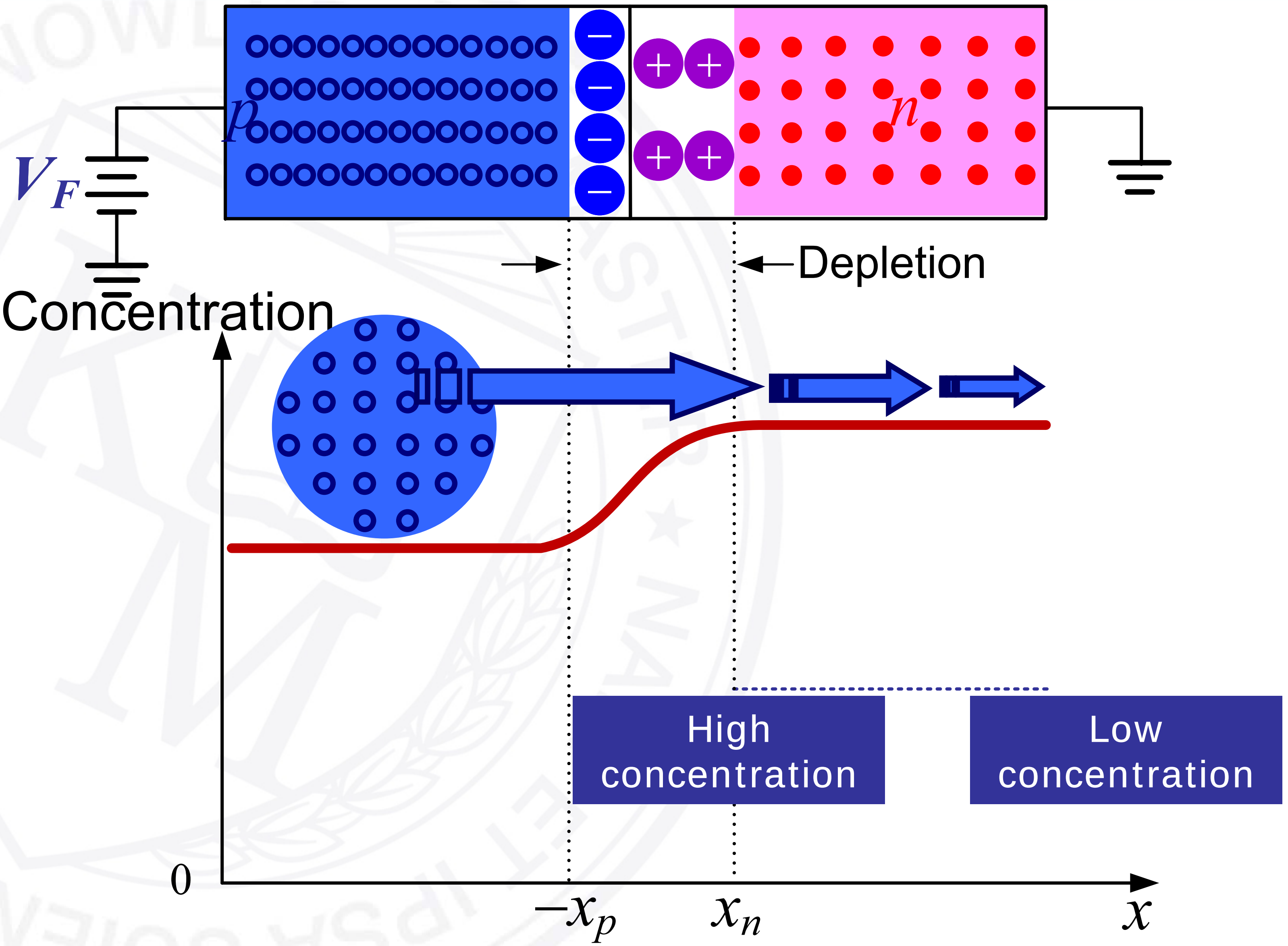
Minority Carrier Injection



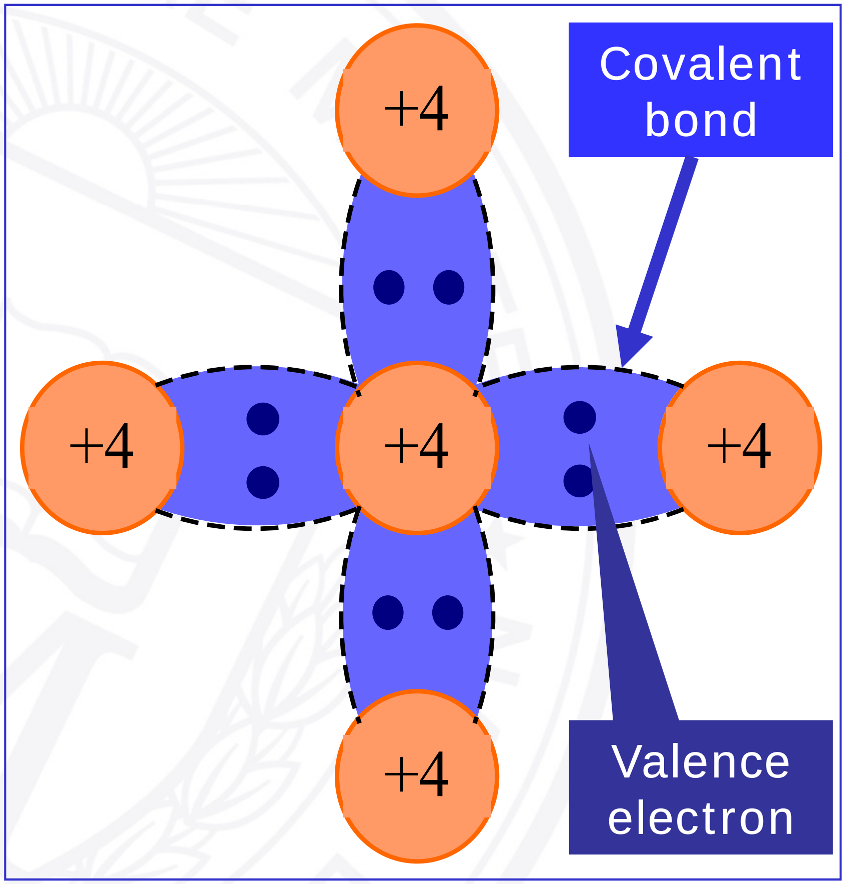
Minority Carrier Diffusion



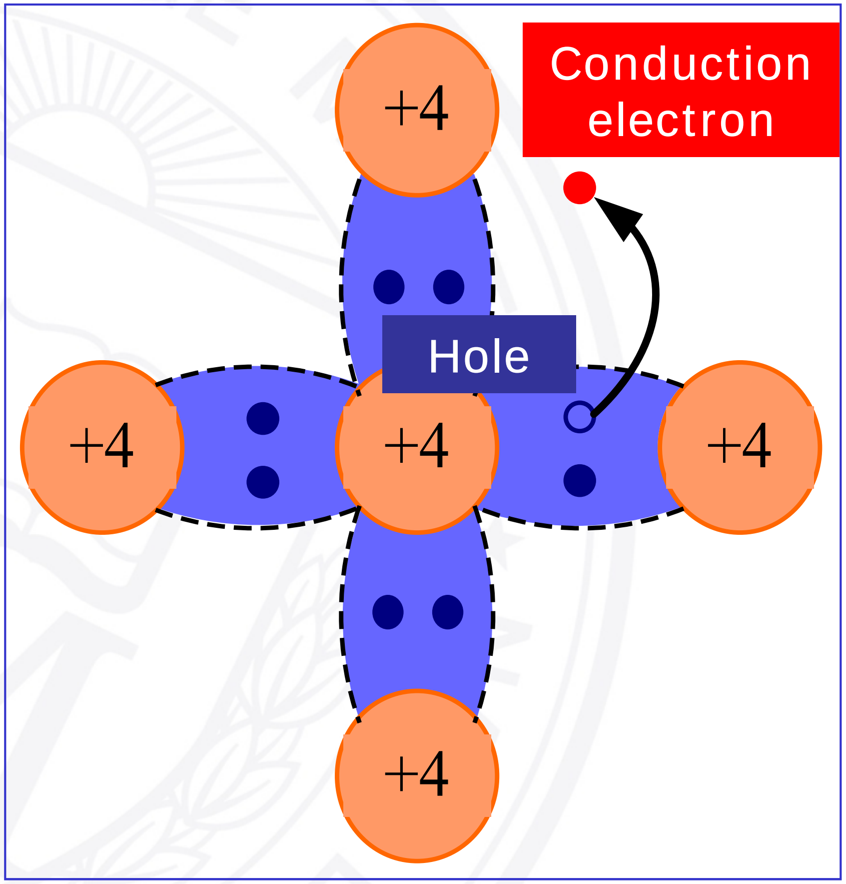
Minority Carrier Diffusion



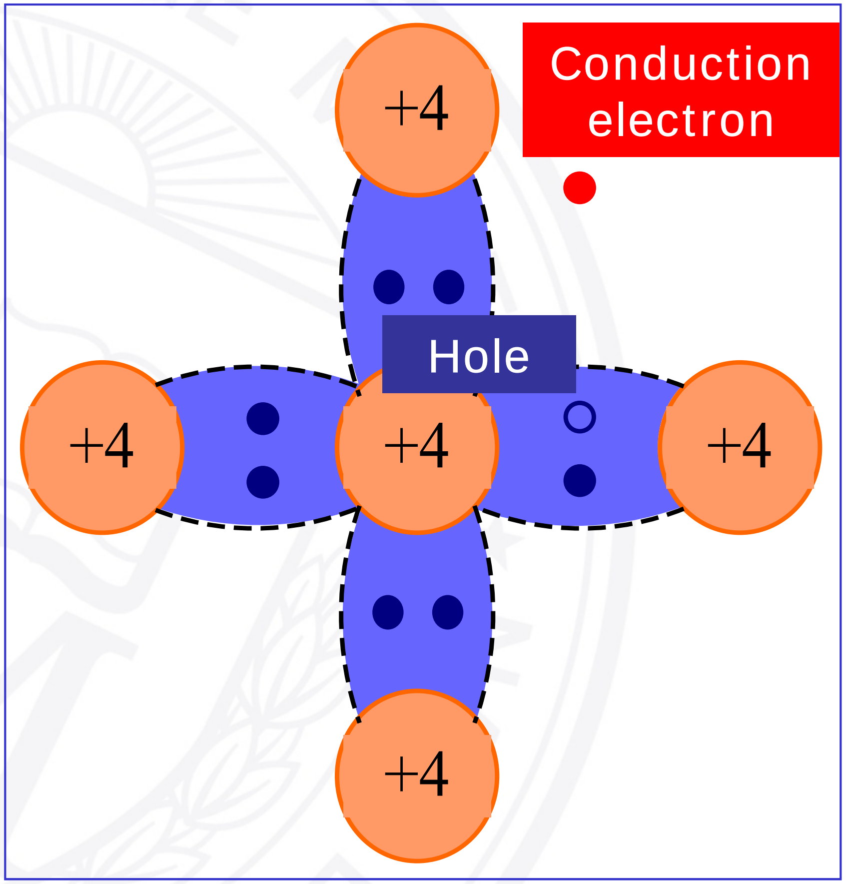
Carrier Generation



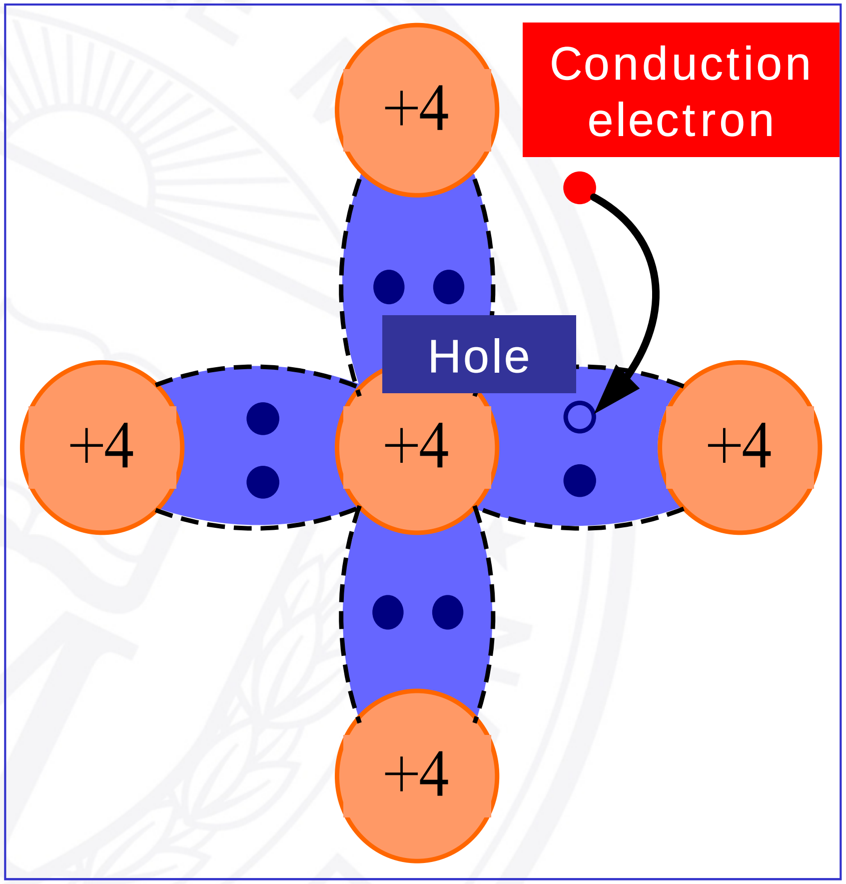
Carrier Generation



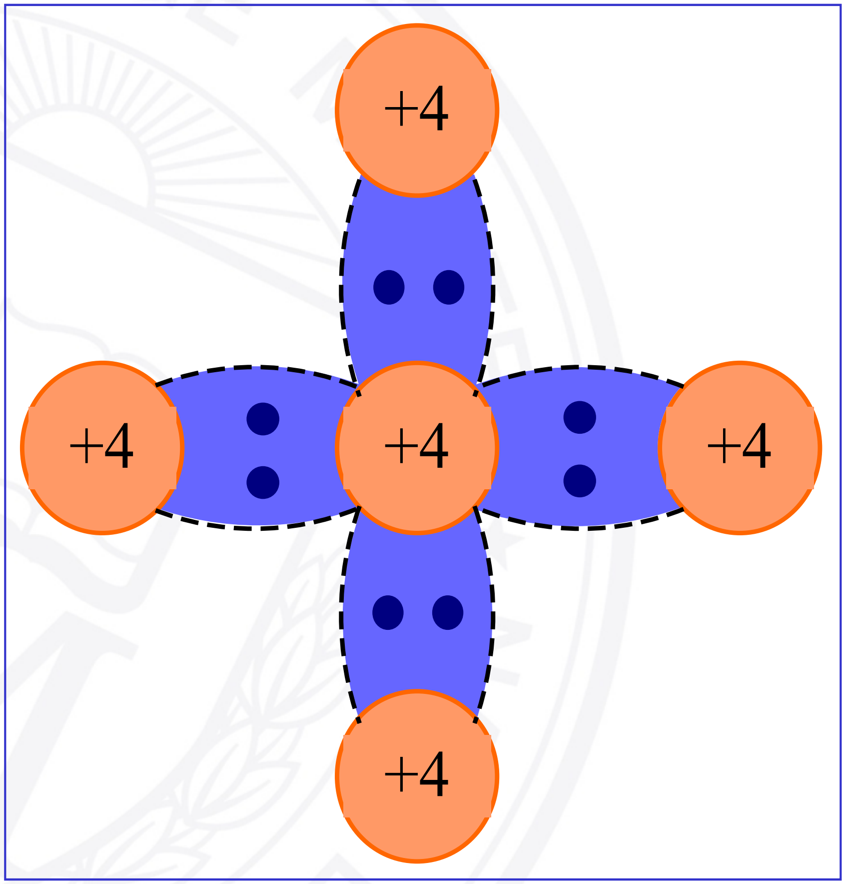
Carrier Recombination



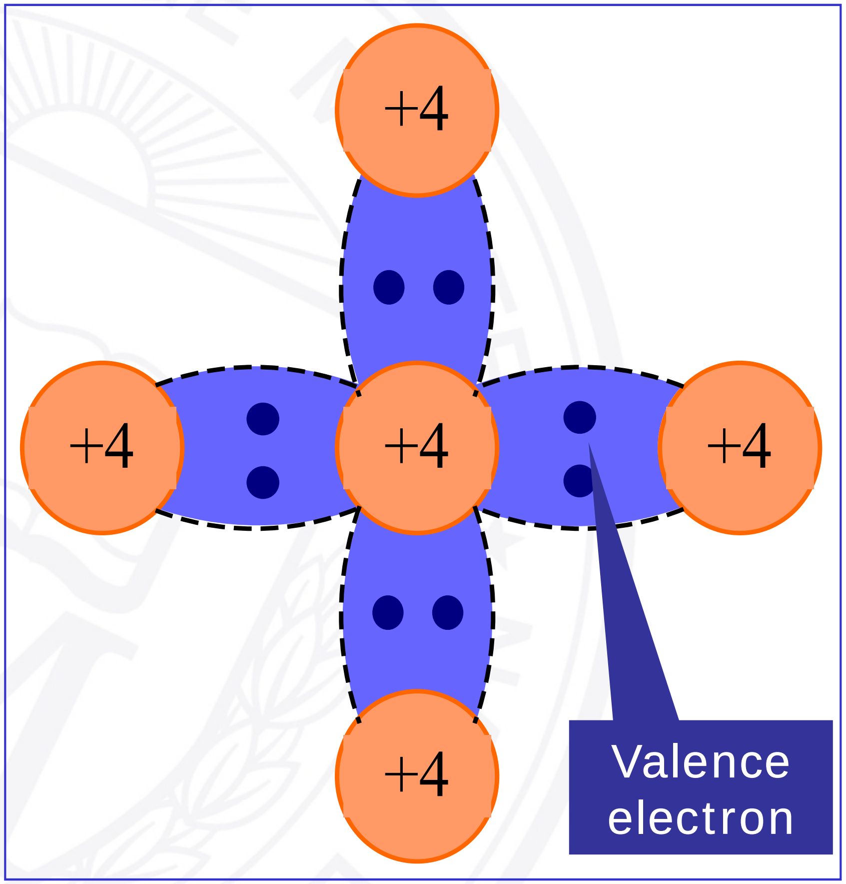
Carrier Recombination



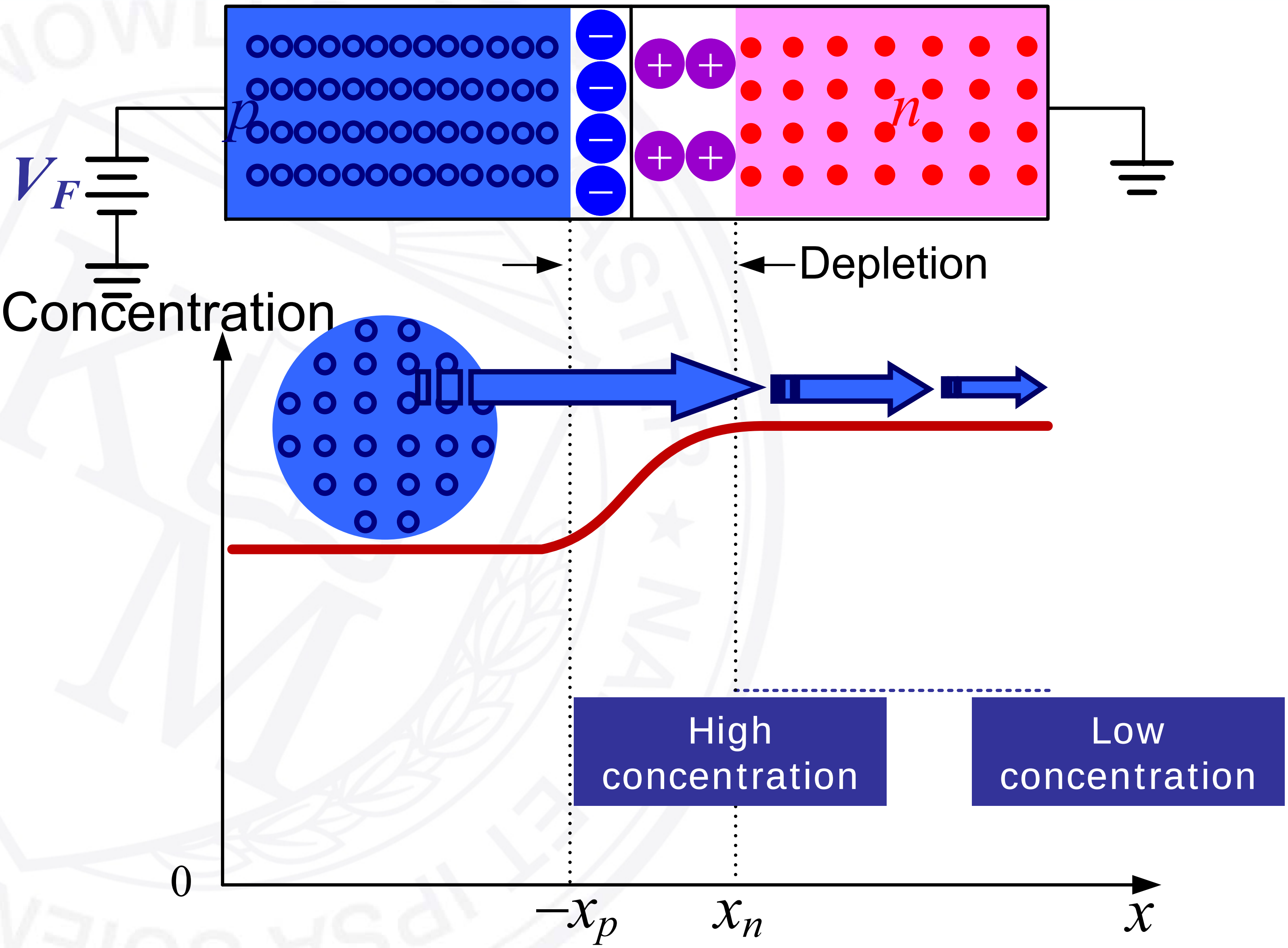
Carrier Recombination



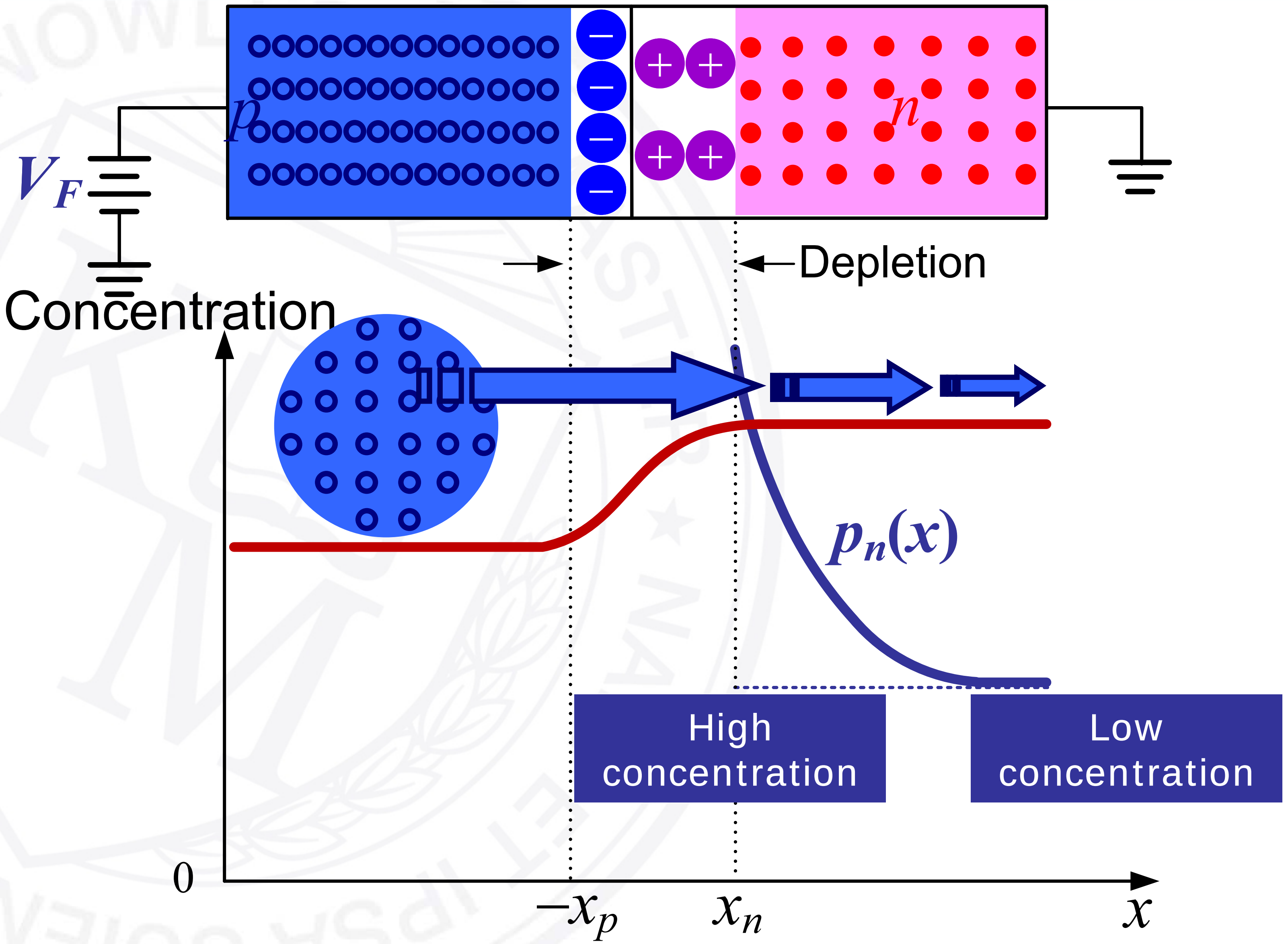
Carrier Recombination



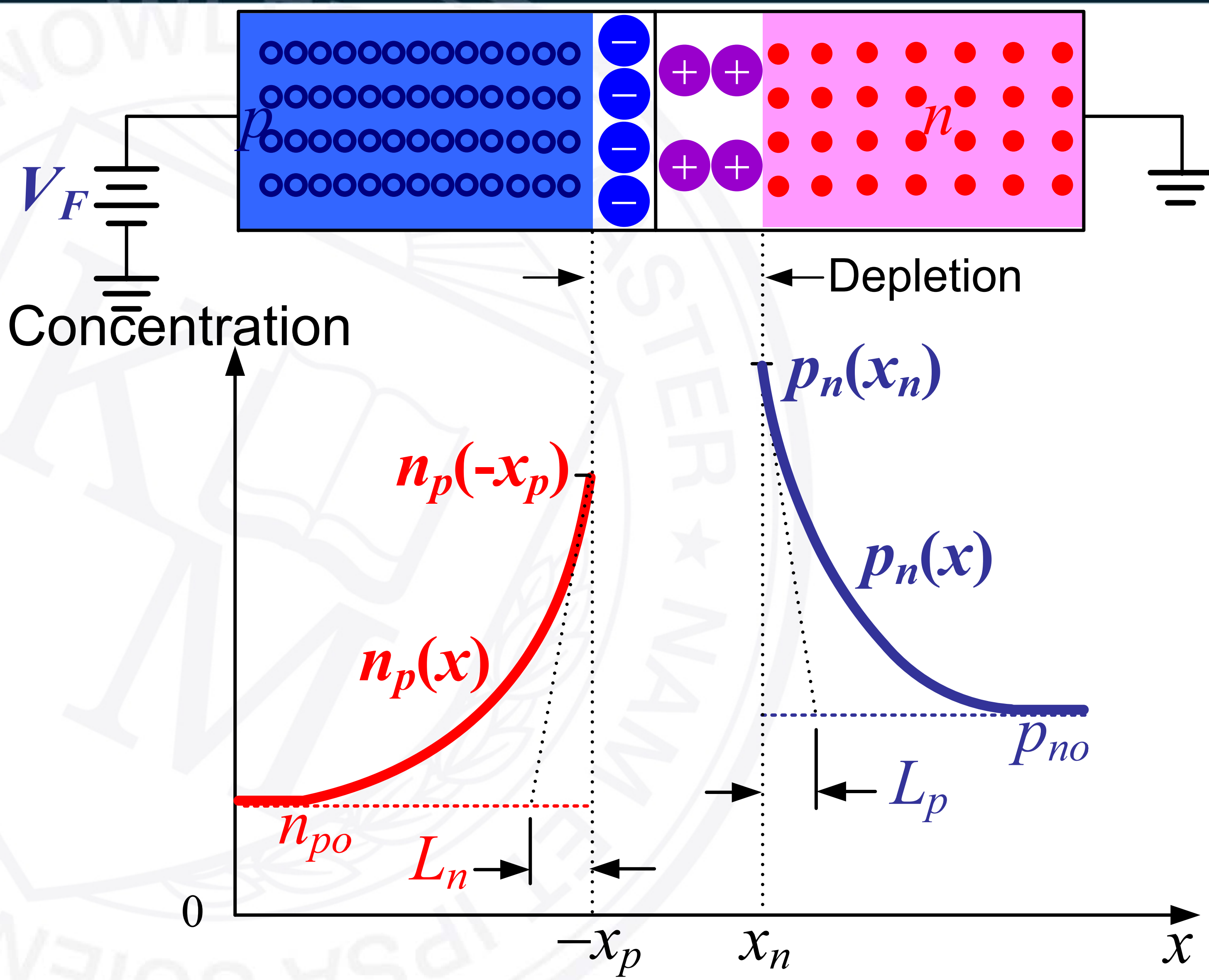
Minority Carrier Diffusion



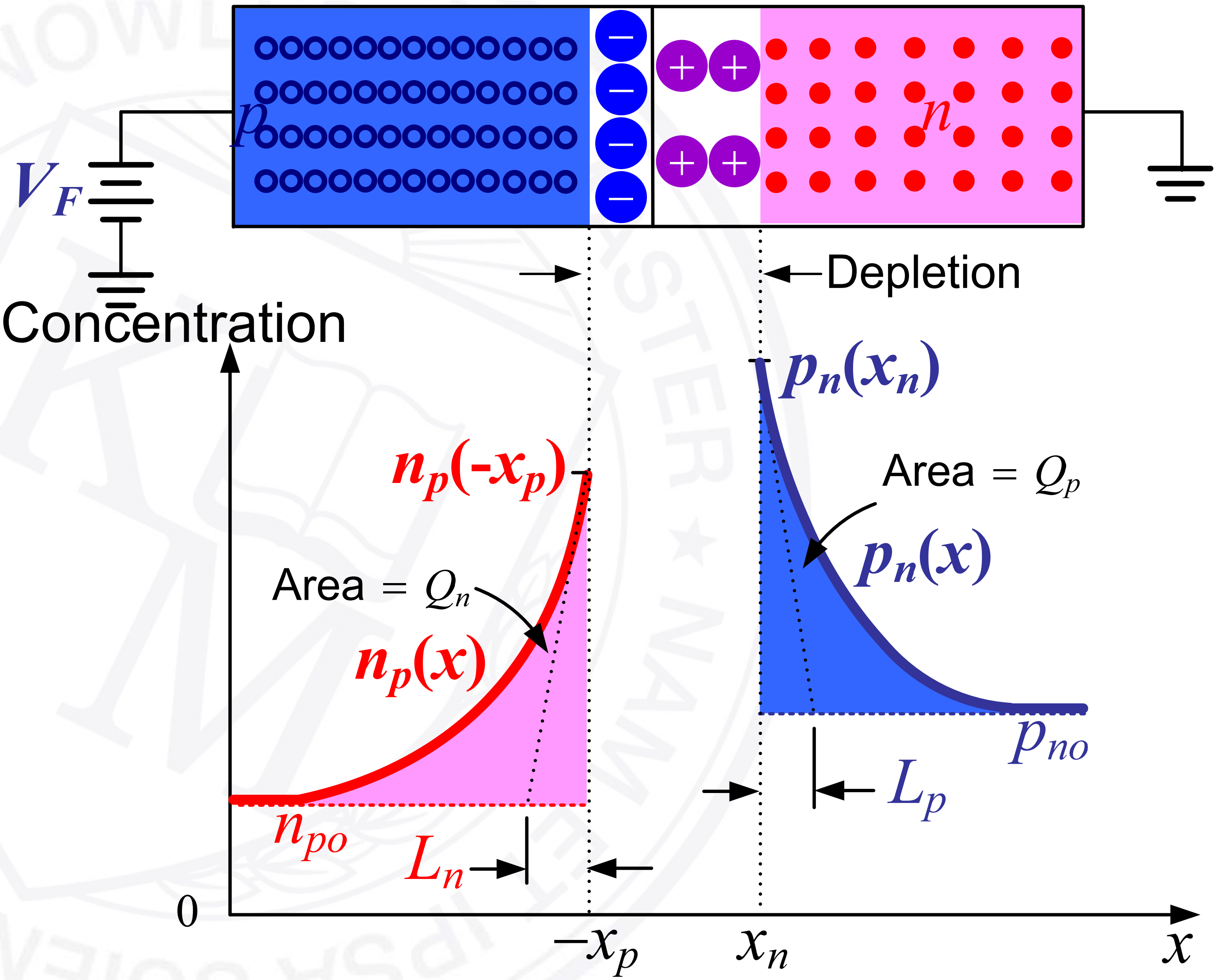
Minority Carrier Distribution



Minority Carrier



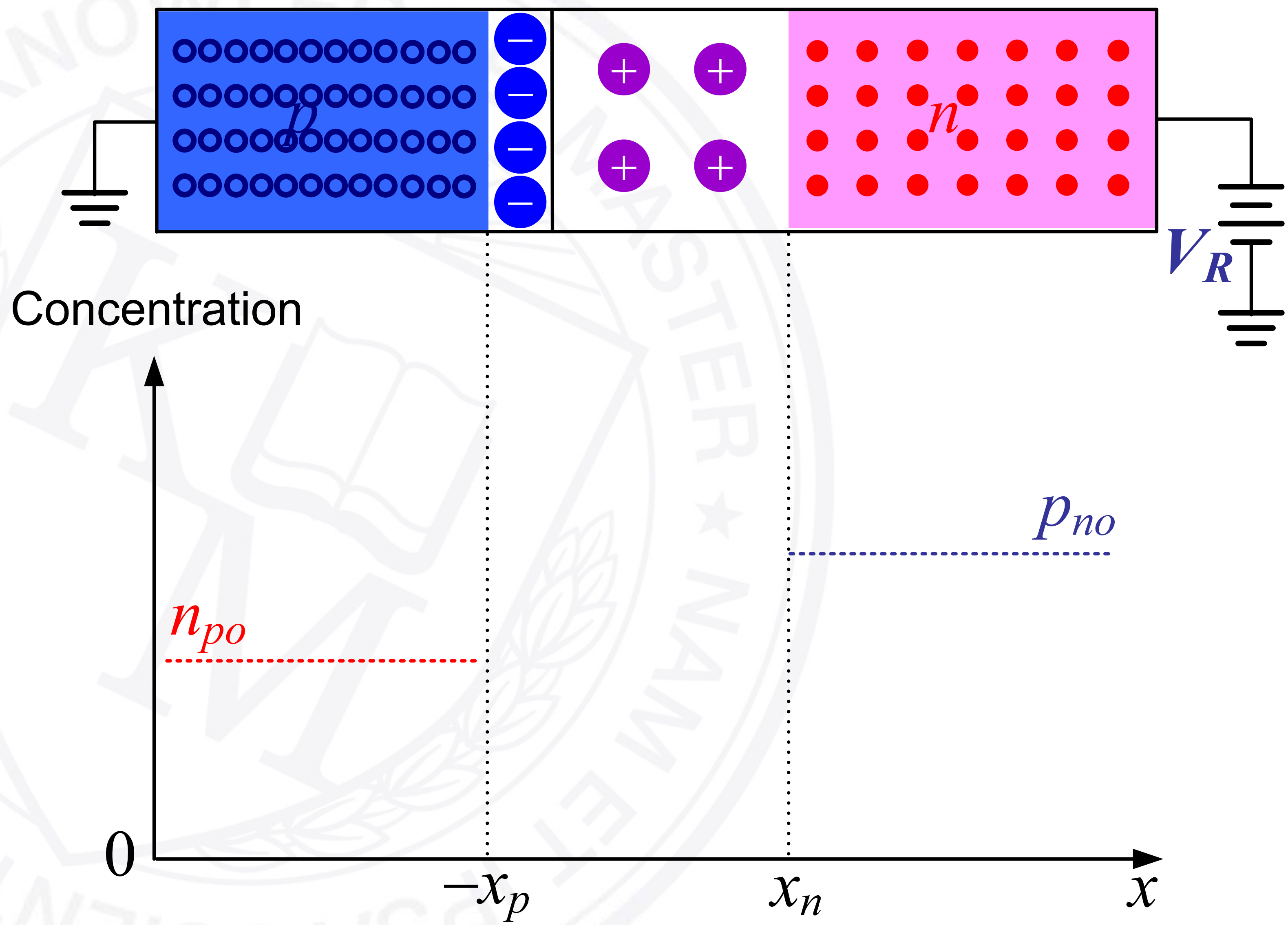
Minority-Carrier Storage Effect



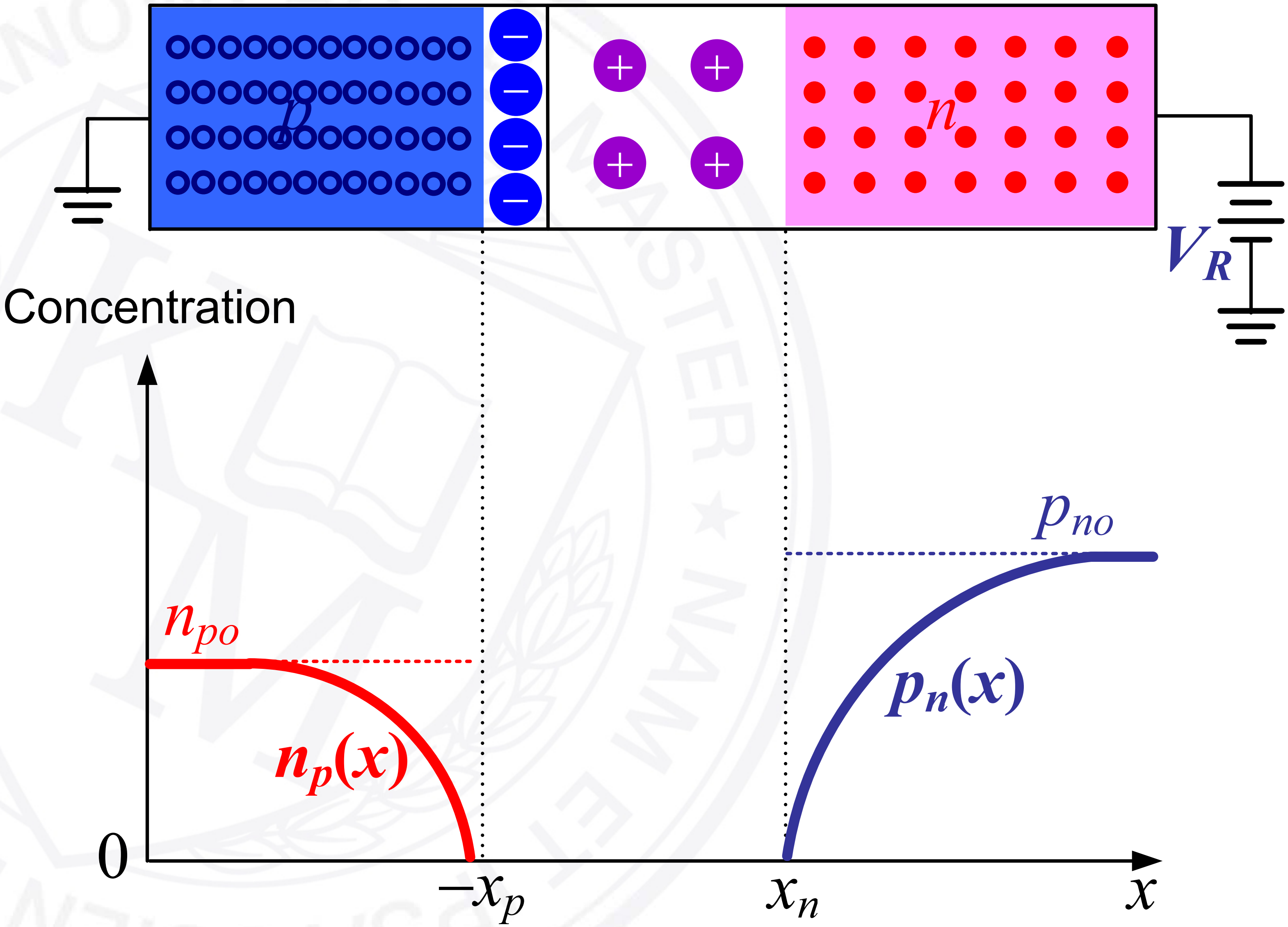
Outline

Zero Bias	Forward Bias	Reverse Bias
• Thermal equilibrium	• Physical meaning • Distribution	• Distribution • Saturation current

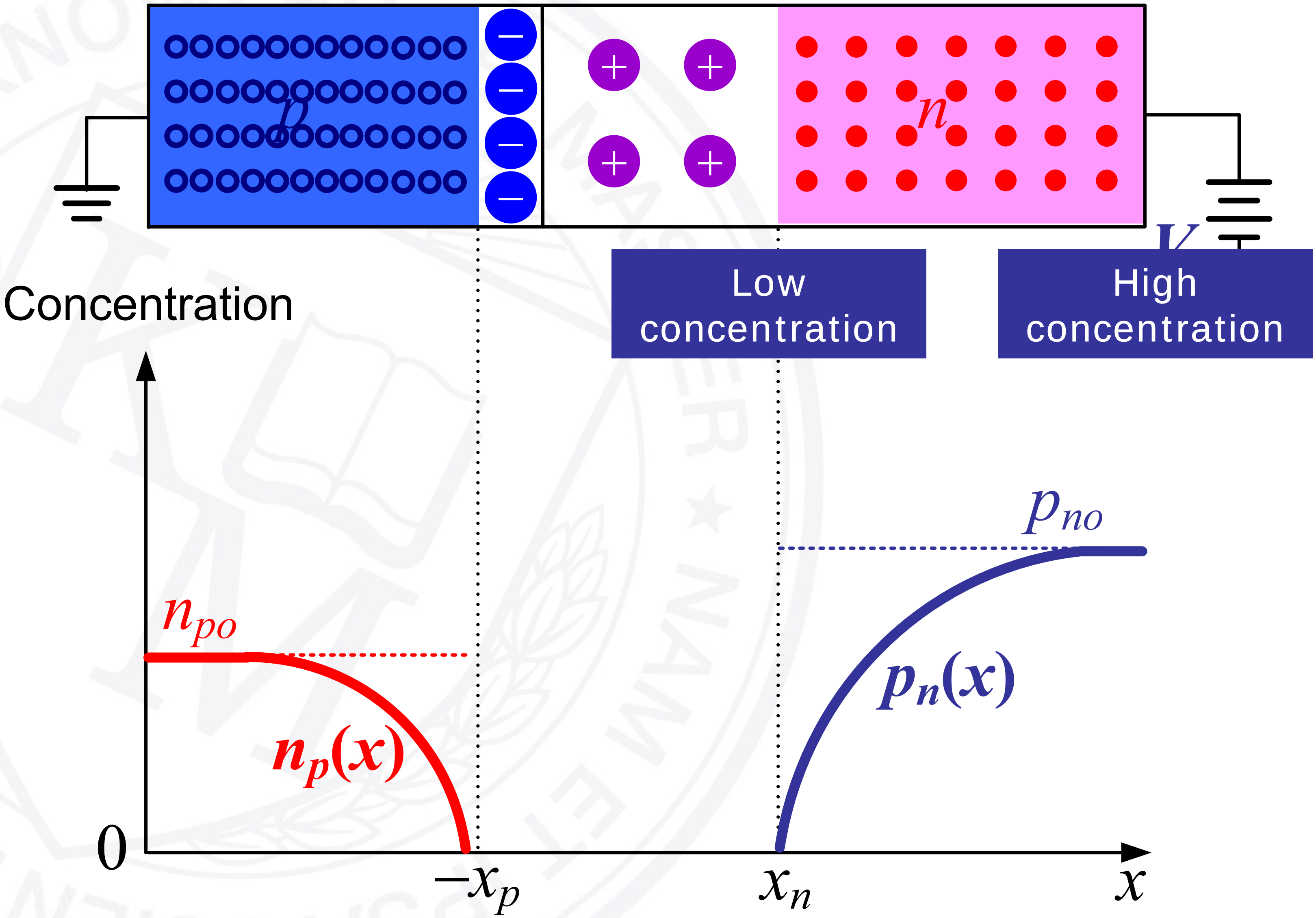
Minority Carrier (Fig.3-16b, P144)



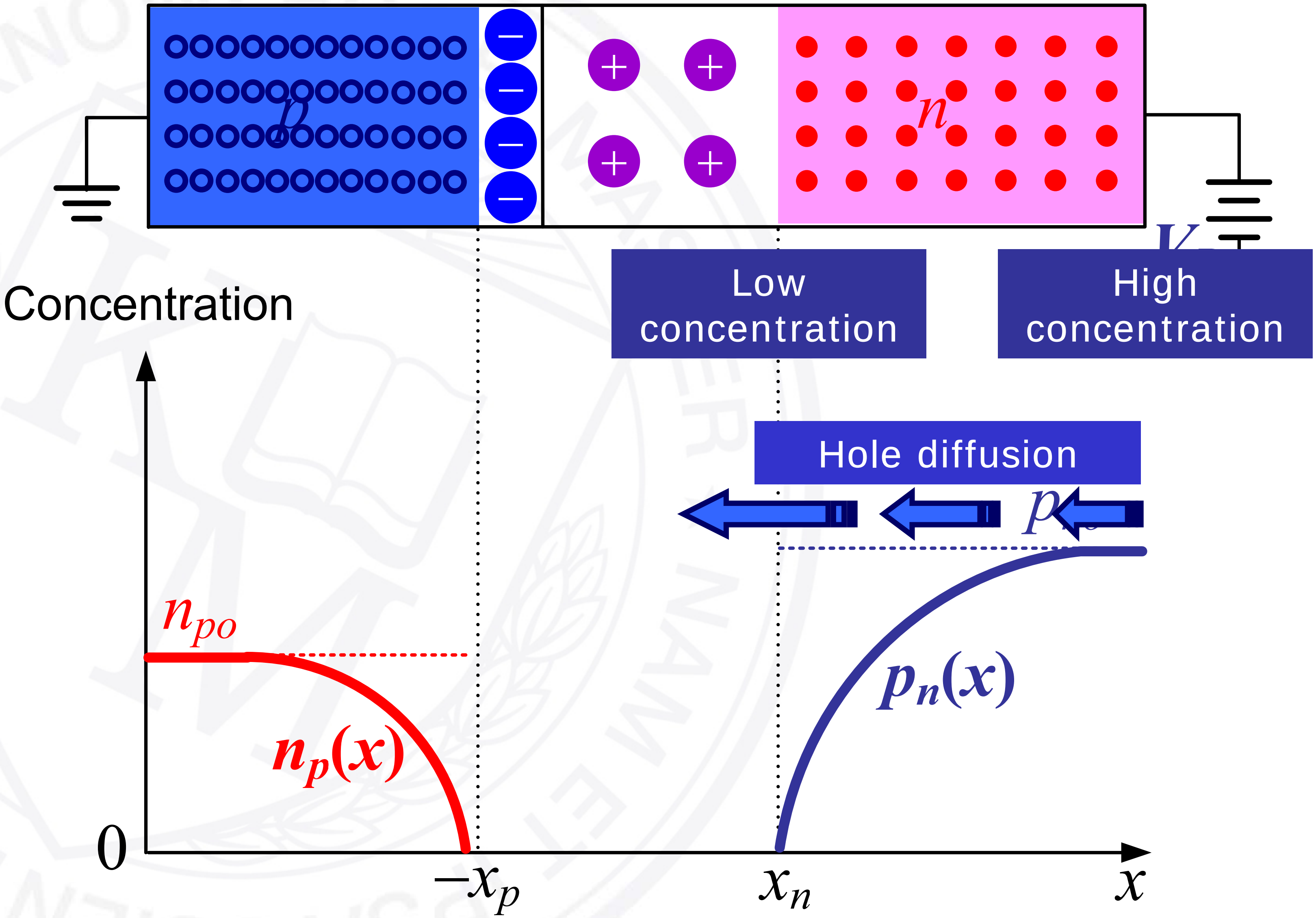
Minority Carrier (Fig.3-16b, P144)



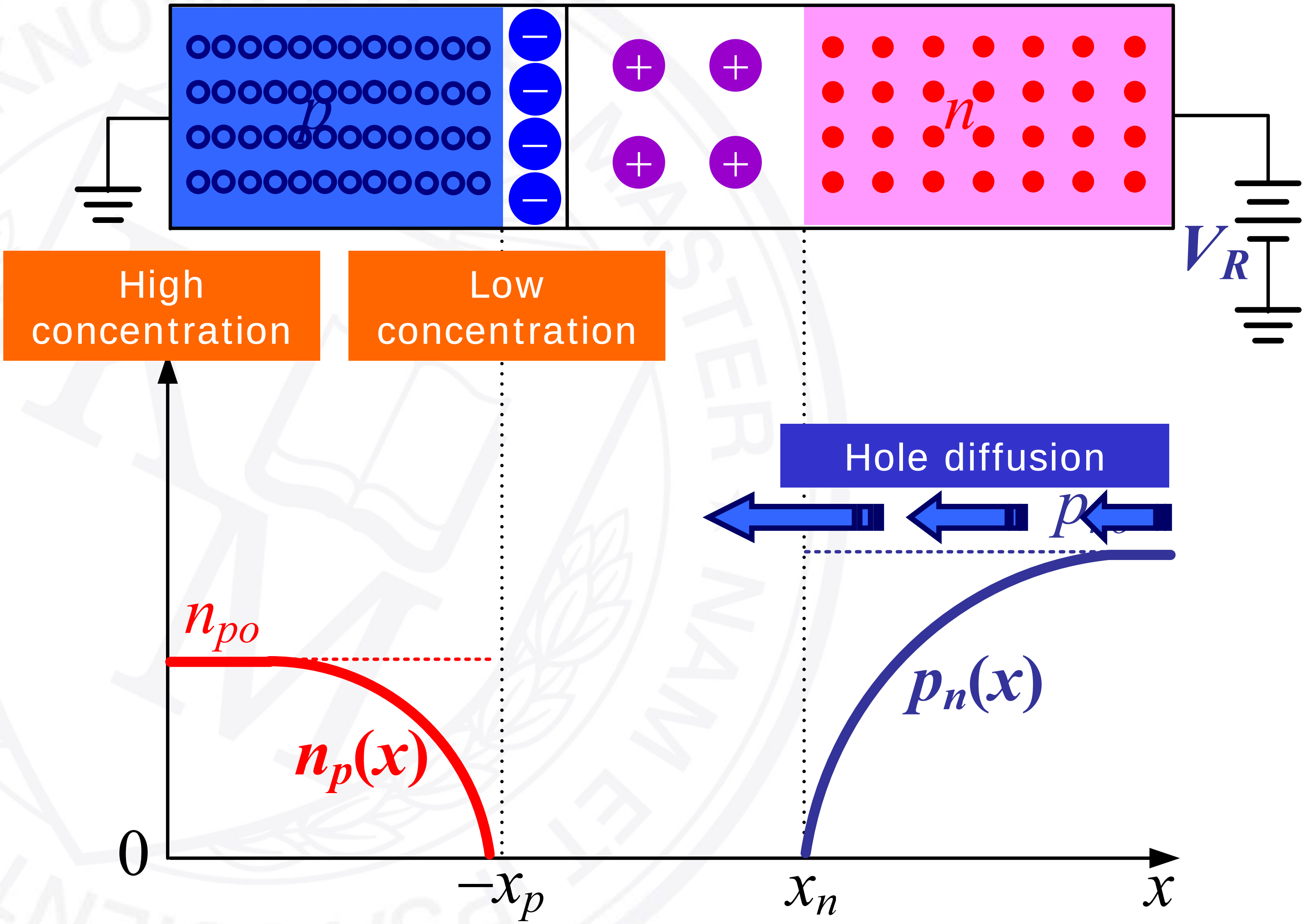
Physical Concept (Take Note)



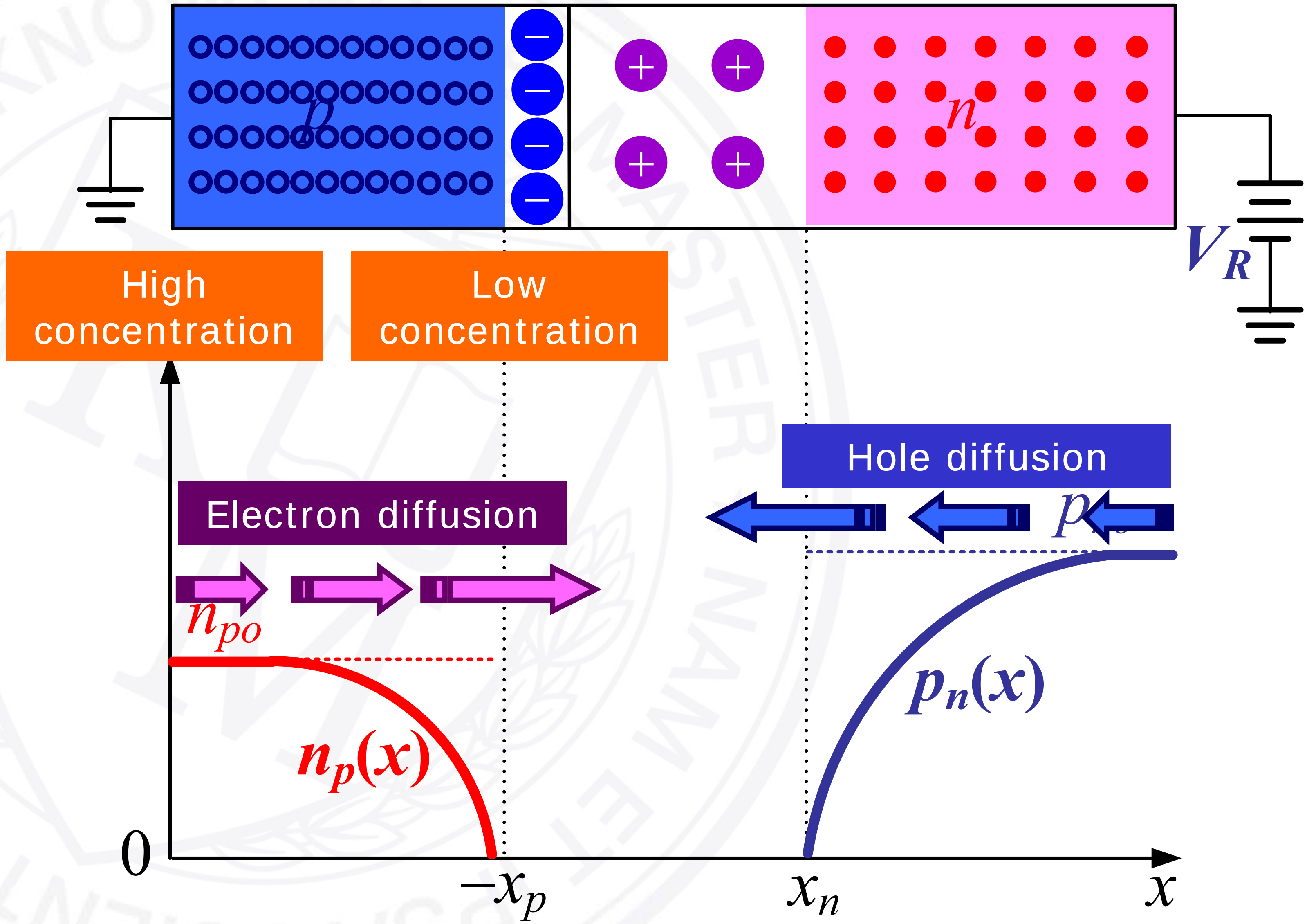
Physical Concept



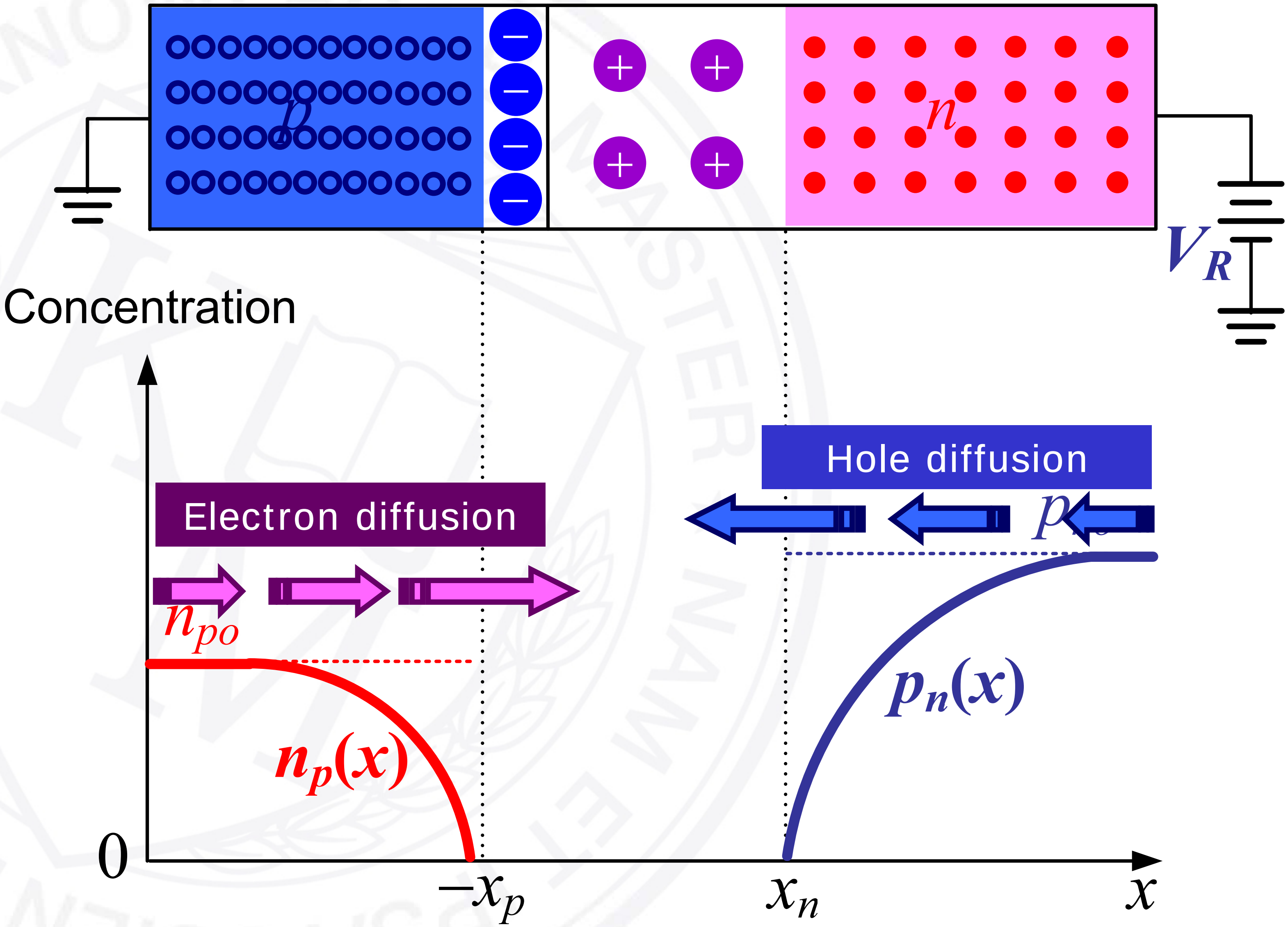
Physical Concept



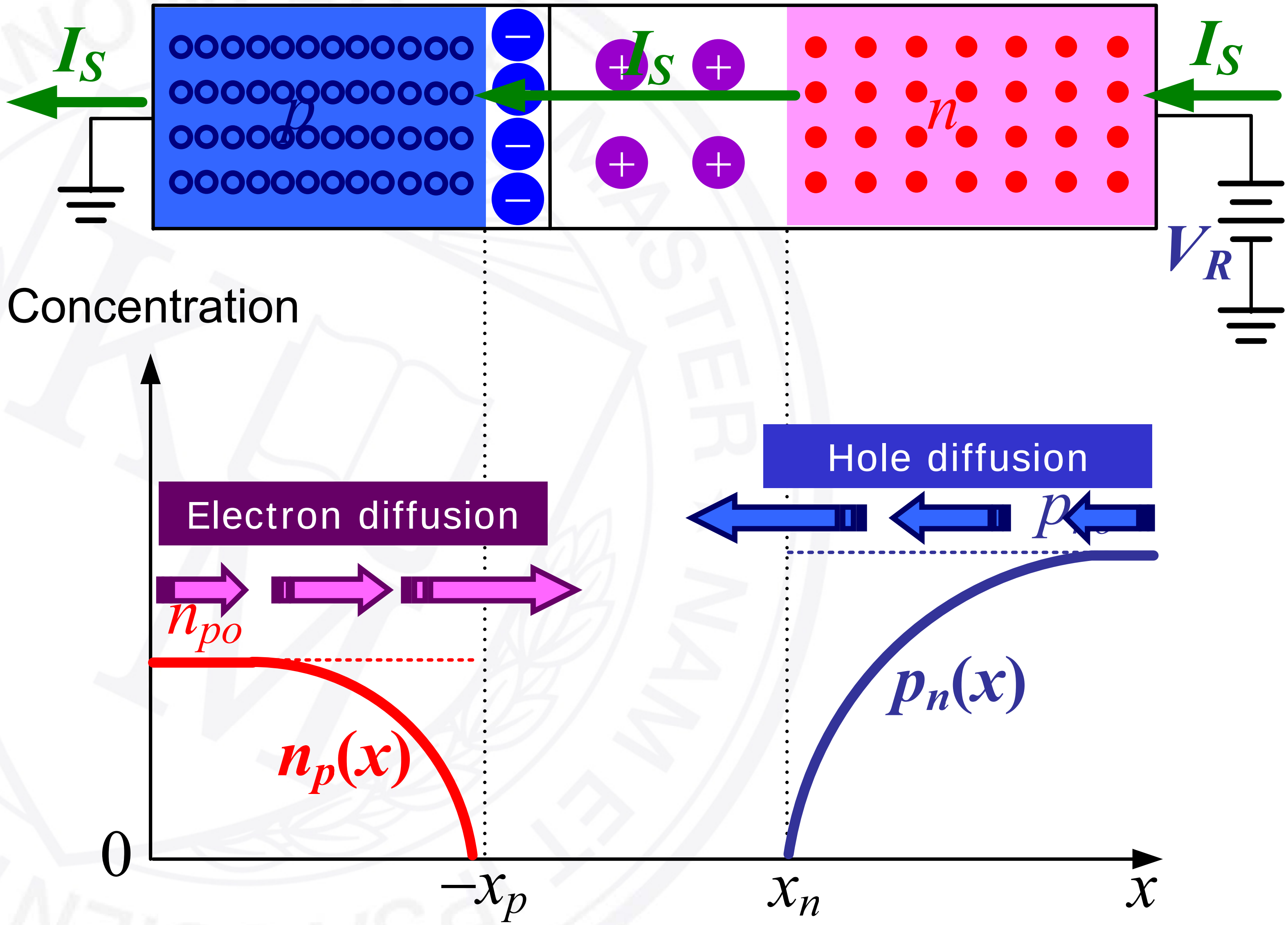
Physical Concept



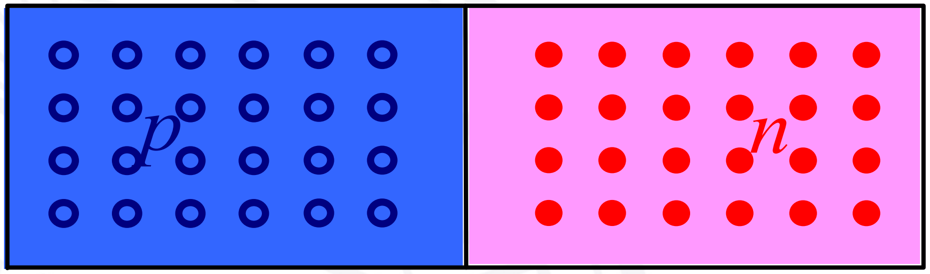
Minority Carrier Diffusion Current



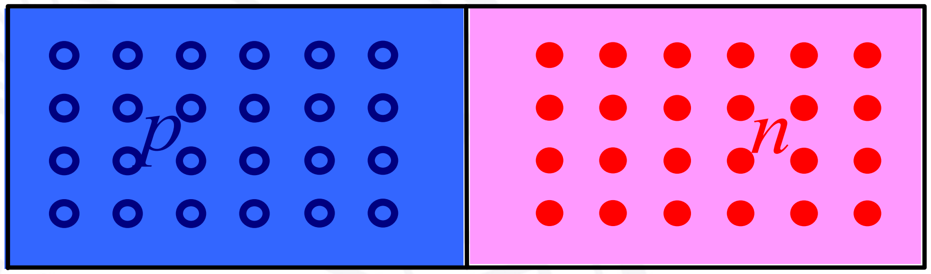
Reverse Saturation Current

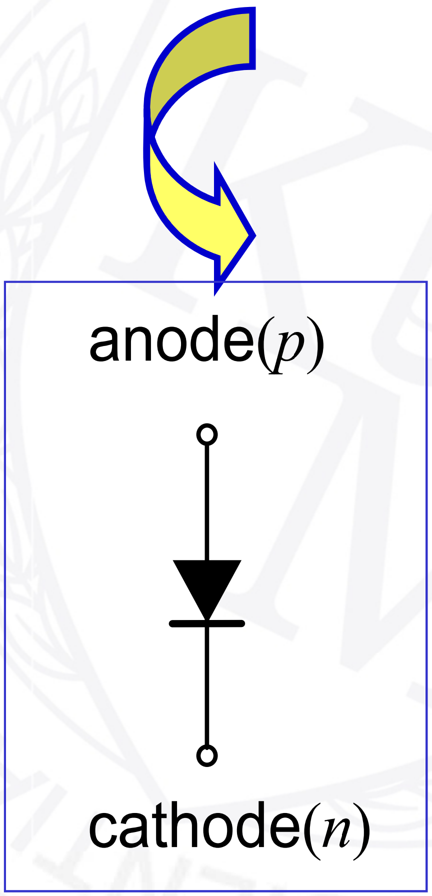


pn Junction Diode

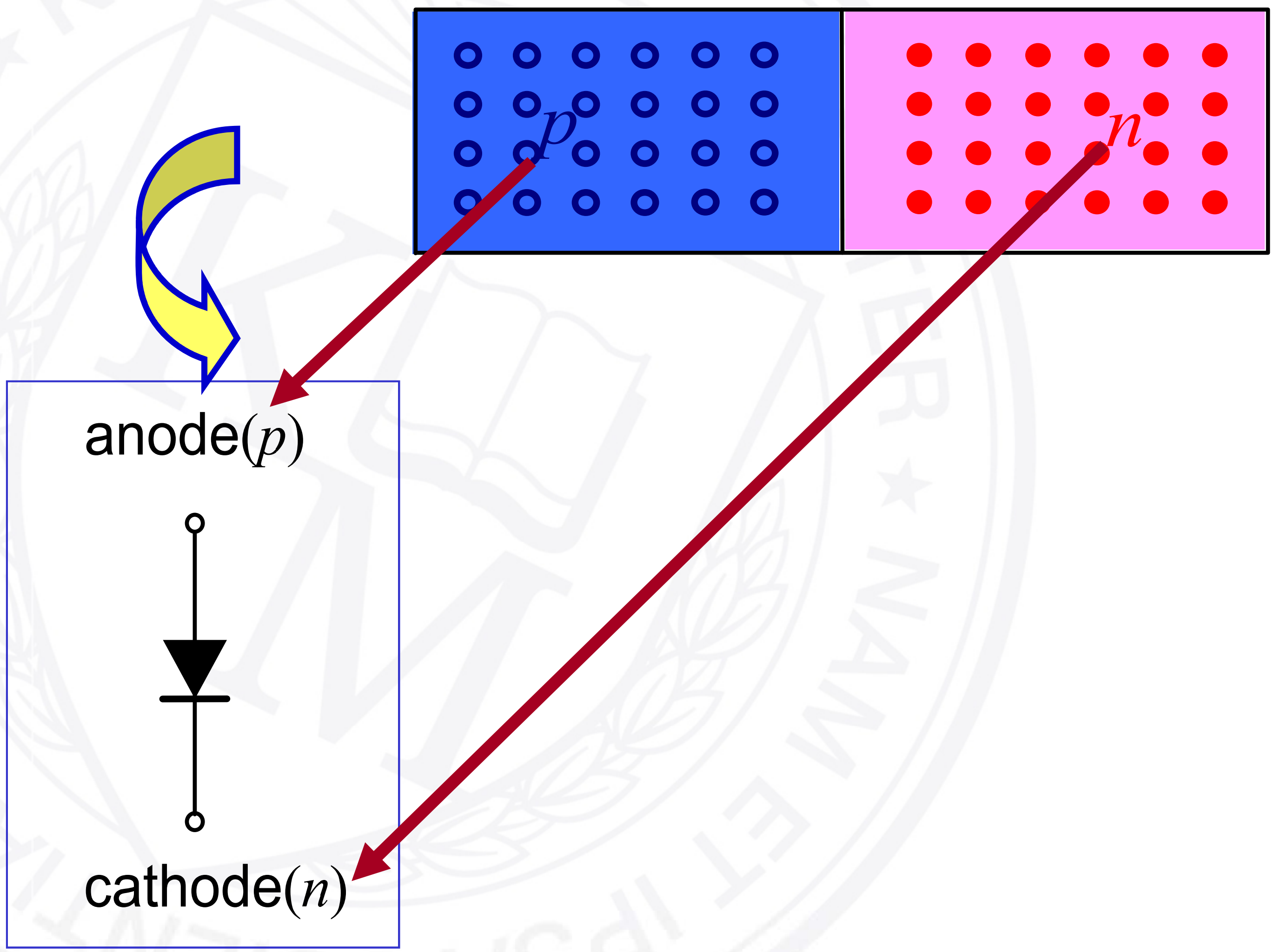


Circuit Symbol

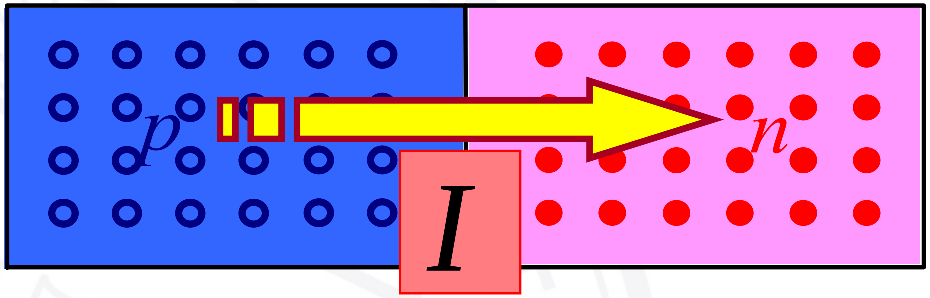


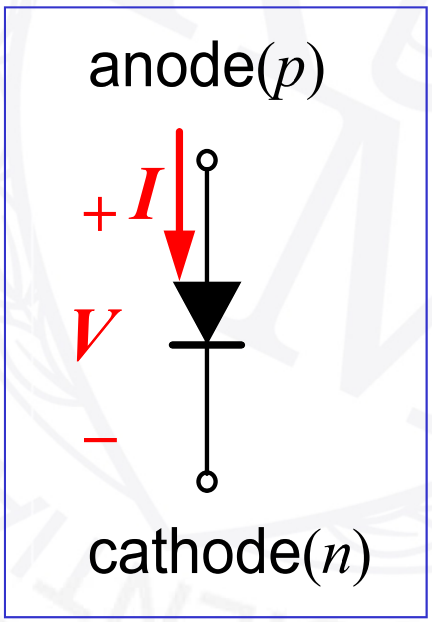


Circuit Symbol



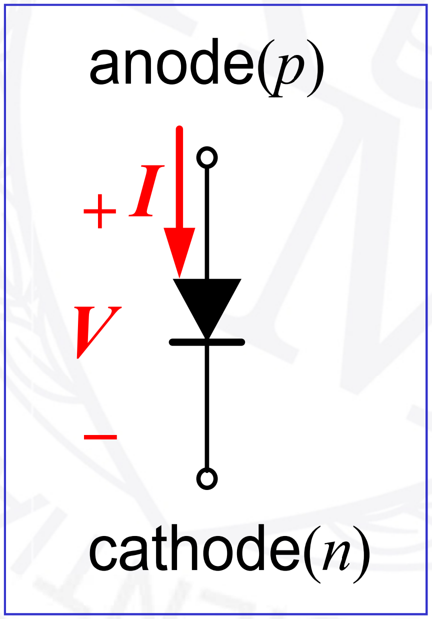
Diode Current and Voltage





Current-Voltage Characteristic

$$I = I_S(e^{V/V_T} - 1)$$

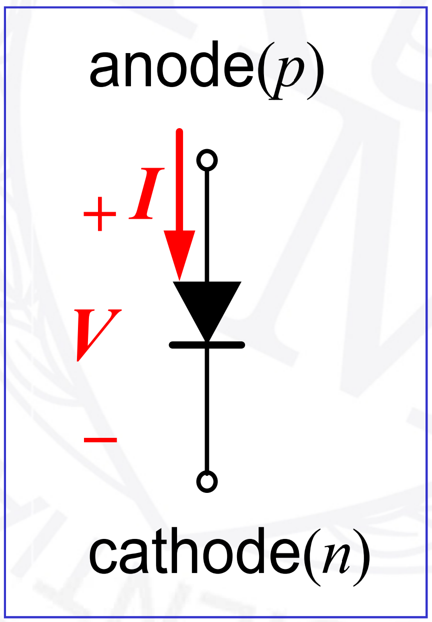


Device Parameters

Saturation current

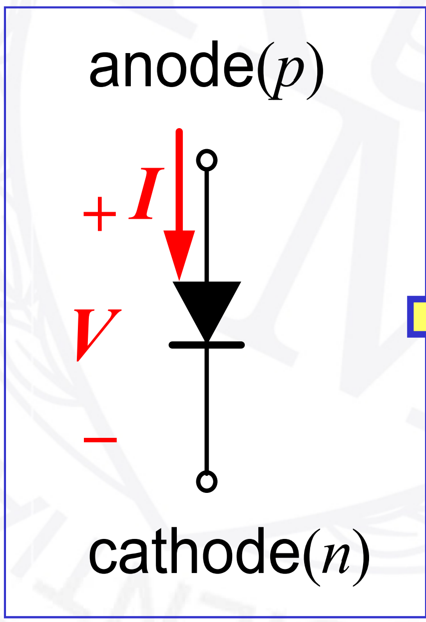
Thermal voltage

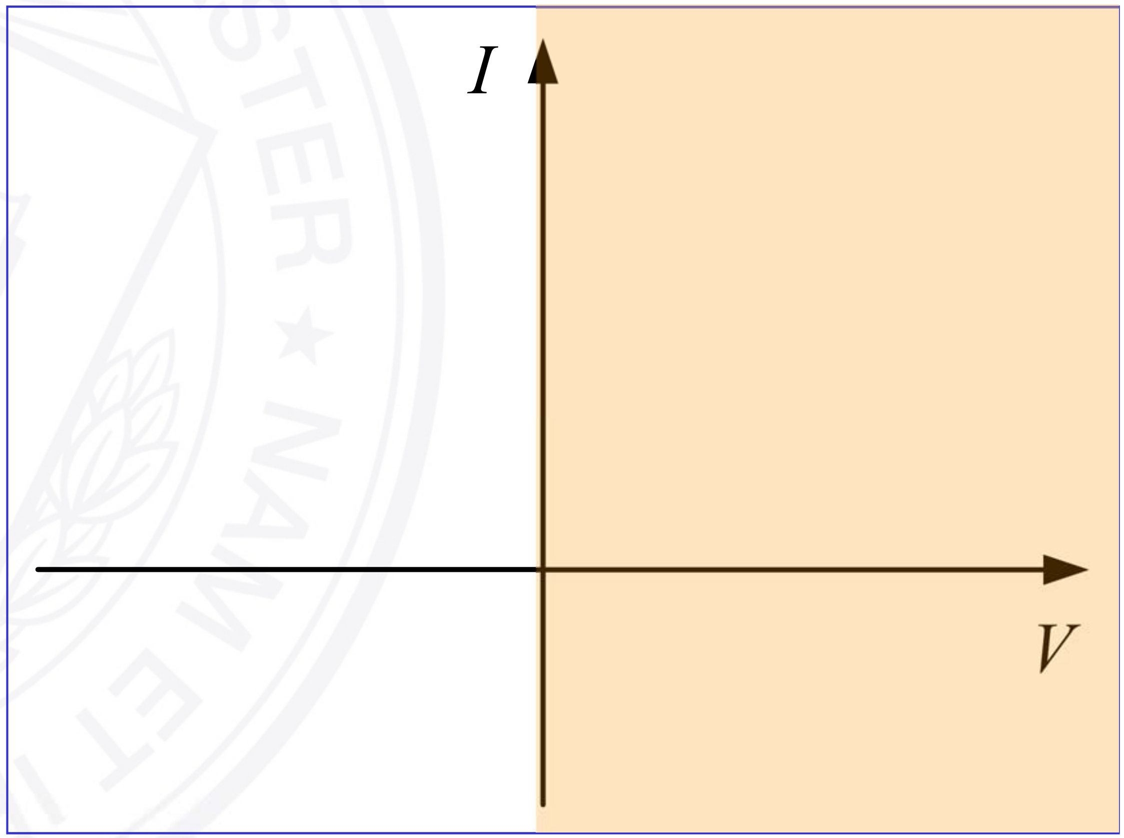
$$I = I_S\left(e^{V/V_T} - 1\right)$$



Forward Bias

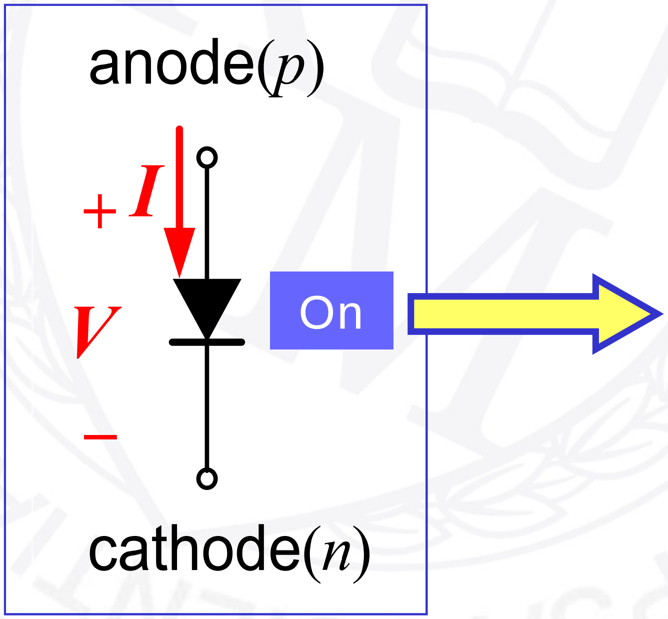
$$I = I_S(e^{V/V_T} - 1)$$

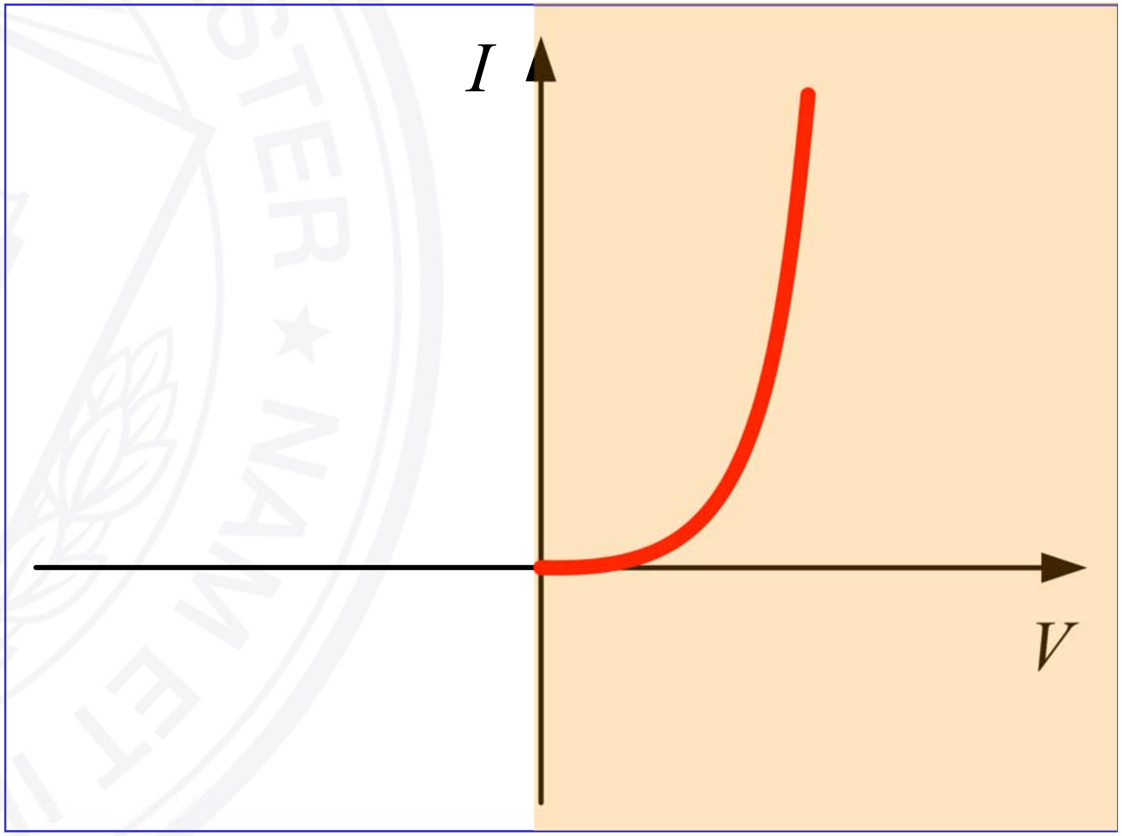




Forward Bias

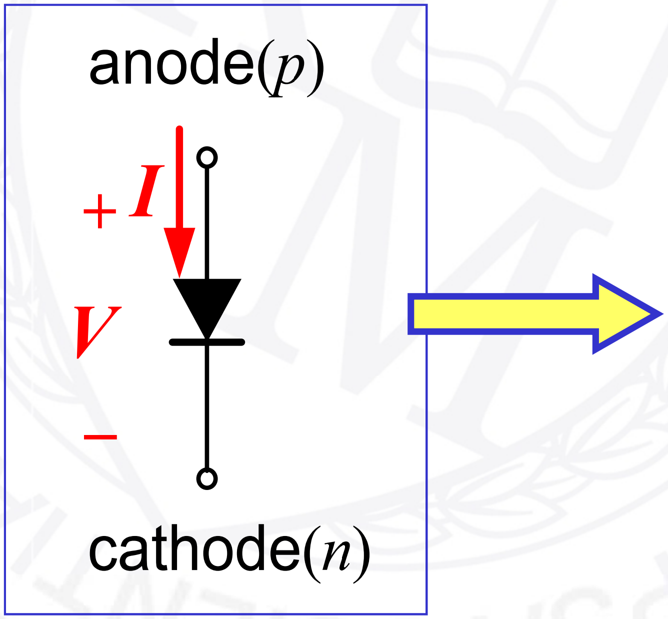
$$I = I_S(e^{V/V_T} - 1)$$

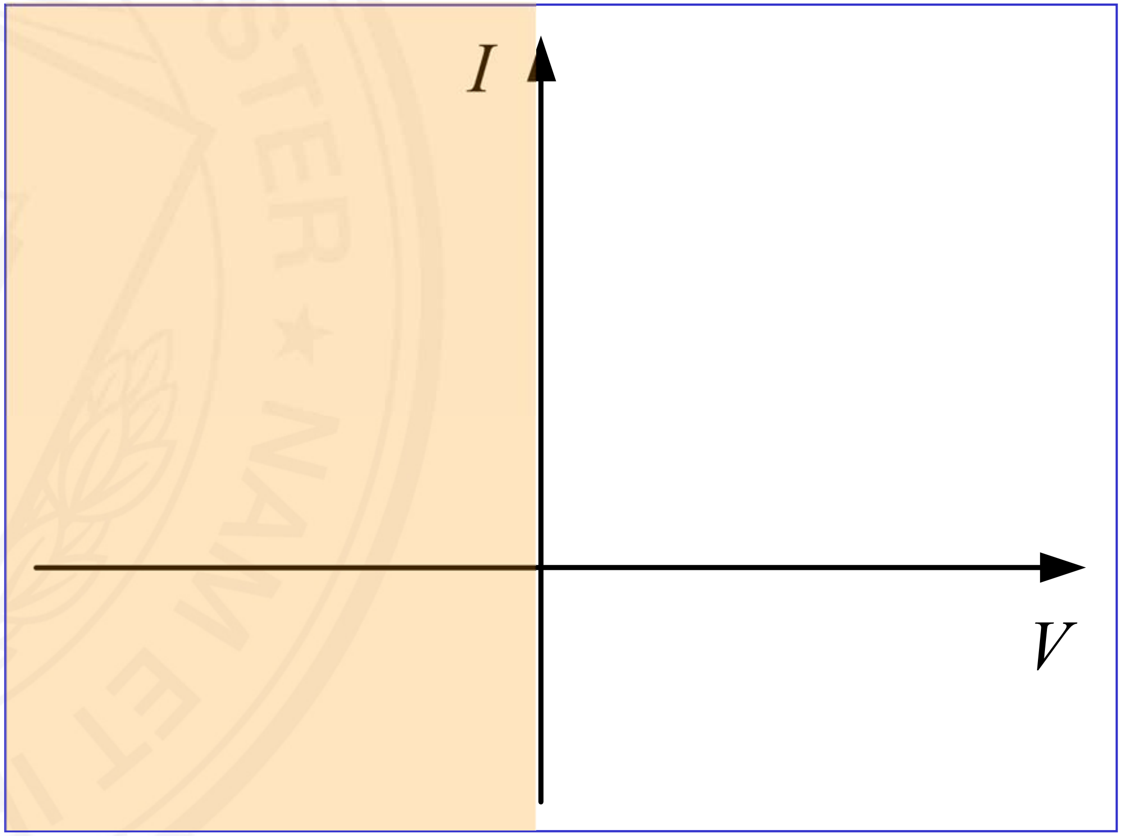




Reverse Bias

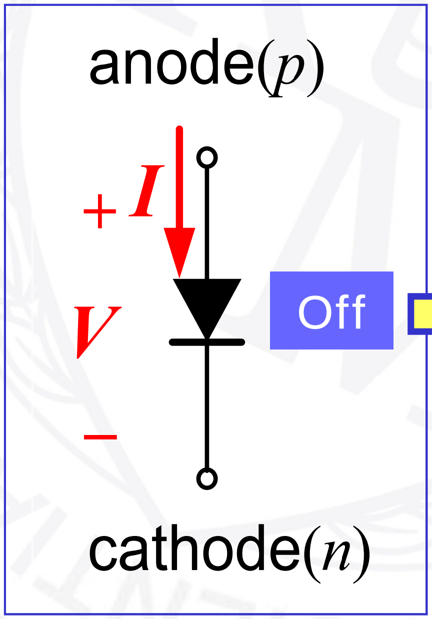
$$I = I_S\left(e^{V/V_T} - 1\right)$$

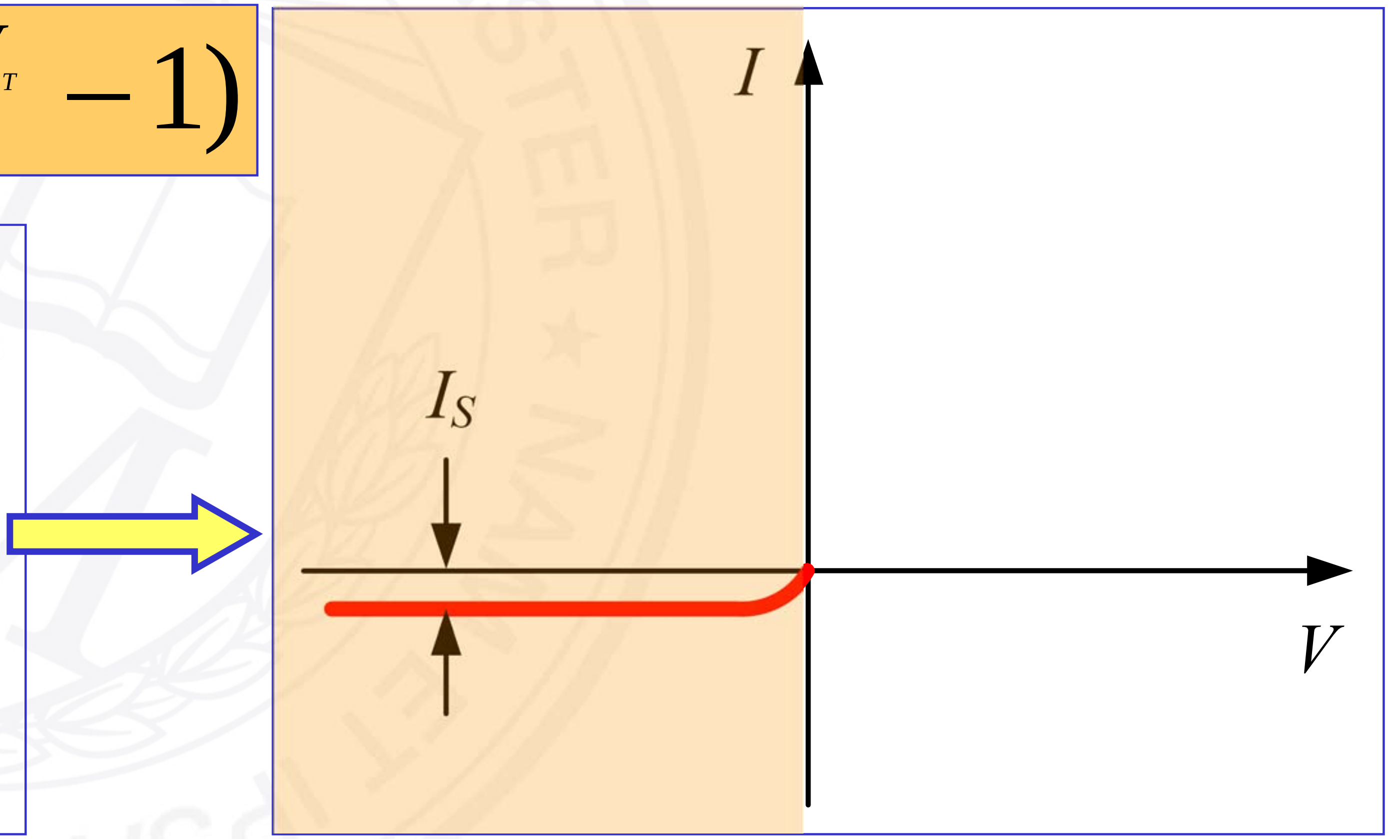




Reverse Bias

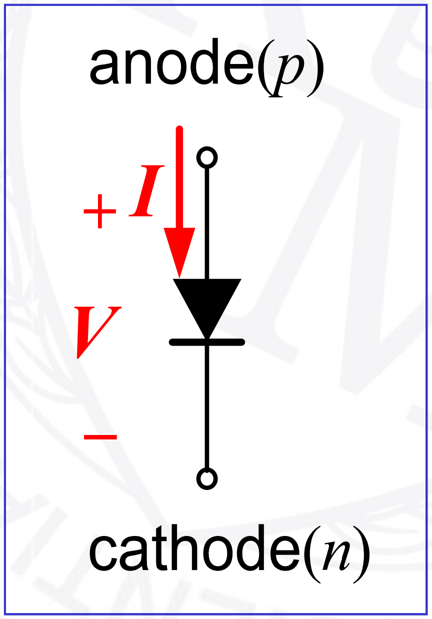
$$I = I_S(e^{V/V_T} - 1)$$

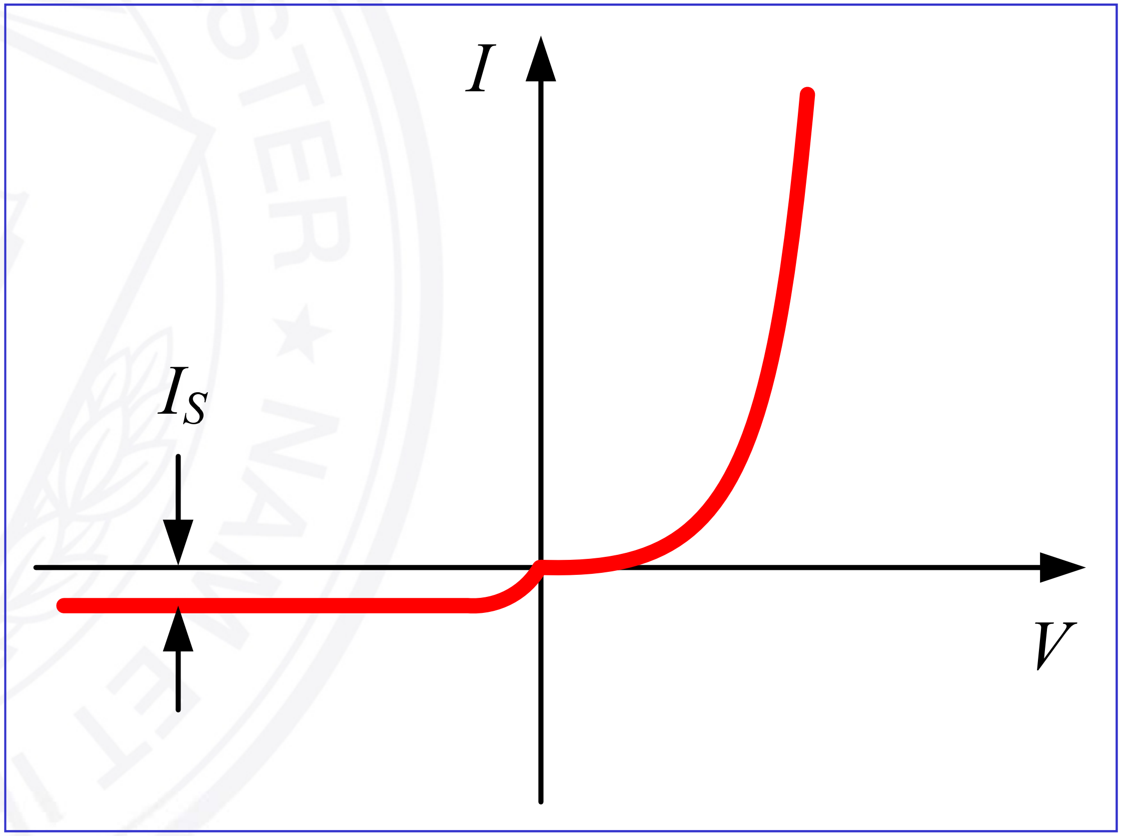




I-V Characteristic

$$I = I_S\left(e^{V/V_T} - 1\right)$$

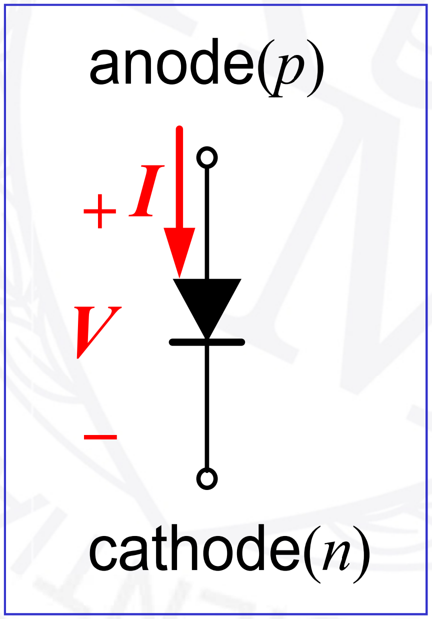


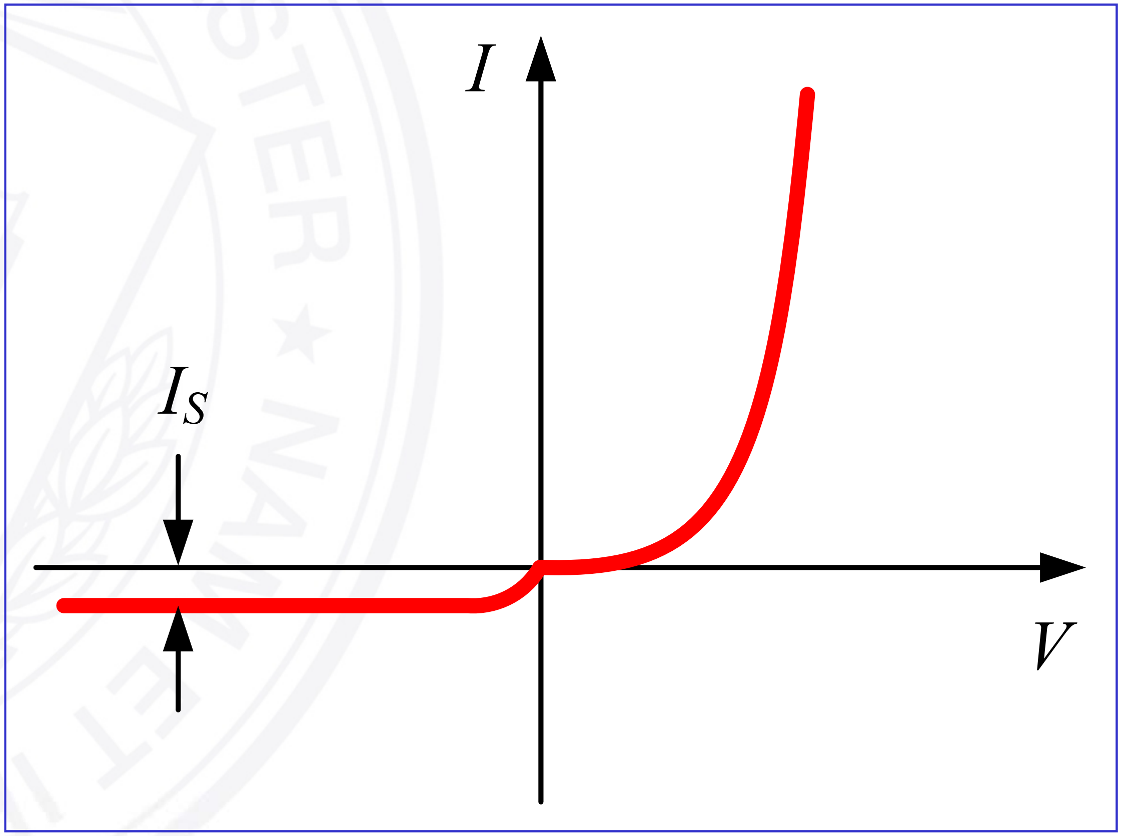


Saturation Current

$$I_S = Aqn_i^2\left[\frac{D_p}{L_pN_D}+\frac{D_n}{L_nN_A}\right]$$

$$I = I_S(e^{V/V_T}-1)$$

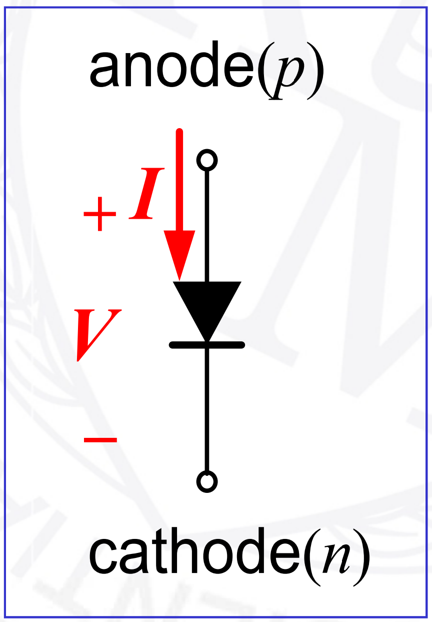


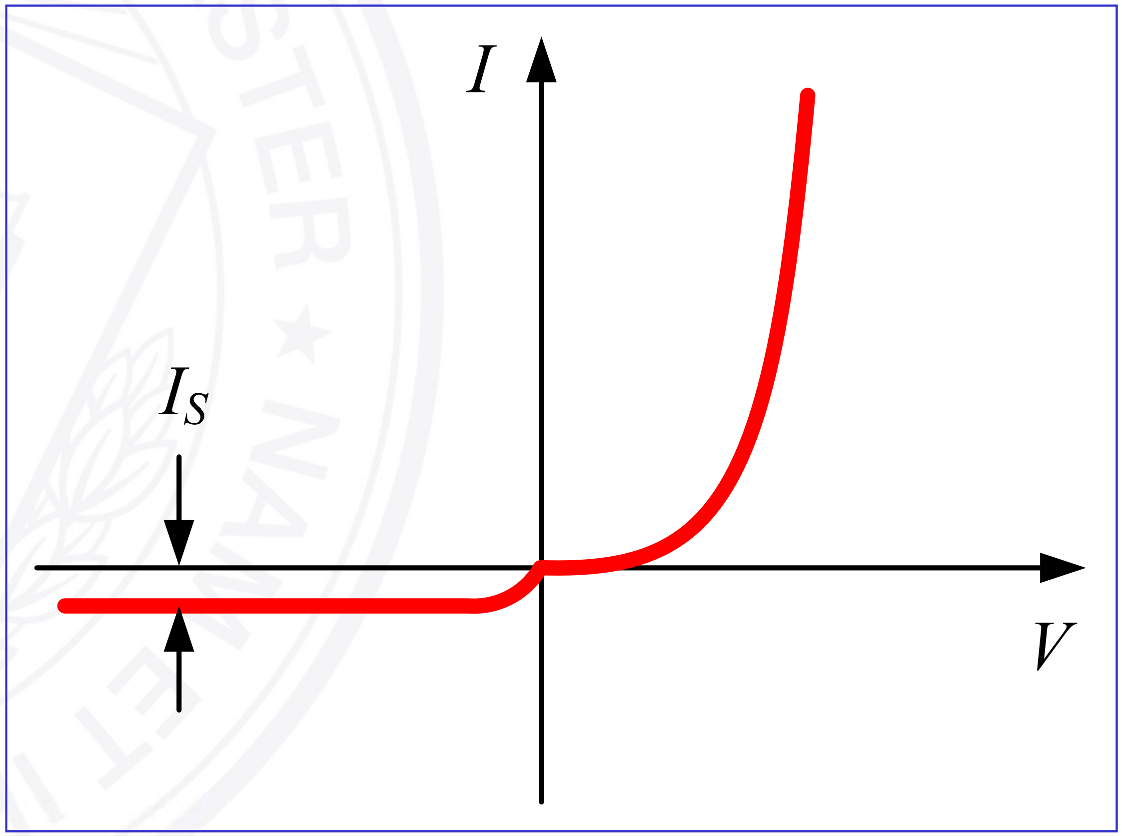


Saturation Current

$$I_S = Aqn_i^2\left[\frac{D_p}{L_p N_D} + \frac{D_n}{L_n N_A}\right]$$

$$I = I_S\left(e^{V/V_T} - 1\right)$$





WARNING