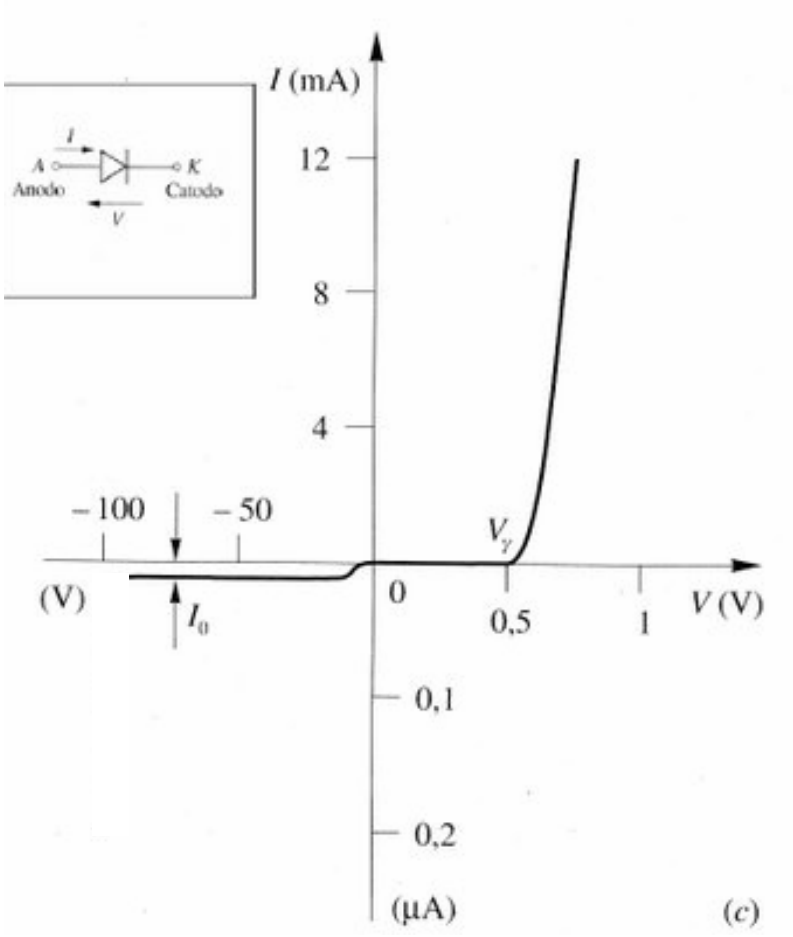
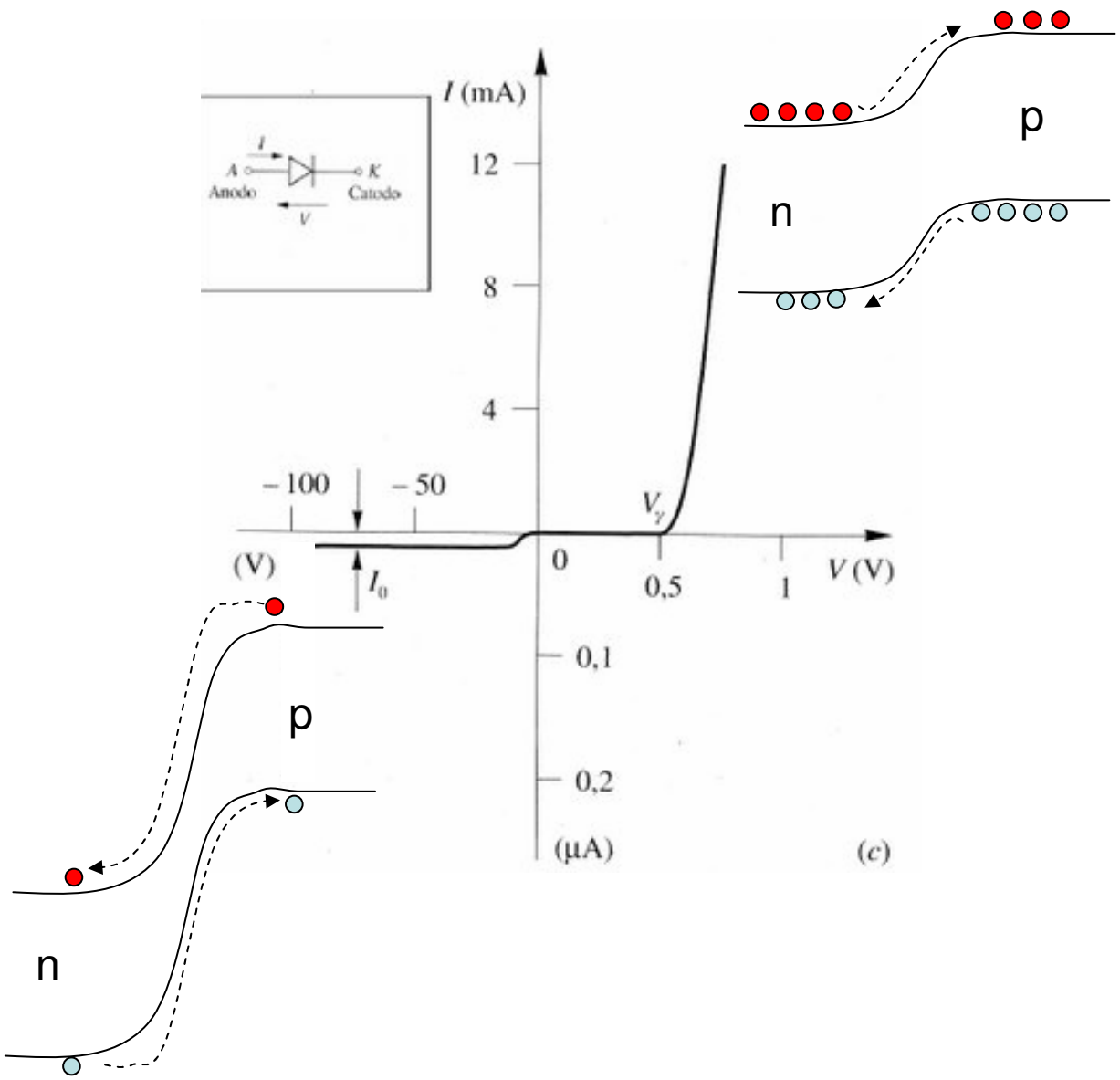
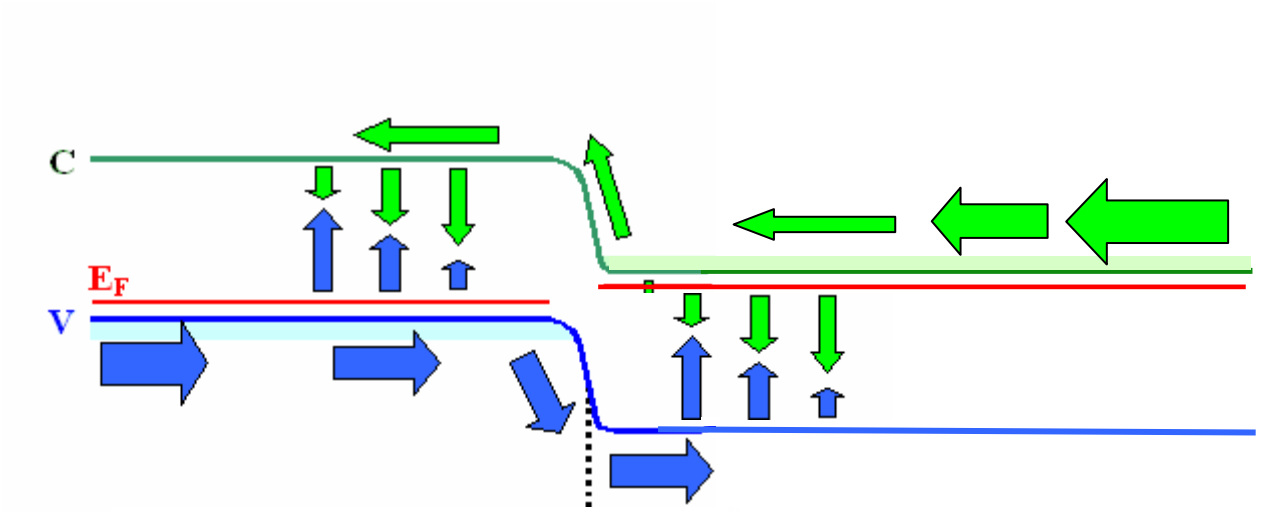
Giunzione np

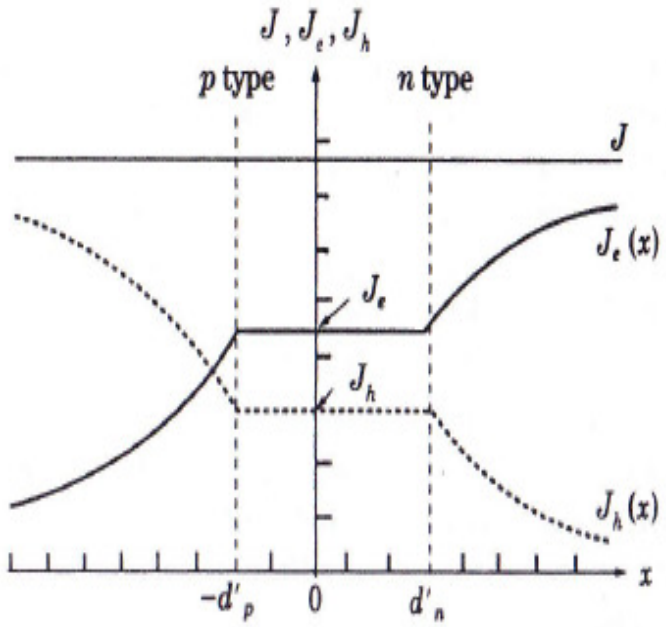


Giunzione np

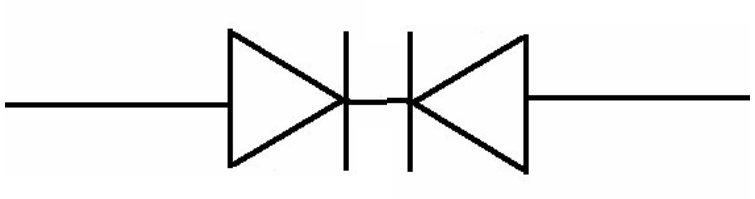


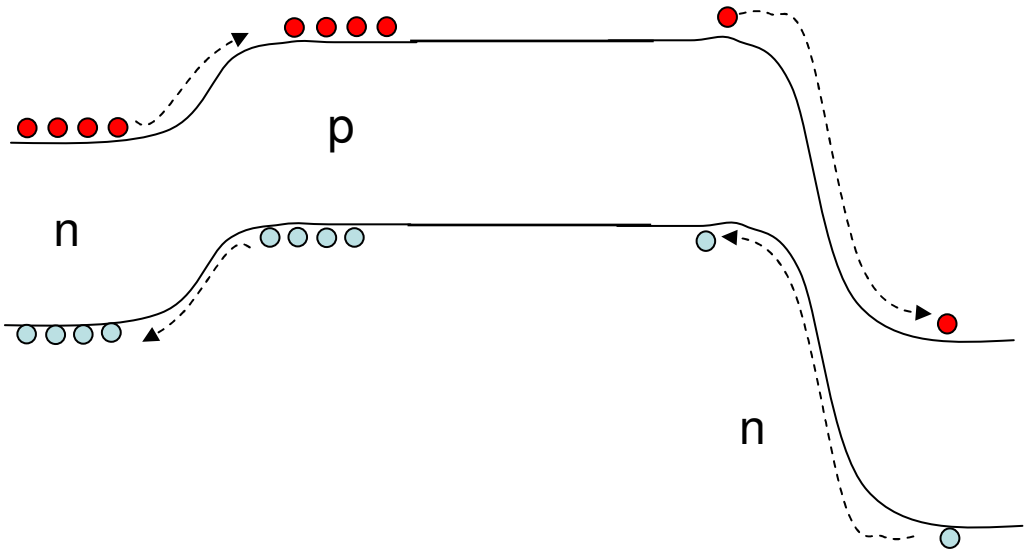
Corrente giunzione pn



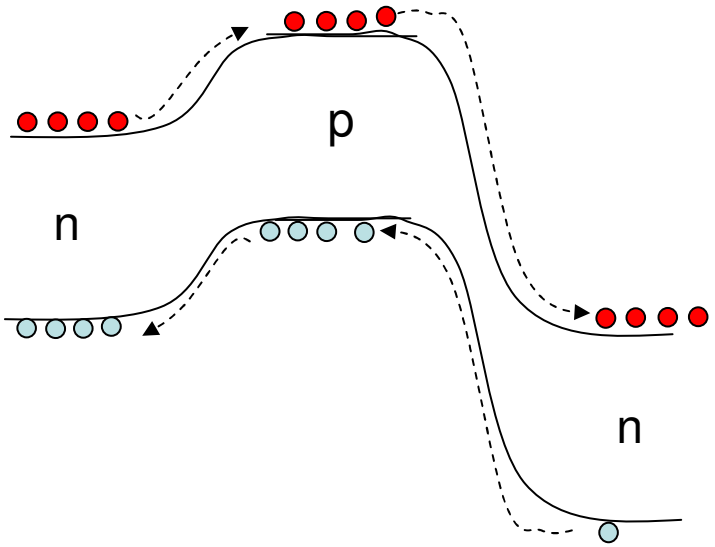


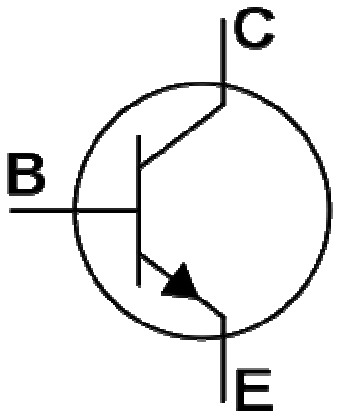
Due giunzioni separate



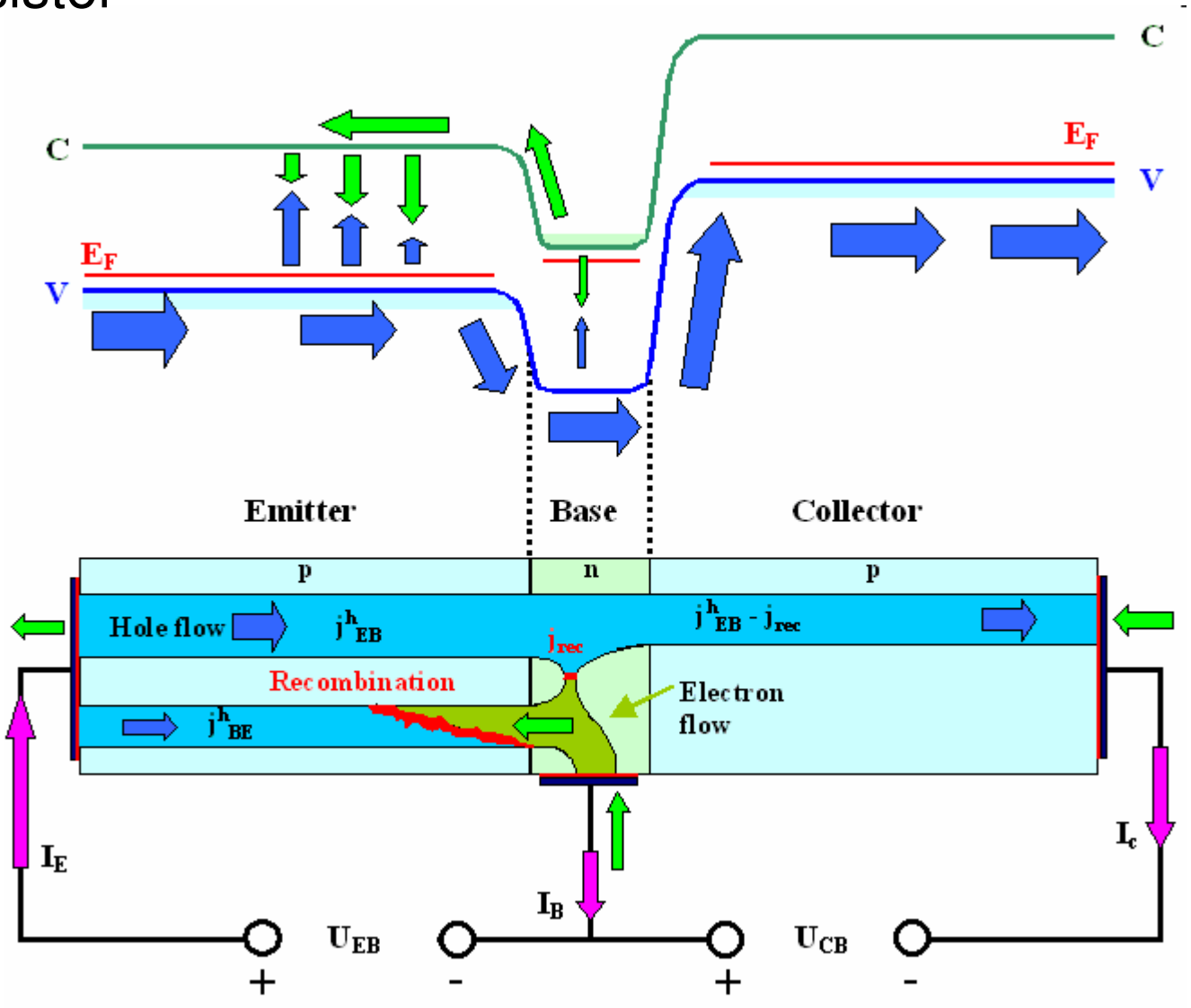


Due giunzioni vicine





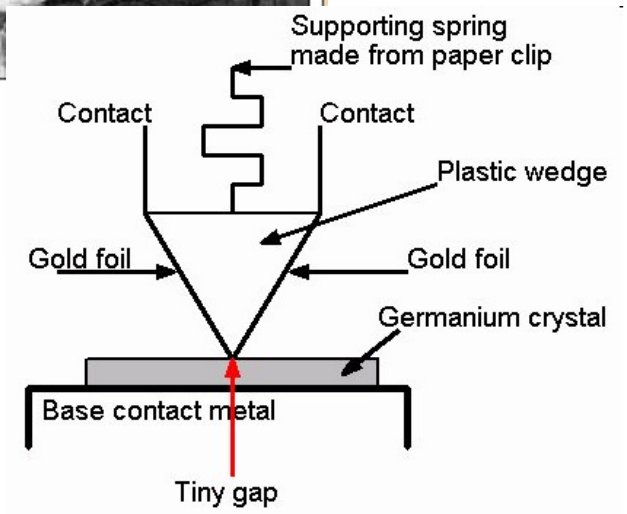
Transistor


C
E_F
V
C
E_F
V
Emitter
Base
Collector
p
n
p
Hole flow
j^h_EB
j^h_EB - j_rec
j_rec
Recombination
Electron flow
j^h_BE
I_E
I_B
I_c
U_EB
U_CB
+
-
+
-

The first point contact transistor

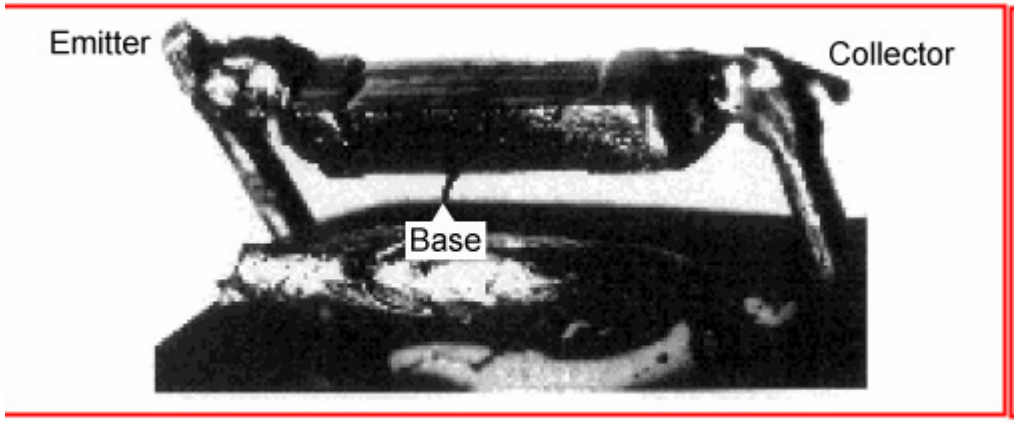
William Shockley, John Bardeen, and Walter Brattain
Bell Laboratories, Murray Hill, New Jersey (1947)

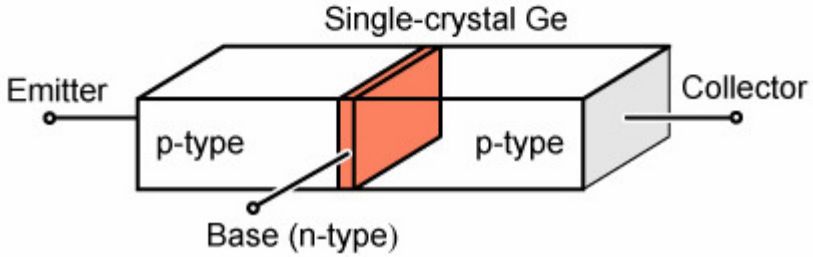
Nobel 1956

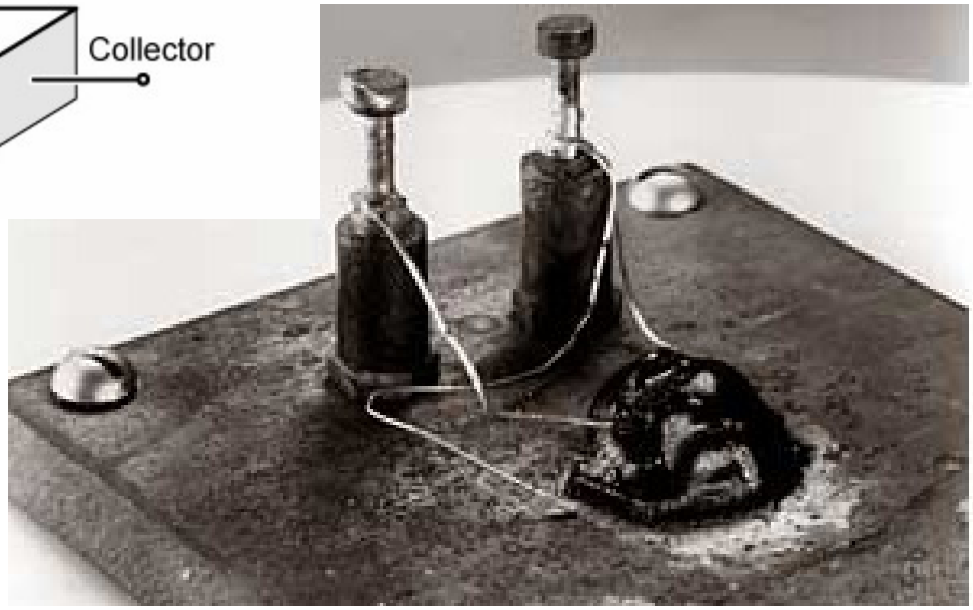


The First Junction Transistor

First transistor with diffused pn junctions by William Shockley
Bell Laboratories, Murray Hill, New Jersey (1949)

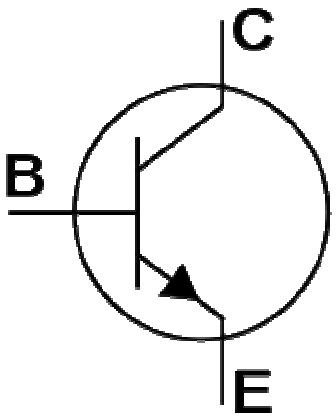




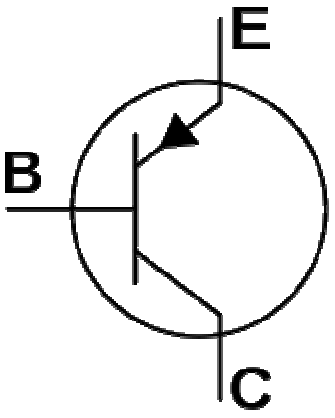


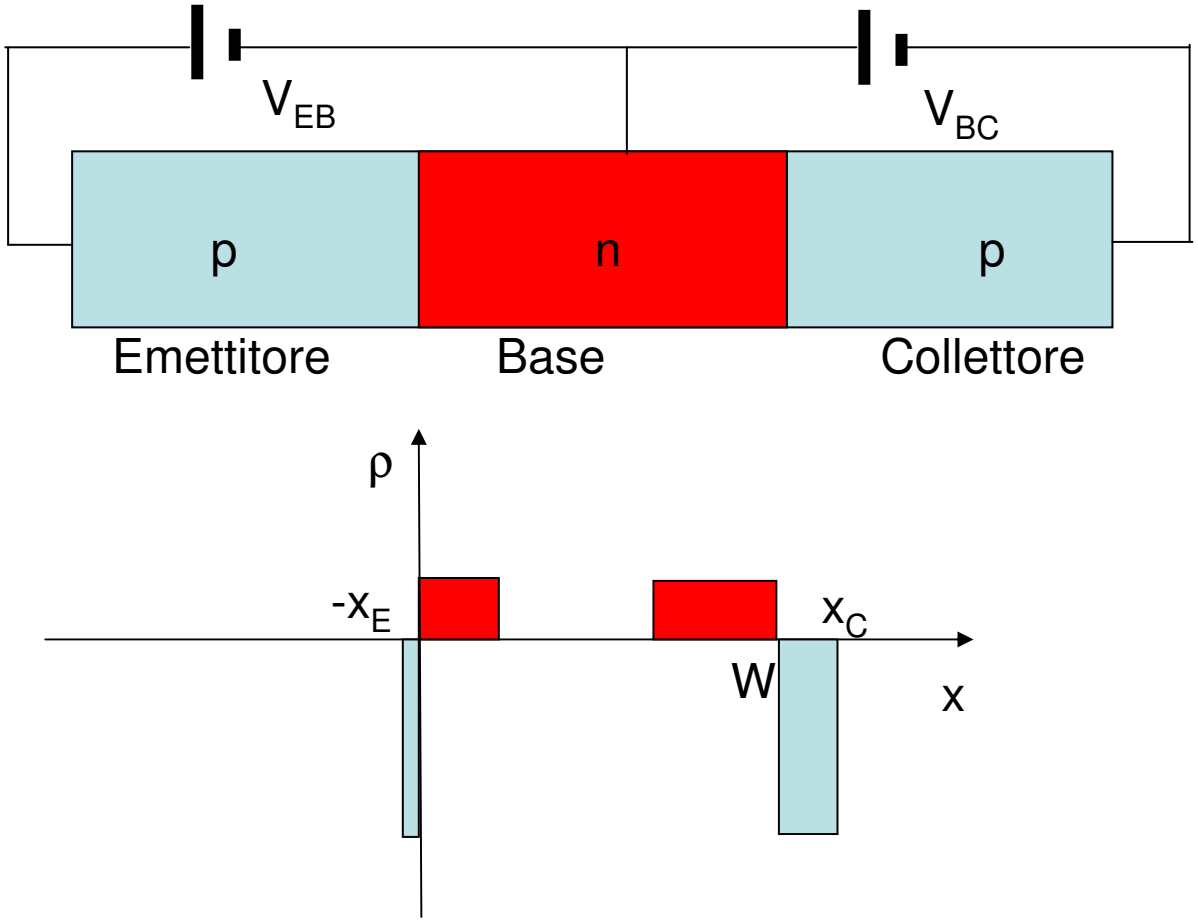
Transistor

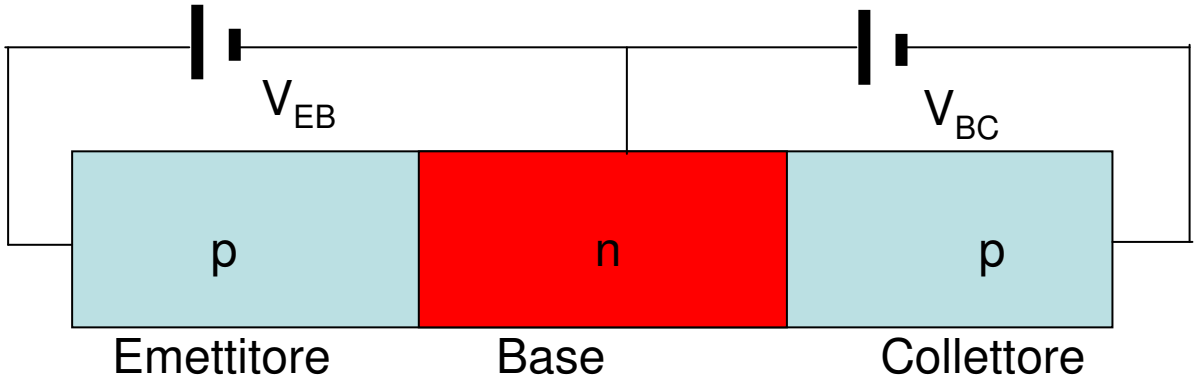
NPN

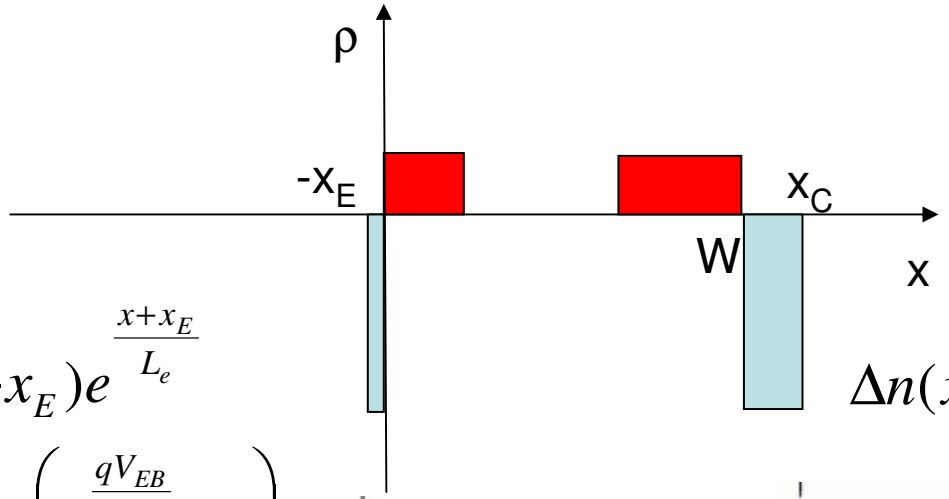


PNP




V_{EB}
V_{BC}
p
n
p
Emettitore
Base
Collettore
ρ
$-x_E$
x_C
W
x



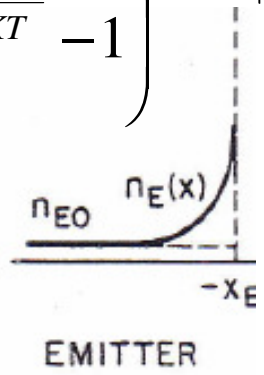


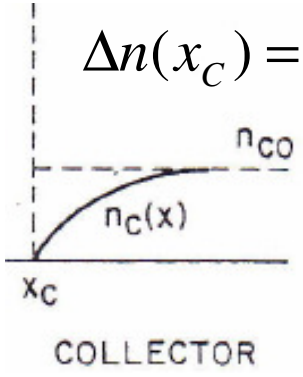
$$\Delta n(x) = \Delta n(-x_E) e^{\frac{x+x_E}{L_e}}$$

$$\Delta n(-x_E) = n_{E,0}\left(e^{\frac{qV_{EB}}{KT}} - 1 \right)$$

$$\Delta n(x) = \Delta n(x_C) e^{-\frac{x-x_C}{L_e}}$$

$$\Delta n(x_C) = n_{C,0}\left(e^{-\frac{qV_{BC}}{KT}} - 1 \right)$$





Lacune nella base

$$\Delta p(x) = \frac{p_{B,0}}{\sinh\left(\frac{W}{L_h}\right)}\left[\left(e^{\frac{qV_{BE}}{KT}} - 1\right)\sinh\left(\frac{W-x}{L_h}\right) - \sinh\left(\frac{x}{L_h}\right)\right]$$

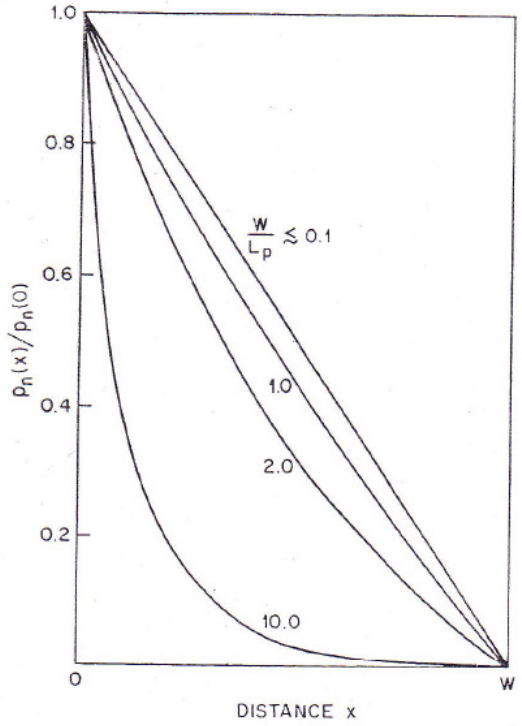


Fig. 6 Minority carrier distribution in the base region for different values of W/L_p. For $W/L_p \lesssim 0.1$, the distribution approaches a straight line.

Distribuzione portatori minoritari

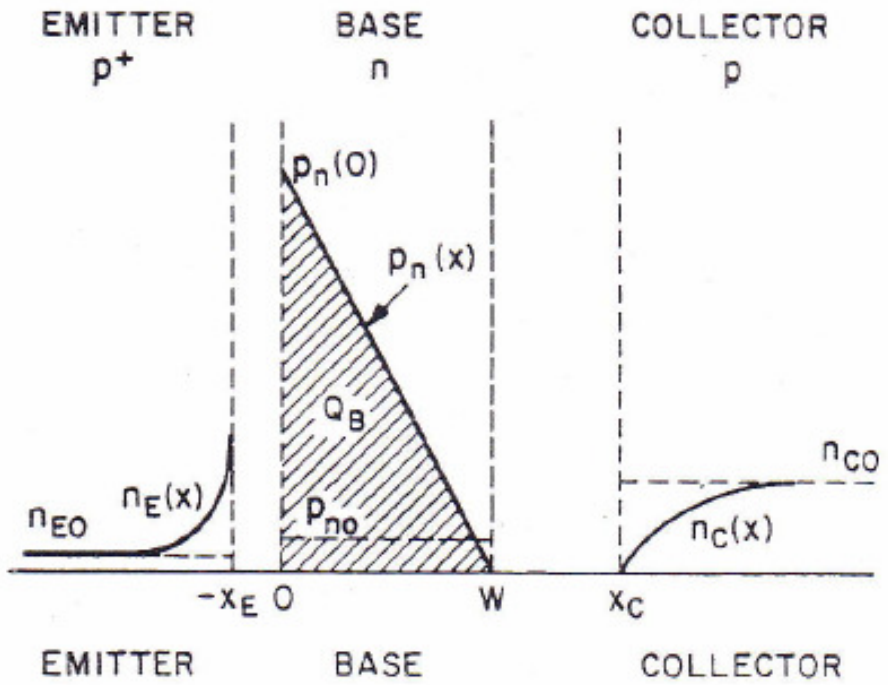
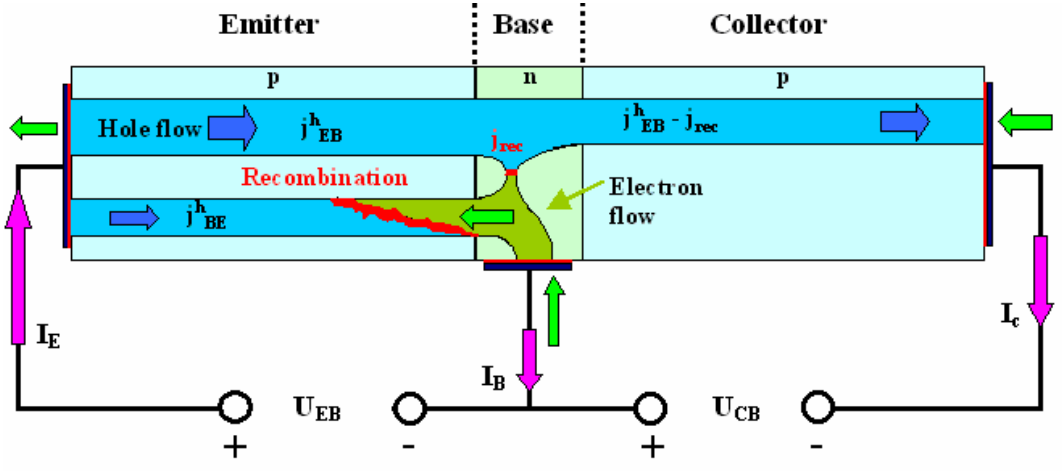


Fig. 7 Minority carrier distributions in various regions of a *p–n–p* transistor under active mode of operation.

Parametri



$$\gamma = \frac{I_{E,p}}{I_{E,p} + I_{E,n}}$$

Efficienza di emettore

$$\alpha_T = \frac{I_{C,p}}{I_{E,p}}$$

Fattore trasporto nella base

$$\alpha_0 = \frac{I_{C,p}}{I_{E,p} + I_{E,n}} = \gamma\alpha_T$$

Guadagno a base comune

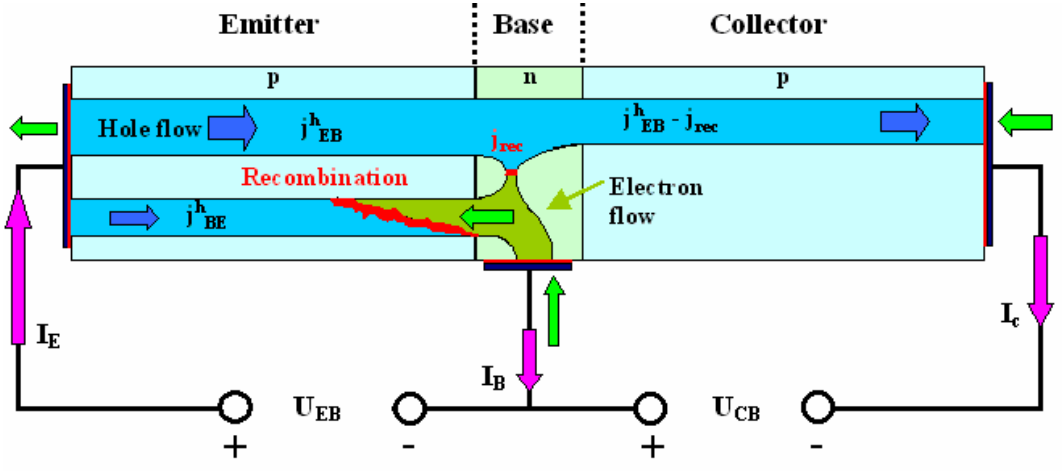
Parametri

$$\gamma = \frac{I_{E,p}}{I_{E,p} + I_{E,n}} = \frac{1}{1 + \frac{D_e}{D_h}\frac{W}{L_e}\frac{N_{D,B}}{N_{A,E}}} = \frac{1}{1 + \frac{1}{1}\frac{5}{50}\frac{1}{100}} = 0.999$$

$$\alpha_T = \frac{I_{C,p}}{I_{E,p}} = 1 - \frac{W^2}{2L_h^2} = 1 - \frac{1}{2}\left(\frac{1}{10}\right)^2 = 0.995$$

$$\alpha_0 = \frac{I_{C,p}}{I_{E,p} + I_{E,n}} = \gamma\alpha_T = 0.994$$

Parametri



$$I_B = I_E - I_C = \left(\frac{1}{\alpha_0} - 1 \right) I_C = 0.006 I_C$$

$$I_C = \left(\frac{\alpha_0}{1 - \alpha_0} \right) I_B = \beta I_B = 166 I_B$$