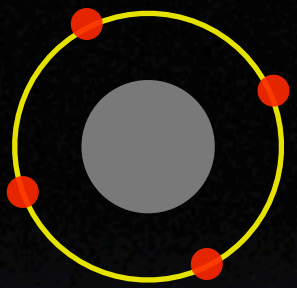
SEMICONDUCTEURS

Electronique - ENSPG 2005 / 2006

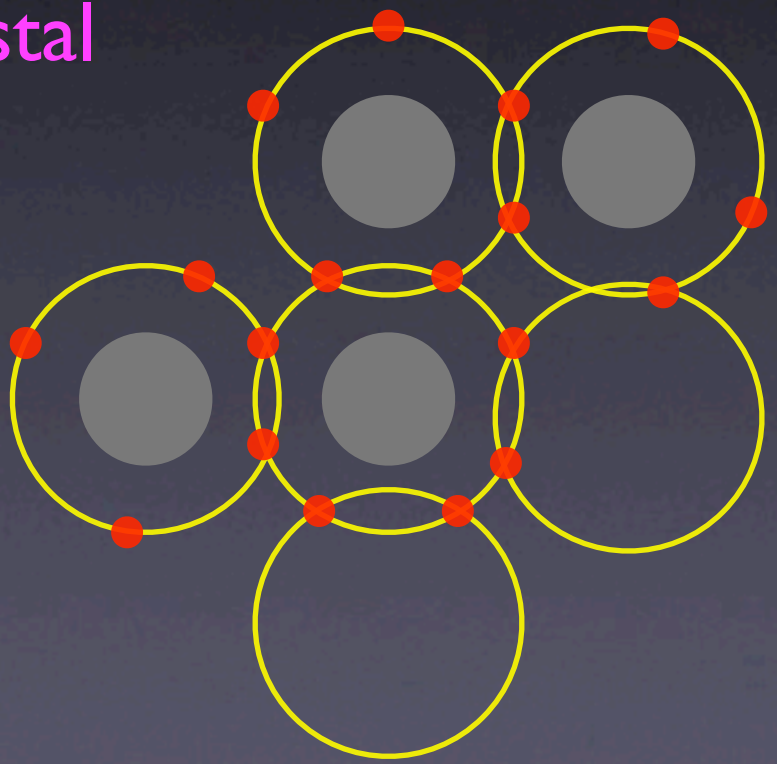
atome

Niveaux d'énergie

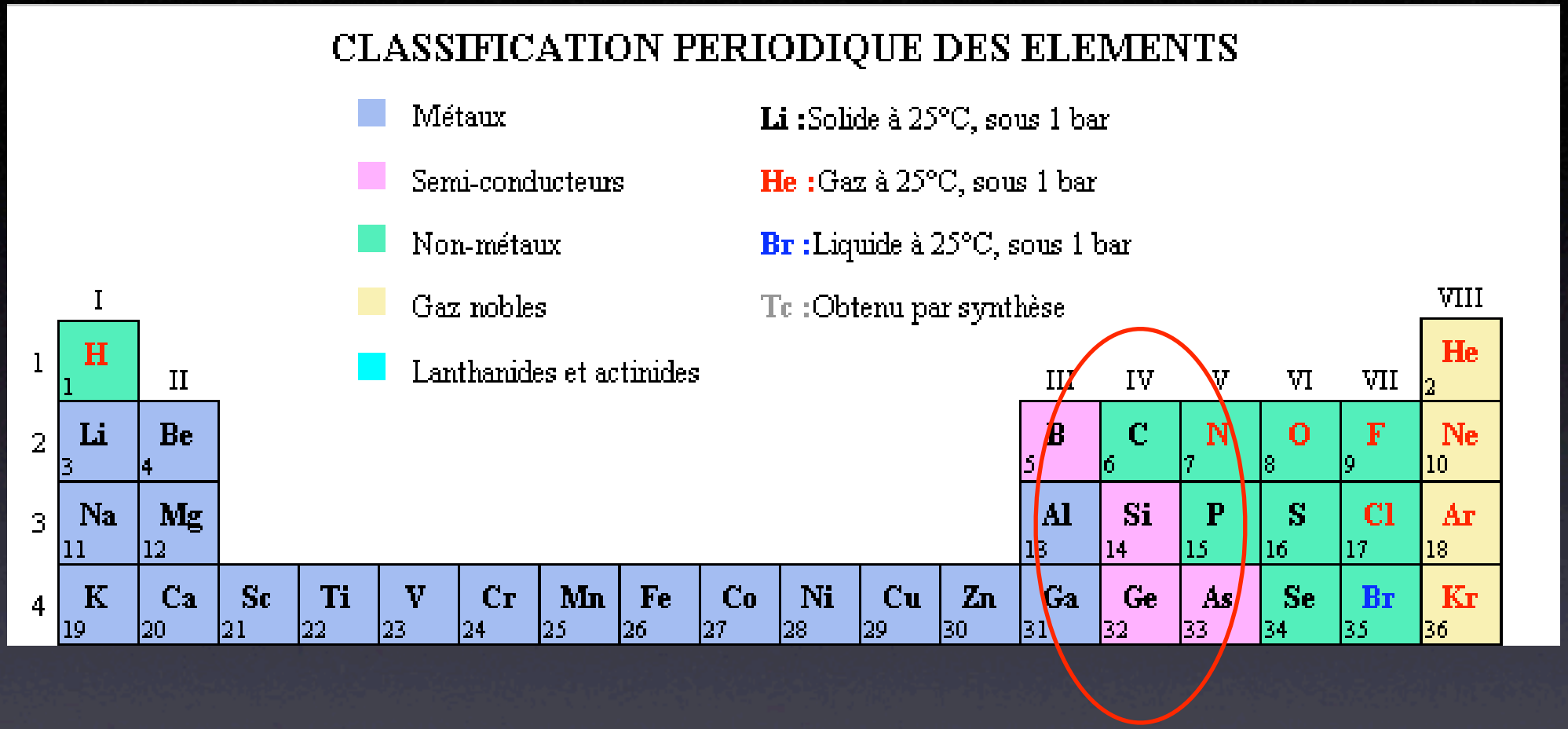


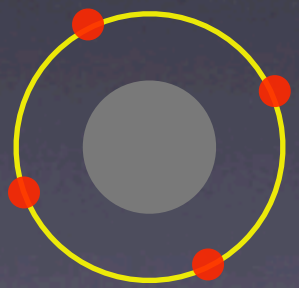
T > 0K

Cristal



Bandes d'énergie



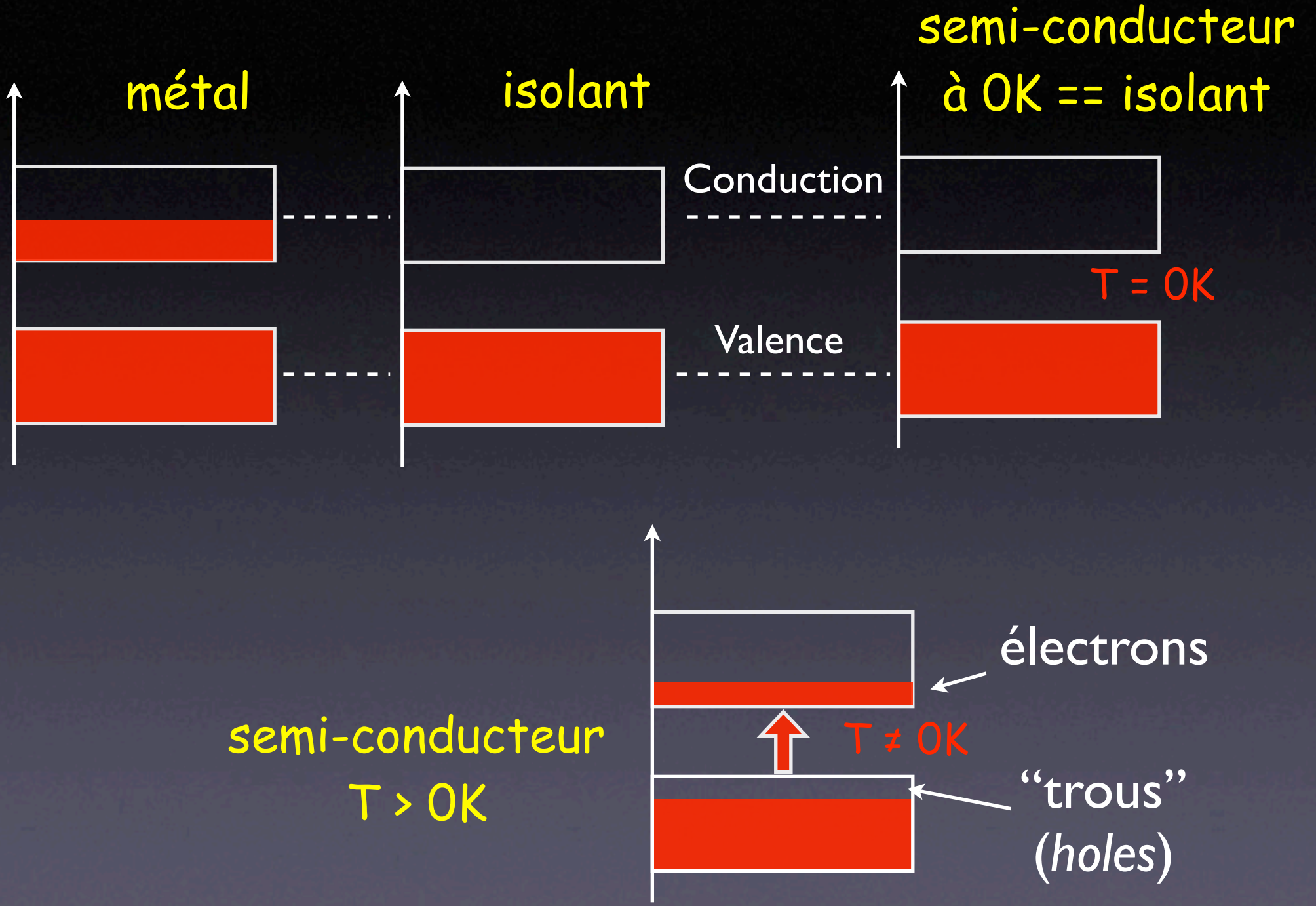


Colonne IV : Si ou Ge

4 voisins : à 0 K, isolant ; à > 0 K : (mauvais) conducteur

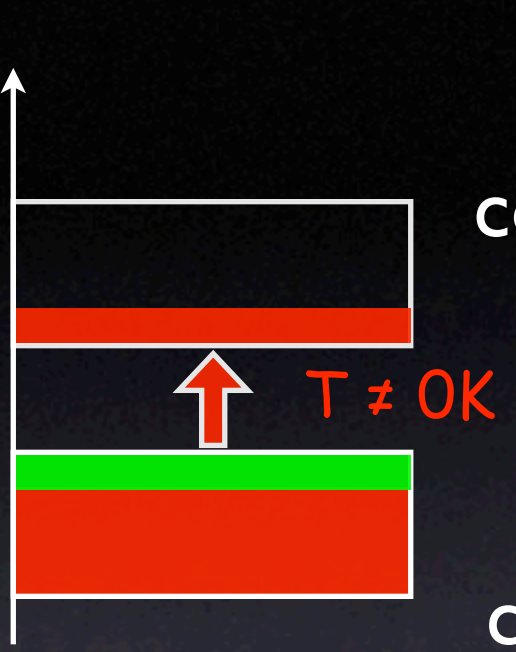
semi

Etat des bandes d'énergie dans un cristal



semi-conducteur

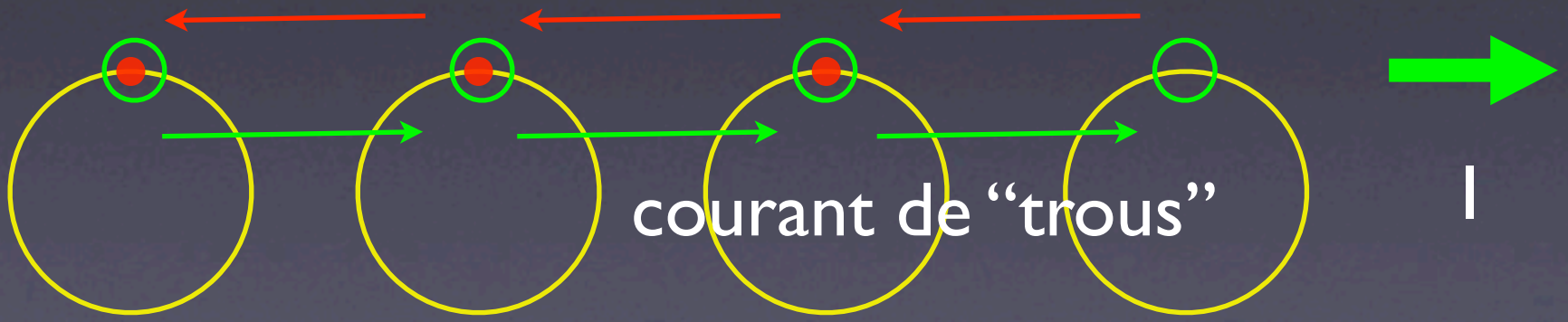
T > 0K



courant d'électrons

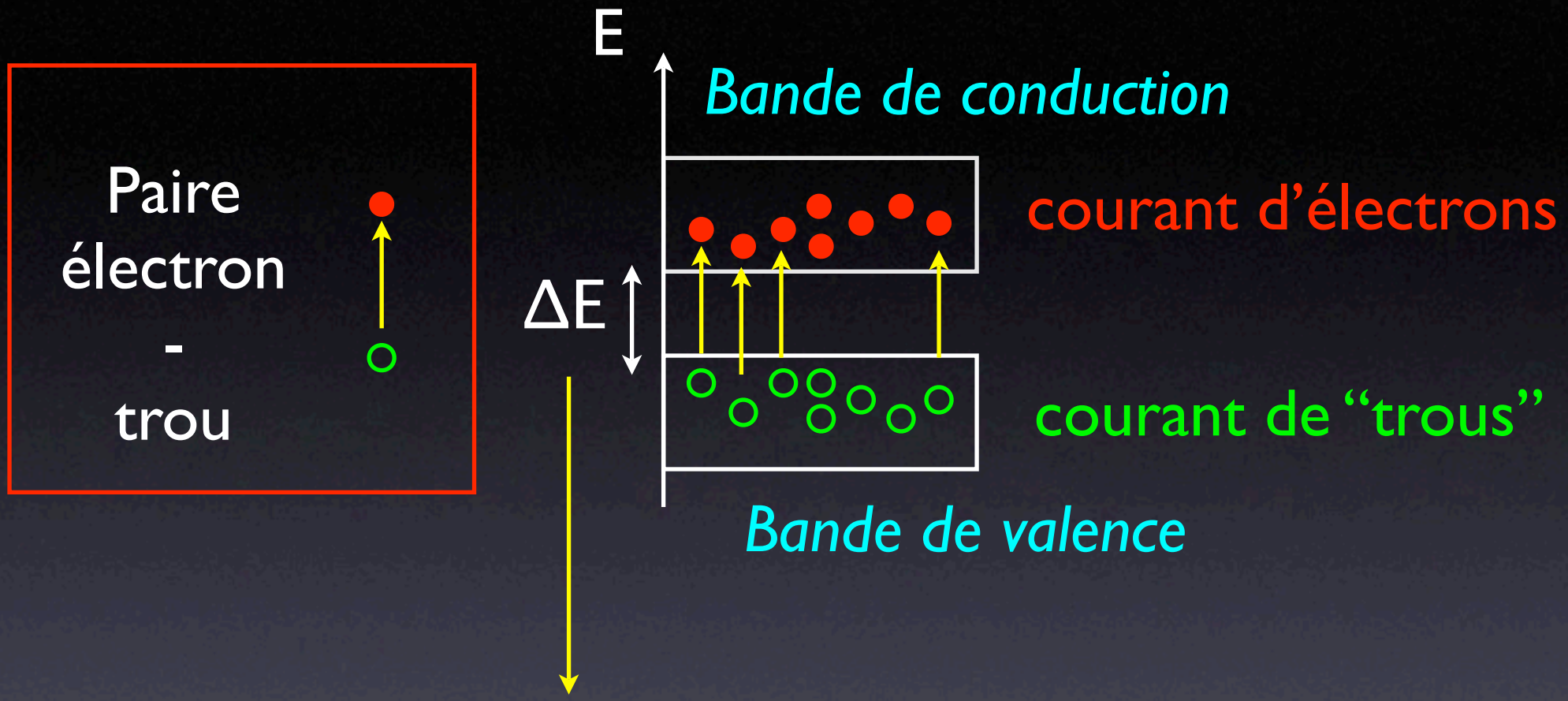
courant de "trous"

courant d'électrons



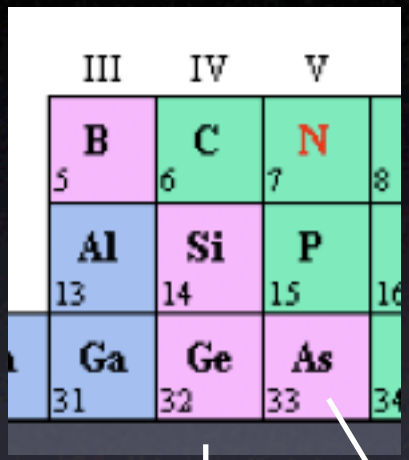
courant de "trous"

I



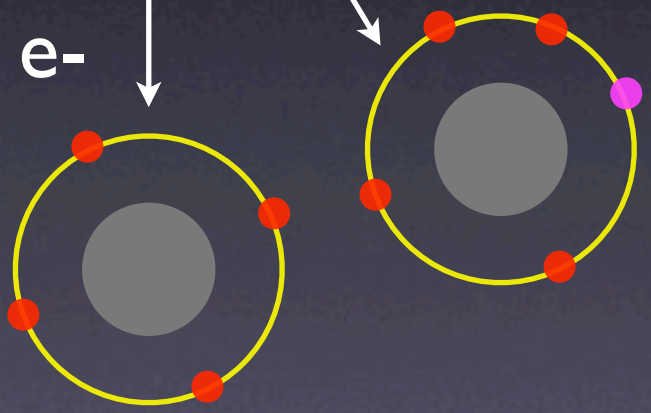
Si : $\Delta E \approx 1$ eV (10^{-19} J)

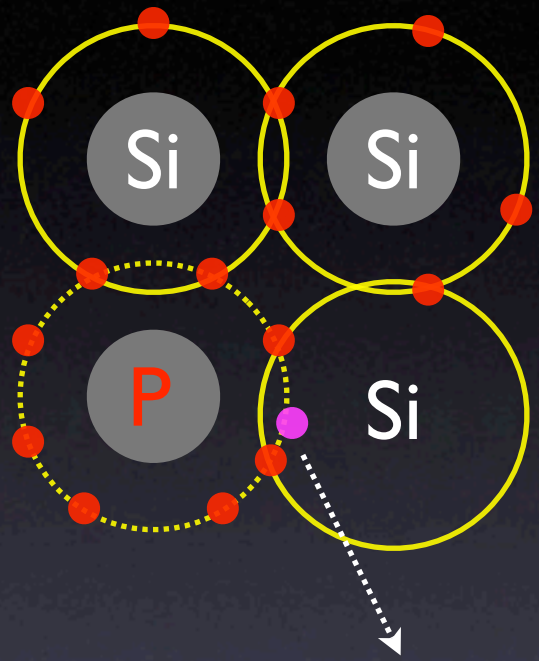
Semiconducteur dopé N (”de type N”)

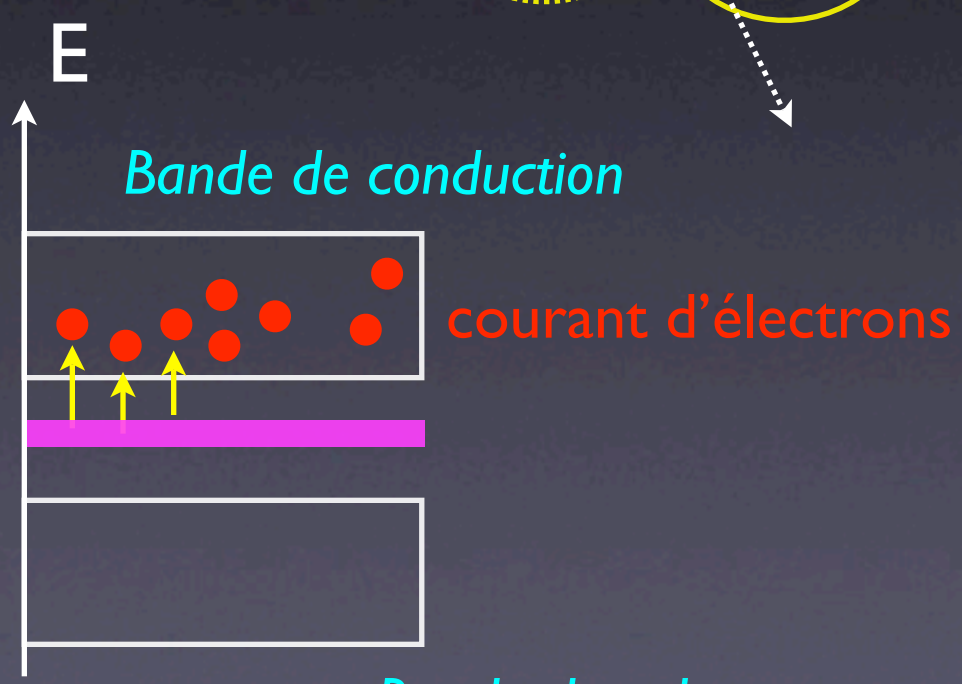


4 e-

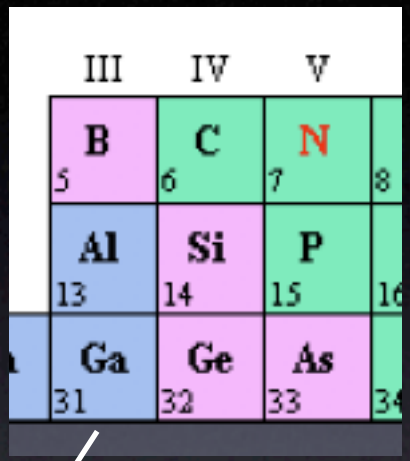
5 e-



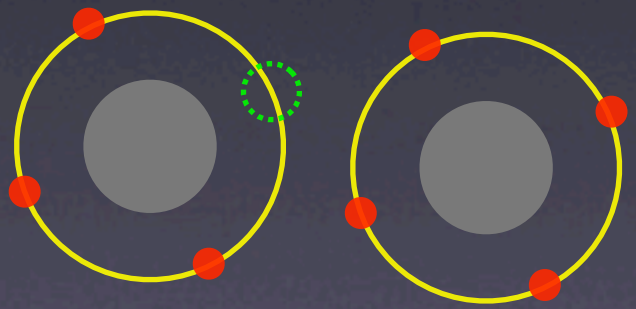




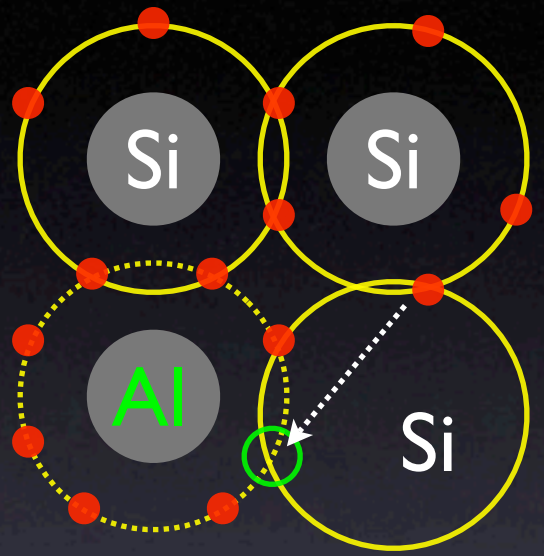
Semiconducteur dopé P (”de type P”)

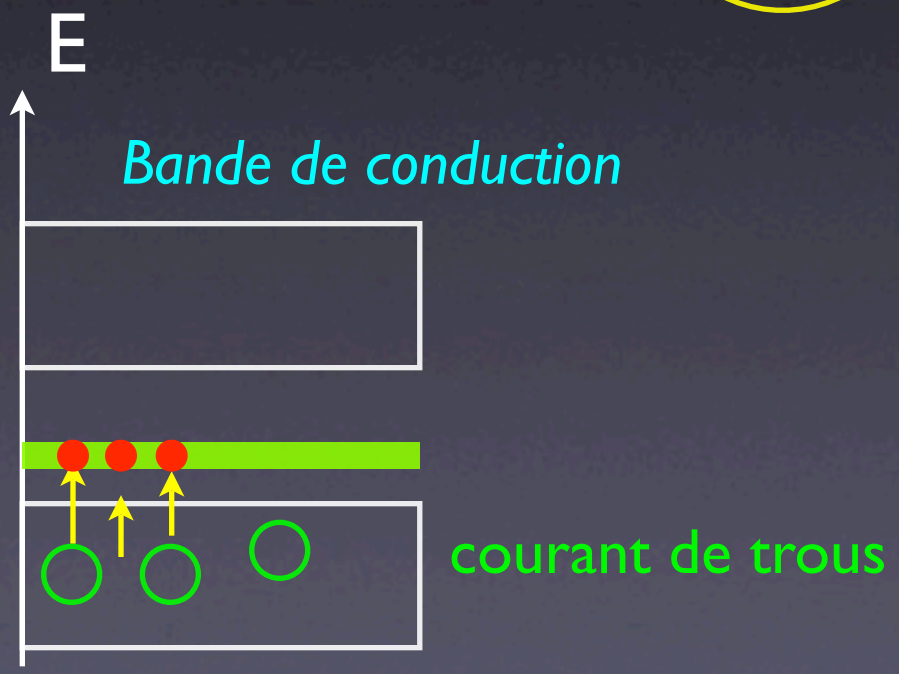


3 e-

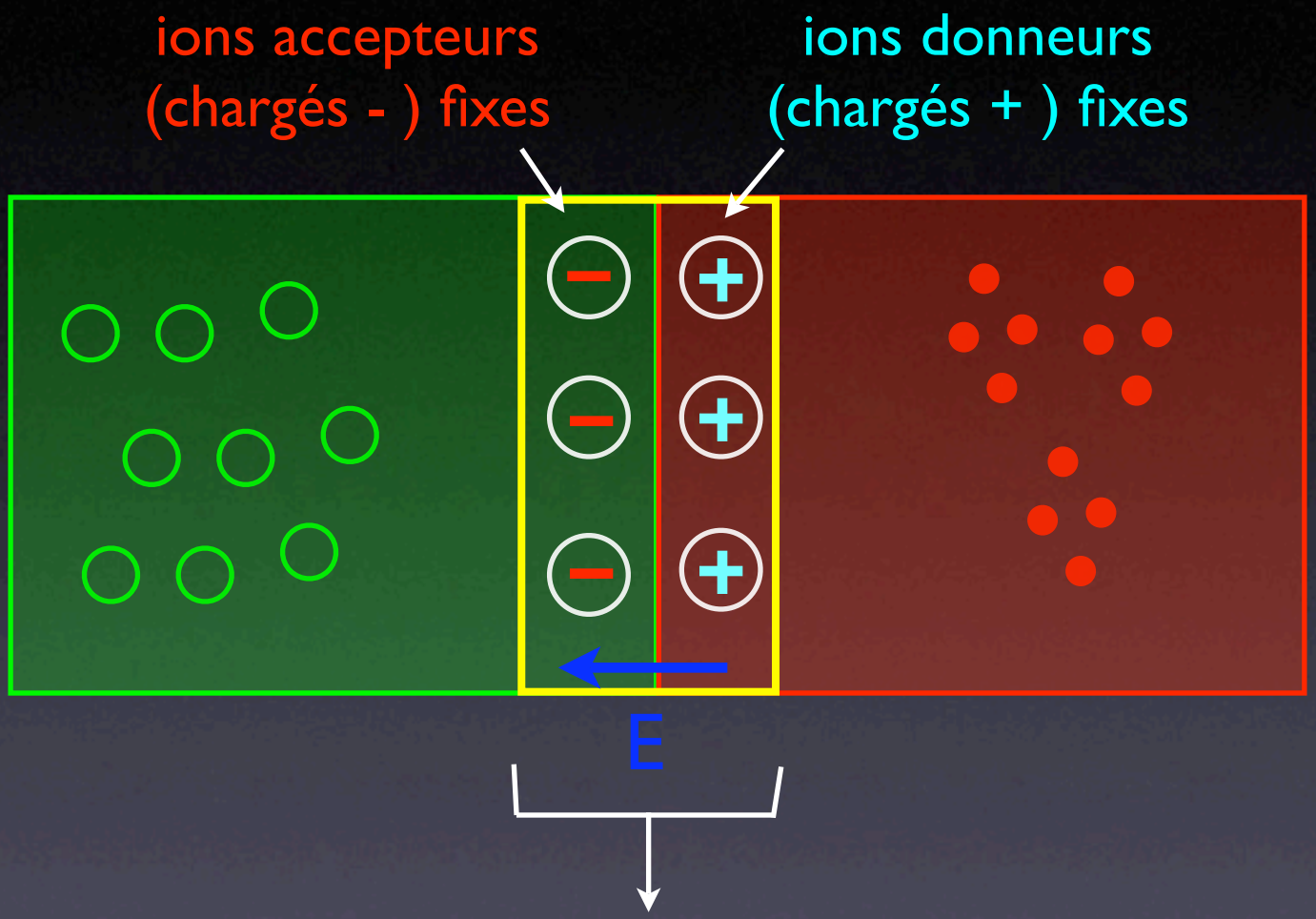


4 e-





Jonction PN

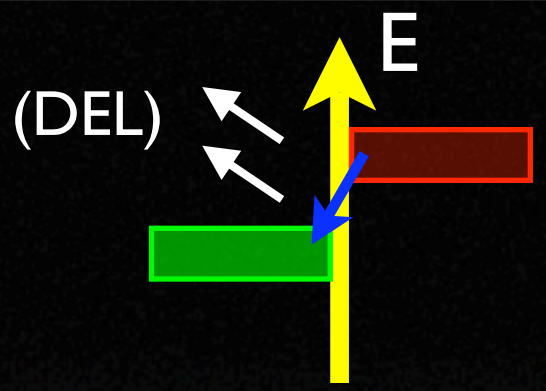


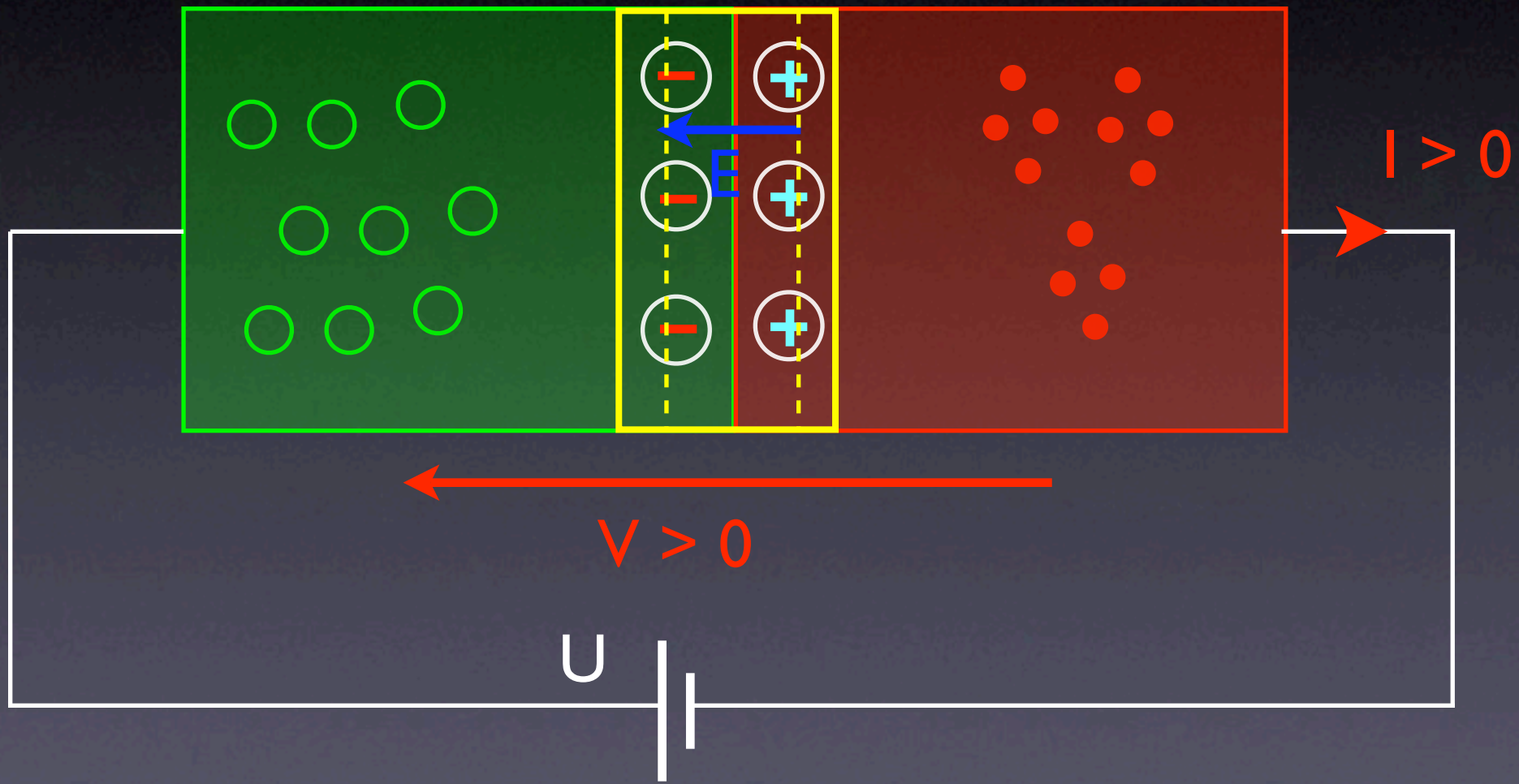
Zone de CHARGE d'ESPACE

$$\int E\,dx = \Delta V$$: barrière de potentiel

(0.6 - 0.8 V)

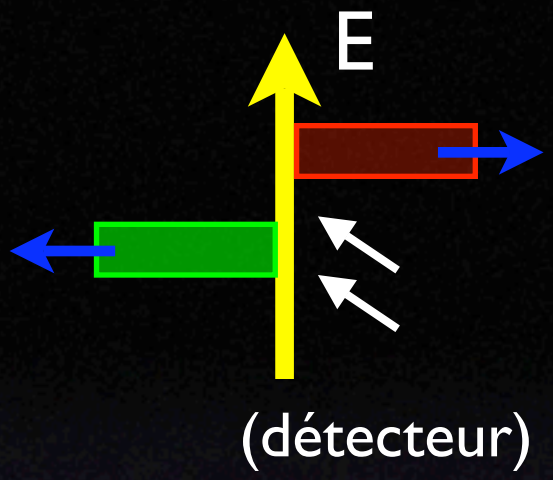
Jonction PN polarisée en direct

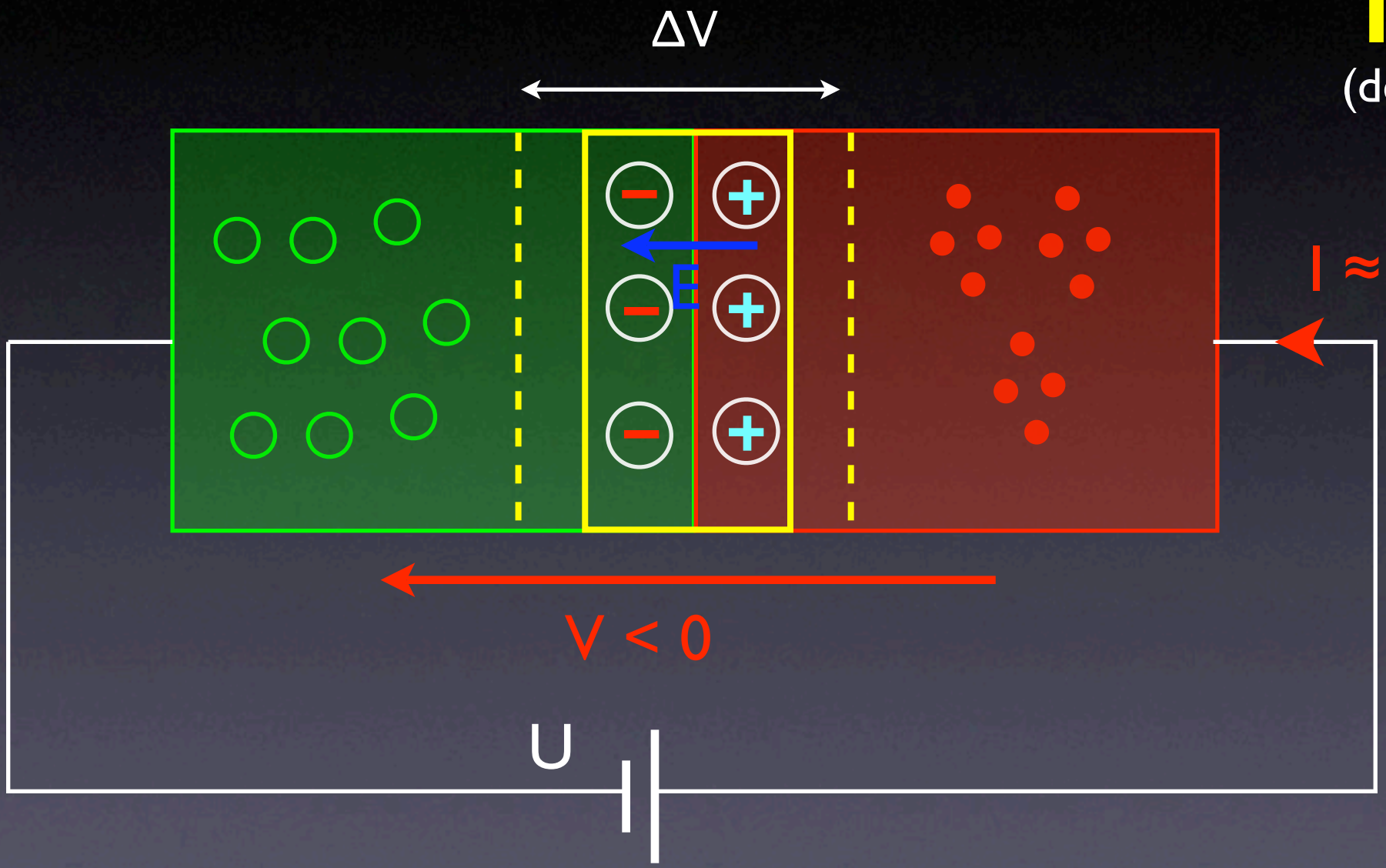




dès que U > ΔV, I est important

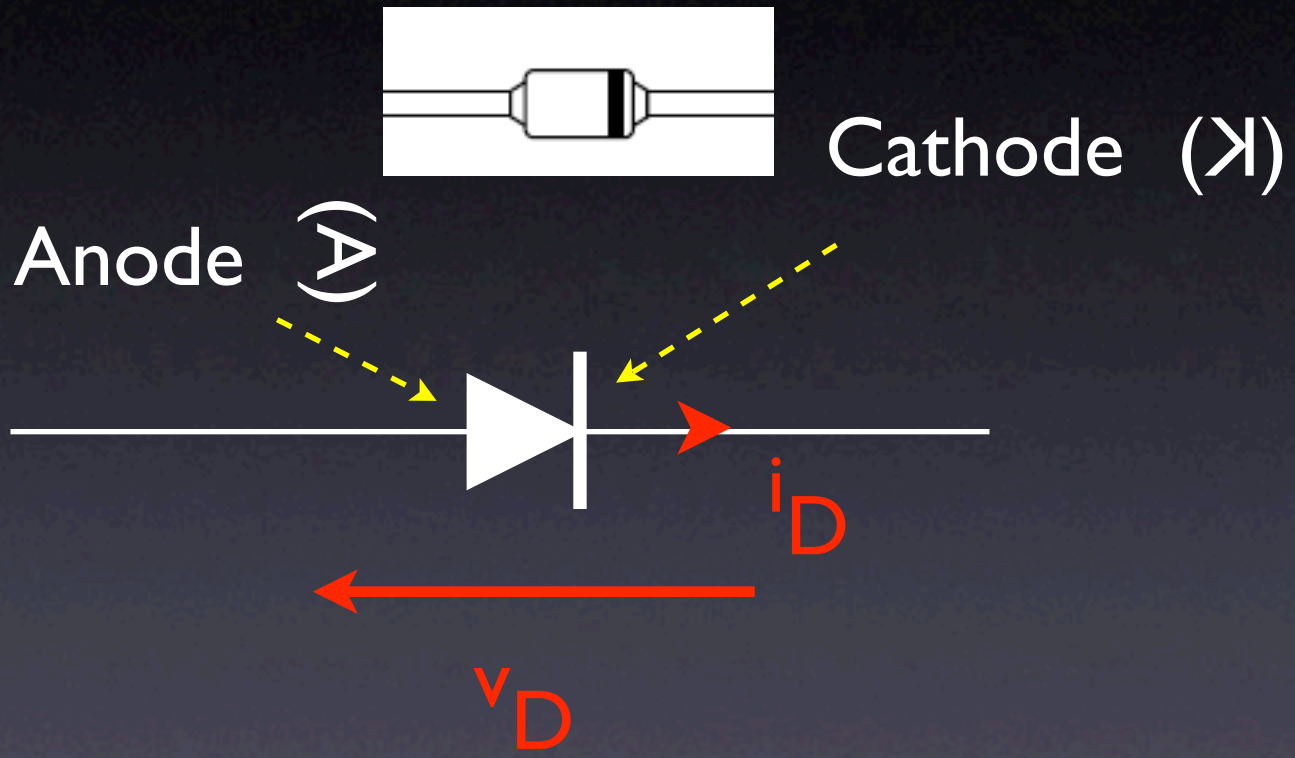
Jonction PN polarisée en Inverse



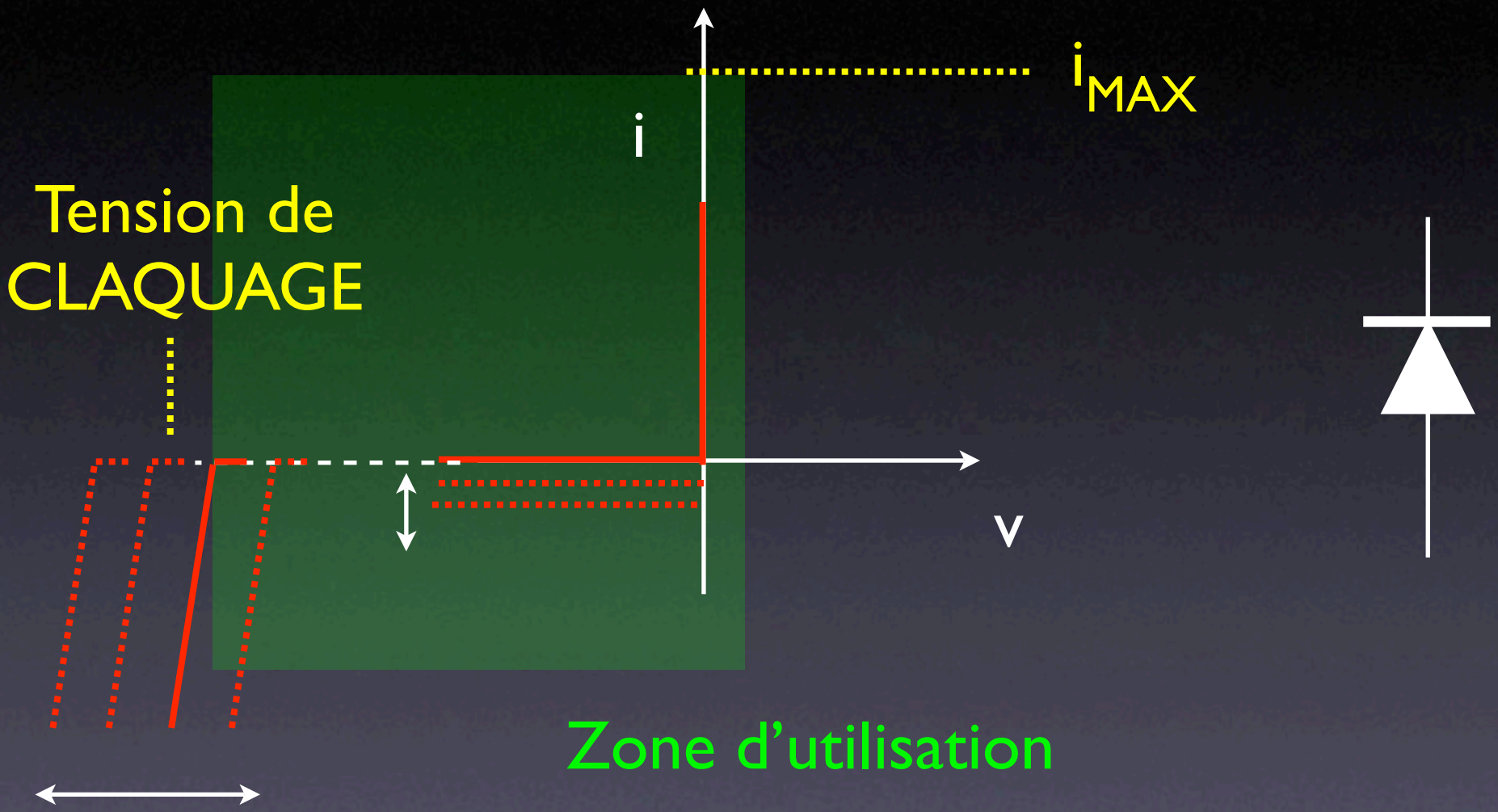


ΔV augmente et I reste très faible

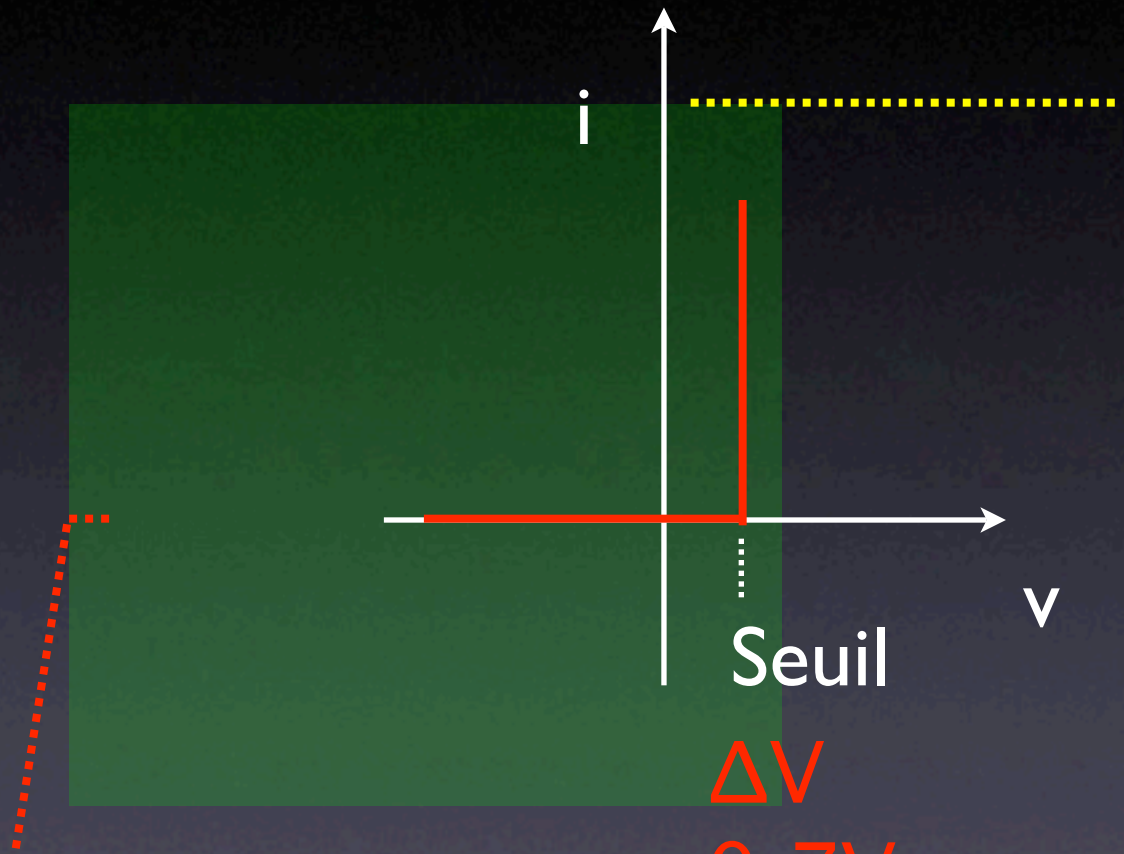
DIODE = dispositif "dysymétrique" unidirectionnel en courant

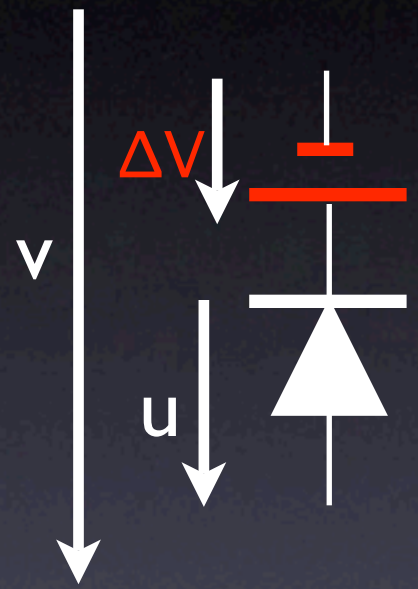


Caractéristique (v,i) de diode
Approximation '0'



Caractéristique (v,i) de diode
Approximation ‘I’



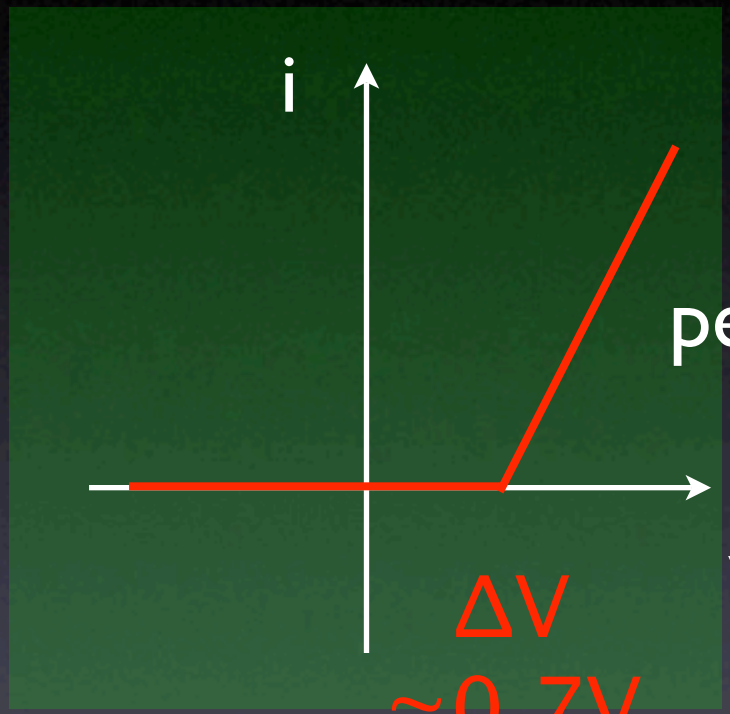


$v = u + \Delta V$

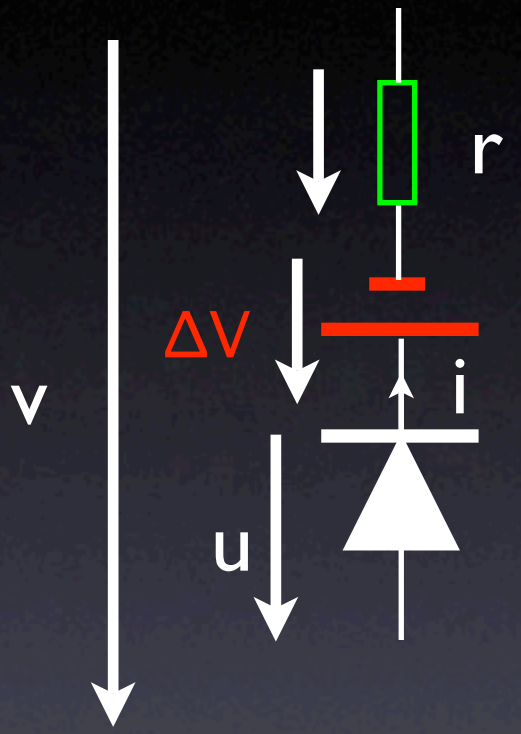
$v > \Delta V \rightarrow u > 0$

diode passante

Caractéristique (v,i) de diode
Approximation 'II'

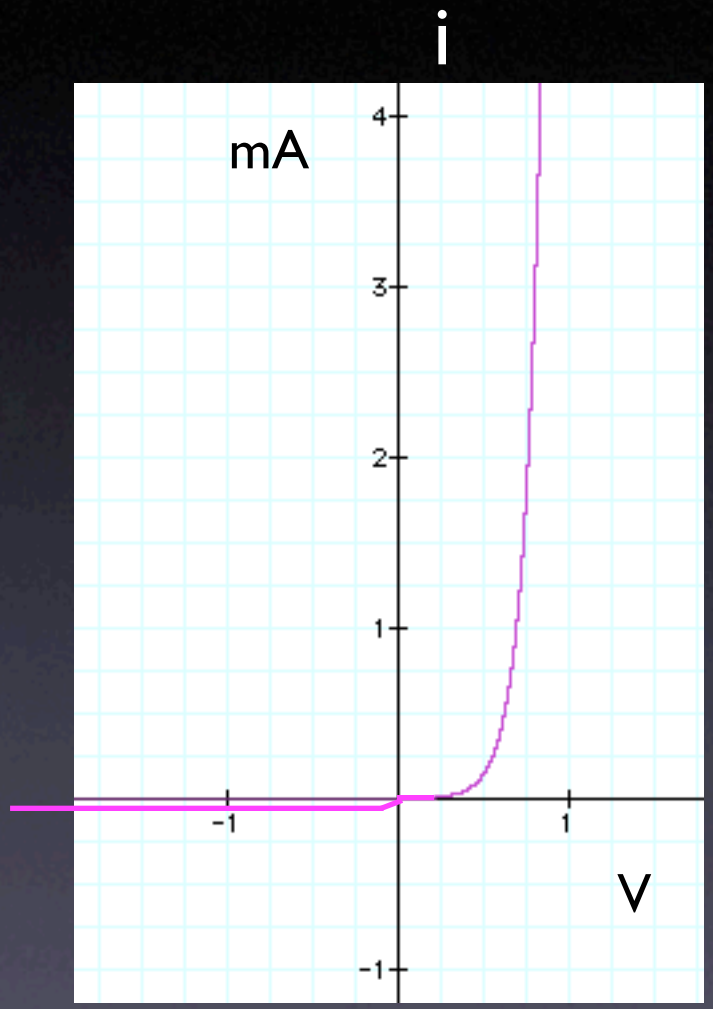


pente ==‘r’



$v = u + \Delta V + ri$

Caractéristique (v,i) de diode
Approximation 'III'

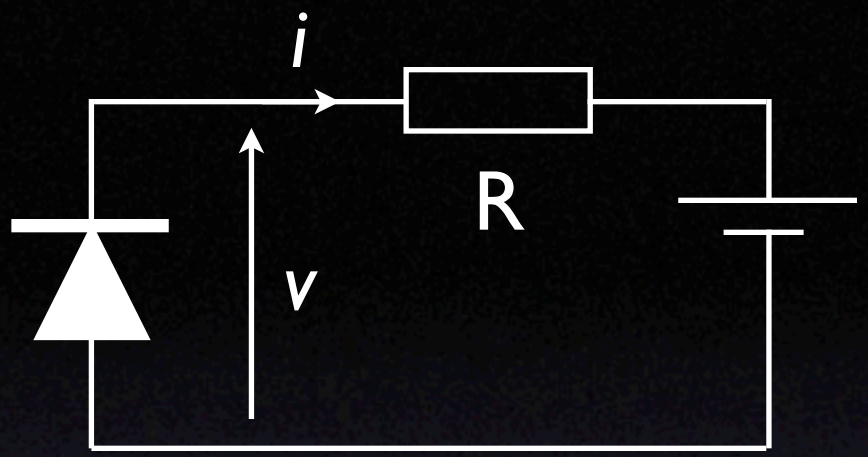


$$i = I_S[\exp(\frac{v}{kT/e}) - 1]$$

I_S

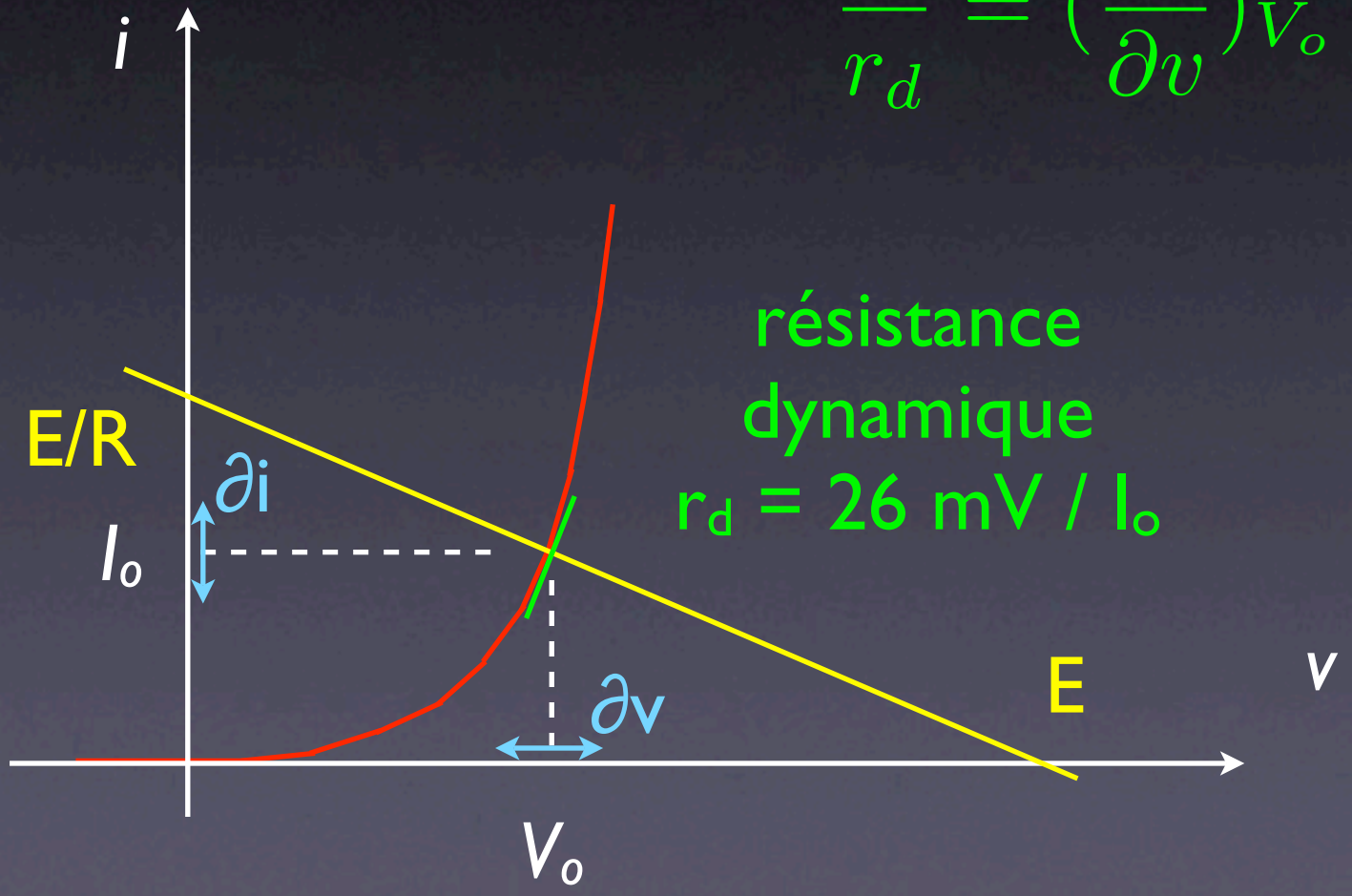
v

kT/e ≈ 26 mV (@ 300K)



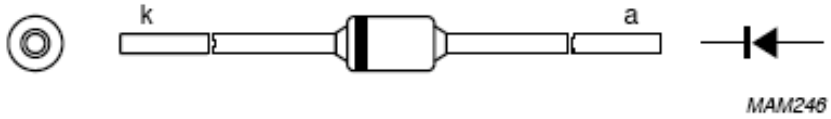
$$i = I_S[\exp(\frac{v}{kT/e}) - 1]$$

$$\frac{1}{r_d} = (\frac{\partial i}{\partial v})V_o = \frac{I_o}{26\,\mathrm{mV}}$$



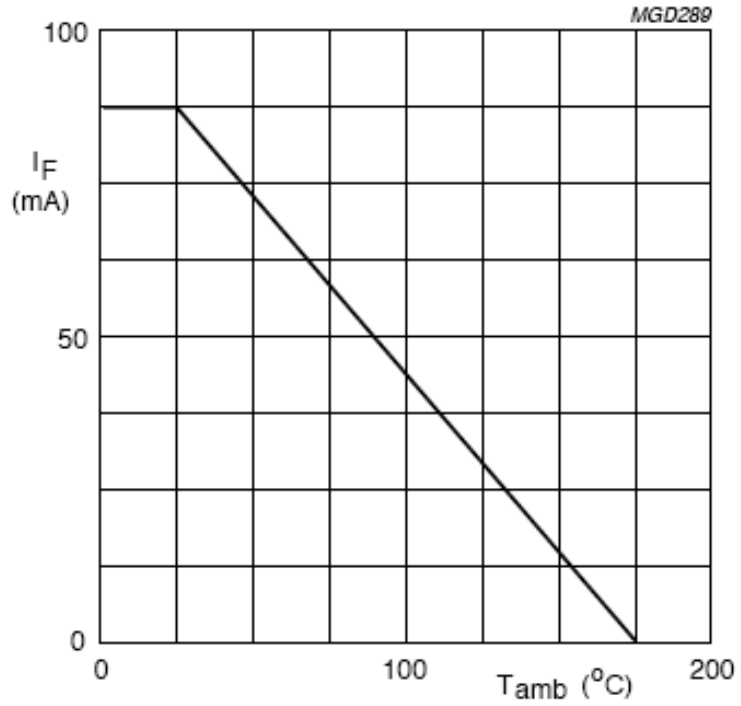
résistance
dynamique
r_d = 26 mV / I_o

1N914
High-speed diode



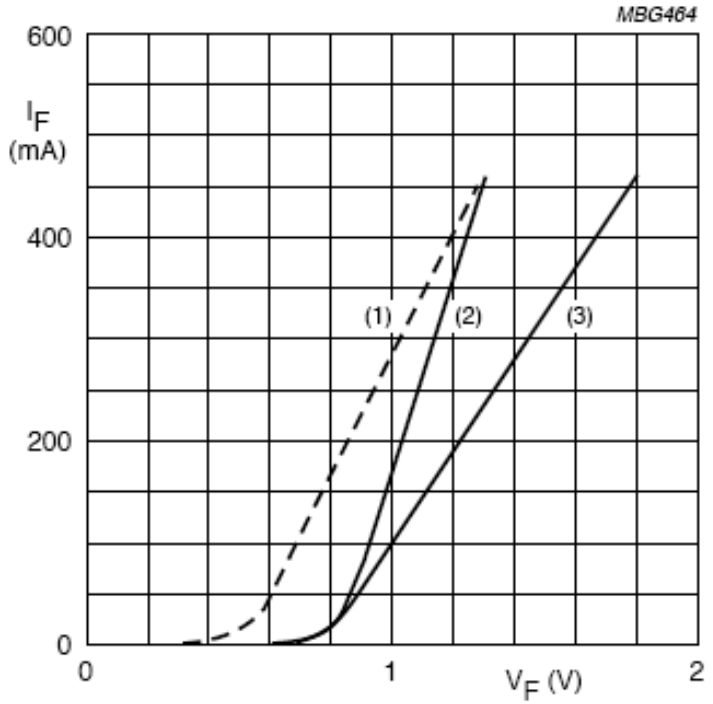
The diode is type branded.

Fig.1 Simplified outline (SOD27; DO-35) and symbol.



Device mounted on an FR4 printed-circuit board; lead length 10 mm.

Fig.2 Maximum permissible continuous forward current as a function of ambient temperature.



(1) T_j = 175 °C; typical values.
(2) T_j = 25 °C; typical values.
(3) T_j = 25 °C; maximum values.

Fig.3 Forward current as a function of forward voltage.

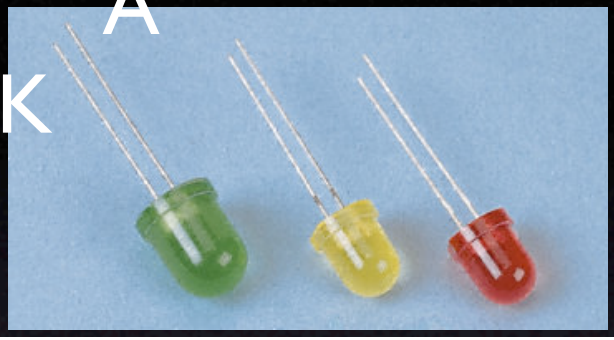
Applications des diodes
Redressement

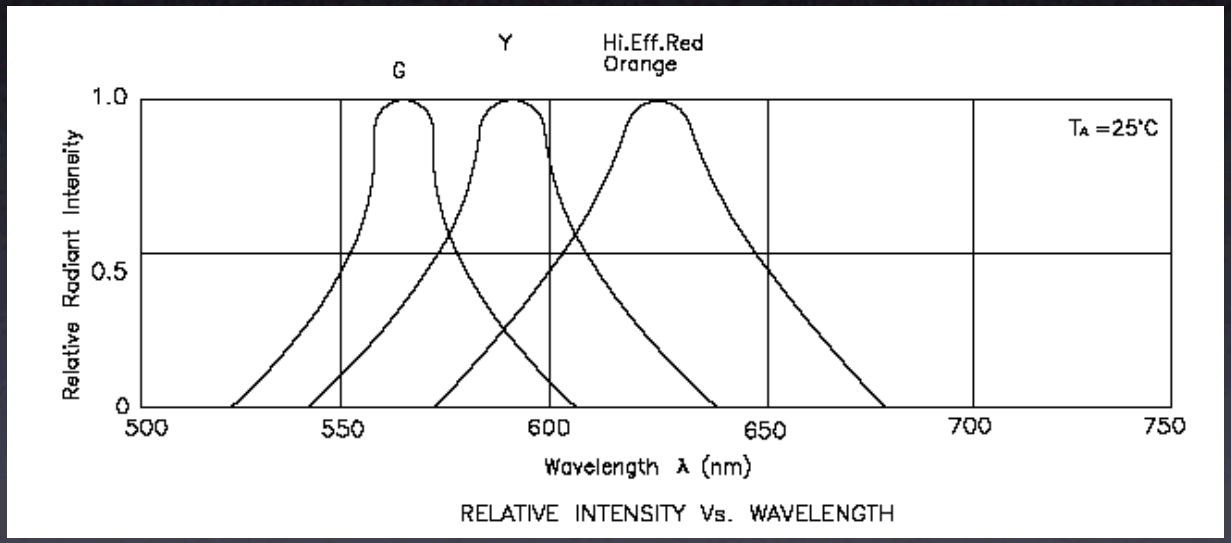
DIODES PARTICULIERES

- DEL (LED)
- Photodiode
- coupleur opto-électronique
- Varicap
- Diode Zener

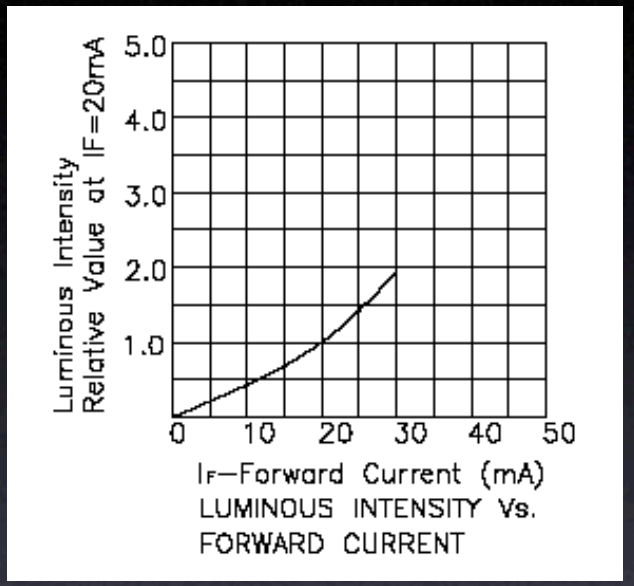
Polarisation directe : Diode ElectroLuminescente (DEL)

Light Emitting Diode (LED)

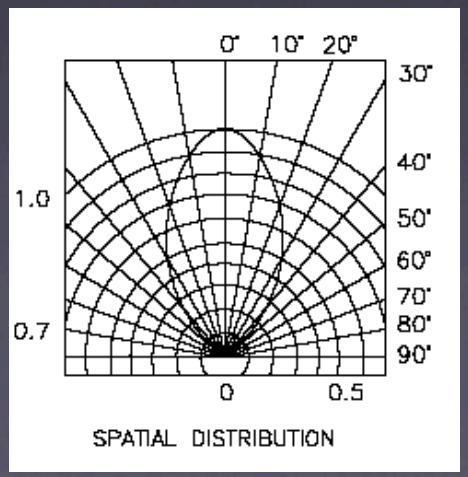




RELATIVE INTENSITY Vs. WAVELENGTH

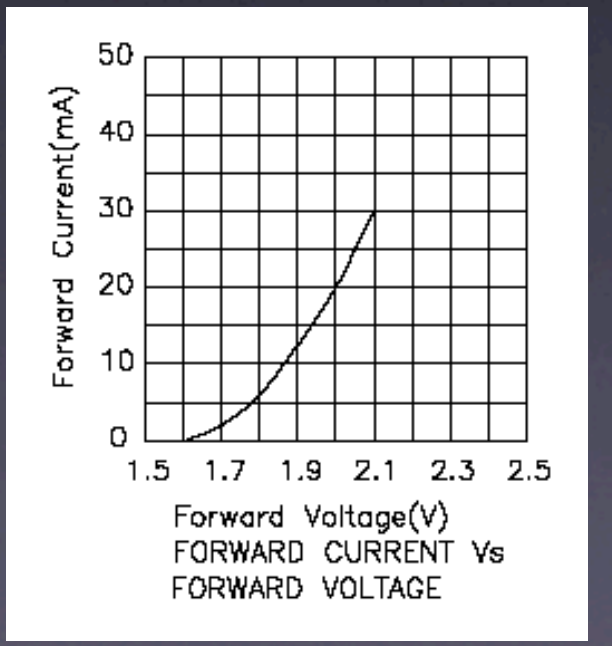


LUMINOUS INTENSITY Vs.
FORWARD CURRENT



SPATIAL DISTRIBUTION

DIODES PARTICULIERES

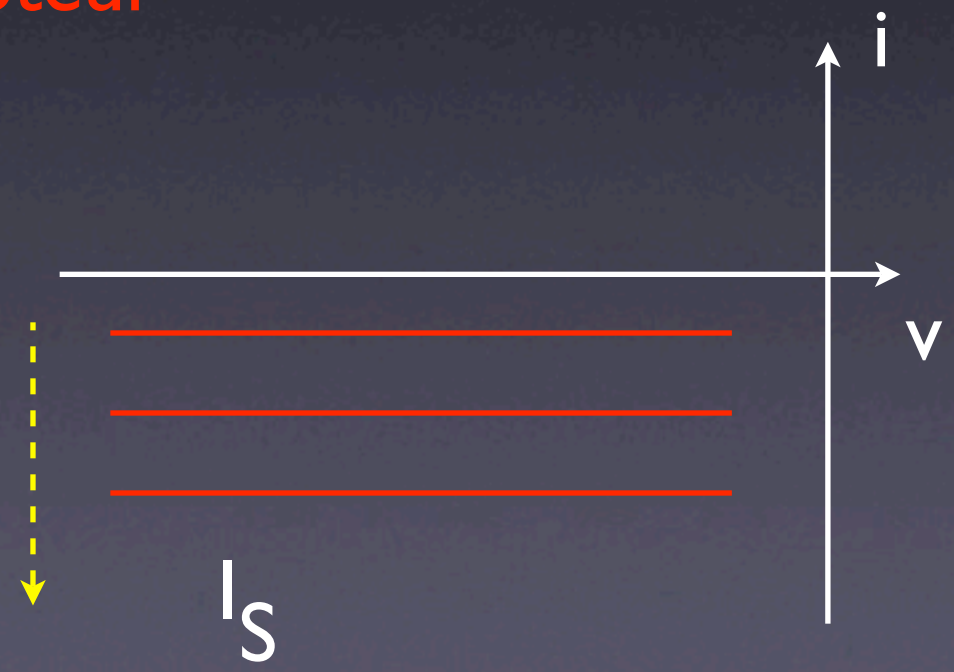


FORWARD CURRENT Vs
FORWARD VOLTAGE

DIODES
PARTICULIERES

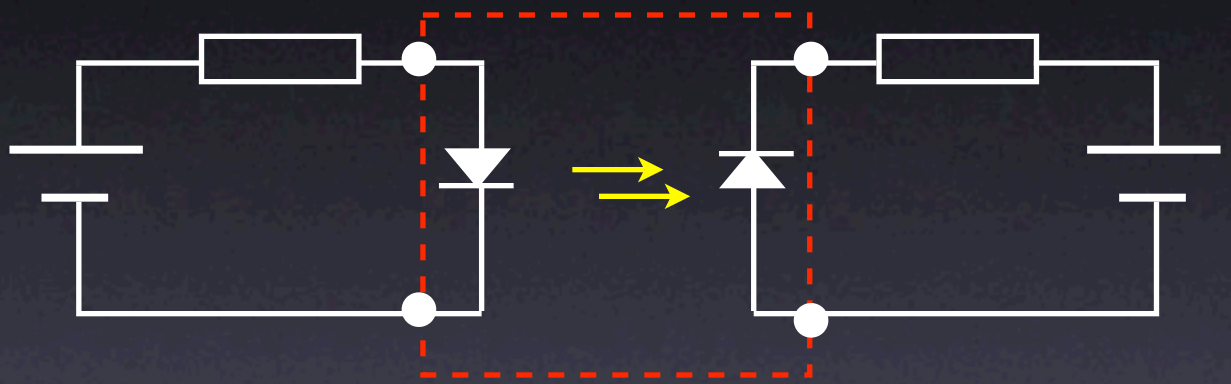
Photodiode

- polarisée en inverse
- sous flux de photons, I_S varie : I_S α Flux incident
- photodiode = capteur



DIODES PARTICULIERES

Coupleur OPTO-ELECTRONIQUE

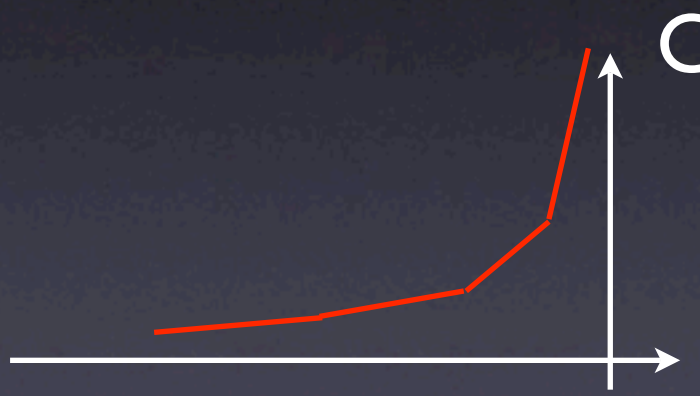


séparation des masses

DIODES PARTICULIERES

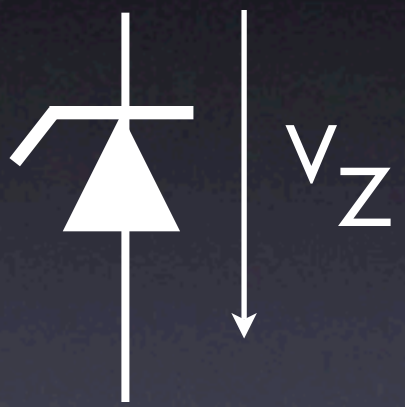
VARICAP

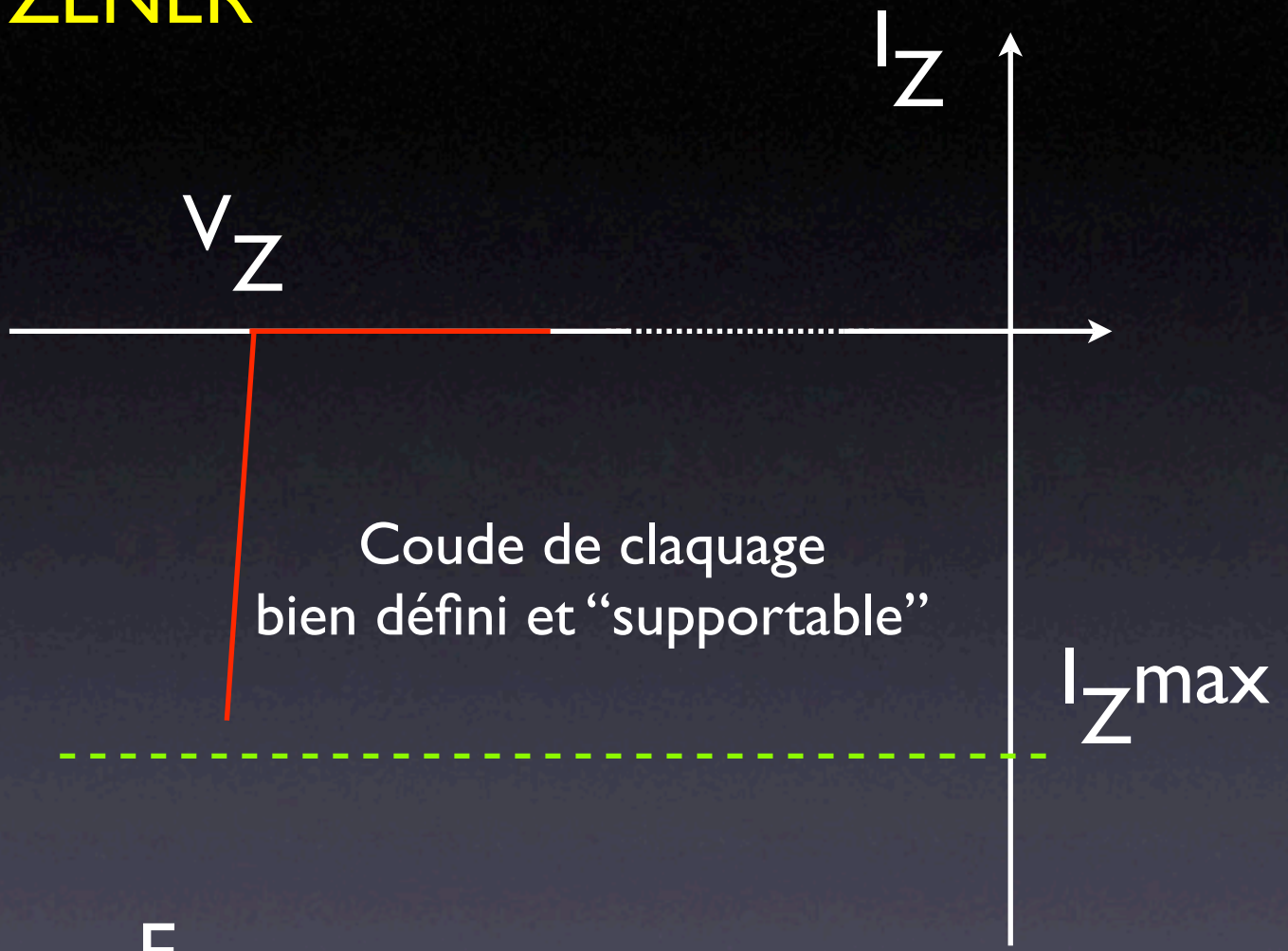
Polsarisation en inverse : capacité variable (ZCE)



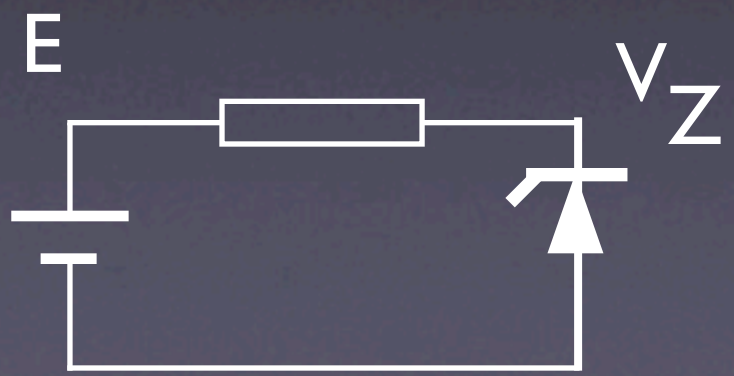
exe : 1N5142 15pF / -4V (5pF / -60 V)

Utilisation de la tension de claquage diode ZENER



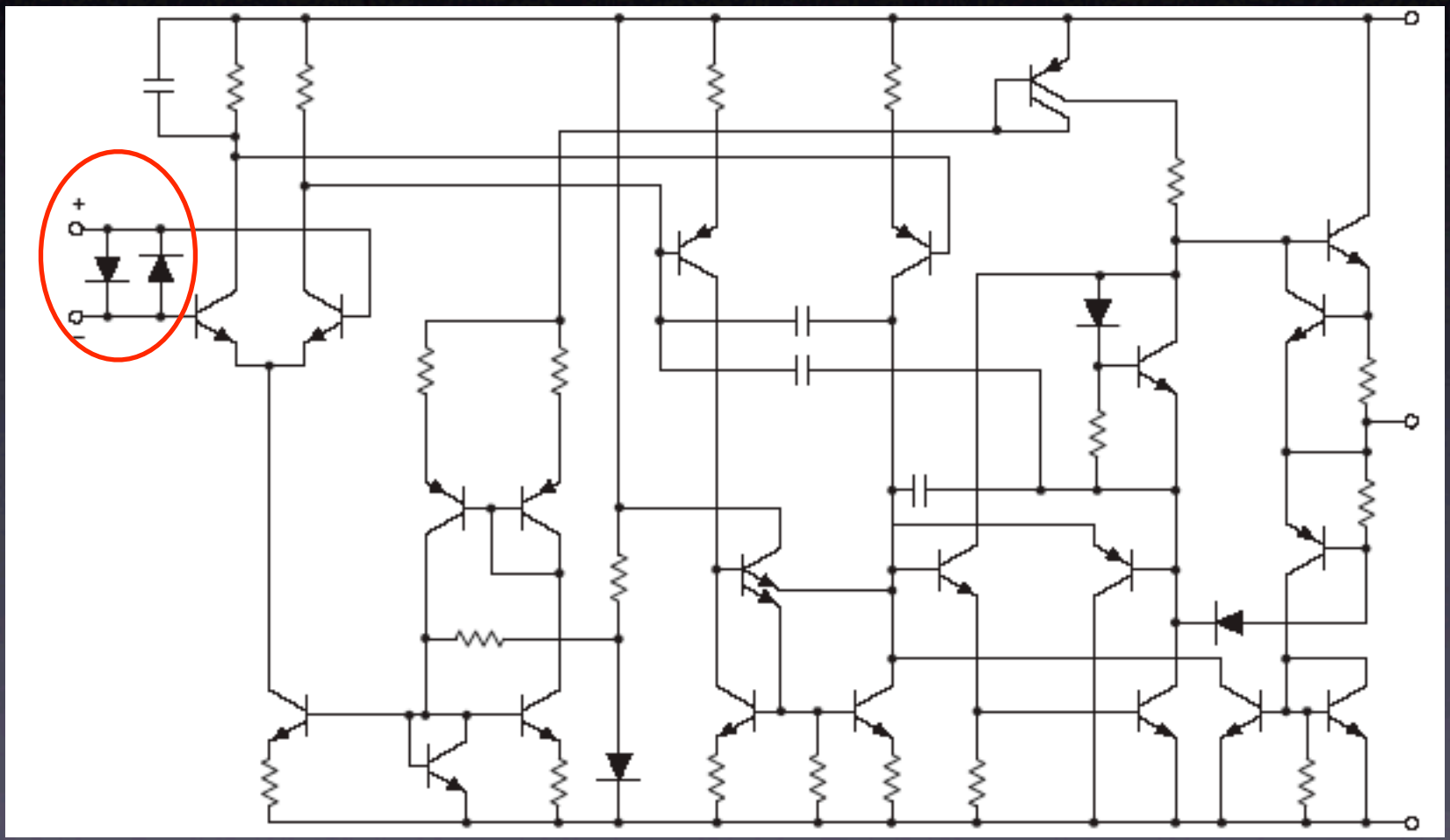


Régulation de tension



Applications des diodes
Ecrêtage (protection)

protection
entrée
Ampli-OP



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Leds 8 et 10 mm clignotantes (4)

Leds 8 et 10 mm rouges haute luminosité (6)

Leds standard 8 et 10 mm (6)

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