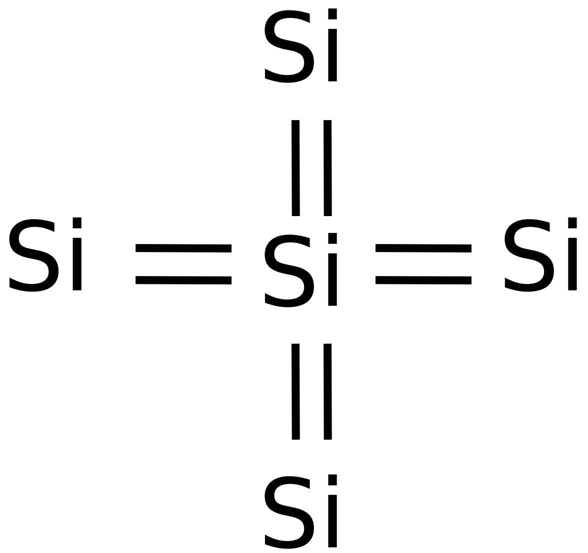
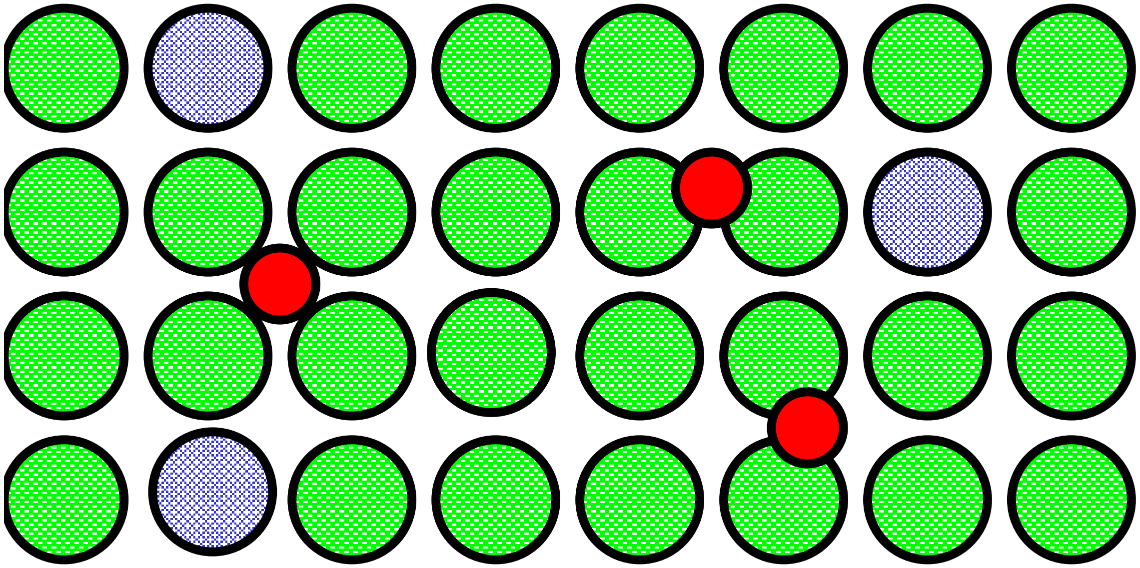
Intrisic Semiconductor



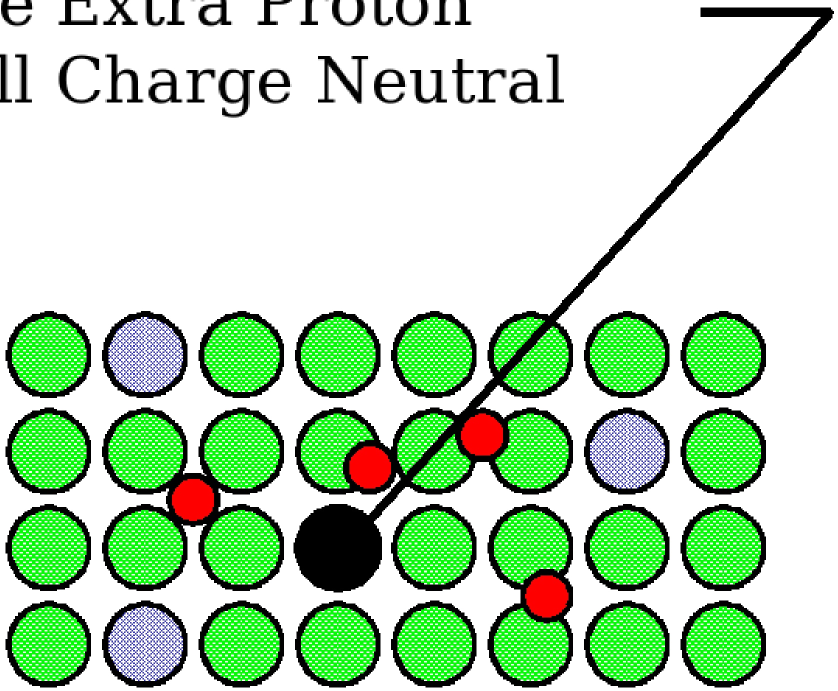
Covalent Bonds

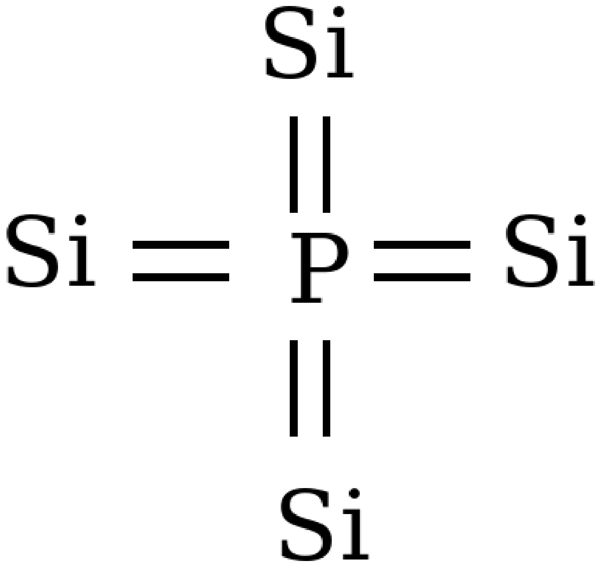


Red free electrons,
blue missing bound electrons,
green neutral

N–Doped Semiconductor

N-Doping
Phosphorus has Valence=5
One Extra Valence Electron
One Extra Proton
Still Charge Neutral



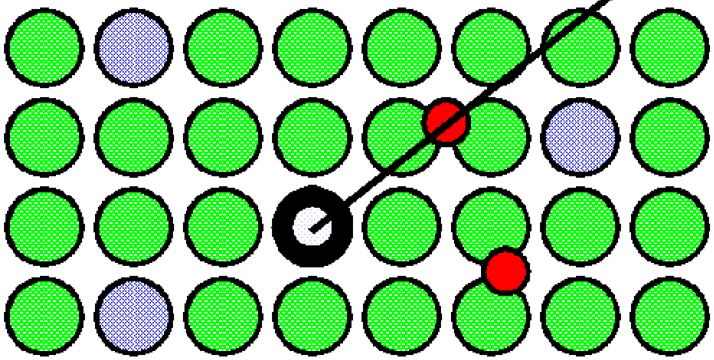


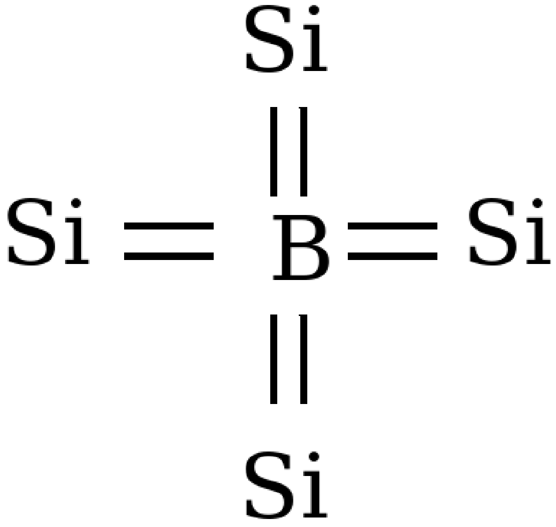
$$\begin{array}{ccc} & \mathrm{Si} & \\ & \| & \\ \mathrm{Si} = & \mathrm{P} & = \mathrm{Si} \\ & \| & \\ & \mathrm{Si} & \end{array}$$

Electrons Are
Majority Carriers

P–Doped Semiconductor

P-Doping
Boron has Valence=3
Short One Valence Electron
One Free Electron Replaces It
Short One Proton
Still Charge Neutral

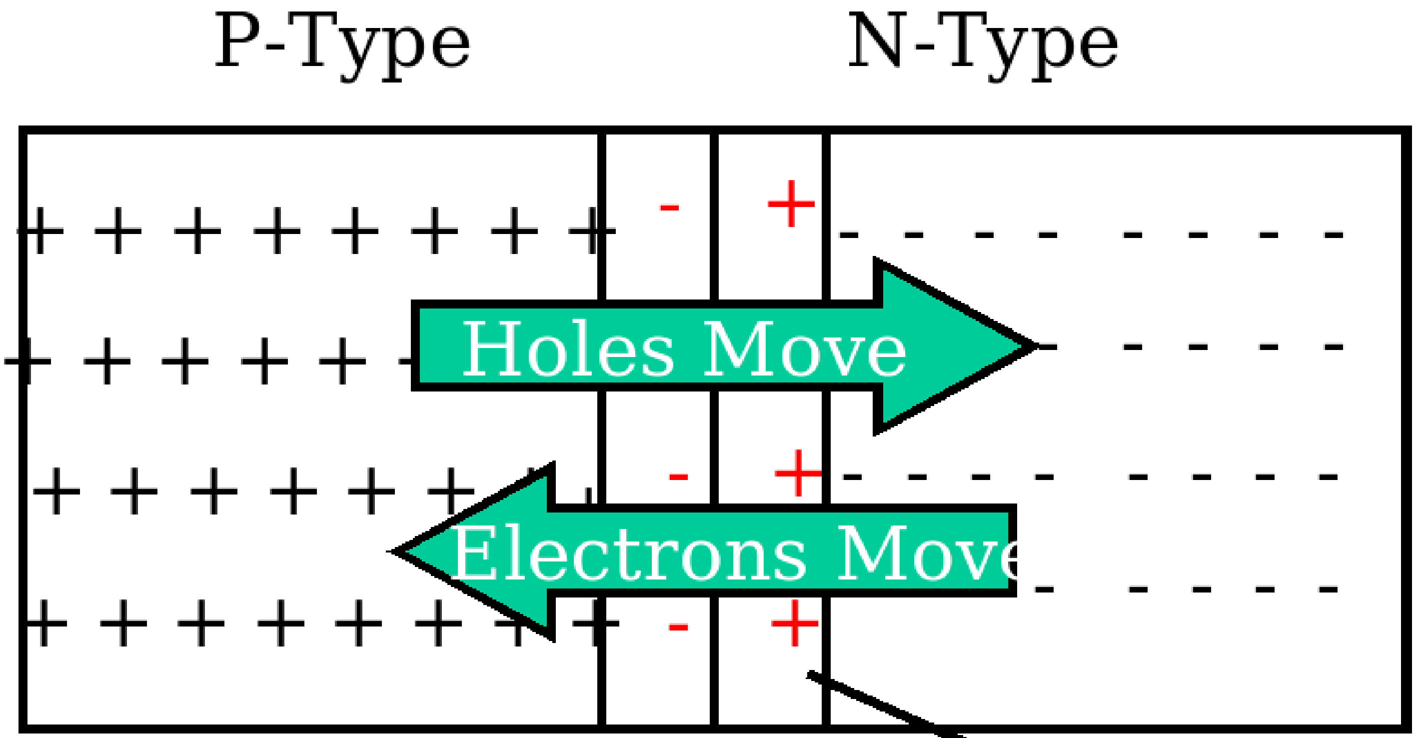




$$\begin{array}{ccc} & \mathrm{Si} & \\ & \| & \\ \mathrm{Si} = & \mathrm{B} & = \mathrm{Si} \\ & \| & \\ & \mathrm{Si} & \end{array}$$

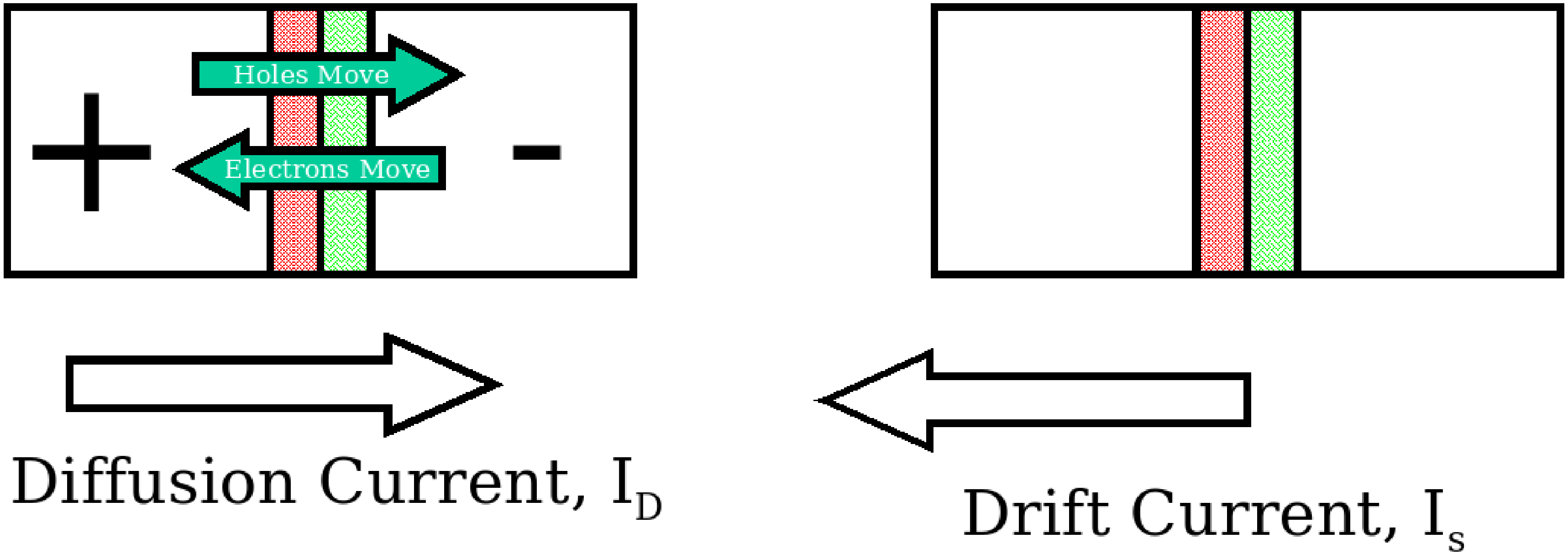
Holes Are Majority Carriers

Junction



Free charges diffuse across boundary and Expose Bound Charges

Diffusion and Drift (Zero Bias)



$$I_D = I_S$$