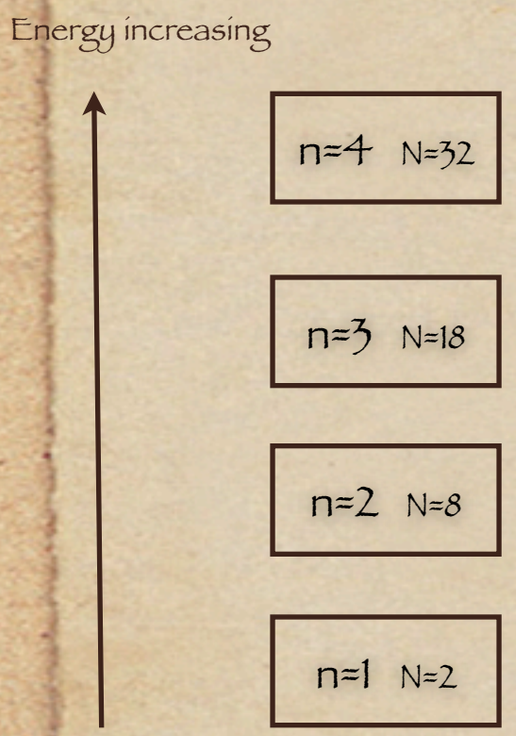
Lecture 20

May 18, 2012



atomic levels

n= Principal Q N
N= number or e's accomodated

Metal

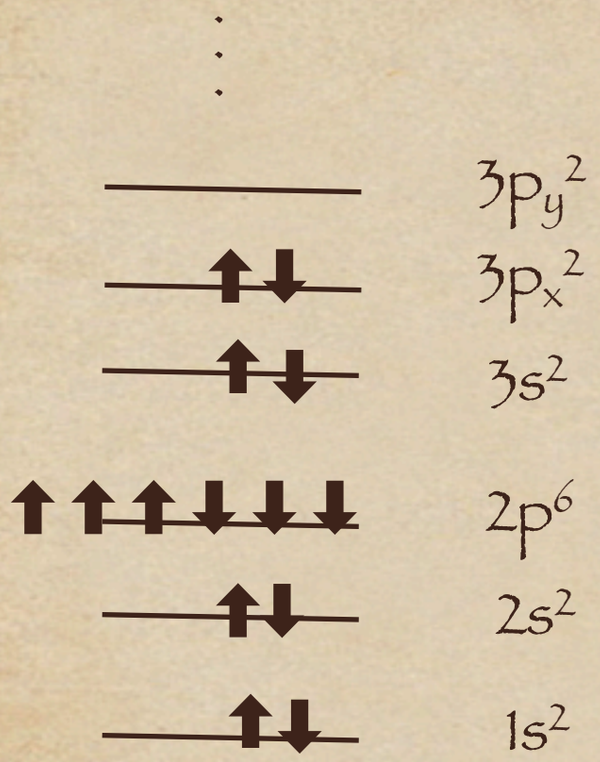
Semiconductor

e.g. Si

Solid= array of atoms

Fermi Level= Energy of top most occupied energy level.

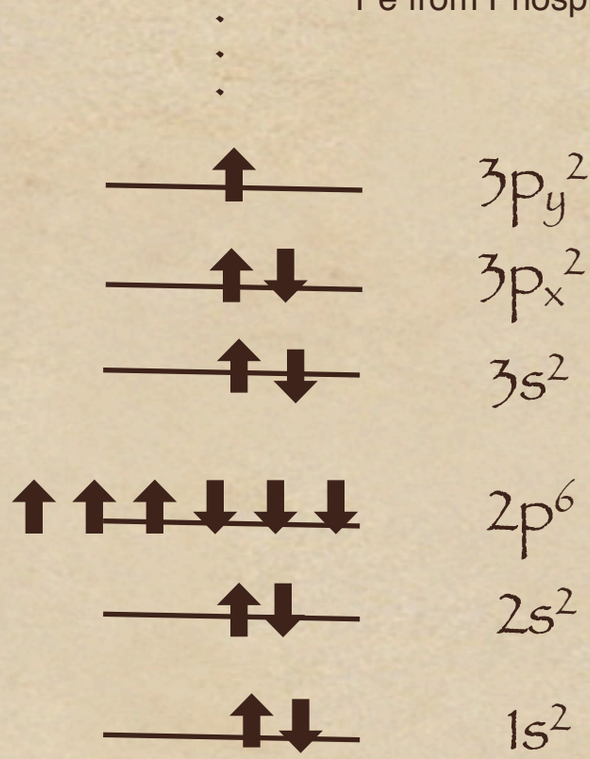
Silicon



Si

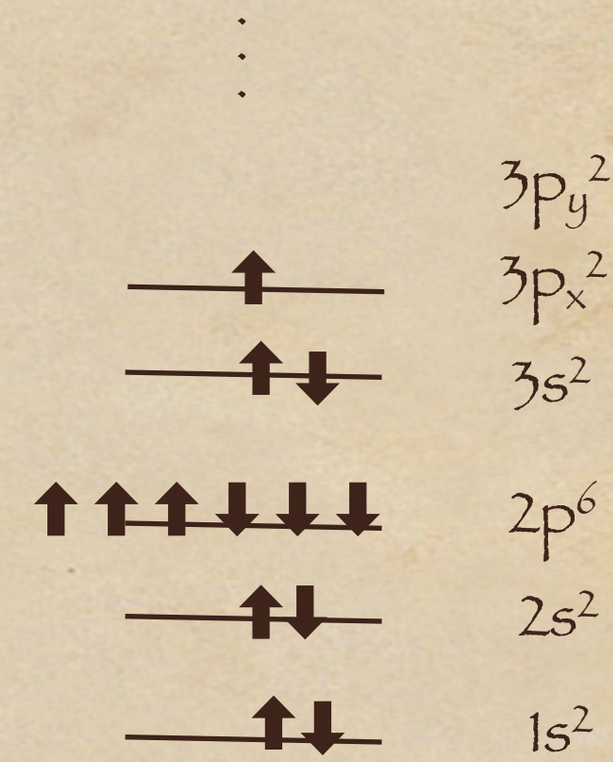
Z=14

Silicon +
1 e from Phosphorous



e doped Si

Silicon
-1 e to Boron



hole doped Si

Silicon

Empty Conduction band

Fermi Level

Filled Valence Band

n-Silicon

Partially empty cond. band

Fermi Level

Added electrons by doping with Phosporous

Filled Valence Band

p-Silicon

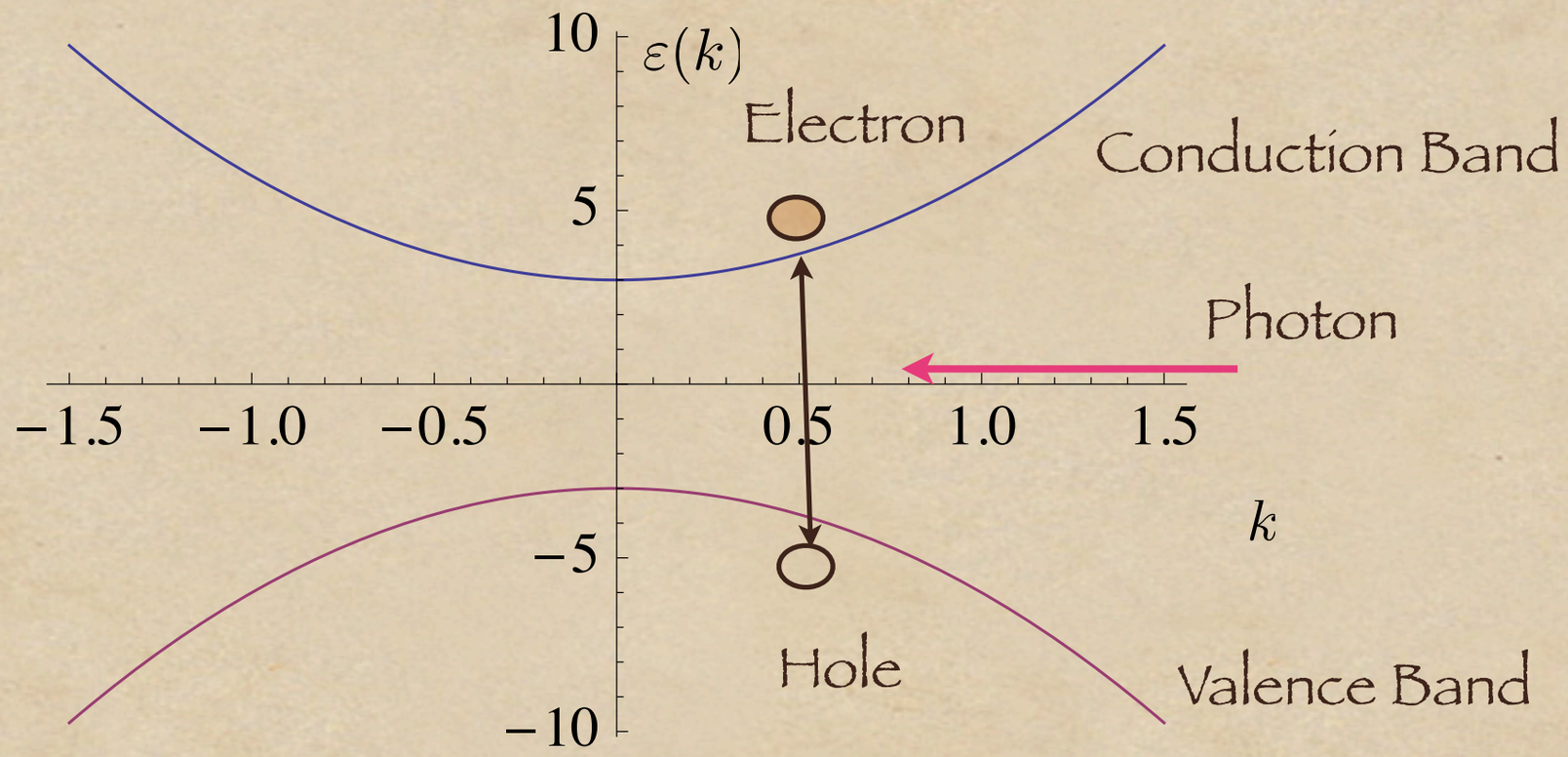
Added Holes by doping with Boron

Empty Conduction band

Partially Filled Valence Band

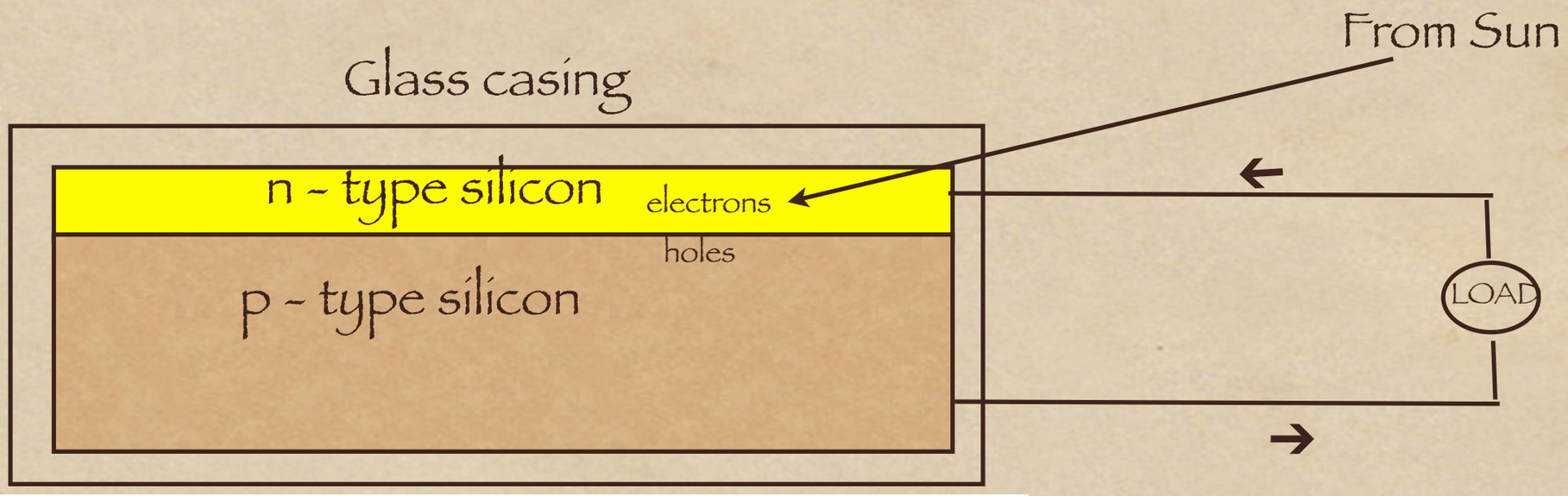
Fermi Level

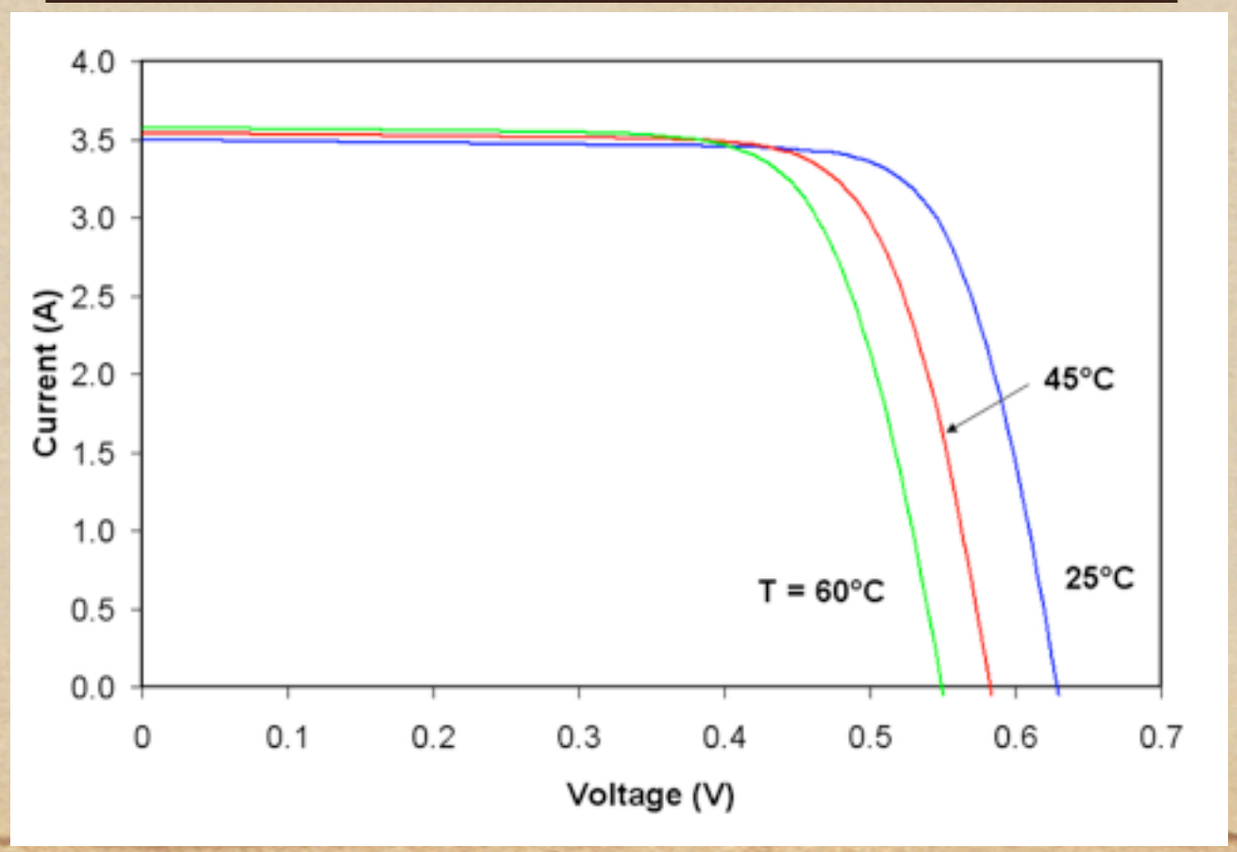
Semiconductor
Picture of optical excitations



Photoelectric effect and p-n junctions and Photovoltaics

Each cell ~ 2” dia and 1/16” thick- stack up some 50 of them to get a voltage of 20/25 volts





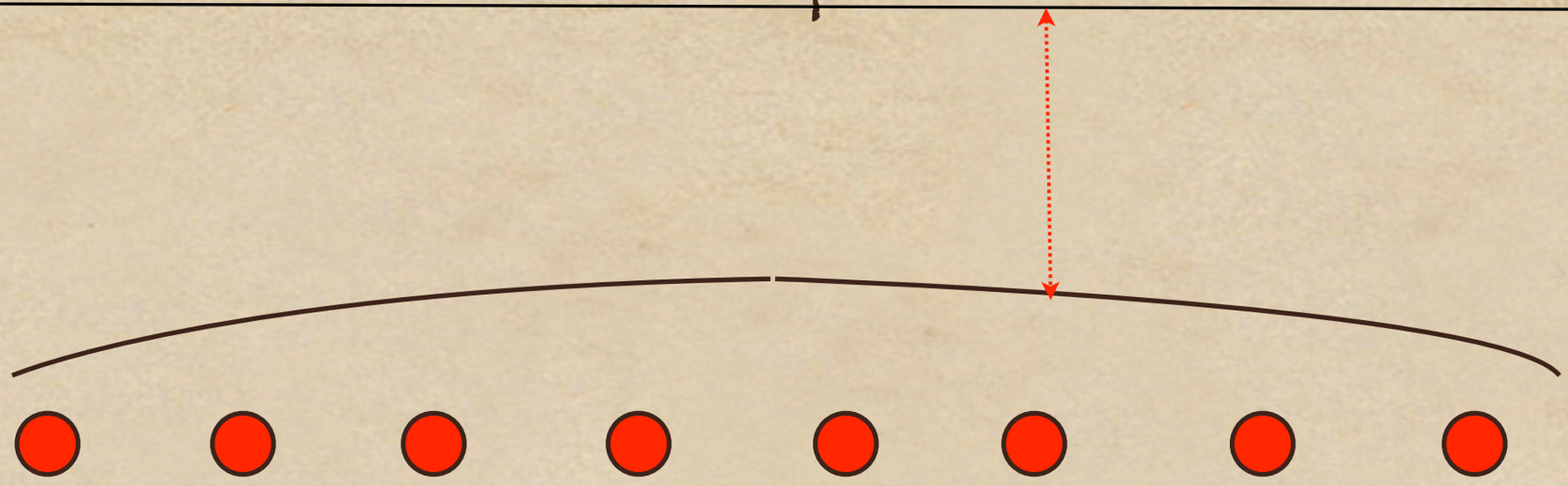
Efficiency of solar cells:

Ratings:
Peak power W_p, the electrical power output when we have $1000W/m^2$ incident at 25^0C

	Efficiency	Manufacturing cost $/ Wp
Si single crystal	14-17%	2.9-4.0
Si amorphous	5-8%	2.00-3.00

Metals and photoemission

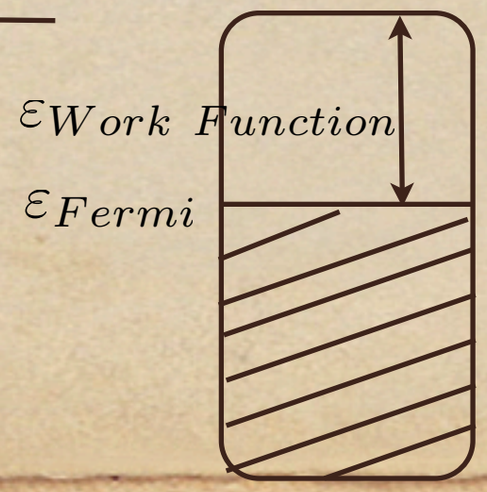
Outside
~~the box~~



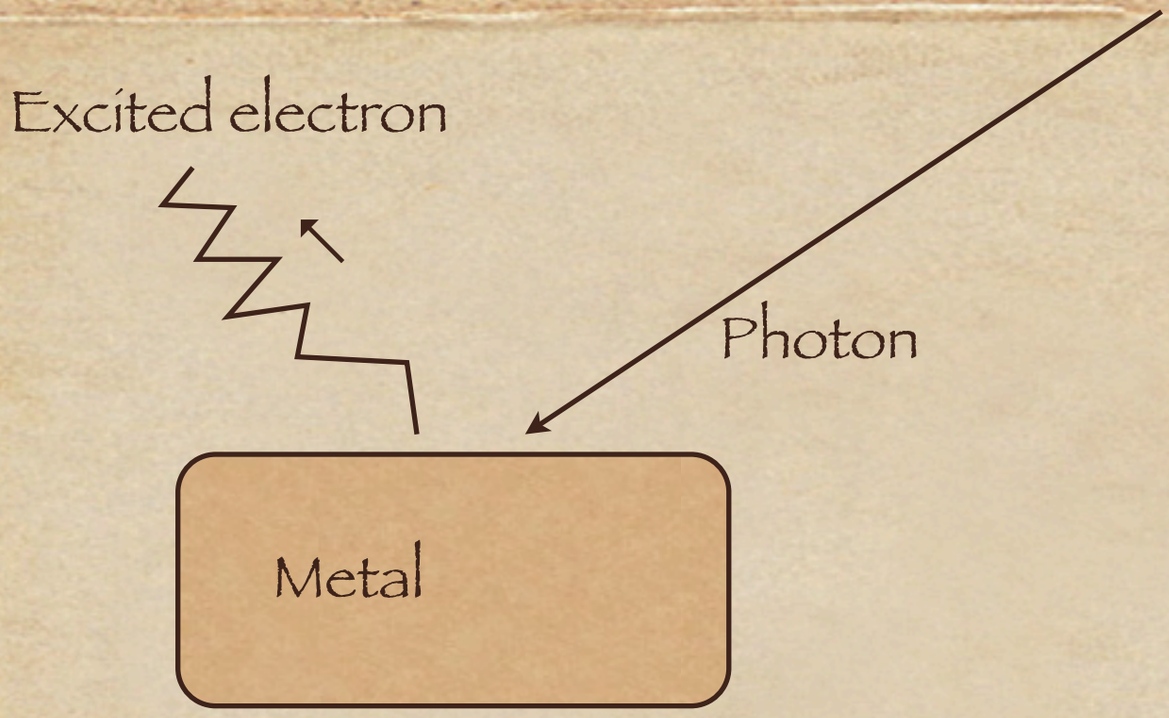
Electron in the metal is shared by many ions. It is "unbound" from any one ion and is delocalized.

But the electron is confined to the box where the ions are located.

Optical transition corresponds to the photoelectric effect.



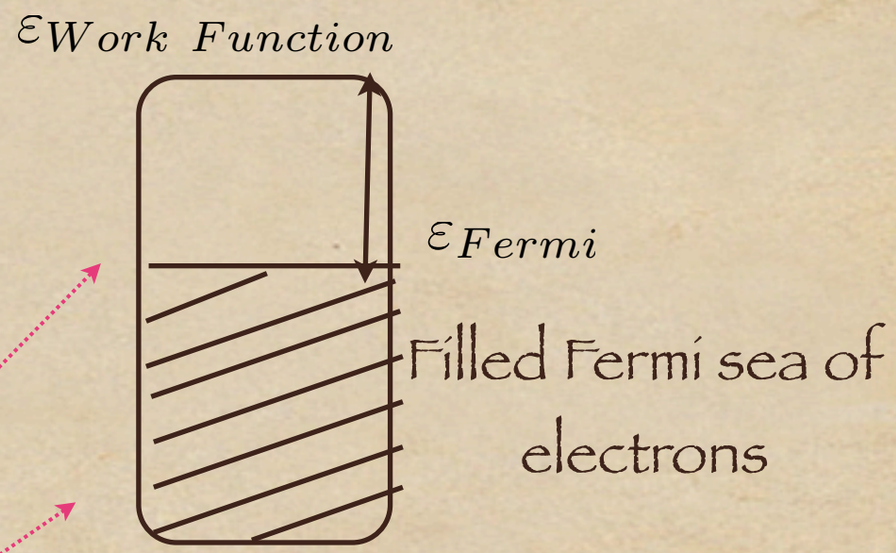
Filled Fermi sea of electrons corresponds to occupied unbound states within the box.



From Sun

Albert Einstein's explanation 1916

Nobel 1921



$$h\nu = \varepsilon_{Kinetic\ Maximum} + \varepsilon_{Work\ Function}$$