

The Solid State

WS 2013/14

Lectures (Tuesday & Friday)

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Last time:

Band structure cont'd, semiconductors

Today:

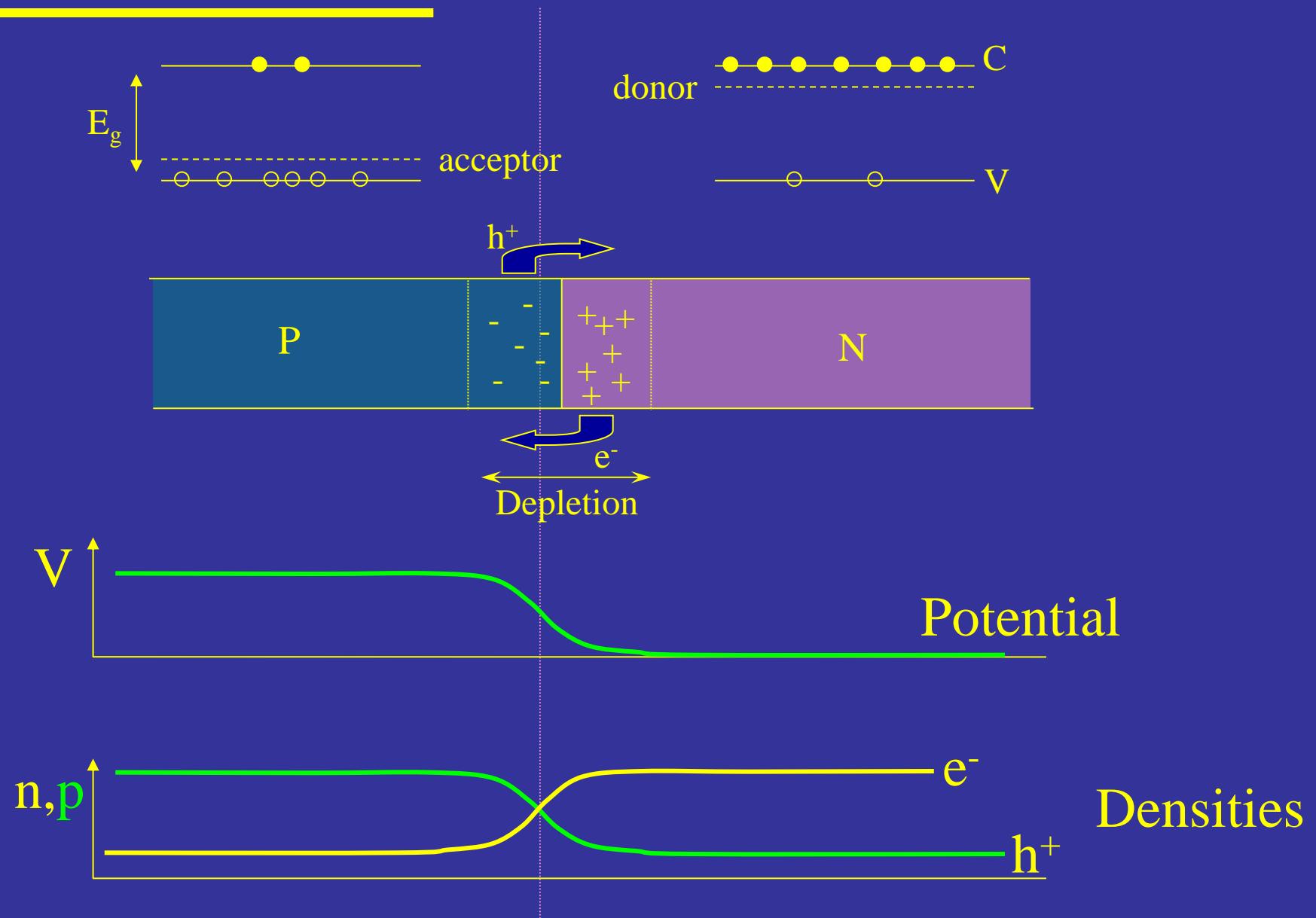
Semiconductor devices

Superconductivity

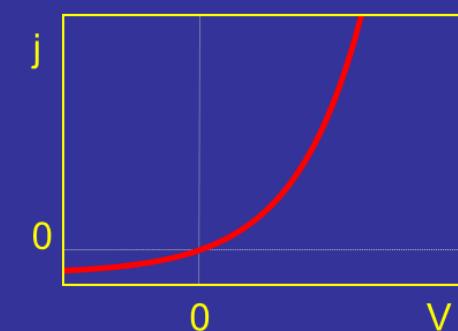
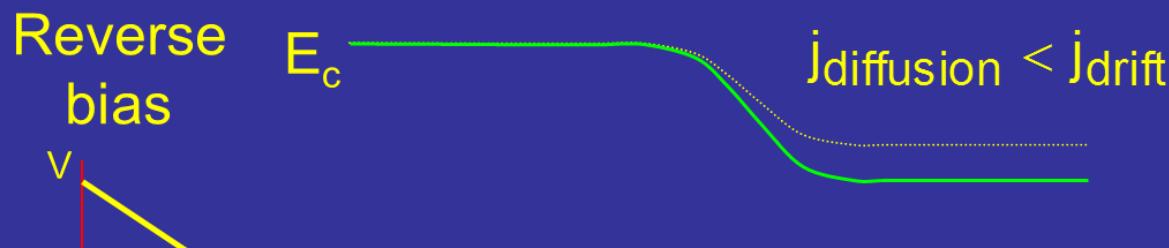
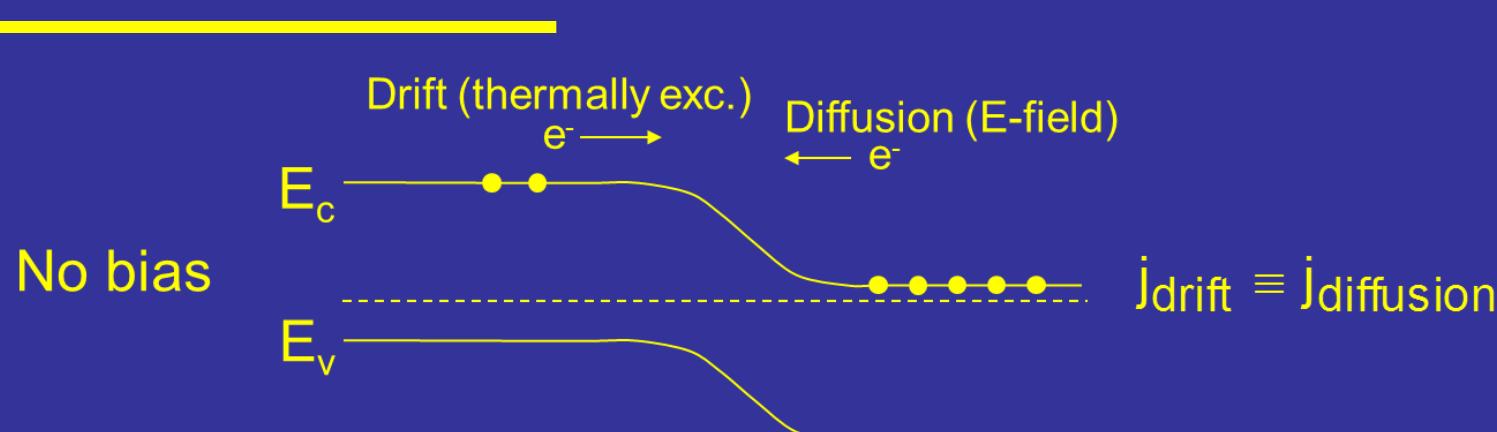
Heterogeneous semiconductors, devices

- PN junction
- Transistor
- Lasers
- Heterostructure & MOSFET 2DEG
- Integer & Fractional Quantum Hall effect

P-N Junction



PN junction

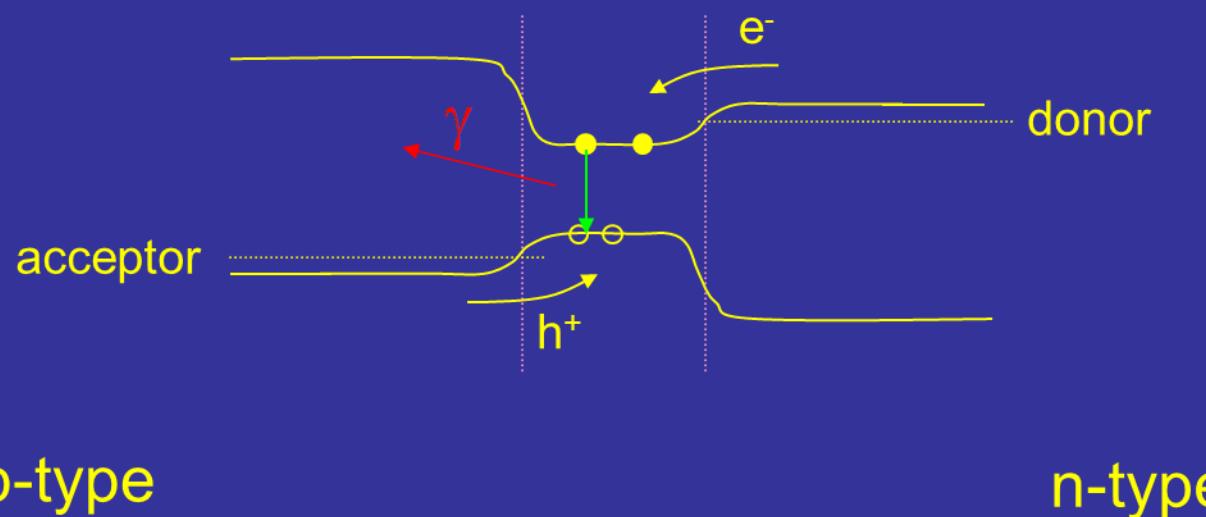


Other heterogeneous S.C.

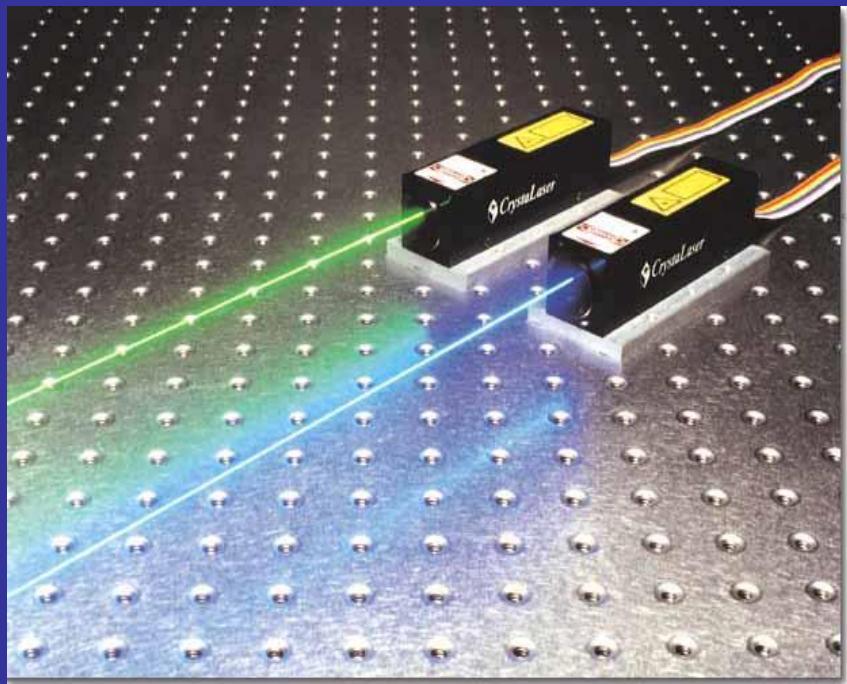
NPN junction (bipolar transistor), JFET transistors

Recombination: $e^- + h^+ \rightarrow \gamma$
LED and Semiconductor laser

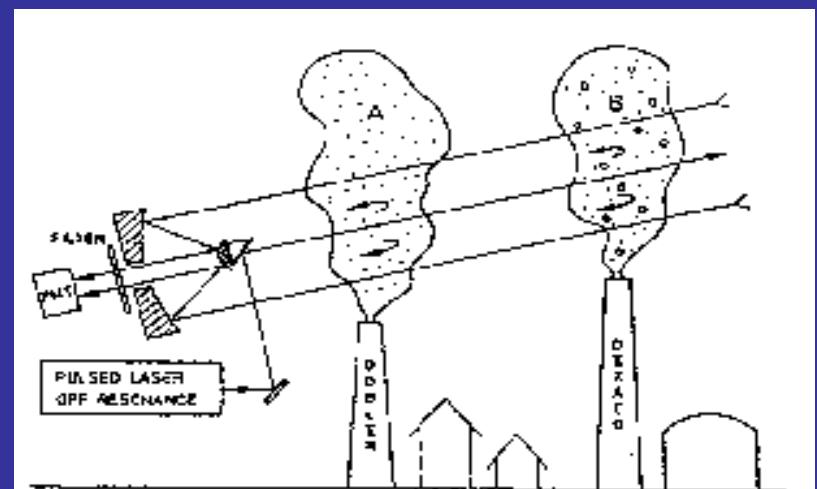
$\text{GaAs}_{1-x}\text{P}_x$
 $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{Al}_y\text{Ga}_{1-y}\text{N}$



SC lasers

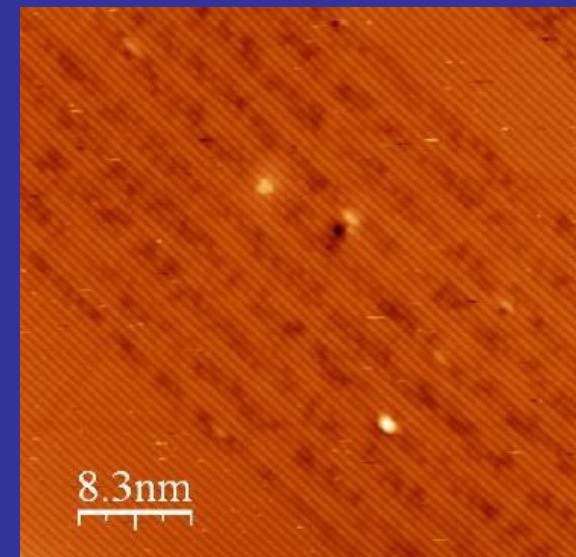
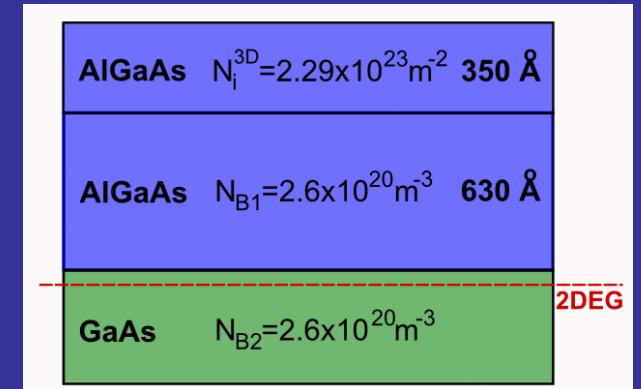
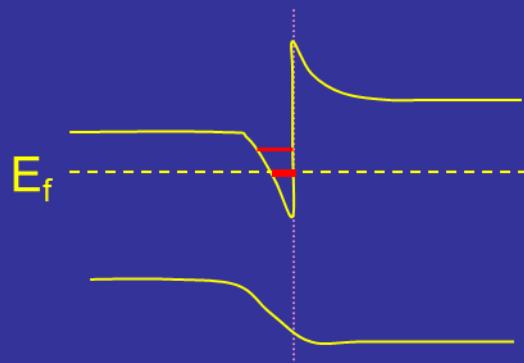


- Storage CD/DVD, MO
- Eye, artery, dental Surgery
- Diagnostic (Caries, Cancer)
- Environmental monitoring
- Remote sensing (speed, chemicals)
- Motion control
- ...
- ...

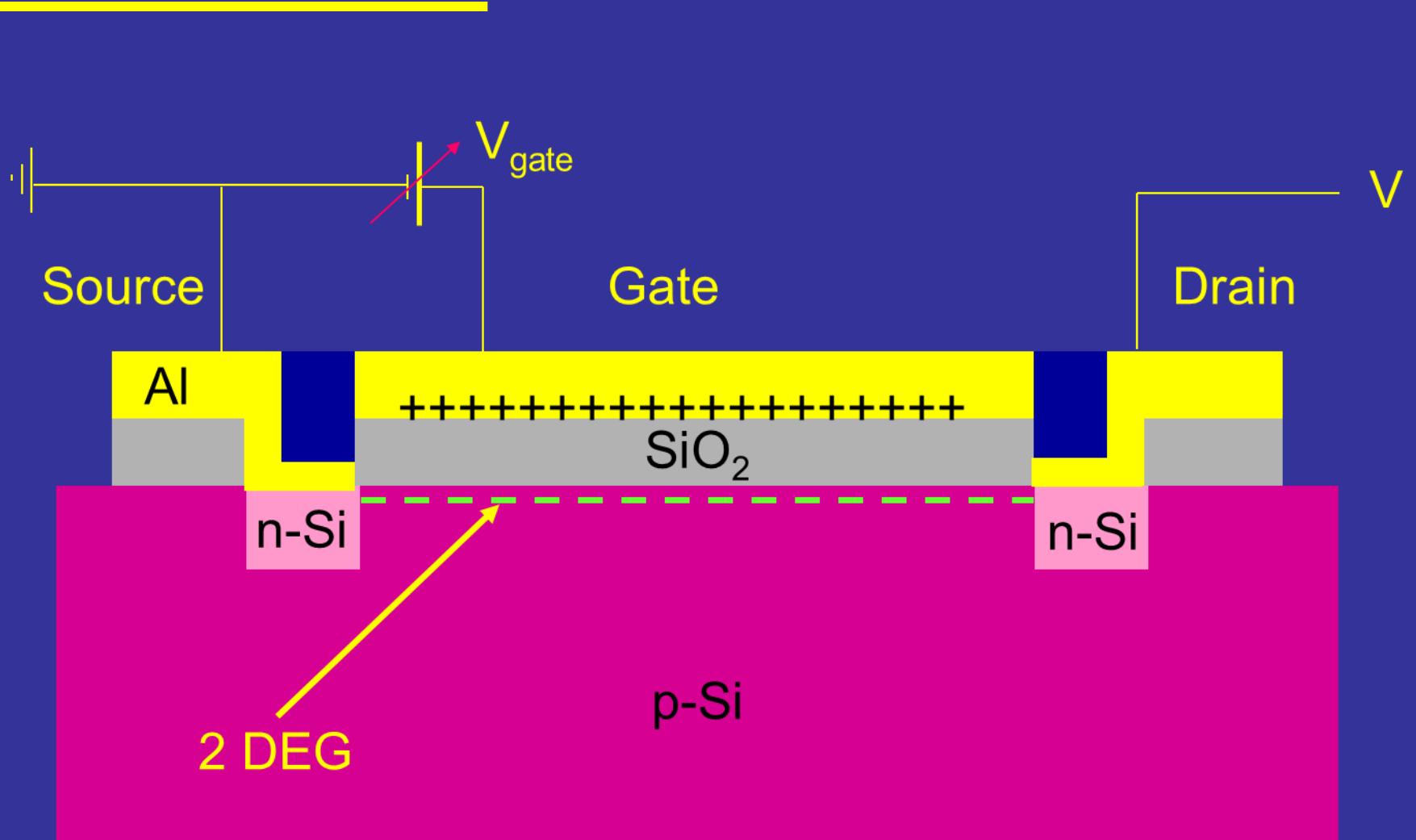


2D electron gases: Heterostructures

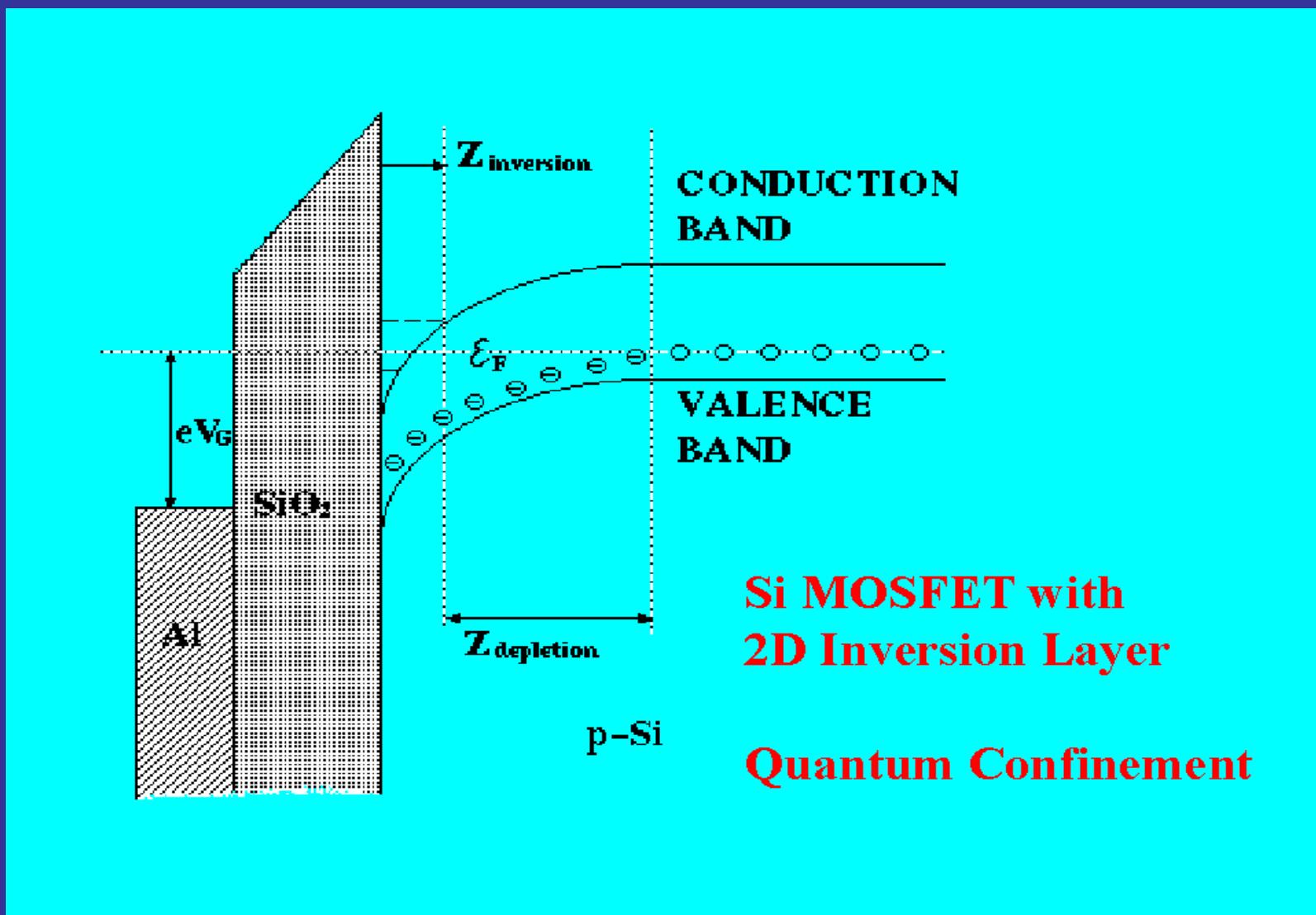
Heterostructure: Lateral confinement => 2 DEG

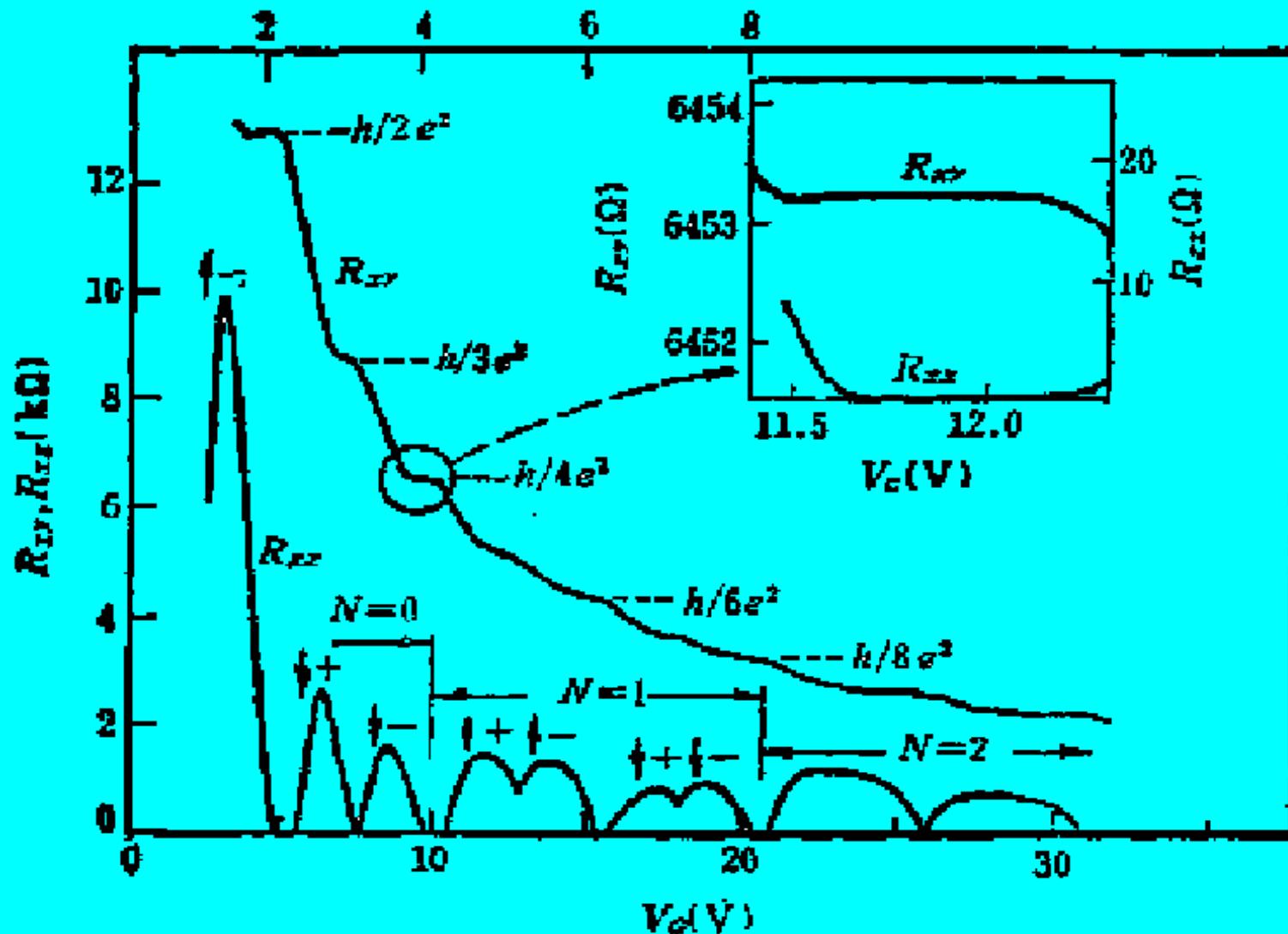


MOSFET 2DEG



Band diagram MOSFET



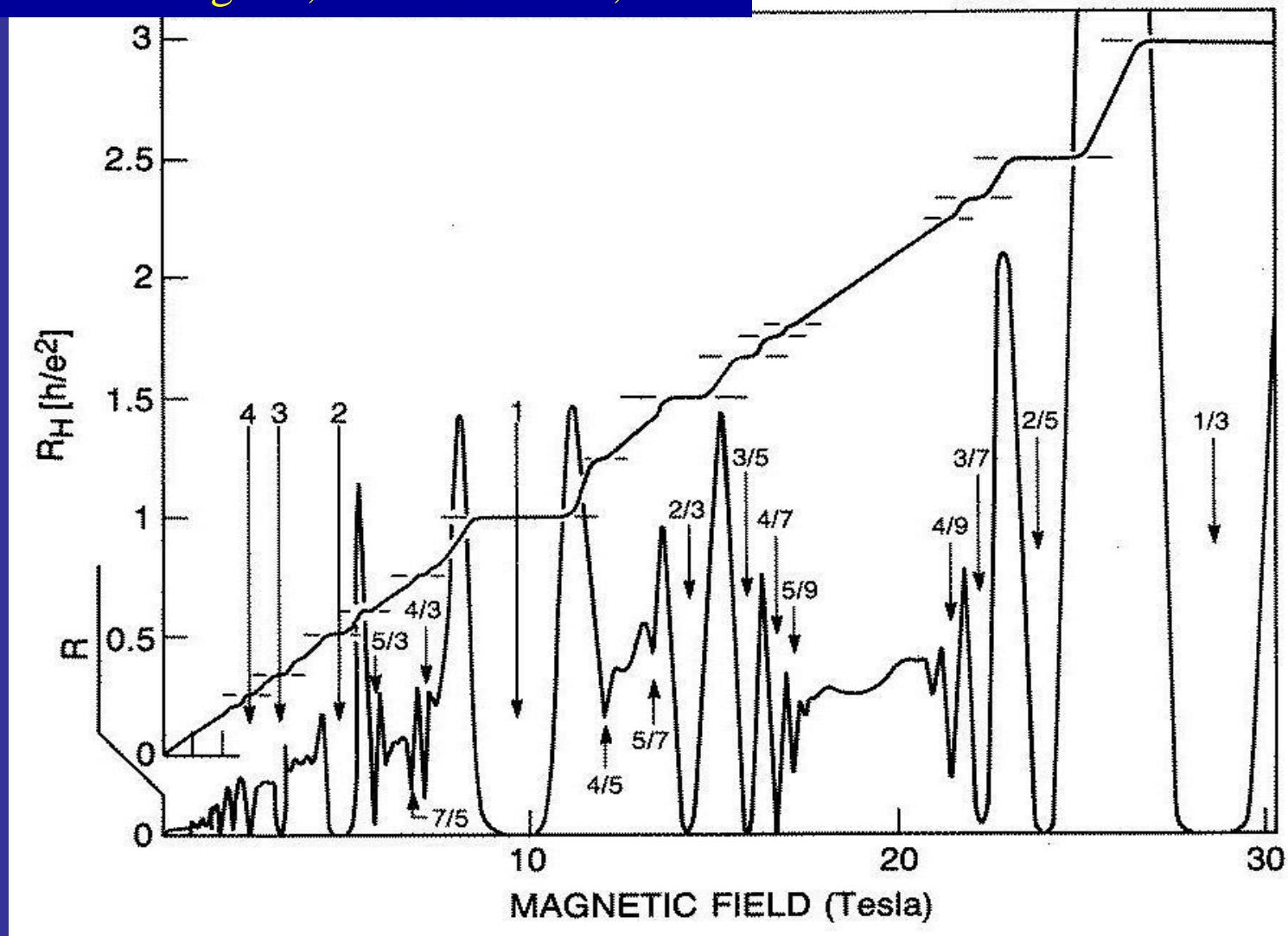


Nobel prize von
Klitzing, 1985

Integer Quantum Hall effect on Si-MOSFET

Fractional quantum hall effect

Nobel prize von Laughlin, Tsui & Stormer, 1998



Composite fermions

