Session 7: Solid State Devices

Resonant Tunneling and Devices

Outline

1. I
2.
3.
4.
5.

- A
  - B
  - C
  - D
  - E
- F
  - G
- H
- I
- J

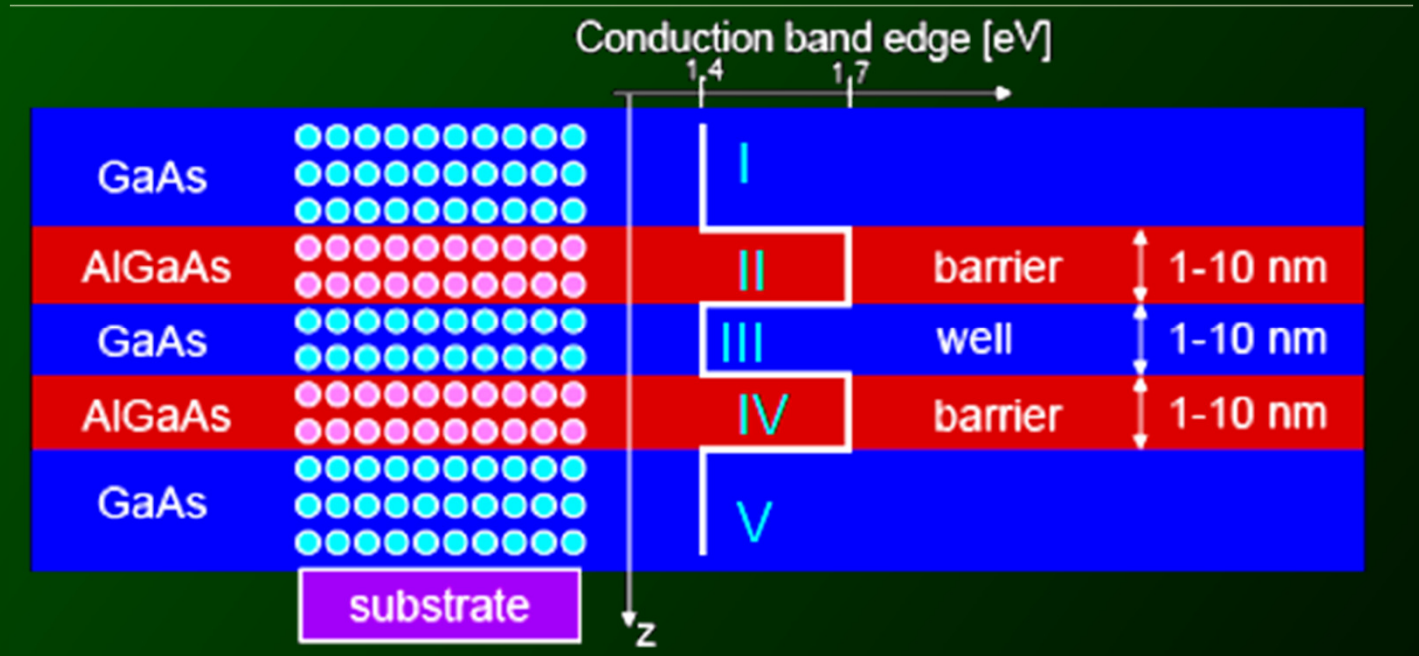
Outline

1. I
2.
3.
4.
5.

- Ref: Brennan and Brown
  Sze and Ng,

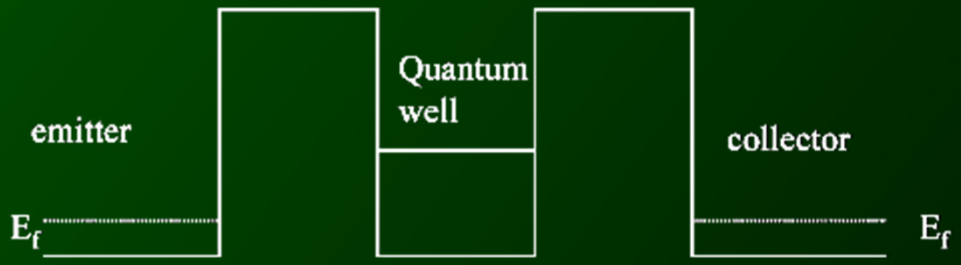
Resonant Tunneling

1. I
2.
3.
4.
5.



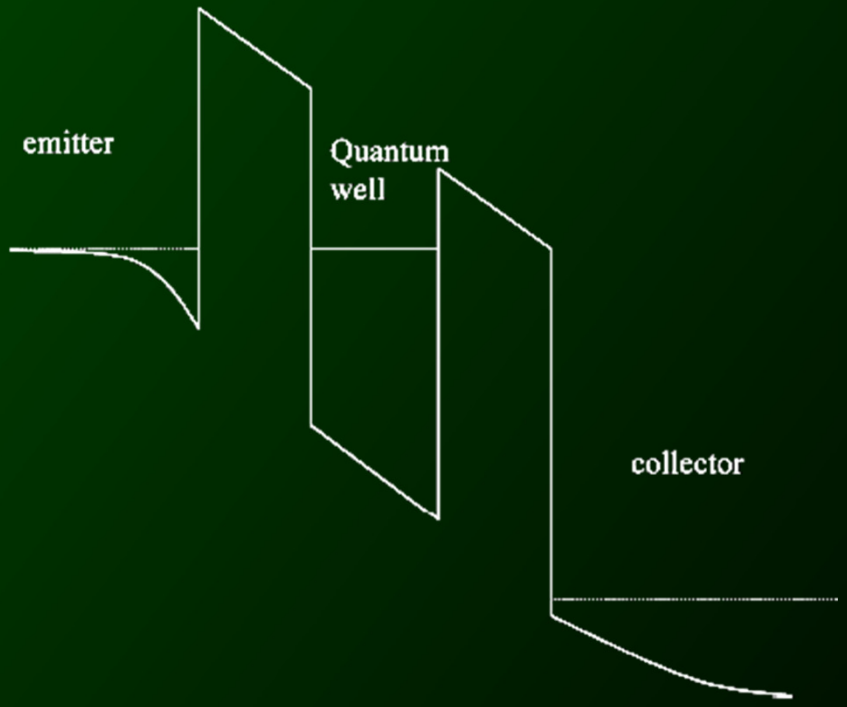
heavily doped (non-degenerate) Ef>EC

Resonant Tunneling



$$E_G(Al_xGa_{1-x}As) = 1.24(GaAs) + 1.247x$$

$$\Delta E_c = \Delta E_G$$



Qualitative!

1. I
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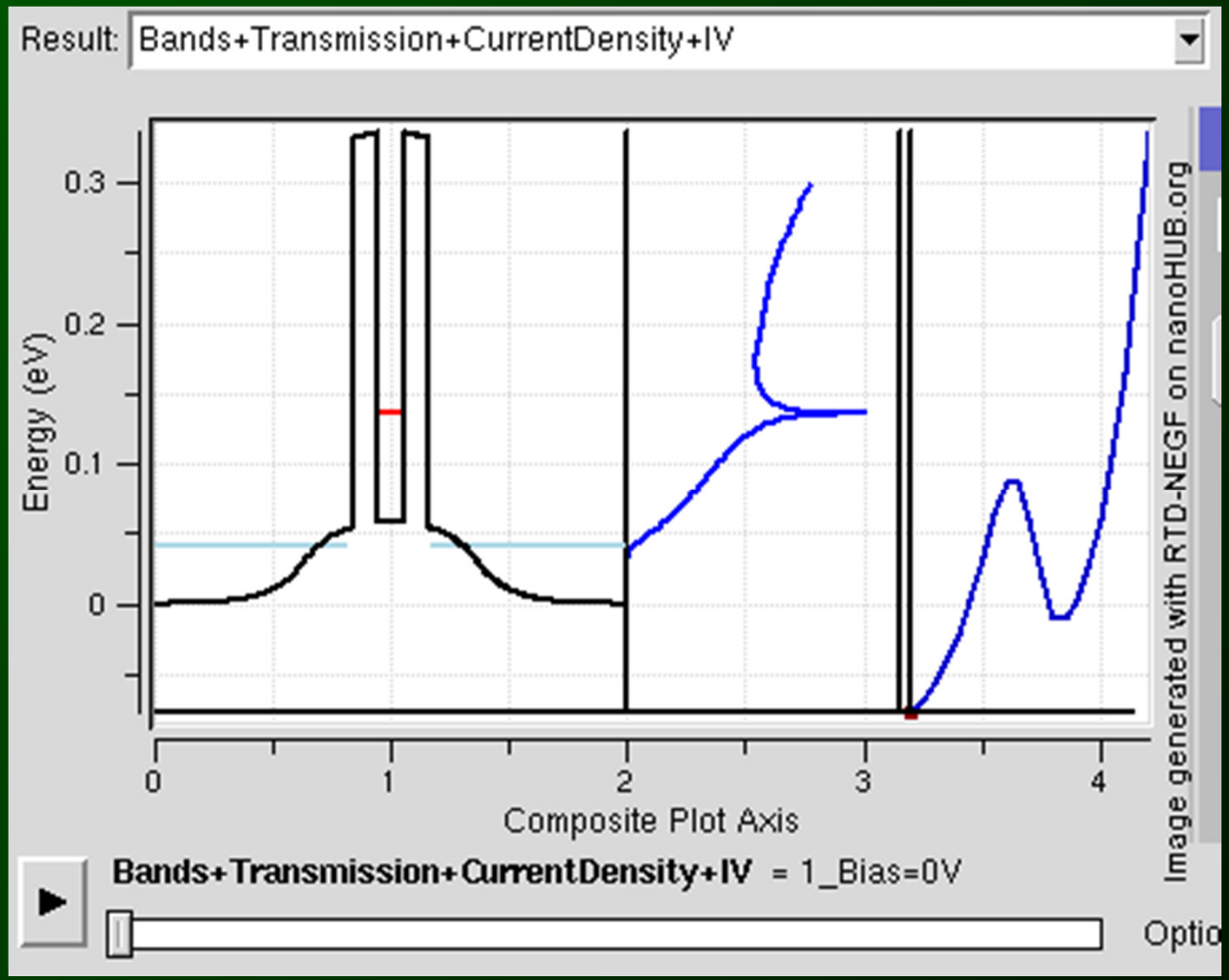
Like Fabry–Perot resonator



Resonant enhancement of the transmissivity can occur only if the electron waves remain coherent.

I. resonant tunneling (coherent)

II. sequential tunneling (incoherent)

$\frac{1}{\tau} \sim 6 \times 10^{12} s^{-1}$ polar optical phonon scattering

RTD : Digital Applications

1. I
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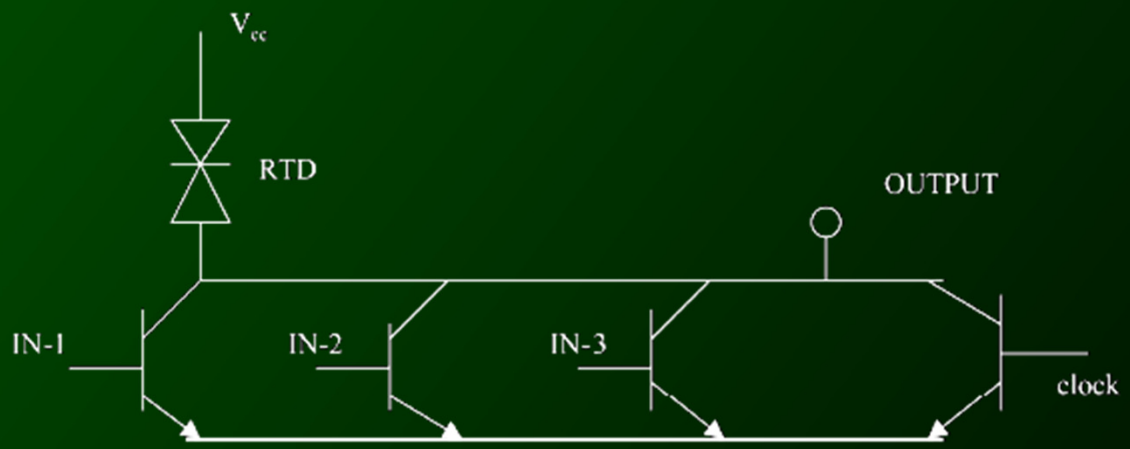
Multiple-valued logic gates → more efficient → less complex interconnect requirements

→ lower power consumption

→ high-speed operation



RTD

1. I
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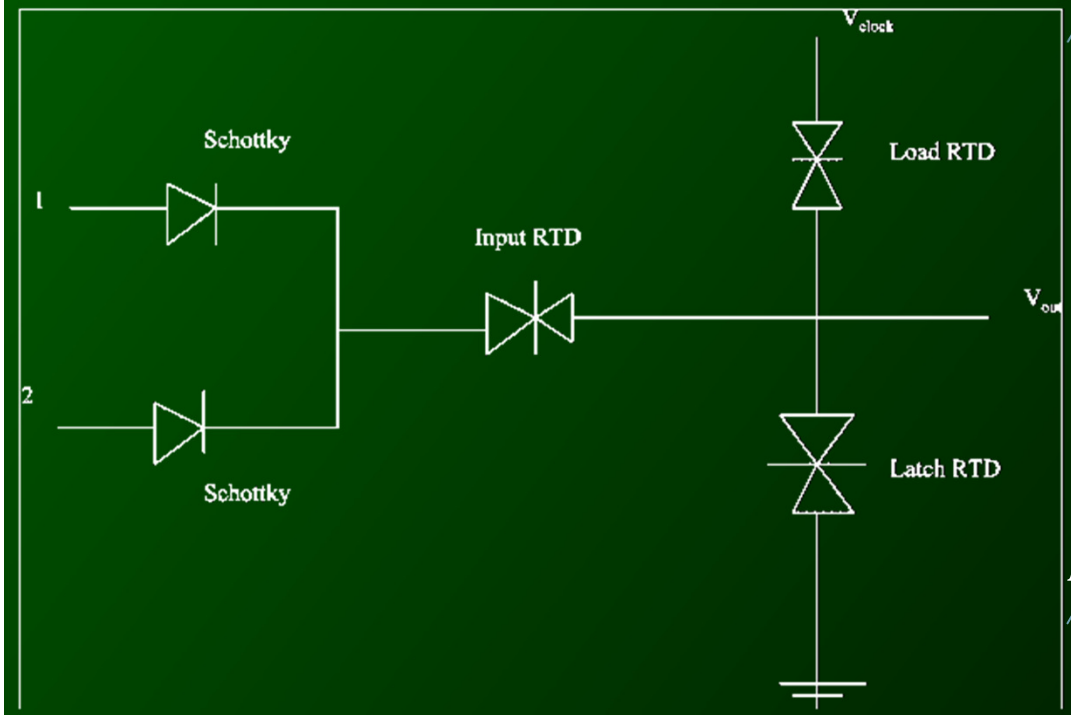
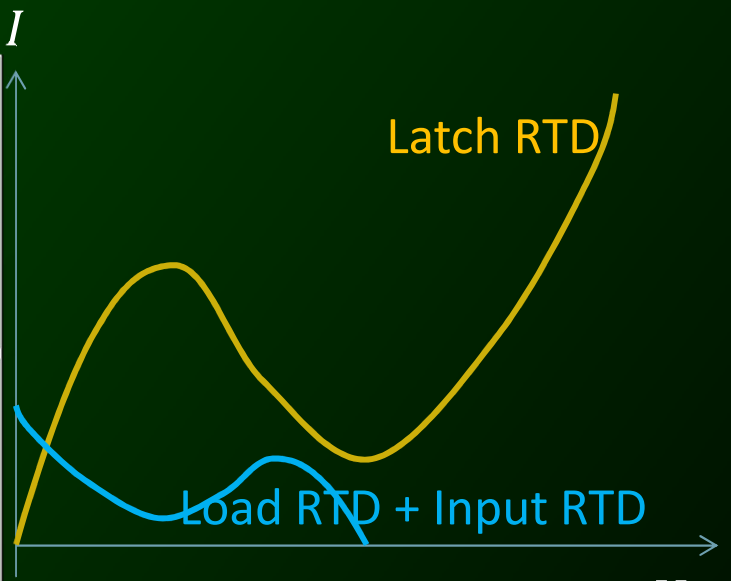
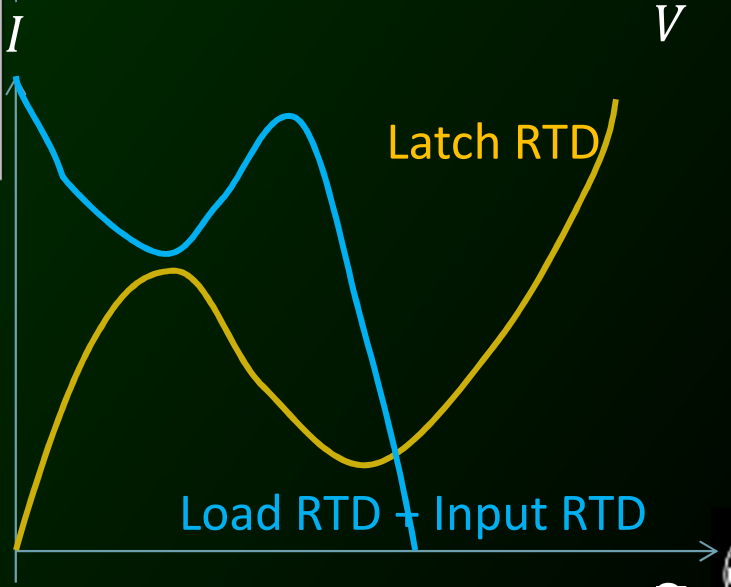
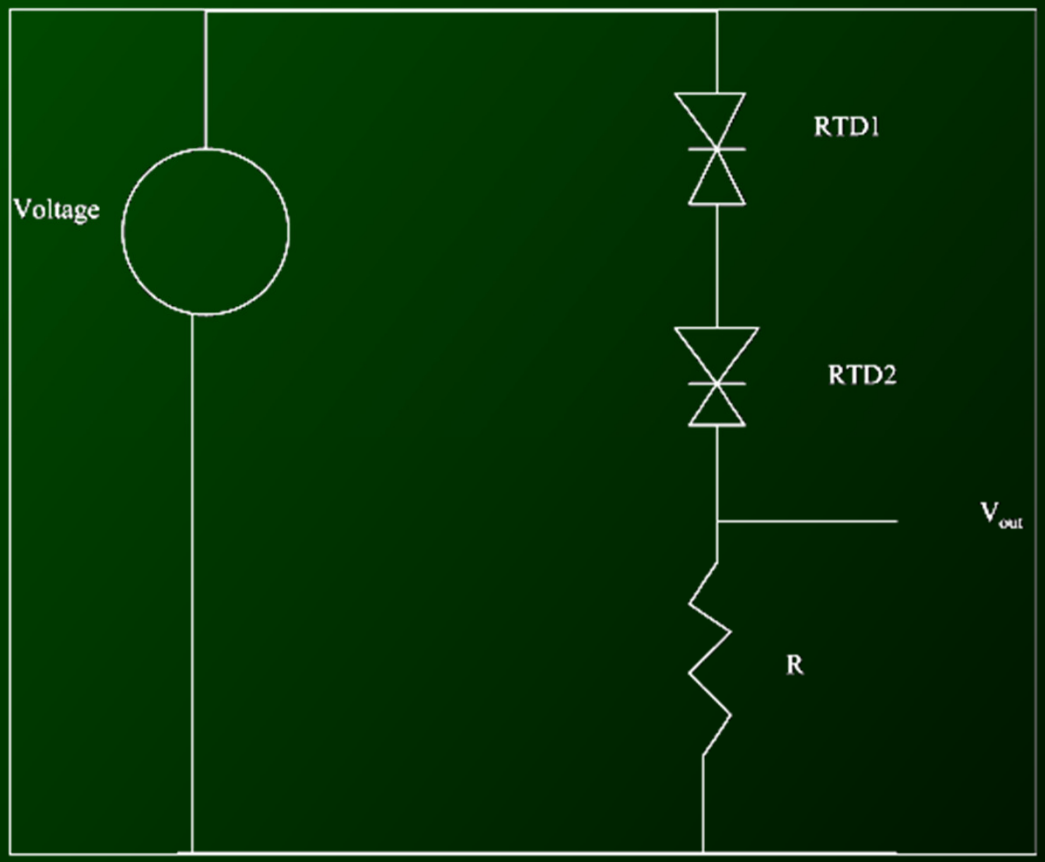

Schottky
1
2
Schottky
Input RTD
Load RTD
Latch RTD


I
Latch RTD
Load RTD + Input RTD
V


I
Latch RTD
Load RTD + Input RTD

Series RTD



Resonant Tunneling Transistor

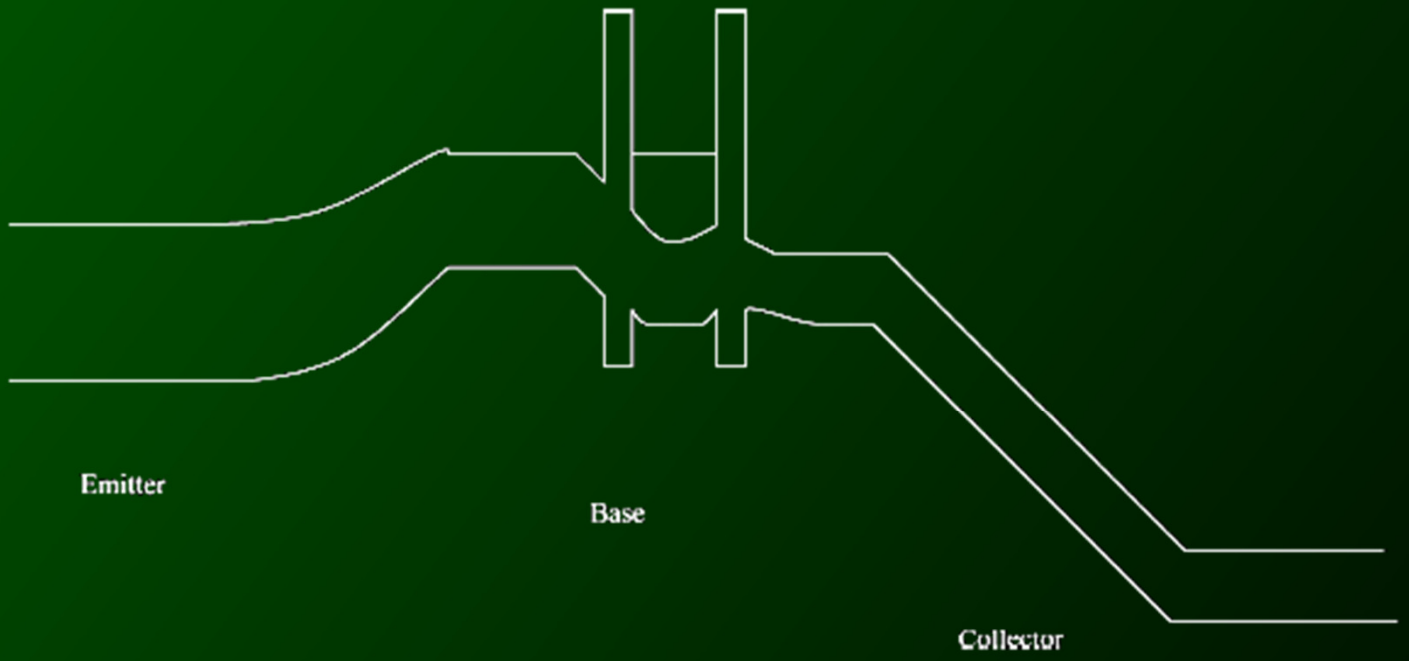


FIGURE 6.6.1 Resonant tunneling transistor with a double-barrier structure in the base region of the device. The region between the emitter and the quantum well is p-type with a bandgap larger than that of the well.