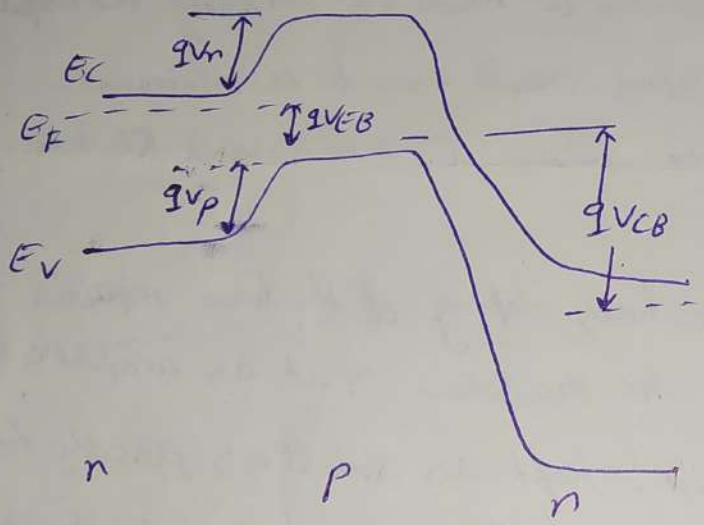
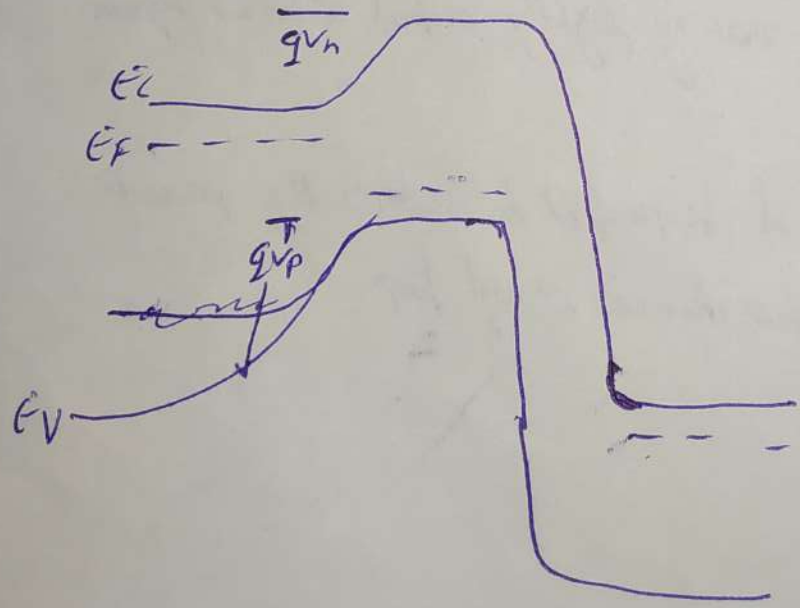
Heterojunction Bipolar Transistors

- For a high beta transistor emitter injection efficiency should be high. However in traditional transistor due to low doping and less area of base region injection efficiency decreases. To counter this problem a heavily doped base and a lightly doped emitter is required.



Homojunction

$qV_n = qV_P$



Heterojunction

$qV_n < qV_P$

- Carrier injection varies exponentially with the barrier height, difference in two barriers result in transport of e^- and holes across the emitter junction.
- Carrier injection across the emitter is given by

$$\frac{I_n}{I_p} \propto \frac{N_d^E}{N_a^B} e^{\Delta E_g / kT}$$

- In HBT ΔE_g also play a vital role in emitter injection.
- A heavily doped base is used to reduce the base resistance and a lightly doped emitter to reduce junction capacitance.
- SiGe alloy composition in the base of an npn is varied such that E_g decreases slightly from E to C side of the base. A built in electric field accelerates e^- through the base region. The resulting field-aided base transport is a major advantages of HBT.

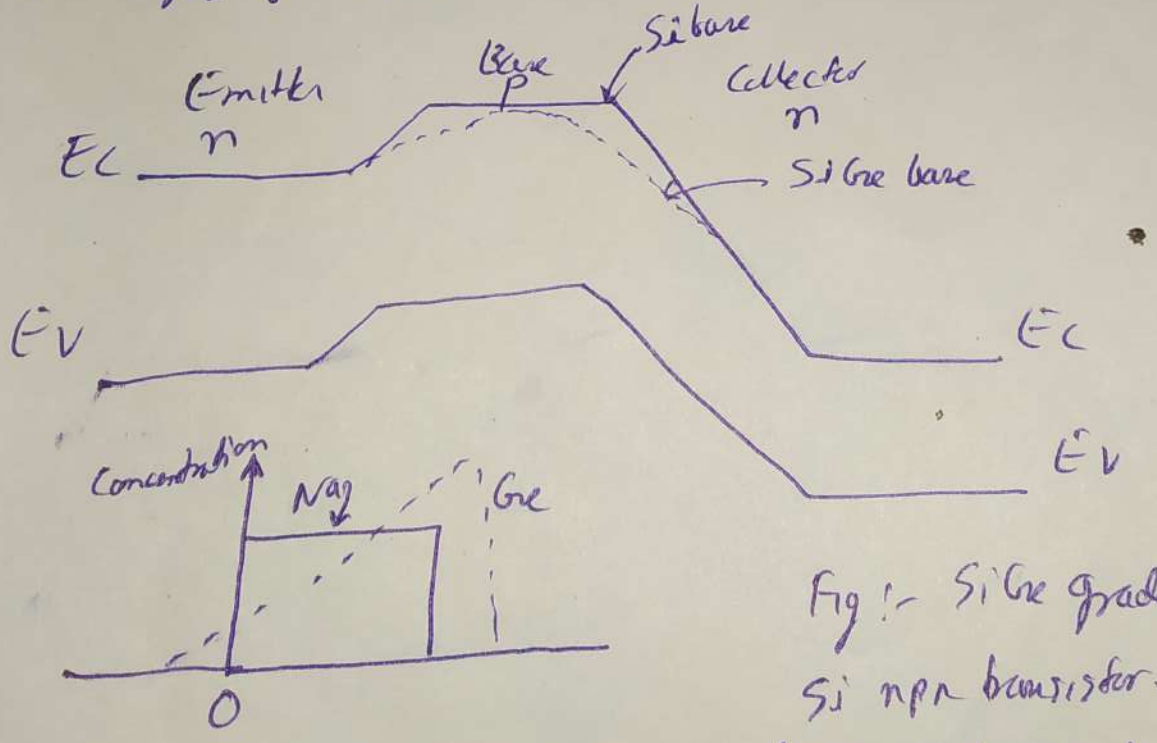


Fig :- SiGe graded base in a Si npn transistor. The built in drift field in the conduction band in base aids e^- transport.