LECTURE 18 — LEDs

ANNOUNCEMENTS → NO LECTURE ON THURSDAY (MIT)/ FRIDAY (NUS)

→ NO RECITATION NEXT WEEK MON (MIT)/TUE(NUS)

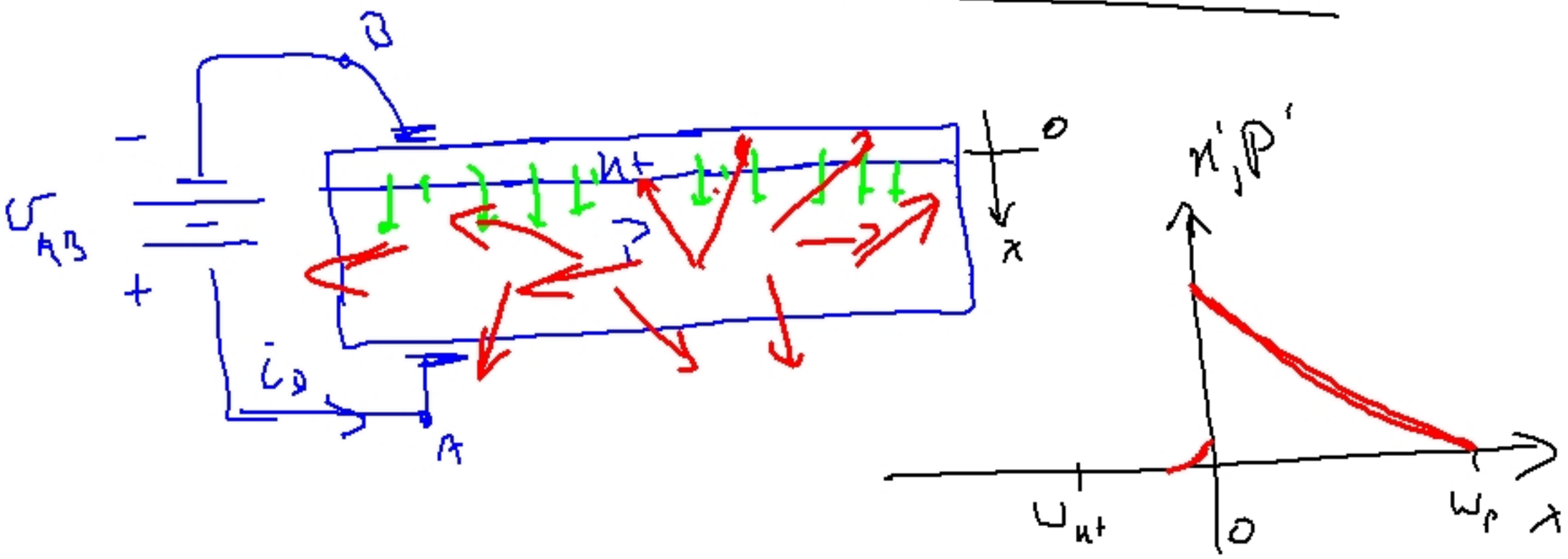
→ LECTURE 19 — LASER DIODE WILL BE TUES 4/22 (MIT) WED 4/23 (NUS)

In high level injection situations: *

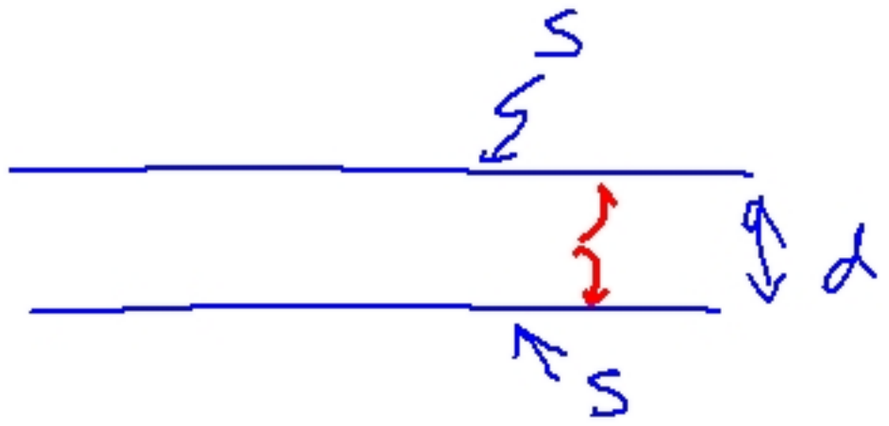
$$\tau_{rad} \rightarrow \frac{1}{B(p_0 + p')}$$

τ_{rad} ↓ as p' ↑

* HLI $\Rightarrow$ $p' \simeq p_0$



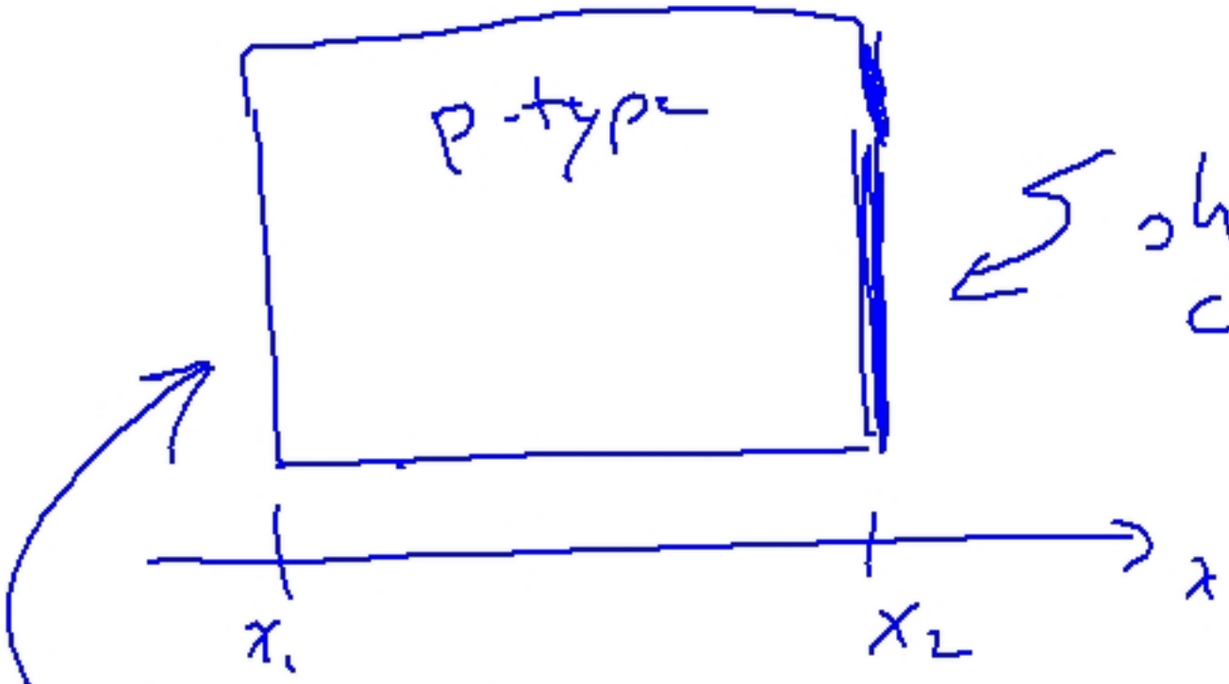
WITH SURFACE RECOMBINATION



$$\frac{1}{\tilde{\tau}_{NW}} = \frac{1}{\tilde{\tau}_{Rad}} + \underbrace{\frac{1}{\tilde{\tau}_{Non-rad}} + \frac{2S}{d}}$$

$$\frac{1}{\tilde{\tau}_{Non-rad\,eff}}$$

$$\tilde{\tau}_{Non-rad\,eff} < \tilde{\tau}_{Non-rad}$$

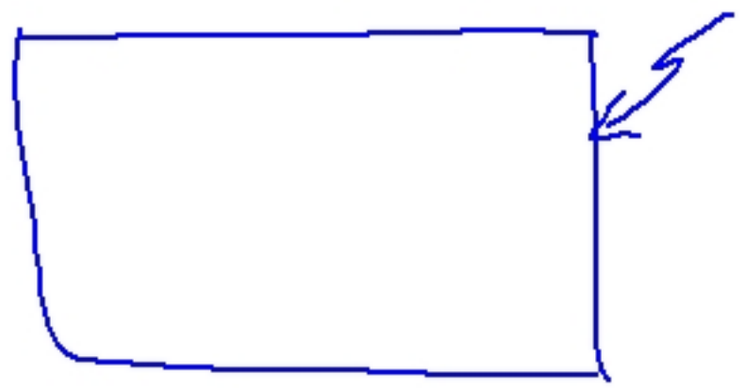


$$n'(x_2) = 0$$

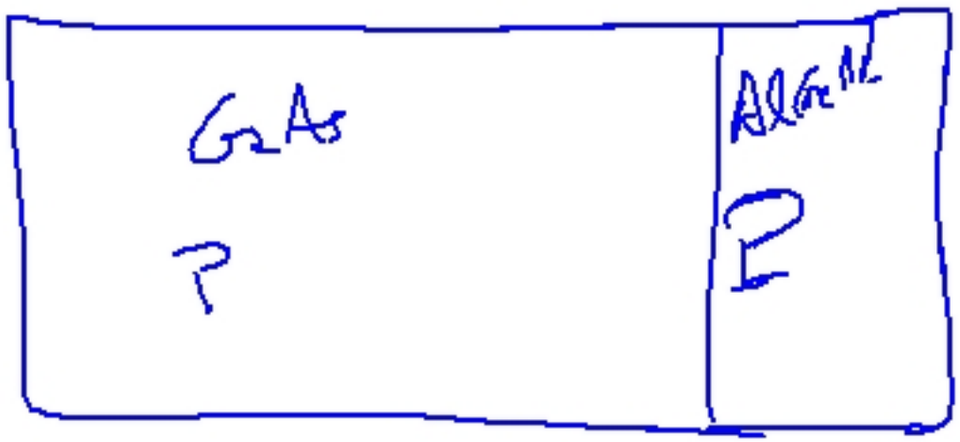
$$p'(x_2) = 0$$

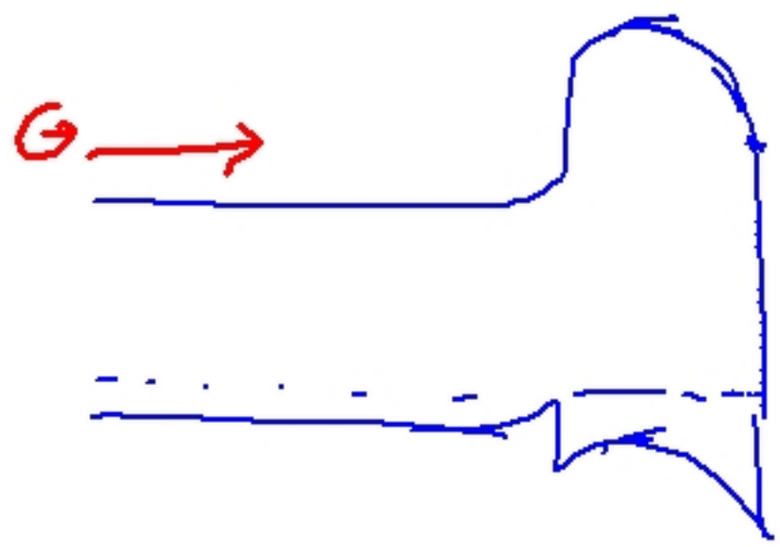
$$\left.\frac{dn'}{dx}\right|_{x_1} = 0$$

$$-D_e \frac{\partial n'}{\partial x} = s n'$$

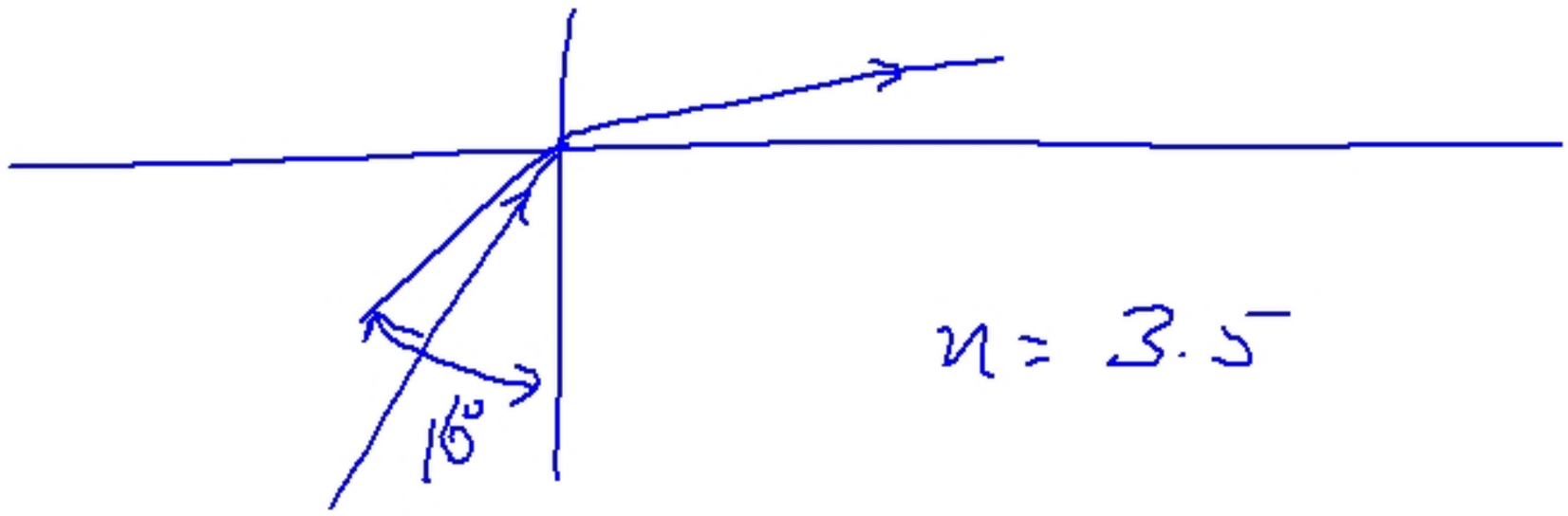


Use HJ to shield carriers from surface

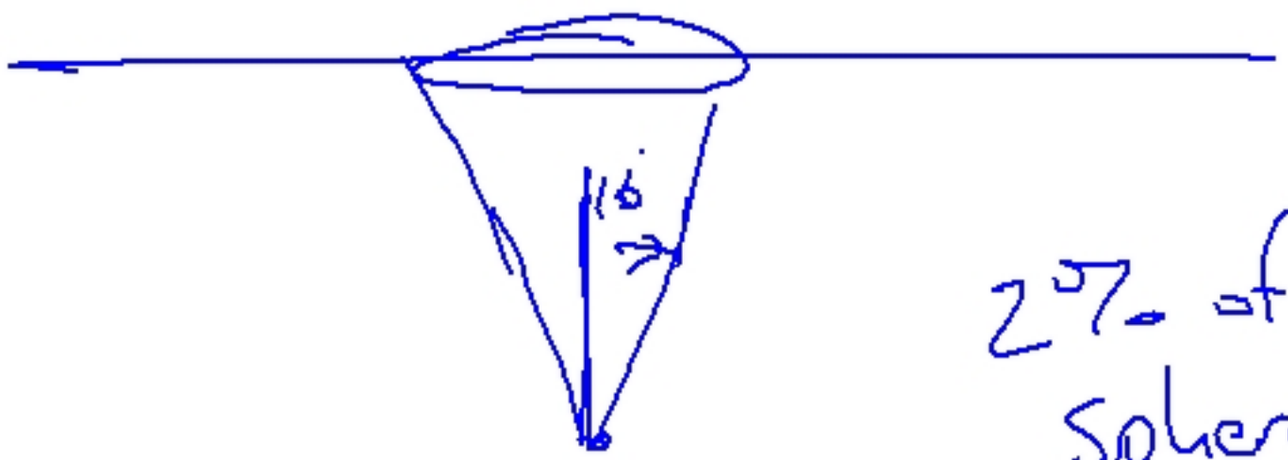




$n = 1.0$



$n = 3.5$



2% of total sphere

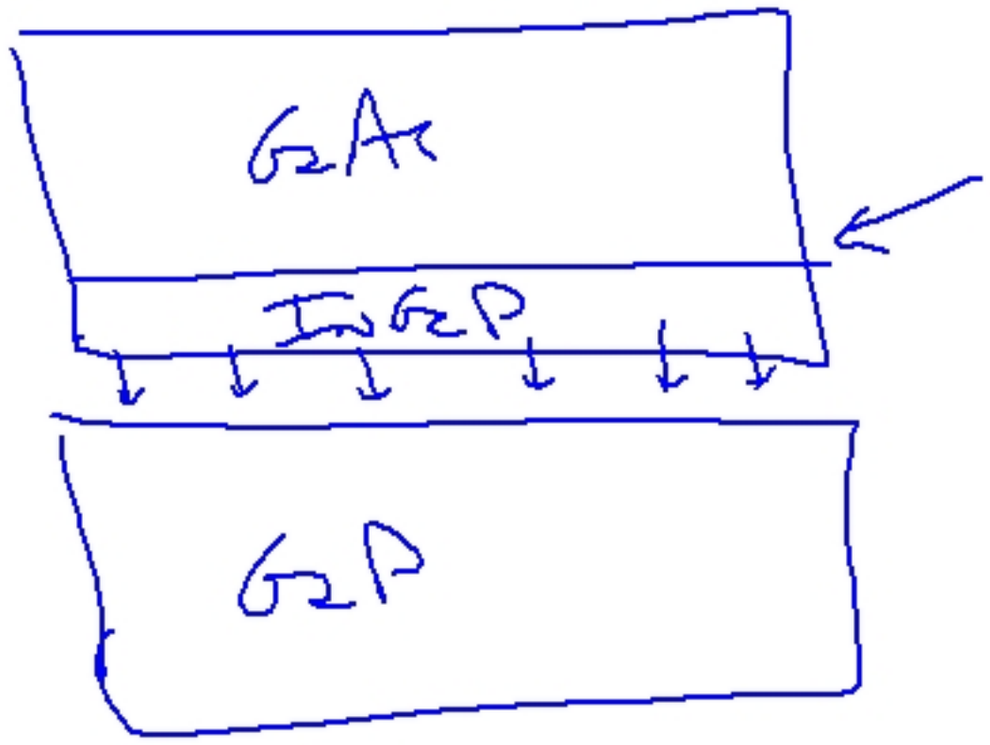
Early LED

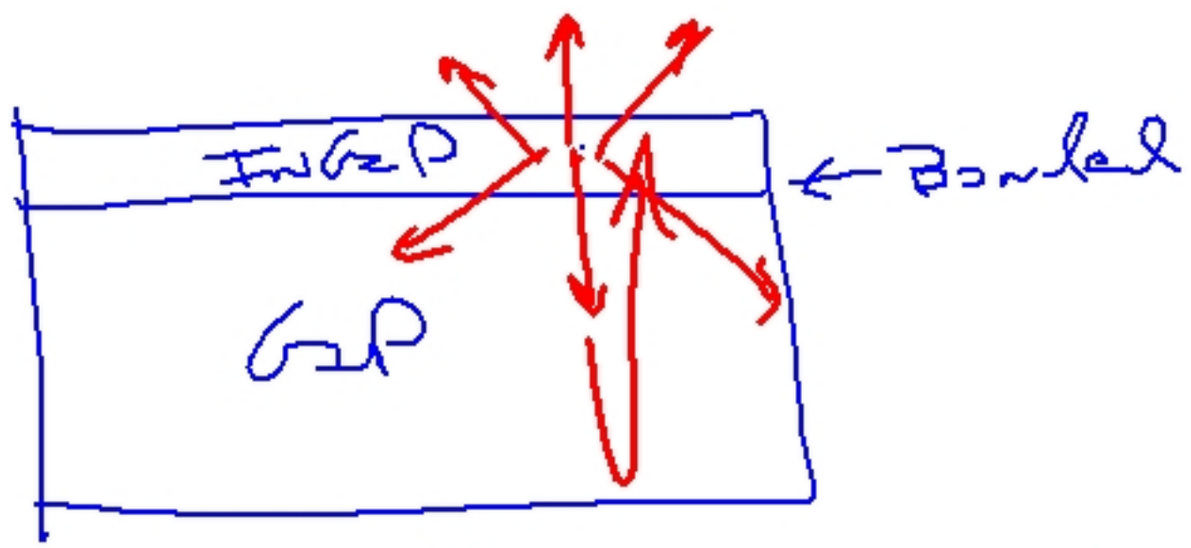
red: $GaAs_{0.6}P_{0.4}$ / GaAs

2 - graded layers

Newer red: $InGaAsP$ / GaAs lattice matched

but some problem





Transferred substrate device