

# Electro-Optic Effect

Refractive index of the material changes with application of Electric field

Lithium Niobate (rather lossy but high EO coefficient)

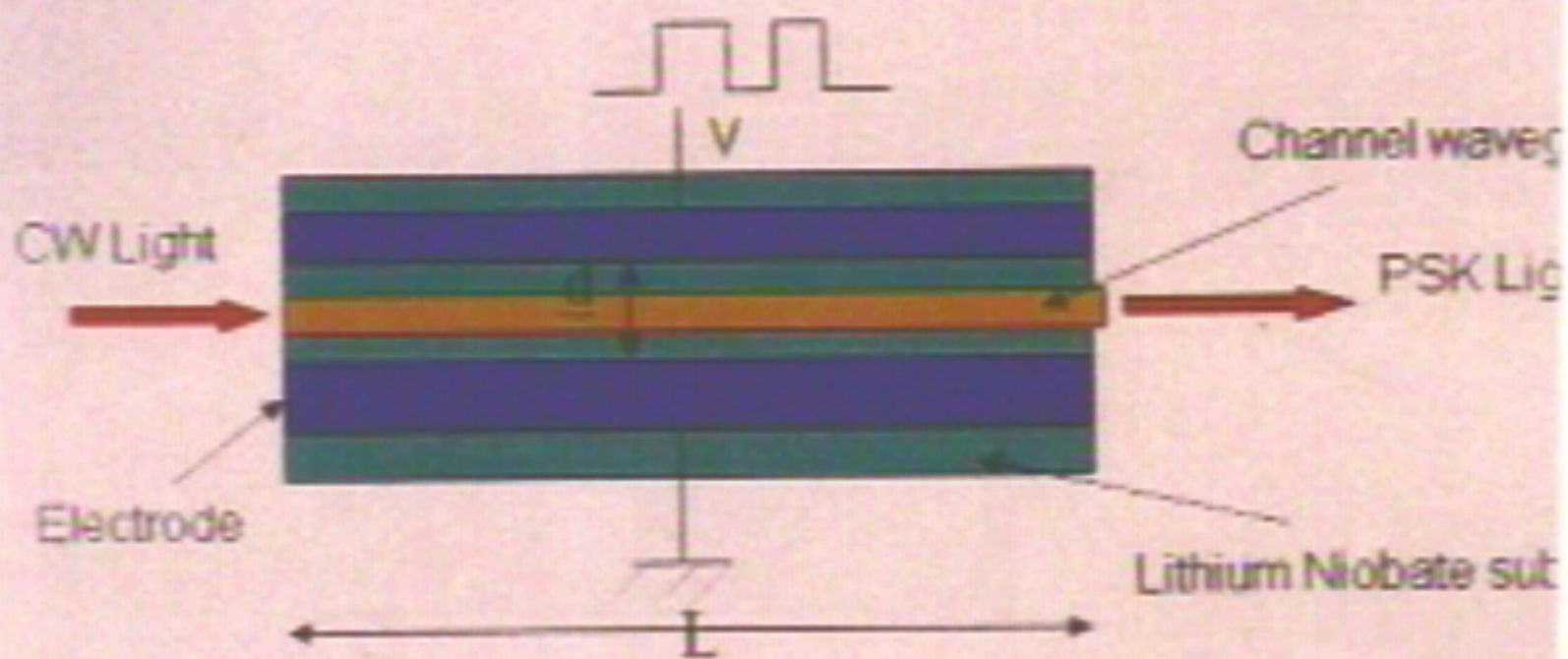
Gallium Arsenide (Low EO coefficient)

$$\text{Change in refractive index } \Delta n = \left( \frac{n^3}{2} \right) r E$$

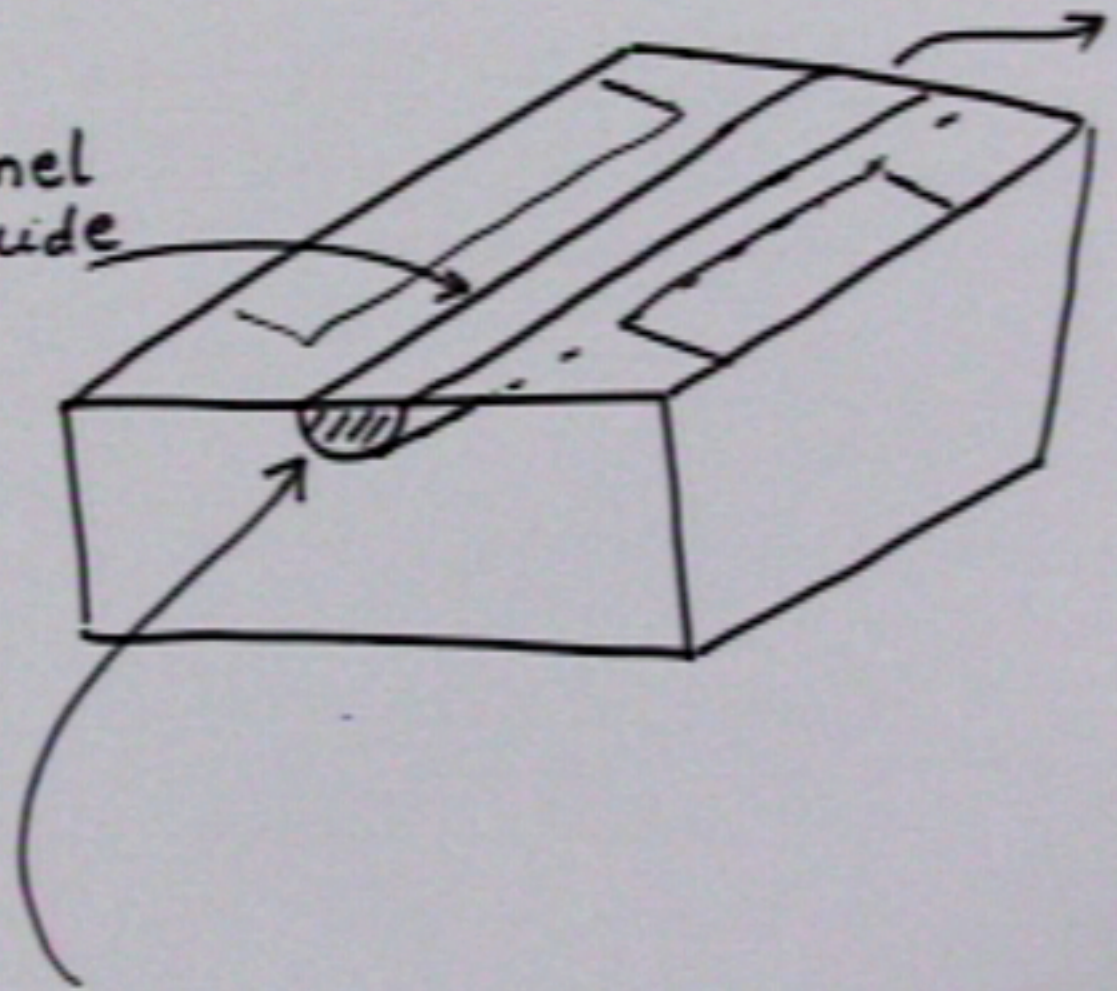
$r$  = Electro Optic coefficient

$E$  = Electric field

## Phase Modulator



channel waveguide



Phase change

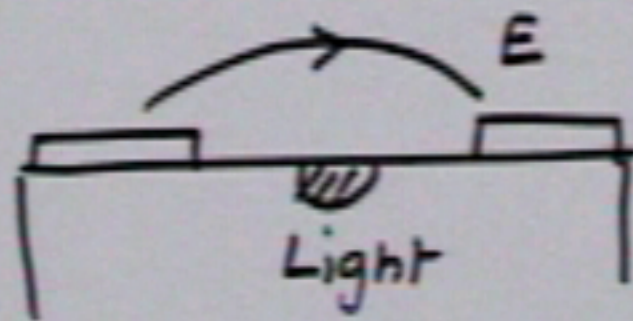
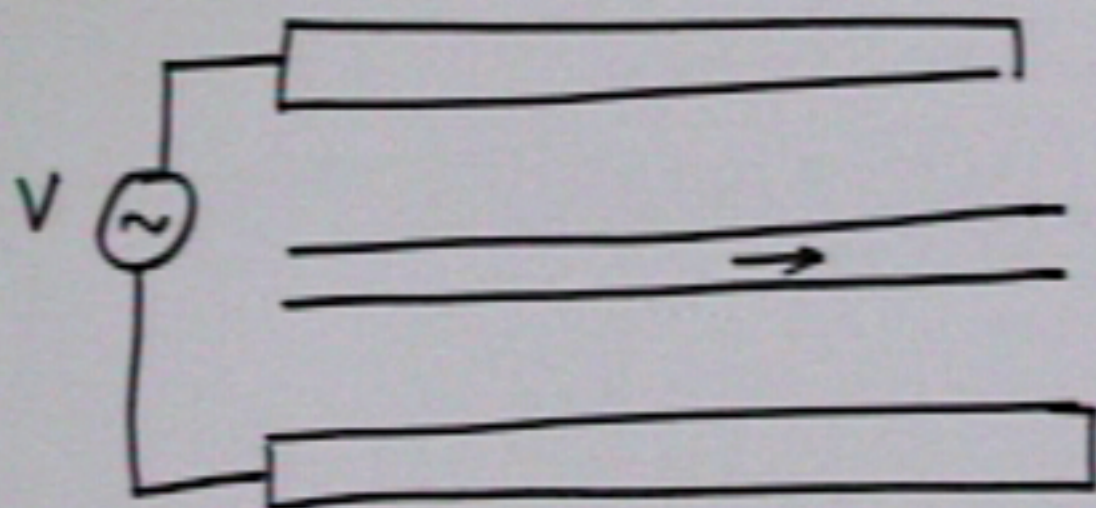
$$\Delta\phi = \frac{2\pi}{\lambda} \Delta n \cdot L$$

$$= \frac{2\pi}{\lambda} \left( \frac{n^3}{2} \right) \tau \underbrace{E L}$$

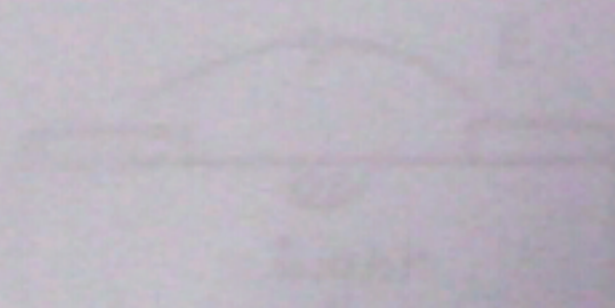
$$= \frac{2\pi}{\lambda} \left( \frac{n^3}{2} \right) \tau \frac{V}{d} \cdot L$$

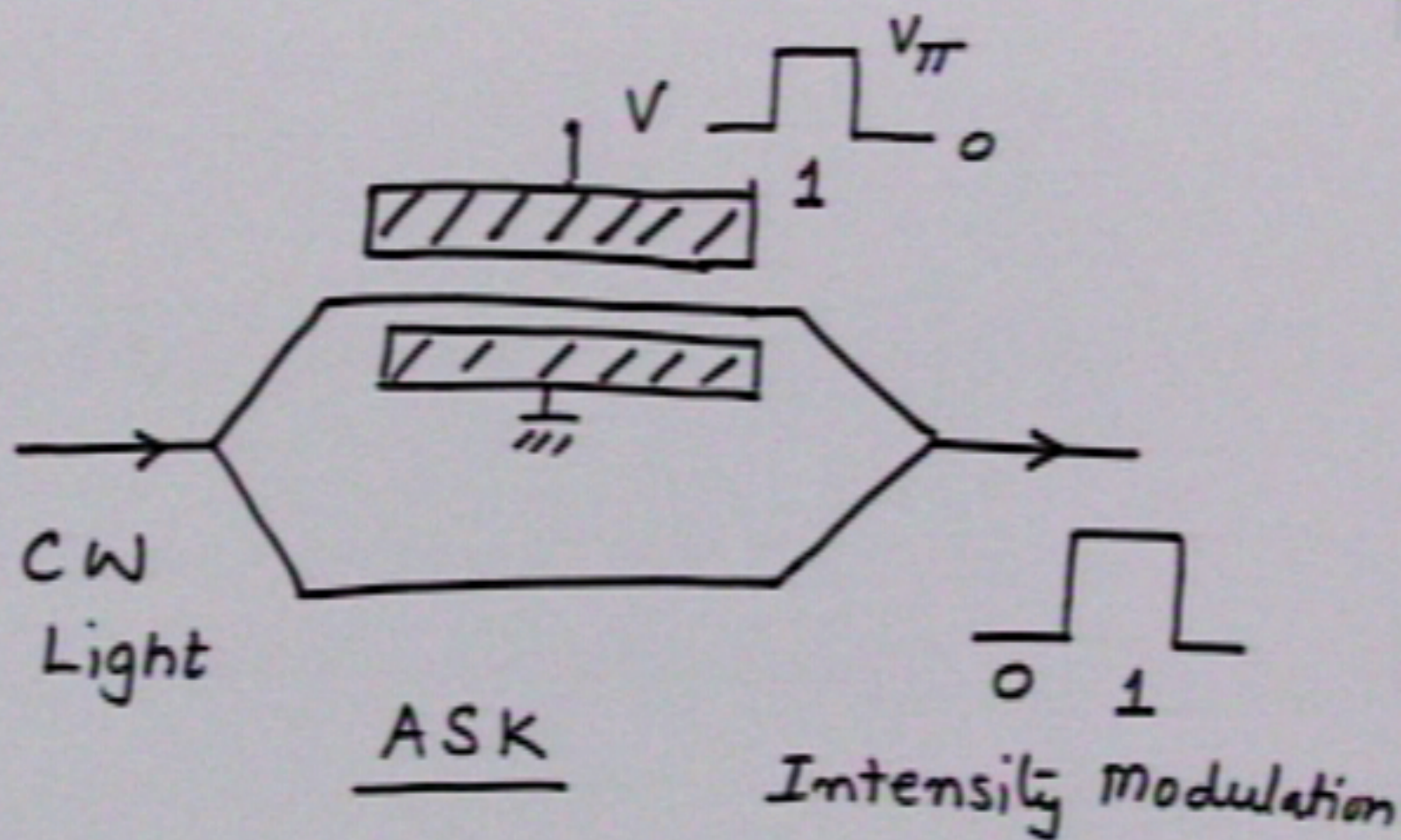
For  $\Delta\phi = \pi \rightarrow V = V_{\pi}$

$$V_{\pi} = \frac{\lambda}{n^3 \tau} \frac{d}{L}$$

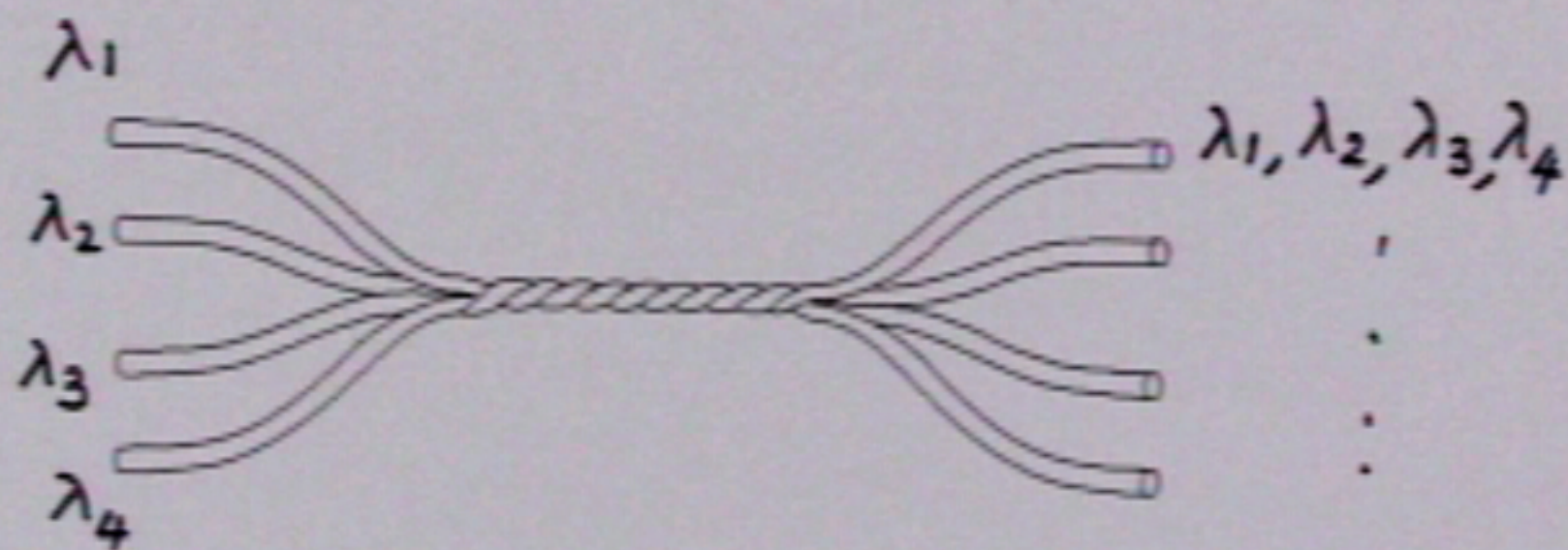


# Mach-Zehnder Interferometer



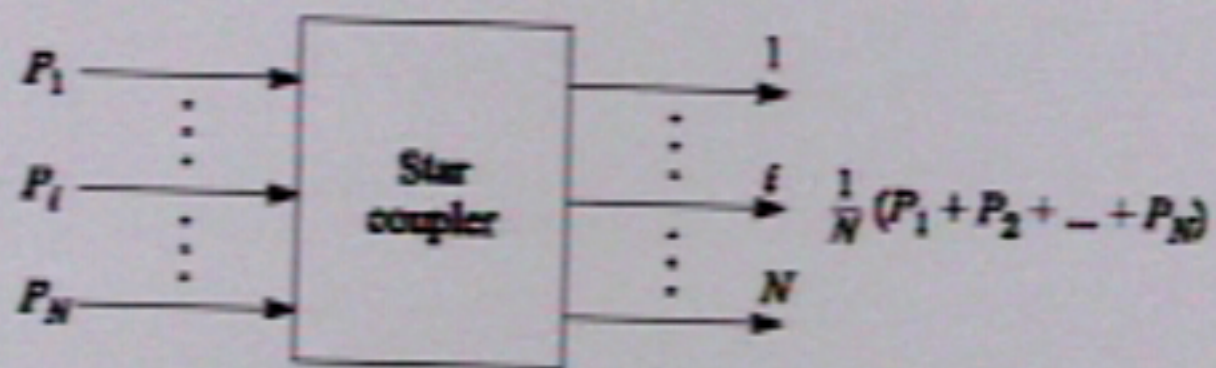


## Fused-fiber star coupler

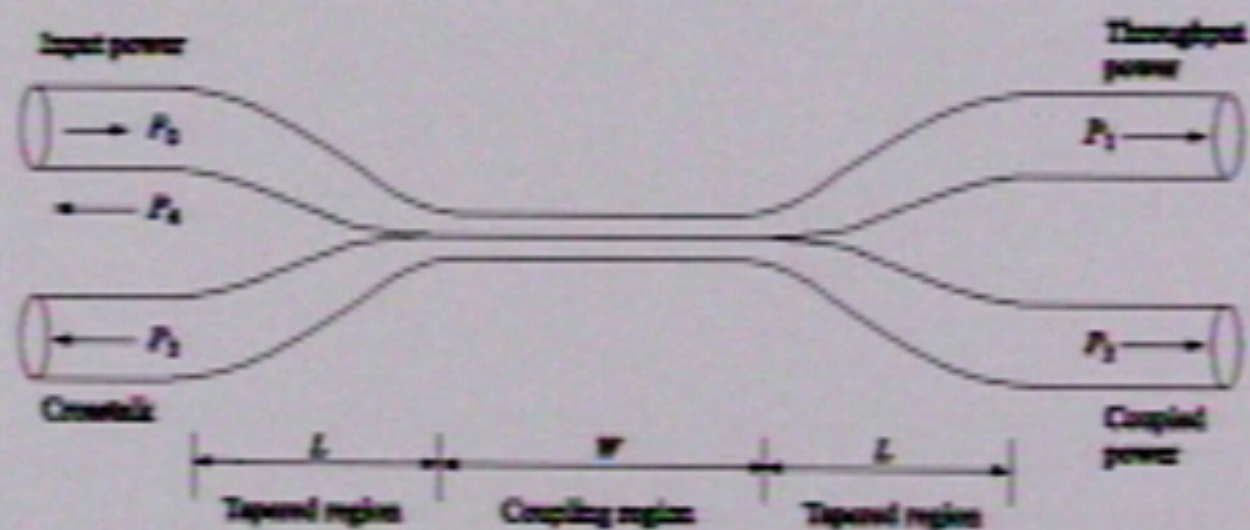




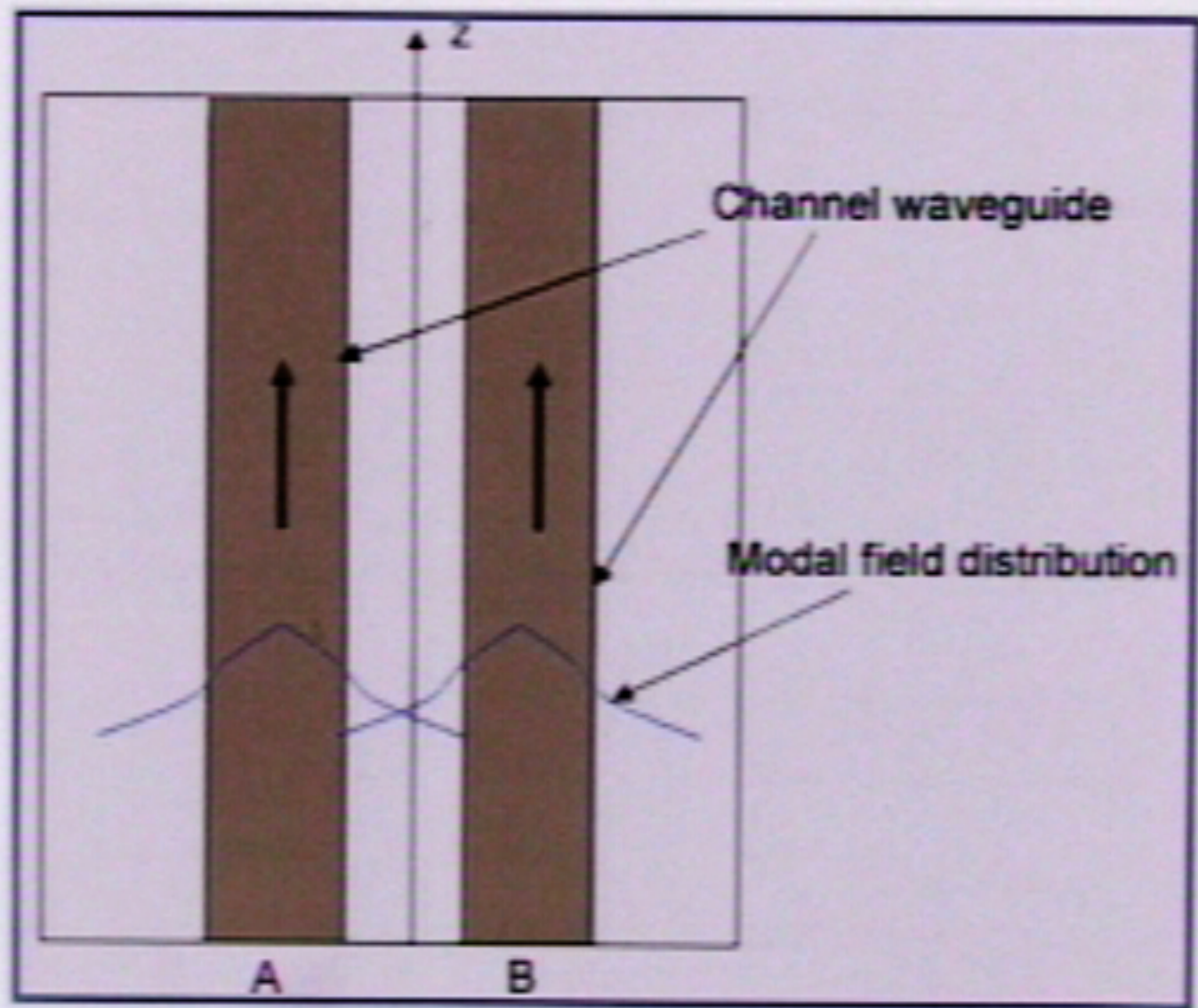
## Basic Star Coupler

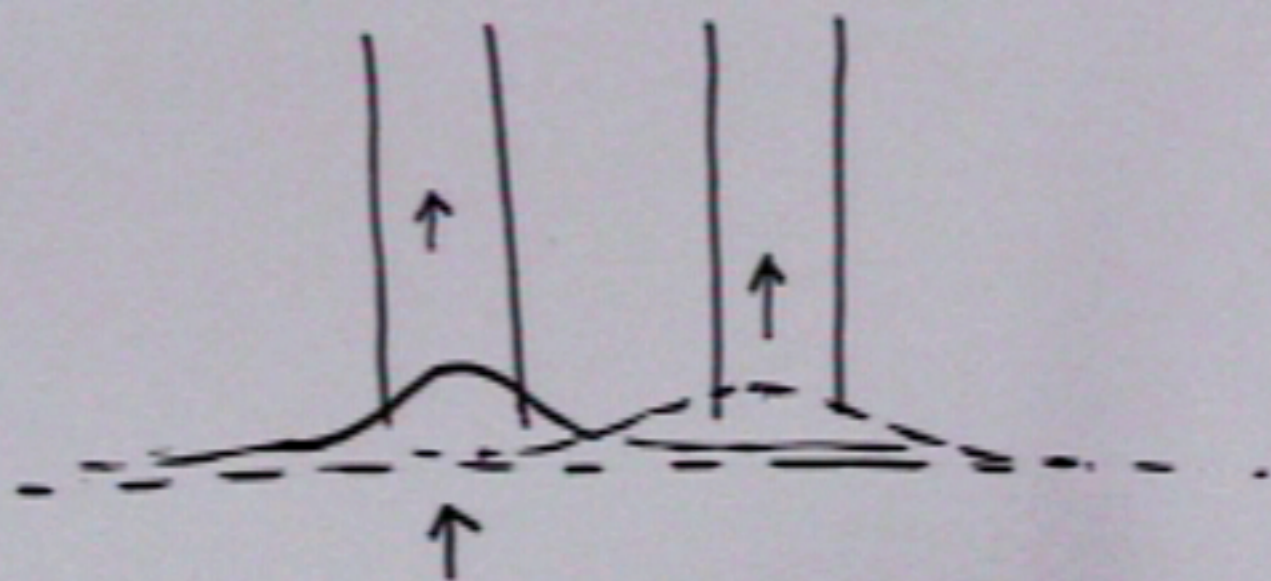


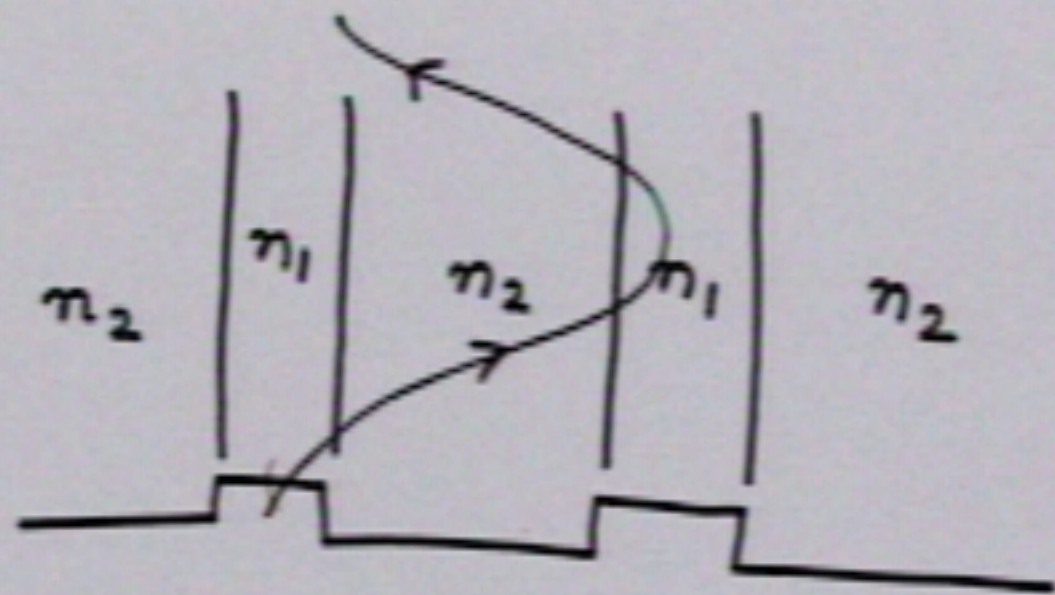
## Fused-fiber coupler



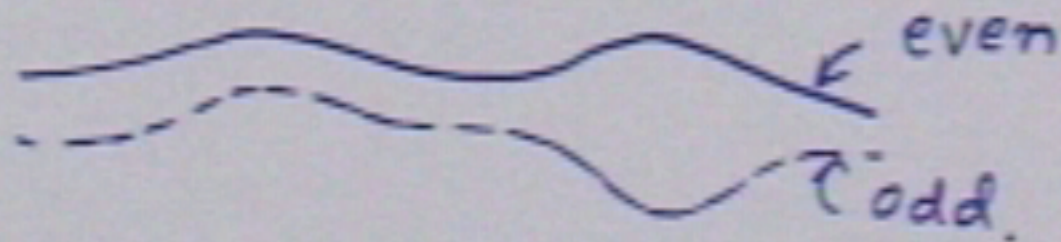
# Directional Coupler







$z=0$



$z_1$

