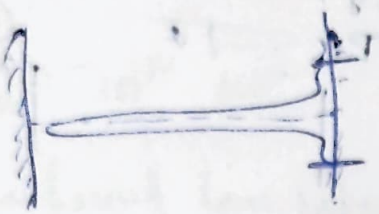
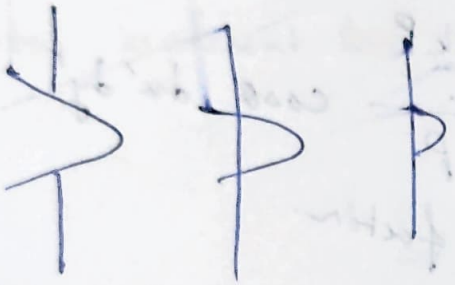
20/1/25 Monday

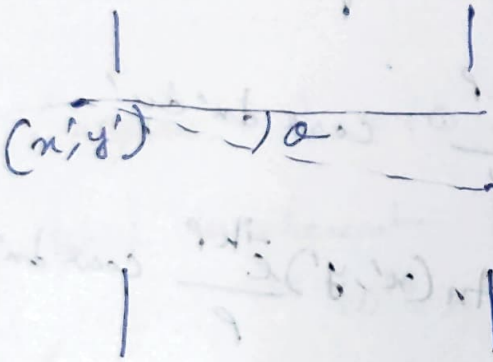
## Diffraction Loss →



Single slit diffraction



because of the diffraction Law.




### Kirchoff's Law

$$A(x,y) = -\frac{i}{\lambda} \iint A_{n-1}(x',y') \frac{e^{-ikr}}{r} \cos\alpha \, dx'dy'$$

In stationary condition

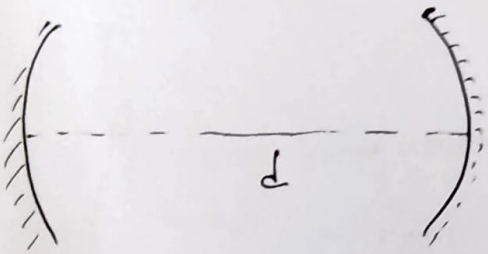
$$A_n(x,y) = C A_{n-1}(x,y) \qquad C = \sqrt{1-\gamma_D}\, e^{i\phi}$$

$\gamma_D$ = diffraction loss for round trip

$$A_n(x,y) = -\frac{i}{\lambda}(1-\gamma_D)^{-1/2} e^{ik\rho} \int A_n(x',y') \frac{e^{-ik\rho}}{\rho} \cos\theta\, dx'dy'$$

field distribution.

for particular case → for this geometry if one finds field distribution → $A_n$ for confocal mirror resonator




2 concave mirror

radii of curvature → $R_1 = R_2 = R = d$

Field distribution becomes

$$A_{mn}^{(r,R,z)} = C^* H_m(x^*) H_n(y^*) \frac{e^{-r^2/\omega^2}}{r} \exp(-i\phi(r,R,z))$$

$$x^* = \frac{\sqrt{2}x}{\omega} \qquad y^* = \frac{\sqrt{2}y}{\omega} \qquad \omega^2 = \frac{\lambda d}{2\pi}\left(1+\left(\frac{2z}{d}\right)^2\right)$$

(m, n) gives you different modes →

$m = n = 0 \qquad H_n = H_m = 1$

$$A_{00} = C^* e^{-r^2/\omega^2} e^{-i\phi}$$

$$I_{00} = I_0 e^{-2r^2/\omega^2}$$ ← (shape of the wave → Gaussian)

at $r = \omega \rightarrow I_{00} = I_0 e^{-2} \Rightarrow$ beam radius

when $z = 0$, min. value of $\omega^2 = \frac{\lambda d}{2\pi}$

r = beam waist

beam waist is min, at $z=0$

beam radius keep on changing.

$$w = r_w = \left(\frac{\lambda R}{2\pi}\right)^{1/2} \quad \text{at } z=0.$$

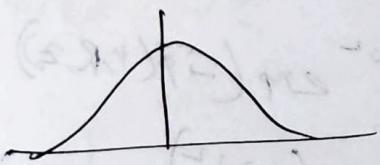
$$r_{1/2} = \left(\frac{\lambda R}{2\pi}\right)^{1/2}\left[1+\left(\frac{2R}{2R}\right)^2\right]$$

$$= 2\left(\frac{\lambda R}{2\pi}\right)^{1/2} = 2r_w$$

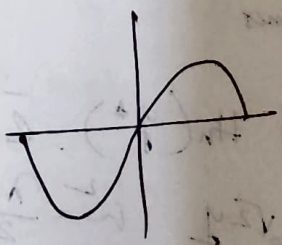
$m=0, n=0$

## TEM mode →

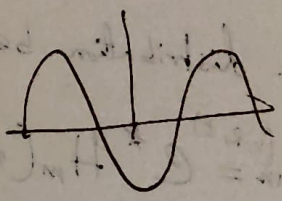
1D TEM$_0$



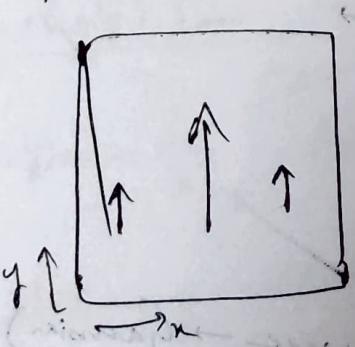
TEM$_1$



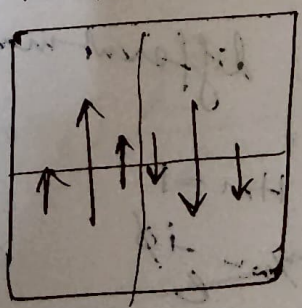
TEM$_2$



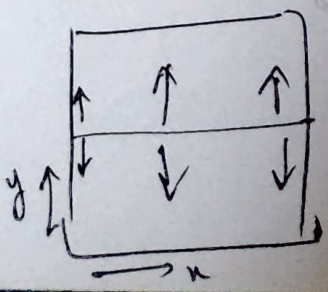
2D TEM$_{00}$



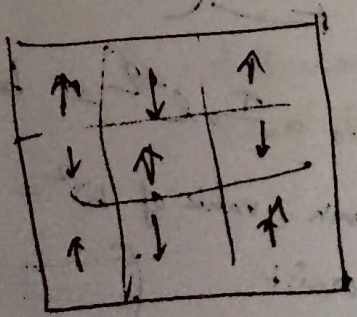

TEM$_{10}$



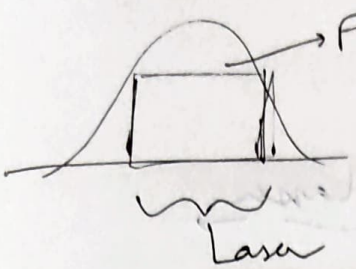
TEM$_{01}$

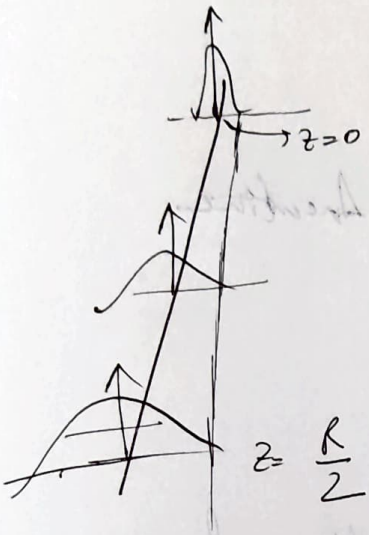



TEM$_{22}$



On the screen we get circular region and intensity decreased gaussian.




not only width changed, phase also has changed. Phase ~~curvature~~ changes with distance.

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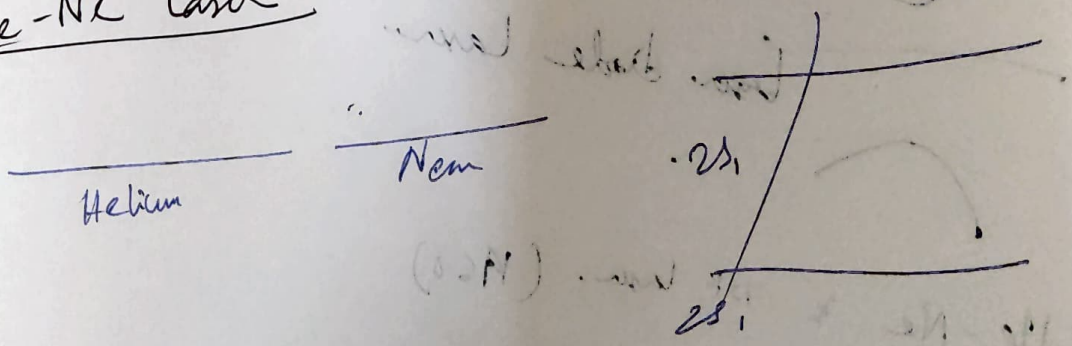
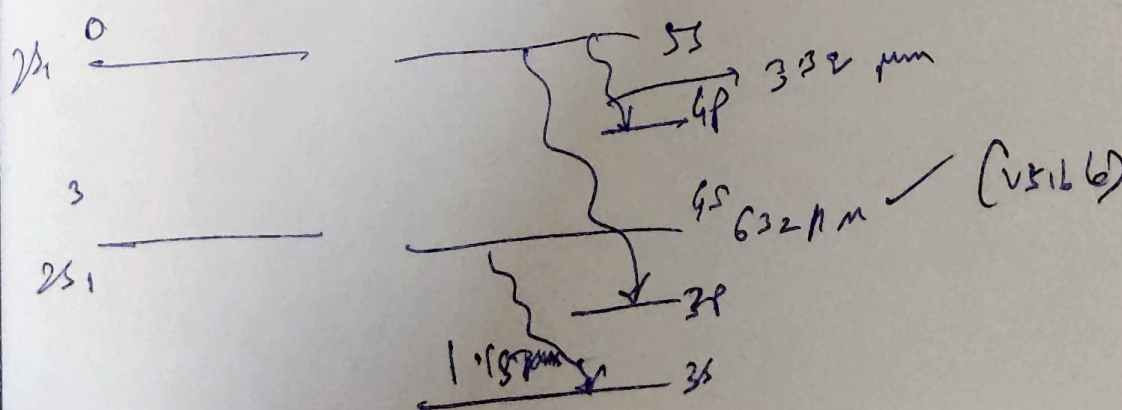
He-Ne Laser → use this; for stability.



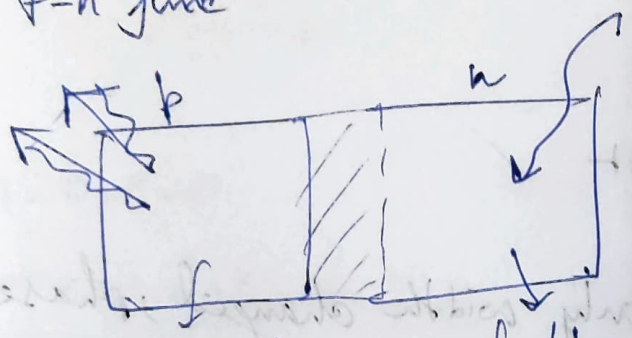
Ar laser:

Continuous wave gas laser. (CW Laser)

~~Semi Conductor laser~~

Semi Conductor laser / Diode Laser

P-n junction




GaAs

Gallium Arsenide

Laser pointer is actually a ~~diode~~ laser diode laser

He-Ne is ist laser. (1960)