Interference in Thin Films

Reflection

Transmission

1. Division of wavefront $I \propto \frac{1}{r^2}$

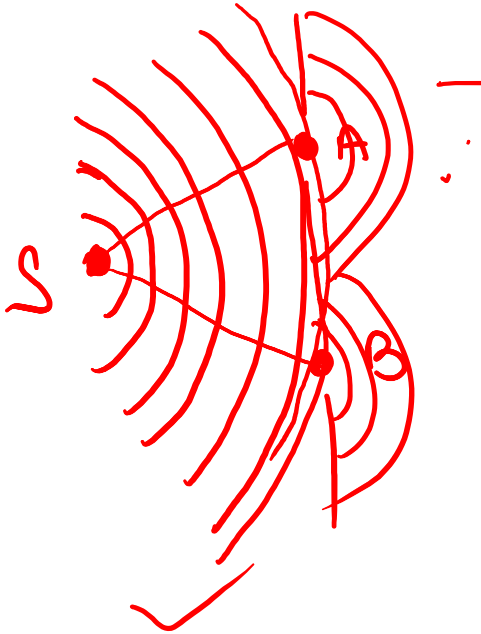
2. " " amplitude $I \propto A^2$

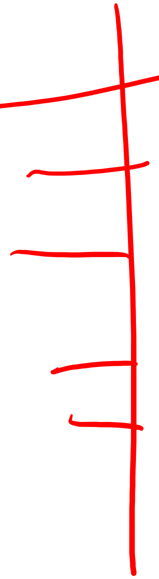
Newton Ring ✓

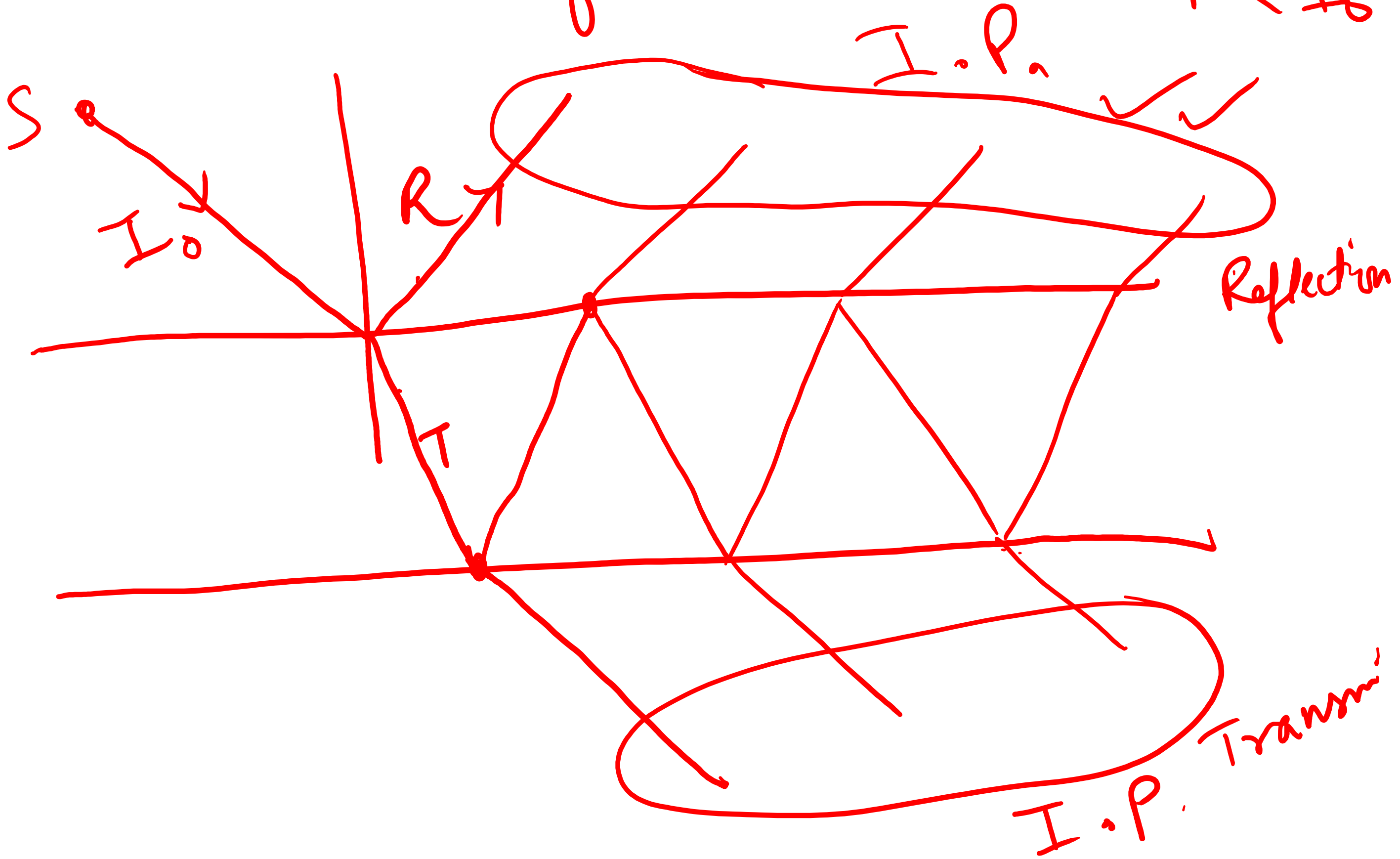
Thin films ✓

$R < I_0$

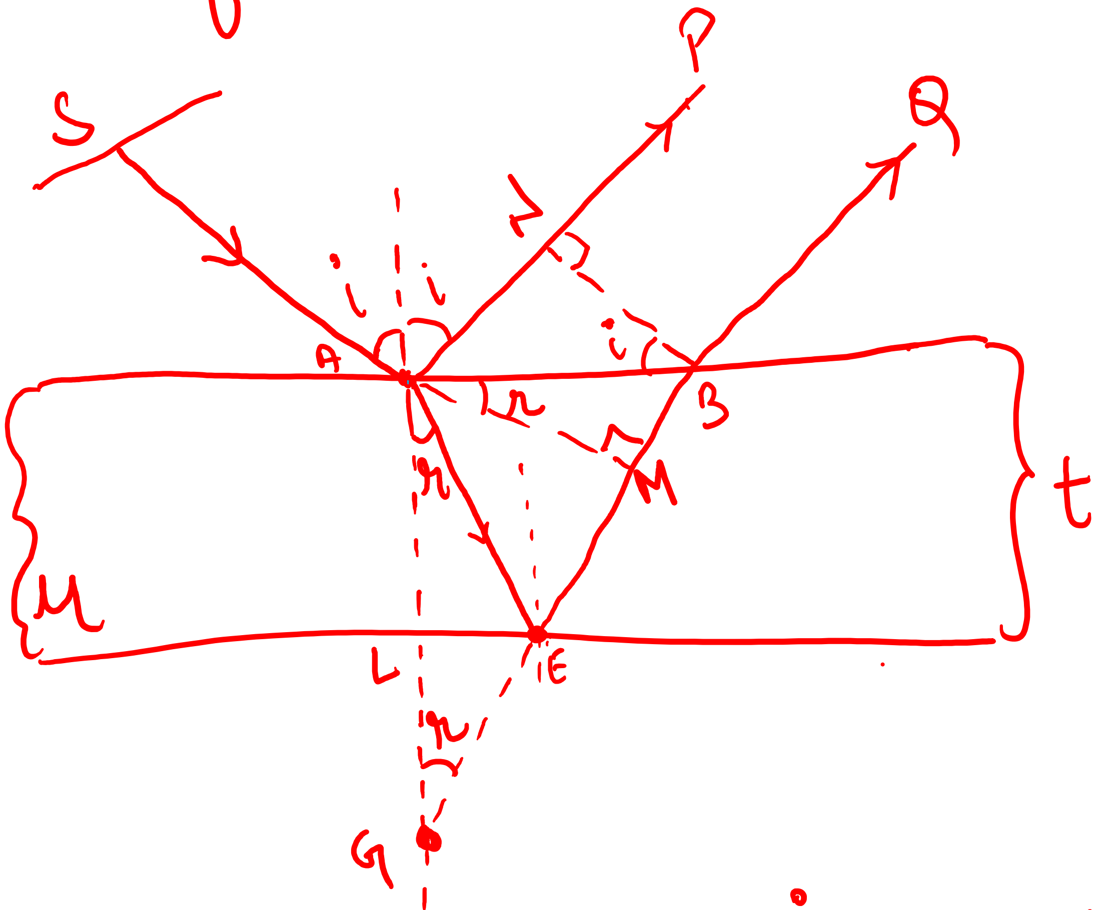
$T < I_0$







Interference due to reflection:



Ray 1 − $\cancel{SA} + AP \to AN + \cancel{NP}$ $+\lambda/2$

Ray 2 − $\cancel{SA} + \underbrace{AE + EB}_{\mu} + \cancel{BQ}$

$$P.D = \mu(AE+EB) - AN + \lambda/2$$
$$= \mu(GE+EB) - AN + \lambda/2$$
$$= \mu(GB) - AN + \lambda/2$$
$$= \mu(GM+MB) - AN$$
$$= \mu GM + \cancel{\mu MB} - \cancel{\mu MB}$$

$$\mu = \frac{\sin i}{\sin r} = \frac{AN/\cancel{AB}}{MB/\cancel{AB}} \Rightarrow AN = \mu MB$$

$\therefore$ PD $= \mu AG \cos r = \underline{2\mu t \cos r} + \lambda/2$

Including <u>reflection a A</u>:

$$PD = 2\mu t \cos r \pm \frac{\lambda}{2}$$

<u>Bright</u>

$$2\mu t \cos r \pm \frac{\lambda}{2} = n\lambda$$

$$\boxed{2\mu t \cos r = (2n \pm 1)\frac{\lambda}{2}}$$

dark

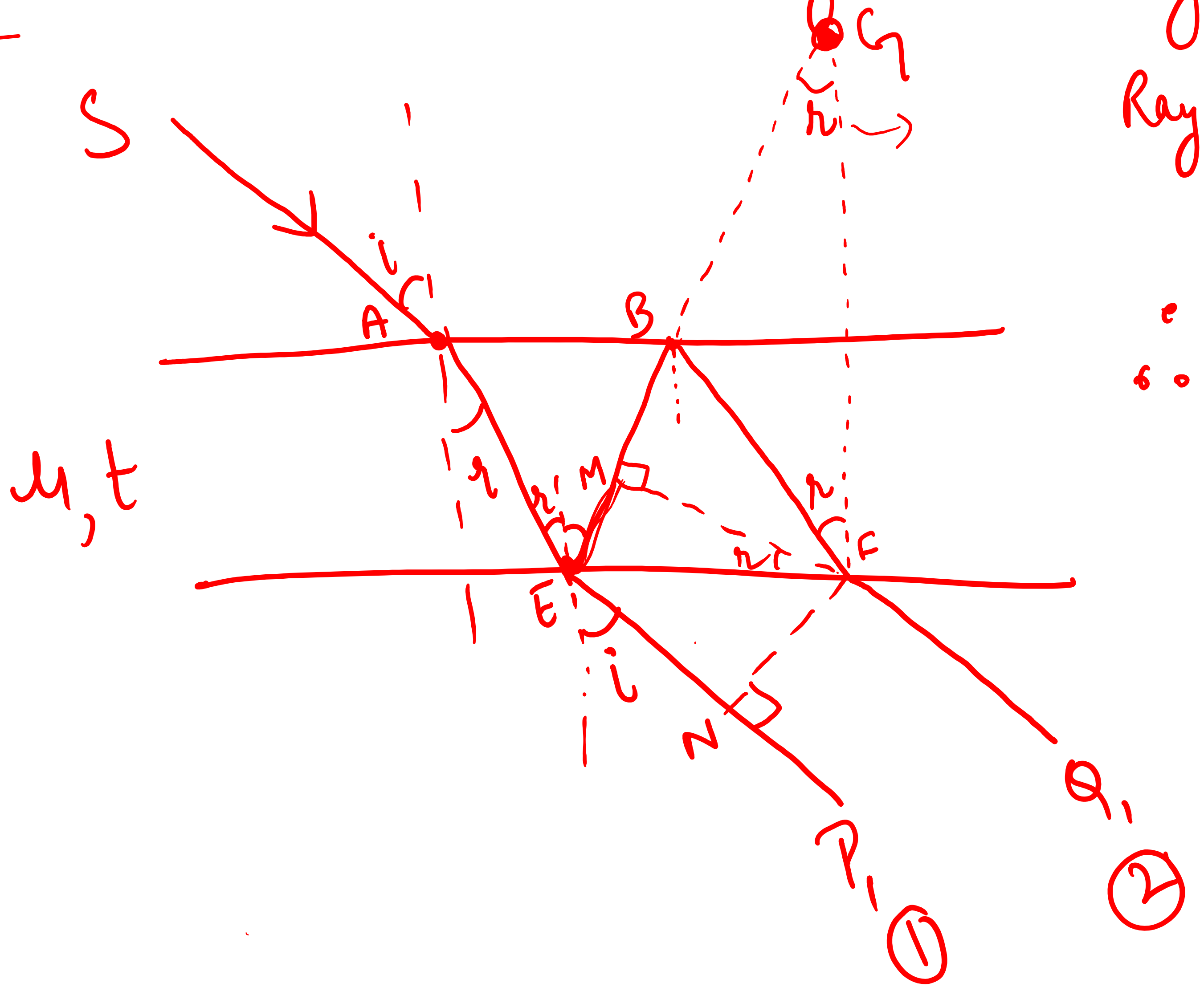
$$2\mu t = \frac{\lambda}{2}$$ destruct.

Dark bands.

$$2\mu t\cos r \pm \frac{\lambda}{2} = (2n \pm 1)\frac{\lambda}{2}$$

$$\boxed{2\mu t\cos r = n\lambda}$$

Transmitted light



Ray ①: $\cancel{SA} + \cancel{AE} + EN + \cancel{NP_1}$

Ray ②: $\cancel{SA} + \cancel{AE} + \underbrace{EB + BF}_{\mu} + \cancel{FQ_1}$

$$\therefore PD = \mu(EB + BF) - EN$$

$$= \mu EG - \underline{EN}$$

$$\mu = \frac{\sin i}{\sin r} = \frac{EN/EF}{EM/EF}$$

$$EN = \mu EM$$

$$PD = \mu(EG - EM) = \mu(MG)$$

$\therefore$ PD $= \mu\, FG \cos r = \boxed{2\mu t \cos r}$

Bright Fringe

$$2\mu t \cos r = \pm n\lambda$$

<u>Dark fringe</u>

$$2\mu t \cos r = (2n \pm 1)\frac{\lambda}{2}$$