Recap

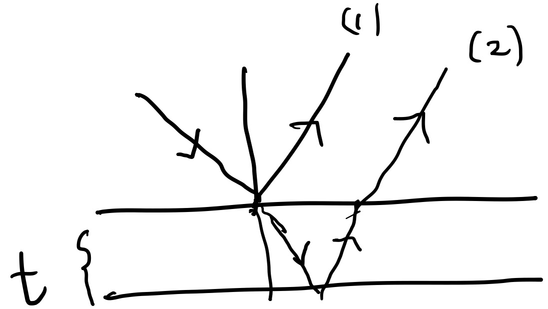
Double slit experiment ⟶ interference pattern analysis.

↓ division of wavefront.

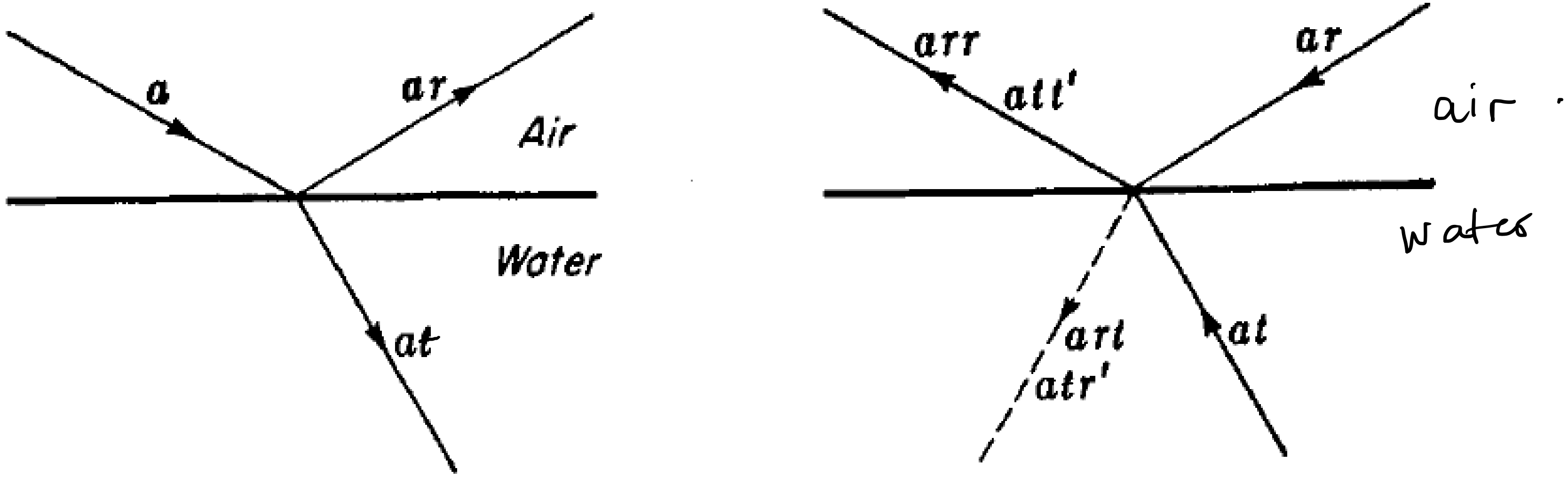
Today we will look at division of amplitude

Interference in thin films ⟶ oil film on water, soap films.

colour of butterflies, beetles, peacocks neck.



Phase change on reflection



(a) (b)

Stoke's Principle of Reversibility → Instantaneous reversal of all velocities in a dynamical system causes the system to retrace its previous path

r: reflection coeff, air - water , t : transmission coeff. : air - water

r' : refl. coeff water - air t' : water - air

$$att' + arr = a \quad \text{—— (1)}$$

$$art + atr' = 0 \quad \text{—— (2)}$$

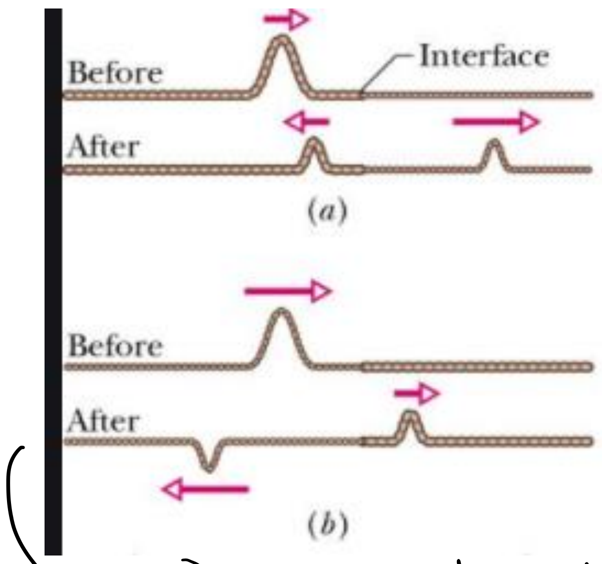
$$tt' = 1 - r^2 \quad \text{—— (3)}$$

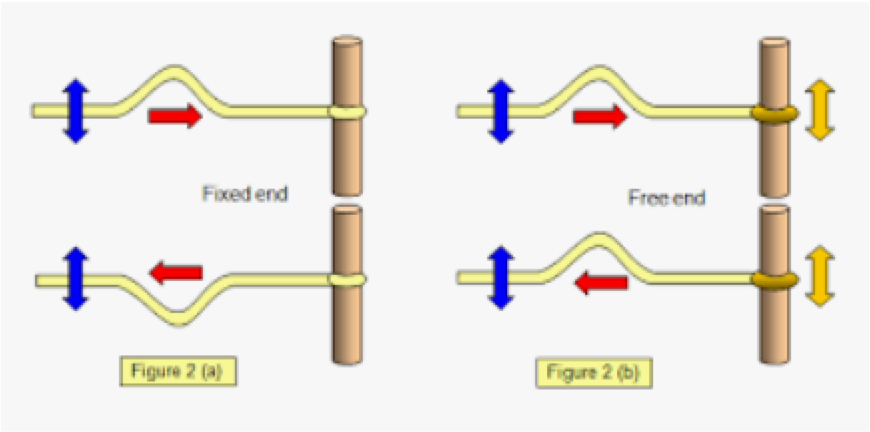
$$\underbrace{r' = -r}_{?} \quad \text{—— (4)}$$

there is relative phase diff^n of π between the reflected wave from rarer to denser vs denser to rarer

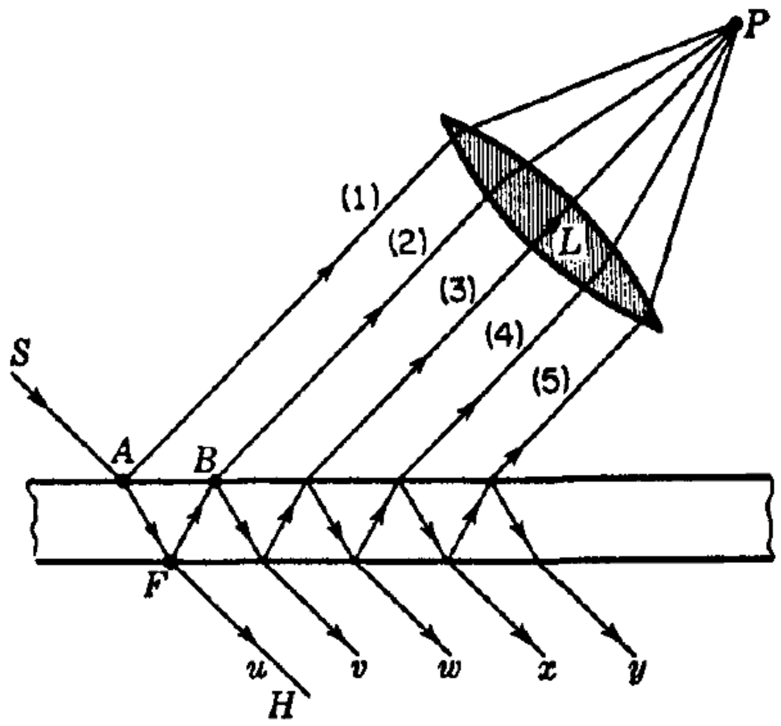
expt. obs → phase change occurs in rarer to denser media reflection

refer to n.





rarer to denser
phase change.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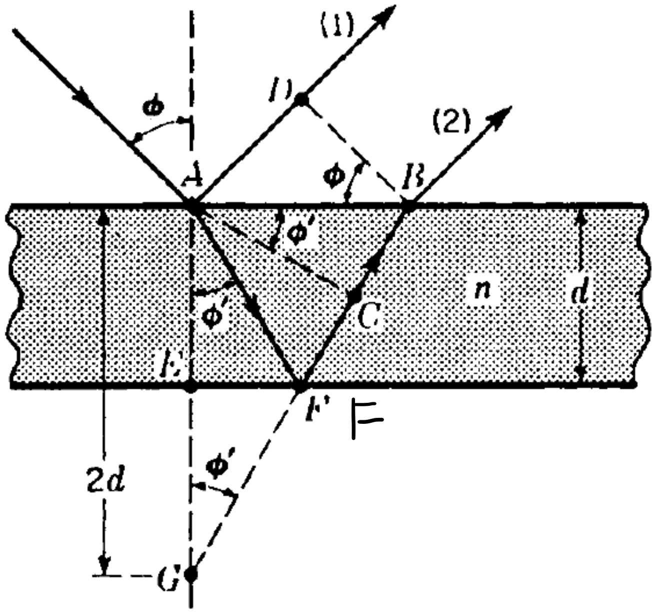


BD and AC are successive positions of the wavefront

↓ $AD = n\,BC$.

↳ optical paths equal

Path difference between (1) and (2)

$$\Delta = n(AFB) - AD$$

Since $\angle GAF = \angle AGF$

$$AF = GF$$

$$\Delta = n(AF + FB) - AD$$

$$= n(GF + FB) - AD.$$

$$= n(GB) - AD.$$

$$= n(GC + CB) - AD$$

$$= nGC + \cancel{AD} - \cancel{AD}$$

$$\boxed{\Delta = nGC = n\,2d\cos\phi'}$$

There is a π phase diff between 1 & 2 due to relative phase change ; phase change for 1 (rarer to denser)
no phase change for 2 (denser to rarer).

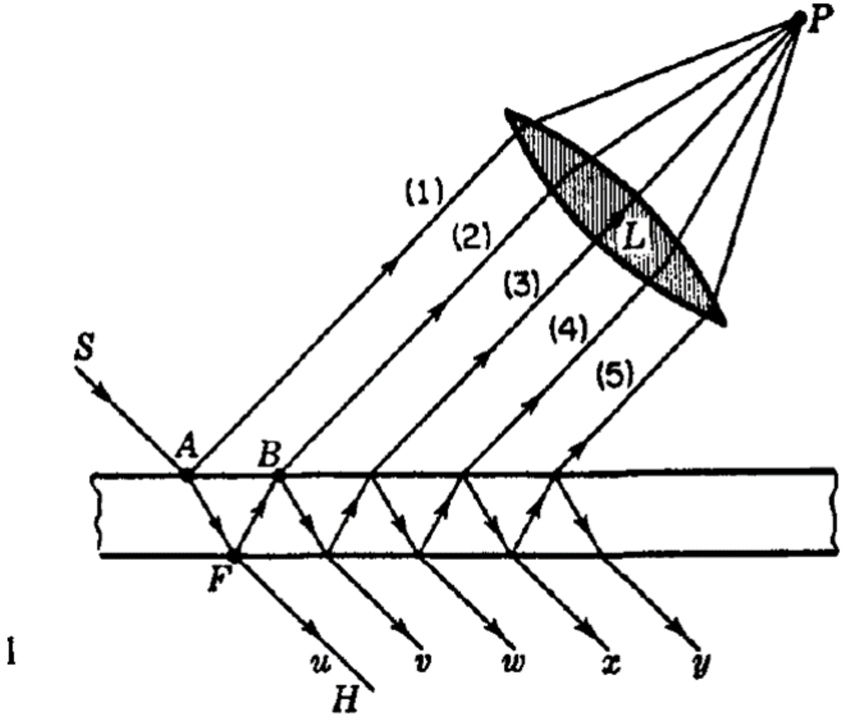
If no phase change due to reflection occured.
then condn. for maxima would have been

$$2dn\cos\phi' = m\lambda \quad \times$$ in this case

↳ phase change of π reverses the condn. for maxima & minima.

$\boxed{2dn\cos\phi' = m\lambda}$ → minima, dark fringe.

$\boxed{2dn\cos\phi' = \left(m+\frac{1}{2}\right)\lambda}$ → maxima, bright fringe.



phases of 3, 4, 5 . . . . (in phase) .

geometry is same, path diff between 3 & 2 will also be given by $2nd\cos\phi'$, but here there are only internal reflections so if $2nd\cos\phi' = m\lambda$ is fulfilled, there will be a maxima (in phase) same for all succeeding pairs

1, 2 will out of phase, but 2, 3, 4 ... will be inphase

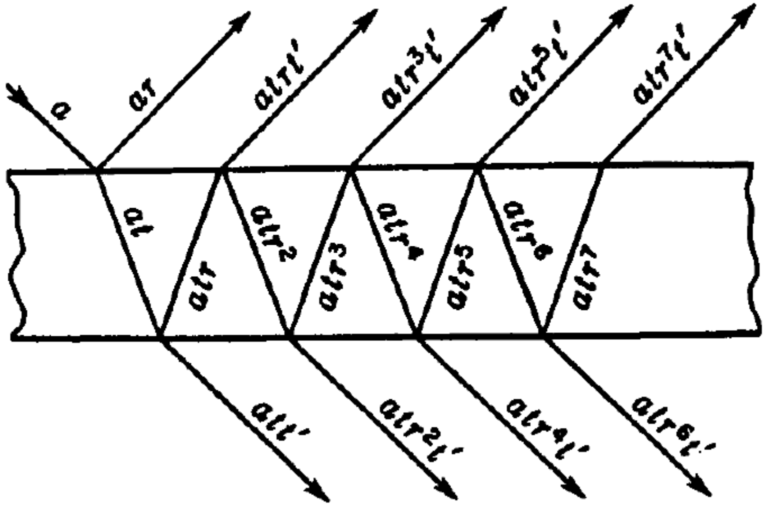
$$\underbrace{1, 2} \rightarrow \boxed{2dn\cos\phi' = m\lambda}$$

2 is more intense than 3, 4, 5. Do we see complete dark fringe?

On the other hand if

$$2nd\cos\phi' = \left(m + \frac{1}{2}\right)\lambda \quad \text{Maxima } (1 \,\&\, 2).$$

2 will be in phase with 1. but 3, 5, 7 will be out of phase with 2, 4, 6. But since 2 is more intense than 3, 4 more intense than 5, minima cannot dominate and we will see a bright fringe.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