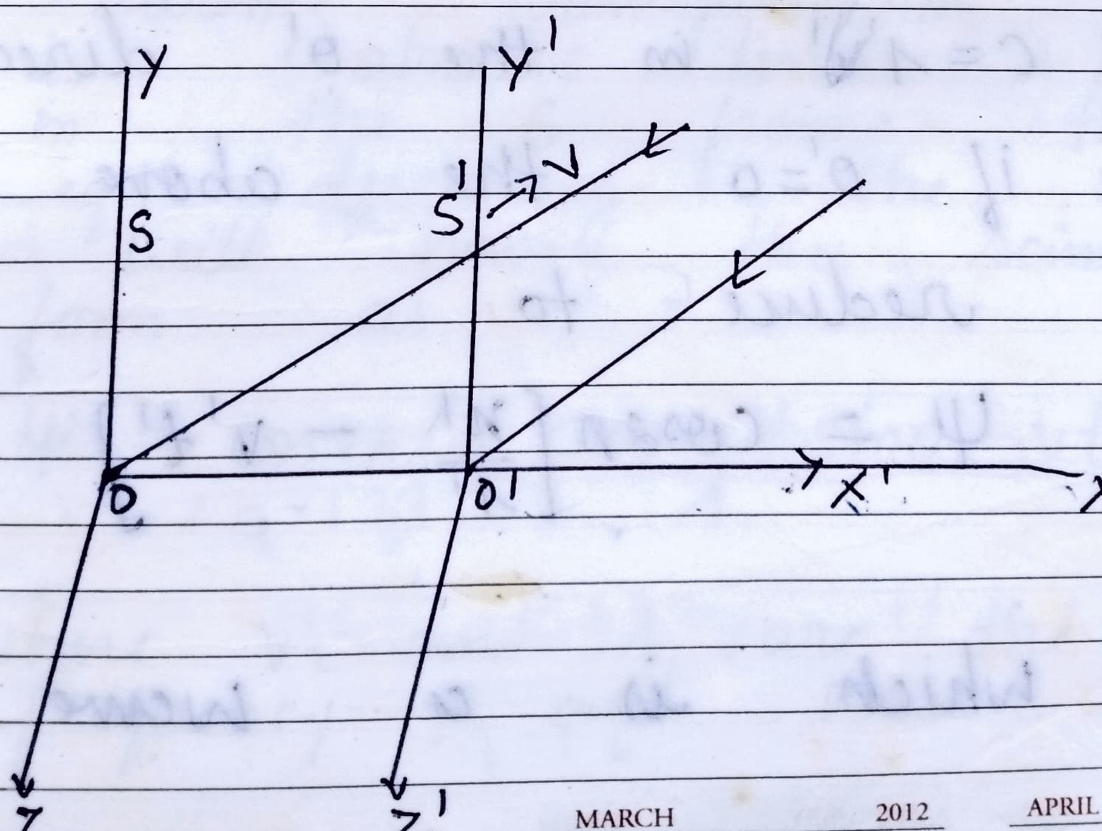
1. Aberration of Light :—

Let us consider a plane monochromatics wave of unit amplitude emitted from a source at the origin of a frame S' moving in x direction with a uniform velocity with respect to a fixed frame S. Let the ray or wave normals be in (x', y'), plane making, an angle 'θ' with the x'- axis.



The wave eqⁿ of such a wave is given by

$$\psi = \cos 2\pi \left[\frac{x'\cos\theta' + y'\sin\theta'}{\lambda'} - \nu' t'\right] \quad \text{—(i)}$$

where λ' and ν' are the wave length and frequency respectively of light emitted in S' frame.
The above eqⁿ is a simple periodic function of unit amplitude moving with a velocity.

$c = \lambda'\nu'$ in the θ' direction

if $\theta' = 0$ the above eqⁿ reduce to

$$\psi = \cos 2\pi \left[\frac{x'}{\lambda'} - \nu' t'\right] \quad \text{—(ii)}$$

which is a wave

moving in direction position of x'- axis

if $\theta' = \pi/2$ it reduce to

$$\psi = \cos 2\pi [y'/\lambda' - \nu' t'] \quad \text{(iii)}$$

which is a wave moving in position x' direction.

In the S frame these wave fronts will be plane as a plane trans-form as a plane due to larentz transfarmation. which is also linear. hence in the S frame the eqn describing the wave will have the same form as

$$\psi = \cos 2\pi \left(\frac{x \cos\theta + y \sin\theta}{\lambda} - \nu t \right) \quad \text{(iv)}$$

where ν and λ are the frequency and wave length in the S. frame and the velocity $C = \lambda\nu$ and θ is the angle that the ray makes with x-axis.

using lorentz transformation eq^n we have

$$x' = \frac{x - vt}{\sqrt{1-\beta^2}}$$

and $$t' = \frac{t - vx/c^2}{\sqrt{1-\beta^2}}$$

where $\beta = v/c$

$\therefore$ from eq^n (1) we have

$$\psi = \cos 2\pi \left[\frac{1}{\lambda'} \frac{x - vt}{\sqrt{1-\beta^2}} \cos\theta' + y \frac{\sin\theta'}{\lambda'} - \nu' \frac{(t - vx/c^2)}{\sqrt{1-\beta^2}} \right] \quad (V)$$

On rearranging the terms we have :

$$\psi = \cos 2\pi \left[\frac{(\cos\theta' + \beta)x}{\lambda'\sqrt{1-\beta^2}} + y\,\frac{\sin\theta'}{\lambda} - \frac{(\beta\cos\theta' + 1)\,\nu' t}{\sqrt{1-\beta^2}} \right] \quad \text{—— (vi)}$$

which is the form of the wave in the S from and must be identical with eqn (4) equating the co-efficients of x, y, z in eqn (4) and (6) we get

$$\frac{\cos\theta}{\lambda} = \frac{\cos\theta' + \beta}{\lambda'\sqrt{1-\beta^2}} \quad \text{—— (vii)}$$

$$\frac{\sin\theta}{\lambda} = \frac{\sin\theta'}{\lambda'} \quad \text{(viii)}$$

and $$v = \frac{v'(1+\beta\cos\theta')}{\sqrt{1-\beta^2}} \quad \text{(IX)}$$

(iv) and the velocity of propagation of light remains the same as.

$$c = v\lambda = v'\lambda'$$

Dividing eqn (viii) by (vii) we have.

$$\frac{\sin\theta}{\cos\theta} = \tan\theta = \frac{\sin\theta'\sqrt{1-\beta^2}}{\cos\theta' + \beta}$$

This is the relativistic eqn far obrervation of light.