Dr. Supriya Kumari
Deptt. of Physics
J.N.C, Madhubani.

Lorentz Transformation equations.

D-1 (H) Paper I.

[Continued ...]

(7)

Substituting the value of x' and t' from eqn (1) & (5) in eqn (7) we have

$$k(x - vt) = c\left[kt + \left(\frac{1-k^2}{kv}\right)x\right]$$

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$$\text{or} \quad kx - \left(\frac{1-k^2}{kv}\right)cx = ckt + kvt$$

$$\text{or} \quad x\left\{k - \left(\frac{1-k^2}{kv}\right)c\right\} = ckt + kvt$$

$$\text{or} \quad x = \frac{ckt + kvt}{k - \left(\frac{1-k^2}{kv}\right)c}$$

$$= \frac{ckt\left(1+\frac{v}{c}\right)}{k\left[1 - \left(\frac{1-k^2}{k^2}\right)\frac{c}{v}\right]}$$

$$= \frac{ct\left(1+\frac{v}{c}\right)}{1-\left(\frac{1}{k^2}-1\right)\frac{c}{v}}$$

$$x = \frac{x\left(1+v/c\right)}{1-\left(\frac{1}{k^2}-1\right)\frac{c}{v}}$$

$$\therefore \quad 1+\frac{v}{c} = 1 - \frac{c}{v}\cdot\frac{1}{k^2} + \frac{c}{v}$$

$$\frac{c}{v}\cdot\frac{1}{k^2} = \frac{c}{v} - \frac{v}{c} = \frac{c^2-v^2}{vc}$$

$$\frac{1}{k^2} = \frac{c^2-v^2}{c^2} = 1-\frac{v^2}{c^2}$$

$$\frac{1}{k} = \sqrt{1-v^2/c^2}$$

$$\text{or} \quad k = \frac{1}{\sqrt{1-v^2/c^2}} \qquad \text{——— (8)}$$

$$x = k\left[k(x-vt) + vt'\right]$$

$$= k^2(x-vt) + kvt'$$

$$= k^2x - k^2vt + kvt'$$

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Substituting the values of K in eq^ns (1) & (5) we have

$$x' = \frac{x - vt}{\sqrt{1 - v^2/c^2}}$$

$$y' = y$$

$$z' = z$$

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

These are Lorentz transformation eq^ns. In order to transform measurements from S' to S we have to replace v by −v. Thus the inverse Lorentz transformation eq^ns are

$$x = \frac{x' + vt'}{\sqrt{1 - v^2/c^2}}$$

$$y = y'$$

$$z = z'$$

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

Two significant aspects of Lorentz transformation eq^n are

(1) The measurement of time as well as position depends

depends upon the frame of reference of the observer so that two events which occur simultaneously in one frame of reference need not be simultaneous when viewed from another.

(2.) If the relative velocity v of the frame S' relative to ~~S~~ S is very small as compared to the velocity of light c, the ~~Lor~~ Lorentz relativistic transformation reduced to the ordinary Galilean eqn. i.e

$$x' = x - vt$$
$$y' = y$$
$$z' = z$$
and $$t' = t.$$

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