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

$$\frac{\partial \varphi}{\partial x} = \frac{\partial \varphi}{\partial x'}\cancelto{1}{\frac{\partial x'}{\partial x}} + \cancelto{0}{\frac{\partial \varphi}{\partial y'}\frac{\partial y'}{\partial x}} + \cancelto{0}{\frac{\partial \varphi}{\partial z'}\frac{\partial z'}{\partial x}} + \cancelto{0}{\frac{\partial \varphi}{\partial t'}\frac{\partial t'}{\partial x}}$$

$$\frac{\partial \varphi}{\partial x} = \frac{\partial \varphi}{\partial x'} \; ; \; \frac{\partial^2 \varphi}{\partial x^2} = \frac{\partial^2 \varphi}{\partial x'^2}$$

$$\frac{\partial \varphi}{\partial y} = \cancelto{0}{\frac{\partial \varphi}{\partial x'}\frac{\partial x'}{\partial y}} + \frac{\partial \varphi}{\partial y'}\cancelto{1}{\frac{\partial y'}{\partial y}} + \cancelto{0}{\frac{\partial \varphi}{\partial z'}\frac{\partial z'}{\partial y}} + \cancelto{0}{\frac{\partial \varphi}{\partial t'}\frac{\partial t'}{\partial y}}$$

$$\frac{\partial \varphi}{\partial y} = \frac{\partial \varphi}{\partial y'} \; ; \; \frac{\partial^2 \varphi}{\partial y^2} = \frac{\partial^2 \varphi}{\partial y'^2}$$

$$\frac{\partial \varphi}{\partial z} = \cancelto{0}{\frac{\partial \varphi}{\partial y'}\frac{\partial x'}{\partial z}} + \cancelto{0}{\frac{\partial \varphi}{\partial y'}\frac{\partial y'}{\partial z}} + \frac{\partial \varphi}{\partial z'}\cancelto{1}{\frac{\partial z'}{\partial z}} + \cancelto{0}{\frac{\partial \varphi}{\partial t'}\frac{\partial t'}{\partial z}}$$

$$\frac{\partial \varphi}{\partial z} = \frac{\partial \varphi}{\partial z'} \; ; \; \frac{\partial^2 \varphi}{\partial z^2} = \frac{\partial^2 \varphi}{\partial z'^2}$$

$$\frac{\partial \varphi}{\partial t} = \frac{\partial \varphi}{\partial x'}\frac{\partial x'}{\partial t} + \cancelto{0}{\frac{\partial \varphi}{\partial y'}\frac{\partial y'}{\partial t}} + \cancelto{0}{\frac{\partial \varphi}{\partial z'}\frac{\partial z'}{\partial t}} + \frac{\partial \varphi}{\partial t'}\cancelto{1}{\frac{\partial t'}{\partial t}}$$

$$\frac{\partial \varphi}{\partial t} = -v\frac{\partial \varphi}{\partial x'} + \frac{\partial \varphi}{\partial t'} \equiv \alpha$$

$$\frac{\partial^2 \varphi}{\partial t^2} = \frac{\partial \alpha}{\partial t} = \frac{\partial \alpha}{\partial x'}\cancelto{-v}{\frac{\partial x'}{\partial t}} + \cancelto{0}{\frac{\partial \alpha}{\partial y'}\frac{\partial y'}{\partial t}} + \cancelto{0}{\frac{\partial \alpha}{\partial z'}\frac{\partial z'}{\partial t}} + \frac{\partial \alpha}{\partial t'}\cancelto{1}{\frac{\partial t'}{\partial t}}$$

$$\frac{\partial \alpha}{\partial t} = -v\frac{\partial \alpha}{\partial x'} + \frac{\partial \alpha}{\partial t'} = -v\frac{\partial}{\partial x'}\left[-v\frac{\partial \varphi}{\partial x'} + \frac{\partial \varphi}{\partial t'}\right] + \frac{\partial}{\partial t'}\left[-v\frac{\partial \varphi}{\partial x'} + \frac{\partial \varphi}{\partial t'}\right]$$

$$\frac{\partial^2 \varphi}{\partial t^2} = v^2\frac{\partial^2 \varphi}{\partial x'^2} - 2v\frac{\partial^2 \varphi}{\partial x'\partial t'} + \frac{\partial^2 \varphi}{\partial t'^2}$$

$$\frac{1}{c^2}\frac{\partial^2 \varphi}{\partial t^2} = \frac{v^2}{c^2}\frac{\partial^2 \varphi}{\partial x'^2} - \frac{2v}{c^2}\frac{\partial^2 \varphi}{\partial x'\partial t'} + \frac{1}{c^2}\frac{\partial^2 \varphi}{\partial t'^2}$$

$$\nabla^2\varphi = \frac{1}{c^2}\frac{\partial^2\varphi}{\partial t^2} = \frac{\partial^2\varphi}{\partial x'^2} + \frac{\partial^2\varphi}{\partial y'^2} + \frac{\partial^2\varphi}{\partial z'^2} = \frac{v^2}{c^2}\frac{\partial^2\varphi}{\partial x'^2} - \frac{2v}{c^2}\frac{\partial^2\varphi}{\partial x'\partial t'} + \frac{1}{c^2}\frac{\partial^2\varphi}{\partial t'^2}$$

$$\therefore \left(1-\frac{v^2}{c^2}\right)\frac{\partial^2\varphi}{\partial x'^2} + \frac{\partial^2\varphi}{\partial y'^2} + \frac{\partial^2\varphi}{\partial z'^2} - \frac{2v}{c^2}\frac{\partial^2\varphi}{\partial x'\partial t'} = \frac{1}{c^2}\frac{\partial^2\varphi}{\partial t'^2}$$

??? <u>NOT</u> <u>Good</u>!! SOMETHING IS <u>'AMISS'</u>

<u>LET</u>

$x' = Ax + Bvt$

$y' = y$

$z' = z$

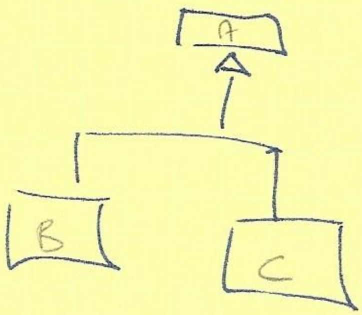
$t' = Dx + Et$

$$\frac{\partial\varphi}{\partial x'} = \frac{\partial\varphi}{\partial x}\frac{\partial x'}{\partial x} + \frac{\partial\varphi}{\partial y'}\frac{\partial y}{\partial y} + \frac{\partial\varphi}{\partial z'}\frac{\partial z'}{\partial x} + \frac{\partial\varphi}{\partial t'}\frac{\partial t'}{\partial x} = A\frac{\partial\varphi}{\partial x'} + D\frac{\partial\varphi}{\partial t'}$$

$$\boxed{\nabla^2\varphi = \frac{1}{c^2}\frac{\partial^2\varphi}{\partial t^2}}$$

$\sim vt$

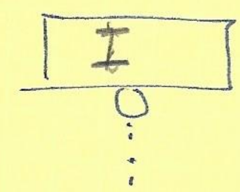
$$\left(1-\frac{v^2}{c^2}\right)\frac{\partial^2\varphi}{\partial x'^2} + \frac{\partial^2\varphi}{\partial y'^2} + \frac{\partial^2\varphi}{\partial z'^2} + \left(\frac{2v}{c^2}\right)\frac{\partial^2\varphi}{\partial x'\partial t'} = \frac{1}{c^2}\frac{\partial^2\varphi}{\partial t'^2}$$



$$x' = Ax + Bt$$

$$t' = Dx + Et$$

$$\frac{\partial\varphi}{\partial x} = \frac{\partial\varphi}{\partial x'}\frac{\partial x'}{\partial x} + \cancel{\frac{\partial\varphi}{\partial y'}\frac{\partial y'}{\partial x}}^{\to 0} + \cancel{\frac{\partial\varphi}{\partial z'}\frac{\partial z'}{\partial x}}^{\to 0} + \frac{\partial\varphi}{\partial t'}\frac{\partial t'}{\partial x}$$



$$\frac{\partial\varphi}{\partial x} = A\frac{\partial\varphi}{\partial x'} + D\frac{\partial\varphi}{\partial t'} \quad ; \quad \frac{\partial\varphi}{\partial y} = \frac{\partial\varphi}{\partial y'} ; \quad \frac{\partial^2\varphi}{\partial y^2} = \frac{\partial^2\varphi}{\partial y'^2}$$

$$\frac{\partial\varphi}{\partial t} = B\frac{\partial\varphi}{\partial x'} + E\frac{\partial\varphi}{\partial t'} \quad ; \quad \frac{\partial\varphi}{\partial z} = \frac{\partial\varphi}{\partial z'} ; \quad \frac{\partial^2\varphi}{\partial z^2} = \frac{\partial^2\varphi}{\partial z'^2}$$

* IMPLEMENTING AN INTERFACE!!

$$\frac{\partial^2\varphi}{\partial x^2} = A^2\frac{\partial^2\varphi}{\partial x'^2} + 2AD\frac{\partial^2\varphi}{\partial x'\partial t'} + D^2\frac{\partial^2\varphi}{\partial t'^2}$$

$$\frac{\partial^2\varphi}{\partial t^2} = B^2\frac{\partial^2\varphi}{\partial x'^2} + 2BE\frac{\partial^2\varphi}{\partial x'\partial t'} + E^2\frac{\partial^2\varphi}{\partial t'^2}$$

$$\frac{1}{c^2}\frac{\partial^2\varphi}{\partial t^2} = \frac{B^2}{c^2}\frac{\partial^2\varphi}{\partial x'^2} + \frac{2BE}{c^2}\frac{\partial^2\varphi}{\partial x'\partial t'} + \frac{E^2}{c^2}\frac{\partial^2\varphi}{\partial t'^2}$$

$$A^2\frac{\partial^2\varphi}{\partial x'^2} + 2AD\frac{\partial^2\varphi}{\partial x'\partial t'} + D^2\frac{\partial^2\varphi}{\partial t'^2} + \frac{\partial^2\varphi}{\partial y'^2} + \frac{\partial^2\varphi}{\partial z'^2} = \frac{B^2}{c^2}\frac{\partial^2\varphi}{\partial x'^2} + \frac{2BE}{c^2}\frac{\partial^2\varphi}{\partial x'\partial t'} + \frac{E^2}{c^2}\frac{\partial^2\varphi}{\partial t'^2}$$

$$\left(A^2 - \frac{B^2}{c^2}\right)\frac{\partial^2\varphi}{\partial x'^2} + \left(2AD - \frac{2BE}{c^2}\right)\frac{\partial^2\varphi}{\partial x'\partial t'} + \frac{\partial^2\varphi}{\partial y'^2} + \frac{\partial^2\varphi}{\partial z'^2} = \left(\frac{E^2}{c^2} - D^2\right)\frac{\partial^2\varphi}{\partial t'^2}$$

* Take Initiative??
* Be Myself??
* Journal?
* Who am I??

* Self-examination??
* Need Pen!!
* Too much Ink
* Need ESD Training??
* ~~Need a Personal Physician.~~
*

$$\nabla^2 \varphi = \frac{1}{c^2}\frac{\partial^2 \varphi}{\partial t^2}$$

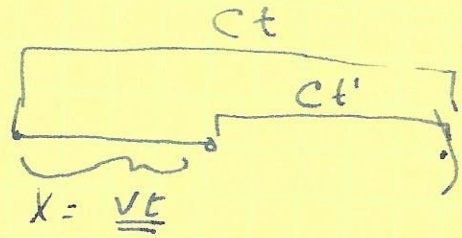
$$X' = X - Vt$$

$$X' = 0;\ \boxed{X = Vt}$$

$$X = 0;\ X' = -Vt$$

$$X' = AX + Bvt$$
$$t' = Dx + Et$$

At $t = 0$,



** Need to investigate!!
* Interesting!!
*

$$\frac{\partial \varphi}{\partial x} = \frac{\partial \varphi}{\partial x'}\frac{\partial x'}{\partial x} + \cancel{\frac{\partial \varphi}{\partial y'}\frac{\partial y'}{\partial y}} + \cancel{\frac{\partial \varphi}{\partial z'}\frac{\partial z'}{\partial x}} + \frac{\partial \varphi}{\partial t'}\frac{\partial t'}{\partial x}$$

$$\frac{\partial \varphi}{\partial x} = \underbrace{A\frac{\partial \varphi}{\partial x'} + D\frac{\partial \varphi}{\partial t'}}_{\alpha}$$

* Need a Primary Care Physician!!
* Who knows!!
* Need to rederive??
* Lots to scan in!!

$$\frac{\partial \varphi}{\partial t} = \frac{\partial \varphi}{\partial x'}\frac{\partial x'}{\partial t} + \frac{\partial \varphi}{\partial t'}\frac{\partial t'}{\partial t}$$

$$\frac{\partial \varphi}{\partial t} = \underbrace{Bv\frac{\partial \varphi}{\partial x'} + E\frac{\partial \varphi}{\partial t'}}_{\beta}$$

$$\frac{\partial^2 \varphi}{\partial x^2} = \frac{\partial \alpha}{\partial x} = \frac{\partial \alpha}{\partial x'}\frac{\partial x'}{\partial x} + \frac{\partial \alpha}{\partial t'}\frac{\partial t'}{\partial x} = A\frac{\partial \alpha}{\partial x'} + D\frac{\partial \alpha}{\partial t'}$$

$$\frac{\partial^2 \varphi}{\partial t^2} = \frac{\partial \beta}{\partial t} = \frac{\partial \beta}{\partial x'}\frac{\partial x'}{\partial t} + \frac{\partial \beta}{\partial t'}\frac{\partial t'}{\partial x} = Bv\frac{\partial \beta}{\partial x'} + E\frac{\partial \beta}{\partial t'}$$

$$\frac{\partial^2 \varphi}{\partial x^2} = A\frac{\partial}{\partial x'}\left[A\frac{\partial \varphi}{\partial x^2} + D\frac{\partial \varphi}{\partial t'}\right] + D\frac{\partial}{\partial t'}\left[A\frac{\partial \varphi}{\partial x'} + D\frac{\partial \varphi}{\partial t'}\right] = A^2\frac{\partial^2 \varphi}{\partial x'^2} + 2AD\frac{\partial^2 \varphi}{\partial x'\partial t'} + D^2\frac{\partial^2 \varphi}{\partial t'^2}$$

$$\frac{\partial^2 \varphi}{\partial t^2} = B^2v^2\frac{\partial^2 \varphi}{\partial x'^2} + 2BEv\frac{\partial^2 \varphi}{\partial x'\partial t'} + E^2\frac{\partial^2 \varphi}{\partial t'^2} \quad \Big| \quad \frac{1}{c^2}\frac{\partial^2 \varphi}{\partial t^2} = \frac{B^2v^2}{c^2}\frac{\partial^2 \varphi}{\partial x'^2} + \frac{2BEv}{c^2}\frac{\partial^2 \varphi}{\partial x'\partial t'} + \frac{E^2}{c^2}\frac{\partial^2 \varphi}{\partial t'^2}$$

$$A^2\frac{\partial^2\varphi}{\partial x'^2} + 2AD\frac{\partial^2\varphi}{\partial y'\partial t'} + D^2\frac{\partial^2\varphi}{\partial t'^2} + \frac{\partial^2\varphi}{\partial y'^2} + \frac{\partial^2\varphi}{\partial z'^2} = \frac{B^2v^2}{c^2}\frac{\partial^2\varphi}{\partial x'^2} + \frac{2BEv}{c^2}\frac{\partial^2\varphi}{\partial x'\partial t'} + \frac{}{c^2}\frac{\partial}{\partial t'^2}$$

$$\left(A^2 - \frac{B^2v^2}{c^2}\right)\frac{\partial^2\varphi}{\partial x'^2} + \frac{\partial^2\varphi}{\partial y'^2} + \frac{\partial^2\varphi}{\partial z'^2} + \left(2AD - \frac{2BEv}{c^2}\right)\frac{\partial^2\varphi}{\partial x'\partial t'} = \left(\frac{E^2}{c^2} - D^2\right)\frac{\partial^2\varphi}{\partial t'^2}$$

1) $A^2 - \frac{B^2v^2}{c^2} = 1$

2) $2AD - \frac{2BEv}{c^2} = \emptyset$; $AD = \frac{BEv}{c^2}$;

3) $\frac{E^2}{c^2} - D^2 = \frac{1}{c^2}$

$\frac{E^2}{c^2} = \frac{1}{c^2} + D^2$

$E^2 = 1 + D^2c^2$

$E^2 - D^2c^2 = 1$

AT $x' = \emptyset$, $\underline{x = vt}$

$\emptyset = Ax + Bvt$

$\emptyset = Avt + Bvt$

$\underline{A = -B}$

$A^2 = B^2$

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

$A^2\left(1 - \frac{v^2}{c^2}\right) = 1$ $\quad A^2 = \frac{1}{1-\frac{v^2}{c^2}}$ $\quad \therefore A = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \equiv \gamma$

$\therefore B = -\gamma$?? $\quad AD = -\frac{AEv}{c^2} \Rightarrow D = -E\frac{v}{c^2}$

$\frac{E^2}{c^2} - \frac{E^2v^2}{c^4} = \frac{1}{c^2}$

$\therefore A = E = \gamma$; $B = -\gamma$; $D = -\gamma\frac{v}{c^2}$

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

$E^2\left[1 - \frac{v^2}{c^2}\right] = 1$

$x' = \gamma x - \gamma vt$

$t' = -\gamma\frac{v}{c^2}x + \gamma t$

$$\boxed{\begin{aligned} x' &= \gamma(x - vt) \\ t' &= \gamma\left(t - \frac{v}{c^2}x\right) \end{aligned}}$$

$\therefore E^2 \frac{1}{1-\frac{v^2}{c^2}} \Rightarrow E = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \equiv \gamma \therefore \boxed{E = A}$

$\frac{\frac{m}{s}}{\frac{m}{s^2}} \cdot m = \frac{\frac{m^2}{s}}{\frac{m}{s^2}}$