Special Theory of Relativity (from the Lorentz Transform)

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10/09/2023

Introduction to the Theory of Relativity – Peter S Bergmann

Reference papers

The Foundations of Mathematical Physics – Chuck Keyser

Of Clocks And Rulers – Chuck Keyser

The Bottom Line – Chuck Keyser

The Relativistic Unit Circle – Chuck Keyser

Boundary Conditions and Interactions between forces - Chuck Keyser

Proof of Fermat's Theorem (and for Multinomials) and other topics - Chuck Keyser

Imaginary Numbers - (not) – Chuck Keyser

Russell's Paradox, Relativity, and Classical Physics - Chuck Keyser

The Complex Plane - Chuck Keyser

Probability – Chuck Keyser

The Quadratic Equation – Chuck Keyser

The Lorentz Transform

To derive the two space and time equations of the Lorentz Tranform, one begins with the expression:

$(x - vt)\alpha = c(\gamma x - \beta t)$ to express equality between arbitrary orientations of the arms of the MM experimental apparatus. Lorentz then squares both sides of this equation, resulting in

$$\left[(x - vt)\alpha\right]^2 = \left[c(\gamma x - \beta t)\right]^2$$

Note that this expression expresses the area of a square

$$A_{\square} = s^2 = \left[(x - vt)\alpha\right]^2 = \left[c(\gamma x - \beta t)\right]^2$$

Or the area of a circle:

$$A_{\bigcirc} = \pi s^2 = \pi\left[(x - vt)\alpha\right]^2 = \pi\left[c(\gamma x - \beta t)\right]^2$$

This equation is then solved by equating coefficients of the expansion of the equation (so π is irrelevant to the analysis), resulting in the space and time equations of the Lorentz Transform:

$$x' = (x - vt)\Gamma$$
$$t' = \left(t - \frac{vx}{c^2}\right)\Gamma$$

where $\Gamma = \dfrac{1}{\sqrt{1-\beta^2}},\ \beta = \dfrac{v}{c}$)

Derivation of the Time Dilation equation

Einstein then applied the condition $x = ct \leftrightarrow x' = ct'$ (the condition that $c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}$ derived from Maxwell's result (using vector calculus). Multiplying the second equation by c results in

$$ct' = x' = \left(ct - \frac{v(ct)}{c} \right)\Gamma = (ct - vt)\Gamma = (x - vt)\Gamma$$

where (a) "space contraction" expression is $x' = (x - vt)\Gamma$. Since the MM experiment for the motion of the apparatus was null in all directions and orientations, the "travel distance" $s = vt$ is simply removed from the equation, resulting in the expression

$$x' = (x)\Gamma$$

Einstein's condition $x = ct \leftrightarrow x' = ct'$ is then applied again, so that $(ct') = (ct)\Gamma$, resulting in the " Time Dilation" equation

$$(t') = (t)\Gamma = \frac{t}{\sqrt{1-\beta^2}} = \frac{t}{\sqrt{1 - \frac{v}{c^2}^2}}$$

Note that the expression $(ct')^2 = (ct)^2 + (vt')^2$ can be solved for t' to produce the same result.

However, the time dilation equation cannot be derived from the real coordinate expression

$ct' = ct + vt'$ since $(ct')^2 = (ct + vt')^2 = \left[(ct)^2 + (vt')^2 \right] + 2(ct)(vt')$ so that

$(ct')^2 \neq \left[(ct)^2 + (vt')^2 \right]$ because of the factor $(ct)(vt')$ which expresses multiplication ("interaction") between the "existence" terms $\left[(ct)^2 + (vt')^2 \right]$ (This is actually the Binomial Expansion for the case $n = 2$), and the foundation for the proof of Fermat's Last Theorem.

The interaction term $2(ct)(vt') := h^2 = 2S$ characterizes the change of entropy where entropy is proportional to area (see Hawkins presentation Beckenstein in "A History of Time") Note that $S = \frac{h}{\sqrt{2}}$, the traditional presentation of "Spin".

There is no “spatial expansion” or “contraction” in the Time dilation equation, since it is removed in deriving the formula from the Lorenz transformations. Furthermore, the expression is second order (and therefore not a spatial transformation) because of the factor $\beta^2 = \frac{v^2}{c^2} = \frac{mv^2}{mc^2} = \frac{(mv)^2}{(mc)^2} = \frac{P_v}{P_c}$ which actually suggests opposing forces since both acceleration and momentum are removed if the forces are equal and opposite so that $m_f = f^2$ at its own “origin” with no extended coordinate system in a vacuum where nothing else exists.

Note that the constant identification of $c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}$ from the Coulomb and Ampere force expressions removes all coordinates from the expression of c, so that it correct interpretation is that of a force where $c^2 = \frac{1}{\varepsilon_0 \mu_0}$ represents the interaction between electric and magnetic forces, after which they are irrelevant in the analysis.

Complex representation

Consider the expressions:

$$\psi = (ct) + i(vt')$$
$$\psi^* = (ct) - i(vt')$$

where $i := \sqrt{-1}$

Then $\psi\psi^* = \left[(ct) + i(vt')\right]\left[(ct) - i(vt')\right] = \left[(ct)^2 + (vt')^2\right]$

So that

$$(t') = (t)\Gamma = \frac{t}{\sqrt{1-\beta^2}} = \frac{t}{\sqrt{1-\frac{v}{c^2}^2}}$$

(This is the reason that Hawking opines that "time is imaginary")

However, $\psi\psi^* \neq (ct')^2$ where the count # is preserved by setting

$$\# = ct + vt'$$
$$\#^2 = (ct + vt')^2$$

Which can be verified by setting $(ct) = 4, (vt') = 3$ and performing the calculations, which work for all Pythagorean Triples (meaning the equation of a circle is wrong…, and so is geometry applied to the relation between light and matter.)

Matrix Representation

If (ct) and (vt') do not interact (entangle, multiply, etc), then the system can be represented by the matrix

$$|\#| := \begin{vmatrix} (ct) & 0 \\ 0 & (vt') \end{vmatrix} \leftrightarrow |\#|^2 = \begin{vmatrix} (ct) & 0 \\ 0 & (vt') \end{vmatrix}^2 = \begin{vmatrix} (ct)^2 & 0 \\ 0 & (vt')^2 \end{vmatrix}$$ so that

$$Tr(|\#|) := \# = (ct) \pm (vt')$$
$$Tr(|\#|^2) := \#^2 = (ct)^2 \pm (vt')^2$$

which will always be positive for $(ct) > (vt')$

Note that component by component ("dot") product of the (column) vectors $\vec{i} \cdot \vec{j} = 0$

If they do interact (entangle, multipy, etc) the result is expressed by the relationship

$$\# := (ct) \pm (vt')$$
$$\#^2 = \left[(ct) \pm (vt')\right]^2 = \left[(ct)^2 + (vt')^2\right] \pm \left[2(ct)(vt')\right]$$

which will always be positive for $(ct) > (vt')$

The matrix representation of the system is:

$$\#^2 = Tr\begin{vmatrix} (ct)^2 & 0 \\ 0 & (vt')^2 \end{vmatrix} \pm Det\begin{vmatrix} (ct) & (ct) \\ -(vt') & (vt') \end{vmatrix}$$

Note that $\#^2 = \left[(ct)^2 + (vt')^2\right] \pm \left[2(ct)(vt')\right]$ is equivalent to the expression:

$$\#^2 = \left[(ct)^2 + (vt')^2\right] \pm \left[2(ct)(vt')\right] = \left[\psi\psi^*\right] \pm \left[2(ct)(vt')\right]$$ where

$$\#^2 = Tr\begin{vmatrix} (ct)^2 & 0 \\ 0 & (vt')^2 \end{vmatrix} \pm Det\begin{vmatrix} (ct) & (ct) \\ -(vt') & (vt') \end{vmatrix} = Tr\begin{vmatrix} (ct)^2 & 0 \\ 0 & (vt')^2 \end{vmatrix} \pm Det\begin{vmatrix} (ct) & (ct) \\ -(vt') & (vt') \end{vmatrix}$$

Finally, note that

$$\varphi = 1 + 1$$
$$\varphi^2 = (1+1)^2 = \left[1^2 + 1^2\right] + \left[2(1)(1)\right] = 4(1^2)$$

which characterizes the existence and interaction of two elements Is not equivalent to

$$Tr\begin{vmatrix} 1^2 & 0 & 0 & 0 \\ 0 & 1^2 & 0 & 0 \\ 0 & 0 & 1^2 & 0 \\ 0 & 0 & 0 & 1^2 \end{vmatrix} = 4(1^2)$$

Which characterizes the existence of four elements without interaction.

Much more to this story, but I don't have the space-time to write it here. But…

Trust me! And send beer and pizza!