Meaning of Twin Paradox and Special Relativity Theory

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Abstract

About the twin paradox of special relativity theory, there are some resolutions. But these might not be the best fit resolution considering the core concept of special relativity theory. Here we will approach the concept of special relativity theory thinking the resolution of twin paradox.

1. Introduction

Typical scenario of twin paradox solution is;

1) Time and space for each of twin is integrated respectively from starting through returning to meeting again,
2) The paradox is recognized resolved by the fact time and space is respectively equal for both of twin when they meet again.

This may admit paradox situation during their travel. If so, this means paradox is not resolved completely.

Here we reconsider this paradox and reasonable resolution.

2. Deductive derivation of Lorentz transformation formulas

Based on the following definition, Lorentz transformation formulas have been derived deductively. [1]

Definition:

Time moves toward time direction also toward space direction with speed c

c: light velocity (a)

Following two system was used there.

s system(2dimensions(ct, x)) and s' system(2dimensions(ct', x')).

Here both are moving relatively with velocity v.

This situation can be shown as Minkowsky graph. (Fig.1)

$\tan\theta = \frac{v}{c}$

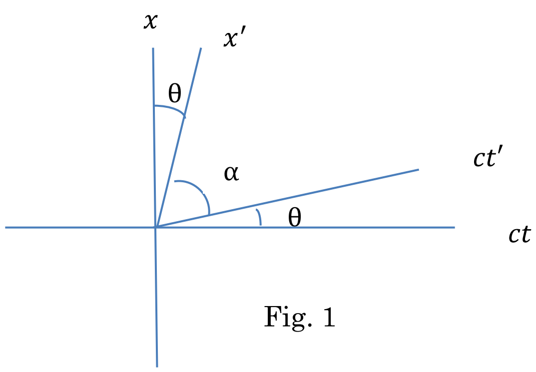

Fig. 1

3. Object points and relevant systems

One object point (one of the twin) A is assigned to (fixed to) s system (base system).

Another object point (another of the twin) B is assigned to (fixed to) s' system.

Object point A can be viewed by s system itself and s' system.

Same as object point A, B also can be viewed by s system and s' system itself.

On this model, following Lorentz transform formulas can be used.

$$ct' = \frac{ct - \frac{v}{c}x}{\sqrt{1-\frac{v^2}{c^2}}} \quad (1)$$

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

4. Applying actual value to the variables of Lorentz formula in the case of looking at object A

(From here t, t', x, x' indicate displacement.)

The object point A which is component of s system is fixed to s system, then

$$x = 0 \quad (3)$$

On (1)(3)

$$ct' = \frac{ct}{\sqrt{1-\frac{v^2}{c^2}}} \quad (4)$$

On (2)(3)(4)

$$x' = -vt' \quad (5)$$

5. Applying actual value to the variables of Lorentz formula in the case of looking at object B

The object point B which is component of s' system is moving with speed v to s system then

$$x = vt \quad (6)$$

On (1)

$$ct' = \frac{ct - \frac{v^2}{c}t}{\sqrt{1-\frac{v^2}{c^2}}} = ct\sqrt{1 - \frac{v^2}{c^2}} \quad (7)$$

On (2)(6)

$$x' = 0 \quad (8)$$

6. Interpretation

When time passes ct with point A, point B system views time passes $\frac{ct}{\sqrt{1-\frac{v^2}{c^2}}}$ with point A on (4). (Fig.2)

The difference of time duration between point A experienced and point B system views is difference of time axis.

Time for point A is passing on its time axis. Point B system views A's time duration on B's system time axis which is mixture of time and space of A's system.

(5) show B system views point A moves distance $-vt'$.

The difference between moved distance of point A and viewed distance by point B system is difference of x axis.

Point A does not move on own x axis. Point B system views moving of point A on B's system x axis which is mixture of time and space of A's system.

Same as above, when time passes ct' with point B, point A system views time passes $\frac{ct'}{\sqrt{1-\frac{v^2}{c^2}}}$ with point B on (7). (Fig.3)

(5) show A system views point B moves distance vt .

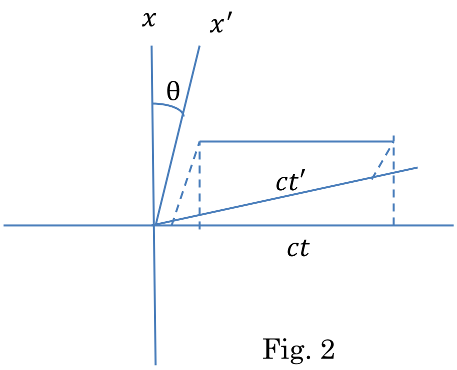

Fig. 2

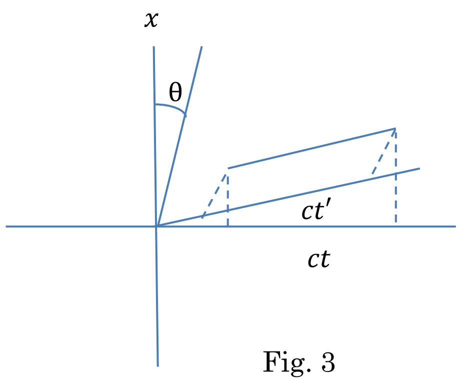

Fig. 3

7. Conclusion

s system nor s' system have no priority and exchangeable. So it is reasonable if we accept same time ct is passing on both systems.

But each view different time is passing with moving another of twin. This is just view. No paradox is there. And when each meet (be on same system), they have same time and same view. So there is no paradox throughout the whole story.

Reference

[1] Tsuneaki Takahashi, viXra:1611.0077,(http://vixra.org/abs/1611.0077)
" Deductive Derivation of Lorentz Transformation for the Special Relativity Theory"