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 thinking the resolution of twin paradox.

1. Introduction

Typical scenario of twin paradox solution is;

1) Time and space are 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 its travel. If so, this means paradox is not resolved completely.

Here we reconsider this paradox and reasonable resolution.

2. View from s system

We consider about following two systems

s system(2dimensions(ct, x)) and s' system(2dimensions(ct', x')). [1]

Here both are moving relatively with velocity v.

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

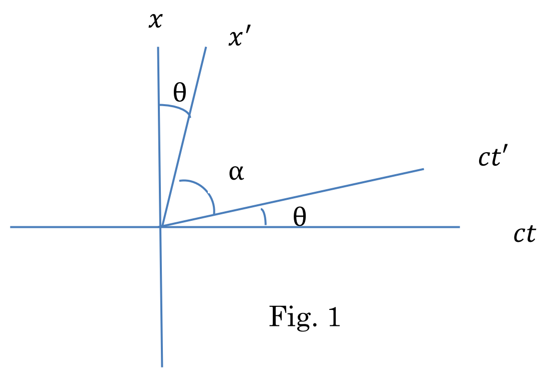

Fig. 1

On Fig.2, A is time t'_A point in s' system. $\overline{PQ}$ is time t'_A line. This is simultaneous line in s' system.

Also B is time t'_B point in s' system. $\overline{RS}$ is time t'_B line. This is simultaneous line in s' system.

These points A, B are same space position for s' system but not for s system. Then regarding to $\overline{AB}$ (elapse time on same space position for s' system) ,elapse time on same space position for s system are $\overline{TU}$, for example. On this situation, time distance $\overline{AB}$ for s' system is recognized as time distance $\overline{TU}$ for s system.

This means;

At space location O, for example, time is measured for s system using own clock. Time for s' system on view of s system also should be measured at location O. In this case, clock at each space position is moving through space point O. Clock which reaches at time-space point U was time zero at time-space V.

The difference of time at U for s system and s' system is based on the fact s' system time is different on s system space location. The reason of this is 'Time Clock (CT) moves in space with velocity v'. [1]

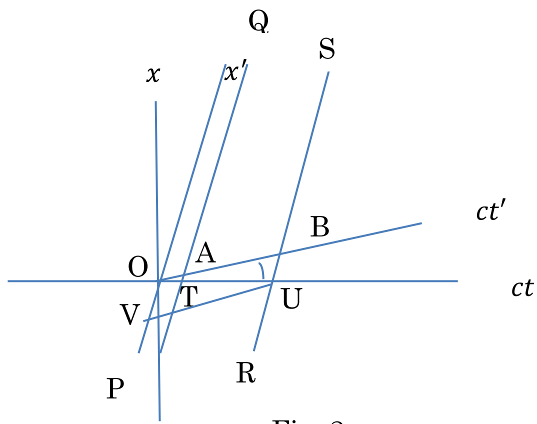

Fig. 2

Lorentz equation is

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

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

Here we set

t' value of point A: t'_A,

t' value of point B: t'_B,

t value of point T: t_T,

t value of point U: t_U,

time distance $\overline{AB} = ct'$

time distance $\overline{TU} = ct$

From (1),

$$ct'_A = \frac{ct_T + 0}{\sqrt{1-\frac{v^2}{c^2}}} \tag{3}$$

$$ct'_B = \frac{ct_U + 0}{\sqrt{1-\frac{v^2}{c^2}}} \tag{4}$$

$$ct'_A - ct'_B = \frac{ct_T - ct_U}{\sqrt{1-\frac{v^2}{c^2}}} \tag{5}$$

$$cl' = \frac{cl}{\sqrt{1-\frac{v^2}{c^2}}} \tag{6}$$

(6) has been called time dilatation of moving object.

3. Time-space distance

On Fig.2 for example, $\overline{AB}$ is time-(space) distance and real existence for s' system. Also $\overline{AB}$ is time-space distance and real existence for s system. $\overline{TU}$ is a projection of $\overline{AB}$ as time distance for s system. Here real existence of time-space distance is only one or common for every inertia system. On the other hand, every inertia systems have own projection as time distance.

4. s system and s' system

There is no inertia system which has priority. Every inertia systems are equivalent. But when multiple systems are described at once, there are following two categories of system as Minkowsky graph in this report.

Staying system: I myself and total staying universe

Moving system: moving parts and assembly of these

In this report, staying system is s system and moving system is s′ system.

In s system, I myself am with staying space, and time is passing simultaneously within whole spaces. s′ system is moving in s system, and it has own frame of reference.

Of course, because both systems are equivalent, each system category is exchangeable. But while one scenario is described, each category should be kept.

5. Twin Paradox

Elapse time difference for s system ($\overline{TU}$) and s′ system ($\overline{AB}$) is on difference of view.

But real existence time-space is common.

Then there is always no paradox situation and it becomes completely same situation when both system becomes same inertia system (same view) except moved distance even though both don't meet again, for example v becomes zero gradually keeping balance.

(Fig.6 → Fig.7→Fig.8)

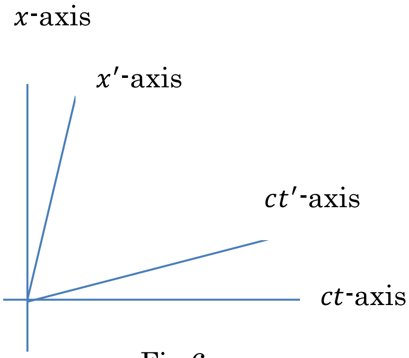

Fig.6

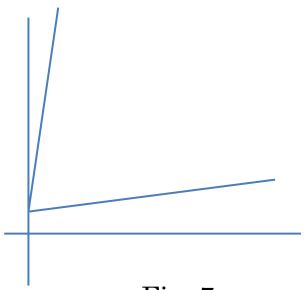

Fig. 7

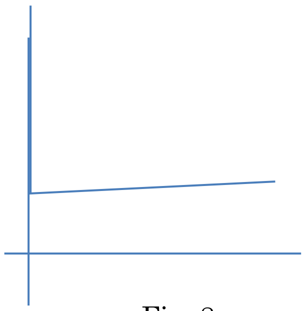

Fig. 8

6. Conclusion

Regarding to relatively moving frame of references, each axis has different target object, so the difference of each's value doesn't make paradox. View is different but real existence is unique. When two systems become have same speed, they have same frame of reference.

Reference

[1] Tsuneaki Takahashi, viXra:1604.0245,(http://vixra.org/abs/1604.0245)