Time In Non-Inertial Reference Frame

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The parity symmetry in physics shows that the motions in two different reference frames are related to each other. By comparing the displacement and the velocity from two reference frames, the elapsed time can be shown to be conserved in both reference frames. For two frames in relative inertial motion, the elapsed time is conserved in all inertial reference frames. If both frames are in circular motion, then the elapsed time is conserved in all local reference frames on the same circle. If both frames are free to move in any direction at any speed, then the elapsed time is conserved in all non-inertial reference frames. Two simultaneous events are simultaneous in all reference frames.

I. INTRODUCTION

The parity symmetry in physics ensures that the physics in one reference frame is equivalent to the physics in another reference frame except the motion is in the opposite direction.

To demonstrate this symmetry, a pair of identical objects are chosen to form an isolated system. Their locations and velocities are specified according to parity symmetry. Any movement of one object ensures the movement of the other object in the oppsite direction.

From the definition of velocity, the elapsed times in the rest frame of each object are shown to be related. This isolated system can be configured as an inertial motion or circular motion or even arbitrary motion. The elapsed time will be derived in these various configurations.

II. PROOF

A. Elapsed Time

Let two objects form an isolated system in a reference frame F_0.

The location of first object O_1 is $\vec{r}$. Its velocity is $\vec{v}$. Let the location of second object O_2 be $-\vec{r}$. Its velocity is $-\vec{v}$. O_2 and O_1 form a parity symmetry in F_0.

Let the rest frame of O_1 be F_1. The origin of F_0 is located at $\vec{R}$ with a velocity of $\vec{V}$ in F_1. Let the rest frame of O_2 be F_2. From the parity symmetry, the origin of F_0 is located at $-\vec{R}$ with a velocity as $-\vec{V}$ in F_2.

Let the time of F_1 be t_1. The motion of the origin of F_0 in F_1 can be described by

$$\frac{d\vec{R}}{dt_1} = \vec{V} \tag{1}$$

Let the time of F_2 be t_2. The motion of the origin of F_0 in F_2 can be described by

$$\frac{d(-\vec{R})}{dt_2} = -\vec{V} \tag{2}$$

From equations (1,2),

$$dt_1 = dt_2 \tag{3}$$

$$t_1 = t_2 + A \tag{4}$$

The time of F_1 differs from the time of F_2 by a constant A.

The elapsed time is conserved in both F_1 and F_2. If dt_1 is zero then dt_2 is also zero.

B. Inertial Motion

Let $\vec{v}$ be a constant vector in F_0. This puts O_1 in an inertial motion relative to F_0. O_2 is also in an inertial motion relative to F_0 but in the opposite direction.

F_1 and F_2 become two inertial reference frames relative to F_0. They are also inertial relative to each other. From equation (3), the elapsed time is conserved in both F_1 and F_2.

Therefore, *the elapsed time is conserved in all reference frames which are inertial relative to F_1.*

C. Linear Acceleration

Let the magnitude of $\vec{v}$ increase with time of F_0 but the direction of $\vec{v}$ remains constant in F_0. Both O_1 and O_2 accelerate but in the opposite direction. F_1 becomes an accelerating reference frame relative to F_2. From equation (3), the elapsed time is conserved in both F_1 and F_2.

Therefore, *the elapsed time is conserved in all reference frames which are accelerating relative to F_1.*

D. Spherical Motion

Let the magnitude of $\vec{r}$ be constant. The magnitude of $\vec{R}$ becomes constant in F_1. Therefore, O_2 is in a spherical motion about the origin of F_1 in F_1. From equation (3), the elapsed time is conserved in both F_1 and F_2.

Therefore, *the elapsed time is conserved in all reference frames which are in spherical motion relative to F_1.*

E. Arbitrary Motion

Remove all restrictions on both $\vec{r}$ and $\vec{v}$ to allow O_2 move in an arbitrary motion in F_1. From equation (3), the elapsed time is conserved in both F_1 and F_2.

Therefore, *the elapsed time is conserved in all reference frames whether they are inertial or non-inertial relative to* F_1.

III. CONCLUSION

The parity symmetry leads to the conservation of the elapsed time. The elapsed time is conserved in all inertial and non-inertial reference frames. There is no time dilation between reference frames.

Lorentz transformation[1,2] claims that two simultaneous events can not be simultaneous in another inertial reference frame because of time dilation. This has been proved to be incorrect by the conservation of the elapsed time.

If the elapsed time is zero for two events in a reference frame, then the elapsed time is also zero for these two events in any reference frame. Two simultaneous events are simultaneous in all reference frames.

[1] Reignier, J.: The birth of special relativity - "One more essay on the subject". arXiv:physics/0008229 (2000) Relativity, the FitzGerald-Lorentz Contraction, and Quantum Theory

[2] H. R. Brown (2001), The origin of length contraction: 1. The FitzGeraldLorentz deformation hypothesis, American Journal of Physics 69, 1044 1054. E-prints: gr-qc/0104032; PITT-PHIL-SCI00000218.

[3] Eric Su: List of Publications, http://vixra.org/author/eric_su