Lorentz Transformation in Inelastic Collision

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An isolated physical system of inelastic collision between two identical objects is chosen to manifest the physics law, conservation of momentum, in two inertial reference frames. In the first reference frame, the center of mass (COM) is stationary. In the second reference frame, one object is at rest before collision. By applying Lorentz transformation to the velocities of both objects, total momentum before and after the collision in the second reference frame can be compared. The comparison shows that conservation of momentum fails to hold when both objects move together at the same velocity.

I. INTRODUCTION

Inelastic collision between two identical objects is an excellent physics system to demonstrate the concept of conservation of momentum. The collision will be examined in two preferred inertial reference frames, the center of mass (COM) frame and the rest frame of one object before collision. Conservation of momentum is expected to hold in both reference frames.

Lorentz Transformation[1] transforms the velocities of both objects from COM frame to the rest frame of one object before collision. The total momentum, before and after the collision, will be calculated in the second reference frame to verify if conservation of momentum still holds when both objects move togethet at the same velocity.

The concept of relativistic mass becomes less popular in modern physics. The momentum of an object is represented by either $\gamma(v) * m(0) * v$ or $m(v) * v$. Both representations are equivalent to each other mathematically. In this paper, $\gamma(v) * m * v$ is chosen to emphasize Lorentz Factor, $\gamma(v)$, in Lorentz Transformation.

II. PROOF

Consider one-dimensional motion.

A. Inelastic Collision

Two identical objects move toward each other to make head-on collision. In the COM frame (Center Of Mass), both objects move at identical speed but opposite direction. At the moment when both objects make contact, there is a repulsive force between them. Both objects eventually slow down to become stationary.

B. Before Collision

Let a reference frame F_1 be stationary relatively to this COM frame.

TABLE I. Velocity and Momentum in Reference Frame

Object	Frame	Value
The velocity of object 1, O_1, in	F_1	is V
The velocity of object 2, O_2, in	F_1	is -V
The momentum of O_1 in	F_1	is $\gamma(V) * m * V$
The momentum of O_2 in	F_1	is $\gamma(-V) * m * (-V)$

C. Lorentz Transformation

Let another reference frame F_2 be stationary relatively to O_2. The velocity of F_1 relative to F_2 is V. The velocity of O_1 in F_1 is V. According to Lorentz Transformation, the velocity of O_1 in F_2 has to be $\frac{V+V}{1+\frac{V*V}{C^2}}$.

TABLE II. COM Frame and Rest Frame

Object	Frame	Velocity
The velocity of O_1 in	F_1	is V
The velocity of O_2 in	F_1	is -V
The velocity of F_1 relative to	F_2	is V
The velocity of O_1 in	F_2	is $\frac{V+V}{1+\frac{V*V}{C^2}}$
The velocity of O_2 in	F_2	is 0

D. After Collision

Upon collision, both objects in F_1 will slow down and come to stand still. As both objects become stationary in F_1, both objects move at the same velocity in F_2.

TABLE III. Both Objects Are Stationary to Each Other

Object	Frame	Velocity
The velocity of O_1 in	F_1	is 0
The velocity of O_2 in	F_1	is 0
The velocity of F_1 relative to	F_2	is V
The velocity of O_1 in	F_2	is V
The velocity of O_2 in	F_2	is V

E. Conservation of Momentum

Let u be the velocity of O_1 in F_2 before collision.

$$u = \frac{2V}{1+\frac{V^2}{C^2}} \tag{1}$$

Total momentum in F_2 before collision is

$$\gamma(u) * m * u + \gamma(0) * m * 0 = \gamma(u) * m * u \tag{2}$$

Total momentum in F_2 after collision is

$$\gamma(V) * m * V + \gamma(V) * m * V = 2 * V * \gamma(V) * m \tag{3}$$

Conservation of Momentum demands, (from equations (2),(3)),

$$2 * V * \gamma(V) * m = \gamma(u) * m * u \tag{4}$$

From equations (1),(4)

$$\gamma(V) = \gamma(\frac{2V}{1+\frac{V^2}{C^2}}) * \frac{1}{1+\frac{V^2}{C^2}} \tag{5}$$

Equation (5) fails to hold for V=$\frac{C}{2}$.

$$\gamma(V) = \frac{2}{\sqrt{3}} \tag{6}$$

$$\gamma(\frac{2V}{1+\frac{V^2}{C^2}}) * \frac{1}{1+\frac{V^2}{C^2}} = \frac{5}{3} * \frac{4}{5} = \frac{4}{3} \tag{7}$$

Total momentum before inelastic collision is different from total momentum after inelastic collision if

$$\frac{V}{C} = \frac{1}{2} \tag{8}$$

III. CONCLUSION

Lorentz Transformation violates conservation of momentum.

Conservation of momentum fails to hold if Lorentz Transformation is applied to an isolated system of inelastic collision. The failure of this physics law is due to the addition of velocity from Lorentz Transformation. The correct formula for velocity transformation has been derived by Eric Su in 2018[2][10].

Lorentz Transformation was proposed on the assumption that the speed of light is independent of inertial reference frame.

As the result of this incorrect assumption[3], Lorentz Transformation violates Translation Symmetry[4] in physics. Translation Symmetry requires conservation of simultaneity[5], conservation of distance[6], and conservation of time[7]. All three conservation properties are broken by Lorentz Transformation.

Therefore, Lorentz Transformation is an invalid transformation in physics. Consequently, any theory based on Lorentz Transformation is incorrect in physics. For example, Special Relativity[8][9]

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