A study on the velocity, inertial mass, momentum, and kinetic energy of the inertial frame moving relative to the absolute stationary inertial frame

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Abstract

Assuming that an absolute stationary inertial frame exists in the universe and the speed of light is constant only in the absolute stationary inertial frame, new equations for inertial mass, momentum and kinetic energy in a moving inertial frame are derived.

In the process of deriving the new equations, an experiment was presented to obtain the velocity of the inertial frame moving relative to the absolute stationary inertial frame. If this experiment is successful, we could find out how fast and in which direction our Earth is moving in space.

1.0 Introduction

Albert Einstein derived the equations for time dilation, mass increase, and kinetic energy in the theory of special relativity published in 1905, assuming that light speed is constant in all inertial frames and the absolute stationary inertial frame does not exist in the universe.

In this study, new equations for inertial mass, momentum, and kinetic energy in an inertial frame moving relative to the absolute stationary inertial frame are derived by assuming that an absolute stationary inertial frame exists and using the two assumptions for the speed of light below.

- Assumption 1: An absolute stationary inertial frame exists in the universe
- Assumption 2: The speed of light observed in an absolute stationary inertia frame is constant regardless of the movement of the light source. That is, light emitted from both a moving and a stationary object have the same speed in an absolute stationary inertial frame.
- Assumption 3: In a moving inertial frame, the round-trip speed of light in all directions is the same and is equal to the speed of light in the absolute stationary inertial frame.

2.0 Conversion Factors to Absolute Stationary Inertial Frame.

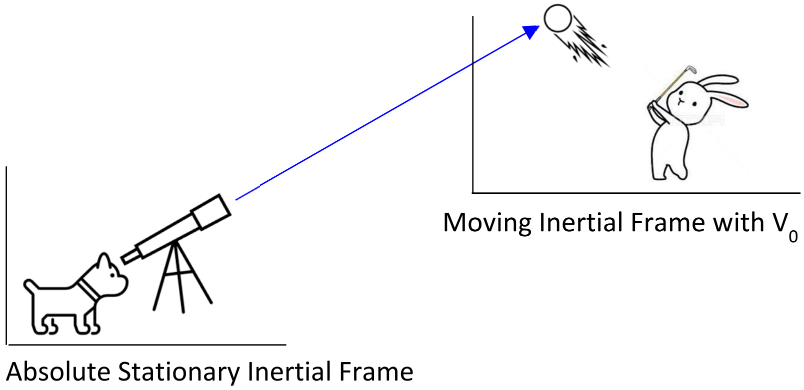

Figure 1. Observe a golf ball hit in an inertial frame flying with velocity V_0 in an absolute stationary inertial frame

As shown in Figure 1, in order to calculate the kinetic energy of an object thrown from a moving inertial frame in terms of an absolute stationary inertial frame, the following four conversion factors are used:

- Length Conversion Factor
- Time Conversion Factor
- Velocity Conversion Factor
- Mass Conversion Factor

In the process of deriving this equation, an experiment is presented to determine the velocity of an inertial frame moving relative to the absolute stationary inertial frame and the new equation for the relative velocity of an object observed in a moving inertial frame to the absolute stationary inertial frame.

2.1 Factor that converts length observed in the moving inertial frame to length observed in the absolute stationary inertial frame

As shown in Figure 2, consider that a spacecraft with a semicircular reflector flies at V_0 speed and generates light at the center of the spacecraft.

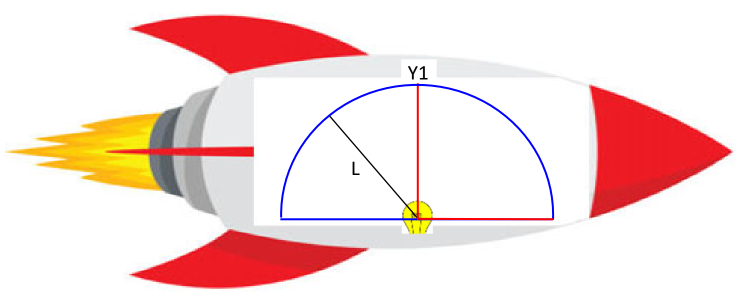

Figure 2. A spaceship flying at velocity V_0 relative to the absolute stationary inertia frame

The path of light emitted from the source at the center of the spaceship hits point Y1. Point Y1 reflects the light back to the source. The motion of this light path is observed from the absolute stationary inertial frame as follows:

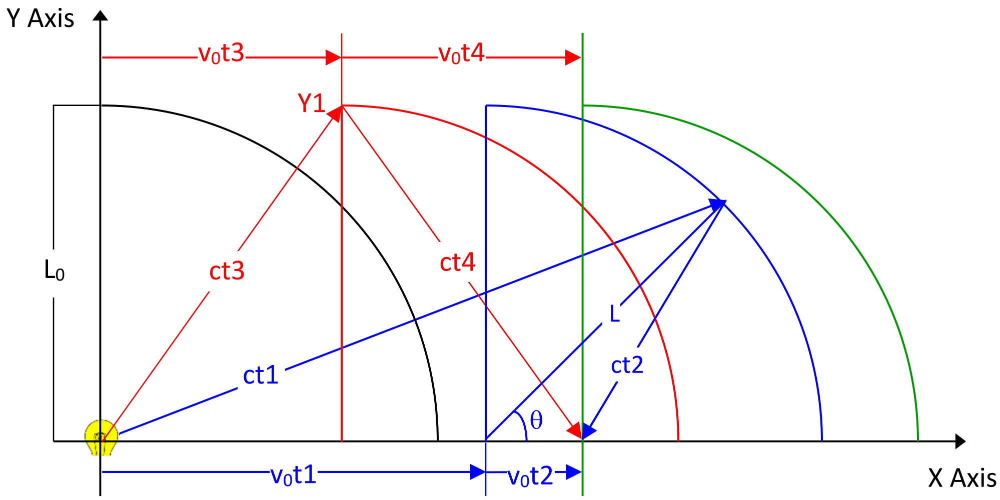

Figure 3. The path of light in a spacecraft observed in an absolute stationary inertial frame

The path of light reflected at point Y1 and returned to the center of the spaceship

Assuming no length contraction in the Y axis, the time t3 + t4, represents the time it takes for the emitted light to hit Y1 point and reflect back to the source. The time t3 + t4 can be calculated as follows in the absolute stationary inertial frame.

t3 : The time it takes for the light emitted from the source at center of the spaceship to reach point Y1 of the reflector.

$$(L_0)^2 + (v_0 t3)^2 = (ct3)^2$$

t4 : The time it takes for the light reflected from point Y1 back to the center of the spaceship.

$$(L_0)^2 + (v_0 t4)^2 = (ct4)^2$$

$$t3 + t4 = \frac{2L_0}{\sqrt{c^2 - {v_0}^2}} \tag{1}$$

The path of light reflected from a point on the reflector and returned to the center of the spaceship

The time t1 + t2, represents the time it takes for the emitted light to travel from the source at center of the spaceship to any point on the reflector, then back to the source. This can be calculated for the absolute stationary inertial frame as follows:

$$(ct1)^2 = (L\,sin\theta)^2 + (L\,cos\theta + v_0 t1)^2 = L^2 + 2Lcos\theta v_0 t1 + (v_0 t1)^2$$

$$t1 = \frac{Lv_0cos\theta + \sqrt{L^2(cos\theta)^2{v_0}^2 + L^2(c^2 - {v_0}^2)}}{c^2 - {v_0}^2} \tag{2}$$

$$(ct2)^2 = (L\ sin\theta)^2 + (L\ cos\theta - v_0t2)^2 = L^2 - 2Lcos\theta v_0t2 + (v_0t2)^2$$

$$t2 = \frac{-Lv_0cos\theta + \sqrt{L^2(cos\theta)^2{v_0}^2 + L^2(c^2 - {v_0}^2)}}{c^2 - {v_0}^2} \tag{3}$$

$$t1 + t2 = \frac{2L\sqrt{(cos\theta)^2{v_0}^2 + (c^2 - {v_0}^2)}}{c^2 - {v_0}^2} \tag{4}$$

Based on Assumption 3, the speed of light is the same in all directions, so the time for the round-trip t1+t2, Equation (4), for any one point, and time for the round-trip t3+t4, Equation (1), for Y1, must be the same.

Hence,

$$\frac{2L\sqrt{{v_0}^2(cos\theta)^2 + (c^2 - {v_0}^2)}}{c^2 - {v_0}^2} = \frac{2L0}{\sqrt{c^2 - {v_0}^2}}$$

The length L_0 in a moving inertial frame is observed to be contracted compared to L in the absolute stationary inertial frame a follows:

$$L = \frac{L_0\sqrt{c^2 - {v_0}^2}}{\sqrt{c^2 - {v_0}^2 + {v_0}^2(cos\theta)^2}} = \frac{L_0}{\sqrt{1 + \frac{{v_0}^2(cos\theta)^2}{c^2 - {v_0}^2}}} \tag{5}$$

The length contraction factor R_L that converts length in a moving inertial frame to length in the absolute stationary inertial frame is defined as follows:

$$R_L = \frac{L}{L_0} = \frac{1}{\sqrt{1 + \frac{{v_0}^2(cos\theta)^2}{c^2 - {v_0}^2}}} \tag{6}$$

2.2 Factor that converts time observed in the moving inertial frame to time observed in the absolute stationary inertial frame

In a moving inertial frame, unit time is defined as the time for light to travel a distance L_0 back and forth as shown in Figure 4.

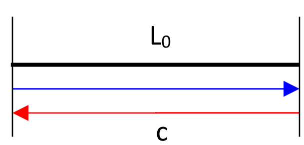

Figure 4. Unit time in an inertial frame

Unit time in an inertial frame is expressed as follows:

$$t0 = \frac{2L_0}{c} \tag{7}$$

Since the absolute stationary inertial frame observes the round-trip time of the moving inertial frame as Equation (1) that is always greater than time of Equation (7), it can be inferred that the unit time in the moving inertial frame is slower than the unit time in the absolute stationary inertial frame.

Using the absolute stationary inertial frame time t as Equation (1) and the moving inertial system time t_0 as Equation (7), the factor R_T that converts the moving inertial frame time to the absolute stationary inertial frame time is defined as follows:

$$R_T = \frac{t}{t_0} = \frac{\frac{2L_0}{c\sqrt{1-\frac{{v_0}^2}{c^2}}}}{\frac{2L_0}{c}} = \frac{1}{\sqrt{1-\frac{v_0}{c^2}}} \tag{8}$$

<u>How to measure the velocity, V_0, of a moving inertial frame</u>

Based on Equations (2) and (3), the difference between the time t1 to reach a surface point and the time t2 to return to the source can be expressed as follows in the absolute stationary inertial frame:

$$\Delta t_a = t1 - t2 = \frac{2Lv_0 cos\theta}{c^2 - {v_0}^2} = \frac{2L_0 v_0 cos\theta}{(c^2 - {v_0}^2)\sqrt{1 + \frac{{v_0}^2(cos\theta)^2}{c^2 - {v_0}^2}}} = \frac{2L_0 v_0 cos\theta}{c^2\sqrt{1-\frac{{v_0}^2}{c^2}}\sqrt{1-\frac{{v_0}^2(sin\theta)^2}{c^2}}} \tag{9}$$

Considering time dilation, the time difference in a moving inertial frame is then

$$\Delta t_s = \Delta t_a\sqrt{1-\frac{{v_0}^2}{c^2}} = \frac{2L_0 v_0 cos\theta}{c^2\sqrt{1-\frac{{v_0}^2(sin\theta)^2}{c^2}}} \tag{10}$$

Max Δt_s occurs at θ=0, so

$$\Delta t_{s\_max} = \frac{2L_0 v_0}{c^2} \tag{11}$$

If the maximum Δt_{s_max} can be measured by experiment, the velocity of the moving inertial frame can be obtained as follows:

$$v_0 = \Delta t_{s\_max}\frac{c^2}{2L_0} \tag{12}$$

If this experiment is successful, one can determine the direction and velocity of the inertial frame moving in space.

2.3 Factor that converts the velocity observed in the moving inertial frame to the velocity observed in the absolute stationary inertial frame

Using the length conversion factor R_L , Equation (6), and the time conversion factor R_T , Equation (8), the factor R_v can then be derived. R_v is the factor that converts the observed velocity in the moving inertial frame to the velocity observed in the absolute stationary inertial frame:

$$R_v = \frac{R_L}{R_T} = \frac{1}{\sqrt{1 + \frac{{v_0}^2(cos\theta)^2}{c^2 - {v_0}^2}}} \cdot \sqrt{1 - \frac{{v_0}^2}{c^2}} = \left(1 - \frac{{v_0}^2}{c^2}\right) \cdot \frac{1}{\sqrt{1 - \frac{{v_0}^2(sin\theta)^2}{c^2}}} \quad (13)$$

<u>Relative velocity of an object observed in a moving inertial frame to the absolute stationary inertial frame</u>

When a moving object is observed as v_A in an absolute stationary inertial frame and v_1 in an inertial frame moving with a velocity v_0, the velocity v_1 in the moving inertial frame is observed as $R_v v_1$ in the absolute stationary frame, so these velocities can be expressed as shown in Figure 5.

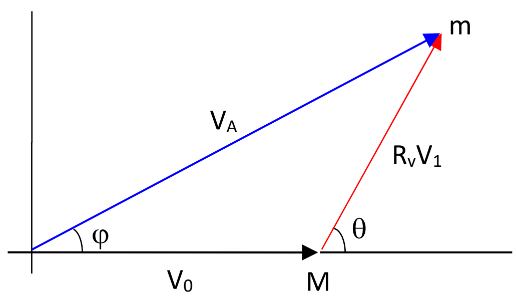

Figure 5. Schematic relationship between velocity V_A and the direction j observed in the absolute stationary inertial frame, and velocity V_1 and direction q observed in an inertial frame moving at velocity V_0

Based on Figure 5, the relationship between v_A and v_1 can be shown as follows:

$$(R_v v_1)^2 = (v_A \cos(\varphi) - v_0)^2 + (v_A \sin(\varphi))^2 = {v_A}^2 - 2v_0 v_A \cos(\varphi) + {v_0}^2 \quad (14)$$

$$v_A sin(\varphi) = R_v v_1 sin(\theta)$$

$$sin(\theta) = \frac{v_A sin(\varphi)}{R_v v_1} = \frac{v_A sin(\varphi)}{\sqrt{{v_A}^2 - 2v_0 v_A \cos(\varphi) + {v_0}^2}} \quad (15)$$

Based on the Equations (13), (14), and (15), the relative velocity v_1 and θ can be expressed by v_0, v_A and φ as follows:

$$v_1 = \frac{\sqrt{{v_A}^2 - 2v_0 v_A \cos(\varphi) + {v_0}^2}}{R_v} = \sqrt{{v_A}^2 - 2v_0 v_A \cos(\varphi) + {v_0}^2} \cdot \frac{c\sqrt{c^2 - {v_0}^2 (sin\theta)^2}}{c^2 - {v_0}^2}$$
$$= \frac{c}{c^2 - {v_0}^2}\sqrt{c^2[{v_A}^2 - 2v_0 v_A \cos(\varphi) + {v_0}^2] - {v_0}^2 {v_A}^2 (sin\varphi)^2} \quad (16)$$

$$\theta = \sin^{-1}\left[\frac{v_A sin(\varphi)}{\sqrt{{v_A}^2 - 2v_0 v_A \cos(\varphi) + {v_0}^2}}\right] \quad (17)$$

The absolute velocity v_A can be expressed by v_1 and v_0 as follows:

$$v_A = \sqrt{{v_0}^2 + 2v_0 R_v v_1 \cos(\theta) + {R_v}^2 {v_1}^2}$$
$$= \sqrt{{v_0}^2 + 2v_0 v_1 \frac{c^2 - {v_0}^2}{c\sqrt{c^2 - {v_0}^2 (sin\theta)^2}} \cos(\theta) + \left(\frac{c^2 - {v_0}^2}{c\sqrt{c^2 - {v_0}^2 (sin\theta)^2}}\right)^2 {v_1}^2} \quad (18)$$

Since the velocity v_A observed in an absolutely stationary inertial frame cannot exceed the speed of light, c, the maximum value of v_1 can be obtained by substituting $v_A = c$ in Equation (18) is as follows:

$$v_{1\_max} = \frac{c}{c^2 - {v_0}^2}\sqrt{c^2 - {v_0}^2 (sin\theta)^2} \cdot \left[-v_0 \cos(\theta) + \sqrt{c^2 - {v_0}^2 (sin\theta)^2}\right] \quad (19)$$

Equation (19) defines the maximum velocity of an object that can be observed or created in an inertial frame moving at velocity v_0.

This is also consistent with the result obtained from kinetic energy Equation (34).

At θ=0, θ= $\pi/2$, θ= π, Equation (19) can be simply expressed as follows:

$$v_{1\_max\ \_at\_\theta=0} = \frac{c^2}{c + v_0}$$
$$v_{1\_max\ \_at\_\theta=\pi/2} = c \quad (20)$$
$$v_{1\_max\_at\_\theta=\pi} = \frac{c^2}{c - v_0}$$

Between 0 < θ < 2π, the average value of v_{1_max}, $v_{1\_ave\_max}$ is obtained by dividing the circumference of a circle with a unit radius; that is, 2π by the time required for circular motion. The time it takes to go around the circle is obtained by integrating the time to travel a unit distance with v_{1_max} , which is $\frac{1}{v_{1\_max}}$ over the interval 0 < θ < 2π.

$$v_{1\_ave\_\max} = \frac{2\pi}{\int_0^{2\pi} \frac{d\theta}{v_{1\_max}}} = \frac{2\pi}{\int_0^{2\pi} \frac{(c^2 - v_0{}^2)d\theta}{c\sqrt{c^2 - v_0{}^2(sin\theta)^2} \cdot \left[-v_0 \cos(\theta) + \sqrt{c^2 - v_0{}^2(sin\theta)^2}\right]}}$$
$$= \frac{2\pi c}{\left|\theta + sin^{-1}\left(\frac{v_0 \sin(\theta)}{c}\right)\right|_0^{2\pi}} = c \qquad (21)$$

Equation (21) indicates that the circular motion speed of an object in a moving inertial system cannot exceed the speed c of light.

Suppose we observe the forward light, that is, the light in the direction of $\frac{-\pi}{2} < \theta < \frac{\pi}{2}$, from a spaceship moving at the speed of light.

When v_0 is close to c, Equation (19) converges to c/2 for the direction of $\frac{-\pi}{2} < \theta < \frac{\pi}{2}$ as follows:

$$v_{1\_\mathrm{max}\_c\_\mathrm{front}} = \lim_{v_0 \to c} \frac{c}{c^2 - v_0{}^2} \sqrt{c^2 - v_0{}^2(sin\theta)^2} \cdot \left[-v_0 \cos(\theta) + \sqrt{c^2 - v_0{}^2(sin\theta)^2}\right] = \frac{c}{2} \qquad (22)$$

That is, the forward light in an inertial frame moving at the speed of light $(v_0 = c)$ is observed as c/2.

2.4 Mass Increase due to a Moving Inertial Velocity

When a bomb with at-rest mass m_0 in the absolute stationary inertial frame flies at a speed of v_0 and explodes at a speed v_1, that is relatively much slower than the speed of light in all directions as shown in Figure 6.

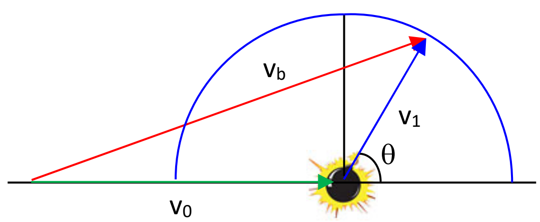

Figure 6. A bomb with at rest mass m_0 explodes with velocity v_1 while flying with velocity v_0

This explosive kinetic energy is assumed as follows considering the mass increase factor:

$$E_{kb} = \frac{1}{2} m_0 v_1{}^2 \gamma^5 \qquad (23)$$

As shown in Figure 6, the velocity v_b of the fragment observed in the absolute stationary inertial frame can be expressed as follows:

$$v_b = \sqrt{v_0{}^2 + 2v_0 v_1 cos(\theta) + v_1{}^2} \qquad (24)$$

Assume that the mass increase factor γ due to the velocity v of a moving inertial frame is as follows:

$$\gamma = \left(\frac{c^2}{c^2 - v^2}\right)^n \tag{25}$$

If v_1 is a very slow speed compared to the speed of light, the fragment kinetic energy in any direction can be calculated as:

$$\begin{aligned} dE_{kb} = Fds = \frac{dP}{pt}ds = v_b d(P) = v_b d\left(\frac{m_0}{4\pi}\gamma v_b\right) = \frac{m_0}{4\pi} v_b d\left[\left(\frac{c^2}{c^2 - {v_b}^2}\right)^n v_b\right] \\ = \frac{m_0}{4\pi}\sqrt{{v_0}^2 + 2v_0 v_1 cos(\theta) + {v_1}^2} \\ \cdot d\left[\left(\frac{c^2}{c^2 - ({v_0}^2 + 2v_0 v_1 cos(\theta) + {v_1}^2)}\right)^n \sqrt{{v_0}^2 + 2v_0 v_1 cos(\theta) + {v_1}^2}\right] \\ = \frac{m_0}{4\pi}c^{2n}\left\{\frac{v_0 cos(\theta) + v_1}{[c^2 - ({v_0}^2 + 2v_0 v_1 cos(\theta) + {v_1}^2)]^{n+1}}[c^2 - (1-2n)({v_0}^2 \right. \\ \left. + 2v_0 v_1 cos(\theta) + {v_1}^2]\right\}\frac{v_1}{2} \end{aligned} \tag{26}$$

Equation (26) can be simplified as follows when v_1 is very close to 0:

$$\begin{aligned} \lim_{v_1 \to 0} v_b d\left(\frac{m_0}{4\pi}\gamma v_b\right) \\ = \frac{1}{2}\frac{m_0}{4\pi}{v_1}^2\frac{c^{2n}}{(c^2 - {v_0}^2)^{n+2}}\{(c^2 - {v_0}^2)[c^2 - (1-2n){v_0}^2] \\ + 2n{v_0}^2(cos\theta)^2[3c^2 - (1-2n){v_0}^2]\} \end{aligned} \tag{27}$$

The total explosive energy of the bomb can be obtained as follows by integrating Equation (27) for all three-dimensional directions.

$$\begin{aligned} Eka_{bomb} = \int_0^\pi \lim_{v_1 \to 0} v_b d\left(\frac{m_0}{4\pi}\gamma v_b\right) \cdot 2\pi \sin(\theta)\, d\theta \\ = \frac{1}{2}m_0{v_1}^2\frac{c^{2n}}{(c^2 - {v_0}^2)^{n+2}}\left\{(c^2 - {v_0}^2)[c^2 - (1-2n){v_0}^2] \right. \\ \left. + 2n{v_0}^2\left[c^2 - \frac{(1-2n){v_0}^2}{3}\right]\right\} \end{aligned} \tag{28}$$

In Equation (28), 1/2 is the only value of n that satisfies Equation (23), so γ can be estimated as follows:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{29}$$

3.0 Kinetic Energy, Momentum and Inertial Mass in an Inertial Frame Moving Relative to an Absolutely Stationary Inertial Frame

3.1 Kinetic Energy Observed in Absolute Stationary Inertial Frame

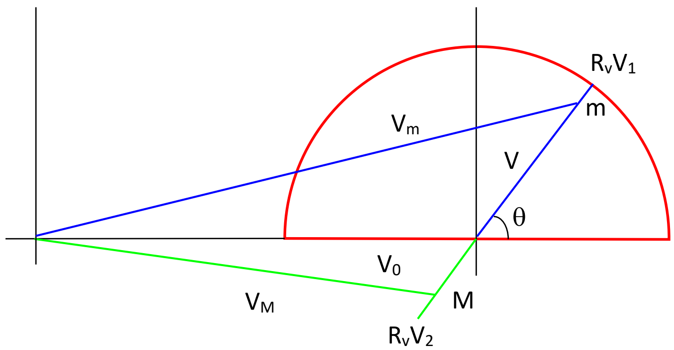

Figure 7. The velocity of an object with mass m thrown at velocity V_1 in an inertial frame with mass M, and the velocity change of the inertial frame with mass M due to reaction force, observed in an absolute stationary frame.

As shown in Figure 7, an object with mass m is thrown at velocity v_1 and angle θ in an inertial frame with mass M moving with velocity v_0.

Observing this in the absolute frame, the object with mass m moves to $R_v v_1$ due to the velocity conversion factor R_v , Equation (13), and the inertial frame with mass M moves in the opposite direction at $v_2 = \frac{mR_v v_1}{M}$ velocity.

Therefore, the velocities of m and M observed in the absolute stationary inertial frame can be expressed as:

$$v_m = \sqrt{{v_0}^2 + 2v_0 v cos(\theta) + v^2} \tag{30}$$

$$v_M = \sqrt{{v_0}^2 - 2v_0 \frac{mv}{M} cos(\theta) + \left(\frac{mv}{M}\right)^2} \tag{31}$$

Using the mass increase factor γ from Equation (29), m and M are expressed as follows:

$$m = m_0 \gamma = \frac{m_0}{\sqrt{1 - \frac{{v_m}^2}{c^2}}} \tag{32}$$

$$M = M_0 \gamma = \frac{M_0}{\sqrt{1 - \frac{{v_M}^2}{c^2}}} \tag{33}$$

Using Equations (30) to (33), the kinetic energy observed in the absolute stationary inertial frame can be calculated as follows:

$$
\begin{aligned}
E_{Ka}(v_1) &= \int_0^{R_v v_1} v_m d(m v_m) + \int_0^{R_v v_2} v_M d(M v_M) \\
&= \int_0^{R_v v_1} v_m d\left(\frac{m_0}{\sqrt{1-\frac{v_m{}^2}{c^2}}} v_m\right) + \int_0^{R_v v_2} v_M d\left(\frac{M_0}{\sqrt{1-\frac{v_M{}^2}{c^2}}} v_M\right) \\
&= m_0 c^2 \left[\frac{1}{\sqrt{1-\frac{\left(v_0{}^2 + 2v_0 R_v v_1 \cos(\theta) + R_v{}^2 v_1{}^2\right)}{c^2}}} - \frac{1}{\sqrt{1-\frac{v_0{}^2}{c^2}}}\right] \\
&- \frac{m_0 v_0 R_v v_1 \cos(\theta)}{\left(1-\frac{v_0{}^2}{c^2}\right)^{\frac{3}{2}}}
\end{aligned}
\tag{34}
$$

3.2 Momentum observed in Moving Inertial Frame

The moving inertial kinetic energy, E_{KS} can be calculated with the momentum, P_s, and velocity, v, as follows:

$$E_{Ks}(v_1) = \int_0^{v_1} v d(Ps) \tag{35}$$

Since the kinetic energy, E_{Ka}, calculated in the absolute stationary inertial frame, and the kinetic energy, E_{KS}, calculated in the moving inertial frame must be the same, $d(Ps)$ can be obtained by differentiating Equations (35) and (34) as follows:

$$d\big(E_{Ks}(v)\big) = v d(Ps) = d(E_{Ka}(v))$$

$$d(Ps) = \frac{m_0 c^3 R_v}{v}\left\{\frac{v_0 \cos(\theta) + v}{\left[c^2 - \left(v_0{}^2 + 2v_0 R_v v \cos(\theta) + R_v{}^2 v^2\right)\right]^{3/2}} - \frac{v_0 \cos(\theta)}{(c^2 - v_0{}^2)^{3/2}}\right\} dv \tag{36}$$

The momentum in the moving inertial frame can be obtained by integrating $d(Ps)$, Equation (36), as follows:

$$Ps(v_1) = \int_0^{v_1} d(Ps)$$

$$= m_0 c^3 R_v \int_0^{v_1} \frac{1}{v} \left\{ \frac{v_0 \cos(\theta) + R_v v}{\left[c^2 - \left({v_0}^2 + 2R_v v_0 v \cos(\theta) + {R_v}^2 v^2\right)\right]^{3/2}} - \frac{v_0 \cos(\theta)}{(c^2 - {v_0}^2)^{3/2}} \right\} dv$$

$$= \frac{m_0 R_v}{\left(1 - \frac{{v_0}^2}{c^2}\right)} \left\{ \frac{R_v v_1 + 2v_0 \cos(\theta)}{\sqrt{1 - \frac{\left({v_0}^2 + 2R_v v_0 v_1 \cos(\theta) + {R_v}^2 {v_1}^2\right)}{c^2}}} \right.$$

$$- \frac{v_0 \cos(\theta)}{\sqrt{1 - \frac{{v_0}^2}{c^2}}} \left[\ln(2) + \ln\left(\sqrt{c^2 - {v_0}^2} \sqrt{c^2 - \left({v_0}^2 + 2R_v v_0 v_1 \cos(\theta) + {R_v}^2 {v_1}^2\right)} \right. \right. \quad (37)$$

$$\left. \left. \left. - R_v v_0 v_1 \cos(\theta) + c^2 - {v_0}^2 \right) \right] \right\}$$

$$- \frac{m_0 v_0 \cos(\theta)}{\sqrt{1 - \frac{{v_0}^2}{c^2}} \sqrt{1 - \frac{{v_0}^2 (sin\theta)^2}{c^2}}} \left[2 - \ln(4) - \ln\left(c^2 - {v_0}^2\right)\right]$$

3.3 Inertial Mass in a Moving Inertial Frame

Using the momentum Equation (37) in the moving inertial frame, the inertial mass in the moving inertial frame can be obtained as follows:

$$m = \lim_{v_1 \to 0} \frac{Ps(v_1)}{v_1} = \frac{m_0}{\sqrt{1 - \frac{{v_0}^2}{c^2}}} \left(1 + \frac{2{v_0}^2 (cos\theta)^2}{c^2 - {v_0}^2 (sin\theta)^2}\right) \quad (38)$$

Based on (38), the inertial mass is a function of the velocity of the inertial frame and direction.

4.0 Conclusion

The conclusion of this study and the difference from the theory of special relativity are as follows:

	Theory of Special Relativity	Conclusion of this study
Absolute Stationary Inertial Frame	None	Exists
Constancy of Light Speed	Constant in all inertial frames	Constant only in the absolute stationary inertial frame. In a moving inertial frame, the round-trip speed of light is constant.
Velocity of a moving inertial frame	No way to measure	Measurable by experiment $v_0 = \Delta t_{s\_max} \frac{c^2}{2L_0}$
Momentum	$\frac{m_0 v_1}{\sqrt{1-\frac{v_1^2}{c^2}}}$	$\frac{m_0 R_v}{\left(1-\frac{v_0^2}{c^2}\right)}\left\{\frac{R_v v_1 + 2v_0\cos(\theta)}{\sqrt{1-\frac{\left(v_0^2+2R_v v_0 v_1\cos(\theta)+R_v^2 v_1^2\right)}{c^2}}} - \frac{v_0\cos(\theta)}{\sqrt{1-\frac{v_0^2}{c^2}}}\left[\ln(2) + \ln\left(\sqrt{c^2-v_0^2}\sqrt{c^2-\left(v_0^2+2R_v v_0 v_1\cos(\theta)+R_v^2 v_1^2\right)} - R_v v_0 v_1\cos(\theta) + c^2 - v_0^2\right)\right]\right\} - \frac{m_0 v_0\cos(\theta)}{\sqrt{1-\frac{v_0^2}{c^2}}\sqrt{1-\frac{v_0^2(sin\theta)^2}{c^2}}}\left[2-\ln(4)-\ln\left(c^2-v_0^2\right)\right]$
Kinetic Energy	$m_0 c^2\left[\frac{1}{\sqrt{1-\frac{v_1^2}{c^2}}}-1\right]$	$m_0 c^2\left[\frac{1}{\sqrt{1-\frac{\left(v_0^2+2v_0 R_v v_1\cos(\theta)+R_v^2 v_1^2\right)}{c^2}}}-\frac{1}{\sqrt{1-\frac{v_0^2}{c^2}}}\right] - \frac{m_0 v_0 R_v v_1\cos(\theta)}{\left(1-\frac{v_0^2}{c^2}\right)^{\frac{3}{2}}}$
Inertial Mass	$\frac{m_0}{\sqrt{1-\frac{v_0^2}{c^2}}}$	$\frac{m_0}{\sqrt{1-\frac{v_0^2}{c^2}}}\left(1+\frac{2v_0^2(cos\theta)^2}{c^2-v_0^2(sin\theta)^2}\right)$