Applied Physics Research; Vol. 15, No. 1; 2023
ISSN 1916-9639 E-ISSN 1916-9647
Published by Canadian Center of Science and Education

# Mass-velocity Formula and Mass-energy Relation Cannot Be Derived Based on Lorentz Velocity Transformation

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Received: January 27, 2023 Accepted: March 6, 2023 Online Published: March 26, 2023

doi:10.5539/apr.v15n1p30 URL: https://doi.org/10.5539/apr.v15n1p30

**Abstract**

The most important achievement of the Einstein's special relativity was to derive the mass-velocity formula and the famous mass-energy relation from the Lorentz velocity transformation formula. Based on the mass-velocity formula, the dynamics of special relativity was established. In this paper, six derivation methods of the mass-velocity formula in special relativity are re-analyzed, including the elastic collision and the inelastic collision of two particles, the particle splitting processes, and the force moment balance methods based on the Lorentz velocity transformation formula, as well as the method to consider the symmetry principle without using the Lorentz transformation formula. It is pointed out that all of them have serious problems so that they cannot hold actually. Besides, it is pointed out that the method of Hamiltonian action to derive the mass-velocity has nothing to do with the Lorentz velocity transformation and does not belong to the category of special relativity. Therefore, the conclusion of this paper is that it is impossible to derive the mass-velocity formula and the mass-energy relation based on the Lorentz velocity transformation formula. The mass-velocity formula can only be considered as an empirical formula which cannot be derived in theory and have nothing to do with special relativity. If the mass-velocity formula and the mass-energy relationship are correct, it just means that Einstein's special relativity is not true.

**Keywords:** Lorentz transformation formula, mass-velocity formula, mass-energy relation, elastic collision, inelastic collision

## 1. Introduction

It is well known that the most important experimental basis for the Einstein's special relativity is the Michelson-Morley experiment (M-M experiment). The experiment attempted to measure the velocity of Earth's motion in the absolutely stationary reference frame of the universe, or the so-called etheric reference frame. However, the results of experiments were that the interference fringe shifts on the Michelson interferometer could not be observed, which indicated that the absolute motion velocity of the earth could not be measured.

In order to explain the zero result of the M-M experiment, Dutch physicist Lorentz proposed the Lorentz coordinate transformation formula in 1895. According to the Lorentz's understanding for this formula, the arm length of Michelson interferometer had undergone an absolute contraction in the motion direction of the earth, resulting in the unchanging of light's speed, so that the interference patterns were not changed.

Einstein put forward the principles of special relativity and light's speed invariance in 1905, derived the Lorentz coordinate transformation formula, and made the relativity explanation for this formula. According to Einstein, the Lorentz transformation formula means that time, space and motion were relative, and the absolute motion did not exist.

Based on the Lorentz velocity transformation formula and considering the momentum conservation of two particle's collision, the mass-velocity formula of an object with speed $u$ could be deduced with

$$m = \frac{m_0}{\sqrt{1-u^2/c^2}} \tag{1}$$

Based on Eq.(1), the famous formula of mass-energy could be obtained

$$E = mc^2 = \frac{m_0 c^2}{\sqrt{1-u^2/c^2}} \tag{2}$$

The dynamics theory of special relativity was established based on Eq.(1), which replaced the classical Newtonian mechanics theory and became the basic theory of modern physics.

The mass-energy relation was regarded as the basic formula of atomic energy and had been fully verified and widely used in practice. Although the kinematics part of special relativity involving the nature of time and space lead to various paradoxes, Einstein's theory of special relativity was still considered indestructible due to the existence of the of mass-velocity formula and the mass-energy relation.

However, the authors of this paper published a paper titled "A re-understanding to the zero result of M-M experiment" in 2023 (Mei Xiaochun, Yan Canlun, 2023). It was pointed out that there were two serious problems in the calculation of the M-M experiment by Michelson, which lead to the wrong understanding of the zero result of the M-M experiment.

1. The first problem was the misuse of the addition formula of light’s velocity. In the calculation of the M-M experiment, Michelson assumed that the light source was fixed on the absolutely stationary reference frame of the universe (Guo Shuohong, 1979), which was completely inconsistent with the actual experiment. In the actual experiment, the light source was fixed on the earth motion reference frame, moving and rotating with the interferometer. Therefore, the velocity addition formula of light used in the M-M experiment was incorrect, resulting in the invalid calculation result.

2. The second problem was the confusion of reference frames. The calculations of the M-M experiments used the observation data of the cosmic reference frame to calculate the observation results on the earth reference frame. In fact, according to the Galileo's principle of relativity, if we considered the earth laboratory as a closed chamber, there was no way for an observer in a closed chamber to determine whether the chamber was moving or not based on the experiments carried out in the chamber. Therefore, the M-M experiment could not detect the absolute motion velocity of the earth in principle, so it was not surprising for the zero result of the M-M experiments.

Given that the light source is fixed on the earth's reference frame, according to the Galilean velocity addition rule and the correct calculation method, it is proved in the paper that the M-M experiments will not produce the shifts of interference fringes whether observed in the moving reference frame of the earth or the absolutely stationary reference frame of the universe. The zero result of the M-M experiment is natural. For the measurement of the earth’s absolute motion, the M-M experiment is an invalid one, and the Lorentz coordinate transformation formula becomes redundant.

Since the zero result of the M-M experiment can also be explained by considering that light’s speed is a constant, a further question is that is the Lorentz velocity transformation formula correct? If it is true, the Galilean’s velocity addition formula is incorrect. For the high-speed motion of objects, the Lorentz transformation formula is still needed, and the special relativity is still valid.

In special relativity, the most important application of the Lorentz transformation formula is the derivation of mass-velocity formula, based on it, the mass-energy relation for an object with mass is obtained and the dynamics theory of special relativity is established. Thought long before Einstein proposed special relativity, physicists had discovered that an object’s mass was related to its speed in experiments.

In 1881, physicist Joseph Thomson discovered that it was more difficult to make a charged objects moving than uncharged ones. Particles moving in an electric field seem to add an "electromagnetic mass" to their mechanical mass. In 1900, William Wien made the further study for the relationship between mass and speed based on the works of Thomson, Heaviside and Searle (Huang Zhixun, 2011). From 1901 to 1903, Walter Kaufmann roughly proved in experiments that Eq.(1) could be used to express the relationship between the electromagnetic mass and the velocity of electrons by analyzing the charge-mass ratio of β rays (high-speed electron streams)(James T. Cushing, 1981).

In 1903, Lorentz proposed a series of hypotheses: 1. Electrons had only electromagnetic mass and no other mass. 2. The length of electron decreases in the direction of motion. 3. An electron was a sphere when it was at rest, and its charge was evenly distributed on the spherical surface. 4. Electrons traveled much slower than the speed of light, ... (Lorentz H.A., 1904). Based on these assumptions, Lorentz derived the transverse mass and the longitudinal mass of electrons. The expression of transverse mass was the same as Eq.(1) and the expression of longitudinal mass was follows

$$m_L = \frac{m_0}{(1-u^2/c^2)^{3/2}} \tag{3}$$

In the Einstein's original paper of special relativity in 1905, the longitudinal mass was the same as Eq.(3), while the transverse mass was (Einstein A., 1905)

$$m_T = \frac{m_0}{1-u^2/c^2} \tag{4}$$

Eq.(4) is obviously different from Eq.(1). It can be seen that although Einstein proposed the special theory of relativity, he never got the formula of mass-velocity expressed by Eq.(1).

According to the definition of Eq. (1), the motion equation of Newtonian mechanics is re-written into the motion equation of special relativity:

$$\vec{F} = \frac{d\vec{p}}{dt} = \frac{d}{dt}\frac{m_0\vec{u}}{\sqrt{1-u^2/c^2}} \tag{5}$$

By considering

$$\frac{du}{dt} = \frac{d}{dt}\sqrt{u_x^2+u_y^2+u_z^2} \quad = \frac{u_x}{u}\frac{du_x}{dt} + \frac{u_y}{u}\frac{du_y}{dt}\frac{u_x}{u} + \frac{du_z}{dt}\frac{u_z}{u} = \frac{\vec{u}\cdot\vec{a}}{u} \tag{6}$$

Eq.(5) can be written as

$$\vec{F} = \frac{m_0}{\sqrt{1-u^2/c^2}}\frac{d\vec{u}}{dt} + m_0\vec{u}\frac{d}{dt}\frac{1}{\sqrt{1-u^2/c^2}}$$

$$= \frac{m_0\vec{a}}{\sqrt{1-u^2/c^2}} + \frac{m_0\vec{u}(\vec{u}\cdot\vec{a})/c^2}{(1-u^2/c^2)^{3/2}} \tag{7}$$

Let $\vec{u}\cdot\vec{a} = ua\cos\theta$, according to the formula $F = ma$ of Newtonian mechanics and Eq.(7), the transverse mass and the longitudinal mass are individually

$$m_T = \frac{m_0}{\sqrt{1-u^2/c^2}} \tag{8}$$

$$m_L = \frac{m_0 u^2 \cos\theta / c^2}{(1-u^2/c^2)^{3/2}} \tag{9}$$

Eq.(8) is different from Eq.(4) and Eq.(9) is also different from Eq.(3).

It can be seen that in the early days of relativity, physicists were confused and inconsistent about what formula should be used to describe the mass-velocity relationship. In fact, it was not until 1909 that Lewis and Tolman, based on the so-called Lorentz transformation formula and considered the momentum conservation in the collision process of two elastic spheres, obtained the mass-velocity formula of Eq.(1) (Huang Zhixun, 2011). After that, the scientific community gradually accepted Eq.(1) as a stander form to represent the mass-velocity formula.

Even so, Einstein was still reluctant to accept the mass-velocity formula of Eq.(1). Late in his life, he wrote to Barnet to say that "It is not good to introduce the concept of the mass $m = m_0/\sqrt{1-u^2/c^2}$ of a moving body for which no clear definition can be given. It is better to introduce no other mass concept than the 'rest mass' $m_0$. Instead of introducing $m$ it is better to mention the expression for the momentum and energy of a body in motion" (Einstein A., 1948).

On the basis of the Lorentz velocity transformation formula, there are two kinds of methods to derive the formula of mass-velocity formula related to the concrete models, namely the momentum conservation method and the torque balance method. In addition, there are several derivation methods that are independent of specific models and only based on symmetry principles such as relativity principle and the Hamiltonian action.

Due to finding that the interpretation of the zero result of the M-M experiment is wrong, it prompts the authors to re-analyze the derivations of the mass-velocity formula in special relativity, including the elastic collision process of two particles, the inelastic collision process, the particle splitting process, and the method of moment balance. The results show that all these derivations have serious problems and are not valid in fact. In addition, the mass-velocity formula derived by the method of Hamiltonian action has nothing to do with the Lorentz transformation, does not belong to the category of special relativity, and also has some problems.

The conclusion of this paper is that it is impossible to derive the mass-velocity formula and the mass-energy relation based on the Lorentz velocity transformation formula. The mass-velocity formula and the mass energy relationship used in modern physics actually has nothing to do with special relativity. If the formulas are correct, it just means that Einstein's special relativity is not true.

In fact, the mass-velocity formula can only be regarded as an empirical formula, which cannot be derived strictly in theory. The correctness of the mass-velocity formula can only be tested by experiment, and whether it needs to be modified for its present form is also the problem that future physics experiments need to pay attention to.

## 2. The Derivation of Mass-velocity Formula Based on the Lorentz Velocity Transformation and the Existing Problems

### *2.1 Using the Momentum Conservation Law of Elastic Collision of Particles to Derive the Mass-velocity Formula*

There are two methods to derive the mass-velocity formula by the collision of particles based on the Lorentz transformations, i.e., elastic collision and inelastic collision. In this section, the method of elastic collision is discussed (Bergmann P. G., 1961).

Suppose that two rigid particles $A$ and $B$ have the same rest mass $m_0$. The masses of particles are related to their velocities and should be written as $m_1(u_1)$ and $m_2(u_2)$. As shown in Figure 1, the elastic collision occurs between two particles in the stationary reference frame $K$. The initial velocity of particle $A$ along the $x$ axis is $u_{1x}$, the initial velocity along the $y$ axis is $u_{1y}$. The initial velocity of particle $B$ along the $x$ axis is $-u_{2x}$, the initial velocity along the $y$ axis is $-u_{2y}$.

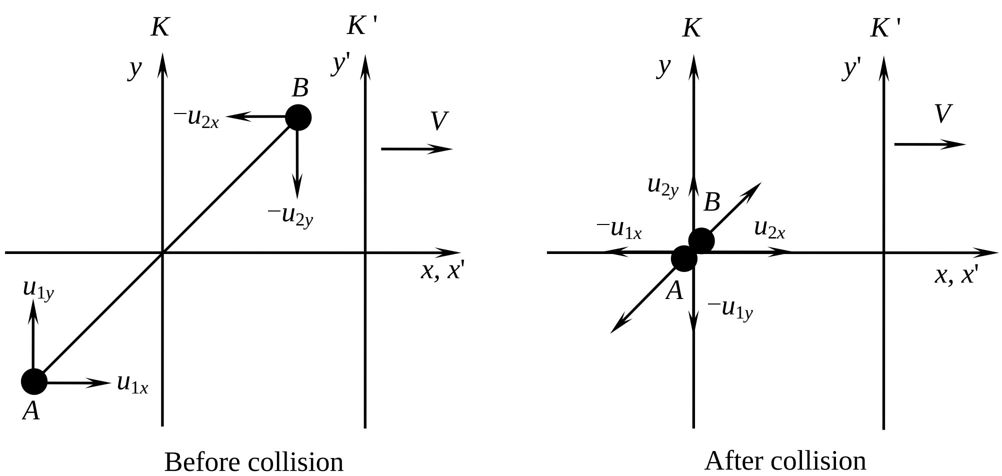


Figure 1. To derive the mass-velocity formula in elastic collision process of two particles

Let $u_{1x} = u_{2x}$ and $u_{1y} = u_{2y}$, according to the law of momentum conservation in the elastic collision, the total momentums of two-particle system in the $x$ axial direction and the $y$ axial direction before collision are

$$m_1(u_1)u_{1x} + m_2(u_2)(-u_{2x}) = 0 \tag{10}$$

$$m_1(u_1)u_{1y} + m_2(u_2)(-u_{2y}) = 0 \tag{11}$$

After the collision, the velocity of particle $A$ along the $x$ axis becomes $-u_{1x}$, the velocity along the $y$ axis becomes $-u_{1\mathrm{y}}$. The velocity of particle $B$ along the $x$ axis becomes $u_{2x}$, the velocity along the $y$ axis becomes $u_{2\mathrm{y}}$. According to the momentum conservation formula, the total momentum of two-particle system after collision is still expressed by Eqs.(10) and (11).

Let the reference frame $K'$ move to the right side with a uniform speed $V$ relative to the reference frame $K$. According to the Lorentz velocity transformation formula, when observed in the reference frame $K'$, the initial velocities of particle $A$ become

$$u'_{1x} = \frac{u_{1x} - V}{1 - u_{1x}V/c^2} \qquad u'_{1y} = \frac{u_{1y}\sqrt{1 - V^2/c^2}}{1 - u_{1x}V/c^2} \tag{12}$$

The initial velocities of particle $B$ become

$$u'_{2x} = \frac{-u_{2x} - V}{1 + u_{2x}V/c^2} \qquad u'_{2y} = \frac{-u_{2y}\sqrt{1 - V^2/c^2}}{1 + u_{2x}V/c^2} \tag{13}$$

After the collision, the velocities of particle $A$ become

$$u'_{1x} = \frac{-u_{1x} - V}{1 + u_{1x}V/c^2} \qquad u'_{1y} = \frac{-u_{1y}\sqrt{1 - V^2/c^2}}{1 + u_{1x}V/c^2} \tag{14}$$

The velocities of particle $B$ become

$$u'_{2x} = \frac{u_{2x} - V}{1 - u_{2x}V/c^2} \qquad u'_{2y} = \frac{u_{2y}\sqrt{1 - V^2/c^2}}{1 - u_{2x}V/c^2} \tag{15}$$

According to the relativity principle, the momentums of particle system before and after the collisions are also conserved when observed in the reference frame $K'$. Considering that the mass of particle is related to the motion velocity, the momentums of two particles before and after collisions satisfy following relations in the $x$ and $y$ axial directions with

$$m'_1(u'_1)u'_{1x} + m'_2(u'_2)u'_{2x} = 0 \tag{16}$$

$$m'_1(u'_1)u'_{1\mathrm{y}} + m'_2(u'_2)u'_{2y} = 0 \tag{17}$$

Substituting Eq.(14) and (15) in Eq.(17), it can be obtained

$$m'_1(u'_1)\frac{-u_{1y}\sqrt{1 - V^2/c^2}}{1 + u_{1x}V/c^2} + m'_2(u'_2)\frac{u_{2y}\sqrt{1 - V^2/c^2}}{1 - u_{2x}V/c^2} = 0 \tag{18}$$

Taking $u_{1x} = u_{2x}$ and $u_{1y} = u_{2y}$ with $u_1 = \sqrt{u_{1x}^2 + u_{1y}^2}$ and $u_2 = \sqrt{u_{2x}^2 + u_{2y}^2}$, we have $u_1 = u_2$, as well as $m_1(u_1) = m_2(u_2)$. Substituting them in Eq.(18), we get

$$m_1'(u_1') = m_2'(u_2')\frac{1+u_{1x}V/c^2}{1-u_{1x}V/c^2} \tag{19}$$

To obtain the mass-velocity formula, let $u_{1x} = u_{2x} = V$ in Eq.(19). The initial velocities of particle $A$ shown in Eq.(12) become

$$u_{1x}' = 0 \qquad u_{1y}' = \frac{u_{1y}\sqrt{1-V^2/c^2}}{1-V^2/c^2} \tag{20}$$

The initial velocities of particle $B$ shown in Eq.(13) become

$$u_{2x}' = \frac{-2V}{1+V^2/c^2} \qquad u_{2y}' = \frac{-u_{2y}\sqrt{1-V^2/c^2}}{1+V^2/c^2} \tag{21}$$

After collision, the velocities of particle $A$ shown in Eq.(14) become

$$u_{1x}' = \frac{-2V}{1+V^2/c^2} \qquad u_{1y}' = \frac{-u_{1y}\sqrt{1-V^2/c^2}}{1+V^2/c^2} \tag{22}$$

The velocities of particle $B$ shown in Eq.(15) become

$$u_{2x}' = 0 \qquad u_{2y}' = \frac{u_{2y}\sqrt{1-V^2/c^2}}{1-V^2/c^2} \tag{23}$$

Eq.(19) becomes

$$m_1'(u_1') = m_2'(u_2')\frac{1+V^2/c^2}{1-V^2/c^2} \tag{24}$$

On the other hand, taking $u_{1y}' = u_{2y}' \to 0$, according to Eq.(22), we have

$$u = u_{1x}' = \frac{-2V}{1+V^2/c^2} \tag{25}$$

From Eq.(25), we get

$$V^2 - \frac{2c^2}{u}V + c^2 = 0 \tag{26}$$

It can be solved from Eq.(26)

$$V = \frac{c^2}{u}\left(1 \pm \sqrt{1-\frac{u^2}{c^2}}\right) \tag{27}$$

Due to $V < c$, by taking negative sign in Eq.(27), we obtain

$$\frac{1+V^2/c^2}{1-V^2/c^2} = \frac{u^2 + c^2(1-\sqrt{1-u^2/c^2})^2}{u^2 - c^2(1-\sqrt{1-u^2/c^2})^2} = \frac{1-\sqrt{1-u^2/c^2}}{u^2/c^2 - 1 + \sqrt{1-V^2/c^2}} = \frac{1}{\sqrt{1-u^2/c^2}} \tag{28}$$

Substituting Eq.(28) in Eq.(24), we obtain at last

$$m_1'(u_1') = \frac{m_2'(u_2')}{\sqrt{1-u^2/c^2}} \tag{29}$$

According to Eq.(23), observed in the reference frame $K'$, the velocity of particle $B$ is $u'_{2x}=0$ along the $x$ axis after collision. Since we have taken $u'_{2y}=0$, so we have $u'_2=0$ in the reference frame $K'$ and let $m'_2(u'_2=0)=m_0$. According to Eq.(25), we can write $m'_1(u'_1=u)=m(u)$, then the formula (29) can be rewritten as

$$m(u)=\frac{m_0}{\sqrt{1-u^2/c^2}} \tag{30}$$

This is just the mass-velocity formula used in the present special relativity.

*2.2 The Existing Problems to Derive the Mass-velocity Formula in the Elastic Collision Process*

It is easy to see that there are many problems in the deduction of Eq.(29), so that it cannot hold.

I) If two particles have no velocity in the $y$ axial direction, the momentum conservation formula is expressed by Eq.(16), and Eq.(17) did not exist. After collision, according to Eqs.(22) and (23), the velocity of $A$ particle $u'_{1x}\neq 0$, the velocity of $B$ particle $u'_{2x}=0$, Eq.(16) becomes

$$m'_1(u'_1)u'_{1x}+m'_2(u'_2)u'_{2x}=m'_1(u'_1)u'_{1x}=-m'_1(u'_1)\frac{2V}{1+V^2/c^2}=0 \tag{31}$$

Because of $m'_1(u'_1)\neq 0$, to made Eq.(32) hold, the only way is to let $V=0$. This means that the two reference frames are stationary together without relative motion, so it is impossible to derive the formula of mass velocity through the conservation of momentum. Due to $u_{1x}=u_{2x}=V$ and $V=0$, it means $u_{1x}=u_{2x}=0$. The is no motion of particles and no mass-velocity formula.

II) In Eq.(24), $m'_1(u'_1)$ is the mass of particle $A$, and $m'_2(u'_2)$ is the mass of particle $B$, so Eq.(29) denotes the relationship between the masses of two different particles. However, according to the understanding of special relativity, Eq.(30) represents the mass-velocity relationship of a same particle. So Eq.(30) is the result of a stolen concept. Especially when the masses of two colliding particles are different, it is impossible to replace Eq.(29) with Eq.(30).

III) This deduction assumes that two particles have the same rest mass, the same speed, and each particle moves in the opposite direction after the collision. This is a very simplified process. The actual colliding process of microscopic particles is much more complicated. For example, if $u_{1x}=u_{2x}\neq V$, then Eqs.(20) ~ (23) are not valid. We must directly adopt Eqs.(12) ~ (15), and cannot get Eqs.(24) and (30) at all.

IV) In the actual collision process, the rest masses of two particles may be not the same. After the collision, they will not move in the opposite directions. In this case, it is even more impossible to deduce the mass velocity formula (30) based on the Lorentz velocity transformation formula.

Therefore, it is impossible to derive the mass-velocity formula through the elastic collision process based on the Lorentz velocity transformation formula.

*2.3 The Deduction of Mass-velocity Formula Through the Inelastic Collision Process and the Existing Problems*

Perhaps some physicists found the unreasonableness of above derivation process, so in some textbooks, the inelastic collision process was used to derive the mass-velocity formula through the momentum conservation and the Lorentz velocity transformation formula (Zhao Kaihua, Luo Weiyin, 1995). Let's discuss this derivation below.

Due to the mass conservation (or energy conservation) and the momentum conservation, observed in $K$, there are following relations

$$m(V)+m_0=M(u) \tag{32}$$

$$m(V)V = M(u)u \tag{33}$$

From Eqs.(32) and (33), we get

$$\frac{M(u)}{m(V)} = \frac{m(V)+m_0}{m(V)} = \frac{V}{u} \tag{34}$$

As shown in Figure 2, the reference frame $K$ is at rest and the reference frame $K'$ moves to the right side with a velocity $V$ relative to the reference frame $K$. When observed in $K$, the rest masses of two particles are $m_A = m_B = m_0$. The particle $A$ is moving along the $x$ axis with the initial velocity is $V$. The particle $B$ is at rest at beginning. After the inelastic collision, two particles combine to form a particle with mass $M(u)$ and velocity $u$.

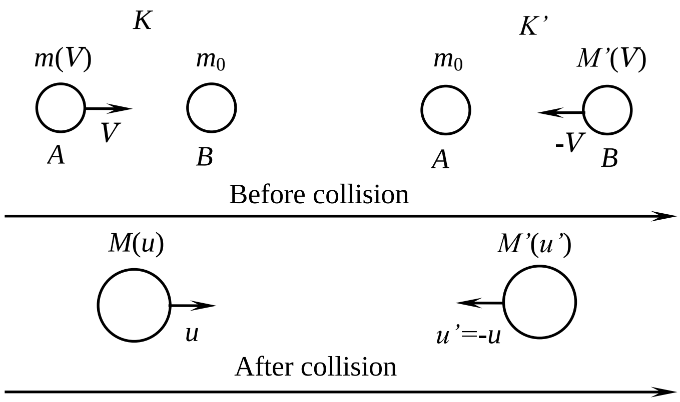


Figure 2. The derivation of mass-velocity formula by inelastic collision process

On the other hand, when observed in $K'$, the particles $A$ is at rest before the inelastic collision with mass $m_0$. The initial velocity of the particle $B$ is $-V$, and the mass is $m_B = m(V)$. After the inelastic collision, the mass of composite particle is $M'(u')$ and the velocity is $u'$. Eqs.(32) and (33) become

$$m_0 + m'(V) = M'(u') \tag{35}$$

$$m'(V)V = M'(u')u' \tag{36}$$

Since Eqs.(32) and (33) are completely symmetric with Eqs.(35) and (36), we have $u' = -u$. According to the Lorentz velocity addition formula, we have

$$u' = -u = \frac{u-V}{1-uV/c^2} \tag{37}$$

It can be obtained from Eq.(37)

$$\frac{V^2}{u^2} - 2\frac{V}{u} + \frac{V^2}{c^2} = 0 \tag{38}$$

or

$$\frac{V}{u} = 1 \pm \sqrt{1-\frac{V^2}{c^2}} \tag{39}$$

Due to $u < V$, the positive sign is taken. Substituting it in Eq.(34), the mass-velocity formula (1) is obtained.

There are three problems in the above derivation.

1.Since Eq.(32) times $c^2$ to be the energy conservation formula of special relativity, this formula actually assumes that the energy of a particle can be written in the form of Eq.(2). However, the formula (2) is based on the mass-velocity formula (1). In fact, according to the expression of dynamic energy in the Newtonian mechanics, even mass is related to velocity, the energy conservation formula (32) should be written as

$$\frac{1}{2}m(V)V^2 = \frac{1}{2}M(u)u^2 \tag{40}$$

Eq.(40) is different from Eq.(32) and cannot be used in special relativity. Eq.(32) has included the static energy of particle $B$ and is obviously the energy of special relativity. However, our purpose is to derive the mass-velocity formula. It is impossible for us to know the form of Eq.(2) before obtaining the mass-velocity formula. Therefore, the above derivation is to take the conclusion as the premise with the problem of logic cycle.

2. Because it is an inelastic collision, part of kinetic energy is converted into internal energy, resulting in the temperature increase of the object. Since there is no nuclear reaction involved in the inelastic collision, there is no static mass loss. This internal energy is converted from the particle's kinetic energy.

Even the logic cycle problem is not considered, according to the mass-energy relation, the energy conservation formula (32) should actually be written as

$$m_0c^2\left[\frac{1}{\sqrt{1-V^2/c^2}}-1\right] = M_0c^2\left[\frac{1}{\sqrt{1-u^2/c^2}}-1\right]+U \tag{41}$$

or

$$m(V)c^2 - m_0c^2 = M(u)c^2 - M_0c^2 + U \tag{42}$$

Due to $M_0 = 2m_0$, Eq.(42) can be written as

$$m(V)c^2 + m_0c^2 = M(u)c^2 + U \tag{43}$$

The momentum conservation formula (33) remains unchanged, so Eq.(34) becomes

$$\frac{m(V)+m_0-U/c^2}{m(V)} = \frac{V}{u} \tag{44}$$

It is obtained from Eq.(44)

$$m(V) = \frac{m_0 - U/c^2}{\sqrt{1-V^2/c^2}} \tag{45}$$

This is not the mass-velocity formula of special relativity.

3. The above derivation is only for a very special case, which requires the initial velocity of particle $A$ to be equal to the relative velocity of two reference frames. But this premise is not of universal significance. As long as we slightly change the condition, it is impossible to obtain the formula of mass-velocity again.

Assume that the particle $A$ is moving at velocity $u_1$ in $K$ before the collision. The particle $B$ is at rest and the mass is $m_B = m_0$. After the inelastic collision, two particles combine to form a particle moving with a velocity $u$ and a mass $M(u)$. When observed in the reference frame $K$, the mass conservation (do not consider internal energy) and the momentum conservation equations in the inelastic collision process are

$$m_A(u_1) + m_0 = M(u) \tag{46}$$

$$m_A(u_1)u_1 = M(u)u \tag{47}$$

The reference frame $K'$ moves at a velocity $V$ to the right side with respect to the reference frame $K$, but $V \neq u_1$. Observe on the reference frame $K'$, Eqs. (46) and (47)

$$m'_A(\mathrm{u}'_1)+m'_B(u'_2)=M'(u') \tag{48}$$

$$m'_A(u'_1)u'_1+m'_B(u'_2)u'_2=M'(u')u' \tag{49}$$

Due to Eqs.(47) and (49) are not symmetric again, it is impossible to have $u'=-u$. So we can not obtain Eq.(1) form Eqs.(46) and (47). By eliminating $M'(u)$ from Eqs.(48) and (49), we get

$$\frac{m'_A(u'_1)}{m'_B(u'_2)}=-\frac{1-u'_2/u'}{1-u'_1/u'}=-\frac{u'-u'_2}{u'-u'_1} \tag{50}$$

The Lorentz velocity transformation formula of two reference frames is

$$u'_1=\frac{u_1-V}{1-u_1V/c^2} \qquad u'_2=-V \qquad u'=\frac{u-V}{1-uV/c^2} \tag{51}$$

Substituting Eq.(51) in Eq.(50), we have

$$\frac{m'_A(u'_1)}{m'_B(u'_2)}=-\frac{u(1-u_1V/c^2)}{u-u_1} \tag{52}$$

If the mass-velocity formula hold, we should have

$$m'_A(u'_1)=\frac{m_0}{\sqrt{1-u_1'^2/c^2}} \qquad m'_B(u'_2)=\frac{m_0}{\sqrt{1-u_2'^2/c^2}} \tag{53}$$

According to Eqs.(53) and (51), we get

$$\frac{m'_A(u'_1)}{m'_B(u'_2)}=\frac{\sqrt{1-u_2'^2/c^2}}{\sqrt{1-u_1'^2/c^2}}=\frac{\sqrt{1-V^2/c^2}(1-u_1V/c^2)}{\sqrt{1-u_1^2/c^2-V^2/c^2+u_1^2V^2/c^4}} \tag{54}$$

Eq.(54) is obviously different from Eq.(52) so in general cases, we cannot derive the mass-velocity formula based on the inelastic collision process.

*2.4 The Derivation of Mass-velocity Formula Through the Particle's Splitting Process and the Existing Problems*

Another method to derive the mass-velocity formula in the inelastic process is to consider the splitting process of a particle (Lu Tianming, 2013).

Let the reference frame $K'$ move to the right side along the $x-$axis with velocity $V$ relative to the reference frame $K$. There is a stationary particle in $K'$ with a mass $M$. Suppose that the particle suddenly explodes and splits into two identical particles $A$ and $B$ with the same rest mass $m_0$ and the same speed $V$ but moving along the opposite directions as shown in Figure 3.

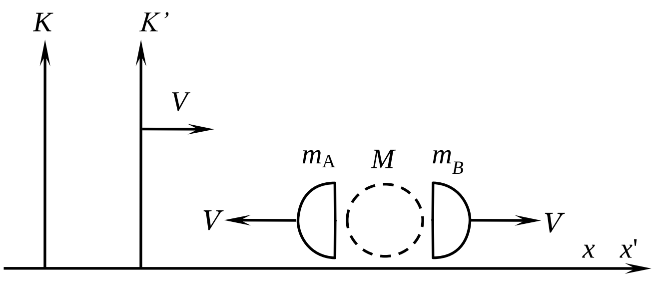


Figure 3. To derive the mass-velocity formula in the particle's splitting process

Observed in $K$, the velocity of particle before the explosion is $V$, the mass is $M(V)$. After the explosion, the velocities of two particles are individually

$$V_A = \frac{V-V}{1-V^2/c^2} = 0 \qquad V_B = \frac{V+V}{1+V^2/c^2} = \frac{2V}{1+V^2/c^2} \tag{55}$$

The momentum conservation formula is

$$M(V)V = m_B(V_B)V_B \tag{56}$$

To write $m_B(V_B) = m(V_B)$, if the total mass is also unchanged in the process, we have

$$M(V) = m_A + m_B = m_0 + m(V_B) \tag{57}$$

Substituting Eq.(55) and (57) in Eq.(56), we get

$$[m_0 + m(V_B)]V = m(V_B)\frac{2V}{1+V^2/c^2} \tag{58}$$

By connecting Eq.(55) and (58), we get the mass-velocity formula

$$m(V_B) = \frac{m_0}{\sqrt{1-V_B^2/c^2}} \tag{59}$$

This deduction has following three problems.

1. A stationary object explodes, creating two moving objects, the essence is that the internal energy is converted into kinetic energy. For the same reason, internal energy $U$ should be added to the right of Eq. (57) to write it as

$$M(V) + U/c^2 = m_0 + m(V) \tag{60}$$

According to Eq.(60), Eq.(58) should be written as

$$[m_0 + m(V_B) - U/c^2]V = m(V_B)\frac{2V}{1+V^2/c^2} \tag{61}$$

Form Eq.(61), the same result with Eq.(45) is obtained which is not the mass-velocity formula.

2. If the mass-velocity formula (59) is commonly tenable, observed in $K$, before the explosion, we should have

$$M(V) = \frac{2m_0}{\sqrt{1-V^2/c^2}} \tag{62}$$

Substituting Eq.(59) and (62) in Eq.(56), we have

$$\frac{2m_0 V}{\sqrt{1-V^2/c^2}} = \frac{m_0 V_B}{\sqrt{1-V_B^2/c^2}} \tag{63}$$

Substituting Eq.(55) in Eq.(63), we get

$$1 - \frac{V^2}{c^2} = \left(1 - \frac{V^2}{c^2}\right)^2 \tag{64}$$

In order to made Eq.(64) tenable, the only way is to take $V = 0$ and $V = c$. However, these two results are meaningless in special relativity.

In order to explain such results and make the deduction of mass-velocity formula meaningful, the authors of the paper had to introduce the concept of mass loss and the expression of mass-energy relationship of special relativity. However, as we known that there is no mass loss in the mechanics and chemical explosion processes of common objects. The mass-energy relation in special relativity is derived from the mass-velocity formula, and this explanation is also a circular demonstration.

3. This derivation has no universal meaning. If the two pieces of the particle have different masses after splitting, for example, the mass of particle $A$ is twice greater than the mass of particle $B$, it is impossible to derive Eq.(59). Therefore, it is impossible to derive the mass-velocity formula by using the method of particle splitting and the Lorentz velocity transformation formula.

### *2.5 The Derivation of Mass-velocity Formula Through the Balance of Force Moment and the Existing Problems*

The second kind of method to derive the mass-velocity formula in special relativity is to consider the balance of force moment (Mao Jingtao, Li Baojun, 2004). This approach is rarely mentioned in textbooks, but we think it is necessary to discuss it here.

As shown in Figure 4, we have a balance that is initially stationary on the ground. Put weights $A$ and $B$ with the rest mass $m_A = m_B$ on the desks. The two arm's length of the balance is $L_A = L_B$. The balance is placed in a uniform gravity field with

$$m_A g L_A = m_B g L_B \tag{65}$$

Because the balance has no motion, for the observers $A$ and $B$ who are at rest with two weights, Eq.(65) holds. Then suppose that relative to the stationary reference system on the ground, two disks move uniformly to the left and the right directions at the same speed $V_0$, and two arms extend equally to maintain the balance.

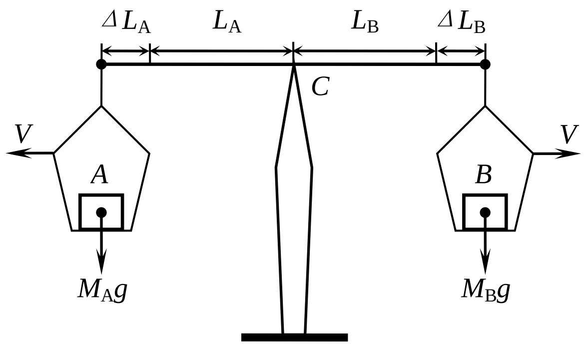


Figure 4. The derivation of mass-velocity formula through the balance of force moment

Observed by $A$, the pivot C of the balance is moving away to the right with speed $V_0$ and the arm length $L_A$ is getting longer. The other end $B$ of the balance moves away with speed $V_0$ relative to the pivot C. The relative velocity $B$ with respect to $A$ satisfies the Lorentz velocity addition law with

$$V = \frac{V_0 + V_0}{1 + V_0^2 / c^2} = \frac{2V_0}{1 + V_0^2 / c^2} \tag{66}$$

We obtain from Eq.(66)

$$V_0 = \frac{c^2}{V}\left(1 \pm \sqrt{1 - \frac{V^2}{c^2}}\right) \tag{67}$$

At arbitrary moment, from the angle of observer $A$, the increments of both arm's lengths are individually

$$\Delta L_A = V_0 t_A \qquad \Delta L_B = V t_A - V_0 t_A \tag{68}$$

Due to $VV_0 < c^2$, it takes negative sign in Eq.(67). From Eqs.(67) and (68), we get

$$\frac{\Delta L_A}{\Delta L_B} = \frac{V_0 t_A}{V t_A - V_0 t_A} = \frac{(c^2 / V)\left(1 - \sqrt{1 - V^2 / c^2}\right)}{V - (c^2 / V)\left(1 - \sqrt{1 - V^2 / c^2}\right)} = \frac{1}{\sqrt{1 - V^2 / c^2}} > 1 \tag{69}$$

So $\Delta L_A > \Delta L_B$, the balance is imbalance. In order to balance the balance in the gravitational field before and after the arm's extension, there must be

$$M_A g(L_A + \Delta L_A) = M'_B g(L_B + \Delta L_B) \tag{70}$$

$$M_A g L_A = M'_B g L_B \tag{71}$$

From Eqs.(69), (70) and (71), it is obtained

$$M'_B = \frac{M'_A}{\sqrt{1 - V^2 / c^2}} \tag{72}$$

That is to say, the mass of weight $B$ is greater than the mass of weight $A$ according to the observer $A$. It also follows that, according to observer $B$, the mass of weight $A$ is greater than the mass of weight $B$.

This derivation has following problems.

I) There is no velocity for the two ends of balance at the initial moment. Eq.(65) represents the result seen by observer A when the motion velocity is equal to zero at the initial moment. By comparing Eq.(71) with Eq.(65), it is obvious that that we must have $M_A = M'_B$. This result contradicts with Eq.(72) unless $V = 0$ without the mass-velocity formula.

II) This method is not universally effective. In fact, if we assume $M_A = M_B / 2$ and $L_A = 2L_B$, we can also make Eq.(65) tenable. To an observer at rest on the ground, if $A$ moves to the left with a velocity $V_0$ and $B$ moves to the right with a velocity $V_0 / 2$, the balance can also be balanced.

In this case, observed by $A$, the velocity of $B$ shown in Eq.(66) become

$$V = \frac{V_0 + V_0 / 2}{1 + V_0^2 / c^2} = \frac{3V_0 / 2}{1 + V_0^2 / (2c^2)} \tag{73}$$

Eq.(67) becomes

$$V_0 = \frac{2c^2}{3V}\left(1 \pm \sqrt{1 - \frac{8V^2}{9c^2}}\right) \tag{74}$$

Taking negative sign in Eq.(74), and Eq.(69) becomes

$$\frac{\Delta L_A}{\Delta L_B} = \frac{V_0 t_A}{V t_A - V_0 t_A} = \frac{(2c^2 / 3V)\left(1 - \sqrt{1 - 8V^2 / (9c^2)}\right)}{V - (2c^2 / 3V)\left(1 - \sqrt{1 - 8V^2 / (9c^2)}\right)} \neq \frac{1}{\sqrt{1 - V^2 / c^2}} \tag{75}$$

So in the general situations, it is impossible to obtain the mass-velocity formula by this method. In fact, this method involves the problem of moment balance in special relativity, which is actually a paradox. We do not discuss it in this paper, but it is certainly clear that it is impossible to use it to get the mass-velocity formula.

## 3. Using Other Methods to Derive the Mass-velocity Formula and the Existing Problems

### *3.1 Using Relativity Principle and Symmetry Method to Derive Mass-velocity Formula*

By careful investigating the derivation process of the mass-velocity formula based on the principle of relativity and other symmetry principles, we find that the premise has already the shadow of the mass-velocity formula. In other words, this kind of derivations are actually derived on the premise of the known mass-velocity formula or the mass-energy formula, so there are also the problems of logic cycles.

For example, the author considered the symmetry of space rotation and the finite motion velocity of particles, and deduced the mass-velocity formula, but assuming in advance that the mass of particles meets the following form (Dai Youshan, 2014).

$$m(v)=m_0 f\left(\frac{v^2}{v_m^2}\right)=m_0\left[1+a\frac{v^2}{v_m^2}+b\left(\frac{v^2}{v_m^2}\right)^2+b\left(\frac{v^2}{v_m^2}\right)^3+\cdots\right]$$

$$\approx m_0\left(1+A\frac{v^2}{v_m^2}\right)^n \tag{76}$$

Here $v_m$ is the limit velocity of particle. And then it is determined with $A=-1$ and $n=-1/2$ by the relativistic equations of motion. As a premise, Eq.(76) is obviously influenced by the known form of the mass-velocity formula. Moreover, this kind of derivation has nothing to do with the Lorentz transformation formula, and cannot be used to prove the correctness of the Lorentz transformation formula.

In another paper, the author tried to derive the mass-velocity formula without relying on the laws of conservations (Dai Youshan, 2012). But the author assumed that in an arbitrary inertial reference frame $K'$, the particle's momentum and energy could be expressed as

$$\vec{p}' = m(v'^2)\vec{v}' \qquad E' = E(v'^2) \tag{77}$$

According to the principle of relativity, on anther inertial reference frame $K$, the relation of a particle's momentum and energy were written as

$$p_x = b_{11}p'_x + b_{12}p'_y + b_{13}p'_z + b_{10}E'$$

$$p_y = b_{21}p'_x + b_{22}p'_y + b_{23}p'_z + b_{20}E'$$

$$p_z = b_{31}p'_x + b_{32}p'_y + b_{33}p'_z + b_{30}E'$$

$$E = b_{01}p'_x + b_{02}p'_y + b_{03}p'_z + b_{00}E' \tag{78}$$

Then, through the Lorentz velocity transformation formula, the following relation is obtained

$$p_x = b_{11}p'_x + b_{10}E' \qquad p_y = p'_y \qquad p_z = p'_z \qquad E = b_{01}p'_x + b_{11}E' \tag{79}$$

Based on Eq.(79), the mass-velocity formula is derived.

The problem is that the four-dimensional momentum linear transformation formula (78) assumed by the author is based on the mass-velocity formula (1) and the mass-energy relation (2). If the mass-velocity formula is not in the form of formula (1), for example, to let

$$m = \frac{m_0}{\sqrt{1-2V^2/c^2+3V^4/c^4}} \tag{80}$$

The momentum of particle still satisfies the requirement of Eq.(77), but the mass-energy formula is not in the form of Eq.(2), and Eq.(78) is not valid. Therefore, this derivation method still has the problem of logic cycle.

*3.2 The Derivation of Mass-velocity Formula by the Hamiltonian Principle*

In the book of Landau L D and Lifshitz E M titled "Classical Theory of Fields" (Landau L. D., Lifshitz E. M.,), a method was proposed to derive the mass-velocity formula by means of the Hamiltonian principle and the Lagrange function, without considering the momentum conservation formula and the Lorentz transformation formula. Let's discuss this method below.

In any coordinate system of uniform motion, the four-dimensional line element is

$$s^2 = c^2t^2 - x^2 - y^2 - z^2 \tag{81}$$

$$ds^2 = c^2dt^2 - dx^2 - dy^2 - dz^2 \tag{82}$$

The Hamiltonian action $S$ of a mechanism system is defined as

$$S = \int Ldt \tag{83}$$

Where $L$ is the Lagrange function. Let

$$S = -\alpha\int\sqrt{ds^2} = -\alpha\int\sqrt{c^2dt^2 - dx^2 - dy^2 - z^2}$$

$$= -\alpha\int\sqrt{1 - \frac{dx^2 + dy^2 + dz^2}{c^2dt^2}}cdt = -\alpha c\int\sqrt{1 - \frac{u^2}{c^2}}dt \tag{84}$$

By comparing Eq.(84) with Eq.(83), it can be obtained

$$L = -\alpha c\sqrt{1 - \frac{u^2}{c^2}} \tag{85}$$

When $u / c << 1$, we have

$$\sqrt{1 - \frac{u^2}{c^2}} = 1 - \frac{u^2}{2c^2} + \cdots \tag{86}$$

and
$$L = -\alpha c + \frac{\alpha u^2}{2c} + \cdots \tag{87}$$

On the other hand, if a particle is moving at a low speed, according to classical mechanics, the Lagrange function is defined as

$$L = T - U = \frac{m_0u^2}{2} - U \tag{88}$$

In Eq.(88), $T$ is the kinetic energy of particle, and $U$ is the potential energy. By comparing Eq. (88) with Eq. (87), we get

$$\alpha = m_0c \qquad\qquad U = \alpha c = m_0c^2 \tag{89}$$

So in the general case, the Lagrange function can be written as

$$L = -m_0c^2\sqrt{1 - \frac{u^2}{c^2}} \tag{90}$$

According to the Hamiltonian equation, the momentum of a particle is

$$P = \frac{\partial L}{\partial u} = \frac{\partial}{\partial u}\left(-m_0c^2\sqrt{1 - \frac{u^2}{c^2}}\right) = \frac{m_0u}{\sqrt{1 - u^2 / c^2}} \tag{91}$$

Then the mass-velocity formula (1) is obtained.

This deduction has following problems.

1. Since Eqs.(81) and (82) describe the space-time metric of an inertial system without interaction, it implies that the particle has no potential energy, so in Eqs.(88) and (89), we should have $U = \alpha c = 0$ or $\alpha = 0$.

According to Eq.(85), we have $L = 0$ and the mass-velocity formula cannot be obtained.

2. $U = m_0 c^2$ is the rest energy of a particle, not the potential energy. Potential energy is the interaction energy of field acted on a particle, not the energy contained in the mass of particle itself, so Eq.(87) is not a true Laplace quantity.

3. The above derivation has nothing to do with special relativity, or more specifically, has nothing to do with the Lorentz transformation formula. Eqs.(81) and (82) are just the expression of the four-dimensional space-time metric, and the Lorentz transformation invariance has not be used in the derivation.

4. In fact, for the motion of a classical particle, we can also write its four-dimensional space-time metric in terms of Eqs.(81) and (82). If it is the four-dimensional space-time metric of special relativity, for another reference $K'$ moving with relative velocity $V$, the following relationship is required

$$s^2 = c^2 t^2 - x^2 - y^2 - z^2 = c^2 t'^2 - x'^2 - y'^2 - z'^2 = s'^2 \tag{92}$$

$$ds^2 = c^2 dt^2 - dx^2 - dy^2 - dz^2 = c^2 dt'^2 - dx'^2 - dy'^2 - dz'^2 = ds'^2 \tag{93}$$

According to the same calculation, for an identical particle, the result in the reference frame $K'$ is

$$L' = -m_0 c^2 \sqrt{1 - \frac{u'^2}{c^2}} \tag{94}$$

$$P' = \frac{\partial L'}{\partial u'} = \frac{\partial}{\partial u'}\left(-m_0 c^2 \sqrt{1 - \frac{u'^2}{c'^2}}\right) = \frac{m_0 u'}{\sqrt{1 - u'^2 / c^2}} \tag{95}$$

However, the derivations above do not require $u$ in Eqs.(90) and (91) and $u'$ in Eqs.(94) and (95) satisfy the Lorentz velocity transformation formula, because $u$ and $u'$ can also satisfy the Galilean velocity transformation formula. Therefore, even if the mass-velocity formula can be obtained according to the methods of the Hamiltonian action, it is not related to the Lorentz velocity transformation formula, or has nothing to do with special relativity.

In fact, if Eq.(91) is a result of special relativity, we should be able to transform Eq.(91) into Eq.(95) by the Lorentz velocity transformation formula, but it is obviously impossible.

In short, we have examined almost all the methods of deriving the mass-velocity formula in special relativity, and come to the conclusion that it is impossible to derive the formula consistently, universally and effectively on the basis of the Lorentz transformation formula.

## 4. The Essence of the Mass-velocity Formula and the Mass-energy Relation

### *4.1 The Essence of the Mass-velocity Formula*

The above discussions prove that it is impossible to derive the mass-velocity formula based on the Lorentz velocity transformation formula. We can only think that the mass-velocity formula is an empirical formula, which has nothing to do with special relativity. In the present frame of physics, the mass-velocity formula cannot be derived by theory, and its correctness can only be judged by experiments.

On this issue, the Chinese scholar Ji Hao had done some valuable work. In 2010, Ji Hao published a paper in Engineering Physics in China to show his experiments on the accelerator of Shanghai Institute of Atomic Energy (Ji Hao, 2006, 2009). The experiments reveled that there was some deviation from the mass-velocity formula (1) when the velocity of particles approached the speed of light. Therefore, this problem is open. The experiments of Ji Hao need to be verified by physicists further.

### *4.2 The Derivation of the Mass-energy Relation*

In special relativity, the mass-energy relationship for objects with mass is derived from the mass-velocity formula. After considering Eq.(1), the second law of Newton mechanism is expressed by Eq.(5). The increase in the kinetic energy $T$ of a particle is equal to the work done by the force. Considering the displacement $d\vec{l} = \vec{u}dt$, we have

$$dT = \vec{F} \cdot d\vec{l} = \left( \frac{d}{dt} \frac{m_0 \vec{u}}{\sqrt{1-u^2/c^2}} \right) \cdot \vec{u} dt \tag{96}$$

Due to

$$\vec{u} \cdot \left( \frac{d}{dt} \frac{\vec{u}}{\sqrt{1-u^2/c^2}} \right) = \vec{u} \cdot \vec{u} \left( \frac{d}{dt} \frac{1}{\sqrt{1-u^2/c^2}} \right) + \frac{1}{\sqrt{1-u^2/c^2}} \vec{u} \cdot d\vec{u}$$

$$= \frac{u^2/c^2}{(1-u^2/c^2)^{3/2}} u \frac{du}{dt} + \frac{1}{\sqrt{1-u^2/c^2}} \vec{u} \cdot d\vec{u}$$

$$= \left[ \frac{u^2/c^2}{(1-u^2/c^2)^{3/2}} + \frac{1}{\sqrt{1-u^2/c^2}} \right] \vec{u} \cdot d\vec{u}$$

$$= \frac{1}{(1-u^2/c^2)^{3/2}} \vec{u} \cdot d\vec{u} = \frac{d}{dt} \frac{1}{\sqrt{1-u^2/c^2}} \tag{97}$$

Eq.(96) can be written as

$$dT = \frac{d}{dt} \frac{m_0 c^2}{\sqrt{1-u^2/c^2}} \tag{98}$$

By taking the integral of Eq.(98), we get

$$\Delta T = \int_0^u \frac{d}{dt} \frac{m_0 c^2}{\sqrt{1-u'^2/c^2}} dt = \int_0^u d \frac{m_0 c^2}{\sqrt{1-u'^2/c^2}} = m_0 c^2 \left[ \frac{1}{\sqrt{1-u^2/c^2}} - 1 \right] \tag{99}$$

Under the conditions $u/c << 1$, Eq.(99) can be written as the approximate form of Newtonian kinetic energy

$$\Delta T = \frac{1}{2} m_0 u^2 \tag{100}$$

Therefore, Eq.(99) has nothing to do with the internal energy of particle. In special relativity, Eq.(99) is written as

$$\Delta T = \Delta E = E - E_0 \tag{101}$$

And $E_0 = m_0 c^2$ is regarded as the rest energy of a particle with a rest mass $m_0$, and $E = mc^2$ is regarded the total energy of a particle with a moving mass $m$. That is the famous mass-energy formula.

However, as mentioned above, it is impossible to obtain the mass-velocity formula (1) by using the Lorentz transformation formula, so it is also impossible to obtain the mass-energy relation based on the Lorentz transformation formula. Or for an object with rest mass, the mass-energy relationship actually has nothing to do with Einstein's special relativity.

### *4.3 Mass-energy Relationship and Mass Defect*

It is obvious that regarding $E = m_0 c^2$ as the rest energy contained in a particle's rest mass is beyond the original meaning of Eq.(99). In fact, the rest mass of a particle does not change during the derivation of Eq.(99), and there is no basis to think that the mass-energy relationship of Einstein's special relativity predicts the existence of atomic nuclear energy.

According to the present view, atomic energy is converted by the defect of rest mass during the interaction of particles. However, special relativity had not predicted mass defect, and the defect of rest mass can only be regarded as an experimental fact, not a theoretical prediction. The fact is that nuclear physicists discovered the existences of atomic energy and connected it to the defect of rest mass. It is inconsistent with the history of physics to credit Einstein with the discovery of atomic energy in contemporary media propaganda to the public.

In fact, even before Einstein proposed his special relativity, physicists had developed a similar mass-energy relationship. Einstein had nothing to do with the discovery of mass defect in the processes of nuclear reactions. We should revert to the historical truth and credit the discovery of atomic energy to the pioneers of nuclear physics, such as Marie Curie, Joliot Curie, Otto Hahn, Enrico Fermi, Strassman and Lise Meitner, rather than Einstein.

## 5. Conclusions

The authors have proved that the reason why the M-M experiment has zero results is that Michelson fixed the light source on the cosmic absolutely stationary reference frame (or etheric reference frame) when designing the experiment. But in the actual experiment, the light source is fixed on the earth's motion reference frame and rotates with the Michelson interferometer.

If the light source is fixed on the Earth reference frame, the Galilean velocity transformation formula can be used to explain the zero result of the M-M experiment, and there is no need for physicists to introduce the Lorentz coordinate transformation. The principle of constant speed of light, the contraction of space-time and its relativity based on the Lorentz transformation are also unnecessary.

This paper further examines almost all derivations of the mass-velocity formulas in special relativity and proves that it is impossible to derive the mass-velocity formula from the Lorentz velocity transformation formula. This result indicates that the Lorentz coordinate transformation cannot be correct. The mass-velocity formula is essentially an empirical formula and has virtually no relation to Einstein's special relativity.

Since the mass-energy formula for a particle with mass is derived from the mass-velocity formula, the mass-energy formula which is widely used in atomic energy industry has virtually no relation to Einstein's special relativity too.

Einstein put forward the invariance principle of light’s speed and the principle of relativity in 1905, and derived the Lorentz coordinate transformation formula on this basis. According to the general understanding of modern physics, the invariance principle of light’s speed and the principle of special relativity have been fully verified by experiments. If the Lorentz coordinate transformation formula cannot be correct, the both principles cannot be correct.

As we know, in classical physics, the concepts of time and space are independent and absolute. However, in the Lorentz coordinate transformation formula, the concepts of time and space are intertwined together. The measure of space is related to time, and the measure of time is related to space. This approach completely confuses the boundary between time and space, mixes up two things that have nothing to do with each other, violates the human basic understanding for the objective world, and turns physics into an elusive, same thing like witchcraft.

According to classical physics, time and space are the most basic physical quantities. Speed is not the basic quantity of physics, but the derived quantity from time and space. Special relativity steals the show from the host. It elevates the speed of light to the first fundamental quantity of physics, turn space and time into the derived quantities dependent on the speeds of reference frame and light. It is completely unreasonable.

According to Einstein's understanding for the Lorentz transformation formula, measurements of time and space are relative, depending on the motion of the reference frame. When time and space become the subjective visual impression of the observer, physics loses its universal standard and is no longer deterministic in the scientific sense. The simplicity, objectivity and natural beauty of classical physics are gone.

Since Einstein put forward the special theory of relativity, physicists have found a lot of space-time paradoxes (Liu Youchang, 2011). These paradoxes are so varied and endless, so contrary to basic human knowledge, they are unprecedented in the history of science. For a scientific theory with so many abnormal logic problems, this fact indicates that the theory itself has fundamental defects.

This is the main reason why so many people have questioned Einstein’s special relativity since it was established more than a century ago. The skeptics include the famous people like Michelson, Lorentz, Maher and others who are considered the pioneers of relativity. This is really an ironic. However, the textbooks of special relativity tried to explain these paradoxes with various excuses. The paradoxes are considered as false paradoxes. Critics of relativity are instead accused of not understanding it.

We cannot discuss these issues in detail in this paper. To be sure, most experiments in the kinematics part of special relativity are subject to misunderstanding and calculation errors. Some have other explanations. The explanations of special relativity are not the unique ones. We will discuss them in separate papers.

The most important mathematical foundation of Special relativity is the Lorentz coordinate transformation formula. The mass-velocity formula and the mass-energy relation are its most important physical foundational formulas. Since it is impossible to deduce the mass-velocity formula and the mass-energy relation from the Lorentz transformation formula, we should abandon Einstein's special relativity completely.

At the same time, according to the observations of cosmology (Penzias A. A., Wilson R. W.,1965), we can introduce the absolute rest reference frame of the universe (Smoot G. F., 1992, Tan Zhansheng, 2007). On this basis, the mass velocity formula is adopted to reconstruct the Newton's kinetic theory (Mei Xiaochun, 2014), thoroughly solve a series of difficult problems in present astrophysics and cosmology.

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