Mass energy and momentum in the special relativity with variable speed of light

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Article

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Mass energy and momentum in the special relativity with variable speed of light

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Abstract

On the basis of establishing the special theory of relativity with variable speed of light and obtaining the step function relationship between mass and speed, this article further seeks the proper collocations of mass, energy and momentum allowed by the "ontology" of moving masses which are in various stages of motion properties or in different physical environments. Three ontology collocation types are obtained. If we consider the basic fact that the lower the energy, the more stable it is, the real physical world ranges from astrophysics issues such as white dwarfs, red giants, and celestial space speeds, to the various light and heavy elementary particles existence, combination and performance， which qualitative knowledge can all be derived from the "ontology collocation ". Two of these three types of collocations are derived from the mass-velocity step function relationship contented of quantum properties, so all the quantum phenomena of modern physics will not be obliterated. It is hoped that the modern physics knowledge accumulated in the laboratory and the scattered various theories will be explained under the dominance of a classic theory. The article also deduced the conversion relationship between the inertial system *S* and *S'* of the three collocation types of mass, energy and momentum of the moving mass. Derive the upgrade and downgrade law of the complete special relativity system, this also greatly expands the way to understand modern physics from the theory of relativity.

Key words: mass and energy-momentum vector in space-time four-dimensional space; the ontological collocation of mass, energy, and momentum; the conversion relationship of the three collocation types of mass, energy and momentum between the inertial system *S* and *S'*; the upgrade and downgrade of the complete special relativity system

1 Introduction

The momentum $\vec{P}(P_x, P_y, P_z)$ and energy E of the moving mass body in the space-time four-dimensional space just match to form a four-dimensional vector $(P_x, P_y, P_z, i\dfrac{E}{c})$ in the four-dimensional space, which is called the energy-momentum vector, their transformation between the two inertial coordinate systems S and S' is just

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like the Lorentz transformation formula between space-time coordinates (x, y, z, ict), and the square of the absolute value of this energy-momentum vector can be obtained as $-m_0c^2$. This is the basic content of relativistic mechanics. [1] The force on a mass body moving at speed $\vec{u}$ is equal to the derivative of its momentum with respect to time $\frac{d\vec{P}}{dt}$, the work A done by this force per unit time is equal to the change in the kinetic energy T of the mass body $\frac{dT}{dt} = A = \frac{d\vec{P}}{dt} \cdot \vec{u}$. Relativistic mechanics is different from classical Newtonian mechanics in that the mass in momentum is a continuous function of velocity $m = f(u) = \frac{m_0}{\sqrt{1-\frac{u^2}{c^2}}}$. Thus, we have $\frac{dT}{dt} = \frac{d\vec{P}}{dt} \cdot \vec{u} = \vec{u} \cdot \frac{d}{dt}\left(\frac{m_0\vec{u}}{\sqrt{1-\frac{u^2}{c^2}}}\right) = \frac{d}{dt}\left(\frac{m_0c^2}{\sqrt{1-\frac{u^2}{c^2}}}\right)$. Integrate this formula and take $T = 0$ when $u = 0$, the kinetic energy $T = \frac{m_0c^2}{\sqrt{1-\frac{u^2}{c^2}}} - m_0c^2$ and total Energy $E = T + m_0c^2 = \frac{m_0c^2}{\sqrt{1-\frac{u^2}{c^2}}} = mc^2$ can be obtained. This is the famous formula of the theory of relativity that introduced mankind into the nuclear energy era. However, in the face of the vast and colorful knowledge market of modern atomic physics and nuclear physics, the current theory of relativity can only take this formula from time to time in and out, and nothing else. In fact, the proper collocation of mass, energy and momentum allowed by the "ontology" of a moving mass in various stages of motion or in different physical environments should not only be the one situation given by the traditional special theory of relativity. This situation has dragged on for more than a century because another jumping step function relationship between the mass of the moving mass and the speed has not been discovered; Moreover, outside the atom in the case of $c' \to 0$ and $c' \to c$, the step function solution is very close to the traditional solution, even if the physical phenomenon of the step function solution exists objectively, it is difficult to be discovered. The author has established the special theory of relativity with variable speed of light [2] 、[3], and the step function solution of the mass-velocity relationship has been obtained [4], that can collude inside and outside the atom , and the theory of relativity is no longer only take the single form of one formula going when enter the inside of the atom.

In the traditional special theory of relativity, there is only one type of four-dimensional vector formed by energy and momentum. Now, because in the special theory of relativity with variable speed of light, there are two independent and non-coexisting function relationships between mass and speed [4]. A moving mass body due to its own acceleration, or enters and exits the medium, or is in the gravitational field, its mass can realistically exist two numerical values of large or small for the same speed; however for the same speed its energy can realistically exist three numerical values of large, medium and small, the small value can even be as small as negative value. Therefore, when energy and momentum are realistically combined into energy-momentum four-dimensional vectors suitable for mutual conversion between any two-coordinate systems, there are three different types of collocations. This article gives out in detail three types of reasonable collocations of mass, momentum, and energy in the 'ontology' that conform to the existence of the moving mass, two of them are derived from the mass-velocity step function relationship of the content of quantum properties, so all quantum phenomena in modern physics will not be obliterated. On this basis, the conversion relationship between the three types of collocation types of mass, energy and momentum of the moving mass body in the inertial system S and S' is further derived, and the upgrade and downgrade law of the complete special relativity system is obtained. It has greatly enriched the basic account of how the mass, energy, and momentum of the moving mass body in the real physical world can ontologically be matched existence and transformed.

2 Three sets of collocation types of mass, energy and momentum in the four-dimension space

Now starting from the two independent and non-coexisting function relationships between mass and speed, we will discuss three reasonable combinations of mass, energy and momentum in the 'ontology' that conform to the existence of the moving mass. The so-called "ontology" refers to the "ontology" that grasps all physical quantities based on the transformation between any two coordinate systems. Specifically, it means that certain physical quantities are actually matched to form vectors, tensors..., etc., suitable for mutual conversion between any two-coordinate systems. The 'ontology' of vectors, tensors... should not be changed, because of the difference in the observation coordinate system. So that the laws of physics linking these physical quantities do not differ depending on the coordinate system.

In [4], we have obtained two independent and non-coexistent function relations of the mass of the moving body with the speed. One of them is the traditional continuous increasing function relationship: $m = f(u) = \frac{m_0}{\sqrt{1-\frac{u^2}{c^2}}}$. Under the assumption that the rest mass is m_0 and the known speed u , the combination of mass, energy and momentum of a moving mass body can be written as a set of basic formulas in the inertial system S :

$$m = \frac{m_0}{\sqrt{1-u^2/c^2}}; \quad \vec{P} = m\vec{u} = \frac{m_0}{\sqrt{1-u^2/c^2}}\vec{u}$$
$$E = mc^2 = \frac{m_0c^2}{\sqrt{1-u^2/c^2}} \quad ; \quad E_0 = m_0c^2 \tag{1}$$

In the inertial system S' there are also:

$$m' = \frac{m_0'}{\sqrt{1-u'^2/c'^2}}; \quad \vec{P}' = m'\vec{u}' = \frac{m_0'}{\sqrt{1-u'^2/c'^2}}\vec{u}'$$
$$E' = m'c'^2 = \frac{m_0'c'^2}{\sqrt{1-u'^2/c'^2}} \quad ; \quad E_0' = m_0'c'^2 \tag{1'}$$

It should be noted here that in the relativity theory of variable speed of light, only when $\frac{u^2}{c^2} = \frac{u'^2}{c'^2}$, there is $m = m'$. In addition, even if $m = m'$, it is still $E' = m'c'^2 \neq E = mc^2$.

In addition, the mass of the moving body changes with the speed, there is another discontinuous jump step function relationship. For the same mass $m = \frac{m_0}{\sqrt{1-u^2/c^2}}$, there can be two different speeds: $u_1 = (\frac{c-c'}{c+c'})u$ and $u_2 = u$; for the same speed u , there can be two different mass values: $m_1 = \frac{m_0}{\sqrt{1-\frac{u^2}{c^2}}}$ and $m_2 = \frac{m_0}{\sqrt{1-\frac{u^2}{c^2}(\frac{c+c'}{c-c'})^2}}$. Therefore, in addition to the form given by equation (1), the four-dimension vector formed by the combination of mass, energy and momentum must have two other different forms. If for the same speed u , its mass $m_2 = \frac{m_0}{\sqrt{1-\frac{u^2}{c^2}(\frac{c+c'}{c-c'})^2}}$ is used to determine the momentum, then $\vec{P} = \frac{m_0\vec{u}}{\sqrt{1-\frac{u^2}{c^2}\frac{(c+c')^2}{(c-c')^2}}}$. Follow the standard calculus steps in the relativistic dynamics of the previous introduction:

$$\frac{dT}{dt} = A = \frac{d\vec{P}}{dt}\cdot\vec{u} = \vec{u}\cdot\frac{d}{dt}\left(\frac{m_0\vec{u}}{\sqrt{1-\frac{u^2}{c^2}(\frac{c+c'}{c-c'})^2}}\right) = \frac{d}{dt}\left[\frac{m_0\frac{c^2(c-c')^2}{(c+c')^2}}{\sqrt{1-\frac{u^2}{c^2}(\frac{c+c'}{c-c'})^2}}\right]$$

Integrate this formula and take $T = 0$ when $u = 0$, determine the integral constant $C = -m_0c^2(\frac{c-c'}{c+c'})^2$; then:

$$T = \frac{m_0c^2(\frac{c-c'}{c+c'})^2}{\sqrt{1-\frac{u^2}{c^2}(\frac{c+c'}{c-c'})^2}} - m_0c^2(\frac{c-c'}{c+c'})^2$$

In this way, another set of collocations of the mass, energy and momentum of the moving mass body is immediately obtained:

$$m=\frac{m_0}{\sqrt{1-\frac{u^2}{c^2}(\frac{c+c'}{c-c'})^2}} \quad , \qquad \vec{P}=m\vec{u}=\frac{m_0\vec{u}}{\sqrt{1-\frac{u^2}{c^2}\frac{(c+c')^2}{(c-c')^2}}} \quad ,$$

$$E=mc^2(\frac{c-c'}{c+c'})^2=\frac{m_0c^2(\frac{c-c'}{c+c'})^2}{\sqrt{1-\frac{u^2}{c^2}(\frac{c+c'}{c-c'})^2}} \ , \ E_0=m_0c^2(\frac{c-c'}{c+c'})^2 \qquad (2)$$

A set of symmetric formulas in the S' system is also easy to write:

$$m'=\frac{m_0}{\sqrt{1-\frac{u'^2}{c'^2}(\frac{c'+c}{c'-c})^2}} \quad , \qquad \vec{P}'=m'\vec{u}'=\frac{m_0\vec{u}'}{\sqrt{1-\frac{u'^2}{c'^2}\frac{(c'+c)^2}{(c'-c)^2}}} \quad ,$$

$$E'=m'c'^2(\frac{c'-c}{c'+c})^2=\frac{m_0c'^2(\frac{c'-c}{c'+c})^2}{\sqrt{1-\frac{u'^2}{c'^2}(\frac{c'+c}{c'-c})^2}} \ , \quad E_0'=m_0c'^2(\frac{c'-c}{c'+c})^2 \qquad (2')$$

Of course, the equivalent physical quantities in the two sets of formulas will not be equal. Special attention should be paid to $E'\neq E$, because this inequality has little to do with u and u'.

If for the same mass $m=\frac{m_0}{\sqrt{1-u^2/c^2}}$, another corresponding velocity $u_1=(\frac{c-c'}{c+c'})u$ is used to define momentum, then $\vec{P}=\frac{m_0(\frac{c-c'}{c+c'})\ \vec{u}}{\sqrt{1-\frac{u^2}{c^2}}}$. The same calculation obtains the third set of collocations of the mass, energy and momentum of the moving mass:

$$m=\frac{m_0}{\sqrt{1-u^2/c^2}};\ \vec{P}=m\vec{u}=\frac{m_0(\frac{c-c'}{c+c'})}{\sqrt{1-u^2/c^2}}\vec{u}$$

$$E=m\ (\frac{c-c'}{c+c'})\ c^2=\frac{m_0(\frac{c-c'}{c+c'})\ c^2}{\sqrt{1-u^2/c^2}} \quad ; \quad E_0=m_0(\frac{c-c'}{c+c'})\ c^2 \qquad (3)$$

A set of symmetric formulas in the S' system can also be written:

$$m' = \frac{m_0}{\sqrt{1-u'^2/c'^2}}; \quad \vec{P}' = m'\vec{u}' = \frac{m_0(\frac{c'-c}{c'+c})}{\sqrt{1-u'^2/c'^2}}\vec{u}'$$

$$E' = m' \ (\frac{c'-c}{c'+c}) \ c'^2 = \frac{m_0(\frac{c'-c}{c'+c}) \ c'^2}{\sqrt{1-u'^2/c'^2}} \quad ; \quad E'_0 = m_0(\frac{c'-c}{c'+c}) \ c'^2 \tag{3'}$$

It is important to note that if $c > c'$, E' and E'_0 can be negative in the S' system.

In the above three sets of collocations of mass, energy and momentum, for the same speed, mass, energy and momentum have different values. There are two values of large (m_L) and small (m_S) for mass:

$$m_L = m_2 = \frac{m_0}{\sqrt{1-\frac{u^2}{c^2}(\frac{c+c'}{c-c'})^2}} \quad , \quad m_S = m_1 = \frac{m_0}{\sqrt{1-\frac{u^2}{c^2}}}$$

There are three values for momentum: large $(\vec{P}_L)$, medium $(\vec{P}_M)$ and small $(\vec{P}_S)$:

$$\vec{P}_L = \vec{P}_2 = \frac{m_0\vec{u}}{\sqrt{1-\frac{u^2}{c^2}\frac{(c+c')^2}{(c-c')^2}}} \quad , \quad \vec{P}_M = \vec{P}_1 = \frac{m_0\vec{u}}{\sqrt{1-\frac{u^2}{c^2}}} \quad , \quad \vec{P}_S = \vec{P}_3 = \frac{m_0(\frac{c-c'}{c+c'}) \ \vec{u}}{\sqrt{1-\frac{u^2}{c^2}}}$$

There are also three values for energy:

$$E_1 = \frac{m_0c^2}{\sqrt{1-\frac{u^2}{c^2}}} \quad , \quad E_2 = \frac{m_0c^2(\frac{c-c'}{c+c'})^2}{\sqrt{1-\frac{u^2}{c^2}(\frac{c+c'}{c-c'})^2}} \quad , \quad E_3 = \frac{m_0(\frac{c-c'}{c+c'}) \ c^2}{\sqrt{1-\frac{u^2}{c^2}}} \quad .$$

They are the energy values respectively in the (1), (2), (3) three collocation types.

Let $\quad Q = \frac{c^2(c-c')^2}{2(c^2+c'^2)} \qquad R = \frac{2c^2(c-c')^2(c^2+c'^2)}{3c^4+10c^2c'^2+3c'^4} \qquad S = c^2(\frac{c-c'}{c+c'})^2$,

It can be calculated:

When $u^2 < Q$ and $E_3 > 0$, then $E_1 > E_3 > E_2$;

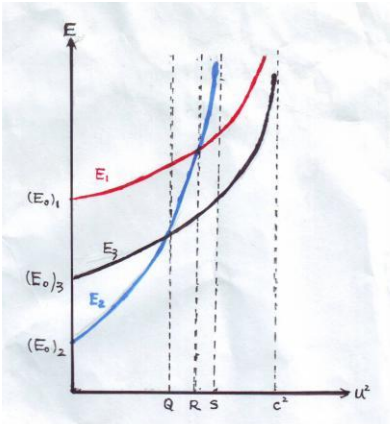
When $Q < u^2 < R$ (or $E_3 < 0$), then $E_1 > E_2 > E_3$;

When $R < u^2 < S$, then $E_2 > E_1 > E_3$;

When $< u^2 < c^2$, then $E_1 > E_3$, E_2 does not exist.

When $u^2 = 0$ and $E_3 > 0$, then $(E_0)_1 > (E_0)_3 > (E_0)_2$.

The curve of the energy E versus the square of velocity u^2 in the three sets of collocation types is shown in (Fig. 1), and the changes in the three energy values of E_1, E_2, E_3 can be clearly seen.



(Fig. 1)

The three sets of collocation types (1), (2) and (3) can be expressed as:

$$m = m_s = m_1 \quad , \vec{P} = \vec{P}_M = \vec{P}_1, \quad E = \begin{cases} E_L = E_1 & (u^2 < R \ \ or \ \ u^2 > S) \\ E_M = E_1 & (R < u^2 < S) \end{cases} \qquad (1a)$$

$$m = m_L = m_2 \quad , \vec{P} = \vec{P}_L = \vec{P}_2 \, , \quad E = \begin{cases} E_s = E_2 & (u^2 < Q) \\ E_M = E_2 & (Q < u^2 < R) \\ E_L = E_2 & (R < u^2 < S) \end{cases} \qquad (2a)$$

$$m = m_s = m_1 \quad , \vec{P} = \vec{P}_s = \vec{P}_3 \quad , \quad E = \begin{cases} E_M = E_3 & (u^2 < Q \ \ and \ \ E > 0) \\ E_s = E_3 & (Q < u^2 \ \ or \ \ E < 0) \end{cases} \qquad (3a)$$

It should be noted that (Fig. 1) does not indicate that the mass of the three types of ‘ontology collocation’ also changes in this way. The mass of the two types (1) and (3) is less than the mass of type (2) for any speed—this is a key. Look at the energy comparison in (Fig. 1), it varies with the speed: when the velocity square u^2 is less than the Q value, the energy of type (2) E_2 is the smallest; u^2 is between R and S, (2) type has the largest energy E_2 , and it rises more sharply when it is close to S; when the velocity square $u^2$is greater than the Q value, the energy of type (3) E_3 is the smallest; when u^2crosses the Q point and R point, the energy of (2) type increases rapidly and surpasses type (3) and (1) respectively, at this time, type (2) is most likely to change to other types. This is even more an important key. A universal fact in the materialistic world is that the lower the energy, the more stable the state. Therefore, a moving mass body with a moving speed square u^2far below the Q value must generally exist as type (2); the moving mass bodies with the moving speed square u^2far above S must be of type (3); only when u^2 is around close to the three values of Q, R, S and between QS, the moving mass bodies can likely change from (2) type to other types, and its masses change from large to small. The mass changes from large to small causes the split of the moving mass. For example, when the velocity square u^2 of type (2) moving mass body increases to a value equivalent to point *R*, its energy has reached the intersection of the two types of energy curves (1) and (2), and it is easy to automatically "degenerate" into (1) Type. This can explain the natural disintegration of radioactive elements and the emergence of "new stars" that suddenly increase in brightness in the distant horizon. Although the values of a series of physical quantities of "ontological collocation "involved are very different.

There are quite a few definite reasons to explain many real physical phenomena based on the details provided in the three sets of collocation types of mass, energy and momentum. For example: (A) (1) and (2) or (3) will not coexist; (B) Under the appropriate numerical conditions of c and c', the difference between m_L and m_S is quite large; (C) The lower the energy of the mass body, the more stable; (D)The abrupt transition between m_L and m_S is completely allowed by the relativity with variable speed of light, and has the characteristics of "ontology", and is neither "split" or "merge", nor "diminish small" or "grow up"; (E) The jump conversion of $\vec{P}_L$, $\vec{P}_M$ and $\vec{P}_S$ also meets the requirements of the relativity with variable speed of light, and there is no need to pursue the reason of 'force', because in the theory of relativity, “force” is not a real physical quantity that can be included in the “ontological collocation”; (F) Special attention should be paid to (3) the negative energy instinctively equipped by the mass body; etc. These are all the results of the special theory of relativity that allows $c \neq c'$ between S and S'. It is hoped that all the modern physics knowledge accumulated in the laboratory and the observation of the universe, and the various theories that have been scattered about this knowledge, will be explained under the dominance of a classic theory of relativity, In the end, it will be able to explain all the physical problems of the interior of the atom, the interior of the nucleus, nucleons, elementary particles and cosmic rays, thermonuclear subgroups, as well as white dwarfs, red giants, variable stars, supernovae, and earth cores. If in understanding and explaining the internal structure of atomic nuclei and the decay and annihilation phenomena of various elementary particles in the laboratory, the "great unification theory" that attempts to unify all the interacting "forces" in nature is still faltering and hopeless, then you might as well throw away Develop hypotheses about various "forces" and explore how the mass, energy, and momentum of the moving mass body in the real physical world can “ontologically” collocation exist and transform. Isn’t it possible that a mass body with the same static mass m_0 exhibits several elementary particles with masses between m_L and m_S? A closer look at the conversion of the four-dimension energy-momentum vector between S and S' will certainly help to understand these problems.

3 The conversion of mass, energy and momentum in four-dimension space

Now use the three collocation types of mass, energy and momentum of the moving mass body to find the conversion relationship between them in the inertial system S and S'. The relative motion of the inertial system S and S' is as in the previous literature [1], [2], [3] .

For the first type collocation given by (1) and (1'), the transformation of the four-dimension energy-momentum vector composed of it between S and S', even in the case of $c \neq c'$, is the same as the traditional special theory of relativity. There is no big difference in the calculation process. Using the formula of velocity transformation given in [1], the transformation between $\sqrt{1-u^2/c^2}$ and $\sqrt{1-u'^2/c'^2}$ can be obtained,

$$\sqrt{1-\frac{u'^2}{c'^2}} = \frac{\sqrt{(1-\frac{u^2}{c^2})(1-\frac{\mathrm{v}^2}{c^2})}}{1-\frac{u_x \mathrm{v}}{c^2}} , \quad \sqrt{1-\frac{u^2}{c^2}} = \frac{\sqrt{(1-\frac{u'^2}{c'^2})(1-\frac{\mathrm{v}'^2}{c'^2})}}{1-\frac{u'_x \mathrm{v}'}{c'^2}}$$

, thus the transformation relationship between mass, momentum and energy obtained :

$$m = \frac{m'(1-\frac{u'_x \mathrm{v}'}{c'^2})}{\sqrt{1-\frac{\mathrm{v}'^2}{c'^2}}}$$

$$\frac{P_x}{c} = \frac{\frac{P'_x}{c'} - \mathrm{v}'\frac{E'}{c'^3}}{\sqrt{1-\frac{\mathrm{v}'^2}{c'^2}}} , \quad \frac{P_y}{c} = \frac{P'_y}{c'} , \quad \frac{P_z}{c} = \frac{P'_z}{c'} , \quad \frac{E}{c^3} = \frac{c'}{c}\frac{\frac{E'}{c'^3} - (\frac{P'_x}{c'})\frac{\mathrm{v}'}{c'^2}}{\sqrt{1-\frac{\mathrm{v}'^2}{c'^2}}} \tag{4}$$

The symmetry relationship can also be introduced:

$$m' = \frac{m(1-\frac{u_x \mathrm{v}}{c^2})}{\sqrt{1-\frac{\mathrm{v}^2}{c^2}}}$$

$$\frac{P'_x}{c'} = \frac{\frac{P_x}{c} - \mathrm{v}\frac{E}{c^3}}{\sqrt{1-\frac{\mathrm{v}^2}{c^2}}} , \quad \frac{P'_y}{c'} = \frac{P_y}{c} , \quad \frac{P'_z}{c'} = \frac{P_z}{c} , \quad \frac{E'}{c'^3} = \frac{c}{c'}\frac{\frac{E}{c^3} - (\frac{P_x}{c})\frac{\mathrm{v}}{c^2}}{\sqrt{1-\frac{\mathrm{v}^2}{c^2}}} \tag{4'}$$

Compared with the coordinate transformation relationship between the inertial system S and S' given in [1], it can be seen that the transformation between $(\frac{P_x}{c},\frac{P_y}{c},\frac{P_z}{c},\frac{E}{c^3})$ and $(\frac{P'_x}{c'},\frac{P'_y}{c'},\frac{P'_z}{c'},\frac{E'}{c'^3})$ is the same as the Lorentz transformation formula between (x, y, z, t) and (x', y', z', t') . If " $\Leftrightarrow$ "means equivalent," $\rightarrow$ "means transformation, and "1" is added to the lower left corner to indicate the first collocation type given by equation (1), then the above corresponding transformation relationship can be expressed as:

$$\begin{array}{c} (\frac{{}_1P_x}{c}, \frac{{}_1P_y}{c}, \frac{{}_1P_z}{c}, \frac{{}_1E}{c^3}) \Leftrightarrow (x, y, z, t) \\ \downarrow \ \uparrow \qquad\qquad \downarrow \ \uparrow \\ (\frac{{}_1P'_x}{c'}, \frac{{}_1P'_y}{c'}, \frac{{}_1P'_z}{c'}, \frac{{}_1E'}{c'^3}) \Leftrightarrow (x', y', z', t') \end{array} \tag{4a}$$

Undeniable, this "$\Leftrightarrow$" represents "equivalent" indeed shows that $\vec{P}$ and E in formula (1) coexist with the four-dimensional space and time dominated by Lorentz's transformation formula, and they are true. It is easy to calculate that the square of the absolute value of this energy-momentum vector $(\frac{{}_1P_x}{c}, \frac{{}_1P_y}{c}, \frac{{}_1P_z}{c}, ic\frac{{}_1E}{c^3})$ in the four-dimension space does not change due to the transformation:

$$\frac{{}_1P^2}{c^2} - \frac{{}_1E^2}{c^4} = \frac{{}_1P'^2}{c'^2} - \frac{{}_1E'^2}{c'^4} = -m_0^2 \tag{4b}$$

When $c = c'$, (4), (4') and (4b) all are the same as the traditional special theory of relativity; (4a) is also not much different. Special attention should be paid to $-m_0^2$ on the right side of equation (4b). It is the invariant of the four-dimensional energy-momentum vector transforming between S and S', while $E_0 = m_0c^2$ is not an invariant. This is consistent with the assumption that $m_0 = m_0'$ exists in S and S' when deriving the mass-velocity relationship in [4]. We did not make any other assumptions about m_0, such as the issue of whether m_0 is divisible or not. "Undividable" is against the correct philosophical point of view. Therefore, m_0 can be a combined system of many smaller mass bodies, and the sum of its static mass is not equal to m_0; the difference between its positive and negative can be expressed as various kinds of energy in the system. This ' difference ' is always there. Unable to know for sure. The value of m_0 can only be determined from the value of the relevant quantity that can be observed on the left side of equation (4b), and it is equal in S and S', and its existence is a universal constant. But at the same time, the analysis combination of m_0 does not have the eternal certainty of ‘one hoe to the end’.

For the second type collocation given in (2) and (2'), the transformation of the four-dimension energy- momentum vector composed of it between S and S', as long as it is assumed to replace c and c' with $c(\frac{c-c'}{c+c'})$ and $c'(\frac{c'-c}{c'+c})$ respectively in the Lorentz transformation formula , all calculations from (4) to (4b) above can be obtained in the same way, and the results are as follows:

$$m=\frac{m'[1-\frac{u'_x\mathrm{v}'}{c'^2}(\frac{c'+c}{c'-c})^2]}{\sqrt{1-\frac{\mathrm{v}'^2}{c'^2}(\frac{c'+c}{c'-c})^2}} \quad ,$$

$$\frac{{}_2P_x}{c(\frac{c-c'}{c+c'})}=\frac{\frac{{}_2P'_x}{c'(\frac{c'-c}{c'+c})}-\mathrm{v}'[\frac{{}_2E'}{c'^3(\frac{c'-c}{c'+c})^3}]}{\sqrt{1-\frac{\mathrm{v}'^2}{c'^2}(\frac{c'+c}{c'-c})^2}},\quad \frac{{}_2P_y}{c(\frac{c-c'}{c+c'})}=\frac{{}_2P'_y}{c'(\frac{c'-c}{c'+c})},\quad \frac{{}_2P_z}{c(\frac{c-c'}{c+c'})}=\frac{{}_2P'_z}{c'(\frac{c'-c}{c'+c})},$$

$$\frac{{}_2E}{c^3(\frac{c-c'}{c+c'})^3}=(-\frac{c'}{c})\frac{\frac{{}_2E'}{c'^3(\frac{c'-c}{c'+c})^3}-[\frac{P'_x}{c'(\frac{c'-c}{c'+c})}][\frac{\mathrm{v}'}{c'^2(\frac{c'-c}{c'+c})}]}{\sqrt{1-\frac{\mathrm{v}'^2}{c'^2}(\frac{c'+c}{c'-c})^2}} \qquad (5)$$

The symmetric relationship can also be written one by one:

$$m'=\frac{m[1-\frac{u_x\mathrm{v}}{c^2}(\frac{c+c'}{c-c'})^2]}{\sqrt{1-\frac{\mathrm{v}^2}{c^2}(\frac{c+c'}{c-c'})^2}} \quad ,$$

$$\frac{{}_2P'_x}{c'(\frac{c'-c}{c'+c})}=\frac{\frac{{}_2P_x}{c(\frac{c-c'}{c+c'})}-\mathrm{v}[\frac{{}_2E}{c^3(\frac{c-c'}{c+c'})^3}]}{\sqrt{1-\frac{\mathrm{v}^2}{c^2}(\frac{c+c'}{c-c'})^2}},\quad \frac{{}_2P'_y}{c'(\frac{c'-c}{c'+c})}=\frac{{}_2P_y}{c(\frac{c-c'}{c+c'})},\quad \frac{{}_2P'_z}{c'(\frac{c'-c}{c'+c})}=\frac{{}_2P_y}{c(\frac{c-c'}{c+c'})}$$

$$\frac{{}_2E'}{c'^3(\frac{c'-c}{c'+c})^3}=(-\frac{c}{c'})\frac{\frac{{}_2E}{c^3(\frac{c-c'}{c+c'})^3}-[\frac{P_x}{c(\frac{c-c'}{c+c'})}][\frac{\mathrm{v}}{c^2(\frac{c-c'}{c+c'})}]}{\sqrt{1-\frac{\mathrm{v}^2}{c^2}(\frac{c+c'}{c-c'})^2}} \qquad (5')$$

In this way, the equivalent relationship of the transformation between $\left[\frac{{}_2P}{c(\frac{c-c'}{c+c'})},\frac{{}_2E}{c^3(\frac{c-c'}{c+c'})^3}\right]$ and $\left[\frac{{}_2P'}{c'(\frac{c'-c}{c'+c})},\frac{{}_2E'}{c'^3(\frac{c'-c}{c'+c})^3}\right]$ and the transformation

Between (r,t) and (r',t') can be expressed as:

$$\left[\frac{{}_2P}{c(\frac{c-c'}{c+c'})},\frac{{}_2E}{c^3(\frac{c-c'}{c+c'})^3}\right]\begin{matrix}\rightarrow\\ \leftarrow\end{matrix}\left[\frac{{}_2P'}{c'(\frac{c'-c}{c'+c})},\frac{{}_2E'}{c'^3(\frac{c'-c}{c'+c})^3}\right]\Leftrightarrow\left\{\begin{matrix}c(\frac{c-c'}{c+c'})\text{代}c\\ c'(\frac{c'-c}{c'+c})\text{代}c'\end{matrix}\right\}[r,t]\begin{matrix}\rightarrow\\ \leftarrow\end{matrix}[r',t']$$

(5a)

For simplicity, the three components of momentum (P_x,P_y,P_z) are written as P , and

(x,y,z) is written as r.

If in these results, let $u(\frac{c+c'}{c-c'})=w$, $u'(\frac{c'+c}{c'-c})=w'$, $\mathrm{v}'(\frac{c+c'}{c'-c})=\mathrm{v}'_{w'}$, that is, the speed is replaced by the same ratio; then:

$$m(w)=\frac{m'(w')(1-\frac{w'_x\mathrm{v}'_{w'}}{c'^2})}{\sqrt{1-\frac{\mathrm{v}'^2_{w'}}{c'^2}}},$$

$$\frac{{}_1P_x(w)}{c}=\frac{\frac{{}_1P'_x(w')}{c'}-\mathrm{v}'_{w'}\frac{{}_1E'}{c'^3}}{\sqrt{1-\frac{\mathrm{v}'^2_{w'}}{c'^2}}},\ \frac{{}_1P_y(w)}{c}=\frac{{}_1P'_y(w')}{c'},\ \frac{{}_1P_z(w)}{c}=\frac{{}_1P'_z(w')}{c'},$$

$$\frac{{}_1E(w)}{c^3}=(\frac{c'}{c})\frac{[\frac{{}_1E'(w')}{c'^3}-(\frac{{}_1P'_x(w')}{c'})\frac{\mathrm{v}'_{w'}}{c'^2}]}{\sqrt{1-\frac{\mathrm{v}'^2_{w'}}{c'^2}}},\ {}_1E(w)=\frac{m_0c^2}{\sqrt{1-\frac{w^2}{c^2}}}$$

These are just the transformation relations (4) between S and S' of the first collocation of mass, momentum, and energy given by equation (1). This leads to a very important conclusion: if the related speed in S and S' is converted according to the same proportion of the upper limit speed, the second type of collocation of mass, momentum and energy given by equation (2) exists between S and S' in the special relativity of the upper limit speed $c(\frac{c-c'}{c+c'})$ and $c'(\frac{c'-c}{c'+c})$ respectively, just like the first type of collocation given by equation (1) exists between S and S' in the special relativity of the upper limit speed c and c' in the same way. The so-called "same" means that the speed is converted according to the same ratio, so this ratio is also used for the upper limit speed. The above equivalent conversion relationship can be illustrated as:

$$\begin{array}{ccccccc}
\left[\frac{{}_2P}{c(\frac{c-c'}{c+c'})},\frac{{}_2E}{c^3(\frac{c-c'}{c+c'})^3}\right] & \begin{array}{c}\rightarrow\\ \leftarrow\end{array} & \left[\frac{{}_2P'}{c'(\frac{c'-c}{c'+c})},\frac{{}_2E'}{c'^3(\frac{c'-c}{c'+c})^3}\right] & \Leftrightarrow & \left\{\begin{array}{c}c(\frac{c-c'}{c+c'})\\ c'(\frac{c'-c}{c'+c})\end{array}\right\} & [r,t]\begin{array}{c}\rightarrow\\ \leftarrow\end{array}[r',t'] & \\
\downarrow\uparrow & & \downarrow\uparrow & & & \downarrow\uparrow & \\
\left[\frac{{}_1P}{c},\frac{{}_1E}{c^3}\right] & \begin{array}{c}\rightarrow\\ \leftarrow\end{array} & \left[\frac{{}_1P'}{c'},\frac{{}_1E'}{c'^3}\right] & \Leftrightarrow & \left\{\begin{array}{c}c\\ c'\end{array}\right\} & [r,t]\begin{array}{c}\rightarrow\\ \leftarrow\end{array}[r',t'] & (5b)
\end{array}$$

As pointed out when defining the inertial coordinate system in [2], a necessary condition for the existence of an inertial coordinate system is that there is a fixed upper limit in the observed speed group, that is, the upper limit speed; this upper limit speed may not necessarily be c, the speed of light in vacuum, and the application of special relativity is thus broadened. When facing real physical problems, there is no light on the scene, but only, for example, β-rays appearing as the upper limit speed. In this problem, the special theory of relativity conforming to the four-dimension vector formed by the combination of ${}_2\vec{P}$ and ${}_2E$ can still be used correctly. It is reasonable that one of $c(\frac{c-c'}{c+c'})$ and $c'(\frac{c'-c}{c'+c})$ is a negative value, because speed is a vector originally, and it has the meaning of positive and negative; the so-called upper limit speed of course refers to its absolute value. The above results show that the special theory of relativity starts with c and c' as the upper limit speed, and exists according to the ratio of $\pm(\frac{c-c'}{c+c'})$ decreasing (or reducing) orderly. Face (Figure.1), take the situation of the speed replaced before the schematic diagram (5b) to see, and consider that the smaller the energy of the moving mass is, the more stable it is, then the original special theory of relativity is applied to the right of point R on the E_1 curve . The special theory of relativity after the first descending is applied to the left of point R on the E_2 curve.

It is easy to prove that the square of the absolute value of the energy-momentum vector in the four-dimension space formed by the collocation of ${}_2\vec{P}$ and ${}_2E$ in (4), i.e. the square of the absolute value of $\left[\frac{{}_2P_x}{c(\frac{c-c'}{c+c'})}, \frac{{}_2P_y}{c(\frac{c-c'}{c+c'})}, \frac{{}_2P_z}{c(\frac{c-c'}{c+c'})}, ic(\frac{c-c'}{c+c'})\frac{{}_2E}{c^3(\frac{c-c'}{c+c'})^3}\right]$ does not change due to the transformation:

$$[\frac{{}_2P}{c(\frac{c-c'}{c+c'})}]^2-[\frac{{}_2E}{c^2(\frac{c-c'}{c+c'})^2}]^2=[\frac{{}_2P'}{c'(\frac{c'-c}{c'+c})}]^2-[\frac{{}_2E'}{c'^2(\frac{c'-c}{c'+c})^2}]^2=-m_0^2 \qquad (5c)$$

Same as (4b), attention should be paid to ((5c) , it ensure that the basic hypothesis of $m_0=m_0'$ could be accurately determined, but the true existence of m_0 still cannot be understood by "one hoe to the end ".

Now for the third type collocation given in (3) and (3’), discuss the transformation of the four-dimension energy-momentum vector composed of it between S and S'. The same calculation can be obtained by applying speed transformation:

$$m=\frac{m'(1-\frac{u_x'\mathrm{v}'}{c'^2})}{\sqrt{1-\frac{\mathrm{v}'^2}{c'^2}}}$$

$$\frac{{}_3P_x}{c}=-\frac{\frac{{}_3P_x'}{c'}-\mathrm{v}'\frac{{}_3E'}{c'^3}}{\sqrt{1-\frac{\mathrm{v}'^2}{c'^2}}} \quad , \quad \frac{{}_3P_y}{c}=-\frac{{}_3P_y'}{c'} \quad , \quad \frac{{}_3P_z}{c}=-\frac{{}_3P_z'}{c'} \quad ,$$

$$\frac{{}_3E}{c^3} = -\frac{c'}{c}\frac{\frac{{}_3E'}{c'^3} - (\frac{{}_3P'_x}{c'})\frac{v'}{c'^2}}{\sqrt{1-\frac{v'^2}{c'^2}}} \tag{6}$$

And symmetry, we have:

$$m' = \frac{m(1-\frac{u_x v}{c^2})}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$\frac{{}_3P'_x}{c'} = -\frac{\frac{{}_3P_x}{c} - v\frac{{}_3E}{c^3}}{\sqrt{1-\frac{v^2}{c^2}}} \quad , \quad \frac{{}_3P'_y}{c'} = -\frac{{}_3P_y}{c} \quad , \quad \frac{{}_3P'_z}{c'} = -\frac{{}_3P_z}{c} \quad ,$$

$$\frac{{}_3E'}{c'^3} = -\frac{c}{c'}\frac{\frac{{}_3E}{c^3} - (\frac{{}_3P_x}{c})\frac{v}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}} \tag{6'}$$

Obviously, the four-dimensional vector transformation conditions of space-time four-dimensional space dominated by the special theory of relativity no longer exist between $(\frac{{}_3P_x}{c}, \frac{{}_3P_y}{c}, \frac{{}_3P_z}{c}, \frac{{}_3E}{c^3})$ and $(\frac{{}_3P'_x}{c'}, \frac{{}_3P'_y}{c'}, \frac{{}_3P'_z}{c'}, \frac{{}_3E'}{c'^3})$. But if we divide both sides of equation (6) by $(\frac{c-c'}{c+c'})$, we get:

$$\frac{{}_1P_x}{c} = \frac{\frac{{}_3P'_x}{c'(\frac{c'-c}{c'+c})} - v'\frac{{}_3E'}{c'^3(\frac{c'-c}{c'+c})}}{\sqrt{1-\frac{v'^2}{c'^2}}} \quad , \quad \frac{{}_1P_y}{c} = \frac{{}_3P'_y}{c'(\frac{c'-c}{c'+c})} \quad , \quad \frac{{}_1P_z}{c} = \frac{{}_3P'_z}{c'(\frac{c'-c}{c'+c})} \quad ;$$

$$\frac{{}_1E}{c^3} = \frac{c'}{c}\frac{\frac{{}_3E'}{c'^3(\frac{c'-c}{c'+c})} - (\frac{{}_3P'_x}{c'(\frac{c'-c}{c'+c})})\frac{v'}{c'^2}}{\sqrt{1-\frac{v'^2}{c'^2}}} \tag{7}$$

Similarly, divide both sides of equation (6’) by $(\frac{c'-c}{c'+c})$, get:

$$\frac{{}_1P'_x}{c'}=\frac{\frac{{}_3P_x}{c(\frac{c-c'}{c+c'})}-\mathrm{v}\frac{{}_3E}{c^3(\frac{c-c'}{c+c'})}}{\sqrt{1-\frac{\mathrm{v}^2}{c^2}}}\quad,\quad \frac{{}_1P'_y}{c'}=\frac{{}_3P_y}{c(\frac{c-c'}{c+c'})}\quad,\quad \frac{{}_1P'_z}{c'}=\frac{{}_3P_z}{c(\frac{c-c'}{c+c'})}\quad;$$

$$\frac{{}_1E'}{c'^3}=\frac{c}{c'}\frac{\frac{{}_3E}{c^3(\frac{c-c'}{c+c'})}-(\frac{{}_3P_x}{c(\frac{c-c'}{c+c'})})\frac{\mathrm{v}}{c^2}}{\sqrt{1-\frac{\mathrm{v}'^2}{c'^2}}}\qquad(7')$$

Seeing from (6) and (6'), the transformation $[\frac{{}_1P}{c},\frac{{}_1E}{c^3}]\to[\frac{{}_3P'}{c'(\frac{c'-c}{c'+c})},\frac{{}_3E'}{c'^3(\frac{c'-c}{c'+c})}]$ and $[\frac{{}_1P'}{c'},\frac{{}_1E'}{c'^3}]\to[\frac{{}_3P}{c(\frac{c-c'}{c+c'})},\frac{{}_3E}{c^3(\frac{c-c'}{c+c'})}]$ are like the transformation $[r,t]\to[r',t']$ and $[r',t']\to[r,t]$, they are all the transformation relationship under the Lorentz transformation formula of special relativity. The equivalent conversion relationship can be illustrated as:

$$\begin{array}{ccccc}
[\frac{{}_1P'}{c'},\frac{{}_1E'}{c'^3}] & \begin{array}{c}\to\\ \nleftarrow\end{array} & [\frac{{}_3P}{c(\frac{c-c'}{c+c'})},\frac{{}_3E}{c^3(\frac{c-c'}{c+c'})}] & \Leftrightarrow & [r',t']\to[r,t] \\
\uparrow\ \downarrow & & \times\ \ \times & & \uparrow\ \downarrow \\
[\frac{{}_1P}{c},\frac{{}_1E}{c^3}] & \begin{array}{c}\to\\ \nleftarrow\end{array} & [\frac{{}_3P'}{c'(\frac{c'-c}{c'+c})},\frac{{}_3E'}{c'^3(\frac{c'-c}{c'+c})}] & \Leftrightarrow & [r,t]\to[r',t']
\end{array}\qquad(8)$$

Both "$\nleftarrow$" and "×" above indicate that conversion is not possible. We noticed that all conversions are $[\frac{{}_1P}{c},\frac{{}_1E}{c^3}]$ transform to $[\frac{{}_3P}{c(\frac{c-c'}{c+c'})},\frac{{}_3E}{c^3(\frac{c-c'}{c+c'})}]$, no matter whether it is $S\to S'$ or $S'\to S$; the transformation of $[\frac{{}_3P}{c(\frac{c-c'}{c+c'})},\frac{{}_3E}{c^3(\frac{c-c'}{c+c'})}]$ to $[\frac{{}_1P}{c},\frac{{}_1E}{c^3}]$ does not happen. For this conversion situation between the first collocation (Eq. (1)) and the third collocation (Eq. (3)), it is easy to understand as long as the comparison (Fig. 1) and use the principle of the lower the energy the more stable. The most interesting thing is that in the generalized special theory of relativity, there is no direct transformation between $[\frac{{}_3P}{c(\frac{c-c'}{c+c'})},\frac{{}_3E}{c^3(\frac{c-c'}{c+c'})}]$ and $[\frac{{}_3P'}{c'(\frac{c'-c}{c'+c})},\frac{{}_3E'}{c'^3(\frac{c'-c}{c'+c})}]$, nor is it interlinked by the transition between $[\frac{{}_1P}{c},\frac{{}_1E}{c^3}]$ and $[\frac{{}_1P'}{c'},\frac{{}_1E'}{c'^3}]$; but there are two non-coexisting ways in which $[\frac{{}_1P}{c},\frac{{}_1E}{c^3}]$ transform from S to S', the same goes for $[\frac{{}_1P'}{c'},\frac{{}_1E'}{c'^3}]$ from S' to S.

It is worth noting that when $(c'-c)$ is negative, ${}_3E'$ is the lowest, that is, ${}_3E'$ is below any ${}_1E$, ${}_2E$, ${}_3E$ of the same value of speed u. In the unidirectional conversion of the diagram of equation (8), It cannot be considered that the denominator $(\frac{c'-c}{c'+c})$ of ${}_3E'$ should be eliminated by the factor $(\frac{c'-c}{c'+c})$ of ${}_3E'$ itself in the formula (3'). Because ${}_3E'$, m_S and ${}_3P$ in formulas (3) and (3') exist as a collocation of physical quantities under the permission of the special theory of relativity. The coefficients attached to P and E in the vector transposition in four dimension space-time space are all as the coordination of the analysis and understanding of Riemann geometry. Therefore, the real physical world allows without increasing $m'=\frac{m_0}{\sqrt{1-u'^2/c'^2}}$ which is originally light in mass, to exist as a moving mass with a low energy of negative ${}_3E'=\frac{m_0(\frac{c'-c}{c'+c})\ c'^2}{\sqrt{1-\frac{u'^2}{c'^2}}}$. This is different from the lower part of the E_2 curve on (Fig. 1), that is accompanied by a decrease in energy and an increase in mass.

Of course, in the special theory of relativity with variable speed of light where (c,c'), $[b=c(\frac{c-c'}{c+c'}),b'=\pm c'(\frac{c'-c}{c'+c})]$, $[b(\frac{b-b'}{b+b'}),\pm b'(\frac{b'-b}{b'+b})]$ ..., etc. lower the upper limit speed successively, which also allow the become larger mass $m=\frac{m_0}{\sqrt{1-\frac{u^2}{c^2}(\frac{c+c'}{c-c'})^2}}$ to exist in the state of the lower lower-level energy ${}_3E'=\frac{m_0b'^2(\frac{b'-b}{b'+b})}{\sqrt{1-\frac{u'^2}{c'^2}(\frac{c'+c}{c'-c})^2}}$ that is more negative; and it is in the state of motion, that is, u' is small and $u'\neq 0$. This seems to have explained a lot of real physical problems, from the attachment of positive and negative electrons to nucleons or mesons, baryons, or superconductors, to the interior of white dwarfs, and so on.

3 Upgrade and downgrade of the complete special relativity system

According to the above-mentioned three types of collocations of mass, energy and momentum in the "ontology" and their transformation relations, it is possible to explore the law of upgrading and downgrading of the complete special relativity system.

Let $c > c'$, $b = c(\frac{c-c'}{c+c'})$, $b' = c'(\frac{c'-c}{c'+c})$; then $\frac{b-b'}{b+b'} = \frac{c+c'}{c-c'}$, $b(\frac{b-b'}{b+b'}) = c$, $b'(\frac{b'-b}{b'+b}) = c'$ .Therefore, in the special theory of relativity that successively lowers the upper limit speed, as long as $b' < 0$, continuing to lower the upper limit speed will not work automatically, When it continues to lower for the second time, it will automatically restore the special theory of relativity back to the beginning. On the contrary, if $b' = -c'(\frac{c'-c}{c'+c}) = c'(\frac{c-c'}{c+c'})$ is taken, then $\frac{b-b'}{b+b'} = \frac{c-c'}{c+c'}$, $b(\frac{b-b'}{b+b'}) = c(\frac{c-c'}{c+c'})^2$, $\pm b'(\frac{b'-b}{b'+b}) = \mp c'(\frac{c-c'}{c+c'})^2$. This is the situation of continued reduction of the absolute value of the upper limit speed. We call the rise and fall of the upper limit speed in the special theory of relativity as the upgrade and downgrade of the special theory of relativity.

Can you be sure that the current stage dominated by the traditional special theory of relativity is the highest grade? That is: how can guarantee that are not $c = a(\frac{a-a'}{a+a'})$ and $c' = a'(\frac{a-a'}{a+a'})$? The extended special theory of relativity allows $c \neq c'$, It successfully forge traditional general relativity into the form of special relativity. It makes the mass body speed addition in S and S' to add from small to large to c and c', respectively. It makes the de Broglie wave-particle velocity relation in S and S' have true and exact corresponding forms of $uw = c^2$ and $u'w' = c'^2$ respectively, and also makes the addition of the mass wave phase velocity to add from large to small to c and c' respectively. These are detailed in [3]. All the results have made great progress than the traditional special theory of relativity. But the more important progress is: The special theory of relativity forms a self-contained system that can not only decrease the upper limit speed in S and S' according to the proportion of $b = c(\frac{c-c'}{c+c'})$ and $b' = c'(\frac{c-c'}{c'+c})$ respectively as in the deduction (5); it can also rises them according to the proportion of $b = c(\frac{c-c'}{c+c'})$, $b' = c'(\frac{c'-c}{c'+c})$, $b(\frac{b-b'}{b+b'}) = c$ and $b'(\frac{b'-b}{b'+b}) = c'$ as indicated above. All the previous arguments and details can be used in the complete system of special relativity at each stage after this rise and fall, and it is equipped with the three types of "ontology" collocations of mass, energy and momentum and their transformation relationships. It greatly broadens the way to understand modern physics from a classical theory. Because since the downgrade has no bottom, the upgrade must also be endless. Not only does the sentence "electron is infinitely divisible" have a scientific basis, it is no longer just a philosophical saying that cannot be refuted. It can also wait and see that the currently hidden "superluminal physics" will eventually be discovered, and make human civilization a great breakthrough. This prediction does not at all contradict A.

Einstein's special theory of relativity, because he said that the speed of light in a vacuum cannot be exceeded, just as the upper limit speed in each complete system of special relativity cannot be exceeded.

Mastering the laws of upgrading and downgrading the complete system of special theory of relativity can make a qualitative understanding to the laboratory knowledge accumulated and the many scattered discourses in modern physics under the dominance of the theory of relativity. And then compare these qualitative knowledge with the existing relevant data to quantitatively calculate. And at last make answers and predictions to the inconclusive modern physics problems

4 Conclusion

Based on the special theory of relativity with variable speed of light (i.e. the general relativity in the special form), deduces and demonstrates the authentic existence of momentum and energy of a moving mass body in the three "ontology" collocation types, they all are matched to form a four-dimensional vector in a four-dimensional space. And discussed the transformation relationship between three sets of collocations in the inertial system S and S', and the law of upgrading and downgrading of forming a complete system of special relativity. In the face of a large amount of realistic data, when applying the three "ontology" collocation types of mass, energy and momentum and their transformation relations, we must emphasize several important points in our theory:

(1) The mass-velocity relationship of the traditional special theory of relativity is $m = \frac{m_0}{\sqrt{1-u^2/c^2}}$,the special relativity with variable speed of light also allows this relationship to exist (equivalent to $\alpha^2 = 1$); when $u = 0$, then $m = m_0$, this only shows that there is no contradiction with the basic assumption of the existence of m_0. The special relativity with variable speed of light has another step function solution (equivalent to $\alpha^2 \neq 1$) that does not coexist with the traditional solution. In which there are two mass values $m = \frac{m_0}{\sqrt{1-u^2/c^2}}$ and $m = \frac{m_0}{\sqrt{1-\frac{u^2}{c^2}(\frac{c+c'}{c-c'})^2}}$ for the same u; when $u = 0$, also $m = m_0$, but when $u = 0$ and $c = c'$, m and m_0 could not have definite relationship, that is, m is any value. In this case. ${}_2E$ also can be any value, but ${}_2E_0 = m_0 c^2 (\frac{c-c'}{c+c'})^2 = 0$ is definite. Therefore, for the step function solution, when a moving mass body is at rest, its mass and energy could not be measured, although its rest energy is definitely zero.

(2) The mass-velocity relationship in traditional special relativity is $m=\frac{m_0}{\sqrt{1-u^2/c^2}}$ and $m'=\frac{m_0}{\sqrt{1-u'^2/c^2}}$ in *S* and *S'* respectively, so $m=m'$ is only when $u=u'$. But in the traditional special theory of relativity, due to speed transformation, when the mass body velocity in *S* is *u*, the mass body velocity *u'* in *S'* is not equal to *u*. So consider the speed changes of the moving mass, the value of *m* measured at a certain time and in a certain place in *S* is not equal to the value of *m'* measured when this place and time are transformed to a corresponding place and time in *S'* according to the Lorentz conversion formula. The so-called "materialism" should be based on the mass value of the mass body, take the mass value of the mass body as the main body. When the same mass value is measured in *S* and *S'*, the corresponding location time coordinate is not the corresponding location time coordinate transformed by the Lorentz conversion formula. In other words, when the value of *m* at a certain time and place in *S* is exactly equal to the value of m' at another time and place in *S'*, transform the time and place of *S'* to another corresponding time and place in *S* according to the Lorentz conversion formula, the value of *m* in *S* has changed, because its *u* has changed. Therefore, if the masses of the mass body are arranged in the order of recognition, the recognizing of *S* and *S'* are not synchronous coordination, but make a differentiated recognizing of the changing stage of movement nature (including u) of the motion mass body. The special theory of relativity with variable speed of light allows $c \neq c'$, it make the above difference more prominent. Recognizing that *S* and *S'* are both inertial coordinate systems attached to different stages of motion of the moving mass itself, the condition of $c \neq c'$ for different circumstances can be multifaceted, such as the acceleration of moving mass, different media, electromagnetic fields, force fields, etc.; the descriptions of *S* and *S'* on the different stages of motion nature of the attached motion mass body are actually their own expressions of these different stages of motion nature. This is the "ontology" that we emphasized, which means that the three collocations (1), (2) and (3) of mass, momentum and energy are existence on the "ontology", and the only unified dominating theory is the developed special relativity of variable speed of light. This is actually the realization of the mutual correspondence between the flat Euclidean space at each point of a motion curve in the four-dimensional Riemann space of the traditional general relativity, and it is realized in terms of the realistic collocation of mass, momentum and energy. This realization avoids the so-called 'intrinsic factors' that may exist between the two transitions of the nature of the movement. It is equivalent to avoiding all kinds of "forces", avoid all kinds of "fields" dressed up from Newton to modern Yukawa, Yang-Mills, etc. It also avoids the aerial mathematics castle of Riemannian geometry that A. Einstein sighs that he has not yet solved it, and even avoids supergravity theory, superstring theory, and M theory. Summarize everything to the numerical values represented by c and c', along the approachable special theory of relativity approach, use the values of mass, momentum and energy that should be matched together on the "ontology" to understand and explain the various existing moving masses and real physical problems that we face.

(3) If we separate the *S* and *S'* attached to the moving mass in the two different

stages of motion nature, and use a single self-to-self method for isolated understanding for *S* or *S'*, it will inevitably fall into the situation of no progress so far as described in (1) . Therefore, the way of research is to tap on both sides of *S* and *S'*. That is in *S* to explore the situation of the moving mass body in *S'*, in *S'* also to explore the situation when it is in *S*. Both sides use the energy-momentum four-dimension vector to convert each other as a guide according to the three type of collocations of mass, momentum and energy. That is, the transformation of energy-momentum four-dimension vector between *S* and *S'*, as same as the Lorentz transformation of space-time coordinates. This will inevitably change the situation in which the theory of relativity only shoulders a single mass-energy formula to enter and exit the modern physics market .

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Dong Zhonglin (1907-1976), one of the second batch international students in 1934 that scholarship supported by the Gengzi Indemnity of Sino-British. Received a doctorate degree from Cornell University in 1937. He has taught at Northwest Associated University, Guangxi University, Fudan University, Nanjing University, Tongji University, Wuhan Institute of Surveying and Mapping and other institutions. Unfortunately, he died of a sudden cardiac infarction in his residence at Fudan University on April 27, 1976. With deep memory and admiration for Mr. Dong Zhonglin, the author of this article releases the research results to commemorate this forefather's pursuit and exploration of scientific truth.

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