The Special theory of relativity in different media (Ø)

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Research Article

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The Special theory of relativity in different media(II)

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Abstract

This paper analyzes the problems and contradictions that occur when the traditional special theory of relativity which uses the speed of light in a vacuum as an invariant constant, studies the propagation of light in media. These problems are re-examined and discussed with the special theory of relativity of variable speed of light. The transformation relationship of the characteristic quantities describing light wave frequency ν , phase velocity w and the direction angle α of the wave normal between the two inertial coordinate systems in vacuum S and in medium S' were derived; combining the transformation of the light ray speed u which describes light granular motion, the de Broglie wave-particle velocity relationship in the vacuum $uw = c^2$ is extended to the medium to become $u'w' = c'^2$. Corrected the approach of the traditional special theory of relativity when dealing with these problems, in which the transformation from the space-time coordinates to the relevant physical quantity is limited to the half-sided transformation of the media S' into the vacuum S (not two sided transformation), so that the resulting contradictions and problems are all solved. Optical experiments that support the traditional special theory of relativity, such as the Fizeau experiment and the Michelson-Morley experiment, not only still support and agree with the generalized special theory of relativity with variable speed of light, but also obtain a more correct and satisfactory interpretation from it.

Key words: Propagation of light in media; The transformation of the characteristics of the light wave between vacuum and medium; The de Broglie wave-particle velocity relation in the vacuum and the media; the Fizeau experiment; the Michelson-Morley experiment;

1 Introduction

The traditional special theory of relativity using the speed of light in a vacuum c as an invariant constant is only suitable for dealing with the physical problems of the two inertial coordinate systems S and S' in vacuum. It not only restricts the discussion

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of the problem of the transformation of two inertial coordinate systems in different media and the related physics problems about relativity in different media (or in vacuum and media), even such problems in the same media can promote disorder, and these problems are unavoidably encountered in reality. The value of the speed of light c measured in the inertial coordinate system S on the water surface and the value of the speed of light c' in the inertial coordinate system S' in the water must not equal to each other. When one view down vertically from S looking at the instantaneous angular velocity of the origin of S' in the water, it is in line with the relation of the sine ratio of the refraction, that is, the relationship between c and c' . Making the water surface bisect the distance between the two origins of S and S' , then the relationship $-\frac{v}{c} = \frac{v'}{c'}$ is indeed established. Therefore, for any instant, the transformation relationship between S and S' is really a special relativistic transformation relationship in different media. The same is true of the time measurement and time service in a star passing through the zenith that were mentioned in the previous article [1]. Considering the knowledge about the material of modern interstellar space, modern quantum field theory, problems such as electron clouds in atoms and nuclei, the so-called "vacuum" does not exist. Therefore, the special theory of relativity in different media is a theory that should be thoroughly discussed and accurately established.

When dealing with these problems the traditional special theory of relativity chooses the unconvincing method limited to the half-sided transformation (rather than two-sided). That is, the transformation from coordinates to the relevant physical quantity is limited to from the medium S' to the vacuum S , and the faults arising from the transformation of S to S' are hidden from view. This naturally maintain the relations $c = c'$, $v = -v'$ and $\tau = \tau'$, and never understand the true relations $\frac{v}{c} = -\frac{v'}{c'}$ and $c\tau = c'\tau'$. So forget that the transformation relationship of the theory of relativity must be through both $S \rightarrow S'$ and $S' \rightarrow S$, that is, the results of "reverse transformation" and "solution of the original transformation" must be the same and unified. The resulting problems and contradictions in mechanical form have not attracted enough attention.

Chapter II of "The Theory of Relativity" by C. Møllre is a typical example of the special theory of relativity with a half-side transformation. [3] The book regards the travel of light waves or photons in the medium as a physics problem handled in the inertial system S in a vacuum. But at the beginning, it must use another inertial system S' of the vacuum tightly bound to the medium to write the propagation equation of a beam of light emitted from the common origin o (o') of S and S' in the system S' : $x'^2 + y'^2 + z'^2 - w'^2 t'^2 = 0$, $w' = \frac{c}{n} \neq c$; Then apply the coordinates transformation formula of traditional special relativity to transform this equation from the system S' to the system S , which becomes the formula (II 75) in the literature [2]:

$$(x-at)^2/b + y^2 + z^2 - bw'^2t^2 = 0 \quad ; \quad a = v \frac{1-w'^2/c^2}{1-v^2w'^2/c^4}, \quad b = \frac{1-v^2/c^2}{1-v^2w'^2/c^4},$$

Through such a transformation relationship the light waves propagating in the moving medium are converted into the processing objects within the system S of the vacuum. This light propagation equation is obviously not the real light propagation equation in the system S , because the system S is in a vacuum, and the light propagation equation seen really in the system S should be $x^2 + y^2 + z^2 - c^2t^2 = 0$. But when S and S' have no relative motion $v = 0$, $a = 0$, $b = 1$, the above equation (II 75) becomes $x^2 + y^2 + z^2 - w'^2t^2 = 0$. This equation can only be said the equation of light propagation in the S' system assumed from the point of view of the system S . It is neither the light propagation equation really in the system S nor the light propagation equation really in the system S' (because the space-time coordinates of the system S are used). On the other hand, the light propagation equation in the system S is $x^2 + y^2 + z^2 - c^2t^2 = 0$, if we apply the transformation formula of traditional special theory of relativity transforming this equation from the system S to the system S' , it becomes $x'^2 + y'^2 + z'^2 - c^2t'^2 = 0$. This is obviously not the light propagation equation seen by the system S' of the medium (because the speed of light in the medium is not c). The relative motion of S and S' (it is not necessary to assume who moves and who does not move) leads to a completely asymmetric description of the same beam of light. This is a clear violation of the relativistic principle of relativity.

This contradictory result occurs because the coordinate transformation formula of the traditional special theory of relativity used here is derived from $x^2 + y^2 + z^2 - c^2t^2 = 0$ and $x'^2 + y'^2 + z'^2 - c^2t'^2 = 0$. The latter is the foundation of the traditional special theory of relativity. Using relativity to deal with a physics object expressed in equations that does not conform to this foundation, how reluctant and accommodating can be imagined. The resulting contradictions are conceivable. Later in the book, when calculating the transformation relationship of the energy propagation speed of light u (i.e., the photon motion speed) and of the wave surface of light wave propagation speed w between S and S' systems, only $S' \rightarrow S$ one side of the Lorentz transformation formula is applied to transform the relevant physical quantities from the medium to vacuum; avoid the application of inverse transformation $S \rightarrow S'$. So you can avoid $x'^2 + y'^2 + z'^2 - c^2t'^2 = 0$ in the medium, In order to avoid conflict with $x'^2 + y'^2 + z'^2 - w'^2t'^2 = 0$ ($w' = \frac{c}{n} \neq c$) of the physical object. In fact, according to the positive and reverse coordinates transformation of the traditional special theory of relativity, it is easy to find the positive and reverse transformation of the ray speed u and u' representing photon motion, and of the

speed of wave surface w and w' between systems S and S' . However, C.Møllre tried every possible way to use this $S' \rightarrow S$ one-sided transformation (rather than two-sided) of traditional special theory of relativity, and his work was very meticulous. Such as (1): When he derived the formula representing the direction angle of wave

surface propagation velocity in S $\tan \alpha = \frac{\sin \alpha' \sqrt{1 - v^2 / c^2}}{\cos \alpha' + vw' / c^2}$ (i.e. formula (II 77)

in literature [2]), he clearly stated that he used the "inverse equation" of

$\tan \alpha' = \frac{\sin \alpha \sqrt{1 - v^2 / c^2}}{\cos \alpha - vw / c^2}$ (formula (II 71) in [2]). The word "inverse" refers to

the inverse meaning of the Lorentz transformation formula of the special theory of relativity, i.e. the inverse transformation. Since he deduced the formula (II 71) in literature [2] explicitly by used the transformation of $S \rightarrow S'$, after this "inverse", it is equal to that the formula (II 77) is deduced by used the transformation of $S' \rightarrow S$. (2): When he derived the formula for the speed of light propagation u representing the photon motion in the S system

$$u = \frac{u' \sqrt{1 - v^2 / c^2} \sqrt{1 - v^2 / u'^2 + v^2 \cos^2 \theta / u'^2 (1 - u'^2 / c^2)} + v \cos \theta (1 - u'^2 / c^2)}{1 - v^2 / c^2 + v^2 \cos^2 \theta / c^2 (1 - u'^2 / c^2)}$$

(formula(II 86) in literature [2]), Said that it was obtained by solving him

$$u' = u \frac{\sqrt{1 - 2v \cos \theta / u + v^2 / u^2 - v^2 \sin^2 \theta / c^2}}{1 - uv \cos \theta / c^2} \quad \text{(formula (II 47) in [2]), and was not}$$

expressed by its "inverse equation", that is, it was not obtained by the inverse transformation. It turned out that his formula (II 47) was derived using the transformation of $S' \rightarrow S$; so this time he had to use the "solution" of (II 47) to avoid using the reverse transformation $S \rightarrow S'$.

Despite this careful treatment of the problem of light wave travel in the medium with the traditional special theory of relativity, inevitably, there are still formal contradictions that cannot be concealed. C.Møllre concluded in the book: (1) The shape surface of light wave emitted from the origin is seen as a spherical surface in the S' system of the moving medium, and the light ray coincide with the normal of the wave surface, that is to say, the direction of light propagation speed representing photon motion and the direction of wave surface propagation speed representing wave motion are the same. In the S system, the shape surface of light wave is no longer a spherical surface, and its curve of intersection with the xy -plane is an ellipse. The light ray and the normal of the wave surface no longer coincide, so in the S system, the direction of the light propagation velocity representing the photon motion and the direction of wave surface propagation speed representing the wave motion is different. (2) If the de Broglie wave-particle velocity relationship is established in the system S , that is, $uw = c^2$; then there is also in the system S' $u'w' = c^2$. Careful analysis can reveal that these two conclusions are contradictory. First of all, when dealing with the transformations between system S in a vacuum and system S' in a

medium using the traditional special theory of relativity, the results obtained from the "solving" of the transformation $S' \rightarrow S$ and from the inverse transformation $S \rightarrow S'$ (i.e. the "reverse" transformation of $S' \rightarrow S$) are not uniform. If the direction angle θ of the light propagation speed representing the photon motion in the S system is obtained not by solved from the transformation of $S' \rightarrow S$, but is obtained by the

inverse transformation $S \rightarrow S'$, then it is $\tan \theta = \frac{\sin \theta' \sqrt{1 - v^2 / c^2}}{\cos \theta' + v w' / c^2}$, consider

that there is also " $u'w' = c^2$ " in the system S' , after substituting it and comparing with

$\tan \alpha = \frac{\sin \alpha' \sqrt{1 - v^2 / c^2}}{\cos \alpha' + v w' / c^2}$, obviously, if it is $\alpha' = \theta'$ in the system S' , then there

is also $\alpha = \theta$ in the system S . That is to say, in the system S , the direction of light propagation velocity representing photon motion and the direction of wave surface propagation velocity representing wave motion are also the same. This obviously contradicts the results obtained by C. Møller in his book! He carefully chose the approach of one-sided transformation $S' \rightarrow S$ to deal with the traveling of light waves in the medium under the relativistic signboard, concealing the above-mentioned conclusions $\alpha = \theta$. He never thought that this problem could not be dealt with by the traditional special theory of relativity. According to the conclusion he got, looking at the elliptical Huygens traveling wave group in the moving medium is the result of the mechanical imagination of the blind man touching the half of the elephant. In addition, C. Møller introduced the De Broglie wave-particle velocity relationship to the theory of relativity, and only explicitly wrote: If there is $uw = c^2$ in the S system, then there

is also $u'w' = c^2$ in the S' system, and no detailed proof of this major conclusion has been made. In fact, this is easily verified by the speed transformation relationship of relativity. But he didn't do it, it turned out that he hit the wall! His formula (II 73) is

$w' = \frac{c}{n}$ clearly; his formula (II 87) is $u' = \frac{c}{n}$ clearly; so his $u'w' = \frac{c^2}{n^2} = c'^2 \neq c^2$. Faced

with such an apparent contradiction form that cannot be concealed, why it not be explained. This shows that the traditional special theory of relativity does have limitations when dealing with physics problems in different media (or vacuum and media).

In the previous article [1], the author has established the main basis of the special theory of relativity in different media (or with variable speed of light). The formulas of

the space-time coordinates transformation and basic relationships $\frac{v}{c} = -\frac{v'}{c'}$, $c\tau = c'\tau'$

have obtained, so that real physics can be objectively observed and recognized through multiple channels and more ways to understand. This article will use the results of the previous article [1] to discuss the propagation of light in the vacuum and

the medium. First, we derive the transformation relationship of the phase velocity of the light wave between the two inertial coordinate systems in the vacuum S and in the medium S' . Combined with the transformation formula of the particle motion velocity obtained in the previous [1], the de Broglie wave-particle velocity relationship

$wu = c^2$ in the vacuum system S is extended to $w'u' = c'^2$ in the medium system S' , so that in different media, it does not violate the relativistic principles that physics laws exist objectively departing from the observation coordinate system. Finally, the theory of this paper is used to review the optical experiments in detail. Not only all optical experiments that have supported the traditional special theory of relativity, but also support the special theory of relativity in different media after the promotion; and the use of the special theory of relativity in different media after the promotion can make these optical experiments get a more correct and satisfactory interpretation.

2 Transformation of wave propagation characteristics

Let S is the inertial coordinate system in vacuum, S' is the inertial coordinate system in medium; the x -axis and x' -axis of the two coordinate systems are parallel, and the two origins coincide when $t = t' = 0$. They move relative to each other along the x -axis. The velocity of S' observed in system S is v , and the speed of light is c ; the velocity of S observed in system S' is v' , and the speed of light is c' .

The space-time coordinate transformation between S and S' had been derived in [1]; where the transformation formula for $S' \rightarrow S$ is:

$$\begin{aligned} x' &= \frac{x - vt}{\sqrt{1 - v^2/c^2}} \\ y' &= y \\ z' &= z \end{aligned} \quad (1)$$

$$t' = \frac{c}{c'} \frac{t - \frac{v}{c^2}x}{\sqrt{1 - v^2/c^2}}$$

And the transformation formula for $S \rightarrow S'$ is:

$$\begin{aligned} x &= \frac{x' - v't'}{\sqrt{1 - v'^2/c'^2}} \\ y &= y' \\ z &= z' \end{aligned} \quad (2)$$

$$t = \frac{c'}{c} \frac{t' - \frac{v'}{c'^2}x'}{\sqrt{1 - v'^2/c'^2}}$$

According to the relativistic relative relationship, the only condition that the (x, y, z, t) solving from the transformation formula (1) is exactly the same as the inverse transformation formula (2) is:

$$\frac{v'}{c'} = -\frac{v}{c} \quad (3)$$

Suppose there is a traveling plane monochromatic wave in S , the wave surface normal $\vec{n}$ is on the xy plane of S , and the angle to the x axis is α , the wave frequency is ν , and the wave surface travel speed (phase velocity) is w ; then the function describing the wave can be expressed as:

$$\Psi = A \cos(2\pi F)$$

$$F = \nu \left(t - \frac{x \cos \alpha + y \sin \alpha}{w} \right) = \nu \left(t - \frac{l}{w} \right) \quad (4)$$

F is the phase function of the wave, or wave phase for short; l is the distance from the origin to the point $P(x, y)$ which wave surface passing through.

In the system S' , the wave function can also be expressed as:

$$\Psi' = A' \cos(2\pi F')$$

$$F' = \nu' \left(t' - \frac{x' \cos \alpha + y' \sin \alpha}{w'} \right) = \nu' \left(t' - \frac{l'}{w'} \right) \quad (5)$$

According to the simplest theorem of physics from the perspective of relativity, the phase function of a wave is invariant in different coordinate transformations:

$$F = \nu \left(t - \frac{x \cos \alpha + y \sin \alpha}{w} \right) = \nu' \left(t' - \frac{x' \cos \alpha + y' \sin \alpha}{w'} \right) = F' \quad (6)$$

Now using equation (2), transform the space-time coordinates in the S system on the left side of equation (6) into the system S' , and note that $y = y'$, and then compare the coefficients of t' , x' and y' ; then The transformation relationship of frequency ν , phase velocity w and wave surface normal direction α are obtained:

$$\frac{\nu'}{c'} = \frac{\nu}{c} \frac{1 - \frac{v \cos \alpha}{w}}{\sqrt{1 - v^2/c^2}} \quad \frac{\nu' \sin \alpha'}{w'} = \frac{\nu \sin \alpha}{w} \quad (7)$$

$$\tan \alpha' = \frac{\frac{\sqrt{1 - v'^2/c'^2} \sin \alpha}{\frac{w\nu'}{cc'} + \cos \alpha}}{\frac{\sin \alpha \sqrt{1 - \frac{v^2}{c^2}}}{\cos \alpha - \frac{v w}{c^2}}} \quad (8)$$

$$w' = \frac{\frac{c'}{c} w + v' \cos \alpha}{\sqrt{1 - v'^2 \sin^2 \alpha / c'^2 + w^2 v'^2 / c^2 c'^2 + 2 w v' \cos \alpha / c c'}} \quad (9)$$

when $\alpha = 90^\circ$, then:

$$v' = \frac{(\frac{c'}{c})v}{\sqrt{1 - \frac{v'^2}{c'^2}}} , \quad w' = \frac{(\frac{c'}{c})w}{\sqrt{1 - \frac{v'^2}{c'^2}(1 - \frac{w^2}{c^2})}} , \quad \tan \alpha' = \frac{cc'}{wv'} \sqrt{1 - \frac{v'^2}{c'^2}} \quad (10)$$

When $\alpha = 0^0$, then:

$$v' = \frac{(\frac{c'}{c} + \frac{v'}{w})v}{\sqrt{1 - \frac{v'^2}{c'^2}}} , \quad w' = \frac{(\frac{c'}{c})w + v'}{1 + \frac{wv'}{cc'}} , \quad \alpha' = \alpha = 0^0 \quad (11)$$

In equations (9), (10) and (11), if taken $w = c$, then $w' = c'$; if taken $v' = c'$, then $w' = c'$.

3 De Broglie wave-particle velocity relationship in different media

Light has wave-particle duality. According to the de Broglie hypothesis, the physical quantities that characterize granular properties (such as energy E , momentum P), and the physical quantities that characterize wave properties (such as wavelength λ , frequency ν) satisfy the relationship: $E = h\nu$, $P = \frac{h}{\lambda}$, h is the Planck

constant. Phase velocity of de Broglie wave $v_p = \nu\lambda = w$, which is the phase velocity of

wave surface propagation w . Group velocity $v_g = \frac{d\nu}{d(\frac{1}{\lambda})} = \frac{dE}{dP} = u$, which is the velocity

of light ray u representing the photon movement.

There is a traveling light wave in the system S , the speed of its wave-like motion (phase speed) is w , and the speed of its granular motion (ray speed) is u . Due to

$w = \nu\lambda = \frac{E}{h} \frac{h}{P} = \frac{E}{P} = \frac{mc^2}{mu} = \frac{c^2}{u}$, the wave-particle speed satisfies the relationship:

$$wu = c^2 \quad (12)$$

In the system S' that moves relative to the system S (the system S' can of course be in an isotropic non-dispersive uniform medium), the de Broglie wave-particle velocity relationship can be obtained by the transformation of the wave surface propagation phase velocity w and the granular motion velocity u between S and S' . The transformation relationship of wave surface propagation phase velocity w is (8) and (9).

The transformation relationship of the granular motion velocity u had been obtained in the previous article [1]. If the particle motion is on the xy plane, $\vec{u}$ and $\vec{u}'$ are perpendicular to the z -axis, and their angles to the x -axis are θ and θ' respectively, then

$$u' = u \left(\frac{c'}{c} \right) \frac{\sqrt{1 - 2v \cos \theta / u + v^2 / u^2 - v^2 \sin^2 \theta / c^2}}{1 - uv \cos \theta / c^2} \quad (13)$$

$$\tan \theta' = \frac{\sin \theta \sqrt{1 - v^2 / c^2}}{\cos \theta - v / u} \quad (13a)$$

If the direction of the granular motion velocity in the system S is the same as the normal direction of the wave surface propagation:

$$\theta = \alpha \quad (14)$$

Noticed $\frac{v}{c} = -\frac{v'}{c'}$, and according to (12), there are $w = \frac{c^2}{u}$, then formula (8) can be changed to formula (13a), namely:

$$\tan \alpha' = \frac{\sqrt{1 - v'^2 / c'^2} \sin \alpha}{\frac{wv'}{cc'} + \cos \alpha} = \frac{\sqrt{1 - v^2 / c^2} \sin \theta}{\frac{c^2 v'}{c'cu} + \cos \theta} = \frac{\sqrt{1 - v^2 / c^2} \sin \theta}{\cos \theta - \frac{v}{u}} = \tan \theta'$$

And so

$$\theta' = \alpha' \quad (14a)$$

Substitute $w = \frac{c^2}{u}$, $\theta = \alpha$ and $\frac{v}{c} = -\frac{v'}{c'}$ into (9), after a simple calculation, you get

$$w' = \frac{c'^2 (1 - \frac{uv}{c^2} \cos \theta)}{u \left(\frac{c'}{c} \right) \left[1 - \frac{2v}{u} \cos \theta + \frac{v^2}{u^2} - \frac{v^2}{c^2} \sin^2 \theta \right]^{\frac{1}{2}}}$$

Comparing formula (13), we have:

$$w'u' = c'^2 \quad (15)$$

Equation (15) is the de Broglie wave-particle velocity relationship in the system S' . It shows that the de Broglie wave-particle velocity relation $wu = c^2$ in the system S of

vacuum can be extended to the system S' of media to become $w'u' = c'^2$, let it do not violate the principle of relativity, i.e. physics laws exist objectively separated from the observation coordinate system of different media. Equations (14) and (14a) show that if the velocity direction of the granular motion coincides with the wave surface propagation normal direction of the wave motion in the system S , then they also coincide in the system S' ; this coincidence is not different due to the difference of inertial coordinate system, even in different media. This naturally solves the difficulties and contradictions encountered when C.Møller uses traditional special relativity to deal with the travel of light waves in a moving medium or the propagation of light energy with photons.

It is necessary to further comment on the above results. c (or c') is regarded as the "upper limit speed" of the "speed group" observed in S (or S'), that is, the "upper limit value" that can be reached added by the special speed addition in the theory of relativity. It does not contain any meaning that aside from this special non-Euclidean geometric vector addition, the physical world is not allowed to have a velocity value exceeding the "vector addition limit". Therefore, the theory of relativity and the de Broglie wave-particle velocity relation are compatible with each other, which allows one of u and w (or u' and w') to be greater than c (or c'). The most obvious meaning is to discuss the equation (9) when $\alpha' = \alpha = 0$ and the equation (13) when $\theta' = \theta = 0$ in the parallel case: It is not only when $w < c$ (or $u < c$) is added to v' , although the more it increases, it can't add $w' > c'$ (or $u' > c'$); What's even more strange is that when $w > c$ (or $u > c$) is added to v' , it gets smaller and smaller, but it can't get $w' < c'$ (or $u' < c'$) by added. Straightforwardly multiply the equations (9) and (13), and take $uw = c^2$ among the four terms of the multiplication of the numerator and

denominator on the right, and then naturally get $u'w' = c'^2$ on the left. This take the "infinite" numerical meaning of mathematics of broken through Euclidean geometry vector addition to apply to the value of c (or c') in the inertial coordinate system S (or S') of reality observation from the two ends. That is: the theory of relativity allows De Broglie's views on the granular and wavy aspects of moving particles to coexist, which is consistent, not contradictory! The proof of the multiplication of the equations (9) and (13) emphasizes that this agreement has nothing to do with the speed of the inertial coordinate system, and is completely in line with the principle of relativity. It is quite clear from this that there is no need to add to the point that the speed of light in the special theory of relativity should be the energy propagation speed, not the phase propagation speed. There is also no need to doubt the basic question why the theory of relativity should hold up the speed of light. And there is no need to try to replace the speed of light with other kinds of speeds, to take a truly metaphysical approach and to establish other "new relativity" [3]. What we call "variable speed of light" means that c in the system S becomes c' in the system S' , but we still emphasize that c is a constant in S and c' is a constant in S' .

The importance of the problem far exceeds the above description. The main key of the special theory of relativity with variable speed of light popularized and reconstructed is: $\frac{v}{c} = \frac{v'}{c'}$ (omit the sign), which is $\frac{v}{v'} = \frac{c}{c'} = m$. m is a parameter existing between any two inertial coordinate systems S and S' , It depends on the values of the "limit speeds" c and c' respectively measured in the systems S and S' , that is, changes with S and S' ; the m between S and S'' is another value. This m is different from the usual n . The so-called "speed of light in the medium is $\frac{c}{n}$ " in general physics books and literatures that are all conceived or implemented from the viewpoint of a system S out of the medium to deal with physics problems. It is not equal to the self-determined value of c' in the system S' of the medium. The difference

between $\frac{c}{n}$ in the system S and c' in the system S' is not only based on the presence or absence of a medium, but more importantly is the difference between S and S' based on each include all "inertia" the space-time metrical unit used. The meaning of "inertia" has been fully explained in the previous article [1]. $u'w' = c'^2$ is to establish the de Broglie wave-particle velocity relationship in the system S' , which is the same as $uw = c^2$ in the system S ; $u'w' = \frac{c^2}{n^2}$ is the result of use the inertia metrical unit of the system S to verify this relationship in the system S' , indicating the fact that the value of the product of u' and w' for any moving particle in the system S' observed by the system S is always $\frac{c^2}{n^2}$. This is in line with the principle of the theory of relativity, that is, the laws in the system S' are also correct verified in the system S . It is correct not to care whether the value of $\frac{c^2}{n^2}$ in the system S is equal to the value of c'^2 in the system S' , but to care about the value of $\frac{c^2}{n^2}$ in multiple experimental observations in the system S is always the same $\frac{c^2}{n^2}$. The principle of relativity does not stop there. There should also be this de Broglie wave-particle velocity relation in the system S , that is: $uw = c^2$; It must be verified in the system S' as well $uw = \frac{c'^2}{n'^2}$, n is the value in the system S , and n' is the value in the system S' ; it is difficult to find the relationship between n and n' . In essence, it is the same reason as the inconsistency between the coordinate time and the proper time of uniform disappearance mentioned in [1]. This is the reason why "subjective knowledge" and "objective existence" can't be exactly the same. Therefore, we must carefully distinguish the so-called $\frac{c}{n} = c'$ in general books, and the c' we use in the system S' .

Now, taking the de Broglie wave-particle velocity relationship $u'w' = c'^2$ in the system S' as the main object, validated by each inertial coordinate system $S_1, S_2,$

$S_3, \dots$, we get $u'w' = \frac{c_1^2}{n_1^2}, u'w' = \frac{c_2^2}{n_2^2}, u'w' = \frac{c_3^2}{n_3^2}, \dots$. The relative meaning of the above

theory of relativity does not care that $\frac{c_i}{n_i}$ in each system S_i is equal to c' in system S' ,

and of course it cannot be interpreted as $\frac{c_1}{n_1} = \frac{c_2}{n_2} = \frac{c_3}{n_3} = \dots$. The important meaning

is that $n_1, n_2, n_3, \dots$ are a dimensionless physical property expression parameter of the system S' measured in $S_1, S_2, S_3, \dots$, respectively, (This is very different from the basic meaning that the "speed upper limit" value of the system S' is measured by $S_1, S_2, S_3, \dots$); according to the relative principle of the theory of relativity, what can be

judged should be: $n_1 = n_2 = n_3 = \dots$, and $\frac{c_1}{n_1} \neq \frac{c_2}{n_2} \neq \frac{c_3}{n_3} \neq \dots$. In this way, n

becomes the "universal constant", which is the "universal constant" for any inertial coordinate system to observe c' of a specific system S' . From Maxwell's electromagnetic theory $n = \sqrt{\epsilon_1 \mu_1} = \sqrt{\epsilon_2 \mu_2} = \sqrt{\epsilon_3 \mu_3} = \dots$, the "one is divided into

two" of n is the same as the most basic $c\tau = c'\tau'$, $\frac{v}{c} = -\frac{v'}{c'}$ (not $c = c'$, $\tau = \tau'$, $v = -v'$). Therefore, the Gaussian electromagnetic unit system still uses three basic dimensional units after integrating electromagnetics into mechanics. It is a serious mistake in theory to determine that $\epsilon_0 = \mu_0 = 1$ in a vacuum. A. Sommerfeld emphasized in Chapter I of "Theoretical Physics Volume III Electrodynamics" that the four basic physical dimension units of KMSQ should be used to show the "universal constant" meaning of n (rather than ϵ_0 or μ_0), which is very reasonable [4].

This makes the basic concepts of electromagnetism much clearer and easier to understand, and also encompasses all the electromagnetism of the Gaussian unit system. This is similar to our "variable speed of light" special theory of relativity, which is deeper and more realistic than the traditional special theory of relativity, and include all the traditional special theory of relativity without omission. A. Sommerfeld and we are the same. The theory of relativity involves all physics, and it is of course more meaningful to attack the whole physics from the most basic than to attack the corner of electromagnetics.

If you don't raise the theory of relativity, any physics book discusses physics of different categories only limited in one coordinate system S . This system S is any inertial system. If the physical details discussed are necessarily correct for any other system S' , there is no need for relativity. It is precisely because this "inevitability" cannot be encountered that the theory of relativity plays an important role. The application of the theory of relativity is mainly to identify the not exactly correct opinions of any two S and S' , to identify which subjective knowledge of S (or S') does not conform to the objective existence. Because you can't run in and out casually between S and S' , and can't directly in S and S' to observe and verify your knowledge respectively; therefore, you have to "imagine" or deduce in S that how it should be in

S' . In the system S we said that the $u' = w' = \frac{c}{n}$ of system S' has this meaning, it is neither u', w', c' of the S' , nor u, w, c of the S . The method of understanding physics has to be taken a step further by using the theory of relativity (mainly using the Lorentz transformation formula). Of course, this method of epistemology will never be perfect. The generalized special theory of relativity with variable speed of light is more efficient and effective than the traditional one. Because the latter takes $c = c'$ and $v = -v'$, it is itself a theory of relativity in S "imagining" S' . Therefore, for u', w', c' and $c' = \frac{c}{n}$

(which are all in S "imagining" S'), the $u'w' = c'^2$ cannot be obtained by using the traditional special theory of relativity (which must use the half-sided transformation of $S' \rightarrow S$); and there is no agreement between $\alpha' = \theta'$ and $\alpha = \theta$. However, this is better than only standing in one system S to discuss physics without using the theory of relativity. The theory of relativity cannot be completely defeated and abolished, and sometimes it is necessary to use it to compare transitions. The method of epistemology is inherently difficult and tortuous.

Finally, it is worth emphasizing that the propagation equation of a beam of light emitted from the common origin $O(O')$ of the system S and the system S' in the system S' is: $x'^2 + y'^2 + z'^2 - c'^2 t'^2 = 0$; and in the system S is: $x^2 + y^2 + z^2 - c^2 t^2 = 0$. These are two equations describing the objective and true laws of light propagation in the medium system S' and the vacuum system S respectively. It is easy to prove by applying coordinate transformation (1) and (2) that no matter whether they are transformed by $S' \rightarrow S$ or $S \rightarrow S'$, the result remains the same. This is more in line with the basic principles of the theory of relativity, showing that the objective and true light propagation equation does not change with different inertial coordinate systems.

4 Discussion about optical experiments

Now use the above conclusions to review the relevant optical experiments in detail. Not only all optical experiments that have supported the traditional special theory of relativity, they still support the special theory of relativity with variable speed of light; and the generalized special theory of relativity with variable speed of light can make more accurate and satisfactory interpretations for these optical experiments.

(1) H. L. Fizeau experiment [5]--[8]

This is an optical experiment to study the propagation of light in a moving medium done before the theory of relativity is put forward. The experiment layout is like (Fig. 1)

(Fig.1)

The light emitted by the light source L is divided into two beams by a beam splitter P and injected into a horseshoe-shaped glass tube. The water is stored in the tube, and the water can be controlled to be static or flow at a constant speed. Two opposing rays of light pass through the water with a distance of l , one is opposite to the direction of the water flow, and the other is the same direction of the water flow. When the water is still, the interference fringes are used to adjust the two opposite optical paths to be equal, and then make them slightly different by a few wavelengths to make the static interference fringes clear and obvious. Then let the water flow at a constant speed. Due to the change of the optical path difference of the two beams, the shift of the interference fringes can be observed and the shift value can be measured.

After the special theory of relativity was proposed, the interpretation of the experimental results does not require the assumption of the existence of "absolute system" and "ether" and their being dragged by the moving medium. The experimental results can be explained by the velocity transformation formula of relativity. When the water is still, the wave phase difference between the two paths of light passing through the water in the system S outside the glass tube and in the system S' in the water inside the glass tube are both:

$$\Delta F' = \nu' \left(\frac{l'}{c'} - \frac{l'}{c'} \right) = \nu \left(\frac{l}{c} - \frac{l}{c} \right) = \Delta F = 0$$

When water is flowing, according to the relativistic velocity transformation formula, the observer in the system S outside the glass tube observes that the speed of light flowing with the water in the glass tube is:

$$u = \frac{u' \pm v}{1 \pm \frac{u'v}{c^2}} = \frac{\frac{c}{n} \pm v}{1 \pm \frac{v}{nc}} = \left(\frac{c}{n} \pm v \right) \left(1 \mp \frac{v}{nc} \right) = \frac{c}{n} \pm v \left(1 - \frac{1}{n^2} \right) \quad (15)$$

In this way, when the water is flowing, the phase difference between the two light rays passing through the water should be observed in the system S outside the glass tube is:

$$\Delta F = \nu \left[\frac{1}{\frac{c}{n} - v \left(1 - \frac{1}{n^2} \right)} - \frac{1}{\frac{c}{n} + v \left(1 - \frac{1}{n^2} \right)} \right] = \frac{2\nu v}{c^2} (n^2 - 1) \quad (16)$$

This is consistent with the result of fringe shift obtained by experimental observation.

Because $\left(1 - \frac{1}{n^2} \right)$ is the so-called Fresnel dragging coefficient, it is easy to be misunderstood by classical kinematics. In fact, such a classical kinematics interpretation is only correct in the "absolute system", and it is incorrect in any system S .

Re-examination using the special theory of relativity of variable speed of light reveals that this explanation has obvious problems. First, take $u' = \frac{c}{n}$ in equation (15), as mentioned in the previous section, it is that the observer in the system S outside

the medium "imagines" the speed of light in the system S' in the stationary medium. The evidence is that when $v = 0$, $u = u' = \frac{c}{n}$. This shows that S and S' are actually in the vacuum outside the medium, as required by the traditional special theory of relativity, are all the inertial systems with the speed of light of vacuum as the upper limit speed. The system S' is not a real inertial system with the speed of light c' as the upper limit speed in the medium. It is supposed to be placed next to the medium and move with the medium at the same step. When the medium is static S' is also static, when the medium moves relative to S , and S' also moves relative to S at the same speed. Can such an arrangement be realized realistically? A pool of clear water on the ground that observed by the observers who leave the earth's gravitational field and stops in outer space is movement, but is stationary quiet to observers standing by the pool; cannot make people standing by the pool stop suddenly in outer space and suddenly return go to the pool. Therefore, it is unrealistic to use the inertial system S' with the speed of light in vacuum c as the upper limit speed to move with the medium step by step. Only when the inertial system S' with the speed of light c' of the medium as the upper limit speed is used, and it stops or moves with the medium together, can it truly be integrated with the medium and follow the same step. Secondly, the system S outside the glass tube observes the velocity value v of the system S' flowing with the water, which can not be equal to the velocity value v' of the system S observed by the S' system inside the water backward to; even if the former approaches zero according to $v_1, v_2, v_3 \dots$, the latter also approaches zero according to $v'_1, v'_2, v'_3 \dots$; there can only be reason to believe that the two speed approaching limit values zero are equal, not $v_1 = v'_1, v_2 = v'_2, v_3 = v'_3 \dots$. According to our special theory of relativity with variable speed of light, their relationship should be $\frac{v}{c} = -\frac{v'}{c'}$. Finally, we must face reality: what is happening is inside the medium, and the observed interference fringe shift is outside the medium.

Now use the variable speed of light special theory of relativity to make a correct explanation. Let S' and S'' be the two inertial systems in the water of the glass tube; S' is still in the water, and S'' moves with water. First, the system S' in still water and the system S'' in flowing water are treated by the theory of relativity. Because S' and S'' are both in the same medium of water, so there is $v' = -v''$, $c' = c''$; Here c' and c'' are the upper limit speed (speed of light) in S' and S'' respectively, v' and v'' are the S' and S'' observe the movement speed of the other party respectively. It should be noted that the value of c'' in S'' is not known in S' at all, by the observational metrical of the system S' to "imagine" and express the speed of light in the system S'' should be $\frac{c'}{n'}$; the so-called $v' = -v''$ and $c' = c''$ are all judgments out from of the system S' . The derivation similar to (15) can be obtained, the speed of light of flowing water u' measured in the system S' is:

$$u' = \frac{\frac{c'}{n'} \pm v'}{1 \pm \frac{v'}{n'c'}} = \frac{c'}{n'} \pm v' \left(1 - \frac{1}{n'^2}\right) \quad (17)$$

The positive sign is taken when the motion of the water and the light ray are in the same direction, and the negative sign is taken when the flow is reversed. Therefore, the measured phase difference of the two opposing rays of light in the S' system of still water is:

$$\Delta F' = \nu l' \left[\frac{1}{\frac{c'}{n'} - v' \left(1 - \frac{1}{n'^2}\right)} - \frac{1}{\frac{c'}{n'} + v' \left(1 - \frac{1}{n'^2}\right)} \right] = \frac{2\nu l' v'}{c'^2} (n'^2 - 1) \quad (18)$$

Where l' and ν' are the distance and frequency of light measured in the water in the system S' , respectively.

Since the observation of the interference fringe shift is in the laboratory coordinate system S outside the glass tube (outside the medium), the system S' in the medium must be transformed to the system S in the vacuum outside the medium by the theory of relativity. Because S and S' are at rest with each other, we can see from equation (13), the $\frac{v'}{c'}$ of S'' measured in the system S' is also the $\frac{v}{c}$ of S'' measured in the system S ; for the length and the frequency given by the previous formula (11), since $v' = 0$, it can be known that $l' = l$, $\frac{\nu'}{c'} = \frac{\nu}{c}$. In this way, the phase difference (18) in the system S' is expressed as the relevant quantity in the laboratory coordinate system S outside the glass tube (outside the medium):

$$\Delta F' = \frac{2\nu l v}{c^2} (n'^2 - 1) \quad (18a)$$

According to the experimental results, (18a) should be equal to the phase difference (16) between the two rays measured in the S system outside the glass tube:

$$\Delta F = \frac{2\nu l v}{c^2} (n^2 - 1) = \frac{2\nu l v}{c^2} (n'^2 - 1) = \Delta F'$$

In this way, the system S' does not have to abrupt static and motion with the water, which not only corrects the faults of the traditional interpretation, but also proves: $n' = n$.

As mentioned in the previous section, n' is the refractive index of water flowing in the system S'' measured by system S' (It is hard to turn around and say that it is the refractive index of water with S'' "still" together. Because of saying this, S'' have committed the problem of sudden changes in motion and static, which is not straightforward); n is the refractive index of water at rest in the system S' measured by any S system. Therefore, the refractive index $n = \sqrt{\epsilon\mu} = n'$ of any non-dispersion homogeneous medium does not change due to its moving speed; n is a "universal constant", and neither ϵ nor μ is a "universal constant". This problem of fundamental

physics, which has not been clearly understood and explained, is demonstrated by Fizeau experiment through the application of the special theory of relativity with variable speed of light.

(2) Michelson-Morley experiment [9]---[11]

This experiment is considered to be the basis for the establishment of the special theory of relativity, as shown in (Fig. 2).

(Fig. 2)

The light emitted by the light source L on the ground is divided into two perpendicular beams by the beam splitter P . The two beams are reflected back by the mirrors S_1 and S_2 , and then merged into the observation mirror T after passing through the beam splitter P . Interference occurs due to the optical path difference. To apply the theory of relativity to discuss this experiment, of course, one has to put aside the viewpoints of "etheric wind" and "absolute frame of reference". The main focus of the research is: the light is divided into two perpendicular beams by the beam splitter P , and then reflected back by the mirrors S_1 and S_2 respectively, and then merged into the observation lens T after P , will there be a difference in the time (or optical path) of the round trip between the light actually on the two mutually perpendicular optical road? Thereby it can be judged whether the interference fringe shift caused by the change of the optical path difference can be observed when the instrument is rotated 90° to exchange the positions of the two beams. The result of the experiment is that no any interference fringe shift is observed, even if the instrument is immersed in water.

According to the theory of relativity, in an inertial system S' that is stationary relative to the instrument, the distance traveled by light on two mutually perpendicular light road is $2l_0$, the speed of light propagating in all directions is also the same, so the actual back and forth time of light on these two mutually perpendicular optical paths is the same: $t'_1 = t'_2$. Naturally, no interference fringe shift will be observed after the instrument is rotated by 90° .

However, for any other inertial system S , during this period of time, the entire instrument is affected by its rotation and revolution with the earth, as well as the overall motion of the solar system, and the movement of the Milky Way, the distance traveled by light on two mutually perpendicular light paths may not be the same $2l_0$. Suppose the instantaneous speed of the entire instrument relative to the inertial system S along the parallel optical path is v . If the instrument is in a vacuum (not immersed in water), it can be explained by applying the length contraction formula according to the traditional special theory of relativity. This length contraction formula

is no different in our special theory of relativity with variable speed of light $l = l_0\sqrt{1 - v^2/c^2}$ [1]; so both can be explained without error. Suppose the time for light

to travel along the parallel path of PS_1 is t_1^+ , at this time the mirror S_1 also moves forward vt_1^+ , so looking from the inertial system S , the distance traveled by light is

$ct_1^+ = l + vt_1^+ = l_0\sqrt{1 - v^2/c^2} + vt_1^+$, so get $t_1^+ = \frac{l_0\sqrt{1 - v^2/c^2}}{c - v}$. Similarly, the return time

is $t_1^- = \frac{l_0\sqrt{1 - v^2/c^2}}{c + v}$. The total time back and forth on the parallel light path is

$t_1 = t_1^+ + t_1^- = \frac{2l_0}{c\sqrt{1 - v^2/c^2}}$. On the vertical light path, the light travels back and forth in

an isosceles triangle with a top-to-bottom vertical distance of l_0 and a bottom length of vt_2 . It can be calculated immediately according to the right triangle theorem :

$t_2 = \frac{2l_0}{\sqrt{c^2 - v^2}} = \frac{2l_0}{c\sqrt{1 - v^2/c^2}}$. So $t_1 = t_2$, there is still no optical time difference, and no

difference between the parallel light path and the vertical light path can be seen. Naturally, there is still no interference fringe shift after 90° rotation.

Note the relationship between the coordinate time t and the proper time τ given in [1], the calculation in the previous paragraph actually proves that on two

perpendicular light paths, we have $c\tau_1' = ct_1\sqrt{1 - v^2/c^2} = c\tau_1 = 2l_0$,

$c\tau_2' = ct_2\sqrt{1 - v^2/c^2} = c\tau_2 = 2l_0$, $c\tau_1' = c\tau_1 = c\tau_2' = c\tau_2 = 2l_0$. That is to say, for the

travel of light waves (or photons), if use the "proper time" of the instantaneous inertial coordinate system anytime and everywhere to calculate, the optical path is not affected by the speed v of any instantaneously attached inertial coordinate system, and from any inertial coordinate system looks like this. Consider the wave-like travel of light: The so-called wavelength " λ " must be measured "simultaneously" in accordance with the "same phase", according to the special theory of relativity, the wavelength " λ " has lost its true and reliable "inherence"; the so-called frequency " ν " (or period " T ") must be measured in the "same place", according to the special theory of relativity, the frequency " ν " (or period " T ") retains its true and reliable "inherence". In order to remedy the loss of the "inherent" true reliability of the space metrical unit, the special theory of relativity starts with the basic requirements of Riemann geometry by maintaining the "optical path" unchanged. This is the basic principle discussed in detail in the previous article [1]. Therefore, the Michelson-

Morley experiment actually proves that this basic principle of special relativity is correct.

The generalized special theory of relativity with variable speed of light no longer regards the "vacuum" condition as the basis of the theory of relativity, so that it breaks the limitation of "vacuum" in the transformation of inertial coordinate system. ^[1] Therefore, if the Michelson-Morley experimental instrument (except the observation mirror and the light source) is immersed in water (or mercury), the above two calculations and statements are equally correct and effective, and thus can also give a correct and satisfactory explanation. Because what happened at this time was inside the water, and the observation equipment outside the water did not move relative to the water. Therefore, in addition to the observation coordinate system S in vacuum, two inertial systems S' and S'' in the water are also set: The speed of light in S' and S'' is c' and c'' respectively; the instrument is still in the system S'' , driven by the movement of the earth and the overall motion of the solar system, the moving speed of the system S'' and the immersed instrument relative to the system S' is v' , and the system S' and the system S are relatively static. First of all, from the inertial system S' and S'' , the length of the two perpendicular optical paths should be $2n'l_0$, so there are

$$\text{still} \quad c''\tau_1'' = c't_1'\sqrt{1-v'^2/c'^2} = c'\tau_1 = 2n'l_0 \quad c''\tau_2'' = c't_2'\sqrt{1-v'^2/c'^2} = c'\tau_2 = 2n'l_0$$

$$c''\tau_1'' = c'\tau_1' = c'\tau_2' = c''\tau_2'' = 2n'l_0. \text{ Therefore, not only in the } S'' \text{ system, we have } t_1'' = t_2'',$$

$$\text{in the } S' \text{ system, still have } t_1' = t_2' = \frac{2n'l_0}{c'\sqrt{1-v'^2/c'^2}}. \text{ Secondly, if the above optical time}$$

calculation on two mutually perpendicular optical paths is repeated in the S' system, the same result can be obtained $t_1' = t_2'$. As mentioned above, in the system S' , there is no knowledge of the value c'' of S'' at all, in the system S'' "imagine" the speed of light of S'' should be $\frac{c'}{n'}$ instead of $c' = c''$ (this is a judgment away from S'). When the system S'' is moving at speed v' relative to the system S' , according to the speed transformation formula (3.9b'), the speed of light in the S'' system in the parallel

$$\text{optical path and the vertical optical path measured by the } S' \text{ system are: } u' = \frac{\frac{c'}{n'} \pm v'}{1 \pm \frac{v'}{n'c'}}$$

(light and v' in the same direction take the positive sign, and take the negative sign in

$$\text{the reverse direction}), u' = \frac{c'}{n'} \sqrt{1 + \frac{n'^2 v'^2}{c'^2} - \frac{v'^2}{c'^2}}. \text{ The distance that the light travels and}$$

returns on the parallel light path along PS_1 are respectively

$$u't_1^{'+} = l' + v't_1^{'+} = l_0\sqrt{1-v'^2/c'^2} + v't_1^{'+} \quad , \quad u't_1'^{-} = l' - v't_1'^{-} = l_0\sqrt{1-v'^2/c'^2} - v't_1'^{-} \quad . \text{ So}$$

after solving for $t_1'^{+}$ and $t_1'^{-}$, we can get that the time for the light to go back and forth

on the parallel light path is $t_1' = t_1'^{+} + t_1'^{-} = \frac{2n'l_0}{c'\sqrt{1-v'^2/c'^2}}$. According to the right-angled

triangle theorem, it can be calculated that the round-trip time of light on a vertical

light path is $t_2' = \frac{2l_0}{\sqrt{u'^2 - v'^2}} = \frac{2n'l_0}{c'\sqrt{1-v'^2/c'^2}}$. And so, $t_1' = t_2' = \frac{2n'l_0}{c'\sqrt{1-v'^2/c'^2}}$ is still

established. Finally, transform from S' system to the observing system S , since there is

no mutual movement between S and S' at this time, so $t' = \frac{c}{c'}t$, the $\frac{v'}{c'}$ of S'' measured

in the S' system is also the $\frac{v}{c}$ of S'' measured in the S system; the $n = n'$ discussed

above still holds; this way you get $t_1 = t_2 = \frac{2nl_0}{c\sqrt{1-v^2/c^2}}$ naturally.

Although the traditional special theory of relativity obtains the same result, its explanation is a bit ambiguous [2]. It is worth pointing out that Einstein propose the theory of relativity did not because of the encouragement of Michelson's experiment; on the contrary, it was inspired by the theory of relativity that Michelson did the experiment again by immersing his instrument in water. According to the special theory of relativity with variable speed of light, such a redo is completely unnecessary.

5 Conclusion

This article uses the special theory of relativity with variable speed of light to study and deal with the propagation of light in the medium. Derive the transformation relationship of the characteristic quantities describing light wave frequency ν , phase velocity w and the direction angle α of the wave normal between the two inertial coordinate systems in vacuum S and in medium S' ; combining the transformation of the ray speed of light u which describes the granular motion, the de Broglie wave-particle velocity relationship $uw = c^2$ in the vacuum inertial coordinate system S is

extended to $w'u' = c'^2$ in the medium inertial coordinate system S' . Corrected the traditional special theory of relativity in dealing with these problems, the transformation from the space-time coordinates to the relevant physical quantity, that is limited to the half-sided transformation of the media system S' into the vacuum system S (rather than two sided), which caused the contradictions and problems all solved easily. Optical experiments that support the traditional special theory of relativity, such as the Fizeau experiment and the Michelson-Morley experiment, not only still support the generalized special theory of relativity with variable speed of light, but also can get a more correct and satisfactory explanation from it.

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Figures

Figure 1

H. L. Fizeau experiment [5]–[8] This is an optical experiment to study the propagation of light in a moving medium done before the theory of relativity is put forward. The experiment layout is like (Fig. 1)

Figure 2

Michelson-Morley experiment [9]–[11] This experiment is considered to be the basis for the establishment of the special theory of relativity, as shown in (Fig. 2).