Inconsistencies in the special theory of relativity

Xianming Meng,
Email: mxmbox@yahoo.com

Abstract

The special relativity theory is a very successful and popular theory that can explain many relativistic phenomena. However, the inconsistencies in some of the detail of the theory are largely ignored by physicists. This paper examines the issues in the theory and finds that they are not solvable within the current framework of the theory. In order to overcome these inconsistencies, the paper calls for a new theory to update or replace the current special relativity theory.

Key words: special relativity, Doppler effect, absolute motion, time dilation, length contraction

Introduction

When the special relativity theory was put forward by Einstein, it experienced a significant amount of criticism. Israel et al. (1931)[i] collated the criticism of a number of authors. However, Einstein's theory can explain relativistic phenomena such as the phenomenon of the measured mass of electrons increasing with their speed, the Fizeau water tube experiment, the Michaelson–Morley experiment, the transformation of mass to energy in nuclear reactions, and the Ives–Stilwell experiment. The world has now accepted Einstein's theory and any criticism is all but forbidden in most academic journals.

Although the special relativity theory is largely a consistent theory, some of its explanations are not satisfactory – they are either inconsistent with reality or ambiguous in concept definition and application. Most people choose to ignore these issues simple because many predictions from the theory are confirmed by experiments or observations; however, this attitude prevents us from gaining a deeper and more accurate understanding of relativistic phenomena, so the author thinks it is important to examine all possible issues in order to have full confidence in the theory and to further develop the theory. According to Popper (1963)[ii], scientific progress is achieved through falsification, where a single piece of negative evidence can disprove a theory. For example, Ptolemy's earth-centred theory, which dominated the world from the 4th century BCE until the 17th century CE, could explain why stellar bodies move around the earth; however, because it could not explain more detailed stellar observations, it was falsified and the Copernican heliocentric model has ruled the world till today. This example reminds us that it is important to pay attention to the detail and to solve any inconsistences both within the theory and within reality. History also shows that any theory will eventually evolve or be replaced by new theories. The special relativity theory is already more than 100 years old, therefore it may be time to upgrade the special relativity theory to a new theory.

Previous criticism of the special relativity theory focused on the contradiction of Einstein's prediction with common sense, with many paradoxes being proposed, such as the twin clock paradox, the two spaceship paradox, and the paradox of a ladder flying into a barn. However, the constructed paradoxes are inevitably subject to different interpretations, involve many aspects/factors, and thus complicate the basic problems in the special relativity theory. Therefore, this paper will not use illustrative paradoxes to make an argument, but focus on the key basic issues embedded in the theory.

Mass-energy equation vs. thermal energy

A key outcome of the special relativity theory is the energy mass equation, which is proven by nuclear energy generation. However, what the experiments and applications show is that mass can be transformed into energy, which does not support the claim of the special relativity theory that energy and mass are interchangeable.

The claimed equivalence of mass and energy results from enforcing conservation of momentum and energy in an inelastic collision. The special relativity theory claims that when two balls of equal velocity and rest mass smash into each other and form a big ball at rest, the kinetic energy of the two balls is transformed into internal energy or rest energy. Using the mass energy equation, the theory predicts that rest mass is created during an inelastic collision.

The above reasoning on the creation of rest mass ignores the fact that during an inelastic collision, there is a rise in temperature. Classical physics suggests that the kinetic energy of two balls is transformed into thermal energy, causing a temperature increase. It is clear, therefore, that energy conservation during an inelastic collision must include thermal energy, as if it is excluded, applying energy conservation to an inelastic collision will lead to an invalid calculation. It could be argued that the heat generated can be viewed as a part of internal/rest energy; however, this view contradicts the definition of rest energy, $E_0=m_0c^2$, which shows that rest energy is related only to rest mass, not to temperature. Since temperature is not included in this formula, heat is clearly not part of rest energy. In other words, if rest energy is redefined to include thermal energy, then the mass energy equation should also be revised to include a temperature variable, for example $E_0=m_0c^2+f(T)$. If so, an increase in rest energy does not necessarily mean an increase in rest mass. Either way, the calculation of rest mass after a collision in the special relativity theory is invalid.

Einstein's prediction of the creation of rest mass has never been observed in any experiments during a low speed collision. Although it is claimed that there are increases in rest energy during a high-speed collision, the claimed increases in rest energy are not measured but calculated based on the energy conservation in inelastic collisions proposed by Einstein. Some experiments do generate new particles by smashing old particles or photon-nuclear interaction; for example, high-energy photons passing close to atoms may generate positron and electron pairs. However, due to the limited knowledge on subatomic particle structure, it cannot be claimed that these new particles are transformed from energy rather than from old particles or existing matter. For example, Burke et al (1997)[iii] claimed an experimental confirmation of positron production in multiphoton light-by-light scattering, but their experimental result was achieved by scattering a laser with an electron beam. Even if the laser beam was off, positrons were detected. With laser beam on, more positrons were detected. This increased positrons detected were viewed as the results of photon collisions and the pair production equation of Breit and Wheeler (1934)[iv] was used to explain the result. An alternative explanation can be simply that the photon-electron collision (i.e. with laser beam on) enhanced the positron creation in the electron beam (i.e. with laser beam off). If so, this is not a process of creating positrons purely from energy. Some physicists designed and implemented experiments to smash high-energy photons to create electrons (Wilson, 2014[v]; Starr, 2018)[vi], but so far, these experiments have not been successful.

Rest mass/energy vs. absolute motion/rest

Rest mass and rest energy are vital concepts in the special relativity theory, but these concepts are defined vaguely by assuming a zero velocity for an object. Velocity is a comparative term – the speed of an object is compared with another object or with its reference frame. A zero velocity in one reference frame will become non-zero for another reference frame of different speed, whether or not the relativistic speed addition or Galilean speed addition formula is used. As such, before Einstein specified a zero velocity for the concept of rest energy, he should have specified a stationary reference frame. However, in the special relativity theory, he claimed that all inertial frames are equivalent and that there is no preferred frame (interesting enough, all results in special relativity theory are based on the moving frame obtained through the Lorentz transformation, indicating that Einstein in fact preferred the moving frame over the stationary frame. This is also an inconsistency in the special relativity theory). As such, rest energy/mass cannot be determined because there is no certainty if the speed of the object is truly zero.

In practice, one may simply use the earth frame to determine the rest mass and rest energy. In doing so, the earth frame is effectively viewed as a preferred stationary frame, even though the frame is known not to be stationary. This practice is a loose application of concepts that are not well-defined. If the reference frame changes, the assumed rest object on earth is no longer stationary and thus the measured rest mass and rest energy need revision. Since the rest mass forms the foundation of the relativistic system, the change in rest mass will result in a revision of the whole system, including the relative mass, relative energy, and momentum. As such, the special relativity system cannot be firmly established without a concept of absolute rest.

To sum up, the concept of rest mass/energy and the assumption of no absolute motion/rest are contradictory. Since the special relativity theory rules out any preferred stationary frame as absolute rest, it is not possible to determine rest mass and therefore not possible to establish the base for the special relativity theory.

Assumption of constant speed of light in a vacuum vs. the Doppler effect of light

The constant speed of light in a vacuum is a key postulate for the special relativity theory. It is claimed that this postulate is supported by some experiments, notably the Michaelson–Morley experiment. This claim is not necessarily true because the null result of the Michaelson–Morley experiment can be explained perfectly if photons can pick up the speed of the inertial reference frame. One may quickly point out that the full dragging types theories such as Stokes (1845[vii]) and Hertz (1890[viii]) cannot explain the Fizeau water tube experiment. However, a close examination of historical experiments shows that photon matter scattering can impart the speed of the frame fully to the photons, and then the speed is discounted by the refractive index of the medium. This mechanism can explain all existing experiments on the constant speed of light, including Fizeau (1851)[ix], Hoek (1868)[x], Michaelson–Morley (1887)[xi], Kennedy–Thorndike (1932)[xii], and Sagnac (1899)[xiii]. The detailed examination of historical experiments constitutes a separate paper. In this section, the focus is on examining the consistency of the assumption with the Doppler effect of light.

Most studies on the Doppler effect of light adopt an abstract approach based on the wave theory of light; however, this paper uses a material approach based on the particle theory of light. The adoption of this approach is based on the fact that waves are the second nature of materials. Traditional waves need media to propagate while quantum experiments show that even ordinary particles have wave property. Moreover, light is not a traditional wave, and the photoelectric effect proves that light possesses the nature of particles.

Generally speaking, the Doppler effect of light is claimed as being the evidence for the special relativity theory. The ordinary Doppler effect is interpreted as the inability for light to change speed: when the energy of light changes, the speed of photons cannot change so the frequency changes. The secondary (or relativistic) Doppler effect confirmed by Ives and Stilwell (1938[xiv], 1941[xv]) is hailed as direct evidence of time dilation. On the work of Ives and Stilwell, Christov (2010[xvi]) pointed out that the only problem in the analysis of the experiment is its assumption that the light frequency emitted by atoms is independent of the speed of the atoms. Christov (2010) proposed a mechanism that relates the photon emission rate to the speed of atoms, and demonstrated that it is possible that the relativistic Doppler effect may result from an emission frequency change for high speed atoms rather than being caused by time dilation. It is beyond the scope of the current paper to examine the mechanism that causes the change in emission frequency (presented in a separate paper), but the resultant photon emission frequency can be produced here:

$$f = f_0\sqrt{1-\frac{v^2}{c^2}} \quad (1)$$

where f_0 is the photon emission frequency of a stationary light source and f is the photon emission frequency of a moving light source.

As will be shown later, this formula can explain accurately the relativistic Doppler effect as an addition to ordinary Doppler effect.. Next, three cases (moving light source, moving observer, and moving mirror) are used to examine if the Doppler effect supports Einstein's postulate of the constant speed of light in a vacuum.

A. The Doppler effect of a moving light source

Figure 1 shows the effect of a moving light source and a moving observer on the perceived light frequency.

Panel (a) shows the baseline case of a stationary light source emitting two consecutive photons (or wavefronts in the terminology of wave theory) in period T_0, so the emission frequency is $f_0=1/T_0$. Given the speed of photons c, the distance between the two photons (wavefronts) can be viewed as the wavelength:

$$\lambda_0=cT_0=c/f_0$$

Panel (b) shows that the light source moves to the observer at the speed of v. If the speed of the photons does not depend on the speed of light source v, the speed of photons 1 and 2 is still c. The time for the first photon to travel from A to B is the same as in panel (a), that is $T_0=\lambda_0/c$.

When photon 1 travels from A to B to be perceived by the observer, the light source has travelled a distance $s_1=vT_0$ and starts to emit photon 2. The new wavelength λ_1 is the distance between photon 2 at point C and the observer (or photon 1) at point B:

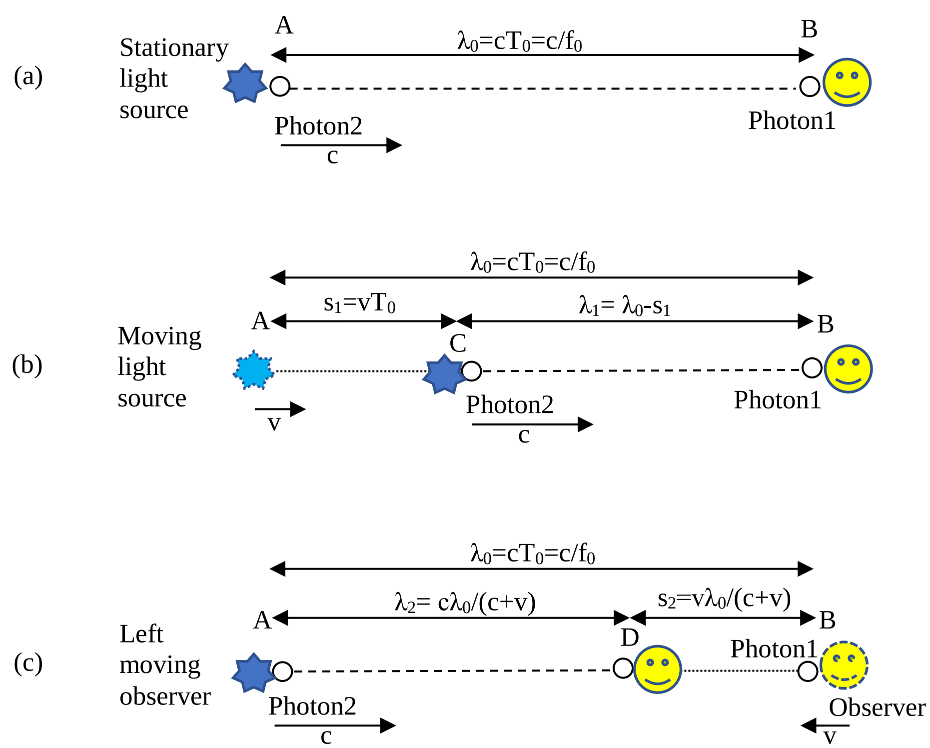
$$\lambda_1=\lambda_0-s_1=(c-v)T_0=\lambda_0(c-v)/c$$

or

$$\lambda_1/\lambda_0=(c-v)/c \quad (2)$$

This result is consistent with the measured ordinary Doppler effect in experiments, therefore it supports the assumption that the speed of light is independent of the speed of the light source.

Fig.1 Photonic interpretation of the Doppler effect of light



However, the above explanation assumes that the photon emission frequency does not change when the light source is moving. If the emission frequency changes according to equation (1), the wavelength at the light source will change to λ_0':

$$\lambda_0' = \lambda_0 / \sqrt{1-\frac{v^2}{c^2}} \quad (3)$$

Since this additional change in wavelength will also be perceived by the observer, the perceived wavelength should be:

$$\lambda = \frac{\lambda_1}{\lambda_0}\lambda_0' = \frac{c-v}{c}\frac{\lambda_0}{\sqrt{1-\frac{v^2}{c^2}}} = \sqrt{\frac{c-v}{c+v}}\lambda_0 \quad (4)$$

This equation is the total Doppler effect, including the relativistic Doppler effect.

The common derivation of the relativistic Doppler effect shown in equation (4) relies on time dilation. In considering the relationship between wavelength and period $\lambda=cT$, equation (2) can be rewritten as:

$$\frac{\lambda}{\lambda_0}=\frac{cT}{cT_0}=\frac{T}{T_0}=\frac{c-v}{c}$$

According to the special relativity theory, the time is dilated in terms of the reference frame of the moving light source, so the T_0 in the above equation should be replaced by $T_0'=T_0/\sqrt{1-\frac{v^2}{c^2}}$. As such, we have:

$$\frac{T}{T_0'}=(T/T_0)\sqrt{1-\frac{v^2}{c^2}}=\frac{c-v}{c} \qquad (5)$$

Rearranging equation (5) and utilizing $\lambda=cT$, we arrive at:

$$\frac{T}{T_0}=\left(\frac{c-v}{c}\right)/\sqrt{1-\frac{v^2}{c^2}}=\sqrt{\frac{c-v}{c+v}}=\frac{\lambda}{\lambda_0}$$

This equation is the same as equation (4), which was derived using a change in photon emission frequency at the light source. However, the method for deriving equation (5) is not a rigorous procedure. According to the special relativity theory, the full transformation from the stationary frame to the moving reference frame also needs to include a relativistic speed addition for the relative speed between the moving light source and the photons (*c*-*v*), which would give a relative speed of *c*:

$$v'=\frac{c-v}{1+\frac{c(-v)}{c^2}}=c$$

Replacing *v*' with *c*-*v* in equation (5), we have:

$$\left(\frac{T}{T_0}\right)\sqrt{1-\frac{v^2}{c^2}}=1$$

or

$$\frac{T}{T_0} = \frac{\lambda}{\lambda_0} = 1/\sqrt{1 - \frac{v^2}{c^2}} \qquad (6)$$

Equation (6) shows that if the relativistic velocity addition is applied, the speed of light is the same for reference frames of different speeds and the ordinary Doppler effect disappears. This conclusion contradicts experimental results.

B. The Doppler effect of a moving observer

Panel (c) in Figure 1 shows the case where the observer moves to the left at speed *v*. When the observer perceives photon 1 at point B, the light source starts to emit photon 2, which travels at speed *c*. In considering that the observer moves to the left at speed *v*, the relative speed between photon 2 and the observer is $c+v$. When they meet at point D, the time they have travelled is $\lambda_0/(c+v)$. During this period, the observer moves a distance:

$$s_2=v\lambda_0/(c+v)$$

and photon 2 travels a distance:

$$\lambda_2=c\lambda_0/(c+v)$$

or

$$\lambda_2/\lambda_0=cT_2/cT_0=T_2/T_0=c/(c+v) \qquad (7)$$

Here λ_2 is the distance between photon 2 and photon 1(or the observer) at point D, so it is the new wavelength. Since the light source is stationary, there is no change in emission frequency at the source and thus there is no high-order (or relativistic) Doppler effect. The above formula will be the total Doppler effect of a moving observer, which is different from the Doppler effect of a moving light source described by equation (4). This result shows that, just like the case of a traditional wave, the Doppler effect of light is also asymmetric.

However, the relativistic approach gives a different answer. By adding the time dilation effect to the moving observer, namely replacing T_2 in equation (7) with $T_2' = T_2/\sqrt{1-\frac{v^2}{c^2}}$, we have:

$$T_2'/T_0 = T_2/\left(T_0\sqrt{1-\frac{v^2}{c^2}}\right) = \frac{c}{c+v}$$

or

$$\frac{T_2}{T_0} = \sqrt{1-\frac{v^2}{c^2}} * \frac{c}{c+v} = \sqrt{\frac{c-v}{c+v}} = \frac{\lambda_2}{\lambda_0} \qquad (8)$$

Equation (8) is essentially the same as equation (4), so it is claimed and popularly believed that the Doppler effect of light is symmetrical. As discussed previously, the above approach is not rigorous because the velocity addition ($c+v$) in equation (7) is not relativistic. If the relativistic velocity addition or the second part of Einstein's postulate is applied, it must be concluded that the speed of light with respect to the moving observer in panel (c) is c – the same speed as with respect to the stationary observer in panels (a) and (b) – then $\lambda_2 = c\lambda_0/c = \lambda_0$. This result indicates that there would be no ordinary Doppler effect when the observer moves towards the light source, but time dilation will cause a relativistic Doppler effect. Again, this conclusion of no ordinary Doppler effect contradicts the experimental results, so the second part of Einstein's postulate that the speed of light is the same for all reference frames is not consistent with experiments and observations.

Given the above apparent contradiction of the special relativity theory with the experimental results, how does the theory resolve the issue and obtain the correct formula shown in equation (4)? The answer comes from the Lorentz transformation of wave functions. Einstein (1905) used a wave function in three-dimensional space. For simplicity, the approach is explained using the two-dimenstional space as demonstrated by Resnick (1968).

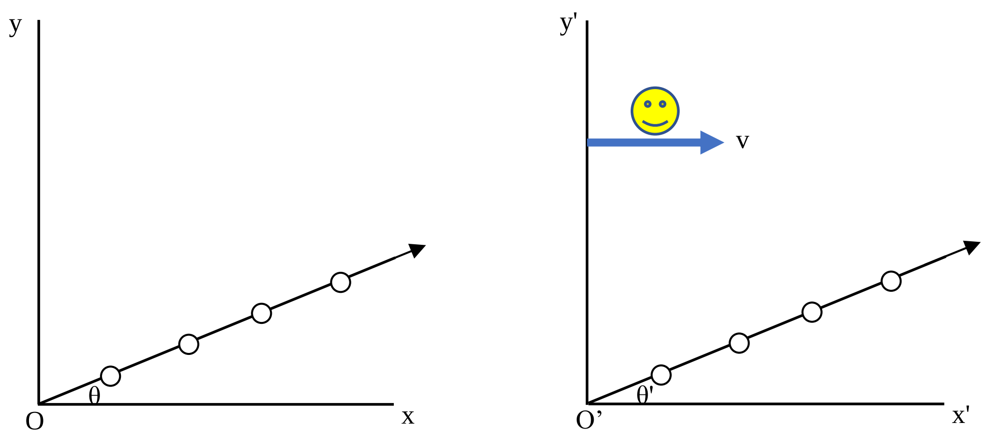
Figure 2 shows a light ray (plane wave) viewed from different reference frames: frame (a) is stationary and frame (b) moves to the right at speed v. The light wave propagates in the x-y or x'-y' plane and forms angle θ or θ' with the horizontal axis. The points in the light ray indicate the photons or wavefront. The wave propagation in frames (a) and (b) can be described by amplitude-normalized wave functions, respectively:

$$\Psi(x, y, t) = cos2\pi[\frac{cos\theta}{\lambda}x + \frac{sin\theta}{\lambda}y - f * t] \qquad (9)$$

$$\Psi'(x', y', t') = cos2\pi[\frac{cos\theta'}{\lambda'}x' + \frac{sin\theta'}{\lambda'}y' - f' * t'] \qquad (10)$$

Where Ψ and Ψ' are the displacement of the waves, λ and λ' are the wavelengths, *f* and *f'* are the frequency of the waves, (*x*, *y*) and (*x'*, *y'*) are position coordinates, and *t* and *t'* are the time of wave propagation.

Fig.2 Wave function approach to relativistic Doppler effect



(a) Stationary reference frame (b) Moving reference frame

The two-dimensional Lorentz transformation can be expressed as.

$$x' = \beta(x - vt), \qquad y' = y, \qquad t' = \beta\left(t - \frac{xv}{c^2}\right), \qquad \beta = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Where *c* is the speed of light in a vacuum, *v* is the speed of the moving reference frame, *x* and *t* are the position and time in the stationary reference frame, respectively, *x'* and *t'* are the position and time in the moving reference frame, respectively, and β is the Lorentz factor.

Applying the above Lorentz transformation to wave function (10), we can have:

$$\Psi'(x,y,t) = cos2\pi\left[\frac{cos\theta'+\frac{v}{c}}{\lambda'\sqrt{1-\frac{v^2}{c^2}}}x + \frac{sin\theta'}{\lambda'}y - \frac{1+\frac{v}{c}cos\theta'}{\sqrt{1-\frac{v^2}{c^2}}}f' * t\right] \qquad (11)$$

Comparing the last term in equations (9) and (11), the following equation can be obtained for the Doppler effect:

$$f = \frac{1+\frac{v}{c}cos\theta'}{\sqrt{1-\frac{v^2}{c^2}}}f' \qquad (12)$$

Utilizing $f\lambda=c$ and letting $\theta=\pi$ (the observer moves towards the light source), one can obtain the same formula for the Doppler effect as shown in equation (8).

A hidden logical mistake occurs when wave functions (9) and (11) are compared to obtain equation (12). Equations (9) and (10) are wave functions in different reference frames. They may be in a similar form, but they are not the same, as indicated by the different dependent variables Ψ and Ψ'. Equation (11) is transformed from equation (10) so they are essentially the same – the change in independent variables simply adds an extra layer of transformation onto the intermediate variables (*x', y'*, and *t'*). As such, equation (11) may appear similar to equation (9) but is in fact different and, thus, it is invalid to compare these two equations and obtain equation (12). This same logical mistake occurred to Lorentz when he attempted to obtain a proper wave equation for light using his transformation formula. According to Miller (1981, p28[xvii]), Lorentz himself noticed that the speed of light from his proper wave equation was $(c^2-v^2)^{1/2}$, which is less than c, but he satisfied that this is only a difference of the second order because v is generally much smaller than *c*. This result is inconsistent with the Lorentz transformation formula – it is easily verified that the speed of light *c* is unchanged after the Lorentz transformation. This inconsistency is a confirmation of the logical mistake in the above-mentioned approach.

In short, the postulate of the constant speed of light in a vacuum has two parts. The first part is that the speed of light is independent of the speed of the light source, and the second part is that the speed of light is the same measured from any inertial reference frame. The measured Doppler effect of light confirms the first part but rejects the second part.

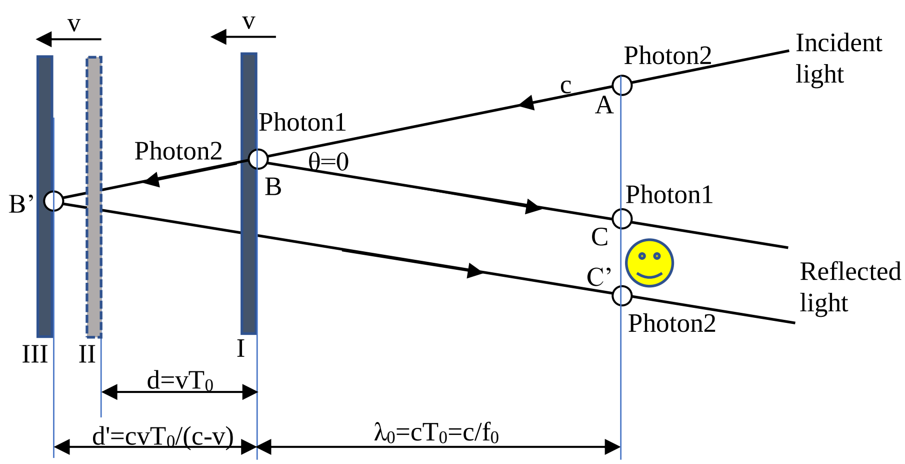
C. The Doppler effect of a moving mirror

The above conclusion can be drawn from the case of the Doppler effect of a moving mirror. The formula for Doppler effect of moving mirror was derived by O'Rahilly (1938)[xviii] based on the wave theory. A similar derivation was also performed by Gjurchinovski (2013)[xix]. A photonic approach is used here to derive the formula.

Figure 3 is intended to illustrate a horizontal light ray projected onto a vertical mirror that is moving to the left at speed *v*. For the convenience of interpretation, a small angle is used to illustrate the path of the incoming ray and the reflected ray separately. As photon 1 in the incident ray reaches point B and is reflected by the mirror, the next photon (photon 2) is at point A travelling at speed *c*, so the original wavelength is $\lambda_0=cT_0=c/f_0$. When photon 2 travels to point B during time T_0, photon 1 travels to point C to be perceived by the observer, and the mirror moves from position I to II, travelling a distance $d=vT_0$. Afterwards, photon 2 continues to travel from point B to the left while the mirror moves at speed *v* from position II to the left. The relative speed between photon 2 and the mirror is *c-v* and the time for photon 2 to reach point B' to be reflected by the mirror is:

$$t=d/(c-v)=vT_0/(c-v)$$

Fig.3 Photonic illustration of the Doppler effect from a moving mirror



The distance between I and III (or the distance of BB') is:

$$d' = ct = cd/(c-v) = cvT_0/(c-v)$$

After the observer perceives photon 1 at point C, he/she has to wait for photon 2 to travel a distance BB' plus B'C' to arrive at C', so the new wavelength is:

$$\lambda = 2d' + \lambda_0 = 2cvT_0/(c-v) + cT_0 = [2cv/(c-v) + c]\ \lambda_0/c = \lambda_0\ (c+v)/(c-v)$$

This result is the same as in O'Rahilly (1938).

However, if the speed of light with respect to the moving mirror is independent of the speed of the mirror, as claimed by Einstein, the relative speed between photon 2 and the mirror is *c*, so the time for photon 2 at point B to reach the mirror is:

$$t' = d/c$$

In order for photon 2 at point B to reach the mirror, the distance to be travelled by photon 2 is:

$$d' = ct' = c * d/c = d$$

So the new wavelength should be:

$$\lambda = 2d' + \lambda_0 = 2vT_0 + cT_0 = 2\ \lambda_0 v/c + \lambda_0 = \lambda_0\ (2v+c)/c$$

This result does not agree with experiments, so the postulate that the relative speed between photon 2 and the mirror is independent of the speed of the mirror is rejected.

Given the above explanation, Einstein's postulate that light speed in a vacuum is the same for all reference frames is clearly untenable. How did Einstein use his postulate to obtain the same formula as O'Rahilly (1938) obtained? The key is the problematic equation (12) for a moving observer. For the moving mirror case, Einstein (1905, p152)[xx] simply used twice the equation of the relativistic Doppler effect, which is similar to equation (12) but with different expressions. By assigning a proper value for the angle θ', the same result as seen in O'Rahilly (1938) can be obtained.

It would seem that it does not matter what methods are used as long as the correct answer can be obtained. However, the validity of the method is crucial. The purpose of scientific research is to uncover the cause or mechanism of natural phenomena or experimental results to improve our understanding, and not all explanations reveal the true mechanism. The earth-centred theory can explain why the sun and moon rise from the eastern sky and set in the western sky; however, it is an incorrect explanation. Similarly, Einstein's approach to explaining the Doppler effect of a moving mirror suggests that this Doppler effect is caused by time dilation implied by equation (12), but in fact the case involves only an ordinary Doppler effect.

Length contraction and time dilation vs. common space and universal time

Length contraction and time dilation are the direct consequence of the Lorentz transformation. Based on the formula for the one-dimensional Lorentz transformation, any two points viewed at the same time t_0 from two reference frames can be expressed as:

$$x_1{}' = (x_1 - vt_0)/\sqrt{1-\frac{v^2}{c^2}} \text{ and } x_2{}' = (x_2 - vt_0)/\sqrt{1-\frac{v^2}{c^2}}$$

So the distance between these two points is:

$$\Delta x' = (\Delta x)/\sqrt{1-\frac{v^2}{c^2}}$$

Therefore, the distance between two points is perceived differently from different reference frames. Since light speed in a vacuum is assumed to be unmatchable, $v<c$, then $\Delta x'>\Delta x$. Namely, the distance measured in the moving reference frame is greater than that measured in the stationary reference frame, which means the length in the moving frame looks shorter from the perspective of the stationary frame – as if the distance in the moving reference frame is contracted.

Similarly, it is possible to consider a time interval $[0,t]$ during which an object moves from x=0 to $x=vt$ in the stationary reference frame. Substituting $x=vt$ into the Lorentz equation, we have:

$$t' = \left(t - \frac{v^2 t}{c^2}\right)/\sqrt{1-\frac{v^2}{c^2}} = t\sqrt{1-\frac{v^2}{c^2}}$$

This equation shows that the time measured in the moving reference frame is less than that measured in the stationary reference frame (i.e. $t' > t$), as if the time passes slower in the moving reference frame. This phenomenon is called time dilation.

Based on the above explanation, it should be made clear that the so-called length contraction and time dilation are in reality a measurement issue: the position of the two points and the time interval are objectively the same but they are perceived differently from two reference frames. However, in the special relativity theory, they are viewed as the objective change in distance and time in the moving reference frame, which is simply a popularized logical mistake.

If length contraction and time dilation are objective changes as claimed by the special relativity theory, they will cause logical problems. For example, if a moving object causes time dilation and length contraction in the direction of its speed, its speed would be reduced because speed is calculated by dividing the measured distance by the measured time. This would prevent any object from increasing its speed to reach the speed of light in the vacuum. Relativity supporters happily accept this result. However, the length contraction and time dilation should also be applicable to photons emitted by the object as they are in the same reference frame of the moving object. As such, the speed of the photons should also be reduced by length contraction and time dilation, resulting in a contradiction with the postulate of the constant speed of light in a vacuum.

When time dilation and length contraction are applied to multiple objects, it leads to contradictory or even amusing situations.

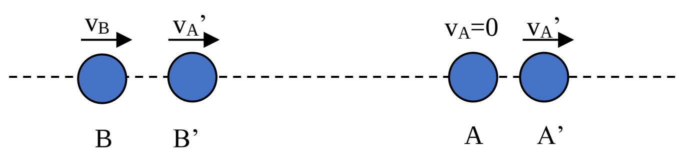
Figure 4 shows the contradiction caused by length contraction. There are four objects A, A', B, and B'. A' is very close to A and B' is very close to B. A is stationary and the other objects move to the right, with A' and B' of the same speed but B of a different speed.

Contradiction 1: Using A as the reference frame, B' is moving, so the length of AB' is expected to contract. However, using A' as the reference frame, B' is stationary, so there is no contraction between AB' (or A'B' because A and A' are very close). Has the length AB' (or A'B') contracted or not?

Contradiction 2: Using A as the reference frame, B and B' are moving, so they cause contraction between A and B or between A and B'. However, the speed of B and B' are different, so the degree of contraction should be different. Should the length AB (or AB' because B and B' are very close) contract according to the speed of B or of B'?

The questions cannot be answered in a definitive fashion unless the one-dimensional space for the four objects is individualized to make the space subjective (each object can change the degree of space contraction simply by varying its speed).

Fig.4 Contradiction caused by relativistic length contraction



If length contraction and time dilation are applied to a football/basketball match, the spacetime for the moving players and the stationary referee must be different. If so, when the referee blows the whistle to indicate the half-time pause, the players will continue to play because they claim their time is dilated (so it is not half time in the match yet) and they cannot hear the whistle from the referee's space. When the referee shows a yellow card to punish a player for failing to respond to his whistle, the player storms towards the referee and knocks him down, explaining 'I was running in my contracted space so did not expect to run into you'. The referee painfully sits up from the ground and produces a red card.

Conclusion

The inconsistencies discussed above do not prove that the special relativity theory is totally wrong, but they do show that the details of theory cannot withstand scrutiny, indicating that it needs to be upgraded or replaced by a new theory. The emerging new theory should be able to overcome all the issues discussed and, in the meantime, explain all the relativistic phenomena as well as the special relativity theory does.

---

[i] Israel, Hans; Ruckhaber, Erich; Weinmann, Rudolf, eds. (1931). Hundert Autoren gegen Einstein. Leipzig: Voigtländer.
[ii] Popper, Karl (1963). Conjectures and Refutations: The Growth of Scientific Knowledge (2002 ed.). London: Routledge
[iii] Burke, D. L. and Field, R. C. and Horton-Smith, G. and Spencer, J. E. and Walz, D. and Berridge, S. C. and Bugg, W. M. and Shmakov, K. and Weidemann, A. W. and Bula, C. and McDonald, K. T. and Prebys, E. J. and Bamber, C. and Boege, S. J. and Koffas, T. and Kotseroglou, T. and Melissinos, A. C. and Meyerhofer, D. D. and Reis, D. A. and Ragg, W., 1997, Physical Review Letters, 79(9): 1626—1629.
[iv] Breit, G. and Wheeler, J., 1934, Collision of two light quanta, Physical Review. 46(12), 1087-1091
[v] Wilson, G., 2014, Scientists discover how to turn light into matter after 80-year quest, https://www.imperial.ac.uk/news/149087/scientists-discover-turn-light-into-matter/
[vi] Starr, M., 2018, Physicists Are About to Attempt The 'Impossible' - Turning Light Into Matter, https://www.sciencealert.com/light-into-matter-breit-wheeler-process-hohlraum-experiment-start-2018
[vii] Stokes, G., 1845, On the aberration of light, Philosophical Magazine, 27: 9-15.
[viii] Hertz, H., 1890, Ueber die Grundgleichungen der Elektrodynamik fur ruhende korper, Annalen der physic und Chemie, 401: 369-399.
[ix] Fizeau, Armand-Hippolyte, 1851, Sur les hypotheses relatives a l'ether lumineux, et sur une experience qui parait demontrer que le mouvement des corps change la vitesse avec laquelle la lumiere se propage dans leur interieur, Comptes Rendus de l'Académie des Sciences 33: 349-355.
[x] Hoek, M., 1868, Determination de la vitesse avec laquelle est entrainée une onde lumineuse traversant un milieu en mouvement. Verslagen en Mededeelingen. 2: 189–194.
[xi] Michelson, Albert A.; Morley, Edward W., 1887, On the relative motion of the earth and the luminiferous ether. American Journal of Science. 34 (203): 333–345.
[xii] Kennedy, RJ, and Thorndike, EM, 1932, Experimental establishment of the relativity of time, Physical review, 42:400-408.
[xiii] Sagnac, G, 1899, Théorie nouvelle des phénomènes optiques d’entraînement de I’éther par la matière, Comptes rendus hebdomadaires des séamces de I’Académie des sciences. 129: 818–821
[xiv] Ives, H. E.; Stilwell, G. R. (1938). "An experimental study of the rate of a moving atomic clock". Journal of the Optical Society of America. 28 (7): 215.
[xv] Ives, H. E.; Stilwell, G. R. (1941). "An experimental study of the rate of a moving atomic clock. II". Journal of the Optical Society of America. 31 (5): 369.
[xvi] Christov, c. 2010, The effect of the relative motion of atoms on the frequency of the emitted light and the reinterpretation of the Ives-Stilwell experiment, Foundation Physics, 40:575-584.
[xvii] Miller, A. Albert Einstein’s special theory of relativity. 1981.
[xviii] O’Rahilly, A., (1938) Electromagnetics: A Discussion of Fundamentals. Longmans, Green and Company.
[xix] Gjurchinovski, A., 2013, Reflection from a moving mirror—a simple derivation using the photon model of light, European Journal of Physics, 34(1):L1.
[xx] Einstein, A., (1905) Zur Elektrodynamik bewegter Körper, Annalen der Physik (Leipzig) 17: 891–921, reprinted in J. Stachel, Einstein's Miraculous Year (Princeton University Press, Princeton, NJ, 1998).