Advanced Materials Research Vols. 433-440 (2012) pp 3218-3222

doi:10.4028/www.scientific.net/AMR.433-440.3218

A Simple Method for Deriving the Formulas of Relativity

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Keywords: Simple; method; formula; relativity; nuclear

Abstract: In this paper, a new and simple method for deriving the formulas of Relativity is introduced. Einstein derived the formulas of Relativity by applying two hypotheses about light velocity, but this process was rather complicated and hard to understand. Nuclear physics has been developing for nearly a hundred years and has accumulated plenty of experiment results. Now it is feasible to derive Einstein's formulas by employing the experiment results of nuclear physics. According to the result that energy is an expression form of mass, $E=\xi m$ can be obtained. We differential the above formula, adopt several steps of simple mathematical calculation, a simple differential equation can be obtained. Take the result of "light velocity is the velocity limit of a moving object" as the boundary condition of the differential equation, we get energy formula and mass formula. Length formula and time formula can also be easily derived based on the experiment result of particle speed in a cyclotron. As all the formulas of Relativity in this paper were derived by applying true experimental results from nuclear physics rather than hypotheses, they are reliable and easy to understand.

Introduction

In 1905, Einstein made two hypotheses, namely ①light velocity is permanent (because of the permanence of light velocity, space and time change); ② light velocity is the speed limitation of a moving object.

According to the above two hypotheses, Einstein derived the following four formulas,

$$E = mC^2 \tag{1}$$

$$m = \frac{m_0}{\sqrt{1-v^2/C^2}} \tag{2}$$

$$\Delta L = \Delta L_0 \sqrt{1-v^2/C^2} \tag{3}$$

$$\Delta t = \frac{\Delta t_0}{\sqrt{1-v^2/C^2}} \tag{4}$$

We call formulas (1) to (4) energy formula, mass formula, length formula and time formula respectively for convenience.

Practice reveals that Einstein's Relativity is successful, but his time and space are hard to understand. To solve this problem, a lot of researches have been carrying out, and reference [1] is such one.

Reference [1] points out that the problem originates from Maxwell's classical electromagnetic wave theory. This theory regards electromagnetic wave as: electricity produces magnetism, magnetism produces electricity, and electricity produces magnetism again… Such a continual circulation is just electromagnetic wave.

But according to the theory, in one wavelength, its field intensity will decay from the original 100% to 2%. It is obvious that the electromagnetic wave attenuates too fast. Another defect of Maxwell's theory is that it can not explain why the velocity of light keeps a constant C. Moreover, this theory does not consist with some experiments.

Reference [1] can overcome the above shortcomings. It puts forward many new viewpoints among which the most favorable for us is that light velocity is the character of light itself, it has nothing to do with time and space.

That is to say, reference [1] suspects Einstein's hypothesis ①.

This paper indicates that when hypothesis ① is abandoned, not only can formulas (1) to (4) be derived, but the method is also easy to comprehend.

Practice shows that Einstein's hypothesis ② is correct. Therefore, it is not regarded as a hypothesis in this paper but as an experiment result.

Reference [1] points out that light continuously adjusts its velocity automatically. This result inspired the author of this paper to simplify the method for deriving the formulas (1) to (4).

The Derivation of Formula (1) and Formula (2)

Let m be mass, E be energy, and ξ be a coefficient. Many experiments [2,3] have proven that energy is an expression or form of matter; that is,

$$E = \xi m \tag{5}$$

When E_0 is the rest energy and E_k the kinetic energy, we have

$$E = \xi m = E_0 + E_K \tag{6}$$

Differential Formula (6) gives

$$dE_K = \xi dm \tag{7}$$

$$dE_K = Fds = Fvdt$$
$$= v(Fdt) = vd(mv) \tag{8}$$

From Formulas (7) and (8), we get

$$\xi dm = vd(mv) \tag{9}$$

$$\frac{vdv}{\xi - v^2} = \frac{dm}{m} \tag{10}$$

$$\int_0^v \frac{vdv}{\xi - v^2} = \int_{m_0}^m \frac{dm}{m} \tag{11}$$

From Formula (11), we get

$$m = \frac{m_0}{\sqrt{1 - v^2/\xi}} \tag{12}$$

Experiments have proven that, when regarding the laboratory in which the equipment is placed as the reference system for velocity, the velocity **v** of an object can only approach the velocity of light, rather than reach it [4]. When **v**=C, m=∞:

$$m = \frac{m_0}{\sqrt{1 - C^2/\xi}} = \infty ; \quad \xi = C^2 \tag{13}$$

Substituting Formula (13) into Formulas (5) and (12), we have the following:

$$E = mC^2 \tag{14}$$

$$m = \frac{m_0}{\sqrt{1 - v^2/C^2}} \tag{15}$$

Formula (14) and formula (15) are just the energy formula and mass formula of Relativity that are derived by the new method introduced in this paper. Their physical meanings are exactly the same as the explanations of Einstein.

But where does the mass increment ($m-m_0$) come from? The following example will illustrate it. There is a particle whose rest mass is m_0, when the particle is accelerated by an accelerator, its speed quickens up from 0 to v, and its mass increases from m_0 to m. Electric power is needed for

the accelerator's work, suppose that the efficiency of all the electrical equipments, including the power plant and the accelerator, is 100%, ($m-m_0$) equals to the net mass loss of the fuel of the power plant.

The Derivation of Formulas (3) and (4)

Many experiments [5] have indicated that particles follow uniform circular motion in the D-shaped box of a cyclotron. Let r and **v** be the radius and linear velocity of the circular motion of a particle. Let m and Z express the mass and number of charges of the particle, respectively. Let e be the charge of an electron, H be the magnetic field intensity of the cyclotron, and C be the velocity of light. Then, the following relation can be constructed:

$$r = \frac{Cmv}{ZeH} \tag{16}$$

Formula (16) can be changed into:

$$v = \frac{rZeH}{Cm} \tag{17}$$

At t_1, during time Δt, the distance that this particle actually travels (ΔL) is:

$$\Delta L = v\Delta t = \frac{rZeH}{Cm}\Delta t \tag{18}$$

However, to an observer who doesn't know that the mass of an object will increase while it's moving at high speeds (formula (15)), at t_1, he will expect the distance ΔL_0 to be

$$\Delta L_0 = \frac{rZeH}{Cm_0}\Delta t_0 \tag{19}$$

Figure 1 shows the D-shaped box of a cyclotron, a charged particle, ΔL and ΔL_0.

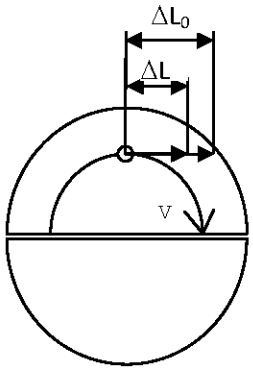

Fig. 1 A cyclotron

If $\Delta t=\Delta t_0$, from formulas (15), (18) and (19), we get

$$\Delta L = \Delta L_0\sqrt{1-v^2/C^2} \tag{20}$$

This means that at the moment of t_1, the observer finds that during the same period of time, the distance that the particle actually covers is shorter than he expected. However, because he doesn't know that this is caused by formula (15), he misunderstands it as "space shortening."

The origin of formula (20) is formula (15), that is, the higher the speed, the larger the mass is. The explanation of formula (20) is also consistent with our daily experience: if the mass of an automobile is larger than the other one's, its speed will be lower, and it will cover shorter distance during the same time.

If $\Delta L=\Delta L_0$, from formulas (15), (18) and (19) we can obtain the following:

$$\Delta t = \frac{\Delta t_0}{\sqrt{1-v^2/C^2}} \tag{21}$$

That is, at t_1, the observer sees the above particle and finds that, to cover the same distance, the time that the particle actually spends is longer than he expected. Because he doesn't know that this is caused by formula (15), he misunderstands it as "time slowing down."

The origin of formula (21) is also formula (15), that is, the higher the speed, the larger the mass is. The explanation of formula (21) is in accord with our daily experience: if the mass of an automobile is larger than the other one's, its speed will be lower, and it will spend longer time in covering the same distance.

Formula (20) and formula (21) are just the length formula and time formula of Relativity which are derived by the new method introduced in this paper. They bring us a new way to comprehend Einstein's time and space.

Discussion

The first question to be discussed is that, why two different spacetime views can lead to completely identical formulas?

The author's preliminary thought (for reference only, not yet summarized into a new paper) is that, Lorents transformation and $E=\xi m$ are equivalent in the process of deriving the formulas of Relativity; besides, Einstein's hypothesis ② is used in both two methods. Therefore, the same formulas can be derived by using two different methods.

The second question is about the explanations of formula (3) and formula (4). According to Einstein's spacetime, formula (3) and formula (4) are explained as: while an object is moving at high speed, space shortens and time slows down.

The basis of the above explanation is **π**-meson decaying experiment, this explanation can derive redshift formula [6].

But the author considers that these bases have shortcomings:

(1) "**π**-mesons with higher energy are easily to be observed" and "time slowing down" are two independent and disrelated matters. To correlate them together lacks quantitative experiment report.

(2)The author's another unpublished paper indicates that redshift formula [6] can also be derived by applying the spacetime view in this paper.

This paper gives us actual and reasonable explanations of formulas (3) and (4) because it is based on true and quantitative experiment results [5] of accelerators which are under stable state.

The third question is the relation between this paper and Einstein's. The author will employ a metaphor to illustrate it. That is, Einstein led us to a brilliant peak, but after we arrive at the top, we find a shortcut when we look back.

Conclusion

(1)Einstein's formulas can also be derived if the hypothesis of "permanence of light velocity" is abandoned.

(2)The explanation of formulas (14) and (15) is that energy is a form of expression of mass.

(3)The interpretation of formulas (20) and (21) is that, an observer does not know the fact that the mass of an object will increase while it's moving at high speed, he will 'find' that space shortens or time slows down. And of course this is a misunderstanding.

(4)This paper makes Relativity simpler and easier to understand.

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