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Interpretation of the results of the special theory of relativity on the base of classical mechanics

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(Received 10 October 2010, accepted 25 March 2011)

Abstract
Einstein's Special Theory of Relativity (SRT) is examined the behaviour of a quantum of light in the vacuum. According to second postulate of SRT, the speed of a quantum of light is an universal constant value. In this paper we showed another derivation of equations for mass and energy of a particle on the second postulate of theory of special relativity.

Keywords: Special Theory of Relativity, Physics Education.

Resumen
En la Teoría Especial de la Relatividad de Einstein (TER) se examina el comportamiento de un cuanto de luz en el vacío. Según el segundo postulado de la TER, la velocidad de un cuanto de luz es un valor constante universal. En este trabajo se muestra otra derivación de las ecuaciones de masa y energía de una partícula en el segundo postulado de la Teoría de la Relatividad Especial.

Palabras clave: Teoría Especial de la Relatividad, Educación en Física.

PACS: 03.30.+p, 01.40.Fk **ISSN 1870-9095**

I. INTRODUCTION

There is growing interest of students to modern physics topics, such as Einstein's Special Theory of Relativity (SRT). However, students have several difficulties in understanding this topic. According to Arriassecq and Greca [1], when we consider the students' everyday experience, the traditional mechanics taught in high school, which is considered to be more intuitive than the SRT [1]. Much research shows the students'difficulties on this topic [2, 3].
Second postulate of Einstein's Special Theory of Relativity (SRT) is examined the behavior of a quantum of light in the vacuum. According to second postulate of SRT, the speed of a quantum of light is an universal constant value [1, 2]. However, in this paper we will show that it is possible to prove that there is universal constant value between energy and mass of body even within the framework of classical mechanics.

II. METHOD

It is possible to show that there is universal constant value between energy and mass of body even within the framework of classical mechanics.

We will proceed from the well-known equality between the change in the energy dE and the work with the displacement of the body:

$$dE = vdp, \tag{1}$$

let us rewrite equation (1) in the form:

$$dE = \frac{dp^2}{2m}, \qquad p = mv, \tag{2}$$

for to simplify , we consider the classic case of m=m_0 , the general case is proved in [4], then equation (2) takes the form:

$$d(E - \frac{p^2}{2m_0}) = 0,$$

hence:

$$E - \frac{p^2}{2m_0} = E_0, \tag{3}$$

where E_0 is a constant of integration and equal to rest energy of the body, which has velocity v_0. Let us rewrite equation (3) in the form:

$$\frac{v^2/2}{E_0}=\frac{(E/E_0-1)}{m_0}\frac{a}{a}, \qquad a\neq 0. \tag{4}$$

Here value *a* is the unknown value, which to ensures the equalities of the denominators of relations and, therefore numerators from (4):

$$E_0=m_0a\,, \tag{5}$$

$$\frac{v^2}{2}=a(\frac{E}{E_0}-1)\cdot \tag{6}$$

Based on the Eqs. (5) and (6) the following results are obtained:

1. E_0 is not depended on the speed of the particle from equation (5).
2. The left side of equation (6) is depended on the speed, hence, right side of equation is also depended on the speed. Since the value *a* is not depend on the speed, only E/E_0 is depended on the speed, *i.e*.

$$\frac{E}{E_0}=f(v) \tag{7}$$

3. The left side of Eq. (6) is not depended on the mass, hence, right side of equation is also not depended on the mass. Consequently only for the speed dependence of E/E_0, the value *a* is not depended on the mass. Thus, in the framework of classical mechanics, value *a* is proven to be a universal constant that is not depended on either speed or the mass.

When Eq. (5) is taken into consideration, we can rewrite (7) as:

$$E=ma, \tag{8}$$

where

$$m=m_0f(v)\,, \tag{9}$$

By the classical expression of the total energy E from equation (6), and the exact classical expression of the mass from equation (2) we can write:

$$E=E_0+\frac{m_0v^2}{2}=E_0+E_{kin.}\,, \tag{10}$$

$$m_{class.}=m_0(1+\frac{v^2}{2a})\cdot \tag{11}$$

Indeed, from equation (1) we can obtain the equation:

$$adm=v^2dm+\frac{m}{2}dv^2\,, \tag{12}$$

and we found the following solution to the last equation,

$$m^2=\frac{m_0^2}{1-v^2/a}\,, \tag{13}$$

$$E^2=\frac{E_0^2}{1-v^2/a}\,, \tag{14}$$

or

$$v^2=a(1-\frac{m_0^2}{m^2})=a(1-\frac{E_0^2}{E_2})\cdot \tag{15}$$

When the $v=0, m_0$ coincides with a mass in the Newtonian definition, but it is different from the exact classical expression m_{class}..

III. RESULTS

Equation (15) implies that all particles can be divided into two groups:

1) The particles have no rest mass ($m_0=0$) and hence, moving with a large energy and constant velocity $v_{\max}^2=a$
2) The particles, have a rest mass that are moving slower speed than $v_{\max}(v<v_{\max})$

The particles have no rest mass, including the photon, are moved at the maximum and constant speed $v_{\max}=\sqrt{a}=c$.

In this case, our results go over into the results of Einstein's Special Theory of Relativity [5, 6, 7]:

$$m=\frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}\,, \qquad E=mc^2\,.$$

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