On Superluminal Particles

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A simple proof for the existence of superluminal particles is given.
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I. INTRODUCTION

Consider the division of all Natural phenomena into two distinct sectors, i.e., subluminal and superluminal. In subluminal sector, particles travel with speeds less than or equal to the speed of light, c. In superluminal sector, particles travel with speeds greater than c. The correctness of special theory of relativity (STR) in subluminal sector is confirmed by innumerable experiments. STR is so rigid that it does not admit superluminal particles though it can not exclude their existence. There are various authors who have considered superluminal phenomena like tachyons [1–4], superluminal reference frames and generalized Lorentz transformations [4], etc. Also see [5] and references therein.

The present paper is based on an observation that assuming the existence of a constant speed (speed of light) in Newton's definition of force and energy leads to the Einstein's relativistic mass formula and mass-energy relation valid in the subluminal sector. Similarly, assuming the existence of a constant mass parameter leads to a new "relativistic" mass formula valid in the superluminal sector. It is possible to assume the existence of a constant mass parameter because Newton's definition of force and energy has the flexibility to do so as it will be shown below.

II. DERIVATION OF RELATIVISTIC MASS FORMULA IN A NEW WAY

As it is well-known that force is rate of change of momentum, i.e.,

$$F = \frac{dp}{dt} = \frac{d(mu)}{dt}, \qquad (1)$$

where, $p = mu$ is momentum, m is mass, u is velocity and t is time.

Force multiplied by displacement is work done given by

$$dE = u^2 dm + mudu, \qquad (2)$$

where, $u = |u|$.

If one assumes the existence of constant speed, c (speed of light), then the above equation becomes

$$dE = c^2 dm. \qquad (3)$$

Equations (2) and (3) are same. Equation (3) is just written in terms of c. In order to find the relation among m, u and c, equating (2) and (3), one gets

$$c^2 dm = u^2 dm + mudu, \qquad (4)$$

Integrating the above equation, one obtains the well-known result,

$$m = m_0 \left(1 - \frac{u^2}{c^2}\right)^{-\frac{1}{2}}, \qquad (5)$$

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where, m_0 is the integration constant identified with the rest-mass of a moving particle. Integrating (3) results

$$E = (m - m_0)c^2, \tag{6}$$

where, E is the well-known kinetic energy of a moving particle in the subluminal sector.

III. SUPERLUMINAL PARTICLES

Notice that in (2), energy depends upon speed and mass. By assuming the existence of a constant speed and keeping the mass as a variable, one arrives at the relativistic mass formula valid in the subluminal sector. Still there is one more possibility of keeping mass as a constant and speed as a variable. We explore this second possibility. Postulating the existence of a constant mass parameter, M, (2) becomes

$$dE = M u du. \tag{7}$$

(7) is just another form of (2) written in terms of M. In order to find the relation among M, m and u, equating (2) and (7), one gets

$$M u du = u^2 dm + m u du. \tag{8}$$

Integration of the above equation yields

$$m = M\left(1 - \frac{c}{u}\right), \tag{9}$$

where, c is a constant arising out of integration and identified with the speed of light. As it is clear from the above equation, $u \geq c$ because m is positive or zero. This suggests the existence of superluminal particles in Nature. One reason they are not yet detected means that they must be interacting with the subluminal matter very very weakly.

Kinetic energy of superluminal particles can be obtained by integrating (7) as,

$$E = \frac{1}{2}M u^2 - \frac{1}{2}M c^2. \tag{10}$$

The above equation can also be written as follows;

$$E = \frac{p^2}{2M} + cp, \tag{11}$$

where, $p = |p| = mu$, or

$$E = \frac{1}{2}M c^2 \left[\left(1 - \frac{m}{M}\right)^{-2} - 1\right]. \tag{12}$$

When m/M is very small, (12) reduces to $E = mc^2$.

When $\frac{(u-c)}{c}$ is very small, (10) can be approximated as

$$E = M c^2 \frac{(u-c)}{c} = mc^2. \tag{13}$$

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IV. CONCLUSIONS

In the present paper, I have shown that all physical phenomena in the sublumibal sector is preserved in accordance with the special theory of relativity. Speed of light is a constant but not an upper bound. Where special theory of relativity ends, there the present superluminal theory starts.

When Big-Bang occurred, considerable amount of matter might have been thrown into the superluminal sector. These superluminal particles pervade entire cosmos.

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