

## RE-CONSIDERATION OF EINSTEIN EQUATION $E = mc^2$

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### Abstract

The basic principle of conversion of mass into energy is explained with Einstein's equation  $E = mc^2$ . This equation is examined with the help of the presence of strings in the space and elementary particles are formed from them. Rest mass is associated with the structural part of strings and hence the energy liberated is vibrational. The close relation between electric field and vibrational energy suggests that the energy released is related with electromagnetic fields and it turns out that the constant of proportionality  $c^2$  is originated from the permittivity constant  $\epsilon_0$  and the degree of magnetization of the space  $\mu_0$ .

In the special theory of relativity, the rest mass of the body and

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energy is not considered independent, but they are related with the equation

$$E = mc^2, \quad (1)$$

where  $c$  is the velocity of light. The energy liberated is often called rest mass energy as there is no motion associated with the above equation. The equation (1) is accepted, even though, it is not proved vigorously and the rest mass is also not well defined. This indicates that the matter simply by having mass has an inherent energy which is known as rest energy and it is convertible to other forms of energy. Conversion of mass into energy is mainly detected in nuclear reactions, particularly, nuclear fission. It is worth to point out that in some reactions the number of nucleons does not change before and after the reaction [1]. A typical example is uranium 235 when it is hit by a neutron; it splits into several nucleons. The number of nucleons before and after is 236 [1]. Then it is interesting to examine from where the energy is liberated.

The elementary particles are constituted from vibrating strings [1, 2] and each particle has specific construction which creates a specific mode of vibrations characteristic of that particle. In the present investigation, we will examine this aspect with respect to the electron and can be extended to other systems with specific alterations.

According to electrodynamics, the observed mass of the electron consists of two parts [3]. The first contains non-electromagnetic part or the structural part based on the cohesive force of the components. The second part is based on electromagnetic energy which deals with the generation of electric and magnetic fields. In equation (1), it is not mentioned which part of the mass is converted into energy and what is the mechanism behind it.

According to the string theory [1, 2] elementary particles are constructed with the specific arrangement of vibrating strings indicating

that a considerable energy is concentrated in a small area. The form of energy is vibrational and it is not only concentrated in the structural part but it induces vibrations in the compact fluid of strings. This view explains several aspects of electricity and magnetism and it is extensively discussed earlier by Joshi [4-6].

When the mass of the particle is shattered, strings forming the structural part including D-branes are separated and a considerable amount of vibrational energy is liberated associated with strings. This is the cohesive energy of the system which is formed from strings and it is proportional to the total rest mass  $M_{\text{rest}}$ .

$$M_{\text{rest}} = K_{\text{coh}} M_{\text{de-str}}. \quad (2)$$

$K_{\text{coh}}$  is a cohesive constant related with the formation of the particle from strings and  $M_{\text{de-str}}$  is the mass related with decoupling of strings. It is difficult to estimate the amount of mass converted into energy as the details of the structure of the elementary particles, the manner in which strings are combined with each other to provide a definite composition is not known.

Certainly, energy liberated is related with the structural component of the mass. Large amount of energy in a very small region means the presence of very high density of energy. Obviously, energy will flow towards the low density region. As revealed earlier that the vacuum is not an empty space but it is filled with compact, incompressible liquid of strings and energy flows outside through these compact vibrating strings [7]. The energy liberated is proportional to the rest mass or the structural part of strings which forms the particle.

String theory is associated with Gauge fields which are responsible for electromagnetism. Stoke's shift is originated from vibrational energy and it is altered in the presence of electric field. When the built in electric field produced near quantum well structure, a considerable variation in

Stoke's shift is detected [8]. This suggests the close relationship between vibrational energy and electric field in conversion process. Moreover, the recent investigation about the correlation between electro-magnetic fields and vibrations of strings confirms the above principle [4-6].

The amount of energy liberated is converted instantaneously into electric and magnetic energy because of its close relation with vibrational energy. The capacity of converting into electro-magnetic energy depends upon the medium (in the vacuum). The capability of vacuum to permit electric field depends upon the permittivity constant  $\epsilon_0$  and degree of magnetization  $\mu_0$  [9]. The motion of electric field creates magnetization  $\mu_0$ . This is a vector quantity which measures density of induced dipole moment  $\mu_0$ . Permittivity is the measure of a material's ability to store an electric field in the medium. Therefore, the magnitude of electro-magnetic energy,  $E$ , liberated in the space is  $E\mu_0\epsilon_0$ . It is worth to point out that the mass used is given by equation (2). Therefore

$$E\mu_0\epsilon_0 = M_{\text{rest}}. \quad (3)$$

As  $1/\mu_0\epsilon_0 = c^2$ , the equation (3) becomes

$$E = K_{\text{coh}} M_{\text{de-str}} c^2. \quad (4)$$

Equation (4) is similar to equation (1) except that the constant  $K_{\text{coh}}$  is introduced and the rest mass  $M_{\text{rest}}$  is found to be related with the decoupling of strings which form the elementary particle. Moreover,  $c$ , the velocity of light appears in equation (4) because of the capability of vacuum to electric field and the degree of magnetization converted from the vibrating energy of strings. In addition to these details, stick-slip process give rise to self-excited vibrational system in the space. It turns out that the velocity of light is related with universal constants namely the length of string ( $10^{-35}$  meters) and Planck's force constant

( $10^{44}$  Newton) [11]. In short, the present work not only provides the origin for mass-energy relation but also supports the presence of vibrating energy in the space as predicated earlier [4-6, 10, 11].

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