

Electric Charges as Energy Pairs

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Abstract

The kinetic energy of a moving mass is attributed to the mass increase because of its velocity. Thus, mass is recognized as a special form of energy.

As will be shown in this article, there are similarities between mass and charge which might lead us to conclude that charge should also be considered as a special form of energy.

Thus, this article does claim that **Charge might also be recognized as another form of Energy, as mass turned to be**. This claim, if found viable, and supported by additional findings, will make Energy as the only distinct entity (in addition to time and space), **a simpler and cleaner view of nature**.

Also, this article suggests the following:

1. Analogous to the equation:

$$E = m c^2 \quad \text{where } E \text{ is energy, } m \text{ is mass and } c \text{ is the speed of light.}$$

derived by the special theory of relativity, which describes the relation between the **energy** embedded in mass and **mass magnitude**, this article **suggests** the equation :

$$E = K q \quad \text{where } K \text{ is a constant factor and } q \text{ is the charge magnitude.}$$

This equation might describe the relation between the **energy** and **charge magnitude**.

2. Since charge comes in two types, a positive charge and a negative charge, then the energy embedded in charge also comes in two energy types.

This might be one of the crucial reasons why it was difficult to recognize charge as another form of energy.

However, the article provides a logical explanation to this issue. The article also assigns these energy types to one set of Energy Pairs.

This Energy Pairs Theory is also used to explain why in the electron and positron collisions the charges completely disappear.

Introduction

Mass is recognized as a special form of energy. It is not constant and mass increases by velocity according to: (Ref 1)

$$m = m_0 / (1 - v^2/c^2)^{1/2} \quad \text{where } c \text{ is the speed of light.}$$

And it can be converted to energy according to: (Ref. 2)

$$E = m c^2 \quad \text{where } E \text{ is energy, } m \text{ is mass and } c \text{ is the speed of light.}$$

As will be shown in this article, there are similarities between mass and charge which might lead us to conclude that charge should also be considered as a special form of energy.

Thus, this article does claim that **Charge might also be recognized as another form of Energy, as mass turned to be.** This claim, if found viable, and supported by additional findings, will make Energy as the only distinct entity (in addition to time and space), **a simpler and cleaner view of nature.**

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However, the article provides a logical explanation to this issue. The article also assigns these energy types to one set of Energy Pairs.

This Energy Pairs Theory is also used to explain why in the electron and positron collisions the charges completely disappear.

When an electron and a positron collide they annihilate each other and gamma ray photons are emitted, with energy equal to the sum of the energies embedded in the masses of the electron and the positron.

However, the charges of the electron and the positron are not converted to any new substance (such as energy) and they simply disappear without leaving any trace of their previous existence.

This charge disappearance seem to be an unusual, strange and unexpected mystery, although this charge disappearance obey the charge conservation principle. This charge disappearance is strange, because charge seem to be a basic element in physics, and such basic elements should not disappear.

The Energy Pairs mentioned above provides a reasonable and logic explanation to this charge disappearance mystery. This is done by assuming that Energies belonging to Energy Pairs, might, in certain situations, cancel each other if they coexist in the same space volume.

Review of Energy densities equations

The embedded energy per unit volume in the electric field u_e is provided by the following formula: (Ref. 7)

$u_e = \epsilon_0 |E^{->}|^2 / (2)$. Where $E^{->}$ is the electric field magnitude in the unit volume, and ϵ_0 is the vacuum permittivity and is equal to: $8.854187817... \times 10^{-12}$ F/m (Farad per meter)

Since, for a non moving point charge q_0 ,

$|E^{->}| = (1 / (4\pi \epsilon_0)) (q_0 / r^2)$ Where q_0 is the non moving point charge magnitude and r is the distance from the non moving point charge to the location of the unit volume. (Ref 3), then,

$$u_e = (1 / (32 \epsilon_0 \pi^2)) (q_0^2 / r^4)$$

If we denote $K = 1 / (32 \epsilon_0 \pi^2)$ then

$$u_e = (K q_0^2) / r^4$$

Since K is a constant and r^4 is dependent only on the unit volume in space where $E^{->}$ resides, then, u_e , the embedded energy per unit volume in the electric field, is directly dependent and is directly proportional only to the square of the magnitude of the non moving point charge q_0 that generated $E^{->}$.

Similarly, the embedded energy per unit volume in the magnetic field u_m is provided by the following formula: (Ref. 6)

$u_m = |B^{->}|^2 / (2 \mu_0)$. Where $B^{->}$ is the magnetic field in that volume unit and μ_0 is the vacuum magnetic permeability and is equal to: $4\pi 10^{-7}$ H/m (Henry per meter).

Since, for a moving point charge q ,

$$|B^{->}| = (\mu_0 / (4\pi)) (qv \sin \alpha / r^2) \quad (\text{Ref 4}).$$

Where q is the moving point charge magnitude that generated the magnetic field $B^{->}$ moving at the velocity v , and α is the angle between v and the line connecting that moving charge to that volume unit.

then,

$u_m = (\mu_0/(32\pi^2))(q^2 v^2 \sin^2 \alpha / r^4)$ and since $\mu_0 = 1/(\epsilon_0 c^2)$ (Ref 4), and, $v \sin \alpha$ is the velocity component that is perpendicular to the line that connects the external spectator to the moving point charge q , and thus, can be denoted V_1

then

$$u_m = (1/(32 \epsilon_0 \pi^2))(q^2 (V_1^2/c^2)/r^4)$$

since we already denoted $K = 1/(32 \epsilon_0 \pi^2)$ then,

$$u_m = (K q^2 (V_1^2/c^2)) / r^4. \quad \text{Denoting } x = (V_1^2/c^2), \quad \text{then,}$$

$$u_m = (K q^2 x) / r^4 \quad \text{and as shown above } u_e = (K q_0^2) / r^4$$

Both equations, u_m and u_e , have exactly the same structure, only u_m contains $q^2 x$ as its generation source and u_e contains q_0^2 as its generation source.

Also, it turns out that what generates u_e is q_0^2 and what generates u_m is a fraction of q^2 since x spans from 0 for $v=0$ to a maximum of 1 when $v=c$. Thus, these equations already imply that charge should be the energy embedded in the electric and magnetic fields. Because, the only components in these equations that can be considered as containing the energy are q_0^2 and q^2 . Since, all the other components in these equations are either constants, or components that depend only on the location in space where these energy densities reside.

Arguments why charge might be also Energy

At this point we can refer to the reasons why we claim that charge might also be considered as another form of energy.

In the previous paragraph we already claimed that the only components in the energy densities equations of the electric and magnetic fields u_e and u_m that can be considered as containing the energy, are q^2_0 and q^2 .

Indeed, u_e and u_m are the energy density embedded in the electric and magnetic fields and not in the charges that generated these fields.

But, according to Ref 8 "The gravitational field of a point mass and the electric field of a point charge are structurally similar" and when analyzing "the energy density for the electric field, and a similar expression" which "represents the energy density for the magnetic field, no such energy density term has ever been defined for the gravitational field. But one suspects that it could be, and possibly even should be".

Also, Ref 8 does provides an expression for the energy density in the gravitational field in which m^2 (the square of the mass magnitude) can be considered as the only component containing the energy, as q^2_0 and q^2 are the only components that can be considered as containing the energy densities u_e and u_m in the energy density equations for the electric and magnetic fields.

And, since mass is already recognized as being another form of energy, it implies that the energy in the mass is also manifested in the energy density of the gravitational field.

Thus, analogous to the above, the fact that the only components in the energy densities equations of the electric and magnetic fields u_e and u_m that can be considered as containing the energy, are q^2_0 and q^2 , should also imply that this energy density is a manifestation of the energy embedded in the charge, and that the charge is also another form of energy.

In addition to that, modern physics sees the detection of magnetism by a spectator external of a moving charge, as a combination of maxwell equation and special relativity. And, analogous to the detection of magnetism by a spectator external to a moving charge, a spectator external to a moving mass sees a phenomenon denoted as gavitational electromagnetism (GEM), which is the analogy of magnetism in gravitation (Ref 12).

Thus, structural similarities between mass and charge extends beyond the case of stationary masses and stationary charges, as described above.

These strong similarities between mass and charge, strongly implies that charge might also be a form of energy, as mass turned to be.

Indeed, there are also differences between mass and charge.

An external spectator to a moving mass sees an increase of this mass. On the other hand, because of the charge invariance principle, charge does not increase by velocity.

Also, masses are usually positive entities and always attract each other, while charge comes as positive and negative charges and different signed charges attract each other while similar signed charges repel each other.

Also, masses can be converted to energy, while, according to the charge conservation principle, the total number of positive and negative charges must balance each other, such that only one type of charges cannot be eliminated alone.

Also, equations such as $P = m V$ or $F = m a$ do not exist in the case of charges.

However, these differences do not cancel the similarities between charge and mass presented before, and do not cancel the possibility that charge might be also another form of energy, implied by the similarities between charge and mass described above.

However, these differences might provide additional difficulties for finding the exact relation between charge and its embedded energy, analogous to the equation

$E = m c^2$ found for mass.

However, since Energy is proportional to mass by a constant factor (c^2), analogous to the equation:

$E = m c^2$ where E is energy, m is mass and C is the speed of light.

derived by the special theory of relativity, which describes the relation between the **energy** embedded in mass and **mass magnitude**, this article **suggests** the equation :

$E = K q$ where K is a constant factor and q is the charge magnitude.

This equation might describe the relation between the **energy** and **charge magnitude**.

The Energy Pairs Theory

Since charge comes in two types, a positive charge and a negative charge, then the energy embedded in charge also comes in two energy types.

This might be one of the crucial reasons why it was difficult to recognize charge as another form of energy.

However, the claim that charge is another form of energy can be used to provide an explanation to the following:

When an electron and a positron collide they annihilate each other and gamma ray photons are emitted, with energy equal to the sum of the energies embedded in the masses of the electron and the positron. However, the charges of the electron and the positron are not converted to any new substance (such as energy) and they simply disappear without leaving any trace of their previous existence. This charge disappearance seem to be an unusual, strange and unexpected mystery. In interactions of particles that do not contain any charge, sometimes parts of the masses are converted to energy, but nothing disappears.

A logical explanation to that paradox might be the assumption, that certain energies, such as the energy embedded in charges, come in an Energy Pair form, such that the member in that pair that has smaller intensity, can cancel the amount of energy of the other member in that pair which is equal to its energy intensity, if both happen to coexist in the same space volume.

From the above, it is obvious that the Energy Pair embedded in charges contains the following two energy types: one type is the energy embedded in positive charges, the other type is the energy embedded in negative charges.

The Energy Pairs assumption is actually derived from the findings that charge is another form of energy, because such energy must have two values, one for the energy attributed to positive charges, and one for the energy attributed to negative charges.

The assumption that certain energies can cancel each other is not a new concept in physics. According to Ref 9, the energy embedded in the gravitational fields, in the whole universe, is now considered to be a negative energy, such that it offsets completely the energies embedded in the masses, in the whole universe, such that the net energy of the universe which relates to masses and gravitational fields is zero.

This fits with the assumption that the energies embedded in charges belong to one set of Energy Pairs, and, if the charge conservation principle holds, the net energy embedded in charges, in the whole universe, is again zero.

On the other hand, according to Ref 8, we already showed that Ref 8 defined an equation for the energy density in the gravitational field. If we adopt the idea presented in Ref 9 that this energy density is a negative energy, then, we should conclude also that the energy embedded in the mass and the energy embedded in the gravitational field belong also to an Energy Pair.

Also, the energy in the charge and the energy in the electric field or magnetic field should also belong to an Energy Pair.

Also, as Ref 10 implies, modern physics is evaluating the concept of negative mass. Ref 11 even informs that it may be that physicists created "negative mass". If the notion of negative mass is found to be a viable concept, it further increases the similarities between mass and charge, as related to energy. Then, since mass is already recognized as a special form of energy, this increases the possibility that charge should also be recognized as a special form of energy.

Summary, Results and Conclusions

Before the presentation of the special theory of relativity, the science of physics recognized actually three distinct entities: energy, mass and charge (apart from time and space).

After the presentation of the special theory of relativity, the mass ceased to be a distinct entity, and it is recognized as a special form of energy. So, now there are only two distinct entities: energy and charge (apart from time and space).

Also, as shown in this article, there are similarities between mass and charge which might lead us to conclude that charge should also be considered as a special form of energy.

Thus, in regard to the above, the question why charge is still a distinct entity remains open.

This article deals with this question, by suggesting that **Charge might be also a special form of Energy.**

Thus, if charge will be recognized as a special form of energy, the Energy remains the only distinct entity (apart from time and space), which turns to be a much simpler and cleaner view of nature.

Also, analogous to the equation:

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derived by the special theory of relativity, which describes the relation between the **energy** embedded in mass and **mass magnitude**, this article suggests the equation :

$$E = K q \quad \text{where } K \text{ is a constant factor, and } q \text{ is charge magnitude.}$$

This equation might describe the relation between the **energy** and **charge magnitude**.

Also the claims that charge is a special form of energy brought about another concept, **the concept of Energy Pairs**.

This concept states that certain energies, such as the energies embedded in charges, should exist as pairs of energies, such that energies belonging to an Energy Pair might, in certain cases, annihilate each other, if both happen to coexist in the same space volume.

Moreover, the Energy Pairs concept was used to provide an explanation to an unresolved mystery of charge disappearance in electron positron collisions.

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