

On the Possible Structures of Electron and Proton

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Abstract

In this work, the possible structures of electron and proton have been explored. Based on the potential expressions of electron and proton, we found that the electron and proton share the similar structure inside r_e and r_p . And within r_e and r_p , the conventional charge concept stops working, the same charge repelling force doesn't exist anymore and as a result, the requirement of charge conservation is automatically removed. Whereas beyond r_e and r_p , the potential expressions of electron and proton obey the point charge potentials as we normally understand. Therefore, the conventional charge concept can be applied and the requirement of charge conservation takes effect. Furthermore, a possible mechanism for the creations of electric monopole and magnetic monopole is discussed. In addition, to compare the particle size in micro-world, the balloon criterion is proposed. By this balloon criterion, the proton is determined about 10 times bigger than electron. From the physical picture about electron and proton described above, the stabilities of electron and proton can be explained quite well.

Keywords

Electromagnetic Spacetime, Quantum Mechanics, Electron, Proton, Standard Model, Particle Physics, "Yin-Yang" Philosophy, Electric Monopole, Magnetic Monopole, Charge Conservation

1. Introduction

Since the electron has been discovered, scientists always try to elucidate its structure. Due to the shortage of the useful technique to reveal the structure of electron, at the beginning, scientists only can guess the structure of electron. The first proposed structure of electron is the soup structure or plum pudding model [1]. Then, the rigid spherical model, the deformable model... continuously appeared in litera-

tures [2]-[5]. But none of these proposed models can give satisfied explanation about the electron. This situation has no change even after the quantum mechanics is established.

Based on the quantum mechanics principle [6], the electron should have no volume, but the experimental scientists do get some evidence that the electron has a volume and mass, the radius of electron has been determined [7]. Now the fact that the electron is not a no volume point charge has been generally accepted in scientific field.

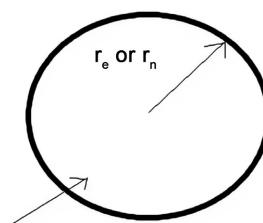
Recently, several scientific publications about the structure of electron appeared [8]-[13]. These scientific publications just offered the explanation about the structure of electron from the different angle of view. The situation becomes wherever the electron needs the volume and mass, then the particle concept of electron will be applied; wherever the electron needs no volume and mass, then the no volume point charge concept of electron will be applied. About the structure of electron, no consistent concept can be reached in scientific field yet.

The author paid attention to the structure of electron for a long time but recently, the author suddenly understands what the game the nature may play with the human beings about the structure of electron. In this work, the detail about the possible structure of electron will be presented.

2. Theory and Discussion

From **Figure 1**, we know the following facts about electron:

The Zone of Point Charge Electromagnetic Field



The Zone of the Compressed Electromagnetic Field

Figure 1. The Illustrations of electron and proton.

- 1) The electron has a radius, which is r_e (for proton, the radius is r_n);
- 2) The total energy of electron surrounded in r_e is $m_e c^2 - 1/r_e$;
- 3) Inside the sphere (radius is r_e), we only know its energy doesn't change with time;
- 4) About the structure of the sphere (radius is r_e), we know nothing but we do know the structure of electron inside the sphere (radius is r_e) should obey the quantum mechanics principle;
- 5) Our previous works demonstrate that our spacetime is the electromagnetic spacetime [14]-[18]. All matters in our universe are nothing but the compressed electromagnetic spacetime, which is experimentally evidenced by the annihilation

of electron and anti-electron (positron [19]);

6) Inside the sphere (radius is r_e), we don't know the detail about the compressed electromagnetic field but we do know from r_e on, the electromagnetic field follows the electromagnetic field of point charges [20];

Based on the above facts, we can get the Hamilton Operator and wave function of electron ($r \leq r_e$),

$$H = -\frac{\hbar c \lambda}{2\pi} \nabla^2 + p(r) \tag{1}$$

$$\text{and } \varphi(r) = A e^{-(m_e c^2 - 1/r_e)r} = A e^{-kr} \quad (r_e > 0 \text{ and } r \leq r_e, \quad k = m_e c^2 - 1/r_e) \tag{2}$$

Normalization:

$$\begin{aligned} \int_0^{r_e} A^2 e^{-2kr} d\tau &= A^2 \int_0^{r_e} e^{-2kr} r^2 \sin \theta dr d\theta d\phi \\ &= A^2 \left[-\frac{1}{2k} e^{-2kr_e} r_e^2 - \frac{1}{2k^2} e^{-2kr_e} r_e - \frac{1}{4k^3} e^{-2kr_e} + \frac{1}{4k^3} \right] 4\pi \end{aligned} \tag{3}$$

$$A = \pm \frac{1}{\left[4\pi \left(-\frac{1}{2k} e^{-2kr_e} r_e^2 - \frac{1}{2k^2} e^{-2kr_e} r_e - \frac{1}{4k^3} e^{-2kr_e} + \frac{1}{4k^3} \right) \right]^{1/2}} \tag{4}$$

To determine the potential distribution in the sphere (radius is r_e),

$$H\varphi(r) = k\varphi(r) \tag{5}$$

$$\left[-\frac{\hbar c \lambda}{2\pi} \frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial}{\partial r} \right) \right] \varphi(r) + p(r)\varphi(r) = k\varphi(r) \tag{6}$$

$$-\frac{\hbar c \lambda}{2\pi} \left[\frac{2}{r} \varphi'(r) + \varphi''(r) \right] + p(r)\varphi(r) = k\varphi(r) \tag{7}$$

$$-\frac{\hbar c \lambda}{2\pi} \left[-\frac{2k}{r} + k^2 \right] \varphi(r) + p(r)\varphi(r) = k\varphi(r) \tag{8}$$

$$p(r) = k + \frac{\hbar^2 c^2}{2\pi} \left[k - \frac{2}{r} \right] = 5383.3 \times 10^4 - \frac{2907.6}{r_e} - \frac{5813.2}{r} \quad (r \leq r_e) \tag{9}$$

Till now we still do not assign the value to r_e but now we can determine the value of r_e by the continuity requirement of potential at the boundary of the sphere surrounded by r_e , that is,

$$p(r) = -\frac{1}{r_e} \quad (r_e > 0) \tag{10}$$

$$5383.3 \times 10^4 - \frac{2907.6}{r_e} - \frac{5813.2}{r_e} = -\frac{1}{r_e} \quad (r_e > 0) \tag{11}$$

$$\text{Then, } r_e = 1.6198 \times 10^{-4} \text{ (a.u.)} \tag{12}$$

$$\text{Therefore, } p(r) = 3588.3 \times 10^4 - \frac{5813.2}{r} \quad (r \leq r_e, r_e > 0) \tag{13}$$

Based on the similar strategy, we can get the potential expression for proton,

$$p(r) = 9.8810 \times 10^{10} - \frac{2.9066 \times 10^3}{r_n} - \frac{5.8132 \times 10^3}{r} \quad (r \leq r_n, r_n > 0) \tag{14}$$

$$\text{At } r = r_n, \quad p(r) = \frac{1}{r_n} \quad (15)$$

Therefore,

$$9.8810 \times 10^{10} - \frac{2.9066 \times 10^3}{r_n} - \frac{5.8132 \times 10^3}{r_n} = \frac{1}{r_n} \quad (16)$$

$$r_n = 8.8248 \times 10^{-8} \text{ (a.u.)} \quad (17)$$

Now, $p(r)$ for proton can be expressed as

$$p(r) = 6.5874 \times 10^{10} - \frac{5.8132 \times 10^3}{r} \quad (r \leq r_n, r_n > 0) \quad (18)$$

Comparing the potential expressions for electron and proton, it is noticed that the expressions all consist of two terms, the first term is a positive constant, and the second one is distance dependent and negative term, which means the second term forms the attractive potential well in electron and proton cases. The existence of attracting term is counter intuitive to the conventional understanding because for electron and proton, due to they are composed of the same charge, only the repelling term should exist in the potential expressions.

In fact, inside of electron and proton, no charge concept should be applied because the concept of charge is created by the outside behavior of electron and proton, not inside electron and proton. As we pointed out in our previous works, our universe is nothing but the electromagnetic spacetime. All matters in our universe are the compressed electromagnetic spacetime. Under the compression, the electromagnetic spacetime will experience twisting, phase reversing and displacing, finally form the electron and proton. The whole process can be illustrated in **Figure 2** by taking the simple electromagnetic wave as example here.

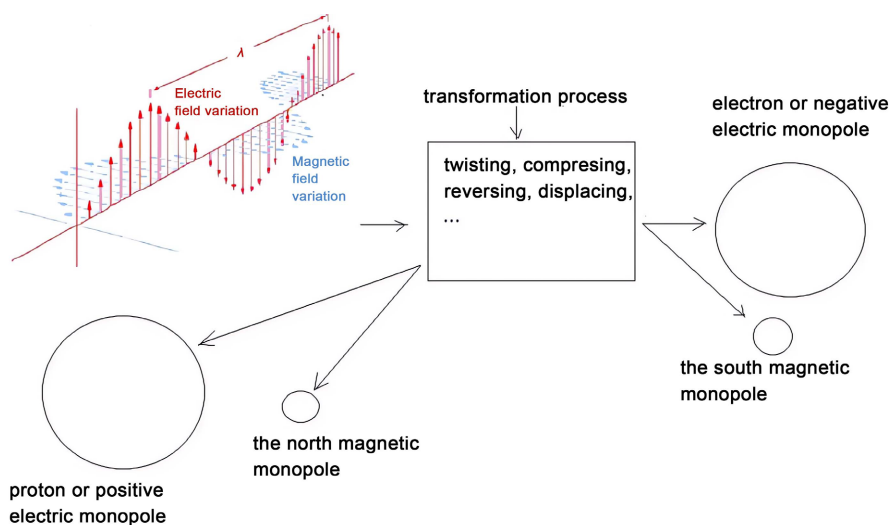


Figure 2. The transformation of electromagnetic spacetime under compressing.

It is interesting if we assemble the electronic part and magnetic part in **Figure 2** together, we find it is exactly the half “Yin-Yang” picture (**Figure 3**) [21]. Based

on this half “Yin-Yang” picture, we should conclude that there definitely exist the counter part of electron and proton, which is revealed experimentally [22], called positron and anti-proton. Then, whole “Yin-Yang” picture will be perfectly shown up.

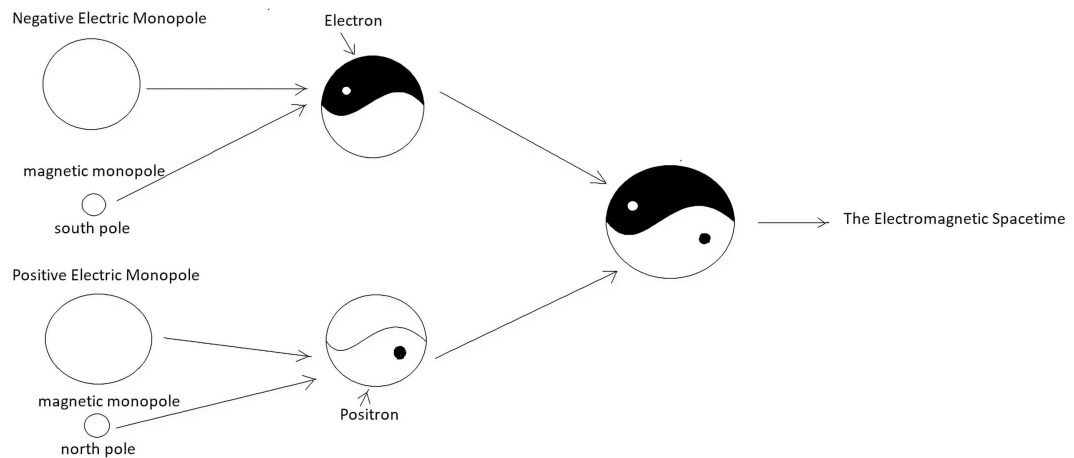


Figure 3. The Illustration of the transformation of the electromagnetic spacetime under compressing, twisting, displacing.

During the electromagnetic spacetime transformation, the “charge conservation” will be broken. Therefore, under extremely high compression condition, the “charge conservation” will become invalid.

From time to time, some researchers announced that they observed the magnetic monopole experimentally, but the existence of the magnetic monopole still needs further experimental support [23]. Based on our result above, we can see the magnetic monopole exactly exists inside of electron and proton. The electromagnetic spacetime is composed of electric part and magnetic part, the electric part and magnetic part of electromagnetic spacetime can’t be separated. Before the compression, the electromagnetic spacetime is as a whole entity, after the compression, the electric part of electromagnetic spacetime is changed to charge monopole (electron or proton), but the magnetic part of electromagnetic spacetime is changed to magnetic monopole (the south magnetic monopole for electron, north magnetic monopole for proton). The new electromagnetic entity consists of the electric and magnetic monopoles, the electric and magnetic parts in electromagnetic fields still exist as an entity together, never separated. It is surprised that the whole process of the electromagnetic spacetime during the transformation is exactly described in “Yin-Yang” picture several thousand years ago.

The first term in the expressions of potential for electron and proton comes from the confined kinetic parts of the electromagnetic spacetime during the electromagnetic spacetime transformation. As we know the electromagnetic spacetime keep constant speed, c , then the electromagnetic spacetime should carry the constant kinetics during the electromagnetic spacetime transformation. Only difference between electron and proton is the amount of the electromagnetic spacetime

involved in transformation under the compression. The potential of electron is just like the lake on the plain land, but the potential of proton is the lake on the highland (the difference in height between the plain land and high land depends on the first term in the potential expressions of electron and proton). The depths of the lake depend on the second term in the potential expressions of electron and proton. In our case, the depths of potential wells for electron and proton are the same.

Here we should stress that r_e and r_n determined above for electron and proton are not the sizes of electron and proton, the values of r_e and r_n just tell us that since where on, the potentials of electron and proton will behavior as a point charges (as we discussed above, the potentials of electron and proton include the contributions from the magnetic monopoles inside the electron and proton, just due to the insignificance of the contribution from the magnetic monopole inside electron and proton, usually, we select to ignore this insignificant contribution. It looks like only point charge or charge monopole exists but the magnetic monopole disappeared. Here we show it is not real situation.

From the discussion above, one may ask how the electron and proton keep stable. Based on our result here, outside the r_e and r_n , the electron and proton obey the point charge potential, therefore, in our electromagnetic spacetime, these point charges will cause the counter electric charge around the electron and proton, called "mirror" charge, it is the existence of "mirror" charge, keep the electron and proton stable, not collapse under attractive potential within the r_e and r_n .

The second question one may ask is how to compare the particle size in the microworld [24]-[29]. Most of people may think this is simple, just need to compare the size directly. In fact, in the microworld, the situation is different from the macroworld, because the size of particle will be different under different condition. Here we would like to propose a criterion for comparing the size of particle each other in the microworld, that is, take the size of electron as a standard to make the size comparison among the sizes of particles in the microworld. The reason to do so is just like for us to compare the sizes of balloons, we have to put the two balloons under the same pressure, then we can compare the sizes of two balloons, therefore, our method here also can be called as the balloon standard. Now we can compare the sizes of electron and proton,

$$\frac{m_n c^2 - \frac{1}{r'}}{\frac{4}{3}\pi r'^3} = \frac{m_e c^2 - \frac{1}{r_e}}{\frac{4}{3}\pi r_e^3} \quad (19)$$

$$m_n c^2 - \frac{1}{r'} = \left[\frac{m_e c^2 - \frac{1}{r_e}}{r_e^3} \right] r'^3 \quad (20)$$

Solving this equation, r' is determined as 2.2706×10^{-3} (a.u.). This value is about 10 times bigger than r_e of electron, that is, the proton is 10 times bigger than

electron. The r_n determined above about the proton is the boundary between the normal electromagnetic field (here it is the positive point charge) and the compressed electromagnetic field. It is also noticed that the r_n (8.8248×10^{-8} a.u.) is much smaller instead of bigger than the r_e (1.6198×10^{-4} a.u.) of electron. This means that compared to the electron, the proton is the entity with much high concentrated energy or compressed electromagnetic spacetime. It is interesting that the cosmologist prefers to describe this case as beyond r_e (r_n for proton), the electromagnetic spacetime is “flat”, whereas within r_e (r_n for proton), the electromagnetic spacetime is highly curved.).

The third question one may ask is that since the electron and proton obey the quantum mechanics principle, then, the electron and proton should have the excited energy state and there should have the quantized energy levels in electron and proton. Here we can list the ground and first excited states for electron and proton (**Table 1**).

Table 1. The energy level distribution for electron and proton.

The State Energy for Electron	Quantum Number	The State Energy for Proton
$\frac{m_e c^2 - \frac{1}{r_e}}{n^2}$	n	$\frac{m_n c^2 - \frac{1}{r_n}}{n^2}$
1.2341×10^4 (a.u.)	1	2.2663×10^7 (a.u.)
3.9675×10^3 (a.u.)	2	7.6842×10^6 (a.u.)

The r_e and r_n are energy level dependent, not constant. From the gap between the ground and first excited states, we know that the electron and proton are very difficult to be excited. That means both of electron and proton are very stable and the proton should be more stable (the gap between the ground state and the first excited state: 1.4979×10^7 (a.u.) than the electron (the gap between the ground state and the first excited state: 8.3735×10^3 (a.u.)).

3. Conclusion

In this work, the possible structures of electron and proton have been explored. It is found that electron and proton share similar structure inside r_e and r_n . Within r_e and r_n , the conventional charge concept becomes invalid. Consequently, the repelling force from the same charge doesn't exist and as a result, the requirement of charge conservation is automatically removed. But beyond r_e and r_n , the electron and proton obey the point charge potentials, the conventional charge concept can be applied and the requirement of charge conservation takes effect. Furthermore, a possible mechanism for the creations of electric monopole and magnetic monopole is discussed. In addition, to compare the particle size in micro-world, the balloon criterion is proposed. By this balloon criterion, the proton is determined about 10 times bigger than electron. From the physical picture about electron

and proton described above, the stabilities of electron and proton can be explained quite well. The further result will be presented later.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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