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Original Research Article

ZA models of neutron and proton in scale electric field originated by the Planck particle

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Abstract: A new ZA matter model has been established to explain why mass has the instinct property of electricity. It is shown that the pure energy particle to originate matter is an electric pulse called ZA0 and it was proved being the Planck particle. Matter formation was derived by theoretical analysis based on a suggested binary growth law of quantum mechanics. It is found that there is a smallest matter particle called as ZA1 with a same format of ZA0 but different size to form any other matter particles. Structures of electron, neutron and proton have been suggested and prediction of their mass meets experiments wonderfully. It was found that matter mass consists of two parts: one (a scale electric field) is electric pure mass coming from motion energy of the photon in minimum size and the other (the overlapped gravity field) coming from potential energy of the bent space. Sizes of basic matter particles were discussed based on the particle nature of isolated electric field. The size predictions can explain the weird experimental phenomenon that size of an electron is significantly larger than that of a neutron. It was found that electric charges in micro scale like γ-ray are represented at the zero potential nodes by opposite two momentum directions. It is shown by photoelectric effect experiments that electric force in micro by ZA model in form of light can be exchanged into the macro electric force to drive electrons in macro current. The proton ZA model can be applied to explain why many protons can be collaborated in a nucleus as the reactive binding force between protons and neutrons can overcome the electric repelling force between positive charges.

Keywords: electricity in mass; Planck particle; matter origination; neutron structure; nucleus structure

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1. Introduction

Nucleus structure has been a research hot topic in contemporary science for a long time and to understand mass origination is the key to make a breakthrough in particle physics and in development of nuclear energy technology. However, physical matter model has been in very poor development especially in mechanism how mass comes from pure energy by Einstein's theory[1]. Particle physics has a very close link with the development in cosmology. There have been many remarkable achievements in universe observations but very limited progress in theoretical physics over past 80 years. Observations need theory to interpret the experiments into physical conclusions so that some conclusions on basic particles such as bosoms and quarks by experiments are wrong to hind progress in mass nature[1,2]. Therefore, a new matter model is needed urgently to develop new theory in explanation of matter origination and of why mass has two instinct properties of electricity and gravity.

The standard models (SM) have dominated theoretical studies on the basic particles and nucleus for many decades, but the works are mathematic phenomenology rather than physical mechanisms[3]. SM tries to solve

Einstein dynamic equation in great difficulty by the gauge fitting theory in different the metrics and in physical figuration of the driving energy momentum tensor.

The solutions from the SM are the necessary motion behaviors but not sufficient conditions to define particle nature[4]. Solutions by phase field models on thermodynamic equations are probably more reliable to set up a matter model but there is few of them in publications. The quark theory according to SM relies on the experiment of electron diffractive pattern by neutrons, and the pattern shows quantum behavior of neutron but it is not sufficient to identify the quarks. The unified SM theory has defined the quarks in four flavors, 3 colors and 2 parity conjunction possibilities so that the constitution of the three features can make several ten quarks[5]. Therefore, the quark matter model looks too much artificial and there has not been any report on direct observation of any quarks indeed[6,7].

Intensive on unified SM studies have been carried out to explain experiment on basic particle observations. However, the studies have to accept failure to explain the observations because there have been more than a few hundred basic particles by experiment[1,2,7]. This suggests that the overrating unified SM theory should be challenged, and particle physics should not rely on mathematic work too much. It probably is the time to go back classical research methodology on physics, i.e., physicians imagine a model based on observations and then ask help from mathematicians.

An attempt will be carried out first to look for the Planck particle in new belief that the quantum mechanics rules play a more important role than the relativity law in matter origination. Theoretical logic will be applied then to derive basic particle models in belief that thermodynamic rules are more important than dynamic equation solutions to find structure of mass. A new ZA matter model will be established to explain micro electric mechanism, to explain why matter has two basic properties of electricity and gravity and to explain the rule of mass coming from energy. The ZA proton model will be used finally to discuss the structure of nucleus.

Present ZA models will be developed and discussed in the base of the following two basic rules:

$$E = hC/\lambda \tag{1}$$

where E is electrical energy, h is the Planck constant, C is light speed and λ is wave length of a ray[8].

$$E = C^2 m \tag{2}$$

where E is energy, C is light speed and m is mass[9].

2. Model of the pure energy particle ZA0

Einstein relativity theory and Hawking big-bang theory both believe in that matter comes from pure energy[1,10]. The quantum mechanics believes that Planck particle is the original base particle of matter and it also makes black hole[8,10]. Any correct matter model has to follow both laws to set up models of basic particles. However, the SM is not able to do so because the modeling is based on the solutions of only one dynamic equation with only one metric in a time. A new approach here must be attempted. A pure energy particle in minimum size was suggested in a name of ZA0 particle as shown in **Figure 1** following the relativity idea of Equation (2). The ZA0 is defined here as an electric pulse with a size of Planck length (1.62×10^{-35} (m)) so that its wavelength is the double of its size. The definition was so made because quantum mechanics has priority to guide present work. The electric energy (pure energy) of ZA0 particle can be found by Equation (1) if put its wavelength value into the equation. The mass of ZA0 can be found by Equation (2) as 6.82×10^{-8} (kg) if put its energy value into the equation. Quantum mechanics defined the Planck particle with a size of

Planck length and a mass of Planck mass value m_p ($m_p = \sqrt{\frac{\hbar C}{G}} = 2.18 \times 10^{-8}$ (kg))[10]. It is easy to find that ZA0 particle is the Planck particle because the size of the two particles is same and the mass of the two particles is surprisedly very close. To find physical model of the Planck particle makes present work one of remarkable achievements.

ZA0 is a scale of the electric field as shown in **Figure 1** and **(a)** is its image in an instant time, and **(b)** is its stereo image as its instant image alters position in the light speed 3-dimensionally. However, **Figure 1(a)** in its circuit identity can be regarded as its principle model the signal figure has included all of its features. The micro electric current in the circuit here is the movement of photons. The photon is suggested as a group of vacuum particles based on the string theory[11]. This micro electricity supplies a good mechanism for the concepts of vacuum energy and neutrino oscillation which are hot research topics in recent 10 years both theoretically[12] and experimentally[13].

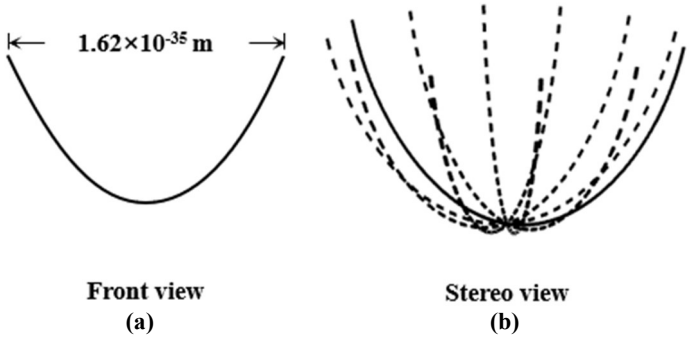

Figure 1. ZA matter model of ZA0 pure energy particle of electric pulse in electric current circuit diagram. **(a)** the principle model and **(b)** the stereo shape image.

3. Logical derivation of basic matter particle formation by ZA0 particle

ZA matter model is established following the quantum mechanics law that matter is originated by the Planck ZA0 particles. Any sensible matter particle needs astronomical number of ZA0 particles to make it because of the extremely tiny size of ZA0. This is naturally impossible because the structure of the sensible particle would be a random if there were too many the constitutive particles making countless possibilities. Therefore, the ZA0 particles must grow big into a critical size to be the constitutive particles called as ZA1 particle by present work. Astronomical number of ZA particles in size between ZA0 and ZA1 will be given a name of ZA0.xx particles.

Quantum mechanics predicts that Big-Bang will result in a highest Planck temperature[8,10]. Free energy of ZA0.xx particles can be calculated by the following equation[14]:

$$F = U - TS \tag{3}$$

where F is free energy, U is the inner energy, T is temperature, and S is entropy. Both inner energy and entropy of ZA0.xx during Big-Bang were very tiny compared with the temperature so that its free energy was minus by Equation (3) due to enormous value of the TS term. Any ZA0.xx particle with a minus free energy cannot takes part in any phase transformation to form basic matter particles. ZA0.xx particle would change its size with decreasing temperature until it become ZA1 when Equation (3) equals to zero. This is the time that basic matter particles start to be formed by ZA1 particles.

Next task is to find how ZA0 grew into ZA1. Quantum mechanics is my helper again and it tells us that ZA particles cannot grow continuously because of their tiny micro scale. It is logical that his earliest matter

origination growth must observe a simplest quantum law to make matter have quantum instinct. It is naturally to believe that binary code is the simplest quantum law. Therefore, the following binary quantum law is suggested:

$$\lambda(n) = 2^n\lambda(0) \tag{4}$$

where, $\lambda(n)$ is wavelength of ZA0.xx particle after quantum growth of n times, n is nature number and $\lambda(0)$ is the wavelength of the ZA0 particle. Equation (4) is a mathematic expression, but it needs a reasonable physical mechanism behind to make it an acceptable law. There is a growth mechanism behind Equation (4) fortunately, i.e., a self-copy format like the re-producing process of single-cell microbe. The self-copy mechanism means that a ZA0.xx electric pulse would grow into two big identical electric pulses in a totally same shape and structure of the mother pulse. The big pulse has less energy and Equation (1) offers that energy of the mother pulse equals exactly to the energy of two big pulses made by the self-copy operation. This indicates that Equation (4) has a good nature in coherence with Equation (1). Therefore, Equation (4) can probably be regarded as a self-evident truth, and it is believed that temperature and speed changes would follow Equation (4) during early universe evolution. The wavelength of ZA1 particle can be obtained by Equation (4) if the n in the equation can be guessed correctly.

It is not difficult to find out how ZA1 particles can link each other to form a heavier matter particle by phase transformation. **Figure 2** gives the sequence by which different transitive matter particles would be formed. It is shown in **Figure 2** that the particles in a frame will follow the phase transformation indicated on the arrow to form into the particles in the next frame. It will be shown later that ZA10 is electron, ZA18468 is neutron and ZA18456 is proton.

Figure 3 is the ZA models of the transitive matter particles and principle models are given a name of front view. A front view in the figure is really the front view of a particle in a special moment and it is an electric circuit diagram in vacuum to indicate all features of an electric field. The stereo view is the electric field shape of a particle during a very short period. This is a brand new concept by present ZA matter theory that a matter particle is a scale of conservated electric field.

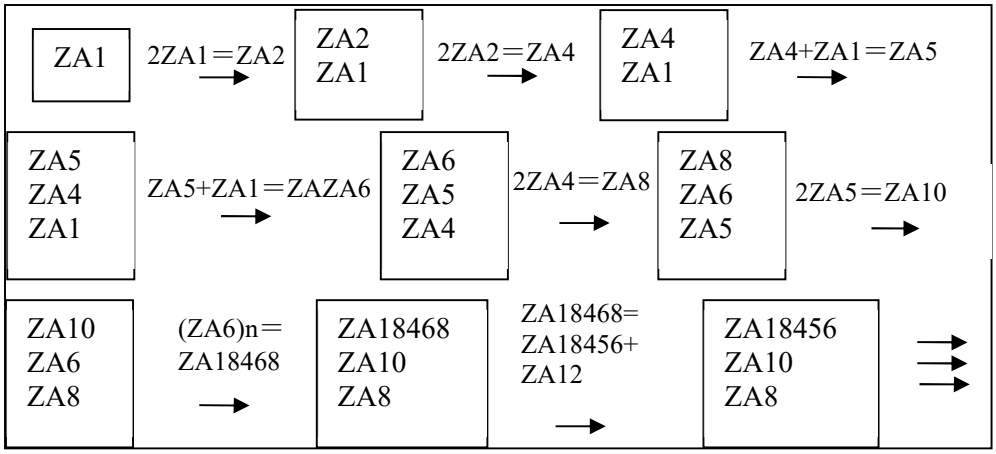

Figure 2. Formation of basic matter particles by ZA1 electric pulse particles in different stages step by step.

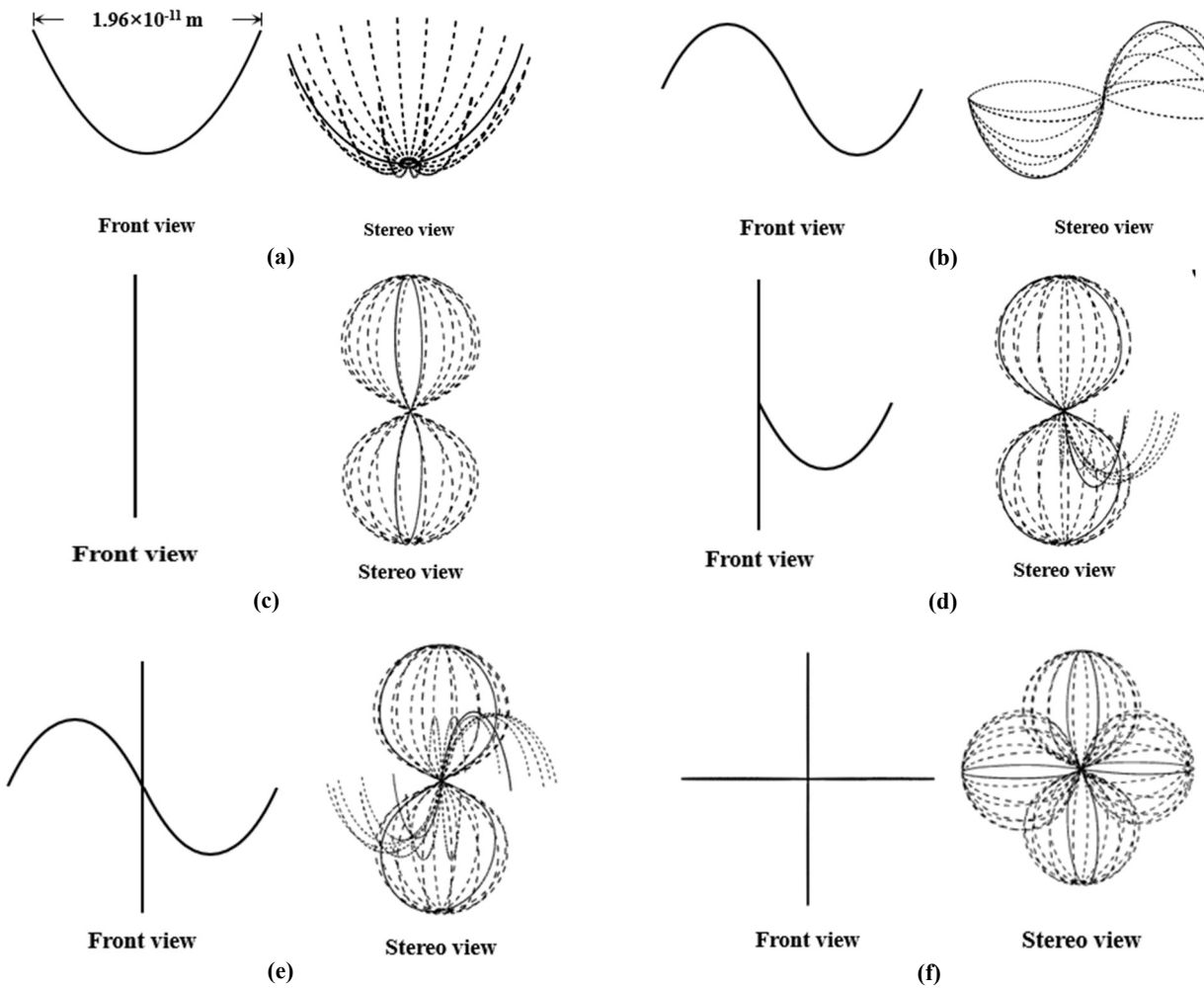

Figure 3. ZA particle models of transitive particles in electric current circuit diagram (front view) and electric field shape (stereo view). **(a)** ZA1 particle, **(b)** ZA2 particle, **(c)** ZA4, **(d)** AZ5, **(e)** ZA6 particle, and **(f)** ZA8 particle.

4. The ZA models of electron, neutron and proton

Figure 4(a) is the electric circuit diagram of electron and **Figure 4(b)** is stereo view of electron as a scale electric field. It is shown that electron consists of two ZA4 particles linked by a ZA2 particle and there are two zero penitential nodes (ZPN). There are 3 current lines at the inner side of ZPN but 2 at the outside of ZPN. The different between inside and outside indicates that the ZPN is not at true zero potential but is polarized as an electrode. The ZPN on electron looks like a socket and is define as a negative electrode. A neutral ZPN should have 3 in and 3 out but the ZPN on electron has 3 in and 2 out so that the ZPN on electron should show 1/6 negative unit charge (6/6 – 5/6 = 1/6). An electron has two sockets so that an electron has 1/3 negative unit charge.

During matter formation in **Figure 2**, ZA6 particles would like to link each other into a $(ZA6)_n$ chain as shown in **Figure 5(a)** to lower free energy in best meeting a high temperature environment. The $(ZA6)_n$ chains then would like to link each other to grow long chains with n in big number until n arrives 3078 when the $(ZA6)_{3078}$ chain become a ZA6 loop. The chain would like to be a loop because the potential of chain ends varies as a function of n value and the potentials of the two ends will be same when n = 3078. The electric circuit diagram of neutron ($(ZA6)_{3078}$ loop) is given in **Figure 5(b)**. The micro current format and direction in neutron are not important but the numbers of ZPN and the relationship between them as a scale electric field. Therefore, the principle model of neutron becomes **Figure 5(c)** with only ZPNs and the link feature. A scale

electric field would like to save space as much as possible provided all field features can keep. This can be an analogy with a macro circuit that applicants and voltage decide circuit identity but not length or shape of connecting wire. Thus, neutron model finally becomes **Figure 5(d)** with all ZPNs and the link feature in a very small sphere. It should be noticed that ZPNs in the sphere is not distributed in even but in quantum charact.

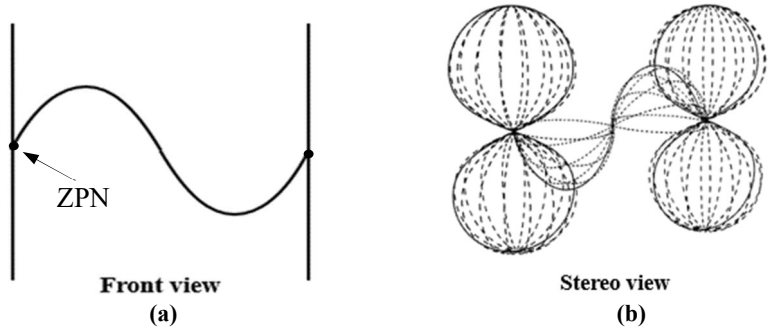

Figure 4. ZA model of electron in electric current circuit diagram **(a)** and its three-dimensional shape in a scale electric field **(b)**.

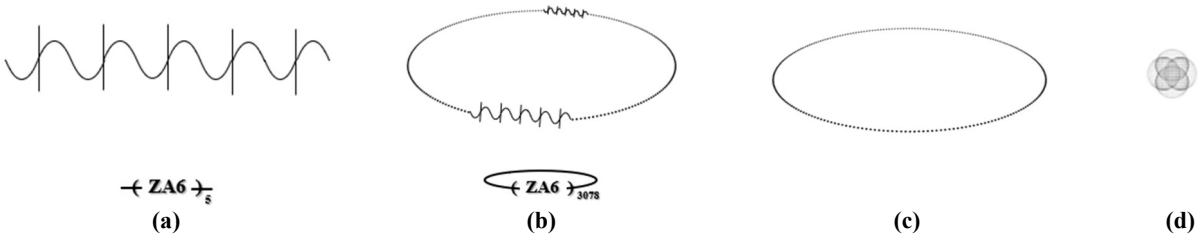

Figure 5. ZA particle model of neutron in electric current circuit diagram and principle sketches. **(a)** a part of neutron of $(ZA6)_5$ chain, **(b)** circuit diagram, **(c)** principle model and **(d)** stereo shape sketch of neutron electric field.

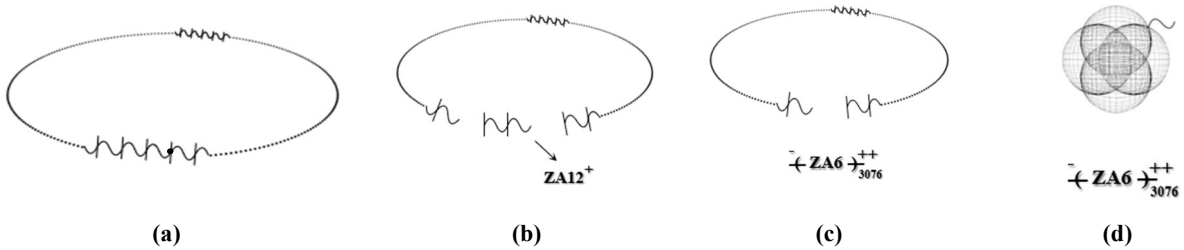

Figure 6. ZA model of proton in electric current circuit diagram and principle sketches. **(a)** an unstable neutron, **(b)** a broken neutron with a separated ZA12 super positron, **(c)** circuit diagram of proton, i.e., $(ZA6)_{3076}$ open loop and **(d)** stereo view of proton electric field.

The potential of all ZPNs in the neutron ZA6 loop is not in ideal zero but is in a tiny tolerable mismatch from zero because the phase angle of the neutron loop is an irrational number of 2p, and the potential cannot be adjusted to zero by the numbers of ZA6 particles but to very close zero. An unstable neutron is shown in **Figure 6(a)**, because the mismatches at all ZPNs have come to one ZPN shown in a big spot by accident or by an applied electric field. It is shown in **Figure 6(b)** that the neutron loop would be then broken at the spot meanwhile a ZA12 positron would be splintered away if there are many electrons around the neutron. Therefore, the proton is an open ZA6 loop shown in **Figure 6(c)**, and it comes from decay of neutron. It can be seen from the figure that protons have two electrodes at the gap with one socket and one plug. The plug has 1/2 unit intensity of positive charge because the plug needs only one elongated current line to make it neutral so that the proton has 1/3 unit positive charge. A proton is also a scale electric field, and its stereo shape is contracted into a very small sphere shown in **Figure 6(d)** like a neutron.

5. Mass calculation of basic matter particles

Mass calculation success depends on if we can find mass value of ZA1 particle. Fortunately, we have a precious picture of **Figure 4**, and it is shown that electron has 10 ZA1 particles. The rough mass value of ZA1 particle is now known because the mass value of electron by experiments can be found easily. However, mass value of ZA1 particle must meet its physical model by mass value of the Planck particle. The wavelength of ZA1 can be found by Equation (4) if n = 80 is brought into the equation. The wavelength then is brought into Equation (1) to find out its electric energy as 5.07×10^{-15} (*J*). The mass of ZA1 can be obtained as 5.64×10^{-32} (*kg*) if Equation (2) is used by putting the electric energy in it. If let n = 81, the calculated ZA1 mass value is too small, and if let n = 79, the calculated mass value is much bigger than the target value. The calculated electric mass value is 3.43×10^{-32} (*kg*) less than the target value, thus it is suggested that some mass in matter is contributed by gravitons in it. The suggestion is surprise incoherence with Einstein theory that the gravitons make space bent to produce gravity force. The bent space must have some potential energy and energy is equivalent to mass by Equation (2). Let the 3.43×10^{-32} (*kg*) mass comes from the extra potential energy or graviton energy, the mass of ZA1 equals to the electric mass plus the gravity mass as 9.07×10^{-32} (*kg*).

The present ZA matter model can be expressed in another way. The ZA1 particle is a conserved electric field, movement of the field requires an applied force so that it shows inertial property. The inertial behavior is the measurement for we to identify mass so that the electric mass is defined as the true mass. Meanwhile, ZA1 particle has many gravitons in it and they make a gravity field. Movement of gravity field also need applied external force to expose its inertial property. The potential energy in gravity field will contribute matter with a gravity mass called as extra mass. It is shown by present work that the gravity mass is 37.8% of total matter mass. It should be noticed that present work has made sure of gravity mass existence, but the percentage is only a rough estimate in open for experiment and other calculations.

Now, it is very easy to calculate mass of any basic matter particles by counting how many ZA1 particles in the basic particle shown in **Figures 4–6**, and then by multiplying the above mass value of ZA1. It is shown that the calculated mass values of electron, neutron and proton meet the experimental values[15] respectively well with an error less than 0.1%. Moreover, it is shown in **Figure 6** that mass of proton should be $12 \times 9.07 \times 10^{-32}$ (*kg*) less than that of neutron. This is true in deed by experiments[16]. The accurate mass value predictions by present work are great supports to the ZA matter models.

6. Discussions

The ZA matter model demonstrates first time that matter is consistent only of electric energy with some extra gravity potential energy. Any basic matter particle is just a scale electric field by overlapping many ZA1 electric pulses in a specific circuit diagram and a more gravity field. Therefore, all basic particles should have a same size because an electric field overlapped by many of them happens by increasing local intensity meanwhile keeping field size. More fields overlapped should result in strong intensity to concentrate its original size even a bit smaller. It can be predicted by the ZA model that electron should have a size same of the size of ZA1 particle and neutron should have a similar size even smaller by overlapping three orders more ZA1 particles than electron, i.e., mass of neutron three orders higher. This has exactly explained the experiment fact puzzling us for many decades that electron is significantly bigger than neutron[15]. The experiments support the ZA model that basic particle is a scale electric field. Therefore, the main finding of ZA model tells us that matter and electricity is the same body, and no independent separate electricity matter exists. This conclusion from present model can be supported by the fact that no monopole electricity without mass has been found though so many attempts[1,12].

The new concept of micro electric mechanism is achieved successfully by present work that the circuits in **Figures 4–6** are movement orbits of photons in vacuum to exchange their motion energy in the particles respectively. The different electric charges are not different matters but two opposite directions of photon movement in nuclei and basic particles. Positive charge particle collided with negative charge particle will usually become a new particle with possible by-products and will even change into a negative particle because the collision may change movement direction of the photon in it. This is an opposite prediction from conventional big-bang theory by which matter meeting anti-matter would vanish into energy[10]. A proton meeting an electron becomes a hydrogen atom and an electron meeting a positron may produce a positronium (τ meson)[15]. These two facts support the ZA micro electric mechanism. Therefore, it is not necessary to worry about that the attempt to look for antimatter may explode off our world.

The ZA matter model has achieved a most important progress that proton is formed by decay of neutron. It can be seen in **Figure 6** that the condition for the decay is quite low and very possible in nature to have plenty of electrons around a neutron. The progress in particle physics can explain the intendedly covered question why many protons can stay together in a tiny nucleus except the mathematical explanation of colored quarks. It is the key to interpret the mechanism that there always are equal number or more neutrons than protons in any nuclei except hydrogen one. It is suggested based on the ZA matter model that neutron is always transformed into proton and vice versa, and the reaction force between them can overcome the electric repel force between protons. This mechanism supports the shell structure theory in nuclei by Mayer et al.[17] because protons and neutrons cannot distribute randomly but must stay in an order structure of alternative sequence alike.

The electricity of electric charge and current by general physics is not in same concept as ZA micro electric mechanism. The current in ZA model is movement of photons and electric charge sex is decided by the feature of ZPN in different movement directions of photons. The ZA micro electric model happens to describe wonderfully electric behaviors of light in micro scale innovatively whereas optics studies light behaviors only in macro scale. The electric current in common sense or in macro scale is the movement of electrons or ions, and electric charge sex is identified by different matters of electron or proton. However, the famous experiment of the photoelectric effect[18] can prove that the ZA micro electric mechanism is coherent to electricity in macro very well. The experiment shows that motion energy of photons can be exchanged into motion energy of electrons, or in another word that the electric force in micro has same format in macro to drive electrons forming an electric current. This coherence gives great evidence to ZA matter model in its reliability.

The ZA matter model can be used to explain some experiments failed to be interpreted by conventional SM theory. The ZA6 chains in different length for example can be used to explain hundred unknown particles being observed by experiment[1]. The ZA matter model has a very good collaboration feature with the other models. Quantum physics has been relied on by present work but the ZA model has adopted the gravity mechanism of bent space by relativity theory. Any predictions by ZA matter model did not show any contradiction with experiment observations[15]. The model can accept any calculations from SM but some of them must be explained in different new physical mechanisms not in SM theory. Nevertheless, ZA matter model can explain quark phenomena because electric field of neutron for example in **Figure 5(d)** does not require a homogenic field but an uneven clustered field to meet any quantum feature requirements. The flexibility and self-consistence of ZA matter model make it unique and more reliable. ZA model exposes that any matter is consisted of photons and the main implement of the new model will results in a new scientific branch of photon dynamics because photons have different size, structure, movement to make different basic

matter particles by the model. The study can supply new ways to increase operation efficiency of nuclear reactors.

7. Conclusions

(1) It is suggested that the Planck particle is a pure electric energy particle. It is proved that the ZA0 pure energy particle is an electric pulse in the size of Planck length and in mass very closed to Planck mass so that ZA0 was found being the Planck particle in physical model.

(2) The structure models of electron, neutron, proton, and other transitive matter particles were suggested. It is shown by the ZA matter model that a basic particle is a scale electric field overlapped by a gravity field.

(3) Mass predictions of basic particles can meet with their experimental value very well respectively. This is a strong support to the ZA mass theory that matter mass is consistent of pure electric mass and some extra gravity mass.

(4) Size predictions of basic particles by ZA matter model can explain the puzzling experiment fact that electron is significantly bigger than neutron.

(5) The ZA matter model shows that proton is formed by decay of neutron. This can explain the question why many protons can stay together in a tiny nucleus. The reaction force between neutron and proton in no-stop-transformation each other can overcome the electric repel force between protons.

(6) The ZA micro electric mechanism was suggested in that the current is movement of photons, and the electric charge sex depends on the opposite directions of photon movement. The experiment of the photoelectric effect supports the model in evidence that electric force in micro has a same effect of electric force in macro.

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Conflict of interest

The author declares no competing interests.

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