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On the Relationship between Quarks and Electrons

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Abstract

In this study, the relationship between the elementary masses and elementary charges of quarks and electrons is considered in connection to the strong nuclear force and the color charge. The relationship is further considered in connection with the matter-antimatter asymmetry problem, and the decay times for different particles. The results strongly suggest that the quarks can be expressed as charge equalization of the electron, and that the coincidence of the charges has no alternative way to be unified with the elementary masses. To solve these problems, a new standard model with a second group of antiparticles is proposed, and the strong nuclear force is considered as an interaction between equalized electric charges instead of being a fundamental force, which also explains its short-ranged high strength. A new periodic table of elements is proposed to unfold the overall number of elementary charges that make up the atomic nucleus of different elements.

Keywords

Standard Model, Elementary Particle, Antiparticles, Elementary Charge, Elementary Mass, Strong Nuclear Force, Grand Unified Theory

1. Introduction

The standard model of particle physics contains more than one physical constant for each individual elementary particle. The relationship between these constants is incompletely understood. The quarks coincide with one- and two-thirds of the electrons charge [1], all of them treated as elementary charges according to the existing theory. It is an unanswered question whether the quarks and the electron have something in common that makes the charges coincide that way, and followingly, why the quarks are color charged while the electron is not. Besides, it can be questioned whether the strong nuclear force is fundamental or not, including the possibility to be unified with the electromagnetic force together with the weak nuclear force in a so-called grand unified theory. The accompanying problem is the inequality of the number of charge oppositions, where the electric charge only has two oppositions, more specifically negatively charged and positively charged, while the color charges have three oppositions theorized by the use of colors. This inequality makes the fundamental forces difficult to unify unless the possibility for the existing theory to be deficient.

Although quarks are less charged than the electron, the masses are larger. The up-quark has a mass in excess of four electrons, and the down-quark in excess of nine electrons. The only way to mathematically unify the elementary masses with the elementary charges is by using the electrons charge for equalization, with the accompanying possibility for the strong nuclear force to be explained as an interaction between such equalizations. However, this is rather impossible with the current model, and there is no way to solve the problems this way.

In order to answer and solve the mentioned questions and problems, a new standard model is proposed, hereinafter named the three-dimensional standard model (3DSM). The 3DSM, Figure 1, ranges the particles by charge in ascending order, and introduces a second group of antiparticles. By introducing the second group of antiparticles, the 3DSM contains three oppositions of electric charges in total.

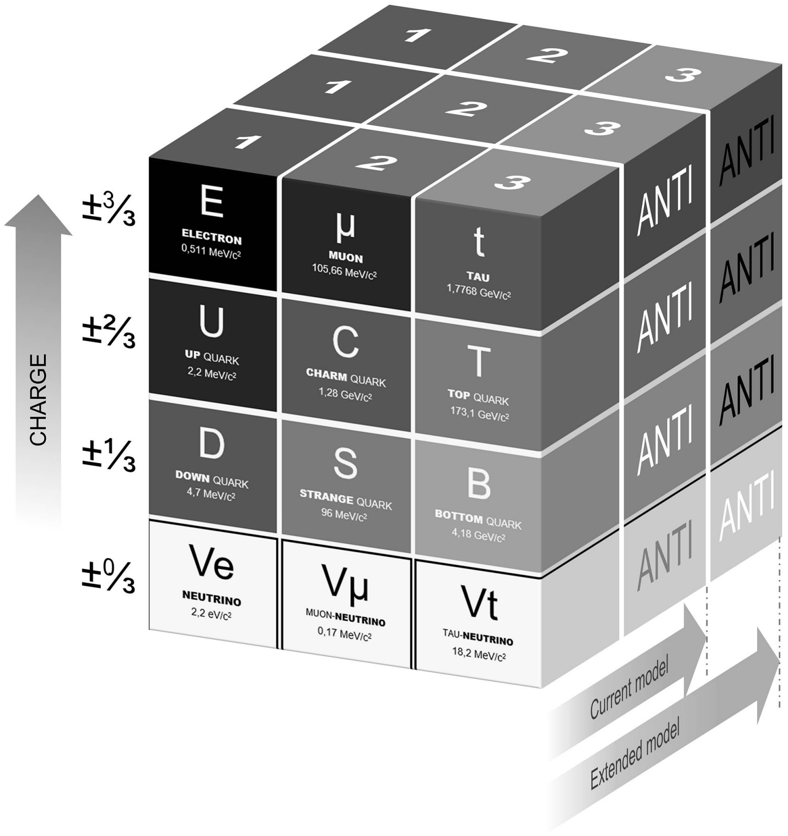


Figure 1. The three-dimensional standard model (3DSM).

2. Charge Equalization

Based on the current standard model, there is no way build any of the two charges of quarks, equalling 1/3 and 2/3, through equalization of the electrons charge. Two opposite charges do only have the possibility to become equalized to zero, which will annihilate each other instantaneously. This is well understood from the research of electrons and positrons [2] [3] [4], and can be expressed as:

$$+1-1=0$$

With the 3DSM, the possibilities of charge equalization are different. In this paper, a confinement of three charge oppositions is described. The third opposition is hereinafter named the triotron. This enables three oppositions in total, the electron, the positron and the triotron. Both antiparticles will behave identical to the electron, and it is not possible to distinguish them from each other unless they are confined together.

How a confinement of three charge oppositions is equalized depends on the physics involved. In this paper, the charge oppositions are considered as a three-dimensional vibration. A confinement of three such vibrations provides 9 phases in total, where the charge equalization can be expressed as:

$$\frac{C}{D\times E}=\frac{3}{3\times 3}=\frac{3}{9}=\frac{1}{3}$$

where D is the number of dimensions, E is the number of elementary charges, and C is the number of counter phases.

Within a confinement of three charge oppositions equalized to 1/3, a fourth charge of 1 is equalized to 2/3, which coincides with the charge of the up-quark. Followingly, this is not far from coinciding with the mass of the up-quarks, in excess of four electrons. The up-quark equalization can be expressed as:

$$\frac{3}{3}-\frac{1}{3}=\frac{2}{3}$$

Three confinements of three opposite charges, in total nine electron charges, are equalized to 1/3, and coincide with the charge of the down-quark. Followingly, this is not far from coinciding with the mass of the down-quarks, in excess of nine electrons. The down-quark equalization can be expressed as:

$$\frac{1}{3}-\frac{1}{3}+\frac{1}{3}=\frac{1}{3}$$

Based on the assumption that the charge equalizations follow three-dimensional symmetry, it opens the possibility for the elementary charges and the elementary masses of the first-generation particles to be unified.

3. The Strong Nuclear Force

According to the current standard model, three different fundamental forces are present except gravity. The electromagnetism and the weak nuclear force are unified by the electroweak theory. Several theories have attempted to unify the strong nuclear force [5] [6] [7] with the electroweak theory [8] [9] [10] [11]. One of the unanswered questions is how the strong nuclear force can have its short range in the femtometer-range, simultaneously as it is about hundred times stronger than the electromagnetism.

According to the current standard model, each elementary particle is an excitation in its own quantum field. If the elementary particles were to be unified to one single elementary charge, as shown with **Figure 2** of the atomic structure, then the fields and forces would be unified too.

While the electromagnetism is carried by photons, the strong nuclear force is carried by gluons [7]. However, gluons and photons are known to have identical properties except that gluons are only present in so-called bound states inside hadrons and mesons.

If the quarks are made up of equalized electric charges, it raises the possibility for the strong nuclear force to be an effect of the interaction between those charges, which unfolds its strength when coming close together. This will imply that the strong nuclear force is an aspect of the electromagnetism, which does only occur when the quarks are as close as they are in the atomic nucleus. The short range of the strong nuclear force, combined with its strength, is then answered as an effect of this interaction. The difference between gluons and photons is thereby answered as an effect of how the gluons are confined, but it is still the same phenomena in the sense they are generated by electric charges, which builds up the color charges. Such unification can be considered as a grand unified theory.

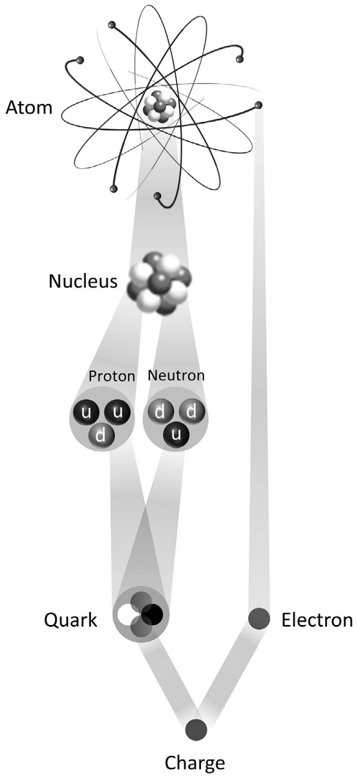


Figure 2. Principal sketch of the structure of atoms.

4. Electrons, Positrons and Triotrons

According to the Feynman-Stueckelberg interpretation, two oppositions of electric charges, namely the particles and the antiparticles, are made possible through time reversal. However, the physical fundament for this interpretation is not well understood, and it can be questioned whether the oppositions of charges through time reversal really is correct or not.

The 3DSM illuminates that everything fundamental comes in three. There are three generations of particles, three levels of charges, three color charges and three dimensions. The limitation of only two oppositions of electric charges is the only phenomena which violates from this nature at the elementary level. It can be argued that the three dimensions of space is the only possible fundament for charge oppositions if the Feynman-Stueckelberg interpretation were to be incorrect. The second group of antiparticles is a possible solution to this problem.

The 3DSM opens the possibility for triotons to exist within the exact same rules as the positrons. The triotrons will annihilate both electrons and positrons, and the annihilation will have identical characteristics as an annihilation between electrons and positrons [3] [4]. To this day, no known experiments can distinguish the triotrons from annihilations and show if they do exist or not, because the energy from the annihilation in the form of photons has identical properties. In order to identify and distinguish between positrons and triotons, there is a demand for new theoretical or experimental solutions.

5. Elementary Charges and Elementary Masses

The mass of an electron is 0.511 MeV/C^2, and the mass of the up- and down-quark is 2.2 MeV/C^2 and 4.7 MeV/C^2, respectively.

The up-quark being made of a confinement of four elementary charges, gives the following mass per charge:

$$\frac{2.2\,\text{MeV}/\text{C}^2}{4} = 0.55\,\text{MeV}/\text{C}^2$$

The down quark being made of a confinement of nine elementary charges, gives the following mass per charge:

$$\frac{4.7\,\text{MeV}/\text{C}^2}{9} = 0.522222\,\text{MeV}/\text{C}^2$$

How the confinements gain extra mass per charge is unknown. The mass-giving mechanism for elementary particles is in general not well understood. As the charges are equalized to one- and two-thirds of the electron, it appears to follow that the overall mass is slightly increased.

6. Difference in Lifetime and Decay Time

Different particles are identified to have large differences in decay time. The decay time is a measured value, and there is no theory to explain what the difference in decay time is originating from. This is seen from the second and third generation [12] of elementary particles, and as the lifetime for different types of particle-antiparticle pairs.

A unification of the elementary charges and the elementary masses of the first-generation particles according to **Figure 3** will open the possibility for the second and third generation of particles to be unified in the same way. However, the elementary masses are not near to coincide. The masses of those particles are however important to be compared with the decay time. As a general role, it is known that the larger the mass, the shorter the decay time. This raises the question whether the events going on within the decay time is contributing to the increase of mass, and if so, what kind events is going on and where is the difference in decay times originating from.

The charm- and strange-quark have a decay time of 1.1 picoseconds and 12.4 nanoseconds, respectively. This is a difference of 11,272 times. If the charm-quark is made of a confinement of four elementary charges in line with the up-quark, and the strange-quark is made of a confinement of nine elementary charges in line with the down-quark, it is possible that the greater number of elementary charges is contributing to the extended decay time. The same difference can be seen from the third generation of quarks, where it is even larger. The top- [12] and bottom-quark have a decay time of 0.5 yoctoseconds and 1.3 picoseconds, respectively.

While positron-electron annihilation is an instantaneous event, different types of quark-antiquark pairs, known as mesons [13], have different lifetimes. The longest living mesons have lifetimes of several nanoseconds. With the 3DSM, the extended lifetime of mesons compared to positron-electron pairs can be answered to originate from the number of elementary charges that is confined within the quarks, while the electrons and positrons do not contain such confinements.

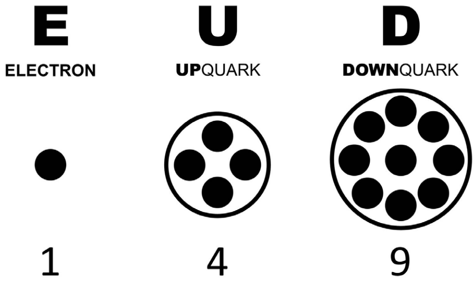


Figure 3. Number of elementary charges per particle.

7. The Matter-Antimatter Asymmetry Problem

According to current theories, particles and antiparticles were created in identical numbers during the creation of the universe. It is estimated that around a billionth of the original particles were remaining at the end, resulting in our current universe. This billionth is what we know as the particles, while the corresponding antiparticles disappeared. The imbalance of particles and antiparticles is known as the matter-antimatter asymmetry problem [14] [15].

With the 3DSM, the matter-antimatter asymmetry is a rather natural consequence, and is in that sense not a problem. Three charge oppositions will randomly annihilate each other. A slight predominance of positron-triotron annihilation would leave the electrons as the remaining particles. In order to create a viable universe, it can be argued that three charge oppositions are fundamentally necessary since pair-production will always result in complete annihilation.

8. The Periodic Table of Elements

With the quarks made of equalized electron-charges, the entire atomic structure can be unified to one elementary charge. Each element in the periodic table can thereby be defined by the total number of elementary charges it contains.

The number of elementary charges E per proton is given by:

$$E = (4 \times 2) + (9 \times 1) = 17$$

The number of elementary charges E per neutron is given by:

$$E = (4 \times 1) + (9 \times 2) = 22$$

The number of elementary charges $\boldsymbol{E}$ for the atomic number is given by:

$$E = Z \times 18$$

where Z is the atomic number, and 18 is the number of elementary charges per proton with one electron.

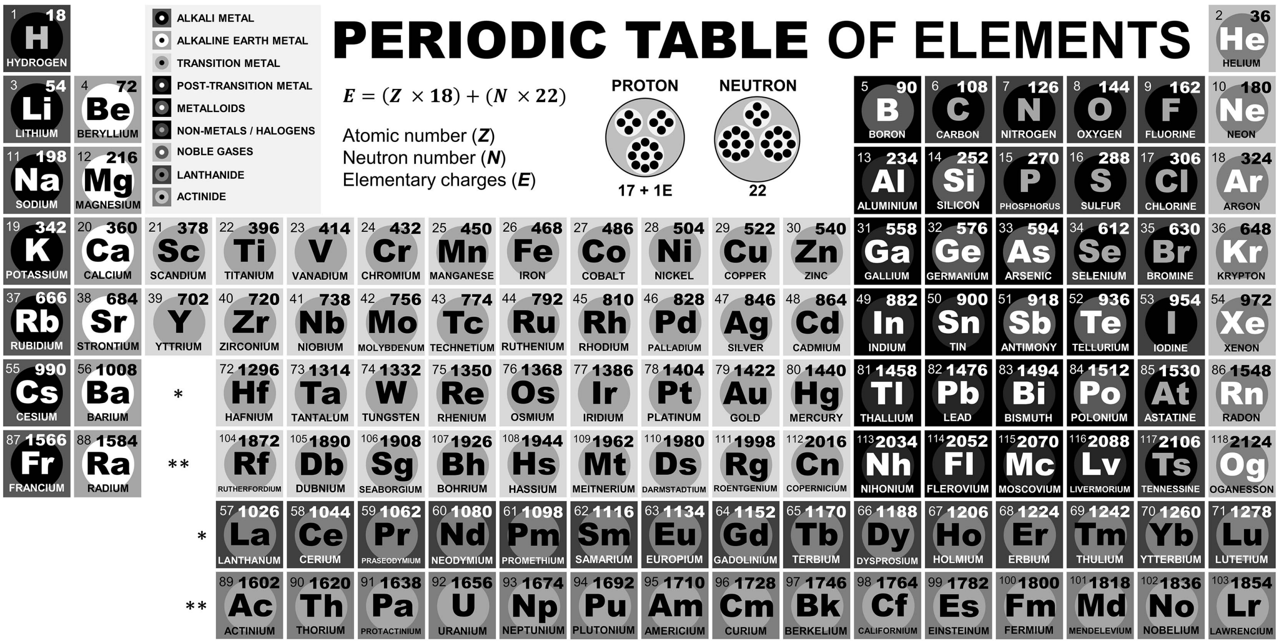
The number of elementary charges $\boldsymbol{E}$ for the neutron number is given by:

$$E = N \times 22$$

where N is the neutron number, and 22 is the number of elementary charges per neutron.

The number of elementary charges for atomic isotopes is given by:

$$E = (Z \times 18) + (N \times 22)$$



PERIODIC TABLE OF ELEMENTS

$E = (Z \times 18) + (N \times 22)$

Atomic number (*Z*)
Neutron number (*N*)
Elementary charges (*E*)

- ◉ ALKALI METAL
- ◉ ALKALINE EARTH METAL
- ◉ TRANSITION METAL
- ◉ POST-TRANSITION METAL
- ◉ METALLOIDS
- ◉ NON-METALS / HALOGENS
- ◉ NOBLE GASES
- ◉ LANTHANIDE
- ◉ ACTINIDE

1 18 H HYDROGEN																	2 36 He HELIUM
3 54 Li LITHIUM	4 72 Be BERYLLIUM											5 90 B BORON	6 108 C CARBON	7 126 N NITROGEN	8 144 O OXYGEN	9 162 F FLUORINE	10 180 Ne NEON
11 198 Na SODIUM	12 216 Mg MAGNESIUM											13 234 Al ALUMINIUM	14 252 Si SILICON	15 270 P PHOSPHORUS	16 288 S SULFUR	17 306 Cl CHLORINE	18 324 Ar ARGON
19 342 K POTASSIUM	20 360 Ca CALCIUM	21 378 Sc SCANDIUM	22 396 Ti TITANIUM	23 414 V VANADIUM	24 432 Cr CHROMIUM	25 450 Mn MANGANESE	26 468 Fe IRON	27 486 Co COBALT	28 504 Ni NICKEL	29 522 Cu COPPER	30 540 Zn ZINC	31 558 Ga GALLIUM	32 576 Ge GERMANIUM	33 594 As ARSENIC	34 612 Se SELENIUM	35 630 Br BROMINE	36 648 Kr KRYPTON
37 666 Rb RUBIDIUM	38 684 Sr STRONTIUM	39 702 Y YTTRIUM	40 720 Zr ZIRCONIUM	41 738 Nb NIOBIUM	42 756 Mo MOLYBDENUM	43 774 Tc TECHNETIUM	44 792 Ru RUTHENIUM	45 810 Rh RHODIUM	46 828 Pd PALLADIUM	47 846 Ag SILVER	48 864 Cd CADMIUM	49 882 In INDIUM	50 900 Sn TIN	51 918 Sb ANTIMONY	52 936 Te TELLURIUM	53 954 I IODINE	54 972 Xe XENON
55 990 Cs CESIUM	56 1008 Ba BARIUM	*	72 1296 Hf HAFNIUM	73 1314 Ta TANTALUM	74 1332 W TUNGSTEN	75 1350 Re RHENIUM	76 1368 Os OSMIUM	77 1386 Ir IRIDIUM	78 1404 Pt PLATINUM	79 1422 Au GOLD	80 1440 Hg MERCURY	81 1458 Tl THALLIUM	82 1476 Pb LEAD	83 1494 Bi BISMUTH	84 1512 Po POLONIUM	85 1530 At ASTATINE	86 1548 Rn RADON
87 1566 Fr FRANCIUM	88 1584 Ra RADIUM	**	104 1872 Rf RUTHERFORDIUM	105 1890 Db DUBNIUM	106 1908 Sg SEABORGIUM	107 1926 Bh BOHRIUM	108 1944 Hs HASSIUM	109 1962 Mt MEITNERIUM	110 1980 Ds DARMSTADTIUM	111 1998 Rg ROENTGENIUM	112 2016 Cn COPERNICIUM	113 2034 Nh NIHONIUM	114 2052 Fl FLEROVIUM	115 2070 Mc MOSCOVIUM	116 2088 Lv LIVERMORIUM	117 2106 Ts TENNESSINE	118 2124 Og OGANESSON

*	57 1026 La LANTHANUM	58 1044 Ce CERIUM	59 1062 Pr PRASEODYMIUM	60 1080 Nd NEODYMIUM	61 1098 Pm PROMETHIUM	62 1116 Sm SAMARIUM	63 1134 Eu EUROPIUM	64 1152 Gd GADOLINIUM	65 1170 Tb TERBIUM	66 1188 Dy DYSPROSIUM	67 1206 Ho HOLMIUM	68 1224 Er ERBIUM	69 1242 Tm THULIUM	70 1260 Yb YTTERBIUM	71 1278 Lu LUTETIUM
**	89 1602 Ac ACTINIUM	90 1620 Th THORIUM	91 1638 Pa PROTACTINIUM	92 1656 U URANIUM	93 1674 Np NEPTUNIUM	94 1692 Pu PLUTONIUM	95 1710 Am AMERICIUM	96 1728 Cm CURIUM	97 1746 Bk BERKELIUM	98 1764 Cf CALIFORNIUM	99 1782 Es EINSTEINIUM	100 1800 Fm FERMIUM	101 1818 Md MENDELEVIUM	102 1836 No NOBELIUM	103 1854 Lr LAWRENCIUM

Figure 4. The periodic table of elements including the number of elementary charges.

Figure 4 introduces a new periodic table where all the elements are defined by the overall number of elementary charges.

9. Conclusion

How many electric charge oppositions can exist may sound like an easy question, but the fact that it is not possible to distinguish more than two in parallel makes it difficult to identify the existence of possible third opposition. Many well-known problems can however be solved by introducing the third opposition of electric charges. Why the quarks coincide with one- and two-thirds of the electrons charge is answered through equalization, and what causes the elementary mass to increase when the elementary charge decrease is answered as a result of the equalized charges confined within quarks. The inequality of the number of charge oppositions for the electric charges and the color charges is solved by the second group of antiparticles, where the color charge is rather built on electric charges. The short range of the strong nuclear force combined with its strength is answered as an effect of the interactions between equalized electric charges. The large differences in decay time and lifetime for different types of elementary particles and particle-antiparticle pairs are answered as a result of internal annihilations between equalized charges. The matter-antimatter asymmetry problem is turned into a natural consequence of the asymmetry in the annihilation of three opposite charges. The described solutions strongly suggest that the third opposition of electric charge is existing, but without our ability to experimentally identify them with known methods.

Conflicts of Interest

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

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