

Particle Structure Causes Discrete Fundamental Charge e

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Paul Dirac, in 1931, attempted to determine why the fundamental charge e has the same value, for both the electron and proton. His attempt was mathematical, and he (mistakenly) postulated a fixed value magnetic monopole. I find that the electron, positron, muon and proton, are constructed with a cubic geometry, fixing the value of fundamental charge, the same for all. Basic particle structure details are given and the fundamental charge is shown to be a constant. The charge density times the particle current loop area, is equal to the exact NIST fundamental charge e , independent of cube particle size.

1. The Electron Charge

The electron charge was first measured by Millikan’s famous liquid drop measurement of the electron charge. In 1931, P.A.M. Dirac [1] tried to calculate a reason for the electron and proton both having the same exact charge e , and (mistakenly) proposed fixed value magnetic monopoles as the cause. Dirac firmly believed in the power of mathematics for physical research. He had been able mathematically to develop positive energy electrons and holes with negative energy. The hole he first thought was the proton, till Oppenheimer, and Weyl convinced him that the hole should have the same mass as the electron, an anti-electron. Then, also in 1931, Carl Anderson [2] detected the positron in Cosmic rays, making the anti-electron real.

Dirac did not have a geometric structure for his equations making him at a disadvantage. In 1975, I [3] reverse engineered the photon and found that the photon could only form five particle structures (three pair because the electron type neutrino was shown to be its own anti-particle under space rotations of 180 degrees). There is a natural boundary on the number and types of fundamental basic particles.

2. Particle Structure Development

One can deduce the scaled structures for the composite muon, proton and neutron, using those three pair of photon indicated fundamental basic particles, as will be demonstrated.

2.1. The Photon Model

Photo production of the electron positron pair has been known since 1930’s (Blackett-Dirac) [4]. But, without a good photon structure model, no one has previously detailed the photo-production of the electron positron pair formation.

First the photon structure has to be deduced. The travelling wave of electromagnetic energy is the starting point for a photon model (Fig. 1). What one first notices about the travelling wave is the electric field strength E is shown in phase with the magnetic field strength H . They are supposed to be related by their time rate of change in a sine-cosine exchange, not sine-sine as we see from our stationary observer’s frame of reference. To model the photon one must imagine what the photon sees from its relativistic frame of reference. Lateral events are not distorted by

relativity so it is apparent that there are two E to H and H to E resonances, as shown in the (Fig. 1) vectors.

The mystery of the travelling wave, passing through zero twice each cycle, is explained by a Lorentz-Fitzgerald contraction distorting our stationary frame of reference view (Fig. 1).

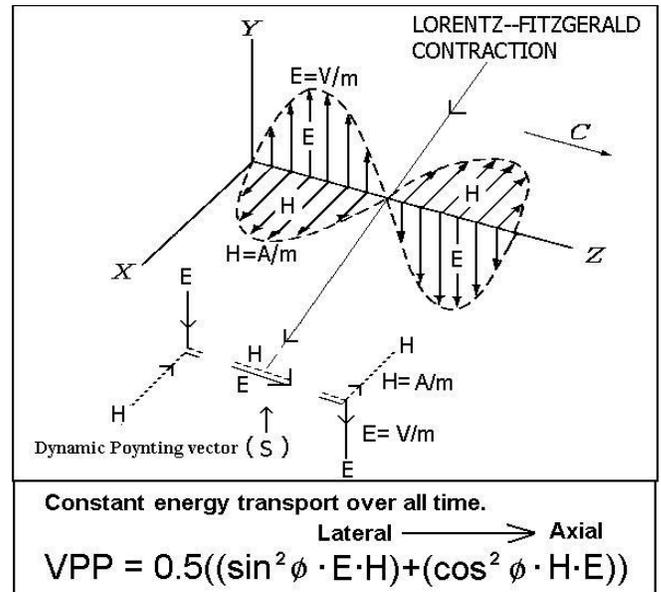


Fig. 1. The travelling wave model for the photon’s vector structure and the supporting mathematics are shown in the lower panel.

The vectors are quantum in nature by making their amplitudes equal to wavelengths. We see as lateral E differentiates into axial H and lateral H differentiates into axial E , energy is transported by the photon at constant amplitude, as it must. The mathematics shown in the lower panel of (Fig. 1) shows the resulting trigonometric identity that equals one over all time.

2.2. The Structure of Basic Particles

Much to my surprise, when constructing structures from the quantum wave length vectors, only five basic structures were possible. This provides a natural boundary condition on the numbers of basic particles possible. These were later found to act like those labels given in (Fig. 2).

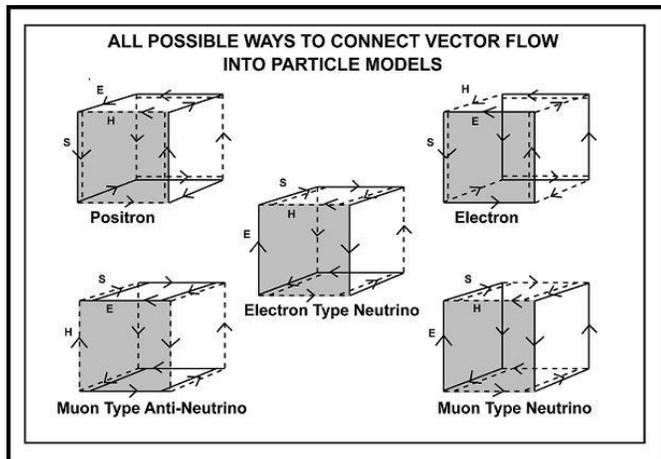


Fig 2. There is a natural boundary on the types of basic particles possible constructions, from the photons quantum vectors. The electron type neutrino was found to be its own anti-particle by rotation of 180 degrees. Thus there a natural boundary of just three pair of basic particles being possible in nature, all other particles can be shown to be composites of these.

The formation of the electron positron pair from the photon fireball would not be possible were it not for the superior near field magnetic moments that are simultaneously created by the fireball spin. In the near field, the magnetic repelling force is greater than the negative to positive charge attraction force. It is found that the pair of electron-positron completely separates when forces null as shown in (Fig. 3).

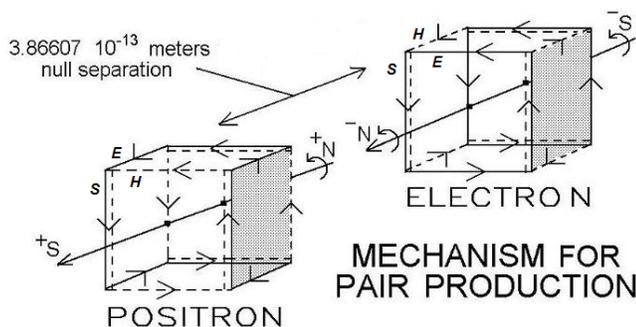


Fig. 3. The electron and positron both spin in the same direction by the thrust in the same direction of their vectors in the front and back cube faces. The magnetic moment repelling force is superior to electric attraction in the near field, fully separating the pair. Were this separation not possible, matter as we know it could not exist.

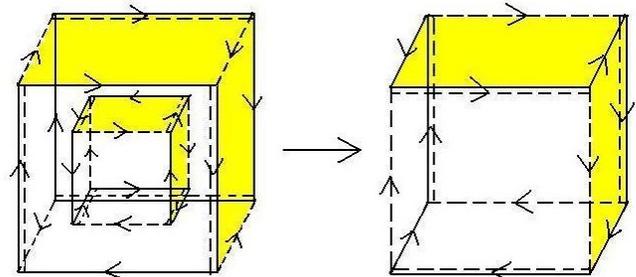
It has been a mystery to me why the magnetic moments of the electron, proton and neutron have been ignored by particle physics. I find the magnetic moments explain the pairing of electrons in superconductors and account for the strong force between nucleons in nuclei.

2.3. The Neutrino aided Structure of Composite Particles

The neutrino structures given to us by blindly connecting photon vectors in (Fig. 2) clearly show that the neutrino does not spin. Adding energy to the neutrino structure causes neutrino to pucker up rather than move. This allows the neutrino to add mass energy to the formation of composite proton and neutron. Scaling is the smallest (more massive) neutrino that will just fit in the outer spinning assemblage. The neutrino vectors combine

with those of the electron or positron to acquire spin and form all composite particles in the universe. Figs. 4 and 5 show the process for the combining electron type neutrino and the electron or positron, real or virtual. The neutrino acquires spin angular momentum, mass and charge in the process.

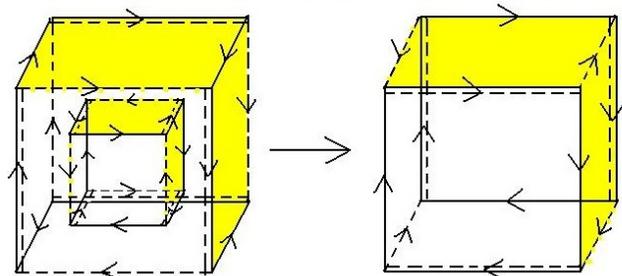
Electron + electron neutrino = Virtual positron



Rules are: Like vectors going in opposite directions cancel, and; un-like vectors going in the same direction form a Poynting 'S' vector (double vector edge)

Fig. 4. Electron changing the electron type neutrino layer into a virtual positron. This creates alternating polarity layers which holds the composite together and stores electrical potential energy between layers, adding extra mass energy to the composite.

Positron + electron neutrino = Virtual electron



Rules are: Like vectors going in opposite directions cancel, and; un-like vectors going in the same direction form a Poynting 'S' vector (double vector edge)

Fig. 5. Positron changing the anti-electron type neutrino into a virtual electron. This creates an alternating polarity layers holding the composite together and storing electrical potential energy, which adds extra mass energy to the composite.

In 1977 [5] I constructed a proton model on a spread sheet that was 'B' size and took six hours to calculate with a hand held calculator. I corrected for the anomalous magnetic moment as a small geometric extension. Much to my surprise, the spread sheet summed to the mass ratio of the proton to within 3 parts per million of the published value, moreover, the first two layers of the structure had exactly the mass ratio of the known decay electron and neutrino of the neutron! So I immediately had the model of the neutron by adding an electron and electron type neutrino to the proton! Moreover, this gave the mass ratio of the neutron to within 0.4 parts per million of the empirical value. Both proton and neutron have an active core particle precisely scaled by the nested cubes. The neutron core (despite overall zero neutron charge) has a negative charge and thus a negative magnetic moment experimentally.

The proton core particle has a mass ratio of 512.840824588 electron masses, almost 1/3 the mass of the proton.

2.4. The Muon Structure

The muon was indicated in cosmic rays by Street and Urey and confirmed by Nishina in 1937 [6]. The muon decays into an electron or positron and two neutrinos. The clear message nature was sending, in the 1930's, only to be ignored in the 1960's, was that all composite particles (except for the stable proton) are constructed from just the electron or positron and neutrinos, as final decay particles. The muon was (mistakenly) thought to be composed of a mixed doublet of neutrinos (i.e., an electron type neutrino and a muon type neutrino) because two neutrinos had never been detected annihilating each other. We now know that the neutrino does not move or spin, so cannot annihilate. The muon [7] can be modeled by combining the muon type of neutrinos of (Fig. 2.) as shown in (Fig. 6).

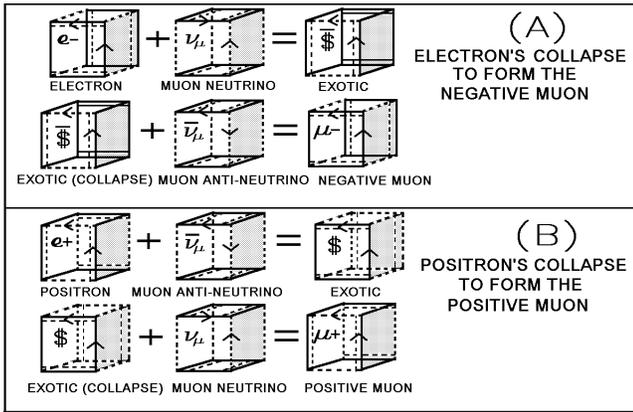


Fig 6. The negative muon is an electron that has been collapsed by the action of two muon type neutrino, the positive muon is a collapsed positron. The muon forms without charged layers to hold the muon together making the muon quickly decay in about 2.2 microseconds.

2.5. The Proton Model Core Particle Structure

The proton has a small core particle that is the source for the proton's charge and magnetic moment [8]. The vector proton structure scales to the small core particle that determines the charge and magnetic moment of the proton, the outer structure is neutralized by alternate layer polarities. The core particle has a wavelength calculated as follows [9]. The scaling to the core particle wavelength scales from the host positron Compton wavelength adjusted geometrically for the anomalous magnetic moment (a_u) calculated from the QED fine structure constant (α_e) alternating power series summed over five terms, rather than use NIST [10] published value for (α_e) obtained using questionable coefficients obtained by Feynman diagrams. Using a normal power series for (α_e) gives the value to within about 40 parts per billion of NIST.

$$a_e = \sum_{n=1}^5 ((-1))^{(n+1)} \left[\frac{1}{n+1} \right] \left(\frac{a}{\pi} \right)^n = 1.15961435847841 \times 10^{-3}$$

$$a_u = 2 \left[\left(\sqrt{1+a_e} \right) - 1 \right] = 1.15927837688945 \times 10^{-3}$$

$$\lambda_p = \left[\left(\frac{\sqrt{2}}{2} \right)^{18} \left(1 - \sqrt{2} a_u \right) \right] \lambda = 4.7311179352317 \times 10^{-15} \text{ m}$$

2.6. Deriving Particle Charge from Structure

The process that one can use to derive the charge of a particle proceeds by calculating the electric potential energy, volume, power density, magnetic field strength, and then the charge as charge density times the current loop areas [11]. The electrical potential energy $J_{ep} = amc^2$. The volume $V = \lambda^3/16\pi^2$.

The power density $P_e = 2J_{ep}c/V$, also equals the product of the electric and magnetic field strengths E and H . The impedance of space $Z_o = E/H$, so the magnetic field strength $H = H = \sqrt{P_e/Z_o}$. Charge density $D_e = H/c$.

The two current loop area is $L^2 = \lambda^2/4\pi$. The fundamental charge is finally $e = D_e L^2$.

2.7. Electron Derived Fundamental Charge

The electron charge is calculated using NIST [10] values for mass (kg), fine structure constant α , and wavelength λ .

$$J_{ep} = 5.9744192188651 \times 10^{-16} \text{ kg-m}^2\text{s}^{-2}$$

$$V = 9.04522271540347 \times 10^{-38} \text{ m}^3$$

$$P_e = 3.96029125893362 \times 10^{30} \text{ kg-s}^{-3}$$

$$H = 1.02529367947748 \times 10^{14} \text{ A-m}^{-1}$$

$$D_e = 3.42001158507291 \times 10^5 \text{ A-s-m}^{-2}$$

$$L^2 = 4.68471092891699 \times 10^{-25} \text{ m}^2$$

$$e = 1.60217656496138 \times 10^{-19} \text{ A-s}$$

$$e_{\text{NIST}} = 1.602176565 \times 10^{-19} \text{ A-s}$$

The geometry of the vector electron gives the charge of the electron exactly equal to the rounded off NIST value, e_{NIST} .

2.8. Muon Derived Fundamental Charge

The muon charge is calculated using NIST [10] values for mass (kg), fine structure constant (α) and wavelength (λ).

$$J_{ep} = 1.23532041135565 \times 10^{-13} \text{ kg-m}^2\text{s}^{-2}$$

$$V = 1.02321640010642 \times 10^{-44} \text{ m}^3$$

$$P_e = 7.23873742640102 \times 10^{39} \text{ kg-s}^{-3}$$

$$H = 4.3834507185735 \times 10^{18} \text{ A-m}^{-1}$$

$$D_e = 1.4616177278666 \times 10^{10} \text{ A-s-m}^{-2}$$

$$L^2 = 1.09575875574771 \times 10^{-29} \text{ m}^2$$

$$e = 1.60217656485057 \times 10^{-19} \text{ A-s}$$

$$e_{\text{NIST}} = 1.602176565 \times 10^{-19} \text{ A-s}$$

The geometry of the vector muon gives the charge of the electron exactly equal to the rounded off NIST value, e_{NIST} .

2.9. The Proton Derived Fundamental Charge

The proton active core particle scaling of Section 2.5 above is used to estimate the proton charge. The proton core particle mass becomes $m = h/\lambda_{pc} = 4.67166308490853 \times 10^{-28} \text{ kg}$.

$$J_{ep} = 3.06392584374743 \times 10^{-13} \text{ kg-m}^2\text{s}^{-2}$$

$$V = 6.70612422694412 \times 10^{-46} \text{ m}^3$$

$$P_e = 2.73941200234918 \times 10^{41} \text{ kg-s}^{-3}$$

$$H = 2.69658052479394 \times 10^{19} \text{ A-m}^{-1}$$

$$D_e = 8.9948244288185 \times 10^{10} \text{ A-s-m}^{-2}$$

$$L^2 = 1.7812204974676 \times 10^{-30} \text{ m}^2$$

$$e = 1.60217656437338 \times 10^{-19} \text{ A-s}$$

$$e_{\text{NIST}} = 1.602176565 \times 10^{-19} \text{ A-s}$$

The geometry of the vector proton gives the proton charge to within about 0.3911 ppb of the NIST [10] value, e_{NIST} .

3. Conclusion

It will be useful to summarize the charge density and current loop areas for the electron, muon and proton core to highlight that subatomic particles must be constructed from the dynamic spinning electromagnetic cube structure.

Charge Density of Electron, Muon and Proton Core

Electron	$D_e = 3.42001158507291 \times 10^5 \text{ A-s-m}^{-2}$
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Muon	$D_e = 1.4616177278666 \times 10^{10} \text{ A-s-m}^{-2}$
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Proton core particle	$D_e = 8.9948244288185 \times 10^{10} \text{ A-s-m}^{-2}$
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Current Loop Areas Electron, Muon, and Proton Core

Electron	$L^2 = 4.68471092891699 \times 10^{-25} \text{ m}^2$
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Muon	$L^2 = 1.09575875574771 \times 10^{-29} \text{ m}^2$
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Proton core particle	$L^2 = 1.7812204974676 \times 10^{-30} \text{ m}^2$
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Product of Charge Density and Current Loop Areas

Electron	$e = 1.60217656485057 \times 10^{-19} \text{ A-s}$
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Muon	$e = 1.60217656485057 \times 10^{-19} \text{ A-s}$
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Proton core particle	$e = 1.60217656437338 \times 10^{-19} \text{ A-s}$
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These last three all compare well with the NIST value:

$$e_{\text{NIST}} = 1.602176565 \times 10^{-19} \text{ A-s}$$

We now understand that Paul Dirac is not to be faulted for not being able to determine why the electron and proton have the same charge (e). From 1931 to 1977 [3] the geometric structures for the electron, muon and proton particle, had not been derived. It has been demonstrated, that particle detailed structures are essential. The unique spinning electromagnetic cube structure gives the charge density times current loop areas, always equal to the fundamental charge (e) exactly. This highlights the falsity of the standard model theory that relies on fractional charged quarks.

References

- [1] G. Fanelo, **Hidden Life of Paul Dirac**, pp. 185-187 (Basic Books, 2009).
- [2] Carl D. Anderson, "The Positive Electron", *Phys. Rev.* **43** (6): 491-494 (15 Mar 1933).
- [3] T. N. Lockyer, "A Rigorous, Coherent, Geometric Model For The Structure of Subatomic Matter", Copyright Registration Number, TX0000002688 / 1978-02-14.
- [4] op. cit. [1], pp. 218-219.
- [5] op. cit. [3], Table IIc.
- [6] J. C. Street, E. C. Stevenson, "New Evidence for the existence of a particle of mass Intermediate between the Proton and Electron", *Phys. Rev.* **52**: 1002 (1937).
- [7] op. cit. [3], p 22.
- [8] op. cit. [3], p. 28, 30-32.
- [9] T. N. Lockyer, **The Quantum Vector Particle Physics**, pp. 28-29 (TNL Press, 2004).
- [10] <http://physics.nist.gov/cuu/Constants/>.
- [11] op. cit. [9], pp. 21,22.