Structure of Elementary Nuclear Particles in in Delta-c Mechanics

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Introduction

In previous research, the mass values of particles within the atomic nucleus have been presented. However, this paper aims to delve deeper by exploring the internal structure of these particles and elucidating why elementary mass particles exhibit specific, quantifiable values. The foundational studies, *"Nuclear Particle Structure in Delta C Mechanics"* and *"Neutrino Binding Between Nuclear Particles in Delta-C Mechanics"* [13][14], laid the groundwork for this ongoing investigation, providing the initial direction for understanding nuclear particle interactions [2].

A common presumption in the field has been that the energy levels of particles are determined solely by potential energy, much like the quantized energy levels of electrons in atoms. According to this view, nuclear particles occupy specific potential wells that correspond to quantum mechanical conditions, where each particle is assigned a distinct place defined by its potential. However, this assumption oversimplifies the complexity of mass particle formation and fails to capture the true underlying mechanisms.

In contrast, this paper demonstrates that the mass values of elementary particles are governed not merely by potential levels but by intricate mechanical interactions and standing wave dynamics between the particles themselves. Through these mechanical interactions, particles achieve specific mass values that are not attributed to potential energy, but a deficit of energy

The binding of two opposite $\pm$ particles is equivalent to the escape energy. Thus as two free particles bind together the mass is reduced. When the binding is closer than the radius of the electron, more energy is radiated away than their free particle mass, and on acquiring a state exists as a deficit in energy. The mass of a nuclear particle is then:

$$m = -E / c^2. \tag{1}$$

This is the deficit energy required to remove a particle from a nucleus, and perhaps explains the balance of energy in the universe between inertial mass energy, and electromagnetic energy.

By examining the mechanical and wave-like interactions of the path density flows at the subatomic level, it is uncovered that the generation of elementary particle mass arises from a more nuanced process than previously assumed. It is the collective and dynamic interplay of particles—including their relation with electrons—that contributes to the mass values observed in nuclear particles, rather than a simple potential energy framework.

Charge

The concept of electric charge has long been understood as a fundamental property of matter that governs the electrical interactions between particles. Traditionally, it is believed that this property, often referred to simply as "charge," plays a critical role in the way particles attract or repel each other. In this framework, charged particles create electric fields that influence their surroundings, leading to observable forces. Electric repulsion is not present inside the Compton radius of a composite particle because the external probability flow is symmetric and has no differential effect on internal parties. Opposite particle pairs existing inside the Compton radius (electrons-positrons), cannot annihilate since their energy is less than their free energy.

Building on this foundation, the theory of Delta-c Mechanics introduces a novel perspective by positing that the interaction between particles is fundamentally linked to the flow density and direction of photons along various action paths. The probability distribution of photon flow density interacts with the flow density of other particles, effectively altering the “index of refraction” of the medium through which photon probability move. This change in the index of refraction significantly changes the mechanism of how particles interact with one another, providing an alternate understanding of electrical interactions. In this view, the dynamics of photon flow not only mediate particle interactions but also transform our comprehension of charge to physical phenomena.

Preliminaries

Photons & and particles

Delta-c Mechanics postulates the photon is a rotating Planck particle having a radius of λ_{PL} (10E-33 cm), and a probability flow direction rotating at the Compton frequency, having energy of $\varepsilon = \hbar\omega$. If the photon is not in rotation, it has no energy, but still has an interaction with the probability flow of other photons, changing the flow direction, thus having an effect on the index of refraction of other action photons, and particle direction.

The primary rest mass particle is the electron, formed by the self-binding of two photons which having sufficient probability flow to direct by the change in the index of the other into an orbit (See [5] for details). The change in the velocity of light near a rotating particle due to the probability of its photon location is:

$$\frac{\Delta c}{c_0} = \left(\frac{\lambda\!\!\!^{-}_{PL} \bar{\nu}_e}{r} \right) \tag{2}$$

This is the change in the velocity of light at a distance r from the rotation of a Planck particle at the repetition rate of the electron Compton frequency.

The product of two particles gives the mutual reduction of the change in c which reduces the mutual mass energy by, $\Delta\varepsilon$. The structure of this is discussed in [12].

$$\frac{\Delta c}{c_0} = \frac{\Delta \varepsilon}{\varepsilon_0} = \frac{1}{2}\left(\frac{\sqrt{2}\lambda\!\!\!^{-}_{PL} \bar{\nu}_e}{r} \right)\left(\frac{\sqrt{2}\lambda\!\!\!^{-}_{PL} \bar{\nu}_e}{r} \right) = \left(\frac{\lambda\!\!\!^{-}_{PL} \bar{\nu}_e}{r} \right)\left(\frac{\lambda\!\!\!^{-}_{PL} \bar{\nu}_e}{r} \right) \tag{3}$$

This relation shows the change in the velocity of light at one particle at a distance r from the, and giving the interaction energy $\Delta\varepsilon$ as a result of the particle biding. $\Delta\varepsilon$ is the deficit in energy created by the binding, and is radiated away when the particles have a an integral $\hbar$ solution $n\hbar = mcr$. The numerators in Equation(3), are the Electron Creation Radius which is the radius of the two photons forming the first stable elementary inertial mass particle, the electron:

$$\Re_0 = \sqrt{2}\lambda\!\!\!^{-}_{PL} \bar{\nu}_e \tag{4}$$

The Planck particle radius $\lambda\!\!\!^{-}_{PL}$ is the radius of the bare photon and defined in elementary terms as $\lambda\!\!\!^{-}_{PL} = \sqrt{G\hbar / c^3}$.

$\bar{\boldsymbol{\nu}}$, is the ratio of the velocity light travels in free space to the relative velocity of the photons in the electron Compton orbit. It is "unitless" but its magnitude is equivalent to the electron frequency.

$$\bar{\boldsymbol{\nu}}_e v_e = c_0 = \boldsymbol{\nu}_e \lambda\!\!\!^{-}_e \rightarrow \bar{\boldsymbol{\nu}}_e = \frac{c_0}{v_e} \tag{5}$$

The relations above are developed in [5].

The Ground State

For atomic as well as nuclear particles, Equation(3), the binding energy ratio of two particles, has solutions at integral values of the action quqntum $\hbar$. The value of the binding of two electrons forms the ground state E_0 of the atomic-nuclear, particles. The nuclear ground state E_0 is a unitless the ratio of the binding energy of two $\pm$ electrons to the mass of an electron.

$$E_0 = \frac{1}{2}\left(\frac{\Re_0}{\lambda_e}\right)\left(\frac{\Re_0}{\lambda_e}\right) = \left(\frac{\lambda_{PL}\bar{v}_e}{\lambda_e}\right)\left(\frac{\lambda_{PL}\bar{v}_e}{\lambda_e}\right) = \frac{Gm_e}{\lambda_e}\left(\bar{v}_e\right)^2 \tag{6}$$

The fundamental value of the electron creation radius $\Re_0$ is shown in Eq.(4), and has been expressed in more fundamental terms in Equation(6). Note that the value E_0 is a creation of a particle with the energy extracted from the mass of the bound particles. When bound, this energy is radiated away leaving the bound pair having less mass than the free particles. The Ground state of nuclear particles is the solution, when the radius corresponds to the free electron's Compton radius. This state marks the ground state of both atomic and nuclear particles.

The base state of any particle, like the electron, defined as in Equation(6), as the binding of a positive and negative particle. If designated particle x then the nuclear base state and the binding state of the x particle and E_0 is:

$$E_0 = \frac{1}{2}\left(\frac{\Re_0}{\lambda_e}\right)^2 \qquad\qquad E_X = \frac{1}{2}\left(\frac{\Re_0}{\lambda_X}\right)^2 \tag{7}$$

Escape and Deficit Energy

The integral of the potential energy from λ_e to infinity is the escape energy of an electron from the nuclear ground state.

$$\frac{\varepsilon_0}{m_e c_0^2} = \int_{r=\lambda_e}^{\infty}\left[\frac{1}{2}\left(\frac{\Re_0}{r}\right)^2\right] = \frac{1}{2}\left(\frac{\Re_0}{\lambda_e}\right) = 0.0036571 \text{ electrons} \tag{8}$$

When the particle solution or Compton radius is less than, $\lambda_X < \Re_0 / 2$, the and the particle is bound in that position, the escape energy, equal to the binding energy, is radiated away. The particle mass Thus exists as a "deficit energy".

The Rydberg energy ground state of atomic particles is not at the radius λ_e, but because of the QED induced delay in the completion of the Compton radius, makes the radius greater by the factor of the Anomalous Gyromagnetic Ratio, g_A . The Rydberg ground state $n_K = 1$ is at a radius of $r = \lambda_e g_A^2$

If this radius is set as the solution to Equation(3) , the energy levels are the ionization energy of two opposite ± electrons or twice the ionization energy of positronium,

$$\frac{E_0}{g_A^4} = \frac{1}{2}\left(\frac{\Re_0}{\lambda_e g_A^2}\right)\left(\frac{\Re_0}{\lambda_e g_A^2}\right) = \frac{1}{2}\alpha^2 \rightarrow 13.606 \text{ eV} / m_e \tag{9}$$

Inserting $\Re_0$ from Equation(4) and the Rydberg integers, the Rydberg series gives the relation in fundamental terms as:

$$\frac{E_0}{g_A^4 n^2} = \frac{1}{2}\left(\frac{\lambda_{PL}\overline{v}_e}{\lambda_e n_{R1} g_A^2}\right)\left(\frac{\lambda_{PL}\overline{v}_e}{\lambda_e n_{R1} g_A^2}\right) = \frac{1}{2}\frac{\alpha^2}{n_{R1} n_{R1}} \tag{10}$$

This is the atomic Rydberg levels of the atom. The Rydberg integers n_R are multiples of Planck's constant in the Compton radius of the electron. Note that the product of the Rydberg integers n_R must also be an integer, $n_{R1} n_{R1} = n_R$ and has a physical cause in the binding of nuclear particles, (see section below).

The expressions in parentheses in Equation(10) represents what is called the "Kernels of particle creation", K forming the binding mechanism for both atomic and nuclear particles.

This function, distinguished by an integer value of the Rydberg integer, is central to both atomic and nuclear particles. While hydrogen atomic states exhibit only two particles in the binding, nuclear particles demonstrate multiple bindings of particles with the same Kernel. The multiplicity defined by n_K in Equation(10) constitutes the structure of atomic particles.

Particle Masses

In Equation(9), it can be observed that the energy created by the binding is extracted from the rest mass of the bound electrons thus the mass of the orbiting particles have decreased. On acquiring a Rydberg state with $n_R\hbar$ the binding energy is radiated away and m', the bound particle mass is as shown here:

$$m' = m_e - \frac{1}{2}\left(\frac{\alpha}{n_K}\right)^2 m_e \rightarrow \text{Photon Radiated Energy} = \frac{1}{2}\left(\frac{\alpha}{n_K}\right)^2 = \frac{m_e - m'}{m_e} \tag{11}$$

In Equation(9), when the radius of the particle solution λ is greater than $\Re_0$ or $r = \lambda_X > \Re_0$, the particle is bound in the Rydberg state n_R and the energy radiated away is less than the mass energy of the free electron (Atomic).

When the state energy has a solution with a Compton radius that is less than $\Re_0$, that is $r < \Re_0$, the energy radiated away is greater than the electron mass (Nuclear):

$$\text{Radiated Energy} \qquad \underset{\text{Atomic}}{\frac{m_e - m'}{m_e}} \rightarrow -\underset{\text{Nuclear}}{\frac{m' - m_e}{m_e}} \tag{12}$$

In Equation(12), $m' < m_e$, the left relation is the energy in the atomic system in which the particles are attractive, and on acquiring the state, the energy radiated away leaves a particle with less energy than the free electron.

The second is the nuclear particle in which the particle mass is greater than the electron. On acquiring the state the energy is radiated away leaving the mass of the particle as a creation of a deficit in energy.

It is important to emphasize that this process does not imply negative energy. Instead, the radiated energy is released into the universe as electromagnetic radiation. However, it does imply positive inertial mass is created by an energy deficit. Since the inertial mass of all particles is positive, we can assert that the Einstein Energy Relation for nuclear particles should be:

$$m = -\varepsilon / c_0^2 \tag{13}$$

This goes to the creation of atomic particles as being put together in an environment having a very low velocity of light, and now cannot escape due to a deficiency of energy.

Differential Atomic Levels

For familiarity, including the Bohr-Sommerfeld atomic states can be expressed as:

$$\frac{E_{nl}}{\left(m_e c_0^2\right) g_A^4} = \frac{1}{2}\left(\frac{\alpha}{n_R}\right)^2 \left[1 + \left(\frac{\alpha}{n}\right)^2 \left(\frac{n}{l + 1/2} - \frac{3}{4}\right)\right] + O\left[\alpha^6\right] \tag{14}$$

Note that the Anomalous Gyromagmetic factor g_A^4, appears is the base value and doesn't show in the radiation differentials.

The base state of all particles as discussed is E_0, that is the binding energy of two free electrons Equation(6). The radius λ_e of the Rydberg atomic ground levels is slightly larger than the free electron due to the QED induced rotational delay of the Anomalous Gyromagnetic ratio g_A, this delay causes the Rydberg ground level to be at a larger radius of $\lambda_R = \lambda_e g_A^2$.This makes the ground energy of the Rydberg levels slightly less than the nuclear ground state energy, E_0. The exponent n of Eta $g_A^{\pm n}$ depends on the number of mass particles bound with the electron.

There are two anomalous ratios that play a role in nuclear-atomic systems. They are the QED determined loop integral delay for particles moving in a circle. The ratio has no effect on the free electron, but when it is bound in rotation the Feynman action integral loops cause a delay that alters the electrons Compton radius. For atomic or Rydberg levels with radii above the electron, at $r = \lambda_e g_A^2$, the Anomalous Gyromagnetic ratio g_A^2 increases the electron Compton radius. Its value is:

$$g_A = 1.0011596521807 \tag{15}$$

The exponent of g_A is the number of mass particles engaged for Rydberg levels this is 2

The second is a similar factor that applies to particles with Compton radii less than $\Re_0$, is here designated as Eta. η. The value can be determined with precision by relations between the mass of several elementary particles and it is:

$$\eta = 1.00060014721177 \tag{16}$$

For nuclear particles, with Compton radii less than $\Re_0$, it is found that the QED effect on the radius is about ½ that of the Anomalous Gyromagnetic ratio.
The Nuclear Anomalous ratio Eta, η represents the change in the Compton radius for a mass $\lambda'_X = \lambda_X \eta$ particle bound within the nucleus. This factor is consistently present in the mass of all nuclear states. As the value of the Anomalous Gyromagnetic ratio is very precise, it also is very precise. Eta (η), is exact to at least twelve significant digits and uniform across all nuclear particles. The exponent of Eta $\eta^{\pm n}$ also depends on the number of mass particles bound and the sign depends on relative spin.

Although the value of η has not yet been determined by QED methods, it should not be dismissed as arbitrary, as it is crucial to the precise mass of several interconnected known particles. This factor, like the Anomalous Gyromagnetic ratio is an offset to the nuclear ground state. Originally this factor was mistakenly presumed to be a neutrino (See Appendix I).

The Particle Kernels

From Equation(10) , the Kernel of atomic and nuclear particles K is identified as:

$$K_{(\text{Atomic})} = \underbrace{\left(\frac{\lambda_{PL}}{\lambda_e g_A^2}\frac{\overline{v}_e}{n_R}\right)}_{\text{Atomic Electrons}} \qquad K_{(\text{Nuclear})} = \underbrace{\left(\frac{\lambda_{PL}}{\lambda_e \eta}\frac{\overline{v}_e}{n_R}\right)}_{\text{Nuclear Quarks}} \tag{17}$$

The product of these relations establishes particle masses. Note that, the Rydberg integer n_R, is a multiple of the action quantum, $\left(n_R \lambda = n_R \hbar / mc\right)$, and plays the same role in a nuclear particles as in atomic states. The kernels are the same accept for the QED effects. The value of η in the kernel can be $\eta^{\pm n}$ indication an increase or decrease in the electron radius, presumably the result of the relative spin between different particles.

All nuclear particles exhibit similar binding mechanisms. While the atomic system showcases the binding of two opposite electron-positrons, other particles have base states also, that are related to E_0.

The forms illustrating the interacting binding of two particles in Equation(7) are; first in the atomic form $\lambda_e > \Re_0$ and; second applies to particles with mass greater than the electron $\lambda_e < \Re_0$ in the nuclear form.

The ratio of the binding energy of the electrons to the binding energy an arbitrary particle x yields the mass of the x particle in electrons.

$$\frac{E_0}{E_X}=\frac{\frac{1}{2}\left(\frac{\Re_0}{\lambda_X}\right)^2}{\frac{1}{2}\left(\frac{\Re_0}{\lambda_e}\right)^2} \quad\rightarrow\quad \frac{1}{2}\left(\frac{E_X}{E_0}\right)=\left(\frac{m_X}{m_e}\frac{m_X}{m_e}\right) \quad\rightarrow\quad \sqrt{2\frac{E_X}{E_0}}=\frac{m_X}{m_e} \tag{18}$$

E_0 is the ground state of the nuclear-atomic system. The ratio here is the binding energy of positive & negative x particle energy relative to the ground state energy. The last term in Equation(18), is the expression solved for the mass of the single x particle.

*Binding Kernels (*redefind in later vesion*)*

As atomic bindings creates a state particle, namely photons, from the binding of two electrons, the binding of two or more sub-particles defined by the Kernels in Equation(17) can create state particles.

Atomic

$$E_X = E_0\left[(K_1)(K_2)\right]$$

$$\frac{m_X}{m_e}=\sqrt{\left[(K_1)(K_2)\right]}$$

Nuclear

$$E_X=\frac{E_0}{(K_1)(K_2)(K_3)} \tag{19}$$

$$\frac{m_X}{m_e}=1/\sqrt{(K_1)(K_2)(K_3)}$$

The difference is that in the atomic case the particle can radiate away reducing the mass of the bound particle, but for a nuclear particle the energy radiated away exceeds the free particle rest mass and thus the bound particles are trapped as deficits in energy. All sub particles have the same kernel as electrons with the difference being the QED factors g_A and η.

Including the electron in the Rydberg calculations shows binding radiated energy.

Atomic

$$\left[\begin{array}{l} \Delta E_X = E_0\left[1-\left(\frac{\sqrt{2}\lambda_{PL}}{\lambda_e g_A^2}\frac{\bar{\nu}_e}{n_{K1}}\right)\left(\frac{\sqrt{2}\lambda_{PL}}{\lambda_e g_A^2}\frac{\bar{\nu}_e}{n_{K2}}\right)\right] \\ \quad \rightarrow \frac{m_e^2-m_X^2}{m_e^2}=\left(\frac{\sqrt{2}\lambda_{PL}}{\lambda_e g_A^2}\frac{\bar{\nu}_e}{n_{K1}}\right)\left(\frac{\sqrt{2}\lambda_{PL}}{\lambda_e g_A^2}\frac{\bar{\nu}_e}{n_{K2}}\right) \\ \quad \rightarrow \frac{(m_e-m_X)}{m_e}=\frac{1}{2}\left(\frac{\sqrt{2}\lambda_{PL}}{\lambda_e g_A^2}\frac{\bar{\nu}_e}{n_{K1}}\right)\left(\frac{\sqrt{2}\lambda_{PL}}{\lambda_e g_A^2}\frac{\bar{\nu}_e}{n_{K2}}\right) \\ \quad \rightarrow \frac{\Delta c}{c_0}=\frac{(m_e-m_X)}{m_e g_A^4}=\frac{1}{2}\left(\frac{\alpha^2}{n_K}\right) \qquad \frac{\text{Radiated Energy}}{\text{See Equation(11)}} \end{array}\right] \tag{20}$$

The above particle created is the photon of the radiated energy.

Nuclear

$$\left[\begin{array}{c} E_X = E_0\left(\frac{\sqrt{2}\lambda_{PL}\eta}{\lambda_e}\frac{\bar{\nu}_e}{n_{K1}}\right)^{n1}\left(\frac{\sqrt{2}\lambda_{PL}\eta}{\lambda_e}\frac{\bar{\nu}_e}{n_{K2}}\right)^{n2}\left(\frac{\sqrt{2}\lambda_{PL}\eta}{\lambda_e}\frac{\bar{\nu}_e}{n_{K2}}\right)^{n3} \\ \frac{E_X}{E_0}=\left(\frac{m_X}{m_e}\right)^2 \\ \frac{m_X}{m_e}=1\Big/\sqrt{\left(\frac{\sqrt{2}\lambda_{PL}\eta}{\lambda_e}\frac{\bar{\nu}_e}{n_{K1}}\right)^{n1}\left(\frac{\sqrt{2}\lambda_{PL}\eta}{\lambda_e}\frac{\bar{\nu}_e}{n_{K2}}\right)^{n2}\left(\frac{\sqrt{2}\lambda_{PL}\eta}{\lambda_e}\frac{\bar{\nu}_e}{n_{K2}}\right)^{n3}} \end{array}\right] \tag{21}$$

The nuclear mass created is equal to the energy radiated away on binding at an integral value of $\hbar$.

The simplified result of the internal mass of the particles could be stated as:

$$\frac{1}{2}\left(\frac{m_e}{m_X}\right)^2=\left(\frac{m_e}{m_1}\right)^2\left(\frac{m_e}{m_2}\right)^2\left(\frac{m_e}{m_3}\right)^2 \tag{22}$$

The mass of m_X is not the sum of the particle mass, but the product.

Binding Interaction Mechanism

Particles are bound to each other at the Compton radius in a plane, and as they spin, the interaction consists of simultaneous rotations intermeshing with another. For a stable solution representing an existing particle, this interaction manifests as a standing wave and continuity of probability flow between the two particles. For this to hold true, the number of electron cycles of one particle must be an integral multiple of the other; otherwise, a complete cycle cannot occur, and probability flow would not be conserved. This means the product of the Rydberg integer n_K of one multiplied by the other must also be an integer.

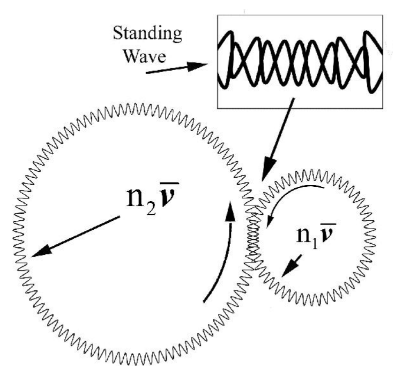

Figure 1, The rotation connection of two bound particles

The interaction point is illustrated in Figure 1, which depicts the continuous standing wave pattern at the contact point between the two particles. For the interacting particles, there has to be a continuous standing wave, thus the product of the Rydberg integer for two interacting particles also has to be an integer.

$$\frac{\bar{v}_e}{n_{K1}} \times \frac{\bar{v}_e}{n_{K2}} = \frac{\bar{v}_e}{n} \quad \text{or} \quad (\bar{v}_e n_{K1}) \times (\bar{v}_e n_{K2}) = \bar{v} n_e \tag{23}$$

The value of n can be $n^{\pm 1}$, and there can possibly be many combinations specifying infinity of particles, but the interaction of particles having irrational products can't work. In some instances two particles in a group can individually bind with another particle, but not with each other

Calculated Values

The makeup of following particles and calculations are shown below. Codata and experimental values determined by the particle data groups, area included in Appendix IV. Those illustrated are:

Proton, Tauon, Muon, Charged Pion, Z Boson, W Boson, Top Quark

Summary

Particle Mass

	Theory		Experimental, Codata, & PDG	
	Electrons	GeV	Electrons	
Proton	1836.15267344		1836.15267344	
Neutron	1838.68366173		1838.68366173	
Tauon	3477.18825		3477.135 +/- .136	
Muon	206.76743435		206.76828298	
Pion+/-	273.131906		273.1321133	
Z Boson	177190.369	90.544	90.04 - 90.76	GeV
W Boson	157359.58	80.410	80.433 +/-.0009	GeV
Top Quark	336153.82	171.7225	171.77 +/- 0.38	Gev

Proton

To illustrate the preceding mechanics, the mass of the proton can be shown. The binding energy for the Proton as illustrated in Equation (21) is:

$$\text{proton} \quad \frac{1}{2}\left(\frac{\Re_0}{\lambda_P}\right)^2 = \frac{\left(\frac{\Re_0}{\lambda_e}\right)^2}{\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\bar{v}}{2^5}\right)\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\bar{v}}{1}\right)^{1/2}\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\bar{v}}{2}\right)^{1/2}} \qquad (24)$$

$$\left(\frac{m_P}{m_e}\right) = 1/\sqrt{\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\bar{v}}{2^8}\right)\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\bar{v}}{1}\right)^{1/2}\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\bar{v}}{2}\right)^{1/2}} \qquad (25)$$

Note that the elements of this are the same as electrons in atomic Rydberg states and there are three particles, two with root exponents. It is asserted that these three elements are bound Quarks.

The values of the Rydberg integers for the Proton n_R for the three Quarks in the proton are 2^8, 1, and 2. Note that the first and third particle cannot combine without an irrational n_R product, $\sqrt{2}$ in the mass.

Using the data in Appendix IV the values of the proton and quarks can be calculated to the precise value of the proton.

Product	Mass Mass in Electrons	Name
0.000323831	111.14006301801	Quark 1
0.017995311	3.7272654691143	Quark 2
0.025449213	4.4324906153747	Quark 3
1.48304E-07	1836.15267344223	Proton

Proton within experimental error-bars

The identified quarks here are not the same as the experimental values of the Quarks as determined in the Standard model. (u= 4.501,   d= 9.393)

Neutron

The structure of the neutron is the same as the proton with the added sub particle composed of an electron in orbit at a Rydberg level $r = \lambda_e g_A^3$, (1), and another part that can be probably identified as a neutrino(2). The calculated value is shown to be as precise as the proton.

The product of the binding of atomic and nuclear Kernels form Equation(19) is:

$$\left(\frac{\Re_0}{\lambda_e}\right)^2 = \left(\frac{\Re_0}{\lambda_n}\right)^2 \frac{\overset{(2)\downarrow}{\left(\dfrac{\lambda_{PL}\eta^3\overline{v}}{\lambda_e}\right)}}{\underset{(1)\uparrow}{\left(\dfrac{\lambda_{PL}\overline{v}}{\lambda_e g_A^3}\right)}} \left(\frac{\lambda_{PL}\eta^3\overline{v}}{\lambda_e 2^6}\right)\left(\frac{\lambda_{PL}\eta^3\overline{v}}{\lambda_e}\right)^{1/2}\left(\frac{\lambda_{PL}\eta^3\overline{v}}{\lambda_e 2}\right)^{1/2} \tag{26}$$

$$\left(\frac{m_X}{m_e}\right) = \sqrt{\frac{\left(\dfrac{\lambda_{PL}\overline{v}}{\lambda_e g_A^3}\right)}{\left(\dfrac{\lambda_{PL}\eta^3\overline{v}}{\lambda_e}\right)\left(\dfrac{\lambda_{PL}\eta^3\overline{v}}{\lambda_e 2^6}\right)\left(\dfrac{\lambda_{PL}\eta^3\overline{v}}{\lambda_e}\right)^{1/2}\left(\dfrac{\lambda_{PL}\eta^3\overline{v}}{\lambda_e 2}\right)^{1/2}}} \tag{27}$$

This gives, 1837.6836, and adding the electron into the mass gives:

Product	Mass Mass in Electrons	Error
Neutron	1838.68366173244	Within experimental error

Muon

Two Ks with $n_R = 2^4$ and two Ks with $n_R = 2^3$

$$\frac{1}{2}\left(\frac{\lambda_\mu}{\lambda_e}\right)^2 = \left(\frac{\lambda_{PL}\bar{\nu}_e}{\lambda_e \eta}\,2^4\right)^2 \times \left(\frac{\lambda_{PL}\bar{\nu}_e}{\lambda_e \eta}\,2^3\right)^2 \qquad (28)$$

$$\frac{m_\mu}{m_e} = 1 \;/\; \sqrt{\frac{1}{2}\left(\frac{\lambda_{PL}\,\bar{\nu}_e}{\lambda_e \eta}\,2^4\right)^4} \qquad (29)$$

	Product of terms	Mass Mass in Electrons	Experimental
	0.00683963394338	8.55004839045560	
	0.00170990848584	17.1000967809112	
Muon	0.00001169514811	206.767434351182	206.768282983826
			Error 1 / 243,647.

This error of one part in 250,000 is at this point is not explained.

$$\left(\frac{m_W}{m_e}\right) = \left(\frac{\hbar}{S_e}\frac{2^5}{\eta^3}\right)\sqrt{\left(\frac{\hbar}{S_e}\frac{2^6}{\eta^3}\right)^{1/2}\left(\frac{\hbar}{S_e}\frac{1}{\eta^3}\right)^{1/4}\left(\frac{\hbar}{S_e}\frac{2}{\eta^3}\right)^{1/4}}$$

Tauon

$$\frac{1}{2}\left(\frac{\lambda_\tau}{\lambda_e}\right)^2 = \left(\frac{\lambda_{PL}}{\lambda_e}\frac{\bar{\nu}_e}{2}\frac{\eta^3}{1}\right)^2\left(\frac{\lambda_{PL}}{\lambda_e}\frac{\bar{\nu}_e}{1}\frac{\eta^3}{1}\right)^{3/4}\left(\frac{\lambda_{PL}}{\lambda_e}\frac{\bar{\nu}_e\eta^3}{1/2}\right)^{1/4} \qquad (30)$$

$$\frac{m_\tau}{m_e} = 1 / \sqrt{\left(\frac{\lambda_{PL}}{\lambda_e}\frac{\bar{\nu}_e\,\eta^3}{1}\right)^2\left(\frac{\lambda_{PL}}{\lambda_e}\frac{\bar{\nu}_e\eta^3}{1}\right)^{1/4}\left(\frac{\lambda_{PL}}{\lambda_e}\frac{\bar{\nu}_e\,\eta^3}{2}\right)^{3/4}} \qquad (31)$$

Product of terms	Mass In Electrons	Experimental
0.000026845864459	136.47286	
0.319056188741313	1.2518474	
0.019312078693610	5.08827401	
1.65414504620E-07	3477.18825	3477.228+/- 0.459 Within experimental error-bars

Charged Pion

The pion appears to be the binding of two opposite quarks with an electron, that orbits at the Electron Rydberg making it a two quark atom. The structure in the form of Equation(19), as illustrated in Equation(27) is:

$$\frac{1}{2}\left(\frac{\Re_0}{\lambda_e}\right)^2 = \frac{1}{2}\left(\frac{\Re_0}{\lambda_{\pi+}}\right)^2 \frac{\left(\frac{\lambda_{PL}}{\lambda_e \eta^2}\frac{\overline{\nu}_e}{1}\right)^4}{\left(\frac{\lambda_{PL}}{\lambda_e g_A^2}\frac{\overline{\nu}_e}{1}\right)^2} \tag{32}$$

Or:

$$\frac{m_{\pi+}}{m_e} = \frac{\alpha}{\left(\frac{\lambda_{PL}\overline{\boldsymbol{\nu}}}{\lambda_e \eta}\right)^2} \tag{33}$$

Calculated Mass Electrons	Calculated Mass MeV	Particle Data Group MeV
273.1319063	139.570104	139.57039± 0.00017 [18][19],

Note that the calculated mass value is at the edge of the experimental error bars for the charged pion by the PDG [18][19], but within the scatter of the latest experimental data (see Appendix III)

Z boson

In [13] it had been found the relation for the mass of the Z boson in terms of the proton and the nuclear ground state E_0 was :

$$\frac{1}{2}\left(\frac{\lambda_Z}{\lambda_e}\right)^2 = 2\left(\frac{\lambda_P}{\lambda_e}\right)^2 E_0$$

By putting the values for the proton and E_0 from above, the particles in the Z boson are:

$$\frac{1}{2}\left(\frac{\lambda_Z}{\lambda_e}\right)^2 = 1\Big/\left[\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\bar{\nu}_e}{2}\right)^3\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\bar{\nu}_e}{4}\right)^{1/2}\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\bar{\nu}_e}{2}\right)^{1/2}\right] \tag{34}$$

$$\left(\frac{m_Z}{m_e}\right) = 1\Big/\sqrt{\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\bar{\nu}_e}{2}\right)^3\left[\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\bar{\nu}_e}{4}\right)^{1/2}\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\bar{\nu}_e}{2}\right)^{1/2}\right]} \tag{35}$$

Calculated **Mass** Electrons	GeV	Experimental Mass GeV
177190.369	90.544	90.04 - 90.76

Decay Channel	Entries	Center	Error	Center deviance from Z_m^0(%)	Z-score	Width	Error
Muon	600071	90.76	(6.03E-03)	-0.47	70.70	5.71	(2.38E-02)
Electron	375216	90.04	(8.90E-03)	-1.26	128.96	6.57	(3.68E-02)

Ref. [16]

W Boson

The W boson was found in [14], [15] to be,

$$\frac{1}{2}\frac{\lambda_W}{\lambda_e} = \frac{\lambda_\tau}{E_0}\left(\frac{\lambda_P}{\lambda_e}\right)^2$$

By putting the values for the proton, tauon and E_0 from above, the W boson particle makeup is:

$$\frac{1}{2}\left(\frac{\lambda_W}{\lambda_e}\right)^2 = \left[\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\overline{\nu}_e}{2^6}\right)^2\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\overline{\nu}_e}{2}\right)^{1/2}\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\overline{\nu}_e}{1}\right)^{1/4}\left(\frac{\lambda_{PL}\eta^3}{\lambda_e}\frac{\overline{\nu}_e}{2}\right)^{1/4}\right] \quad (36)$$

$$\frac{m_W}{m_e} = \sqrt{\left(\frac{\hbar}{S_e}\frac{2^5}{\eta^2}\right)\left(\frac{\hbar}{S_e}\frac{2^6}{\eta^2}\right)^{1/2}\left(\frac{\hbar}{S_e}\frac{1}{\eta^2}\right)^{1/4}\left(\frac{\hbar}{S_e}\frac{2}{\eta^2}\right)^{1/4}} = \frac{1}{2^{1/4}}\left(\frac{\hbar}{S_e}\frac{2^5}{\eta^2}\right)\left(\frac{m_P}{m_e}\right)^{1/2} \quad (37)$$

Calculated Mass Electrons	GeV	Experimental Mass GeV
157359.58	80.410	80.433Gev +/-9Mev

Fermilab (CDF) Collaboration 80.433Gev +/-9Mev [17]

Top Quark

The Top Quark was found in [14], [15] to be, $\lambda_{TOP} / \lambda_e = E_0 / 9$. Putting this in the same form as Eq.(19), gives:

$$\frac{1}{2}\left(\frac{\lambda_{TOP}}{\lambda_e}\right)^2 = \left(\frac{\lambda_{PL}\eta}{\lambda_e}\frac{\overline{\nu}_e}{6}\right)\left(\frac{\lambda_{PL}\eta}{\lambda_e}\frac{\overline{\nu}_e}{3}\right)^3 \quad (38)$$

The nuclear energy of this particle is a deficit energy calculated from Equation (38) to be:

$$\frac{m_{TOP}}{m_e} = 1 / \left(\frac{\lambda_{PL} \eta}{\lambda_e} \frac{\overline{\nu}_e}{3} \right)^2 = 336052.6 \text{ Electrons} \tag{39}$$

Calculated Mass		Experimental Mass
Electrons	GeV	GeV
336052.68	171.722	171.77+/-0.38 Gev
		CMS collaboration [15]

Conclusion

Without any injected coupling constants, the mass numbers are exceptionally accurate. Of the calculated mass values presented only the muon mass is out by an unexplained, one part in ¼ of a million. It's difficult to believe these calculated values without arbitrary form factors, having accuracies of up to 12 significant digits are not the result of physical causation.

Earlier papers have focused on the physical aspects of Delta-c Mechanics [1], [2]. This paper's intention is to extend the foundational understanding of particle mass by focusing on the internal structure and mechanical interactions of elementary particles. Unlike prior models that primarily attributed mass values to potential energy levels, our exploration into Delta-C Mechanics reveals that mass states are governed by intricate standing wave dynamics between particle interactions. Key to this process is the electron, which plays a vital role in establishing the ground state for all particles. The insights derived from the interactions between photons and particles, the index of refraction altered by photon flow density, creating the binding mechanisms provide a clearer understanding of mass formation at both atomic and nuclear levels.

The Finding that nuclear particles inertial mass is created by a deficit of energy produces an understanding of the balance of energy in the universe between electromagnetic and inertial mass.

It was illustrated that a proton is actually the same as two positrons and an electron, trapped as an energy deficit of 1833.15 electrons. In the hydrogen atom, the other electron bound at the atomic level completes the sub-particles group, as two complete electron-positron pairs, with 1833 electron equivalent energy, radiated away.

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Appendix I.

Neutrino Misidentification Discussion

In earlier papers "Neutrino Binding Between Nuclear Particles in Delta-c Mechanics", and Nuclear Particle Structure in Delta C Mechanics" [13][14], It was asserted that the slight offsets in the mass were the inclusion of the values of particular neutrinos. Although the developed values were substantially accurate the structural mechanism was incomplete. The presentation here is more complete and the revised values are included.

The neutrinos carry off the extra energy on the breakup of a nuclear particle but the radiated energy is not obvious as a state value in the particle.

The difference in the ratio of the free and bound energy is totally due to the change in the energy difference provided by the QED effects of the anomalous g_A factor, and Eta η ,on the binding , and although it is not a neutrino is somehow related to the Neutrino energy.

Appendix II

The following is the values of the mass of the relation between the nuclear ground state and four elementary particle masses presented in [15] and delineated this paper. The integral numbers in these exact relations between the mass and the nuclear ground state give a clue to important relations developed here.

$$E_0$$

= 2.67493983646500E-05

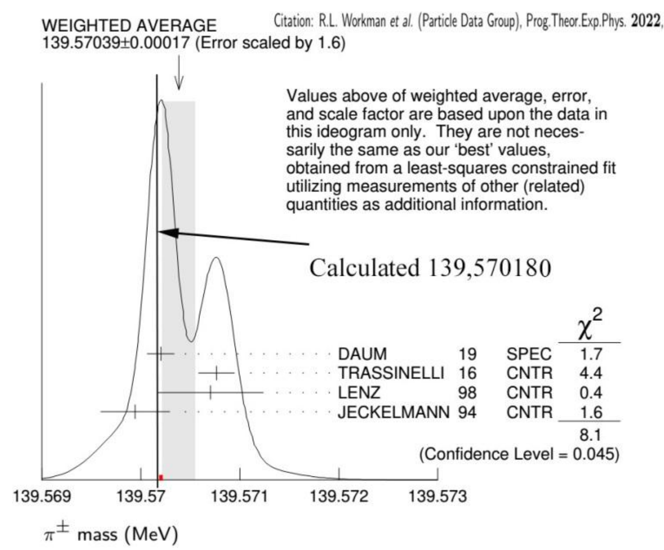
$$E_0 = \frac{1}{2}\left(\frac{\Re_0}{\lambda\!\!\!^{-}_e}\right)^2 \qquad E_0 = \frac{1}{\sqrt{2^{15}}}\left(\frac{\lambda\!\!\!^{-}_\mu \eta^2}{\lambda\!\!\!^{-}_e}\right) \qquad E_0 = 2\left(\frac{\lambda\!\!\!^{-}_{\pi+} g_A^2}{\lambda\!\!\!^{-}_e \eta^2}\right)^2$$

$$E_0 = \sqrt{2}\left(\frac{\lambda\!\!\!^{-}_\tau \eta^{4.5}}{\lambda\!\!\!^{-}_e}\right)^{4/3} \qquad E_0 = \sqrt{2^{13}}\left(\frac{\lambda\!\!\!^{-}_P \eta^3}{\lambda\!\!\!^{-}_e}\right)^2$$

Appendix III

Pion Mass Error Bars

The pion mass error shown in (40) is at the edge of the R.L. Workman et al. (Particle Data Group), 2022 error bars for the value for the Pion mass, and at the center of the error bars in the 1008 publication. It is not believed that the calculated value of the pion mass in this paper is in disagreement with the experimental value. [18],[19]



Comparison in GeV

Theory		PDG
139.57018	2008	139.57018± 0.00035
	2022	139.57039± 0.00017

Appendix IV

The Physical constants and Particle Mass Values Used in this Paper

Particle	Particle Mass (gms)	Particle Mass (Electron)	Compton Radius (cm)
Electron	9.10938370150000E-28	1.0000000000000	3.86159267943989E-11
Muon	1.88353162700000E-25	206.7682829838260	1.86759430591295E-13
Proton	1.67262192369000E-24	1836.1526734400000	2.10308910326354E-14
Tauon	3.16754000000000E-24	3477.1882507793300	1.11055036503721E-14
Neutal Pion	2.40618001661378E-25	264.1430085130310	1.46193257250244E-13
Chgd Pion	2.48806333627759E-25	273.1319063734130	1.41381969273136E-13
Neutron	1.67492749804000E-24	1838.6836617324600	2.10019415509539E-14
Wboson	1.43344876621262E-22	157359.577023480	2.45399279311973E-16
Zboson	1.61700283014969E-22	177509.575086120	2.17542781991699E-16

	Physical Constants		
$\bar{\lambda}_{PL}$	Planck Radius	1.61640095996445E-33	(cm)
α	Fine Structure Constant	7.29735253594845E-03	
$\hbar$	Planck Constant	1.05457181760000E-27	(cgs)
c_0	Velocity of light	2.99792458000000E+10	(cm/sec)
ν_e	Electron Freq.	1.23558996386000E+20	(hz)
$\overline{\nu}_e$	Electron cycle number	1.23558996386000E+20	
m_e	Electron Mass eV	5.10998902000000E+05	(ev)
G	Gravitational Constant	6.67550533180000E-08	$cm^3 / gm\ sec^2$
E_0	Nuclear Ground State	2.67493983646500E-05	
$\Re_0$	ECR Radius	2.82447977709503E-13	(cm)
g_A	Anom Gyromagnetic Ratio	1.00115965218073	
η	Nuclear Anomalous Spin	1.00060014721177	