Feynman Vertex Functions

D.T. Froedge

Formerly Auburn University
dt.froedge903@topper.wku.edu

v060225

Introduction

Vertex Functions are states of mass particles located at the end point, or final states of the Feynman linear action integrals, and represent the rest mass of a collection of Vertex Kernels. The Vertex Kernels defined here are the structure of the probability flow density of electrons in quantum states that bind together as multi-particle structures. The details of the structure is developed in "Feynman Flow Density Alternative to Wavefunctions" [16]

The vertex kernels are solutions to the Feynman flow interaction, $\phi^*\phi$ of particle states, that are alternates to the QM probability density state functions $\psi^*\psi$

Both the Feynman path integrals and the Schrödinger equation, reproduce the initial and final states of particle motion at the vertex of the Feynman diagrams. It is found that these are the vertex function and shown to be the binding energy of atomic states that define the rest mass of nuclear particles.

The vertex function of atomic states will be familiar, as all are states of the electron, but the nuclear states which are also states of the electron may not be as familiar. The vertex "function" is a product of vertex kernels that form the state values. It is illustrated that each quark of the proton is an electrons in action states of $n\hbar$, and the product of the three quarks is the total mass.

"A Feynman Flow Density Alternative to the Wavefunction', will assist in understanding this paper. [20],

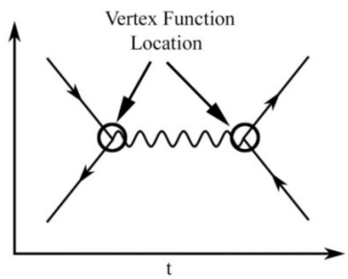
The mass of the vertex function is the product of the vertex kernels and is consistent with Eddington's view of the mass of particles, like wavefunctions should be products, [13].

The energy of a state composed of the product of multiple conjugate flow functions will be shown to be:

$$\phi_X * \phi_X = (\phi_1 * \phi_1)(\phi_2 * \phi_2)\bullet\bullet \rightarrow \left(\frac{\varepsilon_X}{m_e}\right) = \sqrt{\left(\frac{m_1}{m_e}\right)^2 \left(\frac{m_2}{m_e}\right)^2 \left(\frac{m_3}{m_e}\right)^2 \bullet\bullet} \quad (1)$$

The Feynman vector flow functions ϕ_X, and $\phi_X *$,for particular stated of action will be referred to as Vertex Kernels $(K_1)*(K_2)$ And the product as vertex functions.

Fig. 1 Vertex Positions



Flow Probability Density

The Vertex Kernel is the vector flow density of a state of a rotating electron. As the two photons rotate inside the electron there is a probability via the Feynman postulates, of the circularly flow location existing throughout space. This gives the exterior probability flow density in a plane on the action paths as a function of the distance from the center of momentum. The product of the Kernels is the mass energy referenc to the mass energy of the free enectron.

$$\left[(K_1)*(K_2)\bullet\bullet\bullet\right] \rightarrow m_1^2\ m_2^2\, m_3^2 \bullet\bullet\bullet \quad (2)$$

Conjugate Particles

Kernels bind in pairs that shown in fig. 2, and can be referred to as conjugate kernels. Each is the probability density of two oppositely polarized kernels. The asterisk does not represent a negative number, but one is an electron and the other a negative electron (positron), with an opposite polarization, and flow density shown in Fig. 2A. , [3]

The conjugate vectors concept is presented here as a more descriptive explanation of the process. A more mathematical description in the Dirac matrix of Geometric Algebra presented as in: “The Dirac Equation and the two Photon Model” [12].

Conjugate particles are opposite ± particles such as electron-positron that bind due to the counter flow of the probability density:

$\phi * \phi$ $\qquad\qquad$ $\phi * \phi *$

Fig.2A

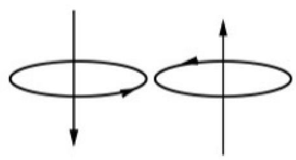
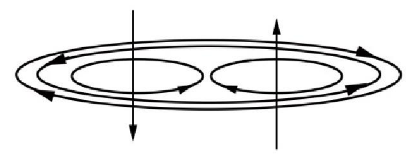


Fig. 2B



Particle-Particle Descriptive

The photons in an electron rotate such that the electric vectors are constant along the radial vector and the magnetic vector is perpendicular to the rotation plane

Fig. 2A shows a positive and negative particle, both rotating clockwise with opposite B vectors. Between the two aligned particles is a volume of space where the action flow probability density decreases the velocity of light or increases the index of refraction. This increase in the index of refraction pulls the action paths from one particle to the other simulating a charge effect. Fig. 2B shows a pair of identical particles with B vectors anti-aligned. The photon action flow in between the particles is in the same direction and does not interfere. On the exterior however there is a flow density interaction which pulls the particles apart, just as would a repulsive charge.

The product of a conjugate pair cancels the up and down $(\uparrow\downarrow)$ time dependent vectors, yielding a scalar energy ratio. A bound pair is not aligned with other parties in a vertex function or an external field. A group of vertex kernels, can only have one aligned kernel, and a neutral vertex function will have no unaligned pairs. Eq.(3), illustrates, a neutral pair and the factoring, showing the positive Vertex function.

$$\phi_X * \phi_X = (\phi_1 * \phi_1)(\phi_2 * \phi_2)\bullet\bullet \rightarrow \quad +\phi_X{}^* = +\phi_1{}^* \sqrt{\left(\phi_2{}^*\phi_1\right)^2 \left(\phi_3{}^*\phi_3\right)^2 \bullet\bullet} \qquad (3)$$

Vertex kernels are higher action states of free electrons, and the interaction energy and mass of the vertex kernels are all expressed as ratios of the mass of the free electron $m = m_X / m_e$

Flow functions of Atomic and Nuclear Kernels

From earlier work it was found that the ratio of the creation radius of rotation of the photons that form the electron, of the classical radius is: (See Appendix I) Eq.(4), shows the equivalent relations.

$$\phi_e = \frac{\sqrt{2}\lambda_{PL}\overline{v}_e}{\lambda_e} = \frac{\Re_0}{\lambda_e} = \frac{\Re_0 m_e c_0}{\hbar} = \frac{S_e}{\hbar} = \alpha \tag{4}$$

First is the relation with the Planck particle, second the relation between the electron radius $\Re_0 = \sqrt{2}\lambda_{PL}\overline{v}_e$, and the electron Compton radius λ_e, third & fourth is the free electron action, and last the fine structure constant. (See [26] for development)

The internal action of the free electron is $S_e = \Re_0 m_e c_0$

Vertex Kernels

Vertex Kernels are all composed of action states of the electron, and for vertex kernels there are two ranges of action states that are possible. One is for atomic states with the action ratio being the ratio of the free electron action, to the action quantum $\hbar$ and having a value less than one:

$$\phi_A = \frac{S_e / n_R}{\hbar} < 1 \tag{5}$$

The second is for nuclear states, with a density flow function that is the reciprocal of the atomic kernel. It is the ratio of the action quantum $\hbar$ to the free electron action, and has a value greater than one:

$$\phi_N = \frac{\hbar}{S_e / n_R} > 1 \tag{6}$$

The flow functions of the atomic and nuclear states are reciprocals accept for the QED effects. (Appendix II)

The two vertex kernels stated in Eq(5)., and Eq(6)., tjhen are:

$$
\begin{aligned}
&(A) \qquad \phi_A = \frac{\Re_0}{\lambda\!\!\!^{-}_e n_R} = \frac{\left(\Re_0 m_e c_0 / n_R\right)}{\hbar} = \frac{S_e / n_R}{\hbar} \\
&(B) \qquad \phi_N = \frac{\lambda\!\!\!^{-}_e n_R}{\Re_0} = \frac{\hbar}{\left(\Re_0 m_e c_0 / n_R\right)} = \frac{\hbar}{S_e / n_R}
\end{aligned}
\qquad (7)
$$

This can be thought of as the ratio of the action inside and outside the electron Compton radius.

Feynman Flow Function

The functions of Eq.(7), were originally found by a more classical approach to particle interaction by flow density and photon-photon mean free paths. It has recently been realized that flow functions are just the Feynman contour integrals of the action paths of the probability flow of the rotating photons. The electron radius originally found in fundamental units $\Re_0$, is the classical electron radius $\Re_0 = \alpha \lambda\!\!\!^{-}_e g_A^2$ with the inclusion of the QED anomalous g_A factor.

The specific values for the flow functions ϕ in Eq.(7), located at the vertex of the Feynman diagrams are referred to as vertex kernels. The binding of the atomic kernels establish the well-known Rydberg energy states. The energy levels of the nuclear kernels are not well known but do establish the well-known mass of the nuclear particles.

Feynman action flow integrals

The Feynman integral action for rotating bound photons is similar to the linear flow integral except it repeats, giving a periodic a space-time vertex kernel.

The Dirac matrix Geometrical Algebra, GA form of the electron photons shown earlier in [10]

Starting with the two conjugate electron photons wavefunction the, the momentum four derivative of the two conjugate photons that make up the electron expressed in GA are:

$$
\frac{\boldsymbol{p}_1}{\hbar} = \left[\gamma^\mu \frac{\partial}{\partial x^\mu} e^{i\left(\frac{m_1 c_0}{\hbar}\left(k \bullet x - c_0 t\right)\right)}\right] \qquad \frac{\boldsymbol{p}_2}{\hbar} = \left[\gamma^\mu \frac{\partial}{\partial x^\mu} e^{i\left(\frac{m_2 c_0}{\hbar}\left(-k \bullet x - c_0 t\right)\right)}\right]
$$

(8)

The sum is:

$$\boldsymbol{p}_1 + \boldsymbol{p}_2 = \left|\left(\gamma^{\mu}\left(\frac{m_1 c_0}{\hbar} - \frac{m_1 c_0}{\hbar}\right) - \gamma^{k}\frac{m_1 \Delta c_1}{\hbar}\right)\right| = \left(\frac{m_e \Delta c_1}{\hbar}\right) \tag{9}$$

The magnitude of two 4 vectors has two polarizations that can be represented as up and down vectors,

$$\frac{\boldsymbol{p}_1 + \boldsymbol{p}_2}{\hbar} \rightarrow \frac{m_e c_0}{\hbar}\downarrow \text{ or } \frac{m_e c_0}{\hbar}\uparrow, \tag{10}$$

Feynman Atomic Kernels

The action flow ratio for atomic particles is the Feynman contour integral of the action around the most probable path. From Eq.(7), this is. $\left(\Re_0 m_e c_0 \ / \ n_R\right)/\hbar$

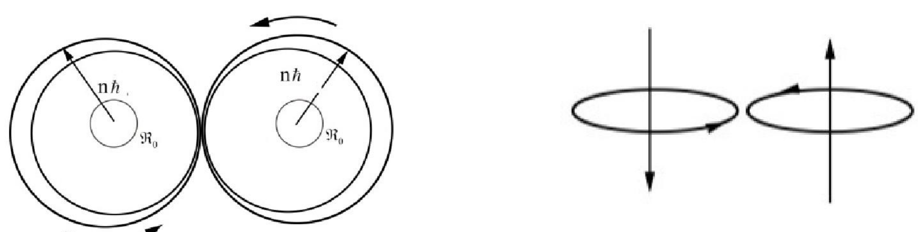
The Feynman integral of action around the most probable path is then:

$$\phi_A = \frac{\int_0^{\Re_0/n_R} m_e c_0 dr}{\hbar} = \frac{\Re_0 m_e c_0}{n_R \hbar} \rightarrow \frac{S_e}{n_R \hbar g_A^2} = \frac{\alpha}{n_R} \tag{11}$$

This is the Feynman vertex kernel for the Rydberg atomic states. The QED anomalous spin factor g_A^2, noted in Eq.(29), Appendix II, has been included.

Pictorially this can be viewed from the perspective of the Compton radius of the binding energy, showing the electron action divided by n times the action quantum $n_R\hbar$, Fig. 3.

Fig. 3



The product of the ± electron flow functions is then the Rydberg energy states:

$$\phi_A * \phi_A \ = \ \left(\frac{S_e}{n_R \hbar g_A^2}\right)^{*}\downarrow\left(\frac{S_e}{n_R \hbar g_A^2}\right)\uparrow \ = \frac{\Delta\varepsilon}{m_e} \ = K_A * K_A = \left(\frac{\alpha}{n_R}\right)^2 \tag{12}$$

This is the product of two opposite flow function vectors, and yields the well-known Rydberg energy states of the interaction.

The explanation of the integral values of the Rydberg integer n_R for the binding of kernels is discussed in **Apppendix III**

Nuclear Kernels

The action flow vector ratio for nuclear particles is the Feynman contour integral of the action around the most probable path. From Eq.(4), this is. $\Re_0 / n_R$
The Feynman integral of action around the most probable path for a nuclear kernel is then:

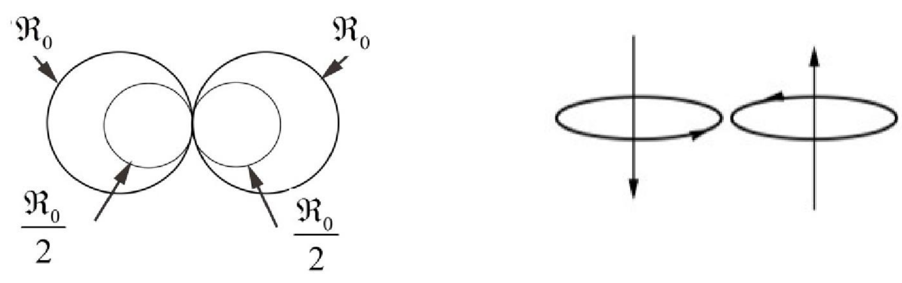
$$\phi_N = \frac{\hbar}{\int_0^{\Re_0/n_R} m_e c_0 dr} = \frac{\hbar}{S_e / n_R} \rightarrow \frac{\hbar\,\eta}{S_e / n_R}$$

This is the Feynman vertex kernel for the nuclear states, including the QED spin factor η from the all space integral Eq.(30), (Appendix II.)

Atomic states are action ratios as multiplies of $n\hbar$ (Eq.(12),). The nuclear action ratios are the reciprocal of the same ratio $n_R\,\hbar$.

Pictorially this can be viewed from the perspective of the Compton radius of the binding energy showing the flow density function ϕ_N as ratio electron radius to fractions of $\Re_0 / n_R$, Fig. 4.

Fig. 4



The corresponding expression to Eq.(12), for the nuclear kernels is:

$$\phi_N * \phi_N = \left(\frac{\hbar\,\eta}{(S_e / n_R)} \right)^* \left(\frac{\hbar\,\eta}{(S_e / n_R)} \right) = \frac{\Delta\varepsilon}{m_e} = K_N * K_N \tag{13}$$

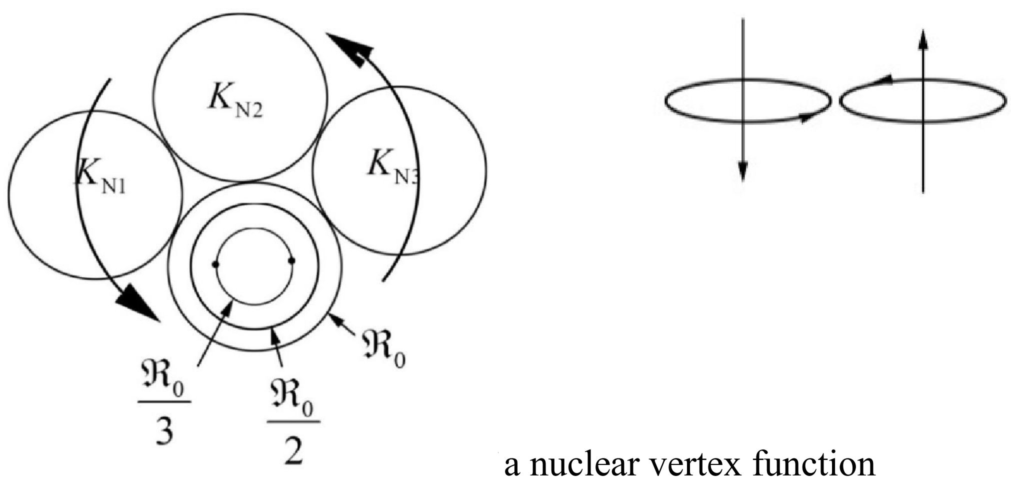
The nuclear kernels can generally be referred to as quarks.

From Eq.(7), and Eq.(13), both atomic states and nuclear states have action that is an integral fraction of the free electron action S_e .

The energy of the nuclear states in Eq.(13), is a deficit of energy and discussed in Appendix IV.

Multiple Kermel Nuclear Vertex Function

The atomic vertex kernels are the the Rydberg states, and generlaly there are only two kernels. The nuclear kernels can bind inside the nucleus in any number, to form complex particles including atomic vertex kernels, as will be illustrated in the paper on vertex functions. When bound together this becomes a Vertex Function of the Feynman path integrals.



a nuclear vertex function

There are generally a number of vertex kernels in the vertex function. They are each polarized and bind in pairs of opposite particles. Once bound they have no polarization, and are not aligned with either, other pairs, or with external B fields.

Any group of vertex neutral pairs can be factored into two products one with a positive kernel and one with a negative kernel, thus implying the effect of a positive and negative charge as shown in Eq,(14).

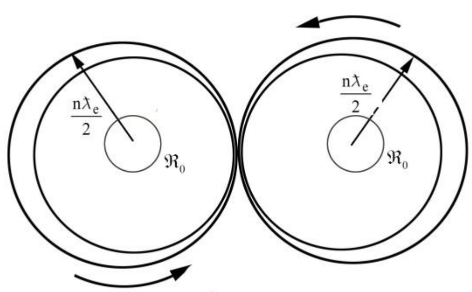
$$
\begin{aligned}
K_P{}^{*}K_P &= \left(K_1{}^{*}K_1\right)\left(K_2{}^{*}K_2\right)\left(K_3{}^{*}K_3\right)\bullet\bullet && \text{a.}\\
K_P{}^{*} &= K_1{}^{*}\sqrt{\left(K_2{}^{*}K_2\right)\left(K_3{}^{*}K_3\right)\bullet\bullet\bullet} && \text{b.}\\
K_P &= K_1\sqrt{\left(K_2{}^{*}K_2\right)\left(K_3{}^{*}K_3\right)\bullet\bullet\bullet} && \text{c.}
\end{aligned}
\tag{14}
$$

Eq.(14), a. shows a neutral vertex function as a group of unaligned kernel pairs, and Eq.(14), b and c. shows positive and negative particles having a single polarized kernel.

Specific Particle Illustrations

Positronium - Atomic

Noting the center of mass orbiting radius of the $\pm$ electrons in positronium is half the Compton radius of the electron, the action of Eq.(11), is reduced by half but the integer is not changed. This is the proper interaction energy of a positive and negative electron establishing the Rydberg energy levels without the concept of charge, and is the exact energy levels of positronium 6.803ev



(15)

$$
\left(K_A * K_A\right) = \left(\frac{S_e/2}{n_R\,\hbar\,g_A^2}\right)^{*}\left(\frac{S_e/2}{n_R\,\hbar\,g_A^2}\right) = \frac{\Delta\varepsilon}{m_e} \rightarrow \left(K_A * K_A\right) = 6.803\text{ev}/n_R
$$

Muon - Nuclear

$$
\left(\frac{m_\mu}{m_e}{}^{*}\frac{m_\mu}{m_e}\right) = \left[\left(\frac{\hbar}{S}\frac{\eta}{2^4}\right)^{*}\left(\frac{\hbar}{S}\frac{\eta}{2^4}\right)\right]\left[\left(\frac{\hbar}{S}\frac{\eta}{2^3}\right)^{*}\left(\frac{\hbar}{S}\frac{\eta}{2^4}\right)\right]
\tag{16}
$$

The Muon is the lowest nuclear mass level, and Eq.(16), is the binding energy of the positive and negative conjugates of its vertex function. Factoring gives the vertex of the positive * and negative muons and the positive and negative mass factors of the muon vertex are:

$$+\frac{m_\mu}{m_e}=\left(\frac{\hbar}{S_e}\frac{\eta}{2^4}\right)\left(\sqrt{\left(\frac{\hbar}{S_e}\frac{\eta}{2^3}\right)^*\left(\frac{\hbar}{S_e}\frac{\eta}{2^4}\right)}\right)=206.7674344$$
$$-\frac{m_\mu}{m_e}=\left(\frac{\hbar}{S_e}\frac{\eta}{2^4}\right)^*\left(\sqrt{\left(\frac{\hbar}{S_e}\frac{\eta}{2^3}\right)^*\left(\frac{\hbar}{S_e}\frac{\eta}{2^4}\right)}\right)=206.7674344 \quad (17)$$

Vertex Functions and of Calculated Mass Values

The vertex functions of several primary particles have been discovered and are presented below with the calculated values. The fundamental constants as well as the mass values used in the calculations are included in Appendix II, from Codata, and the Particle Data Groups

Particles Calculations For:

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

Summary

Particle Mass in Electrons

	Calculated from Theory Mass	GeV	Experimental, Codata, & PDG Mass	
Proton	1836.15267344		1836.15267344	
Neutron	1838.69296925		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 CER CMS

The discovered Particle Vertex Functions and the Calculated Rest Mass

$$\frac{\textbf{Proton}}{1836.15267344} \qquad \pm\frac{m_P}{m_e} = \sqrt{\left(\frac{\hbar}{\mathcal{S}_e}\frac{2^7}{\eta^3}\right)\left(\frac{\hbar}{\mathcal{S}_e}\frac{2}{\eta^3}\right)^{1/2}\left(\frac{\hbar}{\mathcal{S}_e}\frac{1}{\eta^3}\right)^{1/2}} \tag{18}$$

$$\frac{\textbf{Neutron}}{1838.692969} \qquad \left(\frac{m_N}{m_e}-1\right) = \sqrt{\left(\frac{\mathcal{S}_e}{\hbar}\frac{1}{\eta^3}\right)\left(\frac{\hbar}{\mathcal{S}_e}\frac{g_A^3}{1}\right)}\sqrt{\left(\frac{\hbar}{\mathcal{S}_e}\frac{2^7}{\eta^3}\right)\left(\frac{\hbar}{\mathcal{S}_e}\frac{2}{\eta^3}\right)^{1/2}\left(\frac{\hbar}{\mathcal{S}_e}\frac{1}{\eta^3}\right)^{1/2}} \tag{19}$$

$$\frac{\textbf{Muon}}{206.76743435} \pm\frac{m_\mu}{m_e} = \left(\frac{\hbar}{S_e}\frac{\eta}{2^7}\right)^* \left(\sqrt{\left(\frac{\hbar}{S_e}\frac{\eta}{2}\right)^*\left(\frac{\hbar}{S_e}\frac{\eta}{1}\right)}\right) \tag{20}$$

$$\frac{\textbf{Tauon}}{3477.18825} \qquad \left(+\frac{m_\tau}{m_e}\right) = \left(\frac{\hbar}{S/2}\frac{1}{\eta^3}\right)^* \sqrt{\left(\frac{\hbar}{S/2}\frac{1}{\eta^3}\right)^{1/4}\left(\frac{\hbar}{S}\frac{1}{\eta^3}\right)^{3/4}} = \sqrt{\left(\frac{1}{2^3}\frac{m_P}{m_e}\right)^3} \tag{21}$$

$$\frac{\textbf{Charged Pion}}{273.131906} \qquad \pm\frac{m_{\pi+}}{m_e} = \left(\frac{\mathcal{S}_e}{\hbar}\frac{2}{g_A^2}\right)^* \left[\left(\frac{\hbar\eta}{\mathcal{S}_e}\right)^*\left(\frac{\hbar\eta}{\mathcal{S}_e}\right)\right] = 2\alpha\left(\frac{\hbar\eta}{\mathcal{S}_e}\right)^2 \tag{22}$$

$$+\frac{\textbf{W Boson}}{\dfrac{177190.369}{80.410\text{ GeV}}} \qquad \pm\frac{m_W}{m_W} = \sqrt{\left(\frac{\hbar}{\mathcal{S}_e}\frac{2^5}{\eta^2}\right)\left(\frac{\hbar}{\mathcal{S}_e}\frac{2^6}{\eta^2}\right)^{1/2}\left(\frac{\hbar}{\mathcal{S}_e}\frac{1}{\eta^2}\right)^{1/4}\left(\frac{\hbar}{\mathcal{S}_e}\frac{2}{\eta^2}\right)^{1/4}} \tag{23}$$

$$\frac{\textbf{Z Boson}}{\dfrac{177190.369}{90.544\text{ GeV}}} \qquad \frac{m_Z}{m_e} == \sqrt{\left(\frac{\hbar}{\eta^3 S}\right)^2\left(\frac{\hbar}{\mathcal{S}_e}\frac{2^6}{\eta^3}\right)\times\left(\frac{\hbar}{\mathcal{S}_e}\frac{2}{\eta^3}\right)^{1/2}\left(\frac{\hbar}{\mathcal{S}_e}\frac{1}{\eta^3}\right)^{1/2}} \tag{24}$$

$$\frac{\textbf{Top Quark}}{\dfrac{336153.82}{171.7225\text{GeV}}} \qquad \frac{m_{TOP}}{m_{TOP}} = \left(\frac{m_{TOP}}{m_e}\right) = \left(\frac{\hbar}{\mathcal{S}_e/3}\eta^3\right)\left(\frac{\hbar}{\mathcal{S}_e/6}\eta^3\right) \tag{25}$$

All the vertex kernels that compose the particle mass are integral values of the action, and all but two have the cube of the Anomalous Nuclear ratio η^3, the two are the W boson, η^2 and the charged pion, η. The exponents are related to the nuclear contents and configuration, but at this time that is not clear

Some Connections and discussion

Some of the relations between internal parts of nuclear particles seem obvious, some are obscure. The product of the proton times its conjugate istqo pair of conjugate quarks:

Proton

$$\left(\frac{m_P}{m_e}^{*}\frac{m_P}{m_e}\right)=\sqrt{\left(\frac{\hbar}{S_e}\frac{2^7}{\eta^3}\right)^{*}\left(\frac{\hbar}{S_e}\frac{2^7}{\eta^3}\right)}\sqrt{\left(\frac{\hbar}{S_e}\frac{2}{\eta^3}\right)^{*}\left(\frac{\hbar}{S_e}\frac{1}{\eta^3}\right)}$$
$$=\left(\frac{\hbar}{S_e}\frac{2^7}{\eta^3}\right)\left(\frac{\hbar}{S_e}\frac{2}{\eta^3}\right)^{1/2\,*}\left(\frac{\hbar}{S_e}\frac{1}{\eta^3}\right)^{1/2} \tag{26}$$

Factoring the conjugate positive and negative proton gives the individual positive and negative particles to be three quarks:

$$+\left(\frac{m_P}{m_e}\right)=\sqrt{\left(\frac{\hbar}{S_e}\frac{2^7}{\eta^3}^{*}\right)}\left[\sqrt{\left(\frac{\hbar}{S_e}\frac{2}{\eta^3}^{*}\right)^{1/2}}\sqrt{\left(\frac{\hbar}{S_e}\frac{1}{\eta^3}\right)^{1/2}}\right]=1836.15267344$$
$$-\left(\frac{m_P}{m_e}\right)=\sqrt{\left(\frac{\hbar}{S_e}\frac{2^7}{\eta^3}\right)}\left[\sqrt{\left(\frac{\hbar}{S_e}\frac{2}{\eta^3}^{*}\right)^{1/2}}\sqrt{\left(\frac{\hbar}{S_e}\frac{1}{\eta^3}\right)^{1/2}}\right]=1836.15267344 \tag{27}$$

$$\frac{m_P}{m_e}=\frac{m_1}{m_e}\frac{m_2}{m_e}\frac{m_3}{m_e} \tag{28}$$

The individual quark masses in electrons are:

132.1685537
3.4179175
4.0646118

And the product of these is: 1836.1526734 Electrons

These are not the same quark mass as measured by the Particle Data Group for the quarks which are 4.50 & 9.39 electrons.

Muon

$$\pm\frac{m_\mu}{m_e}=\left(\frac{\hbar}{S_e}\frac{\eta}{2^7}\right)^{*}\left(\frac{\hbar}{S_e}\frac{\eta}{2}\right)^{1/2\,*}\left(\frac{\hbar}{S_e}\frac{\eta}{1}\right)^{1/2}$$

The Muon has identical but reciprocal Rydberg integers of the proton-proton conjugate pair, Eq.(26)

Neutron

The neutron without the mass of the free electron is the product of the proton, and a ratio of nuclear and atomic Kernels. This is presumably the Electron neutrino and calculates out to be an energy of 1.000833800924 electrons.[21]

$$\left(\frac{m_N}{m_e}-1\right)=\sqrt{\left(\frac{\mathcal{S}_e}{\hbar}\frac{1}{\eta^3}\right)\left(\frac{\hbar}{\mathcal{S}_e}\frac{g_A^3}{1}\right)}\sqrt{\left(\frac{\hbar}{\mathcal{S}_e}\frac{2^7}{\eta^3}\right)\left(\frac{\hbar}{\mathcal{S}_e}\frac{2}{\eta^3}\right)^{1/2}\left(\frac{\hbar}{\mathcal{S}_e}\frac{1}{\eta^3}\right)^{1/2}}$$

$$\frac{m_N}{m_e}=\sqrt{\left(\frac{\mathcal{S}_e}{\hbar}\frac{1}{\eta^3}\right)\left(\frac{\hbar}{\mathcal{S}_e}\frac{g_A^3}{1}\right)}\times\frac{m_P}{m_e}-\frac{m_e}{m_e}$$

The value $\sqrt{\left(\frac{\mathcal{S}_e}{\hbar}\frac{1}{\eta^3}\right)\left(\frac{\hbar}{\mathcal{S}_e}\frac{g_A^3}{1}\right)}$ = should be the binding energy of the electron with the proton and is the energy of the escaping neutrino.

Calculating this out gives a small undefined error.
Subtracting the two energy values in electrons gives the difference:

1.00083665196259 - 1.000833800924=00000285104 = 1.456 eV

This discrepancy is about twice the 0.8eV upper limit of the current KATRIN Electron Neutrino Experiment for the rest mass of the electron neutrino. The discrepancy is not necessarily connected to the neutrino rest mass, however.

Charged pion $$\left(\frac{m_{\pi+}}{m_e}\right)=\left(\frac{\mathcal{S}_e}{\hbar}\frac{1}{g_A^2}\right)^*\left[\left(\frac{\hbar\eta}{\mathcal{S}_e/2}\right)^*\left(\frac{\hbar\eta}{\mathcal{S}_e}\right)\right]=\alpha\left(\frac{\hbar\eta}{\mathcal{S}_e/2}\right)^*\left(\frac{\hbar\eta}{\mathcal{S}_e}\right)$$

The charged pion is an electron Kernel in the Compton orbit bound with two conjugate quarks.

Top quark

The top quarks appears to be the binding of two quarks,

$$\left(\frac{m_{TOP}}{m_e}\right)=\left(\frac{\hbar}{\mathcal{S}_e/3}\eta^3\right)\left(\frac{\hbar}{\mathcal{S}_e/6}\eta^3\right)$$

Conclusion

The theory presented here provides both the origin of charge, and the mass of elementary particles. There is no numerology, approximates, or coupling constants. The theory defines the mass of particles in a consistent, logical and well known, but extended Feynman theory of Quantum Electrodynamics

It was surmised by this author that nuclear particles would be defined by SU(2)SO(3) group math structure. This turned out not to be the case, and the Dirac matrix of Geometrical Algebra combined with the action flow constructs of Feynman is sufficient to understand the mechanics.

The proof of concept of this theory is in the mass calculations shown in this paper.

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Recent Papers

The following recent papers by the author focus on the application, mechanism, and relation to current theory as well as physical applications.

15. DT Froedge, Calculated Atomic Masses in Delta-c Mechanics
January 2025
DOI: 10.13140/RG.2.2.30292.51842 https://www.researchgate.net/publication/388219158

16. DT Froedge, Structure of Elementary Nuclear Particles in in Delta-c Mechanics
November 2024 DOI: 10.13140/RG.2.2.27181.70884
https://www.researchgate.net/publication/385782943

17. DT Froedge, The Concepts and Principles Behind of Delta-c Mechanics
August 2024
DOI: 10.13140/RG.2.2.31630.37445 www.researchgate.net/publication/382850589

18. DT Froedge, Acceleration Gravitation and Origin of Centrifugal Force in Delta-c Mechanics
July 2024
DOI: 10.13140/RG.2.2.28944.42247 https://www.researchgate.net/publication/381915343

19. DT Froedge, Relativistic Time Dilation Illustrated in Delta-c Mechanics, The Twin Paradox is an Illusion December 2023 DOI: 10.13140/RG.2.2.15584.46085
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DOI:10.13140/RG.2.2.11759.14242, https://www.researchgate.net/publication/392330748

Appendix I

The Physical constants and Particle Mass Values from Codata and the Particle Data Group Used in this Paper

Particle	mass (gms)	Mass (electrons)	Compton Radius (cm)
Electron	9.10938370150000E-28	1.0000000000	3.86159267943989E-11
Muon	1.88353162700000E-25	206.7682829838	1.86759430591295E-13
Proton	1.67262192369000E-24	1836.1526734400	2.10308910326354E-14
Tauon	3.16754000000000E-24	3477.1350000000	1.11055036503721E-14
Neutal Pion	2.40618001661378E-25	264.1430085130	1.46193257250244E-13
Chgd Pion	2.48806819637887E-25	273.1321133000	1.41381693102776E-13
Neutron	1.67492749804000E-24	1838.6836617325	2.10019415509539E-14
Wboson	1.43344876621262E-22	157359.5770234800	2.45399279311973E-16
Zboson	1.61700283014969E-22	177190.3690000000	2.17542781991699E-16

	Physical Constants		
$\lambda\!\!\!^{-}_{PL}$	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)
m_e	Electron Mass eV	5.10998902000000E+05	(ev)
G	Gravitational Constant	6.67550533180000E-08	$cm^3/gm\ sec^2$
	Composit Constnts		
$\bar{\nu}_e$	Electron cycle number	1.23558996386000E+20	Eq 4
E_0	Nuc Atom Ground State	2.67493983646500E-05	Eq 5
$\Re_0$	ECR Radius	2.82447977709503E-13	(cm)Eq 3
g_A	Anom Gyromagnetic Ratio	1.00115965218073	eq 11
η	Nuclear Anomalous Spin	1.00060014721177	Eq 12

Appendix II

Anomalous QED ratios

There are two anomalous ratios that play a role in nuclear-atomic systems, shown in Eq.(29), and Eq.(30), that are the factors g_A and η. They are the QED determined loop integral delay for particles moving in bound orbits. The ratio has no effect on the free electron, but when an electron is bound in rotation in the Feynman action integral loops cause a delay that alters the particle rotation.

The first ratios that applies to atomic or Rydberg levels is the Anomalous Gyromagnetic ratio g_A . When an electron is moving in free space there are no loop delays, however when it is in rotation in the Compton orbit the QED loop delays increase the radius, due to the QED time delay, and lower the binding energy. Its value has been theoretically predicted and measured to about 12 significant digits. The value is:

$$g_A = 1.0011596521807 \tag{29}$$

This factor is an offset of the Rydberg atomic levels.

The second is here designated as Eta. η . It represents the QED effect on the rotating photons inside a nuclear vertex function.

$$\eta = 1.00060014721177 \tag{30}$$

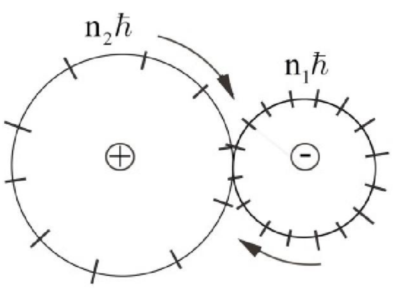
The value of η has not yet been determined by QED methods, but it should not be dismissed as arbitrary, as it is small but crucial to the precise mass of several unconnected known particles [9]. If there is a fudge factor in this development this it is it. This ratio like g_A is not calculated from physical constants.

Apppendix III

The Rydberg Integer $n_R\,\hbar$ *in State functions Rationalization*

Solutions to bound kernels all require integral values $\hbar$ results from the rotating frequency of the kernels being proportional to $\hbar$. If the numbers are integer, then after a period of time the cycles repeat whereas, if they were irrational that could not be true

Particles bind at the rotating most probable action radius, and the relative rotation of each bound particle must be an integral number of $n\hbar$, otherwise the b 5



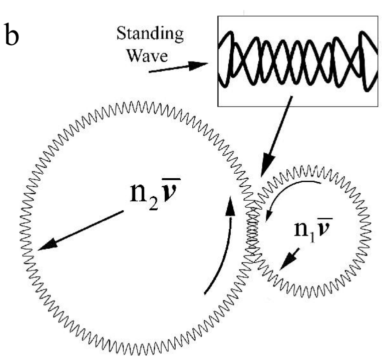


Fig. 5

The interaction of a kernel having action as $n_1\hbar$ with a kernel having action $n_2\hbar$, results in a standing wave of probability flow at the contact point that repeating as the particles counter-rotate. [18] a standing wave is a reciprocal flow probability between kernels that satisfies a unity continuity flow condition.

Note that a vertex function such as Eq.(31):

$$K \neq \left(\frac{\hbar}{S}\frac{\eta}{\sqrt{2}}\right) \tag{31}$$

is not a legitimate kernel. The irrational number $\sqrt{2}$ cannot be in synchronization with integral multiple of $\hbar$,. The mass value of this would be the same however if it were composed of two vertex kernels as shown Eq.(32),:

$$K = \sqrt{\left(\frac{\hbar}{S}\frac{\eta}{2}\right)^*}\sqrt{\left(\frac{\hbar}{S}\frac{\eta}{1}\right)} \tag{32}$$

The mass of a vertex of a Feynman vertex Kernel is the product of an infinite number of products of action paths and thus the factors of Eq.(32), can be vertex kernels. Each of these vertex can bind to produce a neutral mass Kernel.

Appendix IV

Energy Deficit

The conjugate bound pairs in the nucleus are opposite and if in free space would annihilate. In binding however the electrons like their atomic counterparts have given up energy.

And like the atomic counterparts also have insufficient energy to escape. For a hydrogen atom the state energy has to be kinetically injected to remove the electron. For a nuclear mass the same principle applies, the energy of the entire mass has to be injected to remove the particle from the nucleus. This implys that nuclear mass exists as a deficit of energy and particles in the nucleus cannot annihilate unless energetically removed.

This gives another perspective to the Einstein energy relation, in that nuclear mass exists as deficit of energy.

$$mc^2 = \varepsilon \quad \rightarrow \quad mc^2 = -\varepsilon \tag{33}$$