DRAFT

The Wave Equation for Particle Energy and Interaction

Jeff Yee

jeffsyee@gmail.com

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Summary

Subatomic particles, their interactions and the wave equation that governs their mass and motion are presented in this paper. There is one wave equation, in two distinct forms, with three fundamental constants. The wave forms are longitudinal and transverse, and the three constants are density, amplitude and frequency. The equations are further derived based on wave differences – amplitude and frequency – that are the cause of particle formation and interactions with other particles.

This challenges a century-old equation in physics, therefore the burden of proof of a newly proposed wave equation is to not only calculate and match data from existing experiments, but further to explain and derive other known equations as it is suggested that this new wave equation forms the basis of energy equations from classical and quantum mechanics.

First, the new wave equations are proposed and used to match known data as proof that these equations work. In Section 1, amongst other calculations, these equations are used to:

- Calculate the rest energy and mass of subatomic particles that appear in nature
- Calculate energies and wavelengths from hydrogen electron transitions
- Calculate ionization energies of the first twenty elements

Second, the equations are derived with an explanation of why they work, describing the reason for mass, the quantum jumps of the electron in an atomic orbit and what happens to particles in an antimatter collision. The equations give meaning to the way the universe works.

Third, and most importantly, the newly proposed wave equations are used to derive the current equations used for mass-energy, energy-momentum and Planck's relation. In addition, a derivation and explanation is given to the relativity equations.

The findings in this paper conclude that particles and their interactions are not only governed by a simple wave equation that ties quantum and classical equations together, but further that particles themselves are simply made from the building blocks of a wave center that is the sink/source of waves that travel throughout the universe. This building block, possibly the electron neutrino, forms the basis of particle creation similar to how protons assembled in a nucleus give rise to different atomic elements.

Further experiments and calculations to confirm this hypothesis are suggested in the concluding remarks.

1. Particle Wave Equation

This paper introduces longitudinal and transverse wave equations that can be used to calculate particle energy, mass and properties of the electromagnetic wave. These equations derive from a simple wave equation that consists of density, frequency and amplitude, which form matter and govern how particles interact and exchange energy.

The equations explained hereafter match experimental data of subatomic particles, including 1) particle mass and energy, 2) atomic orbitals, 3) photon energy and wavelengths of hydrogen orbital transitions and 4) ionization energies of the first twenty elements. This was accomplished with new wave equations without requiring the use of Planck's constant or the Rydberg constant.

This research began following a previous paper on the structure of matter using a wave equation, where it was noted that leptons mysteriously fit into magic numbers (2,8, 20, 28, 50) also seen in the structures of atomic elements. The work in *Explaining the Mass of Leptons with Wave Structure Matter* was incomplete, but provided the foundation of this paper.[1] In this paper, it is proposed that there is a fundamental particle, matching the properties of the neutrino, and that all particles can be created from various arrangements of neutrinos.

This view of particle formation and their interactions, based on waves, is admittedly very different than the current explanation and energy equations used today. Thus, Section 1 of this paper begins with these new equations and their results, which are consistent with known experiments and data. In later sections, the equations are explained and then used to derive classical energy equations.

To begin, it is assumed that the energy in the universe, including particles, comes from a base wave energy equation in the following form:

$$E = \boldsymbol{\rho} V (f_l A_l)^2 \quad \textbf{(1)}$$

Wave Energy Equation

Where:

E = Energy
ρ = Density
V = Volume
f_l = longitudinal frequency
A_l = longitudinal amplitude

1.1. Longitudinal and Transverse Wave Equations

There are two forms of the energy wave: longitudinal and transverse. Detailed explanations of these waves and how they are derived is reserved for Section 2, however, this section will describe the equations themselves, their constants and variables and the notation used for calculations. For the purpose of understanding the wave equations in this section, it assumes particles are created from longitudinal in-waves and out-waves focused at a wave center, and movement of a particle, particularly a vibration, creates a transverse wave. These are equations are:

Wave Equations

$$E_{l\,(K,n)} = \frac{\boldsymbol{\rho}\frac{4\pi}{3}K^{5}A_{l}^{6}c^{2}}{\lambda_{l}^{3}} \sum_{n=1}^{K} \frac{n^{3} - (n-1)^{3}}{n^{4}} \tag{1.1.1}$$

Longitudinal Energy Equation

$$E_{t\,(K,n)} = \frac{4d\boldsymbol{\rho}\pi\lambda_{l}K^{6}c^{2}}{nA_{l}} \tag{1.1.2}$$

Transverse Energy Equation

$$E_{t\,(K,n_f-n_i)} = 2d\boldsymbol{\rho}\pi\lambda_{l}K^{6}c^{2}\left(\frac{1}{n_f\delta A_l} - \frac{1}{n_i\delta A_l}\right) \tag{1.1.3}$$

Transverse Energy Interaction Equation

$$\lambda_{t\,(K,n)} = \frac{2nA_l}{3K^3} \tag{1.1.4}$$

Transverse Wavelength Equation

$$\lambda_{t\,(K,n_f-n_i)} = \frac{4}{3K^3}\frac{1}{\left(\frac{1}{n_f\delta A_l} - \frac{1}{n_i\delta A_l}\right)} \tag{1.1.5}$$

Transverse Wavelength Interaction Equation

Energy calculations are in joules (J) and wavelength in meters (m) unless otherwise specified.

Notation

The above equations include notation to simplify variations of energies and wavelengths at different particle sizes (K) and shells (n), in addition to differentiating longitudinal and transverse waves. The following notation was used:

Notation	Meaning
λ_l	l - longitudinal
λ_t	t - transverse
$E_{(K,n)}$	Energy at K wave center count and n shell
$\lambda_{t(K,n)}$	Transverse wavelength at K wave center count and n shell

Table 1.1.1 – Wave Equation Notation

Constants and Variables

The equations also include new variables and constants not common in current physics equations and are explained below in Table 1.1.2. The methodology to arrive at the values for amplitude, wavelength and density constants are detailed later in Section 3.

Of particular note is that variable n, sometimes used for orbital sequence, has been renamed for particle shells at each wavelength from the particle core. Orbitals have been renamed to a capitalized N signifying that they are a subset of wavelength shells at certain distances from the particle core.

Symbol	Definition	Value
A_l	Amplitude (longitudinal)	3.63947×10^{-10} (m)
λ_l	Wavelength (longitudinal)	2.78661×10^{-17} (m)
ρ	Density (aether)	9.45942×10^{-30} (kg/m^3)
d	Transverse Inverse Factor	1 (m^3)
K	Particle core wave center count	variable - *dimensionless*
n	Particle shells	variable - *dimensionless*
N	Particle orbits *(formerly n)*	variable - *dimensionless*
δ	Amplitude Factor	variable - *dimensionless*

Table 1.1.2 – Wave Equation Constants and Variables

Amplitude Factor – ***1s Orbital***

The Amplitude Factor is used to calculate amplitude difference between particles. This factor will be different for various particles and distances from other particles that affect its longitudinal amplitude. To calculate the ionization energy for the first twenty elements, up to calcium (Z=20), an equation was created.

Eq. 1.1.6 is the Amplitude Factor for ionization of an electron in the first orbital (1s), for elements up to Z=20. Z is the number of protons, and N1e, N2e, N3e, and N4e are the number of electrons in orbital shell N=1 (1s), N=2 (2s, 2p), N=3 (3s, 3p) and N=4 (4s, 4p) respectively.

$$\delta = \frac{1}{\left(Z - \frac{2}{3}(N1e - 1) - \frac{1}{6}(N2e) - \frac{1}{12}(N3e) - \frac{1}{18}(N4e)\right)^2} \quad \textbf{(1.1.6)}$$

Amplitude Factor Equation – 1s Orbital Ionization (up to Z=20)

Orbital Equation - ***Hydrogen***

Orbitals are gaps where an electron is both attracted and repelled, but the repelling waves cancel at specific points based on the configuration of the atom's nucleus. This is explained in more detail in Section 2.

The structure of hydrogen has been worked into an equation because of its simplicity with one proton in the nucleus. Other structures remain to be completed. For hydrogen, the orbits can be expressed by the number of wavelengths from the particle core, n. The orbit, N, is a function of the fine structure constant as described in Eq. 1.1.7. This yields the number of wavelengths to each orbit (n_N).

$$n_N = 5N^2\left(\frac{2}{\alpha^2}\right) \quad \textbf{(1.1.7)}$$

Hydrogen Orbital Equation

Where:

α = Fine Structure Constant = 7.29735257 x 10^{-3}

1.2. Particle Formulation

This section describes how to utilize the Longitudinal Energy Equation to calculate the energy of lepton particles: electron neutrino, muon neutrino, tau neutrino, electron, muon electron and tau electron.

The three neutrinos are known to oscillate, meaning they can change into each other (becoming larger in mass or smaller in mass). While the electron family, like many other particles, are known to decay into particles of smaller mass. This implies that there may be a fundamental particle that is the basic building block of energy that causes the formation of these particles. In the wave equation solution, this fundamental building block is a wave center (K), which will be shown to have properties matching the smallest neutrino – the electron neutrino. In-waves and out-waves converge at the wave center, creating standing waves which are measured as the particle's mass and energy.

Particle Energy

An example calculation using the Longitudinal Energy Equation (Eq. 1.1.1) is found below to demonstrate the calculation of the electron's mass. Although the energy of a particle (which is distinguished by its number of wave centers, K), can be calculated at any wavelength shell (n) using the equation, the particle's energy is contained where n=K. The electron has ten wave centers, or K=10. At n=10 wavelengths, the electron's energy is found. A detailed explanation will be presented later in Section 2.

The energy in Eq. 1.2.3 is measured in joules, i.e. the rest energy of the electron is 8.18 x 10^{-14} joules.

$$E_{l(10,10)} = \frac{\boldsymbol{\rho}\frac{4\pi}{3}10^5 A_l^6 c^2}{\lambda_l^3} \sum_{n=1}^{10} \frac{n^3 - (n-1)^3}{n^4} \tag{1.2.1}$$

$$E_{l(10,10)} = \frac{(9.45942\cdot 10^{-30})\frac{4\pi}{3}10^5 (3.63947\cdot 10^{-10})^6 (2.99792\times 10^8)^2}{(2.78661\cdot 10^{-17})^3} 2.13874 \tag{1.2.2}$$

$$E_{l(10,10)} = 8.18\cdot 10^{-14} \tag{1.2.3}$$

Using the same equation, all values of K from 1 to 120 were calculated where n=K. The data is provided below for leptons in Table 1.2.1, where the calculations (in GeV) are found in red. This data is compared to the CODATA values for these particles found in italics.[2]

K	**1**	**2**	**8**	**10**	**20**	**28**	**50**
Particle Name	**Neutrino**	**?**	**Muon Neutrino**	**Electron**	**Tau Neutrino**	**Muon Electron**	**Tau Electron**
Calculated Rest Energy (GeV)	**2.4E-09**	**1.10E-07**	**1.63E-04**	**5.11E-04**	**1.73E-02**	**0.0948**	**1.755**
CODATA Rest Energy (GeV)	*2.2E-09*		*1.70E-04*	*5.11E-04*	*1.55E-02*	*0.1060*	*1.777*
Calculated Rest Energy (J)	3.82E-19	1.76E-17	2.61E-14	8.18E-14	2.78E-12	1.52E-11	2.81E-10
CODATA Rest Energy (J)	*3.52E-19*		*2.72E-14*	*8.19E-14*	*2.48E-12*	*1.70E-11*	*2.85E-10*

Table 1.2.1 – Lepton Mass

Note the similarities of the rest energy of these particles at magic numbers that are also found in the Periodic Table of Elements: 2, 8, 20, 28 and 50. Only K=2 is unfilled with a particle that has either not been discovered, or has such small energy that it may be misunderstood to be the electron neutrino.

With the exception of the proton and neutron, which are already known to consist of smaller particles (thought to be quarks), the leptons are particles that appear in nature, even if they rapidly oscillate or decay into other particles. Other particles that are created in particle accelerator labs, including the Higgs boson, were calculated but placed into the Appendix for reference since these particles have very different characteristics than leptons.

Fig. 1.2.1 shows leptons as a function of wave centers (K) and their energies.

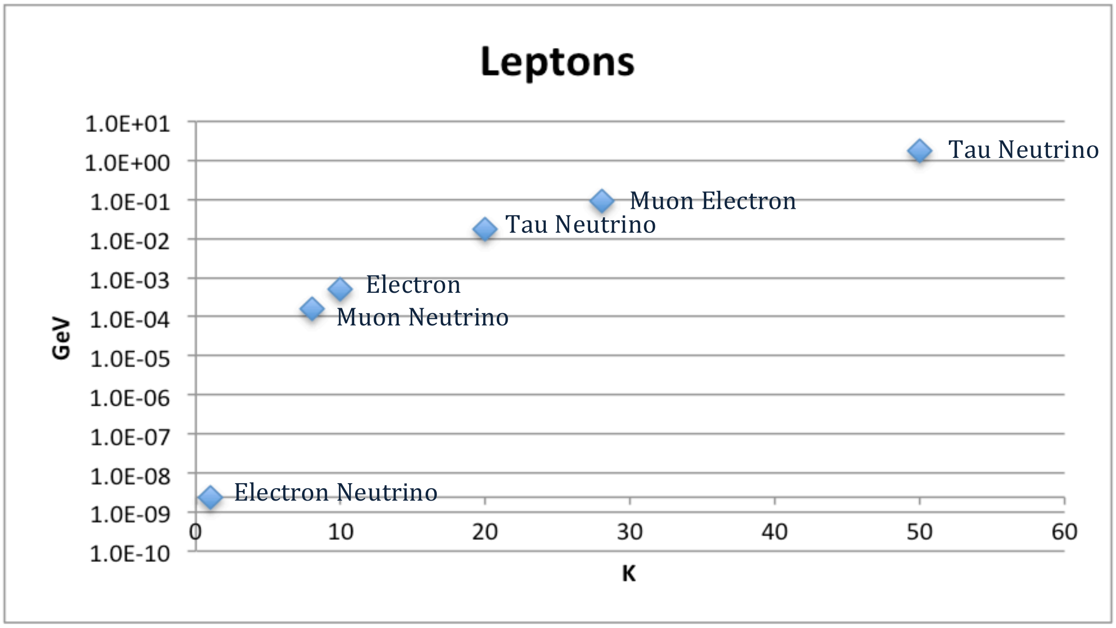


Fig 1.2.1 – Lepton Mass (function of K wave centers)

At this point, it could be merely coincidence that the lepton family of particles fit into the same magic numbers found in atomic elements. But as the next section describes, the second transverse equation also calculates these particles energies at the same values of K and n, and further, that the transverse equations will later be shown to calculate properties of the electromagnetic wave.

Electron

The Transverse Energy Equation (Eq. 1.1.2) can be used to calculate a particle's potential transverse energy. The explanation of the equation and how this energy becomes the electromagnetic wave is illustrated later in Section 2. In this section, an example is provided to calculate the energy of the electron. Once again, the electron's rest energy is found at K=10 and n=10).

$$E_{t\,(10,\,10)} = \frac{4d\boldsymbol{\rho}\pi\lambda_l 10^6 c^2}{10A_l} \qquad \textbf{(1.2.4)}$$

$$E_{t\,(10,\,10)} = \frac{4\,(1)\;(9.45942\cdot 10^{-30})\;(3.1416)\;(2.78661\cdot 10^{-17})\;10^{6}\,(2.99792\times 10^{8})^{2}}{10\,(3.63947\cdot 10^{-10})} \quad \textbf{(1.2.5)}$$

$$E_{t\,(10,\,10)} = 8.18\cdot 10^{-14} \quad \textbf{(1.2.6)}$$

The Compton wavelength of the electron can also be calculated using the Transverse Wavelength Equation (Eq. 1.1.4). Similar to the energy equation, the wavelength can be calculated at any shell (n). But the Compton wavelength is found at n=K=10 in Eq. 1.2.9. Wavelength is measured in meters.

$$\lambda_{t\,(10,\,10)} = \frac{2\,(10)\,A_{l}}{3\,(10)^{3}} \quad \textbf{(1.2.7)}$$

$$\lambda_{t\,(10,\,10)} = \frac{2\,(10)\;(3.63947\cdot 10^{-10})}{3\,(10)^{3}} \quad \textbf{(1.2.8)}$$

$$\lambda_{t\,(10,\,10)} = 2.43\cdot 10^{-12} \quad \textbf{(1.2.9)}$$

A summary of each wavelength shell (n) through n=10, for both longitudinal and transverse energy, including transverse wavelength and frequency is found in Table 1.2.2. Cells in red are highlighted where n=10, due to a match of the electron's known mass and Compton wavelength.[3]

Electron

- K = 10
- Radius = 2.79 x 10^{-16} meters

Shell (n)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Longitudinal Energy (Sum)	**3.82E-14**	**5.50E-14**	**6.40E-14**	**6.95E-14**	**7.32E-14**	**7.59E-14**	**7.79E-14**	**7.95E-14**	**8.08E-14**	8.18E-14
Transverse Frequency	1.24E+21	6.18E+20	4.12E+20	3.09E+20	2.47E+20	2.06E+20	1.77E+20	1.54E+20	1.37E+20	1.24E+20
Transverse Wavelength	2.43E-13	4.85E-13	7.28E-13	9.71E-13	1.21E-12	1.46E-12	1.70E-12	1.94E-12	2.18E-12	**2.43E-12**
Transverse Energy	**8.18E-13**	**4.09E-13**	**2.73E-13**	**2.04E-13**	**1.64E-13**	**1.36E-13**	**1.17E-13**	**1.02E-13**	**9.09E-14**	**8.18E-14**

Table 1.2.2 – Electron Energy by Shell (n)

Note the convergence at n=K=10 for the electron for both the longitudinal and transverse equations, which is also charted in Fig 1.2.2.

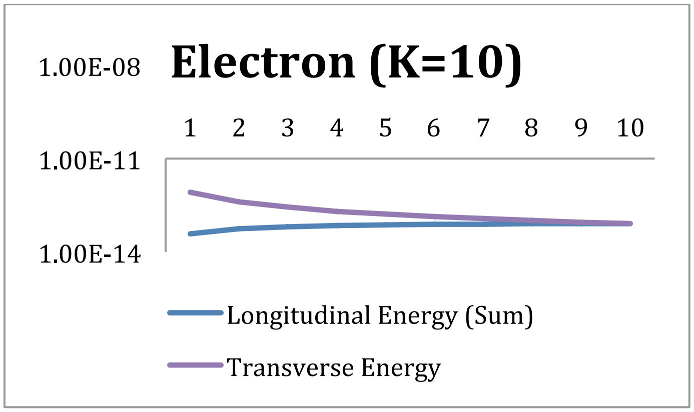


Fig 1.2.2 – Electron Energy Longitudinal and Transverse Convergence

Muon Electron

Similarly, the muon electron has been calculated. It's value of K, from Table 1.2.1 earlier is K=28. At n=28, there is a match of the muon's known rest energy.[4] The muon electron has nearly three times the number of wave centers as the electron (28 vs 10), and thus its particle core is larger. It has a Particle Core Wavelength Offset of 3 wavelengths, which will be explained later in Section 2.3.

Muon

- K = 28
- Radius = 7.80 x 10^{-16} meters

Shell (n)	1	2	3	4	5	6	7	8	9	10	28
Longitudinal Energy (Sum)	6.58E-12	9.46E-12	1.10E-11	1.20E-11	1.26E-11	1.31E-11	1.34E-11	1.37E-11	1.39E-11	1.41E-11	1.52E-11
Particle Core Wavelength Offset	3										
Transverse Energy			3.94E-10	1.97E-10	1.31E-10	9.85E-11	7.88E-11	6.57E-11	5.63E-11	4.93E-11	1.52E-11

Table 1.2.3 – Muon Electron Energy by Shell (n)

Again, like the electron, transverse and longitudinal wave energies converge. For the muon, it converges at a magic number, n=28.

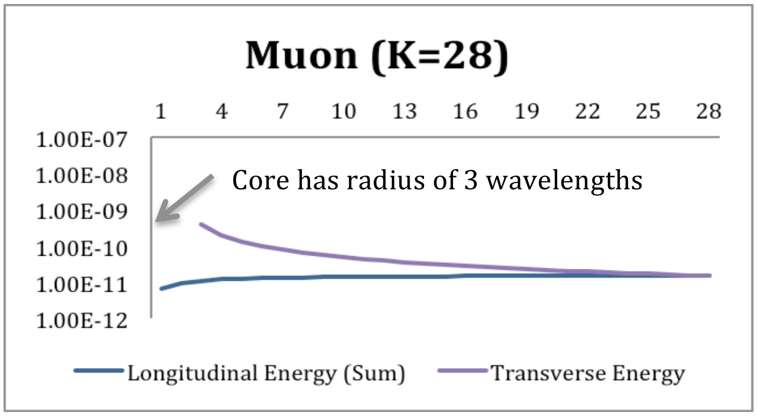


Fig 1.2.3 – Muon Electron Energy Longitudinal and Transverse Convergence

Tau Electron

Lastly, the tau electron was calculated. It's value of K, from Table 1.2.1 is K=50. At n=50, there is a match of the tau's known rest mass.[5] The tau has five times the number of wave centers as the electron (50 vs 10) and has a much larger particle core, with an offset of 5 wavelengths.

Tau

- K = 50
- Radius = 1.39 x 10^{-15} meters

Shell (n)	1	2	3	4	5	6	7	8	9	10	28	50
Longitudinal Energy (Sum)	**1.20E-10**	**1.72E-10**	**2.00E-10**	**2.17E-10**	**2.29E-10**	**2.37E-10**	**2.44E-10**	**2.48E-10**	**2.52E-10**	**2.56E-10**	**2.76E-10**	**2.81E-10**
Particle Core Wavelength Offset	5											
Transverse Energy					**1.28E-08**	**6.39E-09**	**4.26E-09**	**3.20E-09**	**2.56E-09**	**2.13E-09**	**5.33E-10**	**2.78E-10**

Table 1.2.4 – Tau Electron Energy by Shell (n)

Once again, the energies are seen to converge. This time at a magic number n=50.

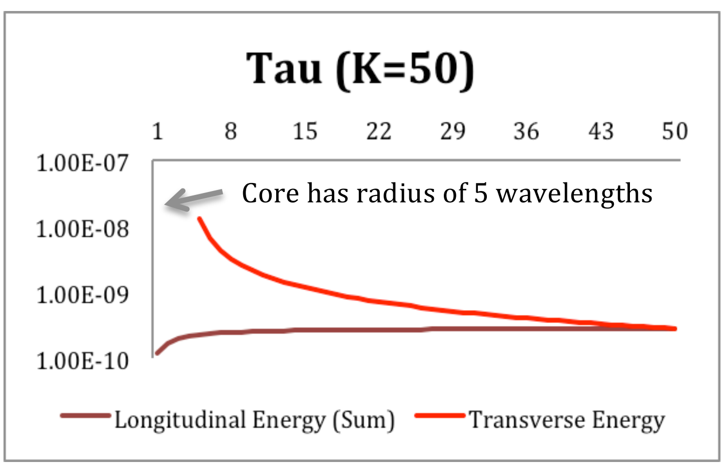


Fig 1.2.4 – Tau Electron Energy Longitudinal and Transverse Convergence

1.3. Particle Interaction

When two or more particles interact, their waves may be constructive or destructive, resulting in a difference in amplitude that causes particle movement. Although the explanation is reserved for later (Section 2), this section describes the use of the transverse equations to calculate the energy required for ionization of electrons, energy produced by annihilation or energy required or produced for orbital transitions in an atom.

Ionization

When a particle experiences an amplitude difference, the transverse equation is modified to be the difference in energy from its initial position n_i to its final position n_f. In the case of ionization, an electron is ejected from an atom and experiences an amplitude difference, as it is no longer attracted to the atom's nucleus. Once ejected, its distance (n wavelengths) is essentially infinity, so n_f is set to infinity.

Using the Transverse Energy Interaction Equation (Eq. 1.1.3), the final position is set to infinity, and the equation simplifies to:

$$E_{t\,(K,\,\infty - n_i)} = 2d\boldsymbol{\rho}\pi\lambda_l K^6 c^2 \left(\frac{1}{\infty \delta A_l} - \frac{1}{n_i \delta A_l} \right) \qquad \textbf{(1.3.1)}$$

$$E_{t\,(K,\,n_i)} = 2d\boldsymbol{\rho}\pi\lambda_l K^6 c^2 \left(0 - \frac{1}{n_i \delta A_l} \right) \qquad \textbf{(1.3.2)}$$

$$E_{t\,(K,\,n_i)} = \frac{(-2)\, d\boldsymbol{\rho}\pi\lambda_l K^6 c^2}{n_i \delta A_l} \qquad \textbf{(1.3.3)}$$

Transverse Energy Interaction - Ionization

A negative sign in this equation means that energy (a photon) needs to be absorbed. A positive value means that a photon is created.

A similar derivation can be used to calculate the photon's wavelength required for ionization, starting with the Transverse Wavelength Interaction Equation (Eq. 1.1.5) and inserting infinity in place of n_f. These ionization equations will be used later in this section.

$$\lambda_{t\,(K,\,\infty - n_i)} = \frac{4}{3K^3} \frac{1}{\left(\dfrac{1}{\infty\delta A_l} - \dfrac{1}{n_i\delta A_l}\right)} \qquad \textbf{(1.3.4)}$$

$$\lambda_{t\,(K,\,\infty - n_i)} = \frac{4}{3K^3} \frac{1}{\left(0 - \dfrac{1}{n_i\delta A_l}\right)} \qquad \textbf{(1.3.5)}$$

$$\lambda_{t\,(K,\,n_i)} = \frac{4}{3K^3} \frac{\dfrac{1}{-1}}{n_i\delta A_l} \qquad \textbf{(1.3.6)}$$

$$\lambda_{t\,(K,\,n_i)} = \frac{(-4)\,n_i\delta A_l}{3K^3} \qquad \textbf{(1.3.7)}$$

Transverse Wavelength Interaction - Ionization

Annihilation

The same energy equation for ionization can be used for annihilation, with one difference. Rather than eject a particle, the particle (e.g. electron) is attracted to the point where it settles in a position near its attracting anti-matter counterpart (e.g. positron) where waves cancel and amplitude reaches zero. Eq. 1.3.8 is very similar to Eq. 1.3.1, with the exception of the initial and final starting positions of the particle. This difference leads to positive sign instead of negative sign in the equation, indicating that it creates a photon instead of requiring energy to be absorbed.

$$E_{t\,(K,\,n_f - \infty)} = 2d\boldsymbol{\rho}\pi\lambda_l K^6 c^2 \left(\frac{1}{n_f\delta A_l} - \frac{1}{\infty\delta A_l}\right) \qquad \textbf{(1.3.8)}$$

$$E_{t\,(K,\,n_f - \infty)} = 2d\boldsymbol{\rho}\pi\lambda_l K^6 c^2 \left(\frac{1}{n_f\delta A_l} - 0\right) \qquad \textbf{(1.3.9)}$$

$$E_{t\,(K,\,n_f)} = \frac{2d\boldsymbol{\rho}\pi\lambda_l K^6 c^2}{n_f \delta A_l} \tag{1.3.10}$$

Transverse Energy Interaction - Annihilation

For example, annihilation of the electron and positron sit at half of the electron radius, where standing waves exactly cancel. An electron is 10 wavelengths in radius (n=10) and its annihilation position with a positron is five wavelengths from its center (n=5). The Amplitude Factor for positron-electron interaction is the same as the hydrogen model (δ =1). Inserting these values into Eq. 1.3.10:

$$E_{t\,(10,\,5)} = \frac{2d\boldsymbol{\rho}\pi\lambda_l 10^6 c^2}{5\delta A_l} \tag{1.3.11}$$

$$E_{t\,(10,\,5)} = 8.18 \cdot 10^{-14} \tag{1.3.12}$$

The result of Eq. 1.3.12 is measured in joules, and shows the energy of a photon that is created during the annihilation process. The positron would go through a similar process, creating a photon of the same energy as it settles to rest five wavelengths from the electron's center.

This indicates that the particles settle in a position where their longitudinal amplitudes completely cancel. There is no mass that can be measured because their standing waves have collapsed and have transferred to transverse energy (photons). However, the particles remain and their wave centers are still resonating at the same frequency – it is just that amplitude is zero or negligible. These particles may eventually be separated again with sufficient energy in the pair production process, which explains why an electron and positron can be created in a vacuum with a photon equal to or greater than the sum of its two masses.[6]

Amplitude Factor Calculations – *1s Orbital*

The above annihilation equation introduced the use of the Amplitude Factor in the interaction equations. For hydrogen, a positron-electron interaction, it has a value of one (1). This section details the use of the Amplitude Factor Equation for the 1s orbital. Future work may include determining this factor for other orbitals, but will likely require further analysis of the nucleus structure for elements beyond hydrogen.

From Eq. 1.1.7, Amplitude Factor for the 1s Orbital (N1), the calculations for hydrogen (1 proton and 1 electron in N1) are as follows:

$$\delta_H = \frac{1}{\left(1 - \frac{2}{3}(1-1) - \frac{1}{6}(0) - \frac{1}{12}(0) - \frac{1}{18}(0)\right)^2} \quad \textbf{(1.3.13)}$$

$$\delta_H = 1 \quad \textbf{(1.3.14)}$$

And Calcium with 20 protons, 2 electrons in N1, 8 electrons in N2 and N3 each, and 2 electrons in N4 is:

$$\delta_{Ca} = \frac{1}{\left(20 - \frac{2}{3}(2-1) - \frac{1}{6}(8) - \frac{1}{12}(8) - \frac{1}{18}(2)\right)^2} \quad \textbf{(1.3.15)}$$

$$\delta_{Ca} = \frac{81}{24025} \quad \textbf{(1.3.16)}$$

A similar process has been used for each of the first twenty elements. Table 1.3.1 lists the element structure, its protons and electron configuration and Amplitude Factor.

Element	Protons	Electrons (N1)	Electrons (N2)	Electrons (N3)	Electrons (N4)	Amp. Factor (δ)
H	1	1	0	0	0	1.00000
He+	2	1	0	0	0	0.25000
He	2	2	0	0	0	0.56250
Li	3	2	1	0	0	0.21302
Be	4	2	2	0	0	0.11111
B	5	2	3	0	0	0.06805
C	6	2	4	0	0	0.04592
N	7	2	5	0	0	0.03306
O	8	2	6	0	0	0.02493
F	9	2	7	0	0	0.01947
Ne	10	2	8	0	0	0.01563
Na	11	2	8	1	0	0.01258
Mg	12	2	8	2	0	0.01034
Al	13	2	8	3	0	0.00865
Si	14	2	8	4	0	0.00735
P	15	2	8	5	0	0.00632
S	16	2	8	6	0	0.00549
Cl	17	2	8	7	0	0.00481
Ar	18	2	8	8	0	0.00425
K	19	2	8	8	1	0.00377
Ca	20	2	8	8	2	0.00337

Table 1.3.1 – Amplitude Factors 1s Orbital (N1)

Orbital Calculations – ***Hydrogen***

It is well understood that atomic elements have orbital configurations that may vary, with hydrogen being the simplest since its nucleus consists of one proton. The remaining energy equations in this section will utilize this orbital distance, measured by wavelengths (n) from the center of the nucleus.

From Eq. 1.1.7, Hydrogen Orbital Equation, the wavelength distance of hydrogen orbitals are calculated. For example, n_{N1} is the number of wavelengths to the 1s orbital (N1). α is the fine structure constant ($7.29735257 \times 10^{-3}$). The first nine potential orbitals for hydrogen have been calculated and placed in Table 1.3.2, ranging from 187,789 wavelengths for the first orbital to 15,210,881 wavelengths for the ninth orbital.

$$n_{N1} = 5\,(1)^2\left(\frac{2}{\alpha^2}\right) \qquad \textbf{(1.3.17)}$$

$$n_{N1} = 187789 \qquad \textbf{(1.3.18)}$$

$$n_{N2} = 5\,(2)^2\left(\frac{2}{\alpha^2}\right) \tag{1.3.19}$$

$$n_{N2} = 751155 \tag{1.3.20}$$

Shell (n)	187,789	751,155	1,690,098	3,004,618	4,694,716	6,760,391	9,201,644	12,018,474	15,210,881
Orbit (N)	1	2	3	4	5	6	7	8	9

Table 1.3.2 – Hydrogen Shells (n) and Orbitals (N)

Hydrogen - Ionization

Using the orbital distances (in wavelengths) and amplitude factors, the wave equations can now be used to calculate energies and wavelengths of particle interaction. Beginning with hydrogen, this example calculates the wavelength of a photon absorbed to eject an electron (K=10) from the first orbital (shell N1, or n=187,1789). Starting with Transverse Wavelength Interaction – Ionization, Eq. 1.3.7:

$$\lambda_{t\,(10,\,187789)} = \frac{(-4)\;(187789)\;\delta_H A_l}{3\cdot 10^3} \tag{1.3.21}$$

$$\lambda_{t\,(10,\,187789)} = \frac{(-4)\;(187789)\;(1)\;(3.63947\cdot 10^{-10})}{3\cdot 10^3} \tag{1.3.22}$$

$$\lambda_{t\,(10,\,187789)} = -91.13nm \tag{1.3.23}$$

Eq. 1.3.23 solves to be -9.113 x 10^{-8} meters, or -91.13 nanometers, a match of known hydrogen ionization energy data. In fact, the calculated values for each of the remaining orbitals (displayed in red in Table 1.3.3) *exactly* match the known ionization energies and wavelengths of hydrogen data, shown in italics in the table.[7]

Hydrogen

- Amplitude Factor = 1.0

Shell (n)	1	5	187,789	751,155	1,690,098	3,004,618	4,694,716	6,760,391	9,201,644	12,018,474	15,210,881
Orbit (N)			1	2	3	4	5	6	7	8	9
Frequency	-6.18E+20	-1.24E+20	-3.29E+15	-8.22E+14	-3.66E+14	-2.06E+14	-1.32E+14	-9.14E+13	-6.71E+13	-5.14E+13	-4.06E+13
Wavelength (Calculated)	-4.85E-13	**-2.43E-12**	**-9.11E-08**	**-3.65E-07**	**-8.20E-07**	**-1.46E-06**	**-2.28E-06**	**-3.28E-06**	**-4.47E-06**	**-5.83E-06**	**-7.38E-06**
Wavelength (Measured)			*-9.11E-08*	*-3.65E-07*	*-8.20E-07*	*-1.46E-06*	*-2.28E-06*	*-3.28E-06*			
Transverse Energy (Calculated)	**-4.09E-13**	**-8.18E-14**	**-2.18E-18**	**-5.44E-19**	**-2.42E-19**	**-1.36E-19**	**-8.71E-20**	**-6.05E-20**	**-4.44E-20**	**-3.40E-20**	**-2.69E-20**

Table 1.3.3 – Hydrogen Ionization

In shell n=5, the ionization energy and wavelength of the electron-positron annihilation also match, showing a relation between ionization and annihilation energies as one equation; simply a difference of amplitude based on the distance between the particles. Also noteworthy about this annihilation distance (n=5) is that orbitals are multiples of 5 times the inverse of the fine structure constant squared (see Eq. 1.1.7).

He+ - Ionization

The same process can be used for other elements, including an ionized helium atom (He+) with 2 protons and only 1 electron in the 1s (N1) orbital. The photon energy required to ionize an He+ atom is shown below. Amplitude Factor for He+ from Table 1.3.1 is 0.25.

$$E_{t\,(10,\,187789)} = \frac{(-2)\, d\boldsymbol{\rho}\pi\lambda_l 10^6 c^2}{187789\,(\delta_{He``+"})\, A_l} \quad \textbf{(1.3.24)}$$

$$E_{t\,(10,\,187789)} = \frac{(-2)\, d\boldsymbol{\rho}\pi\lambda_l 10^6 c^2}{187789\,(0.25)\, A_l} \quad \textbf{(1.3.25)}$$

$$E_{t\,(10,\,187789)} = -8.72\cdot 10^{-18} \quad \textbf{(1.3.26)}$$

He+ (Ionized)

- Amplitude Factor = 0.25

Shell (n)	1	5	187,789	751,155	1,690,098	3,004,618	4,694,716
Orbit (N)			1	2	3	4	5
Frequency	-2.47E+21	-4.94E+20	-1.32E+16	-3.29E+15	-1.46E+15	-8.22E+14	-5.26E+14
Wavelength	-1.21E-13	-6.07E-13	-2.28E-08	-9.11E-08	-2.05E-07	-3.65E-07	-5.70E-07
Transverse Energy (Calculated)	**-1.64E-12**	**-3.27E-13**	**-8.72E-18**	**-2.18E-18**	**-9.68E-19**	**-5.44E-19**	**-3.48E-19**
Transverse Energy (Measured)			*-8.71E-18*	*-2.18E-18*	*-9.68E-19*	*-5.44E-19*	*-3.48E-19*

Table 1.3.4 – He+ Ionization

Again, calculations using the wave equations are shown in red (measured in joules). This matches measured He+ ionization energy, displayed in italics in Table 1.3.4.[8]

First 20 Elements - Ionization

The same equation and process was then used to calculate the ionization of the first 20 elements, from hydrogen to calcium, using the Amplitude Factor for the 1s (N1) orbital. Thus wavelength distance is assumed to be n=187,789 (N1), although this may be an approximation as nucleus proton/neutron configuration becomes more complex as elements increase in size.

Eq. 1.3.25 shows the example calculation for calcium with 20 protons and 20 electrons. The calculation is for the ionization of energy of the electron in the innermost shell (N1), and experimental data was available in MJ per mole. Thus, after arriving at the energy calculation in joules (J) in Eq. 1.3.27, it was converted to MJ / mol.

$$E_{t\,(10,\,187789)} = \frac{(-2)\, d\boldsymbol{\rho}\pi\lambda_l 10^6 c^2}{187789\,(\delta_{Ca})\, A_l} \qquad \textbf{(1.3.25)}$$

$$E_{t\,(10,\,187789)} = \frac{(-2)\, d\boldsymbol{\rho}\pi\lambda_l 10^6 c^2}{187789\left(\frac{81}{24025}\right) A_l} \qquad \textbf{(1.3.26)}$$

$$E_{t\,(10,\,187789)} = -6.46 \cdot 10^{-16} \qquad \textbf{(1.3.27)}$$

Convert energy in joules (J) to MJ/mol using Avogadro's Consant.

$$E_{t\,(10,\,187789)} = \frac{-6.46 \cdot 10^{-16} 6.022 \cdot 10^{23}}{1 \times 10^6} \qquad \textbf{(1.3.28)}$$

$$E_{t\,(10,\,187789)} = -389.021 \qquad \textbf{(1.3.29)}$$

The same process was repeated for the first 20 elements using Eqs. 1.3.25 to 1.3.29. The ionization energy calculations (red) in MJ/mol are nearly an identical match with experimental data (last column in italics) in Table 1.3.5 below.[9]

Element	Amp. Factor (δ)	Energy J (calc)	-MJ/Mol (calc)	MJ/Mol
H	1.00000	-2.18E-18	**1.31**	*1.31*
He	0.56250	-3.87E-18	**2.33**	*2.37*
Li	0.21302	-1.02E-17	**6.16**	*6.26*
Be	0.11111	-1.96E-17	**11.8**	*11.5*
B	0.06805	-3.20E-17	**19.3**	*19.3*
C	0.04592	-4.74E-17	**28.6**	*28.6*
N	0.03306	-6.59E-17	**39.7**	*39.6*
O	0.02493	-8.74E-17	**52.6**	*52.6*
F	0.01947	-1.12E-16	**67.4**	*67.2*
Ne	0.01563	-1.39E-16	**83.9**	*84.0*
Na	0.01258	-1.73E-16	**104**	*104*
Mg	0.01034	-2.11E-16	**127**	*126*
Al	0.00865	-2.52E-16	**152**	*151*
Si	0.00735	-2.96E-16	**179**	*178*
P	0.00632	-3.45E-16	**208**	*208*
S	0.00549	-3.97E-16	**239**	*239*
Cl	0.00481	-4.53E-16	**273**	*273*
Ar	0.00425	-5.12E-16	**308**	*309*
K	0.00377	-5.77E-16	**348**	*347*
Ca	0.00337	-6.46E-16	**389**	390

Table 1.3.5 – First 20 Elements Ionization (N1)

Although the values are very close, it is not an exact match. The wavelength calculation for N1 may be affected by various arrangements of protons and neutrons in the nucleus structure; however, hydrogen's calculation does appear to be a good approximation.

Hydrogen – Orbital Transition

The last set of data demonstrating proof of wave equations is the transitional energies and wavelengths for an electron in a hydrogen atom that moves between orbitals. In this case, it is a difference in energy between two positions relative to the nucleus, where n_i is the initial orbital and n_f is the final orbital.

For example, the wavelength distances for hydrogen for the third orbital (N3) is 1,690,098 wavelengths from the proton, and 751,155 wavelengths for the second orbital (N2) according to Table 1.3.2. Thus for an electron that transitions from N=3 to N=2 (3->2), n_f = 751,155 and n_i = 1,690,098. Inserting these values into the Transverse Energy Interaction Equation (Eq. 1.1.3) yields:

$$E_{t\,(10,\,751155\,-\,1690098)} = 2d\boldsymbol{\rho}\pi\lambda_l 10^6 c^2 \left(\frac{1}{751155\,(1)\,A_l} - \frac{1}{1690098\,(1)\,A_l}\right) \qquad \textbf{(1.3.30)}$$

$$E_{t\,(10,\,751155\,-\,1690098)} = 3.03 \cdot 10^{-19} \qquad \textbf{(1.3.31)}$$

Note a positive value in Eq. 1.3.31, meaning a photon is created. And using Eq. 1.1.5, the Transverse Wavelength Interaction Equation, the wavelength of this photon emitted for hydrogen orbital transition 3->2 is:

$$\lambda_{t\,(10,\,751155\,-\,1690098)} = \frac{4}{3 \cdot 10^3} \frac{1}{\left(\frac{1}{751155\,(1)\,A_l} - \frac{1}{1690098\,(1)\,A_l}\right)} \qquad \textbf{(1.3.32)}$$

$$\lambda_{t\,(10,\,751155\,-\,1690098)} = 656nm \qquad \textbf{(1.3.33)}$$

Eq. 1.3.33 is solved to be 6.56 x 10^{-7} meters, or 656 nanometers. This is an exact match of photon wavelengths measured in experiments. Table 1.3.6 shows the calculations of the above transition (3->2) through to an electron in the ninth orbital transitioning to the second orbital (9->2). Again, the calculations using the above equations are marked in red and the measured data from the hydrogen spectral series in italics.[10]

Hydrogen

- Amplitude Factor = 1.0

Hydrogen Shell Transition							
	3->2	**4->2**	**5->2**	**6->2**	**7->2**	**8->2**	**9->2**
Frequency	4.57E+14	6.16E+14	6.90E+14	7.30E+14	7.55E+14	7.70E+14	7.81E+14
Wavelength (Calculated)	**6.56E-07**	**4.86E-07**	**4.34E-07**	**4.10E-07**	**3.97E-07**	**3.89E-07**	**3.83E-07**
Wavelength (Measured)	*6.56E-07*	*4.86E-07*	*4.34E-07*	*4.10E-07*	*3.97E-07*	*3.89E-07*	*3.84E-07*
Transverse Energy (Calculated)	**3.02E-19**	**4.08E-19**	**4.57E-19**	**4.84E-19**	**5.00E-19**	**5.10E-19**	**5.18E-19**

Table 1.3.6 – Hydrogen Orbital Transition Energies and Wavelengths

Table 1.3.6 is an exact match of the hydrogen spectrum, without the use of the Rydberg constant. It's accurate to at least three digits and can be used not only for orbital transitions, but also for ionization energies and annihilation properties.

Given that the transverse equation can also be used to derive the mass of lepton particles at the same wave center count (K) as the longitudinal equation, it gives strong evidence that these particles are an assembly of wave centers that are most stable when structured in certain configurations, matching the same magic numbers seen in atomic elements. Further, a single wave center configuration has properties that resemble the neutrino's energy, and thus it is suggested that the neutrino is the fundamental particle and a combination of neutrinos creates other known particles.

This section presents the data and strong case that particles are standing waves of energy and their interactions are based on these same waves.

2. Deriving and Explaining the Wave Equation

In the previous section, the wave equations were introduced, including their use and calculation of particle properties including rest energy, ionization energy and transverse wavelengths. This section describes the derivation of these equations, and more importantly, explains why they work and how particles interact.

2.1. Assumptions

Before deriving the equations, it is important to understand the assumptions that were used to create the equations and constants. Since particles are governed by longitudinal and transverse wave equations, an analogy may be helpful to understand how it works.

Imagine a balloon, under water in the middle of a pool, which is rapidly inflated and deflated repeatedly. The balloon will send spherical, longitudinal waves throughout the pool, losing energy proportional to the inverse square of the distance from the balloon. Now, imagine the balloon, while still being rapidly inflated and deflated, also traveling up-and-down, from the bottom of the pool to the top and back again. This will create a secondary, transverse wave perpendicular to the motion – towards the sides of the pool.

Next, consider the balloon as the fundamental particle. There is nothing that is smaller than the balloon. It is the wave center and responsible for creating waves that travel through the pool. However, there may be a number of balloons arranged in geometric shapes that keep them together in a stable formation within the pool. Their collective energies are amplified and the waves in the pool become much larger. Although a simple analogy, this may paint a picture of how particles are formed.

Particle Formation

The following assumptions were made when understanding particle formation and motion:

- The neutrino is the fundamental particle. It is a wave center of spherical, longitudinal in-waves and out-waves. The amplitude of these waves decreases with the square of distance, with each wavelength, or shell (n). It may be thought of as a source/sink for aether waves.
- All other lepton particles are created from a combination of neutrinos. A number of neutrinos (K) form the core of the particle, resulting in a standing wave formation from the combination of in-waves and out-waves.
- Neutrinos prefer to reside at the node of the wave, minimizing amplitude spaced one wavelength apart. They will move to minimize amplitude if not at the node.
- With sufficient energy, neutrinos may be pushed together in arrangement to create a new particle (i.e. neutrino oscillation), but will decay (break apart) if the structure does not lend itself to a geometric shape where each neutrino resides at the node in a wave.
- When neutrinos are spaced in the nodes, at even wavelengths in the core, the waves are constructive. A particle's amplitude is the sum of its individual neutrino amplitudes in the particle core.
- The anti-matter counterpart, the anti-neutrino, is pi-shifted on the wave (1/2 wavelength), residing in a node responsible for destructive waves when combined with the neutrino.

- Particle radius is proportional to the total wave amplitude, and is the edge of where standing waves convert to traveling, longitudinal waves.
- Mass is the energy of standing waves within the particle's radius.

A visual of the wave, its amplitude, wavelength and nodes is shown in Fig 2.1.1. Neutrinos and anti-neutrinos reside in the node of the wave to minimize amplitude and will move towards the node. Neutrinos at wavelengths create constructive waves; a neutrino and antineutrino will be destructive due to wave phase difference.

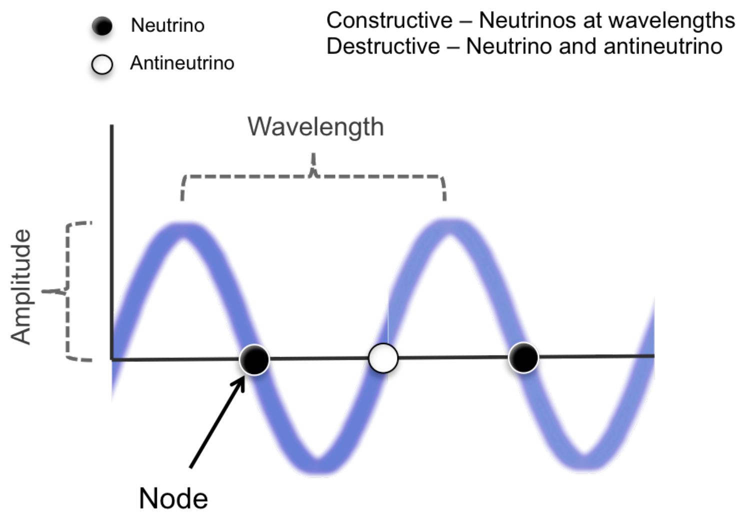


Fig 2.1.1 – Nodes and Neutrino Placement

Figure 2.1.2 illustrates a particle, such as an electron, that is formed from standing waves (in-waves and out-waves). Eventually, standing waves transition to traveling waves as they cannot keep this form for infinity. This defines the particle radius, at the edge of where the transition occurs. The mass of the particle is then the energy captured within this radius, of the standing waves as shown below.

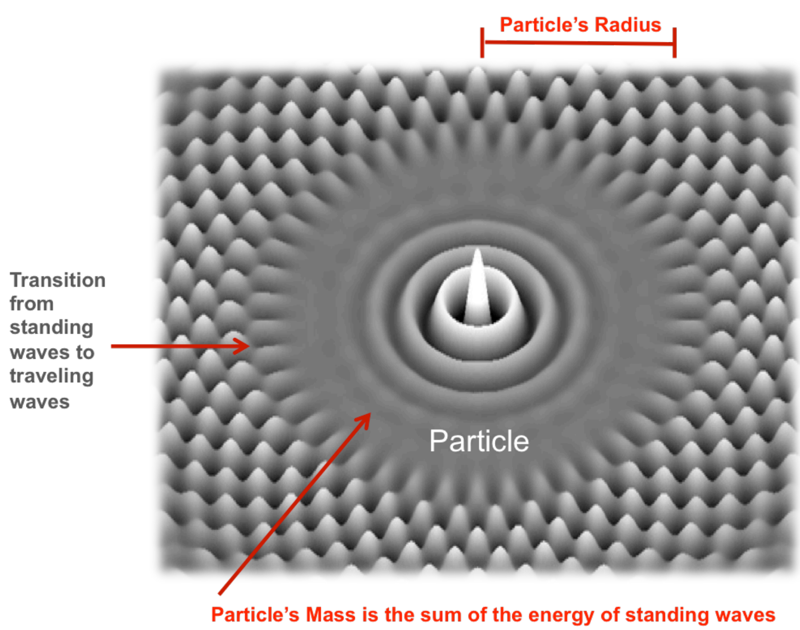


Fig 2.1.2 – Particle Radius and Mass

Particle Interaction

The following assumptions were made when understanding particle interaction, including atomic orbitals:

- Particle vibration creates a transverse wave.
- Longitudinal amplitude difference creates particle motion, as the particle seeks to minimize amplitude.
- The difference in longitudinal energy is transferred to transverse energy in a wave packet known as the photon.
- Particles and their anti-matter counterparts attract because of destructive waves between the particles; like particles (e.g. electron-electron) repel due to constructive waves, seeking to minimize amplitude.
- Electrons in an atomic orbit are both attracted and repelled by the nucleus. A positron is assumed to be at its core to attract the orbital electron; opposing forces in the nucleus repel the orbital electron. These waves are assumed to experience wave cancellation, creating gaps or orbits in the atom.

Fig. 2.1.3 illustrates the nucleus of an atom and how orbitals are created from the cancellation of waves at specific points. It is assumed that there is a force that pushes outward on an electron in the orbital, but it is attracted by a positron in the core of the nucleus. Orbitals will be dependent on the geometric structure of the proton, and or neutrons, and thus have different wave cancellation points that result in different orbitals for various combinations of protons and neutrons that make up an element's core.

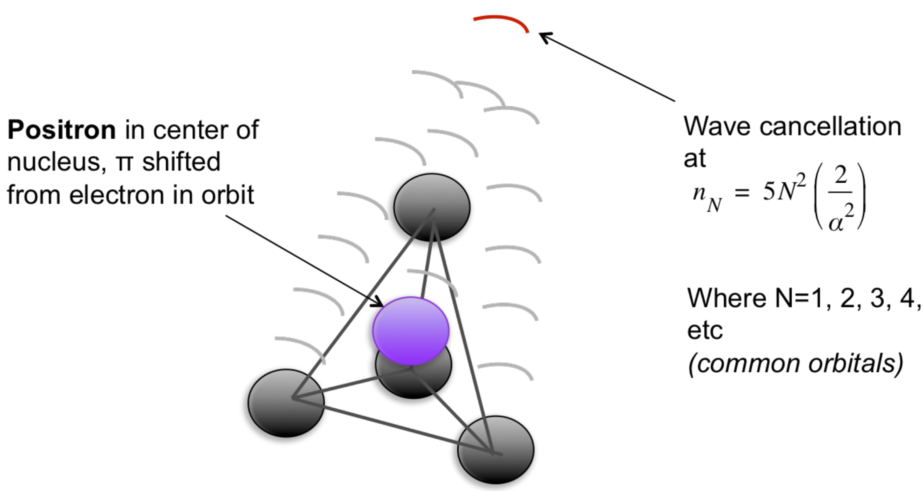


Fig 2.1.3 – Orbitals at Wave Cancellation Points

This paper does not propose a proton structure, but has merely provided an equation to calculate the orbitals for hydrogen. Future work may go deeper into examining the geometric structure of each element's nucleus that creates wave cancellations that match known orbitals. One possibility for the structure of the proton is based on four electrons in a tetrahedron shape, with a positron in the core. Because protons are known to contain three quarks, a proposed structure must match these results. Four electrons and a positron would look like three high-energy electrons (possibly quarks), because the fourth electron and positron would have waves cancel (i.e. annihilation), thus not being detected.

2.2. Deriving the Longitudinal Wave Equation

The Longitudinal Wave Equation was shown in Section 1 to calculate a particle's energy. In this section, the equation is derived from the base wave equation (Eq. 1) consisting of three variables: 1) density, 2) frequency and 3) amplitude. Frequency is then broken into its parts: wavelength and wave speed.

Fig 2.2.1 describes the spherical, longitudinal waves of which amplitude decreases with the square of distance. As described in the assumptions in Section 2.1, the particle is assumed to consist of standing waves as a result of incoming and outgoing waves. Also assumed is that the core of the particle may be made of one or more wave centers (K), expected to be neutrinos in this model. Various combinations of neutrinos (K) will lead to different particles.

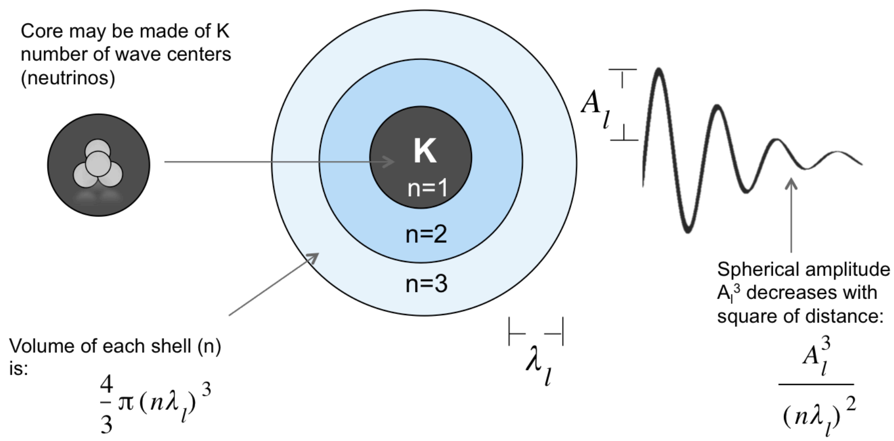


Fig 2.2.1 –Spherical Longitudinal Waves Originating from Particle

From the base wave equation (Eq. 1), a spherical volume is used for volume, frequency is replaced by wave speed and wavelength and a spherical amplitude is used that decreases with the square of distance. This forms Eq. 2.2.1. The distance from the core, radius (r), is unknown, but can be substituted with the number of wavelength shells from the particle core, which is n times wavelength (Eq. 2.2.2).

$$E_l = \boldsymbol{\rho}\left(\frac{4}{3}\pi r^3\right)\frac{c^2}{\lambda_l^2}\left(\frac{A_l^3}{r^2}\right)^2 \qquad \textbf{(2.2.1)}$$

$$r = n\lambda_l \qquad \textbf{(2.2.2)}$$

In the assumptions, it was stated that energy is the sum of standing waves within the particle. Eq. 2.2.3 replaces radius with the number of wavelengths, which is assumed to be one standing wave per wave center core. Thus the energy is assumed to be the sum of each shell, from n=1 to n=K. For example, the electron neutrino at K=1 has one standing wave, and it's particle radius is n=K=1. The electron's radius is n=K=10 wavelengths.

Volume in this equation is a spherical volume of each shell (n), subtract the inner shell (n-1) which has already been calculated in the summation equation introduced in Eq. 2.2.3. This equation can also be used to calculate the energy in each shell, without using the summation and solving for n independently.

$$E_{l(K,n)} = \sum_{n=1}^{K} \boldsymbol{\rho} \left(\frac{4}{3}\pi (n\lambda_l)^3 - \left(\frac{4}{3}\pi ((n-1)\lambda_l)^3 \right) \right) \frac{c^2}{\lambda_l^2} \left(\frac{A_l^3}{(n\lambda_l)^2} \right)^2 \qquad \textbf{(2.2.3)}$$

Another assumption is that neutrinos reside at wavelengths such that their amplitudes constructively combine. Although not every geometric relationship makes this possible for all particles, which leads to decay as wave centers are forced out of a stable position on a wave node, certain structures (especially at magic numbers) make it possible to combine, resulting in increased amplitude as described in Fig 2.2.2. The resultant wave is the sum of the amplitudes.

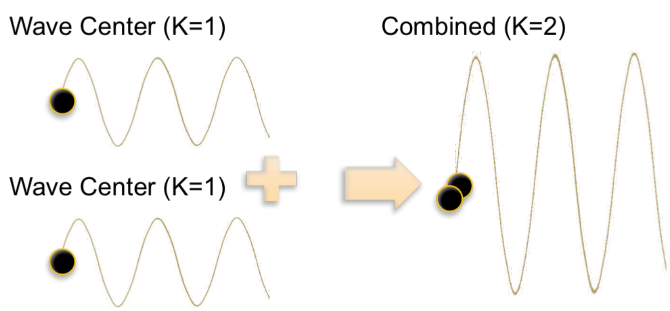


Fig 2.2.2 –Constructive Waves

Another assumption is that radius grows proportionally with the number of neutrinos in the particle core, so K is added into the equation at both radius and amplitude to grow proportionally, seen in Eq. 2.2.4. This is then simplified in Eq. 2.2.5 to become the Longitudinal Energy Equation.

$$E_{l(K,n)} = \sum_{n=1}^{K} \boldsymbol{\rho} \left(\frac{4}{3}\pi (K(n\lambda_l))^3 - \left(\frac{4}{3}\pi (K(n-1)\lambda_l)^3 \right) \right) \frac{c^2}{\lambda_l^2} \left(\frac{KA_l^3}{(Kn\lambda_l)^2} \right)^2 \qquad \textbf{(2.2.4)}$$

$$E_{l(K,n)} = \frac{\boldsymbol{\rho} \frac{4\pi}{3} K^5 A_l^6 c^2}{\lambda_l^3} \sum_{n=1}^{K} \frac{n^3 - (n-1)^3}{n^4} \qquad \textbf{(2.2.5)}$$

Longitudinal Energy Equation

2.3. Deriving the Transverse Wave Equation

This section derives and explains the transverse wave equations for transverse energy and wavelength, including the special case for particle interactions.

Transverse Energy

A transverse wave is created from a vibrating particle, perpendicular to the direction of motion as illustrated in Fig. 2.3.1. A faster vibrating particle results in a transverse wave with a shorter wavelength than a particle that vibrates slower. And the greater the amplitude difference in a particle interaction, the faster the vibration.

At rest, the particle's amplitude is the number of neutrinos in the core (K) times amplitude (A_l). In motion, the particle's vibration range has a maximum of K squared (K^2) times amplitude.

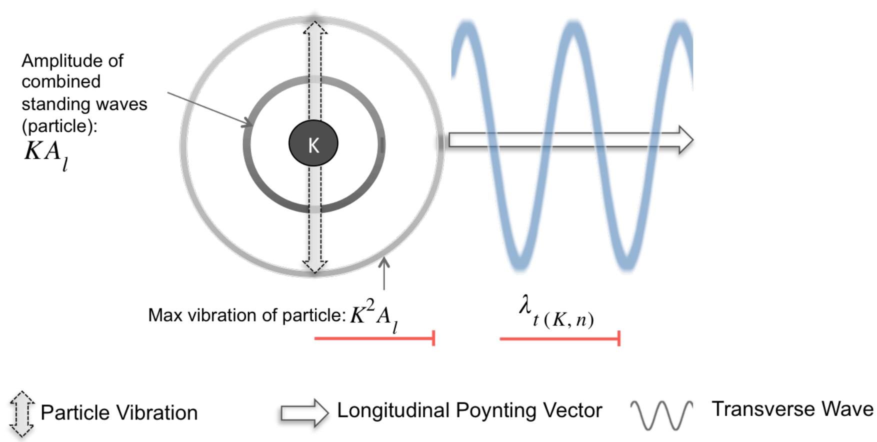


Fig 2.3.1 –Transverse Wave Created by Particle

During the vibration, longitudinal shell energy is transferred to a transverse wave. The characteristic of this transition has an impact on the volume in which the energy is stored. Figure 2.3.2 shows this volume transition from a spherical particle (V_l) to a cylindrical photon (V_t).

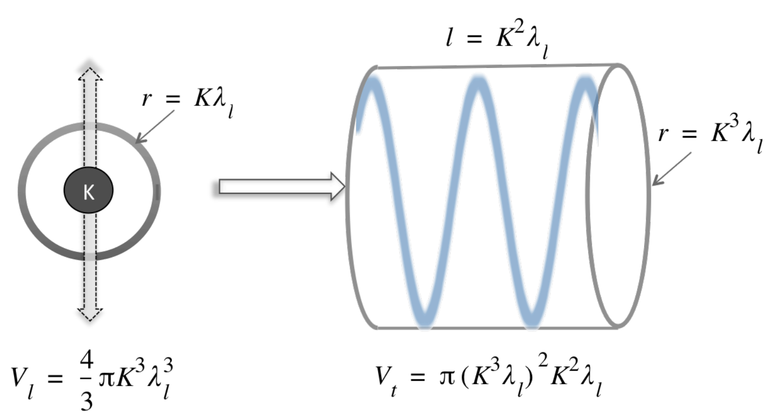


Fig 2.3.2 –Volume Change – Longitudinal to Transverse

The ratio of these two volumes (V_{lt}) is derived in the following:

$$V_{lt} = \frac{V_l}{V_t} \tag{2.3.1}$$

$$V_{lt} = \frac{\frac{4}{3}\pi K^3 \lambda_l^3}{\pi (K^3 \lambda_l)^2 K^2 \lambda_l} \tag{2.3.2}$$

$$V_{lt} = \frac{4}{3K^5} \tag{2.3.3}$$

An interesting note, but unused in the wave equations, is that the fine structure for the electron is related by:

$$\frac{\alpha_e^2}{2} = 2V_{lt} \tag{2.3.4}$$

The transverse wave is the electromagnetic wave, and a property of this wave is that it has both an electric and magnetic field. One possible way to consider the creation of this wave is that a particle is sending its longitudinal out-waves, while vibrating, creating a secondary, transverse wave (see Fig 2.3.2). Thus the energy equation for this wave will have both a transverse frequency and longitudinal frequency, described in Eq. 2.3.5, where V_t is the volume of the cylindrical photon. This origin of this equation is again the base wave equation (Eq. 1), substituting the aforementioned volume, frequencies and amplitudes. It can be described as:

$$E_{t(K,n)} = \boldsymbol{\rho} V_t \frac{c}{\lambda_{t(K,n)}} \frac{c}{\lambda_l} A_t \frac{A_{l_t}^2}{\lambda_l} \tag{2.3.5}$$

The above equation has two new amplitudes related to the electric and magnetic fields: an amplitude of the transverse component (A_t) and an amplitude of the longitudinal component (A_{lt}). Transverse amplitude is related to the inverse of the transformed longitudinal amplitude, which goes through a volume change from spherical to cylindrical (photon) as described in the volume ratio (V_{lt}). A new constant d, dubbed the Transverse Inverse Constant, has been added to the equation to satisfy units in Eq. 2.3.6. The value of d is 1 m^3.

$$A_t = \frac{2V_{lt}d}{A_{l_t}^2} \tag{2.3.6}$$

$$A_t A_{l_t}^2 = 2V_{lt}d \tag{2.3.7}$$

Draft Note: The Transverse Inverse Constant (d) was added to keep units straight in the equation, but there may be another explanation for this equation without the introduction of a new constant. The equation works well with d=1, so its place in the equation is only to keep units straight.

Although the values of A_t and A_{lt} independently are unknown, the relation of these amplitudes in Eq. 2.3.7 can be substituted into Eq. 2.3.5 as shown below. Next, V_t and V_{lt} from previous equations are used to expand the equation in Eq. 2.3.9.

$$E_{t(K,n)} = \boldsymbol{\rho} V_t \frac{c^2 2V_{lt}d}{\lambda_{t(K,n)}\lambda_l^2} \tag{2.3.8}$$

$$E_{t(K,n)} = \boldsymbol{\rho}\pi(K^3\lambda_l)^2 K^2\lambda_l \frac{c^2 2d}{\lambda_{t(K,n)}\lambda_l^2}\frac{4}{3K^5} \tag{2.3.9}$$

This is then simplified into Eq. 2.3.10, before transverse wavelength is substituted into the equation seen in Eq. 2.3.11 (note the transverse wavelength equation used for substitution is upcoming in Eq. 2.3.18).

$$E_{t(K,n)} = \frac{8}{3}d\boldsymbol{\rho}\pi\lambda_l K^3 c^2 \frac{1}{\lambda_{t(K,n)}} \tag{2.3.10}$$

$$E_{t(K,n)} = \frac{8}{3}d\boldsymbol{\rho}\pi\lambda_l K^3 c^2 \frac{1}{\frac{nK^2 A_l V_{lt}}{2}} \tag{2.3.11}$$

Simplify, expand V_{lt} and then the Transverse Wave Equation is finally derived in Eq. 2.3.14.

$$E_{t\,(K,n)} = \frac{16}{3} d\boldsymbol{\rho}\pi\lambda_l K c^2 \frac{1}{nA_l V_{lt}} \tag{2.3.12}$$

$$E_{t\,(K,n)} = \frac{16}{3} d\boldsymbol{\rho}\pi\lambda_l K c^2 \frac{1}{nA_l \frac{4}{3K^5}} \tag{2.3.13}$$

$$E_{t\,(K,n)} = \frac{4 d\boldsymbol{\rho}\pi\lambda_l K^6 c^2}{nA_l} \tag{2.3.14}$$

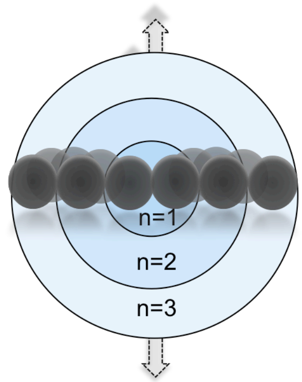
Transverse Energy Equation

As an aside, back in Eq. 2.3.10, Planck's constant can be seen. Its value will be explained and validated later in Section 4.4.

$$h = \frac{8}{3} d\boldsymbol{\rho}\pi\lambda_l K^3 c \tag{2.3.15}$$

The muon electron (K=28) and tau electron (K=50) have a slight modification of the Transverse Energy Equation due to a larger particle core than the electron. These particles have a formation of neutrinos in the core that is larger than one wavelength and requires a particle core offset. This is interesting, because the calculations of the transverse energies of these particles in Tables 1.2.3 and 1.2.4 present information about the size of the core.

To understand why there is an offset, refer to the diagram in Fig. 2.3.3. It is the particle core that vibrates, creating transverse waves. The starting point for the transverse wave is the edge of the core, which may be more than one wavelength (n=1) from the center. The calculations in Section 1.2 show a core of 3 wavelengths for the muon and 5 wavelengths for the tau, which has been labeled the particle core offset (n+2) and (n+4) respectively.



Muon has a core of 3 wavelengths:

$$E_{t\,(K,\,n+2)} = \frac{4d\boldsymbol{\rho}\pi\lambda_l K^6 c^2}{nA_l}$$

Tau has a core of 5 wavelengths:

$$E_{t\,(K,\,n+4)} = \frac{4d\boldsymbol{\rho}\pi\lambda_l K^6 c^2}{nA_l}$$

Fig 2.3.3 –Particle Core Lengths and Offset – Muon Electron and Tau Electron

Transverse Energy Interaction

The transverse energy wave is the difference in longitudinal energy between particles and is a transfer of energy. Fig. 2.3.4 illustrates an electron in orbit, attracted by the nucleus. It starts at initial position n_i wavelengths from the nucleus core and ends at position n_f. Also pictured in the figure is a difference in amplitude as a result of constructive or destructive wave interference, Amplitude Factor δ.

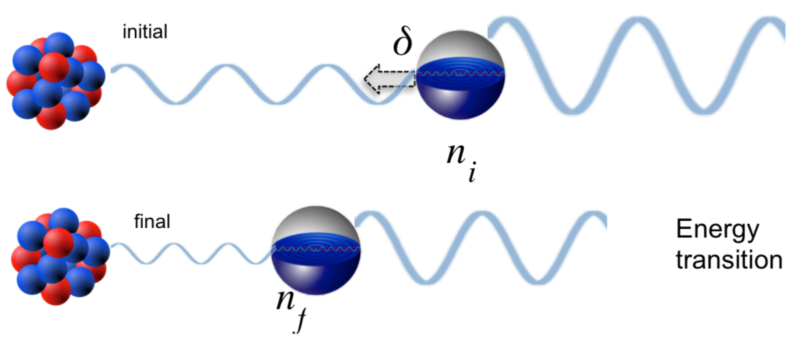


Fig 2.3.4 –Energy Transition

The derivation of the interaction equation assumes the transverse wave energy is the difference between the energy states from the initial location and final location using the Transverse Energy Equation derived in Eq. 2.3.14, for two particles. Also added into the equation is the Amplitude Factor to account for a difference in longitudinal amplitude during the transition. After simplification, the resulting equation for interaction is described in Eq. 2.3.17.

$$E_{t\,(K,\,n_f - n_i)} = \frac{2d\boldsymbol{\rho}\pi\lambda_l K^6 c^2}{n_f \delta A_l} - \frac{2d\boldsymbol{\rho}\pi\lambda_l K^6 c^2}{n_i \delta A_l} \qquad \textbf{(2.3.16)}$$

$$E_{t\,(K,\,n_f - n_i)} = 2d\boldsymbol{\rho}\pi\lambda_l K^6 c^2 \left(\frac{1}{n_f \delta A_l} - \frac{1}{n_i \delta A_l}\right) \qquad \textbf{(2.3.17)}$$

Transverse Energy Interaction Equation

Transverse Wavelength

As the energy transitions from spherical waves to the cylindrical shape of the photon, the new, transverse wavelength is related to the original longitudinal amplitude (A_l) and volume transformation (V_{lt}) of the particle described in Eq. 2.3.16. In Fig 2.3.1, K^2A_l is the maximum displacement the particle can vibrate.

After substituting for V_{lt} and then simplifying, the Transverse Wavelength Equation is derived in Eq. 2.3.18.

$$\lambda_{t\,(K,\,n)} = \frac{nK^2 A_l V_{lt}}{2} \qquad \textbf{(2.3.18)}$$

$$\lambda_{t\,(K,\,n)} = \frac{nK^2 A_l}{2}\frac{4}{3K^5} \qquad \textbf{(2.3.19)}$$

$$\lambda_{t\,(K,\,n)} = \frac{2nA_l}{3K^3} \qquad \textbf{(2.3.20)}$$

Transverse Wavelength Equation

Transverse Wavelength Interaction

Transverse Wavelength Interaction is similar to Transverse Energy Interaction. This derivation starts with Eq. 2.3.10, isolating transverse wavelength in the equation Eq. 2.3.21 below. In this case, wavelength is related to the transverse energy difference for particle interaction from an initial shell (n_i) to final shell (n_f), thus Eq. 2.3.17 is substituted into the equation. After simplifying the equation, the Transverse Wavelength Interaction Equation is shown in Eq. 2.2.23, which yields the wavelength of a photon for a particle changing energy states.

$$\lambda_{t\,(K,\,n)} = \frac{8}{3} d\boldsymbol{\rho}\pi\lambda_l K^3 c^2 \frac{1}{E_{t\,(K,\,n)}} \qquad \textbf{(2.3.21)}$$

$$\lambda_{t\,(K,\,n)} = \frac{8}{3} d\boldsymbol{\rho}\pi\lambda_l K^3 c^2 \frac{1}{2d\boldsymbol{\rho}\pi\lambda_l K^6 c^2 \left(\frac{1}{n_f \delta A_l} - \frac{1}{n_i \delta A_l}\right)} \tag{2.3.22}$$

$$\lambda_{t\,(K,\,n_f - n_i)} = \frac{4}{3K^3} \frac{1}{\left(\frac{1}{n_f \delta A_l} - \frac{1}{n_i \delta A_l}\right)} \tag{2.3.23}$$

Transverse Wavelength Interaction Equation

3. Methodology for Determining Wave Equation Constants

This section describes the methodology that was used to find the constants that are used in the wave equations: 1) Longitudinal Amplitude, 2) Longitudinal Wavelength and 3) Density. The fourth constant that is critical in these equations is already well known – the speed of light constant which is the speed at which waves travel through the aether.

3.1. Longitudinal Amplitude Constant

The first constant solved was Longitudinal Amplitude. The Transverse Wavelength Equation (Eq. 1.1.4) contains both amplitude and wavelength in the equation, but when the equation is set for the known properties of the electron (Compton wavelength of electron at K=10, n=10), one variable remained in the equation to be solved.

The following is the calculation of Longitudinal Amplitude (A_l in meters) in Eq. 3.1.5, based on the Compton wavelength of the electron (2.42631×10^{-12} meters) in Eq. 3.1.1.

$$\lambda_{t(10,10)} = 2.42631 \cdot 10^{-12} \tag{3.1.1}$$

$$\lambda_{t(K,n)} = \frac{2nA_l}{3K^3} \tag{3.1.2}$$

$$\lambda_{t(10,10)} = \frac{2(10)A_l}{3 \cdot 10^3} = 2.42631 \cdot 10^{-12} \tag{3.1.3}$$

$$A_l = \frac{(3 \cdot 10^3)\, 2.42631 \cdot 10^{-12}}{2(10)} \tag{3.1.4}$$

$$A_l = 3.63947 \cdot 10^{-10} \tag{3.1.5}$$

3.2. Longitudinal Wavelength Constant

Knowing Longitudinal Amplitude, the next constant solved was Longitudinal Wavelength. Again, the electron and its well-known properties were used to calculate the constant. Given that transverse and longitudinal energies are equal at n=K, the Transverse Energy and Longitudinal Energy were set to equal (Eqs. 3.2.1 to 3.2.4 describe this process). By doing this, density drops from the equation in Eq. 3.2.5 such that the remaining variables can be inserted. Longitudinal Amplitude was calculated above, and the electron properties are K=10 and transverse and longitudinal energies converge at n=10.

The following is the calculation of Longitudinal Wavelength (λ_l in meters), found in Eq. 3.2.7.

$$E_{t(10,10)} = E_{l(10,10)} \tag{3.2.1}$$

$$E_{t(K,n)} = \frac{4d\boldsymbol{\rho}\pi\lambda_l K^6 c^2}{nA_l} \tag{3.2.2}$$

$$E_{l(K,n)} = \frac{\boldsymbol{\rho}\frac{4\pi}{3}K^5 A_l^6 c^2}{\lambda_l^3} \sum_{n=1}^{K} \frac{n^3 - (n-1)^3}{n^4} \tag{3.2.3}$$

$$\frac{4d\boldsymbol{\rho}\pi\lambda_l K^6 c^2}{nA_l} = \frac{\boldsymbol{\rho}\frac{4\pi}{3}K^5 A_l^6 c^2}{\lambda_l^3} 2.13874 \tag{3.2.4}$$

$$\lambda_l^4 = \frac{nA_l^7}{3dK} 2.13874 \tag{3.2.5}$$

$$\lambda_l = \left(\frac{(10)\ (3.63947\cdot 10^{-10})^7}{3\,(1)\ (10)} 2.13874\right)^{1/4} \tag{3.2.6}$$

$$\lambda_l = 2.78661\cdot 10^{-17} \tag{3.2.7}$$

3.3. Aether Density Constant

Finally, with Longitudinal Amplitude and Wavelength solved, it was possible to calculate density. By using the Longitudinal Energy Equation, along with the known mass of the electron (8.1871 x 10^{-14} joules), density was calculated. Again, electron values of K=10 and n=10 were used along with amplitude and wavelength values calculated above.

The following is the calculation of density ($\boldsymbol{\rho}$, in kg/m^3), found in Eq. 3.3.4.

$$E_{l\,(10,\,10)} = \frac{\boldsymbol{\rho}\frac{4\pi}{3}K^5 A_l^6 c^2}{\lambda_l^3} \sum_{n=1}^{K} \frac{n^3 - (n-1)^3}{n^4} = 8.1871 \cdot 10^{-14} \qquad \textbf{(3.3.1)}$$

$$\frac{\boldsymbol{\rho}\frac{4\pi}{3}K^5 A_l^6 c^2}{\lambda_l^3}(2.13874) = 8.1871 \cdot 10^{-14} \qquad \textbf{(3.3.2)}$$

$$\boldsymbol{\rho} = \frac{24.54 \cdot 10^{-14}\,(2.78661 \cdot 10^{-17})^3}{4\pi\,(2.13874)\,10^5\,(3.63947 \cdot 10^{-10})^6 c^2} \qquad \textbf{(3.3.3)}$$

$$\boldsymbol{\rho} = 9.45941 \cdot 10^{-30} \qquad \textbf{(3.3.4)}$$

3.4. Observations about Constants

There are similarities with the amplitude and wavelength constants with other well-known constants in physics. Although it may be coincidental, it is possible that this is an indication that the Longitudinal Energy Equation is slightly incorrect. The equation assumes a perfect sphere for volume, neglecting an irregular sphere that may be due to the spin of particles. The effect may be very slight given the closeness of these constants. Consider:

- Wavelength is 2.7866 vs 2.81794 for classical electron radius (ignoring magnitude)[11].
- Amplitude is 3.63947 vs 3.64868 for fine structure *divided by* 2 (ignoring magnitude).[12]

Other observations about these constants:

- A wavelength of 2.7866 x 10^{-17} meters puts the electron radius at 2.7866 x 10^{-16} meters (n=10 wavelengths), or one-third the radius of a proton.[13]
- An aether density of 9.45942 x 10^{-30} kg / m^3 is slightly less dense than the critical density of the universe (although it is not certain that aether density is consistent across the universe).

4. Deriving Classical Equations from the Wave Equation

Introducing a new wave equation that describes the energies of particles and their interactions must also fit known classical and quantum equations, as these equations have been rigorously tested and proven. In this section, the wave equation is used to derive these equations as the base from which they form. Further, by looking at these equations in a new way, based on waves of energy, they can also be explained. Section 4.1 attempts to explain the equations, with further details and derivations about each of the energy equations and relativity in Sections 4.2 to 4.5.

4.1. Energy Relationship

The fundamental energy equations are mass-energy ($E=mc^2$), energy-momentum ($E=pc$) and Planck relation ($E=hf$). Long ago, Einstein proposed the relationship for rest mass and momentum in a simple equation ($E^2=(mc^2)^2+(pc)^2$), but the tie to quantum energies and the Planck relation is not well understood. Furthermore, there remain mysteries like annihilation and pair production, where electrons and positrons appear from a vacuum, which is not tied to any of these equations. For the latter, it is well understood that energy is conserved, i.e. that annihilation produces photons equal to the energy of the particles, but the mechanism for how it works is not covered by classical equations.

The following sections will derive the classical equations, including relativity, but this section starts first with a simple explanation of why these energy equations work and how they are related, including the annihilation and creation of particles.

A single particle, in Fig 4.1.1, consists of spherical, longitudinal waves. In the figure, this has been simplified to a simple sine wave to illustrate frequency and amplitude difference. At rest, the particle resonates at the same frequency as its in-waves and has minimized its amplitude difference to maintain a stable position. At rest, there is no frequency or amplitude difference relative to the waves that travel the aether.

When a single particle is in motion, its frequency changes, similar to waves experiencing the Doppler effect. Its leading edge will have a higher frequency than its trailing edge, shown in Fig 4.1.1. It experiences a change in frequency and wavelength relative to the in-waves of its surroundings.

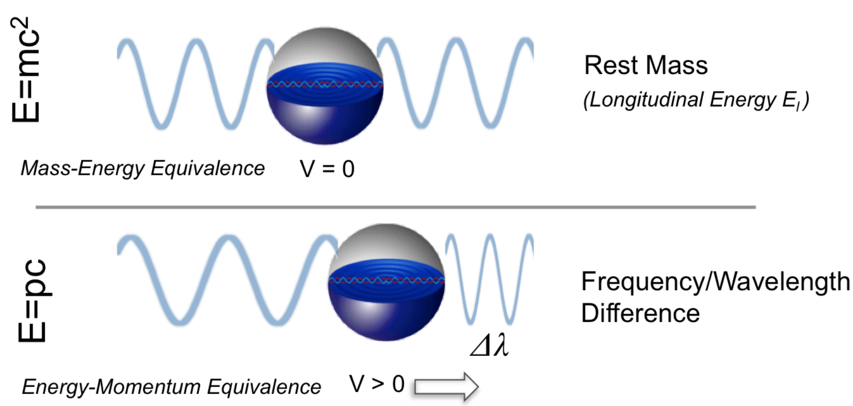


Fig 4.1.1 –Energy Relationship – Single Particle

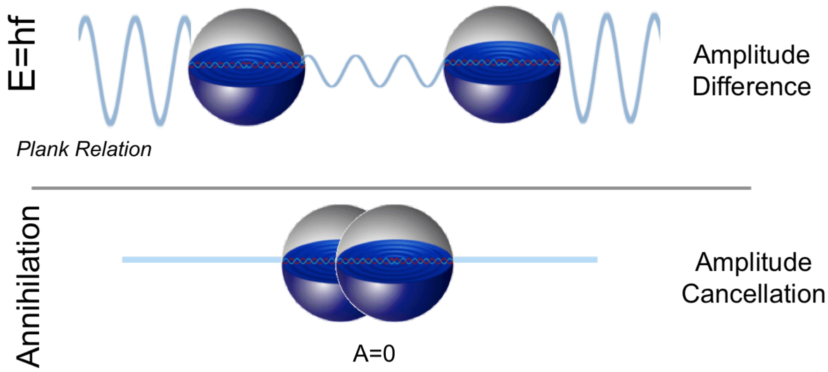


Fig 4.1.2 –Energy Relationship –Particle Interaction

In Figure 4.1.2, two particles interact and may create constructive or destructive wave interference that causes a difference in amplitude. In an electron and positron, the phase difference of their waves are destructive between the particles causing an attraction; two like particles (electron and electron) are constructive causing the particles to repel. When particles like the electron and positron are attracted, they will move to the point of amplitude minimization unless otherwise repelled by additional particle(s).

Annihilation is the point where two particles converge such that there is complete amplitude cancellation. The particles have minimized their amplitude. However, if an electron is attracted by a positron in an atom, it maintains an orbit due to a gap in wave cancellation from opposing forces, as described in Section 1.3. In this case, there is an amplitude difference and the change in its position in longitudinal amplitude creates a transverse wave with a frequency proportional to the amplitude difference. This becomes the Planck relation described in further detail in Section 4.4.

To summarize, the energy equations are simply a difference in amplitude or frequency relative to the universal waves that travel the aether.

4.2. Mass-Energy Equivalence ($E=mc^2$)

As described in Section 2.2, mass is the sum of standing waves within the particle's boundaries before standing waves convert to traveling waves. Mass is apparent in the Longitudinal Energy Equation, as it is energy divided by the square of the wave speed (c^2).

Further proof of the equation is demonstrated by validating the mass of the electron, using Eq. 4.2.2 for mass, with the known rest mass of the electron (Eq. 4.2.5, in kilograms). Finally, the rest energy of the electron is validated (Eq. 4.2.7, in joules).

From Longitudinal Energy Equation (1.1.1)

$$E_{l(K,n)} = \frac{\boldsymbol{\rho}\frac{4\pi}{3}K^5 A_l^6 c^2}{\lambda_l^3} \sum_{n=1}^{K} \frac{n^3 - (n-1)^3}{n^4} \qquad \textbf{(4.2.1)}$$

Mass is the equation without c²

$$m_{(K,n)} = \frac{\boldsymbol{\rho}\frac{4\pi}{3}K^5 A_l^6}{\lambda_l^3} \sum_{n=1}^{K} \frac{n^3 - (n-1)^3}{n^4} \quad \textbf{(4.2.2)}$$

Subtitute mass back into equation for **E=mc²**

$$E_{l(K,n)} = m_{(K,n)} c^2 \quad \textbf{(4.2.3)}$$

Validation: electron mass at K=10, n=10

$$m_{(10,10)} = \frac{\boldsymbol{\rho}\frac{4\pi}{3}10^5 A_l^6}{\lambda_l^3} 2.13874 \quad \textbf{(4.2.4)}$$

Electron mass (kg)

$$m_e = m_{(10,10)} = 9.10 \cdot 10^{-31} \quad \textbf{(4.2.5)}$$

Validation: electron rest energy at K=10, n=10

$$E_{l(10,10)} = m_{(10,10)} c^2 \quad \textbf{(4.2.6)}$$

Electron energy (J)

$$E_e = E_{l(10,10)} = 8.18 \cdot 10^{-14} \quad \textbf{(4.2.7)}$$

4.3. Energy-Momentum Equivalence (E=pc)

Particle motion results in a frequency change, which was illustrated in Figure 4.1.1. A particle sees a higher frequency on its leading edge (direction of motion) than the trailing edge. The change in frequency and thus wavelength is only in the direction of motion (labeled in the following equations as the X axis).

To an observer, the particle experiences the Doppler effect and thus Doppler equations are used to find the leading edge and trailing (lag) frequencies. The particle's frequency while in motion is the geometric mean of the lead and lag frequencies, shown in Eq. 4.3.3. The Lorentz Factor then becomes apparent upon taking the mean of this frequency (Eq. 4.3.7), and will be used later to describe Relativity in Section 4.5.

The following derives the Energy-Momentum relation:

Energy at rest

$$E_0 = \boldsymbol{\rho} V (f_0 A)^2 \quad \textbf{(4.3.1)}$$

Energy equation when moving in direction X

$$E = \boldsymbol{\rho} V f_0 \Delta f_x A^2 \qquad \textbf{(4.3.2)}$$

f_x is the geometric mean of lead and lag frequency

$$\Delta f_x = \sqrt{f_{lead} f_{lag}} \qquad \textbf{(4.3.3)}$$

Doppler equation. Frequency of leading edge.

$$f_{lead} = \frac{f_0}{\left(1 - \frac{\Delta v}{c}\right)} \qquad \textbf{(4.3.4)}$$

Doppler equation. Frequency of trailing (lag) edge.

$$f_{lag} = \frac{f_0}{\left(1 + \frac{\Delta v}{c}\right)} \qquad \textbf{(4.3.5)}$$

Combine Eqs 4.3.3 – 4.3.5. f_x as function of initial frequency.

$$\Delta f_x = \frac{f_0}{\sqrt{1 - \frac{\Delta v^2}{c^2}}} \qquad \textbf{(4.3.6)}$$

Lorentz factor is seen in Eq. 4.3.6.

$$\gamma = \frac{1}{\sqrt{1 - \frac{\Delta v^2}{c^2}}} \qquad \textbf{(4.3.7)}$$

Subtitute Eq. 4.3.6 back into Eq. 4.3.2.

$$E = \frac{\boldsymbol{\rho} V f_0 f_0 A^2}{\sqrt{1 - \frac{\Delta v^2}{c^2}}} \qquad \textbf{(4.3.8)}$$

Substitute wavelength for frequency.

$$E = \frac{\boldsymbol{\rho} V A^2 c^2}{\lambda_0^2 \sqrt{1 - \frac{\Delta v^2}{c^2}}} \qquad \textbf{(4.3.9)}$$

Rest mass is energy divide c^2

$$m_0 = \frac{\boldsymbol{\rho} V A^2}{\lambda_0^2} \tag{4.3.10}$$

Subtitute Eq. 4.3.10 into 4.3.9

$$E = \frac{m_0 c^2}{\sqrt{1 - \frac{\Delta v^2}{c^2}}} \tag{4.3.11}$$

Square both sides

$$E^2 = \frac{m_0^2 c^4}{1 - \frac{\Delta v^2}{c^2}} \tag{4.3.12}$$

Replace E^2 with m^2c^4 (square of E)

$$m^2 c^4 = \frac{m_0^2 c^4}{1 - \frac{\Delta v^2}{c^2}} \tag{4.3.13}$$

$$m^2 c^4 \left(1 - \frac{\Delta v^2}{c^2}\right) = m_0^2 c^4 \tag{4.3.14}$$

$$m^2 c^4 - \frac{m^2 v^2 c^4}{c^2} = m_0^2 c^4 \tag{4.3.15}$$

Rearrange to isolate "mv"

$$m^2 c^4 - (mv)^2 c^2 = m_0^2 c^4 \tag{4.3.16}$$

Momentum (p) is mass times velocity

$$p = mv \tag{4.3.17}$$

Subtitute Eq. 4.3.17 into 4.3.16

$$m^2 c^4 - p^2 c^2 = m_0^2 c^4 \tag{4.3.18}$$

$$E^2 - p^2c^2 = m_0^2c^4 \quad \textbf{(4.3.19)}$$

Einstein's energy-momentum equation

$$E^2 = (m_0c^2)^2 + (pc)^2 \quad \textbf{(4.3.20)}$$

4.4. Planck Relation (E=hf)

Planck's relation is a result of a transverse wave, from the vibration of a particle due to a difference in amplitude, as described in Section 2.3. This may happen during annihilation of a particle, or when a particle transitions between orbitals in an atom. The derivation of this relation thus starts with the transverse wave energy equation, starting at Equation 2.3.10 before transverse wavelength has been substituted. In this equation, shown again in Eq. 4.4.1, Planck's constant (h) is apparent. After showing the derivation of Planck's relation in Eq. 4.4.4, the constant (h) is then validated as a final step in Eq. 4.4.6.

Equation 2.3.10 with transverse wavelength

$$E_{t(K,n)} = \frac{8}{3}d\boldsymbol{\rho}\pi\lambda_l K^3 c^2 \frac{1}{\lambda_{t(K,n)}} \quad \textbf{(4.4.1)}$$

Planck's constant (w/out wavelength)

$$h_{(K)} = \frac{8}{3}d\boldsymbol{\rho}\pi\lambda_l K^3 c \quad \textbf{(4.4.2)}$$

Subtitute Eq. 4.4.2 into 4.4.1

$$E_{t(K,n)} = h_{(K)} \frac{c}{\lambda_{t(K,n)}} \quad \textbf{(4.4.3)}$$

Replace wavelength with frequency.
E=hf.

$$E_{t(K,n)} = h_{(K)} f_{t(K,n)} \quad \textbf{(4.4.4)}$$

Validation: Planck's constant.

$$h_{(10)} = \frac{8}{3}d\boldsymbol{\rho}\pi\lambda_l 10^3 c \quad \textbf{(4.4.5)}$$

Planck's Constant (m^2 kg /s)

$$h_{(10)} = 6.62 \cdot 10^{-34} \quad \textbf{(4.4.6)}$$

Draft Note: Electron-based interactions have the correct value of Planck's constant at K=10 (electron). This would apply to the electron and likely the proton (refer to earlier suggestions it is based on a positron in the core). However, a different value of h is calculated for a muon electron and tau electron. The photon energy from annihilation of these particles matches results, but the calculation of h and Compton wavelength is different than expected calculations. This needs confirmation from wavelength measurement tests of muon and tau photons (if possible).

4.5. Relativity

Einstein's work on Special Relativity and General Relativity laid the foundation of physics over the past century, but has left as many questions as to why these equations work. For example, why does the length of an object contract with motion? Why does mass increase in size?

In this section, the major theories suggested by Einstein are derived and explained with a wave equation.

Relative Mass and Energy

In section 4.3, the energy-momentum relation was explained and velocity is introduced into the equation to calculate the frequency difference when a particle is in motion. To recap, because of motion, the wave experiences the Doppler effect and the new frequency is the geometric mean of the leading and trailing frequencies in the direction of motion.

At low velocities, the frequency difference is negligible. However, at relativistic speeds closer to the speed of light, this difference needs to be considered in calculations. This is the Lorentz factor as derived in Eq. 4.3.7 as the geometric mean of frequencies, relative to the initial frequency. In 4.5.5 and 4.5.6, this factor is apparent in the relativistic mass and energy derivations respectively.

From Eq. 4.3.8

$$E = \frac{\boldsymbol{\rho} V f_0 f_0 A^2}{\sqrt{1 - \frac{\Delta v^2}{c^2}}} \qquad \textbf{(4.5.1)}$$

Subtitute Lorentz Factor Eq. 4.3.7 into Eq. 4.5.1

$$E = \gamma \cdot \boldsymbol{\rho} V f_0 f_0 A^2 \qquad \textbf{(4.5.2)}$$

Change frequency for wavelength

$$E = \gamma \frac{\boldsymbol{\rho} V A^2 c^2}{\lambda_0^2} \qquad \textbf{(4.5.3)}$$

Mass – same as Eq. 4.3.10

$$m_0 = \frac{\boldsymbol{\rho} V A^2}{\lambda_0^2} \tag{4.5.4}$$

Substitute Eq. 4.5.4 into 4.5.3 and divide c² for mass

$$m = \gamma m_0 \tag{4.5.5}$$

Subtitute 4.5.5 into E=mc² equation.
Relative energy.

$$E = \gamma m_0 c^2 \tag{4.5.6}$$

Time Dilation

Time may be thought of as the frequency of the universal waves that travel the aether, responsible for in-waves within particles. Note that frequency is measured in Hertz, or cycles per second. This reintroduces the concept of a universal time, but time is relative to an observer (consistent with Einstein's view) based on a particle's movement. Time is relative due to a change in frequency of a particle or collection of particles, as seen by an observer. As the particle moves, it affects its frequency and how an instrument can measure the frequency cycle of a moving object.

The following starts with the frequency change of a particle from Eq. 4.3.6, in which the Lorentz factor is introduced again. Assuming that our measurement of time is based on the frequency, then Eq. 4.5.9 matches the time dilation equation.[14]

From Eq. 4.3.6

$$\Delta f_x = \frac{f_0}{\sqrt{1 - \frac{\Delta v^2}{c^2}}} \tag{4.5.7}$$

Substitute Eq. 4.3.7 into 4.5.7.

$$\Delta f_x = \gamma f_0 \tag{4.5.8}$$

Time is frequency. Replace frequency with time (t).

$$\Delta t_x = \gamma t_0 \tag{4.5.9}$$

Time dilation.

Length Contraction

When an object is in motion, it contracts in the direction of travel. As with other relativity equations, it is negligible at low velocities but the size of an object will shrink considerably in the axis of motion at relativistic speeds. Why?

The object that contracts is a collection of atoms, bound together by sharing electrons. When atoms that make up the structure are in motion, its frequency changes (Doppler effect), and wavelength becomes shorter. For a single atom, this means its electrons in its orbitals are drawn in closer. Orbitals are gaps created by wave cancellation, and with shorter wavelengths, these orbitals are closer to the nucleus. For example, the Hydrogen 1s orbital was calculated in Table 1.3.2 as 187,789 wavelengths from the particle core. When in motion, its electron will still be 187,789 wavelengths from the particle core, but with shorter wavelengths, it will be closer to the nucleus as illustrated in Fig 4.5.1.

Since atoms share electrons, each atom in the direction of motion equally contracts such that the length is shorter relative to its initial length at the standard frequency/wavelength seen when the atom is at rest. Eq. 4.1.2 describes the length of the object as being the sum of the atoms and their wavelengths to its orbitals. The derivation of length contraction starts with the frequency change from time dilation, Eq. 4.5.8, and the following derivation concludes with a length contraction equation that matches Einstein's relativity. [15]

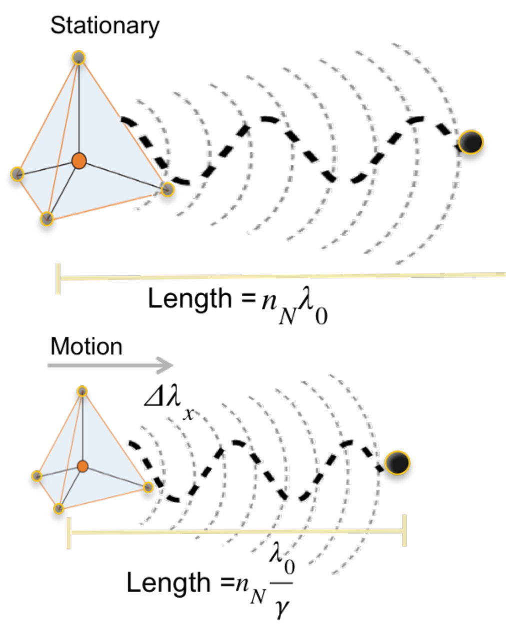


Fig 4.5.1 –Length Contraction

Replace Equation 4.5.8 frequency with wavelength

$$\frac{c}{\Delta\lambda_x} = \gamma \frac{c}{\lambda_0} \tag{4.5.10}$$

Solve for wavelength

$$\Delta\lambda_x = \frac{\lambda_0}{\gamma} \tag{4.5.11}$$

Length is the sum of the distances between atoms

$$L_o = \sum n_N \lambda_0 \tag{4.5.12}$$

Length changes because wavelength contracts in X direction

$$\Delta L_x = \sum n_N \Delta\lambda_x \tag{4.5.13}$$

Subtitute Eq 4.5.11 into 4.5.13

$$\Delta L_x = \sum n_N \frac{\lambda_0}{\gamma} \tag{4.5.14}$$

Subtitute Eq. 4.5.12 into 4.5.14. **Length Contraction.**

$$\Delta L_x = \frac{L_o}{\gamma} \tag{4.5.15}$$

5. Conclusion

Today's classical and quantum equations are undoubtedly correct. Countless experiments have verified the accuracy of these equations from the energies of various atoms and molecules to the specific energy of a photon at various wavelengths. However, there remains a separation of equations for the subatomic (quantum mechanics) and for the world larger than the size of these atoms (classical mechanics).

The conclusion of this paper is that there is indeed one fundamental set of rules and equations that govern everything in the universe, regardless of size. In this view of the universe, all energy comes in the form of waves, with the neutrino being the fundamental particle that resonates to these waves as a sink/source, creating standing waves that are responsible for mass. Further, that various particles seen both in nature and in experiments are a result of a combination of neutrinos, combining to form a particle, whose stability is dependent on the ability to have a core structure in which neutrinos can reside at the nodes of a three-dimensional wave to maintain stability.

Since this view of particle physics is very different from currently accepted models, this paper had the challenge of not only matching existing known data, but to provide an explanation and derivation of existing energy equations.

The following evidence was presented in support of the new, proposed wave equations:

- Calculated energy and mass of all lepton particles in a longitudinal wave equation, which coincides with magic numbers also seen in atomic elements. The same magic numbers for these particles were also derived a second time in a transverse wave equation.

- The same transverse wave equation was used to calculate the annihilation properties of an electron and positron.

- The transverse wave equation was also used to calculate the ionization properties from the first orbital of the first twenty elements.

- Finally, the transverse wave equation was used to calculate the energies and photon wavelengths of hydrogen orbital transitions, an exact match against data seen in the hydrogen spectral series.

Following the presentation of this data in Section 1, a derivation and explanation of the equations were presented, concluding with a tie of these equations to current quantum and classical equations. This paper concludes that all energy comes from a wave equation, in longitudinal and transverse forms, and that classical and quantum energy equations are one - simply a difference of frequency or amplitude experienced by particles. Quantum jumps were further explained as the electron's movement between orbitals as it is both attracted and repelled by the nucleus, where its orbit is a gap in the repelling force because of wave cancellation.

There is sufficient data, with reasonable explanation, that these wave equations should be seriously considered. The fact that the neutrino may be the building block of other particles should also be considered. An equivalent of the Periodic Table of Elements may be created for particles, where the neutrino count is what proton count is to the Periodic Table. These findings provide the basis of a new, encouraging way to explain subatomic particles and their interactions but the work is incomplete.

There is potential work that may prove or expand upon the theory presented in this paper, such as:

- If all of the magic numbers from the Periodic Table of Elements hold true for the leptons, there may be a neutrino at K=2 ($1.10\text{x}10^{-7}$ joules). Locating this neutrino, perhaps in sterile neutrino experiments, may provide additional proof.

- The Compton wavelength calculation for the muon electron and tau electron in this paper is different than currently accepted values. Evidence of the gamma ray wavelengths from annihilations of these particles (wavelengths, not energies), would be proof of these equations.

- Determining the structure of the proton with both attracting and repelling forces would be further proof. It is assumed that there is a positron in the core and that repelling forces, perhaps electrons in the core of the proton, cancel at distances which become the atomic orbitals. Once the basic proton structure is validated for hydrogen, it can be expanded upon for all other elements to determine their orbitals.

- This paper has calculated all of the orbital energies for hydrogen, and ionization of the first twenty elements for the first orbital. Once the above proton structure and orbitals are determined for elements larger than hydrogen, further proof could be in work to build out the models beyond the first orbital and also for remaining elements beyond Calcium.

- Lastly, an ambitious proof may be in the calculation of gravity into the wave equations. It's possible that gravity is the result of a slight amplitude difference, appearing in the Amplitude Factor in these equations. If the universe is filled with longitudinal waves, and large bodies of mass convert some of these waves to transverse, then there will be a difference in amplitude (i.e. shading effect of large bodies). The equations for the positron and electron would work very much the same way for the Earth and Moon, except with a different Amplitude Factor.

Appendix

Other Particle Rest Energies (non-Leptons)

It is not expected that the Longitudinal Energy Equation can be used for all particles in its current form, as it assumes amplitude is perfectly constructive, the resulting amplitude being K times A_l. This means that neutrinos (or wave centers) must be located at exact wavelengths apart from all other neutrinos. Leptons, covered earlier, may fit into this criterion, as magic numbers may reflect geometrically stable shapes. However, not all particles can be expected to meet the same criteria and thus the calculations in Table A.1 have been put into this appendix.

The remaining particles, many of which are created in particle accelerator labs, have been mapped to the closest value of K, if its standing waves are perfectly constructive. This is shown in the table below comparing the calculated rest energy (red) against the particle's CODATA rest energy (italics). What is interesting about the energy of the Higgs boson is that it falls into a range near the end of known elements of the Periodic Table, i.e. there are limits to the types of particles that can be created.

K	30	39	44	45	51	56	62	107	110	117
Particle Name	Pion	Kaons	Proton	Neutron	Strange D	Eta Charmed	Charmed D	W Boson	Z Boson	Higgs Boson
Calculated Rest Energy (GeV)	0.1342	0.5031	0.9229	1.033	1.938	3.101	5.169	79.79	91.65	124.85
CODATA Rest Energy (GeV)	*0.1349*	*0.4970*	*0.9382*	*0.9396*	*1.970*	*2.980*	*5.366*	*80.39*	*91.18*	*125.00*

Table A.1 –Particle Mass as Function of K

Electron Wavelength Count

In 2008, scientists at Lund University in Sweden captured a video of the electron, very much resembling the standing wave structure suggested in this paper.[16] Counting wavelengths from this video may not be scientifically accurate, so this evidence is placed here into the appendix as noteworthy. What makes this interesting is that the electron wavelength counts in Fig. A.1 matches the expected value of standing waves from the Longitudinal Energy Equation. It is a ten wavelength radius from the particle core, otherwise referred to in earlier equations as K=10.

Fig. A.1 shows a still image of electron captured on video. On the left is the original picture; on the right is an attempt to measure wavelengths of the standing waves. At the edge of the particle, standing waves break down to traveling waves. The original video is available at: https://www.youtube.com/watch?v=zKwcWZ1z6J0.

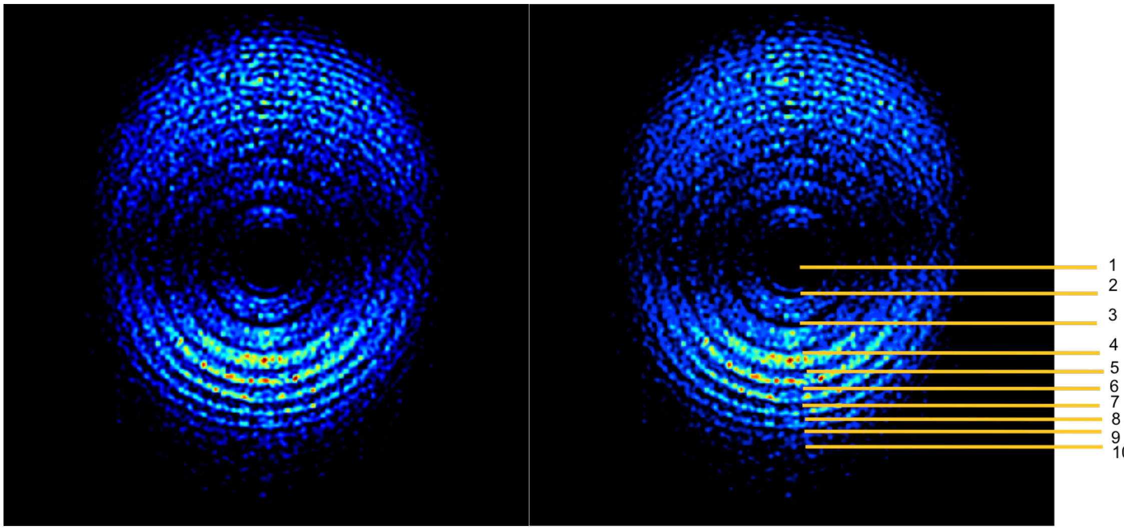


Fig A.1 –Electron as Captured by Lund University (*wavelengths counted on image on right*)

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