The Relation of Relativistic Energy to Particle Wavelength

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Summary

The relativistic nature of matter has never been well understood. Equations accurately model relativity without an explanation for why it occurs. At relativistic speeds (closer to the speed of light), an object's mass increases significantly, but where does this energy come from? Time slows for objects at relativistic speeds, but how is time related to matter and its speed? An object shrinks in the direction of motion, known as length contraction, but why does this happen?

In wave structure of matter theories, the energy of particles is based on standing waves of energy, as a combination of in-waves being reflected at a particle's core to generate out-waves. The combination of these waves create standing waves until the amplitude diminishes to return to traveling wave form. A branch of this work on the wave structure of matter, Energy Wave Theory, has accurately modeled particle rest energy, photon energy and forces based on a fundamental energy equation based on wave properties. However, the original equation, and its derivations, assumed a particle at rest.

In this paper, particle motion is considered in the Energy Wave Theory equations. The addition of particle velocity into the equations derives and explains the nature of relativity as a Doppler effect of a particle's mean wavelength change. The addition of a change in wave amplitude relates particle spin to magnetism and gravity. These new additions to the equations are first described, and then proven to derive the existing Energy Wave Equations and calculations for particles at rest. Next, they are shown to derive and prove relativistic energy. Finally, the correct equation for kinetic energy is described from these equations and compared to the stored energy of gluons in the proton.

Energy Wave Equation Additions – Changes to Wavelength and Amplitude

The equations for Energy Wave Theory originated from the principle of longitudinal in-waves reflecting upon a wave center to become longitudinal out-waves, from Dr. Milo Wolff's work *On the Spherical Wave Nature of Matter and the Origin of the Natrual Laws*.[1] The combination of these waves creates a standing wave to a defined perimeter known as a particle's radius. This principle was expanded to determine a method of calculating the rest energy of each particle based on a combination of wave centers, found in *Particle Energy and Interaction.*[2] Two key energy equations were created for longitudinal standing waves (particles) and for transverse waves (photons). These energy equations were used to derive forces, constants and known equations in physics in the subsequent papers: *Forces*[3], *Fundamental*

Physical Constants[4], *Key Physics Equations and Experiments*[5] and *Atomic Orbitals*[6]. The equations, their notation and the constants are found in the Appendix of this paper.

The original equations did not assume particle motion, nor a slight change in amplitude as a result of wave center motion. The equations accurately calculate a particle's energy, particularly the electron, when at rest. When in motion, a particle's energy changes, although it is not detectable until relativistic speeds are achieved. In this paper, the additions for particle velocity (v) are added to account for relativistic speeds and its changes on energy and hence forces.

In Fig. 1, a visual of the in-waves that affect a particle are described. A particle responds to spherical, longitudinal waves that travel as wavelets according to Huygen's principle.[7] These waves are reflected at wave centers, that combine to create particles, similar to protons in a nucleus that form an atom. The number of wave centers in combination affect the amount of energy that is reflected and the standing wave radius. The energy within the standing wave radius is stored energy – the rest mass and energy of a particle. Meanwhile, the wave centers at the core of a particle constantly move to minimize wave amplitude – the fundamental rule of motion and forces – causing individual wave center motion and the spin of a particle. The motion of the particle affects the wavelength and amplitude of the waves that are reflected. However, energy is always conserved. The in-wave energy ($E_{l(in)}$) is perfectly equal to the out-wave energy, which now takes two forms: a longitudinal out-wave ($E_{l(out)}$) and a new transverse wave due to the spin of the particle ($E_{m(out)}$).

$$E_{l\,(in)} = E_{l\,(out)} + E_{m\,(out)}$$

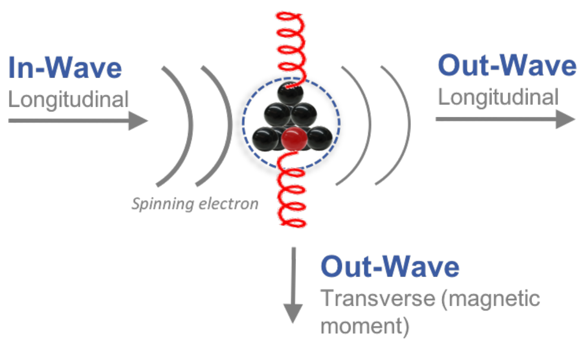

Fig 1 – Conservation of Energy: In-waves and Out-waves of a particle

The conservation of energy relative to the particle can be captured as:

$$E_{l\,(in)} = E_{l\,(out)} + E_{m\,(out)} \tag{1}$$

At the particle-level, an entire particle in motion affects the leading and trailing (lag) wavelengths. This phenomenon is seen throughout wave mechanics and is modeled by Doppler principles.[8] The leading wavelengths are shorter in the direction of motion and longer in the trailing edge. The changes to the leading wavelength ($\lambda_{l(lead)}$) and trailing wavelength ($\lambda_{l(lag)}$) for both the in-waves and out-waves are found in Fig. 2. These additions account for spherical, longitudinal waves that have a maximum wave speed of c (speed of light) and the particle's velocity (v).

Within the particle, wave centers are constantly in motion responding to in-waves and adjusting to the point of minimal amplitude. Stable wave centers are at the node of standing waves where amplitude is minimal. Any wave center not at a standing wave node will have motion to move to the nearest node. This causes the entire structure to spin. It also affects the amplitude in the direction of motion. A wave center not at the node will use some of the wave energy (amplitude) for motion. It increases amplitude on the leading edge and decreases amplitude on the trailing edge as shown in Fig. 2.

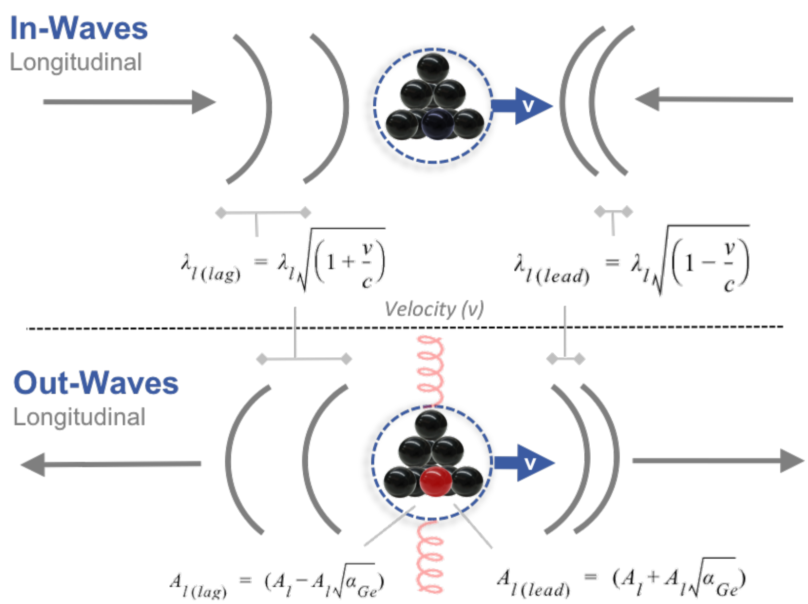

Fig 2 – Changes in Wavelength and Amplitude due to Motion

The changes for wavelength are added to the in-wave of the Longitudinal Energy Equation below in Eq. 3 and highlighted in red. This accounts for particle velocity (v) whereas the original equation assumed a particle at rest. For the complete derivation of the Longitudinal Energy Equation, see *Particle Energy and Interaction.*

$$E_{l(in)} = \frac{1}{2}\rho\left(\frac{4}{3}\pi(K_e\lambda_l)^3\right)\left(\frac{c}{\lambda_l\sqrt{\left(1+\frac{v}{c}\right)}}\frac{(K_eA_l)^3}{(K_e\lambda_l)^2}\right)\left(\frac{c}{\lambda_l\sqrt{\left(1-\frac{v}{c}\right)}}\frac{(K_eA_l)^3}{(K_e\lambda_l)^2}\right) \quad \textbf{(3)}$$

Similarly, in Eq. 4, the changes to the out-wave of the Longitudinal Energy Equation are also adjusted for the changes in wavelength and highlighted in red – in the denominator. In the case of the out-wave, it is now affected by the amplitude change found in Fig. 2. It only affects the amplitude in the direction of motion. This change is also circled in red and is found in the numerator of Eq. 4.

$$E_{l(out)} = \frac{1}{2}\rho\left(\frac{4}{3}\pi(K_e\lambda_l)^3\right)\left(\frac{c}{\lambda_l\sqrt{\left(1+\frac{v}{c}\right)}}\frac{(K_eA_l)^2K_e(A_l - A_l\sqrt{\alpha_{Ge}})}{(K_e\lambda_l)^2}\right)\left(\frac{c}{\lambda_l\sqrt{\left(1-\frac{v}{c}\right)}}\frac{(K_eA_l)^2K_e(A_l + A_l\sqrt{\alpha_{Ge}})}{(K_e\lambda_l)^2}\right) \quad \textbf{(4)}$$

Finally, a third equation is required for the conservation of energy. The energy lost to the changes in amplitude (Eq. 4) are the cause of particle spin and the particle's magnetic moment. Although the energy value is very slight, it must be accounted for in magnetism and also gravitational calculations. Using the conservation of energy, the particle spin energy (E_m) is described in Eq. 5. It accounts for the transfer of energy of amplitude as it creates a new spin (transverse) wave that is perpendicular to the motion of the wave center.

$$E_m = \frac{1}{2}\rho\left(\frac{4}{3}\pi(K_e\lambda_l)^3\right)\left(\frac{c}{\lambda_l\sqrt{\left(1+\frac{v}{c}\right)}}\frac{(K_eA_l)^2K_eA_l\sqrt{\alpha_{Ge}}}{(K_e\lambda_l)^2}\right)\left(\frac{c}{\lambda_l\sqrt{\left(1-\frac{v}{c}\right)}}\frac{(K_eA_l)^2K_eA_l\sqrt{\alpha_{Ge}}}{(K_e\lambda_l)^2}\right) \quad \textbf{(5)}$$

These additions to the Energy Wave Equations are only required when determining relativistic energies (when particles travel at very high speeds closer to the speed of light), and when considering very low energies for the calculations of magnetism and gravity. These equations are considered the complete form.

Particle at Rest – Proof of Existing Equations

The additions to the Energy Wave Equations are first tested for a particle at rest, and for magnetism and gravity, to ensure that these additions still derive existing equations and calculations found in previous papers. In the following section, they are tested for a particle in motion to explain relativity.

Electron Rest Energy and Mass

To be consistent with the existing Longitudinal Energy Equation, hereafter called the short form of the equation, the long form of the equation needs to be able to calculate a particle's rest energy and mass. This is where velocity (v) is zero.

The electron was found in *Particle Energy and Interaction* to contain 10 wave centers. This constant is used through the equations as K_e (K=10). The core of the particle has the greatest amount of energy (E_{core}). It is calculated at one wavelength from the particle where the first in-wave and out-wave combines for a standing wave. This is represented mathematically by Eq. 6.

Fig 3 – Electron (10 wave centers)

$$E_{core} = (E_{l(in)} + E_{l(out)}) \quad \textbf{(6)}$$

The number of wave centers in a particle affects the radius and transition of standing waves to traveling waves. The number of standing waves is proportional to wave centers to reach an amplitude where this breakdown occurs, thus the electron has ten standing waves. Fig. 4 provides a visual of the electron's standing waves – it is stored energy (i.e. mass).

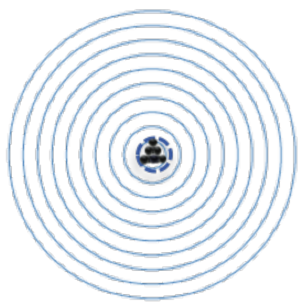

Fig 4 – Electron Standing Waves (stored energy)

The electron's entire energy that is stored within its radius (classical electron radius) is standing wave energy. By the property of standing waves, it has the appearance of not moving. It is stored. Yet, there are in-waves and out-waves creating this behavior. Since amplitude diminishes from the core, the entire electron's energy (E_e) is represented by Eq. 7, where the O_e is the factor that is applied to the core energy, showing the diminishing effect with each wavelength until it reaches the last wavelength at K_e. The details of this explanation can be found in the original derivation in *Particle Energy and Interaction*.

$$E_e = (E_{l(in)} + E_{l(out)})\, O_e \quad \textbf{(7)}$$

$$O_e = \sum_{n=1}^{K_e} \frac{n^3 - (n-1)^3}{n^4} \quad \textbf{(8)}$$

Now, to prove that the rest energy of the electron still matches the original calculations, the long forms of the Longitudinal Energy Equation (Eqs. 3 and 4) are used when velocity is zero (v=0). Eq. 3 and 4 are inserted into Eq. 7, where v=0. This combination is found in Eq. 9 and simplified in Eq. 10. At rest, the equations derive to the short form of the Longitudinal Energy Equation and the electron's rest energy, mass and units are calculated correctly.[9]

$$E_{e_0} = \left(\frac{1}{2}\rho\left(\frac{4}{3}\pi (K_e\lambda_l)^3\right)\left(\frac{c}{\lambda_l}\frac{(K_eA_l)^3}{(K_e\lambda_l)^2}\right)\left(\frac{c}{\lambda_l}\frac{(K_eA_l)^3}{(K_e\lambda_l)^2}\right) + \frac{1}{2}\rho\left(\frac{4}{3}\pi (K_e\lambda_l)^3\right)\left(\frac{c}{\lambda_l}\frac{(K_eA_l)^3}{(K_e\lambda_l)^2}\right)\left(\frac{c}{\lambda_l}\frac{(K_eA_l)^3}{(K_e\lambda_l)^2}\right)\right) O_e \quad \textbf{(9)}$$

$$E_{e_0} = \frac{4\pi\rho K_e^5 A_l^6 c^2 O_e}{3\lambda_l^3} = 8.1871x10^{-14} J \quad \textbf{(10)}$$

Calculated Value: 8.1871E-14
Difference from CODATA: 0.000%
Calculated Units: Joules (kg m^2/s^2)

Electron rest mass is the same Longitudinal Energy Equation without c^2 in the equation. Mass is simply standing, longitudinal waves of energy. This further validates that the long form equation matches electron rest mass.

$$m_{e_0} = \frac{4\pi\rho K_e^5 A_l^6 O_e}{3\lambda_l^3} = 9.1094x10^{-31} kg \quad \textbf{(11)}$$

Calculated Value: 9.1094E-31
Difference from CODATA: 0.000%
Calculated Units: kg

Gravity and Magnetic Moment

In the *Forces* paper, the spin of a particle is described as a new transverse out-wave. This wave is responsible for magnetism. At rest, the energy of magnetism is very small, but since it is a transverse wave, its energy is focused in a one-dimensional wave. This energy needs to be accounted for using the conservation of energy principle. The loss of amplitude due to the wave center's motion, while creating spin, results in a reduction of longitudinal out-wave energy.

Although longitudinal in-waves are three-dimensional and spherical from all directions, a simple visual is found in Fig. 5. Most of the in-wave energy will be reflected back to become out-waves. However, some of this energy is used for the motion of a wave center (marked in red). As it moves, it changes the amplitude of the out-wave, reducing it slightly. This is noted in the figure with a smaller line relative to the in-wave.

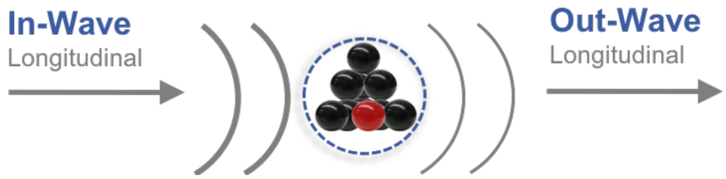

Fig 5 – Reduction in Out-Wave Amplitude Due to Spin

Using Eqs. 3 and 4 from the long form of the Longitudinal Energy Equation, the difference of the energy from the in-wave to out-wave can be calculated. When this difference is shown as a ratio relative to the in-wave energy, the calculated value is 2.4 x 10^{-43}. This is a very slight difference in energy, but it is the ratio that is known as the coupling constant of gravity for the electron (relative to the electric force). This calculation is consistent with the calculations of gravity in the *Forces* paper, showing that the long form of the equation does indeed match existing calculations.

$$\frac{E_{l(in)} - E_{l(out)}}{E_{l(in)}} = \alpha_{Ge} \qquad \textbf{(12)}$$

$$\alpha_{Ge} = 2.4x10^{-43} \qquad \textbf{(13)}$$

Calculated Value: 2.400E-43
Calculated Units: N/A (dimensionless)

At rest, particles have a magnetic moment. With particle motion, the spin energy changes and is found in electromagnetism. Here, the spin energy is calculated when a particle is at rest and compared to the previous derivation of the electron's magnetic moment in the *Forces* paper. From Fig. 1, the focus is the transfer of energy from the in-wave to the transverse component of the out-wave – responsible for the electron's magnetic moment.

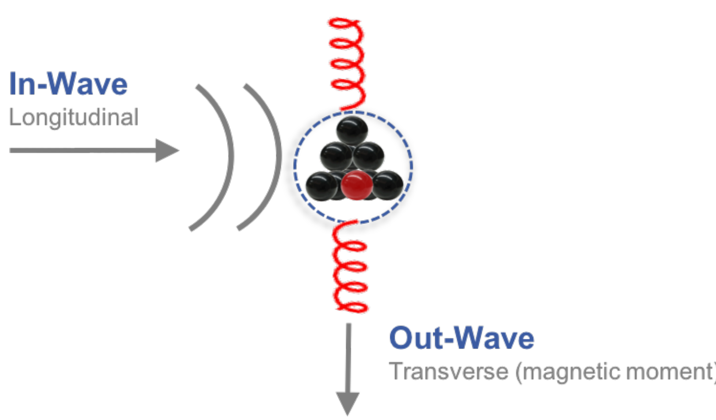

Fig 6 – Transverse Out-Wave Responsible for Magnetism

Rearranging Eq. 1, the magnetic energy is found to be:

$$E_m = E_{l(in)} - E_{l(out)} \tag{14}$$

Using the long form of the equation for the transverse wave (Eq. 5), for a particle at rest (v=0):

$$E_m = \frac{1}{2}\rho\left(\frac{4}{3}\pi(K_e\lambda_l)^3\right)\left(\frac{c}{\lambda_l}\frac{(K_eA_l)^2 K_eA_l\sqrt{\alpha_{Ge}}}{(K_e\lambda_l)^2}\right)\left(\frac{c}{\lambda_l}\frac{(K_eA_l)^2 K_eA_l\sqrt{\alpha_{Ge}}}{(K_e\lambda_l)^2}\right) \tag{15}$$

The equation above can be re-written in a different form moving the terms (the value remains the same).

$$E_m = \frac{16\pi\rho K_e}{3\lambda_l}\left(\frac{1}{2}\frac{K_e^2A_l^3c}{\lambda_l}\sqrt{\frac{\alpha_{Ge}}{2}}\right)\left(\frac{1}{2}\frac{K_e^2A_l^3c}{\lambda_l}\sqrt{\frac{\alpha_{Ge}}{2}}\right) \tag{16}$$

The circled terms above are the Bohr magneton. Two Bohr magnetons are found in the magnetic (spin) energy equation of Eq. 16. For details on the derivation, the units and the inclusion of the angular momentum g-factor, refer to the *Fundamental Physical Constants* paper. The important part of this derivation is to confirm that the changes to the long form equation do not impact previous calculations. The Bohr magneton derivation remains the same. It is:

$$\mu_B = \left(\frac{1}{2}\frac{K_e^2A_l^3c}{\lambda_l}\sqrt{\frac{\alpha_{Ge}}{2}}\right)(\Delta_T^{-1}) = 9.274x10^{-24} \tag{17}$$

Calculated Value: 9.2740E-24
Difference from CODATA: 0.000%
Calculated Units: m^3 / s

For a particle at rest, the key derivations and calculations remain the same using the new long form of the equation, as evidenced by the calculation of the electron's energy, mass, magnetic moment and gravitational coupling constant.

Particle Motion – Relativity and Kinetic Energy

Relativity

When a particle is in motion, it increases its energy. The increase is negligible until reaching significant speeds, relative to the speed of light, so relativity is often ignored in many calculations. The reason for relativity, including relativistic mass increase, time dilation and length contraction are all related to the same principle seen in wave mechanics with the Doppler effect. A particle in motion changes the wavelength.

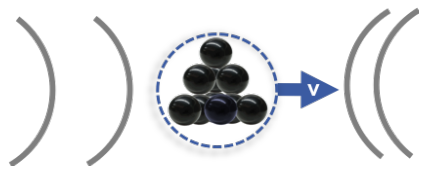

Fig 7 – Particle in Motion Affecting Wavelength – The Cause of Relativity

The new wavelength (squared) is found when multiplying the leading and trailing wavelengths:

$$\lambda_{l'}^2 = \lambda_l^2 \sqrt{1 - \frac{v^2}{c^2}} \tag{18}$$

This is the Lorentz factor ($\boldsymbol{\gamma}$):[10]

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{19}$$

The complete derivation to find the Lorentz Factor is found when using the long form of the Longitudinal Energy Equation for the in-wave (Eq. 3). It is shown again in Eq. 20 and then simplified in Eq. 21. The Lorentz factor can be now found in the energy equation when velocity is considered.

$$E_{l(in)} = \frac{1}{2}\rho\left(\frac{4}{3}\pi(K_e\lambda_l)^3\right)\left(\frac{c}{\lambda_l\sqrt{\left(1+\frac{v}{c}\right)}}\frac{(K_eA_l)^3}{(K_e\lambda_l)^2}\right)\left(\frac{c}{\lambda_l\sqrt{\left(1-\frac{v}{c}\right)}}\frac{(K_eA_l)^3}{(K_e\lambda_l)^2}\right) \quad \textbf{(20)}$$

$$E_{l(in)} = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\frac{2\pi\rho K_e^5A_l^6c^2}{3\lambda_l^3} \quad \textbf{(21)}$$

The symbol for the Lorentz factor is used instead and the equation becomes:

$$E_{l(in)} = \gamma\frac{2\pi\rho K_e^5A_l^6c^2}{3\lambda_l^3} \quad \textbf{(22)}$$

Similarly, the out-wave is simplified just like the in-wave (simplifying Eq. 4). Using the same steps as the in-wave, the out-wave simplifies to:

$$E_{l(out)} = \gamma\frac{2\pi\rho K_e^5A_l^6c^2}{3\lambda_l^3} \quad \textbf{(23)}$$

Since the electron is a combination of in-waves and out-waves that are added to become standing wave energy, found in Eq. 7 and replicated in Eq. 24. Now, the difference between the rest mass of the electron and the relativistic version is simply the addition of the Lorentz contraction factor in the equation.

$$E_e = (E_{l(in)} + E_{l(out)})\,O_e \quad \textbf{(24)}$$

$$E_e = \gamma \frac{4\pi\rho K_e^5 A_l^6 c^2 O_e}{3\lambda_l^3} \quad (25)$$

This is the **relativistic version** of particle energy.[11] The electron's energy is the rest mass version (E_{e0}) and the Lorentz contraction factor.

$$E_e = \gamma E_{e_0} \quad (26)$$

Kinetic Energy - Correct Equation

Kinetic energy is the energy related to motion.[12] Since a particle has rest energy, the total energy is the sum of the motion (kinetic) and rest energy. Typically, kinetic energy is modeled in physics for objects much larger than a particle, but these objects are a collection of particles and thus the kinetic energy for an object can be thought of as a collection of particles with mass in motion. An object, such as a car, would have kinetic energy based on the sum of each of the protons, neutrons and electrons. For the purpose of understanding kinetic energy, it needs to be considered at the particle-level.

Fig. 8 shows an electron particle in motion with a velocity (v). This electron has kinetic energy.

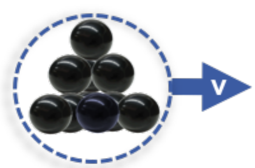

Fig 8 – Electron in Motion: Kinetic Energy

Kinetic energy (E_k) is correctly modeled in the next three equations as the difference between total energy and rest energy of a particle. Eq. 27 models the kinetic energy of a single electron in terms of energy wave constants. Velocity (v) is included in the Lorentz factor (**γ**). Eqs. 28 and 29 model the kinetic energy of a single electron in more familiar terms (electron energy, electron mass). All three equations represent the same thing: kinetic energy is total *relativistic* energy subtract the rest energy. These are the true equations for calculating kinetic energy.

$$E_k = \gamma \frac{4\pi\rho K_e^5 A_l^6 c^2 O_e}{3\lambda_l^3} - \frac{4\pi\rho K_e^5 A_l^6 c^2 O_e}{3\lambda_l^3} \quad (27)$$

$$E_k = \gamma E_{e_0} - E_{e_0} \tag{28}$$

$$E_k = \gamma m_{e_0} c^2 - m_{e_0} c^2 \tag{29}$$

Kinetic Energy - Approximation

The correct form of equations for kinetic energy are more cumbersome and unnecessary when speeds are low. An approximation using Taylor series expansion is often used for non-relativistic speeds of objects, which is often the case unless one considers calculations of rockets, planets or anything with significant velocity.[13] The Taylor series explanation of Eq. 29 is more commonly used. It is:

$$E_k = \frac{1}{2} m_e v^2 \tag{30}$$

Eq. 30 is the Taylor expansion with the first two terms. Additional terms can be added for more accuracy with the Taylor expansion method, but often the first two terms are sufficient for approximation. Fig. 9 shows the velocity of a single electron and a comparison of the correct equation (Relativity - Eq. 29) versus the commonly used kinetic energy equation (Kinetic En. – Eq. 30). Until relativistic speeds, they are nearly equal. Beyond 10,000,000 meters per second, the values calculated by each equation begin to diverge. Also note that the correct equation (Relativity Eq.) correctly shows that the electron is unable to surpass the speed of light, whereas the Taylor series approximation fails to account for this.

$$E_k = \gamma m_{e_0} c^2 - m_{e_0} c^2 \qquad\qquad E_k = \frac{1}{2} m_e v^2$$

Velocity (electron)	Relativity Eq.	Kinetic En. Eq.
0	0	0
100	4.54E-27	4.55E-27
1000	4.55E-25	4.55E-25
10000	4.55E-23	4.55E-23
100000	4.55E-21	4.55E-21
1000000	4.55E-19	4.55E-19
10000000	4.56E-17	4.55E-17
100000000	4.97E-15	4.55E-15
200000000	2.80E-14	1.82E-14
250000000	6.65E-14	2.85E-14
295000000	3.78E-13	3.96E-14
299,792,458	#DIV/0!	4.09E-14

Correct equation shows it is not possible to surpass the speed of light

Begins to diverge at high velocities (although additional Taylor series terms can be added for accuracy)

Fig 9 – Correct Equation vs Approximation Equation (Taylor Series) for Kinetic Energy

Particle Stored Energy – Strong Force

It was described in the earlier section on the derivation of the electron's rest energy that mass is stored energy from longitudinal standing waves. The combination of in-waves and out-waves causes the standing wave form, and by definition, these waves are not moving. It is stored energy.

A second method of storing wave energy is possible with transverse waves. The spin energy of a particle can be stored with two particles in close approximation. This was modeled in the *Forces* paper as the gluon, which is responsible for the strong force. To store this energy, two electrons need sufficient kinetic energy to be placed at standing wave nodes, where they remain at a position of minimal wave amplitude (and thus do not repel).

Kinetic energy can be stored. An example is a ball attached to a spring, where the motion of the ball compresses the spring until the point where the spring is held (compressed). This transfers kinetic energy to potential energy. The same logic applies to two electrons, that normally repel each other with a Coulomb force, but with sufficient energy to overcome it to the point where they are within each other's standing waves and find a node position of minimal amplitude.

This logic was the underlying assumption in the *Forces* paper for the derivation of the strong force and its calculations. However, that paper did not calculate the required velocity of each electron required to overcome the Coulomb force to store the energy. Now, using the long form of the Longitudinal Energy Equation, the velocity can be calculated.

Fig 10 – Two Electrons Moving Toward Each Other with Significant Kinetic Energy

In Figure 10, two electrons travel at high speeds towards each other. With sufficient energy, they overcome the Coulomb (repelling force) and reach a standing wave node and stop. This kinetic energy is transferred to stored energy, referred to as a gluon. It is a transverse wave as the particles continue to spin, but it requires significant energy now to spin (equal to the energy of the gluon).

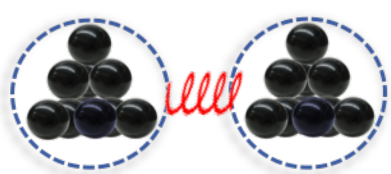

Fig 11 – Two Electrons Locked at Standing Wave Node with Stored Energy (transferred from Kinetic)

In the *Forces* paper, the energy was found to be 137 times stronger in the axial direction between two electrons. This is the inverse of the fine structure constant. It was also found that four electrons need to be arranged – likely in a tetrahedron geometry – to remain stable. With three-dimensional spherical waves, the two-configuration arrangement of electrons (shown in Fig. 11) would likely not be stable. Refer to the *Forces* paper for details.

Using the equations for kinetic energy from this paper, the minimum velocity of each electron can be determined. The total stored energy (E_s) for the gluon would be the kinetic energy of each electron (E_{e1} and E_{e2}), as described in Eq. 31.

$$E_s = E_{e_1} + E_{e_2} \tag{31}$$

Although it is very possible each electron could have a different velocity and still reach the same result, for simplicity of this calculation, assume that the velocity of electron 1 and electron 2 are the same. Therefore, $v_2 = v_1$. This is expressed as 2 times the energy of electron 1, using the long form of the electron's energy (Longitudinal Energy Equation).

$$E_s = 2\left(\rho\left(\frac{4}{3}\pi\,(K_e\lambda_l)^3\right)\left(\frac{c}{\lambda_l\sqrt{\left(1+\frac{v_1}{c}\right)}}\,\frac{(K_eA_l)^3}{(K_e\lambda_l)^2}\right)\left(\frac{c}{\lambda_l\sqrt{\left(1-\frac{v_1}{c}\right)}}\,\frac{(K_eA_l)^3}{(K_e\lambda_l)^2}\right)O_e\right) \tag{32}$$

For the stored energy to be equal to the energy of the gluon, the electron's kinetic energy needs to be roughly 137 times larger than the electron rest energy. This is the value of the fine structure constant and the reason that the relative strength of the strong force compared to the electric force is 137 stronger. This can be represented in Eq. 33. Solving for v_1 in Eq. 32 when E_s is 137 yields the velocity in Eq. 34 when both velocities are assumed to be equal.

$$\frac{E_s}{E_e} = 137 \tag{33}$$

$$v_1 = v_2 = 2.99761\cdot 10^8 \tag{34}$$

This result means that the velocity of each electron must be at least 2.99761 x 10^8 meters per second to have a kinetic energy that will be stored as the gluon once the electrons reach the stable, standing node position. When the position has been reached, kinetic energy becomes stored (potential) energy. Now, the particles do not have a velocity, but the amplitude is modified. Eq. 35 shows the change in amplitude highlighted in red (the square root of the inverse fine structure constant).

$$E_s = \rho\left(\frac{4}{3}\pi(K_e\lambda_l)^3\right)\left(\frac{c}{\lambda_l}\frac{(K_eA_l)^2K_eA_l}{(K_e\lambda_l)^2}\sqrt{\frac{1}{\alpha_e}}\right)\left(\frac{c}{\lambda_l}\frac{(K_eA_l)^2K_eA_l}{(K_e\lambda_l)^2}\sqrt{\frac{1}{\alpha_e}}\right)O_e \qquad \textbf{(35)}$$

Since the fine structure constant itself is a constant that is derived in wave constant terms (refer to *Fundamental Physical Constants*), it can be substituted in Eq. 35 as shown in Eq. 36.

$$E_s = \rho\left(\frac{4}{3}\pi(K_e\lambda_l)^3\right)\left(\frac{c}{\lambda_l}\frac{(K_eA_l)^2K_eA_l}{(K_e\lambda_l)^2}\sqrt{\frac{\lambda_l^3\delta_e}{K_e^4A_l^6}\frac{1}{\pi O_e}}\right)\left(\frac{c}{\lambda_l}\frac{(K_eA_l)^2K_eA_l}{(K_e\lambda_l)^2}\sqrt{\frac{\lambda_l^3\delta_e}{K_e^4A_l^6}\frac{1}{\pi O_e}}\right)O_e \qquad \textbf{(36)}$$

This is then simplified to a very simple form of the energy of a gluon in Eq. 37. This energy value, shown in wave constant terms, matches the energy of the gluon (strong force).

$$E_s = \frac{4\rho K_e c^2\delta_e}{3} = 1.122x10^{-11}J \qquad \textbf{(37)}$$

A velocity of 2.99761 x 10^8 meters per second is nearly the speed of light. The possibility of two electrons colliding at this velocity may be nearly impossible today. Furthermore, it is predicted in the *Forces* paper that it requires four electrons at tetrahedral vertices to form the proton, with each electron placed at an electron wavelength from each other at standing wave nodes, such as the illustration in Fig. 12. A positron eventually in the center of this configuration gives the proton its positive charge, and the eventual annihilation of the positron and one of the electrons is the reason for the finding of three quarks in most proton collisions and the pentaquark configuration (4 quarks and an anti-quark) in recent high-energy proton collisions. The extremely low possibility of four electrons merging simultaneously, at velocities near the speed of light, is likely the reason that protons are not formed today (at least on Earth in our current timeframe).

Fig 12 – Four Electrons at Tetrahedral Vertices (the beginning of the proton's formation)

If gluons are stored energy from the kinetic energy of electrons, then it is possible to calculate kinetic energy without a velocity near the speed of light. For example, if the universe is not uniform in density and is much denser somewhere, the required velocity changes significantly. Similarly, if the universe's density property changed over time, and it was much denser in the beginning of the universe, the required velocity would be much lower. Fig. 13 illustrates two electrons traveling at a lower velocity in a denser aether to achieve the kinetic energy stored in gluons.

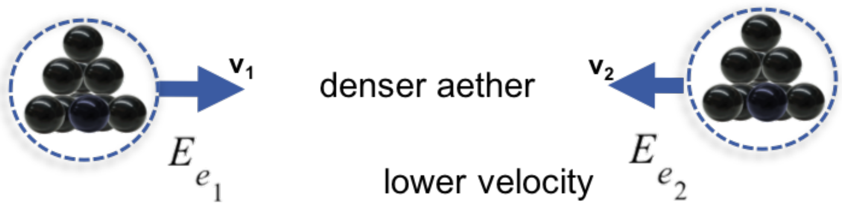

Fig 13 – As the Aether Density Increases, Required Velocity Decreases

While there are many permutations to achieve the same gluon energy level shown in Eq. 37, a density value of 1.281 x 10^{-27} kilograms per meter cubed is assumed (as opposed to a density value of 9.422 x 10^{-30} kilograms per meter cubed). In this example of a denser universe, it is found that the velocities of the electrons only need to be 1,000 meters per second to achieve the gluon energy value (Eq. 41).

$$\rho = 1.281 \cdot 10^{-27} \tag{38}$$

$$v_1 = 1000 \tag{39}$$

$$E_s = \rho\left(\frac{4}{3}\pi\,(K_e\lambda_l)^3\right)\left(\frac{c}{\lambda_l}\,\frac{(K_eA_l)^2K_eA_l}{(K_e\lambda_l)^2}\sqrt{\frac{1}{\alpha_e}}\right)\left(\frac{c}{\lambda_l}\,\frac{(K_eA_l)^2K_eA_l}{(K_e\lambda_l)^2}\sqrt{\frac{1}{\alpha_e}}\right)O_e \tag{40}$$

$$E_s = 1.12x10^{-11}J \tag{41}$$

Therefore, it is possible that protons could be created elsewhere in the universe with a higher density value, or perhaps early in the universe's formation, without requiring velocities near the speed of light.

Conclusion

Relativity is a consequence of particle motion and how it affects wavelength. An increase in energy (relativistic mass), a change in frequency (time dilation) and the shortening of wavelengths to the orbitals where electrons reside (length contraction) are all explained by this change in the geometric mean wavelength of a particle responding to spherical waves. In the original Longitudinal Energy Equation as a part of wave theory, particle motion was neglected. In this paper, the equation is revisited to address a particle's velocity and the equations for relativity become apparent.

The true equation for kinetic energy can now be derived from the revised Longitudinal Energy Equation – referred to now as the long form of the equation as it is only necessary and required at relativistic speeds. The kinetic energy value for an electron in motion was compared to the commonly used approximation method in this paper. Finally, the kinetic energies of two electrons were estimated for the energy required to be stored in gluons, finding that electrons would need to be traveling near the speed of light to achieve this energy value.

Relativity can now be explained logically as a change in particle wavelength and modeled correctly with supporting mathematics when one considers particles as a formation of standing waves.

Appendix:
Energy Wave Constants and Variables

Notation

The energy wave equations include notation to simplify variations of energies and wavelengths at different particle sizes (K) and wavelength counts (n), in addition to differentiating longitudinal and transverse waves.

Notation	Meaning
K_e	e – electron (wave center count)
λ_l λ_t	l – longitudinal wave, t – transverse wave
Δ_e Δ_{Ge} Δ_T	e – electron (orbital g-factor), Ge – gravity electron (spin g-factor), T – total (angular momentum g-factor)
F_g, F_m	g - gravitational force, m – magnetic force
$E_{(K)}$	Energy at particle with wave center count (K)

Table 1.1.1 – Energy Wave Equation Notation

Constants and Variables

The following are the wave constants and variables used in the energy wave equations, including a constant for the electron that is commonly used in this paper. 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.

Symbol	Definition	Value (units)
	Wave Constants	
A_l	Amplitude (longitudinal)	$3.662796647 \times 10^{-10}$ (m)
λ_l	Wavelength (longitudinal)	$2.817940327 \times 10^{-17}$ (m)
ρ	Density (aether)	$9.422369691 \times 10^{-30}$ (kg/m^3)
c	Wave velocity (speed of light)	299,792,458 (m/s)
	Variables	
δ	Amplitude factor	variable - (m^3)
K	Particle wave center count	variable - *dimensionless*
n	Wavelength count	variable - *dimensionless*

Q	Particle count (in a group)	variable - *dimensionless*
Electron Constants		
K_e	Particle wave center count - electron	10 - *dimensionless*
Derived Constants*		
O_e	Outer shell multiplier – electron	2.138743820 – *dimensionless*
Δ_e / δ_e	Orbital g-factor /amp. factor electron	0.993630199 – *dimensionless* / (m^3)
Δ_{Ge}/δ_{Ge}	Spin g-factor/amp. gravity electron	0.982746784 – *dimensionless* / (m^3)
Δ_T	Total angular momentum g-factor	0.976461436 – *dimensionless*
α_e	Fine structure constant	0.007297353 – *dimensionless*
α_{Ge}	Gravity coupling constant - electron	$2.400531449 \times 10^{-43}$ - *dimensionless*

Table 1.1.2 – Energy Wave Equation Constants and Variables

The derivations for the constants are:

The outer shell multiplier for the electron is a constant for readability, removing the summation from energy and force equations since it is constant for the electron. It is the addition of spherical wave amplitude for each wavelength shell (n).

$$O_e = \sum_{n=1}^{K_e} \frac{n^3 - (n-1)^3}{n^4} \quad \textbf{(1.1.1)}$$

The three modifiers (Δ) are similar to the g-factors in physics for spin, orbital and total angular momentum. These modifiers also appear in equations related to particle spin and orbitals, however the g-factor symbol is not used since their values are different. This is due to different wave constants and equations being used. In *Energy Wave Equations: Correction Factors,* a potential explanation for the values of these g-factors is presented as a relation of Earth's outward velocity and spin velocity against a rest frame for the universe.[14] A velocity of 3.3×10^7 m/s (11% of the speed of light) would reduce three g-factors to one based on relativity principles.

The value of Δ_{Ge} was adjusted slightly by 0.0000606 to match experimental data. Since Δ_T is derived from Δ_{Ge} it also required an adjustment, although slightly smaller at 0.0000255. This could be a result of the value of one or more input variables (such as the fine structure constant, electron radius or Planck constant) being incorrect at the fifth digit. The fine structure constant (α_e) is used in the derivation in Eq. 1.1.2 as the correction factor is set against a well-known value.

$$\Delta_e = \delta_e = \frac{3\pi\lambda_l K_e^4}{A_l \alpha_e} \tag{1.1.2}$$

$$\Delta_{Ge} = \delta_{Ge} = 2A_l^3 K_e^{28} \tag{1.1.3}$$

$$\Delta_T = \Delta_e \Delta_{Ge} \tag{1.1.4}$$

The electromagnetic coupling constant, better known as the fine structure constant (α), can also be derived. In this paper, it is also used with a sub-notation "e" for the electron (α_e).

$$\alpha_e = \frac{\pi K_e^4 A_l^6 O_e}{\lambda_l^3 \delta_e} \tag{1.1.5}$$

The gravitational coupling constant for the electron can also be derived. α_{Ge} is baselined to the electromagnetic force at the value of one, whereas some uses of this constant baseline it to the strong force with a value of one (α_G = 1.7 x 10^{-45}). The derivation matches known calculations as $\alpha_{Ge} = \alpha_G / \alpha_e$ = 2.40 x 10^{-43}.

$$\alpha_{Ge} = \frac{K_e^8 \lambda_l^7 \delta_e}{\pi A_l^7 O_e \delta_{Ge}} \tag{1.1.6}$$

The gravitational coupling constant for the proton is based on the gravitational coupling constant for the electron (above) and the proton to electron mass ratio (μ), where μ = 1836.152676.

$$\alpha_{Gp} = \alpha_{Ge} (\mu^2) \tag{1.1.7}$$

[1] Wolff, M., *On the Spherical Wave Nature of Matter and the Origin of the Natural Laws*, Online: http://www.spaceandmotion.com/Wolff-Wave-Structure-Matter.htm (Accessed October, 2017)

[2] Yee, J., Particle Energy and Interaction, Vixra.org 1408.0224 (2017).

[3] Yee, J., Forces, Vixra.org 1606.0112 (2017).

[4] Yee, J., Fundamental Physical Constants, Vixra.org 1606.0113 (2017).

[5] Yee, J., Key Physics Equations and Experiments, Vixra.org 1705.0101 (2017).

[6] Yee, J., Zhu, Y. and Zhou, G., Atomic Orbitals, Vixra.org 1708.0146 (2017).

[7] Huygens, C., *Traité de la Lumière* (1690), translated by Silvanus P. Thompson as *Treatise on Light* (Macmillan, London, 1912).

[8] Possel, M. *Waves, motion and frequency: the Doppler effect.* Einstein Online, Vol 5. Max Planck Institute for Gravitational Physics, Potsdam, Germany, (Accessed March, 2018).

[9] Mohr, P., Newell, D. and Taylor, B., CODATA Recommended Values of the Fundamental Physical Constants 2014 Rev. Mod. Phys. 88, 035009 (2016).

[10] Lorentz, H., *The Relative Motion of the Earth and the Aether*, Zittingsverlag Akad. V. Wet. (1892).

[11] Wikipedia, *Mass in Special Relativity*, Online: https://en.wikipedia.org/wiki/Mass_in_special_relativity, (Accessed March, 2018).

[12] Physics Classroom, *Kinetic Energy*, Online: http://www.physicsclassroom.com/class/energy/Lesson-1/Kinetic-Energy, (Accessed March, 2018).

[13] Wikipedia, *Taylor Series,* Online: https://en.wikipedia.org/wiki/Taylor_series, (Accessed March, 2018).

[14] Yee, J., Energy Wave Equations: Correction Factors, Vixra.org 1803.0243 (2018).