The Geometry of Particles and the Explanation of their Creation and Decay

Jeff Yee* & Lori Gardi†

* jeffsyee@gmail.com
† lori.anne.gardi@gmail.com

October 5, 2019
(second draft)

Abstract: In this paper, subatomic particles are described by the formation of standing waves of energy as a result of energetic oscillations in the spacetime lattice. The creation of new particles with higher energies, or the decay of particles to lower energies, are described by the formation of wave center points that cause an increase or decrease in standing wave energy. The stability of such particles is found to be based on the geometric formation of these center points which allows standing waves to form to a defined boundary that becomes the particle's radius, or the collapse of its standing waves as particles split to become two or more particles, or completely annihilate. The oscillation energy calculation for a single wave center matches the upper range of the neutrino's estimated energy. It is assumed that this single wave center is the fundamental particle responsible for creating the neutrino. It will be shown in this paper mathematically – and possibly modeled in the near future with computer simulations – that this fundamental particle is responsible for the creation of higher order particles, including but not limited to the electron, proton and neutron.

Introduction

Subatomic particles such as the electron, proton and neutron exist within atoms and form the foundation of matter. Yet, hundreds more particles have been discovered in experiments when these three components of matter are excited to high speeds and energies and collide with each other, creating new particles. Nearly all of the new particles that are discovered quickly decay, surviving for only a fraction of a second before becoming a different particle and settling to be one of a handful of known stable particles. In addition to particle collision experiments, various neutrino experiments around the world capture and explain the behavior of the smallest known particle – the neutrino – which has the strange ability to grow in size and energy in a process known as oscillation [1]. The neutrino family of particles, along with other elementary particles, are categorized within the physics community as the Standard Model of Elementary Particles [2]. Still, it raises questions about the meaning of this model. How are new particles created and why do they quickly decay?

In a paper on the *Geometry of Spacetime and the Unification of Forces*, the structure of spacetime at the Planck level was described and mathematically modeled as a spring-mass system to calculate the energy of the electron particle and to unify the forces acting upon the electron as a change in geometry when energy is exchanged between the components of the spacetime lattice referred to as *granules* [3].

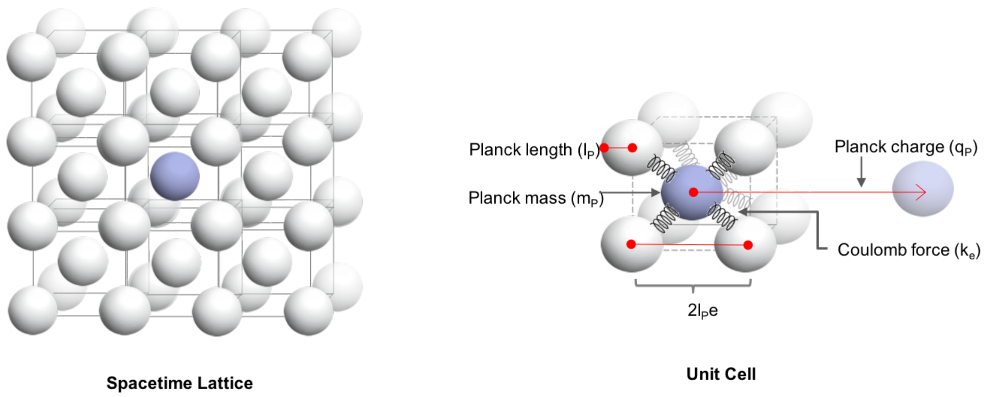

Fig. 1 – Illustration of the spacetime lattice and a unit cell within the structure of the lattice

While the paper is successful at calculating the electron and its forces using classical mechanics, it did not explain various other particles that are found within the atom or in particle collision experiments. Here, in this paper, the geometry of the spacetime lattice that leads to the formation and the decay of particles is explained.

1. Wave Centers

The *Geometry of Spacetime* paper described granules and their motion but it did not describe the phenomenon that occurs when energy reaching a center granule equally from all sides creates a spherical reflection. This center granule is a special case referred to as a *wave center,* since it is the center point of all wave energy. The in-wave energy into a wave center now being reflected to an out-wave causes a defined boundary of standing waves, and the energy sum of all granules within this boundary becomes the energy of a particle. A standing wave contains energy, but by definition, has no net propagation of energy [4]. This becomes the definition of a particle. A single wave center is the *fundamental particle* and a collection of wave centers produces higher-order particles.

As a quick review of the aforementioned paper, the following are the five fundamental constants used to represent a center granule (wave center): mass of Planck mass, radius of Planck length and the time to travel a radius as Planck time. The displacement from a wave center in an electron is Planck charge and the transition of standing waves to traveling waves is the electron's radius.

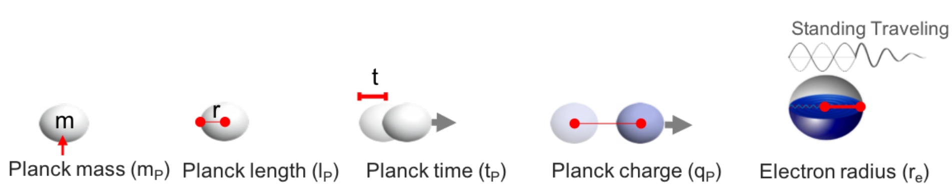

Fig. 1.1 – Five fundamental constants

These constants, and three additional constants derived from these, are found in the following table.

Symbol	Definition	Value (units)
	Five Fundamental Constants	

m_P	Planck mass	2.17643×10^{-8} (kg)
l_P	Planck length	1.61625×10^{-35} (m)
t_P	Planck time	5.39125×10^{-44} (s)
q_P	Planck charge	1.87555×10^{-18} (m)
r_e	Electron classical radius	2.81794×10^{-15} (m)
	Derived Constants	
c	Wave velocity (speed of light)	299,792,458 (m/s)
μ_0	Magnetic constant	1.25664×10^{-6} (kg/m)
e_e	Elementary charge	1.60217×10^{-19} (m)

If the spacetime lattice can be described mathematically like a spring-mass system, then it can be illustrated as the following when energy from the lattice is equal in all directions when reaching a specific point in the lattice. This is referred to as the wave center and is colored blue in the next figure. Energy, in the form of granule displacement, comes into the wave center and is equally forced out.

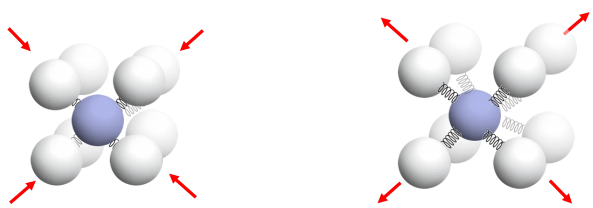

Fig. 1.2 – Wave center (blue)

The harmonic motion of granule oscillation creates the formation of waves, defined by a wavelength (λ). Since spherical waves are difficult to visualize, it is presented in 1D view in the next figure. At time t=0, granules are displaced a half wavelength from the wave center, or what is a full wavelength between the wavefronts created by granules. They reach maximum displacement at this point and return. At time t=π (a time of a half wavelength), they have returned to the center point of the wave center. This harmonic motion continues, providing both in-waves and out-waves that will form a standing wave.

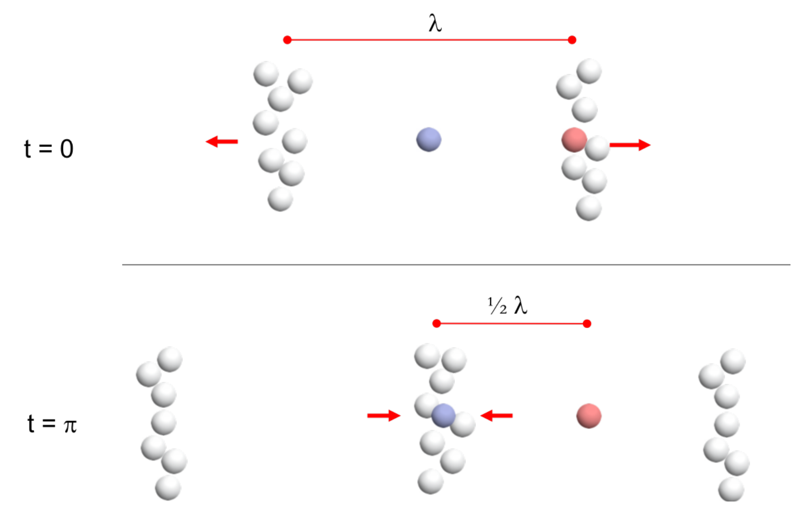

Fig. 1.3 – Spacetime lattice oscillation (1D view) at t=0 and t=π

The half wavelength is the displacement (Planck charge - q_P) and the base of the natural logarithm squared (Euler's number – e^2). This becomes the *first node* of a standing wave. A full wavelength is twice this value, which is the *second node* in a wavelength of a standing wave. The equations to calculate this position from the wave center are:

$$\frac{1}{2}\lambda = q_P e^2 \tag{1.1}$$

$$\lambda = 2q_P e^2 \tag{1.2}$$

Note: e is Euler's number (2.71828)

The nodes of a standing wave are further illustrated in the next figure. The first node position is colored in blue. As wave motion flows in and out, referred to as in-waves and out-waves, standing waves occur. The second node created within one wavelength is colored in red.

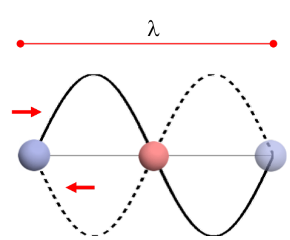

Fig. 1.4 – Harmonic motion represented as a sine wave. When a standing wave forms, there are two nodes per wavelength.

The placement of particles at these nodes will be shown to cause attractive and repulsive features due to the position on the wave as destructive or constructive wave interference.

2. Fundamental Particle

A single wave center forms a fundamental particle as a result of spherical, standing waves. It is now shown as a sphere, although a 2D cross-section is used to illustrate the radius of one wavelength from the wave center.

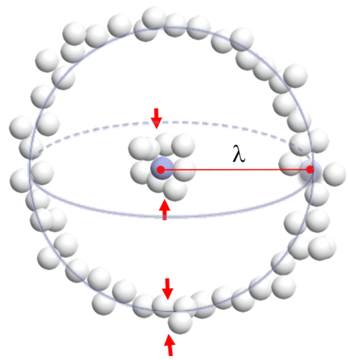

Fig. 2.1 – A **fundamental**, spherical particle created by the oscillation of one wavelength from the wave center (2D cross section view)

A wave center placed on the alternate node of a standing wave (second node in Fig. 1.4) is shown below. This wave center is colored red to indicate its placement on a node separated a half wavelength from where a wave center (blue) would be positioned. This is the formation of the first **antiparticle**.

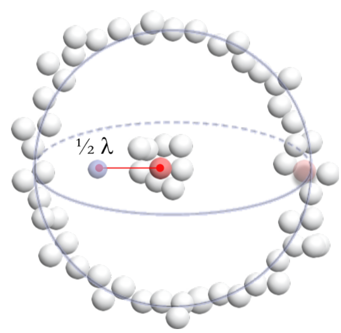

Fig. 2.2 – The antiparticle results from a wave center (center in red) that is at the opposite node (1/2 λ).

Consistent with modern physics, a g-factor is introduced that will satisfy the equations for the electron's radius and the neutrino's energy. The g-factor is presumed to be a result of particle motion compared to a reference frame, causing a change in wavelength consistent with the Doppler effect [5].

$$g_v = 0.983592 \quad \textbf{(2.1)}$$

The radius (r_v) for the fundamental particle is now modified to be one wavelength multiplied by the g-factor. A subscript v is used for the neutrino.

$$r_v = \lambda g_v^{-1} = 2.81794 \cdot 10^{-17} \, (m) \quad \textbf{(2.2)}$$

From the *Geometry of Spacetime* paper, the energy of a particle was simplified to the following equation, where initial wave amplitude (q) and particle radius (r) are the only variables.

$$E = \frac{\mu_0 c^2}{4\pi}\left(\frac{q^2}{r}\right) \tag{2.3}$$

For example, the electron's rest energy (E_e) is calculated when the initial wave amplitude is the elementary charge (e_e) and the radius is the electron's classical radius (r_e).

$$E_e = \frac{\mu_0 c^2}{4\pi}\left(\frac{e_e^2}{r_e}\right) = 8.1871\cdot 10^{-14}\left(\frac{kg\,(m^2)}{s^2}\right) \tag{2.4}$$

If the fundamental particle is assumed to be the neutrino, formed from the energy of a single wave center, then all other particles, including the electron should be formed from a collection of wave centers. The number of wave centers within the core of a particle is assigned the letter **K**.

The number of wave centers for the electron was determined to be 10, as it will be explained later in Section 4 when all particle energies are plotted. This is expressed in Eq. 2.5 as the constant K_e. The electron's classical radius (r_e) can now be calculated using the square of this value, the relationship of charge and Euler's number and wavelength and the g-factor:

$$K_e = 10 \tag{2.5}$$

$$r_e = 2q_P (K_e e)^2 g_v^{-1} = 2.81794\cdot 10^{-15}\,(m) \tag{2.6}$$

To apply the same concept of calculating the energy of the fundamental particle, the initial wave amplitude must be known. Similar to the electron's initial wave amplitude which is found to be the elementary charge (e_e), the fundamental particle's amplitude is given a constant (q_v). Whereas the electron's radius increased *from* the fundamental wavelength proportional to the square of K_e, the opposite occurs to find the fundamental amplitude by dividing K_e from the displacement (Planck charge). This is because the fundamental amplitude will increase proportional to K for each wave center as a result of constructive wave interference. It becomes the numerator of Eq. 2.7. It is cubed because displacement spreads spherically in three dimensions from the center, but it reduces amplitude at the square of distance. The initial displacement distance is a half-wavelength, which becomes the denominator of Eq. 2.7.

$$q_v = \frac{\left(\frac{q_P}{K_e}\right)^3}{\left(\frac{\lambda}{2}\right)^2} \tag{2.7}$$

Now, Eq. 2.3 can be solved for the energy of the fundamental particle. Eqs. 2.7 and 2.2 are used for initial wave amplitude (q) and radius (r) respectively.

$$E = \frac{\mu_0 c^2}{4\pi}\left(\frac{q_v^2}{r_v}\right) = 3.76365\cdot 10^{-19}\left(\frac{kg\,(m^2)}{s^2}\right) \tag{2.8}$$

Eq. 2.8 is expressed in joules. Particle energies are often expressed in electron-volts (eV) instead of joules, so a conversion factor ($6.241*10^{18}$) is applied. In addition, the g-factor (Eq. 2.1) is also applied to correct the final value that will be used for upcoming particle calculations. The subscript for the neutrino is used for the energy value (E_ν) because this energy is very close to the upper range of the neutrino's estimated rest energy [6].

$$E_\nu = \frac{\mu_0 c^2}{4\pi}\left(\frac{q_\nu^2}{r_\nu}\right) g_\nu^{-1} (6.241 \cdot 10^{18}) = 2.39\,(eV) \tag{2.9}$$

3. Particle Creation and Decay

Particles can be described as a combination of wave centers, creating the appearance of a larger sphere of granule motion and standing wave energy when arranged in specific geometries that allow stability. When a single wave center is present, it forms the neutrino. When two or more wave centers are placed within proximity, a new particle is created. When the geometry of multiple wave centers does not allow for stable, standing waves to be created, it will decay into smaller particles.

The process of creating larger particles with greater energy is a result of constructive wave interference. In a similar but opposite process the annihilation of a particle and its antiparticle is a result of destructive wave interference. This process is described in the next figure. When two wave centers are separated at a half wavelength from each other (e.g. a neutrino and antineutrino), the reflected granules meet each other traveling in opposite directions and cancel energy upon collision, similar to the destructive wave interference process seen in air molecules and sound wave cancellation [7]. This cancels wave amplitude, as illustrated in the sine wave representation of granule motion. The opposite occurs for constructive wave interference, where granules transfer energy to other granules in the same direction, increasing their energy and displacement. This increases wave amplitude. This is illustrated in 1D view, due to the complexity of illustrating the 3D process.

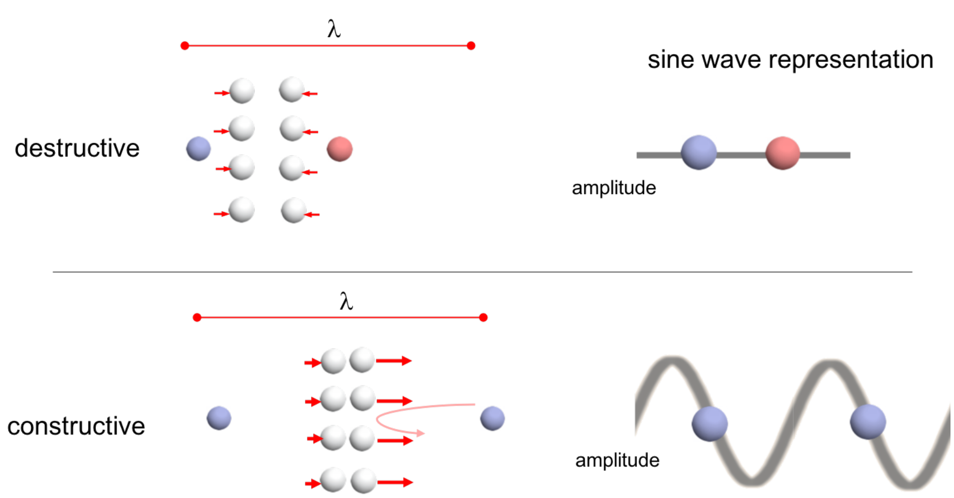

Fig. 3.1 – 1D view of constructive and destructive wave interference depending on node placement of wave center (blue wave centers – same phase; blue and red wave centers – antiphase)

Using this description of constructive wave interference, a 2D cross section of particle formation is now illustrated. Particles are 3D objects, but the cross-section is shown to visualize the wave centers in the core of the particle. On the left of the next figure, three wave centers (three neutrinos) are illustrated in motion with sufficient energy to combine at the core of a new particle. On the right of the figure, a single particle is illustrated as the combination of three wave centers, now with constructive wave interference from all wave centers, increasing the displacement of granules (wave amplitude).

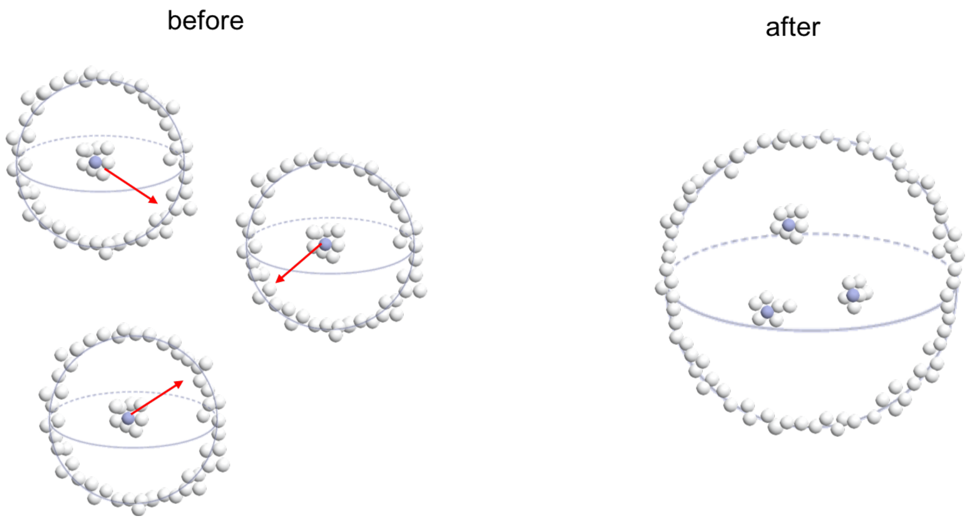

Fig. 3.2 – 2D view of **particle creation** before and after wave centers converge to standing wave nodes

Fig. 3.2 illustrates three wave centers in the same wave phase (blue). The antiparticle would be an identical process for creation, and identical in energy, but resides on the opposite standing wave node. For the purpose of illustration, these wave centers are colored red. The difference in standing wave node placement for a particle and its antiparticle are illustrated in the next figure. In both cases, they are formed from four wave centers and experience constructive wave interference. For simplicity in illustration, **only wave centers are shown in Fig. 3.3** and the following figures. Granules are always assumed to be displaced by these wave centers, such as Fig. 3.2.

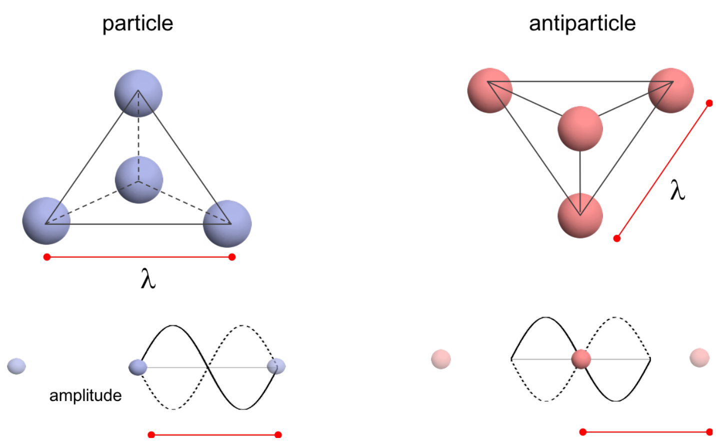

Fig. 3.3 – 3D view of particle creation of wave center convergence at standing wave nodes (without granules)

The simplest platonic solid – the tetrahedron – is used as the geometry of wave center arrangement in Fig. 3.3. If the particle and antiparticle are within proximity of each other, they will produce destructive waves as described in Fig. 3.1. This process creates greater energy on the exterior sides of the particles than the interior side (between the particles), forcing wave centers in motion. They will continue in motion until the particles meet, which is seen as the annihilation of particles, releasing energy in the form of transverse waves of granules (photons) as the particles vibrate before coming to rest [8]. An example of the two particles from Fig. 3.3 are now illustrated after coming to rest;

illustrated as a dual tetrahedra. With fully destructive waves, the particles will have no charge that can be detected by electromagnetic apparatus and appear to be annihilated until separated in the process of pair production [9].

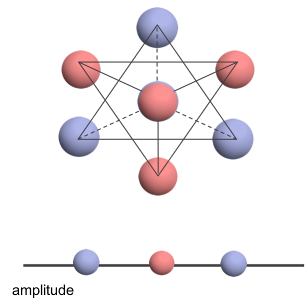

Fig. 3.4 – 3D view of particle and antiparticle merged together (annihilation) and effect on net amplitude

Although the simplest 3D platonic solid may be stable because wave centers can be placed at standing wave nodes from each other – a separation distance of λ – the center of this solid to the circumsphere is not at perfect wavelengths. The length of this radius from the center to circumsphere is $(3/8)^{1/2} * \lambda$. This may cause the motion of wave centers around the center point, causing the spin of a particle, as illustrated in the next figure.

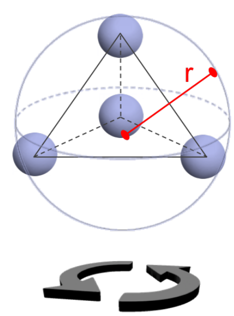

Fig. 3.5 – Spin. Tetrahedron structure of wave centers separated at one wavelength and a radius (r) from center to circumsphere.

The next figure illustrates the stability of particles. Wave centers must be located at the nodes of standing waves for a simple reason. No displacement occurs at a standing wave node [10]. For a wave center to be truly the center of spherical standing waves, it must not be displaced, and instead reflects the energy of incoming granules as their timing coincides exactly at the center. If the wave center is not on a standing wave node, then a difference in energy on a given side will cause its motion. Fig. 3.6 describes a particle with one wave center at the standing wave node (before). Because the wave center to its right is not at a full wavelength distance, it is unstable and will move. After it moves to the standing wave node at a wavelength distance, it is stable.

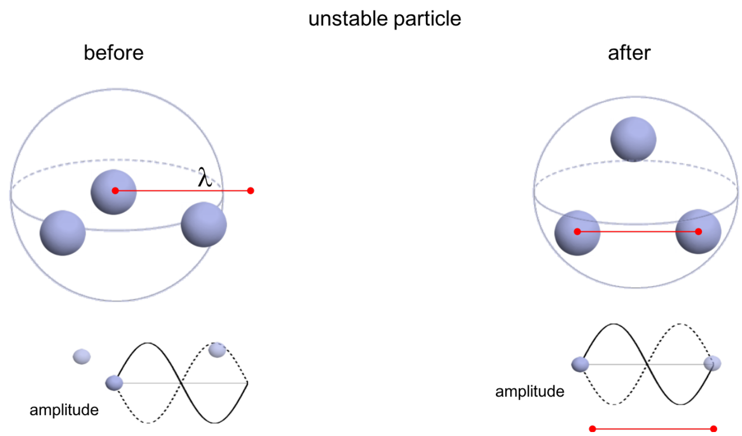

Fig. 3.6 – Unstable particle with wave centers not separated at wavelengths to be at standing wave nodes forces motion to nodes

Even stable, or relatively stable, particles may experience changes as energy is exchanged during collisions with other particles. For example, using the neutral particle from Fig. 3.4, if it were to collide with another particle or photon with sufficient energy to separate the particle into its components, then two or more particles may emerge. This is described in the before and after illustration of particle collision in the next figure, where two particles emerge from the collision. This particular example may match the results of a muon neutrino, which is undetectable by electromagnetism because it is electrically neutral, but has an energy that is recorded when it collides with particles in neutrino colliders. Its value of eight wave centers (K=8), and the calculation of its energy, will be described in the next section.

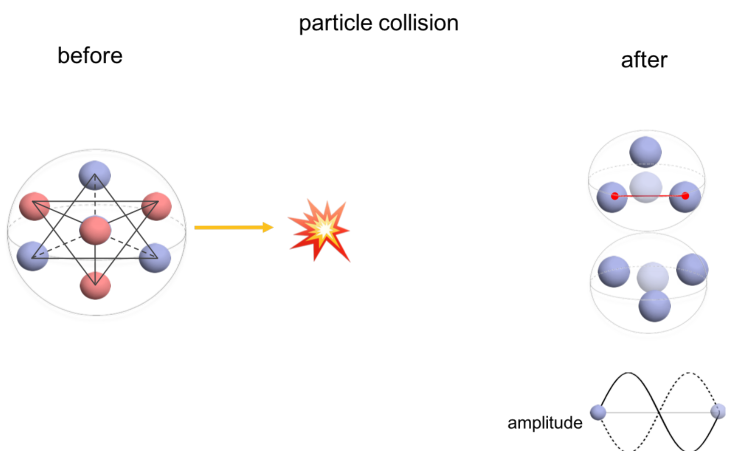

Fig. 3.7 – A particle colliding with other particles may rearrange wave centers and become two or more particles

4. Particle Energy

Calculating the energy of all particles that can be created as a combination of wave centers is easier accomplished with an energy equation for waves, associating wave properties like frequency (f) and amplitude (A) in a given volume (V) with a density (ρ). This energy (E) can be described for in-waves and out-waves as the following:

$$E = \rho V (fA)_{in} (fA)_{out} \tag{4.1}$$

This energy can be visually described as the sum of the energy of all granules in the given sphere (V), where granule motion towards the wave center (in) and away from the wave center (out) creates a number (n) of standing waves, each separated a distance (r). The displacement of granules (amplitude) declines as it spreads its energy to a greater number of granules as it moves further from the source.

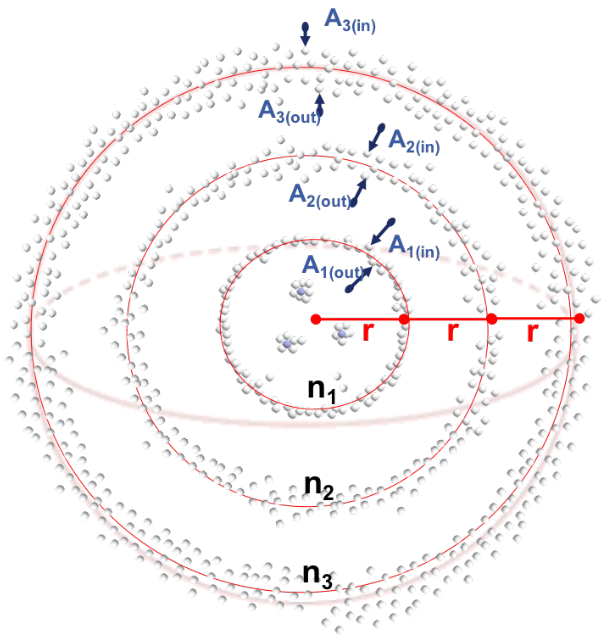

Fig. 4.1 – A particle's energy contained within standing waves (zero net propagation of energy from granules traveling in and out); **r** – wavelength distance; **n** – spherical shell number; **A** – amplitude at wavelength of in- and out-wave granule

All of the variables in Fig. 4.1 are proportional to the number of wave centers (K) at the core of the particle. A greater number of wave centers reflects more energy, increasing granule displacement (amplitude) and wavelength distance. A larger amplitude increases the number of standing wave shells (n), because it requires a longer distance for outgoing wave amplitude to decline to match incoming wave amplitude. A particle's radius (r_x) is defined by this last standing wave shell (n_x), as described by the following equation:

$$r_x = n_x K\lambda \qquad \textbf{(4.2)}$$

In-wave and out-wave amplitude are proportional to the number of wave centers (K) and displacement (q) in three-dimensional space and is therefore cubed (numerator of Eq. 4.3). Amplitude declines at the square of distance (denominator of Eq. 4.3). The radius (r) from Eq. 4.2 is substituted into the denominator of Eq. 4.3.

$$A_{out} = A_{in} = \frac{(Kq)^3}{r^2} = \frac{(Kq)^3}{(n_x(K\lambda))^2} \qquad \textbf{(4.3)}$$

The sum of granule energy in each standing wave shell will be calculated for total particle energy. The volume of each shell in the sphere can be calculated by taking the spherical volume to the shell (n) being calculated and subtracting the spherical volume of the n-1 shell. This is described as the following, where Eq. 4.2 again appears as the radius to the nth shell:

$$V = \frac{4}{3}\pi(n(K\lambda))^3 - \frac{4}{3}\pi((n-1)K\lambda)^3 \tag{4.4}$$

Calculating the Energy of Each Shell

The energy equation from Eq. 4.1 is used to calculate each shell to determine the total energy of the particle. In each shell, density (ρ) and frequency (f) are constant. To the right of the summation symbol in Eq. 4.5 are volume (V) and amplitude (A) which are variable in each shell. These are substituted from Eqs. 4.4 and 4.3 respectively and then simplified. The summation is taken from the first shell (n=1) to the K^{th} shell (n=K) because the number of standing wave shells (n) is proportional to the number of wave centers (K).

$$E = \rho f^2 \sum_{n=1}^{K} V(A_{out})(A_{in}) \tag{4.5}$$

$$E = \rho f^2 \sum_{n=1}^{K} \left(\frac{4}{3}\pi(n(K\lambda))^3 - \left(\frac{4}{3}\pi((n-1)K\lambda)^3\right)\right)\left(\frac{(Kq)^3}{(n(K\lambda))^2}\right)\left(\frac{(Kq)^3}{(n(K\lambda))^2}\right) \tag{4.6}$$

$$E = \rho f^2 q^6 \sum_{n=1}^{K} \left(\frac{4}{3}\pi(n(K\lambda))^3 - \left(\frac{4}{3}\pi((n-1)K\lambda)^3\right)\right)\left(\frac{(Kq)^3}{(n(K\lambda))^2}\right)\left(\frac{(Kq)^3}{(n(K\lambda))^2}\right) \tag{4.7}$$

$$E = K^5\left(\frac{4\pi\rho f^2 q^6}{3\lambda}\right)\sum_{n=1}^{K}\frac{n^3-(n-1)^3}{n^4} \tag{4.8}$$

The energy equation from Eq. 4.8 contains only one variable – the number of wave centers (K). The remaining values are constant and placed into parentheses. Thus, all particle energy can be calculated based on the number of wave centers.

Energy of the Fundamental Particle

Although the values of each constant are unknown in Eq. 4.8, the total product of these constants can be derived. The fundamental particle contains only one wave center, or K=1. When this value is used in Eq. 4.8, only the constants (in parentheses) remain in the equation. The total energy of the fundamental particle was established earlier in Eq. 2.10 as **2.39 electron-volts** (eV). Thus, the total product of the constants can be set to this value, referred to as E_ν for the energy of the neutrino.

Eq. 4.9 now replaces the constants in Eq. 4.8 to become the particle energy equation.

$$E_\nu = E_{(1)} = \frac{4\pi\rho f^2 q^6}{3\lambda} = 2.39\,(eV) \tag{4.9}$$

$$E = E_{\nu} K^5 \sum_{n=1}^{K} \frac{n^3 - (n-1)^3}{n^4} \tag{4.10}$$

Particle energy equation

Energy of Particles

The energy of all particles, whether ones found in nature or manufactured in particle accelerator labs, follows a trend that can be traced back to a fundamental particle. It will be shown in this section that it is a linear trend when the fundamental particle is assumed to be near the neutrino's rest energy (2.39 eV) and when a combination of wave centers (K) is taken to the fifth power.

For example, Eq. 4.10 (Particle energy equation) is used to calculate the **rest energy of the electron**. The fundamental particle energy of 2.39 eV is used, and a K value of 10 waves centers is used (K=10). The result is 511,160 electron volts (eV), matching the known Particle Data Group (PDG) value [11].

$$E_{10} = 2.39\,(10)^5 \sum_{n=1}^{10} \frac{n^3 - (n-1)^3}{n^4} = 511160\,(eV) \tag{4.11}$$

Next, the energies of known particles from the neutrino to the Higgs boson are charted in Fig. 4.2, showing that the particles indeed follow a linear trend. Because the particle energy equation (Eq. 4.10) requires the value of K to the fifth power, two things are required to find the linear solution:

1. The best fit for a particle's K value is determined based on its position relative to the line in Fig. 4.2.
2. The particle's energy is then divided by K^4, using the best fit value from step 1.

For example, the electron's rest energy of 510,998 eV is found at a best fit of K=10. The electron's energy is divided by 10^4, resulting in a rounded value of 51.10, which is then plotted at Particle Number 10 in the next figure. The same process is used for the remaining particles.

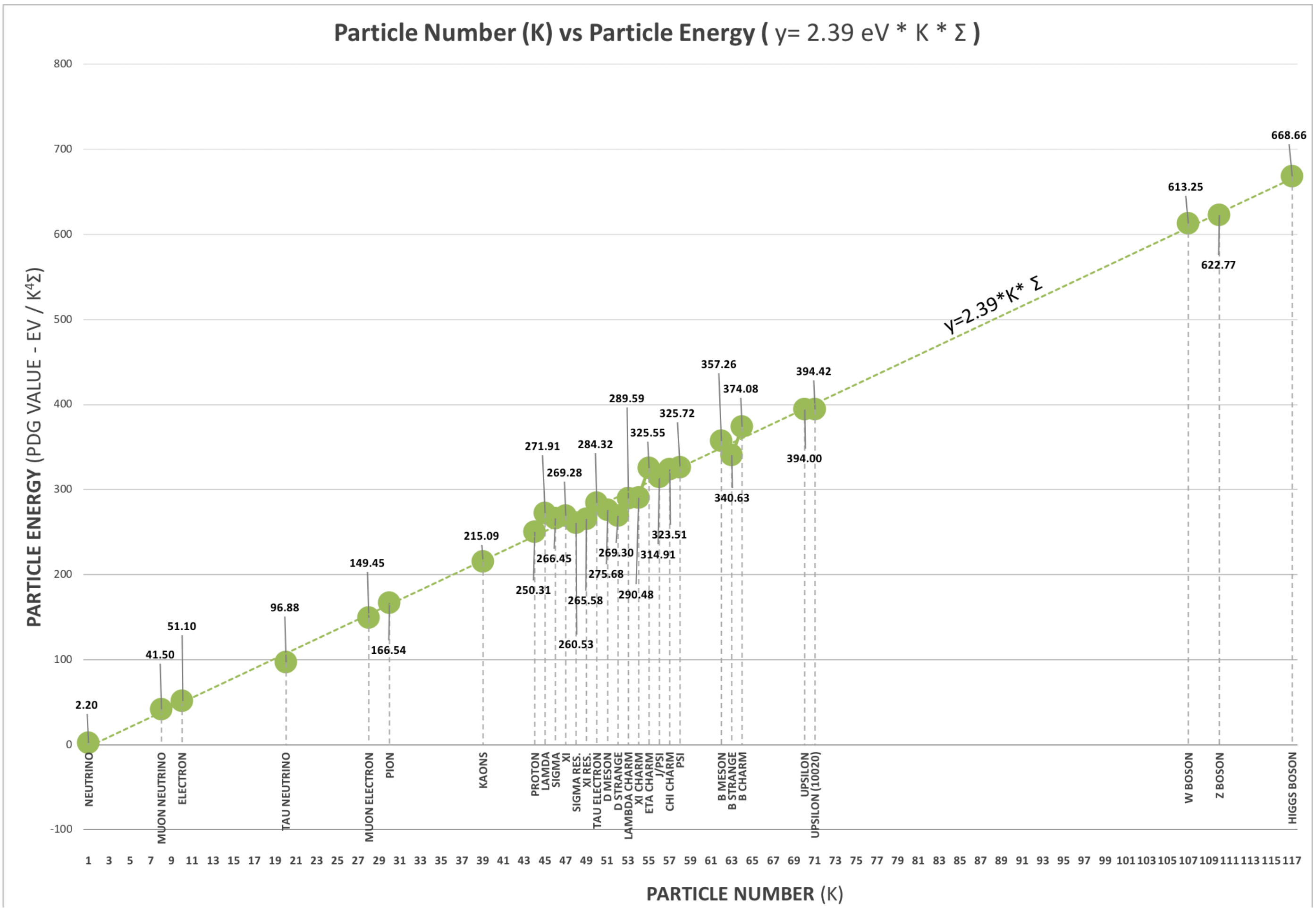

Fig. 4.2 – Particle energy: linearized with function of wave center count (K) to the fourth power

This process creates a linear solution for particle energies based on the total number of wave centers, similar to how atomic elements have a linear solution based on the total number of protons in the element [12].

5. Natural and Composite Particles

There are very few geometric combinations of wave centers that lead to stable particles, as supported by the fact that few particles are found naturally in the universe. The particles that are found naturally, even if they oscillate or decay, will be shown to have similarities with the geometries of stable atomic elements.

Some particles can be described as a natural formation of wave centers, such as the electron. Other particles, such as the proton and neutron, are not made of wave centers directly, but rather by stable particles that are created from a formation of wave centers. The proton and neutron are known as *composite* particles.

For example, the electron is a very stable particle in nature. In Fig. 4.2, it was found to have a wave center count (K value) of 10. In a 3-level tetrahedron, there are 10 units. This geometry meets the requirements where wave centers can be separated at wavelengths to reside at standing wave nodes. A likely geometry of ten wave centers forming a stable particle is shown in the next figure. A combination of ten wave centers in the same wave phase of nodes on the left is the electron particle; the same number of wave centers but on the opposite (anti-phase) standing wave node is the positron. Both particles are identical in mass due to the same number of wave centers and geometry. The only difference is their wave phase, leading to opposite charges.

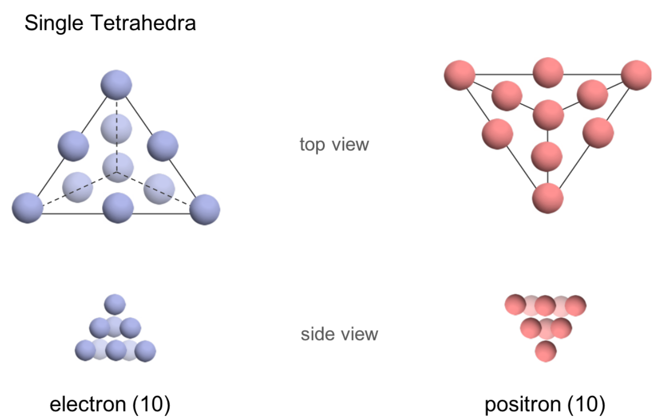

Fig. 5.1 – The electron and positron are the same tetrahedral structure and number of wave centers yet are on opposite (anti-phase) nodes

Another example of a natural particle, meaning that it is created by nature and found in neutrino experiments, is the tau neutrino. From Fig. 4.2 it was found to have a wave center count (K value) of 20. The neutrino has no electrical charge, so it would be expected to have destructive waves that cannot be detected. A combination of two tetrahedrons with 10 wave centers, forming a dual tetrahedron, could match this requirement if each tetrahedron was of opposite wave phase. There would be a total of 20 wave centers, undetected, until the particle collides with another object and the energy of its 20-wave center combination particle could be detected.

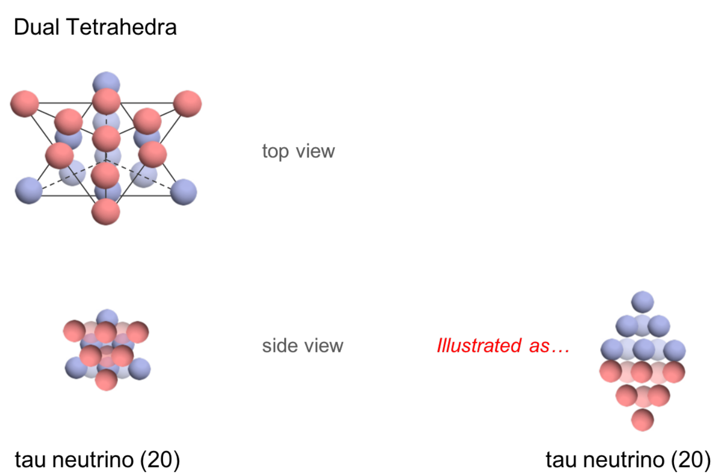

Fig. 5.2 – Particles may form dual tetrahedra as illustrated for the tau neutrino. Due to the complexity viewing dual tetrahedra, it is **illustrated as** two symmetrical tetrahedra in the figure (illustration on the right in Fig. 5.2).

The top view and side view of a dual tetrahedron is shown in the figure above. Due to the complexity of visually describing dual tetrahedra and their wave centers, duals are illustrated for the remainder of this paper as two stacked tetrahedrons, such as the bottom right of Fig. 5.2.

Natural Particles

At low energies, wave centers may combine to form new particles. This occurs in nature today in a process known as oscillation, where neutrinos *oscillate* to become larger neutrinos. The following describes how a wave center – a single neutrino – may collide to form a larger particle.

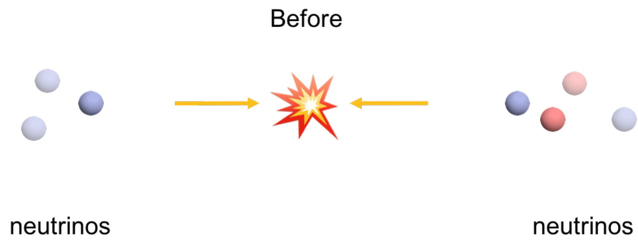

Fig. 5.3 – Before. Collisions of wave centers (neutrinos).

The following are tetrahedra that may be formed from collisions, where these geometries are more stable as a result of wave centers separated at wavelengths to be at standing wave nodes. The number in parentheses is the wave center count (K value) for each particle found in Fig. 4.2. The K value 8 for the muon neutrino is a dual 2-level tetrahedron; the value 20 for the tau neutrino is a dual 3-level tetrahedron; the value 28 for the muon electron is a combination of the former two where it is a dual of both a 2-level and 3-level tetrahedron. Even the electron itself is a tetrahedron at K=10, but not a dual.

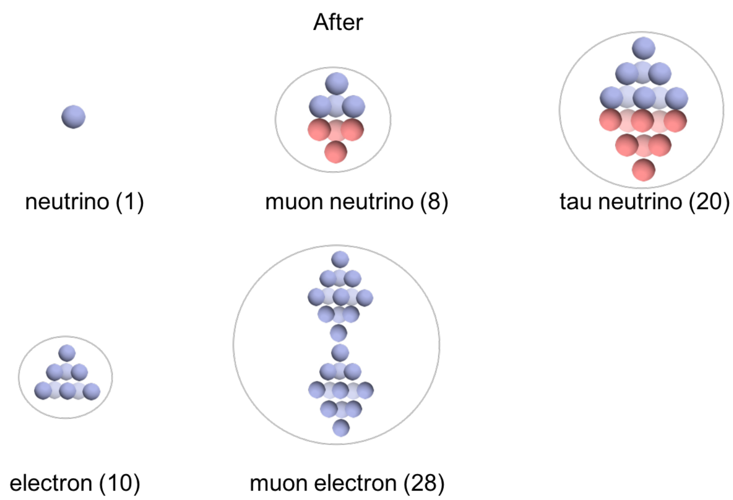

Fig. 5.4 – After. The results of relatively stable lepton particles created from a combination of neutrinos. **(#)** is **wave center** count.

The particles in Fig. 5.4, and one more that will be shown shortly (tau electron at K=50), are the lepton family of particles that are found in nature, and thus relatively more stable than other particles. The numbers for these particles – 8, 20, 28, 50 (muon neutrino, tau neutrino, muon electron and tau electron) – are the same magic numbers that are found in stable atomic elements [13]. This leads to the possibility that these geometries are not only found in subatomic particles, but that it replicates to atomic nuclei that are made from particles.

These magic numbers can be found in the next table with the calculated energy values of each lepton particle using Eq. 4.10 and then compared to the known value from the Particle Data Group (PDG). A refined value of 2.38925 eV is used for the neutrino instead of 2.39 eV, resulting in the exact calculation of the electron's rest energy.

Count	Particle	Calculation (eV)	PDG Value (eV)
1	Neutrino	2.38925	~2.20

8	Muon Neutrino	1.63E+05	1.70E+05
10	Electron	5.11E+05	5.11E+05
20	Tau Neutrino	1.73E+07	1.55E+07
28	Muon Electron	9.50E+07	1.06E+08
50	Tau Electron	1.76E+09	1.78E+09

Table 5.1 – Lepton wave center count and calculated energy value compared to measured (PDG value) in electron volts (eV)

Composite Particles

Particles like the proton and neutron, which exist at the core of atomic nuclei, are known to be composite particles. When smashed in particle accelerators, three or more quarks are often found. Yet quarks are never found isolated in nature. Quarks are only assumed to be elementary particles because their high energies don't match the energy levels of other particles.

If composite particles are indeed made from other particles, it would likely be from a stable particle. The electron and positron are likely candidates because of their stability. Yet it would take significant energy to combine these particles, and it is unlikely that this energy occurs naturally on Earth. However, imagine a scenario, perhaps early in the universe or within large stars, that collides groups of electrons and positrons:

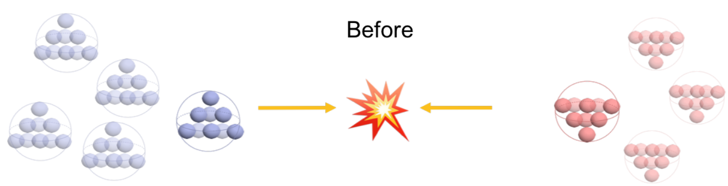

Fig. 5.5 – Before. Collisions of stable particles (electrons and positrons) at early stages of universe or in particle accelerator labs.

In certain geometric arrangements, these particles would also be stable. The same rule applies for wave centers to be at wavelengths for standing wave nodes. However, these larger particles are not formed from wave centers themselves randomly falling into geometric alignment, but rather from smaller, stable particles that merge to form a composite particle. The next figure describes the potential geometries for the tau electron, proton and neutron.

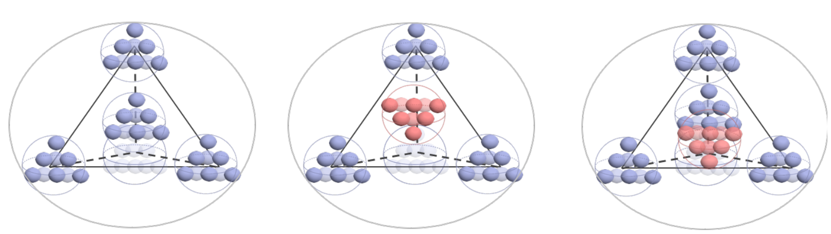

Fig. 5.6 – After. Composite particle creation. **(#)** is **wave center/neutrino** count. **(#)** is **particle/electron** count.

The numbers in Fig. 5.6 represent the wave center count (black) and total number of elementary particles (red) to create the composite particle. Only the tau electron has a wave center count (K=50). The proton and neutron have wave centers of opposite nodes creating destructive interference. The primary difference between the tau electron and proton is their center particle (the tau electron has an electron in its center; the proton has a positron in its center). The only difference between the proton and the neutron is that the neutron has an extra electron in its center for a total of 6 elementary particles.

As a composite particle, with a new formation of standing waves, the electrons that created these particles would cease to be recognized either in charge or energy. The energy from collisions is stored, causing greater standing wave energy, which is why they appear to be quarks in collider experiments.

Proton Collisions

This description of the proton and neutron may explain results seen not only in particle collider experiments, but also in the natural decay of these particles. First, the results from proton collisions are addressed. In particle accelerators like CERN, protons are smashed at high energies as illustrated in the next figure.

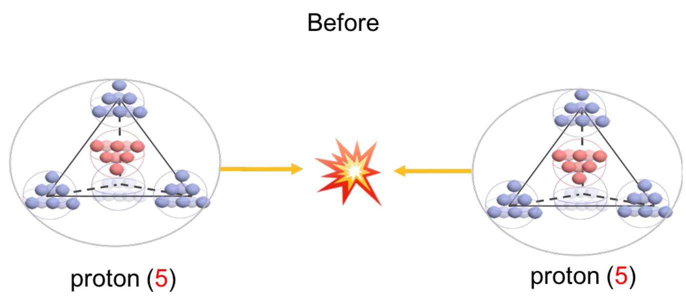

Fig. 5.7 – Before. Proton collisions in particle accelerator experiments. **(#)** is **particle/electron** count.

If a proton consists of five particles, likely four electrons and one positron, it explains the results seen in the next figure.

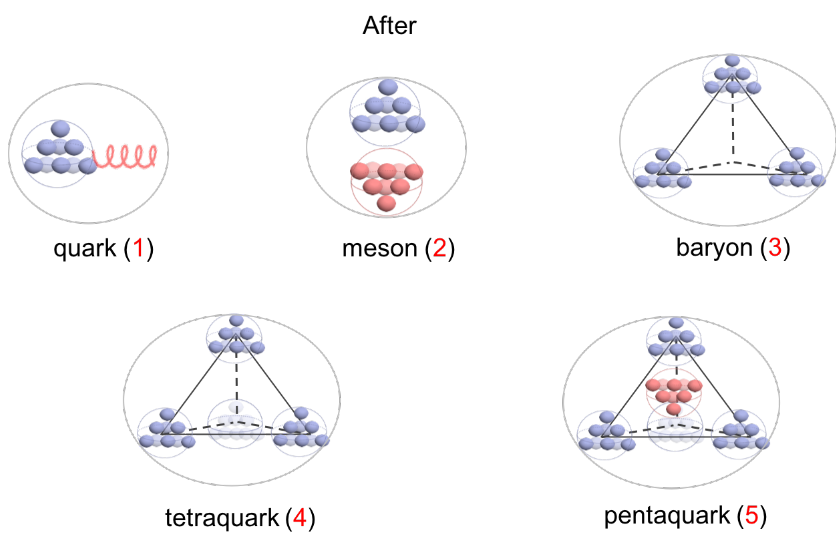

Fig. 5.8 – After. Proton collisions creating particles from its components. **(#)** is **particle/electron** count.

A quark (1) is described as one of these particles in the proton (and neutron). Most of its energy is found in the gluon that is the attractive force between quarks. Thus, this could simply be an electron particle with energy stored in its standing waves. A meson (2) composite particle is found with a particle and anti-particle. This could be an electron and positron combination that is ejected from proton collisions. A baryon (3) composite particle is often found with three quarks. These could be three electrons found as the remaining particle of the proton when one electron and positron annihilate and cannot be detected. A tetraquark (4) composite particle is rare, but when found could be the structure of the proton without the positron in the center. And the more recently discovered pentaquark (5) composite particle, is likely the true nature of the particle as four quarks and an anti-quark are found at high enough energies to separate all the true components of the proton [14].

Proton and Neutron Decay

The composite particle description of the proton and neutron is even better illustrated in the beta decay process. When these particles decay, quarks are never found leaving the particle. Instead, it is electrons, positrons and neutrinos – the stable particles created by wave centers.

In the beta minus decay process, a neutron becomes a proton. There is a probability event of a free neutron doing this process, roughly every 15 minutes [15]. Thus, the event may likely be triggered by something that is frequent on Earth, such as the bombardment of solar neutrinos. In the next figure, the neutron is illustrated again with 6 elementary particles (five electrons and one positron). A solar antineutrino collides with center electron and ejects it, becoming a proton. The two particles ejected in the decay process are the original antineutrino that started the process in the collision, and the electron that is ejected from the center. This matches beta minus decay results.

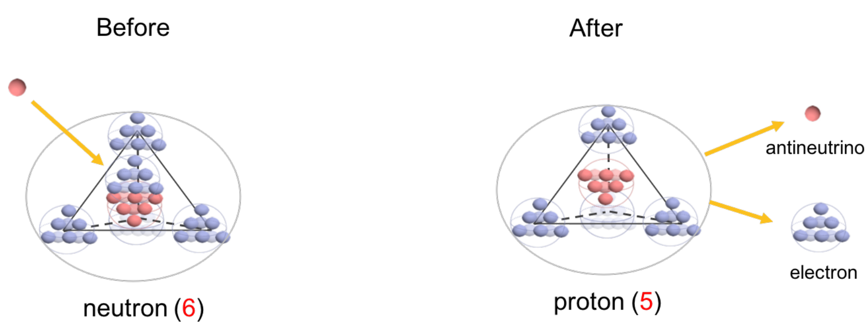

Fig. 5.9 – The beta minus decay process where a neutron becomes a proton

In another example, the beta plus decay of a proton turns the particle into a neutron. A proton has a positron in its center. Similar to the process described above for the neutron, a solar neutrino may be the trigger for the event. If the neutrino collides with sufficient energy with the positron in the center of the proton and ejects it, the remaining particle no longer has a positive charge. It may resemble the tetraquark (Fig 5.8) and be a neutral particle with four remaining elementary particles. It may be stable in an atomic nucleus, but would not be stable outside of the nucleus. The proton becomes a neutron and ejects the original neutrino and a positron. This matches beta plus decay results.

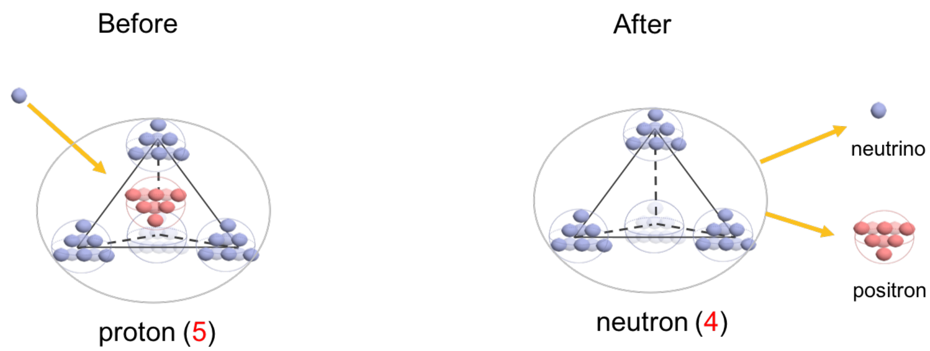

Fig. 5.10 – The beta plus decay process where a proton becomes a neutron

A final example is the electron capture process, where a proton captures an electron to become a neutron. This process is the most straightforward illustration of why the neutron consists of electrons. It is not a quark that is captured. It is an electron. With an extra electron at the center of the proton, it is neutralized with destructive waves.

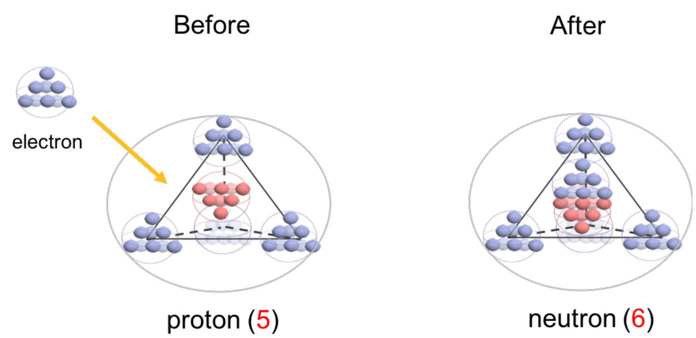

Fig. 5.11 – The electron capture process where a proton becomes a neutron

All three of these examples from beta decay (minus and plus) and the electron capture process logically explain why electrons and positrons are found in the proton and neutron. It is only particle accelerator experiments that create the perception of quarks, yet quarks are never found by themselves. Within the structure of a composite particle, when standing waves merge and have greater amplitude and energy, electrons can be misunderstood to be quarks.

Conclusion

All particles can be described from a single, fundamental particle. The energy of granules in a standing wave formation creates a spherical particle, created from the reflection of waves at a center point called a wave center. The reflection of in-waves to out-waves for a single wave center creates an energy value near the estimated rest energy of the neutrino. Therefore, the neutrino is assumed to be the fundamental particle. The combination of two or more wave centers creates different particles as the energy of a new particle increases proportional to the number of wave centers (K) to the fifth power, as a result of greater amplitude and wavelength from the reflections. This allows energies of all known particles to be linearized such that new particles may be predicted by this model.

The geometry of wave center formation is critical to the stability of a particle. Particles may be created with sufficient energy to combine wave centers. Particles were found to have combination numbers that match the same magic numbers found in atomic elements, leading to the strong possibility that these geometries are consistent across particles and atomic nuclei. The magic numbers for particles coincide with the wave center counts for lepton particles.

The creation of the particles that form the atomic nucleus – protons and neutrons – is more complex as these are known composite particles. It takes the formation of elementary particles, like electrons and positrons, and sufficient energy to merge into a composite particle geometry that allows for their stability. With extraordinary energy to separate these particles, they form temporary particles like mesons, baryons, tetraquarks and pentaquarks. All of these temporary particles found in particle collisions, in addition to stable particles found in beta decay results, can be explained as a combination of electrons and positrons to form the proton and neutron. The particles that are created from these collisions can also be mapped to the linearization of particle energies, showing that all particles are indeed created from a combination of wave centers.

References

[1] Barger, V., Marfatia, D., Whisnant, K.L., 2012. The Physics of Neutrinos. *Princeton University Press*, Princeton, NJ.

[2] Coughlan, G., Dodd, J., Gripaios, B., 2006. The Ideas of Particle Physics: An Introduction for Scientists. *Cambridge University Press,* Cambridge, UK.

[3] Yee, J., Gardi, L., 2019. The Geometry of Spacetime and the Unification of the Electromagnetic, Gravitational and Strong Forces. *ResearchGate*. Online: https://www.researchgate.net/publication/334316805.

[4] Wikipedia, 2019. Standing Wave. Online: https://en.wikipedia.org/wiki/Standing_wave.

[5] Possel, M. 2017. Waves, motion and frequency: the Doppler effect. *Einstein Online, Vol. 5*. Max Planck Institute for Gravitational Physics, Potsdam, Germany.

[6] Ultimate Neutrino Page, 2019. Laboratory measurements and limits for neutrino properties. Online: http://cupp.oulu.fi/neutrino/nd-mass.html

[7] Adobe, 2019. Understanding Sound. Online: https://helpx.adobe.com/audition/using/sound.html.

[8] Wikipedia, 2019. Annihilation. Online: https://en.wikipedia.org/wiki/Annihilation.

[9] Das, A. and Ferbel, T., 2003. Introduction to Nuclear and Particle Physics, *World Scientific*.

[10] Physics Classroom, 2019. Nodes and Anti-Nodes. Online: https://www.physicsclassroom.com/class/waves/Lesson-4/Nodes-and-Anti-nodes

[11] Patrignani, C. et al. (Particle Data Group), 2016. Chin. Phys. C, **40**, 100001.

[12] Harkins, W., 1919. The building of atoms and the new periodic system. Science 1304: 577-582.

[13] Wikipedia, 2019. Magic Numbers. Online: https://en.wikipedia.org/wiki/Magic_number_(physics)

[14] Aiij, R. et al (LHCb collaboration), 2015. Observation of J/ψp resonances consistent with pentaquark states in Λ0b→J/ψK−p decays. *Physical Review Letters*. ***115*** (7) 072001.

[15] Beringer, J., et al (Particle Data Group), 2012. Phys. Rev. D86, 010001.