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The Substructure of Elementary Particles Demonstrated by the I-Theory

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Abstract

Present studies in physics assume that elementary particles are the building blocks of all matter, and that they are zero-dimensional objects which do not occupy space. The new I-Theory predicts that elementary particles do indeed have a substructure, three dimensions, and occupy space, being composed of fundamental particles called I-particles. In this article we identify the substructural pattern of elementary particles and define the quanta of energy that form each elementary particle. We demonstrate that the substructure comprises two classes of quanta which we call "attraction quanta" and "repulsion quanta". We create a model that defines the rest-mass energy of each elementary particle and can predict new particles. Lastly, in order to incorporate this knowledge into the contemporary models of science, a revised periodic table is proposed.

Keywords

I-Theory, I-Particle, Causal, Subtle, Gross, Quanta, Attraction Quanta, Repulsion Quanta, Elementary Particles, Leptons, Bosons, Hadron, Periodic Table, Black Matter, White Matter, Red Matter, Gravitation, Strong Force, Weak Force, Quantum Theory, Heat Quantum, Photon Neutrino

1. Introduction

In a previous article entitled "I-Theory—A Unifying Quantum Theory?" [1], the authors introduced the I-Theory as a unifying theory of quantum physics. It was shown how the I-Theory successfully encompasses the major theories like the Standard Model, General Relativity, Big Bang, Supersymmetry, etc., and finally offers a new and expanded context for main concepts in physics like Dark Matter, Dark Energy and the four interaction forces.

The main difference between the I-Theory and the aforementioned theories is

the introduction of the I-particle, which is defined as the foundational particle of the universe. The I-Theory predicts that elementary particles are not truly elementary but composed of I-particles. The introduction of the substructure of elementary particles allows for a better understanding of quantum physics and its blind spots, such as fractional Hall effects. Interestingly, a new class of particles called "anyon" is being investigated as the hypothetical substructure of elementary particles in order to explain this phenomenon [2] [3] [4].

One large contribution that the I-Theory is poised to make is to the understanding of particle mass. The Standard Model is able to measure the mass of the different particles; however, the enormous variation of these masses has not yet been explained. Additionally, it is known that neutrinos are not massless. They do have a very small mass, but the mechanism behind it is not yet understood [5]. Furthermore, with the discovery of the Higgs boson it can now be physically explained how particle masses are generated, but it is not yet possible to define their values [6]. In this article, we will discuss each of these "mysteries" and resolve them.

This article gives first an introduction how the I-particle fits into the currently known quantum theories (Section 2) and describes the substructure of elementary particles (Section 3). In Section 4 an extended periodic table is proposed, which incorporates the substructures.

In Section 5, the calculations of the rest mass of elementary particles are presented to prove the hypothesis.

2. I-Theory and SM-LQG Quantum Theories

It is well known that the Standard Model (SM) is able to describe three fundamental forces (electromagnetic, weak and strong) but excludes the fourth, which is known as gravitation [7]. Various theories (e.g., Grand Unifying Theory and String Theory) have been developed beyond the SM trying to unify the four fundamental forces. In the article entitled "I-Theory - a Unifying Quantum Theory?" [1], it is shown that the foundational particle is the I-particle, the basic quantum of energy. The I-particle is composed of three matters:

- Black Matter, which is high frequency and short wavelength. Black Matter carries a positive electrical charge.
- Red Matter, which is middle frequency and middle wavelength. Red Matter carries a net neutral (both positive and negative) electrical charge.
- White Matter, which is low frequency and long wavelength. White Matter carries a negative electrical charge.

The shape of the I-particle is a double toroid, as shown in **Figure 1**.

2.1. The Four Fundamental Interaction Forces

As detailed in reference [1], Black, Red and White Matter are related to the fundamental forces, as summarized below.

Red Matter is the origin of Black and White Matter; its electrical charges are given to the others—negative charge for White Matter, and positive charge for

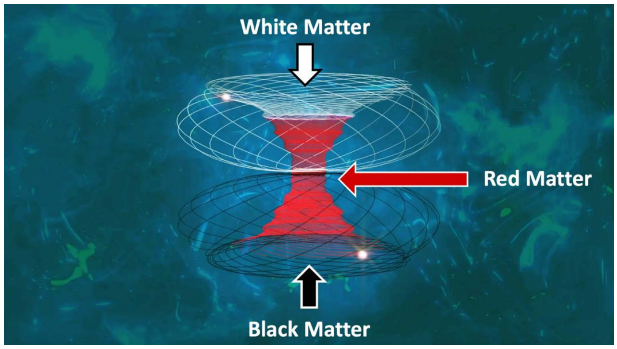


Figure 1. The I-particle has the shape of a double toroid, and creates Black, Red and White Matter.

Black Matter. The fundamental force of Red Matter is gravitation. Red Matter has its own frequency. When the frequency decreases slightly, White Matter forms, and when the frequency increases, Black Matter forms.

White Matter is driven by weak force. As the negative electrical charge flows through White Matter, an electrical field is generated, which is responsible for the force of repulsion.

Black Matter is driven by strong force. The positive electrical charge flowing through Black Matter creates a magnetic field, which is responsible for the force of attraction.

The sum of the electrical and magnetic fields is the electromagnetic field responsible for the electromagnetic force.

Therefore the four fundamental forces originate from the I-particle. The I-particle is the basic quantum of force, or energy. The electromagnetic field is derived from gravitation, which is in accordance with Branderberger's recent work showing that gravitational waves can be damped by spanning a parametric resonance instability of the electromagnetic gauge field [8]. This implies that there is a resonance frequency where the gravitation turns into an electrical field and a magnetic field. The gravitation field generates photons (as the photon is the force carrier of electromagnetic interaction). In terms of the I-Theory, Red Matter variation generates White and Black Matter.

2.2. Time and Space

General Relativity assumes that space-time is a four dimensional continuum. It defines the law of gravity by the curvature of space-time, but General Relativity does not explain what space-time is. Moreover, the continuum assumption is not required by Lorentz invariance and therefore space-time can be discretized [9].

In the I-Theory, the I-particle is the source of space and time. Let's consider a graph of the pulsation of matter. From point 0 to point A the rise of the peak needs a certain quantity of time t. The expansion of the vibration creates the length, or space, l. Furthermore, space and time lie in pulsation and cannot be separated. Since the I-particle is the basic quanta of vibration, it can be considered as the quantum of space-time (**Figure 2**).

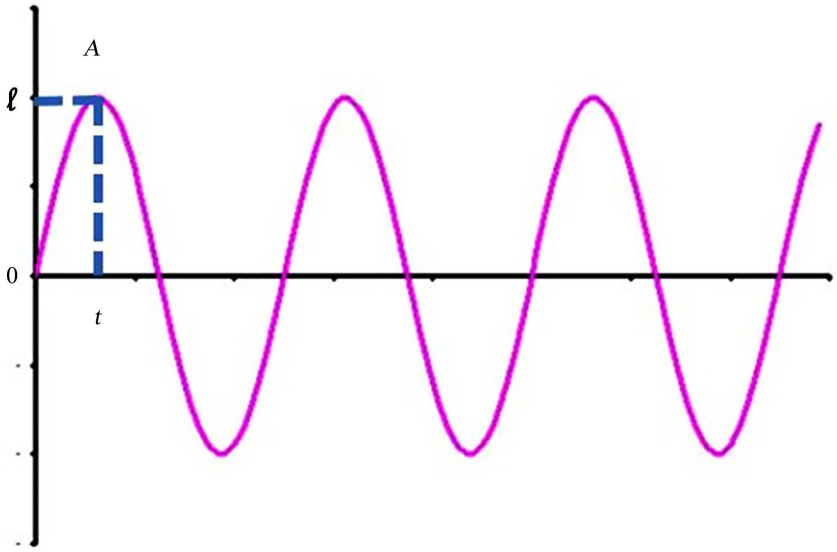


Figure 2. Quantum of space-time.

2.3. Standard Model

SM is currently the most advanced quantum theory. It describes the electromagnetic, weak, and strong nuclear forces and their interactions with elementary particles. It includes not only Quantum Electrodynamics (QED) but also the theory of the weak force (electroweak theory) and Quantum Chromodynamics (QCD), which describes the strong nuclear force.

QED predicts all phenomena involving electrically charged particles interacting by means of exchanging photons with a high accuracy [10] [11]. It represents the quantum counterpart of classical electromagnetism giving a complete account of matter and light interaction. Quantum physicists have already described weak, strong and electromagnetic forces. However, QED still leaves two phenomena unresolved: gravity and the sudden appearance of virtual particles.

QED introduced theoretical particles called "virtual particles" in order to describe interactions between fundamental particles. Virtual particles are seen as quantum vacuum fluctuations [12]. QED uses renormalization/regularization, a set of techniques used to treat infinities arising in calculated quantities by altering values of these quantities to compensate for effects of their self-interactions. But even if no infinities arose in loop diagrams in quantum field theory, it could be shown that it would be necessary to renormalize the mass and fields appearing in the original Lagrangian formulation. Therefore, in quantum field theory a cloud of virtual particles, such as photons, positrons, and others interact with the real particles.

Even if virtual particles are commonly used in quantum mechanics, the concept of having particles arising from vacuum electromagnetic fluctuation is poorly understood. This is not to imply that virtual particles are not real, but that they are created by a perturbation in quantum vacuum [13]. How can particles appear from emptiness?

2.4. Loop Quantum Gravity

SM does not consider gravity, but in order to qualify as a unifying theory, some quantum gravity theories have been developed. The most advanced theory is Loop Quantum Gravity (LQG) developed by Rovelli and Vidotto [14], which is based on a discretization of space by tetrahedrons (**Figure 3**). Rovelli and Vidotto used this unit of geometry because it is the simplest one; however any polyhedron can be used.

A vector is normal to each side of the tetrahedron, and should meet the following criteria:

- The closure relation:

$$\vec{C} = \sum_{a=1}^{4} \overrightarrow{L_a} = 0 \tag{1}$$

- The quantities $\overrightarrow{L_a}$ define all other geometrical quantities such as areas, volume, angles between edges and dihedral angles between sides.
- That the resulting number of degrees of freedom is correct.
- The area A_a and the volume V are defined by $\overrightarrow{L_a}$.

Rovelli and Vidotto have shown that $\overrightarrow{L_a}$ can also be identified to the Ashektar's electrical field [15] [16] and the gravitational field. Therefore, LQG demonstrates that the magnetic and electric parts of the momentum are proportional to one another, and the constant of proportionality is the Barbero-Immirzi parameter.

Since the electromagnetic field is a discrete field and the quantum of this field is the photon, the volume of the tetrahedron can grow only in discrete steps—precisely as the amplitude of a mode of the electromagnetic field. The quantum discreteness is due to the discrete spectrum of area and volume. In LQG, the area of each triangle and the volume of each tetrahedron are quantized.

In short, the space discretization gives a volume quantum which is directly linked to the quantum of the electromagnetic field which is the photon; the gravity is defined by the volume of the tetrahedron; the sum of this electromagnetic field is zero; the closure relation directly illustrates the law of conservation of energy; the electrical field is proportional to the magnetic field; finally, any polyhedral can be used for the discretization.

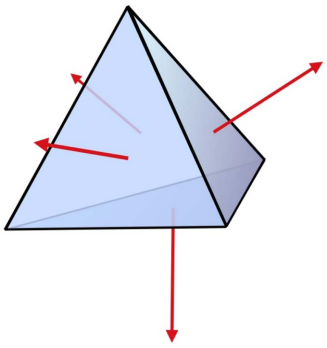


Figure 3. Tetrahedron used for space discretization [14].

Correlating the LQG to the I-Theory, it must be remembered that the basic quantum of gravity is the Red Matter of the I-particle. In a defined volume, the number of particles in attraction or repulsion defines the gravitational field. Due to the fact that Red, Black and White Matter is not distinct and independent entities, there is a direct relation between gravitation, the electrical field and the magnetic field. The greater the volume and number of I-particles in attraction, the greater the gravity. The number of I-particles in White Matter as the electrical field and the number of I-particles in Black Matter as the magnetic field are proportional to each other. Therefore the basic volume of the I-particle gives the discretization of the electromagnetic field and at the same time the discretization of gravity. Lastly, the I-particle is a closed loop (toroid shape) which indicates the conservation of energy.

The gravitational force is difficult to detect at the subatomic level. The gravity quantum is miniscule and is usually considered to be negligible. However, due to the ubiquity of Red Matter, the sum of these quanta is not negligible anymore in a large system, for example on the cosmic scale. Even if it can be reduced, it cannot be avoided. Since White and Black Matters originate from Red Matter, gravitation is the fundamental force for vibration. It is the origin of weak, strong and electromagnetic forces.

At the Planck scale, gravitation is supposed to be no longer negligible for the weak and strong forces [16]. Let's consider the I-particle as the basic quantum and use it as the unit of discretization. Since the Red, White and Black Matter are related to gravitation, weak and strong forces, we implicitly introduce a discretization of gravitation, electrical field and magnetic field.

Now let's consider an electromagnetic wave (**Figure 4**). The magnetic field is perpendicular to the electrical ((Y, Z) plane). The X axis is the propagation axis and corresponds to the wavelength. Its discretization should be the Planck length, which is given by the following equation:

$$l_P = \sqrt{\frac{hG}{2\pi c^3}} = 1.616 \times 10^{-35} \tag{2}$$

where G is the gravitational constant, m; h is the Planck constant, m; c is the speed of light constant, m and l_P is the Planck length, m.

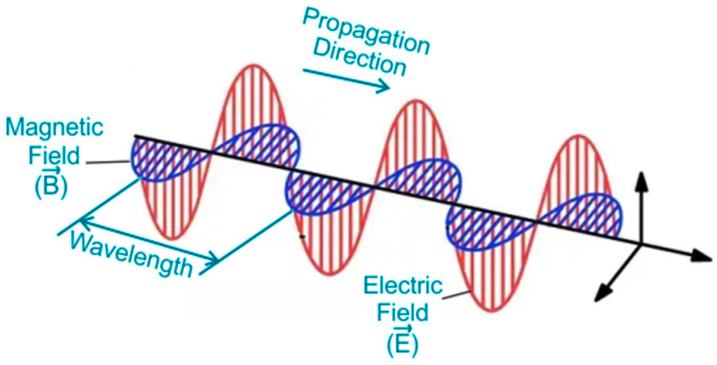


Figure 4. Example of an electromagnetic wave.

Therefore the propagation axis of the electromagnetic field can be expressed by the gravitational constant. This means that the X axis relates to the gravitation propagation (*i.e.*, Red Matter).

3. Elementary Particles' Sub-Structure

3.1. Pure Elements

3.1.1. Composition of Pure Elements

I-particles are not isolated. Since they are electrically polarized, they form groups in states of attraction or repulsion. These groups are called quanta of energy. Quanta can be in two forms: repulsion quanta and attraction quanta.

As stated in ref. [1], the I-Theory introduces five elements (Space, Air, Fire, Liquid and Solid) which form according to the percentage of attraction respective to repulsion. Each element can be in a Pure or Mixture form. Pure Space is characterized by 100% of I-particles in the state of repulsion, while Air, Fire, Liquid, and Solid are characterized by a percentage of I-particles in the state of attraction.

The shape of the I-particle is defined by the Red, Black and White Matter and their associated energy fields. The interaction of two I-particles (attraction or repulsion) modifies these energy fields. The proportion of the three matters are given in **Table 1**.

Two I-particles in repulsion do not merge together, therefore their energy fields can be considered as independent entities ($2 \times 100\%$). While two I-particles in attraction join, their energy fields become one unique field ($1 \times 200\%$).

The first groups composed of I-particles are called causal particles, which are the building blocks of subtle and gross particles. They are the quanta of energy. The repulsion quanta are Causal Space particles which have 100% repulsion, while attraction quanta have four categories: Air, Fire, Liquid and Solid.

3.1.2. Pure Space - Repulsion Particles

Pure Causal Space

As mentioned earlier, the I-particle is a toroid in which the electrical charges flow in a closed double spiral loop (**Figure 1**), negative in one pole and positive in the other. In reference [1], it is explained that the electrical charges are emitted by the Red Matter that develop first White Matter and subsequently Black Matter. The charge transfer is periodic. At a certain point in time neither the White nor the Black Matter are developed, and all the electrical charges are in

Table 1. Proportion of the three matters in I-particles in attraction and repulsion state.

	Repulsion State	Attraction State
White Matter	50%	50%
Red Matter	30%	70%
Black Matter	20%	80%
Volume	100%	200%

the Red Matter. At this time the I-particle presents a Red Matter "face". Due to the absence of electrical charge emissions in this state, the toroid has not yet been fully formed, so the Red Matter face is only the inner stem. When two of these attract, the resulting repulsion particle is the Pure Causal Space quantum.

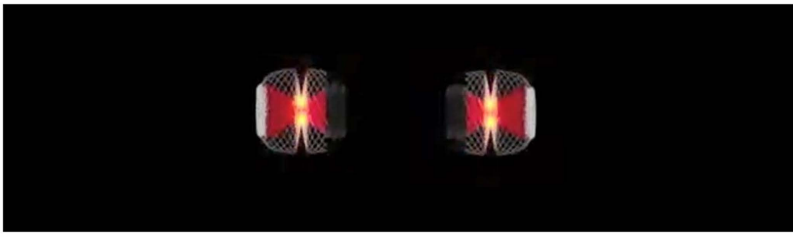
Pure Subtle Space and Pure Gross Space

Pure subtle and pure gross space particles have I-particles in a state of repulsion. In these states a White Matter part faces a White Matter part of the I-particle or a Black Matter part of one I-particle faces the Black Matter part of another I-particle (**Figure 5**). In ref [17], we demonstrate that entropy is the characteristic of repulsion. Therefore, the energy quanta in Space particles are responsible for an increase in entropy.

When the White Matter part of one I-particle faces the White Matter part of another I-particle, the interaction distance is maximized due to the fact that White Matter has the longest wavelength. In this case also entropy is at its maximum. Here the particle is Pure Subtle Space. When the Black Matter part of one I-particle faces the Black Matter part of one or more other I-particles, due to the short wavelength of Black Matter, the interaction distance is minimal and the particle is Pure Gross Space.

Pure Space particles can be summarized in **Table 2**.

(a)



(b)

Figure 5. Subtle and gross space particles. (a) Subtle space; (b) Gross space.

Table 2. Proportion of the three matters in I-particles in states of attraction and repulsion.

	Pure Causal Space	Pure Subtle Space	Pure Gross Space
Attraction	0%	0%	0%
Repulsion	100%	100%	100%
Arrangement	Red facing Red	White facing White	Black facing Black

3.1.3. Pure Air, Fire, Liquid, Solid - Attraction Particles

When repulsion turns into attraction, Pure Air, Fire, Liquid and Solid are formed. We are naming this category of particle "pure attraction particles". Each pure attraction particle has three forms, causal, subtle and gross.

Pure causal attraction particles

As mentioned earlier, the first structure in attraction is a pure causal attraction particle. An increase in negentropy takes place due to pure attraction particles [17] (**Figure 6**).

The percentage of attracting I-particles in pure causal particles is summarized below (**Table 3**).

Pure Subtle and Pure Gross Elements

In ref [1], the relationship between the percentage of attraction and the pure five elements (**Table 4**) was presented, as below.

As attraction increases, causal particles become subtle particles and subtle particles become gross particles (**Figure 7**).

Space is not empty; it is composed of 100% of I-particles in repulsion state. When a small electromagnetic perturbation arises in Space, the state of some

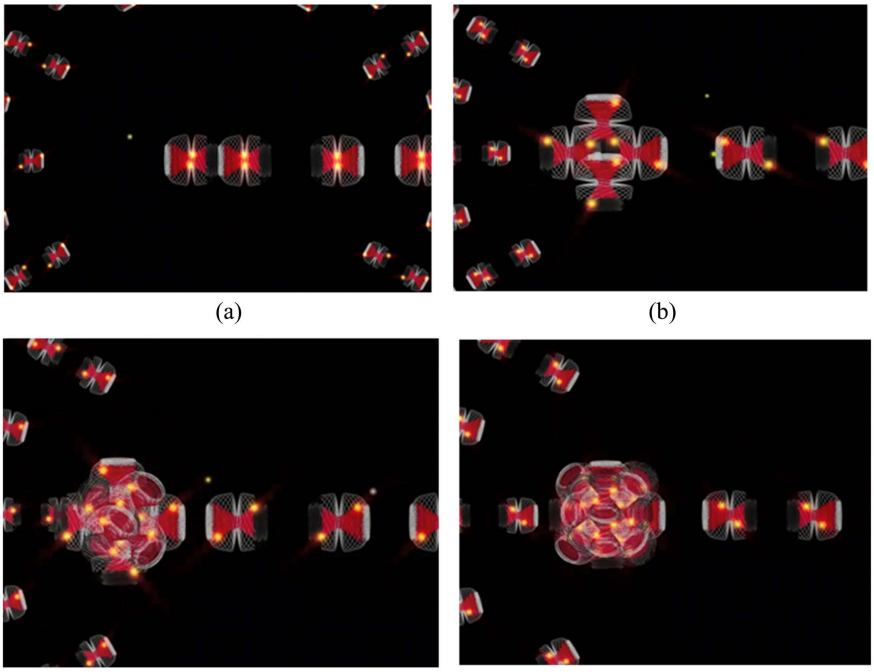


Figure 6. Pure causal attraction particles. (a) Air; (b) Fire; (c) Liquid; (d) Solid.

Table 3. Composition of pure causal particles according to the percentage of attracting and repelling I-particles.

	Causal Air	Causal Fire	Causal Liquid	Causal Solid
Attraction (%)	0.75	1.5	3	6
Repulsion (%)	99.25	98.5	97	94

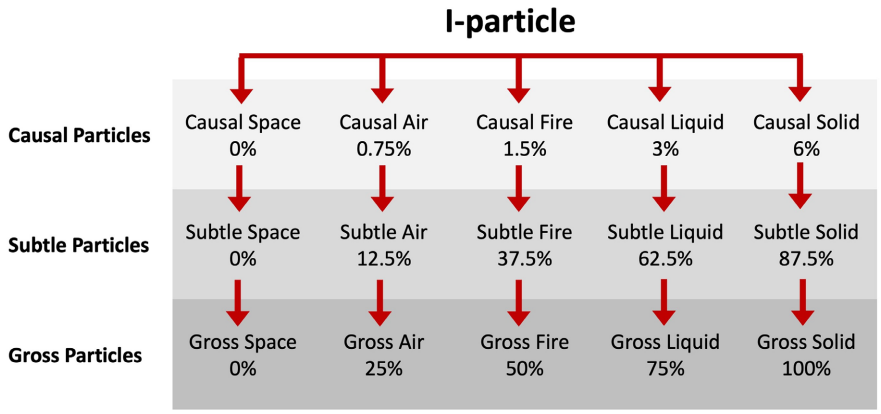


Figure 7. The various substructures of pure elements with the respective percentages of attraction.

Table 4. Composition of matter by percentage of attracting and repelling I-particles.

	Pure Subtle Air	Pure Gross Air	Pure Subtle Fire	Pure Gross Fire	Pure Subtle Liquid	Pure Gross Liquid	Pure Subtle Solid	Pure Gross Solid
Attraction (%)	12.5	25	37.5	50	62.5	75	87.5	100
Repulsion (%)	87.5	75	62.5	50	37.5	25	12.5	0

I-particles can change from repulsion to attraction. This creates causal attraction particles, followed by subtle and gross attraction particles. We will show in Section 4 that these particles are what are presently known as elementary particles.

Thus, the "virtual particle" phenomenon can be explained theoretically.

Subtle and gross particles are shown in **Figure 8** and **Figure 9**.

3.1.4. Quanta of Attraction

Pure Causal Quanta

Attraction quanta are based on groups of I-particles in the state of attraction. Four different quanta, or particles, can be defined according to the percentage of attraction (**Figure 7**):

- Causal Air: 0% - 0.75%
- Causal Fire: 0.75% - 1.5%
- Causal Liquid: 1.5% - 3%
- Causal Solid: 3% - 6%

Causal particles are formed in the following way:

Air = Space + 0.75%

Fire = Space + Air + 0.75%

Liquid = Space + Air + Fire + 0.75%

Solid = Space + Air + Fire + Liquid + 0.75%

Where 0.75% corresponds to the percentage of attraction of Pure Causal Air particles.

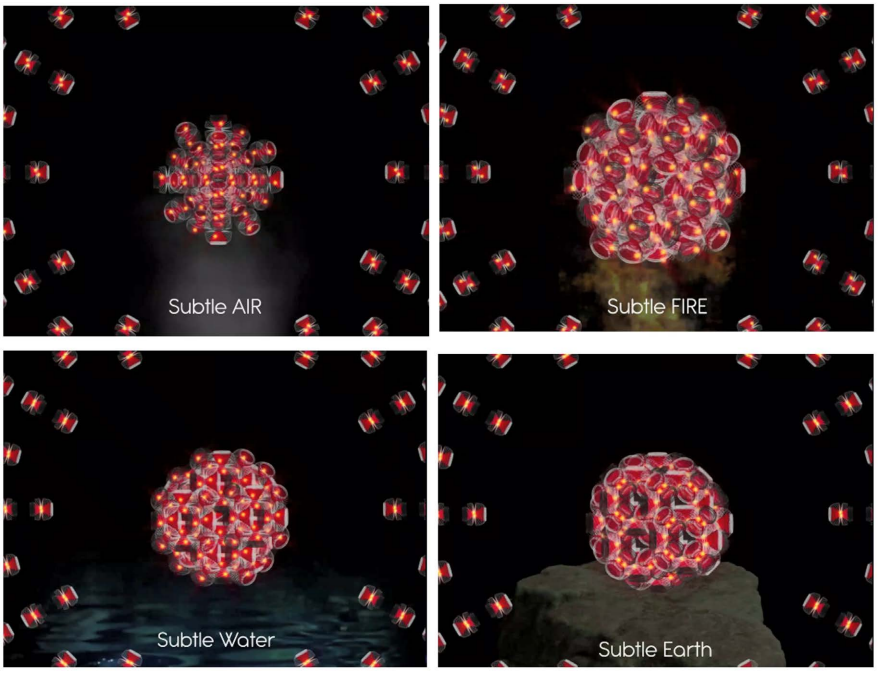


Figure 8. Pure subtle particles.

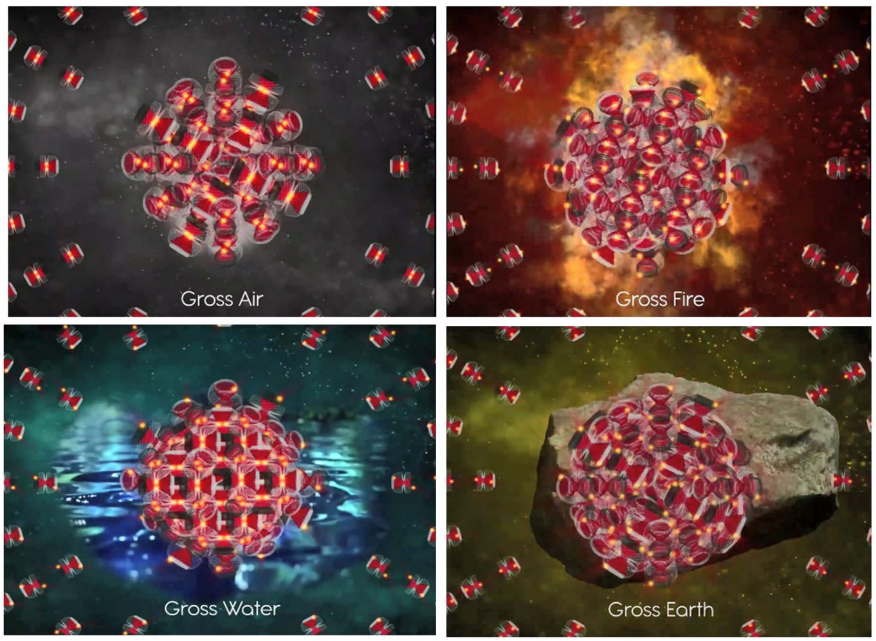


Figure 9. Pure gross particles.

According to Table 3 the general formula giving the level of attraction is:

$$Pure\ Causal_j = \sum_{i=0}^{i=j-1} Pure\ Causal_i + Pure\ Causal_{Air} \quad (3)$$

where i and j are the index element (0 is Space element; 1 is Air element; 2 is Fire element; 3 is Liquid element; 4 is Solid element).

Pure causal particles are the basic quanta forming all other particles. They are the building blocks of Pure Subtle and Pure Gross particles (Figure 10).

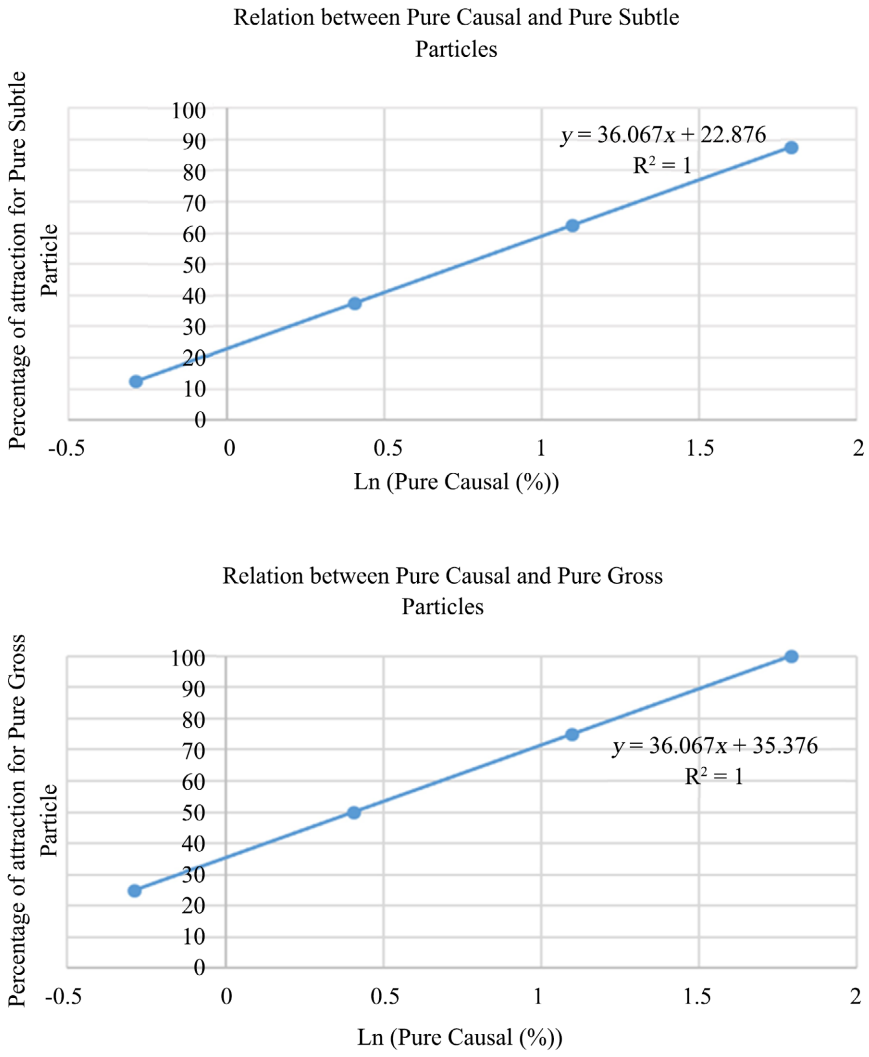


Figure 10. Relationship between the percentages of attraction in causal, subtle and gross particles.

Pure Subtle and Gross Quanta

As shown in **Table 5**, the first attraction particle is Pure Subtle Air. It is constituted by pure causal particles, and as it is the first element formed by them, it can be used as the reference quantum for subtle and gross elements.

As explained in **Figure 10**, the element of the pure causal particles determines the element of pure subtle and pure gross particles. The relation between causal and subtle or gross evolves in a logarithmic form, which indicates that pure subtle and pure gross are constituted by patterns of pure causal.

3.2. Mixture Elements

3.2.1. Composition of Mixture Elements

Mixture elements are made of pure elements, as described in reference [1]. A mixture element is composed of 50% of the considered pure element and 12.5% of the other pure elements. **Table 6** gives the mixture element compositions.

Table 5. Number of Pure Subtle Air Quanta and the respective value of attraction (in %).

	Pure Subtle Air	Pure Gross Air	Pure Subtle Fire	Pure Gross Fire	Pure Subtle Liquid	Pure Gross Liquid	Pure Subtle Solid	Pure Gross Solid
Attraction (%)	12.5	25	37.5	50	62.5	75	87.5	100
Number of Pure Subtle Air Quanta	1	2	3	4	5	6	7	8

Table 6. Mixture elements compositions.

		Pure Element				
		Space	Air	Fire	Liquid	Solid
Mixture Element	Space	**50%**	12.5%	12.5%	12.5%	12.5%
	Air	12.5%	**50%**	12.5%	12.5%	12.5%
	Fire	12.5%	12.5%	**50%**	12.5%	12.5%
	Liquid	12.5%	12.5%	12.5%	**50%**	12.5%
	Solid	12.5%	12.5%	12.5%	12.5%	**50%**

Table 6 can also be applied to causal, subtle and gross quanta (Figure 11).

Mixture particles are made of all five of the elements. Mixture elements are made of these five layers in the following order: Space, Air, Fire, Liquid and Solid. The dominant element (50%) defines the mixture element. In reference [1] we explained that bosons are the repelling energy field and fermions are the attraction energy field.

The general pattern for mixture elements is shown in Figures 12-16.

Similar to pure elements, we can differentiate between mixture repulsion particles (where the repulsion is dominating) and mixture attraction particles.

3.2.2. Mixture Space as Repulsion Particles

As indicated above, Mixture Space particles are composed of Pure Space (50%) and the of pure attraction elements (12.5% of each). Thus even if repulsion is dominating, Mixture Space contains a certain percentage of attraction.

Using the percentage of attraction of a pure element in Table 4 and the definition of the mixture elements (Table 6), we can determine the percentage of attraction of each Mixture Space particle.

$$\begin{cases} Mixture\ Causal_{Space} = \frac{1}{2} Mixture\ Causal_{Space} + \sum_{i=1}^{4} \frac{1}{8} Mixture\ Causal_i \\ Mixture\ Subtle_{Space} = \frac{1}{2} Mixture\ Subtle_{Space} + \sum_{i=1}^{4} \frac{1}{8} Mixture\ Subtle_i \\ Mixture\ Gross_{Space} = \frac{1}{2} Mixture\ Gross_{Space} + \sum_{i=1}^{4} \frac{1}{8} Mixture\ Gross_i \end{cases} \quad (4)$$

where i and j are the index element (0 is Space element; 1 is Air element; 2 is Fire element; 3 is Liquid element; 4 is Solid element) (Table 7).

Causal Elements	=	Causal Space	+	Causal Air	+	Causal Fire	+	Causal Liquid	+ Causal Solid
Subtle Elements	=	Subtle Space	+	Subtle Air	+	Subtle Fire	+	Subtle Liquid	+ Subtle Solid
Gross Elements	=	Gross Space	+	Gross Air	+	Gross Fire	+	Gross Liquid	+ Gross Solid

Figure 11. Causal, subtle and gross mixture element composition.

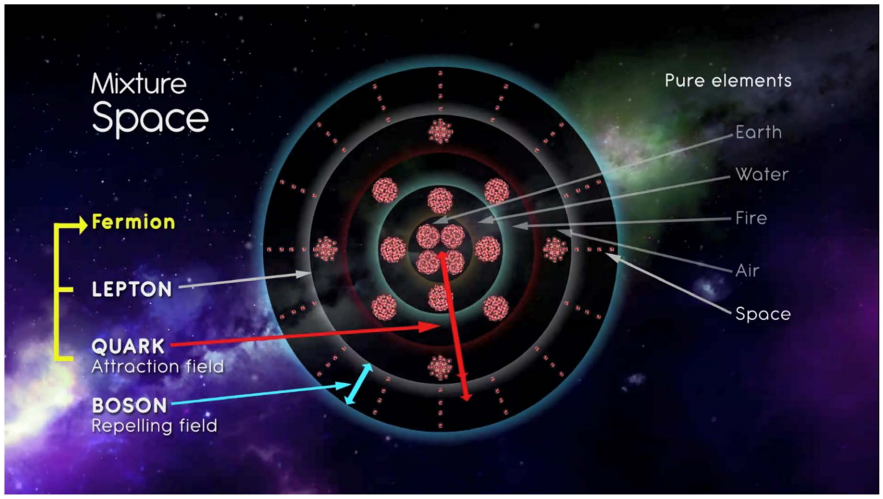


Figure 12. Pure element arrangement in Mixture Space.

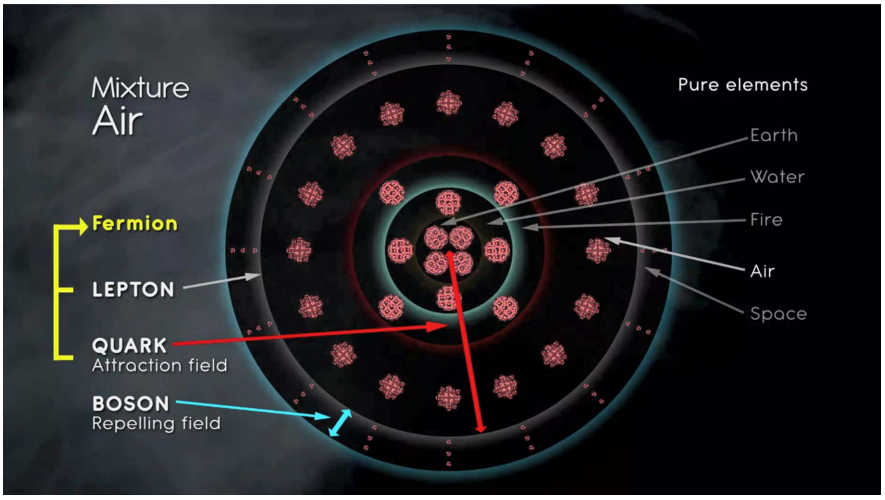


Figure 13. Pure element arrangement in Mixture Air.

Table 7. Percentage of attraction of mixture space particles.

	Mixture Causal Space	Mixture Subtle Space	Mixture Gross Space
Attraction (%)	1.40625	25	31.25

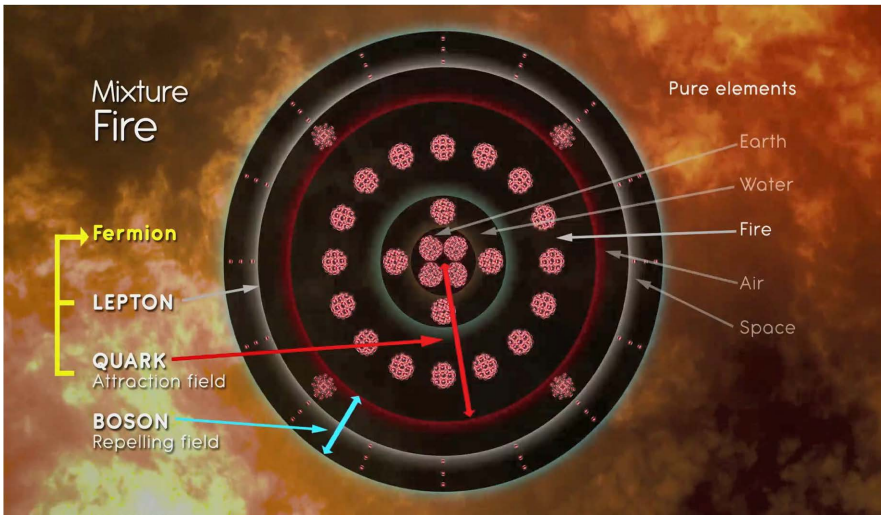


Figure 14. Pure element arrangement in Mixture Fire.

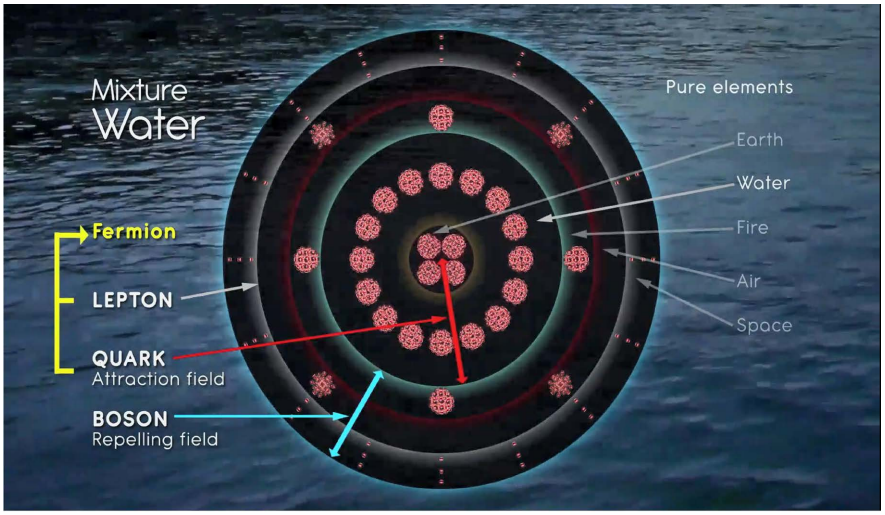


Figure 15. Pure element arrangement in Mixture Liquid.

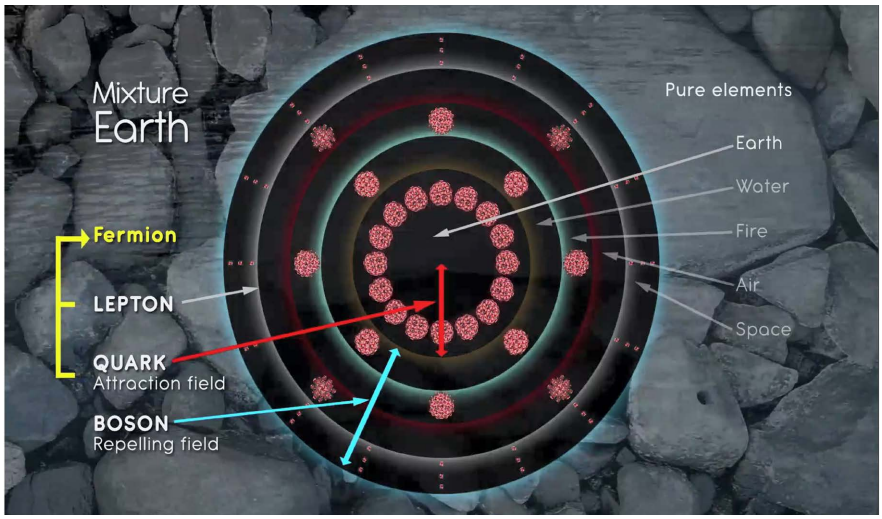


Figure 16. Pure elements arrangement in Mixture Earth.

3.2.3. Mixture Attraction Elements (Air, Fire, Liquid, Solid)

Similar to mixture repulsion particles, the percentages of attraction in Mixture Air, Mixture Fire, Mixture Liquid, and Mixture Solid can be calculated.

Mixture Causal Attraction Particles

The percentage of Mixture Causal attraction particles are defined as below:

$$\begin{cases} Mixt.\ Causal_{Air} = \frac{1}{2} Mixt.\ Causal_{Air} + \sum_{i=0,2,3,4} \frac{1}{8} Mixt.\ Causal_i \\ Mixt.\ Causal_{Fire} = \frac{1}{2} Mixt.\ Causal_{Fire} + \sum_{i=0,1,3,4} \frac{1}{8} Mixt.\ Causal_i \\ Mixt.\ Causal_{Liquid} = \frac{1}{2} Mixt.\ Causal_{Liquid} + \sum_{i=0,1,2,4} \frac{1}{8} Mixt.\ Causal_i \\ Mixt.\ Causal_{Solid} = \frac{1}{2} Mixt.\ Causal_{Solid} + \sum_{i=0,1,2,3} \frac{1}{8} Mixt.\ Causal_i \end{cases} \quad (5)$$

By applying Equation (5), we can calculate the % of attraction each Mixture Causal attraction elements (Table 8).

Mixture Subtle and Gross Attraction Particles

The percentages of mixture subtle and mixture gross attraction particles are defined below:

$$\begin{cases} Mixt.\ Subtle_{Air} = \frac{1}{2} Mixt.\ Subtle_{Air} + \sum_{i=0,2,3,4} \frac{1}{8} Mixt.\ Subtle_i \\ Mixt.\ Subtle_{Fire} = \frac{1}{2} Mixt.\ Subtle_{Fire} + \sum_{i=0,1,3,4} \frac{1}{8} Mixt.\ Subtle_i \\ Mixt.\ Subtle_{Liquid} = \frac{1}{2} Mixt.\ Subtle_{Liquid} + \sum_{i=0,1,2,4} \frac{1}{8} Mixt.\ Subtle_i \\ Mixt.\ Subtle_{Solid} = \frac{1}{2} Mixt.\ Subtle_{Solid} + \sum_{i=0,1,2,3} \frac{1}{8} Mixt.\ Subtle_i \end{cases} \quad (6)$$

$$\begin{cases} Mixt.\ Gross_{Air} = \frac{1}{2} Mixt.\ Gross_{Air} + \sum_{i=0,2,3,4} \frac{1}{8} Mixt.\ Gross_i \\ Mixt.\ Gross_{Fire} = \frac{1}{2} Mixt.\ Gross_{Fire} + \sum_{i=0,1,3,4} \frac{1}{8} Mixt.\ Gross_i \\ Mixt.\ Gross_{Liquid} = \frac{1}{2} Mixt.\ Gross_{Liquid} + \sum_{i=0,1,2,4} \frac{1}{8} Mixt.\ Gross_i \\ Mixt.\ Gross_{Solid} = \frac{1}{2} Mixt.\ Gross_{Solid} + \sum_{i=0,1,2,3} \frac{1}{8} Mixt.\ Gross_i \end{cases} \quad (7)$$

By applying Equations (6) & (7), we can calculate the percentage of attraction each Mixture Subtle and Mixture Gross attraction element (Table 9).

3.2.4. Normalized Mixture Attraction Particles

One of the main differences between Pure Space and Mixture Space is the fact that Mixture Space contains a percentage of attraction, whereas Pure Space contains

Table 8. Percentage of attraction of mixture causal attraction particles.

	Mixture Causal Air	Mixture Causal Fire	Mixture Causal Liquid	Mixture Causal Solid
Attraction (%)	1.6875	1.96875	2.53125	3.65625

Table 9. Percentage of attraction of mixture subtle and gross attraction particles.

	Mixt Subtle Air	Mixt Gross Air	Mixt Subtle Fire	Mixt Gross Fire	Mixt Subtle Liquid	Mixt Gross Liquid	Mixt Subtle Solid	Mixt Gross Solid
Attraction (%)	29.6875	40.625	39.0625	50	48.4375	59.375	57.8125	68.75

no attraction. Equations (5), (6) & (7) shown that Mixture Space is included in all mixture attraction particles. Since Mixture Space surrounds Mixture attraction elements, the percentage of attraction of Mixture Space should be taken into account. Therefore, in order to assess the percentage of attraction of Mixture Air, Mixture Fire, Mixture Liquid and Mixture Solid, the attraction from Mixture Space must be subtracted. This results in a "normalized element". Note that since Pure Space particles have no attraction, pure attraction particles are already normalized.

In the following chapters, normalized elements will be considered using the definitions below:

$$\begin{aligned} Norm\ Mixture\ Causal_{Att} &= Mixture\ Causal_{Att} - Mixture\ Causal_{Space} \\ Norm\ Mixture\ Subtle_{Att} &= Mixture\ Subtle_{Att} - Mixture\ Subtle_{Space} \\ Norm\ Mixture\ Gross_{Att} &= Mixture\ Gross_{Att} - Mixture\ Gross_{Space} \end{aligned} \quad (8)$$

where Norm stands for Normalized and Att stands for Attraction.

Normalized Mixture Causal Particles

The value of attraction (in percentage) of normalised mixture causal attraction particles is given in Table 10.

Thus normalized mixture causal particles follow the same pattern as pure causal particles (see Section 3.1.4).

According to Table 10 the general formula deriving the value of attraction is:

$$Norm\ Mixture\ Causal_j = \sum_{i=0}^{i=j-1} Norm\ Mixture\ Causal_i + Norm\ Mixture\ Causal_{Air} \quad (9)$$

where i and j are the index element (0 is Space element; 1 is Air element; 2 is Fire element; 3 is Liquid element; 4 is Solid element).

Normalized mixture causal particles are developed in the following ways:

- Norm Mixt Causal Air = Norm Mixt Causal Space + 0.28125%
- Norm Mixt Causal Fire = Norm Mixt Causal Space + Norm Mixt Causal Air + 0. 28125%
- Norm Mixt Causal Liquid = Norm Mixt Causal Space + Norm Mixt Causal Air + Norm Mixt Causal Fire + 0. 28125%
- Norm Mixt Causal Solid = Norm Mixt Causal Space + Norm Mixt Causal Air + Norm Mixt Causal Fire + Norm Mixt Causal Liquid + 0. 28125%

Where 0.28125% is the percentage of attraction of normalized Mixture Causal Air.

It can be observed that normalized mixture causal particles have the same

Table 10. Percentage of attraction for normalised mixture causal particles.

	Norm Mixture Causal Air	Norm Mixture Causal Fire	Norm Mixture Causal Liquid	Norm Mixture Causal Solid
Attraction (%)	0.28125	0.5625	1.125	2.25

pattern as pure causal particles (see Section 3.1.4).

Similar to pure causal elements, normalized Mixture Causal Air is the first attraction particle, and thus it can be used as the reference element. The other normalized mixture causal elements are multiples of it, as seen below (Table 11).

It can be observed that the number of quanta of normalized mixture causal particles is the same as for pure causal particles. Pure and mixture causal particles follow the same law.

For each attraction particle, let's consider the percentage attraction ratio between normalized mixture causal and normalized pure causal:

Table 12 shows that the ratio between the percentage of attraction of normalized mixture causal particles is proportional to the attraction level of normalized mixture causal particles. This coefficient of proportionality is exactly the percentage of attraction of Pure Subtle Fire (37.5%). As will be explained in detail in Section 4.2, the photon is believed to be the Pure Subtle Fire particle. Thus the change from normalized mixture to a normalized pure attraction element induces the emission or the absorption of a photon.

Normalized Mixture Subtle and Gross Element Particles

Using Equation (8), the normalization of mixture gross and mixture subtle attraction particles is derived as follows:

- Mixture subtle attraction particle by the subtraction of Mixture Subtle Space
- Mixture gross attraction particle by the subtraction of Mixture Gross Space

It comes as:

As explained, normalized mixture elements have the same behavior as pure elements. The dominating element (Space, Air, Fire, Liquid, Solid) of a mixture causal particle decides the element of the mixture subtle and mixture gross particles. The relation between normalized mixture causal and normalized mixture subtle or normalized mixture gross evolves as a logarithmic law. Thus, normalized mixture subtle and normalized mixture gross particles are constituted by patterns of normalized mixture causal particles (Figure 17).

Similar to pure elements, mixture causal particles start to form into mixture subtle particles, which in turn form into mixture gross particles as soon as attraction starts. Mixture causal particles are the basic quanta forming mixture elements.

According to Table 13, the first attraction particle is normalized Mixture Subtle Air. Mixture Subtle Air is constituted by Mixture Causal Air particles. Normalized Mixture Subtle Air particle is the first element formed by mixture causal particles. Therefore, it can be used as the reference quantum for subtle and gross elements (Table 14).

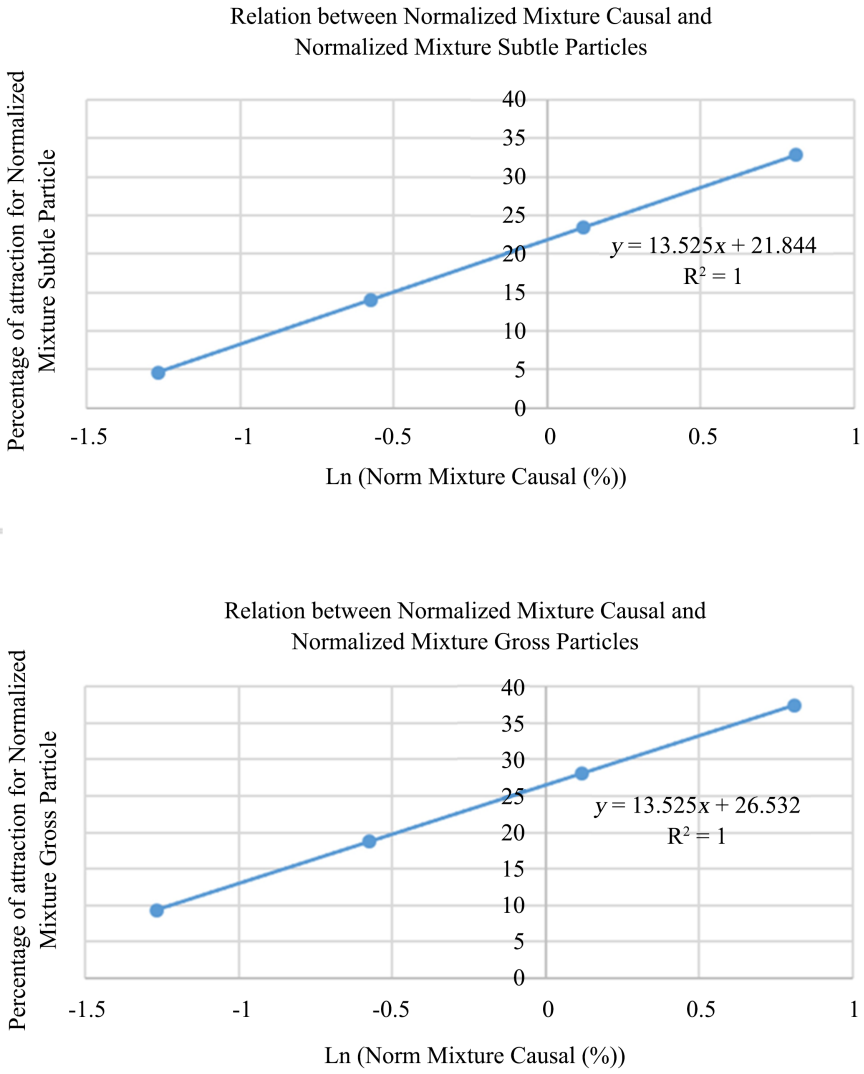


Figure 17. Relationship between percentage of attraction of mixture causal, mixture subtle and mixture gross particles.

Table 11. Number of Normalized Mixture Causal Air quantum.

	Normalized Mixture Causal Space	Normalized Mixture Causal Air	Normalized Mixture Causal Fire	Normalized Mixture Causal Liquid	Normalized Mixture Causal Solid
Number of Normalized Mixture Causal Air Quantum	0	1	2	4	8

Table 12. Ratio between normalized mixture and normalized pure causal particles.

	Air	Fire	Liquid	Solid
$\frac{Mixt\ Causal_i - Mixt\ Causal_{Space}}{Pure\ Causal_i - Pure\ Causal_{Space}}$	0.375	0.375	0.375	0.375

Table 13. Percentage of attration of a normalized subtle and a gross attraction particle.

	Norm Mixt Subtle Air	Norm Mixt Gross Air	Norm Mixt Subtle Fire	Norm Mixt Gross Fire	Norm Mixt Subtle Liquid	Norm Mixt Gross Liquid	Norm Mixt Subtle Solid	Norm Mixt Gross Solid
Attraction (%)	4.6875	9.375	14.0625	18.75	23.4375	28.125	32.8125	37.5

Table 14. Number of normalized mixture subtle air quanta.

	Norm Mixt Subtle Air	Norm Mixt Gross Air	Norm Mixt Subtle Fire	Norm Mixt Gross Fire	Norm Mixt Subtle Liquid	Norm Mixt Gross Liquid	Norm Mixt Subtle Solid	Norm Mixt Gross Solid
Attraction (%)	4.6875	9.375	14.0625	18.75	23.4375	28.125	32.8125	37.5
Number of Norm Mixt Subtle Air Quanta	1	2	3	4	5	6	7	8

It can be observed here that the numbers of quanta of normalized mixture subtle and gross particles are the same as for pure subtle and gross particles. Pure and mixture particles follow the same law.

Similar to mixture causal particles it can be demonstrated that the ratio between normalized pure and normalized mixture particles is the same as the ratio between normalized pure and normalized mixture causal particles: (**Table 15**).

This ratio corresponds to the emission of one photon (Subtle Fire particle). The element Fire is the element of transformation. It turns one element into another one and it is required for the change from pure particles into mixture particles.

4. Extended Periodic Table of the Elements

The current Periodic Table of the Elements takes only atoms into account, and yet atoms, as proven by quantum physics, are not the basic elements of the Universe. Thus a Periodic Table should include all particles starting from the one basic building block, which is proposed to be the I-particle. As such, this article presents an extended Periodic Table, which takes all particles into account. The table shows the classification of the elementary particles and atoms according to the five elements (Space, Air, Fire, Liquid and Solid).

The justification of this classification is based on the rest mass energy calculation (see Section 5). In the following chapters, we further are providing a physical significance (**Figure 18**).

Figure 18. Extended periodic table of the elements.

Table 15. Ratio between normalized mixture and pure causal particles.

	Norm Mixt Subtle Air	Norm Mixt Gross Air	Norm Mixt Subtle Fire	Norm Mixt Gross Fire	Norm Mixt Subtle Liquid	Norm Mixt Gross Liquid	Norm Mixt Subtle Solid	Norm Mixt Gross Solid
Norm Mixt element/Pure element	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375

4.1. I-Particle Plane

High energy particle physics predicts three hypothetical particles (graviton, HECO, high electrically charged object, and magneton) responsible for three fundamental forces [18] [19]. As explained in Section 2.1, the I-particle is the particle unifying all the fundamental forces. The I-particle cannot be broken but it contains the three matters. It is a toroid shape which develops as a cycle. Therefore, each matter can be observed separately. It is assumed that the three matters of the I-particle should be assimilated by these three particles. Red Matter is the primary gravitational force, it would be the graviton. The White Matter electrical force would be the HECO particle, while the Black Matter, as the magnetic force, would be the magneton. Graviton, HECO and magneton should be 3 different aspects of the same particle, the I-particle.

Through the MoEDAL program, CERN is searching for the HECO. The electrical charge of this particle should be between $10e$ and $180e$. The physics beyond the Standard Model predicts that HECOs can be produced as a pair with a magnetic monopole called a magneton [19] [20]. The I-particle cannot be broken, but when the Red Matter frequency decreases it creates White Matter, and when it increases, Black Matter is created. Therefore, the HECO and the magneton should be observed as a different face of the I-particle. But direct observation would require a very high energy collision. The subatomic particle would have to be broken to reveal elementary particles, which again would have to be broken to reach causal particles which finally, upon breaking, would reveal I-particles.

4.2. Elementary Particle Plane

In the I-Theory, "elementary particles" are not elementary but made of the five elements in their pure or mixed forms.

As explained above, Mixture Space (which is usually called "space") is not empty. It is made of the five pure elements. For example, Pure Fire is present, and thus the temperature of space is not zero. Pure Space is also contained in Mixture Space, which is why electromagnetic waves are able to travel.

Figure 19 shows how each category of elementary particles is formed by mixture quanta elements.

As discussed, each element has a causal, subtle and gross form:

- Causal form has the least attraction, White Matter domination.
- Subtle form has a moderate amount of attraction, Red Matter domination.
- Gross form has the most attraction, Black Matter domination.

Elements themselves have more or less attraction. Therefore there is also one form of White, Red and Black Matter domination. Space and Air are White Matter domination, while Liquid and Solid are Black Matter domination and Fire is Red Matter domination.

Pure and Mixture Air, Liquid Solid

Pure elements are constituted by causal, subtle and gross. Their composition is:

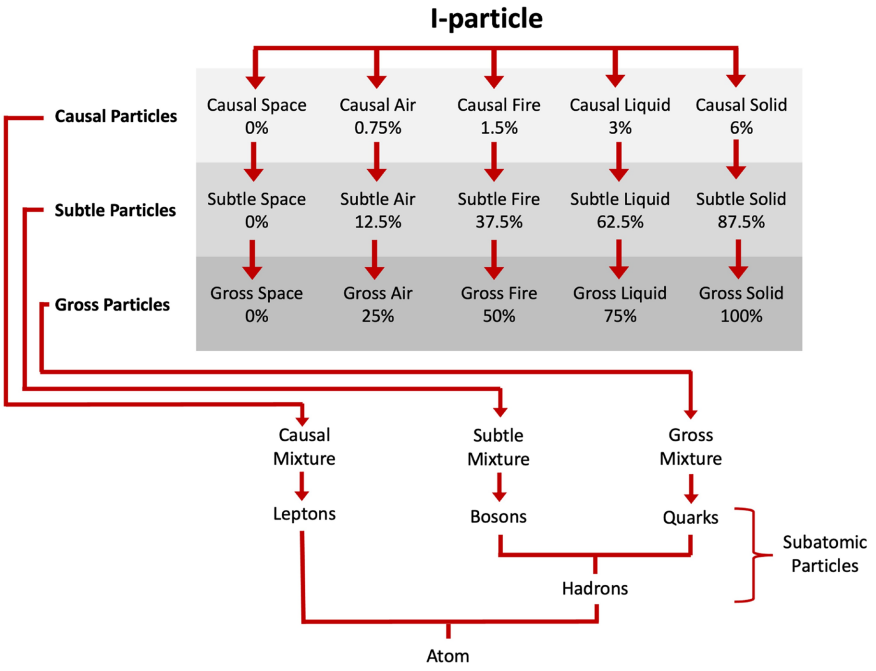


Figure 19. Composition of subatomic particles from the I-particle to the atom.

- Pure Causal = quarks (with electrical charge = −1/3)
- Pure Subtle = Higgs bosons (electrical charge = 0)
- Pure Gross = neutrinos (electrical charge = 0)

Mixture elements are constituted by causal, subtle and gross in the following way:

- Mixture Causal = leptons (electrical charge = −1)
- Mixture Subtle = Higgs bosons (electrical charge = 0)
- Mixture Gross = quarks (with electrical charge = +2/3)

The global charges for pure and mixture elements are:

$$\begin{cases} Q_{Pure} = -\frac{1}{3} + 0 + 0 = -\frac{1}{3}e \\ Q_{Mixture} = -1 + 0 + \frac{2}{3} = -\frac{1}{3}e \end{cases} \quad (10)$$

Therefore, the global electrical charge for both pure and mixture elements is $-1/3e$.

The elements are related to the fermion generation:

- Air is composed of the 3rd generation of fermions (top quark, bottom quark, tau and tau neutrino).
- Liquid is composed of the 2nd generation of fermions (charm quark, strange quark, muon and muon neutrino).
- Solid is composed of the 1st generation of fermions (up quark, down quark, electron and electron neutrino).

Z boson– Pure Space element

A Z boson is produced when a fermion is annihilated by its anti-fermion or when W^- boson is annihilated by W^+ boson (**Figure 20**).

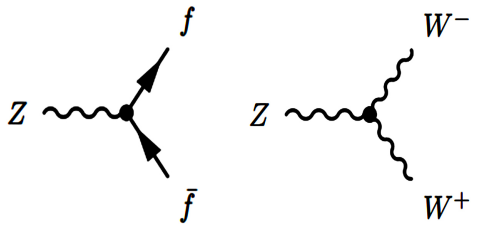


Figure 20. Z boson allowed vertices (where f stands for any fermion).

When a particle is annihilated by its anti-particle, both the particle and anti-particle cease to exist, and their combined mass is converted into energy. From the I-Theory point of view when there is no mass this indicates that all I-particles are in the state of repulsion; there is no more attraction. As such, the Z boson would be the equivalent of the Pure Space particle.

As shown in Figures 12-16, a Space particle is surrounding Air, Fire, Liquid, and Solid. Space is always present in each particle. It defines the limit of it. The repelling energy is concentrated towards the center of the particle where the attraction develops. An opposite repelling energy in the center prevents the particle from collapsing inwardly (Figure 21).

In reference [1], we have shown that the White Matter part is the anti-particle, while the Black Matter is the particle. In the case of Pure Space, Subtle Space is defined by the fact that White Matter is facing White Matter and Gross Space is defined by the fact that Black Matter is facing Black Matter. Also, we can say that Pure Subtle Space is the anti-particle of Pure Gross Space. This is why Z boson is its own anti-particle.

Higgs boson - Pure Fire element

As explained in Section 2.1, gravitation creates the primary electromagnetic field (photon field), and as such, the first element is Pure Fire. It is responsible for the change from one element (Air, Liquid and Solid) to another. As the creative energy of these elements, it is their subtle part. The difference between Subtle Air, Subtle Liquid and Subtle Solid is the share of Pure Fire elements contained therein. Pure Fire is derived from gravitation and gives the attraction (or the mass) to an element. In SM, the mass is given by the interaction of the Higgs field. Therefore, in the I-Theory, Pure Fire can be related to the Higgs boson. The Higgs boson is the quanta of kinetic energy which can be changed into potential energy (mass). This is why it plays a key role in the mass of elementary particles.

For light elements like Air, kinetic energy is not used for creating mass and the share of Higgs bosons is maximum. When the attraction is increasing, the particles are interacting with the Higgs field. One part of this Higgs field is used to change kinetic energy into the potential energy. Thus the number of Higgs bosons should be the reciprocal of the number of quanta of attraction. As stated in reference [1], the Pure Subtle Air particle is believed to be the Higgs boson. It therefore comes as (Table 16).

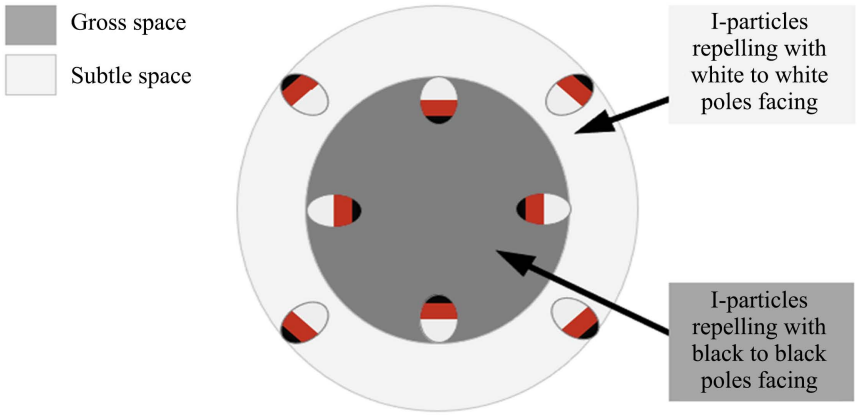


Figure 21. Pure subtle and gross space arrangement.

Table 16. Share of Higgs bosons contained in pure and mixture subtle elements.

	Pure Subtle Air	Mixt Subtle Air	Pure Subtle Fire	Mixt Subtle Fire	Pure Subtle Liquid	Mixt Subtle Liquid	Pure Subtle Solid	Mixt Subtle Solid
Share of Higgs boson (%)	100	87.5	75	62.5	50	37.5	25	12.5

We will see in Section 5 that the share of Higgs bosons and its rest mass (125.25 GeV/c^2) are required for the calculation of the rest mass of each elementary particle.

In the I-Theory, the Higgs boson is an element (Pure Fire element). Therefore, similar to Pure Air, Pure Liquid, Pure Solid, Pure Fire it is itself composed of causal, subtle and gross parts. In reference [1], we stated that attraction is negative spin, while repulsion is positive spin. We also stated that bosons have Gross and Subtle Space having the same spin value. Since the Higgs boson contains Pure Subtle Fire and Pure Gross Fire, the sum of the spin should be zero. This is why the Higgs boson is a scalar boson and not a gauge boson. We will try now to identify its causal, subtle and gross parts.

Like other elements, the subtle part is the functioning energy (or force carrier). Therefore, the Pure Subtle Fire should be a boson itself. Logically we can assume that the Fire boson is the photon.

Fire has two characteristics which cannot be separated: light and heat. Thus a new particle is required, a heat particle. This particle is assumed to be Pure Gross Fire.

As stated above, Pure Air, Pure Liquid and Pure Solid contain neutrinos (tau neutrino, muon neutrino and electron neutrino). Logically Pure Fire should have a neutrino too. Also we propose to introduce a Fire neutrino particle called Photon Neutrino. Many scientists postulate the existence of a 4th neutrino, which they named the "sterile neutrino". Sterile neutrinos are believed to be a special kind of neutrino. While the standard electron, muon, tau neutrinos and anti-

neutrinos interact with matter through two forces (weak and gravity), scientists believe that sterile neutrinos might interact only through gravity [21] [22]. As stated previously, the gravitation force is due to the Red Matter or Fire. We can assume that the sterile neutrino and photon neutrino are the same.

In short, the Pure Fire element is composed of:

- Pure Causal Fire: Photon Neutrino
- Pure Subtle Fire: Photon
- Pure Gross Fire: Heat

The usual decay of Higgs Boson is:

$$H \to ZZ \to 4l \tag{11}$$

where l is the lepton.

Recently, CERN measured the Higgs boson at 13.6 TeV with the following decay [23]:

$$H \to \gamma\gamma \tag{12}$$

The Standard Model (SM) predicts the decay of a Higgs boson into Z bosons and photons [24]. CERN confirmed the Higgs boson decays into photons in 2021 [25].

In any case the Higgs Boson decay involves Z bosons and or photons which is in accordance to the extended periodic table. The decay of Higgs gives one Z boson in the causal part and one Z boson in the gross part. Higgs bosons are made of photons. Therefore its decay should produce photons.

W boson - From Pure to Mixture - the Mixture Space element

Mixture elements are made of pure elements bound together. There should be a force that keeps the pure elements together. Of course beyond a force there is a force carrier, or boson.

For pure elements, we saw that this force is the weak force (see Z boson section). But Z boson is not the only weak force carrier. W^- bosons are also responsible of the weak force. W^- leads to a decrease of attraction, while W^+ leads to an increase of attraction.

Let's consider the Feynman diagrams used in QED for the W boson interactions.

Figure 22 shows that W boson is the force carrier in the change occurring during the transition from pure causal to gross mixture or from causal mixture to pure gross. The W boson is responsible for the change from a pure element to mixture element.

W allows for vertices to cross one family. In the I-Theory this can be explained as a change of the element, such as Mixture Air to Pure Liquid, or Pure Liquid to Mixture Solid. These vertices describe the change from one element into the next element (**Figure 23**).

Finally, W allows vertices crossing two families.

The physical explanation for these vertices is a change from Air to Solid (Pure Air to Mixture Solid or Pure Solid to Mixture Air) (**Figure 24**).

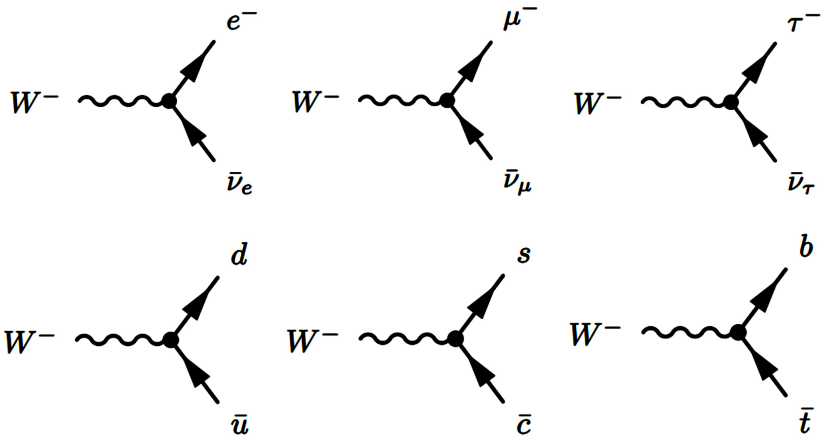


Figure 22. W boson vertices showing the change between a pure element to the same mixture element.

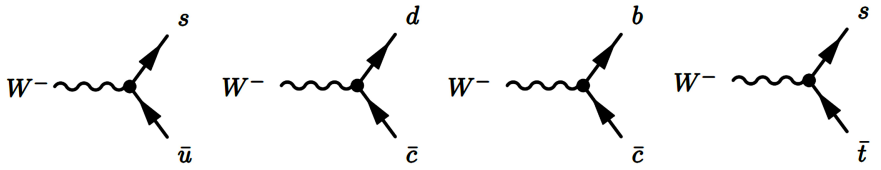


Figure 23. W boson vertices showing the change between pure to mixture with a phase change.

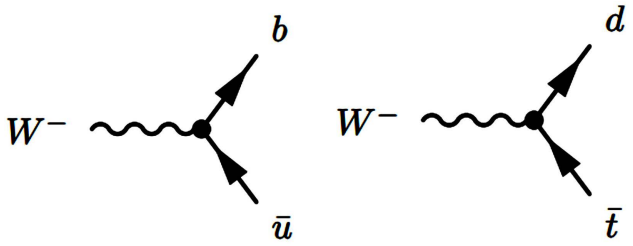


Figure 24. W boson vertices showing the change between pure to mixture with a sublimation phase change.

Z, W^- and W^+ are responsible for the weak force. Z boson is the Pure Space particle. We have seen that all attraction elements come from Space, as attraction starts when two I-particles in a state of repulsion change to a state of attraction. Subtle and Gross Space cannot be separated. Z is its own antiparticle. Similar to Pure Space, W^- and W^+ are Mixture Spaces particles. W^- is the Subtle part, while its antiparticle W^+ is the gross portion. W boson changes Pure Space into Mixture Space.

In September 2022, a study showed that a radiative correction should be introduced in the beta decay of a neutron into a proton, in addition to W boson [26]. This decay indicates a change from a quark down (Pure Solid) into a quark up (Mixture Solid). We demonstrated in Table 12 and Table 15 that the change between normalized mixture and normalized pure elements involves a photon emission/absorption process.

4.3. Hadron Plane

Hadrons are particles composed of quarks. Quarks are bound together by the strong force. As explained in Section 2.1, the vibration of the Black Matter creates the strong force. The gauge boson responsible of the strong force is the gluon. Also, in the I-Theory, the gluon is the Black Matter interaction between quarks, which is why gluons cannot be separated from quarks. There are two kinds of hadrons: mesons and baryons.

Hadrons are made of quarks. Therefore on the hadronic plane, quarks are the causal part.

Mesons

Mesons are usually made of two quarks. Some exotic mesons like tetra-quarks have been occasionally observed in the Large Hadron Collider. But tetra-quarks are very unstable and thus, we will consider only bi-quark mesons in this classification (even if the methodology can be applied to all mesons). Mesons in the form of two or four quarks have always an entire spin; they are bosonic hadrons. Therefore on the hadronic plane, mesons are the subtle part.

As explained in Section 4.2 (section "Pure and Mixture Air, Liquid Solid"), quarks are part of Air, Liquid or Solid elements in their pure or mixture form. This classification is according to the number of attraction quanta. The Higgs boson is the Red Matter (Pure Fire) which allows for the conversion of the kinetic energy (White Matter) into either potential energy (Black Matter) or attraction quanta. Also, quarks from Air element contain fewer attraction quanta than quarks contained in Liquid or Solid elements. Applying Table 5 leads to the following quanta of attraction (Table 17).

The hadron classification should take into account the number of attraction quanta. For example meson π^+ is composed of $u\bar{d}$, which indicates that the number of attraction quanta is equal to $(+8-7)=+1$.

Applying this methodology for all mesons leads to the following classification (Table 18).

We can classify mesons by elements with regard to the total number of attraction quanta, as given in Table 19.

Baryons

Baryons are usually made of three quarks. Some exotic baryons like penta-quarks have been rarely observed in the LHC. But penta-quarks are very unstable, and thus we will consider only tri-quark baryons in this classification. Baryons in the form of three or five quarks have always a half spin. On the hadronic plane, baryons are the gross aspect.

Table 17. Quanta of attraction in pure and mixture air, liquid and solid particles.

	Pure Air		Mixt. Air		Pure Liquid		Mixt Liquid		Pure Solid		Mixt Solid	
Quark	b	$\bar{b}$	t	$\bar{t}$	s	$\bar{s}$	c	$\bar{c}$	d	$\bar{d}$	u	$\bar{u}$
Number of Attraction Quanta	+1	−1	+2	−2	+5	−5	+6	−6	+7	−7	+8	−8

Table 18. Meson classification.

	Symbol	Anti-particle	Quarks	Spin	Mass (MeV/c²)	Mean lifetime (s)	Nb of Attraction Quanta
Pion	π^+	π^-	$u\bar{d}$	0	139.6	2.60×10^{8}	1
	π^-	π^+	$\bar{u}d$	0	139.6	2.60×10^{8}	−1
	π^0	Self	$\left(u\bar{u}-d\bar{d}\right)/\sqrt{2}$	0	135	0.83×10^{16}	0
Kaon	K^+	K^-	$u\bar{s}$	0	493.7	1.24×10^{8}	3
	K^-	K^+	$\bar{u}s$	0	493.7	1.24×10^{8}	−3
	K^0	$\bar{K}^0$	$d\bar{s}$	0	497.7		2
	K_S^0	K_S^0	$\left(d\bar{s}-s\bar{d}\right)/\sqrt{2}$	0	497.7	0.89×10^{10}	0
	K_L^0	K_L^0	$\left(d\bar{s}+s\bar{d}\right)/\sqrt{2}$	0	497.7	5.2×10^{8}	0
Êta	η^0	Self	$\left(u\bar{u}+d\bar{d}-2s\bar{s}\right)/\sqrt{6}$	0	548.8	5.0×10^{19}	0
	η'	Self	$\left(u\bar{u}+d\bar{d}-s\bar{s}\right)/\sqrt{3}$	0	957.8	3.39×10^{21}	0
	η_c	Self	$c\bar{c}$	0	2980.3	2.30×10^{23}	0
	η_b	Self	$c\bar{b}$	0	9390.9		0
Rho	ρ^+	ρ^-	$u\bar{d}$	1	770	0.4×10^{23}	1
	ρ^-	ρ^+	$\bar{u}d$	1	770	0.4×10^{23}	−1
	ρ^0	Self	$\left(u\bar{u}-d\bar{d}\right)/\sqrt{2}$	1	770	0.4×10^{23}	0
Phi	φ	Self	$s\bar{s}$	1	1020	20×10^{23}	0
D	D^+	D^-	$c\bar{d}$	0	1869.4	10.6×10^{13}	−1
	D^-	D^+	$\bar{c}d$	0	1869.4	10.6×10^{13}	−1
	D^0	$\bar{D}^0$	$c\bar{u}$	0	1864.6	4.2×10^{13}	−2
	$\bar{D}^0$	D^0	$\bar{c}u$	0	1864.6	4.2×10^{13}	−2
	D_S^+	D_S^-	$c\bar{s}$	0	1969	4.7×10^{13}	1
	D_S^-	D_S^+	$\bar{c}s$	0	1969	4.7×10^{13}	−1
J/Ψ	J/ψ	Self	$c\bar{c}$	1	3096.9	7.2×10^{21}	0
B	B^+	B^-	$u\bar{b}$	0	5279	1.5×10^{12}	7
	B^-	B^+	$\bar{u}b$	0	5279	1.5×10^{12}	−7
	B^0	B^0	$u\bar{b}$	0	5279	1.5×10^{12}	6
	B_S^0	Self	$s\bar{b}$	0	5366.3	1.47×10^{-12}	4
	B_C^+	B-c	$c\bar{b}$	0	6276 ± 4	4.6×10^{-13}	5
Upsilon	Υ	Self	$b\bar{b}$	1	9460.4	1.3×10^{20}	0
Omega	ω	Self	$\left(u\bar{u}-d\bar{d}\right)/\sqrt{2}$	0	782.65	7.75×10^{-23}	0

The methodology used for meson classification can be applied for all baryons. Table 20 shows a non-exhaustive list of baryons:

Similar to mesons, baryons can be classified into elements with regard to the total number of attraction quanta, as indicated below (Table 21).

Table 19. Meson classification.

	Space	Air	Fire	Liquid	Solid
Number of Attraction Quanta	0	1 - 2	3 - 4	5 - 6	7 - 8

Table 20. Baryon classification.

	Symbol	Quarks	Mass (MeV/c²)	Spin	Mean lifetime (s)	Nb of Attraction Quanta
Proton	p	uud	938.3	1/2	Stable	23
Neutron	n	udd	939.6	1/2	880.31	22
Delta	Δ^{++}	uuu	1232	3/2	0.6×10^{-23}	24
	Δ^{+}	uud	1232	3/2	0.6×10^{-23}	23
	Δ^{0}	udd	1232	3/2	0.6×10^{-23}	22
	Δ^{-}	ddd	1232	3/2	0.6×10^{-23}	21
Lambda	Λ^{0}	uds	1115.7	1/2	2.63×10^{-10}	20
	Λ_c^{+}	udc	2284.9	1/2	2.0×10^{-13}	21
	Λ_b^{0}	udb	5624	1/2	1.2×10^{-12}	16
Sigma	Σ^{+}	uus	1189.4	1/2	0.8×10^{-10}	21
	Σ^{0}	uds	1192.6	3/2	7.4×10^{-20}	20
	Σ^{-}	dds	1197.4	1/2	1.5×10^{-10}	19
	$\sum_c^{+}$	udc	2517.5	3/2	3.87×10^{-23}	21
	$\sum_c^{0}$	ddc	2518.48	3/2	4.3×10^{-23}	20
Xi	Ξ^{0}	uss	1314.8	3/2	2.9×10^{-10}	18
	Ξ^{-}	dss	1321.3	3/2	1.6×10^{-10}	17
	Ξ^{0}_{b}	usb	5952.3	3/2	6.31×10^{-12}	13
	Ξ^{0}_{c}	dsc	2471.8	3/2	1.1×10^{-13}	18
	Ξ^{+}_{c}	usc	2466.3	3/2	4.4×10^{-13}	19
Omega	Ω^{-}	sss	1672.4	3/2	0.82×10^{-10}	15
	Ω_c^{0}	ssc	2697.5	3/2	6.9×10^{-14}	16
	Ω^{-}_{bbb}	bbb	unknown	3/2	unknown	3
	Ω^{+}_{ccb}	ccb	unknown	3/2	unknown	11
	Ω^{0}_{cbb}	cbb	unknown	3/2	unknown	7

Table 21. Baryon classification.

	Space	Air	Fire	Liquid	Solid
Number of Attraction Quanta	0	1 - 6	7 - 12	13 - 18	19 - 24

4.4. Atomic Plane

Atoms are composed of a nucleus and one or more electrons. The nucleus is made of gross solid hadrons (e.g. protons and neutrons). Neutrons and protons are themselves composed of pure and mixture solid (e.g. up- and down-quark).

The classification of atoms in the attraction elements relates to the quantification of repulsion force. As we have already seen, the repulsion force is characterized by W boson (weak force).

The weak force acts in the nucleus by:

$$d \rightarrow u + W^- \tag{13}$$

But W^- is quite unstable and decays by:

$$W^- \rightarrow e^- + \overline{\nu}_e \tag{14}$$

So the final reaction is:

$$d \rightarrow u + e^- + \overline{\nu}_e \tag{15}$$

Or

$$n \rightarrow p + e^- + \overline{\nu}_e \tag{16}$$

This interaction can be represented by the Feynman diagram (Figure 25).

When the weak force dominates, the space increases and the distance between the electron and the nucleus increases. In addition, the distance between the peripheral electrons (external orbit) and the nucleus defines the level of attraction. We are proposing to classify atoms by element regarding their external orbit (s, p, d, f), as below:

- Solid atoms - peripheral obit "s": This orbit is nearest to the nucleus. The attraction between the nucleus and the electrons is maximum.
- Liquid atoms - peripheral obit "p": When the "s" orbit is filled, the electrons can start to fill the peripheral orbit. This is a quantum step. In this orbit, the attraction is still important but comparatively less than the "s" orbit. In addition, the movement of a free electron from the "d" orbit requires less energy than the movement of one electron from the "s" orbit.
- Fire atoms - peripheral obit "d": As stated earlier, Fire is the most balanced element, where attraction and repulsion are almost equal. Fire is also the stage between Liquid and Air. The "d" orbit can start to be filled while the "p" orbit is not completed. For example 3d starts to be filled before 4p (Fire with Liquid tendency). Similarly the "d" orbit can be filled before the "f" orbit. For example 4f is filled before 5d (Fire with Air tendency).
- Air atoms - peripheral obit "f": This is the furthest orbit from the nucleus. The repulsion is maximum. It corresponds to atoms with Air quality (Figure 26).

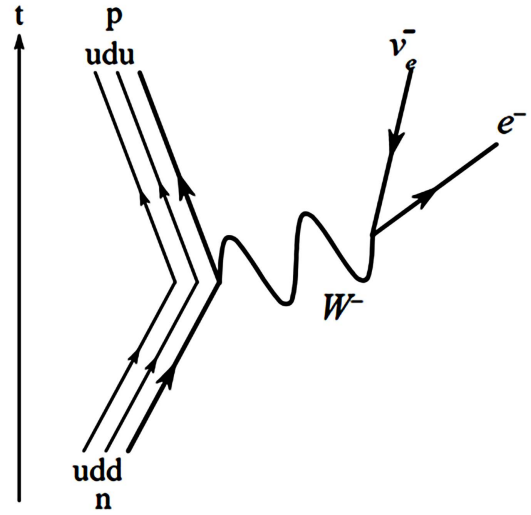


Figure 25. Decay of a neutron into a proton.

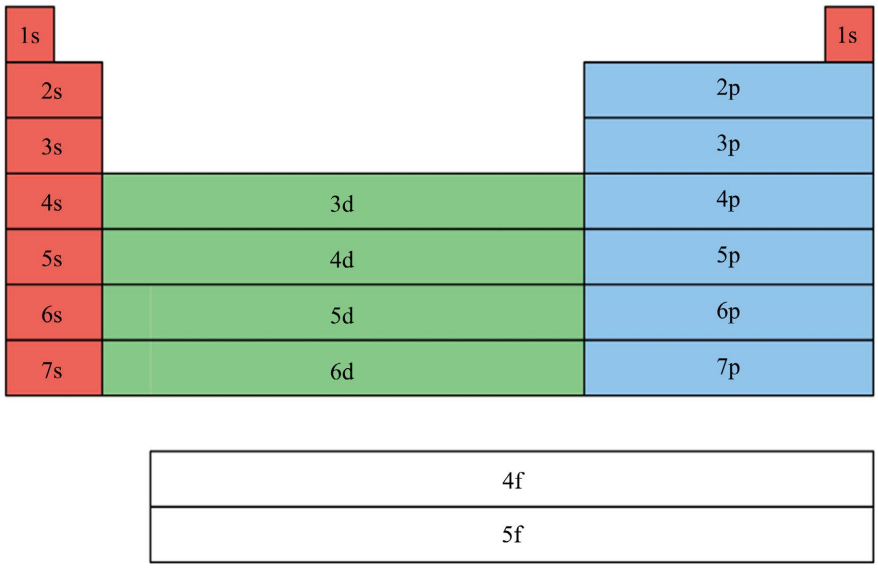


Figure 26. External electron orbit in Mendeleev's Periodic Table.

In the I-Theory, atoms are made of Solid Hadrons (proton and neutron). Therefore, applying the I-Theory concept of causal/subtle/gross on the atomic plane, we can consider Hadrons as the causal part of the atom. Atoms are the subtle part and when the attraction continue, molecules are formed. The molecules are the gross part of the atomic plane.

5. Elementary Particle Rest Mass Calculation

The I-Theory distinguishes between matter, mass and weight. Matter starts from I-particle assembly (I-particles can be in the attraction or repulsion plane). Mass starts from attraction (repulsion particles are matter but do not have a mass). The weight is the mass felt through the force (for example a fighter pilot is exposed to a high acceleration and his weight dramatically increases).

Until this point, we have postulated that the percentage of attraction of the different element follows the same law (e.g., Section 3.1 and Section 3.2). In this section we will show that the rest mass of the so-called "elementary particles" is the weight of the elements (e.g. the mass, percentage of attraction, perceived through gravitation).

In this section, the rest mass of each particle will be used. Toward that end, we will refer to the values commonly accepted and listed in the Particle Data Group [27], which gathers international experts and has the support of CERN, DOE (US), MEXT (Japan) and INFN (Italy).

The rest mass values used are listed in Table 22.

5.1. Energy Field

As discussed earlier, there are only two kinds of energy fields, repelling energy field and attraction energy field.

As explained in Section 2.4 the electric, magnetic and gravitational fields ($\vec{E}$, $\vec{B}$ and $\vec{G}$) can be defined by the Cartesian vectors, x, y and z axis (Figure 27).

When two I-particles are in attraction, White Matter is facing Black Matter, which means that the electrical field of the first particle is facing the magnetic field of the second one. Moreover, the gravitation of both should be in the same direction. According to vector mathematics, the gravitational fields are added to one another and form a larger gravitational field (Figure 28).

The result of the interaction is illustrated in Figure 29.

Table 22. Synthesis of the particles, their mass and their element.

Particle	Mass	Element	% Att	% Rep
Z	91.187 (GeV/c²)	Pure Space	0	100
H	125.25 (GeV/c²)	Pure Fire		
W	80.377 (GeV/c²)	Mixture Space		
Bottom quark	4.18 (GeV/c²)	Pure Causal Air	0.75	99.25
Top quark	172.96 (GeV/c²)	Mixture Gross Air	40.625	59.375
Strange quark	105.66 (MeV/c²)	Pure Causal Liquid	3	97
Charm quark	1.27(GeV/c²)	Mixture Gross Liquid	59.375	40.625
Down quark	4.67 (MeV/c²)	Pure Causal Solid	6	94
Up quark	2.16 (MeV/c²)	Mixture Gross Solid	68.75	31.25
Tau	1.77686 (GeV/c²)	Mixture Causal Air	1.6875	98.3125
Muon	105.658375 (MeV/c²)	Mixture Causal Liquid	2.53125	97.46875
Electron	0.511 (MeV/c²)	Mixture Causal Solid	3.65625	96.34375
Tau Neutrino	18.2 (MeV/c²)	Pure Gross Air	25	75
Muon Neutrino	0.19 (MeV/c²)	Pure Gross Liquid	75	25
Electron Neutrino	1.1 (eV/c²)	Pure Gross Solid	100	0

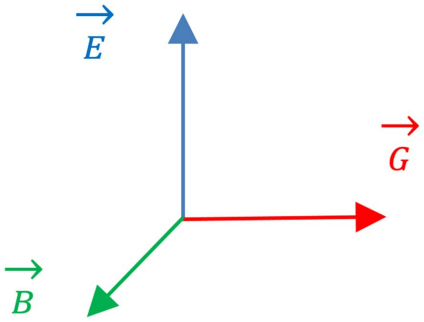


Figure 27. Forces represented in the Cartesian axis.

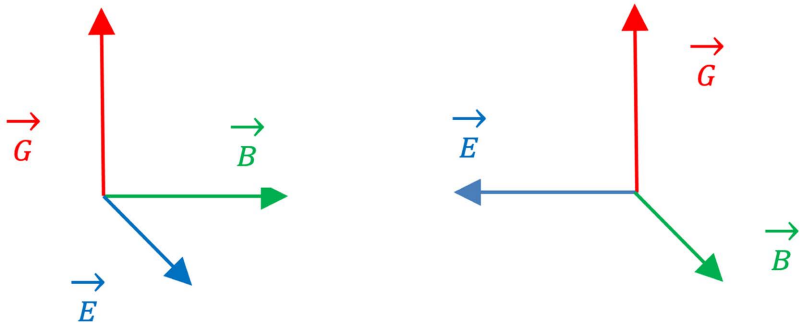


Figure 28. Interaction forces of two I-particles in attraction.

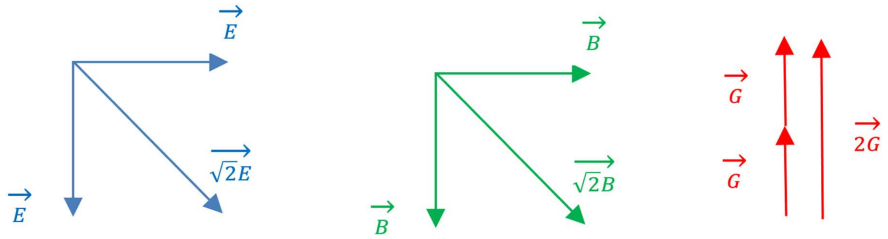


Figure 29. Resulting forces of two I-particles in attraction.

In the case of repelling particles, two possibilities can occur:

- White Matter facing White Matter = Subtle Space
- Black Matter facing Black Matter = Gross Space

For repelling particles, the particles are travelling in opposite directions. This means that the propagation axis, or gravitation axis, of each particles should be in opposite directions (*i.e.*, anti-gravity).

For Subtle Space, it results in the interaction shown in Figure 30.

The resulting forces are: (Figure 31).

The result is that the electrical and gravitational fields are null while the magnetic field is doubled.

For Gross Space, it results in: (Figure 32).

The resulting forces are: (Figure 33).

The result is that the magnetic field is zero and the electrical field is doubled.

In short it means that for Subtle Space the magnetic field of both particles is added, while for Gross Space the electrical field of both particle is added.

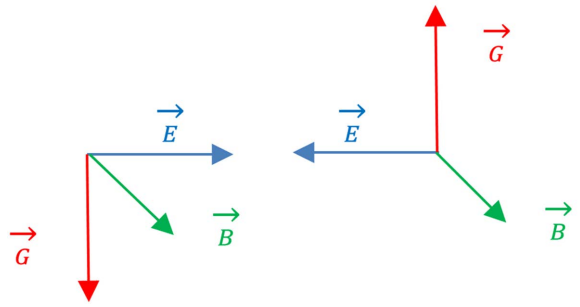


Figure 30. Interaction forces of two I-particles in repulsion where White Matter faces White Matter.

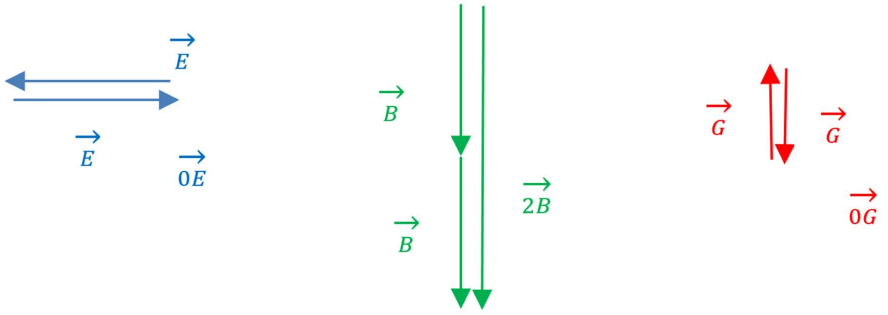


Figure 31. Resulting forces of two I-particles in repelling state, *i.e.*, Subtle Space.

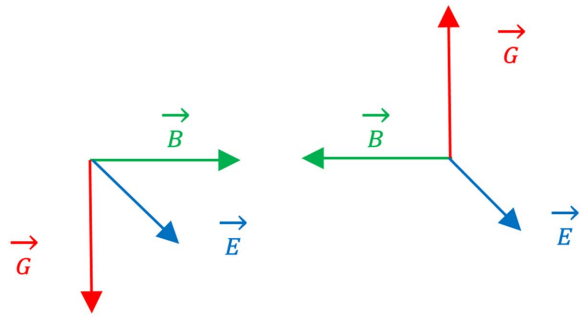


Figure 32. Interaction forces of two I-particles in repulsion where Black Matter faces Black Matter.

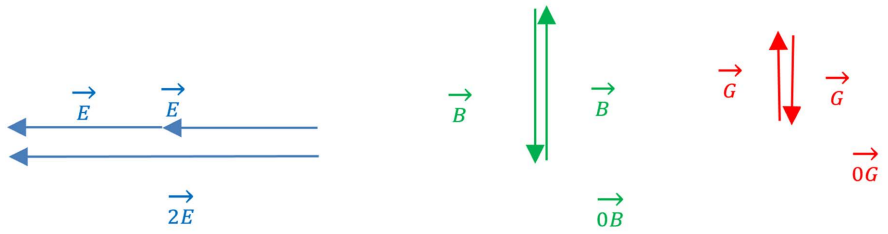


Figure 33. Resulting forces of two I-particles in repelling state, *i.e.*, Gross Space.

5.2. Pure Elements

Causal Particles

Repelling and attraction energy field

Causal particles are formed when attraction starts from Pure Space particles.

In Section 4.2, it is stated that the Pure Space element is the Z boson. Furthermore, there are two kinds of Space (subtle and gross), which always exist together and cannot be separated. Therefore the repelling energy field is 2 * Z bosons.

The value of 100% repelling field is:

$$E_{100\%\ Rep} = 2 * 91.1876\ \text{GeV}/c^2 = 182.3752\ \text{GeV}/c^2 \tag{17}$$

Or

$$E_{1\%\ Rep} = 1.823752\ \text{GeV}/c^2 \tag{18}$$

In Figure 29, we saw that the resulting attraction energy field is $\sqrt{2}$ times the initial repelling energy field. Therefore, the value of the quanta of attraction is equal to:

$$E_{1\%\ Att} = \sqrt{2} * E_{1\%\ Rep} = 2.579175\ \text{GeV}/c^2 \tag{19}$$

Number of attraction quanta

As already seen in Section 4.2:

- The bottom quark is made of Pure Causal Air (0.75% Attraction – 99.25% Repulsion)
- The strange quark is made of Pure Causal Liquid (3% Attraction – 97% Repulsion)
- The down quark is made of Pure Causal Solid (6% Attraction – 94% Repulsion)

The energy of a particle is defined by:

$$E_{Particle} = E_{Rep} - N_{Quanta} * E_{Att} \tag{20}$$

where N_{Quanta} is the number of attraction quanta.

Using the mass value of down, strange and bottom quarks and their percentages of attraction and repulsion (Table 22), we can calculate the number of quanta of attraction for each element (Figure 34).

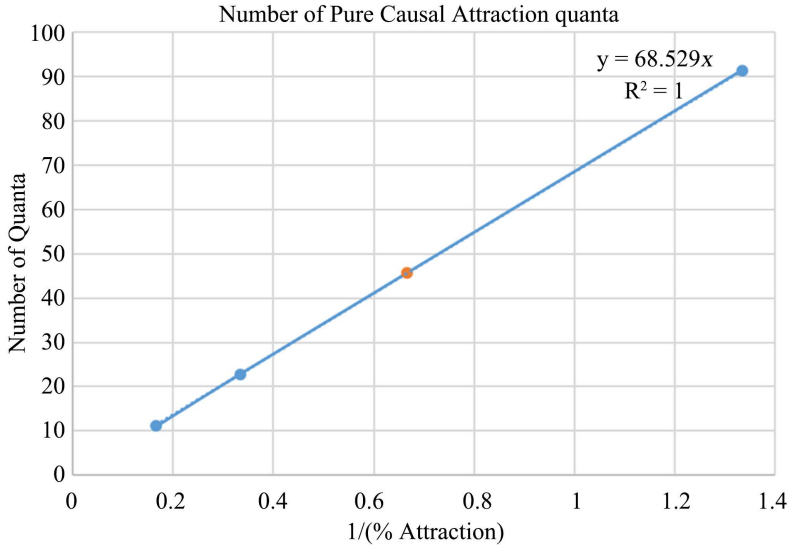


Figure 34. Number of pure causal attraction quanta versus reciprocal attraction.

It can be seen that the number of attraction quanta follow a linear law versus reciprocal attraction. The number of attraction quanta for Pure Causal Fire and the corresponding rest mass energy can be calculated with the regression line ($y = 68.529/x$). Knowing the number of attraction quanta, we can deduce the rest mass of Photon Neutrino by using Equation (20) as below:

$$E_{\nu_\gamma} = 61.1874\ \text{GeV}/c^2 \tag{21}$$

Subtle and gross particles

Repelling and attraction energy field

Subtle and gross particles are composed of causal particles. Therefore the repelling energy field of Causal Air should be the basis for the calculations of Subtle and Gross Air instead of two Z bosons. Similarly, the repelling energy field of Causal Fire, Causal Liquid and Causal Solid should be the basis for the calculation of Subtle and Gross Fire, Liquid and Solid particles.

Similar to Causal particles, the value of the attraction energy field is:

$$E_{1\%\ Att} = \sqrt{2} * E_{1\%\ Rep} \tag{22}$$

Number of attraction quanta

As already mentioned in Section 4.2:

- Tau neutrino is supposed to be Pure Gross Air
- Heat is supposed to be Pure Gross Fire
- Muon neutrino is supposed to be Pure Gross Liquid
- Electron neutrino is supposed to be Pure Gross Air
- (8/8) * Higgs is supposed to be Subtle Air
- (6/8) * Higgs is supposed to be Subtle Fire
- (4/8) * Higgs is supposed to be Subtle Liquid
- (2/8) * Higgs is supposed to be Subtle Solid

The energy of a particle is defined by (Equation (20)). Using the mass value and their percentage of attraction and repulsion (**Table 22**), the number of quanta of attraction for each element Solid, Liquid and Air can be calculated (**Figure 35**).

Similar to pure causal, the number of pure gross elements (Solid, Liquid and

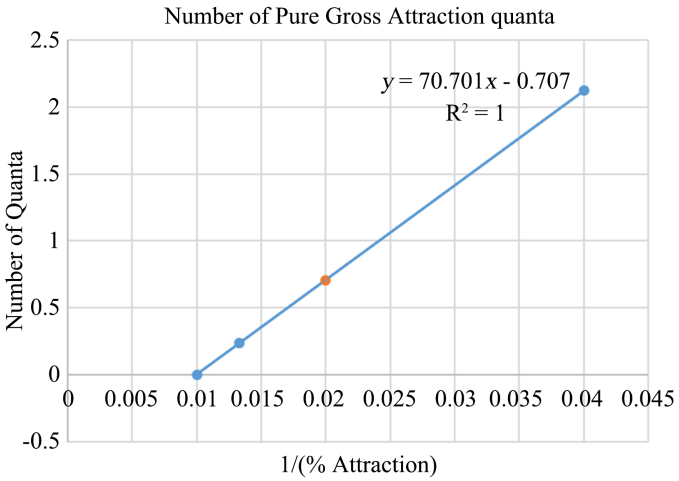


Figure 35. Number of pure gross attraction quanta versus reciprocal attraction.

Air) is following a linear law regarding reciprocal attraction. Using this regression line the number of attraction quanta for Pure Gross Fire and the rest mass energy corresponding to it can be calculated using Equation (20) which leads to:

$$E_{Heat} = -4.09242\ \mathrm{GeV}/\mathrm{c}^2 \tag{23}$$

Surprisingly, the value of this energy is negative. It indicates that the attraction field is higher than the repulsion field. Thus the heat quanta cannot be separated from Subtle Fire, as light cannot be separated from heat. It is an anti-matter particle. Thus, the heat quanta should be integrated into Subtle Fire (*i.e.*, photon).

Figure 36(a) shows a linear progression for Pure Subtle Air, Liquid, and Solid. The integration of Pure Subtle Fire shows a deviation (**Figure 36(b)**). This deviation is corrected by the integration of 1 Heat quanta (Gross Fire particle) in the energy field of the photon (**Figure 36(c)**). Then the number of attraction quanta follows a perfect line versus the reciprocal attraction. This means that Heat (Gross Fire) is created from the photon (Subtle Fire).

We also emphasize that Pure Subtle Air (Higgs boson) has a negative value of the number of attraction quanta, which means that the Higgs boson is providing attraction quanta to other elements. This is in accordance of the Higgs mechanism.

Using Equation (20), we can calculate the rest mass of the Photon with Heat and without Heat:

$$E_{Photon\ without\ Heat} = 93.9150\ \mathrm{GeV}/\mathrm{c}^2 \tag{24}$$

$$E_{Photon\ without\ Heat} = 89.8226\ \mathrm{GeV}/\mathrm{c}^2 \tag{25}$$

5.3. Mixture Elements

Causal Particles

Repelling and attraction energy field

Mixture Causal particles are made of Pure Causal particles. Therefore the repelling field is based on the Pure Space element (or 2 * Z bosons).

For example, the Mixture Causal Air particle is defined by:

$$\begin{aligned} Mixt\ Causal_{Air} = &\frac{1}{8}Causal_{Space} + \frac{1}{2}Causal_{Air} + \frac{1}{8}Causal_{Fire} \\ &+ \frac{1}{8}Causal_{Liquid} + \frac{1}{8}Causal_{Solid} \end{aligned} \tag{26}$$

This indicates that in each quantum of attraction, 1/8 of the Space element is present. It is the same for Mixture Causal Fire, Liquid and Solid. Therefore the repelling energy can be expressed as

$$Repel\ Causal_i = \left(Percent\ of\ \ Repel_i + \frac{1}{8}Nb\ of\ \ Att\ quanta \right) * 2 * Z \tag{27}$$

The mixture causal attraction quantum is given by the attraction part of the mixture element. It is given by the sum of the number of attraction quanta of each pure element in their respective proportion (50% or 12.5%). For that we are using (Equation (5)).

Number of attraction quanta

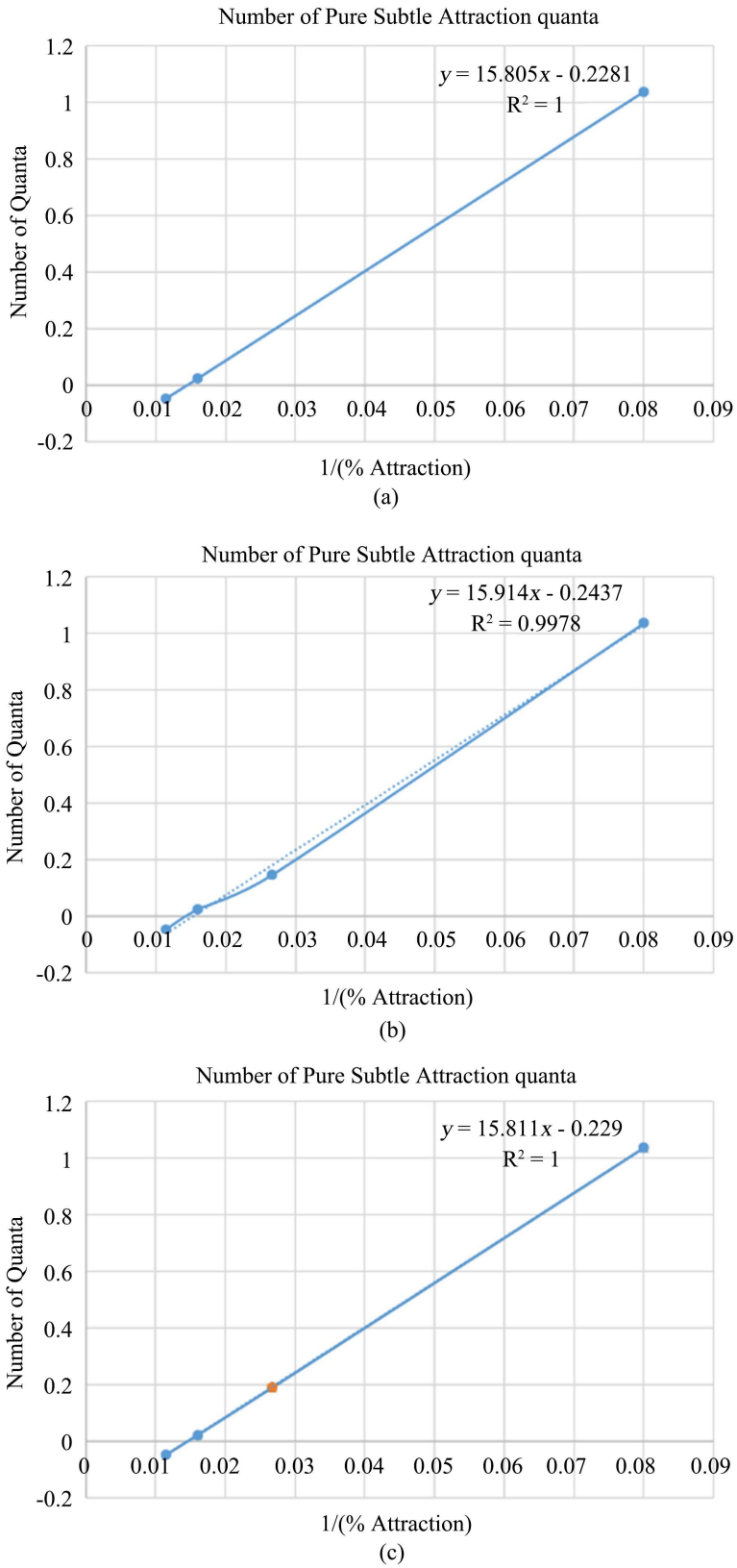


Figure 36. Number of pure subtle attraction quanta versus reciprocal attraction, (a) without Fire element; (b) with Fire without heat quanta integration, (c) with heat quanta integration.

As already mentioned in Section 4.2, tau is composed of Pure Causal Air, muon is composed of Pure Causal Liquid and electron is composed of Pure Causal Solid.

The energy of a particle is defined by (Equation (20)).

Using the rest mass value of electron, muon, tau and their percentage of attraction and repulsion (Table 22), the number of quanta of attraction for each element Solid, Liquid and Air can be calculated (Figure 37).

As we can see, the number of attraction quanta follows a linear law versus the reciprocal attraction. Using this law, the number of attraction quanta for Mixture Causal Fire and the rest mass energy corresponding can be calculated with Equation (20):

$$E_{Mixt\ Causal_{Fire}} = 883.967\ \text{MeV}/c^2 \tag{28}$$

Subtle and Gross Particles

Repelling and attraction energy field

Mixture subtle and mixture gross particles are made of mixture causal particles. Since mixture causal particles are made of repelling particles (Pure Space) and attraction particles (Pure Air, Fire, Liquid and Solid), we can compute the repelling and attraction energy field for each mixture causal particle. These fields are used in the calculations of mixture subtle and mixture gross energy field.

Number of attraction quanta

As stated in Section 4.2:

- Top Quark is supposed to be Mixture Gross Air
- Charm Quark is supposed to be Mixture Gross Liquid
- Up Quark is supposed to be Mixture Gross Air
- (7/8) * Higgs is supposed to be Mixture Subtle Air
- (5/8) * Higgs is supposed to be Mixture Subtle Fire
- (3/8) * Higgs is supposed to be Mixture Subtle Liquid

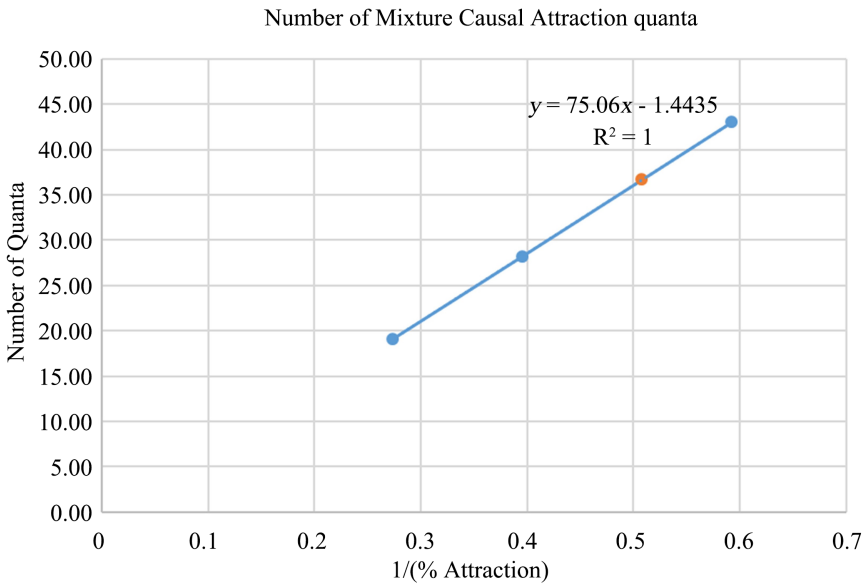


Figure 37. Number of mixture causal attraction quanta versus the reciprocal attraction.

- (1/8) * Higgs is supposed to be Mixture Subtle Solid

The energy of a particle is defined by (Equation (20)).

Using the mass value and their percentage of attraction and repulsion (Table 22), we can calculate the number of quanta of attraction for each element Solid, Liquid and Air.

We can observe a deviation due to the Mixture Subtle Solid (Figure 38(a)). This deviation is corrected by the introduction of −0.25 heat quanta (Figure 38(b)) in the rest mass of the particle. This implies that a quarter of the heat quanta is lost by the Higgs boson for turning the mixture elements into hadrons.

Similar to Pure elements, we can observe a deviation due to the introduction of Mixture Fire (Figure 39(a)). This deviation is corrected by the introduction of 0.5 heat quanta (Figure 39(b)) in the rest mass of the particle. The number 0.5 is deduced from the assumption that Mixture Subtle Fire is made of 50% Pure Subtle Fire and the correction needed for Pure Subtle Fire was 1 heat quanta.

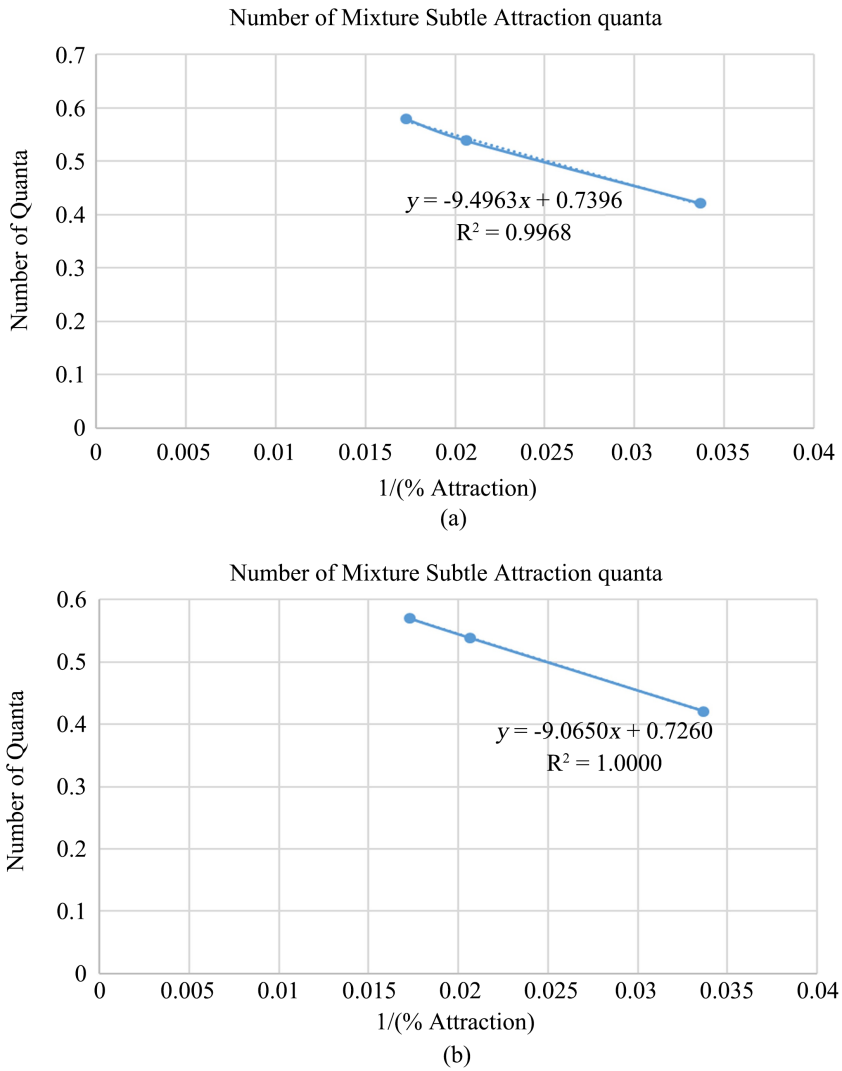


Figure 38. Number of mixture subtle attraction quanta versus the reciprocal attraction, (a) without heat quanta integration, (b) with heat quanta integration on Mixture Subtle Solid.

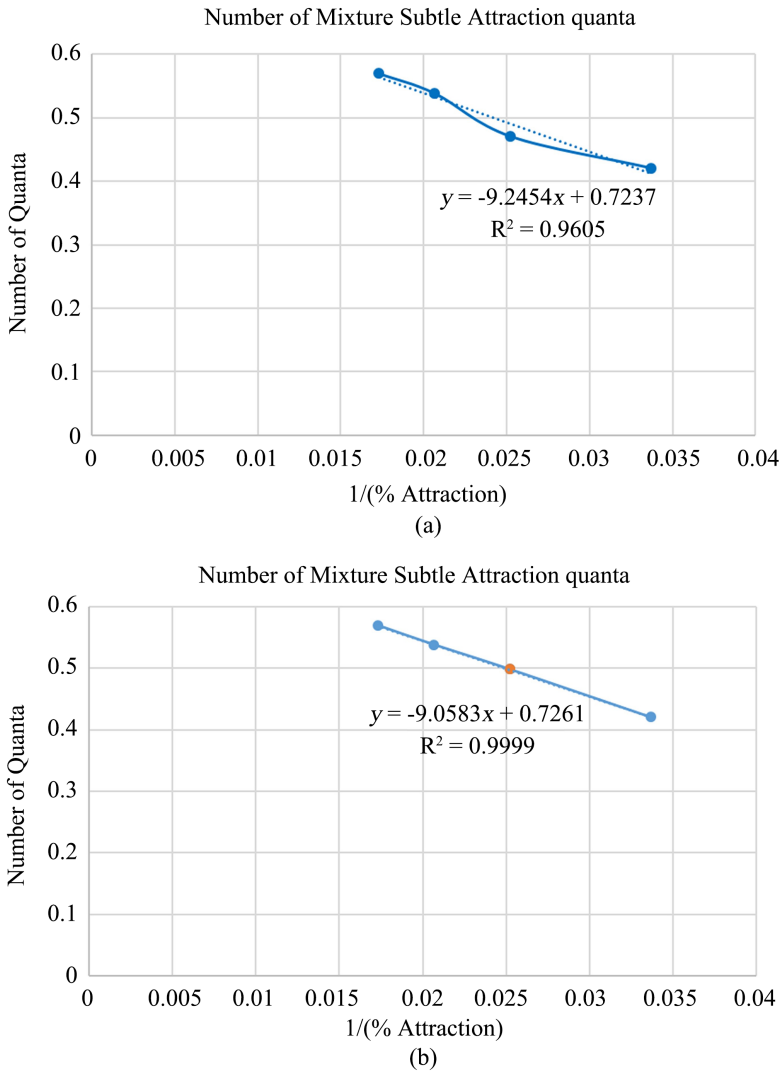


Figure 39. Number of mixture subtle attraction quanta versus the reciprocal attraction, (a) without heat quanta integration in Fire element, (b) with heat quanta integration in Fire element.

Figure 40(a) shows the number of Attraction quanta for Gross Mixture Air, Liquid and Solid. We can observe a strong deviation due to the Air element. Mixture Gross Air is the first element composed by pure elements. As already demonstrated, the change from pure to mixture is due to the W boson (see Section 4.2). Furthermore, W boson is the Mixture Space element and for the repelling energy field, 2 * Z bosons should be considered as the particle and anti-particle. Similarly, 2 * W bosons should be considered (W^- and W^+). The change from pure to mixture cannot be without a heat change, like any chemical reaction. Therefore a second correction with 2 heat quanta (one for W^- and one for W^+) was introduced. Note that **Table 12** and **Table 15** show that the change from pure to mixture involves the Fire element. **Figure 40(b)** shows that taking into account these corrections in the repelling energy field of the Mixture Gross Air, all elements (Air, Liquid, Solid) follow the same law. This indicates that one

part of the repelling energy field is lost for the creation of the W boson and for absorbing the heat quantum in order to compose the top quark (Figure 41).

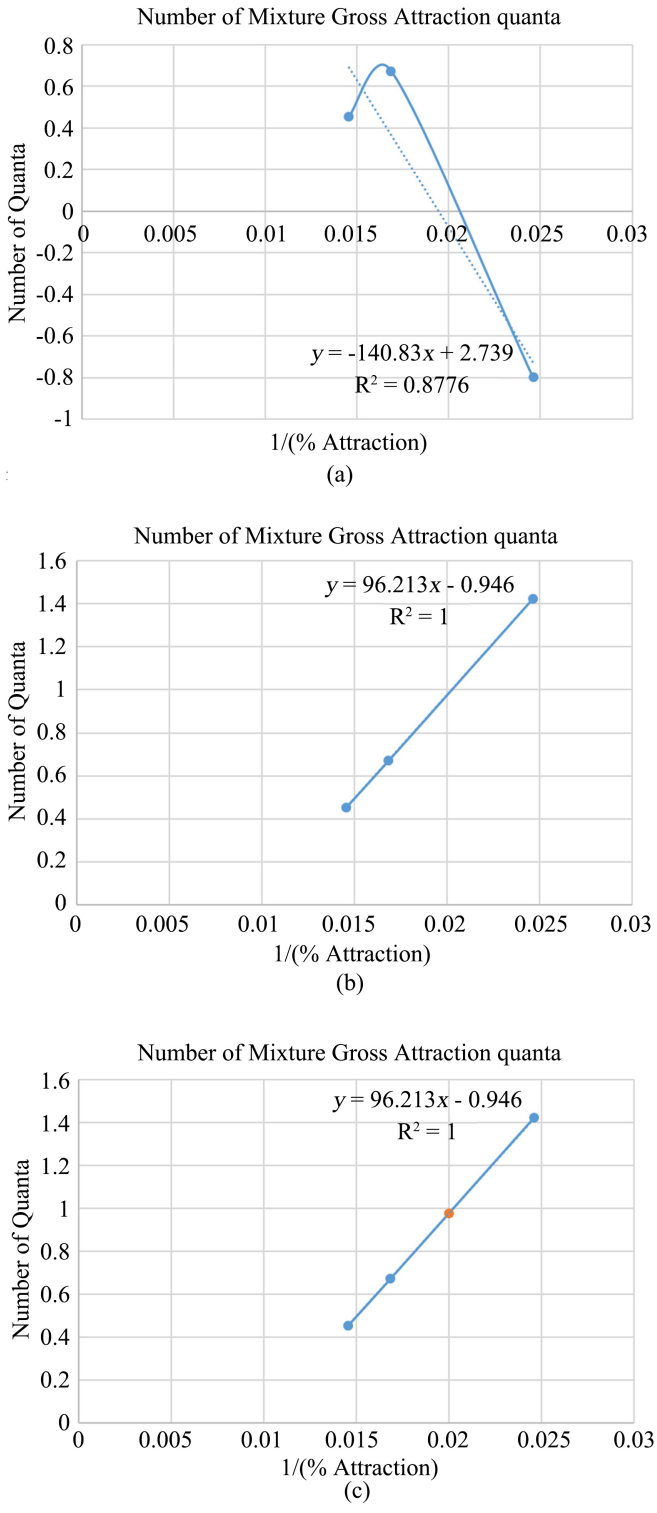


Figure 40. Number of mixture gross attraction quanta versus reciprocal attraction, (a) without correction, (b) with W boson and Heat quanta correction of Air element, (c) with Mixture Gross Fire element.

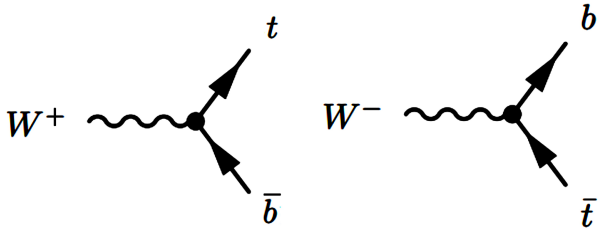


Figure 41. W bosons in the change from pure air to mixture air.

Similar to Pure Gross Fire, the linear law given by Mixture Gross Air, Liquid and Solid can be used for calculating the number of attraction quanta for Mixture Gross Fire. The rest mass energy can be calculated according to Equation (20) to

$$E_{Mixt\ Gross_{Fire}} = 52.1628\ \mathrm{GeV}/\mathrm{c}^2 \tag{29}$$

6. Conclusions and Perspectives

In this article we have applied the I-Theory to show that elementary particles are not elementary but composed of quanta of energy. We have explained the substructure of the elementary particles and defined the quantum of energy in each of them. We showed that the number of attraction quanta of each elementary particle follows a linear law function of the reciprocal attraction. From that, the rest mass of each particle can be explained, which is highly significant in that until now no theory has been able to explain mass particle values.

The I-Theory provides a deeper significance to the Higgs, Z, W and ɣ bosons. This research explains why and how these bosons interact with some particles and not other ones. We showed that mass is created when the space particles turn into attraction particles. All particles originate from Space. This statement is particularly relevant for explaining "virtual particles".

Furthermore, new particles are predicted. We introduced Heat and Photon Neutrinos. Their expected masses have been calculated. We have demonstrated the importance of the heat quanta in the change of elements. Photon neutrino discovery should play a key role in the understanding of the oscillation of neutrinos.

The I-Theory predicts that everything in the universe is made of the five elements, Space, Air, Fire, Liquid and Solid. There are two kind of elements, pure and mixture. Each of them can be causal, subtle or gross. Furthermore, elementary particles belong to one category (for example electron is made of Mixture Causal Solid; bottom quark is made of Pure Causal Air). It is shown that pure and mixture elements follow the same rules in terms of quanta of attraction and repulsion.

Since atoms are made of subatomic particles, a new Periodic Table of the Elements was introduced. We classified all particles starting from the I-particle, elementary particles, hadrons and atoms according to their element (Space, Air, Fire, Liquid and Solid). This new table gives a better understanding about the

composition of each particle and how the bosons interactions can change one particle into another one. This table can be a useful tool in science education.

The deeper significance of the elementary particles' substructure should be a determinant in quantum applications. Using this knowledge, we will be able to understand phenomena like quantum entanglement, tunneling effect and quantum decoherence.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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