The Unified Theory of Physics: Symmetry Physics and Yinyang Physics

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Abstract

The unified theory of physics is based on both symmetry physics and yinyang physics to unify all physical laws and phenomena, all four fundamental forces, and all elementary particles. Conventional symmetry physics preserves the physical features of a system under transformation by a symmetry operator. In unconventional yinyang physics, yin and yang constitute a binary yinyang system of opposite physical properties by yin and yang operators. The three fundamental symmetry operators transform the three fundamental yinyang systems (inclusiveness-exclusiveness, rest-movement, and composite-individual) into the unified theory of physics. In the inclusiveness-exclusiveness system, a particle is transformed into boson with inclusive occupation of position by the integer spin operator, while a particle is transformed into fermion with exclusive occupation of position by the ½ spin operator. The fundamental symmetry operator is supersymmetry to result in M-theory and cosmology. In the rest-movement system, a moving massless particle (kinetic energy) is transformed into a resting massive particle (rest mass) by the attachment space (denoted as 1) operator to explain the Higgs field, while a resting massive particle is transformed into a moving massless particle by the detachment space (denoted as 0) operator to explain the reverse Higgs field. The fundamental symmetry operator is the symmetrical combination of attachment space and detachment space to bring about the three space structures: binary partition space, (1)n(0)n, for wave-particle duality, binary miscible space, (1+0)n, for relativity, and binary lattice space, (1 0)n, for virtual particles in quantum field theory. In the composite-individual system, particles are transformed into fractional charge quark composite by the fractional electric charge operator, while particles are transformed into integral charge particle individuals by the integral electric charge operator. The fundamental symmetry operator is the symmetrical combination of quarks, leptons, and bosons to constitute the periodic table of elementary particles which calculates accurately the particle masses of all elementary particles.

Keywords

unified theory of physics, symmetry physics, yinyang physics, cosmology, periodic table of elementary particles, four force fields, M-theory, supersymmetry, cyclic dual universe, Higgs field, reverse Higgs field, fractional electric charge, spin, multiverse, particle masses

I. Introduction

Conventional physics is symmetry physics based on symmetry. In symmetry physics, symmetry of a system preserves the physical features of the system under transformation by a symmetry operator. Conservation laws are consequences of symmetries. For examples, the conservation laws of angular momentum, momentum, and energy are the consequences of symmetries in the transformations of rotation, space translation, time translation, respectively, by the symmetry operators. In the Standard Model for the electroweak interaction, leptons, quarks, and the gauge bosons are unified by symmetry. In general, symmetries with invariance and conservation laws are fundamentally important constraints for formulating physical theories and models. In practice, symmetries are powerful methods for solving problems and predicting what can happen. Observed physical phenomena are fundamentally symmetrical, but at the same time, observed physical phenomena are also fundamentally diverse. Deterministic general relativity is fundamentally different from non-deterministic quantum field theory. The four forces (electromagnetism, the weak force, the strong force, and gravity) cannot be unified by symmetry. Leptons exist in lepton individuals, while individual quarks are confined in quark composites. Without symmetry for the masses of elementary particles, the particle masses of leptons, quarks, gauge bosons, and the Higgs boson are incalculable [1]. Max Jammer [2] concluded that nobody knows what diverse particle masses really are.

As a result, conventional symmetry physics alone cannot explain observed physical phenomena with both symmetry and diversity. This paper proposes that diversity in observed physical phenomena is derived from unconventional yinyang physics [3, 4,5]. In unconventional yinyang physics, yin and yang constitute a binary yinyang system of opposite physical properties by a pair of yin and yang operators. The three fundamental yinyang systems are the inclusiveness-exclusiveness, rest-movement, and composite-individual systems. Symmetries from symmetry physics are built upon the three fundamental yinyang systems to account for symmetry and diversity in the nature. The three fundamental symmetry operators from symmetry physics transform the three fundamental yinyang systems into the unified theory of physics containing both symmetry and diversity. The unified theory of physics is based on both conventional symmetry physics and unconventional yinyang physics to unify all physical laws and phenomena, all four fundamental forces, and all elementary particles. Section 2 describes yinyang physics and the unified theory of physics. Sections 3, 4, and 5 describe the inclusiveness-exclusiveness system, the rest-movement system, and the composite-individual system, respectively.

2. Yinyang Physics and the Unified Theory of Physics

Fundamentally, the nature is both symmetrical and diverse. This paper proposes that diversity in the nature is introduced by the three yinyang systems of binary opposite physical properties, including inclusiveness-exclusiveness, rest-movement, and composite-individual. Symmetries from conventional symmetry physics are built upon these three yinyang systems to account for symmetry and diversity in the nature. The three fundamental symmetry operators from symmetry physics transform the three fundamental yinyang systems into the unified theory of physics to unify all physical laws and phenomena, all four fundamental forces, and all elementary particles.

In unconventional yinyang physics, yin and yang constitute a binary yinyang system of opposite physical properties by a pair of yin and yang operators. As described in the previous papers [3, 4,5], in the inclusiveness-exclusiveness system, a particle is transformed into inclusive boson with inclusive occupation of position by the integer spin operator, while a particle is transformed into exclusive fermion with exclusive occupation of position by the ½ spin operator based on the Pauli exclusion principle. The fundamental symmetry operator for boson-fermion is supersymmetry which results in M-theory and cosmology [4,6,7]. The inclusiveness-exclusiveness system also explains dark energy, and calculates accurately when dark energy started [7]. In the rest-movement system [4], a moving massless particle (kinetic energy) is transformed into a resting massive particle (rest mass) by the attachment space (denoted as 1 for the space of matter) operator to explain the Higgs field, while a resting massive particle is transformed into a moving massless particle by the detachment space (denoted as 0 for the zero-space of matter) operator to explain the reverse Higgs field. The fundamental symmetry operator is the symmetrical combination of attachment space and detachment space to bring about the three space structures: binary partition space, (1)n(0)n, for wave-particle duality, binary miscible space, (1+0)n, for relativity, and binary lattice space, (1 0)n, for virtual particles in quantum field theory. The rest-movement system also explains the Big Bang [8], dark matter [9], baryonic matter, superconductivity [10], black hole [11,12], and the galaxy evolution [13,14], and calculates accurately the percentages of dark matter and baryonic matter [7, 15,16]. In the composite-individual system [17], particles are transformed into fractional charge quark composite by the fractional electric charge operator, while particles are transformed into integral charge particle individuals by the integral electric charge operator. The fundamental symmetry operator is the symmetrical combination of quarks, leptons, and bosons to constitute the periodic table of elementary particles [18] which calculates accurately and predict theoretically the particle masses of all leptons, quarks, gauge bosons, the Higgs boson, and cosmic rays (the knees-ankles-toe) [5].

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Yinyang physics and the unified theory of physics are described in Table 1.

Table 1. Yinyang Physics and the Unified Theory of Physics

yin operator	yang operator	yin property	yang property	symmetry operator	the unified theory of physics
integer spin	½ spin	inclusiveness (boson)	exclusiveness (fermion)	supersymmetry between boson and fermion	integer spin boson, ½ spin fermion, M-theory, dark energy, cosmology
attachment space	detachment space	rest (rest mass)	movement (kinetic energy)	symmetrical combination of attachment space and detachment space	rest mass, kinetic energy, Higgs field, reverse Higgs field, wave-particle duality, relativity, quantum field theory, the Big Bang, dark matter, baryonic matter, superconductivity, black hole, galaxy evolution
fractional electric charge	integral electric charge	composite	individual	symmetrical combination of quarks, leptons, and bosons	fractional charge quark composites, integral charge particle individuals, the periodic table of elementary particles

3. The Inclusiveness-Exclusiveness System

In the inclusiveness-exclusiveness system, a particle is transformed into inclusive occupation of position by the integer spin operator for inclusive boson, while a particle is transformed into exclusive occupation of position by the ½ spin operator for exclusive fermion. The Bose-Einstein statistics allows bosons of the same quantum-mechanical state in the same position, while the Pauli exclusion principle excludes fermions of the same quantum-mechanical state from being in the same position. The fundamental symmetry operator for the inclusiveness-exclusive (boson-fermion) system is supersymmetry between boson and fermion.

Under supersymmetry, string exists as ten space-time dimensional (10D) string, and its extension is 11D membrane for M-theory. In conventional physics, space-time dimension numbers are fixed. Compactization is required to account for the observed 4D [19]. As described previously [4], under symmetry physics, the space-time dimension numbers oscillate reversibly between 11D and 10D and between 10D and 4D reversibly dimension by dimension. There is no compactization. Matters in oscillating space-time dimension numbers include 11D membrane, 10D string, and variable D particle as particle in 4D to 11D.

As described previously [4], the oscillating space-time numbers from 10D to 4D follow the QVSL (quantum varying speed of light) transformation which transforms both space-time dimension number (D) and mass dimension number (d). In the QVSL transformation, the speed of light increases with increasing space-time dimension number (D) and decreasing mass in terms of decreasing mass dimension number (d) from 4 to 10,

$$c_D = c/\alpha^{D-4}, \tag{1}$$

$$E = M_0 \cdot (c^2/\alpha^{2(D-4)}) \tag{2}$$

$$= (M_0/\alpha^{2(d-4)}) \cdot c^2 . \tag{3}$$

$$c_D = c_{D-n}/\alpha^{2n}, \tag{4}$$

$$M_{0,D,d} = M_{0,D-n,d+n}\ \alpha^{2n}, \tag{5}$$

$$\mathrm{D, d} \xrightarrow{QVSL} (\mathrm{D} \mp n),\ (\mathrm{d} \pm n) \tag{6}$$

$$E_{vacuum,D} = E - M_{0,D}\ c^2 , \tag{7}$$

where c_D is the quantized varying speed of light in space-time dimension number, D, from 4 to 10, c is the observed speed of light in the 4D space-time, α is the fine structure constant for electromagnetism, E is energy, M_0 is rest mass, D is the space-time dimension number from 4 to 10, d is the mass dimension number from 4 to 10, n is an integer, and E_{vacuum} = vacuum energy. For example, in the QVSL transformation, a particle with 10D4d is transformed to a particle with 4D10d from Equation (6). Calculated from Equation (5), the rest mass of 4D10d is $1/\alpha^{12} \approx 137^{12}$ times of the mass of 10D4d. In terms of rest mass, 10D space-time has 4d with the lowest rest mass, and 4D space-time has 10d with the highest rest mass. Rest mass decreases with increasing space-time dimension number. The decrease in rest mass means the increase in vacuum energy ($E_{\text{vacuum, D}}$), so vacuum energy increases with increasing space-time dimension number. The vacuum energy of 4D particle is zero from Equation (7). The mass dimension number is limited from 4 to 10, because 4D is the minimum space-time, and 11D membrane and 10D string are equal in the speed of light, rest mass, and vacuum energy. Since the speed of light increases with increasing space-time dimension number, and the speed of light for > 4D particle is greater than the speed of light for 4D particle, the observation of > 4D superluminal particles by 4D particles violates casualty. Thus, > 4D particles are hidden particles with respect to 4D particles. Particles with different space-time dimensions are transparent and oblivious to one another, and separate from one another if possible.

In conventional physics, supersymmetry transformation is constant supersymmetry transformation where two supersymmetry transformations from boson to fermion and from fermion to boson yield a spatial translation at the same mass dimension number. As described previously [3, 4], in varying supersymmetry, the repetitive transformation between fermion and boson brings about a spatial translation and the transformation into the adjacent mass dimension number. Varying supersymmetry transformation is one of the two steps in transformation involving the oscillation between 10D particle and 4D particle. The transformation during the oscillation between 10D particle and 4D particle involves the stepwise two-step transformation consisting of the QVSL transformation and the varying supersymmetry transformation. The QVSL transformation involves the transformation of space-time dimension, D whose mass increases with decreasing D for the decrease in vacuum energy. The varying supersymmetry transformation involves the transformation of the mass dimension number, d whose mass decreases with decreasing d for the fractionalization of particle, as follows.

$$\text{stepwise two-step varying transformation}$$
$$(1)\quad D,\ d \xleftrightarrow{\text{QVSL}} (D \mp 1),\ \ (d \pm 1) \tag{8}$$
$$(2)\quad D,\ d \xleftrightarrow{\text{varying supersymmetry}} D,\ (d \pm 1)$$

The repetitive stepwise two-step transformation between 10D4d and 4D4d as follows.

$$10D4d \leftrightarrow 9D5d \leftrightarrow 9D4d \leftrightarrow 8D5d \leftrightarrow \bullet\bullet\bullet\bullet \leftrightarrow 4D5d \leftrightarrow 4D4d \tag{9}$$

In this two-step transformation, the transformation from 10D4d to 9D5d involves the QVSL transformation as in Equation (6). The transformation of 9D5d to 9D4d involves the varying supersymmetry transformation. In the normal supersymmetry transformation, the repeated application of the fermion-boson supersymmetry transformation carries over a boson (or fermion) from one point to the same boson (or fermion) at another point at the same mass. In the varying supersymmetry transformation, the repeated application of the fermion-boson supersymmetry transformation carries over a boson from one point to the boson at another point at different mass dimension number in the same space-time number. The repeated varying supersymmetry transformation carries over a boson B_d into a fermion F_d and a fermion F_d to a boson B_{d-1}, which can be expressed as follows

$$M_{d,\,F} = M_{d,\,B}\,\alpha_{d,\,B}, \tag{10a}$$

$$M_{d-1,\,B} = M_{d,\,F}\,\alpha_{d,\,F}, \tag{10b}$$

where $M_{d,\,B}$ and $M_{d,\,F}$ are the masses for a boson and a fermion, respectively, d is the mass dimension number, and $\alpha_{d,\,B}$ or $\alpha_{d,\,F}$ is the fine structure constant that is the ratio between the masses of a boson and its fermionic partner. where $M_{d,\,B}$ and $M_{d,\,F}$ are the masses for a boson and a fermion, respectively, d is the mass dimension number, and $\alpha_{d,\,B}$ or $\alpha_{d,\,F}$ is the fine structure constant that is the ratio between the masses of a boson and its fermionic partner. Assuming α's are the same, it can be expressed as

$$M_{d,\,B} = M_{d+1,\,B}\,\alpha_{d+1}^{2}\,. \tag{10c}$$

As described previously [4,6,7], the oscillation between 10D and 4D results in the reversible cyclic fractionalization-contraction for the reversible cyclic expansion-contraction of the universe which does not involve irreversible kinetic energy.

Under symmetry physics, universe is reversible. As described previously [4,6,7], starting from the zero-energy interuniversal void, our universe is the dual universe as the reversible cyclic dual universe as shown in Figure 1.

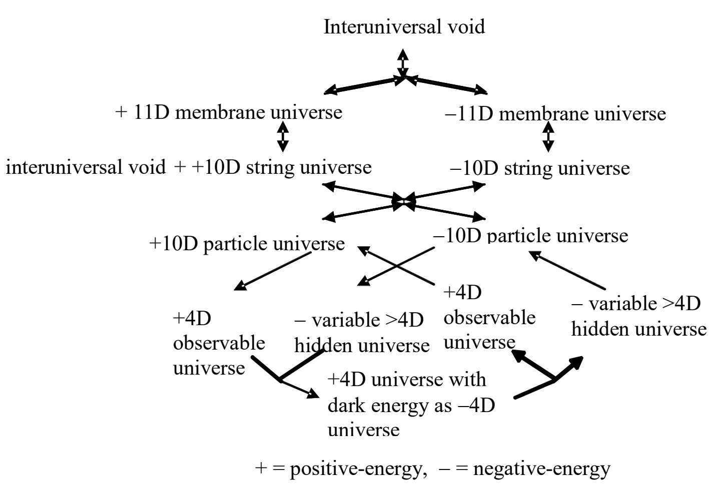

Figure 1. The reversible cyclic dual universe

The four reversible stages in the reversible cyclic dual universe are (1) the formation of the 11D membrane dual universe, (2) the formation of the 10D string dual universe, (3) the formation of the 10D particle dual universe, and (4) the formation of the asymmetrical dual universe. In the stage 3, there are four equal regions: the 10D positive-energy particle universe, the external graviton, the 10D negative-energy particle universe, and the external anti-graviton. In the stage 4, the 10D positive-energy universe is transformed immediately into the 4D positive-energy particle universe with zero vacuum energy. The 10D negative-energy particle universe undergoes the stepwise dimension number oscillation between 10D and 4D. The external graviton and anti-graviton also undergo the stepwise dimension number oscillation between 10D and 4D. The result is the asymmetrical dual universe consisting of the four equal regions of the 4D positive-energy particle universe, the variable D external graviton, the variable D negative-energy particle universe, and the variable D external anti-graviton.

For the variable D negative-energy particle universe, the stepwise dimension number oscillation between 10D and 4D involves the stepwise two-step transformation: the QVSL transformation and the varying supersymmetry transformation from 10D4d to 4D4d. (The particles in the 10D dual particle universe are 10D4d.) The QVSL transformation involves the transformation of space-time dimension, D. The repetitive stepwise two-step transformation from 10D4d to 4D10d as follows.

$$\begin{array}{l} 10D4d \rightarrow 9D5d \rightarrow 9D4d \rightarrow 8D5d \rightarrow \bullet\bullet\bullet\bullet \rightarrow 4D5d \rightarrow 4D4d \\ \mapsto \textit{hidden} \quad \textit{dark} \qquad\qquad \textit{universe} \quad \leftarrow\mapsto \textit{dark} \quad \textit{energy} \quad \leftarrow \end{array} \tag{11}$$

The variable D negative-energy particle universe consists of two periods: the hidden variable D negative-energy particle universe and the dark energy universe. The hidden variable D negative-energy particle universe composes of the > 4D particles. As mentioned before, particles with different space-time dimensions are transparent and oblivious to one another, and separate from one another if possible. Thus, > 4D particles are hidden and separated particles with respect to 4D particles in the 4D positive-energy particle universe (our observable universe). The hidden variable D negative-energy particle universe with D > 4 and the observable universe with D = 4 are the "parallel universes". The 4D particles transformed from hidden > 4D particles in the variable D negative-energy particle universe are observable dark energy for the 4D positive-energy particle universe, resulting in the accelerated expanding universe. The presence of dark energy is not different from the presence of the cosmological constant. According to the theoretical calculation based on the asymmetrical dual universe, dark energy started in 4.47 billion years ago in agreement with the observed 4.71 ± 0.98 billion years ago [7]. Our asymmetrical dual universe consists of the four equal regions of the 4D positive-energy particle universe, the variable D external graviton, the variable D negative-energy particle universe, and the variable D external anti-graviton, so the percentage the variable D area is 75%, three out of four regions, as the maximum percentage of dark energy. After the maximally connected universe, 4D dark energy transforms back to > 4D particles that are not observable. The removal of dark energy in the observable universe results in the stop of accelerated expansion and the start of contraction of the observable universe. The end of dark energy starts another "parallel universe period". Under symmetry, both hidden universe and observable universe contract synchronically and equally. Eventually, the Big Crush occurs in the 4D positive-energy particle universe. The dual universe can undergo another cycle of the cyclic dual universe. On the other hand, both universes can undergo the reverse charge transformation to become the 10D dual string universe, which in turn can return to the 11D dual membrane universe that in turn can return to the zero-energy universe as Figure 1.

4. The Rest-Movement System

In the rest-movement system [4], a moving massless particle (kinetic energy) is transformed into a resting massive particle (rest mass) by the attachment space (denoted as 1 for the space of matter) operator to explain the Higgs field, while a resting massive particle is transformed into a moving massless particle by the detachment space (denoted as 0 for the zero-space of matter) operator to explain the reverse Higgs field. Attachment space attaches to matter permanently or reversibly. Detachment space detaches from the object at the speed of light. In conventional physics, space does not couple with particles, and is the passive zero-energy ground state space. Under spontaneous symmetry breaking in conventional physics, the passive zero-energy ground state is converted into the active, permanent, and ubiquitous nonzero-energy Higgs field, which couples with massless particle to produce the transitional Higgs field-particle composite. Under spontaneous symmetry restoring, the transitional Higgs field-particle composite is converted into the massive particle with the longitudinal component on zero-energy ground state without the Higgs field as follows.

$$\begin{array}{l} \text{zerro} - \text{energy groud state space} \xrightarrow{\text{spon tan eous symmetry breaking}} \text{nonzero} - \text{energy scalar Higgs field} \\ \xrightarrow{\text{massless particle}} [\text{the transitional nonzero} - \text{energy Higgs field} - \text{particle composite}] \xrightarrow{\text{spon tan eous symmetry restoring}} \\ \text{massive particle with the longitudinal component on zero} - \text{energy ground state space without the Higgs field} \end{array} \tag{12}$$

In conventional physics, the nonzero-energy scalar Higgs Field exists permanently in the universe. The problem with such nonzero-energy field is the cosmological constant problem from the huge gravitational effect by the nonzero-energy Higgs field in contrast to the observation [20].

As described before [4], in the rest-movement system, unlike passive space in conventional physics, space as the zero-energy ground state space couples with particles, Attachment space is the origin of the Higgs field. Under spontaneous symmetry breaking, attachment space as the active zero-energy ground state space couples with massless particle to form momentarily the transitional non-zero energy Higgs field-particle composite. The Higgs field is momentary and transitional, avoiding the cosmological constant problem. Under spontaneous symmetry restoring, the transitional nonzero-energy Higgs field-particle composite is converted into massive particle with the longitudinal component on zero-energy attachment space without the Higgs field as follows.

$$\begin{gathered}\text{massless particle} + \text{zero} - \text{energy attachment space} \xrightarrow{\text{spon tan eous symmetry breaking}} \\ \left[\text{the transitional non} - \text{zero energy Higgs field} - \text{particle composite}\right] \xrightarrow{\text{spon tan eous symmetry restoring}} \\ \text{massive particle with the longitudinal component on zero} - \text{energy attachment space without the Higgs field}\end{gathered} \tag{13}$$

Detachment space is the origin of the reverse Higgs field. Unlike the conventional model, detachment space actively couples to massive particle. Under spontaneous symmetry breaking, the coupling of massive particle to zero-energy detachment space produces the transitional nonzero-energy reverse Higgs field-particle composite which under spontaneous symmetry restoring produces massless particle on zero-energy detachment space without the longitudinal component without the reverse Higgs field as follows.

$$\begin{gathered}\textit{massive particle} + \textit{zero} - \textit{energy det achment space} \xrightarrow{\textit{spon tan eous symmetry breaking}} \\ \cdot \left[\textit{the transitional nonzero} - \textit{energy reverse Higgs field} - \textit{particle composite}\right] \xrightarrow{\textit{spon tan eous symmetry restoring}} \\ \textit{massless particle without the longitudinal component on zero} - \textit{energy det achment space without the reverse Higgs field}\end{gathered} \tag{14}$$

For the electroweak interaction in the Standard model where the electromagnetic interaction and the weak interaction are combined into one symmetry group, under spontaneous symmetry breaking, the coupling of the massless weak W, weak Z, and electromagnetic A (photon) bosons to zero-energy attachment space produces the transitional nonzero-energy Higgs fields-bosons composites which under partial spontaneous symmetry restoring produce massive W and Z bosons on zero-energy attachment space with the longitudinal component without the Higgs field, massless A (photon), and massive Higgs boson as follows.

$$\begin{gathered}\text{massless WZ} + \text{zero} - \text{energy WZ attachment space} + \text{massless A} + \text{zero} - \text{energy A attachment space A} \\ \xrightarrow{\text{spon tan eous symmetry breaking}} \\ \left[\text{the transitional nonzero} - \text{energy WZ Higgs field} - \text{WZ composite}\right] + \left[\text{nonzero} - \text{energy A Higgs field} - \text{A composite}\right] \\ \xrightarrow{\text{partial spon tan eous symmetry restoring}} \\ \text{massive WZ with the longitudinal component on attachment space without the Higgs field} \\ + \text{massless A} + \text{the nonzero energy massive Higgs boson}\end{gathered} \tag{15}$$

In terms of mathematical expression, the conventional permanent Higgs field model and the transitional Higgs field model are identical. The interpretations of the mathematical expression are different for the permanent Higgs field model and the transitional Higgs field model. The transitional Higgs field model avoids the cosmological problem in the permanent Higgs field model.

The multiverse has been studied extensively [21]. Under symmetry physics, the multiverse is reversible. The reversible multiverse model is a simple and neat version of the multiverse to exclude all permanently irreversible phenomena and physical laws. One irreversible phenomenon which is not allowed is the collision of expanding universes. The collision of expanding universes which have the inexhaustible resource of space-time to expand is permanently irreversible due to the impossibility to reverse the collision of expanding universes. To prevent the collision of expanding universes, every universe is surrounded by the interuniversal void that is functioned as the permanent gap among universes. The space in the interuniversal void is detachment space [6] which detaches matter and relates to kinetic energy. The interuniversal void has zero-energy, zero space-time, and zero vacuum energy, and detachment space only, while universe has nonzero-energy, the inexhaustible resource of space-time to expand, zero or/and non-zero vacuum energy, and attachment space with or without detachment space. Attachment space attaches matter and relates to rest mass. The detachment space of the interuniversal void has no space-time, so it cannot couple to particles with space-time in universes, but it prevents the advance of expanding universes to the interuniversal void to avoid the collision of expanding universes.

A zero-sum energy dual universe of positive-energy universe and negative-energy universe can be created in the zero-energy interuniversal void, and the new dual universe is again surrounded by the interuniversal void to avoid the collision of universes. Under symmetry, the new positive-energy universe and the new negative-energy universe undergo mutual annihilation to reverse to the interuniversal void immediately. Our universe is the dual asymmetrical positive-energy-negative-energy universe where the positive-energy universe on attachment space absorbed the interuniversal void on detachment space to result in the combination of attachment space and detachment space, and the negative-energy universe did not absorb the interuniversal void. Within the positive-energy universe, the absorbed detachment space with space-time can couple to particles in the positive-energy universe to result in massless particles with irreversible kinetic energy. The formation of our universe involves symmetry violation between the positive-energy universe and the negative energy universe. Irreversible kinetic energy from detachment space is the source of irreversible entropy increase, so the positive-energy universe is locally irreversible, while the negative-energy universe without irreversible kinetic energy from detachment space is locally reversible. The locally reversible negative-energy universe guides the reversible process of the dual universe. As a result, our whole dual universe is globally reversible. Our dual universe is the reversible cyclic dual universe as shown in Figure 1 for the evolution of our universe as described previously [4,6,7].

In the stage 4 of cosmology, the 10D positive-energy universe was transformed immediately into the 4D positive-energy particle universe with zero vacuum energy. The formation of 4D positive-energy particle universe involved the two-step transformation: 1.the inflation and 2, the Big Bang. In the first step, the inflation is the transformation from 10D4d to 4D10d immediately. Calculated from Equation (5), the rest mass of 4D10d is $M_{0,10} = M_{0,4}/\alpha^{2(10-4)} \approx 137^{12}$ times of the rest mass of 10D4d, resulting in the first step of the inflation as the rapid expansion of space from the high vacuum energy 10D4d to the zero vacuum energy 4D10d as follows [6].

$$\begin{array}{l}\text{1. }\underline{\text{the inflation}}\\ \text{10D4d}\xrightarrow{\text{quick QVSL transforma tion}}\text{4D10d}\end{array} \tag{16}$$

As described previously [4,6,7], in the second step of the transformation, the Big Bang is a two-step process as follows.

$$\begin{array}{l}\textit{2. }\underline{\textit{The Big Bang}}\\ \textit{1. massive particles on attachment space + det achment space}\xrightarrow{\textit{total conversion}}\\ \textit{massless particles on det achment space + the external attachment space}\\ \textit{2. massless particles on det achment space + the external attachment space}\xrightarrow{\textit{partial conversion}}\\ \textit{massless particles + massive particles + det achment space + attachment space + the Higgs boson}\end{array} \tag{17}$$

The result of the Big Bang is the the combination of attachment space and detachment in the positive-energy universe. The fundamental symmetry operator for the rest-movement system is the symmetrical combination of attachment space and detachment space. The symmetrical combination of n units of attachment space as 1 and n units of detachment space as 0 brings about three different space structures: binary partition space, miscible space, or binary lattice space as below.

$$\underset{\textit{attachment space}}{(1)_n} + \underset{\textit{det achment space}}{(0)_n} \xrightarrow{\textit{combinatio n}} \underset{\textit{binary partition space}}{(1)_n(0)_n}, \quad \underset{\textit{miscible space}}{(1+0)_n}, \textit{ or } \underset{\textit{binary lattice space}}{(1\ 0)_n} \tag{18}$$

Binary partition space, $(1)_n(0)_n$, consists of two separated continuous phases of multiple quantized units of attachment space and detachment space. In miscible space, $(1+0)_n$, attachment space is miscible to detachment space, and there is no separation of attachment space and detachment space. Binary lattice space, $(1\ 0)_n$, consists of repetitive units of alternative attachment space and detachment space. In conventional physics, space does not couple with particles. In the rest-movement system, space couples with particles.

In binary partition space $(1)_n(0)_n$, an entity is both in constant motion as standing wave for detachment space and in stationary state as a particle for attachment space, resulting in the wave-particle duality. Such duality can be described by the uncertainty principle. The uncertainty principle for quantum mechanics is expressed as follows.

$$\sigma_x \sigma_p \geq \frac{\hbar}{2} \tag{19}$$

The position, x, and momentum, p, of a particle cannot be simultaneously measured with arbitrarily high precision. The uncertainty principle requires every physical system to have a zero-point energy (non-zero minimum momentum) and to have a non-zero minimum wavelength as the Planck length. In terms of the binary partition space, detachment space relating to kinetic energy as momentum is σ_p, and attachment space relating to space (wavelength) for a particle is σ_x. In binary partition space, neither detachment space nor attachment space is zero in the uncertainty principle, and detachment space is inversely proportional to attachment space. Quantum mechanics for a particle follows the uncertainty principle defined by binary partition space. Binary partition space $(1)_n(0)_n$ can also be described by the Schrodinger in quantum mechanics where total energy equals to kinetic energy related to $(0)_n$ plus potential energy related to $(1)_n$.

Detachment space contains no matter that transmits information. Without transmitting information, detachment space is outside of the realm of causality. Without causality, distance (space) and time do not matter to detachment space, resulting in non-localizable and non-countable space-time. The requirement for the system (binary lattice space) containing non-localizable and non-countable detachment space is the absence of net information by any change in the space-time of detachment space. All changes have to be coordinated to result in zero net information. This coordinated non-localized binary lattice space corresponds to nilpotent space. All changes in energy, momentum, mass, time, space have to result in zero [22]. The non-local property of binary lattice space for wavefunction provides the violation of Bell inequalities [23] in quantum mechanics in terms of faster-than-light influence and indefinite property before measurement. The non-locality in Bell inequalities does not result in net new information. Binary partition space explains the nonlocal pilot-wave theory (Bohmian mechanics) where the trajectories of particles are nonlocal and fully determined by the pilot wave [24].

In binary partition space, for every detachment space, there is its corresponding adjacent attachment space. Thus, no part of the mass-energy can be irreversibly separated from binary partition space, and no part of a different mass-energy can be incorporated in binary partition space. Binary partition space represents coherence as wavefunction. Binary partition space is for coherent system. Any destruction of the coherence by the addition of a different mass-energy to the mass-energy causes the collapse of binary partition space into miscible space. The collapse is a phase transition from binary partition space to miscible space.

$$\underset{\textit{binary partition space}}{(0)_n(1)_n} \xrightarrow{\textit{collapse}} \underset{\textit{miscible space}}{(0+1)_n} \tag{20}$$

Another way to convert binary partition space into miscible space is gravity. Penrose [25] pointed out that the gravity of a small object is not strong enough to pull different states into one location. On the other hand, the gravity of large object pulls different quantum states into one location to become miscible space. Therefore, a small object without outside interference is always in binary partition space, while a large object is never in binary partition space.

The information in miscible space is contributed by the miscible combination of both attachment space and detachment space, so information can no longer be non-localized. Any value in miscible space is definite and deterministic. All observations in terms of measurements bring about the collapse of wavefunction, resulting in miscible space that leads to eigenvalue as definite quantized value. Such collapse corresponds to the appearance of eigenvalue, E, by a measurement operator, H, on a wavefunction, Ψ.

$$H\Psi = E\Psi \tag{21}$$

In miscible space, attachment space is miscible to detachment space, and there is no separation of attachment space and detachment space. In miscible space, attachment space contributes zero speed, while detachment space contributes the speed of light. For a moving massive particle consisting of a rest massive part and a massless part, the massive part with rest mass, m_0, is in attachment space, and the massless part with kinetic energy, K, is adjacent to detachment space. The combination of the massive part in attachment space and massless part in detachment leads to the propagation speed in between zero and the speed of light. To maintain the speed of light constant for a moving particle, the time (t) in moving particle has to be dilated, and the length (L) has to be contracted relative to the rest frame.

$$\begin{aligned} t &= t_0 \Big/ \sqrt{1-\upsilon^2/c^2} = t_0\gamma, \\ L &= L_0/\gamma, \\ E &= K + m_0c^2 = \gamma m_0 c^2 \end{aligned} \tag{22}$$

where $\gamma = 1/(1 - v^2 / c^2)^{1/2}$ is the Lorentz factor for time dilation, and length contraction, E is the total energy, and K is the kinetic energy.

Bounias and Krasnoholovets [26] propose that the reduction of dimension can be done by slicing dimension, such as slicing 3 space dimension object (block) into infinite units of 2 space dimension objects (sheets). As shown previously [4,6,7], the positive-energy 10D4d particle universe as our observable universe with high vacuum energy was transformed into the 4D10d universe with zero vacuum energy at once, resulting in the inflation. During the Big Bang following the inflation, the 10d (mass dimension) particle in attachment space denoted as 1 was sliced by detachment space denoted as 0. For example, the slicing of 10d particle into 4d particle is as follows.

$$\underset{10d\ \ particle}{1_{10}} \xrightarrow{slicing} \underset{4d\ \ core\ \ particle}{1_4} \quad \underset{binary\ \ lattice\ \ space}{\sum_{d=5}^{10}\left(0_4\ \ 1_4\right)_{n,d}} \tag{23}$$

where 1_{10} is 10d particle, 1_4 is 4d particle, d is the mass dimension number of the dimension to be sliced, n as the number of slices for each dimension, and $(0_4\ 1_4)_n$ is binary lattice space with repetitive units of alternative 4d attachment space and 4d detachment space. For 4d particle starting from 10d particle, the mass dimension number of the dimension to be sliced is from d = 5 to d = 10. Each mass dimension is sliced into infinite quantized units (n = ∞) of binary lattice space, $(0_4\ 1_4)_\infty$. For 4d particle, the 4d core particle is surrounded by 6 types (from d = 5 to d = 10) of infinite quantized units of binary lattice space. Such infinite quantized units of binary lattice space represent the infinite units (n = ∞) of separate virtual orbitals for virtual particles in a gauge force field, while the dimension to be sliced is "mass dimensional orbital" (DO), representing a type of gauge force field. In addition to the six DO's for gauge force fields from d = 5 to d = 10, gravity appears as the seventh DO at d = 11. As a result, there are seven mass dimensional orbitals as in Figure 2.

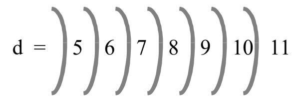

Figure 2. The seven mass dimensions as mass dimensional orbitals.

10d particle was sliced into six different particles: 9d, 8d, 7d, 6d, 5d, and 4d equally by mass. Baryonic matter is 4d, while dark matter consists of the other five types of particles (9d, 8d, 7d, 6d, and 5d).

$$10D4d \xrightarrow{\text{the inflation}} 4D10d \xrightarrow{\text{the Big Bang}} \text{baryonic matter (4D4d) + dark matter (4D5d, 4D6d, 4D7d, 4D8d, 4D9d) + kinetic energy} \tag{24}$$

The mass ratio of dark matter to baryonic matter is 5 to 1. At 72.8% dark energy, the calculated values for baryonic matter and dark matter (with the 1:5 ratio) are 4.53% (= (100 – 72.8)/6) and 22.7% (= 4.53 x 5), respectively, in excellent agreement with observed 4.56% and 22.7%, respectively [7, 15.16].

As shown in the periodic table of elementary particles described previously [18], the lowest dimensional orbital is for electromagnetism. Baryonic matter with maximum number of gauge force fields (dimensional orbitals) is the only one with the lowest dimensional orbital for electromagnetism. With higher dimensional orbitals, dark matter does not have this lowest dimensional orbital. Without electromagnetism, dark matter cannot emit light, and is incompatible to baryonic matter with electromagnetism, like the incompatibility between oil and water. Derived from the incompatibility between dark matter and baryonic matter, the modified interfacial gravity (MIG) between homogeneous baryonic matter region and homogeneous dark matter region to separate baryonic matter region and dark matter region explains galaxy evolution and unifies the CDM (Cold Dark Matter) model, MOG (Modified Gravity), and MOND (Modified Newtonian Dynamics) [13,14]. The space structures based on the combination of binary partition space and binary lattice space explain superconductivity [10] and superstar without singularity to replace black hole with singularity [11,12]. Singularity is permanently irreversible by losing information permanently, forbidden in the reversible multiverse.

5. The Composite-Individual System

In the composite-individual system [17], particles are transformed into composite by the fractional electric charge operator to explain fractional charge quark composites, while particles are transformed into individual by the integral electric charge operator to explain integral charge particle individuals. In a fractional charge quark composite, individual quarks are confined in a quark composite, and not allowed to have irreversible kinetic energy which split the quark composite. Individual leptons, on the other hand, are allowed to have irreversible kinetic energy. Therefore, as described before [17], the composite-individual system corresponds to the system of the disallowance for fractional electric charge particle and the allowance of irreversible kinetic energy for integral electric charge particle. Collective fractional charges are confined by the short-distance confinement force field where the sum of the collective fractional charges is integer. As a result, fractional charges are confined and collective. The confinement force field includes gluons in QCD (quantum chromodynamics) for collective fractional charge quarks in hadrons and the magnetic flux quanta for collective fractional charge quasiparticles in the fractional quantum Hall effect (FQHE) [27,28,29].

The fundamental symmetry operator for the composite-individual system is the symmetrical combination of quarks, leptons, and bosons. Under the symmetry operator, integral charge particles and fractional charge quarks are symmetrical in terms of mass dimensional orbitals. There are seven mass dimensional orbitals for integral charge particles, and fractional charge quarks have their own seven mass dimensional orbitals as the seven auxiliary mass dimensional orbitals in addition to the seven principal mass dimensional orbitals for leptons as in Figure 3

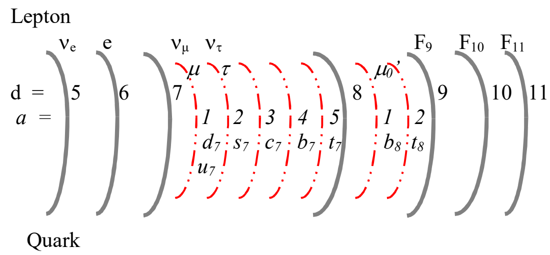

Figure 3. Leptons and quarks in the seven principal dimensional orbitals (solid lines) denoted by the principal dimensional orbital number d and the seven auxiliary dimensional orbitals (dash-dotted lines) denoted by the auxiliary dimensional number *a*.

The four reversible stages in the globally reversible cyclic dual universe are (1) the formation of the 11D membrane dual universe, (2) the formation of the 10D string dual universe, (3) the formation of the 10D particle dual universe, and (4) the formation of the asymmetrical dual universe. The pre-strong force (the prototype of observed strong force) and pre-gravity emerged in the stage 2. The pre-electromagnetism emerged in the stage 3, while the weak force emerged in the stage 4. The four force fields (gauge bosons) are the four of the seven principal mass dimensional orbitals (B_d) as in Table 2. The other three of the seven principal mass dimensional orbitals are for the CP (right) nonconservation, the CP (left) nonconservation, and the weak (right) force.

Table 2. The masses of the principal mass dimensional orbitals (gauge bosons)
$\alpha = \alpha_e$, d = mass dimensional orbital number

B_d	M_d	GeV (calculated)	Gauge boson	Interaction
B_5	$M_e\, \alpha$	$3.7\text{x}10^{-6}$	A = photon	Electromagnetic
B_6	M_e/α	$7\text{x}10^{-2}$	gluon	Strong
B_7	M_6/α_w^2	91.1876 (given)	Z_L^0	weak (left)
B_8	M_7/α^2	$1.71\text{x}10^6$	X_R	CP (right) nonconservation
B_9	M_8/α^2	$3.22\text{x}10^{10}$	X_L	CP (left) nonconservation
B_{10}	M_9/α^2	$6.04\text{x}10^{14}$	Z_R^0	weak (right)
B_{11}	M_{10}/α^2	$1.13\text{x}10^{19}$	G	Gravity

The periodic table of elementary particles for leptons, quarks, and gauge boson is in Table 3 with both the principal mass dimensional orbital numbers and the auxiliary mass dimensional orbital numbers.

Table 3. The periodic table of elementary particles
d = principal mass dimensional orbital number, a = auxiliary mass dimensional orbital number

d	a = 0	1	2	1	2	3	4	5	
	Lepton			Quark					Boson
5	ν_e								$B_5 = A$
6	e								B_6 = gluon
7		ν_μ / μ	ν_τ/τ	d_7/u_7	s_7	c_7	b_7	t_7	$B_7 = Z_L^0$
8		μ_0' (hidden)		b_8 (hidden)	t_8				$B_8 = X_R$
9	F_9								$B_9 = X_L$
10	F_{10}								$B_{10} = Z_R^0$
11	F_{11}								B_{11} gravity

The periodic table of elementary particles calculates accurately and predict theoretically the particle masses of all leptons, quarks, gauge bosons, the Higgs boson, and cosmic rays (the knees-ankles-toe) by using only five known constants: the number (seven) of the extra spatial dimensions in the eleven-dimensional membrane, the mass of electron, the masses of Z and W bosons, and the fine structure constant. The gauge boson mass formula is derived from Equation (10c),

$$M_{d+1,\ gauge\ boson} = M_{d,\ gauge\ boson} / \alpha^2_{d+1} . \tag{25}$$

Each dimension has its own α_d, and all α_d's except α_7 (α_w) of the seventh dimension (weak interaction) are equal to α, the fine structure constant of electromagnetism. The lowest energy boson is the Coulombic field for electromagnetism based on Equation (10b). As described previously [5], the second lowest energy boson B_6 (M_e/α = 70MeV) exists in two forms: the flux quanta for the mass of constituent quark and gluon for the interaction among current quarks in QCD. As described previously [30], B_8, F_9, and B_9 in Table 3 are observed in cosmic rays as the first knee, the second knee, and the toe, respectively, where the calculated masses are in good agreement with the observed masses [30]. The calculated energy for B_{11} is $1.13\text{x}10^{19}$ GeV in good agreement with the Planck mass, $1.22\text{x}10^{19}$ GeV for gravity.

As described previously [5], the lepton mass formula is expressed as follows.

$$M_{lepton} = M_e + \frac{3M_e}{2\alpha} \sum_{a=0}^{n} a^4 , \tag{26}$$

where n = 0, 1, and 2 are for e, μ, and τ, respectively. The calculated mass of τ is 1786.2 MeV in good agreement with the observed mass as 1776.82 MeV.

As described previously [5], the quark constituent mass formula is as follows.

$$M_{quark} = \frac{1\ or\ 2\ Me}{3} + \frac{9Me}{2\alpha} + \frac{9M_\mu \alpha_w}{2} \sum_{a=1}^{n} a^4 + \frac{3M_Z}{2} + \frac{9M_Z\alpha}{4} \sum_{a'=1}^{n'} a'^4 \tag{27}$$

where n =1, 2, 3, 4, and 5 for d/u. s, c, b, and t, respectively, and n' = 1 and 2 for b and t respectively. The calculated masses for d, u, s, c, b, and t are 328.4 MeV, 328.6 MeV, 539 MeV, 1605.3 MeV, 4974.6 MeV, and 175.4 GeV, respectively. In the Standard Model, there are three generations of leptons. The calculated mass of top quark is 175.4 GeV in good agreement with the observed 172.4 GeV [31]. The calculated masses are the constituent masses which are comparable to the quark masses proposed by De Rujula, Georgi, and Glashow [32], Griffiths [33], and El Naschie [34]. The quark current mass [33] is derived mostly from the quark constituent mass minus $9M_e/2\alpha$ (the second term in Equation (27)) which becomes massless gluons in QCD. The masses of hadrons are the combinations of the constituent quark masses minus the binding energy in the hadronic bond among quarks [35,36]. As described previously [5, 37], the mass of the Higgs boson involves the extra-muon μ_0' in the periodic table of elementary particles (Table 3). The calculated mass of the Higgs boson is 126 GeV [5,37] in excellent agreement with the observed 125 GeV [38] or 126 GeV [39].

6. Summary

The unified theory of physics is based on both symmetry physics and yinyang physics to unify all physical laws and phenomena, all four fundamental forces, and all elementary particles. Conventional symmetry physics preserves the physical features of a system under transformation by a symmetry operator. In unconventional yinyang physics, yin and yang constitute a binary yinyang system of opposite physical properties by yin and yang operators. The three fundamental symmetry operators transform the three fundamental yinyang systems (inclusiveness-exclusiveness, rest-movement, and composite-individual) into the unified theory of physics.

In the inclusiveness-exclusiveness system, a particle is transformed into inclusive boson with inclusive occupation of position by the integer spin operator, while a particle is transformed into exclusive fermion with exclusive occupation of position by the ½ spin operator based on the Pauli exclusion principle. The fundamental symmetry operator for boson-fermion is supersymmetry which results in M-theory and cosmology. The inclusiveness-exclusiveness system explains dark energy, and calculates accurately when dark energy started.

In the rest-movement system, a moving massless particle (kinetic energy) is transformed into a resting massive particle (rest mass) by the attachment space (denoted as 1 for the space of matter) operator to explain the Higgs field, while a resting massive particle is transformed into a moving massless particle by the detachment space (denoted as 0 for the zero-space of matter) operator to explain the reverse Higgs field. The fundamental symmetry operator is the symmetrical combination of attachment space and detachment space to bring about the three space structures: binary partition space, (1)n(0)n, for wave-particle duality, binary miscible space, (1+0)n, for relativity, and binary lattice space, (1 0)n, for virtual particles in quantum field theory. The rest-movement system also explains the Big Bang, dark matter, baryonic matter, superconductivity, black hole, and the galaxy evolution, and calculates accurately the percentages of dark matter and baryonic matter.

In the composite-individual system, particles are transformed into fractional charge quark composite by the fractional electric charge operator, while particles are transformed into integral charge particle individuals by the integral electric charge operator. The fundamental symmetry operator is the symmetrical combination of quarks, leptons, and bosons to constitute the periodic table of elementary particles for all elementary particles. The periodic table of elementary particles calculates accurately and predict theoretically the particle masses of all leptons, quarks, gauge bosons, the Higgs boson, and cosmic rays (the knees-ankles-toe) by using only five known constants: the number (seven) of the extra spatial dimensions in the eleven-dimensional membrane, the mass of electron, the masses of Z and W bosons, and the fine structure constant. The calculated masses are in excellent agreements with the observed masses. For examples, the calculated masses of muon, top quark, pion, neutron, and the Higgs boson are 105.55 MeV, 175.4 GeV, 139.54 MeV, 939.43 MeV, and 126 GeV, respectively, in excellent agreements with the observed 105.65 MeV, 172.4 GeV, 139.57 MeV, 939.27 MeV, and 126 GeV, respectively.

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