

Physical Foundations and Mathematical Logic of the Natural World

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Abstract

This paper reconstructs the logical foundations of the physical and mathematical theories that reveal the most fundamental laws of the natural world, based on the Geometry of Space-Time Structures created by the author. There are no quarks in the natural world, and the most fundamental particles in the natural world are protons and electrons. Protons p^+ in atomic nuclei can form strong mutual attraction by exchanging electrons e^- in their immediate neighborhood, there are no neutrons in atomic nuclei. Cosmic expansion does not exist, redshift is a natural phenomenon in the macroscopic world. Geometry of Space-Time Structures is the geometry of motion, which truly reveals the relationships and inner laws of motion and change in the natural world.

Introduction

In the past 100 years since the creation of quantum mechanics and other basic theories, physics, which reveals the most basic laws of nature, has never seen any convincing revolutionary innovation achievements, and the practice of basic theory innovation represented by particle physics and cosmology seems to have gone astray [4-6], especially the mainstream theoretical theories on the structure of the elementary particles, the origin of the universe and other basic issues [7-8].

Based on the most general objective facts, the author reconstructs the logic of the physical foundation of the entire system of natural sciences, establishes the corresponding mathematical system, and creates the geometric theory of space-time structure [1-3].

1. Physical Foundations of the Natural World

1.1 The proton p^+ and the electron e^- are the smallest particle units that make up the objective material world

Proton p^+ and electron e^- are the smallest particle units that make up the objective material world, there are no quarks and fractionally charged elementary particles, the particles with non-zero mass are all composite particles made of p^+ , p^- , e^- and e^+ , there are no other non-composite elementary particles including neutrinos. Protons p^+ in atomic nuclei can form strong mutual attraction by exchanging electrons e^- in their immediate neighborhood, the attraction between protons p^+ in atomic nuclei is the material energy of electrons; the interaction between particles exchanging non-zero mass particle is a zero-distance neighbor strong matter interaction. All other complex particles, including atomic nuclei, are attenuated. The basic structure of the atomic nuclei is $\sum (p^+e^-p^+)$ structure, independent neutrons do not exist in atomic nuclei, atomic nuclei has only a finite size, so the β decay of atomic nuclei, also doesn't

exist the problem of spin non-conservation.

As a fundamental particle, it should be the most prevalent, the most stable, indivisible energy mass quantum, quarks (varieties) are many [9-10], so far not found, the proton p^+ cannot be broken into quarks in high-energy collisions which the energy level of protons even reaches the "limit state" of more than 10Tev [10-11], but protons can annihilate into gamma photons. That quarks do not exist and that protons are the most fundamental mass-matter particles is a very natural underlying physics assumption. The non-existence of quarks does not affect the correctness of the theory of relativity based on the Lorenz transform of Minkowski space [12-13]; the triple symmetry feature of the structure and change of matter is common in nature, and the non-existence of quarks does not affect the application of the Li group based on the successive infinitesimal symmetry transformations in the analysis of the particle reactions and changes of the births and deaths[9][13], and the applicability of the existing gauge transformations[12-13] is not affected. However, the basic particles are only protons, electrons, and photons, the logical basis of theories such as particle physics, much more concise.

In nature, there is no nucleus composed of two protons, nor is there a nucleus composed of two neutrons; high-intensity proton collisions (including protons in high-intensity plasma) do not form a nucleus of two p^+ ; there are no truly stable "mesons" found to be exchanged in "strong interactions" between particles [10-11]; the "neutrinos found" are negligible compared to protons, electrons and photons [5][10]. Therefore, it is natural judgment that there is no strong mutual attraction between nucleons in atomic nuclei, which is formed by the exchange of "mesons". Inside atomic nuclei, neutrons in the high-energy state must disintegrate, and there are only protons p^+ and electrons e^- in atomic nuclei, the protons can form a strong mutual attraction through the exchange of electrons, and the original doubts (β decay spin problem, etc.) can be solved.

1.2 Proton, electron, neutron, photon, the strong action of positive and negative particles

The proton is the mass quantum, inertial quantum; the electron is the charge quantum, the charge-mass ratio quantum, both indivisible. The neutron is the composite structure of the proton and the electron.

Conservation of energy in the natural material world, any material structure and movement form are the manifestation of material energy. Photon is one of the most basic forms of material energy and motion manifestation, is the most basic filler and filler medium of the natural space, the rest mass is zero, the energy is $h\nu$, the spin is \hbar , and the speed of c (light speed) is maximum. Mass, charge, and spin are the basic intrinsic properties of non-zero mass particles. The inertial mass m of a particle is another fundamental manifestation form of energy, with an energy of mc^2 . Positive and negative charges e is one of the endowed energy structural properties of elementary particles, there are no indivisible elementary particles that are not charged, there are no indivisible elementary particles with fractional charge or multiple charge, and the elementary particles with non-zero mass are only the proton and the electron.

With m and \bar{m} , to denote positive and antiparticles, respectively, and with γ and $\bar{\gamma}$, to denote positive gamma photons and negative gamma photons, there exists positive and negative particle annihilation and transformation equation:

$$m + \bar{m} \rightleftharpoons \gamma + \bar{\gamma} \tag{1}$$

The antiparticle of the negative electron e^- is the positron e^+ , the antiparticle of the positive

proton p^+ is the negative proton p^- , the antiparticle of the neutron n is the antineutron \bar{n} ; the neutron n is the (p^+, e^-) composite particle structure, the antineutron \bar{n} is the (p^-, e^+) composite particle structure.

The positive and negative particle annihilation equation (1) reveals that the structure and state of motion of positive and negative particles with the same mass must be the "positive and negative matter symmetry structure" (or "yin and yang symmetry structure") state of matter, which strongly attracts and cancels out mutually. Positive and negative particles are equal in mass and energy, and have opposite structural and kinematic properties such as charge, spin and momentum. The annihilation process of positive and negative particles, is the interconversion of non-zero-mass and zero-mass states of matter, is the most intuitive explanation of the fact that any material structure and motion form is an energy manifestation form. The mass and motion of particles are energy carriers, and the positive and antisymmetric structural properties of particles, such as charge and spin, do not contribute to the total energy of matter, but the charge and spin of protons and electrons, which are the decomposition and combination variables of the energy of the motion of matter, are the dominant factors for the generation of all things of nature by the atomic nuclei and the electrons in space and time.

Positive and negative particle pairs annihilate only if the yin and yang structure states are perfectly antisymmetric. If the states of motion of the positive and negative particle are not in antisymmetric form, such as the positive and negative electron pairs (e^-, e^+) , if $\vec{P}_{e^-} \neq -\vec{P}_{e^+}$, the positive and negative electron pairs do not immediately annihilate into gamma photons and can form instantaneous neutral particle states, and many instantaneously decaying neutral particles are precisely such positive and negative electron pairs in different energy states. Different yin and yang particles, such as (p^+, e^-) pairs, or nuclei and extranuclear electrons, will not be annihilated, but will only form atomic nuclei \rightarrow atoms \rightarrow clusters of atomic molecules \rightarrow natural everything in space-time space, due to different positions and distances, different forms of action and time changes. The proton is much smaller than the electron, but $m_p \gg m_e$, it is the "anchor" of the stability of the structure and state of the object; the spatial scale of the structure of the object, supported and filled by electrons and electromagnetic action, including photons.

The strong interaction can be defined as the interaction between particles that causes a change in inertial mass, and its amount ε is the material energy Δmc^2 corresponding to the inertial mass change Δm , i.e.,

$$\varepsilon = \Delta mc^2 \tag{2}$$

The strong interaction is only related to the mass of the particle, is the process performance of the increase, decrease, recombination and distribution of particle mass, is the simplest, most direct and most essential action form of combination, decomposition or transformation of matter energy, and is the near-neighborhood interaction of high-energy particles such as electrons, protons and their composite particles at zero distance.

The elementary particles with non-zero rest mass only are protons and electrons. There are many strong interaction processes dominated by electrons and their composite particles, which are not strong interaction processes in the existing theories, the typical example being the β decay of atomic nuclei, from which the existing theories also create "weak interactions" and "neutrinos".

Described in geometrical language, the nature of the strong interaction is the superposition and reconstruction of the particle mass-energy yin-yang structure; similarly, electromagnetic and gravitational interactions are the manifestation of the superposition and reconstruction of the

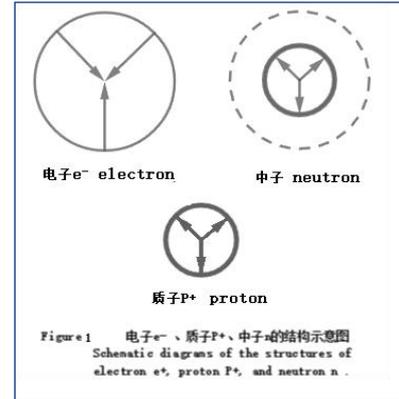
corresponding energy structure states, taking into account the isotropic nature, in the three-dimensional geometrical space, the superposition action of the field energy structure states of the point charge q_1 and q_2 , or of the point mass m_1 and m_2 , is obviously proportional to $\frac{q_1 q_2}{r^2}$ or $\frac{m_1 m_2}{r^2}$, respectively. This in fact explains the so-called "grand unification problem of the four fundamental interactions".

To the annihilation of positive and negative electron pairs, there is an equation:

$$\begin{cases} e^- + e^+ \rightleftharpoons \gamma + \bar{\gamma} \\ 2m_e c^2 = 2h\nu \end{cases} \quad (3)$$

This relationship (3) completely connects the basic forms of matter energy, i.e., the photon, Charge quantum e and its mass quantum m_e . The mass energy of the positron and negative electrons can be completely interconverted with the electromagnetic energy; the electron, as a charge quantum, has an electromagnetic structure, which is itself a basic form of energy and an energy structure; stationary energy has a mass, and according to the relation (3), it can be deduced that the electromagnetic energy of the stationary positive and negative electrons, is its stationary mass energy $m_e c^2$, the inertial mass of the electrons is exactly another manifestation of their electromagnetic structure energy. The electron itself completely unifies electromagnetic energy, mass energy and inertial mass. Strong interaction, electromagnetic interaction, inertial gravitational effect, etc., are only different forms of interaction between objects because of different spatial scales, different structural forms, etc.

Figure 1 is a schematic diagram of the space-time structure of an electron, a proton, and a neutron. The electronegativity of an electron is inward, in a pure electromagnetic matter state, the structure is relatively loose and broad. A proton are positively charged outward and as the main carrier of inertial mass and material energy, with high density and small scale. A neutron is composed of a proton and a rapidly moving electron, the mass centers of the proton and electron completely coincide with the positive and negative charge centers, resulting in the disappearance of their external charge and zero charge, the electron is constrained by a centrally symmetric high-energy potential barrier, and the proton is wrapped around the center of the spacetime structure. So a neutron has a magnetic moment similar to an electron. The energy level of a neutron is higher than that of a proton by $\Delta E = m_n - m_p = 1.2933 \text{ MeV} / c^2 = 2.531 m_e$. Because the high-energy structure of neutrons, there is a high probability of electron escape, and beta decay becomes the norm. There can be no independent neutrons in atomic nuclei, or in other relatively stable heavy particles.



The neutron and ${}^4_2\text{He}$ are the most important composite particles. The high energy level ΔE and decay period τ of the neutron are important space-time matter parameters. At a high energy level of $+2.531 m_e c^2$, the neutron n is destined to have a short lifespan, with an experimental result of 877.75 seconds in 2021 [15]. In 2022, Yixing D.Z. from China discovered that the neutron decay period τ can be obtained entirely using physical constants according to the following formula [16], with a calculated result of 879 seconds:

$$\tau = \frac{\pi h}{(m_n - m_p) c^2} \frac{m_p}{m_e} \sqrt{\frac{c^2}{4\pi\epsilon_0 G m_p m_e}} = \frac{h}{(m_n - m_p) c^2} \frac{\pi e}{m_e} \sqrt{\frac{1}{4\pi\epsilon_0 G}} \sqrt{\frac{m_p}{m_e}} \quad (4)$$

Such a simple and elegant formula is in line with the theoretical logic of expressing natural laws intuitively and concisely in the Geometry of Space-Time Structures. The equation simply unifies the so-called four natural forces into one algebraic formula. The neutron decay period is obviously inversely proportional to its high energy level, directly proportional to the charge mass ratio of a electron (because the electron with high-speed moving is strongly influenced by the positive charge of the proton; including π and a dimensionless correction), and the square root of the mass ratio ($\sqrt{m_p/m_e}$) contributed by the secondary effect of universal gravity.

As shown in Figure 2, three points 1, 2, and 3 on a unit sphere can form a spherical triangle $\Delta 123$, the line connecting them to the center o of the sphere forms a triangular pyramid with o as its vertex, and corresponds to a solid angle Ω with the center o of the sphere as its vertex. There is,

$$\Omega = \iint_s d\Omega = \iint_{\Delta 123} \frac{dS}{R^2} = \iint_{\Delta 123} \kappa^2 dS = \iint_{\Delta 123} dS = S_{\Delta 123} = \angle 1 + \angle 2 + \angle 3 - \pi \quad (5)$$

Where, R is the radius of the surface, $\kappa=1/R$ is the curvature of the surface, and the unit sphere's R and κ are both 1, the final step uses the Spherical Excess Formula. The solid angle corresponding to the entire sphere is 4π . The Gauss-Bonnet theorem gives the relationship between the Gaussian curvature K on any closed smooth surface S and the Euler Characteristic $\chi(s)$ and genus g of the surface S , that is, $\iint K dS = 2\pi\chi(s) = 4\pi(1-g)$. For the $0 \rightarrow 1$ creation of the space-time structure at the scale of $\Delta r \rightarrow 0$ and $\Delta t \rightarrow 0$, the compact convex surface $g=0$, the surface shape is not important or topologically equivalent, and can be a unit sphere, the principal curvature κ and Gaussian curvature $K=\kappa^2$ are both 1 then $\iint K dS = \iint dS = 4\pi$. The surface integral of Gaussian curvature is the solid angle Ω of surface S . In compact discrete spaces, surface calculus is meaningless, Gauss Bonnet theorem and other differential geometric logic are not applicable for analyzing nuclear strong interaction structure of atomic nuclei in extreme small spaces. The solid angle $d\Omega$ is essentially the $\sin \theta * d\theta * d\varphi$ of the polar coordinate system (r, θ, φ) , and is a continuous 2D variable. The continuously differentiable solid angle cannot be used to characterize the structure and fractional dimension of strongly interacting space-time with discreteness, but it can describe the electronic space-time state within composite particles.

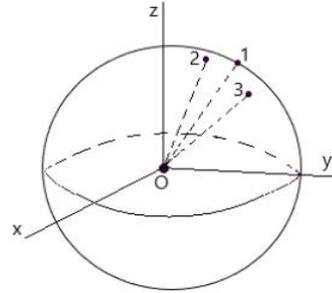


Figure 2 单位球，球心O和球面上点1,2,3连接成三棱锥立体角
Unit sphere, a solid angle of the triangular pyramid formed by the center O and points 1, 2, and 3 on the sphere

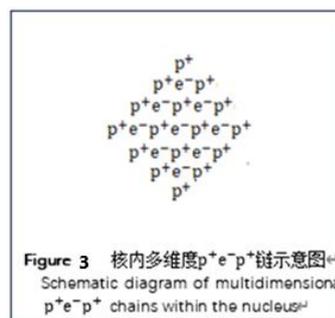
The interaction between the proton and the electron in a neutron is a strong matter interaction, because of the integration of material properties such as charge, mass, and space, it can be concluded that the high energy level of $+2.531 m_e c^2$ of a neutron is entirely contributed by high-speed moving electron. According to the above, the electronic space-time structure state set of a neutron is equivalent to a unit sphere, with one sphericity as one electronic state unit, so the number of motion states of the electron is exactly the solid angle of the unit sphere, which is 4π . Therefore, the degree of freedom D (i.e. space-time structure dimension) of the electron is $D=\ln 4\pi=2.531$, which means that the material energy of the electron in a neutron is $+2.531 m_e c^2$, including motion energy $1.531 m_e c^2$.

1.3 Atomic nuclide structures and calculations of nuclear binding energy

The nucleons inside the atomic nucleus are all protons p^+ , and neighboring protons are strongly attracted to each other by exchanging high-energy electrons e^- , forming a multidimensional dynamic fully symmetrical structure with $(p^+e^-p^+)$ as the basic repeating structural unit, as shown in Figure 3. Protons in atomic nuclei cannot be distinguished from each other, and there is no distinction between inside and outside. This nucleon space-time structure, constructed by the

zero distance neighboring strong interaction of protons with equal positions, is a compact fractal structure with a structural dimension D of fraction.

In the $0 \rightarrow 1$ creation process of atomic nuclei, the shape is uncertain, but the fractional dimension D is determined. Geometrically speaking, the $0 \rightarrow 1$ creation of the space-time structure of an atomic nucleus is the creation of a structural unit with a fractional dimension D . Each fractional dimension D corresponds to a fractal structure and a fractal factor. The fractal factor is defined as the fractal unit at the lowest level within the fractal structure of dimension D . Fractal factors of the same



dimension D are divided into two types: centrosymmetric and non-centrosymmetric. It can be assumed that the $p^+e^-p^+$ quantum pair formed by two neighboring protons is a line connecting a point on the surface of a unit sphere to the center of the sphere (i.e., unit radius line). The N_j neighboring $p^+e^-p^+$ quantum pairs of a proton can be regarded as the lines connecting N_j arbitrarily distributed points on the sphere to the sphere's center o (of course, a centrosymmetric distribution can be chosen). This combination of unit radius lines in the unit sphere is the centrosymmetric fractal factor of the fractional dimension D , and $N_j=e^D$, $D=\ln N_j$. For example, the lines connecting o_1 , o_2 , and o_3 in Figure 1 represent the three $p^+e^-p^+$ neighboring quantum pairs of point o . The fractal factor is the geometric representation of the fractional dimension D . For a complete 3D space unit, $D=3$, and $N_j=20.0855$. If a unit radius line in the unit sphere corresponding to a $p^+e^-p^+$ quantum pair represents a triangular pyramid, then the regular icosahedron is an ideal fractal factor for a compact space structure with dimension $D=3$.

In the 3D space sense, the four protons and two electrons in ${}^4_2\text{He}$ can be randomly combined into two $p^+e^-p^+$ pairs, and four protons are fully enveloped by the space-time structure of electrons, densely packed into a highly symmetric regular tetrahedron structure where each proton and electron is completely equivalent. When $A>4$, any four neighboring nucleons in the atomic nucleus have this regular tetrahedron structure relationship; the newly added proton can tightly stack with any of the three neighboring protons (regular triangle) in nucleus A to form a new regular tetrahedron structure; therefore, when $A>4$, each proton represents one polyhedral vertex and one regular tetrahedron unit. In this way, the 3D space structure of large nuclides is related to the fractal factor structure and corresponding characteristics of regular icosahedra. But it should be noted that the dense packing in 3D space is rigid, with a fixed and integer number of neighbors, while the space-time structure of atomic nuclei is a spatiotemporal topological structure that maintains A , Z , and volume (physical energy) unchanged. Obviously, when A is an even number or a multiple of 4, the nuclide is more stable.

The volume of a regular icosahedron is 18.51 times that of a regular tetrahedron with the same side length. If a regular icosahedron represents a fractal factor of center symmetry with a dimension of $D=3$, and the 20 regular pyramids with its center O as the vertex represent 20 protons in the nucleus, then the proton at the center O has a maximum of 20 neighboring protons. According to the topological invariance of matter energy, for the same size, with a regular tetrahedron as the structural unit (representing one proton), the proton at the center O can only have a maximum of 18.51 nearest neighbor protons. This means that there exists a multi-level self similarity relationship within the atomic nucleus of Big A , characterized by a maximum of 18. $A \leq 20$, when $A=4$, only one regular tetrahedron unit is formed, then each proton added after $A>4$ can represent one regular tetrahedron

unit. For atomic nuclei with $A \geq 56$, there exists a third-level correlation with a combination of approximately 20 (I)+18 (II)+18 (III): each proton in the first level is directly strongly correlated with no more than 16 neighboring protons (level I); At the same time, these 16 neighboring protons (level I) have the same correlation with other level II protons, which is a secondary correction for level I strong correlation (approximately $1/18-1/20$); there is a similar relationship between level II protons and level III protons (which may also be level I protons), which is a secondary after secondary correction to the strong correlation of level I (approximately $1/18^2-1/20^2$). So, the binding energy of ${}^{56}_{26}\text{Fe}$ is the highest. Combining fully symmetrical topological structures with regular tetrahedron as a unit, the maximum structural dimension D is $\ln 18.51 \approx 2.92$. Due to the stronger repulsion between positive charges in nuclides with larger A values, the D value of nuclides is less than 2.9. This proton dynamic equal position neighbor correlation relationship, also exists in the brain nervous system.

The existing theory calculates the binding energy ε of nucleons in nuclide ${}^A_Z\text{X}$, using the formula $\varepsilon = [M - Zm_p - (A - Z)m_n]c^2/A$, where M is the mass of the nuclide, A is the number of nucleons, Z is the number of protons, and $A-Z$ is the number of neutrons. No neutron exists in atomic nuclei, and this algorithm is wrong, each neutron increases the binding energy by 0.783 Mev. When $A > 2$, the binding energy ε formula should be:

$$\varepsilon = \frac{[M - Am_p - (A-Z)m_e - Zm_e]c^2}{A} = \frac{[M - Am_p - Am_e]c^2}{A} \quad (6)$$

where M is the atomic mass and Zm_e is the mass of the Z extra-nuclear electrons of the atom.

The data such as the atomic masses of the nuclides used in the following calculations are taken from the reference book [17], and because of the underlying logical problems of existing theories, these classical data, it is difficult to ascertain whether they are all accurate.

The structure of atomic nucleus ${}^2_1\text{H}$ is a pep quantum pair state. There are two equivalent states p_1ep_2 and p_2ep_1 of the pep quantum pair in the structure of ${}^2_1\text{H}$. As shown in the left figure of Figure 4, two tightly bound protons can occupy any equivalent state inside their circumscribed sphere. The volume of the circumscribed sphere is four times of the pep pair, that means ${}^2_1\text{H}$ has four equivalent states including p_1ep_2 and p_2ep_1 , each state exchanges one electron, four equivalent states contribute $-4m_e c^2$ to the binding energy; In addition, it should include as many as possible angular spin quantum states of odd combinations of the same kind quantum (the sum of the quantum numbers of an even number of angular spin quanta is 0), that is, ${}^2_1\text{H}$ should includes possible angular spin quantum states composed of at least 3 and 5 units, contributing $-2 \times (1/3! + 1/5!) m_e c^2 = -2 \times 0.175 m_e c^2$. Therefore, the total binding energy of ${}^2_1\text{H}$ is approximately $-4.35 m_e c^2$, and the binding energy of one proton is approximately $-2.175 m_e c^2$; the conventional value is approximately $-2.176 m_e c^2$. This is also the binding energy of one pep quantum pair in the nuclide structure, the average value for one proton is of $-1.088 m_e c^2$ (excluding ${}^2_1\text{H}$). The volume ratio of a regular icosahedron to a regular tetrahedron is 18.51, and the equivalent ratio of the number of pyramids (pep) for the two structures is $20.0855/18.51=1.085$.

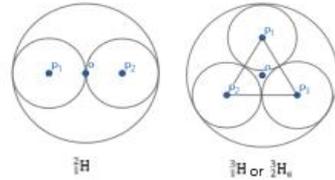


Figure 4 ${}^2_1\text{H}$, ${}^3_1\text{H}$ or ${}^3_2\text{He}$, 核子时空示意
Spacetime diagram of ${}^2_1\text{H}$, ${}^3_1\text{H}$ or ${}^3_2\text{He}$

The structures of ${}^3_1\text{H}$ and ${}^3_2\text{He}$ are almost identical. As shown in the right figure of Figure 4, the circumscribed sphere of the tightly bound three protons are $(1+2\sqrt{3}/3)^3 * 1/3$ times their volume, and the triangle composed of every 3 adjacent protons, including 3 pep equivalent states (contributing $-3m_e c^2$), and one definite angular spin quantum state ($-1m_e c^2$), and possible indefinite angular spin quantum states ($-0.175 m_e c^2$). So the total binding energy of ${}^3_1\text{H}$ or ${}^3_2\text{He}$ is approximately $-4.175 * (1+2\sqrt{3}/3)^3 * 1/3 m_e c^2 \approx -13.92 m_e c^2$, then the binding energy of one

proton is about $-13.92m_e c^2/3 = -4.64m_e c^2$. The conventional values of ${}^3_1\text{H}$ and ${}^3_2\text{He}$ are $-4.58m_e c^2$ and $-4.59m_e c^2$, respectively.

Helium ${}^4_2\text{He}$, similar to a highly symmetrical regular tetrahedron structure, can be simply assumed that all four vertices are the same vertex, and each vertex has 3 neighbors, making a total of $3 * 4$ neighbors; Or 6 edges with 2 neighbors per edge, for a total of $2 * 6$ neighbors, so a single proton has a total of $2 * 6 = 3 * 4 = 12$ pep quantum states, its binding energy is $12 * 1.088 m_e c^2 \approx 13.06m_e c^2$. The conventional value is about $13.14m_e c^2$.

When $A \leq 20$, the binding energy can be calculated using the relationship,

$$\varepsilon = \frac{1}{2} e^D \varepsilon_{\text{pep}} = -\frac{1}{2} e^D (2 + \Delta_J) m_e c^2 = -1.088 e^D m_e c^2 = -1.088 C_p m_e c^2 \quad (7)$$

where, e^D is the number of nearest neighbors for each proton p in the atomic nucleus structure, i.e., the pep quantum pair number, $m_e c^2$ is the electronic matter energy, Δ_J is the spin quantum number for each pep pair, and $\varepsilon_{\text{pep}} = -(2 + \Delta_J) m_e c^2$ is the energy level of each pep quantum pair (which is exactly 1/2 of the energy level of ${}^2_1\text{H}$, $-2.176m_e c^2 = -1.112 \text{ Mev}$), $C_p = e^D$. When $A \leq 20$, $\Delta_J \approx 0.176$; when A is sufficiently large, the number of nearest neighbors of a proton no longer changes with the increase of A and Z, and the nucleon structure inside the nucleus tends to be stable, then, $\Delta_J \rightarrow 0$.

The A protons of nuclide ${}^A_Z\text{X}$ can form many polyhedrons with A vertices. Assuming these polyhedra are convex polyhedra with A vertices formed by stacking tetrahedral units of the same size, there are $2A - 4$ equilateral triangular faces and $3A - 6$ edges. Each edge is connected to 2 vertices, assuming the j-th vertex has a number of A_j neighbors, the sum of the neighbors of all vertices is $\sum_j A_j = 6A - 12$. For the same A, there can be many combinations i, where the number of vertices is all A. However, each vertex has multiple combinations of neighbors, and the sums of the neighbors of vertices are all $\sum_j A_{ij} = 6A - 12$, which remains unchanged. Take the weighted average of the nearest neighbors of each vertex of all these polyhedrons as C_p , so the formula is:

$$C_p = e^D = \frac{\sum_i \sum_j (A_{ij} m_{ij})}{\sum_i \sum_j m_{ij}} \quad (8)$$

where, A_{ij} and m_{ij} are respectively the number of neighbors and the number of vertices with the same number of neighbors of the jth vertex in the i-th combination of A vertex convex polyhedron structures [1].

If $A > 56$, the number of nearest neighbors of protons, reaches its maximum value and no longer increases with the increase of Z and A values, but the repulsive effect of the increased ΔZ positive charge on protons becomes apparent and increases uniformly with the element number Z value. κ is used to represent the positive constant of the binding energy decreasing linearly with Z, so the binding energy ε of large Z nuclide should be,

$$\varepsilon = -e^D m_e c^2 + \kappa Z \quad (9)$$

$A \geq 200$, the structural dimension D of non artificially synthesized nuclides tends to e, i.e., $D \rightarrow e$, then the nucleon binding energy ε tends to $-e^e m_e c^2 = -7.74 \text{ meV}$.

Traditional physics theory suggests that strong attraction occurs between nucleons through the exchange of π mesons (energy levels $> 130 \text{ MeV}$), which have energy levels much higher than the highest level of strong interaction between nucleons in nuclides, which is 8 MeV , and there are no stable π particles present, which is clearly incorrect.

Finally, estimate the limit of nuclide ${}^A_Z\text{X}$, i.e., the limits of Z and A. The nuclide ${}^A_Z\text{X}$, after the A of exceeds 56, the proton binding attraction by the eight immediate neighbors has reached its maximum value of $17m_e c^2$. However, as Z continues to increase, the repulsive force between the

protons increases and the proton binding energy tends to decrease, and the decrease in binding energy $\Delta\varepsilon$ is linearly related to ΔZ . When the binding energy is weakened to a certain extent, the nuclide A_ZX disintegrates. Denote the classical radius of the electron by r_e , there are, $m_e c^2 = \frac{ee}{4\pi\epsilon_0 r_e}$, $17m_e c^2 = \frac{170ee}{4\pi\epsilon_0 10r_e}$, i.e., the net charge number $Z > 100$, the positive charge repulsion between protons, will cause the nuclide to disintegrate. Taking $10r_e$ as the diameter as a ball, can hold up to 125 electrons, large nuclide generally $A > 2Z$, obviously, the largest nuclide has a net charge $Z < 125$, and its $A < 300$.

1.4 Particle-constructed cluster structures

Exception of the atomic nuclei, the other particles are basically neutral particles or particles with a positive charge e^+ or a negative charge e^- . Particles with non-zero mass are made up of protons and electrons, including instantaneous states. These are categorized as follows;

$$\text{Total set of particles} \left\{ \begin{array}{l} \text{A. negative electron } e^-, \text{ positron } e^+, \text{ both have a mass of } m_e \\ \text{B. positive proton } p^+, \text{ antiproton } p^-, \text{ both have a mass of } m_p \\ \text{C. particles composed of } e^\mp \text{ electrons} \left\{ \begin{array}{l} \text{a. neutrals, } \Sigma(e^-, e^+), \pi^0, K^0, \eta^0, \text{ etc} \\ \text{b. negative, } e^-\Sigma(e^-, e^+), \mu^-, \tau^-, \pi^-, K^-, \eta^- \\ \text{c. positive, } e^+\Sigma(e^-, e^+), \mu^+, \tau^+, \pi^+, K^+, \eta^+ \end{array} \right. \\ \text{D. particles composed of 1 proton and } e^\mp \text{ electrons} \left\{ \begin{array}{l} \text{a. neutron, } n(p^+e^-), \bar{n}(p^-e^+) \\ \text{b. positive, } p^+\Sigma(e^-, e^+), \Sigma^+, \Xi^+, \Omega^+ \\ \text{c. negative, } p^-\Sigma(e^-, e^+), \Sigma^-, \Xi^-, \Omega^- \\ \text{d. neutrals, } (p^\pm e^\mp)\Sigma(e^-, e^+), \Lambda^0, \Sigma^0, \Xi^0 \end{array} \right. \\ \text{E. nuclides composed of protons and electrons} \left\{ \begin{array}{l} \text{a. atomic nucleus, } \Sigma p^+ e^- p^+ \\ \text{b. antimatter nucleus, } \Sigma p^- e^+ p^- \end{array} \right. \end{array} \right.$$

The $\Sigma(e^-, e^+)$ in the total classification set of particles are high-energy electron pairs, 1 or more high-energy pairs of electrons form an instantaneous state. there exists a decay chain, i.e., large particles \rightarrow (intermediate particles) \rightarrow small particles $\rightarrow \gamma$ photons. Pairs of positive and negative electrons (e^-, e^+) will annihilate instantaneously, and all of these particles are just instantaneous complexes of electrons or electrons and protons. The instantaneous states of high-energy electron-positron pairs $\Sigma(e^-, e^+)$ can be regarded as the "vacuum excited state" in space-time space.

$e^\mp \Sigma(e^-, e^+)$ in the total classification set of particles are the instantaneous states formed by 1 electron e^- or 1 positron e^+ with 1 or multiple positive and negative electron pairs (e^-, e^+) , the structure is dominated by the $e^-e^+e^-$ or $e^+e^-e^+$; the multi-level complex structures, such as $e^-e^+e^-e^+e^-$ or $e^+e^-e^+e^-e^+$, are also possible. For example, the $\tau^\mp \rightarrow \pi^\mp \rightarrow \mu^\mp \rightarrow e^\mp + \gamma$.

Similarly, the $p^\pm \Sigma(e^-, e^+)$ or neutral $(p^\pm e^\mp) \Sigma(e^-, e^+)$ structures are instantaneous states formed by 1 positive proton p^+ or 1 negative proton p^- with 1 or multiple positive and negative electron pairs (e^-, e^+) , or by one (p^+e^-) or one (p^-e^+) with 1 or multiple positive and negative electron pairs (e^-, e^+) . For example, $\Omega^\mp \rightarrow \Lambda^0 + K^\mp \rightarrow \mu^\mp \rightarrow e^\mp + \gamma$, $\Lambda^0 \rightarrow p^+ + \pi^- \rightarrow \mu^- \rightarrow e^- + \gamma$, $\Xi^\mp \rightarrow \Lambda^0 + \pi^\mp \rightarrow \mu^\mp \rightarrow e^\mp + \gamma$, $(\Xi^0) \Sigma^0 \rightarrow \Lambda^0 \rightarrow n + \pi^0 \rightarrow \gamma + \gamma$.

It should be noted that the spin of a particle is a quantum statistical property, and if the spin quantum of a particle is not zero, its state will change to be subjected to a strong electromagnetic field. "Mesons" with e^\mp charge, such as π^\mp , K^\mp , etc., have a spin of 0, that are definitely

problematic. As a statistical property, a "particle" which decays and disappears instantaneously has a spin that is practically meaningless.

Because of the (e^-, e^+) pair and (p^+, p^-) pair necessarily annihilate in the state of nature, the set of particles is a finite set. All structural states of matter in the real world are composed of positive protons p^+ and negative electrons e^- ; there are no stable positrons e^+ and negative protons p^- and the stable structural states of matter in which they participate; with structural components such as $p^-\Sigma(e^-, e^+)$ or $e^+\Sigma(e^-, e^+)$, the instantly charged particles, or $(p^-e^+)\Sigma(e^-, e^+)$, the neutral instantaneous composite particles, are almost absent.

The decay process of complex particles, the decay reaction chain is not necessarily unique, However, the decay reaction or fusion reaction processes of all particles in the total particle set are energy-conserving, momentum-conserving, charge-conserving, and proton number-conserving (if there are positive proton p^+ and negative proton p^- , are involved in the reaction at the same time, all (p^+, p^-) pairs will annihilate; defining 1 positive proton p^+ has a baryon number of +1, and the baryon number of 1 negative proton p^- is -1, a constant number of protons becomes a constant number of baryons.).

High energy is always instantaneous, atomic nuclei are more stable because they become neutral atoms with extra-nuclear electrons. In nature, the role of atomic nuclei is the ultimate energy and inertia anchor. Only neutral atomic molecules and electrons that can move relatively freely and light energy are the dominant and genes of nature that are relatively stable and in thousands of changes.

2. Mathematical Logic of the Natural World

This chapter describes the underlying mathematical logic that describes the fundamental laws inherent in the natural world, and focuses on some of the foundations of the author's own creation of the geometry of spacetime structures [1-3].

2.1 Natural space-time space

The free space of motion of objects in nature is three-dimensional, integrating time, space, and matter, and time is not an independent dimension; time acts on all "points" and objects in 3D space, and is the dynamic filling medium of 3D space. Time dimension is the dynamic dimension that keeps moving forward with its inherent speed of light c and different rhythms, and the average optical quantum $h\bar{\nu}$ of the optical quantum field is the manifestation of the action energy level of the time dimension of the corresponding time-space subspace. The natural space-time space is the moving space, the Geometry of Space-Time Structures built on the natural space-time space is the geometry of motion. Natural space-time space is defined as the real space of the natural world, the mathematical form is the quasi-four-dimensional space composed of the stationary 3-dimensional space of the natural world plus the quasi1-dimensional time dimension advancing at the speed of light c . It is not a mathematical space such as Minkowski space or Euclidean space or Riemann space or a Hilbert space, but of course it contains the basic properties of these particular spaces. Natural space-time space is a complex space, the time dimension of natural space-time space is "imaginary", and the time of motion fills and acts in 3D space, so the coordinates of points in natural space-time space are of the form (x, y, z, ict) or (\vec{r}, ict) . Time dimension is actually time forward order, only forward a direction, irreversible, so the structure and movement of 3D space matter, in the time order is fractal form, which is the essence of fractal geometric logic universally;

3D matter in the time order to show stability or periodicity, is a special case of fractal.

The 3D subspace (x, y, z) coordinate system of natural spacetime is a near-range continuous orthogonal coordinate system, and all the near-neighboring 3D subspaces of the same scale are connected to form the 3D natural space, and time acts at any point in the 3D space, so the quasi 4-dimensional coordinate system of natural spacetime space (x, y, z, ict) is a near-range continuous orthogonal coordinate system. The distance differential of natural space-time space is defined as:

$$ds^2 = \begin{cases} n_x^2 dx^2 + n_y^2 dy^2 + n_z^2 dz^2, & \text{In the 3D natural space} \\ n_x^2 dx^2 + n_y^2 dy^2 + n_z^2 dz^2 - c^2 dt^2, & \text{In the quasi 4D space} \end{cases} \quad (10)$$

n in Eq. (10) is generalized refractive index of the space medium (metric coefficient), which is a function of the space coordinates (x, y, z) . There are only curves in natural space, there is no absolute straight line as in Euclidean space, the photon path is the shortest path curve for any two points in 3D space. Time, space, and objects are "connected" by light, the position, distance, and form of objects are all related to time. The meaning of quasi-four-dimensional $ds^2 = 0$ is the optical path, the time synchronization and distance determined by light in 3D natural space. At the microscopic scale, the photon "track" is uncertain, the photon path curve is randomly twisted, the curvature is less than 0.

Any two points in natural space, (x_1, y_1, z_1) and (x_2, y_2, z_2) , the distance S between them is:

$$S = \int_1^2 ds = \int_1^2 \sqrt{n_x^2 dx^2 + n_y^2 dy^2 + n_z^2 dz^2} \quad (11)$$

the integral path in equation (8) is the optical path.

The distance in natural space between any two points (x_1, y_1, z_1) and (x_2, y_2, z_2) , is the optical path between the two points. The optical path is a line segment in a stationary homogeneous space (i.e., a Euclidean space); the natural space determined by light-time, the optical path S between two points is a curved curve. On the ultra-macroscopic scale, the optical path is an isochronous curve with curvature greater than 0, the 3D coordinate system composed of optical path curves is an isochronous coordinate system.

The 3D natural space of natural space-time space is not a topological space in the general sense. The 3D space itself and the subspace sets within it, are all open sets and are all objectively existent, and their structure at any moment is unique; there are no logical relationships such as union or intersection between subspace sets and subspace sets (i.e., the relationship of the algebraic operations is 0), but only the relationships of the nearest neighbors and the non-nearest neighbors under the overall structure; the optical paths determine the differential transformation relations of the near-neighbor orthogonal coordinates. Non- nearest-neighbor subspace sets are related and time-aligned with photons, especially for giant scales like space.

After the gauge, distance determination, at macro scale, the spatial structure and geometric figure of the objects determined by the coordinates and relative position, that is, to establish, with coordinate transformation invariance, i.e., the geometrical invariance, and the relevant mathematical analysis is the important part of vector, matrix, group theory, and linear algebra. The spatial geometry represents the structure and internal relationship of objects, the "geometric invariance" of quasi-4-dimensional natural space-time space reveals the law of the change of the object structure with time, is the geometric representation of the energy distribution structure and motion form of the object.

Points in natural space-time space are open sets, and there are no "lines" and "surfaces" in the

traditional geometric sense, so the microscopic world is dominated by the mathematical logic of discrete, fluctuating, stochastic, statistical, and aggregation, etc. This characterizes the microscopic world as a quantum world, composed of particles, which are characterized by wave-particle duality.

The geometry of spacetime structure built on top of natural spacetime space thus contains the underlying logical relationships of all relevant physics such as relativistic mechanics and quantum mechanics.

2.2 Mathematical logic characterization of different spatial scales within natural space-time

Microscopic, macroscopic and gigantic objects, with their different natural manifestations, have their own characteristics of mathematical analysis and characterization.

In equation (11), if the point (x_1, y_1, z_1) is the origin, then the distance S is the distance from the point (x_2, y_2, z_2) to the origin $(0,0,0)$. In Euclidean space, the point (x,y,z) to the origin $(0,0,0)$ is the distance $r = \sqrt{x^2 + y^2 + z^2}$. As an approximate formulation, the natural spatial distance $S \approx r$ is used to describe the spatial scale size in the following discussion of different spatial scale problems.

Physically and mathematically, natural space can be roughly divided into:

① $r \leq 10^{-16}m$, proton scale, spatial points. On this scale, space and time have no meaning, just a point, the spatial dimension $D = 0$, and all terms and quantities of equations (10) and (11) are equal to zero.

② $10^{-15}m \leq r \leq 10^{-12}m$, atomic nucleus, particle scale. Ultra-microscopic, finite set of points, discrete property, Minkowski space-like. Time, space, and matter are closely related, near-neighbor action, the interaction energy is the matter energy, $\Delta r \approx 0$, $\Delta t \approx 0$, $\Delta S \approx 0$. 3D space has Roche space property (negative curvature).

③ $10^{-11}m \leq r \leq 10^{-8}m$, atomic- molecular scale. Microscopic, stable binary neutrally structured quanta (atoms) and finite sets composed of them. Atoms and molecules are the basic building blocks of all macroscopic objects, which are generally large-scale infinite sets of their reversible periodic ordered structures, that is, spatial groups generated by atoms and molecules. Electromagnetic action of electrons, atoms, molecules, and photons is the main focus, and the microscopic quantization, uncertainty, fluctuation, and the certainty, continuity, periodicity of the macroscopic infinite set, perfect unity. Atoms and molecules are structurally stable, electromagnetic action is much weaker relative to matter energy, the spatiotemporal correlation of atomic and molecular states transitions towards statistical correlation, and on a larger scale (infinite set) there will be a clear reversible macroscopic state phase transition process. At this microscale, spatial features begin to transform from a Minkowski like space to a Euclidean like space. Under the action of the independent variable, time t , the random combinations of the finite quantum states in the 3D natural space, begin to transition to the macroscopic thermal statistical equilibrium states. 3D space also has a Roche space property (negative curvature), but the curvature approaches zero from negative.

④ $10^{-7}m \leq r \leq 10^{-5}m$, the scale of biological macromolecules and the cellular. Submicroscopic, cells are the building blocks of living organisms. The laws of survival and growth of cellular organisms are different from the laws of motion of ordinary matter at the same scale, so they are in a separate category. The development, growth, decay and extinction of organisms is an irreversible self-organizing process. Irreversible changes do not exist in an

equilibrium isotropic state, and the conversion of clusters of organic macromolecules into cellular structures with life-like characteristics is a key step in the evolutionary upgrading of organisms in the natural environments of the earth, such as light, air, water, and soil. The irreversible process of natural transformation into an orderly high-energy structure is a dynamic holographic process, and the self-organizing growth and evolution process of the system structure is a synchronous and orderly self-organizing evolution process of structures at all levels, with unique and strong temporal, spatial, and material correlations, and only the cellular structure and its splitting and metabolism and replication and reproduction mechanisms, satisfy this high-level self-organization process with life cycle characteristics. Structurally speaking, at the physical level, the fluid environment of organisms and the electrical properties of large organic molecules, as well as the membrane and nuclear structure of cells are the key structures; at the mathematical level, according to the geometry of the space-time structure, the self-organization process corresponds to the self-similarity of structural morphology, which is characterized by fractal geometry.

⑤ $10^{-4}\text{m} \leq r \leq 10^6\text{m}$, human scale, macroscopic. There are definite coordinates, shape, size, and time, the 3D natural space is Euclidean-like. Time and space are relatively independent. The laws of motion of objects are mainly described by classical physics, and the main mathematical representations are overwhelmingly traditional mathematical logic.

⑥ $10^7\text{m} \leq r \leq 10^{15}\text{m}$, the scale of earth, solar system and close-in star, super-macroscopic. Large mass, large space, gravitational effects, 3D space is Riemann-like geometric space (elliptical geometric space, positive curvature). For observers on the earth, the planet changes very little with time, the parallel rays of space are reduced to one point of light, the simultaneity occurs mutual delay between 2 stars at a distance, the Euclidean geometric coordinates of the stars are different from its actual positions, the optical path with simultaneity between 2 stars curves naturally, this is a scale effect, which is the same for all observers like humans in natural space. Spatial "bending" is only a scale effect, the phenomenon of spectral redshift of the stars is also a scale effect. The photons emitted by stars continuously engage in various possible interactions with space time and environmental matters over long distances, causing their energy and momentum to decay, so the spectrum of stars arriving on Earth naturally exists a redshift. The redshift of the stellar spectrum exists equally for all observers at all locations in the universe, "all feeling like they are at the center". There is no continuous expansion of the universe, and there are problems with the logic underlying the Big Bang theory.

⑦ $10^{16}\text{m} \leq r \leq 10^{22}\text{m}$, the scale of Milky Way and space galaxies, supergiant. The distances of the stars from the earth, $S \approx r$, are more than "light years", and mankind can only rely on the detected light to analyze and study the simple characteristics of these cosmic objects, and time, space, and matter are completely integrated. Relative to the star's near-infinite distance r from the Earth, all quantities in Eq. (10) are approximately 0, i.e., $\Delta x \approx 0$, $\Delta y \approx 0$, $\Delta z \approx 0$, $\Delta t \approx 0$, $\Delta S \approx 0$, any star is just a point, and in the celestial coordinate system it is too, and the space dimension $D \approx 0$. For galaxies distant from the Earth, their spectral redshifts are the only reliable way to determine their distance from Earth. $\Delta\lambda$ denote the wavelength redshift of light, λ is the wavelength, r is the distance from the star to the earth, and χ_1 is a dimensionless constant, then we have:

$$r \cong \chi_1 \Delta\lambda \quad (12)$$

⑧ $r \geq 10^{23}\text{m}$, farther into the cosmic heavens. Natural space-time knows no boundaries. Stars at this scale space are only geometrically distant points, 0-dimensional points. Some people believe that the universe has a size and age, the chance discovery of such dark stars, can be used to

"estimate" the universe's "scale" and "age". Using Eq. (12), $2r \cong 2\chi_1\Delta\lambda$ can be used as an estimate of the scale size of the universe; If τ denotes the age of the universe, then the age of the universe can be estimated using $\tau \cong \frac{r}{c} = \frac{\chi_1\Delta\lambda}{c}$. Because of the integration of space, time and matter, the age of distant stars (also denoted by τ) must also be proportional to their spectral redshift $\Delta\lambda$, χ_2 is a dimensionless constant, i.e., there is a general relation:

$$\tau \cong \frac{\chi_2\Delta\lambda}{c} \quad (13)$$

The "structure" of the farther reaches of the universe, or of smaller points at the cosmic "edge", is of little significance to mankind, and exceeds the limits of mankind's ability to truly observe and verify.

2.3 Mathematical characterization and calculation of particles, nuclei, and their interactions

Space at the scale of 10^{-15}m , the nuclei and particles scale, time, space, and matter are integrated, the spatial coordinates or position of particles are indeterminate, the set of particles is a discrete finite set, and its elements are all composite quantum states consisting of protons and electrons, the strong interaction between the particles is near-neighbor, with the magnitude of Δmc^2 that the material energy exchanges.

The motion state of open set point particles under the integration of time, space, and matter, is dominated by mass-energy, without too complex motion patterns, the $(\vec{P}, iE/c)$ coordinate satisfies the invariance of Minkowski space, that is, the relativistic mass-energy equation:

$$E^2 = p^2c^2 + m_0^2c^4 \quad (14)$$

where E is the energy of the particle, P is the momentum of the particle, and m_0 is the rest mass of the particle.

Geometrically, the strong interaction is the superposition and reconstruction of the mass-energy yin-yang structure of the near neighbour particles, in addition to mass, momentum, and energy level, other parameters such as charge, spin, etc., are secondary, these are just individual characteristics of particles in the same energy level state, which can be simply characterized by phase in the complex coordinate system.

Take a proton p^+ and an electron e^- as examples to illustrate the characterization method of particle motion state in the $(\vec{P}, iE/c)$ complex space coordinate system.

Simply put, a particle is an energy point, with a particle rest mass m_0 and momentum \vec{P} , which are sufficient, and according to equation (14), the free particle energy (energy level) E is also determined.

At the spatial scale of 10^{-15}m , the interaction between two or more particles is the reaction of the near-neighbor exchanging material energy, satisfy the conservation of total energy, total momentum and total charge. Since the proton p^+ and the electron e^- are the most stable fundamental particles, if there are no their antiparticles p^- and e^+ to participate in the reaction at the same time, the number of protons p^+ and electrons e^- are also constant before and after the reaction. Spin does not play a role in particle reactions; the spin of composite particles with spin quantum properties is determined by the spin states of participating protons, electrons, γ photons. The Feynman diagram is an image-only method for analyzing particle interactions intuitively and schematically, and its utility is an illustration of the simple intuitive character of the logic of the origin of matter [9,13].

Assuming the angles between the particle momentum \vec{P} and the P_x , P_y , and P_z axes of the

complex space coordinate system $(P_x, P_y, P_z, iE/c)$ are θ_x , θ_y , and θ_z , respectively, the phase parameter can be directly expressed as $e^{i\theta_x}e^{i\theta_y}e^{i\theta_z} = e^{i(\theta_x+\theta_y+\theta_z)}$, if it is a 2-dimensional complex plane $(P, iE/c)$, the angles of the particle momentum with respect to the axial direction of P are only 0 and π , and the values of $e^{i\theta}$ are 1 and -1.

The phase angles of positive and negative charges are taken as $-\pi/2$ and $\pi/2$, respectively, and the charge phase parameters of the proton and the electron are $e^{-i\frac{\pi}{2}}$ and $e^{i\frac{\pi}{2}}$, respectively, i.e., -i and i, respectively. There is a product relation: $(-i)*i=1$ and $(-i)*(-i)=i*i=-1$, i.e., positively-negatively charged matter can attract, and positively-positively or negatively-negatively charged in the opposite way. Multi-charge particles have the same phase parameters as single-charge particles. 0-charge particles have a charge phase parameter of 1 and a phase angle of 0.

Spin parameters may be useful when analyzing fine structure. The spin phase of a particle can be taken as an independent quantity. The spin quanta may have projective components in the vector field, forming multiple degenerate states. The phase parameters for the 1/2 and -1/2 spins are taken as i and -i, respectively, and the phase angles are $\pi/2$ and $-\pi/2$, respectively; the phase parameter for a spin of 0 is 1 and the phase angle is 0; the phase angles for spins of 1 and -1 are taken as π and $-\pi$, respectively, and the phase parameters are all -1. By analogy, the larger number of spin quanta can be equally divided by symmetry.

Suppose the momentum phase angle of a particle is θ_p , the charge phase angle is θ_\mp , the spin phase angle is θ_h , and the total phase angle is θ , then the phase parameter of the particle is:

$$e^{i\theta} = e^{i\theta_p} * e^{i\theta_\mp} * e^{i\theta_h} = e^{i(\theta_p+\theta_\mp+\theta_h)} \quad (15)$$

The phase parameter of the proton is: $e^{i\theta} = e^{i\theta_p} * e^{-i\frac{\pi}{2}} * e^{i\frac{\pi}{2}} = e^{i\theta_p}$. If θ_p is 0, then it is 1.

The phase parameter of the electron is: $e^{i\theta} = e^{i\theta_p} * e^{i\frac{\pi}{2}} * e^{i\frac{\pi}{2}} = -e^{i\theta_p}$. If θ_p is 0, then it is -1.

Of course, if the particle has other material properties, the phase parameter of the corresponding property can also be added.

For the positive and negative particles m and \bar{m} , the total phase angles are expressed by θ and $\pi+\theta$, respectively, and the phase parameters are $e^{i\theta}$ and $-e^{i\theta}$, respectively, should be: $e^{i\theta} * (-e^{i\theta}) = -e^{i2\theta} = \pm 1$, that is, θ is 0 or $\pi/2$. It can be determined that the total phase angle θ of the positive particle is 0 and the total phase angle $\pi+\theta$ of the antiparticle is π , and the phase parameters are 1 and -1, respectively, which is the same as the momentum phase parameter of the positive and negative particles. The relations $1+(-1) = 0$ and $1*(-1) = -1$, positively reflect the yin-yang opposition characteristics of the material properties of positive and negative particles.

Composite particles are composed of protons and electrons, and their phase parameters can be determined according to the hedging principle of phase parameters with different properties.

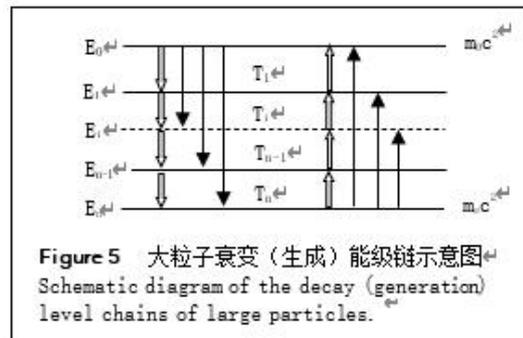
Like there is a correspondence between atomic electron energy levels and photon energy levels, there is a one-to-one correspondence between high-energy γ -ray energy levels and high-energy composite particle instantaneous states. Since the number of elements in the high-energy particle set is limited, the high-energy γ spectrum is also a discrete finite set. Because high-energy composite particles have extremely short lifetimes, there are very few photons γ cosmic rays. The vast majority of cosmic rays are protons p^+ , and the rest are α particles and a very small number of electrons e^- , etc.

High energy composite particles are almost all instantaneous states of matter. According to the

particle total set classification diagram above, except for the fundamental particles protons and electrons, the structure of other particles can be divided into two main categories: one is the lepton composed of electrons, and the structure is represented as $\Sigma(e^+, e^-)$ or $e^{\mp}\Sigma(e^+, e^-)$; the other is the baryon with proton participation, and the structure is represented as $(p^{\pm}e^{\mp})\Sigma(e^+, e^-)$ or $p^{\pm}\Sigma(e^+, e^-)$. The positive and negative electron pairs $\Sigma(e^+, e^-)$ can be regarded as high-energy "vacuum excited states" under the extreme space-time space conditions of $r \rightarrow 0$ and $t \rightarrow 0$; in an infinitesimal 3D space, the excited state should be an isotropic "symmetric state", at least, three equivalent states exist. This is exactly the reason for the repeated occurrence of three times the mass relation of neutral leptons between the energy levels of composite particles. For example, $\tau^{\mp} \sim 3\eta^0 + \pi^{\mp}$, $K^0 \sim 3\pi^0 + 3\nu_{\tau}$, etc. Charged composite particles, which are composite structures of high-energy vacuum excited states and positive or negative electron(or proton), have no such symmetry. The lepton triplet phenomenon has nothing to do with protons.

Under the extreme space-time conditions of $\Delta r \rightarrow 0$ and $\Delta t \rightarrow 0$, the instantaneous decay process of large particles is the isoenergetic change under the action of time, and can be described as follows: large particles (whose energy and mass are denoted by E_0 and m_0 respectively) \rightarrow (multiple intermediate particles) \rightarrow small particles $\rightarrow \gamma$ photons, the instantaneous decay chain, the related particles in the chain form a finite set G. The large particles are composite particles, which are instantaneous excited states of $\Sigma(e^+, e^-)$, or instantaneous excited states composed of $\Sigma(e^+, e^-)$ and e^- or p^+ ; the intermediate particles are also similar excited states, but the number of high-energy electron pairs of $\Sigma(e^+, e^-)$ is less; Large particles finally decay into stable γ photons, the final states of large particles with positive and negative charges also have e^- or p^+ finally.

Figure 5 illustrates the large particle decay (or generation) process in the time sequence, energy levels and other correspondences. Suppose that the energy level of the initial state of the large particle at rest is E_0 , $E_0 = m_0c^2$. The time interval of the decay process is, $T_1 \rightarrow T_2 \cdots T_i \cdots T_{n-1} \rightarrow T_n$, where T_i denotes the i -th intermediate interval, the total decay period is $T = \sum_{i=1}^n T_i$, the time sequence cannot be



swapped, but the sum of adjacent intervals forms a larger time interval. The energy levels of the new particles corresponding to each time interval are E_1 , E_2 , E_i , E_{n-1} , and E_n , and the lowest energy level in the figure 5 is E_n , which is the electron energy level or the γ photon energy level generated by electron annihilation, $E_n = m_e c^2 = h\nu$. Of course, the decay of large particles may have the complex state in which multiple intermediate particles decay at the same time. In addition, the generation process of large particles can be regarded as the reverse process of their decay.

The natural decay period of large particles is extremely short, and the total energy and total momentum are conserved. Assuming an initial state energy level is $E_0 = m_0c^2$ and initial state momentum $\vec{P}_0 = 0$. The natural decay process of the particle can be mathematically characterized as a continuous topological transformation under the action of time, denoted by time T, any size time interval T_i in Figure 5 is a time (topology) transformation, which corresponds to a matrix in the complex vector space $(\vec{P}, iE/c)$, that is a quantitative representation of the time action transformation. Complex vector space $(\vec{P}, iE/c)$ is a quasi-4-dimensional space with

4-dimensional coordinates $(P_x, P_y, P_z, iE/c)$. For any free particle, the coordinates $(\vec{P}, iE/c)$ have a relation, $E^2 = P^2c^2 + m_0^2c^4$. Note that the vector \vec{P} here, including the line vector and the spin vector, denoted by \vec{P}_{\parallel} and \vec{P}_{\odot} , respectively, i.e.:

$$\vec{P} = \vec{P}_{\parallel} + \vec{P}_{\odot}, \quad \vec{P}_{\parallel} \perp \vec{P}_{\odot}, \quad \vec{P}_{\parallel} \cdot \vec{P}_{\odot} = 0 \quad (16)$$

The temporal transformation T (or temporal action operator) is continuous and can be partitioned into n time intervals, the time length is the sum of the time intervals, but the continuous time-action transformations are product operations. The initial coordinate of the large particle $(P_{x0}, P_{y0}, P_{z0}, iE_0/c)$, after T time-action transformations, the final coordinates of the free system is $(P_x, P_y, P_z, iE_0/c)$, then we have the operation:

$$T \begin{pmatrix} P_{x0} \\ P_{y0} \\ P_{z0} \\ iE_0/c \end{pmatrix} = \left(\prod_{i=1}^n T_i \right) \begin{pmatrix} P_{x0} \\ P_{y0} \\ P_{z0} \\ iE_0/c \end{pmatrix} = \begin{pmatrix} P_x \\ P_y \\ P_z \\ iE/c \end{pmatrix} = \begin{pmatrix} P_{x0} \\ P_{y0} \\ P_{z0} \\ iE_0/c \end{pmatrix}, \quad T = \prod_{i=1}^n T_i \quad (17)$$

Both the intermediate and final states of the natural decay of large particles, may have many particles coexisting, so that the values of the final or intermediate state $(P_x, P_y, P_z, iE/c)$ are the momentum sum and energy sum of all the coexisting particles, assuming that there are Q particles in the final state, taking into account the conservation of total momentum and total energy, there are:

$$P_x = \sum_j^Q P_{xj} = P_{x0}, \quad P_y = \sum_j^Q P_{yj} = P_{y0}, \quad P_z = \sum_j^Q P_{zj} = P_{z0}, \quad E = \sum_j^Q E_j = E_0 \quad (18)$$

In the vector space, the time transformation acts equivalently on all points and is an orthogonal transformation, the natural decay process of large particles, energy-momentum conservation, equation (17) means that the determinant values of the time transformation T and its sub-transformations T_i are all 1, so the time transformation T matrix is the unitary matrix in the complex vector space. The characteristics of the Hermitian conjugation and determinant value invariance of the unitary matrix, exactly reflect the symmetry of particle states in 3D real space and the invariance of energy and momentum in the time dimension.

The continuous decays of large particles in the extreme space-time space of $r \rightarrow 0$ and $t \rightarrow 0$, generate various instantaneous states of particles (including γ photons), which have strong space-time correlation relations dominated by the strong action of the immediate neighbors, and the time transformation $T = \prod_{i=1}^n T_i$ is a continuous transformation, the time interval T_i can be $T_i \rightarrow 0$, and n can be $n \rightarrow \infty$. Energy-momentum conservation corresponds to space-time symmetry, so the time transformation T constitutes a symmetry group. The time transformation T has a time sequence, only the sequential $T_{i-1}T_iT_{i+1}$ transformation may not be equal to 0, and the other $T_iT_j (i \neq j \text{ or } j \neq i \pm 1)$ are all 0 (no relation); $T_{i+1}T_i$ can be thought of as an inverse transformation of T_iT_{i+1} ; Any time transformation T is composed of the ordered product of infinitesimal space-time symmetric transformations. Therefore, the time transformation group T (matrix) is a Lie group, the product relation of the elements is the Lie algebra.

The above corollary does not have many constraints and is natural and universal.

In the quasi-4-dimensional space $(\vec{P}, iE/c)$, the coordinate values $(P_x, P_y, P_z, iE/c)$ of the final state of the natural decay of large particles are the algebraic values of multiple T-transformations, which are the sum of all particles in the final state, as shown in equations (17) and (18). Each particle in the final state is the result of one or more transformations on the corresponding time series. Due to the conservation of momentum and energy, the total momentum and total energy are constant at any point in time, so the state coordinates $(P_{xi}, P_{yi}, P_{zi}, iE_i/c)$ of any i particle are the decomposition values of the initial coordinates $(P_{x0}, P_{y0}, P_{z0}, iE_0/c)$ of the large particle.

Obviously, the decomposition values at the same time point may have different combinations, i.e., there may be multiple paths for the decay of the large particle, but the end points are all γ photons and electrons e^- or p^+ . The multiple electron pairs $\Sigma(e^+, e^-)$ in the composite particles are all instantaneous high-energy "vacuum excited states", and due to the space-time symmetry, static large particle decay can occur the γ photon double symmetry state and the new particle triple symmetry state.

In the $(\vec{P}, iE/c)$ coordinate system, the free particles have the relationship $E^2 = P^2c^2 + m_0^2c^4$, if the complex coordinate system $(\vec{P}, iE/c)$ is replaced with the one-to-one corresponding real number coordinate system (\vec{P}, m_0c) , it is more intuitive to analyze particle states using the SU(4) matrix.

In addition, in a quasi-four-dimensional coordinate system $(\vec{P}, iE/c)$, in the very small strong action scales of $r \rightarrow 0$ and $t \rightarrow 0$, the simple complex matrix representation of the energy momentum conservation transformation is the "transposed conjugation" change of momentum coordinates or the "transposed conjugation" change of mass and momentum, so Eq.(17) can be simplified as follows:

$$T \begin{pmatrix} P_{x0} \\ P_{y0} \\ P_{z0} \\ iE_0/c \end{pmatrix} = \begin{pmatrix} ([SU3]^\#, 0) & (0, (-i, 1)) \\ (0, (i, 1)) & ((0, -1), 0) \end{pmatrix}_{4 \times 4} \begin{pmatrix} P_{x0} \\ P_{y0} \\ P_{z0} \\ iE_0/c \end{pmatrix} = \begin{pmatrix} P_x \\ P_y \\ P_z \\ iE/c \end{pmatrix} \quad (19)$$

where, the $[SU3]^\#$ are the eight generators of SU(3) group[9,13], except that its eighth matrix

element $\frac{1}{\sqrt{3}} \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -2 \end{pmatrix}$ is changed to $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{pmatrix}$, which makes the structure simpler and

more reasonable, so that the corresponding SU(4) matrix is $\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{pmatrix}$.

The creation of new "composite particles" and the study of the elemental composition of instantaneous particle sets are of limited value. Those who are interested can go ahead and do it, and there are many opportunities for reconstructing the basic theory.

2.4 Revisiting the natural properties of natural space-time space – a few essential logics of physics and mathematics that need to be emphasized

The contents of this section are also all summarized in part from the author's Geometry of Space-Time Structures. There are also parts from the author's own dissertation works on The Nature of Thermal Motion and Self-Organization - Statistical Thermodynamics in Space-Time (2014, online) and The Space-Time Topology of the Thermal Internal Energy of Objects (unpublished).

Geometry of Space-Time Structure based on the natural space-time space, reveals the changing laws and internal logic of the natural world intuitively and essentially and accurately, and calculates and depicts the dynamic and beautiful natural world. It is far from enough to recognize only the constant quantities and reveal the invariant logical relations, but it should also accurately reveal the process of natural changes and show the three-dimensional structure of natural changes over time.

a. Photons (electromagnetic material waves) and time

Light is the most basic natural existence, is one of the most basic forms of energy, is the linkage medium of the integration of time, space and matter, the speed of light is determined and maximum, this is the real law of nature, of course, should also be the foundational logic of modern physics and related mathematics.

Like photons, time is the real amount of motion change and power, acting uniformly on any

point in 3D space, time keeps "moving forward", no object can catch up with time, time moves forward or passes at the speed of light c , the average optical quantum $h\bar{\nu}$ of the photon field is the time quantum, the average frequency $\bar{\nu}$ of the photon is the rhythm of the movement of time, the light quantum field is the time action field, and have a relationship, $h\bar{\nu} = k_B T$ (T here is the temperature of the thermal radiation field, and k_B is the Boltzmann constant). The fundamental energy of the natural world, is just the rest mass energy $m_0 c^2$ of the object and the light quantum field energy (i.e., the temporal action energy). Therefore, the mirror spaces corresponding to the quasi four-dimensional natural space-time space (\vec{r}, ict) , are the momentum energy space $(\vec{P}, iE/c)$ and the wave vector phase space $(\vec{K}, i\omega/c)$, and have a relationship: $\hbar \frac{\partial}{\partial t} = E = \hbar \omega = cP$.

The integration of time, space and matter, in the limit space-time space of $r \rightarrow 0$ and $t \rightarrow 0$, is more naturally revealed: matter (energy) becomes space-time point, high-energy light quanta (space-time points) can annihilate and turn into positive and negative electron pairs (e^- , e^+), and "vacuum" fluctuation excitation can generate particles with rest mass. Time, space, and matter are all natural forms of energy.

b. The natural operation logic of geometric structures and the natural constant e

From algebra (number set) to geometry (space), is a great leap in the basic logic of mathematics, the mathematical logic contents related to space, form, structure, order, and corresponding change relationships, such as points, distances, directions (vectors), dimensions, matrices, transformations, continuity, calculus, differential geometry, etc., can truly generate and achieve a leap forward, and mathematical logic can be further more practically close to the inherent logic of nature. The combination structure and operation logic of "numbers" have also shifted from simple sum and multiplication logic to intuitively, rich and even "complex" geometric logic (product, exponent, etc.). This is the reason why geometric mathematics is called "geometry".

From infinitesimally small relations of continuous variation, it is natural to derive simply the calculus and the natural constant e and the natural exponential functions, e^x , e^t , e^{-t} and so on. The sum and multiplication logic becomes "geometric" logic in geometry, and the change is calculus. If x is a matrix, the extension of e^x naturally includes Lie groups and Lie algebras.

A spatial coordinate system with points and distances, there are naturally direction vectors and geometric structures, and vector linear transformations naturally derive matrix operations, orthogonal groups, unitary groups, Lorenz groups, and so on. Symmetry is the natural manifestation of natural variation states in a dimensional space, and the gauge invariance (phase transformation) of a particular functional relation is a corresponding manifestation.

Coordinate system transformations (mappings) where the independent variable changes naturally derive the Fourier transform.

From discrete to continuous, the infinite series is logic connection "point".

c. Complex numbers, complex spaces, functions of complex variable, and natural constant e

The transition from real numbers to complex numbers and from real space to complex space is also a great leap in the logic of the nature of mathematics. The arithmetic relation between the "invisible" illusory matter and the real world connected by the, $i^2 = -1$, $z = re^{i\theta} = r(\cos \theta + i \sin \theta) = x + iy$ and $|z|^2 = r^2 = (x + iy)(x - iy) = x^2 + y^2$, the set of real numbers is also naturally expanded into a complete set of complex numbers.

The definition of the complex function $f(z)$ (i.e., $f(z) = u(x,y) + iv(x,y)$), and the definition of its

derivative definition, and the Cauchy-Riemann condition for the derivability of the $f(z)$ (i.e., $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$, $\frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}$), determine the quantitative relationship between $f(z_0)$ at any point in the range space of the complex function and all other points in the range space, i.e., the Cauchy formula, etc. (which is precisely why the complex function has become a powerful tool for numerical analysis, including number theory studies). The characteristics of the complex function, i.e., its intrinsic relationship, its multi-value, its periodicity, and the complex independent variable $z = x + iy = re^{i\theta}$ with rotational motion property, are consistent with the essence of electromagnetic motion and the integration of time, space, and matter in the microscopic world.

The infinity ($r \rightarrow \infty$) of complex space corresponds to a pole, 0 dimension, this is exactly the view of natural space-time space.

Also, $e^{i\theta} = \cos \theta + i \sin \theta$ is the inevitable consequence of the natural variation of complex vector space.

Complex space $(\vec{r}, i\text{ct})$ and $(\vec{P}, iE/c)$ more comprehensively characterize the natural logical relations in nature.

d. Free randomness, statistical correlation, self-organization, fractal dimension, and natural constant e

The free random motion of microscopic particles, namely random fluctuations, so particles naturally have wave-particle duality. The random thermal motion of particles within a multi-particle system has an overall statistical logic, that is, the physical quantities have e^{-x^2} distribution character (microscopic particle statistical property can be subdivided into Bose distribution and Fermi distribution). Statistical logic includes statistical average and dynamic statistical correlation logic; the statistical correlation is the property of the space-time motion relationship between all particles of the multi-particle system, and in the geometric space $(\vec{r}, i\text{ct})$, it exhibits a fractal structure morphology, which is an inevitable consequence of the irreversible random (thermal) motion of the multiparticle system. The geometric invariance of the fractal structure is the fractional fractal dimension D , and the morphological self-similarity can be also considered as scale invariance.

The orderliness and self-organization process of the thermodynamic system is a higher-level statistical correlation, generally refers to the emergence of a relatively stable macroscopic fractal structure, such as biological growth and reproduction, topographic feature, etc., and the self-organization process, that is, an open thermodynamic system with relatively free particles or macromolecular units inside, constantly absorbing external energy and matter, and irreversibly over time "growing out" a fractal structure with a certain order of high energy states. Self-organization is a dynamic process with irreversible life cycle characteristics. In natural space-time, the time transformation T is sequential, irreversible, and an ordered semi-group. The simplest and most explicit, such as the cell division process of biological growth, can be described as a $\{2^n\}$ semi-cyclic group.

The fractal dimension D is the geometric "constant" of the fractal structure, and the fractional dimension is relative to the 1, 2, and 3 integer dimensions (denoted by D_0) of the orthogonal geometric coordinate system. Geometrically, fractal structures are self-similar structures that cannot fill the entire space of corresponding integer dimension, so naturally the fractional dimension has meaning of the filling degree of the fractal structure. According to the Geometry of

the Space-Time Structure, the filling degree of a fractal structure is equal to D/D_0 .

Considering the logic of natural geometry and the significance of dimension, the "position" of microscopic particles in natural space-time cannot be determined, and can only be characterized by degenerate space-time structure form sets or quantum states, and the number of degenerate states of a single particle in the natural state of change is the power of e^D . If the temperature of the thermodynamic system with N particles is T , then the number of degenerate states of the system is $M = e^{ND}$, the entropy S of the system is:

$$S = k_B \ln M = k_B \ln e^{ND} = k_B ND \quad (20)$$

The total thermal internal energy of the system is $U = NDk_B T$.

Protons within atomic nuclei are completely near-neighbor equivalent free states, the fractal dimension of the structure of atomic nuclei naturally tends to the constant of e .

3. Summary

This paper reconstructs the logical foundations of the physical and mathematical theories that reveal the most fundamental laws of the natural world, based on the Geometry of Space-Time Structures founded by T.W. Song. There are no quarks in the natural world, the most fundamental particles in the natural world are protons and electrons. Protons p^+ in atomic nuclei can form strong mutual attraction by exchanging electrons e^- in their immediate neighborhood, there are no neutrons in atomic nuclei. Cosmic expansion does not exist, redshift is a natural phenomenon in the macroscopic world; the cosmology represented by the Big Bang theory, etc., similarly, there are fundamental logical errors. Geometry of Space-Time Structures is the geometry of motion, which truly reveals the relations and inner laws of motion and change in the natural world.

The reconstruction of the theoretical foundation of modern physics will inevitably bring about a new era of great changes in scientific theory and technology. It is hoped that scientific and technological workers around the world, especially in China, will seize the opportunity and work together to create a reliable, more accurate and complete scientific system for the continuous civilization and progress of human society.

The key problem for mankind to realize controlled nuclear fusion may lie in the formation of a large number of controllable neutrons in a moderately sized space. Now all the nuclear fusion technology being explored, there are a lot of difficulties [13-14][20], is there a route method problem? we believe that controlled "hydrogen bomb" technology is one of the more feasible technical paths.

The natural world does not have a stable positron e^+ and a negative proton p^- , this is what makes nature perfect. Some people may think that symmetry is perfect, but then they use the so-called "symmetry breaking", "positron e^+ and negative proton p^- have short decay cycles" to explain the above [9-10]. The γ -photon energy spectrum determines, the annihilation of e^+ or p^- must be accompanied by e^- or p^+ respectively. therefore, this theoretical explanation is definitely wrong. The visible natural space-time is (x,y,z,ict) , then the invisible "virtual" space (ix,iy,iz,ct) at the same time does not really exist? In the distant and invisible sky of $r \rightarrow \infty$, is there antimatter? Are all the "star points" in the infinite distance "virtual universes" like those seen by human beings? Is the dynamic virtual space of computer network close to (ix,iy,ct) or (ix,iy,iz,ct) space? Is it simpler to conjure up ideal virtual worlds using the geometric logic of (ix,iy,iz,ct) space?

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