G super unification vector presentation

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Abstract. The velocity vector generated by the rotation of the particles in the complex space distracts the time dimension, the vector forms the weak charge in the space projection; its rotary angular velocity vector distracts the energy dimension, the vector forms the mass charge in the space projection; Its rotary centripetal acceleration vector distracts the space dimension to form the electric charge; the acceleration jerk (variation of acceleration) generated by the rotation of the vector distracts the color dimension, the vector forms the color charge in the space projection; the projections of the electric charge, mass charge, color charge and weak charge into the 3D space form the three-nature (positive, negative and neutral electrodes), three-generation, three color and the past, present and future of particles; The direct product group U (1) ×SU (2) ×SU (3) ×U (4) or simple group U (20) constitute the super unification group of the physical world. The universe is holographic, bounded and boundless. All information in the universe can be stored on the visual interface in the form of holographic images formed by the interference of the imaginary part of the material wave. This is the physical mechanism of quantum entanglement.

1. Introduction
Within the long time production activities, people found that some physical quantities have both amplitude and orientation, and the physical quantities were termed as vector. About 350 BC, an ancient Greek physicist, Aristotle, expressed force as vectors, and the composition of forces were obey the parallelogram law. During the investigation of vector properties, Helmholtz found that when the divergence, rotation and the distribution on the boundary were fixed, the vector field was confirmed exclusively. For the infinite space, if the amplitude was attenuated to zero at infinite long spot the divergence and rotation were confirmed uniqueness, and can be expressed as equation (1)[1].

\[ \mathbf{F} = \mathbf{F} (\text{source, non-rotation}) + \mathbf{F} (\text{non-source, rotation}) \]  

(1)

2. Definition of divergence
For a vector field, there are two different definitions of divergence. The first definition of divergence was independent on the coordinate.

\[ \text{div} \mathbf{F} := \lim_{V \to 0} \frac{1}{V} \iint_{E} \mathbf{F} \cdot d \mathbf{s} \]  

(2)
\[
\text{div} F := \nabla \cdot F = \frac{\partial F_x}{\partial x} + \frac{\partial F_y}{\partial y} + \frac{\partial F_z}{\partial z}
\]  

(3)

By demonstration, the two definitions of divergence are equivalent under limiting condition. Therefore, the divergence of vector \( F \) were frequently expressed as \( \nabla \cdot F \).

By the definition of divergence, the \( \text{div} F \) denote the flux of vector \( F \) in unit volume at a certain spot. Therefore, the \( \text{div} F \) denoted the density of flux source.

The divergence was a intensity properties of vector field, such as density, concentration, and temperature. And the divergence is corresponding to the flux at the face of a closed region. The divergence can used to represent the divergence intensity of vector field at any spot in space. In the aspect of physics, the meaning of divergence was the source of field. When \( \text{div} F > 0 \), it means that there was a positive source at the spot (divergent source). When \( \text{div} F < 0 \), it means that there was a negative source at the spot (divergent source). When \( \text{div} F = 0 \), it means that there was no source at the spot.

3. The Gauss theorem and its application in the field of physics

The Gauss theorem [2]:

\[
\int \int \int \left( \frac{\partial P}{\partial x} + \frac{\partial Q}{\partial y} + \frac{\partial R}{\partial z} \right) dV = \int \int \int (P \cos \alpha + Q \cos \beta + R \cos \gamma) ds
\]

(4)

The meaning of Gauss theorem was the flux throughout any closed hook face was equal to the integration of divergence of vector in the closed volume. The Gauss theorem gave the conversion relation of closed hook face and the covered volume. The Gauss theorem were important equations used in vector analyzing, and one of the important equation used in the field of investigation.

The application of Gauss theorem in the electricity can be formed as:

\[
\phi_E = \int \int \int F \cdot dS = \frac{1}{\varepsilon_0} \sum q_i
\]

(5)

In the aspect of electricity, the Gauss theorem can be defined as the amount of electric flux passing through an arbitrary curved surface was equal to the total quantities of electric charge.

4. The definition of charge and its physical meaning

4.1. Definition on g charge

Assume five-dimensional vector \( F \), obtain:

\[
\hat{F} = F_r + mF_s = \int \int \int \text{div} F \text{d}V + m \int \int \int F_r \cdot \text{dl}
\]

(6)

(m: fifth-dimensional vector)

Assume four-dimensional vector

\[
G = F_r
\]

(7)

Definition on g charge: namely, unified charge is G charge within time, space, energy space and color space.

Mathematical presentation:

\[
g = \int \int \int \text{div} G \text{d}V
\]

(8)

Namely: integral of four-dimensional volume surrounded by four-dimensional vector G’s divergence to three-dimensional closed surface.

G vector projection in the space forms the charge \( q \), forms the weak charge \( t \) in the time projection, forms the color charge in the color space projection and forms the mass charge \( m \) for projection in the energy space.
It may be expressed by quaternary [1]: namely, composed by mutually vertical time t, space r, color space s and energy dimension e’s direct sum [3].

\[
A = a_0 + \alpha = a_0 i t + a_1 \vec{r} + a_2 \vec{s} + a_3 \vec{e}
\]

\[
= i t + a_1 \vec{r} + a_2 \vec{s} + a_3 \vec{e}
\]

\[
= \left| \left( i \cos \phi + (r \cos \alpha + s \cos \beta + \vec{e} \cos \gamma) \sin \phi \right) \right|
\]

Therein:

\[
i^2 = r^2 = s^2 = e^2 = -1;
\]

\[
r \vec{s} = -s \vec{i} = -e \vec{r} = -e r = \vec{s} e = -e \vec{s} = \vec{r}
\]

\[
A^2 = a_0^2 + a_1^2 + a_2^2 + a_3^2
\]

We take time and space as two mutually vertical axles, the absolute value of energy dimension and color dimension serves coordinate’s Upper half axis and Lower half axis (energy dimension and color dimension vertically) to draw up the schematic diagram of G Hyper-space Quaternary model (See figure 1).

\[
\int \int \int_\Omega \left( \frac{\partial T}{\partial t} \frac{\partial R}{\partial r} + \frac{\partial S}{\partial s} + \frac{\partial E}{\partial e} \right) dV
\]

\[
= \int \int \int_\Omega \left( \tilde{l} \cos \phi + \tilde{r} \cos \alpha + \tilde{s} \cos \beta + \tilde{e} \cos \gamma \right) d\sigma
\]

Namely:

\[
\int \int \int_\Omega \text{div} G dV = \int \int \int_\Omega \left( \tilde{l} \cos \phi + \tilde{r} \cos \alpha + \tilde{s} \cos \beta + \tilde{e} \cos \gamma \right) d\sigma
\]

(E: Energy, e: energy coordinate, T: time quantum, t: time coordinate, R: space quantum, r: space coordinate, S: color space quantum, s: coordinate, cos\(\phi\), cosa, cos\(\beta\), cos\(\gamma\) respectively refers to time,
space, color space and energy space’s external normal direction cosine, and $t\cos\phi$, $r\cos\alpha$, $s\cos\beta$, $e\cos\gamma$ respectively forms the weak charge, charge, color charge and mass charge. $\Omega$ four-dimension volume.)

Namely:

$$g = \frac{1}{\varepsilon_0} \sum_{\gamma,m} g_{\gamma} = \iiint_{V} \text{div} G dV = \iiint_{V} G \cdot d\sigma$$

Namely: the amount of flux that $G$ vector passing through an arbitrary sealed three-dimensional curved surface (hyper-surface) is equal to the integral of the volume that surrounded by a three-dimensional closed surface by divergence of a vector, is also equal to algebraic sum of charge loading surrounded by sealed hyper-surface (three-dimensional curved surface).

4.2. Mass definition

Namely, $G$ vector projection divergence’s integral on energy dimension.

$$m = \int_{l} \text{div} G_{m} dl$$

Physical meaning: the particle is supported by the angular velocity vector of the rotating angular velocity in the complex space-time, and the vector forms the mass (charge) in the space.

4.3. Definition of charge

Namely, $G$ vector projection divergence’s integral on space dimension.

Physical meaning: the particles are rotated centripetal acceleration vectors in complex space-time to form a space dimension, thereby forming a charge;

$$q = \int_{l} \text{div} G_{q} dl$$

Formula:

$$q_r = -a_r = |a| \cos \theta = |a| \sqrt{1 - \frac{v_r^2}{c^2}}$$

4.4. Strong charge definition (color charge)

Namely, $G$ vector projection divergence’s integral on color space.

Physical meaning: the acceleration jerk (change of acceleration) supports the color dimension by the rotation of the particles in the complex space-time, and the vector forms a color charge in the projection of the space.

$$s = \int_{l} \text{div} G_{s} dl$$

Formula:

$$s = b_r = -\frac{c^2 \dot{v}_r}{\hbar^2}$$

$b$ is acceleration jerk.

Description: color charge with the increase of the absolute value of the velocity increased. This is why the early universe or the microscopic world of color force dominates.

4.5. Weak charge definition (time)

Namely, the integral of the divergence of the projection of the $G$ vector within time.

Physical meaning: the velocity vector generated by the rotation of particles in the complex space-time opens the time dimension, and the vector is projected in space to form a weak charge.

$$t = \int_{l} \text{div} G_{t} dl$$
5. G Super unified model

5.1. The direct product group representation of G super unified model [4]

The super unified model can be expressed as a direct product group, i.e. U (1), XSU(2), XSU(3), XU(4).

The element of this group is

$$U(x) = \exp(-i\theta^\alpha T^\alpha - i\theta^\beta T^\beta - ig \theta^\gamma T^\gamma - i\theta^\lambda T^\lambda)$$

Direct product group covariant derivative:

$$W_\mu = (\partial_\mu + ig_1 A_\mu^a T^a + ig_2 B_\mu^\beta T^\beta + ig_3 C_\mu^\gamma T^\gamma + ig_4 D_\mu^\lambda T^\lambda)$$

\(A_\mu^a\) Electromagnetic gauge field; \(B_\mu^\beta\) Weak interaction gauge field; \(C_\mu^\gamma\) Strong interaction gauge field; \(D_\mu^\lambda\) Gravitational gauge field; \(T^a\) Electromagnetic group generator; \(T^\beta\) Weak interaction generator; \(T^\gamma\) Strong interaction generator; \(T^\lambda\) Gravitational generators. In which \(\alpha = 1, \beta = 1, 2, 3, \gamma = 1, 2, 3, 8, \lambda = 1, 2, 3, 16\)

5.2. Single-group representation of G super unified model

The G-super unified model can be expressed by a twenty-dimensional unitary unit U (20).

Set the gravitational field as:

$$\zeta = \overline{\psi} (i\gamma^\mu \partial_\mu + \hat{M}) \psi$$

It is clear that the above equation is invariant in U (20) overall specification.

$$\psi(x) \rightarrow \psi'(x) = U \psi(x)$$

$$U = \exp(-iT^\alpha \theta^\alpha) \quad (\alpha = 1, 2, 3, \ldots 400)$$

Where \(\theta^\alpha\) It is 400 real parameters that are independent of X , \(T^a\) is the 400 generators of U(20). Covariant derivative is:

$$W_\mu = \partial_\mu + ig I_\mu$$

Then the constant Lattice density in a super-unified domain specification can be obtained

In this way, the invariant Laplace density is obtained under the super-uniform fixed - domain gauge transformation formula:

\[
\zeta = \overline{\psi} (i\gamma^\mu W_\mu - M) \psi - \frac{1}{4} F_\mu^a F_{\mu\nu}^a \\
= \overline{\psi} (i\gamma^\mu \partial_\mu - M) \psi - \frac{1}{4} F_\mu^a F_{\mu\nu}^a - g \overline{\psi} \gamma^\mu I_\mu^a T^a \psi
\]
coupling constant $g$ characterize the interaction intensity. In addition, different with from the Abel situation, in addition to the derivative in $F^\alpha_\mu$, there are also product terms of $F^\alpha_\mu$, therefore, the second term on the right side contains $F^I_\mu$ three and four terms, which represent the self-interaction of the super-unified gauge field.

Therefore, if it is a 20-state super-unified field, it is necessary to introduce 400 gauge fields in the U (20) local specification transform (14), which must be transformed according to the local specification transformation, and with the 20-state isotonic vector flow coupling to determine the interaction between them. In addition to the divergence term, there is also a product term of the unified gauge field, which stipulates that the unified gauge field has self-interaction because of the non-Abelianness of the U (20) group [5].

With the expansion of the universe, the temperature is decreasing, and the phase transition occurs, that is: $10^{-44}$ second after the big bang, the first symmetry breaking (the universe phase was change, gravity was separated, and that is, space and time was created).

$U(20)$ (Supersymmetric space, 400 parameters)

$= U(4)$ (G particles, Gravitational effect 16 parameters) $\times$ $U(5)$ (25 parameters)  \hspace{0.5cm} (28)

$10^{-36}$ Second after the big bang (Energy is $10^{15}$ GeV ), The second symmetry is broken (phase change), strong action is separated, i.e.

$U(5)$ (Y particles, 25 parameters) $=$ SU(3) (Strong interaction space, 8 parameters)

$\times$ SU(2) (weak interaction space, 3 parameter) $\times$ U(1) (electromagnetic space, 1 parameter)  \hspace{0.5cm} (29)

$10^{-10}$ second after the Big Bang, the third symmetry breaking (phase change), the weak effect is separated, leaving one-dimensional electromagnetic interaction to maintain the U (1) nature. (Because strong, weak interaction is short-range force, so there are unitary model limit, electromagnetic force, gravitational potential long-range force so there is no unitary limit).

Further, after the gravitational space is broken, spaces of leptons and quark is formed, both spaces interact to form a three-dimensional fully symmetric real space and one-dimensional anti-symmetric virtual space --- time, when the bending of time and space is equivalent to the role of force (See figure 2).

That is:

$U(4)$ (fermion gravity space) $=$ U(2) (quark isospin) $\times$ U(2) (lepton isospin)

$= R_{ij}$ (three-dimensional space) $+ T_{ij}$ (one-dimensional time)  \hspace{0.5cm} (30)

![Figure 2. The schematic diagram of grand unified theory.](image-url)
6. G Complex space-time cosmological model

6.1. Non-Euclidean universe

Set the cosmological function as:

\[ \psi = \psi_r + i \psi_i = |\psi| \left( \sqrt{1 - \frac{v^2}{c^2}} - i \frac{v}{c} \right) \quad (31) \]

Where the static characteristics of material are reflected in the real part, forming the Riemann space; the dynamic characteristics of material represented in the imaginary part, forming the Lobachevsky space.

In the three-dimensional space, the universe seems like a photo sphere whose glossy is described as visual interface. Together, the visual interface of universe is equipotential surface as well, with the rest mass and gravitation being zero. The visual interface is comprised by wave-like material that is linear, stackable as well as non-dispersive. In other word, visual interface is considered as Boson Ocean. The above characteristics are fully embodied in the imaginary part of cosmological function. The inside content of visual interface is called as Fermion Ocean with involvement of rest mass and gravitation. Therefore, cosmological function has achieved all the characteristics above by following the features of non-linear, non-stackable and dispersive.

6.2. Bounded immense universe

Matter moving at velocity of light consists of interface of positive and negative universe. But the observer inside the interface can still think that its universe is infinite, because, all rulers of observers approaching interface continuously are continuously shortened with the continuous increasing of velocity according to formula of relativity theory. Hence, the observers can measure infinitely with their rulers which will never come to border of universe comprising of matters moving at velocity of light and this is the unity of being finite and infinite.

Through the white hole, anti-universe is the source of positive universe, whereas positive universe is the source of anti-universe through the black hole. The concept is similar to the Chinese diagram of universe constituted by yin and yang of fish. Furthermore, the chirality of positive universe and anti-universe is opposite.

6.3. Oscillatory universe

The early universe expands increasingly at super velocity of light, mainly repulsive force, it is Lobachevsky space, with negative space curvature and is a negative energy state area; when universe expands to certain dimension \( r=rc \) or \( t=tc \), the universe begins to slow down expansion at low velocity of light and is attractive force-base and Riemann space, with positive space curvature and is a positive energy state area. With gravitational action when universe expands to certain degree, it begins to accelerate shrink and it is Riemann space still in which is mainly attractive force still; when it shrinks to certain dimension \( r=rc \) or \( t=tc \), i.e. horizon surface, the universe begins to slow down shrink at super velocity of light and at the time it is repulsive force-bases and is Lobachevsky space again. The universe moves in circles in that way.

6.4. Holographic

And then form a visual interface of universe (suction surface) by the luminary motion material. With the interference of linear waves, the hologram is obtained (so that every point on the visual interface contains the information of the entire surface of Photon compose and universe).

6.5. Universally relationship

Each dot on the apparent interface (luminous surface) is generally related to the particles in the interface through quantum entanglement (the real virtual relation of the complex number). Because the particle is the excited state of the matter wave.
Mutually entangled particles are entangled by the phase (imaginary part) of their own waves. If the phase of one particle wave changes, the phase change of the other particle will affect the state of the other entangled particle.

6.6. Multiple universes
When $\Delta r < \hbar$ (That is, the moving space of matter is smaller than the reduced Planck scale $\hbar$) or $\Delta t < \Delta t_c$ (The existence time of matter is less than the limit time $\Delta t_c$) (see figure 3), then its inner space, mass and electric charge will change into reverse signs, namely change into reverse system of their own, that is to say: The original real space changes into negative space. In other words, at the time space-time turns into anti space-time (microcosm) and matter turns into antimatter; there is horizon surface consisting of velocity of light between microcosm and our macrocosm and there special areas (microcosm) will generate a large number of small black holes and white holes in our present macrocosm.

![Figure 3. Top view of G complex space-time 3D model.](image)

7. Conclusions
The velocity vector generated by the rotation of the particles in the complex space distracts the time dimension, the vector forms the weak charge in the space projection; its rotary angular velocity vector distracts the energy dimension, the vector forms the mass charge in the space projection; Its rotary centripetal acceleration vector distracts the space dimension to form the electric charge; the acceleration jerk (variation of acceleration) generated by the rotation of the vector distracts the color dimension, the vector forms the color charge in the space projection; the projections of the electric charge, mass charge, color charge and weak charge into the 3D space form the three-nature (positive, negative and neutral electrodes), three-generation, three-boson and the past, present and future of particles; The direct product group U (1) XSU (2) XSU (3) XU (4) or simple group U (20) constitute the super unification group of the physical world. The universe is holographic, bounded and boundless. All information in the universe can be stored on the visual interface in the form of holographic images formed by the interference of the imaginary part of the material wave. This is the physical mechanism of quantum entanglement.

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