Title:

Quantum macroscopic analysis of space position energy

-Based on classical mechanics and quantum field theory

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In the 'Natural gravity theory', space is the center of the universe that has a global unity that encompasses the microscopic and macroscopic worlds. Here, space position energy (+) interacts symmetrically with the existing Gravity energy (-). This dynamical symmetry is a general principle found in nature.

The 'Natural gravity theory' opens a new dimension that solves physical problems that have not been solved so far. It can interpret phenomena based on classical mechanics based on mass energy and explain the essence with quantum field theory based on energy density.

1. The essence and phenomenon of existence as told by the double slit experiment

The source of existence is energy, and energy has quantized waves as its essence. The essence of matter is the quantized wave mechanism, and human intuition can be seen as fixing particles and recognizing them for the efficiency of perception. Only with quantum mechanics did humans discover their own dualistic recognition structure as a scientific principle. The 'observer effect' of the double slit experiment may be a simple structure. It shows that humans perceive the wave mechanism, which is the essence of energy, as a phenomenal particle for the efficiency of perception. This strongly suggests that energy itself is not dualistic, but that human perception has developed into a dual structure of essence and phenomenon.

This means that the existing macroscopic theory of classical mechanics centered on phenomenal particles can be reinterpreted as a quantum field theory centered on wave energy, which is the essence. This is a challenging task at present, but it becomes a new goal of physics that needs to be pioneered through the development of quantum mechanics and quantum field theory.

2. Challenge of quantum field theory to macroscopic theory

The macroscopic theory of quantum field theory can start from the interpretation of specific physical phenomena. For example, it is the interpretation of the perihelion movement of Mercury, which is a major topic in physics, and the interpretation of the rotational motion of galaxies. Here, we will analyze it through the 'natural gravity theory' and 'Space position energy' discussed earlier. This theory interprets gravity as the movement of energy density and explains the interaction between space and matter. The natural theory of gravity sees gravity as the energy density movement due to the compression and expansion of space. It also understands the Coulomb interaction in the microscopic world and the gravity in the macroscopic world as the energy density movement of the integral space. The input of mass energy into space increases the energy density, and the increase in energy density itself becomes potential energy (+), and at the same time generates Gravity energy (-) as a reaction. This is the essence and basic mechanism of gravity.

A. Classical Mechanical Interpretation

1. Interpretation of Mercury's Perihelion

Mercury's perihelion can be said to be the first time that Space position energy (+) has revealed itself to us humans in space. Mercury's perihelion is the result of the interaction between the Sun and Mercury, but the biggest cause can be seen as the Sun's Space position energy exerting a 'repulsive force' on Mercury. This can be expressed and calculated as the alpha term of the UH equation.

$U_H = \frac{1}{2}mv^2 - \frac{GMm}{r} + \alpha\frac{GM_Tm}{R} + \rho(r)$, the first two terms $\frac{1}{2}mv^2 - \frac{GMm}{r}$ represent the kinetic energy and Gravity energy of traditional classical mechanics. This is a vector energy with a clear direction. The last two terms $\alpha\frac{GM_Tm}{R} + \rho(r)$ express the newly discovered Space position energy and the energy density of the space.

As the name suggests, the 'Space position energy' is a scalar energy. This is a potential energy that is global toward the entire space based on ordinary matter. Here, the 'coefficient' is a self-adjusting coefficient of the alpha term. The default value is 1, and it can reflect the interaction with the Gravity energy of the space and the interaction with the potential energy of nearby celestial bodies.

If we interpret Mercury's perihelion through the UH equation, it can be expressed as follows.

Calculating the position energy of space:

Mass of ordinary matter in the universe: 1.641×10^53 kg
Mass of our galaxy: 2.984×10^42 kg
Cosmic Radius: R= 4.4×10^26 m
Gravitational constant: G=6.67430×10^－11 m^3 kg^－1 s^－2
Solar mass: M=1.989×10^30 kg
Mass of Mercury: m=3.3011×10^23 kg
Average orbital radius of Mercury: r_Average orbital radius= 5.79×10^10 m
Perihelion distance of Mercury: r_Perihelion=4.6×10^10 m

Mercury has an elliptical orbit with an eccentricity of (e): 0.2055. This means that the perihelion orbital kinetic energy: 5.74×10^32 J is more than 60% of the absolute value of the perihelion Gravity energy -9.53×10^32 J. This is much larger than the normal 50% according to Kepler's law. This is mainly because the Sun's gravity overwhelms Mercury.

However, the Sun and Mercury try to adjust their excessive approach to each other. Accordingly, in the perihelion orbit, the Sun's Gravity energy of 2.984×10^42 kg(-) corresponds to the Sun's potential energy of 4.95×10^46 J(+). At the same time, Mercury's potential energy of 8.22×10^39 J(+) also acts, although very small. These energies act as a repulsive force(+) and cause a movement (perihelion precession) that pushes Mercury forward from the strong gravitational field of the Sun. This adjustment process uses only a small portion of the potential energy of the Sun and Mercury.

Mercury Perihelion Precession Kinetic Energy Required:

The perihelion motion is $\Delta\theta \approx 0.1036$ arcseconds/orbit, which is a forward motion of 23.1 km/orbit. The kinetic energy used here is calculated as KE_required=1.52×10^18J. It can be

seen that the Sun and Mercury are stably adjusting Mercury's orbital motion through their interaction using a small portion of their potential energy in space.

2. Interpretation of galactic motion

Until now, in the interpretation of galactic motion, a hypothetical substance called dark matter has been introduced to supplement the shortcomings of the existing gravity theory. Dark matter does not interact at all with other substances in the universe, such as light, but it has mass and forms gravity, and it appears to interact only with gravity. However, the fact is that the Space position energy (+) is equivalent to this in terms of characteristics and scale.

As $U_H = \frac{1}{2}mv^2 - \frac{GMm}{r} + \alpha\frac{GM_Tm}{R} + \rho(r)$, $\alpha\frac{GM_Tm}{R} + \rho(r)$ increases the mass of the galaxy to sufficiently compensate and firmly stabilize the spatial density.

Here, the role of the alpha term and the density term can be conceptualized as follows.

In classical mechanics, at the galaxy rotation speed $v = \sqrt{\frac{GM}{r}}$, the Space position energy increases M which theoretically increases the Gravity energy that was lacking. Accordingly, it becomes $v = \sqrt{\frac{G(M + M_{Uspace})}{r}}$, and the galaxy moves stably on its own. $v = \sqrt{\frac{G(M + M_{darkmatter})}{r}}$, which was assumed to be the role of dark matter, can be naturally explained.

Here, too, the 'α coefficient' is the self-adjusting coefficient of the Space position energy. The default value is 1, and it can be seen that the deficiency is compensated for through interaction with the Gravity energy of the space. Therefore, the stable movement of the galaxy can be said to be the second case that shows us the nature and reality of the Space position energy (+).

Mass density-based calculation of the UH equation for the rotation speed of our galaxy

Universal ordinary matter mass: 1.641×10^53 kg
Mass of our galaxy: 2.984×10^42 kg
Cosmic radius: R= 4.4×10^26 m
Galactic radius: r=1.621 x 10^21 m

① Using an equation that extends the classical mechanics theory

$M(r) = \rho \times V(r)$, ρ is the mass density of the galaxy (kg/m^3),
Galactic Gravity energy: U_M =−3.67×10^53 J
Galactic space position energy: U_{space}= 4.207×10^{58} J,
Mass conversion value of space position energy ≈ 4.674×10^41 kg :
Galactic total kinetic energy requirement (estimated): KE= 2.549×10^54 J
1. Orbital motion: 4.543×10^53 J
2. Geokinetic motion: 2.881×10^52 J
3. Internal energy requirement such as star formation: 2.066×10^54 J

$U_{space} \approx U_M$ ×2.0231×10^5, so the ability to adjust Space position energy is sufficient.
: Mass conversion value of part of Space position energy of Galaxy M. Next, according to the traditional gravity formula, the rotational speed can be calculated as follows:

$$v = \sqrt{\frac{G(M + M_{Uspace})}{r}}$$

② The outer velocity of our galaxy:
Estimated mass considering about 220 km/s, etc. : 2.984×10^{42} kg
Mass of visible matter (stars, gas, etc.): $\approx 1.69 \times 10^{42}$ kg
1) Required dark matter amount based on the gravitational system based on observational data: $\approx 1.294 \times 10^{42}$ kg
2) Estimated dark matter amount based on the NFW (Navarro-Frenk-White) profile: 1.3×10^42 kg

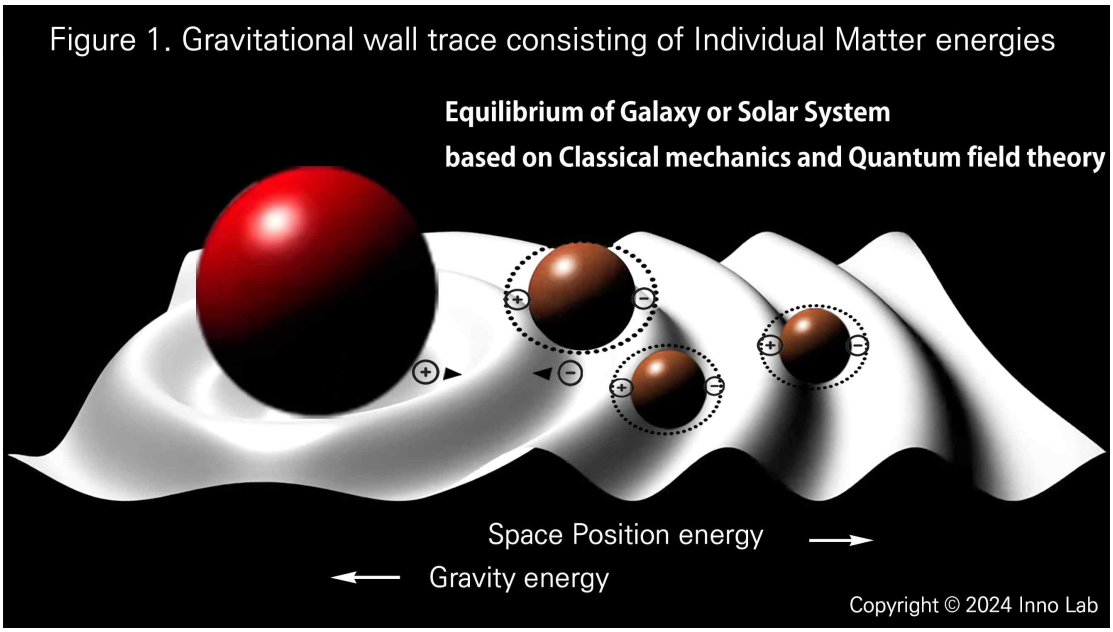
The NFW profile is an empirical model to explain the density distribution of dark matter halos. It is the result of numerous computer simulations and is used to describe the distribution of dark matter around galaxies and galaxy clusters. Here too, it is close to the observational estimate.

However, the estimated mass and NFW profile from observations are models that do not consider the thermal pressure and radiation pressure, which are expansionary energies (+) inside the galaxy, because they are modeled only by pure gravitational action (-). In addition, there is a limitation that the dynamic effects of galactic motion and the mechanism of inertial momentum such as the initial centrifugal force are not explicitly sufficiently considered. Therefore, the calculation amount of NFW may be overestimated.

③ Summary of interpretation of dark matter
1) The Space position energy of our galaxy = 4.207×10^{58} J, $\approx 4.674 \times 10^{41}$ kg
2) The required amount of dark matter based on the NFW (Navarro-Frenk-White) profile $\approx 1.294 \times 10^{42}$ kg
3) Interpretation: 1/2≈ 36%
The Space position energy(+) is 36% of the estimated gravitational dark matter(-), which is less than the amount of Gravity energy. If we interpret this differently, we can interpret that the structural characteristics of the Space position energy(+) can efficiently achieve stable operation of the galaxy with only 36% of the energy of the gravitational dark matter(-).

Figure 1 below intuitively shows how the Space position energy can achieve a stable balance in the orbital motion of a planet or the rotational motion of a galaxy. The Space position energy efficiently induces and regulates the stable motion of planets and galaxies. Here, the concept of ‘Gravity wall’ expresses the principle of interaction between Space position energy (+) and Gravity energy (-) that induces the stable motion of objects.

In this way, the actual space shows that the bidirectional symmetrical structure is much more efficient and stable than the single structure of the gravitational field. This is the appearance of a universal dynamical system that also complies with the law of conservation of energy and the principle of least action in the nature of the universe.



B, Quantum Field Theory Interpretation of Gravity

Energy, the source of the universe, has duality as a wave and particle in quantum theory. In the 'natural gravity theory', the essence of mass energy is understood as a wave mechanism, and this is realized as a phenomenon called particle. Therefore, existence can be explained as a physical wave and expressed as the movement of particles. In other words, when the essential mechanism of mass energy, wave, is concentrated at high density, our perception can be interpreted as sensing mass.

The 'Natural gravity theory' interprets gravity as the energy density movement of space. Here, space has globality that integrates the microscopic and macroscopic worlds into a single entity. Ontologically, space is seen as the subject that comprehensively operates the universe.

This Natural gravity theory is the UH Universal Hamiltonian equation :

$$U_H = \frac{1}{2}mv^2 - \frac{GMm}{r} + \alpha\frac{GM_Tm}{R} + \rho(r)$$

This can be expressed as a Lagrangian function $L = T - U_{gravity} + U_{space} + |\Psi(r)|^2$.

Here, gravity is interpreted as mass-energy density motion, and not only kinetic energy but also Gravity energy and Space position energy can be expressed as a (time-independent) quantum field theory wave equation.

Time-independent wave function: $\Psi(x) = A(x)\cdot e^{i\phi(x)}$

$A(x)$: Amplitude of wave function, local energy density expression.

$\phi(x)$: Phase adjustment factor including potential energy and scalar value.

Here, we can approach the analysis of macroscopic theory based on Louis de Broglie's 'matter wave theory'. Matter wave theory is a wave theory derived from the mass-energy equivalence law $E = mc^2 = h\nu$.

Here, particle momentum is defined as $p = mv = h/\lambda$ and

the de Broglie wavelength is defined as $\lambda = \frac{h}{p} = \frac{h}{mv}$.

h: Planck's constant (≈6.626 x 10^-34 J s)

p: Momentum

m: Mass

v: Velocity

If we express this as a time-independent matter wave function,

$\Psi(\vec{r}) = A \cdot e^{ik \cdot r}$

$\Psi(\vec{r})$: matter wave function, A: amplitude, wave intensity

k : wave number vector, a vector related to the particle's momentum p, the magnitude of which is expressed as follows:

$|k| = \frac{2\pi}{\lambda}$

$k \cdot r$: phase

Here, the UH equation can be expressed as a wave equation as follows.

$E\Psi(\vec{r}) = \Psi(\vec{r})\left(-\frac{\hbar^2}{2m}\nabla^2 - \frac{GMm}{r} + \alpha\frac{GM_T}{R}\right)$

Here, the celestial body M,m, which is a large mass, can be seen as a complex high-frequency wave with high-density energy. In other words, it can be interpreted as a single wave equation (mean value concept) based on mass. The mass m of classical mechanics or Einstein's theory of relativity is also essentially a mean value concept. Based on this, it is considered that the development of a quantum field macroscopic theory is also challenging.

Therefore, the Universal Hamiltonian $U_H = \frac{1}{2}mv^2 - \frac{GMm}{r} + \alpha\frac{GM_Tm}{R} + \rho(r)$ can be interpreted as the Universal Lagangian

$U_{\mathcal{L}} = \frac{1}{2}(\nabla\phi)^2 - \frac{1}{2}G\phi\nabla^2\phi + \alpha G\frac{\phi\phi_T}{R^2} + \rho(r).$

1. Quantum field-theoretical interpretation of Mercury's perihelion

Einstein extended Newton's classical mechanics with a relativistic interpretation of Mercury's perihelion. However, this was only a phenomenal interpretation of macroscopic physical motion, and was far from the essential clarification of gravity, which is the core of motion. Natural gravitational theory explains gravity as the density motion of mass energy. This was previously expressed and proven in space dynamics.

Energy density is also a key concept in quantum theory. Energy density is confirmed as a key concept that integrates the macroscopic and microscopic worlds based on the global single space of the universe.

Here, the de Broglie matter wave theory based on microscopic quantum theory provides important implications for macroscopic physical motion, although it is still limited.

Here, Mercury's perihelion motion is interpreted as the coordinating action of the Space position energy of the Sun and Mercury (repulsion or space elasticity) rather than gravitational motion (attraction or space deformation). This explains the energy density motion, which is the basic concept of natural gravitational theory. The perihelion of Mercury can be interpreted not simply as a result of physical forces, but as an autonomous interaction between the Sun and Mercury. This is done by adjusting the energy density.

When Mercury gets too close to the Sun's gravity, the Sun and Mercury adjust their Space position energy to maintain a stable orbit. The energy used in this process is Space position energy.

The orbital motion of Mercury can be expressed as a wave energy density function in quantum field theory.

If we express this in $\rho(r) = |\Psi(r)|^2$ as a density function based on a Gaussian normal distribution, bsed on $\rho_{space}(r) \propto e^{-2\frac{r}{r_0}}$, the wave function can be calculated as $\Psi(r) \propto e^{-2\frac{r}{r_0}}$, and the probability density can be calculated as

$$\rho_{quantum}(r) = |\Psi(r)|^2 = e^{-2\frac{r}{r_0}} \qquad \rho(r) = |\Psi(r)|^2$$

Therefore, $\rho_{space}(r) = |\Psi(r)|^2$can be expressed as $\rho_{space}(r) = A^2 e^{-2\frac{r}{r_0}}$.

Here, the normalization constant A can be set as follows:

$A^2 = \frac{U_{space}}{\pi r_0^3}$ Therefore, the energy distribution in space can be expressed exponentially as follows: $\rho_{space}(r) = \frac{U_{space}}{\pi r_0^3} e^{-2\frac{r}{r_0}}$

The size of the Space position energy of Mercury and the Sun

The space position energy of the Sun calculated by the wave function U_space, sun: 4.95×10^46 J, The space position energy of Mercury (based on perihelion) U_space, Mercury (perihelion): 9.53×10^32 J. This is overwhelmingly larger than the energy required for

Mercury's perihelion movement KE_required=1.52×10^18J.

The mass density of Mercury's perihelion space

$\rho_{space}(r) = \frac{1.3246}{\pi} kg/m^3$ is 4.45×10^25 times larger than the average density of the universe, 9.47×10^-27. This shows that a 'repulsive force' can act enough to overcome the gravitational force between the Sun and Mercury. The difference in the mass energy density of space also proves the existence of Space position energy. Gravity is a force created by the difference in mass energy density.

2. Quantum field theory interpretation of dark matter

The Space position energy is equivalent to dark matter in terms of characteristics and scale. Assuming that this dark matter is spatially distributed, the wave function of dark matter is as follows.

$$\Psi_{dark}(r) = A \cdot e^{-\frac{r}{r_0}}$$

Ψ(r): Space wave function according to the distance r from the center of the galaxy (spatial distribution of potential energy density).

A: Wave normalization constant.

r_0: Characteristic distance (parameter that determines the range of action of potential energy).

$\rho_{space}(r) = |\Psi(r)|^2$ can therefore be expressed as

$$\rho_{space}(r) = A^2 e^{-2\frac{r}{r_0}}.$$

The UH equation can be expressed as the wave equation centered on the energy density as follows.

$$E\Psi(\vec{r}) = \Psi(\vec{r})\left(-\frac{\hbar^2}{2m}\nabla^2 - \frac{GMm}{r} + \alpha\frac{GM_T}{R}\right)$$

Here, the calculated value of the corresponding space dark energy is the space position energy of the alpha term $\Psi(\vec{r})\alpha\frac{GM_T}{R}$.

3. Conditions for balanced galactic motion based on density function

The current NFW density calculations that require dark matter can be seen as being excessively concentrated in the center, as expressed in Table 1. This is a structure that is entirely dependent on the theory of gravity. However, items 2 and 3 of Table 1 show that much more stable galactic motion can occur if the motion of the galaxy is analyzed using the exponentially decreasing density function $\rho_{space}(r) = \frac{U_{space}}{\pi r_0^3} e^{-2\frac{r}{r_0}}$.

Table 1.Various interpretations of the galaxy density distribution

Radius (kpc)	1. NFW density (kg/m³)	2. Gaussian exponential density (kg/m³)	3. Wave density function (kg/m³)
0.0	무한대 (∞)	1.0 ×10 ^−4	1.0
2.63	1.06×10^-20	7.7×10^-5	7.7×10^-1
5.25	4.26×10^-21	5.9×10^-5	5.9×10^-1
7.88	2.33×10 ^−21	4.6×10^−5	4.5×10^-1
10.51	1.46×10 ^−21	3.5×10 −5	3.5×10^-1

* kpc is an astronomical distance unit, 1 kpc = 1,000 parsecs = approximately 3,260 light years. Our galaxy is considered to be about 15 to 20 kpc in radius.

4. Interpretation of the wave function of the macroscopic motion

The wave function, which assumes the exponential decrease of the Gaussian shape of the spatial density, can be expressed as follows.

Based on $\rho_{space\,(r)}(r) \propto e^{-2\frac{r}{r_0}}$, the wave function is calculated as the probability density $\Psi(r) \propto e^{-2\frac{r}{r_0}}$, $\rho_{quantum}(r) = |\Psi(r)|^2 = e^{-2\frac{r}{r_0}}$ when the wave function is .

This result shows that the density of galaxies is distributed in a very gentle structure as in Table 1. This shows that the structure of galaxies can be much more efficient and balanced than the existing evaluation.

Although there are still limitations in analyzing the macroscopic scale with a microscopic methodology, we attempted to interpret the macroscopic motion based on the wave function. This was a study based on the truth that the microscopic space and the macroscopic space are not essentially different and that the motion of matter is based on the common foundation of the motion of energy density. We hope that this will be a starting point for the development of a methodology and theoretical system that can completely connect the microscopic world and the macroscopic world in the future.

Quantum Field Theory (QFT) Interpretation of Gravitational Field

The above Figure 1 presents a new concept explaining the general equilibrium of galaxies and solar systems based on the synthesis of Classical Mechanics and Quantum Field Theory (QFT). In particular, the innovative concept of the “gravitational wall” is a natural equilibrium structure formed by the interaction of Gravity energy (-) and Space position energy (+), which guides individual matter along a stable path of movement. This constitutes a more structurally sound and stable space system than the simple interpretation of the existing gravitational field. The universe has evolved to find more efficient structures and methods.

This can rationally explain physical phenomena without artificial hypotheses such as dark matter or dark energy. The structure of the self-regulating scalar energy field of Space position energy (+) combined with the Gravity energy (-) of the vector energy field also conforms to the general principles of nature.

It can provide a new paradigm explaining the movement and equilibrium of the space

system. Additional research on this can provide meaningful new implications for understanding not only the macroscopic space system but also the microscopic world. We look forward to the participation of researchers with a sense of purpose, and this researcher also plans to continue to study the quantum field theory gravity model based on energy density and update this discussion here.

Critical reflection on the methodology of modern science

The above integrated study on the nature of the universe can lead to the following understanding.

1. The limitations of the linear partial understanding of nature that is biased towards the phenomenon of modern science can be overcome through a holistic understanding through essentialism and multi-layered pattern analysis.
2. Here, a critical reflection on the phenomenon-centered interpretation theory that forms the mainstream theory is necessary. Einstein raised the level of innovation in his special theory of relativity. However, in his general theory of relativity, the creation of arbitrary 'spacetime' and geometric spatial interpretation are separated from the essence of the natural principle. In other words, this is the methodological limitation and epistemological abstraction of the general theory of relativity.
3. It is necessary to reflect on the fact that the innovation of Einstein's general theory of relativity is overestimated. He created time and space without intending to, and caused humans to distrust their innate natural principle a priori subjectivity. We need to acknowledge that the human a priori cognitive system is much more harmonious and balanced than the partial world perception of science.

Science will develop more harmoniously and more valuablely when it serves as a tool to help and expand the highly developed human a priori cognitive system.

4. The universe and nature are a complete 3D world according to human a priori senses. Einstein's self-distrust of the natural principle sense and perception that he left to humans may be a great mistake in human history. I believe that physics and science can achieve development in accordance with natural principles when they overcome this 'Einsteinian world perception' and 'methodological abstraction'.
5. We need to understand that the physical foundation and dimension of the natural principle sense of the five senses of humans and the inertial sense that we sense with our whole body share the same base as the physical principles of the universe. Life and humans have evolved according to natural principles. The fundamental principles of nature in the universe are composed of principles that life and humans can intuitively perceive and understand. Therefore, this is the view that the a priori cognitive system, which is the original human cognition, has an essential advantage over mathematical abstraction in terms of the density and scale of cognition of nature in the universe.
6. A consistent characteristic found in the principles of nature in the universe is that the physical principles of nature are very precise and elaborate even at a very low density of $1.0\times10^{-27}/m^3$. This is a characteristic of nature's strict laws and elaborate interactions that transcend our stereotypes. There are only strict and honest physical principles here, and dependence on virtuality and imagination is fundamentally impossible.

This is fundamentally different from the tendency of human culture and civilization to depend on virtuality, imagination, and even self-deception, and the inefficiency and danger of partial and dogmatic communication methods. This is enough to give us fundamental reflection.

Limitations and tasks of this study

The discussion so far has been conducted through multi-layered pattern analysis and review, and can be said to be a hypothesis that has gone through a multi-faceted inference and verification process. However, additional experiments and verification, supplementation of the shortcomings, and developmental research are needed in the future.

Here, the celestial body M,m, which is a large mass, can also be viewed as a complex high-frequency wave with high-density energy. In other words, it can be interpreted as a single wave equation (mean value concept) based on mass. The mass m of classical mechanics or Einstein's theory of relativity is also essentially a mean value concept. Based on this, it is considered that the development of a quantum field macroscopic theory is also challenging. Both macroscopic and microscopic theories share the same physical foundation of energy density and waves, with the same space as their matrix.

We look forward to much interest and cooperative research from researchers with a sense of purpose.