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The Unity Principle-The Way to The Essence of Quantum Gravity

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Abstract

So far, theoretical physics has not been successful in finding answers to the questions of what physical reality consists of and according to what basic principle it is built. The essence of matter, energy, space and time, gravity and other forces is undetectable mystery. The fundamental discovery of the Unity Principle derived on the base of dialectical logic is presented illustrating the exact mechanism how the physical universe may work at its macro and micro levels. At the same time, the essence, composition, structure and principle of construction of a unified quantum field are revealed, in which all force interactions take place, including the gravitational one, to which the main attention is paid.

Keywords: Cosmic expansion, Unity Principle, Universe, Quantum dipole, Quantum field, Quantum gravity.

1. Introduction

Contemporary theoretical physics enters a deep crisis as it is unable to find answers to the fundamental questions about the universe, such as: what our being consists of, what are the basic building blocks from which the whole reality is built and according to what principle, what is the common essence of all force interactions, including gravitational, what space consist of, why is the universe expanding, and more. This crisis results from positivistic and post-positivistic approach, which assumes that reality is mechanical and atomistic, made of point-like particles or one-dimensional strings. However, reality is dialectical, consisting of bipolar relations of opposite poles (+/-), which form the unified field that Albert Einstein unsuccessfully sought and which even current academic science, including string theory within the so-called theory of everything (TOE), is unable to find. The reason is simple. The application of formal logic alone is insufficient in the effort to penetrate the deepest secrets of our being, and dialectical logic, as the most effective tool, is unknown to contemporary science.

2. Definition of the Unity Principle

Derivation of the Unity Principle based on dialectical logic is presented in my several publications [2-7].

The essence of the Unity Principle can be expressed as follows:

The entire "Being", including its physical reality, is built of elementary bipolar relations of counterparts (quantum dipoles, quantum connections (+/-)), where every positive pole "+" creates relations to all negative poles "-" of the Universe (and this relation is reciprocal).

That is, each quantum dipole (bipolar connection) is connected to the entire Universe and every object created from quantum dipoles is connected to all other objects in the Universe due to direct quantum connections (+/-). An elementary quantum dipole (connection) is an elementary quantum of space. Therefore, the volume of space is dictated by the number of elementary quantum connections.

Opposite poles of the quantum dipole (+/-) attract and repel each other, manifested as vibration-oscillation. Repulsion and attraction are two opposite forces, through which both counterparts are in mutual motion. This motion is the energy of the quantum dipole. Therefore, energy is a measure of mutual attraction and repulsion of counterparts.

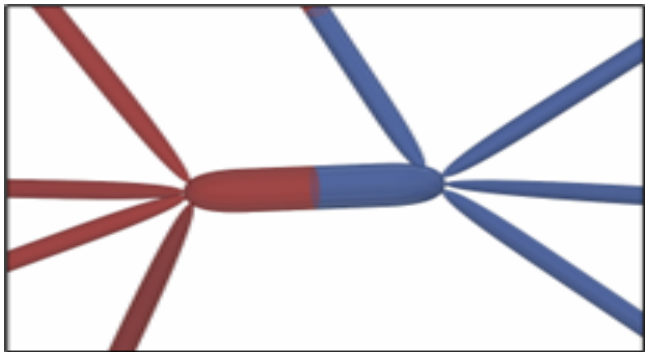


Fig. 1: Bipolar connections +/- representing elementary quantum connections (dipoles) from which the whole reality (the Universe) is created.

3. The Photon: An elementary quantum dipole (+/-)

A photon is both a particle and a wave. How is this possible? What is the solution? The photon as the elementary quantum of free energy clearly shows the bipolar nature of the whole Being.

The photon γ (+/-) as the simplest particle (+/-) is an elementary oscillating quantum dipole which, due to mutual attraction and repulsions of its opposite poles, performs permanent oscillation (vibration, pulsation) manifesting externally in flight as an electromagnetic wave. This is a real and factual explanation of the "wave-particle" duality of light, because only the bipolar dynamic unity of counterparts can lead to the oscillation (motion, energy) of the photon.

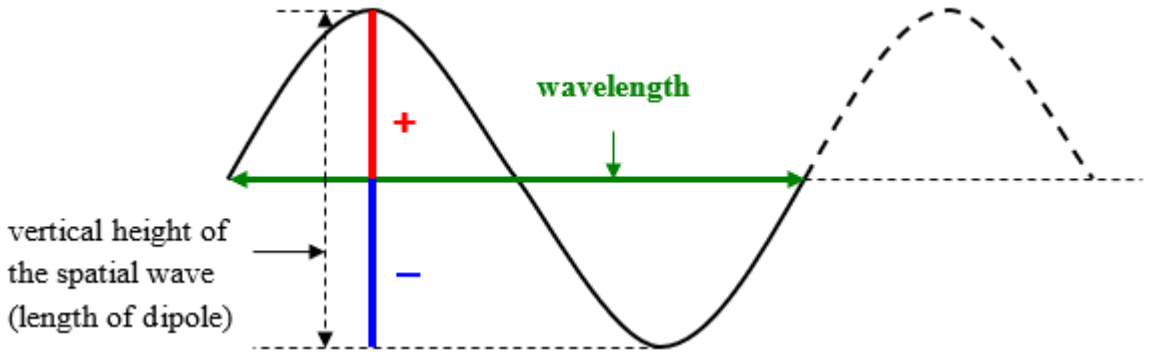


Fig. 2: Sinusoidal wave as a result of the photon oscillations

A photon is a carrier of an elementary quantum of energy. The energy of a photon $\mathbf{e}_i$ as a measure of its motion (vibration frequency $\mathbf{f}_i$) can only be the result of the mutual attraction and repulsion of its counterparts. Planck´s equation $\mathbf{e}_i=\mathbf{hf}_i$ indicates that the energy of a photon is given by its vibration rate (frequency).

Knowing the essence of light makes it possible to understand the essence of existence. There is no space and energy outside of quantum connections. They alone create a cosmic network of quantum connections forming a unified cosmic quantum field that represents the whole reality. Quantum connections (dipoles) are not located in space, but create it. They represent elementary quanta of space. Although the elementary quantum dipoles are indistinguishable in their spatial volume, they differ from each other by the energy content $\mathbf{e}_i$ and the length $\mathbf{d}_i$, so the following basic constant δ_t is valid:

$$\delta_t = \mathbf{e}_i\mathbf{d}_i$$

Very short quantum dipoles form the structure of the subatomic particles (photons, electrons and protons), while long quantum dipoles form their mutual connections. Very long quantum dipoles connecting the celestial bodies to each other at their quantum level create a cosmic vacuum, so they can be called vacuum quantum connections.

The value $\delta_t = \mathbf{e}_i\mathbf{d}_i$ is a constant, which is same for each quantum dipole (connection) and represents the fundamental cosmic law, which implies other very important laws, e.g. Newton´s and Coulomb´s laws. This means that the shorter the quantum dipole, the higher its energy. The longer it is, the lower its energy. Energies of the very long quantum dipoles that connect celestial bodies to each other and create a cosmic vacuum are very small, but their numbers are huge. Vacuum is made of the quantum connections (which are carriers of energy) connecting physical bodies together.

Since everything is made up of elementary quantum dipoles (connections), which, as we have said, are photons, we can say that everything comes from light (energy), which can exist in the form of free-flying photons or bound in the form of basic particles (protons and electrons) as well as in the form of vacuum.

4. Localism versus non-localism

Contemporary physics divides the whole reality into its parts. Mechanical separation of parts from the whole means the destruction of their interrelations so that these parts can only interact with one another by local contacts. Localism dominates in contemporary theoretical physics, where the interactions between "point-like" particles are presented as a result of mutual exchange of virtual bosons moving at a limited speed of light. Strangely, such a naïve mechanical interpretation of particle interactions has been incorporated into the Standard Model, despite the observed fact that non-locality results directly from quantum mechanics.

Space is the basic attribute of each physical entity with its quantitative measure of volume. There are no entities without spatial volume. Point-like particles or one-dimensional strings do not exist. Space is not only a basic feature of everything, but it also separates things from one another and connects them simultaneously.

All things and their interconnections are made up of the same components-elementary quantum connections (dipoles). Objects move towards each other only because of their quantum interconnections, which create free space – the vacuum.

There are only two basic interactions – non-local and local. Non-local interactions manifest themselves through attraction and repulsion of opposite poles of quantum dipoles, while local interactions are always repulsive forces acting by local contact pressures between adjacent elementary dipoles that press against each other with their spaces. The attractive force is always non-local, while the repulsive force may be non-local or local. Local force is always repulsive:

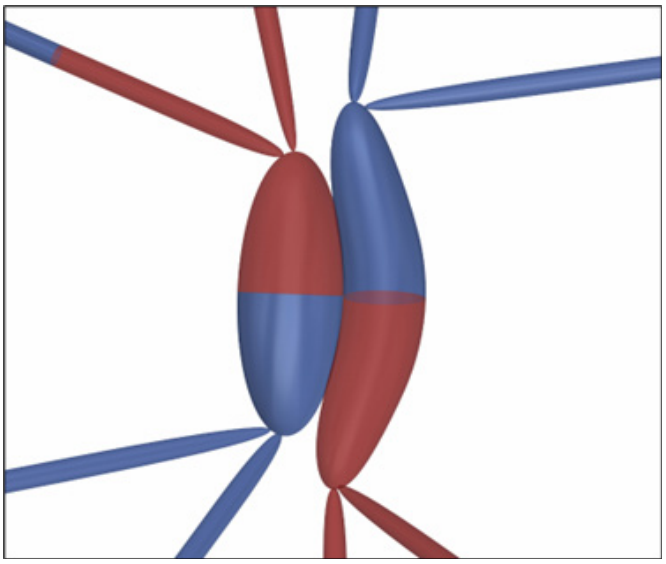


Fig. 3: Two quantum dipoles that press against each other with their spaces (fixed volumes)

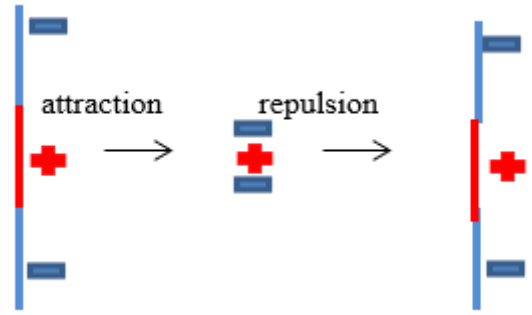
The above figure shows two quantum dipoles acting locally by their mutual repulsive pressures. Elementary quantum connections (dipoles) represent elementary quanta of space, but differ in lengths and energies. Here, the left one is shorter, stronger with more energy and the right one is weaker, longer with less energy.

Since all experienced interactions affect our human senses locally through tactile interactions, theoretical physics has difficulty to accept "invisible" non-local connections, although they result directly from dialectical logic and quantum mechanics. Their manifestations are confirmed experimentally, even having practical usage. So, there are only two basic forces attraction and repulsion and two basic interactions-local and non-local. All known interactions according to contemporary physics: mechanical, electromagnetic, strong, weak, nuclear and gravitational, are just their manifestations. The two basic forces - attraction and repulsion are always in a dynamic balance with each other at all levels of the hierarchy, starting with elementary quanta, particles, molecules, bodies..., ending with the entire universe.

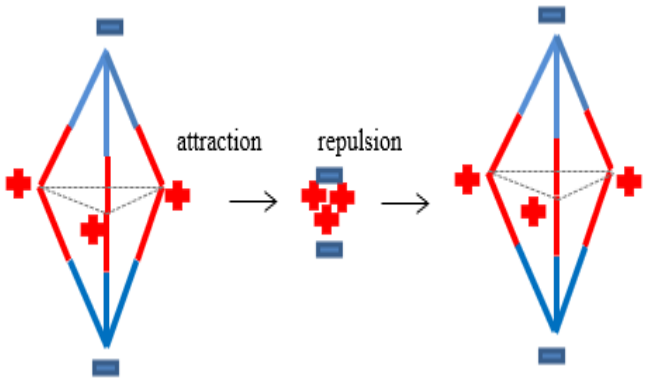
5. Basic particles

Visible matter is made up of three fundamental particles-the electron, the proton, and the neutron.

Electron e^- (+/2-) consists of two quantum dipoles:

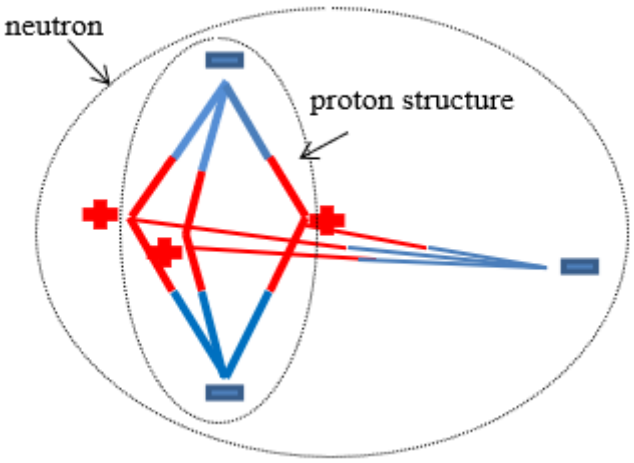


Proton p^+ (3+/2-) consists of six elementary quantum dipoles:



All stable structures (particles) oscillate in one line (axis of oscillation) to one common centre during attraction. The dipoles which make up the total proton are short and strong (energetic). These energetic forces make the proton the most stable composite structure, as they are able to overcome the mutual repulsive pressures between dipoles. The proton has three positive poles which form a triangle. It is because of these positive poles that in electron-proton scattering experiments, the electrons scatter from three points inside the proton. This is not due to the quark structure, but due to the bipolar nature of the proton.

Neutron n (3+/3-) in its basic state (not excited) consists of nine quantum dipoles:



Inside the neutron we see a proton structure (short and strong quantum dipoles). One negative pole is connected to three positive counterparts by much weaker and longer connections, which can be released from this structure during beta decay.

All forces are nothing but the attraction and repulsion of quantum dipoles. Very short quantum dipoles create the strong attractive forces inside hadrons (proton/neutron) and leptons (electron/neutrino). Nuclear forces are formed from short and strong quantum dipoles between nucleons. Electrostatic forces are formed from weaker and longer quantum dipoles. Other forces between atoms and molecules are weaker than electrostatic ones, and the weakest are the gravitational forces between massive objects, which manifest themselves through long mutual quantum connections representing a cosmic vacuum.

6. The essence of quantum gravity

Gravity has a global quantum character and manifests itself through the cosmic network of quantum connections (+/-). It is a reaction to the expansion force of the universe causing its expansion. Since attraction has its opposite in repulsion, these two opposing forces are mutually balanced. However, their balance and symmetry is not static, but dynamic, having various forms. The gravitational force **G** of the universe is that part of its total attractive force that represents the counterbalance to the total expansion force of the universe **Fe** causing the cosmic expansion. The magnitudes of both forces are therefore equal:

$$\mathbf{Fe = G}$$

The total gravitational force of the universe is equal in magnitude to the total expansion force with the opposite orientation. In order to understand it more deeply, it is therefore necessary to first understand how the expansion of the universe manifests itself at the quantum level. Since the gravitational force is also a specific manifestation of the electrostatic force, knowledge of its nature is also necessary for knowledge of the nature of gravity.

6.1. Cosmic expansion

The Universe evolves gradually, step by step, forming and ejecting new positive "+" and negative poles "-". The ongoing internal structuring and differentiation of the Universe means its cosmic expansion. The Universe is an expanding network of quantum dipoles (connections) moving from one quantum state to the next.

At the beginning of expansion, the Universe is just a simple quantum dipole **(+/-).** It then ejects, suppose, first one positive pole **(+)** and another negative one **(-)**, so after two elementary quantum jumps the Universe represents the structure **(2+/2-)**. To simplify our analysis, we only consider and calculate quantum transitions between the symmetric quantum states when two new poles are ejected (formed) one by one. In the first quantum state the structure of the Universe is **(+/-)**, in the second symmetric quantum state it is **(2+/2-)**, in the third quantum state it is **(3+/3-)**… In the **k**-th symmetric quantum state, it has a structure **(k+/k-)** and consists of $\mathbf{V_k = k^2}$ elementary quantum dipoles (connections). The value $\mathbf{V_k = k^2}$ represents the volume of space given by the number of elementary quantum dipoles. The value **k** represents the number of positive or negative poles, as well as the serial number of the symmetric quantum state of the Universe, which represents the cosmic time (i.e. the number of elementary quantum double-jumps of the Universe since the beginning of its expansion).

The Universe jumps from its one quantum state **k** to the next **k+1**, forming (ejecting) new positive + and negative – poles with **2k+1** new quantum dipoles +/-. The inner structuring of the Universe that causes its cosmic expansion can be easily described using the following basic quantum space-time equation:

$$\mathbf{V_k = k^2}$$

This equation reflects the internal division and structuration of the Universe, creating its own expanding space and flowing time. The Universe is quantized because its energy and space are localised in its elementary quantum connections and its time is given by its elementary quantum jumps.

Elementary quantum jumps represent the elementary changes of the Universe, its elementary quanta of motion (time), to which all other changes (motions, times) can be related. These elementary quantum jumps define the cosmic time. Time is not a mystery, but a manifestation of motion of the Universe. Time is a measure of motion. Every local motion can be compared to a universal cosmic motion, so each process (motion) and its duration can be compared with universal time. Cosmic time is a universal base through which all local processes (motions, times) can be expressed. Space and time are therefore quantized and their quantitative characteristics can be numbered and expressed in integers. If we associate $\Delta\mathbf{t}$ sec to one quantum jump, then the time of cosmic expansion is:

$$\mathbf{t = k\Delta t}$$

The basic space-time equation of the Universe, where the volume **V** is expressed in $\mathbf{m^3}$, takes the following form:

$$\mathbf{V = z\, t^2,} \quad \text{where} \quad \mathbf{z = (d^2V/dt^2)/2}$$

$$\mathbf{dV/dt = (d^2V/dt^2)\, t}$$

$$\mathbf{(dV/dt)^2 = 2Vd^2V/dt^2}$$

This is the basic equation of the spatial dynamics of the Universe expressed in real dimensional units, where the spatial volume of the Universe is directly proportional to the square of the cosmic time. In this form, space and time are presented as continuous values, but we must remember that in fact they are quantized and can only be correctly expressed by integers. So, if we want to explore space and time in terms of cosmology, we can use them as continuous values, but such an approximation at the quantum level is inappropriate.

The expansion rate of the spatial volume **dV/dt** is directly proportional to the time of cosmic expansion. The acceleration $\mathbf{d^2V/dt^2}$ is constant throughout the evolution of the Universe.

The three-dimensional space is self-closed, so it can be viewed as the ideal three-dimensional surface of a four-dimensional sphere, for which the following formula is valid:

$$V = 2\pi^2 r^3$$

where **r** - radius of spatial curvature of the four-dimensional sp here.

From the relation for the circumference of the Universe $o = 2\pi r$ and previous relations we get:

$$(do/dt)^2 = -2\, o\, d^2o/dt^2$$

The relations between spatial circumference **o** and time **t** are:

$$o = u\, t^{2/3}$$

$$do/dt = (2/3)u\, t^{-1/3}$$

$$d2o/dt2 = -(2/9)u\, t^{-4/3}$$

where $u = (2\pi d^2V/dt^2)^{1/3}$

These equations show that the spatial circumference **o** increases by time, but its velocity **do/dt** decreases. Acceleration is negative. This means that the rate of cosmic expansion is slowing down (or "decelerating").

The length of the longest quantum dipoles, representing the highest possible distances and connecting the two opposite sides of the Universe, is equal to half the circumference of the Universe **o/2**. The rate of its increase due to cosmic expansion is the highest possible speed-the speed of light ***c***:

$$c = (do/dt)/2 = o/3t$$

$$o/2 = \pi r = (3/2)ct$$

The speed of light represents the speed of cosmic expansion. As the cosmic expansion rate decreases, the speed of light also decreases.

The deceleration of cosmic expansion is also the gravitational acceleration **g** of its longest quantum connections of length **o/2** in the opposite direction (the law of action and reaction), which is oriented inside the quantum connections:

$$g = -(d^2o/dt^2)/2$$

The speed of light expresses the speed of cosmic expansion. The deceleration of the expansion of the universe is its gravitational acceleration. The relationship between the speed of light and the gravitational acceleration of the universe is:

$$g = -dc/dt$$

The gravitational acceleration of the universe is equal to the deceleration of the speed of light during the expansion of the universe.

Substituting **c** and **g** into the fundamental equation of cosmic motion $(do/dt)^2 = -2o.d^2o/dt^2$ we get:

$$c^2 = g.o$$

The square of the speed of light is the product of the gravitational acceleration of the universe and its circumference. The expansion rate of the universe is the rate at which the universe is escaping from itself, is its escape velocity, and this escape velocity is the speed of light **c**.

Cosmology now incorrectly accepts accelerated cosmic expansion due to the so-called dark energy. This deceptive appearance is based on the observation that bright stars are much further away and the light from them is therefore darker than it would be if the universe was expanding uniformly. This means that the universe has expanded much more than expected. However, this is not because the universe is accelerating its expansion, but because it expanded much faster in the past and the speed of light was much greater than it is today. The universe is slowing down its expansion, but for the "discovery" of its acceleration, the Nobel Prize was awarded in 2011 to theoretical physicists who actually discovered the slowing down of the expansion rate of the universe and interpreted it as acceleration. Namely, the result regarding the expansion of the universe is the same. Let's illustrate this with the example of a car that accelerated uniformly from 50 km/h to 100 km/h during 1 minute of driving. It traveled the same path in one minute, i.e. 1.25 km as a car decelerating from 100 km/h to 50 km/h. There is no need for dark energy to accelerate the expansion of the universe.

6.2. Force and energy – Coulomb's law for electrostatic force

The force of attraction and repulsion $\mathbf{f_i}$ acting over the entire length $\mathbf{d_i}$ of the quantum dipole **i** gives, when multiplied by this length, the total energy of the quantum dipole $\mathbf{e_i}$:

$$e_i = f_i d_i$$

The total force $\mathbf{f_i}$ consists of two components – the attractive force $\mathbf{f_{ia}}$ and the repulsive force $\mathbf{f_{ir}}$, which are in mutual equilibrium:

$$f_{ia} = f_{ir}$$

$$f_i = f_{ia} + f_{ir} = 2f_{ia} = 2f_{ir}$$

$$e_i = 2f_{ia}d_i$$

While the attractive force manifests itself as the mutual attraction of the opposite poles, the repulsive component manifests itself either as the local repulsive pressure of the quantum dipole on its neighbors, or, as is the case with free photons, as the mutual repulsion of the opposite poles, which, in conjunction with their attraction, causes pulsation, vibration, oscillation. A quantum dipole that does not pulsate freely, but is bound in a more complex structure, presses its space on the spaces of the surrounding quantum dipoles. This is a mutual local pressure action between quantum dipoles. If we imagine reality as a huge network of quantum bonds connecting all objects to each other, it might seem that during the mutual complex movements of these objects, this network begins to tangle. However, this would only be the case if this network consisted of threads (quantum connections) that were mutually impermeable. If the mutual local pressures, and this applies mainly to long and weak connections, exceed a certain level, then these connections rearrange - they mutually penetrate each other. This mutual penetration may occur through the fourth dimension during the quantum states between elementary quantum jumps. They bypass each other through the fourth dimension (similar to how two-dimensional formations bypass each other through the third dimension).

For the magnitude of the attractive force $\mathbf{f}_{ia}$ between the opposite poles of a quantum connection (+/-), the classical **Coulomb´s law** of mutual force interaction between two point charges applies, which in the case of a quantum dipole correspond to elementary charges:

$$\mathbf{f}_{ia} = (\mathbf{q}^2/4\pi\varepsilon)/\mathbf{d}_i^2$$

where **q** – elementary electric charge, ε – dielectric constant.

From this Coulomb's law and the relation for the fine structure constant $\alpha = \mathbf{q}^2/(2\varepsilon\mathbf{hc})$ we get:

$$\mathbf{f}_{ia} = \alpha\mathbf{hc}/(2\pi\mathbf{d}_i^2)$$

where α - fine structure constant, **h** - Planck's constant, **c** - speed of light.

This is actually **Coulomb's law expressing the attractive force acting between the opposite poles of a quantum dipole (+/-), which is inversely proportional to the square of the length of the quantum dipole.**

For the **fundamental law of the universe** (invariant) $\delta_t = \mathbf{e}_i\mathbf{d}_i$ we get:

$$\delta_t = \mathbf{e}_i\mathbf{d}_i = \mathbf{f}_i\mathbf{d}_i^2 = 2\mathbf{f}_{ia}\mathbf{d}_i^2 = \alpha\mathbf{hc}/\pi = 4{,}614\text{x}10^{-28}\ \mathbf{kgm^3s^{-2}}$$

Coulomb's law is thus a manifestation of the fundamental law $\delta_t = \mathbf{e}_i\mathbf{d}_i = \mathbf{f}_i\mathbf{d}_i^2 = \alpha\mathbf{hc}/\pi$, expressing the dialectical relationship between the energy, force and length characteristics of quantum dipoles.

Particles or any physical objects with a prevalence of positive poles are positively charged. Particles with a prevalence of negative poles are negatively charged. The minimum amount of prevalence is the elementary charge. The proton is the most known particle with a positive charge. The electron is the most known particle with a negative charge. Particles with a balance of positive and negative poles are neutral.

Long quantum dipoles representing interconnections of material objects are affected by attractive forces of their opposite poles. The sum of attractive forces of all quantum dipoles connecting two massive objects creates an overall attractive force between them.

Let **d** is the average distance between two neutral mass objects. The first object contains $\mathbf{k}_1$ positive and $\mathbf{k}_1$ negative poles, and the second one contains - $\mathbf{k}_2$ positive and $\mathbf{k}_2$ negative ones. The total number of elementary quantum connections between the two objects is $2\mathbf{k}_1\mathbf{k}_2$. The whole attractive force $\mathbf{f}_a$ between the two objects is the sum of the attractive forces of all their quantum interconnections with the average length **d**. The next relation is valid:

$$\mathbf{f}_a = (\alpha\mathbf{hc}/2\pi)2\mathbf{k}_1\mathbf{k}_2/\mathrm{d}^2 = (\alpha\mathbf{hc}/\pi)\mathbf{k}_1\mathbf{k}_2/\mathrm{d}^2$$

where **h** – is Planck´s constant, α - is the fine structure constant, **c** - is the speed of light.

This relation expresses the total attractive force $\mathbf{f}_a$ between two electrically neutral objects, proportional to the number of quantum dipoles connecting them. However, as we know, there is no attractive electrostatic force between electrically neutral objects. This force can only be identified if these objects are electrically charged and proportional to the product of their charges. Indeed, this force affects all quantum dipoles connecting two material objects, but is completely compensated by the repulsive spatial pressures of quantum connections, so it seems that there is no attractive force. If two objects are oppositely charged with charges $\mathbf{q}_1$ and $\mathbf{q}_2$, the attractive forces affecting their direct quantum interconnections are not fully compensated by the repulsive spatial pressures of outgoing external quantum dipoles, and therefore their uncompensated mutual attractive force is directly proportional to the product of their charges. If two objects have like charges, the missing interconnections between them cause the repulsive spatial pressures of external quantum connections to prevail over the attractive force of the quantum dipoles interconnecting these objects, which manifests as an electrostatic repulsive force directly proportional to the product of their like charges.

Although Coulomb´s law is the same for expressing attractive

and repulsive electrostatic forces, their reasons are different. The attractive electrostatic force is due to the non-local attraction between the opposite poles of the quantum dipoles. The repulsive electrostatic force is caused by the prevalence of local repulsive pressures of quantum dipoles due to the lack of mutual non-local quantum connections.

6.3. Gravitational force

Each quantum dipole participates in the expansion of the universe by emitting new quantum connections, but at the same time it reacts to this expansion with its resistance, which manifests itself as its mass causing the deceleration of the expansion. The relationship "mass-deceleration of expansion" is a mutual dialectical relationship, one is a manifestation of the other. Mass is a manifestation of the deceleration of expansion and the deceleration of expansion is the cause of mass. Mass is a consequence, a manifestation and a measure of the deceleration of expansion. Since the deceleration of the expansion of the universe is also its acceleration in the opposite direction, mass is also a manifestation of this acceleration. We call this acceleration gravitational acceleration:

"deceleration of expansion of a quantum dipole = gravitational acceleration"

At the level of elementary quantum connections (dipoles), the unity of mass, energy, and deceleration of expansion manifests itself in the following way: the shorter and more energetic the quantum dipole, the greater its resistance to its own expansion, and the greater is its mass. The longer the quantum dipole, the smaller its internal energy, internal mass, and the smaller is its resistance to expansion. **The internal energy of a quantum dipole is thus a measure of its internal mass.**

Therefore, the constancy of the product of energy and length $\mathbf{e_i d_i}$ for all quantum dipoles also implies the constancy of the product of the internal mass $\mathbf{m_i}$ and the length $\mathbf{d_i}$ of the quantum dipole $\mathbf{m_i d_i}$.

The measure of the internal mass of any body is its internal energy given by the sum of the energies of all its elementary dipoles.

From the fundamental equation for the motion of the universe $\mathbf{(do/dt)^2 = -2o.d^2o/dt^2}$, which expresses the relationship between the length, expansion rate (length increase) and deceleration of the expansion rate not only for the universe as a whole, but also for each of its elementary quantum dipoles, it follows that the mutual ratios of the parameters of length $\mathbf{d_i}$, velocity $\mathbf{c_i}$ and acceleration $\mathbf{g_i}$ are the same for all quantum dipoles $\mathbf{c_i^2 = -2d_i g_i}$.

There are three invariants of cosmic expansion:
$\mathbf{m_i g_i}$ - the invariant of the expansion (gravitational) force,
$\mathbf{m_i c_i}$ - the invariant of the expansion momentum,
$\mathbf{m_i d_i}$ - the invariant of mass and length.

These invariants express symmetry. The symmetry of the expansion force is manifested in the fact that each quantum dipole exerts the same expansion (or gravitational) force on the universe. The symmetry of the expansion momentum means that all quantum dipoles have the same momentum related to the expansion of the universe. These symmetrical invariants manifest the dialectical unity of quantum dipoles in their relationship to the expansion of the universe.

The invariants $\mathbf{e_i d_i}$ and $\mathbf{m_i d_i}$ express the fact that the shorter the connection, the more intense it is (it contains more energy and mass) and the weaker it is (with less energy), the longer it is. Therefore, the connections in elementary particles are intense because they are very short, while the connections between distant material objects are very weak, almost negligible because they are very long and manifest themselves only gravitationally. Their existence is not otherwise detectable.

From the invariant relation for the expansion force $\mathbf{f_e}$, acting through each quantum dipole, or exerted by each quantum dipole $\mathbf{f_e = m_i g_i}$ it follows that there is an immediate inverse relationship between the internal mass of a quantum dipole and the deceleration of its expansion rate. Similarly, from the invariant relation for the expansion momentum $\mathbf{m_i c_i}$ it follows that there is an inverse relationship between the mass of a quantum dipole and the rate of its expansion. This means that the greater the mass of a quantum dipole, the slower the rate of its expansion. Since each elementary quantum dipole exerts the same expansion force $\mathbf{f_e = m_i g_i}$ the total expansion force **Fe** (or the oppositely oriented gravitational force **G**) of the universe, which in quantum state **k** has $\mathbf{k^2}$ elementary quantum dipoles, is:

$$\sum_{i=1}^{k^2} \mathbf{m_i g_i = f_e.k^2 = Fe = G}$$

The ratio $\mathbf{f_e/f_{ia}}$ between the expansion force $\mathbf{f_e}$ exerted by a quantum dipole and the internal force of attraction of the opposite poles of the quantum dipole $\mathbf{f_{ia}}$ is, due to the constancy of the force $\mathbf{f_e}$, the greater the longer the quantum dipole. For the longest quantum dipoles of the universe with a length $\mathbf{d_i = o/2}$, this ratio reaches the value **1**. This means that apart from the attraction, which is the counterbalance to the expansion, the longest quantum dipole no longer contains any other attraction. For it, $\mathbf{f_{ia} = f_e = f_g}$, where $\mathbf{f_g}$ is the magnitude of the gravitational force of the quantum dipole as a reaction to the expansion force $\mathbf{f_e}$.

For the longest quantum dipoles in the universe with length **o/2** and minimum energy $\mathbf{e_{min}}$, the fundamental law takes the form:

$$\delta_t = \mathbf{e_i d_i = e_{min}(o/2) = 2f_{ip} d_i^2 = 2f_e(o/2)^2} = \alpha\mathbf{hc}/\pi$$

Quantum gravity is the attractive force of quantum dipoles not compensated by the repulsive pressures of their spaces, the deficit of which is caused by the fact that a certain part of the repulsive forces is bound in the expansion force of the universe. This is the cause and at the same time the consequence of the mass of the universe as a measure of its resistance to expansion, manifested in the deceleration of the expansion rate with a deceleration parameter of 2/3. The universe would expand uniformly if it had no mass, and thus no brake that would slow down its expansion.

The attractive forces of long quantum dipoles connecting different bodies, which are not compensated by the repulsive pressures of quantum dipoles, represent the **gravitational force of bodies**. The total mass of the universe, which is on the one hand the **internal mass of quantum dipoles** and is unevenly distributed between them (the more massive the quantum dipole, the shorter it is), is on the other hand its **gravitational mass** evenly distributed between the poles, determining the total size of the gravitational charges of bodies, through which bodies gravitationally attract each other through mutual quantum connections.

The internal mass of quantum dipoles is proportional to their internal energy. However, material bodies manifest themselves externally through their mutual relations. In these relations, they identify themselves to each other through the numbers of poles they have, because these determine the number of their mutual connections. The number of poles (+,-) in a material object defines its gravitational charge. The material object manifests itself externally through it, because the number of poles of an object determines the number of its external connections, through which it is connected to other material objects and towards which it manifests itself gravitationally.

Let us assume a mutual balancing of positive poles and negative opposite poles in the body. Let there be $\mathbf{k}_i$ positive and $\mathbf{k}_i$ negative poles in the body. Then the relationship between the external gravitational mass $\mathbf{m}_i$ of the **i**-th object and the number of its poles $\mathbf{2k}_i$ is:

$$\mathbf{m}_i = \varphi 2\mathbf{k}_i$$

$$\mathbf{k}_i = \mathbf{m}_i/(\mathbf{2}\varphi)$$

where φ is the elementary gravitational charge of one positive (+) or one negative (-) pole. After substituting the relation $\mathbf{k}_i = \mathbf{m}_i/(\mathbf{2}\varphi)$ into the Coulomb relation $\mathbf{f}_a = (\alpha\mathbf{hc}/\pi)\mathbf{k}_1.\mathbf{k}_2/\mathbf{d}^2$ we get:

$$\mathbf{f}_g = \mathbf{f}_a = (\alpha\mathbf{hc}/(4\pi\varphi^2))\mathbf{m}_1.\mathbf{m}_2/\mathbf{d}^2$$

This is the classical Newtonian law of gravity, in which the attraction between two bodies is expressed through their external gravitational masses $\mathbf{m}_1, \mathbf{m}_2$:

$$\mathbf{f}_g = \kappa.\mathbf{m}_1.\mathbf{m}_2/\mathbf{d}^2,$$

where $\kappa = \alpha\mathbf{hc}/(4\pi\varphi^2)$ is the gravitational constant, from which:

$$\varphi^2 = \alpha hc/(4\pi\kappa)$$
$$\varphi = (\alpha hc/(4\pi\kappa))^{1/2} = 1.314824 \times 10^{-9}\,kg$$

The constant φ = **1.314824** x **10**$^{-9}$ **kg** represents the magnitude of the elementary gravitational charge per one positive or negative pole.

The unification of Coulomb's and Newton's laws is a consequence of the fact that both laws express in different aspects the same fact-the attraction between the opposite poles of quantum dipoles acting directly-non-locally.

The mass of the universe **M** is determined by the relation:

$$M = 2k\varphi = k(\alpha hc/(\pi\kappa))^{1/2} = 2.2 \times 10^{53}\ kg$$

$$M^2/k^2 = \alpha hc/(\pi\kappa)$$

For the expansion force exerted by all quantum dipoles of the universe, and therefore also for the gravitational force as a reaction to the expansion force (the law of action and reaction), we have derived the relation $f_e.k^2 = Fe = G$.

Then:

$$e_{min}(o/2) = \alpha hc/\pi = 2f_e(o/2)^2$$

$$f_e = (\alpha hc/(2\pi))/(o/2)^2$$

$$G = Fe = (\alpha hc/2\pi)k^2/(o/2)^2$$

By substituting the relation k = M/(2φ) we get:

$$G = (\alpha hc/(2\pi\varphi^2)).(M/2).(M/2)/(o/2)^2$$

From the relation for the gravitational constant $\kappa = \alpha hc/(4\pi\varphi^2)$ we get:

$$G = 2\kappa(M/2)(M/2)/(o/2)^2$$
$$2\kappa = Go^2/M^2$$
$$\kappa = Go^2/(2M^2)$$

The second way is to calculate the gravitational constant from the relation for escape velocity:

$$v^2 = 2\kappa M/R$$

In our case, the escape velocity v is the speed of light c and the distance R is the greatest distance o/2 = πr. Then the relation for the escape velocity of the universe has the form:

$$c^2 = 2\kappa M/(\pi r)$$

By adjusting this relation to the form:

$$M = (\pi c^2/(2\kappa))r$$

we have obtained the relation also given by A. Einstein for the dependence of the mass of a closed universe on the radius of its curvature. From the above relation we obtain the expression for the gravitational constant:

$$\kappa = c^2\pi r/(2M)$$

By substituting the relation $c^2 = go$ we obtain:

$$\kappa = g(o/2)^2/M$$

From the two relations for the gravitational constant $\kappa = g(o/2)^2/M$ and $\kappa = Go^2/(2M^2)$ taking into account the relation $c^2 = go$ we obtain:

$$Mg = c^4/(4\kappa)$$

$$G = Fe = Mg/2 = c^4/(8\kappa) = 1.51 \times 10^{43}\ N$$

This is the exact value of the expansion and gravitational force of the universe at present. The universe is currently expanding with such force, and as a consequence, so is the total magnitude of its gravitational force as a reaction to the expansion.

Quantum gravity is the result of immediate non-local quantum interactions (relations) between physical objects. Einstein´s theory of gravity cannot naturally explain why the galaxy´s rotations are faster than they should be calculated by the masses of the stars in them. So it is assumed that there is a mysterious invisible dark matter. Dark matter is nothing else than non-local vacuum quantum interconnections, that holds the galaxy together despite its rapid rotation. The mass of Galaxy is, of course, much greater than the total mass of its bodies, because the vast amount of energy (matter) is found in the non-local quantum interconnections forming the cosmic vacuum.

7. Results

The discovery of the Unity Principle allowed us to reveal the quantum nature of all interactions, including gravity, which is a reaction to the cosmic expansion realized through elementary quantum connections of opposite poles (+/-). A mathematical apparatus describing gravity at the quantum level has been developed and the exact value of the expansion and gravitational forces of the universe has been calculated.

8.Conclusions

Cosmic gravity acts on all objects, on all elementary quanta of space, through the entire cosmic network of quantum connections as a reaction to the expansion of the universe. It has a global and at the same time quantum character. **The dynamically growing cosmic network of elementary quantum connections (dipoles) represents a unified field of all quantum interactions, including gravity.** These interactions are direct relations, not actions mediated by virtual particles. **Cosmic gravity (attraction) as a global cosmic phenomenon confirms that the universe is expanding, because it represents a counterbalance to its repulsive expansion force.**

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