Article

Basic Cosmic Characteristics (Energy and Force)

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ABSTRACT

The nature of electrostatic and gravitational forces will be derived by using a dialectical logic for finding the basic relations between fundamental physical characteristics of the Universe.

Key Words: energy, force, dialectical logic, quantum dipole.

Dialectic Relation of Quantity and Quality and the Basic Cosmic Etalons

My goal is to use a dialectical logic consistently for deduction of the most important notions. Everything must be clearly notionally defined in order to eliminate any uncertainty about how the given notions have been deduced. I have chosen the way from the most general to more specific and concrete notions in order to form a clear view to the basic characteristics of the Universe.

By using a dialectics of contradictions, relations between whole and part, continuity and discreteness it was shown that the Universe is an increasing network of elementary quantum relations (connections) named quantum dipoles, where every positive pole "+" is connected with all negative ones "-" and reciprocally. The quantum dipoles represent the basic building blocks of mater (space, energy). The Universe starts its expansion from initial state when it is a sole elementary quantum connection (dipole) "+,-". At the quantum state k it consists of k^2 quantum connections. The cosmic transition from the quantum state k to k+1 is accompanied by the creation of 2k+1 new elementary quantum connections. The volume of the Universe is given by the number of elementary quantum connections $k^2$and the cosmic time is represented by the number of elementary quantum transitions (jumps) k.

For confirmation of the above mentioned facts and analysis of other basic characteristics of the Universe, we again need to use a dialectics to study the relation between such philosophical categories like quality, quantity and measure.

Quality is a determined being. Being becomes concrete – quality – only if it is determined and defined. Something determines itself by its limit - boundary. Quantity unlike quality is indifferent to its determination as well as to its limit. Quantity is undetermined being. So it can refer to any quality remaining indifferent to it. Quantity cannot find its determination in qualities although it becomes one of their basic characteristics. If quantity refers to some general form of existence it becomes a magnitude. Space is one of the most general forms of matter and is characterized by the magnitude named volume. Quantity as a magnitude remains indifferent to all specific qualities. For the volume it is absolutely indifferent what object it refers to, whether ball, tank, house, particle, atom, etc. But volume is the basic characteristic of any material form. Ball, tank, house, particle, molecule, etc. cannot exist without their

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volumes. So, the volume is a magnitude which all material objects dispose of and which is connected with their spatial manifestation.

The quantity, determined by its limit, becomes a quantum. Quantum without any other determinations is a number. So, the number is the most abstract determination of quantity. Number (quantum) differs one quantity form another and allows their existence in various indifferent specifications. Quantity cannot exist independently (in-itself) but only in a unity with a quality as well as quality cannot be without quantity. The measure represents the unity of quantity and quality. The change of quality is always accompanied by quantitative change. But quantitative changes within a certain range (scale) do not cause a qualitative change. It means that quality remains indifferent to quantitative changes in certain limits. But if these limits are exceeded the given quality changes into another one. For example, the water as a liquid, changes into ice by crossing a temperature limit of zero centigrade degree. The measure detects what quality changes and what substance remains untouched for both forms. The transition from "liquid water" into "solid ice" does not change a chemical compound of water H_2O, but only its forms like liquid and solid. So the measure detects a common substance of both qualities. Qualitative jump caused by quantitative measure transcendence shows what is changing and what remains untouched.

The most general characteristic of matter is the relationship between attraction and repulsion of anti-poles. This relationship creates its deepest essence. The penetration into the essence of things means the abstraction from their secondary external manifestations. By sensual perception we can receive only concrete manifestations of existence, but essences can be recognised only by mind and notions. Our mind allows us to create such notions as number and quantity. Mathematics as an exact science is based on a number which is a product of rational abstraction. Such number is considered to be an essence of philosophy of Pythagoras. But his understanding is much wider. The number is a product of a divine mind expressing the fundamental characteristic of existence. So, Pythagoras became the founder of philosophical thinking known as objective idealism. He put the notion (idea) into the centre of being. It is incorrect to interpret his understanding of number to be only the product of rational abstraction. The numbers were for Pythagoras the fundamental manifestations of quantitative characteristics of being without which no quality can exist. The essence of things is hidden in notions, existing in objective reality, which can be detected by mind (intellect), abstractions and creation of rational notions. The knowledge is true only if rational notion corresponds to the real one creating the essence of thing. Idealistic philosophy, where notion (idea) is a real essence of a thing, goes from Pythagoras through Plato and Aristotle to Hegel. In Hegelian dialectics the notion is an element, even a stage of development of absolute idea, in which the contradict substance of Absolute Spirit and Nature is unified.

Let us analyse quality and quantity as aspects of matter. First the most abstract qualitative determination of matter is its bipolarity as a relationship of repulsion and attraction of anti-poles. Now we can study, how this quality manifests itself quantitatively. The question is: How large is the intensity of repulsion and attraction, how big is the intrinsic contradiction of matter and what magnitude can express it? "One" manifests itself only in relation to "other" and reflects in it. "One" is the same as the "other" but at the same time they differ and manifest themselves as positive and negative charges of certain quantity, which determine the measure of their mutual motion – repulsion and attraction. The measure of intrinsic motion of the Universe is expressed by its whole energy. So the first quantitative characteristics, which

can be deduced at the highest level of abstraction, are the quantities of the whole cosmic charges Q^+, Q^- and the amount of the whole energy E. They represent the basic cosmic constants. During cosmic splitting they are gradually divided and transferred into the increasing network of universally connected elementary parts – quantum dipoles (bipolar relations of anti-poles). The cosmic expansion in which the number of elementary quantum connections (dipoles) increases is explained in the chapter "The basic space-time equation of the Universe".

The material energy is either the potential for motion or the motion as such. The inner tension between anti-poles of quantum dipole is manifested by the motion of repulsion and attraction, so pulsation, rotation, vibration and oscillation. If imagine the cosmic network of quantum dipoles, where every positive pole "+" is connected with all negative anti-poles "-", we can see that it is impossible for all quantum dipoles to perform active and independent oscillation. Some dipoles provide free oscillations, others reflect a motion of oscillating neighbours, but cannot freely oscillate and only hold their potential for this motion which can be manifested by appropriate opportunity, for example, if they are selected as separate quantum dipoles – flying oscillating photons. Motion and potential for motion of internal quantum dipoles in selected particle create its intrinsic energy that manifests itself as its internal mass. The external kinetic energy of moving particle is represented by changing of the length of its external connections with surroundings. It is a relative form of energy of a particle expressing its motional relation to the objects towards which it moves and changes the length of their mutual quantum relations. For these relations, which change their lengths, the external energy of a particle represents their internal motion as an expression of their internal energy. Every quantum dipole disposes of its energy which can be manifested in two forms – in a form of tension to motion (potential energy as a consequence of attraction between anti-poles) and in a form of mutual motion of anti-poles (internal kinetic energy as a consequence of attraction and repulsion of anti-poles manifested by oscillation, rotation, vibration of elementary quantum).

The number n is the next important quantitative characteristic of the Universe. It represents the maximal number of different quantum states n, in which the Universe can occur. The Universe transits from one quantum state to the next by quantum jump (transition). The cosmic transitions through quantum states represent the cosmic time flow. The time is one of the basic characteristics of the Universe. The elementary change (cosmic transition from one quantum state to the next) represents the basic qualitative determination of time. The number of quantum jumps represents the quantitative characteristic of time. Time is a universal manifestation of cosmic motion. No mystery is hidden in it, although many unbelievable and absurd speculations are made about it. So it needs more detail analysis. Time relativism manifests itself by different speeds of time flow in various systems. The speed is lower in fast moving systems and in places with higher gravity. How can we put together the time universality with its relativity? How can we compare the time flow in different systems with different conditions? Even though, how to compare it in different stages of cosmic expansion? What should be the time etalon in order to make possible a comparison of separate times in different systems and different stages of cosmic evolution? The answer is very simple. Time is nothing more than manifestation of changes, processes. If identical processes run in two different systems, for example with different gravitational potentials, the different conditions cause the different speed of identical processes. The elementary cosmic quantum jump as a time etalon is a base for determination of this difference. We can say that while the entire

process is complete during x quantum cosmic jumps in the first system, in the second system it is complete during y quantum jumps. In a system with a slower time flow the entire process needs more quantum cosmic jumps than identical one with a faster time flow. So the elementary quantum cosmic jump represents the etalon for measurement the speed of process in different systems and different stages of the Universe. Why this etalon and not other? Now we practically use others etalons. For example, the etalon of second is defined by 9 192 631 770 periods of radiation adequate to the transitions between two levels of very subtle structure of the basic state of nuclide 133 Cs (caesium).

The problem is how to apply such etalons for the whole Universe, knowing that they did not exist during the whole history of the Universe. They even gradually lose a portion of their energy during cosmic expansion, transfer it to new quantum dipoles and slow-down their inner processes. Such processes cannot be etalons for cosmic time measuring, because they change their speed during cosmic expansion and by transition from one system (with lower gravity) to the other one (with higher gravity). The universal process, which can be used as a time etalon for the whole Universe, is only its elementary motion - quantum jump from one quantum state to the next. More elementary and shorter motion does not exist. All other motions and processes can be derived from and compared with this universal motion. All changes in separate objects are only subsets of all cosmic changes. All processes are only subsets of universal cosmic motion, so, all local times of systems are only subsets of universal cosmic time, which they relate to and compare with. Time of every process can be measured by the number of elementary quantum jumps of the Universe. Local times are different for the same processes by different conditions (different gravity, speed of system). This is the time relativity of systems. Time relativity means that identical processes need the different number of elementary cosmic quantum jumps in different conditions. If cosmic time is measured in different local systems, it can get different values. For example, if the sky-rocket moves towards Earth by the speed, when its time flows twice slower, the cosmic expansion shows to be twice longer from the viewpoint of Earth than of the sky-rocket. One second in the sky-rocket corresponds to two seconds on Earth, but both times correspond to x cosmic quantum jumps. So one second on Earth corresponds to x/2 quantum jumps of the Universe. The 14 billion years of cosmic expansion on Earth correspond to 7 billion years of cosmic expansion in the rocket. So, in different local systems, we can measure different local times of global cosmic expansion, but they will correspond to the same number of quantum jumps. Problem of different times occurs only if compare different local systems. But if the universal cosmic time is measured by the number of elementary quantum cosmic jumps, this problem vanishes and every local process can be measured by its comparison with the universal cosmic motion.

Let us now analyse the volume of space. The reason for determination of quantum dipole as an etalon of volume is the same as by time. There is no more elementary part of the Universe then a quantum dipole is. While time is an existence of consecutive cosmic states, the volume is a side by side existence of universally connected quantum dipoles. The volume of space is manifested by spatial elementary relations (connections, dipoles) and increases proportionally to their number. There is no reason for different volumes of separate elementary quantum dipoles, so every quantum dipole defines an elementary quantum of space. It represents the basic elementary structural unit (building block) of space and its volume etalon. Separate quantum dipoles nevertheless differ quantitatively from one another. The energy, as a measure of intrinsic motion of their anti-poles, is a characteristic that allows their distinguishing. Their differentiation in this characteristic needs other characteristic that

as a counterbalance returns this differentiation into unity. This characteristic is the length d_i which in conjunction with energy e_i gives the same value for every elementary quantum dipole i:

$$\delta_t = e_i . d_i , \qquad \text{where} \qquad E = \sum_{i=1}^{k^2} e_i$$

This value represents the universal law which gives the energetic and length (geometric) characteristics of the Universe into the mutual relation. As it will be shown later this simple law unifies Coulomb´s and Newton´s laws. The unity between energetic and lengths characteristics of quantum dipoles, as elementary building blocks of the Universe, is the reason, why the geometry of the Universe is in relation to its energy, what Einstein intuitively disclosed during creation of his theory of gravity.

The dialectical relation between energy and length of quantum dipoles allows their quantitative and qualitative differentiation as well as demonstration of their unity. In contrast with it, the spatial volume of elementary quantum dipole has not its counterbalance in another characteristic. So all quantum dipoles are indistinguishable in this quantitative characteristic and represent the same spatial volume. The volume of space is given by the number of elementary quantum dipoles. The energetic etalon of the Universe is expressed by its whole energy E, and the diameter of a sphere, with a volume of one quantum dipole, represents the length etalon, as it is the shortest possible length with the highest possible energy contained in one quantum dipole.

If we talk about pulsating quantum dipole, which length continually changes, we bear in mind its maximum length occurring during pulsation. If we express its pulsation, vibration, oscillation as rotation, its length is represented by a diameter of rotating quantum dipole. Rotation projected to the perpendicular plane looks like oscillation. It does not matter if talking about rotation or oscillation (pulsation, vibration) as these motions manifest outwards by the same way.

The distance between two tops of opposite poles represents the length of bound quantum dipole, which position in a complicated structure as well as pressures of neighbouring quantum dipoles do not allow its free oscillation.

So we have established the etalons for basic cosmic characteristics: time, spatial volume, energy and length. Only etalons derived from universal cosmic characteristics can be used as fixed basis towards which all characteristics of local systems and processes can be related. The opposite approach, when etalons are chosen from local processes, can introduce considerable confusions into cosmology. In spite of this, all important cosmological characteristics can be expressed by the system of units SI, as all they can be fixated in relation to the basic cosmic etalons.

The whole internal energy of quantum dipole e_i consists of two parts: attractive e_{ia} and repulsive e_{ir} . While attractive part is manifested by an attraction of anti-poles, the repulsive one by their repulsion or by the pressure of quantum dipole on the neighbours. In case of free quantum dipoles like photons, the relation between attractive and repulsive parts is manifested

by oscillation. Quantum dipole, bound in a composite structure, cannot freely oscillate, so it presses on neighbours by its space. In this case the interaction between quantum dipoles represents the mutual local pressure action. So the attractive part of energy is in equilibrium with its repulsive part presented by local pressure. A negligible part of repulsive energy is connected with a cosmic expansion, as it is used for creation of new elementary quantum connections during cosmic quantum jumps. As attraction is totally compensated by repulsion, so the attractive part of energy of quantum dipole is equal to the repulsive one. The following relations are valid:

$$e_{ia} = e_{ir}$$

$$e_i = e_{ia} + e_{ir} = 2e_{ia} = 2e_{ir}$$

The motion of elementary quantum dipole influences the motion of all quantum dipoles coming out of it. At the same time it is influenced by them. These quantum dipoles are also affected by other ones and they, in addition, act mutually with their neighbours by local pressures of their spaces. So every cosmic motion at the micro and macro levels is mutually coordinated with all other motions in the Universe.

If quantum dipole changes its energetic level, it also changes its length. By losing a part of energy it elongates. By its receiving it shortens. The quantum dipoles are in mutual exchanging of their energies.

Any form of energy, e.g. kinetic or potential, is always an internal energy of elementary quantum connections presented through the equilibrium of their two parts, attractive and repulsive, because attraction and repulsion are two sides of the coin, representing the dialectical contradiction of quantum dipole.

If attractive part of energy cannot cause the motion of quantum dipole, as it is compensated by the pressure of neighbours, it exists in a form of potential energy.

From the basic cosmic relation between energy and length of elementary quantum dipole $\delta_t = e_i d_i = 2e_{ia} d_i$ we can derive the following relation:

$$e_{ia} = \delta_t / 2d_i$$

As we can see it is a classical Coulomb´s relation between potential energy of dipole with elementary charges and its length:

$$e_{ia} = (q^2/4\pi\varepsilon)/d_i ,$$

where: $\delta_t = q^2/2\pi\varepsilon$
q – elementary electric charge,
ε – dielectric capacitance

From the relation for a fine structure constant $\alpha = q^2/(2\varepsilon hc)$ and Coulomb´s relation we get:

$$e_{ia} = \alpha hc/(2\pi d_i)\,,$$

where: α - fine structure constant,
h – Planck constant,
c - speed of light

Then:

$$e_i d_i = \alpha hc/\pi.$$

Coulomb´s relation $e_{ia} = \alpha hc/(2\pi d_i)$ is a manifestation of a universal cosmic law $\delta_t = e_i d_i = \alpha hc/\pi$, expressing the dialectical relation between energy and length of elementary quantum dipoles.

The Relationship between Force and Energy

Force of attraction and repulsion f_i acting between anti-poles through the entire length d_i of quantum dipole creates, in conjunction with its length, the whole energy e_i of quantum dipole:

$$e_i = f_i \,.d_i$$

From the dialectical relation between internal energy and length of quantum dipole

$$\delta_t = e_i \, d_i = \alpha hc \,/\, \pi$$

we get the relation:

$$f_i = \delta_t \;/\; d_i^{\,2} = \alpha hc \,/\, (\,\pi d_i^{\,2})\,.$$

For the attractive force f_{ia} of quantum dipole which corresponds to its potential energy $e_{ia}=e_i /2$ the next relation is valid:

$$f_{ia} = \alpha hc \,/\, (2\pi d_i^{\,2})\,.$$

It is the classical Coulomb law expressing the dependence of attractive force, acting between elementary electric charges, on their distance. It is at the same time an expression of attractive force acting on an elementary quantum dipole with a length d_i. This force is indirect proportional to the square of its length.

The whole force f_i affecting a quantum dipole is a sum of attractive f_{ia} and repulsive f_{ir} forces:

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

and the whole energy e_i of quantum dipole is a sum of its attractive e_{ia} and repulsive e_{ia} parts:

$$e_i = e_{ia} + e_{ir}$$

The relation of attractive and repulsive forces of free quantum dipole, e.g. photon, is manifested by its oscillation. The repulsive force in a bound quantum dipole is expressed by the pressure of its space on neighbours. The negligible part of repulsive force of every quantum dipole is used for cosmic expansion by expelling of new elementary quantum connections during elementary quantum jumps of the Universe.

The long quantum dipoles, as connections of material objects, are affected by attractive forces of their anti-poles. The sum of attractive forces of all quantum dipoles connecting two massive objects creates the whole attractive force between them. Let d is an average distance between two neutral material objects. The first objects contains k_1 positive and k_1 negative poles an the second one - k_2 positive and negative ones. The whole number of elementary quantum connections between two objects is $2k_1k_2$. So the whole attractive force f_a between both objects is a sum of attractive forces of all mutual quantum connections. If d is an average length of quantum dipoles, the next relation is valid:

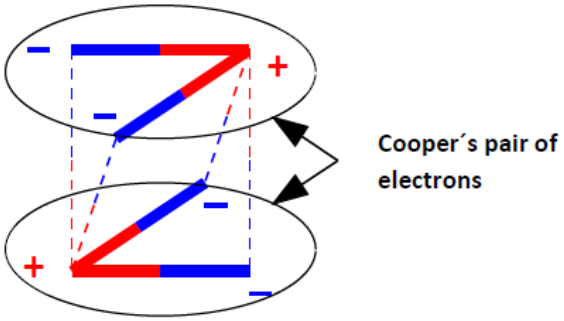
$$f_a = (\alpha hc/2\pi).2k_1.k_2 /d^2 = (\alpha hc/\pi).k_1.k_2 /d^2$$

This relation expresses the electrostatic attractive force between two electrically neutral objects and is directly proportional to the number of quantum dipoles connecting them. But, as we know, there is no attractive electrostatic force between electrically neutral objects. This force can be identified only if these objects are electrically charged and it is proportional to the conjunction of their charges. Indeed, this force affects all quantum dipoles connecting two material objects, but is fully compensated by the repulsive spatial pressures of quantum dipoles coming out of these objects, so it looks like if there is no attractive force between them. If two objects are oppositely charged with charges q_1 and q_2, the attractive forces affecting their direct quantum connections are not fully compensated by pressures of outgoing external quantum dipoles, and so their mutual attractive force is directly proportional to the conjunction of their charges. If two objects have like charges, the missing mutual connections between them cause that the repulsive pressures of their external quantum dipoles prevail over the attractive forces of quantum dipoles connecting these objects, what is manifested by electrostatic repulsive force directly proportional to the conjunction of their like charges. The fact, that the same Coulomb relation is valid for expression of attractive and repulsive forces, proves that the attractive force of quantum connections between opposite charges of charged objects is nowise compensated. It means that this force represents the full attraction of $q_1.q_2$ elementary quantum dipoles and formula for the attractive force of elementary quantum dipole is the same as the relation for the attractive force between two bodies with elementary opposite electric charges. This statement will be clearer after the following explanation.

In oppositely charged objects with charges q_1 and q_2 the number $q_1.q_2$ represents the prevalence of elementary quantum connections above their number between electrically neutral objects, where attractive forces are in equilibrium with repulsive ones. So the attractive force of $q_1.q_2$ quantum connections represents the total attractive force between both oppositely charged objects. In objects with like charges q_1 and q_2 the number $q_1.q_2$ represents the deficiency of elementary quantum connections in compare with their number between electrically neutral objects, where attractive forces are in equilibrium with repulsive ones. So the attractive force of $q_1.q_2$ quantum connections represents its deficiency between both like charged objects and so it is equal to the total repulsive force between both like charged objects.

Although Coulomb´s law is the same for expression of attractive and repulsive electrostatic forces, their reasons are different. The reason for attractive electrostatic force lies in non-local mutual attraction between opposite poles of quantum dipoles. The repulsive electrostatic force is caused by local repulsive pressures of quantum dipoles as a consequence of deficiency of mutual non-local quantum connections.

The indirect evidence for this statement is an existence of mutual attraction between like charged particles, e.g. electrons, which can be manifested by certain conditions, e.g. by very low temperatures. So electrons are not point-like particles, but a structures consisting of quantum dipoles with positive and negative poles. By low temperature, when the motions are very slow, the electrons can create the bound compositions known as Cooper´s pairs. Their ability for mutual attraction allows the existence of superconductivity. Electrons in their basic states represent probably the structures with one positive and two negative poles. The bound state of two electrons creating a Cooper´s pair can be pictured:



The BCS theory, by explanation of superconductivity, supposes the existence of a hypothetical particle – phonon which mediates the attractive force between two electrons. Application of this non-existing particle is a consequence of unknowing the direct elementary quantum connections between electrons.

Cooper´s pair represents such a mutual configuration of two electrons (in quantum physics interpreted by their opposite spin) that the mutual attractive forces of opposite poles can compensate the repulsive mutual pressures of quantum connections coming out of negative poles.

Casimir´s phenomenon is another evidence for existence of attractive electrostatic force between neutral objects. This force acts between two neutral conducting plates. If approach them closely, the mutual attraction, known as Casimir´s attractive force, starts to act. Quantum physics try to explain its existence by vacuum fluctuation, when during permanent creation and extinction of virtual pairs of particles and antiparticles, the very small distance between two plates limits the possible wavelengths, what means, that the number of virtual particles and antiparticles in an internal vacuum between plates is less than in external one, so the external overpressure occurs and presses the plates together.

But in reality, this effect means, that the attractive forces between quantum dipoles, connecting both closely approached plates, are greater than repulsive spatial pressures of quantum connections, coming out of them.

There is no principled difference between electromagnetic force and others like strong and weak. They differ only by their intensity. In stable particles, the strong and weak forces are created by very short and energetic elementary quantum connections which can effectively compensate the great repulsive pressures of their spaces. The electromagnetic interactions can be converted into the strong ones, if the barrier of huge repulsive pressures is overreached by a close approach, where the long connections are dramatically shortened and attractive forces increased.

Analogical is an opposite process, where the strong interactions inside protons and antiprotons are changed after collision into elementary quantum dipoles – photons - as carriers of electromagnetic energy.

The Nature of Gravity (the Unity of Coulomb´s and Newton´s Laws)

After derivation of Coulomb´s relation for the attractive force acting between two neutral massive objects $f_a = (\alpha hc/2\pi)2k_1.k_2/d^2$ we have mentioned, that this force is compensated by repulsive force of pressures of quantum dipoles coming out of both objects. However, this compensation is valid only relatively, a certain part f_g of attractive force f_a is not compensated $f_g = \beta f_a$ and represent the attractive gravitational force f_g of bodies.

$$f_g = \beta f_a = \beta(\alpha hc/2\pi)2k_1.k_2/d^2$$

Uncompensated part of attractive forces by repulsive pressures of quantum dipoles is a consequence of deficiency of repulsive forces of the Universe caused by the fact, that a certain part of these forces is used for cosmic expansion. The total measure of this deficiency of repulsive forces and prevalence of attractive ones is manifested in a form of gravity acting between bodies through their long mutual vacuum quantum connections. Then the whole quantity of gravitational force G of the Universe acting between cosmic bodies is equal to the quantity of cosmic expansive force F_e as its counterbalance:

$$G = F_e$$

The internal mass of any object is given by its internal energy as a sum of energies of all its quantum dipoles. From constant relation $e_i d_i$ follows the constant relation $m_i d_i$ where m_i is an internal mass of quantum dipole i.

But material objects manifest outwards through their mutual quantum relations. For their mutual identification, the number of their positive and negative poles plays the important role, as it defines the number of their mutual connections. So, the number of positive and negative poles in material object defines its external gravitational mass, through which it manifests outwards. The number of positive and negative poles defines the number of external elementary connections (dipoles) coming out of this object towards all other objects of the Universe.

The relation between the internal and external masses of material object will be explained later.

Let us suppose the mutual equilibrium of positive and negative poles inside the body. Let there are k_j positive and k_j negative poles. Then the relation between an external gravitational mass m_j of the body and its number $2k_j$ of both poles has the following forms:

$$m_j = \varphi\, 2k_j ,$$

$$k_j = m_j/2\varphi ,$$

where: φ - ratio coefficient

After its substitution into the relation $f_g = \beta\, (\alpha hc /2\pi)\, 2k_1.k_2 /d^2$ we get:

$$f_g = \beta(\alpha hc/(4\pi\varphi^2))\, m_1.m_2 /d^2$$

It is a classical Newton´s gravitational law, in which the attraction between two bodies is expressed by their external masses m_1, m_2:

$$f_g = \kappa.m_1.m_2 /d^2,$$

where: $\kappa = \beta\alpha hc /(4\pi\varphi^2)$ is a gravitational constant.

We have detected the relation between Coulomb´s and Newton´s laws. Both they are only different expressions for the same attractive and repulsive forces acting through quantum dipoles of material structures.

The unification of Coulomb´s and Newton´s laws is a consequence of the fact that both laws, in different aspects, express the same reality – attraction between anti-poles of quantum dipoles acting directly – non-locally. Moreover Coulomb´s law describes a repulsion of like charged bodies caused by the local action of spatial pressures of external quantum connections coming out of these bodies outwards.

Now we can understand that a hypothetic graviton as a medium of gravitational interaction is not a specific elementary particle, transmitting the gravitational interaction by limited speed, but it is an elementary quantum connection (dipole) of anti-poles +, -.

Elementary quantum dipoles are the medium for gravitational interaction as well as for all others. So the cosmic gravity, as well as any other interaction, has a quantum character. Gravity has a significant manifestation only thanks enormous amount of long quantum connections between material bodies. It is negligible at a micro-level.

This understanding of gravity clearly shows why the so-called gravitational energy cannot be localised. It is concentrated in all external quantum connections of selected material object with the whole Universe. These connections cannot be localised in a certain closed area as they are branched to the whole Universe. It is a paradox, that Einstein´s equations of gravitational field violate the law of energy conservation at local level. So the gravitational

energy is a global phenomenon following from its universality. It is maybe the greatest Einstein´s paradox when his non-local character of gravity contradicts his locality principle.

Cosmic Gravity

Relation $f_a = (\alpha hc/2\pi)\ 2k_1.k_2\ /d^2$ expresses only the attraction between two material bodies, but does not contain the whole attraction inside the system with two bodies, as it does not include the attractive forces of quantum dipoles creating these material bodies. If we want to express the whole attractive force F_a inside some neutral system (structure), e.g. the Universe as a whole, we can represent this system with the whole mass M consisting of k positive and k negative poles. Then:

$$\mathbf{F_a = \sum_{i=1}^{k^2} f_{ia}}$$

From the relation $f_{ia} = \alpha hc / (2\pi d_i{}^2)$ we have:

$$\mathbf{F_a = (\alpha hc/2\pi) \sum^{k^2} 1/d_i^2}$$

This relation shows that very short quantum dipoles create the main contribution into the whole attractive force. It is specific for the gravitational force, that it manifests itself through long distances, where attractive forces are not fully compensated by the repulsive spatial pressures of quantum dipoles and are mediated by the cosmic vacuum between material bodies.

The following relation between the mass M of the Universe and the number of its positive and negative poles 2k is valid:

$$M = \varphi\ 2k,$$

$$\mathbf{k^2/d_a^2 = \sum_{i=1}^{k^2} 1/d_i^2},$$

where: d_a is a length of a quantum dipole with an average attractive force $f_a=F_a/k^2$. The value $\varphi = M/2k$ represents the elementary gravitational mass (elementary gravitational charge) of one pole of quantum dipole. Then:

$$k = M/2\varphi$$

$$F_a = (\alpha hc / 2\pi)\ k.k\ /d_a{}^2$$

$$F_a = (\alpha hc / 2\pi\varphi^2)\ (M/2)(M/2)\ /d_a{}^2$$

$$\alpha hc/(2\pi\varphi^2) = 4F_a d_a^2/M^2$$

From the invariant value $e_i d_i$ we obtain:

$$e_i d_i = f_i d_i^2 = e_a d_a = ed = 2f_a d_a^2$$

$$E.d = 2\ k^2 f_a d_a^2 = 2F_a d_a^2 = 2F_e(o/2)^2 = 2G(o/2)^2$$

$$\alpha hc/(2\pi\varphi^2) = 2E.d/M^2\ ,$$

where: d - length of quantum dipole with an average energy e and average mass m.
E - whole energy of the Universe.

The expression $\alpha hc/(2\pi\varphi^2) = 4F_a d_a^2/M^2$ is remarkable as thanks to the invariant relations, e.g. $F_a d_a^2 = G.\ (o/2)^2$, the relation $\alpha hc/(2\pi\varphi^2)$ can be universally applied for the expression of any global cosmic force, not only for its whole attractive force F_a, but also for the whole gravitational force G (or expansion force F_e) of the Universe. In this case, the relation $\alpha hc/(2\pi\varphi^2)$ represents the gravitational constant κ:

$$\kappa = \alpha hc/(2\pi\varphi^2) = 2E.d/M^2$$

From the invariant relation $F_a d_a^2 = G.\ (o/2)^2$ we obtain the following expression for the gravitational law of the whole Universe:

$$\kappa = G.o^2/M^2$$

$$G = \kappa.M^2/o^2$$

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

It is a classical Newtonian gravitational law for the whole Universe, where its mass is divided into two equal parts, which mutual distance represents the maximum distance of the Universe connecting its two opposite sides. As shown before, the whole repulsive forces of these longest quantum dipoles are just their expansion forces fully compensated by gravitational force.

From both relations for gravitational constant

$$\kappa = 2Ed/M^2 \text{ and } \kappa = c^2\ \pi r/(2M) = g(o/2)^2/M$$

where $c^2 = go$ and $E = Mgo$ we obtain:

$$d = (o/2)/4 = \pi r/4,$$

As we can see, the quantum dipole with an average energy $e = E/k^2$ and average internal mass $m = M/k^2$ has a length which represent the 1/4 part of the length ($o/2=\pi r$) of the longest quantum dipoles, and so it contains four times higher energy and mass than the longest ones.

From the relations $\kappa = go^2/4M$ and $o=c^2/g$ we have:

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

Then from the relation:

$$\kappa= Go^2/M^2= go^2/4M$$

We obtain the formula for the whole gravitational (expansion) force of the Universe:

$$G = F_e = Mg/4 = c^4/(16\kappa)= 7{,}566.10^{42}\ N$$

where :
$g/4$ - gravitational acceleration of the quantum dipole with an average mass m,
average energy e and average length $d = (o/2)/4 = \pi r/4$
So we know the exact value of the expansion and gravitational forces of the Universe.

This value decelerates during the cosmic expansion according to the following relation:

$$G = E/4o = (1/4)(2\pi d^2V/dt^2)^{-1/3}.t^{-2/3}$$

The cosmic gravity affects all objects, all elementary quanta of space. It means that the gravity, as a reaction to the cosmic expansion, has a global and quantum character.

Conclusion

It is remarkable that contemporary theoretical physics explains any form of interaction as an exchange of virtual particles moving by the limit speed through the vacuum. But the nature of vacuum is not explained. It is only a background for moving virtual particles which are at the same time carriers of field quanta. But the relations between discrete virtual particles, continual force fields and vacuum are full of paradoxes. However this situation is quite simply explained, if accept, that all force fields and vacuum are created by elementary bipolar quantum connections through which all interactions are directly mediated. So we need no any background arena for all interactions. Vacuum does not create the virtual particles and antiparticles for mediation of interactions. It is just a network of direct elementary connections mediated all known interactions between physical objects.