The Basic Space-time Equation of the Universe (Cosmic Dynamics)

Peter Kohut

Email: pekohut@gmail.com

The elementary building unit of the Universe - quantum connection of opposite poles (quantum dipole) represents the elementary quantum of space. The Universe pulsates thanks to its dialectic contradiction between attraction and repulsion. The cosmic expansion is caused by systematic expelling of new quantum dipoles accompanied with the transition of the Universe from one quantum state to the next by elementary quantum jump, which represents the elementary quantum of time. This fact can be expressed by simple space-time equation of the Universe, which has important consequences and enables to calculate such cosmic characteristics like mass and energy of the Universe, its volume, average density, radius of cosmic curvature and others.

1. Introduction

The Universe as a whole is a dialectic unity of finality and infinity. *As a space, it is a three-dimensional surface of a four-dimensional sphere.*

So, the Universe is a limit of "something" thanks which it curves and encloses, remaining without any limit. In my monograph "God and the Universe" [1], it is shown that the Universe is a network of non-local connections of anti-poles, where every "+" pole is connected with all "–" poles and reciprocally. Everything is connected with everything. Every separated part is connected with all parts of the Universe.

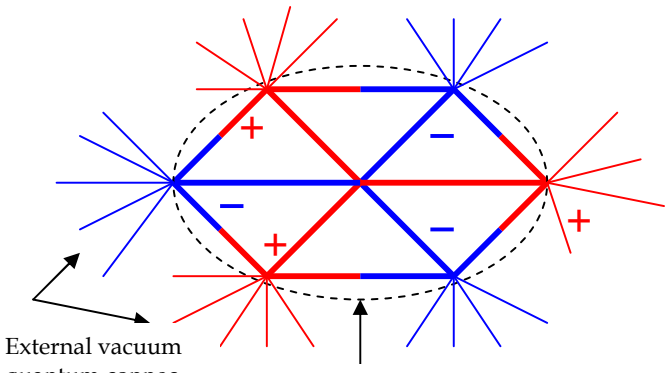

Fig. 1. Scheme of a particle compound of three '+' and three '-' poles with nine internal connections (quantum dipoles) and indication of external connections with the whole Universe.

The principle of universal connection of everything with everything creates a general unity of the Universe. *The Universe is a pulsating, expanding and contracting finitude without any limit.*

2. Dialectic Relationship of Finite and Infinite

Let us look in more detail at the Hegelian dialectics of finitude and infinity. Hegel analyses their relation in a wider context than only spatial understanding. He grasps it in an aspect of a whole Being, which as a self-reflection, returns to itself through its contradiction. So, self-reflection (subject) is a negation of negation.

Hegel in his "Logic" begins with an undetermined immediate "being in itself" which is infinite. Then he comes to the determined "being", in which "something" is in opposite relation to the "other". As this "something" has its limit in the "other", it is finite and negatively determined not only in relation to the "other" but also to itself (being for other). The "other" as a contradiction is a first negation of "something". The solution of this contradiction, in which both determinations manifest themselves, is infinity as a negation of negation with a consequent "being for itself" (subject). Something, by negation of negation, creates again and again its simple relation to itself. Continuing in this thought, Hegel develops the dialectical relation between Spirit (God) and Nature. "Other - object" is taken not only in relation to "something" but also as "other" in itself. Such determined internal "other" is a physical Nature – other of the Spirit. Spirit (God) is a real "something" and Nature is an "other" of Spirit and "other" in itself. So, Nature exists outside itself in its determinations of space and time. God refers to its "being in other" (Nature), which is contained in God and simultaneously differentiated from it. Through negation of negation God manifests its self-reflection - "being for itself". Thus God as an absolute Spirit at the highest level of self-reflection represents the consciousness of himself in his being (world) and at the same time the consciousness of his world in him. So God realizes his self-consciousness, self-knowing, through its own limit – physical Nature (other of something). As a consciousness self, God is a person (subject).

The relation between Spirit (God) and physical Nature is at the same time, the relation between inside and outside. "Something" obtains its determination (quality) only through its limit. The limit is a simple first negation. The point is a limit of line, which is a limit of two-dimensional surface, which is a limit of three-dimensional space, which is a limit of - what?

The dialectical law of negation of negation, at a level of a whole Being, is a manifestation of dialectical relation "subject-object" as an relation of universal Ego to itself through its contradiction – non-Ego. Being, as a whole, represents a universal self-consciousness of God. All existence is in God, including the object (physical Nature). Nature represents the border through

which God realizes his self-reflection. The individual human consciousness has its object (physical Nature) outside itself. But, as an individual human spirit, man also represents a consciousness of his own world, and reciprocally, the consciousness of himself in his world. God as an absolute Spirit is the truth of the whole Being.

Finality and infinity reciprocally determine each other. Finality is finite only in its relation to infinity which is infinite only in relation to finality. Their reciprocal transition means that infinity emerges from finality and reciprocally, finality from infinity. The progress to infinity is only a perpetual repetition of tedious alternation of finitude and infinity. Such an abstract progress to infinity remains undone and cannot overreach itself. This "spurious" infinity is a negation of finality incapable to overreach it. Such infinity is false and beyond its reach and so it cannot exist. In this progress of egression, the finality and infinity exist side by side and follow one after the other. This progress is only an external happening, alternation of both moments. In real dialectical comprehension, finality and infinity refer one to the other in an infinite progress. Starting from finality, the limit is transcended and we are in infinity, where the limit arises again. This limit has the same fate and must be negated. Both finality and infinity create the movement in which everything returns to itself through its negation. This is a complete motion returning to its beginning. Finality finds only itself in its opposite side. The same does infinity. The negation of negation is an affirmation of both infinity and finality. Finality and infinity are only moments of totality, and it is absolutely indifferent which of them is considered to be a beginning. Infinity as a return to itself through its limit has not an abstract, but determined existence, because it restores itself by negating of its negation. Being, as a whole, is a finite "one" which nowhere and never begins and ends. So it is infinite, too.

Hegel presents a straight line as an image of false and unreachable infinity (spurious infinity). The circle represents the true infinity, as it is a line which has reached itself, closed and present, without beginning and end.

The spurious infinity, especially as a quantitative progress to infinity, this perpetual exceeding the limit and falling into it, is usually considered as tremendous. Even philosophy often presents this progress as a top of thinking. Kant considered this description to be fantastic. This problem and incorrect approach to infinity has survived up to now. Many astronomers and cosmologists keep opened the question whether space is opened and suffered from a spurious infinity. The knowledge of the real dialectics of finality and infinity remains no doubts about the fact that the Universe is spatially closed, but without any limit.

3. Dynamics of the Universe, Space and Time

The material Universe, as the simplest relationship between attraction end repulsion of anti-poles, can be is easily mathematically formalised and recognised through physical and mathematical magnitudes. The grasp of existence in a wide aspect is possible only through philosophical thinking. Whereas we use mathematical and physical quantities, we are at the ground of material existence of the Universe – space and time. The whole of "Being" cannot be described by using mathematical and physical language, but its material manifestations can.

The material Universe is "one–whole" which anticipates "many – parts" included in "one– whole". The expanding Universe as a whole in its parts, as a "one" in its "many", expels thanks repulsion a new "one–part" from itself. This "one" as a quantum dipole (+,-) is bipolar. The repulsion means that one new negative pole "-" is expelled from all positive poles "+" of existing parts (quantum dipoles) and consequently, new positive pole "+" is expelled from all existing negative ones "-". Expelling of one new pair "+" and "-", means at the same time the creation of many elementary connections of this new pair with all existing elementary quantum connections (dipoles) of the Universe. So, the Universe is an expanding network of quantum dipoles, in which every positive pole is connected with all negative anti-poles and reciprocally. All these connections in cosmic network represent elementary quantum dipoles (+,-).

At the starting point of cosmic expansion, the Universe exists only as a sole quantum of energy-space, as a single connection of anti-poles + and - (quantum dipole (+,-)). Then the mutual repulsion and attraction of anti-poles are maximal. During cosmic expansion, the repulsive force is in its active stage, and the attractive force, as a reaction to repulsive one, is in a passive stage and manifests itself as a global cosmic gravity. Both these forces are equal but with mutually opposite orientation. This mutual relationship between repulsion and attraction manifests itself as a law of action and reaction. When the repulsive force will exhaust itself in its active stage, the stage of cosmic expansion ends, and the attractive force starts cosmic contraction. Then repulsive force passes to its passive stage, and as a reaction to attractive force (being now in an active stage), manifests itself as a global cosmic antigravity. During cosmic contraction, the Universe gradually incorporates its quantum dipoles into itself, until it becomes only a sole quantum dipole and starts again another stage of cosmic expansion. The Universe, as an internally bipolar whole, permanently pulsates. Relation "expansion-gravity" changes into "contraction-antigravity". Going from its unity, as a sole quantum dipole, to its plurality, as many quantum dipoles, the Universe performs its expansion. Return from its plurality to its unity is performed during cosmic contraction. It is its eternal pulsation – egression from itself and return into itself without violation of general unity manifested through its plurality.

As a sole quantum dipole (+,-), the Universe is in its initial quantum state. Cosmic transition to the second state is accompanied by an expelling and creation a new pair "+,-" in such a way, that every "+" is connected with all "-". So, in the second state, we have four quantum connections (+,-).

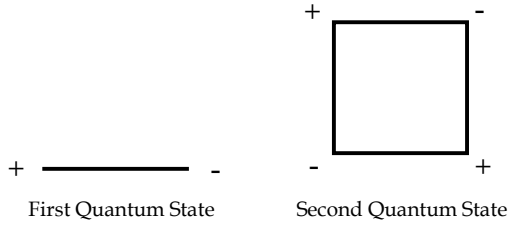

Fig. 2. Quantum States of the Universe

Every expelling of a new pair "+,-", represents the transition of the Universe from one quantum state to the next. In reality, the Universe expels firstly one pole and than the other opposite one. The Universe alternates its symmetric states, when the number of positive and negative poles is equal, with its asymmetric states, when the number of ones poles is greater than the number of opposite poles. In order to simplify our analysis, we will consider only quantum transitions between symmetrical quantum states, when two new poles are created, but we will take in a mind that the Universe transits also through its asymmetric states.

The Universe in its symmetric quantum state k consists of k positive and k negative anti-poles with k^2 connections – elementary quantum dipoles.

The space is created of elementary quantum connections – dipoles.

The dynamic network of quantum dipoles represents this unitary field which Einstein was unsuccessfully finding in his theory of unified field. This network can be easy described by the matrix in which the lines represent the positive poles, and the columns – the negative ones. Points of intersections represent the elementary quantum dipoles as connections of anti-poles. Cosmic quantum transition (jump) from one symmetric quantum state to the next, during cosmic expansion, can be described by an addition of a new line and column. New points of intersections represent the new quantum dipoles which are created during elementary quantum cosmic transition (jump).

Quantum state		**1**	**2**		***k*-1**	***k***	***k*+1**		***n***
	Poles	**-**	**-**	**...**	**-**	**-**	**-**	**...**	**-**
1	**+**						(+,-)		
2	**+**						(+,-)		
							(+,-)		
***k*-1**	**+**						(+,-)		
k	**+**						(+,-)		
***k*+1**	**+**	(+,-)	(+,-)	(+,-)	(+,-)	(+,-)	(+,-)		
n	**+**								

Table 1. Increasing Cosmic Network of Quantum Dipoles

The cosmic transition between two symmetric quantum states k and k+1 is accompanied by creation of a new pair (+,-), marked with a red colour, together with creation of new quantum dipoles in a new line and column belonging to the symmetric quantum state k+1 (yellow colour). We can clearly see that during transition from the state k to k+1, the new 2k+1 quantum dipoles appear. Symmetric quantum state k is represented by k^2 quantum dipoles (+,-).

4. The Basic Quantum Space-time Equation of the Universe

The elementary quantum connection (dipole) represents the elementary quantum of space, its volume etalon. Quantum transition from one quantum state to the next represents the elementary quantum of time – time etalon. One quantum transition (jump) of the Universe is the smallest possible cosmic change – motion, which the elementary quantum of time is connected with. So, the time of cosmic expansion is given by the number of quantum jumps k and the volume of space is defined by the number of elementary quantum dipoles. The following relation is valid:

$$V_k = k^2, \qquad k = 1,2,...,n \tag{1}$$

This relation represents the basic quantum space-time equation of the Universe, where:

k : Quantum state of the Universe, the number of elementary quantum transitions, between symmetrical quantum states, from the beginning of cosmic expansion until now. It also represents the number of positive (or negative) poles.

V_k : The number of elementary spatial quanta of the Universe in a quantum state k.

n : The number of quantum transitions from beginning to ending of cosmic expansion.

The basic quantum equation of the Universe $V_k = k^2$ represents the basic rule for space-time quantization and represents at the same time the dialectical unity of space and time. Parameter k varies from 1 to n (expansion) and backwards from n to 1 (contraction). Parameter of the number of elementary quantum connections V_k consequently varies from 1 to n^2 and backwards. Parameter n cannot be infinite, so neither V_k can.

The next relations follow from the basic quantum equation of the Universe, if spatial volume and time of cosmic expansion are expressed by quantum dimensionless quantities:

$$V_k = k^2 \qquad \frac{dV_k}{dk} = 2k \qquad \frac{d^2V_k}{dk^2} = 2 \tag{2}$$

$$\Rightarrow \qquad \left(\frac{dV_k}{dk}\right)^2 = 2V_k \cdot \frac{d^2V_k}{dk^2} \tag{3}$$

The basic quantum equation of the Universe $V_k = k^2$ can be approximately transformed to the form where space and time are expressed by continuous quantities V, t expressed in real dimensional units like meter and second.

If we allocate Δt sec to the one quantum jump, then the time of cosmic expansion is:

$$t = k \cdot \Delta t \tag{4}$$

and the basic space-time equation of the Universe in which the volume V is expressed by m^3, obtains the following form:

$$V = z \cdot t^2 \tag{5}$$

where z is the gear ratio between units of volume and time, and can be expressed by following relation:

$$z = \frac{1}{2}\left(\frac{d^2V}{dt^2}\right) \tag{6}$$

The relation (5) is the basic equation of space dynamics of the Universe, expressed in real dimensional quantities, in accordance with which the spatial volume of the Universe is directly proportional to the square of time of cosmic expansion.

The next relations are valid:

$$V = z \cdot t^2 \tag{7}$$

$$dV/dt = \left(d^2V/dt^2\right) \cdot t \tag{8}$$

$$\left(dV/dt\right)^2 = 2V.\left(dV^2/dt^2\right) \tag{9}$$

The quantity dV^2/dt^2 is a fixed constant during the whole evolution of the Universe.

All these equations express the space-time unity of the Universe. The speed of expansion of spatial volume dV/dt is directly proportional to the time of expansion. It accelerates unceasingly and this acceleration dV^2/dt^2 is constant.

The Universe as a three-dimensional surface of a four-dimensional sphere is closed with no space limit, but with the final volume:

$$V = 2\pi^2 r^3 \tag{10}$$

where r is a radius of spatial curvature.

From the relation for circumference of the Universe $o = 2\pi r$ we obtain:

$$V = o^3/(4\pi) \tag{11}$$

$$dV/dt = \left(3o^2.do/dt\right)/(4\pi) \tag{12}$$

$$d^2V/dt^2 = \left(3\left(2o\left(do/dt\right)^2 + o^2.\left(d^2o/dt^2\right)\right)\right)/(4\pi) \tag{13}$$

From these relations and basic space-time equation we get the following equation expressing the relation between length and time characteristics:

$$\left(do/dt\right)^2 = -2o.\left(d^2o/dt^2\right) \tag{14}$$

This relation remains valid for every length parameter of the Universe and also for the speed of its change and acceleration. The role of circumference o can also play a radius r of space curvature as well as a length of any quantum dipole. It represents the basic law of motion of the Universe that manifests itself at macro and micro levels. It is the basic law of motion for every quantum dipole of the Universe relative to the whole dynamics of the Universe.

The relations between spatial circumference o and time t are:

$$o = u.t^{2/3} \tag{15}$$

$$do/dt = (2/3)u.t^{-1/3} \tag{16}$$

$$d^2o/dt^2 = -(2/9)u.t^{-4/3} \tag{17}$$

where $$u = \left(2\pi d^2V/dt^2\right)^{1/3} \tag{18}$$

These equations show that the spatial circumference **o** increases in time but its speed decreases. So, acceleration is negative. It means that the speed of cosmic expansion decelerates.

Hubble´s constant is:

$$H = \left(do/dt\right)/o = (2/3).t^{-1} \tag{19}$$

The time of cosmic expansion is:

$$t = (2/3).H^{-1} \tag{20}$$

As mentioned, the basic cosmic equation expressed in a form (14) has a general character. It is valid for the Universe like a whole as well as for every its quantum dipole, in which the length of quantum dipole d_i, plays the role of parameter **o**. Every motion as a result of length change of a quantum dipole, caused by the whole cosmic dynamics, subordinates to this law. We can write it in the following form:

$$c_i^2/2 = -a_i d_i \tag{21}$$

c_i : The speed of length increase of quantum dipole
a_i : Acceleration
d_i **:** The length of quantum dipole

This law reflects the increase of length of quantum dipole thanks to cosmic expansion. The speed of increase is negligible for short quantum dipoles and represents the ratio between the length of dipole and the whole cosmic circumference multiplied by the speed of increase of cosmic circumference.

For the longest quantum dipoles representing the highest possible distance equal to the half circumference of the Universe, e.g. $o/2$, the speed of its increase, thanks cosmic expansion, represents the highest possible speed – speed of light c. Then:

$$c = \left(do/dt\right)/2 = o/(3t) \tag{21}$$

$$o/2 = \pi r = (3/2)ct \tag{22}$$

Speed of light represents the speed of cosmic expansion, so it is an escaping speed for the whole Universe. As speed of cosmic expansion decreases so speed of light decreases, too.

The *light* propagates from given point to all directions by the speed of cosmic expansion. The longest quantum dipoles with a length $o/2$ connect objects at opposite sides of the Universe. As an opposite side of the Universe moves from us by the speed of light, so the light, at opposite side, is in rest in relation to us, as its speed towards us is fully compensated by the speed of cosmic expansion.

As cosmic gravitation is a reaction to cosmic expansion, so we can represent the deceleration of cosmic expansion (represented by deceleration of the speed of cosmic extension of its longest quantum dipoles with a length $o/2$), as a cosmic gravitational acceleration g:

$$g = -\left(d^2o/dt^2\right)/2 \tag{23}$$

Speed of light represents the speed of cosmic expansion, the gravity its deceleration. The deceleration of cosmic expansion is its gravitational acceleration as expansion and gravitation act in opposite directions. The force of cosmic expansion is equal to the force of cosmic gravitation, only their orientations are opposite. The relation between the speed of light and gravitational acceleration is:

$$g = -dc/dt \tag{24}$$

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

The following relation is valid:

$$c^2 = g.o \tag{25}$$

The square of light speed is equal to the gravitational acceleration multiplied by cosmic circumference.

After multiplying of relation $c^2 = g.o$ by the whole mass M of the Universe, we get:

$$Mc^2 = M.g.o = E \tag{26}$$

So we have received the relation for the whole energy E of the Universe $E = Mc^2 = M.g.o$, which can be modified to the form expressing the equality between kinetic and potential energy of the Universe:

$$Mc^2/2 = Mg(o/2) \tag{27}$$

where $E_p = Mg(o/2)$ - potential energy (28)

$E_k = Mc^2/2$ - kinetic energy. (29)

The relation (28) expresses the fact that the Universe with a mass M is affected by a gravitational acceleration g in relation to the distance $o/2$ between opposite sides of the Universe. Kinetic energy (29) represents the fact that the Universe with mass M moves towards its base (which is the Universe in itself**)** by the light speed c, which represents its escaping speed through which the Universe escapes from itself (escaping speed of opposite sides of the Universe**).**

As the whole cosmic energy $E = Mc^2$ is constant, the deceleration of speed of light means that the entire mass M of the Universe increases during cosmic expansion.

The following relation is valid for the escape speed from a gravitational field of an object with mass m and radius R:

$$v^2 = 2\kappa m/R \tag{30}$$

where κ is a gravitational constant.

In our case, where speed of light c represents the escape cosmic speed and the role of parameter R plays the maximal cosmic distance $o/2 = \pi r$, the relation for the escape speed of the Universe has the following form:

$$c^2 = 2\kappa M/(\pi r) \tag{31}$$

After modification we get:

$$M = \left(\pi c^2/(2\kappa)\right) \cdot r \tag{32}$$

So we have received the same relation, which A. Einstein derived for the relation between mass of the Universe and a radius of its curvature in his model of closed Universe.

The relation for the gravitational constant is the following:

$$\kappa = c^2 \pi r/(2M) \tag{33}$$

Using the relation $c^2 = g \cdot o$ we have:

$$\kappa = g(o/2)^2/M \tag{34}$$

From relations (15), (17), it can be verified that the expressions $g \cdot (o/2)^2$, $M\kappa$ represent the universal constants which do not change during cosmic expansion. Given the first four of the following constants, we can derive and calculate the remaining important cosmic characteristics:

Characteristic	**Symbol**	**Value**	**SI Unit**
Hubble´s constant	H	1.51×10^{-18}	s^{-1}
Time of cosmic expansion	t	$4.41806 \times 10^{+17}$	s
Speed of light	c	299 792 458	ms^{-1}
Gravitational constant	κ	6.67259×10^{-11}	$m^3kg^{-1}s^{-2}$
Radius of cosmic curvature	$r = c/(\pi H)$	$6.32 \times 10^{+25}$	m
Universe circumference	$o = 2\pi r$	$3.97 \times 10^{+26}$	m
Cosmic gravitational acceleration =			
Decel. of cosmic expansion	$g = c^2/o$	2.26×10^{-10}	$m\text{-}s^{-2}$
Mass of the Universe	$M = \pi c^2 r/(2\kappa) = c^3/(2H\kappa)$		
		$1.34 \times 10^{+53}$	kg
Energy of the Universe	$E = Mc^2$	$1.2 \times 10^{+70}$	$kg\text{-}m^2s^{-2}$
Volume of the Universe	$V = 2p^2r^3$	$4.99 \times 10^{+78}$	m^3
Avg. cosmic mass density	$\rho_M = M/V = \pi H^2/(4\kappa)$		
		2.68×10^{-26}	$kg\text{-}m^{-3}$
Avg. cosmic energy density	$\rho_E = Mc^2/V = \pi c^2 H^2/(4\kappa)$		
		2.41×10^{-9}	$kg\text{-}m^{-1}s^{-2}$

5. Conclusion

By using a dialectical logic, the basic quantum space-time equation of the Universe was derived together with its various modifications and consequences. It was discovered the nature of cosmological constants like speed of light c and gravitational constant κ which express certain aspects of cosmic expansion. Other basic physical constants like elementary electric charge q, Planck´s constant h, constant of fine structure α, also represents the specific aspects of cosmic expansion, which nature is explained in [1]. The cosmic gravity as a consequence of cosmic expansion has a quantum character as it is realized through elementary quantum dipoles mutually connecting all material objects. It means that gravity is a direct immediate action between objects mediated by elementary quantum relations. The dynamic and increasing cosmic network of quantum dipoles represents a unitary cosmic field which is a carrier of all interactions including gravity. This field has quantum character and changes by elementary quantum jumps. These jumps are manifestations of quantum character of cosmic time. But this field shows that all interactions are immediate direct relations and not actions mediated by limited speed.

References

[1] P. Kohut, “God and the Universe” VDM Verlag Dr. Muller, Saarbrucken 2011
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