Off-Site Continuums as Cosmological Models of Galaxies and the Universe

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Abstract: The off-site continuums are proposed for the cosmological models of the galaxies and the Universe. It is shown that many visual properties of galaxies and the Universe may be described on frames of the off-site continuums methodology. In cosmological scale the appearance of off-site objects is quite similar to the influence of the 'dark matter' and the 'dark energy'. Analogies to known relic radiation are also looked through. It is discussed few possible models of galaxies and the Universe. Such point of view may appear useful for the investigation of conceptual problems of modern cosmology.

1. Introduction: the root of the problem

The general theory of relativity (GR) generates conservation laws inside itself (E.Schrödinger [1]), because four identical relations between Hamiltonian derivatives of some invariant density $\Re$ may be obtained only from the fact of the general invariance of the Integral:

$$\Im = \int_G \Re d^4 x . \tag{1}$$

These relations appear like conservation laws. Here G is a four-dimensional space-time continuum, which corresponds to our 'material World'. Physics exactly deals with the description of this continuum: physical laws and objects in it. However, do we have some restrictions to existence of another, off-site continuums differed from G? If such continuums may exist, so there are other Worlds, off-site space-time continuums, which differ from 'our' World. This way, how could they be observed from 'our' World? Can we describe them mathematically? Do they have some correspondences with well-known physical objects? Whether do we really need such continuums to make our scientific Worldview consistent?

2. Space-time continuums

Let's suppose, that continuums $\tilde{G}$ differed from G really exist. We will call such continuums as off-site ones (OSC). It is possible to consider continuums G and $\tilde{G}$ as some mathematical sets. If some correspondence $F: \; G \xleftrightarrow{F} \tilde{G}$ is determined between elements of two continuums, it means that there are some regions or subsets $D \subset G$ and $\tilde{D} \subset \tilde{G}$: $G \supset D \xleftrightarrow{F} \tilde{D} \subset \tilde{G}$. In the paper we will usually consider that G is a continuum of the observer and, so, for short, we will denote the subset D: $\tilde{G} \cap G = D$ as a common region of continuums $\tilde{G}$ and G.

For example, coordinate transformations $x^i = \arctan(\tilde{x}^i)$, $i = 0..n-1$ between two continuums G: $\{x : (x^0, x^1, ..., x^{n-1})\}$ and $\tilde{G}$: $\{\tilde{x} : (\tilde{x}^0, \tilde{x}^1, ..., \tilde{x}^{n-1})\}$ reflect the n-dimensional continuum $\tilde{G}$ inside n-dimensional unit cube from G: $\tilde{G} \leftrightarrow D_1 \subset G$. Another transformations $\tilde{x}^i = \arctan(x^i)$ reflect G inside n-dimensional unit cube from $\tilde{G}$: $G \leftrightarrow \tilde{D}_1 \subset \tilde{G}$. Note that continuums G and $\tilde{G}$ have the same power of set by Cantor. It is proved in the mathematical theory of sets that any multi-dimensional continuum has the same power as a unit line segment $[0,1]$. It means, in particular, that one-dimensional continuum is identical to two-, three- or any n-dimensional one.

In general theory of relativity the invariant density $\Re$ from Eq.(1) defines the space-time topometry (topology and metrics) and also depends on physical objects existing in this space-time. L.Landau and E.Lifshitz had described this fact in [2] as: "It is necessary, strictly speaking, to have a set of infinite number of the bodies filling all space, like some 'medium'. Such system of bodies together with connected to each of them arbitrarily clocks is a frame of reference in the general theory of relativity". Thus, the continuum G with invariant density $\Re$ defines or generates the 'medium', i.e. the system including 'a set of infinite number of bodies' and corresponding conservation laws for these physical objects. We don't have reasons to deny an existence of some OSCs and to reject their possibility to generate its own physical system including its own physical objects, own space-time structure and conservation laws. This 'medium' may differ from one generated by G.

Some correspondence F: $G \xleftrightarrow{F} \tilde{G}$ assigned between elements of two continuums G: $\{x:(x^0,...,x^n)\}$ and $\tilde{G}$: $\{\tilde{x}:(\tilde{x}^0,...,\tilde{x}^m)\}$ may be represented functionally (functions f and $\tilde{f}$ may be of any kind) as:

$$\tilde{x}^j = f^j(x^0,...,x^n), \quad j=0..m \qquad \text{or} \qquad x^i = \tilde{f}^i(\tilde{x}^0,...,\tilde{x}^m), \quad i=0..n. \qquad (2)$$

If we suppose that the off-site continuum $\tilde{G}$ has its own invariant density $\tilde{\Re}$, so we may write for it analogously to Eq.(1) the off-site Integral: $\tilde{\Im} = \int_{\tilde{G}} \tilde{\Re} d^m \tilde{x}$. If it is supposed that $\tilde{G}$ has some metrics, so we may consider that some interval $d\tilde{s}^2 = \tilde{g}_{jl} d\tilde{x}^j d\tilde{x}^l$, where $j,l = 0..m$, (as usual, the summation on repeating indexes is meant) is introduced. Note that from OSC definition $\tilde{\Re}$ and $d\tilde{s}^2$ have to differ from $\Re$ and ds^2, which, for example, is not true for coordinate transformations between inertial frames.

Not only the OSC topometry (topology and metrics), but also the transformation functions f and $\tilde{f}$ from Eq.(2) are very important for observability of continuums. For example, if each element of two identical one-dimensional continuums $G: x \in (-\infty,\infty)$ and $\tilde{G}: \tilde{x} \in (-\infty,\infty)$ is represented as a decimal number: $x = ...a_1, a_0, a_{-1}, a_{-2}...$; $\tilde{x} = ...b_1, b_0, b_{-1}, b_{-2}...$, where $a_i, b_j = 0,1..9$ and the correspondence $G \leftrightarrow \tilde{G}$: $b_{2k+1} = a_{2k}, b_{2k} = a_{2k+1}$, $k = 0,\pm1,\pm2,...$ is introduced, so, in spite of both G and $\tilde{G}$ are continuous and measurable, and the correspondence is biunique, the 'mutual visible metrics' can't be introduced. We understand as 'mutual visible metrics' the metrics in one continuum observable or visible from another one.

An introduction in many modern physical theories of some additional hidden or compact spaces may be considered as a particular case of the OSC methodology. From OSC's point of view, it means that the OSC dimension is more than the dimension of the observer's continuum: $m > n$ and n from m components of the OSC is considered as identical to the corresponding ones from the observer's continuum. It is considered that the rest $m-n$ components are responsible for some 'internal' parameters of the OSC object. Of course, it is only one particular case, quite specific type of transformations between OSC continuums. Such approaches are based on the ungrounded supposition of uniqueness of 'our' continuum, the continuum of the observer. Exactly this uniqueness is considered as controversial in this paper.

Note that mathematical and physical correspondences between continuums usually don't coincide. Indeed, coordinate transformations between motionless and uniformly rotating with some frequency ω frames of references are 'mathematically' biunique for a whole 4D continuum, but 'physically' it may be used up to distance $r = c/\omega$ from the axis of rotation (c is a speed of light), because, as it is usually declared: "such system may not be realized by real bodies" [2].

If functions f and $\tilde{f}$ from Eq.(2) are continuously differentiable, so, on the field of definition, using $d\tilde{x}^j = (\partial f^j/\partial x^i)dx^i = (\partial\tilde{x}^j/\partial x^i)dx^i$, one can get the expression for the visible off-site metrics ($d\tilde{\tilde{s}}^2 \leftrightarrow d\tilde{s}^2$):

$$d\tilde{\tilde{s}}^2 = \tilde{g}_{jl|\tilde{x}=f(x)} \frac{\partial\tilde{x}^j}{\partial x^i}\frac{\partial\tilde{x}^l}{\partial x^k} dx^i dx^k \overset{def}{\equiv} \tilde{\tilde{g}}_{ik} dx^i dx^k; \; i,k = 0..n; \; j,l = 0..m. \qquad (3)$$

Generally, the visual metric tensor $\tilde{\tilde{g}}_{ik}$ is not a tensor in G and is defined only in common regions. Only in common regions it is possible to observe the visible part of the OSC Integral, so:

$$\tilde{\Im} = \int_{\tilde{G}} \tilde{\Re} d^m\tilde{x} \mapsto \int_{\tilde{D}} \tilde{\Re} d^m\tilde{x} = \int_D \tilde{\Re}_{|\tilde{x}=f(x)} \left|\frac{\partial\tilde{x}^j}{\partial x^i}\right| d^n x \overset{def}{\equiv} \int_D \tilde{\tilde{\Re}}(x) d^n x, \qquad (4)$$

where $\left|\partial\tilde{x}^j/\partial x^i\right|$ is a functional determinant. Note, that functional determinant needs to be defined, so Eq.(4) may be used with $n = m$, which, generally speaking, is not necessary in Eq.(3). To overcome such limitations some 'mathematical tricks' like the considered above example with hidden spaces are usually used. Above correspondences Eq.(4) may be represented by equalities in important particular cases of the enclosed ($\hat{G}$: $\hat{G} \leftrightarrow D \subset G$) and containing ($\breve{G}$: $G \leftrightarrow \breve{D} \subset \breve{G}$) OSCs:

$$\widehat{\Im} = \int_{\widehat{G}} \widehat{\Re} d^m \widehat{x} = \int_D \widehat{\Re}_{|\widehat{x}=f(x)} \left|\frac{\partial \widehat{x}^j}{\partial x^i}\right| d^n x, \quad (5a) \qquad \Im = \int_G \Re d^n x = \int_{\breve{D}} \breve{\Re}_{|\breve{x}=f(x)} \left|\frac{\partial x^i}{\partial \breve{x}^j}\right| d^m \breve{x}. \quad (5b)$$

3. Visible topology and metrics of Off-site continuums

Before starting the mathematical analysis of the off-site continuums, it is necessary to make clear the physical background of the proposed idea of OSC existence. Further in paper we will analyze the off-site continuums from 'our' four-dimensional continuum $G:\{x:(x^0, x^1, ..., x^n)\}$, $n=3$. We will denote the time as $dt = d\tau / c = dx^0 / c$. To investigate the visible structure or topometry of continuums, we need to suppose that, at least, OSCs have such topometry by themselves. So, we consider that some metrics $d\tilde{s}^2 = \tilde{g}_{jl} d\tilde{x}^j d\tilde{x}^l$, $j,l = 0..m$ is defined in $\tilde{G}$. We will analyze continuously differentiable in common regions functions f and $\tilde{f}$ from Eq.(2). Therefore, we're coming straight to the analysis of the visible off-site metric tensor from Eq.(3): $\tilde{\tilde{g}}_{ik} = \tilde{g}_{jl|\tilde{x}=f(x)} \frac{\partial \tilde{x}^j}{\partial x^i} \frac{\partial \tilde{x}^l}{\partial x^k}$, $i,k = 0..n;\ j,l = 0..m$.

The following physical interpretation of parameters of 'usual' metric tensor in the system of the observer was given by L.Landau and E.Lifshitz [2]: "It is necessary to emphasize a difference between meanings of a condition $g_{00} > 0$ and a condition of a certain signature (signs on principal values) of the metric tensor g_{ik}. The tensor g_{ik}, non-satisfying to the second one of these conditions, can't correspond to any real gravitational field at all, i.e. the metrics of the real space-time. Non-fulfillment of the condition $g_{00} > 0$ would meant only, that the corresponding frame of references can't be realized by real bodies; thus if the condition on principal values is carried out, it is possible to achieve to g_{00} becomes positive by appropriate transformation of coordinates".

Generally, the visible OSC metric tensor $\tilde{\tilde{g}}_{ik}$ is not at all a tensor in G, but we will consider that its parameters determine the observable physical space-time structure of $\tilde{G}$ and the visual properties of the off-site physical objects. The schematic drawings of possible structures of OSCs are presented on Fig.1. Following by L.Landau and E.Lifshitz [2] we may conditionally separate the visual structure of the off-site continuum into three regions: 1) the timelike region ($\tilde{\tilde{g}}_{00} > 0$ and $\det(\tilde{\tilde{g}}_{ik}) < 0$); 2) the spacelike region ($\det(\tilde{\tilde{g}}_{ik}) > 0$) and 3) the transitive region covering the rest part ($\tilde{\tilde{g}}_{00} < 0$ and $\det(\tilde{\tilde{g}}_{ik}) < 0$). Here, we've replaced a condition of the certain signature of the metric tensor by the condition of the sign of $\det(\tilde{\tilde{g}}_{ik})$, because, generally, $\tilde{\tilde{g}}_{ik}$ is not a tensor in G. It is also shown the fourth principally non-observable region in OSC, which, of course, even couldn't be imagined in paper [2], because it is 'outside' the observer's continuum. It is a rest part of OSC without common regions.

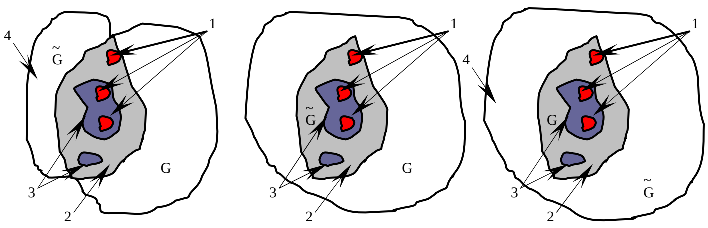

Fig. 1 The schematic drawings of the visible OSC regions:
1) timelike; 2) spacelike; 3) transitive; 4) non-observable.

It is shown on Fig.1 three possible variants of correspondences of the OSC $\tilde{G}$ and the continuum of the observer G: (A) $G/D \neq \emptyset$ and $\tilde{G}/\tilde{D} \neq \emptyset$; (B) $\tilde{G}$ is completely included in G ($\tilde{G}$ is an enclosed continuum); and (C) $\tilde{G}$ completely contains G ($\tilde{G}$ is a containing continuum). If $\tilde{G}$ has non-common regions ($\tilde{G}/\tilde{D} \neq \emptyset$), these regions will be principally non-observable from G. These regions (region 4) exist in A and C variants. Generally speaking, there exists another variant, where G and $\tilde{G}$ have no any common regions at all, but for the OSC to be observed it needs to be some 'media' between continuums, so this variant may be considered as a particular case of variants A or C.

Timelike regions ($\tilde{\tilde{g}}_{00} > 0$ and $\det(\tilde{\tilde{g}}_{ik}) < 0$). These are regions of 'normal' matter. The visible time and distance in OSC may be defined, following by L.Landau and E.Lifshitz [2], as: $d\tilde{\tilde{\tau}} = \sqrt{\tilde{\tilde{g}}_{00}}dx^0$ and $d\tilde{\tilde{l}}^2 = \tilde{\tilde{\gamma}}_{\alpha\beta}dx^\alpha dx^\beta$, $\tilde{\tilde{\gamma}}_{\alpha\beta} = -\tilde{\tilde{g}}_{\alpha\beta} + \tilde{\tilde{g}}_{0\beta}\tilde{\tilde{g}}_{0\beta} / \tilde{\tilde{g}}_{00}$. Hence, the physical correspondence may be introduced and OSC objects may be identified as visual 'normal matter' from G . As far as the motion of OSC objects in timelike regions will be defined by their own topometry, this motion will be observed from G as quite unusual. For the observer it will look like the action of some 'forces' applied to these OSC objects, holding them inside some region of D_α ($D : D_\alpha \times \tau$, so D_α is understood as a cross section of D at each τ). Exactly such 'forces' were introduced in quantum physics to explain the capturing of charged particles inside the nuclei. Analogies with strong interactions, phenomenon of confinement are arising at once. It will be shown in next section that such 'forces' really have obvious correlations with strong interactions and string models. We don't have any reasons to decline such processes in cosmological scales, but these processes will have some specifics: D_α may not be limited in space, also it's not clear how identify the boundaries of D_α , which may be also time-dependent.

Transitive regions ($\tilde{\tilde{g}}_{00} < 0$ and $\det(\tilde{\tilde{g}}_{ik}) < 0$). "Non-fulfillment of the condition $g_{00} > 0$ would mean only, that the corresponding frame of references can't be realized by real bodies; thus if the condition on principal values is carried out, it is possible to achieve to g_{00} becomes positive by appropriate transformation of coordinates" [2]. Therefore, OSC objects would have 'mixed' perception in transitive regions depending on concrete reference frame of the observer. As far as physical space correspondences are not able to introduce, OSC physical objects from transitive regions will be observed as something amorphous, distributed in space. However, from another reference frame in G , these OSC physical objects may look like 'real bodies'. Therefore, the OSC objects from transitive regions will look like strange 'amorphous' media distributed in some space regions, but possessing some 'real' physical characteristics, may interact as 'real body'. For example, real massive body identified in one reference frame may not be identified as this body from another frame, but its gravitational action to other bodies wouldn't disappear for the observer. Even from such schematic view, one may notice the correlations of transitive OSC objects with dark matter. Indeed, dark matter is understood as some invisible distributed in space substance, strange 'amorphous' media interacting gravitationally with identified visible objects.

Spacelike regions ($\det(\tilde{\tilde{g}}_{ik}) > 0$). The observation of OSC physical objects from spacelike regions may be even more unusual than the OSC objects from transitive regions: "The tensor g_{ik} can't correspond to any real gravitational field at all, i.e. the metrics of the real space-time" ([2]). The spacelike OSC physical objects also will be observed as some amorphous media, distributed in space, but also the macro-characteristics of these objects couldn't be identified with corresponding characteristics of 'normal' matter, 'real bodies', 'real gravitational field'. Therefore, the OSC physical objects in spacelike regions may possess quite unusual, even unphysical characteristics. Such unusual characteristic as negative pressure is used for the description of dark energy in Einstein's cosmological principle (Y.V.Baryshev [3]).

Non-observable regions. It is impossible to observe the OSC physical objects from the non-observable regions, but it doesn't mean, that it is impossible to register their influence or action on the physical objects from the continuum of the observer. It might be streams of particles flowing somewhere from the invisible source or disappearing somewhere in space. This way, if physical 'matter exchange' with non-observable regions really exist, it may lead to visual violations of conservation laws. Note that similar violation of the energy conservation law is a real problem in the standard model of the expanding Universe [3].

It's possible, that so 'strange' properties of the physical objects from different OSC regions are only their perception. Without knowing the transformation laws, we can't say anything about their 'real' properties in 'home' continuum. So, may be, even 'visual forces' observed between OSC objects don't exist in their 'home' OSC. Also note, that the visible OSC metric tensor may be time-dependent in the system of the observer, so, the OSC internal structure is dynamical for the observer. The time-scale of the observation may be quite different for different OSCs.

Thus, we have supposed the existence of the OSCs together with their 'own' physical objects and have found some analogies of these objects with known physical objects. But it, for example, means that one can observe the 'real' or 'normal' matter, dark matter and even dark energy 'locally' in space (variants A and

B on Fig.1) or ‘globally’ (variant C). It is quite interesting to make some huge geometrical estimation of relations between observed matters in different OSC regions. If we consider, that OSC ‘matter’ is distributed uniformly inside enclosed OSC continuum and one has equal possibility to observe $\tilde{\tilde{g}}_{00}$ or $\det(\tilde{\tilde{g}}_{ik})$ positive or negative, so geometrical volumes of observable ‘normal’ and dark matter in enclosed OSC (variant B on Fig.1) will be 25% each, the rest 50% will be for dark energy. The modern observations of the Universe give 60% for dark energy, 35% for dark matter and only 5% for ‘normal’ matter. Hence, the ‘global’ dark energy and dark matter of containing OSC prevail in ‘our’ continuum. Everyone can ask, how normal is ‘normal’ matter?

One of the conclusions of our approach is that OSC objects may be observed locally in space. Last data from the Hubble space telescope show that such localized objects really exist. On Fig.2A the three-dimensional map offers a first look at the web-like large-scale distribution of dark matter, an invisible form of matter that accounts for most of the universe's mass. The image shows that the supercluster galaxies lie within the clumps of dark matter (Credit: NASA, ESA, R. Massey (Caltech)). The ‘geometrical’ ratio between dark and normal matter may be seen on Fig.2B at the tremendous collision of two large clusters of galaxies. Dark matter and normal matter have been wrenched apart. This composite image shows the galaxy cluster 1E 0657-56, also known as the ‘bullet cluster’. The hot gas detected by ‘Chandra’ in X-rays is seen as two pink clumps in the image and contains most of the ‘normal’ matter in the two clusters. The bullet-shaped clump on the right is the hot gas from one cluster, which passed through the hot gas from the other larger cluster during the collision. The geometrical areas of the normal and dark matter approximately equal to each other as were predicted above for enclosed continuums.

In addition, there are some reports about the HST observations of the local dark energy. The group of authors in papers [4,5] estimated the local dark energy nearby galaxy groups M81/82 and Cen A/M83. They conclude that the local density of dark energy in the area is to be near the global dark energy density or perhaps exactly equal to it. This fact also is in a good agreement with the OSC model.

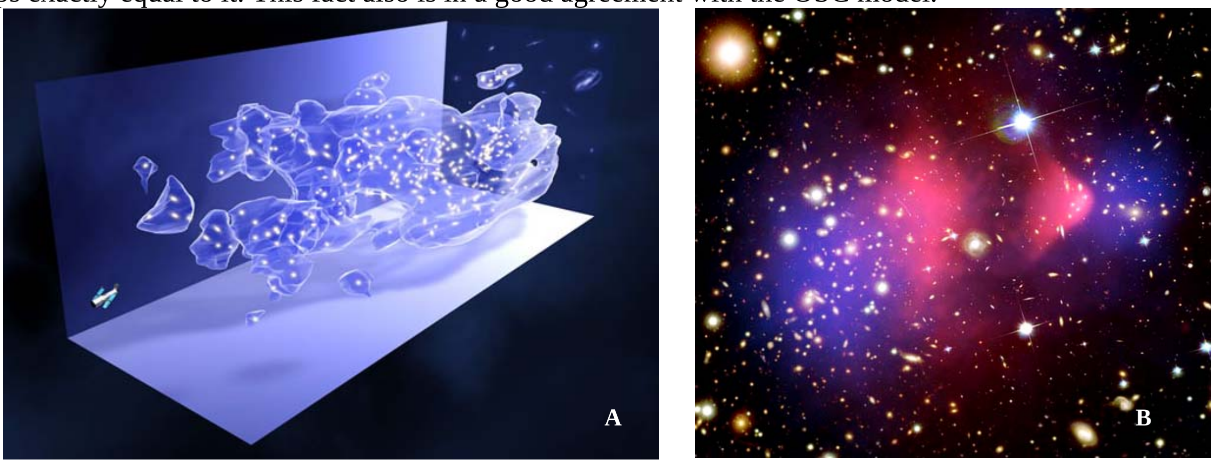

Fig. 2 The dark and normal matter distributions:
A) the 3D map of the large-scale distribution of dark matter; B) the collision of two large clusters of galaxies 1E 0657-56.

4. Models of mathematical description of OSC physical objects

If OSC physical objects really exist and may interact with the objects from the observer’s continuum, its influence is needed to be taken into account in variation of the Integral Eq.(1). From the OSC point of view the observer’s continuum is only one of many OSCs, all of them are needed to be considered during variation. One can try to find the general or global ‘Integral’ of such system:

$$\Im_S = \int_{G\cup\tilde{G}} \Lambda\left(\Re, \tilde{\Re}_{(1)}, \dots, \tilde{\Re}_{(p)}\right) d\Omega^* \equiv \int_{\tilde{G}} \Lambda\left(\tilde{\Re}\right) d\Omega^* , \qquad (6)$$

where $d\Omega^*$ is some generalized elementary volume of ‘combined’ continuums. To simplify notations we’ve denoted here $\Re$ as $\tilde{\Re}_{(0)}$ and G as $\tilde{G}_0$. We put indexes in braces to avoid further conflicts in notations with corresponding tensor indexes.

One can demand from function $\Lambda(\tilde{\Re})$: $\forall k = 0..p : \left\{\Lambda(\tilde{\Re}_{(k)}) = \tilde{\Re}_{(k)}\right\}$. Also if functions $\tilde{\Re}_{(k)}$ have no common regions, so, are independent: $\Lambda(\tilde{\Re}) = \sum \tilde{\Re}_{(k)}$. From other side, if OSCs’ fields of definition completely coincide, $\Lambda(\tilde{\mathfrak{R}})$ needs to be the scalar density, so it may be equal to any $\tilde{\mathfrak{R}}_{(k)}$ or their accidental linear combination. This conclusion looks strange from the first sight, but as a matter of fact it is a warning in GR and is logical consequence of OSC approach. Indeed, it was mentioned by E.Schrödinger in [1], that in GR identical relations gotten from variation of the Integral (1) "are not the only ones. Any scalar density creates some system of identities. We would prefer to get some assertion concerned with only one concrete density $\mathfrak{R}$, and even not necessary the identity. … from other side, the conservation laws by themselves represent the only one separated fact, but not the kind of facts". In fact, this supposition is 'physically' confirmed in OSC by declaring that not only one concrete density may be physically realized. And these realizations may create their own 'system of identities'.

Thus, we may consider that 'matter' may be realized or organized in some states characterized by some corresponding scalar density $\tilde{\mathfrak{R}}_{(k)}$ or by combinations of scalar densities. This way, one may try to find the general scalar density of the OSC system and, so, using Eq.(6), its general Integral, as:

$$\mathfrak{I}_S = \sum_{k=0}^{p} \tilde{\mathfrak{I}}_k , \qquad \Lambda(\tilde{\mathfrak{R}}) = a_0\tilde{\mathfrak{R}}_{(0)} \oplus a_1\tilde{\mathfrak{R}}_{(1)} \oplus \ldots \oplus a_p\tilde{\mathfrak{R}}_{(p)} . \tag{7}$$

The coefficients a_k reflect the degree of state realization: if some a_k is zero, so the k-state is not realized and $\tilde{\mathfrak{I}}_k = 0$. It's not straight summation for $\Lambda(\tilde{\mathfrak{R}})$, because of their interconnections in common regions. Anyway, according to 'global' invariance of $\mathfrak{I}_S$, one may conclude, that the 'matter' can't disappear, so disappearing in one state of the closed system, it needs to appear in some others.

Let's consider that some state $\hat{\mathfrak{R}}$ corresponding to the enclosed OSC with its Integral $\hat{\mathfrak{I}}$ is realized. The enclosed OSC is defined on some common regions D from G. One may separate as before the common regions D to: $D_\alpha \times D_\tau$, where D_α is understood as a cross section of D at some $\tau \in D_\tau$. If $D_\tau = [\tau_1, \tau_2]$, it means that this state may exist in G only during some time period. But according to declared global invariance of a system, the realization can't disappear, so this or another state or states need to be realized. It may correspond, for example, to some virtual particles' excitation and, hence, to a model of physical vacuum. At the first sight, this chain couldn't be broken, but at a moment we don't know anything about a sign of the state realization or, may be, its 'phase', if, for example, $\hat{\mathfrak{I}}$ is a complex number. If such possibilities exist, this 'chain' or 'chains' can be initiated from 'zero', from 'nothing', so, in principle, with some possibility may disappear.

If $D_\tau = (-\infty, \infty)$, the OSC objects or system state are stable in time and there are no 'matter exchange' between states. According to Eq.(5a): $\hat{\mathfrak{I}} = \int d\tau \int_{D_\alpha} \Lambda dV$, where $\Lambda = \hat{\mathfrak{R}}_{|\hat{x}=f(x)} \left|\partial \hat{x}^j / \partial x^i\right|$. $\hat{\mathfrak{I}}$ is invariant, and for some fixed space point $x_p^\alpha \in D_\alpha$ one may write an invariant equals to it: $\hat{\mathfrak{I}}_p = -a\int ds = -a\int d\tau_0 = \tilde{\mathfrak{I}}$, where a is some constant and ds is an interval in observer's continuum at space point x_p^α, $d\tau_0$ is an intrinsic time at rest frame of x_p^α. Using the invariance of the elementary volume one can write: $\hat{\mathfrak{I}} = \int d\tau \int_{D_\alpha} \Lambda dV = \int d\tau_0 \int_{D_\alpha} \Lambda dV_0$. Note, that due to usual properties of 'our' continuum, function Λ doesn't depend explicitly on x^i, which means that conservation laws don't change with time or space shifts [1,2]. Applying $\int_{D_\alpha} \Lambda dV_0 = -mc$ one may get an 'outside' description of the stable enclosed OSC object as a 'material point' or some 'massive particle' with the rest mass m. So, mass is general 'outside' characteristic of the OSC system 'as a whole'.

In GR it's also possible to get expressions connecting the function Λ with elements of corresponding energy-momentum tensor by standard method, considering stable enclosed OSC objects as some closed system [2]. So, from the OSC point of view, the 'field' equations in GR (Einstein-Hilbert equations) are valid only 'outside' the common regions for space points $x^\alpha \notin D_\alpha$.

According to OSC methodology one can get Einstein-Hilbert equations for any OSC. Using Eqs.(6,7) and applying the same Einstein-Hilbert method of getting gravitational 'field' equations to any OSC, it is possible to get the 'field' equations also for common regions:

$$R^{ik}-\frac{1}{2}g^{ik}R-\frac{8\pi K}{c^4}T^{ik}=-\frac{1}{a_0}\sum_n a_n\left(\tilde{R}^{jl}_{(n)}-\frac{1}{2}\tilde{g}^{jl}_{(n)}\tilde{R}_{(n)}-\frac{8\pi K}{c^4}\tilde{T}^{jl}_{(n)}\right)\frac{\partial x^i}{\partial\tilde{x}^j_{(n)}}\frac{\partial x^k}{\partial\tilde{x}^l_{(n)}}\,. \qquad (8)$$

Here, $\tilde{R}=\tilde{g}^{ik}\tilde{R}_{ik}=\tilde{\Re}/\sqrt{-\tilde{g}}$ are 'internal' curvatures in corresponding OSC, also the observer's one. Summation is made by states for which the considered regions are common; the states non-defined in this regions are accounted by means of energy-momentum tensors of corresponding OSC. Corresponding coordinate transformations $\partial x^i\partial x^k/\partial\tilde{x}^j_{(n)}\partial\tilde{x}^l_{(n)}$ are used here to express equations in observer's continuum. One can get gravitational 'field' equations like Eq.(8) for any OSC from the system using corresponding coordinate transformations.

On the boundaries of common regions 'outside' and 'internal' solutions need to correspond to each other, so solutions of Eqs.(8) and usual 'field' Einstein-Hilbert equations need to be matched. Due to coordinate transformations $\partial x^i\partial x^k/\partial\tilde{x}^j_{(n)}\partial\tilde{x}^l_{(n)}$ the visual OSC curvature and 'real' 'inside' OSC curvature don't coincide. It means that OSC objects inside common regions are not seemed as captured due to their own gravitational forces as it, for example, is in case of black holes. They will be observed as captured for some unknown reasons. This effect is described in quantum physics by introducing the new 'fundamental' interaction – the strong forces. It doesn't need such 'fundamental' interaction in our OSC model. By the way, note, that string theory models describe the confinement and quarks (see, for example, L.D.Soloviev [6,7] and A.Polyakov [8]) are using actions, which may be considered as an integral of kind of Eq.(5a). The string models differ mainly by the concrete form of Λ. This way, the mathematical description of strong interactions, quarks and confinement doesn't contradict to the methodology of the OSC model.

Inside the OSC methodology many conceptual problems of modern cosmology may be easily solved. If the observer's continuum is included in some containing OSC, corresponding terms on the right of Eq.(8) may be responsible for global cosmological constant or global dark energy [2,3]. 'Matter exchange' between visible and non-observable regions of some OSC may be perceived by the observer as violations of conservation laws. Moreover, as we already know, any non-stable OSC or non-stable states are responsible for the 'matter exchange'. So, for example, if our expanding Universe is non-stable OSC or state, the 'global' violations of conservation laws need to be observed.

5. Excited fields of OSC physical objects

OSC objects may be observed in quite nonlinear motion in timelike regions or in dynamics in others. But if some of them have an electric charge, they need to excite the electromagnetic (em) fields in the continuum of the observer. It means that they will excite the em fields in the continuum of the observer, so the 'matter exchange' exist between continuums. Hence, OSCs are not stable. But we know that 'normal matter' described as OSC objects mainly consists of stable charged particles: electrons, protons, nuclei etc. This paradox is not explained in quantum physics. In fact it is postulated that charged particles don't excite the em fields in some stable states. On frames of OSC, dynamical charged 'matter' may not emit the em radiation.

According to [2] and the previous section analysis the Integral of enclosed OSC with charged 'matter' on common regions D in observer's continuum may be rewritten as:

$$\tilde{\Im}=-c\int_D\mu\,d^4x-\frac{1}{c^2}\int_D A_i\,j^i d^4x-\frac{1}{16\pi c}\int_D F_{ik}F^{ik}d^4x\,, \qquad (9)$$

where A_k and F_{ik} are the 4D potential and tensor of the em fields and $j^i=4\pi\varepsilon\,dx^i/d\tau$, μ and ε are understood as some mass and charge distributions on $D:D_\alpha\times\tau$. For the enclosed OSC object to be stable we need to demand the zero variation of two last terms right somewhere outside the common regions. For unsteady em fields it leads to the wave equations with edge conditions:

$$g^{lm}\frac{\partial^2 A^i}{\partial x^l\partial x^m}-\frac{4\pi\varepsilon}{\sqrt{g_{00}}}\frac{dx^i}{dx^0}=0\cong\frac{\partial^2 A^i}{\partial\tau^2}-\Delta A^i-\frac{4\pi}{c}j^i \qquad (10)$$

$$\left(A^i(x^\alpha,\tau)\not\equiv 0,\ x^\alpha\in D_0\subset D_\alpha\right)\bigcap\left(A^i(x^\alpha,\tau)=0,\ x^\alpha\notin D_0\right). \qquad (10a)$$

Here, $\Delta=\sum_\alpha\left(\partial/\partial x^\alpha\right)^2, i=0..3,\ \alpha=1..3$ and j^i is defined somewhere on $D_0\subset D_\alpha$. We're neglecting for simplicity changing of curvature on D in observer's continuum, considering it flat. Remember, by previous section analysis it's not contradict to OSC object 'capturing' in D_α.

It was shown by the author in [9] that it may be found such A^i and corresponding 'source' functions j^i satisfying to Eq.(10) with edge conditions (10a) (see, for example, V.S.Vladimirov [10]). So, em fields A^i excited by j^i may be compensated outside space region D_0 at some special distributions of j^i. It means that these em fields are self consistent with their source functions and compact in space in the continuum of the observer. Usually it means that only discrete space sizes of compact fields are permitted to compensate em fields with some fixed frequencies outside space region D_0. Conditions (10a) define the quantization of excited em fields, and stable OSC system has only discrete steady states. States differed from stable ones are forbidden, because it will be excited em fields, which organize the 'energy exchange' between OSCs. Hence, OSC system may pass from one stable state to another with exciting or absorbing em quanta. The process of excitation of the em fields in the continuum of the observer by the OSC is illustrated on Fig.3 for 2D case. It is also shown two quanta of em field excited during state changing.

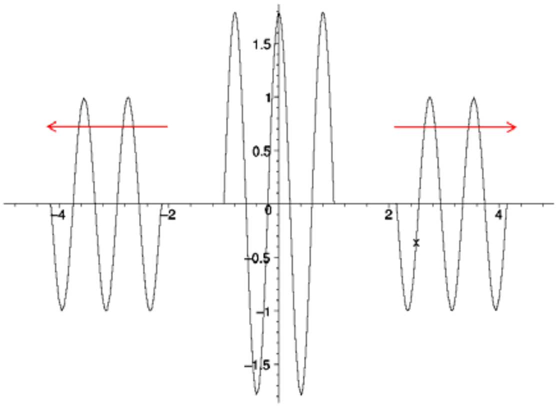

Fig. 3 Excited fields of the enclosed physical objects (2D case)

It is interesting to consider quantum mechanics approach from OSC point of view. If described excited fields will be associated with the whole OSC system, so some function Ψ may be supposed to be proportional to A^0. With $A^i \sim j^i$ one may come from Eq.(10), remembering Eq.(7), where $j^0 \sim \varepsilon \sim \mu$, to the Klein-Gordon-Fock equation for free particle: $(\partial^2 / \partial\tau^2 - \Delta)\Psi = -\varsigma m^2 \Psi$ (see also [9]). Analogously, the Dirac's equations may be considered as a particular case of the Eq.(10), if all components of A^i are taken in consideration for spinor fields. It is a mathematical method of matrix factorization of KGF equation [10]. It may be shown that together with conditions of quantization of excited em fields, the function Ψ is exactly the wave function of the quantum mechanical object. Of course, such identifications seem quite specific from the OSC point of view, but don't contradict to OSC approach.

According to our analysis, only these excited em fields and quark-like objects from the timelike regions may be observed as 'normal' matter. Exactly these objects are investigated in quantum mechanics and quantum chromo dynamics correspondingly. However, from the OSC point of view such approach is quite incomplete. Detailed analysis of Eqs.(10,10a) is not in frames of this paper, corresponding one is in preparation. Running ahead, note, that, accidentally, though the KGF and Dirac's equations may be considered as particular cases of Eqs.(10,10a) they have no steady-state solutions, while Eqs.(10,10a) have.

The excited compact self-consistent em fields of the enclosed objects will possess explicit quantum properties for the observer, which is a consequence of the energy conservation law in the system of the observer. These fields are good candidates for a role of weak interactions. Such interpretation is already confirmed experimentally by a fact of equivalence of weak and electromagnetic interactions at high energy levels. As far as such interactions through the quantification conditions are connected with the spatial sizes of the OSC objects, so in macro-scale, scale of the galaxies and whole Universe, these em fields need to have some correspondences with the relic radiation. Unfortunately, analysis of the Eq.(10,10a) for cosmological objects may be more complicated, because, generally, it is not known whether the conditions of OSC stability and boundedness are fulfilled or not, because, at a moment we don't know how to define these boundaries. This 'relic' radiation differs by nature from registered streams of particles from 'empty' space regions of the Universe, which may be excited by OSC objects from non-observable regions.

If the common regions are limited on all space and time coordinates in the observer's continuum, the observer should see the occurrence and disappearance in the limited space area D_α of some virtual objects. According to our analysis, the occurrence and disappearance of such objects need to be accompanied by absorption during appearance and by emission during disappearance of quanta of em field excited in the system of the observer. Most likely, the continuous process of quanta exchanging should be initiated inside some system of the off-site virtual objects. This process corresponds to modern representation of physical vacuum.

6. Foundations of modern physics

In spite of all successes of both relativistic and quantum theories, these 'cornerstones' of modern physics can't be acknowledged as noncontradictory, self-consistent and systematic. Not only backgrounds of these theories contradict to each other, but also there are a lot of contradictions inside them [11,12]. For example, A.Einstein did not believe in the validity of quantum mechanics because of the EPR-like effects [13], but further experiments had confirmed the quantum mechanics conclusions. In spite of this, the Nobel prise winner M. Gell-Mann considered the quantum physics as "an anti-intuitive discipline ... full of mysteries and paradoxes, which we do not quite understand, but are able to use ... limits, in which, as we suppose, any correct theory should be included" [14]. In one's turn, a lot of 'conceptual problems' are also in relativistic theories [3], which lead to the 'absurd Universe' of modern cosmology, violation of energy conservation law, etc. Even basic physical concepts of modern physics are quite contradictory. For example, we know a lot of 'elementary' particles and four 'fundamental' interactions, but 'elementary' particles can annihilate to em quanta and, so, 'elementary' particles and two 'fundamental' interaction may simply disappeare. On the other hand, the invariance principle of special relativistic theory (SR) is valid in general relativity only locally, so 'absolute frame of references' declined in SR is declared again in GR. But, anyway, in SR the 'origin' of the inertiality is not understood. So, it seems that conclusions contradict to backgrounds, which is a sign of inconsistency. The main Paradox is that both relativistic and quantum theories have found a lot of excellent experimental confirmations. What's why modern physisists need to implement such contradictory physical reality description.

From this point of view, the main achievement of the OSC hypothesis is the possibility of elimination of contradictions between and inside relativistic and quantum approaches and even their unification, the possibility to introduce the noncontradictory description of the physical reality. Remarkable, that it's possible without changing their basic principles, but extending them to OSCs. It looks like only OSCs can make our physical World view systematic, can create a noncontradictory selfconsistent logical system of reality description. From OSC point of view it is clearly seen the limits of relativistic and quantum approaches.

Indeed, relativistic and quantum approaches are implemented inside the observer's continuum, but contradictions exist mainly in perseption of different OSC objects. Extending the relativistic principle of Eq.(1) to the OSCs, one may easiely come to the quantum physics description. Quantization is the particularity of the OSC perception by the observer and is a consequence of an energy conservation law in the observer's continuum. Stable states are not postulated, but follow from the OSC methodology. Strong (Eq.(6)) and weak (Eqs.(10,10a)) interactions are not 'fundamental' in OSC: strong interactions are only the perception of the OSC topometry and weak interactions are simply excited compact self-consistent em fields. 'Elementary' particles are not 'elementary' at all, it is the same 'matter', but organized in different way, in different states. As far as the OSC objects are principally percieved as 'non-local', so there are no conceptual problems to explain their duality - 'wave' and 'particle' properties.

The 'relativistic' problems of the inertiality 'origin' and existence of 'absolute' frame of references are also easiely solved in OSC. The 'absolute' frame is defined by OSC objects and exists in every OSC, but it is not 'absolute' for another OSC. Hence, every observer has 'absolute' frame of references, but this frame doesn't coincide with one from different OSC. This way the 'inertiality' problem simply doesn't exist.

OSC gives a possibility to explain many conceptual problems in the standard cosmological model. Origins of dark matter and dark energy together with their correspondences with visual 'normal' matter are clearly looked through. The explaination of violations of conservation laws in standard models, for example, in expanding Universe, are available on frames of OSC by 'matter exchange' with OSC non-observable regions.

The OSC approach gives such powerful mathematical tool as theory of sets for the description of the physical reality. This theory gives many possibilities for physical reality description. As far as, generally, the ambiguous correspondences between physical objects from different OSCs are introduced, so chaotic, fractal, statistical methods of mathematical description may be effectively used inside OSC frames. Due to fundamental properties of OSC objects, the chaotic modeling and simulation are quite appropriate to the description of the OSCs. The mathematical analysis of the OSC with help of the theory of sets is universal enough and may include many mathematical approaches of modern physics. It was pointed out before, that, for example, additional hidden, compact spaces used in many modern physical theories may be considered as a particular case of the OSC.

Within the framework of OSC approach it is possible to overcome frames of our observable material World, Universe, and to reach the realities inaccessible to us essentially, going out of the limits of an observable physical reality to other ones. It may be considered as connecting of fields of investigation of a fundamental science, philosophy and even religion. The religious paradigm of the logical wholeness of the material and non-material Worlds gives us hopes and perspectives for further investigations.

7. Conclusion

It was found that the off-site continuums are available for the cosmological models of the galaxies and the Universe. A lot of conceptual problems of the standard cosmological model, such as 'dark matter' and 'dark energy', violations of energy-momentum conservation laws, may find physical explanation. On frames of OSC approach many correlations between relativistic and quantum physics and, hence, between cosmological and quantum physical objects were ascertained. Such point of view may appear useful for the investigation of conceptual problems of modern cosmology.

Remarkable, that OSC approach can eliminate a lot of contradictions in foundation of modern physics by unification of relativistic and quantum approaches without changing their backgrounds. From OSC point of view it is clearly seen the limits of relativistic and quantum approaches. It may be a way to non-contradictory description of physical reality. It looks like within the framework of OSC approach it is possible to overcome frames of our observable material World, Universe, and to reach the realities essentially inaccessible to us.

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