On the Cosmological Origin of Astroparticles: New Concepts, Phenomena and Processes in galactic SMBH

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Abstract. The previous theoretical studies concerning the Russian programs OLIMPIA and “Synthesis of heavy elements” are developing based on original cosmological phenomenon of “gravitons’ entanglement”, revealed in scope of Non-Inflationary Cosmology theory, created by author. The broad review of this theoretical concept together with prediction of “initial cosmic quasiparticles” – mixture of correlated carriers of the fundamental physical fields in their vacuum states – were able to initiate another phenomenon, so called “large-scale entanglement of the prototypes of astroparticles”. These phenomena could generate within earliest Universe and be continued even during the formation of galaxies, when the trapped inside the SMBH initial Bose-condensate could become a large-scale coherent state through the induced gravitational collapse, turning further into an effective model of a galactic source of high energies. Such a model is able to verify the theoretical mechanism of the galactic jet.

1. Introduction
The first theoretical studies of Russian programs OLIMPIA and “Synthesis of heavy elements” [1] recently has been progressing with use of new phenomenon – entanglement of gravitons [2]. While hypothetical, the concepts of these new phenomena of Non-inflationary cosmology (NIC) are indicated the reality of their applications in [1] with further revision and development. The central idea of this article is the cosmological applications of the new discoveries of NIC’s in the problem of generation and further stabilization of the prototypes of astroparticles during early evolution of the Universe. In contrast, the Modern Cosmology (MoC) actually ignores such a “multi-stage scenario”, authorizing the Weinberg hypothesis, thus assuming that all families of elementary particles have been generated just during “first three minutes, and not continuously. However, the epistemology of NIC consistently develops a completely different from MoC approach, according to which the corresponding time of cosmological generalization-standardization processes of astroparticles must be estimated as a specific process of statistical thermodynamics, requiring an essentially long period. Thus, it seems intuitively obvious that the proposed by NIC and Standard Model processes probably required an incomparably longer period for such a “stabilizing cosmological process”, than accepted in MoC the qualitative estimates based on “thoughts of uncertainty principle”.

In addition, the cosmology still needs more precise consideration of the matter’s state inside the SMBH, specifically clarifying its mission within the scenario of formation of galactic jet. Since the generation of primary particles in the rapidly evolving earliest Universe took place in parallel with primary substantial fluctuations, the changing parameters of the initial prototypes of astroparticles should have significantly differ from those steady-state parameters, which experimentally confirmed for indiscernible elementary particles of each identified family. Since the testing mechanisms of
fundamental problems must be general for the entire Universe, the revealed new phenomena certainly might play significant role also in the later periods of cosmic evolution, in the formation process of galaxies, in general, and, specifically, within its components, mainly within the core of SMBH.

Indeed, since we are interested in the astrophysical essence of the formation and action of galactic jets, the physical outline of the matter state inside the SMBH becomes unavoidable. We expect that physically deeper and broad illustration of this scenario may also shed light on the energetic activity of galactic core. So, one intuitively has envisaged that the mission of global entanglement phenomenon in scope of the problem of formation and continuously stabilization of astroparticles, might play crucial role also in next stages’ scenarios of cosmic evolution. Based on this epistemological supposition, one may state that the initially fluctuated values of primary parameters of the prototypes of astroparticles (likely in the form of initial Gaussian distributions!), might be stabilized over the time around these values by means of cosmological mechanism of large-scale quantum entanglement.

The theory of NIC from the very beginning has constructed its new scientific strategy based on general principles, in the scope of which NIC always accepted it physically reasonable to state the scenario of new cosmological mechanisms more deeply and comprehensively, especially the problem generation and evolution of the prototypes of astroparticles, using the entire arsenal also of the Standard Model. Hopefully, such a scenario of the earliest stages of the evolution of the Universe has been capable, in principle, to reveal completely new horizons for the understanding of the essence of the origin of cosmic objects, as well as of unique phenomena and processes, at this stage considered even hypothetical. The proposed by NIC new scenarios for the trapping of matter (by means of the phenomenon of induced gravitational collapse!) inside a galactic SMBH in the state of Bose-condensate, initiated by galactic explosion (called as cosmic small bang (CSB), to acknowledge it from Big Bang) and its consequence – super-strong shock waves (SSW) [3,4], may radically change our understanding about the internal state of SMBH.

In the light of such an idea of the squeezing Bose-condensate within SMBHs under huge pressure initiated by the phenomena of CSB and SSW, the neighboring the galactic core piece of “cosmic lattice” of Higgs bosons within the self-gravitating Bose-condensate likely has been trapped inside SMBH, constructing thus a unique “cosmic quantum lattice” (CQL) inside SMBH. Therefore, the external boundary layer of SMBH might work as a “quantum transformer-carrier” of physical phenomena and processes from the inner region to outdoors. In particular, such a scenario likely could enhance the role of the outer layer of SMBH in the formation-accumulation of high-energetic jet, using the phenomenon of “classical bunching” and coherent mechanism of “quantum modulation” phenomenon [5], developed by author as a possible mechanism for the pulsar’s radio-emission. Specifically, such a scenario can raise the role of the external layer of SMBH in the problem of accumulation of the energetic jet via the generalized coherent mechanisms of mentioned above phenomena.

Above all, these predictions could have advanced applications in galactic SMBH. Indeed, a quantum entangled and squeezed Bose-condensate, trapped inside the gravitational well of SMBH by means of “induced gravitational collapse” via CSB and SSW [3,4], probably could become large-scale coherent state which could turn into a realistic, transparent and efficient model for the sought-for source of high energies of galactic core, justifying the theoretical mechanism of galactic jet, previously considered in [1] in bare outlines.

In connection with the question – “why not follow the concepts and develop the corresponding mathematical approaches” – the theory NIC has its own explanation. It should be clearly and honestly noted that NIC deliberately postpones the specific mathematical calculations mainly because of “coordination of concepts” of presented hypothetical phenomena as scrupulously as it necessary, especially in contact with new observations. Note, that it is necessary to test all the subtleties of theoretical modelling comprehensively and with desired accuracy, in order to get rid of “random computational waste and trivia”, to establish consistent approaches for a more realistic cosmological scenario of the Universe. Moreover, since the beliefs of NIC adopts the method of “trial and error” in the evolution dynamics, the cosmological research must adhere to cognitive principles, continuing additional theoretical study with opened way against alternative ideas and approaches, sometimes even
contrary to common sense. Just for this reason, one expecting all reactions from professionals in order to weigh their suggestions and clarifications, mostly the reproaches from those scientists who long before me perhaps could think about similar problems. After all, even an infinitesimal truthful step towards understanding the phenomena and processes of the Universe is impossible without admission of alternative approaches and collective discussions and multistage adjustments. So, one still waiting for their unbiased opinions, especially their reconsideration of previous own approaches in the light of the latest theoretical disclosures and observations.

The next sphere of possible implementations of concepts of this paper may be the study of gravitational attraction’s astrophysical aspects inside SMBH, specifically the disclosure and explanations of possible correlation of concepts of this paper with nature of quantum gravity. If these a’priori ideas will supported even by indirect observational facts, for example, by the registration of high-frequency gravitational radiation from the galactic core, then SMBHs will become objects to identify the features of quantum gravity. This expectation may be considered reasonable, since the high-energetic jet still remains as a single identifier associated with phenomena inside SMBH.

2. The quantum entanglement between prototypes of astroparticles

As a progressed attempt of NIC’s hypothetical proposal on possible “large-scale correlation between primordial gravitons in the initial Universe”, one has expanded the boundaries of this cosmic phenomenon generalizing this conceptual idea towards more universal case – “entanglement between the prototypes of astroparticles”, aiming at further implementation towards the whole spectrum of elementary particles. In mentioned circumstance one guess that such a possibility might be realized within the network of periodic 3D endless potential wells, generated by the regular spatial distribution of Higgs bosons, dominated in the early Universe in the state of Bose-condensate. Based on the abovementioned, one has set the following realistic problematic query: could the periodic potential of translational invariance guarantee the identity of quantum-mechanical states throughout the entire Universe? Associating this possible scenario with the method of cosmomicrophysics, one has assumed that it can be possible to simplify the model, by adopting the analogue of well-known Kronig-Penny model by several generalizations. This thought prompted us to the idea of correlation between the prototypes of astroparticles just after their appearance at the minimums of cosmic 3D-lattice.

Apparently, these a’priori considerations can be a confirmation of Nature’s responsibility on the consistent stabilization of the fluctuating values of the generated proto-particles, using the cosmological mechanism of entanglement between the prototypes of astroparticles, systematically bringing their “wandering” values closer to the experimentally established values of elementary particles within each identical family. As a first announcement on possible association between two concepts – phenomenon of “entanglement of astroparticles” and phenomenon of “chaotic inflation” – one may note that initially must be discussed the concepts of cosmological fundamental measures in scopes of MoC and NIC [6,7]. It is necessary to explain the main aspects of basic “attitudes” of NIC and MOC: in scope of MoC the Planck scales constructed based on the dimensional consideration (!?), which ignores the fact of evolution of physical concepts as general, including especially the constants of physics (!!), the current values of which have been established only during of entire evolution period. Next issue: MoC “established dual power”, while the Standard Model accepts the Higgs boson mission as the original particle of the entire universe and “assigns” mass to all elementary particles, Planck’s hypothetical “particle” mission is still an open question.

Going deep into the depth of NIC Theory, one may say that the idea of a translation-invariant infinite network of 3D periodic potential wells were proceeded from the hypothesis on “entanglement of gravitons” [2]. The revealed “collective excitations” had decisive role in these innovative studies. Anyway, the “wandering” above vacuum background of fundamental physical fields in their vacuum states’ gravitons must be distinguished from the other “collective excitations”. Although, for the regularization of prototypes of elementary particles mostly the entangled gravitons were predetermined as a foundation of the corresponding 3D-potential wells, however, in further scenarios the cosmological missions of represented in [2] missing members of “collective excitations” – “photogluon” and
“gluphoton”, “photoW-Z-on” and “W-Z-photon”, “gluW-Z-on” and “W-Z-gluon” will be study in scope of additional tasks of future investigations.

For the beginning, the generalized Kronig-Penney model in the form of periodically repeating infinite rectangular potential wells, may be a simplified quantum mechanical model for testing this hypothetical cosmological model. In addition, taking into account the possibility of appearance of the quantum-mechanical phenomenon of two symmetrically located sub-minimums within each potential wells of initial endless periodic wells, one may assume that inside such double wells could be generated just pairs of elementary particles along with all the consequences of this presumption, needed the further improvement primarily by the Standard Model. In addition, taking into account the possibility of the appearance of a quantum-mechanical phenomenon of two symmetrically located sub-minimums inside each potential well, one can go further and assume that it is precisely pairs of elementary particles that could be generated inside presumed double wells. Of course, such an assumption needs further arrangement, first of all, by the involvement of Standard Model.

2.1 The Universe as a limitless spatial lattice of translational-invariant potential wells

Most transparent qualitative estimations of the space-period (d_cl) of initial “cosmic lattice” based on the new fundamental cosmological scales, revealed by NIC in the threshold of Matter Era (ME) [6,7]:

\[ m_{ME} = \alpha_{ME}^2 (h_{ME} G/c^5)^{1/2}, \quad t_{ME} = \alpha_{ME}^6 (h_{ME} G/c^3)^{1/2}, \quad l_{ME} = \alpha_{ME}^6 (h_{ME} G/c^3)^{1/2}. \] (1)

Here \( h_{ME} \approx 6.03 \cdot 10^{-27} \text{erg} \cdot \text{s} \) was the time-dependent Planck’s constant’s value in the period of currently disclosed phenomena, so \( \alpha_{ME} = e^2/h_{ME} c \approx 1.21 \cdot 10^{-3} \) was the value of fine-structure constant. The mass of Higgs boson \( M_{HB} \approx 125 \text{GeV} \approx 2.2 \cdot 10^{-22} \text{g} \). So de-Broglie wavelength \( \lambda_{HB} = h_{ME}/M_{HB} c \approx 9 \cdot 10^{-17} \text{cm} \). If accept the initial average density in the Universe \( \rho_0 \sim 10^{-29} \text{g/cm}^3 \), the average distance (d_cl) between Higgs bosons in “cosmic lattice” \( d_{cl} \equiv d_0 \sim (M_{HB}/\rho_0)^{1/3} \sim 6 \cdot 10^2 \text{cm} \). As \( d_{cl} \gg \lambda_e \gg \lambda_p \gg \lambda_{HB} \), then the alleged initial lattice can be considered classical. Numerical estimates show that quantum effects could be revealed during the further gravitational collapse of Bose-condensate already inside the central SMBH, specifically with characteristic masses in the range \( M_{BH} \sim 10^{6-10} M_\odot \). These masses correspond to the values of SMBH’s average densities in the range of \( \rho_{BEC} \sim 6 \cdot 10^{-24+4} \text{g/cm}^3 \), which correspond to the average distance between Higgs bosons within the SMBH \( d_{CQL} \sim 3 \cdot (10^{9} \div 10^{7}) \text{cm} \). As the de-Broglie wavelength of electron was about \( \lambda_e \sim 0.2 \cdot 10^{-9} \text{cm} \) in mentioned state, it explicitly stated the quantum nature of the system inside SMBH. One believes that the above mentioned can be considered as a direct proof of our assumptions about the formation of a coherent state – formation of CQL inside SMBH.

Thus, inside CQL satisfied the conditions \( \lambda_e \sim d_{CQL} \gg \lambda_p \gg \lambda_{HB} \), so physically reasonable to accept the quantum description of main astrophysical phenomena and processes inside SMBH. Moreover, as de-Broglie wavelength of created baryons, more than of leptons were incomparably large compared to the de-Broglie wavelength of Higgs boson, it becomes clear that one will adopt the “model of weak coupling” in scope of the CQL problem within SMBH.

2.2 The Universe as a limitless time-lattice of translational-invariant potential wells

Within the framework of NIC theory, a unique approach has been developed for the modelling of early Universe as “spatial-CQL”, but also as possible “time-CQL”. Some astrophysical assessments on the illustrations of parameters “spatial-CQL” done in section 2.1. Regarding the explanation of time-period of hypothetical “time-CQL” would be useful to discuss as a basic guide first of all within the framework of the time of Higgs boson’s characteristic decay. The ATLAS and CMS experiments have already provided the first measurements of all couplings of the Higgs boson to the heavy quarks (top and bottom quarks) and tau-leptons. The CMS collaboration in their corresponding experimental analysis considered the Higgs boson candidates, decaying into the bottom quarks, in association with a Z-boson, which in turn is decaying to an electron and a positron. During several past years, the ATLAS and CMS
collaborations have analysed more statistical data, probing the decay of the Higgs boson into a pair of muons, always looking for deviations in the data that could point to physics beyond the Standard Model. The detectors at the LHC only record the interactions of the Higgs boson’s decay products. The experimentally accessible channels also include the decays to two photons, two W or Z-bosons, a quark pair and a ττ lepton pair. As a consequence, for a Higgs boson with mass about $M_{\text{H}} \approx 125 \text{ GeV}$ its lifetime was estimated as $\tau_{\text{H}} \approx 10^{-22} \text{ s}$. If also consider the τ-lepton lifetime, which is about $2.9 \cdot 10^{-13} \text{ s}$, it can be concluded that τ-leptons decay before reaching any detector system of CMS experiment. Of course, inside the CQL the cosmological situation of the Bose-condensate might be essentially different from the same one in LHC, due to Higgs bosons’ close adhesion to each other. This means that the initially existing cosmological situation of CQL inside SMBH was fundamentally different from the physical circumstances inside “experimental LHC”.

Only after revealing the adequately complete visible picture of the problems mentioned above one will undertake concrete mathematical activity for the accepting of appropriate attempt to assess the space-time periods of CQL. Thus, it is clear why one does not make an attempt to develop even a numerical computational method, for example, in the framework of the Kronig-Penney model, of course, with the appropriate replacement of the parameters of ordinary lattices by the similar ones for yet hypothetical “cosmic lattice” and CQL inside SMBH. Such a “wait-and-see” strategy of NIC is dictated primarily by the desire to accumulate as much data as possible, mostly observational. By the way, the zone-structure of the energy within the CQL can guarantee, in principle, joint consideration of the dynamics of formation and stabilization of leptons and baryons. The general tactics of this alternative theory from the very beginning was built on precisely such a strategy, on which we will continue to trust. Thus, the theory NIK expects that method of cosmomicrophysics will be especially useful, if not the exceptional one, in solution of this problem.

3. The “squeezing” of Bose-condensate inside the galactic SMBH in the form of CQL

The major outcomes of NIC – the CSB and SSW phenomena – are straight consequences of the NIC’s concept on the initial hierarchy of Bose-statistics in the early Universe, being generated due to abrupt and shape increase of the pressure via the global phase-transition process from the Bose-statistics to Fermi-statistics, with further appearance of Pauli excursion principle. These phenomena jointly have initiated the “trapping” process of the initially monotonously self-gravitating collapsing of Bose-condensate within the central SMBH by means of the original mechanism of “induced gravitational collapsing” [3,4] (note, that monotonous growth of the prior BH in the galactic core has been initiated due to the self-gravitating process). Such a scenario might guarantee the next step of evolution – the “squeezing” of Bose-condensate in the form of CQL, in which the large-scale coherence might provide all the necessary conditions for the realization of the galaxies observed energetic activity. On the other hand, the emergence of CQL inside SMBH might initiate the generation of coherent phenomena, thus ensuring the energetic activity of galactic nucleus. The next idea associated with such a concept formulated as a new problem in Task 1 below.

As it was mentioned in [2], the correlations between “collective excitations”, specifically between graviphotons and photogravitons, might guarantee the accumulation of unique phenomenon inside SMBH – the appearance of gravitons’ Bose-condensate, in some sense similar to Bose-condensate of photons, much earlier manifested in [3,4,6,7]. One expects that the mechanism of gravitational radiation from the CQL – cosmic coherent system inside the SMBH – might be sharply differ from the merging mechanism of BHs’ system by their parameters, especially by the values of frequency and intensity.

The assumption about cosmic web could be generalized for the additional investigations of the mission of the concept of “entangled gravitons” in favor of explanation of physical essence of the phenomenon of entirely original cosmological concept – “global causality principle of the Universe”. On the light of this essentially new cosmological principle, can be paved the efficiency path towards the cosmic superluminal source, which will crucially change the concept about causality in cosmic events. As direct consequences of phenomena revealed in this work, one points out the major problems at their intensive research stage. It is believed that not only an accelerated solution of these problems, but also
a substantially wide and scrupulous study of the following 4-problems requires broad scientific cooperation with professionals, therefore any proposal of theorists and observers will be warmly welcomed, moreover, any alternative idea aimed at adjustment and improvement of the formulation of following problems.

(1) Investigate the properties of the hypothetical CQL by all possible means of quantum mechanical and quantum electrodynamical methods. Specify the Kumakhov’s effect revealed in usual lattice and generalize the corresponding attempts. Study the CQL as a possible unique source of high energetic particles beam, involving within research also the generalized phenomena of classical bunching and quantum modulation [5], initially revealed for the explanation of neutron stars’ coherent mechanism of radiation.

(2) Evaluate the possible theoretical model for the “Fermi Bubbles” around active galactic nuclei, involving into investigations the galactic CSB and SSW phenomena [3,4] together with recent disclosures of current paper – phenomena of entanglement in various circumstances – explaining the first possible physical aspects in scope of the “Fermi Bubbles” – the emission in the broad range of frequencies, starting from the microwaves till the gamma-rays.

(3) Study the role of presented in this paper hypothetical ideas in favor of disclosure of probable role of SMBH’s “surface” in the process of generation and accumulation of high energetic jet by the means of large-scale entanglement phenomena [2] and classical bunching and quantum modulation phenomena [5].

(4) Investigate the astrophysical fundamentals of possible gravitational radiation of hypothetical CQL – the coherent state inside SMBH, analysing the main characteristics of such radiation by its frequency and intensity, illustrating thus the major differences of gravitational radiation of this model from the already observed gravitational radiation of merging two BHs.

4. Conclusions

The most important theoretical conclusions of this paper may be the further broad and deep studies of the following, still hypothetical phenomena: the formation of a network of scalar fields with infinite and periodic three-dimensional potential wells formed by the spatial regular distribution of the original Higgs bosons. Such cosmic phenomenon might guarantee the quantum-entanglement between prototypes of astroparticles ensuring the identity of elementary particles in each family. The concept of this phenomenon further may be developed as an original and global cosmological principle of cosmological causality in the Universe, furthermore for the searching of cosmic possible superluminal source. In favor of this seemingly “supernatural” hypothesis may evidence, first of all, the spatial-time unlimited dimensions of the Universe, in which the usual concept of causality, apparently, encounters difficulties with explanations of several observations. The state of matter in the form of CQL inside SMBH could guarantee the emergence of a high-energy galactic jet. These studies open up new prospects against additional four theoretical problems, in anticipation of their possible observational confirmation.

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