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Ara K. Avetissian

New Astrophysical Mechanism of Disk-Shaped Galaxies' Rotation by the Theory of Non-Inflationary Cosmology

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Introduction. Our major investigations on cosmology and astrophysics [1] have been devoted to the principally new state of cosmic matter in the starting Universe, specifically in Matter Era (ME). Based on the hypothesis on "The earliest hierarchy of the Bose–Einstein statistic's (BES) over the Fermi–Dirac one (FDS)" have been developed new astrophysical models of galaxies and massive black holes in their core, as well as massive stars over than 100 times exceeding the Chandrasekhar's mass limit, including also supernova – though, being non-mandatory standard candles, as it believes in the Modern Cosmology (MoC). The investigation of the consequences of this original hypothesis and newly revealed astrophysical mechanisms in these articles were explored new and promising pathways to the consistent development of the new theory of alternative cosmology, called as "Non-inflationary Cosmology" (NIC), to distinguish it from the MoC. The comparison of new investigations' results with observational data referred us to another original and brave hypothesis – "The Planck's constant regular time-variation" during the global evolution of the Universe. The first main astrophysical phenomenon discovered in NIC as a straight hypothesis of the earliest hierarchy of BES over the FDS has been the "Local cosmological explosion within self-gravitating configuration in the state of Bose-condensate (BEC)". To distinguish this cosmological explosion from the Big Bang, one called this local explosion as "Cosmological Small Bang" (CSB). As a direct consequence of the CSB has been revealed major astrophysical process within Bose-configuration, "The strong shock wave (SSW)", generated in the closest vicinity of the spherical layer where the CSB phenomenon has been appeared. Since these original phenomena have been revealed as direct consequences of the cosmological

phase transition process from the BES to FDS just within the ME, the NIC requires to construct new cosmological scales thoroughly differ from the Planck scales. Note, at the beginning stage of investigations one has no other substantial theoretical data about time-space measures of CSB phenomenon in ME, besides the global Planck scales, so we had just one possibility – to use the Planck scales for the preliminary estimations of the characteristics of CSB as well in ME. In frame of this preliminary approach the estimation of the energy outcome in galaxy core already in the frame of NIC gave approximately $E_{tot}^{gal}(theory) \sim 5,55 \cdot 10^{77} erg$ [2] for the energetic activity of galaxies. Actually, this estimation radically exceeds the observations data $E_{tot}^{gal}(observ) \sim 10^{59-61} erg$ [3]. Facing such a discrepancy and being forced to establish appropriate new fundamental scales just for the ME stage, one has focusing directly on the problem of time-duration of the CSB. The new cosmological/astrophysical circumstances were requested to specify the method on time-evolution of physical fundamental constants and their combinations, initially discussed in [4]. The adequate assessment of the situation forced us to propose an original hypothesis about time-evolution of Planck constant [5]. Let us note here about the dominant gnoseological facts of theoretical physics, being used during the construction of main equation of the Planck constant's time-evolution [5]. Nevertheless, the preliminary qualitative comparison of theoretical estimations for the mass-correlations of components of the spiral galaxies' based on the graphical presentations found in [1] guaranteed several expectations on coincidences of our model [6] with observational data [7]. This fact has additionally stipulated the further exploration of new theoretical models aiming at disclosure of alternative fundamental scales, corresponding to these new original phenomena GSB and SSW in ME, which might even qualitatively describe the time-space scales of fundamental cosmological phenomena and processes. Fortunately, when in 2013 has been manifested the Higgs boson's experimental disclosure [8], this fact stipulated the author to return to his preliminary belief on cosmological role of the Nature's main boson in the initial stage of ME. This fundamental fact ultimately led to investigation of the Higgs boson's cosmological mission and astrophysical role, and soon the problem of fundamental cosmological new scales (CNS) in ME has been disclosed qualitatively [9]. Moreover, our prediction about reality of CNS in ME thoroughly differs from the Planck scales, created in frame of MoC, especially has been constructed based on the own original theoretical model of *"Higgs bosons' trapping within the counterparts 6-photonic potential wall"*. This new idea guaranteed both the realization of BEC and further postulation of *"Higgs boson's mass as the mass-etalon of CNS in ME"*. Finally, the physical concepts about fundamental CNS were presented in the following precise mathematical forms [10]:

$$m_{ME} = \alpha_{ME}^{6}(\hbar_{ME} c / G)^{1/2},\ t_{ME} = \alpha_{ME}^{-6}(\hbar_{ME} G / c^{5})^{1/2},$$
$$l_{ME} = \alpha_{ME}^{-6}(\hbar_{ME} G / c^{3})^{1/2}. \quad (1)$$

Here $M_{ME} \equiv M_{HB} \approx 125GeV \approx 22,2 \cdot 10^{-22} g$ is the mass of Higgs boson (hereafter mass-etalon of CNS), G is the gravitational constant, c is the speed of light. In accordance with [5], $\hbar_{ME} \approx 6,03 \cdot 10^{-27} erg \cdot \mathrm{s}$ and $\alpha_{ME} = e^2 / \hbar_{ME} c \approx 1,21 \cdot 10^{-3}$ are "renormalized values" of the Plank constant and fine structure correspondingly. From (1) one obtains the characteristic values of mass, time and length of fundamental CNS in ME:

$$m_{ME} = 2,22 \cdot 10^{-22} g, \; t_{ME} \approx 3 \cdot 10^{-26} \mathrm{s}; \; l_{ME} \approx 0,9 \cdot 10^{-15} cm. \qquad (1a)$$

As it seen from (1a), despite the Planck scales in MoC, the fundamental measures in ME already may be considered as quite realistic scales for the awareness of Earth-physics and corresponding experiments.

1. Estimations of the energetic activity of galaxies in frame of CNS. As it is seen from (1a), the fundamental measures in ME already are comparable with lower bound of corresponding characteristics in terrestrial physics already registered experimentally. Especially, the value of t_{ME} is same order entity as relaxation time in the system of nuclear spins, and the value of l_{ME} is same order entity as the radius of nuclear interaction. In particular, this fact was conditioned by the hypotheses about Planck's constant time-evolution, also due to revealing of the "6-photonic trapping process of Higgs bosons" within the initial BEC-configuration. Note, that after publications of main papers of NIC [1], one has maintained in mind a desirable long-term goal, connected with theoretical possibility of cosmic realization of Higgs bosons' BEC, being sure that the initially predicted phenomenon of phase-transition from BES to FDS within the baryon-antibaryon pairs BEC [1] might be generalized, in principal, also for the configuration consisted of Higgs bosons. Fortunately, after experimental registration of Higgs boson and later disclosure of *"Higgs boson's decay to a pair of bottom quarks"* [11], more confidence woke up in our physical imaginations, which in turn pushed us to suggest much brave physical judgments on favor of previously presented new ideas' validation not only in astrophysics and cosmology, but even in ground-based experiments, especially in high energies nuclear physics (the results of these theoretical investigations are waiting for some experimental data to be presented for publication).

It looks like that the main necessary bridges now already are built to attract new unknown domains, especially to make cosmological and astrophysical new calculations based on (1). The review of paper [2] needs substitution of early used Planck scales with CNS measures (1a) in all calculations. The general estimation of the order of energy outcome ($\Delta\varepsilon_{HB}^{decay}$), corresponding to the phenomenon of Higgs boson's decay on two quarks (i.e. fermions) [11] may be found arising just from the principle of uncertainty:

$$\Delta\varepsilon_{HB}^{decay}\cdot\Delta t_{CSB}\sim\hbar_{ME}\ \Rightarrow\ \Delta t_{CSB}\sim t_{ME}\sim 3\cdot 10^{-26}\,\mathrm{s}\ \Rightarrow$$
$$\Delta\varepsilon_{HB}^{decay}\sim\hbar_{ME}/\Delta t_{CSB}\approx 0,2erg\,. \qquad (2)$$

Note, that the principle of uncertainty, in general, quite accurately illustrates the main physical picture in arbitrary scenario of microworld, so in this consideration also one may progress the cosmological and astrophysical investigations without resorting to the specific mechanisms of the unknown or yet uncertainty channels of Higgs bosons' decay into fermions. In accordance with graphical presentations of [1] and several additional theoretical conclusions about future evolution of CNS and SSW phenomena within the BEC-configuration and taking into consideration the assessed average number of Higgs bosons within the explosion zone in order of $N_{HB}^{CSB}\sim 10^{60-61}$, the renewed typical value of galactic energetic activity has been found in accordance with the formulas (1), (2):

$$\Delta E_{core}^{gal}=N_{HB}^{CSB}\cdot\Delta\varepsilon_{HB}^{decay}\sim 2\cdot 10^{59-60}erg. \qquad (3)$$

Note, this characteristic value of energetic activity already is consistent with observational data.

2. Dark Matter "transfers" its main astrophysical mission to CSB and SSW phenomena! The reasonable coincidences of observational data with the theoretical calculations of the galaxy's energetic activity, and mass-correlations between components of galaxies, as well as several major morphological features caused by the CSB phenomenon within NIC also became an impetus for the application of the CSB phenomenon in theoretical explanation of recent observational facts. Especially, in [12] has been manifested about the following unique observational fact: *"It has been revealed that the rotation's period of all recently observed disk-form galaxies is about 1 Gyr, regardless of galactic mass and size"*. To be honest, this observational fact did not surprise us, because till this disclosure one has repeatedly mentioned about significant role of CSB and SSW phenomena in the theoretical explanation of the galaxy rotation phenomenon, especially on the observational profile of disk-shaped galaxies. In this regard one did not give major credit on direct input of Dark Matter in the problem of rotation of spiral galaxies. Hence, during presentations and circumstantial discussions in a dozen conferences one has constantly manifested that CSB and SSW phenomena may be alternative scenario to hypothetical "Dark Matter concept", especially the role in the galaxies' rotation problem. Particularly, we have managed to show also that the basic morphological regularities of the galaxies also can be explained due to CSB and SSW phenomena. Really, if the initial spherical symmetry of CSB might be changed into cylindrical one, then due to this process could be generated the rotation momentum. Starting this stage, the global method of the cosmomicrophysics required, in principle, to implement the well-known

physical theorem about *"the energy re-distribution between all degrees of freedom"* also in the case of galaxy.

In accordance with this expected fact one may take into account, that about 1/3 part of total energy, generated in the core of galaxy, might be converted into rotational energy. On the other hand, in accordance with observational data the total number of spiral galaxies approximately makes up just 1/3 of the total number of galaxies in the Universe, so the probability of deviation of CSB symmetry from the spherical to cylindrical one likely may be considered also in order of 1/3. Our preliminary investigations and further reasoning about concept of the sequential series of CSB and SSW phenomena may be applied to the theoretical justification of the remarkable phenomenon [12] and illustrate this observational fact on the rotation curve profile of spiral galaxies based on the theory of NIC. After such a thorough theoretical justification of observed regularities it may be very realistic to declare the aforementioned idea, formulated as a title of current paragraph: "*Dark Matter "transfers" his main astrophysical mission to CSB and SSW phenomena"!* In favor of this theoretical prediction are testifying also recent observations mainly in infrared domains, which are indicated that the explanation of the galaxy's rotation curve profile does not require the existence of DM. Really, in [13] has been shown that the ultra-diffuse galaxy NGC1052–DF2 in the Coma Cluster demonstrates that DM is not always coupled with baryonic matter on galactic scales. More than, in [14] was observed a galaxy even without DM. Considering these observational data sufficient at a given stage, let's start theoretical reconsideration and methodical analysis of the rotational phenomenon taking into consideration just CSB and SSW phenomena.

The simplest physical estimations of our main model assures that each subsequent element of the CSB and SSW phenomena, might provided monotonically increasing explosions at more and more distances from the core of galaxy, with corresponding quantities of energy within the spherical layers, neighboring with the specified explosive zone. The profile of the rotating curve of galaxy might be saturated step by step due to the collision of extending outside the front of SSW against the spherical layer of self-compressing Bose-condensate, falling on the propagating outward SSW front. So, *the described above sequence of relatively high-density concentric spherical layers in the BEC state may replace, in principle, the hypothetical Dark Matter just by the ensemble of CSB and SSW phenomena.* Let's note also, that the registered rule of monotonic decrease of the galactic spiral arms' curvature towards the edges of the galaxy can also be attributed to the aforementioned regularity. Finally, it becomes also obvious that based on the above mentioned physical judgments one may predict the following major fact: the registered in [12] independence of the rotation period from the mass and size of the galaxy. Really, after the completion of CSB and SSW phenomena at remote outer layers, the self-gravitational collapsing might be continued for long period, thus increasing the total mass (size) of the spiral galaxy without extra input in disk's rotation momentum, so do not changing the rotation profile.

3. The theory of NIC is able to ensure the rotation energy of the disk-shaped galaxy! The simplification of strong mathematical calculation of the astrophysical model sometimes does not change substantially the real picture in Nature, besides it makes already realistic astrophysical situation more transparent for further qualitative improvement and progress of initial model. Especially, aiming at qualitative estimations at the first step of research, the model requires replacement of real parameters with the already known values of the well-known objects from the same group, just for the simplification of the problem. Indeed, as the advance explanation of galaxy's rotation problem till nowadays connected with several gap also in observational data, one has no other choice than replace the unknown moment of inertia of real galactic disk and galaxy at whole by the theoretically estimated analogous values of simplest case – of homogeneous disk and sphere accordingly. Thus, taking into account the observed data $M_{halo}+M_{bulge}\approx 0,9M_{gal}$; $M_{disk}\approx 0,9M_{gal}$, and $R_{disk}\approx 0,8R_{gal}$, one gets the following expressions:

$$I_{disk}=M_{disk}R_{disk}^2/2\approx 0,4M_{disk}R_{galaxy}^2,$$
$$I_{globe}=2(M_{halo}+M_{bulge})R_{gal}^2/5\approx 1,8M_{gal}R_{gal}^2/5. \quad (4)$$

As it is well-known, the contribution of galaxy's classical bulge cannot be larger than ~ (8-10) % of the disk's mass [7]. Note also, that the theoretical calculations of presented new model within the theory of NIC confirm the observational data on mass-correlations of disk-form galaxy's components [6]:

$$M_{SMBH}\sim 10^{6-10}M_{\odot};M_{SMBH}\sim 10^{-3}M_{disk}\sim 10^{-2}M_{bulge}\ . \quad (5)$$

It is noticeable that extra requirements on the adjustment of parameters of galaxies and its components do not change essentially the characteristics of the rotation curve. Moreover, as the parameters of Milky Way are most accurate-definable and recognized from the observations, for the initial qualitative assessments one may use these parameters. As $M_{Gal}\approx 4,8\cdot 10^{11}M_{\odot}\approx 0,96\cdot 10^{45}g$ ($M_{\odot}$ is Sun's mass), $R_{Gal}\approx 5\cdot 10^{22}cm$, $R_{disk}\approx 0,8R_{Gal}\approx 4\cdot 10^{22}cm$, then the rotation energy of galaxy may be estimated based on expression $E_{rot}=I\Omega_{rot}^2/2$. In accordance with [12] the rotation period of disk-shaped galaxies is $T_{rot}\approx 1Gyr$, $\Omega_{rot}=2\pi/T_{rot}\approx 2\cdot 10^{-16}\sec$, so the $M_{bulge}\sim 0,1M_{disk};M_{disk}\sim(0,9-0,95)M_{gal}$ are well approximated expressions. Furthermore, $E_{rot}^{halo}\ll E_{rot}^{bulge}\ll E_{rot}^{Disk}$, and the rotational energy of the typical disk-shaped galaxies can be represented as follows:

$$E_{rot}^{Gal}=E_{rot}^{halo}+E_{rot}^{bulge}+E_{rot}^{Disk}\approx E_{rot}^{disk}\sim 10^{57-58}erg;\ \Rightarrow$$
$$E_{rot}^{gal}/E_{tot}^{gal}\approx 10^{-2-3}. \quad (6)$$

At this stage a very naturalistic question may be raised: *is the galaxy's rotation the single possible phenomenon, which self-subsists from the energetic reservoir of the galaxy core activity?* The answer on this epistemological question also may be found based on the regularities of the cosmomicrophysics [15, 16]. Indeed, it is well-known approach: the cosmological/astrophysical models, as well as investigated in frame of NIC another hard-solving problems (mainly multi-parametric), may be simplify based on the global similarities/analogues between the Earth and cosmic circumstances. In this regard, one may formulate the following heuristic problem and try to search it based on well-progressed approach of cosmomicrophysics: *"Is it possible that the Nature had created similar global regularities on extreme small scales (i.e. in molecular system), and extreme large scales (i.e. in galactic system)?"*

In fact, this is a physical query about conceivable analogues between energetic terms of molecule and "hypothetical energetic terms of disc-shaped galaxies", namely between their vibration and rotation terms. Specifically, starting to search the relationships of similarities between experimentally confirmed total (basic), vibration and rotation terms of the molecule $E^{mol}_{total} \sim 10^{1-2} E^{mol}_{vib} \sim 10^{3-4} \cdot E^{mol}_{rot}$, further one may construct, in principle the anticipated hypothetical terms of galaxies in the expected possible form: $E^{gal}_{main} \sim 10^{1-2} E^{gal}_{vib} \sim 10^{3-4} E^{gal}_{rot}$. If in the Nature such a global correspondence might be realized, then the expected relation $E^{gal}_{vib} \sim (10^{-1} \div 10^{-2}) \cdot E^{gal}_{main}$ for the spiral galaxy may reveal very interesting, and the same time very promising characteristic future of the halo (also for bulge!), especially: "*It may be possible to observe within the galactic halo several regularities of vibration type in the corresponding range of moderate frequencies".* This possible disclosure of such a new phenomenon may be important mainly for the elliptical, spherical, and even irregular galaxies, because the characteristics of their halo are hidden in the optical range. Besides in the range of "hypothetical vibration frequencies" these regularities may be completely registered in near-infrared or lower ranges. We hope that the "probe-testing" of galactic halo within the mentioned above range of frequencies is very important not only for the progress of instability problem, suggested by Ambartsumian [3,16], but also for the reverse problem, for the investigations of stability phenomenon in final stage of galaxies' evolution (see also [9]).

4. On hypothetical gravitational radiation of the spiral galaxies predicted in frame of NIC. The investigated above theoretical scenarios and interpretations of observed rotation profile of disc-shaped galaxies', as well as the predicted phenomenon of the vibration of galactic halo, are specifying a perspective scenario for the investigation of another problem, namely the possibility of gravitational radiation of disk-shaped galaxy. This idea has been manifested early by author [17], declaring about theoretically calculated specific type of the speqtrum of galaxies' gravitational radiation, especially being revealed within the two asimptotes, namely in long-wave and short-wave ranges. At the present, the revision and adjustment of previous investigations on

relic gravitational radiation [17] will be fulfilled by the numerical integration of enhanced rotation model of NIC, based on the theoretical explanation of the recently observed rotation profile of disk-shaped galaxy's [12]. Note also, that the improvement of the galaxy's supposed gravitational radiation model and corresponding parameters will be done based on the renewed measures of CNS in ME. This project may play important cosmological role for the decipher of fingerprints of evolutionary processes and phenomena in the earliest Universe using the asymptotic behavior of the relic gravitational radiation.

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Viktor Ambartsumian Observatory, Yerevan State University
e-mail: aavetis@ysu.am

A. K. Avetissian

New Astrophysical Mechanism of Disk-Shaped Galaxies' Rotation by the Theory of Non-Inflationary Cosmology

The original astrophysical mechanism for the explanation of observed unique phenomenon of disk-shaped galaxies' rotation character has been revealed within the frame of Non-Inflationary Cosmology, established and developed by author. This new mechanism revealed also real perspectives in favor of the reconsideration of the hypothetical Dark Matter's role, especially in the expected possibility of galaxies rotation profile's explanation. New mechanism is replacing the hypothesis of Dark Matter by the newly disclosed phenomenon of cosmological local explosion inside the galaxy, discovered in frame of the Non-Inflationary Cosmology. The presented mechanism opens also broad perspectives towards the investigation of possible phenomenon of gravitational radiation of disk-shaped galaxies.

Ա. Կ. Ավետիսյան

Սկավառակաձև գալակտիկաների պտույտի նոր աստղաֆիզիկական մեխանիզմը Ոչ-ինֆլյացիոն կոսմոլոգիայի տեսությամբ

Հեղինակի կողմից ստեղծված և զարգացված Ոչ-ինֆլյացիոն կոսմոլոգիայի տեսության շրջանակներում բացահայտվել է սկավառակաձև գալակտիկաների պտույտի ինքնատիպ բնույթը տեսականորեն բացատրող նոր աստղաֆիզիկական մեխանիզմ: Այն իրական հեռանկարներ է բացում գալակտիկայում հիպոթետիկ Մութ Զանգվածի վարկածի դերի վերանայման հարցում, մասնավորապես պտույտի կորի հիմնահարցում, այն փոխարինելով Ոչ-ինֆլյացիոն կոսմոլոգիայի տեսությամբ բացահայտված կոսմոլոգիական բնույթի տեղային պայթյունի նոր ինքնատիպ ֆենոմենով: Ներկայացվող մեխանիզմը լայն հեռանկարներ է ուրվագծում սկավառակաձև գալակտիկայի սկզբունքորեն հնարավոր գրավիտացիոն ճառագայթման հետազոտության համար:

А. К. Аветисян

Новый астрофизический механизм вращения дискообразных галактик по теории Неинфляционная космология

В рамках созданной и развитой автором теории Неинфляционная космология выявлен новый астрофизический механизм, иллюстрирующий наблюдаемый уникальный характер феномена вращения дискообразных галактик. Этот механизм открывает реальные перспективы в проблеме пересмотра роли гипотетического феномена Темной Материи, в частности, заменив эту гипотезу феноменом уникального космологического локального взрыва внутри галактики, выявленного в рамках новой теории Неинфляционная космология. Представленный механизм намечает также перспективы в изучении возможного гравитационного излучения дискообразной галактики.

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