Hypothesis for a baryonic cold skeleton of the Universe as an implication of phenomenon of Universal Skeletal Structures

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Modern cosmology is governed, roughly speaking, by the competition of two phenomena whose distinct signs are not ever found in the laboratory: gravitational *attraction* of a “dark” (i.e. electrodynamically invisible) matter and the *repulsion* caused by a “dark energy”. Here we discuss the hypothesis for a baryonic cold skeleton of the Universe, suggested in [1(a,b)] in the framework of the project “Universal Skeletal Structures” (USS) (for the current status of the project see [1(d)]). The identification of USS phenomenon in the range 10^{-5} -10^{23} cm [1(c)] makes it reasonable to extend the hypothesis for self-similar skeletons, composed of a fractal condensed matter, farther to cosmological length scales.

1. Phenomenon of “Universal Skeletal Structures”: brief history

Two findings by V.A. Rantsev-Kartinov, namely:

(i) observations of transverse-to-electric current, few-centimeters long and ~1 mm thick straight filaments [1(e)] of an anomalously long lifetime [1(f)] in the plasma of gaseous electric discharge, a Z-pinch, and

(ii) identification of opaque, “dark” filaments [1(e)] in the Z-pinch and astrophysical objects,

stimulated the author’s hypotheses [1(g,f)] for

(a) ***quantum*** nature of unexpected longevity of such filaments,

(b) the presence, in the observed macroscopic filaments, of a tubular skeleton which is a ***fractal condensed matter*** composed of superlarge molecules (most probably, of wildly formed carbon nanotubes),

(c) self-similarity of skeleton’s structure, i.e. successive repeat of the same structure (in given case, a tubule) at various length scales, starting from nanoscale, to give the ***“generations” of self-similar tubules***, generally unlimited in size,

(d) self-assembling of a skeleton during electric breakdown stage of discharge (or similar transient process) via electrodynamic coupling of nanoblocks.

In the proof-of-concept studies, V.A. Rantsev-Kartinov revealed the following phenomena:

(i) the presence of skeletal structures of certain distinctive topology (namely, tubular and cartwheel-like structures, and their simple combinations) in the range 10^{-5} -10^{23} cm in laboratory electric discharges of various type [1(h)] (including the dust deposits in tokamak [2]), severe weather phenomena [1(a,c,j)], and space [1(c)],

(ii) the trend toward self-similarity within above skeletal structures,

(iii) self-illumination of skeletal structures, in their critical points, in the range 10^{-1}-10^{22} cm (e.g., the shining butt-end of a truncated filament) [1(c,b)],

(iv) some signs of skeletal structuring in the galaxies redshift surveys, in the range 10^{24}-10^{26} cm [1(a)].

The proof-of-concept studies enabled us to call these structures (namely, tubular and cartwheel-like structures, and their simple combinations) a universal skeletal structures (USS) [1(i)]. The topological identity (i.e. the similarity) of the above structures (especially, of the cartwheel as a structure of essentially non-hydrodynamic nature), and the observed trend toward assembling of bigger structures from similar smaller ones (i.e. the self-similarity), in the range 10^{-5}-10^{23} cm, enabled us to put all these skeletal structures under one roof and claim the probable presence, in these structures, of a skeleton composed of a fractal condensed matter of particular topology of the fractal [1(c)]. Specifically, this matter may be self-assembled from nanotubular blocks in a way predicted in [1(g,f)] (formation of tubular macroblocks from tubular nanoblocks) and found in the skeletons in the submicron dust particles [2]. Also, the following facts, namely (i) the presence of skeletons of certain topology in the dust particles and films [2], and hailslones [1(a,c,j)], and (ii) fine resolution of nanotubular filaments and the presence of carbon in the dust deposits [2] suggested the presence of carbon nanotubes in the above skeletons.

Note that recent findings in the physics of carbon nanotubes gave some support to suggested probable microscopic picture of skeleton’s assembling and chemical composition, as well as to probable mechanisms for the macroskeletons assembled from carbon nanotubes to survive (i.e., possess an anomalous longevity) in hot plasmas (for more detail see [1(c)] and references therein).

2. Hypothesis for a baryonic cold skeleton of the Universe as an extension of the contribution of electrodynamics to structuring at cosmological length.

The hypothesis of the presence of skeletons self-assembled from nanodust and embedded in, and to some extent hidden by, the ambient plasma was suggested [1(g,f)] to provide observed unexpected longevity of some filaments in laboratory plasmas. The hypothesis [1(g,f)] for the presence of similar internal skeleton in cosmic filaments as well allows, to our mind, to shed a new light on the approach by H. Alfvén's [3] and his disciples and followers to underestimated role of electrodynamics, namely that of plasmas, in the Universe. The conjecture [3] implies that the long-living filaments of electric current («plasma cables») may form electric circuits at length scales of cosmic systems, in particular, of the Solar system. The hypothesis [3] was supported, at a rough qualitative level [1(e,k)], by the similarity of networking of filaments (of luminosity) in laboratory plasmas and space. The resolution of fine structure of filaments and their networks in space, Earth's atmosphere and laboratory electric discharges -- that has been achieved, in particular, thanks to the recent substantial progress in the imaging of cosmic objects by the space telescopes -- enabled us [1(c)] to indicate phenomena which suggest the possibility to strengthen and substantially extend the approach [3]. Here, the most strong evidence appeared to be the self-illumination of skeletal structures in their critical points (e.g., the shining butt-end of a truncated filament with its diameter in the range 10^{-1}-10^{22} cm, [1(c,b)]). Such a structuring, and its similarity at different length scales, suggests that the skeleton may work as a guiding system for (and/or a conductor of) electromagnetic signals, thus being a sort of the electrically conducting filaments in the picture [3] which we append with *a filament's internal skeleton composed of a fractal condensed matter*. Indeed, local disruption of such an electric circuit (e.g., its sparkling, fractures, etc.) and the presence of the open end (in particular when the circuit has a dendritic structure) may self-illuminate the circuit to make it observable.

3. Hypothesis for a baryonic cold skeleton of the Universe vs. major cosmological facts.

The identification of USS phenomenon in the range 10^{-5} -10^{23} cm [1(c)] and, thus, some predictive force of hypotheses [1(g,f)] enabled the author to suggest the presence of a baryonic cold skeleton of the Universe (BCSU) which may be compatible with major reliable cosmological and astrophysical facts: ultrahigh isotropy of cosmic microwave background radiation (CMBR) and the "dark matter"-generating observations.

3.1. Ultra-high isotropy of CMBR vs. coldness and darkness of BCSU.

At cosmological lengths the temperature of the overwhelming part of BCSU (i.e. excluding its critical, burning points, which are called the galaxies or clusters of galaxies, depending on the distance to such a hot spot) should be equal to that of CMBR. Indeed, the hypothetical skeleton composed of condensed matter should be closer to thermodynamic equilibrium and be colder than any other hypothetical dark baryonic matter in the liquid and/or gaseous phase states because in a skeleton the role of individual degrees of freedom (including the temperature) is minimal. As far as the cosmological skeleton is actually not dark (as it should be for any baryonic matter), it may be visible preferably as a thermally equilibrium (i.e. Planckian and isotropic) part in the entire observed cosmic radiation spectrum. Thus we come to a conclusion about thermal equilibrium between BCSU and CMBR and respective coldness of the overwhelming part of the skeleton.

A qualitative analysis of the probable radiative and mechanical properties of BCSU suggests it to have no unavoidable conflicts with the ultrahigh isotropy of CMBR. Distortion of ultra-high isotropy of CMBR due to interaction of BCSU with other spectral components of cosmic radiation is expected to be small because of the likely anomalous blackness of self-similar skeletal matter (similarly to that of Carbon Black).

Thus, ***BCSU is dark because it is very cold and very black***.

3.2. “Dark matter” problem vs. mechanical strength of BCSU.

Certain mechanical strength of skeletal structures (strictly speaking, the rigid-body like behaviour of skeleton’s constituent blocks), observed at laboratory length scales (see, e.g., Fig. 1 in [1(f)]), at galactic and extra-galactic length scales suggests the possibility to avoid the necessity to introduce a «dark matter». Indeed, the well-known controversy between «apparent masses» and their gravitational dynamics may be resolved because the bright spots, which belong to skeletons, may move faster than predicted by their masses estimated from their luminosity. Also, the skeleton may involve the ambient gas/plasma in a faster motion. The proposed reinterpretation is applicable to both historic sources of introducing a dark matter, namely to the halo of rotating galaxies and, especially, the clusters of galaxies because the effect of mechanical strength is stronger just at larger lengths.

3.3. Hubble expansion vs. elasticity of BCSU.

Elasticity of BCSU may contribute to expansion of the Universe and thus be a generator of the antigravity in the form of “cosmological constant” or “dark energy” in the present day formalisms.

4. Conclusions.

The baryonic cold skeleton of the Universe (BCSU) may substantially change the role of both major competing components of the modern cosmology. Generally speaking, purely gravitational description of the large-scale structure of the Universe is likely to be appended with electrodynamics of the fractal condensed matter which form the BCSU.

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