

# Evolution of the Milky Way and Similar Massive Galaxies

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**Abstract:** Here, applying the lacking part of ultimate theory, i.e. the Scale-Symmetric Theory, evolution of the Milky Way (and similar massive galaxies) has to be explained descriptively and partially quantitatively. There is described production of the protoarms of the massive spiral galaxies, production of the Fermi Bubbles, and dwarf galaxies. Due to the two succeeding transformations of groups of the binary systems of electron-positron pairs via the electromagnetic-type weak condensates inside the bare electrons, there are emitted the gamma-rays with central values of energy in approximation equal to: 1.3 GeV, 2.6 GeV, 5.3 GeV, 10.6 GeV, 21 GeV, 42 GeV and 85 GeV. For muon-antimuon pair we obtain about 137 GeV, whereas for kaon-antikaon pair is 639 GeV.

## 1. Introduction

The General Relativity leads to the non-gravitating Higgs field composed of tachyons [1A]. On the other hand, the Scale-Symmetric Theory (SST) shows that the succeeding phase transitions of such Higgs field lead to the different scales of sizes [1A]. Due to the saturation of interactions via the Higgs field and due to the law of conservation of the half-integral spin that is obligatory for all scales, there consequently appear the superluminal binary systems of closed strings (entanglons) responsible for the quantum entanglement, stable neutrinos and luminal neutrino-antineutrino pairs which are the components of the luminal Einstein spacetime (it is the Planck scale), cores of baryons, and the cosmic structures (protoworlds) that evolution leads to the dark matter, dark energy and expanding universes (the “soft” big bangs) [1A], [1B]. The non-gravitating tachyons have infinitesimal spin so all listed structures have internal helicity (helicities) which distinguishes particles from their antiparticles [1A]. SST shows that a fundamental theory should start from infinite nothingness and pieces of space [1A]. Sizes of pieces of space depend on their velocities [1A]. The inflation field started as the liquid-like field composed of non-gravitating pieces of space [1A]. Cosmoses composed of universes are created because of collisions of big pieces of space [1A], [1B]. During the inflation, the liquid-like inflation field (the non-gravitating superluminal Higgs field) transformed partially into the luminal Einstein spacetime (the big bang) [1A], [1B]. In our Cosmos, the two-component spacetime is surrounded by timeless wall – it causes that the fundamental constants are invariant [1A], [1B].

Due to the symmetrical decays of bosons on the equator of the core of baryons, there appears the atom-like structure of baryons described by the Titius-Bode orbits for the nuclear strong interactions [1A].

According to SST, the early Universe was the double-loop composed of protogalaxies built of the modified neutron black holes (the MNBHs do not contain a central singularity but there

is a circle with spin speed equal to the speed of light in “vacuum”  $c$ ) that was created inside the core of the Protoworld [1B]. To conserve the spin of the Protoworld and its left-handedness, the two loops in the double-loop had the same left-handed internal helicity and antiparallel spins [1B]. Protogalaxies were the rotating discs with planes perpendicular to the circular axis defined by the double-loop.

The dark matter consists of the additional Einstein-spacetime components entangled with baryonic and other visible matter. It appeared due to the evolution of the core of the Protoworld that appeared after the inflation (the big bang) but before the observed expansion of our Universe (the “soft” big bang). Just SST shows that the “soft” big bang was separated in time from the big bang.

Due to the quantum entanglement, the protogalaxies were grouped in bigger structures. The quantum entanglement leads to following formula which describes the number of binary systems of protogalaxies found in the structures of the Universe

$$D = 4^d, \quad (1)$$

where  $d = 0, 1, 2, 4, 8, 16$  for a flattened spheroid-like structures, and  $d = 3, 6, 12$  for a chain-like structures [1B].

The inflows of the dark matter (it appeared due to the evolution of the core of the Protoworld) and the inflows of the dark energy (it consists of the free additional neutrino-antineutrino pairs i.e. they interact gravitationally only) caused the exit of numerical neutron black holes from their black-hole state – they transformed into the big stars [1B].

Because in the double cosmic loop there were  $2 \cdot 4^{16}$  binary systems of protogalaxies then mean distance between the planes of rotation of the binary systems of protogalaxies was 0.28 light years [1B]. Each protogalaxy consisted of  $4^{16}$  MNBHs so initial mass of binary system of protogalaxies was about  $4.2 \cdot 10^{41}$  kg. On the assumption that in each protogalaxy the MNBHs were maximally packed in a disc, the initial radius of protogalaxy was about 55 times smaller than the distance from the Sun to Earth.

In each protogalaxy dominated two magnetic fields. The magnetic axes of the MNBHs (the spins of the neutrons) in a protogalaxy were polarized in such a way that they were tangent to the disc and their directions overlapped or were parallel. Just the disc was a magnetic domain. Such magnetic axes we will refer to as the tangent (to the discs) magnetic axes. Since the rotational axes of the protogalaxies were perpendicular to the discs and tangent to the double-loop so the tangent magnetic axes rotated around the local segments of the double-loops.

Due to the inflows of the dark matter and dark energy into the double-loop, [1B], numerous MNBHs transformed into big stars so inside and around each protogalaxy appeared plasma that rotated together with protogalaxy. Such rotating plasma created magnetic axis overlapping with the rotational axis of the protogalaxy i.e. such magnetic axis was perpendicular to the disc of the protogalaxy. Such magnetic axes we will refer to as the perpendicular (to the discs) magnetic axes.

The rotating tangent magnetic axes lead to the  $B$ -modes in the CMB whereas the perpendicular magnetic axes to the  $E$ -modes in the CMB.

The cosmic structures in the expanding double-loop were mostly moving in directions perpendicular to the segments of the double-loop. Due to the law of conservation of spin, the rotational axes of the protogalaxies should overlap with the directions of motion of the protogalaxies i.e. they should be perpendicular to the segments of the double-loop [1B].

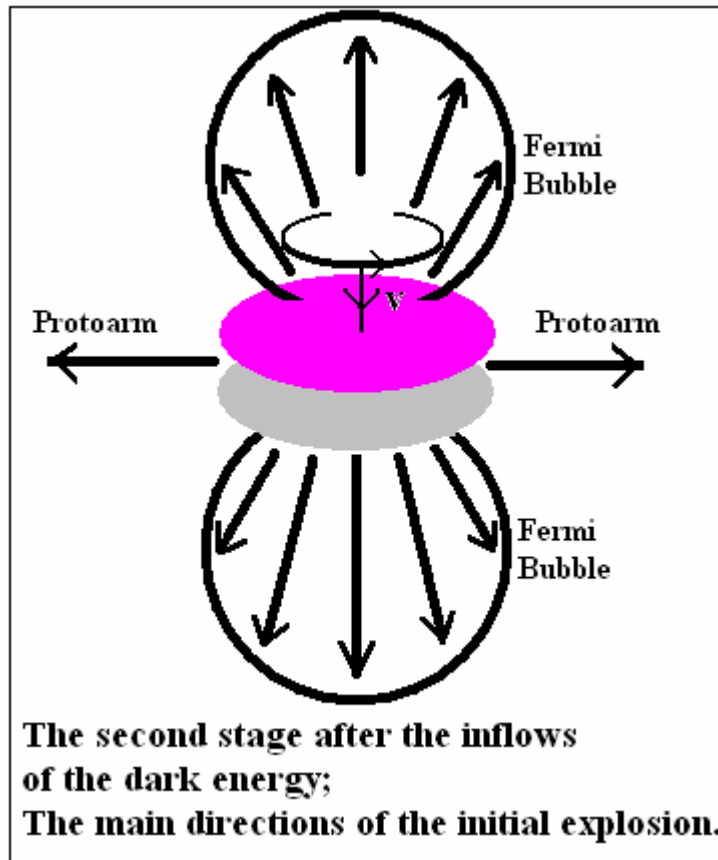
Here, applying the SST, evolution of the Milky Way, and similar massive galaxies, has to be explained descriptively and partially quantitatively.

## 2. Calculations

Due to the inflows of the dark matter and dark energy into a binary system of protogalaxies numerous MNBHs transformed into big stars. Their synchronized explosions caused that the very highly ionized plasma composed of ions and electrons was moving, first of all, along the two main magnetic axes. Due to the very dense and parallel discs of the two protogalaxies, the plasma, that created the protoarms of the big spiral galaxies, was highly collimated, whereas the plasma that created the Fermi Bubbles [3] was scattered (Fig.).

With time, the size of the two Fermi Bubbles, i.e. the regions of the halo that still emit the gamma-rays, decreases. But it does not mean that there decreases size of the halo. Just temperature of the external layers of the halo decreases faster.

Most important is the fact that the coupling constant for the weak interactions of the weak condensate in the centre of the bare electrons with protons is  $\alpha'_{W(\text{electron-proton})} = 1.11944 \cdot 10^{-5}$  [1A]. Calculated fine-structure constant is  $\alpha_{em} = 1/137.036$  [1A].



Consider a transition of an electromagnetic energy  $E$  into an additional electromagnetic-type weak condensate overlapping with the weak-type weak condensate in bare electron [3]. In an additional electromagnetic-type weak condensate, the spins of the confined Einstein-spacetime components (they are the carriers of gluons and photons [1A]) rotate – gluons and photons are the rotational energies. Creation of such additional weak condensate causes emission of energy equal to  $E\alpha_{em}$ . Outside the bare electrons, the additional weak condensates transform again into electromagnetic energy so there appears the factor  $f = \alpha_{em}/\alpha'_{W(\text{electron-proton})}$  [3]. Due to the electromagnetic  $\rightarrow$  weak transition and the weak  $\rightarrow$  electromagnetic return transition, the initial energy  $E$  is increasing to

$$E_{o,em} = E (1 - \alpha_{em}) \alpha_{em} / \alpha'_{W(electron-proton)} = 647.12 E. \quad (2)$$

There should appear objects containing  $2^n$  entangled binary systems of electron-positron pairs (then their spin can be equal to zero), where  $n = 0, 1, 2, 3, 4, \dots$ . The stellar GASER ([4]; Gamma Amplifier by Stimulated Emission of Radiation) and the four-neutrino symmetry [1A] cause that abundances should be higher for objects containing 1, 4, 16, 64, ... entangled binary systems of electron-positron pairs.

Calculate central values of energies of the emitted gamma-rays. Energy of a binary system of electron-positron pairs is 2.044 MeV. Due to the two succeeding transitions, this energy increases to  $E_C = 1.323$  GeV (see formula (2)). Energies of the  $2^n$  entangled  $E_C$  are as follows: 1.32 GeV, 2.65 GeV, 5.29 GeV, 10.58 GeV, 21.16 GeV, 42.33 GeV and 84.65 GeV. The next value is higher than for a muon-antimuon pair.

Applying formula (2), for a muon-antimuon pair we obtain 136.7 GeV, whereas for a kaon-antikaon pair is 639 GeV.

Due to the explosion that created the Fermi Bubbles, the two parallel discs transformed into one disc. The explosions created the dwarf galaxies as well.

Due to the tangent magnetic axis associated with the MNBHs in centre of the Milky Way that did not transform into plasma during the inflows of the dark matter and dark energy, there could be created flat magnetic domains parallel to the disc of our Galaxy. Distances of the flat magnetic domains from the abstract plane-disc of the Milky Way should be defined by the Titius-Bode law  $R_D = A_D + dB_D$ , where  $A_D / B_D = 1.3898$  and  $d = 0, 1, 2, 4, 8, 16, 32, 64, 128$  [1A].

### 3. Summary

Here, applying the Scale-Symmetric Theory, evolution of the Milky Way (and similar massive galaxies) has to be explained descriptively and partially quantitatively.

There is described production of the protoarms of the massive spiral galaxies, production of the Fermi Bubbles, and dwarf galaxies.

Due to the two succeeding transformations of groups of the binary systems of electron-positron pairs via the electromagnetic-type weak condensates inside the bare electrons, there are emitted the gamma-rays with central values of energy in approximation equal to: 1.3 GeV, 2.6 GeV, 5.3 GeV, 10.6 GeV, 21 GeV, 42 GeV and 85 GeV. For muon-antimuon pair we obtain about 137 GeV, whereas for kaon-antikaon pair is 639 GeV.

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