The Origin of the Hubble Sequence for Distant and Local Massive Galaxies

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Abstract: Due to the mergers of the binary systems of protogalaxies, there were created the elliptical protogalaxies whereas evolution of the not merging binary systems of protogalaxies leads to the spiral protogalaxies. Due to evolution of the disc-sphere structures described within the Everlasting Theory, some elliptical protogalaxies transformed into lenticular galaxies whereas some spiral protogalaxies into peculiar galaxies. Some of the peculiar galaxies a second time transformed into spiral galaxies. For distant massive galaxies we obtain following abundances: for elliptical is 3.8%, for lenticular 15.1%, for spiral 30.4% and for peculiar 50.7%. On the other hand, for the local massive galaxies we obtain: for elliptical 3.8%, for lenticular 15.1%, for spiral 71.0% and for peculiar 10.1%. The theoretical results obtained within the Everlasting Theory are consistent with observational facts.

1. Introduction

The scale-symmetric Everlasting Theory, [1] (the foundations) and [2], starts from the expansion of the cracked space (it is the inflation of the Higgs field – the big bang) which leads to the Einstein spacetime (E spacetime). There appear the four succeeding phase transitions of the modified Higgs field (due to the size of our Cosmos, the next phase transitions are impossible) and the atom-like structure of baryons. The atom-like structure of baryons leads to the exact mass, spin and radius of proton.

Due to the four phase transitions, there are in existence the four scales i.e. the superluminal-quantum-entanglement scale, luminal Planck scale concerning the E-spacetime components, observed-particles scale and cosmological scale. Just the Everlasting Theory is the scale-symmetric theory [3]. The scales are partially dual i.e., for example, there is an analogy between the strong interactions concerning the observed-particles scale (especially the core of baryons – it is the black hole in respect of the strong interactions) and strong gravitational interactions concerning the cosmological scale.

Due to the collapse of the outer shell of the expanding Einstein spacetime, there were created the entanglons responsible for the quantum entanglement of the Einstein-spacetime components from which are built up, besides the neutrinos, all observed particles [4], [5], [3].

Associations of the liberated entanglons created left-handed and right-handed vortices in the Einstein spacetime – it solves the matter-antimatter asymmetry in our Universe (our Universe was created due to evolution of a left-handed vortex [1]). Due to the quantum entanglement and the fourth phase transition of the modified Higgs field, there appeared the cosmic objectantiobject pairs (the protoworld-antiprotoworld pairs). Due to the evolution of the left-handed Protoworld, there appeared the dark energy and the expanding Universe (the ‘soft’ big bang) [1].

Our Universe appeared inside the Protoworld as the Cosmic Loop composed of the binary systems of protogalaxies i.e. the binary systems of protogalaxies were created already before the ‘soft’ big bang [1]. The protogalaxies consisted of the neutron black holes.

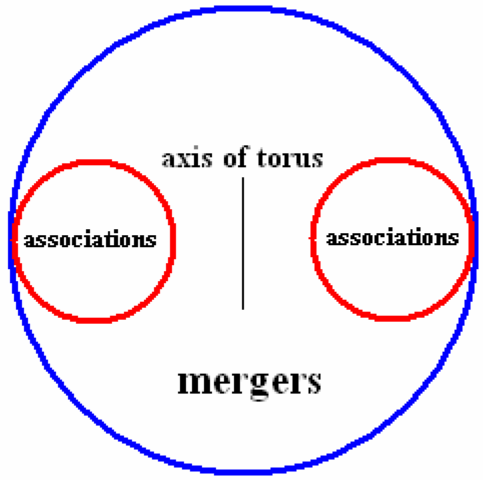
The age of the Universe is 20.9 Gyr [1] but due to the size and evolution of the Cosmic Loop, the time distance to the observed most distant galaxies is 13.4 Gyr i.e. they are already 7.5 Gyr old [6]. Just we cannot see the period 7.5 Gyr from the beginning of expansion of the Universe.

2. Abundances of massive galaxies

We know that following equation defines a torus:

$$(x^2 + y^2 + z^2 - a^2 - b^2)^2 = 4b^2(a^2 - z^2). \quad (1)$$

For the torus inside the Protoworld is b = 2a (such tori are most stable) [1].



The plane section of the expanding early Universe with the plane overlapping with the axis of the torus.

Due to the first inflow of the dark energy into the Cosmic Loop, the Cosmic Loop transformed into expanding torus and next into expanding sphere (i.e. b = 0 and a = r). Assume that due to the initial internal helicity of the expanding torus, the mergers of the binary systems of protogalaxies inside expanding torus (the proportions of such torus are the same as in the Protoworld) were impossible (the binary systems in the associations of the binary systems did not conglutinate). The mergers were possible in the remaining volume of the sphere which radius was equal to the external radius of the torus (Fig.).

The fraction Y of merging binary systems of protogalaxies we can calculate from following formula

$$X = (4\pi / 3 - 4\pi^2 / 27) / (4\pi / 3) = 1 - \pi / 9 = 0.65093. \quad (2)$$

In this paper the Hubble sequence (the morphological classification) is defined the same as here [9]. We distinguish between following classes: E (elliptical galaxies), S0 (lenticular galaxies), S (spiral disk galaxies), and P (peculiar galaxies – the main characteristic is the presence of asymmetrical features).

Due to the mergers of the binary systems of protogalaxies, there appeared the massive elliptical/E protogalaxies whereas evolution of the not merging binary systems of protogalaxies leads to the massive spiral/S protogalaxies. Here [7], within the Everlasting Theory, I showed that typical massive elliptical galaxy should have mass 8 times greater than typical massive spiral galaxy. This leads to conclusion that initial number of massive E protogalaxies should be proportional to X/8 whereas of massive S should be proportional to 1 – X. Since the most distant galaxies are already 7.5 Gyr old so we cannot see this period in evolution of the massive protogalaxies.

Calculate the initial abundance A of massive E protogalaxies

$$A = 100\%\ X / \{8(X / 8 + 1 – X)\} = 18.9\%, \tag{3}$$

and initial abundance B of massive S protogalaxies

$$B = 100\%\ (1 – X) / (X / 8 + 1 – X) = 81.1\%. \tag{4}$$

Since the region filled with the E protogalaxies was separated from the region filled with the S protogalaxies so we can assume that there appeared discs composed of the E protogalaxies and discs composed of the S protogalaxies. On the edges of the discs there at first appeared the tori composed of the protogalaxies which transformed into spheres i.e. most popular were discs surrounded by spheres. Assume that surface mass density of the discs was the same as of the spheres. It means that the spheres consisted of four times more protogalaxies.

Most of the disc-sphere structures composed of the E protogalaxies had been placed nearer to the centre of the expanding Universe and these protogalaxies were more massive than the disc-sphere structures composed of the S protogalaxies. It means that the disc-sphere structures composed of the E protogalaxies had evolved much faster. The very high pressure caused that the E protogalaxies placed on the spheres were flattened so they transformed into the lenticular/S0 protogalaxies. Due to the spheres surrounding the discs, the E protogalaxies in the discs were protected from such flattening. Described above processes took place during a period we cannot see.

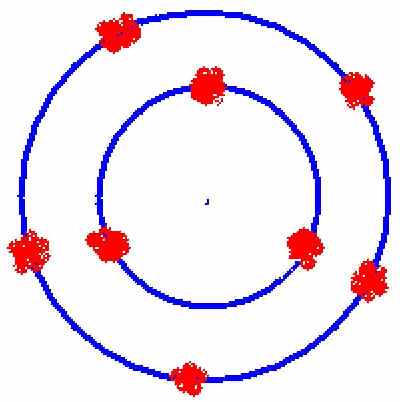
We should observe 4 times more the lenticular/S0 protogalaxies than the E galaxies. **Abundance of the distant and local E galaxies should be A/(1 + 4) ≈ 3.8% whereas of the distant and local S0 galaxies should be 4A/(1 + 4) ≈ 15.1%.**

The disc-sphere structures composed of the S protogalaxies have evolved slower. In the discs and spheres most numerous were the “small” discs/associations composed of eight binary systems of the S protogalaxies. Assume that in each association the distribution of the 8 binary systems was as follows. On two concentric circles with radii 0.6 and 1 are moving respectively 3 and 5 binary systems (Fig.). Then, the lengths of the all 8 circular arcs between the nearest binary systems, on the same circle, are the same.

Due to the outer 5 binary systems, the inner 3 binary systems are partially protected from interactions with other associations. This leads to conclusion that the inner binary systems should be most symmetrical i.e. they are the distant S protogalaxies whereas the outer ones are the distant peculiar/P protogalaxies. **Abundance of the distant spiral/S galaxies should be 3B/(3 + 5) ≈ 30.4% whereas of the distant peculiar/P galaxies should be 5A/(3 + 5) ≈ 50.7%.**

The 4/5 of all distant P galaxies are placed on the spheres i.e. 4A/(3 + 5) = 40.6% of them. With time, they as well were flattened i.e. they transformed a second time into the S galaxies.

We can see that abundance of the local spiral/S galaxies should be 30.4% + 40.6% = 71.0% whereas of the local peculiar/P galaxies should be 50.7% – 40.6% = 10.1%.



An association composed of eight binary systems of S protogalaxies.

The theoretical results obtained within the Everlasting Theory are consistent with observational facts [9]. They are collected in Table 1.

Table 1 *Abundances of the different morphological types for distant and local massive galaxies* [%]

Type of galaxy	**Distant (Theory)**	**Distant [9]**	**Local (Theory)**	**Local [9]**
Elliptical	3.8	4 ± 1	3.8	3 ± 1
Lenticular	15.1	13 ± 2	15.1	15 ± 4
Spiral	30.4	31 ± 7	71.0	72 ± 8
Peculiar	50.7	52 ± 9	10.1	10 ± 3

3. Summary

Due to the mergers of the binary systems of protogalaxies, there were created the elliptical protogalaxies whereas evolution of the not merging binary systems of protogalaxies leads to the spiral protogalaxies.

Due to evolution of the disc-sphere structures described within the Everlasting Theory, some elliptical protogalaxies transformed into lenticular galaxies whereas some spiral protogalaxies into peculiar galaxies. Some of the peculiar galaxies a second time transformed into spiral galaxies.

For distant massive galaxies we obtain following abundances: for elliptical/E is 3.8%, for lenticular/S0 15.1%, for spiral/S 30.4% and for peculiar/P 50.7%. On the other hand, for the local massive galaxies we obtain: for elliptical 3.8%, for lenticular 15.1%, for spiral 71.0% and for peculiar 10.1%. The theoretical results obtained within the Everlasting Theory are consistent with observational facts [9].

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