A Revised Scenario for the Evolution of Galaxies

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Abstract: Recent observations suggest that the models of synchronized co-evolution of supermassive black holes (SMBHs) and their host galaxies in the early Universe are partially incorrect - Trakhtenbrot et al. (10 July 2015). They found in the galaxy CID-947, which is placed in time distance about 12 Gyr (z = 3.328), a black hole with a mass of about 10 % of the total galactic mass. On the other hand, the SMBH in such a normal-size galaxy achieves up to about 0.2 to 0.5 % of the host galaxy mass in the present day i.e. their mass is about 20 to 50 times smaller (!). This observational fact is consistent with the cosmology described within the Scale-Symmetric Theory (SST). Here we present a revised scenario for the evolution of galaxies. We can see all galaxies but we cannot see the initial period 7.75 Gyr of their 21.61 Gyr evolution (the Ludwig et al. data (2009) suggest that the Universe is about 22 Gyr old but within the Scale-Symmetric Theory we showed that we can see only the last period about 13.8 Gyr). During the unseen period, due to the inflows of dark matter and next of the turbulent inflows of dark energy, evolution of the initial protogalaxies had been differentiated. The SST shows that in the visible period of evolution of the Universe, the ratio of mass of the central black hole to total mass of galaxy (it concerns the quasars also) should be equal to or lower than 0.583 and this result is consistent with new data.

1. Introduction

The extended General Relativity leads to the superluminal non-gravitating Higgs field [1A]. New symmetries of such field cause that in our Cosmos, [1A], [1B], [2], there appeared five succeeding scales [1A]. The last scale is the cosmological scale with characteristic size/diameter about 1 Gyr [3], [1B]. Within theory of this scale, [1B], we showed the origin and calculated mass/energy density and abundance of the baryonic matter (the calculated mass density within the Scale Symmetric Theory (SST) is $0.385 \cdot 10^{-27}$ kg/m^3 [1B] – it is about 92% of the Planck data + BAO + SNe [4]; the calculated within SST abundance is 4.91% [1B]), of the dark matter (the calculated within SST abundance is 26.46%) and dark energy (68.63%) [1B].

Here we present a revised scenario for the evolution of galaxies.

2. A revised scenario for the evolution of galaxies

2.1. The initial state

The cosmological scale appeared after the inflation (i.e. after the big bang), which is correctly described within SST [5], but before the expansion of the Universe (i.e. before the "soft" big bang) [1B].

Due to the properties of the cosmological scale, formation of the very early Universe composed of protogalaxies grouped in larger structures (which were built of neutron black holes (NBHs)) took place already before the expansion of the Universe [1B]. The evolution of the cosmological scale caused that there appeared the dark matter and dark energy. First there were the inflows of dark matter [1B] into the very early Universe that started its expansion. Due to the inflows, the outer NBHs in each protogalaxy transformed into the first-generation big stars and next the produced dust created torus around the core composed of the unchanged NBHs i.e. around the central black hole. We can see that the protogalaxies grouped in larger structures (it was due to the quantum entanglement [1A]) transformed into groups of entangled quasars. Internal structure of very early quasars mimicked the structure of proton, [6], so the initial ratio of mass of the central black hole to total mass of a quasar was about $F = 0.583$. Next there were the turbulent inflows of the dark energy [7]. It caused that single quasars and merged quasars had evolved in different way i.e. there appeared quasars with different masses, different rate of evolution and different ratios F but there still were some predominant scenarios of evolution [8]. The rate of evolution of quasars depended on density and amount of inflowing dark energy.

We can see that the protogalaxies composed of the neutron black holes were the initial states in evolution of galaxies. Due to the inflows of the dark matter, the protogalaxies had transformed into the typical quasars. Next, the turbulent inflows of the dark energy differentiated evolution of single and merged quasars.

2.2. The picture of the Universe at the beginning of the visible period of its evolution i.e. of the Universe in time distance about 13.8 Gyr

The quantum entanglement of radiation with its sources causes that the speed of light in “vacuum”, c, is the speed of photons in relation to their source or in relation to a last-interaction object and sometimes it is a detector. Such interpretation is consistent with the result obtained in the Michelson-Morley experiment. This interpretation and the existence of the cosmological scale are destructive for the mainstream cosmology. Just it causes that the correct age of the Universe since the beginning of its expansion is 21.61 Gyr [9] (the Ludwig *et al.* data (2009) suggest that the Universe is about 22 Gyr old [9]) but we cannot see the initial period of about 7.75 Gyr of evolution of the galaxies, i.e. the time distance to the most distant galaxies is 13.866 ± 0.096 Gyr [1], [9], [10], [11], as it is in the mainstream cosmology (about 13.8 Gyr). But SST shows that we can see the CMB which was produced about 21.614 Gyr ago [12].

Emphasize once more that due to the duality of relativity and the existence of the cosmological scale with the diameter of about 1 Gyr, we cannot see the initial period 7.75 Gyr of evolution of the quasars. In the most distant Universe we can see the final stage of evolution of the quasars (about 2 Gyr of the 10 Gyr). Moreover, due to the turbulent inflows of the dark energy during the unseen period of evolution of galaxies, the structures of the most distant quasars and galaxies are differentiated. Moreover, during the unseen period 7.75 Gyr of evolution of galaxies, the number density of merging galaxies was highest and the number density of explosions of quasars, which had led to creation of the dwarf galaxies, was highest as well.

Recent observations suggest that the models of synchronized co-evolution of supermassive black holes (SMBHs) and their host galaxies in the early Universe are partially incorrect – Trakhtenbrot et al. (10 July 2015). They found in the galaxy CID-947, which is placed in time distance about 12 Gyr ($z = 3.328$), a black hole with a mass of about 10 % of the total galactic mass [13]. On the other hand, the SMBH in such a normal-size galaxy achieves up to about 0.2 to 0.5 % of the host galaxy mass in the present day i.e. their mass is about 20 to 50 times smaller (!). We can see that this observational fact is consistent with the cosmology described within the Scale-Symmetric Theory. Just due to the turbulent inflows of dark energy during the unseen period of evolution of galaxies, more and more NBHs transformed into dust i.e. with time, due to the inflows of the dark energy, the initial ratio $F = 0.583$ characteristic for typical quasars had decreased. So the value $F \approx 0.1$ for CID-947 is permissible. But more plentiful inflows of the dark energy caused that in the most distant Universe there as well should be galaxies with lower value of F. Just there should be quasars/galaxies with F defined by following interval $<0, 0.583>$.

Due to the inflows of the dark energy, there appeared accretion disc around the central black holes. We can see that during this period, the evolution of black holes was reversed.

It is assumed that in the very distant Universe, with increasing distance, number of faint galaxies should grow exponentially but the Scale-Symmetric theory shows that this assumption is incorrect. There was not an up→down evolution of galaxies (i.e. due to gravitational attraction, there should be the shrinking volumes filled with dwarf galaxies). Due to the initial properties of the cosmological scale and the inflows of the dark matter and next of the dark energy, there was described here the down→up evolution of galaxies (i.e. there were the exploding massive protogalaxies/quasars and their expansion due to the inflows of the dark energy and due to the expansion of the Universe). The turbulent inflows of the dark energy differentiated evolution of the massive galaxies. But the largest increase in the number of the dwarf galaxies was during the unseen period 7.75 Gyr. Moreover, such increase was due to the down→up evolution of massive galaxies, not due to an up→down evolution. It leads to conclusion that with time, in the visible period of evolution of the Universe, the number of galaxies practically should not change.

2.3. Structures of the dark matter in galaxies

Within SST we described the dark-matter structures in galaxies [14]. Such structures (i.e. the ordered motions) decrease local pressure in the Einstein spacetime so there are inflows of additional Einstein-spacetime components that increase local mass density – we can see that there appear regions with higher mass density. The dark-matter structures are the concentric circles composed of the entangled luminal Einstein-spacetime components i.e. of the entangled neutrino-antineutrino pairs. They were produced in the very dense baryonic matter when the dark matter had flowed into the rotating protogalaxies. Next, due to the weak interactions of the stars with the very stable dark-matter structures, there appeared the characteristic rotation/velocity curves of disc galaxies which solve the galaxy rotation problem i.e. the discrepancy between observed galaxy rotation curves and the theoretical predictions which follow from the distribution of the visible matter and theory of gravitation. But SST shows that there are in existence also the other mechanisms leading to production of the dark-matter fields, for example, the initial flows of baryonic plasma between early quasars produced the filaments of dark-matter connecting the quasars.

3. Summary

Here we present a revised scenario for the evolution of galaxies.

The theory of the cosmological scale described within the Scale-Symmetric Theory shows that the protogalaxies composed of the neutron black holes, which were grouped in larger structures, were the initial states in evolution of galaxies. Due to the inflows of the dark matter, the protogalaxies had transformed into the typical quasars. The initial ratio of mass of the central black hole to total mass of typical quasar was about $F = 0.583$. Next, the turbulent inflows of the dark energy differentiated evolution of single and merged quasars.

The correct age of the Universe since the beginning of its expansion is about 21.614 Gyr but due to the duality of relativity and the existence of the cosmological scale with the diameter of about 1 Gyr, we cannot see the initial period about 7.75 Gyr of evolution of the galaxies, i.e. the time distance to the most distant galaxies is $13.866 \pm 0.096 \text{ Gyr}$ as it is in the mainstream cosmology (about 13.8 Gyr). But we can see the CMB and the final stage of evolution of the quasars (about 2 Gyr of the 10 Gyr). Moreover, due to the turbulent inflows of the dark energy during the unseen period of evolution of galaxies, the structures of the most distant quasars and galaxies are differentiated. During the unseen period 7.75 Gyr of evolution of galaxies, the number density of merging galaxies was highest and number density of explosions of quasars, which had led to creation of the dwarf galaxies, was highest as well.

Due to the turbulent inflows of dark energy during the unseen period of evolution of galaxies, more and more NBHs transformed into dust i.e. with time, due to the inflows of dark energy, the initial ratio $F = 0.583$ characteristic for typical quasars had decreased so the value $F \approx 0.1$ for CID-947 is permissible. But more plentiful inflows of the dark energy during the unseen period of evolution of the Universe caused that in the most distant Universe (i.e. at the beginning of the visible period of evolution) there as well should be galaxies with lower value of F. Just there should be quasars/galaxies with F defined by following interval $<0, 0.583>$.

Due to the inflows of the dark energy, there appeared accretion disc around the central black holes. Just during this period, the evolution of black holes was reversed.

It is assumed that in the very distant Universe, with increasing distance, number of faint galaxies should grow exponentially but the Scale-Symmetric theory shows that this assumption is incorrect. The largest increase in the number of the dwarf galaxies was during the unseen period 7.75 Gyr due to the down→up evolution of massive galaxies (i.e. the exploding massive protogalaxies/quasars and their expansion due to the inflows of the dark energy and due to the expansion of the Universe) so with time, in the visible period of evolution of the Universe, the number of galaxies practically should not change.

The structures of the dark matter consist of the concentric circles composed of the entangled luminal Einstein-spacetime components i.e. of the entangled neutrino-antineutrino pairs. They were produced in the very dense baryonic matter when the dark matter had flowed into the rotating protogalaxies. Next, due to the weak interactions of the stars with the very stable structures of dark matter, there appeared the characteristic rotation/velocity curves of disc galaxies which solve the galaxy rotation problem i.e. the discrepancy between observed galaxy rotation curves and the theoretical predictions which follow from the distribution of the visible matter and theory of gravitation. But SST shows that there are in existence also the other mechanisms that lead to production of regions in the Universe with increased mass density of the Einstein spacetime. The main mechanism is associated with ordered motions of entangled Einstein-spacetime components produced by motions of baryonic plasma in early Universe. Such ordered motions decrease local pressure in the Einstein spacetime so there are the inflows of additional Einstein-spacetime components.

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