Detection of a Dim Sphere Composed of Massive Cold Galaxies (they Consist of Bare Neutron Black Holes) at Mean Redshift 0.6415 will Validate the Scale-Symmetric-Theory Cosmology

Sylwester Kornowski

Abstract: In a cosmic scale of a few hundred Mega-parsecs, according to the General Relativity (GR) cosmology, the mean number density of massive galaxies (mass greater than 11 powers of ten multiplied by solar mass) should be about 0.0072 massive galaxies per cubic Mpc whereas according to the Scale-Symmetric Theory (SST) should be 0.0067. We can see that both results are similar, about 0.007. On the other hand, the surveys of massive galaxies lead to number densities about 10 times lower. It leads to conclusion that there must be big number of dim massive galaxies. N. Trujillo formulated following question: Where are the untouched massive "relic" galaxies in the nearby Universe? Here, applying the SST, we show that most of them should be close to the threshold redshift 0.6415 and they should be composed of the bare neutron black holes. Such dim sphere of massive galaxies forces the radial acceleration of all galaxies at redshift about 0.35 up to 0.6415, and deceleration of all galaxies above such threshold redshift. We showed that the postulated within the GR cosmology an acceleration of expansion of spacetime is an illusion (for redshift 0.35 up to about 0.6, we observe an acceleration whereas for redshift higher than about 0.6, we observe a deceleration). In reality, the SST shows that there indeed are the regions of acceleration and deceleration but their existence follows from the gravitational attraction of the massive dim sphere at mean redshift 0.6415. Future more precise surveys of galaxies should confirm that the SST cosmology is correct.

Introduction and motivation

The Scale-Symmetric Theory (SST), [1], shows that the succeeding phase transitions of the superluminal non-gravitating Higgs field during its inflation (the initial big bang) lead to the different scales of sizes/energies [1A]. Due to a few new symmetries, there consequently appear the superluminal binary systems of closed strings (entanglons) responsible for the quantum entanglement (it is the quantum-entanglement scale), stable neutrinos and luminal neutrino-antineutrino pairs which are the components of the luminal gravitating Einstein spacetime (it is the Planck scale), cores of baryons (it is the electric-charges scale), and the cosmic-structures/protoworlds (it is the cosmological scale) that evolution leads to the dark matter, dark energy and expanding universes (the "soft" big bangs) [1A], [1B]. The electric-charges scale leads to the atom-like structure of baryons [1A].

The SST shows that there is the two-component spacetime that consists of the superluminal non-gravitating Higgs field composed of tachyons (the gravitational fields are the gradients produced in Higgs field by gravitating masses), and the luminal gravitating Einstein spacetime composed of the neutrino-antineutrino pairs [1A]. In the Einstein spacetime, the neutrino-antineutrino pairs interact gravitationally only – such pairs we will refer to as the free pairs. The dark energy consists of the additional free neutrino-antineutrino pairs that appeared due to the evolution of the Protoworld that was created before the expansion of the Universe (i.e. before the "soft" big bang which was separated in time from the initial big bang) [1B]. The dynamic pressure of the dark energy causes that the gravity cannot stop the expansion of the Universe. According to SST, the dark matter consists as well of the neutrino-antineutrino pairs but the pairs are entangled (it is the long-distance superluminal/non-local quantum entanglement) so there are the dark-matter (DM) structures – such structures, due to the quantum entanglement or/and confinement, can interact with visible matter i.e. with hadrons and charged leptons [1A], [1B]. Photons and gluons are the rotational energies of the neutrino-antineutrino pairs [1A]. The DM structures consist of entangled *non-rotating-spin* neutrino-antineutrino pairs. Speed of the pairs in relation to their moving emitter/source and their mass are unchangeable so DM structures are perfectly elastic. Spins of neutrinos in a pair are parallel so it carries unitary spin. Resultant weak charge of a pair is equal to zero whereas gravitational mass of a pair composed of stable neutrinos is very small ($m_{pair} \approx 6.67 \cdot 10^{-67}$ kg [1A]) so detection of the neutrino-antineutrino pairs is much difficult than the neutrinos. It is the reason that we still cannot detect them.

In a cosmic scale of a few hundred Mega-parsecs (there, in the Universe, are the walls, nodes, filaments, voids and the two-component spacetime), according to the General Relativity (GR) cosmology, the mean number density of massive galaxies (mass $M_G > 10^{11}$ solar masses) should be ~ 0.0072 Mpc^{-3}. This value follows from the observed mean density of baryonic matter $\rho_{B,GR} = (0.4181 \pm 0.0043) \cdot 10^{-27}$ kg/m^3 [2] and the SST cosmology which shows that initially, the masses of all massive galaxies were quantized $M_{G,initial} = 8.52 \cdot 10^{11}$ solar masses, [3], and they consisted of the neutron black holes [1A]. Such massive galaxies evolved due to the inflows of the dark matter and dark energy [1B]. Due to such different inflows, the massive galaxies with the quantized-mass had exploded in different way so there appeared different numbers of the dwarf and satellite galaxies. According the SST, a prescription for evolution of massive galaxies is very simple – lower observed mass of massive galaxy means more dwarf and satellite galaxies and more intergalactic gas and dust (for example, we can compare the Milky Way with Andromeda). Moreover, luminosity of less massive massive galaxies should be for the same redshift z lower. It means that if inflows of dark matter and dark energy were insignificant then such massive galaxies should be dim and their mass should be close to $M_{G,initial}$. Since number density of visible massive galaxies is much lower than it follows from the mean baryonic density so there should be big number of such dim galaxies.

According to the SST, the mean number density of massive galaxies should be ~ 0.0067 Mpc^{-3}. This value follows from the calculated mean density of baryonic matter $\rho_{B,SST} = (0.385 \pm 0.008) \cdot 10^{-27}$ kg/m^3 [1B]. We can see that both results are similar, about 0.007. On the other hand, the surveys of massive galaxies lead to number densities about 10 times lower than the mean [4], [5]. In paper [4], the obtained number density of red massive galaxies is about 0.00025 for redshift $z = 0$ and about 0.0001 for $z = 0.7$. Even if we add the blue massive galaxies (on the assumption that there is about 4 times more the blue than the red ones), we obtain respectively 0.00125 and 0.0005. These results are respectively 5.6 and 14 times lower than the mean number density ~ 0.007. In paper [5], the obtained number density of all massive galaxies is about 0.001 for redshift z = 0.65 and about 0.0001 for z = 2. These results are respectively 7 and 70 times lower than the mean number density ~ 0.007. It leads to conclusion that there must be big number of dim massive galaxies. N. Trujillo formulated following question: Where are the untouched massive "relic" galaxies in the nearby Universe [6]?

Emphasize as well a few facts that follow from SST.

1.

To avoid the transformation of the initial disc in the most massive galaxies, [1B], into an ellipsoid, galaxies must decrease their angular momentum via explosions i.e. via production of dwarf and satellite galaxies. It leads to conclusion that the dim massive galaxies should be the ellipsoids composed of the bare neutron black holes.

2.

SST shows that if not the dynamic pressure in the initial region filled with the massive protogalaxies, then all the massive galaxies should be on a sphere with the threshold redshift z = 0.6415 [1B].

3.

All of a sudden in the most distant Universe appear well formed large galaxies at redshift of about 12 and smaller. SST shows that it is not due to the end of some dark ages and reionization as it is assumed in the Cosmological Standard Model (CSM) but due to the fact that we cannot see the initial period 7.75 Gyr of evolution of the protogalaxies – we can see only the last period about 13.8 Gyr [1B].

4.

According to SST, the ground state of the Einstein spacetime, which density dominates, does not expand – there expands the dark energy but its mass density is about 10^{54} times lower than the Einstein spacetime so the two-component spacetime and the Universe as a whole are flat [1B]. The expanding dark energy counteracts the gravitational braking. Just the dark energy is needed to balance the gravitational braking.

5.

Number of satellite galaxies and dwarf galaxies should be independent from redshift or should insignificantly decrease with decreasing redshift. It follows from the fact that such galaxies were produced due to the explosions of the massive galaxies during the unseen initial period 7.75 Gyr of their evolution [1B]. Such conclusion is consistent with observational facts [6]. With time, not numerous the smaller galaxies were "re-absorbed" by the massive galaxies.

We can see that most of the dim massive galaxies/black-holes should be on the sphere with mean redshift z = 0.6415. Future more precise surveys of galaxies and massive black holes should confirm that the SST cosmology is correct. Such dim sphere of massive black-holes forces the radial acceleration of all galaxies at redshift about 0.35 up to 0.6415 and deceleration of all galaxies above the threshold redshift (see both Figures and Table 1). We substantiated that the postulated within the GR cosmology an acceleration of expansion of spacetime is an illusion (for redshift 0.35 up to about 0.6, we observe an acceleration whereas for redshift higher than about 0.6, we observe a deceleration). In reality, the SST shows that there indeed are the regions of acceleration and deceleration but their existence follows from the gravitational attraction of the massive dim sphere at mean redshift 0.6415. But why the acceleration is observed only from $z \approx 0.35$, not from $z = 0$? According to SST, initially the neutron black holes in centres of the massive-galaxies/quasars had produced antiparallel half-jets in the Einstein spacetime, [7], and there was radial polarization of them. It caused a compression of the quasars in centre of the dim sphere (there appeared a minimum in the number density between the centre of the dim sphere and the sphere) and formation of cascades of aligned quasars outside the sphere. The cascades of the luminal motions/jets in the Einstein spacetime caused that there appeared galaxies with redshift greater than 1. With time, the jets decayed so the recession velocities (recessional velocity is the rate at which an object is moving away, typically from Earth) of the galaxies decelerated below $z = 1$. But according to SST, the speed of light in "vacuum" c, due to the quantum entanglement, is the speed of photons in relation to their source or a last-interaction object (it can be a detector) i.e. we must treat, for example, a decelerating galaxy and the earlier emitted photons as one system, i.e., when kinetic energy of the galaxy decreases then the earlier emitted photons, for an observer on Earth are redder and redder i.e. their redshift is invariant and still can be greater than 1 even if actual radial speed of the galaxy is lower than the c. Due to the quantum entanglement, it is wrongly assumed in CSM that after the light is emitted, it does not matter what happens to the emitting photons; it is untrue that a change in radial velocity of a galaxy-source does not change wavelengths of the photons that are received even if the spacetime does not expands. Of course, it is true that cosmological redshift can result from expansion of spacetime also.

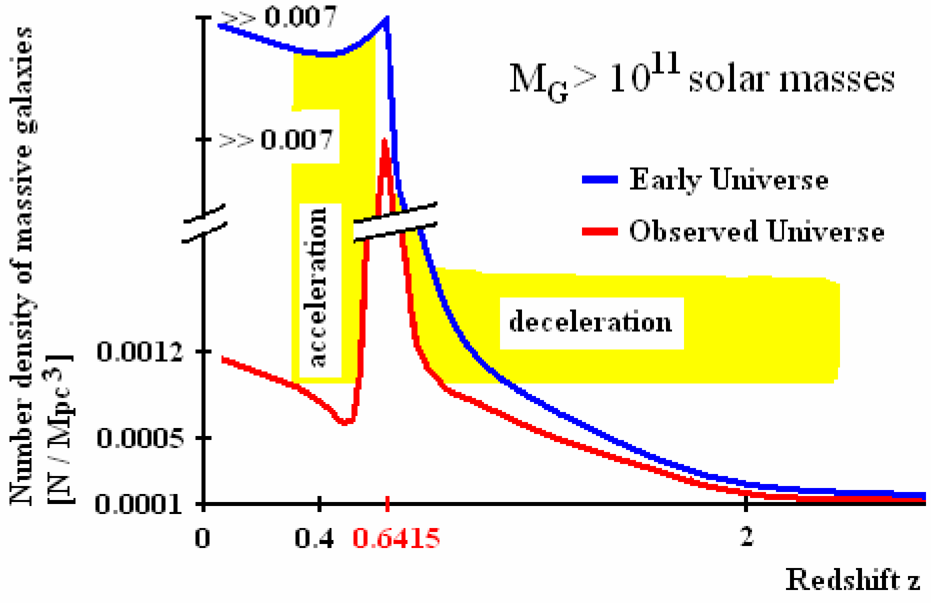


Fig. 1. Number density of massive galaxies as a function of redshift

But why the dim/cold massive galaxies are primarily at redshift 0.6415? It results from the initial large-scale structure. The very early Universe was the double loop composed of protogalaxies grouped in larger structures [1B]. The inflows of the dark matter and dark energy were less intensive in the central parts of the larger structures composed of the typical massive galaxies. Lack of explosions in the central parts of the larger structures caused that the dim massive galaxies are primarily at the threshold redshift 0.6415. Moreover, the dim sphere can have the equator with higher mass density of the cold massive galaxies. In absence of explosions of the most massive galaxies, there did not appear baryonic plasma so creation of accretion disc is impossible so impossible is also creation of visible jet but there still is produced the invisible jet in the Einstein spacetime [7]. The invisible pairs of antiparallel half-jets with radial polarization, produced by the cold massive galaxies the dim sphere consists of, cause that other galaxies cannot reach the dim sphere due to the gravitational attraction but they can move toward it for some period.

The very low mean mass density of the baryonic matter in comparison with the of Einstein spacetime (about 1 part in 10^{55} parts) causes that even due to the not smooth distribution of the baryon matter and dark matter, the Universe behaves as a flat object.

Existence of the dim sphere composed of dim massive galaxies/black-holes solves the problem of the missing baryons [8].

Consider the differences between GR and SST.

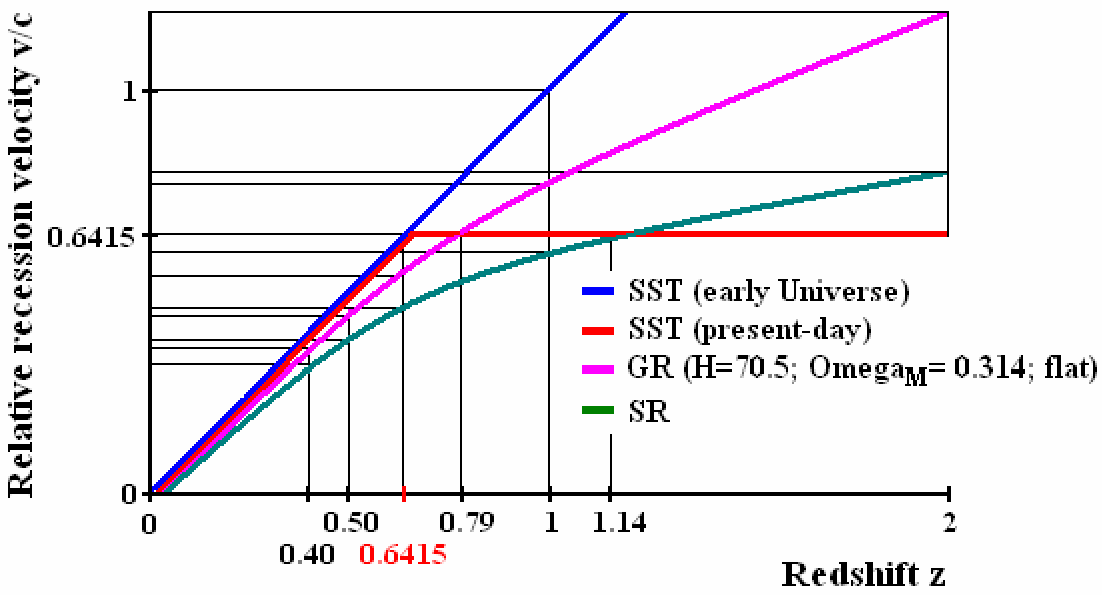
The radial components in the Friedmann-Robertson-Walker (FRW) metric are as follows [9]: $ds^2 = -c^2 dt^2 + a(t)^2 d\chi^2$. For $dt = 0$, radial distance is $D = a \chi$. Differentiating this proper distance gives a two-component velocity i.e. the derivative of the a multiplied by χ (it is the recession velocity that appears in the definition for the Hubble constant, H, in GR; it is associated with the expansion of the Einstein spacetime in the Universe – SST shows that the ground state of the Einstein spacetime is invariant so physical constants are invariant as well [1A]) plus the a multiplied by derivative of the χ (it is the recession velocity in Special Relativity (SR) that does not appear in the definition for Hubble constant; it is not associated with the expansion of the Universe).

Table 1 *Relative recession velocity, v/c, as a function of redshift for* H=70.5, Ω_M=0.314 *and flat Universe*

Redshift z	Relative Recession Velocity from GR	Relative Recession Velocity from SR
0.28	0.262	0.242
0.4	0.363	0.324
0.5	0.441	0.385
0.6415	0.544	0.459
0.787	0.642	0.523
1	0.769	0.600
1.14	0.844	0.642
5	1.797	0.946
12	2.265	0.988
10^7	3.198	~1

Here we calculated the recession velocities within SST, GR and SR. We used the parameters that are derived within the SST: H = 70.5 km s^{-1} Mpc^{-1}, Ω_M = 0.314, Ω_Λ = 0.686, **flat Universe**. We used the cosmological calculator [10].

We can see that the distance between the SST curve and GR curve increases with increasing redshift for redshift about 0.35 up to the threshold redshift z = 0.6415. It causes that for this interval, the Type Ia supernovae are in distances greater than it results from GR so they are fainter than they should be and it is consistent with the observational facts. Moreover, due to the existence of the dim sphere, there is the gravitational acceleration for this interval of redshift. But emphasize once more that this acceleration does not follow from acceleration of expansion of the Einstein spacetime, i.e. does not follow from an increase in energy density of the dark energy.



Discrepancy between SST, GR and SR for recession velocity.

Summary

Detection of a dim sphere composed of dim massive galaxies (they should be the massive bare black holes composed of the neutron black holes described within SST) at mean redshift 0.6415 will validate the Scale-Symmetric-Theory Cosmology.

References

[1] Sylwester Kornowski (2015). *Scale-Symmetric Theory*
[1A]: http://vixra.org/abs/1511.0188 (Particle Physics)
[1B]: http://vixra.org/abs/1511.0223v2 (Cosmology)

[2] Planck Collaboration (10 August 2015). “Planck 2015 results. I. Overview of products and scientific results”
arXiv:1502.01582v2 [astro-ph.CO]

[3] Sylwester Kornowski (18 June 2016). “The Dark-Matter Mechanism and Orbital Speeds of Stars in Galaxies”
http://vixra.org/abs/1410.0031v8

[4] Brown, Michael. J. I., *et al.* (January 2007). “The Evolving Luminosity Function of Red Galaxies”
ApJ, Volume 654, Issue 2, pp. 858-877
arXiv:astro-ph/0609584v2
See Figure 4 in following paper:
Aday R. Robaina, *et al.* (30 June 2010). “The Merger-Driven Evolution of Massive Galaxies”
arXiv:1002.4193v2 [astro-ph.CO]

[5] S. Tamburri, *et al.* (Accepted 2 September 2014). “The population of early-type galaxies: how it evolves with time and how it differs from passive and late-type galaxies”
A&A 570, A102 (2014)

[6] Nacho Trujillo “The growth channel of massive galaxies”
www.iac.es/project/traces
www.physics.ox.ac.uk>trujillo_iau311

[7] Sylwester Kornowski (25 January 2016). “The Revised Theory of Black Holes and Accretion Discs”
http://vixra.org/abs/1508.0215

[8] “The problem of the missing baryons”
https://astro.uni-bonn.de>igm>whim

[9] Tamara M. Davis and Charles H. Lineweaver (2000). “Superluminal Recession Velocities”
http://cds.cern.ch>record>files

[10] Edward L. Wright (10 October 2006). “A Cosmological Calculator for the World Wide Web”
arXiv:astro-ph/0609593
http://www.astro.ucla.edu/~wright/DlttCalc.html (2006, PASP, 118, 1711)