An Illusion of Acceleration and Deceleration of Expansion of the Observed Universe

Sylwester Kornowski

Abstract: Here, applying the lacking part of ultimate theory, i.e. the Scale-Symmetric Theory (SST), we described phenomena that lead to an illusion of acceleration of expansion of the Universe for z > 0.45 and of deceleration for z > 0.60. We cannot neglect both the perturbant/"gravitational" redshift for z > = 0.53 and the duality of relativity. The derived formulae for time distance between source and observer, give the time distances greater than calculated within the mainstream cosmology (for z = 0.45 is about 30%). On the other hand, the distances of the Type Ia supernovae were, on average, 10% to 15% farther than expected. This means that the Type Ia supernovae are fainter than they should be not due to an acceleration of expansion but due to inaccurate formula for time distance applied in the mainstream cosmology. Correctness of the new formula follows from the fact that calculated maximum redshift is z = 11.9. This value is consistent with the present-day observational facts (the maximum is z = 11.8 +- 0.3 for the candidate protogalaxy UDFj-39546284). Due to the duality of relativity and due to the perturbant/"gravitational" redshift for compact cosmological objects, it is very difficult to calculate within the mainstream cosmology the exact time distances to the Type Ia supernovae. The uncertainty is much higher than the assumed about 5%.

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 [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 [1A]. 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].

SST shows that the quantum entanglement fixes the radial speed of photons equal to the speed of light in "vacuum" c in relation to their sources or a last-interaction object (it can be a detector) – such is the correct interpretation of the Michelson-Morley experiment [1B]. It causes that relative speed of photons depends on relative radial speed of galaxies in relation to Earth. It leads to conclusion that, generally, time distance is not equal to spatial distance that relates to the c – it is the duality of relativity because of the dual distances to galaxies [1B].

Here we will prove that some phenomena that follow from the SST (they do not appear in the mainstream cosmology) lead to an illusion of acceleration of expansion of the Universe for redshift about $z > 0.45$ and to an illusion of deceleration for redshift about $z > 0.60$.

2. An illusion of acceleration and deceleration of expansion of the Universe

The Scale-Symmetric Theory shows that the most distant galaxies are already 7.75 Gyr old and that the time distance to them is 13.866 Gyr [1B]. When we neglect the unseen initial 7.75-Gyr period of evolution of galaxies, when we neglect the duality of relativity [1B], and protuberant/"gravitational" redshift [2], then observed age t of galaxies we can calculate from following formula

$$t = T\,(1 - z / 0.6415), \tag{1}$$

where $T = 13.866$ Gyr whereas z is the mean kinematical redshift – its upper limit (i.e. for most distant galaxies) is $z = 0.6415$ [1B].

The duality of relativity [1B] causes that the relative speed of light observed on Earth, emitted by galaxies changes from $v = 0.3585c$ for most distant galaxies to c for the nearby galaxies. It causes that the time distance to galaxies is longer than the spatial distance associated with the speed c. The age of galaxies reduced by 7.75 Gyr, we can calculate from following formula (it follows from the duality of relativity)

$$t_{duality} = T - z\,T_1 / (1 - z), \tag{2}$$

where $T_1 = 0.3585\,T / 0.6415 = 7.75$ Gyr.

The difference in the age $\Delta t = t_{duality} - t$ is

$$\Delta t = z\,(T - T_2\,z) / (1 - z), \tag{3}$$

where $T_2 = T + T_1 = 21.614$ Gyr.

The derivative of the function (3) leads to the extremum for $z = 0.40$ – the maximum difference in age is 3.48 Gyr.

Explosions of the Type Ia supernovae near to Schwarzschild surfaces of the modified black holes (MBHs do not contain a central singularity but there is a circle with spin speed equal to the c) in centres of galaxies cause that the supernovae are fainter than they should be also. It is important for the distant compact cosmological objects and centres of massive galaxies because for them probability of such explosions is much higher.

But most important is the fact that the relation between the time distance from an observer to source and the observed redshift applied in the mainstream cosmology gives too short distances. In reality, the spacetime does not expand, there expands only matter, the dark energy, dark matter and CMB [3], [1B]. Moreover, generally, the local radial speeds of the dark matter, dark energy and cosmic structures are practically the same i.e. in very good approximation the cosmic objects are in the rest in relation to the expanding dark matter and dark energy. It leads to conclusion that we do not need relativistic formulae – relativistic formulae lead to wrong conclusions.

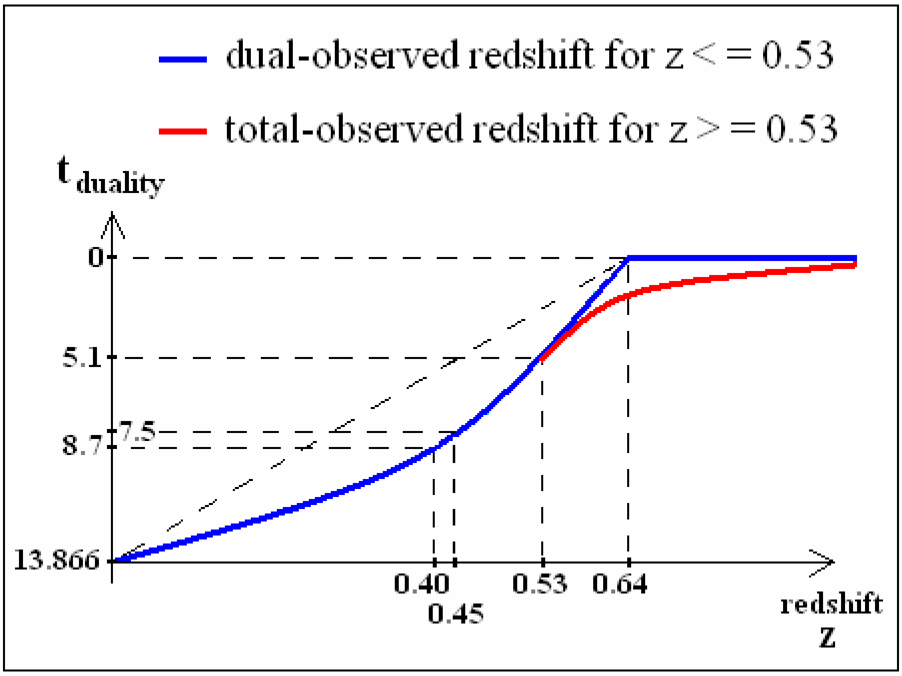
How should look the correct relation between the time-distance and observed-redshift?

Total-observed redshift, z_T, is the sum of the kinematical redshift, $z_{K,dual}$, and protuberant/"gravitational" redshift, z_G [2]

$$z = z_T = z_{K,dual} + z_G. \tag{4}$$

The time distance from observer to source, $L_{K,dual}$, associated with the duality of relativity we can calculate from formula (2)

$$L_{K,dual,z \le 0.53} = T - t_{duality} = z\, T_1 / (1 - z). \tag{5}$$



It is obvious that the protuberant/"gravitational" redshift was more important in the earlier Universe. Can we calculate lower limit for the protuberant/"gravitational" redshift i.e. a value below which the protuberant/"gravitational" redshift can be neglected? The SST shows that the modified black holes consist of the modified neutron black holes [1B]. It leads to conclusion that plasma appears above the Schwarzschild surface for the nuclear strong interactions in neutrons [1A]. Gravitational redshift is zero when on surface of the plasma appear the relativistic neutral pions with mass the same as in the $d = 1$ state i.e. M = 208.643 MeV [1A]. It follows from the fact that due to the $d = 1$ state, the plasma confines the relativistic pions with the masses M (there are the exchanges of such pions).

Since range of a boson with a mass of 187.57 MeV is $A + 4B$ = 2.7048 fm ([1A]: A = 0.6974425 fm is the external radius of the core of neutron, whereas A/B = 1.3898) so range of the mass M is R = 2.4316 fm.

In a good approximation, the modified neutron black holes are some analogs to spherically symmetric, non-rotating (the Einstein spacetime inside such black hole has the same angular velocity as the black hole so the black hole is in the rest in relation to the spacetime [1B]), uncharged black hole. For such black hole, the relation between the gravitational redshift and the radial coordinate of the point of emission, r, looks as follows

$$z_G = \{1 / sqrt\ [1 - 2\ G\ M_{BH} / (r\ c^2)]\} - 1. \tag{6}$$

For the black hole of neutron in respect of the nuclear strong interactions is $GM_{BH}/c^2 = A$ [1A] so we can rewrite formula (6) as follows

$$z_G = [1 / sqrt\ (1 - 2\ A / r)] - 1. \tag{7}$$

For $r = R$, we obtain z_G = 0.53. It leads to conclusion that for $z_G \leq 0.53$, the gravitational redshift is equal to zero, i.e. for the interval $0 \leq z_G \leq 0.53$ the time distance can be calculated using the formula (5). For z_G = 0.53, the time distance is $L_{K,dual}$ = 8.7 Gyr.

On the other hand, from the cosmological facts follows that for bigger and bigger distances, the same changes in time distance cause greater and greater increases in total redshift. It leads to conclusion that total redshift should depend exponentially on total time distance, L_T, i.e. the relation between the time distance and total redshift should look as follows

$$L_{T,z\geq 0.53} = a\ ln\ (z + 1) + b. \tag{8}$$

Assume that the a is the kinematical age t calculated from formula (1) for z = 0.53

$$a = t = T\ (1 - z / 0.6415) = 2.41\ Gyr. \tag{9}$$

The constant b we can calculate from the condition that for z = 0.53 the formulae (5) and (8) must give the same time distance – it leads to b = 7.71 Gyr.

Now, we can test whether the formula (8) is correct. Calculate maximum z for the maximum distance L_T = 13.866 Gyr – we obtain z_{max} = 11.9. Distance can be determined via spectroscopy or using a photometric redshift technique. Spectroscopy is more precise. We know that the maximum photometric redshift is $z = 11.8 \pm 0.3$ – it is for the candidate protogalaxy UDFj-39546284 [4]. It leads to conclusion that obtained here theoretical result, z_{max} = 11.9, is so far consistent with observational facts so probability that formula (8) is correct is very high.

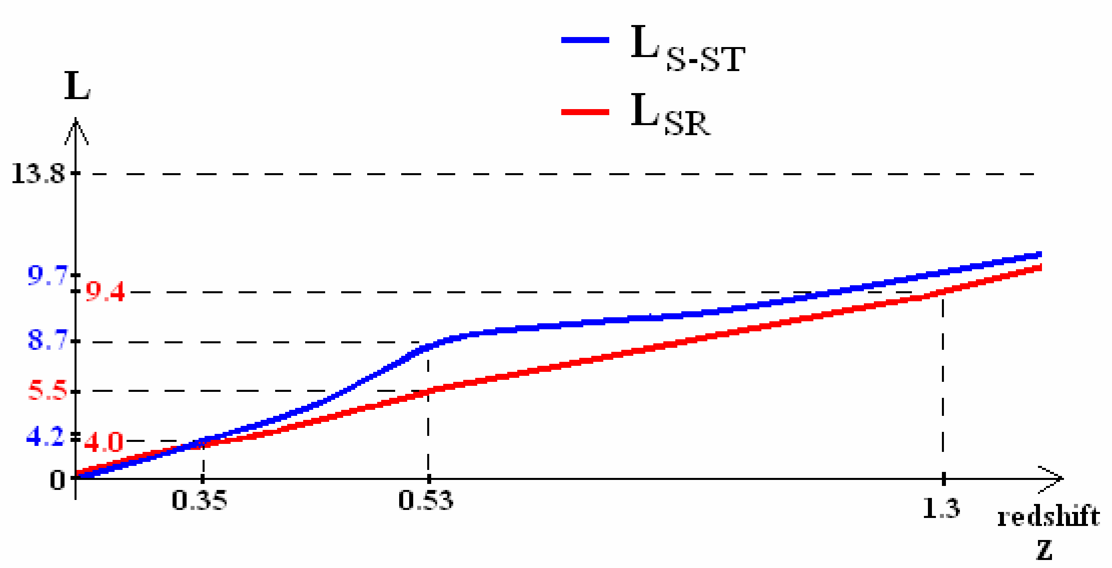
Now we can compare the results obtained using the formulae (5) and (8) with results obtained within the mainstream cosmology. Generally, presented here model leads to greater time distances of cosmological objects in comparison with the mainstream cosmology and it concerns the Type Ia supernovae as well. For example, for z = 0.45, formula (5) gives time distance about 1.4 Gyr greater i.e. about 30% bigger. On the other hand, the distances of the Type Ia supernovae calculated within the mainstream cosmology were, on average, 10% to 15% farther than expected [5]. This means that the Type Ia supernovae are fainter than they should be not due to some acceleration of expansion but because of the inaccurate formula for time distance applied in the mainstream cosmology.

Moreover, the duality of relativity and the protuberances of the dark matter and dark energy that carried the protogalaxies at the beginning of expansion of the Universe cause that the calculated within the mainstream cosmology the value of the Hubble constant is incorrect. We can see (Fig.) that for redshift from $z = 0$ to $z = 0.45$ the function (2) is in an approximation linear. The change in the age 6.4 Gyr ($13.866 - 7.5 \approx 6.4$) is for the change in the kinematical redshift equal to 0.45. It leads to conclusion that for this period (i.e. for the nearby Universe) the Hubble constant is about $H \approx 69$ – it is close to the value applied in the cosmological standard model (about 70). But it is an illusion that follows from the duality of relativity. The space distances, not time distances, lead to $H = 45.24$ [2].

The Fig. shows that we should observe an acceleration of expansion of the Universe for the interval $0.45 < z < 0.6$ and a deceleration for redshift higher than about 0.60 (i.e. for distant Universe). But it as well is an illusion.

Due to the inflows of the dark matter and dark energy into the baryonic matter, there was very rapid acceleration of expansion of the Universe at the beginning of the expansion [2B]. But we cannot see it because the most distant galaxies, in reality, are already 7.75 Gyr old.

Let us compare the distance-redshift relations obtained within Special Relativity (SR) and SST.



Differences in distances L from observer obtained within SR and S-ST.

The kinematical redshift of Special Relativity, z_{SR}, we obtain from following formula

$$z_{SR} = (z^2 + 2z) / (z^2 + 2z + 2). \tag{10}$$

Distance between observer and source, L_{SR}, we can calculate within SR applying following formula

$$L_{SR} = z_{SR} L_o, \tag{11}$$

where L_o = 13.8 Gyr ≈ 4230 Mpc.
Calculate the Hubble constant within the SR cosmology

$$H_{SR} = z_{SR} c / L_{SR} = c \text{ [km/s]} / L_o \text{ [Mpc]} = 70.9. \tag{12}$$

In the Fig. below, we present the differences in distance L of source from observer obtained within SR (formula (11)) and SST (formulae (5) and (8)).

We can see that, in reality, for $z > 0.35$, the Type Ia supernovae are more distant than it follows from the SR formula applied in mainstream cosmology (so they are fainter than they should be).

3. Summary

Here, applying the lacking part of ultimate theory, i.e. the Scale-Symmetric Theory, we described phenomena that lead to an illusion of acceleration of expansion of the Universe for $z > 0.45$ and of deceleration for $z > 0.60$.

We cannot neglect both the protuberant/"gravitational" redshift for $z \geq 0.53$ and the duality of relativity. The derived formulae for time distance between source and observer, give the time distances greater than calculated within the mainstream cosmology (for $z = 0.45$ is about 30%). On the other hand, the distances of the Type Ia supernovae were, on average, 10% to 15% farther than expected. This means that the Type Ia supernovae are fainter than they should be not due to an acceleration of expansion but due to the inaccurate formula for time distance applied in the mainstream cosmology. We proved that, in reality, for distances from observer greater than about 4 Gyr the Type Ia supernovae are more distant than it follows from SR applied in mainstream cosmology (so they are fainter than they should be).

Correctness of the new formula follows from the fact that calculated maximum redshift is $z = 11.9$. This value is consistent with the present-day observational facts (the maximum $z = 11.8 \pm 0.3$ for the candidate protogalaxy UDFj-39546284).

Due to the duality of relativity and due to the protuberant/"gravitational" redshift for compact cosmological objects, it is very difficult to calculate within the mainstream cosmology the exact time distances to the Type Ia supernovae. The uncertainty is much higher than the assumed about 5%.

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