Interactions of the Dark-Matter Loops with Baryonic Matter Once More

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Abstract: Here, applying the Scale-Symmetric Theory (SST), we present a recapitulation concerning the main formula describing the interactions of the dark-matter (DM) loops with baryonic vortex or stars via the condensates composed of the Einstein-spacetime components. We show that within the same model we can explain very different problems such as the non-gravitational orbital motions of stars outside the bulge of spiral galaxies, different upper limits for radii of accretion discs of black holes, the illusory changes in gravitational constant or the rotation braking of the main-sequence normal stars. We calculated upper limit for mass of single DM loop - it is about 17 powers of ten lower than the mass of electron. Here as well we motivate why the mainstream big bang of the Universe cannot be realized by Nature.

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/condensates/loops/quantum-physics 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 that was separated in time from the initial big bang – it was expansion/inflation of the Higgs field [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.

Rotating baryonic plasma can create the DM loops/circles. Number density of the DM loops depends directly proportional on initial mass of the baryonic plasma or on mass of dominating most heavy component of it. Due to possible explosions in the vortex of baryonic plasma, mass of it can change but due to the perfect elasticity of the DM loops, number density of the DM loops does not change with time. But notice that decreasing mass causes that intensity of interactions of the DM loops with baryonic matter decreases as well. The DM loops, due to the condensates of the Einstein-spacetime (Es) components, which are in centres of charged leptons and baryons [1A], can interact with their source i.e. with the rotating baryonic vortex or with other baryonic matter as, for example, stars in spiral galaxies – it is due to the SST confinement [1A]. The different condensates cause that there appear different coupling constants describing the interactions of the DM loops with baryonic matter via virtual pairs containing the Es condensates. Notice that the neutrino-antineutrino pairs in a loop are moving with the speed of light in "vacuum" c.

Due to the interactions of the DM loops with baryonic vortex or stars in spiral galaxies via virtual pairs containing Es condensates, there appears the advection i.e. the baryonic vortex or stars outside the central stellar bulge of a spiral galaxy acquire their unusual orbital speeds (we will call them the advection orbital speeds).

Virtual mass m^* that is the mediator of the interactions of the DM loops with the actual mass m_{actual} of baryonic vortex is defined by the product of the actual baryonic mass m_{actual} and the coupling constant that defines type of weak interactions $\alpha_{w(....)}$ i.e. $m^* = \alpha_{w(....)} m_{actual}$. It is assumed that speed of such virtual interactions is c. The inner kinetic energy of such virtual vortex is $E^* = 2\, m^* c^2 = 2\, \alpha_{w(....)}\, m_{actual}\, c^2$ (the factor 2 follows from the fact that according to the SST, the sum of the absolute virtual masses (there are the virtual pairs) is two times greater than the real mass that creates the virtual pairs [1A]). On the other hand, the virtual interactions caused that the initial baryonic mass m_o that was the source of the DM loops (number density of the DM loops depended initially directly proportional, and still depends, on the initial baryonic mass $m_{o,initial}$), acquired the advection speed $v_{advection,orbital}$ that is the invariant for the actual mass m_{actual} as well. The inner kinetic energy E_{IBV} of the initial baryonic vortex was $E_{IBV} = m_{o,initial}\, v_{advection,orbital}^2$. From equality of the two inner kinetic energies, $E_{IBV} = E^*$, we obtain the main formula

$$v_{advection,orbital} = c\, (2\alpha_{w(....)}\, m_{actual} / m_{o,initial})^{1/2} = const.. \qquad (1)$$

Non-gravitational motions of stars in spiral galaxies

Consider the non-gravitational motions of stars in spral galaxies. According to SST, due to the separation in time of the inflation and the "soft" big bang, formation of the protogalaxies composed of the neutron black holes was already before the "soft" big bang [1B]. Initially there were two loops of protogalaxies each composed of $2 \cdot 4^{32}$ neutron black holes (it follows from the pairing, the four-object symmetry and the structure of nucleons [1A], [1B]) grouped in $2 \cdot 4^{16}$ protogalaxies [1B]. Initial mass of each protogalaxy was $M_{Protogalaxy} = 1.0656 \cdot 10^{11}$ solar masses [1B]. But due to the pairing and the four-object symmetry, population of spiral binary systems composed of 8 protogalaxies, $m_{o,initial} = 2(4M_{Protogalaxy}) = 8.525 \cdot 10^{11}$ solar masses was highest. Such objects could transform into spiral galaxy or barred spiral galaxies. But explosions of such objects caused by the inflows of dark matter and dark energy, [1B], created the satellite dwarf galaxies and decreased the initial mass. But such explosions did not destroy the perfectly elastic DM loops created by the initial vortex of baryonic plasma in the typical massive spiral galaxies. In formula (1), the m_{actual} is the actual visible baryonic mass of a massive spiral galaxy whereas the interactions of the DM loops with the visible baryonic matter are via the weak Es condensates in the virtual electron-positron ($e^- e^+$) or muon-antimuon ($\mu^- \mu^+$) pairs – according to SST, coupling constant for such interactions is [1A]

$$\alpha_{w(electron\text{-}muon)} = 9.511082 \cdot 10^{-7}. \quad (2)$$

We can measure the advection speeds of stars outside the central bulge of the massive spiral galaxies and next, applying formula (1), we can calculate their actual visible baryonic masses. We can calculate the actual visible baryonic masses applying different methods and test whether formula (1) is correct. The known data suggest that formula (1) indeed describes correctly the interactions of the DM structures with stars in spiral galaxies [2].

Notice that in barred massive spiral galaxies that evolution was peaceful (i.e. without explosions leading to formation of the satellite dwarf galaxies i.e. $m_{actual} = m_{o,initial}$), the upper limit for the orbital speed of stars outside the central bulge of such barred galaxy is 413.48 km/s.

The correctness of formula (1) leads to conclusion that the mainstream big bang of the Universe was not realized by Nature. The correctness of formula (1) suggests that in reality, the beginning of expansion of the Universe was separated in time from the superluminal inflation of the Higgs field.

External radii of the accretion discs of black holes

Consider the external radii of the accretion discs of black holes [3]. Temperature inside such accretion discs is much higher than the surface temperature of stars so there are created the baryonic core-anticore pairs. The Es condensates in centres of the baryonic cores are much more massive ($Y = 424.12$ MeV) than in electrons and muons [1A]. According to SST, coupling constant for weak interactions via the baryonic core-anticore pairs is [1A]

$$\alpha_{w(proton)} = 0.0187229. \quad (3)$$

On the other hand, for accretion discs still powered by baryonic matter is $m_{actual} = m_{o,initial}$ so we can rewrite formula (1) as follows

$$v_{advection,accretion\text{-}disc} = c\,(2\,\alpha_{w(proton)})^{1/2} \approx 58{,}000 \text{ km/s}. \quad (4)$$

External radii of the accretion discs, R_{Disc}, we can calculate from equality of the advection velocity (formula (4)) and the gravitational orbital velocity that is tangent to the DM loops i.e. $v_{advection,accretion\text{-}disc}{}^2 = GM_{MBH} / R_{Disc}$, where R_{Disc} is the mass of central modified black hole [3]

$$R_{Disc} = G\, M_{MBH} / (2\, \alpha_{w(proton)}\, c^2) = 1.983 \cdot 10^{-26}\, M_{MBH},$$

$$R_{Disc} \approx 2 \cdot 10^{-26}\, M_{MBH}. \quad (5)$$

Observational data have higher accuracy for more massive modified black holes [4]. From formula (5) follows that for $M_{MBH} = 2 \cdot 10^{38}$ kg is $R_{Disc} = 0.4 \cdot 10^{13}$ m whereas for $M_{MBH} = 6 \cdot 10^{39}$ kg is $R_{Disc} = 1.2 \cdot 10^{14}$ m. These theoretical results are close to observational facts [4].

Illusory changes in the gravitational constant G [5]

According to SST, each electric charge produces one virtual electron-positron pair ($e^- e^+$ pair). Such virtual pair disappears in one place of the Einstein spacetime and appears in another one, and so on. Using such model we calculated, for example, the magnetic moments of electrons and muons with very high accuracy [1A]. We can see that Earth produces a cloud composed of the virtual $e^- e^+$ pairs. On the other hand, initially, instead the Earth there was a ring/loop composed of plasma overlapping with the later Earth orbit. Such plasma loop created the dark-matter (DM) loops. Today, the DM loops/structures overlap with the Earth orbit and their spin speed is equal to the speed of light in "vacuum" c. The condensates in centres of the components of the virtual cloud (their mass is $M_{C,electron} = 0.25520$ MeV [1A]), produced due to the weak interactions by the condensates in centres of the protons (mass of the proton condensates is $Y = 424.12$ MeV [1A]) the Earth consists of, due to the confinement and entanglement, interact with the DM loops so there appears the advection of the virtual cloud i.e. the cloud orbits the Sun as well but its orbital speed differs from the orbital speed of Earth.

According to SST, the coupling constant for the weak interactions of the virtual $e^- e^+$ pairs with the central Es condensates Y in protons is [1A]

$$\alpha'_{w(proton\text{-}electron)} = 1.11943581 \cdot 10^{-5}. \quad (6)$$

According to formula (1), the speed of advection of the virtual cloud is

$$v_{advection,virtual\text{-}cloud} = c\, (2\, \alpha'_{w(proton\text{-}electron)}\, M_{C,electron} / Y)^{1/2} = 34.796 \text{ km/s}. \quad (7)$$

This value is greater than the orbital speed of Earth $v_{orbital,Earth} = 29.783$ km/s [6]. It leads to the origin of the illusory changes in the gravitational constant G [5].

Rotation braking of the main-sequence normal stars [7]

The distribution of angular momentum among main-sequence normal stars shows that the stars at early spectral type O have rotational velocities higher than about 200 km/s up to about 400 km/s, next there is a plateau about 200 km/s at late O, all B and early A whereas at late A and especially at spectral type F, there is a significant decrease to about 10 km/s at

$G0$ and next there appears the second plateau about 10 km/s for colder main-sequence normal stars [8], [9].

There are the two models to solve this rotation-braking problem.

In both solution, the DM loops interact with a baryonic vortex in a star (the baryonic vortex creates the DM loops) via the Es condensates in the virtual e^-e^+ or $\mu^-\mu^+$ pairs so there is valid the coupling constant defined by formula (2).

Due to the advection and rotation of stars, near their equators can appear electron vortex or proton vortex or both vortices rotating in the same direction. It leads to conclusion that the m_{actual} in formula (1) is the mass of electron $m_{electron} = 0.5109989$ MeV or proton $m_{proton} = 938.2725$ MeV, [1A], whereas the initial mass $m_{o,initial}$ is the mass of proton.

The above remarks lead to following values for the stellar equatorial rotational velocities of the vortices caused by the advection

$$v_{advection,electron\text{-}vortex} = c\,(2\,\alpha_{w(electron\text{-}muon)}\,m_{electron} / m_{proton})^{1/2} = 9.65 \text{ km/s}, \quad (8a)$$

$$v_{advection,proton\text{-}vortex} = c\,(2\,\alpha_{w(electron\text{-}muon)}\,m_{proton} / m_{proton})^{1/2} = 413.48 \text{ km/s}. \quad (8b)$$

We can see that obtained results are close to the lower and upper limits for equatorial rotational velocities of main-sequence normal stars. Now we must motivate why there appear the two plateaus and two intervals of rotation braking. The explanation is as follows. In the early O (i.e. from $O0$ to $O5$) stars, there dominate the ions so, generally, due to the very high temperature, electrons are separated from protons and it causes that turbulent motions near the equator destroy the electron vortex (it has lower inertia than the proton vortex). It means that there dominates the proton vortex and the proton-vortex advection velocity. This and the below remarks lead to conclusion that for such stars, the rotational velocities should be from about 414 km/s down to 212 km/s – it is the first rotation braking. With decreasing temperature, there is more and more *neutral* helium so the electron vortex is stronger and stronger because electrons are coupled to the proton vortex – it decreases the mean advection velocity. In the late O, all B, all A and early F main-sequence normal stars, there dominates the neutral helium and next the neutral hydrogen so electrons are not separated from protons so the mean rotational velocity should be close to the mean advection velocity for the electron and proton vortices i.e. should be close to about 212 km/s – it is the first plateau. In the late F, all G and all K main-sequence stars, there appear the neutral metals i.e. the heavier atoms, so due to gravity, the rapid rotation is transferred to the cores of stars (the proton vortex inspirals towards the core) – due to the law of conservation of angular momentum, the rotational velocities near the equators decrease. Due to very high temperature in the cores, there dominate the proton vortices so the inner advection velocities should be close to 414 km/s – it causes that near the equators, the rotational velocities are a few km/s. Such is the origin of the second rotation braking and the second plateau.

But the first rotation braking and first plateau we can explain in a different way. We can assume that the stars from $O0$ to early F appear as helium vortex (i.e. the DM loops are created by the helium vortex) and next the angular momentum of such vortex, due to gravity is transferred to the core of stars so for lower and lower surface temperatures of stars, influence of the proton vortex is higher and higher. Mass of the atomic nuclei of helium is about $M_{He} = 3727.7$ MeV so we obtain

$$v_{advection,proton\text{-}vortex} = c\,(2\,\alpha_{w(electron\text{-}muon)}\,m_{proton} / m_{He})^{1/2} = 207.44 \text{ km/s}, \quad (9a)$$

$$v_{advection,helium\text{-}vortex} = c\,(2\,\alpha_{w(electron\text{-}muon)}\,m_{He}\,/\,m_{He})^{1/2} = 413.48 \text{ km/s}. \qquad (9b)$$

They are the lower and upper limits for the surface rotational velocities for stars from early F to $O0$.

We can see that applying formula (1), we solved four different problems. We showed that the problems can be solved because of the interactions of the DM loops with baryonic matter (which created the DM loops) via the weak interactions of the virtual or real particle-antiparticle pairs.

Upper limit for gravitational mass of single dark-matter loop

SST shows that due to the pairing, four-object symmetry and the structure of proton, a single DM loop can be composed of maximum $2{\cdot}4^{32}$ neutrinos (i.e. of 4^{32} entangled pairs) – its total mass is $1.23{\cdot}10^{-47}$ kg i.e. is about 17 powers of ten lower than the mass of electron.

References

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

[2] Sylwester Kornowski (11 January 2016). "The Dark-Matter Mechanism and Orbital Speeds of Stars in Galaxies"
http://vixra.org/abs/1410.0031

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

[4] Morgan, Christopher W., *et al.* (2010). "The Quasar Accretion Disk Size – Black Hole Mass Relation"
Astrophys. J. 712 (2010) 1129-1136

[5] Sylwester Kornowski (21 May 2016). "The Origin of the Illusory Periodic Changes in the Gravitational Constant"
http://vixra.org/abs/1605.0222

[6] Jorge Penarrubia *et al.* (21 September 2014). "A dynamical model of the local cosmic expansion"
MNRAS **443** (3): 2204 – 2222. doi: 10.1093/mnras/stu879

[7] Sylwester Kornowski (13 June 2016). "Interactions of the Dark-Matter Loops with Stars via Leptons Solve the Rotation Braking"
http://vixra.org/abs/1606.0131

[8] McNally D. (1965). "The distribution of angular momentum among main sequence stars"
The Observatory **85**: 166–169

[9] Simone Daflon, *et al.* (October 2007). "The projected rotational velocity distribution of a sample of OB stars from a calibration based on synthetic He I lines"
The Astronomical Journal, **134**:1570–1578