Unification of the Structures of Proton and Nucleus of Active Galaxy

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Abstract: Here, we unify the weak and strong interactions inside protons with the strong gravitational interactions in active galactic nuclei i.e. we unify particle physics with cosmology. Within the lacking part of ultimate theory, i.e. the Scale-Symmetric Theory (SST), we showed that outside the strong fields the gluons behave as photons. Due to the leaking internal structure of protons and the changing distances between the entangled Einstein-spacetime components, there appear the virtual dark-matter structures with different sizes which mimic the internal structure of protons and the characteristic motions of the entangled part of the Einstein spacetime inside it. The characteristic flows in the Einstein spacetime cause that there appear characteristic distribution and advection of the mass inside the nuclei of active galaxies. The core of proton consists of the condensate composed of the confined Einstein-spacetime components (it is the black hole with respect of the weak interactions) surrounded by the torus/charge composed of the carriers of gluons. There as well appear loops composed of entangled Einstein-spacetime components. On the other hand, a nucleus of active galaxy consists of gravitational black hole surrounded by accretion disc and of much bigger opaque torus of neutral gas and dust. Here, due to the characteristic flows in the Einstein spacetime, the advection is the transport mechanism of the mass of a nucleus of active galaxy by the moving entangled part of the Einstein spacetime. There as well appear the two relativistic jets which direction overlaps with the axis of the opaque torus. For their creation are responsible the two baryonic-plasma loops with parallel spins and opposite internal helicities. They appear on the Schwarzschild surface of the gravitational black hole. The obtained results are consistent with observational facts.

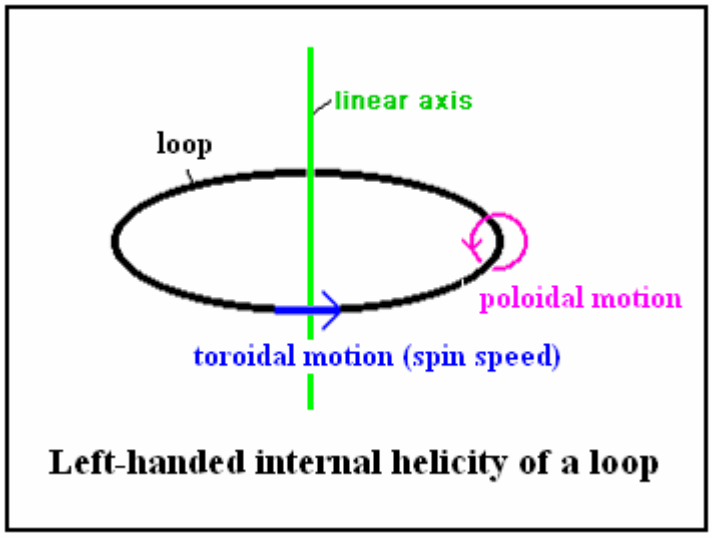
1. Introduction

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 (it is the quantum-

entanglement scale), stable neutrinos and luminal neutrino-antineutrino pairs which are the components of the luminal 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 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 (the big bang) [1A], [1B]. 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].

Applying 7 parameters only and a few new symmetries we calculated a thousand of basic physical (and mathematical) quantities consistent or very close to experimental data and observational facts (http://vixra.org/author/sylwester_kornowski). In SST, there do not appear approximations, mathematical tricks, and free parameters which are characteristic for the mainstream particle physics and mainstream cosmology.

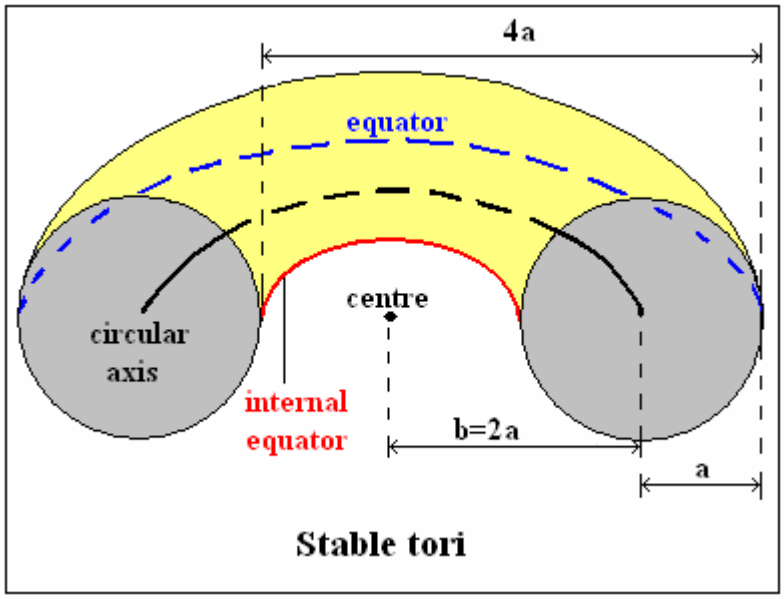


The core of proton consists of the condensate composed of the confined Einstein-spacetime components – it is the modified black hole (MBH; SST shows that in the MBH there is not a central singularity but there is a circle with spin speed equal to the speed of light in "vacuum" c) in respect of the weak interactions and its rest mass is $Y \approx 424.1$ MeV [1A]. The weak black hole is in centre of a torus/charge that mean radius (the b in formula (1)) is $F \approx 53.4$ times greater than the weak black hole. A virtual loop composed of entangled Einstein-spacetime components, created on equator of the weak black hole, has mass F times smaller than the large loop responsible for the strong interactions of mesons so its mass is $M_{Weak\text{-}Loop} \approx 1.27$ MeV and it is close to the mass distance between proton and bound neutron [1A].

Such loop has left-handed or right-handed internal helicity (Fig.). The torus/charge inside the core of nucleons has left-handed internal helicity and its rest mass is $X \approx 318.3$ MeV.

We know that following equation defines a torus:

$$(x^2 + y^2 + z^2 - a^2 - b^2)^2 = 4\,b^2\,(a^2 - z^2). \tag{1}$$



Tori are most stable when $b = 2a$ (Fig.). Therefore, the radius of the internal equator is equal to a. A most distant point of such torus (i.e. a point on the equator of torus) is in distance $3b/2 = 3a$. The weak black hole is in the centre of the torus/charge inside the core of nucleons.

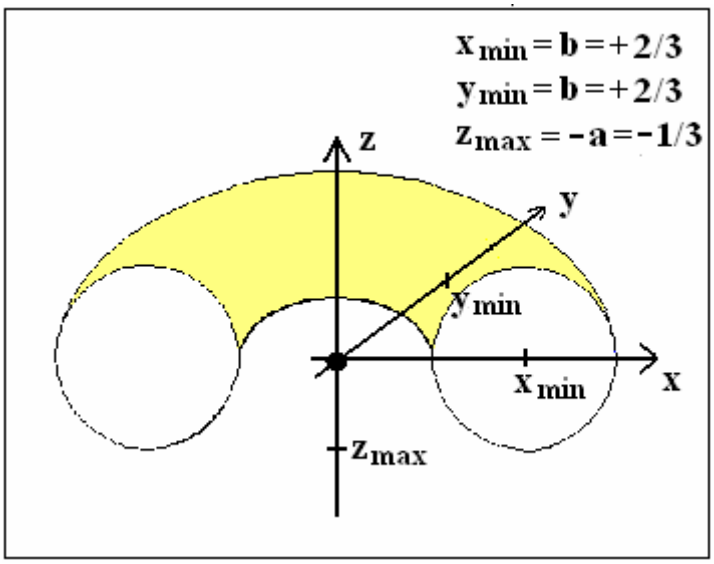
The spin speed of the Einstein-spacetime components on the equator of the torus/charge is equal to the speed of light in "vacuum" c. Due to the tremendous value of the two shortest-distance quantum entanglement, [1A], the torus/charge is practically indestructible. Since it consists of the luminal Einstein-spacetime components so there must appear the radial speeds of them. It is easy to notice that the mean spin speed of the torus is $2c/3$ so the mean radial speed of the Einstein-spacetime components must be $v = 0.745356c$.

Existence of such torus follows directly, first of all, from the succeeding phase transitions of the superluminal non-gravitating Higgs field [1A] but some indirect evidence results from the Kasner solution for the flat anisotropic model obtained within the General Relativity [2], [3]. Due to the very high mass density and pressure of the Einstein spacetime, it is flat [1B]. The Kasner metric [3] is the exact solution of the Einstein equations for "empty" spacetime i.e. in the SST such spacetime consists of the non-rotating-spin neutrino-antineutrino pairs moving with speed equal to the c. Such pairs cannot transfer any energy to other systems i.e. we can assume that the ground state of the Einstein spacetime is "empty". The total weak charge of each Einstein-spacetime component is equal to zero so its detection is much difficult than neutrinos. On the other hand, the virtual torus/charge has internal helicity so it is an anisotropic object.

The Kasner solution $(-1/3, +2/3, +2/3)$ we can interpret as a torus. In a three dimensional Cartesian coordinate system, with axis lines x, y, and z, on the assumption that radius of the equator of the torus is equal to 1, we obtain (Fig.)

$$(-1/3, +2/3, +2/3) \equiv (z_{max}, y_{min}, x_{min}). \quad (2)$$

Assume that the external radius of the torus decreases. Then, the absolute value of the dimension z increases whereas the dimensions x and y decrease.



The scales of sizes are partially dual i.e., for example, there is an analogy between the strong-weak interactions concerning the electric-charges scale (the torus in the core of baryons behaves as the black hole in respect of the strong interactions whereas the condensate in its centre behaves as weak black hole) and strong gravitational interactions concerning the cosmological scale.

Due to the collapse of the outer shell of the expanding Einstein spacetime, there were liberated the entanglons responsible for the quantum entanglement of the Einstein-spacetime components. From the entangled Einstein-spacetime components are built, besides the neutrinos, all observed particles [5], [6], [4].

The gluons and photons are the rotational energies of the Einstein-spacetime components. Outside the strong fields, the gluons behave as photons [1A]. This and the entanglement cause that the virtual structure of protons leaks from proton. Since distances between entangled particles can increase (for example, the distance can be periodically doubled [1C]) so in the Einstein spacetime appear virtual dark-matter structures which mimic the structure and motions in the core of protons. Such virtual dark-matter structures can be via the weak interactions of charged leptons entangled with gravitating matter, for example, with mass of nuclei of active galaxies. It leads to conclusion that distribution of mass and its motions in nuclei of active galaxies should mimic the core of protons. It is the advection inside the nuclei of active galaxies. We can say that due to the quantum entanglement, the Einstein spacetime exhibits the chaotic behaviour [1C]. Universality in chaos is the idea that very different systems can exhibit the same type of chaos.

Here, the advection is the transport mechanism of the mass of the nuclei of active galaxies by the entangled Einstein-spacetime components (by the virtual dark-matter structures) due to the characteristic motions in it.

The structure of proton leads to number very close to the first Feigenbaum constant $\delta = 4.6692016\ldots$ applied in the Chaos Theory [1C].

We can see that the transition from the weak-strong interactions in protons to the strong gravitational interactions in the nuclei of active galaxies should lead to modified gravitational

black hole surrounded by accretion disc and much bigger opaque torus of neutral gas and dust. On the Schwarzschild surface of a modified gravitational black hole should appear binary system of loops composed of baryonic plasma. Since protogalaxies had angular velocity not equal to zero, [1B], so spins of the two loops should be parallel. Since total internal helicity of a protogalaxy is zero so the two loops should have opposite internal helicities. The baryonic-plasma loops are charged positively so they produce very strong magnetic field with magnetic axis overlapping with the axis of rotation of the opaque torus.

Our Universe appeared inside the Protoworld as the Double Cosmic Loop composed of the binary systems of protogalaxies i.e. the binary systems of protogalaxies were created already before the "soft" big bang. Each protogalaxy consisted of 4^{16} modified neutron black holes (MNBHs) [1B]. Mass of each MNBH is 24.81 times greater than mass of the Sun and its radius is about 37 km [1B]. Mass of each binary system of protogalaxies was $M_{2*Proto} = 4.2 \cdot 10^{41}$ kg i.e. $2 \cdot 4^{16}$ MNBHs [1B]. Such binary systems transformed into AGN and next into massive galaxies. This leads to conclusion that abundance of active galactic nuclei with jets, in the distant massive galaxies, should be much higher than observed. To explain this discrepancy notice that the age of the Universe is 21.866 ± 0.096 Gyr but due to the duality of relativity the time distance to the observed most distant galaxies is 13.866 ± 0.096 Gyr i.e. they are already 7.75 Gyr old [7]. Just we cannot see the period 7.75 Gyr from the beginning of expansion of the Universe.

2. Calculations

Calculate the initial conditions for the AGN. At the beginning of expansion of the very early Universe, the binary systems of protogalaxies were the modified black holes. Their Schwarzschild surface had radius

$$R_{BH,S,initial} = 2\,G\,M_{2*Proto} / c^2 \approx 6.3 \cdot 10^{14} \text{ m} \approx 0.021 \text{ pc}. \quad (3)$$

Due to the inflows of the dark matter and dark energy, it transformed into the proto-AGN. It consisted of the central black hole composed of the MNBHs. Its mass we can calculate from following formula (we neglect the binding energy)

$$M_{BH,initial\text{-}AGN} = M_{2*Proto}\,Y / (X + Y) \approx 2.4 \cdot 10^{41} \text{ kg} \approx 1.2 \cdot 10^{11}\,M_{Sun}. \quad (4)$$

Since the most distant galaxies are already 7.75 Gyr old so we do not see such massive black holes inside active galaxies. The "seen" most massive black holes have mass about 10 times smaller.

The radius of the Schwarzschild surface is

$$R_{BH,S,initial\text{-}AGN} = 2\,G\,M_{BH,initial} / c^2 \approx 3.6 \cdot 10^{14} \text{ m} \approx 0.012 \text{ pc}. \quad (5)$$

The initial mean radius of the opaque torus (i.e. the b in equation (1)) is

$$R_{Torus,initial\text{-}AGN} = R_{BH,S,initial}\,F \approx 0.62 \text{ pc}. \quad (6)$$

The initial mass of the opaque torus is

$$M_{Torus,initial\text{-}AGN} = M_{2*Proto}\,X / (X + Y) \approx 1.8 \cdot 10^{41} \text{ kg} \approx 0.9 \cdot 10^{11}\,M_{Sun}. \quad (7)$$

Due to the asymmetrical inflows of the dark matter and dark energy, the resultant masses of the MNBHS in the central black hole can be different in different active galaxies. There are 4 different carriers of gluons (they can be left-handed or right-handed so there are 8 different gluons) [1B]. It leads to the four-carrier symmetry i.e. systems containing following number, for example, of binary systems of neutron black holes are most stable [1B], [1D]

$$D = 4^d, \text{ where } d = 0, 1, 2, 4, 8, 16. \tag{8}$$

It leads to conclusion that the present-day massive spiral galaxies with black hole containing $2 \cdot 4^8$ MNBHs should be most stable i.e. they should be most numerous among the massive galaxies. Since mass of neutron black hole is 24.81 times greater than the mass of the Sun so the mass of the black hole in centres of the present-day massive spiral galaxies should be about 3.25 million times greater than the mass of the Sun. We know that such mass has the black hole in the centre of the Milky Way galaxy.

Due to the advection, the mass of the opaque torus flows into the accretion disc (similar to nucleons there are the spin and radial motions) and next between the baryonic-plasma loops (it is the Broad Line Region). The strong magnetic field produced by the binary system of the baryonic-plasma loops, causes that the charged particles are moving along spirals which axes overlap with the axis of the opaque torus. It means that the charged particles accelerate so there appear the synchrotron photons. The charged particles moving inside the jets along the spirals, take away the angular momentum of the accretion disc. Until now the two processes, i.e. the formation of jets and the transport of the angular momentum from the accretion discs were not well understood (both phenomena are described within SST [8]). These phenomena were among the unsolved problems in physics.

Due to the inflows of the dark matter and dark energy into the central black hole, the created gas and dust as well supplies the accretion disc. In such a way the mass of the central black hole is reduced.

The dark-matter flows inside the AGN that mimic the motions in nucleons and the dark-matter—baryonic-matter advection causes that matter from the opaque torus flows via accretion disc towards the association of the MNBHs and next along jets – it decreases the temperature inside the opaque torus.

We must emphasize that the radial speed of the mass near the opaque torus which follows from the advection, is much lower than the mean radial speed of the entangled Einstein-spacetime components.

3. Summary

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The obtained results are consistent with observational facts.

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[1B]: http://vixra.org/abs/1511.0223 (Cosmology)
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