Unification of the Structures of Proton and Nucleus of Active Galaxy

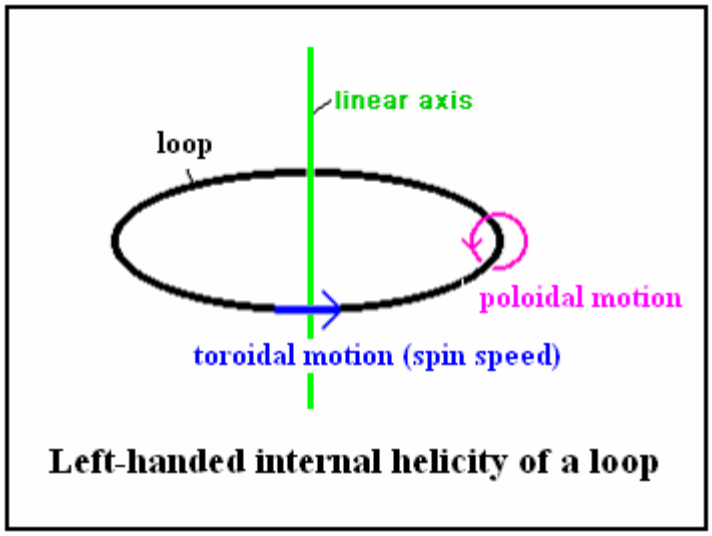
Sylwester Kornowski

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 Everlasting Theory, I 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 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 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 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 the observational facts.

1. Introduction

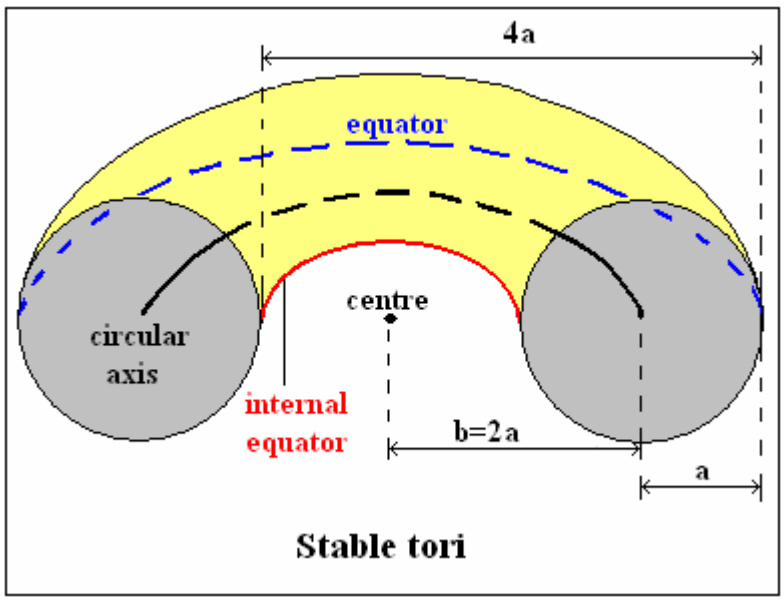
The scale-symmetric Everlasting Theory, [1] (the foundations) and [2], starts from the expansion of the cracked space (it is the inflation of the Higgs field – the big bang) which leads to the Einstein spacetime (E spacetime). There appear the four succeeding phase transitions of the modified Higgs field (due to the size of our Cosmos, the next phase transitions are impossible) and the atom-like structure of baryons. The atom-like structure of baryons leads to the exact mass, spin and radius of proton.

The core of proton consists of the condensate composed of the confined E-spacetime components – it is the black hole with respect of the weak interactions and its rest mass is Y ≈ 424.1 MeV [1]. The weak black hole is in centre of a torus which mean radius (the b in formula (1)) is F ≈ 53.4 times greater than the weak black hole. A virtual loop composed of entangled E-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 $M_{Weak\text{-}Loop}$ ≈ 1.27 MeV and it is close to the mass distance between neutron and proton. Such loop has left-handed or right-handed internal helicity (Fig.). The torus inside the core of nucleons has left-handed internal helicity and its rest mass is X ≈ 318.3 MeV.



We know that following equation defines a torus:

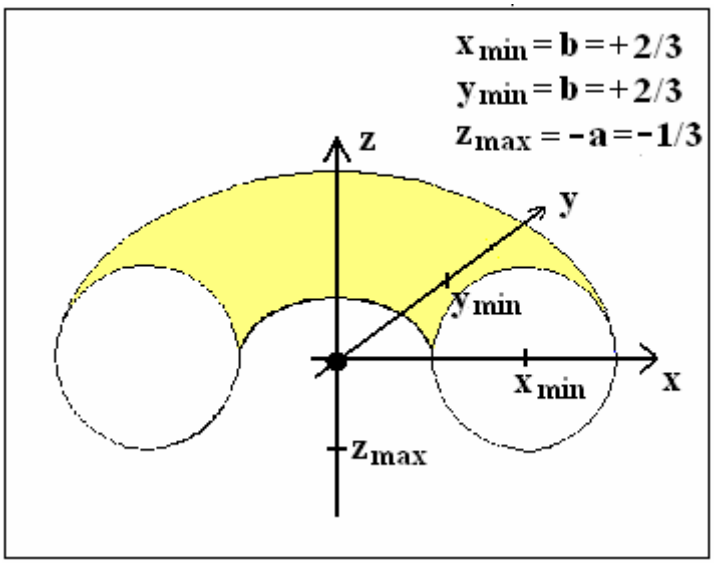
$$(x^2 + y^2 + z^2 - a^2 - b^2)^2 = 4b^2(a^2 - z^2). \quad (1)$$



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 inside the core of nucleons.

The spin speed of the E-spacetime components on the equator of the torus is equal to the speed of light in “vacuum” c. Since the torus must be a stable object and because it consists of the luminal E-spacetime components so there must appear the radial speeds of the E-spacetime components the torus consists of. It is easy to notice that the mean spin speed of the torus is 2c/3 so the mean radial speed of the E-spacetime components must be v = 0.745356c.

Existence of such torus follows directly, first of all, from the succeeding phase transitions of the modified Higgs field [1] but some indirect evidence results from the Kasner solution [3] for the flat anisotropic model obtained within the General Relativity ([1] – see Chapter “General Relativity in Reformulated Quantum Chromodynamics and New Cosmology”). Due to the very high mass density and pressure of the E spacetime, it is flat. The Kasner metric [3] is the exact solution of the Einstein equations for ‘empty’ spacetime i.e. in the Everlasting Theory nomenclature 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 an E-spacetime component is equal to zero so its detection is much difficult than neutrinos. On the other hand, the virtual torus 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.

Due to the four phase transitions, there are in existence the four scales i.e. the superluminal-quantum-entanglement scale, luminal Planck scale concerning the E-spacetime components, observed-particles scale and cosmological scale. Just the Everlasting Theory is the scale-symmetric theory [4]. The scales are partially dual i.e., for example, there is an analogy between the strong-weak interactions concerning the observed-particles 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 E spacetime, there were liberated the entanglons responsible for the quantum entanglement of the Einstein-spacetime components. From the entangled E-spacetime components are built up, besides the neutrinos, all observed particles [5], [6], [4].

The gluons and photons are the rotational energies of the E-spacetime components. Outside the strong fields, the gluons behave as photons [1]. This and the entanglement cause that the virtual structure of protons leaks from proton ([1] – see Chapter "Proton and Loops as Foundation of Theory of Chaos"). Since distances between entangled particles can increase (for example, the distance can be periodically doubled) so in the E spacetime appear virtual structures which mimic the structure and motions in the core of protons. Such virtual structures can be entangled with 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 E spacetime exhibits the chaotic behaviour. 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 E-spacetime components (by the virtual structures) due to the characteristic motions in it.

The structure of proton leads to number 4.66913 ([1], see formula (225)) which is very close to the Feigenbaum constant $\delta = 4.6692016\ldots$ applied in the Theory of Chaos. We can interpret from δ that as a system approach chaos (in proton), in a region of E spacetime is created the torus (a), next the condensate in its centre (b) and next the relativistic pion (c). The ratios of these masses in proton in an approximation are $a : b : c \approx 3 : 4 : 2$. We can see that ratio of mass of the core (torus + condensate) to mass of the relativistic pion is about $(a + b)/c \approx 7/2$ whereas of the torus to the condensate is $a/b \approx 3/4$. The ratio of these two ratios is $14/3 \approx 4.66(6)$ and this result is very close to the δ (the exact value for proton is 4.66913).

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 gravitational black hole surrounded by accretion disc and much bigger opaque torus of neutral gas and dust. On the Schwarzschild surface of the gravitational black hole should appear binary system of loops composed of baryonic plasma. Since protogalaxies had angular velocity not equal to zero 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 lines parallel to the axis of the opaque torus.

Due to the quantum entanglement and the fourth phase transition of the modified Higgs field, there appeared the cosmic object-antiobject pairs (the protoworld-antiprotoworld pairs). Due to the evolution of the left-handed Protoworld, there appeared the dark energy and the expanding Universe (the 'soft' big bang) [1].

Our Universe appeared inside the Protoworld as the 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} neutron black holes. Mass of each neutron black hole is 24.8 times greater than mass of the Sun and its radius is about 37 km [1]. Mass of each binary system of protogalaxies was $M_{2*Proto} = 4.2 \cdot 10^{41}$ kg i.e. $2 \cdot 4^{16}$ neutron black holes [1]. 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 20.9 Gyr [1] but due to the size and evolution of the Cosmic Loop, the time distance to the observed most distant galaxies is 13.4 Gyr i.e. they are already 7.5 Gyr

old [7]. Just we cannot see the period 7.5 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 black holes. Their Schwarzschild surface had radius

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

Due to the inflows of the dark energy, it transformed into the proto-AGN. It consisted of the central black hole composed of the neutron black holes. Its mass we can calculate from following formula

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

Since the most distant galaxies are already 7.5 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

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

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

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

The initial mass of the opaque torus is

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

We can see that due to the asymmetrical inflows of the dark energy, the resultant masses of the neutron black holes in the central black hole can be different in different active galaxies. There are 4 different carriers of gluons [1] (they can be left- or right-handed so there are 8 different gluons [1]). 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

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

It leads to conclusion that the present-day massive spiral galaxies with black hole containing $\mathbf{2 \cdot 4^8}$ neutron black holes should be most stable i.e. they should be most numerous among the massive galaxies. Since mass of neutron black hole is 24.8 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 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 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 jets formation and the carriage of the angular momentum of the accretion disc were not well understood. These phenomena were among the unsolved problems in physics.

Due to the inflows of the 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.

In the accretion disc and on surface of the baryonic-plasma loops are possible following transformations

$$2\ p + e^{-}\ e^{+} + \nu_e\ \nu_{e,anti} \rightarrow n + p + \pi^{+} \tag{9}$$

In such processes about 7% of mass is transformed into radiation and it is about 10 times more than in the nuclear transformations inside the San.

The advection 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 E-spacetime components.

3. Summary

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 Everlasting Theory, I 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 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 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 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 the observational facts.

References

[1] Sylwester Kornowski (14 March 2014). “The Everlasting Theory and Special Number Theory”.
http://www.rxiv.org/abs/1203.0021 [v3].

[2] Sylwester Kornowski (2012 – 2014).
http://www.rxiv.org/author/sylwester_kornowski .

[3] Kasner Edward; “*Geometrical Theorems on Einstein’s Cosmological Equations.*”; American Journal of Mathematics **43** (4): 217 – 221 (1921).

[4] Sylwester Kornowski (26 August 2014). “The Hierarchy Problem and Oscillations of Neutrinos in the Scale-Symmetric Everlasting Theory”.
http://www.rxiv.org/abs/1408.0179 .

[5] Sylwester Kornowski (26 November 2013). “The Inflation in the Everlasting Theory”.
http://www.rxiv.org/abs/1311.0174 .

[6] Sylwester Kornowski (24 August 2014). “The Origin of the Quantum Entanglement and Acceleration of Expansion of the Universe”.
http://www.rxiv.org/abs/1408.0116 .

[7] Sylwester Kornowski (21 June 2014). “The Evolution of Massive Galavies”.
http://www.rxiv.org/abs/1406.0014 [v4].