Mathematical Constants in Physics

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Abstract: Theories that describe the same phenomena but contain more parameters are the worse theories. Mathematical constants applied in physics if they have not a physical meaning are the parameters as well. It leads to conclusion that to reduce number of parameters we must show how mathematical constants applied in physics arise from physical initial conditions. In the Scale-Symmetric Theory, number of all parameters is reduced to 7. Here, using the Scale-Symmetric Theory, we described the origin of mathematical constants in physics. We showed that the state of spacetime and the structure of baryons that due to the dark-matter structures leaks out, leads to a number that is close to the base of the natural logarithm, whereas the entanglons responsible for the quantum entanglement lead to number Pi and to the imaginary unit i = sqrt(-1).

1. Introduction

Theories that describe the same phenomena but contain more parameters are the worse theories. Mathematical constants applied in physics if they have not a physical meaning are the parameters as well. It leads to conclusion that to reduce number of parameters we must show how mathematical constants applied in physics arise from physical initial conditions.

The physico-mathematical relations are very important in order to decipher the structure of Nature. In physics the mathematical constants $e \approx 2.71828$, the number $\pi \approx 3.14159$ and the imaginary unit $i = sqrt(-1)$ appear almost everywhere. This must have a very deep meaning.

Here we will show that the Scale-Symmetric Theory, [1], [2], [3], [4], leads to the mathematical constants applied in physics.

2. The state of spacetime leads to number 2.71667 whereas structure of baryons leads to number 2.71954 (mean value is 2.71810)

Number e is a constant approximately equal to 2.71828

The number e can be calculated as the sum of the infinite series [5]

$$e = \Sigma_{n=0\,,\,\infty}\, 1 / n! = 1 + 1 / 1 + 1 / (1 \cdot 2) + 1 / (1 \cdot 2 \cdot 3) + \ldots =$$

$$= 1 / 1 + 1 / 1 + 1 / 2 + 1 / 6 + 1 / 24 + 1 / 120 + \ldots \qquad (1)$$

We can see that in the denominators there is following series: $S = 1, 1, 2, 6, 24, 120, \ldots$

SST shows that during the inflation, the initial inflation field, i.e. the superluminal Higgs field composed of the non-gravitating tachyons, partially transformed into the luminal Einstein spacetime composed of the neutrino-antineutrino pairs [1]. The succeeding phase transitions of such Higgs field lead to different scales of sizes. There appear structures having following number of degrees of freedom [1]

$$N = (d - 1) \cdot 8 + 2, \tag{2}$$

where $d = 0, 1, 2, 4, 8, 16$ (16 is the upper limit that follows from size of our Cosmos [2]. We obtain following series $S_1 = -6$ (for tachyons), 2 (for rotational energies), 10 (for entanglons responsible for quantum entanglement), 26 (for neutrinos and neutrino-antineutrino pairs), 58 (for cores of baryons and electrons), 122 (for cosmic structures). The spinning of tachyons is eternal so the absolute value of -6, i.e. 6, represents their ground state. The sign "–" means that free tachyons have broken contact with other objects (they do not produce any field) i.e. they are the imaginary objects. Rotational energies, i.e. photons and gluons, are eternal so the 2 represents the ground state of photons and gluons. In the ground states, the neutrinos, cores of baryons and cosmic objects do not rotate so instead 26, 58, 122 we have 24, 56, 120.

Which objects are the constituents of the spacetime?

The spacetime is the two-component object i.e. there is the imaginary part, i.e. the superluminal Higgs field, and the real luminal Einstein spacetime [1]. Each component can be represented by number 1 so we have 1 and 1. There are the eternal rotational energies of the Einstein-spacetime components, i.e. the photons, which are represented by number 2. The components of the Higgs field are represented by number 6. The superluminal entanglons are frozen inside neutrinos and can be exchanged only so there is not in existence a field composed of entanglons – it means that they are not components of spacetime. The ground state of the Einstein spacetime consists of the non-rotating-spin neutrino-antineutrino pairs so they are represented by number 24. There is not a field filling whole Cosmos composed of the cores of baryons and electrons so they are not a part of spacetime. In whole Cosmos are created cosmic vortices in the Einstein spacetime, [2], so they are a part of the spacetime and they are represented by number 120. Due to the size of the Cosmos, [2], in the spacetime which fills whole Cosmos bigger structures cannot appear.

We can see that following series represents the spacetime

$$S_{Cosmos} = 1, 1, 2, 6, 24, 120. \tag{3}$$

In reality, we must use the inverse numbers – it suggests that phase spaces containing more elements (more degrees of freedom) are less and less important.

Using formula (1) we obtain that following number should be common in physics

$$e_S = \Sigma_{n=0,\ 5}\ 1 / \mathrm{n!} = 1 + 1 + 1 / 2 + 1 / 6 + 1 / 24 + 1 / 120 \approx 2.71667 \tag{4}$$

What can be found in the Titius-Bode law for the strong interactions is [1]

$A = 0.6974425$ fm,
$B = 0.5018395$ fm.

If we change these values, we obtain incorrect values for, for example, the mass of nucleons and the magnetic moments of nucleons. The theory is very sensitive for each change in value of the initial parameters. The internal structure of the baryons, due to the dark-matter structures, leaks outside them [3].

We can see that the following expression is close to the e

$$e_{TB} = 1 + (A + B) / A = 2.71954.$$

The mean value is then very close to e

$$e_{Mean} = (e_S + e_{TB}) / 2 = 2.71810.$$

3. Number π in particle physics and cosmology

Similarly to the number e, the number π is also extremely common in physics. This means that the number π should have very significant physical meaning. The invariance of π applied in particle physics and cosmology suggests that the first phase transition of the Higgs field should lead to inflexible physical circles and SST shows that during the inflation the Nature had realized such scenario. Just the first objects cannot be flexible as it is in the string/M theory because then the gravitational constant could not be invariant, and so on [1].

Moreover, due to the superluminal quantum entanglement between the neutrino-antineutrino pairs the Einstein-spacetime consist of, there appear the dark-matter structures that can be the physical circles as well [2], [3].

SST shows that physical circles/loops indeed are extremely common in our Cosmos.

4. What is the physical meaning of the imaginary unit 'i'?

Within the SST we showed that the smallest circles (the closed strings) have internal helicity [1]. It causes that due to the interactions of them with the Higgs field, they produce half-jet in direction perpendicular to the plane of a circle. Due to the internal helicity and shape of the closed string, the winds created in the Higgs field around the closed string separate from it on the internal equator of the closed string because there the pressure of the Higgs field is lowest. The winds that are separated are the jets perpendicular to the plane defined by the closed string. Assume that such half-jet represents the real axis of the circle. We can assume as well that the closed string cut out an imaginary circle from the imaginary Higgs field.

The formula $i = exp(i\pi/2) = sqrt(-1)$ shows that the imaginary plane is perpendicular to the real axis (there is $\varphi = \pi/2$). Let us cut out the circle that has a radius equal to i from the imaginary plane. The imaginary area of such circle equals $-\pi$. Let us assume that the x-axis is the real axis whereas the plane defined by the axes iy and iz is the imaginary plane. Let as also assume that such a mathematical object is moving along the axis iy and that the real x-axis rotates around the axis iy. Using those assumptions the arising wave along the axis iy, associated with the interval $< 0, 1 >$ on the real axis x, and the interval $< 0, i >$ on the axis iz, describes the frequently applied Euler formula

$$exp(i\,\varphi) = cos\varphi + i\,sin\varphi. \qquad (5)$$

We can see that if the half-jet of the closed string rotates around the direction of the motion then the aforementioned Euler formula describes the arising wave.

5. Summary

Theories that describe the same phenomena but contain more parameters are the worse theories. Mathematical constants applied in physics if they have not a physical meaning are the parameters as well. It leads to conclusion that to reduce number of parameters we must show how mathematical constants applied in physics arise from physical initial conditions.

In the Scale-Symmetric Theory, number of all parameters is reduced to 7.

Here, using the Scale-Symmetric Theory, we described the origin of basic mathematical constants in physics. We showed that the state of spacetime and the internal structure of baryons lead to a number that mean value is close to the base e of the natural logarithm, whereas the entanglons responsible for the quantum entanglement lead to number π (the other loops/circles that appear in particle physics and cosmology lead to this number as well) and to the imaginary unit $i = sqrt(-1)$.

References

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[5] Encyclopedic Dictionary of Mathematics 142.D