

Review Article

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Emptiness and Vacuums

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ABSTRACT

This article presents the author's mathematical study concerning the void and the vacuum regions contained within it. It demonstrates the interaction between these regions—an interaction possible in a four-dimensional space shaped like a sphere. Three of these dimensions form a cosmological constant that acts upon the remaining fourth dimension, balancing the vacuum region and preventing it from collapsing into a singularity.

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Introduction

This article is based on the author's reflections on the concept of emptiness. How can "everything" arise from "nothing"? This question belongs more to the realm of philosophy than to physical science. Nevertheless, a logical analysis of this concept has made it possible to formulate certain physical regularities inherent to it. The proposed theory was developed on this foundation. The principles underpinning the theory allow for the establishment of connections between the concept of emptiness and the vacua contained within it.

It should be noted that the mechanism behind the emergence of vacua is not the primary factor.

The theory of three-dimensional time developed by the author predicts the emergence of various chronotrajectories, each corresponding to specific types of vacua within different hyperplanes. The selection of chronotrajectories is a separate issue; however, general patterns regarding their emergence can be identified through research. To facilitate further understanding, it should be noted that three-dimensional time is described within a three-dimensional rectangular system of chronocoordinates $\tilde{\psi}, \psi, \tau$. Each coordinate, multiplied by the speed of light, yields three metric chronocoordinates of 3-dimensional time: $\tilde{l}$ - a spatial direction in the vertical hyperplane; $\tilde{l} = c\tilde{\psi}$ - a spatial direction in the horizontal hyperplane; $s = c\tau$ - the one-dimensional direction of proper time.

The specified coordinates define three hyperplanes. Two of these—and —possess their own time vectors, which are linked to the coordinates via trigonometric relations. These vectors are interdependent. The study of their interaction forms the basis of the theory of time [1]. Each time vector describes a specific

planar chronotrajectory. Rotating a chronotrajectory around a chosen coordinate axis generates a volume that encompasses a region known as a vacuum. The geometric properties of the chronotrajectory determine the geometry of the vacuum.

Using the theory of time, the author has constructed a consistent framework that leads to conditions allowing us to speak of a "Beginning."

Let us briefly outline its stages. The theory is founded on the existence of primordial elementons—gravitons and chronons—which form chronal-graviton fields; these manifest in three-dimensional time as counter-propagating flows of the aforementioned particles. Their characteristics are detailed in [2]. These fields create regions within the void, which we designate as vacua.

Theory of Emptiness

Based on the information presented above, let us proceed to examine the theory of void. We shall supplement the definition of void set forth in the author's work [2]:

Absolute void is a space devoid of intrinsic time, possessing zero matter density and zero total energy.

This fundamental property of absolute void can be expressed mathematically in a general form as the derivative of vacuum mass with respect to its volume:

$$\rho_{\Pi} = \frac{dm_{vac}}{dV_{\Pi}} = 0 \quad (1a)$$

It follows from the property of the derivative that the mass of the vacuum is a constant quantity:

$$m_{vac} = const$$

In this case, the volume of the void is an infinite quantity:

$$\rho_{\Pi} = \frac{dm_{\text{bak}}}{dV_{\Pi}} = \frac{m_{\text{bak}}}{V_{\Pi}} = \frac{m_{\text{bak}}}{\infty} = 0$$

Thus, constant mass is present in the void, existing within an infinite volume. However, logic suggests that mass should be distributed within a finite volume. In this regard, the formula (1.1a) for the density of the void can be written as:

$$\rho_{\Pi} = \frac{m_{\text{bak}}}{V_{\text{bak}}} \cdot \frac{V_{\text{bak}}}{V_{\text{ck}}} \cdot \frac{dV_{\text{ck}}}{dV_{\Pi}} = \rho_{\text{bak}} \cdot \frac{V_{\text{bak}}}{V_{\text{ck}}} \cdot \frac{dV_{\text{ck}}}{dV_{\Pi}} = 0 \quad (1b)$$

Where $\rho_{\text{bak}} = \frac{m_{\text{bak}}}{V_{\text{bak}}} \neq 0$ there is a mass density of the primordial vacuum,

$$\rho_{\text{bak}} \cdot \frac{V_{\text{bak}}}{V_{\text{ck}}} = \frac{m_{\text{bak}}}{V_{\text{ck}}} = \rho_{\text{ck}} \text{ there is a medium density in the scalar}$$

field

$$\frac{dV_{\text{ck}}}{dV_{\Pi}} = 0 \text{ there is a derivative of the change in the volume of the}$$

chronal medium with respect to the volume of the void.

A volume ratio equal to zero implies that the volume of the medium contained within the scalar field is constant.

Let us consider another property of the void in terms of energy. By this, we mean the energy contained within vacua.

Based on this definition, let us represent the void in terms of energy density:

$$\varepsilon_{\Pi} = \rho_{\Pi} u_{\Pi}^2 \quad (2a)$$

Assuming $\rho_{\Pi} = \text{const} = 0$ we differentiate the formula:

$$\begin{aligned} d\varepsilon_{\Pi} &= \rho_{\Pi} du_{\Pi}^2 = \rho_{\Pi} 2u_{\Pi} du_{\Pi} \\ \frac{d\varepsilon_{\Pi}}{du_{\Pi}} &= 2u_{\Pi} \rho_{\Pi} = 2u_{\Pi} \cdot 0 = 0 \end{aligned}$$

where

Thus we have

$$d\varepsilon_{\Pi} = 0 \quad (2b)$$

The integration of the equation depends on the initial condition. This condition may be either zero or non-zero. A zero initial condition applies to a primordial vacuum not subjected to an influx of energy from the outside. A non-zero initial condition arises in the primordial vacuum following an external energy influx.

Let us consider the primordial vacuum at $\varepsilon_{\Pi}(0) = 0$. Integrating (2b) leads to a constant energy density:

$$\int_0^{\varepsilon_{\Pi}} d\varepsilon_{\Pi} = \varepsilon_{\Pi}$$

The formula takes the form

$$\varepsilon_{\text{en}} = \rho_{\text{bak}} c^2 = \frac{m_{\text{bak}} c^2}{V_{\text{bak}}} = \text{const} \quad (3)$$

Here, c is the limiting speed of motion in a vacuum.

Two primordial particles participate in the formation of the vacuum: the graviton and the bichronon, which have the same wavelength, equal to P . This wavelength is the gravitational radius, defined by the formula [2]:

$$\lambda_{\text{cp}} = P = \frac{M_p G}{c^2} \quad (4a)$$

Where $P = (\ell_0 \alpha_e n_e) \alpha_e n_e^2 = r_e \alpha_e n_e^2$ is the radius of a 3-dimensional ball;

$M_p = m_0 \alpha_e^2 n_e^3$ - the mass of the primordial graviton vacuum contained within a three-dimensional spherical volume and creating a density equal to:

$$\varepsilon_{\Pi} = \rho_{\Pi} c^2 = \frac{M_p c^2}{\frac{4\pi}{3} P^3} \quad (4b)$$

A 3-dimensional ball is placed inside a 5-dimensional sphere of the same radius. Within this sphere, the circumference of the same radius—situated in the two additional dimensions—is occupied by a bichronal mass defined by the formula

$$M_{\text{b.chp}} = 2\pi M_p = \frac{2\pi P c^2}{G} \quad (4c)$$

he interaction between graviton mass and chronal mass is mediated by the square of the speed of light in the energy density formula:

$$c^2 = \frac{M_{\text{xp}} G}{2\pi P} = \frac{2\pi M_p G}{2\pi P}$$

Substituting into the given formula, we obtain

$$\varepsilon_{\text{en}} = \rho_{\text{bak}} c^2 = \frac{M_p c^2}{\frac{4\pi}{3} P^3} = \frac{M_p}{\frac{4\pi}{3} P^3} \cdot \frac{2\pi M_p G}{2\pi P} = \frac{2\pi M_p \cdot M_p G}{\frac{8\pi^2}{3} P^4} \quad (4d)$$

Where $S_5 = \frac{8\pi^2}{3} P^4$ - surface area of a 5-dimensional sphere.

The primordial vacuum is associated with the horizontal hyperplane and serves as an energy reservoir for it. However, it is linked to the vertical hyperplane and can derive additional energy from it. The theory of time implies the existence of an energy transfer channel—taking the form of a pseudosphere—connecting the vertical and horizontal hyperplanes.

Upon this transfer, two additional vacuum regions form within the primordial vacuum; these regions possess different types of volumes but equal energy densities. To study them, we integrate (2b) under the condition $\varepsilon_{\Pi}(0) = p_{V0}$

$$\int_{p_{V0}}^{\varepsilon_{\Pi}} d\varepsilon_{\Pi} = \varepsilon_{\Pi} - p_{V0} = 0$$

The formula shows that the specified energy densities are individually non-zero; only their difference yields a zero result. However, this difference can also be interpreted from another

perspective. Positive energy density corresponds to the vacuum in forward time, while negative pressure corresponds to the vacuum in reverse time. Thus, their emergence is linked to the appearance of forward and reverse directions in proper time, rather than in time itself. In light of this, we shall associate these energy densities with the energies of media possessing different volumes:

$$\varepsilon_{\kappa\eta} = \frac{m_{\kappa\eta} c^2}{V_{\kappa\eta}} \text{ и } p_{V0} = \frac{M_{m.m.} c^2}{V_{\text{вак}}}$$

Substituting, we obtain:

$$\varepsilon_{\kappa\eta} - p_{V0} = \frac{m_{\kappa\eta} c^2}{V_{\kappa\eta}} - \frac{M_{m.m.} c^2}{V_{\text{вак}}} = \frac{1}{V_{\kappa\eta}} (m_{\kappa\eta} c^2 - M_{m.m.} c^2 \frac{V_{\kappa\eta}}{V_{\text{вак}}}) = 0$$

In this case $V_{\kappa\eta} \neq V_{\text{вак}}$, we have an energy difference equal to the total zero-point energy of the vacuum.

$$m_{\kappa\eta} c^2 - M_{m.m.} c^2 \frac{V_{\kappa\eta}}{V_{\text{вак}}} = 0$$

From which their equality follows:

$$m_{\kappa\eta} c^2 = M_{m.m.} c^2 \frac{V_{\kappa\eta}}{V_{\text{вак}}} \quad (4e)$$

They determine the composition and velocity of particles in the interacting vacua.

The formula will be applicable to the study of vacua in the horizontal hyperplane formed after the transfer of energy to it from the vertical hyperplane.

Investigation of new vacuum volumes

It follows from the theory of time that, following the transfer of energy into the horizontal hyperplane, the formation of initial chronotrajectories—described by duration vectors in polar form—is possible:

$$ct = 2l_0 \frac{\cos^2 \alpha}{\sin \alpha} \quad ct = 2l_0 \cos \alpha$$

The first chronotrajectory is a cissoid. The second is an osculating circle. Both formulas incorporate the initial value of the spatial quantum formed at the moment of energy transfer. Both chronotrajectories rotate around the axis of proper time and represent vacuum volumes in a nascent state. The first volume, generated by the rotation of the cissoid, is a torus. The second volume is an osculating 3D sphere.

For these vacuum volumes to expand to cosmic dimensions, a primary temporal flow—constituting a flow of chrontal energy—must emerge. Driven by this flow, exponential dependencies governing spatial coordinates come into effect, allowing the vacuum volumes to rapidly reach cosmic radii.

The theory of primary flow formation and the expansion of vacuum volumes was developed by the author. The main result derived from it is the formation of vacuum volumes in the form of a torus and a sphere with limiting radii equal to $P\alpha_{GU}$, where

$\alpha_{GU} = 1/4\pi^2$ is the Grand Unification Field (GUF) constant.

The volume formulas are of the form:

$$V_{\text{тор}} = 2\pi^2 (P\alpha_{GU})^3 - \text{volume of a torus; } V_{\text{вак}} = \frac{4}{3} \pi (P\alpha_{GU})^3 -$$

volume of a sphere.

The relationship formula (4d) between the masses of the new vacua and their volumes was derived above. Taking the obtained volumes into account, we write it in the form::

$$M_{xp} c^2 = M_{m.m.} c^2 \frac{V_{\text{тор}}}{V_{\text{вак}}} \quad (5)$$

Where $m_{\kappa\eta} = M_{xp}$ there is chrontal mass; $M_{m.m.}$ - mass of dark matter.

The identified volumes correspond to two types of new vacua. The torus serves as a receptacle containing mass M_{xp} , while the sphere acts as an object for dark matter mass $M_{m.m.}$ interacting with chrontal mass.

The formula implies the equality of densities in both types of vacua:

$$\rho_{\kappa\eta} = \frac{M_{xp}}{V_{\text{тор}}} = \frac{M_{m.m.}}{V_{\text{вак}}} = \rho_{m.m.} \quad (6a)$$

Let us determine the mass M_{xp} given the known mass of dark matter. Experiments indicate that dark matter accounts for 25% of all vacuum matter. The total mass of matter is $M_{P\alpha_{GU}}$. Therefore, we take one-quarter of it:

$$M_{m.m.} = \frac{M_{P\alpha_{GU}}}{4} \quad (6b)$$

Taking it into account, we will determine the mass. M_{xp} :

$$M_{xp} = M_{m.m.} \frac{V_{\text{тор}}}{V_{\text{вак}}} = M_{m.m.} \frac{2\pi^2 (P\alpha_{GU})^3}{\frac{4}{3} \pi (P\alpha_{GU})^3} = M_{m.m.} \frac{3\pi}{2} = \frac{M_{P\alpha_{GU}}}{4} \frac{3\pi}{2} = \pi M_{P\alpha_{GU}} \frac{3}{8} = \pi M_{P\alpha_{GU}} \frac{\alpha_e(q)}{\alpha_{GU}} = \pi M_{P\alpha_e(q)} \quad (7a)$$

Where $\alpha_e(q) = 3/32\pi^2$ - electromagnetic constant in a polarized vacuum.

$3/8 = \sin^2 \alpha_{GU}$ - square of the sine of the Weinberg angle for PVO

The presence of the numerical π value indicates that the mass found is chrontal.

Let us express the mass of dark matter in terms of its gravitational radius

$$M_{m.m.} = \frac{P_{m.m.} c^2}{G}$$

Substitute into formula (5)

$$M_{xp} = M_{m.m.} \frac{V_{\text{тор}}}{V_{\text{вак}}} = \frac{P_{m.m.} c^2}{G} \frac{V_{\text{тор}}}{V_{\text{вак}}}$$

Let us transform it into the form:

$$\frac{M_{xp} G}{c^2} = \frac{P_{m.m.} V_{m.m.}}{V_{\text{бак}}} = \frac{2\pi^2 (P\alpha_{GU})^3 P_{m.m.}}{V_{\text{бак}}} = \frac{2\pi^2 (P\alpha_{GU})^3 P\alpha_{GU}}{V_{\text{бак}}} = \frac{\pi^2 (P\alpha_{GU})^4}{\frac{4}{3}\pi (P\alpha_{GU})^3} = \frac{V_{4\text{ш}}}{V_{\text{бак}}} = \pi M_p \alpha_e(q) \frac{G}{c^2} \quad (7b)$$

Where $V_{4\text{ш}} = \frac{\pi^2}{2} (P\alpha_{GU})^4$ - volume of a 4-dimensional vacuum sphere; $V_{\text{бак}} = \frac{4}{3}\pi (P\alpha_{GU})^3$ - volume of a 3-dimensional vacuum sphere.

The expression written in this form includes the ratio of two volumes: the volume of a 4-dimensional sphere to the volume of a 3-dimensional sphere.

Let us express the mass M_{xp} in terms of the dark matter mass using (5).

$$M_{xp} = \pi M_p \alpha_e(q) = \frac{M_{m.m.} V_{m.m.}}{V_{\text{бак}}} = M_{m.m.} \frac{2\pi^2 (P\alpha_{GU})^3}{\frac{4}{3}\pi (P\alpha_{GU})^3} = M_{m.m.} \frac{3\pi}{2} \quad (7c)$$

We find the mass of dark matter in the form:

$$M_{m.m.} = \frac{2M_{xp}}{3\pi} = \frac{2}{3\pi} \pi M_p \alpha_e(q) = \frac{2}{3} M_p \alpha_e(q) = \frac{2}{3} M_p \frac{3}{8} \alpha_{GU} = \frac{M_p \alpha_{GU}}{4} \quad (7d)$$

Let us define the parameters associated with both types of vacua. We write formula (7b) in the form:

$$\frac{c^2}{\frac{4}{3}\pi (P\alpha_{GU})^3} = \frac{GM_{xp}}{\frac{\pi^2}{2} (P\alpha_{GU})^4} \quad (8a)$$

Multiplying both sides by the mass of dark matter, we arrive at the vacuum energy density associated with dark matter:

$$\rho_{m.m.} c^2 = \frac{M_{m.m.} c^2}{\frac{4}{3}\pi (P\alpha_{GU})^3} = \frac{M_{xp} \cdot M_{m.m.} G}{\frac{\pi^2}{2} (P\alpha_{GU})^4} \quad (8b)$$

As we can see, the energy density for the 3-dimensional vacuum volume of dark matter is equal to the energy density of interacting masses within a 4-dimensional sphere.

We express the mass of dark matter in terms of density and volume:

$$\begin{aligned} \rho_{m.m.} c^2 &= \frac{M_{xp} \cdot M_{m.m.} G}{\frac{\pi^2}{2} (P\alpha_{GU})^4} = \frac{M_{xp} \cdot \rho_{m.m.} \frac{4}{3}\pi (P\alpha_{GU})^3 G}{\frac{\pi^2}{2} (P\alpha_{GU})^4} = \frac{M_{xp}}{\frac{\pi^2}{2} (P\alpha_{GU})} \frac{4\pi G \rho_{m.m.}}{3c^2} c^2 = \\ &= \frac{M_{xp}}{\frac{\pi^2}{2} (P\alpha_{GU})} \frac{4\pi G \rho_{m.m.}}{3c^2} c^2 = \frac{M_{xp}}{\frac{\pi^2}{2} (P\alpha_{GU})} \cdot \frac{\Lambda_{m.m.} c^2}{3} \end{aligned} \quad (8c)$$

Where $\frac{4\pi G \rho_{m.m.}}{c^2} = \Lambda_{m.m.}$ - cosmological constant generated by the dark matter vacuum.

It follows from the obtained energy density formula that:

$$\frac{\Lambda_{m.m.} c^2}{3} = \frac{M_{xp} \cdot M_{m.m.} G}{\frac{\pi^2}{2} (P\alpha_{GU})^4 \frac{M_{xp}}{\frac{\pi^2}{2} (P\alpha_{GU})}} = \frac{M_{m.m.} G}{(P\alpha_{GU})^3}$$

Thus, three of the four dimensions are involved in the formation of the cosmological constant, which balances the remaining fourth dimension. To demonstrate this, we show $\Lambda_{m.m.}$ the connection to the angular velocity of rotation $\Omega_{m.m.}$.

$$\begin{aligned} \Omega_{m.m.}^2 &= \frac{\Lambda_{m.m.} c^2}{3} = \frac{4\pi G \rho_{m.m.}}{3c^2} c^2 = \frac{4\pi G M_{m.m.}}{3c^2 \frac{4}{3}\pi (P\alpha_{GU})^3} c^2 = \frac{M_{m.m.} G}{c^2 (P\alpha_{GU})^3} c^2 = \\ &= \frac{P\alpha_{GU}}{4(P\alpha_{GU})^3} c^2 = \frac{c^2}{(2P\alpha_{GU})^2} \end{aligned} \quad (8d)$$

Substituting into the energy density formula (8c), we obtain:

$$\rho_{m.m.} c^2 = \frac{M_{m.m.} c^2}{\frac{4}{3}\pi (P\alpha_{GU})^3} = \frac{M_{xp} \Omega_{m.m.}^2}{\frac{\pi^2}{2} (P\alpha_{GU})} \quad (8e)$$

Let us write formula (8e) in the form:

$$M_{xp} \Omega_{m.m.}^2 P\alpha_{GU} = \frac{M_{m.m.} c^2}{\frac{4}{3}\pi (P\alpha_{GU})^2} \frac{\pi^2}{2} (P\alpha_{GU}) = \frac{M_{m.m.} c^2}{(P\alpha_{GU})^2} \cdot \frac{3\pi}{8} (P\alpha_{GU}) = \frac{M_{m.m.} M_{xp} G}{(P\alpha_{GU})^2} \quad (9a)$$

$$\text{Where } \frac{3\pi}{8} P\alpha_{GU} = \frac{3\pi}{2} \cdot \frac{P\alpha_{GU}}{4} = \frac{3\pi}{2} \frac{M_{m.m.} G}{c^2} = \frac{M_{xp} G}{c^2}$$

Thus, we arrive at the equation equating centrifugal and gravitational forces in interacting vacua.

We show that the gravitational acceleration on the right-hand side is equivalent to the acceleration expressed in terms of a constant radius of curvature. Canceling out M_{xp} , we obtain the following for the right-hand side of (9a):

$$\frac{M_{m.m.} G}{(P\alpha_{GU})^2} = \frac{M_{m.m.} G}{c^2 (P\alpha_{GU})^2} c^2 = \frac{P_{m.m.}}{(P\alpha_{GU})^2} c^2 = \frac{P\alpha_{GU}}{4(P\alpha_{GU})^2} c^2 = \frac{c^2}{4P\alpha_{GU}} = \frac{c^2}{\rho_{xp}} \quad (9b)$$

Equating this to the left-hand side, we obtain the equation for the equality of accelerations along the helix [5]:

$$\Omega_{m.m.}^2 P\alpha_{GU} = \frac{c^2}{4P\alpha_{GU}} = \frac{c^2}{\rho_{xp}} \quad (9c)$$

Where $R_y = P\alpha_{GU}$ - cylinder radius; $4P\alpha_{GU} = \rho_{sp} \cdot c^2$ - radius of curvature; c^2 - square of the absolute velocity;

$\sin^2 \gamma = \frac{R_y}{\rho_{sp}} = \frac{P\alpha_{GU}}{4(P\alpha_{GU})} = \frac{1}{4}$ - the square of the sine of the angle of

inclination of the radius of curvature; $\sin \gamma = \frac{1}{2}$; $\gamma = 30^\circ$ -

inclination angle of the radius of curvature.

Thus, gravitational acceleration is replaced by the acceleration arising in a cylindrical helix with a constant radius of curvature. An analysis of the acceleration vector along the helix reveals that it is directed toward the axis of rotation. This demonstrates that gravity arises within helical motion, acting as its equivalent.

The radius of curvature in quadratic form follows from the obtained formula:

$$\rho_{sp} = \frac{c^2}{M_{m.m}G} (P\alpha_{GU})^2 = \frac{(P\alpha_{GU})^2}{P_{m.m}} = \frac{(M_{p\alpha_{GU}})^2 G}{P_{m.m}} \cdot \frac{G}{c^4} \quad (9d)$$

As a result, we arrive at the energy formula for dark matter.

$$F_0 P_{m.m} = \frac{(M_{p\alpha_{GU}})^2 G}{\rho_{sp}} \quad (9e)$$

Let us comment on the force balance equation (9a). From the conventional perspective, the lefthand side describes the centrifugal force associated with the circular motion of the chronal mass.

The right-hand side represents the gravitational force generated by the mass of dark matter concentrated at the center. The interplay of these two forces results in equilibrium. According to the classical approach, the net acceleration resulting from these forces is zero:

$$a_0 = 0 = M_{sp} \cdot \Omega_0^2 P\alpha_{GU} - \frac{M_{sp} \cdot M_{m.m} G}{(P\alpha_{GU})^2} = M_{sp} \cdot \frac{\Lambda c^2}{3} P\alpha_{GU} - \frac{M_{sp} M_{m.m} G}{(P\alpha_{GU})^2} \quad (9f)$$

The equation written in this form is the Einstein equation for a stationary universe containing a Λ -term. It was not accepted by the scientific community because the resulting equation implied, from a scientific standpoint, an instability in development. Furthermore, Hubble discovered the law of galactic recession, which pointed to a non-stationary Universe. Consequently, the model of equal accelerations was rejected in favor of the Friedmann models, which describe non-stationary universes.

However, the situation is not as simple as it appears at first glance. The equality of accelerations points to the approach developed by the author; it leads to a helical motion of chronal mass. This model cannot be applied to the origin of the Universe, as there are no grounds for explaining the cause of that beginning. The equality of accelerations serves as an intermediate model describing the motion of chronal mass within the primordial vacuum. To reach the point of origin, one must understand how baryonic and antibaryonic matter formed from vacuum mass. The author has investigated these avenues—but that is a completely different story.

At this stage, it should be noted that the emergence of two types of vacua led to their interaction. The contacting sphere became embedded in the toroid. A common contact area was formed in the form of a transverse circle of radius $P\alpha_{GU}$, passing through the center of the sphere. It is precisely to this circle that equation (9a) applies.

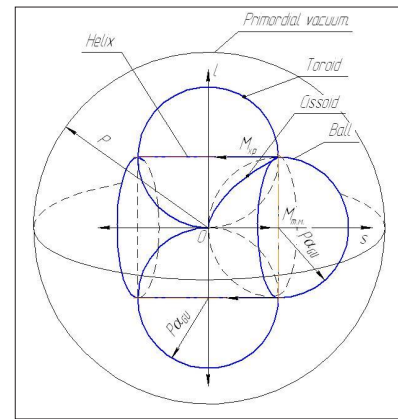


Figure 1: Interaction of Vacuum Volumes

In its general form, the cisoid considered above $l_0 = P\alpha_{GU}$ describes one of the Friedmann models in Cartesian coordinates.

$$s^2 = \frac{l^3}{2P\alpha_{GU} - l} \quad (10a)$$

We rewrite it in the form:

$$\frac{l^2}{s^2} c^2 = \frac{2P\alpha_{GU}}{l} c^2 - c^2$$

Express in terms of the square of the velocity and the mass:

$$\frac{l^2}{s^2} c^2 = v_p^2 = \frac{2P\alpha_{GU}}{l} c^2 - c^2 = \frac{2M_{p\alpha_{GU}} G}{l} - c^2 \quad (10b)$$

As a result, we arrive at the Friedmann model without the Λ -term. It describes a pulsating Universe model. This model would hold true if only one type of vacuum—in the form of a torus—were taken into account. Nothing would prevent the branches of the cisoid from extending beyond the torus, provided that time emerged simultaneously with it. In the equation, time appears merely as a parameter, and its nature is not investigated; this is the source of all errors associated with time. Since the time of Newton, it has been viewed as a parameter serving as a convenient reference system. In General Relativity, time became geometrically linked to space, yet it continued to function as an additional coordinate within a unified curved interval—acting as a passive element. This passivity of time hinders the advancement of science in the necessary directions.

Conclusion

The author's new approach to interpreting the equality of centrifugal and gravitational forces offers a fresh perspective on gravity-related processes. It is precisely helical motion—and the processes occurring within it—that allows for an examination of the mechanism behind this force and potentially explains observational discrepancies. Reference [3] provides an example of an explanation for this force's mechanism.

Furthermore, helical flows must be viewed as flows of time that transport energy. In these flows, time manifests as an active agent. The chronal energy carried by these flows is linked to graviton energy; their interaction acts as the driving force behind the creation of matter and the Hubble vacuum in which it exists. The author discusses the active properties of time in work [4].

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