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Dynamic-algebraic model of the Universe formation and the physics of portals

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Dynamic-algebraic model of the Universe formation and the physics of portals

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1) Practical applications of the dynamical-algebraic model (DAM) [1] of the formation of the Universe are proposed through the introduction of the physics of “portals” based on it, which are an extended concept of the neighborhoods of critical points of various critical phenomena. Earlier [1–6], a hypothesis of a phase transition-decomposition of the mother universe was proposed, which is described by a matrix representation of the semisimple Clifford algebra (CA) $Cl_{1,9}$ [7, 8]. $Cl_{1,9}$ decomposes as the starting mother “algebra-space” into the direct sum of CA $Cl_{1,3}$ (which corresponds to our Universe) and the residuals from the full decomposition of the “algebra-universe” $Cl_{0,4}$ and $Cl_{0,6}$, which have a degenerate time degree of freedom. The reason for such a phase transition, that is, a change in the topology of space and the order parameter, could be the fluctuation of physical time, the manifestations of which now remain only in our Universe.

2) The very high probability of such a decomposition can be confirmed by using the Frobenius theorems [7, 8], the Wedderburn theorem [9], and the general properties of the internal symmetry of CA-complements or two-sided ideals formed after the full decomposition of $Cl_{1,9}$:

$$\mathrm{Cl}_{1,9} \cong Cl_{1,3} \oplus \mathbb{C} \cong Cl_{1,3} \oplus \bigoplus_{i=1}^{n_1=15} (Cl_{0,6}) i \oplus \bigoplus j = 1^{n_2=3} (Cl_{0,4})_j$$
$tag1$

Based on the DAM, the theory of inverse portal energy tunneling (IPET) between the Minkowski spaces $Cl_{1,3}$ and $Cl_{0,4}$, which are isomorphic in the sum of signatures $p+q=1+3=0+4=4$. The isomorphism of the spaces $Cl_{1,3}$ and $Cl_{0,4}$ provides the highest probability of their interaction due to the smaller height and width of the topological barrier than between the spaces $Cl_{1,3}$ and $Cl_{0,6}$: $p+q=1+3 \neq 0+6$. The interaction occurs through the aforementioned portals under the condition of their ”opening”. Such conditions are given through the physical interpretation of the achievement by the key observable component of the studied system of a certain geometric size—the length of the portal, as well as by the parameters of the portal, that meet the condition of continuity and smoothness for the correct stitching of metrics in adjacent regions near the portal (see (2) and (3)):

$$\mathrm{Cl}_{1,3} \leftrightarrow \text{portal} \leftrightarrow Cl_{0,4}$$
$tag2$

$$\begin{aligned} ds^2_{1,3} &= -c^2dt^2 + dx^2 + dy^2 + dz^2, \leftrightarrow \\ \leftrightarrow ds^2_{(1,3)} &= -f(t)dt^2 + a^2(dx^2 + dy^2 + dz^2), \leftrightarrow \\ \leftrightarrow ds^2_p &= -f_p(\xi)d\xi^2 + a^2(dx^2 + dy^2 + dz^2), \leftrightarrow \\ \leftrightarrow ds^2_{(0,4)} &= g(w)dw^2 + b^2(dx^2 + dy^2 + dz^2 + du^2) \end{aligned}$$
tag3

where $ds^2_{1,3}$ is the Minkowski metric, $ds^2_{(1,3)}$, ds^2_p, and $ds^2_{(0,4)}$ are metrics near the border $Cl_{1,3} \leftrightarrow$ portal, inside the portal, and near the border portal $\leftrightarrow Cl_{0,4}$, respectively; $-f(t)$, $-f_p(\xi)$, $g(w)$, a, b, du^2 are portal parameters, where du^2 is the space elasticity parameter $Cl_{0,4}$, which has compactified properties on the boundary portal $\leftrightarrow Cl_{0,4}$ and is introduced by analogy with the gauge degree of freedom à la Kaluza-Klein theory [10].

3) The manifestation of interspatial interactions $Cl_{1,3} \leftrightarrow Cl_{0,6}$ and $Cl_{1,3} \leftrightarrow Cl_{0,4}$ can be any critical phenomena, such as manifestations of the dark sector of the Universe, phase transitions for different states of matter, spontaneous processes of asymmetric subbarrier fission of heavy nuclei, etc. In addition to the selection of portal parameters, in particular, the length of the portal d, an important factor is the correctness of the choice of the observed macroscopic quantity—the characteristic of the approach of the studied system to the portal zone: (i)To search within IPET for critical points of phase transitions of completely different states of matter, namely, water, ordinary hadronic matter, quark-gluon plasma (QGP), colored glass condensate (CGC), and preons (with corresponding values for $d = 0.27, 0.2, 0.1, 0.05, 0.01$ fm), the temperature was chosen. (ii)To study spontaneous asymmetric subbarrier fission (SASF) of heavy nuclei through tunneling within IPET, the probability of this process was taken, which was compared with the Gamow formula [11]:

$$\mathrm{P}_{\text{Gamow}} \sim \exp\left(-\frac{2}{\hbar}\int_a^b \sqrt{2\mu(V(r)-E)}dr\right),$$
$tag4$

where a and b are classical turning points, μ is the tunneling nucleus mass, and $V(r) - E$ is the effective barrier. The length of the portal was compared with the length of the "neck" $d \approx 2$ fm between future fission fragments in the quasiclassical representation of the dumbbell-like appearance of the nucleus before fission [12]. It is shown that taking into account the interaction $Cl_{1,3} \leftrightarrow Cl_{0,4}$ in IPET significantly reduces the effective fission barrier.

4) The results of testing the IPET theory are: Obtaining predictions for the values of the critical temperatures of the phase transitions QGP ↔ hadron gas, QGP ↔ CGC, quarks ↔ preons. Adjusting the Gamow formula towards increasing the value of P to correspond to experimental data [13] for the SASF of the nucleus ^{252}Cf:

$$^{252}\text{Cf} \rightarrow ^{140}\text{Xe} + ^{112}\text{Ru}$$
$tag5$

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