Possibility of spacetime-dimensions as orthogonal quantum states II

Big Bang as a germ of elliptic umbilic point and the universe as an enfolding of this germ

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Abstract:

In Thoms catastrophe theory there can exist control-variables, which can describe the system variables of a physical system changing in a continuos manner, while the system variables change spontan and abruptly their physical states and so the equlibrium of the whole system.This is a „catastrophe“ after Thoms definition. The system variables can be defined over a class of germ-functions, which minimal enfoldings are the added functions of controlling variables. Most descriptions are time - and space-dependend.
But in this modelling the description of universe itself can be given of Big Bang as a germ of an elliptic umbilic point and the universe expansion as its enfolding. If the assumption is made, that the three spacelike dimensions are generated in a different energy spectrum, then inertia could be explained over supposed anisotropy of spacetime in the microscale of Planck-length.

Key-words:

Big Bang; germ; elliptic umbilic point; phasespace; dimension enfolding; catastrophe theory; first cause; prae-Big bang; energy spectrum; threephase generation; equlibrium state; resonance potential; caused inertia; dimension energy steps; quantum anisotropy; Quantum spacetime field; deltoid; quantum lattice-net; local oscillation pattern.

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1. Introduction:

In a previous paper it was pointed out that the Big Bang can be described by an elliptical umbilic [1.]. In catastrophe theory, the elliptic umbilic point is a singular point on a caustic surface where three parabolic "ribs" (or cusped edges) meet at a focus, and is associated with the D4− elementary catastrophe [2.]. This type of singularity describes systems with two state variables and often

appears in diffraction patterns, such as those created by light passing through a water droplet, where it gives rise to hexagonal diffraction maxima.
In following writings a model of universe is constructed, which is described over an elliptic umbilic point as a germ, which enfolded to the minimal mathematical and physical description in catastrophe theory of Thom. This model is regulated by some control variables which can change in a stetic way. The coupled variables, which describe the physical system, which here is the BB resp. the whole universe, then can change abruptly or spontan, to get a new equilibrium state, because the old got unstable. This phenomenen is called a catastrophe by Thom [3.]. Undoubtedly, the origin of the universe is such a catastrophe because the equilibrium point of the underlying prae quantum vacuum became unstable during the generating of space-time and spontaneously changed its state. Since the controlling variables have to be metric (in length or square-length or square roots of square-length), the only meaningful assignment is that of the metric components of Einstein's field equation, such as the Riccitensor, Ricciscalar, or the cosmological constant, which should determine spacetime even in its early phase. In principle, you can fold the universe into its dimensions and carry it away in a suitcase. For philosophical meaning the ontological problem must be seen in the context of Leibniz's presentation and investigation of the statement already known from antiquity : "Warum ist überhaupt etwas, und nicht vielmehr nichts?" (Why is there something at all and not rather nothing at all?) [4.],[5.]. This model tries to explain some aspects, which lie at the bases of the large scale structure and the cosmic expansion [6.] .
In measuring processes of its inner physical contents in measurement theory, the universe of spacetime, as we know it today, knows no zero, only minimal and maximal Planck-sizes but the universe itself can possibly defined as a single large decomposition of zero. If the model of the elliptic umbilic point is used, there are two branches in development of the unfolding of the germ (see Picture 1). So this trying of a universe-description may be called a Di-universe (or Diverse). Double-universes are not new in cosmological descriptions (e.g. E(8) x E(8) or SO(32) x SO(32) in superstring-theories or discussed by Jean-Pierre Petit) but in practice it is rather difficult to measure the postulated other part of the theoretical description in the different models. Dark matter may be an indication for this phenomenon. (Also, in the past sometimes was discussed, if the universe was divided in a matter part and in an antimatter part as a trying to solve the in the past applying observable problem of missing antimatter).

<u>1.1 Some comments on inertia:</u>

1. Conservation of the equivalence principle:
What is inertia? Well known is the description of inertia mass of a moving object, like a matter particle or an energy quantum like a photon. The equivalence principle is only enclosed in the fact, that inertia mass and heavy mass, causing the own gravity field of the physical object, seem to be the same, meaning of the same size. This topic is no part of the local discussion, since its characteristics are well defined and both ep.s base on the base, that the falling inertial mass follows gravity field lines of another heavy mass, because the fieldlines of a radial gravity field always are geodesics. Since there exists no parallel gravity field lines except as a rough approximation, there can nevertheless be demonstrated, that a right conclusion can be made from a wrong proposition after Aristoteles' classical binary logic. So, this description may be also possibly true, when there is the fault, made by Einstein, to justify his description on a false, non existing base, since parallel accelerating fields cannot be compared with radial gravity fields [7.]. But this in macroscopic physics solved problem is no part of discussion of this paper but it must be said, that later, the e.p. must be again be tested critically on a microscopic base of Planck-quantum gravity. In this case some measurements are already made today but on a too great metric scale to prove the statements in Planck-area. Furthermore to measure in scale-lengths near Planck-area, there has to go into strong gravity fields but not in form of erratic quantum foams but in geometric resonance patterns.

2. Suggestion of new definition of inertia:
But now to the main theme: what is inertia?
Following the description in Newtons Principia [8.], inertia is the resistance of a moving physical object, maybe matter or energy, against changing its direction of velocity by an outer acting force or a momentum. What now is the reason, that this resistance exists? There are several tryings of explanation in modern physics: The eldest explanation is Machs principle [9.], where inertia should be caused by cosmic masses of all other existing global matter [10.]. This hypothesis must first explain a causal coupling of an acting force, may be a global form of gravity, which resulting are the descriptions of Einsteins field equations for gravity. Second it can be refuted by looking at the global cosmic horizon, where whole galaxies disappear behind this spacelike limit and so break causal contact to local masses. If Machs principle also is involved, then inertia must decrease in local matter. This phenomenon is not measured resp. observed. So Machs principle must be excluded from the explanation, when no examination of non-local quantum gravity phenomena is made in correlation with this description. Another trying is the method of coupling inertia as an explanation to electromagnetic processes like charge and current or the electromagnetic quantum vacuum, which mankind is easier accesible today (like Casimir effect as an solution of QED), than the gravity vacuum is in its high density states of its quantum effects which are difficult to measure today. The new explanation now for local inertia is a postulated difference in the quantum gravity energy eigenstates of spacelike dimensions. Then isotropy of spacetime in microarea is broken. The main characteristics of the hypothesis are, that in the generation of spacetime after enfolding of spacelike dimensions in Big Bang, this phenomenon was caused by a bounded state of dimension potentials over a potential wall, which only could be overthrown (or tunneled) after generating the third spacelike dimension. This characteristic then expresses itself in three different strong energy potentials of spacetime spacelike dimensions, which are permanent periodically caused through a timelike potential. The cause for inertia is the trying of moved bodies, in coupling to gravity vacuum of quantum spacetime dimensions, to overthrow this different energy states for every dimension even in flat systems without matter caused gravity field but only over the necessary vacuum caused gravity quantum field of spacetime dimensions itself, which lie at the base of all movement.

There are many tryings to explain inertia in a logical way: first Machs principle causing it by coupling of local inertia masses to intergalactic cosmic masses. But this galaxies vanish behind the cosmic horizon by time, so local inertia has to decrease. But nothing of this phenomenon is measured. Then, second trying, a global scalar field in Scalar-Tensor-theories like Higgs-Field, but the Higgs-field couples only at U(1) x SU(2) matter interactions of the elektroweak field not at gravity fields or spacetime itself, at least in low energy limit of today's state of universe and other fundamental scalar fields are not known today. Third: the trying to couple this inertia to electromagnetic field. But all these trials and attempts are not very convincing.
Here is therefore another fundamental trying of explanation:
First, lest inertia be defined: it is a resistance against movement changing. Now if the vacuum energy states of the three spacelike dimensions are different, when caused by a timelike resonance of quantum gravity potentials, then isotropy of spacetime could be broken in the microworld of Planck-length area. If this situation is the case, the movement in different directions of spacetime cause different energy expenditures in kinetic or potential energies even in macroscopic fieldfree states caused by coupling of all movement to spacetime dimensions.. It's like: "you need one Joule for length, two Joule for width and three Joule for height. Now move and fly a curve. Hic Rhodos, hic salta!" So it coulf be seen as a gradient in different vacuum directions of spacetime dimensions.
It seems, that dimension energy states in their continous generation could be more like a spectrum of fermion-statistic-states, than an Einstein-Bosonian one with same energy-states for spacelike

dimensions at the microscale. This possible energy difference may be a convincing approach to a solution for describing the problem of inertia. This idea could possibly be pursued further. The possibility of the idea to neglect inertia, of which is often heard in physical, technical or general scientific discussions could be deal with the inner truth of reality, changing the pulsation frequency of spacetime itself, its basic self-generating rhythm or neglecting the fundaments of spacetime itself to generate a quantum pre-vacuum without spacetime and so without inertia. Taken the statement of Wheeler: "matter tells the spacetime how to curve and spacetime tells matter how to move" [11.] tells only half of the story [11a.]: well-known is the influence of matter at spacetime like the situation of black-holes but the back-reaction, how spacetime influences the inner structures of matter (energy) not only its moving paths along geodesics isn't answered. This problem is shown by the effect of inertia.

<u>1.2 On generating spacetime dimensions from a quantum vacuum:</u>

On suppose there is a virtual gravity quantum potential of timelike form, which can generate a timelike and a spacelike dimension, when this potential resonances with a spacelike dimensional potential. For simple reasons look only for integer dimension numbers (no fractal dimensions and no fuzzy logic should be used in first approximation). Furthermore the diction of (+++,-) is chosen for spacetime signature in later forming a stable spacetime. This means (+) is chosen as a sign for description of spacelike dimensions and (-) for timelike. The quantum vacuum includes all solely (+) and (-) states. But they are unstable. Stability of a spacetime only occurs in the minimal enfolding of one timelike and three spacelike dimensions, because the potential wall of virtual spacetime vacuum state only then can be overthrown (or tunneled) as a minimal stable eigenstate, when it gets the correct resonance. This means, that higher virtual states including more dimensions at generating the spacetime system are not stable in their unsteady, uncertain fluctuations, because they build not a minimal structure.

Let $\Psi(t)$ be a timelike generating potential. If this potential gets in resonance with another spacelike potential $\Phi(r)$ in gravity quantum vacuum, there it build a halfstable structure. The potential resonance generates the existence and stability of real, no virtual dimensions. But to get this case, the resonance must take over three steps from this quantum timelike with three other spacelike potentials for a stable enfolding in a sort of Big Bang, because with less or other dimension coupling, there isn't enough energy to overthrow (or tunnel) the potential wall of gravity quantum vacuum. *Four dimensions are the minimal stable state of a real existence.* If this state is generated, no other states with greater dimension number in coupling come to existence because they are not minimal. Nature always like minimalism in its actions. Suppose furthermore, timelike potentials only can make constructive resonances with spacelike and not with each other because they are orthogonal in phase space. Then the minimal from gravity quantum vacuum outprojected stable spacetime is in its macroscopic enfolding a fourdimensional manifold. May be more: the enfolding of the minimal spacetime system into a macroscopic state suppressses all other virtual fluctuations. The energy spectrum of the dimensions follow the spin 2- state of graviton in a way of generating three dimensions in form of a fermionlike fourspectrum via quantum defined ON/OFF-operators in resonance of $N=(2\cdot n+1); n\in\mathbb{N}$.

Then for the timelike potential/dimension there is N=1, and for the three spacelike dimensons there is in every case: n=3/n=5/n=7. After these numbers are realized in the short resonance spectrum of possible virtual resonances, the vacuum potental wall of the virtual gravity field vacuum can be overthrown (or tunnelled) by the new stable microuniverse because there is enough energy collected and concentrated for now. A Big Bang is born. The dimensions can enfold and suppress all other possible (but not including minimal energy) states. *The boundary of the curvature of its enfolding will get its minimal maximal state.*

Generating a stable spacetime from a virtual quantum gravity vacuum is a shifting of the equlibrium of this stable point of vacuum. The trying is now, to describe this shifting over the enfolding of an elliptic umbilic point in Thoms catastrophe theory. Thereby is supposed, that the timelike potential in every Planck-second generates the spacelike dimensions in a periodic continuity of this discrete small spectrum one after the other. Supposed is, that the states of spacelike dimensions are orthogonal in sense of a mathematical quantum description in Hilbert-Space, so they are always only two dimensions in existence: the timelike dimension generating another spacelike one. In measuring of macroscopic mean, the spacetime then looks fourdimensional in permanence on great metric scales but isn‘t in reality.

The enfolding of spacetime now comes over description of these elliptic umbilic point. There is a geometrical model of the „hair“, which looks in phasespace like a body of three planes, which area of crossection is a hypocycloid, a deltoid [12.] , which represents the resonance effect of the permanent stable dimension building over quantum ON/OFF operators (QUOPS) for the generating of the orthogonal spacetime system of enfolded universe O(1,3) = O(1*,1_1)+O(1*,1_2) +O(1*,1_3) as real quantum states. (Maybe the oscillation process generates at the same time of beginning in three steps the matter particle generations, today known:e, μ, τ and its affilated Baryon-Quark-Gluon-generations) through the strong oscillation process of early pre-spacetime. All other chemical elements are formed later from boring innerspace matter evolution over U(1) x SU(2) x SU(3). In real fact, this standardmodel describes nothing fundamental but only unimportant “slick on the surface of the ocean” because it doesnt’ deal with the fundamental spacetime structures, which are the real underlying facts of the physical world. The real thing.

2. Methods/Calculation:

2.1. Terms of catastrophic theory:

Theorem of Thom 1:
Let $f \in m2(n)$ be a finitely determinate germ. Then (F, r) is a stable unfolding with codimension $r \leqslant 4$ that has a local minimum at 0. Then F either has a simple minimum at 0 or F reduces to one of the 7 irreducible canonical unfoldings $G_k$of the germ g_k.
Proof see [2.].
For the elliptic umbilic point as one of the 7 minimal classical unfoldings there are the conditions of Table 1:

Elementary catastrophe:	Elliptic umbilic
Germ g_k	$f(x,y) = x^3 - x \cdot y^2$
Enfolding G_k	$F(x,y) = x^3 - x \cdot y^2 + u \cdot (x^2 + y^2) - v \cdot x - w \cdot y$
Co-dimension r	3
ADE-classification:	D_4^{-0}

Theorem of Thom 2:
Let C be a four-dimensional parameter space, let X be an arbitrary finite-dimensional state space and let V be a smooth generic function on X parameterized by C. Then M is a smooth hypersurface

in XxC and the only type of singularity of M for the elliptic umbilic point is its classical elementary catastrophe:
Proof see [2.].
Table 2:

Elementary catastrophe:	Elliptic umbilic
Dim X	$X \geq 2$
Normal form V	$F(x,y)=x^3-x\cdot y^2+u\cdot(x^2+y^2)-v\cdot x-w\cdot y$
Dim C reducable to:	3
$\Phi(s,C)$	$s_1^3-3\cdot s_1\cdot s_2^2-C_3\cdot(s_1{}^2+s_2^2)-C_2\cdot s_2-C_1\cdot s_1$

2.2. Spacetime as a germ and its enfolding in Big Bang:

If a classical spacetime is set like Minkowski-space with some metric tensor components , which is the base of all spacetime description [13.] and in this case describes the germ of development, which then comes in the enfolding of curvature after BB:

$$s^2=g_{\mu\mu}\cdot x^2-g_{vv}\cdot y^2, \qquad (1a.)$$

where is defined:

$$x^2=x_1^2+x_2^2+x_3^2;\ y=c_0\cdot t\ ;\ g_{\mu\mu}\ for\ \mu=1;2;3;\ g_{vv}\ for\ v=4 \qquad (1b.)$$

All other $g_{\mu v}=0;\ \mu\neq v$.

with c_0 local invariance velocity. This system (1a.) then can be normed through a conformal transformation. Since the components of metric tensor are only numbers without measuring unit, they can be divided. Then from (1a.) comes the normed form of lineelement:

$$\widehat{s^2}\stackrel{def}{=}\frac{s^2}{g_{vv}}=\frac{g_{\mu\mu}}{g_{vv}}\cdot x^2-y^2=\hat{k}\cdot x^2-y^2 \qquad (1c.)$$

with: $\hat{k}\stackrel{def}{=}\frac{g_{\mu\mu}}{g_{vv}}$ (1d.)

This leads to a description, that then the germ of the elliptic umbilic point is its integral after x (written without the conform factor $\hat{k}$ as a flat Minkowski spacetime):

$$s(x,y)=\int(x^2-y^2)dx=\frac{1}{3}\cdot x^3-x\cdot y^2=-\int(x^2-y^2)dy \qquad (1e.)$$

Included the conform-factor from the metric tensor, there is:

$$s(x,y)=\int(\hat{k}x^2-y^2)dx=\frac{1}{3}\cdot x^3\cdot\hat{k}-\int\left(\frac{1}{3}\cdot x^3\cdot(\hat{k})'\right)dx-x\cdot y^2 \quad (1f)$$

This condition leads to the final integral of:

$$s(x,y)=\int(\hat{k}x^2-y^2)dx=\frac{1}{3}\cdot x^3\cdot\hat{k}-x\cdot y^2-\frac{1}{12}\cdot x^4\cdot\frac{\partial\hat{k}}{\partial x}+\frac{1}{60}\cdot k^5\cdot\frac{\partial^2\hat{k}}{\partial x^2}+O(x,\hat{k}) \quad (1g.)$$

Comment: In principle integrating up than down, leads mathematical to an infinite, decreasing, divergent integral series but in a practical sense there are only terms until second order in derivation necessary because higher terms contain no relevant information.
Also they can be neglected because they exist beyond the minimal state to the enfolding of the germ. Partial integrating to the lower side would extinguish the spacelike part of the original integral.
The different sign in the integrals (1e.) depend only from free choice of spacetime signature and also give the same description of the germ and of its unfolding, if signature and spacelike and timelike coordinates are changed. Suppose a highy symmetric state at the beginning, so the $g_{\mu\mu}$ is symmetric in all three components of its spacelike dimensions, also gives the same description for all three. The only difference between the three spacelike coordinates may be their generating energy level and this early formed situation can be but also can be not play an important role in metric tensor description. If the energy levels of the three spacelike dimensions in their forming before BB are different and involve metric tensor, they must be reformulated. But in first case, this situation is not a closer examination.

This germ now can be enfolded in a phase space after three controlling variables and this minimal enfolding is:

$$S(x,y)=\frac{1}{3}\cdot\hat{k}\cdot x^3-x\cdot y^2+u\cdot(x^2+y^2)-v\cdot(x)-w\cdot(y)+1 \quad (2.)$$

Maybe that $\hat{k}$ is included into the controlling parameters. If now these controlling variables of phase space are changend continously near the equilibrium point of the germ, this germ can abruptly change its behaviour in a spontaneous manner, what is commonly called a “catastrophe”. This control of discrete quantum variables over continous values can couple the early quantum state of spacetime with its later determined continous variables of GRT. In phase space its a discrete spontan changing of physical behaviour of system variables set (x,y) which mathematically can be described as a transition mapped between two different Riemann-surfaces in phase space. Undoubtedly Big Bang is such a spontaneous, discrete sudden process. The values of the variables of the three controlling parameters are metric descriptions with units of length or length square (or its inverse), so the choice can be made, to choose terms of GRT to describe the enfolding of the BB-system: $u:\stackrel{def}{=}\|R_{\mu\nu}\|;v:\stackrel{def}{=}R;w:\stackrel{def}{=}\Lambda$. In phase space spacelike dimension states are orthogonal to timelike state, which generates them. The cosmic expanse is defined over the area of spacelike dimensions, which are enfolded. This area is one of a curved triangle and its value is:

$$A_{SLC}(u,r)=\frac{8\cdot u\cdot r}{3} \quad (3a.)$$

for every spacelike dimension state. The area of timelike dimension state in phase space then is defined as the area of the deltoid itself to:

$$A_{TLC}(r)=2\cdot\pi\cdot r^2 \quad (3b.)$$

Since all these considerations are done in an only mathematical defined smooth manifold of an affine Hausdorff -Space , the area of the curved triangle is isomorph to the area of a flat triangle, because the curving doesn't change any metrical ranges [14.] .

Then the quotient of timelike and spacelike dimension area is [15.],[16.]:

$$N=\frac{A_{TLC}(u,r)}{A_{SLC}(r)}=\frac{3}{4}\cdot\pi\cdot\frac{r}{u} \quad , \quad (3c.)$$

where r is radius of the inner circle of the deltoid and u is a physical term (see 3.1). Then this equation also can be written as:

$$N=\frac{3}{4}\cdot\pi\cdot\sqrt{\|R_{\mu\nu}\|}\cdot\sqrt{\frac{R+\Lambda}{R\cdot\Lambda}} \quad (3d.)$$

where N is a real number :$N\in\mathbb{R}$.

Quantum gravity forces must be neglected in this pure geometric defined examination of lowest order in phase space. In higher order this problem may be taken into account, if the basic phasespace structure may be defined as a sort of fluctuation. If this situation occurs, then it is a description, which is more difficult.

2.3. Reasons for the formulation of enfolding:

A main question aims to understand why the termx^2+y^2appears in the unfolding $F(x,y)$of the germ $f(x,y)$. To understand this, there must be considered the concepts of catastrophoc theory, particularly the unfolding of singularities, which is in our concept of description a very important tool to describe hypothetical states of the early universe.
Catastrophic theory studies how the qualitative structure of solutions to system-equations changes under small changes of the parameters. An unfolding is a family of functions, that contains the original function and describes how the function behaves under small pertubations.The term x^2+y^2 in the unfolding plays an important role in resolving the singularity of the germ

$$f(x,y)=\frac{x^3}{3}-x\cdot y^2 \quad (3e.)$$

at the critical point of Big Bang singularity $S(0;0)$ in chosen coordinate system.

Why does this term x^2+y^2 now appears in the enfolding of the germ, the expansion? There has to be considered the Hessian matrix and the second derivatives of the germ, but as seen before, this matrix is the zero-matrix at the critical point. In this case, the second derivative criterion does not apply. This means, that the critical point is a singularity, that requires further investigation. The term x^2+y^2 in the expansion $F(x,y)$ is a quadratic term that affects the form of the function near the critical point $S(0;0)$. It can be considered a kind of „regularization“ of the singularity. To better understand this, consider the Taylor series expansion of $f(x,y)$ around the point $S(0;0)$:

$$f(x,y)=f(0;0)+\frac{\partial f}{\partial x}(0;0)\cdot x+\frac{\partial f}{\partial y}(0;0)\cdot y$$
$$+\frac{1}{2}\cdot\left(\frac{\partial^2 f}{\partial x^2}(0;0)\cdot x^2+\frac{2\cdot\partial^2 f}{\partial x\cdot\partial y}(0;0)\cdot x\cdot y\,\frac{\partial^2 f}{\partial y^2}(0;0)\cdot y^2\right)+\ldots \tag{4.}$$

Since now all first and second derivatives of f are zero at $S(0;0)$, the Taylor-expansion begins with terms of third order, namely $x^3$and $x\cdot y^2$. So the term x^2+y^2 fills the gap in the expansion created by the absence of quadratic terms in the Taylor expansion of f. This term is important to ensure the stability of the expansion. It ensurses, that the expansion is a Morse-function, i.e. a function with the non-degenerated one and only critical point at $S(0;0)$, the singularity of BB.
The terms in the expansion of the germ arise in considering the universal expansion of the germ. The universal expansion contains all possible deformations of the germ that can arise from adding lower order terms.

The universal expansion of a germ mathematically is given by the monomials in the basis of the local ring.The local ring is:

$$R[[x,y]]\multimap\langle x^2-y^2;-2xy\rangle \text{ or } R[[x,y]]\multimap\langle \hat{k}\cdot x^2-y^2;-2xy\rangle \tag{5a.}$$

written with the conformal factor $\hat{k}$.

A basis for this ring can be get by finding the monomials.
A possible basis then is:

$$B:=(1;x;y;x^2) \tag{5b.}$$

The expansion then has the well known form of (2.), where $x^2+y^2\Leftrightarrow x^2$(equivalent) up to a constant conform factor. This means at last the terms $(x;y;x^2)$are part of the chosen basis and (x^2+y^2) is a possible combination of these terms. They arise of considering the universal expansion of the germ and the basis of the local ring. The specific form of the expansion then depends of the choice of basis and coefficients.

3.1. Physical meaning of the controlling variables:

Since the control variables have metrical structure, they can be identified with the variables of GRT or its square roots like cosmological constant, which must be in this case considered as a radial function [17.], the Ricci-scalar as a quantum function of the cosmological term and the third control variable possibly can be identified with norm of the Ricci-tensor [18.]. Possibly in the beginning before the BB, there is a flat spacetime considered, which has the size of a “metron”, which means it is the square of a Planck-length. Only in the BB, after overcoming or tunneling through the potential wall, will a high curvature of it appear in the transition through the expansion, like a global outer solution of Schwarzschild-metric which flattens out over time [19]. The matter then is created by the triple fluctuation states of pre-spacetime, with high oscillation speed, which generates the material structures of the universe as a residual waste or superflous waste, that shouldn’t actually be produced at all but later is identified with ordinary matter. In this case, the generating of matter is an unimportant secondary process and should not distract any researcher

from exploring the fundamental structures of spacetime without being distracted by something as irrelevant and superfluous as matter because lightning matter like stars, galaxies, hydrogen, the other elements of PSE and its planetary or cosmic dust derivatives are only an unneccessary side-effect of generating universe caused by early strong gravity field oscillations [20.].
In GRT there is a well-known influence of matter on spacetime described [21.], like the Thirring-Lense-effect (rotating and carrying along of local classical defined inertialsystems near rotating bodies) or the changing of spacetime curvature in Black Holes [22.] but the feedback representation of spacetime on matter is missing [23.]. In this respect, the GRT is incomplete, not only in the sense of the lack of a quantum basis for its description but in the lack, how changing in spacetime influences matter structures. Only the quadrupole coupling and onetime passage of linear plane gravity waves of weak energy density to matter is measured and known, generated from a pair of black holes or neutron stars by LIGO [24.-27.] or other interferometer gravity wave antennas. A linear plane wave far away from its generation point is only an rough approximation of the real nonlinear solitonlike spherical gravity wave near its source [28.] and doesn't tells us much about its true fundamental base by measuring it [29.]

The physical enfolding equation for BB then is:

$$S(x,y)=\frac{1}{3}\cdot\hat{k}\cdot x^3-xy^2+\frac{1}{\sqrt{\|R_{ik}\|}}\cdot(x^2+y^2)-\frac{1}{R}\cdot x-\frac{1}{\Lambda}\cdot y+1 \quad , \tag{6a.}$$

the constant 1 can be transformed away by suitable choice of coordinate system.

where $\|R_{ik}\|:=\sqrt{(R_{ik}\cdot R^{ik})}$ Norm of Ricci-tensor [30.], Summing over i,k.

The derivation $\frac{\partial S(x,y)}{\partial x}$ then gives the first local metric lineelement of the enfolding:

$$s^2(x,y)=\hat{k}\cdot x^2-y^2+\frac{2\cdot x}{\sqrt{\|R_{ik}\|}}-\frac{1}{R} \tag{6b.}$$

with conform factor (1d.): $\hat{k}\overset{def}{=}\frac{g_{\mu\mu}}{g_{\nu\nu}}$ and to avoid other mathematical singularities (except BB): $g_{\nu\nu}\neq 0$,

and the ordinary conditions of (1b.): $x^2=x_1^2+x_2^2+x_3^2;\ y^2=c^2{}_0\cdot t^2;\ g_{\mu\mu}\ for\ \mu=1;2;3;\ g_{\nu\nu}\ for\ \nu=4$ [31.]

Then there is the concrete lineelement of:

$$s^2(x,y)=\hat{k}\cdot x^2-c^2\cdot t^2+\frac{2\cdot x}{\sqrt{\|R_{ik}\|}}-\frac{1}{R} \tag{6c.}$$

Problem: It may be, that the conform factor (including the $g_{\mu\mu}\wedge g_{\nu\nu}$) must appear also in the enfolding - and maybe that it contains the parameter variable x , which could be interpreted as the timedependent radial spacelike size of universe [32.]. Then the whole ansatz must be modified.

Comment: The assignment of the three controlling variables to the physical values may be chosen in another order or sequence. In this chosen assignment above the cosmological constant disappears from this metric. There is the possibility, that the chosen three control variables have another order of sequence. And: iff x and y are not interpreted as independent, because the derivation of y after x is not announced at zero, then the description of the enfolding to the lineelement in its derivations changes like:

$$s^2(x,y)=\hat{k}\cdot x^2-y^2-\frac{2\cdot x\cdot y\cdot c}{v}+\frac{2\cdot(x+y)}{\sqrt{\|R_{ik}\|}}-\frac{1}{R}-\frac{1}{\Lambda}\cdot\frac{c}{v} \qquad (7a.)$$

which in last consequence leads to the lineelement and its metric of:

$$s^2(x,ct)=\hat{k}\cdot x^2-c^2t^2-2\cdot x\cdot c\,t\cdot\frac{c}{v}+\frac{2\cdot(x+c\,t)}{\sqrt{\|R_{ik}\|}}-\frac{1}{R}-\frac{1}{\Lambda}\cdot\frac{c}{v} \quad , \qquad (7b.)$$

where $v:=\frac{\partial x}{\partial t}$. (7c.)

This equation then leads with (1d.) to the final metric of:

$$s^2(x,ct)=g_{\mu\mu}\cdot x^2-g_{\nu\nu}\cdot\left(c^2t^2+2\cdot x\cdot c\,t\cdot\frac{c}{v}+\frac{2\cdot(x+c\,t)}{\sqrt{\|R_{ik}\|}}-\frac{1}{R}-\frac{1}{\Lambda}\cdot\frac{c}{v}\right) \qquad (8a.)$$

If now is set:

$$v\overset{def}{=}\frac{x}{t} \qquad (8b.)$$

then this definition leads to the final metric of:

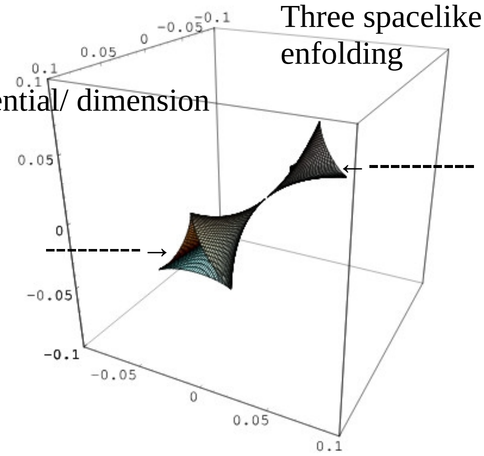
$$s^2(x,ct)=g_{\mu\mu}\cdot x^2-g_{\nu\nu}\cdot\left(3\cdot c^2t^2+\frac{2\cdot(x+ct)}{\sqrt{\|R_{ik}\|}}-\frac{1}{R}-\frac{1}{\Lambda}\cdot\frac{ct}{x}\right) \qquad (8c.)$$

with the non-divergent condition :

$$\lim_{x\to x_{PL},\,t\to t_{PL}}\left(\frac{ct}{x}\right)=1 \qquad (8d.)$$

This enfolding doesn’t project the Einstein-field equation out [33.] but a basic, fundamental lineelement structure of Lorentz-metric [34.] including its spacetime variables and coefficients of gravity field-equation. It has always bothered in description, that Einstein's field equation is basically upside down in metric coefficients.

3.2. Elliptic Umbilic point and its enfolding in phase-space:



Picture 1: The image of the umbilic catastrophe of Big Bang in u,v,w - phasespace as an enfolding and cosmic expansion of generating spacetime dimensions from a BB germ. A catastrophe, which can occur for three control factors and two behaviour axes. The elliptic umbilic is catastrophe of codimension 3, *that has the equation* $F(x,y)=\frac{1}{3}\cdot x^3-x\cdot y^2+u\cdot(x^2+y^2)-v\cdot x-w\cdot y$.
In the picture the left front axis is u, the right axis is w and the vertical, perpendicular, orthogonal axis is v.

4.1. Dimensions of spacetime as orthogonal quantum states:

In quantum mechanics, there are only certain properties [35.] and states of conditions of these properties, concentrated in a specific region of space [36.]. These concepts are called a "particle" in every day life because the humans need simple language concepts to describe the allday world [37.]. But there is to be more precise with philosophical terms in QT than in everyday life, because these properties define our thinking and thus our worldview and the description of reality that underlies physics [38.]. From this thinking follows, that there is no "substance" independent of interactions, states and properties [39.].

If one removes all the possible states of all the properties and these too, only the unpolarized quantum vacuum in its ground state without the matter states remains, nothing of the "particle" is left, no substance independent of properties and states exists [40.].

In QT there is no “substance” [41.]. This concept of substance is a classical Kantian concept without sense in QT. *So there are only properties, interactions, and states* [42.]. One could say that the sum of all these concepts constitutes the quantum mechanical substance and hence physics and the description of bases of nature. Beyond that, there is nothing. Only those natural philosophers who come from the classical Kantian school and want to deal with quantum mechanics and its measurement processes insist on their classical concepts. However, Heisenberg only considers observable values in a consistent description, i.e., measurable quantities in the description of physical microsystems. That’s the deal. Only properties, no “particle” [43.].

In this BB description, the dimensions are as a trying defined as orthogonal quantum states, which must tunnel through or get over a potential wall. The announcement is that the timelike dimension generates the spacelike ones, which are orthogonal, so spacetime always is only twodimensional but looks as a fourdimensional manifold in larger scale ranges [1.]. In contradiction to this description in real space, in (u, v, w)-phasespace of enfolding the definition of timelike dimension is orthogonal to the three spacelike ones.

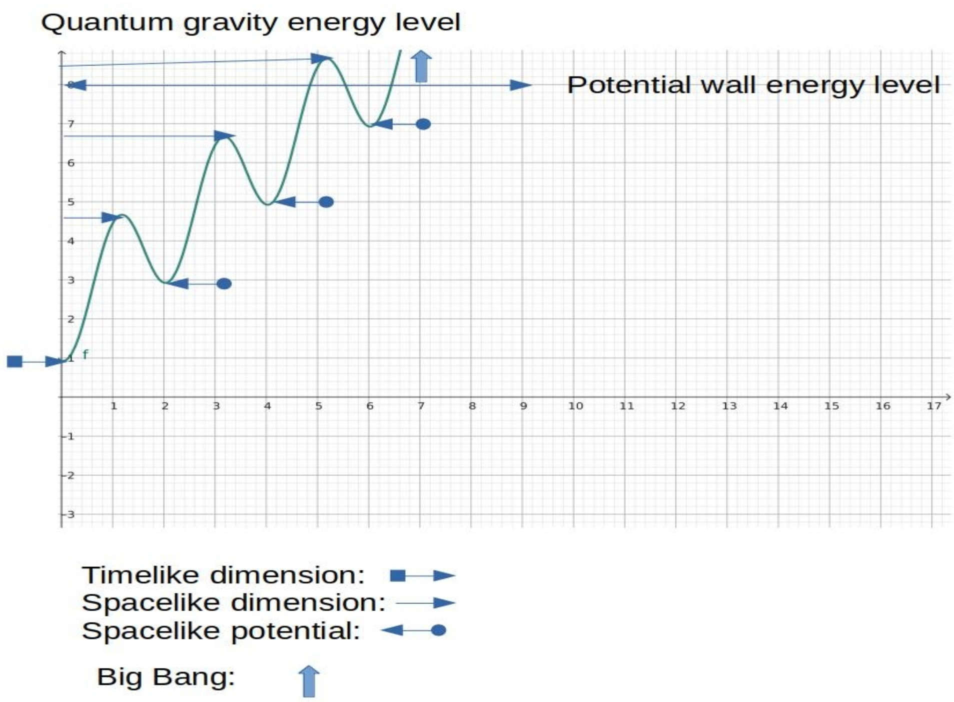
The thought is: a timelike potential comes in resonance with three spacelike ones one after the other (later after BB in a periodic way) in a quantum pre-vacuum of gravity. This coupling of potentials causes the resonance and produces the timelike dimension by coupling to the spacelike poterntial. If the second spacelike dimension is generated, the first vanishes because of system of orthogonal quantum state and the same appears with the third and the second. Every production of a spacelike dimension leads to a higher energy level through an accumulated resonance effect and after the third spacelike dimension is in resonance with the timelike potential, the coupling energy is big enough to pass the potential wall and to generate a BB or to tunnel under it in a quantum mechanical way. The responsible quantum operators (QUOPS) for this action then causes the enfolding of the germ. Since the controlling variables come from Einstein fieldequation of gravity, the QUOPS must be coupled to these classical parameters. There are three classical gravity parameters of GRT field equation, also three controlling parameters of the enfolding system and also three QUOPS to couple to the orthogonal quantum states. See [1.].
Then the interpretation of dimensions, potentials resp. their ON-operators can be interpreted over the areas of an expanding phasespace-model in the enfolding of an elliptic umbilic point.

If phase space can be mapped into or interpreted as a Hilbert function(al)- space [41], then the interpretation of the general generating process of dimensions must be changed: in this case there are not the SL dimensions orthogonal quantum states and the spacetime is not permanent 2-dimensional (one TL, one SL) with an average of four measured dimensions at large scale structure but the universe would be 4-dimensional in reality, whereby the TL dimension and the SL dimensions are orthogonal quantum states to each other. There would be a stetic changing of stabilizing the SL dimensions by the timelike potential function in a periodic way but the three SL dimensions always were permanent real, so long as they are permanent stabilizied by the TL quantum potential. In this way there was a permanent fourdimensional manifold present as a fact because the characteristic of orthogonality quantum state must move the timelike potential out of place and shift it to the next (and then third and so on periodically) stable resonance point of the corresponding deltoide curve, which represents the generating process. May be, the shifting process of resonance orthogonality stablepoint could be interpreted as a force and also maybe, that the timelike dimension only exists *between* the permanent spacelike ones because of their orthogonal quantum state coupling in phase-space.

4.2. The quantum ON/OFF-operators:

P (ON) =ψ ⟨ t ,0 /0 ⟩ activates ψ ⟨ 0 , r/0 ⟩ into ψ ⟨ t , r/ x n ⟩ and Dim (t / x n) ,+ P (OFF) =ψ ⟨ t , r/ x n ⟩ activates ψ ⟨ t , r/ x m ⟩ ;n ≠m , erases ψ ⟨ t , r/ x n ⟩ because ψ ⟨ t , r/ x n ⟩ ⊥ ψ ⟨ t , r/ x m ⟩ ;n ≠m are orthogonal quantum states and generates Dim (t / x m). And so on until BB and after that periodically until today and later. Today the measurable quantum energy level of gravity vacuum is an average of the three potential values generating the spacetime dimensions, which perhaps causes inertia.

The ON/OFF quanta are spacetime quantum potentials and act on some Hilbert-space. (Mathematicians should puzzle over the details. May be, it’s like a Pauli spinmatrix). Since active dimension states can be described over 0 ∧ 1, because of orthogonality, this must be not difficult. Reminder: orthogonal quantum states, even describing coordinate-systems of spacetime dimensions, has nothing to do with orthogonal coordinate axes of an RCCS. The reference frame of space-time itself can be chosen in any, arbitrary system of coordinates and angles. It's the quantum states of spacelike dimensions, which are orthogonal not the coordinate system in real spacetime. How the universe is generated, can be seen in Picture 2:



Picture 2: Generating the local oscillation-pattern of universe by resonance of the timelike potential with the minimal three spacelike ones in gravitational pre-vacuum, creating orthogonal spacelike dimensions, which energy level at last rises over the level of potential wall and generates the at great scales stable four-cosmos.

5.1. The deltoid:

A deltoid is a special hypocycloid that is formed when a circle of size $r=1\cdot n$ rolls inside a fixed larger circle of size $R=3\cdot n$, $n\in\mathbb{N}$ [44.]. The deltoid has three peaks and is therefore also referred to as a 3-peak hypocycloid [45.]. If the peaks map exactly on the edge of the outer circle, there is resonance between the timelike and the spacelike potentials. A 3-cusped Deltoid also is called a tricuspoid. The deltoid was first considered by Euler in 1745 in connection with an optical problem. It was also investigated by Steiner in 1856. It is also known as a Steiner hypocycloid [46.].

Definition: A hypocycloid is the path of a point on the circumference of a circle rolling on a larger, fixed circle [47]. Special case of deltoid: If the radius of the fixed circle is three times that of the rolling circle, a deltoid with three vertices is formed. The name “Steiner hypocycloid” is derived from the Swiss mathematician Jakob Steiner, who studied this curve intensively. A deltoid is a special hypocycloid with three points. It is generated, when a smaller circle rolls inside a larger circle. The deltoid curve is created when the ratio of the radius of the larger circle to the radius of the smaller, rolling circle is exactly:

$$\frac{R}{r}=\frac{3}{1}. \qquad (9.)$$

This term shall be called the resonance-condition.

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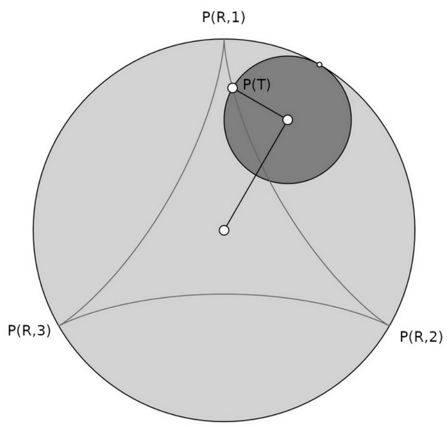
5.2. The deltoid as cross-section area of the enfolded umbilic point by generating quantum spacertime potentials:



Picture 3: The cross-section of umbilic point enfolding at constant control-value u. It describes the resonance generating of spacelike potentials and dimensions by a timelike potential exactly at the edge of the outer circle coupling to the corners of the deltoid. This exact projection of the corners at the edge of the circle generates the positive, constructive resonance of spacelike potentials. The enfolding areas, limited by the deltoide-edges describe the spacelike dimensions in phasespace. The inner circle, which rotation causes the three edges and corners represents the timelike potential and dimension. In phasespace it is orthogonal to the spacelike areas. In quantum Hilbert-space the three spacelike dimensions are supposed to be orthogonal to each other.

6. Summary:

Proposed is a model where the dimensions of spacetime, at the Planck scale, emerge from a periodic resonance effect of orthogonal quantum states.
Core ideas are including following key concepts:

1. Periodic generation of dimensions:

Instead of a permanent four-dimensional manifold [48.], spacetime on the Planck scale is envisioned as a "flat spacetime" that is only two-dimensional at any given instant. It consists of a permanent time-like dimension and one space-like dimension that is periodically and sequentially caused by the "quantum potential" of the time-like dimension. The model suggests that the three spatial dimensions do not exist simultaneously and permanently. Instead, they are generated one after another in periodic intervals at extremely high frequencies, possibly at the Planck scale.

2. Orthogonal quantum states:

The space-like dimensions are represented by quantum states that form an orthogonal system, similar to how basis vectors define a vector space. The concept suggests that the existence of spatial dimensions at any moment is governed by these orthogonal states. The spatial dimensions are described as forming an orthogonal system of quantum states. The concept of "orthogonal" here does not refer to the perpendicularity of coordinate axes in physical space, but rather to the orthogonality of quantum states in a mathematical sense, similar to how spin states are described.

3. Spacetime as an "ON/OFF" system:

The formation of dimensions is described using "ON/OFF-operators" that have similarities to spin operators in standard quantum mechanics. This implies that the dimensions are not always present but are blinking in and out of existence at the Planck scale, which is not observable at macroscopic scales. Introduced are a form of quantum ON/OFF operators, that resemble spin operators to describe the generation of these dimensions.

4. Macroscopic four-dimensional appearance:

From a global, or macroscopic, perspective, the universe appears to be four-dimensional because the periodic, high-frequency "toggling" of spatial dimensions at the Planck scale averages out to a constant, four-dimensional structure. The four-dimensional classical spacetime which is experienced would then be an emergent, or "globally seen average or mean," of this rapid, periodic process. Gravity and the Ricci tensor: For each generated spatial dimension, a two-dimensional Ricci tensor can be constructed. These can be combined to form a four-dimensional structure, but only without intercoupling. Proposed is that a possible intercoupling could lead to the description of the classical general relativity (GR) structure.The model constructs a two-dimensional Ricci tensor for each dimension.

5. Analogies to geometry and resonance mechanism:

Analogies are used from geometry, specifically a deltoid-shaped hypocycloid, to describe the resonance points, where the time-like and space-like dimensions interact and are generated. This is presented as a way to construct a four-dimensional structure without the "intercoupling" seen in classical general relativity. The periodic generation of spatial dimensions is caused by a "quantum potential" from the timelike dimension. The dimensions are produced at resonance points between the timelike and spacelike potentials, a mechanism that can be described mathematically using a deltoid hypocycloid.

6. The germ and the enfolding:

There is an expansion obtained to a germ by adding pertubation tertms to the original function of $f(x,y)=x^3-x\cdot y^2$.The pertubastion terms are necessary to resolve the singularity of atthe critical point $S(0;0)$ and to capture all small pertubations of f. The parameters $u:\overset{def}{=}\frac{1}{\sqrt{\|R_{ik}\|}};v:\overset{def}{=}\frac{1}{R};w:\overset{def}{=}\frac{1}{\Lambda}$ are the controlling parameters that determines the strength of the pertubations. The term x^2+y^2 appears in the in the expansion F of f because it plays an important role in resolving the singularity of the germ f at the critical point S. It fills the gap caused by the lack of quadratic terme in the

Taylor expansion of f and ensures that the expansion is a Morse function. This term arises in the expansion from considering the minimal universal expanding of the germ f and the basis of tjh local ring. The terms $x^2; x; y$are part of this basis and $x^2+y^2$is a possible combination of these terms, which are basis monomials of the local ring. The specific form of the expansion then depends on the choice of basis and coefficients.

7. Conclusion:

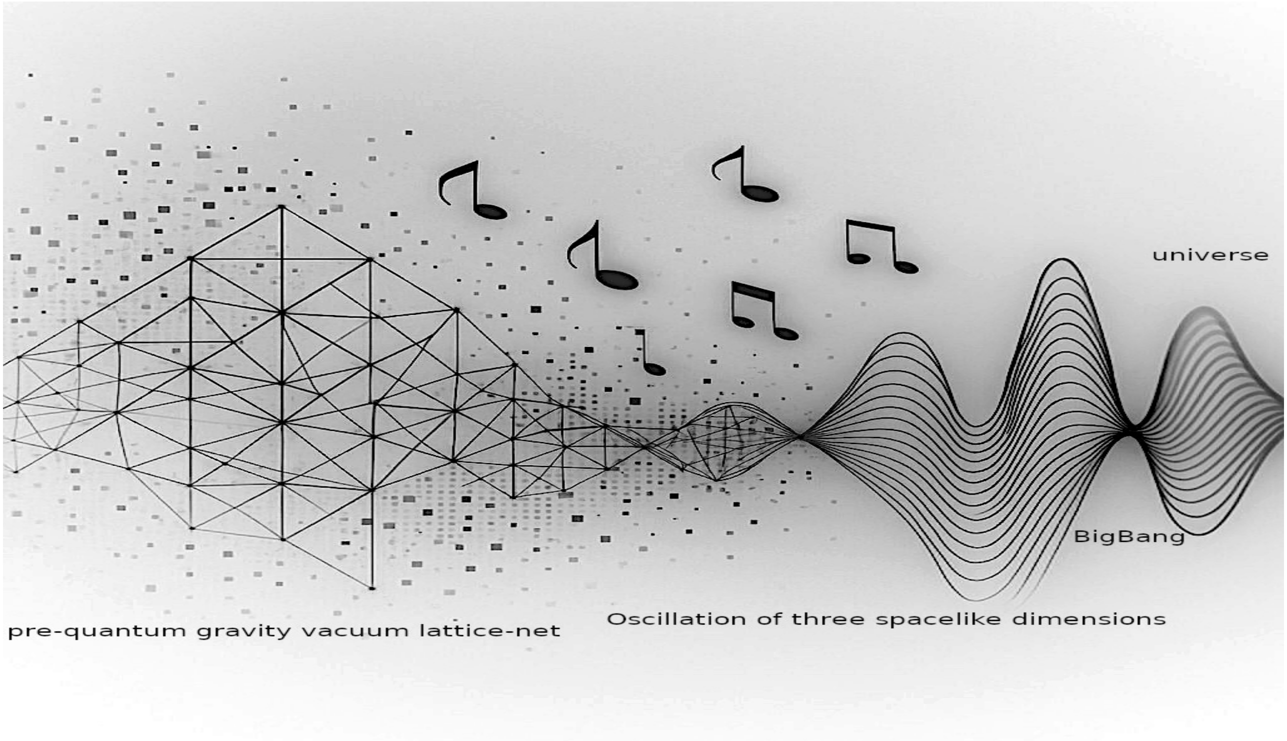
The Big bang of universe can be written in equations, which describes the enfolding of cosmos in form of an elliptic umbilic catastrophe in terms of Thoms catastrophic theory. This is a more classical nota pure, real quantum description because only terms of classical GRT are involved. Nevertheless some quantum operators (QUOPS) are introduced, which are supposed to generate the spacetime dimensions from a sort of timelike quantum potential. These QUOPS can be seen as similiar to Pauli spin matrices. The controlling variables in phase space of the expansion come from GRT and are well-known because they are the main variables in Einstein-field-equation of gravity. When time resonates, space emerged. The resonance of the timelike potential-component with the spacelike ones in the deltoid crossection of enfolding corresponds to an increase in the space components of dimensions. A conservation law applies to both, based on the constancy of the spacetime tensor and the local four-momentum. The spacelike dimensions are represented in phasespace through the areas of the enfolding.

8. Discussion:

Contrast with mainstream physics:

Mainstream physics approaches to quantum gravity, such as superstring theory [49.] and loop quantum gravity {50.], are much more mathematically developed and differ fundamentally from this concept [51.]. This model is not recognized within these standard areas of research. This recently proposed theoretical model suggests that spacetime dimensions could be described as orthogonal quantum states of each other.

This idea proposes that at the Planck scale, the universe is not a permanent four-dimensional structure [52.] but is instead composed of a permanent timelike dimension and periodically generated spacelike dimensions. Contrast with mainstream physics: This model is a highly speculative departure from mainstream approaches to quantum gravity, such as superstring theory and loop quantum gravity. The concepts proposed—a non-permanent, periodic nature of spatial dimensions and an emergent classical spacetime—are not part of the current scientific consensus. Mainstream efforts to unify general relativity and quantum mechanics do not typically rely on such mechanisms. In this case, the new ideas may bring a forthcoming nearer solution method to an old problem by new forms of thinking and this may lead to implications for understanding gravity: This model could offer a new approach to describing classical general relativity (GRT) and potentially explain the emergence of its four-dimensional structure from a more fundamental quantum reality. Quantum-Classical Transition: It provides a mechanism for understanding how a discrete, quantum-level structure of dimensions can give rise to the continuous, four-dimensional spacetime described by classical GRT. From the ontological standpoint of philosophy the universe was seen in the past two centuries as an developement of several paradigms: a great machine, a brain, a thought, a computer or a hologram. Now in the actual state its new paradigm is interpreted as the local oscillation-pattern of a pre quantum-vacuum. For more information see Picture 4:



Picture 4: A more qualitative, artlike description of the beginning of universe, but it shows the fundamental ideas: Evolution of developement from left to right. On the left side there is the gravitative pre-quantum vacuum in form of a net-lattice, then the three dimensions are generated one after the other in form of local maxima of the curves with different, increasing energy states. The Big bang follows at the dark point at the right side and then the last curve shows the average of spacetime energy superposition of the four dimensions in building permanent a routine universe of a four spacetime after a Big Bang.

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Picture sources:

. Picture 1: https://mathworld.wolfram.com/Elliptic Umbilic Catastrophe.html, modified by author,

. Picture 2: made by author,

. Picture 3: [47.], modified by author,

. Picture 4: https://songagent.com, modified by author.

10. Acknowledgements:

Many thanks to Prof (PhD) Philip E.A. Mortimer, former member of Universities of Glasgow and Edinborough (Edinburgh), for help- and colourful ideas, advices, discussions and suggestions and for his following two statements:

1.Theorem 1: It always takes longer, than you suppose. Proof: see reality!

2. The scientific joke of the day: Two physicist are talking. Said the first: „You have made some errors in your last papers!“. The second nodded and replied: „May be – but you have made nothing at all at last!“

Also many thanks to Goethe for his aphorism [53.]: "Wer Vieles bringt, wird Vielen etwas bringen!" (Whoever brings much will bring something to many).

11. Verification:

This paper is definitely written without support of an AI or chatbot like Chat GPT 4 or other artificial tools. It is fully human work.

2025, October.