Possibility of spacetime-dimensions as orthogonal quantum states

Two-dimensional periodic resonance-effect of timelike dimension-potential possibly causes four-spacetime by generating spacelike dimensions

---

Abstract:

There is the possibility that on a Planck-scale the universe is not a fourdimensional manifold but only a flat spacetime, consisting only of a permanent timelike dimension and periodic caused spacelike dimensions by the quantum potential of this timelike dimension. In this case the quantum-states of spacelike dimensions form an orthogonal system. For this model a twodimensional Riccitensor can be constructed for every dimension and four of them can be formed to a fourdimensional structure but without intercoupling. A possible intercoupling then would lead to description of classical GRT-structure. This model also can be described mathematically by a special hypocycloide, a deltoide, where the points of the curve mapping exactly on the outer circle of the rotation process. These are the resonance-points of the timelike with the spacelike potentials, causing the dimensions as triple eigenvalue of signature. And so a form of ON/OFF-operators are introduced, which shows similiar structures as spin-operators and can possibly be used to describe the forming of the dimensions.

Holger A.W. Döring
Technische Universität Berlin
Germany
DPG-departement matter and cosmos
Section: GRT and gravity
Physikalische Gesellschaft zu Berlin
Oxford-Berlin University Alliance
Orcid: 0000-0003-1369-1720
e-mail: holger.doering@alumni.tu-berlin.de
h.doering.physics.tu-berlin@t-online.de

---

1. Introduction:

Maybe there is no room at the bottom - Is the universe in reality a flat spacetime? Possible orthogonal quantum-states form only one spacelike dimension after the other, not at the same time.
In global measurements for the whole manifold the universe seems to look then like a fourdimensional spacetime. But a finer examination from a nearer place shows, that at the same time-interval only two dimensions exist: the timelike dimension and one spacelike but this in periodic intervals. In this way, the observer thinks that the measured effects are a permanent, four-dimensional structure, but in reality they are periodically two-dimensional and the global four-structure for great scales is only a global seen mean of this permanent periodic causing of a double-structure, born in a high frequency of Planck-scale and fast intervals.

Think of this gedankenexperiment in a model: There are four bells. The first has a bright sound, the other three have a similarly dark one. The four bells are positioned so that the bright-sounding bell is in the center of an equilateral triangle, whose three corners are formed by the dark-sounding bells. Now, the bright bell from the center periodically strikes each bell in the corners one after the other.
The first bell periodically strikes the other three successively, causing them and itself to ring. The bells are spacetime quantum-potentials or quantum-forces; the resonances of the sounds are dimensions. Only two bells ring at a time, but they ring so quickly that a listener might think all four bells were ringing simultaneously because the listener cannot distinguish the individual bell tones from one another. Furthermore, three of the bells are supposed to sound the same frequency and intensity which means the same pitch and volume and which means the existence of three equal measuring spacelike dimensions, if isotropy holds also in gravity quantum-vacuum, too, like in classical spacetime at large scales. If the sound is measured from a wider range, only a mixing of all four noises is acceptable in interpretation of a listener but in reality always there are only two bells at a time in sound-resonance. The basic measuring process will need a very, very, fast shorttime physics, to distinguish the bell-ringing, which means to distinguish the special resonance processes of the different spacelike dimensions of their lonely, individual interaction with the timelike dimension or its potential. Possibilities of measuring these processes is but far away from our technical potencials and abilities today, but it may be that other coupling matter interactions at lower scales can be used as an indication of this possible phenomenon. It's important to always be one step ahead of the current day's developments. That's why research is pioneering work.

2. Calculation/Methods:

2a. General mathematics in classical description of GRT:

In $\mathbb{R}^2 := \mathbb{R}\, x\, \mathbb{R}$ applies for the Riemann curvature tensor [1.],[2.]:

$$R_{1212} = R_{2121} = -R_{1221} = -R_{2112}, \tag{1a.}$$

for all other components of Riemanntensor there is:

$$R_{gikl} \equiv 0. \tag{1b.}$$

Following relation holds:

$$R_{ik} - \frac{1}{2} \cdot g_{ik} \cdot R = 0, \tag{1c.}$$

but Riccitensor and Ricci-scalar alone are not zero, only the difference is zero in two dimensions. This then leads to reduced Einstein-field equation for gravity-field in two dimensions [3.],[4.] of:

$$-\frac{1}{2} \cdot \Lambda \cdot g_{ik} = T_{ik}\,. \tag{2a.}$$

With the relation of:

$$R = \sum_{kl} g^{kl} \cdot R_{kl} = \sum_{iklm} g^{ik} \cdot g^{lm} R_{iklm} \tag{2b.}$$

follows then [5.],[6.]:

$$R=-2\cdot\begin{vmatrix}g^{11} & g^{12}\\ g^{21} & g^{22}\end{vmatrix}\cdot R_{1212}=-2\cdot det\, g^{ik}\cdot R_{1212} \qquad (3.)$$

for the invariant Ricci-scalar.

With

$$det\, g^{ik}=g^{11}\cdot g^{22}-g^{21}\cdot g^{12}=\frac{1}{g} \qquad (4a.)$$

(and Abelian announced multiplication):

$$g^{ii}\cdot g^{kk}=g^{kk}\cdot g^{ii} \qquad (4b.)$$

follows the relation between Riemanntensor component and Ricci-scalar of [7.],[8.]:

$$R_{1212}=-\frac{1}{2}\cdot g\cdot R. \qquad (4c.)$$

Because the following relations hold:

$$g\cdot g^{22}=g_{11};\, g\cdot g^{11}=g_{22};\, g\cdot g^{12}=-g_{12};\, g\cdot g^{21}=-g_{21}, \qquad (5a.)$$

then there is in$\mathbb{R}\, x\, \mathbb{R}$.:

$$R_{kl}=\frac{1}{2}\cdot g_{kl}\cdot R \qquad (5b.)$$

Also in addition, the following relationships appear for components of Ricci-tensor from only existing Riemann-tensorcomponent [9.],[10.]:

$$\begin{matrix} R_{11}=g^{22}\cdot R_{2112}=-g^{22}R_{1212}; \\ R_{12}=g^{21}\cdot R_{2121}=g^{21}\cdot R_{1212}; \\ R_{21}=g^{12}\cdot R_{1212}; \\ R_{22}=g^{11}\cdot R_{1221}=-g^{11}\cdot R_{1212} \end{matrix}. \qquad (5c.-f.)$$

With

$$g=\left(g^{11}\cdot g^{22}-g^{21}\cdot g^{12}\right)^{-1} \qquad (6a.)$$

(supposed abelian) follows:

$$R_{11}=\frac{1}{2}\cdot g^{22}\cdot g\cdot R;$$
$$R_{12}=-\frac{1}{2}\cdot g^{21}\cdot g\cdot R;$$
$$R_{21}=-\frac{1}{2}g^{12}\cdot g\cdot R;$$
$$R_{22}=\frac{1}{2}\cdot g^{11}\cdot g\cdot R.$$
(6b. - e.)

2b. concrete metric components:

For this twodimensional, general metric, the following tensor metric now applies [11.]:

$$g^{ik}=\begin{pmatrix} K & c_V \\ c_V & 1-K \end{pmatrix} \tag{7a.}$$

and

$$g=\frac{1}{K-K^2-c_V{}^2} \tag{7b.}$$

where $c_V:=\frac{\Lambda}{R}\neq 0$ is a dimensionless vacuum constant. The term K is defined as follows:

$$K:=\frac{\hbar^2\cdot k\cdot\Lambda}{p^2};k=2\cdot n+1;n\in N \tag{8.}$$

The symbol p is interpreted as the fourmomentum of graviton.

This terms all lead to the concrete spacetime-description in two dimensions of [12.],[13.]:

$$R_{11}=\frac{1}{2}\cdot g(1-K)\cdot R;$$
$$R_{12}=-\frac{1}{2}\cdot g\cdot c_V\cdot R;$$
$$R_{21}=-\frac{1}{2}\cdot g\cdot c_V\cdot R;$$
$$R_{22}=\frac{1}{2}\cdot g\cdot K\cdot R.$$
(9a. - d.)

Following conditions could be set:

$R=(2\cdot n+1)\cdot\Lambda$ and $\Lambda=\frac{1}{R^2{}_{PL}}$ instead of $k\in K$. If these conditions are set here, then $k=1$ must be set in K, not $k=(2\cdot n+1)$ anymore.

Perhaps the cosmological constant Lambda and the fourmomentum p of the vacuum graviton could be described over 2x2 matrices like:

$$\Lambda=\Lambda\begin{pmatrix}1 & 0\\ 0 & 1\end{pmatrix} \text{ and } p=\begin{pmatrix}p_0 & 0\\ 0 & \sum_{r=1}^{3} p_r\end{pmatrix}. \qquad (10.)$$

These terms lead finally in $\mathbb{R}\,x\,\mathbb{R}$ to Ricci-tensor of $R_{ik}\neq 0$ and:

$$R_{ik}=\frac{1}{2}\cdot R\cdot g\cdot\begin{pmatrix}1-K & -c_V\\ -c_V & K\end{pmatrix}=\frac{1}{2}\cdot(2\cdot n+1)\cdot\Lambda\cdot g\cdot\begin{pmatrix}1-K & -c_V\\ -c_V & K\end{pmatrix}. \qquad (11.)$$

(But the difference of Riccitensor and Ricciscalar is zero, see above).

This condition leads to Einstein field-equation of gravity in two dimensions of [14.].[15.]:

$$-\frac{1}{2}\cdot\Lambda\cdot g^{ik}=\chi\cdot T^{ik}, \qquad (12a.)$$

with

$$\chi=\frac{8\cdot\pi\cdot G}{3\cdot c^4} \qquad (12b.)$$

Einstein gravity constant and

$$T^{ik}=\begin{pmatrix}T^{00} & T^{01}\\ T^{10} & T^{11}\end{pmatrix} \qquad (12c.)$$

matter-tensor in two dimensions. Flat matter! (It could be real, like in Abbotts novel. [16.])

This Ricci-tensor (11.) now is a description for *one* spacelike coordinate x_1 and its forming timelike coordinate x_0.
This all is well-known classical physics except the new formulation of K-metric in R_{ik} (11.).

All three spacelike coordinates are formed now by the timelike dimension one after the other and this effect always new in a periodic form. This condition means, that there are connections between the timelike and the spacelike dimensions but not between the spacelike coordinates itself because its one way ***or*** the other but not “and the other”. Every spacelike coordinate exists only, when there is no other spacelike coordinate existing. *This is in quantum description a state of orthogonality of spacelike spacetime dimensions.* Only the overlapping mean value, measured from a great distance or through large time differences, appears to take the form of a fourdimensional manifold, which, in reality doesn’t exist. Maybe, the universe could be a periodic flatland, which only induces fourdimensionality through orthogonality of its spacelike quantum dimension-operators.

Remark: As a reminder, it should be mentioned that Lie-groups (Lie-algebras), which describe GRT-activity in fourdimensional spacetime are neither Schrödinger/Heisenberg- nor Dirac quantizable. Since Lie-algebras aren’t Schroedinger-quantizable, there must be made an investigation, why not. Lie-algebras contain linearity, associativity and a Lie-bracket. Since similar forms of Lie-brackets are used in quantum descriptions like the Berry-phase, the non-quantizable condition can't be the Lie-bracket but must be the condition of linearity or assoziativity or both. Usually the Born condition for matrices is used for quantizing (p-momentum, q-spacelike coordinate):

$$p \cdot q - q \cdot p = i \cdot \hbar \qquad (13a.)$$

May be, that this condition no longer holds but must be substituted by another term without associativity or only a weak form of it like the Jordan-condition or something similiar:

$$\frac{p \cdot q + q \cdot p}{2} = i \cdot \hbar \ . \qquad (13b.)$$

3. On the rotation effect causing the spacelike dimensions:

The modelling is, that a form of a timelike quantum potential for the first dimension comes in resonance with a similiar potential for a spacelike dimension. In this resonance, both dimensions are caused, since this phenomena is a periodic process for three dimensions, the process is periodic. After establishIing a spacelike dimension, the other further caused spacelike dimension is washed out, until a new generating of this dimension begins. In this case, the quantum process is like a model of an electromagnetic three-phase current. The resonance can be described by simple mathematics of a special hypocycloide, a deltoid. The movement of the inner circle, which corresponds to the timelike quantum potential, generates a deltoid whose corners lie on the outer circle. This circle stands for a spacelike quantum potential. The resonance of the tips with the outer circle creates the timelike dimension as well as a single spacelike one, of which three are created one after the other. Each creation erases the previous dimension, because the corresponding quantum states are orthogonal so that a constant, periodic re-formation occurs. This form of rotation seems in greater time-intervalls or at larger scales as a permanent existence of four dimensions, which isn't true in this spacetime-model. The dimensions occur as permanent produced eigenvalues from the potential-eigenfunctions.

The corresponding deltoid can be described by some formulas. In a rectangular Cartesian coordinate system (RCCS) this description is:

$$X = (R - r) \cdot \cos(\alpha) + r \cdot \cos\left(\left[\frac{R}{r} - 1\right] \cdot \alpha\right); \quad Y = (R - r) \cdot \sin(\alpha) + r \cdot \sin\left(\left[\frac{R}{r} - 1\right] \cdot \alpha\right), \qquad (14a.,14b)$$

R - radius of spacelike circle; quantum space-potential $P(s)$,
r - radius of timelike circle; quantum time-potential $P(t)$,
α - angle between edge of the deltoid on outer circle and the positive abszissa,

$P(X, Y)$ caused couple of timelike/spacelike dimension.
This description also can be given in complex form over exponential functions or in polar-coordinates.

For a classical deltoid with following values:

$R=3;r=1;\alpha_1=120°=\frac{2}{3}\cdot\pi;\alpha_2=240°=\frac{4}{3}\cdot\pi;\alpha_3=0°=360°=2\cdot\pi$

the following coordinates occur in a twodimensional RCCS mapped in $\mathbb{R}x\mathbb{R}$ for the spacelike dimensions:

$$P_1=(3;0);P_2=\left(\frac{3}{2};\frac{3\cdot\sqrt{3}}{2}\right);P_3=\left(\frac{-3}{2};\frac{-3\cdot\sqrt{3}}{2}\right). \quad (15.)$$

This description can be developed to a more further system, where all terms are constructed over a germ-function in Thoms catastrophic theory. More of this stuff in the next paper. There the interpretation of dimensions, potentials resp. their ON-operators than can be interpreted over the areas of an expanding phasespace-model in the enfolding of an elliptic umbilic point.

4. The quantum ON/OFF-operators:

$P(ON)=\psi\langle t,0/0\rangle$ activates $\psi\langle 0,r/0\rangle$ into $\psi\langle t,r/x_n\rangle$ and $Dim(t/x_n)$, (16a.)

$P(OFF)=\psi\langle t,r/x_n\rangle$ activates $\psi\langle t,r/x_m\rangle;n\neq m$, erases $\psi\langle t,r/x_n\rangle$, (16b.)

because

$\psi\langle t,r/x_n\rangle\perp\psi\langle t,r/x_m\rangle;n\neq m$ are orthogonal quantum states and generates $Dim(t/x_m)$ and so on periodically.

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) [17.]. Since active dimension states can be described over $0 \wedge 1$, 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 spacetime 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 [18.], [19.].

Orthogonal measurement processes are not a question of Bohr's Copenhagen interpretation or Bohm's many-worlds theory; it's solely and exclusively about the following: It is not about the sovereignty of interpretation in the interpretation of the measurement processes, but solely about whether a measurement shows the status of the state of a quantum event or not. It is exclusively about observable quantities. [20.],[21.]. This condition leads to the following requirement for measurers identified as “observers”:

5. Quantum requirement:

There is a clearly defined measurement space in which the state of a quantum mechanical event (like spin up or spin down) either occurs or does not occur after a measuring, when the quantum *system no longer exists in a mixture of indeterminate superpositions and orthogonality holds. If this does not occur, it is completely irrelevant whether it does not occur in principle at all or occur in a differently defined measurement space (“another” universe), which is not accessible to the result of this measurement. In any case, the event definitely does not occur in the specified measurement space of this described and prepared quantum-system, when the collapse of the wave function occur. According to Heisenberg, only information content about measurable systems hold including measurements of the state of a system after the measurement. That’s all, nothing more.*

Example given: If Schroedingers cat is measured living after a measurement, it lives. That is the only statement that can be made. Not even the statement: "she is not dead" can be made, because this statement is already a projection that leaves the measuring space, by mentioning the non-occurring state "dead", which as a concept does not exist in the quantum measuring space after the measurement.
No other statements make any sense because they all leave the measuring-space after the measuring except one state [22.],[23.]. Since these are orthogonal states, the specific second state not only does not exist, but even the term for it cannot be used after the measurement in a senseful way. If the measured state is "spin up," it cannot be defined as "not spin down," because the concept of orthogonality removes this "spin down" designation from the measurement space after the measurement. The term can only be used in the higher-order classical announced metaspace outside of the measurement, because it maps different measurement spaces onto one another. If in this space “spin-up” is measured, and “spin-down” not, it is no measured quantity, which isn’t defined in the measuring space but only in the description of classical metaspace. In quantum systems, the metaspace also collapses into the measurement space after the measurement. *Any terms not present in the measurement space may not be used to describe the measured state of the quantum system.* The state space of the system also applies to concepts. Only those terms that exist in the state space can be used if genuine quantum theory has to be practiced and thought about it. The quantum theoretical concepts of description must also be applied rigorously and in discipline of using the right concepts at the right place.

Followed are some remarks on quantum-theoretical measurement states. Within the framework of quantum mechanics, a physical microsystem MS does not possess all properties simultaneously, but only a specific subset of them. These properties are called objective. Only one objective property can be meaningfully related to a microphysical object system, whereby it is not necessary to know whether this property is present at the time or not. These objective properties are commensurate with the system MS, i.e., they can be measured sequentially in any order without their values changing. *In other words, they are measurably abelian.* Knowledge of all objective properties is the greatest possible amount of information that can be obtained or stated about the quantized system MS.

This amount is represented by the system's state operator |A>, or the property corresponding to the state |A> is present. Knowledge of the state then allows one to predict the results of the measured values of all objective properties. (Objective inner eigen-properties of a matter fermion or energetic field boson in classical matter quantum theory include spin, effective charge, electric or magnetic momentum, or effective rest mass. All inner eigenproperties, which can characterize the physical eigenstates of the particle). In quantum mechanics, states such as |A > are represented by vectors in the associated Hilbert space, whereas measurable quantities are represented by Hermitian operators. If an observable is objective with respect to the state |A>, then | A> is an eigenstate or eigenvector of A. The eigenvalue then specifies the measured value of A in the respective state, which should therefore be denoted by | A’>. Then: A|A’> =A’ |A’>. This consideration is generally limited here to operators with discrete spectra. And in spacetime-geometry there is supposed, that there is a discrete spectrum of dimension-states.

In the context of spacetime dimensions as measurable quantum objects with physical properties (such as tensile strength) and/or states (such as temporal measurability), it is always assumed in this discussion that the measured values of the dimensions are mutually exclusive, i.e., that the states involved in the three space-like dimensions are orthogonal to each other and, under normalization of the states, the following applies: .<A(k)|A(l)>=$\delta_{k,l}$.
Furthermore, it is assumed that the entire Hilbert space is spanned by the states |A>, i.e., that the states |A> are complete, which is expressed by the relationship Sum (k) |>A<| = 1. If two observables are commensurate, then the corresponding operators commute.

Another Gedankenexperiment may show this phenomenon:

The shell game with three cups and a die beneath one of them is well known. It involves a kind of quantum-gravitational Laplace demon that only recognizes the cup with the die beneath it. All three cups are visible to all other observers. The die serves as an operator, transforming the cup above it into the one-projection state. The other two cups are in the zero-projection state. If the player changes the position of the die, that cup is transformed into the one-projection state, and the previous one is set to zero.

Example given: if a spacelike dimension is measured, only the concept of another (yet not measured) dimension is purely nonsense until after it has been measured. Only measured systems, interactions, or states exist and make meaningful statements in physical terms possible.

There is nothing more to say about processing these orthogonal systems, and according to Wittgenstein, one must remain silent when there is nothing to say, when no meaningful conclusions can be reached. Anything else would be non-redundant chatter without information content. "Whereof one can not speak, thereof one must be silent". This theorem also applies to the definition of quantum mechanical systems. It must not only be calculated in quantum mechanical terms, but also thought in this way. If a state exists after a measuring process, it exists. If it doesn't exist, it doesn't exist. Other statements like "this state is now real, other states are unreal"are meaningless, even contrary negative ones because the concept of "other states" doesn't exist in the measuring space after the measuring.
Note: In a superimposed, i.e., indeterminate quantum state not yet clearly measured from outside the cat's perception, Schrödinger's cat is not "dead and alive,"as often is said, but "neither-nor." This distinction is often mistakenly confused in descriptions and it's not the same. The cat has no definite eigenstate and not both. Poor cat.

6. Summary:

Classical four spacetime after Einstein-description can be formulated in two dimensions, not only as a shortened description with one spacelike and one timelike coordinate like it is often done to describe phenomena more simply but for real. This description is nothing new. But this twodimensional state can be seen as a periodic quantum state, where the spacelike dimensions are orthogonal states and also don't exist in the common seen or measured resp. supposed way but one after the other. The timelike potential is the base and generated the spacelike ones in form of a three-edge curve of a deltoid in phase space.

7. Conclusion:

The timelike potential is the base and generated the spacelike ones. Why? No idea! This paper is a trying in description of the process not in whole explanation. In research never all answers are

known. All themes mentioned are only suggestions. In this context, it should also be mentioned that the assumption is made here that the space-like dimensions, when formed one after the other, first create an unstable quantum state, which twice led to an unstable, closed Big Bang (BB) as the first of three causes and only after the third activation of the last third dimension it has enough energy to left the bound pre-vacuum system and generated a free, "ionized" state of the Big Bang to build our universe.
“Thrice are the steps of time” said Schiller in his “Sprüche des Konfuzius” [24.].

8. Discussion:

Spacetime-generation as a process of description in form of Thoms catastrophic-theory is discussed in the next paper, because this way is the logical elaboration of the deltoid description [25.], [26.]. In Thoms catastrophic theory physical states of a system can develop spontaneous and go over in another stable state of phase space, if their controlling variables are changing steadily. In spacetime itself the controlling variables control the unfolding process of the system in the form of an elliptical umbilical point (see next paper). In this sense, BB is a “catastrophic point”, because it changes abruptly its equilibrium in a new state of phase state.These sort of state transitions always can be described over mapping them in two different Riemannian surfaces.

If spacetime itself also is considered as a physical system, the control variables will turn out to be the mathematical-physical quantities of Einstein's field equation, since, as variables controlling the unfolding process, they must be metric itself. This constraint comes from the unfolding equation of the universe as germ in BB-description. This is the only logical choice that this description allows. The generation of the third spatial dimension requires a higher internal energy level than for the second, which in turn must be higher than the building of the first spatial dimension. However, all of this only works in the closed, bounded system shortly before the Big Bang: the fact that the creation energy for the third dimension is highest is not reflected in the structure of these dimensions. If that were the case, the motion in the three spatial directions in field-free space-vacuum of universe would have to be of different strengths, and this could be measured, if isotropy of spacelike dimensions with reference to their generating energies is a real phenomenon in quantum gravity microspace or not - but according to all common assumptions since Aristotle, but also according to the modern, universal theories of isotropy or homogeneity of space-time vacuumstructure, a deviation from this isotropy does not seem to be the case. However, the announcement of these oscillations are a hypothesis of modern physics that is in principle measurable, and therefore testable, verifiable or falsifiable, and so isotropy of movement in spacelike dimensions at the microscale of Planck-length in possible quantum gravity is not a fact that can be taken for granted.

9. References:

. [1.] Einstein, A., Grundzüge der Relativitätstheorie, Friedr. Vieweg & Sohn Verlagsgesellschaft mbH, **1990**. 6. Auflage Nachdruck.

. [2.] Wasserman, R.H., Tensors and Manifolds, Oxford **1992**.
.
. [3.] Misner, C.W., Thorne, K.S., Wheeler, J.A., Gravitation,W.H. Freeman, San Francisco, **1973**.

. [4.] Lee, J.M.,Introduction to smooth manifolds, graduate texts in mathematics, Springer **2003**.

. [5.] O'Neill, B., Semi-Riemannian Geometry with applications to relativity, Academic Press, **1983**.

. [6.] Hawking, S.,Ellis, G., The Large Scale-Structure of Space-Time, Cambridge University Press, **1973**.

. [7.] Esposito, F.P., Witten,L. Eds. (1977): Asymptotic Structure of Space-Time, NY: Plenum Press, **1977.**

. [8.] Eisenhart,L., Riemannian Geometry, Princeton University Press, 6. Ed.,**1966**.

. [9.] Sachs,R.K., Wu,H., General Relativity for Mathematicians, Springer **1977**.

. [10.] Warner, F.H., Foundation of Differentiable Manifolds and Lie-groups, Springer **1983**.

. [11.] Döring, H., Cosmological constant of GRT as a radial function in dependence of velocity, **2024**, doi:10.5281/zenodo.10963813 https://zenodo.org/records/10963814.

. [12.] Dirschmidt, H.J., Tensoren und Felder, Springer **1996**.

. [13.] Bishop,R.L., Goldberg, S.J., Tensor Analysis On Manifolds, Mac Millan, **1968**.

. [14.] Abraham,R., Marsden, J.E.,Springer, **1983**. Ratiu, T., Manifolds, Tensor Analysis and Applications,

. [15.] Spivak, M., Calculus on Manifolds, NY: Benjamin, **1965,**

. [16.] Abbott, E. A., Flatland: A Romance of Many Dimensions (6th ed.), New York, Dover, **(1952), [1884],**

. [17.] Reichenbach, H., Philosophical Foundations of Quantum Mechanics, University of California Press, Los Angeles **1948,**

. [18.] Heisenberg, W., Die physikalischen Prinzipien der Quantentheorie, Leipzig 1930, Mannheim **1958**,

. [19.] Jammer, M., The conceptual Developement of Quantum Mechanics, McGraw-Hill, New York, **1967**,

. [20.] Jauch, J.M., Foundations of Quantum Mechanics,Addison Wesley, Reading, Mass. **1968**,

. [21.] Ludwig, G., Die Grundlagen der Quantenmechanik, Berlin **1954**,

. [22.] Neumann, J.v., Mathematische Grundlagen der Quantenmeachanik, Berlin **1932**,

. [23.] Piron, C., Foundations of Quantum Physics, W.A. Benjamin, Reading Mass., **1976**

. [24.] http://www.zeno.org/Literatur/M/Schiller,+Friedrich/Gedichte/Gedichte+(1789-1805),

. [25.] Thom, R., Structural Stability and Morphogenesis:An Outline of a General Theory of Models. Addison-Wesley, Reading, Mass. **1989**, ISBN 0-201-09419-3.

. [26.] Zeeman, E.C., Catastrophe Theory, selected papers, 1972-1977, Addison-Wesley, Reading, Mass. **1977**.

10. Appendix:

A really unnecessary appendix, but a small gift for the musicians among the physicists.
The generation of the universe as a music melody. Description of the generating of universe in music notes is not very complicated but really simple.

Explanation: the notes on the lines represent the spacetime-dimensions or their potentials, the notes between the lines the ON/OFF-quantum operators (QUOPS). The note on the lowest line (E) represents the timelike dimension or its generating potential in pre-vacuum which must be defined. The accord is the Big Bang. Left side of accord is state of prae-Big Bang oscillations of bounded energy dimension-spectrum in excited states of increasing values until „ionization-energy“ of BB is reached by generating the third spacelike dimension through the timelike potential part. After Big Bang (right side of accord), the QUOPS couple to the spacelike dimensions in their free states (are not seen any longer) and generate orthogonal quantum states of dimension-existence in Plancktime-oscillation, when coupled to the timelike dimension one after the other (played in C-Dur). A really boring monotonous melody of ever the same four tones. Nothing very brilliant or ingenious but pure physics.

Picture1: Spacetime generation, Big Bang and permanent enfolding of dimensions of universe as a simple note series in six described oscillation cycles.

11. 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.

12. 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, September.