FOUNDATIONS FOR A NEW BASIC COSMOS-MODEL. EINSTEIN – ONLY PART OF A WHOLE

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Abstract. Whenever the explanation of a system is one's aim, particularly that of the universe or the 'cosmos' as it was called by the Greeks, the essential components and comprehensive laws on which the system is based must be known. A model for the universe should be a maximal one which offers room for all models which are built for subdomains of natural reality. We call such a model "Basic Cosmos-Model" (abbreviated to BCM). In the following we present foundations for a BCM which are new in so far as they are designed with regard to a broader and more comprehensive pretension than the 4-dimensional spacetime continuum of relativistic physics built by Einstein. We call these principles for structuring space, time, masses and their interactions *Cosmic Laws.* We think that these laws present guidelines for the design, respectively the construction of models of natural reality. We consider this approach an appropriate feasibility to represent natural reality in a comprehensive way and to exclude misleadings and inexplicable "singularities".

Key words: Cosmos models – critical stability – evolutionary causality – multidimensional universe.

1. INTRODUCTION

If the universe as a whole is modeled and studied, the principal problem arises that it cannot be included into a larger model or system, about which something as for structure, laws or evolution is known. The various limitations of perception of mankind and individual human beings reinforce the difficulties of creating such a model. One has to extrapolate models and laws which are appropriate and valid for "subsystems" to design a maximal model for the universe as a whole. The first question is which models and laws are appropriate for such an extrapolation, the next one is how the extrapolation should be performed.

In science the extrapolation of models and laws from a domain, in which their validity can be assured either by experience or by experiments, to a much larger domain, generally leads to delicate questions as to its admissibility.

Since mathematics offers the keys to deal with science and to explain natural reality, extrapolations are performed via or by means of mathematical models. In general these models can be extrapolated to any extent or "up to infinity" according to the rules of mathematics. But if one wants to learn about natural reality, the question remains, whether an extrapolated mathematical model corresponds to a phenomenon existing in natural reality or not, i.e. whether a mathematical extrapolation is valid or admissible with regard to natural reality. Especially in the context of "infinity", i.e. "infinitely large or small" (infinitesimal magnitudes e.g.), the problems of extrapolation reach their peak.

With respect to the problem of admissible extrapolations or of limited admissibility of theoretical or mathematical models and laws, we point out three basic reasons for inadmissible extrapolation:

First, the validity of a model may be restricted with respect to various aspects of the phenomenon to be modeled, i.e. some aspects are modeled appropriately, others not. As a classical example we mention the models for light, wave or particle. Another example is induced by the stochastic process of Brownian motion which represents the usual mathematical model for the motion of a small particle in a liquid. As is well-known, all paths of this process are almost everywhere non-differentiable, hence a velocity of the particle cannot be derived from this model. Of course, the velocity of the particle can be explained by means of a different model.

Second, the right, true model respectively law can perhaps not be determined by observation or experiment because of the natural restrictions in the perception of human beings. The restrictions are either caused by the lack of appropriate technical instruments for observation or experimentation, or they are brought about by the observable range of the corresponding phenomena. Starting from a smaller range of observation, which is under control, and going to a larger one, there may be a change in the structure of the model or law. Up to some time in the past mankind had not been able to find out the laws of relativistic mechanics, but only those of "classical" mechanics. As further examples we mention some physicists' doubt in our days that the well-known law of gravitation is correct over any wide range in the universe and Newton's second law is correct under any circumstances, cf. Milgrom (2002). Maybe the true laws applicable to the whole universe have not been found up to now, because of our limited capacity of observation.

Third, necessary parameters for the evaluation or application of a certain law of nature possibly are not measured correctly. For example the law of gravitation in its known form may induce misleadings, because distances are not measured correctly.

If inadmissible extrapolations are performed, they will provoke misleadings, contradictions, bizarre phenomena. On the level of mathematical models there appear so-called singularities, which in some sense represent the concentrated rest of unaccountable or contradictory facts and insufficiencies.

Again, we mention some examples demonstrating these effects: The seeming possibility of time travelling (in the strict sense); a statement like "The effect precedes the cause"; the phenomenon of Dark Matter which is possibly caused by applying incorrectly the known law of gravitation or a false law; a statement like "There is a multitude of universes parallel to ours" without providing any empirical hint to that. With respect to the last statement the term "a multitude of universes" seems to be contradictory in itself already from the linguistic point of view.

If one wants to build a model for the universe as a whole, in spite of the problems described, we propose to look out for general or basic principles, which are universally valid in nature. Therefore we are going to speak of foundations for a basic cosmos-model (abbreviated to BCM). We propose three principles or *"Cosmic Laws"*:

- first, a universally observable law for structuring and restructuring natural reality;
- second, a principle for ordering events in natural reality, a procedure that is necessary, if one wants to do and develop science claiming reliability;
- third, an extension of the existing dimensionality, a mean that is necessary because of the insufficiencies and incompleteness of the existing models.

The *Cosmic Laws* proposed by us do not constitute a scientific model for the universe as a whole. But they do represent foundations and are "test principles" to be applied to other complex models and theories, in order to find out, whether those are in accordance with the "Cosmic Laws", and thus to avoid inadmissible extrapolations. The huge amount of strange particularities and contradictory competing models which can be found in the literature on astrophysics and cosmology (cf., e.g., Breuer 1993) is caused, as we think, mainly by inadmissible extrapolations. There may exist more than three *Cosmic Laws*. By collecting such laws and following our guideline referring to them when extrapolating models and laws to any extent, maybe to the whole universe, the situation could be improved.

2. FIRST COSMIC LAW: CRITICAL STABILITY

Every system, as for example any accumulation or condensation of masses, is subject to the natural law of "critical stability" respectively instability. This phenomenon of nature appears because of the following reason: At least one influence factor associated to the system is always active, modeled by a metric variable X with values $x \geq 0$, so that, if the value of X exceeds a critical lower bound K_g, the instability of the system increases with increasing values of . The increase of X is caused by an accumulation or condensation of the system, in the above example by an increase of the mass or a condensation of matter. In case that the value of X becomes equal to a critical upper bound G, the instability of the system exceeds each finite value, in a mathematical formulation it tends to reach infinity or becomes infinity, which actually manifests itself in the decay or decomposition of the system. This law concerns the accumulation or condensation of energy as well.

Therefore instability represents a mechanism of a permanent remodelling of natural reality including the universe as a whole. This natural phenomenon of instability may be formulated positively as the phenomenon of limited or critical stability. At the critical upper bound K_G stability collapses. We derive this law of nature by our experiences with the natural reality in all subsystems of the universe. Since it is valid for all subsystems, like for example the size of atomic nuclei, the masses of suns, the size of galaxies, we claim to call the law a universal cosmic one.

The ability of abstract thinking allows man to deal with the term “infinity” in mathematics and physics, although our world of experience is finite. As conclusion we formalize the first *Cosmic Law*:

The function I which describes the instability as a function of should not depend on the critical bounds K_g , K_G , but be the same for all cases. Therefore the variable X is rescaled or normed with respect to K_g and $_G$ into the variable by setting:

$$(x) = (x - K_g)^+ /(K_G - x) \quad \text{for} \quad \leq x < K_G \ .$$

where $(x - K_g)^+$ denotes the maximum of $x - K_g)$ and 0, so that $= K_g$ induces $Y(K_g) = 0$ and $x = K_G$ induces $(K_G) = \infty$. As a function of , the instability in any case begins in $y = 0$ and is “infinite” for $= \infty$.

Taking into account this normed scale, we take the exponential function to represent the instability I as a function of . The exponential function generally in science represents “the” natural law of growth.

With regard to (in)stability each system depends on its internal state and external conditions which influence the system. The internal state may be characterized by the sort of matter and the structure of the system; external conditions may be for example pressure, temperature or gravitational effects. The dependence of instability on internal and external conditions refers to the critical bounds K_g , K_G , as well as to the increase of instability for increasing values of between K_g and K_G . Concerning those critical bounds they have to be denoted as $K_g = K_g^{i.e.}$, respectively as $K_G = K_G^{i.e.}$, for concrete internal and external conditions, in order to represent that dependence. If a system is studied under certain “normed” internal and external conditions, one is allowed to omit the superscript “*i.e.*” and simply write K_g and K_G . The dependence of the increase of the instability on increasing values of X between $_g^{i.e.}$ and $_G^{i.e.}$ is represented by two positive constants, $_i$, $_e$, which serve as parameters in the functional relation. Since the constant $_i$ refers to the internal state, it appears as factor of $(x - K_g^{i.e.})^+$, whereas $_e$ appears as factor outside the exponential term, because it is determined by external conditions. At last, the instability I is normed in the sense that it begins with the value 0 in $x = K_g^{i.e.}$.

With regard to the above considerations the natural law of instability or the first *Cosmic Law* is presented in the formula:

$$I(y) = C_e\{\exp[C_i y] - 1\}, \quad 0 \le y < \infty \ ,$$

if I is a function of the “normed” variable , respectively in the formula

$$I(x) = C_e\{\exp[C_i (x - K_g^{i.e.})^+ /(K_G^{i.e.} - x)] - 1\}, \quad 0 \le x < K_G^{i.e.} \ ,$$

if the instability I is represented as a function of the original variable .

Stability S is defined as reciprocal instability, i.e.

$$S(x) = 1 / I(x), \quad 0 \le x < K_G^{i.e.} \ ,$$

Instability as a term should be considered analogously to terms like (mathematical) entropy or probability. Within corresponding contexts terms like health or explosivity have a similar nature like instability. According to the above formula instability is a dimensionless term like those cited before. The natural phenomenon of instability manifests in different effects.

In a concrete context instability therefore must be represented by an associated and apt measurable characteristic M , in order to be able to study *measurable* effects of this phenomenon. When measuring instability using a measurable characteristic it may attain a physical dimension. Such a measurable characteristic M is found by the application of a rule of measuring to I , i.e. M is a function F of I , $M = F(I)$; that F represents a rule of measuring it has to be “order-preserving” in the following sense:

A rule of measuring F for I has the property of being valid for any possible values i_1 , i_2 of I with $_1 \le i_2$ either always $(i_1) \le F(i_2)$ or always $F(i_1) \ge F(i_2)$, according to the object which is measured. Mathematically, should be a monotonically increasing or a monotonically decreasing function of I .

As an example one may consider the measurable characteristic $= F(I)$ = reciprocal lifetime of the system, i.e. if the instability of the system attains the value i , its reciprocal lifetime is $F(i)$. In this case the rule of measuring preserves the order in the form that $_1 \le i_2$ implies $(i_1) \ge F(i_2)$. The measurable characteristic M in this example has a physical dimension, namely the reciprocal time = 1/hour.

Of course the constants $_i$ and $_e$ have to be adapted to the rule .

In microcosmos the law of instability is active for example in the accumulation of nuclear substances in an atom. Here the atom represents the system; the influence factors which cause the instability are the mass of the nucleus in combination with the constellation of the charge distribution in the atom. For instable elements exist already below the critical nuclear mass because of their constellation of the charge distribution. Whether 238 or 266 is taken as critical upper bound for the nuclear mass depends on the context, that is, whether only natural elements are considered or synthetic elements as well. It is obvious that an arbitrary accumulation of the nuclear mass is impossible. The finding and definition of one single valid metric influence variable X , in which the above influence factors are comprised, should be the subject of research in nuclear physics.

Next we show that the law of decay of radioactive matter presents an example of the law of instability, respectively the measuring of instability according to that law. Any radioactive element has a characteristic constant λ which is part of its law of decay. This law states that out of a mass of N_0 nuclei of this element after a time of length t in the mean $N(t)$ nuclei still exist where $(t) = N_0 \exp(-\lambda t)$. In our context the element induces a certain value x_0 of the influence variable and by that a value $\lambda(x_0) = \lambda$ on the normed scale, i.e.

$$\lambda(x_0) = (x_0 - K_g)^+ /(K_G - x_0) \ .$$

Therefore the instability of this element is $I(x_0) = C_e\{\exp[C_i\lambda(x_0)] - 1\}$

Under normed conditions the constants $_i$ and $_e$ are equal to 1. If the rule of measuring takes into account a time interval, the normed influence variable has to be related to time, i.e. its effectiveness is understood per one time unit. Therefore $\lambda(x_0)$ attains the physical dimension (1/time), (1/hour) e.g., which is expressed in our law by means of $_i$ = (1/hour). Correspondingly the effect of the variable Y over a time of length t is measured by $C_i\lambda(x_0)t) = \lambda t$, which again is dimensionless. The rule of measuring F_t with respect to a fixed chosen time length t , $0 < t < \infty$, is given by

$$F_t\,(I(x_0)) = F_t(\exp[C_i\lambda(x_0)] - 1) = \exp[C_i\lambda(x_0)t] = \exp(\lambda t) = N_0 \,/\, N(t) \ ,$$

where F_t represents a monotonically increasing function of I and the measured instability is dimensionless. The greater $\lambda = \lambda(x)$ m, the greater the instability of the element with value x for X , the faster the decay.

Also in mesocosmos, i.e. within the range of nature which is directly perceptible by man we find the validity of the law of instability everywhere:

- The size of buildings and technical constructions as systems in the above sense, is limited owing to the laws of statics as to internal conditions, and because of interactions of the system with its environment as to the laws of mechanics.

- Similarly, the growth of plants and living beings as systems in the above sense is limited, where the internal conditions are determined by the potential and abilities of the "system" with respect to constitution and structure; the external conditions are determined by their environment in form of light, air, water, etc.

- Phenomena like the turning over of water in a lake caused by a lack of oxygene, the collapse of the circulation in a human being caused by increasing stress factors could be modeled, comprehended and finally measured by applying the law of instability.

In a quite general context the failure probability of a technical system up to time t, $0 < t < \infty$, is determined as $1 - \exp(-\lambda t))$, λ is a positive parameter induced by the system. Analogously to the example of radioactive decay, the instability of the system with the parameter λ is described by $(\lambda) = \exp(\lambda t) - 1$, for a fixed t. The rule of measuring F_t can be chosen as the monotonically increasing function $F_t : \mathbf{R}_+ \to [0,1]$, with $_t(i) = i/(i+1)$, $\in \mathbf{R}_+$, so that

$$F_t(I(\lambda)) = I(\lambda)/[I(\lambda)+1] = 1 - \exp(-\lambda t) .$$

Here the measured instability is a probability and therefore without dimension.

We mention the size of stars as example in macrocosmos, i.e. the system is represented by a star, its instability is caused by the accumulation of matter and perhaps measured by means of its reciprocal life-time. In this case the critical upper bounds $K_G^{i.e.}$ are in a range between 90 and 100 Sol in dependence of the internal and external conditions, cf. Kaler (2000). Stars with a bigger mass do not exist, as they become instable and explode when their mass approaches the critical bound.

With respect to astrophysics and cosmology the consequences of the first *Cosmic Law* are:

- Also Black Holes have a limited stability and cannot absorb any amount of mass.

-- The whole mass of the universe itself is not stable.

Since the physics of condensed matter in Black Holes, even more in the range of the total mass of the universe is not developed enough, one is not capable of knowing the critical upper bound $K_G^{i.e.}$ in the law of critical stability. Thus it remains an open question at the moment, at which level of accumulation of mass or under which conditions a Black Hole or the mass of the universe become unstable. But we are sure that respective critical bounds $_G^{i.e.}$ do exist, since we are sure of the validity of the law of critical stability.

This law can be found everywhere in natural reality, therefore it is an actual principle for the structuring of masses, respectively their interaction, and one of its consequences is that any accumulation of masses is limited.

3. SECOND COSMIC LAW: THE PRINCIPLE OF EVOLUTIONARY CAUSALITY

Regarding the universe under conventional scientific aspects, one has to deal with the ideas of space and time. Due to Einstein we know that time depends on the velocity of a reference system and therefore is a relative term. If man, in searching for perception, wants to establish a concept of order within the totality of happenings in nature, if he claims for an absolute lawfulness or a universal principle of order, such a principle cannot be based on time, as a relative term cannot be used to represent an absolute principle.

In this context Kronheimer and Penrose (1967) for example introduce causal spaces endowed with causal relations to distinguish between causal and chronological order.

The essential physical components of the universe are space, energy and matter which are linked by interactions. We state as universal law for all happenings in the cosmos, i.e. as second *Cosmic Law* the principle of Evolutionary Causality:

For each interaction between the components themselves or with others it holds true: If a cause has generated an effect, a directed chain of events "cause-effect" exists. This chain is irreversible in the sense that an event which happened cannot be made undone or changed.

This is not the classical strong principle of causality of philosophy and physics. Randomness is admitted as cause, chaotic phenomena are explained by uncertainty because of inobservability or by random effects. In particular determinism of the happenings is not implied.

The principle of Evolutionary Causality, however, implies: What has happened cannot be made reversible as event nor altered. An event remains forever with all its consequences and interactions. Therefore, in particular, time travelling (in the strict sense), i.e. with influence on and change of former events, is not possible.

This principle suits all laws of nature which have the structure "if-then", i.e. such laws which describe a certain effect provided a certain condition in form of an active cause is fulfilled.

We regard some scientists' statements that in the range of microcosmos the principle of causality should be questioned in the sense that the cause precedes the effect (cf. Delbrück 1986) as misinterpretation. The reason for their interpretation is that not all causes are taken into account in the design of the experiment or by the technique of measurement or that randomness is not admitted as cause. Particularly, in such a context the principle of Evolutionary Causality should be applied as directrix for a consistent modelling and explanation of the phenomena.

We design the ordered scale of causality to formalize the above principle. With respect to this scale one is able to state "The cause precedes its effect". All events of the structure "cause-effect" are "mapped" on this scale.

The causality-scale is modeled by a set K endowed with a complete order $\preceq$, i.e. as ordered or directed scale. For any elements k_1, k_2, k_3 of K it holds true:

$$k_1 \preceq k_2 ,$$
$$k_1 \preceq k_2 \text{ and } k_2 \preceq k_1 \text{ implies } k_1 = k_2 ,$$
$$k_1 \preceq k_2 \text{ and } k_2 \preceq k_3 \text{ implies } k_1 \preceq k_3 ,$$
$$k_1 \preceq k_2 \text{ or } k_2 \preceq k_1 .$$

The elements or points on the scale K can be "measured" or "evaluated" with respect to their position in relation to other points on K by means of the complete order $\preceq$, but "distances" between k_1 and k_2 for $k_1 \preceq k_2$ cannot be interpreted. The ordered causality-scale cannot directly or completely be observed, but only be indirectly conceived when observing events.

In principle all events can be located on K independently of a reference system, since they have their history of the type "cause-effect-cause", in which of course, randomness is admitted as cause. Man is unable to grasp the totality of events and to locate them on K , since that would require knowledge about all causes and effects. He can only relatively locate such events on the causality scale, whose cause-effect relations are known to him, i.e. he can locate them in their relation to other events linked to those. Thus the causality-scale becomes partially observable.

The causality-scale models the principle of Evolutionary Causality in the sense that for all events of the type "cause-effect" the point , associated to the cause, precedes the point v , associated to the effect, i.e. $\underline{\text{p}}\, v$.

The location of events on K requires facilities for observing and measuring events. The causality-scale can indirectly be conceived by means of an associated time-scale, which in turn is modeled by the real line . In contrast to the ordered causality-scale, the time-scale, i.e. the real line , is not only completely ordered by means of the relation $\le$ for real numbers, but moreover the distances of two points t_1 , t_2 , for $_1 \le t_2$, can be interpreted as time interval, respectively duration of time $(t_2 - t_1)$.

We explain a time measurement as a function $: K \to \mathbf{R}$, which is order-preserving in the sense: for all points $_1, k_2 \in K$, with $_1 \underline{\text{p}}\, k_2$, the associated time points $T(k_1)$, (k_2) satisfy $(k_1) \le T(k_2)$. Furthermore the measurement procedure has to define a zero-point $= 0$ (called presence) and a time unit, i.e. the point $t = 1$ and thus the time span $0,1]$. On the basis of such a time-scale, time can be measured in a reference system, time measurement can be transferred to other reference systems, if their "reference" to the underlying system is known. Time measurement does not only depend on a reference system, but in addition on a medium such as for example light.

Since to man causalities and effects are not always perceivable, for practical purposes an established order for chains of events with respect to a time-scale is installed. For a wide range of the reality that we are able to perceive, the time-scale is equivalent with the causality-scale. But since time is a relative magnitude, its scale may be biased with respect to the causality-scale, because of an inadequate . As a consequence, paradox events may appear.

The principle of Evolutionary Causality is absolute. It is neither conditioned by a medium like light, nor is it conditioned by the velocity of light at all. Should higher velocities than the one of light ever be detected in the future, this principle requires no alternation nor correction, whereas in Einstein's model with velocities exceeding the one of light, phenomena may appear, for which the effect seems to precede the cause.

4. THIRD COSMIC LAW: THE NUMBER OF DIMENSIONS OF THE UNIVERSE IS LARGER THAN 4

The universe is the complete totality of natural reality, that means the whole where this reality is located and takes place. It presents the space for matter and energy, and the scenery on which events may take place.

A BCM should offer the facility to describe and analyze the universe with regard to its state and evolution within sciences, such as physics, astrophysics or cosmology. Such a model must have an absolute "nature" and not a relative one. That means it must be separated from reference systems and any restricting subsystems of the universe in order not to narrow, shorten or condition perception, facilities of measurement, knowledge and understanding. For this purpose up to now spacetime models have been designed like the four-dimensional spacetime continuum of relativistic physics, which is widely regarded and accepted as a "standard model".

We think that this model is not sufficient as a BCM as explained above, because of the following reasons:

- time is a relative term, it lacks the absolute nature as principle of order for processes,
- 3 dimensions of space are too few to make room for all items which exist in natural reality.

This idea itself is not new. Kaluza (1921) and Klein (1926) dealt with a higher-dimensional model. In the context of cosmology Liebscher (1994, chapter 9) takes into consideration a model with more than 3 dimensions for representing space. For more than 20 years a group of physicists has been working with higher-dimensional models aiming at explaining the different physical interactions within a unified theory (GUT, Grand Unified Theory), see Breuer (1993). Since the eighties the champions of the so-called string-theory have been assuming more than 3 space-dimensions for their theory, for instance a 10-dimensional spacetime. In his remarkable book *Hyperspace*, Kaku (1995) presents an impressive overview of arguments

and approaches to models with more than 3 space-dimensions. How many space-dimensions should be considered, remains an open question to him, too. That depends on the phenomena to be studied. The totality of those has not been known up to now. We want to draw the important conclusion that *more* than 3 space-dimensions have to be accepted as requirement for a model of the universe.

As a consequence we state as third *Cosmic Law*: The number of dimensions in a BCM is larger than 4.

Essential for this statement are the comprehension of, respectively the requirements for the concept of dimension. As characteristics we state:

- dimensions induce an ordering structure in our range of cognition,
- they are necessary for localizing and measurement,
- they do not depend on measurements in different reference systems, like e. g. on velocity, but are invariants given by nature.

Considering the number of dimensions which is necessary for a BCM we claim:

- The BCM must be endowed with enough dimensions to represent masses and physical interactions. It must be closed in the sense that masses cannot disappear from the model "into some nothing", neither can they coming "from the nothing" enter the model. The BCM shall include the whole natural reality.

- If one or more of the dimensions given by nature are omitted when designing a BCM, possibilities of comprehending, representing and investigating natural reality are lost, the view is narrowed. One might encounter contradictions in a narrowed model.

Based on this comprehension of the concept of dimension, we need more than 4 dimensions for the equipment of the BCM. We are going to explain this approach in detail, as follows:

First, there is no doubt about the 3 dimensions of the space, which we can directly see. But time does not satisfy the requirements of a dimension. Time is not apt as an ordering principle, since it is relative, i.e. time differs depending on a velocity in space. Moreover time is bound by space, as already Augustinus stated. Instead of time we integrate the causality-scale as dimension into the BCM. As explained above, time is a map of this scale which depends on a reference system. Therefore time can appear as dimension in a "relative" model, which represents a section of natural reality like in the 4-dimensional spacetime continuum, however not in a BCM, that means in a model of absolute nature.

The relativistic 4-dimensional spacetime continuum represents a "projection" of the BCM, which is appropriate for modelling efficiently an important, large section of natural reality.

But it is possible that 3-dimensional objects are transformed by a physical interaction in such a way, that they "lose" their dimensionality. As an example we mention the transformation of matter into energy. According to our requirements for the concept of dimension, respectively the number of dimensions, the question arises about how to conceive such a phenomenon with respect to dimensionality. In a system with 3 dimensions for space and 1 for time energy does not have a dimension, since one cannot represent or locate it within those dimensions. As energies undoubtedly exist in nature, they must be conceived in one or more additional dimensions according to our requirements to dimensionality, otherwise the BCM would not be complete. If one does not admit an additional new dimension for energies, 3-dimensional energy would disappear into nothing, as it cannot be represented in the 4-dimensional spacetime either.

5. CONCLUSIONS

As has already been indicated, we consider these three *Cosmic Laws* indispensable when designing or constructing models for natural reality, particularly for the whole universe. They are indispensable in order to avoid fallacies as well as "unaccountable singularities", and to represent the phenomena comprehensively.

The first *Cosmic Law* restricts speculations on an unlimited growth. Black Holes for example will not expand infinitely, and the mass of the universe will not persist in "a point". As a whole this law presents a basis for the structures of matter in the universe.

The second *Cosmic Law* gives an order to the processes of events in natural reality. Even if in the big-bang the universe existed as pure energy, the principle of Evolutionary Causality was already active for this state, although time did not exist yet, since time is bound by space.

The third *Cosmic Law* does not determine the number of dimensions of natural reality, but ascertains that the number 4 of the relativistic spacetime continuum is insufficient. This view opens new important perspectives.

The question of the dimensionality of the universe as reality in itself is of eminent importance, as measurements of distances for instance or of volumes always depend on the dimension of the space in which the process of measuring takes place. So the 3-dimensional unit cube has the 4-dimensional volume zero. The shortest distance between two points depends on the space structure, which is available for the process of measuring, and thus it particularly depends on the dimensions of this space. The shortest distance between two points on a 3-dimensional sphere for example is shorter than the shortest distance between these points on the 2-dimensional surface of the sphere.

The true distances between two masses may differ from the actually measurable distances in a 3-dimensional space-structure because of a higher dimensionality of natural reality. This fact can cause misleadings when applying the law of gravitation in so far, as masses are measured incorrectly on the basis of measured forces of attraction. Based upon this, a new aspect of the phenomenon of Dark Matter might be revealed.

A higher-dimensional universe with corresponding higher-dimensional masses offers interesting perspectives for the use of 3-dimensional infinitesimal masses as a model, the same applies to argumentations in the physics of elementary particles or in cosmology in the context of the big-bang. An “infinitesimal something” with respect to 3 dimensions may be a 4-dimensional object.

Provided that the big-bang takes place in a reality of a higher dimension than the conventional one, the extension of events is not subject to the conventional space-time-structure. This leads to the conclusion that masses and energies which exist in reality do not have to be detectable in the 3 space-dimensions which we are able to ascertain. Based upon this a new aspect of the phenomenon of Dark Matter is revealed too. The expansion of the matter which was produced by the big-bang may also take place inhomogeneously or incontinuously through the visible space, since deviations through additional dimensions might be possible.

The additional dimensions of an *N*-dimensional universe, > 4 , would furthermore offer room for the unification of physical interactions, an approach strived for by many physicists, see Kaku (1995); this applies also to para-psychological or super-sensory phenomena, like the occasional ability of some human beings to foresee events, and to post-big-bang models, cf. Breuer (1993), Fahr (1992, 1995).

Of course, it is true that one only finds what one is looking for. We hope that our study will encourage physicists, astronomers, cosmologists to venture into unknown areas.

REFERENCES

Breuer, R. (Ed.): 1993, *Immer Ärger mit dem Urknall*, Rowohlt Taschenbuch Verlag, Reinbek bei Hamburg.

Delbrück, M.: 1986, *Eine Verschwörung der Natur*, in Mannheimer Forum 85/86, Boehringer, Mannheim.

Fahr, H. J.: 1992, *Der Urknall kommt zu Fall*, Franckh-Kosmos, Stuttgart.

Fahr, H. J.: 1995, *Zeit und kosmische Ordnung*, Hanser, München, Wien.

Kaku, M.: 1995, *Hyperspace*, Oxford University Press, Oxford.

Kaler, J. B.: 2000, *Sterne – die physikalische Welt der kosmischen Sonnen*, Spektrum Akad. Verlag, Heidelberg.
Kaluza, T.: 1921, *SBer. Preuss. Akad. Wiss.*, 966.
Klein, O.: 1926, *Z. Phys.*, **37**, 895.
Kronheimer, E. H., Penrose, R.: 1967, Proc. Cambridge Philosoph. Soc., **63**, 481.
Liebscher, D. E.: 1994, *Kosmologie*, Johann Ambrosius Barth, Leipzig, Heidelberg.
Milgrom, M.: 2002, *Scientific American*, **287**, No. 2, 30.

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