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RESEARCH ARTICLE

Time-Ordered Momentary States of the Universe and a Dynamic Generic Model of Reality: Étale Over a Dynamic Non-Commutative Geometry

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ABSTRACT

We introduce a generic model for space-time where time is just a totally ordered set ordering the states of the universe at moments where over (not in) each state we define potentials or pre-things which are going to evolve via correspondences between the momentary potentials to existing things. Existing takes time and observing takes more time. The theory developed is generic in the sense that existing theories like Relativity and Quantum Theory are obtainable by specialization, that is by introducing more assumptions, such as measuring by numbers. In each state we may assume a topology or geometry and the most generic is a non-commutative topology, the correspondences are assumed to satisfy minimal process conditions which will allow to let them evolve to "change" which can be observed. It is essential to define existing by some manifestation at some suitable time interval – called an existence interval – allowing mutations when existence intervals of the same process are not consecutive but separated by some intervals of non-existence. Since something exists "at" an interval and not in any moment our theory of the "existing reality" has a certain discreteness which is enhanced in "observed reality" but which includes the existence void – where processes of potentials on short time intervals are brewing the future existing events – there is "continuity on the moment level". In the three versions of reality, we have now causality is not behaving as assumed in observed reality and that is the main reason for the new paradigms that evolve. We show how our model (the dynamic interval-moment model) allows to obtain elegant explanations for several counter-intuitive effects in quantum theory; we will also hint at some drastic philosophical impact on interpreting events in this model of the universe.

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1. INTRODUCTION

Perhaps the geometry used to describe the events in the universe is the most important ingredient in Physics. It can vary from Euclidean, over a manifold as in Differential Geometry to Minkowski space or curved space-time as in Einstein's relativity theory. It is awkward to think of an elephant or your brain activity as being embedded in some fixed geometry, the more specific the geometry the stranger it is to embed reality in it. So, we strived for the most generic geometry which still has enough structure to yield a plausible description of reality in it. Then we do not embed reality in it, but consider it over the geometry sort of like étale space. Moreover, for time the same remark can be made, one may treat time as a dimension, a parameter, something a clock measures, ... or just the total ordering of momentary states of the universe. For the geometry we will use a very general pre-geometry based upon non-commutative topologies in the states of the universe, made dynamic via morphisms between states forming strings over time intervals and for "time" just a totally ordered set. Then we automatically are led to define "existing reality" – not in moments which do not exist themselves – but in nontrivial time intervals; the existing events are defined as strings of potentials defined "over" – thus not in – states for correspondences connecting potentials over states at later moments, and "existence" happens at "existence intervals" specific for the event which is evolving towards existence from the existence void. This leads to the DIM-model (Dynamic Interval Moment) I introduced in [1].

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Since observation intervals contain several existence intervals, what we observe are different manifestations of something existing. Thus, it is immediately clear there will be some new paradigms concerning identification of observed objects, definition of place of an observed object versus the existing one with new interpretations of the uncertainty principle, definition of causality and cause-consequence relations. Since we assume minimal assumptions for our theory – weaker than what is assumed in relativity and quantum theory – these can both be seen as specializations of our model. Here let us just mention one remarkable effect, namely that the Big Bang is not an explosion or a singularity, but just the sudden Big Exodus from the existence void into the existing reality by passing the minimal existence time intervals for the short strings, so the Big Bang is now taking some time interval on the level of existence intervals; moreover the "creation" of the universe is ongoing with many – tiny, small or relatively big – bangs probably observable as supernovae, or sudden appearances of particles.

Another important effect is that in mathematical formulae where time is used as a parameter of change (a mistake but just an approximation of course) one cannot let time go to zero because – even in the actual models, below the Planck time unit – one leaves the observable reality, but below the minimal existence interval one leaves the existing reality and is descending in the void where momentary potentials and short strings of these are busy generating the later existing reality. Physics in its actual construction cannot deal with the most important part of reality, that is the void where potentials are generating all future existing things. It is immediately obvious that many philosophical paradigm changes will result from the DIM model, in Biology, Psychology, Medicine, Philosophy for example, as well as in Physics, I mentioned some of these, often related to the "dark" pre-interactions in the void and the changes in (observed versus existing and even pre-existing) causality, in [1].

The chosen generic nature of our construction is not allowing calculations or measurements by numbers – but that can be added to our assumptions (as in relativity or quantum theory) and still new paradigms will arise – it is amusing to go back to Euclid's plane geometry and see how the use of only non-measured widths of the compass makes lines into isomorphic totally ordered groups (up to a choice of an origin on each line) not parametrized by the real numbers, unless one later introduces coordinatization by choosing a field of numbers and Pythagoras' theorem then proving the rational numbers do not suffice.

The mathematics needed is elementary but is of a new type relating strings of correspondences (these are not set maps) of potentials over states to "geometric" morphisms in the underlying geometry. The choice of the "geometry" in a state is arbitrary – as states are non-existing and thus abstract in some existential sense – but the dynamic structure defined by the choice should be evaluated in a comparison with physical observations one wants to describe as real. The non-commutative topology I would propose is the weakest structure necessary to obtain a generic construction allowing relativity and quantum theory as specializations, so that model is without contradictions for all accepted physical theories. The non-commutativity introduces specific new interpretations [2] but is not essential for the main paradigm shifts.

2. DEFINITION OF TIME IN REALITY

Time is a very intuitive notion and seldom you will find an attempt at a more precise definition. Physicists will often say that time is what a clock measures; but what does a clock measure? Well, a clock measures some regular (approximately) periodic movement with as a unit the passing of some fixed point on the orbit; so we have days, months, years and scale subdivisions of these periods abstractly defined. More modern we have clocks measuring vibrations like in crystals, current fluctuations, atomic movements, but all measure some periodic movement in reality. The movement is a change depending on time and speed even more depending and acceleration still more depending on time; but identifying an effect of time and the essential time itself is an unfounded leap of faith. Also viewing time as an extra dimension is wrong, for example we observe that the "passing of time" (itself a wrong intuition) is irreversible, and dimension depends on the field of numbers one uses, real or complex, or why not the non-commutative field of quaternions? Usually, time is used as a parameter in a four-dimensional space (real or complex) again, for example Minkowski space with some non-positive definite quadratic form defining distance forcing a relation between time and the metric. The choice of the coefficient-c^2 – where c is the speed of light – for t^2 in the quadratic form entails some special role of c in time-space (dilation of time etc...).

(1) We will look at time as a totally ordered set T, with no structure as a real vector space or even a real line; at one place it would be interesting to assume it is a totally ordered additive group in order to get a grip on translations of time intervals (see the remark in the introduction about Euclidean lines being totally ordered groups!).

(2) The universe U is then constructed as a set of states at moments – where moments are the elements of T – say $U(t)$ at t in T. Hence, the total order of Time is just the total order of the states of the universe and we may think of U as a book with pages $U(t)$ indexed by elements of T.

(3) The pages will be glued together by some maps $f(t, t')$ for $t < t'$ in T, where $<$ is the order of T, $f(t, t')$: $U(t) \to U(t')$, which we will give some topological or geometric meaning hereafter. The choice of a geometry in the $U(t)$ is in fact arbitrary, then later it has to be checked that the resulting dynamic geometry of the model fits well with observations, but for generic reasons we will choose a topology with minimal assumptions – weaker than what is used in relativity and quantum theory – namely a non-commutative or virtual topology as I described axiomatically in [3]. One can also use the non-commutative Grothendieck topology I also defined in [3]. We demand only the following properties for now:

1. $f(t, t) = I(t)$, the identity of $U(t)$
2. $f(t, t'') = f(t', t'')f(t, t')$ for every $t < t' < t''$ in T

In [3] some weak continuity types of properties are added once some topologies on the states have been fixed. For now, we only use the notion of a place in $U(t)$, this can be any subset of $U(t)$, but later when existing objects are being considered we will talk about existence-places.

Conclusion about time. Time is not passing, it is the fixed ordering of states, but the maps $f(t, t')$ define a relation between states at t and t' for every $t < t'$ in T; later when objects will evolve over the states and their topology we will see how this leads to the notion of "change" so time also does not create change and change does not say anything about time except that time allows to order change and "before or after" will be well defined!

3. DEFINITION OF SPACE, MOMENTARY POTENTIALS AND DYNAMIC PLACES

The notion of space and place will develop simultaneously from the definition of the "Existing Reality" consisting of existing events, interactions, objects, …. The material reality will be defined, not in the geometry but over it, hence the word étale in the title.

(4) Potentials. Over a state $U(t)$ at moment t, we consider a set $S(t)$ of pre-things or t-potentials and we look at the set $PS(t)$ of all subsets of $S(t)$, including the empty subset and $S(t)$ itself. These pre-things are defined over something momentary so nothing will exist there, and the potentials are in some sense abstract like symbols. Like for the geometry on $U(t)$, we have transitions between the $S(t)$, for $t' > t$.

(5) We let $s(t, t')$ denote a map from $PS(t)$ to $PS(t')$ which may be viewed as a correspondence from $S(t)$ to $S(t')$, this mathematical concept is just a map from subsets of $S(t)$ to subsets of $S(t')$ as already mentioned, we write $A(t)$, for some subset of $S(t)$ and $s(t, t')(A(t)) = A(t')$ for all $t' > t$.

(6) Viewing all $t' > t$ for some t in T we get a "long string" of $A(t')$ with $S(t, t')(A(t)) = A(t')$, for an interval $[t, t'] = I$ in T we have the $A(I)$ as the "short string" of $A(t'')$ with t'' in I. On the $s(t, t')$ we impose the same conditions as on the $f(t, t')$, namely $s(t, t)$ is the identity of $S(t)$ and the composition $s(t', t'')s(t, t') = s(t, t'')$. Moreover the correspondence acting on the empty set is always the empty set; thus no pre-things arise as the result of a correspondence of the empty set! No thing comes from nothing!

(7) An $A(t)$ is a "*creative t-potential*" if it is not of the form $s(t'', t)A(t'')$ for some $t'' < t$ and $A(t'')$ a t''-potential. Hence every long string can be extended in the past till it starts with a creative potential at some moment of origin or else there are strings which have potentials at each moment before some fixed moment and then the string may extend over all time or reduces to the empty set after that final moment. Conclusion, potentials may appear as a creative potential at some first moment t and its long string may disappear at some other given moment or extend till the end of time.

Now we are ready to provide a new definition of "*existence*" using the strings of potentials.

(8) Some short string starting at some $A(t)$ for some t in T, over some interval can be existing at some specific interval I in T, then we say I is an existence interval for the object A defined by $A(I)$, and $A(I)$ is a manifestation of the object A given by the long string. That manifestation does not exist at some moment in the interval and not at the end of the interval but "at" the interval.

Let I end at moment $t(1)$, then $A(t(1))$ continues with a long string which is also the continuation of the string starting at $A(t)$, so if that string has another existence interval $I(1) = [t(1), t(2)]$, then $A(I(1))$ is a consecutive manifestation of the object a, this time at the interval $I(1)$. Hence we either find I, $I(1)$, …, $I(n)$ corresponding to "*consecutive manifestations*" of the object A at existence intervals $I = I(0)$, $I(1)$, …, $I(n)$, then at $t(n + 1)$ we have $A(t(n + 1))$; let us assume that this potential does not realize to an existing manifestation. If $A(t(n + 1))$ is empty the string stops there but if it is not empty it is possible that at some $t' > t(n)$ the potential $A(t'')$ is continuing in the long string of $A(t)$ and it may exist again at some new existence interval $J = [t', t'(1)]$ perhaps with a new series of consecutive manifestations of a certain length.

(9) The object realized in the second series is not a manifestation of A even if it is part of the same long string, we call the new manifestations after $A(t')$ "*mutations*" of $A(t)$. There is no reason whatsoever to identify the manifestations of $A(t)$ and the mutations which are manifestations of $A(t')$. The difference between them and the reason for coming into existence again may be found in the role of the new creative potentials appearing in $A(t')$, e.g. some $\{a(t')\}$ not the image of some $B(t)$ with $t < t'$.

Note that the correspondences $s(t, t')$ do not respect inclusions. Hence if $B(t)$ is apart of $C(t)$ the $s(t, t')(B(t))$ need not be in $s(t, t')(C(t))$! So even if every $A(t')$ for $t' > t$ is $s(t, t')(A(t))$ there is no determinism in the sets $A(t'')$ for $t < t'' < t'$. In other words the elements of $A(t')$ are not coming from those of $A(t)$ via the correspondence taking $A(t)$ to $A(t')$. Thus $A(I)$ and $A(J)$ should not be seen as manifestations of the "same" object but since both fit in the same long string it is plausible that the existing differences between the object and its mutations will be minor or at least not destructively large. This already shows some problem with the identity principle for existing objects; humans with their observations of change already apply an identification to changed objects, even to themselves, neglecting all minor changes between the manifestations of "themselves" over longer time periods, so you at 80 is considered the same person as you at 12, and that is a very coarse identity notion!

Next let us turn to some definitions relating to (dynamic) places and space.

(10) Motivation for the use of non-commutative topology in states (and beyond). We made the $U(t)$ sets but a geometry on it need not be a geometry given by sets of points. The non-commutative topology $X(t)$ is given by a non-commutative lattice structure on the set U(t) where there is a partial order < on the set and two operations, $\wedge$ and $\vee$ being meet and join generalizing the intersection and union of topological sets of points. In [3] I introduced some properties of this construction defining skew and non-commutative topologies as well as virtual topologies where the $\vee$ is an abelian operation but the $\wedge$ is not, in all non-commutative topologies. In fact, non-commutativity of the topology is characterized by $x \wedge x$ not being equal to x but $x \wedge x < x$, elements x where the equality does hold are called "idempotent" and the set of idempotents in a virtual topology forms a commutative lattice with respect to join v and a modified meet μ defined by taking the largest idempotent inside the meet. This lattice is then the "*commutative shadow*" of the virtual topology.

Since points do not exist the description of it by pointwise geometry is a very unfounded assumption, talking about an elephant as a set of coordinates over some number field, or even as its barycenter, is not very satisfying! Since I aim at a generic theory the use of a non-commutative topology in the sense of [3] fits this aim much better than the more classical geometries one may assume on the $U(t)$. Note that any choice will yield a dynamic geometry (topology) on existing reality with dynamic places for existing objects. One may even assume that the $U(t)$ are vector-spaces over the field of real numbers $\mathbb{R}$, or real manifolds, so one can calculate as "usual". Yet all new paradigms appearing in the generic model will remain effective then and thus quantum theory and relativity theory may be obtained as specializations of the generic theory presented here. I will not use the typical non-commutative aspects in the deriving of the new paradigms though, but when comparing the theory of reality in the dynamic geometries induced on it, the most generic – that is the non-commutative one – will fit best.

(11) Starting moment fixing a unique existence interval for the manifestation. If a manifestation $A(I)$ of an event A on the existence interval $I = [t, t']$ happens then we can also look at $A(t'')$ for t'' in I and ask if that potential at t'' realizes to the same existing manifestation $A(I)$ at the interval $J = [t'', t']$? Since $s(t'', t')s(t, t') = s(t, t')$ holds for all t'' in $[t, t']$ the information in the string over I compared to the string over J seems to be the same. Well, not completely, if we only know the situation starting at t'' then we do not know (of course we cannot observe there but we now think abstractly about the situation!) which sub-potentials of $A(t'')$ are creative potentials. Moreover, since at moment t'' we do not know the future states and the transition correspondences to it, which depend on the potentials at moment t'' and the past of that. Hence there is more information in the string over I than in the one over J. However, if we assume that $A(t'')$ realizes in an existence interval shorter than J than that realization realizes $A(t)$ in a shorter interval and we take the existence interval to be the shortest one for that. Forcing that existence takes time and there is a shortest time, and that is an acceptable axiom. On the other hand, if $A(t'')$ realizes in another interval containing J, say $[t'', t(1)]$, then the long string of A has two different realizations in the existing reality, but in intervals having a non-empty intersection. That would make the existence process of A chaotic with different overlapping manifestations (but these would not be observed in observation intervals!), thus it is plausible to take as the existence axiom.

(12) Axiom. Existence is in closed (extreme moments included in it) time intervals such that tails of one are also existence intervals. So, the end moments of manifestations and mutations correspond uniquely to the evolution of the existing event and for every moment in some existence interval, the interval from that moment to the end of the interval is the unique shortest existence interval for the potential at that moment.

(13) Time discreteness of the existing reality. Consecutive manifestation intervals for some event A, say $[t, t']$ and $[t', t'']$, allow for intervals $[t(1), t(2)]$ with $t(1)$ in $[t, t']$, $t(2)$ in $[t', t'']$ and $t(1)$ not equal to $t(2)$, and A does not exist at $[t(1), t(2)]$ because if it does then it would exist at the tail $[t', t(2)]$; but that is shorter than the next manifestation interval $[t', t'']$. In fact we may assume that Time has the property of "*convexity*", that is between every two different moments there is at least one different other moment. If that does not hold then time itself has some discreteness and statement **(13)** follows directly from that then. A nice example would be to take for Time a Euclidean line (or higher dimensional Euclidean object), without coordinates. I will not assume convexity in the generic theory, it seems to be a harmless assumption but as Time corresponds to the ordering of states of the universe, the assumption that between any two states there is another different one is not descriptive but almost godlike.

(14) We can define a "*place map*", $p(t)$: $PS(t) \to U(t)$ where some $A(t)$ is taken to an element $pA(t)$ of the non-commutative nc-lattice $L(t)$ giving the topology of $U(t)$ such that $p(t)$ respects the (inclusion) partial orders on $PS(t)$ and $U(t)$, thus for $B(t)$ contained in $A(t)$ we have $pB(t) < pA(t)$, we assume p takes the empty set to the initial (zero) element of $L(t)$ and the whole of $S(t)$ to the maximal element of $L(t)$. In [3], I took $pA(t) = \vee \{p(\{a(t)\}), a(t) \text{ in } A(t)\}$ – we then say p is basic – which is harmless and seems logical for the notion of "place" yet we do not use that here. If the topology in non-commutative note that $p(A \wedge B)$ is in $p(A)$ and in $P(B)$ hence $p(A \wedge B) \wedge p(A \wedge B)$ is in $p(A) \wedge p(B)$ but not necessarily $p(A \wedge B)$ unless this is an idempotent element of the nc-lattice.

(15) A string of correspondences, over an interval $I = [t, t']$, starting with $A(t)$ then yields places $p(A(t''))$ with t'' in I. If $f(t, t'')p(A(t)) = p(A(t''))$ for all t'' in I, then we say the object A is immobile on I. In particular if we have consecutive existence intervals $J = [t, t(1)]$, $J(1) = [t(1), t(2)]$ and for all t' in J, t'' in $J(1)$, we have that $f(t', t'')(p(A(t')) = p(A(t''))$, then we say that the manifestation $A(J)$ is immobile in the second manifestation $A(J(1))$. The dynamic place of the existing $A(I)$ is the series of places $p(A(t'))$ with t' in I, and this for every existence interval of the object A. When $A(t)$ or $A(I)$, is not immobile then we say it *"moved*" over the time intervals considered; hence mobility is discovered by the string of places not being a string for the geometric transitions $f(t, t')$. Note that for a basic place we do have $p(A \vee B) = p(A) \vee p(B)$, but not for the (intersection) meet which fits nicely in the concept of a virtual topology.

(16) Remark. On the product space of the $U(t)$ we may introduce a "dynamic topology of existing places" by taking the nc-lattice generated (for $\vee$ and $\wedge$) by the dynamic places on existing intervals of existing objects. We may think of this as the nc-topology of "places" where something exists at certain intervals. Such places are at the basis of what we observe as "the place" of an existing (observed) object. Obviously, observing happens in intervals different (larger) from existence intervals and this will create some fundamental problems.

4. OBSERVATION PROCESSES AND NON-EXISTENCE OF OBSERVED OBJECTS: SUPER-OBJECTS

When we want to observe something, we have already sensed it before, so it existed before in some manifestation and there has been a process in our mind to measure or observe the object better before actually using some tool to do it, or more primitively to look at it together with some cognitive analysis. Thus, after the manifestation of the object there is a process of beginning an interaction and the process of the interaction itself, plus another mental process of "thinking" the conclusion of the interaction, which we call the observation. The interactions in the process may be completely in our mind like when seeing reflected light of the object – the object is not "touched" by us – or may be partially via some tool like sending some particle or photon to "touch" the object and then deal with the effects. The first method of observation, that is completely via our senses, is not really influencing the object and is also very imprecise – you cannot calculate precisely from that – and untrustworthy. Anyway, the observation interval starts somewhere after some manifestation, so in a following existence interval of the object (and several ones may have passed by then) and the whole interaction process, partially in the mind and on the object, takes several existence intervals, both in the cognitive actions in the brain and the physical interactions with the object.

(17) Conclusion. An observation interval is much larger than several existence intervals; during the process we mix information about different manifestations as if they were the same original manifestations. The purely physical intervals of existence are depending on the number of states only the cognitive part is depending on the speed of our brain activity and the giving of meaning to that, so the latter are much "longer" (in the sense that they contain the other). What is observed in reality is in fact a series of manifestations and most probably even mutations part of the same string of existing of the object. The series does not exist in reality as it is a group of manifestations of something and we identify those as the changes of the same object, we call that a "*super-object*". Note that one observation interval is longer than the *Planck time unit*, say *ptu*, in case we use our actual Physics. We may define an *existence time unit*, say *etu*, as the smallest existence interval (up to assuming a "translation" property for comparing time intervals which

holds for example if we assume T is a totally ordered additive group, which is a lot weaker than what existing physics theories assume). An *etu* may contain many *ptu*'s, at least two but probably millions.

(18) What we observe is a super-object that does not exist in reality and what is existing in reality is never the observed thing. The dynamic places of the existing manifestations are well defined, but the dynamic place of the super-object contains many manifestations of the existing object at the start of the observation. This "*super-place*" is not describable related to the dynamic places of the existing manifestations because the existing object is moving and so the places of it are not related by the geometric maps $f(t, t')$ as explained earlier.

(19) The assumption of quantum mechanics based on Heisenberg's uncertainty principle, namely that a particle should be replaced by a cloud of distribution probabilities is an error but the only way perhaps to (partially) avoid the problems concerning "place" in the dynamic universe. Yet viewing the cloud as the existing object is wrong in several ways, not in the least because it identifies the super-object and the manifestations and mutations (!) of the existing thing one is supposed to observe as one existing object. Also, the mathematical theory of probability is based on the "existence" of pure coincidence and unbiased tests, thus this does not apply to reality except as an approximation which in fact is a rather big leap of faith! In [1] I gave some more explanation about "interactions" with super-objects being a more complex process of pre-interactions. Indeed two super-objects "interacting" is not just a matter of two existing manifestations or mutations interacting because the existence intervals of one (e.g. the observer A) and the other (e.g. the observed B) are not simultaneous, say $A(I)$ and $B(J)$, where I and J may overlap, but some t in J but before in I will relate to some pre-interaction of $A(t)$ and $B(t)$, which is however about the manifestation of A before I. Note also that the existence interval of a person is different from the existence interval of some of his brain activity (or for a tool and its interior measurement action). Anyway, a living human is a very complex super-object!

(20) Synchronized existence. Theoretically one may consider objects with existence intervals coinciding in a certain time period. Since all of the existence intervals are small (way below the Planck time unit) the assumption that all of them are synchronized would be a neglectable error but with some possible unpredictable effects. When defining fields, we will assume some things are synchronized. But it is not necessary to assume synchronization for any of the theory we will develop at the cost that this "interaction" is more complicated to describe correctly when one focusses on existing interactions on the corresponding time intervals, but this is not the case at the level of the momentary pre-interactions (which are of course non-observable, whereas the existing ones lead to observed super-interactions). In the DIM model existence is not essential in the physical interpretation but for organisms and biological interpretations it is more essential.

5. DARK INTERACTIONS, DARK MATTER AND DARK INFLUENCERS

It is clear from foregoing argumentations that the short strings (that means the strings on intervals shorter than existence intervals) and momentary potentials have a lot of activity in the void. The pre-interaction between $A(t)$ and $B(t)$ in $S(t)$ is written as $I(A, B)(t)$, in [1] I put $I(A, B)(t)$ equal to $\vee \{i(a(t), b(t))$ for $a(t)$ in $A(t)$, $b(t)$ in $B(t)\}$.

(21) Remember that the name pre-interaction is given on the basis of the future realization of the potentials as an existing interaction, and this is not recognizable on the element of $S(t)$ as such. However, there is then a logical assumption, namely that $s(t, t')(I(A, B)(t)) < I(A, B)(t')$ for $t < t'$, meaning that the correspondences $s(t, t')$ do not change the nature of the later realization as an interaction. Hence the $s(t, t')$ respect the dichotomy between pre-interactions and other potentials we will call pre-objects, both together are pre-things.

(22) There are pre-things in $S(t)$ which never realize to an existing thing. Some may give rise to a mutation which is an interaction or an object, then we include them in the classes defined above, but some may never realize – before the end of time (if that is present) – and I call these dark potentials.

(23) Now with pre-interactions there are several possibilities.

(23a) $A(t)$ and $B(t)$ realize synchronized on an interval I. Then the pre-interactions are called "*synchronized pre-interactions*" and the interaction exists at the same interval and is observed as such later.

(23b) One, say $A(t)$ realizes before the other as $A(I)$ and $B(J)$ for their respective existence intervals I, J. Then the effect of the pre-interactions of A on B includes effects of the pre-interactions of $A(t')$ for t' past I – so in the existence interval of the next manifestation of A – but in the existence interval for B or perhaps in a further existence interval for some later manifestation of B. We assume, very plausibly, that a pre-interaction can only "exist" when both interacting objects have existed somewhere after the start moment of the pre-interactions, here t. So interactions from different existing manifestations have an effect in the existence of the interaction but for the existing interaction there is no existing difference. There is, however, an effect on the pre-interactions between A and B on A before it exists and thus in its first manifestation while the origin B of the effects will only exist later (and in a dynamic place which can be "far" from the place of the observed object A).

The effect of B on the manifestation of A is then called "dark interaction" Since B realizes in the future of A you may think that it is an action of a future object on some object in the past but that is wrong of course, the pre-interaction of B and A was starting at the moment t in the string of both A and B (choice of moment t). Depending on the existence interval for B compared to an observation interval for A it is even possible to measure some unexplainable effect on A before B even exists. If for example gravity has some origin in the void (cohesion seeking, see section on force fields) then a "gravity effect" could be detected on A, before there is B and later B is at some place unrelated to the place of A! That would be a first kind of dark matter, something non-existing causing it and existing at unrelated places later.

(23c) One of the objects, say B, will never realize to an existing object, so all of its pre-interactions will be dark! On existing manifestations of A the present pre-interactions of B will have effects which are itself not existing material events but which "influence": existence manifestations observations and measurements, without possible causal relations to an existing entity. Such B are called *"dark influencers*" and their effect "*dark influence*". This also provides a second type of dark matter, some which always stays dark, I would say "strictly dark". Some B may have a string covering all time in the future of t and not exist in a closed interval before the end of time. In the case there is an end of time $e(T)$ then it is theoretically possible that B exist at $[t, e(T)]$, thus it will exist at the end of the book of the universe but not written on a page (state). This prompts some religious ideas. For example, could the soul of humans (and others, e.g. God?) be such a final object? It is not a contradiction. Anyway, dark influence can never be observed since the interactor is non-existing and never will be (except perhaps in the final interval if that is present, i.e. if there is an end of time, what most people believe).

6. ORGANIC CAUSATION IN MOMENTS: CONSEQUENCES OF FAILURE OF CAUSALITY IN REALITY

From Section 4 it is already clear that finding some cause in the past for some event later may be impossible, thus the classical notions of cause and consequence in the observed reality are going to fail and we must rethink the notion of causality in reality.

(24) Organic objects, sub-objects, and structural entanglement. Looking at an object A starting at a moment with the potential $A(t)$ there are pre-interactions $i(a(1), a(2))$ with $a(1)$ and $a(2)$ in $A(t)$. Let us call such *inner pre-interactions* for A at t, there are other of the type $i(x(t), a(t))$ for $a(t)$ in $A(t)$ and $x(t)$ not in $A(t)$, these are "*exterior pre-interactions*" for A. We may construct $A(t)^*$ by adding $\{i(x(t), a(t))$, for $a(t)$ in $A(t)$ and $x(t)$ not in $A(t)\}$ to $A(t)$. The splitting of pre-things in pre-interactions and pre-objects allows to put some structure on the process by the condition that $s(t, t')(I(A(t), B(t)))$ is in $I(A(t'), B(t'))$ where we write $I(A(t), B(t)) = \{i(a(t), b(t))$, $a(t)$ in $A(t)$, $b(t)$ in $B(t)\}$. Therefore, some pre-thing which will manifest as an existing interaction logically consists of momentary pre-interactions at every moment in the existence interval. We have $s(t, t')(A(t)^*)$ for every t' and if A manifests itself at the interval I then $A(I)^*$ need not exist there. Furthermore $A(t')^*$ need not be equal to $s(t, t')(A(t)^*)$. The names pre-object pre-interaction are ad hoc (because I act as if I know in advance the nature of the pre-things' realization in the future) but we may view a pre-thing not of the form $i(a(t), b(t))$, say $x(t)$ in $S(t)$, as $i(x(t), x(t)) = x(t)$ by definition.

With this harmless assumption we have $A(t)^* = I(A(t), S(t))$ and $s(t, t')(A(t)^*)$ is only in $I(A(t'), S(t')) = A(t')^*$, so not equal to it. Thus the "string" for A^* is not the one for the evolution of $A(t)^*$ yet the latter is a sub-string of the $A(t')^*$, which we call the string for A^* but it is not a string of the correspondences from t to t'. In case we have that $s(t, t')(A(t)^*) = A(t')^*$ we say that A^* is the *"organic string"* of A. The string for A completely defines the string for A^* but we have no argument linking the existence of $A(I)$ to some realization of A^* over I or any other time interval. Also the series of places of the $A(t)$ is not related to the series of places for the $A(t)^*$ as the place of some pre-interaction $i(x(t), a(t))$ with $x(t)$ not in $A(t)$ is in no way related to the places of the $a(t)$ in $A(t)$ since its definition involves the place of $x(t)$ which could be "far" away from the place of $a(t)$. However if we have a situation where the string A^* also realizes, so that could only happen when $A(t')^* = s(t, t')(A(t)^*)$, for all t' in some interval $J = [t, t(1)]$, then the manifestations of A and A^* are said to be *"structurally entwined*".

Now first let us define sub-things of some existing thing, say A manifesting over an existence interval I starting at t. A sub-string B starting at t, in the string for A is said to be a *"sub-thing*" of A if in addition to $B(t')$ being a subset of $A(t')$ for all t' in I, we also have for some non-empty sub-interval $I(1)$ of I so that for each $t(1)$ in $I(1)$ there is an $a(t(1))$ in $A(t(1))$ with $a(t(1))$ not in $B(t(1))$ for which there is some $b(t(1))$ in $B(t(1))$ and $i(a(t(1)), b(t(1)))$ in $B(t(1))^*$, hence the latter pre-interaction is inner in $A(t(1))$ but exterior on $B(t(1))$. The extra condition in the definition – meaning that the organic objects of A and B are entwined – is to exclude for example some rock temporarily swallowed by some organism to be counted as a sub-object. Also, some object inside another and no interactions existing between both would not classify as a sub-process of the larger thing. There are some borderline cases like the stomach acids we produce, these interact with external things like food which then goes on to play a fundamental role in our life system,

but is it an organic subprocess of the organism process? Similar questions about everything we produce to secrete. The production is a process of some organs, but the produced product is chemical waste matter, not a process part of the living activity of the organism. I would defend a notion of sub-thing to be connected to the "structural process" of evolving of the organism or material object and thus neglecting waste production caused by the structural process.

Later we introduce some notions of cohesion and coherence of some process and then one may look at these problems again. We may also consider long strings A and B such that the strings A^* and B^* coincide, so the manifestations of A and B may be seen as sub-things of the same organic object, then we say that A and B are "*structurally entangled*". Real life examples of such a situation are an ice cube and the volume of water it melts to or some mass of uranium and the volume of lead it decays to. The interactions in the transitions of the objects (warmth or some interior structural decaying process) changes the object but retains some part of the essential characteristics which expresses the entanglement. For more about related observations, see [1].

(25) Organic causation, deformation, and failure of existing and observed causality. We have seen that existence starts at some creative potentials. Those may be found by looking at some $A(t)$ at moment t and then for $t' < t$ if there is some $A(t')$ such that $s(t', t)(A(t')) = A(t)$ then we restart the process with $A(t')$ at t'. Thus either we find a first $A(t(1))$ at moment $t(1) < t' < t$ for which there is a string from $A(t(1))$ to $A(t)$ or there are such $A(t')$ for every $t' < t$ which means the string existed over the whole time in the past. We may assume nothing existed in manifestations over the whole time (this may be an axiom if you like) so we may conclude the string passing $A(t)$ started in $A(t(1))$ for some $t(1) < t$. That $A(t(1))$ is then a creative potential. It is interesting to look at special $A(t)$, for example $A(t) = \{a(t)\}$ for some pre-thing $a(t)$ in $S(t)$. The $a(t)$ is said to be creative when $\{a(t)\}$ is not $s(t', t)(\{A(t')\})$ for some $A(t')$ at $t' < t$. The fact that these $s(t', t)$ are not respecting inclusions allows that a non-creative $A(t)$ contains some creative $a(t)$ and a creative $A(t)$ does not necessarily contain a creative $a(t)$. So even a non-creative $A(t)$ may contain some creative $a(t)$ which expresses some creativity on the $S(t)$ level.

Looking for characteristics of $A(t)$ which will realize to existence, one may think of $A(t)$ being creative on the $PS(t)$ level or at least containing a creative $a(t)$ on the $S(t)$ level. We will also indicate coherence as a source for "existence". Anyway, every realizing string starts with a creative $A(t(1))$ at some moment $t(1)$ and we may pick it up looking at $A(t)$ somewhere in the manifestation process. Looking for the causes of some "event" $A(t)$ at moment t we have to look at all the pre-interactions on $A(t')$ thus $A(t')^*$ at all moments t' with $t(1) < t' < t$, those are the ones defining the $s(t', t)$ on $A(t')$ for all t'. We have assumed that the $s(t', t'')$ for any $t' < t''$ are defined by all the elements of $S(t')$ but in particular by the pre-interactions in some unknown way. It is therefore logical to describe the effect on $A(t')$ from the pre-interactions on it in $S(t')$. Thus the A^* contains at each t' the information about the causes for the event $A(t)$. If we demand that the causation of an existing event will be an existing event too (in another existence interval however) then we have to look for an existing sub-object B with string being a substring of A^*, so that will then be a structurally entwined thing with respect to the existing thing A in each manifestation. We have noted that the dynamic place of such structurally entwined thing need not be related to the dynamic place of the existing event (and they may be there in different time intervals!). So, in our observations, even if we could observe the causing event, those would only appear to be significantly correlated and then rather "coarsely" be viewed as causally related.

Definition of organic causality, cf. [1]. We let I, I' be the existence intervals for A and B as above, where I depends on I'. Then $B(I')$ is said to be the "realized organic cause" for $A(I)$ if: $A(I)^*$ is in $s(I', I)(B(I')^*)$, where $s(I', I)$ is the set of $s(t', t)$ with t' in I' and t in I and the notations being interval-wise. In [1], pp. 65–67, there is more detail and more explanation about why the organic causality is not a transitive relation, so not a partial order. Also, it is easy to look at non-realized organic causation, thus the cause does not exist before (or even never) the consequence, where the relation on the intervals is just that I' starts before I and nothing related to existence of an object B.

For observed objects the situation gets even more complex. Let $O(A)$, $O(B)$ be the observed objects of A and B, thus assuming these exist, and let $F(t)$ and $F(t)$ be the respective existence intervals. It is possible to observe a causal relation of $F(t)$ and $O(A)(J)$ with $B(I')$ and $A(I)$ not organic causal related and it is even possible that then there is an I'' later than I such that $A(I'')$ and $B(I')$ are organic causally related! So $A(I)$ and $B(I')$ can be "almost" organically related, up to some time-shift allowing the organic causality to establish itself. We do not have to fix the intervals in the above so it is convenient to view organic causality as a process and having meaning in certain intervals, but for later manifestations and mutations it can be lost in the further evolution of the processes what is of course natural when processes are observed over longer periods. For example, some causal relation between an event in an atom, depending on the fine micro-structure of sub-particles and nuclear forces (quantum effects). It is also obvious that organic causality, thus the causality in the reality cannot be retro-causal because the interval for the cause always starts before the consequence's interval and the creative input for the cause is thus also before the creative input of the consequence (see [1], pp. 69). The order of observing the organic cause and consequence is less fixed but that is only due to differences in observation intervals then. Wrongly (!) observed organic causality will then usually be interpreted as a strong form of correlation, observing non-organic causality as observed causality is then just wrong (!).

Conclusion. The failure of organic causality to be a partial order and the more chaotic relations between organic causality, existing causality and observed causality prompts us to use utmost care when trying to reason about organic causality because our logic is built on the transitivity of logical implications. This will influence certain theories about reality, for example evolution theory, free will, but even the applicability of probability in reality is problematic just like the notion of randomness. I can expand some of these ideas in a more philosophical (yet applied) article, but see also [1].

7. ACTIONS, FIELDS AND SELF-ORGANIZING STRUCTURES

We aim to give a generic definition of fields as these are seen as the basic building block of modern physics and we must start from observations in reality. The idea is that some action is in some way universal, that is some type of thing interacts with another type of thing by specific interactions which have the same effect everywhere it happens. The field of gravity seems to work on things with mass, magnetic fields interact with special molecules of some fixed type. So if I have to go into the void and try to understand how such fields are generated there, I have to start by looking at some structure of the pre-things and the pre-interactions. Then since the pre-interactions are symmetric, I have to relate these to some "action" of one on the other where the one acting has at least that as a special property, so a pre-action as some "asymmetric pre-interaction".

In [1] I started from observed things to descend to existing things, and this fits if one has to think about the classes of things to be used in the construction of fields. But the existing things are not the observed ones as we have seen, so here I will start from existing things and define "classes" of these by assuming similarity in their pre-interactions leading to actions on specified other existing things. We consider a type X of existing things as a set of objects having similar properties in arbitrary time periods (where they manifest) and arbitrary place in the reality with their interactions also having similar properties. So a "*type*" X is given by two classes of existing things $a(X)$ and $o(X)$ together with a class of identified interactions $i(o(X), a(X))$, that is for given $O(X)$ in $o(X)$ and $A(X)$ in $a(X)$ there are $i(X)(O(X), A(X))$ of the prescribed type X. In a moment we will see $O(X)$ as operating on $A(X)$ via some X-action we have to define. Once a type X has been fixed we will drop the X from the notation. Now the existing A has manifestations in series existence intervals, I, $I(1)$ ... $I(n)$, ..., where we may for now allow some mutations to be there as well, similar for the O in $J, J(1)$, ... $J(m)$, ... let the $I(n)$ start at $t(n)$ with $t(0) = t$ and similarly for $J(m)$ at $t'(m)$ with $t'(0) = t'$.

Since the fields we aim to define are supposed to be quite universal, thus at least existing for a longer time period, we may act as if they go on forever. However, it is possible to assume there is a limit on the time of the existence history, thus we can consider fields which will disappear after some "finite" time – in the sense of a limited number of existence intervals – and the theoretical treatment remains the same up to small adjustments. Hence in the series we may always find intervals $I(n)$ which intersect non-trivially with $J(m)$ and then replace the one starting before the intersection by its tail after the starting moment of the intersection, so we then may assume that $I(n)$ and $J(m)$ start at the same moment t and we look at the situation renaming $I(n)$ as I and $J(m)$ as J so we look at that manifestation in an existence interval starting at a common t. Also for every moment t we have representing potentials $A(t)$, $O(t)$ and $I(O(t), A(t))(X)$ realizing to the strings of existing things and interactions in their existence intervals (and further to their observed phenomena).

Note that our idea to describe real observed fields through the observed similarity and universality makes it plausible that also the existing phenomena have such similarities and then it is also plausible that we have corresponding similarities in the potentials at moments generating the existing similarities. To assume this is only plausible not a fact, but it does not matter because we can start from similarities at the momentary level, and these are described abstractly, and then view the realized similarities – and the observed ones – as those describing the type X. Thus we may use the structural properties of the type of existing things as the same type but worded in the pre-thing level if we know those generate the existing similarities. So this means that $I(O(t), A(t))(X)$ is not the whole set of pre-interactions but is a "typical" subset given by the fact that it has to realize to an interaction of the type X (e.g. gravity, magnetism, ...).

We have no information on the momentary things but yet we may impose some structure in that chaos (freedom from genericity) by retroactively extrapolating our knowledge of the observed phenomena later. This will never be contradicted by the realizations so it is an acceptable strategy. For example, look at a set of electrons, or photons, or iron atoms, ... These are so similar – almost identical – so they obviously belong to a nice well-defined class of existing things, their interactions with elements of another class are also almost identical. Thus from our observations we obtain many possible classes defined by some structural properties. So let us consider a class A of "very similar" elements, one may even say, "*indistinguishable*" for us, but non identical elements; since we can only observe finitely many elements it is not restrictive to consider only a finite number of existing elements $A = A(0), A(1), ..., A(n)$ in A. Let us add some structural hypothesis on A by asking that the elements of A are synchronized in the sense that their existence intervals coincide. We have noticed above that we may always assume (up to some shifting of manifestations in the series, that they start at the same moment t; the shifting of the manifestations only adds

technical problems in the treatment and does not change the core of the theory, so we restrict here to synchronized existing things in a class.

Let I be the first existence interval we consider, say $I = [t, t(1)]$, where $t = t(0)$, and $A(I)$ the existing manifestation of A at I. Since we regard consecutive manifestations of A we have a new existence interval $I(1)$ starting at $t(1)$ and for t' in $I(1)$ we have: $s(t, t')(A(t)) = s(t(1), t')(A(t(1))$. Repeating this we obtain the series of existence intervals: I, $I(1)$, ..., which goes on till the endpoint of all consecutive manifestations of A. If there is a mutation appearing at some moment t'' in the future then by the indistinguishability assumption the same will happen at the same moment for all $A(n)$ in A, and so we continue with the series of consecutive manifestations of the mutated thing starting at t''. Thus we also obtain a process of existing things $A(I)$, $A(I(1))$, ..., and similar for all $A(j)$ in A over the same intervals. Since we added the empty set to $S(t)$, if $t(n)$ is the first moment where $A(t(n))$ is empty, that is the endpoint of a last manifestation interval, then A disappears in the whole future of $t(n)$ and similar for all elements of A. The relation connecting $A(I(n))$ and $A(I(n + 1))$ is obtained by associating to the string $s(t(n), t')A(t(n))$ with t' in $I(n)$ the string $s(t', t'')A(t')$, observe that the fact that the $s(t, t')$ forms a transition system makes every $A(t')$, with $t' > t$, a transition of $A(t)$ for $s(t, t')$, thus the following equalities are also obvious:

$$s(t(n), t'')A(t(n) = s(t(n), t'')s(t, t(n))A(t) = s(t, t'')(A(t)) = s(t(n + 1), t'')A(t(n + 1)), \text{ for } t'' \text{ in } I(n + 1)$$

Now we consider another class of synchronized existing objects, say B which we assume to be a finite set $\{B, B(1), ..., B(m)\}$; we say A and B are synchronized if all the existence intervals are the same. So, we may look at the join of A and B and view them as identified subsets of one bigger set F, but we will later let A and B play a different role in the field theory or in the actions we will define. Now we must look at existing interactions $I(A(j), B(k))$ and the pre-interactions evolving to these. It suffices to study the case of only two existing A and B and the interactions $I(A, B)$ (it is easy to consider the join of interactions between different $A(j)$ and $B(k)$ and we leave the boring detail as an exercise). The pre-interactions $I(A(t), B(t))$ for $a(t)$ in $A(t)$ and $b(t)$ in $B(t)$ will realize at the interval J which may be larger than I – if we assume there is an existing interaction between $A(I)$ and $B(I)$ then it must come from the pre-interaction level – so from $I(A(t), B(t))$ and its string over the interval J. This yields a chain of realization intervals, J, $J(1)$, ..., for the $I(A(t), B(t))$. But $I(A(t(1)), B(t(1)))$ is realized in a chain of intervals $H(1)$, $H(2)$, ..., different from $J(1)$, $J(2)$, ..., because $s(t(1), t(2))(I(A(t(1)), B(t(1))$ is inside $I(A(t(2)), B(t(2)))$ but not necessarily equal to it. In [1], pp. 90, some relations between certain unions of some consecutive $J(k)$ and of consecutive $H(l)$ can be found but these are just technicalities and not essential for the definition of actions and fields.

(26) Actions and process fields. With notation as before we look at synchronized classes A and B and we look at $I(A, B)$ for one A in A and a B in B (again leaving the writing down of the case with more elements as a straightforward exercise). We define an "*action*" of B on A by putting at the starting moment t for the synchronization: $(B \cdot A)(t) = I(B(t), A(t)) \cdot A(t)$ a set in $S(t)$. Since $I(B(t), A(t))$ respects inclusions and unions on both arguments by definition we also demand this for $(B \cdot A)(t)$ and therefore $(B \cdot A)(t) = \vee\{i(b(j)(t), a(k)(t)) \cdot a(l)(t)$, for all $b(j)(t)$ in $B(t)$ and $a(k)(t)$, $a(l)(t)$ in $A(t)\}$, so it suffices to know all the actions of singletons in $B(t)$ on singletons of $A(t)$. For $t' > t$ we put $(B \cdot A)(t')$ equal to $s(t, t')(B \cdot A)(t)$, since $s(t, t')$ does not respect inclusions the reduction to singletons does not work in $(B \cdot A)(t')$.

We have $s(t, t')(I(B(t), A(t)))$ is contained in $I(B(t'), A(t'))$ by our assumption on transitions of pre-interactions, and since t' may be seen as the starting point of some common existence interval of some next manifestation of A and B it is plausible to demand that we have also an action $B(t') \cdot A(t')$ which is the union of the singleton actions of the $b(t')$ on the $a(t')$ and $(B \cdot A)(t')$ is in $B(t') \cdot A(t')$ but not equal to that, hence behaving just like the pre-interaction sets. Hence with these mild and plausible assumptions each $(B \cdot A)(t')$ is in a set union of $B(t')$-singleton actions but no $b(t') \cdot a(t')$ needs to be in $(B \cdot A)(t')$. Note: These extra assumptions were not demanded in [1], but they are logically pleasing even if the reduction to singleton pre-interactions can never be practically used.

The action $A \cdot B$ after moment t is said to be a "*process-action*" if it realizes to an existing action and the consecutive existence intervals are exactly the same series as the one for $I(B(t), A(t))$ hence the intervals $J, J(1), ..., J(m)$. If moreover the series $J, J(1), ...$, coincides with the series $I, I(1), ...$, then the action is called "*direct*".

For convenience let us write $A(I(n))$ as $A(n)$, $B(I(n)) = B(n)$ and $S(I(n) = S(n)$ where $S(I(n))$ is the set of all strings from $S(t)$ to $S(t(n + 1)$ (with notation as before), which is not confusing because now we only look at one A and B. The interaction $I(B, A)$ defines a "process field" if $I(B(n), A(n))$ is in $S(m)$ for some m depending on n; by our assumption that the action is a process action the same then holds for $B(n) \cdot A(n)$. This means that not only the series $I, I(1), ...$, coincides with, the $J, J(1), ...$, with $J \vee J(1) \vee ... \vee J(n) = I \vee H(1) \vee ... \vee H(m)$ but even $J \vee J(1) \vee ... \vee J(n) = I(1) \vee ... \vee I(m)$. Thus $B(n) \cdot A(n)$ is in $S(m)$ and the union of the $I(j)$, j ranging from zero to m, equals the union of the $J(k)$, k ranging from zero to n. This means that non-direct actions will be in some sense "time-shifted direct" if it is a process field.

(27) Organization and self-organization. We now define an action of an existing object A on the set of synchronized field processes F, which is given by $\{I(B(j), A)$, each $B(j)$ being synchronized with $A\}$. We define $A \cdot F$ by selecting a finite subset $\{B(1), \ldots, B(n)\}$ which defines process fields, that is $I(A(t), B(t))$ being in $S(t)$ and $B(j)(n) \cdot A(n)$ being in $S(m)$ for some $m > n$, depending on n. Thus "*organization* at A" is by choosing some interactions by synchronized process fields so that the realization of the action happens in the string of existence intervals of A (and of the $B(j)$ by synchronization), so one can say in the reality of A. Now "*self-organization*" of A is the organization at A but such that $B(j)(n) \cdot A(n)$ is in $A(m)$ for some $m > n$, so now the action of each selected field stays within the process of A. You may say, the actions now steer the evolution of A somewhat. At moments the self-organization means that for each $I(n)$ and some t in $I(n)$ there is an m larger than n such that $b(j)(t) \cdot a(t)$ is in $A(m)$ for all $a(t)$ in $A(t)$ and $b(j)(t)$ in $B(t)$.

Note: It is possible to let the choice of fields be restricted to some time interval and at some moment change the selection of fields (still being synchronized with A) and then continue with the new process field actions. This is just a matter of composing the actions over the separate intervals and they never interfere with each other, so there are no problems there. It may look like self-organization creates a certain determinism in the growth process however it is almost the opposite, a living organism may seem to fix something in the future of t by some "choice" at that moment, however the transition correspondences after t are not fixed at t, so the choice of the fields to be used influences the correspondences $s(t, t')$, thus the change of the universe structure(!).

When I describe the model I do that from the point of view of the finished universe when all the $s(t, t')$ have happened and are fixed, but "in time" the $s(t, t')$ depend on the potentials in $S(t)$ and so a choice of action by some fields or not does influence the nature of the $s(t, t')$! "Hence every living thing making self-organizing "choices" co-creates the universe!" The "choice" of A for $A \cdot F$ at t is prepared at earlier moments but not determined by them because of the possibility of new creative potentials at t (having no history in the past as explained earlier). That makes the "choice" – perhaps it is better to call it a "planning" – for the fields an act of "free will" which then would be an abstract property of every living thing. I will propose this ability as a characteristic defining Life (see the final section about some paradigm changes). Since self-organization has to support itself at all existence intervals it is not very plausible to view it as the result of coincidence (which is not even well-defined in the DIM model!), so there is some planning of the organism, to with the use of epigenes to manipulate gene expression. Humans plan, animals plan, that is easily accepted because they have a brain, but eukaryotic cells plan too and these have no brain, but a nucleus and at some level of development a nervous center.

(28) Timeless fields determining the finished universe. Reality being the realm where existence takes place contains an important part which is not existing and the latter generates the existing part via some evolving processes. But we can also speak about the "unreal" things not in the reality, for example, the meaning of our ideas, fantasy stories, even mathematics being an abstract system built by our cognitive activities is not a part of reality. However, the meaning of our ideas dictates most of our actions in reality and this interfering with reality (brain activity and motoric reactions) is part of reality. Our notion of space and place is also an abstract construct based on observations of reality but not part of it. Therefore, space-time is a strange mixture of real and unreal things, the unreal part stemming from the human desire to describe observations by the senses in abstract concepts which can be communicated. We agree that the abstract concepts are unreal but are there other unreal things? So can there be non-existing beings out of time and can such beings interact with reality?

There are some interesting philosophical questions here but let us not go too far into the science fiction and just see whether it is possible to define "timeless" fields. I provide here somewhat more information compared to [1]. We first need a type X consisting at moment t of potentials of type T, and since interactions between type X things should be of type X, the $i(a(t), b(t))$, with $a(t)$, $b(t)$ in $X(t)$, should be in $X(t)$ too. Then subsets of $X(t)$, say $A(t)$, are of type X too and $I(A(t), B(t))$ for subsets of $X(t)$ is of type X too and a subset of $X(t)$. Since we want the type to be respected by the transition maps taking an $A(t)$ in $X(t)$ to an $s(t, t')(A(t))$ in $X(t')$, for all $t < t'$, thus subsets of $X(t)$ transition to subsets of $X(t')$ but subsets of some $A(t)$ in $X(t)$ need not transition to subsets of $s(t, t')A(t)$.

Let us write s for the system of correspondences $s(t, t')$ and $s|X$ for the system of correspondences restricted to the $X(t)$, t in T. Then the set of X-states $X(t)$ with the system $s|X$ satisfies the conditions we put on the universe system, so all constructions we did in U, s we can do in X, $s|X$. When we separate pre-interactions from pre-objects we may change s to $s' = s(max)$, a deformed system of correspondences in a standard way, by putting:

$$s'(t, t')(i(a(t), x(t))) = I(s(t, t')(a), s(t, t')(x)) \text{ and}$$

$$s'(t, t')(I(A(t), B(t)) = I(A(t'), B(t'))$$

that is the s' passes between the brackets in pre-interactions up to replacing it with s inside the brackets, for pre-objects $a(t)$ we put $s'(t, t')(a(t)) = I(s(t, t')(a(t)), s(t, t')(a(t)))$. It is very easy to verify that s' satisfies the composition rules imposed on a system of correspondences. Moreover $s'|X$ is well defined because pre-interactions between

subsets of type X remain a set of type X. Now we look at some field acting on the $X(t)$, t in T, let us call it F given by $F(t)$ and $F(t) \cdot A(t)$, t in T, for every A of type X, and F respects the type X, that is $F(t) \cdot A(t)$ is again in $X(t)$.

By the finiteness of $X(t)$ it is clear that $F(t) \cdot A(t)$, $F(t) \cdot (F(t) \cdot A(t))$, ..., and $F(t') \cdot A(t')$, $F(t') \cdot (F(t') \cdot A(t'))$, ..., must for some number of moments repeat itself and even for all t in a finite time interval, so the assumption that we may look at some F such that for all t, and $A(t)$ in $X(t)$, we have $F(t) \cdot F(t) \cdot A(t) = F(t) \cdot A(t)$ is acceptable, we then say F is in the X-core of fields. Any X-core field can act as a "timeless field" on type X things as follows. For $A(t)$ of type X we define $s(t, t')^{F(t)}(A(t)) = s'(t, t')(F(t) \cdot A(t))$ now since the action of $F(t)$ is defined via the pre-interactions $I(F(t), A(t))$ and s' acting on $I(Y, Z)$ yields $I(s(Y), s(Z))$ (with obvious notation), $s'(t, t')(F(t) \cdot A(t) = F(t') \cdot A(t')$ for all $t < t'$ in T. The deformation of the $s(-, -)$ system at moment t' is given by $F(t')$, and we may calculate:

$$s(t', t'')^{F(t')} s(t, t')^{F(t)}(A(t)) = s(t', t'')^{F(t')}(F(t') \cdot A(t')) = F(t'') \cdot F(t'') \cdot A(t'')$$

and since F is a core field for X we get that the composition $s(t', t'')^{F(t')} s(t, t')^{F(t)}(A(t)) = F(t'') \cdot A(t'') = s(t, t'')^{F(t)}(A(t))$ and so the composition condition for a system of correspondences holds for the $s(t, t')^{F(t)}$, for all $t < t'$ in T.

One can extend the foregoing to the $X(I)$, $A(I)$, $F(I)$, ..., defined over existence intervals, $I = I(0), I(1), \ldots I(n), \ldots$, as before. Then we obtain deformed (other $s(—, —)$ correspondences!) series of existing $F(I) \cdot A(I)$. Note that here again the field action changes the whole universe at least locally at type X things, indeed for $B(t)$ not in $X(t)$. One may keep the original $s(t, t')$ to define $B(t')$, and since the $s(t, t')$ map in $X(t)$ to $A(t')$ in $X(t')$ there will never be ambiguity.

(29) Direction from the finished universe? If time is only the ordering of states, then we can think of the whole finished book of states as being (not existing) in a moment, you could think about "at eternity" but it is only a word. An existing thing in that book looks like a "sausage" or better a thick "rope" of very many entwined strings of potentials – starting at the first moment some ingredient of the thing is in a state at that moment – leading to series of existing things with manifestations and mutations of the different strings combining all the ingredients of the existing thing; for example me, from dust and plasm after the Big Exodus (Bang) to some living organisms I evolved from and after my death again material ingredients dispersing in the universe. So I "am" that rope which is in the finished universe. The finished universe does not exist in some closed time interval since T does not necessarily have a first and last moment, but if you assume that for T then the finished universe exists at the whole set T and not a smaller interval or at some moment in it. We said the $S(t)$ will determine the system of correspondences $s(t, —)$, note that even some timeless field – if we have one – which takes part in determining the finished universe stems from pre-interactions in some $A(t)$ without history (a creative potential), but the $s(t, t')$ do not exist at moment t and $s(t, t'')$ with $t < t''$ has to pass via $s(t, t')$ for every t', $t < t' < t''$. Thus at t' the $s(t', t'')$ is determined by the $S(t')$ which is larger than $s(t, t')(S(t))$, so to be more correct one would have to say that, for every $t < t'$, $s(t, t')$ is determined by the ordered system $S(t)$, ..., $S(t')$. A timeless field seems to change the $s(—, —)$ but we cannot write down the one that it changed from because that never evolves in the future; only the "changed" one appears in the finished universe. So, even if the whole history of the evolving reality is fixed in the finished book of ordered states, it is at every moment completely undetermined what the ultimate universe will look like(!), and things evolving in time by changes are writing a few symbols on every page (potentials in states).

Moreover, living organisms derive their free will and creativity from the fundamental uncertainty in the structure of the $s(—, —)$ when they make a decision for some action in reality. So is the finished rope object "me" defining a "direction" or "aim" for my evolution in time, from the origin to the final end? Some timeless field F for type X (note that we may look at $X = S$ as some type what then yields global timeless fields) leads to some X^{μ}, F^{μ} on the finished universe. If F is in the core of X then $F(t) \cdot A(t) = F(t) \cdot (F(t) \cdot A(t))$ holds for all $A(t)$ in $X(t)$ and all t where the actions exist and are empty otherwise, so F^{μ} is in the core of X^{μ}. Timeless fields are thus coming from some F^{μ} on the finished universe..., which "is" what it "is". So thinking about this DIM model from the finished universe (out of time) point of view, the whole reality system the $\{U(t), S(t), T, s(t, t')$ for all $t < t'$ in $T\}$ is determined, the evolution of all fields and existing things is unambiguously there and everything is encoded in the transition correspondences for the $S(t)$; the geometric structure (and the places) is not in the finished universe, it is in the abstract world we constructed in our minds. So we can only speak and think about the reality by mixing the "real reality" and the abstract structure we invented on it.

8. SOME IDEAS ON PARADIGM SHIFTS PROMPTED BY THE DIM MODEL

A. Related to Physics

1. Objects as probability distributions, a crude approximation.
2. Particles simultaneously at different places until observed.
3. Entanglement independent of distance.

4. Influence of future on past? No, but correlation and influence!
5. The now as an interval in time.
6. The existing as well as the observed universe is discrete.
7. Organic causality in reality is not transitive, thus not a partial order.
8. Observed causality does not fit in reality!
9. Non-existing things influence existing things. Dark interactions etc.
10. The void: a primordial soup of potentials as germs of existence.

B. Related to Biology and Philosophy

11. Organisms co-creating reality with some organism free will.
12. Inter-species interaction as planned cooperation?
13. Interaction of organisms and the biotope as pseudo-organism.
14. Evolution created by interaction of organisms and their biotope, both being pseudo-organisms and the interaction being.
15. Human telecommunication or uncontrollable abstract contact.
16. The soul as an abstract process. Existence interval: the future?
17. The abstract world constructed makes humans Time Hybrids!
18. Micro-learning process "deforms" knowledge to understanding.
19. A god outside time without human properties?

Here I will say only a few words about some of the new insights, perhaps a second – more philosophical – article can extend this section (or look up [1]).

1 and 2. An observed object being a series of consecutive manifestations and mutations of an existing object makes its place non-observable, except by crude approximation not looking at the well-defined places of each existing manifestation but replacing this by a distribution in a cloud of probabilities for places. Like Einstein felt, there is no correct application of probability in reality since no test can be done twice, the original states of the universe and the configuration space where the first test happened (in some non-trivial time interval) is gone forever when another test has to be done. Theoretically reasoning with the well-defined existing places allows to develop some theory independent of observing and the observatory, providing a different but real background for quantum theoretic models.

3. Pre-interactions where no distance is defined are realized to existing interactions which may or may not depend on (be correlated to) locality which results from the geometric realization of the place of the interaction. This locality is expressed in the "smallest" set in the dynamic topology of U containing the event, if some metric is assumed on every $U(t)$; some pre-interaction like pre-gravity, or the pre-versions of the standard forces, realize to a distance-dependent event, but some other like entanglement may realize to a distance- independent event. The difference is in the structure of the pre-interactions, probably forever unknowable to us.

4, 5 and 6. We have seen that existing as well as observed reality have discrete structure, existing events are separated by many intervals where the manifestations do not exist. The now we define is not a moment – you may define it like that but then we cannot do anything in the now – so it is a time interval containing intervals in the past and the future of the non-existing moment "now" we may theoretically define. I do not support the information-universe model (it is OK to use it as a model (!), but it leads me to too many questions and problems) but then the now contains information from the past as well as from the future of the abstract Now. To know this information will however require observations and is thus restricted to some further future. Yet if people can have some direct unconscious knowledge (cf. [1]) there could be some form of premonition? 4. is explained in the text.

7 and 8. Have been dealt with in the text. These are important new paradigms and a lot of Sciences have to take this into account since the causality principle is the basis for almost all sciences, in particular the question "Why?" – popular even with young children – is a dangerous one. In reality there is always an answer starting with creative potentials at some moments, but if the cause realizes to existence after the consequence – and this is possible in our DIM-system – then it will be observed as a correlated event or an influencing event. If the cause is realized before the so-called consequence, then by several observations and/or experiments we may often conclude the causal relation.

However, this depends on where the events are realized, if the consequence is realized far from the realized cause – think of another galaxy even – then there is no way it would be observed as a consequence. For example, if entangled particles are very far apart we can never observe them and conclude they are actually entangled. So causality as used in Physics (of the observed universe!) depends on the locality of the realizations of the strings of potentials defining them. Organic causality is the theoretical way out in the DIM–model, but it is not a partial order relation so requires utmost care in the use of logical implications in our thinking and communication because these are transitive! Again, if we would have direct knowledge hence not depending on observations – and the Planck time unit, or in fact the "existence time unit" we defined more generally – then organic causality would be natural to use. If humans will ever be able to use direct knowledge, we would be an essential step closer to godlike! Probably it will never happen.

9 and 10. The Void being the existence void is the cradle of the ongoing creation of the reality and it is not empty because there "are" momentary potentials and short strings of them acting as germs of existing events later. Existing interactions between events are happening "over" the void, using it as a channel for the potential-processes leading to the interactions. Existing things – born from the void – have a dynamic place connected to the places defined for the pre-things becoming dynamic places in their evolving process. If the geometric (topological) structure of the system of states satisfies the axioms of a dynamic topology, cf. [3], then the existing place should be in the dynamic neighborhood of the dynamic places evolving to it. Our intuitive thinking about places (in the classical or concrete sense) would then place the existence place "close" to the places in the void evolving to it. This means that the image of a cheese, full of large holes, would be an acceptable simplification of the "geometry" of existing reality, the "large" holes being the void, except that "large" does not have a real meaning for the void. So, it is plausible to view reality as containing the existing reality dynamically together with the void being connected to the existing reality by a lot of pre-interactions.

The observed reality is not part of the existing reality, it is an abstract – because fitting in the abstract cognitive world we created – deformation thereof; observing an existing event as a super-event (see super-objects in the text) replaces the real existing event by a number of manifestations and mutations in observation intervals which can theoretically be dealt with in the DIM model without identifying the event with the observed event by wrongly redefining the existing event as a distribution of real events. Aiming at some predictability quantum theory does that by introducing probabilities instead of the real places of the existing events, but since the mathematical theory of absolute coincidence has no meaning in reality the approximating value of this model cannot get closer than the Planck units. When we see the place of a tree every day in the "same" place that is completely wrong, yet in our evolution we have accepted that as a fact and in a sense it is lucky that our observations are that coarse. In reality we are connected to the tree and our dynamic places are evolving according to the common principle of time-evolution of the universe structure. That is in fact an unknown miracle!

11, 12, 13 and 14. Let me just highlight some basic idea for the application of the DIM model in biology and leave other philosophical consequences for a separate later article where a global philosophical context will be proposed and explained.

First it is necessary to agree on what is a living organism. The usual definition nowadays starts from the existence of a metabolic system, some system to gain energy and transform this in actions in reality, first some levels of mobility usually. In this definition viruses are not to be considered as living structures. Viruses have several enzymes waiting to become active when a future host has to be entered and the beginning of a virus invasion of a host is not arbitrary or by accident. I will argue it is done by following a plan and a "decision" at some special moment. The problem is we do not know exactly how a virus acts, for example it may have some unknown sense hidden in the biochemical activities we can observe and register. This is not fiction. Let me give the example of the quorum sense. Certain bacteria have a quorum sense, that is applied when some bacteria are about to attack a future host but they postpone the attack because they first "observe" whether there are enough bacteria around to have a successful attack. This biochemical tool does check the number of the same genus of bacteria around and it recognizes whether a certain critical amount is reached. The research also revealed that they also recognize which of the bacteria present are clones of themselves.

Now there is a virus which views those bacteria as its favorite victims and these viruses have learned to spy on the bacterium's quorum sense, so they check whether there are enough bacteria around to make an attack worthwhile. The viruses postpone their own attack till the bacteria announce (chemically) that they are in quorum to attack and only then do they start their attack on the bacteria. However, this strange interaction between virus and bacteria originated, it is a plan for the attack; there is communication between the bacteria which is identified by the viruses and then these communicate when the attack of the bacteria has been decided. This "decision without brain" starts at some moment with some pre-interaction in the universe related to the existence-processes of the virus and the bacteria and of the bacteria and the hosts, nothing in the normal existence process of the viruses related to the behavior of the bacteria, the potentials in the $V(t)$, the subset of the $S(t)$ evolving to the virus' manifestation after some existence time interval, determine the string starting at moment t.

It is not so strange that the biochemical structure of the virus can recognize some interaction with the biochemical communication of the bacteria (so they have some primitive sensor activity at least) but without any awareness or version of understanding, how can they be aware of the decision of a different organism to start an attack. Surely, they do not "know" it is an attack but they are aware of that special moment when their action will be most productive. You cannot say they remember from past experience that the biochemical signal is marking the right time to attack as they do not have a memory … at least this is what we think now. Since the memory is constructed in primitive cells by interior electro-biochemical reactions to regular exterior actions (e.g., temperature up and down's following the day and night rhythm) the most primitive versions of a memory are perhaps some yes-no recognitions of some action on the membrane.

Viruses can have such primitive pre-memory to, the root of some nervous system in eukaryotic cell developments but in viruses remaining at the primitive level … as far as we can see. If we take as the definition for a living structure the ability to start some activity in reality with a creative pre-interaction, not related to the string history in the system of the structure, then I propose viruses are living organisms, without a metabolic system but with a parasitic energy transfer and survival system probably using mutations after visiting (several) hosts as the flexibility providing technique. The ability to start an action in reality based on a potential without history in its evolution process is a creative interaction co-creating something in the universe and the non-deterministic character of that creative activity makes this a property of an abstract free will which will lead to awareness if the activity of deciding an activity in reality is observed as an inner change; this immediately splits the biological structure from its inner observer (navigator) and begins to create the abstract image of the biological being; thus the construction of the (non-holy) trinity of the ego: (real) living being, observer or (abstract) identity of it, constructed abstract image of it by inventing properties. Even now after billions of years of existence on earth we still have life-forms at every possible level of development. The adaptations in some species are faster than in others (depending on many factors including (dark or existing) influencers on the evolving string realizations. I hope it is clear that the DIM model will interfere with our understanding of almost all processes.

There are thousands of references one could relate to the topics mentioned, I have only read a few of them, so I restrict the list to the three most narrowly related to the topic.

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