

Emergence and Relativity of the Local Spacetime Portrait of Reality

a novel account of time and reality in which quantum physical reduction and the singularities of general relativity turn out to be inverse transitions: into and out of local spacetime

Abstract: The paper is a highly speculative, philosophical offer to re-think time and reality, almost from scratch. Our present account of time and reality is rooted in a post-socratic symmetry breaking. Aristotle's philosophy paved the way for a development that eventually led to modern science and technology. Reaping all benefits of this great and powerful way to frame reality eventually took 2500 years. But, by focusing our attention increasingly on the linear-sequential aspect of time, and the related, factual aspect of reality, this initial symmetry breaking also led to a fundamental, increasingly self-immunizing one-sidedness of our notions of time and reality. It is argued that the rift between quantum physics and general relativity is rooted in this deprivation, or more specifically, in the reduction of time to its sequential aspect and the related "facticity imprisonment" of our thinking. In the novel account, facts are only the traces of the actual taking place of reality, left behind on the canvas of local spacetime. The actual taking place of reality itself occurs still in the nonlocal time-space of the present. Far from being a point-like now, or just a subjective confabulation, the present becomes an aspect of (physical) time in its own right. The nonlocal time-space of the present is the primordial form of time and the "stage" on which all of reality actually "takes place" – and only thus becomes part of local spacetime. The task of the paper is to show that and how time and reality can be re-thought in this way, and why this step is crucial for a better understanding of quantum physics and its relation to general relativity.

(1) In order to unite quantum physics and general relativity we need to relativize **facticity**, and the canvas on which it is painted, **local spacetime**. Local spacetime is a very powerful mode of addressing reality, especially by allowing for descriptions that enable manipulating reality with a predictable outcome, i.e. for all forms of technology. But, the local spacetime portrait is available only for the factual aspect of reality. And this is inherently incomplete as it can't cover that and how facts come into being in the first place. Quantum physics addresses this actual taking place of reality. The 'trouble with physics' (Smolin) hinges on prematurely applying the factual, local spacetime portrait to quantum physics – and to oversee that and how also the singularities of general relativity transcend this specific conceptual framework. Complementary to the powerful, but inherently incomplete factual portrait of reality, painted on the canvas of local spacetime, two others are possible and useful.

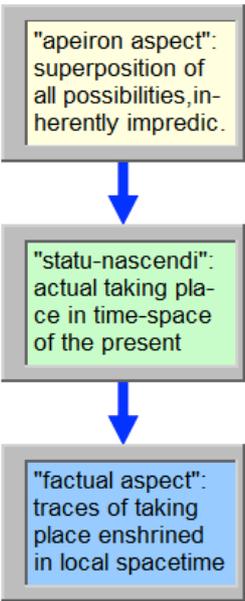
(2) The second aspect of reality is its **actual taking place**. Facts are the traces which this actual taking place leaves behind in local spacetime. Reality "in statu nascendi", i.e. the actual taking place of reality occurs still outside local spacetime, in the time-space of the present. This present is neither a point-like now, nor a subjective confabulation. It is an aspect of (physical) time in its own right. The time-space of the present is the "primordial" form of time, out of which the sequential structure of time emerges. The present is a not yet local "platform" on which all of reality actually occurs. Only as something "takes place" there, it becomes part of local spacetime. Local spacetime emerges and becomes applicable only together with factization, as only there a prior starts separate from a later in a clear-cut way.

(3) Our **subjective experience of a present** is not just a misleading, subjective confabulation, as often implied by today's physics. In neurobiological terms, the experience of the present it is the most costly endeavor of our brain. As that, it would hardly have survived evolutionary selection pressures if it wouldn't reap huge benefits in interacting with reality. Seen from the novel account of time and reality introduced here, our experience of a present turns out to be quite to the point: It is the hitherto most advanced adaptation of cognitive evolution to the actual taking place of reality – as it occurs in the time-space of the present.

(4) The essential feature of the present is **constellatory unfolding**. All that is present constitutes a constellation - in which it unfolds into what it subsequently is as a fact. Without this actual unfolding the emergence of something genuinely novel can't even be thought, i.e. we are conceptually locked in block universe picture – in which eventually not even our quest for truth makes any sense, because all that happens is already predetermined. Within the second aspect, all that is present unfolds mutually, thus becoming what it is thereafter as a fact. Reality in statu-nascendi, i.e. while unfolding, is not yet well-defined enough that it could be tackled by the sharp means of Boolean logic or causality, the sequential order of time or a clear-cut separation between observer and observandum. Metaphorically one can address this aspect of reality as the “concertus mundi”. While unfolding, reality is both, (partially) pre-determined and thus foreseeable, due to already existing facts and what there perseverance implies for the future, and (partially) unpredictable due to genuine novelty. The actual taking place of reality is characterized by the interplay between fact-based predictability and genuine novelty. A good example for this interplay is improvisation, e.g. in Jazz. The different musicians authentically respond to each other, taking up what just emerged, expanding and unfolding it further. If felicitous, an overarching, coherent piece of music emerges, that is a realization of both, ultimate freedom and almost stringent necessity, i.e. by being exactly right, “just as it is”. The authentic experience of “Stimmigkeit” (approximately translatable as “elegance”) is the only available criterion of “truth” in this second aspect of reality, i.e. its actual taking place in the time-space of the present.

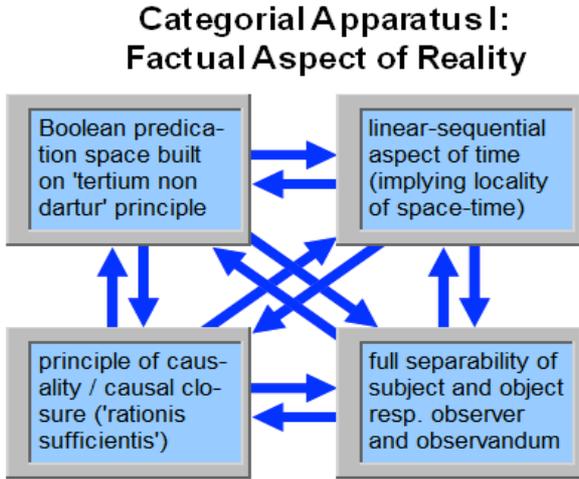
(5) The third aspect of time and reality, finally, is a radically **alocal superposition of all possibilities**. (The notion “nonlocal” is often understood as being here and there at the same time. But this understanding implies already the availability of a local spacetime background. The use of the alpha privativum should, instead, indicate that the phenomenon of locality isn't applicable, neither in confirmed nor compromised form.) This third aspect constitutes the irreducible unity of reality, and it is source from which the actual taking place is fed. Because of its absolute inseparability it is, with reference to Anaximander, also called the "apeiron aspect" of reality. It may eventually turn out that the mysterious “dark energy” is a footprint of this apeiron aspect of reality, seen from the factual perspective. In its alocality and apeiron constitutedness, all there is, is “ubiquitous”, but as such factually (!) undetectable. The main role of the apeiron aspect is (a) to assure the coherence and unity of reality, and (b) to provide the “reservoir of unrealized reality” - from which the actual taking place is continuously sourced.

(6) The novel account of time and reality, thus, comprises three complementary aspects of reality, and it is, therefore, called “**triality account**”. Its three constituent layers are:



(7) In order to understand and handle these three complementary aspects appropriately we need to consider a hitherto unknown phenomenon for which **the notion of an underlying “categorical apparatus”** is introduced. Whenever we address reality we draw on categories as the most fundamental structures by which we frame what we want to address. Immanuel Kant’s great achievement was to make us aware of these primordial preparations that human cognition inevitable undertakes. What is new is that these categorial underpinnings don’t come one by one but as an apparatus, i.e. imbedded into a set of four interrelated and even fully interdependent components. Neither of these constituent components of an apparatus can be abandoned, or substantially modified, without unraveling the entire apparatus.

(8) The categorial apparatus that underlies and constitutes the factual portrait of reality is composed of four, as mentioned fully interdependent components:



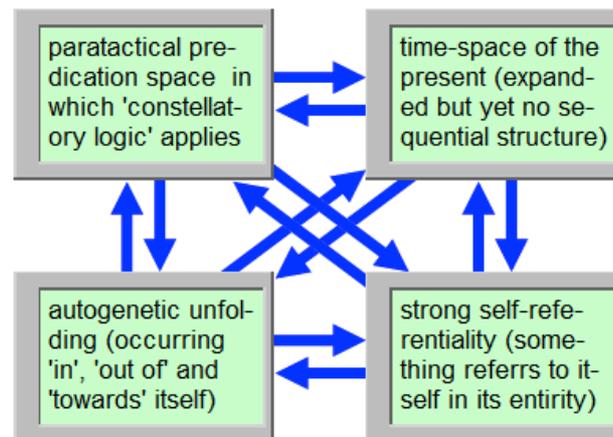
(9) But this categorial framework, subsequently also referred to as “F framework”, doesn’t allow for a comprehensive picture of reality. It is especially incapable of handling two phenomena. The first is **strong self-referentiality**, defined as the phenomenon that something refers to itself in its entirety. (Gödel’s ingenious proof of 1931 shows that strong self-referentiality can’t be avoided, not even even in most basic formal systems, just strong enough to derive natural numbers.) The second phenomenon is **autogenesis** by which something unfolds in and out of itself, i.e. in the absence of external causation. A closer look at these two phenomena shows that they are closely interrelated: Strong self-referentiality is the structural portrait of autogenesis, while autogenesis is the procedural portrait of strong self-referentiality.

(10) As a side remark it should be mentioned that most, if not all the big **enigmatic issues** that modern science continues to struggle with seem to be characterized by these twin phenomena. This applies to quantum physical reduction and the singularities of general relativity, to the phylo- and ontogenetic self-constitution of life, and, based on the latter, to the emergence of consciousness respectively mind. Seen from the triality account, these three foundational enigmas, located at the roots of physics, biology and cognitive science, can be interpreted as first, second and third order self-referentiality. The strength of the F apparatus is that it allows for well-defined descriptions. But this is, incidentally, its central weakness, too. It imputes that reality is infinitely well-defined – which it isn’t as long as it is “still in the making”, i.e. as long as it still unfolds itself in the time-space of the present. The F apparatus is structurally incapable of handling strong self-referentiality respectively autogenesis. Reducing reality to what can be appropriately addressed by means of the F apparatus constitutes exactly the “facticity imprisonment” mentioned above.

(11) In order to be able to address also these hitherto inaccessible phenomena, and the actual taking place of reality that is characterized by them, a second categorial framework is required. Building it requires firstly to gain insight into the very existence of categorial apparatus (pl.), and secondly to understand their **general structure**. The structure is rather simple. It consists of four, fully interdependent constituents. A categorial apparatus contains (a) the structure of a predication space, (b) a related aspect of time respectively space, (c) a specific way how events are interlinked, and finally (d) a basic epistemological setting.

(12) Based on understanding this basic structure of a categorial apparatus, one can develop **a second, complementary categorial framework** that allows to address “reality in the making”, i.e. the actual self-unfolding of reality. Neither of the constituents of this second framework, subsequently also referred to as “E framework”, can be put into the F framework. This would lead immediately to the collapse of any meaningful predication. But taken together, these four constituents form a second, for us today rather unusual but inherently consistent way of addressing reality. Its four components and their interrelations are the following:

Categorial Apparatus II: Actual Taking Place of Reality



(13) All components of this second categorial apparatus have a long tradition, in all branches of cultural evolution. Its components have just never been seen as belonging inherently together. **Constellatory logic** is a specific way to concatenate propositions. Like in a poem, the individual components unfold their meaning mutually, i.e. only in the authentic presence of all other components. This is the reason for the impossibility to formalize a poem, and constellatory predications in general. Constellatory logic doesn't allow for any kind of formal conclusions. A good example for highly self-referential, constellatory unfolding is improvisation in Jazz. The different musicians authentically respond to each other, taking up what just emerged, expanding and unfolding it further. If felicitous, an overarching, coherent piece of music emerges, that is a realization of both, ultimate freedom and almost alternativeless necessity, i.e. being exactly right "just as it is". The authentic experience of "Stimmigkeit" (approximately translatable as "elegance") is the only available criterion of "truth" in the E framework.

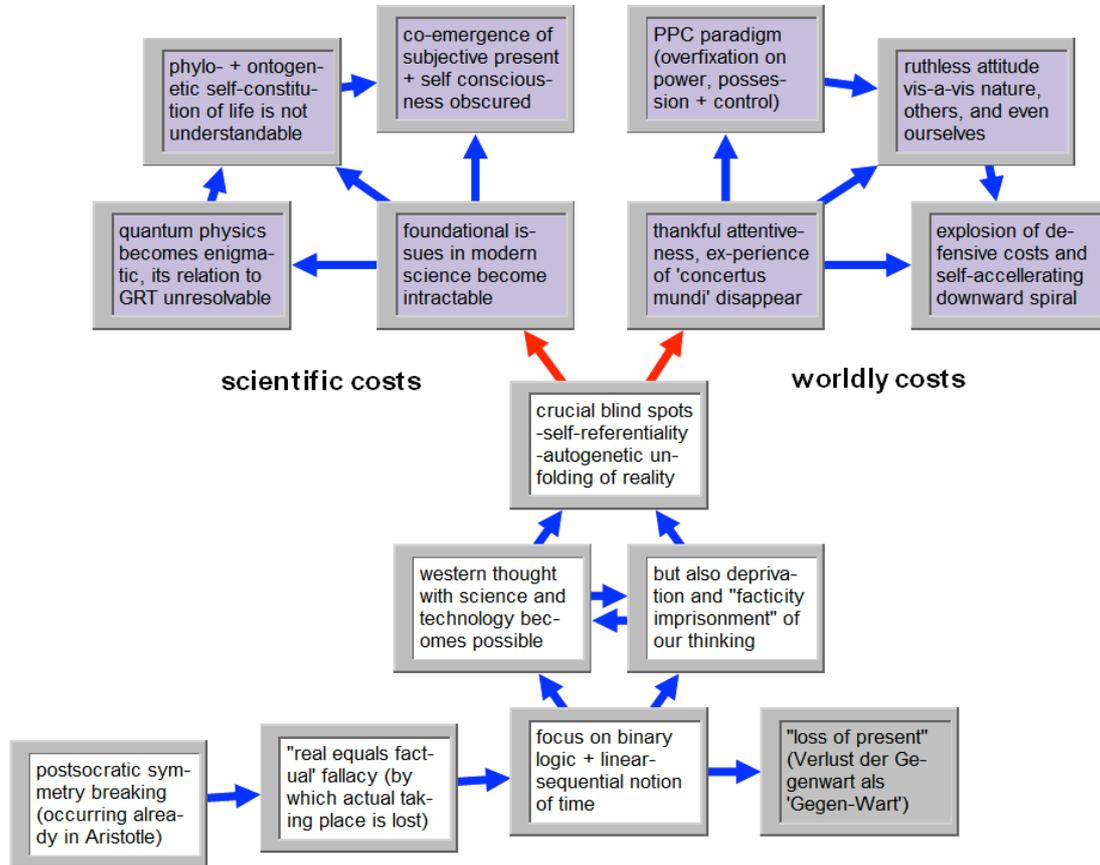
(14) In addressing reality we can now draw on both categorial apparatus. The **appropriate mix** varies, depending on the degree of self-referentiality within the addressed object-space. But neither of the two can ever go to zero completely, i.e. all predications about reality, required irreducibly both aspects. (See the ingenious Einstein quote at the end of the paper.)

(15) For the third layer of the triality account, the apeiron aspect, there is no separate categorial apparatus needed or possible. Its **inherent structurelessness defies direct predication**.

(16) Natural language is characterized by the use of concepts that are not completely well-defined. Our concepts are moving targets that change their meaning while we use them. But this isn't a bug. It is **the crucial success factor of natural language**. It combines the principle of semantic constancy and the possibility of semantic unfolding in a most sophisticated balance. This balance emerged during cognitive and cultural evolution. Only due to this most sophisticated balance we are capable to address both, the factual aspect of reality and its on-going, not anticipatable unfolding. Via its semantic unfolding natural language

enables us to address and re-present the unfolding of reality, its actual taking place in the present.

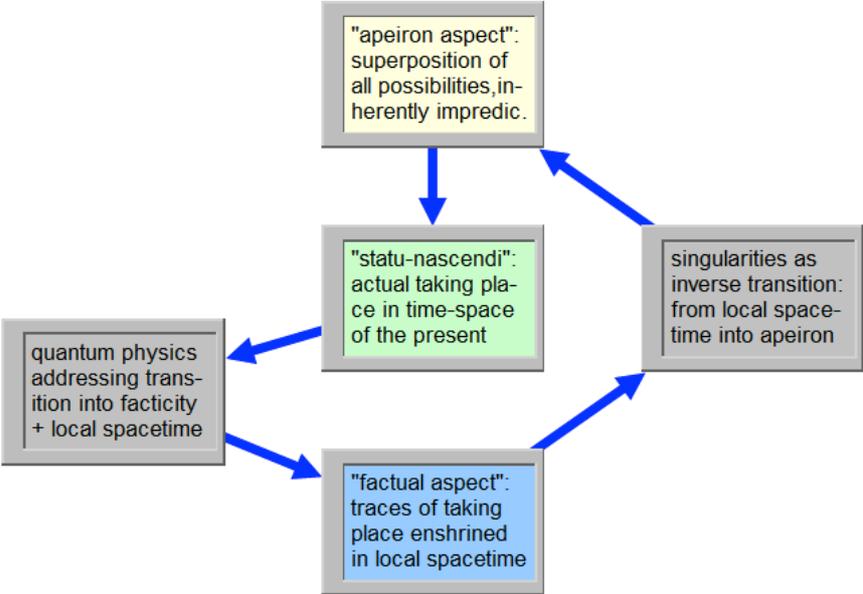
(17) The history of the **categorial deprivation and its costs** can be roughly summarized as follows:



(18) It is not the task of this paper to discuss also the worldly costs of the post-socratic symmetry breaking. For reasons of completeness, they should only be mentioned briefly in passing. At present we observe a dangerous **over-fixation of modern civilization on power, possession and control (PPC paradigm)**. This paradigm defines our basic tenor towards the world, others and often even ourselves. Seen from the novel account of time and reality, it could be exactly this tenor, respectively the underlying categorial deprivation of our thinking that brought mankind to the brink of self-extinction. If the overall approach presented here is roughly correct, this ruthless PPC attitude is less an ethical than an epistemological problem. Focusing just on the sequential aspect of time, makes time appear as the merciless "dent" (which was already Aristotle's metaphor) that constantly nibbles away everything there is. And the PPC paradigm would just be a futile effort to stem against this endless wresting.

(19) After this brief excursion into the wider historical and cultural context we can now come back to our central theme, the quest what it takes to overcome the present rift between quantum physics and general relativity. The answer is rather simple. It takes to un-

derstand what the two theories address: **the emergence of facticity**, in the case of quantum physics, and of **the features and limits of the local spacetime portrait of reality**, in the case of relativity. In the triality account, singularities turn out to be a crucial, constitutive aspect of general relativity. They mark the limits of the local spacetime portrait, where the factual mode of reality eventually melts down again, together with the canvas on which it is painted, local space time. Interestingly, and in complete accordance with the triality account, this vanishing of facticity and local spacetime is due to strong self-referentiality becoming overwhelming. Singularities occur when gravity starts to act so strongly upon itself that run-away solutions appear. In the triality interpretation, quantum physics and relativity thus turn out to address inverse transitions: into respectively out of local spacetime. This, in turn, requires a conceptual framework in which local spacetime is not apriori given, but a specific background that emerges together with, and applies to, a specific constitutedness of reality. The novel account of time and reality offers exactly this:



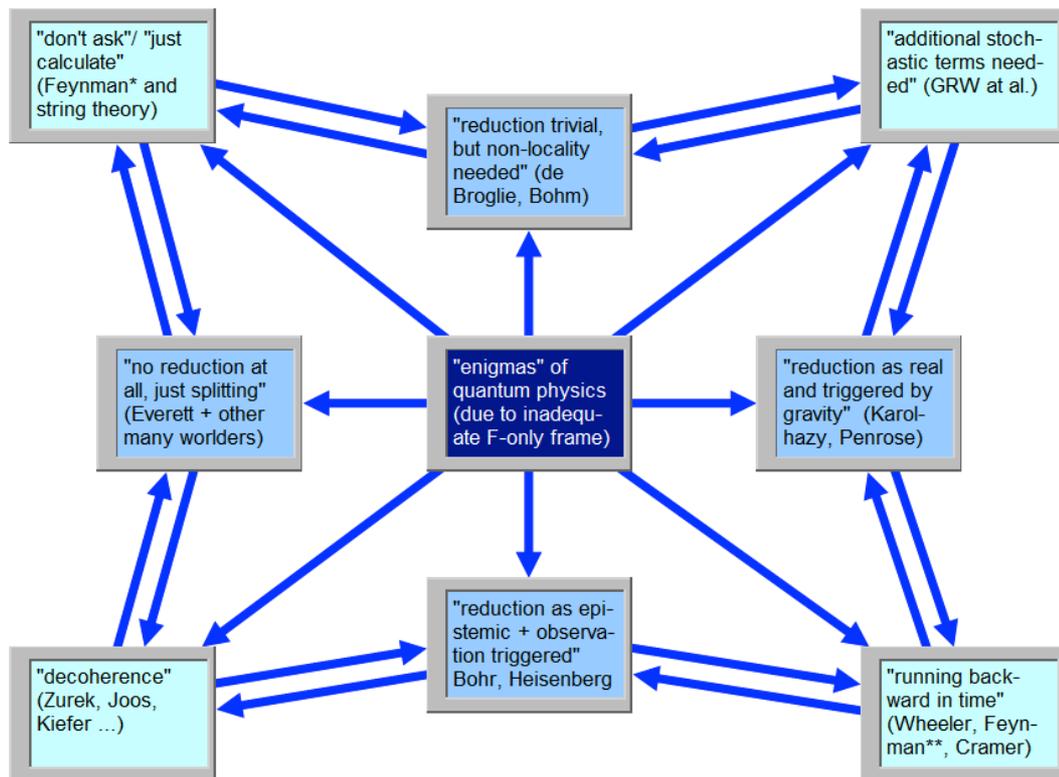
All three aspects, and the indicated transitions between them, constitute the “triality account”. Categorical relativity means that none of the three aspects is dominant, or could stand alone. One could characterize this new approach also as an **open ontology**. It is genuinely open because only one of the three complementary layers can claim approximate well-definedness and provability. Conceptually the three layers are interlinked like Borromean rings. Together they allow for a coherent account, but taking out any one of them would leave the other two an insurmountable duality. Altogether, the triality account allows and is required for a coherent interpretation of an “**autogenetic universe**”. This constitutes itself, but not only in the sense of an initial singularity. Autogenetic unfolding – the irreducibly wonderful “concertus mundi” - is a cross-cutting feature of all of reality. The present is the “stage” on which this “concertus mundi” is played - and our experience of the present is the hitherto most advanced form of listening to it.

(20) For quantum physics, the triality account offers a novel interpretation that can be summarized in the following 12 theses:

- I. Quantum physics addresses “reality in the making”, i.e. its *statu nascendi* respectively its actual taking place of reality.
- II. For that reason still both principles apply, fading but irreducibly existent unity and emergent richness, i.e. separability – which eventually leads to asymptotic well-definedness in local spacetime.
- III. This hybrid character manifests in two ways, as apparent unity despite inherent diversity, and as apparent diversity despite inherent unity. The first is called “superposition”, the second “entanglement”.
- IV. All “enigmas” of quantum physics are the consequences of a premature application, respectively an exuberant use of the categorial apparatus that belongs to the factual aspect of reality.
- V. State reduction is the asymptotic coupling of new, emergent reality to the one that already exists in a factual manner.
- VI. As long as this coupling has not yet begun, matters are still in the timespace of the present. This is what “delayed choice” experiments show us. As long as the coupling has not yet progressed too far, it can be reverted. This is what “quantum eraser” experiments are all about.
- VII. Neither “delayed choice” nor “quantum eraser” effects require the constructs of retro-causation respectively backward running time. These are inherently flawed notions as they imply decoupling the direction of time from the direction of causation – which is nonsensical as this decoupling unravels both, the concept of time and that of causality.
- VIII. Both types of experiments draw on situations in which local spacetime is not yet fully available. In the framework of the triality account they are interpreted as evidence that local spacetime emerges and thus becomes applicable only together with factization.
- IX. Eventually it should become possible to derive all crucial quantum phenomena - from uncertainty and quantization, through superposition and entanglement, to non-locality and noncommutability - as expressions of the still lacking crispness of the local spacetime.
- X. If we utilize local spacetime prematurely, as in most hitherto proposed interpretations of quantum physics, we inevitably create an explanatory gap somewhere. Like a blanket that is too short, we are able to pull it here or there, but whether it is head or feet, something remains always uncovered. The resulting interpretations are literally “allover the place”, as the blanket can be pulled in all possible directions in 360 degrees. (See the somewhat tongue-in-cheek figure next page, indicating the four main and four intermediate “directions” of pulling the blanket.)
- XI. In sum: In quantum physics we came for the first time so close to the very fabric of reality that its continuous emergence became irreducibly evident. This on-going emergence can’t be fully anticipated, respectively “causally explained”, in the way

we are used from facts. Dick Feynman is, thus, right and wrong if he states that quantum physics can't be understood. He is right in that quantum physical events can't be understood fully in a factual manner. This, however, isn't a deficit, but an inherent feature of the taking place of reality. And that, in turn, can be understood – as soon as we become aware which categorial apparatus belongs to which aspect of reality.

The Main Options How to Pull the Blanket



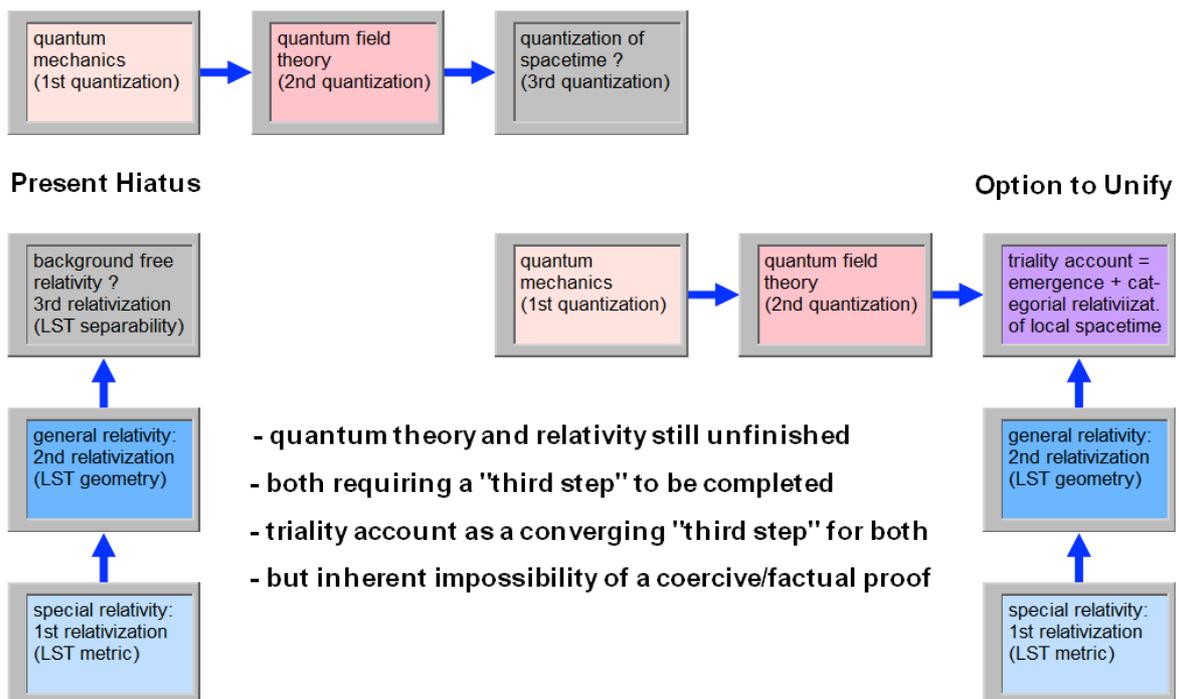
XII. Quantum physics and relativity can never be united just by harmonizing their mathematics. One has to go the philosophical extra-mile and see that they address different aspects of reality. Once we see the full triality picture of reality, all falls into place by itself. The discrepancy between the two portraits of reality is not longer a deficit. It is the essential message: How they belong together in their difference.

(21) In the triality account both, quantum physics and relativity, find their place and can be brought to a convergent completion. **Categorial relativity** is a third and concluding step in the process of relativization. In special relativity the metric of local spacetime was relativized. General relativity relativized the geometry of local spacetime. Categorial relativity, finally, relativizes local spacetime perspective on reality, altogether. The root feature of the factual respectively local spacetime portrait of reality is clear-cut separability. The argument is, that only by this third relativization, relativity is completed, as only this allows recognizing singularities as an integral and necessary feature - in which the factual aspect

of reality, and its background, local spacetime, are eventually relativized, too. In the triality account the transition back into the primordial apeiron state of reality becomes an integral and crucial part of relativity.

(22) At the same time, quantum physics is also in need of a third step. In quantum mechanics position and momentum were quantized. Quantum field theory brought the quantization of the probability wave. The missing third step is the **third quantization**, that of spacetime. The triality account provides this, but in a hitherto not considered way. Quantization is not primarily about chopping something up into indivisible junks. This is just a consequence. The essence of quantization is to show the irreducible complementarity of two features, unity and diversity, when addressing the statu nascendi of reality. The statu-nascendi is the transformation of reality, from the inseparable apeiron unity into separable spacetime facticity. Once separability is (asymptotically) given, we are in facticity and local spacetime. As long as there is absolute unity, we are in the apeiron mode. What occurs between the two, i.e. the getting from here to there, is the theme of quantum physics. As the bridge between these two aspects or modes of reality, the statu-nascendi respectively quantum physics is necessarily characterized by both features, separability and inseparability. Only if we erroneously reduce reality to its F portrait, this combination becomes irreducibly enigmatic.

(23) What the triality account allows is (a) to make this **third step in both theories**, and (b) to show that and how the two converge via this third step. By separating the three layers of the triality account, facticity and its canvas, local spacetime, turn out to be one of three complementary aspects of reality. In this inherently needed third relativization, relativity theory starts to converge with the equally required third quantization, the quantization of space time. Recognizing the specificity of the local spacetime picture is the essence of both third steps, and the point of an eventual convergence of quantum and relativistic physics.



(24) Taken all together, the triality account offers a coherent, hopefully elegant account of our autogenetic universe. But it should also be stressed that it remains **just an offer**. The institute of coercive proof is available only within the factual aspect of reality. Overcoming the “facticity imprisonment” of modern science is, therefore, just an option, and thus up to deliberate acceptance. This is a direct consequence of categorial relativity, and the reason why we call it triality 'account', and not 'theory'. If we assume that the phenomenon coercive proof is most closely related to mathematics, as the science of pure structure, Einstein is once again ingeniously right in observing: “As far as the laws of mathematics refer to reality, they are not certain; as far as they are certain, they do not refer to reality.”

Concluding remarks:

- In the triality account quantum physical reduction and the singularities of general relativity turn out to be inverse transitions: into and out of local spacetime.
- As inverse transitions, quantum physics and general relativity can be united without reducing one to the other. The two theories are complementary portraits of reality.
- Each of the two theories can, and needs to be completed by a third step. The two third steps converge, thus providing a bridge to the respective other theory.
- The richer categorial framework required for the above offers a new approach also to other persistent stumbling blocks of modern science. Matter, life and mind can be seen as subsequently emerging higher levels of strong self-referentiality and auto-genesis. The resulting framework is a coherent, but “modest ToE” - as it positions itself just as an offer.
- Overcoming the “facticity imprisonment” of modern science implies to explicitly abandon the claim of comprehensive provability. In this way, irreducible wonderfulness becomes again a legitimate and irreducible aspect of reality.
- In the triality account, explainability and wonderfulness of reality are even no longer at the expense of each other; instead, they deepen mutually.
- Finally, a specific attitude towards reality seems to result from the novel account of time and reality. It could be characterized as “thankful attentiveness”. This old-new tenor is appropriate for an autogenetic universe that, as part of its self-unfolding, starts to perceive itself in us.