A Toy Theory for a Theory of Everything

A preliminary philosophical article

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Currently, all manifestations of the physical reality cannot be interpreted within a general theory. Scientific community has been searched for long time for a Theory of Everything. Up to 90s, the impossibility of formulating such theory caused substantial embarrassment. More recently, the topic suffered a complete loss of interest. The present work, on the contrary, aims to come to the formulation of a Theory of Everything through the expedient of a Toy Theory. From this point of view, the only possible way is that of leading science back to its wider, original, philosophical field.

Introduction

This work is inspired by the studies of Max Tegmark and an interesting article by Stanley L. Jaki, which raises the following question: theoretical physics (understood as an axiomatic system) is subject also to what was demonstrated by Gödel's incompleteness theorem? We can then ask ourselves whether there may be "physical realities" that cannot be proven within the axiomatic formulation of physics, and also "physical entities" that are proven within the axiomatic formulation of theoretical physics but do not have a validity observable in the "physical reality"? Jaki's article is definitely interesting and the question that arises can be solved with a simple expression: *in the physical reality there exists time (and thus the reality evolves).* However, to understand this, the discussion must first be extended: we can certainly state that physics, as a science, is nothing but a set of more-or-less well-connected mathematical models of the reality and, therefore, a simulation of it. An approximation of reality is not reality, and it represents the first step to ask ourselves what reality is and, if the science that aims to explain more of the others, physics, has the qualities and the best means to realize this objective. Our perception of reality passes through the same tools that actually the reality provides us, tools that operate by comparison in the various scale orders. In all these cases, our analysis had the perception that the entities space and time are the only invariants of scale. In any real environment there will always be space and time.

In mathematics, for example, the point and its association with the concept of number (Peano's axiomatic group) is formally the basis on which almost all of different mathematics are built. In physics, can the same modus operandi be used assimilating the concept of space-time "particle" to the mathematical point? Can we then deductively think of physical reality in mathematical terms, or rather logical-mathematical terms, and describe it fully through axioms and rules of inference? And, perhaps even a more disturbing question, can physical reality be fully described by models of mathematical derivation? Physics, as a science, has also the duty not to be content with finding its axioms and to try to understand what its most intimate nature is.

In this case, the works of Tegmark clearly arise the problem and address it. In one of his works, he defines physical reality with a single axiom, "everything that exists mathematically exists also physically".

Here, now, a very sensitive issue opens, considering that physics, as a science, is not just a theoretical discipline but also, above all, an experimental discipline. This aspect, which seems to give us a better chance to investigate, has its well-known limit in the uncertainty principle. This means that there is a limit from the experimental point of view.

This issue, along with the preceding considerations, is crucial. In fact, if our knowledge of Physical Reality passes through experiments and if our theoretical hypotheses based on experiments go through the mathematical formulations of the same, we can ask ourselves, for example: *What value can our visions and theoretical hypotheses have, if the basis on which they are based are indeterminate in the case of the experiments and incomplete in the case of the theory?*

In our opinion, this node can be addressed only through the study and analysis of the invariants of scale: space and time as well as space-time and also time-space.

Synthetically, to complete what is in our opinion the problematic of this critique of physics understood as a physical science, we pose the following questions:

1. Currently, does the physical science have the instrument that can completely describe the physical reality?

2. If, as we do believe, the answer to the first question is no, what must be done in order to understand the physical reality and by which means?

The aim of this work is to seek an answer to the second question. For the moment, we leave the issues related to the uncertainty and incompleteness. The easiest way to get answers to the second question is to go directly to nature!! ?? But how? The vastness of Physical Reality due to the experiments and to the various and complex theories that try to give an interpretation of them can represent a wall too high to be addressed and overcome, in order to arrive at a theory of everything. Therefore, it is necessary to proceed in a less complex way, reflecting only on some aspects of Physical Reality.

We can start by considering the experimental evidence of high-energy physics, wherein, starting from stable particles, particles with a very short mean lifetime are obtained as a result of collisions.

The second consideration is inspired by the fact that field, particle and their mutual interaction hide a deeper meaning.

The third consideration concerns the so-called background radiation of the universe at 2.73 K, which is explained by relating it to the Big Bang or initial singularity.

The last is the use of geometries in physical theories.

To these considerations, we must finally add all the problems related to the axiomatization of physics. And here, we have to explain our choices about the system that we adopted in the preparation of this work. We speak of the system because the complexity we face requires the use of various techniques and the abandonment of others used so far. The first evidence is the fact that until now those who have addressed these issues using brutally and uncritically the scientific method were not able to reach objective results and to understand the key issues. It is clear, then, that the brutal use of the scientific method does not allow having the necessary and sufficient tools to address them. This does not mean surrender to the illogic, as it will be confirmed later.

Another question regards the adopted artifice of using a Toy Theory to reach a Theory of Everything. The Toy Theory is nothing more than a set of concepts, assumptions, equations relatively simple, which are used to address problems of a certain

complexity. They fall broadly into two categories: mathematical and descriptive. In this case we will use a mix of the two, as both are functional for the purpose. Practically, the Toy Theory is nothing more than the rule or set of the game rules, functional to the game itself and defining the scope of existence and development.

It is not possible to speak of physical theories without addressing the problem relative to their bases. Mainly, there are two different types of theories: those based on observations, which are defined as hypotheses, and those not based on observations, which are defined as conjectures. It is easy to see how the first ones are always preferred in science than the other ones. The reason is obvious. A theory based on observations has a competitive advantage because it makes use of both the comfort of the experiments and - feature even more appreciated - a mathematical apparatus in support of them. This at least until we become fully aware that both are somewhat limited (Gödel's Incompleteness, Heisenberg's Uncertainty).

In this paper we have set ourselves in a very original condition. Summarizing, we can say that we want to reach the Theory of Everything using the expedient of the Toy Theory, making some conjectures without an excessive use of complex mathematics and without the complete and fundamental contribution of the experimental results. While this may seem absurd at first reading, this decision was taken with a logical and rational approach. We have partly tried to explain it in this introduction, but other reasons may be better understood by reading the following parts.

1. Postulates through which we see the Physical Reality

As mentioned in the introduction, the present work is strongly inspired by the articles of Max Tegmark. In his *Is "the Theory of Everything" merely the ultimate theory?*, the proposal of a theory of everything is exhaustively studied and analysed. But the conclusions, or at least some of them, may be actually different, if one moves from different considerations and approaches. The different approach is of course ascribable to the nature of the Toy Theory, which allows us to be not too formal, at least in the initial considerations.

In this case, we can agree with Tegmark, when he highlights that the axioms should be "few", otherwise the same theory will be inconsistent.

In relation to this issue, it is more illuminating what the same Tegmark writes in his previous work "The interpretation of quantum mechanics: manyworlds or manywords?" In it, he highlights two paradigms:

- The outside view (the mathematical structure) is physically real, and the inside view and all human languages used to describe it are only an incomplete approximation to describe our subjective perceptions.
- The subjective perception in the inside view is physically real, and the outside view and all its mathematical languages are only an incomplete approximation.

In a later work, "The Mathematical Universe", the same author reassesses the previous paradigms introducing the following assumptions:

- External Reality Hypothesis (ERH) – there exists an external physical reality, completely independent of us human.
- Mathematical Universe Hypothesis (MUH) – our external physical reality is a mathematical structure.

Also in this case we have an "inside" and an "outside" view and this contrast is the main cause of the incompatibility of the mathematical and physical views of our reality. It may seem simplistic to just focus on these points of the articles, given their complexity and length, but they represent the main premises, from which the conclusions present in them are carried out. Moreover, from them derives the possibility that we have to analyse and interpret, in its true essence, reality, without falling in areas that seem logical from a scientific point of view but do not allow us to really understand it.

With regard to this problematic, Stanley L. Jaki wrote in his "A late awakening to Gödel and physics", previously mentioned in the introduction:

"... "*a physical theory is a mathematical model." It should also be obvious that the more advanced is a physical theory the more mathematics it contains and the more advanced is the mathematics. From this the ground for connecting Gödel's theorem with physics readily follows. For insofar as Gödel's theorem states that no non-trivial system of arithmetic propositions can have its proof of consistency within itself, all systems of mathematics fall under this restriction, because all embody higher mathematics that ultimately rests on plain arithmetic. Then it follows that there can be no final physical theory which would be necessarily true at least in its mathematical part.*"

Jaki concludes:

"Herein lies the ultimate bearing of Gödel's theorem on physics. It does not mean at all the end of physics. It means only the death knell on endeavours that aim at a final theory according to which the physical world is what it is and cannot be anything else. Gödel's theorem does not mean that physicists cannot come up with a theory of everything or TOE in short. They can hit upon a theory which at the moment of its formulation would give an explanation of all known physical phenomena. But in terms of Gödel's theorem such a theory cannot be taken for something which is necessarily true. Apart from Gödel's theorem, such a theory cannot be a guarantee that in the future nothing essentially new would be discovered in the physical universe which would then demand another final theory and so on."

Wanting to translate the thought of Jaki and others, from the point of view of Tegmark we come to the absurd conclusion that our external reality is mathematically incomplete and that consequently our own physical reality is inconsistent. We wished to report Jaki's consideration, as it is exactly the vision that the most physicists currently have of the problem represented by the possibility of having a Theory of Everything, unification or other. If within this theoretical environment, this crisis can be seen and experienced as a defeat, it remains to consider what impact it may have in the experimental field. In fact, the consequences might be even more critical. It might be possible to think that some of the experimental results considered reliable are not actually corresponding to an objective reality. Can they be considered incomplete, perhaps, with respect to the physical reality in which they were conducted? And even more complex to think about, can objectively true realities, that cannot be detected or only partially detected in this physical reality, exist? The possible answers to these questions would require from us, in the sense of "humans" of Tegmark, the knowledge of the basic structures through which physical reality manifests.

If now we summarize the assumptions, as briefly introduced by the cited articles, it results that a theory of everything is conditioned on the following three points:

1. It must have as few axioms as possible.

2. Nevertheless, the axioms would be still incomplete if seen from an external perspective and perhaps insufficient from an internal point of view, having in any case to define their respective natures of external and internal realities.

3. Strongly conditioned by Gödel's incompleteness theorem.

Regarding the first point, for example, Tegmark in his work suggests that there is only one axiom:

"Everything that exists mathematically exists also physically".

In fact, this simple axiom connects everything to a simple equality between mathematical existence and physical existence, but the problem of a fewer number of axioms, apparently solved, reappears in an objective lack of relation between mathematics and physics. Simplifying much, and also in the light of the strong simplification made by Tegmark with his only axiom, we might

think of the lack of a zero theorem of physics-mathematics regarding the terms and the areas of use of mathematics in physics. The same physical reality that we can appreciate through the experiments must be subject to the same conditions. In this case, the concrete possibility of a complete block of the theoretical or instrumental investigations, that we are able to conduct on physical reality, arises. But the physical reality does exist, and, even if partially, manifests to our senses in a perceivable manner. This is an evidence, regardless of the fact that as simple "humans" we are able or not able to appreciate it and to connect it to a mathematical model through a series of approximations. We could also think of an "imaginary" physical reality and, consequently, of an "imaginary" existence of us, but the link between the two "entities" would be anyway real. From the contextualization of the three points listed above with respect to the considerations made in the introduction, we proceed with the construction of the Toy Theory.

A first important aid about the points above could come from the unpublished writings of the same Gödel. We refer to the article entitled "Is mathematics the syntax of language?", present in Kurt Gödel's Collected Works, Volume III, Unpublished essays and lectures. There are different versions of this article, but in the volume only versions III and V are published. The article was to be included in the scheduled volume on Rudolf Carnap and was part of the series "The Library of Living Philosophers". Gödel practically worked on it from 1953 to 1959, but he did not authorize the publication, and the reason was written clearly in a letter to the editor of the series. In summary, Gödel thought that the publication of an incomplete article would have been counterproductive to his own theses. He didn't consider sufficient the evidences brought in support of his thinking, given the widespread prejudices on issues that were fundamental in philosophy, as the objective reality of the concepts and their relations.

We grasp positively this vision of Gödel, who identifies the need for some parts of mathematics to have their own independent existence. It is not actually possible in this case to summarize his thought, it must be reported.

"...We might, e.g, possess additional sense that would show to us a second reality completely separated from space-time reality and moreover so regular that it could be described by a finite number of laws. We could then, by an arbitrary decision, recognize only the first reality as such and declare perceptions of the additional sense to be mere illusion, and sentences referring to the other reality to be without content and true only in consequence of syntactical conventions. These could be so chosen as to make exactly those sentences true which could be seen or inferred to be true with the help of the supposed additional sense."

And in conclusion:

"All this adds up to the conclusion that also from the empirical point of view, there is no reason to answer the question of the objective existence of mathematical and space-time objects differently. As to the specific nature of these two kinds of objects and facts, it is true, there are profound differences. They become fully visible only if the meaning of the mathematical and empirical terms is considered. But they also appear from the syntactical point of view in the different role which these terms play in the formalism of science."

Here it is explained why we have been working on a Toy hypothesis. Science and its method are perhaps at the state of the facts incompatible with the goal that we have set, or at least ineffective. The scientific method must be therefore extended, taking care to insert the comfort of the logical reasoning, not only the pure mathematical logic, but also the philosophical one. We cannot simply refer to the logic, as we know it is bound to problems of consistency, but we can rely on philosophy and its quality of discipline to discover the rule by "playing". The problem is of course more complex than it has been exposed, and it is also complex to try to synthesize or to reduce it through a series of rules or laws, especially if faced with the methods used up to now. Alternatively, we can choose another way and different methods to address these issues.

By "playing", we can introduce the postulates through which, according to us, the physical reality manifests. They are two, the first is certainly more familiar and is referred to "existence"; the second one is related to "relation". We give a formal definition of them:

First postulate or of "**existence"**

- "Any element, to be part of a given system, has to exist in that system".

Articulating in a more logical way, we can say that "if there exists a system S with a property P, any element x belonging to the system S has the same property as P". We represent the first postulate with the character **III.**

Second postulate or of "**relation**"

- "Any element that is part of a given system has, as a consequence of his existence in the system, a relation with all the elements in that system";

Also in this case, articulating in a more logical way, we can affirm that "each element x in the system S has relations with any other element belonging to the system S".

We represent the first postulate with the character **Я.**

The two characters III e Я were taken from the alphabet of the Russian Language only to highlight, through the different graphical structure, the difference that the words "existence" and physical "relation" have in comparison with the corresponding mathematical symbols ($\exists$ e R).

Other considerations regarding the axioms of existence and relation can be done. The first axiom can be seen as the axiom that allows the presence and permanence of matter in the form of particle, or more in general of element within a system. The second axiom has the prerequisites to justify both physical fields in a general sense and the operation of measurement in the sense of comparison. We had to learn that the operations of measurement and comparison are not so trivial, and this not only because there is the uncertainty principle. At this early stage, we can be content to accept a simpler and more general formulation. In formulating the axioms of existence and relation, we have given the relative definitions a positive logic. Of course, it is possible to have a definition of the axioms in negative logic, but the latter are subject to the existence of the former, i.e., they are not independent.

In the case of the first axiom, the negation can be defined as follows:

"An element that does not have the properties of a given system cannot exist in that system".

And in the case of the second axiom, it can be concluded:

"An element that is not part of a given system has no relation with the elements of that system".

We take now the two symbols used for the two axioms III, Я and their negations $\overline{\text{III}}$, $\overline{\text{Я}}$ the latter to be understood as "non existent" and "no relation". In the case of combination of symbols taken separately and in groups of two, the following configurations are possible: IIIЯ, $\overline{\text{III}}\overline{\text{Я}}$, III$\overline{\text{Я}}$ and $\overline{\text{III}}$Я. The first two relations seem certainly true: if any "thing" exists, it must have necessarily a relation with the surrounding "world", just as surely as if a "thing" does not exist, it cannot have any relation with the "world". The third relation, which is read as "exists but has no relations", and the fourth one, which is read as "does not exist but has relations", put us in front of important issues. Mainly the third configuration, at least from a physical point of view, is fully justified. We can mention many cases in which this situation occurs. It might be the case, for example, of all those particles that are the result of scattering interactions and have a very short mean lifetime in our physical reality. However, this does not mean that, once their "relation" with our reality terminates, they actually cease to exist. This also highlights a dynamic aspect between the different configurations.

Both the existences and the relations can change and this result is fully realized in our physical reality. The problem would be to figure out if with the existence and the extension of a

physical system, the axioms of general existence and relation become or may become or take on, in some cases, a relative value or, anyway, a value of locality. The configurations "it exists and is in relation" and "it does not exist and is not in relation" are by their very nature general configurations that we could also define as absolute; while the configuration "it exists but is not in relation" can be considered true if, for example, reformulated in the following way: "it exists in the system S but is not in relation with the system S". Then, accordingly, we may define them as relative. Referring to a physical context, it makes more sense to define them as dynamic. A curious fact about the configurations is that they can recall by similarity the square of Aristotle, if arranged in a certain way:

ШЯ	$\bar{Ш}$Я
Ш$\bar{Я}$	$\bar{Ш}\bar{Я}$

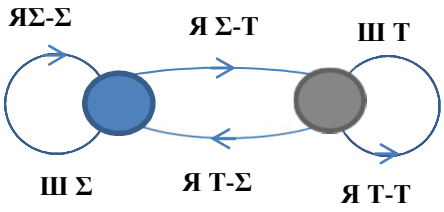
A more current version is the semiotic square of Greimas. Once again, wanting to define the basis of Physical Reality, we encounter the problematics of language already pointed out in the works of Gödel. Are different configurations possible, e.g., with respect to the number and/or the nature of the fundamental entities composing the physical reality?
It is possible to assume that the Universe we live in is made of or it has other entities in addition to Space and Time. For instance, can we assume the existence of other entities, just as physical as Space and Time, and name them "Uvio" and "Vixio", which contribute to the definition of Physical Reality of this Universe in the same way as Space and Time do, even though at the moment we are not physically or experimentally aware of them?

The answer to the question above is extremely complex. Our opinion is that the answer is, if not possible, maybe, less complex, if we expand our view. We must not look for a Theory of Everything valid for this Universe, but a Theory of Everything that tries to understand all Possible Universes, given the same conditions. For same conditions, one has to intend both the Entities, in nature and number, and the axioms or rules, in nature and number. Ultimately, we aim to outline and define a coherent Toy Theory, while maintaining the axioms of "existence" and "relation", in both positive and negative definitions, unchanged. How is it possible? How can it be done? This will be the subject of a next section. We consider at the moment the Theory of Everything for a single Universe.

2. System relations

In this section, we start from the relations that are established between the Entities participating in the definition of the Physical Reality.

The figure below depicts these relations. The Greek letters Σ (sigma) and T (tau) identify respectively space and time.



Even if from only a schematic point if view, we have sketched a model for the Toy Theory. In it are present the existence of both Entities Space and Time and their relations.

If we consider the graph theory, even from an operational point of view, and in particular the case of the lemma stating that an arc connects always and only two nodes, we can deduce that a connection, in our model a relation (*Я*), is only possible between two Entities (e.g., Space-Time and / or Space-Vixio). This is a fundamental step. Accepting it, it allows us to propose as a thesis the fact that even if our Physical Reality shows itself only through the relation between the Entities Space and Time, giving us the feeling of their only existence, this is not a necessary and sufficient condition to conclude that they are the only Entities present.

But the current model is de facto in an undifferentiated state.

The reason why this happens is immediately clarified. We consider, for instance, the issues relative to its origin. The hypothesis that the Big Bang has originated our Universe seems to explain some of the instrumental evidences (cosmic background, the current anisotropy of matter in comparison with antimatter, etc.), but it places us in a controversial situation. The first problem is the Bing Bang, the initial singularity. But to this is added another one, perhaps even more treacherous, concerning the initial singularity: the change of the parameters relative to the physical laws. But what do we exactly mean by the change of the parameters of the physical laws? With this word, we indicate all those necessary changes in the physical parameters, relative to the instants following the birth of the Universe, which are necessary to justify its evolution itself, in the terms dictated by the models. In this case, we can only conjecture that the axioms have to be always valid. This simply means that in the game, as in the reality, once the rules have been decided, they do remain fixed, we could say unchangeable, but in this first phase we also can be satisfied that they are not contradictory. For a better comprehension of this point, we can think of the Big Bang, for instance, as a series of laws. Now, if we assume their immutability, we deduce that the same laws can and maybe have to be active, operating as in the original moment of the Big Bang. In this case, only two possibilities are given: the first leads us to the conclusion that the Big Bang did not happen, at least not in its current definition; the second to the conclusion that the Big Bang is still active and working. How and in what way? Maybe generating other entities, perhaps, besides Uvio and Vixio, there are infinitely many other entities with different properties and nature, both actually and potentially. Naturally, none of the two hypotheses is acceptable from a physical point of view, not even net of the experimental evidences in a context like that of a Toy Theory. We want even more to point out that the hypothesis we have formulated, the immutability of the physical laws, has its logical validity, although at the moment it is difficult to prove.

Up to this point we have not substantially introduced nothing new and nothing particularly exotic. But now, we move away from things commonly accepted in physics and we assume Space and Time to be Entities totally independent, at least in their genesis, and to have equal dimensions. This means:

$$\dim \Sigma = \dim T.$$

We define

$$\Sigma^4 = (\sigma_0; \sigma_1; \sigma_2; \sigma_3; \sigma_4)$$

and

$$T^4 = \begin{pmatrix} \tau_0 \\ \tau_1 \\ \tau_2 \\ \tau_3 \\ \tau_4 \end{pmatrix}$$

as, respectively, the row vector relative to the Entity Space and the column vector relative to the Entity Time. To some extent the understanding of this setting will become clearer in the next sections. In the meantime, we justify the dimensional choice of 4 for Σ and T, with the fact that it can be used in the comparison with our Physical Reality and its apparent dimension 4. It is easy to see how the subscripts of σ e τ are related to the dimension of the Physical Reality, considering that they identify not only a dimension, but also a position. In this case, both the product $\Sigma \circ T$ and the product $T \circ \Sigma$ are algebraically defined, even though diverse between them.

Regarding the product $\Sigma \circ T$ this results in:

$$\Sigma^4 \circ T^4 = (\sigma_0 \otimes \tau_0) \oplus (\sigma_1 \otimes \tau_1) \oplus (\sigma_2 \otimes \tau_2) \oplus (\sigma_3 \otimes \tau_3) \oplus (\sigma_4 \otimes \tau_4) \quad \textbf{(1)}$$

Regarding the product $T \circ \Sigma$ this results in:

$$\mathrm{T}^4 \circ \Sigma^4 = \begin{pmatrix} \tau_0\otimes\sigma_0 & \tau_0\otimes\sigma_1 & \tau_0\otimes\sigma_2 & \tau_0\otimes\sigma_3 & \tau_0\otimes\sigma_4 \\ \tau_1\otimes\sigma_0 & \tau_1\otimes\sigma_1 & \tau_1\otimes\sigma_2 & \tau_1\otimes\sigma_3 & \tau_1\otimes\sigma_4 \\ \tau_2\otimes\sigma_0 & \tau_2\otimes\sigma_1 & \tau_2\otimes\sigma_2 & \tau_2\otimes\sigma_3 & \tau_2\otimes\sigma_4 \\ \tau_3\otimes\sigma_0 & \tau_3\otimes\sigma_1 & \tau_3\otimes\sigma_2 & \tau_3\otimes\sigma_3 & \tau_3\otimes\sigma_4 \\ \tau_4\otimes\sigma_0 & \tau_4\otimes\sigma_1 & \tau_4\otimes\sigma_2 & \tau_4\otimes\sigma_3 & \tau_4\otimes\sigma_4 \end{pmatrix} \textbf{\textit{(2)}}$$

What meaning should the expressions in ***(1)*** e ***(2)*** take on from a physical point of view, in the model of the Toy Theory? The product $\Sigma \circ \mathrm{T}$ from an algebraic point of view, has as result a number, a quantity. Instead, to the product $\mathrm{T} \circ \Sigma$, corresponds, from an algebraic point of view, a square matrix, in this case of order 5.

For the simplicity of the adopted model, it results easy to attribute to the product $\Sigma \circ \mathrm{T}$ the meaning of representing the physical manifestation of the existing relation between Space and Time $Я\ (\Sigma - \mathrm{T})$, to which we give the name of particle (or mass?).

While to the product $\mathrm{T} \circ \Sigma$ the meaning of representing the physical manifestation of the relation between Time and Space $Я\ (\mathrm{T} - \Sigma)$, to which we assign the name of wave.

What have we actually done?

First of all, this artifice allows us to overcome the problematic related to the question whether the field is generated by the particle or the particle is generated by the field. If we take the axioms of existence and relation, the previous issue can be solved only by imposing the simultaneous validity of the axioms themselves, this leading us to the logical conclusion that field and particle, and thus the associated wave are substantially aspects of a same event. This same event is the simultaneous validity and operability of the two axioms of "existence" and "relation", in both positive and negative form. To this physiology (?) we associate the word "Meta-Crasis". The word metacrasis is a compound word from the word "Meta", to which we give the meaning of mutation, modification but also of an activity that reflects on itself, on its nature, as well as that of a half which must be able to exist only with its other half. To the word "Crasis" we do not give only the meaning of union and mixing, but we also attribute the task of perennial merging and switching between the aspects of the axioms, thus having a more dynamic view.

The definition we have given above can, rather must be replaced by the description given by Pierre Cassou-Noguès in his book "Les démons de Gödel: Logique et folie [Gödel's demons: Logic and craziness]" to describe the relations of causality. Gödel wrote in his notes that they are "the fundamental philosophical concept." Pierre Cassou-Noguès comments:

"The relations of causality must be probably understood as relations of implication between the concepts (or propositions) that define the monads … The relation of causality between two monads seems to translate the way in which the concept of one determines certain properties of the concept of the other."

In this case, the metacrasis should not be confused from a philosophical point of view with the monad, as the first, the metacrasis, represents the complex union of two concepts, shapes or actions in a new concept that is wider than their simple fusion. The second, the monad, is rather representative of a concept, shape or action that is inherently indivisible. Ultimately, both of these concepts identify a singularity, a unique element, with the substantial difference that the metacrasis is the result of an operation of synthesis and the monad, instead, is the result of a subtraction operation.

Both the products $\Sigma \circ \mathrm{T}$ and $\mathrm{T} \circ \Sigma$, and their respective relations $Я\ (\Sigma - \mathrm{T})$ and $Я\ (\mathrm{T} - \Sigma)$, must be defined, bringing us back to the condition indicated at the beginning of this section, when we have imposed $\dim \Sigma = \dim \mathrm{T}$. In this section we have played with the "dimensions" of Σ and T but we cannot say anything regarding their intimate natures and relations yet. Another question concerns the characteristics and the morphology of the fields.

3. Universe and Universes of Reality

In order to develop a Toy Theory able to make verifiable predictions about our Universe, we must in some way expand our field of action, thinking of a representation of the complexities in a complex way. In this game of words hide a little truth and a lot of big lies. These many lies regard the fact that, even in the light of current knowledge, we are not able to define and, therefore, to associate with the word Universe none of its basic characteristics, necessary to define its characteristics. All the data we have are partial, they are called, for example, dark matter, dark energy, cosmic censor, age of existence (?), etc. And this explains the title of this section. If one had the intention to address this issue in the terms characteristic of the scientific method, he/she would have few, if not null, chances to find a solution. Wanting to achieve this goal, we can arrive through the model at a possible identification of the parameters intervening to define the Physical Reality. We imagine being able to fully describe the present Universe as well as all other possible universes through an explicit notation. We took the cue from reading Feynman's "Lectures on physics".

In a paragraph of the second volume of his "Lectures", the scientist jokes on the possibility to define the Universe through a single equation and introduces the following equation:

$$U = 0$$

It consists of the sum of all square differences of all known physical laws. It is certainly obvious that the equals sign, after having introduced the axioms of existence and relation, but especially, the concept of metacrasis, looses its meaning in the model. First of all, we try to identify the parameters through which the characteristics of the Universe manifest. Let's take a further leap of imagination by introducing new parameters on Feynman's notation:

$$\textbf{\textit{(3)}}$$

wherein the individual letters identify the following characteristics: "b" indicates the bases of the Universe of Reality, "d" indicates its dimension, "p" its power and "q" its quadrant or signature.

For "basis", we mean the number of entities that define the Universe. In our case, the Physical Reality, this number is two, Space and Time. If Uvio and Vixio were also present, the number associated with this parameter would be four.

For "dimension" we mean the dimension through which the universe manifests. In our case of Physical Reality, we have the number of four, three spatial dimensions and one time dimension. We will see later how the current concept of dimension has to be modified.

For "power" we mean the parameter that, once associated with the parameter "basis", makes possible in number the presence of the entities. To better understand this fact, it is enough to think about our Physical Reality in 4 dimensions, i.e., three spatial dimensions and one temporal. Under these conditions the parameter "power" has to have the value of 3, therefore, three dimensions of the Space entity and three dimensions of the Time entity must be present. Perhaps, now, we can better understand what we have written in the previous section, that the ratio between the dimensions of the entities should be one.

For "quadrant" or "signature" we mean the direction with respect to a predetermined orientation. For example, in the case of existence of the entities Space and Time, four quadrants or signatures are possible (++,+-, -+, --).

Through this notation, both the characteristics and the morphology of the fields present in different Universes of Reality are easy to individuate.

For better understanding how these parameters come into play, it is useful to see how our Universe can be described, at its current (assumed) stage of development, through Feynman's notation:

$$\textbf{\textit{(4)}}$$

The expression above has to be read in the following way: "there exists" a Universe of base 2, dimension 4, power 4 and quadrant ++, such that the "relation" between the bases spaces and time in dimension 4 and equal signature (implied in the notation) gives rise to the "union of the fields" ω of dimension

<4|0> (it has to be read 4 space dimensions and zero time dimensions), <3|1>, <2|2>, <1|3>, <0|4>. With the Greek letter ω we indicate the fields. With the operator ⊎ borrowed from algebra, we indicate the relation of copresence of the different fields operating at the same time. The notation just introduced takes the cue from the article of Srivastrava, Widom and Swain "Theory of low energy nuclear transmutations", in which the authors show direct evidences of how all the fundamental forces - gravitational, electromagnetic, nuclear weak and strong - are always operating together in any interaction taking place in the Universe of Reality.

As acknowledgement of their important contribution, we call this operator ⊎ the Srivastrava-Widom-Swain operator.

But, what is the meaning to attribute to these fields, also from a physical point of view?

It is useful to have a more physical view. We then pose our attention also on the particles, which we indicate with the Greek letter α, and their relation with their respective fields ω. As concerns the number of particle species present in our Universe of Reality, it can be calculated through the binominal coefficient $\binom{n}{k}$ if we give n the value "b•p", i.e., multiplying by two the power parameter of U in Feynman's notation, and k the value "d", the dimension parameter. Therefore, we calculate the following:

$$\binom{n}{k} = \frac{(b \cdot p)!}{d! \cdot (2p - d)!} = \frac{8!}{4! \cdot 4!} = 70$$

The values to be given to the binominal coefficient are defined by the nature of the Universe of Reality itself. If, for instance, given the same power parameter, we were in the condition in which the "d" parameter assumes the value 3, we would obtain:

$$\text{III } {}^{3}_{2}U^{4}_{++} \quad \text{allora} \quad \binom{n}{k} = \frac{8!}{3! \cdot 5!} = 56$$

At the conditions highlighted in the expression, we have for our Universe of Reality,70 particles. We see now how the particles distribute within the different fields. We start from the following table ***{1}***:

${}^{4}_{2}U^{4}_{++}$	Fields	$\langle 4\|0\rangle_{2}\omega$	$\langle 3\|1\rangle_{2}\omega$	$\langle 2\|2\rangle_{2}\omega$	$\langle 1\|3\rangle_{2}\omega$	$\langle 0\|4\rangle_{2}\omega$
Particles		1	16	36	16	1
Type I	6	-	-	6	-	-
Type II	48	-	12	24	12	-
Type III	14	-	4	6	4	-
Type IV	2	1	-	-	-	1

Table {1} – Fields and Particles of ${}^{4}_{2}U^{4}_{++}$

The first column indicates the type of particle (implicitly also its respective wave). The classification is due to the presence of pairs of space-time indices and for the different fields. Therefore, different types of particles and associated waves are possible, with indices $n, m, p, q \in Z$.

- The particles and the waves of **Type I** are composed of space-time elements whose indices are all coupled between them. We indicate such particles with $\langle \sigma_n, \sigma_m | \tau_n, \tau_m \rangle^{\circ}$ and their associated waves with $\langle \sigma_n, \sigma_m | \tau_n, \tau_m \rangle^{\sim}$.

- The particles and the waves of **Type II** are composed of space-time elements, in whose indices one space-time couple is at least present. The particles are

$$\langle \sigma_n, \sigma_m | \tau_{n;\,m}, \tau_q \rangle^{\circ}, \langle \sigma_n, \sigma_m, \sigma_p | \tau_{n;\,m;\,p} \rangle^{\circ} \quad \text{or}$$

$$\langle \sigma_{n;\,m;\,p} | \tau_n, \tau_m, \tau_p \rangle^{\circ}$$

and the associated waves

$$\langle \sigma_n, \sigma_m | \tau_{n;\,m}, \tau_q \rangle^{\sim}, \langle \sigma_n, \sigma_m, \sigma_p | \tau_{n;\,m;\,p} \rangle^{\sim} \quad \text{or}$$

$$\langle \sigma_{n;\,m;\,p} | \tau_n, \tau_m, \tau_p \rangle^{\sim}.$$

- The particles and the waves of **Type III** are composed of space-time elements, in which it is not possible to associate any couple of indices. The particles are

$$\langle \sigma_n, \sigma_m | \tau_p, \tau_q \rangle^{\circ} \langle \sigma_n, \sigma_m, \sigma_p | \tau_q \rangle^{\circ} \quad \text{or}$$

$$\langle \sigma_n | \tau_m, \tau_p, \tau_q \rangle^{\circ}$$

and the associated waves

$$\langle \sigma_n, \sigma_m | \tau_p, \tau_q \rangle^{\sim} \langle \sigma_n, \sigma_m, \sigma_p | \tau_q \rangle^{\sim} \quad \text{or}$$

$$\langle \sigma_n | \tau_m, \tau_p, \tau_q \rangle^{\sim}.$$

- The particles and the waves of **Type IV** are composed of either space elements or time elements. The particles are

$$\langle \sigma_n, \sigma_m, \sigma_p, \sigma_q | 0 \rangle^{\circ} \quad \text{or} \quad \langle 0 | \tau_n, \tau_m, \tau_p, \tau_q \rangle^{\circ}$$

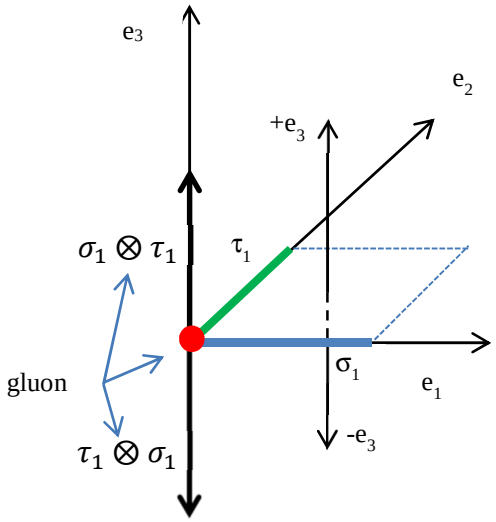
and the associated waves

$$\langle \sigma_n, \sigma_m, \sigma_p, \sigma_q | 0 \rangle^{\sim} \quad \text{or} \quad \langle 0 | \tau_n, \tau_m, \tau_p, \tau_q \rangle^{\sim}.$$

Physical meaning of the operators ⊕ and ⊗

In the relations **(1)** and **(2)** we have introduced these operators. In the Toy Theory they play the same role that in the Physical Reality gluons carry out. In this case, they are functional to the adopted notation, with a dynamics that will be better understood in the following sections.

These particle "operators" have also their own rule of use, which provides that the operator ⊕ precedes the operator ⊗ during the release. This means that a particle of equation **(1)** has, as a consequence of a collision, the release of the 4 operators ⊕ that keep space-time couples joined, naturally if the relations describing them are equal or similar to the relations **(1)** and **(2)**.



In the graphic above, we represent the existing relations between σ e τ and their necessary interaction with the particles (or operators), named gluons.

In the following table, their orientation with respect to a set of three Euclidean axes is showed.

σ_1 e τ_1		
e_1	e_2	e_3
σ_1	τ_1	⊗ ⊕

Why are σ_0 and τ_0 excluded from the calculation of permutations?

In the calculation of the permutations, this couple is excluded, as it results to be always present in every particle and every wave. It has the same role that in the set theory is played by the null

element present in every set. We will see then, that it assumes other meanings, but for now, we stop at this simple observation.

Introduction of the quantum operator $\delta_{\sigma;\tau}$

The quantum operator $\delta_{\sigma;\tau}$ is the neutral geometric element. We will appreciate better the meaning of this operator, also from the physical point of view, later in this article. For the moment, we can appreciate its usefulness, from the point of view of the notation used in the Toy Theory. In algebra, two neutral elements exist according to the type of operation: the zero, which represents the neutral element for the operations of addiction and subtraction; the unity, representing the neutral element for multiplication and division. If we apply the relations **(1)** e **(2)**, we can meet with cases, in which an element σ or τ, sometime even both, is or are lacking in the structure. In these specific cases, the quantum operator will take its or their places. The process of substitution can be better understood in the next section.

4. The development of table {1} in physical terms

What follows is the core of the model. It is the result of the possible combinations of σ and τ taken in groups of 4. We define these combinations as **Fields**. Therefore, we have 5 Fields:

$\langle \mathbf{4}\vert\mathbf{0}\rangle_{\mathbf{2}}\boldsymbol{\omega}$	$\langle \mathbf{3}\vert\mathbf{1}\rangle_{\mathbf{2}}\boldsymbol{\omega}$	$\langle \mathbf{2}\vert\mathbf{2}\rangle_{\mathbf{2}}\boldsymbol{\omega}$	$\langle \mathbf{1}\vert\mathbf{3}\rangle_{\mathbf{2}}\boldsymbol{\omega}$	$\langle \mathbf{0}\vert\mathbf{4}\rangle_{\mathbf{2}}\boldsymbol{\omega}$

The result of these combinations presents remarkable symmetries.

Field $\langle \mathbf{4}\vert\mathbf{0}\rangle_{\mathbf{2}}\boldsymbol{\omega}$

It is a field with 4 space dimensions e 0 time dimensions. From the mathematical point of view, this field can be considered scalar, while, from the physical point of view, we associate to it temperature. Only particles of Type IV can be referred to this field, and at the current moment of evolution of our Universe one*:

** See table **{1.1}** in the appendix*

So, given:

$$\Sigma^4 = (\delta_{\sigma_0};\ \sigma_1;\ \sigma_2;\ \sigma_3;\ \sigma_4) \qquad \text{e} \qquad T^4 = \begin{pmatrix} \delta_{\tau_0} \\ \delta_{\tau_1} \\ \delta_{\tau_2} \\ \delta_{\tau_3} \\ \delta_{\tau_4} \end{pmatrix}$$

we get:

$$\Sigma^4 \circ T^4 = (\delta_{\sigma_0} \otimes \delta_{\tau_0}) \oplus (\sigma_1 \otimes \delta_{\tau_1}) \oplus (\sigma_2 \otimes \delta_{\tau_2}) \oplus (\sigma_3 \otimes \delta_{\tau_3}) \oplus (\sigma_4 \otimes \delta_{\tau_4})$$

and

$$T^4 \circ \Sigma^4 = \begin{pmatrix} \delta_{\tau_0}\otimes\delta_{\sigma_0} & \delta_{\tau_0}\otimes\sigma_1 & \delta_{\tau_0}\otimes\sigma_2 & \delta_{\tau_0}\otimes\sigma_3 & \delta_{\tau_0}\otimes\sigma_4 \\ \delta_{\tau_1}\otimes\delta_{\sigma_0} & \delta_{\tau_1}\otimes\sigma_1 & \delta_{\tau_1}\otimes\sigma_2 & \delta_{\tau_1}\otimes\sigma_3 & \delta_{\tau_1}\otimes\sigma_4 \\ \delta_{\tau_2}\otimes\delta_{\sigma_0} & \delta_{\tau_2}\otimes\sigma_1 & \delta_{\tau_2}\otimes\sigma_2 & \delta_{\tau_2}\otimes\sigma_3 & \delta_{\tau_2}\otimes\sigma_4 \\ \delta_{\tau_3}\otimes\delta_{\sigma_0} & \delta_{\tau_3}\otimes\sigma_1 & \delta_{\tau_3}\otimes\sigma_2 & \delta_{\tau_3}\otimes\sigma_3 & \delta_{\tau_3}\otimes\sigma_4 \\ \delta_{\tau_4}\otimes\delta_{\sigma_0} & \delta_{\tau_4}\otimes\sigma_1 & \delta_{\tau_4}\otimes\sigma_2 & \delta_{\tau_4}\otimes\sigma_3 & \delta_{\tau_4}\otimes\sigma_4 \end{pmatrix}$$

We associate to these expressions:

$\mathbf{\Sigma^4 \circ T^4} \equiv \boldsymbol{r_f}$ the background radiation.

$\mathbf{T^4 \circ \Sigma^4} \equiv \tilde{\boldsymbol{r_f}}$ the wave associated to the background radiation.

Field $\langle \mathbf{3}\vert\mathbf{1}\rangle_{\mathbf{2}}\boldsymbol{\omega}$

It is a field with three space dimensions and one time dimension. From the mathematical point of view, this field can be considered tensorial, while from the physical point of view, it is a field obeying Fermi-Dirac statistics.

Exclusively particles of Type II and Type III are related to this field has and, at the current moment of the Universe evolution, their number is 16.

** See table **{1.2}** in the appendix*

For instance, for the Type II particles, given

$$\Sigma^4 = (\delta_{\sigma_0};\ \sigma_1;\ \sigma_2;\ \sigma_3;\ \delta_{\sigma_4}) \qquad \text{e} \qquad T^4 = \begin{pmatrix} \delta_{\tau_0} \\ \tau_1 \\ \delta_{\tau_2} \\ \delta_{\tau_3} \\ \delta_{\tau_4} \end{pmatrix}$$

it results:

$$\Sigma^4 \circ T^4 = (\delta_{\sigma_0} \otimes \delta_{\tau_0}) \oplus (\sigma_1 \otimes \tau_1) \oplus (\sigma_2 \otimes \delta_{\tau_2}) \oplus (\sigma_3 \otimes \delta_{\tau_3}) \oplus (\delta_{\sigma_4} \otimes \delta_{\tau_4})$$

and

$$T^4 \circ \Sigma^4 = \begin{pmatrix} \delta_{\tau_0}\otimes\delta_{\sigma_0} & \delta_{\tau_0}\otimes\sigma_1 & \delta_{\tau_0}\otimes\sigma_2 & \delta_{\tau_0}\otimes\sigma_3 & \delta_{\tau_0}\otimes\delta_{\sigma_4} \\ \tau_1\otimes\delta_{\sigma_0} & \tau_1\otimes\sigma_1 & \tau_1\otimes\sigma_2 & \tau_1\otimes\sigma_3 & \tau_1\otimes\delta_{\sigma_4} \\ \delta_{\tau_2}\otimes\delta_{\sigma_0} & \delta_{\tau_2}\otimes\sigma_1 & \delta_{\tau_2}\otimes\sigma_2 & \delta_{\tau_2}\otimes\sigma_3 & \delta_{\tau_2}\otimes\delta_{\sigma_4} \\ \delta_{\tau_3}\otimes\delta_{\sigma_0} & \delta_{\tau_3}\otimes\sigma_1 & \delta_{\tau_3}\otimes\sigma_2 & \delta_{\tau_3}\otimes\sigma_3 & \delta_{\tau_3}\otimes\delta_{\sigma_4} \\ \delta_{\tau_4}\otimes\delta_{\sigma_0} & \delta_{\tau_4}\otimes\sigma_1 & \delta_{\tau_4}\otimes\sigma_2 & \delta_{\tau_4}\otimes\sigma_3 & \delta_{\tau_4}\otimes\delta_{\sigma_4} \end{pmatrix}$$

To these expressions correspond: $\Sigma^4 \circ T^4 \equiv p^+$ (proton), $T^4 \circ \Sigma^4 \equiv p^{\sim}$ (wave associated to the proton).

For the Type III, we have for instance:

$$\Sigma^4 = (\delta_{\sigma_0};\ \sigma_1;\ \sigma_2;\ \sigma_3;\ \delta_{\sigma_4}) \qquad \text{e} \qquad T^4 = \begin{pmatrix} \delta_{\tau_0} \\ \delta_{\tau_1} \\ \delta_{\tau_2} \\ \delta_{\tau_3} \\ \tau_4 \end{pmatrix}$$

from which, it results:

$$\Sigma^4 \circ T^4 = (\delta_{\sigma_0} \otimes \delta_{\tau_0}) \oplus (\sigma_1 \otimes \delta_{\tau_1}) \oplus (\sigma_2 \otimes \delta_{\tau_2}) \oplus (\sigma_3 \otimes \delta_{\tau_3}) \oplus (\delta_{\sigma_4} \otimes \tau_4)$$

and

$$T^4 \circ \Sigma^4 = \begin{pmatrix} \delta_{\tau_0}\otimes\delta_{\sigma_0} & \delta_{\tau_0}\otimes\sigma_1 & \delta_{\tau_0}\otimes\sigma_2 & \delta_{\tau_0}\otimes\sigma_3 & \delta_{\tau_0}\otimes\delta_{\sigma_4} \\ \delta_{\tau_1}\otimes\delta_{\sigma_0} & \delta_{\tau_1}\otimes\sigma_1 & \delta_{\tau_1}\otimes\sigma_2 & \delta_{\tau_1}\otimes\sigma_3 & \delta_{\tau_1}\otimes\delta_{\sigma_4} \\ \delta_{\tau_2}\otimes\delta_{\sigma_0} & \delta_{\tau_2}\otimes\sigma_1 & \delta_{\tau_2}\otimes\sigma_2 & \delta_{\tau_2}\otimes\sigma_3 & \delta_{\tau_2}\otimes\delta_{\sigma_4} \\ \delta_{\tau_3}\otimes\delta_{\sigma_0} & \delta_{\tau_3}\otimes\sigma_1 & \delta_{\tau_3}\otimes\sigma_2 & \delta_{\tau_3}\otimes\sigma_3 & \delta_{\tau_3}\otimes\delta_{\sigma_4} \\ \tau_4\otimes\delta_{\sigma_0} & \tau_4\otimes\sigma_1 & \tau_4\otimes\sigma_2 & \tau_4\otimes\sigma_3 & \tau_4\otimes\delta_{\sigma_4} \end{pmatrix}$$

We are not able to associate any particle and wave to these expressions.

Field $\langle \mathbf{2}\vert\mathbf{2}\rangle_{\mathbf{2}}\boldsymbol{\omega}$

It is a field with two space dimensions and two time dimensions. From the mathematical point of view, this field can be considered spinorial, while from the physical point of view it is a field obeying Bose – Einstein statistics (electromagnetic field). It is related exclusively to particles of Type I, Type II and Type III, and at the current moment of evolution of our Universe, their number is 36*:

** See table **{1.3}** in the appendix*

For the Type I, we have for instance:

$$\Sigma^4 = (\delta_{\sigma_0};\ \sigma_1;\ \sigma_2;\ \delta_{\sigma_3};\ \delta_{\sigma_4}) \qquad \text{and} \qquad T^4 = \begin{pmatrix} \delta_{\tau_0} \\ \tau_1 \\ \tau_2 \\ \delta_{\tau_3} \\ \delta_{\tau_4} \end{pmatrix}$$

from which, it results:

$$\Sigma^4 \circ T^4 = (\delta_{\sigma_0} \otimes \delta_{\tau_0}) \oplus (\sigma_1 \otimes \tau_1) \oplus (\sigma_2 \otimes \tau_2) \oplus (\delta_{\sigma_3} \otimes \delta_{\tau_3}) \oplus (\delta_{\sigma_4} \otimes \delta_{\tau_4})$$

and

$$T^4 \circ \Sigma^4 = \begin{pmatrix} \delta_{\tau_0}\otimes\delta_{\sigma_0} & \delta_{\tau_0}\otimes\sigma_1 & \delta_{\tau_0}\otimes\sigma_2 & \delta_{\tau_0}\otimes\delta_{\sigma_3} & \delta_{\tau_0}\otimes\delta_{\sigma_4} \\ \tau_1\otimes\delta_{\sigma_0} & \tau_1\otimes\sigma_1 & \tau_1\otimes\sigma_2 & \tau_1\otimes\delta_{\sigma_3} & \tau_1\otimes\delta_{\sigma_4} \\ \tau_2\otimes\delta_{\sigma_0} & \tau_2\otimes\sigma_1 & \tau_2\otimes\sigma_2 & \tau_2\otimes\delta_{\sigma_3} & \tau_2\otimes\delta_{\sigma_4} \\ \delta_{\tau_3}\otimes\delta_{\sigma_0} & \delta_{\tau_3}\otimes\sigma_1 & \delta_{\tau_3}\otimes\sigma_2 & \delta_{\tau_3}\otimes\delta_{\sigma_3} & \delta_{\tau_3}\otimes\delta_{\sigma_4} \\ \delta_{\tau_4}\otimes\delta_{\sigma_0} & \delta_{\tau_4}\otimes\sigma_1 & \delta_{\tau_4}\otimes\sigma_2 & \delta_{\tau_4}\otimes\delta_{\sigma_3} & \delta_{\tau_4}\otimes\delta_{\sigma_4} \end{pmatrix}$$

To these expressions, correspond: $\Sigma^4 \circ T^4 \equiv \gamma$ (photon), $T^4 \circ \Sigma^4 \equiv \gamma^{\sim}$ (associated wave of the photon).

For the Type II, we have, for example:

$$\Sigma^4 = (\delta_{\sigma_0};\ \sigma_1;\ \sigma_2;\ \delta_{\sigma_3};\ \delta_{\sigma_4}) \qquad \text{e} \qquad T^4 = \begin{pmatrix} \delta_{\tau_0} \\ \tau_1 \\ \delta_{\tau_2} \\ \tau_3 \\ \delta_{\tau_4} \end{pmatrix}$$

from which, it results:

$$\Sigma^4 \circ T^4 = (\delta_{\sigma_0} \otimes \delta_{\tau_0}) \oplus (\sigma_1 \otimes \tau_1) \oplus (\sigma_2 \otimes \delta_{\tau_2}) \oplus (\delta_{\sigma_3} \otimes \tau_3) \oplus (\delta_{\sigma_4} \otimes \delta_{\tau_4})$$

and

$$T^4 \circ \Sigma^4 = \begin{pmatrix} \delta_{\tau_0}\otimes\delta_{\sigma_0} & \delta_{\tau_0}\otimes\sigma_1 & \delta_{\tau_0}\otimes\sigma_2 & \delta_{\tau_0}\otimes\delta_{\sigma_3} & \delta_{\tau_0}\otimes\delta_{\sigma_4} \\ \tau_1\otimes\delta_{\sigma_0} & \tau_1\otimes\sigma_1 & \tau_1\otimes\sigma_2 & \tau_1\otimes\delta_{\sigma_3} & \tau_1\otimes\delta_{\sigma_4} \\ \delta_{\tau_2}\otimes\delta_{\sigma_0} & \delta_{\tau_2}\otimes\sigma_1 & \delta_{\tau_2}\otimes\sigma_2 & \delta_{\tau_2}\otimes\delta_{\sigma_3} & \delta_{\tau_2}\otimes\delta_{\sigma_4} \\ \tau_3\otimes\delta_{\sigma_0} & \tau_3\otimes\sigma_1 & \tau_3\otimes\sigma_2 & \tau_3\otimes\delta_{\sigma_3} & \tau_3\otimes\delta_{\sigma_4} \\ \delta_{\tau_4}\otimes\delta_{\sigma_0} & \delta_{\tau_4}\otimes\sigma_1 & \delta_{\tau_4}\otimes\sigma_2 & \delta_{\tau_4}\otimes\delta_{\sigma_3} & \delta_{\tau_4}\otimes\delta_{\sigma_4} \end{pmatrix}$$

To these expressions correspond: $\mathbf{\Sigma^4 \circ T^4 \equiv e^-}$ (electron), $\mathbf{T^4 \circ \Sigma^4 \equiv e^{\sim}}$ (associated wave of the electron).

For the Type III, we have, for instance:

$$\Sigma^4 = (\delta_{\sigma_0};\ \sigma_1;\ \sigma_2;\ \delta_{\sigma_3};\ \delta_{\sigma_4}) \qquad \text{and} \qquad T^4 = \begin{pmatrix} \delta_{\tau_0} \\ \delta_{\tau_1} \\ \delta_{\tau_2} \\ \tau_3 \\ \tau_4 \end{pmatrix}$$

from which, it results:

$$\Sigma^4 \circ T^4 = (\delta_{\sigma_0} \otimes \delta_{\tau_0}) \oplus (\sigma_1 \otimes \delta_{\tau_1}) \oplus (\sigma_2 \otimes \delta_{\tau_2}) \oplus (\delta_{\sigma_3} \otimes \tau_3) \oplus (\delta_{\sigma_4} \otimes \tau_4)$$

and

$$T^4 \circ \Sigma^4 = \begin{pmatrix} \delta_{\tau_0}\otimes\delta_{\sigma_0} & \delta_{\tau_0}\otimes\sigma_1 & \delta_{\tau_0}\otimes\sigma_2 & \delta_{\tau_0}\otimes\delta_{\sigma_3} & \delta_{\tau_0}\otimes\delta_{\sigma_4} \\ \delta_{\tau_1}\otimes\delta_{\sigma_0} & \delta_{\tau_1}\otimes\sigma_1 & \delta_{\tau_1}\otimes\sigma_2 & \delta_{\tau_1}\otimes\delta_{\sigma_3} & \delta_{\tau_1}\otimes\delta_{\sigma_4} \\ \delta_{\tau_2}\otimes\delta_{\sigma_0} & \delta_{\tau_2}\otimes\sigma_1 & \delta_{\tau_2}\otimes\sigma_2 & \delta_{\tau_2}\otimes\delta_{\sigma_3} & \delta_{\tau_2}\otimes\delta_{\sigma_4} \\ \tau_3\otimes\delta_{\sigma_0} & \tau_3\otimes\sigma_1 & \tau_3\otimes\sigma_2 & \tau_3\otimes\delta_{\sigma_3} & \tau_3\otimes\delta_{\sigma_4} \\ \tau_4\otimes\delta_{\sigma_0} & \tau_4\otimes\sigma_1 & \tau_4\otimes\sigma_2 & \tau_4\otimes\delta_{\sigma_3} & \tau_4\otimes\delta_{\sigma_4} \end{pmatrix}$$

To these expressions correspond: $\mathbf{\Sigma^4 \circ T^4 \equiv r}$ (closed electromagnetic radiation), $\mathbf{T^4 \circ \Sigma^4 \equiv r^{\sim}}$ (wave associated to the electromagnetic radiation).

Field $\langle \mathbf{1}|\mathbf{3} \rangle_{\mathbf{2}}\boldsymbol{\omega}$

It is a field with one space dimension and three time dimensions. From the mathematical point of view, this field can be considered tensorial. It is difficult to give a physical definition, but from the made assumptions, it seems to correspond to a field in which particles of Type II, which are part of it, can be neutrinos (Pauli, Fermi, Majorana, Pontecorvo statistics? Neutrino field)?
To this field, we have associated the particles indicated in the appendix in table **{1.4}**.

As regards the particles referable to it, the field has exclusively particles of Type II and Type III and, at the current moment of our Universe evolution, their number is 16:

For the Type II, we have for instance:

$$\Sigma^4 = (\delta_{\sigma_0};\ \sigma_1;\ \delta_{\sigma_2};\ \delta_{\sigma_3};\ \delta_{\sigma_4}) \qquad \text{and} \qquad T^4 = \begin{pmatrix} \delta_{\tau_0} \\ \tau_1 \\ \tau_2 \\ \tau_3 \\ \delta_{\tau_4} \end{pmatrix}$$

from which, it results:

$$\Sigma^4 \circ T^4 = (\delta_{\sigma_0} \otimes \delta_{\tau_0}) \oplus (\sigma_1 \otimes \tau_1) \oplus (\delta_{\sigma_2} \otimes \tau_2) \oplus (\delta_{\sigma_3} \otimes \tau_3) \oplus (\delta_{\sigma_4} \otimes \delta_{\tau_4})$$

and

$$T^4 \circ \Sigma^4 = \begin{pmatrix} \delta_{\tau_0}\otimes\delta_{\sigma_0} & \delta_{\tau_0}\otimes\sigma_1 & \delta_{\tau_0}\otimes\delta_{\sigma_2} & \delta_{\tau_0}\otimes\delta_{\sigma_3} & \delta_{\tau_0}\otimes\delta_{\sigma_4} \\ \tau_1\otimes\delta_{\sigma_0} & \tau_1\otimes\sigma_1 & \tau_1\otimes\delta_{\sigma_2} & \tau_1\otimes\delta_{\sigma_3} & \tau_1\otimes\delta_{\sigma_4} \\ \tau_2\otimes\delta_{\sigma_0} & \tau_2\otimes\sigma_1 & \tau_2\otimes\delta_{\sigma_2} & \tau_2\otimes\delta_{\sigma_3} & \tau_2\otimes\delta_{\sigma_4} \\ \tau_3\otimes\delta_{\sigma_0} & \tau_3\otimes\sigma_1 & \tau_3\otimes\delta_{\sigma_2} & \tau_3\otimes\delta_{\sigma_3} & \tau_3\otimes\delta_{\sigma_4} \\ \tau_4\otimes\delta_{\sigma_0} & \tau_4\otimes\sigma_1 & \tau_4\otimes\delta_{\sigma_2} & \tau_4\otimes\delta_{\sigma_3} & \tau_4\otimes\delta_{\sigma_4} \end{pmatrix}$$

To these expressions correspond: $\mathbf{\Sigma^4 \circ T^4 \equiv \nu}$ (neutrinos), $\mathbf{T^4 \circ \Sigma^4 \equiv \nu^{\sim}}$ (wave associated to the neutrinos).

For the Type III, we have for instance:

$$\Sigma^4 = (\delta_{\sigma_0};\ \sigma_1;\ \delta_{\sigma_2};\ \delta_{\sigma_3};\ \delta_{\sigma_4}) \qquad \text{e} \qquad T^4 = \begin{pmatrix} \delta_{\tau_0} \\ \delta_{\tau_1} \\ \tau_2 \\ \tau_3 \\ \tau_4 \end{pmatrix}$$

from which, it results:

$$\Sigma^4 \circ T^4 = (\delta_{\sigma_0} \otimes \delta_{\tau_0}) \oplus (\sigma_1 \otimes \delta_{\tau_1}) \oplus (\delta_{\sigma_2} \otimes \tau_2) \oplus (\delta_{\sigma_3} \otimes \tau_3) \oplus (\delta_{\sigma_4} \otimes \tau_4)$$

and

$$T^4 \circ \Sigma^4 = \begin{pmatrix} \delta_{\tau_0}\otimes\delta_{\sigma_0} & \delta_{\tau_0}\otimes\sigma_1 & \delta_{\tau_0}\otimes\delta_{\sigma_2} & \delta_{\tau_0}\otimes\delta_{\sigma_3} & \delta_{\tau_0}\otimes\delta_{\sigma_4} \\ \delta_{\tau_1}\otimes\delta_{\sigma_0} & \delta_{\tau_1}\otimes\sigma_1 & \delta_{\tau_1}\otimes\delta_{\sigma_2} & \delta_{\tau_1}\otimes\delta_{\sigma_3} & \delta_{\tau_1}\otimes\delta_{\sigma_4} \\ \tau_2\otimes\delta_{\sigma_0} & \tau_2\otimes\sigma_1 & \tau_2\otimes\delta_{\sigma_2} & \tau_2\otimes\delta_{\sigma_3} & \tau_2\otimes\delta_{\sigma_4} \\ \tau_3\otimes\delta_{\sigma_0} & \tau_3\otimes\sigma_1 & \tau_3\otimes\delta_{\sigma_2} & \tau_3\otimes\delta_{\sigma_3} & \tau_3\otimes\delta_{\sigma_4} \\ \tau_4\otimes\delta_{\sigma_0} & \tau_4\otimes\sigma_1 & \tau_4\otimes\delta_{\sigma_2} & \tau_4\otimes\delta_{\sigma_3} & \tau_4\otimes\delta_{\sigma_4} \end{pmatrix}$$

We are not able to match any particle and any associated wave to these expressions.

Field $\langle \mathbf{0}|\mathbf{4} \rangle_{\mathbf{2}}\boldsymbol{\omega}$

It is a field with zero space dimensions and four time dimensions. From the mathematical point of view, this field can be considered scalar and we think that it is the field of existence of the tachyons. Regarding to the particles referable to it, the field has exclusively particles of Type IV and, at the current moment of the Universe evolution, a single one*:

** See table **{1.5}** in the appendix*

$$\Sigma^4 = (\delta_{\sigma_0};\ \delta_{\sigma_1};\ \delta_{\sigma_2};\ \delta_{\sigma_3};\ \delta_{\sigma_4}) \qquad \text{and} \qquad T^4 = \begin{pmatrix} \delta_{\tau_0} \\ \tau_1 \\ \tau_2 \\ \tau_3 \\ \tau_4 \end{pmatrix}$$

So, given:

$$\Sigma^4 \circ T^4 = (\delta_{\sigma_0} \otimes \delta_{\tau_0}) \oplus (\delta_{\sigma_1} \otimes \tau_1) \oplus (\delta_{\sigma_2} \otimes \tau_2) \oplus (\delta_{\sigma_3} \otimes \tau_3) \oplus (\delta_{\sigma_4} \otimes \tau_4)$$

and

$$T^4 \circ \Sigma^4 = \begin{pmatrix} \delta_{\tau_0}\otimes\delta_{\sigma_0} & \delta_{\tau_0}\otimes\delta_{\sigma_1} & \delta_{\tau_0}\otimes\delta_{\sigma_2} & \delta_{\tau_0}\otimes\delta_{\sigma_3} & \delta_{\tau_0}\otimes\delta_{\sigma_4} \\ \tau_1\otimes\delta_{\sigma_0} & \tau_1\otimes\delta_{\sigma_1} & \tau_1\otimes\delta_{\sigma_2} & \tau_1\otimes\delta_{\sigma_3} & \tau_1\otimes\delta_{\sigma_4} \\ \tau_2\otimes\delta_{\sigma_0} & \tau_2\otimes\delta_{\sigma_1} & \tau_2\otimes\delta_{\sigma_2} & \tau_2\otimes\delta_{\sigma_3} & \tau_2\otimes\delta_{\sigma_4} \\ \tau_3\otimes\delta_{\sigma_0} & \tau_3\otimes\delta_{\sigma_1} & \tau_3\otimes\delta_{\sigma_2} & \tau_3\otimes\delta_{\sigma_3} & \tau_3\otimes\delta_{\sigma_4} \\ \tau_4\otimes\delta_{\sigma_0} & \tau_4\otimes\delta_{\sigma_1} & \tau_4\otimes\delta_{\sigma_2} & \tau_4\otimes\delta_{\sigma_3} & \tau_4\otimes\delta_{\sigma_4} \end{pmatrix}$$

to these expressions correspond: $\mathbf{\Sigma^4 \circ T^4 \equiv t}$ (tachyon), $\mathbf{T^4 \circ \Sigma^4 \equiv t^{\sim}}$ (wave associated to the tachyon).

Surely, the graphic 1 in the appendix is of help. In it, the fields are represented at their actual state of development. For the moment, we have introduced the fields **Γ** (games) instead of the field of Reals **R** and of the Minkowsky spaces **M,** as we want to be independent from the mathematical properties of these fields,

non sufficient for us to fully describe the physical and geometrical properties of the fields of the Toy Theory.

5. The evolution of the fields Γ^4

Even in this case, the solution arises from considerations of principle.

The first one regards the cited work of Tegmark, in which it is possible, moreover, to recover a scheme corresponding to the graphic 1 in the appendix. The reason why we consider the fields $\mathbf{\Gamma^4}$ really existing, while Tegmark considers them only hypothetic, comes from a new interpretation that we give to the Lorenz transformations (LT). We take in consideration the fields $\langle 3|1\rangle_2\omega$ and $\langle 2|2\rangle_2\omega$ of $\mathbf{\Gamma^4}$ and their respective particles $\langle \sigma_1, \sigma_2, \sigma_3|\tau_2\rangle^\circ$ and $\langle \sigma_1, \sigma_2|\tau_1, \tau_2\rangle^\circ$.

The increase of mass of the particle $\langle \sigma_1, \sigma_2, \sigma_3|\tau_2\rangle^\circ$ (proton) consequent to the increase of speed, according to (LT), which at speed close to that of light tends to assume an infinite value, is interpreted in this model as the necessary reaction, i.e. the relation that the **Field** $\langle \mathbf{3|1}\rangle_2\boldsymbol{\omega}$ carries out against the same particle. We recall that the only particle to be able to go at the speed of light seems to be, at the moment, the photon. The photon is part of the electromagnetic field and, in our Toy Theory, is represented by the **Field** $\langle \mathbf{2|2}\rangle_2\boldsymbol{\omega}$. In this context, it is to be added that, from the experimental evidences, the consequences of the Lorentz transformations intervene also for particles such as the electron, which in the model is part of the **Field** $\langle \mathbf{2|2}\rangle_2\boldsymbol{\omega}$. Natural considerations lead us to assume that this system of intervention is always operating on all the particles with high kinetics, independently of the field they belong to.

The second consideration comes from the fact that for $\mathbf{\Gamma^4}$ are worth the following Feynman's notations:

$$Ш\ {}_2^4U_{++}^2 \mid {}_{\langle\sigma|\tau\rangle}{}^4Я \ \longmapsto\ \langle 2|2\rangle_2\omega \quad \textbf{(5)}$$

$$Ш\ {}_2^4U_{++}^3 \mid {}_{\langle\sigma|\tau\rangle}{}^4Я \ \longmapsto\ \langle 3|1\rangle_2\omega \uplus \langle 2|2\rangle_2\omega \uplus \langle 1|3\rangle_2\omega \quad \textbf{(6)}$$

in addition to **(4)**. The succession of events is such that to the **(5)**, table ***{2},*** follows the **(6)**, table ***{3},*** and than the **(4)** that we have already seen in table ***{1}***.

$\mathbf{{}_2^4U_{++}^2}$	**Fields**	$\langle 2\|2\rangle_2\omega$
Particles		1
Type I	1	1

Table {2} – Fields and Particles of $\mathbf{{}_2^4U_{++}^2}$

$\mathbf{{}_2^4U_{++}^3}$	**Fields**	$\langle 3\|1\rangle_2\omega$	$\langle 2\|2\rangle_2\omega$	$\langle 1\|3\rangle_2\omega$
Particles		3	9	3
Type I	3	-	3	-
Type II	12	3	6	3

Table {3} - Fields and Particles of $\mathbf{{}_2^4U_{++}^3}$

This cosmogony overcomes the contradictions observed in a precedent section, relatively to the initial singularity, because the relation **(5)** describes how our Universe, keeping unchanged the laws that rule it, can have manifested in this dimension with only one field and with the only relative particle, the photon. At this point it could appear unnecessary, but we reaffirm that the photon is not only the mediator of force, as predicted by the standard model, but in this Toy Theory it is a particle in all the respects. This takes us to other considerations in regards of the generation of the space-time couples.

The third consideration is relative to the objective reality of the σ's and the τ's. Our belief is that they are real. We are reasonably convinced that, e.g., the particles that after a collision show themselves in this reality for small fractions of second belong to the other fields of **Γ**. To express better this concept, we take for instance the particle $\langle \sigma_1, \sigma_2, \sigma_3|\tau_2\rangle^\circ$ of the **Field** $\langle \mathbf{3|1}\rangle_2\boldsymbol{\omega}$ and we see that the particle itself is given by the expression:

$$\Sigma^4 \circ \mathrm{T}^4 = (\delta_{\sigma_0} \otimes \delta_{\tau_0}) \oplus (\sigma_1 \otimes \delta_{\tau_1}) \oplus (\sigma_2 \otimes \tau_2) \oplus (\sigma_3 \otimes \delta_{\tau_3}) \oplus (\delta_{\sigma_4} \otimes \delta_{\tau_4})$$

In a first decay, the signs $\oplus$ are first released, therefore:

$$(\delta_{\sigma_0} \otimes \delta_{\tau_0}); (\delta_{\sigma_4} \otimes \delta_{\tau_4}) \rightarrow \langle 0|0\rangle_2\omega|\ \Gamma^0$$

$$(\sigma_1 \otimes \delta_{\tau_1});\ (\sigma_3 \otimes \delta_{\tau_3}) \rightarrow \langle 1|0\rangle_2\omega|\Gamma^1_{++}$$

$$(\sigma_2 \otimes \tau_2) \rightarrow \langle 1|1\rangle_2\omega|\Gamma^2_{++}$$

plus the 4 gluons (operators) $\oplus$.

This is the first type of proton decay. But, if we consider what has been written above and we confront it with what has been verified experimentally in the standard model, we see that the proton particle is constituted by two quarks up and one quark down. The particle α: $\langle \sigma_1, \sigma_2, \sigma_3|\tau_2\rangle^\circ$ of the **Field** $\langle \mathbf{3|1}\rangle_2\boldsymbol{\omega}$ can be seen as the proton of the standard model. We have already said that the operators $\oplus$, can be seen as gluons. The particles $(\delta_{\sigma_0} \otimes \delta_{\tau_0})$ and $(\delta_{\sigma_4} \otimes \delta_{\tau_4})$ or more clearly $\langle \delta_{\sigma_0}|\delta_{\tau_0}\rangle^\circ$ and $\langle \delta_{\sigma_4}|\delta_{\tau_4}\rangle^\circ$ can be seen as particles that have no interaction, because composed of only the quantum operator, representing in the model the neutral geometric element. The forth consideration comes from the study of the relation **(6)**, that can be associated to the beta decay, neutron that decays in a proton, an electron and an electronic antineutrino. For us, the proton belongs to the **Field** $\langle \mathbf{3|1}\rangle_2\boldsymbol{\omega}$ the electron belongs to the **Field** $\langle \mathbf{2|2}\rangle_2\boldsymbol{\omega}$ and the antineutrino to the **Field** $\langle \mathbf{1|3}\rangle_2\boldsymbol{\omega}$. This leads us to conclude that the neutron can be seen in this model as a particle generated in the second phase of formation of our Universe and, moreover, that it is a synthesis particle, as it is given by the formation of particles belonging to different fields of Γ^4. We can now see what has been written above about the Srivastrava-Widom-Swain operator, valuating its action not only on Universal scale, but also for the particles.

The last important consideration regards the development of the fields from ${}_2^4U_{++}^2$ to ${}_2^4U_{++}^3$. As it appears evident in the relation (5) and (6), the Universe of Reality manifests and evolves without the presence and the action of the gravitational field. In its first phase, the Universe of Reality develops initially in ${}_2^4U_{++}^2$, with only the electromagnetic field, continuing then in ${}_2^4U_{++}^3$, with the addition of the fields associated to Fermi - Dirac statistics and Pauli, Fermi, Majorana, Pontecorvo statistics. The gravitational field is the last field to come into action in Γ^4, and the only way it can do is through the two scalar fields $\langle 4|0\rangle_2\omega$ and $\langle 0|4\rangle_2\omega$, with the help of the Srivastrava-Widom-Swain" operator. Definitely, this is one of the many surprises that we have encountered in the development of the model.

We take in consideration now the graphic 1. We can see that it is possible to associate the following matrices Ω_{00}, Ω_{11}, Ω_{22}, etc. to the development of the fields, or:

$$\Omega_{00} = \left(\langle 0|0\rangle_2\omega\right)$$

$$\Omega_{11} = \begin{pmatrix} \langle 1|-1\rangle_2\omega & \langle 1|0\rangle_2\omega & \langle 1|1\rangle_2\omega \\ \langle 0|-1\rangle_2\omega & \langle 0|0\rangle_2\omega & \langle 0|1\rangle_2\omega \\ \langle -1|-1\rangle_2\omega & \langle -1|0\rangle_2\omega & \langle -1|1\rangle_2\omega \end{pmatrix}$$

$$\Omega_{22} = \begin{pmatrix} \langle 2|-2\rangle_2\omega & \langle 2|-1\rangle_2\omega & \langle 2|0\rangle_2\omega & \langle 2|1\rangle_2\omega & \langle 2|2\rangle_2\omega \\ \langle 1|-2\rangle_2\omega & \langle 1|-1\rangle_2\omega & \langle 1|0\rangle_2\omega & \langle 1|1\rangle_2\omega & \langle 1|2\rangle_2\omega \\ \langle 0|-2\rangle_2\omega & \langle 0|-1\rangle_2\omega & \langle 0|0\rangle_2\omega & \langle 0|1\rangle_2\omega & \langle 0|2\rangle_2\omega \\ \langle -1|-2\rangle_2\omega & \langle -1|-1\rangle_2\omega & \langle -1|0\rangle_2\omega & \langle -1|1\rangle_2\omega & \langle -1|2\rangle_2\omega \\ \langle -2|-2\rangle_2\omega & \langle -2|-1\rangle_2\omega & \langle -2|0\rangle_2\omega & \langle -2|1\rangle_2\omega & \langle -2|2\rangle_2\omega \end{pmatrix}$$

The matrices in their development keep a symmetry with respect to their central element $\langle 0|0\rangle_2\omega$. In this particularity, we have seen a geometrical conservation rule. Different rules of conservation are known and taken for granted, such as: energy, charge, baryonic number, etc. These rules or principles have assumed, for science, a value of axioms intrinsic to the physical reality itself, while they actually represent shadows that obscure and inhibit the knowledge of the true substrate of the reality. We believe to see the following evidence in this model of Toy

Theory: the only rule of conservation is geometric, all the other rules result to some extent subordinated to it or derived from it.

Naming it principle of geometric conservation, in this case the conservation must be seen as a rule of respect of the geometric characteristics of the Entity to which it refers, and thus, it allows that any relation can happen only within its own context. The law of geometric conservation allows us to appreciate in a more substantial way the introduction of the quantum operator.

6. The Toy Model

The model and, more in general, the idea of a Toy Theory came to our minds reading the essay on the origins of nuclear physics "Dal segno al nucleo [From the sign to the nucleus]" by Giuseppe Bruzzaniti. In this essay, the author faces the origins and the development of nuclear physics by using a particular approach, which impressed us. The author divides the essay in three parts, referring to three distinct historical phases:

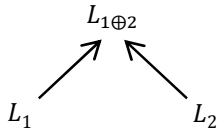
"the discovery of radioactivity and the way in which this contributed to the acquisition of the idea of atom as a complex structure, the construction of the concept of nucleus, the rise of nuclear physics as an area of independent research."

Its peculiarity stays in the fact that Bruzzaniti ties the three parts and their development to the formation of the terms and the scientific concepts, with which these paths have developed, in structures like:

$$\langle L, A, H \rangle$$

"where L represents the language – understood in an informal way as a set of terms and propositions – which makes possible the formulation of hypotheses, experimental descriptions and theories relative to that specific sector of investigation; A is the axiomatic context and represents the set of non-descriptive propositions assumed by the members of the scientific community operating in that sector and communicating each other through L; H is the horizon and represents the set of the scopes, expectations, problems and all those questions, to which leads the heuristic of the research programs, which develop within the considered sector of investigation. The historiographical hypothesis consists then in considering that the dynamics of the processes characterizing the evolution of a research area is analysable with the analysis of the reciprocal causal relations, which exist between the changes of L, A and H. Generally, it is a matter of various and composite relations. They give rise to a plurality of evolutionary processes hardly reducible to simple schematizations valid once and for all, because they reflect in themselves that methodological pluralism through which scientists interrogate nature. To simplify the problem, consider two simple cases. The first is referred to a research area $\langle L, A, H \rangle$*, whose evolution is determined by the continuous increase of problems solved within the programs operating in such sector. The description of the growth processes that could happen would lead to various study cases. For example, a continuous and cumulative growth could take place if to the variation of H corresponded the invariance of A and of the meaning of the terms of L. Different would be instead the case, in which the change of H induced an extension of L or, however, sematic variations of its own terms. In this circumstance, the variations of L could, in fact, induce in turn mutations of A and of H, making possible, for instance, the rise of a circular process. The resulting outcome could be that of a sudden amplification of the initial event. It would become, in this way, the starting point of those discontinuities, to which the untranslatability of the present in terms of the past can be led according to a historiographical perspective.*

The second example, which can characterize the dynamics of the discontinuous and non-cumulative evolutionary processes, refers to the confluence of two research areas $\langle L_1, A_1, H_1 \rangle$ *and* $\langle L_2, A_2, H_2 \rangle$*. The most important fact, in this case, is the formation of a new language* $L_{1\oplus 2}$ *obtained from the confluence of* L_1 *and* L_2*:*



The greater expressive capabilities of $L_{1\oplus 2}$ *show themselves in the set of rules established by the symbol* $<<\rightarrow>>$*, which can be interpreted in the following way: everything which can be expressed through the terms of* L_1 *and* L_2 L_2 *can also be expressed through the terms of* $L_{1\oplus 2}$*, but not vice versa."*

This last citation, taken from the preamble to the second part of the essay of Bruzzaniti, sublimely explains what we have proposed through the model of the Toy Theory. Certainly the context, the language, the examples refer to a particular aspect of the concept of atomic nucleus, which he analyses in a historiographical way and not only; but, maybe, it is the last paragraph, which assumes for us a particular meaning. Even the used words, simple and clear, can be illuminating. We give to L_1 and L_2 the meanings of Mathematical Language and Physical Language and we can see how everything follows as a consequence. In this case, we cannot talk about inside or outside view, as the mathematical and physical languages are equally ranked and their metacrasis is the Physical Reality, comprehensible only through a physical-mathematical language. Even for A, one can think of the formation of a new axiom $A_{1\oplus 2}$, metacrasis of the two axioms A_1 and A_2. Metacrasis of the axiom of "Existence" and of "Relation", but which of them belongs to the language of mathematics and which one to that of physics?

In the meantime, we underline the fact that for each Language there is only one axiom, as requested by Tegmark, in order to avoid their instability and their incongruence. It is known that both in the Mathematical Language and in the Physical Language there exist different axioms. With A_1 and A_2, A_2, we don't want to indicate a generic axiom, but the only "founding" the Languages L_1 and L_2.

If we accept what is above, we can state that the founding axiom of the Mathematical Language, both the one denominated "Relation" and the one named "Existence", is the founding axiom of the Physical Language. Therefore, the metacrasis of the Physical and Mathematical Languages, the metacrasis of the Axioms of "Relation" and of "Existence" and the metacrasis of the mathematical and physical entities take us to a structure able to describe the Physical Reality.

Is the language $L_{1\oplus 2}$, able to describe the Physical Reality, a Language able to overcome the limitations imposed by Gödel's theorem?

The answer to this question, as it is posed, would make no sense according to what is reported in Bruzzaniti's work, because Gödel's theorem is valid only for the Mathematical Language and not for the Mathematical-Physical Language. If this thesis were true, then Jaki's about the impossibility to describe in mathematical form physical theories, as reported at the beginning of the present article, would turn out to be correct, although wrong in the assumptions.

Conclusions

We can claim to have a valid nucleus for the formulation of a model of Toy Theory, which be descriptive, interpretive and predictive of the Physical Reality, of its entities and their relationships.

In the introduction, we have listed the aspects that we wanted to investigate through the Toy Theory and that, thanks to the proposed model, seem to find an explanation.

We therefore start from the results of high-energy experiments, where particles with short mean lifetime appear. In fact, this is just one of the "odd" evidences of the Physical Reality that shows the simultaneous existence of so-called stable particles and others with a time of permanence in our reality or of decay. In the model this instability or decay is overcome. Unstable particles in Γ^4 can become stable, for instance, in Γ^2,

their stability depends solely on their own structure and the field, which can contain them.

We can now analyse the second consideration we have highlighted, that relative to the meaning of field of particle and their mutual interaction. We have seen in the different sections of the present article how this aspect can be interpreted within the model from the simple geometrical arrangement of the various Γ's.

The third consideration, relative to the background radiation of the Universe at 2,73 K, takes us to a model of development of the Universe (cosmogony) less energetic and destructive with respect to the visions of the Bing Bang or the initial singularity.

The last consideration regards the use of the geometries in the physical theories. In this case, we have set ourselves in the condition of having a new element able to handle these structures with the introduction of the Γ's, with which we believe to overcome some inconsistencies still existing in the physical theories. We have also introduced some other elements, currently difficult to handle.

We remind that in the introduction, to the four themes mentioned above, we have added the problematic relative to the axiomatization of physics, which was also integrated in the aspects proposed in the opening section and which, in the terms of the Toy Theory and its model, we can consider solved.

1. The theory is based on the metacrasis of only two axioms.

2. In the development set by us, we are sure that the issues relative to the incomplete and/or insufficient view, depending on whether you look at the Universe in an external or internal point of view, are substantially overcome.

This point involves Tegmark's inside and outside views. It is possible to match the field Γ^0 to these views, for what concerns the mathematical structure, and the fields of reality to Γ^p's all the other Γ^p's, together form the Universe given by:

$$\begin{matrix} d \\ b \end{matrix} U \begin{matrix} p \\ q \end{matrix}$$

3. Gödel's theorem of Incompleteness turns out to be overcome by the consideration that this construction is no longer mathematical, but substantially, physical-mathematical.

It results that in the Physical Reality only the mathematics we need exists; if the number of the couples σ e τ changes, the system adjusts. The Physical Reality is of order higher than only Mathematics and its axioms.

These are only some of the positive impressions we had from the model of Toy Theory. Nevertheless, there are still perplexities and some missing confirmation, which do not allow us to raise it to the level of a Theory. In this case, we are not only speaking from a physical point of view, but also from a logical point of view. From a physical point of view, there are missing analyses and developments about cosmological and quantum issues that can be faced, if not solved. From the logical point of view, instead, the possibility of verifying the management system of the physical system itself remains suspended for its complexity. In this case, we are not referring to the experimental possibility of analysis of the introduced single concepts or elements as the Γ's or the metacrasis of the axioms of existence and relation, but to the complex way of existence and relation that these concepts and elements have and realize reciprocally.

Thus, it is undoubtedly interesting, even though not resolutive, to try to verify with a series of experiments, even only qualitative, the degree of correspondence between the Reality and the model.

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Tables outside the text

Particles of the Field ${}^{\langle \mathbf{4}\vert\mathbf{0}\rangle}{}_{\mathbf{2}}\boldsymbol{\omega}$ of ${}^{\mathbf{4}}_{\mathbf{2}}\boldsymbol{U}^{\mathbf{4}}_{++}$						
Type	**Particles**	**Spin**	**Mass**	**Particles**	**Mean lifetime**	**Visibility**
	Toy Theory			**Physical Reality**	**in Γ^{-4}**	
I	-	-	-	-	-	-
II	-	-	-	-	-	-
III	-	-	-	-	-	-
IV	$\langle \sigma_1, \sigma_2, \sigma_3, \sigma_4 \vert 0 \rangle$	?	$\sim E = kT$	background radiation	stable	?

Table {1.1} – Scalar Field Particles ${}^{\langle \mathbf{4}\vert\mathbf{0}\rangle}{}_{\mathbf{2}}\boldsymbol{\omega}$ assumed in the model and possible comparison with existing particles of the Physical Reality.

Particles of the Field ${}^{\langle \mathbf{3}\vert\mathbf{1}\rangle}{}_{\mathbf{2}}\boldsymbol{\omega}$ of ${}^{\mathbf{4}}_{\mathbf{2}}\boldsymbol{U}^{\mathbf{4}}_{++}$						
Type	**Particles**	**Spin**	**Mass**	**Particles**	**Mean lifetime**	**Visibility**
	Toy Theory			**Physical Reality**	**in Γ^{-4}**	
I	-	-	-	-	-	-
II	$\langle \sigma_1, \sigma_2, \sigma_3 \vert \tau_1 \rangle$	½	938,27	proton	stable	
	$\langle \sigma_1, \sigma_2, \sigma_3 \vert \tau_2 \rangle$	½	938,27	proton	stable	yes
	$\langle \sigma_1, \sigma_2, \sigma_3 \vert \tau_3 \rangle$	½	938,27	proton	stable	
	$\langle \sigma_1, \sigma_2, \sigma_4 \vert \tau_1 \rangle$	½	938,27	proton	stable	
	$\langle \sigma_1, \sigma_2, \sigma_4 \vert \tau_2 \rangle$	½	938,27	proton	stable	yes
	$\langle \sigma_1, \sigma_2, \sigma_4 \vert \tau_4 \rangle$	½	938,27	proton	stable	
	$\langle \sigma_1, \sigma_3, \sigma_4 \vert \tau_1 \rangle$	½	938,27	proton	stable	
	$\langle \sigma_1, \sigma_3, \sigma_4 \vert \tau_3 \rangle$	½	938,27	proton	stable	
	$\langle \sigma_1, \sigma_3, \sigma_4 \vert \tau_4 \rangle$	½	938,27	proton	stable	
	$\langle \sigma_2, \sigma_3, \sigma_4 \vert \tau_2 \rangle$	½	938,27	proton	stable	yes
	$\langle \sigma_2, \sigma_3, \sigma_4 \vert \tau_3 \rangle$	½	938,27	proton	stable	
	$\langle \sigma_2, \sigma_3, \sigma_4 \vert \tau_4 \rangle$	½	938,27	proton	stable	
III	$\langle \sigma_1, \sigma_2, \sigma_3 \vert \tau_4 \rangle$	?	?	?	stable	
	$\langle \sigma_1, \sigma_2, \sigma_4 \vert \tau_3 \rangle$	?	?	?	stable	
	$\langle \sigma_1, \sigma_3, \sigma_4 \vert \tau_2 \rangle$	?	?	?	stable	yes
	$\langle \sigma_2, \sigma_3, \sigma_4 \vert \tau_1 \rangle$	?	?	?	stable	
IV	-	-	-	-	-	-

Table {1.2} – Tensorial Field Particles ${}^{\langle \mathbf{3}\vert\mathbf{1}\rangle}{}_{\mathbf{2}}\boldsymbol{\omega}$ assumed in the model and possible comparison with existing particle of the Physical Reality.

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Particles of the Field ${}^{\langle \mathbf{2}\vert\mathbf{2}\rangle}{}_{\mathbf{2}}\boldsymbol{\omega}$ of ${}^{\mathbf{4}}_{\mathbf{2}}\boldsymbol{U}^{\mathbf{4}}_{++}$						
Type	**Particle**	**Spin**	**Mass**	**Particle**	**Mean lifetime**	**Visibility**
	Toy Theory		**MeV/c²**	**Physical Reality**	**in Γ⁻⁴**	
I	$\langle\sigma_1,\sigma_2\vert\tau_1,\tau_2\rangle$	1	0	photon	stable	yes
	$\langle\sigma_1,\sigma_3\vert\tau_1,\tau_3\rangle$	1	0	photon	stable	
	$\langle\sigma_1,\sigma_4\vert\tau_1,\tau_4\rangle$	1	0	photon	stable	
	$\langle\sigma_2,\sigma_3\vert\tau_2,\tau_3\rangle$	1	0	photon	stable	yes
	$\langle\sigma_2,\sigma_4\vert\tau_2,\tau_4\rangle$	1	0	photon	stable	yes
	$\langle\sigma_3,\sigma_4\vert\tau_3,\tau_4\rangle$	1	0	photon	stable	
II	$\langle\sigma_1,\sigma_2\vert\tau_1,\tau_3\rangle$	½	0,511	electron	stable	
	$\langle\sigma_1,\sigma_2\vert\tau_1,\tau_4\rangle$	½	0,511	electron	stable	
	$\langle\sigma_1,\sigma_2\vert\tau_2,\tau_3\rangle$	½	0,511	electron	stable	yes
	$\langle\sigma_1,\sigma_2\vert\tau_2,\tau_4\rangle$	½	0,511	electron	stable	yes
	$\langle\sigma_1,\sigma_3\vert\tau_1,\tau_2\rangle$	½	0,511	electron	stable	yes
	$\langle\sigma_1,\sigma_3\vert\tau_1,\tau_4\rangle$	½	0,511	electron	stable	
	$\langle\sigma_1,\sigma_3\vert\tau_2,\tau_3\rangle$	½	0,511	electron	stable	yes
	$\langle\sigma_1,\sigma_3\vert\tau_3,\tau_4\rangle$	½	0,511	electron	stable	
	$\langle\sigma_1,\sigma_4\vert\tau_1,\tau_2\rangle$	½	0,511	electron	stable	yes
	$\langle\sigma_1,\sigma_4\vert\tau_1,\tau_3\rangle$	½	0,511	electron	stable	
	$\langle\sigma_1,\sigma_4\vert\tau_2,\tau_4\rangle$	½	0,511	electron	stable	yes
	$\langle\sigma_1,\sigma_4\vert\tau_3,\tau_4\rangle$	½	0,511	electron	stable	
	$\langle\sigma_2,\sigma_3\vert\tau_1,\tau_2\rangle$	½	0,511	electron	stable	yes
	$\langle\sigma_2,\sigma_3\vert\tau_1,\tau_3\rangle$	½	0,511	electron	stable	
	$\langle\sigma_2,\sigma_3\vert\tau_2,\tau_4\rangle$	½	0,511	electron	stable	yes
	$\langle\sigma_2,\sigma_3\vert\tau_3,\tau_4\rangle$	½	0,511	electron	stable	
	$\langle\sigma_2,\sigma_4\vert\tau_1,\tau_2\rangle$	½	0,511	electron	stable	yes
	$\langle\sigma_2,\sigma_4\vert\tau_1,\tau_4\rangle$	½	0,511	electron	stable	
	$\langle\sigma_2,\sigma_4\vert\tau_2,\tau_3\rangle$	½	0,511	electron	stable	yes
	$\langle\sigma_2,\sigma_4\vert\tau_3,\tau_4\rangle$	½	0,511	electron	stable	
	$\langle\sigma_3,\sigma_4\vert\tau_1,\tau_3\rangle$	½	0,511	electron	stable	
	$\langle\sigma_3,\sigma_4\vert\tau_1,\tau_4\rangle$	½	0,511	electron	stable	
	$\langle\sigma_3,\sigma_4\vert\tau_2,\tau_3\rangle$	½	0,511	electron	stable	yes
	$\langle\sigma_3,\sigma_4\vert\tau_2,\tau_4\rangle$	½	0,511	electron	stable	yes
III	$\langle\sigma_1,\sigma_2\vert\tau_3,\tau_4\rangle$	?	?	closed EM radiation	stable	
	$\langle\sigma_1,\sigma_3\vert\tau_2,\tau_4\rangle$	?	?	closed EM radiation	stable	yes
	$\langle\sigma_1,\sigma_4\vert\tau_2,\tau_3\rangle$	?	?	closed EM radiation	stable	yes
	$\langle\sigma_2,\sigma_3\vert\tau_1,\tau_4\rangle$	?	?	closed EM radiation	stable	
	$\langle\sigma_2,\sigma_4\vert\tau_1,\tau_3\rangle$	?	?	closed EM radiation	stable	
	$\langle\sigma_3,\sigma_4\vert\tau_1,\tau_2\rangle$	?	?	closed EM radiation	stable	yes
IV		-	-	-	-	-

Table {1.3} – Spinorial Field Particles ${}^{\langle \mathbf{2}\vert\mathbf{2}\rangle}{}_{\mathbf{2}}\boldsymbol{\omega}$ assumed in the model and possible comparison with existing particle of the Physical Reality.

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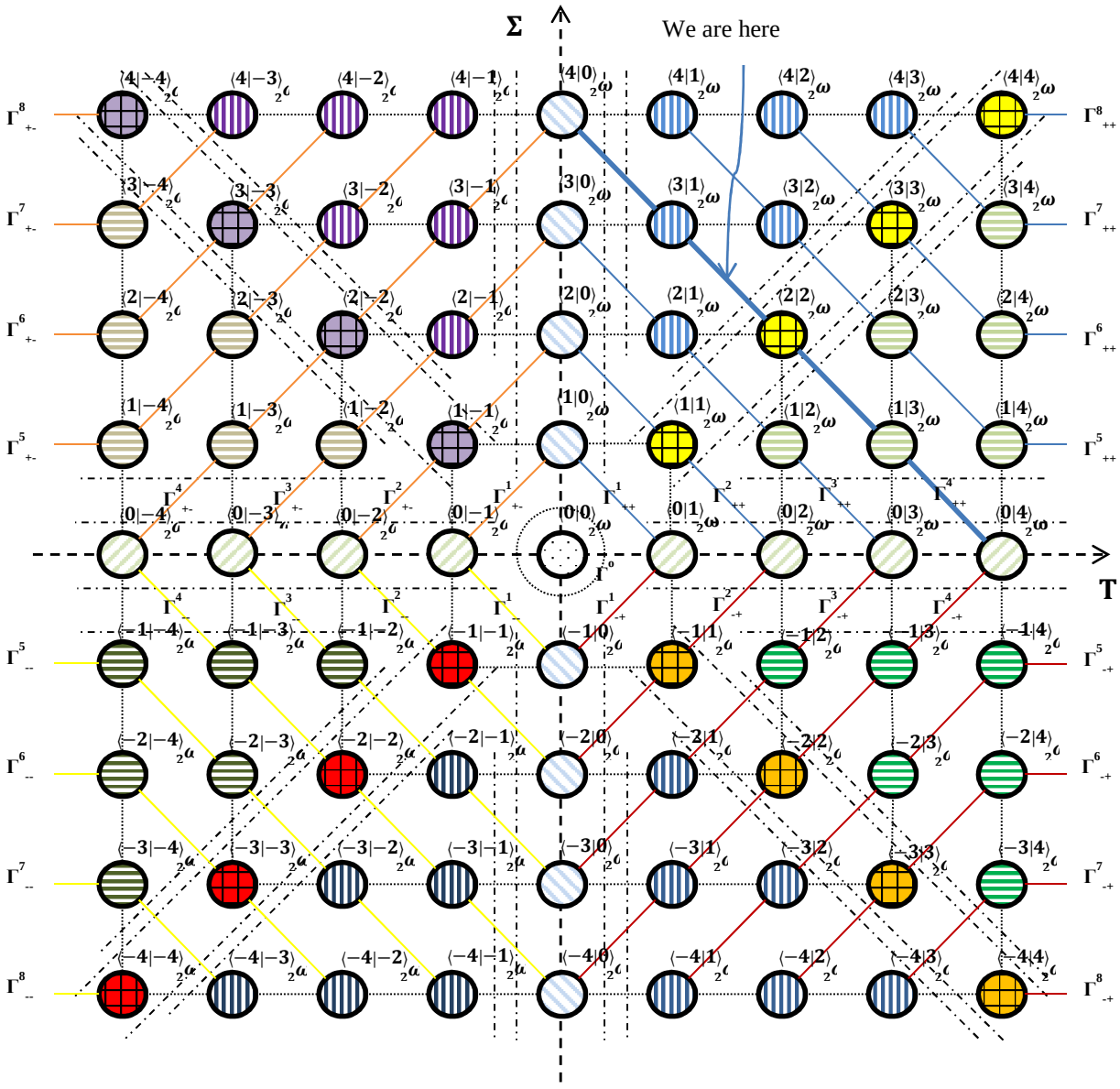
Particles of the Field $^{\langle \mathbf{1}\vert\mathbf{3}\rangle}{}_{\mathbf{2}}\boldsymbol{\omega}$ of $^{\mathbf{4}}_{\mathbf{2}}\boldsymbol{U}^{\mathbf{4}}_{++}$						
Type	**Particle**	**Spin**	**Mass**	**Particle**	**Mean lifetime**	**Visibility**
	Toy Theory		**eV/c²**	**Physical Reality**	**in Γ⁴**	
I	-	-	-	-	-	-
II	$\langle\sigma_1\vert\tau_1,\tau_2,\tau_3\rangle$	½	0,05	neutrino	stable	yes
	$\langle\sigma_1\vert\tau_1,\tau_2,\tau_4\rangle$	½	0,05	neutrino	stable	yes
	$\langle\sigma_1\vert\tau_1,\tau_3,\tau_4\rangle$	½	0,05	neutrino	stable	
	$\langle\sigma_2\vert\tau_1,\tau_2,\tau_3\rangle$	½	0,05	neutrino	stable	yes
	$\langle\sigma_2\vert\tau_1,\tau_2,\tau_4\rangle$	½	0,05	neutrino	stable	yes
	$\langle\sigma_2\vert\tau_2,\tau_3,\tau_4\rangle$	½	0,05	neutrino	stable	yes
	$\langle\sigma_3\vert\tau_1,\tau_2,\tau_3\rangle$	½	0,05	neutrino	stable	yes
	$\langle\sigma_3\vert\tau_1,\tau_3,\tau_4\rangle$	½	0,05	neutrino	stable	
	$\langle\sigma_3\vert\tau_2,\tau_3,\tau_4\rangle$	½	0,05	neutrino	stable	yes
	$\langle\sigma_4\vert\tau_1,\tau_2,\tau_4\rangle$	½	0,05	neutrino	stable	yes
	$\langle\sigma_4\vert\tau_1,\tau_3,\tau_4\rangle$	½	0,05	neutrino	stable	
	$\langle\sigma_4\vert\tau_2,\tau_3,\tau_4\rangle$	½	0,05	neutrino	stable	yes
III	$\langle\sigma_1\vert\tau_2,\tau_3,\tau_4\rangle$	?	?	?	stable	yes
	$\langle\sigma_2\vert\tau_1,\tau_3,\tau_4\rangle$	?	?	?	stable	
	$\langle\sigma_3\vert\tau_1,\tau_2,\tau_4\rangle$	?	?	?	stable	yes
	$\langle\sigma_4\vert\tau_1,\tau_2,\tau_3\rangle$	?	?	?	stable	yes
IV	-	-	-	-	-	-

Table {1.4} – Tensorial Field Particles $^{\langle \mathbf{1}\vert\mathbf{3}\rangle}{}_{\mathbf{2}}\boldsymbol{\omega}$ assumed in the model and possible comparison with existing particle of the Physical Reality.

Particles of the Field $^{\langle \mathbf{4}\vert\mathbf{0}\rangle}{}_{\mathbf{2}}\boldsymbol{\omega}$ of $^{\mathbf{4}}_{\mathbf{2}}\boldsymbol{U}^{\mathbf{4}}_{++}$						
Type	**Particle**	**Spin**	**Mass**	**I° decay**	**Mean lifetime**	**Visibility**
	Toy Theory		**MeV/c²**	**Physical Reality**	**in Γ⁴**	
I	-	-	-	-	-	-
II	-	-	-	-	-	-
III	-	-	-	-	-	-
IV	$\langle 0\vert\tau_1,\tau_2,\tau_3,\tau_4\rangle$	?	(-?)	tachyon	stable	yes

Table {1.5} – Scalar Field Particles $^{\langle \mathbf{0}\vert\mathbf{4}\rangle}{}_{\mathbf{2}}\boldsymbol{\omega}$ assumed in the model and possible comparison with existing particle of the Physical Reality.



Graphic 1 – Fields $\langle\sigma|\tau\rangle_{2}\omega$ assumed in the model (scalar, tensorial and spinorial) in their current development in the Universe consisting of Space and Time in dimension 4 + 4.