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A Two-Dimensional Time to Reconcile Quantum Theory and General Relativity

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Abstract

Currently, modern physics considers space-time in 4 dimensions (3 spatial, and 1 temporal) and is facing the problem of unifying the two major theories: quantum theory and general relativity. To circumvent the obstacles to this unification, we propose to think of a space with 5 Dimensions (3 spatial, 2 temporal). We thus make the hypothesis of a decomposable time in a two-dimensional orthonormal space, just like a distance is decomposable in a 3-dimensional space:

First Dimension: *The classical time* ***T*** *that we know, that of mass in the sense of intuitive perception, but in fact that of matter, or "corpuscular" time and therefore our reference time in our perceived reality. In our thought experiment, this will be the time T of the macroscopic observer* ***(Thought Experiment)***

Second Dimension: *Quantum time $T^{\cdot}$ Which is imperceptible to us and only intervenes at the microscopic level.*

Thought Experiment

The following thought experiment has no physical value, but is simply the thought experiment that originally led me to establish the hypothesis for this work. It led me to imagine a similarity between quantum mechanics and general relativity. It is therefore a thought experiment that I use only for the purpose of popularization, and not for its physical reality in itself.

Suppose the following thought experiment:
- *A traveler on the horizon of a black hole or at the speed of light (which is not in practice Not possible);*
- *For him, things are going normally, and he can move. For example, he can raise his hand.*
- *An observer is on Earth, for him the traveler's time is fixed according to General Relativity (whether on the horizon of the black hole or at the speed of light), so for the observer the traveler cannot move since its time does not move.*
- *Yet the traveler who goes at the speed of light or on the horizon of the black hole has moved his hand.*

We therefore have an inconsistency:
- *For the traveler, he raised his hand.*
- *For the observer after the same second, the traveler was unable to move his hand, because his time is frozen.*

Question: what does the observer see?
What if the observer saw one of the hand positions statistically?
Note: *this thought experiment is questionable since a human cannot go at the speed of light, and technically, a traveler cannot "stay" on the black hole horizon unless going at the speed of light. light. But that's not the point.*

Conclusion of the Thought Experiment

This thought experiment seemed to me to be analogous to the notion of wave packet reduction or rather, the parallel of the reduction of the wave packet of a quantum particle in the interpretation of the classical world, it made me think that a mass object which would have a purely quantum energy (which is impossible once again times), would also have a statistical perception of its shape. This is where the idea of quantum time was born.

The time of any system is therefore the time $T^{\cdot\cdot}$ which is the component of its two temporal dimensions
T *and $T^{\cdot}$. The proper time of any system is then defined by $\ddot{T} = \sqrt{(T^2 + T^{\cdot 2})}$.*

We will show in this work that this conception of time makes it possible to integrate the mathematical models of Quantum Physics and General Relativity into a broader theoretical framework which retains the results of each of them when *applied in their field of validity. We will first verify that the formalism of these two major theories is compatible with the framework that is proposed, then that the interpretation of quantum phenomena is also consistent with the results, with in particular the role of measurement. Then we will verify that the major open questions of current physics (dark matter, dark energy, preponderance of matter over antimatter, the vacuum catastrophe) also find an answer or possible answers in this new theoretical framework. Finally, specific fields of physics such as superconductivity or superfluidity and even the Big Bang are approached to open a newlook at these phenomena in this new theoretical framework.*

1. Introduction

We wish to propose here a global theoretical framework bringing together the two theories of General Relativity and Quantum Mechanics, both from a theoretical and empirical point of view. This unique framework is relatively simple, but still very counterintuitive. However, it makes it possible to interpret the strangest phenomena of the quantum world such as:

- The reduction of the wave packet and the role of measurement
- Entanglement
- Young's cleft
- The Pauli exclusion principle

This framework also makes it possible to give an interpretation to the surprising phenomena or contradictions of general relativity, such as:

- Time dilation
- The nature of the speed of light
- The nature of dark energy
- The nature of dark matter
- The catastrophe of the void
- The singularities of general relativity

Without calling into question the Big Bang of course, my theory offers a new interpretation that is mathematically compatible in every way with what is currently commonly accepted.

Here is the structure of this document:

- Postulates
- State of the art (Details in appendix)
- Framework of the new theory
- Model
- Interpretation of the two major theories within the framework of this model
- Consequences and interpretations of major physical experiments
- Conclusion

I specify that this framework makes it possible mathematically to find the two major theories, but that the expression of the corresponding unified formalism will require in-depth work by experts in the field to establish the generalized equations of quantum mechanics in this new framework (if this is possible depending on the constraints that we could establish), equations which will be in every way compatible with the current formalism by projection. This is clarified later.

1.1. Starting Postulations

We rely on, without calling into question, the following findings commonly accepted by the scientific community:

- General relativity describes gravity and the world as we perceive it on our scale,
- Quantum mechanics for its part, although counterintuitive, is a formidable tool for prediction of the infinitely small,
- Quantum mechanics does not integrate gravity or time,
- As soon as the conditions of application of general relativity are found in the domain of the quantum world (Planck scale) then not only are the two theories incompatible, but in addition general relativity tends towards infinities and therefore singularities which make it inapplicable,
- We are not yet able to model what happens in the areas where the two theories must coexist (Big Bang or black hole).

1.1.1. Starting Postulate No 1:

Whatever the system, the principle of conservation of energy is verified, that this energy either of a quantum or relativistic nature (pulse energy).

1.1.2. Starting Postulate No 2:

Currently, what determines whether a particle with mass has predominantly “quantum” or “classical” behavior is the energy ratio of its “at rest” mass to its “energy-momentum” (momentum for momentum), The postulate that we pose is that this relationship is true by extending energy-momentum to “any nature of energy other than the mass energy that a mass particle could have”

So the ratio Em/Ei (Mass Energy / Energy-momentum) extrapolated to the ratio Em/Et (Mass Energy / Total Energy) determines the preponderance of one world over the other of a particle having mass. The passage is continuous, but the impacts are exponential. We will see, subsequently, that other forms of energy have not been taken into account. They explain the gaps (dark matter, dark energy) in cosmology and the divergences at the limits of the models.

A massless particle is quantum by nature, but its energy, through its quantification, leads us to perceive corpuscular effects (photoelectric effect for example). Or more precisely, when a particle has a total energy greater than the mass energy of a baryonic particle, then the effect of this particle by energy equivalence leads us to observe behaviors identical to the effects of a corpuscular particle.

2. Framework of the Theory

To “represent” how the two theories fit together, I carried out different thought experiments. It was during one of them (see Thought experiment) that the idea came to me to explore the model below. But before specifying the model, let us share a certain number of thoughts on time, space and certain simultaneities of phenomena in current models.

2.1. Reflection on Time'

Time is one of the 4 dimensions of a physical whole defined in special relativity as “space-time”. However, time as we understand it does not appear directly in quantum formalism. The very basis of the incompatibility between the two great theories comes first of all from the fact that this time that we define does not appear in the quantum formalism. “In quantum mechanics, time and space are differentiated. In the theory of relativity, time and space forms a single entity: space-time, and matter and energy are linked.”

2.1.1. Arrow of Time

First we can notice that there is no time in absolute terms. We only know how to measure a period or a delay. Speaking of an hour or a time is, in fact, the expression of a delay about an exogenous reference, but which speaks to us all: Date and time about the birth of Christ, time relative to midnight, day of the year relative to the start of the year, billions of years relative to the Big Bang, and finally “universal atomic time” which defines the second as: “9,192,631 770 periods of radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium atom. By extrapolation, we speak of a time as a delay to a reference time known to all.

The only way to measure our time is to construct a time frame to a movement of matter. It is necessary for something to “move”, a movement to be able to establish a time. We understand that on a completely fixed system, there cannot be time. So our time is intimately linked to matter.
Besides, what does time mean for a photon?

2.1.2. Let's Take the Example of the First Light to Appear in the Universe'

That which appeared 13.8 billion years ago, 380,000 years after the Big Bang. It is customary to say that this photon “traveled” for 13.8 billions years. But the photon goes at the speed of light, so according to general relativity its time no longer changes. His time has completely stopped. It no longer makes sense. So when we say that the photon took 13.8 billion years to rejoin: in fact for the photon it is false: for it is “instantaneous” according to our temporality. Moreover, quantum formalism does not include the formalization of decoherence. This phenomenon belongs to interpretation in our temporality.

2.2. Thinking on Space

General relativity demonstrates that space and time (as we know it) are the same physical object, on the other hand, our time T is intimately linked to matter. We can therefore also wonder if space is not also closely linked to the appearance of matter.

There are several reasons to consider this point:
a) Space-time is the same physical object according to general relativity.
b) Space and time appeared at the same time and developed together during the big Bang.
c) It is intuitively logical that the physical object SPACE must exist for MATTER to exist. This is not the case for fields. Indeed, for entangled photons: we are obliged to conceive that it is the same entity that is not limited by the locality; there is a relationship that transcends the speed of light. To avoid being in contradiction with general relativity, we are obliged to consider the two entangled photons as a single quantum system without considering the space between the two photons.
d) Likewise, in Young's slit experiment, we can only observe interference between photons sent punctually. This amounts to saying that our temporality is ignored by quantum physics.
e) Furthermore, in quantum mechanics, Heisenberg's uncertainty principle shows that the relationship of the quantum world with our space is not simple.

2.2.1. Besides, What Does Distance Mean for a Photon?

Let's take the example of the first light to appear in the universe: that which appeared 13.8 billion years ago. We have seen that time (as we measure it) for a photon “is zero”. So, if the photon wave moves at the speed of light for 13.8 billion years, but this is instantaneous for the quantum particle: everything happens for it as if it had teleported instantly into our physical object “Space-Time”. The photon has, for the same moment t, all the positions it has taken during 13.8 billion years. We see it: saying that it has moved in our space has no meaning for the photon. Furthermore, the notion of wave-particle duality shows that what is true for a photon is also true in its “corpuscular” interactions with our space. We can conclude from this representation that our time and space are irrelevant for a non-mass particle.

2.3. Reflection on Space-Time-Mass

Together we are faced with some great difficulties in theoretical physics.

- Dark matter (in the sense of dark mass)
- Dark energy
- The matter-antimatter imbalance
- Time, our time, is not present in quantum mechanics

However, as we saw above: time and space do not seem to mean much in the quantum world. Time is absent from quantum formalism, quantum particles can only be understood through a probability of presence, and a position in space-time for a quantum particle has no meaning. Moreover, the mass appeared with the Higgs field at the same time as inflation, and our time.

Note: We can note that the fact that the Higgs field becomes non-zero can be interpreted as an asymmetry in the same way as the matter-antimatter asymmetry. This allows us to open avenues for the predominance of matter in our universe as we will see later (E - Reflection on the explanation of the predominance of matter over antimatter).

2.4. Thinking About Energy

Whether in quantum mechanics or the theory of general relativity, any phenomenon is translated into energy via equations that:

- Reflect energy conservation for any system
- Allows us to translate, either by one or the other model, the laws that govern the evolution of this energy (even if it is probabilistic in quantum mechanics)
- Which establishes an exact correspondence between the energies of the quantum and mass worlds: whatever the

nature of the energy in one world, it can be transformed in the other by perfect equality.

Except that, in the case of general relativity, we treat with accuracy the relationship of mass (in the broad sense since it is impulse energy) with its physical container which is our space-time. Mass appeared with the Higgs field and our space-time, and is perfectly modeled by general relativity.

2.4.1. While the Quantum Worldview

- Does not have a clear link with our times,
- Is incompatible with general relativity when gravitation is in orders of density of energy comparable with "local" quantum energy,
- Does not allow us to identify quantum behavior at our scale,
- Maintains a duality between disturbance wave and energy quanta
- Shakes up our conception of localization with the concept of entanglement,
- Does not take our time into account in its formalism, forcing us to conceive of probability waves.
- Forces us to conceive that there is a large part of the energy that we cannot see the dark matter and dark energy.

2.5. Consequences

We can conclude the following:

- There remains a fundamental principle which is the principle of conservation of energy and that this is always in the form of quanta.
- If we take the standard model again, we can conclude that everything can be expressed under
- Shape of particles which respect the rules of symmetry.

The interactions between these particles are summarized in 4-gauge bosons: photons, W and Z bosons and gluons. Each corresponds to one of the three elementary interactions of the standard model:

- Photons are the gauge bosons of electromagnetic interaction,
- W and Z bosons those of the weak interaction,
- Gluons those of the strong interaction.

Current knowledge leads us to think that these three forces could be one and the same phenomenon at very high energy density, therefore before the appearance of space-time. These bosons can be interpreted as the exchange of a quanta of energy (attractive or repulsive) between two elementary particles through a field of zero average value. None of the particles in the Standard Model have mass of their own (which would have violated the symmetry of the model).

In order to interpret the mass, the existence of a Higgs field was imagined, a field that appeared at the time of the Big Bang, or rather a field which took on a non-zero average value at the time of the Big Bang. The interaction of particles with this field gives them mass. But who says mass says space-time, because the nature of "mass-energy" requires space: mass is an energy of a new nature which would require density, therefore space. We conclude that at the same time as the Higgs field became non-zero, the space-time object appeared in a so-called inflation period.

Mass influences the geometry of space-time which is extremely rigid, but gives rise to a new "force" which is gravitation. We treat it like this, incorrectly calling it "force", because we see an (attractive) effect of any mass in the same way as the 3 other interactions, but which is absolutely not of the same nature and does not have at all to be treated in the standard model as such.

In other words, we humans come from the space-time-mass world, and we seek to model the quantum world from our perceptible universe. While mass, the Higgs field, space-time is only a small part of a whole which previously existed, but whose simple break in symmetry represented by the non-nullity of the Higgs field led to the appearance of this space-time-mass from which we seek to construct the complete model.

All this leads us to the following intuition: let us imagine a prior world where time exists, but not space. Energy exists, particles exist, but nothing is spatial. At one point, there is a symmetry break in the Higgs field, mass appears. It is a new form of energy that requires space. There is inflation and space appear. Attached to this space, part of the existing time is associated with this space. What part of the time? The proportion of energy of the mass of the particle to the total energy of the particle. With this in mind, we have a clue to understanding the fact that we only see 5% of the energy in the universe. Let's look at the consequences of such an approach.

2.6. Introduction to the Model

Let us assume that the quantum world exists beforehand. There is time, but the Higgs field is zero. Standard Model particles exist, but have no mass. Energy is in the form of quantas. All this exists, but there is no space in the geometric sense of the term, at least not our space. At one point, there is a breaking of symmetry of the Higgs field, it taking a non-zero value. Mass appears, and particles of the standard model acquire a mass determined according to their nature. But mass needs "matter" in the sense of "concentration of energy" per unit of volume: which implies space. This is created instantly at the same time as the particles begin to interact with the Higgs field: this is inflation.

From this moment, everything we perceive passes through the interaction of the quantum pre-existing with our space-time. The volume of this being very small initially, there is a high concentration of interactions which we measure as an extreme energy density. This will be diluted according to the well-understood Big Bang model. This is also an avenue for giving legitimacy to the cosmological constant by giving it a physical explanation. Indeed, nothing requires that the entire quantum world be "visible" from the beginning of the appearance of space-time, there could be a part of the quantum energy which is "connected" to the volume of our space-time, thus allowing a "volume of interaction in constant evolution".

Part of the energy is found in matter. The proportion of energy that is in the form of matter conditions the proportion of time which is associated with our space-time and which is time that we perceive. Impulse energy distorts our space-time which is logical, because it is the cause, the origin, the essential coexistence. The bridge exists between the quantum world and this new form of energy that is mass, but the quantum world interacts with our space in forms that challenge our understanding because our perception is limited by our space (more than by time, moreover).

Seen by us, who are limited to the space-time-mass world: quantum particles appear in an entangled form, in the form of a wave of disturbance, our time means nothing for observed quantum phenomena, it even often appears in probabilistic form. We have succeeded in establishing the quantum model which makes quantum behavior in its interaction with our space-time, but we do not understand its nature, and we can only predict a probability of behavior. In other words, even an intelligent fish that has no idea what the atmosphere, wind and moon are, can model wave behavior and the water surface. We are in the same situation: a human in our mass space-time only sees quantum behavior through its "surface" interaction with our space-time.

If it is difficult to imagine what space means for the quantum world, however, we can easily imagine that the evolution of a system, whatever its nature in the quantum world requires a specific time which by nature is the only way to qualify an evolution of a system, which leads us to introduce a second dimension for time, specific to developments quantum.

3. The Model: Time in Two Orthonormal Dimensions

Currently, we consider space to have 4 dimensions (3 spatial, 1 temporal). Let's imagine a space with 5 Dimensions (3 spatial, 2 temporal). Time is then endowed with two components which we pose as orthonormal. There is only one time in a 2-dimensional space, in the same way that a distance needs 3 dimensions.

- **The First Dimension of Time:** This is the time that we know classically, that of mass in the sense of intuitive perception, but in fact that of matter, or "corpuscular" time, and therefore our reference time in our reality. In the thought experiment in the appendix, this is observer time. It's time T.
- **Second Dimension of Time:** Let us establish a quantum Time which we call $\dot{T}$.
- **Component of these two dimensions:** The time of any system is therefore the time $\ddot{T}$ which is the component of its two temporal dimensions T and T. This means that any system has proper time: $\ddot{t} =\surd(t^2+)$ $\dot{t}$ 2 Consequently, whatever the nature of the object, its proper time is always identical (relative), it only has two components. Thus: if we represent in plan the two temporal dimensions of our 5-dimensional space-time, we could establish that our own time is the component of the quantum and mass temporal dimensions.

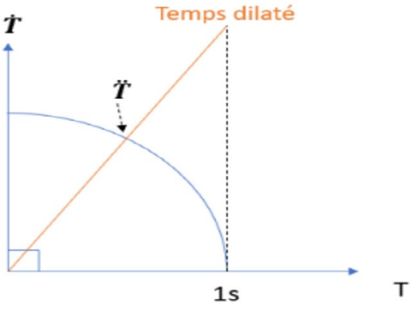

Figure 1

Or said differently since mass is energy, there is duality between vision wave and corpuscle, but time, in the two equivalent approaches, is not the same. In other words:

For a purely "mass" system (without momentum): its proper time is $\ddot{t} = t$ with $\dot{t} = 0$

A system composed entirely of non-mass energy has proper time $\ddot{t} = \dot{t}$ with $t = 0$

For any system whose total energy is composed of mass E_m and other forms of energy E_i (pulse energy, but also all other forms of energy, weak and strong interaction, electromagnetic or even kinetic energy depending on quantum time), its time would be the combination in proportion to the energy ratio of mass time t and quantum time $\ddot{t}$.

Note: We are talking about quantum time, but we understand that a mass particle that travels at very high speed is increasingly subject to the influence of this time: as if it were becoming more and more "quantum". It is its non-mass energy that becomes the majority and at the macroscopic level, we do not perceive the dimension of quantum time, it is inaccessible to us, and conversely mass time is inaccessible to quantum particles (see the interpretation of Young slits below. This hypothesis is counterintuitive, in my opinion, it is no more so than expanding time, 11-dimensional space, or the existence of several universes (multiverses). As we will see, this hypothesis remains completely compatible with the two major current theories and it allows us to give an interpretation of many phenomena which seem strange to us.

4. Interpretation of the Two Major Theories in our Framework

If the model proposed in this work turns out to be correct, this assumes that we can evolve the mathematical models of Quantum Physics and General Relativity by integrating this new temporal dimension. But in all cases, the two major theories remain completely valid in their domain of validity.

4.1. For General Relativity

By integrating a new dimension of time into General Relativity, we move from a hypothesis of time dilation to that of a distortion of time. Indeed, general relativity describes very well the projection of gravity from this 5-dimensional space-time into a 4-dimensional space-time with the only temporal dimension T, except at the limits, when quantum energy becomes largely preponderant.

4.1.1. General Relativity

General relativity is a relativistic theory of gravitation. It establishes several essential points:

- The notion of space and time is a whole called space-time (Special Relativity)
- Whether space-time is deformed in the presence of matter or rather energy, we speak of energy-momentum (this is the curvature of space-time). In other words, space-time is locally deformed in our reality in the presence of energy-momentum which is mass energy, kinetic energy (speed), and binding energy for example. The energy/mass equivalence ($E=MC^2$) means that, factually, when a particle goes very fast: it “is” more “mass”. Likewise, for example, the human body has a mass composed of 5% of its baryonic components (protons, neutrons, electrons), the rest comes from the binding energy inside its atoms.

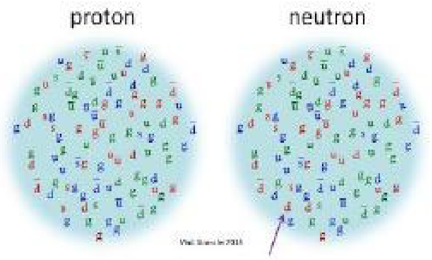

Figure 2

“A more realistic, though still imperfect, image of protons and neutrons as full of quarks, anti-quarks and gluons, moving around at high speed. More precisely, a proton consists of two up quarks and a down quark plus many gluons (g) plus many quark/antiquark pairs (u, d, s stand for up, down and strange quarks; antiquarks are marked with a bar.) The edge of a proton or neutron is not sharp”.

• And therefore that gravity is not the result of a gauge boson (sometimes theorized by the “graviton”: a particle never found), but that it is the consequence of a linear movement in a space with non-geometric Euclidean (curve) called geodesic.

$$G_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu} - \Lambda g_{\mu\nu}$$

Einstein's equations of general relativity with cosmological constant (lambda at RIGHT). On the left is the Einstein tensor G which describes the geometry of space-time, on the right appears the energy-momentum tensor T which describes the material content. According to Wheeler's phrase "space-time tells matter how it should move and matter tells spacetime how it should bend.

In the same way: general relativity is a theory which has largely demonstrated its effectiveness.

4.2. For Quantum Mechanics

Everything that is statistical becomes temporal again, but according to time $T^{\cdot}$. The quantum formalism will simply have to be identical to the current formalism once projected into temporality T. Thus, any probability wave function of quantum mechanics $|\psi(t) >$, would be the projection into our temporality of a function $\psi\ (t^{\cdot};\ t)$ where the > describes the fact that this is what we see in our temporality. There exists an infinity of functions $\psi\ (t^{\cdot};\ t)$ whose projection gives the existing formalism $\psi(t) >$ to establish a unifying theory. Only experimental constraints will eventually make it possible to establish the functions $\psi\ (t^{\cdot}; t)$ which would be compatible with what is observed experimentally and modeled statistically. This would then make it possible to improve understanding, or even prediction, of quantum phenomena (see end of document: G - Constraints on the new formalism to be established).

In the experimental constraints, we should, among other things, have:

• $P\ [\psi\ (t^{\cdot};\ t)] = |\psi(t) >$ where P is the projection that can be noted: $\psi(t^{\cdot}; t)\psi(t)>$

• The energy E of a system is conserved. It is the sum of the energy Em and Ei.

$$\text{or } Em = mc2$$
$$\text{and } Ei = Ec + Ep + E\psi(t^{\cdot}) + \cdots$$

• As we will see later, dark energy and dark matter would be all or part directly declinable from the existing quantities of movement in the temporal dimension $T^{\cdot}$. We could even hypothesize that dark matter would be linked to the momentum of a mass particle vibrating according to a function of quantum time, which would therefore not require "new matter", and that dark energy would be linked to the energy of quantum particles evolving according to quantum time.

For a particle without mass, therefore purely quantum, it is normal and natural that time T does not intervene in the current formalism.

4.2.1. The Quantum World

To summarize the difficulties linked to understanding the quantum world, we can summarize them in some key points:

1. Superposition of States: This states that in the quantum state a particle does not have an established state: but it can be several states at the same time. This notion has been the subject of numerous debates. According to the current consensus: it is the Copenhagen interpretation which takes precedence: *“the quantum state has no physical meaning before the measurement operation. Only the projected state, after measurement, has* *physical meaning."* In particular, Albert Einstein favored the idea that if the state of a particle is not known, it is because there are hidden variables that prevent us from establishing it. Thanks to Bell's inequalities published in 1964, a theoretical framework made it possible to design a test making it possible to arbitrate between the two approaches. The experiment was carried out in 1982 by Alain Aspect and was in line with the Copenhagen interpretation. In this experience, the notion of locality is key.

2. Probability of Presence: Thus, due to the superposition of states, the quantum mathematical formalism establishes that in the "classical" world we perceive quantum behavior as "statistical" with a notion of "probability of presence". In other words, in its normal state, we cannot model quantum objects. *"In quantum mechanics, which deals with the physical behavior of atomic and subatomic particles, the wave function makes it possible to calculate the probability density of the presence of a particle at certain points. Indeed, at this scale, any measurement attempt directly influences the particle so that it is impossible to simultaneously know its position and its speed, this is the famous Heisenberg uncertainty principle. As a result, the measurements do not express certainties, but only probabilities, represented by the wave function. For physicists, the wave function is a mathematical and statistical abstraction that makes it possible to reduce, not completely, quantum uncertainty.*

3. Decoherence: On the other hand, in order to explain the reality of quantum behavior, in particular during physical experiments, theorists of quantum mechanics have been led to consider that the environment of a quantum particle can force it here to undergo quantum decoherence. This phenomenon is also called wave packet reduction, since the best way to represent a quantum particle is to model it as a probability wave. The notion of reduction of the wave packet which involves the observer in the state of a quantum particle which *"poses numerous difficulties on a logical and epistemological level".* Nevertheless, it is clear that a simple measure "forces a particular the quantum to fix its state". Avenues of interpretation are explored such as Quantum Darwinism, but to date is still only exploratory. In any case, this finding is compatible with the proposed theory.

4. Uncertainty Principle: 29 Finally to complete everything, Heisenberg's uncertainty principle establishes: *"The quantum state of a particle is defined by "quantum numbers". The exclusion principle prohibits any fermion belonging to a fermion system from having exactly the same quantum numbers as another fermion in the system ».* The exclusion principle is often said to indicate that we cannot know the position and velocity of a quantum particle at the same time. This summary is only a consequence of the principle.

5. Standard Model: All this must be considered with the standard model of particle physics: Representation of the standard model which describes all subatomic particles (fermions), and the 3 other forces electromagnetism, strong and weak interactions (gauge bosons) and the Higgs boson which explains the mass of elementary particles as being the consequence of their interaction with the Higgs field.

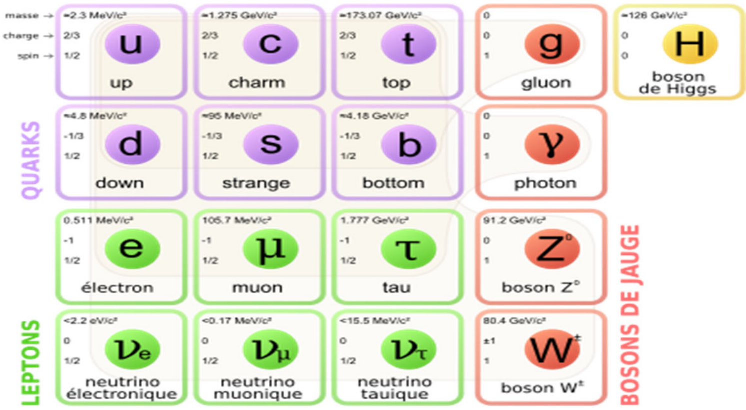

Figure 3

Special relativity has also made it possible to establish certain points which concern the
quantum mechanics like:

- The quantum world is made up of energy quantas
- That there is a direct relationship between energy and mass which is $E = mc^2$
- That the speed of massless energy is 300,000 km/s (electromagnetic wave, gravitational wave, etc.) and therefore that this speed is an absolute. In fact, this limit is directly linked to the physical principle of relativity of frames of reference: a physical phenomenon cannot be dependent on the inert frame of reference in which it is modeled, and that physical laws are isotropic.
- That time is a function of the frame of reference considered
- All these strange notions are, however, widely demonstrated and accepted.

5. Interpretation of Emblematic Physics Experiments in our Model

In this part, we analyze the consequences of our theoretical framework on the different emblematic experiences. These are accepted facts within the meaning of the "Copenhagen interpretation". We will extend this analysis to other phenomena currently observed. At this level of hypothesis, it is appropriate to "represent" what the existence of this second temporal dimension linked to any form of energy of a system other than mass energy gives.

5.1. Time Dilation

We understand that with this second dimension of quantum temporality, we have complete coherence with the dilation of time T as a function of the energy of a system that we observe experimentally. We also go beyond the notion of relativity of reference speeds (which is the example generally used to explain this phenomenon) since this dilation of time is not explained only as a function of speed, but also by the presence of other forms of energy.

The Langevin twin paradox materializes as follows:

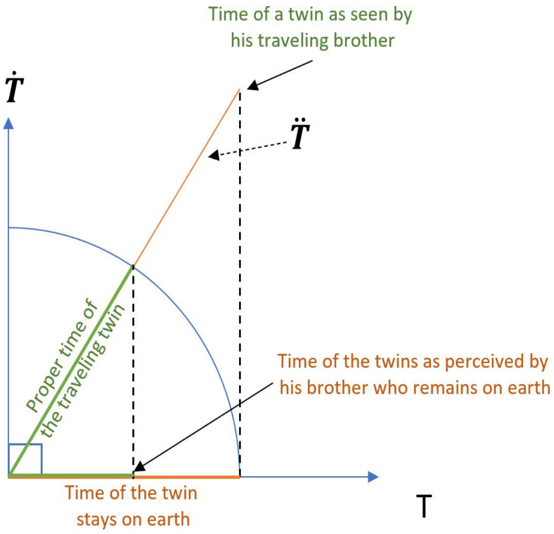

Figure 4

This interpretation is detailed in a video available on https://youtu.be/TtavBnvIs4s

5.2. Absence of Time in the Quantum Formalism

(apart from the mathematical formalism which describes the probability function. But it is not the same time):

“The Problematic Schrödinger Equation

A serious difficulty with the Wheeler-DeWitt equation emerged very early on. Indeed, while we perceive that the universe is evolving, that space in particular is expanding, the version of the Schrödinger equation applying to space-time in its entirety (therefore including its past and its future), as well as its content in matter and force fields, does not depend on time. How is it that we, the observers who are part of the universe, actually notice that it changes over the billions of years of its history? This is what is traditionally called the time problem in quantum cosmology.”

The fact that in current quantum mathematical models, time T (the one we know) does not intervene is linked to the fact that in the model proposed in this work, its projection on the axis T is zero in quantum time T. It is therefore normal that time as we perceive it does not intervene in Quantum Mechanics.

5.3. Wave Packet Reduction

At the quantum level, only quantum time $T^{\cdot}$ prevails. At the “classic” level, time T predominates. The common point between these two worlds is the geometric space to observe phenomena. When a quantum particle moves in this space, it does so in time $T^{\cdot}$. An observer placed in the “classical” world will therefore only see one of the random projections of the position of the quantum particle. Hence the notion of probability waves AND the role of the observer in measuring the quantum object.

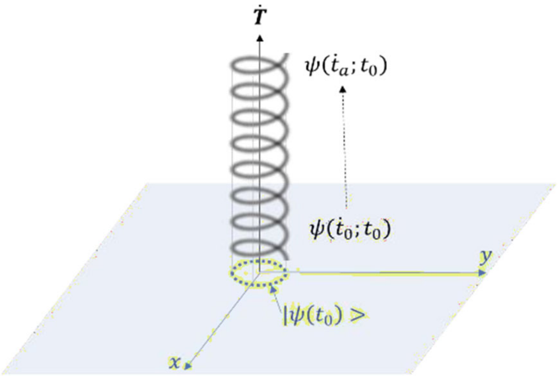

Figure 5: Representation of a quantum particle by representing 2 spatial dimensions and the “quantum” temporal dimension $T^{\cdot}$

At any time t0 of the “perceived time” T, a quantum particle can be represented by a probability function $\psi(t0)$>. At this precise instant t0, a quantum particle can evolve according to the temporality $\dot{T}$ according to a function $\psi\ (\dot{t};\ t0)$. In our space-time. When an “observer” wants to look at the state of a quantum particle, he will see statistically, one of the positions of the quantum particle since it does not have “access to quantum time”. This explains the decoherence, or regression of the wave packet.

$$\forall \dot{t};\ \psi\ (\dot{t};\ t0) = |\psi(t0) >$$

See the animated presentation of this phenomenon: https://youtu.be/Rie3crjyaiw

If we look at this phenomenon of wave packet reduction, or decoherence according to Zurek's interpretation (or Quantum Darwinism), we realize that it is compatible with our approach.

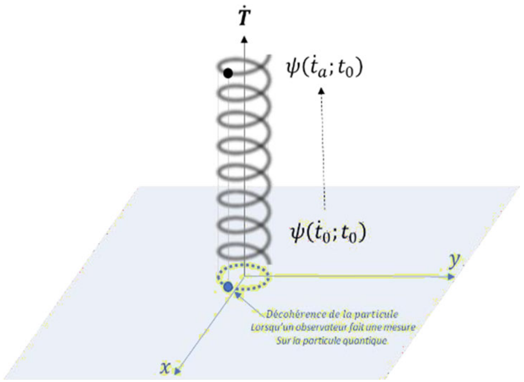

Figure 6

A particle therefore has the coordinate $\{x\ y\ s\ t\ \dot{t}\}$, which can be written as following the state function of a particle:

$$|P> = \begin{Bmatrix} a\cos b\dot{t} \\ a\sin b\dot{t} \\ 0 \\ t \\ \dot{t} \end{Bmatrix}$$

The state function in our space-time has one dimension less and is therefore:

$$\forall\ \dot{t}\ ;\ |P> = \begin{Bmatrix} |P_x> \\ |P_y> \\ 0 \\ t \end{Bmatrix}$$

5.4. Heisenberg’s Uncertainty Principle

Using the same example, we understand that a quantum particle responding to a wave function with in quantum temporality cannot have in our temporality a position and a speed defined at the same time. The Heisenberg uncertainty principle goes further than this simple shortcut, but this simplification of this principle also allows us to illustrate it below:

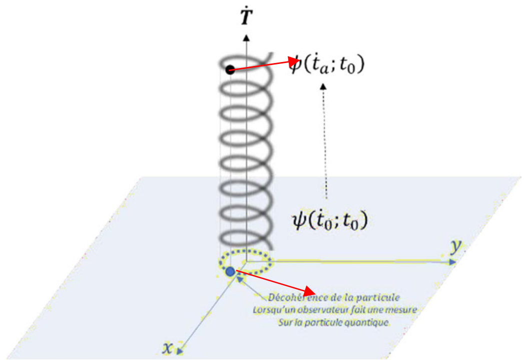

Figure 7

We understand in this example that at any instant I cannot know the speed and position of the quantum particle which responds to this sinusoidal function as a function of quantum time, because we do not have access to it and we do not We are not able to consider the tangential speed of the particle in our space-time.

5.5. Quantum Entanglement

In the EPR thought experiment, two entangled quantum particles y1 and y2 move away. Let us represent 3 of the 5 spaces: the two temporal dimensions, and the spatial dimension in the axis of the two photons which move away from each other.

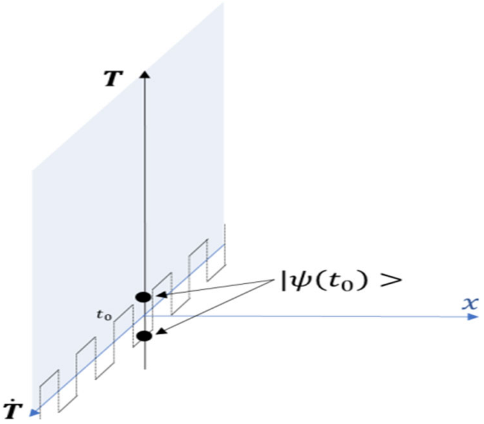

Figure 8: t_0: 2 entangled photons are emitted in the temporal dimension x: They have the same spin function according to the quantum temporality $T^{\cdot}$

When an observer measures one of the properties (e.g. the SPIN) of y1, he will see one of the random solutions of the observed property (see point 3). The state functions being of the two photons being synchronized according to $T^{\cdot}$, whatever this random solution, it will be identical for the two particles.

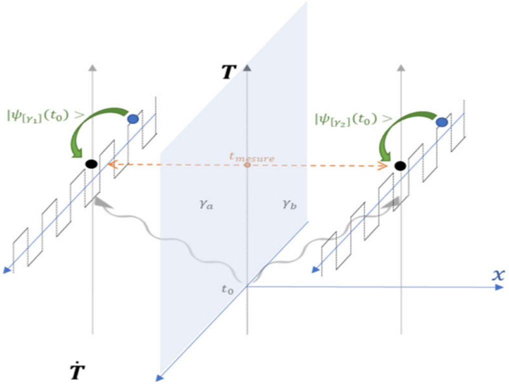

Figure 9: $t_{measurement}$: the 2 entangled photons moved in opposition along x and have the same coordinates on the temporality T The measurement of the spin of y1 gives the value of the spin, whatever its decoherence value, it is the same for the 2 photons because it responds to the same quantum temporality $t_{\cdot mesure}$ which is random in our temporal dimension

This gives the feeling that their states were linked (entanglement). In fact, they are synchronized
in the quantum temporality $T^{\cdot}$ which is not accessible to the observer, but this explains the "role" of the observer in the final observation.

See the animated video which details this phenomenon: https://youtu.be/oRjPUwlSSTQ

5.5.1. Formalization

In the model presented here, the two photons are governed by the same state function, let us assume a state function depending on the temporality $T^{\cdot}$ which gives a 50% chance of having the spin +½ and a 50% chance of 'have the spin -½. So, the states of these two particles are synchronized in quantum time $T^{\cdot}$ since they are emitted from the same source.

The state function of the two photons can be written as:
For the spatial location P: (the two photons move away along the x-axis according to the rule:
$\Upsilon P1 = \{x = c.t; y = 0; z = 0\}$
$\Upsilon P2 = \{-x = -c.t; y = 0; z = 0\}$

it's our time

For the Spin of the two Spin particles:
$Ps1 = Ps2 = ½\ (|cos(t^{\cdot})|/\ cos(t^{\cdot}))$
Where $t^{\cdot}$ is quantum time. For both particles, the time $t^{\cdot}$ is the same, because they are synchronized since generated at the same source.

The spin function above is an example of a function so the projection (= regression), gives the probability 50% - 50%. The quantum temp $t^{\cdot}$ of the two spins are the same since emitted at the same time.

Thus, the state function of two entangled particles P1 and P2; $Pi = \{xi\ yi\ zi\ t\ si\}$ with $(y = 0; z = 0)$ is written:

$$P_1 = \left\{ \begin{matrix} c.t \\ 0 \\ 0 \\ t \\ ½\,(|\cos(\dot{t})| / \cos(\dot{t})) \end{matrix} \right\} ; P_2 = \left\{ \begin{matrix} -c.t \\ 0 \\ 0 \\ t \\ ½\,(|\cos(\dot{t})| / \cos(\dot{t})) \end{matrix} \right\}$$

$$\forall\, \dot{t}\,; |P_1> = \left\{ \begin{matrix} c.t \\ 0 \\ 0 \\ t \\ |P_s> \end{matrix} \right\} ; |P_2> = \left\{ \begin{matrix} -c.t \\ 0 \\ 0 \\ t \\ |P_s> \end{matrix} \right\}$$

Whatever the moment t when we look at one of the two entangled particles, whatever the quantum time of the two particles, the spin function of the two particles is the same and their value is the same.

5.5.2. Noticed

Bell's inequality, which made it possible to arbitrate between Einstein-Podolsky-Rosen and Bohr in favor of the Copenhagen interpretation defended by Bohr, following the experiment carried out by Alain Aspect, is only valid if the principle of locality is respected. From the moment we consider quantum time, this principle of locality is no longer respected.

“the principle of locality: two distant objects cannot have an instantaneous influence on each other, which amounts to saying that a signal or an influence cannot propagate at a speed greater than a limiting speed, which happens to be the speed of light in a vacuum;”

Except that for a quantum particle, with its own time, the contingency of the speed of light no longer exists. So, the second part of this announcement is no longer necessarily true. In our model, the principle of locality must be expressed as follows:

“the principle of locality: two distant objects having mass cannot have an instantaneous influence on each other, which amounts to saying that a signal or an influence cannot propagate at a speed greater than a limiting speed, which happens to be the speed of light in a vacuum;”

Moreover, the current interpretation of quantum mechanics considers that the violation of Bell's inequalities demonstrates the existence of a "certain form" of non-locality. We do indeed have a certain form of correlation or “influence” between two non-local particles, but this certain form of influence is too weak to come into contradiction with relativity. Indeed, it is possible to demonstrate that no energy or information can be transmitted by this means. This shows that the hypothesis of “a priori” synchronization according to quantum time, to explain entanglement, respects the limits observed on the scope of the experiment with respect to general relativity. There is no “transport” of information or energy, there is an observation of an identical state.

5.6. Young's Clefts

Let's review the different experiences of Young slots.

5.6.1. First Approach to the Explanation with Quantum Time

In Young's slit experiment, let us study different results, the most inexplicable according to our classical perception of the experience, in order to see to what extent, the existence of quantum time could explain the observed phenomena. We will first begin by recalling that, when an electron is emitted, it responds to a spatial evolution which obeys a function of quantum temporality $T^{\cdot}$: in other words, at each instant t of our time as we Let us conceive it, the electron, or rather its energy quanta, will move spatially according to the wave function which is a function of quantum time. Everything happens as if, although the electron is a matter, at the moment of the experiment, when it is emitted, it is only its energy dimension which plays a role and this responds in terms of spatial position to the function of temporality $T^{\cdot}$. When the electron arrives on the screen, the screen plays the role of observer. As a result, this generates a regression of the wave packet, which results in a unique impact on the screen at a specific location. This is one of the random positions he has in time $t^{\cdot}$.

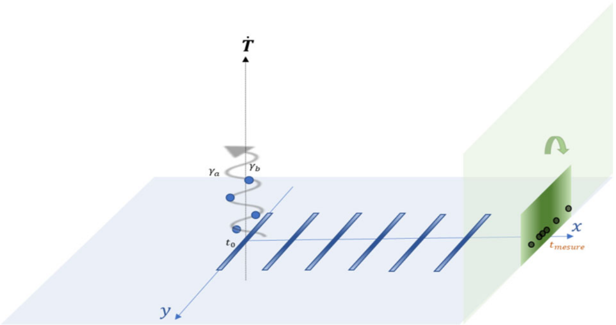

Figure 10

a) Young's experiment begins by sending a large number of photons through two slits. Photons are well modeled as waves. When we carry out the experiment the passage of photons through the two slits generates diffraction which results in interference fringes on the screen.

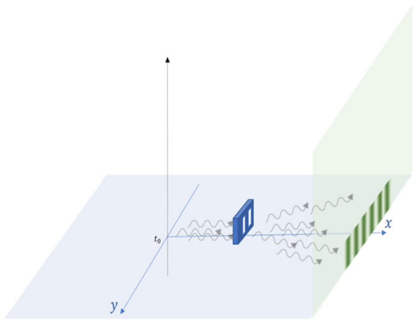

Figure 11

b) If we reproduce the experience by sending electrons (corpuscle), but through a single slit, these generate point impacts on the screen. But after a while their distribution creates a diffuse fringe: exactly what we expect from a wave passing through a slit and undergoing diffraction, and not a single fine fringe in front of the slit. This proves that the electron behaves like a wave and not like a corpuscle at the slit. On the other hand, once it arrives on the screen, the screen plays the role of an observer, and the electron will decohere giving one of the positions it has in its temporality $T^{\cdot}$ randomly at the moment it arrives on the screen. We recall that the electron displacement function according to quantum temporality gives an infinity of solutions, only one will be visible randomly according to the orthogonal projection of $T^{\cdot}$ on the unique time t of the impact.

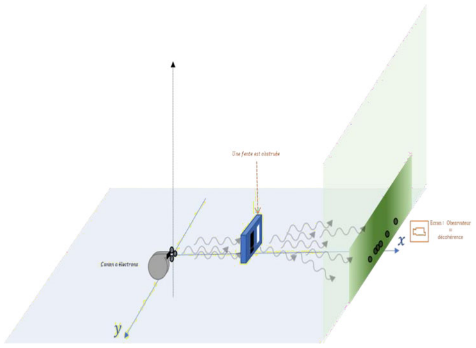

Figure 12

c) If we use an electron gun, through the two fringes, then the electrons appear on the screen in a punctual manner: but their statistical distributions gradually redraw probability fringes exactly equivalent to the interference fringes of the photons.

This shows that although it is electrons that have been sent, they behave like a wave: they diffract as they pass through the slits, and interfere at the screen. However, the screen being an "observer", there is regression of the wave packet, that is to say that the electron gives one of the random positions which takes in the quantum temporality to choose one at the moment of the impact on the screen.

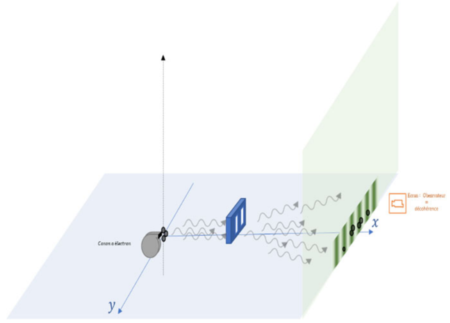

Figure 13

d) If we put a detector (or observer) just before the slits, then the regression of the wave packet takes place directly before the slits and at that moment we have randomly one of the spatial positions of the electron according to the temporality $T^{\cdot}$ at the moment when it passes the slit (and not on the screen): everything happens as if the two times synchronize $(T^{\cdot} et T)$, and therefore the electron keeps its decohered behavior until it arrives on the screen The figure obtained is not that of a ball thrown: since this would give a fine fringe (the width of the slit), but rather of a diffraction of a wave at the level of the slits, but without interference: the Successive impacts redraw two diffracted waves. The observer "plays" the role of synchronizing the behavioral waves in the two temporalities, which impacts the way we perceive the results of the experiments.

e) Let us now consider the most disturbing experience according to our classic perception of Young's clefts. Electrons are sent pointwise through two slits. Although sent at different times in the classical temporality T, we notice interferences. How is it possible? Quantum formalism predicts this result well, and the Copenhagen interpretation clearly confirms "that there is no need to represent with our perception of the world, the way in which the quantum world works".

Let us now look at how the existence of quantum time impacts this experience. By sending electrons, we send quantum objects since they behave like a wave (as long as they do not touch the screen). But our temporality T does not intervene in the quantum temporality $T^{\cdot}$.

- In the same way that an observer who looks at a quantum object "forces" the position of the object by decoherence at one of the random points predicted by the quantum model. This is explained in our model as being one of the positions that the electron takes in its temporality $T^{\cdot}$, which by orthogonal projection is perceived by the observer as being a random position in our temporality.
- Symmetrically, in a purely quantum world, our temporality is inaccessible. In other words, what for us consists of sending the quantum objects that are the electrons one by one in OUR temporality T, happens at exactly the same time in the dimension $T^{\cdot}$. Quantum objects can interfere with each other, because for them everything happens at the same time in quantum temporality. In other words, the Young Slits experiment is the symmetry of entanglement. It is an experiment that measures the behavior of a purely quantum system, in which our temporality has been canceled at the moment of decoherence.

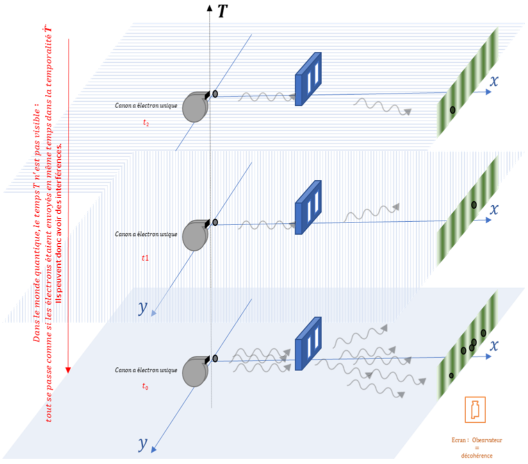

Figure 14

See the animated video of this phenomenon: https://youtu.be/ChylbDoPkuU

5.6.2. Let's Go Further in the Theoretical Explanation

a) Let's return to Young's slit experiment and start analyzing what happens with a single electron:

- If we have a slit and we pull a single electron. According to our model, we can envisage that it has a slight vibration around its direction axis according to quantum time. Consequently, there is a single impact in front, but which, if we repeat the experiment, will give a diffraction. This diffraction is even wider as the fringe is thin, because due to its vibration according to quantum time around its axis of movement, it will have a greater chance of interacting with the edge of the fringes and therefore of being diverted. . But as a result, we understand that near the fringe, the electron which has a slight vibration according to quantum time around its axis can thus more or less interact with the edge of the fringe and diffract.
- If we have two slits: then it is the same phenomenon, but it has two paths: therefore there will only have an impact, but no interference yet.

b) With several electrons, interference can exist. But once these "hit the screen", the movement according to our temporality stops, but not according to quantum time: this is why mathematically, the interferences exist, because we find the sinusoidal function according to the quantum time which will determine the location of the electron, but where our time freezes (the electron no longer moves according to our temporality).

It is difficult to imagine this, because we are limited to our world: but let's take sinusoidal functions according to quantum time which represents the probability of presence once impacted on the screen. Let us assign a sinusoidal vibration function according to quantum time to each electron, and another electron sending function according to our linear time.

Once on the screen, the linear function stops, and only the sinusoidal functions remain according to quantum time. Modeled through two slits, we will find the interference formalism. Mathematically, this amounts to modeling two wave functions according to our time through a slit, then substituting time t with quantum time. And we add a linear function which models the displacement according to our time at a frequency f of the electrons. On the screen, the linear function cancels out, leaving only the interference function.

Now suppose the two synchronous electrons of common pulsation ω. The wave state of the resulting wave at M is written as:

$$\psi(M,\dot{t},t) = e_1\left[\cos(\omega\dot{t}-\phi_1)+\frac{1}{f}t_1\right]+e_2\left[\cos(\omega\dot{t}-\phi_2)+\frac{1}{f}t_2\right]$$

as

$$\langle \cos^2(\omega\dot{t}+\phi)\rangle = \frac{1}{2}$$

and

$$\cos(\omega\dot{t}-\phi_1)\cos(\omega\dot{t}-\phi_2) = \frac{1}{2}[\cos(2\omega\dot{t}-\phi_1-\phi_2)+\cos(\phi_2-\phi_1)]$$

and that on the screen, the point is frozen according to our time:

$$t_1 = t_2 = t_0$$

$$I(M) = \frac{1}{2}A_1^2+\frac{1}{2}A_2^2+A_1A_2\langle \cos\Delta\phi\rangle+\frac{n}{f}t_0 avec \Delta\phi = \phi_2-\phi_1$$

and the result is therefore an interference function in which quantum temporality has disappeared, and the intensity of the fringes on the screen is a proportional function of our time T. The disappearance of quantum time is what, in our temporality, results in interference.

Note: diffraction could be an interesting constraint to exploit to determine the vibration function of an electron according to quantum time.

5.7. Calculation of Quantum Time When Changing Reference Frame

Let us calculate the quantum time of a mass particle in uniform rectilinear motion when changing the Galilean frame of reference in the Space-time-mass frame. We are going to take the Lorentz transforms again. According to our hypothesis: the combined time is constant, whatever the frame of reference. SO:
For the first frame of reference: $t2 + \dot{t}^2 = \ddot{t}^2$
For the second frame of reference: $t'^2 + \dot{t}'^2 = \ddot{t}'^2$
And, according to our model: $\ddot{t}^2 = \ddot{t}'^2$
Now thanks to Lorentz transformations, the formula for dilation of durations is in a
change of reference along the x-axis:

$$t' = \gamma\left(t - \frac{vx}{c2}\right) et\ x' = \gamma(x - vt)$$

Or: $t' = \gamma\left(t' + \frac{vx\prime}{c2}\right) et\ x' = \gamma(\mathrm{x}' + \mathrm{vt}')$

With: $\gamma = \frac{1}{\sqrt{1-\beta^2}}\ et\beta = \frac{v}{c}$

Which makes it possible to establish that:

$$t'^2 + \dot{t}'^2 = t^2 + \dot{t}^2$$

$$\dot{t}'^2 = t^2 - t'^2 + \dot{t}^2$$

$$\dot{t}'^2 = t^2 - \gamma^2\left(t - \frac{vx}{c^2}\right)^2 + \dot{t}^2$$

$$\dot{t}'^2 = t^2 - \gamma^2\left(t^2 + \left(\frac{vx}{c^2}\right)^2 - 2\frac{vx}{c^2}t\right) + \dot{t}^2$$

Or : $v = \frac{x}{t}$

SO :

$$\dot{t}'^2 = t^2 - \gamma^2\left(t^2 + \frac{1}{c^2}\left(\frac{v}{c}\right)^2 x^2 - 2\frac{v^2}{c^2}t^2\right) + \dot{t}^2$$

$$\dot{t}'^2 = (1 - \gamma^2 + 2\gamma^2\beta^2)t^2 - \frac{\gamma^2\beta^2}{c^2}x^2 + \dot{t}^2$$

$$\dot{t}'^2 = \left(\frac{1-\beta^2}{1-\beta^2} - \frac{1}{1-\beta^2} + \frac{2\beta^2}{1-\beta^2}\right)t^2 - \frac{\gamma^2\beta^2}{c^2}x^2 + \dot{t}^2$$

$$\dot{t}'^2 = \left(\frac{\beta^2}{1-\beta^2}\right)t^2 - \frac{\gamma^2\beta^2}{c^2}x^2 + \dot{t}^2$$

$$(c\dot{t}')^2 = \gamma^2\beta^2(ct)^2 - \gamma^2\beta^2x^2 + (c\dot{t})^2$$

$$\boxed{c\dot{t}' = \gamma\beta\sqrt{(ct)^2 - x^2 + \frac{(c\dot{t})^2}{\gamma^2\beta^2}}}$$

6. Clarifications on the Special Role of the Mass

6.1. Introduction

From the beginning, mass has played a special role in physical phenomena in general. As a result, it also has a particular role in the theoretical proposition of this document since it is she who “carries” the temporality and space that we know (See 6.1.1).

6.1.1. Understanding Mass According to Brout, Englert and Higgs

First of all, let us recall what is currently accepted as best modeling the mass in quantum theory. The standard model which gives all its beauty through its simplicity and coherence, not only did not give legitimacy to the mass for the different particles, but on the contrary, imposed that the components of the standard model, is not of mass "in either ". Hence the Higgs field theorized by Brout, Englert and Higgs.

The following summary specifies
“The origin of the Brout-Englert-Higgs mechanism
Robert Brout, François Englert and Peter Higgs hypothesized that particles acquire mass by interacting with a “Higgs field”

In the 1970s, physicists realized that two of the four fundamental forces were closely related: the weak force and the electromagnetic force. These two forces can be described using a single theory (the same symmetry group), on which the Standard Model was built. A so-called “unified” theory because it describes electricity, magnetism, light and certain types of radioactivity as manifestations of a single fundamental force, called the electroweak force.

The fundamental equations of the unified theory perfectly account for the electroweak force and the force-carrying particles associated with it, namely the photon and the W and Z bosons. Except that there is a catch: according to this model, these particles would be massless. However, if the photon does indeed have no mass, we know that the W and Z particles have one, equivalent to nearly 100 times the mass of the proton. Fortunately, theorists Robert Brout, François Englert and Peter Higgs developed a theory that would solve the problem. What we today call the Brout-Englert-Higgs mechanism gives mass to the W and Z when they interact with an invisible but omnipresent field in the Universe, recently named “the Higgs field”.

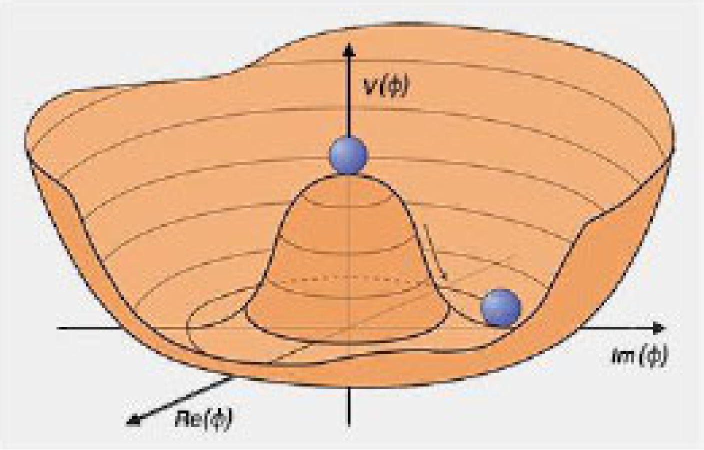

Figure 15

Immediately after the Big Bang, the Higgs field was zero. However, the Universe began to cool, and when its temperature fell below a critical value, the Higgs field increased spontaneously – and imparted mass to all the particles that interacted with it. The more a particle interacts with this field, the more massive it is. Particles which, like the photon, do not interact with it, remain massless. All fundamental fields are associated with a particle. The Higgs field is associated with the Higgs boson, which is the visible manifestation of the Higgs field, much like a wave on the surface of the sea.

This is summarized in the following lecture: https://youtu.be/YU1bffYC3bU at (1:32:00 to 1:34:30)

And this must be completed by the role of the symmetry groups U (1), SU (2) and SU (3) which is a quantification operation: complete theory here:

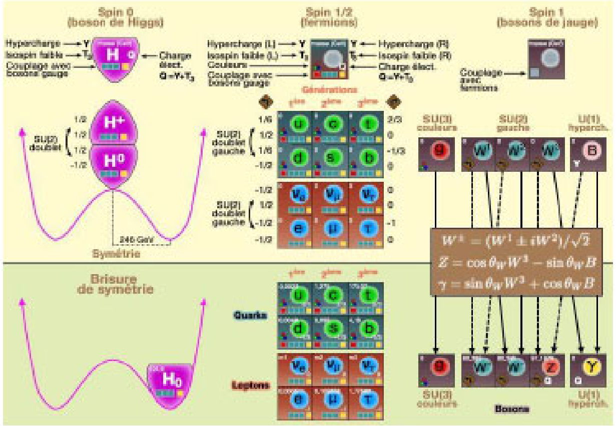

Figure 16

6.2. Interpretation According to our Model

So, in our model: time as we know it is intimately linked to mass and therefore to the Higgs field. But if this is the case, this allows us to immediately put forward some consequences which are again completely consistent with what we observe:

6.2.1. Legitimacy of Quantum Time

If a time is associated with the Higgs field, then it is legitimate to consider that the other quantum fields also have their own time, which legitimizes the hypothesis of a quantum time (or a time per field or type of energy). Indeed, including in the quantum world, if there is evolution, there must be a time to measure it. Why should it be what we perceive?

6.2.2. New look at Inflation

As indicated above and in the conference: "The big lessons of a small boson", the Higgs field would not be "active" at the very beginning of the big bang (before the breaking of electroweak symmetry, $<10^{-10}$ second). To be more precise, the Higgs field filled the universe, but the average value of this field was zero. This means that not all particles have mass. What our theory implies is that then, only quantum time existed, and therefore that the Big Bang is not the origin of the universe, but simply the origin of our time, our space and of the material. So, if the universe as we know it at its origin at the Big Bang, there already existed a quantum universe in a purely immaterial form (so with the Higgs field zero on average, without matter and without our space- time).

Between zero and 10^{-10} seconds, the Higgs field acquires a non-zero average value, and certain particles interact with this field, which "brakes" them as if they were bathed in a "viscous" field. This slowdown is materialized by the appearance of a mass for the particle, greater as the interaction is important.

As a result, inflation which is this extremely rapid period of growth of space-time: *"Cosmic inflation is a cosmological model fitting into the paradigm of the Big Bang during which a region of the Universe comprising The observable Universe experienced a phase of very rapid expansion which would have allowed it to grow by a considerable factor: at least 1026 in an extremely short time, between 10-36 and 10-33 seconds after the Big Bang. This cosmological model offers a solution to both the horizon problem and the flatness problem"*, has it only in our temporality: nothing prevents us from considering that all this happened "slowly according to quantum time $T^{\cdot}$".

6.2.3. Inflation or "Primordial Scalar Field"

Hypothetical particle, sometimes theorized, it is no longer essential to explain inflation.

6.2.4. A New Energy for Dark Energy and/or Dark Matter

According to our model, any system which has an energy E has for its own temporality a combination of "classical" time T and "relativistic" time $T^{\cdot}$. This combination is a function of the proportion of mass energy vs the other energies of the system (see the hypothesis in paragraph D). The existence of a temporality $T^{\cdot}$ allows us to assume that: beyond the energy of a system as we measure it, there exists an energy linked to quantum temporality.

For example: the quantity of movement that an electron has in its movement according to quantum temporality. According to the "classic" evaluation of the momentum of an electron: an electron carries its momentum, its mass and its speed in our temporality. In addition, it is intrinsically probabilistic in nature.

But in our model, its a priori "probabilistic" nature describes movements in the space of this system that we do not perceive, but which carries within itself a quantity of movement in temporality $T^{\cdot}$. This represents an energy that we do not quantify and cannot see in our classical world. And this applies to any object having a quantum component. This is a real possible explanation of dark energy, in any case it must be taken into account in this model.

6.2.4.1. This Hypothesis is Supported by the Theory of Energy Equipartition

This theory makes it possible to relate the vibration energy of a baryonic particle to the temperature. In particular, in a monatomic rare gas, this is directly associated with the kinetic energy of the particle.

“Monatomic ideal gas: the example of rare gases *Noble gases are typical examples for the application of the equipartition theorem. Each atom has three degrees of freedom associated with the three components of speed, that is to say the three directions of space. If we decompose the speed of the atom according to these three directions by denoting them vx, vy and vz, denoting m the mass, then the kinetic energy (Newtonian) is written as a sum of three terms each of which corresponds to a degree of freedom:*

$$H^{cin} = \frac{1}{2}mv_x^2 + \frac{1}{2}mv_y^2 + \frac{1}{2}mv_z^2$$

In thermodynamic equilibrium, each degree of freedom contributes according to the equipartition theorem for 1/2⍰⍰⍰to the kinetic energy. The total average kinetic energy of a particle is therefore 3/2⍰⍰⍰, and the total energy of an ideal gas composed of N particles is 3/2⍰⍰⍰⍰.

Knowing the average kinetic energy, we can calculate the root mean square speed vqm gas atoms where M = mNA is the mass of a mole of gas:

$$v_{qm} = \sqrt{\frac{3k_BT}{m}} = \sqrt{\frac{3RT}{m}}$$

On the other hand, the same article specifies:
“... it is faulted when the quantum effects become significant, in particular for sufficiently low temperatures or high densities".

And for good reason, in our hypothesis, we cannot ignore, when the mass particle is close to the quantum domain, the energy coming from the Brownian motion of the particle, but with 2 temporal components, which brings its kinetic energy in the example from ideal gas to:

$$H^{cin} = \frac{1}{2}m\left(\frac{\Delta d}{\Delta t}\right)^2 + \frac{1}{2}m\left(\frac{\Delta d}{\Delta \dot{t}}\right)^2$$

6.2.4.2. Remarks

1. This does not call into question the possibility of the existence of a cosmological constant which is widely debated in the scientific community. But in our model, it is appropriate to first establish the description functions of the particles in our 5-dimensional space, in order to be able to make an energy balance, and thus see if we need to use the cosmological constant which is theoretically possible.
2. This could also explain the phenomenon of diffraction of an electron passing through a fine fringe, a vibration according to the quantum temporality of the electron around its axis of direction in our space-time-mass, could explain the diffraction observed that we Let us once again perceive it as a statistic. (Cf the analysis of Young’s slits according to our model).

6.2.5. An Explanation for Dark Matter and its Location

This is a very good explanation for dark matter too. Obviously, the existence of this new temporality means that we must question the energy balance of baryonic matter as we currently do. Indeed, this baryonic matter is, in certain situations (when it is of a size compatible with the quantum world: see the paragraph above), animated by a kinetic energy linked to quantum temporality. $T^{\cdot}$. However, in the cosmos, and expressed in a popular way:

- Between galaxies there is almost no matter: the spontaneous appearance of particles is rare and rapid and therefore has little impact on gravity. Having an incomplete energy balance has little influence.
- Close to matter wells (black holes, stars, planets, gas clouds and dust), the deformation of space “concentrates” the energy in such a way that baryonic matter is much more stable (less “quantum”) and therefore "visible" and contributes directly to gravitation as it is modeled by general relativity, and its energy balance makes the energy according to the quantum dimension negligible compared to the calculation as it is classically evaluated: as indicated in the paragraph above.
- But around the edges of the galaxies, there is a whole zone where the influence of gravitation is weak, but not zero and this zone allows locally to have a local concentration of energy linked to quantum time which, due to the fluctuation of quantum fields, allows virtual particles to appear spontaneously much more often (therefore becoming baryonic, but invisible from an optical point of view) than in the rest of the universe (reaching its mass energy level). These baryonic particles have significant quantum energy due to the quantum temporality currently ignored. This zone could be a “nursery” of particles rich in momentum according to the quantum temporality $T^{\cdot}$ (in fact, for a particle to appear, the quantum fluctuation must allow at a given moment an energy-momentum greater than mc2, with m mass of the particle that appears). It turns out that there is approximately 10 times more dark matter than the matter balance that we make in the universe. And this dark matter can be explained by the fact that with the contribution of energy linked to the dimension quantum time, the energy-momentum reaches the mc2 limit more often.

Considering the volume concerned by this zone, and the very quantum aspect of the particles appearing spontaneously, we have a strong hypothesis for dark matter in our model.

The existence of this quantum time allows:

- To explain by the quantity of movement of baryonic matter according to quantum temporality, the existence of complementary and non-visible gravitational matter.
- To explain why it is mainly found around the edges of galaxies, and not in its center nor between galaxies.
- To explain why it must be necessarily composed of a part of matter which appears spontaneously and over short times, and as it is in zones of low space-time deformation, these particles are composed of a strong component quantum and therefore of a significant momentum if we take into account the momentum component according to the temporality $T^{\cdot}$.

6.2.6. Singularity of General Relativity

General relativity is just the 4-dimensional projection of a 5-dimensional space. In the same way that gravitation according

to Newton is only valid in a domain of validity, we must consider the two temporal dimensions in our model.
a) In any case, time as we understand it no longer diverges, because below the Planck scale, every object becomes pure quantum again. Thus, according to our model, our time T "disappears".
b) We can even hypothesize that on the horizon of the black hole, "our time" stops and that this is the limit of the domain of validity of general relativity which, let us remember, is only the theory on 4 dimensions of a reality on 5 dimensions.

Beyond: quantum mechanics alone remains valid, but with a temporal dimension. Because of the quanta, it no longer diverges in terms of space contraction, but it is necessary to reconstruct the time functions $T^{\cdot}$ to be able to make predictions.

This reality leads us to consider the hypothesis described in the following paragraph: it simply invalidates the notion of space and time (classical) when an energy becomes purely quantum. If this hypothesis is confirmed, then the domain of validity of general relativity effectively stops around black holes.

6.3. New Validation of the Concept of Space-Time-Mass

6.3.1. A New Look at Space-Time

Consequently, only the energy-momentum of baryonic matter could deform space-time since AND space AND time would be intimately linked to matter. However, currently it is generally accepted that all energy contributes to the curvature of space-time. This is necessary because the energy-momentum alone of baryonic matter is not sufficient to explain curvature as observed in astronomy. In fact, all energy arising from our temporality t has an influence on our space-time, but it is not all the energy of the system.

But this is no longer true with our new model where baryonic matter has much more momentum due to its vibration in quantum temporality not currently taken into account. Especially since, including in a vacuum, quantum fluctuation also allows the appearance of baryonic matter in a fleeting manner, with its energy-momentum, which has its gravitational impact.

6.3.2. A Solution to the Vacuum Catastrophe Problem?

From the moment when baryonic matter has a much greater energy-momentum than that which we had considered until now, then it is no longer necessary to consider that the energy of other quantum fields has an influence on the curvature of space-time.

This is therefore a path to solving the problem of the vacuum catastrophe, since we no longer need to relate the energy of the quantum fields of the vacuum and cosmological observations:
"Effect on the curvature of space-time:

This energy density in principle leads to physical, measurable effects on the curvature of space-time. However, macroscopically, referring to the upper limit of the cosmological constant, the vacuum energy as physically observable has been estimated at 10−9 joules (10−2 ergs) per cubic meter, i.e. also of the order of ~5 GeV/m³.

Conversely, the theoretical approach leads to enormous energy, whether infinite or "simply"
limited to the Planck energy density, 4.63309 × 10^{113} pascals.

For theoretical physics, this gap, of the order of 10^{120} between quantum theory and astronomical observation, has been described as a "vacuum catastrophe": why does the observable vacuum energy not correspond to the calculated value, with an unthinkable gap of a factor of 10^{120}? However, this gap must be put into perspective, the question appearing rather to be "why is the violence of quantum fluctuations, probably produced at the quantum scale, not observable at our scale?".

The problem of the immensely large total value of the zero-point energy of the vacuum remains one of the fundamental unsolved problems of physics, because it remains to discover the physical phenomena with opposite energy, which allow to explain the observed low value for the cosmological constant of vacuum energy".

In summary:
- The energy-momentum of baryonic matter taking into account the quantity of movement linked to quantum time, would be sufficient to explain dark matter.
- Space-time closely linked to the non-zero Higgs field and therefore to mass, allows us to assume that the energy of other quantum fields has no influence on space-time
- Which would solve the problem of the vacuum catastrophe.
- All these could be constraints on the formalism to be established.

6.4. Reflection around Superconductive or Suprafluidity Phenomena

"Supra" phenomena appear when in our space-time-mass, only the energy of mass (mC2) remains. The "cold" limits the intervention of other forms of energy-impulse.

In our new model, we understand that we cannot ignore quantum temporality. In other words, if the rules which govern the movement in our temporality of a baryonic particle indicate a cancellation of a certain number of atomic interaction phenomena at the level of the particles when they are cooled, they say nothing on what happens at the quantum level, and in particular at the level of quantum temporality.

In my opinion, superconducting or superfluidity behavior is a strong constraint on the law behavior of energy according to quantum temporality.

Example of a line of thought: suppose that the vibration functions according to the quantum time of an electron around protons are also a function of a sinusoidal law according to quantum time with a frequency specific to the atom considered. Below a certain temperature, the vibration energy according to mass time becomes lower than the vibration energy of a particle according to its natural vibration frequency according to quantum time. The Brownian motion according to our time disappears, and the synchronization of the wave functions of the electrons can be synchronized according to quantum time canceling the perceptible effects of resistance or capillarity on our scale.

In any case, it is an area which makes it possible to annihilate the disturbances of "classic" movements in the functions of evolution of energy according to quantum temporality.

6.5. Reflection on the Explanation of the Predominance of Matter Over Anti-Matter

There has recently been a lead that explains the predominance of matter over antimatter, which is linked to the violation of CP symmetry of the weak interaction on neutrinos as measured since 2013 in T2K. This is not yet a certainty (ST2K project for 2027), but it would explain that out of 1010 matter and antimatter generated, there is one more that is matter. By annihilation of antimatter by matter, only matter would remain.

If this lead is not confirmed, we could assume that, when the Higgs field was of zero value, all the quantum particles have a vibration function of the zero-sum electrical property. At the moment when the Higgs field goes through its symmetry break and acquires a non-zero value, the first mass particles appear. We could imagine that the electrical property is linked in a specific way to mass, and is "fixed" at a fixed value. The electrical balance of the universe "controlling" the electrical values of other particles. This representation, which is very speculative, shows that there could be explanations for the preeminence of matter over antimatter in a model like the one presented here.

6.6. Reflection on Time Again

It is obvious that time is an atypical physical notion, the existence of the arrow of time is an example. However, it is so omnipresent that we take it as intangible and the basis for the construction of physics. However, as we have seen, general relativity associated time with space and made it relative. Then quantum mechanics does not know how to treat it or integrate it into its formalism.

We can wonder about the fact that time could only be a notion induced by the laws of the evolution of a system, interpreted by our brain as physical data in the same way as the others. Time would then be to the evolution of mass energy, what colors are to electromagnetic waves or temperature to the activity of atoms. Then our perceived time would be the only one we can imagine, even measure; and for the rest, what escapes us in our human perception, it could have its metric of evolution, in other words its own time.

Relativizing the importance of time as a scientific basis of reference can help to imagine a notion so counterintuitive as another time that escapes our senses.

6.7. Constraints on the New Formalism to be Established

Thus, it will be necessary to define the global formalism integrating quantum temporality. There are several constraints on the equations to be established:

- The function $f(t; t^{\cdot})$ which governs any particle must give the model of general relativity by projection into our space-time. $(\forall t^{\cdot}$
- The function $f(t; t^{\cdot})$ which governs any particle must give the model of quantum mechanics by projection into our space. $fx(t^{\cdot}; t) = f(x) > (\forall[t^{\cdot}; t])$
- The energy balance of the universe must allow, through the complement of energy modeled by quantum time, to give the sum of dark energy + dark matter.
- The balance of dark energy on dark matter is also a constraint on the formalism to be established as a function of quantum time, whether in the evolution of its proportion since the big bang, or the localization of dark matter as a function of the deformation of space-time.
- The formalism will respect gauge theory.
- The phenomena of superconductivity and superfluidity will certainly be strong constraints on the formalism to be established.
- Diffraction could also be constraints on the quantum energies of baryonic particles.
- The formalism must also explain the PAULI exclusion principle.

This formalism will allow, among other things, a function of two particles with state functions:

$\psi 1(t^{\cdot}; t; x; y; z) <> \psi 2(t^{\cdot}; t; x; y; z)\ \forall[t^{\cdot}; t; x; y; z]$

6.8. Publications on the Expression of Time in the Form of an Imaginary Number

Interestingly, Stephen Hawking proposed the use of tense expressed as an imaginary number in his book "The Universe in a Nutshell".

This makes it possible to express the interval d in Minkowski space-time of the format:

$d^2 = x^2 + y^2 + z^2 - t^2$

In the format:

$d^2 = x^2 + y^2 + z^2 + (it)^2$

Thanks to this approach which retains the notion of one-dimensional time, we realize that at limits, in particular in general relativity, this makes it possible to eliminate singularities. It has also been shown that we can also show that the Euclidean quantum field theory of space-time of dimension D+1 is equivalent to the quantum statistical mechanics of space of dimension D. Although this proposal is not ours, it is interesting to note its existence, because it confirms that our approach resolves certain problems, and provides solutions to the quantum statistical approach.

6.9. Publications on a Model with Several Temporal Dimensions

There have already been some research attempts positing the existence of several temporal dimensions. The first is in the F-theory framework of string theory. But she then considers this second dimension to be compacted, which is not our proposal. The second approach consists of expressing time in complex form (called Kime) which is not our proposal either. The third is that of Itshak Bars in 2006. It expresses part of the ideas established in the present formalism. Although this proposal caused a lot of noise, Max Tegmark demonstrated that in such a space protons and electrons would be unstable unless the temperature is close to absolute zero. However, Itshak Bars' proposal also differs from our proposal in that the space-time envisaged by Bars is 4+2 dimensions. But, whatever these hypotheses, they do not integrate the constraint which is the proportion between time and the nature of the energy of the system as our proposal does. Constraint which solves the problem of the instability of protons and electrons.

7. Conclusion

The model therefore proposes to now work on a 5-dimensional space. This model encompasses the two theories: General Relativity and Quantum Mechanics which are differentiated by the proportion of mass energy to the total energy of a system. In theory, it would therefore be possible to write an equation based on time $T^{\cdot\cdot}$ linking these two models by integrating their respective temporalities, namely T and $T^{\cdot}$. This equation must restore general relativity by eliminating the temporal component $T^{\cdot}$, and by projection according to this same temporal dimension, must reconstitute the probabilistic dimension of the quantum formalism.

By going to the logical end, we can hypothesize that:

- That the equivalence:

Total energy of a particle > mass energy
«»
transition from the quantum world to the baryonic world.

- Space and time are only linked to baryonic matter and therefore to the non-zero Higgs field. And that general relativity is ONLY the modeling of the influence of this baryonic matter on this space-time object. But for a particle "close to the quantum world", we must consider its quantum energy, this would explain the lack of energy necessary for baryonic particles to have the gravitational influence observed: dark matter, dark energy, equipartition of energy at the level close to the quantum world.
- And that quantum energy has no influence on gravitation. Hence an answer to the problem of the vacuum catastrophe, the inflation observed at the Big Bang, and eliminates the singularities of general relativity.
- All this by giving an explanation in our space-time to quantum phenomena such as the Pauli exclusion principle, the phenomenon of quantum entanglement, Young slits, the regression of the wave packet and the "role of the 'observer ". But also: why our time does not fit into the formalism of quantum mechanics.
- Finally: matter to the detriment of antimatter could be linked to the asymmetry of the value of the Higgs field and therefore legitimized the predominance of matter alone in our space-time.

7.1. Measurement and Observation

For the moment, I have not found any thought experiments that would allow us to measure quantum time $T^{\cdot}$. Currently, the only access to quantum time is its statistical consequence. Is there a way to see quantum time and measure it? Right after a decoherence? By an interpretation of the big bang which integrates the new temporal dimension?

7.2. General Relativity and Quantum Mechanics

However, in areas where general relativity and quantum mechanics apply: Major incompatibility exists between these two theories.

- This is particularly the case during the big bang at < 10-10 s, or at the center of black holes. Indeed, general relativity diverges at the limits (infinite mass, infinite energy, point dimension, etc.) even though it cannot be ignored. And quantum mechanics doesn't describe anything about gravity in these cases.
- In addition, gravity cannot currently be modeled in quanta, unlike other forms of forces. Any attempt to quantify gravity generates numerous discrepancies in the resulting model, with no solutions to date.
- In the same way, quantum mechanics has difficulty “exiting” the limits of the Planck size due to decoherence.
- And quantum mechanics does not intrinsically integrate time (except for the writing of probability wave functions, but that has nothing to do with common time).

This is why for over 100 years; physics theorists have been searching for a “theory of everything”. The two most worked approaches are:
String theory, the formalism of which is magnificent. But:

- It involves a notion of supersymmetries. However, currently this theory faces the fact that theorists expected the latest LHC experiments to confirm their existence. This is still not the case. *‘From squarks to gluinos: It's not looking good for supersymmetry’*
- In addition, it involves 11 dimensions (for the most standard) which require us to consider spatial dimensions curved on themselves.
- And finally, in the current state of the theory, it does not allow any practical prediction. Indeed, 10^{500} parameters would need to be established to have a predictive formalism.
- Loop theory, which is not a “theory of everything”, but an approach to quantifying gravity [1-67].

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