

## Chapter XXIV

### Quantum theory of gravity

#### 3. UNIFIED FORCES

**"It is at night that it's beautiful to have faith in light."**

**- Edmond Rostand -**

Unifying Forces! Where is the formula for a Unifying Force?

As we all know, all physicists do like formulas!

Oh yes ... the formula! The truth is, I must confess, I did not find the formula. This formula has already been discovered by contemporary physicists, but they still do not know that they have already found it!

What all physicists do wish to achieve is the official unification of the Quantum Theory with a Gravity Theory.

It is practically impossible to marry the classical Theory of Gravity with a Quantum Theory of everything else ... how many times did I already hear this sentence! It seems impossible to join these two theories together. Perhaps that is so because, maybe, they do not wish to get married! If that is their will, let them stay single but happy!

The Standard Model works very well for all the other three forces of Nature, except for the Force of Gravity. The reason why this problem remains is because we are still looking at these four forces as having the same origin and nature. Considering these four forces as all being original in the Cosmos, but what we have here, if we look more closely, is a clear problem of perspective!

It is true that we see four forces, but the subtlety is to realize that not all of them are original forces of the Cosmos. One of them is a secondary force, only three of them are really quantum forces, because Gravity, as I said before but I will say again, is not an original force of the Cosmos but a consequence, a side effect. Of which can be concluded that what we call Gravity is an atomic force and so it is not a quantum force, as such, it cannot be included in the Standard Model.

This debate which aims to unify the three pattern forces of Nature: the Weak Force; Strong Force; and Electromagnetic Force with a fourth one: the inconvenient

Gravity, is now eliminated! This scientific speech which has continued and persisted for years; this scientific saga which physicists have carried for a long time is then resolved.

And maybe the search for a Unified Formula is just to mislead. Perhaps such a formula does not exist for this unification.

The only unification which I can present is the one of the current Standard Model. But this unification which unites three Forces: Strong, Weak and Electromagnetic, physicist already have it ... or almost. The unification is still pending in the Strong Force and the Electroweak Force.

Making a vain analogy, I would say that physicists have first discovered the developments of Maxwell's Equations before they even find the formula for the Electric Field, which is, actually, much more difficult to accomplish. But, somehow, they have succeeded. The two formulas of this unification are very complicated, there is still missing a final rearrangement and a simplification.

The theory of the Strong Force is studied by Quantum Chromo-dynamics, short known as QCD, whose presentation in the language of Physics is:

### **STRONG FORCE FORMULA**

$$L_{\text{QCD}} = -\frac{1}{4} F_a^{\mu\nu} F_{\mu\nu}^a + \sum_f \bar{\Psi}_f (i\partial - M + g_S A^a T_a) \Psi_f$$

$$F_{\mu\nu}^a = \partial_\mu A_\nu^a - \partial_\nu A_\mu^a + g_S f_{bc}^a A_\mu^b A_\nu^c$$

The theory of Electroweak Force is studied by the Quantum Electrodynamics, short known as QED, whose formula is:

## ELECTROWEAK FORCE FORMULA

$$L_{E-W} = L_g + L_f + L_H + L_m$$

$$L_g = -\frac{1}{4} G_a^{\mu\nu} G_{\mu\nu}^a - \frac{1}{4} B^{\mu\nu} B_{\mu\nu}$$

$$L_f = \sum_i \Psi_{Li} (i\partial + g' W_a^a t_a + g B \gamma) \Psi_{Li} + \sum_{Ri} \Psi_{Ri} (i\partial + g B \gamma) \Psi_{Ri}$$

$$L_H = - (D_\nu \phi)^\dagger (D^\nu \phi) - \mu^2 (\phi^\dagger \phi) + \lambda (\phi^\dagger \phi)^2$$

$$L_m = - \sum_{i,j} (c_{ij} \Psi_{Li} \phi \Psi'_{Rj})$$

As you can see, the expressions which describe these interactions are horribly complicated, but they do show a mathematical consistency which is in full agreement with the experimental predictions and, therefore, among its main protagonists, some were reward with the Nobel Prize.

But there is a possibility for a simplification ...

First, the Strong Force is, without doubt, the most complex force in Nature and the most difficult to simplify.

We know that the Strong Nuclear Force acts through protons and neutrons inside the nucleus, keeping them together and preventing the electromagnetic repulsive force between protons to manifest. However, it would be more accurate to say that this force acts, not quite between protons and neutrons but rather between their most fundamental constituent particles, inside the level of its internal constitution: the quarks. The Strong Force joins protons together but also joins neutrons inside the nucleus, because it's a force between quarks. In a way, we can ignore that there are protons and neutrons in the nucleus and consider that within this system there are only quarks.

Inside this system there is a significant degree of complexity that arises whenever we want to study the physical behavior of this force.

While in the electromagnetic force we only have to consider one photon as the mediator particle of this force, with the strong force we must considered eight gluons particles mediating this strong interaction. These different categories of gluons can occur randomly and with an additional feature. Again, making an analogy with the electromagnetic force, the photons are electrically neutral particles, and therefore

they do not interact with each other. But with the Strong Force that does not happened. We can say that these gluon particles can also feel the strong force, and therefore they interact with each other. Under these conditions, the treatment for this force is a little more demanding and exigent. And that is why it comes the complexity of the equations.

Without wishing to move towards the complex details of Quantum Chromodynamics, I can say that this is a science that has just started to make their first steps, because its deeper knowledge still escape and eludes our understanding.

Essentially, we can say that the fundamental particles of the whole matter are quarks and leptons. We have seen that leptons and quarks always form duplets and also that they react in a similar way to the Weak Force. However, leptons and quarks appear to behave quite differently to in the presence of the electromagnetic force and the strong force. Since the quarks feel the strong force and leptons don't. Moreover, once quarks have a fractional charge of  $+ 2/3$  or  $-1/3$  and leptons ( electrons and neutrinos ) have a whole charge number of  $-1$  or  $0$ , the power of participating in a electromagnetic field varies from one to another but only in a quantitative manner, because the electromagnetic properties expressed are, in fact, identical. Both quarks and leptons feel the electromagnetic force.

There is a triangle that must be accomplish and that means that all forces have to work together, which suggests once again that these forces are not as distinct and independent as we think.

Until very recently it was thought that these forces had no relationship between them, since they act in a very different way and also with quite different intensities.

The power of intensity of these forces is an interesting measure which allows us to make a relationship between them and, as we know, the intensity of these forces differs from each other. Even the intensity of the forces varies, depending of the environmental energy, it is therefore not a constant value but a function of temperature.

In the cold Universe of today, these intensities are well defined and can be related through the Fine Structure constant.

The Fine Structure constant is a very special constant in Physics, and characterizes and describes the intensity and magnitude of the Electromagnetic Force. It is defined as  $\alpha = 1 / 137$ . This alpha arises from the unification of three fundamental constants ...

$$\alpha = \frac{e^2}{2 \epsilon_0 h c} \approx \frac{1}{137}$$

... The electric charge, the permittivity, the Planck constant and the speed of light. These constants represent and combine different components from different areas of Physics:

$c$  = relativistic component;

$h$  = quantum component;

$e$  = component of the electromagnetic interaction

$\epsilon_0$  = component related with the charged particles of vacuum.

This constant is actually extremely important. If our Universe is the way it is today, that only happens due the value of this precious fine structure constant. If, by any chance, this constant were modified, making it a little stronger or a little lower, if alpha had a different value, even minimum ... the essential characteristics of our Universe would no longer be the same and everything would change.

Disturbing this constant involves changing the energy levels of the atom; meaning that the values of the atomic energy connections would be different ... implicating a major modification in the whole atomic process! This would mean, in practice, that we would get a new Universe!

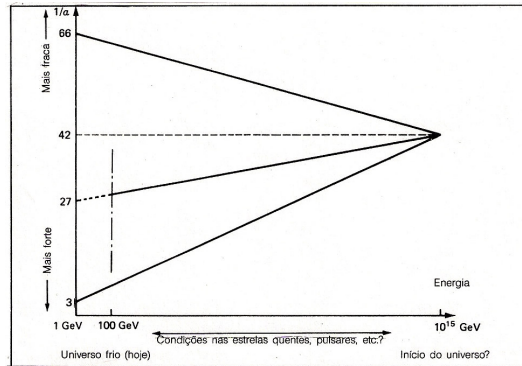
The coupling constant that defines the electromagnetic force is the reason to be of everything around us.

The Standard Model aspires to obtain a unification of the various coupling constants in a high energy environment.

The Grand Unification Theory requires that the natural forces and the particles on which they act, produce, in a high energies environment, a uniformity that is obscured at low energies. So that, it is briefly concluded that these forces act in a similar way in a remote past in the form of a single Unifying Force.

The introduction of this idea allows the high energy physicists deduce that there is a similar behavior between the main forces of Nature when they are exposed to very high energies, in the order of  $10^{15}$  GeV and, therefore, they consider that there was a primitive unification at a time when our Universe was still very hot and young.

The Unification presented is, as such, a function of the scales of energy involved. The theory provides a different evolution with distinct intensities for each force of Nature, according to the increase of temperature, as described in the following graph:



### - Unification of coupling constants $\alpha$ -

The development of this evolution seeks to identify a magic point in time, the point which would unify and change all Forces of Nature into one!

The idea of unification does have some meaning. It is clear that Particle Accelerators show us new processes of mutation and disintegration of particles that can only happen in high energies levels. However, even agreeing that the intensity of forces converge into higher energies, how can we be so secure that their properties and characteristics also change and converge to a single unified force?

According to the current Model of Unification it is consider that there are several steps in the liberation process of the four Forces of the Universe. First it is considered that the four forces of Nature were join together in one single branch and that the spread branches of the forces happens in a partial and gradual process. With this process of ramification results that the Force of Gravity was the first force to get separated and to emerge from this Grand Unified Force, however, as we have seen before, it is exactly the opposite that happens. The Force of Gravity is the last to emerge and it is, therefore, the youngest force of the Universe!

And for the following ramifications it would be necessary to clarify a little better the reasons and justifications for this process.

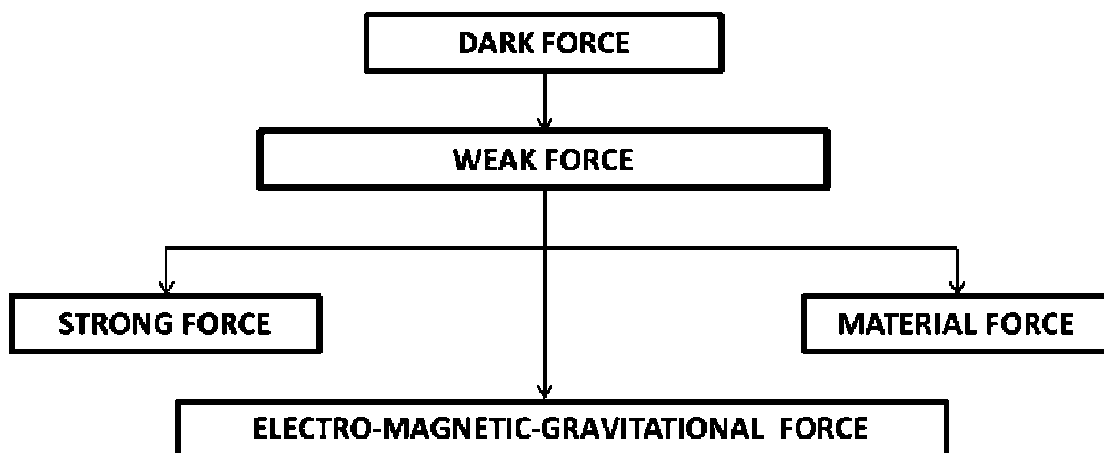
In my point of view, there is no unification. There is, quite simply, evolution. And very hardly the forces would change their properties as if they were the same substance in a phase transition ... I do not think that it is reasonable to treat the Forces of Nature as liquid water, ice and water vapor ...

As we saw earlier, the justification is simple and it is withdraw from the cosmological evidence.

We can notice that all forces of Nature have a common characteristic, which is to unify, and as such the Electromagnetic Force, the Strong Force, and the Force of Gravity respect the symmetry. However, there is a force that does not share this characteristic of unification, because its main function runs exactly in the opposite direction. Its power is to disunify and it is, therefore, a force of imbalance and instability.

We can consider that the Weak Force is within the origin of all forces of Nature, once this is the only force which breaks the symmetry. As so, it is from this dissymmetry that evolves and emerges all the other three forces that surround us.

Thus, we can simplify the development and evolution of the forces of Nature, proposing a more balanced and symmetric branching:



**- Evolution of the Forces of Physics -**

With this structure in mind, we can emphasize that it was not the temperature that has conditioned all these physical processes. The external factor of greater relevance which more conditioned these circumstances is according to a natural process of Evolution and its influence is predominant and crucial ... the external agent more effective in this process was ... the Time!

I must remind you that the Particles Accelerators cannot reproduce all forces ... and time is definitively ... a huge force!

Time is a great force but given its extraordinary subtlety and discreet nature of its activities, it's a force which nobody notices ...

But this force acts constantly, cleverly, without being noted. It is an actor that hides its true nature and identity, by showing, or to be more accurate, by hiding behind their actions among things.

It is with its actions that we must count on, in order to draw a complete perspective of the Evolution of the Universe, it is with this action that we must conceived the whole History of the Cosmos.

Time is also a Force ... always forgotten ...

The simple structure, functional, harmonious and beautiful of our Universe is due to the complementarities and interactions of all these forces.

Returning to the theory of unification, it is possible to compare the magnitude of the forces with each other and thus obtain a relative magnitude.

The main relationship is made from the fine structure constant.

Usually the magnitude of the Electromagnetic Force is stipulated as having a value of  $1/137$  and this force is considered to be 137 times weaker than the Strong Force;

The Weak Force is by its turn  $10^6$  times weaker than the Strong Force;

And the Gravity Force is the weakest of all, in the order of  $10^{40}$  times weaker than the Strong Force.

With these data we can establish a relationship, in which the more intense force is the Strong Force and we match it to the unit 1:

$$\text{Strong Force} = 1$$

$$\text{Electromagnetic Force} = 1 / 137$$

$$\text{Weak Force} = 1 / 10^6$$

$$\text{Gravity Force} = 1 / 10^{40}$$

We can also adjust these equations by multiplying the intensity of all forces by 137. And we began to define the coupling constant, not according to the Strong Force but in order of the Electromagnetic Force:

$$\text{Strong Force} = 137$$

$$\text{Electromagnetic Force} = 1$$

$$\text{Weak Force} = 137 \times 10^{-6}$$

$$\text{Gravity Force} = 137 \times 10^{-40}$$

With this definition, there are several relationships which can emerge from this structure, as for example:

$$F_E = 1 \times F_E$$

$$F_S = 137 \times F_E$$

$$F_W = 137 \times 10^{-6} \times F_E$$

$$F_G = 137 \times 10^{-40} \times F_E$$

Other equivalences can also be deducted. Transforming the equation and considering that  $F_{EM} = 1 / 137 \times F_S$ , appear as:

#### UNIFIED FORCES:

$$F_E = \alpha F_S$$

$$F_S = \alpha^{-1} F_E$$

$$F_W = \alpha^{-1} \times 10^{-6} F_E$$

$$F_G = \alpha^{-1} \times 10^{-40} F_E$$

With the exception of the Material Force, about which we know very little, this is our alternative for the unified and simplified formulas of Electromagnetic Force, Strong Force, Weak Force and Gravitational Force. Thus avoiding to present these equations through extremely complicated developments.

Considering that we know the relationship of alpha ' $\alpha$ ' as also the formula of the electric field  $F_E$ , it is possible to obtain a decomposition and resolution of these forces.

However, the theoretical physicists wish to facilitate the calculations and, therefore, they would like to obtain one single Unified Force ... but if the forces are exactly these ones, then, there is nothing else to simplify ... there is no Unifying Force!

At this point I am reminding me of the classification for the scientific system according to the physicist John Barrow: 'Every time a new idea is presented and notice in the scientific community it necessarily has to get through three steps: 1<sup>st</sup> It does not worth anything, we do not even want to hear about it; 2<sup>nd</sup> It is not wrong, but it probably has no relevance; 3<sup>th</sup> It is the greatest discovery of all time and we were the ones who found it first. And by then there will be many more candidates claiming the priority of the discovery. "

It is unfortunate that some scientists never deviate from what is already known, always choosing to follow the safer trail. They do not even risk crossing the berm, transgressing the trail, or even give any chance to an alternative theory.

It is their responsibility to expand the frontiers of Physics and open new horizons.

Clearing new trails and discovering something completely new is fascinating! What's more magic in Science is the ability to go and get lost in the jungle of the unknown.

"The most beautiful experience is the encounter with the unknown." - Einstein-

Science is above all a human activity very rewarding. Perhaps the most purest of all in a world far from perfection ...

Only scientists feel very deeply what they do and only they feel real passionate in what they seek.

"In the Universe no one has more fun than us." - João Magueijo-

## **Chapter XXV**

### **FORMULA OF TIME**

**"Time does not exist. It is only a convention. "**

**- Jorge Luis Borges --**

What is Time? What is Space?

We could begin by naively assuming that we do not know what Time is, that we do not know what Space is.

We only know what is a relationship of space, that space is a distance between two points, but we are not capable to say what is the concrete and absolute meaning of space itself.

We also cannot say what it is the precise definition of time, we only know what is a relationship of time, that time defines a duration between two events.

But defining objectively these two concepts becomes very difficult and it almost locks our thought every time we try to define the origin of time and the limits of space.

Once you invoke the idea of an origin or a beginning, and therefore, a start, this abstract idea immediately transcends us.

Let us admit that the Universe did have a beginning. But considering that the beginning is a moment of existence preceded by a time before this beginning had started, so we can say that there was a time when our Universe did not exist, the time before the origin of the Universe; and in a way what we are considering is a time before time, so that we can define it as a pre-time or, let's say, an empty time. But, speaking about the beginning of time itself, even considering it surrounded by an empty time, a time when nothing still existed, it means that we are still situating time in time ... we are continuing the same limitation of time ... in time. That is a vicious cycle!

Nobody understands how can we design a creation of time outside time itself. Possibly because that conception is not possible!

There isn't, by definition, a period before time, nor can exist. So, the question of what could exist at that time, before the beginning of time, has no meaning.

It is always dangerous to ask what could have existed before the birth of the Universe. If you believe that time didn't exist in that period, what we are considering is that there was a time when time didn't exist. Please do notice the paradox of this last sentence ... " a time when time didn't exist" ... so what we are saying is that there was a time when time didn't existed!

In fact what we are saying is that there was a pre-time, maybe different from our usual physical meaning of time, but still so, in practice, what we are doing is assigning a new concept for time, which in fact is far from answering our question, just transforms it and modifies it into another perspective.

If we assume that there was no time before time, then there could also exist no History to be situated it in that time before time. Concluding that if there was nothing to be situated in time there could not exist any Historical time ... as well it could not existed any historical time around, surrounding a time when time didn't exist, thus mean, the time when our History is included. What I intend to say is: Accepting our historical time around a time that didn't exist is equivalent to situate that time that never existed in time in time itself ... which is an absolute paradox!

Therefore, we must conclude that there is no possibility of conceiving the existence of time outside time, and as such, that time has always existed and that there never could have been a beginning of time. The only possible and logical statement is that time is eternal, immortal and infinite!

Let us now move towards a more fundamental question which is:

Is it possible existing several moments of time ... at the same time!? Or even different types of time! Is time an absolute measure, effective, unchangeable, always equal and immutable in its form, always constant in all fields of the Universe and in all Universes, or is it possible that time could be a more variable and versatile concept?

If you look well, this Force of Time is the dominant force! Very subtle, but always present and active. This force reigns since the beginning of time and it was already present long time before all the other forces have emerged. I would say that is a kind of Supreme Force.

But nobody has ever heard about this Time Force! How come something so obvious to us can go unnoticed?

I understand that it is often when things are under the disguise of obviously that no one can see them.

What are the main features of time? There is nothing in known Physics which establish a law for the passage of time. Is this concept still too abstract?

We have already seen that it is not possible to conceive a beginning of the Universe outside of time. The same argument is valid if we conceived the end of time of the Universe ... so this means that our Universe can have no end! Even in this time when everything would have an end, even in this world where nothing is happening, a cold and dead Universe, static and inert, even then when nothing is moving, the Time itself, is the only thing that remains active and alive to continue to be and do its work.

Time it's the artisan of its own preservation, of the renovation of Present, of the continuity of time. Its true stop would mean, not only the immobilization and absence of movement of all things, but also the immediate interruption of Present, and with this, the disappearance of all that exists. When I say everything, I truly mean to say absolutely everything! What is difficult idea to conceive in our intellect. This instantaneous and complete annihilation would result in a true Apocalypse! In this apocalypse everything would have an end. The complete abolition of time what would mean the end of the 'end' itself, as such, there could not even ever existed the moment of the end. Because the moment of the end also follows the principle of causality, which in our case would mean that there would not have existed a cause to precede the end. And if anything leads to an end ... then, there could not exist an end at all! What I want to say more clearly is that the end of time is not conceivable. We would face another paradox.

There cannot exist a world without time, or time outside of time. So the time is consubstantial to the world and to time itself.

Thus means that time cannot be finite in both directions; time must be infinite in all directions. We cannot trust in a asymmetric model of time for our Universe, establishing a beginning of time in one side and an infinite or indefinite time at the end of the Universe.

Time is symmetric, constant and infinite in all directions and in all dimensions.

Let us try to decode a formula for time.

If time is everything at it is everywhere, absorbing everything that happens and even what does not happened ... where is the fundamental formula of the time?

How come that physicist aspires to build a Unified Theory without including the Force of Time? Time is also a force, a strong one, this is also a seed of our Universe. How can we imagine to build a Universe without time?!

First, it is possible to demonstrate, mathematically, that time does not exist; that time is simply an abstract concept.

When we say that time has no real existence, we are considering that time has got, simultaneously, a physical magnitude null and infinite. This Fundamental Force of Time can reach quite distinct values, since the value zero up to the infinity.

According to the deduction of António Saraiva, this mathematical demonstration is possible. Beginning with the assumption that zero is equal to infinity, it appears that:

$$\begin{aligned}
 0 &= \infty \\
 \log 0 &= \log (+\infty) \\
 -\infty &= +\infty \\
 \log (-\infty) &= \log (+\infty) \\
 \log (-1) + \log (+\infty) &= +\infty \\
 i.\pi + \infty &= \infty \\
 \infty &= \infty
 \end{aligned}$$

The conclusion is that zero is equal to infinity, and vice versa, that the infinity is equal to zero.

This theoretical formulation can be transported to a practical formulation, as follows: First, we can consider that time has no real concrete existence. In this case, we are assigning a zero value for time. What this means is that we can say that there is no physical and objective existence of a temporal duration, in practice, it means that we cannot usually say 'there goes that little bit of time'. Because time does not exist as a physical entity in space, we cannot find it with physical dimensions of an object in

particular, because the natural time is not formed of three space dimensions. Time, as a relationship of duration between two events, past and future, has got a null physical existence, and that is the reason why we cannot find it in a physical way. More simply, time takes value number zero because time is not a physical object. And that is why time doesn't exist ...

Furthermore, we all feel the passage of time. But this time which we all perceived is a Present time, one single moment, it's a moment with no duration or dimension, it is a singularity. And so, therefore, Present time is infinite. This is when time takes its other side, the value of infinity.

Time assumes an ambivalent and multifaceted feature, simultaneously null and infinite, present and absent. So that we can say: in Time nothing is eternal and nothing is ephemeral!

If we wish to understand this concept by the nature of the physical perception of our senses, we will stay completely limited. This means that, if we cannot handle Time physically, maybe we can understand and treat this concept mathematically.

But in order to proceed to a mathematical manipulation of time, we need to know a fundamental formula of time. What is the mechanism that encodes and decodes the constant temporal relationship? What its messenger, the particle of time?

So, let's see, does time affects all organisms and all objects simultaneously and at the same way?

A bacterium is scheduled to reproduce in a very precise rate of time. The timing of cell division of bacteria varies from species to species and it is also influenced by many external factors such as temperature. But in the best growth conditions of these unicellular organisms they can perform a cell division every twenty minutes. This means that a single bacterium can produce 280 trillion descendants in one day!

A radioactive mineral is programmed to disintegrate at a specific rate of time, designated as the half-life period. This decay period corresponds to the time required for half of the original nuclide to disintegrate into a more stable nucleus.

The trees of the family of conifers, called Sequoias, know that their life expectancy is estimated at an average of 3500 years of time. Indeed, the oldest tree in the world is 9500 years old; it's a common pine in Norway.

How come everything that exists knows how much time is passing by?

Possibly because all material bodies have their own internal biological clock, which keeps them tuned with this frequency of time. Only that, nobody knows what are those exact mechanisms which contains this enigmatic Force of Time. This vast empire

is still waiting for an astute and courageous explorer to find the absolute domain and knowledge of the flow of time.

If we could discover the basic mechanisms of time, their most intimate secrets, we would have in our hands the greatest force that governs the entire Universe!

If time is what makes everything change at a constant rate, with the same speed for all beings and substances that have the same properties, so that nothing can remain equal to itself, we can say that Time is a Constant of Changing.

But if time is also what makes everything to continue, so, in a similar way, we could also consider it as being a Constant of Continuity.

The changing and the impermanence require a timeless law of eternity and continuity.

In an obvious sense, we can say that we are all travelers in time, because, even if we do nothing at all, we will still be inexorably dragged under by this force of time into the direction of the future. Thus, we can deduce that time ensure and guaranties that all matter remains informed about the passage of this force, without exceptions. There is always a pattern in time and a sintony which sensitizes all molecular substances and all chemical elements for the passage of this force.

And what is the main key, the fundamental constitution of biological and non-biological organisms? What is the fundamental constitution of matter?

Again we return to the Field and Energy! So that we can say that time is a form of energy, like so many others. Turning the redundancy, we can say that time is the energy that affects energy. Which means, quite clearly, that time also travels through space in a uniform, constant and continuous way, tracking the speed of light, because this temporal field also distributes at the speed of approximately 300.000 km / s. Because Time is a Field associated with Space.

Time is a field! And this temporal field is, in its essence, uniform and homogeneous. Of course, there may be individual cases in which the very structure of space is altered and distorted. In such cases, if time spreads through space, or rather, it's a prisoner of space, we can assist to different flows of time ... Because the expression of time can be changed ...

If the energy of time is dominant, always present even in the absence of all other forces, what is the field force which produces it? If the energy of time is constant, what is the field responsible for giving this consistency?

This Common Time, which we are surrounded, is, first of all, a particular time and it is not the Fundamental and Absolute Time.

Another interesting physical relationship, established by António Saraiva is:

Considering a Hydrogen atom, we can determinate that an electron travels an orbit in a fundamental and curious pattern. In this fundamental movement the electrons velocity is minimal and its energy is also minimal. So that this movement follows a constant cycle with a well defined period.

More important than what numbers can show us, is the theoretical interpretation that arises from this. And this is the part we must highlight: that all atoms in the Universe follow a constant pattern. The dislocation of the electrons charge in an atom follows a well defined period. This repetitive motion is the same for all atoms. And these are the biological clocks of Nature.

The atoms themselves were designed and created from the beginning to respond to a specific flow of time. As such, if any object also have atoms in its constitution, all the entire structure of more complex groups of matter produced from them, from molecules to cells, to life itself, follows this same pattern of time.

Thus it is easy to conclude that it is the speed of the electrons in atoms that sets the course of time, the life-time of an atom.

If we could build a physical equipment capable of measuring and recording the number of orbits completed by an electron in an atom, it would be possible to verify that this number is a Constant. Except when this atom stops to be at rest and starts to move with speed, and then we would assist to the phenomenon of General Relativity and conclude that the number of orbits performed were clearly lower. The result of this process is reflected in a reduction of the flow of time.

To understand the subtlety of this force we must again remember about that valuable constant: The Fine Structure constant. This constant re-enter on stage in a more fundamental question of Physics, which is Time.

In the annotations of A. Saraiva we can see the perimeter  $P$ , corresponding to one stable orbit, has an exact value as it is showed in the following equation:

$$P = 2\pi R_b = 137\lambda_e$$

Where:

$R_b \Rightarrow$  Bohr radius =  $5.292 \times 10^{-11}$  m

$\lambda_e \Rightarrow$  Compton wavelength =  $2.426 \times 10^{-12}$  m

The Bohr radius ( or average radius of an atom ), and the Compton wavelength ( or the average wavelength of an electron ), represent units of measure that allow us to determine the perimeter of the path made by the electron. This perimeter, as we can see, has got a very precise value, exactly  $137\lambda_e$ . Similarly, we can also try to predict the average speed of the electron while it moves in this stable orbit, which also follows an interesting relationship, by the following equation:

$$v = c / 137$$

Again, the Fine Structure constant  $\alpha = 1 / 137$ , seems to have an important role in the speed of this particle, or rather, in the speed with which follows Time itself ... and, interestingly, associated with the speed which Time is spread, the speed of light  $c$ . We can define that the velocity of time, or the formula of time, is given by:

**FORMULA OF TIME:**

$$v_t = c \alpha$$

**Chapter XXVI**

**FORMULA OF THE COSMOS**

**"God wishes, the man dreams, and the work is born."**

**- Fernando Pessoa -**

It should be good to begin by recalling that if Physics had a Theory of Constants, it would find one single constant, unique and universal. That means that, eventually and inevitably, it would be discovered the Constant of Nature, the Fundamental Constant!

There is a constant that dominates the Universe and that is our constant of reference, the constant that identifies our Cosmos.

Unlike the speed of light 'c'; the electrical charge of the electron 'e'; and the Planck's unit 'h'; this new constant is still unknown to all.

The deduction of this constant is quite simple to demonstrate.

The formula that I will present establishes a very interesting relationship, as follows:

$$a = Q \cdot c^2$$

Substituting the values in this equality, the charge of the electron 'Q' and the speed of light 'c', is that:

$$a = 1,6 \times 10^{-19} \times (3 \times 10^8)^2$$

$$a = \mathbf{0,0144} \quad \text{C.m}^2/\text{s}^2$$

Considering the Einstein formula for energy, it comes that:

$$E = m \cdot c^2$$

$$c^2 = E/m$$

Relating to the above formula, is that:

$$a = Q \cdot c^2$$

$$c^2 = a/Q$$

From where it can be deduced that:

$$c^2 = c^2$$

$$E / m = a / Q$$

Transforming and matching the two expressions it is obtained two fundamental equations of Physics:

$$\mathbf{Q \cdot E = m \cdot a}$$

The formula of Electric Field (  $F=Q \cdot E$  );  
and the formula of Newton for Movement (  $F=m \cdot a$  ).

The next question is: what does it mean that  $a = 0.0144$ ?!

If you notice carefully, there are three most fundamental equations of Physics, which can be practically reduced to the following:

$$F = m.a \dots F = Q.E \dots E = m.c^2$$

It is by the combination of these formulas that we obtained this precious constant:

$$F = m.a \dots F = Q.E \dots$$

$$m.a = Q.E \dots$$

$$E = m.a / Q \dots E = m.c^2 \dots$$

$$m.a / Q = m.c^2 \dots$$

$$a / Q = c^2 \dots a = Q.c^2 \dots$$

The value that is obtained is a Force value, a constant of a Fundamental Force present in our Universe.

What kind of force is this?

Only later I realized that this is a Gold number, the number of the Cosmos!

This force is associated with the movement of gold which absorbs our entire Universe, from the Astrophysics to the Microphysics.

As we have seen before, all bodies of the Universe seem to have a circular motion responsible for this delicate balance of Nature. This kind of movement is perfect and perpetual, just like a pendulum. It only needs that 'someone' provides the very first initial clicking ...

The natural essence of matter itself, incorporates this fundamental quantity; which corresponds to the essential natural Flow of Energy that is always in constant motion ... everything is energy in motion.

This fundamental value is associated with this movement of rotation that is always present and involving us. We can associate it with an angular momentum of energy ... the energy that placed our Universe in motion.

In this closed system, our entire Universe has an angular momentum of energy eternally constant.

#### **FORMULA OF THE COSMOS:**

$$a = Q. c^2 = 0.0144$$

#### **Chapter XXVII**

#### **FORMULA OF THE UNIFIED THEORY**

**"The number dominates the Universe."**

**- Pythagoras -**

What if we did find the Final Theory of the Universe, the Great Unified Theory? ...

What would that discover mean? ... What would we do with it? ... What would that change?

Would we be absolutely certain that we did find the correct theory? ...

If we had in our hands a mathematically consistent theory, which could make the correct predictions of physical events, always in agreement with the observations, we could acquire a reasonable degree of confidence, we could think that maybe this is the true theory, we could fall into the illusion that we have conquered the absolute understanding of our Universe ...

"However, if we discover a complete theory, which shall be understood within a few time, in its general concepts, by everyone and not just by some scientists. So all of us, philosophers, scientists and just ordinary people, will be able to take part in the discussion of knowing why we and the Universe exist. If we find the answer to this, it will be the ultimate triumph of Human reason, because, with the knowledge of this theory we will understand the mind of God. "- Stephen Hawking -.

Physics will be mature when it reaches a Unified Formula that fits within a T-Shirt. Something more or less of this type:

$$\mathbf{F = m a \dots or \dots E = m c^2}$$

A Unified Formula that will be an authentic work of art and which will immortalize its author ... contained in one single constant that will also reveal the reason of all the other constants that surround us.

Understanding the origin of our constants is one of the big questions of Physics ...  
... This formula could be contained in one fundamental constant, as simple as ...

#### **FORMULA OF THE UNIFIED THEORY:**

$$\mathbf{a = 2 \alpha}$$

$$0,0144 = 2 \cdot \mathbf{1 / 137}$$

$$0,0144 = 2 \cdot 0,007$$

$$\mathbf{0,0144 = 0,0144}$$

From this simple number follows the full complexity of our Universe:

$$\mathbf{a = Q c^2 = 2 \alpha}$$

$$a = 2 \alpha = 2 \cdot \frac{e^2}{2 \cdot \epsilon_0 \cdot h \cdot c} = \frac{e^2}{\epsilon_0 \cdot h \cdot c}$$

And from here arises the most fundamental constants that surround us:

Charge of the electron ... .. e = 1.602 x 10<sup>-19</sup> C

Electric Permittivity of vacuum ... ..ε<sub>0</sub> = 8.854 x 10<sup>-12</sup> F / m

Planck constant ... ..h = 6.626 x 10<sup>-34</sup> Js

Speed of light ... ..c = 3 x 10<sup>8</sup> m / s

All these constants can be practically reduced into one:

Fine Structure constant ... .. α = 7.297 x 10<sup>-3</sup> ≈ 1 / 137

... Which has a direct relationship with all the forces of Nature that surround us ...

The classical equation of the electric field is given by the Coulombs law, in which:

$$F_e = K \cdot \frac{Q^2}{r^2}$$

But this equation can also be defined as the following relation:

$$F_e = K \cdot \frac{Q^2}{\lambda_e^2}$$

In which it is replaced the value of the distance r by the length of Compton λ<sub>e</sub>. The Compton wavelength relates three fundamental constants:

$$\lambda_e = \frac{h}{m_e c}$$

$$m_e \cdot c$$

Replacing in the previous equation, we obtain the following development:

$$F_e = K \cdot \frac{Q^2 \cdot m_e^2 \cdot c^2}{h^2}$$

$$F_e = \frac{Q^2 \cdot m_e^2 \cdot c^2}{4\pi \cdot \epsilon_0 \cdot h^2}$$

Where 'm' is the particle which emits and receives the corresponding radiation. In this case,  $m_e$  is the mass-energy of the electron and is related with the Electromagnetic Radiation.

In the case of Gravitational Radiation, we could first begin to evaluate our 'gravitational constant' G. Let us try to determine the origin of this constant...

**still continues ...**