VALENTIN IONESCU

THE COLD BIG BANG MODEL

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I dedicate this work to the
memory of my father,
Mihail IONESCU

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Science is the means through which
mankind explains Creation.

THE COLD BIG BANG MODEL
OR
HOW SPACE, TIME AND ENERGY-MASS WERE CREATED

Summary

- the work presents the hypothesis of building and evolution, step by step, from nothing, of *the space-energy-mass-time* elements[1] that together define the universe;
- several fundamental concepts are redefined, such as:
  - *space* is not defined here as a form in which matter is poured or as a philosophical category that designates objective forms of existence. In this work *space*, *energy-mass* and *time* are a unitary whole that is the *universe* itself. In order for the gulf between these concepts and the classical ones not to be insurmountable, I will divide the *universe* into two concepts with which it can operate: *time* and *space-energy-mass;*
  - *time* thus becomes a subjective element that depends on the consciousness that has divided the universe into two concepts and is defined in the work;
  - *space-energy-mass* is the part that remains of the concept of the *universe* after the extraction (against nature) of *time*. The work identifies *space-energy-mass* with dark *matter*, a notion present in contemporary cosmology;
  - *time* and *space-energy-mass* are explained (presented) by logical-mathematical models of the discontinuous. The mathematical formalism of the linear continuum will be used less often, and the results will be quantified;

[1] The common nouns that refer to concepts redefined in this work I will write them with italics.

  - *quantum gravity*, defined here, is the element that gives dynamics to the universe;
- the cosmological inflation hypothesis is preserved;
- based on the axioms, definitions and theorems in the work, we have built a software application that generates models of universes that can be analyzed through the generated reports and images. The work presents, for different definitions of universes, several reports and images. Due to the huge calculation times, evolutions of universes unfolding only over several million units of Planck time are presented. The digital model has no claim to calculate, step by step, the universe over long periods of *time*, which is why it does not address problems related to the way *dark energy* acts ; however, in order not to appear gross violations of the laws of conservation of energy, algorithms quantitatively store dark *energy* perhaps for future developments;
- by its consequences, this work:
  - it answers or invalidates, or it makes useless some questions like*: If the universe is finite, then what is beyond it? or How is it possible that all this huge amount of matter in the universe has arisen from nothing or has been concentrated at an infinitely small and dense point?*
  - to answer the above questions, this work does not force us to add new hypotheses such as *the cyclicality of Big Bangs and implosions* or the interaction with parallel *universes* (how can they be parallel if they interact?!) and this only to save the hypothesis of the hot Big Bang;
  - the work excludes one of the hypotheses of the end of the universe, namely *the hypothesis of the great frost;*
  - cancels *the Information Paradox of the Black Hole* of Stephen Hawking, because according to this work (The Cold Big Bang Model) and associated articles there is another process related to black holes that causes the Hawking radiation not to lead, in the end, to their evaporation;

- the *missing* process mentioned above explains why there are super massive black holes in the universe as long as it seems that the age of the universe is too small to permit the formation of such giants only by the absorption of matter and/or by fusions and/or by direct implosion of matter in the early universe;
- the work shows that the value of *the gravitational constant* decreases over *time* and in addition it depends on the age and total mass of the universe. At the Lindau Nobel Laureate Meeting in 1979, Paul Dirac made a similar hypothesis.

Introduction

This work is a plea in support of the idea that the universe in which we live is a simulation, that is, there is a Person, a Consciousness that thinks of a mechanism of construction of components that evolv and engage in a unitary whole that I will call the Universe. [2]

Obviously, a logical-mathematical demonstration of the above statement cannot be made, but I will try to give it value by building, literally, a digital model that contains both the construction mechanisms and the resulting components of a unitary whole that could be the primordial Universe at the level of human understanding.

Corollary 1

Let's note the following:

- so far we have not had to deal with the notions of space and time;
- the assertion of some that a Creator of the Universe *"could not have existed for the simple reason that prior to creation that had the effect of the very appearance of space and time there could be no other space and time in which the Creator acted"* is a statement that has no support, since the Creator could be a timeless Person from the point of view of the created time, that is, He could live in another space and time than that resulting from Creation.

[2] In this work I use the notion of *„universe“* with reference to all that existsand. *„Universe“*– with capital – with reference to the model of the universe describe here.

- a simplistic but suggestive model of the above idea is the activity of creating a software application by a programmer:
  - from nothing material the programmer builds an entire "universe";
  - the programmer's thinking, transposed into the programming environment, is the very application in question;
  - the space and time of the programmer are those that we know, that is, those of this universe, while the space and time of the application are completely different, respectively, the memory space and the frequency of the processor.
- in the paradigm of these statements we get rid of the idea of the universe which, mechanically, is infinitely cyclical – that is, the Big Bang, implosion, the Big Bang, implosion, etc. –
- the notion of a multiverse takes on another content: there is only one Universe – the one conceived by the Programmer. This Universe may consist of parts that do not interact, i.e. "*parallel universes*" (v. §Multiverse).

Since the human race has no concepts and words to describe this beginning, when there was nothing, we cannot describe Creation as if we were within it. I rely on the verse in the Bible (Genesis. 1:26-27) when I dare to believe that we have the right to try to look back at the Big Bang from the outside, as if we were witnessing the way the universe was built. To the question *of what outer space and time this Big Bang occurred in,* my answer is in the space and time *of thought.*

In the next chapter I will give an idea of how thought constructs objects, object *space* and *time*.

Unlike the classic models, we have chosen here a step-by-step construction model of *space* and *time*, a model in which *the energy-mass* in the Universe is generated in parallel with *space* and *time*. So, I do not take into account the idea that the universe was born from an infinitely small singularity, dense and hot, because of the difficulties of understanding, on a physical level, the notion of a singularity, even if from the point of view of mathematical

analysis the notion is not foreign to me. Paraphrasing Stephen Hawking I would also ask: "*In what space and time was there this infinitely small and dense singularity that encompassed the entire amount of matter that fills the universe today, when there was still neither time nor space?* "

By my logic, I cannot accept the idea that all the energy-mass in the universe already existed, in its entirety, before the creation of space and time, and then spread to the whole universe.

That's where the name *cold Big Bang* that I gave to this work comes from in opposition to the idea of contemporary cosmology that the primordial universe was extremely hot.

Brief considerations about continuous spacetime

Before proceeding to the description of a discontinuous or discrete model of *space, time* and *energy-mass,* I try to make below a criticism of the application of the linearspace-time continuum in physics. At the same time, I try to suggest, no more and no less, that mathematical thinking has its own discrete *time;* disregarding this *time* leads, in some cases, to paradoxes.

They say that a set is discrete or countable if there is a bijective function defined on that set with values in the set of natural numbers or on a subset of natural numbers.

Zeno's paradoxes of Elea (ca. 490 î.Hr. – about 430 î.Hr.)

The paradox of Achilles and the turtle

The simplified statement would be: *How can one travel distance x, from point A to point B,* as long as it is necessary to travel first half of the initial *distance, i.e. x/2 then, it is necessary to travel half of the remaining distance, so a quarter of the total distance, or x/4. And so on for the following distances (x/8, x/16 ...)?*

Suppose I met two math students at a brewery and asked them this question, what would they answer? Probably, on a napkin at the table would write the following:

Let $D_n = \sum_{k=1}^{n} \frac{x}{2^k}$, for n > 0, no. natural; $\lim_{n\to\infty} D_n = \frac{\frac{x}{2}}{1-\frac{1}{2}} = x$; Q.E.D.

I understand (I would say). But Zeno's deeper question was: *How is it possible that through an infinite number of actions I travel a finite distance?*

- Here's the sir, I just showed you how! (one of them would answer).
- Ok, how good that we invented or discovered the linear continuum! But what about that what do you say?

The paradox of dichotomy:

His statement would be: *Suppose someone wants to go to the end of a road. Before you get there, you need to get to the halfway point. Before they get to the middle of the road, they have to make a quarter of the way. Before you travel a quarter of the way, you need to travel an optimal; before an eighth, a sixteenth; and so on.*

The paradox is that there is no first distance to be travelled, because any possible (finite) distance could be divided in half and therefore cannot be first. So the journey can't even begin. The paradoxical conclusion would then be that movement over any finite distance can neither be completed nor begun, so any movement must be an illusion.

Let me now resume the discussion with my much younger imaginary colleagues, on the same topic, but simplified:

- Dear ones, so it can be reached from point A to point B.
- Categorical!
- Then it means that you can also get from B to A, going back through all the countable steps in your geometric series. So what's the first step from B to A?

Of course the question was rhetorical. I didn't wait for the answer; I had finished the beer and the budget. Or... who knows? Maybe they'll respond in a future PhD thesis.

The *paradox of the arrow*

According to Aristotle's story, Physics VI: 9, 239b5

"*If everything that occupies a space equal to [himself] is at rest, and if what is in motion always occupies such a space at any time, the flying arrow is actually motionless*" or in otherwords: if the arrow is motionless at every moment and time is composed entirely of such moments, then movement is impossible.

The question is: is it that two and a half millennia after the formulation of these paradoxes, during which we have developed mathematics and physics so much, can we still understand and accept these reasonings? On the road of development of science, on which we walked, we did not leave behind some unexplored paths and now it is very difficult for us to go back and ask *ourselves: what would it have been like if we had thought otherwise from the beginning?*

These paradoxes would have no object if we questioned one of the hypotheses that Zeno used in his paradoxes, namely that between any two different points in space or time there is always another point distinct from the other two, that is, if we dropped exactly the definition of the continuum.

Logical-mathematical *paradoxes*

There are several statements about objects that belong to the field of mathematics and that developed on the basis of a mathematical logical reasoning lead to conclusions that contradict the conventions, axioms, definitions or demonstrations stated previous. These statements we call paradoxes. The vast majority of mathematicians state that these statements are not logical-mathematical paradoxes, but only paradoxes generated by common language. Of course, we will never accept that the beauty and grandeur of mathematical thought is actually based on vaguely defined notions such as that of the *set* or of *natural number*, and finally, this thinking leads to paradoxes.

- Here's one such statement: *Let A be the set of all abstract notions; since A is in turn an abstract notion it follows that A is a set that encompasses itself as an element.*

The major stupor that this statement causes is that only in six words do we build an object that cannot be analyzed with mathematical formalism. Indeed, mathematics does not work with statements like this: *either A a set with property* $A \in A$.

There is at least one way to avoid this paradox

Let's introduce the following **Definition**:

1. Mathematical thinking is the form of thought that is based on mathematical logic.

Let's introduce the following **Axioms**:

1 Mathematical thinking creates objects of thought. The totality of the objects of mathematical thought forms the space of mathematical thought.

2 Mathematical thinking is carried out in countable steps then and only when, as a result of thinking, an object has resulted that can no longer be analyzed with the mathematical tools defined previously, or that did not exist in the previous step.

I will not address the discussion here if the creations of mathematical thinking belong to objective reality.

Definition: 2. I call *time* proper to mathematical thinking the sequence of countable steps resulting as an effect of *axiom 2*. For simplicity I will say that within this paradigm, the *time* of mathematical thinking is the set of natural numbers, supplemented by element 0, which I write down with N. In everything that follows the *time* of mathematical thinking I will simply call it *time*.

Corollary: 2. There can be no moments or intervals of time when nothing happens.

Let's resume the above statement, based on the definitions and axioms stated:

- **Time** moment **0**. I'm saying: *Be the set of all abstract notions.* So, according to *Axiom 1*, we have created a new object, A_0. It can no longer be analyzed with the previously defined mathematical tools, since it would result in $A_0 \in A_0$, so according to *Axiom 2*, I have to give the clock of *time* to mathematical thinking with one unit ahead.
- **Time** moment **1**. The statement *Be* the *set of all abstract notions*, whether they rethink it or not, it still remains active, since it has not fully consumed its effects. Resuming the reasoning, we have created a new object A_1 that is not to be contained as an element, but must contain both the abstract notions considered at the moment 0 and A_0, the new object built, according to *Axiom 2* at the time moment 0; thus: $A_1 = A_0 \cup \{A_0\}$ But A_1 is also an abstract notion, left orphaned, in the sense that it does not belong to any other set of abstract notions defined above, so the clock must be given one unit before.
- **Time** moment **2**. Without repeating the previous reasoning, I created the object
  $A_2 = A_0 \cup \{A_0, A_1\}$
  -
  -
  -
- **Time** moment **n**. $\forall n \in N$. The newly created object is
  $A_n = A_0 \cup \{A_0, A_1, A_2, \ldots A_{n-1}\}$
  In the end I found *the set of all the abstract notions* that I will write down (through abuse of notation) with $A\ \aleph_0$[3]. This set can be analyzed with the tools defined so far;
- it does not encompass itself as an element;

[3] I wrote down with $\aleph_0$ cardinal number aleph 0. The concept belongs to the set theory and was introduced by the mathematician Georg Cantor, which defined the notion of cardinality as the size of infinite sets that can be well ordered

- it encompasses all the abstract notions ever considered, that is $\forall\, k \in N$, $k < \aleph_0$ and $A_k \in A\, \aleph_0$;

➢ One last example: either the sentence P with the statement: *This sentence states about itself that it is false.*

If the sentence is false then what it says is false, so the sentence is true. If the sentence is true then it is true what it says is therefore false; we have a paradox.

Let's analyze the sentence based on the axioms above:

- **Time** moment **0**. I think of a sentence with the statement: *This sentence states about itself that it is false.* Reasoning: According to its own content, the statement is false, so it is false that the statement is false, that is, the statement is true. This reasoning, according to *Axiom 1*, has created a new object, that is, the sentence P_0 that is true, that is, its statement is true. So I started from a false statement and then found the statement to be true. Since in mathematics a statement cannot be at the same time false and true we must apply *axiom 2*, that is, give the clock of *time* to mathematical thinking with a unit ahead.
- **Time** moment **1**. So I'm at the time of *time* 1 and I know that P_0 is true. The reasoning: *P_0 is true that is, it is true what it states, but it states that it is false, so it is true that* it is false, so it is false leads me, according to *Axiom 1*, to the fact that I have built a new object, that is, the sentence P_1 that has the same statement as P_0 but that this time it follows that it is false. Since a statement cannot be both false and true at the same time, I must invoke *Axiom 2*, that is, give the clock of *time* to mathematical thinking with a unity ahead.

And so on, development can continue and it can be demonstrated by induction that P_n is true at the moment of *time* n even and false for n odd. The paradox was raised because we are no longer dealing with a sentence that is simultaneously both false and true.

I state that all logical-mathematical paradoxes can be treated on the basis of the two axioms above, that is, by introducing the notion of *time* into logical-mathematical thinking.

There is no cause for concern for the fact that mathematics should be rewritten, taking into account the two axioms. For example, geometry, according to Hilbert's axiomatization, could have at most two moments of *time:* moment 0 of the axiom formulation and moment 1 of the creation of Euclidean space (if the last axiom were the postulate of Euclid's parallels). If a student were asked to prove that the sum of the angles of a triangle is 180^0, probably the student would say: *I build a certain triangle and through a vertex I carry a parallel to the opposite side, and then analyze the angles formed in this vertex*. In fact, the student did not build anything, the triangle and the parallel already existed at time 1, before he even drew them. In conclusion, no new objects were created, all possible geometric objects being created at time 1.

Big bang, discreet model, space, time, energy-mass

I tried in the previous chapter to do the following things:

- a brief critique of models based on the linear continuum showing that in certain situations these models make it difficult to understand physical reality, and I am also referring here to the notion of the singularity that appears in the geometric patterns of gravity;
- we have shown that it is reasonable to consider that thinking based on logical-mathematical can create objects of thought and at the same time be the engine of discrete *time* movement.

All this I did so that the idea presented in the introduction, namely that we live in a universe that could be a simulation, no longer seems so exotic.

In this regard, I would like to present a constructive model of the formation of the Universe from scratch. For biological and technological reasons this model will not be able to be developed to the present stage reached by the universe, but I believe that it will be able

to fill the gap of knowledge relative to the first moments of the creation of the universe.

I continue with the following axioms and definitions:
Axiom:

3 The Big Bang (BB) built step by step *space*, *time* and *energy-mass.*

4 *Space* is discreet and not continuous and is formed, where the construction of *space* has ended, from indivisible units of *space*.

5 BB started from a single such unit and not from an infinitely small, dense and hot point.

6 Physical space contains, since its formation, *energy-mass* and is not a empty space into which matter is then poured. This primordial form of *energy-mass* I called *dark matter* with direct reference to the same name in contemporary astrophysics.

7 A *unit of space* contains at its formation an indivisible amount of *energy-mass* corresponding to a frequency of $1s^{-1}$ based on Planck's formula.

8 *The energy-mass* can be moved to another unit of *space* under the following conditions:
- if the entire amount of *energy-mass* has been moved, the unit of initial *space* does not remain empty, but in it spontaneously appears the indivisible amount of *energy-mass* defined above.

In order not to start this work with a violent violation of the principles of energy conservation, I will refer, only metaphorically, to the notion of *dark energy:* its appearance is the price that must be paid in order to be able to build, from nothing, the entire Universe; it is as if every time *Axioma 8* is applied, a spring would compress a little and we know will come for a while when it will have to relax, returning all the potential energy accumulated. *Dark energy* is not the subject of this work, because here I deal with the (extremely) early stages of the Universe, stages in which

dark energy still does not act. However, in the table in *Panel 2*, the accumulation of this energy is calculated step bystep. The principles underlying this calculation will possibly be the subject of another work.

***Definitions**:*

3 I call *physical time* that subset of *time* proper to mathematical thinking that refers to objects appeared in the thought process of BB (see the previous chapter, the subchapter of logical- mathematical paradoxes).
For simplicity, I will call it *time,* and the moments of *time* I will write them down with natural numbers.

4 The indivisible units of *space, time* and *energy-mass* I will call them Planck units of *space, time* and *energy-mass* respectively, without any reference to quantum mechanics. Next I will use the abbreviations:

- **Psu** pentru Planck space unit;
- **Ptu** for Planck time unit;
- **Peu** for Planck energy unit.

The Ontological Principle of Digital Modeling

In a digital modeling, the analysis can be done on the basis of the linear continuum, but the application is made by quantifying the results, this since the continuum cannot be modeled/simulated, because it would mean the modeling/simulation of infinity.

The basic construction of the Universe

Among the many possibilities of repetitive geometric construction, for this model we have chosen the one derived from the string of Fibonacci numbers, defined by the recurrence relations $F_0 =1$, $F_1 = 1$, $F_i = F_{i-1} + F_{i-2}$,, where $i \geq 2$, natural number. For example, for $i \leq 7$ the Fibonacci string comprises the following numbers: 1, 1, 2, 3, 5, 8, 13, 21. An important clarification is that in most of the documentations about this string, the first Fibonacci number is 0 and

then follows 1, 1, 2, 3 and so on. I did not choose this variant because for the construction algorithms that I use, the value 0 associated with the index 0 has no meaning. As a result, if you want to apply the formulas of this model of universe you will have to use the above definition or take into account that the F_i in this work is F_{i+1} from the usual documentations.

We made this choice because of the beauty of this construction, due to the surprising formulas that link the Fibonacci numbers to each other and not least because the geometric patterns derived from this string are often found, at least in the living world.

Another important clarification is that the model presented here is a section of the Universe, this due to the difficulties related to knowing a priori the geometry of space, even more so of a discrete space.

This work has associated a software application that generates digital models of the Universe. The figures presented are screenshots generated by this application, from which we removed the command windows (menu, toolbar, status bars, etc.). When this is the case, I will present the mathematical formulas used but, without proof, this, on the one hand, so as not to increase the editing space, and on the other hand to let the reader focus on the essentials.

In *Figure 1* I present the first 7 steps (corresponding to squares 1, 2, 3, 4, 5, 6, 7) of the development in section of the Universe. The Fibonacci square with no. 1 is the primordial unit of *space* from which the BB started. Graphically, the side of this square is assigned a size expressed in pixel. The side value is chosen by the user and intervenes only in the graphical interface, for the transformation of objects, from theinternal representation, to the representation defined by the screen coordinate system. All algorithms are independent of the graphical context. In the images presented in

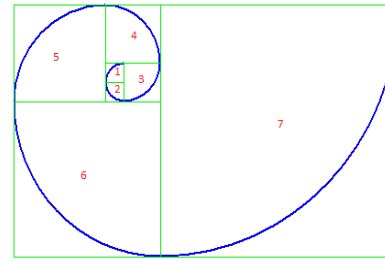


Figure 1

this work, the primordial unit is a square with a side of 20 pixels.

According to the definitions and axioms defined above, we can write:

- *elapsed* time: 7 Ptu, the Planck clock recording one unit of *time* for the construction of each Fibonacci square (1, 2, 3, ... , 7);
- built space: 273 Psu (the sum of the areas of all 7 squares built, that is, the sum of the squares of the Fibonacci numbers, starting with the iteration 0 to 6: $1^2 + 1^2 + 2^2 + 3^2 + 5^2 + 8^2 + 13^2 = 273$ Psu;
- *the mass-energy* of the Universe at the moment is 273 Psu $\cdot$ 1 Peu/Psu = 273 Peu ie: $273 \cdot 6.6260755 \cdot 10^{-34}$ J;
- the information used until now to construct the Universe section from *Figure 1*: we traverse the Fibonacci sequence starting from the index i=0. The square no. 1 from the figure is the primordial Planck space unit. From the upper right corner of the square we construct an arc of a circle with the radius F_0 to the opposite corner so the arc drawn counterclockwise to be within the interior of the square;

For i = 1: at the end point of the arc from the previous step we take the tangent to the arc and in the direction indicated by the arc we build a segment with the length F_1. On the perpendicular to this segment, in the free point of the segment, in the direction of the previously built arc, we take a segment also with the length F_1. We close the square no. 2 adding the missing segment. At the end of this step we build the arc of the circle, with the radius F_1, from the end point of the anterior arc to the opposite point of the square no. 2.

For i = 2, 3, 4, 5, 6 we always repeat the algorithm from the previous step, obviously the values of the radius of the arcs and the length of the segments will be F_i.

Definitions:

5 The Spiral of Fibonacci drawn in *Figure. 1* with arcs and blue color, I will call it the golden *spiral*, although it is an approximation of the golden spiral as it is definedin literature. The end point of the first arch of the golden *spiral* I will call it the absolute center of *construction of* the Universe, and the end points of the other arches *I will call relative centers of construction of* the Universe. From the primordial unit (square no. 1 in *Figure 1)* three more golden spirals can be built, as shown in Figure *2*. The developments generated by the four spirals push the *space* in four cardinal directions. As a result, I will baptize after the cardinal points (E, N, W, S) these golden spirals that are the true builders of the model of the Universe presented here.

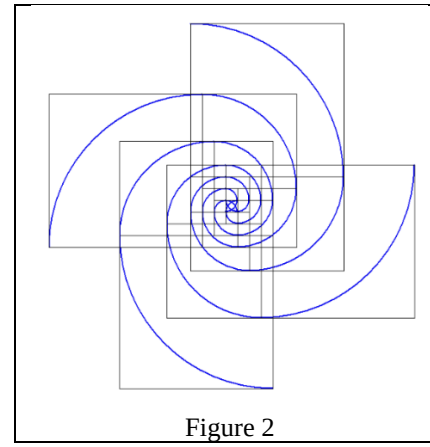


Figure 2

6 I call the number of *iterations* of the basic construction of the Universe the last index of the Fibonacci number used in the construction algorithm.

Cosmological inflation

Within the model described here, no matter how many steps the basic construction of the Universe may *take*, it will not encompass enough *energy-mass* that would lead to the formation of billions of observable galaxies. In addition, *the space* would remain made up of larger and larger cells as the indices in the Fibonacci string advance. As a result, we have introduced here the inflation hypothesis, inspired by the cosmological model generally accepted today.

Definition*:*

7. Inflation is the completion of the generation of the Universe. After the completion of the basic construction, the first *step* of inflation follows; it consists of a construction similar to the basic construction, this time carried out in each relative center of construction of the *Universe.* As a result of this process, new golden spirals are generated. The next steps *of inflation* follow the same rule, that is, each end point of arc becomes the relative center of construction of the *Universe,* for each arc of each golden spiral generated in a previous *step.* One end of the arch can be once relative center of *construction.* Each *step* of inflation will have the same number of *iterations* as that of the basic construction.

Figure 3 shows the end of the first step of *inflation,* applied to the partial construction shown in *Figure 1*. Of course, inflation had to be applied to the basic construction shown in *Figure* 2; we did not do so, because the resulting image would be too dense and therefore complicated to understand. You can see a few Psu already established and the expansion *of the space* from the basic construction.

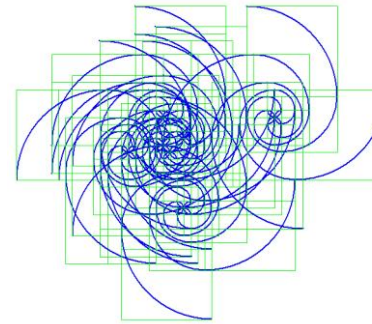


Figure 3

According to *Axioms 6 and 7*, inflation adds additional *energy-mass* or in other words heats up the *space*.

Definition*:*

8. I call *the definition of the Universe the* pair of natural numbers C|I where C is the number of *iterations* of the basic construction, and I is the number of *steps of inflation.*

Based on what is said above, *Figure 2* shows a Universe with the definition of 6|0.

Inflation adds more *space, time* and more *energy-mass* to the existing model. I will present some formulas:

- the *time* duration of inflation with the number k=0, 1, 2, 3, ..., I is:

(1) $$T_k = c_1\, 4^{k+1}(C+1)^{k+1}$$

Where $c_1 = 1$ Ptu is a constant (to ensure the consistency of units of measurement); for $k = 0$, T_0 is the duration of the basic construction of the Universe or, based on this formula, inflation 0;

- the age of the Universe with the definition C|I will be: $T_{total} = \sum_{k=0}^{I}(T_k + Ŧ_k)$, $Ŧ_k$ being the age accumulated after the end of inflation with no. k, as a result of other processes that will be described later;
- *the mass-energy* generated during inflation k is: $ɗb_k = c_2\, 4^{k+1}\, F_C\, F_{C+1}\, (C+1)^k$, where $c_2 = 1\, \frac{Peu}{Psu^2 Ptu}$ is a constant; $\frac{Peu}{Psu^2 Ptu}$for $k = 0$, $ɗb_0$ is the *energy-mass* generated during basic construction.

It is interesting that taking into account the formula (1) it can be written:

(2) $$ɗb_k = c_2 \frac{F_C\, F_{C+1}}{C+1} T_k$$

I would like to remind you that the notation F_i represents the number of Fibonacci of the index i. As a result, the total *mass-energy* of the Universe with the definition C|I will be:

(2') $$M_{total} = \sum_{k=0}^{I}(ɗb_k + ɋp_k)$$

$ɋp_k$ being *the mass-energy* accumulated after the end of inflation with no. k, as a result of other processes that will be described later.

Some clarifications are still needed in relation to the units of measurement. The construction of this model starts from natural numbers that are initially not associated with physical quantities. During the development of the model, some concepts expressed quantitatively by numbers receive physical interpretations to which are attributed, according to the context, units of measurement of length, mass or *time*. For example, fibonacci numbers are interpreted here as lengths; F_i where $i \in N$ are interpreted as the sides of the Fibonacci squares that build a section of the Universe, as we indicated above. To

compensate for this shortcoming we chose the artifice with the unit constants ϵ_1 and c_2.

Note that the formula (2) shows a connection between *space* (F_c and F_{C+1}), *time* and *energy-mass*.

One of the many interesting properties of the Fibonacci string is that the string $\left\{\frac{F_n}{F_{n-1}}\right\}_{n\epsilon N, n>1}$ has a limit and $\lim_{n\to\infty} \frac{F_n}{F_{n-1}} = \varphi$ which is the famous golden number; this can also be defined as the positive solution to the equation $\varphi^2 - \varphi - 1 = 0$ and has the value $\varphi = \frac{1+\sqrt{5}}{2}$ If we multiply with and divide by F_c, we get:

(2'') $$ð_k = c_2 \frac{F_C^2 \frac{F_{C+1}}{F_C}}{C+1} T_k \approx \varphi \frac{F_C^2}{C+1} T_k$$

I assigned to φ the units of measurement of c_2. . In the sequence defined above, the element with index 14 already approximates the golden number to the fifth decimal place, and the approximation increases as the index increases.

The formula (2") shows a connection between *space, time, energy-mass* and the golden number.

Phase transition

Figure 4 represents the end of inflation in the model with definition 6|1. In this figure were omitted golden spirals. The basic construction was shown in Figure *2*. After the application of the first inflation, the pattern became more complex and apparently more space cells of equal in size were formed with the primordial cell, denoted by no. 1 in Figure *1*. What is seen in the figure is actually an overlap of the F_i squares generated by the construction algorithm. The appearance of small square cells, all of which have the same length of the side, is not forced by the software algorithm of construction, but results simply as

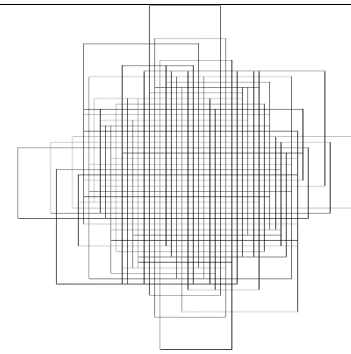


Figure 4

a result of the application of inflation to the basic construction. It can be shown that, whatever a cell and a Fibonacci square, the cell can either be included in the square or outside it, with partial overlays excluded.

Definition*:*

9. I call *phase transition* the process by which the section of universe generated following the basic construction and following the application of an inflation step is completely divided into elementary cells of *space*. Each cell receives, according to *Axiom 7*, a quantity of *energy-mass,* namely 1 Peu for each square Fibonacci (F_i) in which the cell is included or inother words, from the overlapping cells results in a single cell that will receive the sum of the *energy-mass* quantities of the overlapping cells.

From *Figure 4* it can be easily inferred that the cells on the edge of the section, which obviously belong to a single square, will be associated with 1Peu.

Figure 5 re-shows graphically the result of the phase *transition* for a Universe with definition 6|1.

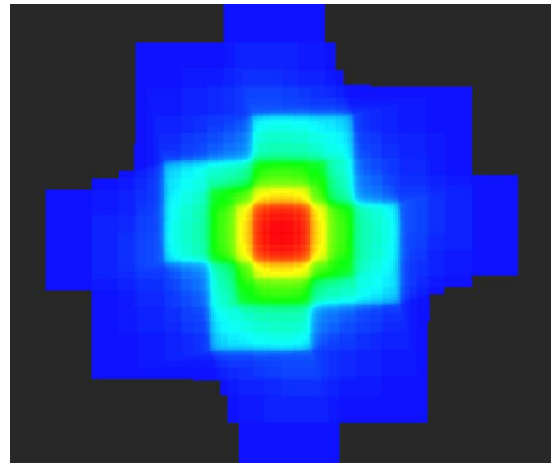


Figure 5

It is evidentied by color shades descres of *energy-mass,* on the red, yellow, green, blue and dark blue scales. Image rasterization is the effect *of the phase transition* that divided *space* into indivisible and individualized cells. *The* built space is just the convex polygon in the

image; the black background has no meaning, it is just the rest of the surface of the display used.[4]

Distance

I write down QS and call it quantum *space*, the set of all cells resulting from the *phase transition*.

I define the function: d: $QS^2 \rightarrow (\{F_n\}_{n\varepsilon N})^4 \cup \{(0,0,0,0)\}$ where $\{F_n\}_{n\varepsilon N}$ are the Fibonacci numbers and $\forall$ (a,b) $\in QS^2$, d(a,b) = (d_1,d_2,d_3,d_4) where d_1,d_2,d_3,d_4 are the sides of the Fibonacci squares in which cell b is found in each of the four developments generated by the golden spirals S, E, N and W, started from cell a (v. *Definition 5*).
By definition $\forall$ x $\in$ QS, d(x,x) = (0,0,0,0).$\forall$

[4] In this way I also answer the question: *If the universe is finite, then what is there outside of it?* The answer is: *If the Personu, the Consciousness that builds the niverse thinking it does not put anything in what we call "apart", then this "outside" exists only in our imagination.*

Table 1 shows the values of the function d for several values assigned to the arguments, for a universe with the definition of 6|3.

id_qs1	id_qs2	d1	d2	d3	d4
1	2	1	5	3	2
1	3	8	5	3	2
1	4	8	5	3	13
…	…	…	…	…	…
2	1	3	2	1	5
2	3	1	5	3	2
2	4	8	5	3	2
…	…	…	…	…	…
3	1	3	2	8	5
3	2	3	2	1	5
3	4	1	5	3	2
…	…	…	…	…	…
4	1	3	13	8	5
4	2	3	2	8	5
4	3	3	2	1	5
…	…	…	…	…	…

Table 1

In the internal representation of the digital model to each cell belonging to the QS, a natural number is associated in the order of cell generation by the *phase transition* algorithm. In the first column are listed the cells taken as the base, that is, those from which the four spirals start. In the second column are the other cells, and in the last four are listed the Fibonacci numbers, that is, the sides of the Fibonacci squares in which the cell *id_qs2* is found in the developments started from the *id_qs1* in the directions S, E, N and W. By abuse of language we could say that the table next to it lists the four coordinates of *id_qs2* in a landmark with origin in *id_qs1*. We have said by *the abuse of language*, because the four coordinates are not independent, so the flat section in which we work does not have four dimensions. Indeed, the following theorem can be demonstrated:

Theorem 1

Whatever the definition of the Universe and $\forall$ (a,b) $\in QS^2$, a $\neq$ b so that d(a,b) = (d1 ,d_2,d_3, d_4), where d_1, d_2, d_3, d_4 $\in \{F_n\}_{n\varepsilon N,}$ then d(b,a) = (d_3, d_4, d1, d_2,).

The demonstration of this theorme and the following is not included in this work, for the reasons set out above (see §

The basic construction of the Universe, last paragraph). Let's study this result more closely, using an analogy: either, in the Euclidean plane, the points $a(a_x, a_y)$ and $b(b_x, b_y)$, $a \neq b$. Using the previous notations, either $d'(a,b) = (b_x - a_x, b_y - a_y)$ the coordinates of b in relation to a and $d'(b,a) = (a_x - b_x, a_y - b_y)$ the coordinates of a in relation tob. Suppose that, for various reasons, we do not want to work with negative numbers and we should find another method of writing the coordinates when changing the reference frame. Without question, one possibility would be this:

(i) $d'(a,b) = (b_x - a_x, b_y - a_y) \stackrel{def}{=} (b_x, b_y, a_x, a_y)$

(ii) $d'(b,a) = (a_x - b_x, a_y - b_y) \stackrel{def}{=} (a_x, a_y, b_x, b_y)$

Of course, the analogy of the definitions (i), (ii) with *Table 1* only goes up to a point; for example, in (i), when b_x, b_y go through the set of real numbers, a_x, a_y remain invariable. This partial analogy suggests to me the definition of a new function. Under the conditions of the definition of function d in the debut of this subchapter I define:

D: $QS^2 \rightarrow R^2$ so that $\forall (a,b) \in QS^2$, $D(a,b) = (|d_1 - d_3|, |d_2 - d_4|)$, where $d(a,b) = (d_1,d_2,d_3,d_4)$

By definition $\forall x \in QS$, $D(x,x) = (0,0)$. (I always put this condition because I did not include the number 0 in the string $\{F_n\}_{n\varepsilon N}$)

The difference module of two Fibonacci numbers is generally not a Fibonacci number. Fortunately for the coherence of this digital model, the following remarkable theorem can be demonstrated:

Theorem 2

Under the terms of the definitions in this subchapter, whatever the definition of the Universe and $\forall (a,b) \in QS^2$, $a \neq b$ such that $d(a,b) = (d_1, d_2, d_3, d_4)$ then: $(|d_1 - d_3| , |d_2 - d_4|) \in (\{F_n\}_{n\varepsilon N})^2$.

Before I go any further, I present in *Figure 6* a screenshot showing the first phases of building the model 6|1.

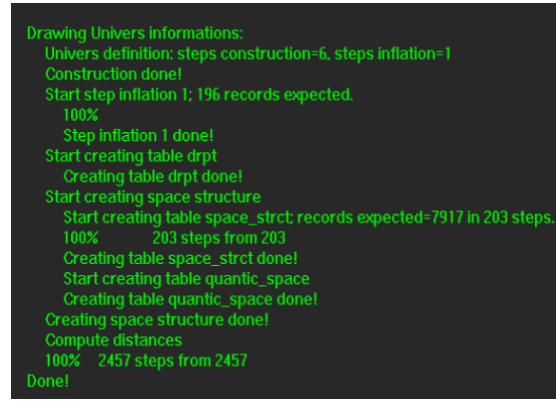


Figure 6

- Rows 2 and 3 refer to the beginning and end of the basic construction of the Univer-s (see § Basic construction).
- Row 4 refers to generating the first step of Inflation (v. §Cosmological inflation). According to the formula (1), it lasts $T_1 = 784$ Ptu. According to *Corollary 2* in each unit of time Planck something happens and the construction of this *something* requires processing time in the digital model. Designing the inflation algorithm, we found a shortcut that allows to calculate inflation only in the E direction (see *Definition 5* and *Figure 3*) and then extrapolates to the other three remaining directions, N, W and S (see *Figure 4*), which saves processing time. For this reason, only 196 records are listed in *Figure 6*, i.e. 784/4.
  - The algorithm continues with the creation of two tables with intermediate data, *drpt* and *space_strct*, and then the algorithm that deals with the phase *transition* and quantum *space* (see §Phase transition and Figure *5)* comes into action.
  - Whereas the remote function D_2 (v. *The theorem 3*) between the cells of quantum *space* is used, in this digital model, a huge number of times and in order not to calculate it over and over again, at the end of this phase the complete table of all distances is built, a table similar to Table *1*.

  - Finally, the 6|1 universe has, so far, the following characteristics:
    - Age = $T_0 + T_1 = 28 + 784 = 812$ Ptu.
    - Total *energy-mass* = $ↀ_0 + ↀ_1 = 31668$ Peu.

- Number of cells of quantum *space* = 2417.

Quantum trigonometric gravity

In this chapter I will present the *gravitational interaction* between *the mass-energies* resident in the cells of quantum *space.* In order to be able to operate with known notions, I will assume that over the section of universe generated so far by the digital model, I can stretch a two-dimensional linear continuum that, at least in portions, can be assimilated with surfaces from the Euclidean plane.

The definition of *trigonometric gravitational interaction* comprises the following steps:

1. For each cell of quantum *space, let's* denote it abbreviated z, calculate the *gravitational interaction* with all other cells, for each of the four directions of development of the golden spirals: E, N, W, and S started from z (see Definition *5*).
2. For each individual case, the result of the calculation will be a vector (in the Euclidean plane of the universe section).
3. Let (x,y) be the starting point of a Fibonacci square of index n generated by one of the four golden spirals, say E. For each cell in the Fibonacci square, the vector $\vec{u}$ is constructed according to the indications in *Figure 7,* as follows:

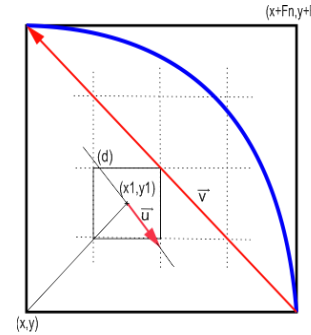


Figure 7

- Let be any cell in the Fibonacci square marked in *Figure* 7 by the small square drawn with continuous lines.
- Let (x1, y1) be the center of this square.
- Let (x,y) be the lower/left corner of the Fibonacci square of index n; this point is also the center of the arc of the blue circle that is part of the spiral E. The drawing direction of the arc is from the right/bottom corner to the upper left corner of the large square and is at the same time the meaning of the vector $\vec{v}$, defined as seen in the figure.
    - Build the line (d), perpendicular to the line (x,y) ÷ (x1,y1) at the point (x1,y1).

- In the direction of the line (d), in the reverse direction of the vector $\vec{v}$, the vector $\vec{u}$ ($\cos(\vec{u}, \vec{v}) < 0$) is constructed.

Definitions*:*

10. By definition, the module of the vector $\vec{u}$ will be: $\|\vec{u}\|$ = K $\frac{EM_z}{{F_n}^2}$, where EM_z is the concentrated *energy-mass* in cell z, F_n is the fibonacci number of index n (or the side of the Fibonacci square of index n generated by the spiral E started from z), and K is a proportionality constant so that the unit of measurement of $\|\vec{u}\|$ it is $\left[\frac{Psu}{Ptu^2}\right]$. Note that in the fibonacci square of the index n there will be ${F_n}^2$ vectors with the same modulus resulting from *the gravitational interaction* with concentrated *energy-mass* in cell z.
11. I will call *K* it the *gravitational constant*.

4. Repeat the algorithm from point 3, for each of the three remaining spirals: N, W and S.
5. Repeat the algorithms from points 3. and 4. for all cells *of* quantum space. In this way, in the center of each cell, there will be $4 \cdot (p-1)$ vectors (9664 vectors for definition 6|1), where p is the number of cells of quantum *space.*
6. For each cell individually, the central vectors are added together, obtaining a field of p vectors describing *the gravitational interaction* between *the energy-mass* resident in the cells of quantum *space.*

Gravitational constant

In classical mechanics, the gravitational constant has the value $6.67408\ 10^{\cdot -11}$ $\left[\frac{m^3}{kg \cdot s^2}\right]$ and is defined as being numerically equal to the force of gravitational attraction between two masses of one kilogram, at a distance of one meter. Since in this digital model the value of the *gravitational constant* is very important for the calculation of some parameters of the Universe, a definition like this does not help me: "In

this model, the value of the gravitational constant is numerically equal to the *gravitational interaction* between the *mass-energies* resident in two cells of quantum *space* located at a distance of 1 Psu and each loaded with 1Peu", if I cannot calculate, or experimentally deduce its value. As a result, I will work with an empirical calculation formula:

Definition 12**.**

I define the formula for calculating the *gravitational constant* as follows:

(3) $K = (\pi^2 \cdot \delta \cdot T_{total}^2)^{-1} \left[\frac{Psu^3}{Peu \cdot Ptu^2}\right]$

where δ is the average density of the Universe and T_{total} is its age.

Let's check this formula on the known universe; for this I will use the following data:

- δ = 5 protons/m^3;
- Mass of the proton = 1,673 $\cdot 10^{-27}$ kg;
- Number of seconds/year = 31556952;
- T_{total} = 13.8 billion years.

With this data results K = 6.3868 $10^{\cdot -11}$, a value surprisingly close to the known one. Coincidentally or not, the formula (3) does not define a constant.

In order to be able to apply *Definition 12,* I will have to complete the notion of "section of the Universe" used in paragraph 3 of chapter §1 in the sense that in order to speak of density in the units of measurement $\left[\frac{Peu}{Psu^3}\right]$, the section of the Universe must be three-dimensional by attributing a height of 1 Psu to each cell of quantum *space*. The vector calculus described in the previous chapter will be done in a median plane of this section. In this context I will note $\delta = \frac{M_{total}}{N_{total}}$ where N_{total} is the total number of cells of quantum *space* and M_{total} is the total *energy-mass* of the Universe. With this formula (3) it is written in the form of:

(3') $$K = \frac{N_{total}}{\pi^2 \cdot M_{total} \cdot T_{total}^{\,2}} \left[\frac{Psu^3}{Peu \cdot Ptu^2}\right]$$

At Lindau Nobel Laureate Meetings in 1979, Paul Dirac chose to talk about a subject that had preoccupied him for over 40 years, the so-called Big Numbers Hypothesis of 1937. In his lecture, Dirac assumed that the age of the universe and the gravitational constant were always inversely proportional. From this draw a number of interesting conclusions. One of them is that the gravitational constant varies with the age of the universe and is decreasing. Another hypothesis of his from 1937 is that the mass of the universe is proportional to the square of the age of the universe. Since the mass of the universe increases with time, this last hypothesis of Dirac is at odds with the classic Big Bang hypothesis which states that all matter in the universe was initially concentrated in the primordial singularity.

The formulas (2") and (3') are consistent with Dirac's hypothesis but, a bit inside out, that is, according to the formulas, the *energy-mass* of the Universe is proportional to the age of the Universe, not to the square of age, and the *gravitational constant* is inversely proportional to the second power of the universe's age and not to its first power.

In *Chart 1* you can see the slow decrease of the *gravitational constant* as an example of a Universe evolves.

I anticipate a little the results developed further, saying that our universe could fit, in terms of age, the amount of matter and the gravitational constant in one of the models with definitions ranging from 95|24 to 110|22. An accurate analysis will be possible when the development of this model will allow the calculation or at least approximation of the quantities φ_k and $Ŧ_k$ defined in §Cosmological inflation, as well as the number of cells of *quantum space*. At the present stage, these quantities are known only after the completion of the algorithms for the construction of the Universe. If we had a super computer, one that would process with the "working speed of our universe", we would have to wait billions of years before we know the quantities listed above.

Really:

- under *Definition 3;*
- based on *Formula (1)*;
- under the convention that 1 Ptu = $5.391245 \cdot 10^{-44}$ s
- taking into account that 1 year = $3600 \cdot 24 \cdot 365.2425$ s

it follows that for a Universe with the definition of 99|23, the processing time, only inflation 23 would be: $T_{23} = 4^{24} \cdot 100^{24} \approx 2.814749 \cdot 10^{62}$ Ptu = $15.175 \cdot 10^{18}$ s = 480.8767 billion years. Similarly it can be calculated that inflation 22 ends when the universe is 1.2052 billion years old. If we only took into account the age of the universe, it would be reasonable to assume that we live in a universe with definition 110|23 and at this time our universe would be at the beginning of inflation 23 (see *Chart 3).* Unfortunately, it is not correct to consider only the age of our universe to establish the definition of the model of the Universe in which we live, and that is because for any number given iteration (*see Definitions 6 and 8*) there is a number of inflation during which the Universe reaches the age of 13.8 billion years, as we have shown above.

If there was a formula on the basis of which we could calculate the no. of cells of quantum *space* according to the definition of the Universe, then we could calculate the mean density and further the *gravitational constant*. Under these conditions, putting $\varphi_k = 0$ and $Ŧ_k = 0$, $\forall\ k \in N$, we could find what are the definitions of the Universe for which at the age of 13.8 billion years, the *gravitational constant* is the one of today in our universe. That would fill many gaps in the knowledge of the early universe.

Energy-mass dynamics

Figure 8 shows the quantum *space* with the definition 6|2 to which the vector field that describes the *gravitational interaction* between the resident *energy-mass* in the cells of *space* has been attached. Judging by the direction and meaning of the vectors we could anticipate that the entire content of *space* is engaged in a vortex that would have the effect of gravitational collapse in the center of the masses. That's not the case. Even though due to the huge computing times I can only address extremely small definitions of universes, I expect that the *energy-mass* (i.e. *dark matter*) will not only focus in the center of themasses, but that there will be more centers of concentration. In addition, I expect the organization of dark *matter* into filaments. Otherwise the digital model described here would have little chance of describing the first moments of the real universe.

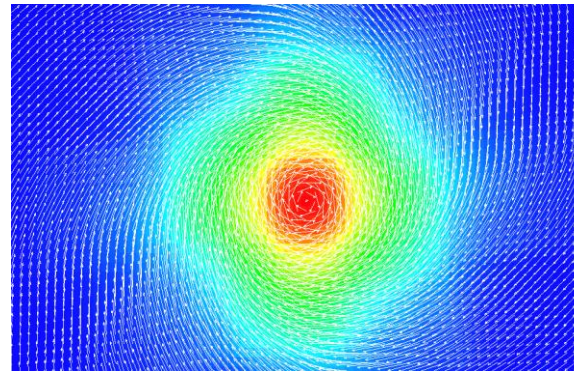


Figure 8

Figure 9 shows the four possibilities of transferring dark matter from the central cell, depending on the direction and the meaning of the vector $\vec{u}$ of *gravitational action*. This migration will be done according to *Axiom 8*. In addition, the transfer will only be made in a cell at a distance of 1 Psu. The only cells that are candidates to receive transferred dark

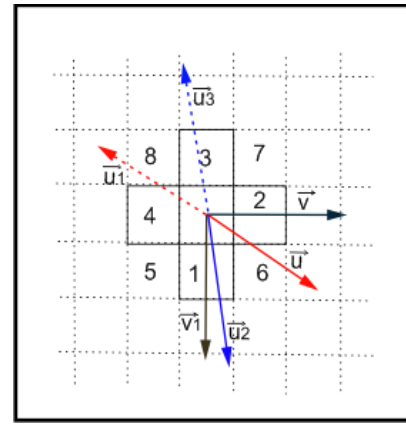


Figure 9

matter are: 1 on the development of S, 2 on the development of E, 3 on the development of N or 4 on the development of W. Cells 5, 6, 7 and 8 are found at 2 distances for any of the developments. If the vector $\vec{u}$ passes through a corner of the cell, since I do not know in which of the surrounding cells to transfer *dark matter*, I chose not to make any transfer. For the universe models that we were able to approach we did not find any situation in which the vectors $\vec{u}$ pass through the vicinity of the corners with a radius of less than 10^{-8}, in the internal coordinates of the digital model.

The *dark matter* transfer algorithm is simple:

- define the vectors $\vec{v}$ and $\overrightarrow{v_1}$ parallel to the axes of coordinates, of any kind and oriented as in the figure;
- the transfer will be done in cell 2 if the $\cos(\vec{u}, \vec{v}) > \frac{\sqrt{2}}{2}$;
- the transfer will be done in cell 4 if the $\cos(\vec{u}, \vec{v}) < -\frac{\sqrt{2}}{2}$;
- the transfer will be made in cell 1 if the $\cos(\vec{u}, \overrightarrow{v_1}) > \frac{\sqrt{2}}{2}$;
- the transfer will be done in cell 3 if the $\cos(\vec{u}, \overrightarrow{v_1}) < -\frac{\sqrt{2}}{2}$;

Definitions:

13 I denote internship the process by which *dark matter* in all cells of quantum *space* is moved over a distance of 1 Psu under the action of the vector field that describes *the gravitational interaction*. Taking into account the order in which the transfer of matter between cells in quantum *space* is made, an internship begins with the movement of matter from the first cell and ends after the movement of matter in the last cell. Since *dark matter* is in constant motion, crossing the cells of space, the end of one internship coincides with the beginning of another. The internships are carried out in discreet *time* and as a result are countable.

14 I complete *Definition 8* as follows: I call the definition of the Universe the triplet of natural numbers C|I|S where C is the number of iterations, I is the number of inflation and S is the number of the last development internship.

Using formulas from the uniformly accelerated motion with initial speed, from classical mechanics, we can write the equation from

which results the *time* in which the transfer is performed for each cell separately:

$$t = \frac{V - V_0}{\|\vec{u}\|} = \frac{\sqrt{V_0^2 + 2 * \|\vec{u}\|} - V_0}{\|\vec{u}\|}$$

where V_0 is the speed with which dark *matter* entered, in the previous internship, into the *space* cell that we are analyzing, and V is the printed velocity at the output of this matter as a result of the action of the vector $\vec{u}$; see also Definitions *10* and *11*. In the previous formula, the space traveled does not appear explicitly, since it is equal to the distance between two neighboring cells, that is, 1Psu. Obviously, for the internship no. 1. $V_0 = 0$.

According to the algorithm described above, for any cell of *space, dark matter* can be transferred to any of the directions E, W, N, S, except for cells on the border of the Universe. Obviously, the converse is also valid, that is, any cell can receive dark *matter* from any of the four directions. As a result, the digital model takes into account that the *energy-mass* in each cell can be assigned four speeds, one for each direction.

The *energy-mass* dynamics essentially depend on three elements:

1. *Axiom 8*.
2. The order in which the transfer is made.
3. Accuracy of calculations.

Without *Axiom 8* everything ends very quickly in a few internships, in the end the Universe becomes completely empty, except for the primordial unit of *space*.

The order in which *dark matter* is transferred between cells of quantum space depends on all the elements defined so far: on the function of distance, on the definition of *time*, velocities, on *gravitational constant* and on the algorithm for calculating vectors of *gravitational interaction*. In addition, this order in which the transfer is made in conjunction with *axiom 8* determines the place and time moment of *the* appearance of an indivisible amount of dark *matter* (see *Axiom 7)* that is added to the total mass of theUniverse.

Without a very, very high accuracy of calculations – which depends on the number of exact digits that the CPU can provide to the computer on which the simulation is made, the entire processing becomes chaotic, worthless, after only a few dozen internships.

Chart 2 shows the dynamics of *energy-mass* transfer or dark *matter (see Axiom 6)* between *space* cells in a universe with the definition of 6|1|15. The end of the transfer, shown in the table, has the effect of moving to the next internship, i.e. to the definition of 6|1|16.

The transfer is done from the *id_qs1* cell to *the id_qs2* during the *time* shown in the *Time* column. The transferred quantity is indicated in the Dark matter transferred column.

The units of measurement are those according to *Definition 4*.

Principle of symmetry

Analyzing the dark *matter* transfer tables between successive internships, a certain symmetry based on the number 4 can be observed. For example, in *Chart* 2:

- the number of simultaneous transfers is a multiple of 4; for transfers made in 11 Ptu is 1x4, the same for transfers made in 18 Ptu and for simultaneous transfers made in 24 and 25 Ptu the number is 2x4;
- the amount of *dark matter* transferred in simultaneous transfers is the same for every 4 transfers.

The number of cells of quantum space containing *the* same amount of dark *matter*at any time is divisibleby 4; these cells are organized by two pairs, the cells of each pair being symmetrical to the absolute center of construction (*see Definition 5*), forming a kind of force couples, more precisely the vectors that define the *gravitational action* have the same module and are in opposite directions in parallel directions. This causes all *dark matter* to rotate slowly, around the absolute center of *construction*, with different angular speeds.

They allow me to discuss in concepts of classical mechanics based on the linear continuum on the basis of the §Ontological Principle of digital modeling and the assumption made at the beginning of the subchapter §Trigonometric Quantum Gravity.

This type of symmetry is explained by the fact that the Universe is built by the 4 possible golden spirals that depart from each *relative center of construction* (*see Definitions 5 and 7*). What is not seen in the tables and images is another, deeper symmetry, in which the number 4 is involved, namely the four-step repetition of the algorithms for building the Universe even through a single golden spiral.

First quantification

Let's go back to *Chart 2* and analyze it from a different perspective, Thus, it is legitimate to ask ourselves: if the first transfer was made in the first 8 Ptu then, through the prism of *Corollary 2* what happened in the moments of *time* from 1 to 7? Based on §the Ontological Principle of digital modeling, the calculations of the dark *matter* transfer were made in floating point, then the results regarding *time* were rounded to the nearest integer, keeping the order in which the transfers were made (order given by the *floating* point times). Based on the same principle, consecutive natural numbers were assigned in the *Qtime* column, starting with 1. In this way *the times* were quantified, considering that these are the true *times* of the universe model and not those that come from floating-point calculus.

The last transfer was made after 515 Ptu quantified and this *time* was added to the age of the Universe.

On the other hand, let's not forget that transfers are made between cells of *space* located at a distance of 1 Psu (see the comments to Figure *9*); it follows that in the Universe there is a maximum speed of transfer of *dark matter*, and this is equal to 1. In addition, the result is a quantification of the velocity, the only possible values of the transfer are of the form $\frac{1}{n}\ \frac{[Psu]}{[Ptu]}$ where n ∈ **N,** n ≠ 0.

If two quantified speeds $\overrightarrow{V_1}$ and $\overrightarrow{V_2}$ acting in the same direction and in the same meaning, then the result of their composition $\overrightarrow{V_r}$, will have the module:

$$V_r = \frac{V_1 + V_2}{1 + V_1 \cdot V_2}$$

If we consider that 1 Psu = Planck length = $1.616229(38)\times10^{-35}$ m and 1 Ptu = Planck time = $5.391\ 06(32) \times 10^{-44}$ s, then $\frac{1\ Psu}{1\ Ptu}$ it is the speed of light in a vacuum. Obviously, the fact that we have found this value is related to how the two Planck units of measurement were correlated with each other when they were defined.

Dark energy

So far, only a brief reference has been made to the need to introduce the notion of *dark energy* in order to save, at all, the principle of energy conservation when applying *Axiom 8* as a result of *gravitational action* (v. §Big bang, discrete model, space, time, energy-mass).

If the geometric patterns of the universe have accustomed us to the notion of continuous space-time, this work refers to a unitary space-time-energy-mass whole whose nature is discontinuous. In order to be able to operate with this unitary whole we divided it into two:

- the first is *time*, an element that is more about the nature of our thinking than about physical reality (v. *Definitions 2 and 3*);
- the second is *space-energy-mass* that defines, no more and no less, than dark *matter*, as it is characterized in contemporary cosmology.

We have defined *the trigonometric quantum gravity* that acts on the quantified amounts of *energy-mass* in the cells of quantum space, having previously defined the process of formation of *space* and *energy-mass* but without starting from an infinitely small and dense singularity. A special place is the *Axiom 8* which, in short, says that if gravity moves the entire amount of energy mass from a cell of *space*, that cell does not remain empty but instantly appears in it the indivisible amount of *energy-mass* that we have called the planck unit of *energy-*

mass (Peu). In this way we have associated with each space cell two amounts of energy, expressed by natural numbers, as follows:

- the first one starts at 0 and increments by a unit whenever *Axiom 8* is applied to that cell; this amount of energy I will call *dark energy;* this form of energy occurs exclusively during the internships of development of the Universe (see §Energy-mass dynamics and *Definition 13*)
- the second quantity of energy sums up the *dark energy* with *the energy-mass* accumulated as a result of the basic construction of the Universe, the cosmological inflations (see §Cosmological Inflation) as well as with the *energy-mass* moved to the respective space cell as a result of *the gravitational interaction* applied in each internship of development. In a word, this second amount of energy stores the total energy associated with that cell at some point in time.

The energy-mass accumulated as a result of the basic construction of the Universe and following inflation is made as a result of *Axiom 7* and does not fall as dark *energy*.

Let's return to the formula (2'); recall that this formula calculates the total *energy-mass* of a Universe with the short definition C|I, $ɗ_k$ is the *energy-mass* generated during inflation k = 0, 1, 2, ..., I. The term $ϕ_k$ whose explanation has remained in suspension, we can now define it, namely it is the *energy-mass* accumulated between inflation k and k+1 as a result of the *gravitational action* and the application *of Axiom 8* in the internships between the two inflations. In other words, $ϕ_k$ is the *dark energy* accumulated between inflation k and k+1. Be $ϕ = \sum_{k=0}^{I} ϕ_k$ the total *dark energy* accumulated as a result of *gravitational interaction* within all internships of development of the Universe, the formula (2') can be written:

$$M_{total} = \sum_{k=0}^{I} ɗ_k + ϕ$$

According to the above, *dark energy* is indeed a form of energy that is part of the entire *energy-mass* of the Universe. *Dark energy* is

resident in the cells of quantum space and is included in total *energy-mass*. As a result *dark energy* is part of *dark matter*, according to all previous definitions.

Based on this new information let's analyze the table in *Chart 1*:

- the short definition of the universe is 7|1 so C = 7, F_C = 21, F_{C+1} = 34;
- according to the formula (1):
  - T_0 base construction duration = $4^1 (7 + 1)^1$ = 32 Ptu;
  - T_1 the duration of the first inflation = $42 (7 +1)^2$ = 1024 Ptu;
  - The age of the universe is $T_0 + T_1$ =1056;
- according to the formula (2):
  - $ф_0 = \frac{714}{8} \cdot 32$ = 2856 Peu;
  - $ф_1 = \frac{714}{8} \cdot 1024$ = 91392 Peu;
  - $φ_0$ = 0 by definition;
  - $M_{total} = ф_0 + ф_1$ = 94248 Peu.
- the total energy of the Universe at the end of internship 23 is M_{total} = 216924 Peu. According to the previous point the *dark energy* $φ = M_{total} - ф_0 - ф_1$ = 122676 Peu or in other words for the Universe with the definition 7|1|23 the total *energy-mass* is 216924 Peu of which 56.55% represents the *dark energy*.

Traditional cosmology associates *dark energy* with relative voids of matter in the structure of the universe. In *Chart 9, 10, 11* you can see these voids, scored in dark blue, indicating that the *energy-mass* in those cells has only a few Peu. In the model discussed in the present work these voids arise exclusively as a result of *gravitational action*.

The fundamental constant of the Universe

According to axiom 7 of the work, a space cell, at formation, contains an *energy-mass* equal to 1 Peu or, in the International System of Units of Measurement (IS), $6.6260755 \cdot 10^{-34}$ J.

Whether a Universe with C iterations, the formula (2') can be written as:

$$\frac{\mathfrak{d}_k}{T_k} = c_2 \frac{F_C^2 \frac{F_{C+1}}{F_C}}{C+1} \approx \varphi \frac{F_C^2}{C+1} \ ,$$

where $c_2 = 1 \frac{Peu}{Psu^2 Ptu}$ and φ is the golden number to which we have assigned the units of measurement of c_2, F_C is the fibonacci number associated with the index C and k = 0, 1, 2, 3, ... the number of inflation. Note that the ratio $\frac{\mathfrak{d}_k}{T_k}$ is constant whatever k. I will generalize this result:

Corollary 3

For a given Universe, the variation in *energy-mass* produced by inflation in the time that inflation lasts is a constant that depends only on the definition of the Universe:

$$\frac{\Delta\mathfrak{d}}{\Delta T} \approx \varphi \frac{F_C^2}{C+1}$$

Here is a remarkable new result: we have a clear constant and what a constant, one that includes the golden number, given that, as we have seen, the gravitational constant is not actually a constant, it depends on *the energy-mass* and age of the Universe (v. *Definition 12*).

Let's now calculate a conversion formula between the Peu/Ptu and J/s (W) units of measurement: starting from the definitions: 1 Peu = $6.6260755 \cdot 10^{-34}$ J and 1 Ptu = $5.391245 \cdot 10^{-44}$ s, it results:

$$\frac{1\,Peu}{1Ptu} = \frac{6{,}6260755 \cdot 10^{-34}}{5.391245 \cdot 10^{-44}} \frac{J}{s} \approx 1.2290 \cdot 10^{10} \text{ W}$$

I will choose from *Chart 3* a definition of the Universe that could even be the definition of our universe, the choice I make according to age in the sense that the Universe with the definition 110|22|1 is 13.285 billion years old after inflation number 22, an age very close to that of today's universe that could be at the beginning of inflation 23 (having the same number of iterations that is, 110). The choice criterion is extremely arbitrary in the absence of knowledge of the gravitational constant for definition 110|22|1, as shown in the observations listed in

Chart 3. In the absence of a more reliable definition of the current universe model, I will work with this:

- F_{110} = 75156614449290893 78
- C = 110;
- $\varphi = \frac{1+\sqrt{5}}{2}$

According to *Corollary 3* and the above conversion formula results:

$$\frac{\Delta ф}{\Delta T} \approx 1{,}01193 \cdot 10^{46} \text{ W},$$

This being the power generated by any cosmological inflation in a Universe with 110 iterations. In other words, in the case of the permanent succession of cosmological inflation, an energy of 1,01193 $\cdot 10^{\cdot 46}$ J is generated in the Univers every second.

Energy pipelines

The dark *matter* dynamics algorithm described in the comments made to *Figure 9* shows the four directions in which the motion of matter can be made, starting from a cell of quantum *space.*

We know that for any internship the vectors of *the gravitational action* can be calculated, and on this basis, it results in a table of the kind listed in *Chart 2*, which shows for each cell, where and how the transfer of dark *matter*is done. On an image of quantum space we can figure this transfer through horizontal or vertical vectors, from one cell to another, see *Chart 6, 7, 10*. These images suggest a network of main pipes through which matter circulates. In the early internship of development of the Universe, these vectors are oriented by the four cardinal points (v. *Definition 5*). In areas of confluence where vectors of different directions meet, filaments of *dark matter* appear from which concentrations can then form (see the next chapter).

It is interesting to analyze the situations in which in a *space* cell a compression of matter takes place, that is, matter enters on one, two, three or four sides of a cell without leaving there, as seen in Chart *6*.

Proto particle

Universes to *iteration* 6 (v. *Definition 6*) inclusive, regardless of the number of *inflations* and associated internship, creates a single concentration of dark *matter* in the middle of the Universe, perhaps, a

kind of Planck particle. From *iteration* 7 inclusively upwards, an increasing number of concentrations of matter appear symmetrically arranged, four at a time, compared to the center. In addition, as the number of inflations increases, so does the number of quadruple concentrations.

From a spatial point of view these concentrations look like a square with the side of two *space*cells. These cells are unevenly filled with *dark matter* that is rotating clock wise inside the four cells. Initially these *four-system*, as the number of *internships* increases, move slightly towardsthe center, fall apart and then recover in several internships and finally establish their positions permanently. *Systems of four* remain in permanent rotation and absorb the surrounding matter, becoming over *time* the main absorption centers, more powerful than the central area of the Universe.

As a result of *Axiom 8*, theamount of dark *matter* in these *systems of four* increases permanently, even after the previously existing matter in the area has been consumed. Using various filters[5] for the visualization of quantum *space* or analyzing the *energy pipelines* it is observed how locally, matter rotates around *systems of four*, forming a kindof accretion zone, so that in the end it is absorbed by the *system of four*.

Definitions:

15. These *systems of four* call them *proto particles*.

Fortunately there is a counterweight to the increase, over *time*, without measure of the amount of *dark matter* in a very small *space*, namely in four cells. This is the decrease in the value of the *gravitational constant*, internship by internship (see The gravitational constant and

[5] In the definitions of Univers mor developed matter is divided în extremely hot (very bright) or extremely cold (very closed) areas. Between these extremes, even if the computer application has 255^3 nuances, the matter of only a few Peu is difficult to notice the front eye of the matter of only 1 Peu. For this reason, a filt is defined to highlight the areait's which would otherwise remain obscure (v. *Definition 9* and comment on *Figure 5*)

The *§1st Chart).* Without this decrease *proto particles* would exert, after a while, a huge *gravitational action* that would create chaos in the Universe. In contrast, due to the decrease in the *gravitational constant*, the *proto particles* mainly have a local influence.

Comment:

In this work I dealt with the early internships of the Universe in which the notions of *energy-mass* and *dark matter* I considered synonymous. As the Universe ages, due to the permanent accumulation of dark *matter* in *proto particles* as well as due to the compression phenomenon, presented in *Chart* 6, new objects appear, qualitatively different from everything that existed previously such as baryonic matter and black holes.

Axiom 8 and the information paradox of the black hole

As Stephen Hawking pointed out in the 70's, due to quantum uncertainty, black holes radiate a small amount of heat, called "Hawking radiation". In the process they lose mass and eventually evaporate. The evaporation in time of black holes leads to a paradox: anything that falls into a black hole will be lost forever, violating "unitary" - a central principle of quantum mechanics that says that the present always retains information about the past.

Axiom 8, which is the central element of this work, applied to this case, states that even if a black hole had absorbed all the barionic matter in the area, it would still have something to consume, namely *dark matter* in the cells of quantum *space* that, according to the axiom, is an inexhaustible source. As a result, a black hole will never evaporate and, on the contrary, will permanently accumulate mass reaching the size of the super massives that we assume exist in the centers of galaxies. I suppose this phenomenon is the missing process that explains how some black holes end up so massive.

Multiverse

According to *the Definition 14*, $\forall$ n, m, p ε N, n > 1, p> 0, there can be a Universe with the definition n|m|p. Since any universe thus defined is in evolution, that is, the parameters m and p can grow independently of each other, it follows that in the said definition, the determining parameter is n, and the other two parameters m and p show the level of development of the respective Universe. It follows that, from the point of view of this model, there can be a countable infinity of universes, that is, the cardinal of the set of all possible Universes is aleph 0 (see Footnote no. 2).

In *Sheet 3* are presented the characteristics of several Universes according to their definition.

CHARTS

Chart 1 - The evolution of the Universe from definition 7|1|1 to 7|1|23.

Sta-giul	**Total *dark matter* [Peu]**	**Age of the Univer [Ptu]**	**No of quantum *space* cells**	***Gravitational* constant**	**inflation no.**
1	94248	1056	6193	5.9704E-09	1
2	98868	1789	6193	1.9830E-09	1
3	103712	2286	6193	1.1578E-09	1
4	108752	2788	6193	7.4230E-10	1
5	113976	3310	6193	5.0250E-10	1
6	119396	3877	6193	3.4964E-10	1
7	124864	4496	6193	2.4861E-10	1
8	130372	5160	6193	1.8077E-10	1
9	135900	5857	6193	1.3460E-10	1
10	141500	6579	6193	1.0245E-10	1
11	147116	7344	6193	7.9082E-11	1
12	152788	8159	6193	6,1693E-11	1
13	158516	8984	6193	4.9044E-11	1
14	164280	9867	6193	3.9233E-11	1
15	170076	10779	6193	3.1754E-11	1
16	175888	11719	6193	2.5977E-11	1
17	181724	12690	6193	2.1442E-11	1
18	187580	13703	6193	1.7815E-11	1
19	193456	14737	6193	1.4935E-11	1
20	199316	15824	6193	1.2573E-11	1
21	205172	16934	6193	1.0665E-11	1
22	211044	18093	6193	9.0825E-12	1
23	216924	19254	6193	7.8028E-12	1

Chart 2 – Shows the total of 2416 events representing the dynamics of the transfer of *dark matter* from id_qs1 to id_qs2, for definition 6|1|15. Qtime is quantified time. The number of simultaneous events is multiple of 4. [Dark matter transferred] = Peu.

id	id_qs1	id_qs2	Time	Qtime	Dark matter Transferred	Dark energy acumulată
1	1021	1020	11	1	1323	7
2	1143	1206	11	1	1323	7
3	1275	1212	11	1	1323	7
4	1397	1398	11	1	1323	7
5	1020	1083	18	2	774	6
6	1206	1207	18	2	774	6
7	1212	1211	18	2	774	6
8	1398	1335	18	2	774	6
9	959	958	24	3	481	7
10	1079	1142	24	3	481	7
11	1339	1276	24	3	481	7
12	1459	1460	24	3	481	7
13	683	727	24	3	256	8
14	846	845	24	3	256	8
15	1572	1573	24	3	256	8
16	1735	1691	24	3	256	8
17	960	959	25	4	422	8
18	1016	1079	25	4	422	8
19	1402	1339	25	4	422	8
20	1458	1459	25	4	422	8
21	639	683	25	4	234	8
22	847	846	25	4	234	8
23	1571	1572	25	4	234	8
24	1779	1735	25	4	234	8
…	…	…	…	…	...	…
2416	2300	2301	14565	515	1	14

Chart 3 – defining elements for some definitions of the Universe.

Given the examples of Universes with tiny definitions calculated so far, one might question whether this model can explain the age and enormous amount of matter in the observable universe. As a result we calculated based on the formulas (1) and (2) for $\varphi_k = 0$, various definitions of Universes with higher iterations. Unfortunately, at the moment I do not have a formula that allows the calculation of no. of cells of a quantum *space* that would lead to the immediate calculation of the average density and then the *gravitational constant*. For now, the only way to find out this number is the full processing of the algorithm for constructing quantum *space* after each inflation.

1 solar unit = the mass of the sun ·˙ the speed of light squared

[Gravitational constant] = $Psu^3/PeuPtu\cdot^2$.

Definition of the Universe	**Total *energy-mass***	**Age Universe**	**Gravitational constant**
5|1|1303	1.084.732 Little	271.135 Ptu	1,078e-15
6|3|485	28.111.644 Little	1.232.775 Ptu	2,199e-17
7|3|403	103.661.824 Little	2.088.459 Ptu	5,152e-18
8|1|279	4.441.720 Little	1.003.345 Ptu	3,553e-16
9|1|236	9.924.204Peu	2.054.932 Ptu	4,775e-17
50|24|1	2,698e-04 solar units	9,451e-03 billions of years	?
70|24|1	1,731e+08 solar units	36,90 billions of years	?
90|22|1	1,154e+14 solar units	0,137 billions of years	?
95|22|1	4,603e+16 solar units	0.471 billion years	?
100|22|1	1,729e+19 solar units	1.515 billion years	?
104|22|1	1,909e+21 solar units	3.701 billion years	?
104|23|1	8,021e+23 solar units	1554 billion years	?
105|22|1	6,159e+21 solar units	4.602 billion years	?
105|23|1	2,611e+24 solar units	1951 billion years	?
110|22|1	2,087e+24 solar units	13.285 billion years	?

Chart 4 – Presented a table describing the accumulation of *dark matter* (see *Axiom* 8) as well as the complete rotation in 8 Ptu (2 Ptu x 4 internships), carried out over 4 internships of a proto particle, in a *system of four*,(v. §Proto particles) arranged in four units of *space* generically called ID_alias 1, 2, 3, 4 so that 1 is the upper-left corner, 2 lower left, 3 lower right. These generic units correspond in quantum *space* to IDs 4668, 4669, 4788 and 4787 of definition 8|1|233 to 8|1|245. I wrote down QTime the quantified *time*.

Internship	**ID_alias**	**Moved to**	**ID**	**E/M of ID_alias**	**QTime**	**Total E/M**
233	1	4	4668	143560	1	319213
	2	1	4669	78439	1	
	3	2	4788	15020	1	
	4	3	4787	82194	**2**	
234	1	4	4668	78733	1	320589
	2	1	4669	15021	1	
	3	2	4788	82874	**2**	
	4	3	4787	143961	1	
235	1	4	4668	15022	1	321516
	2	1	4669	83044	**2**	
	3	2	4788	144526	1	
	4	3	4787	78924	1	
236	1	4	4668	83221	**2**	323292
	2	1	4669	145866	1	
	3	2	4788	79182	1	
	4	3	4787	15023	1	
237	1	4	4668	146185	1	324533
	2	1	4669	79813	1	
	3	2	4788	15024	1	
	4	3	4787	83511	**2**	
238	1	4	4668	80107	1	325910
	2	1	4669	15025	**2**	
	3	2	4788	84192	3	
	4	3	4787	146586	4	
239	1	4	4668	15026	1	326832
	2	1	4669	84362	**2**	
	3	2	4788	147146	1	
	4	3	4787	80298	1	
240	1	4	4668	84539	**2**	328606

Internship	ID_alias	Moved to	ID	E/M of ID_alias	QTime	Total E/M
	2	1	4669	148484	1	
	3	2	4788	80556	1	
	4	3	4787	15027	1	
241	1	4	4668	148787	1	329831
	2	1	4669	81187	1	
	3	2	4788	15028	1	
	4	3	4787	84829	**2**	
242	1	4	4668	81450	1	331177
	2	1	4669	15029	1	
	3	2	4788	85510	**2**	
	4	3	4787	149188	1	
243	1	4	4668	15030	1	332099
	2	1	4669	85680	**2**	
	3	2	4788	149748	1	
	4	3	4787	81641	1	
244	1	4	4668	85857	**2**	333872
	2	1	4669	151085	1	
	3	2	4788	81899	1	
	4	3	4787	15031	1	
245	1	4	4668	151406	1	335115
	2	1	4669	82530	1	
	3	2	4788	15032	1	
	4	3	4787	86147	**2**	

I would like to remind you that in the above case, the transfer of the subject is made, within an internship, over a distance of 1 Psu. If the *time during* which the transfer is made is 1 Ptu it follows that this movement is made at the maximum possible speed.

Chart 5 def. 7|3|403 – filter 1000. To each inflation, a tooth is added on the oblique edges of the Universe.

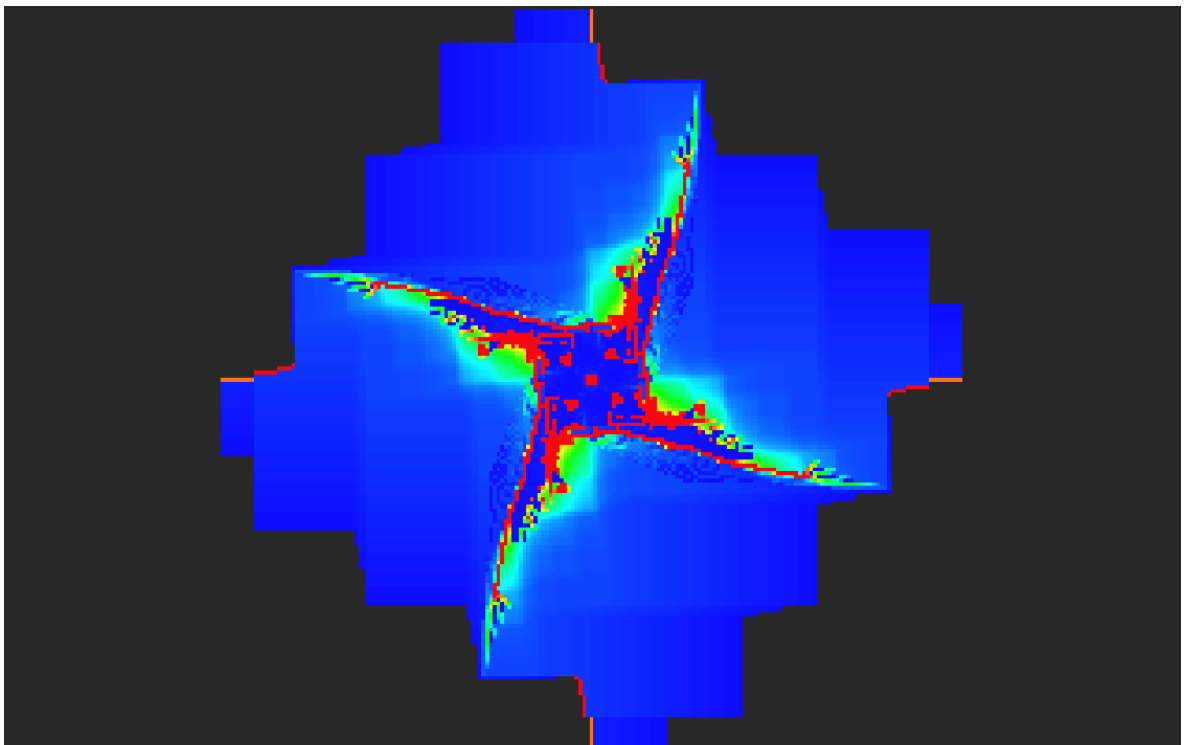
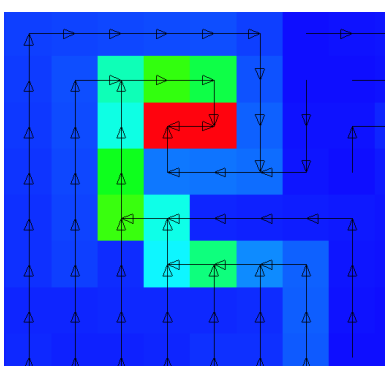
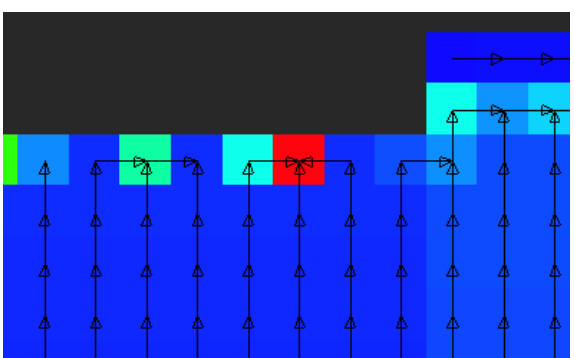


Chart 6 – Various situations of compression of matter.

Definition 8|1|233
The matter is collected from the surroundings and concentrated in the red blood cells, without getting out of there.



Definition 7|1|74 – filter 600
Image from the edge of the Universe. Matter channeled through 1, 2 or 3 inputs.



Definition 7|1|37 – filter 600
Image from the central area of the Universe. Matter channeled through all 4 inputs, without exiting that cell.

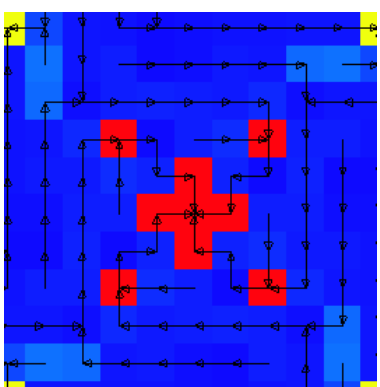


Chart 7 – The graphical evolution of the *proto particle* whose dynamic elements were presented in Chart *4.* The age of the Universe at internship 233 is 824,422 Ptu.

8|1|233 8|1|234 8|1|235 8|1|236

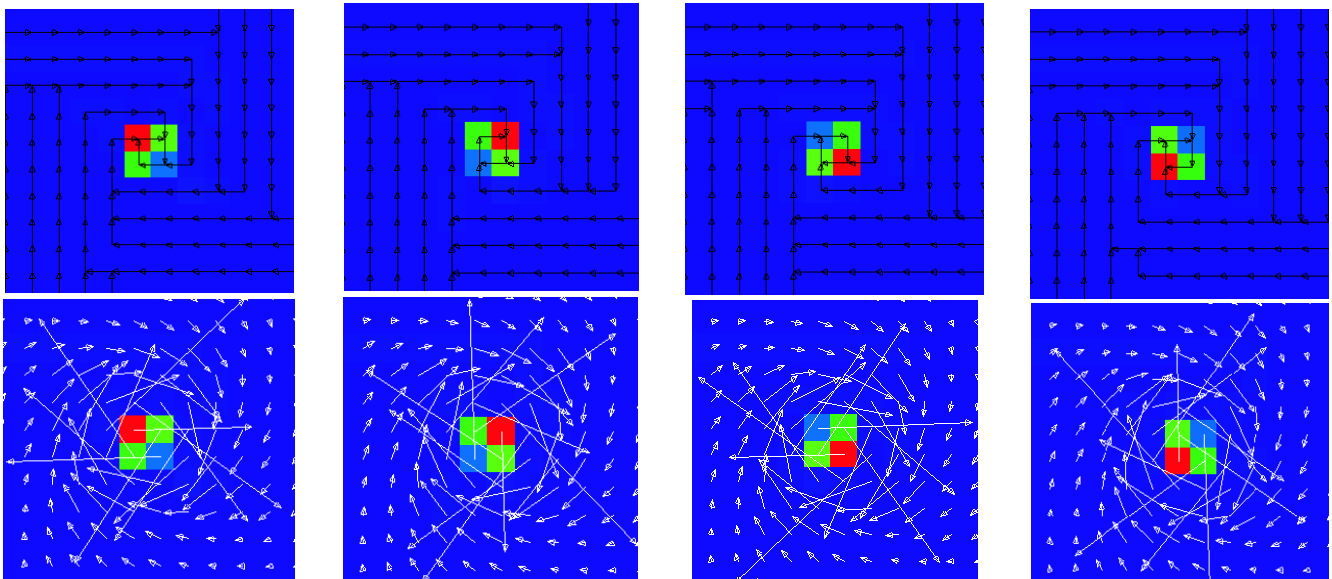


Chart 8 def. 9|1|1 – without filter. The end of the first inflation, before *the gravitational interaction* begins to shape the primordial universe. The hottest areas are in the center.

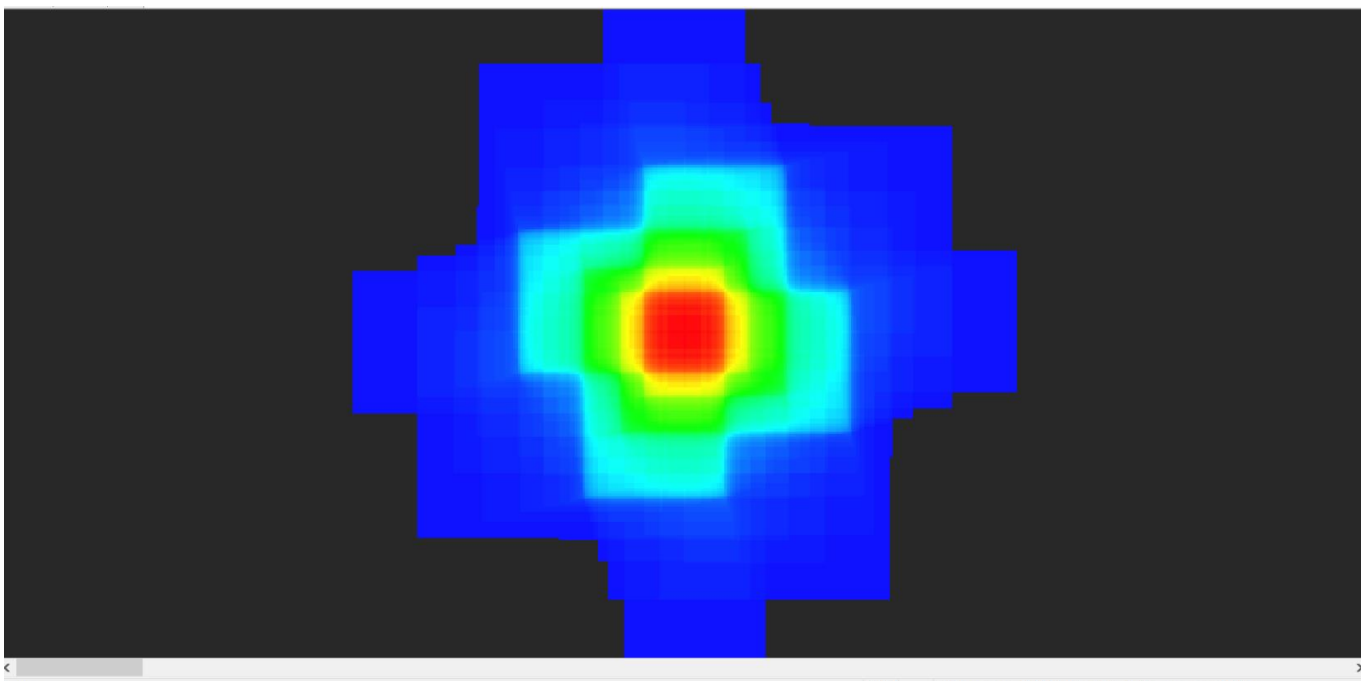


Chart 9 def. 9|1|57 – filter 300. The central area where the result of the transport of matter from the edge areas to the central ones (from dark blue to light blue) is seen, at confluences forming *proto particles*.

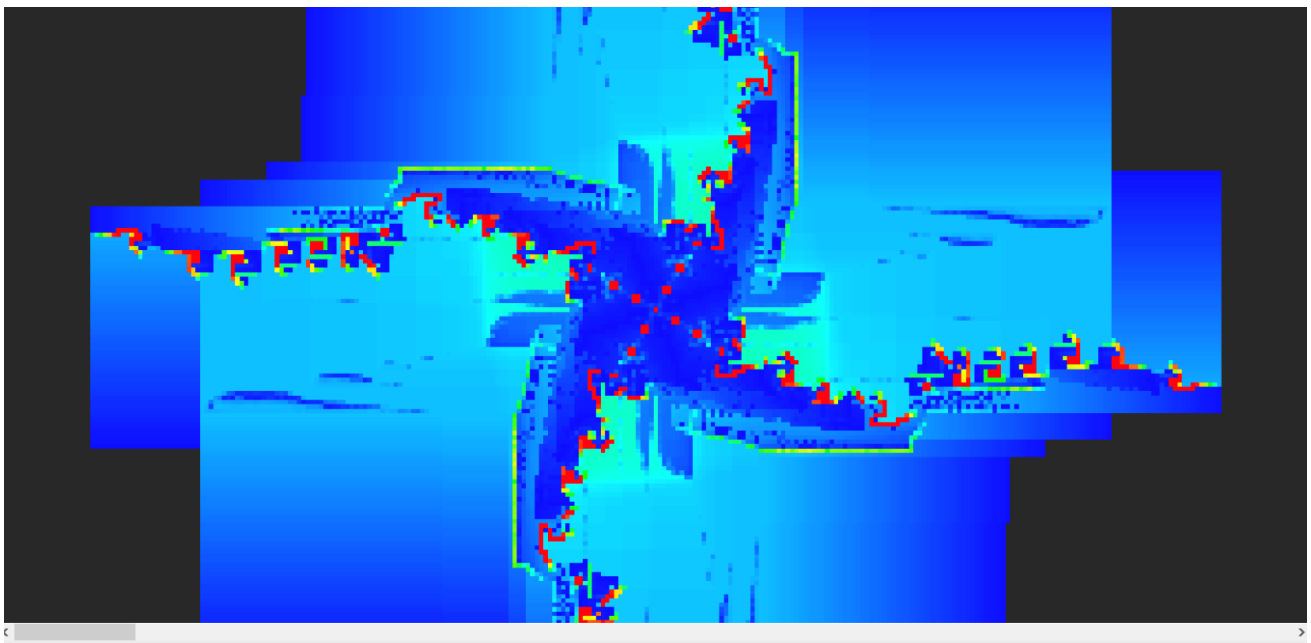


Chart 10 def. 9|1|57 – filter 300, detail. One can observe the grain of quantum *space*, the *energy pipelines* that carry matter, and the relative vacuum - the blue voids appeared as a result of the concentrations formed.

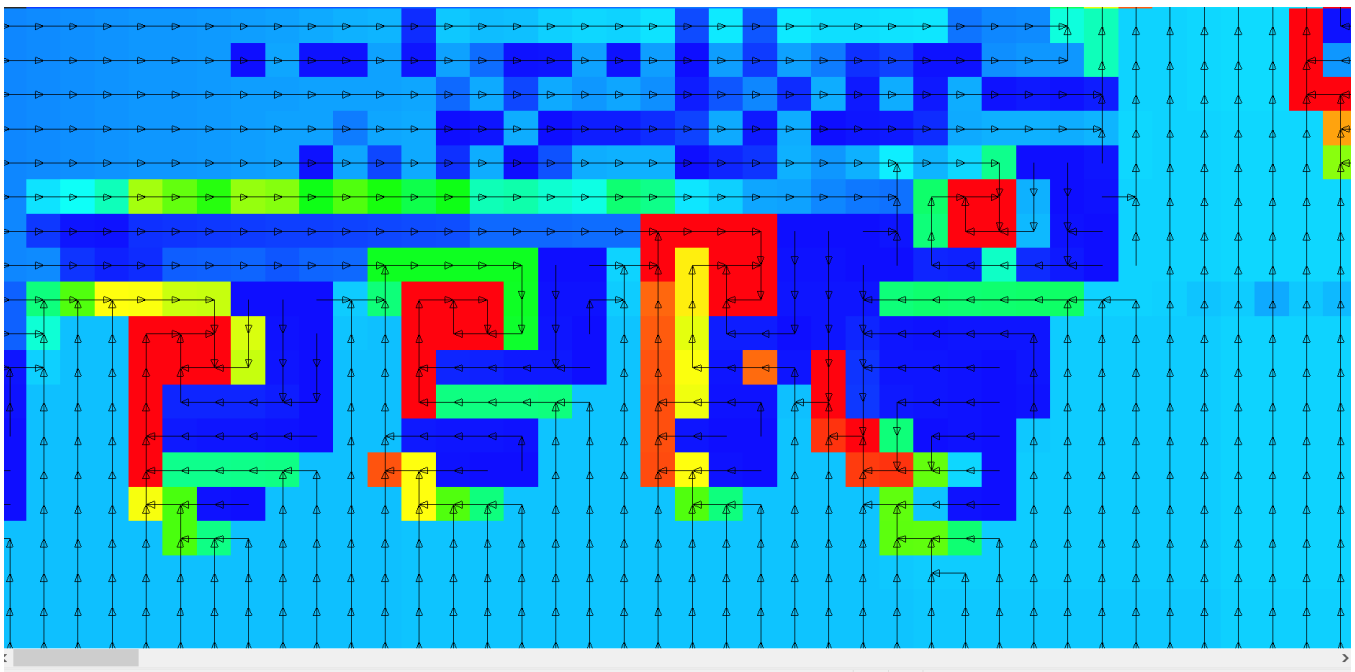


Chart 11 def. 9|1|57 – the previous detail in which the vectors of the gravitational action are shown. For vectors with very small mode, only the arrow that shows the meaning was drawn.

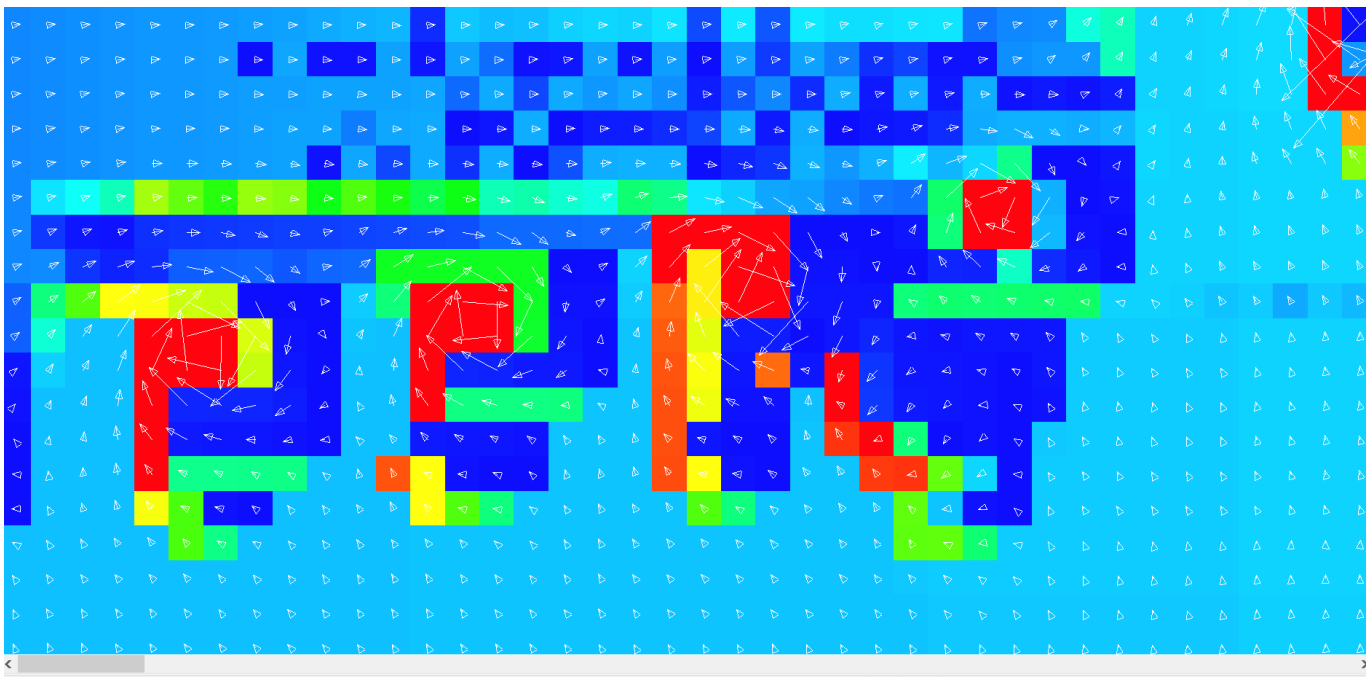
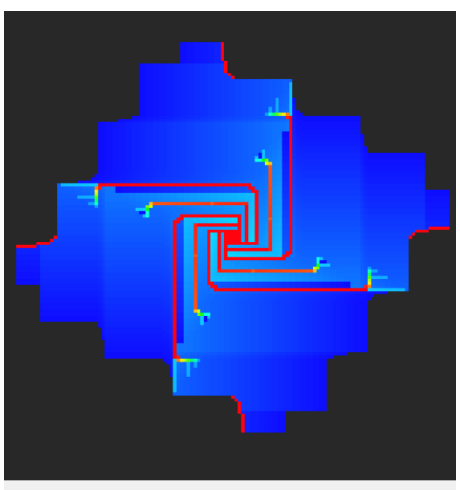


Chart 12 - The universes with no. of iterations below 7 form in the center a single giant particle proto that continuously absorbs matter. These universes are too small compared to the intensity of central gravitational action that is too high to allow the formation of other accumulation centers, apart from matter stuck on the border.

6|3|484 – filter 500 – image scaling factor: 0.237.



Same image as the one on the left but without a filter.

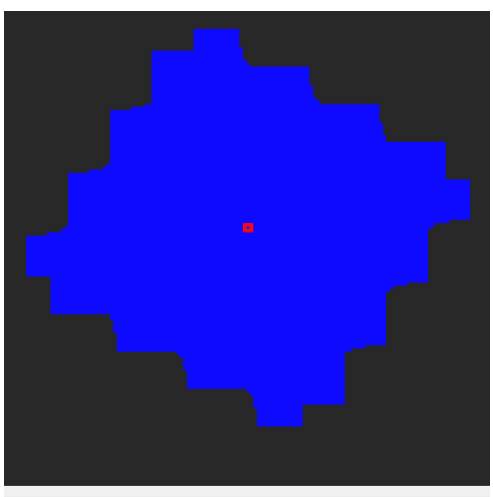
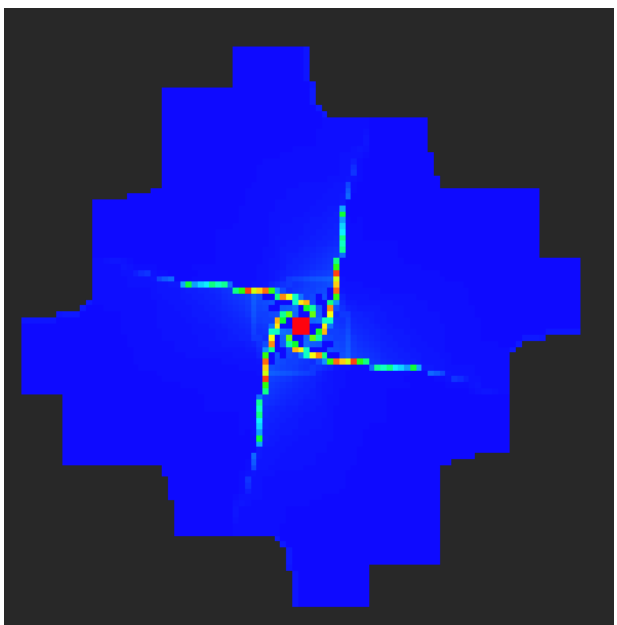
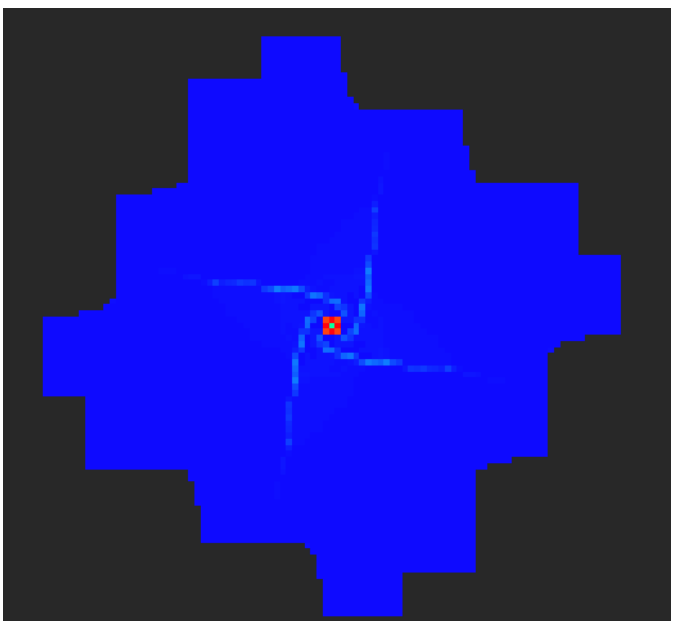


Chart 13 – For this iteration any attempt to form other proto particles ends in such an accretion disk. It's like I've seen such images somewhere before...

6|2|226 – filter 10000 – image scaling factor: 0.237.



Same image as the one on the left but without a filter.



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The book also includes information taken from the free encyclopedia Wikipedia (https://www.wikipedia.org).

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About the author

Valentin IONESCU was born on 02.06.1953.

As a teenager he wanted to become an astronomer; he polished telescope mirrors and asked his parents for a meditator with whom to understand the General Relativity more quickly.

She graduated from the Faculty of Mathematics in Bucharest.

He didn't become an astronomer. He worked as a high school math teacher; he was for 10 years the sole shareholder and manager of an IT&C company. He is a scientific researcher in the field of programming. He worked almost all the time as a programmer.

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