THE FRACTAL CHAOTIC FILLING OF ATOMIC ORBITALS

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Abstract: *Everything is wave-particle duality with three consequences: everything is entangled, fractal and chaotic. It is not easy to prove it, so, I will follow the principle issued by Einstein, Podolsky and Rosen [1]: "In a complete theory there is an element corresponding to each element of reality". So each physical reality can be explain with a fractal chaotic model. The element I want to prove in this paper, is the filling of the atomic orbitals and then I will propose a graphic model of the Cosmic Universe which is also Fractal and Chaotic.*

Keywords: *hologram*, *fractal, chaos, multi-universe, electron, wave-particle duality, black hole, wormhole.*

1 What is an hologram? Can we realize hologram with astrophysics data?

The word *hologram* comes from the Greek words "holos" -*the whole* and "gramma" -*the writing*, because it contains the whole information of the object. A small part of an hologram can restitute whole image [14] but the sharpness of the image will be lower and the angles under which we will able to observe the scene will be more restricted. We find this feature with fractal which is based on the fact that each part is a reduced image of the whole.

Holography is based on the wave nature of light. An hologram is a three-dimensional image resulting on the wave interference between the object beam and the coherent background -*the reference beam* [7]. Two types of holograms can be made. The first are made by "transmission", they are lit from behind and they are visible only under a laser light. Seconds, made by reflection, are lit from the front and are visible by white light [6].

Holography is the transformation of a binary data stored in a 2D sensitive surface into a three-dimensional image. The three-dimensional image contains more detail than an ordinary photography. It can rotate to observe normally hidden areas. We can also determine, in space, the relative position of different objects or parts of objects. If we shoot a hologram, the image rotates with it but retains its depth.

Astrophysical data related to holography are the following: Susskind [2] and Poplawki [4] showed that black hole horizons answer to the storage of sensitive information to implement hologram. Maldacena and Susskind did any work on the validation of connection between black hole via wormhole [3], Lobo and co also [15]. Poplawski goes further by showing that the universe is born from a black hole and every black hole becomes a new universe that expands from a nonsingular bounce [4], this can explain the initial singularity proposed by the brother Bogdanov [11] and show the whole, entangled and fractal, information of the Universe. Haramein demonstrates that electron are black hole [9] and Gertz and co develop the magnonic holographic memory [8] which exploits the spin wave interference of electron for data storage and processing. This make possible the vision of multi-Universe raised by Everett [5] and highlights the fact that the universe is 3D realization through electrons, of information contained on the 2D black hole horizon.

We can find in the cosmos all constituents of hologram: the light with the acceptation of its wave-particle duality by Einstein, the black hole horizon for the sensitive surface [2] [4]. The three-dimensional image of a hologram results from wave interference, in the second part of this paper I will show that electron can be see like the vibration of the stationary wave. The third part will show the peculiarities of the fractal environment to memorize the information of the holographic object as a whole. At this time, I will have all the data to describe the fractal and chaotic filling of atomic orbitals and show the impact of chaos. After that, I would like to present a graphic model of the Fractal Chaotic Cosmic Universe.

2 Electron

The atom is the basic unit of matter and is constituted by an atomic nucleus, with neutrons and protons, surrounded by a cloud of electrons. **The neutrons and protons are constituted of 3 quarks, while the electron is indivisible.**

I think neutrons, protons and electrons are the result of waves interference, via stationary waves which do not move in the space because they are the result of interference between two waves with same frequency, traveling in opposite directions: the principe of hologram [7].

For a same stationary wave, we observe several frequencies of vibration, principally in fundamental mode or inoctave. The vibration in fundamental mode exists by itself, needing nothing else. The vibration in octave is an infinitesimal complexity of the vibration in fundamental mode, needing stabilization. Since three waves, a phase shift creates a volume and gives a particle.

Neutrons and protons are the result of interference wave between the object beam and the reference beam in octave mode, that's why three quarks are needing for the stabilization and materialization of the particles. Instead of electron which is the interference wave in fundamental mode, indivisible and stable because existing by itself.

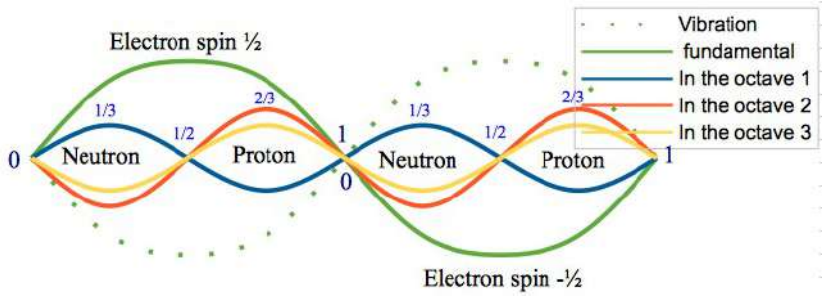

Fig. 1: Schematic representation of two nuclei and two electrons for holographic model with wave interference between the object beam and the reference beam.

The quarks have a charge of -1/3 and 2/3 because the vibration antinode are at 1/3 and 2/3 of the elementary space. The value is negative when the vibration is underneath the slack string and positive when it is above. That is the same for the spin which characterized the rotation of the electron, but comes from the vibration of the stationary wave.

I need to improve my knowledge about spin, but I share the view of Haramein and co about the integration of the notion of torque and coriolis force [10], interaction between transversal and longitudinal wave that we can find in the theory of doubling time [16], and researches about the torus structure [17] [18] [19] [20] [21].

3 Fractal

The fractal bases on the fact that each part is a reduced image of the whole. If a fractal space contains X parts, we observe these X parts on the first observed level, then it exists a sub-level with X parts less one, and so on, until the last level which contains only one fractal part inseparable.

Table 1: fractal space.

Fractal dimension	1st observed level	2nd sub-level	3rd sub-level	4th sub-level	5th sub-level
0	-				
1	1	-			
2	1	-			
	2	1	-		
3	1	-			
	2	1	-		
	3	1	-		
		2	1	-	
4	1	-			
	2	1	-		
	3	1	-		
		2	1	-	
	4	1	-		
		2	1	-	
		3	1	-	
			2	1	-

For a fractal dimension n, we observe n levels of informations and a total of $(2^n - 1)$ informations.

The mathematician Julia, who studied the fractals, has found a function to describe them: $f(z) = 2^Z + c$, where c is a complex constant [12]. Mathematically, -1 is a complex number: i^2. **The fractal space** can be defines with the function of n:

$$\mathbf{f(n) = 2^n + i^2}$$

He has also observed that from an initial value of z, it exists a suite of points which verifies: $z_{n+1} = z_n^2 + c$. Therefor, to study the states of the fractal between two dimensions of complexity, we have this other function:

$$\mathbf{f_{n+1} = (2^n + i^2)^2 + i^2}.$$

To use the function for the filling of atomic orbitals, I isolate the elementary components of the universe, by studying the different states with the function f_{n+1} between the dimensions 0 and 1. *The table 1* shows no observable level for dimension 0, instead of one and only one exits for dimension 1. So by studying dimension 1 from dimension 0, I observe the appearance of the fractal space: **from nothing to something**.

The fractal space observations in *table 1*, show that a fractal dimension n contains $(2^n - 1)$ informations, so $i^2 = -1$. But must we always use $i^2 = -1$?

To answer, I test the 4 possible cases: $f_{n+1} = (2^n + i_1^2)^2 + i_2^2$

$i_1^2 = -1$:

$i_2^2 = -1$	$i_2^2 = 0$
$f(0) = (2^0 - 1) = \mathbf{0}$	$f(0) = (2^0 - 1) = \mathbf{0}$
$f(0+1) = (f(0))^2 - 1 = 0 - 1 = \mathbf{-1}$	$f(0+1) = (f(0))^2 = (0)^2 = \mathbf{0}$
$f(0+2) = (f(1))^2 - 1 = (-1)^2 - 1 = \mathbf{0}$	$f(0+2) = (f(1))^2 = (0)^2 = \mathbf{0}$

$i_1^2 = 0$:

$i_2^2 = -1$	$i_2^2 = 0$
$f(0) = (2^0) = \mathbf{1}$	$f(0) = (2^0) = \mathbf{1}$
$f(0+1) = (f(0))^2 - 1 = 1 - 1 = \mathbf{0}$	$f(0+1) = (f(0))^2 = (1)^2 = \mathbf{1}$
$f(0+2) = (f(1))^2 - 1 = (0)^2 - 1 = \mathbf{-1}$	$f(0+2) = (f(1))^2 = (1)^2 = \mathbf{1}$

We can go until the infinite, we will have only three possible results: **1, 0, -1**.

Either $i_2^2 = -1$, the intermediate states are only a sequence of 0 and -1, or $i_2^2 = 0$ we have always the same result that the initial state. It confirms that the duality is intrinsic in the universe, symbolized by two components, with a mathematic representation by 0 and -1. 0 is a real number, represents the physical reality, -1 is an imaginary number, complex, like the Schrödinger's cat, dead and alive at the same time, represents the unrepresentable physical reality.

This duality also expresses itself by the fact that, if $i_2^2 = -1$, everything is in movement, sequence of 0 and -1 at each new state, and if $i_2^2 = 0$, everything is motionless, no change possible, it is an unchanging reality.

This is in accordance with chaos theory, that is, the behavior of a dynamical system that is very sensitive to the initial conditions evident by Lorenz [22], as well as the presence of the moving particles which traveling among a trajectory in the space of phases and the jumping particles.

4 The Fractal Chaotic Filling of Atomic Orbitals

In the fractal chaotic model, the atomic orbital is a fractal and the molecular orbitals are stationary waves, anchored on the nucleus and the upper level of the fractal. The vibration node and the anchor points of the stationary wave allow some chaotic exchanges between the vibration antinodes.

The change between the two models is the atomic orbital of the electrons. Here, it is a complex fractal space, managing matter and anti-matter, instead of a space defines with a shell and a sub-shell, two quantum numbers l and m which define the orientation. The spin stays the same with two values.

Table 2: Comparison of the two models.

	Bohr – Sommerfeld Model One shell and one subshell			Fractal chaotic model with fractal atomic orbital		
Number	Number of orbital levels	Number of states	Number of electrons	Number of electron shells	Number of states	Number of electrons
n	**n**	**n^2**	**$2* n^2$**	**$(2^n - 1)$ *and* (2^n)**	**$(2^n - 1)^2$**	**$2*(2^n - 1)^2$**
1	1	1	**2**	1	1	**2**
2	2	4	8	*4*	*9*	**18**
3	3	9	**18**	7	49	**98**
4	4	16	32	*16*	225	450
5	5	25	50	31	961	1 922
6	6	36	72	*64*	3 969	7 938
7	7	49	**98**	127	16 129	32 258

The fractal model, change the number of informations, so, the 3-shell gives informations for the filling of 7 electron shells and 98 electrons, instead of the present model, accepting only two shells (one shell and one subshell) by level, needs the 7-shell to inform the same number of shells and electrons.

With a fractal space, the first three shell give informations about: 2 + 18 + 98 = 118 electrons distribute on 7 electron shells. That is the characteristic of Ununoctium, the last element of the periodic table of Mendeleev.

In the fractal chaotic model, the number of the electron shell reports the fractal level, the entropy of the structure, more or less detailed, for atomic orbitals. He conserves the laws of the universe, a sequence of 0 and -1 depending on the observation of physical reality or not representable reality. The complex constant i^2, from fractal function, can take the value 0 or -1 according to the observable measures.

- n: the number of the shell corresponds of the fractal dimension. It is the entropy of the dimension. By increasing the dimension, we get more and more details on the filling and complexity of the data.
- When I study a n-shell, I don't know if all atomic orbitals are matter or anti-matter, so I follow the sequence of 0 and -1. Like f(0) = 0 and f(1) = -1, I define for n = 1 (2^n-1) shells *(i^2 = -1)*, then for n = 2, (2^n+0) shells *(i^2 = 0)* and so on.
- When I observe the states which take the electrons, I look for the points giving by the fractal function $f_{n+1} = (2^n + i^2)^2 + i^2$. Like the electrons are a physical reality, I take $i^2 = 0$ to follow the states, but I don't know if the electron shell is made with matter or anti-matter, so here I take $i^2 = -1$. That's why I have $(2^n-1)^2$ possible states for a n-shell and find the square of states highlighted by Stoner.
- The electron shell represents the physical reality, because electrons fill it, it has no subshell, so it contains at most $2*n^2$ electrons.
- To have the number of electrons, I multiply by 2, because of the spin.

To analyze and report the filling of atomic orbitals, I change the level of complexity. If we look at the periodic distribution of chemical elements, we saw that, when a shell is saturated, it becomes established for the next elements, whose fill it automatically. The saturated shell don't report the action of filling, only the last electron do that. That's why, I positioned atomic numbers, on the K, L, M, N, O, P, Q shells, depending, only, on the position of the last electron, which alone, report the action of filling:

- Hydrogen, one electron on K-shell, I put 1 at the position 1 – K-shell,
- Helium, atomic number 2, the second electron complete the K-shell, I put 2 at the position 2 – K-shell,
- Lithium, atomic number 3, the K-shell is saturated, this information doesn't interest me any more to report the action of filling, I put 3 at the position 1 – L-shell, the position of the last electron.

And so on for the 118 elements. Some elements are more difficult to put because the last electron is not fill linearly. For example:

- Chrome, atomic number 24, the electrons are distributed on the energy levels 2 – 8 – 13 – 1, instead of the previous element,
- Vanadium's electron were distributed on the energy level 2 – 8 – 11 – 2,
- I put the atomic number like for a linearly filling, so 24 at the position 12 – M-shell, beside number 23, andput a black arrow double sense to show the interaction with the upper shell and the different configuration of electrons.

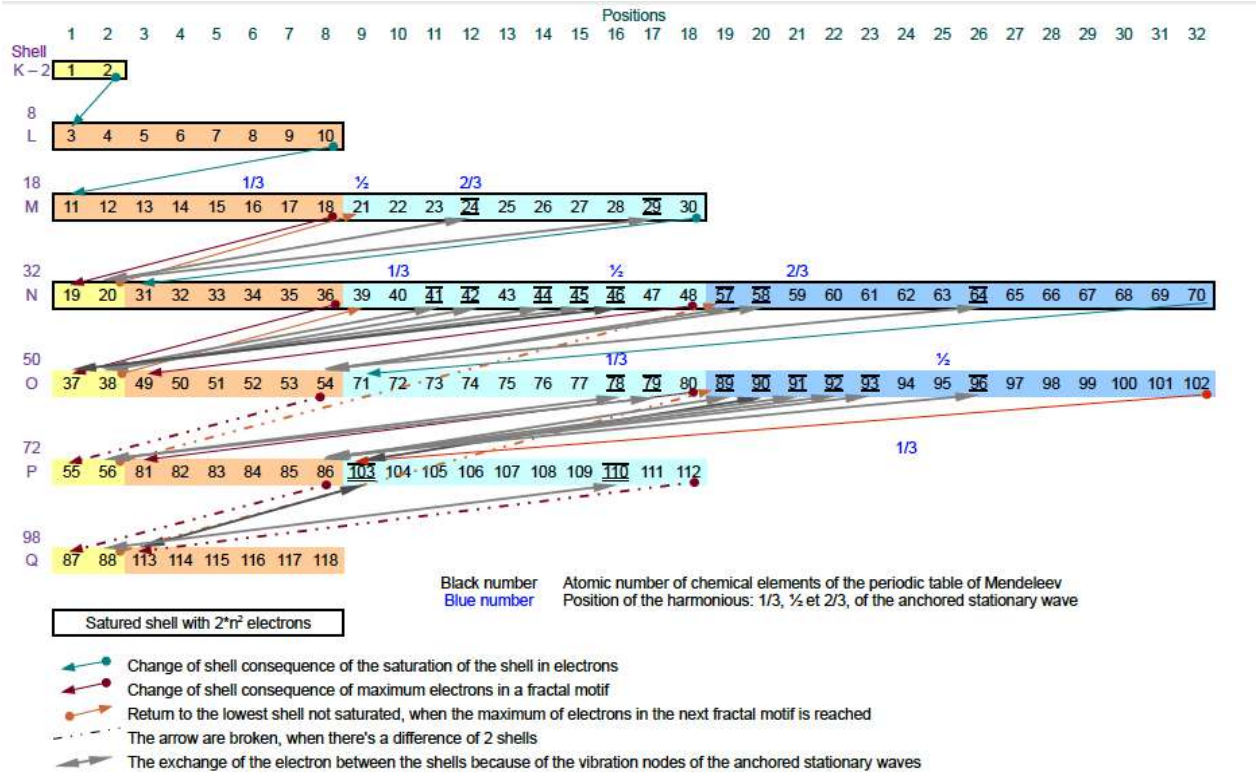

Fig.2: Distribution of the 118 chemicals elements of the periodic table of Mendeleev, according to their atomic number on the electron shells in fractal – stationary wave model.

Since the third M-shell, the filling is no more linearly, but by cycle of fractal motif 2*(number)^2. Many shells fill simultaneously, and interactions appear between the vibration node and the anchors of the molecular orbitals.

Let's study in detail the filling of the 118 chemical elements, with the *fig.2 above*:

- The K and L shells, fill linearly.
- The M-shell begins to fill after the L-shell, when 8 electrons are reached *(maximum electrons number in the lower level at M)*, the upper N-shell begins to fill. When 2 electrons are reached *(maximum electrons number in the first level)*, the filling goes back again on the unsaturated lower M-shell. M becomes saturated with 18 electrons, the filling goes on, on the N-shell.
- The N-shell goes back again with 3 electrons, when 8 electrons are reached *(maximum electrons number in the second level)*, the upper O-shell begins to fill, when 2 electrons are reached *(maximum electrons number in the first level)*, the filling goes back again on the unsaturated lower N-shell. N reaches then 18 electrons *(maximum electrons number in the third level)*, the upper O-shell goes back again to fill. When 8 electrons are reached *(maximum electrons number in the second level)*, the upper P-shell begins to fill. When 2 electrons are reached *(maximum electrons number in the first level)*, the filling goes back again on the unsaturated lower N-shell (two lower levels). N becomes saturated with 32 electrons, the filling goes on, on the O-shell.
- The O-shell goes back again with 9 electrons, when 18 electrons are reached *(maximum electrons number in the third level)*, the upper P-shell goes back again to fill. When 8 electrons are reached *(maximum electrons number in the second level)*, the upper Q-shell begins to fill. When 2 electrons are reached *(maximum electrons number in the first level)*, the filling goes back again on the unsaturated lower O-shell (two lower levels). O reaches then 32 electrons *(maximum electrons number in the fourth level)*, the upper P-shell goes back to fill. When 18 electrons are reached *(maximum electrons number in the third level)*, the filling goes back again on the upper Q-shell. Q reaches then 8 electrons *(maximum electrons number in the second level)* and we are at the last know element in the periodic table of Mendeleev.

The number of the electron shell represents the fractal dimension of atomic orbital. For a fractal dimension n, we observe n information's levels about the filling. In red I add extracts of the Lorenz's article about the chaos "Deterministic nonperiodic flow" [22]:

- n = 1, we obtain one information's level: the linearly filling of the electrons. *"A state which is varying in accordance with (1:$dX_i/dt=F_i(X_1,..X_M)$) is represented by a moving particle which traveling among a trajectory in phase space. For completeness, the position of a stationary particle, representing a steady state, is included as a trajectory."*
- n = 2, we obtain two information's levels: the linearly filling of the electrons, but in the scale of the whole electron shell, many shells are filling together with a fractal motif. This is true since level n+1, therefor the third M-shell. *"In phase space a numerical solution of (1) must be represented by a jumping particle rather than a continuously moving particle."*
- n = 3, we obtain three information's levels: the linearly filling of the electrons, the filling simultaneous of many shells with a growing fractal motif, and the apparition of interactions between the shells. The electrons should be on a specific shell and they go on an other, because the molecular orbitals are stationary waves with interferences, which, in the physical reality give a different configuration. The interference creates some exchanges between the atomic orbitals, at the level of the vibration nodes, to acquire the stability. This is true for the positions upper at the second dimension, therefore the element with more than $2*(2^2-1)^2=18$ electrons, i.e the $19^{ème}$ electron. *"It implies that two states differing by imperceptible amounts may eventually evolve into two considerably different states."*

We find the principle of the fractal, each part is a picture all whole. The property of the smaller dimensions are acquired for the greater dimensions. The greater dimensions are a complexity, one vision more clear and detailed. But the implementation of the greater dimensions requires, beforehand, the realization of smaller dimensions. Everything is cyclic, ordered, determined by the chaos, i.e. the fact that all follow a trajectory (slack string) in a phase space (fractal space), but sometimes to satisfy this phase space, the particle has to jump instead of moving on continuous (fractal motif), and these jumps make that two particles close initially can be found very far after (on over shell).

The question of the ether, worth knowing if there is a not empty and not visible space everywhere in the universe was often explained, but never proved. It could be the fractal space.

5 Conclusion

Each point of the universe belongs to a fractal motif, more or less complex, around the axis of the wave on rest [13] and the two waves interference between the object beam and the reference beam to materialization the matter or anti-matter of the Cosmic Universe, the Multi-Universe.

Two waves and a part of the object seam necessary for all physical reality. Three elements with universal proportion:

- The most plentiful elements in our galaxy are: **73.9%** hydrogen, **24%** helium, **2.1%** other,
- The cosmos: **72.6%** black energy, **22.8%** dark matter, **4.6%** matter,
- The DNA: **75%** uses for the regulation, **20%** inactive, **5%** encodes for the genes.

75%: the anti-reality *(-1)* – 5%: the physical reality *(1)* – 20%: the uncertainly principle *(0)*

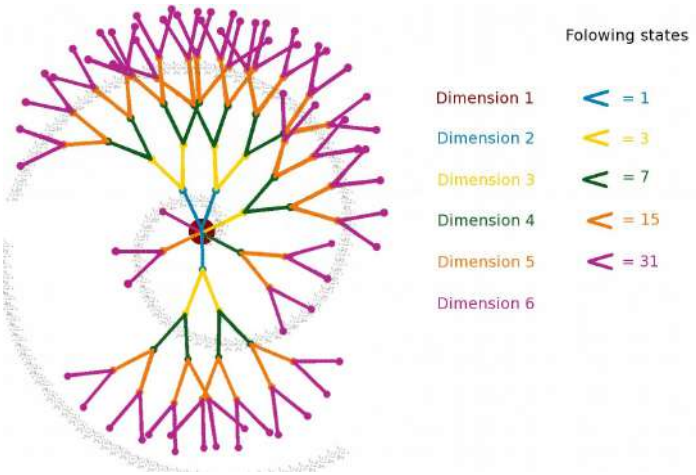

Fig. 3: Representation of the holographic Universe in the fractal and chaotic model.

We have a fractal, each part is a picture of whole.

The elementary component is the duality that I represent in the dimension 1 by a point *(the origin)*, then by a dash, which will have as value $(2^n - 1)$ *(n is the dimension).*

At each new dimension:

* The dash is duplicated to mean the duality and find the square of possible values to pass from one dimension to an other.
* The addition of a dash at the origin to report the new dimension as such.

The wave interference is represented by the grey spiral. The waves will follow all fractal point, with jump from a motif to an other around the axis *(slack string: from initial point to fractal infinity)*.

The schematic representation explains the spiral form of the galaxies or nebula, the structure of nature like the hive.

©Nasa, The spiral galaxy NGC 7424

©Nasa, nebula M57 from the Lyra constellation

With an equiangular representation, we obtain the structure of the hive

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