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On Fractaquantum Hypothesis

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Abstract

In this contribution, we present the following: restore some of the fractal geometry key elements, introduce an extension of the atom notion, restore the importance of the quantum mechanics which is needed to describe the microscopic world. We introduce the fractaquantum hypothesis, which was presented for the first time at the 5th Congress of the European Union of Systemics at Heraklion in 2002. We discuss also about the acceptance of this hypothesis. Then we develop it in three different directions. The integration of the simple element leads us to a quantum theory of the angel. More complex assembling can be described with the help of graph theory and the emphasising is placed on the importance of the loops in such models. Finally, we shall observe if the fractaquantum hypothesis joined with recent atomic physics experiments help imagine intricate macroscopic states.

A propos de l'hypothèse fractaquantique

Résumé

Dans cette contribution, nous présentons quelques éléments fondamentaux de géométrie fractale, introduisons une extension de la notion d'atome, puis rappelons l'importance de la mécanique quantique pour décrire le monde microscopique. Nous énonçons l'hypothèse fractaquantique, introduite lors du cinquième congrès de l'Union Européenne de Systémique à Héraklion en 2002. Nous discutons de la recevabilité de cette hypothèse, puis nous la développons dans trois directions. L'intégration de l'élémentaire conduit d'abord à une théorie quantique de l'ange. Les assemblages plus complexes peuvent être décrits par la théorie des graphes et nous insistons sur l'importance des boucles dans de tels modèles. Enfin, nous posons la question de savoir si l'hypothèse fractaquantique, jointe aux récentes expériences de physique atomique, permet d'imaginer des états macroscopiques intriqués.

Foreword

In this contribution, a certain number of well-known notions of physics and mathematics are freely used through a specialized vocabulary. When this kind of notion appears in the text we use the expression "so-called" without any complete explication about the associated meaning. Introducing a new notion, we describe it in general. However, we will continue to use quotation marks all along the text, especially for the words "atom" and "q-angel".

Contents

Fractal geometry

First statement relates to the shapes that Nature shows to our eyes. The first one is a straight line, even if this fact has been difficult to evidence. Nevertheless, the foundation of classical mechanics (G. Bruno, 1584, G. Galilei, 1632) assumes that without any interaction, a classical object follows a so-called uniform motion with a constant velocity. The difficulty to evidence such a principle is the practical impossibility to observe an object without interaction with the external world. Effectively, the breakthrough done by I. Newton (*Principia*, 1687) when he realizes that "the apple and the Moon fall down to the Earth in the same manner" is a fantastic example of mental unification of multiple observations. We will not comment here the high value of the so-called Cartesian doubt (see the *Meditations*, 1641): "Les sens me trompent. Donc, je doute. Donc je pense..." ["Senses are deceiving me. Thus, I doubt. Thus, I think..."].

The straight line is generalized with the geometrical notion of geodesic, *i.e.* the curve of minimal length between two points. This notion is fundamental for the development of modern theory of gravitation (A. Einstein, 1915), which is, following E. Mach (1921), a natural generalisation of Newton theory. We refer the reader *e.g.* to the books of H. Weyl (1921) or S. Weinberg (1972). This theory claims that the matter creates a curved space. A consequence of this fact is the existence of so-called gravitational lens. A dark object separates a light source from the observer on Earth. The light is curved by dark material and separates it into several rays. An observer can display several light spots in the sky and could *a priori* think of the presence of multiple sources. The precise observations and analysis done by K. Chang and S. Refsdal (1979), and J. Hewitt, G. Langston and co-authors (1986) can be considered as an example of Descartes' preliminary remark: "the appearances are misleading".

The trouble is more important after the discovery of B. Mandelbrot (1975) of the so-called fractal geometry. The fundamental remark is as follows: if we suppose that "the big is analogous to the little", we obtain of course the straight lines but also geometrical shapes that are absolutely not straight lines, called fractal curves. A fractal curve has an infinite length and remains unchanged

under very simple geometric transformations. These self-similar geometrical shapes are present in our natural environment with trees, clouds, ferns or cauliflowers among others. They are present also in our own body with the detailed structure occupied by the lungs. A partial piece of a tree is analogous to the entire tree and this fractal property is characteristic of the fact that "the big is analogous to the little". Moreover, the mathematical nature of corresponding objects is complex and non-integer dimensions have to be considered (see *e.g.* B. Sapoval, 1997). This discovery has an important development in a lot of fields of knowledge, from mathematics with A. Douady and his team in Orsay (see *e.g.* the film about the so-called rabbit dynamics realized with F. Tisseyre and C. Weingarten, 1996), astrophysics and the so-called scale relativity (L. Nottale, 1998), microphysics (G. Cohen-Tannoudji and M. Spiro, 1986), finance markets (J.P. Bouchaud, M. Potters, 2000), up to urbanism (N. Salingaros, 2001).

Let's bare in mind that there is no constraint, Nature offers a spatial self-similarity: the "big" is analogous to the "little", even if the corresponding shapes take a complex appearance. A final remark relates to the straight line: if we imagine that the natural evolution is always a straight line, in what kind of mathematical space a fractal geometry can be considered as a straight line? In which "space" the development of a cauliflower follows a straight line?

"Atoms"

Following a vision that comes from the antic Greek culture (we refer to J. Salem, 1997), we call "atom" (or elementary particle) any natural object whose qualitative properties are modified at least in one subset if we divide it into two parts. Of course, the modern atoms of J. Perrin (1913) that are studied with the so-called atomic physics are "atoms" in our understanding. Note here also that it is also the case for all classical elementary particles of microphysics: proton, neutron, and electron. A stable structure like a molecule is also an "atom" in our understanding. Moreover, the notion of "atom" is not reduced to the micro-scale and we consider here a living cell as an "atom", due to all the properties that are strongly modified or destroyed if it is cut into two parts. We extend the family of "atoms" to highly organised living organisms, including mammals and human beings. At a superior scale, it is not clear for us that the entire social organisation of life and exchanges on Earth constitutes or not an "atom", as suggested by J. Lovelock (1979) or P. Teilhard de Chardin (1955).

Quantum theory

The quantum theory considers that Nature is composed with elementary grains, insecable components (see *e.g.* the book of C. Cohen-Tannoudji, B. Diu, and F. Laloë, 1977). It has been founded during the period 1920-1930 by a collaborative approach of well-known physicists including N. Bohr, M. Born, L. de Broglie, P.A.M. Dirac, A. Einstein, W. Heisenberg, W. Pauli, M. Planck and E. Schödinger among others. It gives on a microscopic scale a mathematical description of "what can be measured and predicted with the human experiments". This theory consists in a semi-empirical approach and also demands a high level of mathematical developments. In this contribution, we will reduce the latter to the strict minimum.

The main issue due to quantum theory according to us is the separation between "matter" and "relations". On the one hand, matter is composed with so-called fermions (protons, electrons, etc.) that are indistinguishable and follow the statistics of Fermi-Dirac. On the other hand, the relations, *i.e.* the interactions between elements of matter, are composed by so-called bosons, like photons, that are the elementary components of light. The bosons are also indistinguishable and follow the statistics of Bose-Einstein. The indiscernability of identical quantum "atoms" is a fundamental postulate of the theory that is in clear accordance with the experiments. In particular, it is not possible to distinguish between two electrons or between two photons. According to D. Bohm (1951), [page 494 of the Dover edition of his book]: "... different electrons do not have an identity, since they do not even act like separate and distinct objects, which are capable, in principle, of being identified". Moreover, the Fermi-Dirac statistics implies also the so-called Pauli exclusion principle that claims that two analogous fermions cannot occupy the same position in space. Our comment about the Pauli exclusion principle is that "matter creates space, bosons give it a structure".

Fractaquantum hypothesis

The fractaquantum hypothesis is motivated by the two preceding remarks; Nature is both fractal and quantum. Consequently, the fractaquantum hypothesis (2002) express that the quantum approach is relevant for all the "atoms" in Nature, whatever their size.

Discussion

The main drawback of the fractaquantum hypothesis is the contradiction of quantum indiscernability with macroscopic appearances concerning human beings for example. It is obvious that "we are all different"! A brutal position is to stop this research and to admit that some kind of macroscopic quantum effects do not exist. Nevertheless, in the same spirit than from previous authors like W. Heisenberg (1969) for pioneering ideas concerning quantum extensions, M. Locquin (1995) for the human language, J.J. McFadden (2000) for biology or H. Stapp (1993) for mind and brain, it seems important to incorporate the quantum approach in our understanding of the world at our macroscopic scale. We prefer hereafter to discuss the acceptance of the fractaquantum hypothesis.

Firstly, the classical philosophy of Descartes insists on a preliminary fact that "our senses are deceiving us". Even if the appearances are contradictory, the fact of thinking creates the fact of being. Secondly, the history of science shows (see A. Koyré (1966) and his introduction to the famous book of N. Copernic, 1543) an example where the initial mathematical hypothesis was not completely correct, thus in contradiction with the precise know-how developed at this time. Copernic supposes that the planets follow exact circles around the sun whereas ellipses (J. Kepler, 1609) are necessary to explain the complex apparent movement of planets in the sky for one year. Thirdly, if we go back to the human example, the common points between two human persons are much more important than the different ones. The existence of medicine establishes empirically this fact! Moreover, recent discoveries concerning the genomic structure of deoxyribonucleic acid in each human cell (J. Venter *et al*, 2001) show that two human deoxyribonucleic acid sequences coincide up to 1 for 10000 parts. Even if the so-called single nucloitidic polymorphism is widely

studied in order to make in evidence local mutations (see *e.g.* Z. Zhao et al, 2003), the first established accounting fact from genomic studies is that two human beings have the same sequence of deoxyribonucleic acid up to 99.99%!

It is very interesting in our quest to review the possibilities of inter-changeability of two cells during the embryogenesis. As we all know (see *e.g.* the book of U. Drews, 1993), a complex organism such as a human being comes from a single cell that divides many times and particularizes themselves. At a certain step of embryogenic development, all the cells are identical, they are *a priori* interchangeable and after a certain time, they are different, they look different and most important, they have been specialized in specifc functions in order to promote the development of the entire "atom" to the superior scale. The understanding of the exact dynamics during the embryogenesis still is an open question (see *e.g.* D. Weisblat, 1998). We consider here that ethical reasons naturally limit the field of scientific research. We can also consider this fact as a macroscopic version of the so-called Heisenberg inequalities (see his book (1969), p. 147 of the French edition): "we cannot make any observation without disturbing the phenomenon under observation".

We can conclude this discussion about the acceptance of the fractaquantum hypothesis by stating that is relevant for small space scales (nuclear physics, atomic physics, chemistry). Because macroscopic "atoms" are recognized, this hypothesis can be considered *a priori* as irrelevant for macroscopic scales that include biology or sociology. One could conclude that the fractaquantum hypothesis is absurd and one could not consider it anymore. Our motivation to go one-step further is firstly motivated by classical philosophical observations introduced by Descartes (1641): "appearances are deceiving". We do not forget also that history of science shows examples where a contradiction between theory and observation can be present at the "zero order" of the theory. Thus our research is going further.

"q-angels"

Once the fractaquantum hypothesis is taken into consideration, we can explore its consequences for simple associations and configurations. Let us consider a system composed by two identical particles of matter; two fermions linked together by one relation, in fact a set of identical bosons that establishes the structure. Such a structure is present in so-called Fermi gases (see *e.g.* D. Petrov, M. Baranov and G. Shlyapnikov, 2003). For such a quantum system, the so-called spin, *i.e.* the way the "atoms" are turning punctually around themselves (!) has discrete values of the type 0, 1/2, 1, 3/2, ... and we refer again to the book of D. Bohm or the one of C. Cohen-Tannoudji and co-authors. Moreover, the so-called spin-statistics observation assumes that fermions may only have a spin of the semi-integer type 1/2, 3/2, ... and bosons have an integer spin equal to 0, 1, 2, ... We insist on the fact that this notion of spin, necessary to explain some precise structure in atomic spectra, like for example the so-called abnormal Zeeman effect, has no classical analogous. Moreover, the notion of spin is mathematically associated with the way the so-called group of rotations of the usual three-dimensional Euclidian space can be mathematically represented by matrices of various dimensions.

The result of this formalism (the so-called Pauli matrices, see *e.g.* his book, 1958) gives the possibility to compose, to add two different spins. This addition has of course some analogies with the usual addition of planar vectors, but the result is completely different. In particular, the addition of two simple "1/2 spins" leads to a structure that has a spin equal to zero or to the unity. We have done in our Andé's (2003) communication this classical calculus. Moreover, the association "1/2+1/2=1" is related to symmetric states. This is in contradiction with the Pauli exclusion principle that claims that two identical particles cannot be in the same quantum state. On the other hand, the association "1/2+1/2=0" is giving an anti-symmetric state for the double system. This result is widely used in atomic physics for the construction of so-called molecular orbital for complex atoms, and by D. Bohm (1951) as an example of so-called intricate states.

Let's bare in mind that the quantum association of two identical particles of spin equal to 1/2 conducts to a boson of spin equal to zero. However, such a boson is a relation because it is a quantum "atom" of integer spin. Therefore, the anti-symmetric association of two "atoms" of matter naturally defines a new relation.

A fractaquantum consequence of this microscopic property is the existence at our scale of a lot of temporal associations that are constructed and exist in order to express some relation, some communication, some exchange. In reference to the classical Biblical traditions that call an angel the "messenger of the Lord", we call (since 2003) a "quantum angel", or abbreviated a "q-angel" the association of two "atoms" in order to express a relation. A "q-angel" is composed by two "atoms" plus a relation between them. It is in itself an interaction. We do not insist here on the coherence of such structures and simple diatomic molecules that found chemistry.

The first example of a macroscopic "q-angel" is the simple conversation between two persons. The internal sense of the relations is associated with the words that are exchanged. The energetic transfer between the two actors is very low (the energy of the acoustic wave!) whereas the mass of this "q-angel" is quite impressive. The "q-angel" is defined as the two actors of the exchange including their exchange, all this during the exchange. The analogy of such "q-angel" (with a very big mass for a very weak interaction) with the so-called intermediate boson, existing under three forms named W and Z0, is very interesting (see C. Rubbia (1984) and the book of G. Cohen-Tannoudji and M. Spiro, 1986). Bare in mind that that these intermediate boson has a mass equal to 90 to 100 times the mass of a proton and a length of life estimated to 10^{-25} second!

Other examples of "q-angels" associated with the relation between two persons can be considered: danse, love, sexuality, etc. Moreover, different "q-angels" can be considered in the creation of a new human being. They have in this case a complex scale dynamics. The first "q-angel" is composed by the loving couple, then the second by the union of the two gametes and finally the third one by the association of the mother and the foetus. Bare in mind that during the nine months of the pregnancy, the mother associated with the foetus can be considered as a "q-angel", *i.e.* a complex structure associated with a relation defined in this case by the development of the embryon. We could multiply the examples of "q-angels" where two "atoms" collaborate in order to

give existence for some message. What is first important for us here is the fractal beauty of analogy between microphysics and macro-world.

Intelligence is in the loops!

Having considered the relation between two "atoms", the general situation of n "atoms" interacting together seems too much difficult. Consider firstly that when n "atoms" interact, the number of possible two by two interactions, the number of possible "dual bosons", is equal to n(n-1)/2. Remark that this number is exactly equal to n when n=0 (no interest!?) or when n=3. The particular case of three "atoms" interacting together is characterized by the fact that the number of dual relations is exactly that of matter elements.

A fundamental of such a triangle is present in Nature for a three atomic molecule. The most famous example is of course water (H2O !). Due to the differences between hydrogen and oxygen atoms, this molecule is still very complex (see *e.g.* S. Zhu, M. Evans, 1996). We prefer here to develop the internal structure of a proton or a neutron. According to so-called quark theory developed by M. Gell-Mann in the sixties (see his book, 1994), the proton is composed by three quarks (three fermions) interacting *via* a permanent exchange of so-called gluons (internal so-called coloured bosons for strong interaction). If the observation of isolated quarks is not possible at usual low energies, the experimental evidence of quarks is now well established (see R. Taylor (1967) and J. Friedmann, H. Kendall, 1972).

What matters for our communication is the kind of representation that is given by a computer simulation of a single proton (see *e.g.* J.F. Colonna, 1992). What is obtained is a simple triangle: the vertices are associated with the quarks and the edges with the permanent exchange of coloured gluons. Our observation is simple: this kind of picture has a nontrivial topological structure with one hole (also called loop, or cycle) inside. The correct mathematical definition of a loop is not elementary. We just have to know here that such a rigorous definition is possible in the framework of so-called graph theory (see *e.g.* the book of C. Berge, 1969).

Consider set of so-called vertices (or fermions for our example, "atoms" of matter) are in relation, interact through a given set of binary links, edges between two vertices. For example, the "q-angels" of the previous paragraph corresponds to n=2, λ=1 whereas the proton composed by three quarks is modelized in this approach with n=3, λ=3. More complex picture can be considered and the use of so-called graph theory is now classical: in the framework of chemistry (M. Eigen, 1971), biology (H. Atlan, 1979) and even in electrical and mechanical engineering (see *e.g.* our work with F. Rapetti and A. Bossavit, 2003). Analysing a (connected) graph composed by n vertices and λ links, the number γ of loops or cycles is equal to $\gamma=\lambda-n+1$. For a "q-angel" there is no loop (γ=1-2+1=0) and this kind of structure can be simply topologically reduced to a simple vertex. With the example of a triangle, we have γ=3-3+1=1, making in evidence one cycle. Then the interaction can circulate and be stabilized in the time the same way than with a classical regulator in automatics (see *e.g.* the book of P. Faurre and M. Robin, 1984).

The graph theory is a good mathematical framework for the description of permanent structures. Our problematics for fractaquantum hypothesis is now the following: given a certain number of "atoms" and relations, is it possible to consider the entire graph as a new "atom"? Referring to I. Prigogine (1947) and H. Maturana and F. Varela (1980), the existence of stable highly organized system demands a permanent exchange with the environment. As a living system, our body is in continual evolution whereas we remain the same human being! Consequently, the number n of "atoms" for the new structure at the superior scale has to be variable. If the number n is varying what could be permanent are the topological invariants, the cycles, the loops for variable number of "atoms" interacting in a permanent changing way. As we have suggested in 2004, "intelligence is in the loops"! Loops allow the so-called feedback regulation that maintains the nontrivial topological structure. Of course, this basic idea wants developing as per *e.g.* D. Harel, Y. Koren (2001) in a "multiscale graph theory". The vertices of the structure at the upper scale could be the permanent loops of the given graph. The interaction between these loops has to be precisely defined. Further research has naturally to be considered...

Next step is to consider the "complex association" of "atoms" linked by "relations". Note that a first example at the macroscopic scale is the crowd and its so-called libidinal links, as suggested by S. Freud (1921). In this case, the structure is fragile and the rupture of the links with the leader provokes the panic, *i.e.* the death. Consequent to our hypothesis that "intelligence is in the loops", we can conjecture that the libidinal links inside a crowd does not present any loop!

Intricate states

We now return to quantum theory and consider the astonishing phenomenon observed by A. Aspect and his colleagues (1982). The story begins with the so-called Einstein-Podolsky-Rosen paradox (1935) and the possibility of existence of so-called hidden variables (D. Bohm, 1951). These authors consider a so-called Gedanken Experiment where two systems (two spins for D. Bohm) have interacted in the past, and form a so-called intricate structure like a "q-angel". From a so-called classical realistic point of view, we are in presence of two objects interacting together whereas from the quantum point of view, we are in front of a unique "atom" that occupies two different macroscopic spatial positions during the experiment that we will name "EPRB-atom" hereafter. It is impossible here to develop the entire thoughts yield by this so-called EPRB paradox and we refer the reader to the books of D. Bohm (1951), B. d'Espagnat (1979) and M. Bitbol (1996).

When a measure occurs, the so-called reduction of the wave packet of the quantum approach predicts that the "EPRB-atom" remains unique and responds in a holistic manner even if it occupies two separate space positions! There is a natural problem with the confrontation of such a point of view with the Einsteinian realism and in particular the theory of relativity that claims that no interaction can proceed at a celerity superior to the one of the light. A detailed analysis of possible cross-correlations has been proposed by J. Bell (1964). As a result, the so-called Bell inequalities show that precise experiment is possible in order to test whereas the two components of the "EPRB-atom" remains correlated or not when they occupy different space positions. Finally, the question is to know whether the quantum mechanics gives a so-called complete description of

the world, as defended by N. Bohr (1935), or not. The experiment of two intricate photons has been proposed and realized with a great success by A. Aspect (1982). The result shows that quantum mechanics gives the good prediction; the Bell inequalities are not satisfied by the experiment, even if "in many other situations, the Bell inequalities are not violated" [A. Aspect, public conference at Orsay University, 02 February 2005]. Consequently, the holistic vision of the intricate photons is now experimentally well established.

We have to reconsider the notion of space and matter, as suggested by B. d'Espagnat (2002). In this quest, we have suggested in 2004 to consider "space" as a mathematical non-separated continuum. With this kind of mathematical notion, the "two" photons of the Aspect experiment occupy the same locus in space-time (!) and the duality of photons is still an appearance! Once again, "our senses are deceiving us"! However, what kind of mathematical model could be considered for general situations in replacement of a so-fundamental notion like "space"? Moreover, the quantum theory itself is founded on the classical existence of a so-called Kantian *a priori* (E. Kant, 1787) called space, which is preliminary to any experiment. Moreover, the predictions of quantum mechanics are formulated in terms of probabilities in the usual Cartesian space! We will not discuss here longer the aesthetic contradictions that are included inside the Copenhagen interpretation of quantum theory... Bare in mind that quantum theory has a great value, because... it works!

Intricate macroscopic states?

A natural question is associated with the fractaquantum hypothesis: does intricate matter, does "EPRB-atoms" exist at a macroscopic scale? Is it possible to evidence at a macroscopic scale phenomena that show that two apparently distinct objects belong in fact to the same "atom"? This question is highly difficult. Firstly, the domain of scientific knowledge is *a priori* limited to what is refutable by a conceivable event, following the now classical protocols formalized by K. Popper (1935).

The next step in this direction is the industrialization of Aspect experiment. This has been presented in cryptography for a secure exchange of keys by A. Ekert (1991). Nevertheless, note that if quantum cryptography has today a great interest for applications, it is more at our knowledge with the so-called BB84 protocol (C.H. Bennett, G. Brassard, 1984). This protocol is founded on the non-commutation of certain operators in quantum mechanics and not on intricate states. Firstly, positive results have been recently obtained by the Group of P. Grangier (R. Alléaume *et al*, 2004). Nevertheless, at our knowledge, Ekert protocol has still to be implemented... Secondly, the possibility of development of a so-called quantum computer has been suggested by R. Feynman (1982). It is founded on the possibility to extract some information from the free evolution of N intricate atomic systems of spin 1/2. An algorithm for "super-fast" Fourier transform has been proposed by P. Shor (1994). The first experiment [the factorization 15=3x5!] with a quantum computer has been conducted with success by L.M.K. Vandersypen *et al* (2001). Note that these works are currently in great development.

Nevertheless, the main difficulty of these micro-physics experiments is due to the so-called decoherence, modelized by W. Zurek (1982) and experimentally established by S. Haroche and his

co-workers (M. Brune *et al*, 1996). When interacting with the environment, mesoscopic quantum systems (the so-called cat of Schrödinger?) loose quickly their coherence properties. An intense field of development is then open in the laboratories of physics to prepare and maintain a certain quantity of matter in an intricate state like in so-called Bose-Einstein condensates. Concerning quantum cryptography, the different comes from the confiict between the micro-scale of a single photon and macroscopic distances. Remember that cryptographic applications are actually considered for distances of the order of one kilometre, as the one proposed by N. Gisin and co-workers (A. Muller *et al*, 1998). The possibility or not for the environment to interact with an "EPRB-atom" without destroying the intrication is a fundamental question. In some sense, if we reverse the fractaquantum hypothesis, going now from the big scale to the little one, micro-experiments could mimic the macroscopic structures (cells!) that remain stable due to the open exchanges.

We focus again on the fact that our goal here is not to construct new computers or new protocols for some secure exchanges. It is simply to understand the world as it is present in Nature all around us (and inside us also!). Generally, the reality of the fact is hidden. We are very astonished by the importance taken by electromagnetism along the history of science. Previous to B. Franklin (1751), electricity is first the natural phenomenon of thunderbolt. Because it is not well known, it provokes fear and human beings have created gods like Zeus and Jupiter in past highly organized civilizations. Following scientific developments during the 18th and 19th centuries, the unification of electrostatics, electro-kinetics, magneto-dynamics and optics *via* the Maxwell equations (1873), Humanity has developed technology and has some control on the electric energy. Moreover, electrostatics interaction with the so-called Coulombian interaction is the fundamental phenomenon that gives the structure of the hydrogen atom (see again your favourite book of quantum mechanics!) and by extension the structure of all "atoms" due to the Pauli exclusion principle, as we have reminded it in this contribution. Consequently, all molecular dynamics, all the chemistry, and all the biology could be considered as a variation on mechanics and electromagnetism. All this electromagnetism is continuously present in our life and *a priori*, we have absolute no consciousness of its presence! What could be the situation for macroscopic intricate states?

We suggest coming back to the embryonic development. On the one hand, a single cell develops in a short (?) long (?) time in order to create a complex highly organized living being. The interaction with the environment is crucial and the way some global information could be presented at the final state of embryonic evolution is an open question that seems to be an acceptable possibility. On the other hand, empirical knowledge developed in China since 3000 years with the acupuncture. A 2000 years old classical book is named *Nei Jing Su Wen*. It is presented as a conversation of the emperor Huang Di with his advisors. Remember that acupuncture sets up some relations between the internal organs inside the body and some precise locations on the skin that are acupuncture points. Of course, these correlations resist to simple explanations through classical scientific approaches, even if recent contributions *e.g.* of J. Dundee *et al* (1989), H.M. Langevin, J.A. Yandow (2002), K.P. Schlebusch, W. Maric-Oehler and F.A. Popp (2005), A. von Bubno (2005) among others begins to create interesting links between modern scientific protocols and traditional acupuncture.

We suggest here that relations between acupuncture points and internal organs could be the sign of the existence of macroscopic intricate "atoms". The correlation with the embryologic development could be a possibility to evidence the past interaction between the corresponding cells. Nevertheless, direct intrusive experiments are impossible and will show nothing else because of the reduction of the wave packet. A remaining possibility is numerical simulation...

We could also think about true twins. They come both from a unique cell and have an identical genetic patrimonium whereas they are two different persons with a strong interaction between themselves (see *e.g.* G. Claridge and S. Canter (1973) and R. Zazzo, 2001). However, do they still compose a unique intricate "atom"? The classical response is negative. Note also that by definition, a strange situation like a macroscopic intricate "atom", or a macroscopic "EPRB-atom" is still to be in the framework of artistic creation. We refer for example to the movie *The double Life of Veronica* (K. Kieslowski, 1991). Nevertheless, the experimental result of Aspect and fractaquantum hypothesis will have to be considered together in the future.

Conclusion

Our goal in this communication is to explore some aspects of the fractaquantum hypothesis, that claims both that "the big is analogous to the little" and "the world is quantum at the microscopic scales of Nature". Thus it implies that "the world has quantum properties at our macroscopic scale". This research conducts to beautiful comparisons and we have presented the notion of"q-angel" in order to express some of them.

Consequently, it seems useful to re-define usual words as "space", "big", "little". As an example, our understanding of the Pauli exclusion principle is "matter creates space, bosons give it a structure". Managing scale complexity with graph theory, we suggest that "intelligence is in the loops". Moreover, a dynamic based on relations between loops could be a first step to link the micro-scale and the macro-scale.

Strange situations of intricate matter are suggested by Aspect experiment. With the fractaquantum hypothesis, we can imagine "intricate macro states". Embryogenic development and traditional Chinese acupuncture suggest that such "intricate macro states" could be present inside each of us. We will give the last word to R. Descartes (1641): "Senses are deceiving me. Thus, I doubt. Thus...".

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