

Granular structure, wave structure, frequencies and evolution in a-temporal physical universe

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Abstract

According to a-temporal gravitation theory, universe can be considered a self-renewing system that recreates itself. It is an a-temporal phenomenon in which physical space and matter are in permanent dynamic equilibrium, and its total entropy tends to zero. The “stage” of the universe is “space-matter”, where time exists only as an irreversible stream of material changes happening in an a-temporal physical space.

Universe has a granular structure: its elementary constituents are quanta of space having the size of Planck length and being endowed with different vibrations. We live in a “sea of frequencies”: our perception of the different physical entities is tied to the different frequencies of vibration of the quanta of space constituting such entities. In particular, quanta of space constituting empty a-temporal physical space vibrate with the “basic frequency” and have got “non-entropic” energy, while quanta of space constituting matter vibrate with appropriate different frequencies (lower than the basic one) and have got “entropic” energy.

Universe has also a wave structure as a consequence of the vibrations of the quanta of space. In particular, the wave structure of the universe has two different types of “components”: quantum waves, which are the effect of the vibrations of the quanta of space at the appropriate frequencies characteristic of the subatomic particles, and electromagnetic waves, which are vibrations of the quanta of space at the frequencies of the electromagnetic spectrum propagating in a-temporal physical space at the speed of light.

Finally, according to the model here proposed, basic frequency of the quanta of space is a driving force of evolution; it is a physical environment in which matter has a continuous tendency to develop towards life and further on into conscious species. The whole process of evolution from chemical, biological events to the evolution of the human being is a continuous process generated by the basic frequency of quanta of space. Matter has a tendency to raise up its frequency towards the basic frequency of a-temporal physical space.

Keywords: a-temporal physical space, quanta of space, frequencies of vibration, subatomic particles, electromagnetic waves, wave behaviour, pilot wave, entropy, evolution.

Introduction On the basis of elementary perception, the passing of time cannot be perceived directly as can be matter and space; we can perceive only the irreversible changes of matter in space. Time cannot be considered a “real” physical entity: we can say that time exists only as a stream of irreversible material changes happening in an a-temporal space. This is an alternative, different point of view from that conventionally adopted in physics, but it is perhaps more correct and appropriate because it is more coherent with experimental facts (i.e. with the fact that there is no evidence that material objects move in time) (1).

The stage in which physical phenomena happen is not space-time but is really a four-dimensional a-temporal space (where the fourth coordinate represents just the stream of changes to which the system in consideration is subjected in the ordinary three-dimensional space we know). Phenomena exist in space-time only in the mathematical models of reality, which sometimes become more real than reality itself, which instead – on the ground of our elementary perception – turns out to be a-temporal.

If time exists only as a stream of irreversible material changes happening in space, a new interpretation of general relativity derives, which bases itself on the following starting-idea: the four-dimensional space temporal continuum is really a four-dimensional a-temporal space. As a consequence, gravitation can be seen as a modification of a four-dimensional a-temporal space. So, general relativity can be interpreted in the following way: gravity is transmitted by the density of the four-dimensional a-temporal space and its effect is to produce modifications in the geometry (i.e. in the curvature) of this a-temporal space (2). This new interpretation of general relativity, which can be defined also as a-temporal gravitation theory, implies that matter makes physical space dense and that material objects move in the direction where the density of physical space is increasing.

Another important consequence of a-temporal gravitation theory is that in the universe matter and physical space are in a permanent dynamic equilibrium. This result is suggested also by studies and observations recently conducted by a team of astronomers from the University of Virginia and the University of Massachusetts. These studies and observations show that the active galactic nucleus (AGN) of Milky Way galaxy is “eating” the galaxy of Sagittarius and, at the same time, continuously emits fresh gas. In other words, one can say that in AGN-s energy of matter transforms into the energy of physical space and at the same time energy of physical space transforms back into fresh gas. This means that in the universe an increase of the entropy of matter is only temporary: AGN-s have the role to renew “old matter” with high entropy into “new matter” with low entropy (3). Therefore, one can say that the universe had no beginning and will have no end; it is an a-temporal phenomenon that recreates itself through the cyclic transformation “space-matter-space-matter...” happening in the AGN-s. A consequence of this result is that universe cannot be considered a closed system: one cannot say how big it is. The total entropy of the universe tends to zero.

Moreover, in order to develop an a-temporal model of matter and physical space, one must take into consideration the following fact: all we observe in nature – matter or energy – is not distributed in a continuous way, but is quantized. Therefore, one can suppose that, as matter and energy, also a-temporal physical space is not continuous, but is quantized, i.e. composed by quanta of space.

The idea regarding the quantization of space is supported also by significant theoretical results. In fact, loop quantum gravity predicts that physical space is not indefinitely divisible, but it has a granular structure given by a net of intersecting loops (called also nodes of “spin networks” because their quantum numbers look like the spin angular momentum numbers of elementary particles), and just these loops constitute the quantum excitations of the gravitational field, i.e. represent the elementary quanta of space. According to loop quantum gravity, nodes of spin networks represent the elementary grains of space, and their volume is given by a quantum number which is associated with the node in units of the elementary Planck volume, $V = (\hbar G/c^3)^{3/2}$, where \hbar is Planck reduced constant, G the universal gravitation constant and c the speed of light. Two nodes are adjacent if there is link between them, in which case they are separated by an elementary surface whose area is determined by the quantum number associated with that link. Link quantum numbers, j , are integer or half-integer and the area of the elementary surface is $A = 16\pi V^{2/3} \sqrt{j(j+1)}$ where V is the Planck volume (4).

On the ground of these results of loop quantum gravity, one can assume that quanta of space having the size of Planck length are the fundamental constituents of physical space. More precisely, according to the model here proposed, as universe is an a-temporal phenomenon where physical space and matter are in permanent dynamic equilibrium, one can say that physical space and matter are composed by the same type of elementary constituents. Therefore, in this model, both “empty” a-temporal physical space (i.e. physical space in absence of matter) and matter are constituted by quanta of space having the size of Planck length: quanta of space are the fundamental bricks of all that we observe. The only difference is that a-temporal physical space, in absence of matter, has not got entropy (there is no experimental evidence that such a space has entropy; its only property is density); instead, matter has got entropy and therefore can change its state (for example, its position, its speed and its atomic and molecular structure). Quanta of space as elementary packets of energy have not been created and cannot be destroyed, in physical terms they are a-temporal entities. First law of thermodynamics rules quanta of space of a-temporal physical space, second law of thermodynamics rules quanta of space building up matter (3).

Materials and methods: the postulates of an a-temporal theory of everything

According to the view here proposed, an a-temporal “theory of everything” is based on the following postulates (5):

1. Energy is composed of basic packets of energy which are of Planck size (here called “quanta of space” – QS). QS constituting physical space have no entropy.
2. QS form physical space and matter. The “arena” (stage) of the universe is “space-matter”, physical reality is composed of space and matter. Each quantum of space is described by a wave-function depending on its position in physical space, a quantum number which indicates its orientation (as to an arbitrary axis) and a frequency of vibration. QS vibrating with the “basic frequency”, defined as the inverse of Planck time (and thus equal to $0.19 \cdot 10^{44} s^{-1}$) constitute physical space, are devoid of mass, and are the “non-entropy state” of energy, and therefore are not perceivable by our senses. QS vibrating with the frequencies characteristic of subatomic particles constitute matter and are the “entropy state” of energy (and therefore are perceivable to our senses). Each subatomic particle is the result of the interaction of energy in the “entropy state” with one or more QS, caused by the vibration of these QS at appropriate frequencies. In particular, particles devoid of internal structure, such as quarks, leptons and intermediate bosons are the result of the interaction of energy in the entropy state with one quantum of space; particles endowed with an internal structure, such as baryons and mesons, are given by the interaction of entropic energy with more QS. QS vibrating at the frequencies of the electromagnetic spectrum generate electromagnetic waves (which propagate through physical space at the speed of light).
3. Time is irreversible change of matter in physical space. Physical space itself is a-temporal (here called “a-temporal physical space” – ATPS). Universe is an a-temporal phenomenon where ATPS and matter are in a permanent dynamic equilibrium. There was no beginning of the universe and there will be no end.

4. The fundamental interactions and physical fields represent special states of ATPS, the different ambient situations existing in ATPS in presence of certain material particles. All interactions produce, determine modifications in the properties of ATPS. In particular, gravity has the effect to produce modifications in the geometrical properties (i.e., in the curvature) of ATPS. The other three interactions (electromagnetic, weak and strong) determine modifications in the vibrations of QS. They can change the frequencies of QS from the “basic frequency” (characterizing empty ATPS) to other appropriate frequencies less than the basic one (which can be the frequencies characteristic of material particles and/or of electromagnetic waves), or can change the frequencies characteristic of some material particles in the frequencies characteristic of other material particles (and/or of electromagnetic waves). Each interaction is characterized by its own strength parameter, which indicates the intensity of the modifications induced in the region of ATPS under study, and its own particular range, i.e. the range in which the modifications of ATPS determined by the interaction happen. Gravitational force is transmitted by the density of ATPS; material objects move in the direction in which the density of ATPS is increasing. The other forces are mediated by the exchange of a particular boson: the photon for the electromagnetic interaction, the intermediate bosons W^\pm and Z^0 for the weak interaction and the gluons for the strong interaction.

5. The description of a force is not altered by any modification of the length scales of rulers and of temporal scales of clocks utilized as measurement instruments (gauge invariance principle). Each interaction satisfies its peculiar gauge symmetry. (For example, in the case of the electromagnetic interaction, the quantum-mechanical description of experiments on charged particles is invariant under local phase transformations on the particle wavefunction, if one introduces a long-range field coupled to the charge - the electromagnetic field - and one makes simultaneously a suitable local gauge transformation on the electromagnetic potential. In the case of the strong interaction, the gauge symmetry is the isospin symmetry: the strong interactions are invariant under rotations in the isospin space).

Granular structure and wave structure of the universe

In quantum gravity and cosmology the universe can be described by a wave-functional Ψ which satisfies the Wheeler-DeWitt equation, i.e. universe as a whole can receive a description of wave type. On the ground of this fact, it is permissible to assume that also the elementary constituents of universe, i.e. the QS, manifest a wave-type behaviour, and therefore can be described by a sort of wavefunction. In this a-temporal model, one assumes thus that the generic quantum of space of the universe can be described by a wavefunction ψ . This wavefunction depends on the position μ_i of the quantum in ATPS (with $i=1,2,3,4$ and the fourth coordinate μ_4 represents the stream of changes to which the system is subjected in the ordinary three-dimensional space we know). Besides, each quantum of space is characterized by a frequency of vibration ν and by an orientation with respect to an arbitrary axis (for example the third axis of an orthogonal Cartesian reference system) described by a quantum number j .

According to the postulate 2 of the model here introduced, QS having the size of Planck length and vibrating at appropriate frequencies are the fundamental bricks of the whole physical reality. Physical space and matter are both constituted by QS, but

endowed with different frequencies of vibration and, consequently, with different “states” of energy.

QS constituting ATPS vibrate with the frequency $0.19 \cdot 10^{44} s^{-1}$ (which is their “basic frequency”), have got a “basic energy” given by $E_{qs} = 1.26 \cdot 10^{10} J$ and change their electrical charge from positive to negative in a Planck time ($5.39 \cdot 10^{-44} s$). Energy of QS constituting ATPS is in the “non entropic state”, and this implies that ATPS appear to us “empty”, without changes, without material objects. QS constituting ATPS are described by a wave function ψ satisfying the following law $\left(R_{\mu\eta} - \frac{1}{2} g_{\mu\eta} R \right) \psi = 0$ [1], where $\left(R_{\mu\eta} - \frac{1}{2} g_{\mu\eta} R \right)$ is Einstein's gravitational tensor (composed by two terms containing Ricci's tensor $R_{\mu\eta}$, metric tensor $g_{\mu\eta}$, and R which is a number given by the composition of metric tensor with Ricci's tensor). Equation [1] is similar to Einstein's tensorial equation of the gravitational field without matter-energy tensor which represents the source (i.e. the distribution of matter and energy) of the gravitational field. Here, the following idea is therefore suggested: QS constituting ATPS appear to us “empty”, without material structure, just because in the equation describing their behaviour there is not the matter-energy tensor, but there are only the metric tensor which represents the geometry of ATPS and Ricci's tensor which represents the curvature of ATPS, i.e. the effect of gravitational interaction (we remember in fact that in a-temporal gravitational theory gravity is transmitted directly by the density of ATPS and its effect is to produce modifications in the geometry of ATPS). As QS constituting ATPS are not material, their quantum waves must be considered empty themselves.

QS constituting matter vibrate at appropriate frequencies characteristic of the subatomic particles in exam, and have got energy in the “entropic state” (and this implies that matter is perceivable by our senses). Each subatomic particle derives from one or more QS vibrating at an appropriate frequency (lower than the basic one): in virtue of this vibration, these QS become seat of a discrete quantity of entropic energy. The generic quantum of space giving origin to a material particle is described by a wave function ψ

satisfying the law $\left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} - \frac{|\nu_{ma} - \nu_{em}| l_p^2 m^2}{\hbar^2} \right) \psi = 0$ [2], where ν_{em} is a frequency of the

electromagnetic spectrum, ν_{ma} is a frequency of matter, l_p is Planck's length, m is the mass of the quantum and c is the speed of light. Taking into account that in Bohm's quantum field theory there is a link between the mass of a subatomic particle and the quantum potential Q , in the model here proposed we suggest that there is a link also between the mass of a material quantum and the quantum potential (because subatomic particles derive from one or more QS). In virtue of this consideration, equation [2] can also

be expressed in the following way: $\left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} - \frac{|\nu_{ma} - \nu_{em}| l_p^2}{c^2} \frac{\delta Q}{\delta \psi} \right) \psi = 0$ [3]. On the basis

of equation [3], turns out to be legitimate and plausible the following interpretation of the mathematical formalism concerning QS of the model here: the vibrations of QS at certain appropriate frequencies, less than the basic one (and different from the frequencies belonging to the electromagnetic spectrum) create the appearance of material particles (in the sense that, because of them, in these QS we have the appearance of mass), and this appearance of mass is strictly related to quantum potential. We suggest that the quantum

waves associated to subatomic particles guide them during their motion, through the action of quantum potential, in agreement with Bohm's pilot wave theory (5). The action of

quantum potential $Q = \frac{\hbar^2}{m^2 c^2} \frac{\left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} \right) |\psi|}{|\psi|}$ is to create the appearance of a subatomic

particle of a given mass (and consequently of entropic energy) in the different points of ATPS. Therefore, in this model each subatomic particle can be interpreted as a structure deriving from one or more QS which vibrate at appropriate frequencies and which, in virtue of these vibrations, assume a discrete quantity of entropic energy, perceivable by our senses, and the appearance of this entropic energy is related to quantum potential. Since in this model each subatomic particle is interpreted as the result of interaction of a discrete entropic energy with one or more QS, and since in Bohm's pilot wave theory the action of quantum potential is to guide the particle into examination during its motion, one can say that there is a correspondence between Bohmian quantum potential and the appearance of entropic energy in the different points of ATPS. In this model, the role of quantum potential is to transfer entropic energy among the QS occupied by a subatomic particle during its motion, to guide this entropic energy among the different QS composing the trajectory described by the particle in ATPS (5).

Besides, regarding the interpretation of subatomic particles, the value and form of the entropic energy that a quantum of space assumes when it becomes a material quantum depend on the particular ambient situation existing in the region in exam, on the particular "potential" to which the region of ATPS is subjected. According to the postulate 3, the ambient situation existing in ATPS can produce modifications in the properties of that region, in particular it can change the frequency of vibration of a quantum of space of that region from the "basic frequency" to a frequency characteristic of a subatomic particle (or simultaneously to more frequencies characteristic of that particle subjected to that ambient situation, in the case of superposition states of energy), determining the appearance in that quantum of space of a discrete quantity of entropic energy (or simultaneously the appearance in that quantum of space of different entropic energies, in the case of superposition states). Therefore, indicating with V the potential, the ambient situation existing in the region of ATPS under study, with $\psi_i(\mu_i, j_i, \nu_P)$ the wave-function which describes a quantum of ATPS (where ν_P is the basic frequency and j_i is the quantum number describing its orientation – a boson will derive from one or more QS whose quantum numbers j_i give for total an integer number, a fermion from one or more QS whose quantum numbers j_i give for total an half-integer number) we have the following results:

- $V\psi_i(\mu_i, j_i, \nu_P) = \psi_i(\mu_i, j_i, \nu_{ma})$ (where ν_{ma} is an appropriate frequency characteristic of a subatomic particle) for the stationary states of energy;

- $V\psi_i(\mu_i, j_i, \nu_P) = \sum_{i=1}^n c_i \psi_i(\mu_i, j_i, \nu_{ma}^i)$, (where ν_{ma}^i are appropriate frequencies characteristic of a subatomic particle and $\sum_{i=1}^n |c_i|^2 = 1$), for the states given by a superposition state of energy.

For example, the electron being in a stationary state of the hydrogen atom derives from a quantum of space which vibrates at one of the frequencies $\nu_n = -\frac{2\pi^2 m_e e^4}{h^3 n^2}$ and, on the ground of this vibration, becomes seat of an entropic energy given by $E_n = h\nu_n = -\frac{2\pi^2 m_e e^4}{h^2 n^2}$ (in these relations n is a positive integer number, m_e is the mass of the electron, e is the elementary charge, h is Planck constant). As far as the electron of an hydrogen atom is concerned, one can say that in a given region of ATPS, the ambient situation represented by the Coulomb field created by a proton (i.e. $V(r) = -e^2 / r$ where r is the distance from the proton) determines a modification in the properties of that region: more precisely, it produces the change of the frequency of a quantum of space, being at a distance $r_n = \frac{n^2 \hbar^2}{m_e e^2}$ from the proton, from the value given by the “basic frequency” to the value $\nu_n = -\frac{2\pi^2 m_e e^4}{h^3 n^2}$. The ordinary stationary states of energy predicted by quantum mechanics for particles devoid of internal structures can be seen as the effect of the vibration of a quantum of space at appropriate frequencies characteristic of the particle in exam: the fact that the frequency is quantized implies then that also the energy (in the “entropic state”) that a quantum of space acquires (as a consequence of that vibration) is quantized and a different quantum wave function will correspond to each of these values.

Besides, on the basis of equations [2] and [3], one can say that the vibration of a quantum of space at one of the frequencies $\nu_n = -\frac{2\pi^2 m_e e^4}{h^3 n^2}$ creates the appearance, in a stationary state of the hydrogen atom, of an electron of mass m_e , and that quantum potential is strictly correlated to the appearance of this mass. In the case of the hydrogen

atom, the action of quantum potential $Q = \frac{\hbar^2}{m_e^2 c^2} \frac{\left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} \right) |\psi|}{|\psi|}$ is therefore to create the appearance of an electron of mass m_e (and consequently of entropic energy) in the different QS of each energetic level. The role of quantum potential is to transfer, to guide this entropic energy among the different QS composing the trajectory described by the electron in an energetic level of the hydrogen atom. There is a correspondence between quantum potential and the appearance of entropic energy in the different points of ATPS. The role of quantum potential is to transfer entropic energy among the QS occupied by a subatomic particle during its motion, to guide this entropic energy among the different QS composing the trajectory described by the particle in ATPS.

In short, as far as the interpretation of matter is concerned, on the ground of the a-temporal model here introduced, all derives from the vibrations at appropriate frequencies (characteristic of material particles). The vibrations of QS at appropriate frequencies create the appearance of material particles (in the sense that because of them, these QS become seat of a discrete quantity of energy in the “entropic state”) and, at the same time, create the wave behaviour, the quantum waves associated with such particles. And, on the ground of equation [3], one can suggest that these waves guide the corresponding particles in the different points of ATPS through the action of quantum potential: the

entropic energy is transferred by quantum potential among the different QS composing the trajectory described by the subatomic particle.

In the model here proposed, equations [2] and [3] allow us to conclude that it is just the vibrations of QS at the frequencies characteristic of subatomic particles which give place to the quantum waves associated to the material particles. The wave behaviour of the subatomic particles arises from the vibrations of the QS constituting them.

Therefore, in this model one can propose the idea that the behaviour of the material particles is determined by the states of ATPS. The quantum waves of matter arise from the particular ambient situations existing in given regions of ATPS. The peculiar ambient situation existing in a given region of ATPS determines the lowering of the frequency of one or more QS from the basic frequency (characterizing empty ATPS) to the frequencies characteristic of material particles; and, then, it is just these vibrations at the frequencies characteristic of the particles that determine the quantum waves associated with those material particles.

These quantum waves can be interpreted both in standard sense (as mathematical tools to compute certain probabilities) and in more “realistic” senses. We emphasize however that we prefer to interpret them in a realistic sense. We suggest, in particular, that these quantum waves can be interpreted like in Bohm’s pilot wave theory. In this model, according to equation [3], the appearance of a mass is related to quantum potential: the role of the quantum potential is to transfer a discrete quantity of entropic energy (associated with a subatomic particle) among the different QS composing the trajectory described by the subatomic particle in ATPS. The quantum waves associated with the material particles guide the corresponding particles during their motion, through the action of quantum potential, in the regions where the wave function is more intense (6, 7).

The quantum waves, determined by the vibrations at appropriate frequencies of QS, confer a wave structure to a-temporal physical universe. Therefore, a-temporal physical universe turns out to have, at the same time, a granular structure, given by a network of QS, but also a wave structure, in virtue of the vibrations of the QS occupied by matter, namely the quantum waves associated with the subatomic particles. We repeat that we want to suggest the idea that these quantum waves, like in Bohm’s pilot wave theory, guide the corresponding particles during their movement (in the regions where the wavefunction is more intense). As a consequence of this “realistic” interpretation, the quantum waves contribute to make all particles interact, link all particles and therefore, in this scheme, we have an image of physical world which appears consistent, at least philosophically, under Einstein’s point of view (because here the waves create just a connection among all the particles, and as we have told, all this can be considered an effect of the vibrations of QS subjected to appropriate “states” of ATPS).

Thus, one can also say that this model, as far as its conceptual and philosophical foundations are concerned, can provide an interesting interpretation of the main starting-hypothesis of Bohm’s pilot wave theory, namely the idea that every subatomic particle must be thought as constituted by a wave and a corpuscle at the same time, with the wave that guides the corpuscle during its motion. In fact, on the basis of equations [2] and [3] and the considerations made above, one can propose that the waves associated with subatomic particles and that guide them during their motion can be considered the effect of the vibrations – at appropriate frequencies - of the QS composing those particles.

Besides, as far as spin is concerned, we suggest that the spin of a subatomic particle derive and depend on the orientations of the QS composing it. We propose that a quantum of space having an orientation (with respect to an arbitrary axis) described by the quantum number j_i can give origin to a material quantum endowed with a spin j_i with respect to that arbitrary axis. For example, a subatomic particle devoid of internal structure such as the electron, being a fermion and so having an half-integer spin, will derive from a quantum of space endowed with an orientation expressed by a half-integer number.

Finally, there are also other peculiar frequencies producing the appearance of physical entities endowed with entropic energy, and therefore perceivable by our senses: the frequencies belonging to the electromagnetic spectrum. QS vibrating at these frequencies generate electromagnetic waves which propagate through ATPS at the speed of light. If a quantum of space vibrates with a frequency of electromagnetic spectrum, i.e.

$\nu = \nu_{em}$, its wave function ψ satisfies the following equation: $\left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} \right) \psi = 0$ [4], which is analogous to the classic equation of electromagnetic waves.

On the ground of the ideas here illustrated, one can say therefore that in this a-temporal model the wave function ψ of a generic quantum of space composing physical universe satisfies the following general equation:

$$(\nu - \nu_{em}) \cdot (\nu - \nu_{ma}) \left(R_{\mu\eta} - \frac{1}{2} g_{\mu\eta} R \right) \psi + |\nu - \nu_P| \left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} - \frac{|\nu - \nu_{em}| l_P^2 m^2}{\hbar^2} \right) \psi = 0 \quad [5]$$

(or even better

$$(\nu - \nu_{em}) \cdot (\nu - \nu_{ma}) \left(R_{\mu\eta} - \frac{1}{2} g_{\mu\eta} R \right) \psi + |\nu - \nu_P| \left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} - \frac{|\nu - \nu_{em}| l_P^2}{c^2} \frac{\delta Q}{\delta \psi} \right) \psi = 0 \quad [6]),$$

where ν_{em} is a frequency of the electromagnetic spectrum, ν_{ma} is a frequency of matter, ν_P is the "basic frequency", l_P is Planck length, $\left(R_{\mu\eta} - \frac{1}{2} g_{\mu\eta} R \right)$ is Einstein's gravitational tensor, m is the (eventual) mass of the quantum, c is the speed of light, and Q is the quantum potential. In fact, one can easily see that for the QS building up ATPS, i.e. vibrating at the basic frequency ν_P , equations [5] and [6] become $\left(R_{\mu\eta} - \frac{1}{2} g_{\mu\eta} R \right) \psi = 0$, i.e. equal to equation [1]; for the QS of matter, i.e. vibrating at the frequencies ν_{ma} of material

particles, equations [5] and [6] become $\left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} - \frac{|\nu_{ma} - \nu_{em}| l_P^2 m^2}{\hbar^2} \right) \psi = 0$ or

$\left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} - \frac{|\nu_{ma} - \nu_{em}| l_P^2}{c^2} \frac{\delta Q}{\delta \psi} \right) \psi = 0$, i.e. equal to equations [2] and [3] respectively; and,

finally, if a quantum of space vibrates at a frequency ν_{em} of the electromagnetic spectrum,

equations [5] and [6] become $\left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} \right) \psi = 0$, i.e. equal to equation [4].

On the ground of equations [5] and [6], one can therefore conclude that the frequency of vibration of QS is the “driving force” which determines the features of the entities present in the universe.

Evolution of Life and Basic Frequency of ATPS

According to the model here proposed, the frequencies of the QS are the fundamental physical entities which determine the value of the entropy of the entities present in the universe. As a consequence, they have an important role as far as evolution is concerned.

Second law of thermodynamics and Boltzmann’s hypothesis as regards the variation of entropy are not compatible with the idea that universe is an a-temporal phenomenon that recreates itself (and therefore with the idea that universe is not a closed system, for which one can not find how big it is). On the ground of the research of our group, self-renewing universe with a total entropy that sums to zero suggests that the relationship between the entropy S of a generic region composing physical universe and the stream of material changes μ_4 happening in ATPS can be expressed through the

following formula: $S = (K \ln P)\mu_4 \exp\left(-\frac{\mu_4}{A}\right)$ [7] (where $\mu_4=0$ is conventionally chosen in

correspondence to the beginning of the transformation, in AGN-s, of physical space into matter, i.e. after fresh gas begins to come out of AGN-s). In this equation K is Boltzmann constant, P is a parameter which indicates the degree of disorder existing in the positions and motions of the material particles present in the region (and practically depends on the number of these particles) and A is a parameter strictly related to the maximum value that entropy can reach in the region during the evolution. Equation [7] allows us to explain and reproduce the increase of entropy of matter after fresh gas begins to come out of AGN-s (i.e. during the evolution of the universe corresponding to the formation of nuclei, atoms, stars and planets); at the same time, it allows us to explain and reproduce the decrease of entropy concerning the evolution of life and conscious species in the regions of the universe which have similar physical circumstances to the earth.

An appropriate value of the frequency of vibration ν of the generic quantum of space corresponds to each value of μ_4 (i.e. of the numerical order of material changes happening in ATPS). Now, as the change in the entropy of a given region is strictly related to the change in the frequency of the QS composing it, one can assume that the relationship between the frequency of the generic quantum of space and the stream of changes happening in ATPS have a similar behaviour to that of the entropy [7], i.e. that the

term $\mu_4 \exp\left(-\frac{\mu_4}{A}\right)$ must be present also in the expression of the frequency of the generic

quantum of space. In particular, taking into account that for $\mu_4=0$ (situation in which it begins the transformation, in AGN-s, of ATPS into matter) the QS vibrate at the “basic frequency”, that successively it happens the cyclic transformation “space-matter-space-matter...” in AGN-s, and that therefore the universe can be seen as a self-renewing system with a total entropy that tends to zero, it derives the following relationship between the stream of material changes μ_4 happening in ATPS and the frequency of vibration ν of

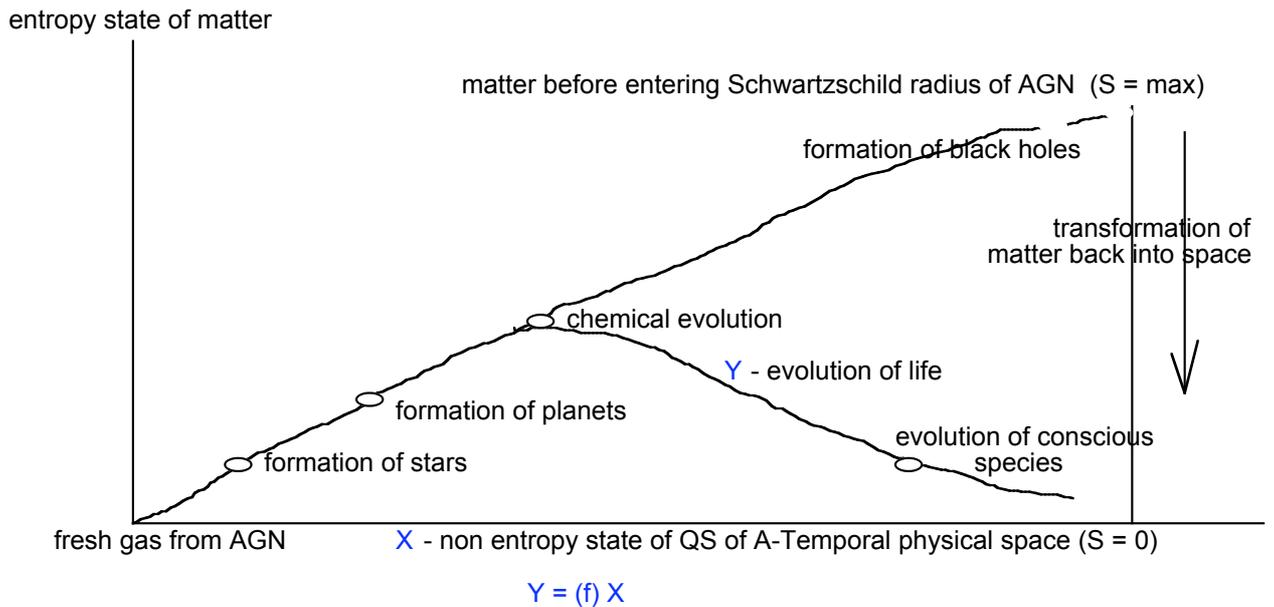
the generic quantum of space: $\nu = \nu_p - \mu_4 \exp\left(-\frac{\mu_4}{A}\right)$ [8].

On the ground of equations [7] and [8], one can now draw the following important results as regards the evolution.

In the centre of AGN-s, when density of quanta of ATPS in the area inside the Schwarzschild radius is at its maximum, energy of physical space begins to transform into energy of material particles ($\mu_4 = 0$). In this initial situation, the entropy of the generic region of the universe is equal to zero (which is its minimum value) while the frequency of QS is equal to the basic frequency ν_p . Then, for $\mu_4 > 0$ QS begin to change their state from non entropic to entropic (and therefore the frequencies of vibration from the value of the “basic frequency” become equal to appropriate values characteristic of subatomic particles). The first particles to form in ATPS are quarks and leptons (i.e. particles composed by one quantum of space). Therefore, in this first phase strong interaction among quarks is the prevalent ambient situation: as a consequence, we have certain appropriate frequencies of vibration of QS (characteristic of quarks) that give origin to the formation of nuclei. With the formation of nuclei, as in ATPS there are nuclei and electrons, ATPS assumes the special state represented by the electromagnetic field (in particular, the Coulomb potential) acting between nuclei and electrons and this peculiar interaction gives origin to atoms. With the formation of many atoms, ATPS tends to assume the special state represented by the Van Der Waals interactions acting among atoms and this leads to the formation of molecules. In other words, with the presence of many atoms, a-temporal physical universe enters the phase of chemical evolution which leads to the formation of more and more complex chemical aggregates.

Now, chemical evolution is the beginning of the negentropic process of biological evolution. Astronomical observations show that the whole observable space is permanently in a phase of chemical evolution. Besides, in the whole observable space there have been discovered basic organic molecules necessary for the development of life (8).

According to the model proposed here, one can say that organic molecules that are needed for the development of life are permanently generated in the whole observable space because of the “basic frequency” of QS that build up ATPS. “Basic frequency” of QS of ATPS is a physical environment for chemical evolution (it “generates” formation of organic molecules) that on the earth and the planets similar to the earth develops into life. Evolution of life is a continuous negentropic process and it can be described as a “function” $Y=f(X)$ determined by the “basic frequency” of QS.



During the processes of formation of subatomic particles, nuclei, atoms, molecules, stars and planets (i.e. until the beginning of chemical evolution), on the ground of equation [7] the entropy of the generic region of the universe increases and reaches its maximum

$$S_{\max} = (K \ln P) \frac{A}{e} \text{ for } \mu_4 = A, \text{ which is just the numerical order of changes corresponding to}$$

the beginning of chemical evolution (situation in which the amount of matter is at its maximum, in other words is in equilibrium with the density of physical space existing inside AGN-s). At the same time, on the ground of equation [8] the frequency of vibration ν of QS composing the generic region of the universe tends to decrease and reaches its

$$\text{minimum value } \nu_{\min} = \nu_P - \frac{A}{e} \text{ for } \mu_4 = A \text{ itself. Then, for } \mu_4 > A \text{ with the process of}$$

chemical evolution we have at the same time the formation of organic molecules: therefore in the universe also the biological evolution begins and there form cellules, pluricellular beings and living organisms. Equation [7] implies that for $\mu_4 > A$ (and thus during the biological evolution) entropy starts to decrease. Equation [8] implies that for $\mu_4 > A$ the frequency of vibration of the generic quantum of space tends to increase: living organisms have a tendency to develop into systems composed of QS with higher frequency. One can predict that at the limit of bigger and bigger numerical order of changes, i.e. with the evolution of human being and his consciousness, entropy tends to become smaller and smaller while the frequency of QS tends to become higher and higher. In particular, one can say that in the phase of conscious experience of man (i.e. $\mu_4 \rightarrow +\infty$), entropy will tend to zero and the corresponding frequency of QS will approach to the “basic frequency”.

In our research, consciousness is interpreted as the “basic frequency” of the QS. Also researches done by Penrose and Hameroff see consciousness as a non local phenomenon that is not only the result of the processes of the brain. Their researches suggest that the force of quantum gravity acting on the mass of neurones within the brain may be responsible for the emergence of consciousness. The process is fundamentally related to the influence of quantum gravity on microtubule networks within the neurones (9, 10).

On the ground of the model here proposed, QS vibrating at the “basic frequency” can be therefore considered the “elementary driving forces” of the evolution. One can say that the basic frequency of QS is a “physical environment” in which matter has a continuous tendency to develop towards conscious species. Physical evolution, chemical evolution, biological evolution and conscious evolution of man can be considered processes generated by the basic frequency of QS. In fact, during the first phases of evolution of the universe corresponding to the transformation of the energy of physical space into energy of matter (i.e. until the beginning of chemical evolution), the entropy of the universe tends to increase and the frequency of QS tends to transform from the value given by the “basic frequency” to other appropriate values (lower than the basic one) characteristic of material particles. Then, with the beginning of the chemical evolution, which leads to the formation of organic molecules and therefore determines also the biological evolution of the universe, entropy tends to decrease and the corresponding frequency of vibration of QS tends to become higher and higher and, at the limit, will approach to the “basic frequency” with the evolution of the human being and his consciousness.

Universe is physically homogeneous. ATPS has the same physical properties in the whole universe. By considering “basic frequency” of ATPS as its driving force, evolution can be understood as an universal process, as an integral part of cosmic dynamics (11, 12).

Conclusions

QS having the size of Planck length and vibrating at appropriate frequencies are the elementary packets of energy which compose all physical reality. We practically live in a “sea of frequencies”: our perception of the different physical entities is tied to the different frequencies of vibration of the QS constituting such entities. QS constituting ATPS vibrate at the “basic frequency” and have got non-entropic energy: for these reasons they are not perceivable by our senses and appear to us “empty”, without material structures. QS constituting matter vibrate at appropriate frequencies (lower than the basic one) characteristic of material particles and have got entropic energy. It is in virtue of the vibration at appropriate frequencies that QS assume a discrete quantity of entropic energy, becoming therefore material quanta, perceivable to our senses (the value and form of the entropic energy that QS assume when they become material quanta depend on the particular ambient situation of the region in consideration, on the particular “potential” to which the region of ATPS is subjected). Also the quantum waves associated with the particles can be seen thus as an effect of the vibration of the QS composing them, and we suggest that they guide the corresponding particles in their movement in agreement with Bohm’s pilot wave theory.

In conclusion, according to the view proposed here, physical universe is an a-temporal phenomenon (built up by ATPS and matter in permanent dynamic equilibrium) having a granular structure and at the same time a wave structure. The granular structure of a-temporal physical universe is tied to the fact that its elementary constituents are QS having the size of Planck length and vibrating at different appropriate frequencies: the “basic frequency” in the case of the QS composing ATPS, the frequencies characteristic of the different subatomic particles in the case of material particles, and the frequencies of the electromagnetic spectrum in the case of electromagnetic waves. The wave structure of a-temporal physical universe is a consequence of the vibrations of the QS and can have two different types of “components”: quantum waves, which are the effect of the vibrations

of the QS at appropriate frequencies characteristic of the subatomic particles, and electromagnetic waves, which are vibrations of QS at the frequencies of the electromagnetic spectrum propagating through ATPS from one quantum to another at the speed of light. Instead the “waves” associated with QS constituting ATPS must be considered “empty”, not perceivable by our senses, because these QS, vibrating at the “basic frequency”, have got non-entropic energy.

Finally, the idea of a self renewing universe characterized by a “sea of frequencies” of QS brings new light as regards the evolution. Physical evolution, chemical evolution, biological evolution and conscious evolution of man can be considered processes generated by the basic frequency of QS. As ATPS has the same physical properties in the whole universe and as the basic frequency of QS is its driving force, evolution can be considered an universal process, an integral part of cosmic dynamics. This new “cosmic approach” goes beyond the “geo centric” approach. It sees evolution as an universal negentropic process that develops towards the “basic frequency” of a-temporal physical space.

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