

A-TEMPORAL PHYSICAL SPACE AND INTRODUCTION TO THE THEORY OF EVERYTHING

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Universe is an a-temporal phenomenon where physical space and matter are in a permanent dynamic equilibrium. The “stage” (arena) of the universe is “space-matter” where time exists only as an irreversible stream of material changes occurring in A-Temporal Physical Space. Matter and space are composed by one energy. The basic “packets of energy” which build up matter and A-Temporal Physical Space are quanta of space. Quanta of space are a “energy medium” which can vibrate with different vibrations (and transmit them to the quanta of space around them too, in the case of electromagnetic waves). In particular, quanta of space constituting A-Temporal Physical Space vibrate with the “basic frequency” and are the “non-entropy state” of energy, while quanta of space constituting matter vibrate with appropriate different lower frequencies and are the “entropy-state” of energy. Each subatomic particle can be interpreted as the result of the interaction of energy in the “entropy-state” with one or more quanta of the A-Temporal Physical Space. This interaction of energy in the “entropy state” with quanta of space is determined by the vibration of these quanta of space at appropriate frequencies. It is as the consequence of the vibration at appropriate frequencies (lower than the basic one) that the quanta of space assume the “entropy-state” of energy, thus becoming material quanta, perceivable to our senses. The discrete quantity of energy, in the “entropy state”, that a quantum of space assumes when it becomes material quantum depends on the particular situation existing in A-Temporal Physical Space. The fundamental interactions and physical fields can be seen, in fact, as different “states”, as different ambient situations existing in A-Temporal Physical Space in presence of certain material particles. One can propose also that the wave behaviour of subatomic particles arises from the vibration of the quanta of space constituting them. The waves associated to the particles can be thus considered an effect of A-Temporal Physical Space and one can assume that they guide the corresponding particles in the regions where the wavefunction is more intense, and therefore in agreement with Bohm’s pilot wave theory (making them appear in the different points of A-Temporal Physical Space).

Keywords: A-Temporal Physical Space, quanta of space, frequencies of vibration, fundamental interactions, subatomic particles, electromagnetic waves, quantum potential, pilot wave

1. INTRODUCTION

Consciousness as a research tool shows that A-Temporal Physical Space (ATPS) is a-dimensional, has no “dimensionality”. One experiences ATPS as three-dimensional because in order to define the

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position of material objects in ATPS one needs three coordinates. A-dimensional ATPS that one experiences through the three dimensional Euclidean space exists only in the mind and not in the universe itself. It is important to underline that Euclidean geometry describes only positions of material objects in physical space but does not describe physical space itself. Besides, by having conscious experience one realizes that time itself is space, because it exists only as a stream of irreversible material changes happening in ATPS: therefore in a mathematical model closer to conscious experience, ATPS must be described by four coordinates, where the fourth coordinate represents just the numerical order of irreversible material changes happening in ATPS (which is the most correct and appropriate way to interpret time, on the basis of elementary perception) (Sorli A. and Sorli I, 2005a).

On the ground of the fact that ATPS has no dimension, one can think that also the “basic grains” which build up ATPS (here called “quanta of space” – QS) have no dimension. In loop quantum gravity, the elementary grains of space are nodes of spin networks and their volume is given by a quantum number that is associated with the node in units of the elementary Planck volume, $V = (\hbar G / c^3)^{3/2}$, where \hbar is Planck’s reduced constant, G is the gravitational constant and c is the speed of light (Rovelli, 2003). On the basis of this result it is lawful to assume that QS of ATPS have a certain volume, related to Planck length.

According to the model presented here, QS as “elementary packets” of the energy have not been created and can not be destroyed (on the ground of the first law of thermodynamics). QS are A-Temporal in the sense that for their existence no change (travel) of particle in ATPS is needed (Sorli and Fiscaletti, 2005). QS which build ATPS have no entropy, their potential energy is constant. QS constituting ATPS vibrate at the “basic frequency” $0.19 \cdot 10^{44} s^{-1}$, have a “basic energy” given by the relation $E_{qs} = h \cdot 0.19 \cdot 10^{44} s^{-1}$ where h is Planck constant ($6.626069 \cdot 10^{-34} J \cdot s$), and thus $E_{qs} = 1.26 \cdot 10^{10} J$, and change their electrical charge from positive to negative in a Planck time ($5.39 \cdot 10^{-44} s$).

2. FEATURES OF QUANTA OF SPACE CONSTITUTING MATTER

In the universe, according to A-Temporal Gravitation Theory, matter and physical space are in a permanent dynamic equilibrium, i.e. universe is a self-renewing system. Universe is an A-Temporal phenomenon: there was no beginning of the universe and there will be no end (Sorli and Fiscaletti, 2005).

Physical space and matter are both constituted by QS, but endowed with different frequencies of vibration and, consequently, with different “states” of energy. In the regions of ATPS where there is not matter, energy is in the “non-entropy state”, and this implies that these regions appear to us “empty”, without changes, without a material structure, without material objects. If in a region of ATPS there is matter, energy is in the “entropy state”, and this implies that matter can change its state (for example, its position, its atomic and molecular structure and its speed). First law of thermodynamics rules QS of ATPS, second law of thermodynamics rules QS that build up matter.

All material objects are different portions, aggregates of QS with their own characteristic frequencies of vibration. All material particles are composed by QS that vibrate at appropriate frequencies and that, in virtue of these vibrations, become seat of a discrete quantity of energy in the “entropy-state”. While QS vibrating at their basic frequency have got energy in the “non-entropy state” (and constitute therefore empty ATPS, where there is not matter), QS vibrating at appropriate frequencies (lower than the basic one) assume energy in the “entropy state” and become thus material quanta, endowed with mass and therefore perceivable by our senses.

Therefore, in this model each subatomic particle is interpreted as the result of the interaction of energy in the “entropy-state” with one or more QS, determined by the vibration of these QS at appropriate frequencies. More precisely one can propose that particles devoid of internal structure, such as quarks, leptons and intermediate bosons, can be seen as the result of the interaction of energy in the “entropy-state” with one quantum of space (caused by the vibration of this quantum of space at a certain appropriate frequency); instead, particles endowed with an internal structure such as baryons

(constituted by three quarks) and mesons (constituted by a quark-antiquark pair) are given by the interaction of entropic energy with more QS (caused by the vibration of these QS at certain appropriate frequencies).

For example, electron can be seen as the result of the interaction of energy in the “entropy-state” with one quantum of space (which is occupied by the electron), interaction determined by the vibration of this quantum of space at an appropriate frequency. The discrete quantity of energy that a quantum of space assumes when it becomes electron (or another particle devoid of internal structure, or part of a more complex material object) depends on the features of the region in exam, on the situation existing in that particular region of ATPS (namely on the type of interaction, “potential” to which the region of ATPS is subjected).

Finally, one can assume that the spin of a subatomic particle derives and depends on the orientations of QS composing it. Thus, 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 an half-integer number.

3. FEATURES OF QUANTA OF SPACE CONSTITUTING ELECTROMAGNETIC WAVES

QS vibrating at the frequencies of the electromagnetic spectrum generate electromagnetic waves: also these peculiar frequencies produce therefore the appearance of physical entities endowed with energy in the “entropy state”. According to the understanding here, electromagnetic waves are vibrations of QS of ATPS characterized by frequencies belonging to the electromagnetic spectrum; they are caused by the accelerated movement of a charged particle (i.e. a charge whose speed is subjected to a stream of changes in space) and propagate inside ATPS at the speed of light. For example, a cellular phone produces vibrations of QS at certain frequencies, X-ray machine produces vibrations of QS at the frequencies of X rays, light bulb produces vibrations of QS at the frequencies of the visible light. In the model proposed here, the existence of electromagnetic waves independently from the source can be justified and explained in a simple way: the vibrations of QS which arise in presence of a charged particle subjected to a stream of changes in space happen in ATPS, which allows thus the immediate transmission of these vibrations from one quantum to another.

4. THE POSTULATES OF THE THEORY OF EVERYTHING

The ideas illustrated in the previous chapters constitute some of our first starting-hypotheses to develop a model of the physical universe, and in particular to interpret the subatomic particles. The model here, besides the first law of thermodynamics and the idea that physical space is a-temporal, integrates also the gauge symmetries (which are essential requisites for any “everything theory”). In this way, the postulates of the model can be so enunciated:

1. Energy is composed by basic packets of energy which have the 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 by space and matter. QS are each 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 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 material 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 density of ATPS is increasing. The other forces are mediated each 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).

There are solid experimental results (for example, the fact that the AGN of Milky Way Galaxy is "eating" the galaxy of Sagittarius and at same time continuously emits fresh gas) and theoretical results (a-temporal gravitation theory and loop quantum gravity) which support the ideas contained in some of these postulates (Sorli and Fiscoletti, 2005).

5. MATHEMATICAL DESCRIPTION OF QUANTA OF SPACE

In this chapter a mathematical description of the elementary grains of physical reality is provided: the ideas already enunciated in the postulate 2 are developed.

As it was said before, QS having the size of Planck length are the fundamental constituents of all physical universe: both ATPS and matter are composed by QS. Now, we know that in quantum gravity and cosmology universe can be described by a wave-functional Ψ which satisfies the Wheeler-DeWitt equation, i.e. that universe as a whole can receive a description of wave type. On the ground of this fact, one can 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 therefore that each quantum of space i of the universe can be described

by a wave function Ψ_i . This wavefunction depends on the position μ_i of the quantum of space in ATPS (with $i=1,2,3,4$ because in the conscious experience, time exists only as a stream of material changes happening in space, time itself is space, and therefore, in the mathematical model which is closer to the conscious experience, ATPS turns out to have four coordinates). Besides, each quantum of space is characterized by a frequency of vibration V_i and by an orientation as to an arbitrary system (for example the third axis of an orthogonal Cartesian system) described by a quantum number J_i .

Consider now a region of a-temporal universe and suppose that this region is constituted by n QS. The state of the region of a-temporal universe can be expressed by a single network of QS or, more in general, by a quantum superposition of more networks of QS. In the case in which the state of the region of the universe under study is expressed by a single network of QS, its wave-functional Ψ can be decomposed in a simple product of the wave-functions of all the QS composing the region: $\Psi = \psi_1(\mu_i^{(1)}, j_1, \nu_1) \cdot \psi_2(\mu_i^{(2)}, j_2, \nu_2) \cdots \psi_n(\mu_i^{(n)}, j_n, \nu_n)$. In the case in which the state of the region of the universe under study is expressed by a superposition of different networks of QS, its wave-functional Ψ can be decomposed in this way:

$$\Psi = \sum_{i=1}^n c_i \psi_1(\mu_i^{(1)}, j_i, \nu_i) \cdot \psi_2(\mu_i^{(2)}, j_i, \nu_i) \cdots \psi_n(\mu_i^{(n)}, j_i, \nu_i)$$

where $\sum_{i=1}^n |c_i|^2 = 1$.

QS constituting ATPS vibrate at the “basic” frequency (equal to the Planck frequency), have not got energy in the entropy-state, have not got mass and therefore are not perceivable to our senses (they appear “empty” to us), while QS constituting the material particles vibrate at the frequency characteristic of those particles, have got energy in the entropy-state and are therefore perceivable by our senses. It is the vibration of the QS at an appropriate frequency less than the basic one that makes such QS material, perceivable to our senses. There are then some peculiar frequencies, less than the basic one, whose physical corresponding entities have not got mass, but are however endowed with energy in the entropy-state, and therefore are perceivable by our senses: these are the frequencies belonging to the electromagnetic spectrum.

In the model here proposed, the wave-function Ψ of a generic quantum of space composing physical universe satisfies the following general equation:

$$\left((v - v_{em}) \cdot (v - v_{ma}) \right) \left(R_{\mu\eta} - \frac{1}{2} g_{\mu\eta} R \right) \Psi + |v - v_p| \left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} - \frac{|v - v_{em}| l_p^2 m^2}{\hbar^2} \right) \Psi = 0, \quad (5.1)$$

where V_{em} is a frequency of the electromagnetic spectrum, V_{ma} is a frequency of matter, V_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 (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), m is the (eventual) mass of the quantum and c is the speed of light. The coordinate μ_4 appearing in this equation must be intended as the fourth spatial coordinate: it measures the numerical order of material change in space, i.e. is the stream of changes which happen in space (as we know, this is the most appropriate and correct way to interpret time, on the basis of elementary perception).

This general equation implies the following features as far as matter, electromagnetic waves and ATPS are concerned. If a quantum of space vibrates with the basic frequency, i.e. $\mathbf{V} = \mathbf{V}_p$, equation (5.1) becomes

$$(\mathbf{v}_p - \mathbf{v}_{em}) \cdot (\mathbf{v}_p - \mathbf{v}_{ma}) \left(R_{\mu\eta} - \frac{1}{2} g_{\mu\eta} R \right) \psi = 0,$$

that is to say

$$\left(R_{\mu\eta} - \frac{1}{2} g_{\mu\eta} R \right) \psi = 0. \quad (5.2)$$

Equation (5.2) can be considered the law which describes the behaviour, the features of QS constituting ATPS. It 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. The idea proposed here is that QS constituting ATPS appear to us "empty", without material structure, just because in their equation 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.

If a quantum of space vibrates at a frequency characteristic of material particles, i.e. $\mathbf{V} = \mathbf{V}_{ma}$, equation (5.1) becomes

$$|\mathbf{v}_{ma} - \mathbf{v}_p| \left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} - \frac{|\mathbf{v}_{ma} - \mathbf{v}_{em}| l_p^2 m^2}{\hbar^2} \right) \psi = 0,$$

that is

$$\left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} - \frac{|\mathbf{v}_{ma} - \mathbf{v}_{em}| l_p^2 m^2}{\hbar^2} \right) \psi = 0. \quad (5.3)$$

Equation (5.3) can be considered the law which describes the behaviour, the features of QS constituting matter. 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 , one can suggest that there is a link also between the mass of a material quantum and the quantum potential. In virtue of this consideration, equation (5.3) can be also expressed in the following manner:

$$\left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} - \frac{|\mathbf{v}_{ma} - \mathbf{v}_{em}| l_p^2}{c^2} \frac{\delta Q}{\delta \psi} \right) \psi = 0. \quad (5.4)$$

On the basis of equation (5.4), it turns out to be lawful 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 correlated to quantum potential. We suggest that the quantum waves associated with subatomic particles guide

them during their motion, through the action of quantum potential, in agreement with Bohm's pilot wave theory. 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 energy in the "entropic state", perceivable by our senses, and the appearance of this entropic energy is related to quantum potential. As in this model each subatomic particle is interpreted as the result of interaction of a discrete entropic energy with one or more QS, and as in Bohm's pilot wave theory the action of quantum potential is to guide the particle in examination during its motion, we 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 (Fiscaletti and Sorli, 2005). Besides, as regards the spin of a subatomic particle, we suggest that it depend and derive from the orientation of the QS composing such particle, i.e. be related to the quantum numbers j_i .

Finally, if a quantum of space vibrates with a frequency of electromagnetic spectrum, i.e. $\nu = \nu_{em}$, equation (5.1) becomes

$$|\nu_{em} - \nu_p| \left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} \right) \psi = 0$$

that is

$$\left(\bar{\nabla}^2 - \frac{1}{c^2} \frac{\partial^2}{\partial \mu_4^2} \right) \psi = 0, \quad (5.5)$$

which represents in fact the classic equation of electromagnetic waves.

6. THE INTERPRETATION OF SUBATOMIC PARTICLES

According to the postulate 2 of this model, QS constituting matter vibrate at appropriate frequencies characteristic of the material particles in examination, and are the "entropic state" of energy. Each subatomic particle derives from one or more QS vibrating at an appropriate frequency: in virtue of this vibration, these QS become seat of a discrete quantity of energy. The value and form of this entropic energy depend on the particular ambient situation existing in the region in exam, on the particular "potential" to which the region of ATPS is subjected.

Now we propose to develop and clarify these ideas under the mathematical point of view, considering particles devoid of internal structure, such as the electron. We start considering the electron being in a stationary state of energy.

On the basis of the postulate 2 of this model, electron, being devoid of internal structure, can be seen as the result of the interaction of a discrete quantity of energy in the "entropic state" with one quantum of space, caused by the vibration of this quantum of space at an appropriate frequency. The value of the discrete entropic energy that a quantum of space assumes when it gives origin to an

electron depends on the features of the region in exam, on the particular ambient situation existing in that region of ATPS (namely on the type of interaction, “potential” to which that region is subjected). According to the postulate 3, the ambient situation existing in ATPS can produce modifications in the properties of that region, in particular can change the frequency of vibration of a quantum of space of that region from the “basic frequency” to a frequency characteristic of electron, determining the appearance in that quantum of space of a discrete quantity of energy in the “entropy state”. 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, besides, j_i must be equal to an half-integer number, $1/2$ or $-1/2$, in order to be able to give origin to an electron) we have $V\psi_i(\mu_i, j_i, \nu_p) = \psi_i(\mu_i, j_i, \nu_{el})$ where ν_{el} is an appropriate frequency characteristic of electron.

For example, the electron being in a stationary state of hydrogen atom, i.e. the ambient situation existing in ATPS represented by the Coulomb field created by a proton, can be seen as the result of the interaction of entropic energy, given by one of the eigenvalues of the energetic spectrum $E_n = -\frac{1}{2}m_e \frac{e^4}{\hbar^2 n^2}$ (where m_e is the mass of electron and n is an integer positive number), with one quantum of space. This quantum of space becomes seat of this entropic energy as a consequence of the vibration at an appropriate frequency ν_n which is obtained by the relation:

$$h\nu_n = -\frac{1}{2}m_e \frac{4\pi^2 e^4}{\hbar^2 n^2}$$

and thus is given by $\nu_n = -\frac{2\pi^2 m_e e^4}{\hbar^3 n^2}$. For $n=1$ we obtain the frequency $\nu_1 = -\frac{2\pi^2 m_e e^4}{\hbar^3}$ which determines the appearance of an electron in the first stationary state of the hydrogen atom: a quantum of space vibrating at this frequency ν_1 becomes therefore seat of a quantity of entropic energy equal to the first eigenvalue of the energetic spectrum of the hydrogen atom, i.e. gives origin to an electron being in the first stationary state of the hydrogen atom. For $n=2$ we obtain the frequency $\nu_2 = -\frac{1}{2} \frac{\pi^2 m_e e^4}{\hbar^3}$: a quantum of space vibrating at this frequency becomes seat of an entropic energy equal to the second eigenvalue of the energetic spectrum of the hydrogen atom and therefore this frequency of vibration corresponds to the appearance in a quantum of space of an electron being in the second stationary state of the hydrogen atom. And so on.

Therefore, in this model, the electron being in a stationary state of the hydrogen atom derives from a quantum of space vibrating at appropriate frequencies less than the basic one. It is the vibration of a quantum of space at an appropriate frequency that causes the change of energy of this quantum of space from the non-entropy state to the entropy state and, therefore, creates the appearance of an electron in a stationary state of the hydrogen atom. It turns out to be lawful the following reading of the mathematical formalism concerning the electron of an hydrogen atom: 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 surrounding the proton from the value given by the “basic frequency” to one of the values $\nu_n = -\frac{2\pi^2 m_e e^4}{\hbar^3 n^2}$. This quantum of space, vibrating at one of these frequencies ν_n becomes seat of a discrete quantity of entropic energy given by $E_n = h\nu_n = -\frac{2\pi^2 m_e e^4}{\hbar^2 n^2}$ and this means that it has become an electron being in a stationary state of the hydrogen atom.

Besides, the particular value of the frequency of vibration determined by the Coulomb potential in a quantum of space depends on the position of that quantum of space in ATPS. That is to say: the ambient situation represented by the Coulomb potential created by a proton produces the change of the frequency of a quantum of space surrounding the proton from the value given by the “basic frequency” to the value $\nu_1 = -\frac{2\pi^2 m_e e^4}{h^3}$ (and therefore determines the appearance in this quantum of space of the entropic energy $E_1 = -\frac{1}{2} m_e \frac{e^4}{\hbar^2}$) in the case in which the quantum of space is at a distance $r_1 = \frac{\hbar^2}{m_e e^2}$ from the proton. Analogously, it produces the change of the frequency of a quantum of space surrounding the proton from the value given by the “basic frequency” to the value $\nu_2 = -\frac{1}{2} \frac{\pi^2 m_e e^4}{h^3}$ (and therefore determines the appearance in this quantum of space of the entropic energy $E_2 = -\frac{1}{8} m_e \frac{e^4}{\hbar^2}$) in the case in which the quantum of space is at a distance $r_2 = \frac{4\hbar^2}{m_e e^2}$ from the proton. In short, we can say that the Coulomb potential $V(r) = -e^2/r$ created by a proton changes 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 $\nu_n = -\frac{2\pi^2 m_e e^4}{h^3 n^2}$ (and therefore determines the appearance in it of the entropic energy $E_n = h\nu_n = -\frac{2\pi^2 m_e e^4}{h^2 n^2}$).

On the ground of this interpretation of the electron being in a stationary state of the hydrogen atom, it derives also the following important consequence. One can say that it's the special “state” of ATPS (in this case represented by the Coulomb potential) to “create” matter (in this case the electron being in a stationary state of hydrogen atom). In other words, one can also say that the presence, in a given point of ATPS, of a mass and a charge equal to the mass and the charge of electron is an effect of the vibration of a quantum of space at a frequency given by one of the values $\nu_n = -\frac{2\pi^2 m_e e^4}{h^3 n^2}$, caused by the ambient situation existing in the region of ATPS in exam. This means that in this model physical quantities like mass and charge are not fundamental quantities but derivate quantities: the real fundamental quantities are the frequencies of vibration and the “states”, the ambient situations existing in ATPS: all derives from the frequencies of vibrations of QS and the states of ATPS.

Also the quantum wavefunction associated to the electron being in a stationary state of the hydrogen atom can be considered an effect of the vibration at the frequencies $\nu_n = -\frac{2\pi^2 m_e e^4}{h^3 n^2}$; in fact, as we have seen, in virtue of the vibration at one of these frequencies the quantum of space assumes an energy in the entropy state given by $E_n = h\nu_n = -\frac{2\pi^2 m_e e^4}{h^2 n^2}$, i.e. equal to one of the eigenvalues of energy of hydrogen atom, and this in turn implies that the electron is described by an eigenfunction of the hydrogen atom, i.e. $\psi_{nlm}(r, \vartheta, \varphi) = R_{nl}(r)Y_l^m(\vartheta, \varphi)$.

This particular example of the electron of an hydrogen atom shows that the ordinary stationary states of energy predicted by quantum mechanics can be seen as the effect of the vibration of a quantum at appropriate frequencies characteristic of that particle: the fact that the frequency is quantized implies then that also the energy (in the entropy state) that a quantum of space acquires (as a consequence of that vibration) is quantized and a different quantum wavefunction will correspond to each of these values.

Besides, if a quantum of space vibrates at one of the frequencies $\nu_n = -\frac{2\pi^2 m_e e^4}{h^3 n^2}$, i.e. represents an electron being in a stationary state of the hydrogen atom, this means that it satisfies equations (5.3) and (5.4) (i.e. the equations which rule the behaviour of the QS composing matter). On the basis of these equations, one can therefore 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 this model 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 "entropy state") and, at the same time, create the wave behaviour, the quantum waves associated to such particles. And, on the ground of equation (5.4), one can suggest that these waves guide the corresponding particles, through the action of quantum potential, in the different points of ATPS: the entropic energy is transferred by quantum potential among the different QS composing the trajectory described by the subatomic particle.

Let us see now how to interpret in this model a subatomic particle devoid of internal structure, such as the electron, which is in a superposition state of Hamiltonian operator. The electron being in a superposition state of energy is always produced by the potential, the ambient situation existing in the region of ATPS under study: the difference as to the stationary states is that, this time, the effect of the special state, the ambient situation existing in ATPS, is the simultaneous vibration of a quantum of space of that region at more than one of appropriate frequencies (characteristic of the electron subjected to that ambient situation). We will have therefore:

$$V\psi_i(\mu_i, j_i, \nu_p) = \sum_{i=1}^n c_i \psi_i(\mu_i, j_i, \nu_{el}^i)$$

with $\sum_{i=1}^n |c_i|^2 = 1$.

For example, an electron being in a quantum state given by a superposition of the first two eigenfunctions of the hydrogen atom with equal weights, can be interpreted as a quantum of space which has a probability of 50% to become seat of a discrete quantity of energy given by the first eigenvalue of the energetic spectrum of the hydrogen atom, i.e. $E_1 = -\frac{1}{2} m_e \frac{e^4}{\hbar^2}$, and a probability of 50% to become seat of a discrete quantity of energy given by the second eigenvalue of the energetic

spectrum of the hydrogen atom, i.e. $E_2 = -\frac{1}{8}m_e \frac{e^4}{\hbar^2}$. Thus, it derives from a quantum of space that, in presence of the ambient situation represented by the coulombian potential created by a proton, has a probability of 50% to vibrate at the frequency $\nu_1 = -\frac{2\pi^2 m_e e^4}{h^3}$ and a probability of 50% to vibrate at the frequency $\nu_2 = -\frac{1}{2} \frac{\pi^2 m_e e^4}{h^3}$.

As a consequence, on the basis of equations (5.3) and (5.4), one can say that, this time, the role of quantum potential is the following: it has a probability of 50% to transfer, to guide the entropic energy $E_1 = -\frac{1}{2}m_e \frac{e^4}{\hbar^2}$ among the different QS composing the trajectory described by the electron in the first energetic level of the hydrogen atom, and has a probability of 50% to transfer, to guide the entropic energy $E_2 = -\frac{1}{8}m_e \frac{e^4}{\hbar^2}$ among the different QS composing the trajectory described by the electron in the second energetic level of the hydrogen atom.

In short, as regards an electron being in superposition states, one can speak only in probabilistic terms about the frequency of vibration of the quantum of space composing it: it is just this simultaneous presence of different frequencies of vibrations which determines the simultaneous presence of the electron in two different eigenfunctions of Hamiltonian operator and the simultaneous transfers of different quantities of entropic energy, through the action of quantum potential, among the QS composing the respective energetic levels.

7. A-TEMPORAL PHYSICAL SPACE AND “ETHER THEORY”

On the ground of the model proposed here, all electromagnetic waves are different vibrations of QS (at the frequencies belonging to the electromagnetic spectrum) that move through ATPS with the speed of light. ATPS is not still, the additional density of ATPS around the earth moves together with the earth (Sorli A. and Sorli I., 2005b).

According to the “ether theory” light is a vibration of the ether. Michelson-Morley experiment has showed that light is not a vibration of the ether: this result was a big surprise at that time. In order to “save” the “ether theory” Lorentz and Fitzgerald speculated between 1890-1900 that earth shrinks in the direction of the movement. Shrinking causes also the shrinking of the beam of the interferometer in the direction of the movement. According to Lorentz and Fitzgerald shrinking of the beam is the reason for the negative result of the Michelson-Morley experiment (Schwarz and Schwarz, 2004).

Lorentz-Fitzgerald “length contraction” has remained as a hypothesis until these days without being proved experimentally. Regarding Special Theory of Relativity in a faster inertial system there is no “length contraction”: the only thing we can say is that in a faster inertial system the speed of physical time is becoming less than in a slower inertial system (Sorli A. and Sorli I., 2004).

8. BEYOND DUALISM “MATTER-CONSCIOUSNESS”

According to the understanding here in the universe there is only one energy, there is no difference between matter and consciousness. In the universe matter and consciousness are not divided, they are one reality. The division has happened in the human mind only, because man did not reach yet into conscious experience of the universe (Sorli A. and Sorli I., 2005a). Human mind has divided something that in the universe is one reality. Matter and consciousness are both two aspects of the one energy. In the model here, consciousness is understood as a “basic frequency” of QS. It is a physical property of ATPS. From this point of view universe is a conscious phenomenon.

Research done by Penrose and Hameroff confirms that human consciousness is deeply related with QS: it suggests 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 linked to the influence of quantum gravity on microtubule networks within the neurones (Penrose, 1994 and Hameroff, 1994).

9. FUNDAMENTAL INTERACTIONS AS SPECIAL “STATES” OF A-TEMPORAL PHYSICAL SPACE

According to A-Temporal Gravitation, universe is a self-renewing system where matter and physical space are in a permanent dynamic equilibrium (we have before synthesised this result inside the postulate 3). According to the standard cosmological model, the fundamental interactions existing in nature (gravitational, electromagnetic, weak and strong) have appeared in different stages of the evolution of the universe. In the standard cosmological model, the evolution of the universe can be seen as a succession of formations of aggregated structures at increasing stages: before all, the quarks give place to the common nuclear forces and thus to nuclei; successively, we have the formation of atoms because of the electromagnetic forces acting between nuclei and electrons; then, in a following stage, we have the formation of molecules in virtue of the residual Van der Waals forces acting among the already formed atoms; finally, because of the specific characteristic of carbon, we have the formation of the plurimolecular structures, of tens, thousands, millions of atoms, which lead to the cells, to the pluricellular beings, and finally to the whole biology outline (Dallaporta, 2003).

Universe here is A-Temporal in sense that in the universe there is no “before” and no “after”, it is only “now”. The only universe that exists is the one we can experience. With clocks we measure the speed of material change which depends on the speed of an inertial system (as to another inertial system) and on the density of ATPS where material change occurs and is measured. Duration of irreversible material change and its numerical order are its “rational descriptions” based on the concept of linear time and do not exist in the physical reality itself (Sorli A. and Sorli I, 2005a).

In this view of the universe, one can put in discussion the idea that the fundamental interactions appeared at different stages, that before appeared nuclear forces, then electromagnetic forces and so on. In A-Temporal universe all the different force fields have not appeared at different periods. All the interactions can have been always present. They represent different “states” of ATPS.

According to the postulate 4 of the model here, all the fundamental interactions and physical fields represent different “states” of ATPS, the special ambient situations of ATPS in presence of certain material particles. The fundamental interactions and physical fields are special states of ATPS determined by the presence of material particles in various QS. If a quantum of space, vibrating at a certain appropriate frequency, assumes a discrete quantity of entropic energy, thus becoming material quantum, it derives a modification in the properties of the surrounding region of ATPS (for example in the frequencies of vibration of the surrounding QS). The modification in the properties of a region of ATPS caused by the presence in that region of appropriate particles is the way to interpret, in this model, the fundamental interactions, the different physical fields. These modifications depend on the features of the present particles and in turn influence the motions of the close particles, determining their most favourable trajectories. In other words, one can say that the presence of entropic energy in one or more QS determines a variation of the state of the surrounding QS, which can so have more or less disposition to the energy transfers: this is an important consequence of the interpretation of physical fields as states of ATPS.

If all physical fields are always present because they represent special states of ATPS, in the model here the state of ATPS can be represented through the following generic linear superposition of the different physical fields:

$$|ATPS\rangle = c_1|gr\rangle + c_2|e.m.\rangle + c_3|q.p.\rangle + c_4|s.f.\rangle + c_5|w.f.\rangle, \quad (9.1)$$

where *gr* stands for gravity, *e.m.* for electromagnetism, *q.p.* for quantum potential, *s.f.* for strong nuclear force, *w.f.* for weak nuclear force and $\sum_{i=1}^5 |c_i|^2 = 1$.

We know that each force field is characterized by its own relative strength parameter, operates over a specific distance or time scale, has its own range, its own typical lifetimes for decay and, finally, is mediated by its particular fundamental bosons (Perkins, 1987). One can argue that it is just the particular values of these properties and quantities to cause, to determine the “collapse” of the generic state of ATPS in the force field characterized by those values of properties and quantities. In particular, it is the particular value of the range of the modifications induced in the properties of ATPS and the particular features (i.e. vibrations) of the bosons transmitting the interaction which determine the “collapse” of the generic state of ATPS in the force field characterized by those properties. Our perception of distinct physical fields is therefore tied to the particular frequencies of vibration of QS (which determine the appearance of certain bosons) joined to the particular value of other properties or parameters, such as above all the range of the interaction (that we interpret as the range of the modifications determined by that interaction in the properties of ATPS). A separated particular consideration concerns the quantum potential which can be seen as the state of ATPS when we have microscopic processes, and therefore problems in which Planck constant assumes an important role (and it is just the presence of this term to produce nonlocal links between the particles, which instead were absent in the macroscopic world of classical physics) (Fiscaletti, 2005). The term represented by quantum potential can therefore appear simultaneously with each of the other terms, just to indicate the fact that we are in the quantum regime (and we have nonlocal correlations among the particles). Besides, as we have seen before, it is important to underline again that, in this model, the role of quantum potential is to guide a discrete quantity of entropic energy among the different QS composing the trajectory described by a subatomic particle during its motion.

10. THE WAVES ASSOCIATED TO SUBATOMIC PARTICLES IN A-TEMPORAL PHYSICAL SPACE; CONSIDERATIONS ABOUT BOHM’S PILOT WAVE AND THE IDEAS OF THE THEORY OF WAVE STRUCTURE OF MATTER

In 1950 Einstein showed that space must have a property to connect particles among them, allowing thus the transmission of a force, of an interaction from one particle to another. According to Einstein, the combination of the idea of a continuous field with the idea of discontinuous points in space appears inconsistent: the concept of discrete particle cannot be present in a coherent field theory. So, also without including gravitation, Maxwell’s electrodynamics cannot be considered a complete theory, according to Einstein (Einstein, 1950). In agreement with the point of view of Greek philosophers and mathematicians of the time who asserted that all matter and motion derive from one substance, Einstein rejected the conception of matter as constituted by discrete particles (because forces and properties of nature don’t agree with the discrete particle) and tried to represent matter as spherical fields in space-time.

In the theory of Wave Structure of Matter developed by Wolff, Mead and Haselhurst, a wave structure replace completely the particles as discrete material points, in agreement with what Einstein wanted: to find that a subatomic particle, such as the electron, does not exist as discrete material point, to remove Bohr’s interpretation of the wavefunction and to assure that God does not play dice, eliminating therefore all the paradoxes of quantum mechanics. The theory of Wave Structure of Matter bases itself on two ideas: 1. that quantum waves exist in space and are solutions of a wave scalar equation, and 2. that the waves coming from all the particles of the universe combine their intensities to form the wave medium represented by space (and, therefore, that it is the waves that create space) (Wolff, 1993; Wolff, 2002a; Mead, 2000; Wolff and Haselhurst, 2004).

In the theory of Wave Structure of Matter the waves of each particle are intermingled with the waves of other particles and all contribute to the density of the space medium: this implies that space depends on the distant matter (Wolff and Haselhurst, 2004; Wolff, 2002b).

Now, the model proposed here is not completely compatible with the view of space predicted by the Wave Structure of Matter. Here the existence of space does not depend from matter because space is a-temporal. It is matter that depends on the states of ATPS (think of the electron in the hydrogen

atom, which is created, as we have seen before, by the particular ambient situation existing in ATPS, i.e. the coulombian potential of a close proton).

In the model here, from equations (5.1) and (5.4) it follows 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 QS constituting them.

Therefore, in this model one can propose the idea that the waves associated to the material particles are created 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 to 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 (like in Bohm’s pilot-wave theory or in the theory of Wave Structure of Matter, for example). 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 (5.4), for the QS vibrating at the frequencies of material particles, 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 to a subatomic particle) among the different QS composing the trajectory described by the subatomic particle in ATPS. The quantum waves associated to material particles guide the corresponding particles during their motion, through the action of quantum potential, in the regions where the wavefunction is more intense (Fiscaletti, 2003; Holland, 1993).

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 to 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).

One can say, like in the theory of Wave Structure of Matter, that these waves form and build up the space medium – which connect the particles among them. But here, contrary to the theory of Wave Structure of Matter, it is not the waves associated to all the particles of the universe that combine themselves to give place to the space medium because the space medium is a-temporal and its existence does not depend on matter, on the motion of particles; instead, it is ATPS, composed by QS, that creates, with the vibrations of its fundamental constituents (i.e. the QS) at appropriate frequencies – when they are occupied by matter - the quantum waves associated to the subatomic particles. In the theory of Wave Structure of Matter, space is a quantum wave medium created by the waves coming from each particle of the universe: the matter of the universe creates the wave medium in all space and the waves coming from each particle create the space medium. Instead, in the model here, this symmetric, reciprocal effect is not possible, because matter derives from physical space (is produced by the special state of a given region of ATPS, which has the effect to change the frequency of vibration of QS from the basic frequency to a frequency characteristic of a material particle, and this vibration determines in turn the quantum waves associated to material particles) but physical space cannot be derived from matter.

So one can also say that this model, as far as its conceptual and philosophical foundations are concerned, can not be completely compatible with the view of space of the theory of Wave Structure of Matter. But it can be compatible with some important ideas of Bohm’s pilot wave theory. It 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 (5.1) and (5.4) (and the considerations made in the chapter “The interpretation of subatomic particles”), one can propose that the waves associated to 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.

For example, electron is given by the interaction of energy of "entropy state" with one quantum of space and this interaction is determined by the vibration of this quantum of space at an appropriate frequency. Besides, on the basis of equation (5.4), it is the vibration of this quantum of space composing the electron at an appropriate frequency that produces the wave associated to the electron, and this wave guides the electron, through the action of quantum potential, in the regions where the wavefunction is more intense, making it appear in different points of ATPS: the role of quantum potential is to transfer a discrete quantity of entropic energy (associated to material quanta) among the different QS composing the trajectory described by the particle.

11. CONCLUSIONS

In the universe matter and physical space are in permanent dynamic equilibrium and therefore are composed by the same type of energy. QS having the size of Planck length are the elementary packets of energy which compose all physical reality. QS constituting ATPS vibrate at the Planck frequency (the “basic frequency”) and are the “non-entropy” state of energy; QS constituting matter vibrate at appropriate frequencies (lower than the basic one) and are the “entropy state” of energy. It is in virtue of the vibration at appropriate frequencies that the QS assume a discrete quantity of energy in the “entropy state”, becoming therefore material quanta, perceivable to our senses. In our model, we suggest therefore that each subatomic particle derives from one or more QS vibrating at an appropriate frequency: in virtue of this vibration, these QS become seat of a discrete quantity of energy (whose value and form depend on the particular ambient situation of the region in exam, on the particular “potential” to which the region of ATPS is subjected). Each fundamental interaction is a particular state of ATPS, a particular ambient situation existing in ATPS and his effect is to produce modifications in the properties of ATPS (such as in the frequencies of vibrations of QS). The wave behaviour of the subatomic particles can be considered itself an effect of the vibrations of QS constituting them. The quantum waves associated to the particles can be seen thus as an effect of ATPS, 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 frequencies: the “basic frequency” in the case of the QS composing ATPS, the frequencies characteristic of the different subatomic particles in the case of matter, or 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 and which propagate through ATPS from one quantum to another at the speed of light. Instead the “waves” associated to QS constituting ATPS must be considered “empty”, not perceivable by our senses, because these QS are not material and vibrate at the “basic frequency”.

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