the general science journal

Perspectives on Newtonian Gravitation and Classical Electromagnetism in A-Temporal Physical Space

Davide Fiscaletti, SpaceLife Institute,
San Lorenzo in Campo (PU), Italy
fiscalettidavide@libero.it

Abstract

A suggestive interpretation of classical gravitation and classical electromagnetism is proposed which is based on the idea that physical space has a granular structure and is a-temporal. In this interpretation, gravity and electromagnetism are states of space which derive from peculiar properties of space: density of cosmic space, electric density of space and magnetic density of space. Moreover, time is interpreted as motion of material objects and more precisely is tied to the speed of the generic quantum of space with respect to the situation in which space is still (namely in which there is no time). Taking into account that the speed of each quantum of space is linked to the magnetic density of space, we underline that the motion of each particle, i.e. time, is tied to the magnetic density of space. This implies that the magnetic density of space is a physical entity which assumes an important role for the behaviour of material objects under the action of a whatever physical field and, therefore also for the behaviour of material objects under the action of the gravitational force.

1. Introduction: the fundamental physical properties of a-temporal physical space

There are different physical theories in which space is treated as a quantum. In particular, space-time reticular dynamics and loop quantum gravity introduce the idea that space, at the Planck scale, is not indefinitely divisible but has a granular structure. Space-time reticular dynamics replaces the idea of a continuous space-time with a discrete structure of elementary space-temporal quanta, unitary grains characterized by an elementary length $l_p = \sqrt{\frac{\hbar G}{c^3}}$ and by an elementary time $t_p = \sqrt{\frac{\hbar G}{c^5}}$. This theory implies that the motion of physical objects is continuous only in macroscopic ambit, but indeed happens in jerks [1, 2]. Loop quantum gravity predicts that at the Planck scale space a quantized structure, given by a net of intersecting loops, and just these loops constitute the quantum excitations of gravitational field, i.e. represent the elementary quanta of space. The image of physical space provided by loop quantum gravity is mathematically precise: nodes of spin networks represent the elementary grains of space, and their volume is given by a quantum number that is associated with the node in units of the elementary Planck volume, $V = \left(\hbar G / c^3\right)^{3/2}$, where $\hbar$ is Planck's reduced-constant, *G* the universal gravitation constant and *c* the speed of light. Two nodes are adjacent if there is a link between the two, in which case they are separated by an elementary surface the area of which is determined by the quantum number associated with that link. Link quantum numbers, j , are integers or half-integers and the area of the elementary surface is $A = 16\pi V^{2/3}\sqrt{j(j+1)}$, where *V* is the Planck volume [3, 4].

On the other hand, a growing number of modern researchers are challenging the view that space-time is the fundamental arena of the universe. They point out that it does not correspond to a physical reality, and propose a "timeless space" as the fundamental arena instead. For example, Girelli, Liberati and Sindoni have recently developed a toy model which shows how the Lorentzian signature and Nordstroem gravity (a diffeomorphisms invariant scalar gravity theory) can emerge from a timeless non-dynamical space" [5]. Julian Barbour says in *The Nature of Time*: "I will not claim that time can be definitely banished from physics; the universe might be infinite, and black holes present some problems for the time picture. Nevertheless, I think it is entirely possible, indeed likely, that time as such plays no role in the universe" [6]. Such challenges are nothing new, and go back as far as Aristotle. Even Ernst Mach said: "It is utterly beyond our power to measure the changes of things by time. Quite the contrary, time is an abstraction, at which we arrive by means of the changes of things".

It seems legitimate to affirm that phenomena run in space-time only in the mathematical models of reality, which sometimes become more real than reality itself. On the ground of elementary perception, there is no evidence about the movement of material bodies in time: one can perceive only the irreversible changes and movements of matter in space, physical universe is a-temporal [7, 8]. Time is a mathematical coordinate which describes the motion of material objects and enters into existence when we measures it through clocks [9]. Change does not run in time, change itself is time. Time means change (movement) and, therefore, when there is no change there is no time. Clocks run in a timeless space. With clocks we measures duration and numerical order of material changes that run into the universe. In this regard, Einstein and Gödel consistently reported that there is no time in the universe, that universe is a timeless (a-temporal) phenomenon [10].

The research about granular and a-temporal space can be considered the starting perspective of this article. The fundamental ideas introduced by the author are in fact the following: physical space is composed by elementary grains, quanta of space (QS), having the size of Planck length and time exists only as a fourth spatial coordinate indicating the numerical order of the irreversible material movements occurring in an a-temporal space. In a complete physical theory based on a granular and a-temporal physical space, new perspectives are opened in the interpretation of the fundamental theories of physics: the possibility that all the different objects of physics (and therefore also matter and the physical fields) can be deduced from space exists [11, 12]. In particular, here we will show that all the features of Newtonian gravity and classical electromagnetism can be derived from the following fundamental properties of space: density of cosmic space, electric density of space and magnetic density of space [13].

The density of cosmic space is the universal property of space associated with the mass of the material objects: the mass of every material object derives from one or more opportune densities of cosmic space, precisely can be interpreted as the portion of space where one or more densities of cosmic space assume their maximum values. For example, an elementary particle devoid of internal structure (such as the electron) of mass *m* derives from an elementary density of cosmic space $D(r) = \frac{mG}{r^2}$ (1) where *G* is gravitational constant, *r* is the distance from the central quantum of space, in which the density of cosmic space (1) assumes its maximum value $D(l_p) = \frac{mG}{l_p^{\,2}}$ (2) where l_p is Planck length. If a region of physical space is characterized by a density of cosmic space given by relation (1), this means that in this region there is a material particle of mass *m*. The physical dimensions of the density of cosmic space are ms^{-2} and therefore the density of cosmic space can be interpreted as an indirect measure of the gravitational acceleration.

Analogously, the charge of a given particle is the physical property which derives from one or more electric densities of space: it can be interpreted as the portion of space where one or more electric densities of space assume their maximum values. For example, a charged particle *q* without internal structure derives from an elementary electric density of space $D_e(r) = \frac{Kq}{l_p^{\,3} r^2}$ (3), where *K* is the constant indicating the strength of the electric force, *r* is the distance from the central quantum of space, in which this electric density of space (3) assumes its maximum value $D_e(l_p) = \frac{Kq}{l_p^{\,5}}$ (4). If a region of space is characterized by an electric density of space given by relation (3), this means that in this region there is a particle of charge *q* [13]. Taking into consideration its physical dimensions, the electric density of space can be interpreted as a measure of the electric field for unit of volume, namely for Planck volume $l_p^{\,3}$.

On the ground of their definition, the density of cosmic space and the electric density of space are properties of each quantum of space which assume their maximum values in the central quantum of space, respectively, of a material object endowed with mass and of a charged particle, and diminish with the square of the distance from this central quantum. The similar behaviour with the distance of density of cosmic space and electric density of space can also be seen as an effect, a reflex of the similar behaviour with the distance of gravitational force and electrostatic force.

The magnetic density of space is defined by the relation $D_m(r) = \frac{\mu_0 v sen\alpha}{4K\pi}$ (5), where μ_0 is the constant of the magnetic permittivity in the vacuum, *v* is the modulus of the speed of the central quantum of space (where the electric density of space assumes its maximum value), α is the angle between the vector r identifying the position of the point P into consideration with respect to the centre of the electric density of space and the speed of the electric density of space.

Moreover, according to the view here proposed, when a particle is moving in space, also the region of space containing this particle is moving, as a consequence of the density of cosmic space (1). Therefore, if the density of cosmic space $D(l_p) = \frac{mG}{l_p^2}$ (2) existing in the centre of a material object is moving with speed v, one can say that the generic quantum of space situated at distance *r* from the central one is moving with speed $\vec{v}(r) = \vec{v}\frac{l_p^5}{r^5}$ (6). Equation (6) is the general formula: it reproduces, as a particular case, also the fact that the speed of the central quantum of space, where the density of cosmic space into consideration assumes its maximum value, is v. Taking into account equation (6), equation (5) can also be expressed in the form $D_m(r) = \frac{\mu_0 v(r) r^5 sen\alpha}{4K l_p^5 \pi}$ (7), which shows clearly that the magnetic density of space characterizing a given quantum of space depends on the position of this quantum (with respect to the central quantum of space, where the electric density of space into consideration assumes its maximum value) and its speed.

2. Gravity, electric field, magnetic field and the link with density of cosmic space, electric density of space and magnetic density of space

If time exists only as a stream of irreversible material changes happening in space, a new interpretation of gravitational interaction can be introduced: the a-temporal gravitation theory. In this model, gravitational interaction is carried directly by the density of cosmic space, has not speed and is a-temporal (in the sense that no movement of particle-wave is needed for its acting). According to a-temporal gravitation, the density of cosmic space is the most important physical property which determines the gravitational interaction between the material objects. The source of the gravitational field is not properly each material body endowed with mass but each region of space endowed with a certain density of cosmic space. Newton's classical law concerning the attraction of two masses can be seen as the consequence of a more fundamental attraction between the densities of cosmic space existing in the centres of such objects on the ground of the relation $\vec{F}_g = \frac{D_1(l_p) \cdot D_2(l_p) \cdot l_p^4}{r^2 \cdot G} \hat{r}$ (8), where D_1 and D_2 are the densities existing in the centers of the two material objects into examination and *r* is the distance between these centers [14]. However, introducing the concept of the density of cosmic space, not only the centers of two material objects attract each other: more in general, all couples of regions of space endowed with different densities of cosmic space attract on the ground of the equation $\vec{F}_g = \frac{D_1(r_1) \cdot D_2(r_2) \cdot r_1^2 \cdot r_2^2}{r^2 \cdot G} \hat{r}$ (9) where $D_1(r_1)$ and $D_2(r_2)$ are the densities of cosmic space existing in the two QS into consideration, *r* is the distance between the two QS. In synthesis, the fundamental result of our a-temporal interpretation of classical gravitational interaction is the following: material objects move in the direction where the density of cosmic space is increasing.

Moreover, it has been shown [11, 13] that the density of cosmic space assumes an important role also inside general relativity: in an a-temporal interpretation of general relativity, gravity is transmitted by the density tensor of cosmic space defined as $D_\mu^\nu = GT_\mu^\nu$ and its effect is to curve this a-temporal space. In other words, we can say that the movement of the density of cosmic space, which is described by the density tensor of cosmic space, has the cosmic space to curve. All the most important effects of general relativity are practically linked to the density of cosmic space.

The electrostatic field is the property of each quantum of space tied to the electric density of space characterizing that quantum of space on the basis of the relation $E = D_e(r) l_p^3 \hat{r}$ (10). Equation (10) clearly puts in evidence that the electric field is a property of space deriving from the electric density of space characterizing the quantum of space into consideration. When in a region of space we have a still electric charge, the space is characterized by a corresponding electric density of space which is itself still. The electrostatic field is the special state of physical space in the presence of a still electric density of space. The value of the electrostatic field in each point of that region depends on the value of the electric density of space in such a point.

Considering the classical domain, the electrostatic force acting between two charges q_1 and q_2 (situated at distance *r*) can be seen as a consequence of a more fundamental interaction between two points of space characterized by a different electric density of cosmic space. In fact, if $D_{e1}(r_1) = \frac{Kq_1}{l_p^3 r_1^2}$ is the density of cosmic space associated with a particle of charge q_1 in a given point of space situated at distance r_1 from its centre, $D_{e2}(r_2) = \frac{Kq_2}{l_p^3 r_2^2}$ is the electric density of space associated with a particle of charge q_2 in a given point of space situated at distance r_2 from its centre, *r* is the distance between these two particular points of space, we can write: $\vec{F}_e = \frac{D_{e1}(r_1) \cdot D_{e2}(r_2) \cdot r_1^2 \cdot r_2^2 \cdot l_p^6}{Kr^2} \hat{r}$ (11) which represents the general law of interaction between two electric densities of cosmic space (the one associated with the charge q_1, the other associated with the charge q_2). Equation (11) establishes that electrostatic force acts between regions of space endowed with different electric densities of space.

It is important to observe that, taking into account the definition of the electric density of space (3), Coulomb's law $\vec{F}_e = K \frac{q_1 \cdot q_2}{r^2} \hat{r}$ (12) is perfectly equivalent to equation (11). We can therefore conclude that, introducing the concept of the electric density of space, Coulomb's law (12) can be considered as a particular case of a more general equation, the equation (11), which describes the interaction between two electric densities of space. We are presented therefore with this interesting perspective: two points of space characterized by a different electric density of space interact each other and this concerns all the pairs of points of space satisfying this condition. And the following interpretation of electrostatic interaction derives: as each point of space is characterized by the property of the electric density of space, not only the centres of the charged particles move but also all the other points move according to equation (11).

Let us now consider the magnetism. As far as magnetic field B is concerned, it is known that there do not exist isolated magnetic monopoles. This hypothesis, which recently arose in high-energy physics and cosmology, has found until now no valid evidence [2]. We know in fact today that the magnetic field is a sort of deformation of the electric field tied to the motion of the charges in virtue of the equation $F = qE + qv \times B$ (13) defining Lorentz force. In particular, from the classical point of view the magnetic field generated by a charge *q* endowed with a speed v in a point situated at distance *r* from the charge is given by the relation $\vec{B} = \frac{\mu_0}{4\pi} \frac{qv \times r}{r^3}$ (14), where μ_0 is the constant of the magnetic permeability in the vacuum. According to the view here proposed, the magnetic field can be thus defined as the property of physical space represented by a deformation of the electrostatic field due to the magnetic density of space in virtue of the relation $B = D_e(r) D_m(r) l_p^3 \hat{b}$ (15) where

$\hat{b}$ identifies direction and versus of the field. Equation (15) clearly shows that the magnetic field existing in a certain quantum of space depends on the electric density of space and the magnetic density of space characterizing that quantum of space. When in a region of space we have a charged particle in motion with speed v, that region of space is characterized by a corresponding electric density of space which is moving itself with speed v. More precisely, we can say that a charged particle in motion is determined by a region of space endowed with a moving electric density of space. The motion of an electric density of space produces a deformation of the electric field present in that region (with respect to the case in which the electric density of space was still), namely a magnetic field whose modulus is given by the product of the electrostatic field with a magnetic density of space D_m $= \frac{\mu_0 v sen\alpha}{4K\pi}$ depending on the speed of the electric density of space and where α can be seen as the angle between the vector r identifying the position of the point P (in which one calculates the field) with respect to the centre of the electric density of space and the speed v of the electric density of space.

The electromagnetic field is the special state of a-temporal physical space in the presence of an accelerated electric density of space and thus is tied to the variation of the magnetic density of space. In fact, if a given electric density of space is subjected to a stream of changes, we can deduce that also the magnetic density of space D_m is subjected to a stream of changes in space, and thus also the magnetic field (15) created by that electric density of space in a point situated at distance *r* is subjected to a stream of changes in space. Therefore, on the ground of the third equation Maxwell's equation $\nabla \times \vec{E} = -\frac{\partial B}{\partial t}$ (16) an electric field itself subjected to a stream of changes in space is created. Then, on the base of the fourth Maxwell's equation $\nabla \times \vec{B} = \mu_0 \vec{j} + \mu_0 \varepsilon_0 \frac{\partial E}{\partial t}$ (17) a new magnetic field subjected to a stream of changes in space is created and so on. It is in this way that electromagnetic waves arise.

The model here suggested introduces a holistic view of the universe: we are presented with the possibility to imagine the world not in dualistic terms (space and matter intended as different entities at all, as entities independent one from the other). This model implies that there is no external background in which particles and fields are inserted: particles and fields are themselves "portions" or "states" of space which present a particular value of some important properties characterizing each elementary grain of space (namely density of cosmic space, electric density of space and magnetic density of space). Particles and fields are themselves space, in a certain sense: one can think to fundamental entities, QS having the size of Planck length, endowed with certain values of density of cosmic space, electric density of space, magnetic density of space and, in the case of subatomic particles, a wavefunction and a peculiar frequency of vibration.

3. The interpretation of time as motion and the link with the magnetic density of space

According to the model here suggested, time can be interpreted as motion of elementary particles, material bodies and stellar objects in an a-temporal physical space [10, 15]. Since matter derives from one or more opportune densities of cosmic space, in order to have a motion the generic quantum of space has to move with a certain speed. Moreover, on the ground of what has been said in chapter 2, speed is linked directly to the magnetic density of cosmic space, and therefore one can say that, when there is a motion in physical space, the generic quantum of space is endowed with a non null magnetic density of space. One can suggest the idea that time derives from a non null magnetic density of space.

Now, if each quantum of space is characterized by a non null speed and, thus, by a non null magnetic density of space, what is its immediate effect? It is clear that the motion of the generic quantum of space determines a modification in the values of certain properties (density of cosmic space, electric density of space, magnetic density of space, frequency of vibration) of certain QS. As a consequence of this motion, there is a change in the global structure of the universe. Therefore, since motion, i.e. time, determines a modification in the configuration of the universe (as regards the properties which characterize the QS composing it), each different configuration of the universe can be interpreted as a particular instant of time.

As regards newtonian gravitation, if the universe is characterized by one density of cosmic space which is still, there is no motion and thus no time because each quantum of space has its peculiar value of the density of cosmic space which does not change. In analogous way, as regards classical electromagnetism, if the universe is characterized by one electric density of space which is still, there is no motion and thus no time because each quantum of space has its own value of the electric density of space which does not change. More precisely, we can also say that the universe presents in each of these peculiar cases only one configuration, namely only one instant of time.

In a-temporal physical space motion derives from a speed, and thus from a non null magnetic density of space. Only in this case we can have different configurations of the universe, namely different instants of time, because only in this case the generic quantum of space can modify the values of its fundamental properties (density of cosmic space, electric density of space and magnetic density of space).

According to our model, in substance, time means motion and motion means variation in the configuration of the universe. Therefore, time can be seen as a parameter indicating the numerical entity in the variation of the configuration of the universe with respect to the situation in which there is no time. The variation in the configuration of the universe and, therefore, time can be practically seen as a sort of effect of an average of all the material movements happening in space. Moreover, since the variation in the configuration of the universe is determined by moving QS, and the motion of QS is somewhat tied to a non null magnetic density of space, one can say that time, the numerical entity in the variation of the configuration of the universe, is tied to the speed – and thus to the magnetic density of space – of each quantum of space (with respect to the situation in which there is no time).

Now, in order to formalize our interpretation of time as motion from the mathematical point of view, we can start by expressing the temporal coordinate *t* of standard physics as a general function $\varphi(s)$ which identifies the a-temporal change of the configuration of each quantum of space with respect to the situation in which each quantum of space is still: $t = \varphi(s)$ (18). In equation (18) *s* represents in fact the shifting of the generic quantum of space with respect to the situation in which there is no time. The form of the function $\varphi(s)$ depends on the characteristic of the motion of each quantum of space. For example, if we consider the simple case of a rectilinear movement with a constant speed *v*(*r*) of one density of cosmic space, time namely the motion of this density of cosmic space with respect to a still inertial system is described by the function $t = \frac{1}{v(r)} \cdot s$ where $v(r) = v\frac{l_p^5}{r^5}$ and *v* is the (constant) speed of the centre of the density of cosmic space into examination, i.e. of the quantum of space where the density of cosmic space (1) assumes its maximum value.

Let us consider now a region of space is characterized by a density of cosmic space which moves in an arbitrary direction with respect to the inertial system. If the inertial system is described by Cartesian coordinates x, y, z, we can indicate these three motions as $t_x = \varphi_1(s)$, $t_y = \varphi_2(s)$, $t_z = \varphi_3(s)$. The global motion of this density of cosmic space can then be expressed through the general equation $t = \varphi(s) = \frac{1}{\sqrt{\frac{1}{(\varphi_1(s))^2} + \frac{1}{(\varphi_2(s))^2} + \frac{1}{(\varphi_3(s))^2}}}$ (19). Even more in general, if we consider a region of space characterized by the motion of more different densities of cosmic space, the function $\varphi(s)$ represents a sort of an average of all the movements happening in space (as to a still inertial system, namely a still space, where there is no time). This function $\varphi(s)$ represents the effect produced in the configuration of the universe by a sort of average of all the material movements happening in space. Making the differential of equation (18) we obtain $dt = \dot{\varphi}(s)ds$ (19). Moreover, the infinitesimal interval of time, i.e. of motion, is linked to the speed $v(r, \varphi(s))$ of each quantum of space through the relation $dt = \frac{dr}{v(r,\varphi(s))}$ (20). As a consequence, we can write $v(r,\varphi(s)) = \frac{1}{\dot{\varphi}(s)} \cdot \frac{dr}{ds}$ (21) which tells us that the speed of each quantum of space depends on the variation with respect to the shifting *s* in space of the function $\varphi(s)$ describing the a-temporal change of the configuration of each quantum of space and the variation of the position of such quantum of space with respect to the shifting *s* in space. Taking into account the link between speed and magnetic density of space on the basis of equation (7), equation (21) leads to the equivalent equation $D_m(r,\varphi(s)) = \frac{\mu_0 r^5 sen\alpha}{4Kl_p^5 \pi \dot{\varphi}(s)} \cdot \frac{dr}{ds}$ (22) which tells that magnetic density of space itself depends on the variation with respect to the shifting *s* in space of the function $\varphi(s)$ describing the a-temporal change of the configuration of each quantum of space and the variation of the position of such quantum of space with respect to the shifting *s* in space. Finally, the acceleration $a(r,\varphi(s)) = \frac{d^2 r}{dt^2}$ of each quantum of space, on the ground of relations (12) and (15), can be expressed through the relation $a(r,\varphi(s)) = \frac{\frac{d^2 r}{ds^2}\dot{\varphi}(s) - \frac{dr}{ds}\ddot{\varphi}(s)}{[\dot{\varphi}(s)]^3}$ (23).

4. An a-temporal version of Maxwell's equations and Lorentz force

On the basis of equations (18), (20), (21) and (22), in our a-temporal interpretation of classical electromagnetism Maxwell's equations can be written in the following way:

$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$ (24) or $\nabla \cdot \vec{E} = 4\pi \frac{dD_e(r)}{dV}$ (24a)

$\nabla \cdot B = 0$ (25)

$\nabla \times \vec{E} = -\frac{1}{\dot{\varphi}(s)} \cdot \frac{\partial B}{\partial s}$ (26) or $\nabla \times \vec{E} = -v(r,\varphi(s)) \cdot \frac{ds}{dr} \cdot \frac{\partial B}{\partial s}$ (26a)

$\nabla \times \vec{B} = \mu_0 \vec{j} + \mu_0 \varepsilon_0 \frac{1}{\dot{\varphi}(s)} \cdot \frac{\partial E}{\partial s}$ (27) or $\nabla \times \vec{B} = \mu_0 \vec{j} + \mu_0 \varepsilon_0 v(r,\varphi(s)) \cdot \frac{ds}{dr} \cdot \frac{\partial E}{\partial s}$ (27a)

or in the equivalent form

$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$ (28) or $\nabla \cdot \vec{E} = 4\pi \frac{dD_e(r)}{dV}$ (28a)

$\nabla \cdot B = 0$ (29)

$\nabla \times \vec{E} = -\frac{1}{\dot{\varphi}(s)} \cdot \frac{\partial B}{\partial s}$ (30) or $\nabla \times \vec{E} = -4Kl_p^5 \pi D_m(r,\varphi(s)) \cdot \frac{1}{\mu_0 r^5 sen\alpha} \cdot \frac{ds}{dr} \cdot \frac{\partial B}{\partial s}$ (31)

$\nabla \times \vec{B} = \mu_0 \vec{j} + \mu_0 \varepsilon_0 \frac{1}{\dot{\varphi}(s)} \cdot \frac{\partial E}{\partial s}$ (32) or $\nabla \times \vec{B} = \mu_0 \vec{j} + \mu_0 \varepsilon_0 4Kl_p^5 \pi D_m(r,\varphi(s)) \cdot \frac{1}{\mu_0 r^5 sen\alpha} \cdot \frac{ds}{dr} \cdot \frac{\partial E}{\partial s}$ (33).

Maxwell's equations that are written here concern the electric and magnetic fields in the vacuum, in the presence of the electric charge of density ρ and of the electric current, i.e. charge in movement, of density j.

It is also important to underline that Maxwell's equations in the static case

$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$ (34) or $\nabla \cdot \vec{E} = 4\pi \frac{dD_e(r)}{dV}$ (34a)

$\nabla \cdot B = 0$ (35)

$\nabla \times E = 0$ (36)

$\nabla \times B = \mu_0 j$ (37)

are obtained for $D_m(r,\varphi(s)) = 0$ and thus for *v*=0 in agreement with the standard view of classical physics.

According to the a-temporal view here introduced, electric and magnetic fields are thus functions not of space and time but of a four-dimensional space in which the fourth coordinate $t = \varphi(s)$ is just represented by the stream of material movements happening in space and, therefore, by the numerical entity in the variation of the configuration of the universe (with respect to the situation in which each quantum of space is still, i.e. there is no time). If a-temporal physical space is characterized by a moving electric density of space (which implies a stream of changes of at least a charged particle in space), in this region an electric field $E(r,\varphi(s))$ depending not only on the three coordinates of the ordinary space but also on the fourth spatial coordinate, i.e. on the stream of changes of the electric density of space (i.e., practically, on the speed of the QS) is generated . This electric field $E(r,\varphi(s))$ depending on the stream of changes of the electric density of space determines, in a-temporal physical space, in virtue of Maxwell's fourth equation, a magnetic field $B(r,\varphi(s))$ which depends on all the four spatial coordinates and thus also on the stream of changes of the electric density of space in space. Then, this magnetic field $B(r,\varphi(s))$ depending on all the four spatial coordinates causes in a-temporal physical space, on the ground of the third equation of Maxwell, a new electric field depending itself on all the four spatial coordinates, and so on. In this way, a set of electric and magnetic fields which feed each other instantaneously, is created on the ground of Maxwell's equations, giving place to the real electromagnetic waves, not because they vary in time, but because there is a stream of changes of an electric density of space in space. The interpretation that one can provide here about the electromagnetic field and electromagnetic waves is therefore the following. The electromagnetic field is the special state of a-temporal physical space when this space is characterized by an electric density of space in motion, i.e. an electric density of space subjected to a stream of movements in space. Electromagnetic waves are vibrations of a-temporal physical space, at a frequency belonging to the electromagnetic spectrum; these vibrations propagate at the speed of light and are caused by an electric density of space subjected to a stream of movements in space.

More precisely, one can suggest that, according to the understanding here, the electromagnetic field can be interpreted as the special state of a-temporal physical space characterized by an accelerated electric density of space, namely by QS whose speed is subjected to a stream of movements in space. In other words, one can say that the electromagnetic field is the special state of a-temporal physical space determined by an electric density of space endowed with a motion with non constant speed. In fact, if QS are endowed with a non constant speed, we can deduce that also the magnetic density of physical space $D_m(r)$ is subjected to a stream of changes in space, and thus also the magnetic field $B = D_e(r)D_m(r)l_p^3\hat{b}$ (15) created by that electric density of space in a point situated at distance *r* is subjected to a stream of changes in space. Therefore, on the ground of equation (26) (or (26a) or (31)) an electric field itself subjected to a stream of changes in space is created.

Furthermore, as far as the variations of electric field are concerned, if one takes into account that electric field is tied to D_m in virtue of the relation $E = D_e(r)l_p^3 = \frac{B}{D_m(r)}$ (38) (from which one can see precisely that if D_m is subjected to a stream of changes in space also electric field changes in space), we are presented with the possibility that there be a sort of "correspondence" between equation (27) (or (27a) or (33)) and equation (38), namely a sort of "correspondence" between the variation of electric field on the basis of equation (27) (or (27a) or (33)) and the variation of the magnetic density of space $D_m(r)$. Then, if we have an electric field subjected to a stream of changes in space, on the basis of equation (27) (or (27a) or (33)), a new magnetic field subjected to a stream of changes in space is created in space too. In synthesis, one can say that the presence of an electromagnetic field in a region of physical space (and thus of a set of electric and magnetic fields which feed each other instantaneously) is tied to the variation, to the stream of changes of the magnetic density of physical space $D_m(r)$ and therefore to the stream of changes of a charge's speed (or, even better, of the speed of an electric density of space) in space. Electromagnetic waves themselves can be thus considered the results of the variation, of the stream of changes of the magnetic density of physical space $D_m(r)$.

Finally, the motion of a charged particle *q* and endowed with speed v in a region seat of an electric field and a magnetic field, which classically is described by Lorentz force $F = qE + qv \times B$ (13), now can be seen as a consequence of the motion of space because each charged particle can be seen as a "portion" of space, where an opportune density of cosmic space and electric density of space assume their maximum values. According to our a-temporal interpretation of classical electromagnetism, the classical equation of Lorentz force (13) must be replaced by equation $D(r)\cdot\frac{\frac{d^2\vec{r}}{ds^2}\dot{\varphi}(s)-\frac{d\vec{r}}{ds}\ddot{\varphi}(s)}{[\dot{\varphi}(s)]^3}$ $=\frac{G}{K}D_e(r)\vec{E}+\frac{G}{K}D_e(r)\frac{1}{\dot{\varphi}(s)}\cdot\frac{dr}{ds}\times\vec{B}$ (39) or the equivalent equation

$$D(r)\cdot\frac{\frac{d^2\vec{r}}{ds^2}\frac{1}{v(r,\varphi(s))}\frac{dr}{ds}-\frac{d\vec{r}}{ds}\frac{\frac{d^2r}{ds^2}v(r,\varphi(s))-\frac{dr}{ds}\frac{dv(r,\varphi(s))}{ds}}{[v(r,\varphi(s))]^2}}{\left[\frac{1}{v(r,\varphi(s))}\frac{dr}{ds}\right]^3}=\frac{G}{K}D_e(r)\vec{E}+\frac{G}{K}D_e(r)v(r,\varphi(s))\cdot\hat{v}\times\vec{B} \qquad (40)$$

where $\hat{v}$ identifies direction and versus of the speed. Taking into account the link between the speed of the generic quantum of space and the magnetic density of such quantum of space, these equations can also be expressed in the other equivalent form: $D(r)\cdot\frac{\frac{d^2\vec{r}}{ds^2}\frac{\mu_0 r^5 sen\alpha}{4Kl_p^5\pi D_m(r,\varphi(s))}\frac{dr}{ds}-\frac{d\vec{r}}{ds}\frac{\frac{d^2r}{ds^2}\frac{4Kl_p^5\pi D_m(r,\varphi(s))}{\mu_0 r^5 sen\alpha}-\frac{dr}{ds}\frac{d}{ds}\left[\frac{4Kl_p^5\pi D_m(r,\varphi(s))}{\mu_0 r^5 sen\alpha}\right]}{\left[\frac{4Kl_p^5\pi D_m(r,\varphi(s))}{\mu_0 r^5 sen\alpha}\right]^2}}{\left[\frac{\mu_0 r^5 sen\alpha}{4Kl_p^5\pi D_m(r,\varphi(s))}\frac{dr}{ds}\right]^3}$ $=\frac{G}{K}D_e(r)\vec{E}+\frac{G}{K}D_e(r)\cdot\frac{4Kl_p^5\pi D_m(r,\varphi(s))}{\mu_0 r^5 sen\alpha}\cdot\hat{v}\times\vec{B}$ (41). The classical relation defining Lorentz force (13) can be deduced from equations (39), (40), (41) by substituting Planck length in the place of *r*: it is in this sense that the motion of a charged particle under the action of the classical Lorentz force can be seen as the consequence of a more general motion of a region of space characterized by an opportune density of cosmic space and an opportune electric density of cosmic space.

5. The motion of material objects under the action of gravitational force in a-temporal physical space

According to classical a-temporal gravitation, on the ground of what has been put in evidence in chapter 2, gravity acts between regions endowed with different density of cosmic space and the result is that material objects move in the direction where the density of cosmic space is increasing. If a-temporal physical space is characterized by two or more densities of cosmic space, an attraction of couples of densities of cosmic space, and thus also motion of material objects, are generated. This motion determines a variation in the configuration of the universe with respect to the situation in which there is one still density of cosmic space namely there is no time.

Now, according to the ideas illustrated in chapter 3, it is also important to underline that motion is tied to the magnetic density of space. So, one can suggest that the magnetic density of space assumes an important role also in the movement of material objects under the action of the gravitational force. Newton's second law applied to gravitational interaction between two densities of cosmic space can be written in the following way $\vec{F}_g = \frac{D_1(r_1)\cdot D_2(r_2)\cdot r_1^{\,2}\cdot r_2^{\,2}\cdot l_p^{\,6}}{r^2\cdot G}\hat{r} = \frac{D_{red}(r)\cdot l_p^{\,3}\cdot r^2}{G}\cdot\frac{\frac{d^2\vec{r}}{ds^2}\dot{\varphi}(s)-\frac{d\vec{r}}{ds}\ddot{\varphi}(s)}{[\dot{\varphi}(s)]^3}$ namely $\frac{D_1(r_1)\cdot D_2(r_2)\cdot r_1^{\,2}\cdot r_2^{\,2}\cdot l_p^{\,3}}{r^4}\hat{r} = D_{red}(r)\cdot\frac{\frac{d^2\vec{r}}{ds^2}\dot{\varphi}(s)-\frac{d\vec{r}}{ds}\ddot{\varphi}(s)}{[\dot{\varphi}(s)]^3}$ (42) or in the equivalent form

$$\frac{D_1(r_1)\cdot D_2(r_2)\cdot r_1^{\,2}\cdot r_2^{\,2}\cdot l_p^{\,3}}{r^4}\hat{r} = D_{red}(r)\cdot\frac{\frac{d^2\vec{r}}{ds^2}\frac{1}{v(r,\varphi(s))}\frac{dr}{ds}-\frac{d\vec{r}}{ds}\frac{\frac{d^2r}{ds^2}v(r,\varphi(s))-\frac{dr}{ds}\frac{dv(r,\varphi(s))}{ds}}{[v(r,\varphi(s))]^2}}{\left[\frac{1}{v(r,\varphi(s))}\frac{dr}{ds}\right]^3} \quad (43)$$

where $D_{red}(r) = \frac{D_1(r)D_2(r)}{D_1(r)+D_2(r)}$. The equivalent equations (42), (43) describe the behaviour, the motion of a density of comic space $D_{red}(r) = \frac{D_1(r)D_2(r)}{D_1(r)+D_2(r)}$ under the action of a gravitational force $\frac{D_1(r_1)\cdot D_2(r_2)\cdot r_1^{\,2}\cdot r_2^{\,2}\cdot l_p^{\,6}}{r^2\cdot G}\hat{r}$. Taking into account the link between the speed of the generic quantum of space and the magnetic density of such quantum of space, these equations can also be expressed in the other equivalent form:

$$\frac{D_1(r_1)\cdot D_2(r_2)\cdot r_1^{\,2}\cdot r_2^{\,2}\cdot l_p^{\,6}}{r^2\cdot G}\hat{r} = D_{red}(r)\cdot\frac{\frac{d^2\vec{r}}{ds^2}\frac{\mu_0 r^5 sen\alpha}{4Kl_p^{\,5}\pi D_m(r,\varphi(s))}\frac{dr}{ds}-\frac{d\vec{r}}{ds}\frac{\frac{d^2r}{ds^2}\frac{4Kl_p^{\,5}\pi D_m(r,\varphi(s))}{\mu_0 r^5 sen\alpha}-\frac{dr}{ds}\frac{d}{ds}\left[\frac{4Kl_p^{\,5}\pi D_m(r,\varphi(s))}{\mu_0 r^5 sen\alpha}\right]}{\left[\frac{4Kl_p^{\,5}\pi D_m(r,\varphi(s))}{\mu_0 r^5 sen\alpha}\right]^2}}{\left[\frac{\mu_0 r^5 sen\alpha}{4Kl_p^{\,5}\pi D_m(r,\varphi(s))}\frac{dr}{ds}\right]^3}$$

(44). Equation (44) shows clearly the link between the magnetic density of cosmic space (or, more precisely, the variation of the magnetic density of space with respect to the stream of movements of matter) and the gravitational force between two densities of cosmic space. This equation opens the possibility that the magnetic density of space assumes an important role also as regards physical phenomena different from electromagnetism: the magnetic density of space is related to all motions. On the basis of equation (44), one can say that the behaviour of couples of densities of cosmic space depends on the magnetic density of cosmic space and its variation with respect to motion in space. The magnetic density of space, by being linked to motion namely to time, can be considered the unifying element of different physical phenomena.

6. Conclusions

Starting from the idea that space has a granular structure at the Planck scale, is characterized by a density of cosmic space, an electric density of space and a magnetic density of space, and that time exists only as a function describing the irreversible motion of matter, we are presented with the possibility to open a new, a–temporal, interpretation of Newtonian gravitation and classical electromagnetism. In this new interpretation, time is linked to the magnetic density of space, the gravitational force acts between regions of space endowed with different density of cosmic space and the motion of a density of cosmic space under the action of the gravitational force depends on the magnetic density of cosmic space too. Moreover, Maxwell's equations and the relation describing Lorentz force can receive themselves an a-temporal version in which motion, i.e. time, is always linked to the magnetic density of space.

References:

1. Licata I., Dinamica reticolare dello spazio-tempo. Bologna: Inediti Scientifici Andromeda, 1989.

2. Licata I., Osservando la sfinge. Roma: Di Renzo, 2003.

3. Rovelli C., Loop quantum gravity, Physics World, Vol. 7, Num.11, 1-5, 2003.

4. Rovelli C., Quantum gravity. Cambridge, Massachussets: Cambridge University Press, 2004.

5. Girelli F., Liberati S. and Sindoni L., "Is the notion of time really fundamental?", http://arxiv.org/abs/0903.4876, 2009.

6. Barbour J., "The Nature of Time", http://arxiv.org/abs/0903.3489, 2009.

7. Sorli A. and Sorli I., Mathematical Time And Physical Time In The Theory Of Relativity, Electronic Journal of Theoretical Physics, Vol. 1, Num. 4, pp. 25-27, 2004. http://www.ejtp.com/articles/ejtpv1i4p25

8. Sorli A. and Sorli I., A-temporal gravitation, Electronic Journal of Theoretical Physics, Vol.1, Num. 2, pp. 1-3, 2004. www.ejtp.com

9. Sorli A. and Sorli K., "From Space-time to A-Temporal Physical Space", Frontier Perspectives, Vol. 14, Num. 1, pp. 38-40, 2005.

10. Yourgrau P., A World Without Time: The Forgotten Legacy of Gödel And Einstein, Amazon, 2006.

11. Fiscaletti D. and Sorli A., Toward a new interpretation of subatomic particles and their motion inside a-temporal physical space, Frontier Perspectives, Vol. 15, Num. 2, pp. 23-30, 2006.

12. Fiscaletti D. and Sorli A., Toward an a-temporal interpretation of quantum potential, Frontier Perspectives, Vol. 14, Num. 2, pp. 43-54, 2005.

13. Fiscaletti D., Perspectives towards the density theory of everything, Scientific Inquiry, Vol. 9, Num. 2, pp. 173-200, 2008.

14. Sorli A. and Fiscaletti D., Active Galactic Nucleus As a Renewing System Of the Universe, Electronic Journal of Theoretical Physics, Vol. 2, Num. 6, 7-13, 2005. www.ejtp.com

15. Fiscaletti D., A-Temporal Physical Space and Quantum Nonlocality, Electronic Journal of Theoretical Physics, Vol. 2, Num 6, 15-20, 2005. www.ejtp.com