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Tensorial Analysis of Essential Kinematics in Vacuum

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ABSTRACT

In this paper, a tensorial analysis of the movement of the essential substrate associated with the underlying vacuum of a physical system is conducted. Two tensors are obtained that generalize the local vectorial quantum model, which allow describing the rotation and translation movement of each substrate point. By independently integrating the tensor equations of motion of the substrate, two local temporal tensors are deduced, which simultaneously and with relative accuracy determine the position and velocity of each substrate point. Consequently, the temporal tensors associated with the position and velocity of the substrate allow us to describe the temporal evolution of the most elementary organized information transmitted by the propagation of light through the underlying vacuum of physical systems. In addition, it follows that, formally, these time tensors must be generated by a time tensor in four-dimensional space. Therefore, the organized information received by physical systems must come from a higher dimensional space.

Keywords: Quantum vector tensor, local temporal tensors, essential substrate, underlying vacuum, organized information.

1INTRODUCTION

In conventional cosmology, it is assumed that the universe is a closed, isolated, self-contained, boundaly-less system, and that it was born simultaneously with time. Consequently, there would be no external influence to the universe capable of affecting it [1].

Traditional cosmologists, who rely on the theory of relativity and quantum mechanics, have made great intellectual efforts in the search for a final physical theory by proposing that everything that occurs within the universe arises from the vibrations of a single hidden entity dwelling in spaces of dimensions higher than the four of space-time according to Einstein. However, these extra spatial dimensions are merely mathematical constructs [2].

In the context of the theory of relativity, it is asserted that space and time constitute a kind of fabric of the cosmos, although it is recognized that they are concepts filled with mystery that lead to esoteric situations. In contrast to some philosophical schools, it is assumed that space-time can be accepted as a physical entity whose functioning must be understood in order to describe objective reality [3], [4].

In the context of quantum mechanics, the concept of empty space (or simply vacuum) is explained in terms of particles and fields. The uncertainty principle implies that in empty space, the so-called zero-point energy exists (which is the state of minimum energy). Moreover, it is acknowledged that the quantum vacuum is filled with a "substance" called the Higgs field, whose vibrations are interpreted as particles called Higgs bosons. The interaction of these bosons with subatomic particles produces their masses [6], [7]. However, the phenomena that occur in the quantum vacuum are considered strange and perplexing.

In this study, a new concept of vacuum is considered, called the underlying vacuum. This concept arises from reinterpreting one of the conclusions of the Rutherford experiment by admitting that if atoms have 99.99% empty space, then every physical system will have it. The underlying vacuum can be geometrically described as the hyperconic rotating sector between the center of a four-dimensional sphere and its surface, which corresponds to the usual three-dimensional space.

The purpose of this study is to use tensor analysis in the simplest way possible to demonstrate that the effects perceived in the physical world, namely natural phenomena, arise from the underlying vacuum as a consequence of executing a very intelligent program based on essential kinematics. Light propagation is assumed to be the only influence capable of transmitting organized information in a physical system's underlying vacuum.

Additionally, this study considers the idea of complementary spatial dimensions, which was introduced in reference [7]. It is proposed that three-dimensional space can be described as the surface that bounds a four-dimensional sphere. Thus, each point on the surface of the four-dimensional sphere, associated with a physical system, can be considered as the origin of coordinates (0,0,0) with respect to which essential kinematics in the underlying vacuum of the physical system can be described.

Light propagation is considered the sole influence for transmitting organized information through the underlying vacuum in natural systems. This has been studied in terms of velocity and acceleration, using a basic substrate expressed by parametric equations to describe the essential kinematics of the vacuum [8], [9].

It is important to emphasize that the present study is an extension of the topics covered in articles [8] and [9]. The mathematical tool used is tensor algebra in the simplest form possible. The physical description is not in terms of particles and fields, but rather in terms of concepts such as light, organized information, and vacuum.

2. TENSOR DESCRIPTION OF SUBSTRATE MOTION

The parametric equations that express the substrate motion in the underlying essential vacuum of a physical system are as follows [8]:

$$x(t) = at\cos\omega t \tag{1}$$

$$y(t) = at\,\mathrm{sen}\,\omega t \tag{2}$$

$$z(t) = bt \tag{3}$$

In these equations a and b are positive constants defined by:

$$a = \frac{1}{3}c \tag{4}$$

$$b = \frac{2\sqrt{2}}{3}c \tag{5}$$

where c is the speed of light in ordinary free space. The quantity ω in equations (1), (2) and (3) is the magnitude of the local vector quantum. Furthermore, $t \geq t_p$, where t_p is the Planck time [8].

The second order derivatives with respect to time t of equations (1), (2) and (3) are respectively:

$$\frac{dx}{dt} = a\cos\omega t - a\omega t\,\mathrm{sen}\,\omega t \tag{6}$$

$$\frac{dy}{dt} = a\,\mathrm{sen}\,\omega t + a\omega t\cos\omega t \tag{7}$$

$$\frac{dz}{dt} = b \tag{8}$$

Equations (6), (7) and (8) express the components of the substrate velocity v_x, v_y, v_z respectively, and can be written in matrix form:

$$\begin{pmatrix} v_x \\ v_y \\ v_z \end{pmatrix} = \begin{pmatrix} 1/t & -\omega & 0 \\ \omega & 1/t & 0 \\ 0 & 0 & 1/t \end{pmatrix} \begin{pmatrix} at\cos\omega t \\ at\,\mathrm{sen}\,\omega t \\ bt \end{pmatrix} \tag{9}$$

Or, using the notations:

$$\vec{\mathbf{v}} = \ddot{\boldsymbol{\omega}}_{\mathbf{r}}(t)\vec{\mathbf{r}} \tag{10}$$

where:

$$\overleftrightarrow{\boldsymbol{\omega}}_{\mathbf{r}}(t) = \begin{pmatrix} 1/t & -\omega & 0 \\ \omega & 1/t & 0 \\ 0 & 0 & 1/t \end{pmatrix} \tag{11}$$

This expression represents the matrix of a general local tensor vector associated with the position of the substrate, in the sense that it operates at each instant t on each point $\vec{r}$ of the underlying vacuum space of the physical system to induce translational and rotational velocity. Note that $\overleftrightarrow{\omega}_r(t)$ s a tensor that depends on time t, but is independent of $\vec{r}$.

In addition, the left side of equation (10) can be written as follows:

$$\frac{d\vec{\mathbf{r}}}{dt} = \overleftrightarrow{\boldsymbol{\omega}}_{\mathbf{r}}(t)\vec{\mathbf{r}} \tag{12}$$

If expression (12) is considered as an equation of motion of the substrate, it can be integrated to obtain:

$$\vec{\mathbf{r}}(t) = \overleftrightarrow{\mathbf{T}}_{\mathbf{r}}(t)\vec{\mathbf{r}}(t_0) \tag{13}$$

where $\vec{r}(t_o)$ is the position vector at the instant $t_o \geq t_o \sim 10^{-43}$s. In equation (13), the temporal tensor $\overleftrightarrow{T}_r(t)$ is defined by:

$$\overleftrightarrow{\mathbf{T}}_{\mathbf{r}}(t) = \overleftrightarrow{\mathbf{T}}_{\mathbf{r}}(t_0)e^{\int_{t_0}^{t}\overleftrightarrow{\boldsymbol{\omega}}_{\mathbf{r}}(t)dt} \tag{14}$$

Applying d/dt to equation (14), the following is obtained:

$$\frac{d}{dt}\overleftrightarrow{\mathbf{T}}_{\mathbf{r}}(t) = \overleftrightarrow{\boldsymbol{\omega}}_{\mathbf{r}}(t)\overleftrightarrow{\mathbf{T}}_{\mathbf{r}}(t) \tag{15}$$

Hare, the initial condition can be assumed:

$$\overleftrightarrow{\mathbf{T}}_{\mathbf{r}}(t_0) = \overleftrightarrow{\mathbf{1}} \tag{16}$$

where $\overleftrightarrow{1}$ is the tensor unit. Consequently, equation (14) is simply written as:

$$\overleftrightarrow{\mathbf{T}}_{\mathbf{r}}(t) = e^{\int_{t_0}^{t}\overleftrightarrow{\boldsymbol{\omega}}_{\mathbf{r}}(t)dt} \tag{17}$$

Or as:

$$\overleftrightarrow{\mathbf{T}}_{\mathbf{r}}(t) = e^{\overleftrightarrow{\mathbf{f}}(t)} \tag{18}$$

where:

$$\overleftrightarrow{\mathbf{f}}(t) = \int_{t_0}^{t}\overleftrightarrow{\boldsymbol{\omega}}_{\mathbf{r}}(t)dt \tag{19}$$

Note that equation (18) can be developed as a power series as follows:

$$\overleftrightarrow{\mathbf{T}}_{\mathbf{r}}(t) = \overleftrightarrow{\mathbf{1}} + \overleftrightarrow{\mathbf{f}}(t) + \frac{1}{2!}\overleftrightarrow{\mathbf{f}}^2(t) + \frac{1}{3!}\overleftrightarrow{\mathbf{f}}^3(t) + \ldots \tag{20}$$

Here, the tensor $\overleftrightarrow{f}(t)$ is fully determined by equation (19) through the knowledge of the general local vector quantum tensor described in equation (11).

So far, the mathematical formalism on the essential kinematics of the substrate points in the underlying vacuum of a physical system has been described. The next step should be the development of the formalism on the velocity of the substrate.

3. TENSOR DESCRIPTION OF SUBSTRATE VELOCITY

The second order derivatives with respect to time t of equations (6), (7) and (8) are respectively [9]:

$$\frac{d^2x}{dt^2} = -2\alpha\omega sen\omega t - \alpha\omega^2 tcos\omega t \qquad (21)$$

$$\frac{d^2y}{dt^2} = 2\alpha\omega cos\omega t - \alpha\omega^2 tsen\omega t \qquad (22)$$

$$\frac{d^2z}{dt^2} = 0 \qquad (23)$$

Eqs. (21), (22) and (23) express the acceleration components of substrate a_x, a_y, a_z respectively, and can be written in the matrix form:

$$\begin{pmatrix} a_x \\ a_y \\ a_z \end{pmatrix} = \begin{pmatrix} \omega_{11} & \omega_{12} & \omega_{13} \\ \omega_{21} & \omega_{22} & \omega_{23} \\ \omega_{31} & \omega_{32} & \omega_{33} \end{pmatrix} \begin{pmatrix} \alpha cos\omega t - \alpha\omega tsen\omega t \\ \alpha sen\omega t + \alpha\omega tcos\omega t \\ b \end{pmatrix} \qquad (24)$$

Performing the matrix multiplication in equation (24) gives the following results:

$$\omega_{11} = \frac{1}{t}\left(1 - \frac{1}{1+\omega^2t^2}\right) \qquad (25)$$

$$\omega_{12} = -\omega\left(1 + \frac{1}{1+\omega^2t^2}\right) \qquad (26)$$

$$\omega_{21} = \omega\left(2 - \frac{\omega^2t^2}{1+\omega^2t^2}\right) \qquad (27)$$

$$\omega_{22} = \omega\left(\frac{\omega t}{1+\omega^2t^2}\right) \qquad (28)$$

It is also clear that:

$$\omega_{13} = \omega_{23} = 0 \qquad (29)$$

$$\omega_{31} = \omega_{32} = \omega_{33} = 0 \qquad (30)$$

Consequently, equation (24) in the tensor notation is written:

$$\frac{d\vec{\mathbf{v}}}{dt} = \ddot{\boldsymbol{\omega}}_{\mathbf{v}}(t)\vec{\mathbf{v}} \qquad (31)$$

where:

$$\ddot{\boldsymbol{\omega}}_{\mathbf{v}}(t) = \begin{pmatrix} \frac{1}{t}\left(1 - \frac{1}{1+\omega^2t^2}\right) & -\omega\left(1 + \frac{1}{1+\omega^2t^2}\right) & 0 \\ \omega\left(2 - \frac{\omega^2t^2}{1+\omega^2t^2}\right) & \omega\left(\frac{\omega t}{1+\omega^2t^2}\right) & 0 \\ 0 & 0 & 0 \end{pmatrix} \qquad (32)$$

Matrix (32) represents a general local tensor vector associated with the substrate's velocity that indirectly operates at each instant t on each point of the physical system's underlying vacuum to induce acceleration and rotation.

By analogy with the previous development, if expression (31) is considered as an equation of motion of the substrate, it can be integrated to obtain:

$$\vec{\mathbf{v}}(t) = \overleftrightarrow{T}_v(t)\vec{\mathbf{v}}(t_0) \tag{33}$$

where $\vec{v}(t_o)$ is the velocity of the substrate at the instant $t_o \geq t_p \sim 10^{-43}$s. In equation (33) the temporal tensor $\overleftrightarrow{T}_v(t)$ is defined by:

$$\overleftrightarrow{\mathbf{T}}_{\mathbf{v}}(t) = \overleftrightarrow{\mathbf{T}}_{\mathbf{v}}(t_0)e^{\int_{t_0}^{t}\overleftrightarrow{\boldsymbol{\omega}}_v(t)dt} \tag{34}$$

Applying d/dt to equation (34) the following is obtained:

$$\frac{d}{dt}\overleftrightarrow{\mathbf{T}}_{\mathbf{v}}(t) = \overleftrightarrow{\boldsymbol{\omega}}_{\mathbf{v}}(t)\overleftrightarrow{\mathbf{T}}_{\mathbf{v}}(t) \tag{35}$$

In the equation, the initial condition can also be assumed:

$$\overleftrightarrow{\mathbf{T}}_{\mathbf{v}}(t_0) = \overleftrightarrow{\mathbf{1}} \tag{36}$$

where $\overleftrightarrow{1}$ is the unit tensor. Thus, equation (34) is simply written as:

$$\overleftrightarrow{\mathbf{T}}_{\mathbf{v}}(t) = e^{\int_{t_0}^{t}\overleftrightarrow{\boldsymbol{\omega}}_v(t)dt} \tag{37}$$

Or as:

$$\overleftrightarrow{\mathbf{T}}_{\mathbf{v}}(t) = e^{\overleftrightarrow{\mathbf{g}}(t)} \tag{38}$$

where:

$$\overleftrightarrow{\mathbf{g}}(t) = \int_{t_0}^{t}\overleftrightarrow{\boldsymbol{\omega}}_{\mathbf{v}}(t)dt \tag{39}$$

Note that equation (38) can be developed in series of values as:

$$\overleftrightarrow{\mathbf{T}}_{\mathbf{v}}(t) = \overleftrightarrow{\mathbf{1}} + \overleftrightarrow{\mathbf{g}}(t) + \frac{1}{2!}\overleftrightarrow{\mathbf{g}}^2(t) + \frac{1}{3!}\overleftrightarrow{\mathbf{g}}^3(t) + \ldots \tag{40}$$

Here, the $\overleftrightarrow{\mathbf{g}}(t)$ tensor is completely determined by equation (39) through the knowledge of the general local quantum vector tensor described in equation (32).

With this, the tensorial analysis of the essential kinematics of the substrate associated with the underlying vacuum of natural systems is completed. The next step will be to analyze the results obtained.

4. RESULT ANALYSIS

Equations (13) and (33) describe the position and velocity of substrate $[\vec{r}(t); \vec{v}(t)]$ respectively, associated with the underlying vacuum of a natural system from initial conditions $[\vec{r}(t_o); \vec{v}(t_o)]$.

At this level of description in Physics, the state of motion of each point of the substrate associated with the underlying vacuum of a natural system would be simultaneously and relatively accurately determined by the action of the temporal tensors $\overleftrightarrow{T}_r(t)$ y $\overleftrightarrow{T}_v(t)$ according to equations. (13) and (33). Therefore, at this level, it would be unnecessary to consider the uncertainty principle of quantum mechanics.

Equation (13) implies that at each moment in time, there would be organized information entering the three-dimensional space from a higher-dimensional space, which is then transmitted through the propagation of light into the underlying vacuum of a physical system. This is described by the action of the tensor $\overleftrightarrow{T}_r(t)$ eat each point of the substrate.

The velocity at which information is transmitted to a physical system is described by equation (15), along with condition (16). It is noteworthy that tensorial analysis reveals that there is actually a direct external action on each point r of the underlying vacuum of each physical system described by the operator $\overleftrightarrow{T}_r(t)$. Conversely, the action of the operator $\overleftrightarrow{\omega}_r(t)$ is indirect, in the sense that it would function as a modulator of the trajectory of rays of light.

According to equation (18) operator $\overleftrightarrow{T}_r(t)$ describes the temporal evolution of the substrate's position in terms of the tensor $\overleftrightarrow{f}(t)$. If the information entering the system comes from a higher-dimensional space, then nonlinear terms in equation (20) would be required to describe the action of the operator $\overleftrightarrow{T}_r(t)$ with increasing accuracy. For example, if the information comes from the four-dimensional space, then it is reasonable to consider in equation (20) an approximation up to the second-order term:

$$\overleftrightarrow{\mathbf{T}}_{\mathbf{r}}(t) \approx \overleftrightarrow{\mathbf{1}} + \overleftrightarrow{\mathbf{f}}(t) + \frac{1}{2!}\overleftrightarrow{\mathbf{f}}^{2}(t) \qquad (41)$$

And so on, it would be reasonable to consider higher-order nonlinear terms in equation (20) for an increasingly accurate description of the velocity at which information is transmitted to the physical system.

In reality, the temporal tensor $\overleftrightarrow{T}_r(t)$ in three-dimensional space must be formally generated by another second-order tensor in four-dimensional space, the description of which is beyond the scope of the present study.

Considering reference [7], figure 1 shows a diagram explaining the action of a time tensor T(t) in dimension four. (4D). The T(t) tensor would represent the influence responsible for the organized information towards the system in the three-dimensional (3D) space. Since this tensor operates on the boundary between the 3D and 4D spaces (which is the underlying vacuum of the system), it would generate the temporal tensor $\overleftrightarrow{T}_r(t)$ in the 3D space, which would act directly on the $\vec{r}$ points of the substrate.

However, the $\overleftrightarrow{T}_r(t)$ tensor would not be the only one generated by the T(t) tensor and that could act on each substrate point in the 3D space. The temporal tensor $\overleftrightarrow{T}_v(t)$ would also be generated; given that equation (33) means that $\overleftrightarrow{T}_v(t)$ acts simultaneously in each time instant to produce movement to each point of the substrate. As a consequence, according to equation (35) there would be rotation movement induced by the $\overleftrightarrow{\omega}_v(t)$ tensor, and therefore, acceleration at each point of the substrate.

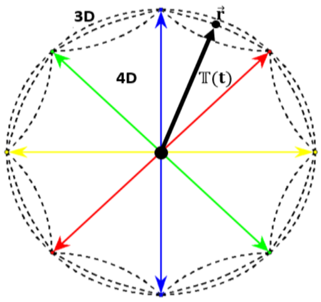

Figure 1. Diagram to explain the action of an external influence, represented by the temporal tensor T**(t)** in the 4D dimension, on each point $\vec{r}$ of the substrate in the 3D dimension. In the spherical-conical sectors, the surface of each cap represents the boundary between 3D and 4D spaces, corresponding to the underlying vacuum of a physical system.

Following the same reasoning as the case of the tensor $\overleftrightarrow{T}_r(t)$; according to equation (38), the operator $\overleftrightarrow{T}_v(t)$ describes the temporal evolution of the substrate's velocity in terms of the tensor $\overleftrightarrow{g}(t)$. If the information entering the system comes from a 4D space, then nonlinear terms in equation (40) would be required to describe the action of the operator $\overleftrightarrow{T}_v(t)$ with increasing accuracy. For example, an approximation up to the second-order term can be considered:

$$\overleftrightarrow{\mathbf{T}}_{\mathbf{v}}(t) \approx \overleftrightarrow{\mathbf{1}} + \overleftrightarrow{\mathbf{g}}(t) + \frac{1}{2!}\overleftrightarrow{\mathbf{g}}^{2}(t) \qquad (42)$$

And so on, in Eq. (40), higher-order nonlinear terms can continue to be considered for an increasingly accurate description of the acceleration with which information is transmitted to the physical system.

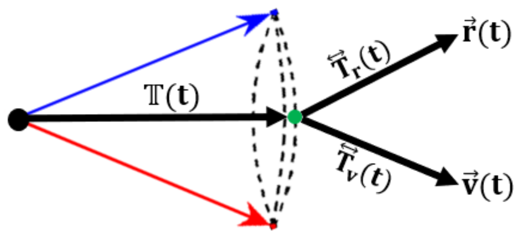

Figure 2. A schematic diagram to illustrate that a temporal tensor T(t) in 4D space would generate two temporal tensors $\overleftrightarrow{T}_r(t)$ and $\overleftrightarrow{T}_v(t)$ In the 3D space, which would simultaneously and relatively accurately determine the position $\vec{r}(t)$ and velocity $\vec{v}(t)$ of the substrate.

In summary, the temporal tensor T(t) in 4D space generates the temporal tensors $\overleftrightarrow{T}_r(t)$ and $\overleftrightarrow{T}_v(t)$ in 3D space, which simultaneously and relatively accurately determine the temporal evolution of the position and velocity of the substrate $[\vec{r}(t); \vec{v}(t)]$ from initial conditions $[\vec{r}(t_o); \vec{v}(t_o)]$. Figure 2 shows a schematic representation of this conclusion.

Therefore, since the quantities $[\vec{r}(t); \vec{v}(t)]$ determine the essential kinematics of the substrate, they would allow for a general description of the transmission of elementary information through the pair of temporal tensors $[\overleftrightarrow{T}_r(t); \overleftrightarrow{T}_v(t)]$. It is important to understand elementary information as that which is transmitted through the propagation of light under the simplest or basic substrate, described by parametric equations (1), (2), and (3). Any other substrate constructed to describe some general property of a physical system could not be considered as elementary information.

This tensorial analysis explains the kinematics of the substrate and its relationship with the background vibrations detected in all physical systems as follows: According to equations (10) and (31), the kinematics of the substrate is described by the indirect action of the pair of tensors $[\overleftrightarrow{\omega}_r(t); \overleftrightarrow{\omega}_v(t)]$ on the rays of light in the underlying vacuum of the physical system, which enables the transmission of organized information to the system. A rigorous study of the fluctuations of the tensor quantities $[\overleftrightarrow{\omega}_r(t); \overleftrightarrow{\omega}_v(t)]$ would rigorously explain the background vibrations in physical systems, but this is a topic for another research study.

5. CONCLUSIONS

The tensorial analysis of the substrate's movement leads to the derivation of a matrix representing a local quantum vector tensor, which acts on each substrate point associated with the underlying vacuum of the physical system, inducing translational and rotational velocity.

By integrating the tensorial equation of motion of the substrate, a temporal tensor is deduced, which acts directly on each substrate point and determines the position at each instant. This tensor describes the temporal evolution of the substrate's position and is fully determined at each instant, and for any order of approximation, through the quantum vector tensor associated with the substrate's position.

Similarly, by integrating the tensorial equation of motion of the substrate, a temporal tensor is deduced, which acts directly on each substrate point and determines its velocity at each instant. This tensor describes the temporal evolution of the substrate's velocity and is fully determined at each instant, and for any order of approximation, through the quantum vector tensor associated with the substrate's velocity.

In the perspective of the open universe, the temporal tensors in three-dimensional space, which determine the position and velocity of the substrate, would be generated by a temporal tensor defined in four-dimensional space. Therefore, it is deduced that the most elementary organized information transmitted through light propagation through the underlying vacuum of physical systems must come from a higher-dimensional space and corresponds to the most elementary substrate.

At this level of description in Physics, the position and velocity of the substrate point associated with the underlying vacuum of a natural system would be simultaneously and relatively accurately determined by the action of the corresponding temporal tensors. Consequently, at this level, the uncertainty principle of quantum mechanics loses its significance because it would only be relevant under the assumption of a closed, isolated, self-contained, and boundary-less universe.

REFERENCES

[1] Hawking, S.W. (2002). *On the Shoulders of Giants*, Running Press, Philadelphia, Pennsylvania. USA.

[2] Greene, B. (2000). *The Elegant Universe*, Vintage Books, New York, USA.

[3] Greene, B. (2005). *The Fabric of the Cosmos*, Vintage Books, New York, USA.

[4] Penrose, R. (2021). The Road to Reality A Complete Guide to the Laws of the Universe, Knopf Doubleday Publishing Group. New York, USA.

[5] Alemañ, B.R. (2013). When “nothing”, according to science, is “something”, Revista digital Matemática e Internet, Universidad de Elche (Alicante), Vol. 13 N° 2, España.

[6] Alemañ, B.R. (2014). From classic vacuum to quantum vacuum, Revista Internacional de Filosofía, vol. XIX-Nº2, España.

[7] Monroy, O. S. (2018). Analysis of an Inertial Reference System, Revista de Investigación de Física, UNMSM, Vol. 21, N°01, Perú.

[8] Monroy, O., Merma, M. (2020). Study of the possible variation of the light speed in a vacuum using the vector quanta model, Revista de Investigación de Física, UNMSM, Vol. 23, N°01, Perú.

[9] Monroy, O., Merma, M. (2021). Study of the acceleration of light in vacuum, Revista de Investigación de Física, UNMSM, Vol. 24, N°01, Perú.

[10] Sloan, D. (2021). New action for cosmology, Physic Rev. D 103 043524, U.S.A. Doi: https://doi.org/10.1103/PhysRevD.103.043524