Electrodynamics in Universal Noninertial Frame Predicts Complete Structure of Zero-Point Electrodynamics

Naveed Hussain[1], Hassnain Abdullah Hussain[2], Ather Qayyum[3,*], Muhammad Ali Shaukat Rao[4]

[1]Department of Physics, Punjab College Abdul Hakeem, Multan Division, Pakistan
[2]Institute of Physics, Bahauddin Zakerya University, Multan, Pakistan
[3]QFBA-Northumbria University Doha-Qatar
[4]RMIT University - Mechanical Engineering Department, Australia

Abstract A frame of reference that is accelerating or rotating or accelerating and rotating is known as noninertial frame of reference. The transformation matrix for noninertial frame of reference is universal in the sense that all the spacetime laws of physics remain same for all observers in their original form after transformation which is the basic requirement of Einstein's principle of relativity (EPR). Electrodynamics in universal noninertial frame based on single transformation law for 4-vectrors and tensors (STL) under universal Lorentz transformation matrix (ULTM) predicts zero-point electrodynamics within usual electrodynamics. As a consequence of transformation of electromagnetic field (EMF), Maxwell's equations (ME) and conservation law in tensor form gave rise to zero-point or new symmetry terms of EMF, ME and conservation law along their corresponding diagonals. Zero- point terms or Singularities $\mathbf{F}^{\mu\mu}$, $\mathbf{F}^{\mu\mu}_{,\mu}$ and $\mathbf{F}^{\mu\mu}_{,\mu\mu}$ are the representatives of zero-point EMF, Maxwell's equations and conservation law respectively. Matrix method and Einstein's summation method are employed. Both methods give the same results up to the transformation of EMF and ME but they differ in the transformation of conservation law. Matrix method obeys usual conservation law but Einstein's method gives zero-point origin of 4D electromagnetic wave and conservation law becomes 7D wave. The most beautiful consequence of STL is the emergence of complete structure of zero-pint electrodynamics without affecting the usual form of electrodynamics. The model completely obeys EPR, conservation law and symmetry. Besides this, electrodynamics, inertia and gravitation in noninertial coordinate metric predict zero-point energy, zero-point Maxwell's equations as **power-force** and zero-point conservation law as 4D wave of energy. These results are also predicted by Lorenz transformation in 2D as well as in 4D but with Lorentz factor given in appendix. These discoveries will provide an unending source of power for space vehicles. An independent theory of zero-point electrodynamics is also developed where complete electrodynamics is obtained.

Keywords Universal Lorentz Transformation for Noninertial Frame, Single Transformation Law for 4-Vectors and Tensors, Purely Zero-Point Model of Electrodynamics, Inertia and Gravitation, Zero-Point Origin of 4D EM wave, Conservation Law as 7D EM Wave

1. Introduction

Albert Einstein left a great treasure of knowledge as heritage for coming generations. He taught us the methodology of doing spacetime physics in the language of 4-vectors and tensors. His work is legendary. On the other hand, Maxwell's work provided a physical interpretation of electromagnetic laws in unified framework. Einstein's presentation of Maxwell's theory in the language of tensors and 4-vectors has opened newer possibilities. Principle of relativity has been waiting for its complete validity and now it is getting its universal status for all observers in noninertial frame.

In Einstein's relativity theory, time and space, energy and momentum, Gauss's law and Ampere's law are relative but as a whole no explanation for spacetime, energy-momentum and Gauss's law -Ampere's law respectively. In principle, spacetime as a whole must appear same for all observers such that length contraction must be balanced by time dilation by the same amount. In the same manner, combination of energy and momentum, Gauss's law and Ampere's law must appear same for all observers independent of inertial and noninertial frame. According to EPR, all the spacetime laws of physics must remain same in every frame of reference. In other words, spacetime laws of physics must appear same for all observers. Time and space individually are relative but their combination must appear same to all observers. On investigation, it is found that 4-vetors and tensors as a whole do not remain same under usual Lorentz transformation (LT). The constancy of speed of light doesn't imply the form invariance of all the spacetime laws of physics. Speed of

light c is time component of 4-velocity that doesn't remain same as a whole under LT. In principle, 4-velocity must appear same for all observers that doesn't put any constraint on the constancy of speed of light. In the context of relativistic electrodynamics, Maxwell's equations in tensor form must appear same to all observers with Gauss's law and Ampere's law as relative concepts. Actually, due to unavailability of ULTM and STL for 4-vectors and tensors, EPR remained in trouble. In the present paper, spacetime electrodynamics is developed in noninertial frame based on STL for 4-vectors and tensors and ULTM for noninertial frame of reference that is accelerating with constant acceleration and rotating with constant angular speed. In this framework, all the 4-vectors, tensors, inner product of 4-vectors, inner product of tensors and 4D wave operator remain same for all observers. In our previous paper [1], all of these relations remain same for all observers based on ULTM for inertial frame of reference. The results of both models are in complete agreement given in the table-1. It is to be noted that ULTM for inertial and noninertial frame are valid for both frame that provides us the actual spirit of EPR, conservation law and symmetry.

The technique of STL for 4-vectors and tensors in spacetime physics is uncovering the hidden world of physical theories not only in electrodynamics but also in the theories of inertia and gravitation in the context of noninertial metrices [2]. Furthermore, application of STL is not confined only to ULTM for inertial and noninertial but for any transformation matrix e.g. in usual Lorentz transformation matrix in 2D and 4D. The validity of EPR, conservation law and symmetry principle depend upon the nature of transformation matrix.

Spacetime physics in noninertial frame is needed to understand our physical world as the most of the natural systems are noninertial like our planet itself is a noninertial frame. Large Hadron Collider (LHC) setup is a noninertial. Particle accelerators are also noninertial systems. The accelerating expansion of our universe is the recent empirical evidence in this context. The most important thing about any physical theory in noninertial frame is to obey EPR, conservation law and symmetry principle. In the contemporary world of spacetime physics, there doesn't exist a single model that fully obeys the above principles. In this paper, we shall mainly focus on the transformation of relations of electrodynamics as it is one of the well-understood physical theories and nicely fits in the framework of relativity.

The earlier models [1-2] motivated to develop a framework for such situations where bodies are moving with constant acceleration **a** and rotating with constant angular velocity **ω.** So ULTM for noninertial frame and STL is constructed to understand general relativity in a very simple language with which we are already familiar. This framework is valid for inertial as well as noninertial frame. The most difficult problem was to introduce acceleration and rotation in 4-position coordinate. Since speed of light c is taken as the time component of 4-velocity so its derivative with respect to time gave zero for time component of acceleration in the context of special relativity. In general relativity

4-acceleratin must contain its time component. Furthermore, special relativity and general relativity must appear as only theory of relativity. For this adventure, a consistent choice of coordinate is required. By choosing $x^0 = c\theta t = c\omega t^2$ and $\mathbf{x}^i = (\mathbf{x}, \mathbf{y}, \mathbf{z})$ have the dimensions of distance so 4-position coordinate $\mathbf{x}^\mu = (c\omega t^2, \mathbf{x}^i)$ is considered such that 4-velocity $\mathbf{v}^\mu = (c\omega t, \mathbf{v}^i)$ and 4-acceleration becomes $\mathbf{a}^\mu = (c\omega, \mathbf{a}^i)$. Here $c\omega$ is time component of 4-acceleration. It has not only generalized special relativity to general but a jump towards the higher order effects like time varying acceleration or jerk ($\frac{d\mathbf{a}}{dt} = \mathbf{j}$) in modern mechanics. Electrodynamic relations viz. 4-current density, EMF, ME, conservation law and wave operator are transformed under ULTM and STL for 4-vectors and tensors. New symmetry terms are observed along the diagonal of EMF, ME and conservation law written in tensor components form. These symmetry terms contribute to validate conservation law and original form of the physical quantities after transformation. It is important to note that hidden structure of electrodynamics is affected by the frame of reference but the usual structure is independent of this effect. The results of our earlier model based on ULTM for inertial frame when reviewed recently [1] found in complete agreement with the results of present model.

An extraordinary consequence of STL for 4-vectors and tensor is the existence of an independent model of purely zero-point theory of electrodynamics The results are presented in tale-2 and table-4. Our model is entirely different from the contemporary models on electrodynamics in noninertial frames [3-9]. Accelerating expansion of our universe and search for dark energy and matter are discussed in [10-12] but our approach will be different from them.

The problem of zero-point energy, zero-point field (ZPF) Lorentz force (Magnetic Force) as the origin of inertia are very popular topics in contemporary world [13-14]. The applications of zero-point energy and ZPF is also interesting for future space vehicle propulsion addressed in [17-22]. In our models [1,2] and [23], zero-point world is naturally present as an integral part with definite origin.

Model-1: Model of Electrodynamics in Universal Noninertial Frame

Notations in this model are adopted according to modern approach of relativity. Greek alphabets μ, ν, α, β, …runs from 0 to 3 and Latin letters i, j, k, … from 1 to 3. Comma (,) denote partial differentiation e. g. $\mathbf{E}_{,0} = \frac{\partial \mathbf{E}}{\partial t}$ Partial derivative of electric field w. r. t. time, $\mathbf{E}_{,1} = \frac{\partial \mathbf{E}}{\partial \mathbf{x}}$ Partial derivative of electric field w. r. t. x-axis, $\mathbf{E}_{,2} = \frac{\partial \mathbf{E}}{\partial \mathbf{y}}$ Partial derivative of electric field w. r. t. y-axis, $\mathbf{E}_{,3} = \frac{\partial \mathbf{E}}{\partial \mathbf{x}}$ Partial derivative of electric field w. r. t. z-axis,

$\mathbf{F}^{\mu\nu}_{,\nu}$ means 4-dimensional or spacetime partial derivative of EMF tensor.

4 dimensional Coordinates $\mathbf{x}^\mu = (x^0, \mathbf{x}^1, \mathbf{x}^2, \mathbf{x}^3) = (ct, \mathbf{x}, \mathbf{y}, \mathbf{z})$ =(ct, $\mathbf{x}^i$) with $x^0 = ct$ and $\mathbf{x}^i = (\mathbf{x}, \mathbf{y}, \mathbf{z})$. Time component ct is scalar while space components $\mathbf{x}^i$ is vector such that $\mathbf{x}^\mu$ is the unification of time and space. The dimensions of all

components are that of length.

1.1. Development of ULTM in 2D and 4D in Noninertial Frame

The incompatibility of Lorentz transformation with EPR and is resolved by the development of a ULTM and UTL for 4-vectors and tensors in our recent paper [1]. Here, we get ULTM for noninertial frame just by replacing $\frac{v}{c}$ to $\frac{a}{c\omega}$ in equation (6) of [1].

$$[L^{\mu}_{\nu}] = \begin{bmatrix} \frac{1}{(1-\frac{a^2}{c^2\omega^2})} & -\frac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & 0 & 0 \\ -\frac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & \frac{1}{(1-\frac{a^2}{c^2\omega^2})} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (1)$$

Det L $= \frac{(1+\frac{a^2}{c^2\omega^2})}{(1-\frac{a^2}{c^2\omega^2})}$

The above matrix acts as a 4 by 4 physical identity matrix. All the spacetime laws of physics (4-vectors and tensors including their inner product) remain same in their original form after transformation in a single step operation.

Its inverse is

$$(L^{\mu}_{\nu})^{-1} = \begin{bmatrix} \frac{1}{(1+\frac{a^2}{c^2\omega^2})} & \frac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & 0 & 0 \\ \frac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & \frac{1}{(1+\frac{a^2}{c^2\omega^2})} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (2)$$

Det $(L^{\mu}_{\nu})^{-1} = \frac{(1-\frac{a^2}{c^2\omega^2})}{(1+\frac{a^2}{c^2\omega^2})}$

Its inverse matrix also behaves as physical identity matrix. Both equations (1) and (2) satisfy the requirement of EPR.

The product of equation (1) and (2), results as an identity matrix to confirm the validity.

$$\begin{bmatrix} \frac{1}{(1-\frac{a^2}{c^2\omega^2})} & -\frac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & 0 & 0 \\ -\frac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & \frac{1}{(1-\frac{a^2}{c^2\omega^2})} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \frac{1}{(1+\frac{a^2}{c^2\omega^2})} & \frac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & 0 & 0 \\ \frac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & \frac{1}{(1+\frac{a^2}{c^2\omega^2})} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (3)$$

1.2. ULTM for Noninertial Frame in 4D

This matrix is nothing but 4 by 4 physical identity matrix for noninertial frame

$$[L^{\mu}_{\nu}] = \begin{bmatrix} \frac{1}{(1-\frac{a^2}{c^2\omega^2})} & -\frac{\frac{a_1^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & -\frac{\frac{a_2^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & -\frac{\frac{a_3^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} \\ -\frac{\frac{a_1^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & \frac{1}{(1-\frac{a^2}{c^2\omega^2})} & -\frac{\frac{a_3^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & -\frac{\frac{a_2^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} \\ -\frac{\frac{a_2^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & -\frac{\frac{a_3^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & \frac{1}{(1-\frac{a^2}{c^2\omega^2})} & -\frac{\frac{a_1^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} \\ -\frac{\frac{a_3^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & -\frac{\frac{a_2^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & -\frac{\frac{a_1^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & \frac{1}{(1-\frac{a^2}{c^2\omega^2})} \end{bmatrix} \quad (4)$$

Its inverse again is a 4 by 4 physical identity matrix

$$(L^{\mu}_{\nu})^{-1} = \begin{bmatrix} \frac{1}{(1+\frac{a^2}{c^2\omega^2})} & \frac{\frac{a_1^2}{c^2\omega^2}}{(1+\frac{a^2}{c^2\omega^2})} & \frac{\frac{a_2^2}{c^2\omega^2}}{(1+\frac{a^2}{c^2\omega^2})} & \frac{\frac{a_3^2}{c^2\omega^2}}{(1+\frac{a^2}{c^2\omega^2})} \\ \frac{\frac{a_1^2}{c^2\omega^2}}{(1+\frac{a^2}{c^2\omega^2})} & \frac{1}{(1+\frac{a^2}{c^2\omega^2})} & \frac{\frac{a_3^2}{c^2\omega^2}}{(1+\frac{a^2}{c^2\omega^2})} & \frac{\frac{a_2^2}{c^2\omega^2}}{(1+\frac{a^2}{c^2\omega^2})} \\ \frac{\frac{a_2^2}{c^2\omega^2}}{(1+\frac{a^2}{c^2\omega^2})} & \frac{\frac{a_3^2}{c^2\omega^2}}{(1+\frac{a^2}{c^2\omega^2})} & \frac{1}{(1+\frac{a^2}{c^2\omega^2})} & \frac{\frac{a_1^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} \\ \frac{\frac{a_3^2}{c^2\omega^2}}{(1+\frac{a^2}{c^2\omega^2})} & \frac{\frac{a_2^2}{c^2\omega^2}}{(1+\frac{a^2}{c^2\omega^2})} & \frac{\frac{a_1^2}{c^2\omega^2}}{(1+\frac{a^2}{c^2\omega^2})} & \frac{1}{(1+\frac{a^2}{c^2\omega^2})} \end{bmatrix} \quad (5)$$

Equations (4) and (5) are ULTM for noninertial frame in 4D.

1.3. The Key Role of Single Transformation Law for 4-Vectors and Tensors

The need of a STL for 4-vectors and tensors is pointed out in [1], here, we mention them directly as

$$\mathbf{F}^{\mu'\nu'}_{,\nu'} = \mathbf{L}^{\mu'}{}_{\alpha}\mathbf{F}^{\alpha\nu'}_{,\nu'} \quad \mathbf{J}^{\mu'} = \mathbf{L}^{\mu'}{}_{\alpha}\mathbf{J}^{\alpha} \tag{6}$$

Both sides of equation are transformed under the same transformation law and the results are in complete agreement.
This also implies the validity of transformation of electromagnetic field and conservation law

$$\mathbf{F}^{\mu'\nu'} = \mathbf{L}^{\mu'}{}_{\alpha}\mathbf{F}^{\alpha\nu'} \tag{7}$$

$$\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{F}^{\alpha\nu'}_{,\nu'\mu'}\mathbf{J}^{\mu'}_{,\mu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{J}^{\alpha}_{,\mu'} \tag{8}$$

STL for 4-vectors and tensors is the decoder of zero-point physics when the tensors are transformed in their component form. It is valid for any 4 by 4 matrix but principle of relativity, conservation law and symmetry hold only for universal transformation matrices.

1.4. Application of ULTM and STL in Electrodynamics

ULTM in 2D and 4D give the same results that is all the spacetime laws of physics remain same in their original form after transformation. Only 2D matrix is used to save the space of expansion of expressions.
Now we apply this transformation matrix transform one example of 4-vector and one for tensor to confirm the validity of ULTM.

1.5. Transformation of 4-Current Density under 4D ULTM in Noninertial Frame

$$\mathbf{J}^{\mu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{J}^{\alpha} \tag{9}$$

$$
\begin{bmatrix} J^{0'} \\ J^{1'} \\ J^{2'} \\ J^{3'} \end{bmatrix} =
\begin{bmatrix}
\dfrac{1}{(1-\frac{a^2}{c^2\omega^2 z})} & -\dfrac{\frac{a_1^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})} & -\dfrac{\frac{a_2^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})} & -\dfrac{\frac{a_3^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})} \\
-\dfrac{\frac{a_1^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})} & \dfrac{1}{(1-\frac{a^2}{c^2\omega^2 z})} & -\dfrac{\frac{a_3^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})} & -\dfrac{\frac{a_2^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})} \\
-\dfrac{\frac{a_2^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})} & -\dfrac{\frac{a_3^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})} & \dfrac{1}{(1-\frac{a^2}{c^2\omega^2 z})} & -\dfrac{\frac{a_1^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})} \\
-\dfrac{\frac{a_3^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})} & -\dfrac{\frac{a_2^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})} & -\dfrac{\frac{a_1^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})} & \dfrac{1}{(1-\frac{a^2}{c^2\omega^2 z})}
\end{bmatrix}
\begin{bmatrix} J^0 \\ J^1 \\ J^2 \\ J^3 \end{bmatrix}
$$

$$J^{0'} = \frac{1}{(1-\frac{a^2}{c^2\omega^2 z})}J^0 - \frac{\frac{a_1^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^1 - \frac{\frac{a_2^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^2 - \frac{\frac{a_3^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^3 = \frac{1}{(1-\frac{a^2}{c^2\omega^2 z})}J^0 - \frac{\frac{a^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^i$$

$$J^{1'} = -\frac{\frac{a_1^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^0 + \frac{1}{(1-\frac{a^2}{c^2\omega^2 z})}J^1 - \frac{\frac{a_3^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^2 - \frac{\frac{a_2^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^3$$

$$J^{2'} = -\frac{\frac{a_2^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^0 + \frac{1}{(1-\frac{a^2}{c^2\omega^2 z})}J^2 - \frac{\frac{a_3^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^1 - \frac{\frac{a_1^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^3$$

$$J^{3'} = -\frac{\frac{a_3^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^0 + \frac{1}{(1-\frac{a^2}{c^2\omega^2 z})}J^3 - \frac{\frac{a_2^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^1 - \frac{\frac{a_1^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^2$$

Adding all components on LHS and RHS and arranging common terms on RHS

$$J^{0'} + J^{1'} + J^{2'} + J^{3'} = \frac{1-\frac{a^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^0 + \frac{1-\frac{a^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})}J^i$$

Since $\dfrac{1-\frac{a^2}{c^2\omega^2 z}}{(1-\frac{a^2}{c^2\omega^2 z})} = 1$ so, we have

$$J^{0'} + J^{1'} + J^{2'} + J^{3'} = J^0 + J^1 + J^2 + J^3$$

$$J^{0'} + \mathbf{J}' = J^0 + \mathbf{J} \tag{10}$$

$$\mathbf{J}^{\mu'} = \mathbf{J}^\mu \tag{11}$$

The transformation is also true for covariant 4-position J_μ

$$J_{0'} - \mathbf{J}' = J_0 - \mathbf{J} \tag{12}$$

$$\mathbf{J}_{\mu'} = \mathbf{J}_\mu \tag{13}$$

Cotravariant and covariant 4-current density densities remain universal for all observers.

1.6. Transformation of Electromagnetic Field Tensor

$$\mathbf{F}^{\mu'\nu'} = \mathbf{L}^{\mu'}_\alpha \mathbf{F}^{\alpha\nu'} \tag{14}$$

Electromagnetic field tensor $\mathbf{F}^{\mu\nu}$ is related to its components electric field $\mathbf{E}$ and magnetic field $\mathbf{B}$ as follows

$$\mathbf{F}^{0i} = \mathbf{E}^i \text{ and } \mathbf{F}^{ij} = \boldsymbol{\varepsilon}^{ijk}\mathbf{B}_k$$

Electromagnetic field tensor in component form is needed to get new terms along the diagonal of Electromagnetic field. It is represented as 4 by 4 antisymmetric matrix

$$\begin{bmatrix} F^{00} & F^{01} & F^{02} & F^{03} \\ F^{10} & F^{11} & F^{12} & F^{13} \\ F^{20} & F^{21} & F^{22} & F^{23} \\ F^{30} & F^{31} & F^{32} & F^{33} \end{bmatrix} = \begin{bmatrix} 0 & \mathbf{E}^1 & \mathbf{E}^2 & \mathbf{E}^3 \\ -\mathbf{E}^1 & 0 & \mathbf{B}^3 & -\mathbf{B}^2 \\ -\mathbf{E}^2 & -\mathbf{B}^3 & 0 & \mathbf{B}^1 \\ -\mathbf{E}^3 & \mathbf{B}^2 & -\mathbf{B}^1 & 0 \end{bmatrix}$$

$$\begin{bmatrix} F^{0'0'} & \mathbf{F}^{0'1'} & \mathbf{F}^{0'2'} & \mathbf{F}^{0'3'} \\ \mathbf{F}^{1'0'} & \mathbf{F}^{1'1'} & \mathbf{F}^{1'2'} & \mathbf{F}^{1'3'} \\ \mathbf{F}^{2'0'} & \mathbf{F}^{2'1'} & \mathbf{F}^{2'2'} & \mathbf{F}^{2'3'} \\ \mathbf{F}^{3'0'} & \mathbf{F}^{3'1'} & \mathbf{F}^{3'2'} & \mathbf{F}^{3'3'} \end{bmatrix} = \begin{bmatrix} \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})} & -\dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & 0 & 0 \\ -\dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0 & \mathbf{E}^1 & \mathbf{E}^2 & \mathbf{E}^3 \\ -\mathbf{E}^1 & 0 & \mathbf{B}^3 & -\mathbf{B}^2 \\ -\mathbf{E}^2 & -\mathbf{B}^3 & 0 & \mathbf{B}^1 \\ -\mathbf{E}^3 & \mathbf{B}^2 & -\mathbf{B}^1 & 0 \end{bmatrix}$$

Zero-point terms are indicated by red color to understand their origin in the form of equations

$$\begin{bmatrix} \mathbf{F}^{0'\nu'} \\ \mathbf{F}^{1'\nu'} \\ \mathbf{F}^{2'\nu'} \\ \mathbf{F}^{3'\nu'} \end{bmatrix} =$$

$$\begin{bmatrix} \dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}^1 & \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}^1 & \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}^2 - \dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{B}^3 & \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}^3 + \dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{B}^2 \\ -\dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}^1 & -\dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}^1 & -\dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}^2 + \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{B}^3 & -\dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}^2 - \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{B}^2 \\ -\mathbf{E}^2 & -\mathbf{B}^3 & 0 & \mathbf{B}^1 \\ -\mathbf{E}^3 & \mathbf{B}^2 & -\mathbf{B}^1 & 0 \end{bmatrix}$$

A new symmetry of electromagnetic field is emerged. Two terms of new symmetry along the diagonal are
Zero-point Term of Electric Field

$$\mathbf{F}^{0'0'} = \dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}^1 \tag{15}$$

Zero-point term of Magnetic field

$$\mathbf{F}^{i'i'} = -\dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}^1 \tag{16}$$

$$\begin{bmatrix} \mathbf{F}^{0'\nu'} \\ \mathbf{F}^{i'\nu'} \end{bmatrix} = \begin{bmatrix} \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E} - \dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}[(\mathbf{B}^3 - \mathbf{B}^2) - \mathbf{E}^1] \\ -\dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\mathbf{E} + \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}[(\mathbf{B}^3 - \mathbf{B}^2) - \mathbf{E}^1] + [(\mathbf{B}^1 - \mathbf{B}^3) - \mathbf{E}^2] + [(\mathbf{B}^2 - \mathbf{B}^1) - \mathbf{E}^3] \end{bmatrix}$$

Electric Field:

$$\mathbf{F}^{0'v'} = \frac{1}{(1 - \frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{E} - \frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{\left(1 - \frac{\mathbf{a}^2}{c^2\omega^2}\right)}[(\mathbf{B}^3 - \mathbf{B}^2) - \mathbf{E}^1] \tag{17}$$

Magnetic Field:

$$\mathbf{F}^{i'v'} = -\frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{\left(1 - \frac{\mathbf{a}^2}{c^2\omega^2}\right)}\mathbf{E} + \frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{\left(1 - \frac{\mathbf{a}^2}{c^2\omega^2}\right)}[(\mathbf{B}^3 - \mathbf{B}^2) - \mathbf{E}^1] + [(\mathbf{B}^1 - \mathbf{B}^3) - \mathbf{E}^2] + [(\mathbf{B}^2 - \mathbf{B}^1) - \mathbf{E}^3] \tag{18}$$

Adding all the terms on right hand side and combining common terms

Adding (17) and (18) with the substitution $\frac{1 - \frac{\mathbf{a}^2}{c^2\omega^2}}{(1 - \frac{\mathbf{a}^2}{c^2\omega^2})} = 1$ so the above relation simplifies to

$$\mathbf{F}^{\mu'v'} = \mathbf{E} + [(\mathbf{B}^3 - \mathbf{B}^2) - \mathbf{E}^1] + [(\mathbf{B}^1 - \mathbf{B}^3) - \mathbf{E}^2] + [(\mathbf{B}^2 - \mathbf{B}^1) - \mathbf{E}^3] = 0 \tag{19}$$

All the terms on right hand side cancel out due to opposite sign so electromagnetic field remains in its original form after transformation that satisfies completely EPR and symmetry principle.

1.7. Transformation of Maxwell's Equations

Maxwell's equations in tensor form is the sum of Gauss's law and Ampere's law. First row of the matrix is Gauss's law and remaining three rows constitute Ampere's law

$$\mathbf{F}^{\mu'v'}_{,v'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{F}^{\alpha v'}_{,v'} \tag{20}$$

Maxwell's equations in terms of tensor in matrix form are

$$\begin{bmatrix} \mathbf{F}^{0'v'}_{,v'} \\ \mathbf{F}^{1'v'}_{,v'} \\ \mathbf{F}^{2'v'}_{,v'} \\ \mathbf{F}^{3'v'}_{,v'} \end{bmatrix} = \begin{bmatrix} \frac{1}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})} & -\frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})} & 0 & 0 \\ -\frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})} & \frac{1}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0 & \mathbf{E}^1_{,1} & \mathbf{E}^2_{,2} & \mathbf{E}^3_{,3} \\ -\mathbf{E}^1_{,0} & 0 & \mathbf{B}^3_{,2} & -\mathbf{B}^2_{,3} \\ -\mathbf{E}^2_{,0} & -\mathbf{B}^3_{,1} & 0 & \mathbf{B}^1_{,3} \\ -\mathbf{E}^3_{,0} & \mathbf{B}^2_{,1} & -\mathbf{B}^1_{,2} & 0 \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}^{0'v'}_{,v'} \\ \mathbf{F}^{1'v'}_{,v'} \\ \mathbf{F}^{2'v'}_{,v'} \\ \mathbf{F}^{3'v'}_{,v'} \end{bmatrix} = \begin{bmatrix} \frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{E}^1_{,0} & \frac{1}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{E}^1_{,1} & \frac{1}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{E}^2_{,2} - \frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{B}^3_{,2} & \frac{1}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{E}^3_{,3} + \frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{B}^2_{,3} \\ -\frac{1}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{E}^1_{,0} & -\frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{E}^1_{,1} & -\frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{E}^2_{,2} + \frac{1}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{B}^3_{,2} & -\frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{E}^3_{,3} - \frac{1}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{B}^2_{,3} \\ -\mathbf{E}^2_{,0} & -\mathbf{B}^3_{,1} & 0 & \mathbf{B}^1_{,3} \\ -\mathbf{E}^3_{,0} & \mathbf{B}^2_{,1} & -\mathbf{B}^1_{,2} & 0 \end{bmatrix}$$

Zero-point terms of Maxwell's equations
Zero-point Term of Gauss's Law

$$\mathbf{F}^{0'0'}_{,0'} = \frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{E}^1_{,0} \tag{21}$$

Zero-point Term of Ampere's Law

$$\mathbf{F}^{i'i'}_{,i'} = -\frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\mathbf{E}^1_{,1} \tag{22}$$

$$\begin{bmatrix} \mathbf{F}^{0'v'}_{,v'} \\ \mathbf{F}^{1'v'}_{,v'} \\ \mathbf{F}^{2'v'}_{,v'} \\ \mathbf{F}^{3'v'}_{,v'} \end{bmatrix} = \begin{bmatrix} \frac{1}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\nabla.\mathbf{E} - \frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}[(\mathbf{B}^3_{,2} - \mathbf{B}^2_{,3}) - \mathbf{E}^1_{,0}] \\ -\frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\nabla.\mathbf{E} + \frac{1}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}[(\mathbf{B}^3_{,2} - \mathbf{B}^2_{,3}) - \mathbf{E}^1_{,0}] \\ [(\nabla \times \mathbf{B})^2 - \mathbf{E}^2_{,0}] \\ [(\nabla \times \mathbf{B})^3 - \mathbf{E}^3_{,0}] \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}_{,\nu'}^{0'\nu'} \\ \mathbf{F}_{,\nu'}^{i'\nu'} \end{bmatrix} = \begin{bmatrix} \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\nabla.\mathbf{E} - \dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}[(\nabla \times \mathbf{B})^1 - \mathbf{E}_{,0}^1] \\ -\dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\nabla.\mathbf{E} + \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}[(\nabla \times \mathbf{B})^1 - \mathbf{E}_{,0}^1] + [(\nabla \times \mathbf{B})^2 - \mathbf{E}_{,0}^2] + [(\nabla \times \mathbf{B})^3 - \mathbf{E}_{,0}^3] \end{bmatrix}$$

Gauss's Law

Gauss's law is affected by frame of reference

$$\mathbf{F}_{,\nu'}^{0'\nu'} = \frac{1}{(1-\frac{a^2}{c^2\omega^2})}\nabla.\mathbf{E} - \frac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}[(\nabla \times \mathbf{B})^1 - \mathbf{E}_{,0}^1] \tag{23}$$

Ampere's Law

Similarly, Ampere's law is affected by frame of reference

$$\mathbf{F}_{,\nu'}^{i'\nu'} = \frac{1}{(1-\frac{a^2}{c^2\omega^2})}\nabla.\mathbf{E} - \frac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}[(\nabla \times \mathbf{B})^1 - \mathbf{E}_{,0}^1] \tag{24}$$

Combined Gauss's Law and Ampere's Law

$$\left[\mathbf{F}_{,\nu'}^{\mu'\nu'}\right] = \frac{1-\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\nabla.\mathbf{E} + \frac{1-\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}[(\nabla \times \mathbf{B})^1 - \mathbf{E}_{,0}^1] + [(\nabla \times \mathbf{B})^2 - \mathbf{E}_{,0}^2] + [(\nabla \times \mathbf{B})^3 - \mathbf{E}_{,0}^3] \tag{25}$$

But the combination of gauss's law and ampere's law remains un-affected by the frame of reference.

$$\mathbf{F}_{,\nu'}^{\mu'\nu'} = \nabla.\mathbf{E} + \left[(\nabla \times \mathbf{B}) - \mathbf{E}_{,0}\right] \tag{26}$$

Maxwell's equations in tensor form remain same.

1.8. Transformation of Conservation Law by Matrix Method

Conservation law can be written in tensor form is very simple but no one has ever noticed this simplicity. First row tells us about conservation of Gauss's law and remaining three give conservation of Ampere's law and their superposition results in conservation of both electromagnetic laws.

$$\mathbf{F}_{,\nu'\mu'}^{\mu'\nu'} = \mathbf{L}_\alpha^{\mu'}\mathbf{F}_{,\nu'\mu'}^{\alpha\nu'} \tag{27}$$

$$\begin{bmatrix} \mathbf{F}_{,\nu'0'}^{0'\nu'} \\ \mathbf{F}_{,\nu'1'}^{1'\nu'} \\ \mathbf{F}_{,\nu'2'}^{2'\nu'} \\ \mathbf{F}_{,\nu'3'}^{3'\nu'} \end{bmatrix} = \begin{bmatrix} \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})} & -\dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & 0 & 0 \\ -\dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} 0 & \mathbf{E}_{,10}^1 & \mathbf{E}_{,20}^2 & \mathbf{E}_{,30}^3 \\ -\mathbf{E}_{,01}^1 & 0 & \mathbf{B}_{,21}^3 & -\mathbf{B}_{,31}^2 \\ -\mathbf{E}_{,02}^2 & -\mathbf{B}_{,12}^3 & 0 & \mathbf{B}_{,32}^1 \\ -\mathbf{E}_{,03}^3 & \mathbf{B}_{,13}^2 & -\mathbf{B}_{,23}^1 & 0 \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}_{,\nu'0'}^{0'\nu'} \\ \mathbf{F}_{,\nu'1'}^{1'\nu'} \\ \mathbf{F}_{,\nu'2'}^{2'\nu'} \\ \mathbf{F}_{,\nu'3'}^{3'\nu'} \end{bmatrix} = \begin{bmatrix} \dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}_{,01}^1 & \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}_{,10}^1 & \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}_{,20}^2 - \dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{B}_{,21}^3 & \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}_{,30}^3 + \dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{B}_{,31}^2 \\ -\dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}_{,01}^1 & -\dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}_{,10}^1 & -\dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}_{,20}^2 + \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{B}_{,21}^3 & -\dfrac{\frac{a^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{E}_{,30}^3 - \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\mathbf{B}_{,31}^2 \\ -\mathbf{E}_{,02}^2 & -\mathbf{B}_{,12}^3 & 0 & \mathbf{B}_{,32}^1 \\ -\mathbf{E}_{,03}^3 & \mathbf{B}_{,13}^2 & -\mathbf{B}_{,23}^1 & 0 \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}_{,\nu'0'}^{0'\nu'} \\ \mathbf{F}_{,\nu'1'}^{1'\nu'} \\ \mathbf{F}_{,\nu'2'}^{2'\nu'} \\ \mathbf{F}_{,\nu'3'}^{3'\nu'} \end{bmatrix} = \begin{bmatrix} \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}\nabla.\mathbf{E}_{,0} - \dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}[(\mathbf{B}_{,21}^3 - \mathbf{B}_{,31}^2) - \mathbf{E}_{,01}^1] \\ -\dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\nabla.\mathbf{E}_{,0} + \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}[(\mathbf{B}_{,21}^3 - \mathbf{B}_{,31}^2) - \mathbf{E}_{,01}^1] \\ [(\mathbf{B}_{,32}^1 - \mathbf{B}_{,12}^3) - \mathbf{E}_{,02}^2] \\ [(\mathbf{B}_{,13}^2 - \mathbf{B}_{,23}^1) - \mathbf{E}_{,03}^3] \end{bmatrix}$$

Zero-point Term of Conservation of Gauss's Law

$$\mathbf{F}_{,0'0'}^{0'0'} = \frac{\frac{a^2}{c^2\omega^2}}{\left(1 - \frac{a^2}{c^2\omega^2}\right)} \mathbf{E}_{,01}^1 \tag{28}$$

Zero-point Term of Conservation of Ampere's Law

$$\mathbf{F}_{,i'i'}^{i'i'} = -\frac{\frac{a^2}{c^2\omega^2}}{\left(1 - \frac{a^2}{c^2\omega^2}\right)} \mathbf{E}_{,10}^1 \tag{29}$$

$$\begin{bmatrix} \mathbf{F}_{,v'0'}^{0'v'} \\ \mathbf{F}_{,v'i'}^{i'v'} \end{bmatrix} = \begin{bmatrix} \frac{1}{(1 - \frac{a^2}{c^2\omega^2})}\nabla.\mathbf{E}_{,0} - \frac{\frac{a^2}{c^2\omega^2}}{(1 - \frac{a^2}{c^2\omega^2})}[(\mathbf{B}_{,21}^3 - \mathbf{B}_{,31}^2) - \mathbf{E}_{,01}^1] \\ -\frac{\frac{a^2}{c^2\omega^2}}{(1 - \frac{a^2}{c^2\omega^2})}\nabla.\mathbf{E}_{,0} + \frac{1}{(1 - \frac{a^2}{c^2\omega^2})}[(\mathbf{B}_{,21}^3 - \mathbf{B}_{,31}^2) - \mathbf{E}_{,01}^1] + [(\mathbf{B}_{,32}^1 - \mathbf{B}_{,12}^3) - \mathbf{E}_{,02}^2] + [(\mathbf{B}_{,13}^2 - \mathbf{B}_{,23}^1) - \mathbf{E}_{,03}^3] \end{bmatrix}$$

Conservation of Gauss's Law

Conservation of Gauss's law is affected by frame of reference

$$\mathbf{F}_{,v'0'}^{0'v'} = \frac{1}{(1 - \frac{a^2}{c^2\omega^2})}\nabla.\mathbf{E}_{,0} - \frac{\frac{a^2}{c^2\omega^2}}{(1 - \frac{a^2}{c^2\omega^2})}[(\mathbf{B}_{,21}^3 - \mathbf{B}_{,31}^2) - \mathbf{E}_{,01}^1]$$

Conservation of Ampere's is also affected by the frame of reference

$$\mathbf{F}_{,v'i'}^{i'v'} = -\frac{\frac{a^2}{c^2\omega^2}}{(1 - \frac{a^2}{c^2\omega^2})}\nabla.\mathbf{E}_{,0} + \frac{1}{(1 - \frac{a^2}{c^2\omega^2})}[(\mathbf{B}_{,21}^3 - \mathbf{B}_{,31}^2) - \mathbf{E}_{,01}^1] + [(\mathbf{B}_{,32}^1 - \mathbf{B}_{,12}^3) - \mathbf{E}_{,02}^2] + [(\mathbf{B}_{,13}^2 - \mathbf{B}_{,23}^1) - \mathbf{E}_{,03}^3]$$

Zero- point Conservation law

$$\mathbf{F}_{,,v'\mu'}^{\mu'v'} = \frac{1 - \frac{a^2}{c^2\omega^2}}{(1 - \frac{a^2}{c^2\omega^2})}\nabla.\mathbf{E}_{,0} + \frac{1 - \frac{a^2}{c^2\omega^2}}{(1 - \frac{a^2}{c^2\omega^2})}[(\mathbf{B}_{,21}^3 - \mathbf{B}_{,31}^2) - \mathbf{E}_{,01}^1] + [(\mathbf{B}_{,32}^1 - \mathbf{B}_{,12}^3) - \mathbf{E}_{,02}^2] + [(\mathbf{B}_{,13}^2 - \mathbf{B}_{,23}^1) - \mathbf{E}_{,03}^3]$$

But the conservation law as a whole remains same for all observers

$$\mathbf{F}_{,,v'\mu'}^{\mu'v'} = \nabla.\mathbf{E}_{,0} + \nabla.(\nabla \times \mathbf{B}) - \nabla.\mathbf{E}_{,0} = 0 \tag{30}$$

1.9. Transformation of Conservation Law by Einstein's Summation Method

In the case of transformation of conservation law, 4D EM wave and higher order wave are affected by the frame of reference. 4D EM wave contains some extra terms that do not constitute a definite physical quantity showing the fragments of Laplacian wave of magnetic field. These terms contribute to complete the structure of conservation law in terms of higher order wave of electric field.

Zero-point 4D EM Wave

$$\mathbf{F}_{,\mu'\mu'}^{\mu'\mu'} = 2\left(\frac{\frac{a^2}{c^2\omega^2}}{\left(1 - \frac{a^2}{c^2\omega^2}\right)}\right)\mathbf{E} + \frac{\frac{a_1^2}{c^2\omega^2}}{(1 - \frac{a^2}{c^2\omega^2})}[\mathbf{B}_{,22}^1 - \mathbf{B}_{,33}^1] + \frac{\frac{a_2^2}{c^2\omega^2}}{(1 - \frac{a^2}{c^2\omega^2})}[\mathbf{B}_{,33}^2 - \mathbf{B}_{,11}^2] + \frac{\frac{a_3^2}{c^2\omega^2}}{(1 - \frac{a^2}{c^2\omega^2})}[\mathbf{B}_{,11}^3 - \mathbf{B}_{,22}^3] \tag{31}$$

The nature of conservation law in terms of 7D wave with invariant character is very surprising indeed. It is affected by the frame of reference that seems to be responsible for the accelerating expansion of our universe [10-11].

$$\mathbf{F}_{,v'\mu'}^{\mu'v'} = [\Box^2 - \nabla^2]\left(\frac{\frac{a^2}{c^2\omega^2}}{(1 - \frac{a^2}{c^2\omega^2})}\right)\mathbf{E} \tag{32}$$

$$[\Box^2 - \nabla^2] = [\frac{\partial^2}{\partial t^2} - 2\nabla^2]$$

1.10. Transformation of Inner Product of Tensors $\mathbf{F}^{\mu\nu}\mathbf{F}_{\nu\mu} = \text{trace } 2[\mathbf{E}^2 - \mathbf{B}^2]$

The inner product of cotravariant and covariant electromagnetic field tensor whose trace gives us scalar quantity called invariant of electromagnetic field as

$$\mathbf{F}^{\mu\nu}\mathbf{F}_{\nu\mu} = \text{tr}\begin{bmatrix} 0 & \mathbf{E}^1 & \mathbf{E}^2 & \mathbf{E}^3 \\ -\mathbf{E}^1 & 0 & \mathbf{B}^3 & -\mathbf{B}^2 \\ -\mathbf{E}^2 & -\mathbf{B}^3 & 0 & \mathbf{B}^1 \\ -\mathbf{E}^3 & \mathbf{B}^2 & -\mathbf{B}^1 & 0 \end{bmatrix}\begin{bmatrix} 0 & -\mathbf{E}^1 & -\mathbf{E}^2 & -\mathbf{E}^3 \\ \mathbf{E}^1 & 0 & \mathbf{B}^3 & -\mathbf{B}^2 \\ \mathbf{E}^2 & -\mathbf{B}^3 & 0 & \mathbf{B}^1 \\ \mathbf{E}^3 & \mathbf{B}^2 & -\mathbf{B}^1 & 0 \end{bmatrix} \tag{33}$$

The product $\mathbf{F}^{\mu\nu}\mathbf{F}_{\nu\mu}$ is decomposed in to 4 components that directly gives the trace of product

$$\mathbf{F}^{\mu\nu}\mathbf{F}_{\nu\mu} = \mathbf{F}^{\mu0}\mathbf{F}_{0\mu} + \mathbf{F}^{\mu1}\mathbf{F}_{1\mu} + \mathbf{F}^{\mu2}\mathbf{F}_{2\mu} + \mathbf{F}^{\mu3}\mathbf{F}_{3\mu}$$

$$\text{Trace } (\mathbf{F}^{\mu\nu}\mathbf{F}_{\nu\mu}) = 2[\mathbf{E}^2 - \mathbf{B}^2] \tag{34}$$

the transformation is now become very simple

$$\begin{bmatrix} (\mathbf{F}^{0\nu}\mathbf{F}_{\nu0})' \\ (\mathbf{F}^{1\nu}\mathbf{F}_{\nu1})' \\ (\mathbf{F}^{2\nu}\mathbf{F}_{\nu2})' \\ (\mathbf{F}^{3\nu}\mathbf{F}_{\nu3})' \end{bmatrix} = \begin{bmatrix} \frac{1}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & -\frac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & 0 & 0 \\ -\frac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & \frac{1}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} (\mathbf{F}^{0\nu}\mathbf{F}_{\nu0}) \\ (\mathbf{F}^{1\nu}\mathbf{F}_{\nu1}) \\ (\mathbf{F}^{2\nu}\mathbf{F}_{\nu2}) \\ (\mathbf{F}^{3\nu}\mathbf{F}_{\nu3}) \end{bmatrix}$$

After multiplying, adding all the terms on left- and right-hand sides, we have

$$(\mathbf{F}^{0\nu}\mathbf{F}_{\nu0})' + (\mathbf{F}^{1\nu}\mathbf{F}_{\nu1})' + (\mathbf{F}^{2\nu}\mathbf{F}_{\nu2})' + (\mathbf{F}^{3\nu}\mathbf{F}_{\nu3})' = \left(\frac{1-\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\right)(\mathbf{F}^{0\nu}\mathbf{F}_{\nu0}) + \left(\frac{1-\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\right)(\mathbf{F}^{1\nu}\mathbf{F}_{\nu1}) + (\mathbf{F}^{2\nu}\mathbf{F}_{\nu2}) + (\mathbf{F}^{3\nu}\mathbf{F}_{\nu3})$$

$$(\mathbf{F}^{0\nu}\mathbf{F}_{\nu0})' + (\mathbf{F}^{1\nu}\mathbf{F}_{\nu1})' + (\mathbf{F}^{2\nu}\mathbf{F}_{\nu2})' + (\mathbf{F}^{3\nu}\mathbf{F}_{\nu3})' = (\mathbf{F}^{0\nu}\mathbf{F}_{\nu0}) + (\mathbf{F}^{1\nu}\mathbf{F}_{\nu1}) + (\mathbf{F}^{2\nu}\mathbf{F}_{\nu2}) + (\mathbf{F}^{3\nu}\mathbf{F}_{\nu3})$$

Now, putting the values of the terms in small brackets and of $\frac{1-\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} = 1$ in above equation

$$(\mathbf{E}^2)' + (\mathbf{E}_1^2 - \mathbf{B}_2^2 - \mathbf{B}_3^2)' + (\mathbf{E}_2^2 - \mathbf{B}_1^2 - \mathbf{B}_3^2)' + (\mathbf{E}_3^2 - \mathbf{B}_1^2 - \mathbf{B}_2^2)'$$
$$= (\mathbf{E}^2) + (\mathbf{E}_1^2 - \mathbf{B}_2^2 - \mathbf{B}_3^2) + (\mathbf{E}_2^2 - \mathbf{B}_1^2 - \mathbf{B}_3^2) + (\mathbf{E}_3^2 - \mathbf{B}_1^2 - \mathbf{B}_2^2)$$
$$2[\mathbf{E}^2 - \mathbf{B}^2]' = 2[\mathbf{E}^2 - \mathbf{B}^2] \tag{35}$$

Inner product of Contravariant and covariant electromagnetic field tensor remains same.

1.11. Inner Product of EMF and Its Dual: $\mathbf{F}^{\mu\nu} * \mathbf{F}_{\mu\nu} = 4\mathbf{E.B}$

$$\mathbf{F}^{\mu\nu} * \mathbf{F}_{\mu\nu} = \begin{bmatrix} 0 & \mathbf{E}^1 & \mathbf{E}^2 & \mathbf{E}^3 \\ -\mathbf{E}^1 & 0 & \mathbf{B}^3 & -\mathbf{B}^2 \\ -\mathbf{E}^2 & -\mathbf{B}^3 & 0 & \mathbf{B}^1 \\ -\mathbf{E}^3 & \mathbf{B}^2 & -\mathbf{B}^1 & 0 \end{bmatrix} \begin{bmatrix} 0 & -\mathbf{B}^1 & -\mathbf{B}^2 & -\mathbf{B}^3 \\ \mathbf{B}^1 & 0 & -\mathbf{E}^3 & \mathbf{E}^2 \\ \mathbf{B}^2 & \mathbf{E}^3 & 0 & -\mathbf{E}^1 \\ \mathbf{B}^3 & -\mathbf{E}^2 & \mathbf{E}^1 & 0 \end{bmatrix} = \tag{36}$$

The above product is also decomposed in to 4 components that only represent the trace of the product

$$\text{Trace } (\mathbf{F}^{\mu\nu} * \mathbf{F}_{\mu\nu}) = (\mathbf{F}^{0\nu} * \mathbf{F}_{0\nu} + \mathbf{F}^{1\nu} * \mathbf{F}_{1\nu} + \mathbf{F}^{2\nu} * \mathbf{F}_{2\nu} + \mathbf{F}^{3\nu} * \mathbf{F}_{3\nu}) = 4\ \mathbf{E.B}$$

$$\begin{bmatrix} (\mathbf{F}^{0\nu} * \mathbf{F}_{0\nu})' \\ (\mathbf{F}^{1\nu} * \mathbf{F}_{1\nu})' \\ (\mathbf{F}^{2\nu} * \mathbf{F}_{2\nu})' \\ (\mathbf{F}^{3\nu} * \mathbf{F}_{3\nu})' \end{bmatrix} = \begin{bmatrix} \frac{1}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & -\frac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & 0 & 0 \\ -\frac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & \frac{1}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} (\mathbf{F}^{0\nu} * \mathbf{F}_{0\nu}) \\ (\mathbf{F}^{1\nu} * \mathbf{F}_{1\nu}) \\ (\mathbf{F}^{2\nu} * \mathbf{F}_{2\nu}) \\ (\mathbf{F}^{3\nu} * \mathbf{F}_{3\nu}) \end{bmatrix}$$

After multiplication, adding all the terms on left- and right-hand side

$$(\mathbf{F}^{0\nu} * \mathbf{F}_{0\nu})' + (\mathbf{F}^{1\nu} * \mathbf{F}_{1\nu})' + (\mathbf{F}^{2\nu} * \mathbf{F}_{2\nu})' + (\mathbf{F}^{3\nu} * \mathbf{F}_{3\nu})' = \frac{1-\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}(\mathbf{F}^{0\nu} * \mathbf{F}_{0\nu}) + \frac{1-\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}(\mathbf{F}^{1\nu} * \mathbf{F}_{1\nu})$$

$$+ (\mathbf{F}^{2\nu} * \mathbf{F}_{2\nu}) + (\mathbf{F}^{3\nu} * \mathbf{F}_{3\nu})$$
$$(\mathbf{E.B})' + (\mathbf{E.B})' + (\mathbf{E.B})' + (\mathbf{E.B})' = (\mathbf{E.B}) + (\mathbf{E.B}) + (\mathbf{E.B}) + (\mathbf{E.B})$$
$$4(\mathbf{E.B})' = 4\mathbf{E.B} \tag{37}$$

inner product of electromagnetic tensor with its duel remains same.

1.12. Electrodynamics in 4D Universal Noninertial and Inertial Frame

Zero-Point results of electrodynamics in universal inertial frame were not presented as a complete structure in [1]. Their physical significance was realized later on during the development of [2]. Now, here they are compared with the results of universal noninertial frame. Since transformation under 4D ULTM occupies a lot of space so the results are given in the table. The similarity between the models is as expected.

Table 1. Comparison of Results of Electrodynamics in 4D ULTM for and 4D ULTM for Inertial Frame of Reference

Electrodynamics in 4D Noninertial ULTM	Electrodynamics in 4D ULTM for Inertial Frame
$[\mathbf{L}^\mu_\nu]$ $$=\begin{bmatrix} \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})} & -\dfrac{\frac{a_1^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & -\dfrac{\frac{a_2^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & -\dfrac{\frac{a_3^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} \\ -\dfrac{\frac{a_1^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})} & -\dfrac{\frac{a_3^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & -\dfrac{\frac{a_2^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} \\ -\dfrac{\frac{a_2^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & -\dfrac{\frac{a_3^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})} & -\dfrac{\frac{a_1^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} \\ -\dfrac{\frac{a_3^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & -\dfrac{\frac{a_2^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & -\dfrac{\frac{a_1^2}{c^2\omega^2}}{(1-\frac{a^2}{c^2\omega^2})} & \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})} \end{bmatrix}$$	$[\mathbf{L}^\mu_\nu]$ $$=\begin{bmatrix} \dfrac{1}{(1-\frac{v^2}{c^2})} & -\dfrac{\frac{v_1^2}{c^2}}{(1-\frac{v^2}{c^2})} & -\dfrac{\frac{v_2^2}{c^2}}{(1-\frac{v^2}{c^2})} & -\dfrac{\frac{v_3^2}{c^2}}{(1-\frac{v^2}{c^2})} \\ -\dfrac{\frac{v_1^2}{c^2}}{(1-\frac{v^2}{c^2})} & \dfrac{1}{(1-\frac{v^2}{c^2})} & -\dfrac{\frac{v_3^2}{c^2}}{(1-\frac{v^2}{c^2})} & -\dfrac{\frac{v_2^2}{c^2}}{(1-\frac{v^2}{c^2})} \\ -\dfrac{\frac{v_2^2}{c^2}}{(1-\frac{v^2}{c^2})} & -\dfrac{\frac{v_3^2}{c^2}}{(1-\frac{v^2}{c^2})} & \dfrac{1}{(1-\frac{v^2}{c^2})} & -\dfrac{\frac{v_1^2}{c^2}}{(1-\frac{v^2}{c^2})} \\ -\dfrac{\frac{v_3^2}{c^2}}{(1-\frac{v^2}{c^2})} & -\dfrac{\frac{v_2^2}{c^2}}{(1-\frac{v^2}{c^2})} & -\dfrac{\frac{v_1^2}{c^2}}{(1-\frac{v^2}{c^2})} & \dfrac{1}{(1-\frac{v^2}{c^2})} \end{bmatrix}$$
Transformation of 4-Current Density $\mathbf{J}^{\mu'} = \mathbf{J}^\mu$ **Zero-Point Terms of EMF** $\mathbf{F}^{\mu'\mu'} = \dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}[\mathbf{E}-\mathbf{E}] + \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}[(\frac{a_3^2}{c^2\omega^2}\mathbf{B}^3 - \frac{a_2^2}{c^2\omega^2}\mathbf{B}^2) + (\frac{a_1^2}{c^2\omega^2}\mathbf{B}^1 - \frac{a_3^2}{c^2\omega^2}\mathbf{B}^3) + \frac{a_2^2}{c^2\omega^2}\mathbf{B}^2 - \frac{a_1^2}{c^2\omega^2}\mathbf{B}^1)]$ $\mathbf{F}^{\mu'\mu'} = 0$ **Usual Electromagnetic field remains same** $\mathbf{F}^{\mu\nu} = [\mathbf{E}-\mathbf{E}+[(\mathbf{B}^3-\mathbf{B}^2)]+[(\mathbf{B}^1-\mathbf{B}^3)]+[(\mathbf{B}^1-\mathbf{B}^2)]=0$ **Transformation of Maxwell's Equations** **Zero-Point of Gauss's Law** $\mathbf{F}^{0'0'}_{,0'} = \dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\mathbf{E}_{,0}$ **Zero-Point Terms of Ampere's Law** $\mathbf{F}^{i'i'}_{,i'} = -\dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\{(\boldsymbol{\nabla}.\mathbf{E}) + [(\boldsymbol{\nabla}\times\mathbf{B})]\}$ **Zero-Point Terms of Gauss's law and Ampere's law** $\mathbf{F}^{\mu'\mu'}_{,\mu'} = -\dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\{(\boldsymbol{\nabla}.\mathbf{E}) + [(\boldsymbol{\nabla}\times\mathbf{B})-\mathbf{E}_{,0}]\}$ **Relation between Zero-Point and Usual Maxwell's Equations** $\mathbf{F}^{\mu'\mu'}_{,\mu'} = -\dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\mathbf{F}^{\mu\nu}_{,\nu}$ **Gauss's Law** $\mathbf{F}^{0'\nu'}_{,\nu'} = \boldsymbol{\nabla}.\mathbf{E} + \dfrac{1}{(1-\frac{a^2}{c^2\omega^2})}[(\boldsymbol{\nabla}\times\mathbf{B})-\mathbf{E}_{,0}] - \dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}[(\mathbf{B}^3_{,2}-\mathbf{B}^2_{,3})-\mathbf{E}^1_{,0}]$ **Ampere's Law** $\mathbf{F}^{i'\nu'}_{,\nu'} = -\dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\{[(\boldsymbol{\nabla}\times\mathbf{B})^2-\mathbf{E}^2_{,0}]+[(\boldsymbol{\nabla}\times\mathbf{B})^3-\mathbf{E}^3_{,0}]$ **Usual Maxwell's Equations remain same** $\mathbf{F}^{\mu'\nu'}_{,\nu'} = [\boldsymbol{\nabla}.\mathbf{E}+[(\boldsymbol{\nabla}\times\mathbf{B})-\mathbf{E}_{,0}]]$ **Transformation of Conservation Law** $\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}[\boldsymbol{\nabla}.\mathbf{E}_{,0}+\boldsymbol{\nabla}.[(\boldsymbol{\nabla}\times\mathbf{B})-\mathbf{E}_{,0}]=0$	**Transformation of 4-Current Density** $\mathbf{J}^{\mu'} = \mathbf{J}^\mu$ **Zero-Point Terms of EMF** $\mathbf{F}^{\mu'\mu'} = \dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}[\mathbf{E}-\mathbf{E}] + \dfrac{1}{(1-\frac{v^2}{c^2})}[(\frac{v_3^2}{c^2}\mathbf{B}^3 - \frac{v_2^2}{c^2}\mathbf{B}^2) + (\frac{v_1^2}{c^2}\mathbf{B}^1 - \frac{v_3^2}{c^2}\mathbf{B}^3) + \frac{v_2^2}{c^2}\mathbf{B}^2 - \frac{v_1^2}{c^2}\mathbf{B}^1)]$ $\mathbf{F}^{\mu'\mu'} = 0$ **Usual Electromagnetic field remains same** $\mathbf{F}^{\mu\nu} = [\mathbf{E}-\mathbf{E}+[(\mathbf{B}^3-\mathbf{B}^2)]+[(\mathbf{B}^1-\mathbf{B}^3)]+[(\mathbf{B}^1-\mathbf{B}^2)]=0$ **Transformation of Maxwell's Equations** **Zero-Point of Gauss's Law** $\mathbf{F}^{0'0'}_{,0'} = \dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\mathbf{E}_{,0}$ **Zero-Point Terms of Ampere's Law** $\mathbf{F}^{i'i'}_{,i'} = -\dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\{(\boldsymbol{\nabla}.\mathbf{E}) + [(\boldsymbol{\nabla}\times\mathbf{B})]\}$ **Zero-Point Terms of Gauss's law and Ampere's law** $\mathbf{F}^{\mu'\mu'}_{,\mu'} = -\dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\{(\boldsymbol{\nabla}.\mathbf{E}) + [(\boldsymbol{\nabla}\times\mathbf{B})-\mathbf{E}_{,0}]\}$ **Relation between Zero-Point and Usual Maxwell's Equations** $\mathbf{F}^{\mu'\mu'}_{,\mu'} = -\dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\mathbf{F}^{\mu\nu}_{,\nu}$ **Gauss's Law** $\mathbf{F}^{0'\nu'}_{,\nu'} = \boldsymbol{\nabla}.\mathbf{E} + \dfrac{1}{(1-\frac{v^2}{c^2})}[(\boldsymbol{\nabla}\times\mathbf{B})-\mathbf{E}_{,0}] - \dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}[(\mathbf{B}^3_{,2}-\mathbf{B}^2_{,3})-\mathbf{E}^1_{,0}]$ **Ampere's Law** $\mathbf{F}^{i'\nu'}_{,\nu'} = -\dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\{[(\boldsymbol{\nabla}\times\mathbf{B})^2-\mathbf{E}^2_{,0}]+[(\boldsymbol{\nabla}\times\mathbf{B})^3-\mathbf{E}^3_{,0}]$ **Usual Maxwell's Equations are universal** $\mathbf{F}^{\mu'\nu'}_{,\nu'} = [\boldsymbol{\nabla}.\mathbf{E}+[(\boldsymbol{\nabla}\times\mathbf{B})-\mathbf{E}_{,0}]]$ **Transformation of Conservation Law** $\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \dfrac{\frac{v^2}{c^2}}{(1-\frac{v^2}{c^2})}[\boldsymbol{\nabla}.\mathbf{E}_{,0}+\boldsymbol{\nabla}.[(\boldsymbol{\nabla}\times\mathbf{B})-\mathbf{E}_{,0}]=0$

Relation between Zero-Point and Usual Conservation law	Relation between Zero-Point and Usual Conservation law
$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = -\dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = 0$	$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = 0$
Usual conservation law holds as it is	**Usual conservation law holds as it is**
$\mathbf{F}^{\mu'\nu'}_{,\ ,\nu'\mu'} = \nabla\cdot\mathbf{E}_{,0} + \nabla\cdot(\nabla\times\mathbf{B}) - \nabla\cdot\mathbf{E}_{,0} = 0$	$\mathbf{F}^{\mu'\nu'}_{,\ ,\nu'\mu'} = \nabla\cdot\mathbf{E}_{,0} + \nabla\cdot(\nabla\times\mathbf{B}) - \nabla\cdot\mathbf{E}_{,0} = 0$
Conservation Law by Einstein's Method	**Conservation Law by Einstein's Method**
Zero-Point Conservation Law as 4D EM Wave	
$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = 2\left(\dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\right)\mathbf{E} + \dfrac{\frac{a_1^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\left[\mathbf{B}^1_{,22} - \mathbf{B}^1_{,33}\right]$	**Zero-Point Conservation Law as 4D EM Wave**
$+\dfrac{\frac{a_2^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\left[\mathbf{B}^2_{,33} - \mathbf{B}^2_{,11}\right] + \dfrac{\frac{a_3^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\left[\mathbf{B}^3_{,11} - \mathbf{B}^3_{,22}\right]$	$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = 2\left(\dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\right)\mathbf{E} + \dfrac{\frac{v_1^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\left[\mathbf{B}^1_{,22} - \mathbf{B}^1_{,33}\right]$
	$+\dfrac{\frac{v_2^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\left[\mathbf{B}^2_{,33} - \mathbf{B}^2_{,11}\right] + \dfrac{\frac{v_3^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\left[\mathbf{B}^3_{,11} - \mathbf{B}^3_{,22}\right]$
Conservation Law as 7D Wave Equation	**Conservation Law as 7D Wave Equation**
$\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = [\Box^2 - \nabla^2]\left(\left(\dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\right)\mathbf{E}\right)$	$\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = [\Box^2 - \nabla^2]\left(\dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\right)\mathbf{E}$

1.13. Purely Zero-Point Electrodynamics in Universal Noninertial and Inertial Frame

After the development of above model, the need of an independent model of purely zero-point theory of electrodynamics is emerged. Table -2 represents zero-point electrodynamics in 4D ULTM for inertial and noninertial frame.

Zero-point electrodynamics consists of transformation of EMF, ME and conservation law in tensor form given by three transformation laws.

Transformation of Zero-Point Electromagnetic Field

$$\mathbf{F}^{\mu'\mu'} = \mathbf{L}^{\mu'}_\alpha \mathbf{F}^{\alpha\mu'} \tag{38}$$

Transformation of Zero-Point Maxwell's Equations

$$\mathbf{F}^{\mu'\mu'}_{,\mu'} = \mathbf{L}^{\mu'}_\alpha \mathbf{F}^{\alpha\mu'}_{,\mu'} \tag{39}$$

Transformation of Zero-Point Conservation Law

$$\mathbf{F}^{\mu'\mu'}_{,\mu\mu'} = \mathbf{L}^{\mu'}_\alpha \mathbf{F}^{\alpha\mu'}_{,\mu'\mu'} \tag{40}$$

Table 2.   Comparison of Results of Zero-Point Electrodynamics in 4D ULTM for noninertial and Inertial Frame of Reference

Electrodynamics in 4D Noninertial ULTM	Electrodynamics in 4D ULTM for Inertial Frame
$[\mathbf{L}^\mu_\nu]$	$[\mathbf{L}^\mu_\nu]$
$=\begin{bmatrix} \frac{1}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & -\frac{\frac{a_1^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & -\frac{\frac{a_2^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & -\frac{\frac{a_3^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} \\ -\frac{\frac{a_1^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & \frac{1}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & -\frac{\frac{a_3^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & -\frac{\frac{a_2^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} \\ -\frac{\frac{a_2^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & -\frac{\frac{a_3^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & \frac{1}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & -\frac{\frac{a_1^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} \\ -\frac{\frac{a_3^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & -\frac{\frac{a_2^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & -\frac{\frac{a_1^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)} & \frac{1}{\left(1-\frac{a^2}{c^2\omega^2}\right)} \end{bmatrix}$	$=\begin{bmatrix} \frac{1}{\left(1-\frac{v^2}{c^2}\right)} & -\frac{\frac{v_1^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)} & -\frac{\frac{v_2^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)} & -\frac{\frac{v_3^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)} \\ -\frac{\frac{v_1^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)} & \frac{1}{\left(1-\frac{v^2}{c^2}\right)} & -\frac{\frac{v_3^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)} & -\frac{\frac{v_2^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)} \\ -\frac{\frac{v_2^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)} & -\frac{\frac{v_3^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)} & \frac{1}{\left(1-\frac{v^2}{c^2}\right)} & -\frac{\frac{v_1^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)} \\ -\frac{\frac{v_3^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)} & -\frac{\frac{v_2^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)} & -\frac{\frac{v_1^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)} & \frac{1}{\left(1-\frac{v^2}{c^2}\right)} \end{bmatrix}$
Transformation of Electromagnetic Field	**Transformation of Electromagnetic Field**
$\mathbf{F}^{\mu'\mu'} = \mathbf{L}^{\mu'}_\alpha \mathbf{F}^{\alpha\mu'}$	$\mathbf{F}^{\mu'\mu'} = \mathbf{L}^{\mu'}_\alpha \mathbf{F}^{\alpha\mu'}$
Zero-Point Terms of EMF	**Zero-Point Terms of EMF**
$\mathbf{F}^{\mu'\mu'} = \dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2}\right)}[\mathbf{E}-\mathbf{E}] + \dfrac{1}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\left[\left(\frac{a_3^2}{c^2\omega^2}\mathbf{B}^3 - \frac{a_2^2}{c^2\omega^2}\mathbf{B}^2\right) + \left(\frac{a_1^2}{c^2\omega^2}\mathbf{B}^1 - \frac{a_3^2}{c^2\omega^2}\mathbf{B}^3\right) + \frac{a_2^2}{c^2\omega^2}\mathbf{B}^2 - \frac{a_1^2}{c^2\omega^2}\mathbf{B}^1\right)\right]$	$\mathbf{F}^{\mu'\mu'} = \dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}[\mathbf{E}-\mathbf{E}] + \dfrac{1}{\left(1-\frac{v^2}{c^2}\right)}\left[\left(\frac{v_3^2}{c^2}\mathbf{B}^3 - \frac{v_2^2}{c^2}\mathbf{B}^2\right) + \left(\frac{v_1^2}{c^2}\mathbf{B}^1 - \frac{v_3^2}{c^2}\mathbf{B}^3\right) + \left(\frac{v_2^2}{c^2}\mathbf{B}^2 - \frac{v_1^2}{c^2}\mathbf{B}^1\right)\right]$

$\mathbf{F}^{\mu'\mu'} = 0$	$\mathbf{F}^{\mu'\mu'} = 0$
Transformation of Maxwell's Equations	**Transformation of Maxwell's Equations**
$\mathbf{F}^{\mu'\mu'}_{,\mu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{F}^{\alpha\mu'}_{,\mu'}$	$\mathbf{F}^{\mu'\mu'}_{,\mu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{F}^{\alpha\mu'}_{,\mu'}$
Zero-Point Gauss's Law	**Zero-Point Gauss's Law**
$\mathbf{F}^{0'0'}_{,0'} = \dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\mathbf{E}_{,0}$	$\mathbf{F}^{0'0'}_{,0'} = \dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\mathbf{E}_{,0}$
Zero-Point Ampere's Law	**Zero-Point Ampere's Law**
$\mathbf{F}^{i'i'}_{,i'} = -\dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}\{(\nabla.\mathbf{E}) + [(\nabla\times\mathbf{B})]\}$	$\mathbf{F}^{i'i'}_{,i'} = -\dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\{(\nabla.\mathbf{E}) + [(\nabla\times\mathbf{B})]\}$
Zero-Point Maxwell's Equations	**Zero-Point Maxwell's Equations**
$\mathbf{F}^{\mu'\mu'}_{,\mu'} = -\dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{v^2}{c^2\omega^2}\right)}\{(\nabla.\mathbf{E}) + [(\nabla\times\mathbf{B})-\mathbf{E}_{,0}]\}$	$\mathbf{F}^{\mu'\mu'}_{,\mu'} = -\dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\{(\nabla.\mathbf{E}) + [(\nabla\times\mathbf{B})-\mathbf{E}_{,0}]\}$
Conservation Law by Einstein's Method	**Conservation Law by Einstein's Method**
$\mathbf{F}^{\mu'\mu'}_{,\mu\mu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{F}^{\alpha\mu'}_{,\mu'\mu'}$	$\mathbf{F}^{\mu'\mu'}_{,\mu\mu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{F}^{\alpha\mu'}_{,\mu'\mu'}$
Zero-Point Conservation Law as 4D EM Wave	**Zero-Point Conservation Law as 4D EM Wave**
$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = 2\left(\dfrac{\frac{a^2}{c^2\omega^2}}{\left(1-\frac{v^2}{c^2\omega^2}\right)}\right)\mathbf{E} + \dfrac{\frac{a_1^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}[\mathbf{B}^1_{,22}-\mathbf{B}^1_{,33}]$ $+\dfrac{\frac{a_2^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}[\mathbf{B}^2_{,33}-\mathbf{B}^2_{,11}] + \dfrac{\frac{a_3^2}{c^2\omega^2}}{\left(1-\frac{a^2}{c^2\omega^2}\right)}[\mathbf{B}^3_{,11}-\mathbf{B}^3_{,22}]$	$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = 2\left(\dfrac{\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}\right)\mathbf{E} + \dfrac{\frac{v_1^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}[\mathbf{B}^1_{,22}-\mathbf{B}^1_{,33}]$ $+\dfrac{\frac{v_2^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}[\mathbf{B}^2_{,33}-\mathbf{B}^2_{,11}] + \dfrac{\frac{v_3^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)}[\mathbf{B}^3_{,11}-\mathbf{B}^3_{,22}]$

2. Model-2: Zero-Point Results of Electrodynamics, Inertia and Gravitation in Noninertial Coordinate Metric Based on STL for 4-Vectors and Tensors

Quantum theory predicts existence of zero-point energy for ground state of harmonic oscillator $E_0 = \frac{1}{2}h\nu$. Our model of electrodynamics, inertia and Gravitation in table-3, predicts outlandish results. The presence of zero-point energy via equation (1) in each column represents electrical energy, mechanical energy and gravitational energy respectively. They also incorporate the concept of Coulomb potential energy, inertial energy and Newtonian gravitational potential energy

$$q\mathbf{F}^{0'0'} = (\mathbf{x}.q\mathbf{E}) = \frac{kQq}{x} \tag{1}$$

$$m\Omega^{0'0'} = (\mathbf{x}.m\mathbf{a}) = mv^2 \tag{1}$$

$$m\mathbf{G}^{0'0'} = (\mathbf{x}.m\mathbf{g}) = \frac{GmM}{x} \tag{1}$$

Other results can be seen in the table-3. Next, we consider the case of zero-point Maxwell's equations for electrodynamics, inertia and gravitation theories via equations (6) of each column.

$$q\mathbf{F}^{\mu'\mu'}_{,\mu'} = \mathbf{x}.q\mathbf{E}_{,0} - \nabla(\mathbf{x}.q\mathbf{E}) \tag{6}$$

$$m\Omega^{\mu'\mu'}_{,\mu'} = \mathbf{x}.m\mathbf{a}_{,0} - \nabla(\mathbf{x}.m\mathbf{a}) \tag{6}$$

$$m\mathbf{G}^{\mu'\mu'}_{,\mu'} = \mathbf{x}.m\mathbf{g}_{,0} - \nabla(\mathbf{x}.m\mathbf{g}) \tag{6}$$

In mechanics, negative of gradient of potential energy is equal to force so the terms $-\nabla(\mathbf{x}.q\mathbf{E})$, $-\nabla(\mathbf{x}.m\mathbf{a})$ and $-\nabla(\mathbf{x}.q\mathbf{E})$ represent electric force, inertial force and gravitational force. The above equations represent power-force relation for electrodynamics, inertia and gravitation. As we know in special relativity that energy and momentum are unified. The next concept is power and force are unified.

Finally, we consider the case of conservation law by Einstein's summation convention method where zero-point conservation law represent 4D wave of electrical energy, inertial energy and gravitational energy respectively via equation (7) of each column.

$$q\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \square^2(\mathbf{x}.q\mathbf{E}) \tag{7}$$

$$m\Omega^{\mu'\mu'}_{,\mu'\mu'} = \square^2(\mathbf{x}.m\mathbf{a}) \tag{7}$$

$$m\mathbf{G}^{\mu'\mu'}_{,\mu'\mu'} = \square^2(\mathbf{x}.m\mathbf{g}) \tag{7}$$

The set of equations (1), (6) and (7) show clearly that future space vehicles will be extracting energy and power-force from vacuum. The zero-point physical quantities are no more mysteries from now onward.

Table 3.   (Components of Noninertial Coordinate Metric: $\mathbf{g}_0^0 = \mathbf{g}_1^1 = \mathbf{g}_2^2 = \mathbf{g}_3^3 = 1$, $\mathbf{g}_i^0 = \mathbf{g}_0^1 = -\mathbf{x}_i$)

Theory of Electrodynamics	Theory of Inertia	Theory of Gravitation
$$[\mathbf{F}^{\mu\nu}] = \begin{bmatrix} 0 & \mathbf{E}^1 & \mathbf{E}^2 & \mathbf{E}^3 \\ -\mathbf{E}^1 & 0 & \mathbf{B}^3 & -\mathbf{B}^2 \\ -\mathbf{E}^2 & -\mathbf{B}^3 & 0 & \mathbf{B}^1 \\ -\mathbf{E}^3 & \mathbf{B}^2 & -\mathbf{B}^1 & 0 \end{bmatrix}$$	$$\Omega^{\mu\nu} = \begin{bmatrix} 0 & \mathbf{a}^1 & \mathbf{a}^2 & \mathbf{a}^3 \\ -\mathbf{a}^1 & 0 & \boldsymbol{\omega}^3 & -\boldsymbol{\omega}^2 \\ -\mathbf{a}^2 & -\boldsymbol{\omega}^3 & 0 & \boldsymbol{\omega}^1 \\ -\mathbf{a}^3 & \boldsymbol{\omega}^2 & -\boldsymbol{\omega}^1 & 0 \end{bmatrix}$$	$$\mathbf{G}^{\mu\nu} = \begin{bmatrix} 0 & \mathbf{g}^1 & \mathbf{g}^2 & \mathbf{g}^3 \\ -\mathbf{g}^1 & 0 & \boldsymbol{\omega}^3 & -\boldsymbol{\omega}^2 \\ -\mathbf{g}^2 & -\boldsymbol{\omega}^3 & 0 & \boldsymbol{\omega}^1 \\ -\mathbf{g}^3 & \boldsymbol{\omega}^2 & -\boldsymbol{\omega}^1 & 0 \end{bmatrix}$$
Zero Point Electromag. Field $q\mathbf{F}^{\mu'\mu'} = q\mathbf{g}_\alpha^{\mu'}\mathbf{F}^{\alpha\mu'}$	**Zero Point Inertia Field** $m\Omega^{\mu'\mu'} = m\mathbf{g}_\alpha^{\mu'}\Omega^{\alpha\mu'}$	**Zero Point Gravitational Field** $m\mathbf{G}^{\mu'\mu'} = m\mathbf{g}_\alpha^{\mu'}\mathbf{G}^{\alpha\mu'}$
Zero Point Electric field as Electric Energy $q\mathbf{F}^{0'0'} = (\mathbf{x}.\,q\mathbf{E})$ (1)	Zero Point Acceleration Field as Mechanical Energy $m\Omega^{0'0'} = (\mathbf{x}.\,m\mathbf{a})$ (1)	Zero Point Gravitational Acceleration as Gravit. Energy $m\mathbf{G}^{0'0'} = (\mathbf{x}.\,m\mathbf{g})$ (1)
Zero Point Negative Elec. Energy $q\mathbf{F}^{i'i'} = -(\mathbf{x}.\,q\mathbf{E})$ (2)	Zero Point Negative Mec. Energy $m\Omega^{i'i'} = -(\mathbf{x}.\,m\mathbf{a})$ (2)	Zero Point Negative Grav. Energy $m\mathbf{G}^{i'i'} = -(\mathbf{x}.\,m\mathbf{g})$ (2)
Action and reaction of Energy $q\mathbf{F}^{\mu'\mu'} = (\mathbf{x}.\,q\mathbf{E}) - (\mathbf{x}.\,q\mathbf{E})$ (3)	Action and reaction of Energy $m\Omega^{\mu'\mu'} = [(\mathbf{x}.\,m\mathbf{a}) - (\mathbf{x}.\,m\mathbf{a})]$ (3)	Action and reaction of Energy $m\,\mathbf{G}^{\mu'\mu'} = (\mathbf{x}.\,m\mathbf{g}) - (\mathbf{x}.\,m\mathbf{g})$ (3)
Zero Point Maxwell's Equations $q\mathbf{F}^{\mu'\mu'}_{,\mu'} = q\mathbf{g}_\alpha^{\mu'}\,\mathbf{F}^{\alpha\mu'}_{,\mu'}$	Zero Point Maxwell's Eq. Inertia $m\Omega^{\mu'\mu'}_{,\mu'} = m\mathbf{g}_\alpha^{\mu'}\Omega^{\alpha\mu'}_{,\mu'}$	Zero Point Maxwell's Eq. Gravit. $m\mathbf{G}^{\mu'\mu'}_{,\mu'} = m\mathbf{g}_\alpha^{\mu'}\mathbf{G}^{\alpha\mu'}_{,\mu'}$
Zero Point Gauss's Law as electric power $q\mathbf{F}^{0'0'}_{,0'} = \mathbf{x}.\,q\mathbf{E}_{,0}$ (4)	Zero Point Gauss's Law as Inertial power $m\Omega^{0'0'}_{,0'} = \mathbf{x}.\,m\mathbf{a}_{,0}$ (4)	Zero Point Gauss's Law as Gravitational Power $m\mathbf{G}^{0'0'}_{,0'} = \mathbf{x}.\,m\mathbf{g}_{,0}$ (4)
Zero Point Ampere's Law as Electric Force $q\mathbf{F}^{i'i'}_{,i'} = -\boldsymbol{\nabla}(\mathbf{x}.\,q\mathbf{E})$ (5)	Zero Point Ampere's Law as Inertial Force $m\Omega^{i'i'}_{,i'} = -\boldsymbol{\nabla}(\mathbf{x}.\,m\mathbf{a})$ (5)	Zero Point Ampere's Law as Gravitational Force $m\mathbf{G}^{i'i'}_{,i'} = -\boldsymbol{\nabla}(\mathbf{x}.\,m\mathbf{g})$ (5)
Zero Point Maxwell's equations as Power-Force $q\mathbf{F}^{\mu'\mu'}_{,\mu'} = \mathbf{x}.\,q\mathbf{E}_{,0} - \boldsymbol{\nabla}(\mathbf{x}.\,q\mathbf{E})$ (6)	Zero Point Maxwell's equations as Power-Force $m\Omega^{\mu'\mu'}_{,\mu'} = \mathbf{x}.\,m\mathbf{a}_{,0} - \boldsymbol{\nabla}(\mathbf{x}.\,m\mathbf{a})]$ (6)	Zero Point Maxwell's equations as Gravitational Power-Force $m\,\mathbf{G}^{\mu'\mu'}_{,\mu'} = \mathbf{x}.\,m\mathbf{g}_{,0} - \boldsymbol{\nabla}(\mathbf{x}.\,m\mathbf{g})]$ (6)
Conservation Law by Einstein Convention Method $q\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = q\mathbf{g}_\alpha^{\mu'}\mathbf{F}^{\alpha\mu'}_{,\mu'\mu'}$	Conservation Law by Einstein Convention Method $m\Omega^{\mu'\mu'}_{,\mu'\mu'} = m\mathbf{g}_\alpha^{\mu'}\Omega^{\alpha\mu'}_{,\mu'\mu'}$	Conservation Law by Einstein Convention Method $m\mathbf{G}^{\mu'\mu'}_{,\mu'\mu'} = m\mathbf{g}_\alpha^{\mu'}\mathbf{G}^{\alpha\mu'}_{,\mu'\mu'}$
Zero Point Conservation law as 4D Wave of Electrical Energy $q\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \Box^2(\mathbf{x}.\,q\mathbf{E})$ (7)	Zero Point Conservation law as 4D Wave of Mechanical Energy $m\Omega^{\mu'\mu'}_{,\mu'\mu'} = \Box^2(\mathbf{x}.\,m\mathbf{a})$ (7)	Zero Point Conservation law as 4D Wave of Gravitational Energy $m\mathbf{G}^{\mu'\mu'}_{,\mu'\mu'} = \Box^2(\mathbf{x}.\,m\mathbf{g})$ (7)

2.1. Zero-Point Electrodynamics, Inertia and Gravitation in Noninertial Metric

Quantum theory predicts existence of zero-point Casimir force. Our model of electrodynamics, inertia and Gravitation in table-4, predicts outlandish results. The presence of zero-point force via equation (1) in each column represents electrical force, Newton's 2nd law and gravitational force respectively. Since forces appear equal and opposite so Newton's third law is satisfied through equation (3)

$$q\mathbf{F}^{0'0'} = q\mathbf{E} \tag{1}$$

$$m\Omega^{0'0'} = m\mathbf{a} \tag{1}$$

$$m\mathbf{G}^{0'0'} = m\mathbf{g} \tag{1}$$

Other results can be seen in the table. Next, we consider the case of zero-point Maxwell's equations for electrodynamics, inertia and gravitation theories via equations (6) of each column.

$$q\mathbf{F}^{\mu'\mu'}_{,\mu'} = q\mathbf{E}_{,0} - \boldsymbol{\nabla}.\,q\mathbf{E} \tag{6}$$

$$m\Omega^{\mu'\mu'}_{,\mu'} = m\mathbf{a}_{,0} - \boldsymbol{\nabla}.\,m\mathbf{a} \tag{6}$$

$$m\,\mathbf{G}^{\mu'\mu'}_{,\mu'} = m\mathbf{g}_{,0} - \boldsymbol{\nabla}.\,m\mathbf{g} \tag{6}$$

$q\mathbf{E}_{,0} - \boldsymbol{\nabla}.\,q\mathbf{E}$, $m\mathbf{a}_{,0} - \boldsymbol{\nabla}.\,m\mathbf{a}$ and $m\mathbf{g}_{,0} - \boldsymbol{\nabla}.\,m\mathbf{g}$ represent time varying electric force-Divergence of electric force, time varying inertial force-Divergence of force and time varying gravitational force-Divergence of gravitational force. Here time varying force and divergence of force are unified. In modern mechanics, time varying force is known as Yank.

Finally, we consider the case of conservation law by Einstein's summation convention method where zero-point conservation law represent 4D wave of electrical force, Newton's 2nd law and gravitational force respectively via equation (7) of each column.

$$q\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \square^2(q\mathbf{E}) \tag{7}$$

$$m\Omega^{\mu'\mu'}_{,\mu'\mu'} = \square^2(m\mathbf{a}) \tag{7}$$

$$m\mathbf{G}^{\mu'\mu'}_{,\mu'\mu'} = \square^2(m\mathbf{g}) \tag{7}$$

The set of equations (1), (6) and (7) show clearly that future space vehicles will be propelled by these forces.

Table 4

$$(\mathbf{g}^0_0 = 1,\ \mathbf{g}^1_1 = \mathbf{g}^2_2 = \mathbf{g}^3_3 = -1,\ \mathbf{g}^0_i = \mathbf{g}^I_0 = -1)$$

$$[\mathbf{g}^\mu_\nu] = \begin{bmatrix} 1 & -1 & -1 & -1 \\ -1 & -1 & 0 & 0 \\ -1 & 0 & -1 & 0 \\ -1 & 0 & 0 & -1 \end{bmatrix}$$

Zero Point Electrodynamics	**Zero Point Theory of Inertia**	**Zero Point Gravitation Theory**
$[\mathbf{F}^{\mu\nu}] = \begin{bmatrix} 0 & \mathbf{E}^1 & \mathbf{E}^2 & \mathbf{E}^3 \\ -\mathbf{E}^1 & 0 & \mathbf{B}^3 & -\mathbf{B}^2 \\ -\mathbf{E}^2 & -\mathbf{B}^3 & 0 & \mathbf{B}^1 \\ -\mathbf{E}^3 & \mathbf{B}^2 & -\mathbf{B}^1 & 0 \end{bmatrix}$	$\Omega^{\mu\nu} = \begin{bmatrix} 0 & \mathbf{a}^1 & \mathbf{a}^2 & \mathbf{a}^3 \\ -\mathbf{a}^1 & 0 & \boldsymbol{\omega}^3 & -\boldsymbol{\omega}^2 \\ -\mathbf{a}^2 & -\boldsymbol{\omega}^3 & 0 & \boldsymbol{\omega}^1 \\ -\mathbf{a}^3 & \boldsymbol{\omega}^2 & -\boldsymbol{\omega}^1 & 0 \end{bmatrix}$	$\mathbf{G}^{\mu\nu} = \begin{bmatrix} 0 & \mathbf{g}^1 & \mathbf{g}^2 & \mathbf{g}^3 \\ -\mathbf{g}^1 & 0 & \boldsymbol{\omega}^3 & -\boldsymbol{\omega}^2 \\ -\mathbf{g}^2 & -\boldsymbol{\omega}^3 & 0 & \boldsymbol{\omega}^1 \\ -\mathbf{g}^3 & \boldsymbol{\omega}^2 & -\boldsymbol{\omega}^1 & 0 \end{bmatrix}$
Zero Point Electric Field as Newton's second Law	Zero Point Force Field as Newton's second Law	Zero Point Gravitational Field as Newton's second Law
$q\mathbf{F}^{0'0'} = q\mathbf{E}$ (1)	$m\Omega^{0'0'} = m\mathbf{a}$ (1)	$m\mathbf{G}^{0'0'} = m\mathbf{g}$ (1)
Zero Point Magnetic Field	Zero Point Angular Velocity Field	Zero Point Angular Velocity Field
$q\mathbf{F}^{i'i'} = -q\mathbf{E}$ (2)	$m\Omega^{i'i'} = -m\mathbf{a}$ (2)	$m\mathbf{G}^{i'i'} = -m\mathbf{g}$ (2)
Zero-point Electromagnetic Field as Newton's Third Law	Zero-point Inertia Field as Newton's Third Law	Zero-point Gravitational Field as Newton's Third Law
$q\mathbf{F}^{\mu'\mu'} = q\mathbf{E} - q\mathbf{E}$ (3)	$m\Omega^{\mu'\mu'} = m\mathbf{a} - m\mathbf{a}$ (3)	$m\mathbf{G}^{\mu'\mu'} = m\mathbf{g} - m\mathbf{g}$ (3)
Zero Point Gauss's Law as Time Varying Electric Force	Zero Point Gauss's Law as Time Varying Newtonian Force	Zero Point Gauss's Law as Time Varying Gravitational Force
$q\mathbf{F}^{0'0'}_{,0'} = q\mathbf{E}_{,0}$ (4)	$m\Omega^{0'0'}_{,0'} = m\mathbf{a}_{,0}$ (4)	$m\mathbf{G}^{0'0'}_{,0'} = m\mathbf{g}_{,0}$ (4)
Zero Point Ampere's Law	Zero Point Ampere's Law	Zero Point Ampere's Law
$q\mathbf{F}^{i'i'}_{,i'} = -\boldsymbol{\nabla}.q\mathbf{E}$ (5)	$m\Omega^{i'i'}_{,i'} = -[\boldsymbol{\nabla}.m\mathbf{a}]$ (5)	$m\mathbf{G}^{i'i'}_{,i'} = -[\boldsymbol{\nabla}.m\mathbf{g}]$ (5)
Zero Point Maxwell's Equations	**Zero Point Maxwell's Equations**	**Zero Point Maxwell's Equations**
$q\ \mathbf{F}^{\mu'\mu'}_{,\mu'} = q\mathbf{E}_{,0} - [\boldsymbol{\nabla}.q\mathbf{E}]$ (6)	$m\Omega^{\mu'\mu'}_{,\mu'} = m\mathbf{a}_{,0} - [\boldsymbol{\nabla}.m\mathbf{a}]$ (6)	$m\mathbf{G}^{\mu'\mu'}_{,0'} = m\mathbf{g}_{,0} - [\boldsymbol{\nabla}.m\mathbf{g}]$ (6)
Zero Point Conservation Law as 4D Wave of Electric Force	Zero Point Conservation Law as 4D Wave of Newtonian Force	Zero Point Conservation Law as 4D Wave of Gravitational Force
$q\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \square^2(q\mathbf{E})$ (7)	$m\Omega^{\mu'\mu'}_{,\mu'\mu'} = \square^2(m\mathbf{a})$ (7)	$m\ \mathbf{G}^{\mu'\mu'}_{,\mu'\mu'} = \square^2(m\mathbf{g})$ (7)

3. Model-3: Zero Point Spacetime Physics of Electrodynamics

In the above models via table-2 and table-4, zero-point relations of electrodynamics are not independent of effect of frame of reference. In other words, they contain the terms of transformation matrix.

Is it possible to construct a model of zero-point electrodynamics that contains pure relations of electrodynamics consisting of electromagnetic field, Maxwell's equations and conservation law in tensor form? The answer is yes. A transformation is constructed that gives us pure electrodynamics based on STL for 4-vectors and tensors. The process is very short and simple and the results are obtained in matrix form. All the results in final form remain same for all observers.

$$[\mathbf{g}^\mu_\nu] = \begin{bmatrix} 0 & -1 & -1 & -1 \\ -1 & 0 & -1 & -1 \\ -1 & -1 & 0 & -1 \\ -1 & -1 & -1 & 0 \end{bmatrix} \tag{3.1}$$

3.1. Derivation of Zero-Point Electromagnetic Field

$$\mathbf{F}^{\mu'\mu'} = \mathbf{g}_\alpha^{\mu'}\mathbf{F}^{\alpha\mu'} \tag{3.2}$$

$$\begin{bmatrix} \mathbf{F}^{0'0'} & 0 & 0 & 0 \\ 0 & \mathbf{F}^{1'1'} & 0 & 0 \\ 0 & 0 & \mathbf{F}^{2'2'} & 0 \\ 0 & 0 & 0 & \mathbf{F}^{3'3'} \end{bmatrix} = \begin{bmatrix} 0 & -1 & -1 & -1 \\ -1 & 0 & -1 & -1 \\ -1 & -1 & 0 & -1 \\ -1 & -1 & -1 & 0 \end{bmatrix}\begin{bmatrix} 0 & \mathbf{E}^1 & \mathbf{E}^2 & \mathbf{E}^3 \\ -\mathbf{E}^1 & 0 & \mathbf{B}^3 & -\mathbf{B}^2 \\ -\mathbf{E}^2 & -\mathbf{B}^3 & 0 & \mathbf{B}^1 \\ -\mathbf{E}^3 & \mathbf{B}^2 & -\mathbf{B}^1 & 0 \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}^{0'0'} \\ \mathbf{F}^{1'1'} \\ \mathbf{F}^{2'2'} \\ \mathbf{F}^{3'3'} \end{bmatrix} = \begin{bmatrix} \mathbf{E}^1 + \mathbf{E}^2 + \mathbf{E}^3 & 0 & 0 & 0 \\ 0 & [(\mathbf{B}^3 - \mathbf{B}^2) - \mathbf{E}^1] & 0 & 0 \\ 0 & 0 & [(\mathbf{B}^1 - \mathbf{B}^3) - \mathbf{E}^2] & 0 \\ 0 & 0 & 0 & [(\mathbf{B}^2 - \mathbf{B}^1) - \mathbf{E}^3] \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}^{0'0'} \\ \mathbf{F}^{1'1'} \\ \mathbf{F}^{2'2'} \\ \mathbf{F}^{3'3'} \end{bmatrix} = \begin{bmatrix} \mathbf{E}^1 + \mathbf{E}^2 + \mathbf{E}^3 \\ [(\mathbf{B}^3 - \mathbf{B}^2) - \mathbf{E}^1] \\ [(\mathbf{B}^1 - \mathbf{B}^3) - \mathbf{E}^2] \\ [(\mathbf{B}^2 - \mathbf{B}^1) - \mathbf{E}^3] \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}^{0'0'} \\ \mathbf{F}^{i'i'} \end{bmatrix} = \begin{bmatrix} \mathbf{E}^1 + \mathbf{E}^2 + \mathbf{E}^3 \\ [(\mathbf{B}^3 - \mathbf{B}^2) - \mathbf{E}^1] + [(\mathbf{B}^1 - \mathbf{B}^3) - \mathbf{E}^2] + [(\mathbf{B}^2 - \mathbf{B}^1) - \mathbf{E}^3] \end{bmatrix}$$

Zero-Point Electric Field

$$\mathbf{F}^{0'0'} = \mathbf{E}^1 + \mathbf{E}^2 + \mathbf{E}^3 \tag{3.3}$$

Zero-Point Magnetic Field

$$\mathbf{F}^{0'0'} = [(\mathbf{B}^3 - \mathbf{B}^2) - \mathbf{E}^1] + [(\mathbf{B}^1 - \mathbf{B}^3) - \mathbf{E}^2] + [(\mathbf{B}^2 - \mathbf{B}^1) - \mathbf{E}^3] \tag{3.4}$$

Zero-Point Electromagnetic Field

$$\mathbf{F}^{\mu'\mu'} = \mathbf{E}^1 + \mathbf{E}^2 + \mathbf{E}^3 + [(\mathbf{B}^3 - \mathbf{B}^2) - \mathbf{E}^1] + [(\mathbf{B}^1 - \mathbf{B}^3) - \mathbf{E}^2] + [(\mathbf{B}^2 - \mathbf{B}^1) - \mathbf{E}^3] = 0 \tag{3.5}$$

Zero-Point electromagnetic field remains same for all observers.

3.2. Derivation of Zero-Point Maxwell's Equations

$$\mathbf{F}^{\mu'\mu'}_{,\mu'} = \mathbf{g}_\alpha^{\mu'} \mathbf{F}^{\alpha\mu'}_{,\mu'} \tag{3.6}$$

$$\begin{bmatrix} \mathbf{F}^{0'0'}_{,0'} & 0 & 0 & 0 \\ 0 & \mathbf{F}^{1'1'}_{,1'} & 0 & 0 \\ 0 & 0 & \mathbf{F}^{2'2'}_{,2'} & 0 \\ 0 & 0 & 0 & \mathbf{F}^{3'3'}_{,3'} \end{bmatrix} = \begin{bmatrix} 0 & -1 & -1 & -1 \\ -1 & 0 & -1 & -1 \\ -1 & -1 & 0 & -1 \\ -1 & -1 & -1 & 0 \end{bmatrix}\begin{bmatrix} 0 & \mathbf{E}^1_{,1} & \mathbf{E}^2_{,2} & \mathbf{E}^3_{,3} \\ -\mathbf{E}^1_{,0} & 0 & \mathbf{B}^3_{,2} & -\mathbf{B}^2_{,3} \\ -\mathbf{E}^2_{,0} & -\mathbf{B}^3_{,1} & 0 & \mathbf{B}^1_{,3} \\ -\mathbf{E}^3_{,0} & \mathbf{B}^2_{,1} & -\mathbf{B}^1_{,2} & 0 \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}^{0'0'}_{,0'} \\ \mathbf{F}^{1'1'}_{,1'} \\ \mathbf{F}^{2'2'}_{,2'} \\ \mathbf{F}^{3'3'}_{,3'} \end{bmatrix} = \begin{bmatrix} \mathbf{E}^1_{,0} + \mathbf{E}^2_{,0} + \mathbf{E}^3_{,0} & 0 & 0 & 0 \\ 0 & -\mathbf{E}^1_{,1} - [(\mathbf{B}^2_{,1} - \mathbf{B}^3_{,1})] & 0 & 0 \\ 0 & 0 & -\mathbf{E}^2_{,2} - [(\mathbf{B}^3_{,2} - \mathbf{B}^1_{,2})] & 0 \\ 0 & 0 & 0 & -\mathbf{E}^3_{,3} - [(\mathbf{B}^1_{,3} - \mathbf{B}^2_{,3})] \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}^{0'0'}_{,0'} \\ \mathbf{F}^{1'1'}_{,1'} \\ \mathbf{F}^{2'2'}_{,2'} \\ \mathbf{F}^{3'3'}_{,3'} \end{bmatrix} = \begin{bmatrix} \mathbf{E}^1_{,0} + \mathbf{E}^2_{,0} + \mathbf{E}^3_{,0} \\ -\mathbf{E}^1_{,1} - [(\mathbf{B}^2_{,1} - \mathbf{B}^3_{,1})] \\ -\mathbf{E}^2_{,2} - [(\mathbf{B}^3_{,2} - \mathbf{B}^1_{,2})] \\ -\mathbf{E}^3_{,3} - [(\mathbf{B}^1_{,3} - \mathbf{B}^2_{,3})] \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}^{0'0'}_{,0'} \\ \mathbf{F}^{i'i'}_{,i'} \end{bmatrix} = \begin{bmatrix} \mathbf{E}^1_{,0} + \mathbf{E}^2_{,0} + \mathbf{E}^3_{,0} \\ -\mathbf{E}^1_{,1} - \mathbf{E}^2_{,2} - \mathbf{E}^3_{,3} - [(\mathbf{B}^2_{,1} - \mathbf{B}^3_{,1})] - [(\mathbf{B}^3_{,2} - \mathbf{B}^1_{,2})] - [(\mathbf{B}^1_{,3} - \mathbf{B}^2_{,3})] \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}^{0'0'}_{,0'} \\ \mathbf{F}^{i'i'}_{,i'} \end{bmatrix} = \begin{bmatrix} \mathbf{E}_{,0} \\ -\nabla.\,\mathbf{E} - [(\nabla \times \mathbf{B})] \end{bmatrix}$$

Zero-Point Gauss's Law

$$\mathbf{F}^{0'0'}_{,0'} = \mathbf{E}_{,0} \tag{3.7}$$

Zero-Point Ampere's Law

$$\mathbf{F}^{i'i'}_{,i'} = -\nabla.\mathbf{E} - [(\nabla \times \mathbf{B})] \tag{3.8}$$

Zero-Point Maxwell's Equations

$$\mathbf{F}^{\mu'\mu'}_{,\mu'} = -\{\nabla.\mathbf{E} + [(\nabla \times \mathbf{B}) - \mathbf{E}_{,0}]\} \tag{3.9}$$

Zero-Point Maxwell's equation remain same for all observers.

3.3. Derivation of Zero-Point Conservation Law

$$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \mathbf{g}^{\mu'}_\alpha \mathbf{F}^{\alpha\mu'}_{,\mu'\mu'} \tag{3.10}$$

$$\begin{bmatrix} \mathbf{F}^{0'0'}_{,0'0'} & 0 & 0 & 0 \\ 0 & \mathbf{F}^{1'1'}_{,1'1'} & 0 & 0 \\ 0 & 0 & \mathbf{F}^{2'2'}_{,2'2'} & 0 \\ 0 & 0 & 0 & \mathbf{F}^{3'3'}_{,3'3'} \end{bmatrix} = \begin{bmatrix} 0 & -1 & -1 & -1 \\ -1 & 0 & -1 & -1 \\ -1 & -1 & 0 & -1 \\ -1 & -1 & -1 & 0 \end{bmatrix} \begin{bmatrix} 0 & \mathbf{E}^1_{,10} & \mathbf{E}^2_{,20} & \mathbf{E}^3_{,30} \\ -\mathbf{E}^1_{,01} & 0 & \mathbf{B}^3_{,21} & -\mathbf{B}^2_{,31} \\ -\mathbf{E}^2_{,02} & -\mathbf{B}^3_{,12} & 0 & \mathbf{B}^1_{,32} \\ -\mathbf{E}^3_{,03} & \mathbf{B}^2_{,13} & -\mathbf{B}^1_{,23} & 0 \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}^{0'0'}_{,0'0'} \\ \mathbf{F}^{1'1'}_{,1'1'} \\ \mathbf{F}^{2'2'}_{,2'2'} \\ \mathbf{F}^{3'3'}_{,3'3'} \end{bmatrix} = \begin{bmatrix} \mathbf{E}^1_{,01} + \mathbf{E}^2_{,02} + \mathbf{E}^3_{,03} & 0 & 0 & 0 \\ 0 & -\mathbf{E}^1_{,01} + (\mathbf{B}^3_{,12} - \mathbf{B}^2_{,13}) & 0 & 0 \\ 0 & 0 & -\mathbf{E}^2_{,02} - \mathbf{B}^3_{,21} + \mathbf{B}^1_{,23} & 0 \\ 0 & 0 & 0 & -\mathbf{E}^3_{,03} + \mathbf{B}^2_{,31} - \mathbf{B}^1_{,32} \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}^{0'0'}_{,0'0'} \\ \mathbf{F}^{1'1'}_{,1'1'} \\ \mathbf{F}^{2'2'}_{,2'2'} \\ \mathbf{F}^{3'3'}_{,3'3'} \end{bmatrix} = \begin{bmatrix} \mathbf{E}^1_{,01} + \mathbf{E}^2_{,02} + \mathbf{E}^3_{,03} \\ -\mathbf{E}^1_{,01} - (\mathbf{B}^3_{,12} - \mathbf{B}^2_{,13}) \\ -\mathbf{E}^2_{,02} - \mathbf{B}^3_{,21} + \mathbf{B}^1_{,23} \\ -\mathbf{E}^3_{,03} + \mathbf{B}^2_{,31} - \mathbf{B}^1_{,32} \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}^{0'0'}_{,0'0'} \\ \mathbf{F}^{i'i'}_{,i'i'} \end{bmatrix} = \begin{bmatrix} \mathbf{E}^1_{,01} + \mathbf{E}^2_{,02} + \mathbf{E}^3_{,03} \\ -\mathbf{E}^1_{,01} - \mathbf{E}^2_{,02} - \mathbf{E}^3_{,03} - [(\mathbf{B}^3_{,21} - \mathbf{B}^2_{,31})] - [(\mathbf{B}^1_{,32} - \mathbf{B}^3_{,12})] - [(\mathbf{B}^2_{,13} - \mathbf{B}^1_{,23})] \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}^{0'0'}_{,0'0'} \\ \mathbf{F}^{i'i'}_{,i'i'} \end{bmatrix} = \begin{bmatrix} \nabla.\mathbf{E}_{,0} \\ -\nabla.\mathbf{E}_{,0} - \nabla.(\nabla \times \mathbf{B}) \end{bmatrix}$$

Zero-Point Conservation of Gauss's Law

$$\mathbf{F}^{0'0'}_{,0'0'} = \nabla.\mathbf{E}_{,0} \tag{3.11}$$

Zero-Point Conservation of Ampere's Law

$$\mathbf{F}^{i'i'}_{,i'i'} = -\nabla.\mathbf{E}_{,0} - \nabla.(\nabla \times \mathbf{B}) \tag{3.12}$$

Zero-Point Conservation law

$$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \nabla.\mathbf{E}_{,0} - \nabla.\mathbf{E}_{,0} - \nabla.(\nabla \times \mathbf{B}) = 0 \tag{3.13}$$

Zero-Point conservation law remains same for all observers.

All the results consisting of electromagnetic field, Maxwell's equations and conservation law via equations (3.5), (3.9) and (3.13) remain same for all observers in their original form after transformation.

4. Discussion and Comparison

Three models of electrodynamics are presented. The first model is related to universal noninertial frame and its consistency with the results of universal inertial frame of reference. The second model consists of electrodynamics in usual Lorentz transformation in 2D and in 4D Lorentz transformation. Both models contain usual electrodynamics and zero-point electrodynamics. Their zero-point results are presented in table-2 and table-4. The third model deals with the purely zero-point electrodynamics.

Einstein's relativity theory in ULTM for noninertial frame based on STL for 4-vectors and tensors is developed in the language of SR. It predicts very interesting results. STL has caused the emergence of complete zero-point structure of electrodynamics within usual electrodynamics. The zero-point structure is affected by frame of reference but the usual structure remains independent of this effect. It obeys conservation law, EPR and principle of symmetry. Conservation law by matrix method appears as usual but by Einstein's method predicts two very strange results viz. 4D EM wave with zero-point

origin and conservation law as a 7D EM wave having invariant property. The results of this model match with our earlier model completely that is based on ULTM for inertial frame [1]. The predictions of zero-point structure of electrodynamics in this model is unlike the search for dark matter and energy [10-12].

Einstein's SR only talk about the constancy of speed of light and invariance of inner product of 4-vectors and tensors. It doesn't discuss the invariance of spacetime as a whole. In principle, if time and space are relative concept then spacetime must be the same for all observers. This inconsistency is actually due to unavailability of universal nature of Lorentz transformation and STL for 4-vectors and tensors. Our earlier model of ULTM for inertial frame and present model for noninertial frame resolves this issue within the domain of EPR and symmetry principle such that time and space are relative but their combination as spacetime remains same for all observers. This is the marvelous achievement of this adventure.

RESULTS OF THE MODEL:

4.1. Form Invariance of 4-Vectors in Noninertial Frame

All 4-vectors remain same for all observers such that temporal and spatial components are relative but 4-vetor as a whole remains same. For example, 4-current density remains universal

$$\mathbf{J}^{\mu'} = \mathbf{J}^{\mu} \tag{49}$$

4.2. Zero-point Terms of Electromagnetic Field

Zero-point Terms of Electric Field

$$\mathbf{F}^{0'0'} = \frac{\frac{a^2}{c^2\omega^2}}{(1 - \frac{a^2}{c^2\omega^2})} \mathbf{E} \tag{50}$$

Zero-point Terms of Magnetic Field

$$\mathbf{F}^{i'i'} = -\frac{\frac{a^2}{c^2\omega^2}}{(1 - \frac{a^2}{c^2\omega^2})} \mathbf{E} + \frac{1}{(1 - \frac{a^2}{c^2\omega^2})}\left[\left(\frac{a_3^2}{c^2\omega^2}\mathbf{B}^3 - \frac{a_2^2}{c^2\omega^2}\mathbf{B}^2\right) + \left(\frac{a_1^2}{c^2\omega^2}\mathbf{B}^1 - \frac{a_3^2}{c^2\omega^2}\mathbf{B}^3\right) + \frac{a_2^2}{c^2\omega^2}\mathbf{B}^2 - \frac{a_1^2}{c^2\omega^2}\mathbf{B}^1\right)\right] \tag{51}$$

Zero-point Terms of Electromagnetic Field

$$\mathbf{F}^{\mu'\mu'} = \frac{\frac{a^2}{c^2\omega^2}}{\left(1 - \frac{a^2}{c^2\omega^2}\right)}[\mathbf{E} - \mathbf{E}] + \frac{1}{(1 - \frac{a^2}{c^2\omega^2})}\left[\left(\frac{a_3^2}{c^2\omega^2}\mathbf{B}^3 - \frac{a_2^2}{c^2\omega^2}\mathbf{B}^2\right) + \left(\frac{a_1^2}{c^2\omega^2}\mathbf{B}^1 - \frac{a_3^2}{c^2\omega^2}\mathbf{B}^3\right) + \frac{a_2^2}{c^2\omega^2}\mathbf{B}^2 - \frac{a_1^2}{c^2\omega^2}\mathbf{B}^1\right)\right] = 0 \tag{52}$$

Usual Electromagnetic field remains same for all observers

$$\mathbf{F}^{\mu\nu} = [\mathbf{E} - \mathbf{E}] + [(\mathbf{B}^3 - \mathbf{B}^2)] + [(\mathbf{B}^1 - \mathbf{B}^3)] + [(\mathbf{B}^1 - \mathbf{B}^2)] = 0 \tag{53}$$

4.3. Zero-point Terms of Maxwell's Equations

Zero-Point Term of Gauss's Law represents time varying electric field

$$\mathbf{F}^{0'0'}_{,0'} = \frac{\frac{a^2}{c^2\omega^2}}{\left(1 - \frac{a^2}{c^2\omega^2}\right)} \mathbf{E}_{,0} \tag{54}$$

Zero-point term of Ampere's law consists of Gauss's Law and curl of magnetic field

$$\mathbf{F}^{i'i'}_{,i'} = -\frac{\frac{a^2}{c^2\omega^2}}{\left(1 - \frac{a^2}{c^2\omega^2}\right)}\{(\mathbf{\nabla}.\mathbf{E}) + [(\mathbf{\nabla} \times \mathbf{B})]\} \tag{55}$$

Zero-Point Maxwell's Equations

$$\mathbf{F}^{\mu'\mu'}_{,\mu'} = -\frac{\frac{a^2}{c^2\omega^2}}{\left(1 - \frac{a^2}{c^2\omega^2}\right)}\{(\mathbf{\nabla}.\mathbf{E}) + [(\mathbf{\nabla} \times \mathbf{B}) - \mathbf{E}_{,0}]\} \tag{56}$$

Gauss's Law

$$\mathbf{F}^{0'\nu'}_{,\nu'} = \mathbf{\nabla}.\mathbf{E} + \frac{1}{(1 - \frac{a^2}{c^2\omega^2})}\left[(\mathbf{\nabla} \times \mathbf{B}) - \mathbf{E}_{,0}\right] - \frac{\frac{a^2}{c^2\omega^2}}{\left(1 - \frac{a^2}{c^2\omega^2}\right)}\left[(\mathbf{B}^3_{,2} - \mathbf{B}^2_{,3}) - \mathbf{E}^1_{,0}\right] \tag{57}$$

Ampere's Law

$$\mathbf{F}^{i'\nu'}_{,\nu'} = -\frac{\frac{a^2}{c^2\omega^2}}{\left(1 - \frac{a^2}{c^2\omega^2}\right)}\{[(\mathbf{\nabla} \times \mathbf{B})^2 - \mathbf{E}^2_{,0}] + [(\mathbf{\nabla} \times \mathbf{B})^3 - \mathbf{E}^3_{,0}] \tag{58}$$

Zero-point Maxwell's equations

$$\mathbf{F}^{\mu'\nu'}_{,\nu'} = -\frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{\left(1-\frac{\mathbf{a}^2}{c^2\omega^2}\right)}\{\boldsymbol{\nabla}.\,\mathbf{E} + \left[(\boldsymbol{\nabla}\times\mathbf{B})-\mathbf{E}_{,0}\right]\} \tag{59}$$

Usual Maxwell's Equations remain universal for all observers

$$\mathbf{F}^{\mu'\nu'}_{,\nu'} = \left[\boldsymbol{\nabla}.\,\mathbf{E} + \left[(\boldsymbol{\nabla}\times\mathbf{B})-\mathbf{E}_{,0}\right]\right] \tag{60}$$

Relation Between Zero-Point Maxwell's Equations and Usual Maxwell's Equations

$$\mathbf{F}^{\mu'\nu'}_{,\nu'} = -\frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{\left(1-\frac{\mathbf{a}^2}{c^2\omega^2}\right)}\mathbf{F}^{\mu\nu}_{,\nu} \tag{61}$$

4.4. Zero-point Terms of Conservation Law by Matrix Method

Zero-Point Terms of conservation of Gauss's law

$$\mathbf{F}^{0'0'}_{,0'0'} = \frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{\left(1-\frac{\mathbf{a}^2}{c^2\omega^2}\right)}\boldsymbol{\nabla}.\,\mathbf{E}_{,0} \tag{62}$$

Zero Point Terms of Conservation of Ampere's Law

$$\mathbf{F}^{i'i'}_{,i'i'} = -\frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{\left(1-\frac{\mathbf{a}^2}{c^2\omega^2}\right)}\left[\boldsymbol{\nabla}.\,\mathbf{E}_{,0} - \boldsymbol{\nabla}.\,(\boldsymbol{\nabla}\times\mathbf{B})\right] \tag{63}$$

Zero-Point Conservation law holds along the diagonal.

$$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{\left(1-\frac{\mathbf{a}^2}{c^2\omega^2}\right)}\left[\boldsymbol{\nabla}.\,\mathbf{E}_{,0} - \boldsymbol{\nabla}.\,\mathbf{E}_{,0} - \boldsymbol{\nabla}.\,(\boldsymbol{\nabla}\times\mathbf{B})\right] = 0 \tag{64}$$

The combination of temporal and spatial singularities $\mathbf{F}^{\mu\mu}_{,\mu\mu}$ of conservation law constitutes, combination of conservation of Gauss's law and Ampere's law.

Usual conservation law holds as it is

$$\mathbf{F}^{\mu'\nu'}_{,,\nu'\mu'} = \boldsymbol{\nabla}.\,\mathbf{E}_{,0} + \boldsymbol{\nabla}.\,(\boldsymbol{\nabla}\times\mathbf{B})-\boldsymbol{\nabla}.\,\mathbf{E}_{,0} = 0 \tag{65}$$

Relation Between Zero-Point and Usual Conservation Law

$$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{\left(1-\frac{\mathbf{a}^2}{c^2\omega^2}\right)}\mathbf{F}^{\mu'\nu'}_{,,\nu'\mu'} \tag{66}$$

4.5. Zero-point Terms of in Conservation Law by Einstein's Method

By Einstein's summation convention method, we get very strange results. The set of singularities of conservation law $\mathbf{F}^{\mu\mu}_{,\mu\mu}$ is transformed into 4D EM wave with some extra terms.

Zero-Point 4D EM Wave

$$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = 2\left(\frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{\left(1-\frac{\mathbf{a}^2}{c^2\omega^2}\right)}\right)\mathbf{E} + \frac{\frac{\mathbf{a}_1^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\left[\mathbf{B}^1_{,22}-\mathbf{B}^1_{,33}\right] + \frac{\frac{\mathbf{a}_2^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\left[\mathbf{B}^2_{,33}-\mathbf{B}^2_{,11}\right] + \frac{\frac{\mathbf{a}_3^2}{c^2\omega^2}}{(1-\frac{\mathbf{a}^2}{c^2\omega^2})}\left[\mathbf{B}^3_{,11}-\mathbf{B}^3_{,22}\right] \tag{67}$$

Zero-Point Conservation Law as 7D Wave Equation

$$\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = [\square^2 - \boldsymbol{\nabla}^2]\left(\frac{\frac{\mathbf{a}^2}{c^2\omega^2}}{\left(1-\frac{\mathbf{a}^2}{c^2\omega^2}\right)}\right)\mathbf{E} \tag{68}$$

Whereas conservation law is transformed in to 4-times of usual conservation law and 7-dimensional wave of electric field. The 7D wave operator $[\square^2 - \boldsymbol{\nabla}^2]$ is the consequence of transformation of conservation law based on STL for 4-vectors and tensors. It is entirely new result. It possesses 6 dimensions of space and one dimension of time. As there are 4 dimensions of zero-point and 4 dimensions of usual electrodynamics so it represents 8D model of electrodynamics. Our previous models [1,2], also represent 8D models of electrodynamics, inertia and gravitation. It seems to be a string theory of electrodynamics where zero-point electrodynamics has a definite physical significance as each term has a clear source.

The contemporary models on electrodynamics in noninertial frame by Scorgie [3] doesn't possess the explanation of reference frame. Atwater [4] considers Galilean metric as the representative of noninertial metric that is a special case of our noninertial metric [2]. References [5] and [6] are based on differential forms and usual Lorentz transformation that are

replaced by our ULTM. Fedosin's model [7] Lorentz invariance of gravito-electromagnetism without STL for 4-vectors and tensors. Nicolie's model [8] based on monad algebra and Costa [9] on Lie derivatives are of highly importance in accelerating and rotating systems but these models do not discuss the transformation of conservation law and the extra terms in Maxwell's equations do not have clear origin like ours. Furthermore, wave equations are not discussed. Maxwell's equations in accelerating metric have been developed in our earlier model [2], in model-4, page-210. The accelerating expansion of our universe [10-12] can be viewed in the light of our model. Maxwell's equations in noninertial frame based on connection coefficients initiated the need of STL for 4-vectors and tensors and ULTM in 2D and 4D [13], case# 7, page-4.

4.6. Comparison With Contemporary Models: The Case of ZPF

Haisch B. [13], page-682, equation (18), considers magnetic force as zero-point field (ZPF) effect of inertia due to reaction to acceleration.

$$\mathbf{F} = e\frac{\mathbf{v}(\tau)}{c} \times \mathbf{B}_\tau^{zp}(0, \tau) \tag{4.7.1}$$

In our model [2], (page-220, equation (2)) magnetic component of Lorentz force is the consequence of transformation of electromagnetic field in noninertial velocity metric based on STL for 4-vectors and tensors where EMF appears as magnetic force.

$$\mathbf{F}^{\mu'\nu'} = (\mathbf{v} \times \mathbf{B}) \tag{4.7.2}$$

In our model [2], (page-222, equation (2)) magnetic component of Lorentz force is the consequence of transformation of electromagnetic field in Lorentz transformation in 4D based on STL for 4-vectors and tensors where EMF appears as Lorentz factor times magnetic force.

$$\mathbf{F}^{\mu'\nu'} = \gamma(\mathbf{v} \times \mathbf{B}) \tag{4.7.3}$$

In an accelerating metric [2], page-226, electromagnetic field becomes time-varying magnetic force

$$\mathbf{F}^{\mu'\nu'} = (\mathbf{a} \times \mathbf{B}) \tag{4.7.4}$$

4.7. The Case of Zero-Point Energy

As compared to the concept of zero-point energy in quantum mechanics $E_0 = \frac{1}{2}h\nu$, we do have a very rich structure of zero-point electric energy in model-2, in noninertial coordinate metric via equation (1). Zero-point results are possible only by means of transformation of electrodynamics based on STL for 4-vectors and tensors where there is no extra assumptions or speculations. This relation is also obtained in 4D Lorentz transformation presented in appendix.

4.8. The Case of Zero-Point Force

Quantum theory predicts zero-point force as Casimir force. In model-2, via equation (6), we have obtained zero-point Maxwell's equations as power-Force unified concept in noninertial coordinate metric. Lorentz transformation in 4D possesses zero-point Maxwell's equations as power-Force with Lorentz factor, column-2, equation (6) in appendix A-1.

4.9. The Case of Zero-Point Conservation Law as 4D wave of Electrical Energy

The concept of zero-point conservation law as 4D wave of electrical energy is only the prediction of our model in noninertial coordinate metric.

4.10. Applications of Zero-Point Energy in Space Vehicles

Scientists of the day are proposing the possibility of space vehicles to be driven by the zero-point energy [15-21] Our cosmic world is so large that even light years appear very small scale. In order to explore cosmos, a natural and unending source of energy is needed that must be supplied by the vacuum. Zero-point energy and zero-point power-force of vacuum is expected to provide this technology.

A complete framework of electrodynamics in 2D and 4D Lorentz transformation based on similarity transformation method is presented in appendix A-2. It was necessary to differentiate between the two methods viz. STL and STM. It is to be noted that, STM doesn't provide zero-point results.

5. Conclusions

Single transformation law for 4-vectors and tensors has been proved as the decoder of zero-point physics in this model as well as in the previous two papers [1,2] and [23]. The discovery of zero-point electrodynamics and conservation law as 7D wave within usual electrodynamics in noninertial frame are the major consequences of STL for 4-vectors and tensors.

Einstein's principle of relativity has got its real universal status. In other words, spacetime laws of physics remain same for all observers has been achieved in inertial as well as in noninertial frame shown in the table-1. Quantum theory predicted zero-point energy but our present model predicts complete structure of zero-point electrodynamics, 4D EM wave and conservation law as 7D EM wave. Zero-point structure of electrodynamics is also predicted by usual Lorentz transformation in 2D and 4D but based on STL that confirms the validity of our methodology. An independent framework of zero-point complete electrodynamics is developed where we can see the zero-point results in three steps. Electrodynamics in noninertial coordinate metric has predicted zero-point energy, zero-point Maxwell's equation as power-force and zero-point conservation law as 4D wave of electrical energy. These discoveries will help us to develop space vehicles propelled by zero-point energy and power-force. Our previous model [2] and recently [23] have predicted a series of zero-point physical concepts like electric power, time varying electric power etc. In the upcoming papers, framework of inertia and gravitation are expected to be related with quantum theory via simple equations are the topics of our future work.

Appendix

A-1. Zero-Point Electrodynamics under Usual Lorentz Transformation

What kind of electrodynamics is emerged in usual Lorentz transformation based on single transformation law for 4-vectors and tensors? It is the most valid question because 117 years of spacetime physics is relying on it. Very interesting results are obtained in this context. Zero-point electrodynamics is present within the usual electrodynamics. In order to show the importance of this formulation, we transform Maxwell's equations in tensor form and 4-current density under STL which gives us the same results.

Maxwell's equations in tensor form are represented by the divergence of electromagnetic field tensor equal to 4-current density

$$\mathbf{F}^{\mu\nu}_{,\nu} = \mathbf{J}^{\mu} \tag{A1}$$

Now, we transform both sides of (2.1) under STL

$$\mathbf{F}^{\mu'\nu'}_{,\nu'} == \mathbf{L}^{\mu'}_{\alpha}\mathbf{F}^{\alpha\nu'}_{,\nu'} \tag{A2}$$

$$\mathbf{F}^{\mu'\nu'}_{,\nu'} = \gamma(1-\mathbf{v}_1)(\nabla.\mathbf{E}) + \gamma(1-\mathbf{v}_1)\left[(\nabla\times\mathbf{B})^1 - \mathbf{E}^1_{,0}\right] + \left[(\nabla\times\mathbf{B})^2 - \mathbf{E}^2_{,0}\right] + \left[(\nabla\times\mathbf{B})^3 - \mathbf{E}^3_{,0}\right] \tag{A3}$$

$$\mathbf{J}^{\mu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{J}^{\alpha} \tag{A4}$$

$$\mathbf{J}^{\mu'} = \gamma(1-\mathbf{v}_1)\mathbf{J}^0 + \gamma(1-\mathbf{v}_1)\mathbf{J}^1 + \mathbf{J}^2 + \mathbf{J}^3 \tag{A5}$$

Comparing the results of (2.3) and (2.5), we get the same results that establishes the validity of STL for 4-vectors and tensors.

If we transform Maxwell's equations by means of similarity transformation technique

$$\mathbf{F}^{\mu'\nu'}_{,\nu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{L}^{\nu'}_{\beta}\mathbf{F}^{\alpha\beta}_{,\nu'} \tag{A6}$$

$$\mathbf{F}^{\mu'\nu'}_{,\nu'} = \mathbf{E}^1_{,1} + \gamma\mathbf{E}^2_{,2} + \gamma\mathbf{E}^3_{,3} + \gamma\mathbf{v}_1[(\mathbf{B}^2_{,3} - \mathbf{B}^3_{,2}) - \mathbf{E}^1_{,0} - \gamma\mathbf{E}^2_{,0} - \gamma\mathbf{E}^3_{,0} +$$

$$\gamma\mathbf{v}_1[\mathbf{E}^2_{,1} + \mathbf{E}^3_{,1} - \mathbf{E}^2_{,2} - \mathbf{E}^3_{,3}] + \gamma[(\mathbf{B}^3_{,2} - \mathbf{B}^2_{,3}) + \gamma\mathbf{v}_1(\mathbf{B}^3_{,0} - \mathbf{B}^2_{,0}) - \gamma(\mathbf{B}^3_{,1} + \mathbf{B}^2_{,1}) + \mathbf{B}^1_{,3} - \mathbf{B}^1_{,2} \tag{A7}$$

Then the results of both sides of (A1) do not remain same as (A5) and (A7) are different. That is why we need STL for consistency.

A-1.1: Transformation of Electromagnetic Field Tensor

$$[\mathbf{L}^{\mu}_{\nu}] = \begin{bmatrix} \gamma & -\gamma\mathbf{v}_1 & 0 & 0 \\ -\gamma\mathbf{v}_1 & \gamma & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \tag{A8}$$

$$L^0_0 = L^1_1 = \gamma, \qquad L^2_2 = L^3_3 = 1, \qquad L^0_1 = L^1_0 = -\gamma\mathbf{v}_1 \quad c = 1$$

$$\begin{bmatrix} \mathbf{F}^{0'\nu'} \\ \mathbf{F}^{1'\nu'} \\ \mathbf{F}^{2'\nu'} \\ \mathbf{F}^{3'\nu'} \end{bmatrix} = \begin{bmatrix} \gamma & -\gamma\mathbf{v}_1 & 0 & 0 \\ -\gamma\mathbf{v}_1 & \gamma & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \gamma\mathbf{v}_1\mathbf{E}^1 & \gamma\mathbf{E}^1 & \gamma[\mathbf{E}^2 - \mathbf{v}_1\mathbf{B}^3] & \gamma[\mathbf{E}^3 + \mathbf{v}_1\mathbf{B}^2] \\ -\gamma\mathbf{E}^1 & -\gamma\mathbf{v}_1\mathbf{E}^1 & -\gamma\mathbf{v}_1\mathbf{E}^2 + \gamma\mathbf{B}^3 & -\gamma\mathbf{v}_1\mathbf{E}^3 - \gamma\mathbf{B}^2 \\ -\mathbf{E}^2 & -\mathbf{B}^3 & 0 & \mathbf{B}^1 \\ -\mathbf{E}^3 & \mathbf{B}^2 & -\mathbf{B}^1 & 0 \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}^{0'\nu'} \\ \mathbf{F}^{1'\nu'} \\ \mathbf{F}^{2'\nu'} \\ \mathbf{F}^{3'\nu'} \end{bmatrix} = \begin{bmatrix} \gamma\mathbf{v}_1\mathbf{E}^1 & \gamma\mathbf{E}^1 & \gamma[\mathbf{E}^2 - \mathbf{v}_1\mathbf{B}^3] & \gamma[\mathbf{E}^3 + \mathbf{v}_1\mathbf{B}^2] \\ -\gamma\mathbf{E}^1 & -\gamma\mathbf{v}_1\mathbf{E}^1 & -\gamma\mathbf{v}_1\mathbf{E}^2 + \gamma\mathbf{B}^3 & -\gamma\mathbf{v}_1\mathbf{E}^3 - \gamma\mathbf{B}^2 \\ -\mathbf{E}^2 & -\mathbf{B}^3 & 0 & \mathbf{B}^1 \\ -\mathbf{E}^3 & \mathbf{B}^2 & -\mathbf{B}^1 & 0 \end{bmatrix}$$

Zero-point term of Electric Field

$$\mathbf{F}^{0'0'} = \gamma\mathbf{v}_1\mathbf{E}^1 \tag{A9}$$

Zero-point term of Magnetic Field

$$\mathbf{F}^{1'1'} = -\gamma\mathbf{v}_1\mathbf{E}^1 \tag{A10}$$

4D Electric Field

$$\mathbf{F}^{0'v'} = \gamma\mathbf{E} - \gamma\mathbf{v}_1[(\mathbf{B}^2 - \mathbf{B}^3) - \mathbf{E}^1] \tag{A11}$$

Magnetic Field

$$\mathbf{F}^{i'v'} = -\gamma\mathbf{v}_1\mathbf{E} + \gamma[(\mathbf{B}^3 - \mathbf{B}^2) - \mathbf{E}^1] + [(\mathbf{B}^1 - \mathbf{B}^3) - \mathbf{E}^2] + [(\mathbf{B}^2 - \mathbf{B}^1) - \mathbf{E}^3] \tag{A12}$$

Electromagnetic Field

$$\mathbf{F}^{\mu'v'} = \gamma(1 - \mathbf{v}_1)\mathbf{E} + \gamma(1 - \mathbf{v}_1) - \gamma\mathbf{v}_1[(\mathbf{B}^2 - \mathbf{B}^3) - \mathbf{E}^1] \ + [(\mathbf{B}^1 - \mathbf{B}^3) - \mathbf{E}^2] + [(\mathbf{B}^2 - \mathbf{B}^1) - \mathbf{E}^3] \tag{A13}$$

Electromagnetic field doesn't remain same in its original form after transformation

A-1.2: Transformation of Maxwell's Equations Based on STL Method

$$\begin{bmatrix} \mathbf{F}^{0'v'}_{,v'} \\ \mathbf{F}^{1'v'}_{,v'} \\ \mathbf{F}^{2'v'}_{,v'} \\ \mathbf{F}^{3'v'}_{,v'} \end{bmatrix} = \begin{bmatrix} \gamma\mathbf{v}_1\mathbf{E}^1_{,0} & \gamma\mathbf{E}^1_{,1} & \gamma\mathbf{E}^2_{,2} - \gamma\mathbf{v}_1\mathbf{B}^3_{,2} & \gamma\mathbf{E}^3_{,3} + \gamma\mathbf{v}_1\mathbf{B}^2_{,3} \\ -\mathbf{E}^1_{,0} & -\gamma\mathbf{v}_1\mathbf{E}^1_{,1} & \gamma\mathbf{B}^3_{,2} - \gamma\mathbf{v}_1\mathbf{E}^2_{,2} & -\gamma\mathbf{v}_1\mathbf{E}^3_{,3} - \gamma\mathbf{B}^2_{,3} \\ -\mathbf{E}^2_{,0} & -\mathbf{B}^3_{,1} & 0 & \mathbf{B}^1_{,3} \\ -\mathbf{E}^3_{,0} & \mathbf{B}^2_{,1} & -\mathbf{B}^1_{,2} & 0 \end{bmatrix}$$

Zero-Point Term of Gauss's Law

$$\mathbf{F}^{0'0'}_{,0'} = \gamma\mathbf{v}_1\mathbf{E}^1_{,0} \tag{A14}$$

Zero-Point Term of Ampere's Law

$$\mathbf{F}^{1'1'}_{,1'} = -\gamma\mathbf{v}_1\mathbf{E}^1_{,1} \tag{A15}$$

Gauss's Law

$$\mathbf{F}^{0'v'}_{,v'} = \gamma(\nabla.\mathbf{E}) - \gamma\mathbf{v}_1[(\nabla \times \mathbf{B})^1 - \mathbf{E}^1_{,0}] \tag{A16}$$

Ampere's Law

$$\mathbf{F}^{i'v'}_{,v'} = -\gamma\mathbf{v}_1(\nabla.\mathbf{E}) + \gamma[(\nabla \times \mathbf{B})^1 - \mathbf{E}^1_{,0}] + [(\nabla \times \mathbf{B})^2 - \mathbf{E}^2_{,0}] + [(\nabla \times \mathbf{B})^3 - \mathbf{E}^3_{,0}] \tag{A17}$$

$$\mathbf{F}^{\mu'v'}_{,v'} = \gamma(1 - \mathbf{v}_1)(\nabla.\mathbf{E}) + \gamma(1 - \mathbf{v}_1)[(\nabla \times \mathbf{B})^1 - \mathbf{E}^1_{,0}] + [(\nabla \times \mathbf{B})^2 - \mathbf{E}^2_{,0}] + [(\nabla \times \mathbf{B})^3 - \mathbf{E}^3_{,0}] \tag{A18}$$

Maxwell's equations in tensor form do not remain same in its original form after transformation.

A-1.3: Transformation of Conservation Law by Matrix Method

$$\begin{bmatrix} \mathbf{F}^{0'v'0'}_{,v'} \\ \mathbf{F}^{1'v'}_{,v'1'} \\ \mathbf{F}^{2'v'}_{,v'2'} \\ \mathbf{F}^{3'v'}_{,v'3'} \end{bmatrix} = \begin{bmatrix} \gamma & -\gamma\mathbf{v}_1 & 0 & 0 \\ -\gamma\mathbf{v}_1 & \gamma & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0 & \mathbf{E}^1_{,10} & \mathbf{E}^2_{,20} & \mathbf{E}^3_{,30} \\ -\mathbf{E}^1_{,01} & 0 & \mathbf{B}^3_{,21} & -\mathbf{B}^2_{,31} \\ -\mathbf{E}^2_{,02} & -\mathbf{B}^3_{,12} & 0 & \mathbf{B}^1_{,32} \\ -\mathbf{E}^3_{,03} & \mathbf{B}^2_{,13} & -\mathbf{B}^1_{,23} & 0 \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{F}^{0'v'}_{,v'0'} \\ \mathbf{F}^{1'v'}_{,v'1'} \\ \mathbf{F}^{2'v'}_{,v'2'} \\ \mathbf{F}^{3'v'}_{,v'3'} \end{bmatrix} = \begin{bmatrix} \gamma\mathbf{v}_1\mathbf{E}^1_{,01} & \gamma\mathbf{E}^1_{,10} & \gamma\mathbf{E}^2_{,20} - \gamma\mathbf{v}_1\mathbf{B}^3_{,21} & \gamma\mathbf{E}^3_{,30} + \gamma\mathbf{v}_1\mathbf{B}^2_{,31} \\ -\gamma\mathbf{E}^1_{,01} & -\gamma\mathbf{v}_1\mathbf{E}^1_{,10} & -\gamma\mathbf{v}_1\mathbf{E}^2_{,20} + \gamma\mathbf{B}^3_{,21} & -\gamma\mathbf{v}_1\mathbf{E}^3_{,30} - \gamma\mathbf{B}^2_{,31} \\ -\mathbf{E}^2_{,02} & -\mathbf{B}^3_{,12} & 0 & \mathbf{B}^1_{,32} \\ -\mathbf{E}^3_{,03} & \mathbf{B}^2_{,13} & -\mathbf{B}^1_{,23} & 0 \end{bmatrix}$$

Zero-Point Term of Conservation of Gauss's Law

$$\mathbf{F}^{0'0'}_{,0'} = \gamma\mathbf{v}_1\mathbf{E}^1_{,01} \tag{A19}$$

Zero-Point Term of Conservation of Ampere's Law

$$\mathbf{F}^{1'1'}_{,1'} = -\gamma\mathbf{v}_1\mathbf{E}^1_{,10} \tag{A20}$$

$$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \gamma\mathbf{v}_1\mathbf{E}^1_{,01} - \gamma\mathbf{v}_1\mathbf{E}^1_{,01} = 0 \tag{A21}$$

$$\mathbf{F}^{\mu'v'}_{,v'\mu'} = \gamma(1 - \mathbf{v}_1)(\nabla.\mathbf{E}_{,0}) + \gamma(1 - \mathbf{v}_1)[(\nabla \times \mathbf{B})^1_{,1} - \mathbf{E}^1_{,01}] + [(\nabla \times \mathbf{B})^2_{,2} - \mathbf{E}^2_{,02}] + [(\nabla \times \mathbf{B})^3_{,3} - \mathbf{E}^3_{,03}] \tag{A22}$$

Conservation law doesn't remain same in its original form after transformation.

A-1.4: Transformation of Conservation Law (Einstein's Summation Convention Method)

Table 5. Electrodynamics in 2D and 4D Lorentz Transformation (Single Transformation Law Method)

STL Based Electrodynamics in 2D Lorentz	STL Based Electrodynamics in 4D Lorentz
$[\mathbf{L}^{\mu}_{\nu}] = \begin{bmatrix} \gamma & -\gamma\mathbf{v}_1 & 0 & 0 \\ -\gamma\mathbf{v}_1 & \gamma & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$	$[\mathbf{L}^{\mu}_{\nu}] = \begin{bmatrix} \gamma & -\gamma\mathbf{v}_1 & -\gamma\mathbf{v}_2 & -\gamma\mathbf{v}_3 \\ -\gamma\mathbf{v}_1 & \gamma & 0 & 0 \\ -\gamma\mathbf{v}_2 & 0 & \gamma & 0 \\ -\gamma\mathbf{v}_3 & 0 & 0 & \gamma \end{bmatrix}$

$L^0_0 = L^1_1 = \gamma, \qquad L^2_2 = L^3_3 = 1, \qquad L^0_1 = L^1_0 = -\gamma\mathbf{v}_1$	$L^0_0 = L^1_1 = L^2_2 = L^3_3 = \gamma, \qquad L^0_i = L^i_0 = -\gamma\mathbf{v}_i$
Transformation of Electromagnetic Field	Transformation of Electromagnetic Field
$\mathbf{F}^{\mu'\nu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{F}^{\alpha\nu'}$	$\mathbf{F}^{\mu'\nu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{F}^{\alpha\nu'}$
Zero-Point Term of Electric Field	Zero-point Terms of Electric field
$\mathbf{F}^{0'0'} = \gamma\mathbf{v}_1\mathbf{E}^1$	$\mathbf{F}^{0'0'} = (\gamma\mathbf{v}.\mathbf{E})$
4D Electric Field	Zero-point Terms of Magnetic field
$\mathbf{F}^{0'\nu'} = \gamma\mathbf{v}_1\mathbf{E}^1 + \gamma[\mathbf{E}+\mathbf{v}_1(\mathbf{B}^2 - \mathbf{B}^3)]$	$\mathbf{F}^{i'i'} = -(\gamma\mathbf{v}.\mathbf{E})$
Zero-Point Term of Magnetic Field	Zero-point Terms of Electromagnetic field
$\mathbf{F}^{i'\nu'} = -\gamma\mathbf{v}_1\mathbf{E}$	$\mathbf{F}^{\mu'\mu'} = (\gamma\mathbf{v}.\mathbf{E}) - (\gamma\mathbf{v}.\mathbf{E})$
Magnetic Field in Tensor Form	4D electric Field as 4D Lorentz Force
$\mathbf{F}^{i'\nu'} = -\gamma\mathbf{v}_1\mathbf{E} + \gamma[(\mathbf{B}^2 - \mathbf{B}^3) - \mathbf{E}^1] +[(\mathbf{B}^1 - \mathbf{B}^3) - \mathbf{E}^2]$ $+[(\mathbf{B}^2 - \mathbf{B}^1) - \mathbf{E}^3]$	$\mathbf{F}^{0'\nu'} = \gamma\{\mathbf{v}.\mathbf{E} + [\mathbf{E} + (\mathbf{v} \times \mathbf{B})]\}$
Electromagnetic Field	Magnetic Field
$\mathbf{F}^{\mu'\nu'} = \gamma(1 - \mathbf{v}_1)\mathbf{E} + \gamma(1 - \mathbf{v}_1)[(\mathbf{B}^2 - \mathbf{B}^3) - \mathbf{E}^1]$ $+[(\mathbf{B}^1 - \mathbf{B}^3) - \mathbf{E}^2] + [(\mathbf{B}^2 - \mathbf{B}^1) - \mathbf{E}^3]$	$\mathbf{F}^{i'\nu'} = -\gamma\mathbf{E} - (\gamma\mathbf{v}.\mathbf{E})$
Transformation of Maxwell's Equations	Electromagnetic Field
$\mathbf{F}^{\mu'\nu'}_{,\nu'} = = \mathbf{L}^{\mu'}_{\alpha}\mathbf{F}^{\alpha\nu'}_{,\nu'}$	$\mathbf{F}^{\mu'\nu'} = \gamma(\mathbf{v} \times \mathbf{B})$
Zero-Point Term of Gauss's Law	Transformation of Maxwell's Equations
$\mathbf{F}^{0'0'}_{,0'} = \gamma\mathbf{v}_1\mathbf{E}^1_{,0}$	$\mathbf{F}^{\mu'\nu'}_{,\nu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{F}^{\alpha\nu'}_{,\nu'}$
Zero-Point Term of Ampere's Law	Zero-Point Term of Gauss's Law
$\mathbf{F}^{1'1'}_{,1'} = -\gamma\mathbf{v}_1\mathbf{E}^1_{,1}$	$\mathbf{F}^{0'0'}_{,0'} = \gamma\mathbf{v}.\mathbf{E}_{,0}$
Zero-Point Term of Maxwell's Equations	Zero-Point Term of Ampere's Law
$\mathbf{F}^{\mu'\mu'}_{,\mu'} = \gamma\mathbf{v}_1\mathbf{E}^1_{,0} - \gamma\mathbf{v}_1\mathbf{E}^1_{,1}$	$\mathbf{F}^{i'i'}_{,i'} = -\gamma\mathbf{\nabla}(\mathbf{v}.\mathbf{E})$
Gauss's Law	Zero-Point Term of Maxwell's Equations
$\mathbf{F}^{0'\nu'}_{,\nu'} = \gamma(\mathbf{\nabla}.\mathbf{E}) - \gamma\mathbf{v}_1[(\mathbf{\nabla} \times \mathbf{B})^1 - \mathbf{E}^1_{,0}]$	$\mathbf{F}^{\mu'\mu'}_{,\mu'} = \gamma\mathbf{v}.\mathbf{E}_{,0} - \gamma\mathbf{\nabla}(\mathbf{v}.\mathbf{E})$
Ampere's Law	Gauss's Law
$\mathbf{F}^{i'\nu'}_{,\nu'} = -\gamma\mathbf{v}_1(\mathbf{\nabla}.\mathbf{E}) + \gamma[(\mathbf{\nabla} \times \mathbf{B})^1 - \mathbf{E}^1_{,0}] + [(\mathbf{\nabla} \times \mathbf{B})^2 - \mathbf{E}^2_{,0}]$ $+[(\mathbf{\nabla} \times \mathbf{B})^3 - \mathbf{E}^3_{,0}]$	$\mathbf{F}^{0'\nu'}_{,\nu'} = \gamma\{\mathbf{v}.\mathbf{E}_{,0} + \mathbf{\nabla}.[\mathbf{E} + (\mathbf{v} \times \mathbf{B})]\}$
Maxwell's Equations in Tensor Form	Ampere's Law
$\mathbf{F}^{\mu'\nu'}_{,\nu'} = \gamma(1 - \mathbf{v}_1)(\mathbf{\nabla}.\mathbf{E}) + \gamma(1 - \mathbf{v}_1)[(\mathbf{\nabla} \times \mathbf{B})^1 - \mathbf{E}^1_{,0}]$ $+[(\mathbf{\nabla} \times \mathbf{B})^2 - \mathbf{E}^2_{,0}] + [(\mathbf{\nabla} \times \mathbf{B})^3 - \mathbf{E}^3_{,0}]$	$\mathbf{F}^{i'\nu'}_{,\nu'} = -\gamma\{\mathbf{\nabla}(\mathbf{v}.\mathbf{E}) - [(\mathbf{\nabla} \times \mathbf{B}) - \mathbf{E}_{,0}]\}$
Transformation of Conservation Law	Maxwell's Equations in Tensor Form
$\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{F}^{\alpha\nu'}_{,\nu'\mu'}$	$\mathbf{F}^{\mu'\nu'}_{,\nu'} = \gamma\{\mathbf{v}.\mathbf{E}_{,0} + \mathbf{\nabla}.[\mathbf{E} + (\mathbf{v} \times \mathbf{B})]\} - \gamma\{\mathbf{\nabla}(\mathbf{v}.\mathbf{E}) - [(\mathbf{\nabla} \times \mathbf{B}) - \mathbf{E}_{,0}]\}$
Zero-Point Term of Conservation of Gauss's Law	Transformation of Conservation Law
$\mathbf{F}^{0'0'}_{,0'0'} = \gamma\mathbf{v}_1\mathbf{E}^1_{,00}$	$\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{F}^{\alpha\nu'}_{,\nu'\mu'}$
Zero-Point Term of Conservation of Ampere's Law	Zero-Point Term of Conservation of Gauss's Law
$\mathbf{F}^{1'1'}_{,1'1'} = -\gamma\mathbf{v}_1\mathbf{E}^1_{,11}$	$\mathbf{F}^{0'0'}_{,0'0'} = \gamma\mathbf{v}.\mathbf{E}_{,00}$
Zero-Point Conservation Law	Zero-Point Term of Conservation of Ampere's Law
$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = {}^2_1(\gamma\mathbf{v}_1\mathbf{E}^1)$	$\mathbf{F}^{i'i'}_{,i'i'} = -\mathbf{\nabla}^2(\gamma\mathbf{v}.\mathbf{E})$
Conservation of Gauss's Law	Zero-Point Conservation Law
$\mathbf{F}^{0'\nu'}_{,\nu'0'} = \gamma(\mathbf{\nabla}.\mathbf{E}_{,0}) + {}^2_1\gamma\mathbf{v}_1\mathbf{E}^1)$	$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \Box^2(\gamma\mathbf{v}.\mathbf{E})$
Conservation of Ampere's Law	Conservation of Gauss's Law
$\mathbf{F}^{i'\nu'}_{,\nu'i'} = -\gamma\mathbf{v}_1(\mathbf{\nabla}.\mathbf{E}_{,1}) + \gamma[(\mathbf{\nabla} \times \mathbf{B})^1_{,1} - \mathbf{E}^1_{,01}] + [(\mathbf{\nabla} \times \mathbf{B})^2_{,2} - \mathbf{E}^2_{,02}]$ $+[(\mathbf{\nabla} \times \mathbf{B})^3_{,3} - \mathbf{E}^3_{,03}]$	$\mathbf{F}^{0'\nu'}_{,\nu'0'} = \Box^2(\gamma\mathbf{v}.\mathbf{E}) + \gamma(\mathbf{\nabla}.\mathbf{E}_{,0})$
Complete Conservation Law	Conservation of Ampere's Law
$\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = [{}^2_1 - \mathbf{\nabla}^2_1](\gamma\mathbf{v}_1\mathbf{E}^1) + \gamma(\mathbf{\nabla}.\mathbf{E}_{,0}) + +\gamma[(\mathbf{\nabla} \times \mathbf{B})^1_{,1} - \mathbf{E}^1_{,01}]$ $+[(\mathbf{\nabla} \times \mathbf{B})^2_{,2} - \mathbf{E}^2_{,02}] + [(\mathbf{\nabla} \times \mathbf{B})^3_{,3} - \mathbf{E}^3_{,03}]$	$\mathbf{F}^{i'\nu'}_{,\nu'i'} = -\mathbf{\nabla}^2(\gamma\mathbf{v}.\mathbf{E}) + \gamma\mathbf{v}[(\mathbf{\nabla} \times \mathbf{B}) - \mathbf{E}_{,0}]$
	Complete Conservation Law
	Conservation Law as 7D Wave of Electrical Power
	$\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = [\Box^2 - \mathbf{\nabla}^2](\gamma\mathbf{v}.\mathbf{E})$

Table 6.   Zero-Point Electrodynamics in 2D and 4D Lorentz Transformation (Single Transformation Method)

Zero-Point Electrodynamics in 2D	Zero-Point Electrodynamics in 4D
Zero-Point Term of Electric Field $\mathbf{F}^{0'0'} = \gamma \mathbf{v_1} \mathbf{E}^1$	Zero-point Terms of Electric field $\mathbf{F}^{0'0'} = (\gamma \mathbf{v}.\mathbf{E})$
Zero-point Terms of Magnetic field $\mathbf{F}^{i'v'} = -\gamma \mathbf{v_1} \mathbf{E}^1$	Zero-point Terms of Magnetic field $\mathbf{F}^{i'i'} = -(\gamma \mathbf{v}.\mathbf{E})$
Zero-point Terms of Electromagnetic field $\mathbf{F}^{\mu'\mu'} = \gamma \mathbf{v_1} \mathbf{E}^1 - \gamma \mathbf{v_1} \mathbf{E}^1$	Zero-point Terms of Electromagnetic field $\mathbf{F}^{\mu'\mu'} = (\gamma \mathbf{v}.\mathbf{E}) - (\gamma \mathbf{v}.\mathbf{E}) = 0$
Zero-Point Term of Gauss's Law $\mathbf{F}^{0'0'}_{,0'} = \gamma \mathbf{v_1} \mathbf{E}^1_{,0}$	Zero-Point Term of Gauss's Law $\mathbf{F}^{0'0'}_{,0'} = \gamma \mathbf{v}.\mathbf{E}_{,0}$
Zero-Point Term of Ampere's Law $\mathbf{F}^{1'1'}_{,1'} = -\gamma \mathbf{v_1} \mathbf{E}^1_{,1}$	Zero-Point Term of Ampere's Law $\mathbf{F}^{i'i'}_{,i'} = -\gamma \nabla(\mathbf{v}.\mathbf{E})$
Zero-Point Term of Maxwell's Equations $\mathbf{F}^{\mu'\mu'}_{,\mu'} = \gamma \mathbf{v_1} \mathbf{E}^1_{,0} - \gamma \mathbf{v_1} \mathbf{E}^1_{,1}$	Zero-Point Term of Maxwell's Equations $\mathbf{F}^{\mu'\mu'}_{,\mu'} = \gamma[\mathbf{v}.\mathbf{E}_{,0} - \nabla(\mathbf{v}.\mathbf{E})]$
Zero-Point Term of Conservation of Gauss's Law $\mathbf{F}^{0'0'}_{,0'0'} = \gamma \mathbf{v_1} \mathbf{E}^1_{,00}$	Zero-Point Term of Conservation of Gauss's Law $\mathbf{F}^{0'0'}_{,0'0'} = \gamma \mathbf{v}.\mathbf{E}_{,00}$
Zero-Point Term of Conservation of Ampere's Law $\mathbf{F}^{1'1'}_{,1'1'} = -\gamma \mathbf{v_1} \mathbf{E}^1_{,11}$	Zero-Point Term of Conservation of Ampere's Law $\mathbf{F}^{i'i'}_{,i'i'} = -\nabla^2(\gamma \mathbf{v}.\mathbf{E})$
Zero-Point Conservation Law as 1D Wave of Electric Power $\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \square^2_1(\gamma \mathbf{v_1} \mathbf{E}^1)$	Zero-Point Conservation Law as 4D Wave of Electric Power $\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \square^2(\gamma \mathbf{v}.\mathbf{E})$

$$\begin{bmatrix} \mathbf{F}^{0'v'}_{,v'0'} \\ \mathbf{F}^{1'v'}_{,v'1'} \\ \mathbf{F}^{2'v'}_{,v'2'} \\ \mathbf{F}^{3'v'}_{,v'3'} \end{bmatrix} = \begin{bmatrix} \gamma\mathbf{v_1}\mathbf{E}^1_{,00} & \gamma\mathbf{E}^1_{,10} & \gamma\mathbf{E}^2_{,20} - \gamma\mathbf{v_1}\mathbf{B}^3_{,20} & \gamma\mathbf{E}^3_{,30} + \gamma\mathbf{v_1}\mathbf{B}^2_{,30} \\ -\gamma\mathbf{E}^1_{,01} & -\gamma\mathbf{v_1}\mathbf{E}^1_{,11} & \gamma\mathbf{B}^3_{,21} - \gamma\mathbf{v_1}\mathbf{E}^2_{,21} & -\gamma\mathbf{v_1}\mathbf{E}^3_{,31} - \gamma\mathbf{B}^2_{,31} \\ -\mathbf{E}^2_{,02} & -\mathbf{B}^3_{,12} & 0 & \mathbf{B}^1_{,32} \\ -\mathbf{E}^3_{,03} & \mathbf{B}^2_{,13} & -\mathbf{B}^1_{,23} & 0 \end{bmatrix}$$

Zero-Point Term of Conservation of Gauss's Law

$$\mathbf{F}^{0'0'}_{,0'0'} = \gamma\mathbf{v_1}\mathbf{E}^1_{,00} \tag{A23}$$

Zero-Point Term of Conservation of Ampere's Law

$$\mathbf{F}^{1'1'}_{,1'1'} = -\gamma\mathbf{v_1}\mathbf{E}^1_{,11} \tag{A24}$$

Zero-Point Term of Conservation Law

$$\mathbf{F}^{\mu'\mu'}_{,\mu'\mu'} = \square^2_1(\gamma\mathbf{v_1}\mathbf{E}^1) \tag{A25}$$

It represents only one component of 4D wave equation

$$\begin{bmatrix} \mathbf{F}^{0'v'}_{,v'0'} \\ \mathbf{F}^{i'v'}_{,v'i'} \end{bmatrix} = \begin{bmatrix} \gamma(\nabla.\mathbf{E}_{,0}) - \gamma\mathbf{v_1}[(\nabla\times\mathbf{B})^1_{,0} - \mathbf{E}^1_{,00}] \\ -\gamma\mathbf{v_1}(\nabla.\mathbf{E}_{,1}) + \gamma[(\nabla\times\mathbf{B})^1_{,1} - \mathbf{E}^1_{,01}] + [(\nabla\times\mathbf{B})^2_{,2} - \mathbf{E}^2_{,02}] + [(\nabla\times\mathbf{B})^3_{,3} - \mathbf{E}^3_{,03}] \end{bmatrix}$$

$$-\gamma\mathbf{v_1}[(\nabla\times\mathbf{B})^1_{,0} - \mathbf{E}^1_{,00}] = \square^2_1(\gamma\mathbf{v_1}\mathbf{E}^1), \quad -\gamma\mathbf{v_1}(\nabla.\mathbf{E}_{,1}) = -\nabla^2_1(\gamma\mathbf{v_1}\mathbf{E}^1)$$

$$\begin{bmatrix} \mathbf{F}^{0'v'}_{,v'0'} \\ \mathbf{F}^{i'v'}_{,v'i'} \end{bmatrix} = \begin{bmatrix} \gamma(\nabla.\mathbf{E}_{,0}) + \square^2_1\gamma\mathbf{v_1}\mathbf{E}^1) \\ -\gamma\mathbf{v_1}(\nabla.\mathbf{E}_{,1}) + \gamma[(\nabla\times\mathbf{B})^1_{,1} - \mathbf{E}^1_{,01}] + [(\nabla\times\mathbf{B})^2_{,2} - \mathbf{E}^2_{,02}] + [(\nabla\times\mathbf{B})^3_{,3} - \mathbf{E}^3_{,03}] \end{bmatrix}$$

Conservation of Gauss's Law

$$\mathbf{F}^{0'v'}_{,v'0'} = \gamma(\nabla.\mathbf{E}_{,0}) + \square^2_1\gamma\mathbf{v_1}\mathbf{E}^1) \tag{A26}$$

Conservation of Ampere's Law

$$\mathbf{F}^{i'v'}_{,v'i'} = -\gamma\mathbf{v_1}(\nabla.\mathbf{E}_{,1}) + \gamma[(\nabla\times\mathbf{B})^1_{,1} - \mathbf{E}^1_{,01}] + [(\nabla\times\mathbf{B})^2_{,2} - \mathbf{E}^2_{,02}] + [(\nabla\times\mathbf{B})^3_{,3} - \mathbf{E}^3_{,03}] \tag{A27}$$

Complete Conservation Law

$$\mathbf{F}^{\mu'v'}_{,v'\mu'} = [\square^2_1 - \nabla^2_1](\gamma\mathbf{v_1}\mathbf{E}^1) + \gamma(\nabla.\mathbf{E}_{,0}) + \gamma[(\nabla\times\mathbf{B})^1_{,1} - \mathbf{E}^1_{,01}] + [(\nabla\times\mathbf{B})^2_{,2} - \mathbf{E}^2_{,02}] + [(\nabla\times\mathbf{B})^3_{,3} - \mathbf{E}^3_{,03}] \tag{A28}$$

A-2: Electrodynamics in 2D and 4D Lorentz Transformation
(Similarity Transformation Method)

What is the complete structure of electrodynamics under usual Lorentz transformation based on similarity transformation method (STM)? In order to remove all confusions about electrodynamics in Lorentz transformation in 2D and 4D, table-6 contains the complete formulation under STM. Similarity transformation is valid only for tensors not for 4-vectors which is the major difference between STM and STL for 4-vectors and tensors. In STM, zero-point quantities do not exist. The contemporary physicists are limited up to the transformation of EMF only under 2D Lorentz transformation based on STM. Transformation of Maxwell's equations and conservation law under STM are entirely new results.

The results of electrodynamics in 4D Lorentz transformation under STM are clear and comprehensive

Electric Field

$$\mathbf{F}^{0'i'} = \gamma^2\{[\mathbf{E} + (\mathbf{v} \times \mathbf{B})] - \mathbf{v}[\mathbf{v}.\mathbf{E}]\} \tag{1}$$

Magnetic field

$$\mathbf{F}^{iv'} = -\gamma^2\{[\mathbf{E} + (\mathbf{v} \times \mathbf{B})] - \mathbf{v}[\mathbf{v}.\mathbf{E}]\} \tag{2}$$

Electromagnetic Field

$$\mathbf{F}^{\mu'v'} = \gamma^2\{[\mathbf{E} + (\mathbf{v} \times \mathbf{B})] - \mathbf{v}[\mathbf{v}.\mathbf{E}]\} - \gamma^2\{[\mathbf{E} + (\mathbf{v} \times \mathbf{B})] - \mathbf{v}[\mathbf{v}.\mathbf{E}]\} = 0 \tag{3}$$

$$\mathbf{F}^{\mu'v'} = 0$$

Electromagnetic field remains antisymmetric but not in its original form

Maxwell's Equations

Gauss's Law

$$\mathbf{F}^{0'i'}_{,i'} = -\gamma^2\mathbf{v}^2[\nabla.\mathbf{E}] + \gamma^2\nabla.[\mathbf{E} + (\mathbf{v} \times \mathbf{B})] \tag{4}$$

Ampere's Law

$$\mathbf{F}^{i'v'}_{,v'} = \gamma^2\mathbf{v}[\mathbf{v}.\mathbf{E}]_{,0} - \gamma^2[\mathbf{E} + (\mathbf{v} \times \mathbf{B})]_{,0} + \gamma^2\nabla \times [\mathbf{B} - (\mathbf{v} \times \mathbf{E})] \tag{5}$$

Maxwell's Equations in Tensor Form

$$\mathbf{F}^{\mu'v'}_{,v'} = -\gamma^2\mathbf{v}^2[\nabla.\mathbf{E}] + \gamma^2\nabla.[\mathbf{E} + (\mathbf{v} \times \mathbf{B})] + \gamma^2\mathbf{v}[\mathbf{v}.\mathbf{E}]_{,0} - \gamma^2[\mathbf{E} + (\mathbf{v} \times \mathbf{B})]_{,0} + \gamma^2\nabla \times [\mathbf{B} - (\mathbf{v} \times \mathbf{E})] \tag{6}$$

Conservation Law

$$\mathbf{F}^{\mu'v'}_{,v'\mu'} = -\gamma^2\mathbf{v}^2[\nabla.\mathbf{E}]_{,0} + \gamma^2\{\mathbf{v}^2[\nabla.\mathbf{E}]_{,0} + \gamma^2[\nabla.\mathbf{E} + (\mathbf{v} \times \mathbf{B})]_{,0} - \nabla.[\mathbf{E} + (\mathbf{v} \times \mathbf{B})]_{,0}\} = 0 \tag{7}$$

Conservation law holds but not in its original form.

Table 7. Electrodynamics in 2D and 4D Lorentz Matrix (Similarity Transformation Method)

Similarity Based Electrodynamics in 2D Lorentz	Similarity Based Electrodynamics in 4D Lorentz
$[\mathbf{L}^{\mu}_{v}] = \begin{bmatrix} \gamma & -\gamma\mathbf{v}_1 & 0 & 0 \\ -\gamma\mathbf{v}_1 & \gamma & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$	$[\mathbf{L}^{\mu}_{v}] = \begin{bmatrix} \gamma & -\gamma\mathbf{v}_1 & -\gamma\mathbf{v}_2 & -\gamma\mathbf{v}_3 \\ -\gamma\mathbf{v}_1 & \gamma & 0 & 0 \\ -\gamma\mathbf{v}_2 & 0 & \gamma & 0 \\ -\gamma\mathbf{v}_3 & 0 & 0 & \gamma \end{bmatrix}$
$L^0_0 = L^1_1 = \gamma, \quad L^2_2 = L^3_3 = 1, \quad L^0_1 = L^1_0 = -\gamma\mathbf{v}_1$ Transformation of Electromagnetic Field $\mathbf{F}^{\mu'v'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{L}^{v'}_{\beta}\mathbf{F}^{\alpha\beta}$ Electric Field $\mathbf{F}^{0'i'} = \mathbf{E}^1 + \gamma[\mathbf{E}^2 + \mathbf{E}^3] - \gamma\boldsymbol{\beta}(\mathbf{B}^3 - \mathbf{B}^2)$ (1) Magnetic Field $\mathbf{F}^{i'v'} = -\mathbf{E}^1 - \gamma\mathbf{E}^2 - \gamma\mathbf{E}^3 - \gamma\boldsymbol{\beta}(\mathbf{B}^2 - \mathbf{B}^3)$ (2) Electromagnetic Field $\mathbf{F}^{\mu'v'} = \mathbf{E}^1 + \gamma[\mathbf{E}^2 + \mathbf{E}^3] - \gamma\boldsymbol{\beta}(\mathbf{B}^3 - \mathbf{B}^2)$ $-\mathbf{E}^1 - \gamma\mathbf{E}^2 - \gamma\mathbf{E}^3 - \gamma\boldsymbol{\beta}(\mathbf{B}^2 - \mathbf{B}^3) = 0$ (3) $\mathbf{F}^{\mu'v'} = 0$ Electromagnetic field remains antisymmetric but not in its original form Transformation of Maxwell's Equations $\mathbf{F}^{\mu'v'}_{,v'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{L}^{v'}_{\beta}\mathbf{F}^{\alpha\beta}_{,v'}$ Gauss's Law $\mathbf{F}^{0'v'}_{,v'} = \mathbf{E}^1_{,1} + \gamma\mathbf{E}^2_{,2} + \gamma\mathbf{E}^3_{,3} + \gamma\boldsymbol{\beta}[(\mathbf{B}^2_{,3} - \mathbf{B}^3_{,2})]$ (4)	$L^0_0 = L^1_1 = L^2_2 = L^3_3 = \gamma, \quad L^0_i = L^i_0 = -\gamma\mathbf{v}_i$ Transformation of Electromagnetic Field $\mathbf{F}^{\mu'v'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{L}^{v'}_{\beta}\mathbf{F}^{\alpha\beta}$ Electric Field $\mathbf{F}^{0'i'} = \gamma^2\{[\mathbf{E} + (\mathbf{v} \times \mathbf{B})] - \mathbf{v}[\mathbf{v}.\mathbf{E}]\}$ (1) Magnetic field $\mathbf{F}^{iv'} = -\gamma^2\{[\mathbf{E} + (\mathbf{v} \times \mathbf{B})] - \mathbf{v}[\mathbf{v}.\mathbf{E}]\}$ (2) Electromagnetic Field $\mathbf{F}^{\mu'v'} = \gamma^2\{[\mathbf{E} + (\mathbf{v} \times \mathbf{B})] - \mathbf{v}[\mathbf{v}.\mathbf{E}]\}$ $-\gamma^2\{[\mathbf{E} + (\mathbf{v} \times \mathbf{B})] - \mathbf{v}[\mathbf{v}.\mathbf{E}]\} = 0$ (3) $\mathbf{F}^{\mu'v'} = 0$ Electromagnetic field remains antisymmetric but not in its original form Transformation of Maxwell's Equations $\mathbf{F}^{\mu'v'}_{,v'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{L}^{v'}_{\beta}\mathbf{F}^{\alpha v'}_{,v'}$ Gauss's Law $\mathbf{F}^{0'i'}_{,i'} = -\gamma^2\mathbf{v}^2[\nabla.\mathbf{E}] + \gamma^2\nabla.[\mathbf{E} + (\mathbf{v} \times \mathbf{B})]$ (4)

Ampere's Law

$$\mathbf{F}^{i'\nu'}_{,\nu'} = -\mathbf{E}^1_{,0} - \gamma\mathbf{E}^2_{,0} - \gamma\mathbf{E}^3_{,0} + \gamma\boldsymbol{\beta}[\mathbf{E}^2_{,1} + \mathbf{E}^3_{,1} - \mathbf{E}^2_{,2} - \mathbf{E}^3_{,3}]$$
$$+\gamma[(\mathbf{B}^3_{,2} - \mathbf{B}^2_{,3}) + \gamma\boldsymbol{\beta}(\mathbf{B}^3_{,0} - \mathbf{B}^2_{,0}) - \gamma(\mathbf{B}^3_{,1} + \mathbf{B}^2_{,1}) + \mathbf{B}^1_{,3} - \mathbf{B}^1_{,2} \qquad (5)$$

Maxwell's Equations in Tensor Form

$$\mathbf{F}^{\mu'\nu'}_{,\nu'} = \mathbf{E}^1_{,1} + \gamma\mathbf{E}^2_{,2} + \gamma\mathbf{E}^3_{,3} + \gamma\boldsymbol{\beta}[(\mathbf{B}^2_{,3} - \mathbf{B}^3_{,2})] - \mathbf{E}^1_{,0} - \gamma\mathbf{E}^2_{,0} - \gamma\mathbf{E}^3_{,0}$$
$$+\gamma\boldsymbol{\beta}[\mathbf{E}^2_{,1} + \mathbf{E}^3_{,1} - \mathbf{E}^2_{,2} - \mathbf{E}^3_{,3}] + \gamma[(\mathbf{B}^3_{,2} - \mathbf{B}^2_{,3}) + \gamma\boldsymbol{\beta}(\mathbf{B}^3_{,0} - \mathbf{B}^2_{,0})$$
$$-\gamma(\mathbf{B}^3_{,1} + \mathbf{B}^2_{,1}) + \mathbf{B}^1_{,3} - \mathbf{B}^1_{,2} \qquad (6)$$

Transformation of Conservation Law

$$\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{L}^{\nu'}_{\beta}\mathbf{F}^{\alpha\beta}_{,\nu'\mu'}$$

$$\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = \mathbf{E}^1_{,10} + \gamma\mathbf{E}^2_{,20} - \gamma\boldsymbol{\beta}\mathbf{B}^3_{,20} + \gamma\mathbf{E}^3_{,30} + \gamma\boldsymbol{\beta}\mathbf{B}^2_{,30} - \mathbf{E}^1_{,01}\ \gamma\mathbf{B}^3_{,21}$$
$$-\gamma\boldsymbol{\beta}\mathbf{E}^2_{,21} - \gamma\boldsymbol{\beta}\mathbf{E}^3_{,31} - \gamma\mathbf{B}^2_{,31} - \gamma\mathbf{E}^2_{,02} + \gamma\boldsymbol{\beta}\mathbf{B}^3_{,02} + \gamma\boldsymbol{\beta}\mathbf{E}^2_{,12} - \gamma\mathbf{B}^3_{,12}$$
$$+\mathbf{B}^1_{,32} - \gamma\mathbf{E}^3_{,03} - \gamma\boldsymbol{\beta}\mathbf{B}^2_{,03} + \gamma\boldsymbol{\beta}\mathbf{E}^3_{,13} - \gamma\mathbf{B}^2_{,13} - \mathbf{B}^1_{,23} = 0 \qquad (7)$$

$$\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = 0 \qquad (7a)$$

Conservation law holds but not in its original form

Ampere's Law

$$\mathbf{F}^{i'\nu'}_{,\nu'} = \gamma^2\mathbf{v}[\mathbf{v}.\mathbf{E}]_{,0} - \gamma^2[\mathbf{E} + (\mathbf{v}\times\mathbf{B})]_{,0} + \gamma^2\boldsymbol{\nabla}\times[\mathbf{B} - (\mathbf{v}\times\mathbf{E})] \qquad (5)$$

Maxwell's Equations in Tensor Form

$$\mathbf{F}^{\mu'\nu'}_{,\nu'} = -\gamma^2\mathbf{v}^2[\boldsymbol{\nabla}.\mathbf{E}] + \gamma^2\boldsymbol{\nabla}.[\mathbf{E} + (\mathbf{v}\times\mathbf{B})]$$
$$+\gamma^2\mathbf{v}[\mathbf{v}.\mathbf{E}]_{,0} - \gamma^2[\mathbf{E} + (\mathbf{v}\times\mathbf{B})]_{,0} + \gamma^2\boldsymbol{\nabla}\times[\mathbf{B} - (\mathbf{v}\times\mathbf{E})] \qquad (6)$$

Transformation of Conservation Law

$$\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = \mathbf{L}^{\mu'}_{\alpha}\mathbf{L}^{\nu'}_{\beta}\mathbf{F}^{\alpha\nu'}_{,\nu'\mu'}$$

$$\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = -\gamma^2\mathbf{v}^2[\boldsymbol{\nabla}.\mathbf{E}]_{,0} + \gamma^2\boldsymbol{\nabla}.[\mathbf{E} + (\mathbf{v}\times\mathbf{B})]_{,0}$$
$$+\gamma^2\{\mathbf{v}^2[\boldsymbol{\nabla}.\mathbf{E}]_{,0} - \boldsymbol{\nabla}.[\mathbf{E} + (\mathbf{v}\times\mathbf{B})]_{,0}\} \qquad (7)$$

$$\mathbf{F}^{\mu'\nu'}_{,\nu'\mu'} = 0 \qquad (7a)$$

Conservation law holds but not in its original form

Dedicated To Those Who Work and Live for Humanity.

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REFERENCES

[1] Hussain, N., et al. "Re Birth of Einstein's Relativity via Unified Transformation Law." *International Journal of Physics* 11.1 (2023): 6-16.

[2] Naveed Hussain, Hassnain Abdullah Hussain, Ather Qayum. "Electrodynamics in Noninertial Metrices Predicts Entirely New Origin of 4D Electromagnetic Wave." *International Journal of Physics* Vol.11. No .4 (2023): 193-230. DOI:10.12691/ijp-11-4-5.

[3] Scorgie G. C. (1990), Electromagnetism in Noninertial Coordinates, *Journal of Physics A: Mathematical and General,* 1990/11 Vol 23: ISS 22.

[4] H. A. Atwater (1974), Introduction to General Relativity, Pergamon Press.

[5] Obukhov, Yuri N. "Electrodynamics in noninertial frames." *The European Physical Journal C* 81 (2021): 1-11.

[6] Kurz, Stefan, Bernd Flemisch, and Barbara Wohlmuth. "A framework for Maxwells equations in non-inertial frames based on differential forms." *Proceedings of ICAP*. 2006.

[7] Fedosin, Sergey G. "Electromagnetic and gravitational pictures of the world." (2007). Apeiron, Vol.14, No. 4, pp. 385-413.

[8] Nikolie V M, (1996), Relativistic Physics in Arbitrary Reference Frames, General Relativity and Quantum Cosmology, Monad representation of Maxwell's equations, pp. 78-79.

[9] Costa, L. Filipe O., and José Natário. "Gravito-electromagnetic analogies." *General Relativity and Gravitation* 46 (2014): 1-57. Page-30, Max. equations 86-89.

[10] Schmidt, Brian P. "Nobel Lecture: Accelerating expansion of the Universe through observations of distant supernovae." *Reviews of Modern Physics* 84.3 (2012): 1151.

[11] Padmanabhan, T. "Accelerated expansion of the universe driven by tachyonic matter." *Physical Review D* 66.2 (2002): 021301.

[12] Jacquart, Melissa. "Dark matter and dark energy." *The routledge companion to philosophy of physics*. Routledge, 2021. 731-743.

[13] Naveed Hussain (2001), "On the General Covariance of Maxwellian Electrodynamics" *Science International, Lahore*, 13(1), pg1-6.

[14] Haisch, Bernhard, Alfonso Rueda, and Harold E. Puthoff. "Inertia as a zero-point-field Lorentz force." *Physical Review A* 49.2 (1994): 678. Equation (18), page-682.

[15] Musha, Takaaki. *Physics of the zero-point field and its applications to advanced technology*. Nova Publishers, 2013.

[16] Woodward, James F., and Thomas Mahood. "What is the Cause of Inertia?" *Foundations of Physics* 29.6 (1999): 899-930.

[17] Robertson, Glen A., P. A. Murad, and Eric Davis. "New frontiers in space propulsion sciences." *Energy Conversion and Management* 49.3 (2008): 436-452.

[18] Haisch, Bernhard, and Alfonso Rueda. "The Zero-Point Field and the NASA Challenge to Create the Space Drive." *NASA Breakthrough Propulsion Physics Workshop Proceedings*. 1999.

[19] Puthoff, Harold E., S. R. Little, and M. Ibison. "Engineering the zero-point field and polarizable vacuum for interstellar flight." *Journal of the British Interplanetary Society* 55 (2002): 137-144.

[20] Millis, Marc G. "Exploring the notion of space coupling propulsion." *Vision* 21 (1991): 307-316.

[21] Musha, Takaaki. "Possibility of the Space Propulsion System Utilizing the ZPF Field." *AIP Conference Proceedings*. Vol. 1103. No. 1. American Institute of Physics, 2009.

[22] Boyer, Timothy H. "Any classical description of nature requires classical electromagnetic zero-point radiation." *American Journal of Physics* 79.11 (2011): 1163-1167.

[23] Naveed Hussain, Hassnain Abdullah Hussain, Ather Qayum. "Spacetime Exchange Method of Derivation of Electromagnetic Laws Based on Symmetry of Universal Lorentz Transformation Matrix" *International Journal of Theoretical and Mathematical Physics* 2024, 14(2): 17-39 DOI: 0.5923/j.ijtmp.20241402.01.