https://doi.org/10.31871/IJNTR.6.2.15 International Journal of New Technology and Research (IJNTR)
ISSN: 2454-4116, Volume-6, Issue-2, February 2020 Pages 06-11

Determination of Field Parameters in a Strong Electrical Field Using GR Approach

Branko M. Novakovic

***Abstract*. The process of determination of the field parameters in a strong electrical field using GR approach is presented. In that sense a new Relativistic Alpha Field (RAF) theory is employed. This theory extends the application of GRT to the extremely strong fields at the Planck's scale. The solution of the field parameters α and α' in a strong electrical field are obtained as the functions of the normalized electrical potential energy U. Energy-momentum tensor for electrical field is generated automatically from the left side of Einstein's field equations. This tensor satisfies required properties of energy-momentum tensor for electrical field. Derivation of the related electrical force equations confirms valorization for a strong electrical field. In the weak electrical fields these equations are reduced to the well-known force relations. Finally, the related consequences of the solution of field parameters of strong electrical field using GR approach are pointed out. In that sense it is theoretically proved that an electrical field has no interaction with space-time, while a gravitational field has.**

***Index Terms- Relativistic* alpha field theory (RAFT), Strong electrical field, GR approach to electrical field, Determination of field parameters.**

I. Introduction

As it is well known, General Relativity Theory (GRT) [1,2,3] cannot be applied to the extremely strong gravitational field at the Planck's scale, because of the related singularity. Here we employ a new theory that is called Relativistic Alpha Field (RAF) theory [4,5,6]. This theory extends the capability of the GRT for the application to the extremely strong fields at the Planck's scale. Iven more, RAF theory can be also employed for determination of the field parameters in a strong electrical field using GR approach.

It is also well known, that for unification of the electroweak and strong interactions with gravity, one can use the following two possibilities [7-9]: a) trying to describe gravity as a gauge theory, or b) trying to describe gauge theories as gravity. The first possibility (a) has attracted a lot of attention, but because of the known difficulties, this approach set gravity apart from the standard gauge theories. The second possibility (b) is much more radical. The initial idea has been proposed by Kaluza-Klein theory [7], which today has many variations [8,9], and takes the place in the modern theories like high energy physics (supergravity [10-12] and string theories [13-24]). These theories use five or more extra dimensions with the related dimensional reduction to the four dimensions. Meanwhile, we do not know the answers to some questions like: can we take the extra dimensions as a real, or as a mathematical device?

Branko Novakovic, FSB – University of Zagreb, Luciceva 5, P.O.B. 509, 10000 Zagreb, Croatia

Therefore, in the references [5,6] it has been presented the unification of electrical and gravitational forces in the standard four dimensions (4D). This unification is based on the geometric approach by using RAF theory. Further, the unification of SR and GR and four fundamental interactions in RAF theory is presented in [25].

RAF theory starts with the main preposition: if the electrical, gravitational and unified fields (forces) can be described by the geometric approach, then the field parameters α and α′ of a particle in the electrical, gravitational and unified fields should satisfy the Einstein's field equations and the Einstein's geodesic equations. The propositions, related to the satisfaction of the Einstein's field equations and the Einstein's geodesic equations are proved in the second [5] and third [6] parts of RAF theory, respectively. In [4] we show the solutions of the field parameters α and α' of a particle in the electrical, gravitational and unified fields. If RAF theory is correct, then it could be applied to the both weak and strong fields at the Universe and Planck's scales.

In this paper we present the application of RAF theory only to an extremely strong electrical field. In that sense we started with derivation of the field parameters α and α' in an extremely strong electrical field as the function of the normalized electrical potential energy U. Than we presented derivation of energy-momentum tensor (EMT) for electrical field that is generated from the left side of the Einstein's field equations. In that sense we do not need add by hand EMT on the right side of the Einstein's field equations. Further, we presented the theoretical proofs that derived EMT satisfies required properties of energy-momentum tensor for extremely strong electrical field. In order to confirm that the obtained field parameters are valid in the extremely strong electrical field we presented derivation of the related electrical force equations. In the weak electrical fields these equations are reduced to the well-known force equations for the weak fields. Finally, we pointed out the consequences of the solution of field parameters of strong electrical field by employing GR approach.

This paper is organized as follows. In Sec. II, we show derivation of the relative velocity of a particle in an alpha field v_α as the function of the field parameters α and α'. Solution of the field parameters α and α' in an alpha field, as the function of the normalized potential energy U is presented in Sec. III. Solutions of the field parameters α and α' in an extremally strong electrical field is considered in Sec. IV. Energy-momentum tensor for electrical field is pointed out in Sec. V. Derivation of electrical force equations is presented in Sec. VI. Proofs that RAF theory satisfies required properties of energy-momentum tensor for electrical field is pointed out in Sec. VII. Consequences of the solution of field parameters of strong electrical field using GR approach are presented in

Sec. VIII. Finally, the related conclusion and the reference list are pointed out in Sec. IX and Sec. X, respectively.

II. Derivation of Relative Velocity v_α in an Alpha Field

The basic problem of this paper is to determine the field parameters *α* and *α′* of a particle in an extremely strong electrical field. This derivation follows recently developed Relativistic Alpha Field Theory (RAFT) [4]. The RAF theory is based on the following two definitions:

Definition 1. An alpha field is a potential field that can be described by two scalar dimensionless (unitless) field parameters α and α′. To this category belong, among the others, electrical and gravitational fields.

Definition 2. Field parameters *α* and *α′* are described as the scalar dimensionless (unitless) functions of the potential energy *U* of a particle in an alpha field.

In order to solve the field parameters α and *α′* in an extremally strong electrical field, we started with the derivation of the relative velocity of a particle in an alpha field, v_α.

Proposition 1. If the line element in an alpha field is defined by the nondiagonal form with the Riemannian metrics [4]

$$ds^2 = -\alpha\alpha' c^2 dt^2 - \kappa(\alpha-\alpha')_x \, cdt\, dt - \kappa(\alpha-\alpha')_y \, cdt\, dy - \kappa(\alpha-\alpha')_z \, cdt\, dz + dx^2 + dy^2 + dz^2, \quad (1)$$

then the relative velocity of a particle in an alpha field, v_α, can be described as the function of the field parameters *α* and *α'*

$$v_\alpha = v - \frac{\kappa(\alpha-\alpha')c}{2}, \quad \kappa = \pm 1. \quad (2)$$

In the previous equation v is a particle velocity in the total vacuum (without any potential field), *c* is the speed of the light in a vacuum and κ is a constant. Here, field parameters *α* and *α′* should be described as the scalar dimensionless (unitless) functions of the potential energy *U* of a particle in an extremely strong electrical field.

Proof if the Proposition 1. The relation (2) has been proved in [4].

III. Solution of the Field Parameters in an Alpha Field

Proposition 2. Let m_0 is a rest mass of a particle, *U* is a potential energy of a particle in an alpha field, *c* is the speed of the light in a vacuum and (i) is an imaginary unit. In that case the field parameters *α* and *α′* can be described as dimensionless (unitless) functions of the potential energy *U* of a particle in an alpha field. There are four solutions for both parameters *α* and *α′* in an alpha field that can be presented by the following relations:

$$\begin{gathered} f(U) = 2U/m_0c^2 + \left(U/m_0c^2\right)^2, \rightarrow \alpha_1 = 1 + i\sqrt{f(U)}, \\ \alpha'_1 = 1 - i\sqrt{f(U)}, \ \alpha_2 = 1 - i\sqrt{f(U)}, \ \alpha'_2 = 1 + i\sqrt{f(U)}, \\ \alpha_3 = -1 + i\sqrt{f(U)}, \ \alpha'_3 = -1 - i\sqrt{f(U)}, \\ \alpha_4 = -1 - i\sqrt{f(U)}, \ \alpha'_4 = -1 + i\sqrt{f(U)}. \end{gathered} \quad (3)$$

Proof of the Proposition. 2. The relation (3) has been proved in [4].

Remarks 1. From the equations (3) we can see that there are four solutions of the field parameters *α* and *α′* that reminds us to the Dirac's theory.

IV. Solution of the Field Parameters in an Extremely Strong Electrical Field

If a particle has an electric charge and is present in an electrical field, then the potential energy of the particle in that field U_e is described by the well-known relation

$$U_e = qA_0 = \frac{qQ}{r}. \quad (4)$$

Here *q* is an electric charge of the particle and A_0 is a scalar potential of that field. The four solutions of the field parameters *α* and *α′* for a charged particle in an extremely strong electrical field can be obtained by the substitution of the potential energy U_e from (4) into the general relations given by (3):

$$\begin{gathered} f(U_e) = 2qQ/m_0rc^2 + \left(qQ/m_0rc^2\right)^2, \ \rightarrow \\ \alpha_1 = 1 + i\sqrt{f(U_e)}, \ \alpha'_1 = 1 - i\sqrt{f(U_e)}, \\ \alpha_2 = \alpha'_1, \ \alpha'_2 = \alpha_1, \ \alpha_3 = -1 + i\sqrt{f(U_e)}, \\ \alpha'_3 = -1 - i\sqrt{f(U_e)}, \ \alpha_4 = \alpha'_3, \ \alpha'_4 = \alpha_3, \\ qQ << m_0rc^2, \left(qQ/m_0rc^2\right)^2 \cong 0, \ f(U_e) = 2qQ/m_0rc^2. \end{gathered} \quad (5)$$

Here (i) is an imaginary unit and m_0 is a rest mass of the charged particle. The first four lines in (5) describe a strong electrical field. The last line in (5) describes a weak electrical field.

It is easy to prove that the all *αα′* pairs from (5) satisfy the following relations:

$$\begin{gathered} \alpha_i\alpha'_i = \left(1 + \frac{qQ}{m_0rc^2}\right)^2 = \alpha\alpha', \sqrt{\alpha\alpha'} = \left(1 + \frac{qQ}{m_0rc^2}\right), \\ v = 0 \rightarrow E_c = m_0c^2\sqrt{\alpha\alpha'} = m_0c^2\left(1 + \frac{qQ}{m_0rc^2}\right), \\ E_c = m_0c^2 + qQ/r. \end{gathered} \quad (6)$$

Here E_c is the covariant energy of the charged particle standing ($v = 0$) in an extremely strong electric field.

The differences of the field parameters (*α*-*α′*) for a charged particle in an extremely strong electrical field have the forms:

$$(\alpha_1-\alpha'_1)=(\alpha_3-\alpha'_3)=2\,i\sqrt{\frac{2qQ}{m_0rc^2}+\left(\frac{qQ}{m_0rc^2}\right)^2}\,,$$
$$(\alpha_2-\alpha'_2)=(\alpha_4-\alpha'_4)=-2\,i\sqrt{\frac{2qQ}{m_0rc^2}+\left(\frac{qQ}{m_0rc^2}\right)^2}\,. \qquad (7)$$

Remarks 2. The $\alpha\alpha'$ term is a quadratic function of the potential energy of the charged particle in an extremely strong electrical field. But the related covariant energy E_c of the charged particle, standing $(v=0)$ in this field, is a linear function of that potential energy (see 6). This transformation is obtained here on the natural way, without any a priory assumptions.

In the references [4,5,6] it has been shown that field parameters (5) satisfy the Einstein's field equations for extremely strong electrical field. Thus, in the case of the extremely strong static electrical field, the quadratic term $(qQ/m_0rc^2)^2$ generates the related energy-momentum tensor $T_{\mu\eta}$ for the static field. For that case we do not need to add by the hand the related energy-momentum tensor $T_{\mu\eta}$ of the electrical field on the right side of the Einstein's field equations. In the case of a weak static electrical field, the quadratic term $(qQ/m_0rc^2)^2\approx 0$, and the field parameters (5) satisfy the Einstein's field equations in a vacuum ($T_{\mu\eta}=0$) (see the next section).

V. Energy-Momentum Tensor For Electrical Field

The basic problem of this section is to determine the energy-momentum tensor for electrical field in the Einstein's four-dimension (4D), by using the gravity (geometric) concept. Following the well-known procedure [1-6], the line element (1) can be transformed into the spherical polar coordinates in the nondiagonal form

$$ds^2=-\alpha\alpha'\,c^2dt^2-\kappa\left(\alpha-\alpha'\right)c\,dt\,dr+dr^2$$
$$+r^2d\theta^2+r^2\sin^2\theta\,d\phi^2. \qquad (8)$$

The line element (8) belongs to the well-known form of the Riemann's type line element. Starting with the line element (8) we employ, for the convenient, the following substitutions:

$$\nu=\alpha\alpha',\qquad \lambda=\kappa\left(\alpha'-\alpha\right)/2. \qquad (9)$$

In that case the nondiagonal line element (8) is transformed into the new relation

$$ds^2=-\nu\,c^2dt^2+2\lambda\,cdt\,dr+dr^2$$
$$+r^2d\theta^2+r^2\sin^2\theta\,d\phi^2\,. \qquad (10)$$

The related covariant metric tensor $g_{\mu\eta}$ of the line element (10) is presented by the matrix form

$$\left[g_{\mu\eta}\right]=\begin{bmatrix}-\nu & \lambda & 0 & 0\\ \lambda & 1 & 0 & 0\\ 0 & 0 & r^2 & 0\\ 0 & 0 & 0 & r^2\sin^2\theta\end{bmatrix}. \qquad (11)$$

This tensor is symmetric and has six non-zero elements as we expected that should be. The contravariant metric tensor $g^{\mu\eta}$ of the nondiagonal line element (10), is derived by inversion of the covariant one

$$\left[g^{\mu\eta}\right]=\begin{bmatrix}-1/(\nu+\lambda^2) & \lambda/(\nu+\lambda^2) & 0 & 0\\ \lambda/(\nu+\lambda^2) & \nu/(\nu+\lambda^2) & 0 & 0\\ 0 & 0 & 1/r^2 & 0\\ 0 & 0 & 0 & 1/r^2\sin^2\theta\end{bmatrix}. \qquad (12)$$

The determinants of the tensors (11) and (12) are given by the relations:

$$det\left[g_{\mu\eta}\right]=-r^4\left(\nu+\lambda^2\right)\sin^2\theta,$$
$$det\left[g^{\mu\eta}\right]=-1/r^4\left(\nu+\lambda^2\right)\sin^2\theta. \qquad (13)$$

Proposition 3. If the electrical field is described by the line element (10), then the solution of the Einstein field equations determines the energy momentum tensor, $T_{\mu\eta}$, of that field in the following form:

$$T_{\mu\eta}=\left(T_{00},T_{01},T_{10},T_{11},T_{22},T_{33}\right)$$
$$=\left(\nu,-\lambda,-\lambda,-1,r^2,r^2\sin^2\theta\right)\frac{(G_eQ)^2}{8\pi G_er^4}, \qquad (14)$$
$$G_e=q/m_0,\,A_0=Q/r.$$

Here q and m_0 are an electric charge and a rest mass of the particle, while A_0 is a scalar potential and Q is an electric point charge of the electrical field. Parameter $G_e=q/m_0$ is a constant that remands us to the constant of motion in the geodesic equation of the Kaluza-Klein theory [5,7-9].

Proof of the Proposition. 3. The relation (14) has been proved in [6].

Remarks 3. In order to make the solution (14) consistent to the related solution in a gravitational field, we should introduce the parameter $k_e=8\pi G_e/c^4$:

$$k_e=\frac{8\pi G_e}{c^4},\rightarrow T_{\mu\eta}=\left[T_{00},T_{01},T_{10},T_{11},T_{22},T_{33}\right]$$
$$=\left[\nu,-\lambda,-\lambda,-1,r^2,r^2\sin^2\theta\right]\frac{(G_eQ)^2}{8\pi G_er^4}. \qquad (14a)$$

On the other hand, for the consistence to the Maxwell field theory, this parameter should be $k_e=8\pi G_e^2/c^4$:

$$k_e=\frac{8\pi G_e^2}{c^4},\rightarrow T_{\mu\eta}=\left[T_{00},T_{01},T_{10},T_{11},T_{22},T_{33}\right]$$
$$=\left[\nu,-\lambda,-\lambda,-1,r^2,r^2\sin^2\theta\right]\frac{Q^2}{8\pi r^4}. \qquad (14b)$$

VI. Derivation Of Electrical Force Equations

In the time-variant extremely strong electrical field the force equations (F_x, F_y, F_z) for a particle rest mass m_0 is given by the relations [6]:

$$\dot{\lambda} \neq 0, F_x = m_0\ddot{x} = \mp ikm_0 \frac{\partial}{\partial t}\left(\sqrt{\frac{2G_eQ}{rc^2}\left(1+\frac{G_eQ}{2rc^2}\right)}\right)\frac{x}{r}c + \frac{m_0G_eQ}{r^2}\left(1+\frac{G_eQ}{rc^2}\right)\frac{x}{r},$$
$$F_y = m_0\ddot{y} = \mp ikm_0 \frac{\partial}{\partial t}\left(\sqrt{\frac{2G_eQ}{rc^2}\left(1+\frac{G_eQ}{2rc^2}\right)}\right)\frac{y}{r}c + \frac{m_0G_eQ}{r^2}\left(1+\frac{G_eQ}{rc^2}\right)\frac{y}{r},$$
$$F_z = m_0\ddot{z} = \mp ikm_0 \frac{\partial}{\partial t}\left(\sqrt{\frac{2G_eQ}{rc^2}\left(1+\frac{G_eQ}{2rc^2}\right)}\right)\frac{z}{r}c + \frac{m_0G_eQ}{r^2}\left(1+\frac{G_eQ}{rc^2}\right)\frac{z}{r}. \quad (15)$$

For a time-invariant (or very slowly changed) extremely strong electrical field, the relations (15) are transformed into the form valid for the electrostatic field:

$$\dot{\lambda} = 0, \rightarrow F_x = m_0\ddot{x} = \frac{m_0G_eQ}{r^2}\left(1+\frac{G_eQ}{rc^2}\right)\frac{x}{r},$$
$$F_y = m_0\ddot{y} = \frac{m_0G_eQ}{r^2}\left(1+\frac{G_eQ}{rc^2}\right)\frac{y}{r}, \quad (16)$$
$$F_z = m_0\ddot{z} = \frac{m_0G_eQ}{r^2}\left(1+\frac{G_eQ}{rc^2}\right)\frac{z}{r}.$$

The proof of the relations (15) and (16) is presented in [6].

Remarks 4. The electrical force relations given by (15) and (16) generally describe the interactions in the strong fields. In the case of the weak fields the force relations are reduced to the well-known descriptions of the interactions in the weak fields. Thus, from (16) we can see that the electrical field is a weak for $(G_eQ/rc^2) \approx 0$. In that case the term (G_eQ/rc^2) in (16) can be neglected. On the other hand, the electrical field is a strong for $(G_eQ/rc^2) >> 0$. For an example, in the case of the hydrogen atom the amount of this term is $(G_eQ/rc^2) \approx 5.3250 \cdot 10^{-6} \approx 0$. Thus, the electrical field of the hydrogen atom belongs to the weak fields. In the extremely strong electrical fields and extremely short distances, we may have situations where the term (G_eQ/rc^2) is close to unit $(G_eQ/rc^2) \approx 1$, or even greater than unit $(G_eQ/rc^2) > 1$. For those situations the term (G_eQ/rc^2) cannot be neglected.

VII. Proofs that RAF Theory Satisfies Required Properties of Energy-Momentum Tensor for Electrical Field

As it is well known from the quantum relativistic field theories of the other physical interactions, the energy momentum tensor (EMT) of massless boson field obeys the following three crucial conditions [26]: 1) symmetry, $T_{\mu\eta} = T_{\eta\mu}$; 2) positive energy density for static and free field, $T_{00} > 0$; and 3) zero trace, $T = 0$.

It is very important to prove if the EMT in RAF theory for electrical field also obeys the mentioned three crucial conditions. In order to prove this, we started with the matrix form of EMT for extremely strong electrical field (14)

$$\left[T_{\mu\eta}\right] = \begin{bmatrix} \nu & -\lambda & 0 & 0 \\ -\lambda & -1 & 0 & 0 \\ 0 & 0 & r^2 & 0 \\ 0 & 0 & 0 & r^2 \sin^2\theta \end{bmatrix} \frac{(G_eQ)^2}{8\pi G_e r^4}. \quad (17)$$

Symmetry condition. Following (17) one can see that the matrix in (17) has the symmetric form. This means that EMT in (17) satisfies the first crucial condition: 1) symmetry, $T_{\mu\eta} = T_{\eta\mu}$.

Positive energy density. In order to prove the condition of positive energy density for electrical static field, one can start with the element T_{00} of the EMT in (14) and the relation (6):

$$A_0 = \frac{Q}{r},\ G_e = \frac{q}{m_0},$$
$$T_{00} = \nu\frac{(G_eQ)^2}{8\pi G r^4},\ \nu = \alpha\alpha' = \left(1+\frac{G_eQ}{rc^2}\right)^2, \quad (18)$$
$$T_{00} = \left(1+\frac{G_eQ}{rc^2}\right)^2\frac{(G_eQ)^2}{8\pi G_e r^4},\ G_eQ > 0 \rightarrow T_{00} > 0.$$

Since the term $G_eQ > 0$, one can conclude that energy density for electrical static field T_{00} can only be positive quantity. Following the relation (18) we can see that EMT for static electrical field satisfies the second crucial condition: 2) positive energy density for static field.

The zero trace. In order to prove the third crucial condition of EMT: 3) the zero trace, $T = 0$, we have to calculate the trace of the EMT in (17):

$$T = g^{\mu\eta}T_{\mu\eta} = \left[-2\left(\nu+\lambda^2\right)+2\right]\frac{(G_eQ)^2}{8\pi G_e r^4}, \quad (19)$$
$$\nu+\lambda^2 = 1 \quad \rightarrow \quad T = 0.$$

In the previous relations $g^{\mu\eta}$ is contravariant metric tensor (12) of an electrical static field and $T_{\mu\eta}$ is the related covariant energy-momentum tensor (17). The relation $\nu+\lambda^2 = 1$ is derived from the condition that the determinant of the metric tensor of the line element (10) should satisfy the relation (13) (see [4]).

VIII. Consequences of the Solution of Field Paramers in Strong Electrical Field Using GR Aproach

Instead of adding by hand of EMT of the strong electrical field on the right side of the Einstein's field equations here it is generated from the left side of these equations.

No interactions of the strong electrical field with space-time. In order to theoretically prove it we can start with the relations (7) and (9):

$$\lambda = \frac{\kappa\left(\alpha' - \alpha\right)}{2} = \pm i\sqrt{\frac{2qQ}{m_0 rc^2} + \left(\frac{qQ}{m_0 rc^2}\right)^2}. \qquad (20)$$

From (20) we can see that all components in square root are positive numbers. Thus, the solution of the square root cannot be imaginary quantity in the strong electrical field. Therefore, the related solution of the parameter λ in (20) is imaginary quantity. Since the parameter λ physically describes interaction with space and time $\lambda=g_{01}=g_{10}$, one can concluded that interactions of the strong electrical field with space-time is imaginary. This theoretically confirms that no interactions of the strong electrical field with space-time.

In order to compare the solution (20) with the related solution in a strong gravitational field we can started with the solution of the parameter λ in a gravitational field [5]:

$$\lambda = \mp\sqrt{\frac{2GM}{rc^2} - \left(\frac{GM}{rc^2}\right)^2}. \qquad (21)$$

Here G is gravitational constant, M is gravitational mass, r is gravitational radius and c is speed of light in vacuum. This relation can be described with the new form:

$$\lambda = \mp\sqrt{\frac{2GM}{rc^2}\left(1 - \frac{GM}{2rc^2}\right)}. \qquad (22)$$

Following (22) we can find out the characteristic point and regions of parameter λ :

$$r_{min} = \frac{GM}{2c^2} \to \lambda = 0, \quad \frac{GM}{2c^2} \le r \to \lambda = \lambda_{real}, \quad r < \frac{GM}{2c^2} \to \lambda = \lambda_{imag}. \qquad (23)$$

At the minimal radius r_{min} parameter λ is equal to zero. On the other wards, at r_{min} the free fall velocity is equal to zero, while the related acceleration is repulsive and maximal [4-6]. This means that gravitational mass cannot have its radius lass than r_{min}. Thus, no singularity in a gravitational field.

There are interactions of the strong gravitational field with the space-time. The related theoretically proof is presented in the references [4-6]. From (22) and (23) we can see that all solutions of parameter λ for $r > r_{min}$ are real numbers. Since the parameter λ physically describes interaction with space and time, $\lambda=g_{01}=g_{10}$, one can concluded that interactions of the strong gravitational field with space-time are real. Thus, this is a brief theoretically confirmation that there are interactions of the strong gravitational field with the space-time. This is the crucial difference between strong electrical and strong gravitational fields.

IX. Conclusion

Determination of the field parameters in a strong electrical field by using GR approach is presented. For this determination we employ a new Relativistic Alpha Field Theory (RAFT). This theory is useful because it extends the application of GRT to the extremely strong gravitational and electrical fields, including Planck's scale. The generated energy-momentum tensor for a strong electrical field satisfies the well-known properties of EMT for electrical field. Valorization of the presented procedure is done by derivation of the related electrical force equations valid for a strong electrical field. Finally, the related consequences of the solution of field parameters of strong electrical field using GR approach are pointed out.

Acknowledgments

This work is supported by grants (120-1201842-3048) from the National Scientific Foundation of Republic of Croatia.

X. References

[1] A. Einstein, *The Meaning of Relativity* (Princeton Univ. Press, Princeton, 1955).
[2] C. Sean, *Spacetime and Geometry: An introduction to General Relativity* (Amazon.com Books.htm, Hardcover, 2003).
[3] S. W. Hawking, G. F. R. Ellis, *The Large Scale Structure of Space-Time* (Univ. Press, Cambridge, 1973).
[4] B. M. Novakovic, Relativistic alpha field theory - Part I: Determination of Field Parameters. International Journal of New Technology and Research (IJNTR) ISSN:2454-4116, 1, 5 (2015) 23-30. https://doi.org/10.31871/IJNTR.1.5.15
[5] B. M. Novakovic, Relativistic alpha field theory - Part II: Does a Gravitational Field Could be Without Singularity? International Journal of New Technology and Research (IJNTR) ISSN:2454-4116, 1, 5 (2015) 31-38. https://doi.org/10.31871/IJNTR.1.5.16
[6] B. M. Novakovic, Relativistic alpha field theory - Part III: Does Gravitational Field Becomes Positive if $(GM/rc^2)>1$, International Journal of New Technology and Research (IJNTR) ISSN:2454-4116, 1, 5 (2015) 39-47. https://doi.org/10.31871/IJNTR.1.5.17
[7] T. Kaluza, *Zum Unitätsproblem in der Physik* (Sitzungsber. Preuss. Akad. Wiss., Berlin, 1921).
[8] P. S. Wesson, *Space-Time-Matter, Modern Kaluza - Klein Theory* (World Scientific, Singapore, 1999).
[9] P. S.Wesson, *Five-Dimensional Physics: Classical and Quantum Consequences of Kaluza-Klein Cosmology* (World Scientific, Singapore, 2006).
[10] D. Z. Freedman, and A. Van Proeyen, *Supergravity* (Cambridge Univ. Press, Cambridge, 2012).
[11] J. Wess, B. and A. Zumino, Phys. Lett. B **49**, 52 (1974).
[12] M. K. Gaillard, and B. Zumino, Nucl. Phys. B **193**, 221 (1981).
[13] M. B. Green, J. H. Schwarz, and E. Witten, *Superstring Theory* (Cambridge Univ. Press, Cambridge, 1987).
[14] J. Polchinski, *String Theory* (Cambridge Univ. Press, Cambridge, 1998).
[15] R. Brandenberger, and C. Vafa, Nucl. Phys. B **316**, 391–410 (1989).
[16] N. Arkani-Hamed, A. G. Cohen, and H. Georgi, Phys. Rev. Lett. **86**, 4757 (2001).
[17] C. T. Hill, S. Pokorski, and J. Wang, Phys. Rev. D **64**, 105005 (2001).
[18] C. Cshaki, G. D. Kribs, and J. Terning, Phys. Rev. D **65**, 015004 (2002).

[19] E. C. Poggio, H. R. Quinn, and S. Weinberg, Phys. Rev. D **13**, 1958 (1976).
[20] T. R. Taylor, and G. Veneziano, Phys. Lett. B **212**, 147 (1988).
[21] H. C. Cheng, B. A. Dobrescu, and C. T. Hill, Nucl. Phys. B **573**, 597 (2000).
[22] C. Cshaki, J. Erlich, C. Grojean, and G. D. Kribs, Phys. Rev. D **65**, 015003 (2002).
[23] N. Arkani-Hamed, and M. Schmaltz, Phys. Rev. D **61**, 033005 (2000).
[24] M. Gogberashvili, Europhys. Lett. **49**, 396 (2000).
[25] B. M. Novakovic, Unification of SR and GR and Four Fundamental Interactions in RAF Theory. International Journal of New Technology and Research (IJNTR) ISSN:2454-4116, 4, 11 (2018) 26-33, Paper ID- IJNTR04110011. https://doi.org/10.31871/IJNTR.4.11.11
[26] Y. V. Baryshev, Energy-Momentum of the Gravitational Field: Crucial Point for Gravitation Physics and Cosmology, arXiv, October, (2008), www.researchgate.net/publication/1774586

Branko Novakovic is a Professor emeritus at FSB – University of Zagreb, Croatia. Prof. Novakovic received his PhD from the University of Zagreb in 1978. His research of interest includes physics, control systems, robotics, neural networks, and fuzzy control. He is author of three books; Relativistic Alpha Field Theory (RAFT, e-book, 2016), Control Methods in Robotics, Flexible Manufacturing Systems and Processes (1990), Control Systems (1985) and the first co-author of a book Artificial Neural Networks (1998). He has published over 240 research papers in his research of interest.