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Electrogravity Field of a Charged Mass Object

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Abstract: ***This article explores the Electrogravity (EG) field around a charged mass object and derives a Schwarzschild-like solution for Mousavi's EG field equations. The metric functions are derived in a 5D coordinate system, incorporating the concept of the fifth dimension in General Relativity. The implications of this solution for electromagnetism and gravitation are discussed. The Schwarzschild-like solution reveals a deviation in the event horizon radius of charged black holes compared to non-charged ones, highlighting the influence of electric charge on gravitational fields. Experimental evidence supports the presence of cylindrical curvature in spacetime due to electromagnetic fields, further affirming the validity of Mousavi's electrogravity field equations. The EG theory presents a unique perspective on fundamental forces, promising new insights into the nature of spacetime and its relation to electromagnetism in theoretical physics.***

Keywords: Mousavi, Electrogravity, Field Equation, General Relativity, Schwarzschild-like Solution, 5DSpace-Time Coordinate System, Gravity, Electricity

1. Introduction

After Albert Einstein formulated the gravitational field equations [1], Schwarzschild was the first to solve them[2, 3], leading to the discovery of black holes. In this article, we investigate the Electrogravity (EG) field around a charged mass object and derive a Schwarzschild-like solution for Mousavi's EG field equations[4, 5]. We also discuss the implications of this solution for electromagnetism and gravitation.

2. General form of the metric

The solution we consider for Mousavi's vacuum EG field equations has the following general form:

$$ds^2 = A\,dt^2 - B\,dr^2 - C\,d\theta^2 - D\,d\varphi^2 - E\,dz^2 \quad (1)$$

Where the coordinate system is chosen so that: x = [t, r, θ, φ, z].

Here, we work within a five-dimensional (5D) space-time coordinate system in order to determine the metric functions. The concept of the fifth dimension has been a subject of discussion since introduction of the General Relativity theory. It was initially associated with the fourth dimension of space, and by adding a time dimension, a 5D space-time was envisioned. In 1921, Einstein presented a paper by Theodor Kaluza to the Prussian Academy in which Kaluza proposed the fifth dimension for the first time[6, 7].Einstein initially accepted the existence of the extra dimension and expressed positive remarks about this theory in his letter to Kaluza. However, subsequent attempts between 1920 and 1926by Kaluza and Klein to unify gravity with electromagnetism failed[8, 9]. Ultimately, Einstein rejected Kaluza's theory mainly due to the absence of arbitrary constants that could separate the gravitational constant from the electromagnetic constant[10]. This raised issues of consistency and mathematical coherence within the theory.

3. A five-dimensional space-time coordinate system

Here, we use the following four-dimensional (4D) space coordinate system as an example, but alternative 4D space coordinates could also be defined and used. Letx_1,x_2,x_3, andx_4 represent the space coordinates, and x_5 represent the time coordinate. This coordinate system is defined using a combination of spherical and cylindrical coordinates. This coordinate system is defined using the combination of two spherical and cylindrical coordinates. In this new coordinate system, we can have both electromagnetic and gravitational curvatures of the space–time simultaneously. We call this newly defined 4D space coordinate system, the “cylinder-sphere” coordinate, where:

$$\begin{cases} x_1 = r \\ x_2 = \theta \\ x_3 = \varphi \\ x_4 = z \end{cases} \quad (2)$$

and with $x_5 = t$, we obtain a five-dimensional space-time coordinate system. Refer to Figure 1 for an illustration of the definitions of r, θ, φ, and z.

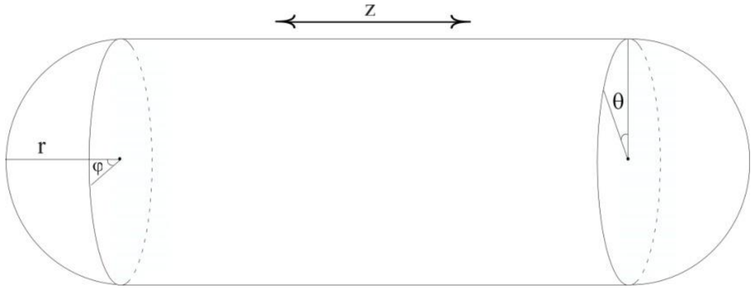

Figure 1

The constraints on each component on the surface of the cylinder-sphere are given by Equation (3).

$$\begin{cases} r = const \\ \theta = 0 \rightarrow 2\pi \\ \varphi = 0 \rightarrow \pi \\ z = 0 \rightarrow L \end{cases} \quad (3)$$

The line element between two adjacent points in this coordinate system is expressed by Equation (4).

$$ds = \alpha_r \, dr \,.\hat{r} + \alpha_\theta (r \, d\theta).\hat{\theta} + \alpha_\varphi (r \, \sin\theta \, d\varphi).\hat{\varphi} + \alpha_z \, dz \,.\hat{z} \quad (4)$$

and the volume element isgiven by Equation (5).

$$dv = r^2 \sin\theta \; d\theta \; d\varphi \; dr + r \; d\theta \; dz \; dr \quad (5)$$

4. Obtaining metric functions as a solution for Electrogravity field equation

By calculating the space-time metric inthis[t,r, θ, φ, z] coordinate system, we derive:

$$ds^2 = A \, dt^2 - B \, dr^2 - C \, d\theta^2 - D \, d\varphi^2 - E \, dz^2 \quad (6)$$

Where:

$$A = 1 - \frac{2(m+q)}{r}, B = \frac{1}{1-\frac{2(m+q)}{r}}, C = r^2,$$

$$D = r^2 (\sin\theta)^2, \text{ and } E = \frac{z}{2(m+q)} \quad (7)$$

Therefore, Equation (7) represents a vacuum solution of Mousavi's EG field equations. The parameters q and m are constants of the system and are of dimension r in the G = C = K = 1 system of units.

Equation (7) exhibits a singularity at

$$r = 2(m+q) \quad (8)$$

indicating the presence of a horizon at this radius.

5. Discussion and Conclusion

One significant result stemming from the Schwarzschild-like solution of Mousavi's EG field equations is that the event horizon radius of a black hole, denoted as $r = 2(m+q)$, where m is the black hole's mass and q is the electric charge of a black hole, differs slightly from the Schwarzschild's radius. The Schwarzschild radius, represented as $r = 2m$, corresponds to the event horizon radius of a non-charged black hole. In the presence of electric charge (q) on the black hole, the event horizon radius is slightly larger due to the additional contribution. This indicates a deviation from the Schwarzschild's radius, emphasizing the influence of the electric charge on the black hole's gravitational field.

Another significant outcome of Mousavi's EG field equations[4, 5] is the observation of cylindrical curvature in spacetime caused when an electromagnetic field is present. This curvature manifests as a moving cylindrical structure with a relatively small radius when compared to the curvature induced by gravity. The validity of the space-time curvature in presence of the magnetic field can be supported by the experimental evidence from studies conducted by Kejie Fang and colleagues [11, 12]and Van Tiggelen and Rikken [13]. In a notable experiment at Stanford University's Department of Physics, Fang and colleagues demonstrated that photons follow circular paths when subjected to a magnetic field. Moreover, they were able to manipulate the radius of the photon's trajectory by adjusting the magnitude of the magnetic field[11, 12]. Similarly, Van Tiggelen and Rikken conducted an experiment that showed how a light ray can travel in a circular path in the presence of a magnetic field[13]. These experimental findings offer supportive evidence for the validity of Mousavi's electrogravity field equations. By showcasing the observed circular paths and the ability to control their radii through magnetic fields, these experiments align with the predictions made by Mousavi's theory. They demonstrate the influence of electromagnetic fields on the curvature of spacetime, offering empirical support for the validity of Mousavi's electrogravity field equations.

The cylinder-sphere coordinate system, as depicted in Figure (1), can provide a visualization of a black hole in motion along a translational path. When the black hole comes to a stop, it exhibits only spherical curvature around itself. However, during its movement, it manifests two types of curvatures. The first type involves spherical curvature at both ends of Figure (1), while the second type is cylindrical curvature that arises while in motion between the two ends. This intriguing observation suggests the presence of a strong magnetic field surrounding a fast-moving black hole.

From the EG field equations[4, 5], we can deduce that there are similar conditions for a charged particle. When a positively charged particle is stationary, it exhibits a spherical curvature around itself with a very small radius. However, when it is in motion, it makes a cylindrical curvature, akin to a magnetic field. In the cylinder-sphere coordinate system, in which both spherical and cylindrical curvatures coexist, not only we have the electric and magnetic fields together, i.e. electromagnetic field, but also, we have the electrogravity field in this coordinate system. Therefore from the EG theory, one can verify that, in some special conditions, if a light beam passes through a very strong magnetic field, it should go on a circular path.

The EG theory provides a fascinating perspective on the relationship between gravity and electromagnetism, corroborating Faraday's intuitive belief in such a connection. Faraday's experiments, conducted over 170 years ago, lacked the precision and tools required to unveil this relationship fully[14]. His experiments predominantly utilized homogeneous magnetic fields and overlooked the potential significance of inhomogeneous fields, which hindered the discovery. Nonetheless, he expressed his conviction in the existence of a relation between gravity and electricity, despite the limitations of his experiments. He ended his landmark 1851 paper with the following words; “Here end my trials for the present. The results are negative. They do not shake my strong feeling of the existence of a relation between gravity and electricity, though they give no proof that such a relation exists.”[14, 15].Now, through the advancements in theoretical physics and the pioneering work of S. Mousavi, we can confirm Faraday's intuition. Mousavi's achievement in establishing the existing relationship between gravity and electromagnetism is significant and represents a realization of the dreams harbored by eminent scientists like Faraday, Maxwell, Einstein, and others. Their pursuit of this connection encountered numerous challenges and setbacks over the years, making Mousavi's success all the more remarkable. The EG theory's ability to unify gravity and electromagnetism opens new avenues of exploration in physics, shedding light on the intricate interplay between these fundamental forces in the cosmos. As researchers delve deeper into the implications of this theory, we may uncover novel insights into the nature of spacetime / gravity and its connection to electromagnetic phenomena, ushering in a new era of understanding in theoretical physics.

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