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Mathematical Analysis of the Static and Rotating Black Holes and its Effect on Earth

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Abstract: As described in this paper, black holes are category of gravitational objects which can be identified by the concept of General Relativity. Arguably, as a result of the gravitational impacts on the space-time, its most noticeable characteristic is that there exists a region of space-time surrounding the black hole in which light cannot elude. In this paper, we take into consideration a stationary black hole. We offer the Schwarzschild "*black hole*" solution. The uncomplicated black hole solution is often reported by Schwarzschild geometry. Most importantly, we did employ Schwarzschild metric in describing the "*Schwarzschild black hole*". Furthermore; we discuss the rotating black hole as part of the solution in Einstein's field equation. The popular exact solutions, namely: Kerr metric and the Kerr Newman metric are considered to be a representative of all spinning black hole solutions within the outside region. We also evaluate some characteristics of black holes in general relativity.

Key words: Schwarzschild Solution · Static and Rotating black holes · Reissner-Nordström solution · The Kerr black hole solution · The light years from the Sun of the 5 nearest Black hole

INTRODUCTION

Black holes are one of peculiar occurrences of nature. These holes are usually formed after a star collapse. Until recently, the black holes existences were thought to be mathematical peculiarity. Astronomers' research and studies provided vast evidence of the occurrence and existence of the black holes. Through his theory of relativity, Albert Einstein became the first person to project the occurrence phenomena of black holes, which was in the year 1916. The whole concept of black hole originated in 1967 and was facilitated by American astronomer by the name John Wheeler. Arguably, the first black hole was discovered in 1971. Besides, Schwarzschild examined the presence of a critical circumference of an object, beyond which the light would be unable to pass: popularly known as Schwarzschild radius. This concept was the same as that of *Michell*, nonetheless this circumference was considered as an obstacle.

This concept perhaps gave the whole idea of the existence of massive stars. The Schwarzschild radius (RS) of an item is:

$Rs = 2GM/c_2$.

where, m = mass of object, G = universal gravitational constant and C = speed of light.

Static and Rotating Black Holes: Rotating black hole are usually formed as a result of collisions of collection of conjoined objects such as stars, gas o gravitational collapse of a spinning star. Generally, stars do rotate and their realistic collisions and poses a non-zero angular momentum, therefore naturally we expect that black holes are rotating black hole. Bearing in mind the fact that celestial components do not have an appreciable net electropositive, it is no doubt that Kerr solution does offer astrophysical relevance. Up to the late 2006, scientists analyze the different spin rates of black hole, this fact were reported in the various scientific publications. A black hole present within the milky way GRS 1915+105 has the ability to rotate approximately 1, 100 times per second, almost reaching the theoretical upper most limit.

A stationary black hole does not rotate. These are just theoretical and are highly unlikely to be found in the nature. The rotating ones, on the other hand are expected

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to exist out there in the cosmos. This is because, stars have some angular momentum. Even if it's not noticeable, the core cannot be perfectly stationary. Even if it wares stationary, the material from accretion disk formed around it when the star dies and neutron star is left would rotate around before falling into it. This would give it some angular momentum. But they generally have some angular momentum. When the star explodes, the material that is left behind is much less massive than that of the original star. This is why the newly formed neutrons are spinning and because neutron star is the last thing that a stare becomes before becoming black hole. It is expected that the black hole begins to spin. This is all yet to be observed directly, but calculation checks outs. This is theoretically true and is expected to be actual as well. This is the difference between the rotating and non-rotating black hole.

In essence, the Schwarzschild black hole is considered uncomplicated type of black-hole given that its core does not spin. As shown in Figure 1 above, this form of black hole usually contains a singularity and event layout.

The Kerr black hole is perhaps the most popular form in nature: it does rotate due to the fact that the star from which it was created from does rotates. In case of collapse of the rotating star, the core proceeds with rotating and is often carried through to the black hole. The components of Kerr black hole includes:

- Singularity - split core
- Event horizon- opening at the hole in which the escape speed is equivalent to velocity of light.
- Ergo-sphere- section of the distorted space which surrounds the event horizon: this section is usually egg-shaped.
- Static limit: this is region which borders the ergo-sphere and normal space.

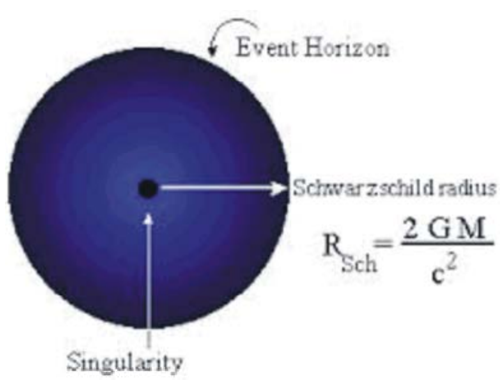


Fig. 1: Image showing Schwarzschild radius of an event horizon

In case an object passes through the ergo-sphere, chance is that it can be pushed out of the black hole due to vast energy emanating due to the hole's rotations. Nonetheless, in case an object passes through the event layout, it will be absorbed in the black hole and therefore cannot escape. Whatever occurs inside the black hole remain unclear, not even the current concepts of physics as far as vicinity of a singularity is concerned are not applicable.

Arguably, it is impossible to observe the black hole, although there are three elements that can be measured, they include: mass, electropositive charge and speed rotation (momentum). As provided by the above properties, we can tentatively examine the exact mass of the celestial object (black-hole) as it does depend on the objects are often in motion around it. If in any case the black hole has a companion material, it is possible to determine the radius of rotation or even the velocity of orbit of the objects surrounding the unseen black hole. Notably, exact mass of the black hole can be evaluated using the *Kepler's Modified* 3rd *Law of Universal Motion*. All other changes occurring within the black hole may either run off to indefinite and reprieved by the black hole. This is possible given that activities within the black hole horizon do not impact on the activities surrounding it.

Exact Solution of the Black Hole: Essentially, there exist four types of black hole solution relating to Einstein field formulae that often defines gravity in relation to the theory of general relativity. Out of the four, two are rotating and the other two are non-rotating. Based on the above characteristics, we can note the following four forms of black-holes:

	Non-rotating ($J = 0$)	Rotating ($J > 0$)
Uncharged (Q= 0)	Schwarzschild	Kerr
Charged (Q # 0)	Reissner-Nordstorm	Kerr-Newman

Schwarzschild Solution: When we put a spherical symmetry, the general static solution is indicated by metric as:

$$ds^2 = A(r)c^2dt^2 - (r)du^2 - r^2d\theta^2 - r^2\sin^2\theta d\varphi^2 \quad (1)$$

Apparently, we equation is equal to one, without loss of generality; the parametric coefficient is linked to the angular component of the metric. A and B entirely rely on the flat coordinate, which is represented by r. Of concern, given the metric tensor, we obtain:

$$g_{ij} = \begin{pmatrix} A(r) & 0 & 0 & 0 \\ 0 & -B(r) & 0 & 0 \\ 0 & 0 & -r^2 & 0 \\ 0 & 0 & 0 & -r^2 \sin^2\theta \end{pmatrix} \quad (2)$$

$$g_{ij} = \begin{pmatrix} \frac{1}{A(r)} & 0 & 0 & 0 \\ 0 & -\frac{1}{B(r)} & 0 & 0 \\ 0 & 0 & -\frac{1}{r^2} & 0 \\ 0 & 0 & 0 & -\frac{12}{r^2 sin^2\theta} \end{pmatrix} \quad (3)$$

Considering the Christoffel symbol, we can have generally:

We have:

$$\Gamma_{ij}{}^{k} = \frac{1}{2} f = g^{k}{}_{h}\{(\partial g_{hi} /) + (\partial g_{hj} / \partial x_i) - (\partial g_{ij} / \partial x_h)\} \quad (4)$$

The indexes run from 0 to 3. Clearly, 0 stands for t, 1 for r, 2 for θ and 3 for φ. Setting k = 0, from (2), (3) and (4),

We obtain: $\Gamma_{010} = \Gamma_{001} dA = \frac{1}{2A}\frac{dA}{dr}$ (5)

All the other symbols (if k = 0) vanish. Setting k = 1, from (2), (3) and (4), we obtain:

$$\Gamma_{100} = \frac{1}{2B}\frac{dA}{dr}, \Gamma_{111} = \frac{1}{2B}\frac{dB}{dr}, \quad \Gamma_{121} = -\frac{r}{B}, \quad \Gamma_{131} = \frac{r \sin\wedge 2\theta}{B} \quad (6)$$

All the other symbols (if k=1) vanish. Setting k=2, from (2), (3) and (4),

We obtain:

$$\Gamma_{122} = \Gamma_{212} = \frac{1}{r}, \quad \Gamma_{332} = -\sin\theta\cos\theta \quad (7)$$

All the remaining symbols (if k = 2) are gone. From (2), (3) and (4), setting k = 3,

We obtain:

$$\Gamma_{313} = \Gamma_{313} = 1/r, _{233} = \Gamma_{323} = 1/\tan\theta \quad (8)$$

All the remaining symbols (if k = 3) are gone. Let's deduce the Ricci Tensor's components now. In general, with the notation's obvious meaning, we have:

$$R_{ij} = \partial\Gamma_{kik} / \partial x^j - \partial\Gamma_{ij}^{k} / \partial x^k + \Gamma_{ik}^{l}\Gamma_{jl}^{k} - \Gamma_{ij}^{l}\Gamma_{kl}^{k} \quad (9)$$

We obtain all the non-vanishing components through some simple mathematical passages, omitted for brevity:

$$R_{00} = \frac{1}{2B} d_2 A / dr_2 + \frac{1}{4B}\frac{dA}{dr}(\frac{1}{A}\frac{dA}{dr} + \frac{1}{B}\frac{dB}{dr}) - \frac{1}{rB}\frac{dA}{dr} \quad (10)$$

$$R_{11} = \frac{1}{2B} d_2 A / dr_2 + \frac{1}{4A}\frac{dA}{dr}(\frac{1}{A}\frac{dA}{dr} + \frac{1}{B}\frac{dB}{dr}) - \frac{1}{rB}\frac{dB}{dr} \quad (11)$$

$$R_{22} = \frac{1}{B} + \frac{r}{2B}(\frac{1}{A}\frac{dA}{dr} - \frac{1}{B}\frac{dB}{dr}) - 1 \quad (12)$$

$$R_{33} = \sin_2 \theta R_{22} \quad (13)$$

Einstein equation for empty space, we have:

$$R_{ij} = 0 \quad (16)$$

From (10), (11) and (16),

We immediately obtain:

$$-\frac{1}{2AB} d_2 A / dr_2 + \frac{1}{4AB}\frac{dA}{dr}(\frac{1}{A}\frac{dA}{dr} + \frac{1}{B}\frac{dB}{dr}) - \frac{}{rAB}\frac{dA}{dr} = 0 \quad (17)$$

$$\frac{1}{2AB} d_2 A / dr_2 - \frac{1}{4AB}\frac{dA}{dr}(\frac{1}{A}\frac{dA}{dr} + \frac{1}{B}\frac{dB}{dr}) - \frac{1}{rB\wedge 2}\frac{dA}{dr} = 0 \quad (18)$$

From (17) and (18), we have:

$$dB/B = -\, dA/A \quad (19)$$

Or, $B = K_1/A$ (20)

It is possible to deduce the value of the constant K_1 by insisting that the normal flat metric must be recovered at infinity. In other terms, the following condition must be imposed:

$$\lim_{r\to\infty} A(r) = \lim_{r\to\infty} B(r) = 1 \quad (21)$$

From (20), taking into account (21), we obtain:

$B = 1/A$ (22) $g_{00}g_{11} = -1$ (23)

From (16) and (12), We have:

$$A + \frac{rA}{2}[\frac{1}{2}\frac{dA}{dr} - A\frac{d}{dr}(1/A)] - 1 = 0 \quad (24)$$

Or, $A + r\frac{dA}{dr} - 1 = \frac{d}{dr}(rA)] - 1 = 0$ (25)

$A = 1 + K_2/r$ (26)

It I s worth pointing out that we could already deduce the "original" Schwarzschild solution at this stage without attributing any particular value to the constant K_2. The value of K_2 can be explicitly deduced by using the so-called Weak Field Approximation. When we denote the Gravity Potential with φ.

We can write:

$$A = g_{00}(1 - \phi/c_2)2 \cong 1 - 2\phi/c_2 = 1 - (2MG)/(rc_2) \quad (27)$$

From (26) and (27), we immediately deduce:

$K_2 = -2MG/c_2$ (28)

From (22) and (27), we have:

$B = 1/\{1 - (2MG/rc_2)$ (29)

The metric can be written immediately at this point. In order to obtain a more compact form directly, however, we can denote with Rs the value of r which makes the metric singular (the so-called Schwarzschild radius):

$(2MG)/c_2 = R_s$ (30)

From (27), (29) and (30), We finally obtain:

$$ds_2 = (1 - Rs/r)c_2dt_2 - dr_2/(1 - R_s/r) - r_2(d\theta_2 - \sin_2\theta d\varphi_2)$$

(31)

Static and Charged Black Hole Solution (Reissner-Nordstrom Solution): When it comes to physical sciences as well as astronomy, it is important to note that Reissner-Nordstorm metric is often a stationary answer to various Einstein Maxwell Field formular, that correlates to gravitational field of an electro-positive object, stationary and equally spherically symmetric object of mass(M). Between 1916 and 1921: Hans Reissner, Herman Weyl, Gunnar Nordstrom and Barker Jeffrey found this particular metric.

For spherical coordinates, that is (t, r, θ, φ), the Reissner-Nordstrom metric (the line element) is given by:

$$g = (1-(r_s/r)+(r^2Q/r^2))c^2dt^2 - (1-(r_s/r)+(r^2Q/r^2))^{-1}dr^2 - r^2g\Omega$$

where c-speed of light, t-time coordinate obtained by a stationary clock at ∞, r is the radial coordinate and gΩ corresponds to the standard metric on the unit radius 2-sphere which if *coordinatised* by Ω = (θ, φ) reads

$$g\Omega = d\theta_2 + \sin_2\theta d\varphi_2$$

where rs represents the Schwarzschild radius of an object and calculated by: $r_s = 2GM/c^2$ and rQ is the featured length scale and is calculated by: $r^2Q = Q^2G/(4\pi\varepsilon_0 c^4)$.

In this case $1/4\pi\varepsilon_0$ is the force of Coulomb constant K

In essence, the total mass (weight) of the central object as well as its irreducible mass are represented by:

$$M_{irr} = (c_2/G)\sqrt{(r_{24}/2)} \rightarrow M = [(Q_2K)/(4GM_{irr})] + M_{ir}$$

The difference between M and M_{ir} is as a result of mass as well as energy similarity which enables the electric field energy impact on the overall mass.

In the event that the charge(Q) or related length-scale becomes zero, then it is possible to recover Schwarzschild metric. Equally, the typically Newtonian theory of gravity can as well be rediscovered within the limit as the ratio (r_s/r) becomes zero. On the other hand, in case the limit of r_Q/r and r_s/r becomes zero, then the metric equals to Minkowski metric for a given special relativity. Practically, the ratio (r_s/r) is usually exceedingly smaller. For instance, the Schwarzschild radius of the planet (Earth) is approximately 9 mm, whereas a given satellite body within the geosynchronous boundary has a radius which is about four billion times bigger, approximately 42, 164 kilometers. Nevertheless, the possible corrections to the Newtonian gravity does forms part of the one billion, regardless of the earth's surface. Typically, the ratio does become bigger when closer of black hole or even ultra-dense objects like neutron stars. Speaking of charged black hole, even though the charged black hole with (r_Q<<r_s) are equal to the Schwarzschild black hole and often comprise of 2 horizons, namely: event horizon and internal Cauchy horizon. As for the case of Schwarzschild metric, the event horizons for a given space-time are situated in are areas where the metric component grr diverges: where:

$$0 = (1/g_{rr})= (1-(r_s / r) + (r^2Q /r^2))$$

This equation contains two solutions;

$$r_{+-} = ½(rs \pm\sqrt{}(r_{2s} -4r_2Q)$$

At 2rQ = r_s, the concentric event horizon usually decreases which correlates to an external black hole. Naturally, black hole with $2r_Q>r_s$ does not exist due to the fact that whenever a charge is larger than the mass, the physical activities within the event horizon ceases. In general objects with charge larger than their mass does exist in nature, only that they can be deformed to a black hole and in case they occur, they would indicate a naked singularity. Scientific theories and concepts on super symmetry have always ensured that the super external black holes are unavailable. In most occasions, the electromagnetic potential $A\alpha$ = [(Q/r),0,0,0].

In case the magnetic monopoles become part of the theory, then the idea of generalization to incorporate magnetic charge P is gotten through replacing Q_2 by Q_2 + P_2 within the metric and inclusion of the term $P \cos \theta d\varphi$ in the electromagnetic potential.

Rotating Black Hole Solution

The Kerr Black Hole Solution: Essentially, the Kerr metric is generalized concept of Schwarzschild metric established in the year 1915 by Karl Schwarzschild. The concept defines the lay-out of space-time within electropositive, spherically-symmetric as well as a non-spinning object. A similar solution for a charged spherical in shape and non-spinning object is Reissner-Nordstorm metric which was founded between the periods of 1916 to 1918. Nonetheless, the accurate determination for electropositive, spinning black hole as well as Kerr metric was unclear until it was founded by Roy Kerr in the year 1963. Within two years, the Kerr-Newman matric was founded; this gave the idea of a natural extension of an electropositive rotating black hole. The Kerr metric notes that a spinning black hole must have a layout-pulling popularly commonly referred to as *Lense-Thirring* precession-this is a distinguishing projection of the theory of relativity. Determination of these layout-pulling effects was in line with the gravitational pull. Apparently, his effects estimates applied stress which can be experienced, but rather due to the fact that the spinning nature of space time itself is linked to rotating objects. As they approach the black hole, the objects including illumination must spin together with the black hole, the section in which all these activities occur is known as ergo-sphere. The Kerr metric is often described in two forms, namely: Boyer-Lindquist and Kerr-Schild form.

Boyer-Lindquist Form (Coordinates): Usually, the Kerr metric defines the layout of space-time while taking into consideration mass (M) with a rotating angular momentum J. That said, the metric within Boyer-Lindquist coordinates are as follows:

$$g = - c_2dr_2 = - (1- r_s r/\Sigma)\, c_2dt_2 + (\Sigma/\Delta)dr_2 +\Sigma d\theta_2 + (r_2 + a_2 + (r_s ra_2 /\Sigma) \sin 2\theta d\, Ø_2 - 2r_s ra/\Sigma) \sin 2\theta cdt\, dØ$$

where, r, θ, Ø are standardized spherical coordinate system which is equal to the Cartesian coordinates:

$$x = \sqrt{r^2} + a^2 sin\theta \cos\varphi$$
$$y = \sqrt{r^2} + a^2 \sin\theta \sin\varphi$$

r_s – Schwarzschild radius given by: $r_s = 2GM/c^2$

and for brevity, the length-scale, a, Σ and Δ can be described as:

$$a = J/M\, c$$

$$\Sigma = r_2 + a_2\cos 2\, Ø$$
$$\Delta = r_2 - r_s + a_2$$

A major characteristic to capture in the metric equation is the multiplication factors of components of dt and d Ø. This means that there exists integration in time and movement in the section of spinning which vanishes whenever the black hole momentum equals to 0.

For instance, in the case of non-relativistic limit, in which M is equal to r_s becomes 0, then the Kerr metric is given by even spheroidal coordinates:

$$g = \rightarrow M \rightarrow 0\{-c_2dt_2[\Sigma dr_2/(r_2+a_2))] +\Sigma d\, \ominus 2+(r_2+a_2) \sin_2\ominus d\, \varphi_2\}$$

Kerr-Schild Coordinates: The Kerr-metric can be described by incorporating both the x and the y-axis as follows: the given solutions were designed by Kerr during the 1960s.

$g_{\mu\nu} = \eta_{\mu\nu} + f\, k_\mu k_\nu$
$f = [Gr^2/(r^4 + a^2 z^2)]\ [2Mr]$
$K = (k_x, k_y, k_z) = [\{(r\,x + ay)/(r^2 + a^2)\}, \{(r\,y - ax)/(r^2+a^2)\}, (z/r)]$
$k_0 = 1$

It should be noted that the vector a is usually controlled across the plane axis. As for such, the value of r is not the radius but instead can be represented as follows:

$$1 = [(x^2 + y^2)/(r^2 + a^2)] + (z^2/r^2)$$

One will observe that the quantity of r is equivalent to the usual radius R.

$$r \rightarrow R = \sqrt{(x^2 + y^2 + z^2)}$$

Whenever the rotational parameter becomes 0. In the solution above, the unit are chosen in a way that the velocity of illumination is 1. At relatively huge distances from the main supply of light: that is R >>a, the formula become the Eddington-Finkelstein component of the Schwarzschild. Usually, in Kerr-Schild, the determining factor of the tensor is always a negative value, regardless of its proximity to the source.

Kerr-Newman Black Hole Solution: The component is the most unique, in the sense that, for a charged object it does offers the general solutions of black hole to the above Einstein-Maxwell equations. This defines space time layout within the section bordering an electropositive spinning object/mass. Furthermore, it tends to generalize the metric by incorporating the electromagnetic field in addition to defining the rotations. The Kerr-Newman solution is kind a unique model which gives the exact solution of the Einstein-Maxwell equation while incorporating a non-zero variable constant.

Limiting Situations/Scenarios: It can be seen that the Kerr-Metric does decrease the other appropriate solutions in the theory of relativity in limited scenarios. It decreases to:

The Kerr metric as the electrified charge approaches 0:

The Reissner-Nordstorm metric as the angular momentum J or $\alpha = J/M$ approaches 0.

The Schwarzschild metric as electropositive charge(Q) and angular momentum both taken as 0.

Minkowski space in case the mass M, charge as well as rotational parameter a becomes zero. Similarly, in case the gravity should be eliminated, Minkowski space emerges if G = 0, without incorporating both the M and Q as zero values. For this case, the electromagnetic field are sophisticated than actually the electropositive fields/dipoles. As noted in the above discussion, the Kerr-Newman metric defines the layout for a particular spinning black hole object; its formula largely relies on coordinates and coordinates conditions. As for such, the two main forms of coordinates are:

Boyer-Lindquist Coordinates: One of the methods of expressing the metric is through putting into place its line componentin a given group of spherical coordinates, commonly referred to as Boyer-Lindquist coordinates.

$$c^2 dT^2 = -\{(dr^2/\Delta) + d\theta^2\}\, \rho^2 + (cdt - a\sin^2\theta d\varphi)^2\, (\Delta/\rho^2) - \{(r^2 + a^2)\, d\varphi - acdt\}^2\, (\sin^2\theta/\rho^2)$$

N/B: (r, ⊖ and φ) are standardized spherical coordinate-system and length-scale:

$a = J/Mc$
$\rho^2 = r^2 + a_2 \cos_2 \ominus$
$\Delta = r^2 - r_s + a_2 + r_2 Q$

Here rs is the massive body's Schwarzschild radius, which is associated with its total mass-equivalent M by $r_s = 2GM/c^2$

where G is the gravitational constant and r_Q the length of the mass corresponds to the electrical charge Q $r^2_Q = \{Q^2 G/ (4\pi\varepsilon_0\, c^4)\}$

where $1/(4\pi\varepsilon_0)$ is Coulomb's force constant.

Consideration of the Electromagnetic Field in the Form of Boyer-Lindquist: The electromagnetic potential in Boyer-Lindquist coordinates is.

$$A\mu = ((r\, r_Q/\rho^2), 0, 0 - [c^2 a\, r\, r_Q \sin^2\theta/(\rho^2 GM)])$$

While the Maxwell-tensor is defined by;

$$F_{\mu\nu} = \partial A_\nu / \partial x_\mu - \partial A_\mu / \partial x_\nu \rightarrow F_{\mu\nu} = g_{\mu\sigma} g_{\nu k} F_{\sigma k}$$

In combination with the symbols second order equations of motion can be derived with.

$$x^i = -i_{jk} x_j x_k + qF_{ik} x_j g_{jk}$$

where q is the charge per mass of the *testparticle.*

Kerr-Schild Coordinates: The Kerr-Newman is described in the form of Kerr-Schildwhile incorporating a given coordinates as shown below:

$g_{\mu\nu} = \eta_{\mu\nu} + f\, k_\mu k_\nu$

$f = [Gr^2/(r^4 + a^2 z^2)][2Mr - Q]$

$K = (k_x, k_y, k_z) = [\{(rx + ay)/(r^2 + a^2)\}, \{(r\,y - ax)/(r^2 + a^2)\}, (z/r)]\ k0=1$

We observe k is a unit vector. M, Q, η and a are equally appropriately described.

Such equations are reduced to the Reissner – Nordström metric at large distances from the origin ($R >> a$) where $A_\mu = (Q/R)\, k_\mu$

Electromagnetic Fields in the Form of Kerr-Schild: The electromagnetic fields can be obtained in a simple way through by distinguishing the 4-potentials to get the appropriate ability. As for such, it would be appropriate to changes to 3-dimensional vector notation defined as follows:

$Au = (-\varphi, A_x A_y, A_Z)$

Equally, the stationary electric and magnetic fields are obtained from unit and scalar potential as follows:

$E = -\nabla_\varphi$
$B = \nabla \times A$

Adopting the Kerr-Newman formula for the 4 potentials in the form of Kerr-Schild, we obtain the below equation:

$E + iB = \nabla\Omega$
$\Omega = Q/\sqrt{(R - ia)^2}$

The value of omega O in the above formula is equivalent to the potential (Columb's), only that the radius unit is adjusted by a projected quantity. Paul Emile Appell defined the complexity of this potential in the early 19^{th} century.

The Nearest Black Holes: It is no doubt that black holes re unique components within the universe. There are a lot of speculations on their existence and it is hard to find even one. The universe is large and stellar black holes size is equivalent to the size of an island (small of course. Moreover, the Milky Way is flat and comprising of several stars. Therefore, Cartesian coordinates are helpful when it comes to mapping the black holes. Notably, the black holes are formed as a result of massive explosions of the star. Unfortunately, this phenomenon does not occur very often within the Milky way, as for such the black holes are in fact far apart. The highly dense cores of the galaxies have necessitated the formation of black holes which have developed gradually into extremely bigger masses comprising of as huge masses of stellar black hole. Some galaxies may contain two or three black holes, but a majority has only one. The nearest black hole to the Universes is V616 Monocerotis, it about 3, 000 light years-away and its mass is about 13 time that of the sun's mass. Followed by Cygnus X-A, situated 6, 000light-years away and contains roughly fifteen solar masses. The GRO JO422+32 is perhaps the smallest of all the black holes discovered, it is about 7, 800 light-years away. All the three identified black holes have one common thing: that is, they all contain companion stars, which makes it very easy to detect them. Usually, the companion star degenerates as it gets sucked by the black hole, before it enters into the event horizon. It does heats up and begins to generate X-rays. For some time now, X-ray have been used to detect the black holes with the assistance of telescopes such those used by the astronomers. The extremely bigger black holes are normally at the core of each and every galaxy and stellar mass black holes are formed whenever the big stars gradually die after explosions. Research and studies have shown that there might be many black holes which are even closer to the Earth other than the above identified.

Table 1: Provides the coordinates of the nearest black holes to the Sun/Solar System

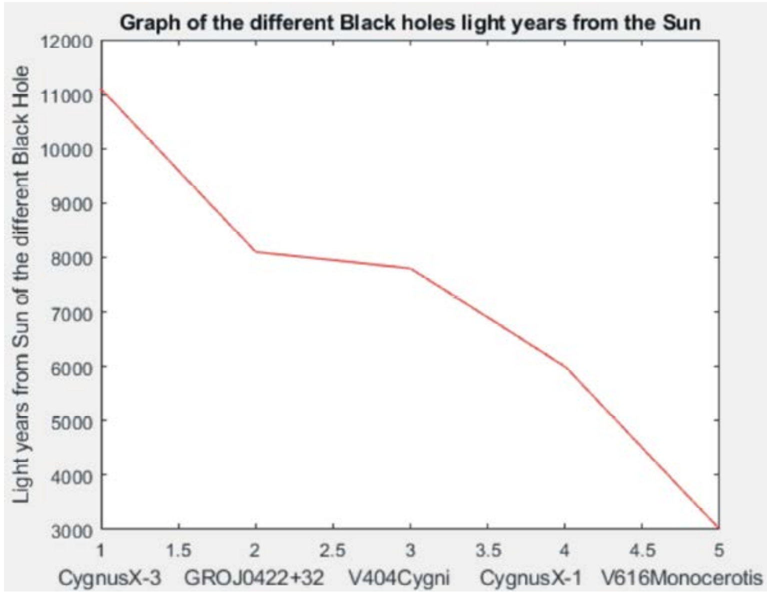
Name	Mass
Cygnus X-3	16
GRO j0422+32	9
V404 Cygni	4
Cygnus X-1	15
V616 Monocerotis	13

Table 2: Shows some of the closest black holes present with the universe

Name	Light year from Sun
Cygnus X-3	11100
GRO j0422+32	8100
V404 Cygni	7800
Cygnus X-1	6000
V616	3000

MATLAB Coding:

```
y = [11100 8100 7800 6000 3000];
plot(y, 'r');
xlabel ('CygnusX-3 GROJ0422+32 V404Cygni CygnusX-1 V616 Monocerotis');
ylabel ('Light years from Sun of the different Black Hole');
title ('Graph of the different Black holes light years from the Sun');
```



We see from above graph, if we draw a line of light years from the sun of 5 black holes, we can imagine the above line beside the Sun.

CONCLUSION

As a particle moves between the static limit and the surrounding event horizon, even though it does not go into the stable orbit, there are higher chances that it will collect some energy. It can escape from the black hole carrying along with its energy. From the discussions, the Schwarzschild solution is a distinct symmetrical solution to the Einstein's equation. Most importantly, the solution we obtained is only valid in a vacuum and therefore it clings outside the region of the star. In essence, when it comes to dealing with gravitational field of the sun, no singularities are involved, although there exist objects which require Schwarzschild metric. From the Schwarzschild solution we know that the Horizon of the world. In this paper, we tried to describe stationary Black Hole with Schwarzschild solution. The Schwarzschild described space-time layout near a stationary and non-charged black hole. Majority of object in the universe which include but not limited to: stars, galaxies, does rotate, thus it is not amazing that the rotating black holes will be present in the universe. The mathematical concept which defines the rotating Kerr black holes was developed by Roy Kerr while employing Einstein Theory of General Relativity (this happened in the year 1963). Notably, the same concept was employed by Karl Schwarzschild in the year 1916 when he tried to describe the concept of non-rotating Schwarzschild black holes. Just like the other rotating objects, the Kerr Black holes comprises of a rotation axis and often flattens along the axis expanding within the plane. This contrasts the Schwarzschild black holes that do not spin. What makes the inside of the black hole sophisticated is the fact that it does comprise of two event horizons in lieu of one. Moreover, in lieu of the Singularity to be a mathematical section, it is disfigured via spinning into a one-dimensional component with the plane. As evident from the paper, we understood that black hole is cluster of gases, which are formed due to the death of stars and it becomes bigger and bigger as much big as it occupies nearby masses. A question demands how it would affect life on earth; if there would be black hole near the earth, our earth would collapse within a second and will be crushed into tiny rocks and get vanished like it was not there. Black hole is something which is only detected; nobody has seen it and nobody has ever experienced it.

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