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A Constant Rotating Kerr-Newman Black Hole with No Electrical Net Charge

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Abstract A black hole solution for the rotating electric charge is given in the Kerr-Newman metric. Incorporation of the oscillating effects show to drive rotation. The model derived enopens consideration of an electrical charged BH with no net charge, which would neutralize. From the solutions a new complete set of tensor elements to modify the Kerr-Newman metric leading to the interesting feature the squared line element can represent a black hole permanently carrying electrical charge, but the charge not evenly distributing and spreading on the surface. Due to its properties, the black hole approached in this theory shows a serrated surface in a kind sawtooth behaviour boosting the idea for determination of torsion effects and detect rotation. An exact representation of the data together with an entire set of information can found to support further evaluation of similar objects. The stability of the structure is discussed.

Keywords: *black hole, Kerr-Newman metric, RN metric*

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1. Introduction

The involvement of the electrical field in black-hole (BH) studies in the metric of Reissner [1] and Nordstrøm [2], RN metric is an important aspect as well as investigations due to torsion of electrical uncharged [3,4], and even charged rotating BH [5,6,7], the Kerr-Newman metric (KN) have been extensively studied. A special point of view is due to the electrical charged objects since they involve both types of interaction at the same time. That leads to the fact the Reissner-Nordstroem solution has two horizons, an external event horzon and an internal `Cauchy horizon´ providing a convenient bridge to the study of the Kerr solution.

Incorporation of the oscillating effects show to drive rotation. The model derived allows consideration of an electrical charged BH. However, there are no known cosmic objects carrying a significant net electrical charge since those bodies are assumed to probably be rapidly neutralized and, therefore the role electrical charged BH play in astrophysics is at least *secundum ordinem*. The presented paper is a study on a BH carrying a permanent electrical charge, which will and can never neutralize.

It has recently be shown a BH can be represented consisting of an electromagnetic wave (EM) alone, which leads to an extension of this model due to an interchanging positive and negative states in the EM [8]. Similarly, that would arrive at the phenomenon of two quantum mechanical states, positive and negative as predicted in the Dirac’s theory [9,10]. The consideration of negative states in atom physics still bears a problem and has not be resolved in the suggestion of so-called anti-atoms, which consist of the same compounds in reversed electrical charges, but still positive mass *m*. Anti-matter has not been detected yet as a positron is either. A description of a BH model on the basis of an EM can not avoid those arguments but should incorporate both of those states together leaving a more precise model, which is the aim of the present study. In a recent study we found a model for a BH consisting exclusively of an EM [11] leading to a Schwarzschild’s description [12,13,14]. It is anticipated the BH of derived in this theory will never be at rest.

2. Theory

A light beam travels any path it takes the shortest time and time interval. An event horizon of a BH is insurmountable for anything claiming the de Broglie formalism. Light will not become anti-light in an anti-universe. Curvature in space is not a secret and a miracle either. It is, simplified illustrated, essentially due to the “discrepancy” between circumference and radius of a sphere in presence of a force field, and nothing else. The simplest example becomes obvious in atom and quantum physics appearing in the involvement of the factor α from electrostatics [15], a “correcture factor” revealing from the both limited speeds forming together the propagation speed of light *c* in the vacuum (see below).

The following theory is restricted to the ususal Coulomb expression, since the magnetic terms involving radii *r* of third and fourth order, respectively and are typically smaller and can be viewed as a perturbation to the spherical symmetric Coulomb term [16,17,18,19]. It regards the diameter of the black hole (BH)

$$d_{BH}=2r \qquad (1)$$

[11] and describes the angular velocity measured relative to a reference frame at infinity

$$\omega_{\phi}=\frac{d\phi}{dt}, \qquad (2)$$

at θ = $\pi/2$, the equatorial area of the BH [20]. From the angular frequency $\vec{\omega}\rightarrow\omega$, typically bold characters assigning vectors in the further, follows the angular momentum

$$\vec{J}=\vec{r}\times m\cdot\vec{v}\equiv mr^{2}\cdot\vec{\omega}. \qquad (3)$$

Though, it is mathematically acceptable to use geometrized units in general relativity to save labour it physically can represent a loss of information due to possibly entailing confusion [21]. Consequently, the current study deals with physical units to later give the results converted following the common geometrized scheme [20].

The general form of the underlying the condition of an EM is the d'Alembertian

$$\Box\psi(r,t)=0, \qquad (4)$$

an operater properly entailing a metric signature (−, + ,+, +), which would lead to results due to a fundamental metric tensor in a square root like $\sqrt{+g}$ in accordance to Goedel [22], but is in contrast to the form $\sqrt{-g}$ suggested from Einstein [23] leading to a signature with reversed signs like (+, −, −, −). An equivalent use of both types leading equal-valued results at the end makes a further discussion redundant.

Due to its character the EM oscillates reversing positive and negative states [8] as presented in separation in the Dirac's equation twin. It has to be emphasized in this investigation one single EM is considered interacting with itself but not annihilating like particle and anti-particle as in the example

$$\begin{array}{rcl} E & = & -\left(i\hbar c\,\boldsymbol{\alpha}\nabla-\beta m_{0}c^{2}\right)\psi(\boldsymbol{r},t)\\ +E & = & +\left(i\hbar c\,\boldsymbol{\alpha}\nabla-\beta m_{0}c^{2}\right)\psi(\boldsymbol{r},t)\\ \hline 2E & = & 0\qquad\qquad\qquad\psi(\boldsymbol{r},t)\end{array} \qquad (5)$$

the related Dirac's equations for two free particles of that kind.

With respect to the the d'Alembertian as underlying condition with an extention to the mechanical momentum of light neither pure electrical nor magnetic fields appear for an observer outside the EM rather electromagnetic and gravitational interactions in oscillation. It sets to reason the factors underlying the basis that for a particle with the elementary charge e there are two speeds limiting the speed of light [24]. The respective maximum and minimum speeds for a bradyon B and the minimal for a tachyon T is close to the propagation c of light in the vacuum pointing as extremae to the limiting speeds

$$\mathrm{v_B}=\left(1-\alpha^{2}\right)^{1/2}\cdot c \qquad (6)$$

$$\mathrm{v_T}=\left[2-\left(1-\alpha^{2}\right)^{1/2}\right]\cdot c, \qquad (7)$$

with

$$\alpha=\frac{\mathbf{e}^{2}}{2h\varepsilon_{0}c}\equiv\frac{\mathbf{e}^{2}}{4\pi\varepsilon_{0}\hbar c} \qquad (8)$$

the fine-structure constant [25], an always positive scalar, and theoretically demonstrated in that context [15]. The basis in that is found in the consideration any particle can cross the light barrier by a "jump" to converse from the subluminal character of a B into that of a superluminal T and reverse in alternating their properties. The transition entails symmetry reflection in a *CPT*– operation in mirroring the signs of, *e.g.*, mass, time interval, and space, respectively. A sign change of the particle's electrical charge is entailed from the Coulomb´s law due to the change in sign of the electrical field, $+\mathbf{E}_B\leftrightarrow-\mathbf{E}_T$. The theory is based on the postulate that a photon is represented by means of permanent interchanging sub- and superluminal state by light-barrier crossing appearing in the B–T pair of the **B** particle and T co– or antiparticle in accordance eq. (1) and illustrated in the twin pair of Dirac´s equations to describe the character of the entire system. Since always related to the propagation of light c the requirement for that phenomena in the entire system is a permanent co–existence of B and T altogether; they behave correlated and the one can never exist without the other. The formulae eqs. (6), (7) are valid towards pure and free electrostatic interactions in the vacuum and valid for any m including m = 0. An eventual appearing discrepancy between their momentae does not affect their validity. That can be verfied in incorporating the two associated electrostatic potentials in the "positive" and the "negative" Dirac's equations. After a "re"-out-factorzation of them the result returns exactly to the d'Alembertian eq. (4).

The differences between the respectice speed limit and c are the same,

$$\Delta\mathrm{v_{c,B}}=c-\mathrm{v_B}\equiv c-\left(1-\alpha^{2}\right)^{1/2}\cdot c\equiv\left[1-\left(1-\alpha^{2}\right)^{1/2}\right]\cdot c, \qquad (9)$$

$$\begin{aligned}\Delta\mathrm{v_{T,c}}&=\mathrm{v_T}-c\equiv\left[2-\left(1-\alpha^{2}\right)^{1/2}\right]\cdot c-c\\&\equiv\left[1-\left(1-\alpha^{2}\right)^{1/2}\right]\cdot c;\end{aligned} \qquad (10)$$

that forms the "speed gap" as the "light-barrier thickness" between sub- and superluminal motion,

$$\begin{aligned}\Delta\mathrm{v_{B,T}}&=\Delta\mathrm{v_{c,B}}+\Delta\mathrm{v_{T,c}}\equiv2\left[1-\left(1-\alpha^{2}\right)^{1/2}\right]\cdot c\\&\approx53.2520634\,74\cdot10^{16}\cdot c.\end{aligned} \qquad (11)$$

Those formulas are valid on any perfect even surface, even on the surface of a BH in the vacuum, where they will be discussed.

The free EM in the vacuum forms the BH in performing one cycle around its centre with the angular velocity

$$\omega_{\theta,\mathrm{free}}(\phi)\equiv\frac{d\phi}{dt}=\frac{1}{\tau},\phi\perp r, \qquad (12)$$

with τ the time interval or respective periode for one cycle, here still measured per second.

The above speed differences create a movement of the “knot”, *i. e.*, the speed gap of the EM due to the condition the maximum of the one half wave must be exactly on the opposite side of the other. That originates as the consequence a shift to the entire system, and whith regard to the system’s mass leads to an orbit momentum and finally rotation of the BH. Consequently, the angular velocity calculates

$$\begin{aligned}\Delta \mathrm{v} &= \Delta \mathrm{v}_{\mathrm{c,B}} + \Delta \mathrm{v}_{\mathrm{T,c}} \left(\equiv \Delta \mathrm{v}_{\mathrm{B,T}}\right) \\ &= 2\left[1-\left(1-\alpha^2\right)^{1/2}\right]\cdot c\end{aligned} \quad (13)$$

→

$$\begin{aligned}\omega_{\mathrm{BH}} &= \frac{\Delta \mathrm{v}}{c}\frac{1}{dt} \equiv \frac{2\left[1-\left(1-\alpha^2\right)^{1/2}\right]\cdot c}{c}\frac{1}{\tau} \\ &= 2\left[1-\left(1-\alpha^2\right)^{1/2}\right]\cdot\frac{1}{\tau}\end{aligned} \quad (14)$$

or the angular frequency respective numerically

$$\omega_{BH} \approx 53.252\,\mu\mathrm{Hz},$$

still valid for any direction.

Since in the following context electrostatical interation is involved that effect needs further attention with regard to the question for similar or even comparable influence as be due to gravity. In that case, the above introduced Coulomb’s energy comes to the forth leading to a relation between electrostatic attraction and the wave length of the EM. If, as in the current study, the same EM is suggested to orbit a centre oscillating in its electrical charge facing opposite charges in a distance $d = 2r$ to leave

$$\frac{\alpha\hbar c}{2r} \equiv \frac{\alpha hc}{2\pi r} = \frac{hc}{\lambda}\left(\equiv\frac{hc}{s}\right), \quad (15)$$

it will describe a circumference s to issue the discrepancy

$$\frac{s}{2\pi r} = \alpha \to 1 = \frac{\alpha\cdot s}{2\pi r}. \quad (16)$$

That seems pointing to a similar effect in curving, though certainly and at the same time entailed from the Lorentz’ transformation in special relativity concerning length contraction as already discussed elsewhere [15]. It is true, the effects from the transformation equations for space and time in a gravitational field are a four times stronger compared to those from the Lorentz’ transformation in the absence of gravity, but strongly degraded with increasing distance, whereas electrodynamics is a long range effect [26]. For short distances gravitation dominates as the wave length is reciprocal to an increase in mass, which can be assigned to the EM entailing a rise in gravitational interaction at the same time, whereas the electrostatic in the case above is not. Consequently the latter can not determine spacetime curving albeit give strong contribution. Those evaluations are illustrated in the current investigation, especially the origin of the basis the BH is sugg belong to.

The properties or respective origin of both fields taken into account in the current theory, $\mathbf{e} = \mathbf{e}(\_)$ and $m = m(r)$ can be illustrated in their associated potentials explicitly appearing in

$$V_{\mathrm{e}}(r) = -\frac{1}{4\pi\varepsilon_0}\frac{\mathrm{e}^-\cdot\mathrm{e}^+}{r}, V_g(r) = -G\frac{m^-(r)\cdot m^+(r)}{r}. \quad (17)$$

Since the variables λ and r, respectively as parameters are freely selectable and arbitrary in choice they are not restricted in the free space, and the above relations are valid for any sphere. However, that bears the consequence, illustrated spoken: the gravitational constant G can never be simply replaced by the electrostatic constant α to give simultaneous results, and there will be no way to describe gravitational spacetime on the basis of one of those effects alone disregarding the other, but all that is properly redundant to note.

In the next step the expression for electrostatic self-interaction of the EM is introduced. As the BH is suggested to consist of a single electromagnetic wave (EM) describing a circumference on an area around its centre it interacts with itself on the opposite side. After combining the energy-mass equivalence (it is obviously equivalent, properly not the same)

$$E_m = mc^2 \quad (18)$$

with the electrostatic interaction between two virtual particles with rest-mass zero (m_0 = 0) of equal electric charge (q = 0) in their separation distance $2r$,

$$E_{\mathbf{e}} = \frac{1}{4\pi\varepsilon_0}\frac{\mathbf{e}^2}{2r} \equiv \frac{\alpha\hbar c}{2r} \quad (19)$$

the result can be assigned a mass from the electrostatic term

$$m_{\mathbf{e}} = \frac{1}{4\pi\varepsilon_0}\frac{\mathbf{e}^2}{2rc^2} \equiv \frac{\alpha\hbar}{2rc}. \quad (20)$$

That “interaction“ or “electrostatic mass”, respectively can be compared to the term appearing in the Schwarzschild metric later establishing the Kerr-Newman metric (KN) in a vice-visa the kind

$$+\frac{qQ}{4\pi\varepsilon_0\cdot 2r} \to -\frac{GmM}{2r}; \quad (21)$$

it increases due to the electrostatic field, which makes the system increase in its entire m due to the “mutual forces” between the charges [17,27]. The negative sign in the Newton’s gravitation law denotes the increase in energy. An introducing of that mass as “interaction mass” m_i into the Newton’s law of gravitation,

$$V_g = -G\frac{m_1\cdot m_2}{2r} \equiv -Gm_i\cdot\frac{m_g}{2r}, \quad (22)$$

and replacing m_i with eq. (20) leads to a kind gravito-electrostatic interaction

$$\begin{aligned}V_{eg} &= -G\left(\frac{1}{4\pi\varepsilon_0}\frac{\mathrm{e}^2}{2rc^2}\right)\frac{m_g}{r} \equiv -\frac{\mathrm{e}^2}{r}\left(\frac{G}{8\pi\varepsilon_0 c^2}\right)\cdot\frac{m_g}{r} \\ &= -\frac{1}{r}\left(\frac{\alpha\hbar G}{2c}\right)\cdot\frac{m_g}{r}\end{aligned} \quad (23)$$

with m_g a "test mass"; exept slightly deviating by the factor ½ involved here, that result is not new. The property eq. (23) can be interpreted

$$m_{eg} = -\frac{e^2}{r^2}\left(\frac{G}{8\pi\varepsilon_0 c^4}\right)\cdot m_g \rightarrow \equiv \frac{V_{eg}}{c^2} = -\frac{1}{r^2}\left(\frac{\alpha\hbar G}{2c^3}\right)\cdot m_g. \quad (24)$$

In accordance to our recent investigation [11], again the BH is suggested to consist of one single EM exactly completing one cycle around it – the reason the electrostatic factor α has been involved already and immediately, and the electrical charge here, is not arbitrary. There, a radius for a BH was obtained, though deviating in ½ from the Schwarzschild radius but

$$r_{ph}(g) = m\cdot\frac{G}{2c^2} \equiv \pm\sqrt{\frac{\hbar G}{2c^3}}, \quad (25)$$

keeping use in the same notation r_S, however. From isolating the radius for the m_i belonging to the electrostatic field in eq. (19) would properly point to

$$r_{ph}(e) = \pm i\sqrt{\frac{2\alpha\hbar c}{G}}\cdot\frac{G}{2c^2} \equiv \pm i\sqrt{\frac{\alpha\hbar G}{2c^3}}. \quad (26)$$

The letter is properly not the right interpretation in consideration of its origin, which truly stems from

$$\left(-r_{ph}(e)\right)\left(+r_{ph}(e)\right) \equiv \left[-\left(\pm\sqrt{\frac{\alpha\hbar G}{2c^3}}\right)\right]\left[+\left(\pm\sqrt{\frac{\alpha\hbar G}{2c^3}}\right)\right]. \quad (27)$$

The form exposing a "pure" G enopens comparison of both distingued photon radii at the same time, and is just

$$r_{ph}^2(e) \equiv -\frac{\alpha\hbar G}{2c^3}. \quad (28)$$

Due to a maximum electromagnetic attraction the extremae of both half-waves of the EM must face each other on their respective opposite sides and brings to the forth the influence of the different velocities. A special assignment due to the opposite signs of the electrical charges is arbitrary, any word redundant.

Due to its basis the entire m_{BH} consists exclusively of one EM, which is in accordance to the extremal principle, it can be assigned completely concentrated within the photon radius r_{ph}, and nowhere else. The final task is now to derive m_{BH} to later determine the angular momentum J together with the associated angular momentum factor α.

In the current study as well as in the results found on the KN the additional term appears due to the electrostatic mass eq. (20), whose radius dependence is quadratic, however and requires modification of our former study [11], where only one linear term is involved to derive m_{BH}. Thus, the extension requires the sum

$$m = m_g + m_e \equiv m_g - \frac{\alpha\hbar G}{2c^3 r_{ph}} \quad (29)$$

with the intention to first determine r_{ph} the calculation follows the strategy already discussed elsewhere [11]. After introducuding into the Newton's gravitational law eq. (22) and equating with the mass-energy equivalence displays

$$c^2 = G\left(m_g - \frac{\alpha\hbar G}{2c^3 r_{ph}}\right)\frac{1}{2r_{ph}} \equiv G\frac{m}{2r_{ph}}$$

$\rightarrow$

$$r_{ph} = \frac{G}{2c^2}\left(m_g - \frac{\alpha\hbar G}{2c^3 r_{ph}}\right), \quad (30)$$

an expression entailed from gravitato-electrostatic interaction of the (entire) m assigned the EM interacting with itself. Since r_{ph} describes the entire system it governs the following action.

As forming the basis of the current study m can be represented by r_{ph} due to the equivalence

$$mc = \frac{\hbar}{r_{ph}} \Leftrightarrow r_{ph} = \frac{\hbar}{mc}, \quad (31)$$

which must be applied on the term in the bracket to determine m_g. That leads to

$$m_g = \frac{2\hbar c^3 - \alpha G\hbar}{2c^3\cdot r_{ph}}, \quad (32)$$

modifies eq. (25) into

$$r_{ph} = \frac{G}{2c^2}\left(\frac{\hbar}{c\cdot r_{ph}}\right) \quad (33)$$

and finally ends up in

$$r_{ph} = \pm\sqrt{\frac{\hbar G}{2c^3}}, \quad (34)$$

or, associated

$$m_{EM} = \pm\sqrt{\frac{2\hbar c}{G}} \equiv m_{BH}, \rightarrow M \quad (35)$$

exactly the same results as in the electrostatically "un-perturbated" case, as expected. The exterior horizon results from r_{ph} [11],

$$r_H^+ = \frac{1}{1.4761581}\sqrt{\frac{\hbar G}{2c^3}}. \quad (36)$$

Since entailed from the orbiting EM that M can be interpreted the total mass as it includes rotational energy and an eventual electrical energy already. Hence, the total angular momentum entailed from the eqs. (14), (34), (35) points to

$$J = \pm\sqrt{\frac{2G\hbar^3}{c^5}} \cdot \frac{\left[1-\left(1-\alpha^2\right)^{1/2}\right]}{\tau} \tag{37}$$

$$\approx \pm 0.21408179 \cdot 10^{-81} \cdot \text{Js}.$$

It has to be strongly emphazisedin value and direction depends on the methods of an observer.

In undisturbed conditions, *i. e.*, free and not interacting with any external forces the wave can spread spherical arbitrary in all directions.

Though, this theory omits incorporation of magnetic fields an outer magnetic field will determine the orientation of the J and the BH, respectively. It will also lead to a break down in degeneracy of the J components at the same time. In accordance to Kerr and KN exposing θ will, *e. g.*, point to a

$$|J_\theta| > \frac{1}{\sqrt{3}}|J|, \tag{38}$$

considered in those theories. The deviation in the values of the respective r in determining the characteristics of the BH given above itselves will not affect the results, however.

Principal difference in the current theory appears there is no electrical charge Q in a steady and even distribution on the surface of the BH rather a point charge e moving synchroniously to α, instead. Thus, special concern is given to the Q-term when the current model is considered in analogy to the KN. The electric charge is represented in the function

$$Q = \text{e} \cdot \exp(i\omega t), \tag{39}$$

with

$$\text{e} \approx 1.518907 \cdot 10^{-14} \cdot \text{kg}^{1/2}\text{m}^{3/2}\text{s}^{-1},$$

to cover the final part of the theory in the square of the line element.

3. Results

In the view of the characteristic the principal results are an evenly distributing and spreading oscillating electrical charge on the surface of the BH enforcing it to an always constant rotation.

From the current model of a BH follow in geometrized units [20,28] for the BH in free space and undisturbed from external conditions individually

$$M = \pm\sqrt{\frac{2\hbar c}{G}}\frac{G}{c^2} \,\hat{=}\, \pm 2.28569331 \cdot 10^{-35} \cdot \text{m}$$

$$r_{\text{ph}} = \pm\sqrt{\frac{\hbar G}{2c^3}} \,\hat{=}\, \pm 1.14284463 \cdot 10^{-35} \cdot \text{m}$$

$$r_{\text{H}}^{+} = \frac{1}{1.47615581}\sqrt{\frac{\hbar G}{2c^3}} \,\hat{=}\, 0.774203189 \cdot 10^{-35} \cdot \text{m}^*$$

$$J = \frac{\left[1-\left(1-\alpha^2\right)^{1/2}\right]}{\tau} \cdot \sqrt{\frac{2G\hbar^3}{c^5}\frac{G}{c^3}}$$

$$\hat{=}\, 2.4770199 \cdot 10^{-117} \cdot \text{m}^2$$

$$a =: J/M = \pm\frac{\left[1-\left(1-\alpha^2\right)^{1/2}\right]}{\tau}\frac{G\hbar}{c^4} \,\hat{=}\, 1.08370063 \cdot 10^{-82} \cdot \text{m}$$

$$\omega = 2\left[1-\left(1-\alpha^2\right)^{1/2}\right] \cdot \frac{1}{c\tau} \,\hat{=}\, 0.17763 \cdot 10^{-12} \cdot \text{m}$$

$$|Q| \equiv \text{e} \to \text{e}_{\text{phys}}\frac{\sqrt{G}}{c^2} \,\hat{=}\, 1.38066 \cdot 10^{-36} \cdot \text{m}$$

* [11].

Though, following the geometrized scheme in the theory of relativity the units in the current study are deviating from those from chosing the natural units in the common use, but based on the relation appropriate to the basis of this theory, instead,

$$\frac{GM}{r} \to \frac{GM}{2r_{\text{ph}}}.$$

Consequently, the deviations in the values for M, r_{ph}, and J are due to the current model, which refers to the distance $d = 2r$ between two oppositing points on both sides of the BH rather than based on the pure radius r from the centre of the BH as in literature. For that reason, a factor $\sqrt{2}$ has to be counted for them, whereas a remains unaffected. Due to the basis of the current theory the product $\left(M, r_{\text{ph}}\right)$ is, therefore comparable to $\left(M \cdot r_S\right)$ in the KN, and in the the tensor elements appear (M / 2) instead of (2M).

There is no further relativistic contribution with respect to any increase in m or M, respectively, and no eventual length contraction in r_{ph} either, as this theory is based on an EM representing itself with no rest mass.

Due to the metric notation (+, −, −, −) generally chosen [20,28] the square of the line element is

$$dr^2 = \left(\frac{r_{\text{ph}}r - Q^2}{r^2 + a^2\cos^2\theta} - 1\right) \cdot dt^2 + \frac{\Sigma}{\Delta} \cdot dr^2 + \Sigma d\theta^2$$

$$+ \frac{\chi}{\Sigma} \cdot \sin^2\theta \cdot d\phi^2 + \frac{2a \cdot \left(\text{e}^2 + r_{\text{ph}}r\right) \cdot \sin^2\theta}{\Sigma} \cdot dt \cdot d\phi$$

with the common abbreviations

$$\Delta := r^2 - r_{\text{H}}r + a^2 + Q^2$$

$$\Sigma := r^2 + a^2 \cdot \cos^2\theta$$

$$\chi := \left(a^2 + r^2\right)^2 - a^2 \cdot \sin^2\theta \cdot \Delta$$

$$= \left(a^2 + r^2\right)^2 - a^2 \cdot \sin^2\theta \cdot \underbrace{\left(r^2 - r_{\text{H}}r + a^2 + Q^2\right)}_{\Delta}$$

$a := J/M$, the angular momentum per unit mass of the BH.

Here, M is assigned the mass equivalent including the energies of electrical charge and rotation of the central body, Q electrical charge given in eq. (39), J orbit momentum, and a orbit-momentum parameter.

The variables Q and a are the same dimension as a length, and r_{ph} finally given in eq. (36). The natural units M, a, Q all have unit lengths. The Hamiltonian for test particle motion in Kerr spacetime is separable in (t, r, θ, φ), the Boyer-Linquist coordinates [7]. In using Hamilton-Jacobi theory the Carter's constant as a fourth constant of the motion can be derived [18,19,29]. In accordance to the Kerr and the KN the theory considers restricted to $\theta = \pi/2$ as illustrated in the equatorial plane.

The connection between the two Boyer-Lindquist coordinates forms a modified KN-metric tensor, whose elements are explicitely

$$g_{11} = \frac{r^2 + a^2\cos^2\theta}{r^2 + a^2 + Q^2 - Mr/2}$$

$$g_{22} = r^2 + a^2\cos^2\theta$$

$$g_{33} = \left[r^2 + a^2 - \frac{a^2\left(e^2 - Mr/2\right)\sin^2\theta}{r^2 + a^2\cos^2\theta} \right]\sin^2\theta$$

$$g_{34} = g_{43} = \frac{a\left(e^2 - Mr/2\right)\sin^2\theta}{r^2 + a^2\cos^2\theta}$$

$$g_{44} = -\left(1 + \frac{Q^2 - Mr/2}{r^2 + a^2\cos^2\theta}\right).$$

It can be recognized the electrical charge is never at rest. *Quod erat demonstrandum*.

4. Discussion

The model for a black hole proposed and discussed in the present work may impress or even astonish in form and composition, but it completely fulfills the requirements and conditions [12,13,14] imposed on such an object from the foundations of the theory of general relativity. The main requirement here is the existence of a light wave circulating around a center in a photosphere, which forms the basis for the development of a new theory of its own. Though, the actual results claiming for an extraordinary tiny object of almost diminishing mass point to a "mini"-BH those circumstances are not necessarily improbable as already discussed elsewhere on quantum gravity processes [30], which assigns them an effect from quatum field theory in curved spacetime.

The metric found for a BH in the current theory is an extention to Kerr-Newman solution. However, found in its principle there is no net electrical charge, but electrical orientation. The advantage follows from the fact there is no fixed or respective preliminary given M of an anticipated huge value. Further, M and r_{ph} are always strictly related to each other. An extreme Kerr BH is excluded due to the fixed a, instead. Both of those principle results reveal the enormous stabiltity of the BH with regard to an eventual loss of charge or a loss of energy due to a speed down or decrease in rotation entailed from external impairs.

A striking feature of the Kerr solution is frame dragging [28], which leads the oblate like BH drag spacetime with it as it rotates arising ultimatively from the off-diagonal elements $g_{34} = g_{43}$ [31]. The same statement is also true for a BH with evenly distributing and spreading electrical charge on the surface, which does not contribute to that effect, however. In the current study the electrical field is not even shaped, but oscillates on the surface just giving the BH a kind "serrated" or even cogged character, which indeed lets that phenomena increase. Since this model describes a BH consisting of an EM the effect is preserving, a very resilient property also in the photon-sphere region, and makes the BH appear a *perpetuum mobile*. In addition, a particle dropped radially onto such a BH will acquire non-radial components of motion as it falls freely in the gravitational field.

Though, quantum vacuum fluctuations allow mass to be extracted from a BH in the form of Hawking radiation [32,33] it is impossible in the case of a "classical" Schwarzschild BH, where all is concentrated within the event horizon, as is the same here. However, the existence of separate surfaces defined in the ergosphere the horizon on the other side implies the possibility of extracting rorartional energy. A way for illustration is seen the feasibility of that through the Penrose process [34]. Here, a particle falling into the ergosphere decays into a twin: one continues on its path falling through the horizon whereas the other exists the latter to escape to infinity. In the view of the Penrose process objects can emerge from the ergosphere with more energy they entered, which is taken from the rotational energy of the BH causing the latter slow. With regard to that behaviour the two speeds involved in the current study comes to the forth as those together determine the propagation speed c of light. That is due to the argument for the here described BH not only claiming but even requiring the condition nothing can escape as long as covered by the de Broglie theory, and otherwise superluminarity would be required. A split into two directions can, therefore amalgamate with the above statements. Since this decay within the ergosphere is a local process it may be analyzed permediate the equivalence principle arguments in a freely falling frame according to the ususal rules of scattering theory. That in turn establishes energy and momentum are conserved in the decay as there sum is at the point of decay. If energy is extracted from a BH due to Kerr BH or respective KN via the Penrose process it will come to the expense of the rotational energy. That is reasoned the captured particle adds a negative angular momentum acting in reducting angular momentum and total energy carried away from the escaping one [35,36]. In contrast to those types of BH the current will act against that kind of loss in energy due to its constitutiton as it even consist of a quasi two energy types to face that influence in a reaction to that: If the part exhibiting positive energy was reduced by a certain absolute value the consequence would be a strengthen of the negative part of the EM in the same amount. Since both half-waves are, however strictly connected to each other the compensate that impair in sustaining their character as an EM to in retrun stabilize itself, which is illustrated in the enormous stability in the propagation speed of light [15,24]. The effect is reasoned in the oscillatory character of EM or light, respectively due to an interpretation of an oscillating mass [8]. Any consequence leaving a pure Schwarzschild BH due to a series of conjectured Penrose events extracting all angular momentum, therefore is completely excluded in the BH suggested in this study.

The same argument holds in case of pure electrostatic field. If a negative field stated to interact with that part of the EM exposed quite in that moment to its positive state, the EM forming the BH would loose energy but at the same time, again the same amount in form of the, then negative energy effects in return the energy balance out.

A quite different feature becomes obvious in a scenario another EM approaches the r_{ph} region as further classical accessibilities to a BH can be a complex EM coupling of the electrically charged rotating BH to external accretion disks and jets and in the form gravitational energy is released in accretion onto the BH [37]. Under those circumstances two objects of the same qualities can interfere [38]. Predicted view from outside the horizon of a Schwarzschild BH lit by a thin accretion disc: within such a disc, friction would cause angular momentum be transported outward enopen matter fall further inward, thus releasing potential energy while increasing temperature of the “gas” [39].

In precise investigation of the given square of the line element interpretation has to be taken carefully with respect to a probably appearing simply summation of the squared spacetime elements in accordance to the Pythagoras into a scalar, whose square root, then also results into a scalar [21]. That in turn, again reveals an absolute value assigned to a true length. It is not, since it is due to the product of two intrinsic vectors separately assigned to the respective two horizons and ergopheres in the solutions demonstrated in the metrics of RN, Kerr, and KN. The facts of an external event horizon and an internal ‘Cauchy horizon’ provides a convenient bridge to corroporate the property of the EM and substantiates the coherence of the two compartments, from whose it is formed. Based on that characteristic of the EM both types of those spheres can be interpreted as always appearing in respective pairs, and one can not be separated from the other. Though, gravitational effects become obvious from the squared line element in a cycle of π rather than the impressionable effect of 2π assigned to the oscillating electrostatic field, which would be a (+/−) detected from an outside observer.

From those arguments arises the question for the time running inside those regions since any object in the ergosphere of the rotating mass will tend to start moving in the direction of rotation, *i. e.*, a drag along spacetime. For a rotating black hole, this effect is so strong near the event horizon that an object would have to move faster than the speed of light in the opposite direction, and it is argued to just stand still [40]. The singularity at the boundary of the Schwarzschild radius as indicating that is interpreted the boundary of a bubble in which time stopped [41,42]; but that is not true. Though, studies on past-future asymmetry of the gravitational field have been worked out [22,41], time will always oscillate forward-backwards between those regions rather than reach the period absolutely zero.

5. Resume

In this theory a model is derived from the basic demands for a BH being the question for the limiting condition a EM can form a circumference around. In accordance to a former theory a photosphere is determined incorporating electrostatics entailed from the EM. The oscillating characteristics of the EM where established to support permanent electrical charge as well as electrical polarization of the BH. On the background of the basis description this modification of the Kerr-Newman metric can give evidence of that charge forcing the BH to rotate due to the shift of the electrical extrema in the EM oscillating in a circumference around the BH. As a consequence, the rotation of the BH is a permanent effect as driven by the EM, therefore a consequence of its structure presented in this study as well. In the view of the characteristic the principal results are an evenly distributing and spreading oscillating electrical charge on the surface of the BH enforcing it to an always constant rotation.

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