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

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ACONSTANTROTATINGKERRNEWMANBLACKHOLEWITHNONETELECTRICALCHARGE

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

T. G. M. Gerlitz [α] & W. Walden [σ]

Abstract- A black hole solution for the rotating electrical charge gives the Kerr-Newman metric. Incorporation of the oscillating effects show to drive rotation. The model derived permits the 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 feature the squared line element can represent a black hole permanently carrying electrical charge, but not evenly distributing and spreading on the surface. Due to its properties, the black hole approached in this theory shows serrated in a kind sawtooth 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 will be discussed.

PACS Numbers:
03.30.+p Special relativity
04.20.−q General relativity
11.30.Er Charge conjugation, parity, time reversal, and other discrete symmetries.

I. Introduction

The involvement of the electrical field in black-hole (BH) studies in the metric of Reissner (1916) and Nordstrøm (1918), RN metric is an important aspect as well as the investigations due to torsion of electrically uncharged (Kerr, 1963; 1965), and even charged rotating BH (Newman and Janis, 1965; Newman et al., 1965; Boyer and Lindquist, 1967), in the Kerr-Newman mteric (KN) are extensively studied. A peculiar point of view is due to the electrically 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 cosmic objects carrying a significant net electrical charge found since those bodies are assumed probably be rapidly neutralized and, therefore the role electrical charged BH play in astrophysics is at least of a *second order*. 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 (Proca, 1936). Similarly, that would arrive at the phenomenon of two quantum mechanical states, positive and negative as predicted in the Dirac's theory (Dirac, 1928a; 1928b). 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, and a positron is it either. A description of a BH model on the basis of an EM may 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 (Gerlitz and Walden, 2017) leading to a Schwarzschild' description Schwarzschild, 1916a; 1916b; 1997).

II. 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. The 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, essential 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 the atom and quantum physics appearing in the involvement of the factor α from electrostatics (Gerlitz, 2015b), a "correction 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 usual Coulomb expression, since the magnetic terms involving radius dependence third and second order and are typically smaller and can be viewed as a perturbation to the spherical symmetric Coulomb term (Boyer, 1979; Carter, 2009; 2010; Melvin, 1964). It regards the diameter of the black hole (BH).

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$$d_{BH} = 2r, \tag{1}$$

(Gerlitz and Walden, 2017) and describes the angular velocity measured relative to a reference frame at infinity

$$\omega_{\phi} = \frac{d\phi}{dt}, \tag{2}$$

at $\theta = \pi / 2$, the equatorial area of the BH (see *e. g.*, Wald, 1983). From the angular frequency $\vec{\boldsymbol{\omega}} \rightarrow \boldsymbol{\omega}$, typically bold characters assigning vectors in the further, follows the angular momentum

$$\vec{\boldsymbol{J}} = \vec{\boldsymbol{r}} \Box m \cdot \vec{\boldsymbol{v}} \equiv mr^2 \cdot \vec{\boldsymbol{\omega}}. \tag{3}$$

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 (Wesson, 1980). Consequently, the current study deals with physical units to later give the results converted following the common geometrized scheme (*e. g.*, Wald, 1984).

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

$$\Box \psi(\boldsymbol{r}, t) = 0, \tag{4}$$

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. *e. g.*, Goedel (1949), but is in contrast to $\sqrt{-g}$ suggested from Einstein (1916) leading to a signature at reversed signs $(+, -. -, -)$. An equivalent use of both types leading equal-valued results at the end makes a further discussion redundant.

Due to its property the EM oscillates reversing positive and negative states (Proca, 1936) as presented in separation in the Dirac's equation twin. It has to be emphazised in this investigation one single EM is considered interacting with itself but not annihilating like particle and anti-particle as in the example

$$\begin{array}{rl} & E = -(i\hbar c \boldsymbol{\alpha} \nabla - \beta m_0 c^2)\, \psi(\boldsymbol{r}, t) \\ + & E = +(i\hbar c \boldsymbol{\alpha} \nabla - \beta m_0 c^2)\, \psi(\boldsymbol{r}, t) \\ \hline & 2E = \qquad 0 \qquad\qquad \psi(\boldsymbol{r}, t) \end{array}, \tag{5}$$

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

With respect Due to the d'Alembertian as the underlying condition with an extension 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 (Gerlitz, 2015a). The respective maximum and minimum speeds for a bradyonic *B* and the minimal for a tachyonic *T* is close to the propagation of light *c* in the vacuum pointing as extrema to the limiting speeds

$$\mathrm{v_B} = (1 - \alpha^2)^{1/2} \cdot c, \tag{6}$$

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

with the fine-structure constant (Sommerfeld, 1916),

$$\alpha = \frac{\mathrm{e}^2}{2h\varepsilon_0 c} \equiv \frac{\mathrm{e}^2}{4\pi\varepsilon_0 \hbar c} \tag{8}$$

an always positive scalar, and theoretically demonstrated in that context (Gerlitz, 2015b). The basis is the consideration any particle can cross the light barrier by a "jump" to converse from the subluminal character of a $\boldsymbol{B}$ into that of a superluminal $\boldsymbol{T}$ 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 change in sign of the particle's electrical charge entailed from the Coulomb´s law is due to the change in sign of the electrical field, $+\mathbf{E}_B \leftrightarrow -\mathbf{E}_T$. The theory is found on the postulate that a photon is represented using 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) 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 $\boldsymbol{c}$ the requirement for that phenomenon in the entire system is a permanent co–existence of *T* and *B* altogether; they behave correlated as the one can never exist without the other. The formulae (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 $\boldsymbol{C}$ are the same,

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

$$\Delta v_{T,c} = v_T - c \equiv \left[2-(1-\alpha^2)^{1/2}\right]\cdot c - c \equiv \left[1-(1-\alpha^2)^{1/2}\right]\cdot c; \tag{10}$$

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

$$\Delta v_{B,T} = \Delta v_{c,B} + \Delta v_{T,c} \equiv 2\left[1-(1-\alpha^2)^{1/2}\right]\cdot c$$
$$\approx 53.25\ 206\ 34\ 74\cdot 10^{-6}\cdot c. \tag{11}$$

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

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

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

with τ the time interval or respective period 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 the consequence a shift to the entire system, and with regard to the system's mass leads to an orbit momentum and finally rotation of the BH. Consequently, the angular velocity calculates

$$\Delta v = \Delta v_{c,B} + \Delta v_{T,c} \quad (\equiv \Delta v_{B,T})$$
$$= 2\left[1-(1-\alpha^2)^{1/2}\right]\cdot c \tag{13}$$

$\longrightarrow$

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

or the angular frequency respective numerically $\omega_{BH} \approx 53.252\ \mu\,\mathrm{Hz}$, still valid for any direction.

Since in the following context electrostatic interaction is involved that effect needs further attention due to the question for similar or even comparable influence as due to gravity. In that case, the Coulomb's energy above introduced comes 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 center oscillating in its electrical charge facing opposite charges in a distance $d = 2r$ to leave

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

a circumference s to issue the discrepancy it will describe

$$\frac{s}{2\pi r} = \alpha \qquad \rightarrow 1 = \frac{\alpha\cdot s}{2\pi r}. \tag{16}$$

That seems a similar effect in curving, though at the same time entailed from the Lorentz' transformation in special relativity concerning length contraction as already discussed elsewhere (Gerlitz, 2015b). It is true, the effects from the transformation equations for space and time in a gravitational field are about 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 (Eriksen and Grøn, 2004). 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 will not determine spacetime curving albeit give essential contribution. Those evaluations illustrates the current investigation, especially the origin of the basis the BH is suggested to belong.

The properties or respective origin of both fields taken into account in the current theory, $e = e\,(\_)$ and $m = m\,(r)$ are reflected in their associated potentials explicitly appearing in

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

Since the variables λ and r, respectively as parameters are freely selectable and arbitrary 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 replaced by the electrostatic constant α to give simultaneous results, and there will be no way to describe gravitational spacetime on basis of one of those effects alone disregarding the other, but all that is redundant to note.

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

$$E_m = mc^2 \tag{18}$$

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

$$E_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{2r} \equiv \frac{\alpha\hbar c}{2r}, \tag{19}$$

the result can be assigned a mass from the electrostatic term

$$m_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{2rc^2} \equiv \frac{\alpha\hbar}{2rc}. \tag{20}$$

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

$$+\frac{qQ}{4\pi\varepsilon_0 \cdot 2r} \rightarrow -\frac{GmM}{2r}; \tag{21}$$

it increases due to the electrostatic field, which makes the system increase in its entire m due to the "mutual forces" between the charges (Boyer, 1979; Griffith and Owen, 1983). The negative sign in 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,

$$V_g = -G\frac{m_1 \cdot m_2}{2r} \equiv -G m_i \cdot \frac{m_g}{2r}, \tag{22}$$

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

$$V_{eg} = -G\left(\frac{1}{4\pi\varepsilon_0}\frac{e^2}{2rc^2}\right)\frac{m_g}{r} \equiv -\frac{e^2}{r}\left(\frac{G}{8\pi\varepsilon_0 c^2}\right)\cdot\frac{m_g}{r}$$

$$= -\frac{1}{r}\left(\frac{\alpha\hbar G}{2c}\right)\cdot\frac{m_g}{r}, \tag{23}$$

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

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

$$= -\frac{1}{r^2}\left(\frac{\alpha\hbar G}{2c^3}\right)\cdot m_g. \tag{24}$$

In accordance to our recent investigation (Gerlitz and Walden, 2017), again the BH is suggested to consist of one single EM exactly completing one cycle around it – the reason the electrostatic factor α is involved already and immediately, and the electrical charge here, is not arbitrary. There, a radius for a BH is obtained, though deviating in ½ from the Schwarzschild radius but

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

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

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

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

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

The form exposing a "pure" G permits comparison of both distinguished photon radii at the same time … and is just

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

Due to a maximum electromagnetic attraction the extreme 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 entirely 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, however quadratic and requires modification of our former study (Gerlitz and Walden, 2017), where only one linear term is involved to derive m_{BH}. Thus, the extension requires the sum (?)

$$m = m_g + m_{\mathrm{e}} \equiv m_g - \frac{\alpha\hbar G}{2c^3 r_{\mathrm{ph}}} \tag{29}$$

with (?) the intention to first determine r_{ph} the calculation follows the strategy already discussed elsewhere (Gerlitz and Walden, 2017). After introducing into Newton's gravitational law eq. (22) and equating with the mass-energy equivalence displays

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

$$\rightarrow$$

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

an expression entailed from gravitato-electrostatic attraction of the (entire) m assigned the EM interacting with itself. Since r_{ph} describes the 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

$$mc = \frac{\hbar}{r_{\mathrm{ph}}} \Leftrightarrow r_{\mathrm{ph}} = \frac{\hbar}{mc}, \tag{31}$$

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

$$m_g = \frac{2\hbar c^2 - \alpha G\hbar}{2c^3 \cdot r_{\mathrm{ph}}} \tag{32}$$

modifies eq. (25) into

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

and finally ends up in

$$r_{\mathrm{ph}} = \pm\sqrt{\frac{\hbar G}{2c^3}} \tag{34}$$

or, associated

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

the same results as in the electrostatically "un-perturbated" case, as expected. The exterior horizon results from r_{ph} (Gerlitz and Walden, 2017),

$$r_{\mathrm{H}}^{+} = \frac{1}{1.47\ 615\ 81}\sqrt{\frac{\hbar G}{2c^3}}. \tag{36}$$

Since it is 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

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

$$\approx \pm 0.21\ 408\ 17\ 9 \cdot 10^{-81} \cdot \mathrm{J\,s}$$

It has to be strongly emphazised in value and direction depending on the methods of an observer.

Under 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 external magnetic field will determine the orientation of *J* and the BH, respectively. It will also lead to a break down in the 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 will not affect the results, however.

The 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 synchronically to α, instead. Thus, special extended view is given to the Q-term when the current model is considered in analogy to the KN. The electric charge is represented

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

with

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

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

III. Results

In the view of the properties 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 (*e. g.,* Chandrasekhar, 1998; Wald, 1984) for the BH in free space and undisturbed from external conditions individually (?)

$$M = \pm\sqrt{\frac{2\hbar c}{G}}\,\frac{G}{c^2} \triangleq \pm\, 2.28\,569\,31\cdot 10^{-35}\cdot \mathrm{m}$$

$$r_{\mathrm{ph}} = \pm\sqrt{\frac{\hbar G}{2c^3}} \triangleq \pm\, 1.14\,284\,63\cdot 10^{-35}\cdot \mathrm{m}$$

$$r_{\mathrm{H}}^{+} = \frac{1}{1.47\,615\,81}\sqrt{\frac{\hbar G}{2c^3}} \triangleq 0.77\,420\,31\,89\cdot 10^{-35}\cdot \mathrm{m}^{*}$$

$$J = \frac{\left[1-(1-\alpha^2)^{1/2}\right]}{\tau}\cdot\sqrt{\frac{2G\hbar^3}{c^5}}\,\frac{G}{c^3} \triangleq 2.47\,701\,99\cdot 10^{-117}\cdot \mathrm{m}^2$$

$$a =: J/M = \pm\frac{\left[1-(1-\alpha^2)^{1/2}\right]}{\tau}\,\frac{G\hbar}{c^4} \triangleq \pm\, 1.08\,370\,63\cdot 10^{-82}\cdot \mathrm{m}$$

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

$$|Q| \equiv \mathrm{e} \rightarrow \mathrm{e}_{\mathrm{phys}}\,\frac{\sqrt{G}}{c^2} \triangleq 1.38066\cdot 10^{-36}\cdot \mathrm{m}$$

(* Gerlitz and Walden, 2017).

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

$$\frac{GM}{r} \quad \rightarrow \quad \frac{GM}{2\,r_{\mathrm{ph}}}$$

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 points opposite on both sides of the BH rather than based on the pure radius r from the center of the BH as in literature. For that reason, a factor $\sqrt{2}$ has to be counted for them, whereas α remains unaffected. Due to the basis of the current theory the product $(M \cdot r_{\mathrm{ph}})$ is, therefore comparable to $(M \cdot r_S)$ in the KN, and in 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 bases on an EM representing itself with no rest mass.

Due to the metric notation $(+,-,-,-)$ chosen (*e. g.,* Chandrasekhar, 1998; Wald, 1984) the square of the line element is

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

$$+\ \Sigma\, d\theta^2 \ + \ \frac{\chi}{\Sigma}\cdot\sin^2\theta\cdot d\phi^2 \ + \ \frac{2a\cdot(\mathrm{e}^2 - r_{\mathrm{ph}}\,r)\cdot\sin^2\theta}{\Sigma}\cdot dt\cdot d\phi$$

with the common abbreviations

$$\Delta \ := \ r^2 - r_{\mathrm{ph}}\,r + a^2 + Q^2$$

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

$$\chi \ := \ (a^2 + r^2)^2 - a^2\cdot\sin^2\theta\cdot\Delta \ \equiv \ (a^2 + r^2)^2 - a^2\cdot\sin^2\theta\cdot\frac{(r^2 - r_{\mathrm{ph}}\,r + a^2 + Q^2)}{\Delta}$$

$a := J / M$, 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 α orbit-momentum parameter.

The variables Q and α are the same dimension as a length, and r_{ph} is finally given in (36). The natural units M, α, Q have unit lengths. The Hamiltonian for test particle motion in Kerr spacetime is separable in (t, r, θ, ϕ), the Boyer-Linquist coordinates (Boyer and Lindquist, 1967). In using Hamilton-Jacobi's theory the Carter's constant as a fourth constant of the motion can be derived (Carter, 1968; 2009; 2010). 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 explicitly

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

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

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

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

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

It can be recognized the electrical charge is never at rest.

IV. 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 entirely fulfills the requirements and conditions (Schwarzschild, 1916)) imposed on such an object from the foundations of the theory of general relativity. The principle demand 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 (Harada, 2006), which assigns them an effect from quantum 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 α, instead. Both of those principle results reveal the enormous stabilitity 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 (*e. g.*, Chandrasekhar, 1998), which leads the oblate like BH drag spacetime with it as it rotates arising ultimative from the off-diagonal elements $g_{34} = g_{43}$ (Carter, 1971). 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* (lat: permanently moving object). 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 matter to be extracted from a BH in the form of Hawking radiation (Bardeen et al., 1973; Page, 2005) 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 rotational energy. A way for illustration is seen the feasibility of that through the Penrose process (Penrose, 1965). 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 that process objects can emerge from the ergosphere with more energy they entered, which is taken from the rotational energy of the BH causing the rotation slow. With regard to (?) that property 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 superluminality 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 concerning the equivalence principle arguments in a freely falling frame according to the usual rules of scattering theory. That in reverse establishes energy and momentum are conserved in the decay as their 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 lead to the expense of the rotational energy. The reason is the captured particle adds a negative angular momentum acting in reducing angular momentum and total energy carried away from the escaping one (Thorne, 1974; Thorne and Price, 1986).

In contrast to those types of BH the current will act that kind of loss in energy, because 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 return stabilize itself, which illustrates the enormous stability in the propagation speed of light (Gerlitz, 2015a, 2015b). The effect is reasoned in the oscillatory character of EM or light, respectively due to an interpretation of an oscillating mass (Proca, 1936). Any consequence leaving a pure Schwarzschild BH due to a series of conjectured Penrose events extracting all angular momentum … therefore is excluded in the BH suggested in this study.

The same argument holds in case of electrostatic fields alone. 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 (Tolman et al., 1931). Under those conditions two objects of the same qualities can interfere (Copperstock and Faraoni, 1993). Predicted view from outside the horizon of a Schwarzschild BH lit by a thin accretion disc: within that, friction would cause angular momentum be transported outward open matter fall further inward, thus releasing potential energy while increasing temperature of the "gas" (McClintock and Remillard, 2006).

In exact investigation of the given square of the line element interpretation has to be taken 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 (Wesson, 2980). That in turn, again reveals an absolute value assigned to a real length. It is not, since it is due to the product of two intrinsic vectors separately assigned to the respective two horizons and ergopheres (→ proper word) 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 corroborate the property of the EM and substantiates the coherence of the two compartments, from whose it is created. 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 just to stand still (Carroll, 2004). The singularity at the boundary of the Schwarzschild radius as indicating that is interpreted the boundary of a bubble in which time stopped (Finkelstein, 1958; Ruffini and Wheeler, 1971); but that is not true. Though, studies on the past--future asymmetry of the gravitational field have been worked out (Finkelstein, 1958; Goedel, 1949), time will always oscillate forward-backward between those regions rather than reach the period absolutely zero.

Resume

In this study a model is derived from the basic demands for a BH being the question for the limiting condition an EM can form a circumference around. In accordance with our recent study a photosphere is determined concerning electrostatics entailed from the EM. The oscillating characteristics of the EM were established to support permanent electrical charge as well as electrical polarization of the BH. On the background of the basic investigation 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 property 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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