Scientific Research Publishing

Journal of High Energy Physics, Gravitation and Cosmology, 2024, 10, 71-81
https://www.scirp.org/journal/jhepgc
ISSN Online: 2380-4335
ISSN Print: 2380-4327

The Structure of Gravity Funnels and Stability Considerations of Matter in SI Units

Tobias Bartusch

Bartusch Plasma and Vacuum, Kissing, Germany
Email: bartusch.plasma@gmail.com

How to cite this paper: Bartusch, T. (2024) The Structure of Gravity Funnels and Stability Considerations of Matter in SI Units. *Journal of High Energy Physics, Gravitation and Cosmology*, **10**, 71-81.
https://doi.org/10.4236/jhepgc.2024.101007

Received: October 17, 2023
Accepted: January 9, 2024
Published: January 12, 2024

Copyright © 2024 by author(s) and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).
http://creativecommons.org/licenses/by/4.0/

Open Access

Abstract

This article describes an extension of the theory of vortices to electromagnetic types with a start point from known fluid systems. From this, properties of gravity-generating objects (particles and black holes) can be derived, which can also describe their possible interior. This also leads to questions about stability, which are then addressed and ultimately lead to considerations of black holes and their possible internal structure. The results fit into the observable areas and can also be directly verified because they were analytically calculated in SI units.

Keywords

Black Hole, Dark Matter, Electromagnetic, Gravity, Singularity, Vortex

1. Introduction

In the year 1864 J. C. Maxwell published his dynamical theory of the electromagnetic field [1]. Although this theory has become a part of the standard of modern physics and electro techniques, one part of his theory concerning the vector rotation is not been given enough attention. This vector rotation can be found in the law of induction and Ampere's law. In those two equations, the vortex can be found directly. It seems to suggest itself to further look into the subject of the electromagnetic (EM) vortex and its implications for other objects. The basic mathematic principle has already been shown in a previous article and some details of the implications now should be handled in a more precise manner [2].

Before the description of mainly unknown objects can be started, is necessary to establish the foundation. A good point to start is the rotation of vectors of conventional (fluid) systems. From there on it can be transformed to these prin-

ciples of EM systems [3]. With the used SI units, the assumptions can be measured and verified directly.

Assuming the EM vortex has similar characteristics as the fluid vortex, there will result interesting equations [4]. The structure of a vortex consists of the area of rotation, called the nucleus, and the area circulation which surrounds the nucleus. The nucleus and the circulation zone differ significantly in their behaviors, whilst assuming that the nucleus itself behaves like a rigid body. This means that it has a constant rotational velocity. This is comparable to usual fluid mechanics of vortices [5] [6]. The vortex itself depicts a deformation of the spacetime if it is handled and understood as an electromagnetic-gravitational object. A special part of this theory is the correlation between pulse and electromagnetism. It is assumed that the observed charge is represented by the mean value of the disturbance of the spacetime. The spacetime is assumed as 6-Dimensional (3× Space, Time, E- and H-field). The charge itself is understood as a non-equalized deformation of the E-field part. This assumption would also easily explain in a geometric way how the action of the field itself is done. In addition it explains the charge as a non-compensated part of the spacetime and also would explain why the charge can't be annihilated without any counter charge. One of the further assumptions is that not only gravity deforms the space and in addition the accelerated charge, but although respective accelerated EM waves can form a dynamic interaction with gravity [7]. The pulse (Poynting vector or power flow) and especial the change of it seem to play an important role.

Remark: With this assumption it is understood that everything which contains positive energy is travelling at least with a part of itself (light, radio waves, the (EM) waves inside of elementary particles) with speed of light and only the center of mass from the derived particle or black hole is slower than speed of light and is not able to reach speed of light which can be observed in the Lorentz transformation. A steady movement/rotation inside the objects reflects the zero point energy or can explain its existence in an electromagnetic way [8].

2. The Vortex as Electromagnetic Rigid Body and Its Properties

As mentioned, in the case of a vortex it can be envisioned that the inner core has a constant angular velocity (ω) and therefore behaves rigidly. However, this means that the internal phase relationships are also constant and, apart from the Lorentz transformed properties, otherwise undistorted. But if one looks at the area outside, the space distorts and changes as shown in **Figure 1**.

This happens from the point of the highest orbital speed (for EM waves: c) r_p and decreases with increasing distance to this point. One can imagine that the phase changes with the frequency [9]. This would also be consistent with the theory that the space around heavy masses is distorted. It should be noted that the density in the area of the vortex is not insignificant and also creates an

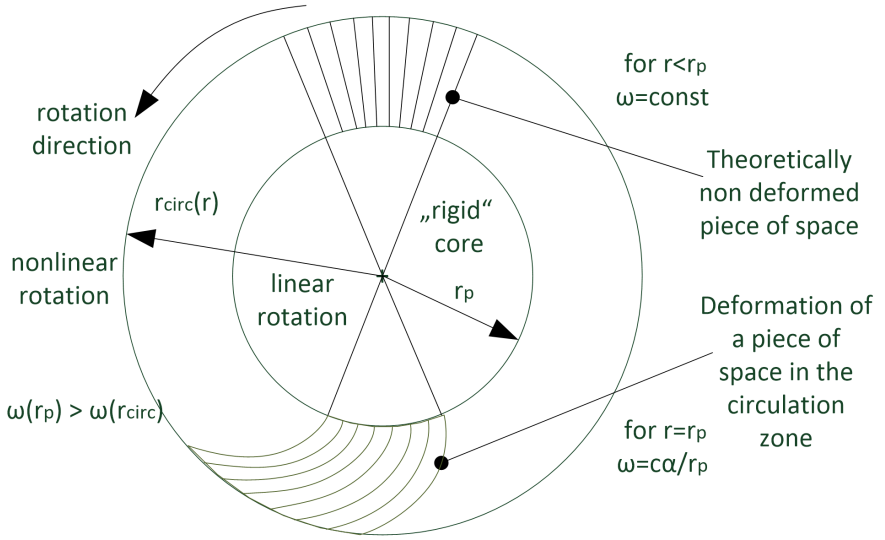

Figure 1. Distortion in the vortex.

interaction zone outside due to the resulting spatial distortion. This would then correspond to the expected "fuzzy" behavior during the interaction since the vortex itself is precisely determined in its parameters but cannot be precisely defined [10]. This is shown in **Figure 2**.

In relation to a rotating EM wave, one can imagine the situation of such a vortex. The wave travels at a maximum speed of light c (accommodating space is vacuum) at radius r_P. This can be assumed because, as a rule, energy transport cannot take place faster than the speed of light [11]. One can assume that the rotating EM pulse of the vortex/object is concentrated on the outer ring as an infinitely thin ring. All calculations and comparisons with measurement results at least point to this assumption [2]. The following applies to rotation:

$$I = mr^2 \tag{1}$$

$$E_{rot} = \frac{L^2}{2I} \tag{2}$$

I is the moment of inertia, m is the moving mass, r is the radius of rotation and L is the fixed angular momentum and E the energy. In the vortex itself, due to the shortening with the Lorentz transformation (circular movement is accelerated movement), the circumference is shorter than π times the diameter as shown in **Figure 3**. Without the shortening, this cannot normally be achieved geometrically [2].

If for example, half the circumference would correspond to the π-quarter diameter, the shortening factor κ would be calculated in a circle and this is only possible relativistically, otherwise it violates the elementary geometry.

$$\kappa\pi r = \frac{\pi}{4} r \Leftrightarrow \kappa = \frac{1}{4} \tag{3}$$

The example corresponds to a theoretical free space propagation of a wave that "meets itself" in a circle. In reality, however, the whole thing is more com-

plicated and the shortening is different (fine structure constant α for shortening). It is assumed that the holding forces and dimensions result from the clear electrical determinacy of the object, thus they are electromagnetic in nature and the wave train cannot be torn apart (conservation of charge). Furthermore, it is assumed that the elementary charge can only be defined in the integral (ζ is the arbitrary "charge amplitude" or deflection of the room) since, according to the current model, it is distributed unevenly in the system.

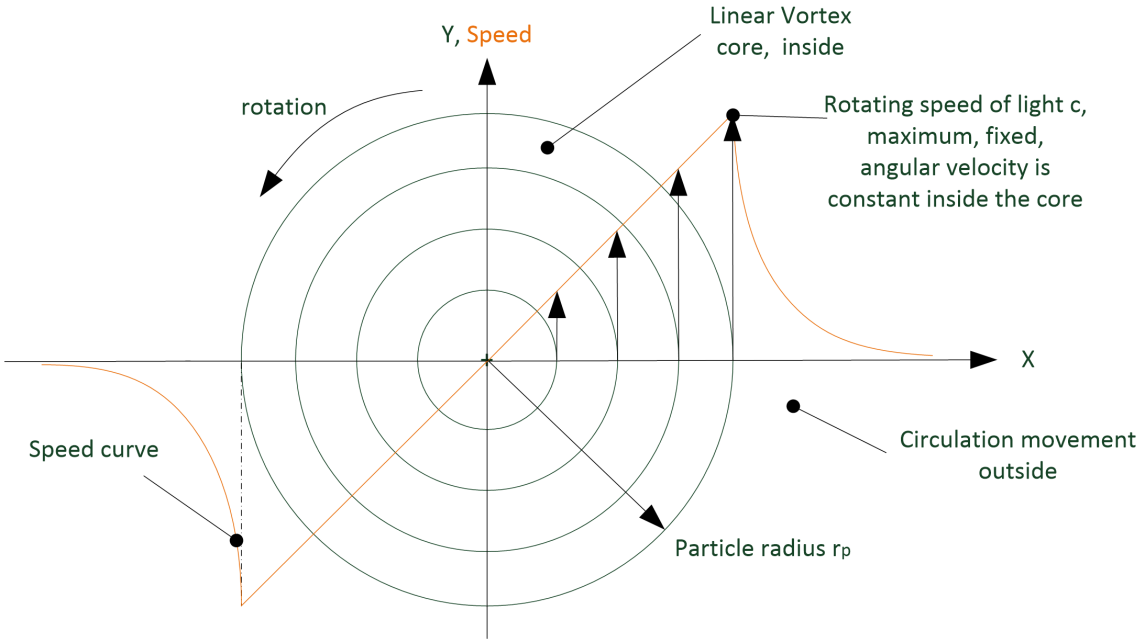

Figure 2. Vortex with a rigid core and its speed ratios.

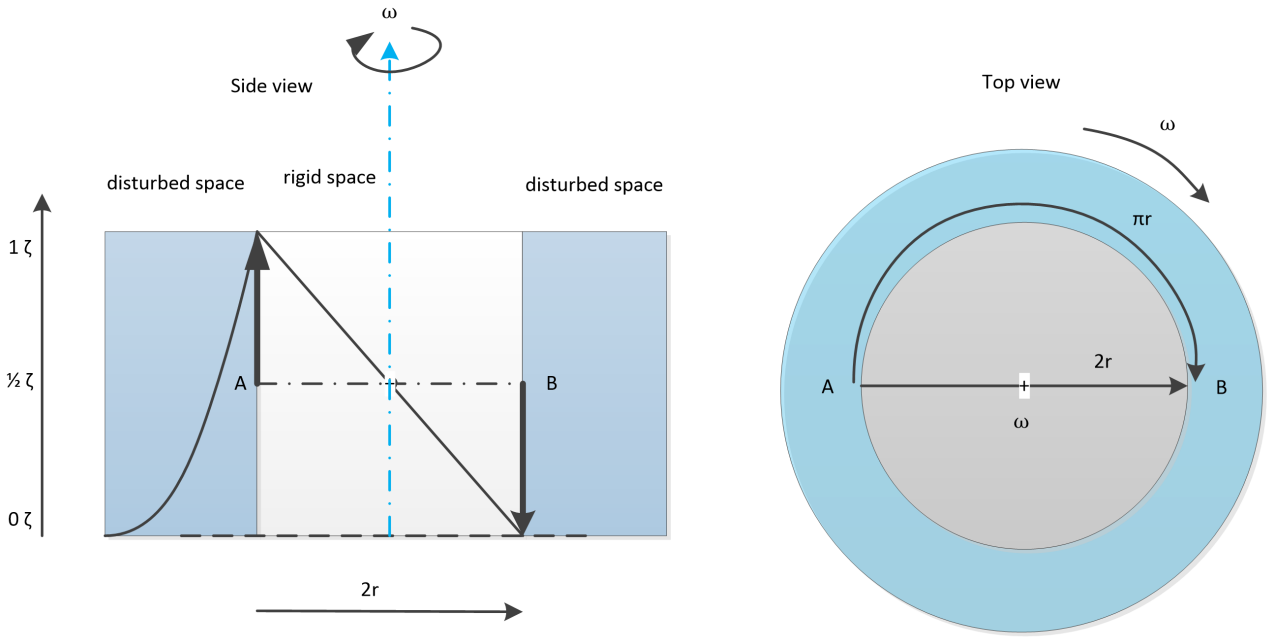

Figure 3. Representation of the adjustment of the necessary relativistic shortening in the vortex.

$$Q = \int_0^T \frac{e^3}{4\pi\varepsilon hr} \mathrm{d}t = \frac{e^3}{4\pi\varepsilon hr}(T-0) \tag{4}$$

$$E = hf = h\frac{1}{T} \Leftrightarrow T = \frac{h}{E} \tag{5}$$

$$Q = \frac{e^3}{E4\pi\varepsilon r} \tag{6}$$

And this means for the charge e:

$$e = \sqrt[2]{E4\pi\varepsilon r} \tag{7}$$

Which also corresponds to the 2nd vortex constant [2]. In other words, this means for the radius:

$$r = \frac{e^2}{E4\pi\varepsilon} \tag{8}$$

According to the original calculations, the energies agree exactly even when assuming a circular ring (based on the mass moment of inertia of an infinitely thin ring). It is assumed that the momentum and the charge automatically shift to the largest diameter and the mass is therefore concentrated there, which then leads to the assumption of an infinitely thin circular ring because the moment of inertia is thereby maximized and the energy is therefore minimized. However, this still needs to be clarified in detail in further consideration.

3. The Vortex

If we now look further at the theory of rigid EM vortices, we can mathematically assume that the vortex can be described by the vector:

$$\boldsymbol{\Omega} = \frac{1}{2} rotU \tag{9}$$

The amount $|\boldsymbol{\Omega}| = \omega$ is the angular velocity inside. The vortex describes a rotation of electric and magnetic fields. Contrary to hydrodynamics (friction in fluids), for easier consideration it is now assumed that this value is constant over time. This is based on the assumption that there is no internal friction in particles or black holes because their properties do not change over time without external influences [12]. Furthermore, it should be further assumed that the highest orbital speed at the radius resulting from the radius is the speed of light. Higher speeds are fundamentally ruled out because energy or an impulse cannot be transmitted faster than light. The vector Ω (**Figure 2**) points out of the plane of projection and is perpendicular to the x and y axes. Using Stokes' theorem, the surface integral can be rewritten into a ring integral. This means that both integrals are equivalent. In case of a circular circulation and thus a circular area, the solution is analytically simple.

$$\begin{aligned} \oint U \mathrm{d}s &= \int_A rotU \mathrm{d}A \\ \Omega &= \frac{1}{2} rotU \end{aligned} \tag{10}$$

With A: Area of vortex core ($A=\pi r^2$). One function, the circulation ζ, is used as a measure of the strength of the vortex.

$$\zeta = \oint U \mathrm{d}s = 2\pi r U\left(r\right) \tag{11}$$

With a circle and the radius and a contour length l of

$$l = 2\pi r \tag{12}$$

U is a function of the velocity. This results from Stokes' theorem:

$$\bar{\Omega} = \frac{1}{2A}\int \left|rotU\right| \mathrm{d}A = \frac{1}{2\pi r^2}\oint U \mathrm{d}s = \frac{2\pi r U}{2\pi r^2} = \frac{U}{r} \tag{13}$$

The vortex core is rigid and therefore Ω must be independent of the radius r. This means that the speed is also proportional to the distance r from the center.

But since, as mentioned, the maximum speed cannot be more than the speed of light, there is a hard limit here.

The mean value is a measure of the strength of the vortex per surface element.

$$\bar{\Omega} = \frac{\xi}{2A} \tag{14}$$

If we look at a frictionless medium (which the vacuum is), it also follows from the conservation laws that vortices can be deformed but the total angular momentum and the total mass must be conserved. For a cylindrical vortex with angular momentum L, the conserved quantity applies:

$$L_1 = L_2 \tag{15}$$

$$L = I\omega \tag{16}$$

$$I = \frac{1}{2}Mr^2 \tag{17}$$

With I: momentum of inertia and mass M and radius r follows then:

$$M_1 r_1^2 \bar{\Omega}_1 = M_2 r_2^2 \bar{\Omega}_2 \tag{18}$$

or alternatively

$$I_1 \bar{\Omega}_1 = I_2 \bar{\Omega}_2 \tag{19}$$

Since these are elementary objects, the mass and radius can change. If we continue to look at the matter geometrically as a rigid body, then vector notation applies:

$$\boldsymbol{U} = \boldsymbol{\omega} \otimes \boldsymbol{r} \tag{20}$$

or scalar:

$$U = \omega r \tag{21}$$

However, since classical mechanics have to be transformed asymmetrically to the speed of light, the vortex vector is shortened asymmetrically by the factor of the fine structure constant (transformation $U \to c$ means $r \to r_p/\alpha$) [2].

$$\bar{\Omega} = \frac{U}{r} = \frac{c}{r_p}\alpha \tag{22}$$

with c: speed of light and α fine structure constant. And with the Energy equa-

tion leads to

$$E = \hbar\omega = \hbar\bar{\Omega} \tag{23}$$

$$E = \frac{\hbar c\alpha}{r_p} \tag{24}$$

4. Stability Analysis of Simple Matter

If one now assumes that the electrical vortex under consideration is also the basis for much heavier objects, an equation for the radius results. It is also conceivable that part of the dark matter is also constructed as an EM vortex.

This means that as the energy increases, the radius of the object decreases, since the fine structure constant and Planck constant are considered constant and the speed of light cannot increase.

$$r_p = \frac{\hbar c\alpha}{E} \tag{25}$$

This applies to normal matter (electron, muon, tauon) in which only the electron is stable. And heavier particles break down again. However, with singularities that also appear to be stable and no longer decay, the question arises as to where the limit might lie. The underlying assumption here is that singularities do not have a complex structure inside, otherwise this could be further compressed [13]. This is also consistent with the assumption that these are "point-like" objects.

In order to create a black hole and violate the stability that occurs with normal matter, matter must now be compressed to such an extent that its original radius is less than the Schwarzschild radius [14]. The radius is calculated:

$$r_S = \frac{2Gm}{c^2} \tag{26}$$

where G is the gravitational constant (6.67259E−11 $m^3/(S^2 \cdot Kg)$) and m is the mass of the object. However, the radius does not apply to stable orbits which we assume for a rotating EM wave. Therefore it makes more sense to take the photon sphere which is 3/2 larger than the Schwarzschild radius [15].

$$r_{Ph} = \frac{3}{2} r_s = \frac{3Gm}{c^2} \tag{27}$$

Now it is assumed that the particle contracts at the moment when it wants to decay (like muons or tauons) then becomes stable again because it is held together by its own gravitational force or, in other words: the particle swallows itself! So if we equate the masses of both objects (lepton and photon sphere), we get a particle radius.

$$m_p = \frac{e^2 \mu_0}{4\pi r_p} \tag{28}$$

With e elementary charge and μ magnetic field constant:

$$m_{SP} = \frac{c^2 r_{SP}}{3G} \tag{29}$$

And with $r_{SP} = r_P$ follows:

$$\frac{c^2 r_{SP}}{3G} = \frac{e^2 \mu_0}{4\pi r_{SP}}$$
$$\Leftrightarrow r_{SP} = \frac{e^2 \mu_0 3G}{4\pi c^2} \tag{30}$$
$$\Leftrightarrow r_{SP} = \frac{e}{2c}\sqrt{\frac{3G\mu_0}{\pi}}$$

Surprisingly, this value depends only on natural constants and amounts to an upper diameter of r_{SP} = 2.3911E−36 = r_{BH} meters. Everything smaller "swallows itself". This value would then arise for a primordial black hole that resulted from a collision or compression during the Big Bang [16]. An alternatively calculation can be found.

If the shape is simply assumed that of a sphere (in reality it probably is more a shape of a torus), the density can also be calculated.

With the volume and the density

$$V = \frac{4}{3}\pi r^3 \tag{31}$$

$$\rho = m/V \tag{32}$$

A possible density is then calculated:

$$\rho = \frac{c^2 r_{SP}}{3G} = \frac{c^2}{4G\pi r_{SP}^2} = \frac{c^4}{G^2 e^2 3\mu_0} \tag{33}$$

$$\rho_{BlackHole} = 2.086\text{E}80 \frac{\text{kg}}{\text{m}^3}$$

In comparison with the density of conventional, stable matter, it shows:

$$\rho_{electron} = 3\frac{e^2 \mu_0}{16\pi^2 r_{electron}^4} = 9.72\text{E}12 \frac{\text{kg}}{\text{m}^3}$$

$$\rho_{Proton} = 1.222\text{E}15 \frac{\text{kg}}{\text{m}^3}$$

So the ratio between the density of the black hole and the density of the proton is 1.7E65. This also shows that normal matter is clearly far away from such a gravitational collapse! This also corresponds to the observation that significant compression is required to cause gravitational collapse [17]. A very interesting alternative calculation for the density and its internal structure of black holes can also be found in [18]. The creation of black holes in accelerators will probably take some time to come.

5. A Possible Explanation of the Structure of a Black Hole

Since no real singularities with a radius of exactly zero can occur in nature, as this contradicts the basic principles of physics (rotational energy can only be stored if a radius is present), the question remains how the problem can be solved. An approach that combines this theory and practice will now be presented. As mentioned, in principle a singular object with a radius of zero whose properties are difficult to combine with other areas of physics must be explained

and of course the calculations point to very small objects that have a small radius. In experimental physics, for example, energy is stored in a rotating object with radius *r*. When contracting, the radius decreases but the energy cannot disappear (which is also confirmed in measurements of the objects' mass) and the angular momentum cannot disappear either. An object with an exact radius of zero cannot store energy. This is obviously a contradiction to the measurement observation [19]. The following picture shows an approach as to how the singularity can still be singular but the radius is not zero and therefore energy can be present in the object. This is also in line with the definition of "point-shaped" which only means that no special internal structure exists. The solution is that the vortex has a center, but the mass is generated by a circulation of electromagnetic charge. In this solution, the radius is determined but the object is still distributed over an area and therefore energy is greater than zero. The center itself, without any actual content, is then at the point with the radius zero. Such an object has verifiable properties such as mass, magnetic fields or charge, which must also be measurable outside the event horizon. Since static electric fields do not have to have mass or momentum, they can also spread across the event horizon [20]. In the case of static magnetic fields, based on the no hair theory, it is assumed that this is not the case, but due to Maxwell's theory, these fields do not show any temporal variance, which nevertheless gives reason to consider this parameter as transparent for the event horizon since they are decoupled in the Maxwell equations and therefore do not interact with gravity (via the Poynting vector and the momentum of the photon). This would be a possible measurement of properties of singularities in an experiment. It is known that magnetic fields occur close outside the singularity in the accretion disk [21] [22]. **Figure 4** illustrates the principle of the singularity.

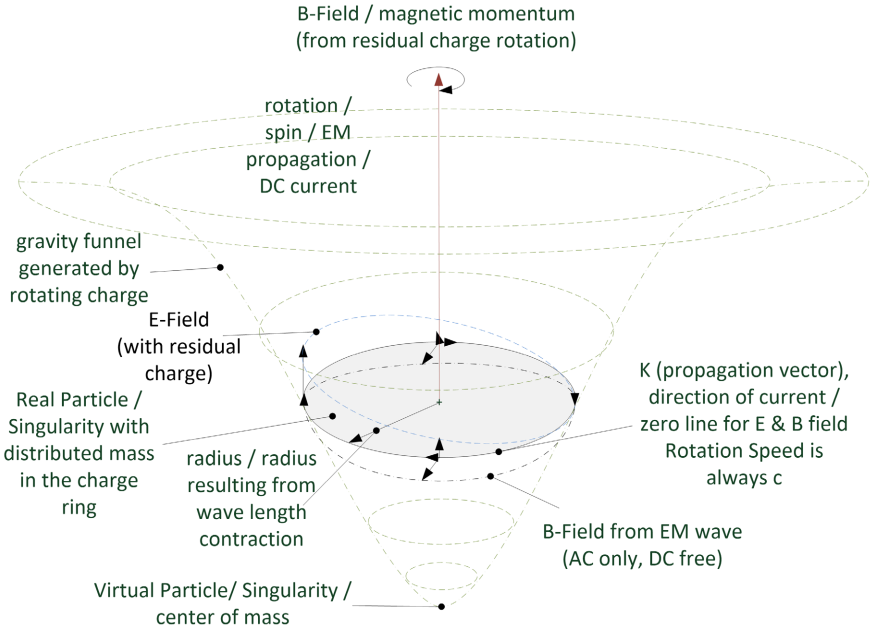

Figure 4. Possible inner structure of a singularity.

What happens when the Schwarzschild radius is exceeded assuming that an EM wave runs inside. This question could be answered by saying that even the light that represents an EM wave cannot return. In this case, incident matter would in practice be torn apart and the momentum/energy of the singularity would be incorporated. The radius of the singularity decreases by the corresponding amount and the event horizon increases. The strong magnetic fields inside probably also orient any incident magnetic fields synchronously with the singularity. Unfortunately, measuring the latter statements will prove difficult in practice, so indirect results will have to be used. The charge remains as such, but since the incident matter is generally neutral, no large static charge is to be expected.

6. Conclusion

The electromagnetic vortex can be described as a rigid body which implies that an area with constant angular velocity exists. With a circular rotating EM wave with a maximum speed of light and therefore the corresponding charge, the vortex can be handled as a part of the de-formed space. The physics within gravity funnels can be described analytically without the occurrence of mathematical singularities (the radius is greater than 0 but very small). This does not alter the assumption of point-like behavior which only explains the point symmetry of the object. The stability of extremely heavy and dense objects results from known properties and only depends on natural constants. The stability of black holes can be understood as a "self swallowing" of point like particles if the event horizon is greater or equal than the corresponding size. As expected, the density of black holes is far above the density of normal matter but not infinity.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Maxwell, J.C. (1965) A Dynamical Theory of the Electromagnetic Field. *Philosophical Transactions of the Royal Society of London*, **155**, 459-512. https://doi.org/10.1098/rstl.1865.0008

[2] Bartusch, T. (2020) The Electromagnetic Particle—A Backward Engineering Approach to Matter in SI Units. *Journal of High Energy Physics, Gravitation and Cosmology*, **6**, 774-801. https://doi.org/10.4236/jhepgc.2020.64052

[3] Rogowski, W. (1914) Wie kann man sich vom Rotor (Wirbel) eines Vektorfeldes und vom Vektorpotentiale eine Anschauung verschaffen? *Archiv für Elektrotechnik*, **2**, 234-245. https://doi.org/10.1007/BF01655798

[4] Hubeny, V.E., Minwalla, S. and Rangamani, M. (2011) The Fluid/Gravity Correspondence. arXiv: 1107.5780

[5] Spurk, J.H. (2010) Strömungslehre. Springer Verlag, Berlin. https://doi.org/10.1007/978-3-642-13143-1

[6] Demtroeder, W. (2015) Experimentalphysik 1: Mechanik und Wärme. Springer Spektrum, Berlin.

[7] Ross, G. (1984) Grand Unified Theories. Westview Press, Boulder.

[8] Stoecker, H. (2000) Taschenbuch der Physik. 4 Edition, Harri Deutsch, Frankfurt/Main, Germany.

[9] Carson, J.R. (1963) Notes on the Theory of Modulation. *Proceedings of the IEEE*, **51**, 893-896. https://doi.org/10.1109/PROC.1963.2322

[10] Heisenberg, W. (1927) Ueber den anschaulichen Inhalt der quantentheoretischen Kinematik und Mechanik. *Zeitschrift für Physik*, **43**, 172-198. https://doi.org/10.1007/BF01397280

[11] Einstein, A. (1905) Zur Elektrodynamik bewegter Körper. *Annalen der Physik*, **322**, 891-921. https://doi.org/10.1002/andp.19053221004

[12] Particle Data Group. https://pdg.lbl.gov/

[13] Misner, C.W., Thorne, K.S. and Wheeler, J.A. (1973) Gravitation. W. H. Freeman, San Francisco, 875-877.

[14] Kutner, M. (2003) Astronomy: A Physical Perspective. Cambridge University Press, Cambridge. https://doi.org/10.1017/CBO9780511802195

[15] Levin, J. (10 April 2019) What the Sight of a Black Hole Means to a Black Hole Physicist. Quanta Magazine. https://www.quantamagazine.org/what-the-sight-of-a-black-hole-means-to-a-black-hole-physicist-20190410/

[16] Green, A.M. and Kavanagh, B.J. (2021) Primordial Black Holes as a Dark Matter Candidate. *Journal of Physics G: Nuclear and Particle Physics*, **48**, Article ID: 043001. https://doi.org/10.1088/1361-6471/abc534

[17] Celotti, A., Miller, J.C. and Sciama, D.W. (1999) Astrophysical Evidence for the Existence of Black Holes. *Classical and Quantum Gravity*, **16**, A3-A21. https://doi.org/10.1088/0264-9381/16/12A/301

[18] Corda, C. (2023) Schrödinger and Klein-Gordon Theories of Black Holes from the Quantization of the Oppenheimer and Snyder Gravitational Collapse. *Communications in Theoretical Physics*, **75**, Article ID: 095405. https://doi.org/10.1088/1572-9494/ace4b2

[19] van den Bosch, R., Gebhardt, K., Gültekin, K., van de Ven, G., van der Wel, A. and Walsh, J.L. (2012) An Over-Massive Black Hole in the Compact Lenticular Galaxy NGC 1277. *Nature*, **491**, 729-731. https://doi.org/10.1038/nature11592

[20] Bekenstein, J.D. (1975) Black Holes with Scalar Charge. *Annals of Physics*, **91**, 75-82. https://doi.org/10.1016/0003-4916(75)90279-1

[21] The Event Horizon Telescope Collaboration, Akiyama, K., *et al.* (2021) First M87 Event Horizon Telescope Results. VIII. Magnetic Field Structure near the Event Horizon. *The Astrophysical Journal Letters*, **910**, L13.

[22] Kollatschny, W., Schartel, N., Zetzl, M., Santos-Lleó, M., Rodríguez-Pascual, P.M. and Ballo, L. (2015) Proving Strong Magnetic Fields Near to the Central Black Hole in the Quasar PG0043 + 039 via Cyclotron Lines. *Astronomy & Astrophysics* (*A&A*), **577**, Article No. L1. https://doi.org/10.1051/0004-6361/201525984