Spacetime Dipole Wave Pressure and Black Holes

A New Way to Obtain the Schwarzschild Metric, Without Using General Relativity Field Equations

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Abstract

This paper is a continuation of work [1] presented by the author, where mass is modeled by pressure variations in a dipole wave sea, that can be seen as energetic waves traveling at light speed permeating all space.

The dipole wave (DW) model was proposed by John A. Macken in the book "Universe is only spacetime"[2].

Based on Macken´s DW model, the author defines a new type of elemental particle, which is analogous to an elastic tube that connects two regions in spacetime, transmitting pressure from one point to another. This new particle was named as a Ulianov Hole (uhole).

The uhole model considers two kinds of particles: a spatial uhole (uhole-S) that has a property related to mass and a time uhole (uhole-T) that has a property related to an electric charge.

One uhole-S can be associated with a micro-black hole, with its event horizon equal to Planck distance. And so, the Schwarzschild metric, that describes the behavior of black holes, can be obtained from the uhole-S model, without needing to solve the field equations defined by Einstein´s General Relativity theory.

The uhole-S model enables a better understanding of what a black hole really is and how its event horizon works. Also, this model allows us to answer a question that has intrigued physicists for almost a hundred years: Where does the mass that falls into a black hole go?

1 – Introduction

In the book "The Universe is Only Spacetime" John Macken develops a number of theories to explain how our universe works, from two assumptions [2]:

- *Basic Assumption: The universe is only spacetime.*
- *Second Assumption: Dipole Waves in spacetime are permitted by the uncertainty principle provided that the displacement of spacetime caused by the dipole wave does not exceed Planck length or Planck time.*

The Dipole Waves (DW) defined by Macken, in the context of Quantum Mechanics, can be seen as a sea of energetic waves, traveling at light speed [2].

From the DW model, proposed by Macken, the author has developed a new model [1] which considers pressure variations in the DW ocean. These variations can be associated with fundamental particles, named as Ulianov Holes (uholes).

A uhole can be associated with an elastic tube that connects two regions of space (or time) generating variations in DW pressure.

A uhole has two sides, as shown in Figure 1, where we also can see two types of uholes. The spatial uhole (uhole-S) that has a property related to mass and the time uhole (uhole-T) that has a property related to an electric charge.

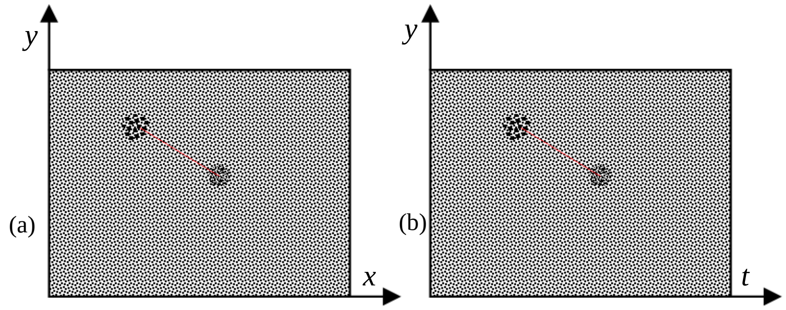

Figure 1 – Two kinds of uholes: a) uhole in space- uhole-S; b) uhole in time - uhole-T.

In the DW model, an empty space has a high pressure (10^{113}J/m^3) equal to Planck pressure (P_p). This pressure can be associated with a high energy density, confined to each Planck volume (l_p^3). This means that in an empty space, each Planck volume has a mass equal to Planck mass (m_P).

Figure 2 represents a pressure curve in a straight line (defined in space or time) that crosses the two uhole ends. Note that the existence of uholes does not affect the DW pressure in a larger volume of spacetime as uholes only transfer pressure from one point to another, and so the average DW pressure remains equal to Planck pressure.

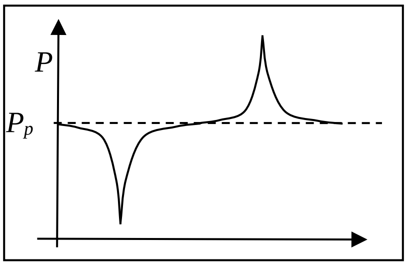

Figure 2 – Pressure in a uhole.

Using an analogy where an elastic membrane represents a two dimensional space, a uhole can be seen as two circular areas in this membrane that are connected by an elastic tube, as shown in Figure 3-a.

In Figure 3-b the uhole is collapsed, therefore its two ends become dots that can no longer be observed. However, the collapsed uhole still affects the DW pressure of surrounding areas, causing variations in DW size.

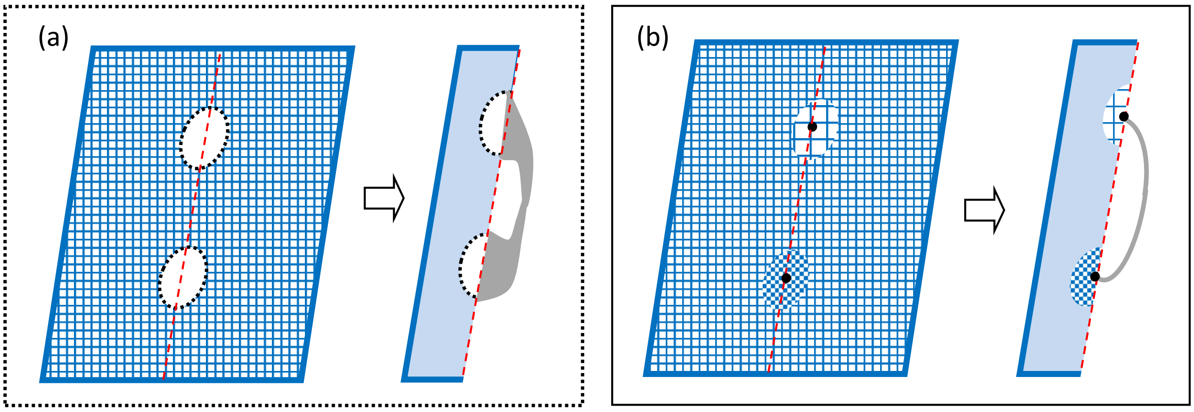

Figure 3 – Uhole placed in an elastic membrane: a)Before the uhole shrinks the membrane; b) After the uhole shrinks the membrane

Figure 4 shows two kinds of DW pressure curves of a uhole-S placed in spacetime.

In Figure 4-a, the DW pressure of one uhole end is null and the other end has double the Planck pressure. In this curve, we can see that the uhole does not affect DW pressure in surrounding spaces. This situation is linked to Figure 3-a, where the uhole "cuts" the space membrane but does not affect its surrounding areas.

In Figure 4-b the spacetime is affected by the uhole, with varying DW pressure in all spaces. This situation is linked to Figure 3-b, where the uhole shrinks the spacetime, affecting surrounding areas.

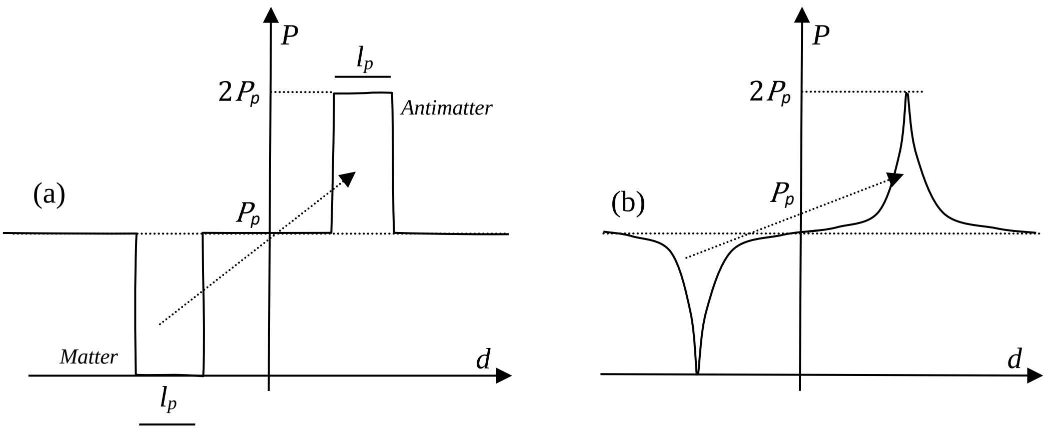

Figure 4 – Two DW pressure curves in a uhole: a)Before the uhole affects the surrounding spacetime; b) After the uhole affects the surrounding spacetime

2 – Uhole-S and micro-black holes

The two ends of a uhole-S may be associated with two micro-black holes, one formed by matter and another formed by antimatter. These two kinds of uhole-S have been named as uhole-SM (uhole-S extremity formed by Matter) and uhole-SA (uhole-S extremity formed by Antimatter). This paper analyzes only the behavior of uhole-SM that is linked to matter particles.

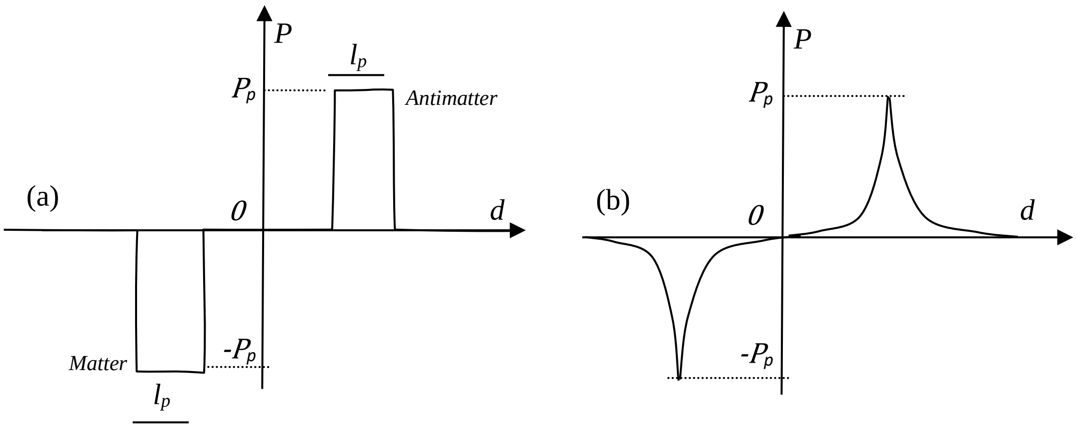

Figure 5 – Two DW relative pressure curves in a uhole: a)Before the uhole affects the surrounding spacetime; b) After the uhole affects the surrounding spacetime

Note: If we consider a relative pressure (taking Planck pressure as a reference), the curves in Figure 4 can be replaced by the curves in Figure 5. In this case, the uhole-SM has a negative pressure (in relation to the empty space) that can explain the collapse that this region of space suffers. However, in the curves represented by Figure 5, the density of energy in an empty space is null, therefore its mass is also null. This statement fits into a more standard space concept, but results in a model where matter particles have a negative mass and antimatter particles have a positive mass. In a standard physics model, the concept of negative mass is considered impossible, in the sense that applying a force to a negative mass moves it in the opposite direction. This is totally implausible, however, if Newton's second law is modified, by including a module function ($F = |m|a$), the concept of the negative mass can be applied without any problems. In this paper the concept of negative mass is not used, in accordance with the pressure curves in Figure 4.

In Figure 4-a, the uhole-SM has a diameter equal to Planck distance (l_p), and so in curve 4-b, where the uhole-SM shrinks the spacetime, the pressure can be defined by the equation:

$$P(d) = \begin{cases} P_p\left(1 - \dfrac{l_p}{2d}\right) & ; \quad d \geq \dfrac{l_p}{2} \\ 0 & ; \quad d < \dfrac{l_p}{2} \end{cases} \tag{1}$$

The uhole-SM can be associated with a black hole that has an event horizon radius (Schwarzschild radius or, r_s) equal to half of Planck distance:

$$r_s = \frac{2GM}{c^2} = \frac{l_p}{2} \tag{2}$$

With the Planck distance defined by:

$$l_p = \sqrt{\frac{\hbar G}{c^3}} \tag{3}$$

Applying equation (3) in (2), the mass can be calculated as:

$$M = \frac{c^2 l_p}{4G} = \frac{c^2 \sqrt{\dfrac{\hbar G}{c^3}}}{4G} = \frac{1}{4}\sqrt{\frac{\hbar c}{G}} = \frac{m_p}{4} \tag{4}$$

Where m_p is the Planck mass.

Figure 6-arepresents the DW pressure curves that appear when three uholes-SM are placed together until they form one bigger uhole with a radius equal to r_n, as shown in Figure 6-b.

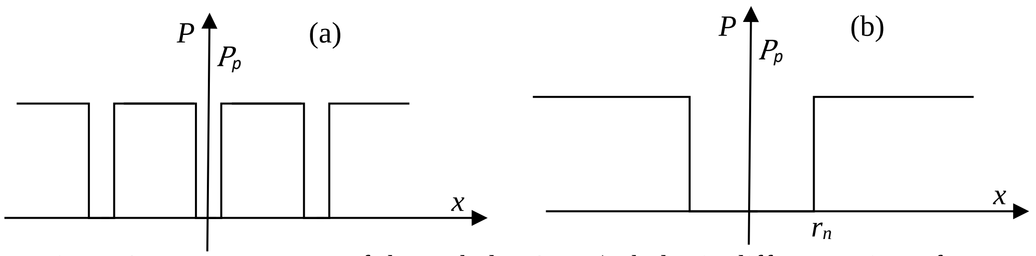

Figure 6 – Pressure curve of three uholes-SM: a)Uholes in different points of space; b) Uholes at the same point in spacetime

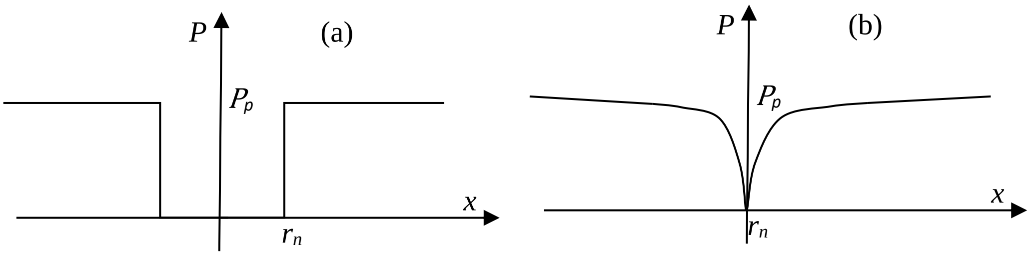

Figure 7 – Pressure curve of *N* uholes-SM: a) Before the uhole affects the surrounding spacetime; b) After the uhole affects the surrounding spacetime

For N particles (uhole-SM) placed at the same point, the total mass M is given by:

$$M = N\,\frac{m_p}{4} \tag{5}$$

And the radius to r_n is given by:

$$r_n = N\,\frac{l_p}{2} \tag{6}$$

In this uhole model, the radius r_n defines a Null Pressure Sphere (NPS) where DWs do not exist and the mass is null.

The radius r_n can be associated with a black hole that has a mass equal to M, linked to N uholes in equation (5). Therefore, the r_n value defined by equation (6) gives an event horizon radius, equal to the Schwarzschild radius (r_s).

From equations (1) and (6), the DW pressure curve generated by the N uholes-SM, represented in Figure 7-b, can calculated as:

$$P(d) = \begin{cases} P_p(1 - \dfrac{Nl_p}{2d}) & ; \quad d \geq \dfrac{Nl_p}{2} \\ 0 & ; \quad d < \dfrac{Nl_p}{2} \end{cases} \tag{7}$$

3 – Spacetime distortions generated by matter

In Einstein's General Relativity theory, the presence of mass "shrinks" space, as shown in Figure 8, where a two-dimensional space, represented by a uniform grid, has been distorted by a body of matter placed on its center.

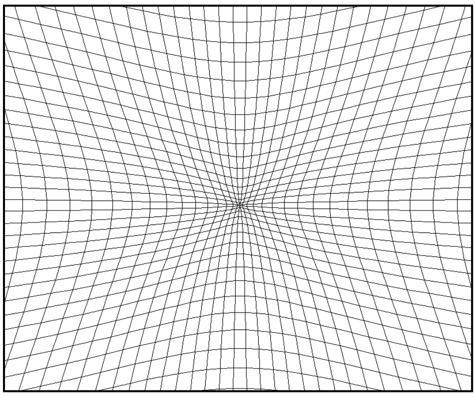

Figure 8–Two-dimensional space that shrinks due to the presence of mass in a central point.

If this body is a solid sphere, with mass *M* and radius *r*, the GR field equations allow the calculation of spacetime distortion, resulting in an equation that defines the Schwarzschild metric [3]:

$$ds^2 = c^2(1-\frac{2GM}{c^2 r})dt^2 - \frac{dr^2}{1-\frac{2GM}{c^2 r}} - r^2 d\Omega^2 \qquad ((8)$$

Where $d\Omega^2$ is defined by:

$$d\Omega^2 = d\theta^2 + \sin^2(\theta)\, d\phi^2 \qquad (9)$$

Where (r, θ, ϕ) specify a single point in a spherical coordinate system.

From the uhole-S model, we can calculate the effect of *N* uhole-SM placed at the same point. For example, Figure 9 shows a rectangular grid, with cell dimensions equal to Planck length, where five uholes-SM are placed at the central point.

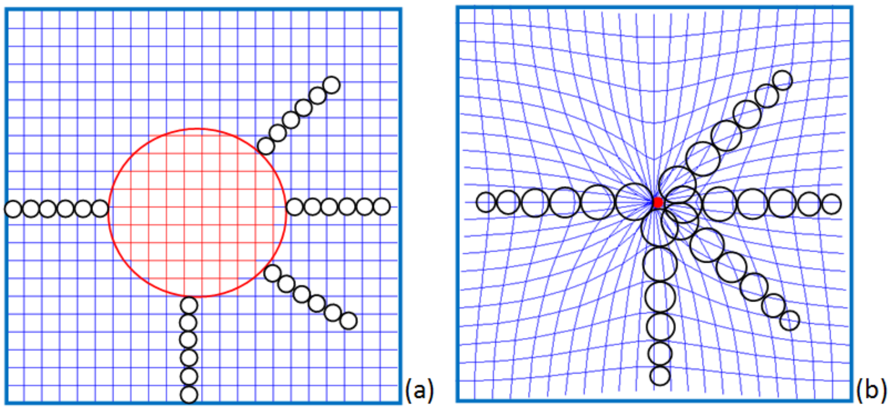

Figure 9–A two-dimensional space, shrunk by the presence of 5 Uholes-SM at a central point.
a) Rectangular grid before the Uholes-SM shrink the space; b) The same grid distorted after the uholes collapse.

In Figure 9-a, the red circle represents an NPS, that can be seen as a spherical region of spacetime where the DW pressure has been sucked in by the uhole-SM. After the appearance of the uhole, this NPS collapses, shrinking the spacetime inside it. In other words, the NPS immediately disappears, because the high pressure around it scrunches up its own spacetime fabric.

However, when dealing with multiple uholes, we can associate the various NPS areas or volumes to calculate the final effect of these uholes. And so, the NPS representation can be a useful tool of analysis, even without having a real existence. The NPS can also be linked to an event horizon's radius that also defines a sphere surrounding a black hole, with the same mass of *N* Uhole-SM.

In Figure 9-b the NPS becomes a red dot, and we can affirm that the presence of mass shrinks the space, but only inside the NPS. Outside of the NPS we can see hat, in fact, the space is expanded by the mass. This kind of expansion cannot be seen in the grid in Figure 8, which has been plotted based on the GR model. But if we plot the DW sizes on some points of this grid, as shown in Figure 10, it is possible to observe that near the center of the grid the DW size increases.

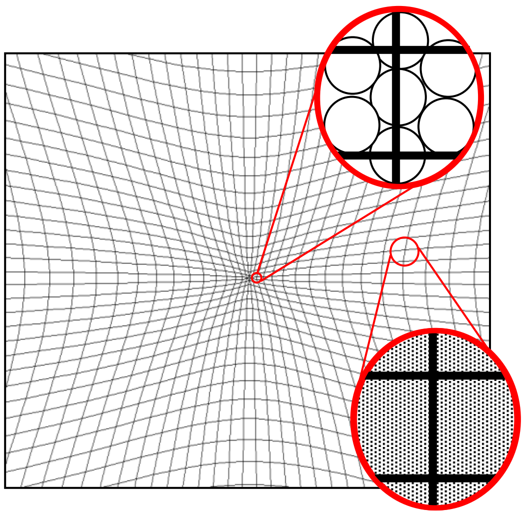

Figure 10– Dipole Waves, observed in some areas of a two-dimensional space that shrinks due to the presence of mass at a central point.

The cause of the DWs size variation can be seen in Figure 9, where dipole waves (represented by black circles) have been placed in some linear formations. In Figure 9-a all these DWs have the same size, but in Figure 9-b, the DWs in the center of the grid increase, occupying the available space that appears after the NPS collapses. The DWs far away from the center of the grid have a small increase in size, but the size of the DWs much further away is not affected.

If we analyze the DW sizes in Figure 9-b, and the pressure curve presented in Figure 7-b, we can see that the larger DWs have a lower pressure. Considering that the internal DW pressure is equal to the sum of forces that act upon it surface, divided by the DW area, we can conclude that the forces acting on the DWs are constant, independent to the DW pressure or DW size, as presented in this equation:

$$F_{Dw} = A_{DW} P_{DW} = l_P^2 P_p = F_P \tag{10}$$

Where F_p is the Planck force and A_{DW} is the DW area.

Applying equation (10) in equation (6) we obtain:

$$A_{DW}(d) = \begin{cases} \dfrac{F_P}{P_p\left(1 - \dfrac{Nl_p}{2d}\right)} & ; \quad d \geq \dfrac{Nl_p}{2} \\[2ex] 0 & ; \quad d < \dfrac{Nl_p}{2} \end{cases} \tag{11}$$

Applying equations (3), (4), (5) and (10) in equation (11):

$$A_{DW}(d) = \frac{l_P^2 P_p}{P_p\left(1 - \dfrac{Ml_p}{\dfrac{m_p}{4} 2d}\right)}$$

$$A_{DW}(d) = l_P^2 \frac{1}{\left(1 - \dfrac{2M}{d}\sqrt{\dfrac{\hbar G}{c^3}\dfrac{G}{\hbar c}}\right)}$$

$$A_{DW}(d) = \begin{cases} l_P^2 \dfrac{1}{\left(1 - \dfrac{2MG}{dc^2}\right)} & ; \quad d \geq \dfrac{2MG}{c^2} \\[2ex] 0 & ; \quad d < \dfrac{2MG}{c^2} \end{cases} \tag{12}$$

Equation (12) confirms the hypothesis that near the point where the mass is positioned, the DW area becomes larger. On the other hand the DW size is connected to Planck length and so we can affirm that Planck length increases itself. And so, a distance between two points, given in the number of Planck lengths, becomes smaller.

In the standard physics model that comes from the GR and quantum mechanics, Planck Length is constant and space is shrunk by the presence of mass. In the uhole model, it is all the opposite, i.e. space is actually expanded by the presence of matter, which makes the Planck Length larger. In others words, near the mass point, the size of the objects remains the same, but if we measure the distances in terms of the number of Planck length, the sizes appear to become smaller.

In an empty space, a displacement (*ds*) can be related to displacements in space (*dr*), and time (*dt*), by a Minkowski Metric, defined as:

$$ds^2 = c^2 dt^2 - dr^2 - r^2 (d\theta^2 + \sin^2(\theta)\, d\phi^2) \qquad (13)$$

Where (r, θ, ϕ) specify a single point in a spherical coordinate system.

Given a massive body, with mass *M*, placed at the center of the spherical coordinate system, the displacement *ds*, defined in equation (13), depends on two unknown functions:

$$ds^2 = c^2 K_T(r) dt^2 - K_R(r) dr^2 - r^2 (d\theta^2 + \sin^2(\theta)\, d\phi^2) \qquad (14)$$

Where $K_R(r)$ and $K_T(r)$ are function that depends on the value of mass *M* and radius *r* that are considered.

If we consider that Planck length squared is proportional to the DW area in equation (12), the distances measured in terms of number of Planck length shrink in the same proportion as the Planck length increases. And so, using equations (14) and (12), the value $K_R(r)$ can be calculated as:

$$K_R(r) = \frac{dr^2(r)}{dr^2(\infty)} = \frac{A_{DW}(r)}{A_{DW}(\infty)} = \frac{1}{1 - \frac{2GM}{c^2 r}} \qquad ((15)$$

The shrinking of space caused by the mass can be associated with the analogy presented in Figure 11, where a river with parallel margins is crossed by rows of stones. If we consider that the stones in the center are bigger, the river width (given in terms of number of stones) is smaller, as shown in Figure 11-b.

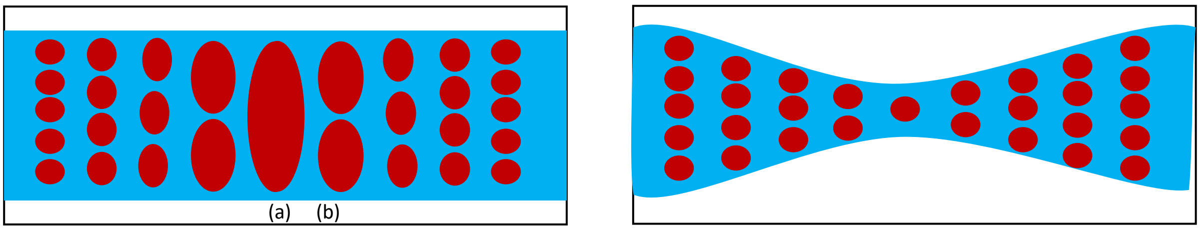

Figure 11–Space analogy where a river has some stones that are placed to form a path: a) The actual width of the stones. b) The width obtained by counting the number of jumps (stone by stone) to cross the river.

Considering the Lorentz invariance [4] in a Minkowski Metric, the unknown functions in equation (14) following the relation:

$$K_T(r)\,K_R(r) = 1 \tag{16}$$

Applying equation (15) in equation (16):

$$K_T(r) = \frac{1}{K_R(r)} = 1 - \frac{2GM}{c^2 r} \tag{17}$$

Note, that near the mass, the DWs radius increases and so the DW time axis expands at the same rate. In the context of the GR, we can say that time (near the mass point) is slower, and so this is equivalent to having a greater Planck time, which agrees with the uhole model.

Figure 12 presents an analogy between Planck time expansion and film reel size expansion. In this analogy, even if the two movies, (a) and (b), are run at the same projection speed, time in movie (b) "runs slower", and we see its images in slow motion.

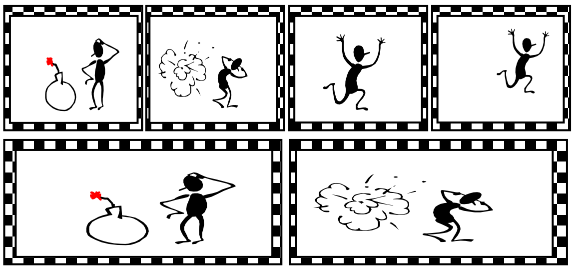

Figure 12– Analogy with film reel size expansion: a)Projection of a normal film reel.
b) Projection of an expanded film reel, where the movie's "time velocity" is slower.

Applying equation (14) to (17) in equation (13) give us:

$$ds^2(r) = c^2\left(1 - \frac{2GM}{c^2 r}\right)dt^2 - \frac{1}{1 - \frac{2GM}{c^2 r}}dr^2 - r^2\left(d\theta^2 + \sin^2(\theta)\,d\phi^2\right) \tag{18}$$

Note, that equation (18), obtained by the uhole-S model, without using the GR field equation, defines the same Schwarzschild metric given by equation (8).

4 – Black holes in the uhole model

In the previous section we have considered that a small black hole has one Planck length diameter. This gives us a Schwarzschild radius equal to half of Planck length, which cannot physically happen as l_P is the shortest distance which can be measured. If we use a Schwarzschild radius equal to a full Planck length, the smaller black hole has a mass equal to Planck mass.

For this smaller black hole, the DW pressure becomes null in a volume equal to l_P cubed and then shrinks to a point with no volume. This affects the surrounding spacetime, expanding it, and so the pressure of the DWs in this region decreases. This occurs because of the forces on the DWs are the same and so the DW volume expands, due to the pressure reduction.

If we put N smaller black holes at the same point, the NPS of each one combines in the same way as soap bubbles collide and form larger bubbles, maintaining the same total area. This occurs as the pressure in each NPS is the same (before shrinking the space) and so the union of two NPSs generates a new NPS with the same total area, thereby, maintaining the same force density per area.

Figure 13 shows three small NPSs that falls into a bigger NPS, represented in blue. The resulting NPS has a total area that is equal to the sum of the initial areas. This means that for a big black hole, each new mass that fall into it, can be represented by smaller black holes, whose areas are "stamped" on the surface of the sphere, defined by the event horizon.

From Figure 13 we can affirm that all information that falls into a black hole is maintained on the surface of the sphere, defined by the event horizon. This means that the mass falling into a black hole only increases the size of the hole, because all the particles with mass are formed by micro black holes.

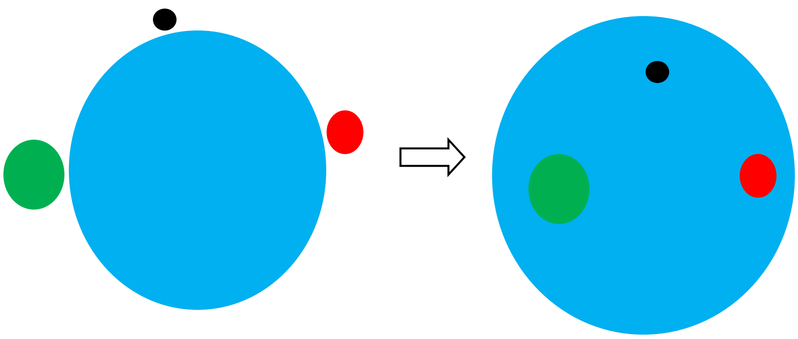

Figure 13– The union of 4 black holes, where the total area is equal to the sum of individual areas.

Note, that the Figure 13 is connected to Figure 9-a´s representation, where Planck length is constant and the black hole´s event horizon can be linked to the NPS surface. On the other hand, in Figure 9-b the event horizon is always equal to zero, forming one singularity, which can be observed as it expands the Planck length on the surrounding areas.

For example, one black hole with the mass of the sun has 10^{38} Planck mass and its event horizon is equal to 2,945m, and so the Planck length near the black hole's singularity, expands by 10^{38}, equaling 1,477 meters. Note, that this new Planck distance is equal to half of the event horizon. The cause of this can be seen in Figure 14, where two kinds of metrics (shown in Figures 9-a and 9-b) are placed in the same space.

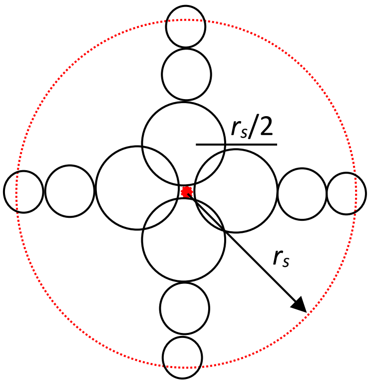

Figure 14– Connection between the black hole's event horizon and the DWs size (Planck Length) surrounding the black hole´s singularity.

5 – Conclusion

This paper is based on John Macken´s work that defines a new kind of Ether where dipole waves (DW) moving at light speed generate a high pressure (Planck pressure) even in an empty space.

The author uses this DW pressure model to define fundamental particles (uholes) that change DW pressure, connecting two points in time (uhole-T) or two points in space (uhole-S). A uhole-S has two ends that can be associated with two micro-black holes, one formed by matter and the other formed by antimatter. The matter uhole-S was named as uhole-SM and the antimatter uhole-S was named as uhole-SA.

A uhole-SA forms a null pressure sphere (NPS) that does not affect DW pressure in the surrounding areas. When the NPS collapses to a non-dimensional dot, its internal space shrinks, but the outside surrounding spaces are expanded. Therefore, DWs in the surrounding areas become bigger and their pressure also decreases. As DW size is connected to Planck length (l_p), we can suppose that when an NPS collapses, it generates a space expansion, where the Planck length increases its value, and also the distance, given in an l_p number, is smaller.

The concept of a model in which mass expands space goes against the standard model (mass shrinks space) defined by Einstein in the General Relativity theory. But despite the two models being in conflict, the same results are reached. We can make an analogy of this by comparing Aristotle's model, in which the universe revolves around the Earth, conflicting with Copernicus' model, in which it is the Earth that revolves. The two models are respectively true for certain observers, and reach the same results. Though Aristotle's model generates more complex calculations as, for example, in describing the movement of a star, it must also take into account the movement of the Earth.

In the same way, considering that mass increases Planck length has led to a model where the Schwarzschild equation can be obtained with primary mathematics, without using the GR field equation or the Tensor Calculus.

This author believes that the uhole model reaches the same results as those models defined by the GR theory, but in a more simplistic way, also making it easier to understand what black holes are and the physical meaning of their event horizon.

The uhole model allows us to answer a question that has intrigued physicists for decades: Where does the mass that falls into a black hole go?

This author's answer is that: mass is composed of small black holes, so when mass falls into a (larger) black hole, it just increases the size of the hole. Similar to how small air bubbles in a liquid come together to form a larger bubble.

One of the criticisms of the model presented in this paper is that the mass of an electron is much smaller (10^{22} times smaller) than Planck mass, thus an electron cannot form a small black hole. However, there are two ways to explain this:

Firstly, for electron mass, the space time pressure curve (presented in Figure 7-b) may not go to zero but to a pressure 10^{22} times smaller than Planck pressure, becoming "only" 10^{91} J/m^3.

For the second explanation, the use of an imaginary time concept is needed, where Planck mass is divided by the number of "steps" defined by the imaginary time extension, given as a new unitary mass (Ulianov mass) that is 10^{38}smaller than electron mass. This model will be explained in more detail in a future paper.

Finally, we can observe that work [1] and this paper present some unusual concepts, but also allow us to obtain many standard equations, such as the law of gravity and Newton's second law, the calculation of orbital velocities, as well the Schwarzschild equation. All this from equations so simple, that even a school student can understand their deduction. Furthermore, the uhole model can explain the fact that inertial mass is equal to gravitational mass. And this is only a small tip of the iceberg that has been discovered by the author.

In future works the uhole model will be expanded to explain what antimatter is, and so explain the electric charge and magnetic field behaviors. Uhole model can also calculate the imaginary time length (Li) and use it value to calculate the masses of the electrons and protons as well as the value of their electrical charges.

5–References

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