Macroscopic Spacetime Shortcuts in the Manyfold Universe and the Abnormal Gravitomagnetic Fields in Rotating Superconductors

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Abstract

Recently the idea of a Manyfold Universe was proposed by some authors to explain Dark Matter . In this study we assume that the Standard Model(SM) of particles and fields with gravity propagating in the Higher Dimensional Spacetime(Bulk) while other interactions are confined to 3+1 Einsteinian spacetime(Brane) is not due to open strings and closed loops but instead is due to the capability of gravity as the weakest and "smallest" interaction to penetrate these small Bulk size (10^{-31}m to 10^{-35}m) while protons,neutrons and other interactions stronger and "larger" than gravity do not "fits" in the size of the Bulk and remains trapped on the Brane and we present a equation to justify this point of view. Our picture relies over the geometrical beauty of the Manyfold Universe proposal that Dark Matter is chemically identical to ordinary matter but lies on other Folds. We present the fact that the exotic particles such as Photinos,Axions,WIMPS,Neutralinos etc all created to explain the Mistery of Dark Matter dont have physical existance because these were not found by a precise instrument as the NASA Chandra Satellite and NASA agrees with the Manyfold Universe and we will shall see this in the text. Also the geometrical point of view for the small size of the Bulk eliminates the need of trapping mechanisms to confine matter in the Brane based on exotic physics (eq Quintessence Fields or Einstein Cosmological Constant) providing a geometric trapping mechanism of natural beauty. Matter cannot enter the Bulk because its size is "larger" than the size of the Bulk itself. Also we "enlarge" the "size" of the Bulk from 10^{-35}m to 10^{2}m demonstrating that the Newtonian Gravity Constant in 3+1 Dimensions G_4 remains constant and the Newtonian Gravity constant G_5 is the affected by this "Bulk Enlargement" so in our model large dimensions are not tied up or constrained by the $\frac{1}{d^2}$ to $\frac{1}{d^3}$ that in large Newtonian spaces could affect for example planets orbits and we compute the energy density of this process and although we still dont know a physical process to enlarge the size of the Bulk (and we have only a theoretical mathematical model as a "fingerprint" but perhaps rotating superconductors can provide the desired answer and we show how a rotating superconductor can "enlarge" the Extra Dimension from Planck Size to Macroscopical one) the energy density remains low and physically affordable. Perhaps if this process will be discovered someday using rotating superconductors it will be able to explore the Bulk "Superluminal" properties and produce a Macroscopic Spacetime Shortcut in the Manyfold Universe that would allow the "Hyperfast" communication between distant regions of the Universe that otherwise would be far away distant forever.

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1 The Manyfold Universe(ADDK)-Nimas Arkani Hamed,Savas Dimopolous,Gia Dvali,Nemanja Kaloper

Recently Nimas Arkani Hamed(A),Savas Dimopolous(D),Gia Dvali(D) and Nemanja Kaloper(K) proposed the Manyfold Universe to explain Dark Matter [1]. In this model our Universe is folded or bended over itself and distant parts at billion light years of distance from each other in the Brane are really at milimeters of distance in the Bulk (pp 988 figure of the Japanese Origami in [2]) and (pp 4 fig 1 in [1]). We adopt the fact that these "entrances" to the Bulk are so small of the order of $10^{-35}m$(pp 3 in [5] and pp 7 in [3]) that only gravity as the weakest and "smallest" interaction [2] can afford to enter in the Bulk. This framework is somewhat different than the usual one of open strings and closed loops (pp 987 in [2])(pp 4 fig 2 in [5] and pp 25 fig 11 [5]) because it is the size of the Bulk too small enough to be penetrated by protons neutrons and other SM interactions that acts like a geometric trapping mechanism of natural beauty that under the SM conditions allows gravity to slip into the Bulk retaining in the Brane all the rest of SM fields and matter(pp 3 in [5] and pp 7 in [3]) without the need of exotic physics(Quintessence Fields or Einstein Cosmological Constant (pp 2,3 and 5 in [3]).We also use a equation to give mathematical consistence for this point of view(pp 12 eq 14 in [5]). According to ADDK model gravity can use the Bulk Shortcuts to travel billion light years in matter of seconds in the Bulk(pp 987,988 in [2]) and (pp 3,16 in [1]) while light needs large amounts of time to cover the same distance in the Brane. Then the gravity of a newly formed star at billion light years would arrive to us in minutes but the object would appear to us as Dark Star until the arrival of the first photons of light(pp 4,5 in [1]). Consider for example a star formed in a Galaxy at 326 million light years away:the gravity of the formed star will reach us in $2,5 * 10^{-10}$ seconds travelling in the Extra Dimension of Planck size while photons of light confined to our 3+1 space needs 326 million light years to cover the same distance (pp 8 in [3]). Now we have a clear picture of what "Dark Matter" really is:our star newly formed at 326 million light years away will interact gravitationally with matter in our local neighbourhoods in $2,5 * 10^{-10}$ seconds after the star formation creating a ADDK Hybrid Object but during the first 326 million years of existance the star will remain to us a "Dark" star until the arrival of the first photons of light to make the star "shine" and "visible".(see pp 5,6 in [1] about the comment that a observer can "see" the "Dark Matter" if the observer waits long enough). When we measure the gravitational field of a body we measure the gravitational field of more than one component at perhaps billion light years of distance from each other although connected by a submilimeter extra dimension and this combination is called by the Manyfold Universe creators(ADDK) as a "Hybrid Object" (pp2 in [1]).If we measure the gravitational part of the visible component of course we will find that this is less than the whole field.The difference is the so-called "Dark Matter". The attempts of Axions,WIMPS,Neutralinos and all the SUSY Particles are not able to solve this problem [11] and NASA agrees with the Manyfold Universe(ADDK) Model [11]

The "Superluminal" properties of the Extra Dimension were already noticed by ADDK authors (see pp,3,16 in [1] and pp 8 in [3]). This does not means to say that gravity propagates at "Superluminal" speeds:it means to say that gravity can take the shortcuts thru the Extra Dimension that connects at Planck size remote parts of the Universe at billion light years away arriving first than photons of light to these remote parts since photons are confined to our ordinary spacetime and cannot take shortcuts. If we assume that there exists a physical process to enlarge the size of the Bulk from $10^{-35}m$ to $10^{2}m$ and although this process remains unknown (and we have only a theoretical mathematical model but rotating superconductors can provide the right answer and we will demonstrate this in the text body of this work)(pp 12 eq 14 in [5]) we compute the energy density and surprisingly we demonstrate that this enlargement needs low and affordable energies.Dark Matter is the strongest proof that we live in a Hyper Dimensional Universe[1, 4].Astronomers are detecting Dark Matter even in our galaxy not at billion light-years away

[4] (pp 5 in [1])where our instruments can give measures with precision.It is difficult to spot a source at billion light years away but a source at 100.000 light years away is well within our capability.This is a fact not a exotic theory and this matter do not have a physical component as a body. The gravity of distant objects at billion light years away in the ordinary 3+1 spacetime are really at milimeters of distance in a Hyper Dimensional Universe and gravity can take the shortcut to reach us in minutes while light needs to travel billion light years(pp 2 in [1]). All we have to do is to enlarge these tiny spacetime shortcuts from 10^{-31} meters to 10^{2} meters large enough to contain macroscopic bodies([6])and then we will be able to explore distant parts of the Universe.(pp 12 eq 14 in [5]) We need to enlarge these tiny holes from 10^{-31} meters(considering a Bulk of this size) to 10^{2} meters keeping the G^{00} of the Einstein Field Equations the energy density low and close to zero(assuming that we need some form of energy to "enlarge" the Bulk then we must worry ourselves about the amount of energy needed) because we will increase a dimension from 10^{-35} meters to 10^{2} meters.We will raise a volume by a magnitude of 10^{37} roughly speaking we will multiply by 10.000.000.000.000.000.000.000.000.000.000.000.000 times and if G^{00} is between 0 and 1 but in the neighbourhoods of 1 this process will require a unphysical amount of energy.We must keep our G^{00} between 0 and 1 but close to zero to keep the energy at a physical reasonable level and we need also to discover a real physical process to enlarge these tiny holes.Rotating Superconductors seems to be the right path .Then if we can figure out this process we can perhaps open a Macroscopic Spacetime Shortcut in the Manyfold Universe connecting remote regions of the Universe([6]) that otherwise would be far away distant forever.

2 Bulk Topology - The Japanese Origami

In the Japanese Origami (pp 988 in [2]) and (pp 4 fig 1 in [1] and "Manyfold Universe" picture in [4]) we can see a folded 3+1 region of Einstein Universe with a lenght of billion light years and with two BraneFolds(one left and another right) separated by a milimeter distance in the Bulk.In order to trap SM fields in each Brane allowing only gravity to slip from one Brane to another the throat can have milimeters in lenght but must have a restraint of about $10^{-35}m$ width and height acting as a "bottleneck" trapping protons and neutrons larger than the throat in the Brane while gravity travels in the Bulk.This "throat" is the "SM bottleneck" and in the next section we will present the equation of this "bottleneck".

Another idea for this "throat" can be figured out looking also to the picture in (pp 3 in [5]).The straight line can be the "milimeter" distance between two Branefolds in the ADDK model but the straight line is actually a cylinder of radius 10^{-35} m.

The Bulk dimension R is composed by $R^2 = p^2 + q^2 + r^2$ where p is the milimeter distance and q and r are the 10^{-35}m "throat bottleneck".

Initially $R^2 = 2 * 10^{-35}$ and $p = 0$ (Left Brane) or $p = 10^{-3}$m (Right Brane) and R corresponds to the Bulk in [3]. Note that 10^{-35}m is so small that R is close to zero and the ansatz of [3] reduces to a SR ansatz(Reductions to SR ansatz will be further mentioned in this work).

If we want a throat with 10^{2}m wide then $q, r = 10^2$ and $R^2 = p^2 + 2 * 10^2$.Negleting p for 0 and 10^{-3} (or 10^{-6} for p^2) then $R^2 = 2 * 10^2$ and $R = \sqrt(2) * 10$. This resembles the $R = 15$ from (pp8 in [3]) .

But what if we could discover a way to "enlarge" this Planck size dimension from 10^{-35} m to 200 meters The Planck size of the Extra Dimension can be written in function of some well-known physical constants and the expression was obtained by a research group in the University of Amsterdam Holland(pp 12 eq 14 in [5]).

3 Enlarging The Bulk Dimension from The Planck Length To A Macroscopical Size - The Dutch Equation-Szczepan W. Kowalczyk,Jorn Mossel

Recently some researchers in Holland (Kowalczyk,Mossel et al)([12, 13]) studied the behaviour of gravitation in 5 dimensions considering all the well-known and proved experimental physics and they arrived at a very interesting result. A equation giving the radius of the extra dimension as the Planck Length in function of some physical constants.(pp 12 eq 14 in [5]). This equation is fundamental in our study to "enlarge" the Bulk to a Macroscopical size and will be further mentioned as the Dutch Equation.By changing the values of some physical constants we will "enlarge" the size of the Bulk.Also Marc Millis from NASA conjectured the possibility to alter some physical constants to create space propulsion(altering the value of the gravitational constant G Bias Drive in [6]).We prefer to do not change the value of G and instead we choose to manipulate the values of electric and magnetic permeability and permissivity in the vacuum to "change" the size of the Bulk to Macroscopical.

The Dutch Equation is:

$$R = \sqrt{\frac{4\pi\epsilon_0 G\hbar^2}{\epsilon^2 c^2}} \tag{1}$$

This equation shows the relation between some physical constants and the geometry of a spacetime.By changing the constants we will change the geometrical properties of the Bulk and the behaviour of a given spacetime can be "engineered"[6].This is why the Dutch Equation is so important:the beauty of spacetime geometry related to physical constants.In the Dutch Equation R is the radius of the Bulk,ϵ is the elementary charge of the electron,$\hbar$ is the Planck Constant,G is the Newton Gravitational Constant and ϵ_0 is the electric permeability of the vacuum.Inserting the known values of the constants we will get a result $R = 1.9 * 10^{-34}$m near the Planck Length.Note also that the size of the Bulk dimension depends only on constants of our physical dimension and this is very good for a spacetime "manipulation"[6],otherwise we would never be able to "control" the Bulk geometry.This another important point of the Dutch Equation.

We choose to work with the electric permeability of the vacuum because eletromagnetic interactions are a well understood phenomema and more easily controllable[6].

Enlarging the electric permittivity in the vacuum by a still unknown physical process we will "uncurl" the extra dimension allowing Macroscopic Shortcuts.We hope that Rotating Superconductors can provide the final answer.

By enlarging ϵ_0 to ϵ_1 a we will raise the size of the Bulk dimension to Macroscopical one but we want to keep $c = \frac{1}{\sqrt{(u_0\epsilon_1)}}$ constant to do not break the Lorentz invariance and retains the laws of electromagnetism valid as many as possible.Then our physical process that will raise the ϵ_1 will proportionally low the u_0 .

Working with $c = 1$ implies that $\sqrt{(u_0\epsilon_1)} = 1$ and we can rewrite the Dutch Equation as:

$$R = \sqrt{\frac{4\pi\epsilon_1 G\hbar^2}{\epsilon^2}} \tag{2}$$

R is directly proportional to $\sqrt{\epsilon_1}$ then we can write $R = P_1\sqrt{\epsilon_1}$ where P_1 encompasses all the other invariant constants.

In the next section we will also work with variables ϵ_0 and u_0 because c can also decrease(VSL Cosmology and Rotating Superconductors).

We must consider that changing the ϵ_1 we are changing the behaviour of electromagnetism and perhaps affecting the molecular or atomic structure of a macroscopic body:Then if we want to enlarge the Bulk to allow the passage of the macroscopic body to the higher dimensional spacetime we must create a "geometric manipulation of spacetime"[6] that will alter ϵ_1 in the neighbourhoods of the body but far away from it and in the spacetime region where the body resides ϵ_1 must remains unchanged.Our idea is to involve the body inside a "bubble distortion" that will change ϵ_1 in the "bubble walls" enlarging the Bulk but inside the "bubble" and far away from it the ϵ_1 remains unchanged to preserve compatibility with the known physical laws($\epsilon_1 = \epsilon_0$).Perhaps Rotating Superconductors can open the possibility to generate this process.

Enlarging ϵ_1 we will decrease the Coulomb Constant affecting the electric forces and the macroscopic body must remain inside the "bubble" where $\epsilon_1 = \epsilon_0$ to retain intact its atomic structure.This must deserves further investigation in the future because we reckognize that the Bulk can be enlarged but inserting a "bubble" containing a Macroscopic Body is somewhat still complicated.

4 The Variable Light Speed(VSL) Cosmology - Joao Magueijo

All our discussion of changing the electric permeability in vacuum to create a shortcut to higher dimensional space would be regarded as useless without a clue of realistic physical experimental evidence that this is really possible. We choosed to change electric permeability instead of G(Millis Bias Drive[6]) because electromagnetism is a more well understood physical interaction than gravity in agreement with Millis.[6]. If we change for example electric permeability in vacuum we may change the value of the speed of light in vacuum and this would not be a absolute constant.If light speed is or is not a constant in the vacuum is one of the most controversial paradigms of modern physics.This paradigm leads us to Joao Magueijo.(pp 5 in [7]).

Magueijo supports the argument that light speed is now slower than it was billion of years ago.Although Magueijo is not alone following this line of reason and he was not the first to propose this idea,he is one of the most stronger and active supporters of this idea.Experimental data obtained from supernova explosions seems to confirm Magueijo point of view.(pp 38 in [7]).

A variable light speed cosmology is very important to our point of view of changing fundamental physical constants to enlarge Bulk Size allowing Macroscopical Shortcuts:It provides the proof that it really can be done,otherwise for a absolute and constant speed of light our discussion would be completely useless.

If light speed varies with time then $c = \frac{1}{\sqrt{(u_0 \epsilon_1)}}$ depends on a variable $\sqrt{(u_0 \epsilon_1)}$ .Here we face the following scenarios:

1) u_0 varies and ϵ_1 is constant;

2) u_0 is constant and ϵ_1 varies;

3) u_0 varies and ϵ_1 varies.

In all the above cases the Dutch Equation will be affected and since light speed slows down then the radius R of the Bulk increases.The desirable situation for our case would be the second item:a variation of electric permeability will affect the Dutch Equation in upper and lower parts of the fraction while first item affects only the lower part.The radius of the Bulk increases because u_0 or ϵ_1 increases.

Although this variation depending on time is pretty small and needs billion years to be verified it really happens,opening the hope that if it can happen in time perhaps the spacetime can be "engineered" to produce a local variation on u_0 or ϵ_1 depending on geometry and electromagnetism.(Millis in [6]).Perhaps a "vacuum polarization" as referred by Magueijo in (abstract of [7]) can be "engineered".

The desirable situation would be the one of eq 3 of previous section.

We considered in the previous section a changing ϵ_1 with the corresponding changing in u_0 to make $c = 1$.

If we consider a varying c due to a increasing ϵ_1 keeping u_0 constant,but having a variable c then we must rewrite the Dutch Equation as follows:

$$R = \sqrt{\frac{4\pi\epsilon_1^2 G\hbar^2 u_0}{\epsilon^2}} \tag{3}$$

Note that now ϵ_1^2 have a more strong influence over the Bulk Radius.

The relation between the size of the Bulk R and ϵ_1 would be given by :

1. u_0 varies and ϵ_1 varies (fixed value $c = 1$ the case of previous section),$R = P_1\sqrt{\epsilon_1}$,$R^2 = P_1^2\epsilon_1$;
2. u_0 is constant and ϵ_1 varies (variable c),$R = P_2\epsilon_1$,$R^2 = P_2^2\epsilon_1^2$.

Again as stated before for P_1,P_2 are the other constants in the Dutch Equation.

The differentials of Bulk radius needed for the ansatz are given by:

1) $dR = P_2 d\epsilon_1$;

2) $dR = \frac{1}{2}\frac{P_1}{\sqrt{\epsilon_1}}d\epsilon_1$.

1) $dR^2 = P_2^2 d\epsilon_1^2$;

2) $dR^2 = \frac{1}{4}\frac{P_1^2}{\epsilon_1}d\epsilon_1^2$.

This allows us to write the General Relativity ansatz in function of the variation of the electric permeability in vacuum.

Note that the values of $P_1 = \frac{2}{\epsilon}\hbar\sqrt{(\pi G)}$ and $P_2 = 2\frac{\hbar}{\epsilon}\sqrt{(\pi G u_0)}$ are low of the order $0 < G < 1$ and $0 < \hbar < 1$ because of the values of $G = 6,67 * 10^{-11} Nm^2/Kg^2$ and $\hbar = \frac{6,626}{2\pi} * 10^{-34} Js$ that divided by $\epsilon = 1,6 * 10^{-19} C$ will still produce low values although $P_2 < P_1$ due to $u_0 = 4\pi * 10^{-7} H/m$.

Then $0 < P_1 < 1$ and $0 < P_2 < 1$ and

1) $\frac{dR}{d\epsilon_1} = P_2$;

2) $\frac{dR}{d\epsilon_1} = \frac{1}{2}\frac{P_1}{\sqrt{\epsilon_1}}$.

1) $(\frac{dR}{d\epsilon_1})^2 = P_2^2$;

2) $(\frac{dR}{d\epsilon_1})^2 = \frac{1}{4}\frac{P_1^2}{\epsilon_1}$.

Note that the derivatives of R with respect to ϵ_1 are extremely low and considering the scenario of $c = 1$ then the derivative will be even lower in the "walls" of the bubble in the region where ϵ_1 have high-values.

Considering now a varying c due to a increasing u_0 then the Dutch Equation can be written as $R = P_3\sqrt{u_0}$ with P_3 being $P_3 = \frac{2}{\epsilon}\epsilon_0\hbar\sqrt{(\pi G)}$ and

1) $dR = \frac{1}{2}\frac{P_3}{\sqrt{u_0}}du_0$;

2) $dR^2 = \frac{1}{4}\frac{P_3^2}{u_0}du_0^2$.

The variation of u_0 could be very similar to the variation of ϵ_1 in eq 3.This can also be applied for the next case of a varying light speed.

In the case that both ϵ_0 and u_0 are varying then the Dutch Equation can be written as $R = P_4\epsilon_0\sqrt{(u_0)}$ with $P_4 = \frac{2}{\epsilon}\hbar\sqrt{(\pi G)}$.Note that in this case $c = \frac{1}{\sqrt{(u_0\epsilon_0)}}$ varies accordingly.

1) $dR = P_4(2\sqrt{(u_0)}\epsilon_0 d\epsilon_0 + \frac{1}{2}\frac{\epsilon_0}{\sqrt{(u_0)}}du_0)$;

2) $dR^2 = P_4^2(2\sqrt{(u_0)}\epsilon_0 d\epsilon_0 + \frac{1}{2}\frac{\epsilon_0}{\sqrt{(u_0)}}du_0)^2$;

3) $dR^2 = P_4^2\epsilon_0^2(4u_0 d\epsilon_0^2 + 2d\epsilon_0 du_0 + \frac{1}{4}\frac{1}{u_0}du_0^2)$.

An interesting feature can be noted when we apply our concept of enlarging the Bulk radius R by increasing ϵ_1 in the framework of the electric and gravitational forces:

1) gravitational force remains the same;

2) electric force looses intensity .

From (pp 12 between eq 13 and 14 in [5]) we can derive the relation between gravitational constants in a $4D$ and in a $5D$ spacetimes: $G_4 = \frac{G_5}{8R}$ $G_5 = G_4 * 8R$. Assuming that G_4 the Newton Constant is really a constant then when we "enlarge" the Bulk we enlarge G_5 keeping the gravitational force $F_g = \frac{G_4 M1 M2}{D_{12}^2}$ constant .Remember that for two bodies $M1$ and $M2$ separated by a distance D_{12},$R << D_{12}$.(pp 9 eq 8 in [5]). The well known paradigm of the $\frac{1}{D_{12}^3}$ for planetary orbits in extra dimensions cannot be applied here because a R of 10^2 m in a localized region of space is much smaller than a D_{12} for example the distance between Earth and Mars and then $R << D_{12}$ remains valid. Also all the experiments to find out the presence of extra dimensions did not reached the Planck size that occurs in natural conditions where ϵ_0 or u_0 or both,remains unchanged.We must first enlarge ϵ_0 or u_0 or both and then verify if the extra dimensions appears "enlarged" because a "curled up" extra dimension will be very difficult to detect.The Gravitational Force in 3+1 dimensions is not affected by the presence of the extra dimension whether "curled up" or "enlarged".

By the contrary the electric force between two charges separated by the same distance D_{12} is proportional to the Coulomb Constant $K = \frac{1}{4\pi\epsilon_0}$ and if we enlarge ϵ_1 then we make K shrinks.Since light speed can have a variable value due to a varying ϵ_1 a growing ϵ_1 can make the value of c and K shrinks.

Then in the scenario of VSL Cosmology if light speed is affected only by ϵ_1 then in the past not only light speed was higher but also the intensity of electric force.Enlarging R we make the electric force smaller(a interesting line of reason would be the size of R to have electric and gravitational forces with the same intensity.)

If light speed is affected only by u_0 electric and gravitational forces are unaffected.A future study would be enable to discover the scenario that better describes a changing light speed.

Also note that if light speed varies then the g_{tt} or g_{00} component of spacetime metric tensor of General Relativity is affected due to the derivatives of these components.

5 The Kalbermann-Halevi Solution of the Einstein Field Equations for Dark Matter-German(Zvi) Kalbermann,Hai Halevi

Our point of view as stated before relies upon geometrical beauty of the Manyfold Universe between chemical equivalence between Dark Matter and ordinary matter(abstract pp 2,4 and fig 1 in [1]) and in the small size of the Bulk that acts as a geometrical trapping mechanism to keep matter and SM fields in the Brane eliminating the need of exotic trapping mechanisms (pp 2,3 and 5 in [3]). We will now introduce the ansatz that suits well in the Manyfold Universe point of view and may explain the behaviour of Dark Matter:The Correct Einstein Field Equation of General Relativity that can describe mathematically the beauty of the ADDK Manyfold Universe was developed by German (Zvi) Kalbermann and Hai Halevi from Jerusalem University,Tel Aviv University and Rehovot University in Israel The Kalbermann-Halevi ansatz [3]. Kalbermann shows(pp 8 eq 8 in [3]) that a signal in the Bulk travels in $2,5 * 10^{-10}$ seconds a distance equivalent to 326 million light years in the Brane. This ansatz explains exactly the behaviour of Dark Matter: Imagine a new star formed at 326 million light years away.Its gravity will reach us in $2,5 * 10^{-10}$ seconds affecting our local neighbourhoods but in the first 326 million years of life the star would appear to us as a Dark Star or a MACHO star until the arrival of the first photons to our local neighbourhoods to make the star "shine"(pp 4,5 in [1]).This does not means that gravity propagates at "Superluminal" speeds:it does mean that gravity can take the Bulk shortcuts.Consider a gravity signal entering in the "throat" of the Origami ,it will travel across the "throat" reaching the other side of the Manyfold at milimeters of distance while light and SM particles and fields travelling across the Brane must take the 326 million years to cover the distance to the other side of the fold. Considering Macroscopic Bodies we cannot accelerate to "Superluminal" speeds due to the limitations in energy requirements but also due to the G-forces that would destroy the integrity of the body.

The Kalbermann-Halevi ansatz is given by the following equation (pp 4 eq 3 in [3])

$$ds^2 = a(R)dt^2 - b(R)dR^2 - c(R)dl^2 \tag{4}$$

where R is the Bulk dimension and dl^2 is the line element of the Brane.

A more specifical example can be written as (pp 7 eq 7 in [3]):

$$ds^2 = (1 + kR^2)dt^2 - b(R)dR^2 - e^{-k(R^2)/2}dl^2 \tag{5}$$

This ansatz have a generic $b(R)$

Solving the Null-Like Geodesics for the equation above and considering that R have small derivatives and $\frac{dR}{dt}$ is close to zero we easily see how Kalbermann arrived at the result of 326 million light years in $2,5 * 10^{-10}$ seconds(pp 8 eq 8 in [3]).

Solving the Null-Like with respect to the dl^2 we have:

$$(\frac{dl}{dt})^2 = \frac{a(R)}{c(R)}[1 - \frac{b(R)}{a(R)}(\frac{dR}{dt})^2] \tag{6}$$

$$(\frac{dl}{dt})^2 = \frac{(1 + kR^2)}{c(R)}[1 - \frac{b(R)}{(1 + kR^2)}(\frac{dR}{dt})^2] \tag{7}$$

The analysis of the equation above shows that $\frac{(1+kR^2)}{c(R)} = (1 + kR^2)e^{k(R^2)/2}$ and since $k = 10^{62}$ (see pp 7 in [3]) then $\frac{(1+kR^2)}{c(R)} >> 1$ (making $c = 1$ in the Ansatz of Kalbermann-Halevi).$\frac{b(R)}{(1+kR^2)}(\frac{dR}{dt})^2$ must also have a small value to enhance the "Superluminal" properties of the shortcut.

We will now study the behaviour of the energy density G_{00} Einstein Tensor in this ansatz when we enlarge the size of the Bulk from 10^{-35}m to 10^2 m allowing matter and SM fields to use the Bulk Shortcuts to travel light years in seconds and we will show that G_{00} remains low and affordable.

The energy density G_{00} in Kalbermann-Halevi ansatz is given by[4] Although we use the G_{00} for illustrative purposes the final considerations will use the G^{00}

$$G_{00} = \frac{3a}{4b^2c}[(\frac{db}{dR}\frac{dc}{dR}) - 2(\frac{d^2c}{dR^2}b)] \tag{8}$$

Note that this G_{00} is different than the one presented in the original Kalbermann work (pp 5 eq 4 in [3]) and since our G_{00} is the correct one (see also the Acknowledgements note in this work) it must replace the G_{00} depicted in the Kalbermann original work.Also all the others G_{pq} must be replaced too.

We are looking for an ansatz that retains the "Superluminal" behaviour (pp 8 eq 8 in [3]) and (pp 3,16 in [1]) and provides a low and affordable energy density whether the Bulk have the size of 10^{-35}m or 10^2m.

We must find the expression for $b(R)$ that will provide a zero energy density $G_{00} = 0$ and from this expression we will deduce the one for low energy densities

Then

$$G_{00} = \frac{3a}{4b^2c}[(\frac{db}{dR}\frac{dc}{dR}) - 2(\frac{d^2c}{dR^2}b)] = 0 \tag{9}$$

when

$$b(R) = (kR)^2 e^{-kR^2} \tag{10}$$

rewriting the Kalbermann-Halevi ansatz we have:

$$ds^2 = (1 + kR^2)dt^2 - (kR)^2 e^{-kR^2} dR^2 - e^{-k(R^2)/2} dl^2 \tag{11}$$

Note that in this ansatz $b(R)$ is not equal to $(kR)^2 e^{-kR^2}$ otherwise G_{00} would be zero. $b(R) \simeq (kR)^2 e^{-kR^2}$ to make $G_{00} \simeq 0$ but of course not null.

Also note that a $b(R) \simeq (kR)^2 e^{-kR^2}$ will have a low value increasing the "Superluminal" features of the Null-Like Geodesics as we desire due to the nature of $(kR)^2 e^{-kR^2}$

$$(\frac{dl}{dt})^2 = \frac{(1 + kR^2)}{e^{-k(R^2)/2}}[1 - \frac{(kR)^2 e^{-kR^2}}{(1 + kR^2)}(\frac{dR}{dt})^2] \dashrightarrow (\frac{dl}{dt})^2 = (1 + kR^2)e^{k(R^2)/2}[1 - \frac{(kR)^2}{e^{kR^2}(1 + kR^2)}(\frac{dR}{dt})^2] \tag{12}$$

$$\frac{(kR)^2 e^{-kR^2}}{(1 + kR^2)} \simeq 0 \dashrightarrow (\frac{dl}{dt})^2 = (1 + kR^2)e^{k(R^2)/2} \tag{13}$$

The equation above outlines the Kalbermann point of view in pp 8 eq 8 in [3])

note that this ansatz retains the Superluminal behaviour and have a null G_{00} energy density whether the Bulk size(dimension e) is of 10^{-35}m or 10^2 meters. Also as in the original Kalbermann-Halevi (pp 7 eq 7 in [3]) it reduces to ordinary special relativity ansatz when $R = 0$

Of course we imagine that our unknown physical process to enlarge the Bulk(uncurling the extra curled up dimensions) would require energy then our ansatz with $G_{00} = 0$ is a mathematical curiousity mentioned only to demonstrate that GR "allows" a ansatz of null-energy when "uncurling" the extra dimensions from 10^{-35}m to $10^2 m$ We are expecting that this process to uncurl the extra dimensions to macroscopic size needed for spacetime shortcuts requires a G_{00} different than zero but low and affordable. At least we know that we can manipulate the value of b to get a G_{00} equal to or close to zero independently of the size of the extra dimension. For the future energy density requirements we will use G^{00} instead of G_{00}

A more realistic ansatz that would enlarge the Bulk from 10^{-35}m to 10^{2}m would be given by

$$G_{00} = \frac{3a}{4b^2c}[(\frac{db}{dR}\frac{dc}{dR}) - 2(\frac{d^2c}{dR^2}b)] = \frac{1}{k} \tag{14}$$

The k in all these equations is given by $k = 10^{62}$(pp 7 in [3]) and if we make $G_{00} = \frac{1}{k}$ we would have a very low energy density(10^{-62}) ideal for our "Superluminal" ansatz. Note that integrating the energy density over the Bulk volume(since the Brane dimensions do not enter in the expression for G_{00}) in these conditions the energy needed for this process would still be very low even considering that the Bulk volume will raise by a factor of 10^{37} times.

We have a and c fixed and explicitly written (eq 6)being b a variable.In this case the value of b will fall near eq 9 since G_{00} will fall near 0.

The contravariant energy density G^{00} for the $G_{00} = \frac{1}{k}$ would be given by:

$$G^{00} = \frac{3}{4ab^2c}[(\frac{db}{dR}\frac{dc}{dR}) - 2(\frac{d^2c}{dR^2}b)] = \frac{1}{a^2k} \tag{15}$$

Note that a large R for Bulk radius will maximize the value of a lowering the energy density as the Bulk radius increase(Fundamental to allow Macroscopic Bodies entering in the Bulk "throat") keeping valid our approximation of b to eq 9..

Rewriting the Kalbermann-Halevi ansatz using the Bulk radius R from the Dutch Equation(case $c = 1$) we should expect for:

$$ds^2 = (1 + k\frac{4\pi\epsilon_1 G\hbar^2}{\epsilon^2})dt^2 - (k^2\frac{4\pi\epsilon_1 G\hbar^2}{\epsilon^2})e^{-k\frac{4\pi\epsilon_1 G\hbar^2}{\epsilon^2}}\frac{1}{4}\frac{\frac{4\pi G\hbar^2}{\epsilon^2}}{\epsilon_1}d\epsilon_1^2 - e^{-k(\frac{4\pi\epsilon_1 G\hbar^2}{\epsilon^2})/2}dl^2 \tag{16}$$

and a variable c for a varying ϵ_0 :

$$ds^2 = (1 + k\frac{4\pi\epsilon_1^2 G\hbar^2 u_0}{\epsilon^2})dt^2 - (k^2\frac{4\pi\epsilon_1^2 G\hbar^2 u_0}{\epsilon^2})e^{-k\frac{4\pi\epsilon_1^2 G\hbar^2 u_0}{\epsilon^2}}\frac{4\pi G\hbar^2 u_0}{\epsilon^2}d\epsilon_1^2 - e^{-k(\frac{4\pi\epsilon_1^2 G\hbar^2 u_0}{\epsilon^2})/2}dl^2 \tag{17}$$

for a varying u_0

$$ds^2 = (1 + k\frac{4\pi\epsilon_1^2 G\hbar^2 u_0}{\epsilon^2})dt^2 - (k^2\frac{4\pi\epsilon_1^2 G\hbar^2 u_0}{\epsilon^2})e^{-k\frac{4\pi\epsilon_1^2 G\hbar^2 u_0}{\epsilon^2}}\frac{1}{4}\frac{\frac{4\pi G\hbar^2\epsilon_0^2}{\epsilon^2}}{u_0}du_0^2 - e^{-k(\frac{4\pi\epsilon_1^2 G\hbar^2 u_0}{\epsilon^2})/2}dl^2 \tag{18}$$

for both varying ϵ_1 and u_0

$$ds^2 = (1+k\frac{4\pi\epsilon_1^2 G\hbar^2 u_0}{\epsilon^2})dt^2 - (k^2\frac{4\pi\epsilon_1^2 G\hbar^2 u_0}{\epsilon^2})e^{-k\frac{4\pi\epsilon_1^2 G\hbar^2 u_0}{\epsilon^2}}\frac{4}{\epsilon}\pi G\hbar^2\epsilon_1^2(4u_0 d\epsilon_1^2 + 2d\epsilon_1 du_0 + \frac{1}{4}\frac{1}{u_0}du_0^2) - e^{-k(\frac{4\pi\epsilon_1^2 G\hbar^2 u_0}{\epsilon^2})/2}dl^2 \tag{19}$$

The four equations above outline the physical beauty of our model:a General Relativity spacetime ansatz "engineered" in function of the physical constants in a inspiration from Millis in [6] and Magueijo in abstract of [7] using the Dutch Equation (pp 12 eq 14 in [5]).

Note that when $R = 0$ this reduces to a SR ansatz.

The equations above were written using the terms P_1,P_2,P_3 and P_4 explicitly written to better illustrate our point of view.A algebraic sample form using P_1,P_2,P_3 and P_4 to simplify the expressions for G^{00} and G_{00} would be given by:

$$ds^2 = (1 + kP_1^2\epsilon_1)dt^2 - (k^2P_1^2\epsilon_1)e^{-kP_1^2\epsilon_1}\frac{1}{4}\frac{P_1^2}{\epsilon_1}d\epsilon_1^2 - e^{-k(P_1^2\epsilon_1)/2}dl^2 \tag{20}$$

for $c = 1$ and

$$ds^2 = (1 + kP_2^2\epsilon_1^2)dt^2 - (k^2P_2^2\epsilon_1^2)e^{-kP_2^2\epsilon_1^2}P_2^2d\epsilon_1^2 - e^{-k(P_2^2\epsilon_1^2)/2}dl^2 \tag{21}$$

for a variable c in a varying ϵ_1 and

$$ds^2 = (1 + kP_3^2u_0)dt^2 - (k^2P_3^2u_0)e^{-kP_3^2u_0}\frac{1}{4}\frac{P_3^2}{u_0}du_0^2 - e^{-k(P_3^2u_0)/2}dl^2 \tag{22}$$

for a variable c in a varying u_0 and

$$ds^2 = (1 + kP_4^2\epsilon_1^2u_0)dt^2 - (k^2P_4^2\epsilon_1^2u_0)e^{-kP_4^2\epsilon_1^2u_0}P_4^2\epsilon_1^2(4u_0d\epsilon_1^2 + 2d\epsilon_1du_0 + \frac{1}{4}\frac{1}{u_0}du_0^2) - e^{-k(P_4^2\epsilon_1^2u_0)/2}dl^2 \tag{23}$$

variable c from both varying ϵ_1 and u_0 .

The G_{00} and G^{00} for the case $c = 1$ would be given by:

$$G_{00} = \frac{3a}{4b^2c}[(\frac{db}{\frac{1}{2}\frac{P_1}{\sqrt{\epsilon_1}}d\epsilon_1}\frac{dc}{\frac{1}{2}\frac{P_1}{\sqrt{\epsilon_1}}d\epsilon_1}) - 2(\frac{d^2c}{\frac{1}{4}\frac{P_1^2}{\epsilon_1}d\epsilon_1^2}b)] \tag{24}$$

$$G^{00} = \frac{3}{4ab^2c}[(\frac{db}{\frac{1}{2}\frac{P_1}{\sqrt{\epsilon_1}}d\epsilon_1}\frac{dc}{\frac{1}{2}\frac{P_1}{\sqrt{\epsilon_1}}d\epsilon_1}) - 2(\frac{d^2c}{\frac{1}{4}\frac{P_1^2}{\epsilon_1}d\epsilon_1^2}b)] \tag{25}$$

and for the case of a variable c due to a varying ϵ_1 by:

$$G_{00} = \frac{3a}{4b^2c}[(\frac{db}{P_2d\epsilon_1}\frac{dc}{P_2d\epsilon_1}) - 2(\frac{d^2c}{P_2^2d\epsilon_1^2}b)] \tag{26}$$

$$G^{00} = \frac{3}{4ab^2c}[(\frac{db}{P_2d\epsilon_1}\frac{dc}{P_2d\epsilon_1}) - 2(\frac{d^2c}{P_2^2d\epsilon_1^2}b)] \tag{27}$$

for a varying u_0 by:

$$G_{00} = \frac{3a}{4b^2c}[(\frac{db}{\frac{1}{2}\frac{P_3}{\sqrt{u_0}}du_0}\frac{dc}{\frac{1}{2}\frac{P_3}{\sqrt{u_0}}du_0}) - 2(\frac{d^2c}{\frac{1}{4}\frac{P_3^2}{u_0}du_0^2}b)] \tag{28}$$

$$G^{00} = \frac{3}{4ab^2c}[(\frac{db}{\frac{1}{2}\frac{P_3}{\sqrt{u_0}}du_0}\frac{dc}{\frac{1}{2}\frac{P_3}{\sqrt{u_0}}du_0}) - 2(\frac{d^2c}{\frac{1}{4}\frac{P_3^2}{u_0}du_0^2}b)] \tag{29}$$

and for a varying ϵ_1 and u_0 by:

$$G_{00} = \frac{3a}{4b^2c}[(\frac{db}{P_4(2\sqrt(u_0)\epsilon_1 d\epsilon_1 + \frac{1}{2}\frac{\epsilon_1}{\sqrt(u_0)}du_0)}\frac{dc}{P_4(2\sqrt(u_0)\epsilon_1 d\epsilon_1 + \frac{1}{2}\frac{\epsilon_1}{\sqrt(u_0)}du_0)}) - 2(\frac{d^2c}{P_4^2\epsilon_1^2(4u_0 d\epsilon_1^2 + 2d\epsilon_1 du_0 + \frac{1}{4}\frac{1}{u_0}du_0^2)}b)] \quad (30)$$

$$G^{00} = \frac{3}{4ab^2c}[(\frac{db}{P_4(2\sqrt(u_0)\epsilon_1 d\epsilon_1 + \frac{1}{2}\frac{\epsilon_1}{\sqrt(u_0)}du_0)}\frac{dc}{P_4(2\sqrt(u_0)\epsilon_1 d\epsilon_1 + \frac{1}{2}\frac{\epsilon_1}{\sqrt(u_0)}du_0)}) - 2(\frac{d^2c}{P_4^2\epsilon_1^2(4u_0 d\epsilon_1^2 + 2d\epsilon_1 du_0 + \frac{1}{4}\frac{1}{u_0}du_0^2)}b)] \quad (31)$$

These G_{00} and G^{00} are similar to the ones used in eq 11 and 12 giving the result of eq 8 since $\frac{1}{k}$ or $\frac{1}{a^2k}$ have values very close to zero due to a large a in the "bubble" "walls" and due to $k = 10^{62}$

This illustrates how a stress energy momentum tensor of the Einstein Field Equations of General Relativity can be "engineered" from a "vacuum polarization" of a variable light speed or a variable electric permeability of the vacuum.(Millis in [6] and Magueijo in abstract of [7])

By enlarging for the eletric permittivity in vacuum we will enlarge the size of the Extra Dimensions allowing matter and SM fields to travel to the Spacetime Shortcuts of the Manyfold Universe.But can this be really done?

6 The Variation of ϵ_0 and u_0 to enlarge the Extra Dimension-Martin Tajmar and Clovis Jacinto de Matos

Martin Tajmar from Austria and Clovis Jacinto de Matos from Portugal are two scientists of ESA(European Space Agency) working for ESTEC(European Space Technology and Engineering Center) that for years dedicated their lives to study anomalous phenomena in Supercondutors.[9, 10]

The studied why the gravitomagnetic field of a Superconductor in rotation is of the order of(eq 5 in [9])

$$B_g = 1,85 * 10^{-5} * w \quad (32)$$

while the gravitomagnetic field of Earth(a entire Planet much more massive than a Superconductor is of the order of(eq 7 in [9])

$$B_g = 3,19 * 10^{-35} * w \quad (33)$$

What could be the cause of such high gravitomagnetic fields of magnitude order of 10^{30} known a Tate results??([9] before eq 6)

Tajmar and Matos suggests a abnormal coupling between Electromagnetism and Gravitation for Quantum Materials of Superconductors and theoretizes different values of G or c(exactly what we need to enlarge the Bulk:different constants . These constants would be drastically different in Superconductors. However G different would imply in reduction weight which is not observed. But a different refraction index(a variable c) being slowed down as Matos and Tajmar mentions a speed of light of $3,9 * 10^{-7}$ m/s would be needed to explain the Tate abnormally([9] after eq 7). Matos and Tajmar mentions experiments carried by other researchers in which the speed of light was reduced by seven orders of magnitude or even the speed of light is completely stopped down(a paradox since by special relativity light cannot stop) in a Bose-Einstein-Condensator made of Sodium atoms.According to Matos and Tajmar this exotic behaviour could explain why rotating Quantum Materials could produce Non-Classical Gravitomagnetic fields even at classical angular velocities solving the Tate abnormally. But can Quantum Materials like Niobium Superconductors affects the Spacetime Geometry and enlarge the Planck Extra Dimensions according to the Dutch Equation??

Tajmar and Matos mentions another Tate experiment with Niobium Superconductor Rings(pp 3 in [10]) that affects the Spacetime Geometry in a way that may be useful to enlaege the Bulk according to the Dutch Equation.

Starting with the Classical Coupling between Gravity and Electromagnetism given by(pp 3 eq 2 in [10]):

$$|k| = \frac{\mu_{0g}}{\mu_0}\frac{m}{e} \tag{34}$$

where μ_{0g} is the Gravitomagnetic Permeability of Vacuum and μ_0 is the Magnetic Permeability of Vacuum m is the electron mass and e is the electron charge.

This Coupling is very small and plays no role in laboratory experiments(pp 3 in [10])

However the interesting point of view proposed by Tajmar and Matos is the fact that a Superconductor in Rotation is no longer tied to 3D+1 Spacetime:As a matter of fact in (pp 5 in [10]) both authors asks if Spacetime is really 4D for Quantum Systems.

They propose a Fractal-Spacetime of D Dimensions for Quantum Rotating Superconductors(pp 6 in [10]) with even non-integer dimensionality but we will assume that this Fractal Spacetime is really a Extra Dimensional Manyfold Universe physical measure.(It would be very had to conceal General Relativity formalism of Ricci Curvature Tensors and Einstein Field Equations using scripts for integer dimensions with a dimension that is a non-integer script).But the idea of Matos and Tajmar is very important and very interesting for the study of Spacetime Shortcuts to reach Remote Parts of the Universe:Macroscopic Quantum Systems(eg Niobium Rotating Superconductors) can open the key to the Extra Dimensional Spacetime.(pp 5,6,7,8,9,10 and 11 in [10]).At least we have a Macroscopical Object that can exntends beyond the $4D$ or $3 + 1$ Spacetime.For the first time we have experimental work on Extra Dimensional Physics beyond all the theoretical BraneWorld models.(Conclusion pp 11 in [10])

They propose a G_D gravitational constant defined as(eq 14 pp 6 in [10])

$$\frac{G_D}{G_4} = l_c^{D-4} \tag{35}$$

l_c is the Compactification Lenght of the Extra Spatial Dimension.(In our case is of the order of Planck Lenght)

Making the D Dimensional spacetime $D = 5$ which means to say $3 + 1$ ordinary Spacetime of 3 Space Dimensions 1 Time Dimension and 1 Extra Planck Dimension

$$\frac{G_5}{G_4} = l_c^{5-4} \rightarrow \frac{G_5}{G_4} = l_c \tag{36}$$

They propose a G_D Gravitational constant of $2,55 * 10^{28}\ \frac{N*m^2}{Kg^2}$ (eq 17 pp 6 in [10]) to explain the abnormal Electromagnetic and Gravitation Coupling found in Niobium Rotating Superconductors of 36 orders of magnitude higher than in Classical Systems.(pp 11 in [10])

We will concentrate ourselves in the fact that a Superconductor can open the way to the Higher Dimensional Spacetime and enlarge the Bulk according to the Dutch Equation.

We know that $\frac{G_5}{G_4} = l_c$ is compatible with our definition for G_5 according to the Dutch Equation.

The G_5 according to the Dutch Equation is

$$G_5 = G_4 * 8 * R \rightarrow \frac{G_5}{G_4} = 8 * R \rightarrow \frac{G_5}{G_4} = l_c \tag{37}$$

R is the radius of the Extra Dimension..note the similarity between R and l_c.Note also that their G_D have the dimensionality of a G_4 but we know that a G_D must have also the dimensionality of l_c or R in our case. But what is more important:Their G_D is larger than G_4 and applying their l_c our case of the Dutch Equation we would have the results of a larger R.Working with a $D = 5$ and a reasonable large R we would have a

$$G_5 = G_4 * 8 * R \rightarrow G_5 = G_4 * l_c \tag{38}$$

They claims that the Spacetime around a Superconductor is not $4D$ to explain the difference of 36 orders of magnitude between Electromagnetic and Gravitational coupling around a Rotating Superconductor.(pp 11 in [10])

The Electromagnetic and Gravitational coupling for Rotating Superconductors can be given by:(pp 3 eq 2 and pp 6 eq 16 without fine structure constants in [10] because we prefer the Gravitomagnetic permeability of vacuum by reasons that we will explain)

$$|k^D| = \frac{\mu_{0g}^D}{\mu_0}\frac{m}{e} \tag{39}$$

in case of $D = 5$

$$|k^5| = \frac{\mu_{0g}^5}{\mu_0}\frac{m}{e} \tag{40}$$

Look that $|k^5| > |k|$ in agreement that Spacetime around a Rotating Superconductor have a Coupling larger that Classical ordinary Spacetime due to a larger size of the Extra Dimension R or lc, and a larger Gravitational Constant $G_5 > G_4$.($G_5 = G_4 * 8 * R \rightarrow G_5 = G_4 * l_c$).

Then we can see how the Dutch Equation can increase the Gravitational Constant in a N-Dimensional Spacetime affecting the Coupling by enlarging R.But exactly what causes the enlargement of the Bulk??What causes the enlargement of R ??

Working now with the Gravitomagnetic permeability of vacuum(pp 3 in [10])

$$\mu_{0g} = \frac{4 * \pi * G}{c^2} \tag{41}$$

$$|k| = \frac{\mu_{0g}}{\mu_0}\frac{m}{e} \dashrightarrow |k| = \frac{\frac{4*\pi*G}{c^2}}{\mu_0}\frac{m}{e} \tag{42}$$

$$|k| = \frac{\mu_{0g}}{\mu_0}\frac{m}{e} \dashrightarrow |k| = \frac{4 * \pi * G}{\mu_0 * c^2}\frac{m}{e} \tag{43}$$

But since $c^2 = \frac{1}{e_0 * \mu_0}$

$$|k| = \frac{\mu_{0g}}{\mu_0}\frac{m}{e} \dashrightarrow |k| = 4\pi G e_0 \frac{m}{e} \tag{44}$$

Then we can say that the Coupling between Electromagnetism and Gravity can be given by:

$$|k| = 4\pi G e_0 \frac{m}{e} \tag{45}$$

$$|k^5| = 4\pi G_5 e_0^5 \frac{m}{e} \dashrightarrow |k^5| = 4\pi G_4 8 R e_0^5 \frac{m}{e} \tag{46}$$

If e_0 and u_0 from e_0 and u_0 to e_0^5 and u_0^5 varies in the Spacetime around a Rotating Superconductor then R varies and G_5 varies too.(If e_0 varies then the Gravitational fine structure constant will vary too).(pp 3,6 in [10]).

$$|k^5| = 4\pi G_4 8 R e_0^5 \frac{m}{e} \dashrightarrow |k^5| = 4\pi G_4 8 (\sqrt{\frac{4\pi G\hbar^2}{\epsilon^2}} \epsilon_0^5 \sqrt{u_0^5}) e_0^5 \frac{m}{e} \tag{47}$$

A large u_5 can make $|k_5| > |k|$ .Then a Physical model of the Dutch Equation able to enlarge the Bulk from the Planck Size to Macroscopical one according to the Rotating Superconductor Model explain the abnormally large Coupling of 10^{36} orders of magnitude implies in a enlargement of e_0 and u_0 according to (pp 11 in [10]).Note also that a very large e_0 and u_0 can make light speed drop by large values or even slow down.([9] after eq 7).

Tajmar and Matos demonstrated the validity and reality of the Dutch Equation.

7 The Tate Effect in Cooper pairs of Rotating Superconductors.

In the previous section we pointed out the importance of the point of view advocated by Martin Tajmar and Clovis Jacinto de Matos[9, 10] that a Superconductor is no longer tied to our $3+1$ Spacetime and extends over Higher Dimensional Space.This can be used to "probe" experimentally BraneWorld considering that the fractal Dimension of Matos-Tajmar is a real integer Extra Dimension for the reasons we explain in the previous section. We present here the correct explanation for the Tate Anomally when measuring the mass of the Cooper Pairs in function of a Extra Dimension enlarged by the Dutch Equation.

Tajmar and Matos defines the Coupling between Eletromagnetics and Gravity using the Gravitational Fine Structure Constant as: (pp 3 eq 2 in [10]).

$$|k| = \frac{a_g}{a} \frac{e}{m} \tag{48}$$

a_g is the Gravitational Fine Structure Constant defined as:

$$a_g = \frac{Gm^2}{\hbar * c} \dashrightarrow a_g = \frac{Gm^2}{\hbar * \sqrt{\frac{1}{e_0 \mu_0}}} \tag{49}$$

and a is the Electromagnetic Fine Structure Constant defined as:

$$a = \frac{1}{4\pi\epsilon_0} \frac{e^2}{\hbar c} \dashrightarrow a = \frac{1}{4\pi\epsilon_0} \frac{e^2}{\hbar * \sqrt{\frac{1}{e_0 \mu_0}}} \tag{50}$$

$$|k| = \frac{a_g}{a} \frac{e}{m} \dashrightarrow \frac{\frac{Gm^2}{\hbar c}}{\frac{1}{4\pi\epsilon_0} \frac{e^2}{\hbar c}} \frac{e}{m} \tag{51}$$

$$|k| = \frac{a_g}{a} \frac{e}{m} \dashrightarrow |k| = \frac{\frac{Gm^2}{\hbar c} \dashrightarrow a_g = \frac{Gm^2}{\hbar \sqrt{\frac{1}{e_0 \mu_0}}}}{\frac{1}{4\pi\epsilon_0} \frac{e^2}{\hbar c} \dashrightarrow a = \frac{1}{4\pi\epsilon_0} \frac{e^2}{\hbar \sqrt{\frac{1}{e_0 \mu_0}}}} \frac{e}{m} \tag{52}$$

Solving the algebraic expressions we arrive at the following results:

$$\frac{a_g}{a} = 4\pi\epsilon_0 G\frac{m^2}{e^2} \tag{53}$$

$$|k| = \frac{a_g}{a}\frac{e}{m} \dashrightarrow |k| = 4\pi\epsilon_0 G\frac{m^2}{e^2}\frac{e}{m} \dashrightarrow |k| = 4\pi\epsilon_0 G\frac{m}{e} \tag{54}$$

In our previous section we defined the $5D$ Coupling as $|k^5| = 4 * \pi * \epsilon_0^5 * G^5 * \frac{m}{e}$ where G^5 was the $5D$ Gravitational Constant and ϵ_0^5 was the enlarged eletric permittivity and we observed that $|k^5| > |k|$ to explain the abnormal large Quantum Coupling. According to Matos and Tajmar a Superconductor is not tied to $3+1$ Spacetime and can "probe" Extra Dimensional space(pp 5 and pp 6 between eqs 15 to 16 in [10]).

We consider here the Tajmar-Matos Fractal Dimension as a Physical Integer Dimension since the dimension mentioned of $D = 3.94$(pp 7 eq 21 in [10]) would mean a fraccionary Dimension(non-integer Dimension) difficult to conceal with the formalism of Einstein General Relativity with integer Dimensions in the Christoffel Symbols etc. But Matos and Tajmar had a excellent idea:the idea that a Superconductor can open the door to Higher Dimensional Spacetime more efficiently that Hadron TeV Colliders.

We know from our previous works that the Eletromagnetic-Gravitational Coupling can be written as

$$|k^5| = 4\pi\epsilon_0^5 G^5\frac{m}{e} \tag{55}$$

with $G_5 = G_4 * 8 * R$ and eq 14 pg 6 of [10] with $D = 5$ and $l_c = 8 * R$

This Enlarged Coupling will affect the Tate Anomally is the result of the fact that the Superconductor do not move in ordinary $3+1$ Spacetime and can access Higher Dimensions(pp 5 and 6 in [10]).This is the most important feature in Matos and Tajmar studies.

Tajmar and Matos says the mass of the Cooper Pair in a Rotation Superconductor is higher than expected due to a "Fractal Dimension".We consider here the Extra Dimension of the Manyfold Universe and we proof that this Dimension can enlarge the mass of the Cooper Pair.Again we want to say that the idea of a Rotating Superconductor accessing Higher Dimensional Spacetime is remarkable and is perhaps the only way to test BraneWorlds in Laboratory.

Writing the Eletromagnetic and Gravitational Coupling in function of the Dutch Equation we should expect for:

$$|k| = 4\pi\epsilon_0 G\frac{m}{e} \dashrightarrow |k| = \frac{a_g}{a}\frac{e}{m} \tag{56}$$

The Dutch Equation is given by:

$$R = \sqrt{\frac{4\pi\epsilon_0^2 G\hbar^2 u_0}{\epsilon^2}} \tag{57}$$

$$R = \sqrt{\frac{4\pi G\hbar^2}{\epsilon^2}}\epsilon_0\sqrt{u_0} \tag{58}$$

$$\frac{a_g}{a} = 4\pi\epsilon_0 G\frac{m^2}{e^2} \tag{59}$$

One can easily see that the Dutch Equation in function of the Coupling is given by:

$$R^2 = \frac{a_g}{a}\frac{\epsilon_0 \hbar^2 u_0}{m^2} \tag{60}$$

Remember that the Coupling raises due to the Higher Dimensional Spacetime[10],then G,ϵ_0 and u_0 raises(lowering the light speed in the vicinity of the Superconductor or even stopping it as in [9] after eq 7).

Coupling raises due to Rotation then Dutch Equation raises the size of the Extra Dimension:this is why we "see" the Higher Dimensional Spacetime for the Rotating Superconductor.

Then:

$$\frac{a_g}{a} = \frac{m^2 R^2}{\epsilon_0 \hbar^2 u_0} \tag{61}$$

Now we can write the Eletromagnetic and Gravitational Coupling in function of the Dutch Equation as follows:

$$|k| = \frac{a_g}{a}\frac{e}{m} \dashrightarrow |k| = \frac{m^2 R^2}{\epsilon_0 \hbar^2 u_0}\frac{e}{m} \dashrightarrow |k| = 4\pi\epsilon_0 G\frac{m}{e} \tag{62}$$

When the Superconductor Rotates its enlarges the size of the Extra Dimension and also enlarges the Coupling:then we can say the Dutch Equation and the Coupling are inter-related phenomena.

The Mass of the Cooper Pair is related to the Coupling and to the Dutch Equation by the following equation(eq 16 pg 6 in [10]).

$$|k| = \frac{a_g}{a}\frac{e}{m} \dashrightarrow |k| = \frac{\Delta_m}{m_{the}}\frac{e}{m} \dashrightarrow |k| = \frac{m^2 R^2}{\epsilon_0 \hbar^2 u_0}\frac{e}{m} \tag{63}$$

$$\Delta_m = m_{exp} - m_{the} \tag{64}$$

Above m_{exp} is the experimental measure of the mass of the Cooper Pair and m_{the} is the theoretical value predicted.We can clearly see that the Rotation of the Superconductor enlarges the Higher Dimensional Spacetime and raises the mass of the Cooper Pair. Then according to Martin Tajmar and Clovis Jacinto de Matos a Superconductor in a Higher Dimensional Spacetime can explain the large Eletromagnetic and Gravitational Coupling and also explain the difference measured by Tate for the mass of the Cooper Pair(pp4 eq 5 in [10]).

$$\frac{\Delta_m}{m_{the}} = \frac{m^2 R^2}{\epsilon_0 \hbar^2 u_0} \tag{65}$$

Above is the relation between the Tate Anomally and the Dutch Equation.

8 Martin Tajmar and Clovis Jacinto de Matos-Abnormal Gravitomagnetic Fields.

This section is almost entirely adapted from (pp 2 and pp 11 in [10]). with the modification from Fractal Spacetime to a Real Spacetime of integer Extra Dimensions:

Tate showed that the Cooper Pairs in Rotating Niobium Superconductor Rings is higher than the one predicted by theory even including the relativistic corrections. In our analysis we used Higher Dimensional Spacetime(instead of Matos and Tajmar Fractal one). But the Gravitomagnetic Field is still much higher than whats Classical General Relativity predicts for the currents of mass involved in the Tate experiment.What is the cause of such Abnormal Gravitomagnetic Fields??

We will still use Higher Dimensional Spacetime to explain this large Gravitomagnetic Field.

The Non-Classical Gravitomagnetic Field is given by(eq 6 pp4 in [10] combined to pp 6 eq 16 in [10]) :

$$B_y = 2w\frac{\Delta_m}{m_{the}} \dashrightarrow B_y = 2w\frac{a_g}{a} \dashrightarrow B_y = 2w\frac{m^2R^2}{\epsilon_0\hbar^2u_0} \tag{66}$$

This Non Classical Gravitomagnetic Field is related to the Abnormal Tate Cooper Pair Mass and the Enlarged Extra Dimension of the Dutch Equation.

9 The Challenge To Create The "Space Drive" - Marc Millis

This section outlines the most direct application of this "spacetime metric engineering" for Macroscopic Shortcuts:Interstellar Travel.

If we want to talk seriously about Interstellar Travel since a shortcut in spacetime means a way to travel to distant parts of the Universe avoiding the speed of light limitations then we must concentrate ourselves on the efforts of NASA scientist Marc Millis.[6]

Actually we know that rockets are not enough for interstellar space travel and Marc Millis proposes the use of "spacetime metric engineering" using electromagnetism to achieve faster than light space travel.[6]

However we also know that "Superluminal" travel in the Brane is impossible thinking on a realistic way:We dont need to mention all the existing "Superluminal" theories because Marc Millis already summarized all of them in [6] but considering for example a Brane Only motion (which means to say motion in ordinary spacetime without shortcuts) that would allow us to cover 326 million light-years in $2,5 * 10^{-10}$ seconds;such a motion would imply in a impossible(and incredible) speed.Even considering the "Superluminal physics" that theoretically allow this speed (not to mention that this physics is often regarded as "exotic" with negative energies etc)we know that Outer Space is not empty and a impact with a wandering asteroid or a Black Hole would destroy the ship(or destroy the "Drive" effect in some of these theories[6]).Even at a "low" speeds of 100.000 light-years in 7 weeks in Brane Only motion for example the impacts with hazardous objects would still deny the trip.Also incoming photons from Cosmic Background Radiation that are scattered everywhere across Outer Space for example would be severely Doppler blueshifted posing a threat to the ship and the crew members.

The Marc Millis purpose to study the so-called "Space Drives" for Interstellar Travel is a remarkable target to be achieved but without breaking the light speed barrier and considering "classical" motion on the Brane Only this target is impossible to be reached due to the time expeditures needed to reach the stars at huge distances from Earth or the "unphysical" behaviours one can get at "Superluminal" speeds on the Brane Only.

Taking the ADDK Model of the Manyfold Universe with gravity using the Bulk Shortcuts of 10^{-35}m size to travel billion light years in seconds as our inspiration we can think about "enlarging" these shortcuts that traps matter and SM fields on the Brane to allow them to enter in a Bulk Shortcut of Macroscopic size to do the same thing that gravity does.Basically we must "enlarge" the "throat" in order to avoid the SM "bottleneck" and allows trips of billion light years.

Of course we dont need "speeds" of 326 million light-years in $2,5 * 10^{-10}$ seconds:at this "speed" a "Space Drive" would cross the entire known Universe in less than an hour but if we can "engineer" a Bulk size of 10^2 m to travel some light-years in a couple of hours this would be more than enough for Marc Millis goal of Interstellar Travel.

The inspiration behind this work on Macroscopic Bulk Shortcuts is not a mathematical abstraction but really is to study the possibility to use them as "Hyper Dimensional Space Drives" that would allow the Marc Millis desired goal of Interstellar SpaceFlight.

10 Conclusion - NASA Breakthrough Propulsion Physics Program(BPP) and the 2005 World Year Of Physics

In 1996 NASA created the Breakthrough Propulsion Physics Program(BPP)[8] to seriously study the scientific possibilities of Interstellar Space Travel.The program was lead by the Aerospace Engineer Marc Millis from John Glenn Space Center at Lewis Field Ohio USA. Marc Millis launched the correct scientific foundations for the so-called "Space Drive":propulsion without propellant,"Superluminal" velocity,capability to engineer motion through spacetime itself,possibility to artificially "engineer" a spacetime ansatz using the "vacuum eletromagnetics" in a way that could resemble Joao Magueijo "vacuum polarization" for variable light speed cosmology according to our model of proposed "Space Drive".Our model have two strong points:the confirmation by NASA Chandra Satellite that Dark Matter exists and the hypothetical Dark particles such as WIMPS Axions etc have never been detected opening the possibility that the ADDK Manyfold Universe correspond to the physical Dark Matter reality and the observed on supernovas fact that light speed is loosing velocity as proposed by Magueijo and others.Our "Space Drive" relies on these two experimental "proved" facts. Unfortunately in January 2003 NASA closed BPP and the explanation given was the lack of physical evidences or physical possibilities for "Superluminal" space travel.

Unfortunately there is at present moment no viable "Superluminal" physics without problems and pathologies of "negative energy" "exotic field" "large amounts of energy needed" "photons highly Doppler blueshifted" "causally disconnected portions of spacetime (aka) Horizons" "WEC NEC SEC energy conditions violations" and many other sad but true features published in the physics peer-review scientific literature and influencing NASA politicians and the final termination of NASA BPP.Unfortunately we cannot condemn or censor NASA politicians.

But perhaps the point of view launched by Nimas-Arkani Hamed,Savas Dimopolous,Gia Dvali,Nemaja Kaloper,Szczepan W. Kowalczyk,Jorn Mossel,German(Zvi) Kalbermann,Hai Halevi,Joao Magueijo,Marc Millis,Martin Tajmar and Clovis Jacinto de Matos can still open a "light in the end of the tunnel".Perhaps if a spacetime ansatz a solution of the Einstein Field Equations of General Relativity can be "engineered" by "vacuum polarization electromagnetics " or other still unknown ways we may still dream on the possibility of Interstellar Space Travel in a far distant future,opening the feasibility for another research program with the pioneer vision and wisdom Marc Millis created for the NASA BPP.

The point of view that Rotating Superconductors can probe the Higher Dimensional nature of spacetime more effective than expensive TeV Colliders deserves further investigation. The point of view that Rotating Superconductors can probe the Higher Dimensional nature of spacetime more effective than expensive TeV Colliders deserves further investigation. The idea of Martin Tajmar and Clovis Jacinto de Matos of European Space Agency is revolutionary and new.It not only can reinforce and give physical meaning and relevance to Higher Dimensional Physics but also can bring the Physics of BraneWorlds from the theoretical and abstract point of view to the Laboratory where at last Brane Models can be tested.

The Year 2005 will be the Year of the Centennary of Einstein Special Theory Of Relativity and unfortunately light speed barrier will remain invincible and unchallengeable:but how for long?.Perhaps a "Macroscopic Spacetime Shortcut in the Manyfold Universe" working as a "Space Drive" may change the whole picture.

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12 Remarks

The work arXiv.org@gr-qc/0408001 was withdrawn from arXiv.org when we contacted the authors about the conflicting nature between Fractal Spacetime with fraccionary dimensions and General Relativity.The Fractal Approach of Spacetime will be replaced by the authors with a more suitable version.But we still keep the original version of arXiv.org@gr-qc/0408001 for References and Bibliographic Purposes because the Tajmar-Matos point of view is a landmark between Material Sciencies and Physics of Extra Dimensions.

References

[1] *Nima Arkani-Hamed,Savas Dimopoulos, Gia Dvali Nemanja Kaloper; arXiv.org@hep-ph/9911386 The Manyfold Universe JHEP(12)-2000-010.*

[2] *Roland Pease ;28 June 2001 Nature 411, 986 - 988 (2001).*

[3] *German Kalbermann;Communication through an extra dimension arXiv.org@gr-qc/9910063 Int.J.Mod.Phys. A15 (2000) 3197-3206.*

[4] *for the solutions of the Einstein Field Equations see the GrTensorII for Maple IX outputs for one Bulk dimensions and 3 Bulk dimensons depicted at http://www.geocities.com/loupwarp http://www.geocities.com/loupdrive and http://www.geocities.com/loupspeed . Also see the mentions to Dark Matter findings by NASA Chandra Satellite.*

[5] *Stefan Kowalczyk,Quinten Krijger,Maarten Van Der Ment,Jorn Mossel,Gerben Schooneveldt,Bart Verdoen;Constraints on Large Extra Dimensions;Department of Physics;University of Amsterdam.*

[6] *Millis, M. "Challenge to Create the Space Drive," In Journal of Propulsion and Power (AIAA), Vol. 13, No. 5, pp. 577-682, (Sept.-Oct. 1997).*

[7] *Joao Magueijo;New varying speed of light theories,arXiv.org@astro-ph/0305457,Rept.Prog.Phys. 66 (2003) 2025 .*

[8] *NASA Breakthrough Propulsion Physics Program - BPP; http://www.grc.nasa.gov/WWW/bpp/.*

[9] *Martin Tajmar,Clovis Jacinto de Matos.Extended Analysis of Gravitomagnetic Fields in Rotating Superconductors and Superfluids.arXiv.org@gr-qc/0406006 .*

[10] *Martin Tajmar,Clovis Jacinto de Matos.Gravitomagnetic Fields in Rotating Superconductors due to Fractal Space-Time. arXiv.org@gr-ac/0408001 .*

[11] *NASA Chandra Satellite Final Report. http://chandra.harvard.edu/resources/faq/dmatter/dmatter-9-html*

[12] *for the Dutch Equation see the Homepage of Jorn Mossel one of the Authors from University of Amsterdam.Holland. http://student.science.uva.nl/ jmossel/ .*

[13] *for the Dutch Equation see the Homepage of Szczepan W. Kowalczyk one of the Authors from University of Amsterdam.Holland. http://student.science.uva.nl/ skowalcz/ .*

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