THE FUNDAMENTAL CAUSE OF GRAVITY AND THE SIGNIFICANCE OF THE GRAVITATIONAL RADIUS.

Peter G.Bass.

ABSTRACT.

The development of the Relativistic Domain theory of gravitation, is completed in this paper with the presentation of two simple hypotheses, which together are shown to be its fundamental cause. The results enable the derivation of all theoretical relationships within the theory, and also enable speculative comment on the nature of the Dark Matter of astrophysics.

1 Introduction.

In the four previous papers on this subject, in Relativistic Domain theory, gravitation was purported to be due to a field of spatial expansion emanating from the gravitational source. The primary relationship from which this proposition was formulated, was that the second order rate of volumetric spatial expansion, was proportional to the product of Newton's gravitational constant, and the mass of the gravitational source, [2]. This enabled derivation of the spatial expansion radial velocities, as well as the associated velocities in the temporal dimension. The field of gravitational spatial acceleration, the Acceleration Potential, was determined via a comparison of the time derivative of the above spatial radial expansion velocity, with Newton's classical equation of gravity, [1].

The results of these exercises, enabled the complete derivation of the gravitational phenomenon, including such dynamic effects as the rotation of the perihelion of the orbit of Mercury around the Sun, and the bending of light rays as they pass close to a gravitational source, [1]. They also enabled extension of the concept into the field of cosmology, to enable the development of a new theory for the origin and existence of the Universe, [4].

However, the above primary relationship was based only upon a dimensional analysis of the two parameters involved, and gave no indication of the fundamental cause behind it. For any theory to enjoy full scientific credibility, it is necessary to at least be based upon sound theoretical hypotheses, from which the complete theory, and all its ramifications, can be derived.

It is the purpose of this paper to provide such hypotheses for the Relativistic Domain theory of gravitation, and to then show how these lead to the development of the main theoretical relationships.

It is essential that in order to fully appreciate the contents of this paper, references [1], [2] and [5] be read and thoroughly understood first.

2 The Fundamental Cause of Gravity.

2.1 Preamble.

In [2], the primary relationship central to the development of the Relativistic Domain theory of gravitation, viz [2], Eq.(3.11), must be derivable from the hypotheses that describe its fundamental cause. This primary relationship is repeated here for convenience.

$$\frac{d^2W}{d\tau^2} = k_0\gamma M_g \tag{2.1}$$

Where

W is the volume of spatial expansion emanating from the source.

τ is gravitational time.

k_0 is, external to the source, a constant of proportionality determined in [2] to

be equal to 12π.

γ is Newton's constant of proportionality.

M_g is the mass of the gravitational source.

For the region inside the source, the parameter k_0 was in [2] shown to be a function of σ_i, $f(\sigma_i)$, given by

$$f(\sigma_i) = 12\pi\frac{\sigma_i}{\sigma_g}\left(2 - \frac{\sigma_i^2}{\sigma_g^2}\right) \tag{2.2}$$

Where

σ_i is the radial distance inside the source, of the point of measurement from its centre.

σ_g is the radius of the gravitational source.

One further parameter that must be theoretically derivable, and whose physical significance must be demonstrated, is the so called gravitational radius of the source, viz [1], Eq.(4.6), thus

$$\alpha = \frac{\gamma M_g}{c^2} \tag{2.3}$$

This parameter was simply stated in [1] without reference as to its origin.
Finally, in [1], the parameter σ, (external to the source), was shown to be given by

$$\sigma = r + \alpha \tag{2.4}$$

Where

r is the Pseudo-Euclidean distance from the centre of the source to the point of measurement.

A similar expression exists in the interior of the source. The origin and physical significance of this relationship must also be demonstrated.
From the fundamental hypotheses to be presented here, it will be possible to derive all the above relationships in general terms from which those specific to the Solar System et al, can be obtained by insertion of the appropriate values.

The two hypotheses to be invoked are stated as follows

1. Pseudo-Euclidean Space-Time, D_0, is subject to a law of conservation.
2. The existence of a matter density within the spatial - temporal domain of Pseudo - Euclidean Space - Time, causes a retardation in temporal velocity.

The manner in which these two hypotheses combine to result in gravitation is the subject of the next two Sub-Sections.

2.2 The Conservation of Space and Special Relativistic Effects.

2.2.1 The Conservation of Space.

The first consideration is the Conservation of Space. It is this hypothesis which leads to an understanding of the significance of the parameter α, the gravitational radius, and also the parameter σ.
In the concluding remarks in [3], it was effectively stated that space is subject to a law of conservation in the same manner as energy and momentum. This means that space can neither be created nor destroyed.
Thus consider the radius vector of a spherical volume of Pseudo-Euclidean space, simplistically represented in Fig. 2.1 below.

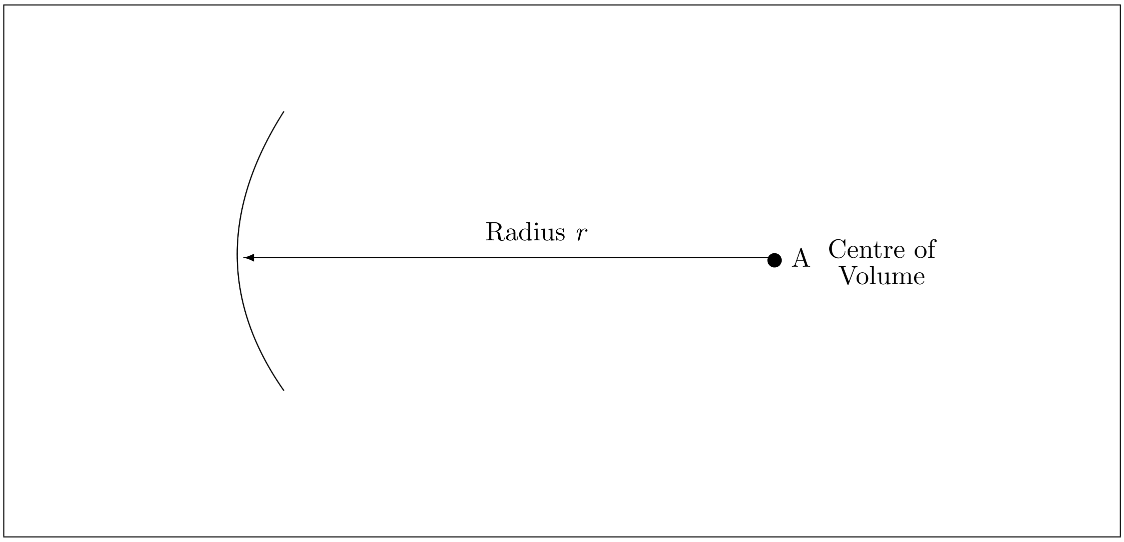

Fig. 2.1 - Empty Space.

If now a gravitational mass is placed in the same location with its centre at A, because of the proposed conservation of space, the true space now occupied by the mass cannot be destroyed or "absorbed" by it, and must therefore be displaced. The result is depicted in Fig. 2.2 below.

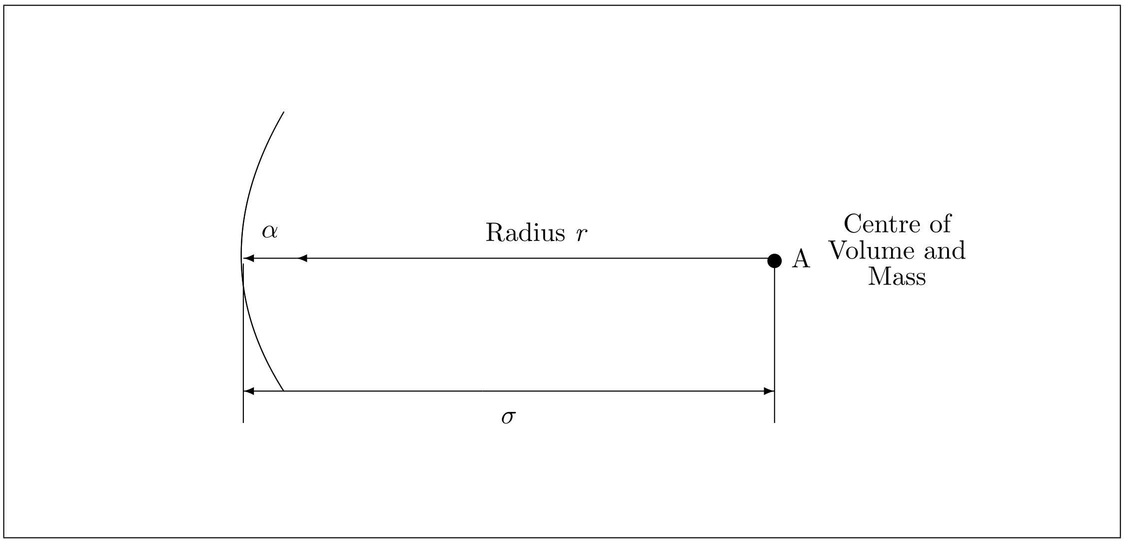

Fig. 2.2 - Occupied Space.

The parameter α in the above Figure is the radius vector of the space displaced from Fig. 2.1 by the presence of the mass. The space displaced is normally much smaller than the overall volume occupied by the mass because the displacement would occur at the atomic level. Matter, being composed of atoms held together in their molecular structures via their valence bonds, is itself largely comprised of empty space. It is the space occupied by the elementary atomic particles, electrons and those of the constituents of the nucleons, that is displaced throughout the body of the mass. The overall result is the parameter α, its radius vector, and it is proposed that this is the so called gravitational radius. The combination of r and α, as shown in Fig. 2.2, was designated σ in [1]. The parameter σ, and therefore α, enters into the promulgation of the radial spatial expansion velocity of the source as shown in the following Sub-Section.
A further significance of the gravitational radius is presented in Appendix B.

2.2.2 **Special Relativistic Effects.**

When a mass is in motion in Pseudo-Euclidean Space-Time, the Special Theory of Relativity has shown that its length in the direction of motion is foreshortened by the temporal rate specific to the velocity. This foreshortened length is rotated into the temporal dimension so that its Existence Velocity Vector passes through the same points on both the actual and foreshortened lengths. This ensures simultaneity of existence in both frames of reference, (see [5]).

In the gravitational case, while any real physical motion of the source produces a relativistic reaction as described above, its radial spatial expansion velocity effectively represents a motion of the source relative to space, and thereby produces a similar relativistic reaction. The associated reduced temporal rate, (u), causes all radius vectors of the mass to become foreshortened to their relativistic lengths. In order that the Existence Velocity vectors of all points on the actual and foreshortened radials experience temporal simultaneity, the foreshortened radials are rotated into the temporal dimension as shown in the following Fig. 2.3, updated from Fig. 2.2.

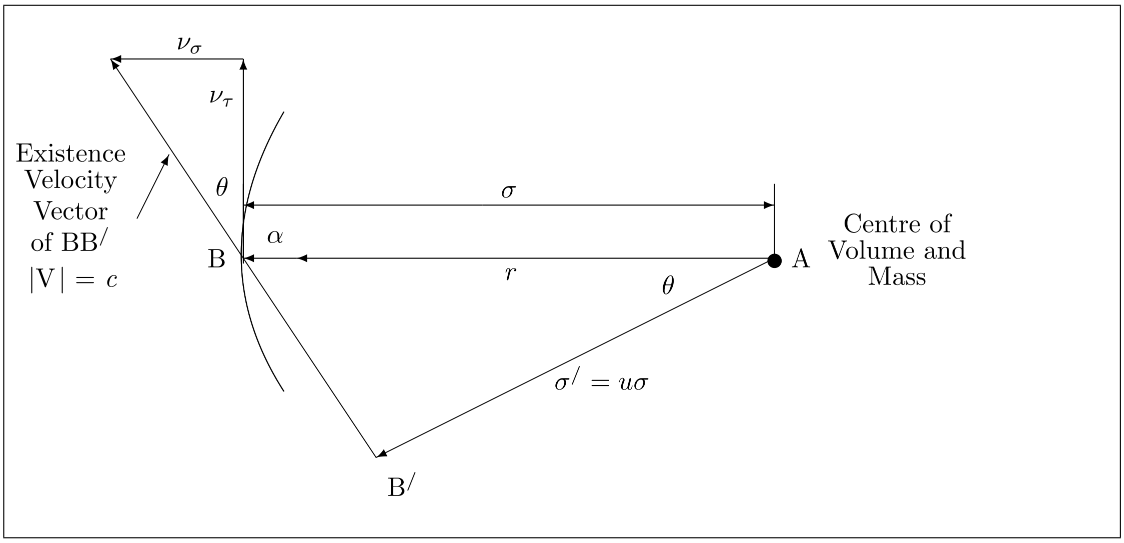

Fig. 2.3 - Promulgation of ν_σ and ν_τ.

Fig. 2.3 represents the situation at the surface of the source. In Fig. 2.3 the new parameters are

u is the gravitational temporal rate at B.

$\sigma^/$ is the relativistic length of the radial σ, rotated into the temporal dimension.

ν_σ is the radial expansion velocity at the point B, $= \left.\frac{d\sigma}{d\tau}\right|_{\sigma=\sigma_g}$

ν_τ is the corresponding temporal velocity at the point B.

The Existence Velocity Vector, V, then, as shown in Fig. 2.3 passes through both points B and B$^/$ on the real and relativistic radial vector lengths σ and $\sigma^/$.
From the Figure it is clear that

$$\left(\nu_\sigma^2 + \nu_\tau^2\right)^{1/2} = |\mathrm{V}| = c \tag{2.5}$$

and

$$\frac{\sigma^/}{\sigma} = \cos\theta = u \tag{2.6}$$

so that

$$\nu_\tau = c\cos\theta = cu \tag{2.7}$$

and

$$\nu_\sigma = c\sin\theta = c\left(1 - u^2\right)^{1/2} \tag{2.8}$$

These are the components of the Existence Velocity Vector in the spatial, ν_σ, and the temporal, ν_τ, dimensions at the surface of the source. The Acceleration Potential is then simply, as shown in [1], the time differential of ν_σ, viz.

$$\left.\frac{d^2\sigma}{d\tau^2}\right|_{\sigma=\sigma_g} = \left.\frac{d\nu_\sigma}{d\tau}\right|_{\sigma=\sigma_g} = \nu_\sigma \left.\frac{d\nu_\sigma}{d\sigma}\right|_{\sigma=\sigma_g} = -c^2 u_g \left.\frac{du_g}{d\sigma}\right|_{\sigma=\sigma_g} \tag{2.9}$$

A similar scenario and promulgation analysis applies internal to the source.
The manner in which ν_σ and ν_τ are generated is the subject of the next Section.

2.3 The Retardation of Temporal Velocity.

This hypothesis is best demonstrated by considering the temporal velocity within a gravitational source at some intermediate point σ_i, as developed in [2], viz., [2], Eq.(3.31)

$$\nu_{i\tau} = cu_i = c\left(1 - \frac{3\alpha}{\sigma_g} + \frac{\alpha\sigma_i}{\sigma_g^3}\right)^{1/2} \tag{2.10}$$

The degree of velocity retardation inherent in (2.10) is then obtained by simply subtracting (2.10) from the temporal velocity extant within Pseudo-Euclidean Space-Time, i.e. in the absence of the source, thus

$$\Delta\nu_{i\tau} = c\left\{1 - \left(1 - \frac{3\alpha}{\sigma_g} + \frac{\alpha\sigma_i}{\sigma_g^3}\right)^{1/2}\right\} \tag{2.11}$$

Expanding the square root binomially gives

$$\Delta\nu_{i\tau} = \frac{3\alpha c}{2\sigma_g}\left(1 - \frac{\sigma_i^2}{3\sigma_g^2}\right)\left[1 + \frac{3\alpha}{4\sigma_g}\left(1 - \frac{\sigma_i^2}{\sigma_g^2}\right) + \frac{9\alpha^2}{8\sigma_g^2}\left(1 - \frac{\sigma_i^2}{\sigma_g^2}\right)^2 - \cdots\right] \tag{2.12}$$

Now substituting for α in the main term gives

$$\Delta\nu_{i\tau} = \frac{3\gamma M_g}{2c\sigma_g}\left(1 - \frac{\sigma_i^2}{3\sigma_g^2}\right)\left[1 + \frac{3\alpha}{4\sigma_g}\left(1 - \frac{\sigma_i^2}{\sigma_g^2}\right) + \frac{9\alpha^2}{8\sigma_g^2}\left(1 - \frac{\sigma_i^2}{\sigma_g^2}\right)^2 - \cdots\right] \tag{2.13}$$

Finally, substituting for M_g then gives

$$\Delta\nu_{i\tau} = \frac{\gamma A_g\rho_g}{2c}\left(1 - \frac{\sigma_i^2}{3\sigma_g^2}\right)\left[1 + \frac{3\alpha}{4\sigma_g}\left(1 - \frac{\sigma_i^2}{\sigma_g^2}\right) + \frac{9\alpha^2}{8\sigma_g^2}\left(1 - \frac{\sigma_i^2}{\sigma_g^2}\right)^2 - \cdots\right] \tag{2.14}$$

Where

A_g is the surface area of the source

ρ_g is the average volumetric density of the source.

Eq.(2.14) shows that temporal velocity retardation is proportional to the average density of the gravitational source. The product of the average volumetric density with the surface area produces a "linear matter density" which, it is proposed, exemplifies the manner in which matter energy projects into the one dimensional temporal domain from the three dimensional spatial. The product of this linear matter density with the constant term $\gamma/2c$ thereby produces the temporal velocity retardation of (2.14) and as inherent in (2.10).

The terms inside the square brackets in (2.14) are the remnants of the binomial expansion and represent a relativistic level power series modifier that, for normal gravitational sources is vanishingly small. However, for extremely dense sources in which α and σ_g are of the same order of magnitude, this series becomes significant. For instance, at the very centre of a source, i.e. with $\sigma_i = 0$, (2.14) becomes

$$\Delta\nu_{i\tau} = \frac{3\alpha c}{2\sigma_g}\left[1 + \frac{3\alpha}{4\sigma_g} + \frac{9\alpha^2}{8\sigma_g^2} - \cdots\right] \tag{2.15}$$

and now when $\sigma_g = 3\alpha$, this power series sums to the value of 2 and (2.15) becomes

$$\Delta\nu_{i\tau} = c \tag{2.16}$$

This is also evident from (2.11).
The relationship of (2.15) may be considered somewhat artificial as a fundamental concept for gravitation because of the presence of the power series. However, it is no different from many other fundamental relativistic relationships. For instance, consider the kinetic energy of relativistic rectilinear motion. This is given by [5], Eq.(3.19) as

$$E_k = mc^2 - m_0c^2 \tag{2.17}$$

Insertion of the expression for relativistic mass from [5], Eq(3.6), and binomially expanding the result gives

$$E_k = \frac{m_0v^2}{2}\left(1 + \frac{3v^2}{4c^2} + \frac{5v^4}{8c^4} + \cdots\right) \tag{2.18}$$

as the relativistically adjusted kinetic energy attained by the mass under the motion, and which clearly exhibits a similar relativistic level power series modifier to that in (2.15), again the remnants of the expansion process.

The next point concerns the Criterion of Existence in D_0, a criterion which is also considered to exist as a result of the hypothesis concerning the Conservation of Space. The reduced temporal velocity of (2.10) within the source, means that its Existence Velocity no longer conforms to this Criterion as stated by [5], Eq.(2.4) viz.

$$|\mathrm{V}| = V = c \tag{2.19}$$

where

V is the Existence Velocity vector of the gravitational source in D_0.

As a consequence, in order to maintain conformance to this criterion, the spatial expansion velocity at the centre of the source results. Thus from (2.10) and (2.17)

$$\nu_{i\sigma}\big|_{\sigma_i=0} = c\left(1 - u_i^2\right)^{1/2}\Big|_{\sigma_i=0} = c\left(\frac{3\alpha}{\sigma_g}\right)^{1/2} \tag{2.20}$$

The resulting spherical spatial wavefront then proceeds outwards from the centre with a linear spatial expansion velocity to complement (2.10) thus

$$\nu_{i\sigma} = c\left(1 - u_i^2\right)^{1/2} = c\left(\frac{3\alpha}{\sigma_g} - \frac{\alpha\sigma_i^2}{\sigma_g^3}\right)^{1/2} \tag{2.21}$$

This was also developed in [2].
Clearly, when $\sigma_i = \sigma_g$, at the surface of the source, (2.21) becomes

$$\nu_{\sigma}\big|_{\sigma_i=\sigma_g} = c\left(1 - u_g\right)^{1/2} = c\left(\frac{2\alpha}{\sigma_g}\right)^{1/2} \tag{2.22}$$

so that external to the source, at some distance σ from its centre

$$\nu_{\sigma} = c\left(1 - u^2\right)^{1/2} = c\left(\frac{2\alpha}{\sigma}\right)^{1/2} \tag{2.23}$$

The time differentials of (2.21) and (2.23) then result in the Acceleration Potential Fields of gravitation internal and external to the source. These relationships and those of (2.20) to (2.23) have all been previously derived in [1] and [2] together with their associated temporal velocities.

The results of this and the preceding Section now permit the derivation of (2.1) and (2.2) from the two hypotheses proposed herein. These are purely mathematical exercises and have therefore been relegated to the Appendices.

3 Gravitational Variations.

There are three ways in which the generation of gravitation can vary. The first two are very simple and well established in current theory. The third is not so, but may be related to concepts extant, but not fully developed, in current theoretical physics. They are presented below in relation to Fig. 2.3.

(i) In Fig. 2.3, if σ_g is varied with a corresponding proportional change in r and α, this represents a variation in the mass of the gravitational source. The result is of course a corresponding change in gravitational strength.

(ii) If σ_g is varied by varying r while maintaining α constant, this represents a change in the average density of the gravitational source. This also results in a change in gravitational strength.

(iii) If σ_g is varied by varying α while maintaining r constant, this represents a change in density via a change in the matter constituency of the gravitational source, such that it will be different from normal matter within the Solar System, and as apparent throughout the Universe. A corresponding change in gravitational strength results. Such matter has not been encountered upon the Earth, but one example could be the Dark Matter of Astrophysics. This is discussed in more detail in Appendix C.

4 Conclusions.

The hypothesis of the Conservation of Space, as proposed in this paper, has only a very small effect in the actual generation of gravity, or its generated magnitude, by normal source matter. However, if this hypothesis did not exist, then neither would gravitation. This is because firstly, the gravitational radius, α, would not exist but, more importantly, the primary criterion of existence in D_0 would not exist. Consequently, the retardation of temporal velocity would not result in the generation of the source's spatial expansion velocity, so that its time derivative, the gravitation Acceleration Potential, similarly would not exist. The only result of temporal velocity retardation would then be the time dilatation effect.

Thus the law of the Conservation of Space is of fundamental importance in the generation of gravity and while it does not contribute greatly to its magnitude, it provides the mechanism by which the process of generation is facilitated.

The hypothesis concerning the retardation of temporal velocity by the presence of a matter density in the temporal dimension, also as proposed in this paper, is the primary means creating the magnitude of the gravity field generated via the mechanism as discussed above. It is similarly responsible for the time dilatation effect, also as stated above. The retardation of temporal velocity is similar to the retardation of the velocity of light in a non-vacuous medium in the spatial dimension.

In [2], as a result of the discussion on the generation of gravitation, it was concluded that the retardation of temporal velocity was unlikely to be the cause, and it was the existence of a radial spatial expansion velocity, without reference as to its origin, that was subsequently shown to be the source.

The results of this paper have partially refuted this argument, in that it is the matter density retardation of temporal velocity which, via the primary criterion of existence in D_0, as facilitated by the Conservation of Space, itself causes the existence of the spatial expansion velocity, by displacing the retarded component of temporal velocity into the spatial dimension. Promulgation of this spatial expansion outwards from the centre of the source is then augmented by the special relativistic effects shown, plus the constraint of spatial volumetric acceleration as demonstrated in [2] and confirmed here.

Thus the overall result is that the entire theory of Relativistic Domain gravitation is based upon just these two hypotheses, the mechanism provided by the law of the Conservation of Space-Time, and the magnitude generated via the retardation of temporal velocity within a matter density. From just these two hypotheses, in conjunction with the primary criterion of existence in D_0, all relationships which characterise the theory can be derived. In turn, from these all the dynamic effects of gravitation, i.e. on other bodies, can also be obtained, as has been demonstrated in [1], [2], [3] and cosmologically in [4] and [6].

However, having made the above statements, there is one important caveat that must be noted. In the theory as expressed internal to a gravitational source, the density used was its average density. This can of course only give "average" expressions for the generation of gravity inside the source. This is because its density will vary with radial distance from its centre. The distribution is minimal at the surface increasing to a maximum at the centre, but will contain discontinuities according to the layering of constituents. In planets, this layering will be the only source of density distribution non-linearity, which may otherwise be reasonable stable apart from thermionic disturbances. However, the layering distribution will vary widely from planet to planet and depend upon the type of constituents present. A general mathematical model for the distribution of density in planets is therefore unavailable.
In stars, a distinct mathematical model for this parameter is also unavailable because, in addition to this layering of constituents, they will also be subject to a slow but continuous variation as the internal nuclear fusion process continues. Consequently, the distribution of density will also be subject to continuous variation which will in turn result in continuous variation of the internal gravity field. The only exceptions will be such objects as white dwarfs and neutron stars in which the fusion process has ceased and their matter constituents become degenerate. Consequently, their density distribution will be largely stable and uniform. However, a precise mathematical model, even in this case, does not appear to have been determined.

This paper concludes the development of Relativistic Domain gravitational theory. Any further developments/amendments will be effected by up issues to [1], [2], [3] or this paper.

APPENDIX A.

Derivation of the Second Order Volumetric

Rate of Spatial Expansion.

This Appendix presents the derivation of (2.1), and is effectively a reversal of that in [2]. Therefore it is included here only for completeness of presentation.

The second order rate of volumetric expansion from a gravitational source is, from [2] Eq.(3.13), external to the source given by

$$\frac{d^2W}{d\tau^2} = 4\pi\sigma^2\frac{d^2\sigma}{d\tau^2} + 8\pi\sigma\left(\frac{d\sigma}{d\tau}\right)^2 \tag{A.1}$$

From (2.8) and (2.9) this becomes

$$\frac{d^2W}{d\tau^2} = 4\pi c^2\left\{2\sigma\left(1-u^2\right) - \sigma^2 u\frac{du}{d\sigma}\right\} \tag{A.2}$$

The parameter u, the gravitational temporal rate, is given by [1], Eq.(4.7), and also from (2.23) as

$$u = \left(1 - \frac{2\alpha}{\sigma}\right)^{1/2} \tag{A.3}$$

Substituting this, and its first derivative with respect to σ into (A.2), finally gives

$$\frac{d^2W}{d\tau^2} = 12\pi\gamma M_g \tag{A.4}$$

as derived in [2].
A similar analysis carried out inside the source produces the result

$$\frac{d^2W_i}{d\tau_i^2} = 12\pi\gamma M_g\left(2 - \frac{\sigma_i^2}{\sigma_g^2}\right) \tag{A.5}$$

also as derived in [2].

APPENDIX B.

Derivation of the Gravitational Radius.

This is the derivation of α in (2.3).

Writing (A.4) as

$$\frac{d}{d\tau}\left(\frac{dW}{d\tau}\right) = 12\pi\gamma M_g \tag{B.1}$$

and again as

$$\frac{d}{d\sigma}\left(\frac{dW}{d\tau}\right)\frac{d\sigma}{d\tau} = 12\pi\gamma M_g \tag{B.2}$$

First substitute from (2.23) to give

$$\frac{12\pi\gamma M_g}{c\left(1-u^2\right)^{1/2}} = \frac{d}{d\sigma}\left(\frac{dW}{d\tau}\right) \tag{B.3}$$

and then from (A.3) yielding

$$\frac{12\pi\gamma M_g}{c}\left(\frac{\sigma}{2\alpha}\right)^{1/2} = \frac{d}{d\sigma}\left(\frac{dW}{d\tau}\right) \tag{B.4}$$

Integrating yields

$$\frac{8\pi\gamma M_g}{c}\frac{\sigma^{3/2}}{(2\alpha)^{1/2}} = \frac{dW}{d\tau} = 4\pi\sigma^2\frac{d\sigma}{d\tau} \tag{B.5}$$

This reduces to

$$\frac{\gamma M_g}{c} = \frac{c}{2}\left\{\,2\alpha\sigma\left(1-u^2\right)\,\right\}^{1/2} \tag{B.6}$$

Substituting again from (A.3), this finally reduces to

$$\alpha = \frac{\gamma M_g}{c^2} \tag{B.7}$$

The desired result.

Note that in view of the Conservation of Space as proposed earlier, the mass of the gravitational source could be expressed as

$$M_g = \frac{4}{3}\pi\rho_m\alpha^3 \tag{B.8}$$

where

ρ_m is the apparent average density of the source if its radius were α.

Because the gravitational radius α, is the radius of the true volume of space occupied by the source, ρ_m must be the maximum average density a mass could theoretically exhibit. Consequently, equating (B.8) to the mass of the source as expressed using its actual radius and average density, viz

$$M_g = \frac{4}{3}\pi\rho_m\alpha^3 = \frac{4}{3}\pi\rho_g\sigma_g^3 \tag{B.9}$$

gives

$$\rho_m = \rho_g\frac{\sigma_g^3}{\alpha^3} \tag{B.10}$$

Alternatively, expressing ρ_m as a function of mass, (by substituting for σ_g^3 *and* α^3)

$$\rho_m = \frac{3c^6}{4\pi\gamma^3 M_g^2} \tag{B.11}$$

However, it was shown in [5] that under gravitational contraction in the absence of opposing forces, when the radius of the source reaches 3α, its gravitational field reverses and becomes repulsive. Gravitational contraction thereby slows and eventually halts when the radius reaches 2α, (as shown in [5]). Consequently, the maximum average density that can actually be exhibited by a large gravitational source occurs at this radius and is

$$\rho_m = \frac{3c^6}{32\pi\gamma^3 M_g^2} \tag{B.12}$$

obtained by replacing α^3 by $(2\alpha)^3$ in (B.10).

As an example of the application of (B.12), consider the home Universe for which M_g was calculated in [6] to be 1.65E55 gms. Insertion of this figure into (B.12) gives a value of ρ_m of 2.64E-28gms/cm^3. This compares very favourably with the figure of 2.71E-28 gms/cm^3 calculated in [6] from other considerations.
This result supports the proposal of the law of Conservation of Space from which (B.12) was derived above.

APPENDIX C.

Dark Matter.

In Section 3.0 it was stated that a variation of α while maintaining r constant represented a change in the average density of the source via a variation in its matter constituents, and that this could exemplify the nature of Dark Matter. The existence of such matter has been proposed because of an apparent anomaly in the rate of orbital rotation of some stars in the outer regions of some galaxies.
The nature of Dark Matter, if it exists, can only be speculated upon. It has been so termed because if its atomic makeup was devoid of electrons, this would purportedly not permit the absorption or emittance of radiant energy. However, if so, it would then have to reflect incident radiant energy and therefore be visible by reflection. With Dark Matter this is not evident from astronomical observation, and so, therefore, any incident radiant energy must indeed be absorbed. It would therefore be expected that the atomic constituents of this matter would be of a Fermionic nature, such as exclusively neutrons, and the subsequent emission of radiation would be with a spectral signature totally unique and at very low frequencies. It could therefore be a source of the microwave background of space.
With the specific nucleonic makeup as suggested above, it is likely that Dark Matter would be extremely dense and therefore exhibit very strong gravitational fields, much like purported neutron stars, and such matter could be the remnants of such bodies. Consequently, it would not possess an electric charge and would, apart from its strong gravitational field, be completely inert in the presence of normal matter, and the electrostatic and magnetic fields that the latter produces.

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