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The Anti-Gravitational Force (F): The Previously Ignored Gravitational Partner

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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Short Communication

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ABSTRACT

Results are presented from an exponential-stress model, which involves an exponential growth of dark matter and an exponential decay of ordinary matter under stress-free conditions. They reveal a previously ignored force, which has been called the anti-gravitational force. The anti-gravitational force (F) is a uniform force which opposes the Newtonian gravitational force that decreases outwards to zero from a singularity at the centre of the universe. The anti-gravitational force is the sum of the outward force ($M_w\ d^2R/dt_o^2$) where t_o is the absolute time at the centre of the universe, due to the dark matter (M_w) left over following formation of ordinary matter (M_P), and the inward force ($M_P\ d^2R/dt_o^2$) due to the ordinary matter. F is shown to be related to the universal gravitational constant (G) by the formula, $F = m_o.c^2\ (1 - \alpha^2)$ where $m_o = c^2/G$, c is the velocity of light, and $\alpha = M_P/M_w$.

In the present mature universe, observations indicate that $\alpha = 0.235$, from which the anti-gravitational force, $F = 1.14\ 10^{44}$ N. At a radius, R, the net outward force is, $F\ (1 - (R_1 / R)^2))$, which is positive for $R/R_1 > 1$ and negative for $R/R_1 < 1$ where R_1 is the radius of the universe, which observations show is $0.90\ 10^{26}$ m.

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In the early universe, the exponential-stress model predicts that an inner universe is first formed, bounded by the radius at which the azimuthal velocity attains the velocity of light. Planetary observations show that this radius is $1.25\ 10^{16}$ m and that it is attained in the remarkably short period of 0.91 yr. The inner universe, of which we are a part, has the paramount property that F (0) = 0, i.e. the initial net stress force is zero. This has enabled evolution to persist in the inner universe to this day.

Keywords: Anti-gravitational force; exponential-stress model; expansion rate of the universe; the generalized law of gravity.

1. INTRODUCTION

In a series of papers of which four are highlighted in the Reference List, it was found that the application of reasoning based on fluid dynamics, which is not usually highlighted in theories of the universe, see for example [1], provides a surprising insight into the ineffable which surrounds us in the universe. The linking concept is stress, and the analytical results are readily obtained by standard techniques, which allow the predictions to be compared with observations. A major feature is the presentation of the generalized law of gravity in Section 5, which incorporates the anti-gravitational Force (F) into Newton's original theory of gravitation.

This is the background to the study which extends to the structure of the universe, and incorporates the results of two previous models which predict the dark matter mass (M) in the universe. In the first model [2], M was obtained for a universe, which was called the 'Inner Universe' which is bounded by a radius (R_D) at which the azimuthal velocity attains the velocity of light (c) Here the analysis leads to the expression, $M = M_D$ where,

$$M_D = m_o R_D \tag{1}$$

in which $m_o = c^2/G$ where G is the universal gravitational constant. On evaluating (1) for $m_o = 1.35\ 10^{27}$ ($c = 3\ 10^8$ m s^{-1}, $G = 6.674\ 10^{-11}$ kg^{-1} m^3 s^{-2}) and $R_D = 1.25\ 10^{16}$ m which was obtained from planetary data in [2], $M_D = 1.7\ 10^{43}$ kg.

In the second model [3],

$$M(t_o) = M_w(t_o) + M_P(t_o) \tag{2}$$

in which $M_w(t_o)$ is the remaining dark matter after the formation of the ordinary matter, $M_P(t_o)$. On assuming that the expansion rates for dark matter and for ordinary matter are $K(t_o) = K_o \exp(\lambda t_o)$ and $K_o \exp(-\lambda t_o)$, indicating respectively exponential growth and decay from an initial expansion rate, $K_o \equiv K(0)$, and integrating the expansion relation,

$$dR/dt_R = K(t_o) \tag{3}$$

in which t_R is the local time at R, assuming that $M_w(0) = M_P(0) = 0$, it was found in [3] that,

$$M(t_o) = m_o R_1 (1 + \alpha) \tag{4}$$

where $\alpha = K_o/c$ and $R_1 = c/\lambda$ is the radius at which the growing expansion rate, $K_o \exp(\lambda t_o)$, equals the velocity of light (c), which is the radius of the universe. On substituting for λ in R_1 we obtain for $t_o = T$, where T is the age of the universe [3],

$$R_1 = c\,T/\ln 1/\alpha \tag{5}$$

and hence, on substituting for R_1 in (4),

$$M = m_o\, c\, T (1 + \alpha) / \ln (1/\alpha) \tag{6}$$

which is the dark matter mass of the universe. On evaluating (6) for the present universe in which observations indicate that $M = 1.5\ 10^{53}$ kg and $T = 13.8\ 10^9$ yr, we obtain $\alpha = 0.235$ [5], and on evaluating (5) $R_1 = 0.90\ 10^{26}$ m.

2. THE PROPERTIES OF THE INNER UNIVERSE

On equating the mass of the inner universe, M_D in (1) with the mass of the universe, M in (6), we have,

$$R_D = c\, T_D \ln (1/\alpha)\, (1 + \alpha) \tag{7}$$

where T_D is the age of the inner universe, from which for $\alpha = 0.235$ and $R_D = 1.25\ 10^{16}$ m, $T_D = 0.91$ yr. Hence it is predicted that the inner universe formed at a very early stage of the universe. This conclusion has many interesting consequences.

In [3] it was noted that $M_P(t_o) / M_w(t_o) = 1$, as $t_o/T \rightarrow 0$, which was interpreted as indicating an

exact wave-particle duality, however it also apparently indicates that the dark matter and ordinary matter masses are equal, which is clearly not supported by data. We need to seek another explanation. This is found in Newton's Third law of action and reaction [4], which is obeyed in the original example of the rectangular basin, in which the fluid circulation exerts a force on the bottom of the basin, which in the absence of a pressure force due to the end walls of the basin would be opposed by an equal and opposite bottom force on the fluid [5] which has inspired this study. We suggest that in the cosmos a similar reactive force can be exerted on the universe as soon as the dark matter creates ordinary matter. This cosmic reaction has allowed the inner universe to become stress free, and hence to be alive rather than sterile.

In terms of forces, $F_w(t_o) = M_w(t_o)\, d^2R/dt_o^2$ and $F_P(t_o) = -M_P(t_o)\, d^2R/dt_o^2$ where $F_w(t_o)$ is the dark matter force, which has the form of a wind force, and $F_P(t_o)$, which has the form of a frictional force, is the ordinary matter force, and the total force,

$$F(t_o) = F_w(t_o) + F_P(t_o) \quad (8)$$

where both modes of matter are subject to the same acceleration , which from the solution of (3), is,

$$d^2R/dt_o^2 = K_o \lambda (\exp \lambda t_o - \exp -\lambda t_o) /(1 - \alpha) \quad (9)$$

As $t_o/T \rightarrow 0$, $M_P(0) / M_w(0) = 1$ [3], and hence $F(0) = 0$, and a stress-free condition exists.

At the origin of the universe, $t_o = 0$, and $F_w(0) = -F_P(0)$, and from (8) the anti-gravitational force, $F(0) = 0$, and we are freed from the effect of anti-gravity and controlled solely by gravity. A higher approximation in which F plays a part shows that this is an excellent condition throughout the inner universe. The radius of the inner universe ($R_D = 1.25\ 10^{16}$ m) was attained at the time, $t_o = T_D$, at which the ratio (δ) of the anti-gravitational force to the gravitational force due to ordinary matter, $\delta = [(M_w(R_D) - M_P(R_D)] / M_P(R_D)$, where for $\lambda T_D \rightarrow 0$, is $\delta = \lambda T_D$. From the observations, $T_D = 0.91$ yr and $R_1 = 0.90\ 10^{26}$ m (which from (5) yields $\lambda = 3.33\ 10^{-18}\ s^{-1}$), and hence $\delta = 2.0\ 10^{-10}$ which shows that the stress-free condition ($F(0) = 0$) is an excellent approximation throughout the inner universe.

Gravity also had its birth from dark matter in the inner universe at $t_0 = T_D$,through the defining of the universal constant of gravity (G). This process was presented in [6] in which it was shown that,

$$G = 3\, c^2 /(4\pi^2\, \rho_D\, R_D^2) \quad (10)$$

where ρ_D is the density of dark matter, which is a universal quantity [3], c is the velocity of light, and $R \equiv R_D$ is the radius of the inner universe. The planetary data indicated that $R_D = 1.25\ 10^{16}$ m and $\rho_D = 2.1\ 10^{-6}$ kg m^{-3} , from which $G = 6.54\ 10^{-11}\ kg^{-1}m^3\ s^{-2}$, which is in very good agreement with the observed value of $G = 6.674\ 10^{-11}\ kg^{-1}m^3\ s^{-2}$. Hence, we conclude that the dark matter of the inner universe is also responsible for the existence and magnitude of the force of gravity through the universal constant of gravity (G).

3. THE PROPERTIES OF THE MATURE UNIVERSE

As time passes the structure of the universe develops and according to the exponential-stress model [3], the dark matter and the ordinary matter masses are respectively,

$$M_w = m_o K_o\ (\exp(\lambda T - 1) / \lambda (1 - \alpha) \quad (11)$$

and

$$M_P = m_o K_o\ (1 - \exp -\lambda T) / \lambda (1 - \alpha) \quad (12)$$

where $t_o = T$ which on substituting for R_1 in (5) yields, $\lambda T = \ln(1/\alpha)$. On substituting for α in (9), (11) and (12), using (2), we obtain, $F(t_o) \equiv F$, where

$$F = m_o c^2 (1 - \alpha^2) \quad (13)$$

which is the anti-gravitational force in the mature universe. An alternate relation is,

$$F = c^2 (c^2 - K_o^2)/ G \quad (14)$$

which shows the fundamental relation of F with G, and also its relation with the initial expansion rate of the universe.

On evaluating (13) from observations for the present universe ($m_o = 1.35\ 10^{27}$ kg m^{-1}, $c = 3\ 10^8$ m s^{-1} and $\alpha = 0.235$), we obtain,

$$F = 1.14\ 10^{44}\ N \quad (15)$$

in the specification of which it is an honour to apply the SI symbol for the Newton.

4. THE SIGNIFICANCE OF THE ANTI-GRAVITATIONAL FORCE (F)

The clear import of this study is that the Newtonian theory of the dynamics of the universe is incomplete without the inclusion of the anti-gravitational force (F). This force can be included once the ratio (α) of the initial expansion rate to the velocity of light, which in the exponential-shear model is equal to the ratio of the mass of ordinary matter to the mass of the dark matter left over after its formation (α) is known. Observations indicate that α = 0.235 [3] which shows that $(1 - \alpha^2) = 0.95$ in (13), and hence the presence of ordinary matter only has a minor effect on the magnitude of the anti-gravitational force (F).

The primary role of the anti-gravitational force (F) is to establish the dynamical equilibrium of the universe. The complete force (H(R)) is comprised of the anti-gravitational force and the gravitational force. Thus,

$$H(R) = m_o c^2 (1 - \alpha^2) - G (M_P + M_w) (M_w - M_P)/R^2 \quad (16)$$

where at the radius of the universe ($R = R_1$), $H(R_1) = 0$

5. THE GENERALIZED LAW OF GRAVITY

Eq. (16) can be re-expressed as follows. On substituting for m_o and α we obtain,

$$H(R) = c^2/G \ (1 - M_P^2 / M_w^2) - G (M_w^2 - M_P^2)/ R^2 \quad (17)$$

which yields, $H(R) = (1 - M_P^2 / M_w^2) [c^2/G - G M_w^2 / R^2]$ in which $M_w/ R_1 = c^2 / G$, and hence,

$$H(R) = (1 - M_P^2 / M_w^2) G M_w^2 (1/ R_1^2 - 1/ R^2) \quad (18)$$

which may be re-expressed as,

$$H(R) = G(M_w^2 - M_P^2) [1 - (R_1 / R)^2] / R_1^2 \quad (19)$$

Eq.(19) is the generalized law of gravity which takes account of dark matter and also the finite radius (R_1) of the universe. An alternate Newtonian form is,

$$H(R) = G M (M_w - M_P) [1 - (R_1 / R)^2] / R_1^2 \quad (20)$$

or in terms of F rather than G,

$$H(R) = F (1 - (R_1 / R)^2) \quad (21)$$

which is independent of the two masses (M_w and M_P). The limits of (20) and (21) are respectively:

(A) The Newtonian limit ($R << R_1$),

$$H(R) = - G M (M_w - M_P)/ R^2 \quad (22a)$$

$$H(R) = - F (R_1 / R)^2 \quad (22b)$$

and

(B) The Einsteinian limit, ($R >> R_1$)

$$H(R) = G M (M_w - M_P)/ R_1^2 \quad (23a)$$

$$H(R) = F \quad (23b)$$

where at the radius of the universe, $H(R_1) = 0$, where R_1 is the radius of the universe.

In general terms, (19) states that in the Newtonian law of gravity, a constant term was omitted, which is decisive at the large radii and ages which occur in the mature universe.

The representation of the complete force, H(R), in terms of F is highly significant, as it shows that the anti-gravitational force (F) is the fundamental force in the dynamics of the mature universe, rather than the gravitational force, which through the universal gravitational constant (G), with the greatest of respect, is an example of F.

6. CONCLUSIONS

Several important topics have been discussed using the exponential-stress model, which are summarized below. In general terms, three guiding concepts have emerged:

Firstly, the conceptual model of the universe, which is based on the dynamics of the circulation which occurs in a rectangular basin, in which there is an equilibrium between two forces: (i) the wind stress, which is an external force, and (ii) the bottom stress, which is an internal force. In the cosmos, it may be argued that the external force is 'the breath of God' and the internal force is the material response.

Secondly. The dynamics of the circulation begin from instabilities which lead to the formation of mass, rather than from 'a big bang'. The key

process is the equilibrium between the internal and the external forces, which occurs over a very short time period following the act of creation in an inner region, spatially limited by the velocity of light.

Thirdly, beyond this inner region, the external force which is the anti-gravitational force, and the internal force which is the gravitational force, oppose each other and at the radius of the universe they are in balance. In the universe the gravitational force dominates, and outside of the universe the anti-gravitational force would dominate.

These processes, which are represented through the exponential-stress model, appear to be broadly consistent with the action of the Holy Spirit and the concept of Heaven and Earth in Christian theology.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. National Geographic. Origins of the universe explained Science/Reference; 2017. Available:https://www.nationalgeographic.com>science>article
2. Bye JAT. Dark matter in the planetary system. Intl. Astron. and Astrophys. Res. J. 2021;3(4):31-38.
3. Bye JAT. The Origin of Wave-Particle duality. Intl. Astron. and Astrophys. Res. J. 2023;5(1):71-74.
4. Newton I. Philosophiae naturalis principia Mathematica. Lib, I, Sec. 11, 12; Lib. III, Prop. 1687;18,19,20. London.
5. Bye JAT. The Significance of Shear Stress in Cosmology. Intl. Astron. and Astrophys. Res. J. 2022;4(4):14-19.
6. Bye JAT. The universal gravitational constant (G) in an expanding universe. Global J. of Science Frontier Res. A. Physics and Space Science. 2021;22(4): 36-37.

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