THE ANTI-GRAVITATIONAL FORCE (F)

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 vector 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 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 $\alpha = M_P/M_w$

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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 anti-gravitational - gravitational 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 universe, which observations show is $0.90\ 10^{26}$ m.

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In the early universe, the exponential-stress model shows that an inner universe is first formed, which is 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 exponential-stress model shows that the inner universe, of which we are a part, has the paramount property that F (0) = 0, i.e. theinitiial net stress force is zero. This has enabled evolution to persist in the inner universe to this day.

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1. Introduction

The background to this study lies with the results of two previous models which predict the dark matter mass (M) in the universe. In the first model [1], 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,

$M_D = m_o R_D$ (1)

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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^2 s^{-2}) and $R_D = 1.25\ 10^{16}$ m which was obtained from planetary data in [1], $M_D = 1.7\ 10^{43}$ kg.

In the second model [2],

$M(t_o) = M_w(t_o) + M_P(t_o)$ (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,

$dR/dt_R = K(t_o)$(3)

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in which t_R is the local time at R, assumingthat $M_w(0) = M_P(0) = 0$, it was found in [2] that,

$M(t_o) = m_o R_1 (1 + \alpha)$ (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, and on substituting for λ in R_1we obtain for $t_o = T$, where T is the age of the universe[2],

$R_1 = cT/ \ln 1/\alpha$ (5)

andhence, on substituting for R_1 in (4),

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

which is the dark matter mass of the universe. On evaluating (6) for the present universe in which $M = 1.5\ 10^{53}$ kg and $T = 13.8\ 10^9$ yr, we obtain $\alpha = 0.235$ [2], and on evaluating (5) $R_1 = 0.90\ 10^{26}$ m.

2. The formation of the inner universe

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

$R_D = c\, T_D \ln (1/\alpha)(1 + \alpha)$ (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 [2] 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 [3], 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 [4] 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 cosmicreaction 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,

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

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

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

As$t_o/T \rightarrow 0$, $M_P(0)/ M_w(0) = 1$ [2], and hence $F\ (0)= 0$,and a stress-free condition exists.

3. The mature universe

As time passes the structure of the universe develops.and according to the exponential-stress model,

$$M_w = m_o\ K_o\ (\exp (\lambda T - 1) / \lambda\ (1 - \alpha) \qquad (10)$$

and

$$M_P = m_o\ K_o\ (1 - \exp -\lambda T\ ) / \lambda\ (1 - \alpha) \qquad (11)$$

where $t_o = T$ which on substituting for R_1 in (5) is defined by the relation, $\lambda T = \ln(1/\alpha)$. On substituting for α in (9), (10) and (11), we obtain, $F(t_o) \equiv F$, where

$$F = m_o c^2 (1 - \alpha^2) \qquad (12)$$

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

$$F = c^2 (c^2 - K_o^2)/ G \qquad (13)$$

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

On evaluating (12) fromobservations 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,

$$F = 1.14\ 10^{44} N \qquad (14)$$

in the specification of which it 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 $\alpha = 0.235$ [2] 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 total force (X) is comprised of the anti-gravitational force and the gravitational force. Thus,

$$X(R) = m_o c^2 (1 - \alpha^2) - G (M_P + M_w)(M_w - M_P)/R^2 \quad (15)$$

where at the radius of the universe ($R = R_1$), $X(R_1) = 0$ Hence within the universe ($R < R_1$) the gravitational force dominates, and without the universe ($R > R_1$) the anti-gravitational force would dominate. At the radius of the universe an equilibrium exists.

Returning now to the inner universe in which $M_w = M_P$, it is apparent from (8) that the anti-gravitational force, F(0)= 0, and hence we are freed from the effect of anti-gravity and controlled solely by gravity. A higher approximation in which F plays a part can be obtained which confirms this conclusion.The radius of the inner universe ($R_D = 1.25\ 10^{16}$ m) was attained at the time, $t_o = T_D$. Here the ratio of the anti-gravitational force to the gravitational force due to ordinary matteris,

$$\delta = [(M_w(R_D) - M_P(R_D)] / M_P(R_D) \qquad (16)$$

On evaluating (16) for $\lambda T_D \rightarrow 0$, we find that $\delta = \lambda T_D$in which $T_D = 0.60\ 10^8$ s and from substituting for R_1 in (5), $\lambda = 3.33\ 10^{-18}\ s^{-1}$. Hence $\delta = 2.0\ 10^{-10}$which shows that the stress-free condition is anexcellent approximation throughout the inner universe.

5, Conclusions

Several important topics have been discussed using the exponential-stress model, which are summarized below:

(i) Dark matter (M_W) and ordinary matter (M_P) have been subsumed (8) in the anti-gravitational force (F). This fundamental relation shows that dark matter is a constituent part of a force, as also is ordinary matter. Eq. (8) shows that $F_P(t_o)$ is analogous to a frictional force.

(ii) F arises in the initial expansion rate of the universe, which in the stress-exponential model (3), is equal between dark matter and ordinary matter. The exponential model suggests that this is a crucial property of the universe.

(iii) The anti-gravitational force , F , is a constant, whereas the gravitational force $G(R) = G\,M(M_w - M_p)/R^2 \rightarrow 0$ as $R \rightarrow \infty$, hence an equilibrium can occur at an intermediate radius, R(T),in which T is the age of the universe.

(iv) Possibly the most important result is that the exponential-stress model predicts that a stress-free condition occurs in the inner universe (of which we are a part)which has allowed evolution to occur in the inner universe, which began in the very early days of the universe, and shows no sign of ceasing.

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References

1. Bye JAT. Dark matter in the planetary system. Intl. Astron. and Astrophys. Res. J. 2021; 3(4): 31-38
2. Bye JAT. The Origin of Wave-Particle duality. Intl. Astron. and Astrophys. Res. J. 2023; 5(1): 71-74
3. Newton I. Philosophiaenaturalis principia Mathematica. Lib, I, Sec. 11,12; Lib. III, Prop. 18,19,20. (London); 1687.
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5. Observable Universe – Wikipedia. Available:https//en-wikipedia.org/wiki/Observable_universe.

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