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One-dimensional Mass and the Sisterhood of Habitable Planets

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Author's contribution

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

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ABSTRACT

This paper shows how the conversion of dark matter into ordinary matter (one-dimensional mass into three-dimensional mass) which occurs under a gravitational equilibrium will, when the principal mass is similar to that of the Sun, create a terrestrial planet which has a planetary temperature suitable for the greenhouse effect acting on its gaseous water vapour envelope, to produce a permanent surface liquid water body. The stellar mass statistics indicate on the assumption that the dark matter conversion process is universal, that this condition is likely to occur. Hence it is predicted that there are many habitable sister planets to Earth in the Universe.

Keywords: Earth science; dark energy; planets; Earth.

1. INTRODUCTION

This is a brief account of an important theoretical finding, namely of our family place in the Universe. Its purpose is to guide the search for our sister planets. The main result is that this is likely to be successful in the planetary systems of stars of similar mass to the Sun. Hence we use the term family as the situation is analogous to the sisterhood and brotherhood that occur in a family where the genetic origin is the same but each family member develops a unique character.

The analysis, which is logically consistent once the primacy of dark matter is accepted, is developed from the prediction for the orbital radius of formation of ordinary matter from dark matter which is universal for all planetary systems. In particular, we know that Earth

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supports life, and hence the successive steps which allow this to occur can be enumerated, and by inference, provide the model for a parallel process to occur in other planetary systems which are controlled by a star of similar magnitude to the Sun.

2. DARK MATTER

Dark matter (M), which is acted on by gravitation, will be assumed to have the form [1] ,

$$dM = m_2\, dR \quad (1)$$

where

$$m_2 = \rho_2\, R^2 \quad (2)$$

in which R is the orbital radius about the principal mass, and ρ_2 is a constant density. Eq. (1) is the constitutive equation for one-dimensional mass, and on substituting (2) in (1), and integrating with respect to R, $M = 1/3\ \rho_2\ R^3$, and the density of dark matter,

$$\rho_D = \rho_2 / 4\, \pi \quad (3)$$

is a constant. Dark matter therefore provides a homogeneous field of 1-D mass throughout the Universe, which is a simple (earlier) form of matter than the 3-D matter with which we are familiar.

.On inserting (1) into Newton's gravitational model, $U^2 = G\, (M_o + M)/R$ where $G = 6.673\ 10^{-11}$ $m^3\ kg^{-1}\ s^{-2}$ is the universal gravitational constant, M_o is the principal mass and U is the azimuthal orbital velocity, we obtain the Law of Gravity for dark matter [1],

$$U^2 = G\ M_o/R\ (1 - (R/R_o)^3) + c^2\ (R/R_o)^2 \quad (4)$$

In (4), the first term on the right hand side is the potential energy due to the ordinary 3-D mass of the primary body (M_o), and the second term is the potential energy due to the 1-D mass of the other bodies. At $R = R_o$, which is the radius of the Universe, the azimuthal velocity, U, attains the velocity of light, $c = 2.998\ 10^8\ m\ s^{-1}$.

For an infinite Universe, (4) reduces to Newton's gravitational expression, however for the finite universe ($0 \le R \le R_o$), U has a minimum at R_c where

$$R_c = (\, R_o^2\ /2m_o)^{1/3}\ \ M_o^{1/3} \quad (5)$$

in which $m_o = c^2/G$ [= 1.35 10^{27} kg m^{-1}]. The minimum in U at R_c (5) is highly significant as it would be expected to be the site for the deposition of dark matter into ordinary matter.

3. THE ENERGY BALANCE FOR THE UNIVERSE

The Law of Gravity (4) can also be interpreted in terms of the energy balance for the Universe. On multiplying each term in (4) by $dM = \rho_2\ R^2$ dR and integrating over the range ($0 \le R \le R_o$) we obtain the energy balance,

$$KE = PE + DE \quad (6)$$

where $PE = 3/10\ G\ M_P\ \rho_2\, R_o^2$ and $DE = 1/5\ c^2\ \rho_2\ R_o^3$ [1] in which $\rho_2 = 3\ m_o\ /\ R_o^2$ [1] and $M_P = M_o$ where M_P is the mass of ordinary matter, which yield,

$$KE = 3/5\ [\ 1 + 3/2\ M_P/\ M\ ]\ \ M\ c^2 \quad (7)$$

Eq. (7) is the Law of Energy for dark matter, expressed in the form of Einstein's Law of Energy for ordinary matter,

$$KE = M\ c^2 \quad (8)$$

in which KE = PE.

In terms of density (7) yields,

$$KE = 3/5\ (1 + 3/2\ \rho_P\ /\ \rho_D\ )\ \ M\ c^2 \quad (9)$$

where from the planetary model in [1], the ratio of the density of ordinary matter to the density of dark matter, $\rho_P\ /\ \rho_D = 2/3\pi\ /(1 + 2/3\pi)$ [0.175], and hence $KE = 0.76\ M\ c^2$, which is about ¾ of the KE when only ordinary matter is recognised.

The mass-energy density ratio of dark energy to potential energy in (6), $DE/M\ /\ PE/M_P = 2/3$ [0.667]. The above two theoretical ratios are both similar to the observed ratios, which are respectively, 0.18 and 0.683 [1].

4. THE EVOLUTION OF THE UNIVERSE

There is considerable interest in the 'big-bang' theory [2] for the formation of the Universe. It is important to briefly contrast this theory with that which follows from the constitutive one-dimensional equation (1), which predicts a uniform density of dark matter (3) throughout the Universe.

In the big-bang hypothesis [2], it is assumed that at the temporal origin there exists a singular point mass of infinite density which expands over time whilst the mass remains constant.

In the one-dimensional mass hypothesis, it is assumed that at the temporal origin the mass is zero as can be seen by integrating (1) with respect to R. In the subsequent expansion, the density of the dark matter (ρ_D) is a constant as shown by (3), but the mass increases, and on substituting (2) in (1) and integrating with respect to R over the range ($0 \leq R \leq R_o$) we obtain, $M = 1/3\ \rho_2\ R_o^3$, which on substituting (3) yields, $M = 4\pi/3\ \rho_D\ R_o^3$

Thus the difference between the two theories is that in order to attain the Universe of radius (R_o), in the big-bang theory the mean density decreases with time, whereas in the one-dimensional mass theory the mass increases with time. In this sense, the one-dimensional mass hypothesis corresponds with an *expanding* universe in that the mass is increasing, whereas the big-bang hypothesis corresponds with a *decaying* universe in which the mean density is decreasing. In this paper, we follow the 1-D mass path, in which the flow of information is from dark matter to ordinary matter rather than the big bang path in which the flow of information is from ordinary matter to dark matter.

5. PLANETARY SYSTEMS

The planetary system is stress-free [1]. This is the basis of Newton's gravitational model, which is shown quantitatively from the orbital properties of the planets. The planetary data are also consistent with Newton's gravitational model, and provide estimates of the longitudinal radius and the transverse radius of the Universe [1]. The two estimates are very similar and yield a spherical Universe of radius, $R_o = 1.25\ 10^{16}$ m. The radius, R_c is an iconic radius for the planetary creation process in all planetary systems, the variability of which depends on M_o (5). For the solar system, on substituting for R_o and M_o in (5), $R_c = 4.87\ 10^{11}$ m.

Before commencing on the discussion of the planetary system, however, it is appropriate to look at the formation of the Sun as the governing principal mass (M_o). We propose that the same creation mechanism exists for the principal mass as for the planets. In bold terms, (5) also applies in the limit of $M_o \to 0$.

For the primary mass, we interpret (5) as being a relation for the iconic radius (R_c) in a dark matter universe in which, $M_D = 1/3\ \rho_2\ R_D^3$ is the mass of dark matter within a radius (R_D). On substituting M_D for M_o in (5) we obtain,

$$R_D/R_c = (\ 6\ m_o/\ \rho_2\ R_o^2)^{\ 1/3} \qquad (10)$$

which yields the *universal* radial ratio, $R_D/R_c = 2^{1/3}$ (1.26) . Hence, since $R_D/R_c > 1$, the dark matter supports a minimum in azimuthal velocity (U) within the primary body, at which a conversion from dark matter into ordinary matter can occur. The iconic radius (R_c) may mark the division between the core and the mantle in the primary mass, in analogy to a similar division in the planetary system between the terrestrial and gaseous planets, which is discussed in Section 9.

Consistent with the limit, $M_o \to 0$, the Sun (and other principal masses) arise from the conversion of dark matter into ordinary matter in a universal process, as has been demonstrated above. We turn now our attention to the properties of the planetary systems

6. CANDIDATE PLANETS

The aim of the analysis is to assess the possibility of planets other than Earth being habitable planets. For the Earth (which is the reference planet), the heat flux balance [3] is,

$$L_o\ (1 - \beta)\ /\ 4\pi R^2 = \sigma\ T_o^4 \qquad (11)$$

where $L_o = F\ \pi\ R^2$ is the Lambertian luminosity of the Sun and F is the solar constant. In (11), $L_o = 0.965\ 10^{26}$ W, F = 1370 W m^{-2} , $\sigma = 5.674\ 10^{-8}$ W m^{-2} K, $^{-4}$ is the Stefan-Boltzmann constant and β = 0.30 [5] is the albedo. R and T_o are respectively the orbital radius and the planetary temperature of Earth, and on evaluating (11), T_o = 255 K.

Table 1 shows how the heat flux balance has evolved for the four terrestrial planets in our planetary system. The solution of (11) indicates that except for Mercury, the planetary temperature (T_o) is much less than the requirement for habitability, however the greenhouse effect acting on the surrounding gaseous envelope in a positive feedback loop fed by the terrestrial substrate increases the global

Table 1. The temperatures of the terrestrial planets

	T_o (K)	T_{eq} (K)	T_{obs} (K)	β[11]	F (Wm^{-2})
Mercury	437	448	440	0.10	9160
Venus	232	329	735	0.75	2650
Earth	255	279	288	0.30	1370
Mars	209	225	215	0.25	580

temperature, which for Venus gives rise to an observed temperature (T_{obs}) much greater than the temperature, $T_{eq} = (L_o / 4\pi \sigma R^2)^{1/4}$, which would have been achieved with no reflection of incoming radiation to space. On Venus, through carbon dioxide, the effect is spectacular ($T_{obs} >> T_{eq}$), whereas on Earth at present it is marginal ($T_{obs} \approx T_{eq}$). On Mars and Mercury, $T_{obs} < T_{eq}$, which indicates a net loss of reflected incoming energy into space.

In this investigation of possible habitable planets in other stellar systems, we will assume that the observable temperature of the candidate planet, $T_{obs} \approx T_{eq}$ as on Earth. The entry of dark matter into ordinary matter on Earth , may occur [1] through the surrounding gaseous envelope in which at about 120 km, the gaseous density is equal to that of dark matter. Similar considerations would apply for all the candidate habitable planets.

In a stellar system [denoted by ′] of principal mass (M′), the orbital radius (R′) of a candidate planet is given by the relation, $L'/ L_o = (1 - \beta)/(1 - \beta') \, (R'/ R)^2 \, (T' / T_o)^4$, in which β′ is the albedo of the planet and T′ is its planetary temperature, and hence, on expressing the radii of the Earth and the candidate planet in terms of their iconic radius ratios: $\theta_o = R/R_c$ and $\theta' = R'/ R_c'$, respectively where $R_c' = (R_o^2/2 m_o)^{1/3} M'^{1/3}$, we obtain,

$$L'/ L_o = (1 - \beta)/(1 - \beta') \, (\theta'/ \theta_o)^2 \, (M'/M_o)^{2/3} \, (T' / T_o)^4 \quad (12)$$

7. THE OBSERVED LUMINOSITY/MASS RELATION

The mass-luminosity relation for main-sequence stars around the coordinate ($M/M_o = 1$, $L/L_o = 1$) is shown in Fig. 1, which is reproduced from Figure 9-4 of [4] on to which the relation,

$$L'/L_o = (M'/M_o)^{4.67} \quad (13)$$

has been superimposed. It is clear that (13) is a very good relation for stars of similar mass to the mass of the Sun. A similar relation may be arguably obtained from later data sets [5] which cover a greater range of masses.

On substituting for L′ in (12) from (13), we obtain,

$$M'/M_o = [(1 - \beta)/(1 - \beta')]^{1/4} \, (\theta'/\theta_o)^{1/2} \, T'/T_o \quad (14)$$

Eq. (14) is the basic result for our purposes which shows that the variability in the temperature/mass relation may arise from the albedo through (β′) and also from the creative planetary process through (θ′).

On the central assumption that we require, $T'/T_o = 1$ for a habitable planet, (14) is essentially an expression for M'/M_o.

8. PLANETARY VARIABILITY

The perturbation equation for the stellar system, in which, ΔM′, Δ β′ and Δθ′ , are the perturbations of the stellar mass, and the planetary albedo and iconic radius ratio respectively, and the planetary temperature is the same as on Earth, from (14); is,

$$\Delta M'/M_o = \left(\tfrac{1}{4} \, \Delta \beta'/(1 - \beta) + \tfrac{1}{2} \, \Delta\theta'/\theta_o \right) \quad (15)$$

which shows that in a stellar system of principal mass greater than that of the Sun, either the albedo of the candidate planet is greater or its orbital radius is closer to its iconic radius than for Earth, or vice-versa. The data points in Fig. 1 indicate that for $L'/L_o = 1$, $\Delta M'/M_o$ has a range of ± 0.05, which on assuming that $\Delta\theta'/\theta_o = 0$, i. e. the planetary creation process is universal, would correspond from (15) with a range of albedo (β′) amongst the candidate planets of 0.15 – 0.45 in which the more massy sun would require a planet of greater albedo [and arguably a more advanced environment]. Eq. (15) indicates that albedo variability is the distinguishing property between the environments of the habitable planets of equal planetary temperature, each revolving about their parent star. This association has a resonance with our sisterhood model. At

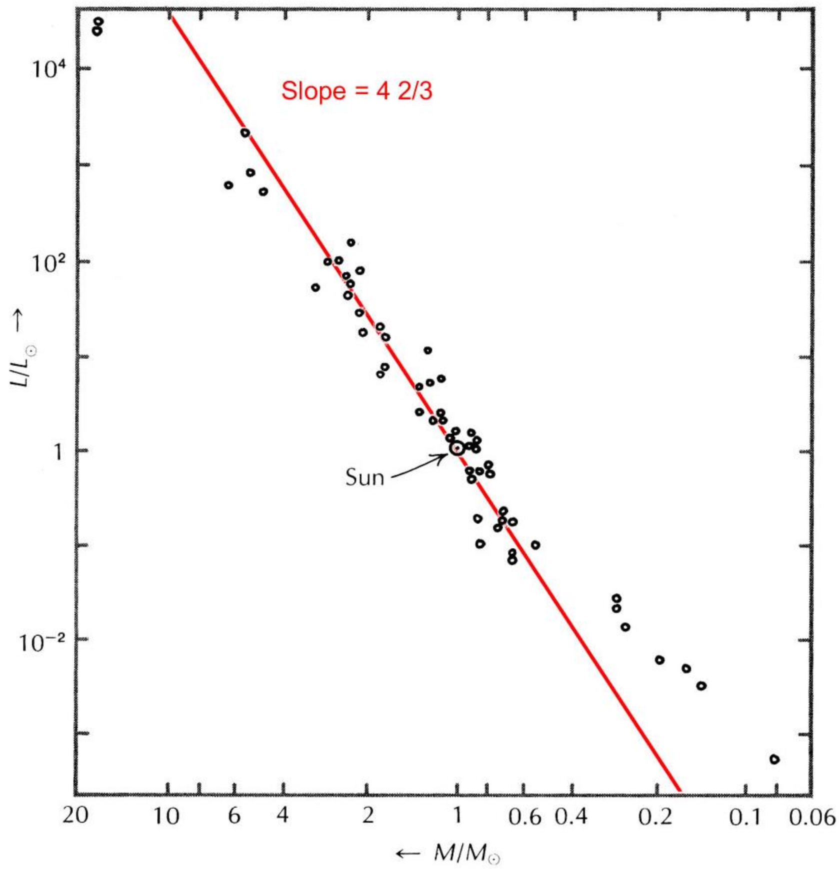

Fig. 1. Luminosity/Mass diagram for main-sequence stars reproduced from Figure 9-4 of [4], on to which the spectral relation (13) has been superimposed: $M_{\odot}$ is M_o and $L_{\odot}$ is L_o

all events, the luminosity/mass data are consistent with the existence of a sisterhood of habitable planets. The ultimate limit may lie in the variability of albedo, which is a question of cloud physics [3].

On Earth M′/Mo = θ′/ θo = 1, and (14) indicates that a lower albedo would be accompanied by a higher planetary temperature and vice-versa, as is being investigated in greenhouse model studies [6] and similarly for other ratios of M′/Mo.

9. THE SIGNIFICANCE OF Θ_O

The planetary data [1] showed that there are two planets in which there is an almost perfect intake of dark matter into ordinary matter. The first planet is Earth and the second planet is Jupiter. This suggests that the creative process occurred between Earth and Jupiter. In particular, the planetary data showed from (5) that the iconic radius ratio (θ_o) for Earth (R = 1.496 10^{11} m) was 0.31, and also that the iconic radius ratio for Jupiter (R_J = 7.783 10^{11} m) was 1.60, which indicated that the iconic radius (R_c = 4.87 10^{11} m) lies approximately mid-way between the orbits of these two planets [½ (R + R_J) = 4.64 10^{11} m] , which prima facie is suggestive of a common origin. The ratio, θ_0 = 0.31, may be just the right ratio for this essential division in planetary structure between the terrestrial and gaseous to occur.

10. A HISTORICAL END-NOTE

It is unknown, however, whether the search for a sister planet may be a replica in space of the search for the *non-existent* great southern land on Earth during the eighteenth century, notably by James Cook.

11. CONCLUSIONS

There are two main aspects to the paper:

(i) The Law of Energy for dark matter is derived in a form, which is analogous to Einstein's Law of Energy for ordinary matter. The context is that dark matter is an earlier form of matter which is one-dimensional in contrast to that for ordinary matter which is three-dimensional. Hence it is apparent that the physics of dark matter is totally different from that for ordinary matter to which we are accustomed. In early times, three-dimensional mass was investigated as a bulk property of nature, only later did its particulate properties become known. The investigations of particle one-dimensional mass may be only at its beginning stage [7,8].

(ii) The understanding of one-dimensional matter brings a new uniformity into cosmology. This is demonstrated by the properties of the planets in the solar system, and leads naturally to the conclusion that there are other planetary systems in the Universe which may support life. Importantly, the creation of ordinary matter from dark matter, which is the first step in this process, is demonstrated in the solar system including in the Sun (the principal mass), and can be expected to apply in a similar manner in other planetary systems in the Universe.

SOME GENERAL REMARKS

The thrust of the analysis has been that there is an evolution of mass from a one-dimensional quantity to a three-dimensional quantity.

1-D mass (1) is a function of a mass density (m_2) which is independent of time (t). 3-D mass is a function of density (ρ) which depends on the three co-ordinates (x_1, x_2 and x_3). 5-D mass is a five-dimensional quantity which depends also on the complex temporal variable ($t = t_1 + i\, t_2$) , and hence there are three spatial and two temporal co-ordinates. The monumental work of Einstein concerns the general properties of 5-D mass, and there is a well-trodden path from 3-D mass to 5-D mass. This is not so for the path from 1-D mass to 3-D mass.

The central question is whether the dominant influence of 1-D mass in the creative process of the Universe as demonstrated in Section 2, is still active today. I believe that the answer to this question, in particular, how does 1-D mass lead to the creation of 3-D mass? may lie outside of 3-D science. Most religions, including Judaism, Christianity and Islam, have at their core a Holy Spirit [9], who guides creativity. In Christian theology, the Holy Spirit enables God, who ′No one has ever seen′ (John 1, 18) [10] to be known to his people through Jesus, who ′shall be called Emmanuel, God with us′ (Matthew 1, 23-24) [10]. This arguably is the relationship between 1-D mass and 3-D mass. In other words, the link between 1–D mass and 3–D mass may be fundamentally a theological as well as a scientific question.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Bye, John. Dark matter in the Planetary System. Intl. Astron. and Astrophys. J. 2021;3(4):31-38. Article no. IAARJ.79041
2. Big Bang – Wikipedia. Available: https://en-wikipedia.org/wiki/Big_Bang
3. Gordon, Adrian, Grace, Warwick, Schwerdtfeger, Peter, Byron-Scott, Roland. Dynamic Meteorology: A Basic Course. Arnold. London. 1998;325.
4. Oster, Ludwig. Modern Astronomy. Holden – Day, Inc. San Francisco. 1973;448.
5. Lang, Kenneth. NASA′s Cosmos. Fig 7_10 Stellar mass luminosity relation.
6. IPCC Sixth Assessment Report (AR6). Working Group 1 Contribution, Summary for Policy Makers. 2020. WMO Geneva. 2010;6.
7. Axion – Wikipedia. Available:https://en.wikipedia.org>wiki> Axion
8. Bentone, Gianfranco. Particle Dark Matter. Observations, Models and Searches. Cambridge Univ. Press. 2010;738.
9. Holy Spirit – Wikipedia. Available: https://en.wikipedia.org/wiki/Holy_Spirit

10. The New English Bible with the Apocrypha. Oxford Univ. Press, Cambridge Univ. Press. Oxford. 1970;336.

11. American Chemical Society _ Predicted planetary temperatures.

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