IOSR Journal of Applied Physics (IOSR-JAP)
e-ISSN: 2278-4861.Volume 6, Issue 3 Ver. IV (May-Jun. 2014), PP 28-38
www.iosrjournals.org

Distribution of Dark Matter in Galaxies, In Search of the Dark Matter Particle

[1] M. E. Isma'eel
[1] *Formerly; Deputy Manager of the Armed Forces Technical Research Center of Egypt*

Abstract: *A new theory called, the Dark Matter Flow Theory based on fluid mechanics concepts, has been given for the first time to derive the density of the dark matter and its distribution inside galaxies and beyond. Although the results are chocking, however they exhibit a high congruence with the measured observations of the velocity rotation curves of galaxies. Also, the paper proposes a more general density profile with cosmic parameters that covers most types of galaxies. A comparison with the rotation disc velocities of the spiral galaxies NGC 4841, NGC 3198 and our Milky Way Galaxy has been given. The high congruence between the theory and the measured observations confirms the correctness of the theory proposed. The paper studies the variation of the cosmic parameters of the predicted disc velocities to show the wide range of galaxy's velocity curves covered by this theory. A comparison with NFW and Einasto profiles has been given, after adapting their equations with the derived results of this paper, to show the high accuracy of our given profile. An estimation of the mass of the dark matter particle has been given, which shows that it is within the range of CERN's reactivation in late 2014, which could be detected by CERN. The paper is considered a bold step in understanding the nature of dark matter and shows our inability to fully understand the physical world so far.*

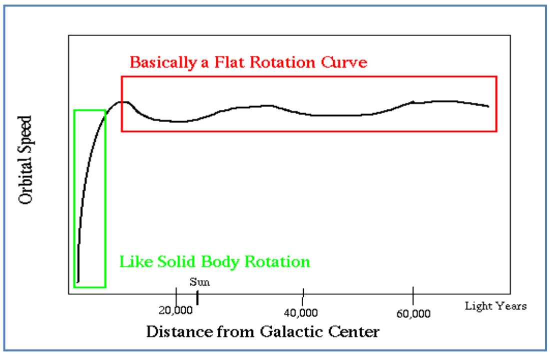
Index Terms: *Dark Matter – Galaxy – Milky Way – Halos – Elementary Particle*

I. Introduction

The nature of dark matter (DM) is one of the greatest puzzles in particle physics and cosmology today. Basically, dark matter cannot be seen or directly detected since it neither emits nor absorbs light or other electromagnetic radiation at any significant level. Instead, its existence and properties are inferred from its gravitational effects on visible matter, radiation, and the large-scale structure of the universe. It is stuff we cannot see or detect but we think it must be there, as it is much easier to assume that dark matter exists rather than having to rewrite all of physics.

According to the Large Underground Xenon dark matter (LUX) experiment and others [1-3], which is a collaboration of more than 100 scientists and engineers across 18 institutions in the US and Europe they said; we now know with certainty that in the entire Universe, all the matter we know – the stars, planets, intergalactic gases, and other odd cosmic objects like black holes – can only account for less than 5% of the mass we know to be there. Thus, five times more abundant is an unknown kind of matter that needs to be there to explain the gravitational behavior of galaxies but we have never been able to see. It would be everywhere, permeating our galaxy and others like it, surrounding us at any given time with incredible density, yet stubbornly avoiding detection despite more than twenty years of dedicated efforts from particle physicists all over the world. Scientifically, this is both very frustrating and very exciting. Many theories have been crafted to try to predict what this dark matter really is, and more are being proposed almost every week. However, no one has succeeded to know the density of the dark matter so far.

According to the astronomical observations and measurements of the velocity rotation curves of spiral galaxies, the speeds of the stars near the center of the galaxies (about 5 - 7% of the radius), i.e. near the black hole, are increasing linearly with the radius. This means that about 5 - 7% of the galaxy disc rotates as a solid rotating disc. This solid-body behaviour can be interpreted as indicating the presence of a central core in the dark matter distribution, spanning a significant fraction of the optical disk. Outside this distance the speeds of the rotating stars are almost constant till the end of the galaxy's disc, i.e. the rotation curves are basically flat. Figure a, shows typical flat rotation curve of our Milky Way galaxy as well the rotation curves of other Galaxies.



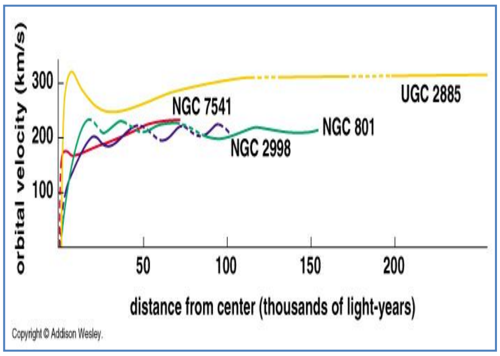


Figure a: the right figure shows the flat rotation curve of our Milky Way Galaxy, which is a typical profile curve of the spiral galaxies. The right curve shows virtual galaxies flat rotation curves of some galaxies, indicating that they are all surrounded by large halos of dark matter. (Bennett et al. [8]).

In this paper, a new theory (called: the Dark Matter Flow Theory) has been introduced based on the concepts of fluid mechanics, by considering the dark matter as a fluid flow that has a drag force effect on all objects in its path towards the black hole at the center of the galaxy. This drag force is treated as a different manifestation to Newton's Gravitation Law. By analogy, reference [4] gives the detailed mechanism of the motion of the dark matter at any mass M, including elementary particles too. The results, as we shall see, show that the dark matter density defies the logic and our understanding the natural world and our daily experience. For this reason, it is necessary to introduce the following section to pave the way towards understanding the theory presented in this paper.

II. Preliminary Concepts

The objective of this section is to shed light on some very simple basic facts, which aids understanding the results derived in this paper.

2.1. Light waves are transverse waves; longitudinal waves travel or propagate through gases, liquids and solids, while transverse waves can't travel through gases and liquids, and travel only through solid materials. And as we know that light (as electromagnetic wave) is a transverse wave**,** then the question arises at once; does it mean that the absolute space of the universe, or the Dark Matter that permeates the universe and carries light waves, is a solid matter? If so, what is its density?

2.2. Density of the absolute space/ Dark Matter; we know that light waves reach the Earth from stars and galaxies away from us for billions of light years. This means that **dark matter** permeates the universe does not attenuate light waves. With slight modification of **Beer-Lambert law**; the attenuation of any electromagnetic signal (light) per unit length is given by;

$$I = I_0\, e^{-(\mu/\rho)\rho_A} \qquad (1)$$

Where;
I_0 is the original intensity of the light wave.
I is the intensity of the wave at a unit distance in the space.
μ is the attenuation coefficient
ρ is the density of the space, and (μ/ρ) is the mass attenuation density.
ρ_A is the surface density, also known as the mass thickness (The surface density is often used to describe the thickness of paper, e.g. 80 g/m^2 is very common).

Now, if $= I_0$, then $\mu/\rho = 0$, that is $\rho = \infty$. This means that, in order that the absolute space does not attenuate light waves, its density should be infinite. The concept of mathematical iteration can be used in this case, as there is no attenuation of the wave through a unit length plus one, then there is no other attenuation through any length. Alternatively, the unit length can be arbitrarily defined in this equation. Note that the order of magnitude of the infinity of ρ is greater than that of ρ_A .

2.3. Density of the Medium; Let us assume that we have a water whirl pool that contains some solid materials of irregular shapes, such as stones, iron pieces.. etc. Of course, these mass will not move due to the medium speed of the water rotation of the whirl pool. However this situation will be changed if the water of the whirl pool is replaced by a heavy density liquid, such as mercury. In this case, the stones and the iron pieces will easily move with rotation of the liquid of the pool. Thus the density of liquid plays the crucial role in moving the mass into it. Similarly, we can say that the (high) density of the dark matter surrounded the black hole of the galaxy's bulge will play the crucial role in moving the huge observable stars and gases of the bulge of galaxy as a solid disc.

III. Density of dark matter in the vicinity of Sun and Earth

So far, there is no theory that derives a formula for the density of the dark matter. To get such formula, we proceed by Newton's gravitational law between two masses M and m separated by a distance r, which is given by;

$$F = G \frac{M\, m}{r^2} \qquad (2)$$

If one of the two masses lies in the flow field of the other, then a Drag Force F_D will affect this mass and its well known formula is given by;

$$F_D = (1/2)\, \rho\, V^2\ C_d\, A \qquad (3)$$

Where;
ρ is the mass density of the Fluid
V is the relative speed between the object and the fluid (the Dark Matter in our case).
A is the cross sectional area of the object normal to the direction of the fluid speed, and
C_d is the Drag Coefficient - a dimensionless number, depends on the shape of the object. When C_d equals 1, this means all of fluid approaching the object is brought to rest, building up stagnation pressure over the whole front surface. This case can be taken for any stellar object as light does not penetrate the object itself.

By analogy, referring to reference [4], the vertical speed V of the dark matter at a distance r from a mass M is given by

$$V = 4\, G\, M / c\, r \qquad (4)$$

Where; G is the gravitational constant and c is the speed of light.

Equate the drag force equation (3) to the Gravitational Force equation (2), making use of equation (4), then, the density of dark matter adjacent to Earth's location ρ_e due to the drag force effect of the sun, with slight modification of nomenclatures, will be given by

$$\rho_e = [\, c^2/8\, C_d\, G] \times [\, (M_e/M_s)/A_e] \qquad (5)$$

Where;
M_e is the mass of the earth.
M_s is the mass of the sun.

Equation (5) gives the density of dark matter in the vicinity of any mass M_e lies in the flow field of any other mass M_s . The First bracket of equation (5), $[\, c^2/8\, C_d\, G]$, is considered a universal constant (as C_d can be taken equals unity corresponding to the stagnation case, as earth is non-transparent with respect to the electromagnetic waves), while the second bracket $[\, (M_e/M_s)/A_e]$ is the mass ratio per unit area, as defined in equation (1). Equation (5) shows that the density is independent of the locations of the two masses. This raises the drag force equation to become a universal law. Or more specifically, the proportionality of the drag force to the square of the fluid velocity is a universal law. Note that; in deriving equation (5), the suffixes are interchangeable, then the dark matter density adjacent to sun's location due Earth's drag force effect will given by;

$$\rho_s = [\, c^2/8\, C_d\, G] \times [\, (M_s/M_e)/A_s] \qquad (6)$$

Use data of table I, then $\rho_e = 3.956\ \times 10^6$ Kg/m^3, and $\rho_s = 3.679 \times 10^{13}$ Kg/m^3, which are very weird results. However, these results have been confirmed by the observational measurements of the galaxies NGC 2841, NGC 3198 and our Milky Way galaxy.

The questions arise at once, is dark matter that permeates the universe is a hyper solid matter? If so, how can we, as well as any stellar object, freely move through this medium? If so, do we really understand the physical world? Or do we still don't know the characteristics of this hyper dense solid matter? And the final question; is Aether is the dark matter? And why physicists accept the name of dark matter and strongly reject the name of Aether?

One final note, in all theories presented to describe the rotation curves of the stars of galaxies, the density of the dark matter is an absent parameter. Therefore, they describe the virtual form of the curves by giving only their profile to describe the phenomenon. On the other side, this paper presents the complete mathematical formulations not only in profile form, but also in a fully quantitative form.

Anyway, back to equations (5) and (6), the ratio between the density of the dark matter adjacent to the sun and the density of the dark matter adjacent to the earth, will be given by;

$$\frac{\rho_s}{\rho_e} = \frac{M_s^2 / A_s}{M_e^2 / A_e} \qquad (7)$$

Use data of table I, we see that this ratio equals 3.198×10^6, which shows that the dark matter density rapidly increases with the approach of bigger masses.

IV. Density of dark matter in the vicinity of a Black Hole at the Center of Galaxy

As we have noticed from equations (5) and (6) that the density in the vicinity of any mass due the effect of any other mass is independent of their locations, and as the suffixes are arbitrary chosen, and by considering the mass of the sun M_s is a typical star in our Milky Way galaxy, and the number of stars in our galaxy is N, then the density of the dark matter in the vicinity of the black hole ρ_0 (not the density of the black hole itself) will be given by;

$$\rho_0 = [\, N\, c^2/8\, C_d\, G] \times [\, (M_{bh}/M_s)/A_s] \qquad (8)$$

The suffix "0" is attached to $\rho, i.e. \rho_0,$ as this density is considered the initial density in deriving any formula later. Use data of table I, then $\rho_0 = 4.286 \times 10^{23}$ Kg/m^3, this value can easily be checked by a calculator. Of course, this is a chocking result; however its correctness can be checked with the measured observations. Now, it is required, to get a formula for the velocity of the dark matter as a function of the radius r from the center of the galaxy, i.e. from the black hole.

V. Velocities of Stars Embedded into the Galaxy Rotation Disc

To derive an expression for the star velocity embedded into the galaxy's disc, we start with Newton's gravitational law, where we can write the relation between the black hole and any moving star around it, in the following formula:

$$m\, \frac{V^2}{r} = G\, \frac{M\, m}{r^2} \qquad (9)$$

Where (V^2/r) is the centripetal acceleration of the rotating star of mass m, and M is the mass of the black hole. To get an idea about the increasing mass, eliminate m and solve for M, to get;

$$M = \frac{r\, V^2}{G} \qquad (10)$$

If the velocity is kept constant with increasing radius, then the mass is linearly proportional to the radius, i.e. more and more mass as we go to larger and larger distances from the center. Flat rotation curve shows there is more matter out beyond the apparent edge of spiral galaxies. For our Milky Way galaxy, some references [11-14] show that the total mass of the galaxy exceeds the visible mass (stars + gas) by about a factor more than 10. This means that the mass of the visible matter is small compared to the mass of the dark matter. So, it is fair enough to assume spherical symmetry of the dark matter around the center of the galaxy, i.e. around the black hole.

Now, if we consider stars are scattered and embedded inside the dark matter permeating the galaxy. Then the velocities of the stars are that of the rotating disc of the dark matter. Solving equation (9) for V^2, with V becomes that of the dark matter, and assuming spherical symmetry of the dark matter about the black hole at the center of the galaxy, i.e. with $M = \frac{4}{3}\, \pi\, r^3 \rho$, we get

$$V^2 = \frac{4}{3}\, \pi\, G\, \rho(r)\, r^2 \qquad (11)$$

Where $\rho(r)$ is the density of the dark matter as a function of the distance r from the center of the galaxy, i.e. from the black hole. As shown from figure a; different galaxies exhibit different rotation curves. So, it is expected that the specific formula that describes these different shapes will include many parameters to meet the requirements of the different shapes. Also, the functional dependence of V on r necessitates that the density profile of dark matter, and as it follows from the previous section, should be in the form;

$$\rho(r) = \frac{a^2\,\rho_0}{d+\left(\frac{r}{b}\right)^{\gamma}}\ ;\ with,\quad \rho(0) = a^2\,\rho_0/d \qquad (12)$$

Where;

$$b = b_0 + b_1\,\cos(\alpha\,r + \theta) \qquad (13)$$

is first two terms of Fourier series, which depends on the galaxy's anatomy, $\alpha = \frac{\beta\,\pi}{R_g}$, β is an arbitrary number to truncate the Fourier series and denotes the periodicity or the number of voids in the galaxy, R_g is the galaxy's adopted radius and ρ_0 is the density of dark matter in the vicinity of the black hole, as given by equation (8). The other parameters a, b_0, b_1, d, β, θ and γ are cosmic parameters depend on the type of galaxy, the mass of the black hole at the center of the galaxy and the number of stars in the galaxy (see equation 8). All the parameters are dimensionless numbers, except b and hence b_0 and b_1 have the dimension of length. This means that the coefficient of ρ_0 of equation (12) is a dimensionless function. Eliminate $\rho(r)$ between equations (11) and (12), we get;

$$V = \frac{\sqrt{(4/3)\,\pi\,G\,\rho_0}\,a\,r}{\sqrt{d+(r/b)^{\gamma}}} \qquad (14)$$

Equation (14) is the velocity distribution of the stars inside the disc of the galaxy. In this equation, the value of $\rho_0 = 4.286 \times 10^{23}$ Kg/m^3.

VI. The Observable Verifications

Case I: Rotation curve of the spiral galaxy NGC 2841

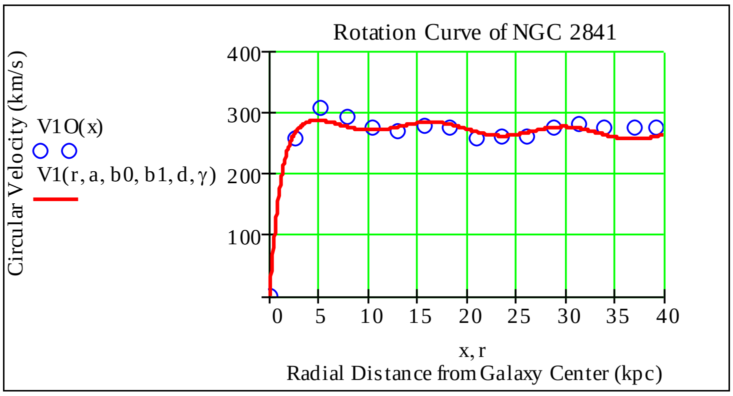


Figure b: shows the HI 21 cm rotation curve of the spiral galaxy NGC 2841. The observed circular velocity is shown in small blue circles, which is highly congruence with the predicted theory shown in solid red line. The chosen parameters to match the observation data are; $a=0.029$, $b_0=1.0$, $b_1=0.032$, $d=2.6$, $\gamma = 2.1$, $\theta = \frac{\pi}{2}$, $\beta = 6$, $Rg = 40$.

Legend: *V1O(x)*: the measured observations [7] (Blue O's).
***V1(z, a,b_0, b_1, d, γ):*the theoretical curve, equation (14), with the shown chosen parameters (Solid red line).**

Using equations (14) and (12-13) to draw the rotation curve of the spiral galaxy NGC 2841 [7], shown in figure b. The figure shows the observation of the rotation curve of the circular velocity plotted against radial distance. The high congruence between the theoretical curve and the measured observation data confirms the correctness of the adopted theory.

Case II: Rotation curve of the spiral galaxy NGC 3198

Similarly, using equations (14) and (12-13) to draw the rotation curve of the spiral galaxy NGC 3198, shown in figure c [7]. The figure gives the rotation curve in the form of the circular velocity plotted against radial distance.

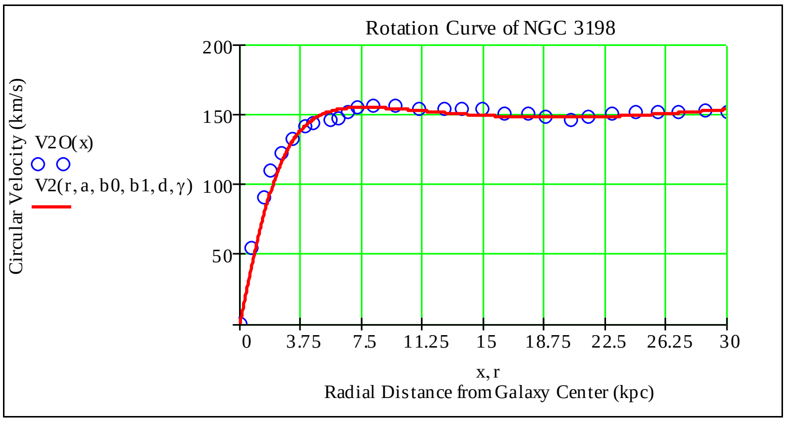


Figure c: shows the spiral galaxy NGC 3198 and its HI 21cm radio rotation curve. The observed circular velocity is shown in small blue circles, which is highly coinciding with the predicted theory, equation (11). The chosen parameters to match the observation data are; $a = 0.0162$, $b_0 = 1.2$, $b_1 = 0.09$, $d = 10$, $\gamma = 2.2$, $\beta = 1$, $\theta = \pi/2$, $Rg = 30$.

Legend: V2O(x): the measured observations (Blue O's).
V2(r,a,b,d, γ):the theoretical curve, equation (14), with the shown chosen parameters (Solid red line).

The high congruence between the theoretical curve and the measured observation data is a second confirmation of the correctness of the adopted theory.

Case III: Rotation curve of our Milky Way galaxy

Similarly, using equations (14) and (12-13) to draw the rotation curve of our Milky Way galaxy, shown in figure d. The figure gives the rotation curve in the form of the circular velocity plotted against radial distance. The observation is taken from **"The Essential Cosmic Perspective, by Bennett et al [8]".**

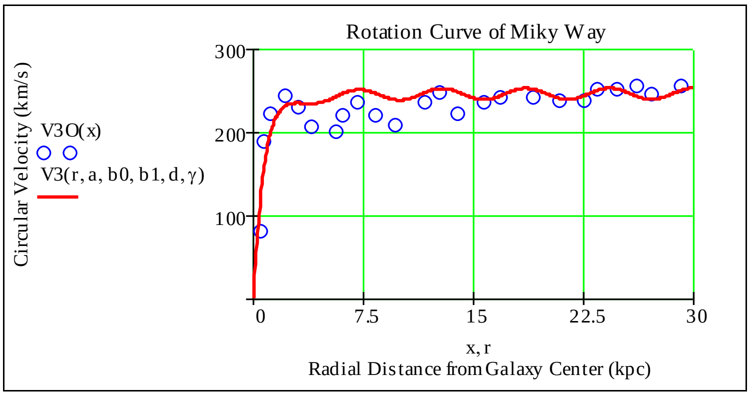


Figure d: shows rotation curve of our Milky Way Galaxy. The observed circular velocity is shown in small blue circles, which shows the compatibility between the observed values and the predicted theory shown in solid red line. The chosen parameters of the theory to match the observation data are; $a = 0.025$, $b_0 = 0.9$, $b_1 = 0.025$, $d = 1$, $\gamma = 2$, $\theta = 3\pi/2.$, $\beta = 7$, $Rg = 20$ *(Radius of Milky Way = 15.3374 kpc).*

Legend: V3O(x): the measured observations (Blue O's)
V3(r, a, b_0 , b_1, d, γ): the theoretical curve, equation (14), with the shown chosen parameters (Solid red line).

The high congruence between the theoretical curve and the measured observation data is a third confirmation of the correctness of the adopted theory.

VII. Comparison with NFW and Einasto profiles

The Navarro-Frenk-White (NFW) profile is often used to model the distribution of mass in dark matter halos of galaxies, [9-10] and is given by:

$$\rho(r) = \frac{constant}{(r/a)(1+r/a)^{\gamma}} \quad (15)$$

It clear that equation (15) is infinite at $r = 0$, i.e. $\rho(0) = \infty$. Also, theoretical dark matter halos produced in computer simulations are described by the Einasto profile [11-12] which is given by;

$$\rho(r) = \rho_0 \, e^{-\alpha r^n} \quad (16)$$

Using equations (15) and (16), and inserting the parameters derived in this paper, e.g. $\rho_0 = 4.286 \times 10^{23}$ Kg/m3, and the best choice of other parameters are shown in the legends.

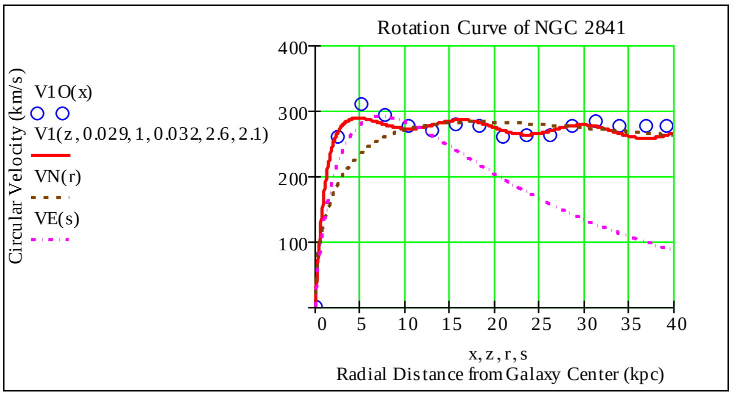


Figure *e*: shows the comparison curves between NFW, Einasto profiles and the theory presented in this paper, when compared with the rotation curve of NGC 2841 Galaxy. The chosen parameters of the theory to match the observation data are in order; $a = 0.029$, $b_0 = 1$, $b_1 = 0.032$, $d = 2.6$, $\gamma = 2.1$, $\theta = \pi/2$, $\beta = 6$, $Rg = 40$.

Legend: V1O(x): the measured observations (Blue O's)
V1(z, a, b_0, b_1, d, γ):the theoretical curve with chosen parameters (Solid red line).
VN(r): NFW Profile with adapted parameters (Brown dashes; constant = 1.096×10^{13}, a = 1, γ = 2
VE(s): Einasto Profile with adapted parameters (Magenta dash-dots); α = 1, n =0.6

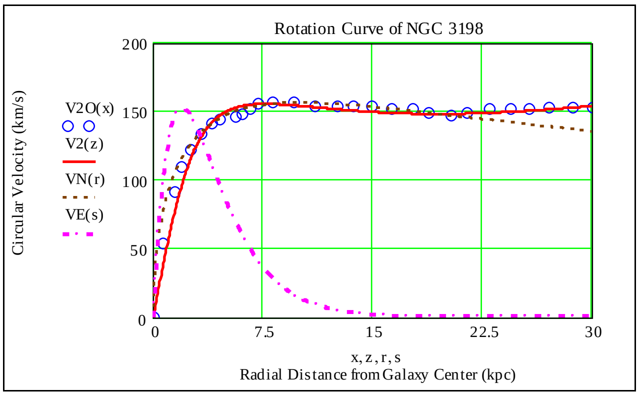


Figure *f*: shows rotation curves of NFW, Einasto profiles and the theory presented in this paper, when compared with the rotation curve of NGC 3198 Galaxy. The chosen parameters of the theory to match the observation data are: $a = 0.0162$, $b_0 = 1.2$, $b_1 = 0.09$, $d = 10$, $\gamma = 2.2$, $\beta = 1$, $\theta = \pi/2$, $Rg = 30$.

Legend: V2O(x): the measured observations (Blue O's)
V2(z, a, b_0, b_1, d, γ):the theoretical curve with chosen parameters (Solid red line).
VN(r): NFW Profile with adapted parameters (Brown dashes; constant = 1.096×10^{13}, a = 1, γ = 2.
VE(s): Einasto Profile with adapted parameters (Magenta dash-dots); α = 1, n = 1.

It is clear from figures ***e*** and ***f,*** the high accuracy of our profile to represent the observable data over those of NFW and Einasto profiles.

VIII. The study of the variation of the cosmic parameters

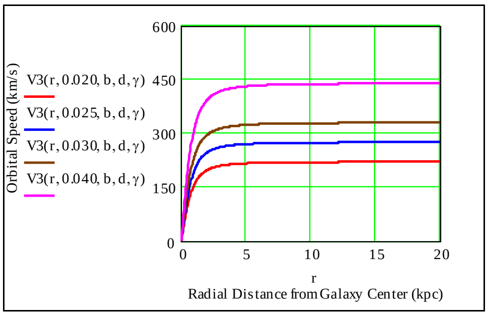


***Fig g-a*:** Using equation (14), with the following parameters*: a= variable as shown, b=1, d=1, γ=2*

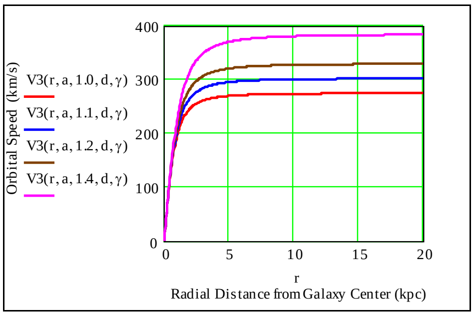


***Fig g-b*:** Using equation (14), with the following parameters*: a= 0.032, b=variable parameter, d=1, γ=2*

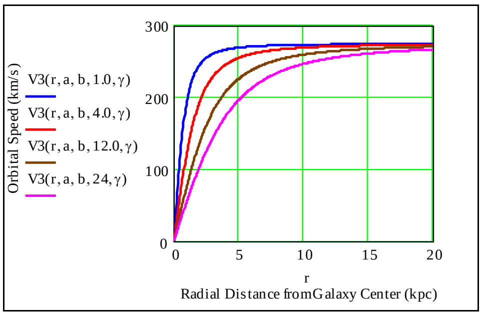


***Fig g-*c:** Using equation (14), with the following parameters*: a= 0.032,b=1, d=variable parameter, γ=2*

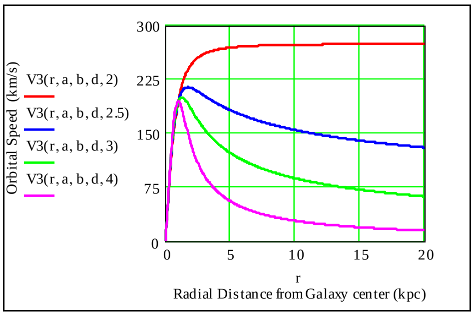


Fig g-d: Using equation (14), with the following parameters*: a= 0.032,b=1, d=1, γ= variable parameter*

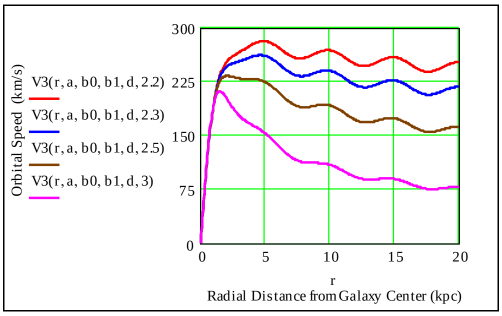


Fig g-e: Using equation (14), with the following parameters*:* $a = 0.03$, $b_0 = 1$, $b_1 = 0.03$, $d = 2$, *γ= variable parameter* as shown.

Figures g (a, b, c, d and g): show the variation of the cosmic parameters and their effects on the shapes of the rotation curves of galaxies.

Figures g (a, b, c, d and g) show the variation of the cosmic parameters and their effects on the rotation curves of the galaxy, using equations (12), (13) and (14). Different parameters are written into the attached boxes. The common chosen parameters are; $a = 0.032$, $b_0 = 0.85$, $b_1 = 0.025$, $d = 1$, $\gamma = 2.15$, $\theta = 3\pi/2.$, $\beta = 8$, $Rg = 20$. The figures show the wide range of the velocity rotation curves of galaxies covered by the given equations (12), (13) and (14).

IX. In Search of the Mass of Dark Matter Particle

Most of physicists believe in the existence of the dark matter particle [1-3]. In this section we will give estimation to the mass of this particle, based on the following hypotheses:

1. The order of volume of DM particle is the same as the volume of the electron volume.
2. The number of dark matter particles per unit volume at any location is proportional to the density of the dark matter at the same location.
3. No separating space between any two adjacent DM particles near the center of the galaxy, i.e. near the black hole.

Now substitute the parameters of Milky Way and NGC 2841galaxies, given in figures (d) and (b), into equations (12) and (13), we can draw the density distribution curves of the dark matter into these two Galaxies as shown in figure (h).

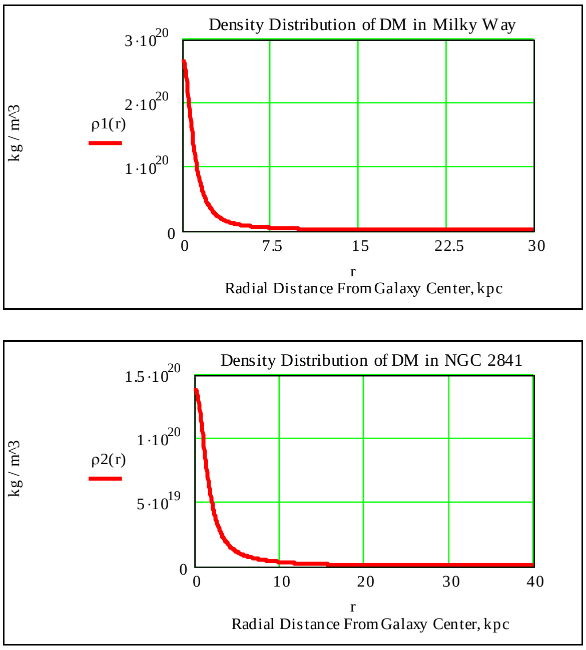


Figure h: The density distribution curves of Milky Way and NGC 2841 Galaxies. The chosen parameters are the same as those given for the two galaxies in figures (d) and (b).

Referring to table I, the classical radius of the electron equals (**2.8179×10^{-15}**) meter, then its volume will be equal to (**9.3727×10^{-44}**) meter^3. The number of dark matter particles per unit volume (which is equal to the number of electrons per unit volume) will be (**1.066927×10^{43}**) particles (compare this number with Avogadro's No. **$6.02214199 \times 10^{23}$** molecules). Then, the mass of the dark matter particle in kg as calculated in our Milky Way Galaxy is simply obtained by dividing, $\rho(0) = 2.6787 \times 10^{20}$ kg/m^3, by this number, i.e. by (**1.066927×10^{43}**), to get **(2.5107×10^{-23} kg) or (1.40814×10^{13} eV) or (14.08 Tera-electron volts).**

The mass of the DM particle, can also be obtained if we calculate the density of dark matter at the solar system, i.e. at Earth location from the center of the galaxy (i.e. at, 28000 ly = 8.589 kpc, see table I), where $\rho(8.589) = 2.906219 \times 10^{18}$ kg/m^3, and divided this number by the number of DM particles at solar system, using the second hypothesis, (1.1575×10^{41} particle), we get the same mass as before. Also it should be noted that, this mass is an estimated value, which will be considerably changed as the number of the dark matter particles is changed.

To get an idea about the density of DM of the absolute space just right after the Milky Way galaxy (neglecting the effect of the 54 galaxies of the local group), we just substitute the radius of the Milky Way galaxy (50,000 ly = 15.337 kpc) into the expression of the density to get (8.732×10^{17} kg/m^3).

If we follow the same steps as before, and use the same number of DM particles near the center of the Galaxy, viz. (**1.066927×10^{43}**) particles, we can calculate the mass of DM particle in galaxy NGC 2841, to get:

(1.299392×10^{-23} kg) or (7.28767×10^{12} eV) or (7.28767 Tera-electron volts). However, if the number of DM particles in NGC 2841is reduced to (**5.5217×10^{42}**), i.e. is reduced by about 48.24%, particles instead of using that of Milky Way number, viz. (**1.066927×10^{43}**) particles, we get the same mass as that calculated in the case of our Milky Way galaxy.

Of course, the range of the estimated mass of the DM particle (7.28 – 14.08 TeV) as calculated using the parameters of these two galaxies is within the range of CERN's reactivation in late 2014 [16]. However, the author is not expecting to detect this particle, because it is unseen matter with incredible density, and neither emits nor absorbs light or other electromagnetic radiation at any significant level. So the advice to physicists is go back first to the three inexpensive experiments given in references [4-6] to be sure about the meaning of the flow of (dark) matter, with a density 5.8×10^{19} heavier than the solid steel density (see table I), to shorten the way of understanding the physical world first, and then we can think about the effect of the high energy collisions of baryonic matter (as well as leptons) embedded into the dark matter, on the dark matter itself.

X. Conclusion

In this paper, a new theory based on the concepts of fluid mechanics, has been introduced, for the first time, to derive the density of the dark matter, and its distribution inside galaxies and beyond. Although the results are chocking, however they give a high congruence with the measured observations of rotating curves of galaxies. The proposed general density profile in this paper, with cosmic parameters, exhibits superiority over the other existing profiles. The correctness of the theory presented has been confirmed by the measurements of the cosmic observations of the rotation curves of the spiral galaxies NGC 4841, NGC 3198 and our Milky Way Galaxy. The paper studies the variation of the cosmic parameters of the predicted rotation velocities to show the wide range of galaxy's velocity curves covered by this theory. The comparison with NFW and Einasto profiles shows the superiority of the given profile over them. An estimation of the mass of the dark matter particle is given, and it shows that this mass is within the range of CERN's reactivation in late 2014, which may be detected by CERN experiments. However, the author is not expecting to detect this particle as mentioned before in section IX. Also, this paper may be a promise by the second coming of Aether with a new name; "Dark Matter"!

In short; this paper is considered a bold step in understanding the nature of dark matter and shows our inability to fully understand the physical world so far, and then we have to accept the act of GOD, and know the meaning of the Almighty Creator.

References

[1]. LUX Dark Matter Experiment; http://luxdarkmatter.org/

[2]. Large Underground Xenon experiment (LUX); http://en.wikipedia.org/wiki/Large_Underground_Xenon_experiment

[3]. Super Cryogenic Dark Matter Search (CDMS); http://cdms.berkeley.edu/

[4]. M. E. Isma'eel, Sherif M. E. Ismaeel; "Gravitational Blue Shift Confirms the New Phenomenon of the Vertical Aether Flow into any Mass", IOSR Journal of Applied Physics (IOSR-JAP), e-ISSN: 2278-4861. Volume 5, Issue 1 (Nov. – Dec. 2013), PP 08- 14, www.iosrjournals.org

[5]. M. E. Isma'eel, Sherif M. E. Ismaeel; "The Phase Theory towards the unification of the Forces of Nature, The Heart beat of the Universe", IOSR Journal of Applied Physics (IOSR-JAP), e-ISSN: 2278-4861. Volume 5, Issue 5 (Jan. 2014), PP 16 - 25, www.iosrjournals.org

[6]. M. E. Isma'eel; "The Last Chapter of the Symphony of Existence"; A Book (1st edition Publisher: Wahba, Egypt, 2010 - 2nd edition, Publisher: Author House, UK, 2012); http://www.amazon.com/The-Last-Chapter-Symphony-Existence/dp/1477234039#reader_1477234039 http://www.amazon.com/The-Last-Chapter-Symphony-Existence/dp/1477234039#_

[7]. A. Bosma; "21-cm LINES STUDIES OF SPIRAL GALAXIES. I. OBSERVATION OF THE GALAXIES NGC 5033, 3198, 5055, 2841, AND 7331". The Astronomical Journal, Volume 86, Number 12, December 1981.

[8]. Jeffrey O. Bennett, Megan O. Donahue, Nicholas Schneider, Mark Voit; " The Essential Cosmic Perspective (6th Edition), Chapter 16, p 447-449".

[9]. Julio F. Navarro, Carlos S. Frenk, Simon D. M. White, (May 10, 1996). "The Structure of Cold Dark Matter Halos", The Astrophysical Journal 463: 563. arXiv: astro-ph/9508025. Bibcode:1996 ApJ...462..563N. doi:10.1086/177173

[10]. Navarro Frenk White profile, Wikipedia; http://en.wikipedia.org/wiki/Navarro%E2%80%93Frenk%E2%80%93White_profile

[11]. Einasto Profile, Wikipedia; http://en.wikipedia.org/wiki/Einasto_profile

[12]. E. Retana-Montenegro, E. Van Hese, G. Gentile, M. Baes, and F. Frutos-Alfaro; "Analytical properties of Einasto dark matter haloes", A&A 540, A70 (2012); DOI: 10.1051/0004-6361/201118543

[13]. David Merritt; "Dark Matter at the Centers of Galaxies", Chapter 5 from Particle Dark Matter: Observations, Models and Searches; Ed. G. Bertone (Cambridge University Press). arXiv: 1001.3706v3 [astro-ph.CO] /9508025. 18 Mar 2010.

[14]. David Merritt,1 Julio F. Navarro, Aaron Ludlow and Adrian Jenkins; "A UNIVERSAL DENSITY PROFILE FOR DARK AND LUMINOUS MATTER"; The Astrophysical Journal, 624:L85–L88, 2005 May 10.

[15]. Nature Publishing group 2001, "Dark Matter in Galaxies"; ENCYCLOPEDIA OF ASTRONOMY AND ASTROPHYSICS, Registered No. 785998.

[16]. Large Hadron Collider; http://en.wikipedia.org/wiki/Large_Hadron_Collider

Table I: Universal Constants and Derived Parameters Used in this Paper

#	Name	Symbol	Value	Units
1	Classical Radius of Electron	r_e	2.8179×10^{-15}	m
2	1 electron Volt	eV	1.60217×10^{-19} 1.783×10^{-36}	J kg
3	Speed of light	c	$299{,}792{,}458 \sim 3 \times 10^{8}$	m/s
4	Gravitational Constant	G	6.67384×10^{-11}	$m^3 / (kg \cdot s^2)$
5	Light Year	ly	9.461×10^{15}	m
6	Parsec (= 3.26 ly)	pc	3.0857×10^{16}	m
7	Astronomical Unit	Au	1.496×10^{11}	m
8	Distance between Earth and Sun	D = 1 AU	1.496×10^{11}	m
9	Mass of Earth	M_E	5.97219×10^{24}	kg
10	Radius of Earth at Equator	R_E	6.378×10^{6}	m
11	Density of Earth	ρ_e	5.495×10^{3}	Kg/m^3
12	Mass of Sun (Solar Mass)	M_s	1.98855×10^{30}	kg
13	Radius of Sun at Equator	R_s	6.963×10^{8}	m
14	Density of Sun	ρ_s	1.406×10^{3}	Kg/m^3
15	Number of stars in a galaxy	N	$(2\text{-}4) \times 10^{11}$ star	Cardinal Number
16	Radius of Milky Way Disc	R_{MW}	(50,000 ly), (15.3374 kpc)	Ly, kpc
17	Distance of Sun from the Center of Milky Way	D_s	28000 ly	8.588957 kpc
18	Mass of galaxy*	M_G	6.363×10^{41}	kg
19	Average Density of Milky Way Based on Visible Matter	ρ_G	2.266	Kg/m^3
20	Mass of black hole** $(4.5 \pm 0.4) \times 10^6$ Solar Masses	M_{bh}	8.551×10^{36}	kg
21	Radius of black hole ($2GM_{bh}/ c^2$)**	R_{bh}	1.27×10^{10}	m
22	Density of Black Hole**	ρ_{bh}	9.968×10^{5}	Kg/m^3
23	Density of dark matter close to the black hole due to all the stars of the Milky Way Galaxy	ρ_{bhG}	4.571×10^{23}	Kg/m^3
24	Density of dark matter at the solar system	ρ_{dms}	2.9062×10^{18}	Kg/m^3
25	Density of dark matter just beyond Milky Way	ρ_{dmby}	8.7322×10^{17}	Kg/m^3
26	Density of steel	ρ_{steel}	7.850×10^{3}	Kg/m^3

* Based on, $M_G = N \times M_s$, $N = 3.2 \times 10^{11}$ stars.
** Based on, $M_{bh} = 4.3 \times 10^6$ Solar Masses.

Note: Since this paper introduces a new theory, so it is imperative to present it in a clear and in an unambiguous way. So, this table is designed to make the paper self-contained and to facilitate the process of following up and reviewing the calculations of the parameters derived in this paper even by using a calculator, as almost all papers published in this field is shrouded in mystery.