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1. ABSTRACT

After the success of the DG theory explaining the data known for DM in M31 and Milky Way and published in [1] Abarca,M., it is right to check the same theory in M33, because DG theory aims to be a universal theory as it is based on a quantum gravitation effect.

Taking as starting point the remarkable rotation curve of Corbelli,E , and applying DG theory it has been possible to show that DG matter in M33 cannot explain the total amount of DM needed to justify the rotation curve of M33. Therefore, it has been postulated that the extra amount of DM is dark baryon. Even such mass has been estimated roughly.

Similarly, thanks a rotation curve of LMC got by Vasiliev,E. and applying DG theory has been demonstrated that in LMC there is a DM proportion at least four times bigger than such proportion in MW. Therefore in order to preserve the DG theory as universal based on a property of gravitational propagation, it has been postulated the existence of an important amount of dark baryonic.

Consequently this conclusion arises an extraordinary test to check the DG theory.

Currently, it has been published a method called nanolensing which might be applied to search a type of dark baryon called SULCOs (Sub Lunar Compact Object) in Milky Way and LMC. Possibly, it could be made measures of DB in the Milky Way and LMC in a close future.

If measures backed the proportion of DB predicted by the theory then DG theory would be a real theory able to explain DG as a universal law.

A second important result showed in the paper is related to the concept of Dark Gravitational mass, DG, because according the theory, the calculus of DG mass has to be extended up to the distance where is placed the interacting system. For example, when it is studied the interaction between M33 and M31, the distance to calculate the DG mass has to be 220 kpc, not only for DG mass of M33 but also for M31, whereas when it is studied the interaction between MW and M31 then both DG masses has to be calculated for a distance of 770 kpc.

By DG theory has been found a lower bound for total masses of M33 and LMC. It has not been possible to calculate a more accurate value of masses for both galaxies because the rotation curve published are a bit short and even at the furthest radius of rotation curve, the proportion of baryonic matter versus DG mass is too high to be neglected. Consequently the parameter C, which is the initial condition of a Bernoulli differential equation, cannot be calculated properly. It would be suitable new measures of rotation curves of M33 especially for radius bigger than 23 kpc in order to calculate parameter C with more accuracy.

It worth to highlight an interesting property of DG mass formula, which is that its value tends to a finite value, Mo, as variable X grows indefinitely. Physically is important that mass does not tend to infinite. However the NFW formula for mass tends to infinite as x grows, so it is only right inside a bounded halo dominion. Similarly it happens with Burkert DM mass, which is unbounded as x grows.

Another important result got in this paper is a very good estimation of Local Group total mass.

According [13]Fattahi & Navarro the dynamical mass at 3 Mpc in the Local Group gives a mass of 10^{13} Msun. Calculus made with DG theory at such distance gives a total mass bigger than $7*10^{12}$ Msun, when it is considered M31, M33, Milky Way and LMC, obviously when is added the total mass of the rest of dwarfs galaxies of Local Group the total mass will be even more close to the value estimated by Fattahi & Navarro.

There is no doubt that this is a magnificent result for DG theory.

2. INTRODUCTION

As the theory developed in this paper has been widely explained in previous papers, it is important to study such theory in [1]Abarca,M. where it is studied M31 and Milky Way rotation curve by an original theory whose main hypothesis is that dark matter is generated by the gravitational field according an unknown quantum gravitation effect.

The main advantage of this theory is that it contains several constants common for all galaxies, and one constant which is the initial condition to solve a Bernoulli differential equation for gravitational field in the halo region. Thus this theory aims to be universal for all galaxies. Not only for giant galaxies such as M31 or MW but for M33 or dwarf galaxies.

In the previous paper [1]Abarca,M. are got the total masses of M31 and MW and results match quite well with NFW model made by other authors. As it is known both galaxies are similar in size, baryonic mass and proportion of baryonic matter versus dark matter, although MW has a proportion of baryonic mass lightly bigger than M31. The theory of DG theory explain perfectly all these characteristic, using some constant common for both galaxies and only one parameter different related to the initial condition of field at the beginning of the galactic halo.

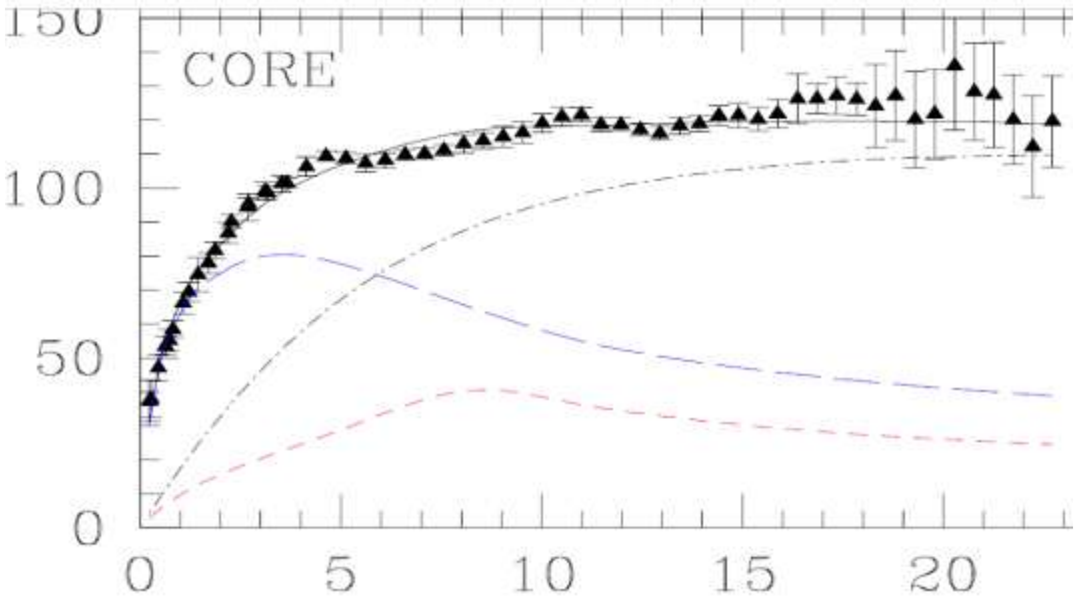
M33 galaxy is a new challenge because DM proportion is far bigger than such proportion in M31 or MW. However, the theory of DG theory is based on a universal effect. Therefore it is vital for the theory to be able to explain DM in M33. This is the reason of this paper.

Data from this paper has been got from [2]Corbelli,E.2014. The baryonic visible matter, stars and gas, has a mass $M=7*10^{11}$ Msun, and the dynamical analysis of M33, gives the parameters of NFW halo: $M_h = 4.3 \pm 1*10^{11}$ Msun and C = 9.5 which is in agreement with ΛCDM predictions.

The starting point of this paper is the remarkable rotation curve of Corbelli, afterwards it is developed the Burkert profile for DM density with data published in [2]Corbelli, in order to be compared with DG density profile called Bernoulli profile which is the specific profile associated to the DG theory . Hereafter, the mass generated by gravitational field will be named symbolically DG mass.

The main thesis defended in this paper is that the total amount of DM inside the galaxy M33 is composed by two types of DM, by one side DG mass, which may be calculated by the DG theory and a bigger fraction of DM which is called dark baryon, DB, because could be composed by little planets of solid Hydrogen, mainly with sub lunar dimension. This type of baryonic matter is quite hard to detect, because does not emit radiation. Fortunately, there is a method called nanolensing able to detect planets whose masses ranges between 10^{-11} Msun and 10^{-7} Msun. Probably in a close future there will be some measures by this method.

3. OBSERVATIONAL DATA FROM CORBELLI PAPER



Graphic come from [4] E Corbelli, 2014. Fig. 1

In the rotation curve of M33, data are filled triangles and the best fitting model is the solid line. Dark matter halo with a constant density core is known as Burkert profile. The dark halo contribution to rotation curve is shown with a dashed and pointed line. The small and large dashed lines show respectively the gas and stellar disk as contribution to the rotation curves.

Radius-kpc	Vel km/s
8	116,3
9	118,7
10	118,7
11	118,7
12	119,3
13	118,7
14	119,3
15	119,88
16	119,88
17	119,88
18	119,88
19	119,88
20	119,88
21	119,88
22	119,3

According DG theory , velocity curve decreases depending on radius by $R^{-0.25}$ inside the region where there is not baryonic matter. As it was demonstrated mathematically in [1] Abarca,M. Chapter 9.

From the graphic it is impossible to deduce a decreasing rotation curve, quite the contrary from 10 kpc up to 22 kpc is quite flat. Therefore this fact suggest there is another type of matter different of visible baryonic matter or gravitational DM. Hereafter, such unknown matter will be named as dark baryonic, because it is right to be baryonic such as little planets made of solid H_2, like the Moon or smaller. As it is known, these objects are very difficult to observe.

The graphic, comes from [2] Corbelli,E .

The magenta represents region with stars, whereas the pink represents region with HI gas.

The cyan curve represents the velocity associated to visible baryonic mass, stars and gas.

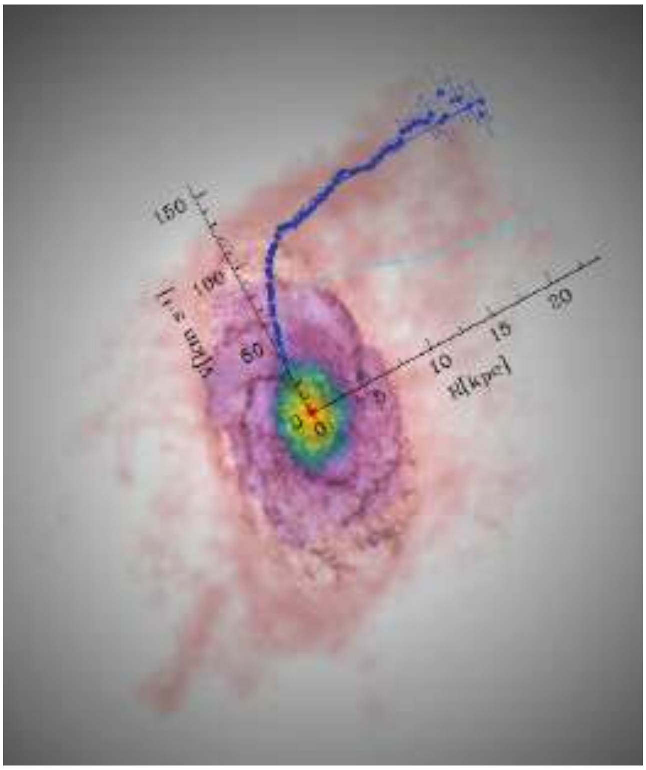
It is clear that there is an enormous lack of mass to get the rotation curve measured represented in blue.

In picture it is possible to see that at 22 kpc there is still gas. Therefore, it is right to consider that at 22 kpc baryonic density is not negligible versus DM density.

Furthermore, in [1] Abarca, was calculated that for Milky Way it is necessary to go up to 35 kpc to get a negligible amount of baryonic density regarding gravitational DM. However it is accepted that Milky way disk extends only up to 20 kpc.

Similarly happens for M31, where it is needed to go up to 40 kpc to get a negligible density of baryonic density.

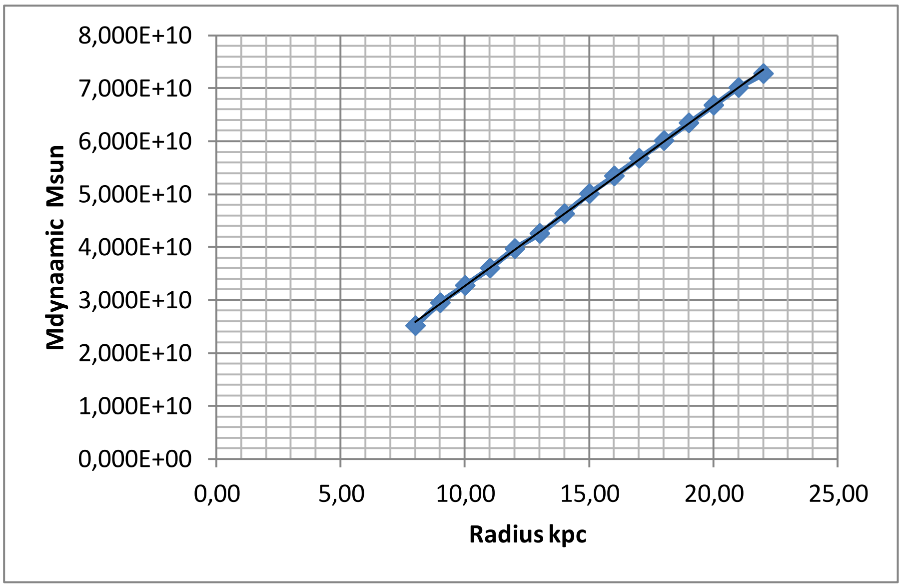
Therefore it is right to think that it is needed to go further 22 kpc to get an amount of baryonic density negligible regarding DG matter. Unfortunately there is not measures in the rotation curve beyond 22 kpc.



4. DYNAMICAL MASSES FOR M33

As it is known, dynamical mass formula is $M_{DYN}(<r) = \frac{V^2 \cdot r}{G}$

Radius kpc	Mdyn Msun
8,00	2,514E+10
9,00	2,947E+10
10,00	3,274E+10
11,00	3,601E+10
12,00	3,969E+10
13,00	4,256E+10
14,00	4,630E+10
15,00	5,009E+10
16,00	5,343E+10
17,00	5,677E+10
18,00	6,011E+10
19,00	6,345E+10
20,00	6,679E+10
21,00	7,013E+10
22,00	7,276E+10
23.00	7.6E+10



As it is shown in the above graph, the function of dynamical mass is very linear. However , according the theory of DM generated by field, the total mass in halo region is proportional to $R^{0.5}$, because velocity in halo region depends on radius according $R^{-1/4}$ being R the radius distance. See chapter 9 [1] Abarca,M. Therefore, there is in the halo a non negligible amount of baryonic mass far away from 22 kpc.

It is possible that inside a rich gas region would exist a bigger proportion of planets composed by solid hydrogen., which are very difficult to detect from the Earth.

In my opinion this phenomenon is a real possibility, especially for a small or medium size galaxy which is subdued by gravitational tide forces coming from M31. See [14]Fattahi&Navarro.

5. VISIBLE BARYONIC MASS IN M33

[2] Corbelli,E.2014 has studied carefully the visible baryonic mass getting these results.

Total gas in molecular form is $3*10^{8}$ Msun the region to calculate this gass is the whole extension where there is HI signal, which is up to 23 kpc

Total stellar mass

There is two results lightly different calculated with two different methods.

According BVI gi-mass map $M_{STARS} = 4.9 *10^{9}$ Msun, and according BVI-map $M_{STARS} = 5.5 *10^{9}$ Msun

Total mass HI = $1.53*10^{9}$ Msun

Adding these three types of baryonic matter is got $7.3*10^{9}$ Msun or $6.7 *10^{9}$ Msun depending on the stellar mass chosen, so is a good approximation to consider $7 *10^{9}$ Msun as the visible baryonic mass for M33.

5.1 RATIO BARYONIC-VISIBLE MASS VERSUS DYNAMICAL MASS AT 23 KPC FOR M33

$M_{DYN} < 23$ kpc = $7.57*10^{10}$ M sun and $M_{BARYONIC\text{-}VISIBLE} = 7*10^{9}$ M sun. Therefore $M_{BARYONIC\text{-}VISIBLE}$ versus M_{DYN} at 23 kpc = 0.092.

This ratio is almost four times lower than for M31 which is 0.32 at 40 kpc or for Milky Way which is 0.34 at 30 kpc, according data got from [1]Abarca,M.2019. Therefore, apparently the radius 23 kpc could be right to be considered as the border of halo. In other words, a place where baryonic matter is negligible regarding DG density.

The criterion followed to consider dynamical masses at 40 kpc for M31 or 30 kpc for Milky Way is that baryonic density is below 6% regarding DM density. In other words, is a criterion to consider an extended disc in order to guarantee that baryonic matter in the halo is negligible.

According DG theory, the rotation curve inside the halo decreases depending on radius with a power equal to -1/4. However, in M33 at 22 kpc the rotation curve is flat. Therefore, there is a total contradiction because the proportion between visible baryonic matter versus dynamical mass at 22 kpc is far lower than such ratio in M31 at 40 kpc, but in M31 at such radius the rotation curve decreases with a power -1/4. The only way to explain this result, is that there is dark baryonic, that is to say, a no visible baryonic matter which allows to be flat the rotation curve.

Put in brief, in M33 at 23 kpc the ratio $M_{BARYONIC\text{-}VISIBLE}$ versus $M_{DYN} = 0.092$ which is four times lower than such ratio in M31 at 40 kpc. However in M31 with a bigger proportion of baryonic matter, at 40 kpc the rotation curve decreases with a power -1/4 whereas in M33 with far lower proportion of visible baryonic matter the rotation curve is flat. The only way to explain this fact is the existence of invisible dark baryonic to produce the flatness to the rotation curve.

The reason to explain this conclusion is that DG theory states that DG generation law is universal. In fact the rotation curve in halo region decreases with a power -1/4 similarly in M31 and Milky Way.

In other words or there is an important amount of dark baryonic in M33 halo or DG theory has to be rejected.

6. BURKERT DARK MATTER DENSITY PROFILE

According [2] Corbelli. 2014 these are Burkert profile parameters for M33.

Dark matter density Burkert profile.Corbelli.2014
Rs = 7.5 +-0.5 Kpc
Do = 0.018 Msun /pc^3

According [3] Lopez Fune. 2017 these are Burkert profile parameters for M33.

Dark matter density Burket profile. Lopez Fune
Rs = 9.6 +-0.5 Kpc
Do = 0.0123 Msun /pc^3

Rs is called length scale and Do is density scale.

$$D_{BURKET}(R) = \frac{D_0}{(1+x)\cdot(1+x^2)}$$ Where x= radius/ Rs

As the last set of parameters are more recent, these parameters has been chosen at present paper.

Below is tabulated such density profile.

Radius kpc	X	Dens Burkett
1	0,104	7,91E-21
3	0,313	2,43E-21
5	0,521	1,26E-21
7	0,729	7,46E-22
9	0,938	4,73E-22
11	1,146	3,14E-22
13	1,354	2,17E-22
15	1,563	1,55E-22
17	1,771	1,14E-22
19	1,979	8,56E-23
21	2,188	6,58E-23
23	2,396	5,16E-23
25	2,604	4,11E-23

Total DM Burkert inside a sphere

D. M. density Burket profile- Lopez Fune.2017
Rs = 9600 pc
Do = 0.0123 Msun /pc^3

It is right to get by integration the total Burkert – DM contained inside a sphere with radius R whose formula is

$DM(<R) = Mo * F(X)$ Where $Mo = 4\pi R_S^3 Do$ =1.367*10^{11} Msun being X = R/Rs and

$$F(X) = \frac{1}{4}\cdot\left[Ln(X^2+1) + 2Ln(1+X) - 2ATAN(X)\right]$$

Radius Kpc	X=Radius/ Ro	Density Kg/m^3	F (X)	M_{DM}<R Msun
1	0,10416667	7,46407E-22	0,00034734	4,748E+07
3	0,3125	5,78271E-22	0,00781873	1,069E+09
5	0,52083333	4,30902E-22	0,02954528	4,039E+09
7	0,72916667	3,14551E-22	0,06539479	8,939E+09
9	0,9375	2,2885E-22	0,11179606	1,528E+10
11	1,14583333	1,67856E-22	0,16476571	2,252E+10
13	1,35416667	1,24881E-22	0,22113475	3,023E+10
15	1,5625	9,44707E-23	0,27872015	3,810E+10
17	1,77083333	7,26979E-23	0,33613094	4,595E+10
19	1,97916667	5,68713E-23	0,39252805	5,366E+10
21	2,1875	4,51785E-23	0,44743315	6,116E+10
23	2,39583333	3,6399E-23	0,50059626	6,843E+10

As at 22 kpc has been got total baryonic mass, it is possible a quick verification of different types of masses.

Baryonic mass M_B = 0.7E10 Msun + M_{DM} < 23 kpc = 6.84E10 Msun is equal to 7.54E10 Msun whereas

M_{DYN} < 23 = 7.57E10. So there is a very good agreement. In other words, Burkett profile fits perfectly the mass inside the galactic disk.

As Burkert profile is just a method to fit the extra DM which is needed to add to baryonic matter to explain the dynamical mass, there is not any physical justification to extend beyond rotation curve measures the calculus of mass for Burkert profile. However it is interesting to study the behaviour of Burket total DM mass up to 220 kpc because according DM theory by gravitational field actually halo radius is the distance between both galaxies,namely M31 and M33.

Below is tabulated in detail Burkert density and Burkert total DM up to 220 kpc.

Radius kpc	X=R/Ro	Den. DM Kg/m^3	F (X)	M_{DM}<R Msun
15	1,5625	9,44707E-23	0,27872015	3,810E+10
19	1,97916667	5,68713E-23	0,39252805	5,366E+10
21	2,1875	4,51785E-23	0,44743315	6,116E+10
23	2,39583333	3,6399E-23	0,50059626	6,843E+10
25	2,60416667	2,97043E-23	0,55190914	7,545E+10

30	3,125	1,876E-23	0,67207587	9,187E+10
35	3,64583333	1,25469E-23	0,78136498	1,068E+11
40	4,16666667	8,78188E-24	0,88104692	1,204E+11
45	4,6875	6,37624E-24	0,97240468	1,329E+11
50	5,20833333	4,77093E-24	1,056574	1,444E+11
60	6,25	2,86828E-24	1,20704039	1,650E+11
70	7,29166667	1,85485E-24	1,33839809	1,830E+11
80	8,33333333	1,26711E-24	1,4548185	1,989E+11
90	9,375	9,03344E-25	1,55928547	2,132E+11
100	10,4166667	6,66371E-25	1,65398932	2,261E+11
120	12,5	3,92439E-25	1,8203209	2,488E+11
140	14,5833333	2,50199E-25	1,96304737	2,683E+11
160	16,6666667	1,69155E-25	2,08800947	2,854E+11
180	18,75	1,19645E-25	2,19912699	3,006E+11
200	20,8333333	8,77122E-26	2,29915483	3,143E+11
220	22,9166667	6,62014E-26	2,39010177	3,267E+11

According [2]Corbelli, E. 2014 The halo total DM mass is M_h =4.3E11 Msun and C= 9.5 (parameter of concentration). Both parameters belong to NFW model of DM.

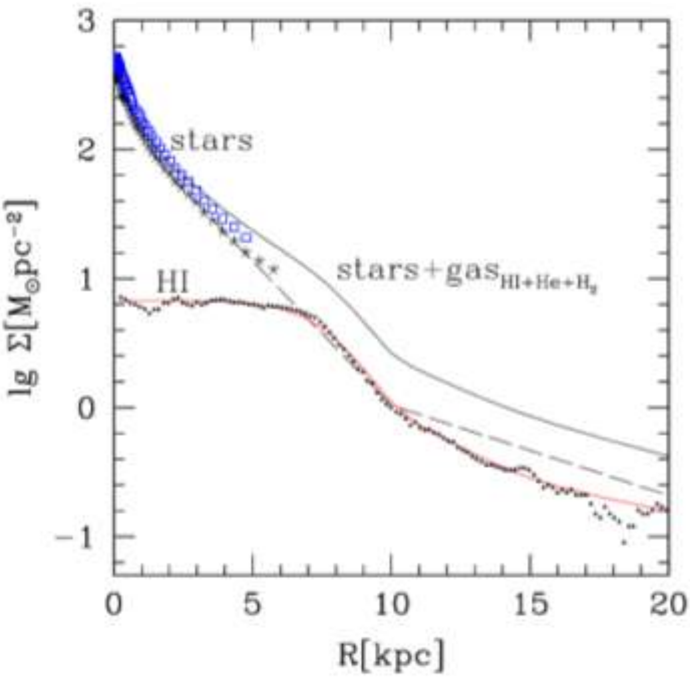
As it has been shown above, Burket total DM up to 220 kpc is 75% of the halo DM mass under NFW model according calculus published by Corbelli,E. 2014.

7. COMPARISON VISIBLE BARYONIC DENSITY VERSUS BURKERT DENSITY

7.1 VISIBLE BARYONIC VOLUME DENSITY

Before begin this paragraph it is important to highlight that baryonic matter always refers to stars and gas, that is visible matter because it is possible to detect from the Earth.

Thanks the remarkable graph published by [2] Corbelli. It is possible to get by numerical analysis the function of baryonic volume density. As mass scale is logarithmic the most suitable fitting function is an exponential. Namely is $D_{BARYONIC\text{-}SURFACE} = p*e^{q*r}$ being p = 115.9 Msun/pc^2 and q = -3.1348*10^{-4} pc^{-1}. Notice that previous formula $D_{BARYONIC\text{-}SURFACE}$ represents a surface density, which can be converted in volume density by the formula $D_{BARYONIC\text{-}VOLUME} = D_{BARYONIC\text{-}SURFACE} / (2* R)$. Hereafter $D_{BARYONIC\text{-}VOLUME}$ = $D_{BA\text{-}V}$. Being R the radius distance.



It is necessary to convert surface baryonic density into volume baryonic density in order to compare with Burkett DM density.

The upper continuous line plotted inside the graph represents the total baryonic density whereas the dashed line below represents the mass star density and the dotted line represent the gas density.

Surface Baryonic density $Msun/pc^2$	$D_{BARYONIC-SURFACE} = p*e^{q*r}$ being p = 115.9 $Msun/pc^2$ and q = -3.1348*10 $^{-4}$ pc^{-1}
Volume Baryonic density $Msun/pc^3$	$D_{BA-V}(R) = \frac{p \cdot e^{q \cdot R}}{2 \cdot R}$ and being R the radius distance.

7.2 COMPARISON BURKERT DENSITY VERSUS VISIBLE BARYONIC DENSITY

Radius kpc	Den. Burkertt	Den. BA-V Kg/m^3	Burkert / Baryonic
1	7,912E-21	2,739E-21	2,89E+00
3	2,429E-21	4,877E-22	4,98E+00
5	1,258E-21	1,563E-22	8,05E+00
7	7,459E-22	5,966E-23	1,25E+01
9	4,730E-22	2,479E-23	1,91E+01
11	3,143E-22	1,083E-23	2,90E+01
13	2,171E-22	4,897E-24	4,43E+01
15	1,549E-22	2,267E-24	6,83E+01
17	1,138E-22	1,069E-24	1,06E+02
19	8,561E-23	5,108E-25	1,68E+02
21	6,583E-23	2,469E-25	2,67E+02
23	5,159E-23	1,204E-25	4,28E+02
24	4,111E-23	5,919E-26	6,95E+02
25	1,599E-23	1,839E-27	8,69E+03
26	7,737E-24	6,225E-29	1,24E+05
27	4,299E-24	2,216E-30	1,94E+06

By the table can be checked that for bigger radius than 11kpc the baryonic density represents less than 3% regarding DM density.

These results are in total disagreement with DG theory because according this theory when baryonic density is negligible versus DM (by the gravitational effect) then the velocity declines according $R^{-1/4}$. However the rotation curve is quite flat up to 20 kpc and beyond. Therefore, supposing that DG law is right for M33, the flatness of rotation curve is the first evidence that in the disk region of M33 there are enormous quantity of non gravitational DM. This matter could be perfectly cold planets, dark baryons are named in this paper, because it is very difficult to detect.

Newly it is important to insist that Burkertt profile considers DM every type of matter which is different to baryonic visible matter, whereas DG matter is produced by field. Therefore if throughout the whole galactic disk the ratio Burkert DM versus Baryonic density is so high and rotation curve is flat then Burkett DM is not DG matter but mainly is another different type of non visible matter.

8. INTRODUCTION OF DARK GRAVITATIONAL THEORY FORMULAS

From the paper [1] Abarca, M.2019 has been extracted the beside parameters and formulas. It is advisable for reader to read previously such paper to know in detail the theory.

New parameters a&b - A&B calculated by M31 data	
B	5/3
$b = \frac{B-2}{2B-2}$	b = -1/4
a new	$4{,}727513 \cdot 10^{10}$
$A = \frac{a^{\frac{-4}{3}}}{8\pi G}$	New parameter A $3.488152 \cdot 10^{-6}$
$D = 8\pi GA = a^{\frac{-4}{3}}$	$5{,}85 \cdot 10^{-15}$

It is remarkable the fact that these formulas and parameters has been got from M31 rotation curve, and afterwards has been processed by the Buckingham theorem to get dimensional coherence. In the same paper the theory has been applied successfully to Milky Way, with the same constants A&B and a&b.

As the DG theory aims to be a universal theory it is vital to study M33 with the same parameters that M31 and Milky Way.

Hereafter, dark gravitational matter will be named, DG, in order to be differentiate regarding DM calculated with Burkert profile.

The theory has been developed for halo region where baryonic matter is negligible, because the Bernoulli differential equation was got under such condition. The solution for field is

$E(r) = \left(Cr^{\frac{4}{3}} + Dr\right)^{\frac{-3}{2}}$ being $D = 8\pi GA = a^{\frac{-4}{3}} = 5{,}85 \cdot 10^{-15}$ and $C = \frac{E_0^{\frac{-2}{3}} - D \cdot R_0}{R_0^{\frac{4}{3}}}$ the initial condition of differential equation solution for E. It is supposed that C should be got at the border of disc where the baryonic density begins to be negligible.

As it has been stated previously at 22 kpc the rotation curve is quite flat, therefore it is clear that the border is far away. In other words, at 22 kpc there is a non negligible amount of baryonic matter, especially non visible. Therefore the value for field E got under this parameter C will be a lower bound, and especially for radius close to 22 kpc the Bernoulli solution for field will be clearly lower than the real field.

Radius kpc	Velocity Km/s	Field $E= v^2/r$ m/s^2	Parameter C
22	119.3	2.097E-11	1.5388E-21

In table below are written Bernoulli formulas for field and for density.

Bernoulli field m/s^2	$E(r) = \left(Cr^{\frac{4}{3}} + Dr\right)^{\frac{-3}{2}}$	C= 1.5388E-21 D=5.85E-15	R radius m
Bernoulli density Kg/m^3	$D_{DM} = A \cdot E^{\frac{5}{3}}$	A=3.488E-6	

8.1 BURKERT DENSITY VERSUS BERNOULLI DENSITY FOR PARAMETER C AT 22 KPC

If it is accepted the D. Gravitational theory, DG, with the same parameters for all galaxies, then Bernoulli density has to be able to work inside the halo of M33 galaxy.

However this Bernoulli solution is only an approximation because the hypothesis to apply Bernoulli solution is that baryonic matter (visible or not) has to be negligible. However there is strong evidences that there is an important amount of dark baryonic matter inside the disk because the rotation curve is flat up to 22 kpc. Therefore, the Bernoulli solution is not able to give an exact solution for DG, throughout the halo. It is right to deduce that at such conditions the Bernoulli profile gives a lower bound to the real DG density.

1	2	3	4	5	6	7
Radius kpc	De. Burkett Kg/m^3	De. Bary. Visible Kg/m^3	De. Berni Kg/m^3	Berni. De. vs Bary.Visible Den.	Burket De. vs Berni. Den.	Burket vs Bary.visible Den.
15	1,549E-22	2,267E-24	1,80E-23	7,9E+00	8,6E+00	6,8E+01
17	1,138E-22	1,069E-24	1,23E-23	1,1E+01	9,3E+00	1,1E+02
19	8,561E-23	5,108E-25	8,73E-24	1,7E+01	9,8E+00	1,7E+02
20	7,488E-23	3,547E-25	7,46E-24	2,1E+01	1,0E+01	2,1E+02
21	6,583E-23	2,469E-25	6,42E-24	2,6E+01	1,0E+01	2,7E+02
22	5,815E-23	1,723E-25	5,56E-24	3,2E+01	1,0E+01	3,4E+02
23	5,159E-23	1,204E-25	4,85E-24	4,0E+01	1,1E+01	4,3E+02
24	4,596E-23	8,436E-26	4,25E-24	5,0E+01	1,1E+01	5,4E+02
25	4,111E-23	5,919E-26	3,75E-24	6,3E+01	1,1E+01	6,9E+02

In this table there are interesting comparisons between different types of densities.

Firstly, the sixth column shows clearly that Burkert density is approximately 10 times bigger than Bernoulli density. Therefore, according the theory DG theory, this fact shows that Burkert density is not only gravitational DM but by the contrary is mainly another type of matter. In my opinion, the most reasonable matter could be dark baryon. Which are very difficult to detect because of the tremendous distance to M33.

The fifth column shows that even at 20 kpc the proportion of Baryonic visible versus DG density is only 5%. Therefore if it were only visible baryonic the rotation curve of velocity would depend on radio by a power close to -1/4. However the curve is quite flat.

The seventh column shows that even at 15 kpc the Burket density is 68 times bigger than baryonic density and at 22 kpc is 340 times whereas Bernoulli DM is only 32 times.

8.2 BERNOULLI DENSITY WITH PARAMETER C AT 25 KPC

As it is known that at 22 kpc there is an important amount of non gravitational DM and consequently Bernoulli solution does not work properly with parameter C calculated at such point. It is needed to go further. As there is not measures beyond 22 kpc a possible approximation would be to consider the DM calculated by Burkert and add the baryonic matter of M33. So $M < 25$ kpc = $DM_{BURKERT} < 25$ kpc + $7*10^9$ M sun . Namely M< 25 kpc = $8.25*10^{10}$ Msun.

radius	Total mass	Eo	Parameter C
25 kpc	8.25E10 Msun	1.84E-11	1.39E-21

In this table the values of Bernoulli density has been calculated with the above parameter C. That is at 25 kpc.

Radius kpc	D. Burkert Kg/m^3	D. Baryonic Kg/m^3	D. Bernoulli Kg/m^3	D. Ber / D. Bary	D.Burk / Berni	D.Burk / Bary
25	4,111E-23	5,919E-26	4,47E-24	7,6E+01	9,2E+00	6,9E+02
30	2,476E-23	1,029E-26	2,55E-24	2,5E+02	9,7E+00	2,4E+03
35	1,599E-23	1,839E-27	1,59E-24	8,6E+02	1,0E+01	8,7E+03
40	1,089E-23	3,357E-28	1,05E-24	3,1E+03	1,0E+01	3,2E+04
50	5,687E-24	1,169E-29	5,25E-25	4,5E+04	1,1E+01	4,9E+05
60	3,327E-24	4,237E-31	2,97E-25	7,0E+05	1,1E+01	7,9E+06
80	1,419E-24	6,015E-34	1,21E-25	2,0E+08	1,2E+01	2,4E+09
100	7,303E-25	9,109E-37	6,00E-26	6,6E+10	1,2E+01	8,0E+11
140	2,674E-25	2,332E-42	2,08E-26	8,9E+15	1,3E+01	1,1E+17
180	1,260E-25	6,498E-48	9,36E-27	1,4E+21	1,3E+01	1,9E+22
220	6,909E-26	1,905E-53	4,95E-27	2,6E+26	1,4E+01	3,6E+27

It is possible to compare density Bernoulli at 25 kpc in both tables. In the former table with parameter C at 22 kpc field E = 3.75E-24 whereas in the later field E = 4.47E-24, which is a 19 % bigger.

Also it is possible to compare ratio D. Burkert/ D. Bernoulli, at 25 kpc. In the former such ratio was 11 whereas in the later is 9.2

This study allows to conclude that this new Bernoulli density is more trustworthy, especially because it has been got at a bigger radius where baryonic matter, visible or not, is more negligible than at radius 22 kpc.

9. TOTAL MASSES IN M33 AT 220 KPC AND 850 KPC

9.1 DARK GRAVITATIONAL MASS CONCEPT

According DG theory the DG mass depend on the scale, because such mass has to be calculated up to the distance between both systems that interacts gravitationally.

For example DG of M33 must be calculated up to 220 kpc when it is considered the interaction between M33 and M31. The DG of MW has to be calculated up to 770 kpc when it is studied the interaction between MW and M31 and conversely the DG mass of M31 has to be calculated up to 770 kpc by the same reason.

Even more, when it is studied the Local Group of galaxies, which has 3 Mpc as diameter, then the DG of each galaxy has to be calculated at least at 1.5 Mpc.

According [13]Fattahi &Navarro.2019. Dynamical mass of Local Group at 3 Mpc is 10^{13} Msun.

In the chapter 13, will be calculated the total mass of M31, MW, M33 and LMC at such distance getting a total mass $7*10^{12}$ Msun., which is a magnificent result of DG theory. Furthermore, the value of total masses got for M33 and LMC are only lower bound of the real total mass, as it will explain in detail. Therefore it could be got a bigger value of total mass for Local Group, improving the parameters of the DG theory. In addition, it is needed to add the mass of the rest of dwarf galaxies included in Local Group. Consequently, the calculus of Mass of Local Group is a big success of DG theory.

9.2 CALCULUS OF DG MASS OF A SPHERICAL CORONA INSIDE THE HALO REGION

In chapter 9 of [1] Abarca,M. has been shown the definite integral to calculate the DM contained inside a spherical corona defined by two radii.

Both radii have to be placed inside the halo because Bernoulli density is right only there.

$$M_{DM} = \int_{R1}^{R2} 4\pi \cdot r^2 \cdot \rho(r)dr = \int_{R1}^{R2} 4\pi \cdot r^2 AE^B dr = 4\pi A \int_{R1}^{R2} r^2 \left[C \cdot r^{4/3} + D \cdot r\right]^{\frac{-5}{2}} \cdot dr$$

Thanks to solution of indefinite integral is quite easy to do these calculus.

The indefinite integral $I = 4\pi A \cdot \int \frac{x^2}{\left(C \cdot r^{4/3} + D \cdot r\right)^{2.5}} = \frac{8\pi A\sqrt{r}}{D \cdot \left(C \cdot \sqrt[3]{r} + D\right)^{\frac{3}{2}}} = \frac{\sqrt{r}}{G \cdot \left(C \cdot \sqrt[3]{r} + D\right)^{\frac{3}{2}}}$

As $\frac{8\pi A}{D} = \frac{1}{G}$. Calling $F(r) = \frac{\sqrt{r}}{G \cdot \left(C \cdot \sqrt[3]{r} + D\right)^{\frac{3}{2}}}$ and by the Barrow`s rule, it is got

$\left. M_{DM} \right|_{R1}^{R2}$ = F(R2)-F(R1) that provided the DG contained inside the spherical corona defined by R1 and R2.

Below are some results at different radius for DG inside spherical corona and total mass.

9.3 MASSES FOR M33 AT 220 KPC AND 850 KPC WITH PARAMETER C AT 22 KPC

It has been chosen 220 kpc and 850 kpc because these are the distance of M33 to M31 and MW respectively.

Radius kpc	F(r) kg	F(r) Msun	Spherical Corona M sun
22	1,45E+41	7,28E+10	0
22-100	1,75E+41	8,81E+10	1,64E+10
22-220	1,89E+41	9,48E+10	2,31E+10
22-850	2,07E+41	1,04E+11	3,24E+10

Adding dynamical mass Mdyn < 22 kpc = 7.28E10 Msun to DG inside the spherical corona it is got total mass at a specific radius. The table below has been highlighted in grey because two pages beyond will be quoted in order to be compared with a new expression for formula mass.

Radius kpc	F(r) kg	F(r) Msun	Spherical Corona M sun	Mtotal M sun
22	1,45E+41	7,28E+10	0	7.28E10
100	1,75E+41	8,81E+10	1,64E+10	8,92E+10
220	1,89E+41	9,48E+10	2,31E+10	9,59E+10
850	2,07E+41	1,04E+11	3,24E+10	1,05E+11

9.4 MASSES FOR M33 AT 220 KPC AND 850 KPC WITH PARAMETER C AT 25 KPC

Radius kpc	Radius m	F(r) kg	F Msun	Spherical corona Msun
25	7,71E+20	1,64E+41	8,25E+10	0
25-100	3,09E+21	1,98E+41	9,93E+10	1,68E+10
25-110	3,39E+21	2,00E+41	1,00E+11	1,79E+10
25-220	6,79E+21	2,14E+41	1,08E+11	2,51E+10
25-850	2,62E+22	2,37E+41	1,19E+11	3,67E+10

Adding dynamical mass Mdyn < 25 kpc = 8.25E10 Msun to DM inside the spherical corona it is got total mass at a specific radius.

Radius kpc	Radius m	F(r) kg	F Msun	Spherical corona Msun	Mtotal<R Msun
25	7,71E+20	1,64E+41	8,25E+10		
100	3,09E+21	1,98E+41	9,93E+10	1,68E+10	9,93E+10
110	3,39E+21	2,00E+41	1,00E+11	1,79E+10	1,00E+11
220	6,79E+21	2,14E+41	1,08E+11	2,51E+10	1,08E+11
850	2,62E+22	2,37E+41	1,19E+11	3,67E+10	1,19E+11

Comparing total masses at 220 kpc, the cyan value is $1.2*10^{10}$ Msun bigger than the red value, which is an important amount of matter.

It is important to highlight that the only difference between two formulas is that the red value has parameter C calculated at 22 kpc whereas the cyan has such parameter at 25 kpc.

Therefore it would be necessary to get a new rotation curve with measures further than 22 kpc because it is crucial to get a rotation curve up to the halo region where the rotation curve decreases, in order to get parameter C inside a region where baryonic matter is negligible.

9.5 REDUCED FORMULA FOR TOTAL MASSES IN M33

In [1]Abarca,M. was got the reduced formula for the indefinite integral of gravitational dark, contained inside a spherical corona, which added to dynamical mass associated to minor radius gives total mass at a specific radius in the halo region.

This formula contains Rs, a radius scale, $Rs =(D/C)^3$ where D is a constant that according the theory have to be the same for all the galaxies. C is a specific constant got as initial condition for Bernoulli differential equation which depends on the specific radius chosen as minor radius for halo.

The formula contains a Mass constant called Mo which depend on L, a universal constant according the theory, also depend on Rs, which is specific of M33.

Indefinite integral for DM in spherical corona mass in halo. M_{DM} (< R) =	$= \frac{8\cdot\pi\cdot L\cdot\sqrt{Rs}\sqrt{X}}{\left(\sqrt[3]{X}+1\right)^{\frac{3}{2}}} = \frac{Mo\sqrt{X}}{\left(\sqrt[3]{X}+1\right)^{\frac{3}{2}}}$ Being X= r/Rs and Rs = $(D/C)^3$	$L = \frac{a^2}{8\cdot\pi\cdot G}$ = $1.3326*10^{30}$ $Mo = 8\cdot\pi\cdot L\cdot\sqrt{Rs}$
D= $5.85*10^{-15}$ Universal constant at galactic scale. C at 22 kpc = $1.5388*10^{-21}$ Is the initial condition	Rs = $5.494*10^{19}$ X = Radius/ Rs dimensionless variable	Mo = $1.3*10^{11}$ Msun

Thanks to dimensionless variable X it is right to check that the mass tends to the value Mo when X grows indefinitely.

It is remarkable the fact that DG mass tends to Mo as x grows indefinitely, whereas total DM in NFW formula grows indefinitely as x grows. Therefore physically DG formula is totally right whereas NFW formula DM mass is only right inside its halo dominion. Similarly happen with Burkert DM mass formula which tends to infinite as x grows.

In table below has been got some total masses for different radius, with previous formula. Such table contains the same results that table highlighted in grey two pages above, because in fact shows the same formula, the former with variable radius, and the later with dimensionless variable X= radius/Rs.

X = Radius/Rs	Radius m	Radius kpc	M<R 22 kpc Msun	M. Sph. Cor. Msun	Total mass Msun
1,24E+01	6,7885E+20	22	7,606E+10	0,000E+00	7,28E+10
1,40E+01	7,7143E+20	25	7,752E+10	1,460E+09	7,42E+10
5,62E+01	3,0857E+21	100	9,208E+10	1,602E+10	8,88E+10
1,24E+02	6,7885E+21	220	9,911E+10	2,305E+10	9,58E+10
4,77E+02	2,6228E+22	850	1,089E+11	3,280E+10	1,06E+11

10. AN APROXIMATED CALCULUS OF DARK BARYONIC IN M33

10.1 A FIRST ESTIMATION OF DARK BARYONIC IN M33 BY D.G. THEORY

This calculus is made supposing that there is not dark baryonic in disc and nearby halo of Milky Way and M31 or at least is negligible. In [10]Abarca,M. 2016. In chapter 7, it is made a comparison between Bernoulli DM density and NFW DM density published by [9]Sofue,Y.2015. Throughout the dominion from 40 kpc to 210 kpc, the Bernoulli profile is around 20% lower regarding NFW profile. This difference is due to the fact that the former consider only

Dark gravitational whereas the later consider all the dark matter contained inside the disc, which may be dark baryonic or dark gravitational. In conclusion, it is clear that inside the Milky Way disc there is dark baryonic matter, however its proportion is far lower than inside the disc of M33, so for the current purpose dark baryonic inside Milky Way and M31 will be neglected.

According [9]Sofue.Y.2015 Baryonic mass for M31 is $1.6*10^{11}$ Msun and for Milky Way is $1.4*10^{11}$ Msun.

By rotation curve of M31 [1]Sofue,Y. 2015. It is right to get the dynamical mass at 40 kpc for M31, M_{DYN} <40 kpc = $4.97*10^{11}$ Msun and for Milky Way is M_{DYN} <30 kpc = $4.1*10^{11}$ Msun . Therefore for M31 the ratio of Baryonic Mass versus Dynamical mass $M_B/M_{DYN} = 0.32$ and for Milky Way $M_B/M_{DYN} = 0.34$ so it is a good approximation to consider $M_B/M_{DYN} = 1/3$ when it is supposed that dynamical mass is composed only by visible baryonic matter , V, and dark gravitational, DG. Symbolically V/(V+DG) = 1/3.

From this ratio is right to calculate that Dark gravitational is two times visible baryonic matter inside galaxy and nearby halo. Symbolically DG = 2*V. The criterion followed to consider the radius 40 kpc for M31 is that at this radius, the baryonic density is lower than 2% of DG density. See chapter 6. [1]Abarca. In other words, at such radius and bigger radius, DG density dominates clearly versus Baryonic density. Similarly, the radius 30 kpc is chosen for Milky Way by the same reason.

Data of masses for M33

From calculus made in previous chapter the dynamical mass at 23 kpc, M_{DYN} <23 kpc = $7.5*10^{10}$ Msun, hereafter DYN= $7.5*10^{10}$ Msun.
According [2]Corbelli,E.2014. Visible baryonic mass is $7*10^{9}$ Msun. Hereafter V= $7*10^{9}$ Msun. Therefore ratio the $M_B/M_{DYN} = 0.093$ which is three times lower than for M31 or MW. This results produces tension with DG theory because the main hypothesis for this theory is that DG law is universal, does not depend on any specific galaxy.

In order to save this problem, the main thesis of this paper is that in M33 there is a huge proportion of dark baryonic inside the galaxy and nearby halo, because this way it is possible to apply the Dark gravitational law got in M31 and Milky Way to M33 galaxy. In other words, this way it is possible to calculate DG in M33 with the same law for M31 or Milky Way. This fact is vital for the theory, which aims to be universal for all the galaxies.

Therefore Baryonic matter, B, is differentiated between visible baryonic matter, V, dark baryonic matter, DB. Thus DYN = B+DG =V+DB+DG = $7.5*10^{11}$ Msun.

Accepting the universality of DG law then inside the galaxy and nearby halo DG = 2B, exactly as happens in M31 or Milky Way.

According previous data of M33 V/DYN = 0.093 so V/(3B) = 0.093 so V = 0.28*B so V=0.28*V+0.28*DB so DB = 2.57*V and finally DB = $1.8*10^{10}$ Msun. Distributed inside the galaxy up to 23 kpc.

Obviously this is a very rough calculus, but it shows a first estimation about the amount of dark baryonic matter that it is needed in M33 in order to save the universality of dark gravitational law.

Conversely, this prediction becomes a crucial test for the theory of gravitational dark matter. Unfortunately is very difficult to detect dark baryon matter such as cold planets, perhaps the only method is nano- lensing, as it will shown in chapter 12.

10.2 SECOND ESTIMATION OF DARK BARYONIC IN M33 BY NFW MODEL IN M31 AND M.W.

According model NFW got by [9]Sofue,Y. Dynamical mass under 30 kpc for M31 is M_{DYN} <30 kpc = $3.45*10^{11}$ Msun and for Milky Way M_{DYN} <20 kpc = $2.5*10^{10}$ Msun. Therefore for M31 the ratio of Baryonic Mass versus Dynamical mass $M_B/M_{DYN} = 0.464$ and for Milky Way $M_B/M_{DYN} = 0.56$ so it is a good approximation to consider

$M_B / M_{DYN} = 1/2$. Therefore for both giant galaxies, if it is supposed that dynamical mass is composed only by visible baryonic matter , V, and dark gravitational, DG. Symbolically V/(V+DG) = 1 /2 then **DG = V**.

This simple calculus has been got supposing that there is not dark baryonic inside Milky Way or M31 which is not completely true. However there is strong evidences that proportion of DB inside galactic disk is far lower regarding M33. Consequently, as conclusion of previous calculus is got that inside the galactic disk of M31 or MW there is the same amount of baryonic matter that dark gravitational. Symbolically **B= DG**

Dark baryonic in M33

Supossing now that in galactic disc of M33 happens the same proportion between baryonic matter and dark gravitational, B = DG. However, in M33 there is a non negligible amount of dark baryonic matter.

Therefore Baryonic matter, B, is split between visible baryonic matter, V, dark baryonic matter, DB. Thus DYN = B+DG =V+DB+DG = 7.5×10^{11} Msun.

Accepting results got in previous epigraph by NFW method, then DG = B, exactly as happens in M31 or Milky Way.

According previous data of M33 V/DYN = 0.093 so V/(2B) = 0.093 so V = 0.187*B so V= 0.187*V + 0.187*DB so DB = 4.3*V and finally DB = 3×10^{10} Msun. Distributed inside the galaxy up to 23 kpc.

Summarising, by dark gravitational theory has been got that inside M33 galactic disc there is DB = 2.57 V whereas with a model NFW of M31 and Milky Way inside galactic disc of M33 there is DB = 4.3*V.

Both methods give different results. However, the most important is that both methods predict an enormous amount of dark baryonic in M33 in order to save the universality of dark gravitational law.

This results has two right consequences:

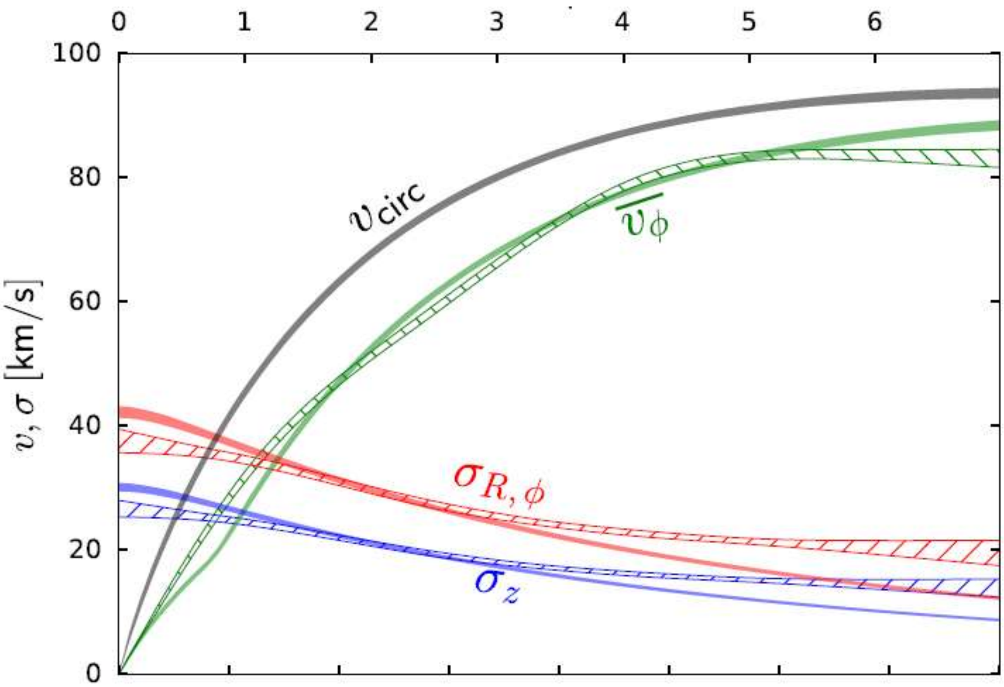
The first is that this prediction provided a way to check the DG theory, although is quite difficult to detect dark baryonic at so large distance.

The second is that the Bernoulli density is lower bound for the real density of DG. Furthermore, as DB is several times bigger that Visible baryonic, it is right to deduce that there is a non negligible amount of Dark baryonic for radius bigger than 22 kpc and consequently Bernoulli density is far lower than real DG density and similarly DG calculated by Bernoulli density is far lower than real amount of DG inside the halo of M33. Put in brief, the total mass for M33 calculated is a lower bound for real total mass of M33.

11. TOTAL MASSES OF LARGE MAGELLAN CLOUD

Large Magellan Cloud is a small satellite galaxy of Milky Way 50 kpc away. Thanks a recent rotation curve, it will be possible to apply the DG theory, although unfortunately the rotation curve reach up to 7 kpc, where the rotation curve is quite flat, therefore by the same reason discussed in M33, at this point the dark baryon is not negligible and consequently DG Bernoulli density is a lower bound of real DG density, thus the total mass calculated for LMC will be a lower bound as well.

11.1 LARGE MAGELLAN CLOUD DATA



From graphic [11]Vasiliev,E.2018.It possible to get rightly the velocity at 7 kpc which is 94.7 km/s .Consequently Eo= 4.15E-11 m/s^2 and the dynamical mass Mdyn < 7 kpc = $1.46 \cdot 10^{10}$ Msun.

According [12] Jarrett. T.H. The visible mass is $M_{VISIBLE} = 1.4 \cdot 10^9$ Msun so ratio $M_{VISIBLE} / M_{DYNAMIC} = 0.096$ which is very similar to the ratio in M33. Thus the same reasoning made in chapter 10 for M33 it is possible to do for LMC.

Therefore, this fact allows to deduce that there is a non negligible amount of dark baryonic inside the disc, according DG theory and consequently the total mass calculated for LMC is a lower bound too lower regarding the real total mass of LMC.

11.2 DARK GRAVITATIONAL THEORY FOR LMC

As it has been said D= 5.85E-15 is universal according the DG theory

Parameter C is the initial condition at 7 kpc, because there is not any more data at larger radius. As it was highlighted for M33, when rotation curve is flat, there is a non negligible amount of dark baryonic matter at such radius and consequently the Bernoulli density DG is only a lower bound for the real density DG.

$$C = \frac{E_0^{\frac{-2}{3}} - D \cdot R_0}{R_0^{\frac{4}{3}}}$$

By previous formula and the initial condition Eo at 7 kpc is got $C = 5.46 \cdot 10^{-21}$ and the factor scale Rs= $(D/C)^3$ = 0.03986 kpc.

LARGE MAGELLAN CLOUD Indefinite integral for DM in spherical corona mass in halo. M_{DG} (R_1<DG< R_2) =	$= \frac{Mo\sqrt{X}}{\left(\sqrt[3]{X}+1\right)^{\frac{3}{2}}}$ Being X= r/Rs and Rs = $(D/C)^3$ D= $5.85*10^{-15}$	Universal constant at galactic scale L= $1.3326*10^{30}$ $Mo = 8 \cdot \pi \cdot L \cdot \sqrt{Rs}$
C at 7 kpc =$5.46*10^{-21}$	Rs = $1.23*10^{18}$ m = 0.03986 kpc	Mo=$1.95*10^{10}$ Msun

Below are the set of data for mass for some radius.

The total mass is got adding to Spherical corona DG the dynamical mass at 7 kpc = $1.46*10^{10}$ Msun.

It is remarkable the mass at 50 kpc whic is the distance to Milky Way. Also it is remarkable the distance at 800 kpc the distance to M33 from Milky Way. This value is its mass when it is studied the dynamical at the scale of Local Group of galaxies.

As it has been said previously, according the theory the mass of a galaxy depend on the scale .For example, when it is considered the interaction between MW and LMC, then it is needed to calculate the mass of MW at 50 kpc of radius and the mass of LMC at 50 kpc of radius.

However when it is considered the dynamical of Local Group of galaxies, then the mass of galaxies has to be calculated at 1.5 Mpc, because the diameter of the group is 3Mpc length.
As it has been said previously, the results for mass at different radius are only lower bound of real total mass, because at 22 kpc where was calculated the parameter C and bigger radius , there is an enormous amount of dark baryonic consequently Bernoulli density is lower regarding the real DG density.

X	Radius kpc	F(x) Msun	Mass of spherical corona Msun	Lower bound for total mass. Msun
175,614651	7	1,52E+10	0,00E+00	1,46E+10
1254,39037	50	1,71E+10	1,83E+09	1,64E+10
20070,2459	800	1,85E+10	3,23E+09	1,78E+10
37631,711	1500	1,87E+10	3,42E+09	1,80E+10
75263,422	3000	1,88E+10	3,59E+09	1,82E+10

12. SULCOs AS SOLUTION FOR DARK BARYONIC IN HALOs OF M33 AND LMC

According [5]Inoue K.T.2017, Sub Lunar mass Compact Objects could be a possible solution for dark baryonic. Inoue and his team has developed a method called nanolensing because it could be detected gravitational lensing produced by little planets whose masses ranges between 10^{-11} Msun and 10^{-7} Msun. Taking as light source the stars of M31 or M33. They claim that their method is able to detect SULCOs in a range of distances between 0.1 kpc and 100 kpc. Therefore it could be a perfect method in order to study the extra dark baryonic needed in the disc and nearby halo of Milky Way and even in LMC.

Dark Gravitational theory is able to explain rotation curve of M31 and Milky Way with a common and universal law of dark gravitational matter, that match perfectly with standard methods such as NFW. See [1]Abarca,M. However, the same theory produces a DG density, called Bernoulli profile, 10 times lower than the standard Burkert profile used to fit numerically the rotation curve of M33 or LMC. Therefore, the existence of other type of dark matter different of dark gravitational is needed in these little galaxies in order to save the universality of dark gravitational theory and dark baryonic is the perfect candidate.

In my opinion, the reason why dark baryonic could be very abundant in the disc and nearby halo of satellite galaxies is that the tidal forces of the giant galaxies might have disturbed widely the processes of star formation, by this way, in the disc and nearby halo of LMC or M33 might have an enormous amount of dwarf planets composed by solid hydrogen.

13. TOTAL MASSES OF LOCAL GROUP OF GALAXIES

According [9] Sofue the relative velocity between M31 and Milky Way is 170 km/s. Assuming that both galaxies are bounded gravitationally it is possible to calculate the total mass of the Local group by a simple formula because of the Virial theorem.

$M = \frac{v^2 \cdot r}{G}$ As r = 770 kpc and v= 170 km/s then $M_{LOCAL\ GROUP}$ at 770 kpc = 5.17 $*10^{12}$ Msun

According [9] Sofue, the total mass of M31 and Milky Way is approximately $3*10^{12}$ Msun, so there is a mass lack of $2*10^{12}$ Msun which is a considerable amount of matter. Namely read epigraph 4.6 of [5] Sofue paper. However, according DG theory when is calculated the interaction between MW and M31 it is needed to extend the halo up to 770 kpc for both galaxies. It is simply Newtonian Mechanics. For example the Moon orbit is calculated through the Earth field at the Moon radius.

13.1 TOTAL MASSES OF M33-M31-MW AND LMC BY DARK GRAVITATIONAL THEORY

Below are the parameters of each galaxy and some specific masses at different radius. As the DG theory is based on the gravitational field is right to consider the extended halo up to the position where is placed the other galaxy.

M33 Galaxy Indefinite integral for DM in spherical corona mass in halo. M_{DG} (R_1<DG< R_2)	$= \frac{Mo\sqrt{X}}{\left(\sqrt[3]{X}+1\right)^{\frac{3}{2}}}$ Being X= r/Rs and Rs = $(D/C)^3$ D= $5.85*10^{-15}$ U. constant at galactic scale	Universal constant at galactic scale. L = $1.3326*10^{30}$ $Mo = 8\cdot\pi\cdot L\cdot\sqrt{Rs}$
C at 22 kpc = $1.5388*10^{-21}$	Rs = $5.494*10^{19}$ m = 1.78 kpc	Mo = $1.3*10^{11}$ Msun

As it has been said previously, the results for mass at different radius are only lower bound of real total mass, because at 22 kpc where was calculated the parameter C and bigger radius , there is an enormous amount of dark baryonic consequently Bernoulli density is lower regarding the real DG density.

M33 Galaxy X	Radius kpc	F(x) Msun	Mass spherical corona Msun	Lower bound for Total mass Msun
12,3595506	22	7,58E+10	0,00E+00	7,28E+10
123,595506	220	9,88E+10	2,30E+10	9,58E+10
477,52809	850	1,09E+11	3,27E+10	1,05E+11
842,696629	1500	1,12E+11	3,60E+10	1,09E+11
1685,39326	3000	1,15E+11	3,94E+10	1,12E+11

M31 Galaxy Indefinite integral for DM in spherical corona mass in halo. M_{DG} (R_1<DG< R_2)	$= \frac{Mo\sqrt{X}}{\left(\sqrt[3]{X}+1\right)^{\frac{3}{2}}}$ Being X= r/Rs and Rs = $(D/C)^3$ D= $5.85*10^{-15}$ U. constant at galactic scale	Universal constant at galactic scale. L = $1.3326*10^{30}$ $Mo = 8 \cdot \pi \cdot L \cdot \sqrt{Rs}$
C at 49 kpc = $6.36*10^{-24}$	Rs = $6.36*10^{26}$ m= 25.22 Gpc	Mo = $4.69*10^{14}$ Msun

M31 Galaxy Radius kpc	Radius m	X=R/Rs	F (x) M sun	Msph Corona Msun	Total mass Msun
49	1,51E+21	1,94E-06	6,41769E+11	0	6,43E+11
200	6,17E+21	7,93E-06	1,28236E+12	6,4059E+11	1,28E+12
385	1,19E+22	1,53E-05	1,76655E+12	1,1248E+12	1,77E+12
770	2,38E+22	3,05E-05	2,47488E+12	1,8331E+12	2,48E+12
1500	4,63E+22	5,95E-05	3,41553E+12	2,7738E+12	3,42E+12
3000	9,26E+22	1,19E-04	4,76039E+12	4,1186E+12	4,76E+12

Milky Way Galaxy Indefinite integral for DM in spherical corona mass in halo. M_{DG} (R_1<DG< R_2) =	$= \frac{Mo\sqrt{X}}{\left(\sqrt[3]{X}+1\right)^{\frac{3}{2}}}$ Being X= r/Rs and Rs = $(D/C)^3$ D= $5.85*10^{-15}$ U. constant at galactic scale Rs = $(D/C)^3$ = $1.83*10^{23}$ m	Universal constant at galactic scale L= $1.3326*10^{30}$ $Mo = 8 \cdot \pi \cdot L \cdot \sqrt{Rs}$
C at 30.5 kpc =1.03E-22	Rs = $1.83*10^{23}$ m = 5.94 Mpc.	Mo=$7.2*10^{12}$ Msun

Miky Way X	Radius kpc	F(x) Msun	M Sph corona Msun	Total mass Msun
0,00514334	30,5	3,12452E+11	0	4,07E+11
0,03372681	200	7,33389E+11	4,2094E+11	8,28E+11
0,06492411	385	9,63991E+11	6,5154E+11	1,06E+12
0,12984823	770	1,26712E+12	9,5467E+11	1,36E+12
0,2529511	1500	1,62088E+12	1,3084E+12	1,72E+12
0,50590219	3000	2,05502E+12	1,7426E+12	2,15E+12

Large Magellan Cloud	C at 7 kpc $1.0314*10^{-22}$	Rs 0.03986 kpc	Mo $1.95*10^{10}$ Msun	Mdyn at 7 kpc $1.46*10^{10}$ Msun
X= R/Rs	Radius kpc	F(x) Msun	M sph corona Msun	Lower bound for Total M. Msun
175,614651	7	1,52E+10	0,00E+00	1,46E+10
1254,39037	50	1,71E+10	1,83E+09	1,64E+10
20070,2459	800	1,85E+10	3,23E+09	1,78E+10
37631,711	1500	1,87E+10	3,42E+09	1,80E+10
75263,422	3000	1,88E+10	3,59E+09	1,82E+10

Below is tabulated the total mass for the four galaxies at three different radius.

The first radius enclose to M31, M33 ,LMC and other dwarfs galaxies from the Milky Way and gives a result quite close to $5.17*10^{12}$ Msun which is the dynamical mass to M31 and MW system.

The third distance 3 Mpc gives a total mass $7*10^{12}$ Msun.

According [13]Fattahi,A:Navarro,J. At such distance the total mass calculated by numerical simulations gives a total mass 10^{13} Msun when it is considerate the whole set of galaxies inside the Local Group. Therefore the total mass belonging to the four galaxies agrees quite well with calculus made by such authors.

At this point it is important to highlight newly that values of total masses got for M33 and LMC are only lower bound of real masses because the parameter C of DG theory cannot be calculated properly, as it was explained previously.

Radius kpc	Total mass of four galaxies Msun
850	$4*10^{12}$
1500	$5.24*10^{12}$
3000	$7*10^{12}$

14. CONCLUSION

After the success of the DG theory explaining the data known for DM in M31 and Milky Way and published in [1] Abarca,M., it is right to check the same theory in M33, because DG theory aims to be a universal theory as it is based on a quantum gravitation effect.

Taking as starting point the remarkable rotation curve of Corbelli,E , and applying DG theory it has been possible to show that DG matter in M33 cannot explain the total amount of DM needed to justify the rotation curve of M33. Therefore, it has been postulated that the extra amount of DM is dark baryon. Even such mass has been estimated roughly.

Similarly, thanks a rotation curve of LMC got by Vasiliev,E. and applying DG theory has been demonstrated that in LMC there is a DM proportion at least four times bigger than such proportion in MW. Therefore in order to preserve the DG theory as universal based on a property of gravitational propagation, it has been postulated the existence of an important amount of dark baryonic.

Consequently this conclusion arises an extraordinary test to check the DG theory.

Currently, it has been published a method called nanolensing which might be applied to search a type of dark baryon called SULCOs (Sub Lunar Compact Object) in Milky Way and LMC. Possibly, it could be made measures of DB in the Milky Way and LMC in a close future.

If measures backed the proportion of DB predicted by the theory then DG theory would be a real theory able to explain DG as a universal law.

A second important result showed in the paper is related to the concept of Dark Gravitational mass, DG, because according the theory, the calculus of DG mass has to be extended up to the distance where is placed the interacting system. For example, when it is studied the interaction between M33 and M31, the distance to calculate the DG mass has to be 220 kpc, not only for DG mass of M33 but also for M31, whereas when it is studied the interaction between MW and M31 then both DG masses has to be calculated for a distance of 770 kpc.

By DG theory has been found a lower bound for total masses of M33 and LMC. It has not been possible to calculate a more accurate value of masses for both galaxies because the rotation curve published are a bit short and even at the furthest radius of rotation curve, the proportion of baryonic matter versus DG mass is too high to be neglected. Consequently the parameter C, which is the initial condition of a Bernoulli differential equation, cannot be calculated properly. It would be suitable new measures of rotation curves of M33 especially for radius bigger than 23 kpc in order to calculate parameter C with more accuracy.

It worth to highlight an interesting property of DG mass formula, which is that its value tends to a finite value, Mo, as variable X grows indefinitely. Physically is important that mass does not tend to infinite. However the NFW formula for mass tends to infinite as x grows, so it is only right inside a bounded halo dominion. Similarly it happens with Burkert DM mass, which is unbounded as x grows.

Another important result got in this paper is a very good estimation of Local Group total mass.

According [13]Fattahi & Navarro the dynamical mass at 3 Mpc in the Local Group gives a mass of 10^{13} Msun. Calculus made with DG theory at such distance gives a total mass bigger than $7*10^{12}$ Msun, when it is considered M31, M33, Milky Way and LMC, obviously when is added the total mass of the rest of dwarfs galaxies of Local Group the total mass will be even more close to the value estimated by Fattahi & Navarro.

There is no doubt that this is a magnificent result for DG theory.

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