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SHORT COMMUNICATION

# The Hypergeometrical Force: The Coma Cluster without Dark Matter

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**ABSTRACT**

This article presents the application of the Hypergeometrical Universe Theory (HU)[1] to the Coma Cluster. Here we do not apply the Virial Theorem since the Hypergeometrical Force is velocity dependent. It is shown that the mass radial distribution used on the M33 Spiral Galaxy properly explain the extra mass currently associated with Dark Matter. HU maps this Halo matter to Hydrogen and Dust.

***Keywords*:** Cosmology, Virial Theorem, Coma Cluster

## 1. INTRODUCTION

The virial theorem was first used by Fritz Zwicky[2,3] to investigate the dynamics of the Coma Cluster. The Coma Cluster is a cluster containing around 1000 galaxies and located at 336 million light years away from us. Zwicky measured the galaxy velocity dispersion and from that he calculated the total cluster mass and average galaxy mass using the Virial Theorem.

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The Virial Theorem is valid only for systems bound by Gravitational Forces where the Gravitational Force is of the form of $\alpha r^{-n}$. He then calculated the average galaxy mass using its Luminosity.

The discrepancy between the required mass for keeping the Cluster together and the Luminous (baryonic) mass gave rise to the speculation about the existence of a Dunkle Materie (Dark Matter). In my discussion of the Coma Cluster analysis, I will use as an archetypal galaxy, the M33 Galaxy which I previously modeled.[4] I will just keep the same mass distribution parameters and rotation curve and study the Dunkle Materie Halo made of Hydrogen/Dust Cloud that the Hypergeometrical Force allows to remain in orbit. The volume studied will be scaled to comply with the total cluster volume.

## 2. 1. Modeling M33 Galaxy

*Falsifying Dark Matter Evidence from M33 Spiral Galaxy Rotation Curve*

We modeled the M33 Galaxy using HU. HU showed that the constant flattening of the Fabric of Space around the orbit path adds one extra force – the Hypergeometrical Force. Below we see the modified Keplerian Dynamics:

$$Total\ Acceleration = -\frac{GM}{d^2} - \frac{cv}{R_0} + \frac{v^2}{d} = 0 \tag{1}$$

Hence

$$v = \frac{\frac{cd}{R_0} + \sqrt{\left(\frac{cd}{R_0}\right)^2 + 4\frac{GM}{d}}}{2} \tag{2}$$

M33 contains 5E10 Sun Masses as measured by the Stars aggregated Luminosity. The mass distribution was modeled simply by:

$$Mass(d) = \frac{M_0}{\left(\frac{d}{r_s}\right)^{\alpha}\left(1+\left(\frac{d}{r_s}\right)^{\beta}\right)^{\delta}} \tag{3}$$

Where these are the optimized parameters:

$$Mass(d) = \frac{M_0}{\left(\frac{d}{r_s}\right)^{-2.66}\left(1+\left(\frac{d}{r_s}\right)^{0.52}\right)^{3.85}} \tag{4}$$

with

$$\text{Scale Radius} = r_s = 7.08E3\_light - years$$

$$M_0 = 5E10\_Sun\_masses$$

Next, we present the M33 Rotation Curve Predictions from the observed luminous matter. The Luminous matter is consistent with the Scale Radius of 7E3 light-years.

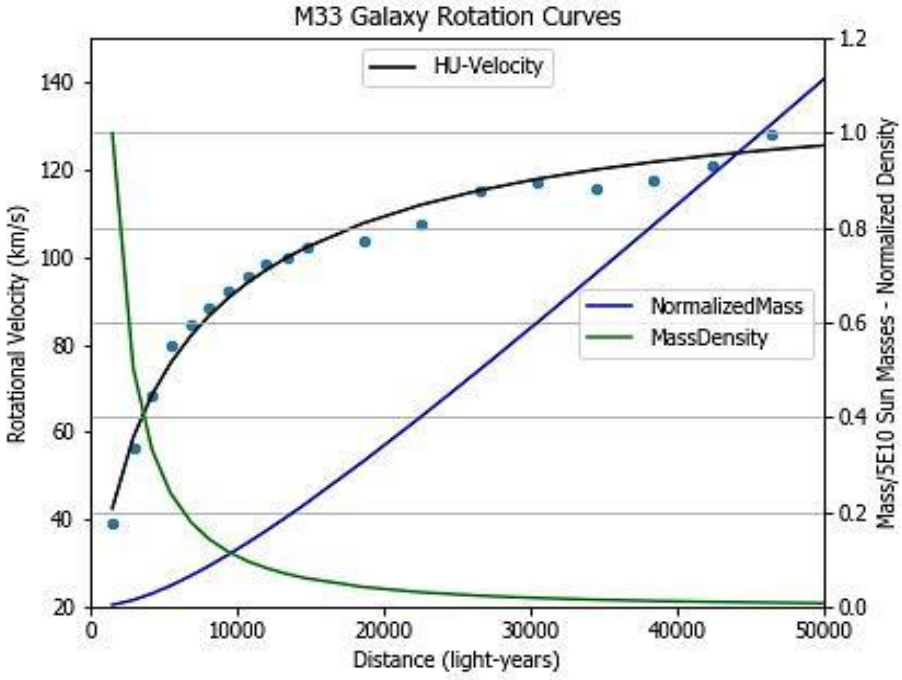


**Figure 1.** Here we see the M33 rotation velocity profile corresponding to the total mass and Mass Radial Distribution profile as well as the observed rotation curve (dots).

## 2. 1. Modeling the Coma Cluster

*Falsifying Dark Matter Evidence from Coma Cluster*

Conversely, one can obtain the Coma Cluster total Mass from the galaxy velocity variance and estimated radius d:

$$M = \frac{d^2}{G}\left(\frac{v^2}{d} - \frac{cv}{R_0}\right) = 4.57\text{E14 Sun Masses} \tag{5}$$

With $v^2 = 3\sigma^2 = 3E12\frac{m^2}{s^2}$, $R_0 = 13.58E9$ Sun Masses, $H_0 = 72km/s/mpc$, d=2.2E6 lyr,

c = speed of light, G = Gravitational Constant. Notice that the calculated total Cluster mass differs from standard Newtonian expectations because of the Hypergeometrical Force.

**Fraction of Non-Luminous Matter and the Number of Galaxies**

The Luminous Matter fraction α at each archetypal galaxy M33 is the same as the total fraction of the Coma Cluster:

$$\alpha_n = \frac{n * M_0}{M} = \frac{n * M_0}{\frac{d^2}{G}\left(\frac{v^2}{d} - \frac{cv}{R_0}\right)} \tag{6}$$

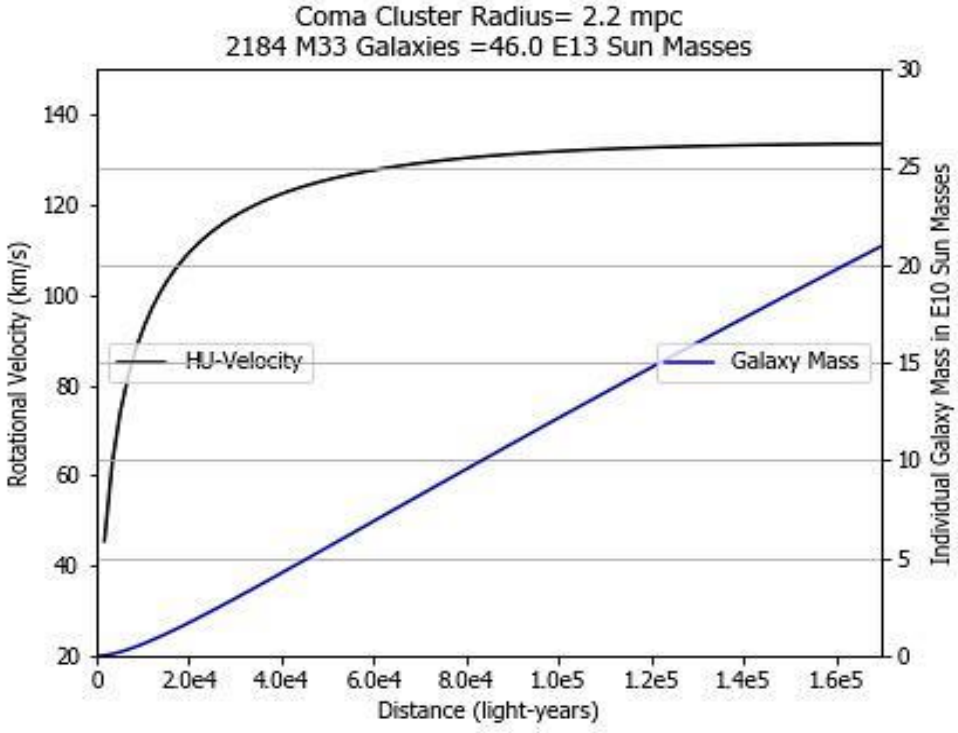


**Figure 2.** Here we see that for a 23.9% Luminous Matter (Stars) ratio to total matter for the M33 archetypal galaxy, the total Coma Cluster matter matches the value required by its galaxy velocity variance.

From eq. (4):

$$\alpha_n = \frac{\left(1 + \left(\frac{d}{r_s \sqrt[3]{n}}\right)^{0.52}\right)^{3.85}}{\left(\frac{d}{r_s \sqrt[3]{n}}\right)^{2.66}} \tag{7}$$

Notice that in eq. 7-8, $M_0$ and $d$ are the visible mass of the M33 Galaxy and the radius of the Coma Cluster, respectively. We scaled the M33 radius inversely proportional to cubic root of the number of galaxies.

$$d_n = \frac{d}{\sqrt[3]{n}} \tag{8}$$

Solving equations 7-8 for n, one obtains n = 2184 and $\alpha = 0.239$

Hence, HU provides a self-consistent picture for Coma Cluster radius of 2.2E6 lyr and a total cluster mass of 4.6E14 Sun Masses.[5] The number of average (M33) galaxies is 2184.

## 3. DISCUSSION

Fig. 1 showed how HU explains M33 Rotation Curve Conundrum without the need for Dark Matter. Fig. 2 demonstrate how the Hypergeometrical Force allows for the loading of HU Dark Matter. There is nothing special about the loading function. Different initial conditions will load galaxies in different ways. Our simulation is just to show that the Hypergeometrical Force allows for the explanation of observations with reasonable parameters/expectations. The simulation is surprisingly precise, even predicting the correct ratio Luminous/Non-Luminous Matter.

### Falsifying Dark Matter Evidence from Bullet Cluster

Notice that the Hydrogen/Dust Surplus (HU Dark Matter) is not added there to solve any puzzling behavior and does not require explanation. Mapping it to Hydrogen or Dust would do just fine. The loose connection to the galaxy core means that upon galaxy collision, unexpected dynamics will occur. Also, collisional cross-sections will differ if the hydrogen is ionized (before or during collision) and for different compositions of Dust/Hydrogen. The very low density of this Surplus will also mean that a **sizeable fraction of the volume will just pass through each other**.

### Falsifying Dark Matter Evidence from SN1a Distances

The Hypergeometrical Universe Theory non-parametrized predictions were shown to consistently reproduce the observational astronomic data better than the best current 6-parameters Friedmann- Lemaitre Cosmological Fitting. Application of this model to different region fittings yielded different set of parameters (Dark Energy/Dark Matter related parameters. That indicates that this General Relativity variant using Dark Energy as Cosmological Constant and Dark Matter as added Gravitational pull fails at large in describing the Universe.

Below are HU parameterless predictions[1,4] of type 1a Supernovae (SN1a) distances from their redshifts *z*.

In addition, HU provided evidence of the existence of an extra spatial dimension. That rendered both General Relativity and L-CDM non-applicable to Cosmology. Both are based

upon the Universe content controlling the Universe dynamics. That cannot be the case with the addition of an extra spatial dimension.[4]

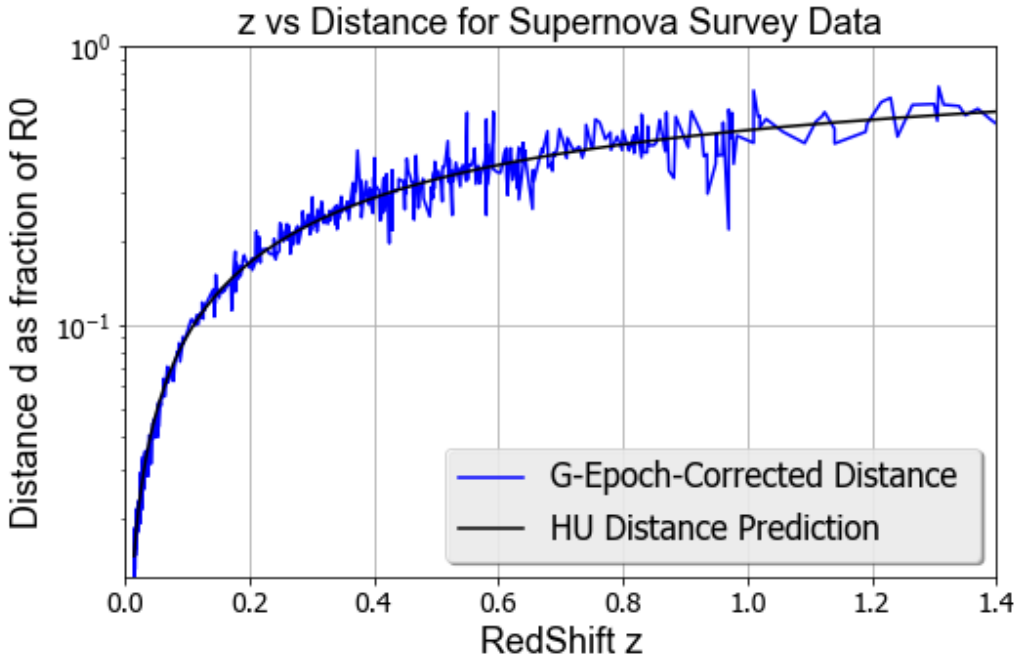


**Figure 3.** HU predictions of SN1a distances (Union 2.1 Supernovae Survey). These are parameterless predictions using the lightspeed expanding hyperspherical topology and thus they do not require Dark Matter nor Dark Energy and are compliant with the SDSS BOSS survey observations.

## 4. CONCLUSIONS

We applied the Hypergeometrical Universe Theory to the Coma Cluster analysis. HU introduced a new Force of Nature – The Hypergeometrical Force. This is a constraint's force and it is dependent only upon the velocity and mass of the probe.

In the analysis we used a loading function which is arbitrary. The peculiarities of each galaxy will dictate the loading profile. HU Celestial Dynamics will constraint the rotation curve. The Hypergeometrical Force eliminates the puzzling behavior of the Dark Matter where it is located only in the Halo. That is not what one would expect from a moiety that is supposedly 6 times more prevalent than baryonic matter. The Hypergeometrical Force is mostly relevant at long distances and thus it is naturally that it will influence loading in a Halo.

The Hypergeometrical Universe Theory provided evidence of an extra spatial dimension. That in itself renders General Relativity and L-CDM unusable and incapable of describing Reality. HU falsified all DM evidence and thus provides an attractive alternative to the Current Cosmological Standard Model and the Geodesics Paradigm proposed by Einstein.

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## References

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