Real and theoretical tangential speed

Dark matter is controversial given this work so it is possible that it is non-existent in the galaxy.

Introduction.

The term "dark matter" was introduced by the Swiss astronomer Fritz Zwicky in the 1930s. Zwicky observed that the rate of rotation of galaxies in galaxy clusters was much greater than expected based on the laws of gravity and the amount of visible mass in the form of stars and gas. To explain these discrepancies, Zwicky proposed the existence of an undetected form of matter, which he called "dark matter", which exerted an additional gravitational influence.

The term "dark matter" was later popularized and became a widely used concept in astronomy and particle physics to refer to the non-visible matter that in the current state of Astrophysics this exotic matter is believed to constitute the majority of. of matter in the universe. Dark matter is thought to interact primarily through gravity and does not emit or absorb light, making it difficult to detect directly.

The concept of dark matter was introduced to explain observed astronomical phenomena that could not be explained by known visible matter. Although the nature of dark matter has not yet been directly identified, its
existence follows from its gravitational effect on observable objects in the universe.

Perhaps the "dark matter" context was a way of resolving a contradictory question in its day, but I have seen in my analysis that this may actually be a mistake.

My investigation

Based on my research work, which has involved a detailed analysis of the data provided by the ESO Gaia project (ESA Gaia Science Community - Gaia - Cosmos), I have come to the conclusion that the existence of dark matter is not necessary to model the speed of the stars in our galaxy.

The Gaia project has provided me with an immense amount of data on over a hundred million stars, which has allowed me to perform statistical analysis and observe patterns in the rotation rates of these randomly located stars in the galaxy.
In my research, I have found that the rotational speeds of stars can be consistently and precisely explained without resorting to the introduction of dark matter. By analyzing the data and making correlations between rotation speeds and other stellar parameters, I have discovered that there is a linear relationship between speed and distance from the galactic center, suggesting behavior similar to that of a solid disk.

These findings challenge the need to postulate the existence of dark matter to explain the velocities observed in the stars of the galaxy. Instead of relying on hypothetical undetected particles, my model proposes that the speed of stars is directly related to their distance from the galactic center and the maximum speed of rotation of the galaxy. This approach provides a simpler explanation that is consistent with the observed data.

While my research has focused on a specific approach using data from the Gaia project, I believe these results may have broader implications in the field of astrophysics and our general understanding of galaxy structure and dynamics.

It is important to continue investigating and analyzing new data to confirm these findings and further explore the implications of a model without exotic dark matter.
Although the observed stars do not include other forms of matter such as black holes present in the galaxy, the study from Gaia based on known and measured stellar data after applying the necessary filters to prevent erroneous observational data from entering the calculations, They can give us a sufficient and precise basis to see that some hypotheses currently considered valid do not clearly correspond to the observations.

This leads us to consider as erroneous models that today are considered valid. If this work is accepted, it is the task of science to offer a consideration and study in the face of a reasonably exposed doubt.

In summary, my research suggests that the introduction of dark matter is not necessary to model the speed of stars in the galaxy. Data from the Gaia project support this idea that the speed of stars can be explained by a linear relationship with the distance from the galactic center.

These findings challenge current theories and open the door to a new understanding of galactic dynamics without the need to postulate the existence of dark matter.

The ESO GAIA project

The projectGaia is the name of a space probe proposed by the European Space Agency that was launched on **December 19, 2013** from the European Spaceport in French Guiana. Gaia is an astrometry space mission, and successor to ESA's Hipparcos mission.
Gaia is currently approximately 1.5 million kilometers from our planet, orbiting a virtual point in space known as L2. From this privileged vantage point, Gaia continuously observes the firmament to map billions of stars in the Milky Way.
ESA's Gaia Observatory and the James Webb Telescope share an orbit around the Lagrange point 2.
On February 18, 2022, the two spacecraft were 1 million kilometers apart.

study data

For the study, 10 million stars have been selected from the Gaia database (Dr3 data set) by means of an SQL query, all the details and the code will be later exposed. The program will work with local data once the query to Gaia has been made.

Figura 1
Estrellas de la muesta: 11380152

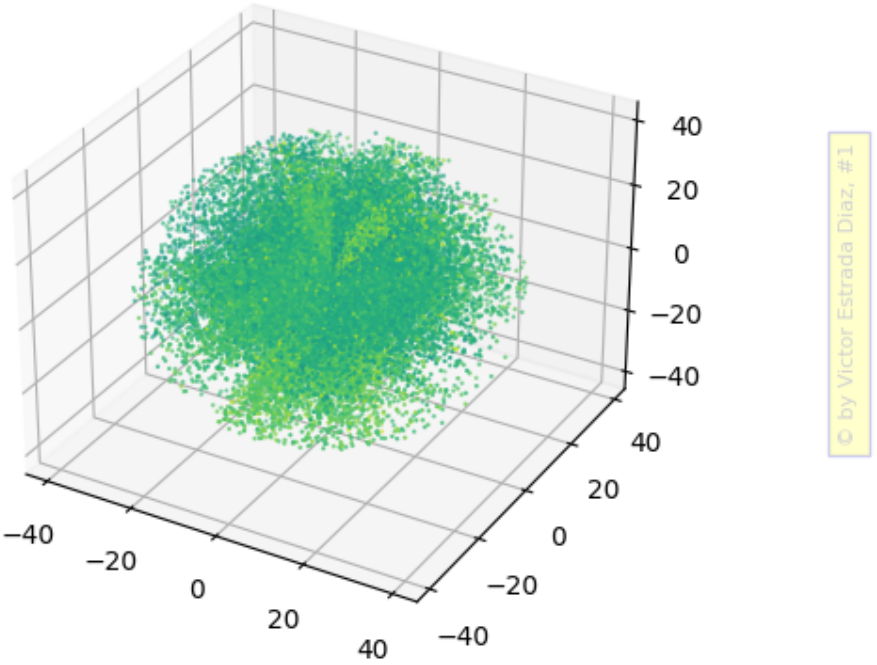


Figure 1 shows where the sample stars are located in the 3d dimensions of the galaxy. A limit of 40 kpc has been set because beyond that there are few stars and there is a great dispersion in speeds for any consideration (kilo parsec of distance to the galactic center, 1 kpc is approximately 3.2616 light years,Pársec - SpeedyLook encyclopedia).

What does the Gaia project contribute to our study?

The database provided by Gaia in addition to others provides us for this study:
14.1.1 gaia_source‣ 14.1 Main tables ‣ Chapter 14 Datamodel description ‣ Part V Gaia archive ‣ Gaia Data Release 2 Documentation release 1.2 (esa.int)

- Situation, in celestial coordinates that use the Sun as a reference, these data are:
  - in angular measures
    - Dec (declination)
    - Ra (Straight Descent)
    - Parallax (parallax)

Straight ascension - SpeedyLook encyclopedia
Stellar parallax - SpeedyLook encyclopedia
These angular position measurements allow us to calculate in Kiloparsec (kpc) the galactic coordinates of the star with respect to its center of gyration in Sagittarius A, with these distances to the center x,y,z we can also determine the galactic gyration radius.

```
distance = 1/(float(parallax)*0.001)
x = distancia * math.cos(float(ra)) * math.cos(float(dec)) /1000.0
and = distancia * math.sin(float(ra)) * math.cos(float(dec)) /1000.0
With = distance * math.sin(float(dec)) /1000.0
radio = math.sqrt(x**2 + y**2 + z**2)
```

- Time:
  - in solar masses
- Movement in declination and straight ascent
  - We observe these movements from the Sun but we have data to determine the magnitude of the tangential velocity in the galaxy that will be perpendicular to the radiol.

```
l       =math.atan(x/y)
B       =math.atan(z/math.sqrt(x**2+y**2))
Vt      = 4.74 * radio * math.sqrt(pmra**2 + (pmdec -
4.95*math.cos(l)*math.cos(B)- 0.169*math.sin(l)*math.cos(B) +
0.02*math.sin(B))**2)
```

  - This measured speed will give us the speed Vt to compare with our theoretical models.

Sample distribution

From the Gaia data we can see where the stars in the sample are and the mass associated with each star in solar masses, we can see how those observable masses are distributed in the galaxy.

Figura 2
Masa estelar y distribución

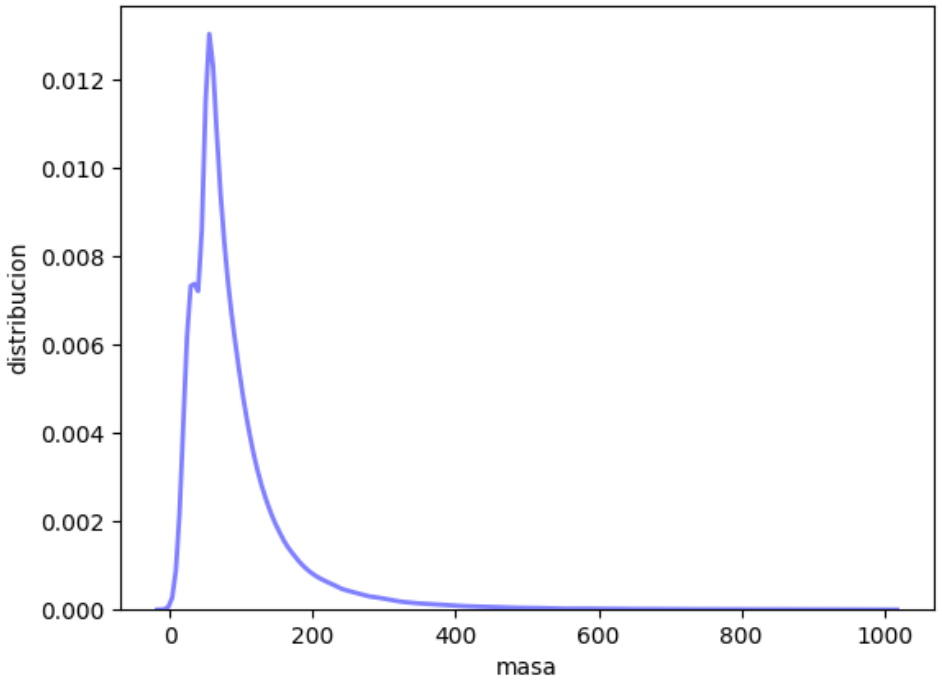


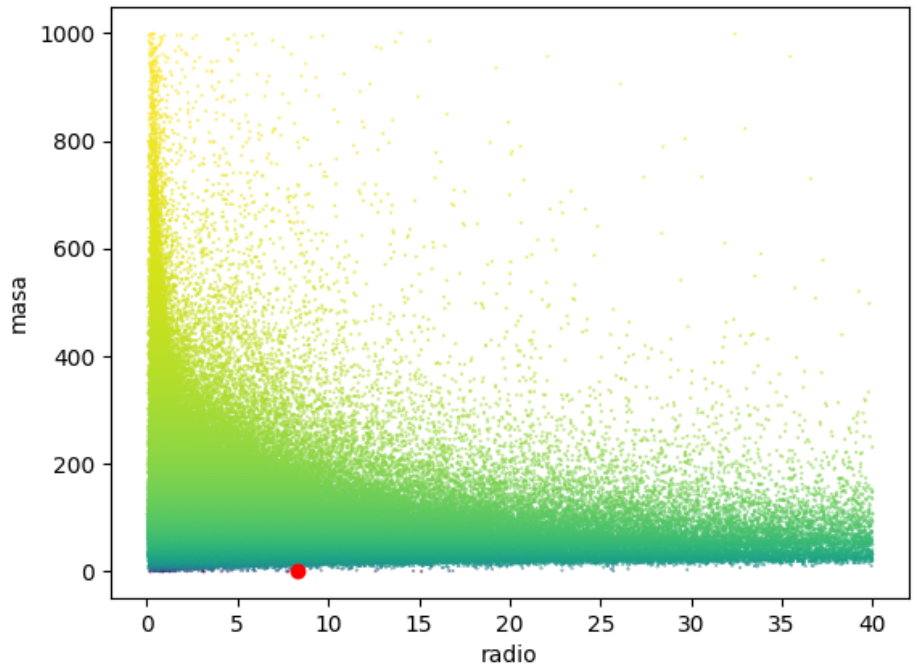
Figure 2 shows the mass density and its distribution, noting that the distribution decays exponentially from 100 solar masses, the first part of the distribution presents a quirk for which I do not know the reason.

Where is the mass located in the galaxy?

Figure 3 shows us where the mass is located in the galaxy, each point is a star, we apply a color scale that goes from blue to yellow, where blue is the representation of a star with low mass, around that of the sun. or smaller and the stars represented by a yellow dot are the most massive, even reaching 1000 times the solar mass, stars with a mass of more than 1000 are rare and I cannot determine if this is due to an error in the Gaia database Due to a wrong determination of this value, values greater than 1000 are filtered out.

It is observed that the stars with the most mass are close to the galactic center and it decreases following a curve as we move away from the center.

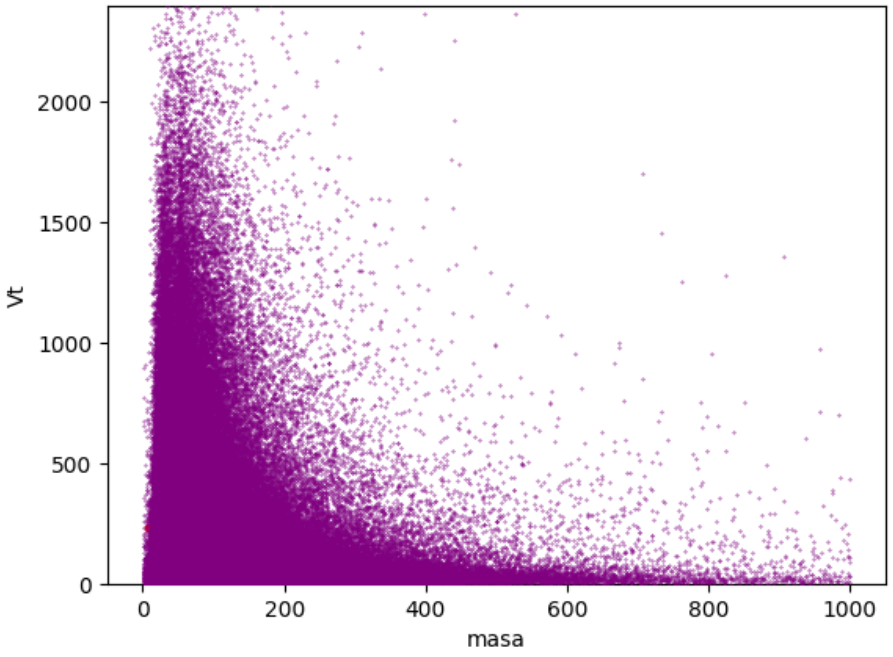
Figura 3
Masa estelar y localización



The mstar loop and actual tangential velocity

Figure 4 shows us how the real tangential speed is related to the mass of the stars and how this speed decreases when the mass increases.

Figura 4
Velocidad tangencial según masa



What is the real tangential velocity of the stars?

Given the data from Gaia we can determine the tangential velocity in modulus of the stars in the sample and a first observation already shows us surprising things.

Let us first show what we see and then expose what surprises us.

1. First of all we see that the distribution of tangential velocities that we observe is that said velocity increases linearly with a slope as we move away from the galactic center.
2. We also see a dispersion in the velocities that also increases with the distance from the galactic center, being increasing with the distance from the center.
3. Both speed and dispersion seem to be in a sort of linear relationship.

What is surprising:

1. Newton's laws and what we know from Kepler's laws in the solar system we should see something similar in the stars of the galaxy but this is not the case, note that in the solar system the most distant speeds decrease their speed with distance from the Sun , note in Figure 5 that the exact opposite occurs for the galaxy.

    a. As proof here is a table of the speeds of the planets, it is seen that these speeds decrease, against what the speeds of the stars in the galaxy do.

Planet	**Orbital speed (km/second)**	**Time (10^24 kg)**
Mercury	**47.9**	0.330
Venus	35.0	4.87
Land	29.8	5.97
Marte	24.1	0.642
Jupiter	13.1	1898
Saturn	9.6	568
Uranus	6.8	86.8
Neptune	**5.4**	102

We will see that none of the current models contrasted with these observed speeds fit the theoretical models.

For this study we are going to calculate the velocities of each star one by one, making the theoretical calculations based on its situation and the model, we will look for whether or not our model adjusts to the velocities observed from Vt.

Therefore, each graph of the model will be built from each star, although the view looks like a continuous line, it really is not.

First, let's show what our models should show, that is, they should correspond to the observed speeds, if they do not, it is because they either do not work or other aspects not contemplated are missing.

But despite the fact that we can find a more exact and justified modeling, thanks to the exposure of the data, we can refute a model under analysis.

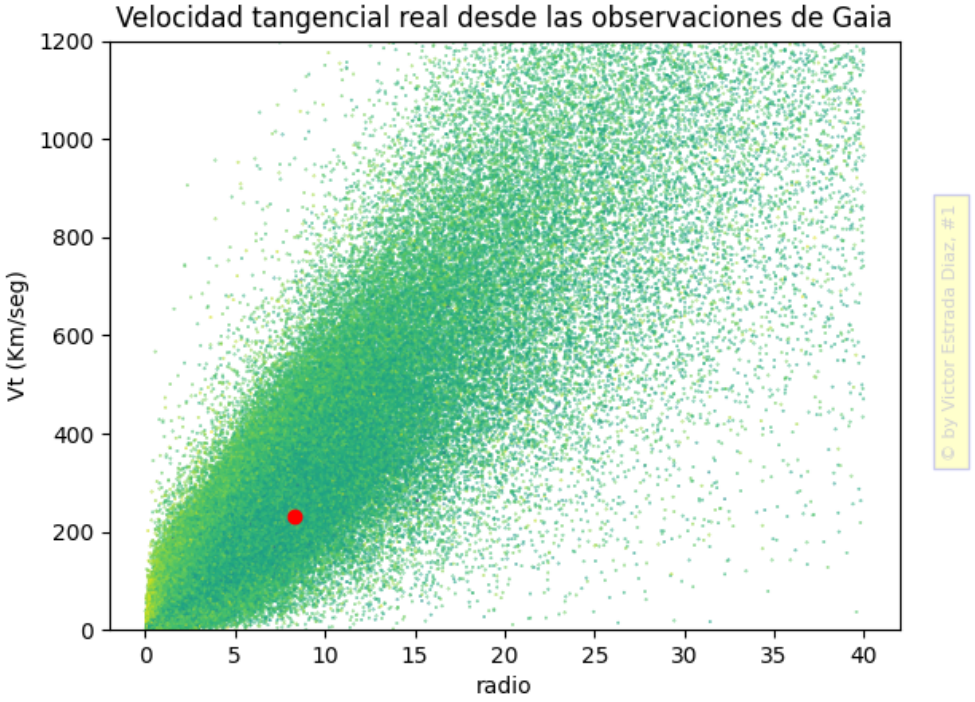
To refute means to contradict, object or deny something by means of a reasoned exposition of arguments that seek to establish the invalidity of what is rejected. The word comes from Latin refutāre. We can refute a point of view, an idea, an argument, a criterion, a hypothesis or a theory

Given the above, our models should respond to the tangential velocities observed by Gaia.

Figure 0 should serve as a basis for how real our theoretical model responds to the speeds observed by Gaia.

Figura 0

Velocidad tangencial real desde las observaciones de Gaia

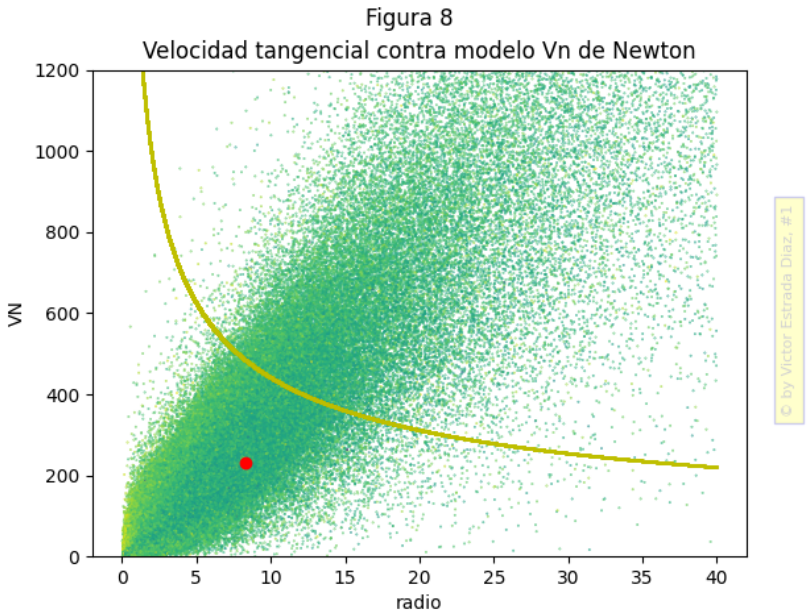


The red dot is the sun with its location and tangential velocity.

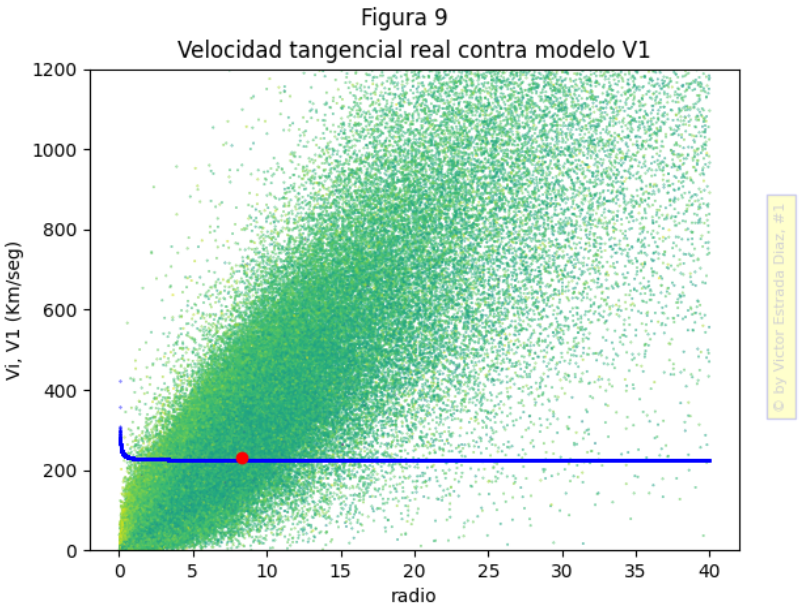
Newton's VN model

This is the model that is most in contradiction with the data, a model that does respond in the environment of the solar system but fails here, it can be seen in Figure 4 that the model responds exponentially decreasing while the reality is an increase in speed almost linear with distance, so

Newton does not work for the galaxy.***refuted model***.



Einstein's V1 model with dark matter



This model gives a very approximate speed for the Sun and the stars in its immediate environment, but it is wrong for distances towards the galactic center, since it gives higher speeds, and it gives very small speeds for more distant stars in the halo, since the speeds are not almost stable. as the model gives if they do not follow a slope, therefore it is an erroneous model,***refuted model***.

A forgetfulness of current theoretical models:

It may be relevant given the distances of hundreds or thousands of years in the galaxy, it has been proven that gravitational waves or space-time ripples propagate at the speed of light. Therefore it cannot be considered that the forces and therefore their effects on the speeds of the stars have to

include in some way that the force and the deformation of space are not transmitted instantaneously, at distances of 40 kpc from the galactic center they are more than 130,000 light years, this distance any force propagation effect would take that long to have any effect.
It is an aspect that has not been considered, but I believe it is extremely important in galactic dynamics.

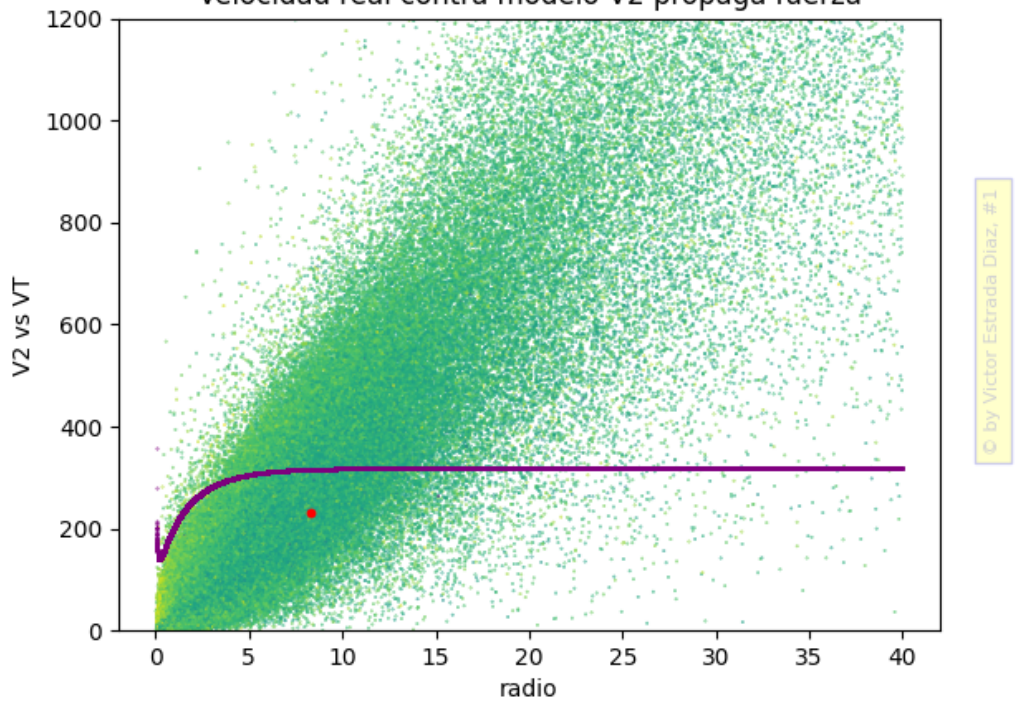
V2 model based on Einstein and dark matter with v. spread.

In an attempt to reconcile this important aspect, which must be the propagation speed of the force or the deformation of space, I have made an attempt to model the tangential velocities of the stars taking this propagative effect into account.

Although in principle the model responds to an increase in the tangential speed of the stars that increases with their distance from the center, then the speed stabilizes but gives very high speeds for the Sun and its surroundings of nearby stars, also the speed no longer increases and is far from the observed values (Vt)

In Figure 10 it can be seen that this model does not work either,**refuted model**.

Figura 10
Velocidad real contra modelo V2 propaga fuerza



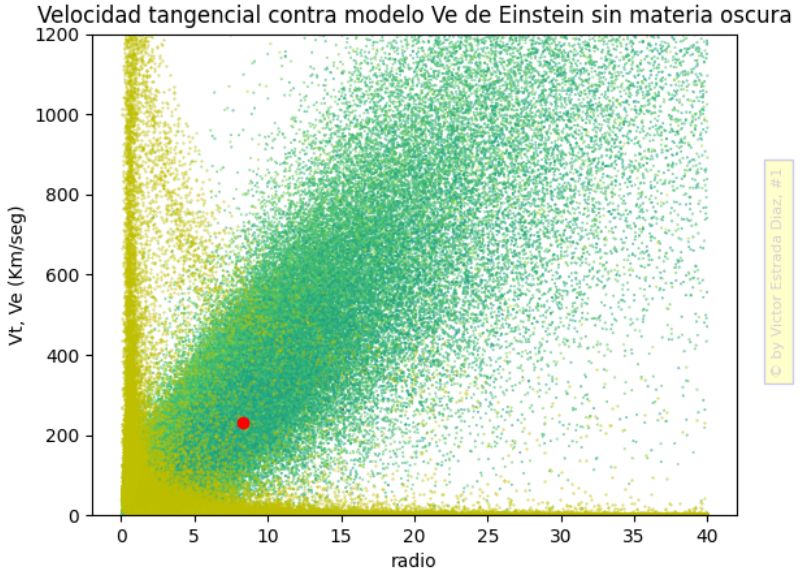
Modelo VE

This model does not work either, it is the pure Einsteinian model, without considering the possibility of introducing corrective factors such as dark matter or effects that I have already explained, such as the speed of propagation of the force or the deformation of space.

It is therefore a pure theoretical model based on Einstein's equations.

Prior to current models, it can be seen in Figure 6 that it is a**refuted model**.

Figura 6
Velocidad tangencial contra modelo Ve de Einstein sin materia oscura



Modelo V4

This model is the one that best fits reality, although it does not explain the dispersion of speeds when moving away, it responds linearly to the increase in hairiness with distance.

Since the speeds do not depend on the Newton or Einstein models, I propose this purely geometric model.

I think that in the case of the galaxy, given the enormous distances to act, the forces at the group level (local behavior is excluded) is so enormous (up to 130,000 and more light years) that the velocity model at the global level responds to effects geometric and not of forces, in any case there must be dimensional effects other than space-time because the stars behave as if they were in a semi-rigid disk where the speed is the exclusive result of the galaxy's rotation and the distance to the center of the star.

Thus, this model can be fixed by looking for the line that passes through the middle of the dispersion.

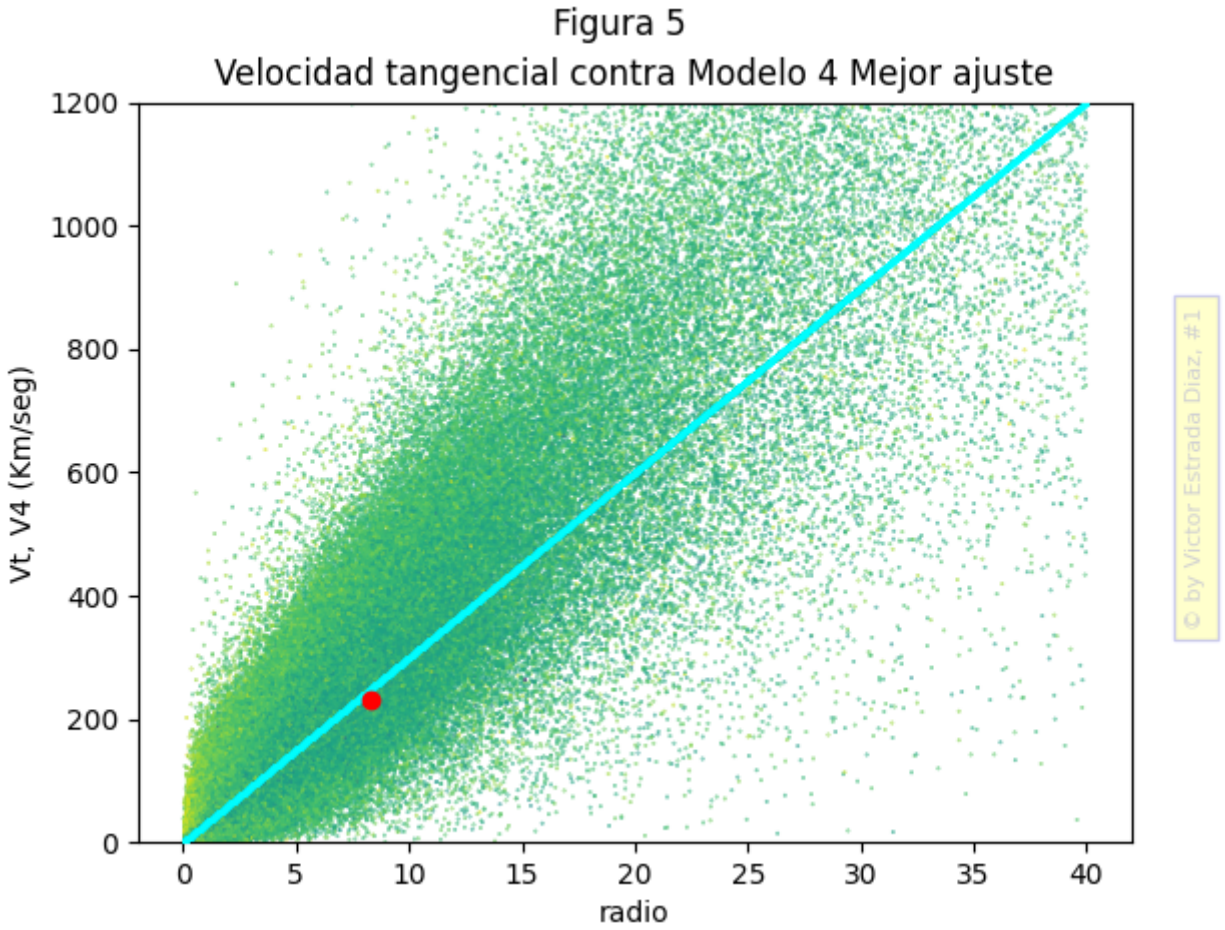
1. It can be, for example, a star in the suburbs in the center of the distribution.
    a. For example (1200Km/sec,40Kpc)
2. The Sun its speed and distance to the center or radius (240Km/sec,8.5kpc)
3. The galactic center (0.0) although the velocity in the center is not zero, it is minimal.

This model responds to a purely geometric criterion:

Star (1200.40)
Sun (240,8.5)

speed_point = 1200
point_distance = 40
slope = point_speed / point_distance

For any star:
v4=radio * pending



It doesn't explain scattering but it doesn't include anything exotic and weird like dark matter.
Nor does it explain that ratio or slope for the entire galaxy.

For all these reasons, this model can be a good basis for new investigations and theoretical modeling and explain why stars move as they do, contradicting all known models.

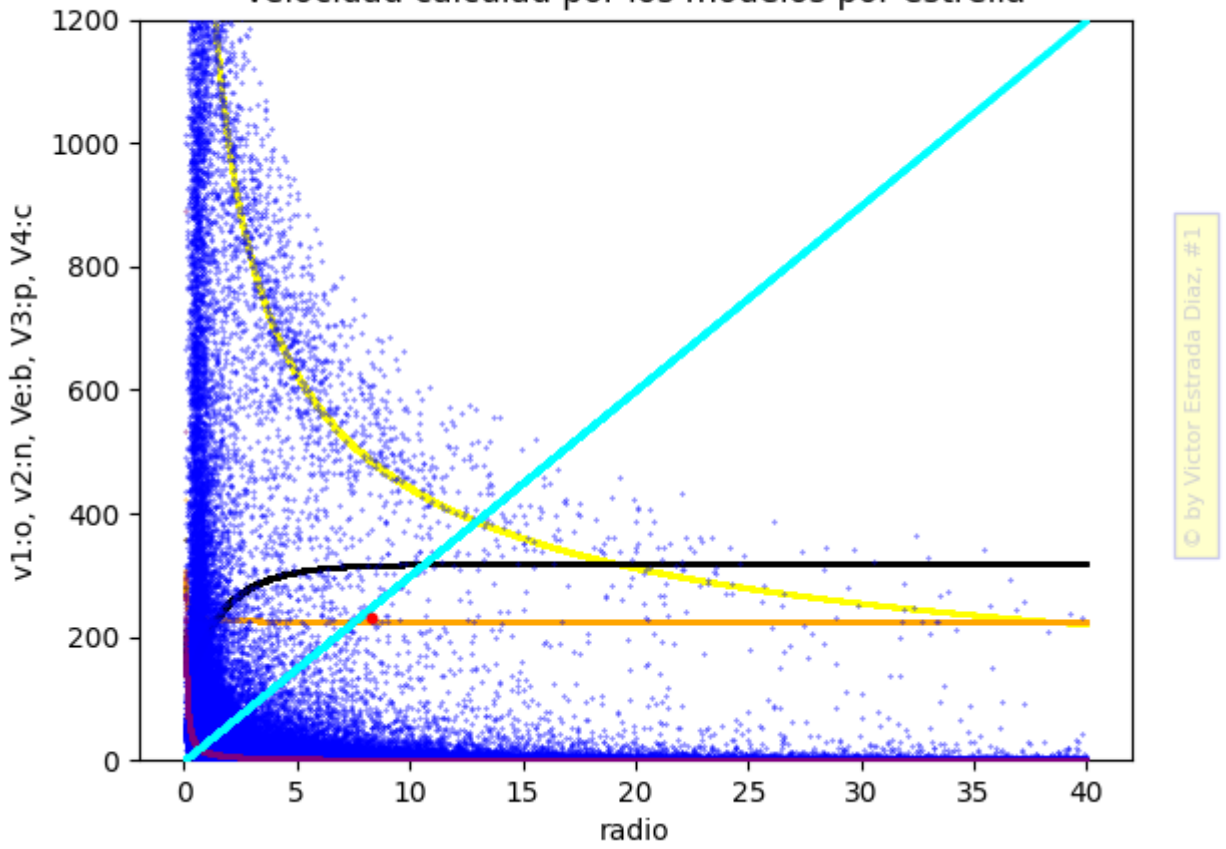
Why exotic dark matter is not justified?

We have seen that introducing dark matter does not provide any relevant data to what is observed and that is that none of the theoretical models work with it.

It is necessary to build models from valid and reasoned assumptions and to go back in the theoretical development to explore new paths when it is observed that a criterion accepted as valid is no longer justifiable with the evidence of new observations.

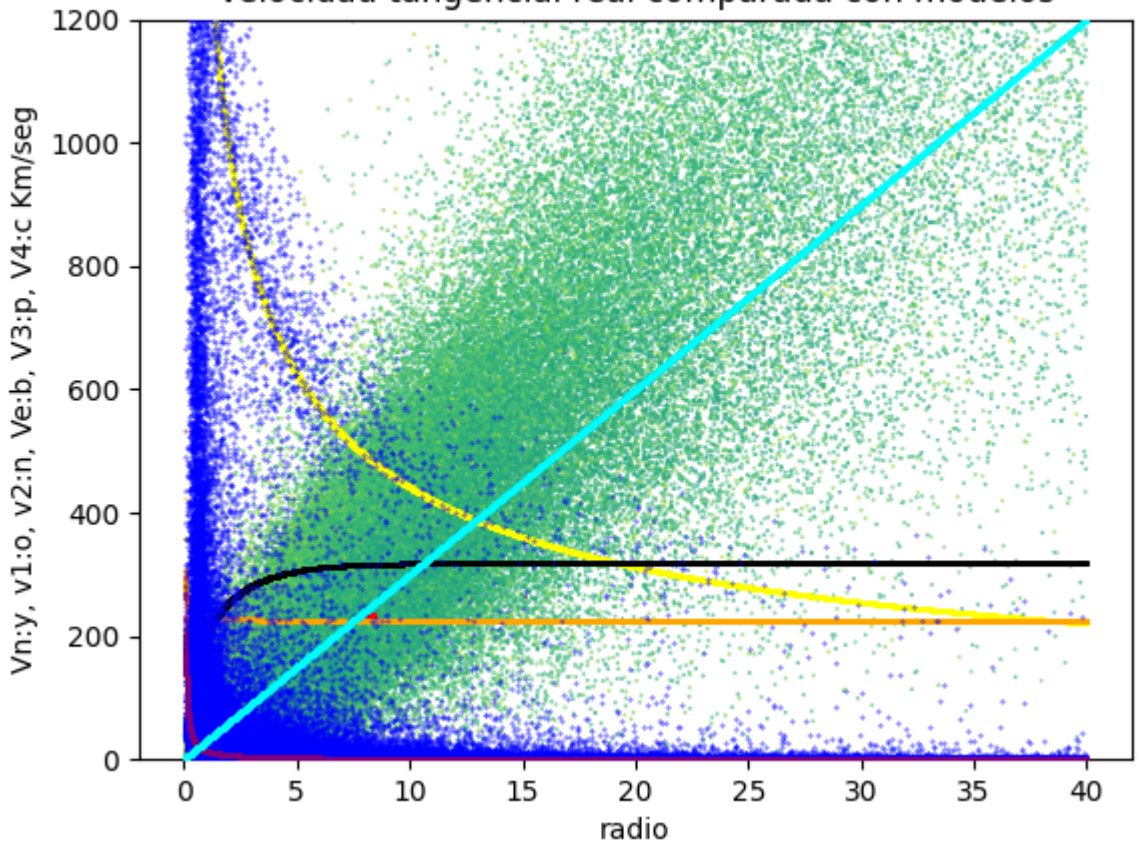
Finally, the Figure shows the different models analyzed.

Figura 11
Velocidad calculad por los modelos por estrella



And this last Figure shows the models contrasted with the reality of the observed tangential velocities (suns from blue to yellow)

Figura 12
Velocidad tangencial real comparada con modelos



This is a free and collaborative work

The data has been obtained using the Python language.

A copy of this work exists on GoogleCollaborative where you can access the project in Jupyter Notebook format where you can reproduce or experiment with this work.