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RC Electrical Modelling of Black Hole. New Method to Calculate the Amount of Dark Matter and the Rotation Speed Curves in Galaxies

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ABSTRACT: Here we mathematically model black holes following dynamics similar to RC electrical model, focusing on their similarities at the singularity. We use this mathematically modelling to hypothesize the origin and growth of a black Hole. Or model consists of several steps defined by: (1) the formation of a black hole following general relativity equations; (2) growth of the black hole modelled as a resistance-capacitance-like electrical circuit. Based on the mathematical modeling of a black hole following dynamics similar to an RC circuit, for a circular motion with constant acceleration, in which the condition is fulfilled, Vt = ω r, we are going to calculate the amount of dark matter in the Milky Way galaxies and the Andromeda galaxy and subsequently the rotation curve of both galaxies to compare them with observed or measured values.

Keywords: RLC electrical model; RC electrical model; cosmology; background radiation; Hubble's law; Boltzmann´s constant; dark energy; dark matter; black hole; Big Bang and cosmic inflation

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Let's remember again the theory of the paper: RLC electrical modelling of black hole and early universe. Generalization of Boltzmann's constant in curved space-time, with which we are going to work to calculate the amount of dark matter in the Milky Way and the Andromeda galaxy M31.

1. RC ELECTRICAL MODEL FOR A BLACK HOLE

If considering electric charge and mass as fundamental properties of matter.

From the point of view of electric charge, we know that a capacitor stores electrical energy and we can represent it as an RC circuit.

Analogously, from the mass point of view, we can consider a black hole as a capacitor that stores gravitational potential energy.

Continuing with the analogy, the space-time that surrounds a black hole can be represented as the inductance L.

from this simple conceptual idea was born RLC electrical modelling of black hole and early universe.

RC electrical model for a Black Hole:

Here we put forward the hypothesis of a black hole growth in analogy to an RC electrical circuit that grows according to a constant Tau being defined as:

$$\tau = RC \qquad (1)$$

First, we will consider the total mass of a black hole to consist of the sum of baryonic mass and dark matter mass (Equation (2)), considering dark matter as an imaginary number.

$$M = m - i\delta \qquad (2)$$

Where M is the total mass of a black hole, m is the baryonic mass; δ corresponds to dark matter and I is the irrational number $\sqrt{-1}$. This equation is in analogy to impedance of an RC circuit.

$$Z = R - iX_c \qquad (3)$$

Where z represents impedance; R represents resistance and Xc represents reactance.

If proper accelerations for the masses are introduced in Equation (2) we obtain the following:

$$F = f - i\varphi \qquad (4)$$

Where F is the total force, f is the force associated to baryonic mass, and $i\varphi$ is the force associated to dark mass. In analogy to a phasor diagram for an RC circuit, in which the reactance phasor lags the resistance phasor R by $\frac{\pi}{2}$, we can represent the two forces associated to barionic matter and dark matter as two orthogonal vectors (Figure 1).

Vector diagram of forces in a black hole for circular motion with constant acceleration:

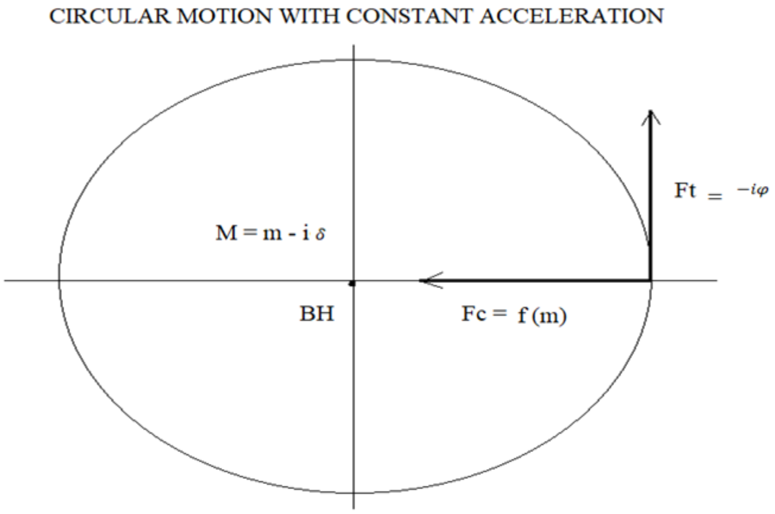

Figure 1. Vector representation of the forces in a black hole. Fc = f, represents the force towards the interior of the black hole generated by the mass m and Ft = -iφ, is a tangential force that retards Fc by 90 degrees, generated by the mass δ.

taking into account Newton's equation of universal gravitation:

$F = -(G\ M1\ M2)/r^2$

The sign (-) of the equation means that the force Fc is at 180 degrees with respect to the resistance R and the force Ft is also at 180 degrees from the reactance Xc.

It is important to make clear the physical interpretation of the imaginary mass, it is simply telling us that the force Ft due to the mass δ lag the force fc by 90 degrees, that lag is represented by the imaginary number i. Later we will determine that the mass δ, is the result of $v > c$ inside a black hole. Where v is the speed of a massless particle and c is the speed of light in a vacuum.

Figure 1 is represented for a circular motion with constant acceleration simply because the tangential velocity of a particle is proportional to the radius from the centre of the black hole multiplied by the average angular frequency.

$$Vt = r\,\omega$$

The contribution of (Ft, Vt) is what makes the speed of the galaxy remain constant as the radius of the galaxy grows.

Where Vt represents the tangential velocity of a galaxy, r is the radius from the galaxy, and ω is the average angular velocity of the rotation of the galaxy.

Circular motion with constant acceleration tells us that the mass input into a black hole is negligible with respect to the black hole's own mass.

The growth of a black hole according to the tau constant is an intrinsic property of a black hole and is independent of the amount of matter that enters a black hole.

To calculate the total energy associated to the black hole, we can introduce its total mass (Equation (2)) into:

$$E^2 = c^2p^2 + c^4M^2 \qquad (5)$$

Where E is energy; c represents the speed of light and m represents the mass. This lead to:

$$E^2 = c^2p^2 + (m^2 - \delta^2)c^4 - 2im\delta c^4. \quad (6)$$

We can assume that during the big bang inflation phase baryonic matter was overrepresented compared to dark matter together with an infinitesimal momentum, which would give us from Equation (6) the following:

$$E^2 = -\delta^2c^4 \quad ; \quad E = (+/-)\delta c^2 i \quad (7)$$

As expected, this result corresponds to the total energy of the universe at the big bang if we consider it to be made of dark matter represented as a reactance in an RC circuit.

The positive value of E is determined by matter, there is no antimatter inside a black hole.

If we consider charge as a fundamental property of matter, $E = (+)\delta c^2 i$, represents the amount of relativistic dark matter inside the black hole at the time of disintegration.

If we consider mass as a fundamental property of matter, $E = (-)\delta c^2$, represents the amount of relativistic dark matter inside a black hole, which exerts a repulsive gravitational force at the moment of disintegration. This repulsive gravitational force is what generates the dark energy after the Big Bang.

At time T0, when the black hole disintegrates and the Big Bang occurs, roughly all matter was dark matter.

We could also consider a universe at infinity proper time in which baryonic matter is dominant over dark matter, which would transform Equation (6) back into Equation (5) but with baryonic matter.

$$E^2 = c^2p^2 + m^2c^4. \quad (8)$$

2. RLC ELECTRICAL MODEL OF THE UNIVERSE

We will analyse the Dirac delta function &(t).

&(t) = {∞, t = 0} ^ {0, t ≠ 0}

If we perform the Fourier transform of the function &(t) and analyse the amplitude spectrum, we observe that the frequency content is infinite.

If we perform the Fourier transform of the function &(t) and analyse the phase spectrum, we observe that the phase spectrum is zero for all frequencies.

We say that it is a non-causal zero phase system.

The most important thing to emphasize in this system is that an infinite impulse has an infinite frequency content.

When we work in seismic prospecting looking for gas or oil, using explosives, the detonations produce an energy peak that generates a frequency spectrum that propagates in the layers of the earth. The energy produced in the detonation is not instantly transferred to the ground, a time delay occurs, it is said to be causal system of minimum phase.

In analogy, we are going to suppose that the Big Bang also behaves like a causal system of minimum phase.

Here we put forward the hypothesis that the big bang is the convolution of the energy released by disintegration of the black hole with the space-time surrounding the black hole, being defined as:

$$(m - i\delta) * \mathcal{E} \quad (9)$$

Where $m - i\delta$, is the total mass of a black hole, Ɛ is the space-time surrounding the black hole and * is the convolution symbol.

Equation (9) can be simplified and considered analogous to an RLC circuit.

Where RC represents a black hole and L represents the space-time around a black hole

$$RC = m - i\delta \quad (10)$$

$$L = \mathcal{E} \quad (11)$$

the resolution of the quadratic equation of the RLC circuit will determine how space-time will expand after the Big Bang and the bandwidth of the equation will give us the spectrum of gravitational waves that originated during the Big Bang.

3. COSMIC INFLATION

From the following equation:

$$ds^2 = -\left(1 - \left(\frac{2MG}{Rc^2}\right)\right)c^2dt^2 + \left(1/\left(1 - \frac{2MG}{Rc^2}\right)\right)dR^2 + R^2d\theta^2 + R^2\sin^2 d\phi^2 \quad (12)$$

We will analyse the Schwarzschild solution for a punctual object in which mass and gravity are introduced.

$$Rs = 2GM / c^2, is\ the\ Schwarzschild's\ radius. \quad (13)$$

Where M is the mass of a black hole, c is the speed of light, and G is the gravitational constant.
if we consider $d\theta = 0$; and $d\varphi = 0$; that is, we move in the direction of dR. (14)

R = Rs, ds = 0, let's analyse this specific situation. (15)

Replacing the conditions given in (13), (14) and (15) in Equation (12), we have:

$(dR / dt)^2 = v^2 = c^2 (1 - (2MG/Rc^2))^2$

R = Rs, v = 0; $ds^2 = 0$; Rs is the Schwarzschild´s radius. (16)

R > Rs, v < c; ds < 0, time type trajectory. (17)

R < Rs, v > c; ds > 0, space type trajectory. (18)

Condition (18) is very important because to the extent that R < Rs, v > c is fulfilled, it is precisely this speed difference that generates the imaginary mass in a black hole given by $-i\delta$.

Planck length equation:

$$Lp = \sqrt{(h\,G\,/c^3)} \quad (19)$$

where h is Planck's constant, G is the gravitational constant, and c is the speed of light.

If we consider condition (18) and Equation (19), to the extent that R < Rs and v > c, are fulfilled, we deduce that the Planck length decreases in value.

We define the following:

$Lp_\varepsilon = Lp = 1.616199\ 10^{-35}$ m; electromagnetic Planck length.

Lp_G = gravitational Planck length.

Always holds:

$Lp_G < Lp_\varepsilon$

Here we put forward the hypothesis that cosmic inflation is the expansion of space-time that is given by Lp_G that tends to reach its normal value Lp_ε after a black hole disintegrates.

If we consider the Planck length Lp_ε, the minimum length of space-time, like a spring and due to the action of v > c (300,000 km/s), this length decreases in values of Lp_G, that is, $Lp_G < Lp_\varepsilon$, allowing us to imagine the immense forces involved in compressing space-time of length Lp_ε into smaller values of space-time Lp_G. The immense energy stored and released in the spring of length Lp_G, to recover its initial length Lp_ε, is the cause of the exponential expansion of space-time in the first moments of the Big Bang.

At time T0, when the black hole disintegrates and the Big Bang occurs, roughly all matter was dark matter, relativistic dark matter.

4. GENERALIZATION OF THE BOLTZMANN´S CONSTANT IN CURVED SPACE-TIME

Equation of state of an ideal gas as a function of the Boltzmann constant.

$$P\,V = N\,KB\,T \quad (20)$$

Where, P is the absolute pressure, V is the volume, N is the number of particles, KB is Boltzmann's constant, and T is the absolute temperature.

Boltzmann's constant is defined for 1 mole of carbon 12 and corresponds to $6.0221\ 10^{23}$ atoms.

Equation (20) applies for atoms, molecules and for normal conditions of pressure, volume and temperature.

We will analyse what happens with Equation (20) when we work in a degenerate state of matter.

We will consider an ideal neutron star, only for neutrons.

We will analyse the condition:

$$(P\,V)\,/\,T = N\,KB = constant \quad (21)$$

This condition tells us that the number of particles remains constant, under normal conditions of pressure, volume and temperature

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However, in an ideal neutron star, the smallest units of particles are neutrons and not atoms.

This leads us to suppose that number of neutrons would fit in the volume of a carbon 12 atom, this amount can be represented by the symbol Dn.

In an ideal neutron star,

$$(\mathrm{P\ V}) / \mathrm{T} = \mathrm{Dn\ N\ KB} \qquad (22)$$

Where Dn represents the number of neutrons in a carbon 12 atom.

However, Equation (22) is not constant, with respect to Equation (21), the number of particles increased by a factor Dn, to make it constant again, I must divide it by the factor Dn.

$$(P\ V) / T = Dn\ N\ KB / Dn \qquad (23)$$

$$(P\ V) / T = N'\ KB' = constant \qquad (24)$$

Where N' = (Dn N), is the new number of particles if we take neutrons into account and not atoms as the fundamental unit.

Where KB' = (KB / Dn), is the new Boltzmann´s constant if we take neutrons into account and not atoms as the fundamental unit.

We can say that Equation (21) is equal to Equation (24), equal to a constant

Generalizing, it is the state in which matter is found that will determine Boltzmann's constant.

A white dwarf star a will have a Boltzmann´s constant KBe, a neutron star will have a Boltzmann´s constant KBn, and a black hole will have a Boltzmann´s constant KBq.

There is a Boltzmann´s constant KB that we all know for normal conditions of pressure, volume and temperature, for a flat space-time.

There is an effective Boltzmann´s constant, which will depend on the state of matter, for curved space-time.

The theory of general relativity tells us that in the presence of mass or energy space-time curves but it does not tell us how to quantify the curvature of space-time.

Here we put forward the hypothesis that there is an effective Boltzmann´ constant that depends on the state of matter and through the value that the Boltzmann´ constant takes we can measure or quantify the curvature of space-time.

Quantifying space-time, considering the variable Boltzmann constant, is also quantizing gravitational waves and, as with the electromagnetic spectrum, we will determine that there is a spectrum of gravitational waves.

These analogies to represent the gravitational and electromagnetic wave equations are achieved thanks to the ADS/CFT correspondence.

We can determine the equations of electromagnetic and gravitational waves as shown below.

Electromagnetic wave spectrum for flat space-time:

$E_\varepsilon = h \times f_\varepsilon$

$C_\varepsilon = \lambda_\varepsilon \times f_\varepsilon$

$E_\varepsilon = h \times C_\varepsilon / \lambda_\varepsilon$

$E_\varepsilon = K_{B\varepsilon} \times T_\varepsilon$

$K_{B\varepsilon} = 1.38\ 10^{-23}$ J/K

Gravitational wave spectrum for curved spacetime:

$E_G = h \times f_G$

$C_G = \lambda_G \times f_G$

$E_G = h \times C_G / \lambda_G$

$E_G = K_{BG} \times T_G$

$K_{BG} = 1.38\ 10^{-23}$ J/K to $1.78\ 10^{-43}$ J/K.

Where the subscript ε means electromagnetic and the subscript G means gravitational.

It can be seen that there is an electromagnetic and a gravitational frequency as well as an electromagnetic and a gravitational temperature.

The maximum curvature of space-time occurs for an effective Boltzmann´s constant of KB = 1.78 10^{-43} J/K, given by the ADS/CFT correspondence in which a black hole is equivalent to the plasma of quarks and gluons to calculate the viscosity of the plasma of quarks and gluons.

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Once a black hole is formed and the maximum curvature of space-time is reached, as a black hole grows following the tau growth law analogous to an RC circuit, as v grows fulfilling the relationship v > c, it happens that the gravitational Planck length becomes less than the electromagnetic Planck length, it holds that $L_{pG} < L_{pE}$.

5. BLACK HOLE´S RADIATION

Equation (2) defines the mass of a black hole, as shown below:

$$M = m - i\delta \qquad (25)$$

Where M is the total mass of a black hole, m is the baryonic mass; δ corresponds to dark matter and i is the irrational number $\sqrt{-1}$.

Also, here we put forward the hypothesis of a black hole growth in analogy to an RC electrical circuit that grows according to a constant Tau being defined as:

$$\tau = RC \qquad (26)$$

If we consider the black hole´s radiation that produces pairs of particles and antiparticles at the event horizon.

Here we put forward the hypothesis:

the HR (matter) particle, with frequency ω and energy hω, falls into the black hole and adds to m and δ increasing the mass of the black hole, that is, it adds mass.

This is defined with the assumption that a black hole grows according to the tau constant just like an RC circuit.

The P particle (antimatter), with frequency ω and energy -hω, moves away from the black hole in the form of a gravitational wave.

According to the proposed hypothesis, a black hole always grows, following the curve of the tau constant in analogy to an RC electrical circuit.

For a black hole of 3 solar masses, the stationary frequency would be approximately $2.6\ 10^3$ Hz.

6. APPLICATION OF THE MODEL AND RESULTS

6.1. Additional calculations. Growth of a black hole in analogy to the tau growth curve of an RC circuit

In the ADS/CFT correspondence to calculate the viscosity of quark-gluon plasma, the following assumption is used, a black hole is equivalent to quark-gluon plasma.

We consider the temperature of a black hole equal to the temperature of the quark-gluon plasma, equal to $T = 10^{13}$ K.

Another way of interpreting it is as follows:

When a star collapses, a white dwarf star, a neutron star, or a black hole is formed.

A white dwarf star has a temperature of about 10^6 K, a neutron star has a temperature of about 10^{11} K. If we consider that a black hole is a plasma of quarks and gluons, its temperature is expected to be higher than 10^{11} K.

Hypothesis: the temperature of a black hole is 10^{13} K.

We will make the following approximation:

$T = 0.0000000000001\tau$, $T = 10^{-13}\tau$

$\tau = 10^{26}$ K

$C_G(T) = C_{Gmax}\ (1 - e^{-(T/\tau)})$

$C_G(T) = C_{Gmax}\ (1 - e^{-0.000000000001(\tau/\tau)})$

$C_G(T) = C_{Gmax}\ (1 - e^{-0.0000000000001})$

$C_G(T) = C_{Gmax}\ (1 - e^{-(1/10^{13})})$

$C_G(T) = C_{Gmax}\ (1 - 1 / e^{(1/10^{13})})$

$C_G(T) = C_{Gmax}\ (1 – 0.9999999999999)$

$C_G(T) = C_{Gmax} \times 10^{-13}$

$C_{Gmax} = C_G(T) / 10^{-13} = 3\ 10^8$ m/s $\times 10^{13}$

$C_{Gmax} \equiv 3\ 10^{21}$ m/s.

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Where T is the absolute temperature, τ represents the growth constant tau, C_G = v represents the speed of a massless particle greater than the speed of light and C_{Gmax} represents the maximum speed that C_G can take.

With the following equations we obtain the following graphs, represented by Table 1 and Figure 2:

Parametric equations:

$C_G (T) = C_{Gmax} (1 - e^{-(T/\tau)})$

T (kelvin) = {(ħ c³) / (8 x π x K_B x G x M)}, Hawking's equation for the temperature of a black hole.

$R_S = (2 \times G \times M) / c^2$, Schwarzschild´s radius.

IMI = K ImI, where K is a constant.

IMI = I δ I

$K_{Bq} = 1.78\ 10^{-43}$ J/K, Boltzmann´s constant for black hole.

a) In item 1 of the Table 1, for the following parameters, T = 10^{13} K, C_G = C = $3 10^8$ m/s, calculating we get the following values:

m = 6 10^{30} kg, baryonic mass.
δ = 0, dark matter mass.
M = m = 6 10^{30} kg
Rs = 8,89 10^3 m, Schwarzschild radius.

b) In item 9 of the Table 1, for the following parameters, T = 5 10^{26} K, C_G = 3 10^{21} m/s, C = $3 10^8$ m/s, calculating we get the following values:

m = 1.20 10^{56} kg, baryonic mass.
δ = 1.20 10^{82} kg, dark matter mass.
M = δ = 1.20 10^{82} kg
Rs = 1.77 10^{29} m, Schwarzschild radius.

c) It is important to emphasize, for the time t equal to 5τ, at the moment the disintegration of the black hole occurs, the big bang originates, the total baryonic mass of the universe corresponds to m = 10^{56} kg.

d) Figure 2 shows the growth of the tau (τ) constant, as a function of speed vs. temperature.

Table 1. Represents values of ImI, baryonic mass; IδI, dark matter mass; IMI, mass of baryonic matter plus the mass of dark matter; IEmI, energy of baryonic matter; IEδI, dark matter energy; IEI, Sum of the energy of baryonic matter plus the energy of dark matter and Rs, Schwarzschild´s radius, as a function of, c, speed of light; C_G, speed greater than the speed of light; T, temperature in Kelvin; using the parametric equations.

Item	T	CG	C	I m I	I δ I	I M I	I Em I	I Eδ I	I E I	Rs
0	kelvin	m/s	m/s	kg	kg	kg	Joule	Joule	Joule	m
1	10^{13}	3 10^8	3 10^8	6.00 10^{30}	0	6.00 10^{30}	5.40 10^{47}	0	5.40 10^{47}	8.89 10^3
2	10^{14}	3 10^{10}	3 10^8	6.00 10^{35}	6.00 10^{39}	6.00 10^{39}	5.40 10^{52}	5.40 10^{56}	5.40 10^{56}	8.89 10^8
3	10^{17}	3 10^{13}	3 10^8	6.00 10^{41}	6.00 10^{51}	6.00 10^{51}	5.40 10^{58}	5.40 10^{68}	5.40 10^{68}	8.89 10^{14}
4	10^{21}	3 10^{15}	3 10^8	6.00 10^{43}	6.00 10^{57}	6.00 10^{57}	5.40 10^{60}	5.40 10^{74}	5.40 10^{74}	8.89 10^{16}
5	1 10^{26}	3 10^{17}	3 10^8	6.00 10^{44}	6.00 10^{62}	6.00 10^{62}	5.40 10^{61}	5.40 10^{79}	5.40 10^{79}	8.89 10^{17}
6	2 10^{26}	3 10^{18}	3 10^8	3.00 10^{47}	3.00 10^{67}	3.00 10^{67}	2.70 10^{64}	2.70 10^{84}	2.70 10^{84}	4.44 10^{20}
7	3 10^{26}	3 10^{20}	3 10^8	2.00 10^{53}	2.00 10^{77}	2.00 10^{77}	1.80 10^{70}	1.80 10^{94}	1.80 10^{94}	2.96 10^{26}
8	4 10^{26}	9 10^{20}	3 10^8	4.05 10^{54}	3.64 10^{79}	3.64 10^{79}	3.64 10^{71}	3.28 10^{96}	3.28 10^{96}	6.00 10^{27}
9	5 10^{26}	3 10^{21}	3 10^8	1.20 10^{56}	1.20 10^{82}	1.20 10^{82}	1.08 10^{73}	1.08 10^{99}	1.08 10^{99}	1.77 10^{29}

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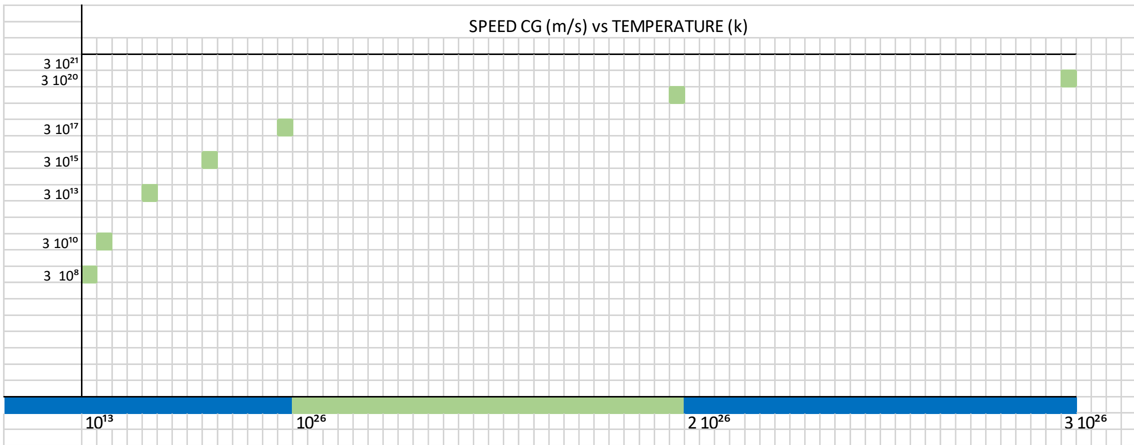

Figure 2. Represents the variation of speed C_G, as a function of temperature T, inside a black hole.

6.2. Calculation of the amount of dark matter that exists in the Milky Way

Mass and Schwarzschild´s radius of the Sagittarius A* black hole:

$m = 4.5\ 10^6$ Ms $= 4.5 \times 10^6 \times 1.98\ 10^{30}$ kg

Where Ms is the mass of the sun.

$m = 8.1 \times 10^{36}$ kg

Rs = 6 million kilometres

Where Rs is the Schwarzschild´s radius of the Sagittarius A*.

$Rs = 6 \times 10^9$ m

If we look at Figure 2, for $m = 8.1 \times 10^{36}$ kg and $Rs = 6 \times 10^9$ m, extrapolating we have approximately that $T = 3\ 10^{14}$ K.

To calculate the speed C_G we are going to use the Hawking temperature equation:

$T = hc^3 / (8\pi \times KB \times G \times M)$

Where h is Boltzmann's constant, c is the speed inside a black hole, KB is Boltzmann's constant, G is the universal constant of gravity, and M is the mass of the black hole.

Substituting the values and calculating the value of C we have:

$C_G = 10.30\ 10^{10}$ m/s

If we look at Figure 3, we see that this value corresponds approximately to the calculated value.

With the value of C_G we calculate δ and M:

$E = m\ C^2$

Where E is energy, m is mass, and C is the speed of light.

$E_G = M\ C_G$

$E_G = K\ m\ C^2$

$E_G = k\ E$

Where K is a constant.

Calculation of the constant K:

$C = 3\ 10^8$ m/s,

$C_G = 10.30\ 10^{10}$ m/s,

$m = 8.1\ 10^{36}$ kg

$E = 8.1\ 10^{36}$ kg $\times\ 9\ 10^{16}$ m²/s²

$E = 72.9\ 10^{52}$ J

$E_G = 8.1\ 10^{36} \times (10.30\ 10^{10})^2 = 8.1\ 10^{36} \times 106\ 10^{20}$

$E_G = 858.6\ 10^{56}$ J

$E_G = (106 / 9)\ 10^4 \times 8.1\ 10^{36} \times 9\ 10^{16}$

$E_G = K\ E$

$K = 11.77\ 10^4$

Calculation of the total mass M:

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M = K m
M = (11.77 10^4) x (8.1 10^{36} kg)
M = 9.54 10^{41} kg, Total mass of black hole Sagittarius A*
m = 8.1 x 10^{36} kg, total baryonic mass inside the black hole Sagittarius A*
Calculation of the mass of dark matter δ:
M = δ
δ = 9.54 10^{41} kg, total dark matter inside the black hole Sagittarius A*
Calculation of the ratio of the mass of dark matter and the mass of the Milky Way

Mvl = 1.7 10^{41} kg (27)

Mvl, mass of the milky way

δ = 9.54 10^{41} kg (28)

δ, dark matter inside the black hole Sagittarius A*
δ / Mvl = (9.54 10^{41} kg / 1.7 10^{41} kg)
δ / Mvl = 5.61, ratio of the mass of dark matter and the mass of the Milky Way
δ = 5.61 Mvl

The total dark matter δ is 5.61 times greater than the measured amount of baryonic mass of the Milky Way Mvl.

Circular motion with constant acceleration.

Let's consider, for a black hole, circular motion with constant acceleration.

Circular motion with constant acceleration tells us that the mass input into a black hole is negligible with respect to the black hole's own mass.

Figure 1, is represented for a circular motion with constant acceleration simply because the tangential velocity of a particle is proportional to the radius from the centre of the black hole multiplied by the average angular frequency.

$$Vt = \omega r \quad (29)$$

Equation (29) is very important, based on this equation we are going to work.

Let's consider the Figure 4, provided by the Federal University of Rio Grande do Sul UFRS:

In Figure 3, we observe that there is a difference between the observed or measured rotation speed of the Milky Way and the rotation speed considering only visible matter.

This difference is attributed to the existence of an invisible matter that we call dark matter, because we do not know its origin.

However, if we look at Figure 3, as the black hole grows, a tangent force Ft appears, as a consequence of v > c inside a black hole, which generates additional mass. This tangential force Ft delays the force Fc by 90 degrees. Both forces are gravitational forces.

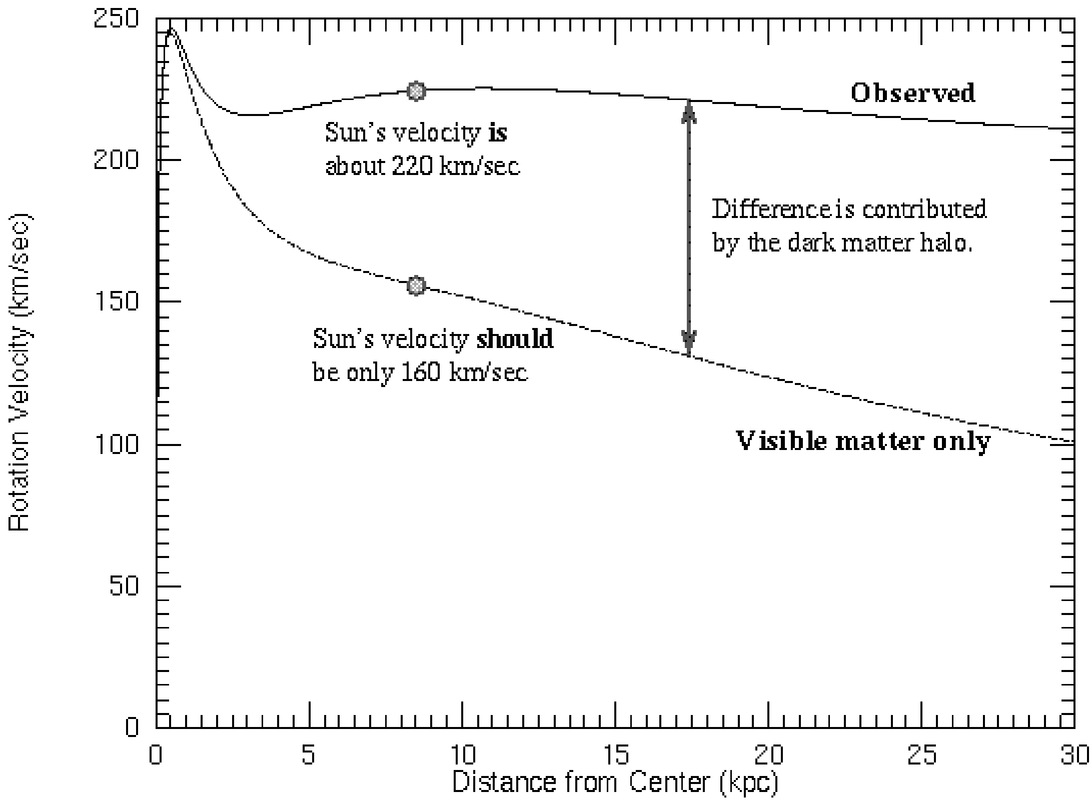

Figure 3. It represents the observed rotation speed of the Milky Way versus the rotation speed of visible matter, ref [1].

Taking as reference (29) and the distance r in Kpc to the centre of the Milky Way; We are going to generate the Table 2:

Let's calculate ω:

To calculate ω, we are going to consider Figure 4.

$\omega = (187\ km/s) / (7\ Kpc)$

$\omega = 187 / 10 \times 21\ 10^{16} = 8.9\ 10^{-16}$

$$\omega t = 8.9\ 10^{-16}\ rad/s \quad (30)$$

ωt, constant angular velocity of the Milky Way.

ωt is theoretical omega ou proposed omega.

We are going to carry out the calculations of the angular rotation speed considering the data provided by the University of São Paulo, USP, ref [2].

For the position of the sun, we have:

$r = 8.5$ Kpc

$Vt = 224.4$ km/s

$Vt = \omega \times r$

$\omega = Vt / r$

$\omega = 224.4\ km/s / 8.5\ Kpc = 224.4 / 8.5 \times 3\ 10^{16}$

$$\omega c = 8.8\ 10^{-16}\ rad/s \quad (31)$$

ωc, calculated value given by USP university.

We observe that the angular velocity ωt, given by (31), is approximately equal to the value calculated ωc, in (30)

If we look at Figure 4, starting at 7 Kpc, we see that the speed begins to decrease gently, therefore, we are going to consider r = 7 Kpc

Taking all this data into consideration, we are going to make the following table:

Table 2. Represents the values of the tangential velocity Vt, angular velocity ω, as a function of the radius r.

Vt	ω	r	r
km/s	rad/s	m	Kpc
187	$8.90\ 10^{-16}$	$21\ 10^{19}$	7
160	$8.90\ 10^{-16}$	$18\ 10^{19}$	6
106	$8.90\ 10^{-16}$	$12\ 10^{19}$	4
53	$8.90\ 10^{-16}$	$6\ 10^{19}$	2

If we analyse Figure 4, we observe that the relationship Vt = ω r, is fulfilled up to 7 Kpc, from 7 Kpc onwards, we observe that the tangency speed does not comply with the relationship Vt = ω r. From 7 Kpc onwards, the tangent velocity due to the contribution of dark matter decreases parallel to the rotation velocity curve of the Milky Way, measured or observed.

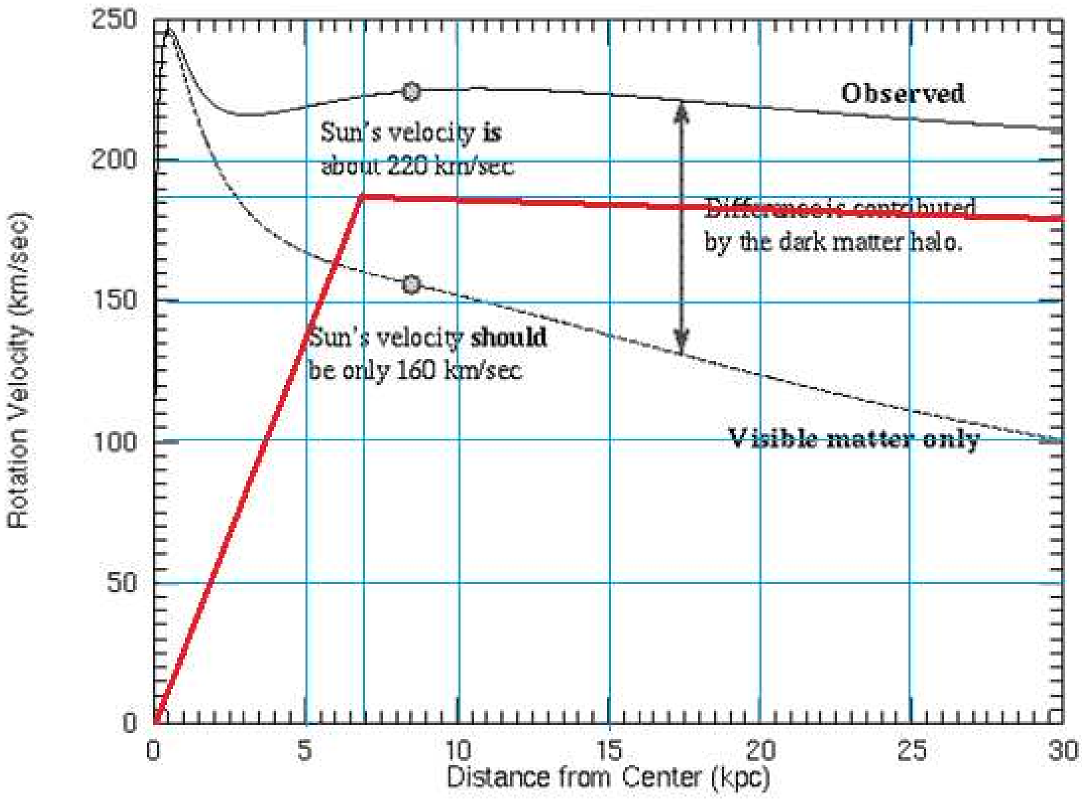

Figure 4. In red you can see the tangential velocity Vt that results from the contribution of dark matter.

Considering the graph of the rotation speed of only the visible matter and the graph in red, of the rotation speed of the dark matter, we are going to calculate the vector sum of both speeds to obtain a total speed and compare it with the graph of the observed or measured rotation speed.

In table 3, we represent the calculations:

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Table 3 - We represent Vdm, tangential rotation speed due to dark matter in red; Vm, tangential rotation speed due only to visible matter, Vc, calculated tangential rotation speed that results from the sum of Vdm + Vm and Vo, is the observed or measured tangential speed.

r	Vdm	Vm	Vc	Vo
Kpc	km/s	km/s	km/s	km/s
2	50	200	206	220
4	110	175	206	220
6	160	165	229	225
7	187	160	246	225
10	185	150	238	226
15	184	138	230	225
20	183	120	218	220
25	181	110	211	212
30	180	100	206	210

It is important to remember that the tangential rotation speeds are vectors, therefore, the sum of speeds is vector and for this we use Pythagoras.

If we look at Figure 5, we see that the observed tangential speed Vo is approximately coincident with the calculated tangential rotation speed Vc, in orange.

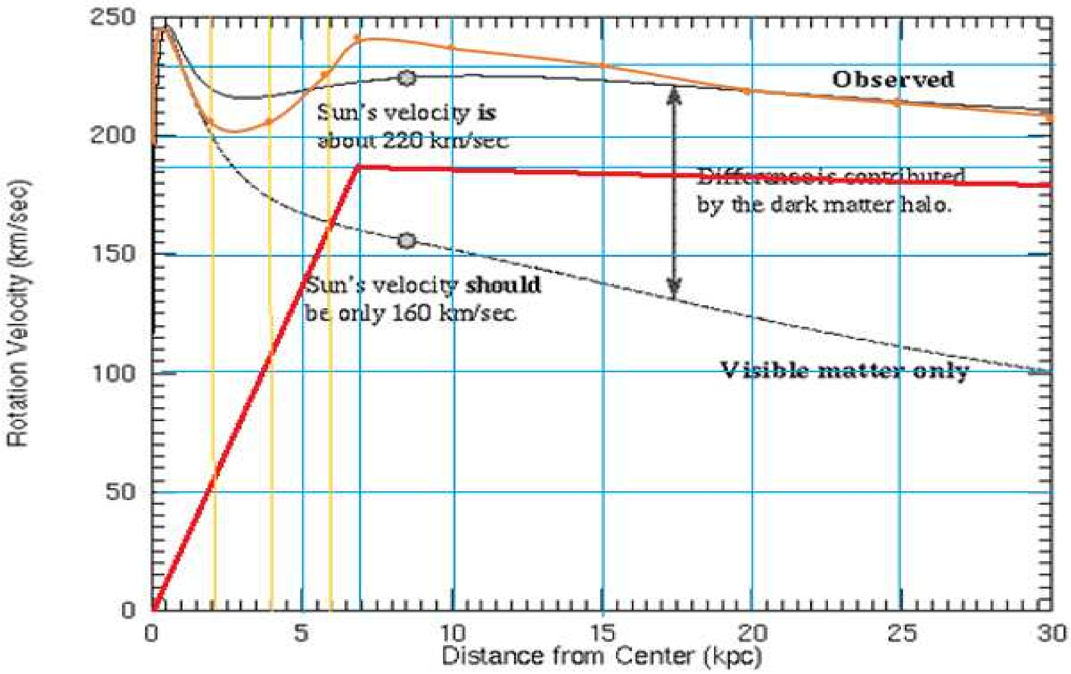

Figure 5. In red is represented the tangential rotation speed Vdm, due to the contribution of dark matter, in orange is represented the sum of the tangential speed due to dark matter plus the tangential speed due only to visible matter, Vdm + Vm.

Vc is the vector sum of the velocity Vdm plus the velocity Vm, Vdm + Vm.

Finally, we have shown that using the theory of RLC electrical modeling of a black hole and the primitive universe and the theory of the generalization of the Boltzmann constant in curved space-time, we can determine the tangential rotation curve of the Milky Way, in coincidence with the observed or calculated values. This is another method that we can use to calculate the tangential rotation speeds of galaxies.

6.2. Calculation of the amount of dark matter existing in the Andromeda galaxy M31

We will consider the mass of the black hole at the centre of the Andromeda galaxy equal to:

Let's assume m the following value, ref [3]:

$m = 1.5\ 10^7\ Ms = 1.5 \times 10^7 \times 2\ 10^{30}$ kg

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Where Ms is the mass of the sun.
$m = 3 \times 10^{37}$ kg
m, mass of the black hole at the centre of the Andromeda galaxy
Let's assume ML the following value, ref [4]:
$ML = 3\ 10^{42}$ kg
Where ML is the luminous mass of the Andromeda galaxy
Next, for our calculations, we will need Table 1 and Figure 2.
If we look at Figure 2, for $m = 4 \times 10^{37}$ kg, extrapolating we have approximately that:
$T = 4\ 10^{15}$ K and $c = 5\ 10^{11}$ m/s.
$T = 4\ 10^{15}$ K (32)
$C_G = 3\ 10^{11}$ m/s (33)
We are going to verify if these extrapolated values are correct or within the order of error.
$MBH = hc^3 / (8\pi \times KB \times G \times T)$ (34)
Where h is Boltzmann's constant, c is the speed inside a black hole, KB is Boltzmann's constant, G is the universal constant of gravity, and M is the mass of the black hole.
Substituting (32) and (33) into (34), we have:
$MBH = 1.5\ 10^{37}$ kg
We see that $m = 3\ 10^{37}$ kg, is approximately equal to $MBH = 1.5\ 10^{37}$ kg
If we look at Figure 3, we see that this value corresponds approximately to the calculated value.
We will take $m = 1.5\ 10^{37}$ kg, as true.
With the value of C_G we calculate δ and M:
$E = m\ C^2$
Where E is energy, M is mass, and C is the speed of light.
$E_G = m\ C_G^2$
$E_G = K\ m\ C^2$
Where K is a constant.
Calculation of the constant K:
$C = 3\ 10^8$ m/s
$C_G = 3\ 10^{11}$ m/s
$m = 1.5\ 10^{37}$ kg
$E = 1.5\ 10^{37}\ kg \times 9\ 10^{16}\ m^2/s^2 = 13.5\ 10^{53}$
$E = 13.5\ 10^{53}$ J
$E_G = 1.5\ 10^{37} \times (3\ 10^{11})^2 = 1.5\ 10^{37} \times 9\ 10^{22}$
$E_G = 13.5\ 10^{59}$ J
$E_G = K\ E$
$K = E_G / E = 13.5\ 10^{59} / 13.5\ 10^{53} = 10^6$
$K = 10^6$
Calculation of the total mass of the black hole of the Andromeda M31 galaxy:
$M = K\ m$
$M = (10^6) \times (1.5\ 10^{37}\ kg)$
$M = 1.5\ 10^{43}$ kg
Where M is the total mass of the central black hole of the Andromeda Galaxy.
$m = 1.5 \times 10^{37}$ kg, total baryonic mass inside the black hole of the Andromeda Galaxy.
Calculation of the mass of dark matter δ:
$M = \delta$
$\delta = 1.5\ 10^{43}$ kg,
Where δ, is total dark matter inside the black hole.
Calculation of the ratio of the mass of dark matter and the mass of the andromeda galaxy.
$ML = 3\ 10^{42}$ kg (35)
Where ML is the luminous mass of the Andromeda M31 galaxy.
$\delta = 1.5\ 10^{43}$ kg (36)
$\delta / ML = (1.5\ 10^{43}\ kg / 3\ 10^{42}\ kg)$

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δ / Mvl = 5

δ = 5 ML

The total dark matter δ is 5 times greater than the measured amount of baryonic mass of the andromeda galaxy.

Let's consider circular motion with constant acceleration.

Circular motion with constant acceleration tells us that the mass input into a black hole is negligible with respect to the black hole's own mass.

Vector diagram of forces in a black hole for circular motion with constant acceleration:

Figure 3, is represented for a circular motion with constant acceleration simply because the tangential velocity of a particle is proportional to the radius from the centre of the black hole multiplied by the average angular frequency.

$$V_t = \omega\, r \tag{37}$$

Equation (37) is very important, based on this equation we are going to work.

From now on, I inform you that the data and graphs with which we are going to work were provided in the Cosmology 1 course, taught by Dr Alexander Sabot, from the federal university of Santa Catarina, UFSC. The graphs were made in Python with real astronomical data.

We are going to carry out the calculations of the angular rotation speed considering the data provided by [4].

a) r = 33,000 Ly; Vt = 250 km km/s

1 Ly = 9.46 10^{15} m

ω = Vt / r

ω = 250 10^3 / 308 10^3 10^{15}

$$\omega a = 8.11\ 10^{-16}\ \text{rad/s} \tag{38}$$

b) r = 80,000 Ly; Vt = 200 km/s

ω = Vt / r

ω = 200 10^3 / 752 10^3 10^{15}

$$\omega b = 2.6\ 10^{-16}\ \text{rad/s} \tag{39}$$

We observe that the angular velocity ωa, given by (38), is approximately equal to the value calculated ωb, in (39)

THEORETICAL ANALYSIS - CALCULATION OF DARK MATTER IN THE COSMOLOGY 1 COURSE, UFSC:

The Python program, developed by Dr Alexander Zabot, from the Cosmology I course, is used to calculate the rotation curves of the Andromeda galaxy due to dark matter, the galactic nucleus and the galactic disk. Ref [5]:

Value of parameters used in Python.

```
# Conjunto possível de valores
Vb = vb( r, 0.1, 0.6e10 )
Vd = vd( r, 8.0, 4.0e11 )
Vh = vh( r, 200.0, 250    )
```

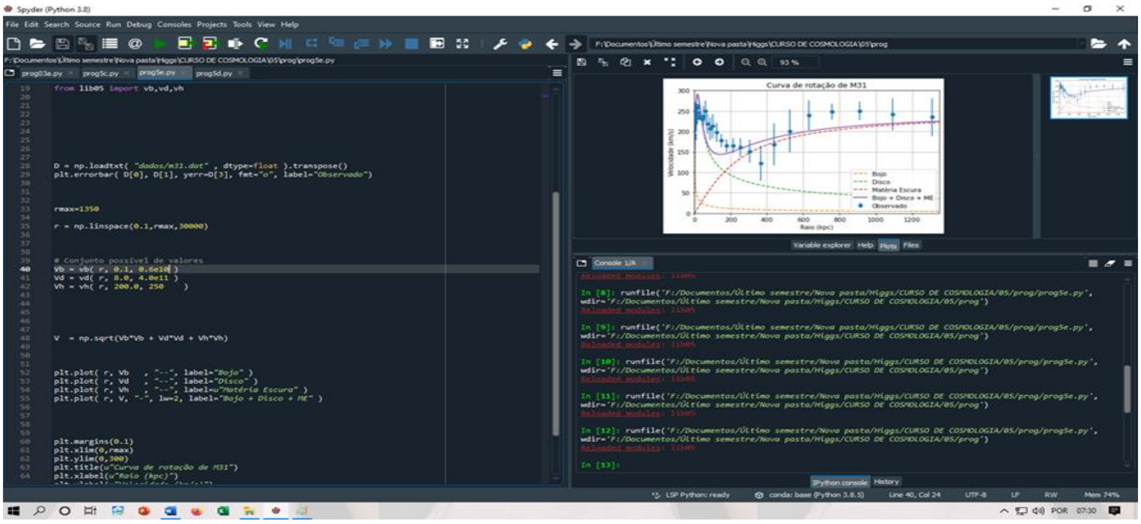

Figure 6 - Parameter values used in the Python program to generate the graph in Figure 8.

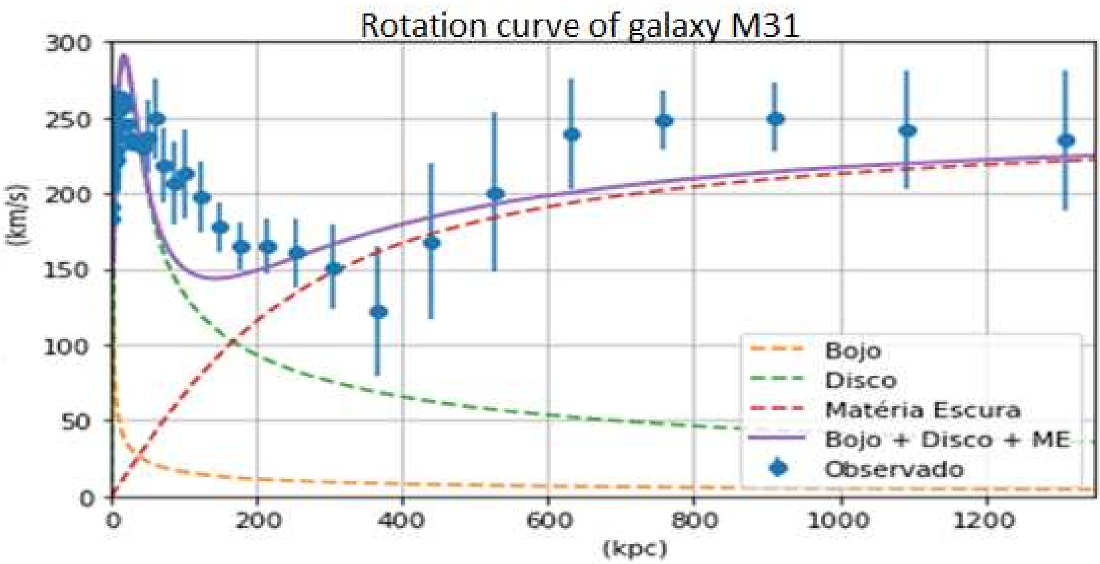

Figure 7. M31 rotation curve, blue, represents the measured or observed values of the rotation speed of M31; green, represents the values of the rotation speed due to the galactic disk; orange, represents the values of the rotation speed due to the galactic centre; red, represents the rotation speed due to dark matter; purple, represents the vector sum of the rotation speed that corresponds to the galactic centre, galactic disk and dark matter.

We observe in Figure 7, how the calculated rotation curve values, in purple, are close to the measured or observed values, in blue.

THEORETICAL ANALYSIS - WE CONSIDER THAT THE BLACK HOLE IS COMPOSED OF THE MASS M = m - i δ, THAT IS, THAT THERE IS A TANGENTIAL FORCE Ft. WE ASSUME THAT THE RELATIONSHIP, Vt = ω r, IS FULFILLED.

The Python program, developed by Dr Alexander Zabot, from the Cosmology I course, is used to calculate the rotation curves of the Andromeda galaxy due to dark matter, the galactic nucleus and the galactic disk. Ref [5]:

Value of parameters used in Python.

```
# Valores possíveis
Vb = vb( r, 0.1, 0.6e10 )
Vd = vd( r, 8.0, 4.0e11 )
```

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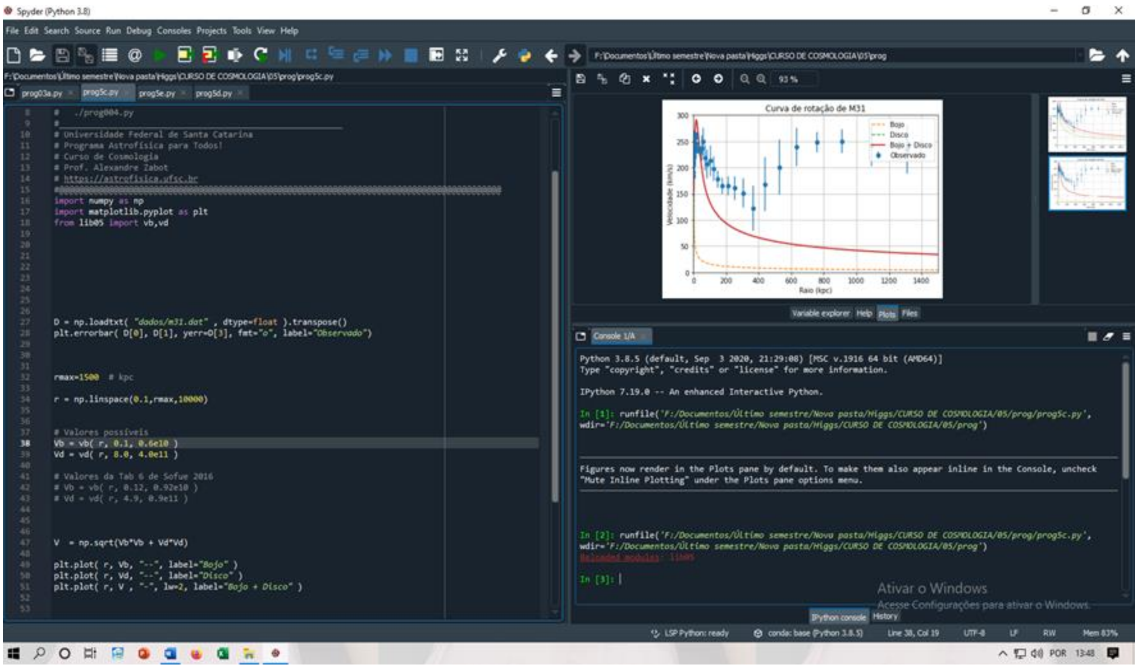

Figure 8. Parameter values used in the Python program to generate the graph in Figure 9.

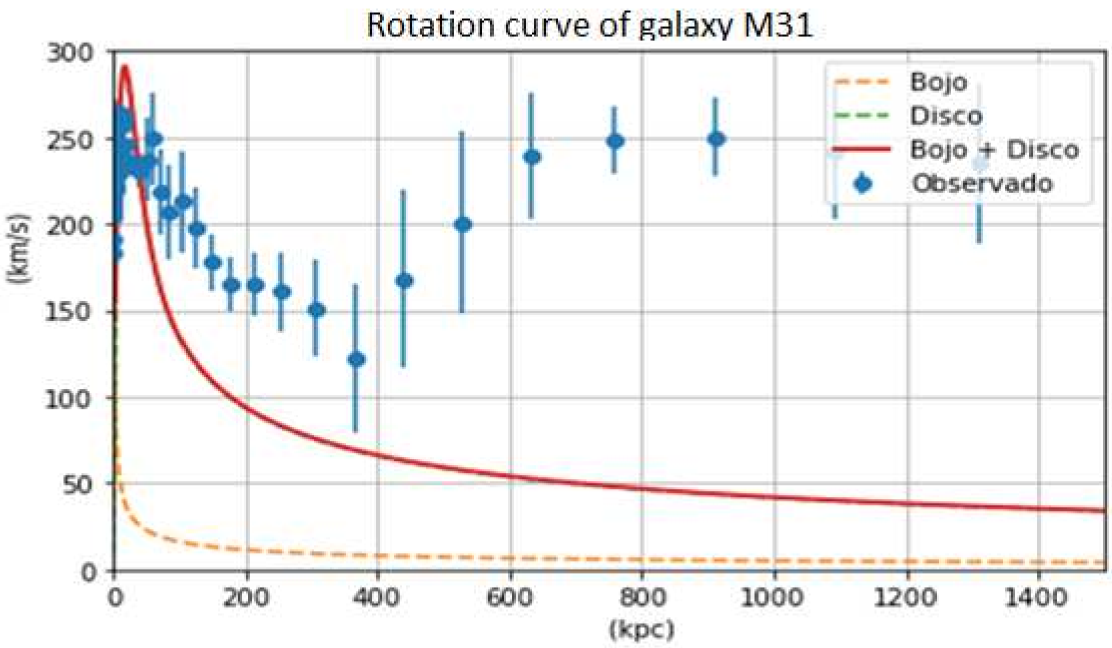

Figure 9. M31 rotation curve, blue, represents the measured or observed values of the rotation speed of M31; red, represents the values of the rotation speed due to the galactic disk; orange, represents the values of the rotation speed due to the galactic centre.

Taking into account Figure 10, we are going to perform the following calculations:

$Vt = \omega\ r$

$\omega = Vt / r$

$\omega = 250\ km/s / 700\ Kpc = (250\ 10^3\ m/s) / 700\ 10^3\ 3\ 10^{16}$

$\omega = 250 / 2100\ 10^{16} = 0.119\ 10^{-16} = 1.19\ 10^{-17}\ rad/s$

$\omega = 1.19\ 10^{-17}\ rad/s$

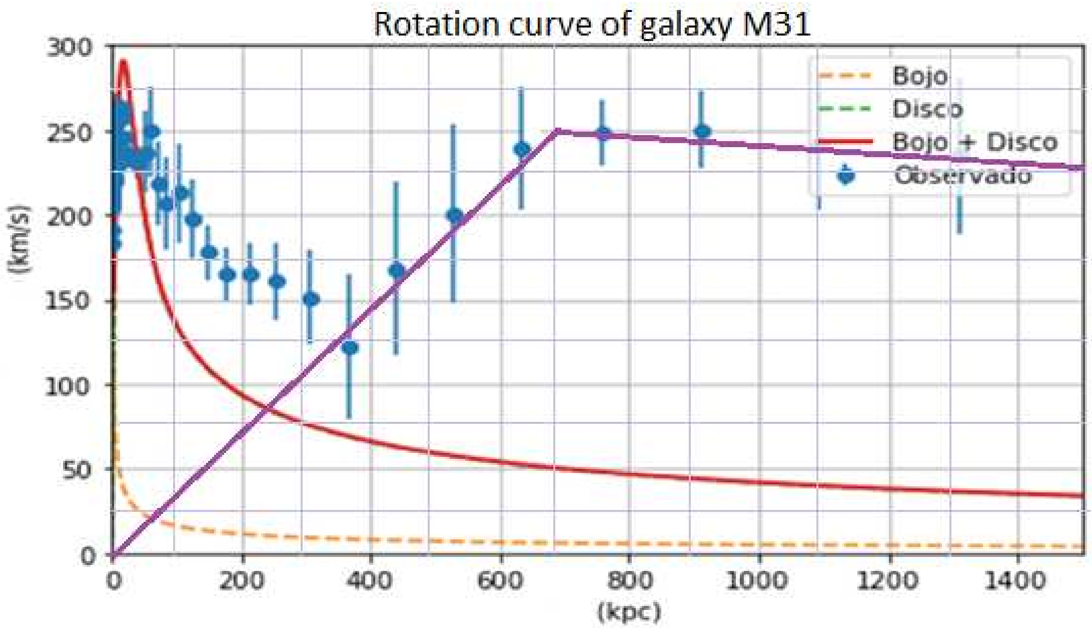

Figure 10. The rotation speed due to dark matter is represented in purple.

With the value of ω, we do the following calculation and fill out the table 4:

Table 4. Represents the values of the tangential velocity Vt, angular velocity ω, , as a function of the radius r.

Vt	ω	r	r
km/s	rad/s	m	Kpc
249	1.19 10^{-17}	2100 10^{19}	700
178	1.19 10^{-17}	1500 10^{19}	500
143	1.19 10^{-17}	1200 10^{19}	400
107	1.19 10^{-17}	900 10^{19}	300
72	1.19 10^{-17}	600 10^{19}	200
36	1.19 10^{-17}	300 10^{19}	100

If we analyse Figure 10, we observe that the relationship Vt = ω r, is fulfilled up to 700 Kpc, from 700 Kpc onwards, we observe that the tangency speed does not comply with the relationship Vt = ω r; from 700 Kpc onwards, the tangent velocity due to the contribution of dark matter decreases parallel to the rotation velocity curve of the Galaxy M31, measured or observed.

Considering the graph of the rotation speed of only the visible matter and the graph in red, of the rotation speed of the dark matter, we are going to calculate the vector sum of both speeds to obtain a total speed and compare it with the graph of the observed or measured rotation speed.

In the table 5, we represent the calculations:

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Table 5. We represent Vdm, tangential rotation speed due to dark matter; Vm, tangential rotation speed due only to visible matter; Vc, calculated tangential rotation speed that results from the sum of Vdm + Vm and Vo, is the observed or measured tangential speed.

r	Vdm	Vm	Vc	Vo
Kpc	km/s	km/s	km/s	km/s
100	36	140	144	218
200	72	90	115	163
300	107	75	130	150
400	143	68	158	125
500	178	60	188	165
700	249	50	253	240
800	246	46	250	250
1000	240	40	243	245
1200	234	35	237	239
1400	228	30	230	233

As seen in Figure 10, from 400 Kpc onwards, the influence of dark matter is predominant.

It is important to remember that the tangential rotation speeds are vectors, therefore, the sum of speeds is vector and for this we use Pythagoras.

If we look at Figure 11, we see that the observed tangential speed Vo is approximately coincident with the calculated tangential rotation speed Vc, in yellow.

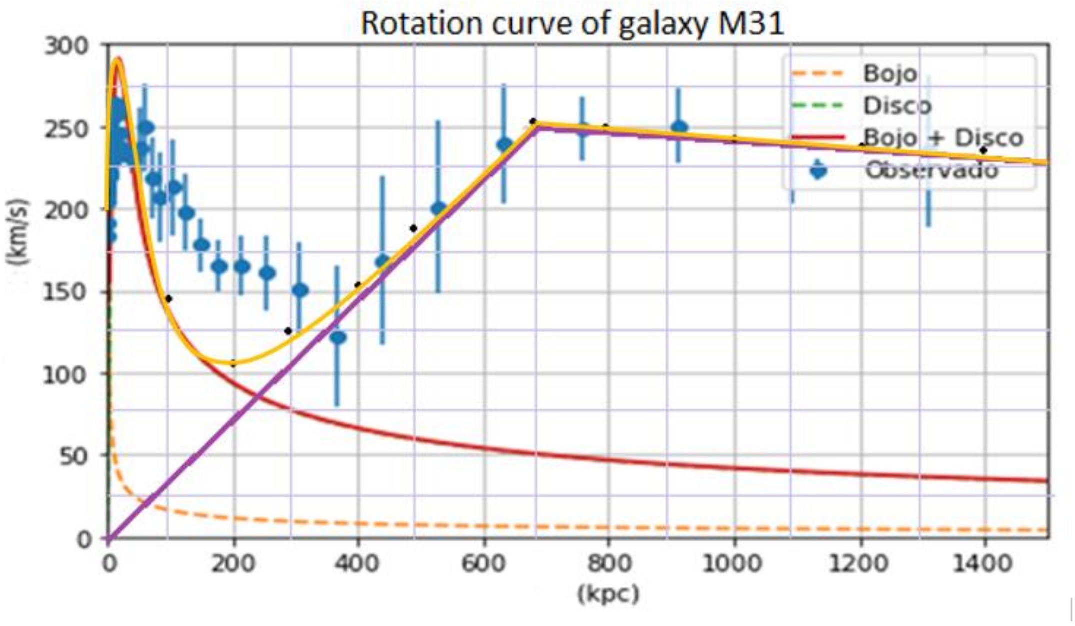

Figure 11. M31 rotation curve, blue, represents the measured or observed values of the rotation speed of M31; red, represents the values of the rotation speed due to the galactic disk; orange, represents the values of the rotation speed due to the galactic centre; purple, represents the rotation speed due to dark matter; yellow, represents the vector sum of the rotation speed that corresponds to the galactic centre, galactic disk and dark matter.

Vc is the vector sum of the velocity Vdm plus the velocity Vm, Vdm + Vm.

Let's compare the following figures:

If we look at Figure 12, it corresponds to the theoretical model that we used in the cosmology course 1 and compare with Figure 13, it corresponds to the RC model of a black hole that has mass M = m - i δ and that satisfies the equation Vt = ω r; We conclude that the rotation curve calculated in Figure 13 fits the observed or measured data of the Andromeda galaxy.

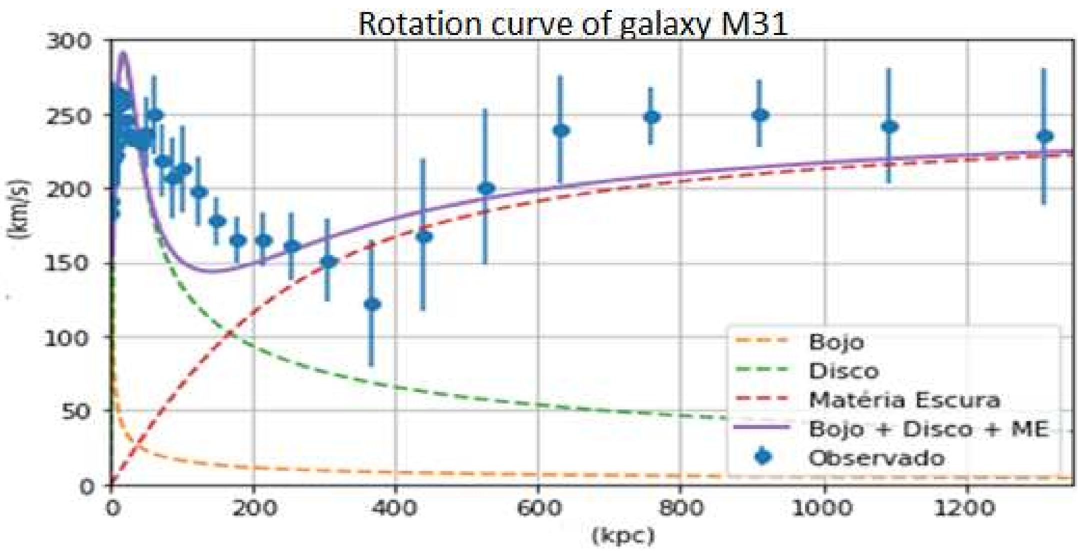

Figure 12. M31 rotation curve, blue, represents the measured or observed values of the rotation speed of M31; green, represents the values of the rotation speed due to the galactic disk; orange, represents the values of the rotation speed due to the galactic centre; red, represents the rotation speed due to dark matter; purple, represents the vector sum of the rotation speed that corresponds to the galactic centre, galactic disk and dark matter.

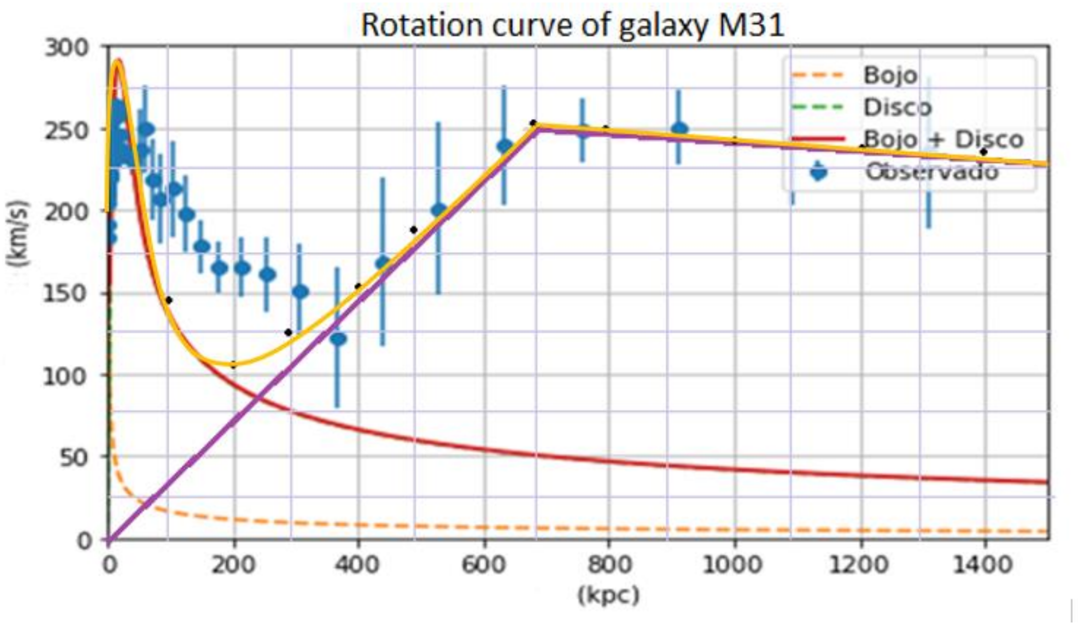

Figure 13. M31 rotation curve, blue, represents the measured or observed values of the rotation speed of M31; red, represents the values of the rotation speed due to the galactic disk; orange, represents the values of the rotation speed due to the galactic centre; purple, represents the rotation speed due to dark matter; yellow, represents the vector sum of the rotation speed that corresponds to the galactic centre, galactic disk and dark matter.

To improve, you could combine both methods, below 400 Kpc, we use the theoretical analysis applied in Cosmology 1, above 400 Kpc, we apply the RC model of a black hole, in which the mass is M = m - i δ and it holds that Vt = ω r.

Finally, we have shown that using the theory of RLC electrical modelling of a black hole and the primitive universe and the theory of the generalization of the Boltzmann constant in curved space-time, we can determine the tangential rotation curve of the galaxy M31, in coincidence with the observed or calculated values. This is another method that we can use to calculate the tangential rotation speeds of galaxies.

6.3. We will describe the contribution of all the forces involved in determining the rotation speed of a galaxy using the RC electrical model of a black hole.

Let us remember that all forces and velocity are vector magnitudes. We are also going to remember that in the RC electrical model of a black hole it is true that $M = m - i\,\delta$ and $Vt = \omega\, r$.

$$\dot{F}_B + \dot{F}_D + \dot{F}dm = (m / r) \times (V_B^2 + V_D^2) + (\delta / r)\, Vdm^2 \quad (40)$$

$$\dot{F}_B + \dot{F}_D + \dot{F}dm = (m / r) \times (V_B^2 + V_D^2) + (\delta / r) \times (\omega\, r)^2 \quad (41)$$

$$\dot{F}_B + \dot{F}_D + \dot{F}dm = (m / r) \times (V_B^2 + V_D^2) + \delta\, \omega^2\, r \quad (42)$$

Equation (40), (41) y (42); represents the contribution of all the forces that intervene in the rotation curve of a galaxy.

Where m, is baryonic matter; δ, it's dark matter.

Where $\dot{F}_B$, force of the bojo or galactic nucleus; $\dot{F}_D$, force of the galactic disk; $\dot{F}dm$, force of the imaginary mass or dark matter inside a black hole and r, radius of the galaxy.

Where V_B, is the rotation speed due to the bojo or galactic nucleus; V_D, is the rotation speed due to the galactic disk; Vdm, is the rotation speed due to dark matter.

$m >> \delta$, r near the black hole, we have:

V, the rotation speed of the galaxy will be the vector sum of the speed of the disk V_D plus the rotation speed of the galactic nucleus V_B, that is:

$$V = V_B + V_D \quad (43)$$

V, is vector sum of velocity.

$$\dot{F}_B + \dot{F}_D + \dot{F}dm \approx (m / r) \times (V_B^2 + V_D^2)$$

a) $\delta >> m$, r far from the galactic centre, we have:

The speed of the rotation curve of the galaxy will be approximately Vdm, due to the contribution of dark matter.

$$V = Vdm \quad (44)$$

$$\dot{F}_B + \dot{F}_D + \dot{F}dm \approx (\delta / r)\, Vdm^2$$

b) $m \approx \delta$, baryon mass of the order of the mass of dark matter.

$$V = V_B + V_D + Vdm \quad (45)$$

V, is vector sum of velocity.

$$\dot{F}_B + \dot{F}_D + \dot{F}dm = (m / r) \times (V_B^2 + V_D^2) + (\delta / r)\, Vdm^2$$

$$\dot{F}_B + \dot{F}_D + \dot{F}dm \approx (m / r) \times (V_B^2 + V_D^2 + Vdm^2)$$

The speed of the rotation curve of the galaxy will be the vector sum of the rotation speed of the galactic nucleus plus the rotation speed of the galactic disk and plus the rotation speed due to dark matter.

$$Vm = V_B + V_D \quad (46)$$

Where Vm represents the rotation curve of visible matter and is the vector sum of the velocity due to the galactic nucleus plus the velocity due to the galactic disk.

Using the criteria described here, a), b) y c), the mentioned approaches, we perform calculations to determine the speed of the rotation curve of a galaxy, Vc, calculated speed represented in the tables, which we compare with Vo, which is the observed or measured speed.

7. Conclusions

Using the theory of RC electrical modelling of a black hole, we have demonstrated how to calculate the amount of dark matter contained in a galaxy and its rotation speed curve. We have shown that if the matter entering a black hole is negligible in relation to the mass of the black hole, the tangential force Ft is constant, therefore, the tangential velocity due to the dark matter is also constant, the angular velocity It is also constant, that is, Ft produces a circular movement with constant acceleration, for this condition is fulfilled that $Vt = \omega r$, very important for our calculations.

In the first instance, we have calculated the dark matter existing in the Milky Way and by applying RC electrical modelling of a black hole, we calculated the theoretical rotation curve of the Milky Way and saw how it approaches the values of the rotation curve measured or observed of the Milky Way. Figure 6.

In a second instance, we have calculated the dark matter existing in the Andromeda galaxy M31, using Python and through this theoretical procedure we calculated the rotation curve of the Andromeda galaxy M31 and compared it with the rotation curve of the measured or observed values. Figure 13. In a second procedure, we calculate the amount of dark matter in the Andromeda galaxy M31, applying RC electrical modelling of a black hole, we calculate the rotation curve of Andromeda M31 and show how it approximates the rotation curve from the measured values and observed, Figure 14.

Finally, we have shown that using the theory of RLC electrical modelling of a black hole and the primitive universe and the theory of the generalization of the Boltzmann constant in curved space-time, we can determine the tangential rotation curve of the galaxies. This is another method that we can use to calculate the tangential rotation speeds of galaxies.

About the authors

HECTOR GERARDO FLORES (ARGENTINA, 1971). I studied Electrical Engineering with an electronic orientation at UNT (Argentina); I worked and continue to work in oil companies looking for gas and oil for more than 25 years, as a maintenance engineer for seismic equipment in companies such as Western Atlas, Baker Hughes, Schlumberger, Geokinetics, etc.

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Conflicts of Interests: The authors declares that there are no conflicts of interest.

References

1. Curva de rotação do nossa galaxia. Instituto de fisica da Universidad Federal de Rio Grande do Sul, UFRGS. https://www.if.ufrgs.br/oei/cgu/galstru/galstru.htm
2. Ronaldo E. de Souza. Via Láctea: a nossa galáxia, Universidad de São Paulo, USP. http://www.astro.iag.usp.br/~ronaldo/extragal/Cap2.pdf
3. Ismaeel A. Al-Baidhany; Sami S. Chiad; Wasmaa A. Jabbar; Ahmed K. Al-kadumi; Nadir F. Habubi ; Hazim L. Mansour. Determine the mass of supermassive black hole in the centre of M31 in different methods. https://doi.org/10.1063/5.0027838

4. Sunshun Yuan, Ling Zhu, Cheng Liu, Han Qu, and Zhou Fan. Constraining Mass of M31 Combing Kinematics of Stars, Planetary Nebulae and Globular clusters. https://doi.org/10.1088/1674-4527/ac7af9
5. Dr Alexander Zabot - Curso de Cosmologia 1. Astrofisica para todos, Universidad Federal de Santa Catarina - UFSC, Brazil. https://astrofisica.ufsc.br/curso-de-cosmologia/cosmologia1/
6. Wikipedia. Andromeda Galaxy. https://en.wikipedia.org/wiki/Andromeda_Galaxy
7. A. Tamm, E. Tempel, P. Tenjes, O. Tihhonova, and T. Tuvikene. Stellar mass map and dark matter distribution in M 31. https://arxiv.org/abs/1208.5712
8. Yoshiaki SOFUE. Rotation and Mass in the Milky Way and Spiral Galaxies. Institute of Astronomy, The University of Tokyo, Mitaka, 181-0015 Tokyo. https://arxiv.org/abs/1608.08350
9. Flores, H.G; Preprints 2023, 2023052246. Rlc Electrical Modelling of Black Hole and Early Universe. Generalization of Boltzmann's Constant in Curved Space-Time. https://doi.org/10.20944/preprints202305.2246.v3
10. Eisberg Resnick, Física Cuántica.
11. Eyvind H. Wichmann. Física cuántica.
12. Sears – Zemansky. Física Universitaria con Física Moderna Vol II.
13. Kostas kokkotas, Field Theory.
14. James B. Hartle, Gravity and introduction to Einstein´s General Relativity.
15. Charles W. Misner, Kip S. Thorne and Jhon Archibald Wheelher, Gravitation.