

Unexpectedly high stellar velocities in a spiral nebula

The Obstruction Theory provides the explanation

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Abstract

Dark matter has been proposed by the scientific establishment as a solution to the inexplicably high velocities of stars within the disk of a spiral galaxy. However, dark matter itself proves to be equally inexplicable; after decades of searching, its nature remains unknown. Furthermore, the high stellar velocities themselves have never been fully explained. In this article, we propose an alternative interpretation of gravity, in which mass is quantified based on the extent to which it obstructs the view of the universe. This allows us to explain why a star gains velocity at the expense of the speed of stars orbiting closer to the galactic center. Using the Triangulum Galaxy as an example, we demonstrate that the calculated velocity is of the same order of magnitude as the observed velocities.

Keywords: Gravity theory, MOND, Dark Matter, Triangulum Galaxy, Obstruction theory

1. Introduction

The concept of **Dark Matter** has been proposed repeatedly over the past century as a solution to the unexplained velocities of stars in spiral galaxies within our universe ¹⁾.

This concerns the very high speeds of stars: speeds that do not align with the orbital velocity one would expect if the stars were simply moving according to **Newtonian laws** around the galaxy's central mass.

Particularly at great distances from the center, velocities are observed that are up to five times higher than expected (see Fig. 3). This implies that the gravitational force experienced by the star must be up to **25** times greater than the force exerted on it by the center of mass. Consequently, the conclusion must be that the mass of the galaxy within the star's orbit is **25** times greater than the observed mass.

Mainstream science seeks the solution in Dark Matter—which supposedly contains about **25** times more mass than the visible mass determined by classical methods. The search for Dark Matter and its properties bears a striking resemblance to the 19th-century quest for the "**Aether**," a substance that, much like a "deus ex machina", was expected to explain otherwise baffling phenomena. It was only when Einstein demonstrated in 1905 that these unexplained phenomena could be understood through a better interpretation of the physical concept of Time that the "Aether" hypothesis—a desperate scientific measure—could finally be discarded.

We find ourselves in a similar situation today. Not a single trace pointing to the existence of Dark Matter has been found. The failure of this theoretical proposal is becoming increasingly obvious. The **Obstruction Theory**—which we have previously employed ²⁾ to explain puzzling phenomena in celestial mechanics—offers us a way to consign this surreal concept of Dark Matter to the dustbin.

We will explain the extreme speeds of stars in a spiral galaxy using the Obstruction Theory. There are two sides to this story:

1st How does such a star, located at a great distance, acquire its extraordinarily high speed?

2nd Why is the star not flung out of the galaxy—in other words, where does the extraordinarily strong gravitational force come from that keeps the star within the galaxy's grip?

Given the great complexity of these issues, we will limit ourselves in this article to the first question. We will address the second question in a subsequent article.

2. Non-Newtonian dynamics in our obstruction theory

In obstruction theory, we have introduced a fundamental change regarding the mechanism of gravity. We move away from the idea that an active force—akin to the electrostatic force—acts between two masses. Instead, we explain acceleration using reasoning rooted in **natural philosophy**. Consider two identical objects: one located at a great distance from a given mass, the other in the vicinity of that mass. Our premise is that the two objects must remain identical as long as both are free to move through space. The objects remain identical even if one exists in a completely different temporal regime—for instance, while orbiting a large mass—than the other. In such a case, they are identical, albeit at different times.

It turns out, for instance, that if we force the last object to remain in a fixed position near the aforementioned mass, time passes more slowly in the section closest to the mass than in the section further away. After some time, the two objects will no longer be identical; chemical processes will give rise to discrepancies. According to our hypothesis, this does not happen if the second object has been free to move.

Time is slowed down in the vicinity of a mass. Consequently, a gradient in the rate of time exists. The object is situated in a time field where, according to our hypothesis, it must naturally adopt a motion such that the rate of time remains constant across the entire object. That motion is the acceleration we recognize as gravitational acceleration. The object undergoes this acceleration without the need to postulate a force, as space possesses no physical properties. We described this in a previous article ³⁾. There, we also described how gravitational acceleration relates to the solid angle subtended by a mass from the perspective of an observer.

According to the obstruction theory, gravitational acceleration is equal to the relative solid angle under which the black spot—the region within the Einstein ring—of the mass is observed ⁴⁾. This implies that the gravitational field also depends on the observer's velocity. It does not, therefore, possess the rigid form fixed to the mass, as the field is traditionally perceived.

An important conclusion that can be drawn from this interpretation of the gravity of a mass is that the acceleration experienced by the object is directed toward the location where the mass is observed, rather than the location – based on calculations involving their relative velocities – where the mass is actually situated. It goes without saying that the speed of light must play an important role in this.

We provided a compelling example of this approach in our explanation regarding the anomalous velocity of the comet **Oumuamua** ⁵⁾.

In a spiral galaxy, we are dealing with billions of stars that move largely in the same direction around the center. Only within the central concentration do the stars move in relatively random directions.

Let us take a closer look at two stars—both orbiting the galaxy's center of mass—where one is located slightly closer to the center than the other.

They move in the same plane and, at regular intervals, reach their closest point—their 'peripoint'—while at other times they are at their furthest point from one another. According to traditional theory, the moment they reach this furthest point lies exactly halfway between the moments of peripoint. The force exerted on the inner star by the outer star as they approach is a mirror image of the force exerted as they move apart. Viewed in this light, no exchange of velocity between the two stars can have occurred after a single orbit from peripoint to peripoint.

The obstruction theory, however, presents a different picture. Viewed from the outer star, the distance to the inner star decreases as it approaches and increases as it recedes. However, the position at which we observe the inner star lags slightly behind its actual position. This is due to the time light takes to traverse the distance. Consequently, it takes longer to see the inner star cover the half of its orbit where it is receding than to see it cover the half where it is approaching.

➤ Naturally, astronomers are aware of this. As early as **1676**, **Ole Rømer** ⁶ made use of this fact to determine the speed of light.

The difference between the obstruction theory and Newton's approach is that Newton, when calculating the gravitational acceleration experienced by an object, relies on the positions where the object and the mass are *actually* located at that moment within that observer's stationary reference frame; the obstruction theory, by contrast, is based on the position where the mass is *perceived to be* at that moment from the object's perspective. This leads to differences that could potentially explain the small discrepancies with which the scientific community is grappling.

Let us return to the two stars orbiting the center of a galaxy. Star M_1 has an orbit with radius R , while the outer star, M_2 , follows an orbit with radius r .

We will see that the speed of the outer star increases because, during a single orbit of M_1 , it causes the speed of the inner star to decrease—due to the prolonged gravitational braking as the stars move apart and the briefer acceleration as they approach. The angular momentum of M_1 decreases. Due to the conservation of angular momentum, the angular momentum of M_2 must therefore increase; in other words, its speed increases. That is the key point!

Let us consider (see Fig. 1), from the perspective of M_2 , the star M_1 tracing its orbit around the center of the galaxy. From M_2 's perspective, it turns out that star M_1 takes $2R/c$ seconds longer to travel from its peripoint to its furthest point relative to M_2 . Conversely, according to M_2 , M_1 takes $2R/c$ seconds less time to travel from the furthest point to the peripoint. The duration of $2R/c$ seconds is simply the time it takes for light to traverse the orbit of M_1 .

As a result, the passage through the farthest point is observed with a greater time lag than the passage through the nearest point. Normally, it takes the star $\pi R/v$ seconds to travel between two opposite points in its orbit; however, when observed from M_2 , the outbound leg takes $(\pi R/v + 2R/c)$ seconds and the return leg takes $(\pi R/v - 2R/c)$ seconds. The differences are relative to a traditional calculation.

If we consider a radial distance of 1 meter, traversing that distance takes v/c seconds longer on the observer's clock when moving away and v/c seconds less time when approaching; it makes no difference whether this 1-meter radial interval is nearby or far away.

Consequently, the force acting on M_1 persists during its orbit for $2R/c$ seconds longer when M_1 is moving away—causing the star to lose more speed than predicted by Newton—while the force acts for $2R/c$ seconds less when M_1 is approaching, causing the star to gain less speed.

As a result, M_1 loses speed whether approaching or receding, thereby losing angular momentum compared to a traditional calculation.

That is an unexpected physical consequence of the interpretation advocated by the Obstruction Theory—namely, that the position to be considered is not the calculated position at our current time, but rather the position corresponding to the time indicated by the observed star M_1 at that moment. We use the word "*position*" here because not only is the distance different from what Newton's theory predicts, but so is the direction in which we observe the star.

This affects the distance we must use and the angle of gravity relative to the speed of movement. This leads to—what we call—the *optical distance effect* and the *optical angle effect*.

3. On the optical distance effect

We will first calculate the distance effect as precisely as possible. We do this using Fig 1. In this figure, M_1 is the inner star, which follows a circular orbit—indicated by a dashed line—around the system's center of mass C at a distance R . The outer star M_2 travels along a much larger circle around the center of mass at a distance r . The distance between M_1 and M_2 is denoted by the letter ℓ . The angle at which M_1 is observed from M_2 , relative to the optical axis, is denoted by ψ . Additionally, ϕ represents the angle between the direction of M_1 's motion and the direction of the gravitational force exerted by M_2 . Finally, we see the angle α , indicating the angular distance M_1 has traversed relative to the optical axis.

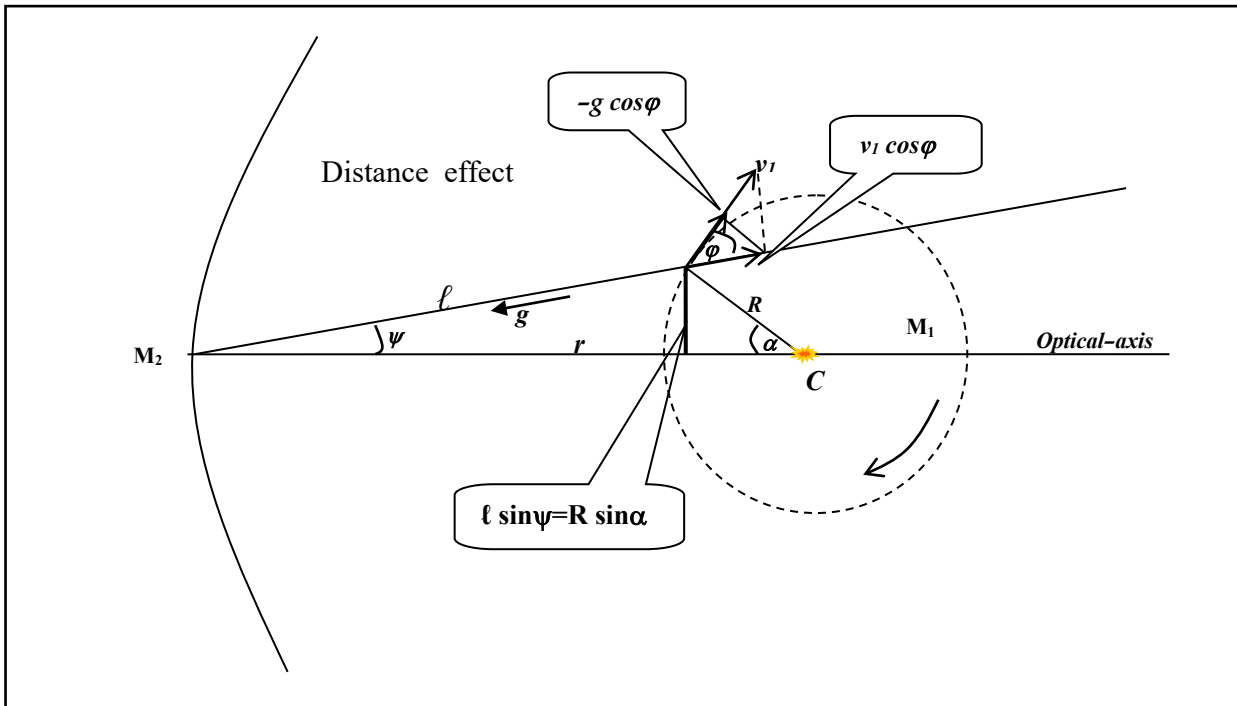


Fig. 1 Optical Distance Effect: M_1 and M_2 follow a path around the center C . Viewed from M_2 , M_1 occupies a position in its path that can be characterized by the angle α . From the figure, we can determine the angle ϕ

as $\phi = \frac{1}{2}\pi - \alpha - \psi$. The angle ψ is determined as $\psi = \arctan\left(\frac{R \sin \alpha}{r - R \cos \alpha}\right)$ and we find $\ell = \frac{R \sin \alpha}{\sin \psi}$.

The speed of M_1 is v_1 m/s. From this, we find that the distance in the radial direction—that is, the direction opposite to gravity—changes at a rate of $v_1 \cos \varphi$ m/s.

The speed of recession is zero when M_1 moves through the peripoint or the farthest point.

At the points where $\varphi = 0$ rad or π rad, the rate of change of distance is at its maximum.

If M_1 moves away from M_2 at a speed of $v_1 \cos \varphi$ m/s while in circular motion, and we observe the star from M_2 , then according to Newton, the actual distance at that moment will be greater than the observed distance of ℓ meters. We see the star at a time on its clocks that lags behind its actual time – that is, the time on our clocks. The actual distance (at our time) is therefore greater by $v_1 T \cos \varphi$ meters, where T is the time light takes to travel the distance ℓ – namely, $T = \ell/c$ seconds. The actual distance is therefore $\ell + \frac{\ell}{c} v_1 \cos \varphi$ meters.

The observed distance ℓ is therefore smaller than the actual distance. Consequently, the gravitational force is actually greater than predicted by Newton, since the gravitational acceleration according to Newton is $g = \frac{GM}{\ell^2}$ m/s², so inversely proportional to the square of the distance.

The difference between the Obstruction Theory and the traditional calculation is found using:

$$\Delta g = \frac{GM_2}{\ell^2} - \frac{GM_2}{\left(\ell + \ell \frac{v_1}{c} \cos \varphi\right)^2} \approx 2 \frac{v_1}{c} \frac{GM_2}{\ell^2} \cos \varphi \text{ m/s}^2.$$

The reverse applies during the approach.

For the acceleration in the direction of motion, we have to use the *component* in that direction:

$$\Delta g_{\text{component}} = \Delta g \cos \varphi = 2 \frac{v_1}{c} \frac{GM_2}{\ell^2} \cos^2 \varphi \text{ m/s}^2.$$

Combined with the expression $\ell = \frac{R \sin \alpha}{\sin \psi}$, we get $\Delta g_{\text{component}} = 2 \frac{v_1}{c} \frac{GM_2}{R^2} \frac{\sin^2 \psi}{\sin^2 \alpha} \cos^2 \varphi \text{ m/s}^2.$

We can calculate the result after one full orbit numerically by dividing the path into segments where α increases by 15 degrees at each step. Thus, for M_1 after 15 degrees, where the time taken

to cover that distance is equal to $T = \frac{2\pi R}{24v_1}$, we find a deceleration of the velocity by the

$$\text{distance effect of } \Delta v_{\text{afstand}} = T \Delta g_{\text{component}} = \frac{\pi}{6c} \frac{GM_2}{R} \frac{\sin^2 \psi}{\sin^2 \alpha} \cos^2 \varphi \text{ m/sec.}$$

By taking successive values for α , the effect after a full revolution is calculated. See Table III.

4. On the optical angular effect

Due to the displacement of M_1 during the time it takes for light to traverse the distance, the *angle* at which M_1 is viewed from M_2 also changes. Consequently, the direction of the gravitational acceleration experienced by M_1 from M_2 changes as well. The component of this acceleration in the direction of motion will therefore take on a different value, causing M_1 to decelerate or accelerate compared to Newton.

Figure 2 below illustrates how to derive an expression for the change in velocity resulting from the angular effect. Star M_1 is shown in orbit around center C, positioned at point A at a given time. At that same moment, star M_2 is located at point B in its orbit around C.

➤ For convenience, we treat for the remainder of the article M_2 to be stationary at point **B**.

From M_1 , one sees star M_2 in a different position, and from M_2 , one sees M_1 in a different position. From M_2 , one sees M_1 at position A^* – where it was actually located earlier – and from M_1 , one sees M_2 at position B^* – where it was previously observed from A^* .

To understand the figure, bear in mind that if M_1 moves clockwise, it appears from M_1 's perspective as though M_2 is moving counter-clockwise.

At that moment, the actual distance between the two stars is ℓ meters. The displacement occurring during the time ℓ/c seconds, the time it takes for light to travel that distance, is then equal to $v\ell/c$ meters. This corresponds to the thick line segment between $\mathbf{B}^*$ and $\mathbf{B}$ (or $\mathbf{A}$ and $\mathbf{A}^*$) in the diagram; thus, $\overline{BB^*} = v\ell/c$. Here, $\overline{BB^*}$ represents the distance between $\mathbf{B}$ and $\mathbf{B}^*$.

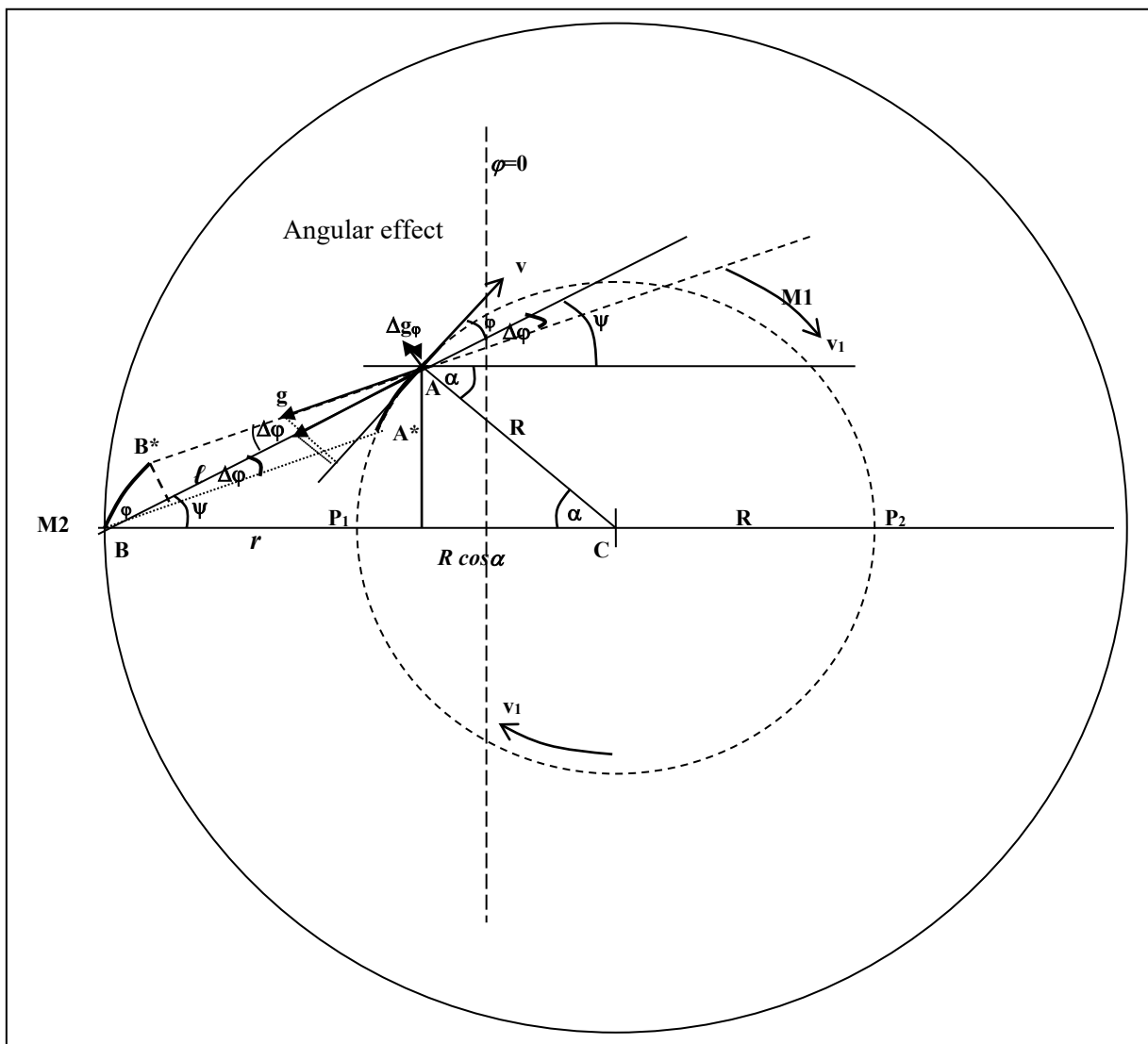


Figure 2 Optical Angular Effect: the angle $\Delta\phi$ is the difference between the position where the other object appears to be and its actual location.

In this figure, the following relations also apply: $\ell = R \sin \alpha / \sin \psi$, $\phi = \frac{1}{2}\pi - \alpha - \psi$, and $\psi = \arctan \{R \sin \alpha / (r - R \cos \alpha)\}$, which we derived in relation to Fig. 1.

What is new here is the small angle $\Delta\phi$. For this angle, $\ell \sin \Delta\phi$ is approximately equal to the altitude from B^* . This altitude is approximately equal to $\overline{BB^*} \sin \phi = v(\ell/c) \sin \phi$; thus, $\ell \sin \Delta\phi = v(\ell/c) \sin \phi$, or $\sin \Delta\phi = (v \sin \phi)/c$.

This yields $\Delta\phi \approx \frac{v}{c} \sin \phi$ rad, representing the deviation in the direction of the gravitational force experienced by M_1 compared to the traditional view.

We now examine the effect of the change in direction angle by $\Delta\phi$ — experienced by the gravitational acceleration from M_1 to M_2 compared to the direction predicted by Newtonian theory. The acceleration component along the motion vector acquires a difference term Δg_ϕ solely due to this angular effect.

In doing so, we neglect the change in distance by setting $\Delta\ell = 0$, yielding:

$$\Delta g_\phi = -\frac{GM_2}{\ell^2} \cos(\phi + \Delta\phi) + \frac{GM_2}{\ell^2} \cos \phi = \frac{GM_2}{\ell^2} \sin \phi (\Delta\phi) = \frac{v}{c} \frac{GM_2}{\ell^2} \sin^2 \phi$$

This component along the direction of motion is always positive. Consequently, during the receding phase, the speed of M_1 decreases less than predicted by Newton—meaning the speed remains higher than Newton's prediction—while during the approaching phase, the speed increases more than predicted by Newton, resulting in a speed that also exceeds Newton's prediction. Thus, after one orbit, the speed always increases due to the angular effect.

➤ As will be demonstrated below, the increase in speed will not offset the reduction in speed caused by the distance effect.

Further elaboration using $\ell = \frac{R \sin \alpha}{\sin \psi}$ yields the increasing speed for every point along the path.

That is the angular effect: $\Delta g_\phi = \frac{v}{c} \frac{GM_2}{R^2} \frac{\sin^2 \psi}{\sin^2 \alpha} \sin^2 \phi$ m/s².

The increase in speed after a duration of T sec is $\Delta v_\phi = T \Delta g_\phi = T \frac{v}{c} \frac{GM_2}{R^2} \frac{\sin^2 \psi}{\sin^2 \alpha} \sin^2 \phi$ m/s.

So the increase in speed as M_1 moves along an arc of 15 degrees of its orbit

in $T = \frac{2\pi R}{24v_1}$ sec will be: $\Delta v_\phi = \frac{\pi}{12c} \frac{GM_2}{R} \frac{\sin^2 \psi_n}{\sin^2 \alpha_n} \sin^2 \phi_n$ m/s.

We had already determined, based on the distance effect, a deceleration of

$$\Delta v_{\text{afstand}} = T \Delta g_{\text{component}} = \frac{\pi}{6c} \frac{GM_2}{R} \frac{\sin^2 \psi}{\sin^2 \alpha} \cos^2 \phi \text{ m/s for } M_1 \text{ over an orbital arc of 15 degrees.}$$

Combining both effects, we obtain a change in the acceleration of M_1 of:

$$\Delta g \approx \frac{v_1}{c} \frac{GM_2}{\ell^2} \sin^2 \phi - 2 \frac{v_1}{c} \frac{GM_2}{\ell^2} \cos^2 \phi \text{ m/s}^2.$$

Over a 15-degree segment of the path, we then obtain a change in the velocity v_1 of M_1 of

$$\Delta v_1 \approx \frac{\pi}{12c} \frac{GM_2}{R} \frac{\sin^2 \psi}{\sin^2 \alpha} \sin^2 \phi - \frac{\pi}{6c} \frac{GM_2}{R} \frac{\sin^2 \psi}{\sin^2 \alpha} \cos^2 \phi \text{ m/s.}$$

Which is
$$\Delta v_1 \approx \frac{\pi}{12c} \frac{GM_2}{R} \frac{\sin^2 \psi}{\sin^2 \alpha} [\sin^2 \varphi - 2 \cos^2 \varphi] \text{ m/s.}$$

From this, it can be immediately deduced that the speed of M_1 will have decreased after one orbit. After all, the expression $[\sin^2 \varphi - 2 \cos^2 \varphi]$ yields a negative average value after one orbit – easily verified with a graphing calculator – whereas all the other expressions are positive. This demonstrates that the two effects do not cancel each other out.

5. Numerical calculations using Excel

In the preceding discussion, we kept star M_2 fixed in position. However, this star is actually in motion. Consequently, the orbital period of M_1 —as observed from M_2 — takes longer. We assume that, apart from the duration, this effect has no other impact on our calculations, and we proceed by treating M_2 as a fixed point.

Using the formulas derived for the optical distance effect and the angular effect, we will now demonstrate—taking an outer star in the **Triangulum Galaxy** (Fig. 3) as an example—how such a star might have acquired its exceptionally high velocity.

Table I lists the values we used in the calculations.

Table I
Data for the numerical calculations

$G = 6.67 \times 10^{-11} \text{ m}^3/(\text{kg} \cdot \text{s}^2)$	$c = 3 \times 10^8 \text{ m/s}$
$M = 1.99 \times 10^{30} \text{ kg}$	$1 \text{ year} = 3.15 \times 10^7 \text{ s}$
$GM = 1.33 \times 10^{20} \text{ m}^3/\text{s}^2$	$1 \text{ light-year} = 9.46 \times 10^{15} \text{ meters}$
$1 \text{ pc} = 3.26 \text{ light-years}$	$90 \text{ degrees} = 1.571 \text{ rad}$

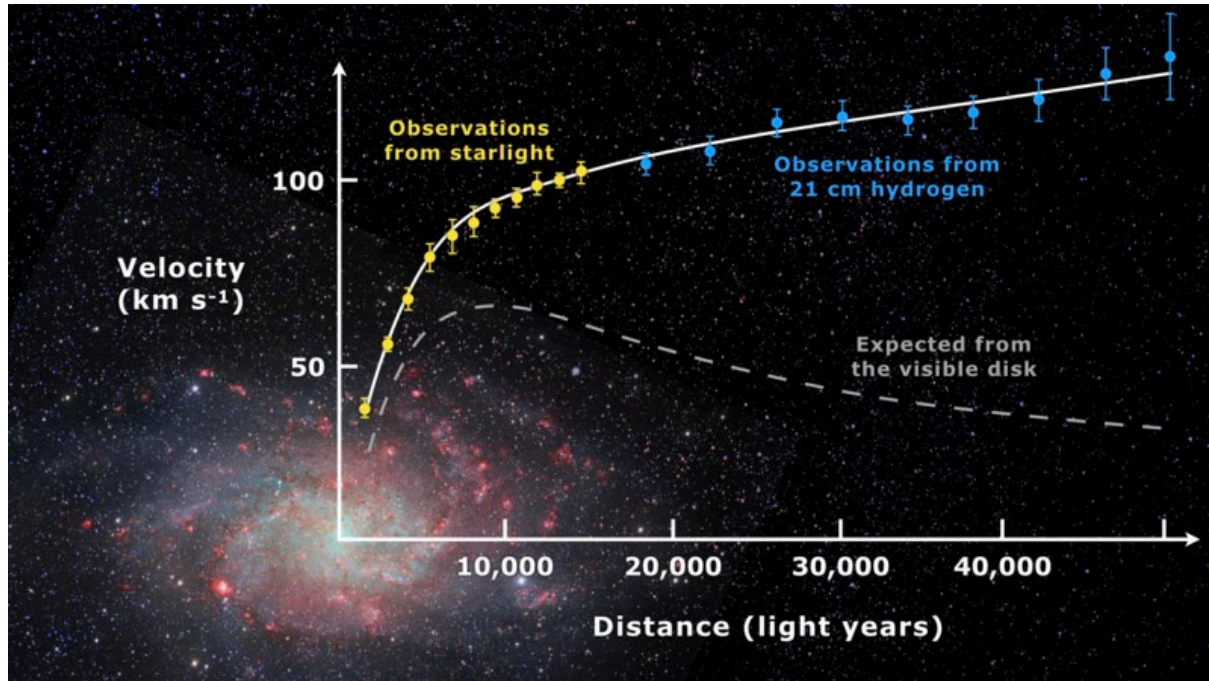


Fig 3 Wikimedia Commons 2018 "Rotation Curve of Spiral Galaxy Messier 33 (Triangulum)" ⁷⁾

From the graphical representation (Fig. 3) of the measured velocities in the Triangulum Nebula, we can compile an overview of stellar velocities at various distances. This is presented in Table II in the first and second columns. Column 3 shows the increase in velocity at successive distances.

Furthermore, the 4th column presents a calculation of the mass within a sphere of a given radius centred on the core, while the 5th column shows the efficiency of influencing the velocity of the star at that distance by the inner stars. Column 6 lists the orbital period for a star moving at the speed given in column 2 at the distance specified in column 1, and the final column states the orbital period in millions of years.

Table II
Data for the Triangulum Galaxy.

Distance R from the center in light-years	Velocity in km/sec	Velocity increase in km/sec	Estimated mass within the sphere of radius R	Estimated efficiency of angular momentum transfer	Orbital period	Orbital period in million years
1	2	3	4	5	6	7
500	27		6.00×10^9	10 %	1.10×10^{15}	34.9
1000	40	13	7.20×10^9	12 %	1.49×10^{15}	47.2
2000	50	10	8.40×10^9	20 %	2.38×10^{15}	75.5
4000	70	20	9.60×10^9	50 %	3.40×10^{15}	108
8000	92	22	1.08×10^{10}	80 %	5.17×10^{15}	164
16000	110	18	1.14×10^{10}	90 %	8.65×10^{15}	274
32000	120	10	1.20×10^{10}	95 %	1.59×10^{16}	503
64000	128	8	1.26×10^{10}	95 %	2.97×10^{16}	943

We use a value of **500** light years for the radius of the **Central Bulge** of the galaxy. This part of the system is different in that the majority of stars do not have orbits that lie in the plane of the disk. These stars lose speed to a lesser extent to the outer stars in the disk because they do not move in the same plane. After all, the previously derived formulas assumed stars that moved in the same orbital plane. This means that there is a certain effectiveness for the angular momentum transfer for which we have made an estimate in the table in the 5th column.

We now consider two stars, M_1 and M_2 , both with a mass equal to the solar mass—so $M_1 = M_2 = M_\odot = 2 \times 10^{30}$ kg. The inner star, M_1 , is located **2000** light-years from the center of the galaxy, while the outer star, M_2 , is at a distance of **4000** light-years.

Using the formula $\Delta v_1 \approx \frac{\pi}{12c} \frac{GM_2}{R} \frac{\sin^2 \psi}{\sin^2 \alpha} [\sin^2 \varphi - 2 \cos^2 \varphi]$ we can calculate the reduction in

M_1 's speed as the star travels **15** degrees along its orbit, starting from a specific value of α . By performing this calculation for **24** consecutive orbital segments, we determine the total reduction in M_1 's speed after a complete orbit.

In doing so, we make use of the previously established relationships $\ell = R \sin \alpha / \sin \psi$, $\varphi = \frac{1}{2}\pi - \alpha - \psi$, and $\psi = \arctan\{R \sin \alpha / (r - R \cos \alpha)\}$ derived in connection with Figures 1 and 2.

We summarize this in Table III. Column 2 lists the chosen successive angles α in increments of 1/24th of a radian. For the value of α , the angle at the midpoint of the segment in question has been chosen. From these, the angles ψ and φ were calculated, with the results presented in the subsequent columns. Using these values, along with the given distances of $R = 2000$ and $r = 4000$ light-years, the final two columns can be determined via the formulas for the distance effect and the angular effect. The summed values of these columns appear at the bottom, representing

the respective contributions of the distance effect and the angular effect. The sum of these two values yields the decrease in the velocity of M_1 relative to M_2 after one orbit; for the given conditions, this is 2.46×10^{-8} m/s.

By applying the conservation of angular momentum $\Delta v_1 M_1 R = \Delta v_2 M_2 r$ we can also calculate

the increase in the speed of M_2 using the formula $\Delta v_2 = \frac{M_1}{M_2} \frac{R}{r} \Delta v_1$. Since we have assumed the

masses M_1 and M_2 to be equal and the orbital radii to differ by a factor of 2, we find that Δv_2 is simply half of the change in speed Δv_1 . In this case, therefore, we find an increase in the speed of M_2 of 1.23×10^{-8} m/s after 75.5 million years—the orbital period of M_1 .

M_2 gains speed due to the presence of M_1 . Naturally, the speed of M_2 will be reduced by stars orbiting the center at a greater distance than M_2 . We might ask how much M_2 's speed is reduced if a star with the mass of the Sun is orbiting the center at a distance of 8000 light-years. In this case, we can treat M_2 as the inner star. Using the same method as for Table III, we find a *speed reduction* of 1.23×10^{-8} m/s after one orbit of M_2 . This is the same value as the *speed increase* observed when the star was orbiting at a distance of 2000 light-years—a result that makes sense upon closer examination of the formulas.

Table III
The deceleration due to the distance effect and the acceleration due to the angular effect as two equal stellar masses orbit the center of the Triangulum Galaxy at distances of 4000 and 2000 light-years

	R=2000 light year	r=4000 light year	Angles in radians	Distance effect of M_2 to M_1 Per 15 degrees	Angular effect of M_2 to M_1 Per 15 degrees
n	α	ψ	ϕ		
1	0.13	0.13	1.31	-7.84E-10	5.56 x10 ⁻⁹
2	0.39	0.34	0.84	-4.24 x10 ⁻⁹	2.60 x10 ⁻⁹
3	0.65	0.47	0.45	-5.47 x10 ⁻⁹	6.35E-10
4	0.92	0.52	0.14	-4.71 x10 ⁻⁹	4.42E-11
5	1.18	0.52	-0.13	-3.49 x10 ⁻⁹	2.81E-11
6	1.44	0.49	-0.36	-2.41 x10 ⁻⁹	1.68E-10
7	1.70	0.44	-0.57	-1.59 x10 ⁻⁹	3.21E-10
8	1.96	0.37	-0.76	-9.85E-10	4.50E-10
9	2.23	0.30	-0.95	-5.60E-10	5.47E-10
10	2.49	0.21	-1.13	-2.73E-10	6.16E-10
11	2.75	0.13	-1.31	-9.53E-11	6.60E-10
12	3.01	0.04	-1.48	-1.04E-11	6.81E-10
13	3.27	-0.04	-1.66	-1.04E-11	6.81E-10
14	3.53	-0.13	-1.83	-9.53E-11	6.60E-10
15	3.80	-0.21	-2.01	-2.73E-10	6.16E-10
16	4.06	-0.30	-2.19	-5.60E-10	5.47E-10
17	4.32	-0.37	-2.38	-9.85E-10	4.50E-10
18	4.58	-0.44	-2.58	-1.59 x10 ⁻⁹	3.21E-10
19	4.84	-0.49	-2.78	-2.41 x10 ⁻⁹	1.68E-10
20	5.11	-0.52	-3.02	-3.49 x10 ⁻⁹	2.81E-11
21	5.37	-0.52	-3.28	-4.71 x10 ⁻⁹	4.42E-11
22	5.63	-0.47	-3.59	-5.47 x10 ⁻⁹	6.35E-10
23	5.89	-0.34	-3.98	-4.24 x10 ⁻⁹	2.60 x10 ⁻⁹
24	6.15	-0.13	-4.45	-7.84E-10	5.56 x10 ⁻⁹
				Sum -4.92E-08	Sum 2.46E-08
				Net effect v_1	-2.46E-08

However, this deceleration is only reached after **108** million years, whereas the corresponding value for acceleration was attained after just **75.5** million years. Consequently, after **75.5** million years, the deceleration will not yet have reached the aforementioned value, but rather a value of $(75.5/108) \times 1.23 \times 10^{-8} = 0.860 \times 10^{-8}$ m/s.

This leaves a net velocity gain for M_2 of 0.37×10^{-8} m/s over the course of **75.5** million years. After **10 billion** years, this figure becomes $(10\,000/75.5) \times 0.37 \times 10^{-8} = 49.0 \times 10^{-8}$ m/s.

This appears to be a disturbingly small number, but we must bear in mind that within the **4000**-light-year orbit lie several billion stars, all of which – to varying degrees – contribute to increasing the speed of M_2 . The question is just how many stars there are. Since we reject the concept of dark matter, we must rely on calculations based on luminous mass. We follow the findings of **Edvige Corbelli** ⁸⁾ who estimates the visible mass of the central concentration – comprising stars and gas – at approximately **10** billion solar masses.

Assuming an average efficiency of **50%**, the star M_2 gains speed as follows:

$$0.50 \times 10^{10} \times 1.23 \times 10^{-8} \times 10\,000 / 75.5 = 8146 \text{ m/s.}$$

At the same time, deceleration comes into play. However, this is significantly less than the acceleration because there are far fewer stars in the outer region. The efficiency per star will be higher, though, because all stars move within the plane of the disk. With **1** billion stars and **100%** efficiency, we find a deceleration of $10^9 \times 1.23 \times 10^{-8} \times 10,000 / 10^8 = 1139$ m/s over **10** billion years.

This leaves a net speed of **7007** m/s.

More than **7** km/s. Table **II** lists a value of **70** km/s for the velocity at a distance of **4000** light-years, and a velocity increase of **20** km/s between **2000** and **4000** light-years.

We see that, in the long run, the increase in a star's velocity—driven by the distance effect and the angular effect—rises to values of the same order of magnitude as the measured velocities. This is promising, as there are many variables that could increase (or decrease) the speed.

For instance, we might consider the fact that we have examined a static situation. In reality, a star that gains speed will move further away from the center; we can therefore assume that the system was more compact in the past. This leads to the conclusion that the rate of velocity increase was much more intense back then, which allowed for higher speeds to be reached over time. The outward migration of stars was more pronounced at that time. The increased velocity we calculated is additive to the cumulative velocity the star already possessed due to its past evolution, potentially leading to much higher final speeds.

Furthermore, it will be necessary to make a better estimate of the masses at various distances. We must also bear in mind that the inner stars are driven toward the center of the system and will eventually merge, forming a black hole that will greedily devour any new star driven inward. It is understandable that the black hole will grow rapidly during the initial phase of a system. Subsequently, when too few stars moving within the plane of the disk remain in the central region, the disk will expand only slowly.

For **spherical star systems**, this evolution will not occur, as the system lacks rotation. This may explain why there is no central black hole in globular star clusters.

Although anyone can perform the calculations described above on their computer using a simple **Excel** program—freely inputting and varying the parameters to obtain the desired results—it is advisable for the *astronomy community* to apply these calculations to various spiral nebulae using the most up-to-date data, in order to test the validity of the new theory's underlying principles.

6. Conclusion

We have demonstrated that a realistic refinement of Newton's law of gravity—grounded in natural philosophy—offers a new perspective for resolving dynamic problems encountered in celestial mechanics. This refinement stems from the Theory of Obstruction, which posits that the magnitude of a mass must be equated to the extent to which that mass obstructs the view of the universe. In this article, we raised the question—and partially answered it using this Theory—of how stars in a spiral galaxy acquire such extreme speeds.

We will address the question of why these fast-moving stars are not flung out of the galaxy due to an insufficiently strong centrally directed gravitational force, in a future article.

¹ Wikipedia, History of Dark Matter

² Vixra; 2606.0028; Shaking up Einsteins Theory

³ Vixra: 2606.0040; Shaking Up the theory of the Expanding Universe; p.4

⁴ Henk Dorrestijn; Time and Cosmos, 2023; p.107

⁵ Vixra Astrophysics 2603.088; Shaking up Newton's Theory

⁶ Wikipedia Rømer's determination of the Speed of Light

⁷ Wikipedia Creative Commons; Mario de Leo; Reproduced unchanged

⁸ Edvige Corbelli; Dark Matter and visible Baryons p.12; Mon. Not.R.Astron.Soc; 2018