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Analysis of The Sixth-Degree Polynomial Correlation Between Rotational Angular Velocity of Spiral Barred Galaxies with Radius

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***Abstract-** The incongruity in the cycle of galaxies has drawn a lot of attention, which led to the review of the connection between the rotational angular velocity of some spiral barred galaxies and radius. There is a need for an alternative method because the morphologies of galaxies that have been categorized so far do not match the rotational angular velocities of these spiral-barred galaxies. To reclassify spiral-barred galaxies and determine the relationship between the rotational angular velocities of eighty-four spiral-barred galaxies and their radius was substantiated here. Python, Visual Studio, and MATLAB are the software deployed to study eighty-four spiral-barred galaxies. Data for this computation of the rotational angular velocity were sourced from the Internet and the National Aeronautics and Space Administration (NASA). These parameter values were used in the equations of rotational angular velocity to calculate it. Rotational angular Velocity equations were used to write a Python calculation programme, and the results were tabulated alongside data sourced from the internet with their units. Some of the results for rotational angular velocity generated for eighty-four spiral barred galaxies are: Black eye =1.17E+03Km/s, Butterfly Nebula = 2Km/s. It was discovered that increased rotational angular velocity with radius of spiral barred galaxies behaved more aberrantly relative to their groups. Conclusively, there is no or little direct correlation between rotational angular velocity and radius.*

***Index Terms-** Spiral Barred Galaxies, Radius, Rotational Angular Velocity, Angular Velocity, MATLAB.*

I. INTRODUCTION

Advanced mathematical modeling, especially with polynomial representations of their rotation curves, can characterize the complicated rotation of spiral galaxies. The underlying structure and dynamics of these celestial systems can be better understood by examining rotational velocity as a function of galaxy radius (Adams et al., 2004).

1.1 The Galactic Rotation Theoretical Framework

Spiral galaxies' rotational behavior is closely related to several important factors:
The distribution of radial velocity: A galaxy's rotation curve shows how its rotating velocity varies as it gets farther out from the galactic center (Ekwubiri and Aiyohuyin, 2026).

1.1 Complexity in Dynamics

Particularly close to the center black hole area, stars and gas in barred spiral galaxies may have non-uniform angular velocities, giving them distinctive rotational features.

1.2 The Representation of Mathematics

An advanced technique for simulating the complex relationship between rotational velocity and radius is the sixth-degree polynomial approach. This approach is used to estimate an unknown event or for the prediction of future occurrences of an event (Adams and Laughlin, 2006).

1.3 A Look at Dark Matter

The peculiar rotation curves seen in various spiral galaxies have showed promise in being explained by self-interacting dark matter models. A hypothetical and invisible type of stuff, dark matter is unaffected by light or other electromagnetic radiation. Gravitational effects imply dark matter, which general relativity cannot account for unless there is more matter than can be seen. These effects take place in the context of galaxy formation and evolution, gravitational lensing, the current structure of the observable universe, the motion of galaxies within galaxy clusters, mass position in galactic collisions, and cosmic microwave background anisotropies (Graham et al., 2017).

1.4 Polynomial Correlation Methodology

The sixth-degree polynomial slant supports a comprehensive analysis by (Alister *et al.,* 2016):

- Capturing non-linear velocity variations
- Accounting for complex gravitational interactions,
- Providing a flexible mathematics framework for representing galactic rotational dynamics.

$$U(r) = a_0 + a_1 r + a_2 r^2 + a_3 r^3 + a_4 r^4 + a_5 r^5 + a_6 r^6 \quad 1.1$$

Where:

- $U(r)$ represents rotational velocity
- r represents the radial distance from the galactic center
- a_0 to a_6 are the polynomial coefficients.

This approach allows researchers to model the intricate relationship between rotational angular velocity and galactic radius with unprecedented precision, offering insights into the fundamental mechanics of spiral galaxy dynamics (Andredakis *et al.,* 2016).

1.5 Angular Rotational Velocity

Across a range of radial distances, spiral barred galaxies' rotational angular velocity displays intricate and surprising behavior.

1.5.1 Basic Quality Features

The distinctive rotating dynamics of spiral galaxies differ greatly from those of conventional orbital mechanics: Central Region: Rotational velocity first rises directly with radius in the vicinity of the galactic center, according to $U \propto r$ relationship. Outer Regions: In contrast to what one may anticipate from classical gravity models, the rotation velocity surprisingly becomes almost constant at greater radial distances.

1.6 Insights into Velocity Distribution.

- Non-Uniform Rotation: Galaxies have equal or increasing rotational speeds over wide radial ranges, in contrast to planetary systems where orbital velocities decrease with distance.
- Pattern Rotation: While the material in the disk fluctuates in angular velocity, the bar pattern rotates more firmly in barred galaxies at a single pattern angular velocity (Ωp) (Atkinson, 2022).

1.7 Philosophical Aspects

The observed rotating behavior suggests complex underlying mechanisms such as:

- The Dark Matter Theory Visible star mass alone cannot account for the constant velocity in outer regions, which suggests a rapid mass increase with radius.
- Relativistic Interpretations: According to certain studies, gas and stars rotate with a nearly constant angular velocity, however, there may be directional variations close to the central black hole

1.8 Mathematical Representation

The rotational velocity can be approximated by:

$$U(r) = U_0 + k.r \qquad 1.2$$

Where:

- U_0 is the initial velocity
- k represents the rate of velocity change with radius
- r is the radial distance from the galactic center

This model captures the initial velocity increase followed by stabilization at larger radial distances (Blanton and John, 2009).

1.9 Dark Matter

Dark matter is essential in understanding the observed rotational dynamics of spiral galaxies due to its ability to resolve basic differences in velocity distribution.

1.9.1 Important Rotational Features

Spiral galaxies' rotation curves show distinctive patterns that are not explicable by visible matter alone (Whitt, 2022).

- Anomaly of Velocity: In contrast to conventional orbital physics, stars orbit the galactic center with equal or rising speeds over great radial distances.
- Mass Discrepancy: The existence of an invisible mass component is suggested by the fact that

mass estimates based on emitted light are insufficient to explain observed velocity patterns.

1.9.2 An explanation of the velocity curve

By extending the mass distribution and assuming a significant amount of non-luminous matter permeates the galaxy beyond the central bulge, dark matter offers a thorough solution to the galaxy rotation problem (Ekwubiri and Said, 2015). Enabling almost equal rotating velocities throughout various galaxy radii is known as maintaining constant rotation. Resolving Gravitational Inconsistencies: Explaining rotation curves that don't match conventional gravitationalnorms.

1.9.3 Quantitative Understanding

Variations in Density: Galactic centers can have a density of dark matter that is more than 10^7 times the mean dark matter density for the entire universe (Whitt, 2022). Dark matter halos exhibit intricate spatial distributions, with differences across galaxies with low and high surface brightness.

1.9.4 The theory of dark matter

According to the dark matter hypothesis, non-baryonic cold dark matter (CDM) is an essential part of the structure of galaxies. Dark matter particles probably have masses greater than 16eV for fermions and 45eV for bosons. By offering a convincing explanation for the observed rotating tendencies of spiral galaxies, dark matter significantly alters our comprehension of galactic dynamics (Chamba, 2020).

1.10 Spiral barred galaxies, both barred and unbarred

The rotation curves of barred and unbarred spiral galaxies differ significantly. In contrast to unbarred galaxies, barred galaxies exhibit distinct rotational motions. We can differentiate between barred and unbarred spiral galaxies using a few essential rotational features, such as:

- Rotation Curve Complexity: The rotation curves of barred galaxies are more intricate, exhibiting prominent peaks and fluctuations.
- Inner Region Dynamics: According to Unzicker (2008), barred galaxies have systematically greater stellar to dark matter mass percentages in their inner regions.

1.10.1 Distribution of Velocity and Underlying Mechanisms

The first two subtopics illustrate how the velocity distribution of barred and unbarred spiral galaxies can be divided into two main categories. These divisions, along with the rotational differences, are caused by some basic elements related to the underlying mechanism that is examined in three different ways, as illustrated below as well:

- Peak Features: While barred galaxies have clear velocity peaks, simulated unbarred galaxies have smoother rotation curves.
- Circular Velocity Range: Unbarred galaxies have more variable circular velocities that span a wider spectrum, whereas barred galaxies have maximum circular velocities that fall between 150 and 200 km/s.
- Mass Concentration: Central mass concentrations grow more quickly in barred galaxies. Angular momentum: Barred galaxies experience a greater transfer of angular momentum from the disk to the halo than unbarred galaxies.
- Star Population: Compared to unbarred galaxies, barred galaxies usually have older star populations and smaller gas percentages.

These differences show how galaxy morphology has a major impact on rotational behavior, highlighting the intricate structural and dynamical differences between barred and unbarred spiral galaxies (Drake, 2016).

1.9 Dark Matter

Dark matter plays a critical role in explaining the observed rotational dynamics of spiral galaxies by resolving fundamental discrepancies in velocity distribution.

1.9.1 Key Rotational Characteristics

The rotation curves of spiral galaxies exhibit unique behaviors that cannot be explained by visible matter alone (Whitt, 2022):

- Velocity Anomaly: Stars revolve around the galactic center at equal or increasing speeds over large radial distances, contrary to traditional orbital mechanics.

- Mass Discrepancy: Mass estimations based on emitted light are insufficient to explain observed velocity patterns, suggesting the presence of an invisible mass component.

1.9.2 Velocity Curve Explanation

Dark matter provides a comprehensive solution to the galaxy rotation problem by:

- Extending Mass Distribution: Hypothesizing a substantial non-luminous matter permeating the galaxy beyond the central bulge (Ekwubiri and Said, 2015).
- Maintaining Constant Rotation: Enabling nearly uniform rotational velocities across different galactic radii.
- Resolving Gravitational Inconsistencies: Accounting for the observed rotation curves that deviate from traditional gravitational predictions.

1.9.3 Quantitative Insights

- Density Variations: Dark matter density in galactic cores can exceed 10^7 times the universal mean dark matter density (Whitt, 2022).
- Halo Characteristics: Dark matter halos demonstrate complex spatial distributions, with variations observed between low and high-surface brightness galaxies.

1.9.4 The dark matter hypothesis

The dark matter hypothesis suggests the following:

- Non-baryonic cold dark matter (CDM) is a fundamental component of galactic structure.
- The mass of dark matter particles likely exceeds 16eV for fermions or 45eV for bosons.

Dark matter effectively transforms our understanding of galactic dynamics by providing a robust explanation for the observed rotational behaviors of spiral galaxies (Chamba, 2020).

1.10 Barred and Unbarred Spiral Barred galaxies

Barred and unbarred spiral galaxies exhibit distinct differences in their rotation curves. Barred galaxies demonstrate unique rotational dynamics compared to unbarred galaxies. There are some key rotational characteristics we can use to distinguish between barred and unbarred spiral galaxies which include:

- Rotation Curve Complexity: Barred galaxies have more complex rotation curves with notable peaks and variations.
- Inner Region Dynamics: Barred galaxies possess systematically higher fractions of stellar to dark matter mass in their inner regions (Unzicker, 2008).

1.10.1 Velocity Distribution and Underlying Mechanisms

Velocity distribution of barred and unbarred spiral galaxies can be structured into two major categories as shown in the first two subtopics coupled with the rotational differences stem from several fundamental factors associated with the underlying mechanism considered in three ways as shown below also:

- Peak Characteristics: Simulated unbarred galaxies have smoother rotation curves, while barred galaxies exhibit distinct velocity peaks.
- Circular Velocity Range: Barred galaxies' maximum circular velocities occur between 150-200 km/s, while unbarred galaxies have more variable circular velocities ranging across a wider spectrum.
- Mass Concentration: Barred galaxies develop faster central mass concentrations.
- Angular momentum: Higher angular momentum transfer from the disc to the halo occurs more in the barred galaxies than in the unbarred galaxies.
- Stellar Population: Barred galaxies typically have older stellar populations and lower gas fractions than unbarred galaxies.

These distinctions highlight the complex structural and dynamical variations between barred and unbarred spiral galaxies, demonstrating that galactic morphology significantly influences rotational behavior (Drake, 2016).

II. MORPHOLOGICAL AND TYPES OF GALAXIES

An Elliptical Galaxy is denoted by an E, a Spiral Galaxy by an S, and a Barred Spiral Galaxy by an SB, following the Hubble Space Telescope classification scheme. Elliptical, Spiral, Peculiar, and Irregular galaxies are the four main categories; two other forms, Lenticels, and Interacting Galaxies, are also mentioned in this paper (Horváth *et al*., 2015).

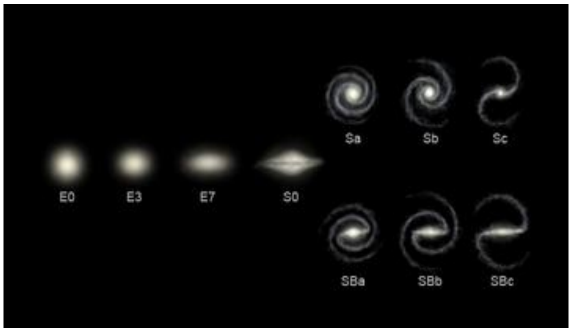

Plate 2.1: Explanation of galaxy forms based on appearance (Wikipedia, 2024).

More information about galaxy types based on their forms is provided by the Hubble Sequence. As the Hubble Sequence only studies the optical morphological type (contour), it may miss important characteristics of galaxies, such as the rate of star production in starburst galaxies and activity in the centers of active galaxies. In a great number of galaxies, supermassive black holes are thought to exist (Horváth *et al*., 2014).

III. ROTATIONAL VELOCITY OF BARRED SPIRAL GALAXIES

According to the relativity solution, the spiral galaxy disk as a whole now circles like a rigid body. The spiral galaxy's gas and star motion should appear to be rotating at a nearly constant speed from Earth. By considering the third component, or the Coriolis force, we may reduce it to the common term (Sobral, 2015);

$$F_c = \frac{3GM(mr^2\Omega)^2}{mc^2r^4} = \frac{3GM_m\Omega^2}{c^2}$$

3.1

Where;

$$L^2 = (mr\,\mathsf{V})^2 \qquad 3.2$$

Recall that, $\mathsf{V} = r\Omega$ 3.3

Substitute equation (3.3) into equation (3.2) to obtain;

$$L^2 = (mr^2\Omega)^2 \qquad 3.4$$

$\Omega = \omega$ = angular velocity of the revolving system.

We can equate the centrifugal force with equation (16) to obtain;

$$F_c = \frac{3GM_m\Omega^2}{c^2} = \frac{L^2}{mr^3} \qquad 3.5$$

Simplifying the right-hand side of equation (3.5) by substituting equation (3.4) into it concerning

$\frac{L^2}{Mr^3}$, we obtain;

$$F_c = \frac{3GM_m\Omega^2}{c^2} = \frac{(mr\mathsf{V})^2}{mr^3} \qquad 3.6$$

3.6

$$F_c = \frac{3GM_m\Omega^2}{c^2} = \frac{m^2r^2\mathsf{V}^2}{mr^3} \qquad 3.7$$

Further simplification of equation (3.7), we obtain;

$$F_c = \frac{3GM_m\Omega^2}{c^2} = \frac{m\mathsf{V}^2}{r} \qquad 3.8$$

Solving for V, which is the rotational angular velocity of a body (system), we arrive at;

$$3GM_m\Omega^2 r = mc^2\,\mathsf{V}^2 \qquad 3.9$$

Making rotational angular velocity the subject of the formula, we divide both sides by mc^2 to obtain (Sofue, 2016);

$$\mathsf{V}^2 = \frac{3GM_m\Omega^2 r}{mc^2} \qquad 3.10$$

$$\mathsf{V} = \left[\frac{3GMr\Omega^2}{c^2}\right]^{1/2} \qquad 3.11$$

Where M = resting mass (M_o) of the galactic nucleus. In a rigid body, the angular velocity (Ω) of the system remains constant. To calculate the rotational velocity of the system and its equivalence with angular momentum (J), which increases almost linearly vis-à-vis any distance from the nucleus. We can write that the angular momentum of the system is;

$$J = M_g r^2\,\Omega. \qquad 3.12$$

Where;

$$\bar{L} = J \text{ and } m = M_g$$

That is M_g = mass of the system (in this case, the mass of the barred galaxies).

The specific angular momentum of each galaxy can be evaluated from the angular momentum, such that (Villard, 2022);

$$j = \frac{J}{M_g} \qquad 3.13$$

Simplifying equation (3.13) further by equating and (3.12) to obtain;

$$j = \frac{M_g r^2 \, \Omega}{M_g} \qquad 3.14$$

$$j = r^2 \Omega \qquad 3.15$$

Equation (3.15) is the equation for specific angular momentum. We can re-write equation (3.12) by comparing it with equation (3.30) to obtain a new equation for angular momentum as;

$$J = M_g r^2 \, \Omega = j \, M_g \qquad 3.16$$

We can derive the equation for angular velocity (Ω) from (Whitt, 2022) making it the subject of the formula from equation (3.16) to obtain;

$$\Omega = \frac{J}{M_g r^2} \qquad 3.17$$

Deducing the equation for the rotational angular velocity of barred galaxies, we substitute the value of angular velocity as in equation (3.17) into equation (3.11) to obtain;

$$\mathrm{V} = \left[\frac{3GM_0 r}{c^2} \times \left(\frac{J}{M_g r^2}\right)^2\right]^{1/2} \qquad 3.18$$

$$\mathrm{V} = \left[\frac{3GM_0 r}{c^2} \times \frac{J^2}{{M_g}^2 r^4}\right]^{1/2} \qquad 3.19$$

$$\mathrm{V} = \left[\frac{3GM_0}{c^2} \times \frac{J^2}{{M_g}^2 r^3}\right]^{1/2} \qquad 3.20$$

Equation (3.28) can be rewritten to obtain;

$$J = j \, M_g \qquad 3.21$$

Substitute equation (3.21) into equation (3.20) to obtain;

$$\mathrm{V} = \left[\frac{3GM_0}{c^2} \times \frac{(jM_g)^2}{{M_g}^2 r^3}\right]^{1/2} \qquad 3.22$$

$$\mathrm{V} = \left[\frac{3GM_0}{c^2} \times \frac{j^2 {M_g}^2}{{M_g}^2 r^3}\right]^{1/2} \qquad 3.23$$

$$\mathrm{V} = \left[\frac{3GM_0 j^2}{c^2 r^3}\right]^{1/2} \qquad 3.24$$

Equation (3.24) is the equation for the rotational angular velocity.
If we have θ= Ωt, we may verify the galaxy's spiral behavior using equation (3.11). To calculate the radius of a black hole, we can also rewrite equation (3.24) in polar coordinates, disregarding the general relativity formula and using the mass, Planck momentum, and Planck length formulas. In doing so, we can also unfold the geometry of the equation and account for the Schwarzschild radius, r(s). John Mitchell derived the precise formula for the Schwarzschild radius in 1783 using a foundation based on classical or Newtonian physics. After applying the concept of conservation of energy to the analysis of a photon emitted by a star with mass (M), it was obtained (Williams, 2019);

$$\frac{1}{2} m \upsilon^2 = \frac{GMm}{r} \qquad 3.25$$

Where;
m is the equivalent mass of a photon
M is the mass of a star (object)
υ is the velocity of the photon (escape velocity of the photon) and r is the radius of the mass.

For the sake of simplicity, Mitchell proposed that the photon's corresponding inertial mass and gravitational mass be the same. Therefore, from an incomprehensible perspective, Einstein did not originate the equivalency principle. Mitchell solved that by substituting the speed of light (c) for the escape velocity (ü) of a photon (Williams, 2016).

$$\frac{1}{2}c^2 = \frac{GM}{r} \qquad 3.26$$

We can observe from equation (3.25) that equation (3.26) was created when the equivalent mass of a photon on the right-hand side of the equation canceled the corresponding mass of the photon on the left-hand side of the equation. Mitchell obtained the following answers for the Schwarzschild radius of a black hole by solving this equation for (r);

$$\frac{c^2}{2} = \frac{GM}{r_s} \qquad 3.27$$

Cross and multiply equation (3.27) to obtain;

$$r_s\, c^2 = 2GM \qquad 3.28$$

Making (r_s) the subject of the formula, by dividing both sides by c^2, we have;

Making (r_s) the subject of the formula, by dividing both sides by c^2, we have;

$$r_s = \frac{2GM}{c^2} \qquad 3.29$$

Because Mitchell's version of equation (3.29) did not provide evidence for the Schwarzschild radius for black holes, it was termed wrong. To appropriately derive this formula, one must apply either general relativity, quantum gravity, or the plank units. That being said, this study will place limitations on further derivations (Wolf *et al*., 2023).

IV. RESULTS AND DISCUSSION

The upshots presented here were generated with the predictive model of "MATLAB". The number of data plotted is for 84 spiral barred galaxies extracted and analyzed. These spiral barred galaxies were grouped into A, B, C, and D for best fit using the software. The grouping was based on the connection sandwiched between the rotational angular velocity and radius of the spiral-barred galaxy. The plots will be explained according to graphic appearance, which is the interpretation of the data as it represents the rotational angular velocity and radius of spiral barred galaxies.

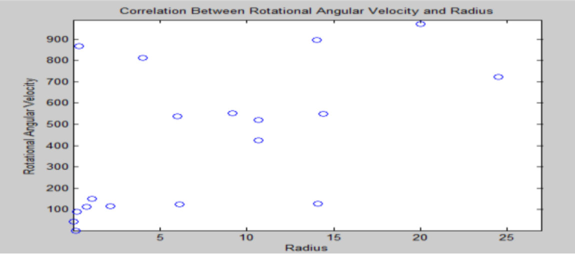

Fig. 4.1: Plot of Rotational Angular Velocity against Radius of Group A Spiral Barred Galaxies.

The spatial distribution of the plot point is an indication of the axis of rotation occupancies of the spiral-barred galaxies within the universe. The scale used is the reason why the spiral-barred galaxies look closely packed together. The larger the scale, the more spaced the spiral-barred galaxies will appear within the plot range. Galaxies that appear to be close to each other are the ones with relatively similar radii or similar velocities from the earth's altitude and latitude. The interactions between different galaxies are dependent on radius, since the angular momentum is dependent on it, the bigger the radius, the greater the angular momentum of the barred galaxies. Therefore, if two or more barred galaxies are close to each other, it could mean, that the bigger radius, with larger angular momentum is attracting the smaller radius to itself, which will eventually form a cluster or merger when they ultimately come together within the space.

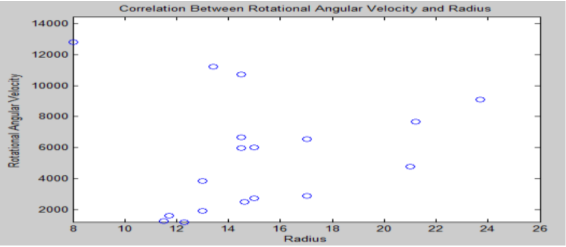

Fig. 4.2: Plot of Rotational Angular Velocity against Radius of Group B Spiral Bared Galaxies.

The scale chosen is the reason why the barred galaxies look closely packed together, while in real space, the axis of the site cycle is not a function of the distance of separation between each spiral barred galaxy as represented in the graph. They appear close to each other as modified by the model because of the grouping which is relative to their radius and rotational angular velocity. The distance of separation between the radius and rotational angular velocity of these barred galaxies is small, and this does not mean they appear close to each other in the universe. Barred galaxies that are far away from the clusters as exposed in the plot are the ones with outstanding radius and rotational angular velocity that differ from the barred galaxies under examination. The rotational angular velocity of a barred galaxy is directly proportional to the linear velocity and inversely proportional to the radius, this means that the rotational angular velocity has no direct relationship with the radius of galaxies, but linear velocity has a direct relationship with the angular velocity and the radius. On a little analysis, the effect of the rotational angular velocity of spiral barred galaxies is a result of its linear velocity. The product of radius and angular velocity is directly proportional to the linear velocity. Hence, the above plot demonstrates the inverse correlation between the rotational angular velocity and the radius of spiral barred galaxies.

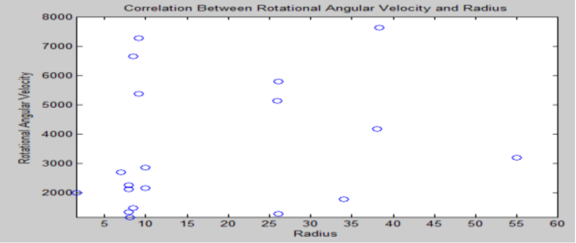

Fig. 4.3: Plot of Rotational Angular Velocity against Radius of Group C Spiral Bared Galaxies.

The rotational angular velocity of almost all spiral barred galaxies is not directly proportional to their radius, as such both do not affect the interest of the other. The upshot of this plot is that the augmentation in radius and rotational angular velocity of spiral-barred galaxies maintain their site of occupancy in space unless gravitational influence occurs.

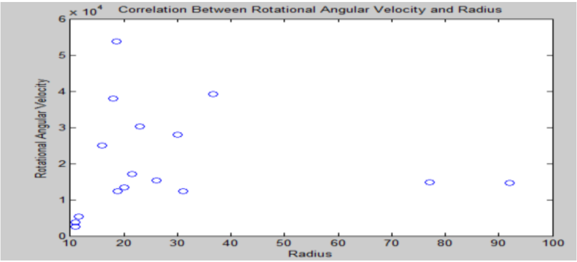

Fig. 4.4: Plot of Rotational Angular Velocity against Radius of Group D Spiral Bared Galaxies.

Expansion of the universe occurs and shifts the galaxy's site of occupancy rotation and this can influence galaxy collision or merge, and according to Hubble’s law, the expansion of the universe takes the galaxies farther apart from each other. Galaxy mergers can occur when two or more galaxies collide. They are the most violent type of galaxy interaction. Expansion can only occur when galaxies collide or merge, and according to Hubble’s law, the spreading out of the universe takes the galaxies farther apart from each other. Galaxy mergers can ensue when two or more galaxies collide. The gravitational collaborations between galaxies and the resistance between the gas and dust have major effects on the galaxies concerned. An increase in the mass of spiral barred galaxies increases the radius linearly and its velocity tends to remain constant, otherwise progressively changes concerning gravitational interactions between its nearby galaxies. Angular momentum is proportional to the square of radius, when angular velocity, radius, and the shape of the galaxy are held constant. Therefore, the increased radius of spiral-barred galaxies generates a momentous effect on the angular momentum of the galaxies. Conversely, rotational angular velocity has no direct relation with the radius of galaxies, hence angular speed does not change with a change in radius, but rather linear speed changes with a change in radius. Tangential velocity, in a circular path, increases with the increase in radius and decreases with the decrease in radius.

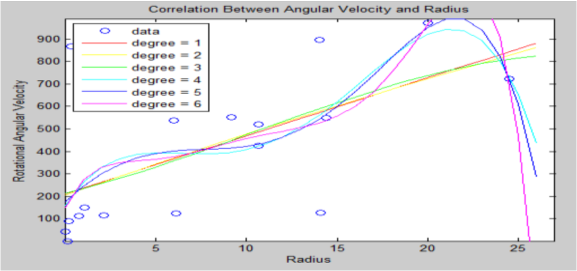

Fig. 4.5: Polynomial Degrees Plot of Rotational Angular Velocity against Radius of Group A Spiral Bared Galaxies.

Figure (4.5) is a polynomial degree plot of rotational angular velocity against the radius of group A spiral barred galaxies. The degree of the polynomial shows the comportment of the correlation between them within the experimental limit of the predictive model. In degree one and degree two polynomial plots, individual galaxies of group A spiral galaxies increased progressively as they behaved alike. 5th and 6th degree polynomials as plotted in Figure (4.5), reviewed a progressive decrease after an initial increase from the plot origin. The degree of decrease of rotational angular velocity with an increase in radius increases with an increase in the polynomial, though part of the chart fails out of the experimental range.

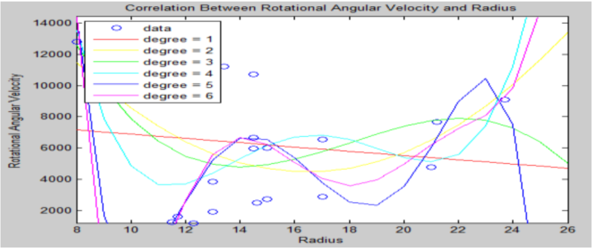

Fig. 4.6: Polynomial Degrees Plot of Rotational Angular Velocity against Radius of Group B Spiral Bared Galaxies.

The mountain-like entrance of the diagram as clarified in Figure (4.5) is akin to the activities of group A spiral barred galaxies. Meanwhile, figure (4.6) above is the polynomial plot of Rotational angular velocity and radius of group B spiral barred galaxies. There is a straight-line decrease in rotational angular velocity with an increase in the radius of group B spiral barred galaxies at degree one polynomial. This means that group B spiral barred galaxies at this degree acted alike indicating a strong reverse correlation. While degree five and six polynomials of group B spiral galaxies acted aberrantly, due to indiscretions associated with weak or little correlation existing between them, with part of their graph following outside experimental observation. At degree two polynomial, the display appeared valley-like in shape which is unique among all the plots shown. The valley-like shape means a decrease in rotational angular velocity of some of the spiral barred galaxies acting coherently while others acting incoherently, that is to say, some galaxies correlate while some do not correlate.

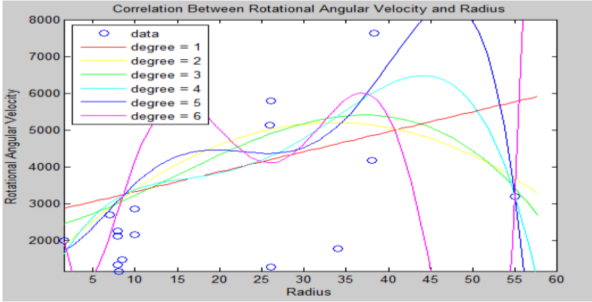

Fig. 4.7: Plot of Polynomial Degrees of Rotational Angular Velocity against Radius of Group C Spiral Bared Galaxies

However, in Figure (4.7) the degree one polynomial plot progressively increased across the plot limit. In contrast, degree five appeared mountain-like and some parts of the plot failed out of the experimental limit, of likewise degree six polynomial plot. Polynomial degrees five and six exhibited unusual anomalies because some of their plot lines failed outside the experimental range while degree two was close to degree three in mountain-like appearance. With this, we can conclude that the increase in the polynomial of group C spiral barred galaxies increases their aberrations in characteristics as observed. One can conclude by the observation that some barred galaxies fall out of expected properties and characteristics. Barred galaxies are peculiar to the way they rotate within their orbital axis, hence angular momentum is a function of the rotational angular velocity and the radius of barred galaxies. Angular momentum builds up at some barred galaxies as a result of the radius of the barred galaxy and the external force experienced at some points during the angular rotation of these barred galaxies could alter their rotational angular velocity as observed in the figure above. The majority of galaxies are arranged into clusters or galactic groups. The local group is a collection of galaxies that includes the Milky Way. Gravity is the force that holds together all of these systems. Upon further examination, a few barred galaxies under investigation ought to belong to the same group and hence display comparable characteristics. Galaxies are drawn to one another based on their mutual gravitational pull, but the gravitational pull of dark matter also keeps them together within their orbits and causes them to group. The internal gravity generated by galaxies is relative to one another, and when a galaxy deforms relative to the other, the one with higher gravity will swallow the other (gravitational pull). So, polynomial degrees four, five, and six that terminated with a sharp bend could be a result of the influence of dark matters or gravity nudges which attract galaxies toward one another: sometimes two, sometimes more, until they meet and merge causing their contents to whoosh and mix, and the slow-moving chaos molds them all into one big galactic galaxy.

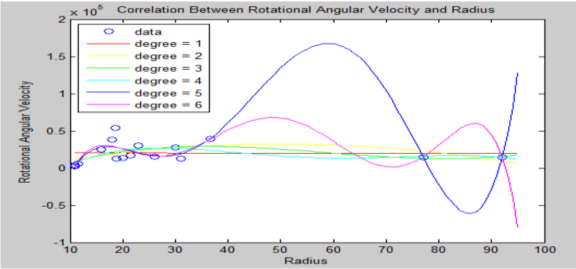

Fig. 4.8: Plot of Polynomial Degrees of Rotational Angular Velocity against Radius of Group D Spiral Bared Galaxies

Considering Figure (4.8) above, degrees one, two, three, and four appeared almost uniform in a straight line in a slightly decreasing routine, although degree five, and six polynomial plans did not follow suit. Polynomial degrees five and six displayed eight-like shapes as shown due to their unique physiognomies at that polynomial level. The intersect shown as an eight-like shape in Figure (4.8) can be a possible galaxy collision or merger which is likely to supervene at that level. All these polynomial plot insinuates that, grouped Spiral Galaxies are peculiar to each other as they affect individual galaxies' space sites. Galaxies at different space sites might demonstrate similar characteristics when their rotational angular velocity and radius are augmented without upsetting each other. The irregularities associated with this predictive model are an indication of what happens within the universe between the rotational angular velocity and radius. Meanwhile, it was noted earlier that the correlation between the rotational angular velocity and radius is a weak one, since all the galaxies under investigation exhibit randomly, which could be attributed to external and internal influence within and outside the barred galaxies. The radius of a barred galaxy is not a function of the rotational angular velocity, though both of them correlate to each other within a minimal magnitude.

V. SUMMARY

Results of a "MATLAB" predictive model for 84 spiral barred galaxies, categorized into A, B, C, and D, are presented in the paper. The axes of rotation occupancies of these galaxies within the cosmos are indicated by the scale on which the data was plotted. In the plot range, galaxies seem more widely separated at bigger scales and more closely spaced at smaller scales.

The axis of rotation occupancies of the spiral-barred galaxies in the cosmos are shown by the spatial distribution of the plot points. The radius affects how galaxies interact with one another; the larger the radius, the higher the angular momentum. When two or more barred galaxies are near one another, it may indicate that the larger mass draws the smaller mass to it, leading to the eventual formation of a cluster or merger as a result of the universe's gravitational pull.

In a barred galaxy, the rotating angular velocity is inversely proportional to the radius and directly proportional to the linear velocity. Its linear velocity is the cause of spiral-barred galaxies' rotational angular velocity effect. For spiral barred galaxies, the linear velocity and angular velocity are directly proportional to the product of radius and angular velocity.

The angular momentum of galaxies can be affected by galaxy mergers and universe expansion. Spiral-barred galaxies have a linear radius increase with increasing mass, yet their velocity tends to stay constant. Tangential velocity rises as the radius increases and falls as the radius decreases. Rotational angular velocity and radius of group B spiral barred galaxies show a strong inverse association when shown against each other using a polynomial plot. However, because of errors and poor correlations, these galaxies' degrees five and six behaved differently. A reduction in rotating angular velocity is shown by the valley-like form at degree two. Because of some underlying factor, some galaxies behaved incoherently, whereas others did so coherently.

The polynomial plot of degree one in group C spiral barred galaxies increased steadily, however, the degree five plot looked mountain-like and some areas failed outside the experimental range. Unusual abnormalities were seen in degrees five and six, indicating that group C spiral barred galaxies' polynomial increases their characteristic aberrations relative to other groups.

Angular momentum depends on the rotational angular velocity and the radius of barred galaxies, which are unique to their orbital axis. The Milky Way is an important component of the galactic groups, or clusters, into which most galaxies are grouped.

Gradients one, two, three, and four in group D spiral barred galaxies seemed nearly uniform along a straight line, however, degrees five and six, because of their distinct physiognomies, showed an eight-like shape. Grouped spiral galaxies are peculiar to one another and influence the spatial sites of individual galaxies, as these polynomial charts show.

VI. CONCLUSION

Spiral barred galaxies' rotational dynamics are thoroughly examined in this article's analysis, which highlights the complex interactions between rotational angular velocity and radius. The results of the MATLAB-created predictive model provide several important insights, as illustrated below: The significance of each galaxy's unique features is highlighted by the grouping of the eighty-four spiral barred galaxies into four groups, A, B, C, and D. The actions of each group highlight how radius affects angular momentum and rotational dynamics.

Spatial Distribution: The charts show that galaxies' spatial distribution is greatly impacted by their rotational and radius characteristics rather than just being a function of distance. Their real separation in the cosmos may differ from the plots' apparent close packing.

Angular Momentum and Gravitational Influence: It is important to understand how angular momentum and radius are related. Potential mergers and clusters may result from smaller radii being drawn to larger ones. The dynamics of galaxies are significantly shaped by their gravitational interactions.

Polynomial Analysis: The polynomial degree graphs shed light on the relationship between radius and rotating angular velocity. The behavior of these galaxies can diverge from expected patterns for a variety of reasons, as evidenced by the intricacies and oddities revealed by higher-degree polynomials while starting degrees exhibit continual growth. Overall, there is a slight connection between rotating angular velocity and radius, which indicates some interaction but is insufficient to establish a direct relationship. Further research into the internal and environmental variables influencing these interactions is necessary in light of this conclusion.

Galactic Merger and Interactions: The paper highlights the possibility of gravitational-driven galaxy collisions and mergers. These interactions are essential to comprehending galactic cluster dynamics and galaxy evolutionary routes.

Research Implications for the Future: The knowledge gathered from this study serves as a foundation for further research into the intricate interactions between the forces operating in the universe. We can better understand dark matter, galaxy evolution, and the wider effects of gravitational interactions in cosmic structures by studying the dynamics of spiral-barredgalaxies. When spiral-barred galaxies are examined using rotational dynamics, a diverse range of interactions and behaviors are revealed. When studying galactic systems, the results highlight the significance of taking into account both internal features and external impacts. For the purpose of solving the universe's riddles and determining the basic laws guiding galaxy behavior, more research in this field is needed.

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