 doi:10.20944/preprints202203.0280.v1

Title: Galaxies in Timeline Order

Author: Sándor Buglyó
Affiliation: Department of Basic Technical Studies, Faculty of Engineering, University of Debrecen, buglyos@gmail.com

Abstract: Here, I present an alternate solution for the dark matter problem. I show that the stars of a galaxy's arm attract each other with a force other than gravity, producing a chain of stars. We already have an abundance of data (ring and multiring galaxies) as proof for the existence of this strong stars' chain. This attraction force does not end at the galaxy's boundaries but gets deeper into the cosmos, and it may explain the dark-energy problem. This attraction force affects only stars and seems to have no effect on planets. I also offer a novel timeline order for the well-known galaxies using Hubble classification. I nominate entangled particles for the role that causes this phenomenon.

Keywords: Dark matter, dark energy, galaxy evolution, gamma rays

Main Text:

1. Introduction

In 1933, Fritz Zwicky found anomalies in the motion of some galaxies [1]. In 1970, Vera Rubin discovered that the angular velocity is the same for every star within an arm [2]. Since then, we know there must be an attraction force other than gravity that does not allow the stars in the suburb to fly apart from the galaxy. How strong is that attraction force? If our Solar System worked the same way and Neptune had the same angular velocity as Earth, it would mean that this force is 164 times stronger than gravity. Why do we not see any other trace of such a strong force, the way we could gather information about a supermassive black hole in the middle of the M87 galaxy even before the famous image was taken [3]? This force certainly does not work within our Solar System because everything obeys gravity here; on the other hand, our Sun is on an arm of a galaxy, so this mysterious force should have some effect on it.

2. The Concept

I introduce my concept using entangled particles [4]. It may work the same way by WIMPs or by other dark matter particles as well [5]. I hypothesize that a wormhole connects the entangled particles [6]. Hence, the distance between them is almost zero. This should be the basis of calculations for the gravitational force between these particles, instead of the distance observed. Therefore, they attract each other with the same force regardless of their distance. I suppose the effect of this force may also be seen in photonic molecules [7]. The entangled state is a very fragile state on planets but may last much longer in the plasma of stars. The fact that a photon freshly born in the core of the Sun needs millions of years to reach the surface is well-known [8]. Therefore, a particle that goes in the opposite direction needs the same time. This may explain why only stars (and not planets) attract each other. So, if the entangled particles hit different stars, we may call them “entangled stars.” The proposed attraction force between them is called “entanglement force” in this paper. The next question is how the twin particles may hit different stars. There must be many ways, but I offer two major possible scenarios. The first one happens, when a supermassive black hole (SMBH) consumes a star, and then sends back a part of it [9]. This matter should contain many entangled particles that hit different stars. The other case is due to gamma-ray bursts (GRBs). A GRB emits two thin rays that may have more energy than the Sun will provide over its entire 10-billion-year lifetime. The light curves of GRBs are very different [10]. Usually, we speak of a “short” population with an average duration of about 0.3 seconds and a "long" population with an average duration of about 30 seconds. The two thin rays are full of entangled particles, but it is impossible for them to be released in opposite directions. It is also not possible that one of them be released earlier than the other with a separate peak. (For this reason, I usually mark them in different colors.)

Let us see if the key fits the lock.

3. Results and discussion

3.1. First stage. A GRB occurs

Let us consider a young galaxy similar in appearance to an elliptical galaxy (E0 type) that works like our Solar System. The stars on the outer orbits are orbiting with lower angular velocities. As I mentioned above, the SMBH eats a star and spits back a part of it that hits many stars in a sphere (we call this sphere a bulge), so these galaxies always have bulges, and I call this type of SMBH a first-generation supermassive black hole (1GSMBH).

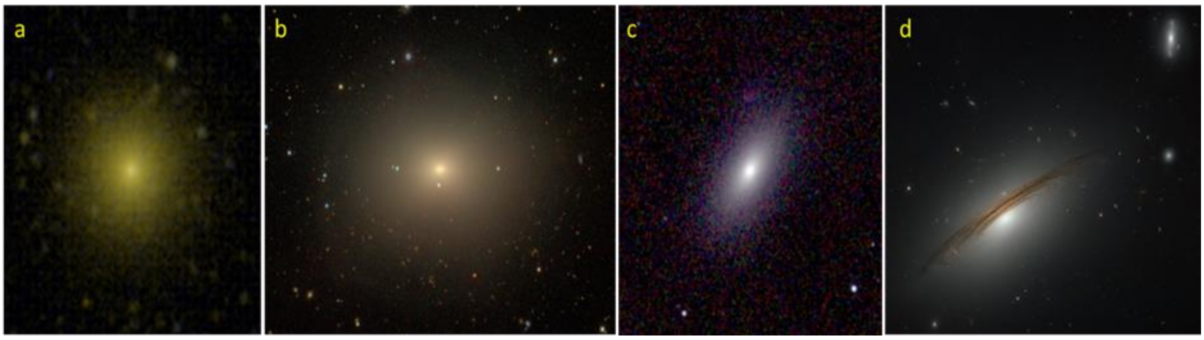
3.1.1. Elliptical and lenticular galaxies

A GRB that occurred outside hits our young galaxy.

Animation1:

https://drive.google.com/file/d/1TKDcN6arJADbEjkem-PhYGvF6hizBsrC/view?usp=sharing

There is a very low chance that the GRB hits only a part of the galaxy. As a result, each star attracts the others by the entanglement force, so they will not orbit with different angular velocities. They move together as if they were one rigid object (an inevitability, each star makes some extra random movements, but we may ignore that). Therefore, we may characterize the motion of these stars with their center of mass. This point probably differs from the 1GSMBH, so its movement determines the shape of this galaxy. If it orbits very slowly around the 1GSMBH, we get an E0 type elliptical galaxy [Fig. 1]. If this point orbits at a higher velocity, we get a flattening type of galaxy. Finally, if it whirls around extremely quickly, the result is a disc, a lenticular galaxy type. The very same process works within the bulge of galaxies, only the reason is different [11].



1. Figure *Images from the NASA/ESA Hubble Space Telescope.* ***a****.) NGC 1379 E0 type elliptical galaxy* ***b****.) NGC 5322 E3 type elliptical galaxy* ***c****.) NGC 0720 E5 type elliptical galaxy* ***d****.) UGC 12591 is a lenticular type of galaxy that whirls around extremely quickly.*

3.1.2. Barred spiral galaxy

A GRB occurs in the center that hits the galaxy from the inside.

Animation2:

https://drive.google.com/file/d/1ycle1-93ngAPGJjiCYCWSFi-Eblc6SvN/view?usp=sharing

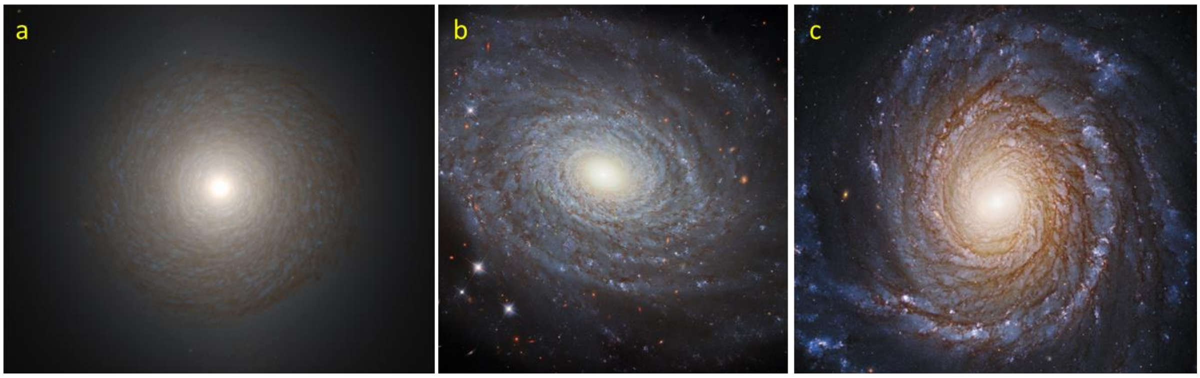
Animation3:

https://drive.google.com/file/d/19Gc44d5UCjsAA39CDinhVpCJloENVETr/view?usp=sharing

We get a barred spiral galaxy with two (or more, but even) arms that are usually symmetrical. Supposing the concept is right, stars on the same arm attract each other stronger than gravity. The long arms are created due to a big difference between the angular velocity of an outer star and an inner star at the

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 21 March 2022 doi:10.20944/preprints202203.0280.v1

moment of the blast. The same is true for other types of spiral galaxies [Fig. 2]. The arms seem blurry because it takes time for the stars to find their proper place (many were orbiting in the opposite direction). The others will join the arms later, e.g., for an external GRB, the strong entangled stars' chain will pull them inside the arm caused by this new connection. The branch arms fuse later for the same reason.



2. Figure *Images from the NASA/ESA Hubble Space Telescope. Galaxies with long blurry arms.* ***a.)*** *NGC 1387 has very long arms, it is also classified as a lenticular type of galaxy.* ***b.)*** *NGC 691* ***c.)*** *NGC 3147*

Animation4:

https://drive.google.com/file/d/1c6icUXUJmkPWTee5Em_I6lL-FKj4Obt_/view?usp=sharing

If the GRB light curve has two or more peaks, we get more branch arms because the blasting star may rotate between the peaks. We get a straight line of stars within the bulge as these stars have already stopped orbiting at different angular velocities (see above). I suppose the following statements are true. The bar is always longer than the bulge as the latter shrinks over time. (The entangled twins of a bulge's star are within the sphere of the bulge, so the sum of the entanglement forces must point to the inside. Therefore, it shrinks.) Every barred spiral galaxy must have had a bulge. Vice versa, if a spiral galaxy has a bulge and an arm going through on it, this arm must also contain a bar [Fig. 3].

3. Figure *Images from the NASA/ESA Hubble Space Telescope. Barred spiral galaxies. The bar is longer than the bulge.* ***a.)*** *NGC 1398 has long arms* ***b.)*** *NGC 1300* ***c.)*** *NGC 4535*

3.1.3. Unbarred spiral galaxy with a bulge

A GRB occurs outside the center and hits the galaxy from the inside.

Animation5:

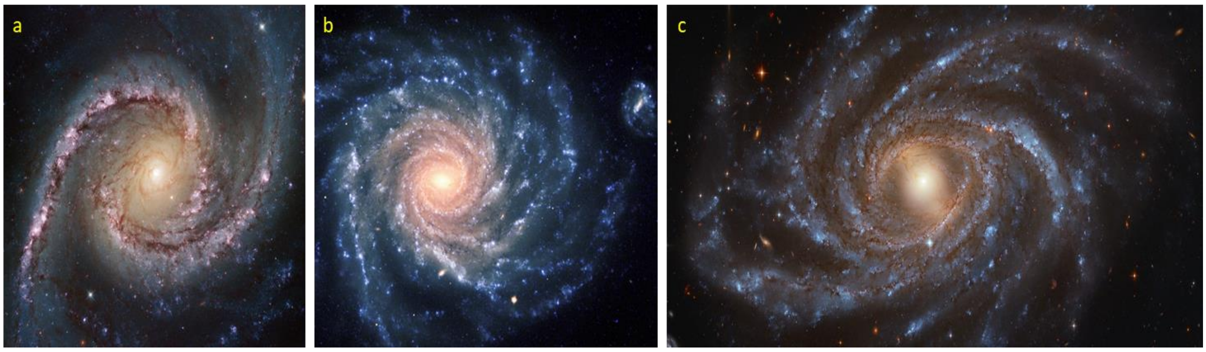
https://drive.google.com/file/d/1ceNcNAJRMVL03ion--ZDOdAnKHOP1vDp/view?usp=sharing

Animation6:

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 21 March 2022 doi:10.20944/preprints202203.0280.v1

https://drive.google.com/file/d/1w1bTqlY-AhZXwYKcTf1OmsXbPN-xKj60/view?usp=sharing

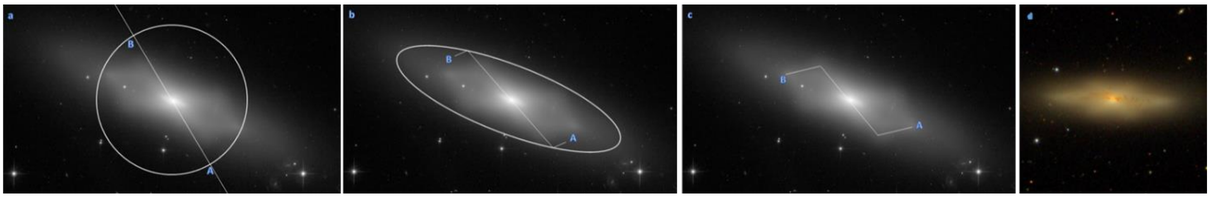
The arms are not symmetrical, and the arms and the bulge are separated [Fig. 4].



__4. Figure__ Images from the NASA/ESA Hubble Space Telescope. __a__.) NGC 1566 Unbarred spiral galaxy, the distance between the bulge and the arm is visible. __b.)__ NGC 1232 is also an unbarred spiral galaxy. __c.)__ NGC 2336 is a barred spiral galaxy. It seems to have been caused by two different GRBs, the first one occurring outside the center, causing the asymmetrical arms, and the second one occurring later, inside the core that produced the bar.

3.1.4. Boxy-shaped galaxy - a special subtype of lenticular galaxy

One GRB hits the galaxy from the outside and – later – another one from the inside [Fig. 5].



__5. Figure__ Images from the NASA/ESA Hubble Space Telescope. NGC 1175 galaxy was an elliptical galaxy, and later a GRB hit it from the nucleus. __a.)__ At the moment of the blast, the size of the galaxy (probably E0 type) is represented by the sphere. There were no different angular velocities, so the line of the GRB remained straight. This AB bar had the same length as the diameter of the galaxy. The stars of the bar may have determined a rotation velocity different from the others. If it were similar or slower, that would have meant the bar remaining almost invisible. The bar pulled other stars with itself because of the higher velocity. So, as it was rotating, now we may see its trace. __b.)__ As a result of the rotation, the galaxy becomes flatter and flatter, like pizza dough. The bar breaks. __c.)__ Stars A and B are the fastest, so they reach the plane of the disc first. __d__.) The shape of NGC 4469 suggests that soon, as the galaxy flattens more, stars A and B will get farther and farther away from the core. Seeing two examples of „boxy-shaped galaxies", we may assume the existence of many more galaxies of the same type.

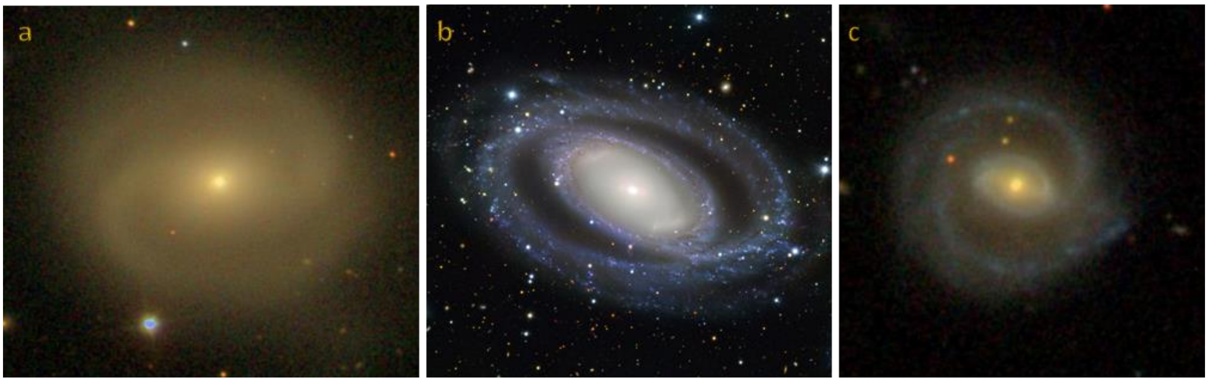
3.1.5. Proof that each arm lives its own unique life

__6. Figure__ Images from the NASA/ESA Hubble Space Telescope. NGC 4622 had two leading outer arms in the past rotating counterclockwise, and it had one inner arm rotating in the opposite direction, as we may see it from the shape of the galaxy. Now, each arm rotates in a clockwise direction. (It has probably *been caused by an outer GRB that occurred later. I suppose they will all fuse in one ring.) The original GRB seems to have had two peaks as we see two outer arms of the galaxy. According to my concept, every star on the arm attracts others more potently than gravity, producing a chain of stars. They move as one rigid object, so the center of mass of the chain determines the direction of the orbit, which may vary from arm to arm. There may have been two inner arms, rotating in different directions initially, but sooner or later, as they were in the same region, the one showing clockwise rotation became the "winner" [12].*

3.2. *Second stage. Intermediate state, between the spiral and the ring galaxy*

An elliptical galaxy does not change much; it does not shrink like the bulge because the sum of the entanglement forces points outside, toward the direction where the GRB occurred. Therefore, the whole galaxy moves in that direction.

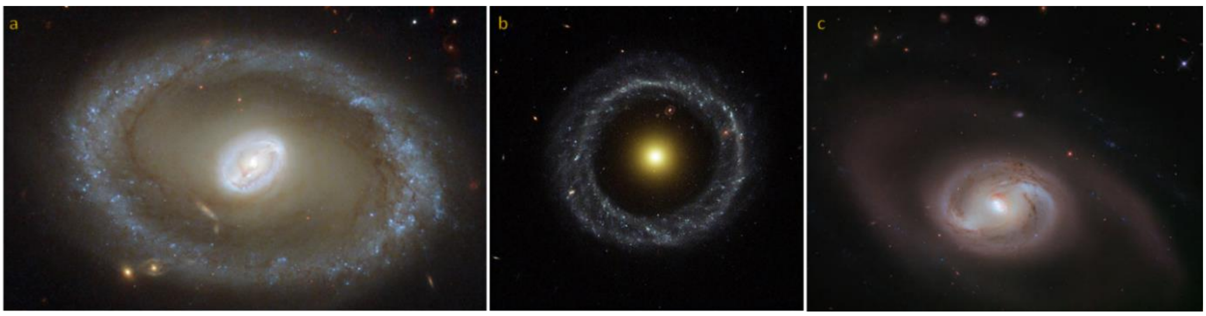
Spiral galaxies evolve very similarly. The chain of entangled stars shrinks (shortens) in a direction pointing to the arm's center of mass. Besides angular velocities, radial velocities begin to resemble [Fig. 7].



7. Figure *Images from the NASA/ESA Hubble Space Telescope. These spiral galaxies are forming a ring shape.* ***a.)*** *NGC 7743* ***b.)*** *NGC 7098 is going to have two rings.* ***c.)*** *NGC 4935*

3.3. *Third stage. Obeying Kepler's third law: ring galaxies*

As the chain of stars shrinks more and more, it may break. Because of the entanglement force, all the stars in the chain have almost the same angular velocity and radial velocity. Thus, each star goes into the same orbit, obeying Kepler's third law. That is why we observe a ring. If different arms have different average velocities, we get more than one ring. Vice versa, if we see a ring galaxy, we see that almost all the stars are inside the ring; hence, they all have the same orbit and the same velocity, which was certainly not true in the past. As a result, they must attract each other stronger than gravity, so they form a chain of stars. Therefore, the perfect proof for the existence of the stars' chain is the multiring galaxy [Fig. 8].



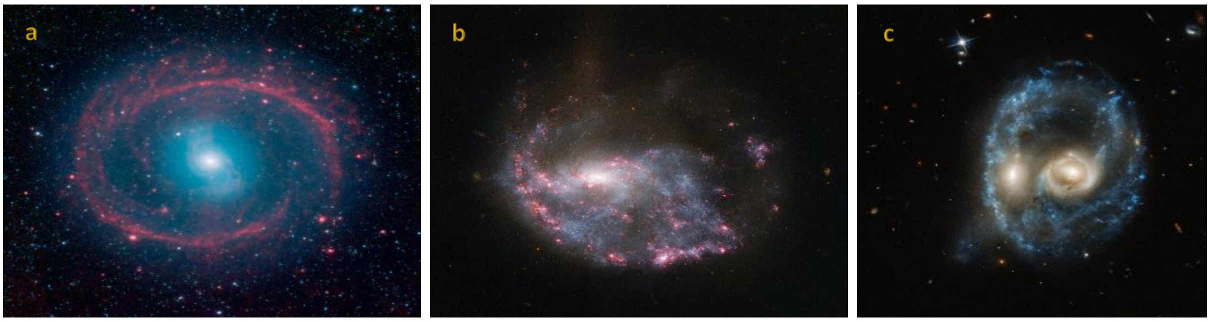
8. Figure *Images from the NASA/ESA Hubble Space Telescope. Ring galaxies: the stars use the same orbit, so they must have the same velocity.* ***a.)*** *NGC 3081* ***b.)*** *Hoag's Object: another ring galaxy within*

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 21 March 2022 doi:10.20944/preprints202203.0280.v1

the ring galaxy. Therefore, ring galaxies should be fairly common with millions of examples. ***c.)*** *NGC 2273 is a multiring galaxy that has two rings, so there are two different velocities.*

3.4. Fourth stage. A new SMBH is to be born

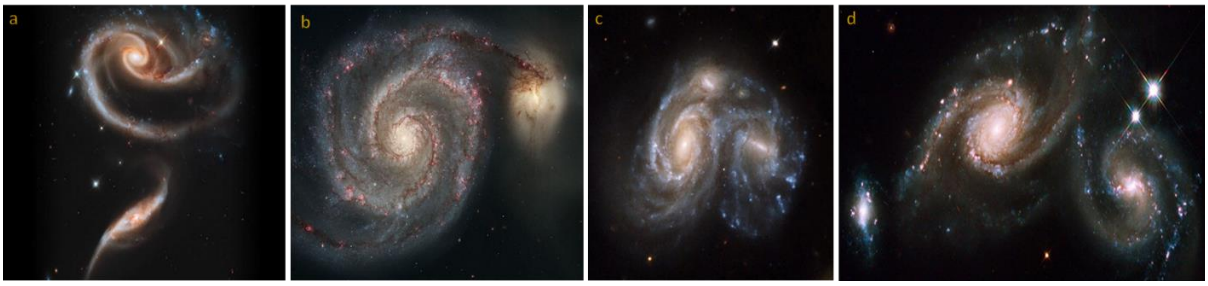
The ring (or rings) shrink(s) towards its center of mass. The region becomes much brighter. At that point, many stars collide directly without spinning around each other (as magnets do), producing a black hole because of the entanglement force. As the black hole consumes more and more stars its mass increases greatly and becomes an SMBH. So gravity regains control and starts to wind the ring of stars in a spiral shape. I call this type of black hole a second-generation supermassive black hole (2GSMBH). Rings are nearly flat, so 2GSMBHs usually do not produce a major spherical bulge, only (possibly) a small one [Fig. 9].



9. Figure *Images from the NASA/ESA Hubble Space Telescope* ***a****.) NGC 1291: two regions are brighter than the others, two new SMBHs may be born* ***b****.) NGC 922* ***c****.) Arp-Madore 2026-424, a new 2GSMBH has been born from the ring.*

3.5. Fifth stage. The 2GSMBH promotes the formation of a spiral. These galaxies do not collide but split

The galaxy splits into two (or more) parts, and the core of the original galaxy remains there alone, usually without its long arms (it becomes a dwarf galaxy). The newborn 2GSMBH is forming the ring into a spiral galaxy. It does not have a big bulge, so it may not become a barred spiral galaxy, but a small bar may be conceivable. The splitting galaxies must be in the same plane for a while because they used to be a part of the same disc. The probability for these galaxies colliding with their edges is extremely low, so they must split [Fig. 10].



10. Figure *Images from the NASA/ESA Hubble Space Telescope. All galaxies are still in the same plane.* ***a.)*** *ARP 273: we may see (at the bottom of the picture) that the original galaxy had been a barred spiral galaxy that lost its arms. The spiral galaxy at the top is forming a new ring. Both use the same plane.* ***b.)*** *M 51 has no bar because it is forming the ring into a spiral.* ***c.)*** *NGC 6050 splits into three parts (the original 1GSMBH is probably the left one). At the top, there may be a newborn SMBH.* ***d.)*** *ARP 274: Sometimes, the oldest remains the biggest, as we may see in this picture. The middle one has the original 1GSMBH because it has a big bulge, and its stars are yellow. The others are 2GSMBHs having blue stars. It is unbelievable that three galaxies collide, and all three meet with their edges.*

3.6. Sixth stage. It repeats over and over

After the fifth stage, we usually get a lone galaxy center (a dwarf galaxy) without its arms and its ring(s), and we get a new spiral galaxy (or more). The spiral galaxy becomes a ring galaxy that splits again. As this process repeats over and over, we may get many galaxies as a result. Frequently, all but one of them are dwarf galaxies. Only the original 1GSMBH may have a big bulge and halo. [Fig. 11].

11. Figure *Images from the NASA/ESA Hubble Space Telescope* ***a.)*** *Cartwheel Galaxy* ***b.)*** *Stephan's Quintet* ***c.)*** *AM 0644-741 surroundings have five more galaxies.*

4. Structure of the Universe. Why do galaxies fly apart?

Let us suppose that in a young galaxy that works similarly to our Solar System, a GRB occurred, having two thin rays, one going left and hitting some galaxies there, and the other going right. As it may fall apart later, some parts may move toward galaxies on the left side, and some others may move toward the right-hand side galaxies. Because of the entanglement force, the motion accelerates along this line, [13], resulting in a web-like structure of the universe, not a knotty one [14].

5. Conclusions

Although it needs to be confirmed, there is a high possibility that entangled particles may produce "entangled stars" displaying an attraction stronger than gravity, regardless of their distance. As explained, this entanglement force may only be present between stars (or perhaps black holes) but not any other matter such as gases in the interstellar medium or planets.

The bottom line of this paper is that we already have data (each ring galaxy) proving the existence of a strong stars' chain. It seems evident that many stars of a ring used to have a different location (outside the ring) and velocity in the past, yet they use the same orbit now and have a velocity nearly identical to the others. This requires the existence of an attraction force between the stars other than gravity. (Current mainstream theory is that ring galaxies are formed as the result of a collision with the bulge staying in place [15]. The problem with this theory is that current observations suggest ring galaxies as fairly common, while such collisions must be very unlikely. It also has no explanation for the multiring structure.) Collisions where galaxies meet with their edges are also unlikely, supporting the concept. Another proof is the NGC 4622 galaxy, in which the orbiting direction varied from arm to arm in the past, confirming that each arm used to represent a unique stars' chain.

Many statements of this paper may be confirmed by collecting more data, e.g., on every ring shrinking towards its center of mass, or proof for the presence of fewer dwarf galaxies in the past, or every barred spiral galaxy having had a bulge, etc.

Funding: The author declares that no funding was received for this work.

Conflicts of Interest: The author declares no conflict of interest.

 doi:10.20944/preprints202203.0280.v1

References and Notes:

1. F. Zwicky; *"On the Masses of Nebulae and of Clusters of Nebulae";* ApJ, 1937, 86**, pp.** *217–246.*
2. V. C. Rubin; K. W. Ford Jr; *"Rotation of the Andromeda Nebula from a Spectroscopic Survey of Emission Regions";* APJ, 1970, 159**,** pp. 379.
3. https://eventhorizontelescope.org/press-release-april-10-2019-astronomers-capture-first-image-black-hole, 2019.
4. S. Buglyó; *Forces attributed to dark matter may originate from entangled particles as seen in the shape of galaxies formed by GRBs*; IJEMS, 2018, 3, pp. 23–32.
5. J. R. Hill; M. P. Solon; *Standard model anatomy of WIMP dark matter direct detection. I. Weak-scale matching*; Phys. Rev. D., 2015, 91, 043504.
6. J. Maldacena; L. Susskind; *Cool horizons for entangled black holes*; Fortsch. Phys, 2013, 61, pp. 781-811.
7. Y. P. Rakovich, et al; *Fine structure of coupled optical modes in photonic molecules*; Phys. Rev. A**,** 2004, 70, 051801.
8. G. A. Seielstad; *Cosmic Ecology: The View from the Outside In*; University of California Press, Los Angeles, 1983.
9. D. Shiga; *Baby black holes may spit out mightiest particles*; New Scientist, 2009, 204, pp. 7.
10. B. Zhang; B. Zhang; *Gamma-ray burst prompt emission light curves and power density spectra in the ICMART model*; ApJ, 2014, 782, pp. 92.
11. J. Kormendy; *Elliptical Galaxies and Bulges of Disc Galaxies: Summary of Progress and Outstanding Issues*; Springer, Cham, 2016.
12. G.G. Byrd; T. Freeman; S. Howard; *The galaxy NGC 4622-Long-lasting leading arms and rings via low mass perturbers*; AJ, 1993, 105, pp. 477.
13. S. Perlmutter; et al; *Measurements of* Ω *and* Λ *from 42 High-Redshift Supernovae*; ApJ, 1999, 517, pp. 565.
14. M. Cautun; et al; *Evolution of the cosmic web*; MNRAS, 2014, 441, pp. 2923-2973.
15. A. Wolter; A. Fruscione; M. Mapelli; *The X-Ray Luminosity Function of Ultraluminous X-Ray Sources in Collisional Ring Galaxies*; ApJ, 2018, 863, pp. 43.