Sphere of Stars Conjecture IN PROGRESS

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Abstract

A sphere of stars is an entity not clearly explained in cosmology.

Spiral galaxies are the most frequently mentioned galaxy type. Our Milky Way is one.

A sphere of stars is either a globular cluster or an elliptical galaxy.

They have similar behaviors so this paper considers them together but with different sizes and star counts.

This paper is a conjecture to explain the observed behaviors of a sphere of stars. There is not enough information to propose a testable hypothesis and some explanations are incomplete. That context results in this conjecture but the accumulated material for each conjecture is worthwhile.

Contents

1 Introduction

A sphere of stars is an entity rarely mentioned in cosmology. Spiral galaxies are the most frequently mentioned galaxy type. Our Milky Way is a spiral galaxy and there are other large spirals in our Local Group including M31 and M33. A sphere of stars is either a globular cluster or an elliptical galaxy. They have similar behaviors. The giant elliptical galaxy has a unique behavior so that type is also described.

This conjecture is a preliminary explanation of the observed behaviors of a sphere of stars, based on the available details. The accumulated material for each conjecture is worthwhile, awaiting its elaboration.

This conjecture is the basis for integrating further details.

2 Terminology

Several terms are explained.

2.1 Metallicity

Metallicity is important when analyzing a sphere of stars. The spectrum of a star is assumed to indicate its age by the distribution of elements on its surface by their absorption lines. The elements not hydrogen or helium are called metals.

The SAFIRE project confirmed fusion can occur on the surface of a star so these assumptions about metallicity are wrong. A video below in the Electric Sun section describes these SAFIRE observations.

2.2 Plasma Physics

excerpt from Wikipedia:

Plasma is one of the four fundamental states of matter. It consists of a gas of ions – atoms which have some of their orbital electrons removed – and free electrons. Plasma can be artificially generated by heating or subjecting a neutral gas to a strong electromagnetic field to the point where an ionized gaseous substance becomes increasingly electrically conductive. The resulting charged ions and electrons become influenced by long-range electromagnetic fields, making the plasma dynamics more sensitive to these fields than a neutral gas.

Plasma and ionized gases have properties and display behaviours unlike those of the other states, and the transition between them is mostly a matter of nomenclature and subject to interpretation. Based on the temperature and density of the environment that contains a plasma, partially ionized or fully ionized forms of plasma may be produced. Neon signs and lightning are examples of partially ionized plasmas. The Earth's ionosphere is a plasma and the magnetosphere contains plasma in the Earth's surrounding space environment. The interior of the Sun is an example of fully ionized plasma, along with the solar corona and stars.

(excerpt end)

A sphere of stars requires a thorough understanding of plasma physics.

reference web-link: Plasma physics

2.3 Sun

Our Sun is the closest star and we expect other stars to be similar to our Sun.

excerpt from Wikipedia: The Sun is the star at the center of the Solar System. It is a nearly perfect sphere of hot plasma. Its diameter is about 1.39 million kilometers (864,000 miles), or 109 times that of Earth, and its mass is about 330,000 times that of Earth. Roughly three quarters of the Sun's mass consists of hydrogen (about 73%); the rest is mostly helium (about 25%), with much smaller quantities of heavier elements, including oxygen, carbon, neon, and iron.

Although no complete theory yet exists to account for the temperature of the corona, at least some of its heat is known to be from magnetic reconnection. The corona is the extended atmosphere of the Sun, which has a volume much larger than the volume enclosed by the Sun's photosphere. A flow of plasma outward from the Sun into interplanetary space is the solar wind.

The heliosphere, the tenuous outermost atmosphere of the Sun, is filled with the solar wind plasma. This outermost layer of the Sun is defined to begin at the distance where the flow of the solar wind becomes superalfvénic—that is, where the flow becomes faster than the speed of Alfvén waves, at approximately 20 solar radii (0.1 AU). Turbulence and dynamic forces in the heliosphere cannot affect the shape of the solar corona within, because the information can only travel at the speed of Alfvén waves. The solar wind travels outward continuously through the heliosphere, forming the solar magnetic field into a spiral shape, until it impacts the heliopause more than 50 AU from the Sun. In December 2004, the Voyager 1 probe passed through a shock front that is thought to be part of the heliopause. In late 2012 Voyager 1 recorded a marked increase in cosmic ray collisions and a sharp drop in lower energy particles from the solar wind, which suggested that the probe had passed through the heliopause and entered the interstellar medium.

The Sun's orbit around the Milky Way is perturbed due to the non-uniform mass distribution in Milky Way, such as that in and between the galactic spiral arms. It has been argued that the Sun's passage through the higher density spiral arms often coincides with mass extinctions on Earth, perhaps due to increased impact events. It takes the Solar System about 225–250 million years to complete one orbit through the Milky Way (a galactic year), so it is thought to have completed 20–25 orbits during the lifetime of the Sun. The orbital speed of the Solar System about the center of the Milky Way is approximately 251 km/s (156 mi/s).

(excerpt end)

my comment:

The Sun's orbit is 'perturbed' because the Sun does not move around a barycenter for the galactic disk like a planet would; this reference to 'mass distribution' reveals a wrong expectation for a star in a spiral galaxy; its stars rotate by the galactic magnetic field, not around a barycenter.

No theory exists to account for the temperature of the corona - except for the electric sun model.

This paper must proceed knowing the electric sun is the correct model.

reference link: Sun

2.4 Heliosphere

The Sun is within a much larger plasma structure called the heliosphere.

excerpt from Wikipedia:

The heliosphere is the vast, bubble-like region of space which surrounds and is created by the Sun. In plasma physics terms, this is the cavity formed by the Sun in the surrounding interstellar medium. The "bubble" of the heliosphere is continuously "inflated" by plasma originating from the Sun, known as the solar wind. Outside the heliosphere, this solar plasma gives way to the interstellar plasma permeating our galaxy. Radiation levels inside and outside the heliosphere differ; in particular, the galactic cosmic rays are less abundant inside the heliosphere, so that the planets inside (including Earth) are partly shielded from their impact.

Flowing unimpeded through the Solar System for billions of kilometres, the solar wind extends far beyond even the region of Pluto, until it encounters the termination shock, where its motion slows abruptly due to the outside pressure of the interstellar medium. Beyond the shock lies the heliosheath, a broad transitional region between the inner heliosphere and the external environment. The outermost edge of the heliosphere is called the heliopause. The overall shape of the heliosphere resembles that of a comet – being approximately spherical on one side, with a long trailing tail opposite, known as the heliotail.

The two Voyager program spacecraft have explored the outer reaches of the heliosphere, passing through the termination shock and the heliosheath. NASA announced in 2013 that Voyager 1 had encountered the heliopause on 25 August 2012, when the spacecraft measured a sudden increase in plasma density of about forty times. In 2018, NASA announced that Voyager 2 had traversed the heliopause on 5 November of that year. Because the heliopause marks the boundary between matter originating from the Sun and matter originating from the rest of the galaxy, spacecraft such as the two Voyagers, which have departed the heliosphere, can be said to have reached interstellar space.

In theory, the heliopause causes turbulence in the interstellar medium as the Sun orbits the Galactic Center. Outside the heliopause, would be a turbulent region caused by the pressure of the advancing heliopause against the interstellar medium. However, the velocity of Solar wind relative to the interstellar medium is probably too low for a bow shock.

The heliosheath is the region of the heliosphere beyond the termination shock. Here the wind is slowed, compressed and made turbulent by its interaction with the interstellar medium. At its closest point, the inner edge of the heliosheath lies approximately 80 to 100 AU from the Sun. A proposed model hypothesizes that the heliosheath is shaped like the coma of a comet, and trails several times that distance in the direction opposite to the Sun's path through space. At its windward side, its thickness is estimated to be between 10 and 100 AU. Voyager project scientists have determined that the heliosheath is not "smooth" – it is rather a "foamy zone" filled with magnetic bubbles, each about 1 AU wide. These magnetic bubbles are created by the impact of the solar wind and the interstellar medium. Voyager 1 and Voyager 2 began detecting evidence for the bubbles in 2007 and 2008, respectively. The probably sausage-shaped bubbles are formed by magnetic reconnection between oppositely oriented sectors of the solar magnetic field as the solar wind slows down. They probably represent self-contained structures that have detached from the interplanetary magnetic field.

(excerpt end)

reference link: Heliosphere

My summary: The Sun we observe is only one part of a plasma entity within its heliosheath. This bubble separates the Sun and its environment including the solar system from the interstellar medium. Nothing called magnetic reconnection exists in valid physics.

3 Electric Sun Model

This paper assumes a star is an electrical phenomenon called the electric sun. The term 'electric sun' and its description originated around 1974 with Ralph Juergens. The Thunderbolts Project (TBP) has continued research into this non-mainstream theory of a new solar model. TBP proposes a new cosmology called the Electric Universe where electromagnetic forces are more important than gravity. Gravity is useful for explaining the solar system but not a galaxy. That inadequacy with gravity results in unknowns like dark matter and dark energy.

The following video describes the electric sun model especially its outer layers.

youtube-link: Donald Scott: The Electronic Sun — EU2012

The following video descibes the results of the SAFIRE project to test the electric sun model and it successfully achieved fusion of elements on the anode's surface.

This video also mentions an assumption from the distribution of elements will not be as expected by the current solar model.

youtube-link: Donald Scott: SAFIRE and the Electric Sun — Space News

The current solar model is a gaseous sphere powered by fusion reactions in its core. The electric sun uses a liquid metallic hydrogen in a lattice as condensed matter for an electric source of the Sun's radiation.

youtube-link: The Sun is NOT a Gaseous Plasma! The LMH Solar Model!

youtube-link: Eddington's Mass-Luminosity Relationship: A Violation of the Laws of Thermodynamics

4 Star

Our Sun is described as surrounded by a heliosheath which is the separation from interstellar space. As of January 9, 2020 the Voyager probes were into the interstellar medium.

Voyager 1 distance: 148 AU Voyager 2 distance: 122 AU

For a convenient reference: 150 AU = 0.00237188 light years = 2.2440 x 10^{10} km

reference link: Voyager status

my comment:

With the closest star over 4 light years away the plasma entity encompassing the Sun is very small on the galactic scale with such a large distance betwen stars.

5 Plasma without Gravity

An interesting experiment was conducted with plasma in the gravity-free context of the International space station.

youtube- link: Plasma in space experiment English subtitles

my comment:

After plasma dust particles were released into a chamber in the gravity-free space station, the particles self-organized into a crystal-lattice structure in a half sphere with a gap in the middle. The video mentions the repulsion between plasma particles but whether the charge is negative or positive is not stated. This observation suggests the possibility of stars (each a plasma entity) could self-organize into a sphere. The cause of the gap is unexplained for this recent unexpected observation.

6 Spiral Galaxy Model

Donald Scott has described a model for a spiral galaxy based on a pair of Birkelund current filaments along the galaxy axis generating a magnetic field that provides the force for the observed rotation curve in the disk.

A spiral galaxy has structure unlike a sphere of stars.

A birkelund current pair is along the galactic axis, generating the galaxy's magnetic field.

The birkelund filament pair is the electrical connection of the galaxy to the external energy source.

These filaments bend at the Z-pinch at the core of the galaxy emitting the observed synchrotron radiation from radio to X-ray. Each star, like the Sun has an axial electrical current with the electrical connection to the galaxy as the external energy source. These details are descibed in the electric sun section.

Computer simulations have confirmed this evolutionary path.

web-link: Spiral galaxy formation

Other birkelund filament pairs extend into each spiral arm. The magnetic field generated by this current brings some structure to the arm. The electrical circuit is completed by the current to the end of the arm then returning to the core (in dark mode) where the break in the current allowed mutiple paths. The filament pair has the behavior where it can draw plasma between the pair and the electrodynamic force can compress the plasma into a sphere to create a star.

Sometimes stars can appear like beads on a string but without a string.

web-link: Birkeland Currents and Dark Matter

7 Globular Cluster

A Globular cluster (GC) is fascinating because gravity only attracts so eventually there should be a collapse or at least collisions within the GC, but they have been moving around perhaps billions of years.

Here is an explanation for GC stability:

excerpt start:

Fortunately for us, we live in out the boring suburbs of the Milky Way. Out here, distances between stars are so vast that collisions are incredibly rare. There are places in the Milky Way where stars are crowded more densely, like globular clusters, and we get to see the aftermath of these collisions. These clusters are ancient spherical structures that can contain hundreds of thousands of stars, all of which formed together, shortly after the Big Bang.

Within one of these clusters, stars average about a light year apart, and at their core, they can get as close to one another as the radius of our Solar System. With all these stars buzzing around for billions of years, you can imagine they've gotten up to some serious mischief.

Within globular clusters there are these mysterious blue straggler stars. They're large hot stars, and if they had formed with the rest of the cluster, they would have detonated as supernovae billions of years ago. So scientists figure that they must have formed recently.

How? Astronomers think they're the result of a stellar collision. Perhaps a binary pair of stars merged, or maybe two stars smashed into one another. (excerpt end)

web-link: Can stars collide?

my comment: The claim is collisions are very rare even through billions of years. The stars at the core of a cluster are assumed be closer than 50 AU (Pluto's orbit's maximum radius) which is less than the Sun's heliosheath at 150 AU. It is reasonable to expect one star entering the heliosheath of another will be disruptive to both.

This explanation of stability is not justified when only gravity is involved. Gravity is known as a weak force but it can't bring stars together when most of them are at a similar distance of only 1 light year or less, Gravity is so strong to maintain the globular structure lasting billions of years, with no collisions. Gravity alone cannot provide a coherent explanation. The mutual electrical repulsion is a better explanation for few if any collisions.

DeepSkyVideos on youtube had a good description of the orbit for M10 GC around the Milky Way. A link is below for reference.

This description makes a GC a challenge because astonomers claim gravity is the force holding the stars together in the cluster. M10 has an elliptical orbit around the core of the Milky Way so its path takes it through the galactic plane. The video mentions a paper that analyzed M10. As the GC passes through this plane of many stars there is a trivial attrition, where rarely some stars are stripped from the GC. This conclusion means the gravity in the GC is strong enough to maintain its shape and to hold most of its members even though periodic disruptions through the galactic plane. It also means passing through the galactic plane does not trigger more collisions within the GC or even its collapse.

This paper investigates the GC behaviors.

my comment:

There is a repulsive force within the cluster. The sun and stars are positively charged being predominantly ionized hydrogen and each is the anode in its heliopause electrical circuit. The electric fields of the positively charged stars should inhibit collisions by their electric fields, because + repels +. Astronomers generally ignore plasma and electromagnetic effects but a GC reveals the importance of an electric field from a positively charged body when there are so many in this sphere.

A simple observation of several GC show the stars are generally spaced uniformly. There are more stars at the center with the density decreasing as stars are further from the center. The observation implies gravity holds the general shape while all the individual members are repelling all the other members. There is no defined outer edge for this shape held together so loosely in this manner. With this explanation for a very loose structure, when M10 passes through the galactic plane the GC behaves like a bundle of ballons tied together by a string; so with a bump they just jostle around.

M10 has an orbital period in millions of years but it has passed through the galactic disk many times and remains an intact GC.

The mechanism for the creation of a globular cluster is not known.

excerpt from an 2014 article:

Thanks to the NASA/ESA Hubble Space Telescope, some of the most mysterious cosmic residents have just become even more puzzling. New observations of globular clusters in a small galaxy show they are very similar to those found in the Milky Way, and so must have formed in a similar way. One of the leading theories on how these clusters formed predicts that globular clusters should only be found nestled in among large quantities of old stars. But these old stars, though rife in the Milky Way, are not present in this small galaxy, and so the mystery deepens.

Globular clusters — large balls of stars that orbit the centers of galaxies but can lie very far from them- remain one of the biggest cosmic mysteries. They were once thought to consist of a single population of stars that all formed together. However, research has since shown that many of the Milky Way's globular clusters had far more complex formation histories and are made up of at least two distinct populations of stars.

Of these populations, around half the stars are a single generation of normal stars that were thought to form first, and the other half form a second generation of stars, which are polluted with different chemical elements. In particular, the polluted stars contain much more nitrogen than the first generation of stars.

my comment: The proportion of polluted stars found in the Milky Way's globular clusters is much higher than astronomers expected, suggesting that a large amount of the first-generation star population is missing. A leading explanation for this is that the clusters once contained many more stars, but a large fraction of the first-generation stars were ejected from the cluster at some time in its past.

This explanation could make sense for GC around the Milky Way, where the ejected stars could easily hide among the many similar old stars in the vast halo, but the new observations, which look at a GC in a much smaller galaxy, call this theory into question.

(excerpt continued)

Astronomers used Hubble's Wide Field Camera 3 to observe four globular clusters in a small nearby galaxy known as the Fornax Dwarf Spheroidal Galaxy.

"We knew that the Milky Way's clusters were more complex than was originally thought, and there are theories to explain why. But to really test our theories about how these clusters form, we needed to know what happened in other environments," said Soren Larsen of Radboud University in Nijmegen, the Netherlands. "Before now, we didn't know whether globular clusters in smaller galaxies had multiple generations or not, but our observations show clearly that they do!"

The astronomers' detailed observations of the four Fornax clusters show that they also contain a second polluted population of stars and indicate that not only did they form in a similar way to one another, but their formation process is also similar to clusters in the Milky Way.

Specifically, the astronomers used the Hubble observations to measure the amount of nitrogen in the cluster stars and found that about half of the stars in each cluster are polluted at the same level that is seen in Milky Way's globular clusters.

This high proportion of polluted second-generation stars means that the Fornax globular clusters' formation should be covered by the same theory as those in the Milky Way.

Based on the number of polluted stars in these clusters, they would have to have been up to 10 times more massive in the past before kicking out huge numbers of their first generation stars and reducing to their current size. But, unlike the Milky Way, the galaxy that hosts these clusters doesn't have enough old stars to account for the huge number that were supposedly banished from the clusters. 'if these kicked out stars were there, we would see them, but we don't!' said Frank Grundahl of Aarhus University in Denmark. Our leading formation theory just can't be right.'

There's nowhere that Fornax could have hidden these ejected stars,

so it appears that the clusters couldn't have been so much larger in the past.

This finding means that .. a leading theory on how these mixed-generation .. globular clusters formed cannot be correct,

and astronomers will have to think once more about how these mysterious objects in the Milky Way and further afield came to exist.

(excerpt end)

reference-link: Mystery of Globular Star Clusters' Formation Deepens

my comment:

Astronomers expected to find stars ejected from a GC but found none; they concluded their current theory is wrong.

This video describes the elliptical orbit of M10 GC around the Milky Way, which passes through the disk.

youtube-link: M10 - Orbits - Deep Sky Videos

my comment: Clearly there are electromagnetic forces maintaining the integrity of the M10 sphere of stars when moving through the galactic disk.

DeepSky Videos also has a video about more of the GC around the Milky Way. In 2018 using Gaia data astronomers plotted motions of the stars in 91 individual GC and found similar patterns among these samples. This video has too many interesting descriptions to be summarized here.

Among them are: a subset where some of the GC had stars with very little rotational velocity.

When looking at a GC like M75 it is not apparent some of those stars are alternately approaching and receding.

There is a subset of 8 called sausage globular clusters because of the shape of the plot of their star's motions in the different directions, either radially or in rotation around the Milky Way.

Wikipedia has only a little information under the topic 'Gaia sausage' and it has a link to only the paper's abstract. I did not get the paper but the video is below.

my comment: Iron to Hydrogen ratio (metallicity) defines the age of each star. The SAFIRE project confirmed fusion can occur on the star's surface so the metallicity assumptions are invalid.

The observed approach/recede combination of motion among some stars cannot come from gravity alone.

youtube-link: Sausage globular clusters

M10 is a well known GC for the Milky Way.

excerpt from Wikipedia: M10 has a spatial diameter of 83 light-years. The density of stars in the core region is about 3.8 solar masses per cubic parsec.

(excerpt end)

web-link: Messier 10

8 Globular Cluster Distribution

There are many globular clusters in the universe.

web-link: Richest Globular Cluster Systems

9 Globular Clusters in Local Group

There are many globular clusters in our Local Group including our Galaxy, M31 and others in our Local Group.

web-link: Local Group Globular Clusters

10 Globular Clusters in Messier list

M2 - radius 84ly,class II, part of gaia sausage, mass=1.04x10^5, metallicity -1.65

M3 - radius 90ly, metallicity -1.34

M4 - radius 35ly, has a pulsar,class IX, mass = 6.7x10^4, metallicity -1.07

M5 - radius 80ly,class V, mass = 8.57x10^5metallicity -1.12

M9 - radius 45ly, class VIII, mass =4.22x10^5 is Oosterhoff type II GC, which precludes extra-galactic origin, metallicity -1.77

M10 - radius 41.6ly, class VII, mass =2.25x10^5class VII,rosette orbit eccentricity 0.21 takes 14My, metallicity -1.25

M12 - radius 37.2ly, class IX, mass = 8.7x10^4, metallicity -1.14

M13 - radius 84 ly,class V, mass = 6x10^5, metallicity -1.33

M14 - radius 50ly but elongated, class VIII, mass = 1.04 x 10^6, metallicity -1.28

M15 - radius 88 ly, class IV, mass = 5.6x10^5, metallicity -2.37; has rare planetary nebula

M19 - radius 70 ly, class VIII, mass = 1.1x10^6, metallicity -1.53

M22 - radius 50 ly, class VII, mass = 2.9x10^5, metallicity -1.49

M28 - radius 30 ly,class IV, mass = 5.51x10^5, metallicity -1.32

M30 - radius none,class V, mass = 1.6x10^5, metallicity -2.27

M53 - radius none, class V, mass = 0.26x10^5, metallicity -1.86

M54 - radius 153ly, class VIII, no mass/met, probably extragalactic

M55 - radius 48 ly, class XI, mass = 2.69x10^5, metallicity -1.94

M56 - radius 42 ly, class X, mass = 2.3x10^5, metallicity -2.00

M62 - radius 49 ly, class IV, mass = 1.22x10^6, metallicity -1.02, class V,radial velocity meas suggest SMBH?, many variable stars

M68 - radius 53 ly, class X, mass = 2.23x10^5, metallicity -2.23, 50 variable stars

M69 - radius 45 ly, class V, mass = 2.0x10^5, metallicity -0.78, 1800ly to M70

M70 - radius 34 ly, class V, mass = 1.79x10^5, metallicity -1.35

M71- radius 13 ly, class X-XI, mass = 1.73x10^4, metallicity -0.78

M72 - radius none, class IX, mass = 1.68x10^5, metallicity -1.48

M79 - radius none, class V, mass = none, metallicity -1.55, at Canis Major Dwarf not MW

M80 - radius 48 ly, class II, mass = 5.02x10^5, metallicity -1.47

M92 - radius none, class IV, mass = none, metallicity -2.16

M107 - radius 30 ly, class X, mass = 1.82x10^5, metallicity -0.95

Mayall II - radius 263 ly, class X, mass = 1.0x10^7, metallicity none, at M31 not MW

11 Elliptical Galaxy

excerpt from Wikipedia:

Elliptical galaxies are characterized by several properties that make them distinct from other classes of galaxy. They are spherical or ovoid masses of stars, starved of star-making gases. The smallest known elliptical galaxy is about one-tenth the size of the Milky Way. The motion of stars in elliptical galaxies is predominantly radial, unlike the disks of spiral galaxies, which are dominated by rotation. Furthermore, there is very little interstellar matter (neither gas nor dust), which results in low rates of star formation, few open star clusters, and few young stars; rather elliptical galaxies are dominated by old stellar populations, giving them red colors. Large elliptical galaxies typically have an extensive system of globular clusters.

The dynamical properties of elliptical galaxies and the bulges of disk galaxies are similar, suggesting that they may be formed by the same physical processes, although this remains controversial. The luminosity profiles of both elliptical galaxies and bulges are well fit by Sersic's law, and a range of scaling relations between the elliptical galaxies' structural parameters unify the population.

Elliptical galaxies are preferentially found in galaxy clusters and in compact groups of galaxies.

Unlike flat spiral galaxies with organization and structure, elliptical galaxies are more three-dimensional, without much structure, and their stars are in somewhat random orbits around the center.

Elliptical galaxies vary greatly in both size and mass with diameters ranging from 3000 lightyears to more than 700,000 lightyears, and masses from 10^5 to nearly 10^{13} solar masses. This range is much broader for this galaxy type than for any other. The smallest, the dwarf elliptical galaxies, may be no larger than a typical globular cluster, but contain a considerable amount of dark matter not present in clusters. Most of these small galaxies may not be related to other ellipticals.

The Hubble classification of elliptical galaxies contains an integer that describes how elongated the galaxy image is.

Thus for a spherical galaxy the Hubble type is E0. While the limit in the literature is about E7, it has been known since 1966 that the E4 to E7 galaxies are misclassified lenticular galaxies with disks inclined at different angles to our line of sight. This has been confirmed through spectral observations revealing the rotation of their stellar disks. Hubble recognized that his shape classification depends both on the intrinsic shape of the galaxy, as well as the angle with which the galaxy is observed. Hence, some galaxies with Hubble type E0 are actually elongated.

It is sometimes said that there are two physical types of ellipticals: the giant ellipticals with slightly "boxy"-shaped isophotes, whose shapes result from random motion which is greater in some directions than in others (anisotropic random motion); and the "disky" normal and dwarf ellipticals, which contain disks. This is, however, an abuse of the nomenclature, as there two types of early-type galaxy, those with disks and those without. Given the existence of ES galaxies with intermediate-scale disks, it is reasonable to expect that there is a continuity from E to ES, and onto the S0 galaxies with their large-scale stellar disks that dominate the light at large radii.

Dwarf spheroidal galaxies appear to be a distinct class: their properties are more similar to those of irregulars and late spiral-type galaxies.

At the large end of the elliptical spectrum, there is further division, beyond Hubble's classification. Beyond gE giant ellipticals, lies D-galaxies and cD-galaxies. These are similar to their smaller brethren, but more diffuse, with large haloes that may as much belong to the galaxy cluster within which they reside than the centrally-located giant galaxy.

(excerpt end)

web-link: Elliptical galaxy

my comment:

There is an inconsistency classifying by galaxy type because the angle of view affects a rating.

The radial motion in an elliptical galaxy is also observed in globular clusters.

It is interesting both a black hole and dark matter (both are invisible) are mentioned. This means cosmologists do not understand the galaxy when needing invisible sources of gravity.

(continue excerpt)

It is widely accepted that the evolution of elliptical galaxies is primarily because of the merging of smaller galaxies. Many galaxies in the universe are gravitationally bound to other galaxies, which means that they will never escape the pull of the other galaxy. If the galaxies are of similar size, the resultant galaxy will appear similar to neither of the two galaxies merging, but will instead be an elliptical galaxy. (excerpt end)

my comment: The formation of elliptical galaxies cannot be explained, just 'widely accepted.'

The theory two spiral galaxies can merge to form an elliptical galaxy is not feasible. This proposed merger is also mentioned in the M49 video. The two spirals have a birkelund axial current generating the galactic magnetic field for rotation. Upon this collision and merger all the stars must stop their non-linear motion and change to radial motion relative to the plasmoid in the elliptical core. The merger is easier for the standard cosmology because every galaxy has a black hole at the center and dark matter explains any anomaly in rotation. BH+BH is easy because neither exists. After BH+BH all the stars and the many GC just settle into place. The GC were in orbit around the spiral but after the merger the GC set just settles near their 'new' galaxy with no details offered.

This paper offers a conjecture on the formation of an elliptical galaxy.

This scenario is frequently observed:

a) nearly every large galaxy cluster has a large elliptical galaxy at its center.

b) Around that elliptical there will be a variety of the other types, from a lenticular, which is essentially a spiral core with its halo and a dust lane but no arms, to a spiral (each having a different configuration of arms), to an irregular (which is many stars but with no defined structure like the other types). Some irregulars after close inspection are found to be one of the other types; one example is when the spiral arms are extremely distorted making an observation of rotation difficult. Another problem is an angle of view preventing a clear perspective of each galaxy or cluster.

c) Globular clusters proliferate in the cluster - around the elliptical and in smaller numbers around the other galaxy types but larger spirals generally have more globular clusters than smaller galaxies.

d) When looking at many galaxy clusters there is usually no apparent alignment pattern in the group.

e) Even with so many 'clusters' of galaxies the galaxy cluster remains dispersed. When viewing many images of galaxy clusters a case where galaxies are seen to be merging are rare. Astronomers sometimes describe mergers and collisions but each case is usually a galaxy with an unusual appearance so with no other easy explanation available it is just described as an odd mix of others from a collision. A separation of two from one can look like a merger of two into one. The force of gravity alone is simply unable to collapse a cluster of galaxies holding billions or even trillions of stars. More than gravity is involved in a cluster's stability with the presence of electric fields capable of attraction or repulsion in a universe that is almost 100% plasma.

e) when jets or arcs are observed the galaxy is an elliptical. Only a plasmoid generates jets.

Though the elliptical seems benign other than observed axial jets, in distant galaxy clusters arcs are seen and those arcs are always around the central elliptical in the galaxy cluster. These galaxy clusters also indicate an active intergalactic medium with X-ray emissions obsrrved by Chandra.

Cosmologists do not have a clear explanation for how an elliptical galaxy or a globular cluster forms.

The observation of there is always a large elliptical galaxy at the center of every large galaxy cluster makes them rather critical in understanding how the universe evolves.

12 Giant Elliptical Galaxy M87

M87 is a giant elliptical galaxy with many GC.

excerpt from NASA: The elliptical galaxy M87 is the home of several trillion stars, a supermassive black hole and a family of roughly 15,000 globular star clusters. For comparison, our Milky Way galaxy contains only a few hundred billion stars and about 150 globular clusters. The monstrous M87 is the dominant member of the neighboring Virgo cluster of galaxies, which contains some 2,000 galaxies. [This] galaxy is located 54 million light-years away from Earth in the constellation Virgo. (excerpt end)

web-link: Messier 87

my comment: M87 is known to have a plasmoid at its core, not a black hole. This plasmoid explains the M87 jets.

13 Giant Elliptical Galaxy M49

M49 is a giant elliptical galaxy with many GC.

excerpt from NASA: The elliptical galaxy M49 was the first elliptical galaxy detected outside of the Milky Way's Local Group. Unlike spiral galaxies that have well-defined structures and picturesque spiral arms, elliptical galaxies are fairly featureless with little structure. The stars in elliptical galaxies are usually much older than those in spiral galaxies. M49 also contains a rich collection of globular star clusters — nearly 6,000.

There is an X-ray source at the core of the galaxy. M49 is located 60 million light-years from Earth in the constellation Virgo.

(excerpt end)

web-link: Messier 49

from another reference:

About 157,000 light years across in size, M49 is one of the cluster's giant elliptical galaxies. It is larger both than the Milky Way (100,000 light years) and the Andromeda Galaxy (140,000 light years). The galaxy contains at least 200 billion stars.

(excerpt end)

web-link: Messier 49

Here is a video about M49 and the metallicity of its stars. There are stated assumptions about metallicity to age.

web-link: M49 - Elliptical Galaxy - Deep Sky Videos

my comment: There is no black hole in M49; M49 has a plasmoid like M87.

This video also mentions assumptions for a relation between a star's color and its metallicity. She mentions this is under debate.

14 Dwarf Elliptical Galaxy

excerpt from Wikipedia:

Dwarf elliptical galaxies, or dEs, are elliptical galaxies that are smaller than ordinary elliptical galaxies. They are quite common in galaxy groups and clusters, and are usually companions to other galaxies.

"Dwarf elliptical" galaxies should not be confused with the rare "compact elliptical" galaxy class, of which M32, a satellite of the Andromeda Galaxy, is the prototype. In 1944 Walter Baade confirmed dwarf ellipticals NGC 147 and NGC 185 as members of the Local Group by resolving them into individual stars, thanks to their relatively little distance. In the 1950s, dEs were also discovered in the nearby Fornax and Virgo clusters.

Comparison with ordinary elliptical galaxies:

Dwarf elliptical galaxies have blue absolute magnitudes within the range -18 mag ¡ M ¡-14 mag, fainter than ordinary elliptical galaxies. The surface brightness profiles of ordinary elliptical galaxies used to be approximated with de Vaucouleur's model, while dEs were approximated with an exponentially declining surface brightness profile. However, both types can be well fit by the same more general function, known as Sersic's model, and there is a continuity of Sersic index - which quantifies the shape of the surface brightness profile - as a function of galaxy luminosity, revealing that dwarf and ordinary elliptical galaxies belong to a single sequence. Still fainter elliptical-like galaxies, called dwarf spheroidal galaxies, may be genuinely distinct.

Dwarf ellipticals may be primordial objects. Within the currently favoured cosmological Lambda-CDM model, small objects (consisting of dark matter and gas) were the first to form. Because of their mutual gravitational attraction, some of these will coalesce and merge, forming more massive objects. Further mergers lead to ever more massive objects. The process of coalescence could lead to the present-day galaxies, and has been called "hierarchical merging". If this hypothesis is correct, dwarf galaxies may be the building blocks of today's ordinary galaxies.

An alternative suggestion is that dEs could be the remnants of low-mass spiral galaxies that obtained a rounder shape through the action of repeated gravitational interactions with ordinary galaxies within a cluster.

This process of changing a galaxy's morphology by interactions, and the removal of much of its stellar disk, has been called "galaxy harassment". Evidence for this latter hypothesis has been claimed due to stellar disks and weak spiral arms seen in some dEs. Under this alternative hypothesis, the anaemic spiral arms and disk are a modified version of the original stellar disk of the now transformed spiral galaxy.

At the same time, the galaxy harassment scenario can not be the full picture. The highly isolated dwarf elliptical galaxy CG 611 possesses the same physical attributes as dE galaxies in clusters - such as rotation and faint spiral arms - attributes that were previously assumed to provide evidence that dE galaxies were once spiral galaxies prior to a transformation process requiring immersion with a cluster of galaxies. CG 611 has a gas disk which counter-rotates to its stellar disk, clearly revealing that this dE galaxy's disk is growing via accretion events. If CG 611 was to fall into a galaxy cluster, ram-pressure stripping by the cluster's halo of hot X-ray gas would strip away CG 611's gas disk and leave a gas-poor dE galaxy that immediately resembles the other dEs in the cluster. That is, no removal of stars nor re-shaping of the galaxy within the dense galaxy cluster environment would be required, undermining the idea that dE galaxies were once spiral galaxies. (excerpt end)

web-link: Dwarf Elliptical Galaxy

my comment: If CG 611 has a rotating disk then it cannot be an elliptical by the very definition of the types. It must be a dwarf spiral. For a long time the Magellanic Clouds were considered a type of dwarf galaxy having no rotation but now both are known as spiral galaxies. The Lambda-CDM model is wrong because it relies on dark matter and dark energy; both do not exist. /newline

M32 is dwarf elliptical galaxy near M31 but M32 has little data, only type cE2.

15 Dwarf Spheroidal Galaxy

excerpt start:

A dwarf spheroidal galaxy (dSph) is a term in astronomy applied to small, low-luminosity galaxies with very little dust and an older stellar population. They are found in the Local Group as companions to the Milky Way and to systems that are companions to the Andromeda Galaxy. While similar to dwarf elliptical galaxies in appearance and properties such as little to no gas or dust or recent star formation, they are approximately spheroidal in shape and generally have lower luminosity.

Despite the radii of dSphs being much larger than those of globular clusters, they are much more difficult to find due to their low luminosities and surface brightnesses. Dwarf spheroidal galaxies have a large range of luminosities, and known dwarf spheroidal galaxies span several orders of magnitude of luminosity. Their luminosities are so low that Ursa Minor, Carina, and Draco, the known dwarf spheroidal galaxies with the lowest luminosities, have mass-to-light ratios (M/L) greater than that of the Milky Way.

(excerpt end)

my comment:

A dwarf spheroidal galaxy is just a globular cluster but a larger volume for its stars resulting in low luminosity.

excerpt from Wikipedia:

The Fornax Dwarf Spheroidal is an elliptical dwarf galaxy in the constellation Fornax. The galaxy is a satellite of the Milky Way and contains six globular clusters; the largest, NGC 1049, was discovered before the galaxy itself. The galaxy mostly contains population II stars.

(excerpt end)

my comment: here is no reference online with the galaxy's size or its star count.

web-link: Fornax Dwarf Galaxy

16 Ejected Plasmoids

There have been observations of ejected plasmoids where Chandra observes an X-ray point source far from any galaxy. Here are some of this author's observations.

09/26/2019 web-link: Plasmoids in a Spiral Galaxy Arms

10/01/2019 web-link: Inconsistent Black Holes

10/10/2019 web-link: M82 Galaxy Is Surrounded By X-Ray Sources

10/14/2019 web-link: Toothbrush Cluster

10/15/2019 web-link: Elliptical Galaxy With an Ignored Remote X-ray Source

01/02/2020 web-link: Arp, Quasars, Seyfert, and M51

In this preliminary version of this paper, the archived copy of each facebook post is linked here. The next version of this paper will integrate the text and its accompanying web link here.

The conclusion:

Plasmoids can be ejected from a galaxy.

When it is ejected an electrical current connection from the galaxy's birkelund current pair must be passed to the plasmoid as well.

This conjecture cannot find an explanation for how the observed X-ray point sources are getting their electrical energy This plasmoid is now in the intergalactic medium so a sheath of charge separation arises around the plasmoid with this becomes a plasma sphere with the plasmoid at its center.

17 Conjecture of a Ring around a Sphere of Stars

A number of giant elliptical galaxies in large galaxy clusters exhibit a sphere or a ring in a 2-D view which is complete or in several arcs, as if portions are in dark mode.

In this preliminary version of this paper, the content in a separate web page is linked here. The next major revision of this paper will integrate the text and accompanying links here.

Here is this author's collection of some of these arcs and rings. Each item has a link to a description and most have a link to just the image

web-link: Collection of Rings and Distortions, With Images

Abell 2667 is a good example where the long arc to the left of a giant elliptical at the center of the galaxy cluster is clearly electrically active with structure near the top and also at the bottom of the arc; these arcs are not symmetrical but each shows unique activity but the radius is maintained.

The Cheshire Cat cluster is interesting with two giant ellipticals, the two eyes, and with a large ring around both. This outer ring is most electrically active at the right but not visible to the left. The image is cropped around the 'cat' so the galaxies to the right or below are not shown.

These rings are observed. A detailed explanation for this ring is conjecture.

18 Conjecture for the Radial Motion by stars in the sphere

All of the spheres of stars have similar behaviors.

a) each sphere has a source of electromagnetic radiation at the core typically extending to X-ray.

This paper offers the conjecture each sphere of stars as a plasmoid at its core based on the observed plasmoid in the elliptical galaxy M87.

b) the stars move radially within the sphere's diameter. To the inside the stars do not collide near the center while to the outside they remain within the same distance from the core, where the outer sphere has the current path back to the plasmoid.

c) each star could be assumed to be in a 150AU heliosheath bubble, like our Sun. I assume each star presents a positive electric field to its sphere of stars. The Sun has a positive charge estimated at 77 coulombs.

d) each star would have an axial electric current (like our Sun) from the plsmoid at the center of of this sphere of stars.

However each star requires a force-free field-aligned birkelund current because a simple electrical current not in the birkelund filament would be generating an external magnetic field affecting all the other stars aound each star. This conjecture expects there are not more magnetic fields beyond those generated by the moving stars.

Each star moves radially between the plasmoid at the center and an outer invisible sphere which is the current path back to the plasmoid, a sphere which captures the edge of the sphere of stars. This hypothetical ring is described in the section Giant elliptical galaxy, near the end of this paper. The ring is associated with the external sphere of the charge separation around the sphere of stars. The radial motion of individual stars is similar to a vibration in a lattice but in the sphere of stars there is mutual repulsion with no countering attraction. Any magnetic fields being generated by the moving stars exert that Lorentz force. The non-synchronized stars do not create a steady magnetic field in one direction.

The proposed outer ring maintains a limit of motion beyond the sphere's radius.

The section above (plasma without gravity) observed plasma particles of the same charge self-organize into a lattice.

This suggests the stars in a sphere, having the same positive charge, will also self-organize. That video of a small chamber in the space station appears to result in a half sphere. In outer space without walls it is reasonable to expect a sphere as a final result. The moving stars could generate a magnetic field affecting the motion of nearby stars. This mix of electrodynamics is beyond the scope of this paper.

19 Conjecture for the number of stars in a sphere

Each sphere of stars has no visible bridge to any other GC or galaxy.

The conjecture is the birkelund current pair to the plasmoid at the center of the sphere collects plasma (protons and electrons) from the intergalactic medium and creates stars to add to its count of stars in the pinch of the helix. The sphere of stars around the plasmoid has no established lattice structure being maintained so a new star jostles into the sphere and the somewhat synchronized motions in the sphere adjusts to the addition. The initial reaction is by electrical repulsion.

The accepted mechanism for a spiral galaxies requires birkelund filament pairs which by Marklund convection pull surrounding plasma into the filament.

This conjecture assumes a simmilar mechanism within each sphere of stars.

20 Conjecture for the creation of a sphere of stars

In a section above, there appear to be plasmoids ejected into intergalactic space from active galaxies.

Each plasmoid accumulates plasma from its intergalactic medium and creates stars for its surrounding sphere.

Hannes Alven proposed a galactic circuit for a spiral galaxy.

The incoming axial current goes the plasmoid at the center, bends at a right angle, extends down the plane of the galactic disk. After the end of the disk, the current splits in half with each taking an an arc up or down converging at the pole opposite the pole with the incomg cuurrent.

With a sphere of stars, the incoming axial current splits at the plasmoid into many radial paths extending out to an outer sphere where all bend and take an arc to converge at the pole opposite that of the incoming current and from that convergence the current retuns to the plasmoid.

All of these radial arcs from the plasmoid defines the path of the stars in their radial orbit. The stars do not collide with the plasmoid nor do they move beyond the outer current ring.

I cannot find this behavior described in a plasma physics or electrodynamics reference. This conjecture for a sphere of stars cannot identify another explanation for the observed radial orbits for stars within a sphere of stars. A quasar, which is a plasmoid, is observed to eject hydrogen atoms having a high velocity. Stars have a liquid metallic hydrogen lattice which is essentially many protons in the state of condensed matter. This mechanism is just conjecture. However there is no other theory for how the spheres of stars are created with such large numbers of stars.

21 Conjecture for the creation of stars in a sphere of stars

A spiral galaxy has a different core than the plasmoid in a sphere of stars. The birkelund currents in a spiral galaxy, isplits n the core with paths into the respective spiral arms, are assumed to form stars like beads on a string in the pinch between the filaments. A sphere of stars has the birkelund current pair passing through iits core. A sphere of stars must have its own star creation mechanism similar to a spiral galaxy.

There are two possibilities: 1) the stars are created at the periphery of the sphere of stars and are drawn to the sphere adding to its count, so they are added from the outside arriving from a distance, or 2) the stars are created in the sphere.

With an external birkelund filament connected to the sphere of stars entity, then Marklund convection is possible to collect protons and electrons.

The creation of a star requires the compression of many protons and electrons in motion. When this simple plasma is compressed under extreme pressure, the result is a lattice called metallic hydrogen where the protons form the lattice and the loose electrons circulate in the lattice maintaining the bonds in what is called condensed matter, where electromagnetic forces maintain the lattice rather than a molecular bond, so the result is a stable lattice rather than a huge individual molecule.

With the plasma in motion during compression a sphere or a star can result.

In the Sun this liquid metallic hydrogen changes its lattice configuration at different depths and layers resulting in changes in density.

22 Conjecture for the Respective Spheres

22.1 Globular Cluster

A globular cluster is a sphere of stars in orbit around a galaxy, of any type. Its star creation resources are limited by its environment so its growth is at a slower rate where many GC while not huge can be observed around a galaxy though the count of GC around a galaxy increases with the size of the galaxy. A dwarf galaxy will have few GC while a large elliptical will have many GC.

The largest spiral galaxies have fewer GC than the largest elliptical galaxies.

An explanation for these numerical relationships is conjecture.

The ejection of the plasmoid which began the creation of the GC provides its initial momentum. The nearby galaxy's force of gravity is not sufficient to disturb the stable sphere of stars called a GC.

There is no clear distinction between either a GC or a dwarf elliptical galaxy or a dwarf spheroidal galaxy other than width and star count. Individual stars are checked by their metallicity to draw conclusions about age and evolution. If metallicity is an unreliable technique then these conclusions are not reliable.

The metallicity could be a clue about GC evolution but no data for a conjecture.

22.2 Elliptical Galaxy

An elliptical galaxy is a large sphere of stars in a galaxy cluster with other galaxies. An elliptical galaxy has more stars than a GC. An explanation for its star count is conjecture. An elliptical galaxy will have a number of GC. An explanation for an elliptical galaxy creating a GC compared to creating more stars is conjecture.

Note: a separate comment about galaxy classifications.

If any galaxy exhibits rotation then it must be classified as a spiral galaxy of some sub-type. This is because a spiral galaxy rotates by the magnetic field generated by the birkelund currents to the Z-pinch at the core. If a galaxy exhibits no rotation then it should not be a spiral galaxy but instead an elliptical galaxy or a sphere of stars. Each sphere of stars has a plasmoid at its core. A sphere of stars has no disk requiring a mechanism for the disk rotation.

There are a number of elliptical galaxy sub-types like dwarf elliptical, or even dwarf spheroidal.

There are vague rules on metallicity distribution when distinguishing between a GC and any of the elliptical types. Metallicity is an unreliable indicator for a star so this method of classification can result in a classification which could change later for another basis, such as a determination of proper motion based on many observations over a long time. A GC is treated as having a certain orbital relation with a specific galaxy. A dwarf elliptical is susceptible to becoming a GC if its orbit is redefined from a loose orbit as just a satellite galaxy.

22.3 Giant Elliptical Galaxy

A giant elliptical galaxy dominates a large galaxy cluster having a variety of galaxy types. An explanation for the observed distribution of galaxy types in a large galaxy cluster is conjecture. With the observation of a giant elliptical in a cluster including mutiple spiral galaxy suggest a cluster have a development sequence of the giant elliptical first, then the surrounding galaxies of theit types and after these galaxies mature each will eject plasmoids which individually evolve into globular clusters.

In the largest galaxy clusters the central giant elliptical galaxy can exhibit a ring or arcs indicating a surrounding filament of electrical activity, possibly including stars. An explanation for this ring or arcs in this context is conjecture. Its observation suggests a behavior of a sphere of stars but it becomes visible with a very high star count in a galaxy cluster.

A conjecture is more stars results in a higher positive charge in the sphere and a sheath develops for the larger charge differential around the sphere of stars.

23 Conclusion

The observed behaviors of a sphere of stars are slightly explained, for the respective sphere types: globular cluster, elliptical galaxy, giant elliptical galaxy.

However there is simply not enough information to create a testable hypothesis so only a conjecture can be described.

Gaia probe data enabled new research into several of the Milky Way GC. Only recently has anything ventured beyond our Sun's domain with the two Voyager probes.

This paper with its conjectures is provided for consideration to begin a thorough explanation of a sphere of stars.