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Formation and Evolution of Stars and Galaxies in the Cosmic Environment

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Abstract: With the advancement of astronomical observation technology, people have a deeper understanding of the formation and evolution of galaxies, but many details of our own Milky Way and other external galaxies are still unknown. Therefore, by studying the formation and orbital transformation mechanism of satellites, planets and stars, the author puts forward a new theory on the formation and evolution of stars and galaxies, thus revealing the hierarchical structure of galaxies and the formation and evolution laws of main sequence stars, red giants, white dwarfs, black dwarfs, supernovae, neutron stars, black holes and quasars. Some special phenomena in the course of star formation and evolution, such as sunspots, flares, fast radio bursts and gamma-ray bursts, have also been revealed.

Key words: Sunspot, red giant, White Dwarf, supernova, neutron star, quasar, fast radio burst, gamma-ray burst.

1. Introduction

With the advancement of astronomical observation technology, people have a more profound understanding of the formation and evolution of galaxies. The observations not only reveal the morphology, structure and dynamics of galaxies, but also provide an important basis for further study of the origin and evolution of the universe [1]. However, many details about our own Milky Way and other external galaxies are still unknown. In this paper, a new theory on the formation and evolution of galaxies is proposed through the study of the formation and orbital transformation mechanism of satellites, planets and stars, which reveals the hierarchical structure of galaxies and the formation and evolution laws of main sequence stars, red giants, white dwarfs, black dwarfs, supernovae, neutron stars, black holes and quasars.

2. The Formation and Evolution of Planetary Systems

Just like the formation of the solar system [2], a star can produce several planets around it, and each planet can also produce zero or several satellites around it, therefore forming a planetary system, which is a hierarchical structure. But before the protostar derived its sub planets, the surface temperature of the protostar was very low, especially the temperature at the poles was often lower than the melting point of ice, so a large number of water molecules were adsorbed at the poles of the protostar, forming a thick ice sheet. The surface of the poles of the protostar is fractured under the long-term erosion of ice meltwater, producing cracks or caverns connecting the mantle. When a large amount of ice water seeps into the mantle and meets the hot magma, a huge explosion pressure will be produced, causing a violent volcanic eruption. In the course of some violent volcanic eruptions, some debris such as ash, volcanic bombs and pumice stones can obtain the first cosmic velocity to enter the orbit around the protostar, and condense into the satellite orbiting the protostar and spanning the poles. These satellites become planets when the protostar becomes a star. Thus, a star generally has several planets that span its poles, such as the sun’s Jupiter, Saturn, Uranus, and Neptune.

Because a star is so massive, it has a thick atmosphere around them. With the rapid rotation of the star, strong

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cyclones will be generated at the two poles and many regions of the star. These atmospheric vortices can absorb a large number of clouds and condense and compress these clouds in the process of sinking, but the original angular momentum of the star remains unchanged, which will gradually accelerate the rotation of the star and drive the revolution of the sub planets to accelerate, making the sub planet gradually move away from the parent star along a spiral line.

As the planet gradually moves away from the parent star, the gravitational attraction of the parent star to the planet gradually decreases, so that the rotation speed of the planet gradually increases. If the planet has a large mass, it has a thick atmosphere, and during the rapid rotation of the planet, the poles of the atmosphere will produce vortices. When a satellite that crosses the poles rotates around the parent planet, it will pull the cloud through the top of the planet's polar vortex, once this cloud is sucked into the planet's polar vortex, it will be compressed, thus making the planet smaller, but keeping the planet's angular momentum unchanged, which will make the planet spin faster, so that the satellite gradually away from the planet.

3. The Formation and Evolution of Stars

3.1 The Beginning of a Star—A New Star

The formation of a star generally goes through the process from a satellite to a planet and then to a star. After the proto-star evolved from a satellite of small size and mass into an earth-sized planet, it generated some satellites, but it still revolved around its parent star, unceasingly accreted the nebula materials near the orbits to become larger and larger, and gradually moved away from its parent star with the frequent collisions of prograding planetesimals or the accelerating rotation of its parent star due to contraction [3]. Afterwards it met a series of impacts from some other planets running into it from behind, making it become a Jupiter-sized planet much farther away from its parent [4]. Since the Jupiter-sized planet's mass is very huge, it can attract various gas molecules to form a dense atmosphere, and produce strong polar vortices during its rotation. Moreover, this kind of polar vortex can generate strong spiral currents, therefore form strong dipole magnetic fields, as is shown in Fig. 1, which is captured by NASA's (National Aeronautics and Space Administration) Hubble Space Telescope.

Although Jupiter's mass is large enough to attract hydrogen in the atmosphere, making the mass ratio of hydrogen in Jupiter reach 75%, which is comparable to the mass ratio of hydrogen in the sun, yet Jupiter lacks oxidants, therefore cannot burn directly. According to scientists' estimate, only one giant that has a mass 70 to 80 times that of Jupiter can it have enough gravity, pressure and temperature to cause fusion reaction between hydrogen elements. So the proto-star needs accreting enough interstellar material near its orbit to become a detonable star.

A series of strong polar vortices can be formed during the rapid rotation of the proto-star, as is shown in Fig. 2. This kind of vortex can continuously absorb hydrogen and other matter from the surrounding space to the proto-star, and they can also eject some material. Originally, the proto-star has at least two groups of vortices, located at the South pole and the North pole respectively, which can span troposphere and stratosphere. As plasma clouds swept in by a vortex of the proto-star sink faster and colder, after a long spiral path, at the bottom of the vortex, the velocity of the airflow is tens of times faster than that of scale *12 t*yphoon, so the cloud clusters have already condensed into ice, and the temperature in the vortex is much lower than that around it, hence from the distant place, the vortex looks like a small sunspot. But in fact, the central depth of the vortex can reach 200,000 km, and its diameter can reach tens of thousands of kilometers.

Since the clouds involved in a vortex are continuous and rotate downward rapidly in a spiral manner, a series of thick spiral cloud belts can be formed. In this kind of plasma cloud belts, the negative ions that get electrons

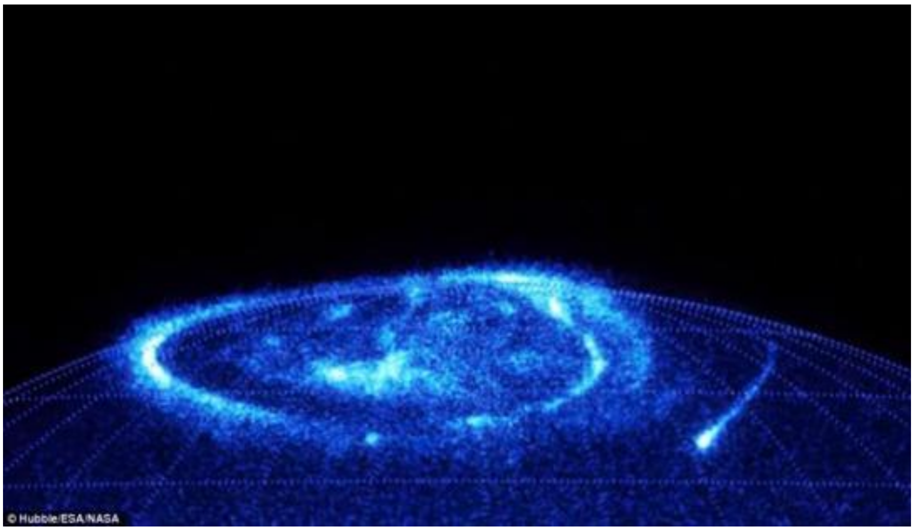

Fig. 1 The spiral current generated by Jupiter's arctic vortex.

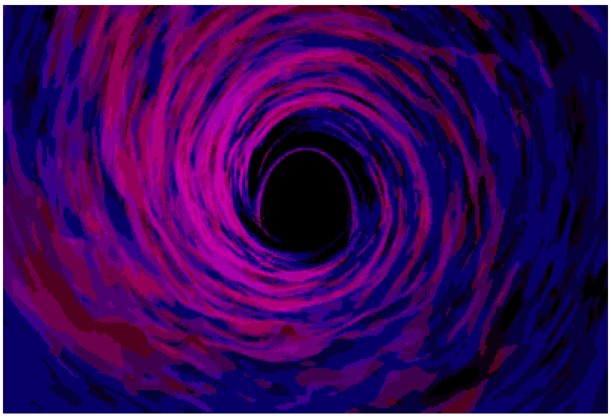

Fig. 2 Polar vortex on the proto-star.

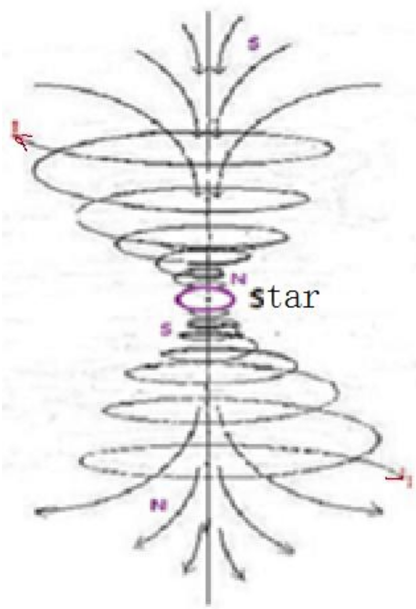

Fig. 3 Magnetic field of vortex.

are heavier than the positive ions that lose electrons, and then move down to the lower part of the cloud or even down to the bottom of the vortex along the spiral cloud belt. The lighter positive ions are gradually carried up to the upper part of the cloud or even up to the top of the vortex along the spiral cloud belt by the updraft, thus forming a current from the bottom of the vortex to the top of the vortex in the spiral cloud belt. In addition, since the clouds along a spiral cloud belt are numerous and revolve rapidly, it is easy to have violent frictions and collisions among clouds, producing frequent electrical discharge or thunderstorms. Each electrical discharge or thunderstorm acts as an electrostatic motor, which can send currents to the upper portion or the lower portion of the vortex. Since a current from the bottom of the vortex to the top of the vortex has been formed in the spiral cloud belt, the dominant current in the spiral cloud belt is a current from the bottom of the vortex to the top of the vortex. Because this current flows continuously from the bottom of the vortex to the top of the vortex along the spiral cloud belt, thus forming a powerful dipole magnetic field, as is shown in Fig. 3.

In addition, since the coverage of a polar vortex on the proto-star is huge, the clouds involved in a polar vortex are numerous and revolve rapidly, when they get to the bottom of the vortex, it is easy to have violent

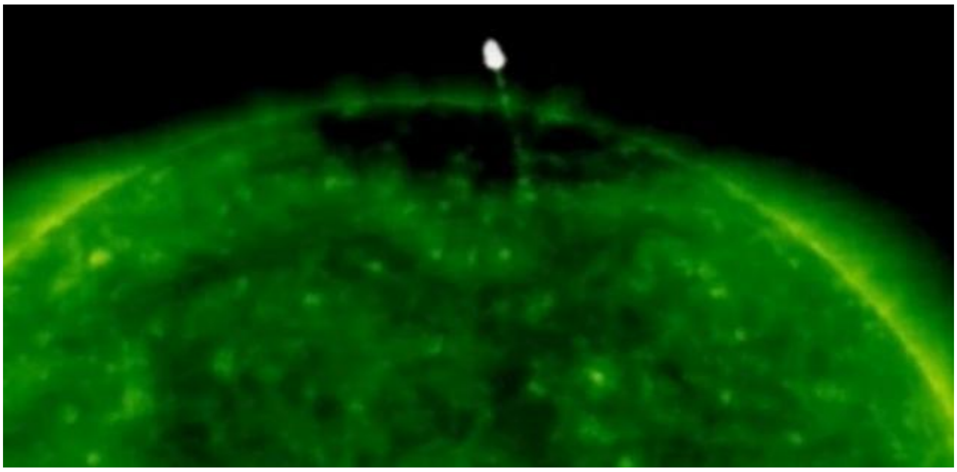

Fig. 4 An earth-sized object flew out of a sunspot region.

frictions and collisions among clouds, and constantly generate violent lightning and release huge electric energy, making the temperature of the surrounding air rise rapidly to tens of thousands of degrees and the atmospheric pressure also rise to more than 1 MPa, so the gaseous hydrogen in the vortex changes into liquid metal hydrogen. This kind of liquid metal hydrogen is gradually cooled as it sinks rapidly along the spiral path. At the bottom of the vortex, the clouds condense into huge metallic hydrogen crystals, and some crystals are even larger than one Earth. For example, famous astronomer Nassim Halamin recently found from an image of SOHO that a white earth-sized object flew out of a sunspot region in the Sun's arctic area, as is shown in Fig. 4.

It is known that the internal temperature of Jupiter is about 30,000 degrees and the internal pressure is about 40 million atmospheres. While the size and mass of the brown dwarf star that will become a star are almost equal to those of the sun, so its volume and mass are more than 1,000 times those of Jupiter. Therefore, the internal temperature of this brown dwarf should be 30 million (> 15 million) degrees, and the internal pressure should be more than 40 billion atmospheres. When the earth-sized metal hydrogen crystal hits the brown dwarf star, the explosion power of metal hydrogen is 50 times that of TNT (Trinitrotoluene) explosive, which can increase the pressure nearby by dozens of times, exceeding 300 billion atmospheres. Hence, it can ignite the thermonuclear reaction of hydrogen to helium in the sunspot and cause a series of thermonuclear reactions beside the sunspot:

$$ {}_{1}^{2}H + {}_{1}^{3}H \rightarrow {}_{2}^{4}He + {}_{0}^{1}n \text{ +17.6Mev} $$

Once a thermonuclear reaction is ignited, a large amount of energy is released in a short time, causing instantaneous heating in local area, generating all kinds of electromagnetic radiation, even many bright spots with rapid enhancement suddenly appearing next to the sunspot, which is the so-called solar flare. Because flares represent the eruption of solar thermonuclear reactions, there are violent explosions, which may change the structure of the sunspot or make it shrink or decay.

In general, the formation and disappearance of a sunspot can only take a few days to a few months, and it can only attract a limited range of hydrogen gas, the hydrogen beyond this scope cannot be processed. So if there is no fast orbiting planet near the star pulling nebular material to fuel the fading sunspot cyclones or no successor sunspot cyclones to take over, thermonuclear reactions on the star will stop. Fortunately, stars usually have multiple planets (such as Mercury, Venus, Earth, etc.) close to the star and orbiting at high speeds to pull nebular material to add thermonuclear fuel to these fading sunspot cyclones, so that the thermonuclear reactions in these sunspot cyclones can continue. In addition, giant planets such as Jupiter have a greater force on the solar polar cyclones, and when it is close to the polar sunspot cyclones, it can tilt, stretch, shear or break the polar sunspot cyclones through the action of gravity, and even drag out some of the sub cyclones, spreading them on the Sun's surface. When a sub cyclone has absorbed enough airflow to become a long, large, heat-resistant cyclone, it falls from the upper to the lower level, becoming a mature and strong sunspot, continuing the thermonuclear reaction of the preceding sunspot.

Table 1 shows the ratio of the gravitation of the major planets of the solar system on the objects on the surface of the sun as well as the revolution periods of these planets. It can be seen that Jupiter has the strongest gravitation on objects on the surface of the sun, while other planets have a much smaller gravitational pull on objects on the surface of the Sun.

In fact, we can even more clearly compare the effects of Jupiter and other planets on sunspots. We know that Jupiter's perihelion distance is $R_{\mathrm{n}} = 7.4052\times10^{8}\,km$, Jupiter's aphelion distance is $R_{\mathrm{f}} = 8.1662\times10^{8}\,km$, and Jupiter has a mass $M_{\mathrm{J}}=1.900\times10^{27}\,kg$, therefore Jupiter at perihelion has a gravitational pull on an object of mass m on the Sun as $F_n=\mathrm{G}\dfrac{M_J m}{R_n^2}$, and Jupiter at aphelion has a gravitational pull on an object of mass m on the Sun as $F_f=\mathrm{G}\dfrac{M_J m}{R_f^2}$.

Assume that Mercury has a mass of M_{w} ($M_{\mathrm{w}}=3.3022\times10^{23}\,kg$), Mercury's distance from the Sun is R_{w} ($=57910000\,km$), and Mercury's gravitational pull on an object of mass m on the Sun is F_{w}, then $F_{\mathrm{w}} = \mathrm{G}\dfrac{M_{\mathrm{w}} m}{R_{\mathrm{w}}^2}$, therefore:

$$\frac{F_{\mathrm{n}}}{F_{\mathrm{w}}} = \frac{M_{\mathrm{J}}}{M_{\mathrm{w}}}\cdot\frac{R_{\mathrm{w}}^2}{R_{\mathrm{n}}^2} \approx 35.19, \qquad \frac{F_{\mathrm{f}}}{F_{\mathrm{w}}} = \frac{M_{\mathrm{J}}}{M_{\mathrm{w}}}\cdot\frac{R_{\mathrm{w}}^2}{R_{\mathrm{f}}^2} \approx 28.93$$

It can be seen that whether Jupiter is at perihelion or aphelion, it exerts a greater force on any object on the Sun (including polar cyclones) than other planets orbiting the Sun exert on that object, so Jupiter is the main planet that attracts solar polar cyclones and produces sunspots. This is true because sunspots have an activity cycle of about 11 years, which is about the same as Jupiter's orbital period around the sun. More detailed observations show that in each sunspot cycle, the number of spots starts in the year with the lowest number, increases in the following three to five years, reaches a peak, and then decreases to a minimum in the following five to seven years. It can be seen that when Jupiter is at perihelion, the most sunspots are generated, while at aphelion, the least sunspots are generated, and almost no sunspots are generated. Because planets other than Jupiter exert much less force on the solar polar cyclones than Jupiter at aphelion does on the solar polar cyclones, these planets cannot extract sunspots from the polar cyclones.

Table 1 The ratio of the gravitation of the major planets of the solar system on the objects on the surface of the sun as well as the revolution periods of these planets.

Planet	Mass	Average distance from the sun	Ratio of planet's gravitation relative to Mercury's gravitation	Revolution periods (Solar rotation period = 25.05 d)
Mercury	3.3022×10^{23}kg	57,909,050 km	1	87.9691 d
Venus	4.8690×10^{24} kg	108,209,184 km	0.42228	224.7 d
Earth	5.9650×10^{24} kg	149,597,888 km	2.70684	365.24 d
Mars	6.4219×10^{23}kg	227,925,000 km	0.12554	686.980 d
Jupiter	1.9000×10^{27} kg	778,547,050 km	31.8327	11.8618 years
Saturn	5.6834×10^{26} kg	1,429,400,000 km	2.850523	29.5 years
Uranus	8.6810×10^{25} kg	2,871,000,000 km	0.169529	84 years
Neptune	1.024×10^{26} kg	4,504,000,000 km	0.512647	164.8 years

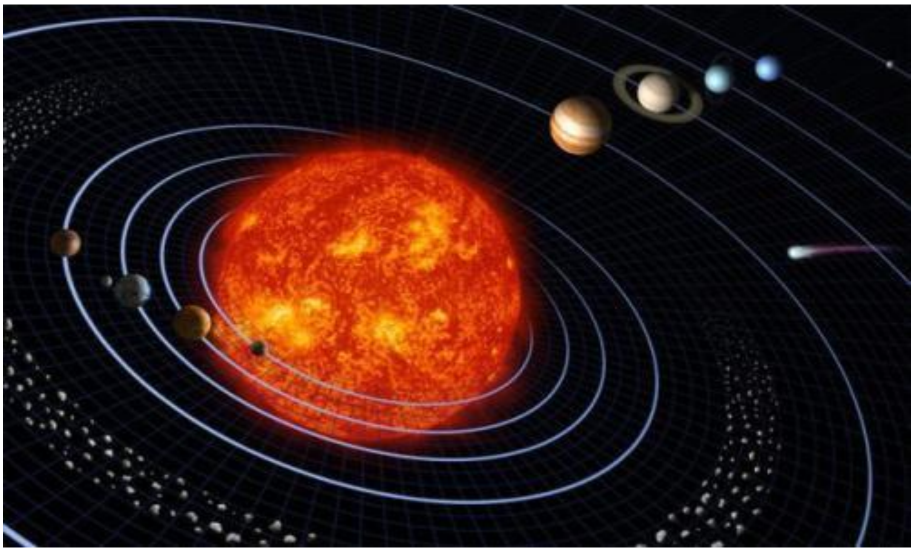

Fig. 5 Orbits of the eight planets in the solar system.

It can be seen that it is Jupiter that brings out the sunspots all over the Sun from the solar polar vortex. Then, Mercury, Venus and Earth, which are close to the Sun and orbit at a fast speed, pull nebulae material to the sunspot cyclones near the orbit, adding fuel to the thermonuclear reaction in the sunspot cyclones, so that the thermonuclear reaction in the sunspot cyclones can continue, as shown in Fig. 5. This is the main sequence phase of a star, which lasts a long time.

3.2 Middle Aged Star—Red Giant

In the process of a star rotating around the center of its galaxy, it continuously absorbs the gas, dust and other interstellar materials near its orbit by virtue of the cyclones on it. These trapped materials are difficult to escape from the dense atmosphere of the star. Therefore, after long-term evolution, the mass of stars increases greatly, even several times the mass of the sun.

Although the galactic structure is stable for a long time, collisions between galaxies occur from time to time on the astronomical time scale. For example, according to the general laws of planetary systems described in Section 2, as the Earth's rotation gradually accelerates, its satellite, the moon, gradually moves away from the Earth and its mass gradually increases. But Venus and Mercury are closer to the sun, and they are in a hot environment for a long time, and their mass does not increase. When the orbit of the moon intersects the orbit of Venus, the mass of the moon may exceed the mass of Venus, and when the moon collides with Venus, it will cause Venus to fall to the sun, as shown in Fig. 6. Similarly, as Jupiter's rotation rate increases, Jupiter's moons gradually move away from Jupiter and their mass increases, and the orbits of Jupiter's moons may intersect the orbits of Mars, Earth, or Mercury, causing Mars, Earth, or even Mercury to be shot down into the Sun. Especially, when a Jupiter satellite reaches the orbit of Mercury, because the orbit of Mercury around the sun is petal shaped, as shown in Fig. 7, the satellite is likely to collide with Mercury, and the collision is enough to knock Mercury down to the Sun and finally be swallowed by the fierce fire of the sun. After the star engulfs some inner planets, the stellar mass increases significantly, the stellar atmosphere also thickens greatly, the internal temperature of the star rises greatly, and releases huge energy, which makes the star tend to expand. After a star such as the Sun swallowed its inner planets, there are no inner planets to fuel sunspot cyclones, so the star cannot absorb enough hydrogen to sustain the hydrogen polymerization reaction inside the star, breaking the balance between the radiation pressure of nuclear fusion and its own shrinking gravity. Therefore, the internal helium nucleus shrinks and becomes hot, and the hydrogen

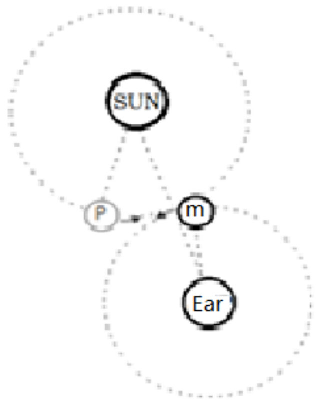

Fig. 6 The moon collides with planet P in the solar system.

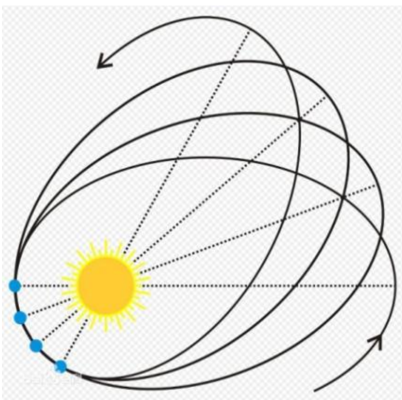

Fig. 7 Mercury's petal orbit around the sun.

shell expands and cools outward. With the contraction of the internal helium nucleus, the rotation of the internal helium nucleus accelerates, and the hydrogen shell drifts outward under the action of centrifugal force, which makes the star expand rapidly into a red giant [5]. This process may last hundreds of thousands of years. The final result of helium fusion is the formation of a white dwarf in the center.

3.3 Late Star—White Dwarf

After the red giant burns the innermost planet, because there is no major inner planet to fuel the sunspot cyclones, the star cannot absorb enough hydrogen to maintain the hydrogen fusion reaction inside the star, and its internal temperature gradually decreases, which will break the balance between nuclear fusion radiation pressure and its own contraction gravity. As a result, the internal helium core shrinks and heats up, and the final core temperature will exceed 100 million degrees, so helium fusion begins again. However, when the helium core burns out, the central gravity of the star cannot be balanced by the radiation pressure generated by the hydrogen fusion or helium fusion, and the interior of the star shrinks. The contraction does not stop until the central gravity of the star is balanced by the electron degenerate pressure in the star center, forming a white dwarf [6], as shown in Fig. 8.

The reason for the formation of the White Dwarf is that the White Dwarf also has a giant planet like Jupiter, which can drag out some sub cyclones from the polar cyclone of the White Dwarf through the effect of gravity, and spread them throughout the White Dwarf, but because there is no fast inner planet to add fuel to these sub cyclones, they lose the ability to emit strong light, making the White Dwarf dim. If the White Dwarf engulfed such a giant planet as Jupiter again, as shown in Fig. 9, it would not be able to scatter sub cyclones on the White Dwarf and would turn the White Dwarf into a black dwarf. When the cyclones at both ends of the rotation axis of the White Dwarf are not facing the earth, people can hardly see the light emitted by the White Dwarf. At this time, people mistakenly think that it is a black dwarf without light. However, because the contracted star still rotates continuously, and the cyclones at both ends of the rotation axis will certainly emit light, there is no black dwarf that absolutely does not emit light.

Fig. 8 A white dwarf.

Fig. 9 Astronomers have discovered a White Dwarf star stripping away the atmosphere of a gas giant four times its size.

Fig. 10 Gamma-ray burst SN 2014J produced by a supernova explosion.

3.4 Rise from Dead—Supernova

Because black dwarfs are stars that contract after the main sequence star has swallowed up planets that can fuel sunspot cyclones, their size is greatly reduced, their rotation speed is greatly accelerated, and there are few cyclones with active flashes outside the poles of the star, and even if there are sporadic cyclones scattered outside the poles, they will lose their luminous ability because there is no inner planet to fuel them. However, black dwarfs still have some exoplanets, such as Saturn, which are massive and have a series of moons orbiting them. With the rotation of these child planets, the rotation radius of their satellites will gradually increase. When a satellite gets close to the black dwarf, it will be attracted by the black dwarf and fall to the black dwarf. Violent collision with the black dwarf will produce intense gamma-ray bursts, release huge energy and shine bright light. A very faint or invisible star suddenly becomes an exceptionally bright supernova [7], as shown in Fig. 10. A supernova explosion sends some of the surface material of stars and moons flying off at high speeds, creating a single-direction jet that then melts and contracts the star's surface layer into a thin onion layer. As the fallen satellite is burned up, the "supernova" will gradually dim, and eventually quietly leave, and it takes a long time or even tens of thousands of years for another satellite to hit the black dwarf to produce a supernova explosion, so people mistakenly think that the supernova explosion is a brilliant "tribute" to the dying star. In fact, people have been curious about gamma-ray bursts since the discovery of the first one in 1967, and later experts using advanced observational techniques to observe the stars in which gamma-ray bursts occur, found that these stars become black holes after the occurrence of gamma-ray bursts, which is a misconception. Because the stars that have gamma-ray bursts have powerful polar cyclones, they were not noticed until after the gamma-ray bursts occurred, and then they were observed. When a polar cyclone is exposed to the human eye, people think that the star becomes a black hole, so the black hole observed from the star of the gamma-ray burst is actually the polar cyclone of the star.

3.5 Later Stages of Stellar Evolution—Neutron Stars

After a main sequence star evolves into a black dwarf, its mass increases significantly compared to the mass of the main sequence star, its atmosphere also thickens significantly, but its volume is greatly reduced, even smaller than the Moon, so its rotation speed is greatly accelerated, and the polar cyclones are greatly enhanced. It grows larger by constantly accreting nebular material near its orbit and satellites or planets in sub-galaxies that enter its gravitational horizon.

In fact, black dwarfs, with their powerful polar cyclones, from time to time absorb the clouds pulled by their sub galaxies, and these clouds can be compressed into huge metallic hydrogen crystals at the bottom of the cyclone. When this huge metallic hydrogen crystal violently hits the surface of the star, it will not only directly produce huge pressure on the surface of the star, but also violent explosions will occur, adding more pressure. It even causes thermonuclear reactions that lead the star to collapse, resulting in huge changes in the material structure of the star. In this case, not only the outer shell of the atom is crushed, but also the nucleus of the atom is crushed, and the protons and neutrons in the nucleus are forced out, and the protons and electrons are pushed together and combined to form neutrons. Eventually, all the neutrons are squeezed together to form a neutron star [8]. In addition, satellites or planets that enter the gravitational horizon of the black dwarf will also fall to the black dwarf, colliding violently with the black dwarf, causing the black dwarf to collapse, resulting in a huge change in the material structure of the black dwarf, and eventually forming a neutron star.

When the star shrinks into a neutron star, its size is greatly reduced and its rotation is greatly accelerated, which greatly enhances the dipole magnetic field generated by the cyclone at the poles of the neutron star, making people think that the neutron star is a very strong magnet. Neutron stars emit electromagnetic waves through the polar cyclones, but under the gravitational action of the outer planets of the neutron star and their child galaxies, the polar cyclones of the star will deviate from the star's spin axis and rotate along an elliptical trajectory during the star's rotation. Therefore, when a cyclone that emits electromagnetic waves is facing the Earth, the Earth people can receive electromagnetic waves; When the polar vortex of the star deviates from the Earth, the Earth does not receive electromagnetic waves. Therefore, the electromagnetic wave received by the Earth is intermittent, and the "lighthouse effect" appears, as shown in Fig. 11.

Due to the rapid rotation of neutron stars, their polar cyclones can generate strong dipole magnetic fields that are opposite in direction. When two neutron stars orbiting each other are close together, their magnetic fields close to each other are in opposite directions and are so attractive that even people on Earth can detect the enormous gravity or gravitational waves of the two merging neutron stars.

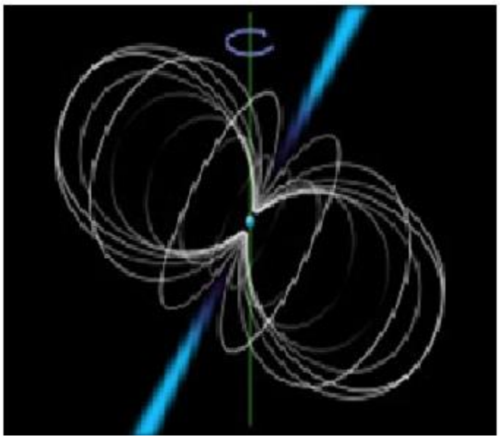

Fig. 11 A neutron star and its dipole magnetic field.

In addition, as the neutron star spins rapidly, its sub galaxies are also constantly rotating around the neutron star, and when the giant cloud pulled by the sub galaxy comes close to the polar cyclone, it is sucked into the powerful polar cyclone, and when the cloud reaches the bottom of the cyclone, it is compressed into huge metallic hydrogen crystals. And when these giant metallic hydrogen crystals slam into the neutron star's surface, they explode violently, ejecting the helical circuits that produce electromagnetic waves and forming violent fast radio bursts, as shown in Fig. 12.

3.6 The End Point of Stellar Evolution—Black Hole

During the evolution of a neutron star into a more massive giant, its polar cyclones continuously accret nebular material near its orbit and the satellites or planets in its sub galaxies that enter its gravitational horizon, increasing its mass and thickening its surface. In particular, as the neutron star spins, its child galaxy also spins around the neutron star, and when the child galaxy pulls a cloud past the neutron star's polar cyclone, the polar cyclone absorbs the clouds pulled by the sub galaxies, and when these clouds get to the bottom of the cyclone, they can be compressed into giant metallic hydrogen crystals, and when these giant

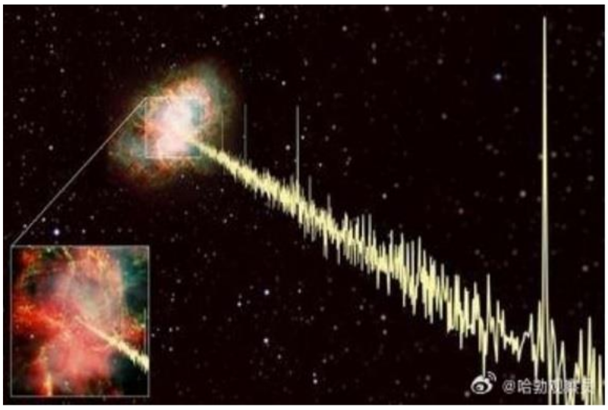

Fig. 12 Fast radio bursts erupting from neutron stars.

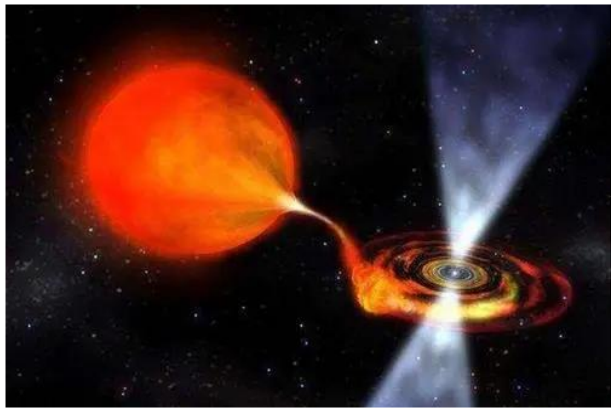

Fig. 13 A neutron star devours stars to become a black hole.

metallic hydrogen crystals slam into the star’s surface, not only will it directly produce a huge pressure on the surface of the star, but also a violent explosion will occur, add more pressure, and even cause thermonuclear reaction, so that the neutron star further collapse, resulting in the transformation of the atomic structure on the surface of the neutron star into a neutron structure or a denser structure, and the mass of the neutron star will become larger.

In addition, during the expansion and movement of galaxies, collisions between galaxies occur from time to time. For example, on June 12, 2020, the American Astronomical Society reported that an international team of astronomers had observed the explosion process of a neutron star engulfing a star. The neutron star (No. “Sax j1808.4-3658”) continuously sucked away the material of a nearby star by virtue of its strong attraction. When the material plunder reached a certain degree, the star was drawn into the polar cyclones of the neutron star and eventually exploded. When the mass of a neutron star exceeds three times the mass of the sun, a black hole is formed [9], as is shown in Fig. 13.

Due to the great mass and strong gravity of the black hole, when a luminous celestial body enters its gravitational horizon, many gaseous, liquid and solid substances of the celestial body will be immediately absorbed by the black hole, so that the resources of the celestial body are insufficient to maintain its luminous effect and extinguish the light, which is the reason why “light can not escape the black hole”.

3.7 Black Holes Evolve into Quasars

Because black holes are the product of stellar evolution in the galaxy structure, the galaxy structure is never resting, always in constant motion and change. As the structure of the galaxy rotates, the black hole also continuously accrets nebulae material around its orbit and satellites, planets, or stars in sub-galaxies that enter the black hole’s event horizon, thus becoming larger and larger. For example, on June 22, 2016, scientists observed a supermassive black hole eating a star, and then NASA released a composite image of the black hole eating the star in detail, as shown in Fig. 14.

Although the evolution of galaxies in the universe is a slow and gradual process, scientific statistics show that the probability of black hole swallowing stars is very low, and will happen once in about 100,000 years per galaxy, but over the long course of galactic evolution in the universe, a black hole that can swallow a star or even a sub-galaxy will eventually become a massive quasar [10]. For example, on March 3, 2015, a research team led by Chinese astronomer Professor Wu Xuebing discovered a super-bright quasar 12.8 billion light-years from Earth, 430 trillion times the luminosity of the sun, and a central black hole with a mass of about 12 billion solar masses. It is the brightest quasar with the most massive central black hole in the distant universe ever observed. Inspired by Professor Wu Xuebing’s scientific wisdom, we have developed this theory of the formation and evolution of stars and galaxies.

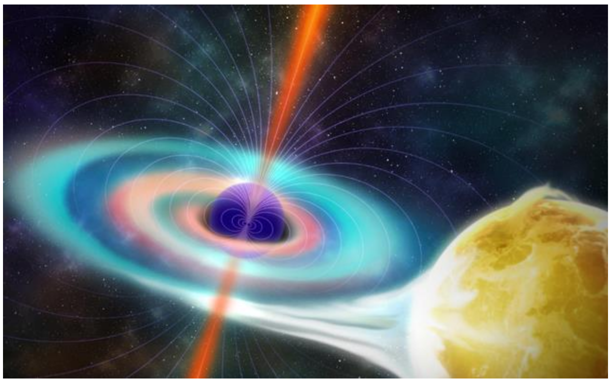

Fig. 14 The process of a black hole swallowing a star.

3.8 Energy Sources and Fuel Supply Mechanisms of Quasars

Because quasars are the result of long-term evolution of galaxies in the universe, it is an active galactic nucleus evolved from stars through multiple stages such as red giant, white dwarf, neutron star, black hole, and supermassive black hole, so there is a rapidly rotating supermassive black hole in the active galactic nucleus. Under the strong gravitational pull of the supermassive black hole, as the black hole rapidly rotates, hydrogen gas, dust, and other interstellar material in the surrounding space form two powerful atmospheric vortices at the black hole's poles, which can reach a height of several light years, and when a polar cyclone faces the Earth observer, it presents a huge accretion disk. The accretion disk can become entangled in a large number of clouds, which are gradually compressed as they sink, becoming thicker and more massive.

After a long spiral path, these clouds are prone to violent friction and collision, frequently producing strong lightning, the surrounding air temperature quickly rises to tens of thousands of degrees, and the atmospheric pressure also rises to more than one million atmospheres, so that much of the gaseous hydrogen in the vortex is transformed into liquid metallic hydrogen. This mixture of liquid metallic hydrogen and liquid hydrogen gradually cools as it descends rapidly down the spiral path and condenses into a series of huge crystals containing both solid metallic hydrogen and solid hydrogen at the bottom of the vortex. Since a quasar 10 billion light-years from Earth can have a mass of more than 1,000 times the total mass of the Milky Way, its central black hole can attract an extremely dense nebula, and its interior can reach the temperature and pressure of a star's thermonuclear reaction (15 million degrees and more than 300 billion atmospheres). When giant metallic hydrogen crystals collide in a black hole cyclone, they immediately ignite a thermonuclear reaction where hydrogen is fused into helium:

$$^{2}_{1}H + ^{3}_{1}H \rightarrow ^{4}_{2}He + ^{1}_{0}n \ \mathbf{+17.6Mev}$$

When thermonuclear reaction occurs, a large amount of energy is released in a short period of time, causing a violent explosion of metallic hydrogen, producing strong electromagnetic radiation, and the emission energy of quasars can reach thousands of times more than that of ordinary galaxies.

Because there is a limit to how much hydrogen an active galactic nucleus can attract, hydrogen beyond its gravitational range cannot be sucked into the cyclone, and if the cyclone does not have enough fuel, its thermonuclear reaction will stop. Fortunately, the active galactic nucleus has rapidly rotating sub galaxies, which are even larger than the Milky Way. They not only rotate rapidly around the active galactic nucleus, but also rotate rapidly around their own center, so the sub galaxies can bring hydrogen and other nebulae from the vast universe to the gravitational range of the active galactic nucleus, providing a constant supply of fuel for the active galactic nucleus, as shown in Fig. 15, thus allowing the thermonuclear reaction of the galactic nucleus to continue. But when the central black hole of a sub galaxy is close to its parent star, the active galactic nucleus' gravity can tilt, stretch, shear, or rupture the polar cyclone, causing the quasar's brightness to change dramatically in a few days or even less.

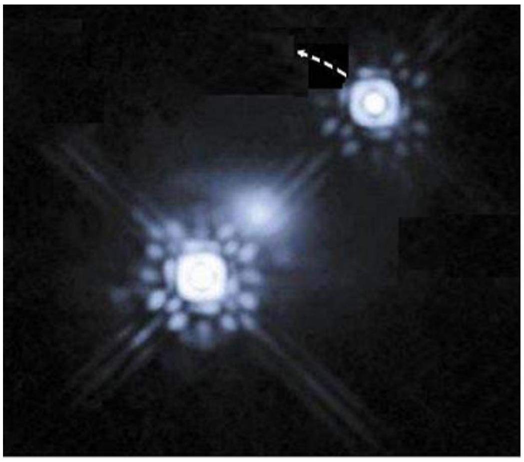

Fig. 15 The nucleus of the galaxy shines as it absorbs the fuel brought by its sub galaxy.

4. Summary

Because galaxies are huge structures made up of stars, planets, moons, gas, dust, and dark matter, understanding what galaxies are made of and the energy that underpins them is crucial. In the past, people simply thought that galaxies were composed of stars and gas and dust embedded in the nebula, and the formation and operation of galaxies were vague. Even with advances in astronomical observation techniques, many details of the universe's galaxies remain unclear. Therefore, through the study of the formation and evolution mechanisms of satellites, planets and stars, the author has thoroughly revealed the hierarchical structure of galaxies, particularly clarifying the dark matter and dark energy that make up the universe's galaxies, thus bringing to light the structure of the universe's galaxies, main sequence stars, red giants, white dwarfs, black dwarfs, supernovae, neutron stars, black holes, quasars, sunspots, flares, fast radio bursts, gamma-ray bursts, etc.

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