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The Formation and Evolution Law of Stars and Quasars

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Abstract: With the continuous deepening of astronomical observation and research, people have gained a deeper understanding of the formation and evolution of stars and quasars, but they still have only a superficial knowledge about star and quasar formation and evolution law. Thus, through the study of the formation and orbit change mechanisms of satellites, planets and stars, the author has proposed a new theory about the formation and evolution of stars and quasars, thereby revealing the general law of star and quasar formation and evolution.

Keywords: sunspot, red giant, white dwarf, supernova, neutron star, black hole, quasar, fast radio burst, gamma-ray burst.

1. Introduction

The formation and evolution of stars are core issues in astrophysics. The birth, growth, aging and movement of stars have aroused the thoughts of many renowned scientists. For instance, when Galileo was observing stars and planets, he discovered Jupiter's four largest moons, sunspots, the rotation of the Sun, details on the surface of the Moon, and countless stars in the Milky Way. Einstein also studied the movement of stars and the magnetic force mechanism of the geomagnetic field. Although he did not solve the problem of the origin of the geomagnetic field, he attached great importance to it. He believed that if someone could solve the problem of the origin of the geomagnetic field, then this person might also be able to solve the problem of the formation and evolution of stars. Although with the continuous deepening of astronomical observation and research, people have gained a deeper understanding of the formation and evolution of stars, the laws governing the formation and evolution of stars remain unresolved. Thus, through the study of the formation and evolution processes of satellites, planets and stars, the author solved the problem of the origin of the geomagnetic field and the cause of the formation of magnetic declination [1], and proposed a new theory about the formation and evolution of stars. This thus reveals the general laws of star formation and evolution, as well as the mechanisms of formation and evolution of main sequence stars, red giants, white dwarfs, black dwarfs, supernovae, neutron stars, black holes and quasars.

2. The Formation and Evolution Process of Stars

2.1 Prime Stars — Main Sequence Stars

The formation of a star generally undergoes an evolution process from a satellite to a planet and then to a star [2]. After a proto-star evolved from a very small satellite in both volume and mass into an earth-sized planet, it produced some of its moons, but it still revolved around its parent star, unceasingly accretion the nebula materials near the orbits to become larger and larger, and gradually moved away from its parent star with the frequent collisions of planetesimals or the accelerating rotation of its parent star due to contraction. 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 [3]. Due to the large mass of this kind of giant, it can attract various gas molecules, forming a thick atmosphere. During its rotation, it generates powerful polar vortices and can form strong spiral currents, thereby generating a

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powerful dipole magnetic field, as shown in Fig. 1.

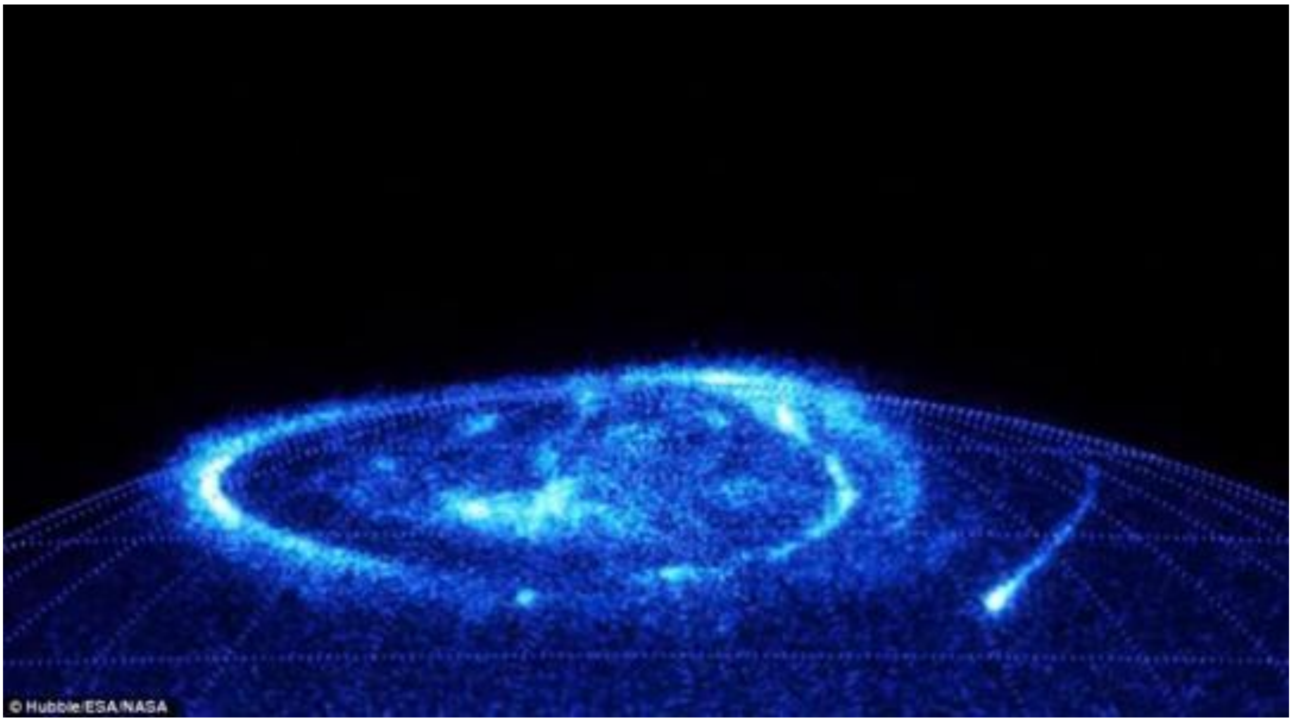

Fig. 1 The spiral current generated by Jupiter's arctic vortex.

Due to Jupiter's large mass, it can attract a large amount of hydrogen, making the mass ratio of hydrogen in Jupiter reach 75%, which is close to the mass ratio of hydrogen in the Sun. However, Jupiter lacks oxidants and cannot be directly burned. Only when the mass of a giant star reaches 70 to 80 times that of Jupiter, that is, more than 7 to 8% of the mass of the Sun, does it have sufficient gravitational force, pressure and temperature to cause hydrogen elements to undergo polymerization reactions and form a star. In fact, the protostar gradually increase their mass by constantly accreting interstellar matter near their orbits, and eventually evolve into a star.

During the rapid rotation of a protostar, powerful polar vortices can form at the poles, as shown in Fig. 2. This polar vortex can constantly absorb hydrogen and other nebular matter in the surrounding space. In addition, the central depth of such polar vortices can reach over 100,000 kilometers, and their diameters can range from several thousand to tens of thousands of kilometers. As the cloud mass drawn into the

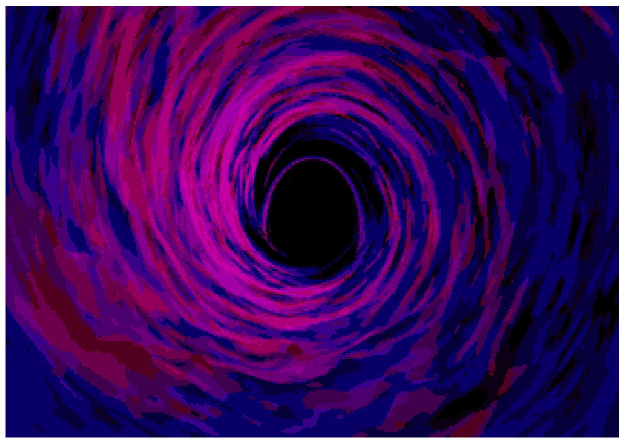

Fig. 2 Polar vortex on the proto-sar.

protostellar polar vortex descends along a long spiral path, it becomes faster and colder during the descent. By the time it reaches the bottom of the vortex, the air flow speed is dozens of times faster than that of a 12-level typhoon on Earth. The cloud mass has long frozen into ice, so the temperature in the protostellar polar vortex is much lower than that in the surrounding area. After a protostar evolves into a glowing and heating star, this atmospheric vortex looks like a tiny sunspot from a distance.

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. In addition, the central depth of such polar vortices can reach over 100,000 kilometers, and their diameters can range from several thousand to tens of thousands of kilometers. 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 typhoon, 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.

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 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, and also forming a powerful dipole magnetic field, as is shown in Fig. 3.

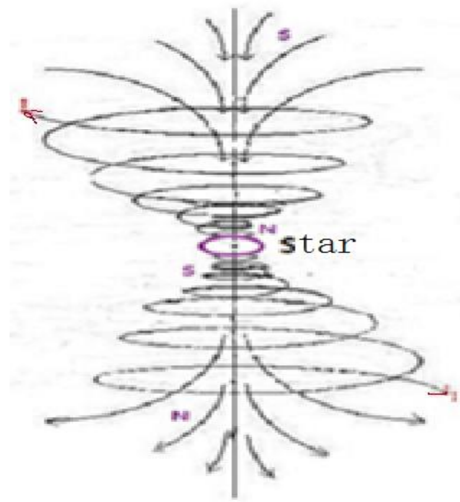

Fig. 3 **Magnetic field of vortex.**

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 frictions and collisions among clouds, and constantly generating violent lightning and releasing 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 are gradually cooled as they sink rapidly along the spiral path. At the bottom of the vortex, the clouds condense into huge metallic hydrogen crystals, 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 30000 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 1000 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 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:

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

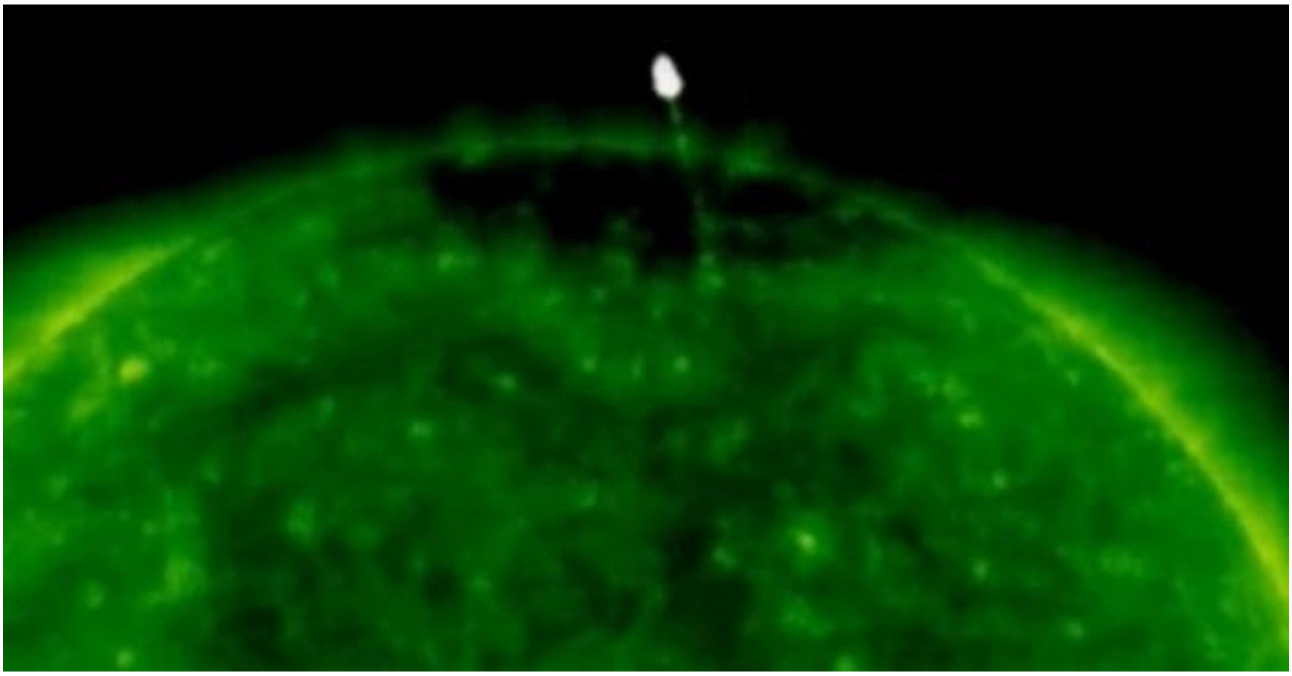

Fig. 4 An earth-sized object flew out of a sunspot region.

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.

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	57909050 km	1	87.9691 d
Venus	4.8690×10^{24} kg	108209184 km	0.42228	224.7 d
Earth	5.9650×10^{24} kg	149597888 km	2.70684	365.24 d
Mars	6.4219×10^{23} kg	227925000 km	0.12554	686.980 d
Jupiter	1.9000×10^{27} kg	778547050 km	31.8327	11.8618 yr
Saturn	5.6834×10^{26} kg	1429400000 km	2.850523	29.5yr
Uranus	8.6810×10^{25} kg	2871000000 km	0.169529	84 yr
Neptune	1.024×10^{26} kg	4504000000 km	0.512647	164.8 yr

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_n = 7.4052×10^8 km, Jupiter's aphelion distance is R_f = 8.1662×10^8 km, and Jupiter has a mass M_J = 1.900×10^{27} kg, therefore Jupiter at perihelion has a gravitational pull on an object of mass m on the Sun as $F_n = G\frac{M_J m}{R_n^2}$, and Jupiter at aphelion has a gravitational pull on an object of mass m on the Sun as $F_f = G\frac{M_J m}{R_f^2}$.

Assume that Mercury has a mass of M_w (M_w = 3.3022×10^{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 $F_w = G\frac{M_w m}{R_w^2}$, therefore

$$\frac{F_n}{F_w} = \frac{M_J}{M_w} \bullet \frac{R_w^2}{R_n^2} \approx 35.19, \frac{F_f}{F_w} = \frac{M_J}{M_w} \bullet \frac{R_w^2}{R_f^2} \approx 28.93$$

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.

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.

2.2 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.

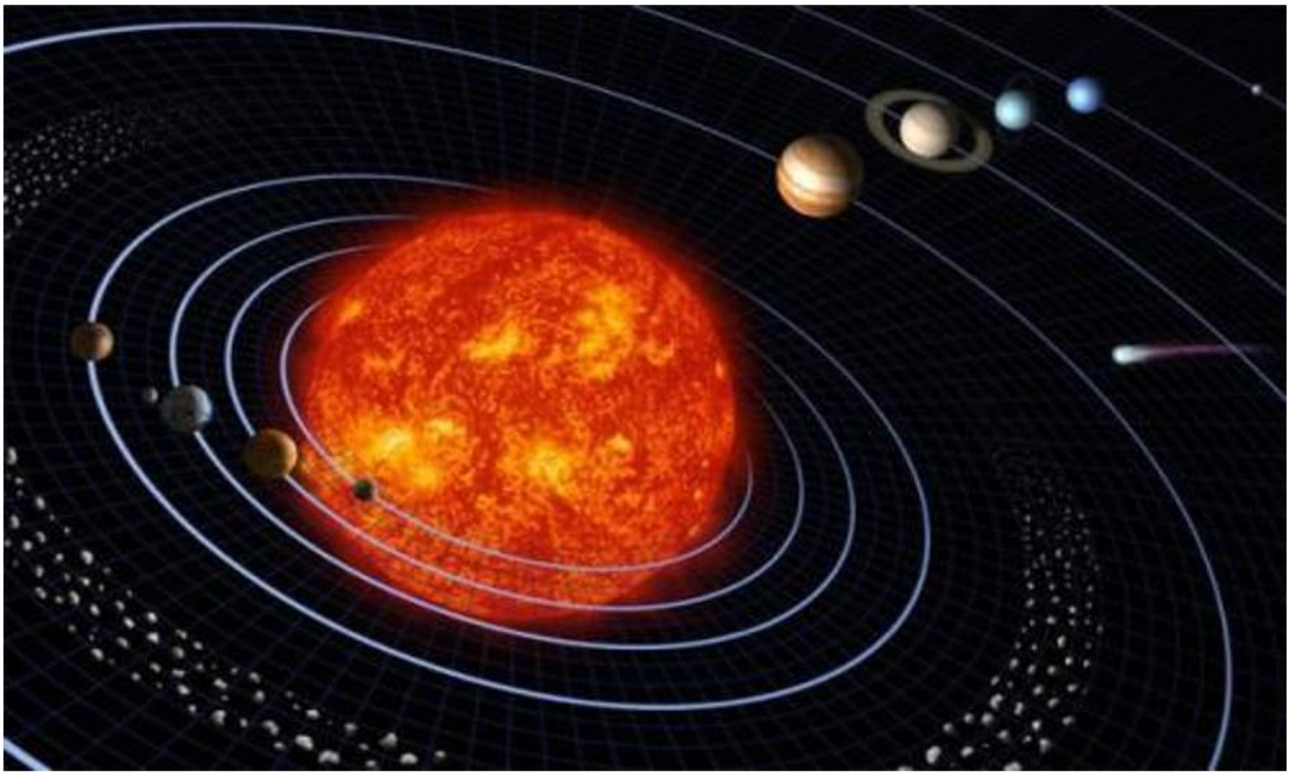

Fig. 5 Orbits of the eight planets in the solar system.

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 movement 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. Additionally, according to observational and computational data, the Moon is moving away from the Earth at a speed of 3.8 cm per year, while the average distance between the Moon and Venus is 38 million kilometers, therefore, in approximately 1 trillion years, the Moon's orbit will intersect with that of Venus. When the orbit of the Moon intersects with that of Venus, the mass of the Moon is large enough. When the moon collides with Venus, Venus will fall onto the Sun, as shown in Fig. 6. At the same time, the Moon will fall onto the Earth and collide violently with it, greatly reducing the Earth's orbital speed and causing the Earth to also fall onto the Sun, as shown in Fig. 7. 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 shell expands and cools outward. With the contraction of the internal helium nucleus, the rotation of the internal helium nucleus accelerates, and

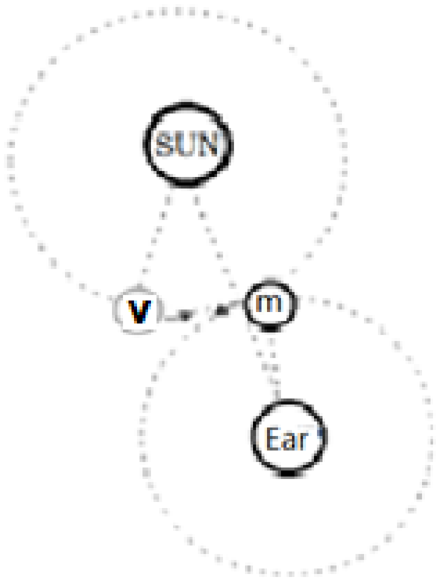

Fig. 6 The moon collides with Venus V in the solar system.

the hydrogen shell drifts outward under the action of centrifugal force, which makes the star expand rapidly into a red giant [4]. The volume of the red giant can reach dozens or even hundreds of times that of the Sun, and thus it can burn up Mercury, which is close to the Sun. At the same time, Jupiter is also moved outward under the effect of centrifugal force, causing the number of sunspot cyclones pulled out by Jupiter from the polar cyclones of the Sun to decrease gradually, and the cloud masses pulled by Jupiter from the atmosphere around the Sun to serve as fuel for the sunspot cyclones also gradually decrease.

Fig. 7 Astronomers once discovered that a star was devouring a planet.

2.3 Late-life Stars — White Dwarfs

When the red giant burns out its main inner planets and causes Jupiter to move away from the Sun, as the fuel that Jupiter pulls from the Sun's surrounding atmosphere to the sunspot cyclone gradually decreases, and there is no main inner planet to refuel the sunspot cyclone, the star cannot absorb enough hydrogen to maintain the hydrogen polymerization reaction inside the star, and its internal temperature gradually drops. This will disrupt the balance between the radiation pressure of nuclear fusion and the gravitational pull of its own contraction, causing the helium nuclei inside to contract and heat up. Eventually, the core temperature will exceed 100 million degrees, and helium fusion will begin again. However, when the helium core burns out completely, the gravitational force at the center of the star cannot be balanced by the radiation pressure produced by the polymerization of hydrogen or helium. As a result, the interior of the star contracts, and its rotation accelerates. Outer planets like Jupiter, under the effect of centrifugal force, continue to move outward. When outer planets like Jupiter can still pull out some sunspot cyclones from the polar cyclones of their star through the effect of universal gravitation and scatter them throughout the star, but since Jupiter is moving away from the Sun, the fuel it pulls from the Sun's surrounding atmosphere to the sunspot cyclone gradually decreases, and there are no rapidly orbiting inner planets to refuel these sub-cyclones. This causes them to lose the ability to emit strong light, making the stars dim and pale, becoming white dwarfs, as shown in Fig. 8. When an outer planet like Jupiter is too far from its parent star to spread a sunspot cyclone over its parent star through the force of universal gravitation, the parent star will turn into a black dwarf. When the cyclones at both ends of the rotational axis of a "black dwarf" do not face the Earth, people can hardly see the light emitted by the black dwarf [5]. However, since the contracted star still rotates continuously and the cyclones at both ends of its rotation axis will definitely emit light, there is no such thing as a black dwarf star that does not emit light at all.

Fig. 8 A White Dwarf and its atmosphere.

2.4 Rise From Dead — Supernova

Because a black dwarf is a star that contracted after a main sequence star has swallowed up inner planets that can fuel sunspot cyclones, and during the process of the star contracting into a black dwarf, its rotation speed increases, causing the centrifugal force of the planets orbiting the star to increase, these planets move away from the star until no planet can draw sunspot cyclones from the star to other parts of the star. Therefore, the black dwarf stars produced by contraction have almost no active and flashing cyclones except at the poles. However, black dwarfs still have some exoplanets, such as Jupiter, 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. 9. 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 another 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 that occur gamma-ray bursts, 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.

Fig. 9 Gamma-ray burst SN 2014J produced by a supernova explosion.

2.5 Cosmic Lighthouse — Neutron Star

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 child 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 waves received by the Earth are intermittent, resulting in the “lighthouse effect”, and thus neutron stars are called “cosmic lighthouses”.

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.

In addition, as the neutron star spins rapidly, its child galaxies are also constantly rotating around the neutron star, and when the giant cloud pulled by the child 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. 10.

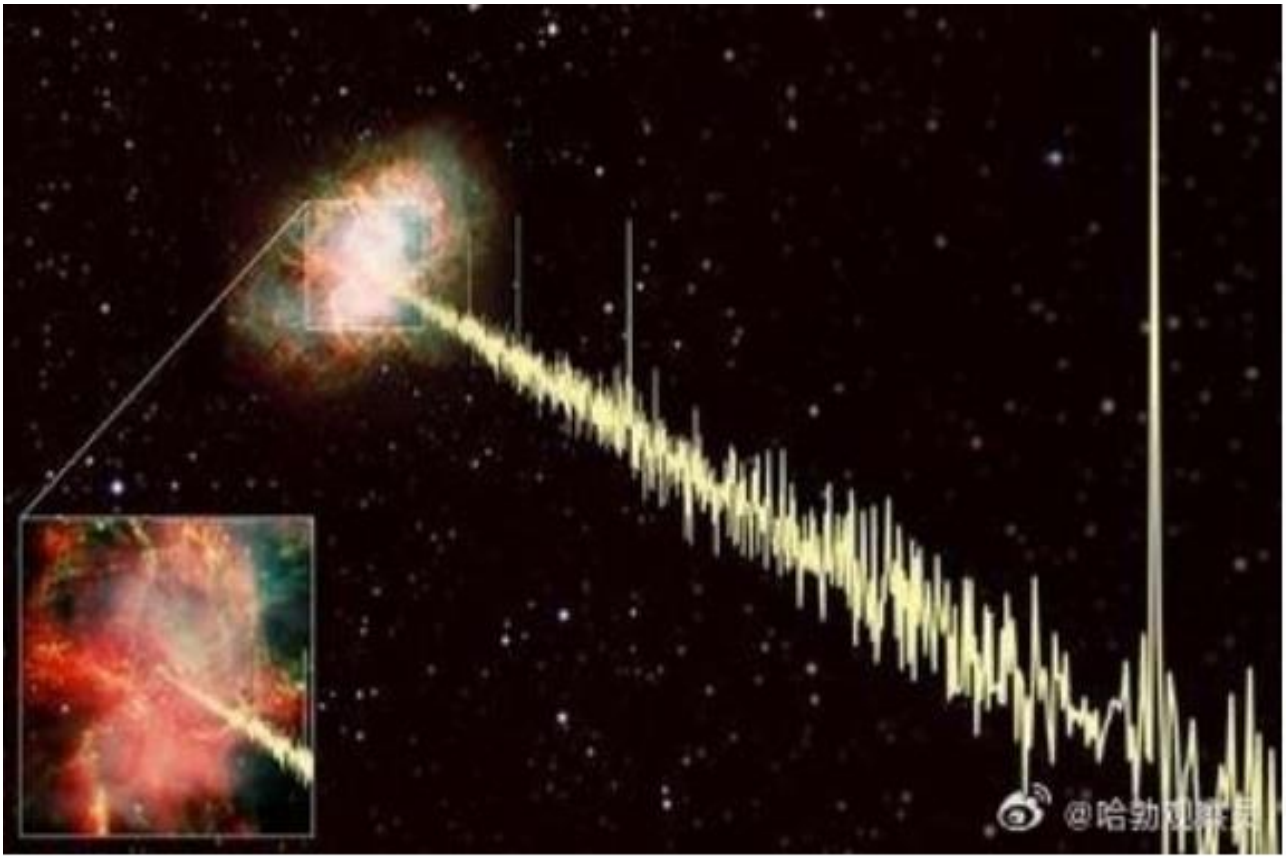

Fig. 10 Fast radio bursts erupting from neutron stars.

2.6 Later Stage 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 child 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 absorb the clouds pulled by the child 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 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 [8], as is shown in Fig. 11.

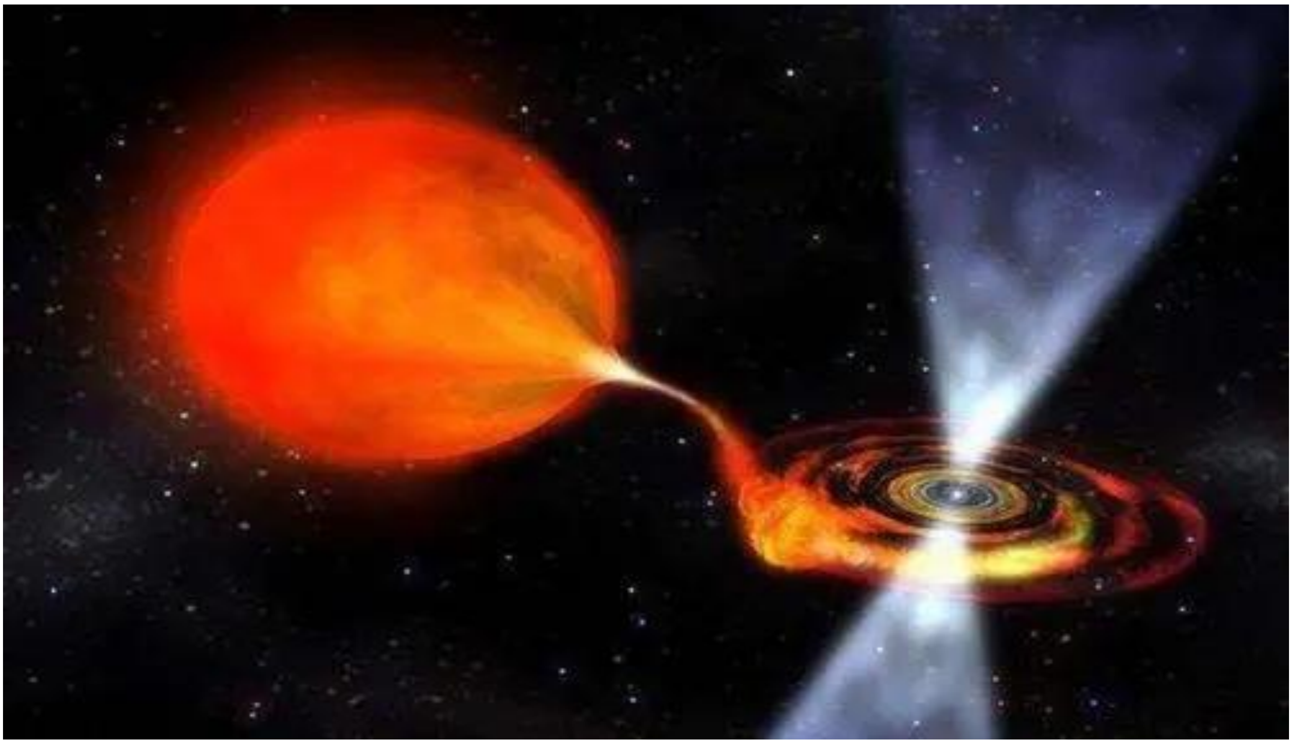

Fig. 11 A neutron star devours stars to become a black hole.

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".

2.7 Black Holes Evolve Into Quasars

Because black holes are the product of stellar evolution in the galaxy structure, and the galaxy structure is never resting, always in constant motion and change. As the structure of the galaxy rotates, the black hole also continuously accretes 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, American 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. 12.

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, about 100,000 years per galaxy will happen once, 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 [9]. 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.

2.8 Energy Sources and Fuel Supply Mechanisms of Quasars

Because quasars are the result of long-term

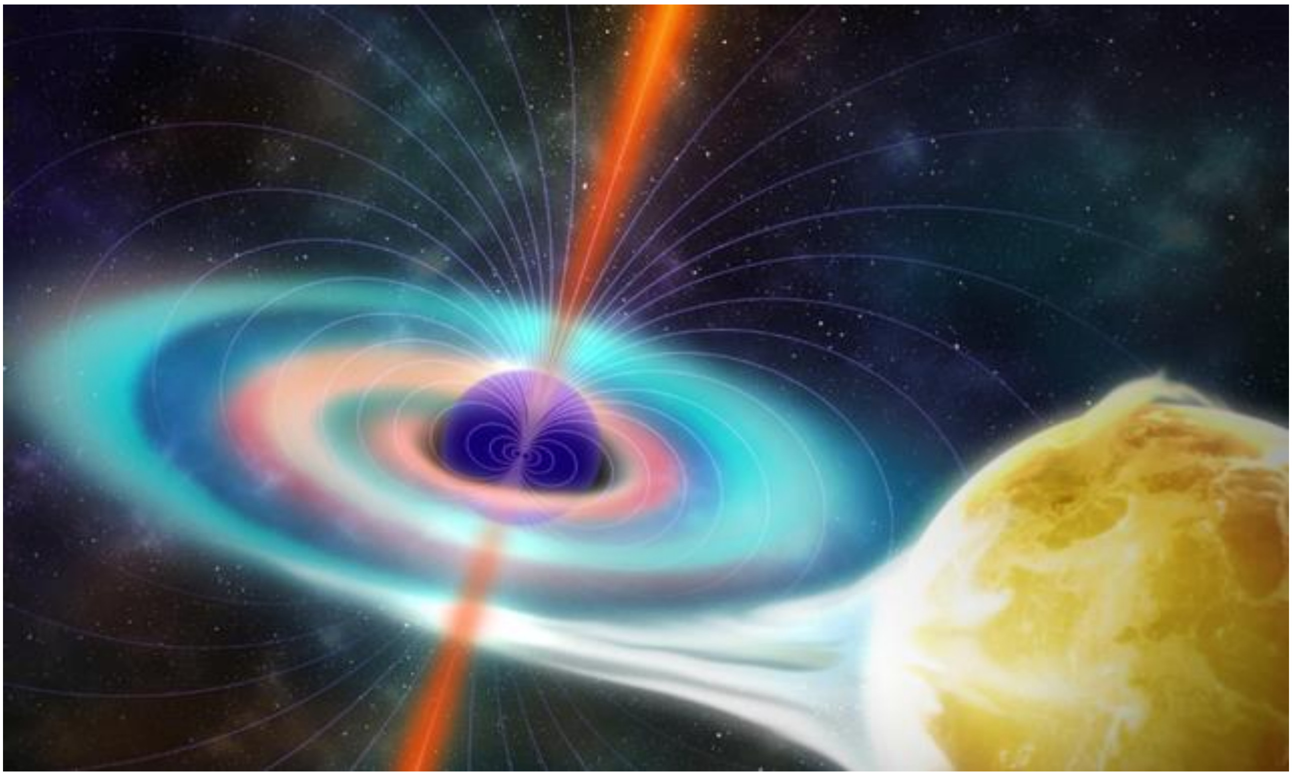

Fig. 12 The process of a black hole swallowing a star.

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 [10].

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:

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

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. 13, thus allowing the thermonuclear reaction of the galactic nucleus to continue. However, when the central black hole of a subgalaxy approaches its parent star, it exerts a strong gravitational pull on the polar cyclone of the parent star, which can tilt, stretch, shear or destroy the polar cyclone, causing the brightness of the quasar to change dramatically within a few days or even less.

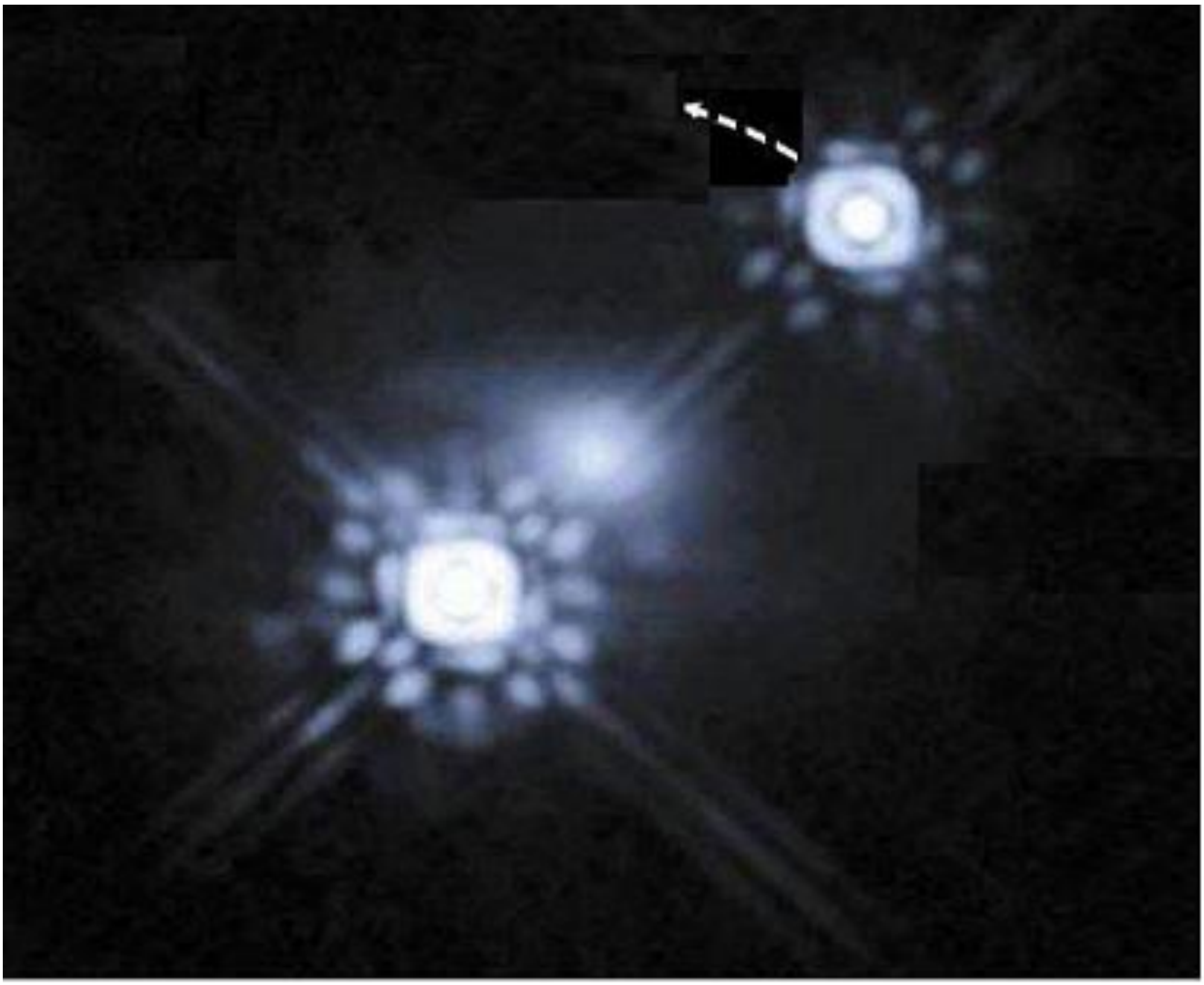

Fig. 13 The nucleus of the galaxy shines as it absorbs the fuel brought by its sub galaxy.

3. Conclusions

In the past, people mainly studied astronomy by roughly observing celestial bodies and celestial phenomena, lacking the precision, continuity, systematicness and logic of observation. As a result, the observational results and theoretical research were half-understood and ambiguous, and could not scientifically and reasonably explain the formation and evolution processes of galaxies and stars. Therefore, by summarizing and correcting the observations and research results of predecessors, the author proposed a complete and scientific new theory on the formation and evolution of galaxies and stars, thereby revealing the general laws of star formation and evolution as well as the mechanisms of the formation and evolution of main sequence stars, red giants, white dwarfs, black dwarfs, supernovae, neutron stars, black holes and quasars.

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