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Proof of Hubble's Law and the Truth about the Expansion of the Universe as Well as Dark Matter and Dark Energy

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Abstract: In 1929, American astronomer Hubble first discovered that the recessional velocity of a galaxy increases with its distance from the earth, and therefore put forward Hubble's law. It is considered the first observational basis for the expansion of the universe and today serves as one of the pieces of evidence most often cited in support of the Big Bang model. Since then the astrophysics community has believed that the universe is in a constant rate of expansion until Saul Permutter, Brian Paul Schmit and Adam Guy Riees discovered the accelerating expansion of the universe through observation of several dozen distant supernovas in 1998, who then won the Nobel Prize in Physics 2011. But human still cannot completely explain the phenomenon that the universe is expanding at an ever-accelerating rate. Thus the author of this paper studied the origin and evolution of galaxies again, and revealed the structure of galaxy and proved Hubble's law, then revealed the truth about the expansion of the universe as well as dark matter and dark energy.

Key words: Galaxies, structure, Hubble's law, universe's expansion, dark matter, dark energy.

1. Introduction

In 1929, Hubble examined the relation between distance and red shift of galaxies. Combining his measurements of galaxy distances with measurements of the red shifts of the galaxies by Vesto Slipher, and by his assistant Milton L. Humason, he found a roughly linear relation between the distances of the galaxies and their red shifts [1]. This meant, the greater the distance between any two galaxies, the greater their relative speed of separation. This discovery later became known as Hubble's law, which is considered the first observational basis for the expansion of the universe and today serves as one of the pieces of evidence most often cited in support of the Big Bang model. Since then, the astrophysics community has believed that the universe is in a constant rate of expansion until Saul Permutter, Brian Paul Schmit and Adam Guy Riees discovered the accelerating expansion of the universe through observation of several dozen distant supernovas in 1998, who then won the Nobel Prize in Physics 2011 [2]. But they could not tell the truth of the accelerating expansion of the universe. Fortunately, the author has propounded a new theory of galaxy structure [3], which can be used to prove Hubble's law and reveal the truth of the expansion of the Universe as well as the essence of dark matter and dark energy.

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2. Cosmic Galaxy Structure

2.1 The Formation and Evolution of Planetary Systems

According to the Solar System's formation law described in some papers of the author [3], a star can produce several planets around it, and each planet can also produce zero or several satellites around it, therefore forming a system consisting of a star and its planetary system, which is a hierarchical structure.

In a hierarchical galaxy, any celestial body other than root-star was initially generated as a satellite of its parent planet. These satellites unceasingly incorporated the nebula materials near the orbits to become larger and larger, and gradually moved away from its parent planet under the impact of moving objects or the pull of its parent planet whose rotation gradually speeds up. Especially, when the parent planet becomes a fixed star, its satellites would become planets. During the planets' revolution around its parent star, they unceasingly incorporate the nebula materials near the orbits to become larger and larger and may also generate new satellites. So except some small planets (like Mercury and Venus of the Solar System) near the parent star, other larger planets have their own thick atmospheres. During the normal revolution of a planet (such as earth) around its parent star (such as the sun), the atmospheric pressure on the trailing hemisphere of the planet is higher than the other hemisphere, effectively increasing its revolution speed, thus making the planet gradually move away from the parent-star along a spiral line [4]. In addition, with the growth of the mass of planet, planet will shrinks from time to time, but conserving the angular momentum of Earth, so a decrease in the rotational inertia results in an increase in the rotation speed of planet, and consequently also an increase in the revolution speed of the Moon, making the Moon move away from Earth.

2.2 The Formation and Evolution of Stars

(1) The birth of stars

During the rotation of a planet around its parent star, it unceasingly absorbed dust and gases near the orbits, making its mass increase gradually and its atmosphere become thicker and thicker. When a planet's mass becomes very large, its core temperature and gas density are high enough to initiate and maintain thermonuclear reactions, a new star is born [5].

(2) Young stars—main sequence star

After a star is born, it enters an evolutionary phase using hydrogen fusion as its major energy source. The outward expansion force of the gas inside the star and the inward contraction force induced by gravity are roughly balanced, making the star neither contract nor expand. So this is a relatively stable phase, the duration is about 90% of its whole life span, which is called the main sequence stage of a star, it is the prime of the star's life [5].

(3) Middle aged star—red giant star

During the rotation of a star around the center of galaxy, it unceasingly absorbed gases, dust and other interstellar matter near the orbits, and the trapped material is barely able to escape from the siege of the dense atmosphere of the star. Many light elements are fused into heavy elements by the thermonuclear reactions of star. So when a star evolves to the end of its main sequence stage, its mass increases greatly and can reach several times the mass of the sun. The greater the mass of a star, the faster its energy is consumed, so it is increasingly difficult to capture external material to meet its energy consumption. Especially, old stars usually have complex sub-galaxies, including a series of planets, satellites and even young stars. These sub-galaxies move around the old star and compete for the resources originally belonging to the old star. When the hydrogen needed for the thermonuclear reactions in the core of the old star is insufficient, the thermonuclear reactions based on hydrogen fusion cannot proceed in the core of the old star. At this point the gravitational force is not balanced by the radiation pressure of the fusion, the core of the star will be compressed, and the temperature will rise sharply. After the temperature of the central helium ball is raised, the upper hydrogen-helium mixture clinging to the helium ball will be heated to the temperature of hydrogen fusion, therefore thermonuclear reaction will resume. So the helium ball gets bigger and bigger, and the hydrogen combustion layer expands outward correspondingly, making the astral outer material expand due to heating, thus the star be transformed to a red giant star [6].

(4) Stars in later years—white dwarf

When a star evolves into its old age and a series of nuclear reactions of the star come to their end, the material in the star no longer undergoes fusion reactions, so the star has no source of energy. As a result, it cannot support itself by the heat generated by fusion against gravitational collapse, but is supported only by electron degeneracy pressure, causing it to be extremely dense. During the contraction of the star, a large amount of energy is released, making the white dwarf white hot, surface temperatures above 10,000 ˚C. This is the reason for white dwarf white. [7] But eventually, white dwarfs will fade into black dwarfs over a very long period of time.

(5) Rise from the dead—supernova

During the movement of a galaxy, a black dwarf unceasingly absorbs dust and gases near the orbits, making its mass increase gradually and its atmosphere become thicker and thicker. When it becomes a massive star and its surface is covered by a thick layer of interstellar matter, if its surface temperature and gas density are high enough to initiate and maintain thermonuclear reactions again, a supernova may be born. Since the thickness and density of cloud around the massive star is much greater than the thickness and density of thunder storm around the earth, when such a star revolves around its progenitor and whirls on its axis fast, lots of cloud clumps would bump each other to cause frequent lightning and thunder. Violent lightning may cause the burning of the surface and atmosphere of the star, even leading to a supernova explosion, making the dense atmosphere be consumed quickly, and the star surface melt and shrink into a thin shell, but conserving the angular momentum of the star.

In addition, a massive star usually has a sub-galaxy consisting of multiple generations of stars, making its spatial scale become overlong, so when the sub-galaxy rotates around the child star of the massive star, its tail satellite may enter the gravitational field of the massive star and finally be annexed by the massive star, as is shown in Fig. 1. Moreover, the impact of the sub-galaxy of the massive star on the massive star will produce tremendous energy even start thermonuclear reactions, to fuse the satellite with the massive star. Due to the strong gravitation of the center of the massive star, the newly added material shrinks immediately, but conserving the angular momentum of the massive star, so a decrease in the rotational inertia results in an increase in the rotation speed of the massive star, thus the child star of the massive star move away from the massive star, widening the distance between the two generation stars. Similar impacts may occur multiple times, finally allowing the passage of the sub-galaxy of the white dwarf.

Undergoing a series of evolution, the star is transformed into an onion-like shell structure in which light elements are outside and heavy elements inside, and its core is mainly composed of iron. Since the interior gravitation of a massive star is very strong, the star has a tendency to shrink inward. When a supernova explosion occurs, and the outer layer of the star is blown off. The luminosity of the supernova explosion may rise to several hundred million times as much as the sun's luminosity, making the star become a supernova. [8]

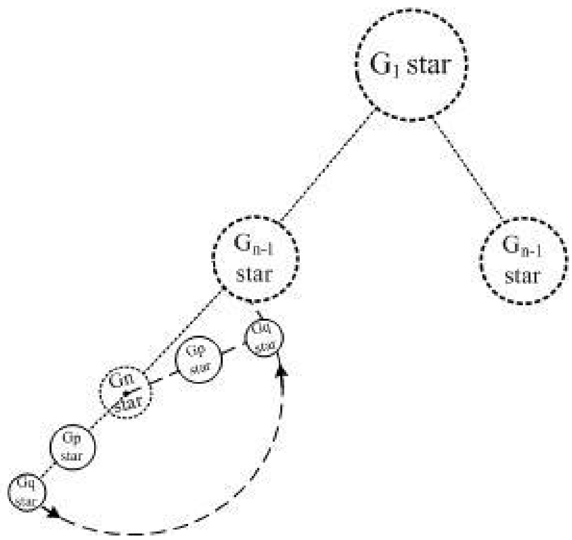

Fig. 1 A star not only merges some impacting celestial bodies of any longer sub-galaxy but also widens the distance between the star and the sub-galaxy.

(6) Late stages of stellar evolution—neutron star

During the evolution of a white dwarf star into a massive star, supernova explosions may occur multiple times. During each supernova explosion, there is an accompanying collapse, causing the material at the core to compress more tightly. When the mass of the white dwarf increase beyond the Chandra limit, which is 1.4 times the mass of the sun, especially when a supernova explosion occurs, the gravitational attraction of the star core is strong enough to compress atomic nuclei and electrons into neutrons, transforming the white dwarf into a neutron star with a diameter of only a dozen kilometers and a density of one billion tons per cubic centimeter. As the star shrinks into a neutron star, its rotation speeds increase greatly as a result of conservation of angular momentum, hence the newly formed neutron star rotates at up to several hundred times per second [9].

(7) The endpoints of star evolution—black hole

Neutron stars also have an upper limit to their mass, often referred to as the Oppenheimer-Volkov limit, which is about 3 times the sun's mass. If the core of a star exceeds the Oppenheimer-Volkov limit at the end of its life, there is no force in any standard theory able to prevent it from collapsing completely into a small particle—black hole. There is a region around the particle, which exhibits such strong gravitational effects that nothing can escape from inside it. [10]

No matter whether it is a white dwarf or a neutron star or a black hole, when a star's surface is covered by a thick layer of interstellar matter, and its surface temperature and gas density are high enough to initiate and maintain thermonuclear reactions again, or when it collides with a huge celestial object from one of its longer sub-galaxies, a supernova explosion can occur immediately, causing massive supergiant visible. For example, using NASA's planet-hunting Kepler Space Telescope, Garnavich and his colleagues saw the shock wave coming from massive star explosion (supernova) that came into Kepler's view in 2011. By analyzing light taken in by Kepler every 30 minutes over a three-year period from 500 distant galaxies—a field of vision that included some 50 trillion stars—they were finally able to catch two supernovae—massive red super-giants called KSN 2011a and KSN 2011d. The stars, each closes to a billion light-years away, are 300 and 500 times the size of our sun, respectively.

2.3 The Structure of Galaxies

According to the formation and evolution theory of planetary system and stars described above: a star may have its own parent-star or higher ancestral stars, and can produce several planets around it, and each planet can also produce several satellites around it; after a satellite grows into a planet, it can also produce its next generation of satellites. Hence, the basic structure of a galaxy is a hierarchical structure composed of many generations of stars, like a tree, and the entire universe contains many such galaxies, like an endless forest. In a typical galaxy structure, a path from the galaxy center as the root of the tree to one of the moons as the leaves of the tree, may contain several black holes, several neutron stars, and several white dwarfs, 0~1 red giant star, 1 main-sequence star, 1 planet and 1 satellite. Each branch of a galaxy usually has at most two layers of luminous stars, and these luminous stars are usually at the bottom of the galaxy.

Milky Way galaxy is just a complicated hierarchical structure composed of multiple generations of stars, and the solar system is only a branch of it. Astronomical observation also shows that Milky Way galaxy has a huge disk structure, consisting of the center of the Milky Way and at least two spiral arms, which are 4,500 light years apart. Our sun is located at the Orion Arm of the Milky Way galaxy, 26,000 light years from the center of the Milky Way. Through a study of the star cluster disk of the Milky Way, astronomer Maria German found that the star cluster in the inner part of Milky Way is older, while the star cluster in the outer part is younger. Thus, it can be inferred that the formation of the Milky Way started from the inner part, then gradually evolved into a star cluster disk about 100,000 light years across. In the process of the Milky Way's growth, it has swallowed up a number of small galaxies, and the celestial objects from other galaxies had been merged into the interior of the Milky Way. So the sun is a fixed star generated from multiple generations of stars, Earth is a child-planet of the sun, and the moon is a last generation star. Similarly, the external galaxies observed by Hubble are also hierarchical structures, appearing long spiral arms. Astronomers have discovered a by far the largest supercluster of galaxies—Laniakea supercluster, which consists of thousands of member galaxies including the Milky Way and other galaxies in the local group of galaxies as well as the nearby Virgo Cluster of galaxies, as is shown in Fig. 2, where green area is crowded with many galaxies marked by white points, white lines show how they center around the super-cluster, orange line marked the margin of Laniakea, and the blue point is the location of our earth.

In addition, for the same hierarchy, the higher the level of a star is, the longer its accumulation, therefore the greater its mass. When the original star collapsed into a white dwarfs, neutron star or black hole, it conserved most of its angular momentum, but the new radius is only a tiny fraction of the original star's radius, a decrease in the rotational inertia resulted in a rapid increase in the rotation speed, producing very high rotation rates. Hence, the higher the level of a star is the greater its rotation speed.

3. The Truth of the Expansion of Universe

3.1 Proof of Hubble's Law

Just as what Hubble discovered in observing some extra-galactic galaxies, the distribution of galaxies is uniform and the average distance of these galaxies is 2 million light-years. So the extra-galactic galaxies observed by Hubble can be roughly shown using Fig. 3. Although these distant galaxies seem to be isolated from the space, observers have found that these galaxies are moving away from our space and the velocity of recession was proportional to the distance from us. This shows that each of them has its own parent star. It is under the gravitational pull of these parent stars so that these galaxies revolve rapidly around their parent star, and they revolve faster than the earth rotates around the sun. Therefore the observers thought they were all moving away from their space.

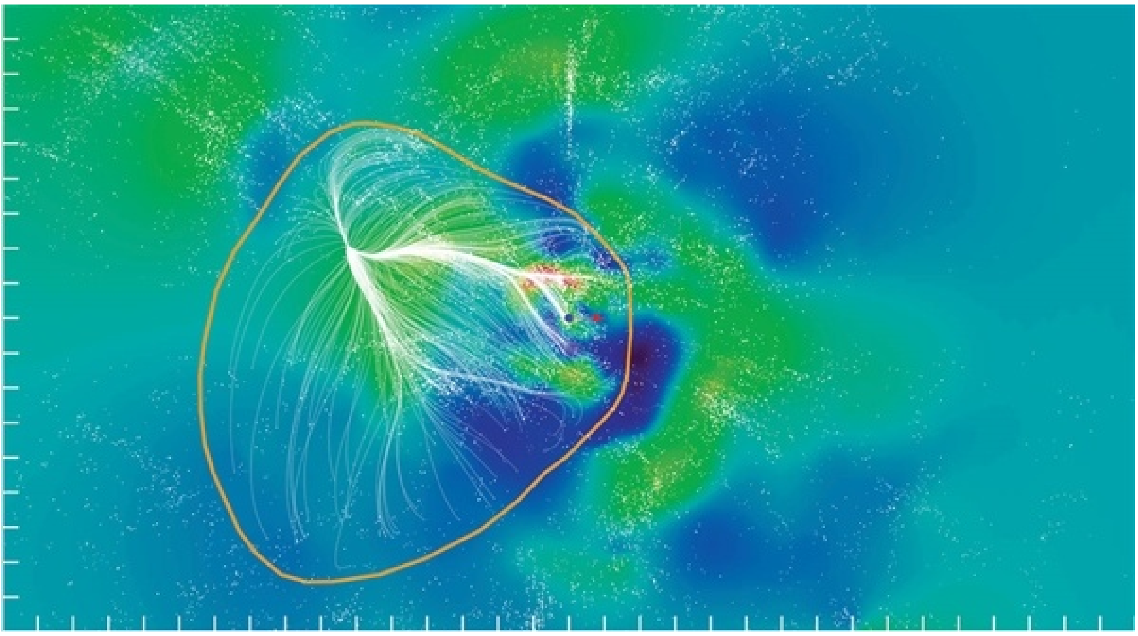

Fig. 2 Laniakea super-cluster with hierarchical structure.

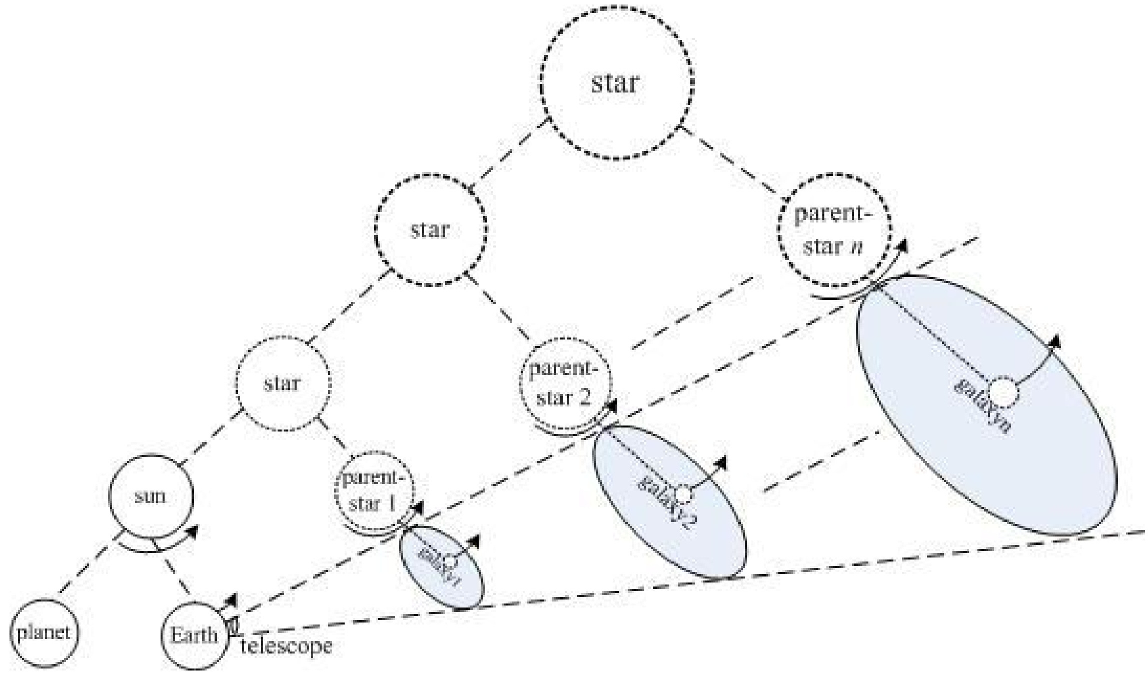

Fig. 3 Some extra-galactic galaxies observed by Hubble.

In addition, according to the symmetry of galaxy formation and evolution, a typical galaxy should be a flat sphere, and its normal projection should be an ellipse. A distant galaxy observed by telescope is generally more complete, so its normal projection should be an ellipse. Suppose the distance between a nearby galaxy and the earth is *d*, and the distance between a distant galaxy and the earth is *nd*. When the image of the distant galaxy observed by a telescope has the same size as the image of the nearby galaxy, the actual size of the distant galaxy should be *n* times the actual size of the nearby galaxy. So if the diameter, width and height of the nearby galaxy are l_1, w_1, h_1, then the diameter, width and height of the distant galaxy are nl_1 nw_1 nh_1. From a large scale, the mass distribution of galaxies is approximately homogeneous, so the mass of the distant galaxy is about n^3 times the mass of the nearby galaxy. Suppose that the mass of the nearby galaxy is m_1 and the mass of its parent star is M_1. Since the larger galaxy centered on this parent star usually consists of 2 two spiral arms, we can infer roughly that the mass of the larger galaxy is $2m_1$. In addition, it is assumed that the mass of the central star in a large galaxy is generally about 0.5% of the total mass of the galaxy, so we have

$$M_1 = 0.5\% \times (2m_1) = 0.01m_1$$

Similarly, suppose that the mass of the distant galaxy is m_2 and the mass of its parent star is M_2, then $M_2 = 0.01m_2$, thus

$$M_2 : M_1 = m_2 : m_1 = n^3 .$$

Generally, the parent star of a sub-galaxy is actually the parent star of the central star of the sub-galaxy, and the distance between the two stars is approximately equal to half the length of the galaxy. Suppose that the mass of the parent star of a sub-galaxy is M and the mass of the central star of the sub-galaxy is m, its distance from the parent star is r and it rotates around the parent star at a speed of v, then according to the law of universal gravitation, we have

$$\frac{GMm}{r^2} = \frac{mv^2}{r}, \quad \text{therefore } v = \sqrt{\frac{GM}{r}}$$

Hence, if we suppose that the diameter of the distant galaxy is l_2, the mass of its parent star is M_2, the revolution speed of the central star of the distant galaxy moving around its parent star is v_2 ,the diameter of the nearby galaxy is l_1, the mass of its parent star is M_1, and the revolution speed of the central star of the nearby galaxy moving around its parent star is v_1, then

$$v_2 : v_1 = \sqrt{\frac{GM_2}{(l_2/2)}} : \sqrt{\frac{GM_1}{(l_1/2)}}$$

$$= \sqrt{\frac{M_2 l_1}{M_1 l_2}} = \sqrt{\frac{n^3 M_1 \bullet l_1}{M_1 \bullet n l_1}} = n$$

That is, the revolution speed of the distant galaxy is about *n* times that of the nearby Galaxy. This proves the famous Hubble's law.

3.2 Proof of Saul Permutter, Brian Paul Schmit and Adam Guy Riees' Discovery

In 1998, Saul Permutter, Brian Paul Schmit and Adam Guy Riees discovered the accelerating expansion of the universe through observation of several dozen distant supernovas, who then won the Nobel Prize in Physics 2011. This counterintuitive discovery shocked the world of astronomy and physics. In fact, according to the author's theory of Galaxy structure, it is not difficult to reveal the truth of the accelerating expansion of the universe.

Since the observers have found that these supernovas are moving away from our space. This shows that each of them has its own parent star, it is under the gravitational pull of these parent stars that these supernovas revolve rapidly around their parent star, and they revolve faster than the earth rotates around the sun, so the observers thought they were all moving away from their space.

Suppose the distance between a nearby supernova and the earth is *d*, and the distance between a distant supernova and the earth is *nd*. When the image of the distant supernova observed by a telescope has the same size as the image of the nearby supernova, the actual size of the distant supernova should be *n* times the actual size of the nearby supernova. So the mass of the distant supernova is about n^3 times the mass of the nearby supernova. Suppose that the mass of a supernova is M , it is assumed that the mass of the central star in a large galaxy is roughly 0.5% of the total mass of the galaxy, so the total mass of the galaxy with the supernova as its center is $200M$. Suppose the supernova has its own parent star, and the galaxy with the parent star as its center has two sub-galaxies or spiral arms, then the mass of the galaxy is about $400M$, so the mass of the parent star of the supernova is $2M$. Suppose that the mass of a nearby supernova is m_1 and its distance from the earth is *d*, the mass of a distant supernova is m_2 and its distance from the earth is *nd*, then the mass of the parent star of the nearby supernova is $2m_1$ and the mass of the parent star of the distant supernova is $2m_2$, and $\frac{m_2}{m_1} = n^3$. Hence, if we suppose that the diameter of the galaxy with the distant supernova as its center is l_2, the mass of its parent star is M_2, the revolution speed of the distant supernova moving around its parent star is v_2 ,the diameter of the galaxy with the nearby supernova as its center is l_1, the mass of its parent star is M_1, and the revolution speed of the nearby supernova moving around its parent star is v_1, then

$$v_2 : v_1 = \sqrt{\frac{GM_2}{(l_2/2)}} : \sqrt{\frac{GM_1}{(l_1/2)}}$$

$$= \sqrt{\frac{M_2 l_1}{M_1 l_2}} = \sqrt{\frac{2m_2 l_1}{2m_1 l_2}} = \sqrt{\frac{m_2 l_1}{m_1 l_2}} = \sqrt{\frac{n^3 m_1 \bullet l_1}{m_1 \bullet n l_1}} = n$$

i.e., the revolution speed of the distant supernova is about *n* times that of the nearby supernova.

In fact, in the process of supernova's explosion, supernova's atmosphere is consumed quickly, and supernova's outer layer burst, a lot of pieces are thrown out, making supernova's mass decrease quickly and supernova's ability of absorbing external combustion sources also decreases quickly, finally causing supernova's brightness decreases quickly. In addition, with the thinning of supernova's atmosphere, the obstacles of supernova's rotation around its parent star will be reduced. Therefore, its rotation speed will increase gradually. On the other hand, with its parent star continuously absorbing a part of the material ejected by the supernova, the mass of the parent star will increase gradually, causing the rotation speed of the supernova around the parent star increase gradually. Hence, the observer feels that the supernova moves away from the earth with accelerated rate. That is the conclusion of Saul Permutter, Brian P. Schmit and Adam G. Riees.

3.3 The Reasons for the Coexistence of Galaxy Red Shift and Violet Shift

Astronomers have made observations outside the galaxy, as is shown in Table 1. They found that the radial velocity of some members of the local group is positive, meaning they are moving away from the Milky way, while the radial velocity of some other members of the local group is negative, meaning they are moving closer to the Milky way [11]. It is obvious that not all galaxies are moving away from us, this is enough to negate the conclusion of cosmic expansion.

In fact, there is no contradiction between the red shift and the violet shift of galaxies, because these galaxies all revolve around their parent stars, but their radial directions are different. As is shown in Fig. 4, the radial direction of galaxy 1 is opposite to the radial direction of galaxy 2. So we see galaxy 1 moves away from us while galaxy 2 moves closer to us.

Table 1 The radial velocity of some members of the local group.

Galaxy	Distance/kpc	Diameter/kpc	Radial velocity/(km/s)
LMC	55	9.2	+ 13
SMC	64	7.7	- 30
M31	890	60.0	- 59
M32	890	2.5	+ 35
M110	890	5.2	- 1
M33	920	18.4	+ 3
NGC147	736	3.2	+ 89
NGC185	706	3.0	+ 39
IC1613	890	4.0	- 125
Draco system	86	1.0	- 31
Ursa Minor Galaxy	74	2.4	- 88

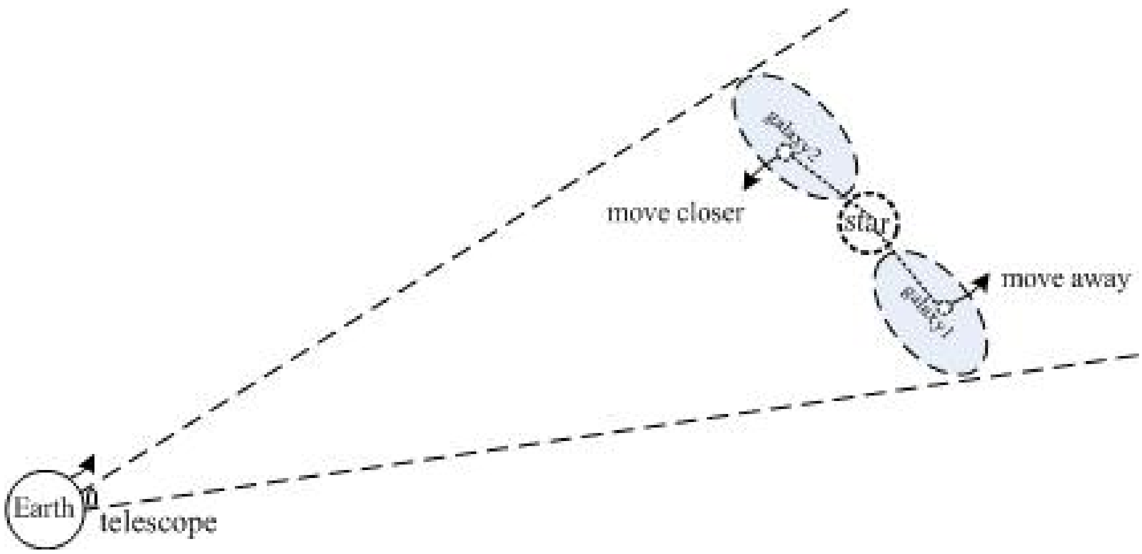

Fig. 4 Not all galaxies are moving away from us.

4. Dark Matter and Dark Energy

In the study of the movement of galaxies, some people observed that some stars of the inner and outer layers of a galaxy moved at a consistent pace around the center of the galaxy. Thus they image the exterior of the galaxy might be enveloped by a large amount of dark matter, which is the only way to ensure the stability of the galaxy. In addition, since Hubble discovered the expansion of the Universe in 1920s, people have always sought an invisible energy—dark energy, because they think only dark energy can stretch space structure and cause the expansion of the universe. But scientists have not yet found the so-called dark matter, nor can they understand clearly the essence and function of dark matter. So the "dark matter" and "dark energy" has become one of the greatest mysteries in the world of astronomy, cosmology and physics.

If the theory of galaxy structure propounded by the author is applied to figure out this mystery, it's easy to explain the expansion of the Universe and the related concepts "dark matter" and "dark energy":

(1) Dark matters that ensure the stability of the galaxy are just the black holes or neutron stars or other massive stars in the galaxies because their gravitational forces are so strong that their sub-galaxies can only move around them.

(2) Dark energy driving a sub-galaxy away from its parent star is essentially the centrifugal force acting on the central star of the sub-galaxy. When a supernova explosion occurs on the parent star, due to the strong gravitation of the center of the parent star, the star surface shrinks immediately, but conserving the angular momentum of the parent star, so a decrease in the rotational inertia results in an increase in the rotation speed of the parent star and consequently an increase in the revolution speed of its child stars around it, thus the child stars move away from its parent star, widening the distance between the two generation stars. So centrifugal force is the real dark energy stretching space structure.

(3) Since a main sequence star shrinks from time to time, the centrifugal force acting on a planet is also the main dark energy driving the planet away from its parent star. In addition, during the normal revolution of a planet (such as earth) around the parent star (such as the sun), the atmospheric pressure on the trailing hemisphere of the planet is higher than the other hemisphere, effectively increasing its revolution speed, thus making the planet gradually move away from the parent-star along a spiral line. Hence, atmospheric pressure is another kind of dark energy driving a planet away from its parent star.

(4) Satellites gradually move away from their parent planet under the effect of increased centrifugal force produced by the accelerating rotation of their parent planet, which also shrinks from time to time with the growth of its mass. So centrifugal force is also the main dark energy.

5. Conclusions

Because before people did not realize that any galaxy is a hierarchical structure, they viewed the galaxies observed by Hubble as independent nebula. As a result, when Hubble discovered that the distance between stars grew larger and larger, the theory of cosmic expansion is wrongly put forward. Only after the author studied and revealed that the galaxy is essentially a hierarchical structure, can people recognize that the galaxies observed by Hubble are essentially sub-galaxies moving around some invisible collapsed stars such as neutron stars or black holes. Since the rotations of these galaxies around their parent stars are faster than the earth's rotation around the sun, people saw these distant galaxies were flying away from the earth at a positive velocity. Since the supernova observed by Saul Permutter, Brian P. Schmit and Adam G. Riees moved around their parent stars faster than the earth moved around the sun, they found these distant supernovas were flying away from the earth at a positive velocity. Hence, the black holes or neutron stars or other massive stars in a galaxies are the dark matter that ensures the stability of the galaxy. The centrifugal force acting on the central star of a sub-galaxy is the dark energy driving the sub-galaxy away from its parent star.

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