Galaxy Anatomy: 'Darwin Spirals'

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Abstract: This whole universe is definitely not of 'relativity'. The universe is hierarchical, absolutely. For example, the biosphere and all laboratorial experiments suffer the same effects of Earth's gravity. In the same time, gravity cannot be testified by scientists' laboratorial experiments, because the gravity between two protons is 10^{40} times weaker than the electricity between the same two protons. The most independent system close to humans is the Solar system, which, however, is effectively an example of two-body system. All theories of gravity are derived from the two-body system. When applied to three or more bodies, the theories give chaotic results. This is similar to the situation that there exists no formula solution to any algebraic equation of order 5 or more. Scientists, however, use the two-body theories of Newton and Einstein to explain the whole universe. This is fundamentally wrong. Galaxies are relatively the independent many-body systems. Dr. He initiated the concept of rational structure and applied it to the study of galaxy structure in 2001. His result is neither a theory nor based on any two-body theory; it is based on the analysis of galaxy images.

keywords: Rational Structure, Spiral Galaxy, Galaxy Arm

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1 Social Crises and the Possibility of New Spiritual Land

In 1492, Christopher Columbus sailed in search of jewels and spices, or money and happiness. He did not want to take the generic Silk Road in order to avoid dangers and obstacles. Also, he had a gut feeling that he could reach Asia by traveling west. Columbus took his original ideas and made it happen with a little help. Since his discovery of the New Land, many great events have occurred one after another. This New Land (the Americas) has brought to the world amazing innovations, and helped thousands of people fulfil their dreams.

Huge technological progress has united the world population, and the globe becomes a 'small village' where most of the technological needs are met. However, there exist many crises around the world such as air pollution, low levels of natural resources, growing amounts of nonnatural food, and spreading climate disasters. To find solutions for these crises, we cannot look for spaces horizontally as Columbus did. We must advance up or down: to either the microscopic world of bacteria or the greater world of galaxies.

2 Introduction to Galaxies

We, people, live in a galaxy called the Milky Way. Our neighborhood is the Solar system. All the theories about electromagnetism and nuclear interactions are not applicable to the formation of the Solar system. Scientists suggest that gravity is responsible for the creation of the Solar system, but the Solar system is a discrete structure. Newton and Einstein's theories are applicable to the orbital calculation of the Solar system. But they are the theories of movement between two bodies, e. g., between Earth and Moon, or Sun and Earth. They cannot explain the behavior of three or more bodies.

Galaxies are composed of billions of stars. We can take images of galaxies which show a smooth structure. All we can see is the stellar density, not the individual stars. We can see individual stars only in our own galaxy: the Milky Way.

There are two types of galaxies: elliptical (football-shaped) or flat (spiral galaxies, see Figure 1). In spiral galaxies, there are lots of dust and gas. Compared to stars, the mass of dust and gas is minute. We know that the origin of galaxies must be due to mass. Therefore, we should take galaxy

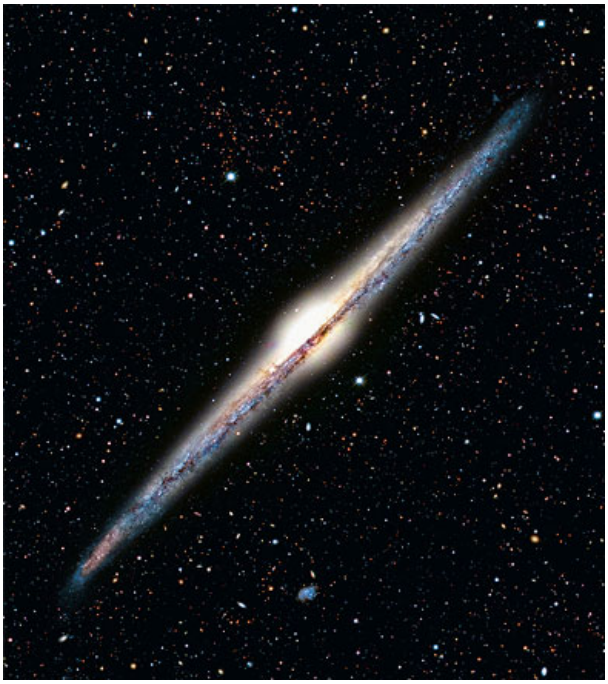

Figure 1: A shorter-wavelength image of edge-on spiral galaxy NGC 4565 (Courtesy of Canada-France-Hawaii Telescope/Coelum)

images that display the stellar distribution, not the dust or gas distribution. Because shorter-wavelength radiation is easily absorbed by dust and gas, we take galaxy images with longer-wavelength radiation.

3 Introduction to Spiral Galaxy Structure

The images of spiral galaxies show that the stellar density near the galaxy center is the highest. The density decreases exponentially as distance from the center increases. We call the main structure of spiral galaxies the exponential disk. There are two kinds of spiral galaxies: barred spiral galaxies and ordinary spiral galaxies. Ordinary spiral galaxies have no bars. Their main body is simply the exponential disk. Barred spiral galaxies are the combination of the major exponential disk and the minor bar.

Most spiral galaxies demonstrate some kind of spiral structure which are called arms (see Figure 2). Therefore, the ordinary spiral galaxy is simply

the exponential disk which is disturbed and shows some spiral-shaped disturbance. This resembles a quiet pool which is disturbed by a fly, a blow of wind, or by some naughty boys or girls. Astronomers observed that all the arms in ordinary spiral galaxies trace the curves of golden spirals. In the next section, we present Dr. He's explanation to why the exponential disk is related to the golden spiral.

4 Dr. He's Explanation to Exponential Disks and Golden Spirals

Astronomers discovered that the arms in ordinary spiral galaxies are all golden spirals. A golden spiral goes around the galaxy center in such a way that the radial line from the galaxy center intersects the spiral and makes a constant angle with the spiral curve at every point. How is a golden spiral related to the exponential disk?

Now we must use some imagination. The flat distribution of exponential stellar density can be imagined to be a three-dimensional surface, like a mountain out-skirt (See the lower-left panel of Figure 3). The mountain slope is an exponential function. Suppose you are at the top of the mountain and want to reach the bottom. You must take a route that spirals down the mountain. The ratio between the mountain height on your left and the height on your right must be constant all the way down the route. This kind of route is called, from now on, the Darwin spiral. Previously, Dr. He called this kind of route the 'iso-ratio curves' or 'proportion curves'. It is easy to show that Darwin spirals in ordinary spiral galaxies must be golden ones.

Dr. He thinks that this explanation must be very unique and elegant. It is unlikely that there are other explanations. Therefore, he generalized this idea to the concept of rational structure.

5 Rational Structure and its Solution

Darwin Curve definition: For given density distribution on the (x, y) plane,

$$\rho(x, y) \tag{1}$$

a route on the plane is called a Darwin curve if the ratio between the density on its left side and the density on its right is constant along the curve.

Figure 2: The shorter-wavelength image of ordinary spiral galaxy M51 (image credit: NASA/ESA). The arms follow equiangular spirals (golden spirals) which are the Darwin curves of exponential disk.

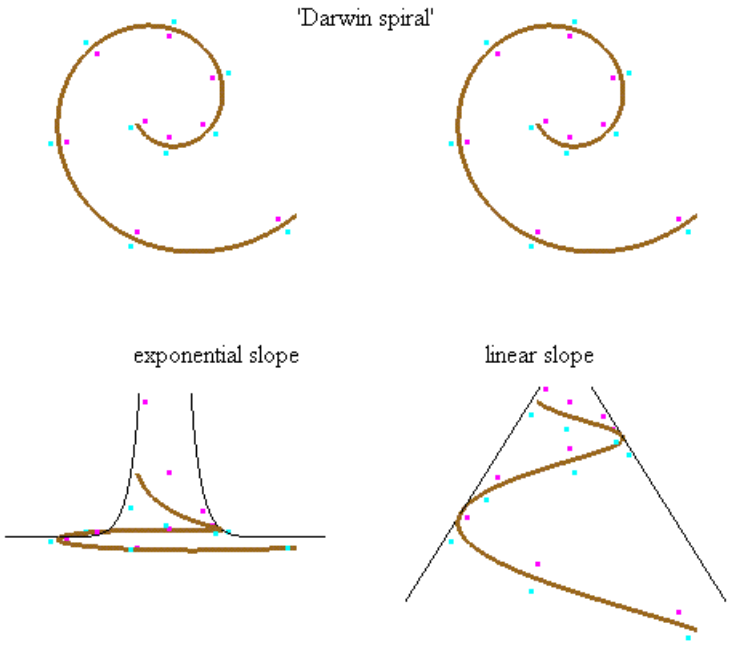

Figure 3: Upper panels are golden spirals. Lower panels show the exponential disk and linear disk (and their golden spirals) in three dimensions respectively. The lower-left panel indicates that the ratio of the mountain height on the left side of the spiral to the one on the right is constant along the spiral.

Rational Structure definition: For given density distribution (1) on the (x, y) plane, if there exist two orthogonal sets of curves on the plane so that each curve is a Darwin curve, then the distribution is called a rational structure. This means that along each curve, the ratio of the density on its left side to the one on its right is constant along the curve.

Dr. He pioneered the concept of rational structure in late 2001 (see the reference [1]). He constructed some differential equations to solve rational structure. According to the equations, two orthogonal sets of curves lead to either a rational or irrational structure. Dr. He tried every elementary complex function. Only a few of them lead to rational structure. All the rational structures are radially symmetric. There is only one exception. A small change of the complex exponential function can lead to a bilaterally symmetric rational structure. In 3D, the structure resembles a camel's back with two humps. Finally, Dr. He realized that the addition of the double-hump structure to the main structure of the exponential disk is the model of a barred galaxy. There are only two types of rational structures based on all elementary complex functions: radially symmetric and double-humped. In the same time, there are only two types of spiral galaxies: ordinary and barred. It is definitely not a coincidence!

Ordinary spiral galaxies are very simple, and explained in Section 4 and Figure 3. Therefore, the anatomy of ordinary spiral galaxies is finished. Dr. He also proposed an anatomy of elliptical galaxies [2] which was published in the academic journal: Astrophysics and Space Sciences. What is left is the anatomy study of barred spiral galaxies.

6 Anatomy of Barred Spiral Galaxies

A longer-wavelength image of the face-on spiral galaxy displays the stellar distribution on the galaxy plane. It is a black and white image where the brightness at each point of the image is proportional to the stellar density at that point. The brighter the point is, the greater the stellar density. Because the image is not in color, each pixel of the digital image corresponds to a numerical value which is proportional to the stellar density. Therefore, a longer-wavelength digital image of a face-on spiral galaxy is simply an array of positive numbers. Galaxy Anatomy is based on this array of numbers.

For a barred spiral galaxy we can use a double-humped rational structure to simulate the bar structure. One set of double-humps may not be enough to

simulate the bar. Generally, a bar needs two sets of double-humps combined. In a few cases, we may need three sets. If the simulation is successful, we have an analytic formula of the stellar distribution of the barred galaxy.

Further analysis of the galaxy depends on the analytic formula. For example, we draw a curve on the galaxy image and calculate the logarithmic density variance along the normal direction to the curve. If the variance is constant along the curve then it is a Darwin curve. We can also find the orthogonal sets of Darwin curves for the stellar distribution which are called the spider curves, a terminology coined by Dr. He.

7 Shorter-wavelength Spiral Galaxy Image and Life Origin

A star is mainly composed of two elements: hydrogen and helium. They are not nutritional materials to raise life. The Bible said that humans were made from dirt. The major components of dirt are carbon, oxygen, and nitrogen, etc. These are heavier elements than hydrogen and helium. Elliptical galaxies have little dust and gas, therefore humans cannot survive in elliptical galaxies. The images of an elliptical galaxy, whatever the wavelength, look the same because there is little dust and gas which blocks stellar radiation.

However, there is much dust and gas in spiral galaxies. A shorter-wavelength image of a spiral galaxy demonstrates more or less the dust or gas distribution in the galaxy. It shows the signs of life. Dust and gas always trace the spiral arms in the galaxy. Therefore the spiral arms are really the origin of life. If Dr. He's galaxy study is successful, then spiral arms must be the disturbance to rational structure. The disturbance is not arbitrary. It traces the Darwin curves of the rational structure. This means that the disturbance to rationality is minimal and harmonic.

8 Conclusion

Galaxies are natural entities. The general-public's curiosity of galaxies can not be blocked, ignored, or misled. Human civilization has reached the point at which the understanding of galaxies is unavoidable! Dr. He's pioneering work on galaxy study can not be covered up. It will be either proved or falsified in the near future.

References

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