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Article 10. Essay: original review of high-dimensional spaces and astronomy theories in modern physics

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Abstract

This article critically reviews the past theories in modern physics that is established on the basis of high dimensional spaces, by comparing and contrasting with the original theories that have been proposed by myself previously. Then the hot issue in astronomy observation, gravitational wave, is reviewed with new discussion of its sources, generating mechanism and future research gaps.

Key words: High dimensional spaces; Topology; Dark Matter; Anti-matter; Gravitational wave; Star formation and Senescence forms

1.Key features of this article:

This paper firstly summarizes the representative theories established on the basis of high-dimensional space [1] in modern physics, which are classified into two parts in this paper. The first part of theories are established on the basis of time axis, from the first proposal of relativity based on the space-time coordinate system [2], to the exploration of macro-space dimension (such as the 11 dimension division of universe space proposed by Hawking [3]), and further to the high-dimensional exploration in the micro-space (such as multi-dimensional quantum space proposed by String theory [4]); The second part of theories are demonstrated without considering time axis as the compulsory factor, so the physics theories of parallel spacetimes [5], dark matter [6], antimatter [7], universal gravity [8], and symmetric cosmic space [9] are all reviewed in this essay. On the basis of the review, this paper compares the original viewpoints proposed by me [10][11][12][13][14] with the previous theories, and discusses and extrapolates the viewpoints by empirical method. Finally, this paper further discusses the related theories of the origin and development of the universe as well as the gestation and development stage of celestial bodies.

In my previous paper, I have discussed that under the effect of dark matter adhesion force on the fourth dimension axis, positively charged protons and their paired electrons do spring-like longitudinal wave motion on the fourth dimension axis to

generate pulse waves. This kind of pulse wave is the origin of radiation such as α Rays, β Rays, γ Rays [15]. The generation of gravitational waves [16] is the space-time bending phenomenon detected under the condition that the mass density and weight of celestial bodies increases significantly. This paper further proposes that the elementary particle motion model in the celestial body of this scenario is similar to that of the ray: the spring-type longitudinal wave motion is performed on the fourth dimension axis, and the pulse wave is generated. However, due to the high mass density of the celestial body that generates the gravitational wave and the aging effect of dark matter, the gravitational wave is low-frequency and has long wave length, compared with the ray. It is deduced that in most cases, the higher the frequencies of gravitational wave, the younger the star form; the stronger intensity of gravitational wave, the heavier mass of the star system (or the stronger gravity per unit mass) to compress the charged elementary particles. When binary star merger happens, the elementary particles between binary stars absorb radiation energy firstly, turning into excited state with higher energy level and more free form (although this excited free form has not reached the ionization state). Then the elementary particles of excited state with more free form are further synthesized into degenerate matter by the gravity contraction. In this degenerate matter synthesis process, the incident particles and atomic nuclei combine to form metastable composite nucleus, which subsequently decays into the final stable particles in a period, further releasing radiation energy. This metastable composite nucleus as the combination of incident particles and nuclei is called the resonant state, and the final stable particles would be the final state of degenerate matter compressed by gravity.

I have previously discussed that dark matter is the origin of universal gravity [10]. The astronomical observation of dark matter is closely related to the phenomenon of anti universal gravity law[6]. Therefore, this paper further believes that the phenomenon of anti universal gravity law observed in astronomy is caused by the uneven distribution of dark matter in the magnetic field intensity between celestial bodies.

With regards to the reasons why there are both positive and negative types of β Decay? this article proposes that the type of β Decay process is mainly determined by the rotation orientations of free electrons around the rotation center point of an atom in the three dimensional spaces. In the electron clouds, if the free electron with rotation motion of clockwise orientation is emitted from the unstable atom, which is defined as the negative pole relatively to the nuclear of an atom, the nucleus would tend to be positive β decay process; if the free electron with rotation motion of anticlockwise orientation is emitted from the unstable atom, which is defined as the positive pole relatively to the nuclear of an atom, the nucleus would tend to be negative β decay process. Consequently, the electrons can be both positive and negative poles relatively to the nucleus of an atom, rather than single pole to the nucleus.

译文：本文首先总结了现代物理学中建立在高维度空间[1]的代表性学说，并且将这些代表性理论分为两类。第一类理论是建立在时间轴的基础上，从相对论的时空坐标系的首先提出[2]，到人类对宏观空间的高维度探究（比如霍金对宇宙空间的 11 维度划分[3]）、再到微观物理学领域的高维度探索（比如弦理论的量子多维度空间[4]）；第二类理论的论证可以不把时间轴作为必须考虑的因素，因此平行空间[5]、暗物质[6]、反物质[7]、万有引力[8]、对称宇宙空间[9]的物理学理论都在本文进行了综述。本文在综述基础上，对比了本人之前提出的与这些理论相关的原创型观点 [10][11][12][13][14]，并且以反证法进行实证性论述。最后，本文进一步论述了宇宙起源与发展的相关理论、天体孕育与发展阶段的相关理论。

本人之前论文论述了在第四维度轴上的暗物质粘合力作用下，带正电荷质子与其配对的电子在第四维度轴上做弹簧式的纵波型运动，产生脉冲波。这种脉冲波就是放射性元素中α射线、β射线、γ射线的起源[15]。引力波[16]的产生则是在天体的质量密度和重量呈现显著增加的条件下探测的时空弯曲现象。本文认为此情景下天体的基本粒子运动模型与射线相类似，在第四维度轴上做弹簧式的纵波型运动，产生脉冲波，但是由于产生引力波的天体质量密度高，以及暗物质的衰老作用，此时引力波相对射线而言是一种低频率的长波。由此推断，在大多数情况下，引力波的频率越高，恒星形态的年龄就越年轻；引力波的强度越强，恒星系统质量的重力越重（或单位质量的引力越强），用于压缩带电的基本粒子。当双星合并时，双星之间的基本粒子首先吸收辐射能量，转变为能级更高、更自由形式的激发态（尽管这种激发态的自由形式尚未达到电离态）。然后通过重力压缩将更具有自由形式的激发态基本粒子进一步合成为简并物质。在这个简并物质合成过程中，入射粒子和原子核结合形成亚稳态复合核，然后在一段时间内衰变为最终形态的稳定粒子，进一步释放辐射能量。这种亚稳态复合核作为入射粒子和原子核的组合，称为粒子共振状态，而且最终形态的稳定粒子则是被重力压缩的简并物质最终状态。

本人之前已经论述了暗物质是万有引力的起源[10]。暗物质的天文观测与反万有引力定律现象密切相关[6]，因此本文进一步认为天文学中反万有引力定律现象是由于天体之间的暗物质在磁场强度上分布非均匀的特性导致的。

关于为什么β衰变同时存在正衰变和负衰变两种类型的原因？本文认为原子核β衰变过程的类型主要是由三维空间中自由电子围绕原子旋转中心点的自旋方向决定的。在电子云中，如果不稳定状态下逃逸的自由电子进行顺时针自旋运动，相对于原子核定义为负极，则原子核趋于正β衰变过程；如果不稳定状态下逃逸的自由电子进行逆时针自旋运动，即相对于原子核定义为正极，则原子核趋向于负β衰变过程。因此，电子相对于原子的原子核既可以是正极，亦可以是负极，而并非单极。

2.Introduction

With the development of quantum physics in modern science & technology period, the knowledge based on the empirical equations of classic physics Law (such as

Newton Gravity Law) can not explain the discoveries of both micro-particles and the astronomy, so that modern physics scientists attempt to solve this by constructing theories on higher dimensional spaces rather than limiting their thoughts within three dimensions. Consequently, this article firstly reviews the modern physics theories constructed on the basis of high dimensional spaces and then attempts to direct the new research gaps in gravitational waves for future study.

3.High Dimensions of Spaces

3.1.Review of high dimensional spaces

High dimensional space refers to the multi-dimensional spaces that is quantized, including micro, macro, and cosmological quantized spaces. For example, atoms and microscopic particles such as electrons, protons, neutrons, and mesons that are smaller than atoms, so their internal spaces are classified into the microscopic quantization space. The earth and astronomy science community has found that there is a lot of 'dark matter' in the universe, which is correspondingly defined as the quantization space of cosmology. The concepts of 'points, lines, and surfaces' in mathematics are only the forms of abstract thinking that helps to interpret the high dimensional spaces. For the spaces of three dimensions, the one-dimensional space is a straight line, the two-dimensional space is a plane, and the three-dimensional space is a solid space. The spatial reasoning of the multi-dimensional axis in mathematics is a kind of abstract expression of high-dimensional space, but is not its own form of existence [1].

What about four dimensions? As it is well known, the fourth dimension is time that is the most popular definition in earth people. From the mathematical thinking, the physical parameter 'time,' as a mathematical coordinate, establishes the arrangement of three-dimensional space on another one-dimensional time axis. Similarly, people can usually argue that four dimensions are more advanced than three dimensions. People have always been afraid of one thing, which is whether there are intelligent creatures living in the fourth dimension or even in higher dimensions, because the world that people perceive is three-dimensional, which eliminates the imagine of our minds to higher dimensional spaces. People usually cannot accept the existence of a creature that we cannot see, but people are seemingly within its grasp. Unfortunately, from the spatial perspective, people living in three-dimensions are inferior to them. In their eyes, we are just like the poor tiger we draw on the paper and cannot escape from our three-dimensional space, so precisely the three-dimensional space where we live traps our thinking [1].

According to the theory of relativity proposed by Einstein, there may be only one way to break through our three-dimensional boundaries, that is to exceed the speed of light. In the world of high-dimensional creatures, the lowest speed is equal to the speed of light, because the speed of light is the boundary point of dimensions, and they always have the results of something before its cause, which is certainly something people

cannot accept. Our brain is limited to causal relationships in three-dimensional space, so how can we have consequences first and then causes? This consequence-causes inversion logic proposed by the theory of relativity cannot be proven [1].

Finally, there are several historic stories (for example, the missed air craft and train) recorded as evidences to support that existence in another time-spaces of our world [1].

In modern physics, one of the representative theories with regards to the classification of universal dimension is M theory, which classifies the universe into eleven dimensions, composed of vibrating planes [3].

3.2.Discussion

Once there is knowledge with regards to the fourth dimension spaces in public domain website in Chinese Mainland above, my article must follow their steps to further discuss the existence in high dimensional spaces. Firstly, as pointed above, the high-dimensional coordinates of mathematics is just the abstract expression of high dimensional spaces other than its real existence, so some people tend to overstate the dimensional number of spaces (such as 11 dimensions classification in M theory). My article only proposes 5 dimensional spaces in total according to the physical properties of magnetism. As demonstrated in another article [11], the fourth dimensional space is called parallel space, because both the magnetic field and electric field display as parallel field lines on the fourth dimensional axis, but the transmission direction is opposite to each other. In the fourth dimensional spaces, both the positive and negative poles of magnetism are distinct without boundary in the middle between both of them, but the boundary of both Yin and Yang poles of magnetism exists in the fifth dimension of spaces, in which the Yin and Yang poles are not distinct and distinguished. My other articles have demonstrated the existence of magnetic line along the fourth dimensional spaces by discussing the driving forces of both elementary particle rotation and star rotation, as well as the sources of generating electric charges of elementary particles [13][14].

There is another issue with regards to creatures in high dimensional spaces as discussed on the public domain website in Chinese Mainland above [1]. My article further proposes that creatures that survive in three dimensional spaces are mainly for growth and reproduction purposes. For the wild populations of creature species with advanced physiological evolution, a small proportion of population may be selected by their ancestors to send back into three dimensional spaces for re-growth and reproduction purposes, which is defined as the key process of ‘natural selection.’ Consequently, in our three dimensional spaces there are some wild populations **with advanced physiology evolution,** who have already been to fourth dimensional spaces, so that they may be not afraid of it. However, this natural selection does not exist in human species any more due to historic reasons.

4.Relativity and Einstein

‘Theory of Relativity’ is the physical theory established by Einstein on the basis of spacetime and gravity, proposing concepts such as ‘simultaneous relativity’, ‘four-dimensional spacetime’, and ‘curved spacetime’[2].

According to the different research objects, relativity can be divided into ‘Special Relativity’ and ‘General Relativity.’ The background spacetime of the special relativity is straight with its curvature tensor of zero, whereas the background spacetime of the general relativity is curved, so its curvature tensor is not zero [2].

A very important conclusion of relativity is to demonstrate the relationship of physical properties between mass and energy: Einstein's famous equation of $E=mc^2$ summarizes this equivalence between mass and energy, which means that mass and energy can be converted into each other [2].

However, it is argued that high dimensional spacetime and high dimensional space are different definitions. For example, in the definition of high-dimensional spacetime, the fourth dimension is time dimension, but it is a pseudo dimension, meaning that its units are different from the other three dimensions. In comparison, the fourth dimension of high-dimensional space still has the same nature as the dimension of three-dimensional space, and time is still a pseudo dimension. Therefore, spacetime and space cannot be confused [3].

5.Topology

5.1.Review of topology

Topology is an inter-discipline originated from the disciplines of geometry and Set theory, which studies the concepts of space, dimension and transformation, on the basis of the theory that some properties of geometry or space that can remain unchanged after continuous shape changes, so it only emphasizes on the positional relationship between continuously changing objects, ignoring the properties of shape and size [17].

5.2.Discussion

As argued by my another article [12], the fourth dimension axis of time-spaces is not time, but is defined by topology with time scale, so the fourth dimension of space possesses the same nature as the three dimensions of spaces.

Consequently, in the topology definition of my article, the properties of geometry or space, which can remain unchanged after continuous shape changes between three-dimension spaces and the fourth dimension spaces, include magnetism, electric field, and dark matter (part of mass). Mass can be divided into elementary particles and dark matters. The properties of elementary particles in three dimensional spaces

will be changed when the space continuously turns to the fourth dimensional space, but dark matter remains constant in topology definition.

6.String Theory

6.1.Review of string theory

String theory is a branch of theoretical physics that attempts to solve some problems of incompatibility between quantum mechanics and relativity, with the basis that the basic units of universal nature are not elementary particles of point form such as electrons, photons, neutrino and quarks, but are the very small linear ‘strings’, including both ‘open strings’ with endpoints and ‘closed strings’ with loops [4].

String theory and its updated version of ‘Super-string Theory’ believe that all subatomic particles are not small dots, but are strings similar to Rubber band so the only difference between the particle types is the frequency variation in the string vibration. The objective of String theory mainly attempts to solve the seemingly incompatible two main physical theories, quantum mechanics and General relativity, intending to create a ‘theory of everything’ that describes the entire universe. However, this theory is very difficult to test, and some adjustments have to be made on the universe we describe, which is that the universe must have more space-time dimensions than the Four-dimensional space proposed by relativity. Scientists believe that these hidden dimensions may have curled up to be so small that we have not detected them [4].

The further discussion of String theory does not only describe ‘string’ objects, but also includes point and film objects, higher dimensional space, and even Parallel universe. It is worth noting that String theory has not yet been able to make accurate predictions that can be verified experimentally [4].

6.2.Discussion

My article must critique the theoretical physics here: the theoretical physics only creates complicated mathematical formulas that are incapable of being verified by experimental or observation data. This is just like mathematical game — neither like physics as natural science nor like applied mathematics which attempts to solve the social issues.

7.Parallel universes

7.1.Review of parallel universe

Parallel universe refers to other universes that are similar to but different from the original universe, existing parallelly to each other. In the multiverse definition, it is a theoretical physics concept combining all possible infinite or finite universes, including all existing and possible physical properties: space, time, matter, energy, as

well as Physical law and Physical constant describing them. Then multiverse is consisted of each universe that is called Parallel universe [5].

In the 1950s, some physicists discovered that the quantum states observed each time were different. Since all matter in the universe are composed of quanta, these scientists have speculated that each quantum possesses a different state, the universe may also be composed of multiple similar universes rather than just one. The concept of parallel universes is proposed according to the scientific discoveries in modern quantum mechanics other than just theoretical physics [5].

7.2.Discussion

My another article has proposed two symmetric three-dimensional spaces along the fourth dimension axis, which is demonstrated and proven by robust physical data [18]. This article further proposes that there are only two symmetric three-dimensional spaces along the fourth dimension which can be defined as parallel universes, rather than infinite parallel universes. The two symmetric three-dimensional spaces show symmetric nature in magnetism and electric field, but the mass between the two three-dimensional spaces are significantly different. One possesses more mass and the other is smaller. The heavy one tends to be Yang pole that is dominant status and the light one tends to be Yin pole that is subordinate status. In our three-dimensional spaces, the majority of cases are like that lighter celestial body is rotated around heavier ones and is following the motion orbit of heavier ones, which is subordinate and dominant status respectively. My another article has further demonstrated the relative directions between magnetic and electric field in parallel spaces [11].

8.Symmetric Universe

The universe of positive and negative symmetry is defined as two universes composed of substances with opposite physical properties and different charged components. The three-dimensional space where we live is called the positive universe (positive space), and the correspondingly opposite of our space is the so-called anti universe (anti space) [9]. However, the past theories underlying this symmetric universe is mainly based on the time-space relativity, whose details are not reviewed in my article again, but the original theories with regards to the symmetric universe are discussed in my another article [18].

9.Law of Universal Gravitation

The Newton's law of universal gravitation is the law of gravity that quantifies the interaction between objects on the basis of empirical data, revealing that any two mass particles attract each other through the gravitational force in the direction along the connecting center line. The magnitude of this gravitational force is directly proportional to the product of the mass between the two objects, but inversely

proportional to the square of their distance, which is independent of the chemical essence or physical state between the two objects [8].

$$\frac{GM1M2}{r*2} = ma = mv^2/r = mrw^2$$

Where G is the gravitation constant, M1 and M2 is the mass of two objects, r is the vector distance between two objects, a is acceleration speed, v is the tangential speed, w is the angular velocity, respectively. This empirical model of Newton's Law is broadly applicable on the physical cases under low speed, macro and weak gravity conditions, but not valid again when conditions turn to be high speed, micro and strong gravity [8]. In other words, this theory derived from macro empirical data is no longer applicable on the physical calculation at quantum level.

10.Dark Matter

10.1.Review of dark matter

Dark matter is a kind of invisible substance that is theoretically proposed to exist in the universe, which is extrapolated indirectly by astronomy observation. It is deduced that dark matter becomes the main component of cosmic matter, but it is not classified into any known substance that constitutes visible celestial bodies [6].

Modern astronomy argues that dark matter would exist in a large number of galaxies, star clusters and the universe, with its mass significantly greater than the total mass of all visible celestial bodies in the universe, which is demonstrated through the observation results of the movement of celestial bodies. This conclusion is deduced indirectly by comparing and contrasting with the natural Laws that is drawn from the empirical results in the earth, including Newton's phenomenon of universal gravitation, the Gravitational lens effect, the formation of the Large-scale structure of the Universe of the universe, and microwave Background radiation. In combination with the observation of Microwave Background Radiation Anisotropy in the universe and the Standard Cosmology model (Λ-CDM model), it can be estimated that dark matter in the universe accounts for 85% of the total mass of all matter and 26.8% of the total mass and energy of the universe respectively, which is composed of Weak Interaction Massive Particles (WIMP). This argument and indirect extrapolation is broadly acceptable by the scientist community, with its mass and interaction intensity nearly at the weak electrical scale, and the observed residual abundance is obtained through the thermal decoupling process during the expansion of the universe [6].

The earliest stage of proposing dark matter: in 1922 astronomer Jacobus Kapteyn proposed that invisible matter could be indirectly inferred from the motion of star systems around stars. In 1933, another astrophysicist, Fritz Zwicky, used spectral redshift to measure the velocities of galaxies in the Coma Cluster relative to the Galaxy cluster. Using the Virial theorem to compare and contrast, it was found that

the velocity dispersion of galaxies in the Galaxy cluster was too high so that the gravity generated only by the mass of visible galaxies in the Galaxy cluster could not bind them in the Galaxy cluster, which was consequently deduced that there should be a lot of invisible dark matter in the Galaxy cluster, whose mass was at least 100 times that of visible galaxies. Later S. Smith's observation of the Virgo Cluster in 1936 also supported this conclusion of dark matter existence [6].

There are several evidences and study methods supporting the existence of dark matter: firstly, the most notable evidence is the astronomy observation calculating galaxy rotation curve and dispersion velocity distribution. Galaxy rotation curve calculates the relationship between the rotation velocity of visible objects in spiral galaxies and their distance to the center of the galaxy. Combined with the Virial theorem, the material distribution in the galaxy can be calculated from the dispersion velocity distribution of visible objects in the galaxy. According to the observation of the distribution in the mass of the visible objects in the spiral galaxy and the calculation of the Newton's law of universal gravitation, the movement speed of the outer objects around the center of the galaxy should be slower than that of the central objects. However, measurements on the rotation curves of a large number of spiral galaxies indicate that the speed of outer celestial bodies is almost the same as that of inner celestial bodies, which is significantly higher than it expected. This inconsistency between the astronomy measurement and Newton's law of universal gravitation implies the presence of massive invisible matter in these galaxies; Secondly, there are three methods to deduce dark matter, including the motion of galaxies in the Galaxy cluster observed and calculated by gravity theory, observing the X-ray produced by the Galaxy cluster, Gravitational lens effect. These three methods are conducted independently with each other which consequently support each other in robust means, comprehensively leading Galaxy cluster observation to be an important mean of studying dark matter; Other dark matter research methods include cosmic microwave background radiation and the formation of the Large-scale structure of the Universe [6].

10.2.Discussion

As deduced above, dark matter would account for 85% of the total mass of all matter and 26.8% of the total mass and energy of the universe respectively, so it must exist everywhere in our planet as well. Additionally, dark matter substance has been also detected by the high-energy particle collision experiment in our earth planet (not just astronomy observation). The original theory discussing the nature of dark matter and the methods to measure the dark matter characters have been proposed by my another article [10], which is summarized in Table 1 for comparison. Particularly, my article has argued that the phenomenon of anti universal gravity law illustrated above is caused by the uneven distribution of dark matter in the magnetic field intensity between celestial bodies. For example, the Coma Cluster observed by Fritz Zwicky is constructed by the dark matter with stronger magnetic field intensity, in comparison

to the galaxy in which the calculation equations of both galaxy rotation curve and dispersion velocity distribution are drawn according to the empirical data.

11.Anti-Matter

11.1.Review of anti-matter

Antimatter is the anti state of normal matter observed in our three-dimension spaces, which will annihilate normal matter to offset each other, exploding and generating huge energy [7].

The common micro-particles of antimatter detected in experiment include positrons and negative protons. Compared with the normal state of electrons and protons, antimatter micro-particles have the same quantity of electric charges but opposite electrical properties. It is argued that there may be spaces completely composed of antiparticle in the universe, which is named as antimatter spaces in which the atom is consisted of negative protons and positrons. In general, normal state elementary particle and anti state elementary particle do not only have opposite charges, but also have opposite properties [7].

The experiment detection of anti-particles in quantum physics: the elementary particle state of both protons and neutrons are collectively referred to as nucleons, which can be converted into each other. It is found that in the study of nuclear phenomena, the elementary particles of proton state can be converted into neutron state, and inversely the elementary particles of neutron can also be converted into proton state, but the total quantity of nucleons in the atomic nuclear system stay as unchanged quantity before and after the conversion. For example, when β decay occurs, the emission of positrons is called 'positron' β Decay, whereas it is called ‘negative β Decay’ if it releases negative electrons. In the positive direction of β decay process, a proton in the nucleus is turned into a neutron, coupled with releasing a positron and a neutrino at the same time, while during negative β decay process, a neutron in the nucleus is turned into a proton, and a negative electron and an antineutrino are emitted concurrently. In addition, electron capture is also one kind of β decay called Electron Capture β Decay in quantum physics [7].

Consequently, it is to better understand that antimatter is the mirror state of normal matter. Normal atoms contain positively charged nuclei, while negatively charged electrons are outside the nuclei. For its inverse state interpreted fundamentally, the composition of antimatter have positively charged electrons and negatively charged nuclei. Einstein predicted the existence of antimatter according to the theory of relativity: ‘For a matter with mass m and charge e, there must be a matter with mass m and charge e (i.e. Antimatter)’. According to physicists' hypothesis, at the beginning of forming stages of the universe, there was equal amount between normal matter and antimatter. Once they are approaching each other, they would annihilate each other and cancel each other, exploding and generating huge energy [7].

11.2.Discussion

My another article has proposed the anti-matter of symmetric three-dimensional spaces along the fourth dimension axis, provided robust evidences supporting this argument [18]. Here it is further to argue that the anti-particles detected by experiments are the unstable state of elementary particles, which are caused by the external electric field (such as the synchrotron phase in the particle collision experiment) or by the decay of dark matter binding these elementary particles (such as β Decay process). Both reasons result in the inverse direction of spinning motions of elementary particles, becoming the properties of anti-particles. However, as discussed in my another article [13], these magnetic elementary particles' cutting motion along the magnetic line on the fourth dimensional axis is the mechanism of generating electric charges, so the spinning motions of elementary particles mentioned above is relative to the magnetic line on the fourth dimensional axis, rather than the rotation motion around the rotation center point of an atom in the three dimensional spaces, but the two kinds of motion orbits must influence each other. With regards to the reasons why there are both positive and negative types of β Decay? this article proposes that the type of β Decay process is mainly determined by the rotation orientations of free electrons around the rotation center point of an atom in the three dimensional spaces. In the electron clouds, if the free electron with rotation motion of clockwise orientation is emitted from the unstable atom, which is defined as the negative pole relatively to the nuclear of an atom, the nucleus would tend to be positive β decay process; if the free electron with rotation motion of anticlockwise orientation is emitted from the unstable atom, which is defined as the positive pole relatively to the nuclear of an atom, the nucleus would tend to be negative β decay process. Consequently, the electrons can be both positive and negative poles relatively to the nucleus of an atom, rather than single pole to the nucleus. Because the electron's cutting motion along the magnetic line on the fourth dimensional axis is the mechanism of generating negative electric charges in electron clouds, the quantity of electric charges must be different between clockwise spinning electrons and anticlockwise spinning electrons in electron clouds according to the theory about the generating reasons of both positive and negative β decay process: for the positive β decay process, the free electrons of clockwise spinning in electron clouds, which is the negative pole relatively to the nuclear of an atom, carries more negative electric charges; for the negative β decay process, the free electrons of anticlockwise spinning in electron clouds, which is the positive pole relatively to the nuclear of an atom, carries less negative electric charges (Please note: the β particles' mass is considered to be equal to the electrons in electron clouds, but both positive and negative β particles from the decaying nucleus are not the electrons spinning in electron clouds. Do not be confused!). Therefore, it is further to deduce that the free electrons of clockwise spinning are more active in chemistry reaction than the anticlockwise ones. The findings of both positive and negative β decay process would further support the 3D modeling of electron clouds designed in my another article [19], which classifies the electron orbits into Yin and Yang poles in the electron clouds according to the

clockwise and anticlockwise spinning orientations respectively. Of course, the clockwise and anticlockwise can be also defined as Yang and Yin poles respectively in this 3D modeling when the observation angle is turned to be opposite.

Table 1. Summary of original physical theories proposed in my articles for comparison.

Conception	Past Theory	My original ones
High dimensional spaces	Time space and Relativity; M theory (11 dimensions)	Five dimensional spaces based on Topology; demonstration of magnetic line along fourth dimensional spaces [12][13][14];
Symmetric Universe	General Relativity;	Demonstration by the force balance analysis of elementary particles [11][18]
Parallel Universe	General Relativity;	Definition by both magnetic and electric field direction[11][18].
Anti-Matter	Both positive and negative types of β Decay; Both normal state and anti-matter spaces in universe	Further development on the causing mechanism of both positive and negative types of β Decay; demonstrating the existence of anti-matter spaces in universe [18].
Dark Matter	To deduce indirectly from the inconsistency between the Newton Gravity Law and the astronomy observation; To be detected by the high-energy particle collision experiment	To deduce from the aspect of both chemistry and mechanics characteristics of materials [10].

12.Gravitational wave

12.1.Review of gravitational wave

Gravitational wave is firstly predicted by Einstein in General Relativity, revealing the disturbance to the space-time of the universe caused by the acceleration of objects. Basically, the mechanism of gravitational is similar but not identical to the water waves generated by the movement of objects on the water surface. Usually, only very

large objects can emit gravitational wave that are easy to detect, such as supernovae explosion or two black holes colliding, which is very rarely observed [16].

Gravitational wave is called as the sound of 'crying' at the birth of the universe, which has been spreading in all directions since the birth of the universe with tiny residual energy that is detectable, so it is also called 'Random Gravitational Wave Background'. In the 'Laser Interference Gravitational-wave Observatory', scientists are trying to find a disturbance event brought by the 'Random Gravitational Wave Background' in the laser light up to 4 kilometers long, whose probability of occurrence is smaller than that of an atomic nucleus [16].

It is great to see that scientists have constructed several facilities at large scale globally for detecting gravitational wave. In the European Gravitational Wave Detection plan, scientists have built land-based Gravitational wave antennas at GEO600 Gravitational wave observatory in Hanover, Germany, and constructed Gravitational-wave observatory in Virgo, Italy, with the interferometer arm of 600 meters long in GEO600 Gravitational Wave Observatory in Hanover, Germany and an arm length of 3000 meters in the Virgo Gravitational-Wave Observatory located in Italy respectively. The detector is likely to encounter the 'short pulse' of Gravitational wave, which is caused by two stars or two black holes circling each other [16].

However, although it has been claimed that Gravitational waves are occasionally detected in the laboratory at transient time, it has not been recognized to reach the consensus. Consequently, astronomers try to indirectly verify the existence of Gravitational wave by observing the changes of orbital parameters of binary stars. For example, the revolution of binary star system, the rotation of neutron star, supernova explosion, and the formation, collision and capture of black holes predicted by theory can radiate strong gravitational waves [16].

12.2.Discussion

This article tries to propose the original theories with regards to the gravitational wave. As described above, the gravitational wave is occasionally detected by the Laser Interference, which may encounter the 'short pulse' of Gravitational wave, so the gravitational wave must be a kind of longitudinal pulse wave rather than transverse wave. In my previous paper, I have discussed that under the effect of dark matter adhesion force on the fourth dimension axis, positively charged protons and their paired electrons do spring-like longitudinal wave motion on the fourth dimension axis to generate pulse waves. This kind of pulse wave is the origin of radiation such as α Rays, β Rays, γ Rays [15]. The generation of gravitational waves [16] is the space-time bending phenomenon detected under the condition that the mass density and weight of celestial bodies increases significantly. This paper further proposes that the elementary particle motion model in the celestial body of this scenario is similar to that of the ray: the spring-type longitudinal wave motion is performed on the fourth dimension axis, and the pulse wave is generated. However, due to the high mass

density of the celestial body that generates the gravitational wave and the aging effect of dark matter, the gravitational wave is low-frequency and of long wave length, compared with the ray. For example, the frequency range of gravitational wave is defined from 10^{-18} Hz to 10^{14} Hz [20], which is significantly lower than the ray frequencies.

Further more, according to the generation mechanism of gravitational wave discussed above, the detection of gravitational wave can be used to estimate the aging stages of star celestial body, so the construction of facilities at large scale globally for detecting gravitational wave is still valuable and meaningful to help better predict and understand the development of our universe.

13.Star Formation

13.1.Star formation and development

A star is a giant sphere composed of glowing plasma mainly with elements of hydrogen, helium, and additionally with trace amounts of heavier elements. The brightness of a star is measured by magnitude in astronomy, with the relationship that the higher brightness is defined as the lower magnitude in this measurement scale. Nuclear fusion is carried out in the core of star to generate energy, transmitting it outward and radiating from the surface to outer space. Once the nuclear reaction of the core is exhausted, the life of the star will end soon. At the end of life stage, stars mainly contain degenerate matter, which is a substance with extremely high density and the star forms including: White dwarf, Neutron star, Strange matter, Metallic hydrogen and Black hole, etc [21].

The classification of stars that is widely recognized is based on spectral classification. According to the spectral characteristics, including spectral lines and bands in spectral class, the relative intensity among these spectral lines and bands, as well as the energy distribution of continuous spectrum, stars are divided into ten major types [21]:

Table 2. Star classification based on spectral characteristics [21].

Star Type	Colour	Spectral Characteristics	Surface Temperature	Life Time	Example
O	Light blue	Strong and continuous UV spectral bands are detected. There are ionized helium, neutral helium, and hydrogen lines. The secondary ionized carbon, nitrogen, and oxygen lines are weak.	30,000 - 60,000 K	About a few million years or less	Orion ι

B	Blue and white color	The hydrogen line is strong with obvious neutral helium line, and there are no ionized helium lines, but there are spectral lines indicating ionized carbon, nitrogen, oxygen, and secondary ionized silicon.	10,000 - 30,000 K	About tens of millions of years	Orion β
A	White	The hydrogen line is extremely strong, with spectral lines of ionized magnesium and ionized calcium, but the helium line disappears.	7,500 - 10,000 K	About several hundred million years	Lyra α
F	Golden and While	The hydrogen line is strong, but weaker than the A-type. The ionized calcium line is greatly enhanced and widened, resulting in the appearance of many metal lines.	6,000 - 7,500 K	About billions of years	Ship base α
G	Yellow	The hydrogen line weakens but the metal line strengthens with very strong and wide ionized calcium line.	5,000 - 6,000 K	About 10 billion years	Sun
K	Orange	The hydrogen line is weak, but the metal line is much stronger than the G-type lines.	3,500 - 5,000 K	About 15 billion to 35 billion years	Boötes α
M	Red	The titanium oxide molecular band is the most prominent, and the metal line is still strong, but the hydrogen line is very weak.	2,000 - 3,500 K	Over billions of years	Orion α
R and N	From orange to red	The spectra are similar to those of K and M types, but are added with strong	---		Pisces 19

		molecular bands of carbon and oxygen, which are consequently classified into carbon stars, denoted as C.			
S	Red	The spectra are similar to the M-type, but are added with strong zirconia molecular bands, often emitting hydrogen radiation.	---		Gemini R

13.2.Discussion of mass source in universe

My another article firstly proposes that creatures would be hatched in stars, whose metabolites become the sources of new mass in our universe (myth stories?), increasing the total mass of our three dimensional space which is always expanding, so that our three dimensional space can keep its balanced state in rotational motion [14]. Here my article further argues that the spectral lines indicating different chemistry elements at different life stages of star would represent the bio-signals of creatures hatched in the stars. At the 'larva' stage of creature, the creatures are hatched by highest temperature. At this stage (Stage O), the star spectral lines of ionized helium, neutral helium, and hydrogen indicate the nuclear fusion in the star reactor, while the spectral lines of weak secondary ionized carbon, nitrogen, and oxygen indicate the organic elements at larva stage of creatures. With the growth of this creature, the spectral lines (Stage B and A) of organic elements become stronger and the temperature required to hatch the creatures decreases. When they turn to be mature, the organic elements of soft organs turn to be hard organs, so metal elements become one of the main components (Stage F, G, K). At the advanced stage, the hard organs of creatures contain heavier metal elements than the mature stage (Stage M) and the advanced creatures yield their offspring creatures, so strong molecular bands of carbon and oxygen indicating larva stage of creatures are added again at R and N star stages.

Next it is to selectively review the theories with regards to physical properties of stars, which can be understandable and validated by empirical data:

13.3.Lifespan and Stellar activity

The relationship between the mass and lifespan of stars usually is defined as: the larger the mass of a star, the shorter its lifespan, mainly because the pressure in the core of the star with heavier mass is correspondingly enhanced, resulting in faster burning rate of hydrogen. Consequently, many supermassive stars have an average lifespan of only one million years, but the lightest stars (such as red dwarfs) burn their

fuel at a very slow rate relatively, and their lifespan can correspondingly last for tens to trillions of years [21].

The magnetic field of a star originates from the region where the convection cycle of gas substances occurs within the star, similar to a conductive plasma generator causing the magnetic field to extend in stars. The intensity of the magnetic field changes with the mass and composition of the star, and the total amount of surface magnetic activity is depended on the speed of Stellar rotation, which can produce star spots where the surface magnetic field is stronger than normal and the temperature is lower than normal [21].

Due to the activity of magnetic fields, young and high-speed rotating stars tend to perform as high surface activity, which also enhances stellar winds, but the rate of rotation gradually slows down as the star ages. Therefore, stars as old as the Sun rotate at a lower rate, and their surface activities are correspondingly mild without strong stellar winds. Stars with slow rotation tend to exhibit periodic changes in surface activity and may temporarily cease activity during the cycle [21].

13.4.Discussion of Solar flare generation

My article here further discusses the increasing incidence of Solar flare caused by the aging of the sun. With the aging of solar nuclear reactor, the magnetic field tends to be uneven distribution occasionally (such as leakage of inner pressure) so that the convection between different gas substance layers in the sun is disturbed; secondly, the slowing down of solar rotation speed also leads to solar winds on the surfaces, both of which become the reasons to increase the solar flare events. Further more, it is to discuss the disturbed fluid movement in star on the basis of equipotential shield effects: the boundary layers are formed inside a star between different substance layers with different properties (such as different density or chemistry composition) [35]. These boundary layers also become the equipotential layers inside a star, whose equipotential shield effect causes the charged particles in the outer space to conduct parallel motion to the equipotential lines, and in my article this type of parallel motion' substance layer is defined as the parallel fluid layer. When the equipotential layers are stable, the parallel fluid layers between different equipotential layers move smoothly; however, when the star goes towards aging, the boundary layers occasionally or periodically break, and the breaking zone of a boundary layer causes the convection disturbance movement between the two sides' substance layers of a boundary layer, and this convection motion direction is vertical to the boundary layer, which is defined as vertical convection fluid in my article. Consequently, the breaking of boundary layers inside the solar star is one of the main reasons resulting in Solar flare events, and this process is illustrated in Figure 1. The substance of outer layers goes down due to heavy gravity while the substance of inner layer goes up due to higher air pressure, thus forming convection and disturbance flows, and Figure 2 shows the formation of dark spots and flash spots due to this motion process.

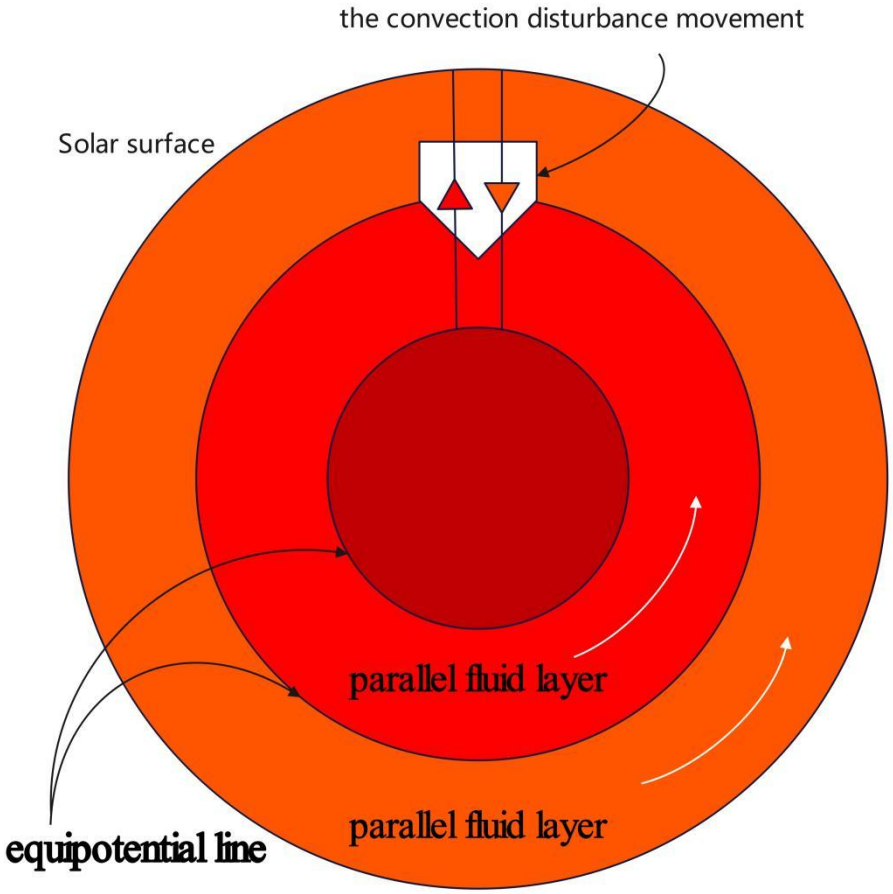


Figure 1. The equipotential shield effects inside solar star. The convection disturbance movement occurs in the breaking zone of an equipotential layer, causing Solar flare.

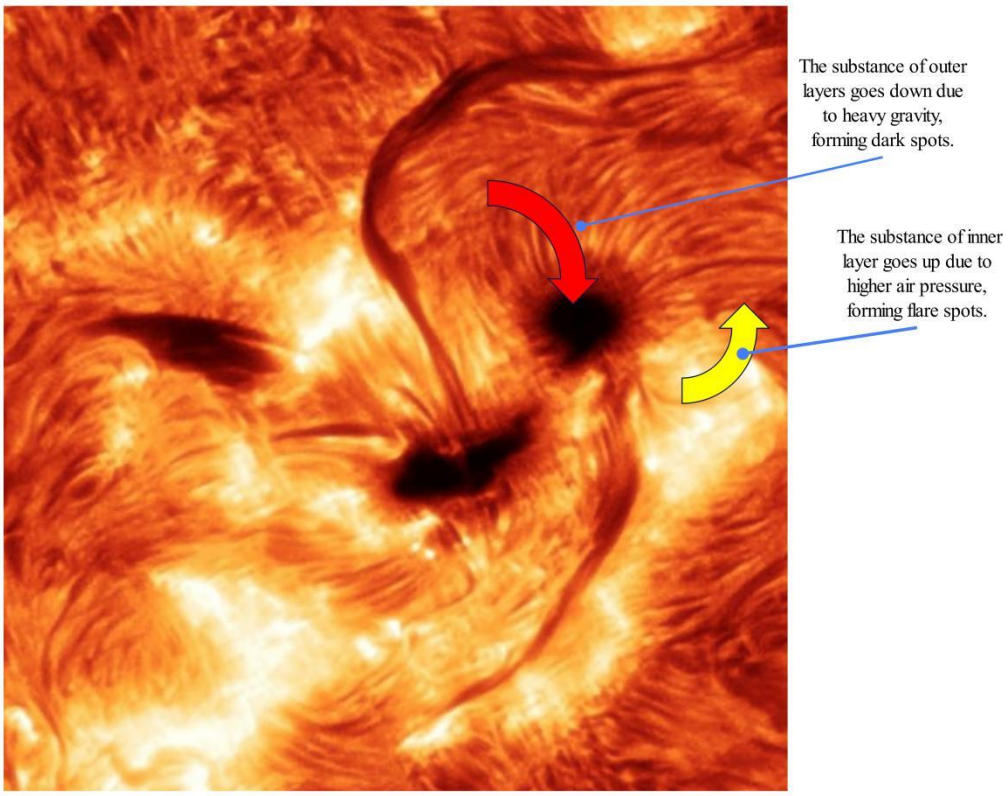


Figure 2. The formation of dark spots and flash spots in Sun surface due to convection motion.

13.5.Aging of Stars

With the aging of star with lower mass (such as the sun), stars expand at the first senescence stage, when the star is called a 'Red Giant' that collapses and becomes a 'White dwarf.' White dwarf further radiates and loses energy, then turning into a 'Black dwarf,' and finally disappears [21].

With the senescence of massive star at a density of not less than 7 times of solar density, stars become a 'Red supergiant,' which ends its life in the form of a supernova explosion and eventually becomes a Neutron star or a Black hole. The Neutron star eventually loses energy, forming a 'Black dwarf,' while black hole emits particles outward, perhaps turning into white holes or completely evaporating [21].

It is to summarize that the senescence forms of stars discussed above, mainly including 'Red Giant,' 'White dwarf,' 'Black dwarf,' 'Red supergiant,' 'Supernova,' 'Neutron star' and 'Black hole,' are not only the forms of degenerate matter, but also the sources detecting the gravitational wave. Consequently, it is to further review the relevant theories interpreting each senescence form of stars below.

14.Senescence forms of stars

Red giant is a kind of unstable stage experienced by stars in the aging process of burning. According to the Stellar mass, Red giant form can last only for millions of years, whose surface temperature is relatively low with red colour, lifted brightness and huge volume, consequently named as 'Red Giant.' The stars are burning by thermonuclear fusion inside them, resulting in nuclear fusion into one helium nucleus from every four hydrogen nuclei, coupled with a large amount of atomic energy and radiation pressure released. Nuclear fusion mainly takes place in its center (core) of a star, achieving balance between radiation pressure and its own shrinking gravity.

Under this balance situation, the burning of hydrogen in the star is extremely fast, and the center forms a helium core and keeps increasing. As time goes on, the hydrogen around the helium nucleus decreases, and the energy generated by the central nucleus is no longer sufficient to maintain its radiation, resulting in the disrupted balance with the expression as the contraction of the helium core and the expansion of the hydrogen shell. The Stellar nucleosynthesis of helium core inside the combustion shell shrinks inward and becomes hot, while hydrogen burning in the stellar shell expands outward and keeps cooling, greatly reducing the surface temperature and becoming a Red giant in rapid expansion. The final result of helium core fusion is to form a White dwarf in the center [22].

White dwarf that is also known as degenerate dwarf is a star with low luminosity, high density and high temperature, named as 'White Dwarf' due to its white color and small size. White dwarf is the final stage of a star evolution, which is mainly composed of carbon covered by hydrogen and helium. White dwarf gradually cools and darkens over hundreds of millions of years, turning to be small in size, low in brightness, but high in density and mass. When the outer region of the red giant star expands rapidly, the helium core shrinks strongly inwards due to the reaction force, and the compressed material continues to heat up. The final core temperature will exceed 100 million degrees, so the helium begins to condense into carbon. When the unstable aging state of the star reaches the critical limit, Red giant will explode, throwing the matter outside the core away from the star body, which diffuses outward into a nebula, so that the helium core is left to become the White dwarf that can be seen. As the result of remaining core substances, White dwarf is usually composed of carbon and oxygen. There is no nuclear fusion reaction inside White dwarf, so the star no longer generates energy, which means that the temperature of White dwarf formation is very high at the first stage, but there is no energy source. Therefore, it will gradually release its heat and gradually cool down, with the colour finally turning from white into red. The balance of electron degenerate pressure against the strong gravitational forces of White dwarf maintains its stability of star. However, when the mass of White dwarf further increases, the electron degenerate pressure may not resist its own gravitational contraction, so White dwarf will collapse into more dense forms: Neutron star or Black hole. Another viewpoint is that after a long time, the temperature of White dwarf will cool down to the point where the luminosity can no

longer be seen, becoming a cold Black dwarf. However, this viewpoint only stays in theory [23].

Red supergiant is a massive star on the verge of death, with low temperature and huge radius varying from hundreds to thousands of times of that in the sun. Red supergiant is one of the Supergiant stars, whose volume is one of the largest stars in the universe. After the outer layer expands, the cohesive force which it receives decreases. Even if the temperature decreases, its expansion pressure can still resist or exceed the gravitational force. At this point, the increase in the radius and surface area of the star exceeds the increase in radiation energy production rate. Therefore, although the total luminosity may increase, the surface temperature will decrease. When a big star with the mass higher than 4 times of the Solar mass re-initiates hydrogen fusion outside the helium core, the energy released outside the core does not increase significantly, but the radius increases many times, so the surface temperature drops from tens of thousands of K to 3000~4000 K, becoming a Red supergiant. When small and medium-sized stars with the mass less than 4 times of the Solar mass enter the Red giant stage, their surface temperature drops, but their luminosity increases sharply, because their outer expansion consumes less energy with more radiation energy production capacity [24].

Supernova is a kind of aging stage in the process of Stellar evolution, which is a violent explosion experienced by stars when they are approaching the end of their evolution, which is extremely bright. The sudden electromagnetic radiation in the explosion can often illuminate the whole galaxy where it is located, and may last for weeks to months before gradually decaying. During this period, the radiation energy released by the explosion can be equal to the total radiation energy of the sun in its lifetime. It is estimated that the probability of supernova explosion in a galaxy like the size of the Milky Way is about once per 50 years, and they play an important role in providing rich heavy elements for Interstellar medium. At the same time, the shock wave generated by the supernova explosion will also compress the nearby Interstellar cloud, which is an important initiating mechanism for the birth of new stars [25].

Neutron star is one of the few terminal forms which may become after supernova explosion via Gravitational collapse at the end of Stellar evolution, which is a kind of star between White dwarf and Black hole, formed by the collapse of stars whose mass is not enough to form Black holes at the end of their lives. Hydrogen, helium, carbon and other elements in the core of stars are exhausted in nuclear fusion reaction, and when these elements are finally transformed into iron, they cannot obtain energy from nuclear fusion again. The surface temperature of Neutron star is about 1.1 million degrees with χ Radiation, γ Radiation and visible light. The Neutron star forms a very strong magnetic field, which makes the Neutron star emit beams of radio waves along the direction of the magnetic pole. The rotation of Neutron star is very fast, which can reach hundreds of revolutions per second. If the magnetic poles of the Neutron star faces to the earth, then the radio wave beams from the Neutron star will sweep the

earth again and again with the rotation like a rotating lighthouse, forming radio pulses, which is consequently called as 'Pulsar'[26].

A supermassive Black hole is hidden in the center of most galaxies in the universe, including the Milky Way where we live. The mass of these Black holes varies from 990000 to 40 billion times of Solar mass. The existence of black holes is usually indirectly inferred by detecting the strong radiation and heat from Accretion disk around them. When matter falls under the gravity of a strong black hole, it will form an Accretion disk around it and spiral down. In this formation process, radiation energy will be released quickly, heating the matter to extremely high temperature, thus emitting off strong radiation. Black holes devour surrounding matter through accretion, which may be their way of growth [27]. The past theories explaining Black hole are based on the time-space relativity, which are not reviewed further in my article.

Based on the relevant theories discussed above, next this article selects and reviews case studies in the astronomy research with specific emphasis on the gravitational wave and Black holes, which have been published in China as PhD or Master theses [29][30][31][32][33]. Then future research gaps in the astronomy observation are discussed on the basis of new theories proposed by my article above.

15.Case studies on gravitational wave

15.1.Case studies

In the gravity research conducted by Wang (2023), the relationship between mass radius and Compact star under the gravity function of f (Q) is studied, where Q is a non-metric scalar. The Compact stars that are chosen as the object studied include both Neutron star and Quark star. The specific f (Q) model as f (Q) = Q+ α Q2 is examined, and SLy, BSk19, AP4 and GM1nph equations of state are selected to study the properties of Neutron star, while MIT bag model equations of state are used to study the properties of Quark star. Using numerical calculation methods, this study has found that when the model parameters α is given as positive value, f (Q) gravity exerts stronger gravitational effect, resulting in degenerate matter pressure only supporting fewer substances per unit neutron gas. Therefore, in this case, the modeled mass of the star will become smaller than that predicted by General relativity. In comparison, when the model parameters α turns to be negative, f (Q) gravity provides additional support for the star, allowing it to obtain greater mass. This means that in f (Q) gravity function, stars can obtain the results of some observations beyond the prediction range of General relativity. In addition, this paper combines the observation data of the Gravitational wave events GW170817 and GW190814, as well as the massive Pulsar PSRJ0030+0451, PSRJ0740+6620, PSRJ2215+5135 to restrict the model parameters α of the f (Q) gravity model. It is found that if the massive object in the Gravitational wave event GW190814 is regarded as a Neutron star with a mass of 2.59 ± 0.08M ⊙, the f (Q) gravitational model is required to

impose additional restriction conditions on model parameters α to explain these observation data with the unit of rg = GM ⊙/c2 (?) 1.48 × 105 cm, including: for the SLy equation of state, model parameters α≤- 1.1rg2; For the BSk19 equation of state, model parameters α≤- 1.695rg2; For the AP4 equation of state, model parameters α≤- 1.779rg2; However, for the GM1nph equation of state, there are no model parameters α that is capable of meeting constraints. Under another hypothesis, if it is to consider that the participating star during the Gravitational wave event GW190814 is not a Neutron star so that the corresponding data is excluded, the constraints will be relaxed: for the SLy equation of state, model parameters α≤- 0.14rg2; For the BSk19 equation of state, model parameters α≤- 0.591rg2; For the AP4 equation of state, model parameters α≤ 0.097rg2; For GM1nph equation of state, model parameters α≤- 1.408rg2 [33].

The core density of a cold Neutron star composed of dense matter can reach several times of the nuclear saturation density, which can not be achieved in the laboratory. Therefore, Gravitational wave naturally becomes a cosmic laboratory for detecting extremely dense State of matter. The rotational properties of Neutron star in equilibrium state based on numerical calculation have been studied by Huang (2023). Starting from the non-rotating Neutron star, it is to calculate the central density and gravitational mass of the rapidly-rotating and uniformly-rotating Neutron star under the j constant law. It is found that when the Neutron star reaches the maximum mass, the core density decreases with the increase of rotating speed, which means that the mass threshold of fast-rotating Neutron star is mainly determined by the low-density Equation of state. At the same time, if the rotational speed of the center of the poorly-rotating Neutron star in the equilibrium state monotonically increases from the boundary to the inside, the mass of the Neutron star that can be maintained will be significantly increased when the core angular velocity is much higher than the boundary one. Therefore, the rotation law plays a decisive role in the mass threshold of Neutron star. Based on the simulation data, the complete process of binary Neutron star merger is described, in which the rotation curve of the merging product is calculated, confirming that the poor rotation Law in the dynamic process represented is completely different from that given by the j constant of equilibrium state. Therefore, it is to deduce that the dynamic effect leads to the merging product with higher mass. The Gravitational wave radiation during the merging process is calculated and the correspondingly gravitational wave spectrum is theoretically analyzed. It has been concluded that the main mode (f2) of the Gravitational wave after merging is generated by the instability of the rod mode with m=2, so its frequency is twice than the angular velocity on the boundary of the merging product, whose properties are consequently simulated on the basis of the state equation of hadron quark transition. Based on the property that the hadron quark transition changes the inertia moment of the merger product, the system correspondingly changes the Gravitational wave frequency by changing the rotation frequency, which may be measured by the Gravitational-wave observatory. Due to the fact that the highest density of the product after merging can reach several times of that before

merging, how quarks are liberated in high-density hadron matter after merger will be revealed by the dynamics simulation. Then based on the state equation of the quark hadron crossover (QHC), the binary Neutron star merger is simulated, finding that for binary merger with a low mass, the maximum Baryon Number Density (nmax) after the merger is below 3 to 4 times than the Saturated Number Density of nuclear matter (n0), so the typical feature of the QHC model within this density range is that hardening leads to lower f2 (~50-100 Hz); in comparison, for the binary stars with large mass, nmax may exceed 4 to 5 times than n0, depending on the specific Equation of state. Whether f2 in the QHC model is higher or lower than the corresponding hadron model is depended on the height of the sound velocity peak. Therefore, the comparison between f2 frequencies under different Equation of state can provide important clues for different types of quark dynamics in the high-density Equation of end state. The simulation results show that the relative size of f2 can be directly used to judge whether quark matter appears in the interior of Neutron star and how hadrons transform into quarks (first order phase transition or continuous transition). The conclusion of this research will soon be tested by the upgraded Advanced LIGO and the third generation Gravitational-wave observatory's kilohertz Gravitational wave observation [32].

The merging of two Compact star (such as binary Neutron star merger, Neutron star merging with black holes and Binary black hole merger) is the important source of gravitational wave radiation in the universe. For the binary Neutron star merger, in addition to generating gravitational wave radiation, it will also generate electromagnetic wave radiation of multi-bands, such as short gamma ray bursts, Kilonova, etc; For the merging of binary Black hole, it is generally believed that almost no electromagnetic radiation will be generated; However, the merger between Neutron star and Black hole is a special case: when the tidal collapse radius of Neutron star is larger than the radius of the innermost stable circular orbit of the black hole, the Neutron star will undergo tidal collapse, and then the disintegrated material fragments will be accreted by the Black hole or moved outwards from Black hole, thus generating electromagnetic radiation. In comparison, when the tidal collapse radius of the neutron star is smaller than the radius of the innermost stable circular orbit of the Black hole, the Neutron star will be completely absorbed by the Black hole without generating any electromagnetic radiation. This paper has studied the gravitational wave events related to the electromagnetic radiation of two merging Compact star. The first work mainly focuses on event GRB 201221D at short-time scale (T90~0.1s) with high redshift (z=1.046), which may originate from the merging of two Compact stars. It is to systematically analyze the observational data of both Swift/BAT and Fermi/GBM, revealing that the energy spectrum of the storm can be well fitted by using the cutoffpower-law model, with peak energy Ep= 113^{+9}_{-7} keV and isotropic energy $E_{\gamma,Iso}=1.36^{+0.17}_{-0.14} \times 10^{51}$ erg respectively. Different classification criteria are used to explore the physical origin of the storm, such as the Amati

relationship ε-Parameters, amplitude parameters, local event rate density, Luminous efficiency function, Host galaxy properties, etc. The analysis results show that the binary Neutron Stars merger can explain most of the observational properties of event GRB 201221D. In addition, it has been found that the radiation area of the storm jet experiences an acceleration process in the instantaneous radiation phase, and the distance between the radiation area and the central engine is about 10^{16} cm, which is far greater than the distance predicted by the photosphere and the internal shock model, but is consistent with the results predicted by the magnetic reconnection and turbulence (ICMART) model caused by the internal collision. Therefore, it is to deduce that the jet of the storm may be dominated by Poynting energy flow, which is consistent with the results predicted by the binary Neutron Stars merging model. The second task of this research paper is to define the Black hole charges in the system composed of Charged Black hole and Neutron star. LIGO and Virgo have detected two Gravitational wave events from the merger of Black holes and Neutron star, which are GW200105 and GW200115 respectively. However, in the follow-up observation of these two events, there are no exact electromagnetic counterpart of gravitational wave obtained, with only some optical candidates that may be related to these two gravitational wave events. Under the hypothesis that the Black hole has a certain amount of charge, the black hole charge is constrained by the electromagnetic radiation that may be related to the Charged Black hole-Neutron star system, as charged Black hole and Neutron star will generate electric dipole and magnetic dipole radiation in the process of approaching. The energy of these radiation flows outwards through Poynting energy, and then the magnetic energy in the energy flow accelerates electrons through the magnetic reconnection process, and finally the accelerated electrons generate observable electromagnetic radiation by the Synchrotron radiation facilities. Firstly, the efficiency of energy transfer from both electric dipole and magnetic dipole to radiation in different wavebands has been studied, showing that the energy conversion efficiency in X-ray wavebands is far greater than that in optical wavebands as well as ultraviolet and radio wavebands; Secondly, the electric charges of Black hole is very limited, which is supported by the results that the maximum Black hole charge in GW200105 and GW200115 events is 1.16×10^{29} esu and 5.36×10^{28} esu, respectively, while the surface magnetic field intensity of Neutron star is $Bp \lesssim 10^{15}$ G and Rotation period P is more than 1 ms [31].

Neutron star is the most compact object that can be observed directly in nature, and its maximum gravitational mass has been paid great attention. The determination of the maximum gravitational mass of Neutron star can not only be used to clearly distinguish Neutron star from Black hole, improving the theory of late Stellar evolution, but also it can identify the equation of state under the extremely dense state of matter, to test the theory of extremely dense matter that cannot be achieved by human laboratories. Due to the limitations of nuclear physics theory and experiment, knowledge about the ultrahigh density State of matter in the core of Neutron star has been seldom understood, so the maximum mass calculated theoretically shows apparent uncertainty. The most convincing result is the maximum mass limit of

3.2M⊙ obtained by Rhodes and Ruffini under extreme limiting conditions. Astronomical observations constantly refresh the record of maximum mass of Neutron star. To date, the maximum mass accurately measured has reached 2.08± 0.07 M⊙, and the probability that the maximum mass is greater than 2 M⊙ is more than 84%. This is the reliable lower limit of maximum gravitational mass of Neutron star, which will continue to be replaced by the later. According to the multi messenger observation results of GW170817 and the numerical simulation results, the maximum gravitational mass of the non-rotating Neutron star is calculated as 2.13-0.08+0.09 M⊙ with 68.3% confidence interval using the Monte Carlo method. This research paper attempts to define the limit of maximum gravitational mass from the perspective of Neutron star mass statistical distribution, so the measurement method of Neutron star mass is introduced firstly by collecting the latest results of Neutron star mass measurement, and then Bayesian method is used to judge the best fitting mass distribution model and estimate the model parameters. The results show that the Neutron star mass distribution meets the double Gaussian distribution and has an obvious maximum mass truncation, which is between 2.21 and 2.38 M⊙ with the median of 2.26 M⊙(68% confidence interval). In order to verify the reliability of the results, the data in the ATNF Pulsar catalog is used to analyze the selection effect, proving that the maximum mass truncation is not significantly affected by the selection effect, deriving the maximum mass truncation approximation for the maximum mass of the non-rotating Neutron star. Using the total mass collapse threshold formula obtained, it is found that there is a great possibility that the binary Neutron star system with a total mass less than 2.7M⊙ will merge to form an overweight Neutron star (SMNS). Finally, through the analysis of the rotational energy after the incidence of merging events, it is deduced that the merging event of binary Neutron star system is likely to be a significant source of EeV Cosmic ray protons [30].

The newly-formed millisecond magnetostar possesses strong magnetic field (B ～ 10^{14}-10^{15}G) and millisecond rotation period (P～1-10 ms), which can very quickly convert its rotation energy into electromagnetic radiation and/or Gravitational wave, providing energy sources for various high-energy phenomena, such as gamma ray bursts, Kilonova/merging nova, and super bright supernovae. The pathways through which the millisecond magnetic stars form include both instantaneous channels and delayed channels. The collapse of massive stars is considered as an instantaneous channel for the formation of magnetic stars, thus naturally linking newborn millisecond magnetic stars with long gamma ray bursts or nuclear collapse type supernovae, while the delay channels include: binary Neutron star merging, Neutron star merging with White dwarf, double white dwarf merging and White dwarf accretion induced collapse, etc. Therefore, millisecond magnetostar is considered as the possible central energy of short gamma ray bursts, or Kilonova/merging nova. This research paper has searched for the signal of Gravitational wave radiation in the electromagnetic observation data of short gamma ray bursts. The joint detection of the Gravitational wave event GW170817 with its electromagnetic counterpart GRB

170817A has confirmed that at least some short gamma bursts are related to the merger of binary Neutron stars, whose residue may be a long-lived, fast rotating and super magnetized magnetostar, emitting persistent Gravitational wave due to its asymmetric deformation or fluid oscillation. The limits of the ellipticity of millisecond magnetic stars are imposed on the observation data of gamma storms, so that it is to extend that the existing model of magnetostar driven by supernovae further considers the influence of Gravitational wave radiation on the photometric evolution of supernovae [29].

15.2.Discussion

The methods, property parameters and observation data of above case studies are summarized in Table 3. Based on the case studies above, the major variables selected for my future research include the mass of Compact stars, both upper and lower limits of gravitational mass, magnetic field of Compact stars, rotational speed, relationship between rotation speed and mass, relationship between central density and rotational speed, as well as physical properties of gravitational waves (wave frequency, energy, occurrence and duration, Amati relationship ε-Parameters, amplitude parameters, local event rate density, Luminous efficiency function, Host galaxy properties etc).

As can be seen from the case studies, there are many uncertainties in the quantitative studies on heavy mass stars due to the extremely long distance and limited observation events. Next it is to qualitatively outline the conclusions that might reach consensus:

In my another article, it is proposed that “the transmission of driving force of both the earth's rotation and the revolution of other galaxies are generated by the electromagnetic induction theorem when the material properties of Yin and Yang poles in three-dimensional space are cutting against the fourth dimensional magnetic line. Therefore, the higher the ratio of total mass to total electric charges (M / E) in celestial galaxies, the slower the angular velocity of celestial rotation. Within the aster of highest mass (such as black holes), even the most basic electromagnetic waves in the universe, light waves, can be hardly observed, indicating that there is almost no rotational force.[13]” This viewpoint is consistent with the above case study of Yuan (2022)[31], who reports that “the electric charges of Black hole is very limited, which is supported by the results that the maximum Black hole charge in GW200105 and GW200115 events is 1.16×10^{29} esu and 5.36×10^{28} esu, respectively.[31]”

As discussed in section 13.4 above, “the boundary layers are formed inside a star between different substance layers with different properties (such as different density or chemistry composition) [35]. These boundary layers also become the equipotential layers inside a star, whose equipotential shield effect causes the charged particles in the outer space to conduct parallel motion to the equipotential lines, and in my article this type of parallel motion’ substance layer is defined as the parallel fluid layer.” Therefore, the velocities of parallel motion must be different at different sides of

boundary layers. This viewpoint is consistent with the above case study by Huang (2022)[32], who models that "at the same time, if the rotational speed of the center of the poorly-rotating Neutron star in the equilibrium state monotonically increases from the boundary to the inside, the mass of the Neutron star that can be maintained will be significantly increased when the core angular velocity is much higher than the boundary one.[32]" Further more, based on my proposed theory that "these magnetic elementary particles cut along the magnetic line on the fourth dimensional axis, thus generating electric charges. The existence of the electromagnetic induction theorem is the transmission pathway of driving force which leads electrons to rotate around the nucleus[13]," it is complemented that the driving force of neutron star rotation is mainly provided by the core sphere of neutron stars, in which the neutrons must NOT be the main elements but the electric-charged particles are the main elements, while the surface sphere of neutron star contributes to little driving force of star rotation because of the poor electric charges on the surface sphere. Obviously, the mass density of neutron layers would be higher than the mass density of electric-charged particle layer, but the rotation speed of electric-charged particle layer would be faster than that of neutron layer. Consequently, the neutron star looks 'blunt' only on the surface sphere, and the star starts to cool down and become denser at the surface layer firstly.

The relationship between detected gravitational waves' parameters and the star mass will be discussed in detail by next section.

Table 3. Summary of case studies on gravitational wave observation events.

Case studies	Methods	Property parameters	Observation data
Wang (2023)[33]	Gravity function of f (Q);	Relationship between mass radius and Compact star;	Pulsar PSRJ0030+0451, PSRJ0740+6620, PSRJ2215+5135, GW170817, GW190814;
Huang (2023)[32]	State equation model of the quark hadron crossover (QHC);	Central density of Neutron star, gravitational mass, rotational speed;	Upgraded Advanced LIGO and the third generation Gravitational-wave observatory's kilohertz Gravitational wave observation;
Yuan (2022)[31]	Cutoffpower-law model, Photosphere and the internal shock model,	Electromagnetic radiation, energy conversion efficiency, surface magnetic field	GRB 201221D, GW200105, GW200115;

	Magnetic reconnection and turbulence (ICMART) model, Binary Neutron Stars merging model;	intensity, rotation period P;	
Shao (2022)[30]	Bayesian method is used to judge the best fitting mass distribution model and estimate the model parameters;	Limits of maximum gravitational mass;	Collecting the latest results of Neutron star mass measurement;
Xie (2022)[29]	Searching for the signal of Gravitational wave radiation in the electromagnetic observation data of short gamma ray bursts;	Electromagnetic waves;	GW170817 with its electromagnetic counterpart GRB 170817A;

16.Future research gaps in gravitational wave:

According the classification of sources of gravitational wave, the sources of gravitational wave are divided into three types: continuous gravitational wave sources including rotational Neutron star and stable binary star system, explosive gravitational wave sources containing supernova explosion as well as binary star merger, random Gravitational wave background sources covering from astrophysical Gravitational wave background to original Gravitational wave [28]. Among these sources, the first type of sources (rotating Neutron star, stable binary star system) generate the gravitational wave at highest frequencies with continuous detecting events. According to the physical motion model of gravitational wave generation mechanism newly discussed in my article above, it is deduced that in most cases, the higher the frequencies of gravitational wave, the younger the star form; the stronger intensity of gravitational wave, the heavier mass of the star system (or the stronger gravity per unit mass) to compress the charged elementary particles. Consequently, the first type of sources would be the early stages of star senescence forms. The first objective of future research gap is to correlate the physical properties of the first type of sources (including Rotation period, Revolution cycle, Half length of track projection axis, Track eccentricity, Pulsar mass) with the physical parameters of gravitational waves detected from the corresponding sources, so that new models are capable of being established to extrapolate the development stages on the first type of sources according to the theories discussed above.

As discussed by my another article [10] on dark matter, resilience nature must be the basic characteristic of dark matter. However, with the aging of dark matter, this resilience nature will be gradually lost, which restrains the spinning motion of elementary particles and correspondingly reduces the electric charges of elementary particle. Although it is deduced that "the stronger intensity of gravitational wave, the heavier mass of the star system (or the stronger gravity per unit mass) to compress the charged elementary particles" in above paragraph, the aging of star's dark matter and the decreased resilience may restrain the spinning motion of elementary particles, so that the electric charges of elementary particle decrease and the detected intensity of gravitational wave will be decreased correspondingly. Consequently, there is the threshold level for the gravitational mass density of the star system: when the mass density of the whole star is below the threshold level, the stronger intensity of detected gravitational wave may indicate heavier mass of the star's surface sphere to compress the charged elementary particles; when the mass density of the whole star is above the threshold level, the stronger intensity of detected gravitational wave may indicate more active status of star system in the core sphere only, but the star's surface sphere may become the neutron layer without emitting electromagnetic waves. This explanation may help to improve the mass threshold calculation in the models used by above case studies.

For the detecting events with occasional occurrence, which only receive gravitational waves at transient time with lower frequencies, it is further to explain that this star form of the gravitational wave sources would be more aging than the first type of sources, and the occasional occurrence of detecting gravitational waves at transient time would be caused by the unstable resonance of gravity field when binary star merger occurs. When resonance of gravity field happens during binary star merger, the radiation energy of stars will be further released and the elementary particles between binary stars are synthesized into the final state of materials like Black hole one. More specifically, when binary star merger happens, the elementary particles between binary stars absorb radiation energy firstly, turning into excited state with higher energy level and more free form (although this excited free form has not reached the ionization state). Then the elementary particles of excited state with more free form are further synthesized into degenerate matter by the gravity contraction. In this degenerate matter synthesis process, the incident particles and atomic nuclei combine to form into metastable composite nucleus, which subsequently decays into the final stable particles in a period, further releasing radiation energy. This metastable composite nucleus as the combination of incident particles and nuclei is called the resonant state, and the final stable particles would be the final state of degenerate matter compressed by gravity. The knowledge and both excited state and resonant state have been discussed in detail in my another quantum physics paper [34]. Consequently, the second objective is to analyze the excited state of elementary particles between binary stars when resonance of gravitational waves occurs during binary star merger, by comparing and contrasting the gravitational wave parameters

with the elementary particle decaying results of excited/resonant state derived from particle collider experiments, so that the energy released is calculated during this binary star merging process.

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