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Identifying the Spatial Structure of Black Hole and Tropical Cyclone Based on a Theoretical Analysis of Orthogonal Interaction

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Abstract

Black holes are recognized by Newton's gravitational theory and Einstein's general relativity, but there is still a lack of understanding the spatial structure of events, especially the nature of event horizon. In this paper, a theoretical analysis is used to compare the structures of tropical cyclone in the atmosphere and black hole in the astronomy so that five results are: 1) Both of them share the similar spatial structure, with tropical cyclone and black hole having the outflow cloud shield and the horizon sphere in the central part, respectively, while four spiral material bands exist in the rotating plane around them; 2) In theoretically, the energy density formed by the orthogonal interaction of the four spiral material bands is as $m_0 v_0^2$ times as the total kinetic energy of the head-on interaction; 3) This region of high energy density can lead to the conversion from mass to energy and the creation of new physical states of matter, which is a black hole event; 4) The outer horizon of a black hole is the outermost interface of events, or the orthogonal interaction interface of particles; 5) High-speed plasma jets extended at the poles of the black hole are directly associated with the shear stress of orthogonal interaction.

Keywords

Black Hole, Event Horizon, Tropical Cyclone, Spatial Structure, Orthographic Interaction

1. Introduction

One of the spatial extreme events is black hole that physicists and astronomists have been widely studied since the late 1960s [1] [2] [3]. One of the atmospheric

extreme events is tropical cyclone (or tropical storm) that meteorologists have studied for a hundred of years [4] [5] [6]. The identification of the internal structure of tropical storms in the Earth's atmosphere is benefited from the three-dimensional space observation such as from the ground radar echoes and space artificial satellites [7]. However, little is known about the internal characteristics of black hole events that occur in space, due to the lack of direct observations. Black holes and tropical storms are two types of extreme events that are far apart on spatial and temporal scales. The reason why they are all called extreme events is because these events occurred with a small probability of high concentration of abnormal energy in the relative space and relative time of their respective environments.

The damage caused by severe tropical storms is enormous, so it is an extreme event in the atmosphere [8] [9]. The formation of tropical storms requires larger-scale environmental conditions and intrinsic dynamics. Tropical storms as extreme events mainly form in the intertropical convergence zone. In terms of dynamics, the formation and development of tropical storms have an internal positive feedback mechanism, accompanied by a high concentration of abnormal mass, abnormal energy, and abnormal angular momentum [10]. The first question is what are the abnormal masses, abnormal energies, and abnormal angular momentum formed in black hole events?

Strong tropical storms present a cloudless central eye [11] [12]. The central eye is vertically surrounded by a deep eye wall. The eye wall is the inner wall of the outflow cloud shield surrounding by spiral rainbands. Although the eye wall was simulated [13], its formation mechanism is still not known. The inner and outer sides of the outflow cloud shield differ in the structure and dynamics of atmospheric circulation, including the distribution of physical quantities. At the same time, changes in the external structure will quickly affect the internal structure and the intensity of storm [14]. The second question is whether is there any similarity between the internal and external structures as well as dynamic characteristics of black hole events and tropical storms?

The internal dynamic issues of tropical cyclones and black hole events have not been fully resolved. Particularly, what mechanism does produce the outflow cloud shield relative to surrounding spiral rainbands? Similar question is also for the formation of event horizon and polar jets relative to the accretion disk of black holes [15] [16]. To answer the above three questions, we use a theoretical method to qualitatively explore the similarity of the internal and external structures between a massive black hole and a strong tropical cyclone. The purpose is to understand the physical nature of the event horizon of black holes and the physical processes that occur inside black holes. This paper is divided into the following aspects. Section 2 provides a comparable analysis of the spatial similarities of tropical cyclones and black holes, respectively. Section 3 describes the energy density distribution and rotational shear stress formed by particle interactions theoretically. Section 4 uses the theoretical results to explain the signi-

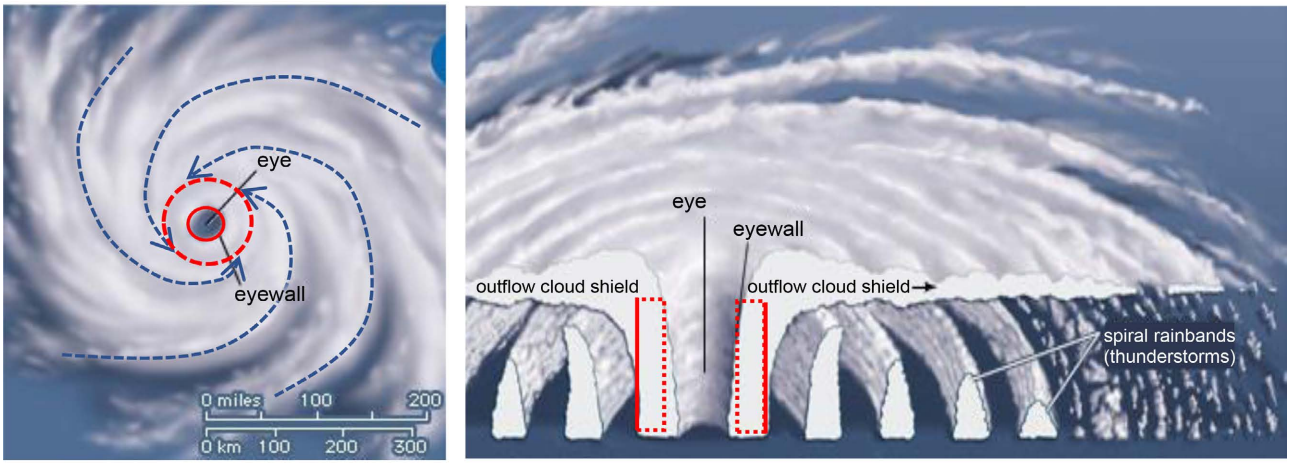
ficance of outflow cloud shield formation in tropical cyclones and the physical nature of the event horizon of black holes as well as the new physical state such as the polar plasma jets. Finally, Sections 5 and 6 give conclusions and discussion of this article, respectively.

2. Spatial Structures of Two Extreme Events

2.1. The Spatial Structure of Tropical Cyclones

A tropical cyclone with a combination of strong winds and heavy rainfall is a low-pressure vortex system that originally occurs in a tropical ocean. It is called hurricanes in the Atlantic Ocean, typhoons in the Northwest Pacific Basin, and tropical cyclones in the Indian Ocean. Their intensity is depended on the 10-minute maximum sustained winds. Tropical depression and super cyclonic storm (super hurricane and super typhoon) are sustained winds of less than 119 km (74 miles) per hour and larger than 240 km (150 miles) per hour respectively, and other tropical cyclones are sustained winds between them. The formation of tropical cyclones requires several conditions. At the large spatial scale, the environmental and dynamical condition is the need for a sufficiently Earth's rotation deflection force (the Coriolis force) [17]. Tropical cyclones mostly occur on warmer ocean surfaces outside the equatorial region because the Coriolis force on the equator is zero. The Coriolis force is not actually a force, but the mass inertia of matter (particles or air parcels) rotates with the Earth. The second environmental condition at a spatial large scale is that the difference of basic air flows (or vertical wind shear) between the upper and lower layers is small so it needs an integrity of atmospheric motion [18]. The third condition is comparable to the scale of a tropical cyclone, requiring the low-layer convergence and upper-layer dispersion of disturbance air flows [19]. Under the above three dynamic requirements, the high temperature and high humidity air flows from the lower layer are blown towards the center of low pressure, forming an internal convergence and upward movement of air flows. During the upward air flows, the water vapor condenses and releases latent heat, forming a warm core in the upper part and a tropical depression in the lower layer. The warm core can be seen as a new physical state formed by the latent heat release. The depression is conducive to the inward convergence of external air flows and the internal warming (forming a warm core) so that a positive feedback mechanism is formed for the growth of a tropical cyclone.

Tropical cyclones have a lifetime ranging from a few days to dozens of days, with their strongest moments occurring on an open ocean. Only tropical cyclones that reach a strength such as strong or super cyclonic storm can have an eye and outflow cloud shield [13]. As shown in **Figure 1(a)**, on the outside of the outflow cloud shield, the distinctive feature is the presence of four spiral rainbands. Therefore, the appearance of eye, outflow cloud shield and four spiral rainbands are signs that the cyclone has reached the strongest moment such as super typhoons and super hurricanes. Delimited by the vertical outer wall of the



(a) (b)

Figure 1. (a) Top view of a tropical cyclone. The red solid circle indicates the eye wall line, the red dotted circle indicates the vertical outer wall of the outflow cloud shield, and four spiral rainbands are indicated by blue dotted arrows converging to the outer wall. (b) A vertical profile of tropical cyclone, from the center outwards is the eye, the eye wall, the vertical part of the outflow cloud shield (red solid line and dotted wireframe), and the four spiral rainbands surrounded on the periphery.

outflow cloud shield, tropical cyclones can be divided into inner and outer parts (**Figure 1(b)**). The internal area occupies only a small fraction of the overall tropical cyclone. The vertical part of the outflow cloud shield is the closed annular area (a thick ring) with the highest mass density of clouds and the strongest updraft. Inside, the eye area is a sinking air flow and a clear sky (no clouds and rain) area. The eye area and the outflow cloud shield form a distinctly contrast of opposite vertical motions. Outside, the four spiral rainbands are close to the vertical outer wall of the outflow cloud shield [20]. Thunderstorms are strong convective cells locally distributed along four spiral rainbands. Tornadoes with severe wind and rainfall are member of thunderstorms. Tornadoes and cyclones have similar circulation structure, but at different scales in space and time [21].

Satellite observations have clearly given spatial structure of eye and outflow cloud shield that are surrounded by spiral rainbands. The two vertical walls of the outflow cloud shield act like the inner and outer horizons of a black hole event, and it is not known what the fate of air parcels along spiral rainbands will go after they reach the outer wall. In the radar echo image, the vertical profile of **Figure 1(b)** is clear about the spatial structure of cloud-rain zones. Once a strong tropical cyclone forms the eye and the outflow cloud shield, the central core of an entire tropical cyclone system is clear [14]. As tropical cyclones move into the vicinity of continental area and mountain terrain, the symmetrical circulation structure in **Figure 1** is disrupted. First, the curvature of outer cloudy-rain bands will change, and the four spiral rainbands will be reduced to three or two. Then, the eye and the outflow cloud shield disappear, and the tropical cyclone enters an extinction phase.

2.2. Spatial Structure of Black Holes

Tropical cyclones are a perceived reality, and black holes are originated from

scientific speculation. Since 1687 Newton proposed the law of gravity, the escape velocity formula has been known. Michell proposed in 1783 the idea of a dark star with so large mass that even light could not escape [22]. If we increase the Sun's mass to hundreds of times, the gravitational force should largely increase according to the Newton's law so that the light and particles radiated by the new Sun cannot go out. The new Sun should become a dark object like a black hole because surface escape velocity exceeds the usual speed of sunlight.

In 1915, Einstein developed his theory of general relativity, having earlier shown that gravity does influence light's motion. Only a few months later, Karl Schwarzschild found a solution to the Einstein field equations that describe the gravitational field of a point mass and a spherical mass [23]. This solution had a peculiar behavior at what is now called the Schwarzschild radius, where it became singular point, meaning that some of the terms in the Einstein equations became infinite. It is the simplest static black hole that has neither charge nor angular momentum, only mass. Some singularities have been noted from Schwarzschild solutions [24] [25]. Black holes were long considered a mathematical curiosity. Until the 1960s, theoretical works showed that they were a generic prediction of general relativity [26] [27].

In 1958, Finkelstein [28] identified the Schwarzschild surface as the event horizon: a perfect unidirectional membrane through which causal influences can only pass in one direction. In 1963, Kerr [29] found the exact solution for a rotating black hole. A galactic X-ray source discovered in 1964 became the first astronomical object commonly accepted to be a black hole [30]. The simultaneous breakthrough of theory and observation marked a beginning of golden age in the field of black hole research [31] [32] [33] [34]. The concept of gravitational collapse and space-time singularities was also proposed in 1965 [35]. Recently, the new results of the latest M87 Event Horizon Telescope and Sagittarius A*Event Horizon Telescope revealed that the shadow of super massive black holes observed by images is consistent with a Kerr black hole predicted by general relativity [36] [37].

According to the theory of the two giants, black holes are the result of Newton's powerful gravitational field, or the result of Einstein's extreme curvature of space-time, so that all particles, not even light, cannot escape. Astrophysics discoveries a ubiquity of black holes in early universe [38] [39]. **Figure 2(a)** is a conceptual diagram depicting a rotating black hole. The outermost layer of a rotating black hole is called the ergosphere [40]. When alien objects reach the vicinity of the ergosphere, their interaction with the black hole will cause dazzling photoelectric phenomena. The scattering of gravitational radiation may be associated with a Schwarzschild black hole [41].

The event horizon is a gravitational (or space-time-curving) threshold around the black hole where the escape velocity exceeds the speed of light of that object. The event horizon coincides with the trajectory of light that cannot escape from the black hole. **Figure 2(a)** shows the outer and inner horizons. There is a

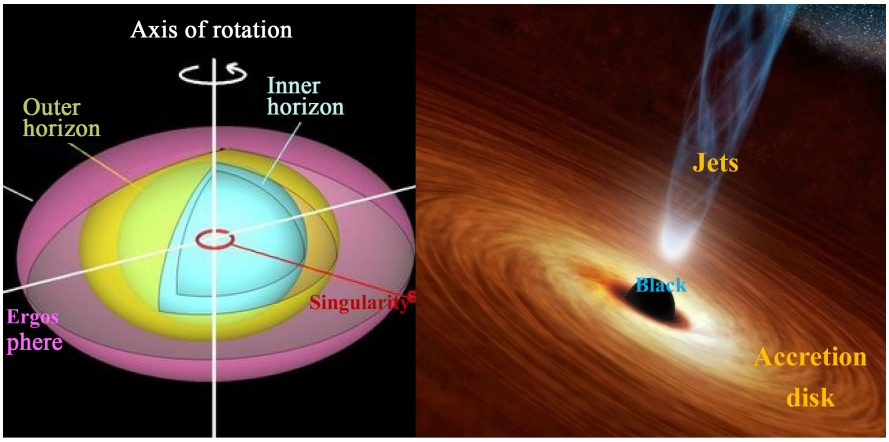


Figure 2. (a) Spatial structure of a rotating black hole with its event horizon and ergosphere. (b) Accretion disk and black hole with its vertical extending polar plasma jets.

thickness between the inner and outer horizons of a black hole event [42] [43], which can be called the horizon sphere, like the vertical part of the outflow cloud shield in a tropical cyclone (red box area in **Figure 1(b)**). Everything, including light, that reaches the outer horizon will be sucked in by the black hole. What will happen after this light, as well as where it will go is impossible to know. The large curvature of space-time at the center of a black hole is due to the infinite material density (large mass) and the infinitesimal size of the volume, becoming a singular point or a singular ring for a rotating black hole [44]. Therefore, a black hole is a celestial body with a curvature so large that no light can escape from its event horizon.

A black hole can swallow matter and radiation from an accretion disk [45]. **Figure 2(b)** shows the spatial distribution of a black hole linked with the accretion disk and the polar plasma jets. Along the axis of rotation of the black hole, high-speed plasma jets which extended outside of the black hole's pole are different from the matter on the accretion disk. There may be a connection between the disk and the polar jets [16]. Accretion disk also has material bands on the rotating plane like the spiral rainbands outside the tropical cyclone's core.

Figure 2 shows the spatial structure of a single black hole which is like a thunderstorm, or like a tornado located on one of spiral rainbands of tropical cyclone. **Figure 3** shows a Milky Way-like nebula system. There is a disk around the galaxy center like a black hole [46]. Like the rainbands of a tropical cyclone, the four spiral nebula bands converge to reach the closed red dotted circle. Along each spiral nebula band, there are many star systems and black holes. The four spiral nebular bands in **Figure 3** also characterize like the circulation structure of tropical cyclone, indicating that these spiral nebula bands are converging or contracting toward the center. The future trend is that the four spiral nebula bands will transport large amounts of surrounding material (stars and black holes) into the area enclosed by the inner red dotted line, increasing the nebula

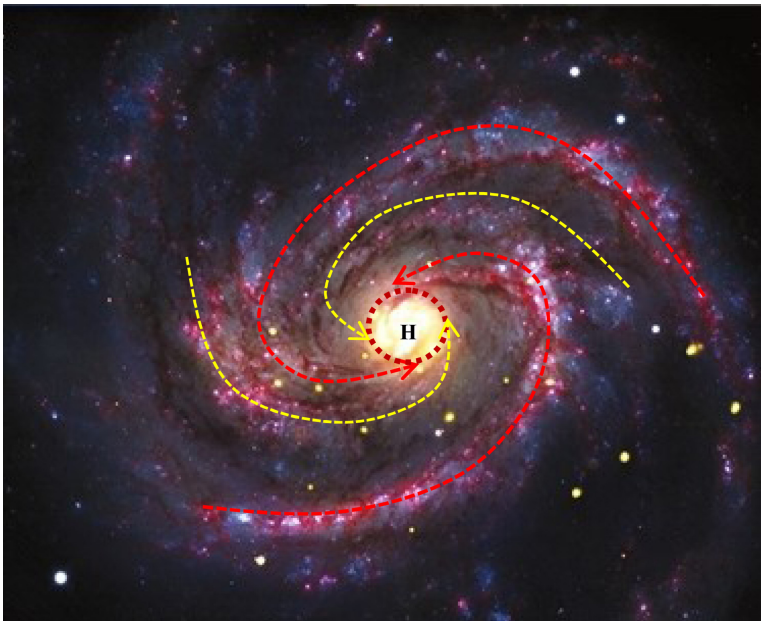


Figure 3. A Milky Way-like nebula system, the four spiral nebula bands (red and yellow arrows) converge to reach the closed red dotted circle. Along each spiral nebula band, there are many star systems and black holes. The letter H indicates the area of high mass and energy density.

density centered on the point H. Lots of black holes may have formed in the area enclosed by the red dotted line. Soon, they will merge to form a super massive black hole because the area will increase.

3. Particle Convergence Interaction Dynamics

Multi-temporal and multi-spatial scale rotational structures appear in tropical cyclone systems (**Figure 1(a)**) and nebular systems (**Figure 3**). As a result, spiral rain (nebula) bands in these systems are not perfectly smooth and symmetrically distributed. However, the overall structure of four spiral rain (nebula) bands is dominant. **Figure 4** shows four spiral bands composed of completely smooth and symmetrical substances. In the case of only four particles (or air parcels), for simply, they converge to the point H to form a regular collision for particles or a regular convergence for air parcels. For the four high-energy particles (or the four low-speed air parcels), they from the four directions will collide (or converge) head-on and orthogonally at the point H, respectively. Over time, a new material formed by collisions (or convergences) accumulates at the point H.

Initially, the new material is a new physical state such as plasma at the point H. And then the new physical state will expand over the area covered by the dotted circle. The dotted circle in **Figure 4** is the same as in **Figure 3** and **Figure 1(a)**. The particles (or air parcels) from the four spiral paths collide (or converge) to the central point H and release light and energy. In high-energy physics, collisions between particles can produce nuclear reactions. In low-speed air motions, convergences between air parcels can produce warm core, cloud, and

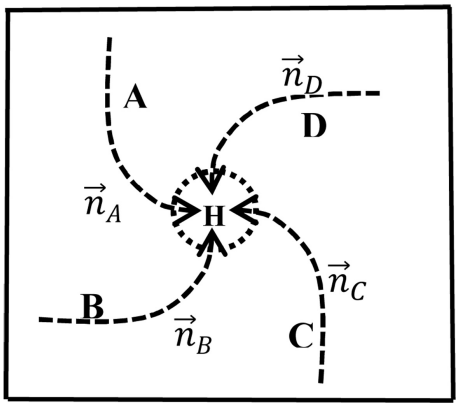


Figure 4. Particles along the four spiral material bands (dotted arrows) collide head-on (as in two particles of A-C, and particles of B-D) and orthogonally (as in two adjacent particles of A-B, B-C, C-D, and D-A). The dotted circle indicates an expanding area. $\boldsymbol{n}_A$, $\boldsymbol{n}_B$, $\boldsymbol{n}_C$ and $\boldsymbol{n}_D$ are the unit vectors of converging particles.

rainfall. To keep it simple, in the following derivation, we only mention the interaction between particles.

In **Figure 1(a)** and **Figure 3**, each particle has a mass m and a velocity v, so they have energy $E=\frac{1}{2}mv^2$. In **Figure 4**, there are two forms of interaction between the particles: head-on collision and orthogonal collision. The energies of four particles are $E_A=\frac{1}{2}m_Av_A^2$, $E_B=\frac{1}{2}m_Bv_B^2$, $E_C=\frac{1}{2}m_Cv_C^2$, $E_D=\frac{1}{2}m_Dv_D^2$, respectively.

There are two pairs of head-on collision, one pair is particles A-C, and another pair is particles B-D in **Figure 4**. For each pair, the total kinetic energy formed when the head-on collision is,

$$E_{T-AC}=\frac{1}{2}m_Av_A^2+\frac{1}{2}m_Cv_C^2, \tag{1}$$

and

$$E_{T-BD}=\frac{1}{2}m_Bv_B^2+\frac{1}{2}m_Dv_D^2. \tag{2}$$

When all four particles collide together simultaneously, the total kinetic energy is,

$$E_T=\frac{1}{2}m_Av_A^2+\frac{1}{2}m_Bv_B^2+\frac{1}{2}m_Cv_C^2+\frac{1}{2}m_Dv_D^2. \tag{3}$$

The head-on collision is a centroid system with the highest combined relative speed [47].

In **Figure 1(a)** and **Figure 3**, there are four spiral material bands. Thus, we can introduce four centripetal forces,

$$\boldsymbol{F}_A = \frac{m_A}{r_A} v_A^2 \boldsymbol{n}_A, \tag{4}$$

$$\boldsymbol{F}_B = \frac{m_B}{r_B} v_B^2 \boldsymbol{n}_B, \tag{5}$$

$$\boldsymbol{F}_C = \frac{m_C}{r_C} v_C^2 \boldsymbol{n}_C, \tag{6}$$

$$\boldsymbol{F}_D = \frac{m_D}{r_D} v_D^2 \boldsymbol{n}_D. \tag{7}$$

When four particles collide at the point H, they form two pairs of shear stress,

$$\boldsymbol{\tau}_H = \left(\frac{m_A}{r_A} v_A^2\right) \cdot \left(\frac{m_B}{r_B} v_B^2\right) \left(\boldsymbol{n}_A \times \boldsymbol{n}_B\right) + \left(\frac{m_C}{r_C} v_C^2\right) \cdot \left(\frac{m_D}{r_D} v_D^2\right) \left(\boldsymbol{n}_C \times \boldsymbol{n}_D\right). \tag{8}$$

If two adjacent particles orthogonally collide, the shear stress modulus caused by the four particles at the point H and reached the maximum is,

$$\tau_{HM} = \left(\frac{m_A}{r_A} v_A^2\right) \cdot \left(\frac{m_B}{r_B} v_B^2\right) + \left(\frac{m_C}{r_C} v_C^2\right) \cdot \left(\frac{m_D}{r_D} v_D^2\right). \tag{9}$$

If taking $r_A = r_B = r_C = r_D = r$,

$$\tau_{HM} = \left(m_A v_A^2\right) \cdot \left(m_B v_B^2\right) / r^2 + \left(m_C v_C^2\right) \cdot \left(m_D v_D^2\right) / r^2. \tag{10}$$

Clearly, Equation (10) indicates that the shear stress modulus is a density of the mass-energy product (or a density of energy product, simply energy density) of two particles collided orthogonally. Equation (10) also implies that mass can transform to energy by nuclear reaction under such condition of orthogonal collision. If we explore their energy at the same area r^2 of point H and equally take their masses as m_0 and velocities as v_0, the radio α of the shear stress modulus to the total kinetic energy is,

$$\alpha = \frac{\tau_{HM}}{E_T / r^2} = m_0 v_0^2. \tag{11}$$

It indicates that the shear stress modulus is as $m_0 v_0^2$ times as the total kinetic energy at the point H. This comparison may be not suitable, but it indicates that the orthogonal collision of particles can produce more energy.

We can see that, under the format of centripetal forces, the energy density is larger for the smaller scale and the faster moving particles (r is smaller, and v is larger). Equations (8) and (10) suggest that the shear stress or the energy density created by an orthogonal collision is significant in magnitude. This could explain how anomalous energies are created and maintained in black holes and super tropical storms. In mathematics, a singularity is a point without definition, such as when a particle speed reaches the speed of light at the Lorenz coordinate system transformation in special relativity. As shown in **Figure 4**, the abnormal vertical motion and polar plasma jets generated by the shear stress of the orthographic collision of particles (air parcels) at the beginning are a singular point at the point H when viewed from the polar altitude. Sustained and enhanced par-

ticle orthogonal collisions extend from the singular point to a singular ring. The singular ring is the hurricane's outflow cloud shield and the black hole's horizon sphere. Therefore, in physics, a singular point or a singular ring has a clear physical meaning.

4. The Physical Nature of Event Horizon

4.1. The Tropical Cyclone Outflow Cloud Shield

For a super tropical cyclone, the vertical outer wall of outflow cloud shield (solid red line in **Figure 1(b)**) acts like the outer horizon of a black hole event. The formation of the outflow cloud shield is a sign when the storm is at its strongest stage. There are four spiral cloud bands or rain bands outside the vertical part of the outflow cloud shield, which convey mass (water vapor) and heat and angular momentum for the maintenance and development of the outflow cloud shield from a larger space around it. When the air parcels on the four spiral cloud rainbands just converge, the total energy at the convergence point increases. Among them, the orthogonal convergence of air parcels will cause rotational shear stress with its direction perpendicular to the horizontal air flows. The shear stress modulus is proportional to the energy density of new material. The direction of the shear stress can be pointed downward the ocean, forming a disturbance of the ocean circulation corresponding to the cyclone on the surface of the ocean, and even agitating the sea surface to decrease. The direction of the shear stress can also be directed towards the upper atmosphere, forming clouds and precipitation.

Tornado vortices are also the product of orthogonal convergences of ambient anomaly air flows [48]. The rotational shear stress caused by the orthogonal convergence of anomalous air flows can be directed downward to the ground, stirring the ground soil to turn up, forming a low-lying puddle. Upward tornado rotational shear stress causes houses and trees to fly in a crushing manner. As can be seen from a tornado vortex, the inside and outside of tornado domain and the front and back of tornado influence are two different worlds. The orderly structure exists outside the tornado, but it is disorderly unrecognizable inside.

The large-scale environmental force that forms a tropical cyclone or a meso-scale vortex is the Coriolis force. In fact, the Coriolis force is not a real force, but an inertial effect corresponding to the rotation of the Earth. The formation of a tropical cyclone requires a small disturbance (anomalies of air pressure, air temperature, or air flow). Once there is a disturbance, the inertial effect comes into play, forming a positive feedback effect, and the cyclone gradually develops.

In the case of a hurricane of tropical cyclones, for example, a super hurricane with eye, outflow cloud shield and four spiral rain bands develops gradually from a tropical depression. The center of the tropical depression can form a drop in air pressure near the surface and warming of the upper air, forming a warm core, while there is a cyclonic convergence of air flows on the outside. The spatial distribution of these quantities is characterized by the representation of the

initial singularity of hurricanes. Many tropical depressions are affected by environmental conditions and cannot develop into hurricanes or super hurricanes. When the convergent air flows around the tropical depression continue to strengthen to a moment, the appearance of eye, outflow cloud shield, and four spiral rain bands is the formation of a super hurricane. The eye inside is the area of downdraft, the outflow cloud shield is a ring of updraft, and the surrounding spiral rain bands are the convergence horizontal air flows. The outflow cloud shield is like a singular ring. Before radar and satellite observations, the dynamic characteristics of outflow cloud shield and eye were unknown so that the outflow cloud shield was an event horizon.

4.2. The Physical Nature of Gravity

Gravity was proposed and statistically given by Newton in 1687. But he did not recognize the physical nature of such a force because it is difficult to be explained by the action at a distance. This statistical relationship is very useful in daily practice and life. In a natural system, one only needs to consider the gravitational effect of large objects on small objects. After more than two centuries of Newton, Einstein proposed the general theory of relativity in 1915. This theory no longer uses the word gravity but sees the effect of large objects on many surrounding small objects as large objects stirring up the surrounding space-time. Although those small objects can also stir space-time, their amount is small. Therefore, the mass of a large object determines the movement of all small objects in the world as it controls. Einstein suddenly expanded Newton's two-body universe to a cosmic system composed of infinite objects. Of course, Einstein used more complex geometric mathematics than Newton's statistical relationship, so that the relativity described the relationship between the motions of matter in the universe is more accurately than Newton's law.

However, neither Newton's gravitational theory nor Einstein's general relativity solves the problem of the nature of gravity. The nature of gravity, like the nature of Coriolis force, is the mass inertia of matter. Changing such mass inertia requires the appearance of forces. The inertial tendency of every particle on Earth is oriented toward geocentric. Particles or objects on the Earth's surface have not reached the center of the Earth because they are reacted by other particles or objects, but they all have a tendency (potential energy) to the center of the Earth. Correctly speaking, gravity is a manifestation of potential energy. The inertial tendency of every celestial body in the solar system is the center of the Sun. The movement of these celestial bodies along elliptical orbits is due to mass inertia or potential energy, not a gravitational action. In nebula systems, such as the Milky Way galaxy, the inertial tendency of every star, including black holes, is the center of the galaxy. All these tendencies are due to mass inertia or the potential energy they have related to different systems. In physics, gravity does not exist. If two artificial objects with masses are placed in a vacuum, there would be no gravitational and space-time curvature between them.

Where does the current mass inertial or potential energy come from? The present mass inertia or potential energy is the product of the last interaction (collision) between old matters (old particles). The collision process of matter (particles) is the transformation from old physical state to new one. In the new state of matter, people cannot find any information even existed in the old state of matter. The rotational shear stress in the last collision has entirely altered the characteristics of original state of matter. The collision of matter (particles) is also a process of conversion from old mass to new energy. If there have been two times of collisions, humans can only know finite characteristics of the current universal state after the first collision, and it is hard to know the old cosmic characteristics before the first collision and the new cosmic characteristics after the second collision.

To understand more concretely the shift of worldview from the gravity of an object (particle) to the inertial motion of an object (particle), we give a further explanation. The shear stress modulus of Equation (10) τ_{HM} is the energy density formed by orthogonal collisions, expressed in the term of total energy E,

$$\tau_{HM} = E. \tag{12}$$

We assume that the orthographic collision of four particles in **Figure 4** results in N new particles, each with a mass m and a velocity of c. Of the total energy, half of the energy is radiated away from the point H and the other half remains at the point H. The energy $1/2E$ leaving the H point has an equivalent relationship with the energy of N new particles radiated out so that we have $1/2\,E \approx N \cdot 1/2 \cdot mc^2$, namely,

$$E \approx N \cdot mc^2 \tag{13}$$

where the term $1/2mc^2$ is the kinetic energy of each new particle.

Equation (13) describes the energy E formed by the orthographic collision of four old particles at the point H, in which new particles N are excited and radiated. The energy of each particle is $1/2{\cdot}mc^2$, which is also the inertial energy of the newly formed particle m. The two sides of the equation describe two different worlds before and after the collision. Apart from this equivalence, the rest of the information in the two worlds is unknown to each other. The spiral convergence air flow around a tornado is an old-world thing. Their particles converge to reach the center of the tornado, colliding orthogonally, shattering old things, and forming new particles, such as lightning high-energy particles. The collision creates the inertial motion of lightning high-energy particles. Of course, atmospheric lightning does not occur in a vacuum, so the path of lightning will bend. Similarly, spiral rain bands around tropical cyclones are a thing of the past would, and they reach the point H and collide orthogonally to form new energy density and excite a warm core (one half of the total energy) and convective vertical motion (the other half of the total energy). Convective vertical motion is the inertial motion after a collision that is different from the horizontal motion of the old thing. Our solar system is also formed after a collision. The information

before the collision is all gone. The collision left is what the present planets and moons, as well as the inertial motion or potential motion tendencies (energies) of various visible substances. Therefore, the gravitational force perceived by people is the inertial motion of matter since the formation of the solar system.

4.3. The Black Hole Event Horizon

According to Newton's theory of gravity, a massive (high-density) object has a huge gravitational range. When the foreign light reaches a sphere of radius outside the center of the celestial body, the light is sucked in by its gravitational field so that the light disappears. Such an outer surface of the sphere is equivalent to the outer horizon of a black hole event. According to Einstein's general relativity, a massive (high-density) object forms a bizarre curvature in space-time. The presence of mass deforms space-time, and the particle path curves towards the mass [44]. When the alien light reaches this curved space-time outside the celestial body, the light is distorted and stretched. The light that entered not only could not come out, but also did not know its whereabouts. Such a space surface is the outer horizon of black hole events under relativity. In the event horizon, this deformation is so strong that no path is far from the black hole. Both theories' interpretation of the outer horizon of black hole events is based on the action of gravitational fields. If gravity does not exist, then this interpretation does not hold.

First, gravity is not needed during the formation of the outflow cloud shield of a tropical cyclone, but rather mass inertia and the potential energy carried by matter (air parcels or particles). The air parcels of the four spiral rainbands of a tropical cyclone constantly converge orthogonally surrounding the outflow cloud shield, creating huge rotational shear stress. This shear stress is upward so that it transports mass (water vapor) and heat upwards. Its modulus is proportional to the energy density. Therefore, the main body of the outflow cloud shield is a ring air column (a singular ring) with a high concentration of mass and energy density. The vertical outer wall of the outflow cloud shield is the outer horizon of tropical storm.

The formation of the event horizon of black holes is also not the product of gravity, but the product of the collision of matter mass inertia (potential energy). As a result of the collision of matter (particles), a spherical shell layer of a certain thickness appears. This spherical shell layer has a high concentration of energy density. The inner and outer surfaces of the spherical shell layer are like the inner and outer horizons, respectively. Thus, we call this spherical shell layer as the horizon sphere. The properties of matter (particles) before celestial interactions or orthogonal collisions are completely different from those of matter (particles) after collisions. In particle physics, the process of orthogonal collision is the converting from an old state to a new one. Therefore, once the particle (light) enters the outer horizon, everything after that happens is not known. Therefore, human beings do not need to worry about the situation inside the horizon but

should rejoice in the formation of new states of matter.

Many nebula systems, including the Milky Way galaxy, have four spiral nebula bands. Their confluence is prone to orthogonal collisions between adjacent nebular bands. Such orthogonal collisions can not only form a high energy density region, but also form polar plasma jets stretched vertically toward outside the accretion disk under the action of rotational shear stress. The polar plasma jets are also a new state of matter that has escaped from a black hole, and its particle flow may be faster than light. The physical nature of the event horizon of a black hole is the outer boundary of a region of high energy density formed by the interaction or orthogonal collision of matter (particles) within the celestial system. Black holes can be thought of as generators of new matter mass and new energy. Half of this energy is dedicated to the Polar Plasma Jets and the other half of the energy forms the central part (event horizon sphere) of the black hole. A spinning black hole started as a singular point and gradually developed into a singular ring. First Sagittarius A*Eevent Horizon Telescope results revealed the shadow of the super massive black hole in the center of the Milky Way [37]. The shadow can be seen as the singular point or the singular ring of the super massive black hole.

5. Conclusions

Black holes are extreme events in modern astronomy. Black hole events have been recognized by Newton's gravitational theory and Einstein's general relativity, but the spatial structure of their events, especially the nature of the event horizon, is still lacking. In this paper, the following results are obtained through the comparison and theoretical analysis of atmospheric tropical cyclone and astronomical black hole. Three questions raised have been answered.

1) Tropical cyclones that occur in the atmosphere have a similar spatial structure to black holes that occur in space. Mature tropical cyclones such as super hurricane and super typhoon radially consist of the vertical inner eye and the vertical outflow cloud shield, and four spiral rainbands surrounded horizontally on the periphery. The outflow cloud shield is a closed, annular cloudy rainband. Four spiral cloudy rainbands continuously deliver water vapor and energy to form the vertical outflow cloud shield which also interacts with converging air streams. The horizontal collided air parcels form the upward motion in the outflow cloud shield and the downward motion in the inner eye. A mature black hole consists of radial plasma jets outward two poles and a horizon sphere between the inner and outer event horizons, as well as four spiral nebula bands outside the event horizon. The outer horizon is the outermost interface of a black hole. Four spiral nebulae bands continuously transport matter (particles) to the event horizon and interact (collide) at the outer horizon of black hole.

2) The similarity of inner and outer structures between tropical cyclones and black holes can be described by the same dynamics. Ideally, four spiral bands of matter (particles) that converge inward around tropical cyclones and black holes

can form orthogonal interactions between adjacent beams of particles and head-on collisions between beams of opposing oriented particles. The total kinetic energy concentrated by the two pairs of particles colliding head-on is their sum, while the result of the orthogonal collision of four particles is the rotational shear stress or the energy density. The energy density of orthogonal collision is as $m_0 v_0^2$ times as the total kinetic energy of head-on collision. The same feature can be used to describe the tropical cyclones, but words of "particle", "collision", and "collide" need to be changed as "parcel", "convergence", and "converge" for the two types of different materials.

3) There are differences in the structure of the singular ring inside black holes and tropical cyclones. Black holes arise in a vacuum, and the two opposite directions of the collision shear stress are perpendicular to the directions of the colliding particles. Half of the energy forms the event horizon sphere, and the other half forms plasma jets. Thus, plasma jets are extended outward two poles. The collision air flows of a tropical cyclone come from the lower atmosphere, and part of the energy of the shear stress is difficult to expand deeply downward, so the formed warm core is in the middle of the atmosphere, while forming an eye and outflow cloud shield should be in the central area. Two beams of plasma jets are symmetry relative to the center of black hole and perpendicular to the accretion disk. The black hole should have a core of high energy density like a warm core of tropical cyclone.

4) Tropical cyclones and black holes do not require gravity, but they require mass inertia or potential material energy. Tropical cyclones cannot form on the equator because where the Coriolis force is zero. Neither gravity nor the Earth's rotation deflection are real forces, they are essentially mass inertia or potential material energy in the motion of matter. This inertia and energy are legacy products of the last collision of matter. Newton's gravity and Einstein's curvature of space-time are respectively statistical and geometric descriptions of mass inertia and material potential energy.

5) The outer horizon of a black hole event is the outer interface of a region where high energy density is formed by main orthogonal collisions of particles inside a celestial system. A galaxy-like nebula system is a legacy of the last cosmic matter collision, including mass inertia and material potential energy and showing that matters rotate and converge toward the central body. The mass inertia or potential energy of matter converges towards the central body forms four spiral nebula bands. Orthogonal collisions of adjacent nebular bands near the central body form a core of high energy density (new physical state of matter). New polar plasma jets emitted outward are the product of shear stress produced by the orthogonal collision of adjacent nebular bands.

6. Discussion

Understanding black holes are inseparable from gravity. In other words, black holes are an application of gravitational theory (statistical relationship) to those

large cosmic events. Similarly, black holes are an application of general relativity (geometric mathematics) to those large cosmic events. Neither gravity nor space-time curvature is real-world physics. Gravity and the curvature of space-time describe the real world well because of the use of clever mathematical methods adapted to human senses. Gravity and relativity can be intuitively and conveniently applied to people's production, life, and scientific research, but they are difficult to explain the physical nature of things.

In the comparable analysis of tropical cyclones and black holes in this paper, there are not only huge differences in space-time scales, but also large differences in particle motion speeds. For the tropical cyclones, the low velocity motion of air parcels can be studied using conventional Newtonian mechanic or fluid mechanics. The particles caused black holes to form are the speed of light so that need to be limited by relativity. The speed of light is what it must escape the gravitational bondage of the excitation source such as stars. Stars of different masses have different gravitational pulls and excite different speeds of light. Therefore, low speed and the speed of light are relative, and the relative motion of particles and the interaction effect are meaningful.

What needed to explain the formation of black holes is not gravity, but mass inertia or the potential energy of matter. This example shows again that it is impossible to unify gravity with other forces. It is possible to unify different material potential energies [49]. The conversion of mass to energy only occurs when matter interacts violently, such as an orthogonal collision of nuclear reaction. If one builds an orthogonal collider as shown in **Figure 4**, it may be the most economical and efficient design.

Neither the center of a tropical cyclone nor the center of a black hole is calm. New material forms (new states of matter) have emerged at the center of tropical cyclones, such as strong downward and upward air flows as well as an unusually warm core [50]. The central warm core of hurricane Sandy (2012) reached 8˚C - 10˚C higher than environmental temperature [51]. The center of the black hole is even less calm, where polar plasma jets appear in the two directions of shear stress. Half of the abnormal energy formed by the collision of particles is concentrated in the center of black hole. The thermodynamic problems of black holes and their ultra spinning counterpart [52] [53] [54] should be related to the internal structure of black holes. Two aspects, one is the observation information of black hole structure, and the other is the dynamic model of the evolution of black hole system, are needed. Black holes have few observations, while tropical cyclones with similar structures have more observations. We hope to propose a dynamic model that can be used in both black holes and tropical cyclones for their physical processes of evolution.

The actual structure of tropical cyclone center and black hole center is not symmetrical. A recent analytical study showed that a typical dipole high-low distribution of the outgoing long-wave radiation (OLR) and water vapour (WV) occurs at the center of tropical cyclone and rotates counterclockwise around the cyclone center [55]. The recent results of the latest M87 Event Horizon Tele-

scope showed that the bright thick ring of the black hole's event horizon also has an azimuthal brightness asymmetry and a comparatively dim interior [36] [37]. Both the asymmetry of the OLR (WV) at the center of the tropical cyclone and the asymmetry of the black hole event brightness may be the result of the interaction of the event center with the outer spiral material bands. Such an interaction can bring a diversification of the spin direction of particles formed inside the outflow cloud shield and the horizon sphere, resulting on the variable intensity and distribution of polar plasma jets. Mathematically it can be studied with the influence of multidimensional topological numbers [56] [57] [58].

Particle collisions produce new states of matter, including new particle charges. In thunderstorms, the interaction of different air parcels (particles) produces different electrical charges. When different charges accumulate to a certain intensity, a discharge occurs between them. The discharge itself also undergoes a re-interaction. Therefore, the presence or absence of charges and the distribution of charges inside tropical cyclones and black holes, as well as rotational parameters and space-time dimensions have a significant impact on the topological numbers. We hope that the interaction dynamics of particle convergence in this paper will be able to correlate with the topological charge inside the system (tropical cyclone and black hole) [57] [58] and the thermodynamics of ultra spinning counterpart [52] [53] [54] combined with research.

Black holes appear to be an astronomical problem that is actually closely linked to high-energy physics. This theory could be confirmed by a recent study in high energy physics. To produce new substances or new physical states (plasma), an electron accelerator is used to obtain an abnormal high energy density through high-speed collision of two-beam particles. There are various colliders developed for this purpose [59] [60]. However, linear collisions are not easily to achieve this goal. Through a comparison among head-on and orthogonal collisions, we theoretically found that the orthogonal collision between two-beam high-velocity particles can produce an abnormal high energy density [61].

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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