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Origin and Evolution of Black Holes

Stephanie Hinton[1]

[1*] Independent Research Scholar

[*]*Corresponding Author:* e-mail: *StephanieHinton@jourrapide.com*

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Abstract— A black hole is a region in space with an enormous density (that is, it contains a very large mass for its size) that often exceeds a million solar masses, and the gravity in it reaches an amount that light cannot escape from, and that is why it is called a black hole. A black hole is formed by the gathering of a lot of matter that compresses under the influence of its own gravity, and devours most of the matter around it until it reaches the state of a black hole. For example, the sun has 1 solar mass, while a black hole is more than 1 million solar masses.

Keywords— Black Hole – Physics – enormous density – Astrophysics

I. Introduction

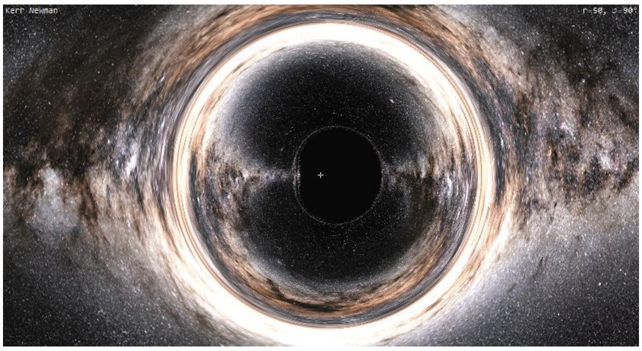
The density of the black hole increases (as a result of the overlapping of its atom particles and the absence of space between the particles), so its gravitational force becomes strong to the point that it attracts any object passing near it, regardless of its speed, and engulfs it, and thus the mass of matter in the black hole increases. Black curving the space around it, causing a beam of light to travel in a curved shape instead of in a straight line.

In relativity, a black hole is more precisely defined as a region of spacetime in which its gravity prevents everything from escaping, including light.

The black hole absorbs light passing near it by the action of gravity, and it appears to those who observe it from the outside as a region of nothingness; No signal, wave, or particle can escape from its area of influence, so it appears black.

It has been possible to identify black holes by observing some of the X-rays that are emitted from materials when their particles are broken as a result of their approach to the black hole's gravitational field and falling into its abyss.

For the Earth to turn into a black hole, it must turn into a ball with a radius of 0.9 cm and a mass of the same mass as the current Earth, i.e. the compression of its material to make it without spaces between its atoms and the particles of its atoms' nuclei, and that makes it small as a table ball in size and its enormous mass remains as it is; As the huge voids between atomic particles due to their small size are governed by physical laws that cannot be bypassed or destroyed under normal circumstances.

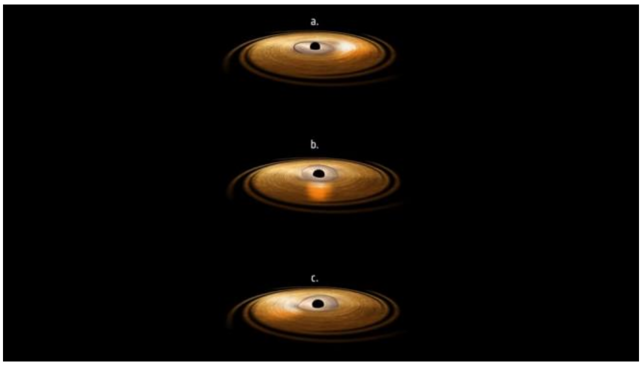


II. HISTORY OF BLACK HOLES

The hypothesis of the possibility of the existence of such a phenomenon was Romer's discovery that light has a limited speed, and this discovery raises the question of why the speed of light does not increase to a greater speed. John Cavendish in the Royal Society, in 1783 AD, an article in which he pointed out that a dense, compact star may have a very strong gravitational pull that light cannot escape from it. Although we cannot see light because it does not emit it, we can only feel its gravity.And these stars are what we call "black holes." They are gaps in space, and these ideas were neglected because the theory of light waves was prevalent at that time.In 1796 AD, the French scientist Pierre Simon Laplace brought this idea to the fore in his book Exposition du Système du Monde (Introducing the order of the universe), but his contemporaries doubted the validity of the idea due to its theoretical fragility.Until Albert Einstein's general theory of relativity came along, which proved the possibility of black holes. Its effects, as the first black hole was discovered in 1971 AD. Opinions about the black hole turned into observational facts through the radio astronomical telescope, which allows observers to see the universe more clearly, and made the theory of relativity an accepted scientific fact for most students of physics.

In 1967, there was a revolution in the study of black holes by the scientist Israel - a Canadian scientist born in Berlin - who showed that black holes are not rotating, according to the general theory of relativity and must be very simple, as they are completely spherical. Its size corresponds only to its mass and any two black holes of equal mass are equal in size. It was possible to put them through a special solution to Einstein's equations shortly before general relativity and it was believed that a black hole does not form only when a spherical object is completely crushed. And that the stars are not perfectly spherical, and therefore can only be crushed individually naked, but there are different interpretations of the result of Israel adopted by Rogerberzor and John Wheeler. Accurately spherical, and according to this theory, any rotating star becomes spherical, regardless of its complex shape and internal structure, and it will end after being crushed by gravity into a completely spherical black hole whose size depends on its mass. In 1963, Doy Kerr found a set of solutions to the equations of general relativity describing rotating black holes that had been overlooked by Israel. If the rotations are zero, the black hole will be completely spherical and the solution will be similar to the

Schwarzschild solution. But if the rotation is non-zero, the black hole bulges outward near the level of its equator, just like the Earth is dented by the effect of its rotation. Israel assumed that any object that collapses into a black hole will end up in a stable state, as Kerr's solution describes.



In 1970 Brandon Carter stated that the size and shape of any fixed-rotation black hole depends only on its mass and rate of rotation provided that it has an axis of symmetry, and after a while Stephen Hawking proved that any black hole with a fixed rotation will have an axis of symmetry. Roe Benson used these results to prove that after gravitational crushing, the black hole is stable in a position that is rotating but not pulsating, and also that its size and shape depend on its mass and rate of rotation without the body that was crushed to form it.

III. General Relativity and Quartz

Black holes have no evidence except calculations based on general relativity, so there were those who did not believe in them. In 1963, Martin Smidt, an American astronomer, observed the redshift in the spectrum of a faint star-like object in the direction of the radio wave source, and found that it was greater than being the result of a gravitational field. in the solar system. This redshift is caused by the expansion of the universe, which in turn means that the object is very far from us, and in order to see it at such a great distance, it must emit a huge amount of energy. .

In 1967, Jocelyn Bell discovered objects in space that emit regular pulses of radio waves, and it was believed that they had contact with strange civilizations in the galaxy, but she concluded that these pulses were caused by pulsating stars that were in fact rotating neutron stars that emit these pulses because of the complex interference between their attractive fields And between the surrounding matter and these pulsations are the first evidence of the existence of black holes, but how can we detect or sense the black hole even though it does not emit light? By studying the force exerted by the black hole on neighboring objects, they saw a star revolving around an invisible one, but this is not a condition that the invisible star is a black hole, as it may be a faint star. With this high gravity and the enormous energy that the black hole emits, particles of very high energy may be generated near the black hole and the magnetic field is so strong that particles collect in fountains that shoot out along the axis of rotation and we see such particles in a number of quasars.

IV. Formation and Evolution of Black Holes

The star consists of a quantity of hydrogen gases by gathering, collapsing and decreasing on each other, and with this contraction, the collision of gases among themselves increases at great speeds, and the gas heats up until it becomes very hot to the point where the hydrogen atoms collide when they collide to form helium, in the form of a nuclear reaction similar to the reactions of a hydrogen bomb because the size of the hydrogen bomb is the same. The star is massive and can withstand its own gravity after it has used up all its fuel. When a star is young, matter particles are very close to each other, and according to the Pauli principle of exclusion, the velocities of the particles must be greater than between the electrodes. Therefore, they are called neutron stars that may not exceed a radius of ten miles or so, with a high density that is hundreds of millions of tons per inch. The one and its existence is predicted and was not able to watch it and was not discovered until after a long time.

And it will be the end of time and the end of any crushing star in the form of this singularity, and the information cannot come to us because it has been disrupted, but any viewer outside the singular is not affected by the disruption of these laws (this means that the laws of physics that we know do not work inside the black hole because they are disabled like the Big Bang disrupted in it The laws, but we are outside the black hole are not affected by this disruption). In other words, these laws do not break, but they work according to other dimensions, including the environment of black holes, according to astronomers.

There are other solutions of general relativity that protect the astronaut in order to avoid collision with the singular, which is to fall into the middle of a wormhole and come out in another region of the universe. These solutions open great possibilities for travel through space and time, and they are still theoretical opinions that do not exist in our current reality.

But these events are not stable, as the existence of anything may change them, and the person in the singularity can only be in his future, because the cosmic censorship laws stipulate that the singularity can only be in the deep past (the Big Bang) or in the future, and it is possible to prove any A formula for cosmic control that it may be possible to travel through the past in close proximity to the ordinary singular.

V. Growth of Black Holes

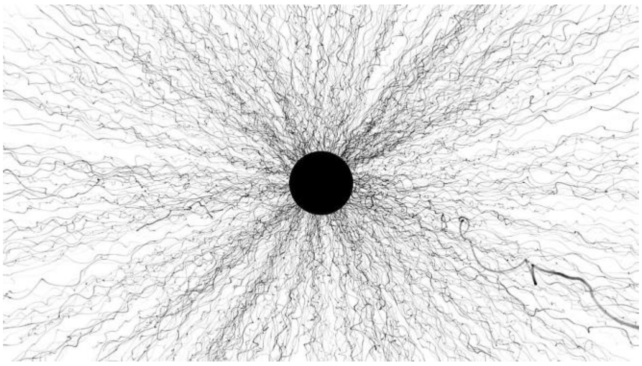
From the idea of defining a black hole as a group of events from which it cannot be escaped, and it means that a black hole, i.e. the event horizon, is composed of paths of light rays in space-time, and therefore light cannot move away from the black hole, but rather hovers at its edges forever. These paths cannot approach each other. If they approach, they must merge to become one, and in this case they fall into a black hole, but if the black hole swallows these rays, this means that they were not on its borders, and this means that the rays must be parallel or divergent. And if the rays that make up the event horizon cannot converge, then the area of the event horizon remains the same or expands with time, and in fact the area expands whenever matter or radiation falls into the black hole, and if two black holes collide and merge together in one hole, the area of the event horizon For the new hole, the sum of the areas of the first two holes is equal or greater, and based on this definition and this idea, the boundaries of the black hole will be the same for the black hole and also their area, provided that the black hole has become a stable position that does not change with time, this behavior of the black hole area was inspired to a large extent. From the behavior of a material amount called "entropy" - which is a measure of the degree of disorder or disorder of a system - and the estimate or description of this precise idea is known as the second law of thermodynamics, it states that the "entropy" of an isolated system increases steadily and when two systems merge together, the "entropy" is a) the unified system, greater than the sum of the two in each, and a research student named Jacob Beckenstein suggested that the area of the event horizon is a measure of the entropy of a black hole; Whenever an entropy-bearing matter falls into it, the area of the event horizon expands, so that the sum of the entropy of matter outside the black holes and the area of the horizons never decreases. Necessary to avoid violating the second law of dynamics. That is, black holes must emit radiation, but black holes, by definition, are objects that are supposed to emit nothing.

In fact, rotating black holes emit atomic particles, but when Stephen Hawking performed his calculations, a disturbing result appeared to him, which is that even non-rotating black holes emit atomic particles, and this result Stephen believed was caused by his miscalculation and finally assured him the spectrum of these particles is exactly what he had It comes from a hot body.

How does a black hole seem to emit particles as long as we know that nothing can escape the event horizon? The answer, according to quantum theory, is that the particles do not come from inside the black hole, but from the (empty) empty space just outside the event horizon of the black hole; In order for the picture to be clear, it is necessary to repeat the idea that what we think of as empty space cannot be completely empty because this means that all fields of gravity and electromagnetisms will be exactly zero, except that the value of the field and its rate of change with time are similar to the position and velocity of the body: the uncertainty principle necessitates that Whenever we know exactly one of these two quantities, the accuracy decreases in the other, and so in empty space it is not possible to determine the zero field precisely because it has a value of zero and a rate of change of zero. Zero Energy Research the life and work of Nicole Tesla.

These particles cannot be seen or detected with searchlights because their effects are indirect. The uncertainty principle predicts the existence of similar hypothetical pairs of matter particles, where one pair is matter and the other is antimatter. And imagine these particles on the borders of the black hole, that is, on the borders of the event horizon. It is very possible for the hypothetical body carrying negative energy to fall and the body with positive energy to survive.

For an observer from afar, it appears that the particle was emitted by the black hole, and with the flow of negative energy into the black hole, the mass of the black hole will decrease, and because the black hole loses some of its mass, the area of its event horizon decreases. More and more mass decreases, but no one knows what happens to the black hole if its mass decreases to a large degree, but the closest belief is that it will end and disappear in a final massive explosion of radiation equivalent to the explosion of millions of hydrogen bombs. The first black hole with a primordial mass of one thousand million tons would be close to the age of the universe. As for primordial black holes with a mass below these numbers, they would have completely evaporated. And those that have a slightly larger mass continue to emit radiation in the form of X-rays and gamma rays. These X-rays and gamma radiation are similar to light waves, but with a shorter wavelength. These holes hardly deserve the black character, as they are actually hot to the point of (red-white) and emit energy at a rate close to Ten thousand megawatts.



VI. ACCUMULATION OF MATTER IN BLACK HOLES

We may search for gamma rays emitted by primary black holes throughout their lives, although the radiation of most of them will be weak due to their great distance from us, but they can be detected. By looking at the background of gamma rays, we do not find any evidence of primary black holes, but it indicates that there can be no more than 300 of them in each cubic light year of the universe. If, for example, its presence is a million times more than this number, then the closest black hole to us is a thousand million kilometers away, and in order to see a primary black hole, we have to detect several quantums of gamma rays emitted in one direction during a reasonable period of time, such as a week, but we need a sensor Great for gamma rays and also must be in outer space because the Earth's atmosphere absorbs a large amount of gamma rays from outside the Earth. The largest gamma ray detector that can capture and pinpoint black holes we have is the entire Earth's air layer. When a high amount of energy from gamma rays collides with atoms in the Earth's atmosphere, it generates pairs of electrons and positrons (anti-electrons, or anti-electrons), and we get a shower of fast electrons that emit light called Cherenkov rays. The idea of radiating black holes is the first example of a physical prediction based on the two great theories discovered in this century: general relativity and quantum mechanics. This is the first indication that quantum mechanics is able to solve some of the singularities predicted by general relativity.

It is known that the laws of physics are based on theories and on this basis, since there are objects called black holes, things can fall into them without return, there must be objects from which things come out called white holes, and from here one can assume the possibility of jumping into a black hole somewhere To come out of a white hole somewhere else. This type of space travel is theoretically possible. There are solutions to the theory of general relativity in which it is possible to fall into a black hole and then exit a white hole as well, but the following works have shown that all of these solutions are unstable: A slight disturbance may destroy the worm’s groove or the crossing that connects the black hole And the white hole (or between our universe and a parallel universe), all of this talk is based on calculations using Einstein’s general theory of relativity, and these measurements cannot be considered completely correct because they do not take the uncertainty principle into account. The black hole loses its mass by emitting particles and radiation until its mass becomes zero and completely disappears, and if we assume that there was a spacecraft that jumped into this hole, what happens? Steve Hawking says, based on his recent work, that the vehicle will go to its own small (child) universe, a small, self-sufficient universe branching off from our region of the universe (the child universe can be explained by imagining a quantity of oil in a basin of water that is collected, move this quantity with a pen that will A small ball of oil separates from the big ball. This small ball is the child universe and the big ball is our universe (note that the small ball may come back and connect with the big ball) and this baby universe may rejoin our region of the space-time world, so an action would appear to us as a black hole Another may form and then evaporate, and particles that have fallen into a black hole appear to be radioactive particles from another hole. This seems to be required to allow space travel through black holes, but there are flaws in this scheme for this cosmic travel, the first of which is that you will not be able to determine where you are going, that is, you do not know where you will go, and also the child universes that take the particles that fell into the black hole happen in what is called imaginary time up A spaceman who has fallen into a black hole to a hateful and painful end is torn apart by the difference between the forces applied to his head and feet Even the particles that compose his body will be crushed in real time and will end in a gravitational singularity, but its histories in imaginary time will continue as they cross into a child's universe Then it reappears as particles radiated by a white hole. Those who fall into a black hole must adopt the slogan: (Think imaginative). What we mean is that going through a black hole is not a candidate to be a satisfactory and reliable method for cosmic travel because it is still in the process of theoretical philosophy, and perhaps after years of studies we will be able to enter the black hole. Some scientists said that the black hole is a gateway to a distant galaxy or another world.

VII. CONCLUSION

On November 27, 2019, Chinese astronomers announced the discovery of a giant black hole on the other side of the Milky Way, and they named it LB-1, 70 times more massive than the Sun. It is estimated that the Milky Way, as well as 100 million stellar black holes, but the size of "LB1" is larger than scientists thought possible, said Liu Jifeng of the Chinese National Astronomical Observatory who led the research. He added, "There can be no black holes of this size in our galaxy, according to most of the prevailing theories about the evolution of stars." Scientists believe that there are two types of black holes, and the most common stellar holes, which are 20 times larger than the sun, are formed when a very large star explodes. "This discovery forces us to reconsider our models for how stellar-mass black holes form," said David Ritz, director of the Florida Geological Wave Laser Interferometer observatory. Recent studies have revealed ripples in time and space due to collisions of black holes that then merge to form new, larger holes, but this is the first time that a black hole of this size has been discovered in the Milky

Way. Using the LAMOST telescope, the team found stars moving across the sky, apparently orbiting an unseen object. Following up on observations using telescopes in Spain and the United States, a star eight times larger than the Sun was discovered that orbits the black hole every 79 days. The massive star was orbiting a "dark companion" located 15,000 light-years from Earth.

Authors Profile

[1] Independent Research Scholar.