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Black Hole Mystery

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Abstract: ***This paper aims at explaining the complicated concepts and phenomenon associated with the Black Holes. The research has been described in a manner that explanations can be grasped by people with a rudimentary knowledge of physics as well. For the same purpose, a negligible amount of math has been provided for ease of understanding. The main purpose served by this text is to introduce the quantum nature of the universe to youngsters through the pretext of Black Holes and provide them with a basic understanding of these intriguing subjects. Not all the problems communicated through the course of this paper have been solved, which in fact, makes it a lot more interesting. The hope remains constant that this piece of literature provides the basic insights into quantum concepts to future scientists who in turn contribute to the solving of these problems.***

Keywords: information paradox, black hole, white hole, thermodynamics

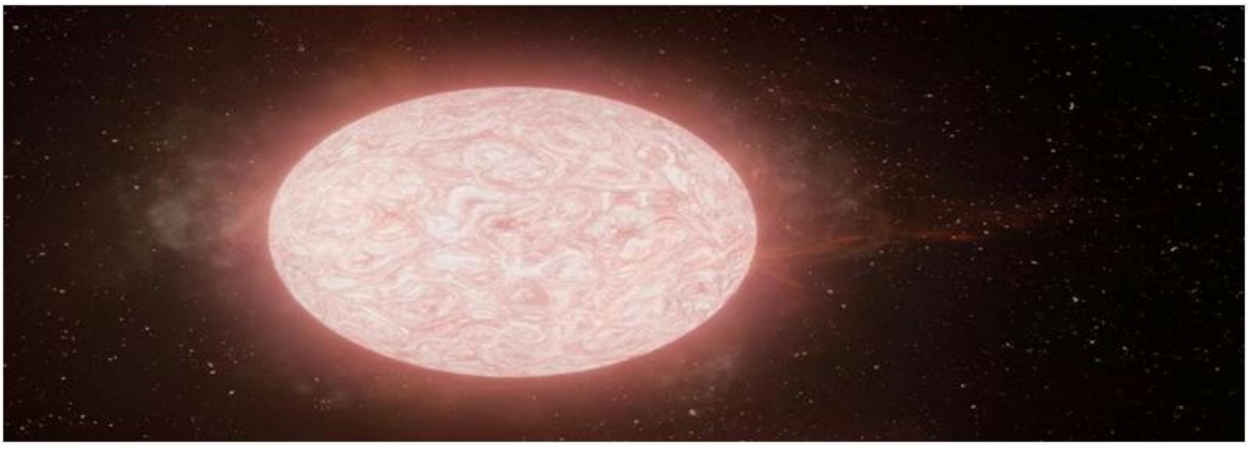
Black Hole is a cosmic body of extremely intense gravity from which nothing, not even light, can escape. A black hole can be formed by the death of a massive star. When such a star has exhausted the internal thermonuclear fuels in its core at the end of its life, the core becomes unstable and gravitationally collapses inward upon itself, and the star's outer layers are blown away. The crushing weight of constituent matter falling in from all sides compresses the dying star to a point of zero volume and infinite density called singularity. The gravity of the black hole is so immense that even light cannot escape from it. These black holes are from formed from the death of a star that is these blacks or black holes are formed as the star dies or we can see as the fuel of the star has been done the immense gravity of the core of the star collapse it by making it a black hole or a neutron star There are two forces which act on a star during his lifetime like there is a Force of the core of the store that's actually the pressure which is acting to outwards it means this force helps the star to maintain equilibrium between the gravitational force which wants the star to shrink and this equilibrium is called as hydrostatic Equilibrium.

Why a Star Dies?

As said earlier a star dies because its fuel is no more and there is nothing to maintain that equilibrium which is keeping the star still which means no Equilibrium can be maintained. As in a star when silicone reacts two form q iron start dies as iron is the stable element So it must absorb energy in order to fuse Into heavier elements. The formation of iron in the core therefore effectively concludes fusion processes and, with no energy to support it against gravity, the star begins to collapse in on itself. The star has less than 1 second of life remaining.

During this final second, the collapse causes temperatures in the core to skyrocket, which releases very high-energy gamma rays.

These **photons** undo hundreds of thousands of years of nuclear fusion by breaking the iron nuclei up into helium nuclei in a process called **photodisintegration**.



At this stage the core has already contracted beyond the point of **electron degeneracy**, and as it continues contracting, **protons** and **electrons** are forced to combine to form neutrons. This process releases vast quantities of neutrinos carrying substantial amounts of energy, again causing the core to cool and contract even further.

Blackholes

As we know the black hole has very much higher gravity than Any other heavenly body in this whole universe So the question arises that what would happen so if we cross the event horizon of a black hole so let's take an astronaut which is crossing the event horizon or we can say The astronaut reached the point of nowhere that it crossed the boundary known as event horizon now what would happen to him or

to his body will simply Spaghettify. Spaghettification It is vertical Stretching and horizontal compression of the objects In long thin Shapes Due to the immense gravity of the black hole. The gravity of the black hole is so powerful that the feet of the astronaut would have much more and powerful gravitational force then its head. So the bodies of the astronaut will Spaghettify From his legs and then will vanish in the black hole.

There are Four types of black hole they are Stellar black hole, super massive black hole, intermediate black hole and miniature black hole.

SETTELER BLACK HOLE: It is a type of black hole Which is formed when A star runs Out of its fuel then the core of the store compresses it by forming it a black hole and this type of black hole is called as settler black hole.

SUPERMSSSIVE BLACKHOLE: These are the black holes which are present in the galactic centre of the Galaxy

These black holes can have Millions to billions solar masses these black holes are very enormous and every star in that Galaxy revolves around galactic center.

INTERMEDIATE BLACKHOLE: These black holes are medium sized black holes. Such bodies could form when stars in a cluster collide in a chain reaction. Several of these IMBHs forming in the same region could then eventually fall together in the center of a galaxy and create a super massive black hole.

MINITURE BLACKHOLE: These Black holes or mini sized black holes. In field of quantum mechanics and many scientists believe that these black holes not even exist because they are too small.

The more mass you place into a small volume of space, the stronger the gravitational pull gets. According to Einstein's general theory of relativity, there's an astrophysical limit to how dense something can get and still remain a macroscopic, three-dimensional object. Exceed that critical value, and you're destined to become a black hole: a region of space where gravitation is so strong that you create an event horizon, and a region from within which nothing can escape. No matter how fast you move, how quickly you accelerate, or even if you move at the ultimate speed limit of the Universe — the speed of light — you can't get out. People have often wondered whether there might be a stable form of ultra-dense matter inside that event horizon that will hold up against gravitational collapse, and whether a singularity is truly inevitable. But if you apply the laws of physics as we know them today, you cannot avoid a singularity.

Black Holes and Mystery

The mystery of the black hole is one of the biggest mysteries of the universes. The first ever Picture of black hole Was taken by Event horizon telescope in 2019 and the black hole was name this M87 that Is 55 million light years away from earth. There are many mysteries about black hole

like we don't know what is on the other end Of the black hole. As we can see if a black hole suck something Like a star An asteroid or some other heavenly body We don't know where they go. Anything which crosses the event horizon Of black hole **IN simple words** we can say that event horizon is a place it's a boundary in a black hole anything or any object all this universe which crosses the event horizon cannot come back. So where does that all matter go there are many theories Related to Black hole. Let's move towards black hole Paradox. This paradox simply states that anything in this universe has some kind of information like for example I would take a paper, I would write some information on it and then due to some unnatural way this information Has been suck my black hole so this paradox simply states As we don't know the things which have been sucked by black hole where they go so that means we cannot get this information back that is a paradox and this paradox is known as Black hole information paradox. AS Outer space is considered in a state of quantum vacuum. As a result, particles are repeatedly coming in and out of existence. Naturally, this phenomenon also extends to the region near the Event Horizon. This brings upon implications that were first posited by Stephen Hawking. He stated that the virtual particles that come into existence at the Event Horizon are at times, torn apart from one another due to the strong gravitational effects of the Black Hole. Of the positive and negative particles formed due to the Quantum Vacuum, the negative particle succumbs to the Black Holes gravity and falls towards the Singularity. The positive particle is seen being emitted as radiation from the Black Hole. This is known as Hawking Radiation. The negative particle which enters the Black Hole reduces the Black Holes mass. As a result Black Holes evaporate over a very long astronomical time frame (for a large Black Hole, time taken to evaporate is of the order 1067 years). One of the most brilliant scientists all the modern days Stephen

Hawking studied The black hole most he also helped humans to know the idea off black hole as like what are Hawking radiations. . So let's know what are these Hawking radiations. Hawking radiations or thermal radiations which come out of a blackhole. It's very well known the Hawking radiation Produced by the black hole and these radiations cause the black hole to evaporate and eventually ends the blackhole. Expert Stephen Hawking said that Hawking radiations cause the black hole to reduce its mass and energy and eventually the black hole ends up. This effect is called us black hole evaporation. Hawking's derivation of the black hole evaporation. has been disputed and checked many times and redone in different settings, and it turned valid, at most allowing some improvements of the unavoidable approximations, as well as mild generalizations. But the result is correct; the radiation is as predicted and thermal in the Kubo-Martin-Schwinger sense. Moreover, it is corroborated via the principle of equivalence with the Unruh radiation, which takes place in the Minkowski space-time for accelerated observers. Hawking's derivation is obtained in the framework of quantum field theory on curved space-time, but since the black hole is considered large and the time scale is also large, the space-time curvature induced by the radiation is ignored.

Black hole and second Thermodynamics

As we know the second law of thermodynamics states about the entropy that is It states that Entropy often isolated system is or we can see can never decrease. In black holes we can see that there is a charm that is that states that the area of the event horizon open black hole can never decrease This term is known as Hawking area theorem. As we all know that anything that crosses the event horizon of a black hole cannot escape because of its immense gravity so as anything which crosses the event horizon simply black hole sucks but will come to know that According to Hawking area term and second law of thermodynamics that's an entropy we came to know that as black hole sucks anything the area of the event horizon increases that is it Can never decrease because of the second of thermodynamics so it means black hole does not violate the second law thermodynamics there are many complications that black holes or violating the second law of thermodynamics but then we move towards quantum mechanics we can see that dear are some particles. All we can The spaces has quantum fluctuations that is we can see the particles and the antiparticles annihilation.

The entropy of A black hole is very high and can reach to Infinity. Because of the singularity and the immense gravity of the black hole the black hole has huge amount of energy concentrated in a small area. This means what we can see by this we came to know that the Black hole has unless amount of fusible energy and very high entropy.

Quantum Tunneling and Blackhole

Quantum tunneling is one of the most peculiar differences between our everyday, classical physics and the surprising realm of quantum mechanics.

For sub-atomic particles, such as electrons, when we say they can tunnel through the barriers, we don't refer to a physical obstacle, but the barriers of energy. The same can be said for the case of black hole tunneling. There are different methods to derive Hawking radiations, mostly relying on quantum field theory in curved space-time. For example, these can be studied by **Bogoliubov transformation between the initial and final states** of incoming and outgoing radiation and the Wick rotation method.

Recently the black hole tunneling method comes into being to investigate the Hawking radiation spectrum and the Hawking temperature, which is a really interesting one.

According to Andew Hamilton, an astrophysicist at the University of Colorado, the horizon of a black hole is an insurmountable barrier for the likes of us humans and, indeed, anything else larger than an atom. But every once in a while, a subatomic particle manages to pass through it. Thus, it is believed that all black holes emit an incredibly faint glimmer of stuff, named "Hawking radiation" after Stephen Hawking, the physicist who first theorized its existence in the 1970s.

Classically, there's no way that any radiation is going to escape from a black hole inside the horizon, space is falling faster than light, so nothing can emerge from it without traveling faster than light the other way. But quantum mechanically, there's some possibility that something inside can tunnel out. "

Doing so requires very special conditions, however.

As well as allowing quantum tunneling, quantum mechanics allows particles to randomly pop into existence. In fact, such "quantum fluctuations" happen all the time: Particle-antiparticle pairs spontaneously arise from the vacuum of space (and usually immediately annihilate each other).

For a particle to escape a black hole, a quantum fluctuation must occur near a black hole's edge. When this happens, sometimes one particle will tunnel out before the annihilation can take place. Its partner immediately gets "spaghettified" by the black hole elongated as it plunges to the center.

What is antimatter and what are antiparticles these are simply those particles having negative Moss they're also called as Exotic matter as in normal matter we can see an electron revolves around the nucleus but in case of antiparticles there is a positron in place of electron so that's why it repels the ordinary matter and makes the quantum tunneling easy out of a black hole as black hole repels it.

The relation between a black hole and a general black body system

Black body Is a body Which absorbs all the electromagnetic radiations falling on it and the radiations produced by blackbody is called as blackbody relations. A black hole is a perfect black body that is it absorbs all the radiation's falling on it.

Taking a black hole as a black body system, using general black body radiation theory, a Schwarzschild black hole and a Kerr–Newman black hole are investigated respectively. It

is concluded that a black hole can be regarded as an ideal general black body system exactly for the changing process only. However, a stationary global black hole cannot be smoothly regarded as a general black body system. A black hole has some special characteristics which different from a general thermodynamics system. This conclusion means that a black hole should be inherently dynamical, at least when it is taken as a black body system.

Inside a Blackhole

When we see A black hole We Think it's nothing But in reality it is a matter concentrated in a very small space or we can say At a single point And this Point is called as singularity. Scientists believe that inside a black hole there is junk of asteroids, meteoroids, and space matter. There is a tonnes of matter inside a black hole.

It is pretty evident that if an object were to cross the Event Horizon, it would eventually be ripped to shreds due to its massive gravity. This process, as Kip Thorne called it, is termed spaghettification. It is theorized that when an object enters the Event Horizon of an astronomically large.

Black Hole, at first the body experiences nothing. However, as time progresses, the body starts to feel a strong tug. As one end of the body is closer to the Singularity than the other, the body is stretched vertically (as gravity is stronger on the closer end of the body than the farther) and at the same time, it is compressed horizontally. The object is then ripped to shreds and is reduced to its elementary particles. But in reality we don't know what is inside a black hole or we can say we Don't know where all the matter goes we just know everything is trapped inside a black hole. yes. The singularity is a place of very intense gravity it's a place where the matter is so concentrated that it burns the curvature of the time. Let's take an example of earth we can make Earth a black hole if we compress Its diameter to 0.3mm. Sun can also be formed as a black hole by compressing its diameter up to three kilometers.

Rouge Blackhole

Most galaxies house a super massive black hole at their core, but occasionally these large cosmic features "go rogue" and wander away from the galactic center. One of these "rogue" black holes was recently spotted near the edge of its parent galaxy, located about 4.5 billion light-years from Earth, according to a statement from NASA. The black hole was spotted using data from NASA's Chandra X-ray Observatory and the European Space Agency's (ESA) XMM-Newton X-ray observatory. The closest rouge black hole is unicorn. Astronauts spotted that these blackholes move at a speed of several millions of km per hour. These black holes move around the edge of the Milky Way or they move around the universe as nomads. These black holes Suck everything coming on their way in this universe whether it may be a star a a asteroid, meteoroids etc.

Usually the mass of these black holes cements them in the centers of their galaxies, which slowly orbit around each other in clusters called galactic groups. But sometimes, an enormous force — such as a collision between two galaxies- can pop a central super massive black hole loose, forcing it to wander the universe like a cosmic vagabond. The wandering monsters can also be set loose when the merging of two black holes is disrupted, sending one or both of them flying.

To estimate how often this occurs, the astronomers ran a set of simulations called Romulus that account for all known rules about how black holes behave to trace how their orbits might evolve over billions of years.

NO HAIR THEORM

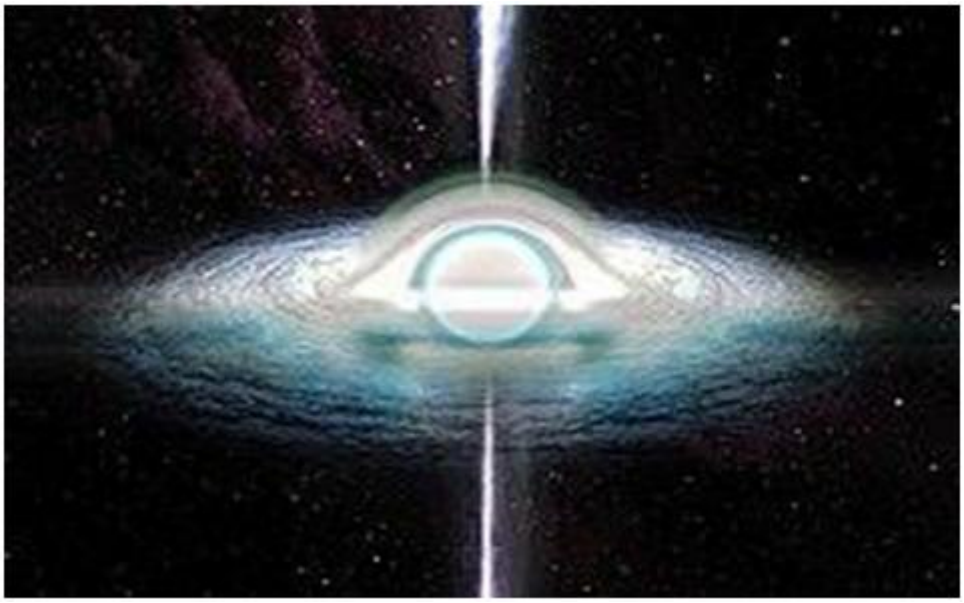
Today we will know about A theorem known as No hair theorem, this theorem was given by Albert Einstein in 20th century this theorem states that A black hole is characterized by Three Observable properties they are Moss angular momentum and Electric charge. General relativity, strong gravity can warp the geometry of space-time so much that black holes are formed—regions from which not even light

can escape. The interior of a black hole, where curvature becomes infinite, is an extremely complex configuration that defies our current theories.

Now newer study suggests that black hole is static that means it neither accelerate or rotate. . If they are isolated, their gravitational field is spherical and is characterized entirely by the black hole's mass MM. But in realistic environments, black holes can be distorted by the mass surrounding them. Mass distortions can be described by a sum of multipole moments, similar to the ones used in electromagnetism to calculate the electric field outside a region containing charges. In classical Newtonian gravity, if a star is spherical, only its monopole moment is nonzero and is given by its mass. But if the star is distorted, its higher multipoles are also nonzero. The Poisson equation relates the "source moments" (multipoles of the given mass distribution) to the "field moments" (obtained by expanding the Newtonian potential in powers of 1/r1/r), which completely determine the gravitational field outside the source. Thanks to the linearity of the Poisson equation, the source multipoles are the same as the field multipoles. But unlike Newtonian gravity, general relativity is governed by equations that are highly nonlinear. As a result, the gravitational field at infinity is more than the sum of the field generated by the individual parts. Instead, this field includes contributions from the black hole and the matter rings, plus a third contribution from the very gravitational field they create. So far, theorists have not been able to cleanly disentangle the three. As a result, no simple relation exists between the horizon moments (the intrinsic black hole's hair) and the field moments (the hair seen by an external observer).

Blackhole and white holes

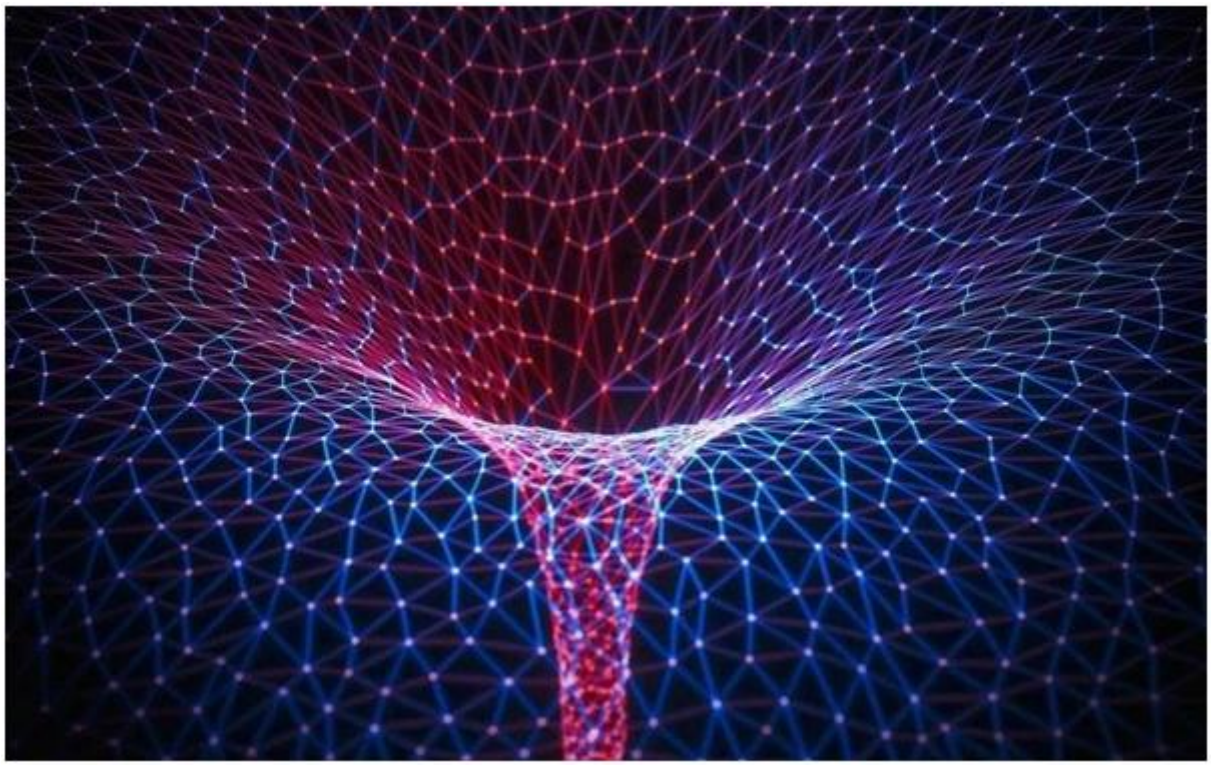
As we above knew about blackholes. What r these white holes then. In simple words if we have to define a white hole It's simply the reverse of black hole. As we know nothing can escape the immense gravity of a black hole and for Whitehole As black hole sucks everything it just throws things away or we can say it repels things.



White holes or the region of space and time or we can say It's hypothetical region of space and time where nothing can go inside it Or we can also say that nothing can go from outside to inside of it however energy matter in formation can come out of it or escape9 from it. White holes are hypothetical. White holes break all the laws of physics so physically they are not possible barring some theories they sre shown that these structures may be possible.

They are predicted by Einstein's theory of gravity, and are most often mentioned in the context of 'wormholes', in which a black hole acts as the entry point to a tunnel through space and time, ending in a white hole somewhere else in the Universe. But this is deeply controversial, because Einstein's theory predicts the existence of a so-called singularity at the centre of black holes – a state of infinite gravity which would prevent anything from passing through to the white hole on the other side. What actually is a wormhole and how this process really works.

The Einstein's general theory Of relativity Predicts the presence of wormhole In our universe but till now we haven't been able to see anyone them. A wormhole Is a shortcut in space and time by which we could travel extraordinary distances in a blink of an eye. It can throw us from one side of the Galaxy what we can see from one side of space and time to other with a Speed f faster than cosmic speed limit. Mathematically these wormholes are very much possible. There is always a disorder in space and time and these wormholes are created in space but till now we are not being able to catch one.



The original idea of a wormhole came from physicists Albert Einstein and Nathan Rosen. They studied the strange equations that we now know describe that inescapable pocket of space we call a black hole and asked what they really represented. Einstein and Rosen discovered that, theoretically at least, a black hole's surface might work as a bridge that connected to a second patch of space. The journey might be as if you went down the drain of your bathtub, and instead of getting stuck in the pipes, you came out into another tub just like the first.

These wormholes or created every time in our universe but according to scientists these wormholes or at microscopic level that is they can be up to of size $\mathbf{10^{-31}}$ cm. It means it's too small Even if we find it we will not being or we can say we will not be able to enter it because it's too small for us to enter. In modern day also we don't have that kind of a technology to find them we can think that in future humans can make some kind of a technology so that we will be able to fix them and make most of them to understand the understanding of this universe.

Let's move towards thermodynamics the second law of thermodynamics states that Change of entropy of a isolated system will be greater or equal to zero. . Or we can say it states that entropy can remain same or increase but it can never decrease. But in case of white holes they decrease the entropy. Since white holes are reverse black holes, they would also be formed by a gravitational singularity — a point in space-time where the gravitational field becomes infinite.

According to the principles of general relativity, the universe cannot support these types of singularities because event horizons were primarily introduced to reconcile the issue of space-time breakdown near black holes. However, some new theories have pointed to the existence of these naked singularities.

My Idea of Blackholes and White Holes

White holes can exist in many ways. As the break the second law of thermodynamics which states that entropy can never decrease in simply so that means if white hole Exists it would be really unstable that is it can exist for up two seconds. In white holes Since the entropy can only increase that's why yeah it's unstable.

As we all know matter can neither been Created and nor Destroyed but in case of blackhole matter is being destroyed. For example a black hole sucks a star now. All the matter of the matter of star is inside blackhole As Stephen Hawking said black hole continuously evaporates By emitting radiation known as Hawking radiations. So now as black old keeps evaporating and evaporating until it vanishes So we have no way to get that matter back which means matter is being destroyed.

Way 1

White holes are unstable as we know it can happen that at The end of the life of a black hole black hole For some instant it can form itself A white hole for some seconds so by throwing all the matter back to the universe and not destroying law. Since white holes are really unstable they can exist for a miniature of seconds. This way can also describe how about universe was formed.

Way 2

As far as I have studied about white holes and black holes and as far as I know both of them. I think that both black holes and white holes are In a equilibrium with one another that is now the question arises as How can these two be in equilibrium. As far as I think that singularity connect the black hole to a white hole in way so that equilibrium is

maintained.

As we all know there Or millions and billions of galaxies in the universe and we cannot explore it all. There can be some particles which can be repelled by blackhole. If not so then how can Hawking radiation came out or a black hole through it's immense gravity so this means these particles are simply repelled by a black hole and black holes cannot suck them

As far as I have studied there could be a Galaxy where the laws of physics could be different. And as I earlier said singularity can maintain equilibrium between a black hole and a white hole. As far as I studied I think that this singularity connects or is a pathway to another galaxies or universes.

So as far as I think White holes can also suck some kind of a matter Or I can say that there could be some kind of a matter In some galaxies which can be attracted by white holes.

I think that the Hawking radiations is not only some kind of a property of a black hole which allows it to evaporate. As we all know Hawking radiations make these blackhole to vanish so entropy is maintained.

So what I think that black holes and white holes or in a stable equilibrium with one another so how is that possible. As for as I studied I think that Black holes and white holes what are connected to each other by singularity. And these Hawking radiations are actually The matter by which a white hole is made up of so as these two are connected with each other. Both white holes and black holes keep on evaporating and White hole too evaporates And what the matter comes out of a white hole on evaporating is actually of black hole and vice versa as singularity is a path between these.

References

[1] '7 Brief Lessons on Physics' by Carlo Rovelli
[2] Black Hole: How an Idea Abandoned by Newtonians, Hated by Einstein, and Gambled On by Hawking Became Loved' by Marcia Bartusiak
[3] Seeing gravity (Bernard laveda)
[4] Einstein fridge (paul sen)
[5] Space time and geometry (sean m corrol).
[6] Google