

# Theories on Space-Time and Black-Holes

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## ABSTRACT

Time is fundamental unit of human. But we even don't know what even the time is. Time is said as the fourth dimension of the infinite universe. 'String Theory' tells us about the 11 dimensions in the universe, 10 dimensions of space and one of time. String Theory, theoretical framework tells us that the smallest particles are defined according to there vibration. These vibrations in the String particles are the definition of there presence in the universe. Two theories, The 'Theory of Special Relativity' and 'Quantum Mechanics' gave phenomena which further gave us the presence of the elementary particles of atoms and gave us knowledge about the smallest particles, which was known as 'String Particle'. 'String Particle' is not an actual dot, but vibration which makes the sub-atomic particles 'Quark'.

According to Sir Albert Einstein, Time and Space are the similar factors. Einstein gave a theory 'Time Dilation' which means that movement of any object will slow-down the time accordingly. It was said that when we move with an extreme speed and gain the speed nearly equivalent to light, the time will stop for us. Also when we exceed the light, we can go into the past. But 'Second Law of Thermodynamics' says that entropy always increases with time. Which means, things will transform to the disordered state of actuality from orderly state of presence.

'Gravity' is the Geometrical Curvature in the field. Space-Time defined as a field which is affected by the 'Gravity' with the help of 'Gravitons'. There are 16 fields, 12 matter fields which made-up this universe and 4 forces of the fields of nature. The string particles in these fields makes up and decides the presence of the components, means that the vibration in field of electrons will make electrons.

'Black-Holes' are the deepest holes in the 'Gravitational Fabrics' which completely absorbs every particle which comes in contact to its gravitational field. Black-Holes are the small dense dot which gains excess mass at a small area, which leads to highly increase in gravity and attracts all the nearby bodies. The visible ring shaped region in Black-Hole is the 'Event-Horizon'. Black-Hole emits radiation, which contains some mass. Which lead to the end of Black-Hole. As said in some theories that everything which takes birth has to finish one day.

## I. KEYWORDS

Space-Time; Black-Holes; Multi-Dimensions; String Field Theory; Big-Bang; Kant-Laplace Nebular Theory; Theory of Special Relativity; Quarks; Time Dilation; Thermodynamics; Event Horizon; Quantum Mechanics; Quantum Physics; Chandrashekhar Limit; Red Giant; Super Red Giant; Supernova; Neutron Star; White Dwarf; Black Dwarf; Nebula; Law of Reflection Gravitation; Euclidean Geometry; Time Paradox; Cosmic Gravitational Waves; Time Paradox; Time Warp; Theory of Everything; Theory of Uncertainty;

## II. INTRODUCTION

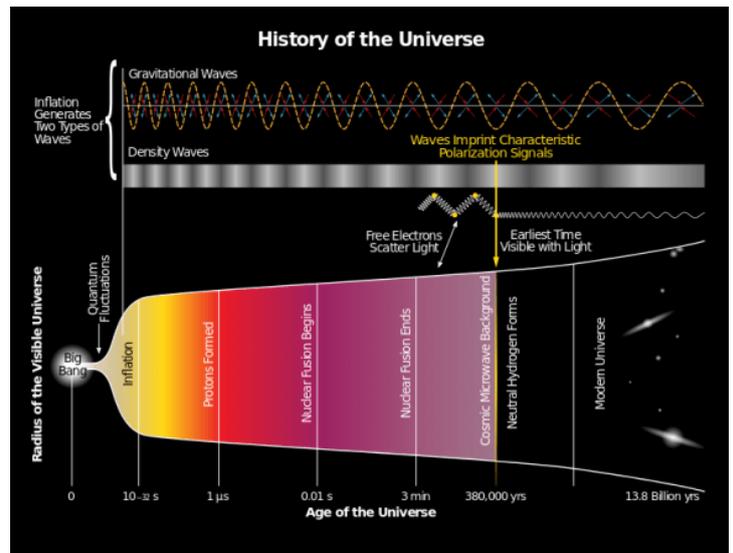
Big-Bang was an event which occurs in the singularity which further made the universe. The most famous theory, Big-Bang Theory was given by George Lamaitre. We started to observe the universe, we saw our Solar System, our Galaxy, other Galaxies, Clusters, Super Clusters, etc. Edwin Hubble started observing that

this infinite universe is continuously expanding. So Hubble decided to go in past time and check what was reason of this behaviour of this universe. He used the Relativistic equation of mass.

$$m = m_0 / \sqrt{1 - v^2/c^2}$$

where,  $m$  = relative mass,  
 $m_0$  = rest mass,  
 $v$  = velocity,  
 $c$  = light speed in vacuum.

With this equation, he came to the result that earlier the matter was contracted in the single point which was also known as Singularity. Later due to unstability it exploded. According to Stephen Hawking, if we compress the earth into a tiny tennis ball, it will have high gravity in a very less area. Then it will turn to unstable state and the last particle will be pulled inside and result to an extreme explosion which will be even billion times hydrogen bomb explosion. According to 'Kant-Laplace Nebular Theory' when the gravity became unstable the particles started moving toward the core and formed a disk which started rotating. The rotation of that disk started gaining angular momentum and with a great explosion, it threw out every matter which it contained and it formed universe.

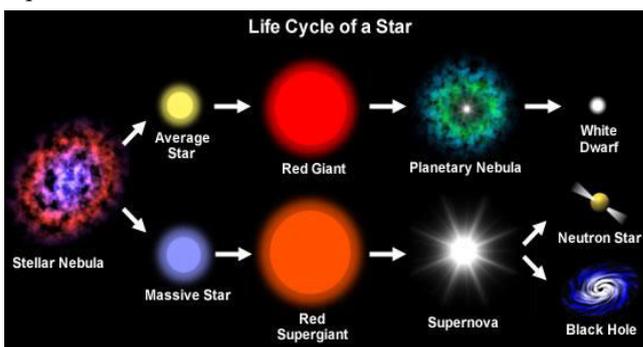


History of the Universe

The above image is the history of this infinite universe, which occurred after Big-Bang explosion. Here the 'Time' came in existence. Time came in presence after 1/10th part of a second. Inflation, which can be viewed in the above image was expansion of

our universe. Then comes the era of the Quarks which last for  $10^{-32}$  seconds. After then every tiny particle quarks started colliding with the anti-quarks to destroy one another and gave a large glow-on and the made a new quark. According to Sir Albert Einstein, Matter and Energy are same things in nature and both can not be made or can not be destroyed. That time Matter started winning over Anti-Matter and one Matter in a million Anti-Matter came in presence. At  $1/10^{-9}$  Neutral laws came in presence, which was 'Strong Nuclear Force', 'Weak Nuclear Force', 'Electromagnetic Force' and 'Gravitational Force'. After this universe was stretched in billions of kilometre and result to a great fall-down in temperature. Then the quarks began to form 'Hadrons' and 'Leptons' like 'Protons' and 'Neutrons'. Many combinations of quarks were formed but very few remained stable and rest evaporated away. After one-second Nucleosynthesis begun and everything came to presence. Every Neutrons and Protons together made-up 'Atoms'. This time universe was filled with infinite particles and energy, and the temperature reached about 10 billion degree centigrade. Slowly in many year everything started to cool down. Hadrons and Leptons formed a stable and electrically neutral environment. Later these Hadrons and Leptons formed a nucleus and Hydrogen atoms were formed. After 200 seconds the Opaque era started where the infinite universe was filled with hydrogen gas which didn't allow even the light to pass through. Years later when hydrogen gas clump together with the gravity, formed stars, nebulas and galaxies. Big-Bang theory was proved accidentally in 1964 when the 'Cosmic Background' picture of the red shifted universe was taken.

In 1935, Subrahmanyan Chandrashekar and William Alfred Fowler gave the joint thesis on life-cycle of stars. In 1983, they got Nobel Price for it. This was the first every theory which told us about Black-Holes. When Hydrogen gas began to clump together they were brought together in lumps. These lumps were made of Gas Clouds and Dust. These lumps were known as Nebula. These Nebula further condense with there own gravity and makes a Protostar. Protostar contains Hydrogen and it works like a Nuclear Reactor. Where Hydrogen atoms convert into Helium and produce a lot of heat and light. Now it comes in the category of Main-Sequence star.



Life Cycle Of a Star

Now the stars are categorized according to their mass in comparison to the sun. Here the Chandrashekar limit compares the masses, which is about 1.44 X mass of sun, which is 2.86 Quintillion Kilograms(on Long Scale). If mass of star is below 1.44 X mass of the sun. Then star will be categorized as a Red Giant. And if mass of star is more than 1.44 X mass of the sun then star will be categorized as a Super Red Giant. Both the stars contains core, but

the outer surface starts to loose temperature due to shortage of Hydrogen on the star, its outer surface stars cooling down and become red or orange in colour and the light dims down. Red Giant which is below the Chandrashekar Limit cools down and the outer most layer of this star cracks away and the inner core which is still burning also cools down and becomes White Dwarf. White Dwarf continues the further process of Fusion. And when the resources are over it forms Black Dwarf and after years it again spreads away and forms a Nebula and this process continues.

The Super Red Giant further continues the Nuclear Fusion and forms Helium, later Helium makes Carbon, then Carbon makes Iron. Iron is extremely denser and started to collapse in the core. Due to collapse the gravity becomes unstable and it explodes with Supernova. Now again mass of this star will decide what star is going to be. If mass of that star is below the 3 X mass of sun(about 5.97 Quintillion KG) then it is a Neutron Star. It is about 10 KM in diameter, containing a lot of matter. If it is above the 3 X mass of sun then it is a Black-Hole. It contains all the matter in about a few meters of diameter.

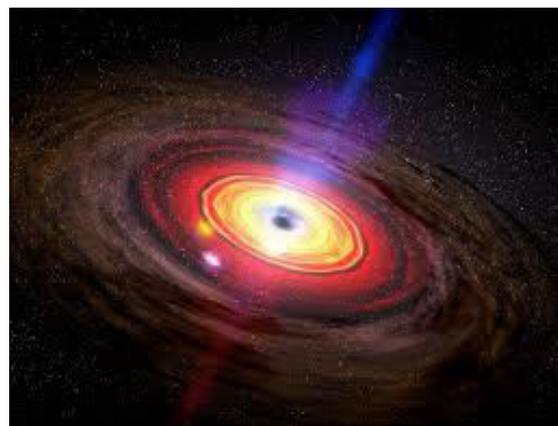
III. LITERATURE REVIEW

From Theory of Special Relativity space-time always has been important thing to be analyzed, that how time works in other places in the universe. Euclidean Geometry told us that our infinite universe has three dimensions of space. Einstein's theory proved that the Time is the fourth dimension which is greatly affected by the Space which is three dimensions. Various theories says, curve of gravitational fabrics slow-down the time. Suppose there are two people, one is sent near high gravity and other is away from that gravity. Both have a watch and they both note down the time. Later it the difference in there watching were discovered. The person apart from the high gravity, is running ahead in time. Whereas the

$$\Delta t' = \frac{\Delta t}{\sqrt{1 - v^2/c^2}}$$

one near the high gravity, has a different time. Law of Reflection Gravity proves that the gravity will be scattered and by the gravity scattering, fundamental interaction may take place. This basic interaction is wave function of the gravitons that carrying electromagnetic fields, primary force. This difference in time, is the Time Dilation. Which can be measured by the given formula.

The above formula and the theory don't define the Dilation in Time. It is discovered that the two watches have a different rate of time on the different ratios.



**Supermassive Black-Hole**

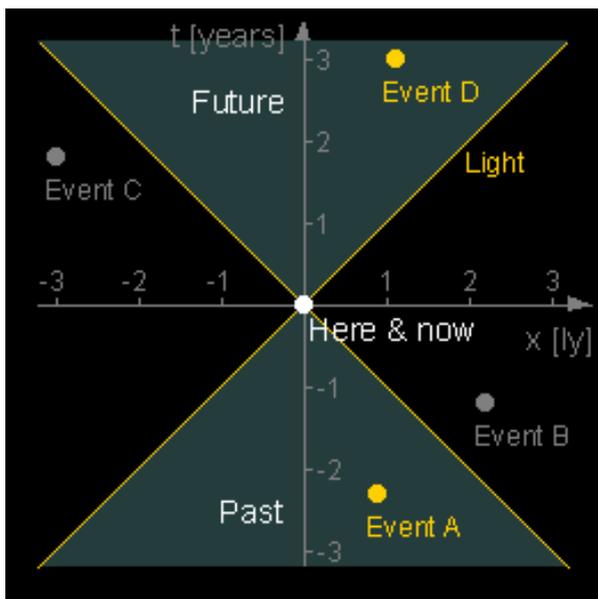
In Einstein's theory, time dilation can be summarized as Special Relativity and the General Relativity. In Special Relativity, anyone moving along the observational system is measured to be moving very slowly. This effect is the Lorentz Transformation. The person is positioned at a low gravity are observed to be moving very slowly. Effect of dilation is related to view of a person who is moving, and the Time will be Dilated for the other one.

Stephen Hawking told us more about Black-Holes and gave his contributions to famous Indian Scientist Subrahmanyan Chandrashekhar who first gave the theory on Black-Holes and Chandrashekhar Limit as explained above. Basically, the star with mass more than 5.97 Quintillion KG makes Black-Hole. Stephen Hawking said that they are a Giant which contain large mass in few meters. And it has high gravity which even doesn't allow the light to come out. Black-Holes are basically deepest hole of Gravitational Fabric, which doesn't allow the object to come out which fall in it. Black-Hole has the dark centre and an extremely glowing outer region named as Event-Horizon. Event-Horizon is the collections of stars, that are trapped in the event-horizon and can not scape away. And slowly the Event-Horizon is eaten up.

Every objects in this Galaxy is also trapped in its Gravity. Which is possibly very large to think that how much strong Black-Hole is. Earlier every scientist believed that they take everything in but Stephen Hawking told in us that Black-Holes emits radiation which contains matter and after a period of time Black-Holes gets evaporated and finishes its life-cycle to singularity.

**IV. METHODOLOGY**

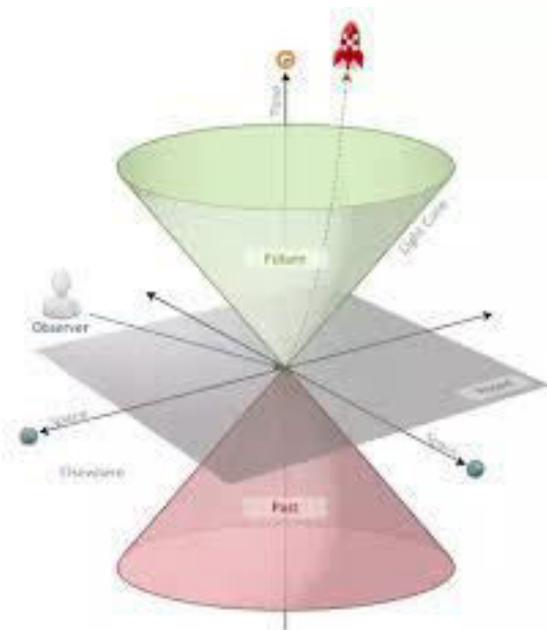
Earlier few Scientists Newton and Aristotle accepted that the Space-Time is constant unit for all in the universe. But Einstein proved that Space-Time is relativistic and not constant. Above topics, we have read about Dilation that how the time is different for everyone in the universe. Einstein said that Space-Time is effected by the gravity. Also, the Gravitational waves get scattered all around.



**Time Cone**  
 Nowadays LIGO (Laser Interferometer Gravitational-Wave Observatory) is made. It detects Cosmic Gravitational Waves

incoming from any sources in the universe. Time is highly affected by the Gravitational Waves, which can curve the space-time. Time Cone which shows the Ripples which will spread when the time will passed away and the future time will be compressed as shown.

It has Four Events A, B, C, and D. X-axis shows distance covered in Light Years and Y-axis is for the time taken. Gravitational waves, the actual position('Here & Now' as marked in the diagram). This diagram will be more clear if we take a rocket which has high speed. Then it is deflected right side at event D in coming time. Now when we see that the increase in the speed continuously deflects the rocket right. This high-Speed movement of Rocket will be Different for the other people on the earth. Time will slowly-slowly Slow down for that rocket. And when rocket will reach the Light the Time will Stop that Rocket and the person seeing the rocket will see it as the rocket is standing still in the space without any movement. When the rocket will Cross speed of time the rocket will enter in the Event B and this will take the rocket to the past.



**Time Cone Showing the Dilations of time**

Suppose a person, in a Space Craft, travels from earth to the space at speed near light and he returns after one day. He will find that Earth has many centuries passed away. So theoretically that person will be known as Time Traveller. These theories Completely prove that Time Travelling is possible but gaining the speed near to light is impossible without any source which can give the infinite source of energy.

According to theory of Time Warp, time is defined by three arrows:

1. Thermodynamics Arrows of Time
2. Psychological Arrows of Time
3. Cosmological Arrows of Time

Thermodynamics Arrows of Time was the theory which gave us an answer that an increment in entropy or energy makes the situation of dis-balance. Psychological Arrows of Time tells us that time is unidirectional but why no one knows. Cosmological Arrows of Time tells us that this infinite universe is continuously increasing in

size not contracting (as earlier scientists believed universe is contracting).

Black-Holes also known as the singularity point in the space which consumes everything and also changes the unidirectional flow of time. Suppose a person is going near Black-Hole, it starts pulling him in then the gravity will work on each atom of the body separately and the difference in the gravity at the body and the leg will be different. If the person's leg is close to Black-Hole than his head, the leg will face a millions of time higher gravity than that on his head. This will stretch his body and the body shape of body will become long and narrow. Black-Holes have a very high mass so Time near it is also very very slow for the one who sees it. So if anyone is watching that person falling in Black-Hole, it would take below a second for that person but one who is watching it will spend more than a year watching him falling.

## V. RESULT

The result of this research paper is how concept 'Time Travelling' is possible in the theories. Even more, theories came in the light which tried to show the possibility to make this concept possible. Such as famous scientist John Wood Campbell gave the theory 'Warp Drive' in his novel 'Islands of Space' which was impossible to make but was only possible solution for the scientists to make

theories. Another way to do Time Travelling was to go near Black-Holes and to return in time. It may take about trillions of years to reach there and infinite resources. So the second solution was to use the Warm Holes. Stephen Hawking gave this concept. Warm Hole can be a bridge, which is possible in theories only, is a short-cut between the galaxies and other faraway places. So using these warm holes we can go near Black-Hole, spend few time and return to original place then we will find that many years have passed.

Theory of Everything which was defined by Sir Stephen Hawking in his book was about the theory which can define the presence of everything, also the possibility of Big-Bang and the other equations, etc. Werner Heisenberg gave the uncertainty principle which tells us that we can not calculate Position and Velocity of any particle at same time. Quantum Mechanics of the microscopic world is all about the study of very small dimensions which may exist in the universe. Quantum Mechanics, General Relativity and Uncertainty principle is combined together can make Theory of Everything.

## VI. CONCLUSION

The conclusion of the overall study was to discuss about the Time from very beginning, Space-Time, Time Dilation, Possibility of Time Travelling, Big-Bang, Black-Holes, Dimensions and various other things. Everything was related to one other. The main theory which is Theory of Everything will explain everything which can not be explained till today.

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