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International Journal For Research in  
Applied Science and Engineering Technology



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# **INTERNATIONAL JOURNAL FOR RESEARCH**

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

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**Volume: 5      Issue: VII      Month of publication: July 2017**

**DOI:**

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# An Introduction to Time Travel

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**Abstract:** Time Travel is an interesting topic for a Human Being and also for physics in Ancient time, The Scientists Thought that the time travel is not possible but after the theory of relativity given by the Albert Einstein, changes the opinion towards the time travel. After this wonderful Research the Scientists started to work on making a Time Machine for Time Travel. Stephon Hawkins, Albert Einstein, Frank j. Tipler, Kurt godel are some well-known names who worked on the time machine. This Research paper introduce about the different ways of Time Travel and about problems to make them practically possible.

**Keywords:** Time travel, Time machine, Holes, Relativity, Space, light, Universe

## I. INTRODUCTION

After the discovery of three dimensions it was a challenge for physics to search fourth dimension. Quantum physics assumes The Time as a fourth special dimension with the three dimensions. Simply, Time is irreversible Succession of past to Future through the present. Science assumes that the time is unidirectional which is directed past to future but the question arise that: Is it possible to travel in Fourth dimension (Time) like the other three dimensions?

The meaning of time Travel is to travel in past or future from present. The present is nothing but it is the link between past and future.

As we know the time is running Symetrically towards future. The rate of Passing time is one second per second(1s/s). In ancient time, there was a normal opinion for time is that the speed of time is same for all the universe that; it shows the time is passing with its constant speed but the special theory of relativity of Einstein changes the view for time and also for time machine. After that Stephon Hawkins worked and make understand that time is referential.

## II. THEORY OF RELATIVITY AND TIME DILATION

The theory of relativity relates the motion of object with reference frame. This theory is based on two postulates which are as follows

- A. The Laws of Physics are the same for all observers in uniform motion relative to one another.
- B. The speed of light in vaccum is constant for all observers regardless of their relative motion or of the motion of the light source.

Relativity word is taken from word relative which is used to relate the things.as it described above it relates the motion of objects and the reference frame.

When an object changes its position with respect to its surrounding (reference frame) it is called in motion. So there is always a need of a frame of reference to describe the motion of an object. Relativity shows that the motion of an object is varies for different frame of references.

Let assume an example: let there is a person (object) sitting in a moving bus and there are two observer in which one is standing outside the bus and another one is sitting in front of the object in the bus. The different observations made by the observers are as follows

For observer standing outside the bus the object is moving with the speed of bus.

For second observer which is sitting inside the bus the same object at the same time is in rest.

The interesting thing is that for the object the position of both observers are same that they actually thinks for object means the first observer standing outside the bus is in moving with the velocity of bus and the second observer sitting in front of object is in rest. It describes that the motion varies with reference frames.

C. The Time Dilation is Simply the Time Difference of Elapsed Time Occurs in two Events. The Time Dilation is of two types

- 1) *Gravitational Time Dilation:* This is the time difference of elapsed time occurs due gravitational potential occurs on the objects. This is seen practically that the time will slower on near the gravitational mass at the high gravitation the time will slow down. Due to which a climber's time is passing slightly faster at the top of a mountain compared to the sea level.
- 2) *Relative Velocity Time Dilation:* This is the time difference of elapsed time occurs due to relative motion of object which are uninfluenced by any gravitational mass. For example; a man sitting in a bullet train, outside the train the time will going to slow for him. This is due to its high velocity but the time dilation is so small which cannot be observed.

The time dilation due to relative velocity can be described by formula:

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

Where; t=Time of frame in which object is moving

t'=time in reference frame

V=velocity of Object

C=Velocity of light

This equation of time dilation shows the relationship between the two times of two different objects in different frames. This equation also correlate the velocity of object and speed of light with time. This equation is base of time travelling and the way get a time machine.

### III. THE EXISTING THEORIES OF TIME TRAVEL

#### A. By Crossing the Speed of Light

The above equation of time dilation explains the way of time travelling. On the basis of above equation the famous scientist Stephon howking make a conclusion for time travel. When any object starts to travel with speed of light, the time will slower down for that object. Sir Stephon howking imagine a railway track around the earth's orbit. He said that, if a train travels on that railway track around the earth's orbit with the speed of light the time would be slow for that train.

Because of the trains velocity the rate of passing time outside the train is so high than the rate of passing time inside. Because of which when the train's passenger felt to past seven days inside the train it actually passed about 60 years outside the train. Which results that the passengers came in future ahead to approximate 60 years than their real time. But it is not possible to get back in their real time or in past again. This is based on that the time is unidirectional and we are always travelling in future from past. With the help of this machine we are actually increase our rate or speed of travelling in future.

But as we know from Einstein's Energy mass equation of theory of relativity

$$E=MC^2$$

To achieve the speed of light a large amount of energy is required. Till now we don't have any method to provide the to provide energy of this level that's why it is just a theoretical method and practically not possible at this time.

#### B. By Black Holes

To understood black holes theory of time travel first we have to understand what is a black hole?

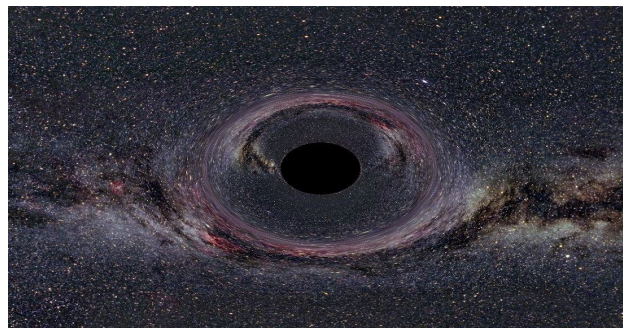


Fig 3.1 Black Hole



Simply the black hole is an astronomical object having high density and high gravity. When the size of a star achieve certain limit (say, Chandrasekhar limit) it will converted into a black hole. Due to high density of that star it's intensity of gravitational force is too high. Because of high intensity it pulls everything inside it even that light also can't cross the black hole.

As it discussed in gravitation time dilation the gravity effects the speed of time. At higher gravity the speed of time reduced. Because the black hole have a very high gravity the speed of time will also slowed down on the black hole. So it make possible to travel in time with the use of a black hole. This is why, a black hole is called natural time machine

Simply, there are two ways of time travel with the help of black holes. Which are as follows:

- 1) The first way to travel in time is to travel on a planet nearby the black hole. Because the planet is so near to the black hole so the time is passing slowly on it due to the effect of black hole and it can make easy to get in future.
- 2) The second way to travel in time is to ride a space ship around the black hole's orbit without effected by the black hole. Because time is passing slowly on black hole it results to get in future. The rate to get in future is twice than the normal rate, which means if we ride the space ship for 5 minutes around the orbit it results 10 minutes had passed in the real world.

Here also the time travel is possible only in the future. This method cannot be used to travel in past.

This theory of the time travel with the help of a black hole can't apply practically because the nearest black hole find till now is about 1600 light years far than our earth so it is not approachable.

### C. Tipler Cylinder

Tipler cylinder is a hypothetical cylinder of dense matter and infinite length. First, the tipler cylinder was discovered by Dutch mathematician Willem Jacob van Stockum in 1924 as the solution of Einstein's equation of relativity then similar solution was given by Hungarian physicist cornel lanczos in 1936.

But in 1974, the frank tipler presents tipler cylinder as a possible way to reach at past. The frank tipler analysed that a massive cylinder of infinite length rotating at high speed around its longitudinal axis could enable to time travel and works as a time machine.

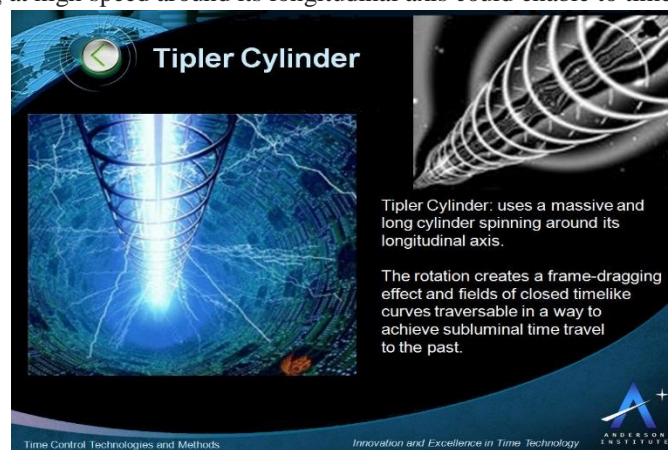


Fig 3.2 Tipler Cylinder

It creates closed time like curves due to which when a space ship is used to move in spiral path of tipler cylinder reaches back in time or get in past. Tripler also explained that this phenomena for a finite cylinder is also applicable if the speed of cylinder is very high

In 1993, stehephon howking proved that it is impossible to create a time machine in any finite region contains no exotic matter with negative energy in his theory but tipler does not involve negative energy in his theory.

At another hand it is also impossible to built an infinite length cylinder and travel in an infinite cylinder.so this method not possible practically.

### D. Rotating Universe

Rotating universe is an excellent solution for time travelling given by sir Kurt Godel in 1949. Kurt godel was a mathematician and friend of Albert Einstein. He proposed a mathematical solution for Einstein's equation of relativity. The godel solutions has a closed time like curves which would allow to travel in time.

According to Kurt Godel if the universe is rotating itself and a spaceship starts to rotate with high speed around the whole universe then it will reach in past and come back in time before he started. This is a foolproof and perfect solution for travel through time.

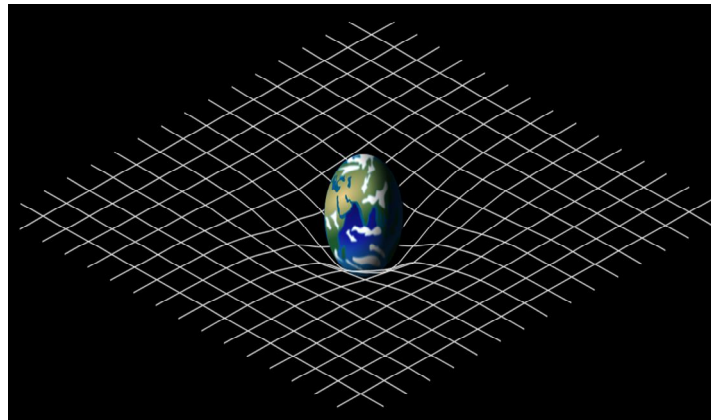


Fig 3.3 Rotating Universe

This method is very applicable theoretically but practically it is not approachable. It is very difficult to cross our galaxy milkyway and other 100 billion galaxies. That's why Albert Einstein also don't like this proposal of Kurt Godel.

#### E. Wormholes (Einstein-Rosen Bridge)

Worm holes or einstine-rosen bridge is a tunnel in space which joins two different corner of space or two different times.

The thought of worm hole was given by Albert Einstein as solution of time travel in gernal relativity. Einstein explains the worm holes as a connection between two corners of universe situated at billion light years in short distance as few meters or the connection of two different points of time. The worm holes are easiest way of time travelling.

Let take an example to understand what actually worm hole is? If we want to look the shortest distance between two points in space/plane, then we assume a straight line between them as their shortest path of joining.



Let consider two points on a paper's corner and try to join them with the shortest path, then we draw a straight line joining them but actually it is not the shortest path of that points. To join them with shortest path we have to bend the whole paper due to which the points are coincides on each other and then if we draw a straight line between them that is actually the shortest distance between them.

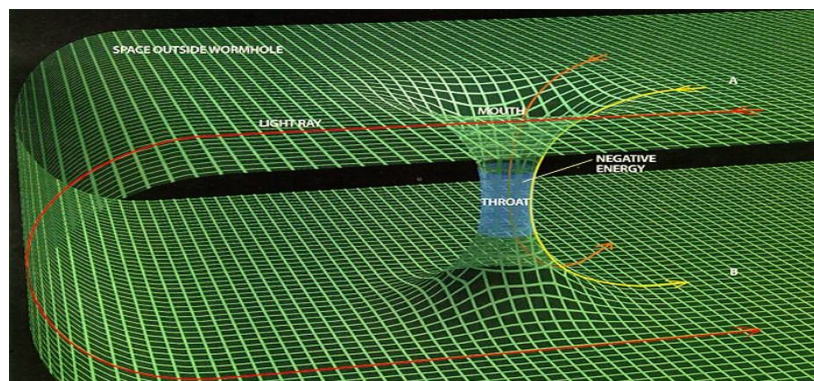


Fig 3.4 Shortest distance b/w two points in Space-Time

Similarly, as described in above example if we bent the whole universe like that paper the two points of space-time will definitely coincides on each other. The tunnels between that two points are called a worm hole and this a shortest distance between two times or between to corners of space.

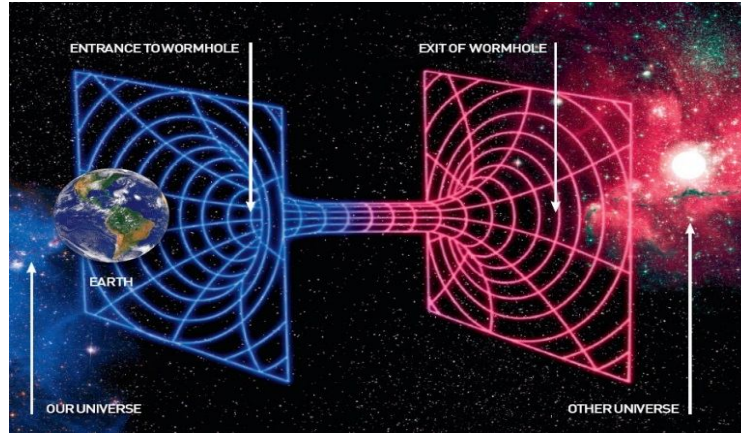


Fig 3.5 Worm Hole

It is a difficult task to bent the universe but it is possible with the help of negative energy. The whole universe can be bent with simple laws of attraction and repulsion, but high amount of energy is required.

Today, nasa is working to create such type of technology to create worm holes. The evidences of worm holes was found in universes but the problem is that, the holes are unstable so much and they exist just for few seconds in the universe so time travel is not possible through them. Scientists are working to make a stable worm hole to travel in time.

#### F. Cosmic String

Cosmic string are topological defects which are left over from the formation of the universe. Cosmic strings are unidirectional and hypothetical in nature. The existence of cosmic string was first contemplated by the physicist tom kibble in 1970.

The cosmic strings are suspected to have spread in large number throughout the universe.

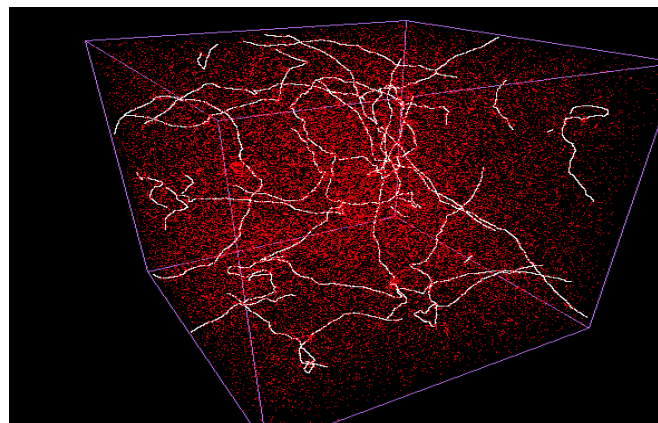


Fig 3.6 Cosmic Strings

It is accepted that at least one string per hubble volume is available in the universe. These assumes to look like the crakes formed on a frozen river (in which water has freezed).

Some scientists suggests that the time travel is possible with the cosmic strings and these can be used to built a time machine. This can be used in time travelling because it is theoretically possible to create close time like curves. This curves can be possible with the maneuvering two cosmic strings close together or with one black hole plus a cosmic string.



We have to fly a space ship around in figure eight around two infinite long cosmic string past each other to travel in time. After the discovery of “Twin Ouarar” in 1979 it might not be hypothetical any longer.

#### G. Wrap Drive

Wrap drive is a spacecraft population which travels with speed of light. This is the new technology on which nasa is working now. According to theory of relativity nothing more then mass of photon can travel with speed of light. Then how it is possible for wrap drive to travel with speed of light?

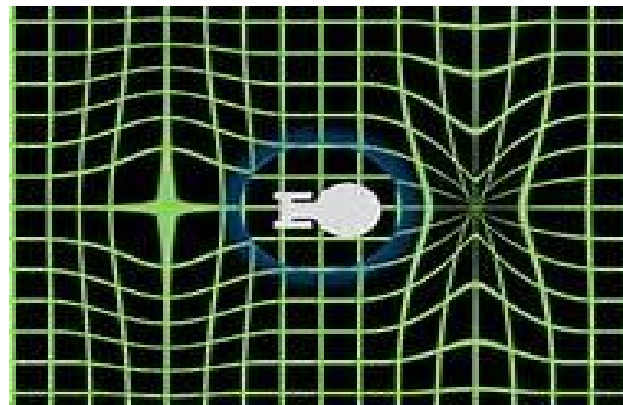


Fig 3.7 Motion of Wrap Drive in Space-Time

Einstein explains that nothing can travel with speed of light except than photon in space-time but he also told that the space-time is flexible and can bent with the use of negative energy.

The wrap drive works on this principal that with the bending of space-time we can drive the machine with more than speed of light. The space is bent in this manner that it compresses at front part of drive and pull it and expands on back part and push it with the help of this we can travel with more than speed of light and can eligible for time travel.

#### IV. PROBLEM IN TIME TRAVELLING (GRANDFATHER PARADOX)

As it discussed that it is very difficult to travel in time due to lack of this type of technology. Assume that we will able to travel in time with the use of any technology described above and changes my past than what will be my present?

This problem can be understood by GRANDFATHER PARADOX. If a time traveller travels in past with the use of any technology. He kills his grandfather before birth of his father then how can he exists in present or at that time.

This problems is to changing the past is called grandfather paradox and it is really a failure of time travelling. This doesn't include only the problem of killing his grandfather but include all changes in past.

Let us assume another example regarding to understand this paradox. If a person named A is a scientist and a research fellow of physics. He make a time machine and then travel in his past. He makes an experiment with himself and decides to choose music as his career. Now a question is arise that if he chooses music as his career then how the time machine will built and how could he exists in that time.

There is need for solution to answer this question which is then explained with the help of Theory of parallel universe.

#### V. PARALLEL UNIVERSE THEORY

The parallel universe theory was purposed as the solution of the problems in paradoxes comes in time travel. It solves the grandfather's paradox with the use of parallel universe.

Parallel universe explains that there are existence of number of universes which have every possibilities of decision can be possible. If we have n no. of ways to perform a work in different manner and we choose a significant manner to do the work. Then in our original universe all the possible ways except the way we choose will be disappear or finished. But according to parallel universe theory when we choose a way to perform the work or leave n-1 possible ways can be chosen, then there will be the existence of n-1

parallel universes. In every universe we are doing that work with different manner. For example if we have two options to choose yes or no and we decided to choose yes then at an exact time in a parallel universe we are choosing no instead of yes.

Actually the above theory (parallel universe theory) assumes that in time travelling we are not moving in time but actually we are travelling from our real universe to its parallel universe. If we changes something in past then actually we are not changing in our real universe. We are changing in our parallel universe which doesn't effects our real universe.



Fig 3.8 Parallel Universe

Let discuss on our above paradoxes (Grandfather Paradox). When that person travel in past and kill his own grandfather before his father's birth, he actually stops the birth of his father in that parallel universe and he will not born in that universe but he is existing in that time because nothing is changed in his own universe.

In second case, when that scientist travelled in past and choose music as his career and become a musician in his parallel universe but nothing changes in his real world. He is a scientist and made a time machine in his real world because he travelled in parallel universe the time machine and also himself exist in his parallel universe also.

The next question arise for parallel universe is that, is the parallel universe real? Yes, even some theories of quantum physics also explains about this. As we know we all made with a fixed configuration, every configuration repeats itself. It can be understand with an example if there is a no. of two digit let it is 51 if we write it in different configuration then we find that after two no. it repeats its configuration which are: 51, 15 and again 51. We can try the above example with any series of numbers. Similar thing can apply with whole universe as our universe is made with a systematic arrangement of atoms. After a fixed period this arrangement will repeats and this is called parallel universe because our universe is so big that's why it needs a large distance to repeats its structure.

This can be understand with the help of Quantum Physics and Schrodinger equation which shows about the different states of electrons at different times that means an electron can exists in different states at a particular time which implies that there may exists many parllel universe in our world.

## VI. FUTURE WORK

On the basis of above theories now a day's scientists are working on the different ways can be used for time travelling and to search parallel universe. It may be possible to travel in time in future. Some works which can be used as future work are describing here.

Tachyon or Tachyonic particals are the hypothetical particals which are always moves faster than light speed. According to Einstein's Theory of relativity nothing can move faster than light but these particals. With working this theory a machine can be made which may possible to capable to go in future which can help us to understand and know about the theories and technologies of future.

With the use of a time machine we can improve our advance technologies and can learn from other parallel universes. By travelling in past we can understand easily about origin of the life on earth and we may able to make an artificial human. So time machine is a revolution in science.

## VII. CONCLUSIONS

The time travelling is possible hypothetically today. This is a theoretical possible subject till this day. Perhaps, scientists are working but they didn't find any practical technology for time travel. These theories can used to make a real time machine in future and time travel may possible. Today nasa is working on wrap drive and trying to create a worm hole.





Hence there is a need to cross the limits of imaginations and work more on these theories to create a time machine.

### VIII. ACKNOWLEDGMENT

I would like to thanks to my parents and guiding faculties who motivated me to write a paper on this topic. I also like to thanks the reviewers to review my paper and to the publication "International Journal For Research in Applied Science and Engineering Technology (IJRASET)" to give me this opportunity and publish my Paper.

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