Wormhole: A Time Travel Portal
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Abstract— Wormholes are the portal to travel huge amount of distances which are impossible in our modern time and travel in time such as past and future. Here we show that the wormholes are made up of exotic matter which shows us the way by which we can travel to different worlds by the 5th special dimension which changes our form of matter.

Key words: Einstein-Cartoon-Sciama-Kibble theory, Schwarzschild black hole, Schwarzschild wormhole, exotic matter, magnetic wormhole, black hole, negative energy density, quantum fluctuations, traversable wormhole, Morris-Throne wormhole, intra-universe wormhole, inter-universe wormhole, Schwarzschild wormhole, teleportation, identical parallel universe

I. INTRODUCTION

As we all have heard about time machines, will you believe, if we say it exist? Can you imagine that you can go back in your past and even can travel in future?

Will you agree if someone tells you that you can change your history by travelling in your past? You can see what will be you doing in your future after 10 years or 100 years. The answer to all these questions is yes! There is a bridge or a tunnel through which you can go anywhere in your past or future or even travel enormous amount of distance such as the distance from our Milky way galaxy to our nearest galaxy Andromeda in just no more than few kilometres. Once you enter into it, you can travel to a different dimension. There are several worlds which are like or unlike the world you are living in present.

The tunnels, we are talking about is called The Einstein-Rosen bridges [¹] or a Wormhole. The Einstein-Rosen bridges was discovered by Ludwig Flamm in1916, and was rediscovered by Albert Einstein and his colleague Nathan Rosen, who published their result in 1935. According to general theory of relativity, the gravitational collapse of a sufficiently compact mass forms a singular Schwarzschild black hole. In the Einstein-Cartoon-Sciama-Kibble theory of gravity, however, it forms a regular Einstein-Rosen bridge. Researchers have no observational evidence for wormholes, but the equations of the theory of general relativity have valid solutions that contain wormholes.

Scientists defined some other types of wormholes that are different in places. The first type of wormhole solution discovered was the Schwarzschild wormhole, which would be present in the Schwarzschild metric describing an eternal black hole, but it was found that it would collapse too quickly for anything to cross from one end to the other. Wormholes that could be crossed in both directions, known as traversable wormhole, would only be possible if exotic matter with negative energy density could be used to stabilize them. Wormholes are also a very powerful mathematical metaphor for teaching general relativity.

There are many researchers researching on physics of the wormholes and attempt to create a wormhole but no one is successful to create any wormhole. In 2015, researchers in Spain had created a tiny magnetic wormhole [²] for the first time ever and they had used it to connect two regions of space so that a magnetic field can travel invisibly between them. But that was not the same as the wormholes that we see in some science fiction movies that allow human or any spaceship to travel through them. This type of wormhole was not able to transport matter. But scientists managed to create a tunnel that allows a magnetic field to disappear at one point and then reappear at another point.

Here we are going to show about some constructions of this magnetic wormhole. This magnetic wormhole was created by the scientists in the department of physics in the University of Barcelona. Scientists designed and constructed a wormhole for a magnetic field. The 9 cm-diameter sphere guides and cloaks a magnetic field from a dipole source placed one side of it (see fig. 1.), such that field lines appear to emanate from a monopole on the other side of the sphere. It seemed as if the field took an invisible shortcut through the intervening space. It was like the field lines have gone through another spatial dimension (see fig. 2.).

The sphere had three parts: Running through it was a tube made from a thin sheet of the nickel-iron ferromagnetic alloy, which was wound into a spiral – it transported the applied field.

II. A HYPOTHETICAL BRIDGE

Wormholes are solutions to the Einstein field equations for gravity that acts as a “tunnel,” connecting points in space-
time in such a way that the trip between the points through the wormhole could take much less time than the trip through normal space.

The first wormhole-like solutions were found by studying the mathematical solutions for black holes. There it was found that the solution itself to an extension whose geometric interpretation was that of two copies of the black hole geometry connected by a “throat”. The throat is a dynamical object attached to the two holes that pinches off extremely quickly into a narrow link between them. Wormhole geometries are inherently unstable. The only material that can be used to stabilize them against pinching off is material having negative energy density, at least in some reference frame. Physicist assumed that no classical matter can do this, but it is possible that quantum fluctuations in various fields might be able to.

A. Paradoxes

There are Paradoxes that restricts to creating a wormhole and travelling into the past. A paradox that arises, however when someone travel into the past is called “grandfather paradox” first given by the writer Rene Barjavel. The paradox is this, if someone were to travel back in time and kill his grandfather before he met his grandmother, then he would not be alive and neither would his parents. Then the only explanation is that he is not born or to make it more believable, that he did not travel back in time. Then scientists researching to create a wormhole is only a wasting of time or there are no wormholes through which we can travel back into the time. Answer is no! There another concept that almost remove these restrictions are “parallel universes”. We shall also discuss this topic that how the parallel universes allow time traveller to travel into the past or future.

III. SPACE TIME GEOMETRY OF WORMHOLES

A wormhole is a tunnel-like connection through space-time, much like the real tunnels bored by worms in an apple. At present, space-time wormholes are only theoretical constructs derived from general relativity; there is no experimental evidence for their existence. Nevertheless, theoretical physicists study the mathematical properties of space-time containing wormholes because of their unusual properties. Study of such strange geometries can help better distinguish the boundaries of behaviour permitted in the theory of general relativity, and also possibly provide insights into effects related to quantum gravity.

For a simplified notion of a wormhole, space can be visualized as a two-dimensional (2D) surface. In this case, a wormhole would appear as a hole in that surface, lead into a three-dimensional (3D) tube (the inside surface of a cylinder), then re-emerge at another location on the 2D surface with a hole similar to the entrance. An actual wormhole would be analogous to this, but with the spatial dimensions raised by one. For example, instead of circular holes on a 2D plane, the entry and exit points could be visualized as sphere in 3D space.

A. Metrics

Theories of wormhole metrics describe the space-time geometry of a wormhole and serve as theoretical models for the time travel. An example of a(traversable) wormhole metric is the following:

\[ ds^2 = -c^2 dt^2 + dl^2 + (k^2 + l^2)(d\theta^2 + \sin^2\theta \, d\phi^2) \]

One type of non-traversable wormhole metric is the Schwarzschild solution:

\[ ds^2 = -c^2 \left(1 - \frac{2GM}{rc^2}\right) dt^2 + \frac{dr^2}{1 - \frac{2GM}{rc^2}} + r^2 (d\theta^2 + \sin^2\theta \, d\phi^2). \]

IV. DIFFERENT TYPES OF WORMHOLES

There are the theories of different types of wormholes, for example there is a theory by Stephen Hawking, that is a kind of wormhole – a flat wormhole – that allows us to go through it and come back just to the time and place we have entered it. There are three other kinds of wormholes:

A. Traversable Wormhole

This would be a wormhole which matter is able to ‘travel’ through. Lorentzian traversable wormholes would allow travel in both directions from one part of the universe to another part of that same universe very quickly or would allow travel from one universe to another. The possibility of traversable wormholes in general relativity was first demonstrated by Kip Thorne and his graduate student Mike Morris in 1988 paper. For this reason, the type of traversable wormhole they proposed, held open by a spherical shell of exotic matter, is referred to as a Morris-Thorne wormhole.

B. Intra-universe wormhole

Intra-universe wormhole connects two locations of the same universe (in the present, in the future or in the past). In the case of an intra-universe wormhole, the wormhole would create a shortcut from one point in space and time to another. This possibility would also create the opportunity of time travelling.

The basic notion of an intra-universe wormhole is that it is a compact region of space-time whose boundary is topologically trivial, but whose interior is not simply connected.

C. Inter-universe wormhole

Inter-universe wormholes are the wormholes that connects one universe with another universe. Also called a Schwarzschild wormhole or Einstein-Rosen bridge. They are not traversable and their mouth can be held open with exotic matter. This kind of wormhole could theoretically be used to travel to parallel worlds.

So here we discussed different types of wormholes, these types of wormholes have their particular importance.

Till now any of the scientists around the world have not created or detected such wormholes, but theories have their implicit solutions having wormholes. But for the discovery of wormholes we’ll have to understand the major problems that are restricting to create wormholes.

V. TRAVELLING THROUGH WORMHOLES

A. Space Travel with Wormholes

We have understood that a wormhole is a hypothetical shortcut between two distant regions of space-time. Although a three dimensional wormhole is almost impossible to fully visualize, a two dimensional analogue can be constructed to aid visualization. Imagine an
intrinsically flat, two dimensional, space as a folded piece of paper embedded in a higher three dimensional space, where a tube connects two distant points, A and B, on the paper. The length through the tube can be much less than the distance from A to B along the paper, creating a shortcut (see figure 3). A full three dimensional wormholes would have entrances and exits that are three dimensional spheres rather than two dimensional rings like the mouths of the paper tube. Such lower dimensional, visualizations are termed embedding diagrams, and the iconic wormhole image is usually shown as the well-known Schwarzschild embedding diagram.

An observer passing through such a wormhole could, in principle, traverse the wormhole in less time than it would take to travel from point A to point B are sufficiently distant in space and the wormhole length is sufficiently short, an observer could potentially traverse the wormhole in a time less than it would take send a light signal from A to B through normal space.

![Fig. 3: A wormhole](image)

**B. Time travel with wormholes**[11]

In addition to facilitating effectively faster than light travel, wormholes could potentially be used as time machines, in the following sense first developed by Caltech theoretical physicist Kip Thorne. Imagine an advanced technology capable of creating, manipulating, and containing both ends of a stable, traversable, wormhole. Place one end in a laboratory on Earth and the other on a spacecraft capable of travelling through space at some reasonable fraction of the speed of light. Imagine the wormhole connecting the lab and spaceship is created in some future year. Now keep one end on Earth and send the spaceship off in any direction at some appreciable fraction of the speed of light for a finite duration after which it will decelerate, turn around, come back to Earth, and stop, so the wormholes ends are brought back together.

Relativity tells us that the clocks of observers left on Earth and those in a relativistically moving spacecraft will begin to differ by an amount that depends on the speed of the craft. Since moving clocks run slow in relativity, a spaceship observer might experience millions of years could pass in the external universe depending on how fast they were travelling. In this sense, time travel to the future is easy, and does not require wormholes, just a ship capable of moving at relativistic speeds. A spaceship executing the above manoeuvre might find itself thousands or millions of years in the future after stopping. Yet an observer at the wormhole mouth in the laboratory on Earth would still have its clock synchronized with the shipboard wormhole. If the ship finds itself, say in year 3500, after returning to Earth, any observers on the ship could return to the year 2500, travelling 1000 years into the past, simply by stepping through their shipboard wormhole back into the laboratory on Earth.

**VI. USING WORMHOLES TO GET IN PARALLEL UNIVERSES**

Einstein theory of general relativity mathematically predicts the existence of wormholes, but none has been discovered till date. Wormhole would have the strange properties that can solve the problems of travelling the distances that are impossible in real life. Wormholes are the portals to travel billions of light years in just few kilometres or metres, travelling in time that would get us into the past or future, but nobody confirms that how to use these wormholes to go back into the time or go into the future or how to use as “teleportation” in our desired place. There are many arguments by scientists that restrict the possibility of wormholes for real life situations. They argue that if we capable to travel in past then our history will be not same, if anyone create a wormhole that is capable to travel him into the past and he goes into the past with our modern weapons technology and kills Nazi leader Adolf Hitler who was one of the most powerful and infamous dictators of the 20th century then the history will not be same that will be a contradiction. There is famous paradox which is known as “grandfather paradox” which says that if any person who goes into his past can kill his grandfather before he meets his grandmother which arises the question on his existence.

To terminate these types of paradoxes there are the possibilities of “parallel universes” that may be identical to our universe or not. This idea of parallel universes came from the Many Worlds Interpretation of quantum physics. Hugh Everett III[12] was the first who proposed Many Worlds Interpretation of quantum physics. In 1952 he came up with a radical idea: that there exist parallel universes, exactly like ours. These universes are all related to ours; indeed, they branch off from us and our universe is branch off of others. With his Many-Worlds Theory, Everett was attempting to answer a rather sticky question related to quantum physics. But discouraged by the scorn of other physicists for many-world interpretation, Everett ended his physics career after completing his Ph.D.

In our previous research paper, we calculated the distance of Identical Parallel Universe which was at the distance of which was approximately equal to 10^{12} meter. This is the enormous amount of distance which we never cross with our known laws of physics. This calculation of parallel universe was the distance of our “identical parallel universe”, this identical parallel universe will be same in all principle and rules of science that are in our universe but time may vary. So this is the clue that apart from our universe there are another types of universes that may be identical to our universe or not, the universes that are identical to our universe are called identical parallel universes and those universes that are not identical to our universe i.e., those universes which ruled by another laws of physics are called parallel universes.

Now the question arises that how we apply these wormholes to go into our identical parallel universe? There is a different solution for this problem! When Einstein was working on his “special theory of relativity”, they took time as another special 4th dimension that always kept with
space (3dimension). From our view wormholes can be assumed as another special dimension apart from the dimensions of space as well as time. This would be 5th dimension! For understanding how wormholes work we will have to understand some real life concept by which we could apply approximately the same conditions to the wormholes.

In our daily life many of us use Radio to listen our audio programs; we use radio waves that are electromagnetic waves to receive our desired channel using variable capacitor. For working of radio there are both transmitter and receiver that transmits the radio waves from one place to another and receiver receives radio waves. Here we use only radio waves in Radio, we match frequency for our desired radio station\[5\]. If we don’t do so, our radio receives other frequency which could not be understood and it will be nothing other than the “cosmic noise.”

![Fig. 4: Wormhole for Identical Parallel Universe](image1)

We can apply the same mechanism in wormholes, i.e., we’ll make a wormhole which works as a transmitter (for transmitting any object) in the form of a special type of energy which will travel through 5th dimension but for travelling in different universes we’ll calculate the energy level of the wormhole and parallel universes that will create into parallel universe then we could get into that universe.

![Fig. 5: Wormhole for Parallel Universe](image2)

We’ll have to make another wormhole which would work as receiver to receive any object through transmitter parallel universe; if the energy level of both the wormhole will be same we could get into our desired parallel universe. There will be many of the civilizations that will be trying to create such wormholes, if our wormholes energy level will be same as their wormhole’s energy level then we will go out from their wormhole and will be in a place where we can find an IDENTICAL PARALLEL UNIVERSE.

**VII. CONCLUSION**

In this paper we describe the working of wormholes which are the tunnels through the fabrics of the space-time having another special 5th dimension that allows travelling in different points of the space and time. If we travel through a wormhole we will need the matter with negative energy density. There are different types of wormholes to travel in different locations of the space-time. We encounter the grandfather paradox which restricts to go into the past and we solve this anomaly with the help of parallel universes.

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