Science or Fiction?

by
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Every so often a movie will come out and we are dazzled by it's spectacular visuals or a TV series or novel will get written and we are captivated by it's story and characters. We are so memorized that we do not even realize that the line the character said which explains these awesome phenomena makes absolutely no sense or at least is a very poor explanation. Most often these kinds of stories fall into the genre Science Fiction, and many of the plots are set in space. So now comes the question: what is fact and what is fiction?

The Hyperspace Bypass

Since the time when the idea of the Einstein-Rosen Bridge (wormholes) was presented science fiction authors have used this idea as a means of getting their characters from point A to point B in the far reaches of space. Fiction such as Star Gate, the Dune series, and even Power Rangers have used various forms, be it a tunnel or tear in space or time, or 'holes' in space, to further their plots. Therefore the question is posed: are any of these forms of travel feasible?

The Star Gates (from the TV series and "Star Gate" movies) are a network of wormholes created by an ancient advanced civilization; the rings on the various worlds in the galaxy act as a passage way into a stable wormhole which transports the characters through a kind of tunnel in the stars to the connected ring on a distant planet in a matter of seconds. A similar kind of wormhole can be scene in "Star Trek: Deep Space 9". The series is set on a Space Station that is on the doorstep of a tear in space which leads to a tunnel that takes a ship over fifty thousand light-years in about thirty seconds. The Einstein-Rosen Bridge described in these fictions is what is more commonly thought of when one describes a wormhole, the type in which a very long journey occurs over a very short time (as oppose to an instantaneous journey). The idea is illustrated by a worm that tunnels its way through an apple instead of going around the outside (hence the term "worm" hole).

In the way that they are described in science fiction, there is little to no difference between a wormhole and a black hole. Presumably a black hole could be a connection between two separate regions our universe or another, the two greatest flaws, however, in using them for travel is their massive instability and the singularity. Unlike the Star Gate series, in which a stable wormhole can last thirty-eight minutes, real wormholes do not last very much longer than a sempto-second, which

would not be long enough to complete a single journey before the tunnel collapsed around the traveler. Even if we found a way to make it through to the other side before everything crashed in around us, there is still the singularity to be dealt with.

The singularity is the point at which all matter is crushed together under the ultimate force of gravity. Supposing one could get near enough to a singularity, there are a few problems that would make traveling through a black hole impossible. The first is the effect of gravity on one's body. Currently the center of gravity that is pulling all of our bodies at this moment is the one at the center of the Earth. The distance from the surface to that point is roughly 6378 km making the weight of gravity pulling our feet and the weight pulling our heads virtually the same. However, standing on the singularity (supposing one could) the proportional difference in the forces of gravity on our head vs. our feet would be massive. Also, the gravity pulling your right side vs. your left side would also be too great. The distortive effect on your body is called the 'toothpaste effect' and, suffices it to say, it would not be a pleasant fate. The other problem is referred to in Stephen Hawking's "A Brief History of Time". When discussing the singularity he states that if an astronaut ever came into contact with it they would likely experience the singularity always being in their future and never in their past. This ties in with a version of the cosmic censorship hypothesis. This hypothesis deals with singularities in relation to time and will be discussed later. The singularity would need to be avoided in order to use wormholes for travel, a problem to which we do not yet have a solution.

The problems that inhibit us from sending an object through a wormhole may not, however, affect information transmissions. We may yet find a way to send radio waves or other forms of data through to the other side. The problem there is that, in a wormhole, time and space lose all meaning; the information may get scrambled and arrival times may not be reliable. The subject of information transmission is in serious discussion but it is vey hard for scientists to experiment with this concept.

The next form of hole in space to be addressed is the idea of folding space. The idea was popularized by Frank Herbert's Dune series (regarded as the best series of science fiction novels). In this series the inhabitants of the know universe can travel from system to system by boarding onto a space ship guided by prescient navigators which then ferries the passengers through folded space making an instantaneous trip over many light-years. This can be illustrated by taking a long piece of paper and making a point at both ends, drawing a line from point to point represents normal space travel. Folding space would be like taking the same piece of paper, folding it so the two points are touching and poking the pencil through the points. Essentially there is no great difference between folding space and a wormhole with the exception of the length of the journey. Realistically, there is very little science to support such a means of travel, it just sounded cool in a story.

Ludicrous Speed

The other commonly seen means of space travel are the many forms of faster than light speed. Warp speed, light speed, and hyper speed are all various forms of speeds commonly heard (yet never explained) in science fiction and are probably best described by Mel Brook's spoof version of them, Ludicrous Speed. Most of these creations were formed on the basis of 'I need my characters to travel 15,000 light-years but I can't have it take that long, so I'll invent a speed faster than light'. Gene Roddenberry's (creator of Star Trek) line of thinking when he invented warp drive was not completely illogical. In his time the sound barrier had been broken and mach speed was realized, so then, why could not the same thing happen with light speed? Sadly after forty-two years we know of nothing that travels faster than light. In order to achieve the speed of light "c" you would need high energy with virtually no mass, based on Einstein's famous equation $c^2 = E/m$ which is possible only for photons not people or ships.

Faster Than 88mph

From the DeLorean in "Back to the Future" to Jewels Verne, time travel has been a favorite for science fiction writers, and though the above examples use time machines that are more physics based there are a number of fictional examples of time travel that have a basis in astronomy. Many stories have included a means of time travel by looping around the sun or traveling through a wormhole or looping around the sun while traveling through a wormhole. So do these theories have any basis in fact? To start off with time travel is not only possible it is happening. We are all time traveling but we are all going only forward and at one consistent speed. What we would really like to know is if there is a means of traveling at different speeds and in different directions. First the constantly used method in science fiction of looping around the sun to propel one through time is only loosely scientific. Getting close to a large concentration of mass like that will only shoot you forward by milliseconds, not enough to notice anything. However there is one theory that suggests a possible jump forward, this is called Time Dilation. This is the theory that the closer one travels to the speed of light the more time slows. So suppose a ship that could travel at nearly the speed of light was invented and it traveled to Proxima Centauri (about 4.2 light-years away). The round trip from Earth and back, for the ship, would take just over eight years, but when they returned to Earth many thousands of years will have passed and there would be no way to reverse it. So on the whole this would not be desirable. Previously, in the wormhole section, I began discussing the cosmic censorship hypothesis. One version of this theory suggests that singularities will always lie fully in the future or in the past. There is great hope that there is fact behind this part of the theory because then one could conceivably travel to the past. This is still very theoretical though.

Hollow Earth

The last phenomenon to be discussed is the theory of the Dyson Sphere, which was used in an episode of Star Trek. Dyson Spheres were a concept proposed by Dr Freeman Dyson. He theorized that a highly advanced civilization would have realized that their star is the greatest source of energy in their solar system and that the bulk of the energy was just floating away into space, wasted. So then, in order to use all the energy they would take all the solid surfaces in their solar system (terrestrial planets, moons, asteroids etc.), pull them apart and reform them into a hollow sphere, with 1 AU radius, surrounding the star with the inhabitants living on the inside surface. This would allow them to capture most of the light (energy) and re-radiate some of it out through the surface of the sphere as infrared. Larry Niven made a world similar to this in his novel Ring World in which the solar system was converted into a ring instead of sphere. Dr Dyson believed that if there were really Dyson Spheres in the universe they could be detected by their unique infrared radiation signature. There are cocooned proto-stars, which resemble this, but so far we have not found such a structure. In our own solar system it is not impossible, but it is pushing logistics. In truth the greatest obstacle in preventing us from achieving this kind of a structure is that it is not very cost effective, as explained by Dr Matthews.

Now much of this may have been very disillusioning and though it is interesting, it may kill the fun of this art form. So I will end with a poem by Walt Whitman:

When I heard the learn'd astronomer,
When the proofs, the figures, were ranged in columns before me,
When I was shown the charts and diagrams, to add, divide, and measure them,
When I sitting heard the astronomer where he lectured with much applause in the lecture-room,
How soon unaccountable I became tired and sick,
Till rising and gliding out I wander'd off by myself,
In the mystical moist night-air, and from time to time,
Look'd up in perfect silence at the stars.

References:

Star Trek Science Logs by Andre Bormanis
A Brief History of Time by Stephen Hawking
An interview with Dr. Jaymie Matthews, Professor of Astrophysics at UBC