

## Time Travel

While wormholes will offer the portal to travel between dimensions and universes, it will also open the time portal, between past, and future. While we are all familiar with the concept of the time machine, from H.G. Wells to current sci-fi writers, few people know that some researchers have actually built time machines, and several others are building ones as you read this article. And while it is generally associated with Science Fiction, physicists know that time travel is a serious prediction of Einstein's general relativity equations. In a new study posted online July 15<sup>th</sup>, 2010, researchers led by Seth Lloyd at MIT analyzed how some of the quirks and peculiarities of real-life time travel could play out. This specific type of time travel avoids some of its most paradoxical predictions, according to Lloyd.

Any theory of time travel must confront the "grandfather paradox," in which a traveler jumps back in time and kills his grandfather, which prevents his own existence, which then prevents the murder in the first place, and well, if you ever watched Star Trek you know what I mean. One model, proposed in the early 1990s by Oxford physicist David Deutsch, can allow inconsistencies between the past a traveler remembers and the past he experiences. So a person could remember killing his grandfather without ever having done it. But Lloyd prefers a model of time travel that explicitly forbids these inconsistencies. This version, posted at arXiv.org, is called a post-selected model. By going back and outlawing any events that would later prove paradoxical in the future, this theory gets rid of the uncomfortable idea that a time traveler could prevent his own existence.

But this ban against paradoxical events causes possible but unlikely events to happen more frequently. Or as stated by Charles Bennett of IBM's Watson Research Center in Yorktown Heights, New York "If you make a slight change in the initial conditions, the paradoxical situation won't happen. That looks like a good thing, but what it means is that if you're very near the paradoxical condition, then slight differences will be extremely amplified." An example of this is, a bullet-maker would be inordinately more likely to produce a defective bullet if that very bullet was going to be used later to kill a time traveler's grandfather, or the gun would misfire, or "some little quantum fluctuation has to whisk the bullet away at the last moment," Lloyd says. In this version of time travel, the grandfather, he says, is "a tough guy to kill."

In an earlier paper posted in May at arXiv.org, Lloyd and his team present an experiment designed to simulate this post-selection model using photons. Though the team couldn't send the photons into the past, they could put them in quantum situations similar to those that might be encountered by a time traveler. As the photons got closer and closer to being in self-inconsistent, paradoxical situations, the experiment succeeded with less and less frequency, the team found, hinting that true time travel might work the same way. The experiments were meant to simulate freaky paths through spacetime called closed timelike curves, which carry anything traveling along them into the past and then back to the future. Einstein's equations predicted that travelers on a closed timelike curve would eventually end up back where they started. Although predicted to exist on paper, no such paths have been observed in the wild. Some physicists predict that these loops might exist in exotic regions where spacetime

is drastically different, such as in the depths of black holes.

Despite its strange predictions, the new model forms “a nice, consistent loop,” says theoretical physicist Todd Brun of the University of Southern California. The new papers make up “a really interesting body of work.”

These days, deciding which theory of time travel is best is largely a matter of taste. Until someone discovers a closed timelike curve in the wild, or figures out how to build a time machine, no one will know the answer, says Brun. “I don’t expect these will be tested anytime soon. These are ideas. They’re fun to play with.” But if we can’t decide on the proper theory of time travel, how can researchers be constructing them?

Well, Jenny Randle’s book *“Breaking the Time Barrier: the Race to Build the First Time Machine”*, explores some of these researchers attempts to “break the time barrier”. The current common thread is the construction of a Tipler Cylinder, conceived by Tulane University professor Frank Tipler in 1974, which is a rotating dense matter cylinder out in space, spinning at thousands of RPMs. The potential time traveler would journey up to the device in a space craft, orbit as close as safely possible a few times, and head home. The distance you travel in the past is based on the number of revolutions the ship makes around the cylinder. Well, THAT seems simple enough! This would work because there is a warped region of space surrounding the spinning cylinder that acts as a time suppressant. Anything outside of the warped region would move further and further into the past.

But there is a problem. (AhA!) Tipler required that the cylinder be infinitely long. But new research indicates this is not necessarily so. Some in fact believe that if you orbited a spinning black hole or neutron star, you could achieve the same effect. This is because a black hole is extremely dense, as is a neutron star, and these will create the exact same kind of warped region artificially created by rotating Tipler’s cylinder.

Still another concept would be to utilize infinitely long and dense cosmic strings that could somehow be made to spin fast enough to get a closed time loop to form around it. Better still, according to Princeton University theorist Richard Gott, creating a time loop could be as simple as finding two strings moving past each other at high speed. The angles would be critical for success, being exactly parallel to each other as they passed, creating the closed loop. Of course, as with many theories there is a catch. So far there is no proof these cosmic strings even exist. But this is a similar concept to my theory on wormhole creation between the universes (See the Research Page for more info).

Physicist Ron Mallett, a professor of Physics at the University of Connecticut, lost his father to death when he was only ten years old. His personal quest is to see his father again. Ron is working on a machine that uses lasers to warp space by orbiting them and spinning them at high speed, creating a time distortion. He believes this distortion will actually be a spatial dimension, a time within its own landscape that a person could navigate in. Ron began construction in 2002. But while Ron has had some success in his studies, there are some issues. In a recent paper by Ken Olum and Allen Everett the authors claimed to have found problems with Mallett's analysis. One of their objections is that the spacetime which Mallett used in his analysis contains a singularity even when the power to the laser is off and is not the spacetime that would be expected to arise naturally if the circulating laser were activated in previously empty space. Mallett has not offered a published response to Olum and Everett, but in his book *Time Traveler* he mentions that he was unable to directly model the optical fiber or photonic crystal which

bends the light's path as it travels through it, so the light circulates around rather than moving in a straight line; as a substitute he chose to include a "line source" (a type of one-dimensional singularity) which would act as a "geometric constraint", bending spacetime in such a way that the light would circulate around on a helix-shaped path in a vacuum (for an older solution involving an infinite cylinder which creates CTCs, in this case due to the cylinder's own rotation rather than light circulating around it, see the Tipler cylinder). He notes that closed timelike curves are present in a spacetime containing both the line source and the circulating light, while they are not present in a spacetime containing only the line source, so that "the closed loops in time had been produced by the circulating flow of light, and not by the non-moving line source." However, he does not provide any additional argument as to why we should expect to see closed timelike curves in a different spacetime where there is no line source, and where the light is caused to circulate due to passing through a physical substance like a photonic crystal rather than circulating in a vacuum due to the curved spacetime around the line source. Another objection by Olum and Everett is that even if Mallett's choice of spacetime were correct, the energy required to twist spacetime sufficiently would be huge, and that with lasers of the type in use today the ring would have to be much larger in circumference than the observable universe. At one point Mallett agreed that in a vacuum the energy requirements would be impractical but noted that the energy required goes down as the speed of light goes down. He then argued that if the light is slowed down significantly by passing it through a medium (as in the experiments of Lene Hau where light was passed through a superfluid and slowed to about 17 meters per second) the needed energy would be attainable. However, the physicist J. Richard Gott argues that slowing down light by passing it through a medium cannot be treated as equivalent to lowering the constant  $c$  (the speed of light in a vacuum) in the equations of General Relativity, saying:

*“One has to distinguish between the speed of light in a vacuum, which is a constant, and through any other medium, which can vary enormously. Light travels more slowly through water than through empty space, for example, but this does not mean that you age more slowly while scuba diving or that it is easier to twist space-time underwater. The experiments done so far don't lower the speed of light in empty space; they just lower the speed of light in a medium and should not make it easier to twist space-time. Thus, it should not take any less mass-energy to form a black hole or a time machine of a given size in such a medium.”*

Later, Mallett abandoned the idea of using slowed light to reduce the energy, writing that, "For a time, I considered the possibility that slowing down light might increase the gravitational frame dragging effect of the ring laser ... Slow light, however, turned out not to be helpful for my research.

Finally, Olum and Everett note a theorem proven by Stephen Hawking in a 1992 paper on the Chronology Protection Conjecture, which demonstrated that according to General Relativity it should be impossible to create closed timelike curves in any finite region that satisfies the weak energy condition, meaning that the region contains no exotic matter with negative energy. Mallett's original solution involved a spacetime containing a line source of infinite length, so it did not violate this theorem despite the

absence of exotic matter, but Olum and Everett point out that the theorem "would, however, rule out the creation of CTC's in any finite-sized approximation to this spacetime."

But can we really travel in time? A few people think we have. Take for example the John Titor story. I wouldn't go into it here, but here is the link that tells you everything, including content from his posts about the world, our world...in 2036, the time he reportedly came from.

<http://www.johntitor.com/Pages/Story.html>

For the original forum posts of John Titor, you can still follow them here:

<http://www.anomalies.net/object/titororiginalpost.html>

Traveling through time is estimated to take a tremendous amount of energy. More than we can muster today. But there may be other phenomena that occur here on Earth that may facilitate time travel. Now Hawkins is in the news with his latest ramblings....

<http://news.discovery.com/space/stephen-hawkings-time-machine.html>

## **The Fourth Dimension**

First, though, you have to get your head around the notion that time is a dimension, just like width, height and length.

Hawking uses the example of driving in your car: You go forward. That's one direction. You turn left or right, that's a second. You journey up a mountain road, that's a third. The fourth dimension is time.

"Time travel movies often feature a vast, energy-hungry machine. The machine creates a path through the fourth dimension, a tunnel through time. A time traveler, a brave, perhaps foolhardy individual, prepared for who knows what, steps into the time tunnel and emerges who knows when. The concept may be far-fetched, and the reality may be very different from this, but the idea itself is not so crazy," Hawking writes.

The laws of physics actually accommodate the notion of time travel, through portals known as wormholes.

"The truth is wormholes are all around us, only they're too small to see. They occur in nooks and crannies in space and time," Hawking writes. "Nothing is flat or solid. If you look closely enough at anything you'll find holes and wrinkles in it. It's a basic physical principle, and it even applies to time. Even something as smooth as a pool ball has tiny crevices, wrinkles and voids.

## Quantum Foam and Tiny Wormholes

"Down at the smallest of scales, smaller even than molecules, smaller than atoms, we get to a place called the quantum foam. This is where wormholes exist. Tiny tunnels or shortcuts through space and time constantly form, disappear, and reform within this quantum world. And they actually link two separate places and two different times."

The tunnels, unfortunately, are far too small for people to pass through -- just a billion-trillion-trillionths of a centimeter -- but physicists believe it may be possible to catch a wormhole and make it big enough for people, or spaceships, to enter, Hawking writes.

"Theoretically, a time tunnel or wormhole could do even more than take us to other planets. If both ends were in the same place, and separated by time instead of distance, a ship could fly in and come out still near Earth, but in the distant past. Maybe dinosaurs would witness the ship coming in for a landing," Hawking writes.

Ultimately, scientists may find that only travel into the future is possible, as the laws of nature may make travel to the past impossible so the relationship between cause and effect is maintained. For example, if you could travel in the past and do something that prevents yourself from being born, how could you exist in the future to travel back in time?

## WIDE ANGLE: Is time travel possible?

Time as a Flowing River

What if we could travel faster than light? How would we do it? Introducing the warpship.

Hawking suspects radiation feedback would collapse any wormholes scientists managed to expand to useable sizes, rendering them useless for actual travel. But there's another way -- navigating the variable rivers of time.

"Time flows like a river and it seems as if each of us is carried relentlessly along by time's current. But time is like a river in another way. It flows at different speeds in different places and that is the key to traveling into the future," Hawking writes.

Albert Einstein first proposed this idea 100 years ago that there should be places where time slows down, and others where time speeds up, notes Hawking. "He was absolutely right."

The proof, says Hawking, lies in the Global Positioning System satellite network, which in addition to helping us navigate on Earth, reveals that time runs faster in space.

"Inside each spacecraft is a very precise clock. But despite being so accurate, they all gain around a third of a billionth of a second every day. The system has to correct for the drift, otherwise that tiny difference would upset the whole system, causing every GPS device on Earth to go out by about six miles a day," Hawking writes.

The clocks aren't faulty -- it's the pull of Earth that's to blame.

"Einstein realized that matter drags on time and slows it down like the slow part of a river. The heavier the object, the more it drags on time," Hawking writes. "And this startling reality is what opens the door to the possibility of time travel to the future."

### Black Holes and Flying at the Speed of Light

The keys to time travel are black holes, objects so dense that not even light can escape their gravitational grip.

"A black hole ... has a dramatic effect on time, slowing it down far more than anything else in the galaxy. That makes it a natural time machine," Hawking writes.

Here's how it might work:

Imagine a spaceship orbiting the super-massive black hole at the center of the Milky Way galaxy, 26,000 light years away. From Earth, it would look like the ship is making one orbit every 16 minutes, Hawking writes.

"But for the brave people on board, close to this massive object, time would be slowed down," Hawking writes. "For every 16-minute orbit, they'd only experience eight minutes of time."

If they circled for five years, local time, 10 years would have passed back on Earth.

This scenario doesn't produce the paradoxes inherent in wormhole travel, but it's still pretty impractical, Hawking acknowledges.

Do aliens exist? Could they harness wormholes to invade Earth? Find out what Hawking thinks.

But there's one more possibility: traveling super fast.

"This is due to another strange fact about the universe," writes Hawking -- the cosmic speed limit: 186,000 miles per second, or the speed of light.

"Nothing can exceed that speed. It's one of the best established principles in science," writes Hawking, but "believe it or not, traveling at near the speed of light transports you to the future."

"Imagine a track that goes right around Earth, a track for a super-fast train. Onboard are passengers with a one-way ticket to the future. The train begins to accelerate, faster and faster. Soon it's circling the Earth over and over again.

"To approach the speed of light means circling the Earth seven times a second. But no

matter how much power the train has, it can never quite reach the speed of light, since the laws of physics forbid it.

"Instead, let's say it gets close," writes Hawking. "Something extraordinary happens: Time starts flowing slowly on board relative to the rest of the world, just like near the black hole, only more so. Everything on the train is in slow motion."

### **Speed of Light Protection**

This happens to protect the cosmic speed limit, Hawking said. Here's why:

Say there's a child running forward up the train. "Her forward speed is added to the speed of the train, so couldn't she break the speed limit simply by accident? The answer is no," writes Hawking. "The laws of nature prevent the possibility by slowing down time onboard. Now she can't run fast enough to break the limit. Time will always slow down just enough to protect the speed limit."

This is the essence of why time travel into the future is possible.

"Imagine that the train left the station on January 1, 2050. It circles Earth over and over again for 100 years before finally coming to a halt on New Year's Day, 2150. The passengers will have only lived one week because time is slowed down that much inside the train. When they got out they'd find a very different world from the one they'd left. In one week they'd have travelled 100 years into the future," Hawking writes.

Right now, the fastest motion on Earth is taking place in the circular tunnels of the world's largest particle accelerator at CERN, in Geneva.

"When the power is turned on (particles) accelerate from zero to 60,000 mph in a fraction of a second. Increase the power and the particles go faster and faster, until they're whizzing around the tunnel 11,000 times a second, which is almost the speed of light. But just like the train, they never quite reach that ultimate speed. They can only get to 99.99 per cent of the limit. When that happens, they too start to travel in time. We know this because of some extremely short-lived particles, called pimesons. Ordinarily, they disintegrate after just 25 billionths of a second. But when they are accelerated to near-light speed they last 30 times longer."

To accelerate humans to that speed, we'll need to be in space, concludes Hawking, noting that so far, the fastest that people have traveled is 25,000 mph aboard Apollo 10.

"To travel in time we'll have to go more than 2,000 times faster (than Apollo 10). And to do that we'd need a much bigger ship, a truly enormous machine big enough to carry a huge amount of fuel, enough to accelerate it to nearly the speed of light. Getting to just beneath the cosmic speed limit would require six whole years at full power.

"We could, in theory, travel extraordinary distances within one lifetime," Hawking writes. "A trip to the edge of the galaxy would take just 80 years."

Perhaps we will find an answer to this enigma soon.

### **Storms and Mysteries**

Aside for our infantile efforts to enter the time displacement race, alien technologies are most likely light years ahead of us in manipulating the energy of the universe. In her book *Time Storms*, Randle postulates that time warps may already exist naturally, based on documented human experiences of lost time, time leaps, altered perception of time, and rifts in the fabric of space. Sometimes when I am traveling through Long Valley I experience these. I leave the little town of Chester, NJ, on Rt. 24, and before I realize it, I am on County Road 513 West Mill Road near Califon. Strangely my son has no idea how we missed out turn either. Hummmmm....

It is quite possible that places such as the Bermuda Triangle, the Great Lakes Triangle, or the twelve vile vortices, Sedona or other questionable spots may be examples of time disturbances. Let me relate an example of this that Boynton Beach, Florida pilot Bruce Gernon experienced on December 4, 1970. Bruce and his father had built up a successful real estate brokerage in southern Florida. By his early 20s, Bruce already logged about 600 hours flying time and was very familiar with Florida and the Bahamas. However, none of this prepared him for an encounter which over 40 years later still blows his mind when he thinks about it.

For those of you who are long-standing groupies of the Triangle's evolving mythos, you have most likely already heard various versions of Bruce's account, the first appearing in 1977 between the pages of Charles Berlitz's sequel "Without A Trace", then later presented on Arthur C. Clarke's *Mysterious Universe*, Discovery Channel and on a recent TLC documentary on the Bermuda Triangle. Many have accused Bruce of embellishment, but he is far from a "snake oil salesman" or publicity hound. He strikes me as the "Clark Kent" type. The only reason his account ever saw the light of day was the result of his friendship with the late J. Manson Valentine, who often cataloged the unexplained in the Bermuda Triangle and was the source for Charles Berlitz's two blockbuster books on the subject.

Gernon was so impacted by his encounter that he wrote down details shortly after it happened and even began to do some of his own investigating. Here he shares some of what he encountered and what he has discovered over the last 40 years of flying the Triangle. His keen memory for detail has aided in the production of pictures and maps, detailing what he experienced.

In his own words:

"My dad and I had been flying our own plane in the Bahamas since 1967, and had made at least a dozen flights to and from Andros Island. Everything seemed normal on that fateful day in December, just after 3 p.m., when my dad and I and Chuck Lafeyette,

a business associate, lifted off the runway at Andros town Airport in a brand new Beechcraft Bonanza A36.

It was shortly after takeoff when I noticed an elliptical cloud directly in front of us about a mile away, hovering only about 500 feet above the ocean. It was a typical lenticular cloud, but I had never seen one that low.”

“Miami Flight Service reported over the VHF radio that the weather was good, so we continued. But the lenticular cloud quickly changed into a huge cumulus cloud. We were climbing at 1,000 feet per minute, and the cloud seemed to be building up at the same rate. Unexpectedly, it caught up and engulfed the Bonanza. After 10 minutes of climbing in and out of this cloud, the airplane finally broke free at 11,500 feet and the sky was clear.“

“I leveled the Bonanza off and accelerated to its maximum safe cruising speed of 195 miles per hour. When I looked back at the cloud, I was astonished. It now looked like an immense squall, abnormally shaped in the form of a giant semicircle extending around us. Visibility was about ten miles and the cloud continued beyond my perception, so it must have been more than 20 miles long. After a few minutes, I lost sight of it.”

“Soon we noticed another cloud building directly in front of us, near the Bimini Islands. It looked a great deal like the cloud that we had just left, except that its top was at least 60,000 feet high. When we came within a few miles of it, we saw that it appeared to emanate directly from the surface of the Earth. Upon entering the cloud we witnessed an uncanny spectacle. It became dark and black, without rain, and visibility was about four or five miles. There were no lightning bolts, only extraordinarily bright white flashes that would illuminate the entire surrounding area. The deeper we penetrated, the more intense the flashes became, and so we made a 135-degree turn to the left and headed due south out of the cloud. “

“We had been flying for 27 minutes. We thought we might be able to fly around the cloud, but after six or seven miles we saw that it continued in a near-perfect curve to the east. After two more minutes it became apparent that the cloud near Andros and the cloud near Bimini were actually opposite sides of the same ring shaped body! The cloud must have formed just off of Andros Island and then rapidly spread outward into the shape of a doughnut with a diameter of 30 miles. This seemed impossible, but there was no other explanation. We were trapped inside a billowing prison, with no way under or over it.”

“Thirteen miles later, I noticed a large U-shaped opening on the west side of the doughnut cloud. I had no choice but to turn and try to exit through the opening. As we approached, we watched the top ends of the U-gap join, forming a hole. The break in the cloud now formed a perfect horizontal tunnel, one mile wide and more than 10 miles long. We could see the clear blue sky on the other side.”

“We also saw that the tunnel was rapidly shrinking. I increased the engine RPM, bringing our speed to the caution area of 230 miles per hour. When we entered the tunnel, its diameter had narrowed to only 200 feet.”

“I was amazed at what the shaft now looked like. It appeared to be only a mile long instead of ten-plus as I had originally estimated. Light from the afternoon sun shone through the exit hole and made the silky white walls glow. The walls were perfectly round and slowly constricting. All around the edges were small puffs of clouds of a contrasting gray, swirling counterclockwise around the airplane.”

“We were in the tunnel for only 20 seconds before we emerged from the other end. For about five seconds I had the strange feeling of weightlessness and an increased forward momentum. When I looked back, I gasped to see the tunnel walls collapse and form a slit that slowly rotated clockwise. All of our electronic and magnetic navigational instruments were malfunctioning. The compass was slowly spinning even as the airplane flew straight. I contacted Miami and told them we were about 45 miles southeast of Bimini, heading east at 10,500 feet. The radar controller replied that he was unable to identify us anywhere in that area.”

“Something bizarre had happened. Instead of the blue sky we expected, everything was a dull, grayish white haze. Visibility seemed like more than two miles, yet we could not see the ocean, the horizon, or the sky. The air was very stable and there was no lightning or rain. I like to refer to this as an “electronic fog,” because it seemed to be what was interfering with our instruments. I had to use my imagination to feel our way west.”

“We were in the electronic fog for three minutes when the controller radioed that he had identified an airplane directly over Miami Beach, flying due west. I looked at my watch and saw that we had been flying for less than 34 minutes. We could not yet have reached Miami Beach— we should have been approaching the Bimini Islands. I told the controller that he must have identified another airplane and that we were approximately 90 miles southwest of Miami and still looking for Bimini.”

“Suddenly the fog started breaking apart, in a weird sort of electronic fashion. Long horizontal lines appeared in the fog on either side of us. The lines widened into slits about four or five miles long. We saw blue sky through them. The slits continued expanding and joined together. Within eight seconds, all the slits had joined, and the gray fog had disappeared. All I could see was brilliant blue sky as my pupils adjusted to the abrupt increase in brightness. Then, I saw the barrier island of Miami Beach directly below.”

“After we landed at Palm Beach I realized that the flight had taken a little less than 47 minutes. I thought something must have been wrong with the airplane’s timer, yet all three of our watches showed that it was 3:48 P.M. I had never made it from Andros to Palm Beach in less than 75 minutes, even on a direct route. Our course on this flight was quite indirect and probably covered close to 250 miles. How could the airplane

travel 250 miles in 47 minutes? We taxied to customs, ending the fortuitous flight. We didn't talk about it for a long time.”

“I could not logically understand what had happened during that flight, although I felt it was significant and reviewed it in my mind several times a day. In 1972 I heard about the so-called Bermuda Triangle and disappearances of boats and airplanes because of a possible time warp. It was then that I realized that time itself was the key.”

“It should have taken about four minutes to travel through the tunnel, since it appeared to be between 10 and 15 miles long. Instead, this is precisely how long it took for us to leave the storm and reach clear skies. The remarkable thing is that we did not come out of the storm 90 miles away from Miami as we should have - We had traveled through 100 miles of space and 30 minutes of time in a little more than three minutes.”

Did Bruce experience a time storm?

Twilight Zone Music..please...