

The Wall Street Journal

November 21, 2003

Physicists Are Looking At How We Might Take A Trip Through Time

Ronald Mallett hadn't even heard of physics when he read H.G. Wells' 1895 classic, "The Time Machine," just a few months after his father died at age 33.

The 10-year old assumed that to build such a device, and see his father again, he should go into electronics, his dad's field. It was only during his stint at the Strategic Air Command that he learned that it was physicists who were discovering seeming impossibilities: that space can bend, time can slow, particles can be waves and waves, particles. It was physics, he realized, that offered the hope of making Wells' fiction and his --boyhood hope-- a reality.

"But I was astute enough not to tell people I was interested in the physics of time travel," says Dr. Mallett, a professor at physics at the University of Connecticut, Storrs. "I chose black holes as my cover story, and didn't come out of the time-travel closet until 1998." The closet is emptying fast. Ever since Einstein formulated his general theory of relativity in 1915, describing gravity as dips and curves in the single entity called space-time, researchers have been finding hidden gems in its equations. Those equations permit numerous "solutions," or particular shapes of space-time—from deep wells to gentle waves. One solution, for instance, implies the existence of black holes; at first only theorized, black holes have since become, through astronomical observations, members in good standing of the cosmic menageries. Now physicists are taking seriously the newest solutions, those that imply geometries of space-time that actually allow travel to the past.

Prof. Mallett theorized in 2000 that if a powerful laser light were bent into a ring, it would create a region at its center where space-time curves back on itself so severely that someone proceeding into the future would wind up back when he started, in his own past. In 1991, Princeton University astrophysicist J. Richard Gott theorized that cosmic strings, thinner than an atomic nucleus but infinitely long and more massive than a galaxy, could warp space-time enough to create these paths to the past, called closed time like curves.

But it is a 1989 discovery, by Caltech's Kip Thorne and colleagues, that has done the most to get the physics of time travel into reputable scientific journals. They theorized that general relativity permits wormholes—tunnels that cut across a curved region of space-time, connecting here to there and now to then. Earlier calculations suggested that wormholes don't stay open long enough to serve as practical time machines, but Prof. Thorne showed that, with enough negative energy, they can be propped open.

That's how the heroes of "Timeline," in theaters next week, travel back to the 14th century (and immediately plunge into nonstop sword-wielding, horse-galloping mayhem). In the film, scientists accidentally discover a wormhole, one end of which is anchored in 1357 France. That gets a thumbs up from physicists: If wormholes and closed time like curves exist, they are going to be found, not created. You'd have to settle for whatever endpoints they have.

Just because wormholes emerge from general relativity doesn't mean they emerge in reality, of course. But physicists take them seriously because of their experience with black holes, which were first only theoretical, too. Maybe wormholes, too, will move from theory to reality. "In physics," says physicist Michio Kaku of the City College of New York, "that which is not forbidden is mandatory. If you want to forbid some bizarre phenomenon, you have to kill it by showing that a law of physics prevents it."

No one has yet done that with wormholes or time travel. The energy needed to prop open a wormhole is about what you would get by converting the mass of a large star into energy through $E = mc^2$. But that is a practical, not a fundamental, objection. British cosmologist Stephen Hawking once proposed a "chronology protection conjecture" that would forbid time travel as a result of the laws of physics, but has since retreated.

That has brought a sea change in physics. "A dozen years ago, if you talked about time travel your name would be mud," says Prof. Kaku. "But now we feel that by exploring the possibility of time travel, we are testing the extremes of the laws of physics, which may lead to new physics."

If new physics is lurking anywhere, a good place to check is the sub-subatomic world of "quantum foam." In this roiling microworld, space itself is holey, and wormholes and black holes 100 billion times smaller than a proton constantly pop into existence (as the blip that became our universe probably did) only to quickly disappear (as our universe didn't). But it might be possible to pump enough energy into an otherwise transitory wormhole to keep it around.

Physicists even have the engineering specs for how to then turn a wormhole into a time tunnel. Anchor one mouth in the present—say, Nov. 21, 2010. Drag the other mouth through space at nearly the speed of light, until Nov. 21, 2011. Moving objects age more slowly than stationary ones, according to relativity. If you hop inside the wormhole, therefore, you could travel to any point in time in-between, back to 2010.

And there's the rub. Time travelers could never reach a time earlier than when a wormhole was engineered. No wonder none have visited us.