

# Has a Speeding Neutrino Really Overtaken Einstein?

[OPINION](#)

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Einstein wrong? Impossible!

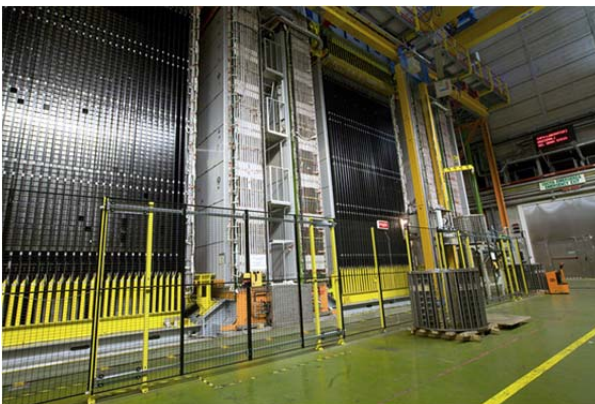
That was the reaction of physicists around the world last week when they heard that experiments in Switzerland indicate that Einstein's theory of relativity might be wrong. Since 1905, when Einstein declared that nothing in the universe could travel faster than light, the theory has been the bedrock of modern physics. Indeed, most of our high-tech wizardry depends on it.

Of course, crackpots have been denouncing Einstein's theory of relativity for years. Like many physicists, I have boxes full of self-published monographs that were mailed to me from people who claim that Einstein was wrong. In the 1930s the Nazi Party criticized Einstein's theory, publishing a book called "100 Authorities Denounce Relativity." Einstein later quipped that you don't need 100 famous intellectuals to disprove his theory. All you need is one simple fact.

Well, that simple fact may be in the form of the latest experiments at the largest particle accelerators in the world, based at CERN, outside Geneva. Physicists fired a beam of neutrinos (exotic, ghost-like particles that can penetrate even the densest of materials) from Switzerland to Italy, over a distance of 454 miles. Much to their amazement, after analyzing 15,000 neutrinos, they found that they traveled faster than the speed of light—one 60-billionth of a second faster, to be precise. In a billionth of a second, a beam of light travels about one foot. So a difference of 60 feet was quite astonishing.

Cracking the light barrier violated the core of Einstein's theory. According to relativity, as you approach the speed of light, time slows down, you get heavier, and you also get flatter (all of which have been measured in the lab). But if you go faster than light, then the impossible happens. Time goes backward. You are lighter than nothing, and you have negative width. Since this is ridiculous, you cannot go faster than light, said Einstein.

[Enlarge Image of CERN](#)



The OPERA neutrinos detector.

The CERN announcement was electrifying. Some physicists burst out with glee, because it meant that the door was opening to new physics (and more Nobel Prizes). New, daring theories would need to be proposed to explain this result. Others broke out in a cold sweat, realizing that the entire foundation of modern physics might have to be revised. Every textbook would have to be rewritten, every experiment recalibrated.

Cosmology, the very way we think of space, would be forever altered. The distance to the stars and galaxies and the age of the universe (13.7 billion years) would be thrown in doubt. Even the expanding universe theory, the Big Bang theory, and black holes would have to be re-examined.

Moreover, everything we think we understand about nuclear physics would need to be reassessed. Every school kid knows Einstein's famous equation  $E=MC^2$ , where a small amount of mass  $M$  can create a vast amount of energy  $E$ , because the speed of light  $C$  squared is such a huge number. But if  $C$  is off, it means that all nuclear

physics has to be recalibrated. Nuclear weapons, nuclear medicine and radioactive dating would be affected because all nuclear reactions are based on Einstein's relation between matter and energy.

If all this wasn't bad enough, it would also mean that the fundamental principles of physics are incorrect. Modern physics is based on two theories, relativity and the quantum theory, so half of modern physics would have to be replaced by a new theory. My own field, string theory, is no exception. Personally, I would have to revise all my theories because relativity is built into string theory from the very beginning.

How will this astonishing result play out? As Carl Sagan once said, remarkable claims require remarkable proof. Laboratories around the world, like Fermilab outside Chicago, will redo the CERN experiments and try to falsify or verify their results.

My gut reaction, however, is that this is a false alarm. Over the decades, there have been numerous challenges to relativity, all of them proven wrong. In the 1960s, for example, physicists were measuring the tiny effect of gravity upon a light beam. In one study, physicists found that the speed of light seemed to oscillate with the time of day. Amazingly, the speed of light rose during the day, and fell at night. Later, it was found that, since the apparatus was outdoors, the sensors were affected by the temperature of daylight.

Reputations may rise and fall. But in the end, this is a victory for science. No theory is carved in stone. Science is merciless when it comes to testing all theories over and over, at any time, in any place. Unlike religion or politics, science is ultimately decided by experiments, done repeatedly in every form. There are no sacred cows. In science, 100 authorities count for nothing. Experiment counts for everything.

*Mr. Kaku, a professor of theoretical physics at City College of New York, is the author of "Physics of the Future: How Science Will Shape Human Destiny and Our Daily Lives by the Year 2100" (Doubleday, 2011).*