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Scientists Report Second Sighting of Faster-Than-Light Neutrinos

By DENNIS OVERBYE

Few scientists are betting against Einstein yet, but the phantom neutrinos of Opera are still eluding explanation.

Two months after scientists reported that they had clocked subatomic particles known as neutrinos going [faster than the speed of light](#), to the astonishment and [vocal disbelief of most of the world's physicists](#), the same group of scientists, [known as Opera](#), said on Friday that it had performed a second experiment that confirmed its first results and eliminated one possible explanation for how the experiment could have gone wrong.

But the group admitted that many questions remain. "This is not the end of the story," said Antonio Ereditato of the University of Bern in Switzerland, the spokesman for the collaboration, explaining that physicists would not accept the result that neutrinos could go faster than light until other experiments had come up with the same conclusion. "We are convinced, but that is not enough in science," he said.

Other physicists said they remained skeptical that the universe was about to be overturned.

The speed of light was established as the cosmic speed limit, at least for ordinary matter in ordinary space, in 1905 by Albert Einstein's theory of relativity (now known as special relativity), foreclosing the possibility of time travel into the past or of timely travel to other stars.

Neutrinos, though ghostly in many regards — they are able to traverse planets and walls of lead like light through a window, and to shape-shift from one of three varieties of the particle to another along the way — are part of the universe, and so there was no reason to expect that Einstein's stricture should not apply to them as well.

But over the course of the last three years, in experiments designed to investigate this shape shifting, neutrinos produced at CERN, the [European Organization for Nuclear Research](#), and [beamed underground](#) to the [Gran Sasso National Laboratory](#) in Italy, an underground facility about 450 miles away, arrived about 58 billionths of a second sooner than would a light beam, according to Opera. The group is based at Gran Sasso, which is near L'Aquila; CERN is in Geneva.

When these results were presented to a meeting at CERN in September, after a prairie fire of blog [rumors](#), they were greeted by fierce skepticism. Among the problems with the original experiment, scientists said, was that the neutrinos were produced in bursts 10,000 billionths of a second long — much bigger than the discrepancy in arrival time.

Last month CERN retooled so that the neutrinos could be produced in shorter bursts, only 3 billionths of a second long, making it easier to match neutrinos at Gran Sasso with neutrinos at CERN, and the experiment was briefly repeated. The neutrinos still arrived early, about 62 billionths of a second early, in good agreement with the original result and negating the possibility, the Opera team said, that the duration of the neutrino pulse had anything to do with the results.

The details of both the first and second round of experiments are contained in a paper posted on the Internet at <http://arxiv.org/abs/1109.4897> and submitted to the Journal of High Energy Physics. In response to reports that some members of the Opera group had refused to sign a preliminary version of the paper in September, Dr. Ereditato said of the new paper, “They all signed.”

Physicists said the new paper had answered some of the questions about the experiment, but many remain: for example, about how the clocks were synchronized between Geneva and Gran Sasso, and how the distance between them was ascertained. “It does appear that they have done a good job,” said John Learned, a neutrino physicist at the University of Hawaii at Manoa who was not involved in the experiment. But, he added, “If there is a deep systematic error in the calculation of expected time difference, this remains.”

Alvaro de Rujula, a CERN theorist, said there were two interpretations of the experiment. “One is that they have stumbled upon a revolutionary discovery; the other, on which I would place my bet, is that they are still making and not finding the very same error.”

In the meantime, Einstein sleeps peacefully.

Asked if he had seen any interesting theoretical explanations of how neutrinos could violate the speed of light among the papers that have been flooding the internet these past two months, Dr. Ereditato demurred. “That’s not our business,” he said. “A good experimentalist tries to be as cool as possible.”

Dr. Learned and Dr. de Rujula both said there were no convincing theories out there yet. “The theory papers are amusing in that it more and more points out how very much trouble this result will cause, if verified,” Dr. Learned said in an e-mail.

He added, “Fun!”