CERN and colliding theories

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Findings that showed faster-than-light travel were released to the public too soon.

What do you do as a scientist when you know a research result that is almost certainly wrong is about to become a media sensation? That is the quandary I found myself in last month as I awaited the announcement from CERN, the European Organization for Nuclear Research, about particles called neutrinos supposedly traveling faster than the speed of light. I had already been informed about the experiment, whose findings, if true, would require an overhaul of physics: Our current understanding - based on Einstein's theory of relativity and consistent with every known physical theory and experiment - is that nothing can travel through space faster than the speed of light.

I hoped that somehow the result would escape the attention of the world news media, but I knew better: A news conference had been scheduled. On the other hand - except for the die-hard would-be Einsteins who have already begun to write me suggesting that the CERN result proves their pet theories - I also knew that for the general public the claim would prove to be a momentary curiosity, forgotten along with much of the rest of yesterday's news.

First, why is it likely that the neutrino result has a mundane rather than earth-shattering explanation? To start, experiments with neutrinos are notoriously difficult - one can only "see" them through rare interactions with other matter. If one produces many neutrinos at a source, one cannot merely track them one by one but must detect the neutrino

"pulse" by probabilistic means.

The claim that neutrinos arrived at the Gran Sasso National Laboratory in Italy from CERN's Large Hadron Collider in Switzerland on average 60 billionths of a second before they would have if they were traveling at light speed relies on complicated statistical analysis. It must take into account the modeling of the detectors and how long their response time is, careful synchronization of clocks and a determination of the distance between the CERN accelerator and the Gran Sasso detector accurate to a distance of a few meters. Each of these factors has intrinsic uncertainties that, if misestimated, could lead to an erroneous conclusion

It's equally important that the speed of light as the ultimate speed limit has been tested numerous times in many situations over the last century, and it has held up. The predictions that flow from it have been correct, in certain cases to better than parts per billion. In addition, more than 20 years ago a colleague and I demonstrated that neutrinos and light traveled the 150,000-year voyage from a distant exploding star at the same speed to an accuracy of better than one part in a billion. This was derived from fact that 19 neutrino "events" - interactions - were observed in two underground detectors within four hours of the visual signal coming from the exploding star. If the same deviation that was claimed in the new experiment applied to the neutrinos in our experiment, they would have arrived instead several years after the visual signal.

This doesn't disprove the CERN result, but it means that for it to be true, physicists must come up with a pretty contrived way of having neutrino velocities vary under different conditions.

Given the potential problems with the CERN finding, the way it was presented to the world is cause for concern. A dramatic claim from a distinguished laboratory that turns out to be false reinforces the notion that somehow science is not to be trusted, that one can dismiss theories

one finds inconvenient, even those whose predictions do agree with observations. This particular claim also reinforces the notion that scientific revolutions sweep away all that went before them. This is not how science progresses. Results that have withstood the test of experiment will continue to remain valid, no matter how physical theory evolves.

The researchers involved in the CERN result have not made exaggerated claims about their findings. They have merely pointed out an anomaly with their experimental result. Their paper will be examined and carefully dissected by knowledgeable referees who will decide if it is worthy of publication.

What is inappropriate, however, is the publicity fanfare coming before the paper has even been examined by referees. Too often today, science is done by news release rather than waiting for refereed publication. Because a significant fraction of experimental results ultimately never get published or are not later confirmed, providing unfiltered results to a largely untutored public is irresponsible.

The CERN result may indeed herald something new and remarkable. But if the overwhelming suspicions that greeted it are true instead, then the public presentation is unfortunate and misleading.

The Large Hadron Collider at CERN is one of the most complex and remarkable machine humans have ever built, and it may one day reveal remarkable new insights into the nature of reality. To date, the careful analyses done by the major experiments there have not produced any new discoveries. It would be a shame for CERN, and for science, if its legacy in the public's mind is a result that will one day be shown to be wrong.

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