Publish and be damned

Controversial and out-of-line results should not be discarded or hidden — even though revealing them may come at some recriminatory cost, as the OPERA collaboration has discovered.

In September 2011, a remarkable announcement was made: in a seminar held at CERN in Geneva, the OPERA collaboration presented experimental results that suggested neutrinos could travel faster than the speed of light. That speed limit of 3×10^8 ms^{-1} had been respected since 1905, when Albert Einstein introduced his special theory of relativity. It was an extraordinary claim by OPERA, and the evidence was in itself, at a significance of seemingly more than 6σ, extraordinary. Yet, six months later, neither the result nor the leadership of the OPERA collaboration still stands.

OPERA — Oscillation Project with Emulsion-tRacking Apparatus — is a stack of interleaved photographic film and lead sheets, sited in Italy's Gran Sasso laboratory. A beam of muon neutrinos generated by CERN accelerators in Geneva travels 730 km through the Earth's crust to reach OPERA, which looks for signatures of tau neutrinos, appearing in the muon-neutrino beam as a consequence of oscillations between the three types of neutrino. The international collaboration that built and runs OPERA reported their first tau-neutrino candidate in May 2010. The measurement of the time-of-flight of neutrinos between CERN and Gran Sasso was an added bonus. Yet the data collected by OPERA suggested that the neutrinos were arriving from CERN almost 60 nanoseconds too soon: they seemed to be travelling faster than the speed of light.

Although the *Nature Physics* editorial team regularly fields claims that Einstein was wrong, physicists are on the whole reluctant to throw away a theoretical framework that has served so well over more than a century, and certainly will not do so on the basis of a single measurement. No explanation for these superluminal neutrinos could, however, be uncovered by the OPERA collaboration. Finally, the decision was taken — although some collaboration members withdrew their authorship — to publish in that September seminar, with the simultaneous posting of a 32-page preprint (http://arXiv.org/abs/1109.4897).

It was big news. The world's media are well attuned to anything CERN-related, and fell on a story that came with a deliciously shocking 'Einstein was wrong' tag. Physicists in the audience at the CERN seminar, and beyond, were understandably sceptical; further investigation and independent confirmation were required. That confirmation didn't come: instead, ICARUS — a sister experiment at Gran Sasso, using liquid-argon-filled time-projection chambers and, crucially, the same CERN beam — has published data that are perfectly consistent with Einstein being right (http://arXiv.org/abs/1203.3433).

The implication of their result was obviously going to make the headlines, and, in a more-than-200-strong collaboration, wasn't going to stay secret forever.

In February 2012, OPERA announced that two sources of possible error were under investigation, and the culprit, it now seems, was a loose optical-fibre connector. It's a disappointingly mundane explanation for those missing 60 nanoseconds — theorists' suggestions that the neutrinos might be taking a short-cut through extra dimensions were much more exciting. But it's the truth. It may not be physics' finest hour, but it is science in action, and not the embarrassing episode some have made it out to be.

That loose connection was hard to find: the OPERA collaboration had struggled for some time to understand what was going on in their data. The implication of their result was obviously going to make the headlines, and, in a more-than-200-strong collaboration, wasn't going to stay secret forever. With justification, the collaboration decided to make their problem public; those in the collaboration who disagreed with that step exercised their right to decline to put their names to it. The presentation at CERN wasn't triumphant, but opened up the entire OPERA process and analysis to the scrutiny of a wider circle of physicists.

Compare that with the conversations that played out, more than a century ago, in the weekly issues of *Nature*. Scientists, including such eminences as Lord Kelvin and Lord Rayleigh, presented their discoveries but also their problems, putting before the *Nature* audience anything that confused or defied explanation — and often, in the following week's issue, someone would offer advice or even an answer. We've become accustomed to large collaborations, especially those in particle physics, presenting publicly only rigorously scrutinized, thoroughly understood data, often simultaneously with confirmatory results from a sister collaboration (as often do ATLAS and CMS, the two general-purpose-detector collaborations operating at CERN's Large Hadron Collider). But it doesn't always work like that.

The OPERA collaboration has published and, in some quarters, been damned. Just a few weeks ago came the news that spokesman Antonio Ereditato and physics coordinator Dario Autiero had resigned from those positions in the leadership of OPERA. Rearrangements of personnel are the collaboration's own business. But there should be no condemnation for openness in science. It would be much poorer practice, for instance, to simply ignore an awkward result that seemed to run counter to prevailing ideas.

Instead, the OPERA problem has been solved, albeit under a media spotlight and amid considerable public interest. The public may be disappointed at the outcome, but it has now gained a sense of the trials and tribulations of real science — the false starts and setbacks that interleave the great leaps forward. Really, honesty is the only policy. ❐