"Delaying the decision in this way seems like a typical Japanese way of saying 'no'." Foster adds that it is especially concerning that the Japanese government has now referred the decision process back to the SCJ, which has not been enthusiastic about the ILC. "How all this will now play out in the European strategy discussions is hard to know." At the press conference, it was noted that negotiations on cost sharing will now be carried out by officials from the KEK particle-physics lab. But Foster warns that this will be a "waste of time". "Negotiations need to take place at a higher level," he adds.

The announcement from the Japanese government is unlikely to result in linear-collider physicists getting behind the ILC and ditching plans for the Compact Linear Collider (CLIC), which would offer higher collision energies up to around 3 TeV. "The statement appears to fall short of a clear positive decision by the Japanese government, and is, frankly, disappointing," says particle physicist Philip Burrows from the University of Oxford, who is CLIC's spokesperson. "CLIC represents a serious alternative design for an energy-frontier linear collider and we will make every effort to keep it on the table for consideration pending greater clarity on the ILC from the Japanese government. This is a real window of opportunity for Japan, but this window cannot remain open for much longer – the world must move on. Other projects are advancing, and CLIC provides a great opportunity for a linear collider Higgs factory in Europe."

It is difficult to be convinced that the Japanese government is serious about this

That view is shared by particle theorist John Ellis from King's College London, who told *Physics World* that the statement is "disappointing" for the community. "For the time being, the European particle-physics strategy update will have to continue without assuming that the ILC will go ahead," he says, adding that there are other projects on the table such as CLIC, China's Circular Electron Positron Collider and the Future Circular Collider at CERN (see pp27–29) that could "do similar physics and provide ways forward for the community".

Facilities

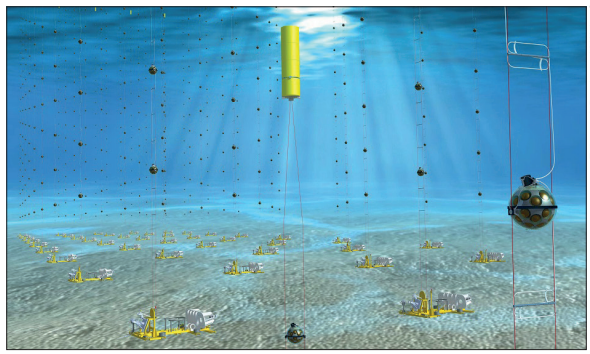
Physicists propose huge European neutrino experiment

An international team of researchers has proposed an ambitious new experiment that would involve firing neutrinos from a particle accelerator in Russia to a detector 2500 km away in the Mediterranean Sea. The researchers claim that the facility would provide unparalleled insights into the properties of neutrinos and elucidate why matter dominates over antimatter in the universe.

Neutrinos are created in huge numbers by cosmic sources but can also be produced by nuclear reactors and particle accelerators. There are currently three known types of neutrino, which can oscillate between their different "flavours" as they travel. But scientists have not yet been able to determine the relative ordering of the three neutrino masses or discover the extent to which neutrinos violate charge–parity symmetry – a finding that could clarify why the universe is dominated by matter rather than antimatter.

Several "long-baseline" accelerator neutrino experiments worldwide are already in operation or being developed, including the Deep Underground Neutrino Experiment project, which is currently under construction. It will involve sending a 3 GeV beam of neutrinos from Fermilab to an underground detector in South Dakota, 1300 km away.

Researchers in Europe have now proposed their own long-baseline facility. A collaboration of 90 researchers from nearly 30 research institutes have published a letter of interest to build the Protvino-ORCA (P2O) experiment (arXiv:1902.06083). In the letter, they explain how they would upgrade a 70 GeV synchrotron particle accelerator at Protvino – 100 km south of Moscow – to generate a neutrino beam. It would then be sent to the Oscillation Research with Cosmics in the Abyss (ORCA) detector, which is currently being built off the coast of Toulon, France, by the KM3NeT collaboration.



Edward Berbee/Nikhef

Vision for the future A proposed long-baseline neutrino facility would involve firing a beam of neutrinos from an accelerator in Russia to a neutrino detector in the Mediterranean Sea.

Neutrinos achieve maximum oscillation at different distances depending on their energy levels. P2O's 2595 km baseline would allow it to achieve maximum oscillation at neutrino energies of around 4–5 GeV. Astroparticle physicist Paschal Coyle, who belongs to the KM3NeT collaboration, says that these parameters make P2O ideal for disentangling the effects of mass ordering and charge–parity violation. "In other long-baseline experiments there are ambiguities that make it harder to decouple the two contributions," he adds.

The realization of the P2O experiment will, however, not come soon. It would require the funding and construction of a new neutrino beamline at the accelerator in Protvino, aligned towards the ORCA site, as well as the accelerator's beam power being increased from 15 kW to at least 90 kW. It may also require an upgrade to the ORCA detector, which has been designed to detect atmospheric neutrinos and is still under construction.

Dmitry Zaborov from the Kurchatov Institute in Moscow, who is one of the authors of the letter, says that P2O has been proposed for inclusion in the upcoming update to the European strategy for particle physics and also has the support of the KM3NeT/ORCA community. "The experiment proposal has substantial support within the particle-physics community in Europe as well as in Russia," he says. The outcome of the strategy update will be concluded in May 2020.

Simon Perks