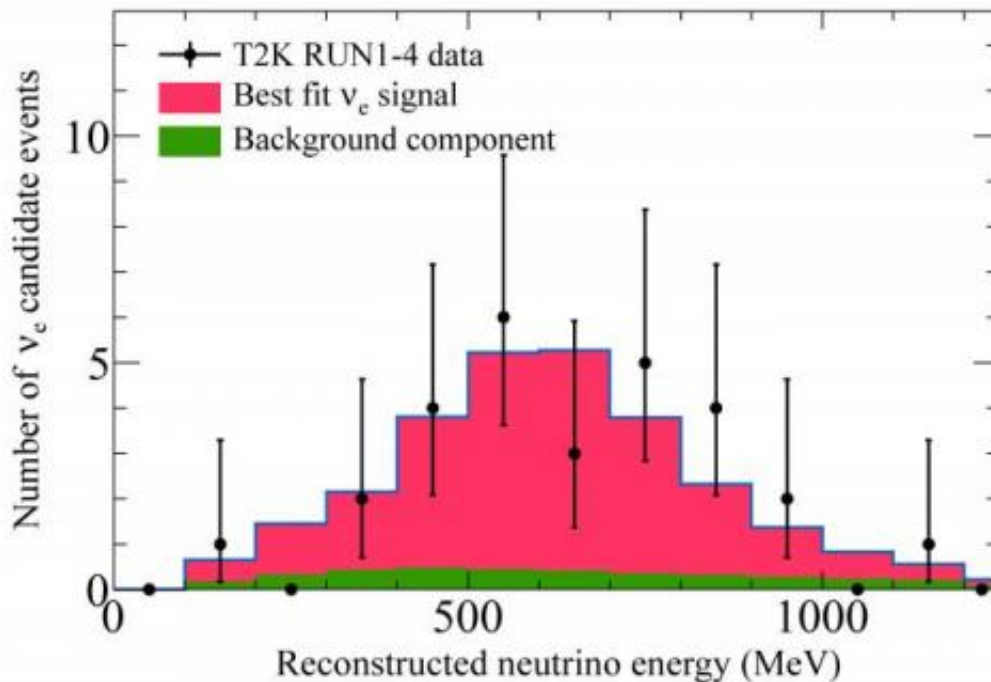


Researchers make new discovery about neutrinos, bringing us one step closer to perhaps solving one of the biggest myster

July 19 2013



Distribution of reconstructed energy of electron-neutrino candidates in Super Kamiokande: the black points represent the data, the pink histogram represents the expected energy distribution of electron-neutrino candidates that have oscillated from muon neutrinos, and the green histogram represents the expected energy distribution of non-oscillated electron neutrinos.

International research including the UK and Japan has confirmed that

subatomic particles called neutrinos have a new form of identity-shifting property. Announced today (19 July 2013) these results could one day help scientists explain why the universe contains matter but very little antimatter.

The findings are further confirmation from the T2K [neutrino experiment](#) in Japan of [neutrinos](#) changing between different types, or oscillating, in a new way.

Dr Alfons Weber, Professor of Physics at STFC and the University of Oxford is one of many scientists in the UK working on T2K - he designed the electronics for the experiment. He explains: "The UK particle physics community was one of the driving forces behind this experiment. We not only provided part of the detector that characterises the beam, but also designed the target that produces the neutrinos in the first place. The long years of hard work have now come to fruition.

"Our findings now open the possibility to study this process for neutrinos and their [antimatter](#) partners, the anti-neutrinos. A difference in the rate of electron or anti-electron neutrino being produced may lead us to understand why there is so much more matter than antimatter in the universe. The neutrino may be the very reason we are here."

In 2011, the T2K collaboration announced the first indication of this process. Now with 3.5 times more data and a significance of 7.5 [sigma](#), this behaviour is firmly established and can now be called a discovery.

There are three types, or 'flavours,' of neutrinos – one paired with the electron (called the electron neutrino), and two more paired with the electron's heavier cousins, the muon and tau leptons. These different flavours of neutrinos can spontaneously change into each other, a phenomenon called neutrino oscillations. Observations have previously been made of a number of different types of oscillations, however the

T2K results are the first discovery of the appearance of electron neutrinos in a beam of muon neutrinos, and it is this kind of oscillation which is the key to making measurements to distinguish the oscillations of neutrinos and anti-neutrinos.

To explore the neutrinos' oscillations, the T2K experiment fired a beam of neutrinos from the J-PARC laboratory at Tokai Village on the eastern coast of Japan, and detected them at the Super-Kamiokande neutrino detector, 295 km away in the mountains of the north-western part of the country. Here, the scientists looked to see if the neutrinos at the end of the beam matched those emitted at the start.

They found 22.5 neutrinos appearing in the beam of [muon](#) neutrinos, where if there were no oscillations they only expected to see an average of 6.4. This indicates the discovery of the new type of oscillation. Now the team must make more accurate measurements of this new oscillation, and then run their experiment with an anti-neutrino beam to see if the results change.

Professor Dave Wark of the Science and Technology Facilities Council (STFC) and Oxford University, leads the UK's involvement in the international experiment. He said: "It's a joy to see T2K deliver the science we designed it for. I have been working on this for more than a decade, and what these results tell us is that we have more than another decade of work ahead of us.

"We have seen a new way for neutrinos to change, and now we have to find out if neutrinos and anti-neutrinos do it the same way. If they don't, it may be a clue to help solve the mystery of where the matter in the universe came from in the first place. Surely answering that is worth a couple of decades of work!"

STFC is the UK sponsor of particle physics and supports the UK

universities involved in the T2K experiment.

Provided by Science and Technology Facilities Council

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