PRESS RELEASE
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A FIFTH TAU NEUTRINO DETECTED AT GRAN SASSO

Scientists of the OPERA experiment report the discovery of tau neutrino appearance in the muon neutrino beam from CERN to Gran Sasso

The OPERA international experiment at the INFN Gran Sasso Laboratory (Italy) has detected the fifth occurrence of a tau neutrino. The neutrino started its flight at CERN as muon neutrino and, after travelling 730 km through the Earth, it arrived at Gran Sasso showing up as a tau neutrino. This important result was announced yesterday during a seminar held at the Gran Sasso Laboratory. According to the Spokesperson of the international research team, Giovanni De Lellis, from Federico II University and INFN in Naples, "The detection of a fifth tau neutrino is extremely important: the direct observation of the transition from muon to tau neutrinos has now achieved for the first time the 5 sigma statistical precision, the usual particle physics threshold for a discovery. We can thus definitely report the discovery of the appearance of tau neutrinos in a muon neutrino beam." The detection of tau neutrinos from the oscillation of muon neutrinos was the motivation of the OPERA project, designed in the late nineties. "This task is extremely difficult due to two conflicting requirements: a huge, massive detector and a micrometric accuracy. The challenge is to bring to the thousands ton scale a detector based on the nuclear emulsion technology, a photographic technique unique in ensuring the required accuracy", De Lellis says.

The international OPERA experiment, involving about 140 physicists from 26 research institutions in 11 countries, was designed to observe this phenomenon. First conceived as a speculation, neutrino oscillations have been a poorly known phenomenon for several decades. In 1998, it was demonstrated that muon neutrinos produced in cosmic-ray interactions arrive at the Earth fewer than expected. The result reported yesterday finally confirms that the "missing" neutrinos are indeed muon neutrinos oscillating into tau neutrinos. "The achievement reported yesterday was made possible thanks to the continuous effort of all the researchers involved in the project, to the excellent performance of the CERN neutrino beam and to the support of all the Funding Agencies", De Lellis finally says.

The OPERA experiment with the CNGS (CERN Neutrinos to Gran Sasso)
Neutrinos produced at CERN, Geneva, travelled toward the Gran Sasso underground laboratory in Italy. Thanks to their extremely small probability to interact with matter, after travelling for about 730 km through the Earth, neutrinos arrived at the OPERA detector, a giant of about 4000 tons, with a 2000 m^3 volume and nine million photographic films: here a small fraction of the incoming neutrinos interacted with the detector, producing particles then observed. In nature there are three kinds, named "flavours", of neutrinos: electron, muon and tau neutrinos. OPERA has been looking for tau neutrinos knowing that all those leaving CERN were muon neutrinos, since the neutrino beam was on purpose produced that way. If neutrinos of a different flavour are detected, this is a proof of the oscillation occurring during their 730 km long flight. After detecting the first few muon neutrinos produced at CERN in 2006, the experiment has collected data for five years, from 2008 to the end of 2012. The first tau neutrino was observed in 2010. The second and third events were reported in 2012 and 2013, respectively, while the fourth one was published in 2014.

Scientists will continue the analysis of the data collected, searching for other tau neutrinos produced from the oscillation of muon neutrinos and possibly measuring the oscillation parameters, using for the first time oscillated tau neutrinos. The technologies developed for the OPERA experiment will be fruitfully employed in forthcoming experiments not only in neutrino physics studies but also in other fields.