

New results from T2K conclusively show muon neutrinos transform to electron neutrinos

July 19, 2013

U.S. Edition

(Strict press embargo until Friday, July 19, 08:30 U.S. Eastern Daylight Savings Time.)

Today at the European Physical Society meeting in Stockholm, the international T2K collaboration announced definitive observation of muon neutrino to electron neutrino transformation. In 2011, the collaboration announced the first indication of this process, a new type of neutrino oscillation, then; now with 3.5 times more data this transformation is firmly established. The probability that random statistical fluctuations alone would produce the observed excess of electron neutrinos is less than one in a trillion. Equivalently the new results exclude such possibility at 7.5 sigma level of significance. This T2K observation is the first of its kind in that an explicit appearance of a unique flavor of neutrino at a detection point is unequivocally observed from a different flavor of neutrino at its production point.

In the T2K experiment in Japan, a muon neutrino beam is produced in the Japan Proton Accelerator Research Complex, called J-PARC, located in Tokai village, Ibaraki prefecture, on the east coast of Japan. The neutrino beam is monitored by a detector complex in Tokai and aimed at the gigantic Super-Kamiokande underground detector in Kamioka, near the west coast of Japan, 295 km (185 miles) away from Tokai. An analysis of the data from the Super-Kamiokande detector associated with the neutrino beam time from J-PARC reveals that there are more electron neutrinos (a total of 28 events) than would be expected (4.6 events) without this new process.

Neutrino oscillation is a manifestation of a long range quantum mechanical interference. Observation of this new type of neutrino oscillation leads the way to new studies of charge-parity (CP) violation which provides a distinction in physical processes involving matter and antimatter. This phenomenon has only been observed in quarks (for which Nobel prizes were awarded in 1980 and 2008). CP violation in neutrinos in the very early universe may be the reason that the observable universe today is dominated by matter and no significant antimatter, which is one of the most profound mysteries in science. Now with T2K firmly establishing this form of neutrino oscillation that is sensitive to CP violation, a search for CP violation in neutrinos becomes a major scientific quest in the coming years, and T2K will continue to play a leading role. The T2K experiment expects to collect 10 times more data in the near future, including data with antineutrino beam for studies of CP violation in neutrinos.

The T2K experiment was constructed and is operated by an international collaboration. The current T2K collaboration consists of over 400 physicists from 59 institutions in 11 countries [Canada, France, Germany, Italy, Japan, Poland, Russia, Switzerland, Spain, UK and US]. The experiment is primarily supported by the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT). Additional support is provided by the following funding agencies from participating countries: NSERC, NRC and CFI, Canada; CEA and CNRS/IN2P3, France; DFG, Germany; INFN, Italy; Ministry of Science and Higher Education, Poland; RAS, RFBR and the Ministry of Education and Science of the Russian Federation; MICINN and CPAN, Spain; SNSF and SER, Switzerland; STFC, U.K.; DOE, U.S.A.

The US T2K collaborating team of approximately 70 members [Boston University, UC Irvine, University of Colorado, Colorado State University, Duke University, Louisiana State University,

Stony Brook University, University of Pittsburgh, University of Rochester, and University of Washington (Seattle)] is funded by the US Department of Energy, Office of Science. The US groups have built super-conducting corrector magnets, proton beam monitor electronics, the second neutrino horn and a GPS time synchronization system for the T2K neutrino beamline; and a pi-zero detector and a side muon range detector (partial detector) in the T2K near detector complex. They are also part of the team that built, upgraded and operates the Super-Kamiokande detector.

This discovery was made possible with the unyielding and tireless effort by the J-PARC staff members and the management to deliver high quality beam to T2K after the devastating March 2011 earthquake in eastern Japan which caused severe damage to the accelerator complex at J-PARC, and abruptly discontinued the data-taking run of the T2K experiment.

More detailed information on this announcement including images, T2K experiment and T2K collaboration can be found from the T2K public webpage: <http://t2k-experiment.org> .

Media Contacts for Further Inquiries:

(For contacts in Japan and elsewhere in the world, see international media contact information on p.3.)

Prof. Chang Kee Jung, International Co-Spokesperson, T2K Collaboration, State University of New York at Stony Brook (Stony Brook, NY, USA) and Kavli IPMU, University of Tokyo (Kashiwa, Japan), chang.jung@stonybrook.edu,
Phone: +1 631-707-2018 (c), +1 631-632-8108/8095 (o), +1 631-474-4563 (h)

Prof. Edward Kearns, Boston University (Boston, MA), kearns@bu.edu,
Phone: 617-353-3425

Prof. Thomas Kutter, Louisiana State University (Baton Rouge, LA), kutter@phys.lsu.edu,
Phone: 225-578-8310.

Prof. Kevin McFarland, University of Rochester (Rochester, NY), kevin@rochester.edu,
Phone: 775-538-4668, 585-275-7076.

Prof. Vittorio Paolone, University of Pittsburgh (Pittsburgh, PA), paolonepitt@gmail.com,
Phone: 412- 624-2764.

Prof. Hank Sobel, University of California, Irvine (Irvine, CA), hsobel@uci.edu,
Phone: 949- 824-6431.

Prof. Walter Toki, Colorado State University (Fort Collin, CO), toki@lamar.colostate.edu,
Phone: 970-491-1548.

Prof. Chris Walter, Duke University (Durham, NC), chris.walter@duke.edu,
Phone: 919-660-2535.

Prof. R. Jeffrey Wilkes, University of Washington (Seattle, WA), wilkes@u.washington.edu,
Phone: 206-543-4232.

Prof. Eric Zimmerman, University of Colorado (Boulder, CO), edz@Colorado.EDU,
Phone: 303-735-5338.

Media Contacts for Further Inquiries (International):

Globally and in Japan:

Prof. Takashi Kobayashi, Spokesperson, T2K Collaboration, The Institute of Particle and Nuclear Studies, KEK (Tsukuba, Japan), takashi.kobayashi@kek.jp,
Phone: +81 90-9840-2413 (c), +81 29-864-5414 (o), +81 29-852-4881 (h)

Globally and in U.S.:

Prof. Chang Kee Jung, International Co-Spokesperson, T2K Collaboration, State University of New York at Stony Brook (Stony Brook, NY, USA) and Kavli IPMU, University of Tokyo (Kashiwa, Japan),
chang.jung@stonybrook.edu,
Phone: +1 631-707-2018 (c), +1 631-632-8108/8095 (o), +1 631-474-4563 (h)

In Canada:

Prof. Hiro Tanaka, University of British Columbia (Vancouver, Canada), tanaka@phas.ubc.ca
Phone: +1 778-772-3690

In France:

Dr. Jacques Dumarchez, LPNHE-Paris (IN2P3) (Paris, France), jacques.dumarchez@cern.ch
Phone: +33 1 44 27 48 42
Dr. Marco Zito, CEA/IRFU (Saclay, France), marco.zito@cea.fr
Phone: +33 6 84 61 09 51

In Germany:

Prof. Achim Stahl, RWTH Aachen University (Aachen, Germany), stahl@physik.rwth-aachen.de
Phone: +49 241 80 27301 (o), +49 172 5761500 (c)

In Italy:

Dr. Maria Gabriella Catanesi, INFN Sezione di Bari (Bari, Italy), gabriella.catanesi@cern.ch
Phone: + 41 764871532

In Poland:

Prof. Ewa Rondio, NCBJ, Warsaw (Warsaw, Poland), Ewa.Rondio@fuw.edu.pl
Phone: +48 691 150 052

In Russia:

Prof. Yuri Kudenko, INR (Moscow, Russia), kudenko@inr.ru
Phone: +7-903-6159125 (c), +7-495-8510184 (o)

In Spain:

Prof. Federico Sanchez, IFAE, Barcelona (Barcelona, Spain), fsanchez@ifae.es
Phone: +34 93 5812835
Prof. Anselmo Cervera, IFIC, Valencia (Valencia, Spain), anselmo.cervera@cern.ch

In Switzerland:

Prof. Andre Rubbia, ETHZ (Zurich, Switzerland), andre.rubbia@cern.ch
Phone: +41 44 633 3873

Suisse Romande

Prof. Alain Blondel, Université de Genève, alain.blondel@unige.ch
Phone: +41 76 487 4058

In U.K.:

Prof. Dave Wark, STFC/RAL/Daresbury Laboratory/Oxford University (Oxford, U.K.),
david.wark@stfc.ac.uk
Phone: +44 7788186085