Discovery of Electron Neutrino Appearance in a Muon Neutrino Beam

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The T2K experiment conducted in the Japan Proton Accelerator Research Complex, J-PARC, discovers a new type of neutrino oscillation. T2K is an abbreviation of Tokai-to(2)-Kamioka. The muon neutrino beam is produced at Tokai, and is observed by Super-Kamiokande 295km away at Kamioka. In 2011, T2K found the indication of electron neutrino appearance and reported that the third neutrino mixing angle θ_{13} is large for the first time. Later, in 2013 after taking more data, the electron neutrino appearance is firmly established —with more than 7σ significance. This discovery makes it possible to measure the symmetry between a particle and an anti-particle (CP symmetry) in neutrino oscillation. In the future, by improving the beam power of T2K, we will search for the CP violation in neutrinos. As the final goal, the Hyper-Kamiokande gigantic neutrino detector could discover the CP violation.