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Antineutrino oscillations with T2K

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T2K is a long-baseline neutrino oscillation experiment, in which a muon neutrino beam is produced at J-PARC and detected 295 km away at the Super-Kamiokande detector. The T2K experiment observed electron-neutrino appearance in 2012. This observation enables T2K to explore CP violation in the lepton sector by comparing electron-neutrino appearance and electron-antineutrino appearance. Indeed, the number of observed electron neutrino events up to 2012 is, though within statistical fluctuation, larger than the expectation, which suggests maximal CP violation. Since 2013, T2K has been accumulating data with a muon antineutrino beam. If the suggested maximal CP violation is true, electron-antineutrino appearance would be suppressed. The signal is further suppressed by the smaller cross section for antineutrinos compared to neutrinos. Hence the observation of electron-antineutrino appearance is an important next step. Furthermore, the CPT theorem imposes that the muon disappearance rate must be the same for muon neutrinos and muon antineutrinos; therefore the comparison between neutrinos and antineutrinos is a good test of the CPT theorem, or else a probe for new non-standard interactions of neutrinos with matter. We will report the result of the first search for electron-antineutrino appearance in T2K, as well as a new measurement of muon-antineutrino disappearance to compare with muon-neutrino disappearance measurements.

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