

【Grant-in-Aid for Specially Promoted Research】

Science and Engineering (Mathematics/Physics)



Title of Project : Measurement of CP symmetry of neutrino by upgrading T2K experiment

Takashi Kobayashi
(High Energy Accelerator Research Organization, Institute of Particle and Nuclear Studies, Professor)

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Research Area : Particle Physics Experiment

Keyword : Neutrino oscillation, CP symmetry, J-PARC, T2K, Super-Kamiokande

【Purpose and Background of the Research】

T2K is an experiment to elucidate mystery of neutrinos, one of the most unknown elementary particles by measuring a phenomena called neutrino oscillation in which a type of neutrino changes into different types of neutrinos during flight. The neutrino beam is produced at J-PARC, high intensity proton accelerator complex at Tokai-village, and detected by the Super-Kamiokande (SK) detector at 295km from J-PARC. T2K discovered new type of oscillation from muon-type neutrino to electron-type neutrino through 2011 to 2013. This KAKENHI research will improve sensitivity of the T2K experiment by upgrading beam power and detectors, and will first look for anti-muon neutrino to anti-electron neutrino oscillation, and then try to measure whether the probability of those oscillations for neutrinos and anti-neutrinos are different (CP violation) each other or not. If CP violation in neutrino is found, it could bring us a hint to solve the mystery of why matter exists in our Universe.



Fig. 1 Overview of T2K experiment

【Research Methods】

In this research, T2K sensitivity will be improved by reducing both statistical and systematic uncertainties. To improve the statistical precision, the number of neutrinos detected at Super-Koamokande have to be increased which means more neutrinos need to be produced at J-PARC. In order for that higher intensity, and high stability proton beam operation for long term is vital. To realize stable operation of high intensity proton beam, the proton beam monitors will be upgraded to improve performance/precision of proton beam monitoring of, such as beam position

and beam width. In addition, a device called electromagnetic horn will be improved to increase number of neutrinos reaching to SK. To improve systematic precision, neutrino detector in J-PARC site to measure properties of neutrinos just after production will be upgraded.

【Expected Research Achievements and Scientific Significance】

Within 1 to 2 years, it is expected to discover anti-muon neutrino to anti-electron neutrino oscillation. Within the period of this KAKENHI research, evidence of CP violation at 95~99% confidence level is expected if CP is maximally violated. Continuing the measurement for additional ~5 years, CP violation could be discovered at 99.9% confidence level for maximal CP violation.

【Publications Relevant to the Project】

- “Indication of Electron Neutrino Appearance from an Accelerator-produced Off-axis Muon Neutrino Beam”, T2K Collaboration (K. Abe (Tokyo U., ICRR) et al.), Phys.Rev.Lett. 107 (2011) 041801
- “Expression of Interest for an Extended Run at T2K to 20×10^{21} POT”, T2K Collaboration, Jan. 6, 2016, http://j-parc.jp/researcher/Hadron/en/pac_1601/pdf/EoI_2016-10.pdf

【Term of Project】 FY2016-2020

【Budget Allocation】 418,600 Thousand Yen

【Homepage Address and Other Contact Information】

<http://t2k-experiment.org/>