論文内容の要旨

論文題目 A Liquid Xenon Scintillation Detector to Search for the Lepton Flavor Violating Muon Decay with a Sensitivity of 10^{-13}

(10^{-13} の感度でレプトン・フレーバー保存則を破るミューオン希崩壊を探索する実験の為の液体キセノンシンチレーション検出器)

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The MEG experiment searches for a rare muon decay $\mu^+ \to e^+\gamma$, which is forbidden in the standard model. Several new theories beyond the standard model predict branching ratio of the decay just below the current experimental limit. The MEG experiment aims sensitivity of 10^{-13} where most of predictions are covered. The discovery of the muon decay is a probe for new physics beyond the standard model.

To realize such a high sensitivity, a new liquid xenon detector was developed for measuring energy, position and time of gamma rays. The detector is the largest xenon detector ever made. Characteristics of liquid xenon, Large atomic number, high density, large scintillation output and fast decay time allow to build a detector with excellent resolutions and high efficiency. It consists of more than 800 litters of liquid xenon and 846 photo-multiplier tubes. We performed beam tests and evaluated resolutions by using a prototype. During the prototype test, fundamental techniques to operate the detector and to analyze data were developed. The construction of the final detector was completed in 2007. An engineering run was conducted in the year to preparing triggers, to evaluate detector performance and to collect a small amount of physics data. The resolutions of the detector during the engineering run were estimated by using gamma rays from pion decays. The estimated best values of resolutions for 54.9 MeV gamma rays are 2.1 ± 0.2 %, 5.9 ± 1.4 mm and 121 ± 8 psec for energy, position and time respectively. Based on the measured resolutions and counting rate in 2007, it was confirmed that the gamma ray detector has a sufficient performance to improve the current experimental limit and realize a sensitivity better than 10^{-12} in 2008.