

【Grant-in-Aid for Scientific Research (S)】

Science and Engineering (Mathematical and Physical Sciences)



Title of Project : Study on the charged lepton flavor mixing using the high-intensity pulsed muon beam

Satoshi Mihara

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

Research Project Number : 17H06135 Researcher Number : 80292837

Research Area : Physics

Keyword : Particle Physics Experiment, Quantum Beam

【Purpose and Background of the Research】

The Charged Lepton Flavor Violation (cLFV) is strictly forbidden in the Standard Model even with neutrino oscillation implemented. However, if new physics at TeV scale exists, cLFV process(es) can be observed in experiments. Therefore, cLFV process is thought to be a clue to investigate the higher energy scale than the LHC experiment (Figure 1).

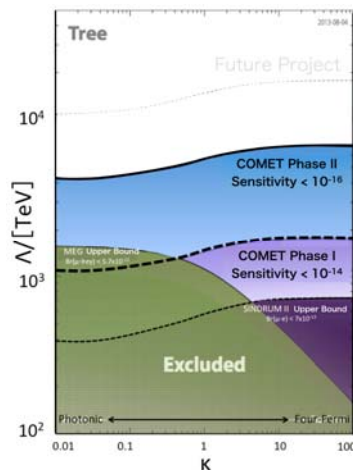


Figure 1 COMET experiment energy reach. The horizontal axis is for the parameter describing elementary processes.

At the moment several new cLFV experiments are in preparation in the world. Among these, this research project intends to optimize the high-intensity pulsed muon beam to realize the COMET experiment with a $\mu \rightarrow e$ conversion search sensitivity of 10^{-16} as early as possible. We believe that this will provide great progress in muon flavor physics and contribute to realize the world's top-class experiment in Japan.

【Research Methods】

We develop a pulsed muon beam necessary to realize the target sensitivity of the COMET experiment (Phase I: 10^{-14} , Phase II 10^{-16}). For this purpose, we develop a LYSO calorimeter detector in addition to the straw-tube tracker for momentum

measurement being constructed in our institute, and integrate them to “StrEcal Detector” (Figure 2 left). Based on the result obtained with this new detector, optimization of the beam collimator system will also be made along with development of a new proton target producing pions/muons.

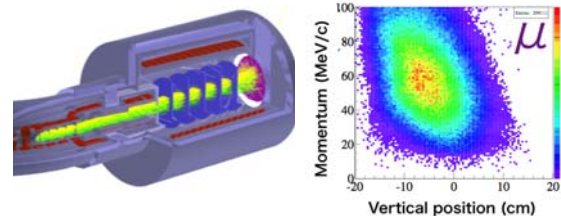


Figure 2 StrEcal detector (left) and simulated beam phase-space distribution (right)

【Expected Research Achievements and Scientific Significance】

The muon beam is the essential part of the $\mu \rightarrow e$ conversion search experiment. Usual muon beam lines available in the world have momentum spread of an order of a few % while the COMET needs several tens MeV spread to maximize the beam intensity. A dedicated detector system is necessary for optimizing such beam. In this research project, we will collaborate with the COMET experiment group and J-PARC facility group to establish the world's best sensitivity in the cLFV search with the new detector system.

【Publications Relevant to the Project】

“Charged Lepton investigating new Physics”, S. Mihara, JPS Journal, Vol. 70, 10 (2015)
S. Mihara et al., Annual Review of Nuclear and Particle Science, 63:1 (2013) 531-552

【Term of Project】 FY2017-2021

【Budget Allocation】 152,000 Thousand Yen

【Homepage Address and Other Contact

Information】 <http://comet.kek.jp/kiban-s>