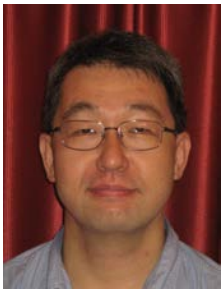
【Grant-in-Aid for Scientific Research(S)】

Science and Engineering (Mathematical and physical sciences)



Title of Project： A Search for Muon-Electron Conversion in a Nuclear Field with an Innovative Experimental Method

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Research Area：Physics
Keywords：Experimental Particle Physics, Muon

【Purpose and Background of the Research】

Muon-electron conversion in a nuclear field (μ^-+A →e^-+A) is a charged-lepton flavor violation (CLFV) process. The CLFV has been searched for with muons, kaons, tau leptons, and other particles for many years, but no signals have been discovered yet.

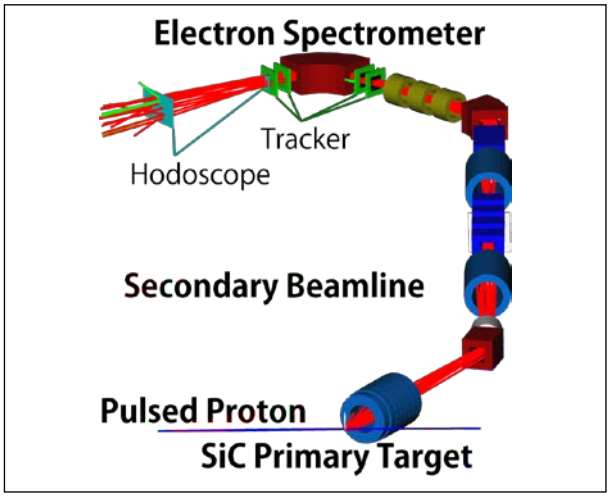
However, there are numerous models beyond the Standard Model of particle physics that predict sizable branching ratios: the supersymmetric see-saw model, which can explain the smallness of the neutrino masses; the extra dimension model; and so on. In fact, it is rather natural to observe CLFV since there is no fundamental symmetry that forbids it.

It is conceivable that CLFV signals are present, undiscovered, just under the current experimental limit. The purpose of this project is to perform an experimental search for muon-electron conversion at sensitivity of 10^{-14}.

【Research Methods】

To achieve a 100-fold improvement over the current limit, the high-power high-quality pulsed proton beam produced by J-PARC (the accelerator facility at Tokai, Ibaraki) will be utilized. The pulsed proton beam will be bombarded on a primary production target, and a copious number of muons will be stopped in the production target (10^{10}/sec). Then, if the muon-electron conversion process exists, some muons will transform to electrons. They will be transported by a large-acceptance secondary beamline, and their momentum will be precisely measured by an electron spectrometer. The signal of the muon-electron conversion is the delayed 105-MeV/*c* electrons.

In ordinary muon experiments, it is common to extract muons to an experimental area by a secondary beamline, and then perform the experiment. However, in this project, muons stopped in the production target itself are utilized. This method enables us to perform the experiment in much more cost-effective and timely manner.



Experimental Apparatus

【Expected Research Achievements and Scientific Significance】

The world's first discovery of muon-electron conversion is expected. Even if it is not discovered, we will obtain indispensable information about the physics beyond the standard model in conjunction with other related experiments worldwide. This project is a highly competitive contribution to the field of particle physics.

【Publications Relevant to the Project】

"Muon-Electron Conversion Experiments" M. Aoki, Meson 32, 26–33 (2010).

"Search for right-handed currents in the decay chain of $K^+ \rightarrow \mu^+ \nu_\mu$, $\mu^+ \rightarrow e^+ \nu_e \bar{\nu}_\mu$" M. Aoki, T. Yamazaki, J. Imazato *et al.*, Phys. Rev. D **50**, 69–91 (1994).

【Term of Project】 FY2012–2016

【Budget Allocation】 167,800 Thousand Yen

【Homepage Address and Other Contact Information】

http://deeme.hep.sci.osaka-u.ac.jp/