Silicon Carbide Target for a Muon-Electron Conversion Search at J-PARC MLF

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It is considered that muon-electron conversion would be one of the most obvious evidence of the new physics beyond the standard model. An experimental search for muon -electron conversion in the nuclear field, DeeMe, is proposed at J-PARC Materials and Life Science Experimental Facility (MLF) [1]. DeeMe experiment will be carried out at a brand-new beamline (H-Line) which will be constructed at J-PARC MLF Muon Science Establishment (MUSE).

The signal electrons from muon-electron conversion in muonic atoms formed in a muon production target are captured and transported to a spectrometer by the beamline. Because the signal electrons are monochromatic (105 MeV/c), they can be identified by the momentum analysis.

The single event sensitivity achieved by the experiment with the current graphite production target of MUSE is estimated to be 1.2×10^{-13}. This is smaller than the current upper limit but it is desirable to make the experiment more sensitive. In order to improve the sensitivity, it is planned to replace the graphite target with a silicon carbide (SiC) target.

Thanks to the larger pion production rate and the larger muon capture rate of silicon nucleus, the number of muonic atoms formed in a SiC target is expected to be totally 6 times as large as in a graphite target and then the single event sensitivity for SiC target is estimated to be 2.1×10^{-14}, nearly two orders of magnitudes below current upper limit.

The replacement of the production target affects the amount of radiation and the profile of the primary proton beam. The effects on the existing beamlines of MLF and the primary beamline were investigated by Monte Carlo simulations. The developments of a SiC target are in progress. The current status of the preparation for the use of a SiC target will be reported.

References

[1] M. Aoki and DeeMe Collaboration, “Proposal to the Experimental Search for μ-e Conversion in Nuclear Field at Sensitivity of 10^{-14} with Pulsed Proton Beam from RCS”, December, 2011.