Design of the J-PARC MUSE H-line for the muon g-2/EDM experiment (E34)

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Though Standard Model (SM) for elementary particle physics was complete by the Higgs observation at LHC, many problems such as dark matter and dark energy still remain unsolved. These questions indicate that new physics (NP) will emerge at higher energy scale. One of the indications for NP up to now is in the muon anomalous magnetic moment (g-2); there is 3.3σ discrepancy between the SM prediction and measurement by the E821 experiment [1] with an accuracy of 0.54 ppm.

The J-PARC muon g-2/EDM experiment (E34) [2] aims to measure the muon g-2 with an accuracy of 0.1 ppm to cast light on NP. To achieve the world best accuracy, high intensity beam at J-PARC MUSE and novel techinique of the ultra-cold muon beam are used. The ultra-cold beam enables muons to be stored and detected in the magnetic field with no electric focusing, resulting in no need to choose the magic momentum of 3.094 GeV/c used in for decades and minimizing dimensions of the stored magnetic field and its systematics. A high-intensity ultra-cold muon beam is a key to achieve the final goal of the measurement.

The ultra-cold muons (3 keV/c) are generated from thermal muonium (Mu) production by surface muon beam, followed by the laser ionization of the Mu. The ultra-cold muons are accelerated to 300 MeV/c without further increase in the transverse momentum and the ultra-cold beam ($p_T/p \sim 10^{-5}$) is generated. One of the main issues for the high intensity ultra-cold beam is high transmission efficiency of the surface muons to the Mu production target. Because the surface muons have a relatively large emmitance and the laser ionization region is limited, the final focusing to the target is important for it.

Latest optics design of the MUSE H-line, especially final focusing to the Mu production target, and status towards the muon acceleration test are presented in this poster.

References

[1] G.W. Bennett *et al.*, Phys. Rev. D **73**, 072003 (2006).
[2] N. Saito *et al.*, AIP Conf. Proc. **73** (2012) 45