Development of Muon LINAC for the Muon g-2/EDM Experiment at J-PARC

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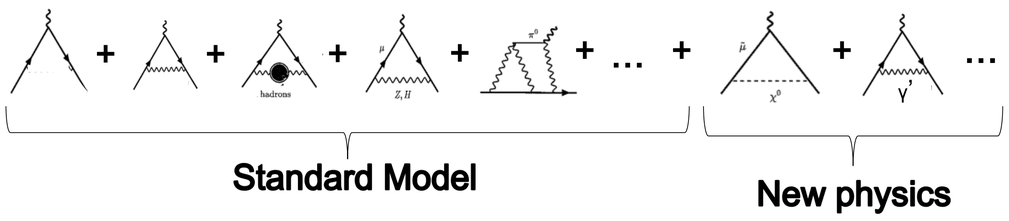
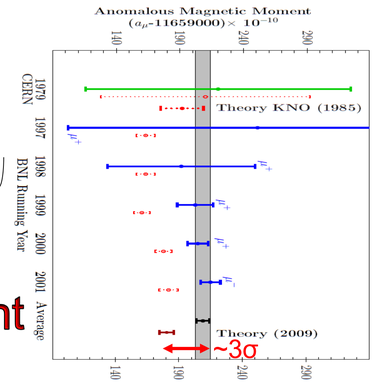
Abstract

We are developing a linac dedicated to the muon acceleration. It enables us to measure the muon anomalous magnetic moment (g-2) very precisely (0.1 ppm) and explore beyond Standard Model of elementary particle physics. As a demonstration of the muon acceleration, we are developing the source of slow muon with which RFQ acceleration is conducted. In order to cover the middle beta (β=0.27~0.7) section of the muon LINAC, the DAW cavity is employed and being designed. This poster describes status of these developments.

Muon g-2 and New Experiment @ J-PARC

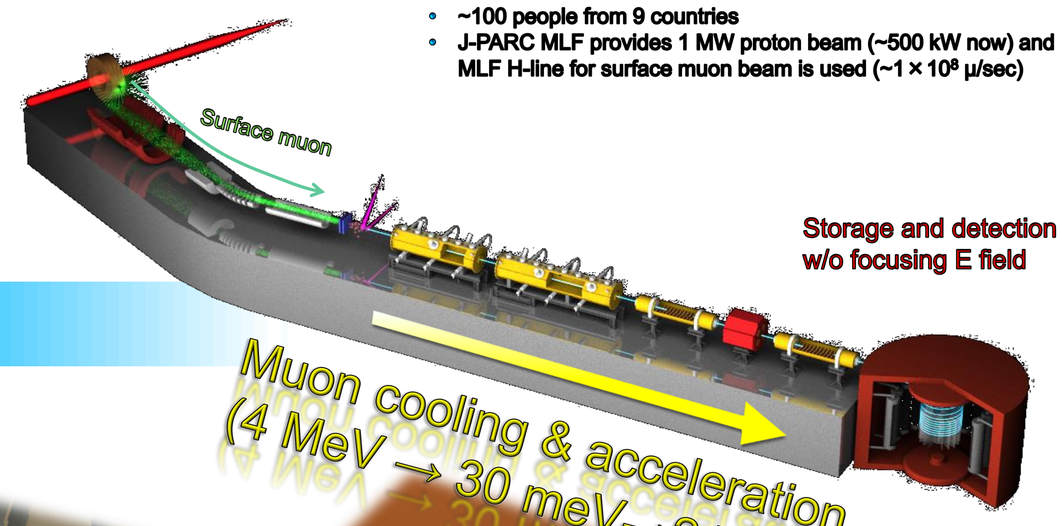




~3σ discrepancy between SM and measurement
→ indicates new physics

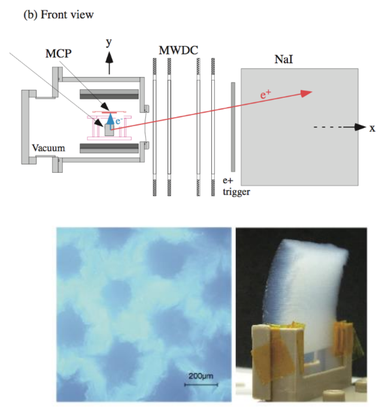
New experiment (J-PARC E34) aims world best (0.1ppm) with ultra-cold muon beam

- ~100 people from 9 countries
- J-PARC MLF provides 1 MW proton beam (~500 kW now) and MLF H-line for surface muon beam is used (~1 × 10^8 μ/sec)

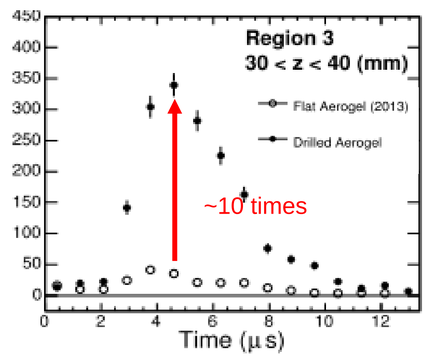


Muon Cooling & electro-static acceleration

- Thermal energy (~30meV) by muonium production and laser ionization towards physics data taking

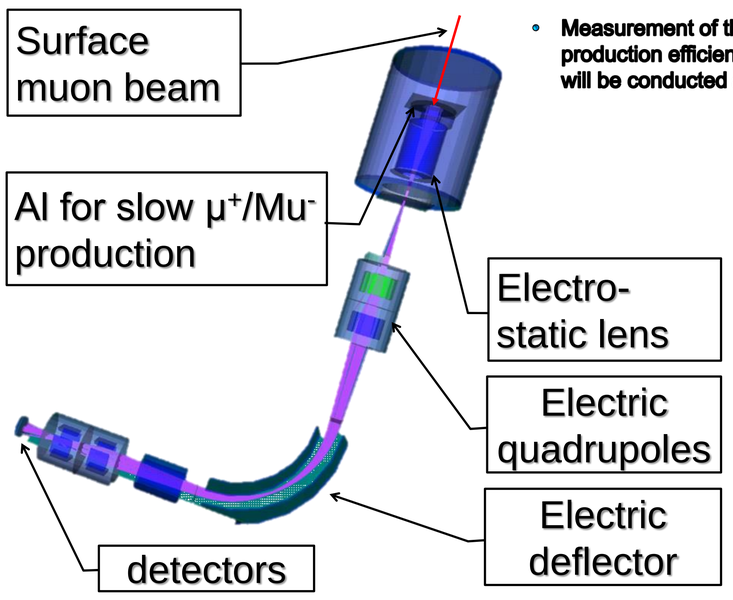


- Experiment was conducted at TRIUMF M15 beamline in 2013[PTEP 2014 (2014) 091C01]

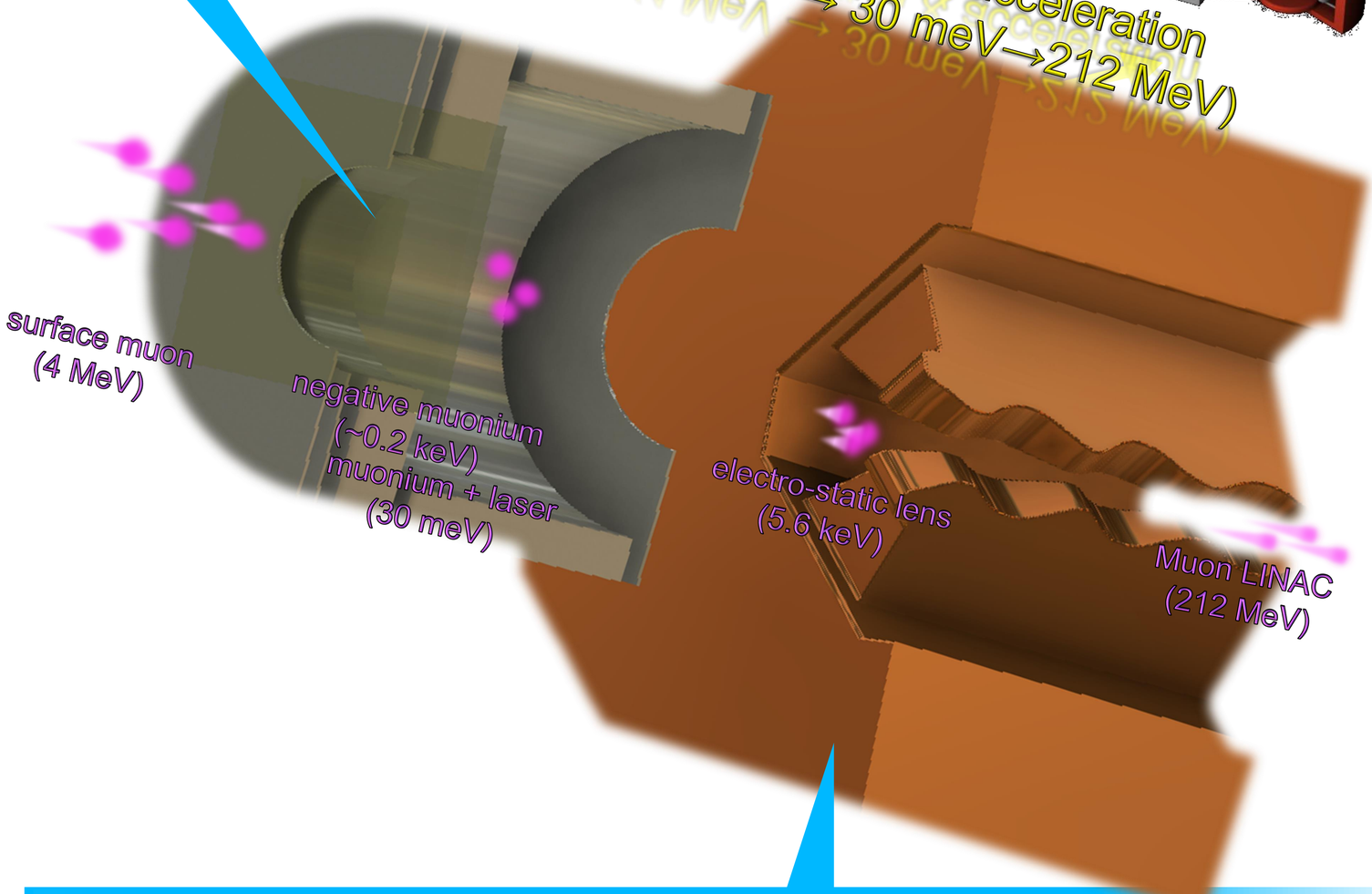


Promised statistics comparable to E821

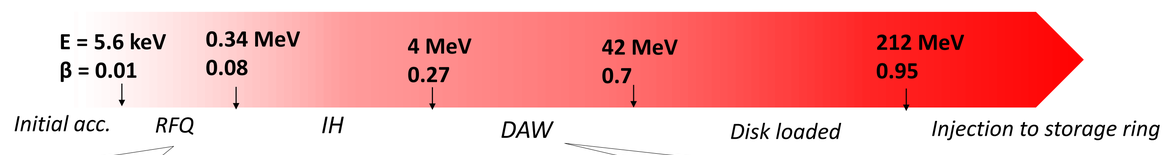
- Epi-thermal (~keV) negative muonium ($Mu^- = \mu^+ e^- e^-$)/μ^+ production for the muon acceleration test.



- Measurement of the Mu^- production efficiency Experiment will be conducted at J-PARC MLF.

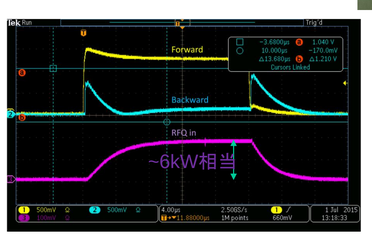


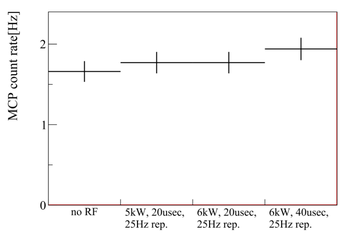
Muon LINAC



- Spare for J-PARC LINAC is available
- RFQ operation and background measurement with MCP were conducted in June 2015

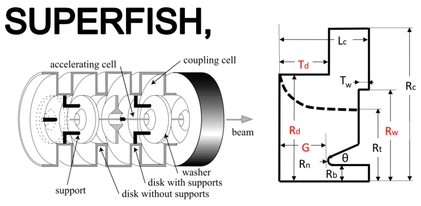
length	3.234 m
Operational freq	324 MHz
Output $\varepsilon_{n,\,rms,\,x}$	0.377 π mm mrad

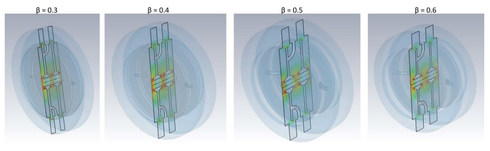


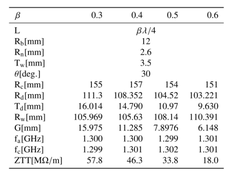


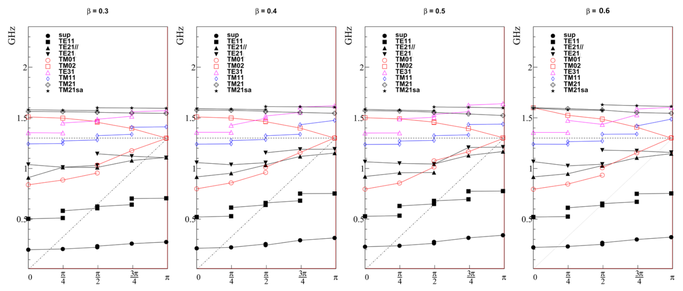
RFQ is ready for muon acceleration

- Disk And Washer is employed for β~0.3-0.7.
- Cell design with SUPERFISH, CST MW and optimization algorithm of SIMPLEX



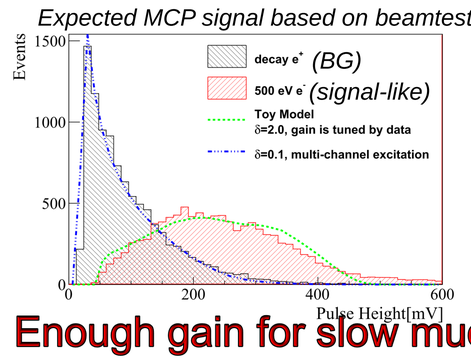




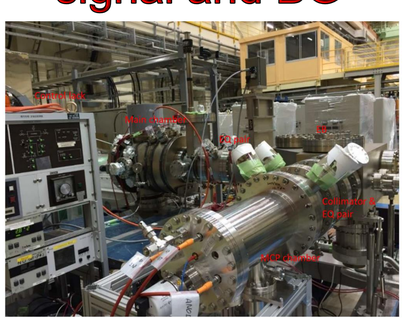


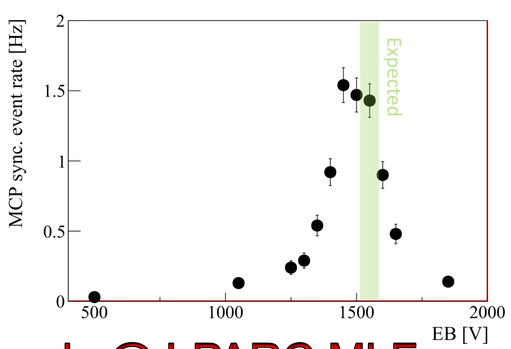
DAW cell design is completed

Clear separation btw signal and BG



Enough gain for slow muons





Equipments are ready @J-PARC MLF

Conclusion

The E34 experiment aims to measure $(g-2)_\mu$ with an accuracy of 0.1 ppm by utilizing muon acceleration. Slow muon beamline and RFQ are ready for experimental verification of the muon acceleration, which will be the first case in the world. Design of the DAW cell, which is one of the RF cavities in the muon LINAC, is completed and measurement with a cold model is scheduled.