Preparation for muon acceleration using an APF IH-DTL

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Contents



Muon g-2 and EDM



We measure g-2 and EDM using a new method!

Muon g-2/EDM experiment at J-PARC



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We are developing the world's first accelerator dedicated to muons

IH-DTL (Inter-digital H-mode Drift Tube Linac)

- A linac consists of four types of cavities
 - Change the cavity to match the velocity $\boldsymbol{\beta}$ of the muon



- Low-velocity muon acceleration
 - High efficiency and short-range acceleration are necessary.
 - Use π mode acceleration \rightarrow Accelerate at half cycle of Alvarez-DTL
 - Use Alternating Phase Focusing (APF) method =E-field convergence



APF IH-DTL is used for muon acceleration

What to do about IH-DTL



- What to do is
 Acceleration test
 - @J-PARC MLF H2 area
 - In 2024
 - Check if muon can accelerate up to 4 MeV
 - Measure beam emittance



The diagnostic beamline

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A diagnostic beamline for acceleration test is needed

Beam Diagnostic Method

- Use Q-scan to derive emittance
- Calculate emittance and twiss parameters(α , β) from the beam size and beam optics.



Flow of developing diagnostic beamline



*GPT: Particle Tracking Tool *Trace3D: Beam trajectory calculation tool using matrix calculations

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Design of diagnostic beamline



- Optimize focusing force of QM and buncher w/ Trace3D
 - Avoid hitting the pipe as much as possible: Transport Efficiency 98%
 - X before entering the BM isn't spread out
 - X and y after the BM aren't spread out



This optics allows beam transport up to the monitor

Evaluation(x-direction)

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- Evaluated at 0.3 mm resolution of existing monitor
- Emittance is estimated to be 1% larger w/o monitor resolution, but decreases by 42% w/ the resolution of the monitor.

 \rightarrow X and z are correlated in the BM, the fit function includes the z parameter, but the resolution of the monitor only contributes to x.

Evaluation(y-direction)





- Evaluated at 0.3 mm resolution of existing monitor
- Emittance is estimated to be 8% smaller w/o monitor resolution \rightarrow There is an effect of beam loss by the pipe.
- And increases by 44% w/ the resolution of the monitor.

Summary

- The real APF IH-DTL for the J-PARC muon g-2/EDM experiment has been fabricated.
- Preparations are currently underway for an acceleration test in 2024.
- Diagnostic beamline was designed for acceleration test, allowing emittance measurements with an error of -42% in the X-direction and +44% in the Y-direction.