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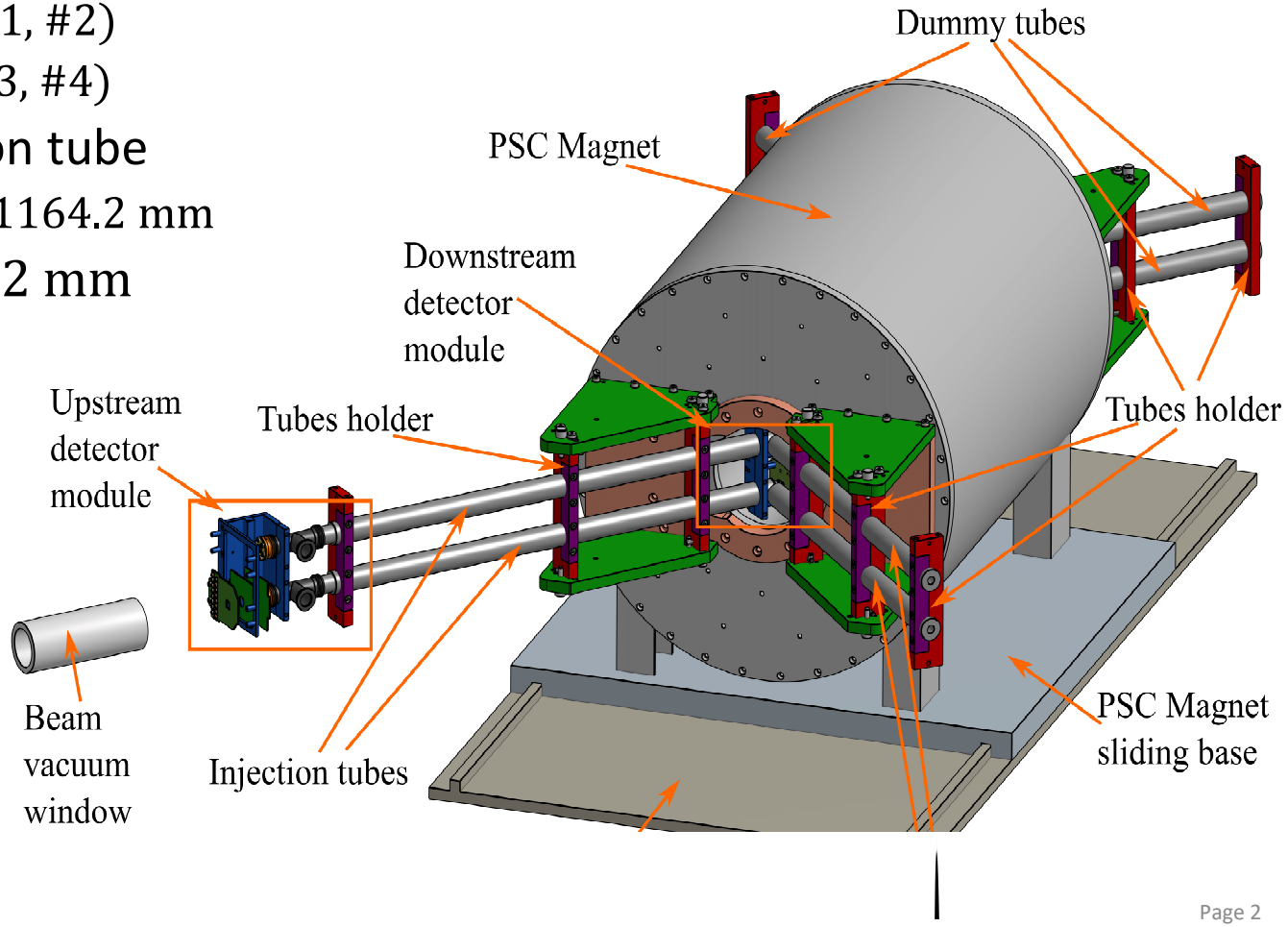
ToF measurement comparison with simulations

muEDM collaboration meeting - 4th April 2024, Pisa

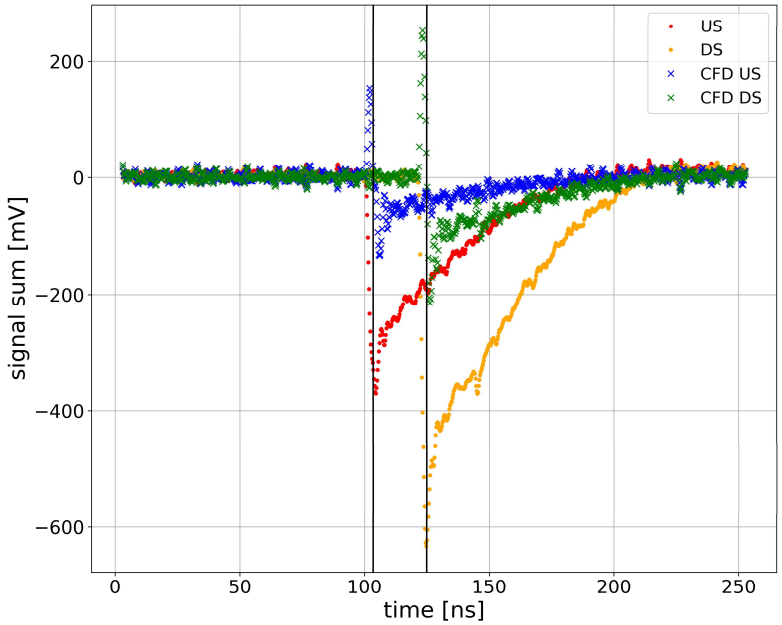
Assembly

- Time of flight measurements with detectors:
  - 200 um (#0)
  - 100 um (#1, #2)
  - 50 um (#3, #4)
- Iron injection tube
  - $d_{\mathrm{US-}} = 1164.2$ mm
- $d_{\mathrm{air}} = 275.2$ mm



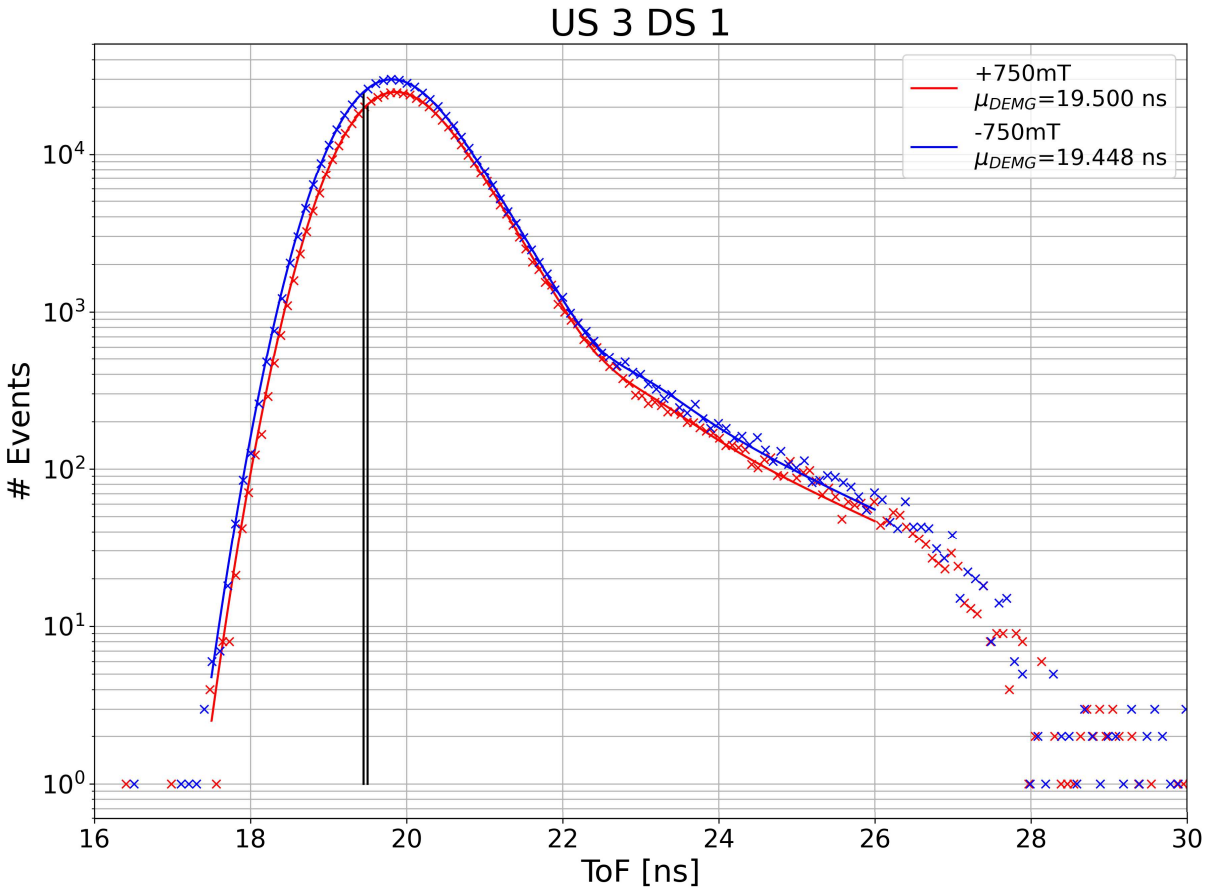
Signal processing

- DAQ by wavedream board
- Sum of channels as input
- Constant fraction discrimination (CFD)
- Extracting time of flight (ToF)



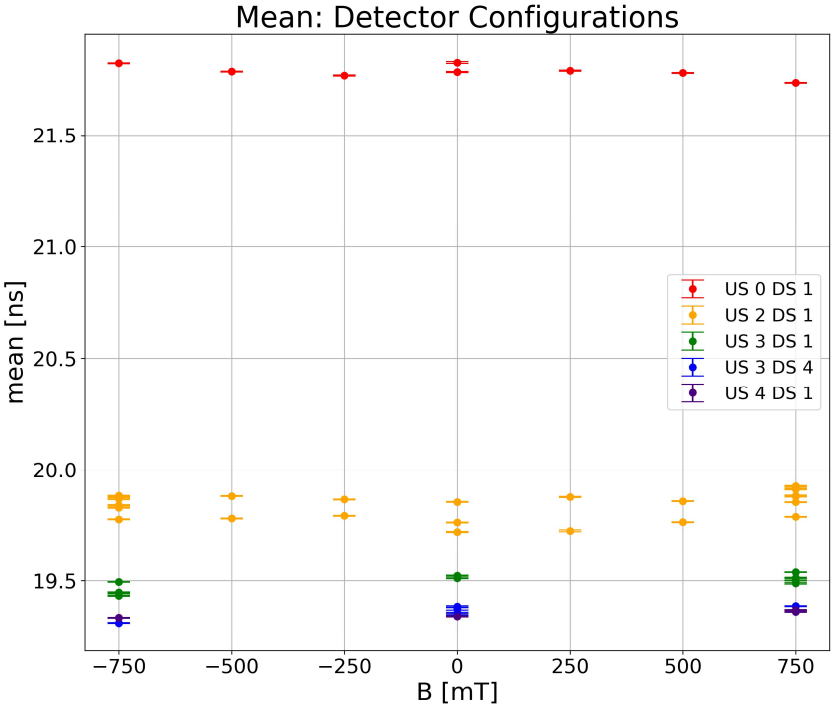
ToF distribution

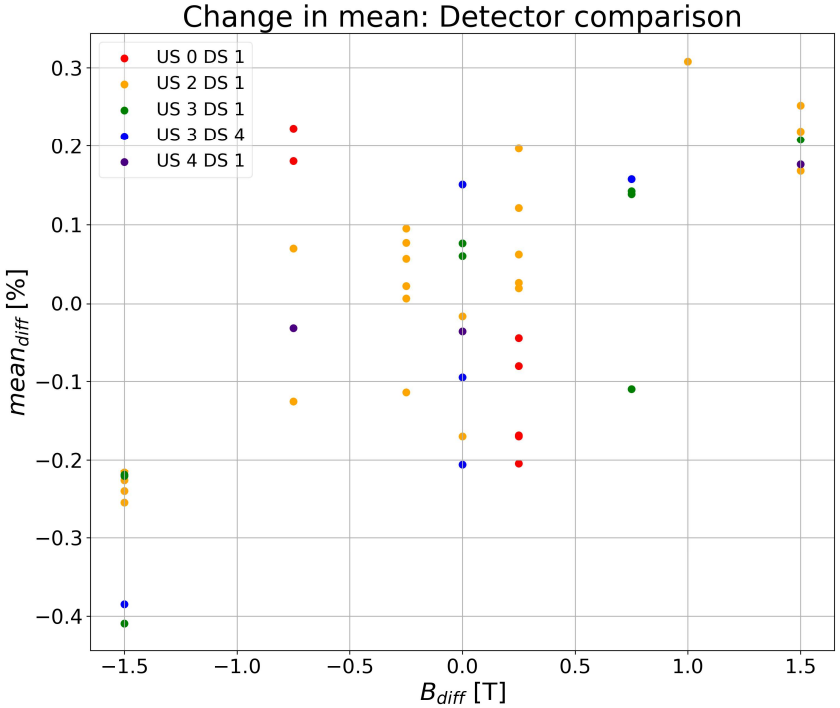
- Double exponentially modified gaussian (DEMG) fitted to ToF



Comparison: Magnetic Field

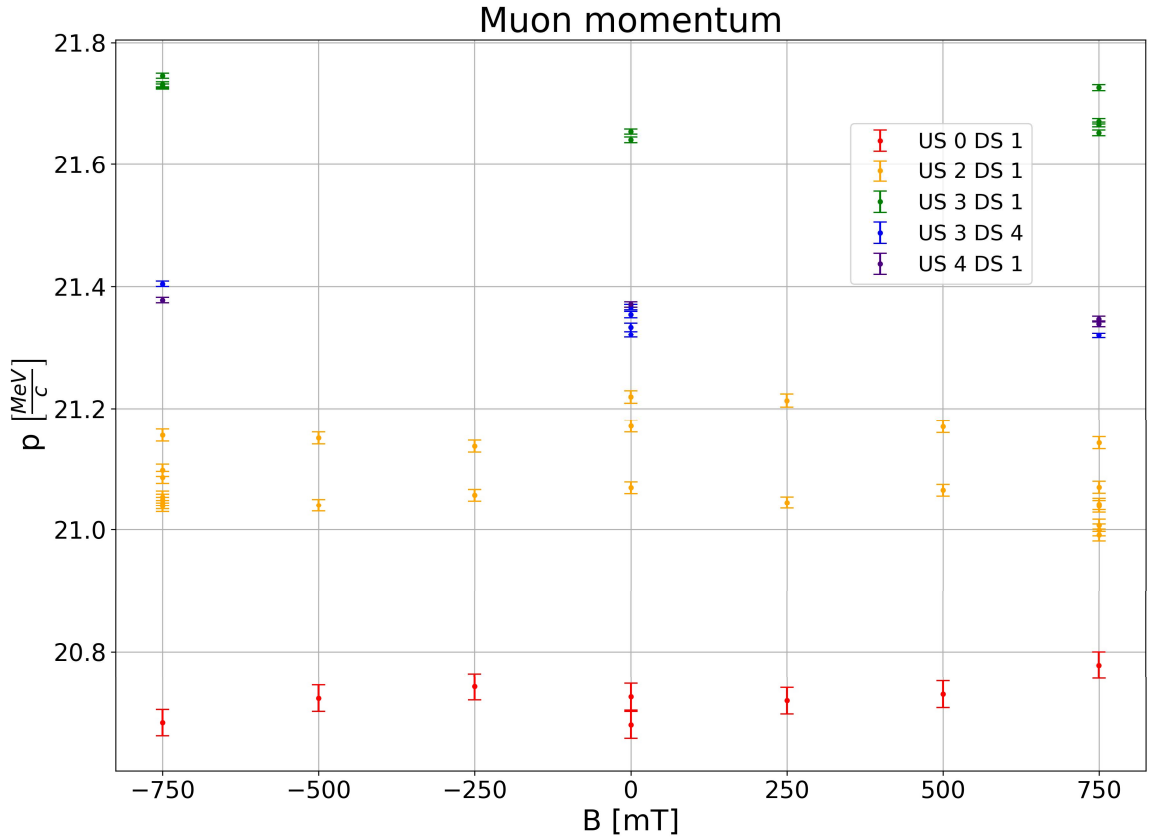
- Limitation on mean momentum difference $\Delta p = 0.5\%$





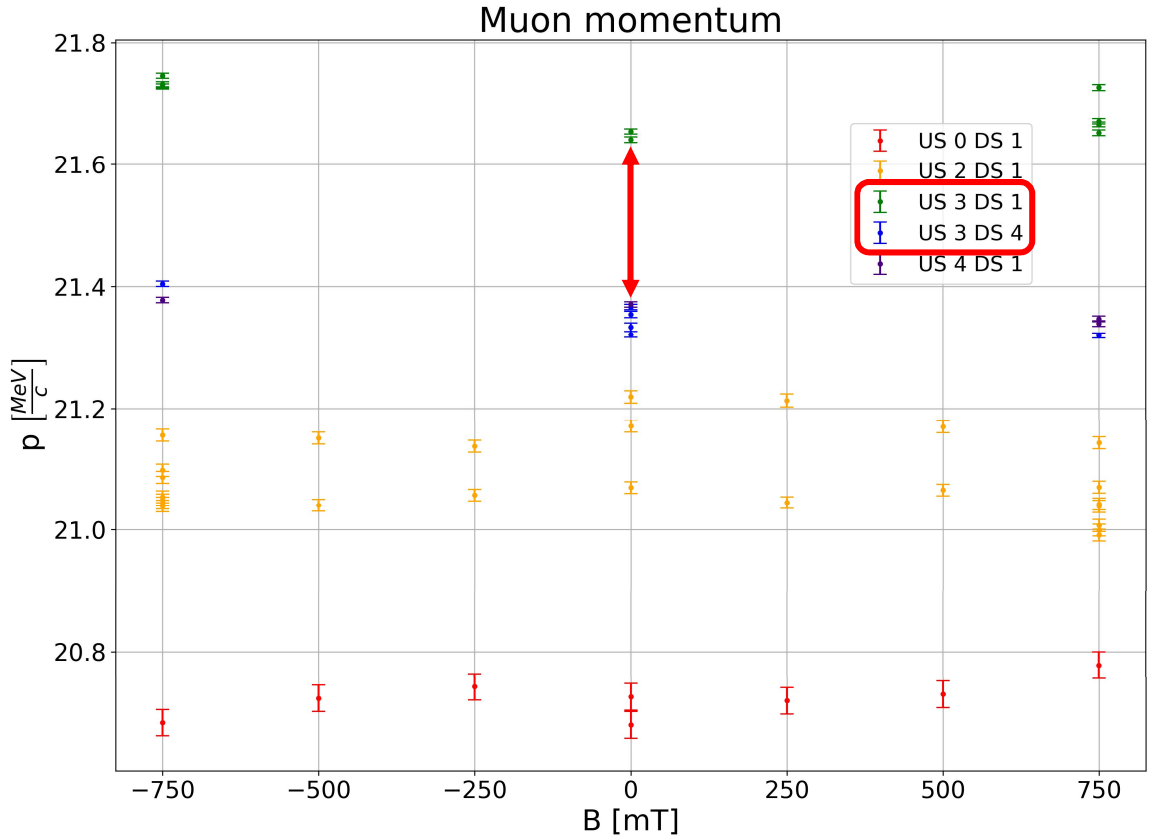
Momentum

- Reference e^+ measurements $\beta \approx 1$
- $d_{\mathrm{US}-} = 1164.2\ \mathrm{mm}$
- No reference for US 4 DS 1



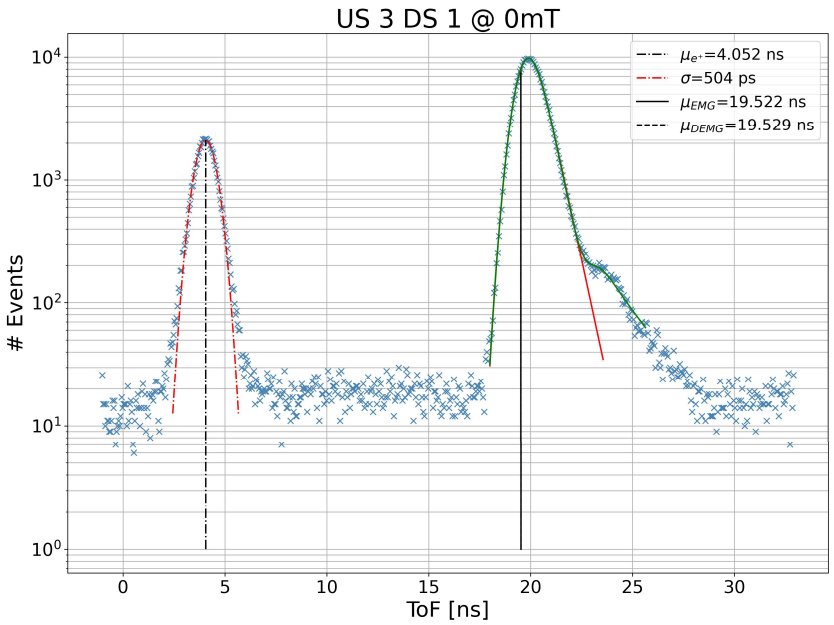
Momentum

- Reference e^+ measurements $\beta \approx 1$
- $d_{\mathrm{US-D}} = 1164.2\ \mathrm{mm}$
- No reference for US 4 DS 1

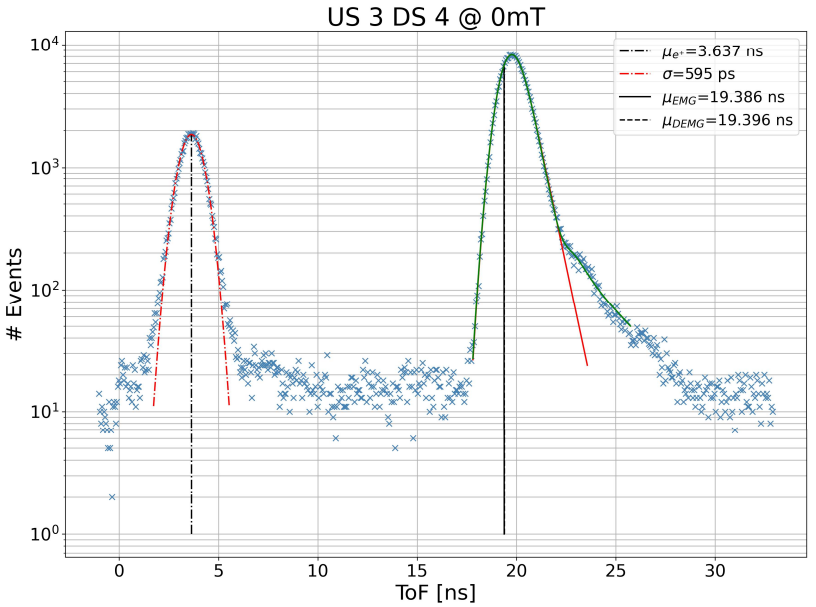


Reference e^+ measurements

- Noticed high noise level and periodic noise
- Grounding US/DS detectors and WDB reduced noise significantly
- e^+ change: $\Delta\mu_{e^+} = 415$ ps
- μ^+ change: $\Delta\mu_{\mu^+} = 133$ ps



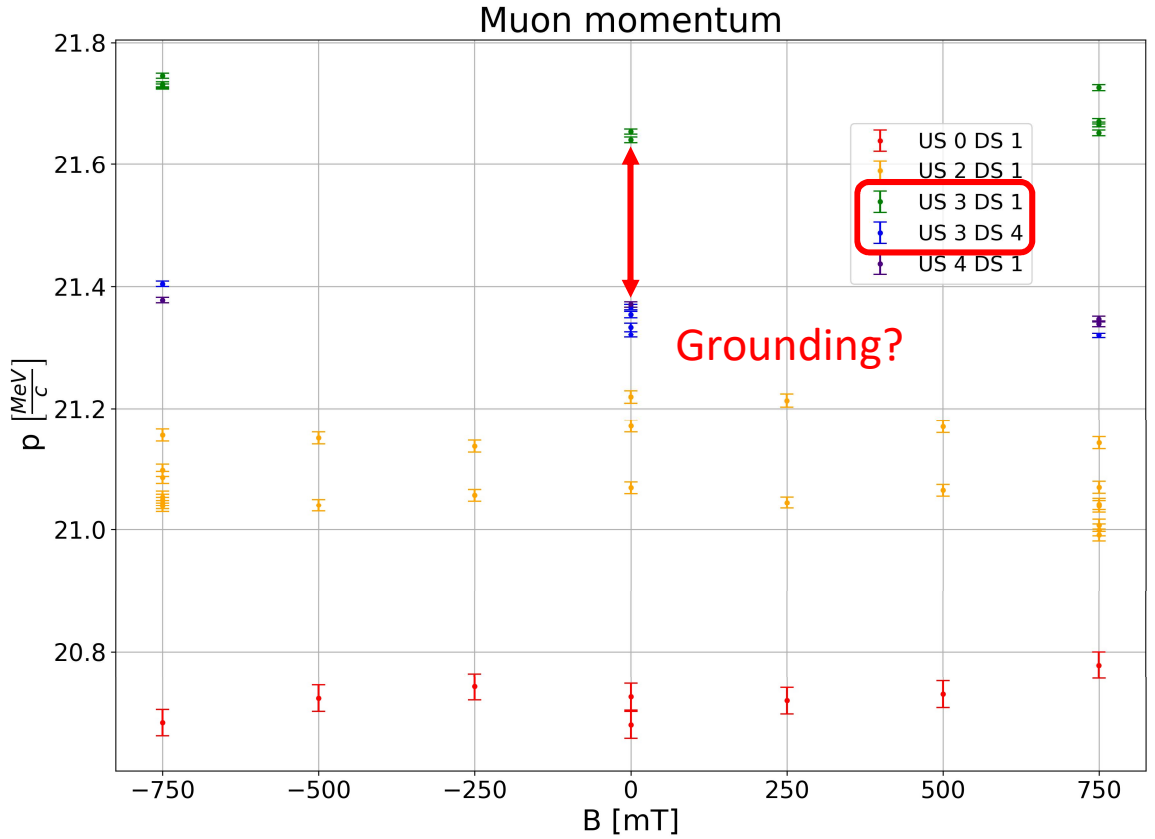
Reference e^+ measurements <u>before</u> grounding



Reference e^+ measurements <u>after</u> grounding

Momentum

- Reference e^+ measurements $\beta \approx 1$
- $d_{\mathrm{US-D}} = 1164.2\ \mathrm{mm}$
- No reference for US 4 DS 1



Simulation of momentum

Beam window 100 um

Entrance scintillator 50 um

Iron injection tube 1 m

Vacuum window 35 um

Air

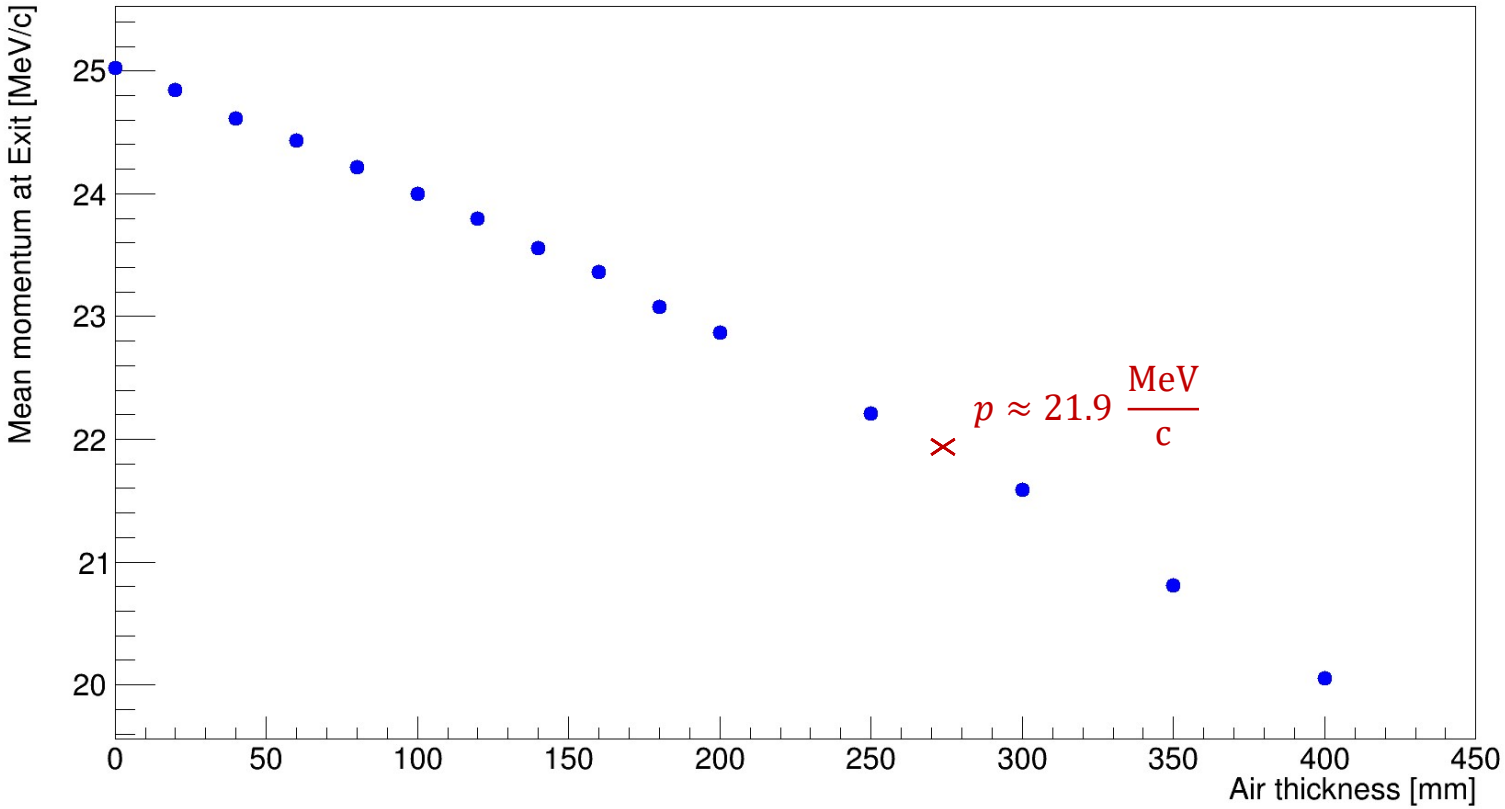
Vacuum window 35 um

Exit scintillator 100 um

- Air thickness variable
- Without Tedlar of 50 um per layer (2-4 layers)

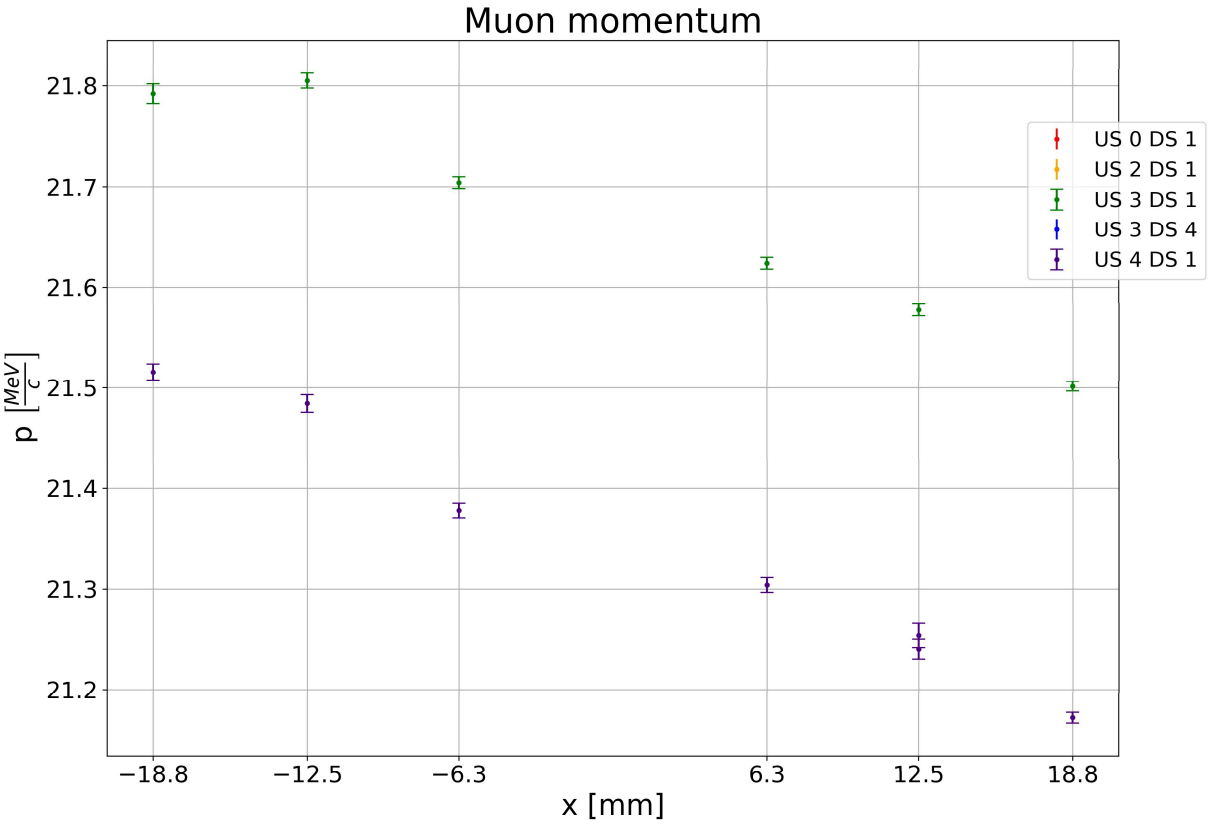
Simulation of momentum

- US 3 DS 1: $\mathrm{p} \approx 21.7 \frac{\mathrm{MeV}}{\mathrm{c}}$ US 3 DS 4: $\mathrm{p} \approx 21.4 \frac{\mathrm{MeV}}{\mathrm{c}}$



Mean muon momentum after exit scintillator depending on the air thickness, simulated in G4Beamline

Position Scans



Mean muon momentum when changing the position of the magnet

Momentum

- Simulation with US 50 um DS 100 um: $\mathrm{p} \approx 21.9 \frac{\mathrm{MeV}}{\mathrm{c}}$
- Measurment with US 50um DS 100um:
  - US 3 DS 1: $\mathrm{p} \approx 21.7 \frac{\mathrm{MeV}}{\mathrm{c}}$
  - US 3 DS 4: $\mathrm{p} \approx 21.4 \frac{\mathrm{MeV}}{\mathrm{c}}$
- Effect of grounding?