UCL

Trento Beam Test QuADProBe (QuARC + SciFI) Initial Analysis

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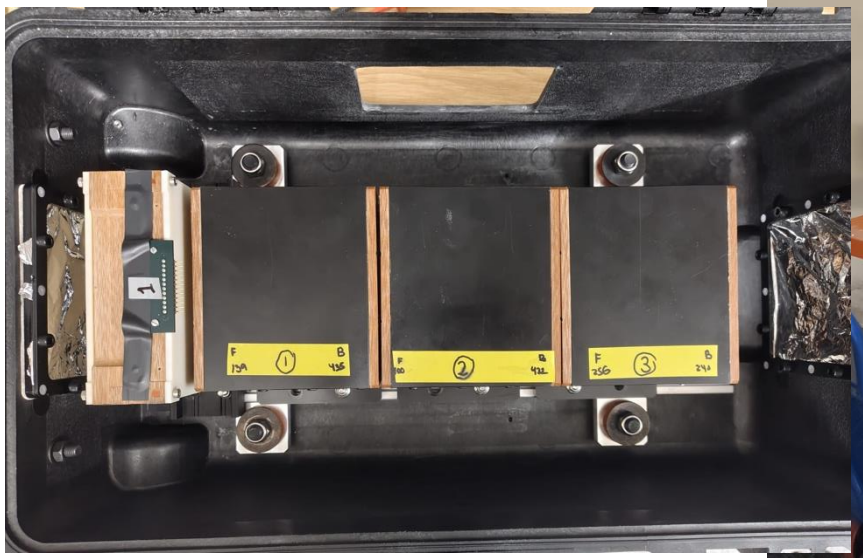
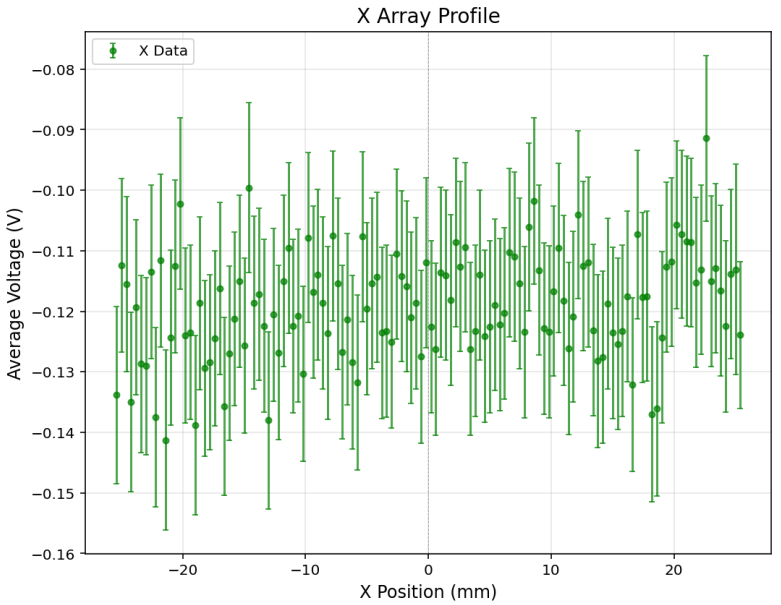
Trento Beam Test Summary

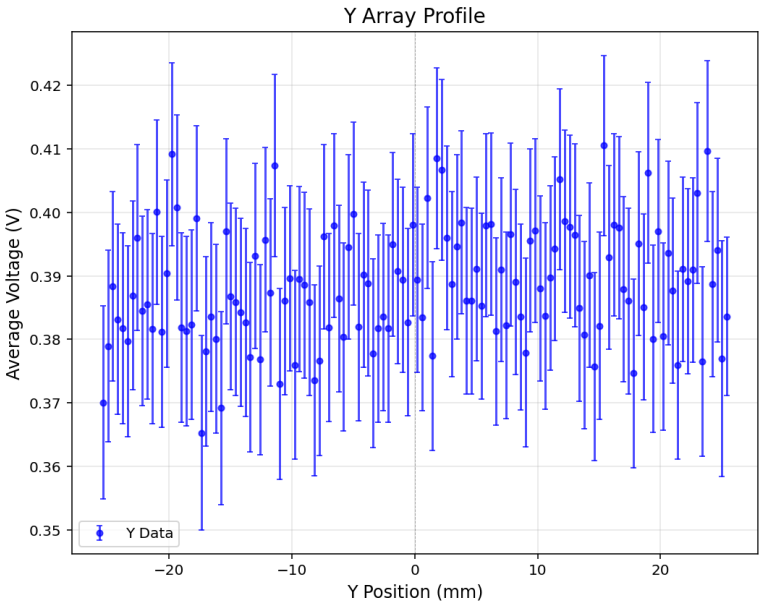
- 3 nights of measurements in the research room at Trento PTC
  - Night 1: QuARC
    - Calibrations and **Bragg Peak measurements** scaling current up to FLASH (briefly).
  - Night 2: Combined QuARC + SciFi:
    - Dynamic range testing (fibres at low gain)
    - Beam position measurements
  - Night 3: SciFi Measurements
    - Dynamic range testing (fibres at high gain)
    - Different spot sizes (varying energy)



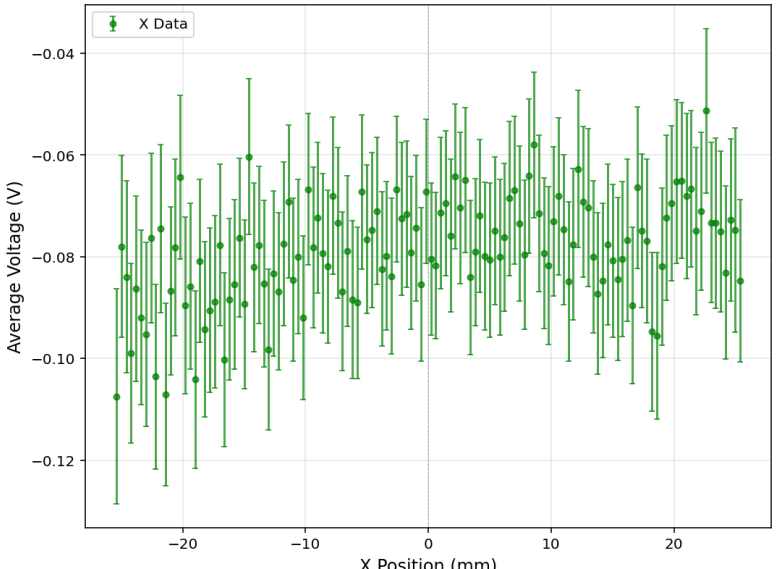
Background Measurements

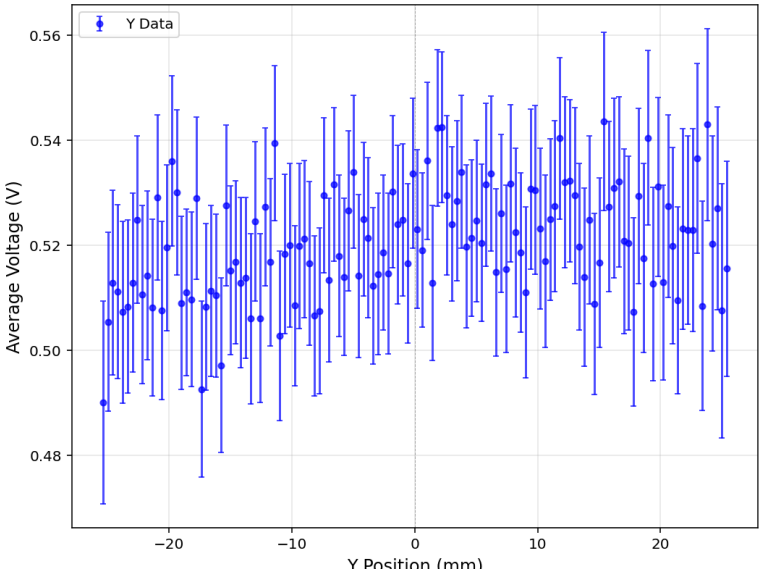
Low gain





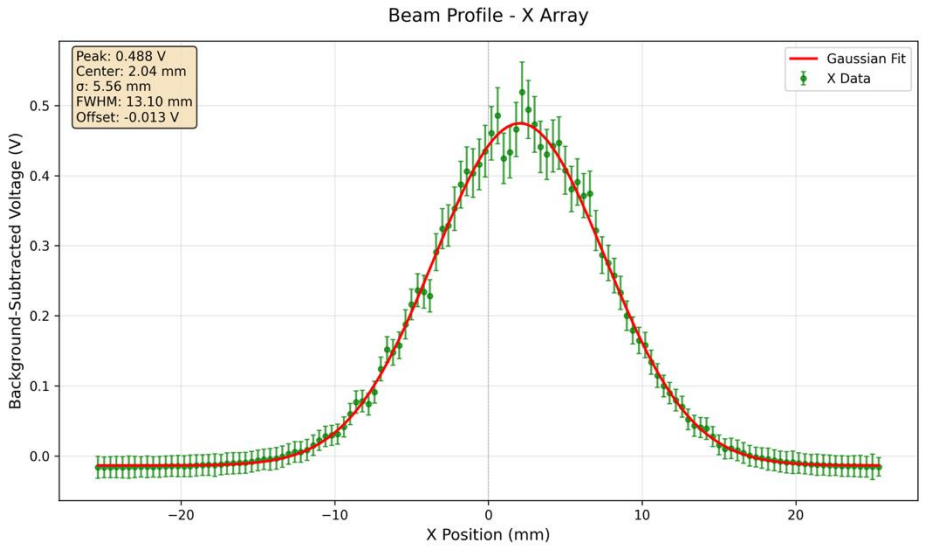
High gain

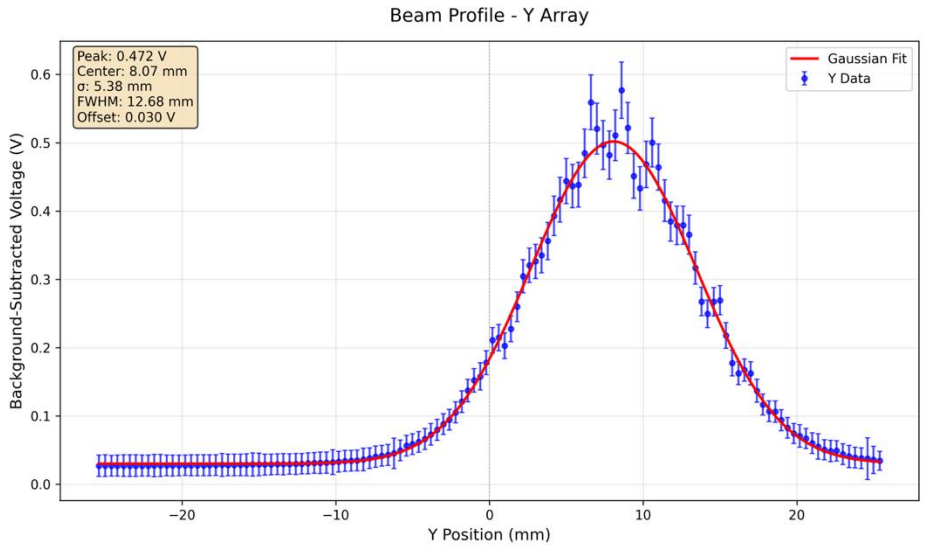




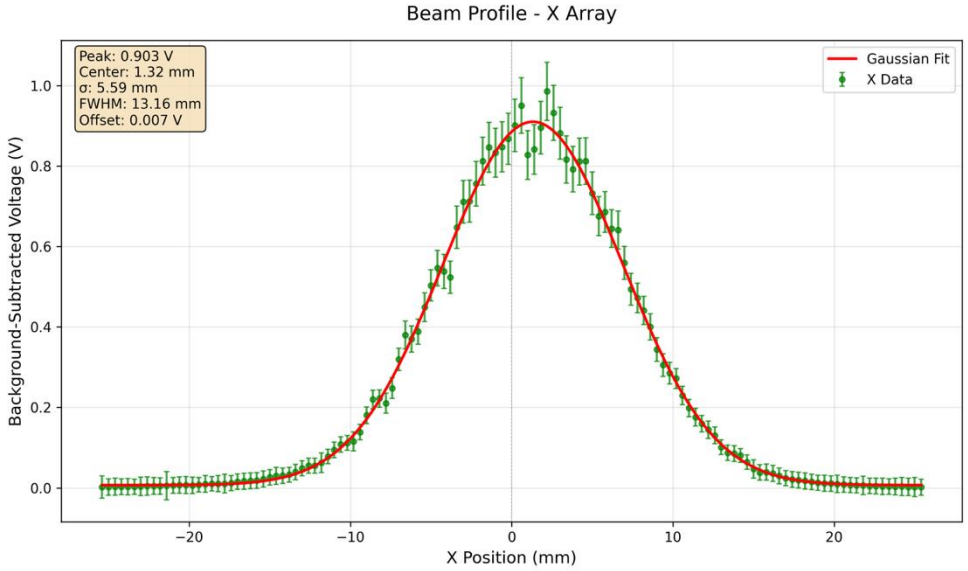
148 MeV Beam Energy 300 nA (max ion source current)

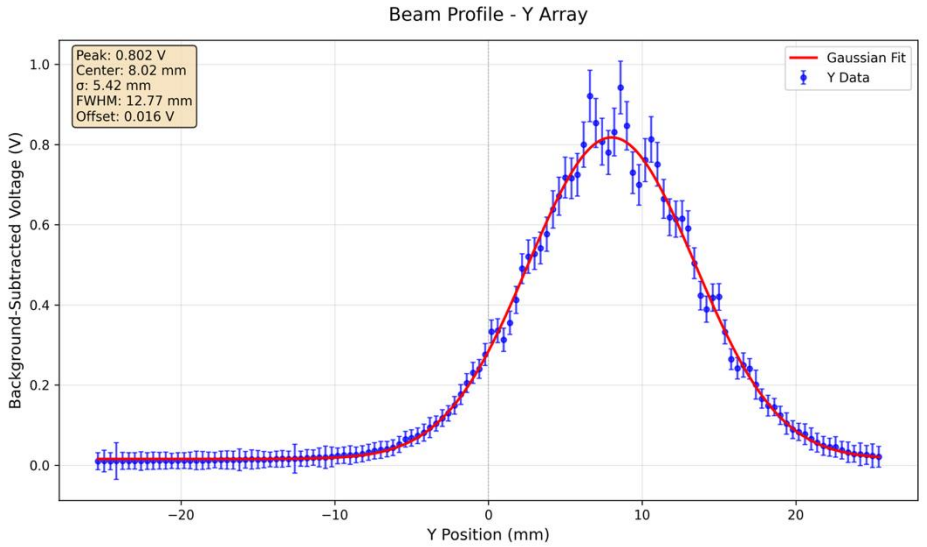
Low gain

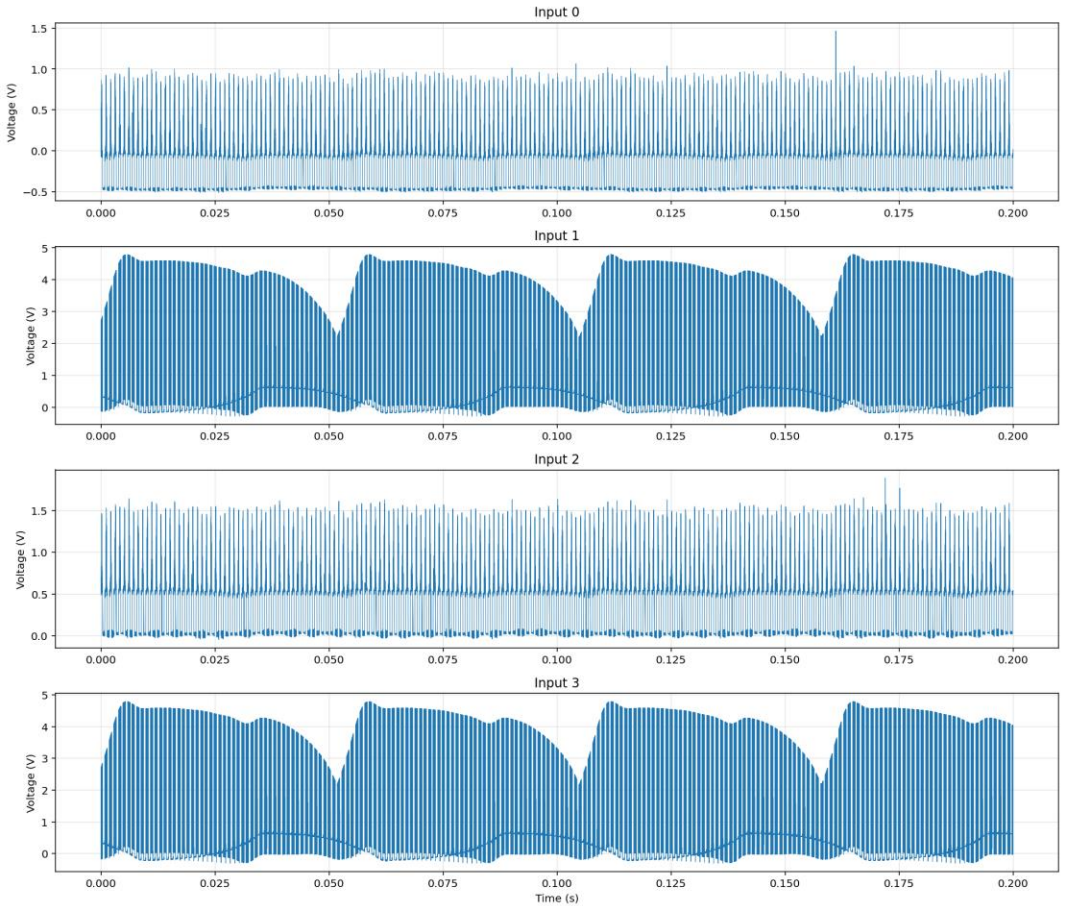


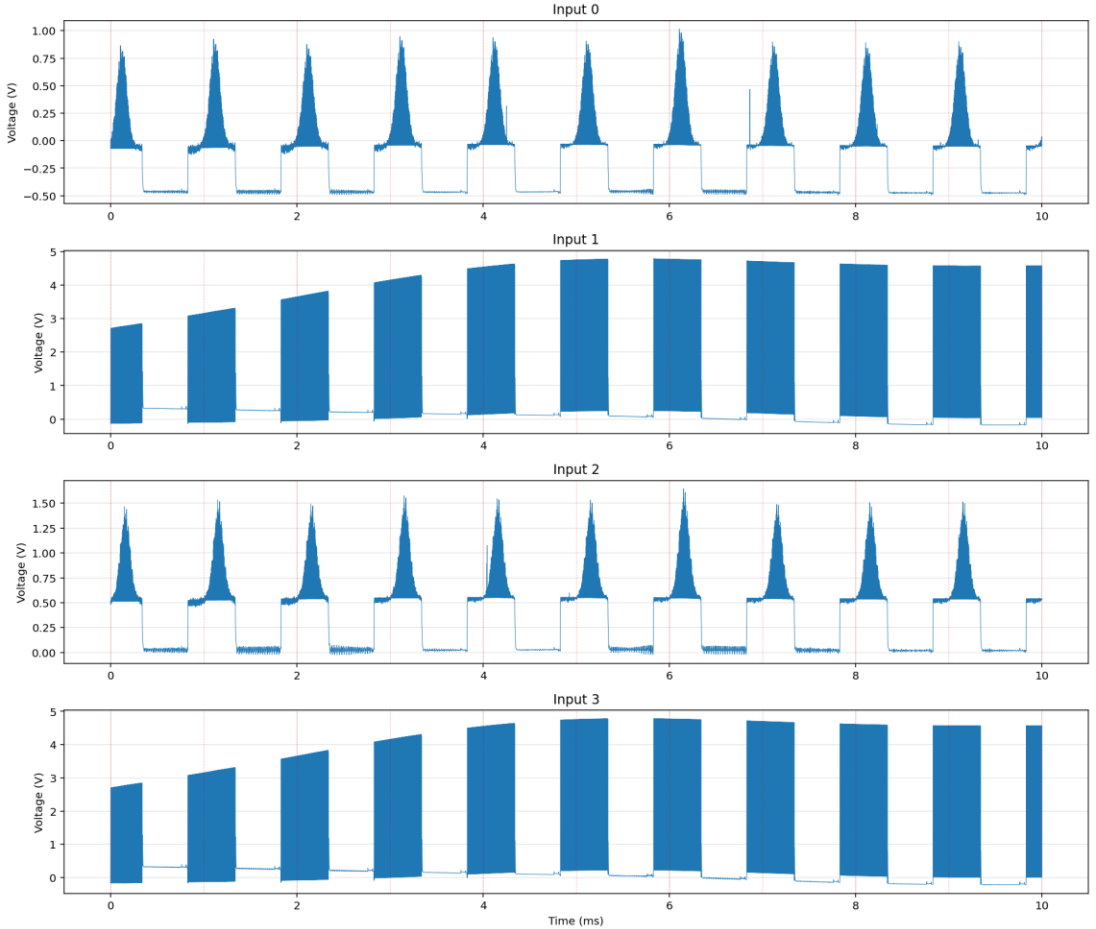


High gain

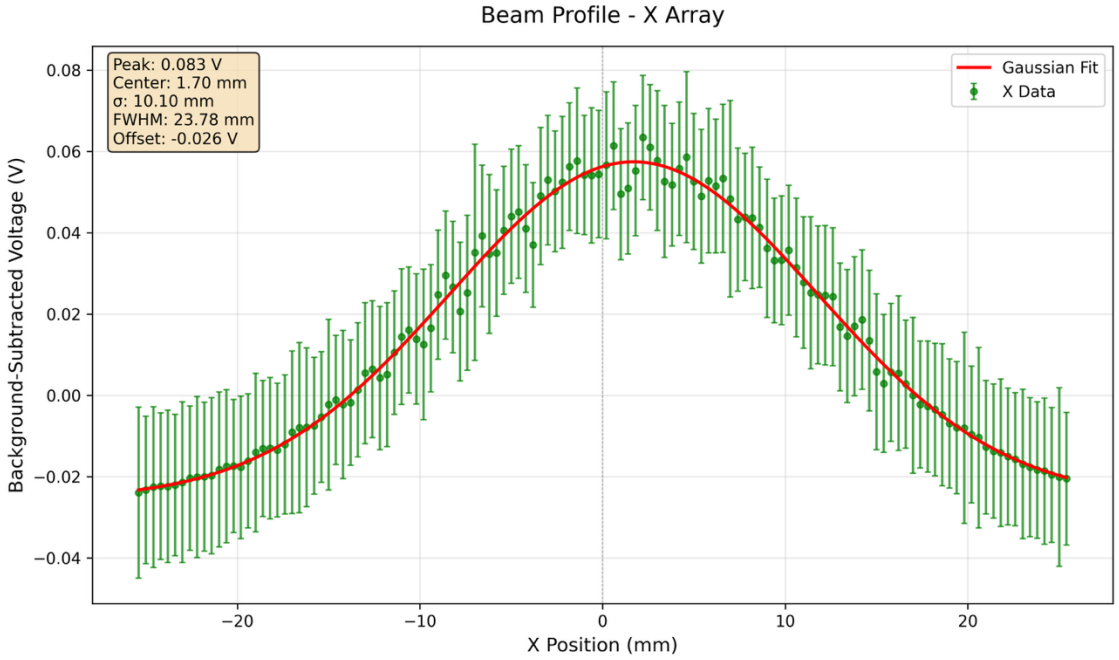


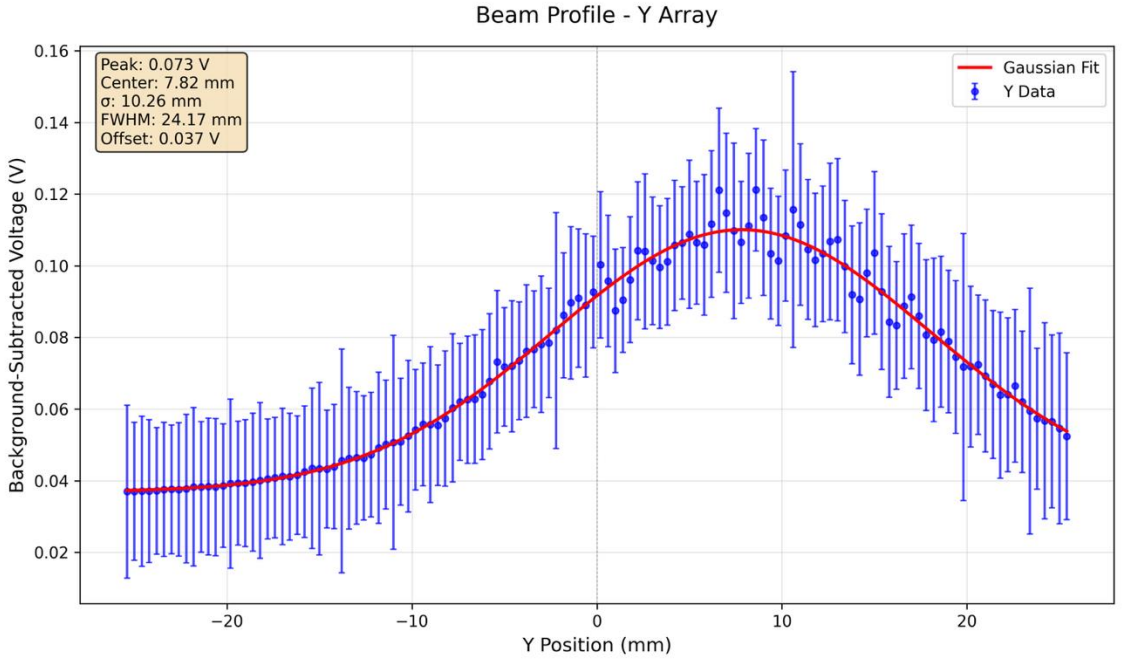



Input 0
Input 1
Input 2
Input 3
Voltage (V)
Time (s)


Input 0
Input 1
Input 2
Input 3
Voltage (V)
Time (ms)

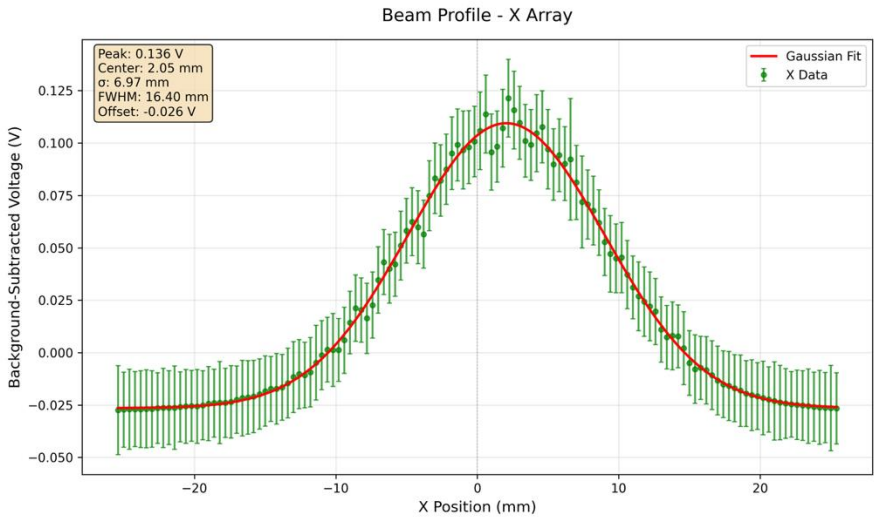
70 MeV Beam Energy 300 nA (max ion source current) High Gain

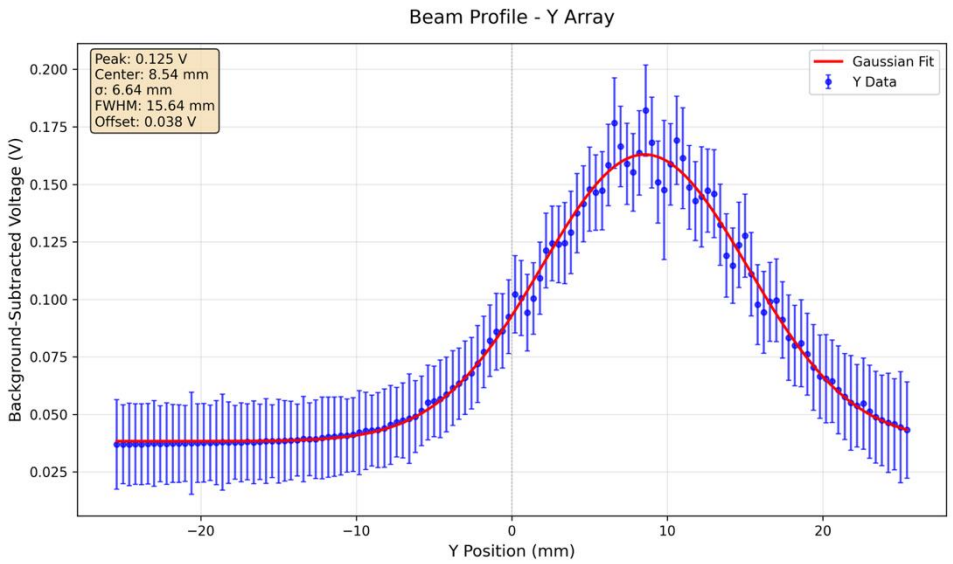




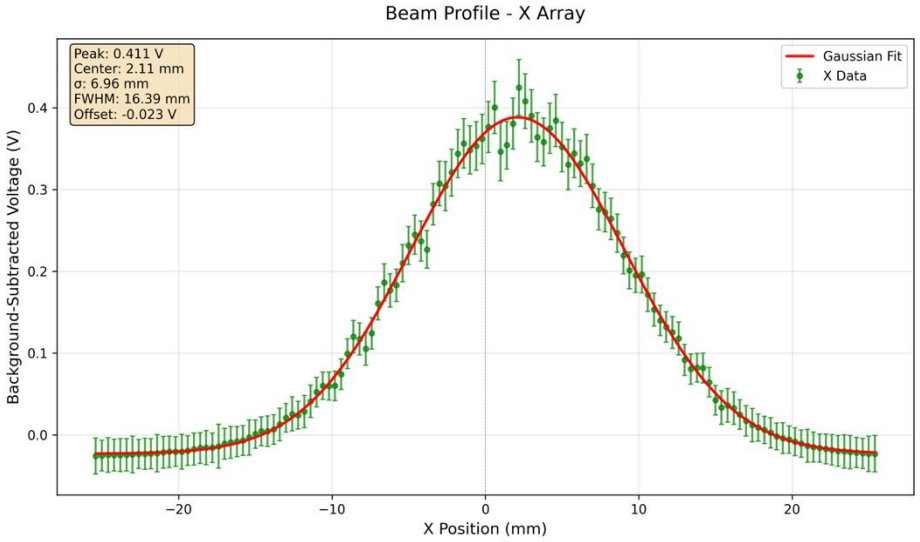
112 MeV High Gain

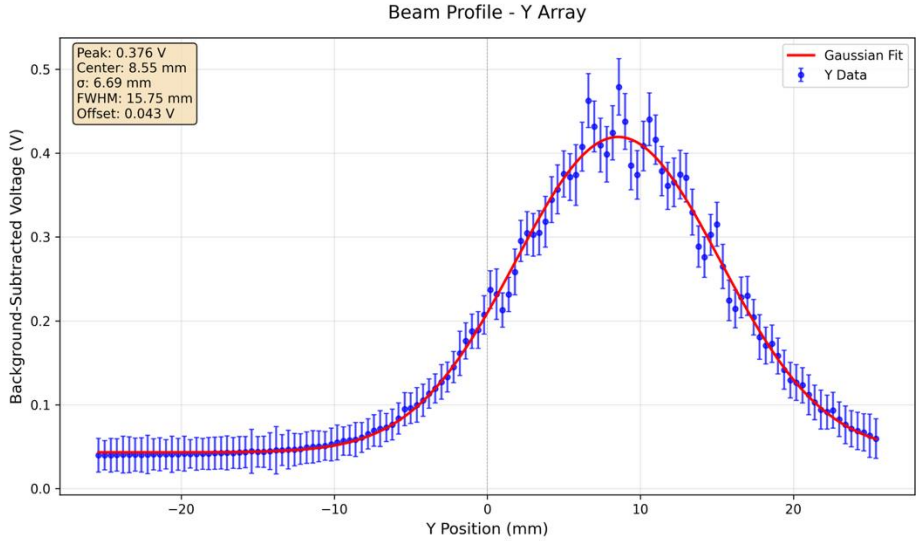
100 nA



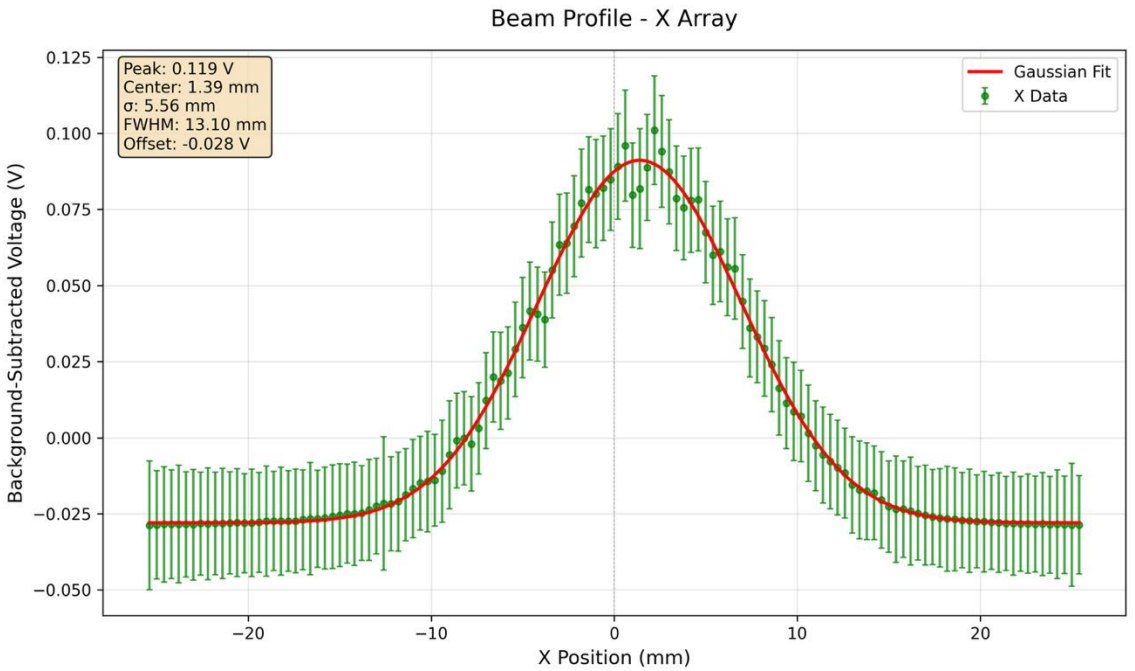


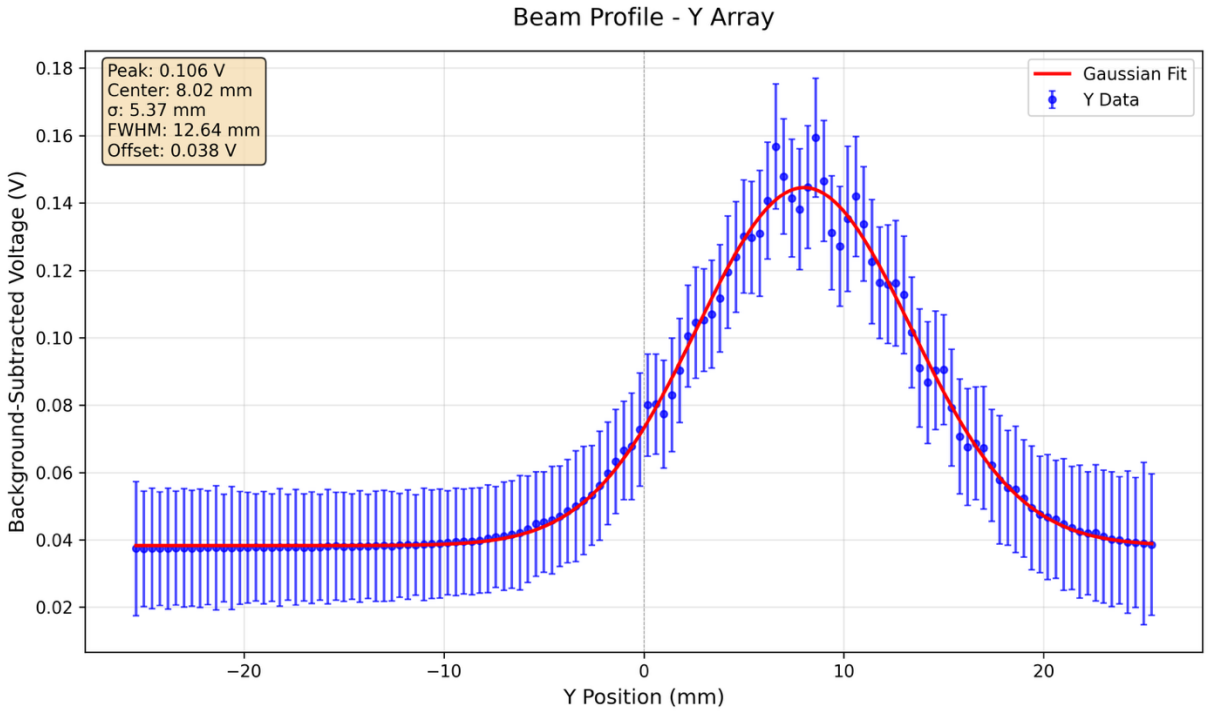
300 nA





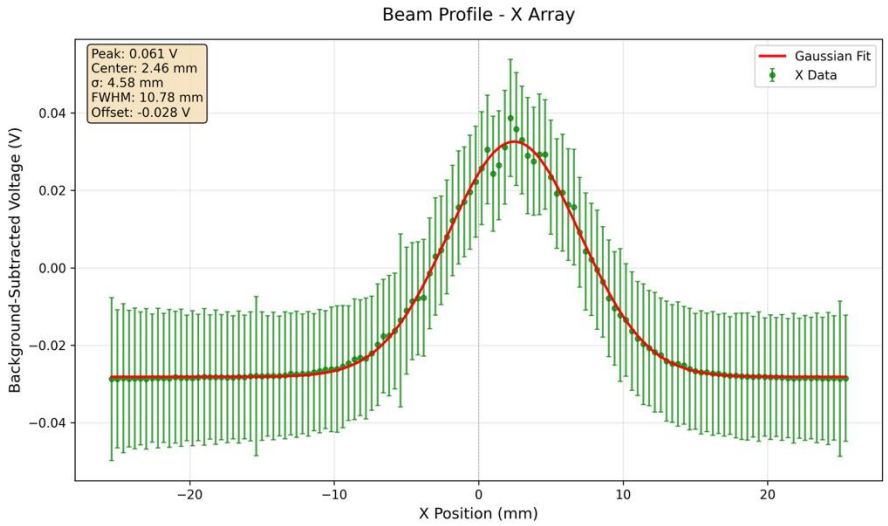
148 MeV 40 nA High Gain

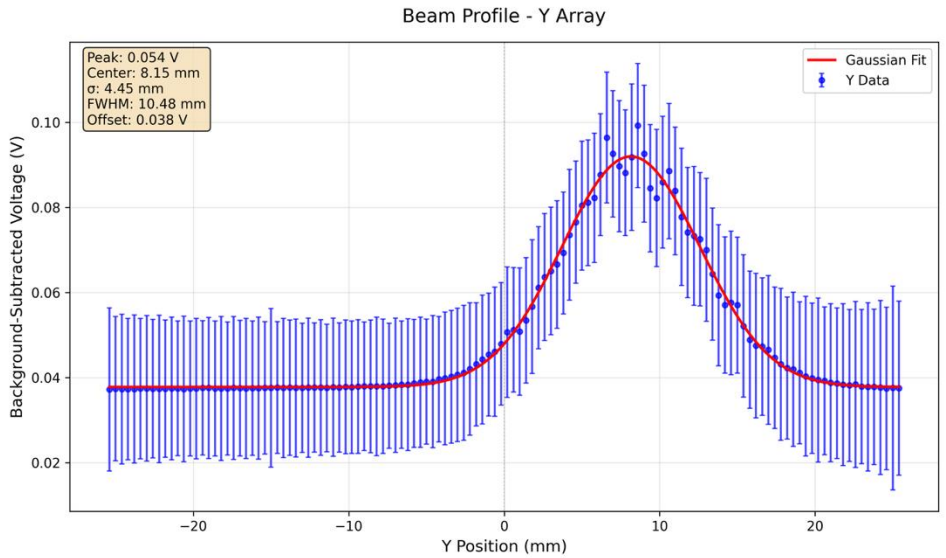




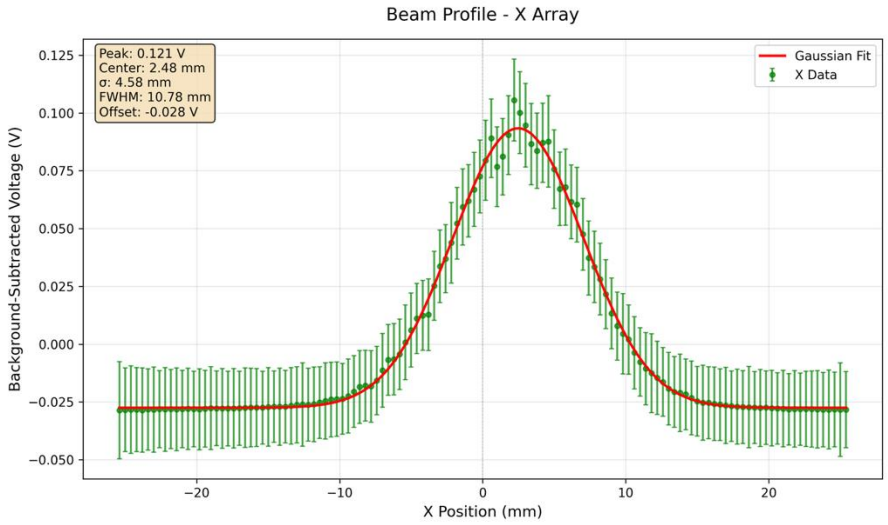
179 MeV High Gain

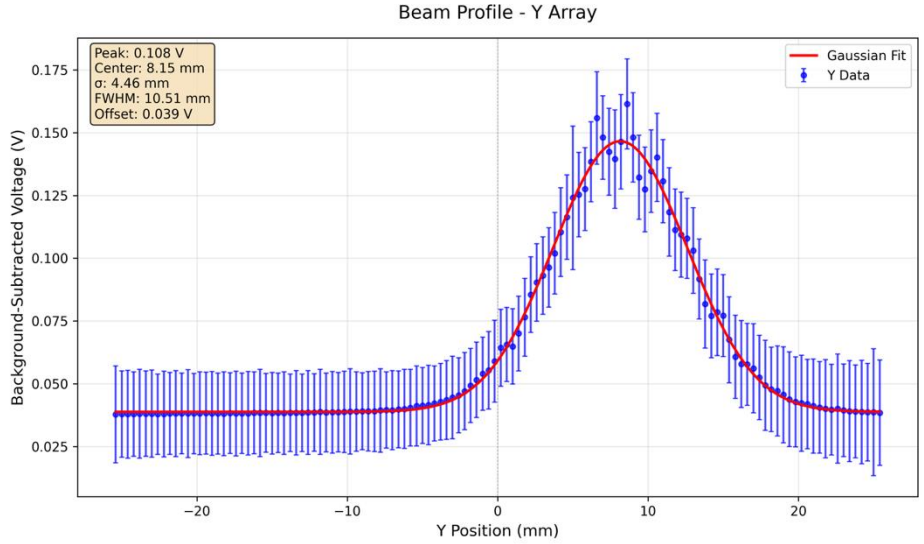
10 nA



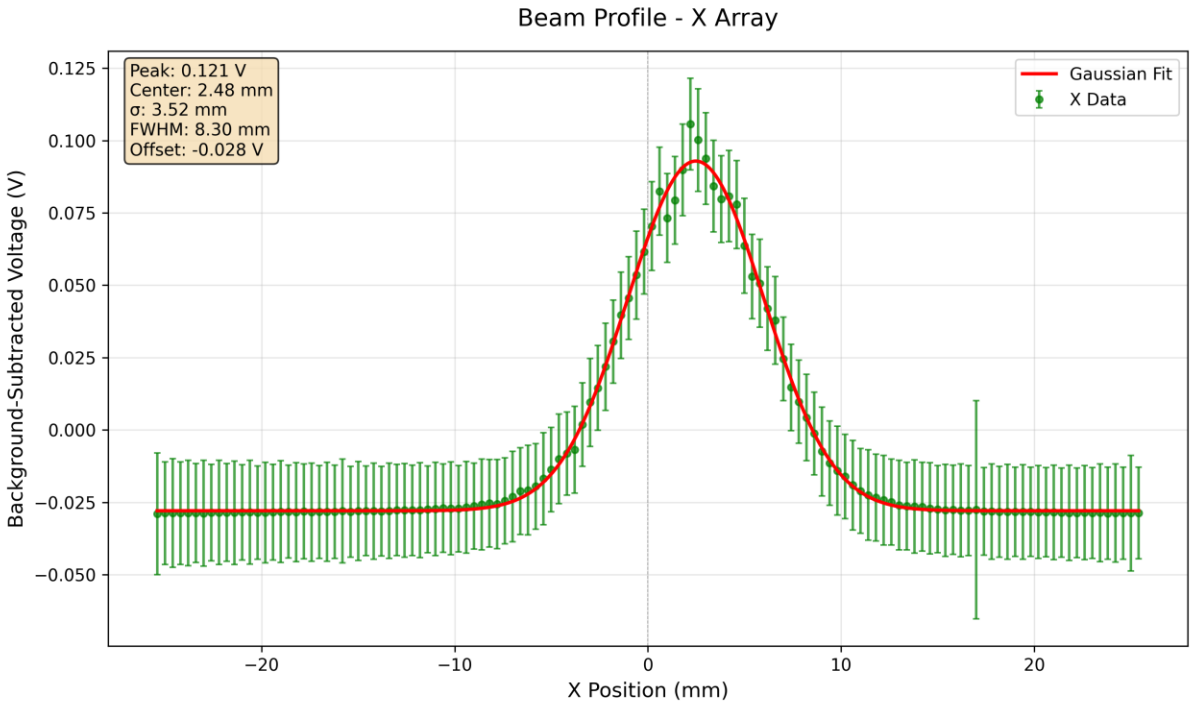


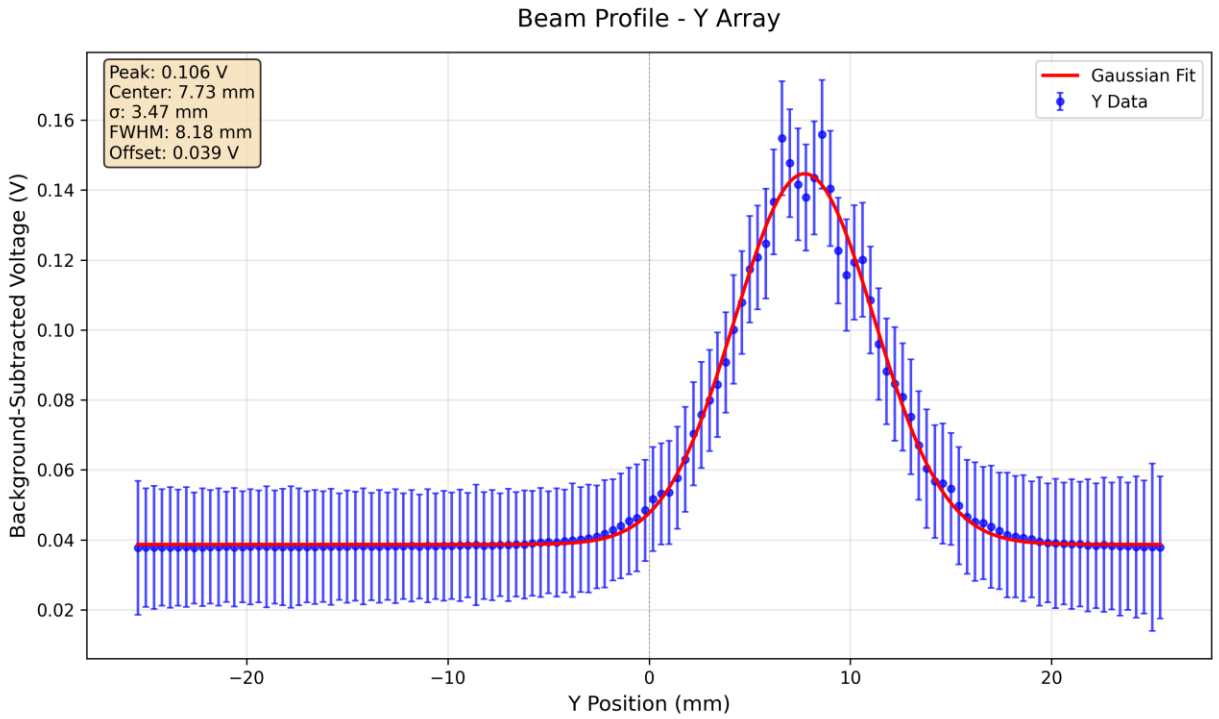
20 nA



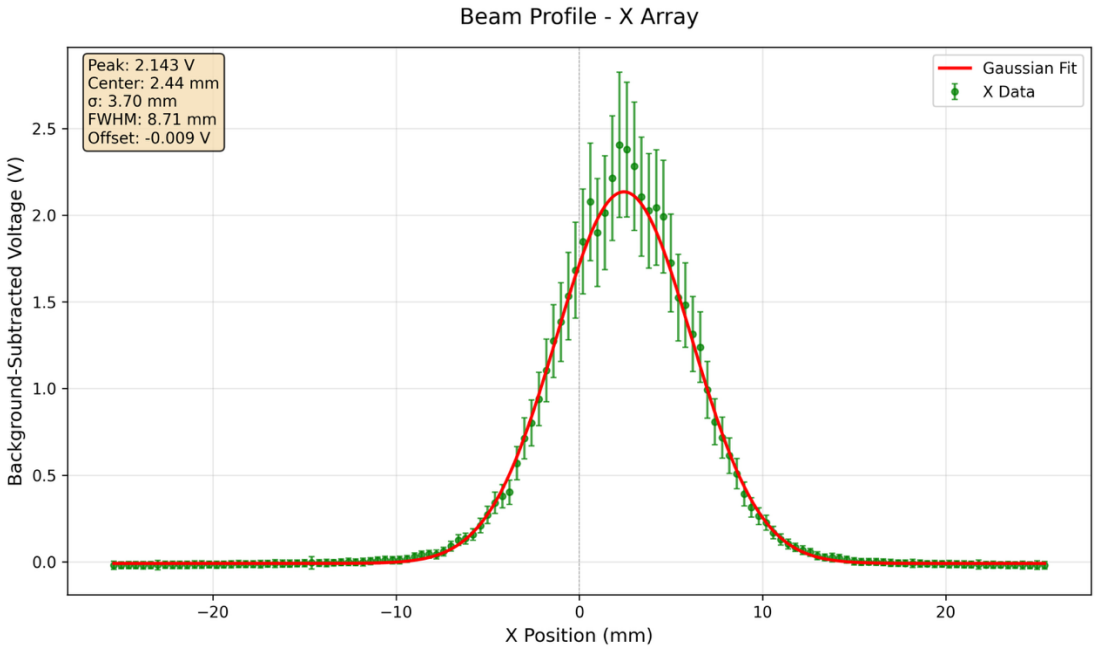


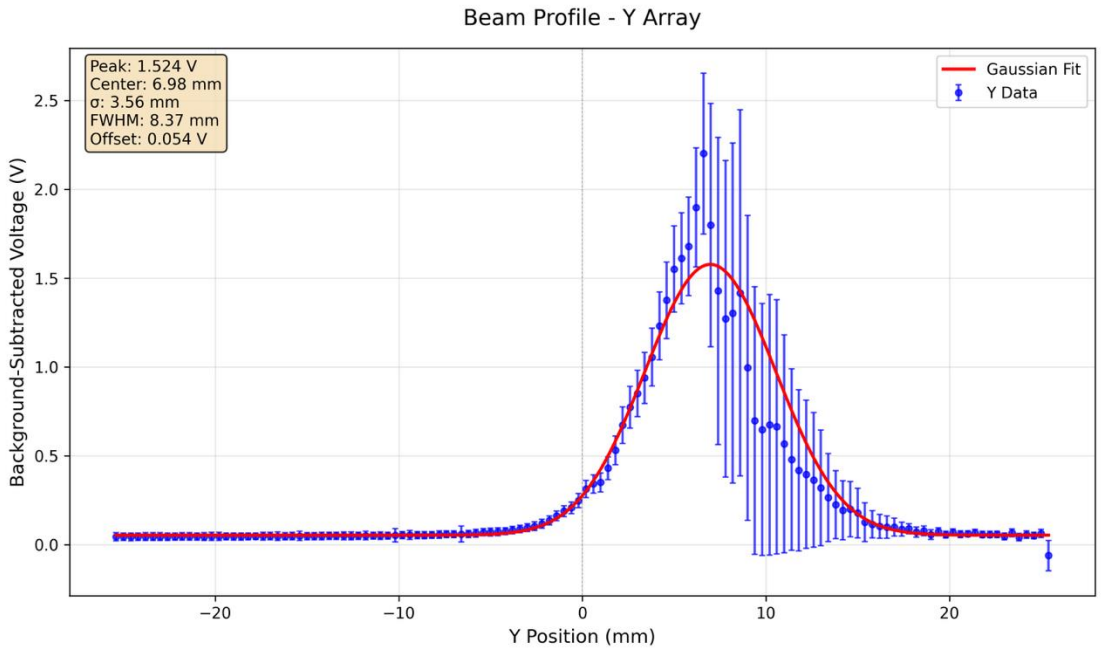
228 MeV 5 nA High Gain





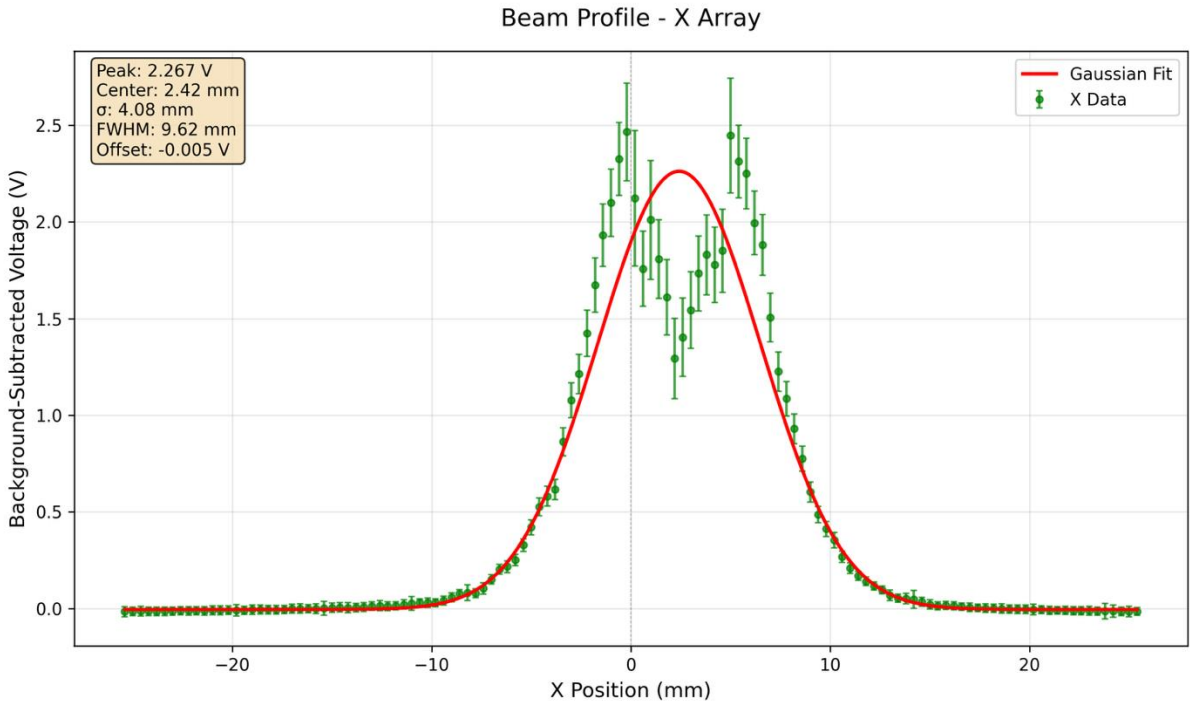
228 MeV 100 nA High Gain

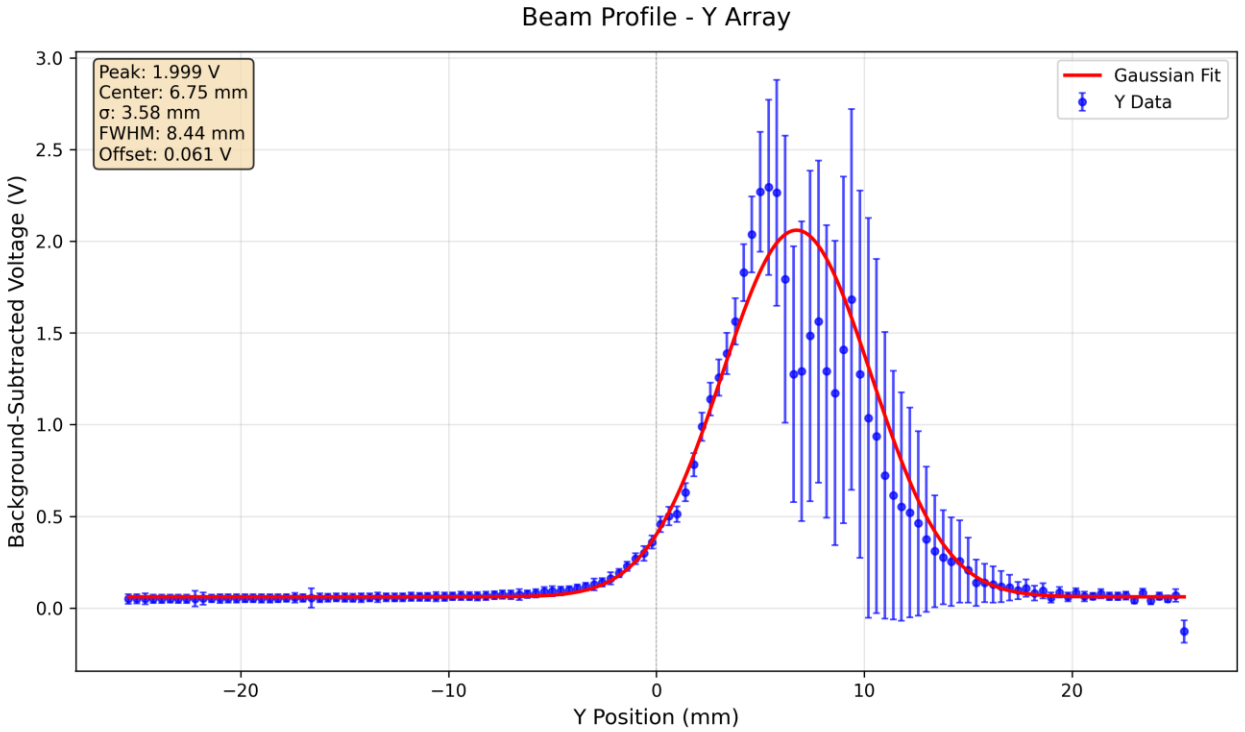




Starting to see some saturation on some of the acquired pulses but not all – hence wh

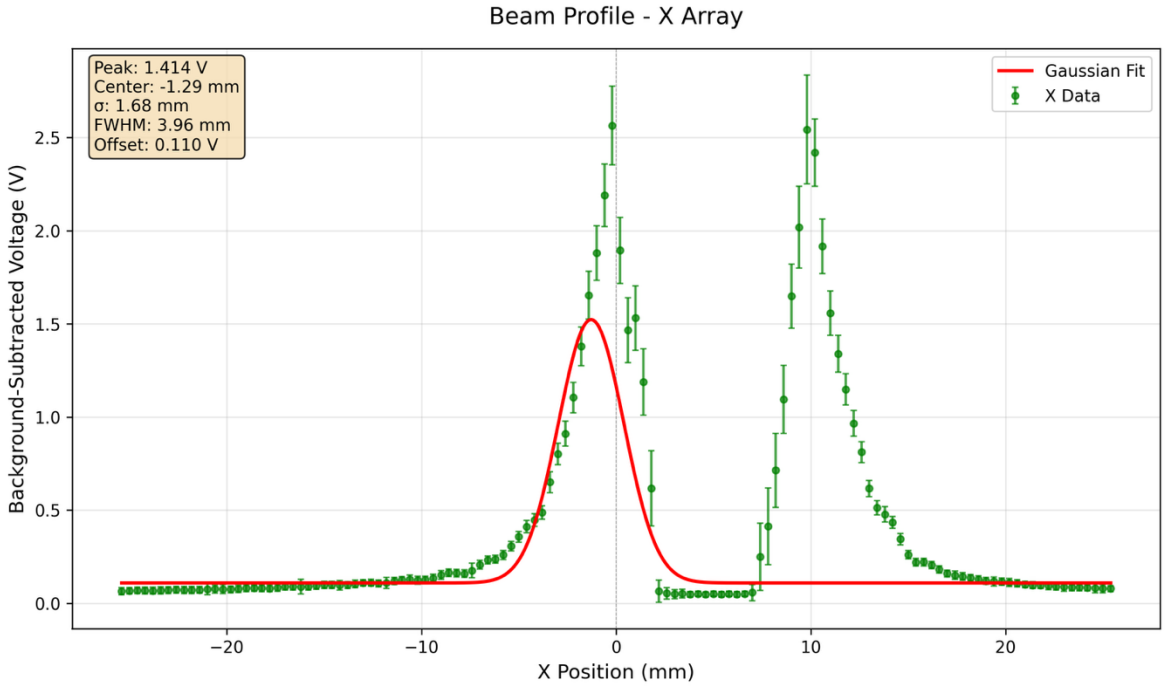
228 MeV 150 nA High Gain

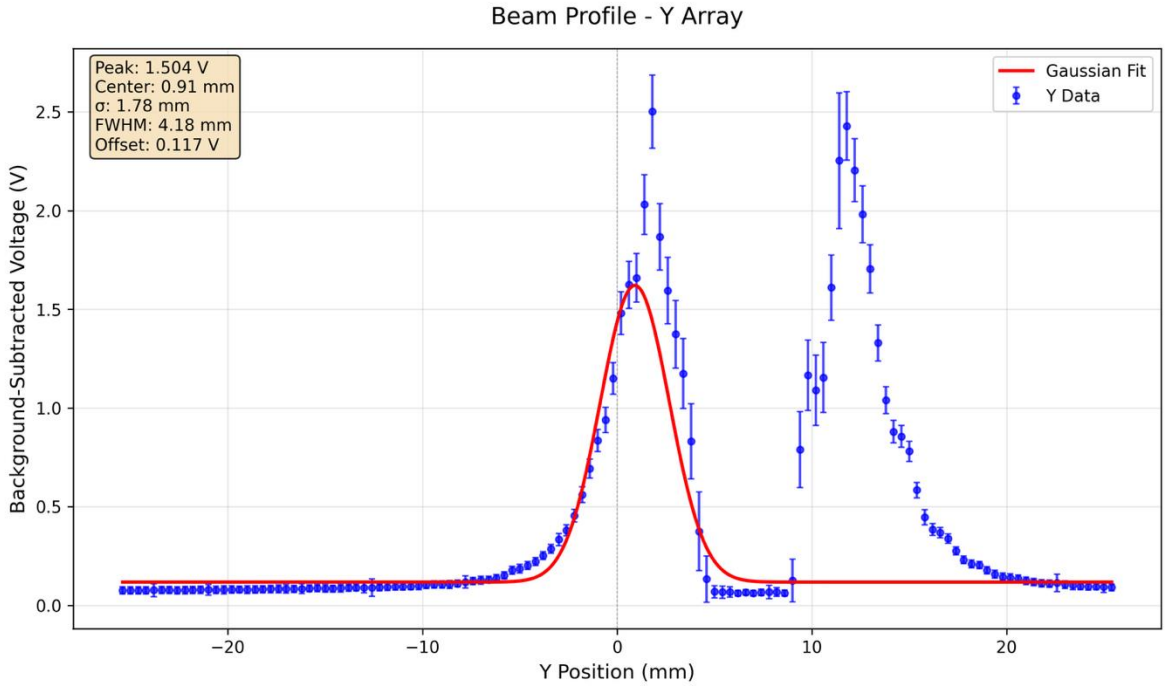




Saturation becoming more apparent – particularly at centre of X-profile.

228 MeV 300 nA High Gain – Maximum Proton Current Output in CONV delivery mode.

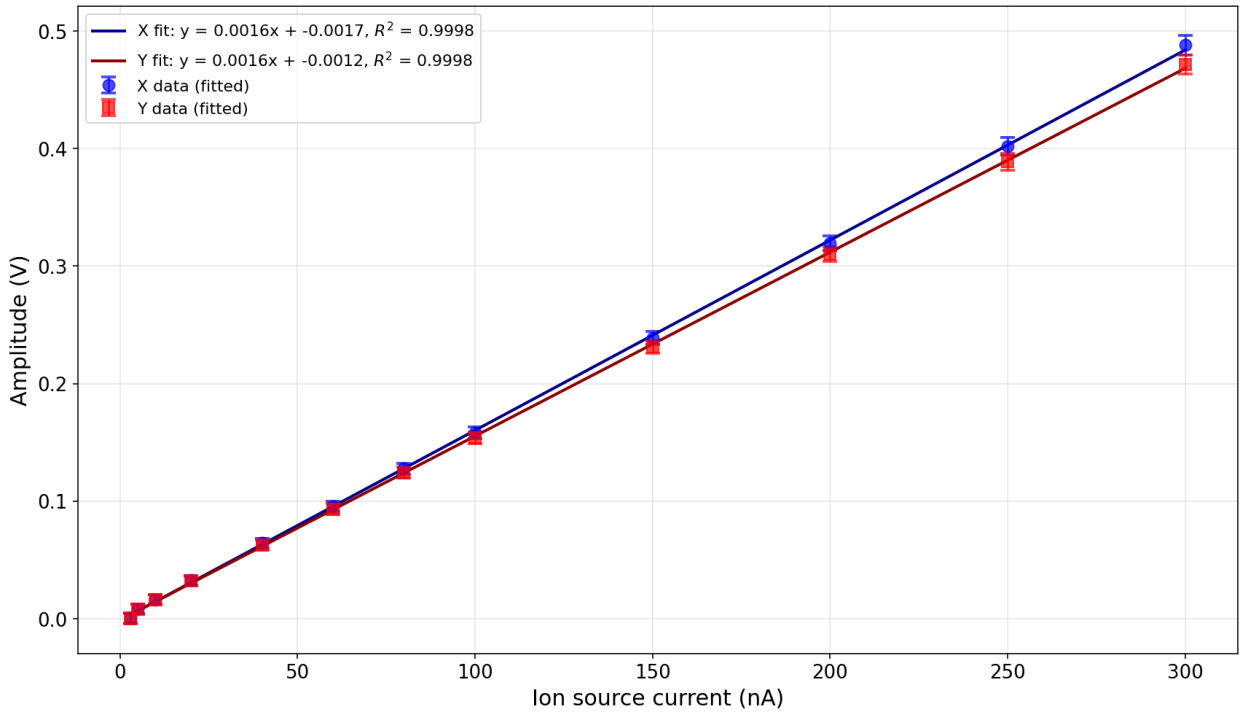




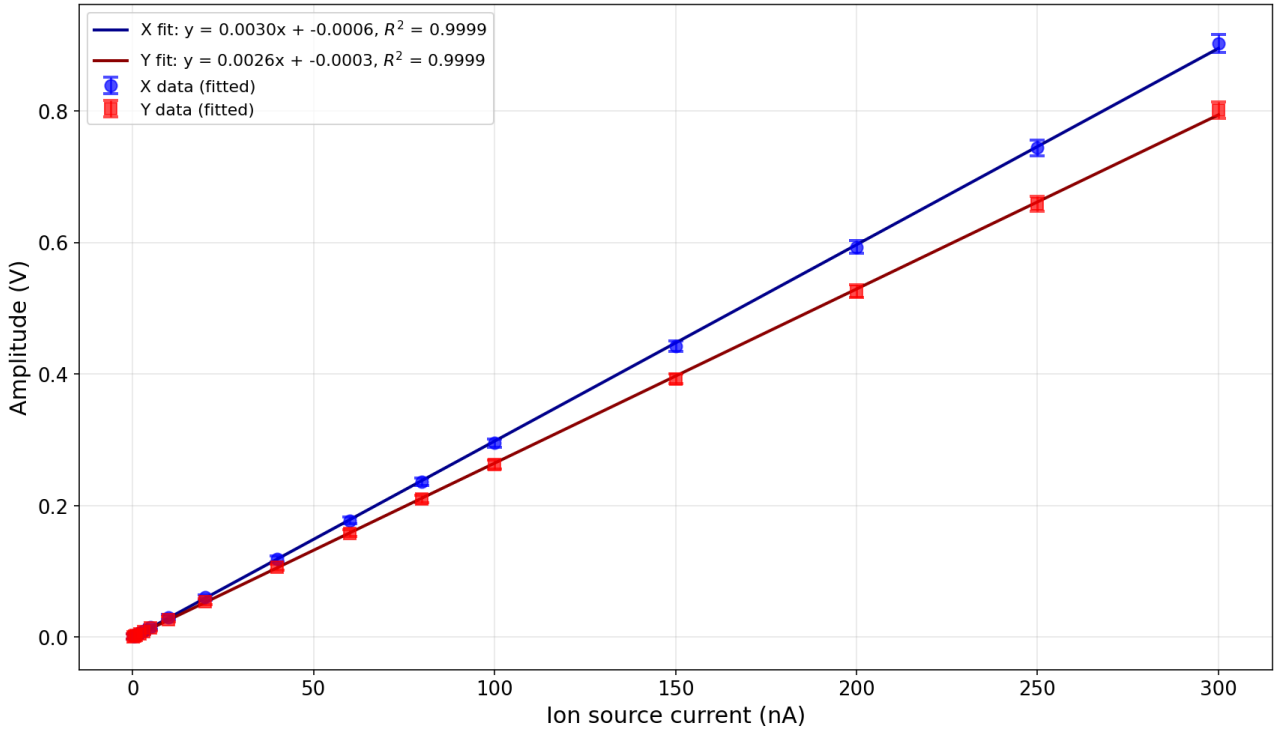
Severe saturation at centre of both beam profiles.

Response Linearity at 148 MeV Beam Energy (using Amplitude of Gaussian Fit)

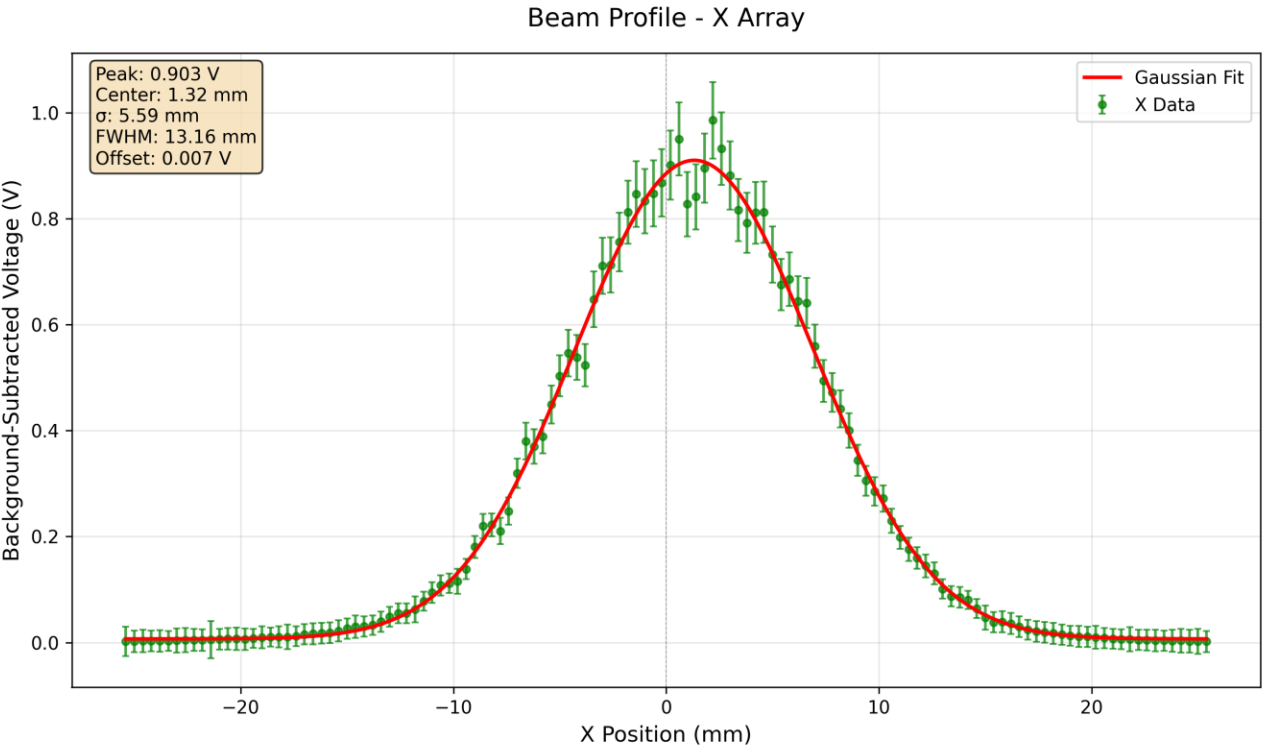
Low gain

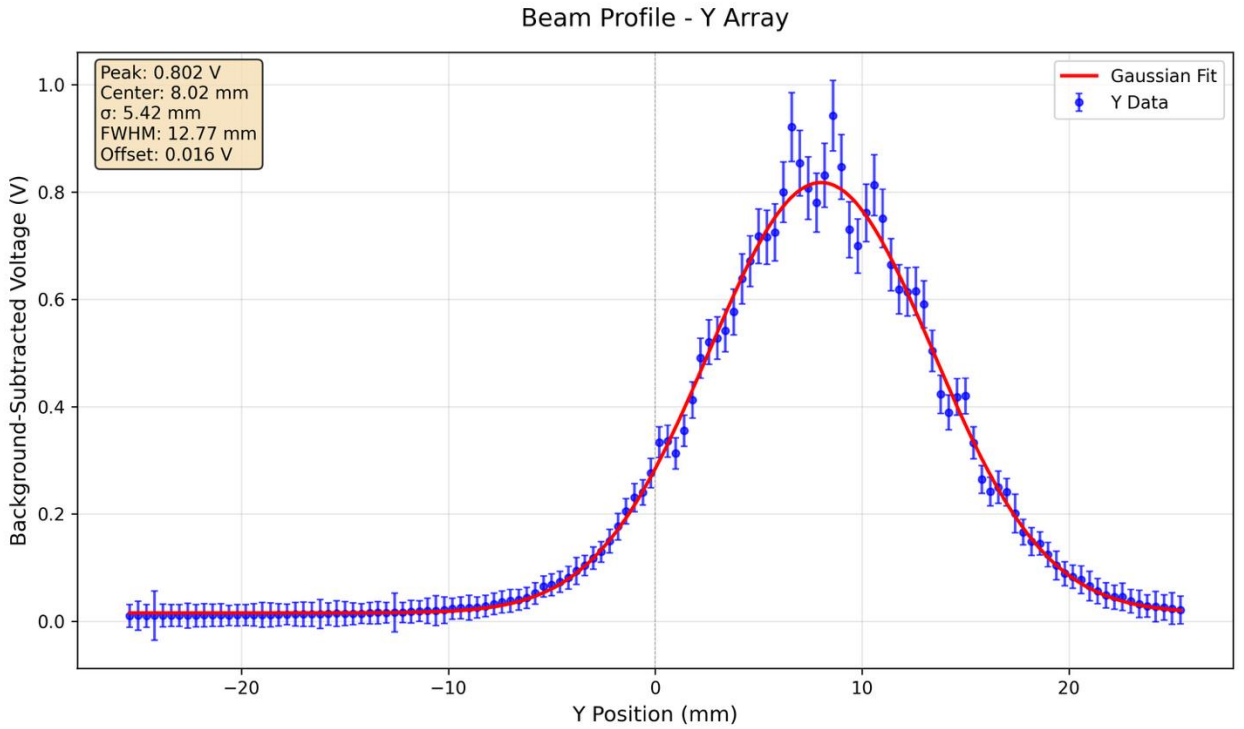


High gain

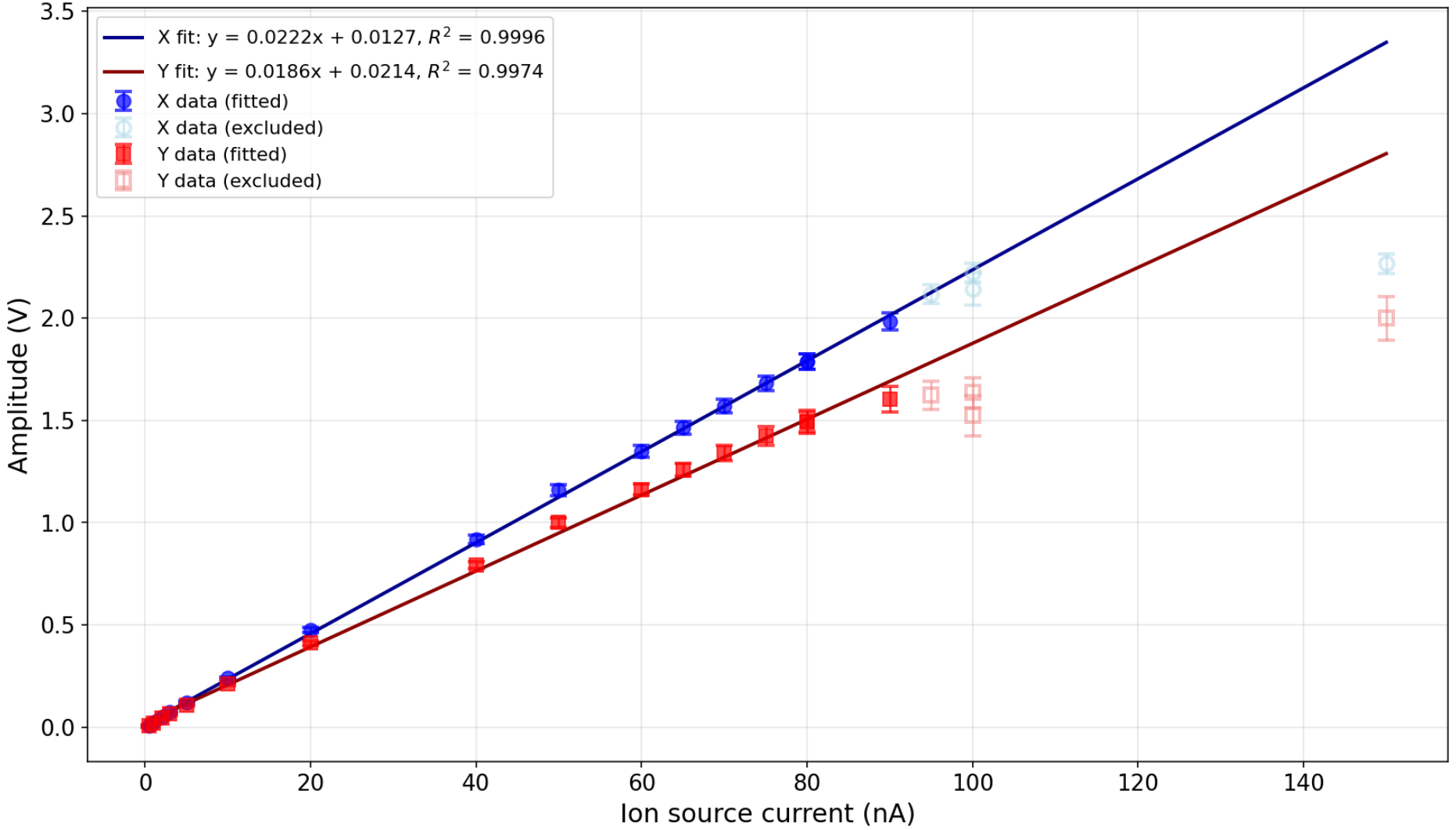


300 nA 148 MeV



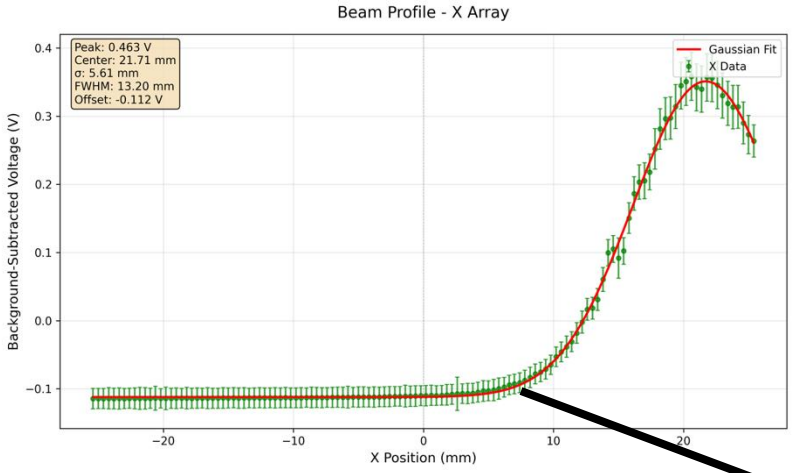


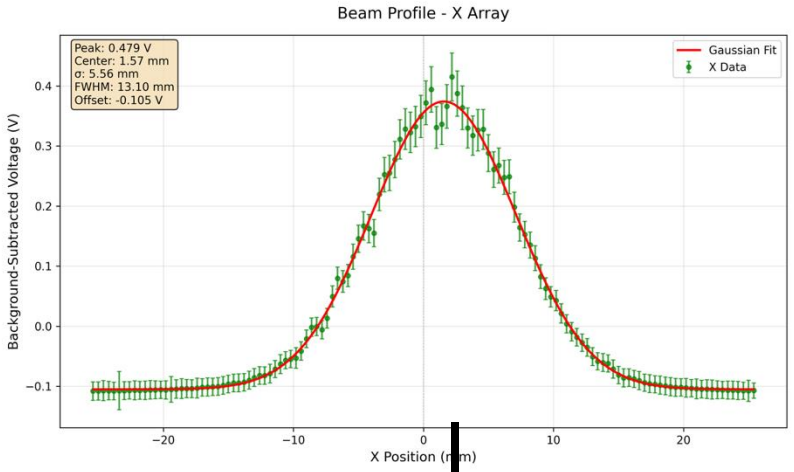
Response Linearity at 228 MeV Beam Energy (using Amplitude of Gaussian Fit)

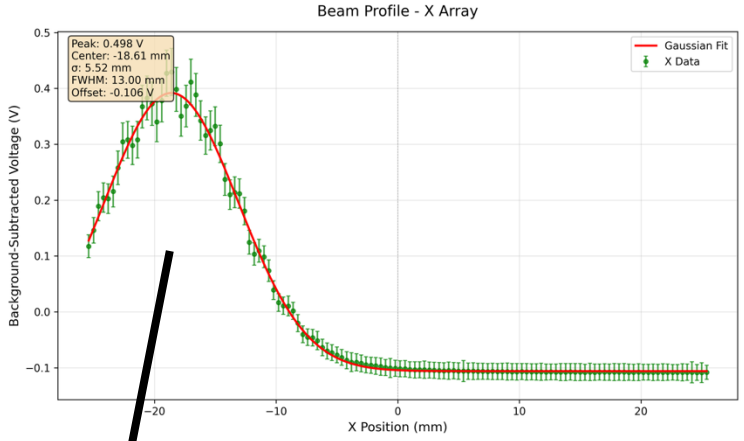


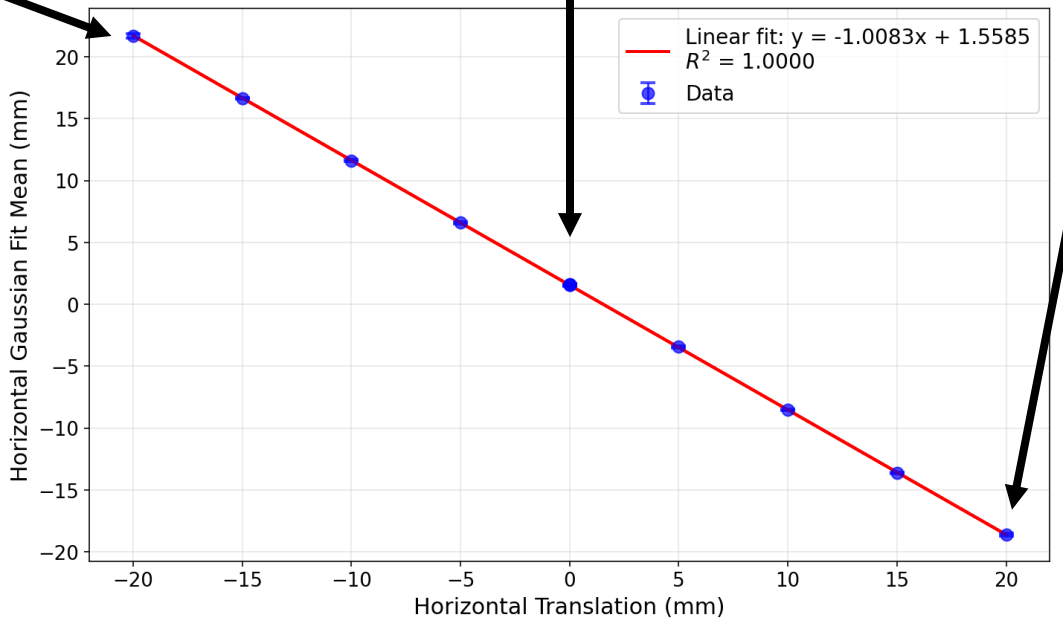
Excluded points where saturation was observed from the linear fit.

Position measurements using stage translation at 148 MeV beam energy 300 nA ion source current (low gain mode)

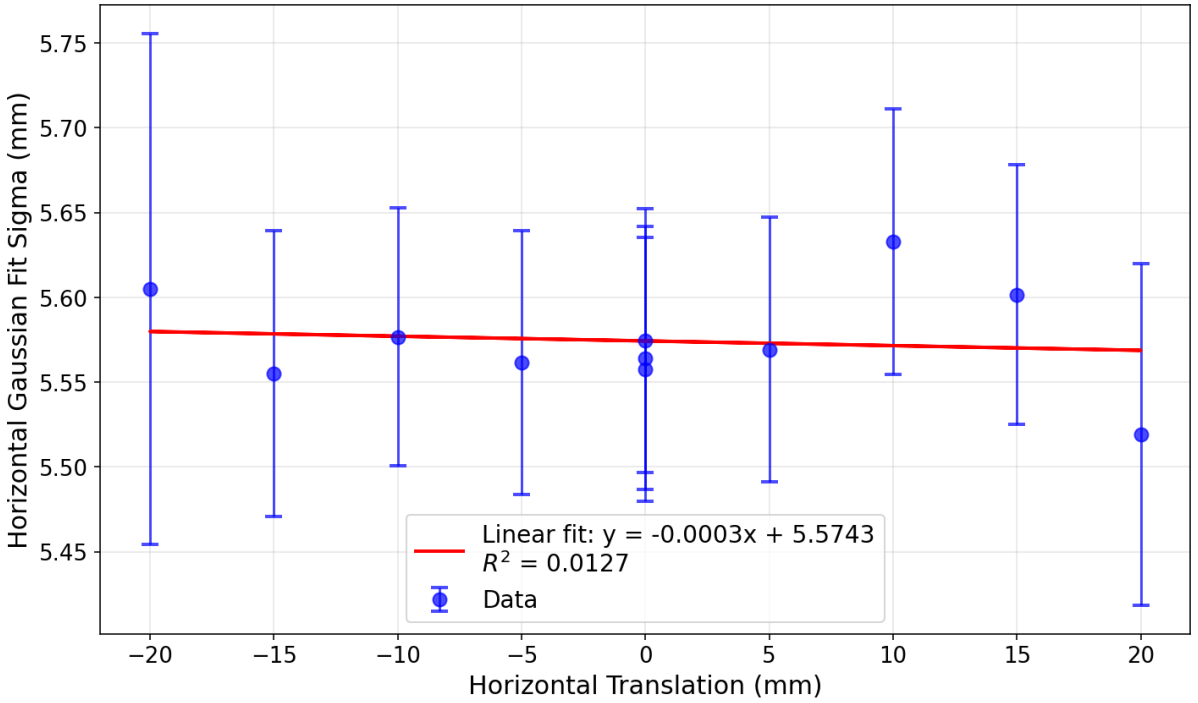


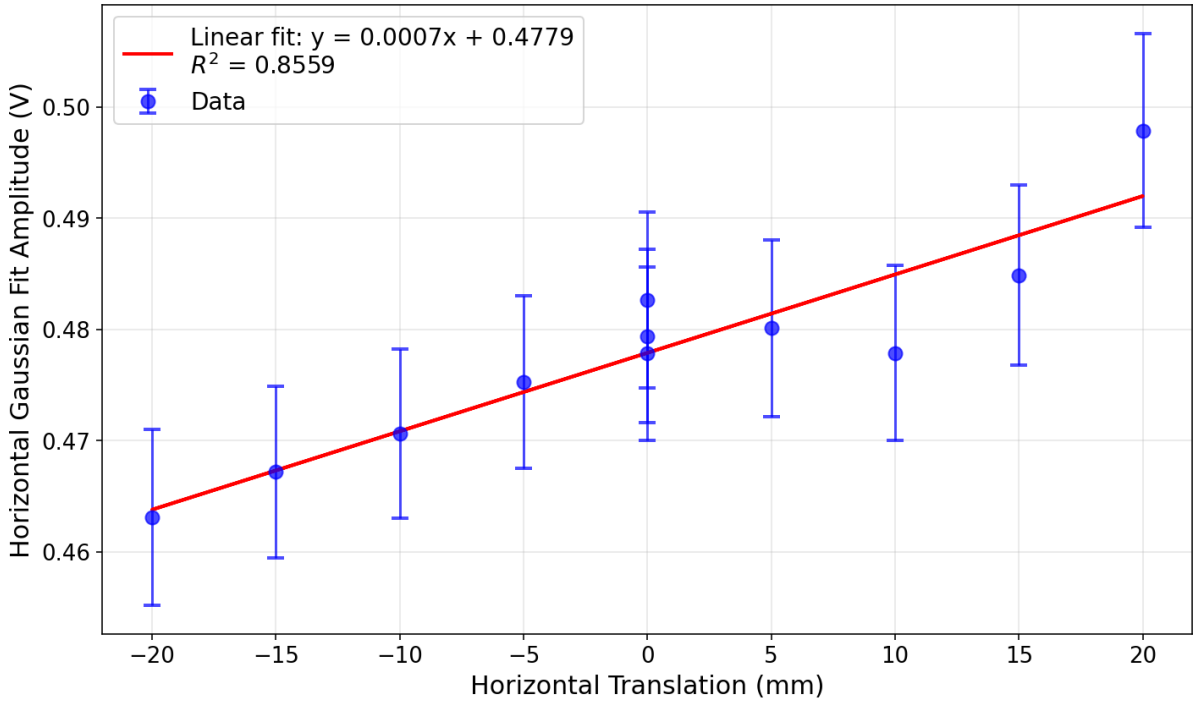




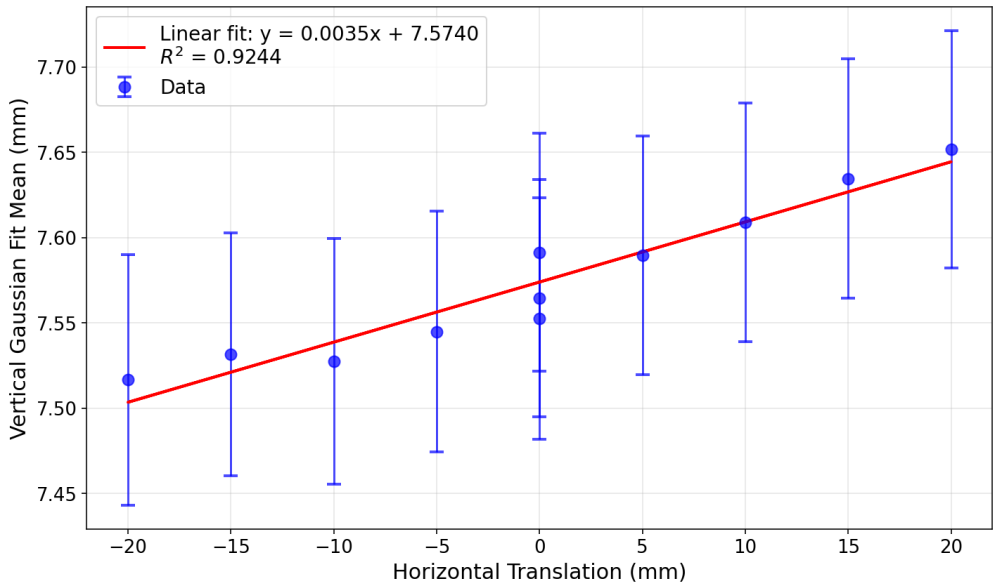


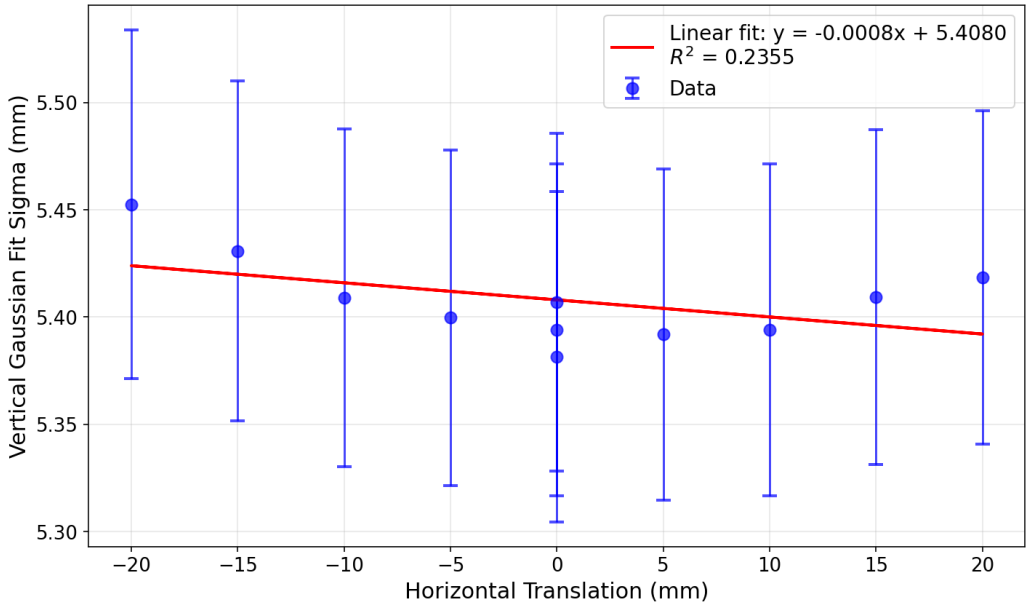
Horizontal Size and Amplitude in Position Scan

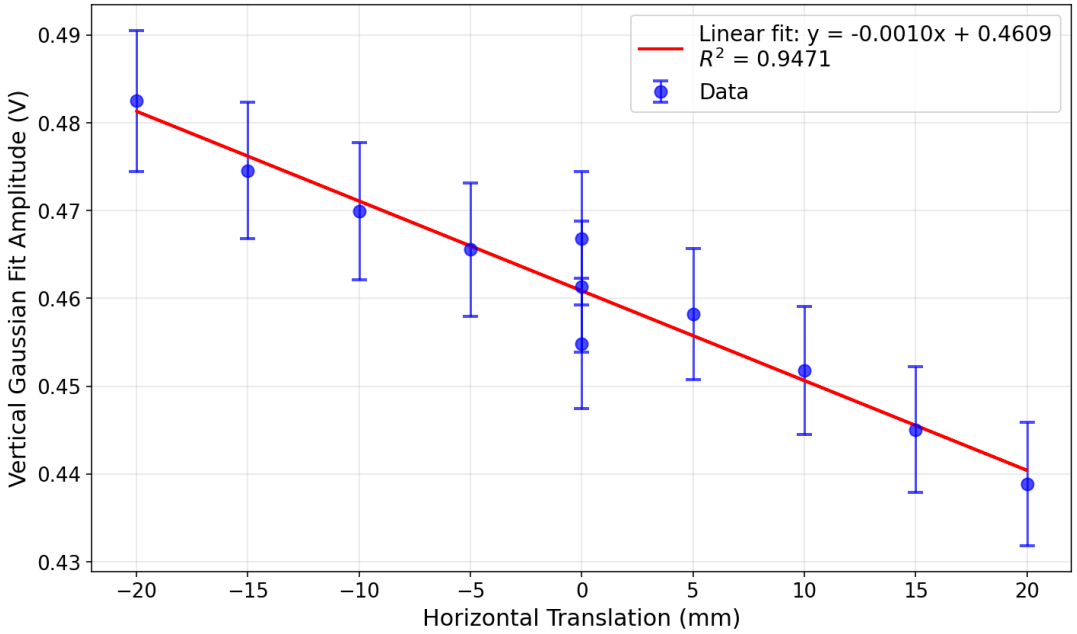




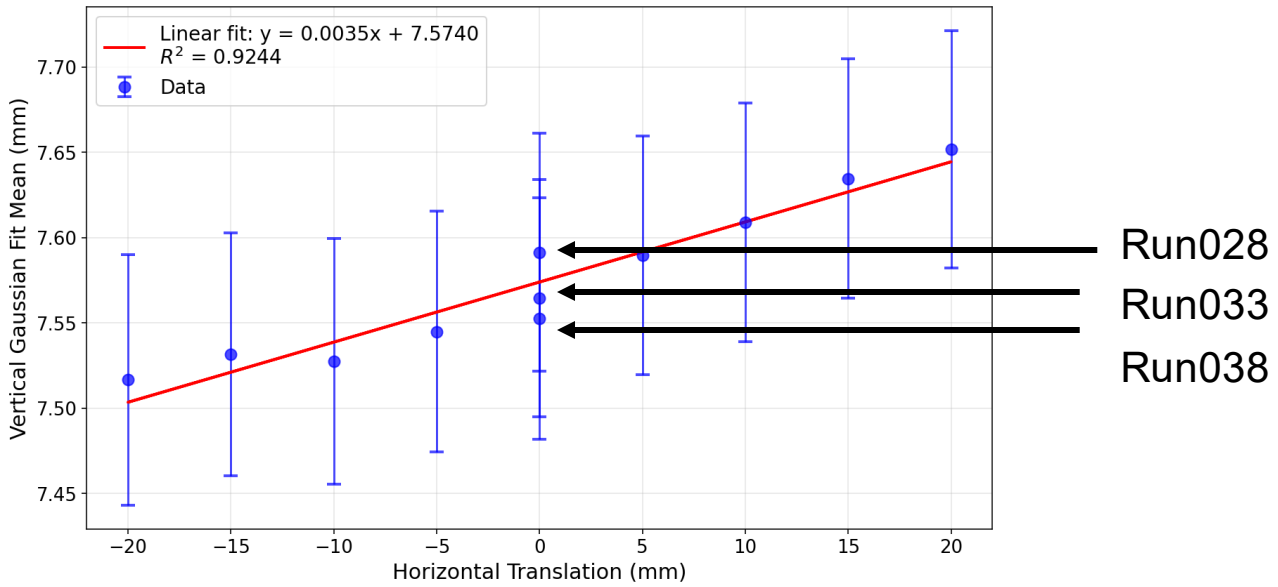
Vertical Parameters in Position Scan

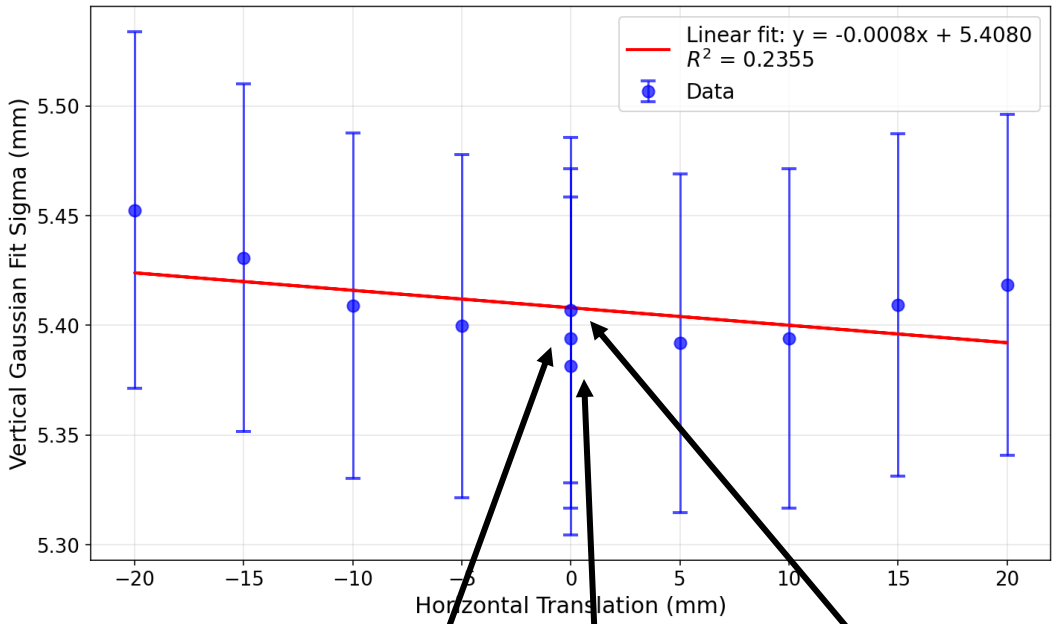


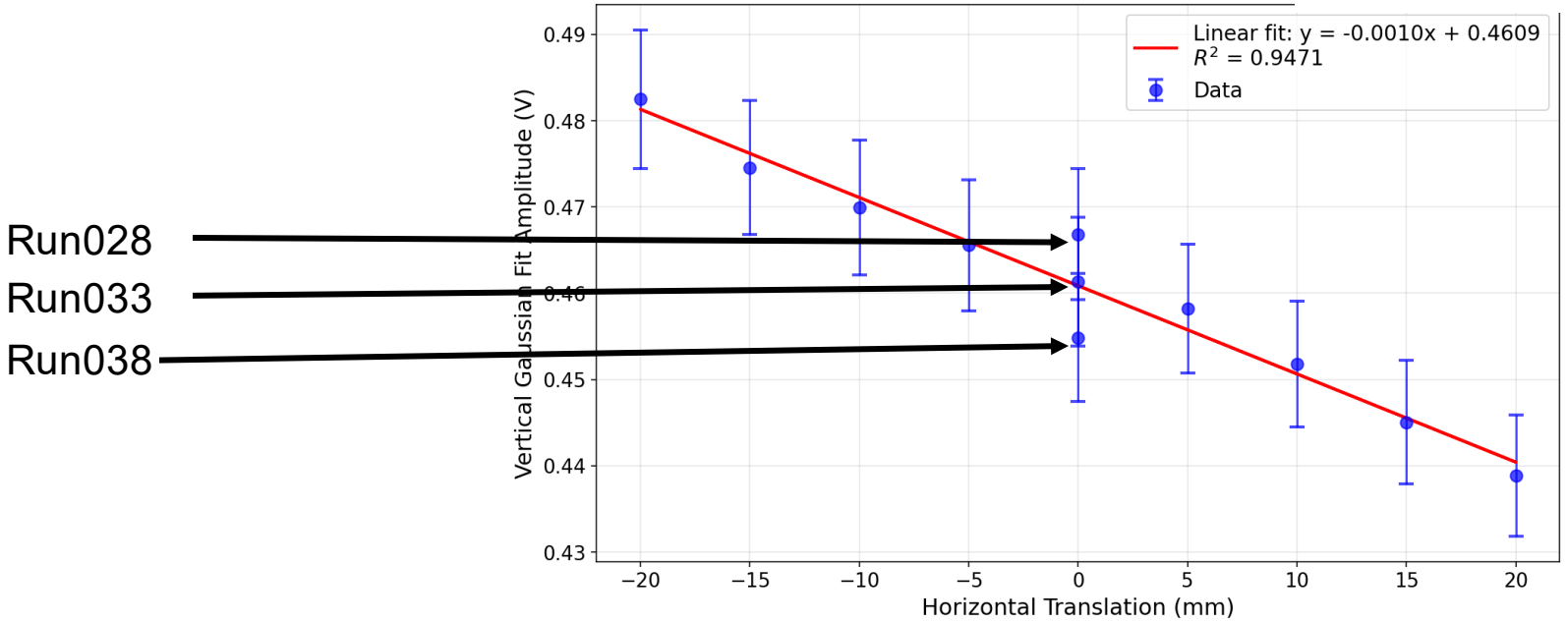




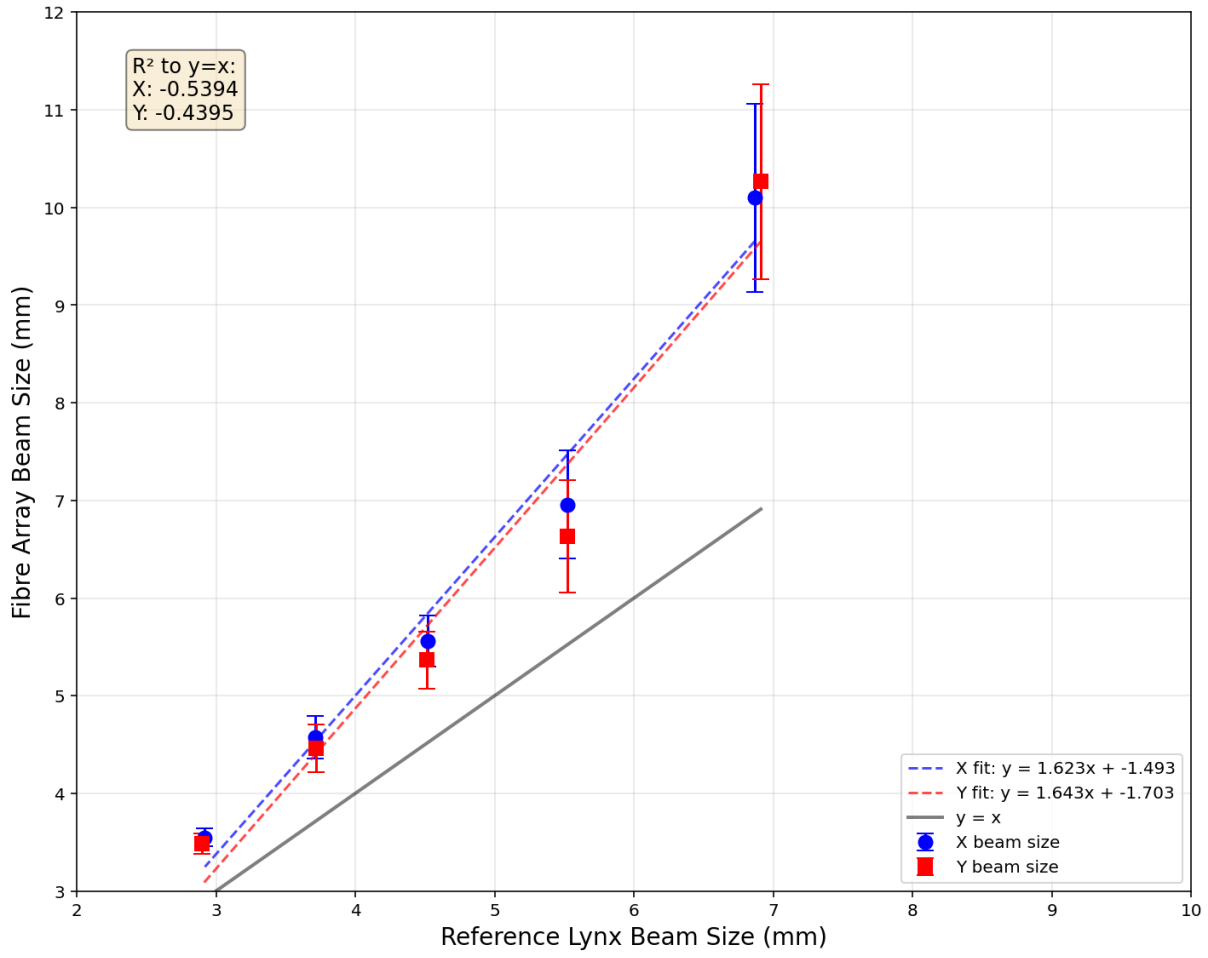
Vertical Parameters in Position Scan

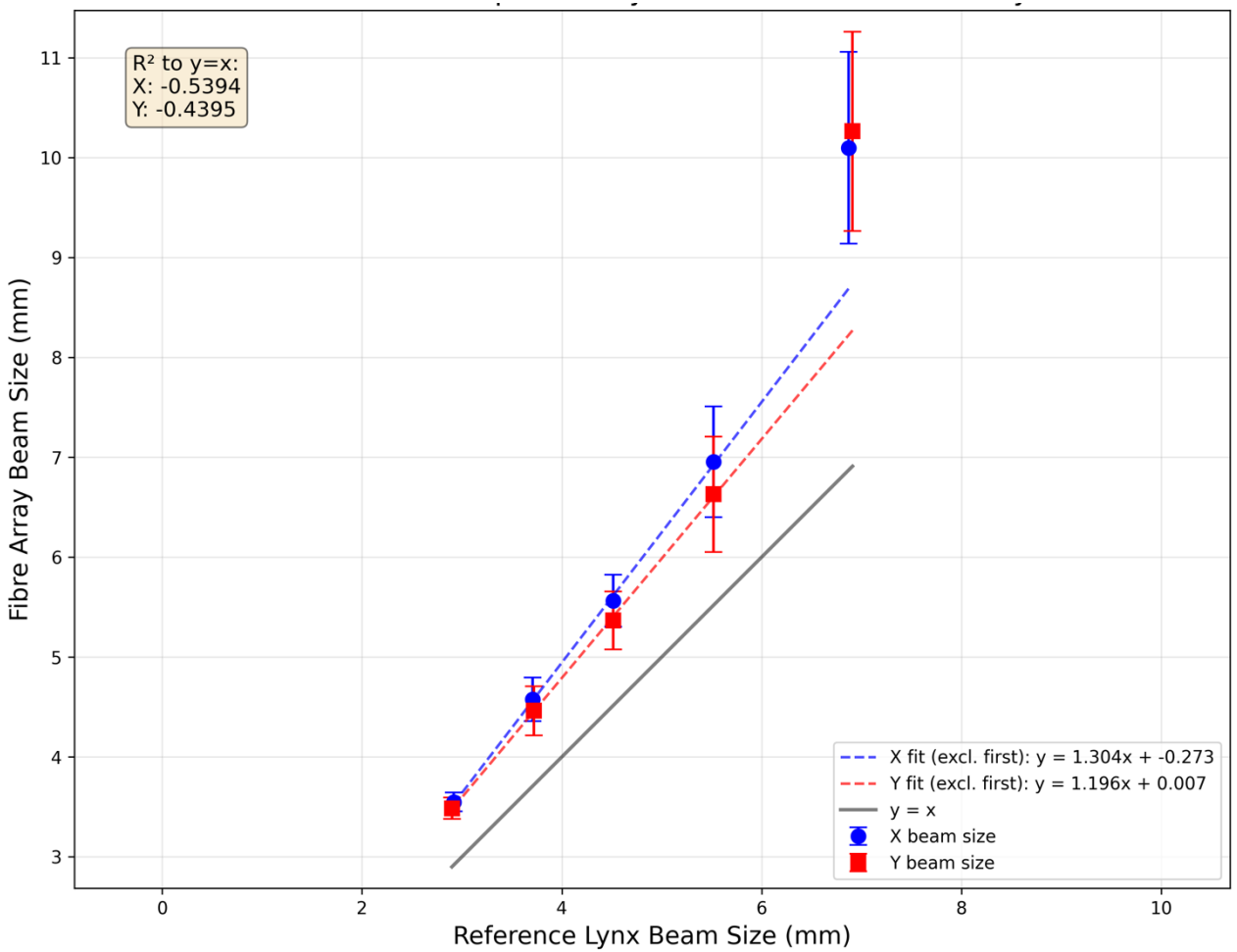




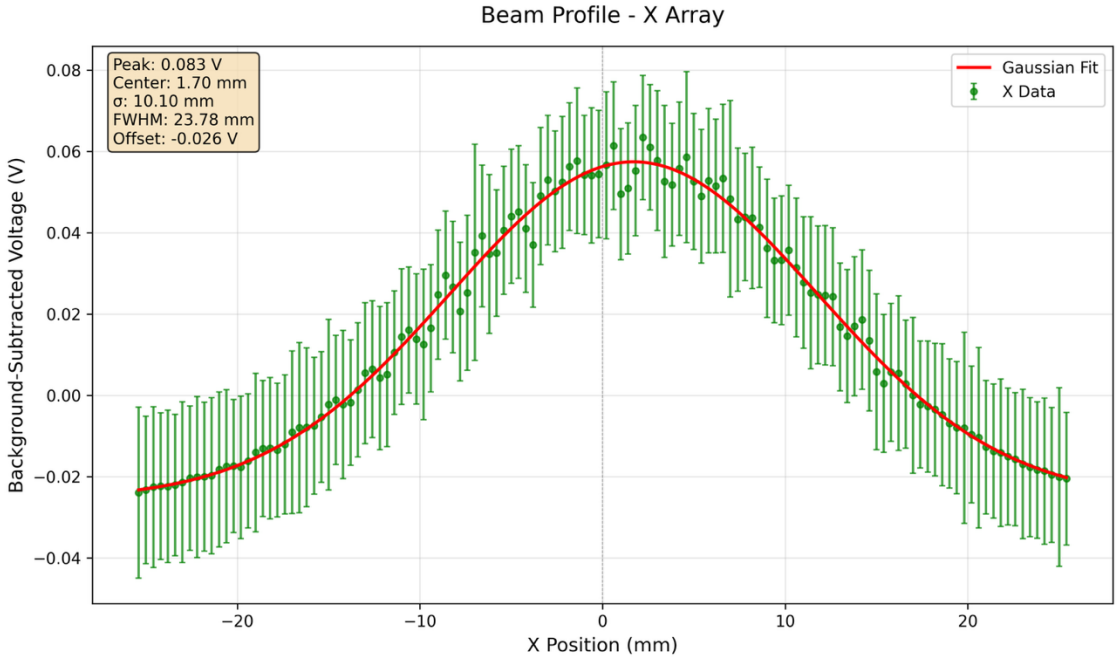


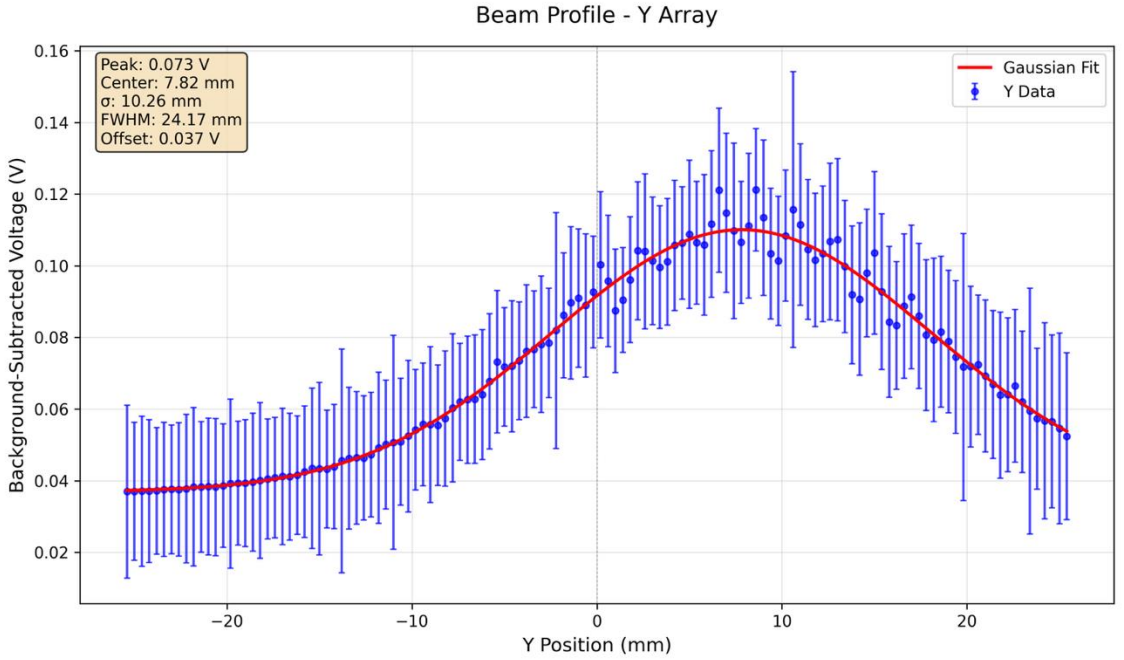
Beam size vs Reference



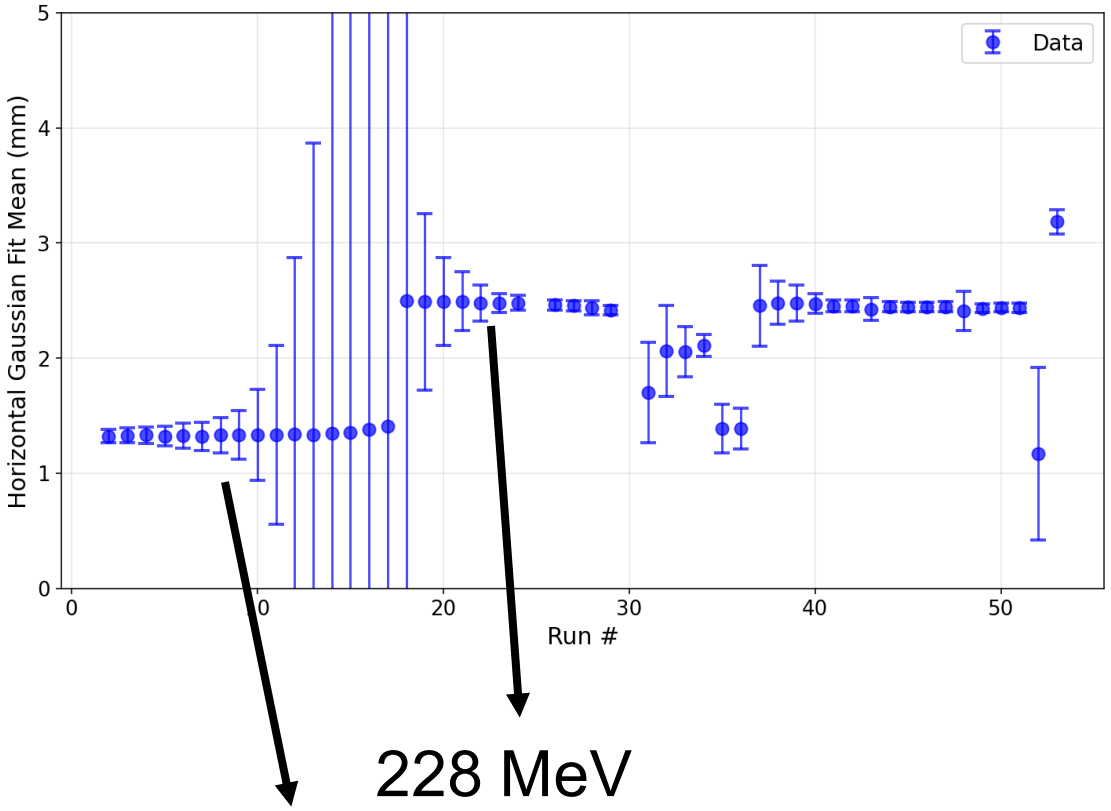


70 MeV 300 nA (max ion source current) High Gain



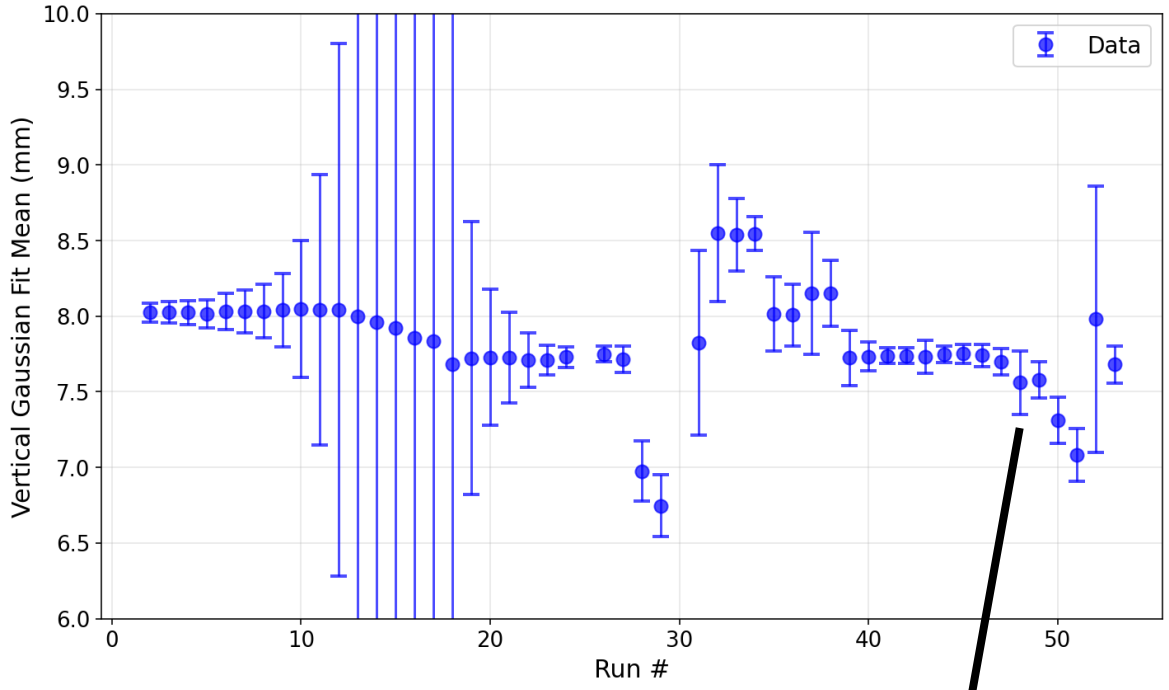


Stability of Mean – 01/10



228 MeV

148 MeV

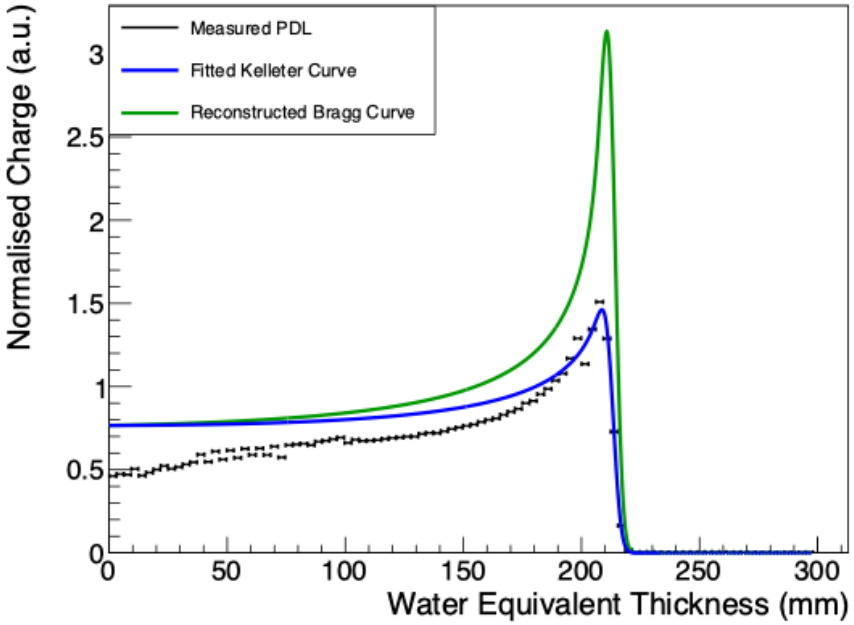


228 MeV current scan – dipping from saturation?

Trento QuARC Measurements

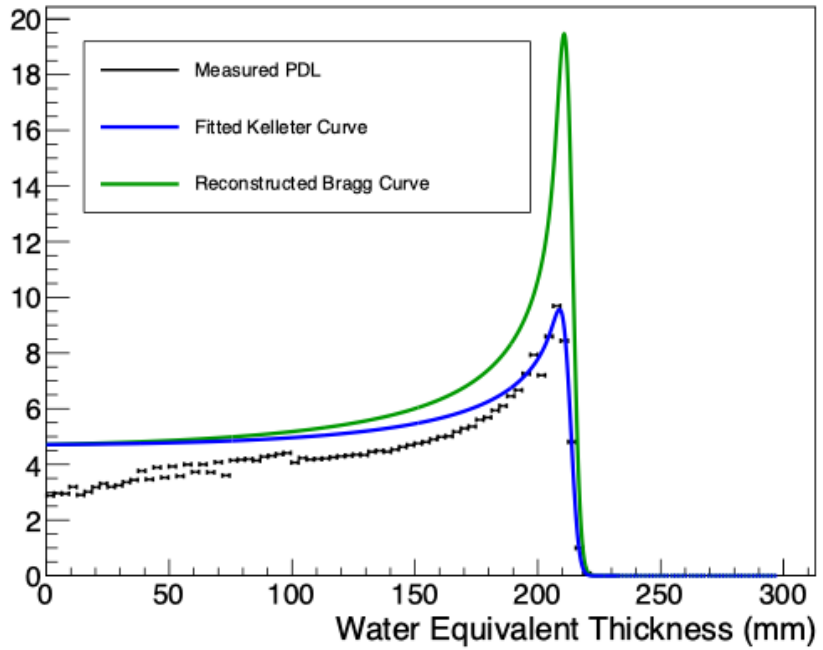
179 MeV Current Scan - Side A

15 nA



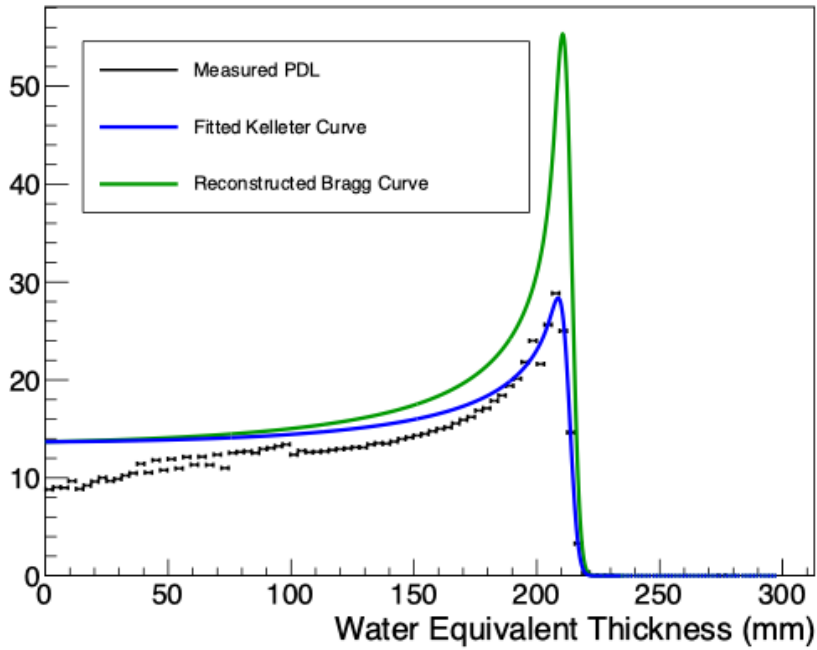
E_0 = 178.92 MeV

100 nA



E_0 = 178.70 MeV

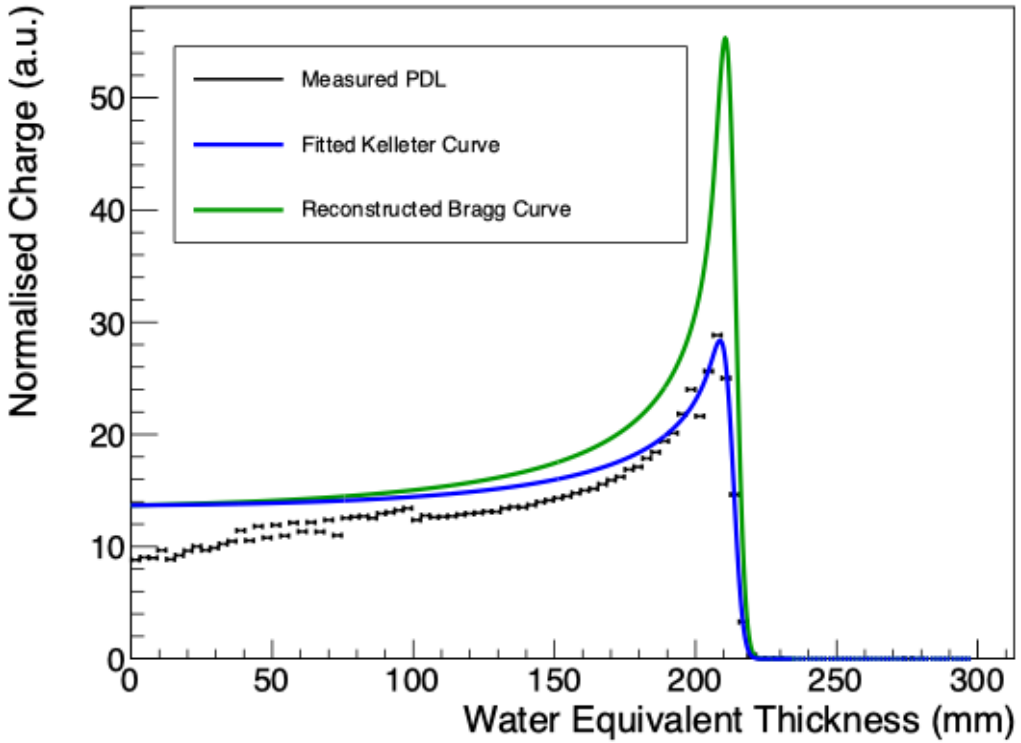
300 nA



E_0 = 178.68 MeV

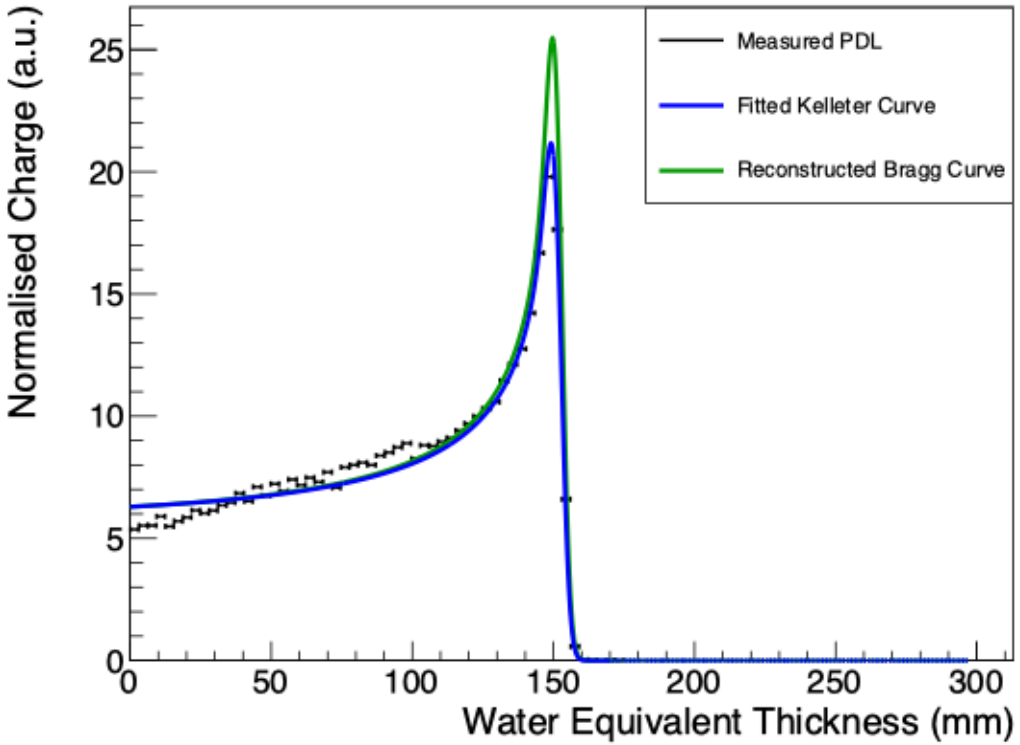
300 nA Energy Scan – look into kelleter fit and

179 MeV



E_0 = 178.68 MeV

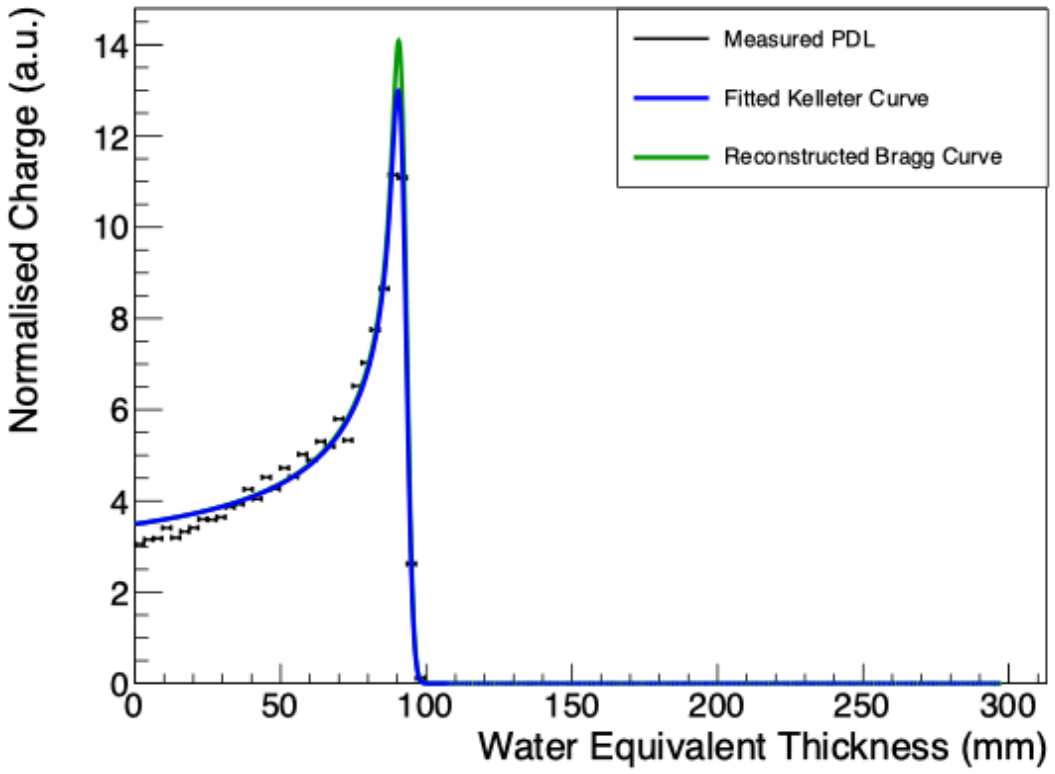
148 MeV



E_0 = 147.16 MeV

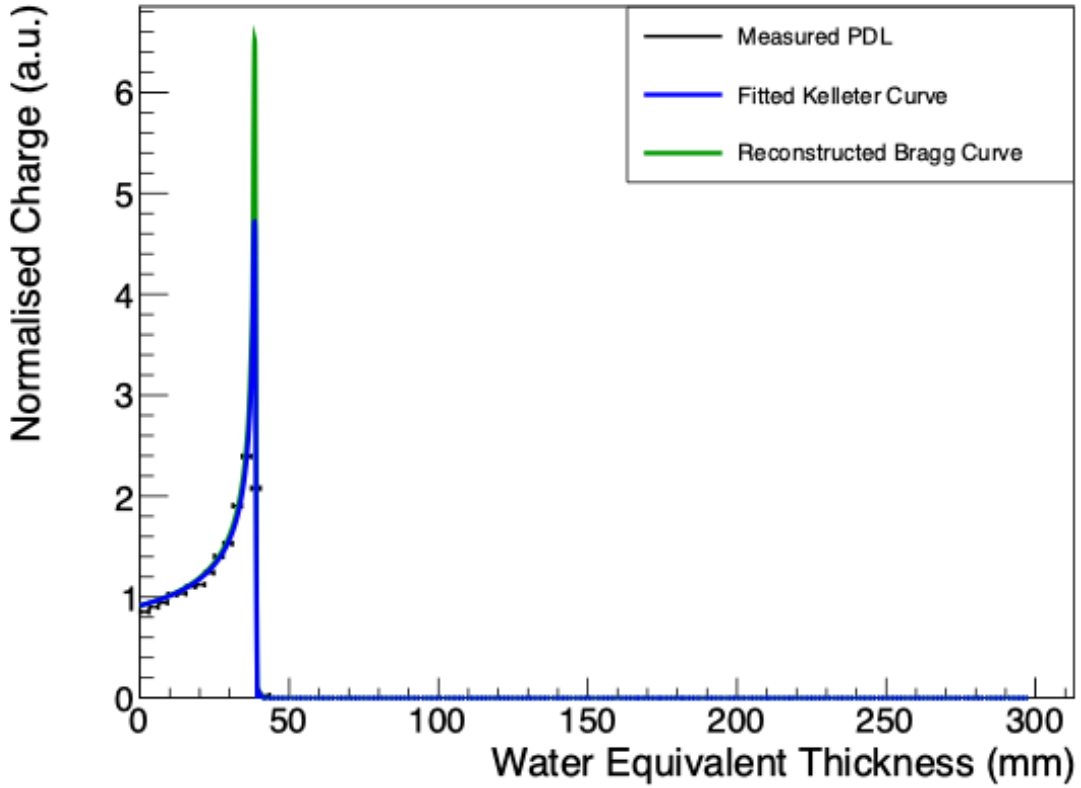
300 nA Energy Scan

112 MeV



E_0 = 110.56 MeV

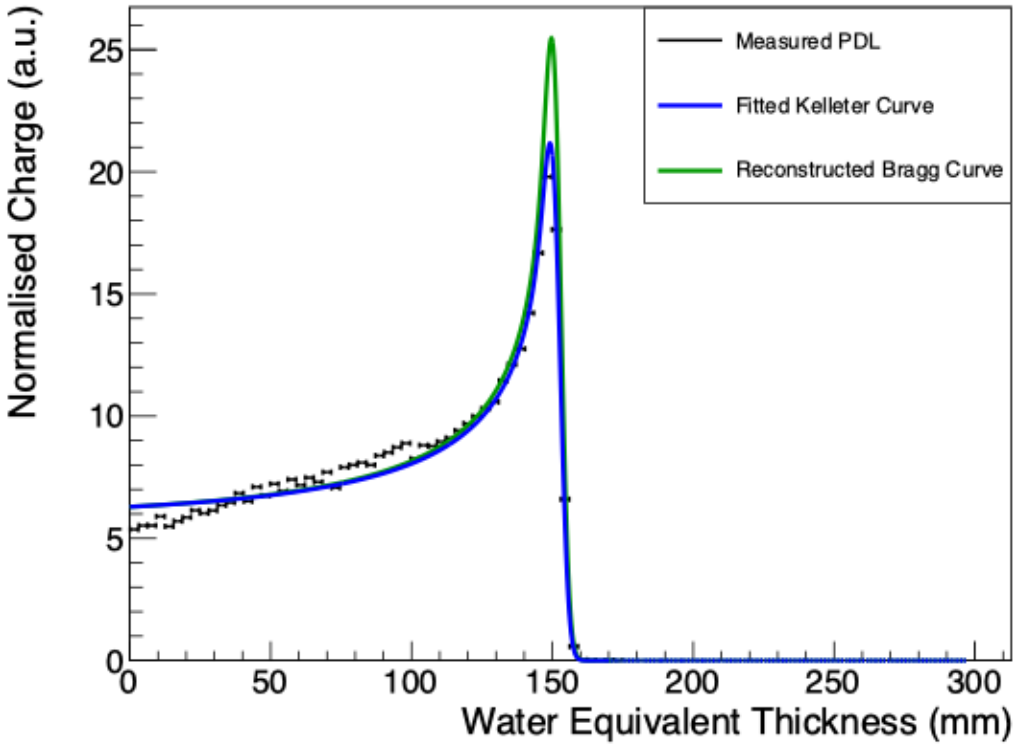
70 MeV



E_0 = 67.11 MeV

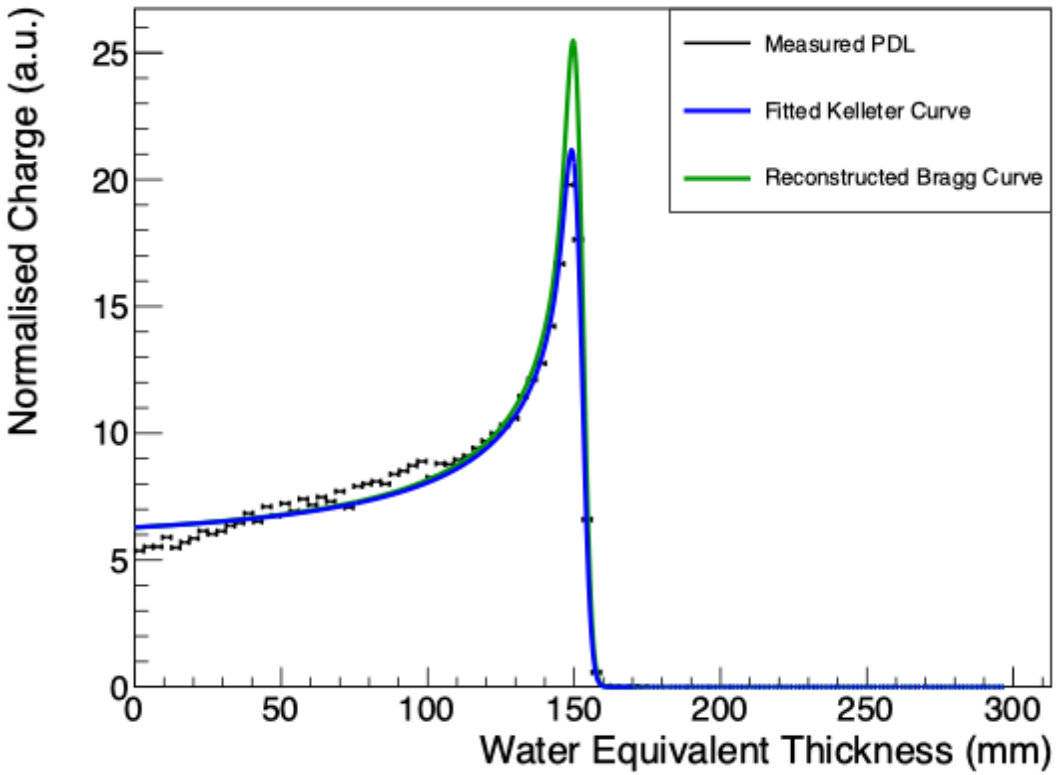
148 MeV Consistency – Side A

Night 1



E_0 = 147.16 MeV
R_0= 151.93 mm

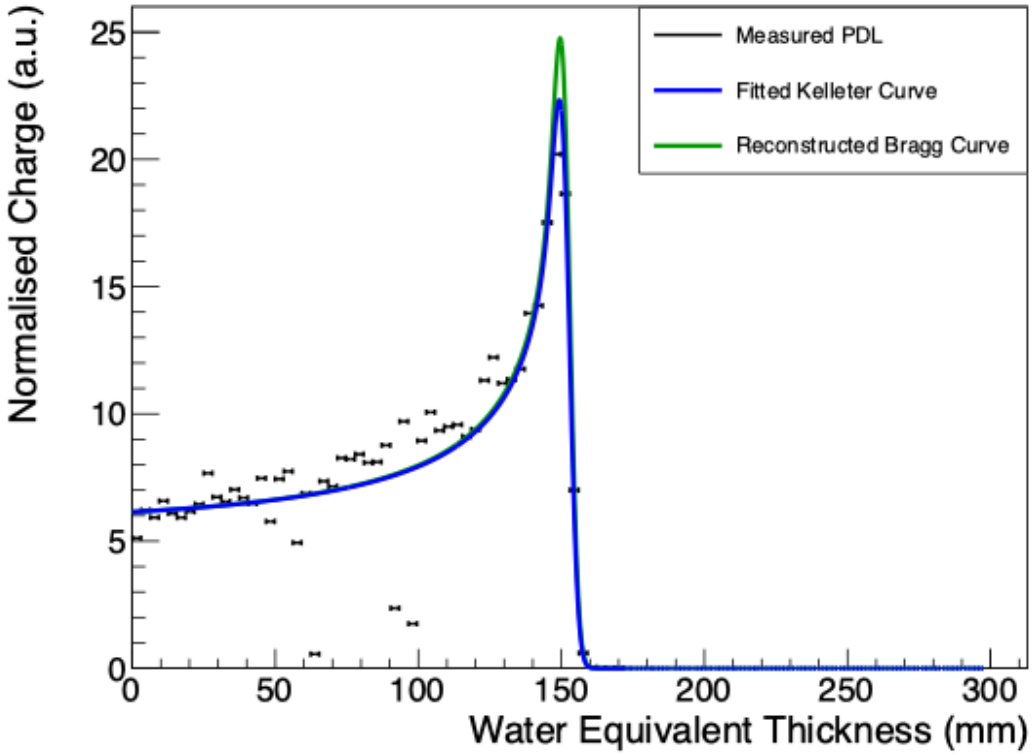
Night 2 (with fibres)



E_0 = 146.81 MeV
R_0= 151.29 mm

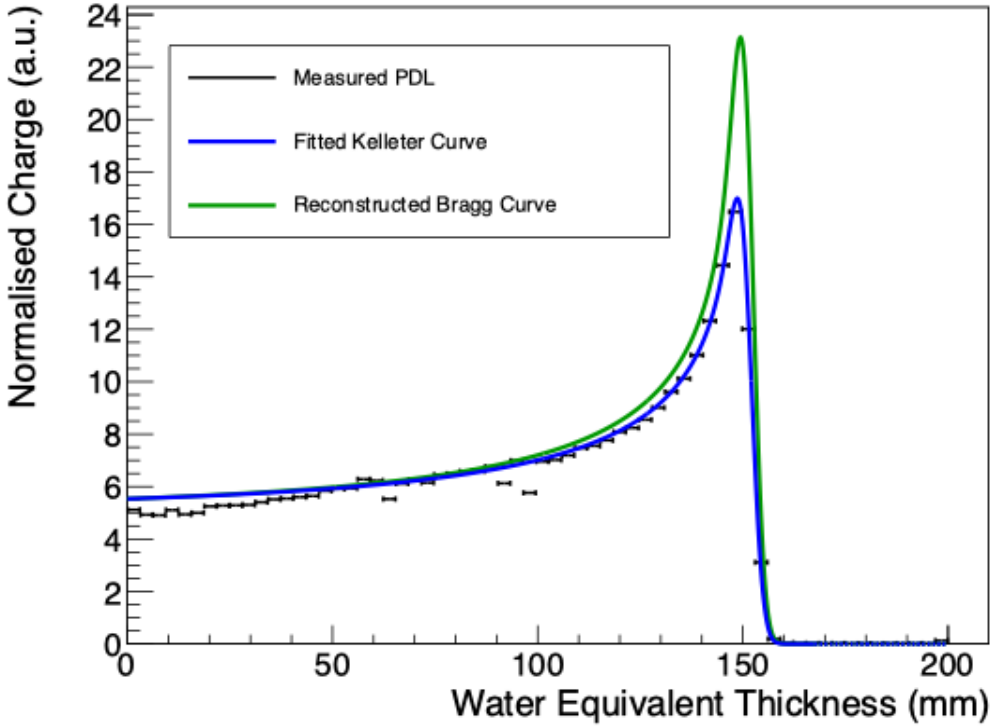
148 MeV Consistency – Side B

Night 1



E_0 = 147.12 MeV
R_0= 151.86 mm

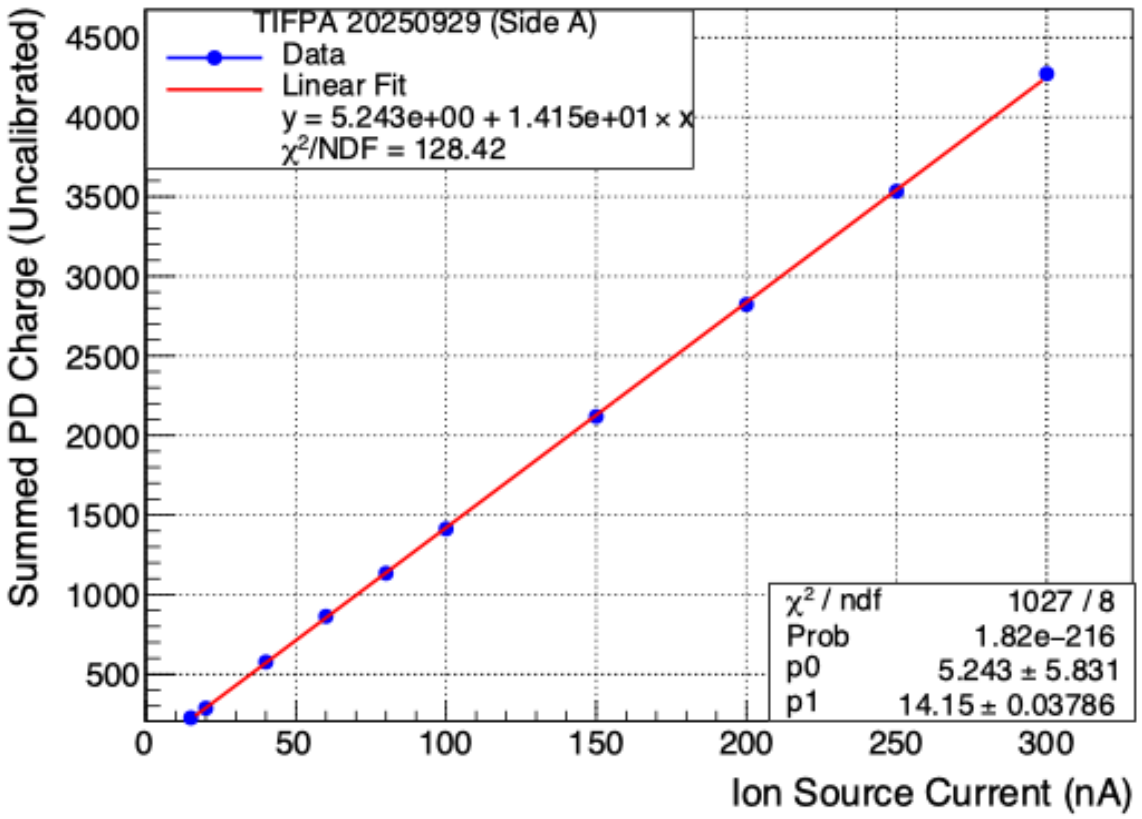
Night 2 (with fibres)



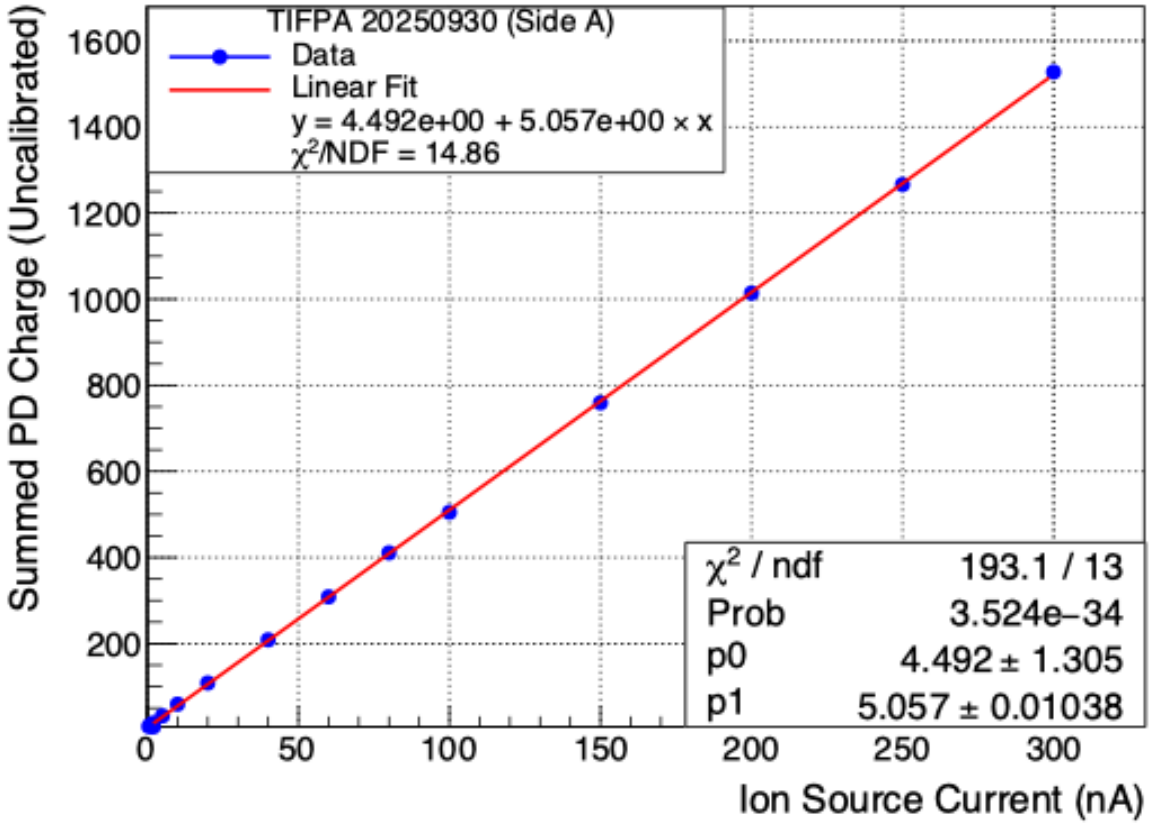
E_0 = 146.96 MeV
R_0= 151.56 mm

Response Linearity – summing all avg PD values

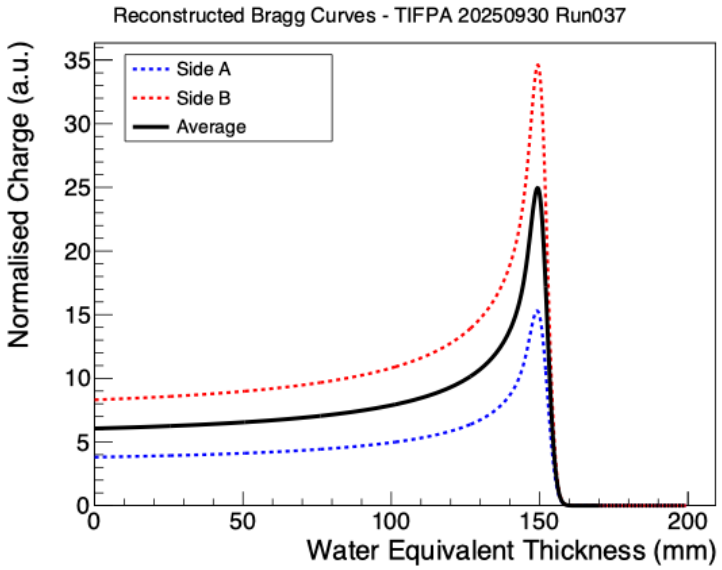
179 MeV



148 MeV



Position Scan - reconstructed 148 MeV Bragg Curves

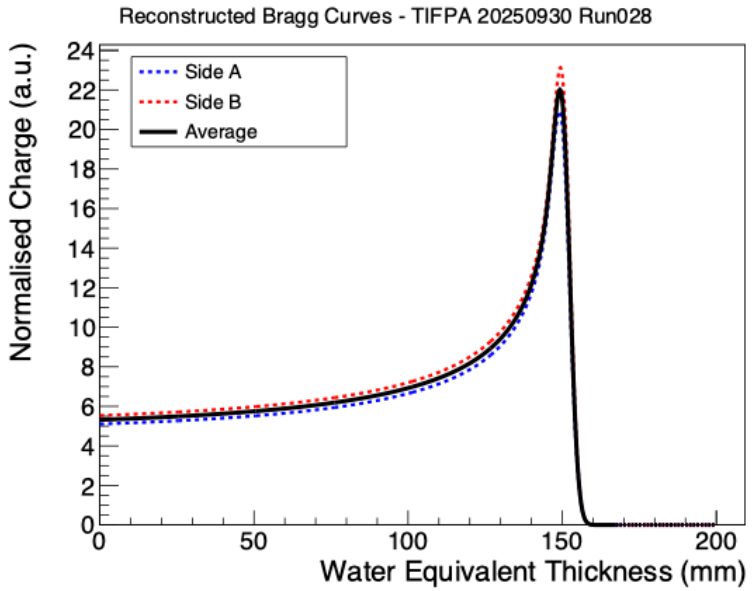


Beam 20mm to left

A: R_0 = 151.47 mm, E_0 = 146.91 MeV

B: R_0 = 151.51 mm, E_0 = 146.93 MeV

Avg: R_0 = 151.49 mm, E_0 = 146.92 MeV

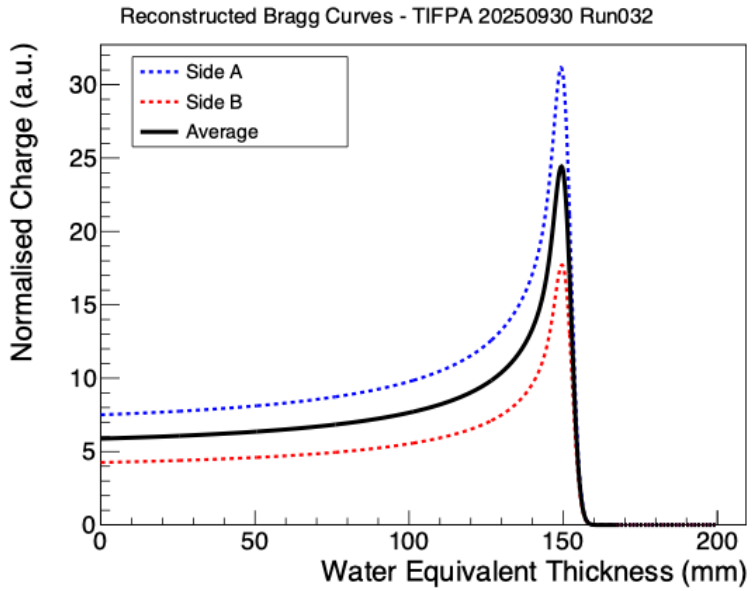


Beam in centre

A: R_0 = 151.29 mm, E_0 = 146.81 MeV

B: R_0 = 151.51 mm, E_0 = 146.93 MeV

Avg: R_0 = 151.4 mm, E_0 = 146.87 MeV



Beam 20mm to right

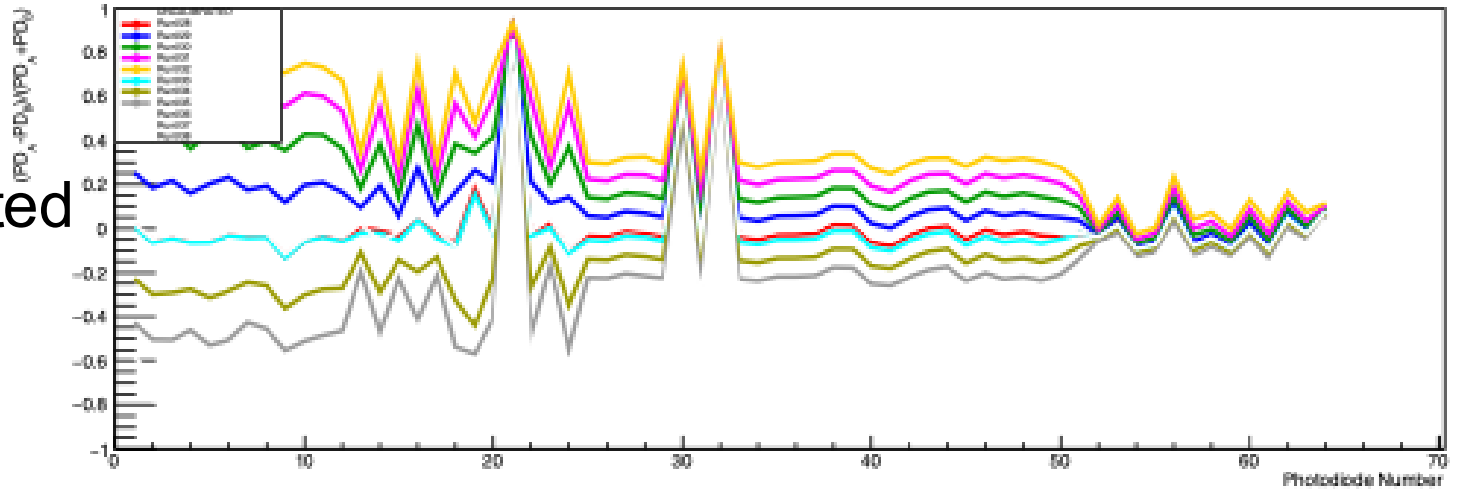
A: R_0 = 151.46 mm, E_0 = 146.9 MeV

B: R_0 = 151.73 mm, E_0 = 147.05 MeV

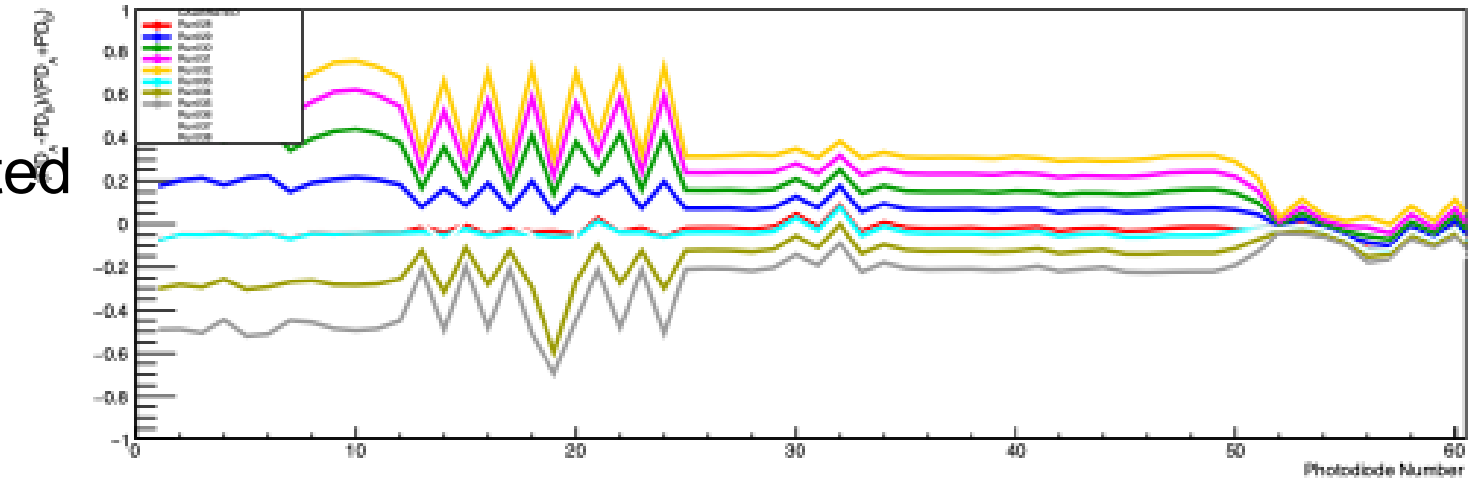
Avg: R_0 = 151.595 mm, E_0 = 146.975 MeV

Position Scan

Uncalibrated



Calibrated



179 MeV - Side B