



Booster Beam Emittance Dependence on LINAC Beam Current (data of 20170707)

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Acknowledgement: Kiyomi Seiya

Goal: Investigation of 400 MeV LINAC beam current intensity on the beam transverse beam emittance at injection in to the Booster.

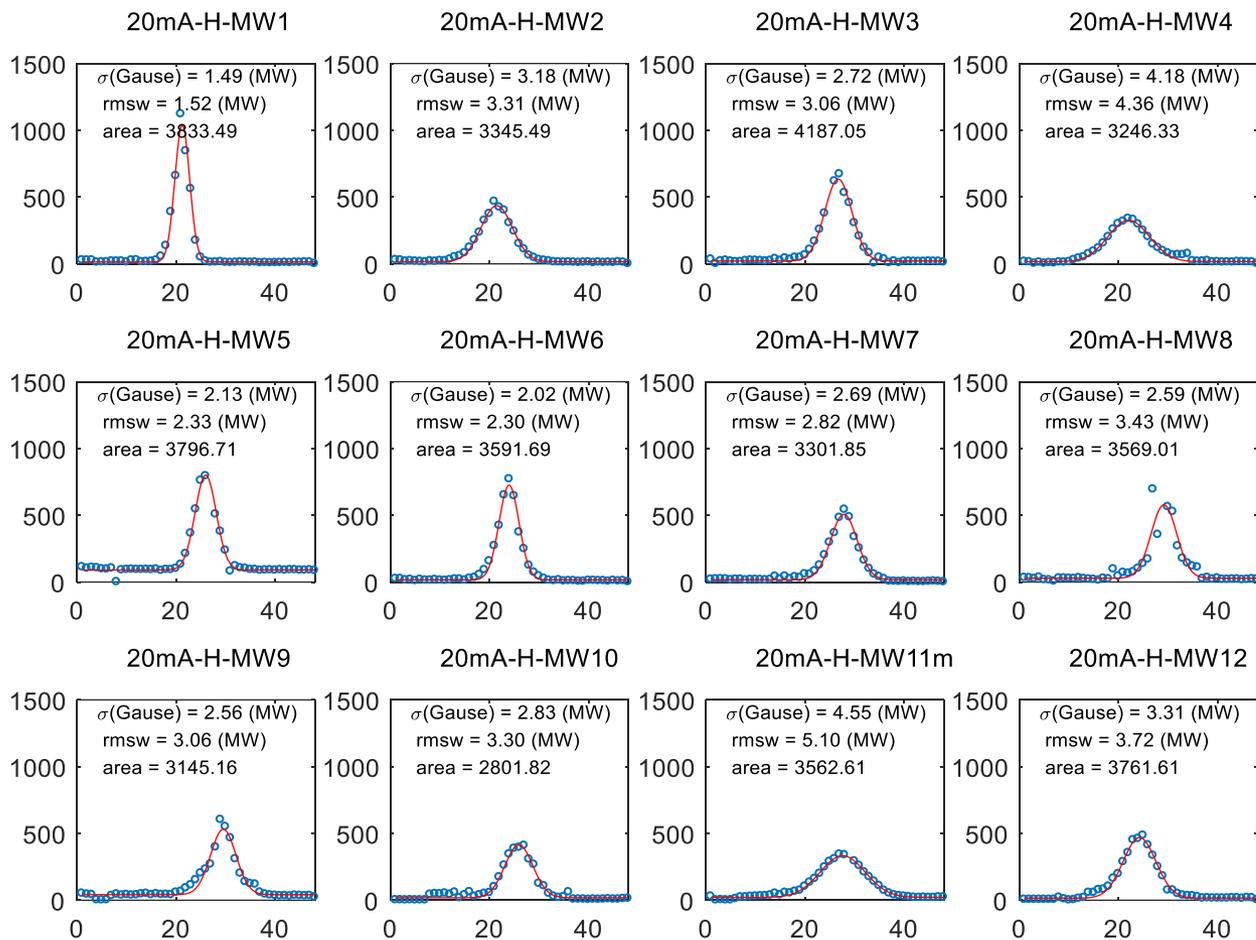
Procedure:

1. Change the LINAC beam current at source. This is accomplished by changing ***the settings on defocusing the solenoid***. We managed to get two sets of LINAC beam current: 20 mA and 25mA
2. Measure the beam size at various locations in the 400 MeV beam line, downstream of the LINAC
3. 12 Booster turn beam for all measurements



LINAC Beam = 20mA: H-Beam Size

Fermilab 400MeV Beamline H-MW 20170707data-(LINAC)=20mA



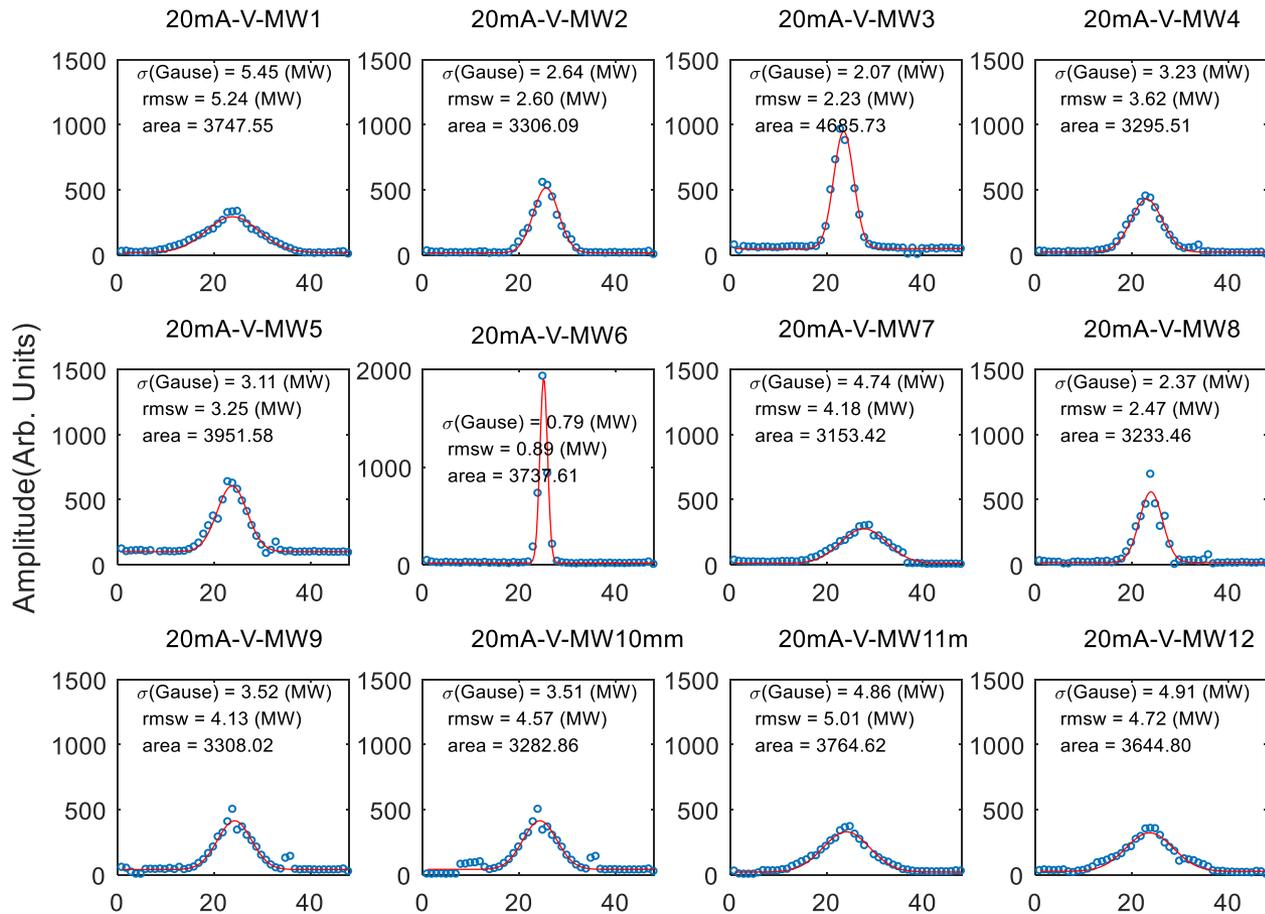
- 1) Gaussian fit to the data
- 2) RMSW with background from Gaussian fit
- 3) Area from Gaussian fit \sim Beam Intensity

Multiwire Number (pitch=0.5mm, Be-CU Wiresize=2mil)



LINAC Beam = 20mA: V-Beam Size

Fermilab 400MeV Beamline V-MW 20170707data-(LINAC)=20mA

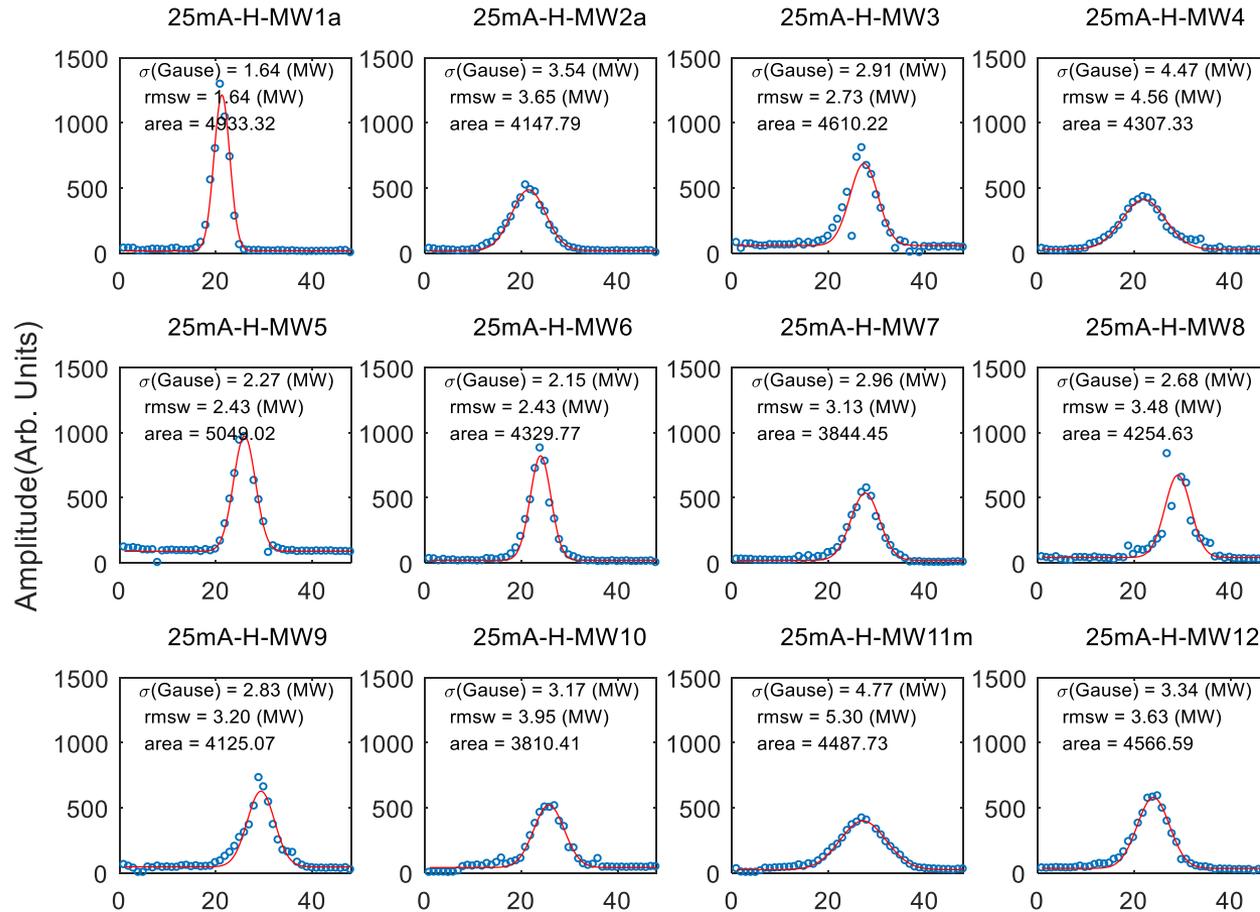


Multiwire Number (pitch=0.5mm, Be-CU Wiresize=2mil)



LINAC Beam = 25mA: H-Beam Size

Fermilab 400MeV Beamline H-MW 20170707data-(LINAC)=25mA

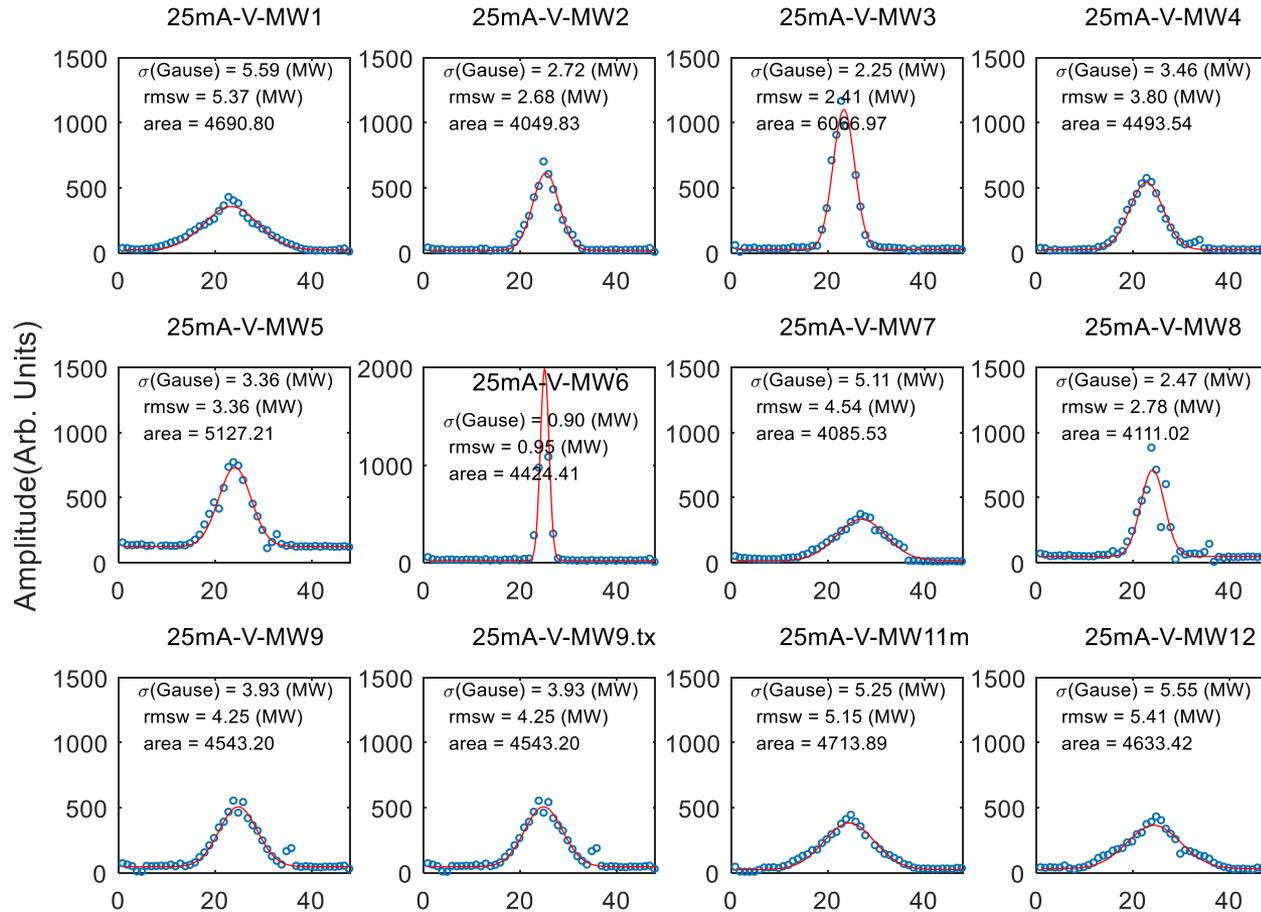


Multiwire Number (pitch=0.5mm, Be-CU Wiresize=2mil)



LINAC Beam = 25mA: V-Beam Size

Fermilab 400MeV Beamline V-MW 20170707data-(LINAC)=25mA



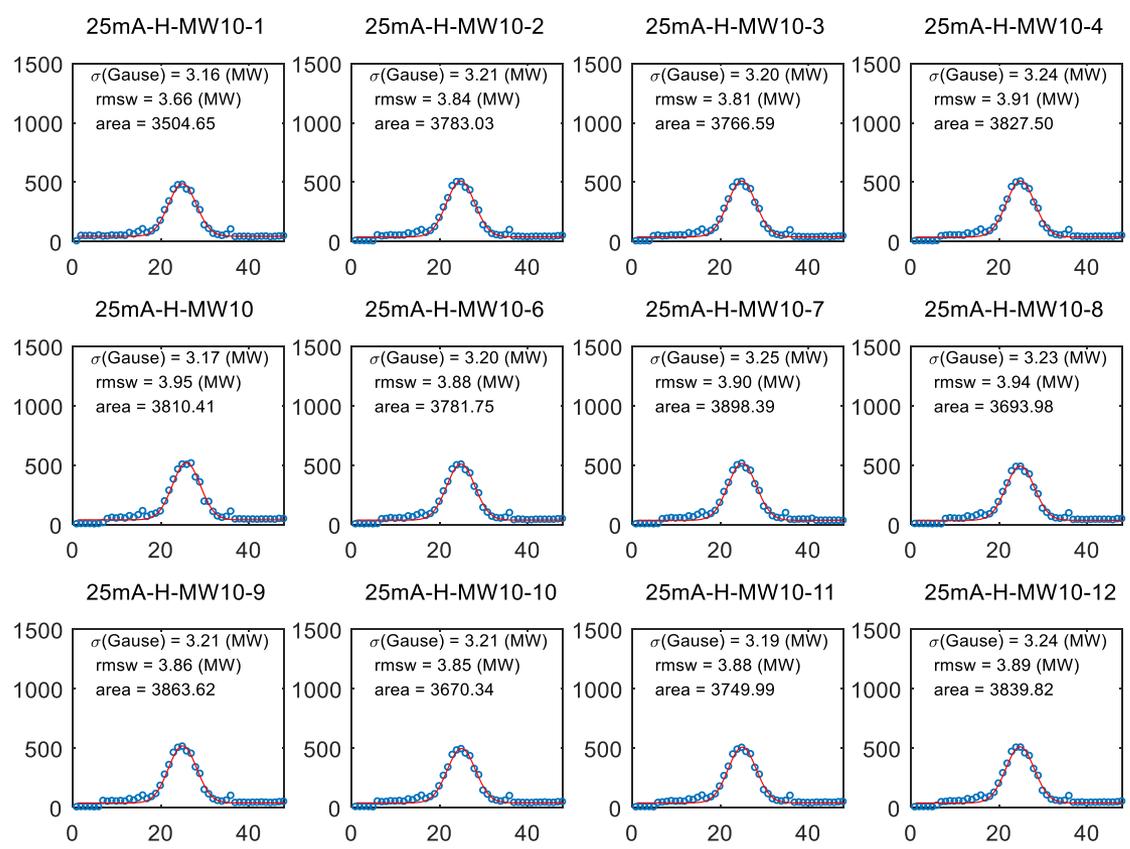
Multiwire Number (pitch=0.5mm, Be-CU Wiresize=2mil)



LINAC Beam = 25mA: MW10-H -Beam Size (Error Analysis)



Fermilab 400MeV Beamline H-MW 20170707data (Error Analysis)



Multiwire Number (pitch=0.5mm, Be-CU Wiresize=2mil)

20170707 Data

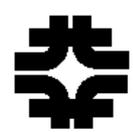
Error Analysis in MW data of 400 MeV Line With limited samples

Data is taken on H- MW10 with LINAC beam current of 25mA

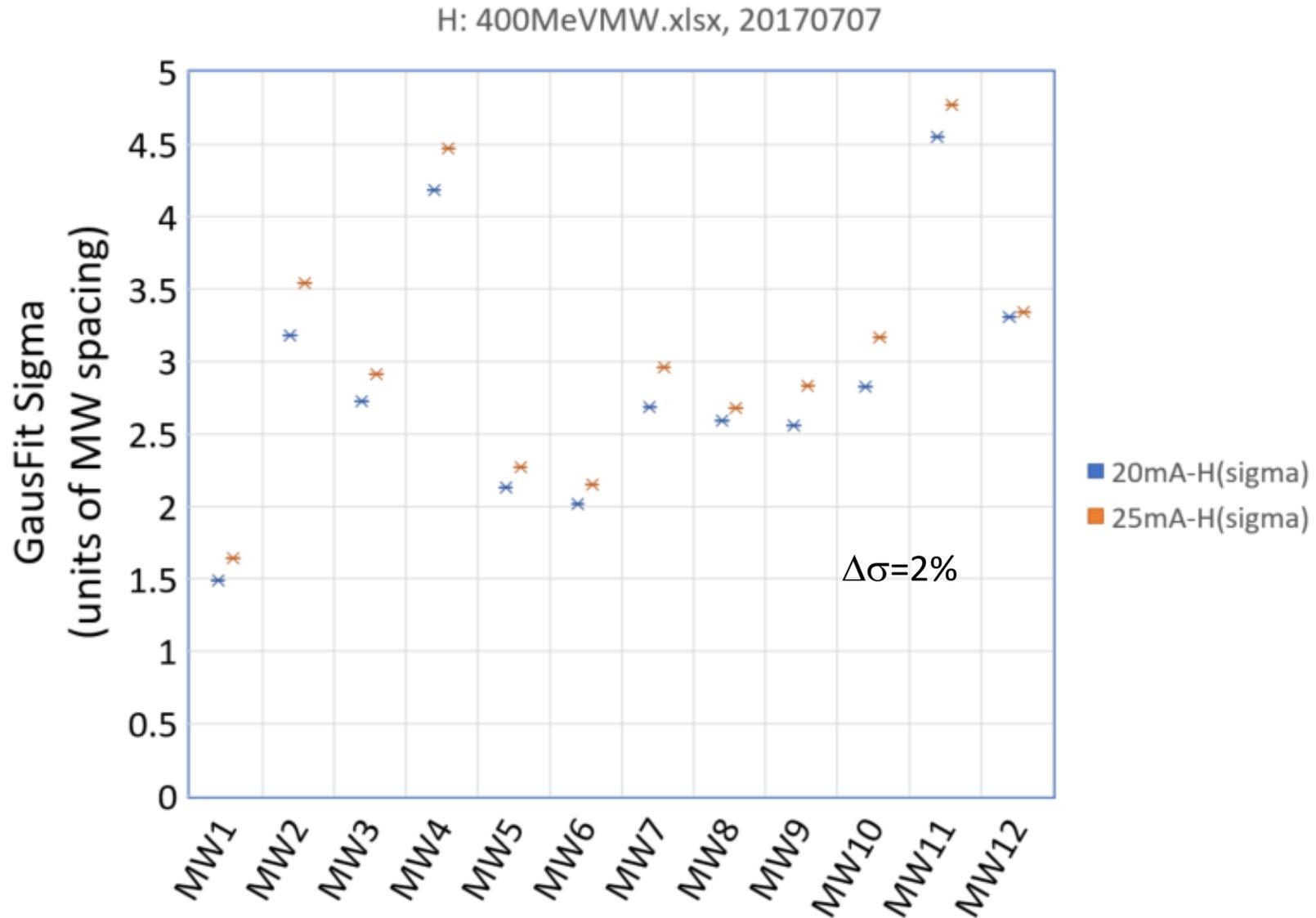
MW == Simply number of MW; This needs to be scaled to pitch and thickness of the wire

Meas #	Gaus Sigm (MW)	RMSW (MW)
1	3.16	3.66
2	3.21	3.84
3	3.2	3.81
4	3.24	3.91
5	3.17	3.95
6	3.2	3.88
7	3.25	3.9
8	3.23	3.94
9	3.21	3.86
10	3.21	3.86
11	3.19	3.88
12	3.24	3.89

Average:	3.209	3.865 MW
Std:	0.028	0.076 MW
Std/B-Size=	0.87	1.96 %



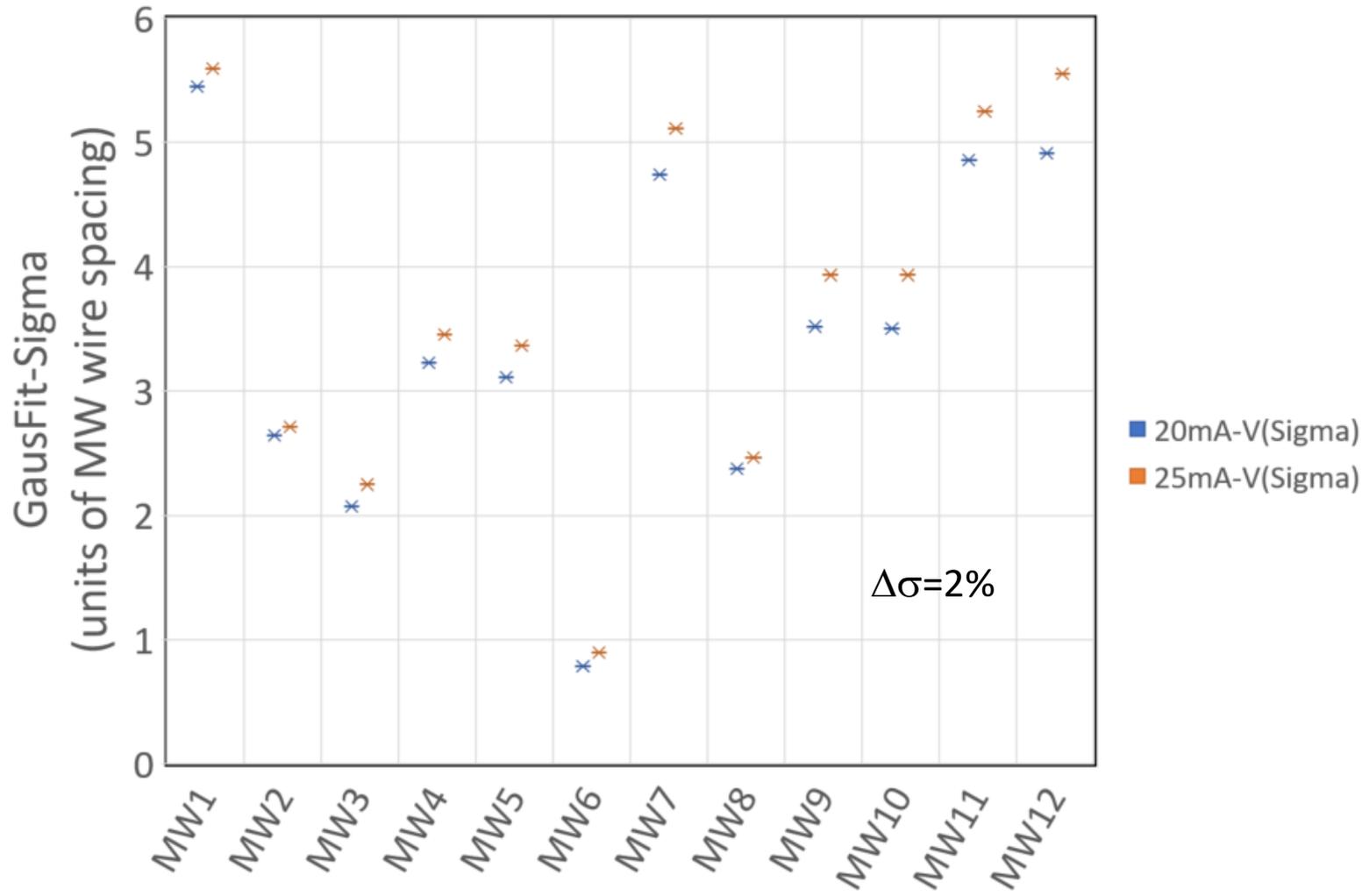
Horizontal Beam Sizes





Vertical Beam Sizes

V: 400 MeVMW.xlsx, 20170707





Conclusions

- The standard deviation is about 0.9% for the Gaussian σ and $\sim 2\%$ for the rmsw value from the data for the same wire. This gives a measure on the statistical error on the measured beam sizes
- The beam σ for 25mA LINAC beam is systematically larger by $>4\%$ than that for 20mA LINAC beam. Emittance Analysis is in progress. (Notice that the emittance scales as σ^2)