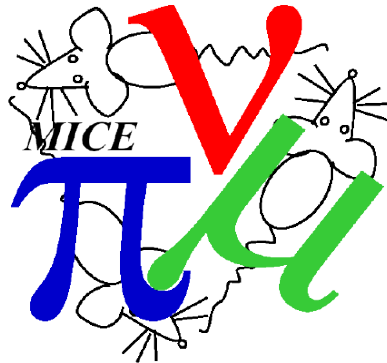




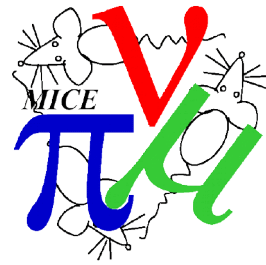
Run Settings



C. Rogers,
ASTeC Intense Beams Group
Rutherford Appleton Laboratory



Settings – for consideration



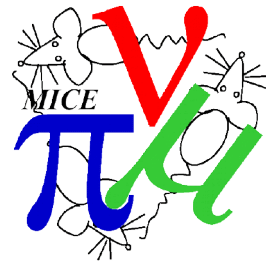
■ Propose

- Fixed beta = 500 mm, fixed momentum = 200 MeV/c, scan emittance (potentially with higher statistics)
- Momentum = 200 MeV/c, scan beta
- Fixed beta = ?800 mm, scan momentum, scan emittance
- Consider going from flip mode to solenoid mode or vice versa (angular momentum conservation, etc)
- Guidance is for 3 settings during the user run, which is less than is suggested here

■ Note

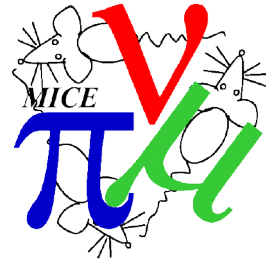
- 140 MeV/c has smaller minimum beta
 - Should we do beta scan at 140 MeV/c?
 - Discussion below...
- Ao has found going to < 3 T may help

Historical data



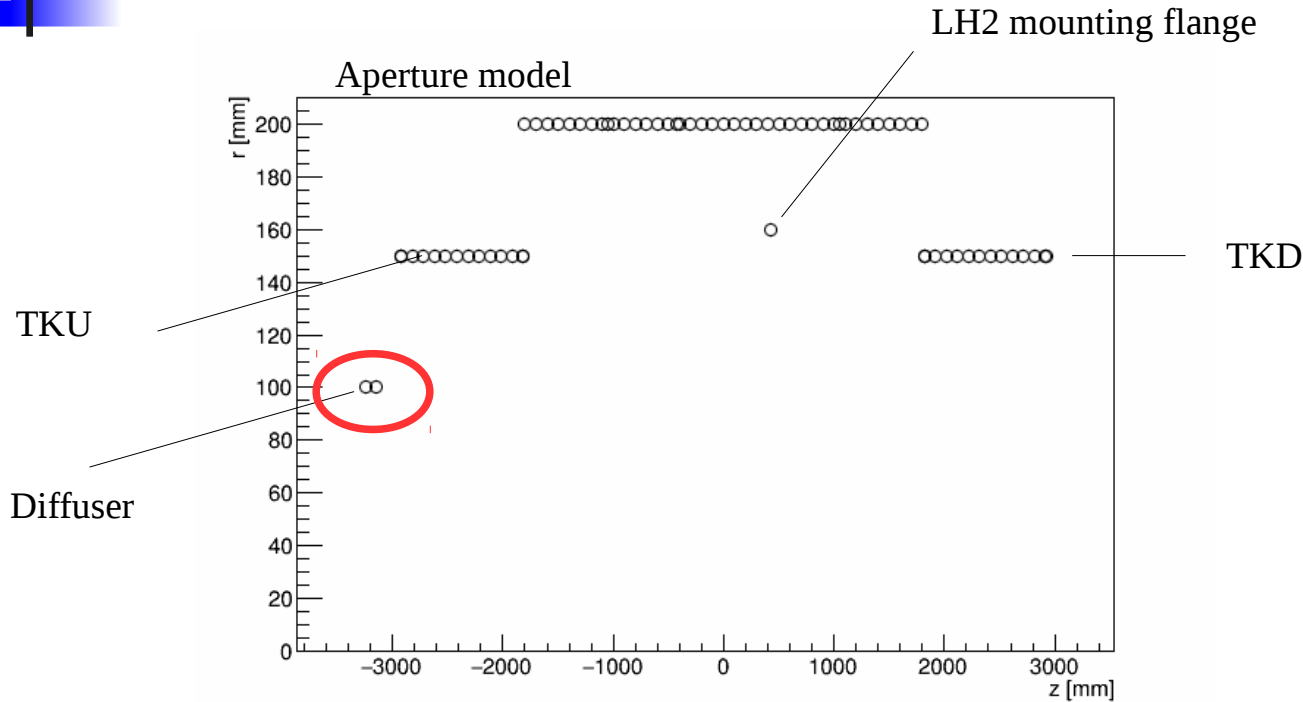
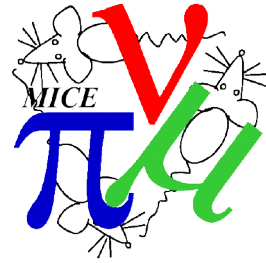
Momentum	Runs	Particle Triggers	TOF2 Triggers	Time	Number at TOF2	Number passing TOF12 cut	Number passing all cuts	Number in peak 4 MeV/c p_tot bin	Number in peak 200 ps tof12 bin
D2: ~70 A	[8445, 8447, 8452, 8457, 8465, 8466, 8470, 8471]	1291302	674955	14 hrs 34 min	287921	193494	90374	27594.0	10583.0
D2: ~83 A	[8448, 8449, 8453, 8458, 8464, 8469]	1361595	536943	10 hrs 46 min	151273	67019	39574	6080.0	4984.0
D2: ~95 A	[8450, 8454, 8455, 8459, 8463, 8468]	2456675	507768	14 hrs 39 min	212530	147673	91475	18382.0	16154.0
D2: ~111 A	[8451, 8456, 8460, 8461, 8462, 8467]	1520791	517116	6 hrs 21 min	232595	149968	89760	14557.0	22636.0

Algorithm



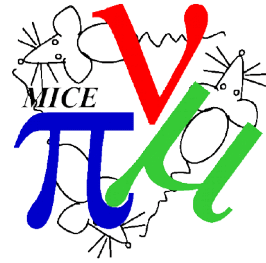
- Throw beam ellipse down MICE beamline 10000 times
 - Throw random magnet currents (why not a grid?)
- Use naive linear model for apertures
- Assume beta is matched at TKU
 - I can remove this constraint with a switch
- Try to map space of acceptance and beta at focus coil
- M2D is switched off and solenoid mode for all solutions
- 3T in SSU and SSD

Constraints



- $253 \cdot 0.66 < M2U < 253$ A; $100 < M1U < 278$ A
- $0 < FC < 114$ A (solenoid) **or** $0 < FC < 180$ A (flip)
- $M1D = M2D = 0$ A
- **Either** $M1U * FC < 18500$ (solenoid) or 28000 (flip)
- **Or** No force limit
- Solenoid mode, 3 T in ECE
- **Use Ao's extrapolated beam parameters at TOF1**

Input Beam (1)



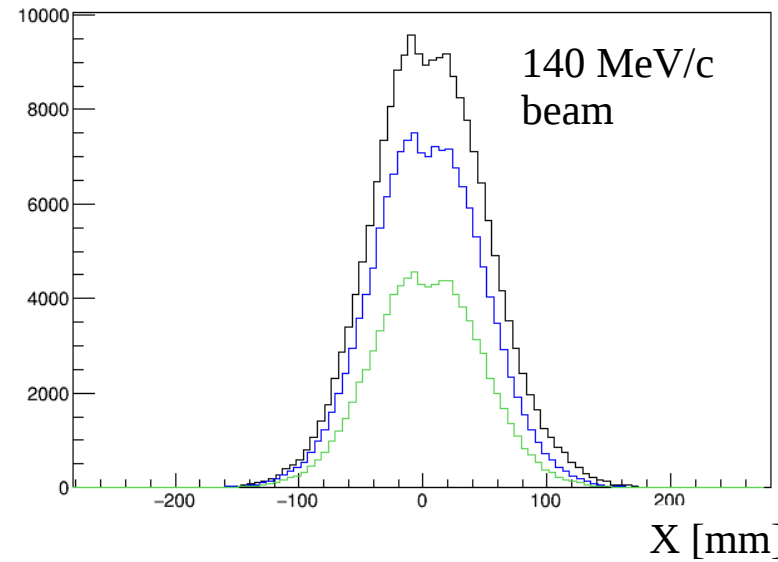
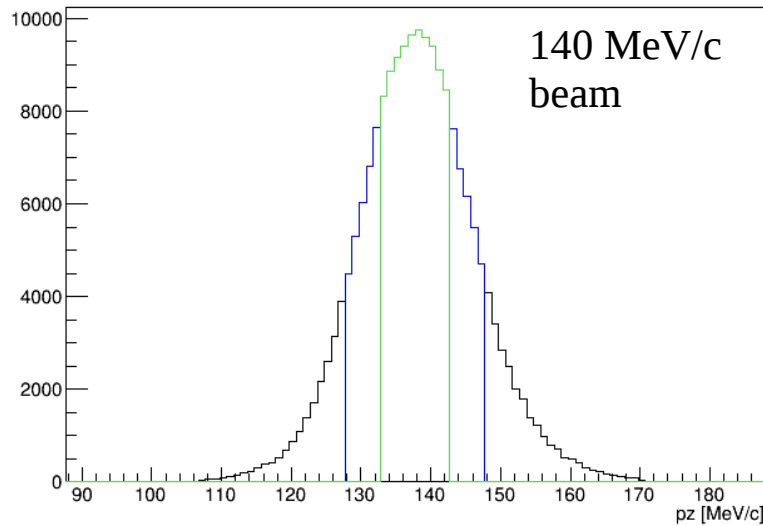
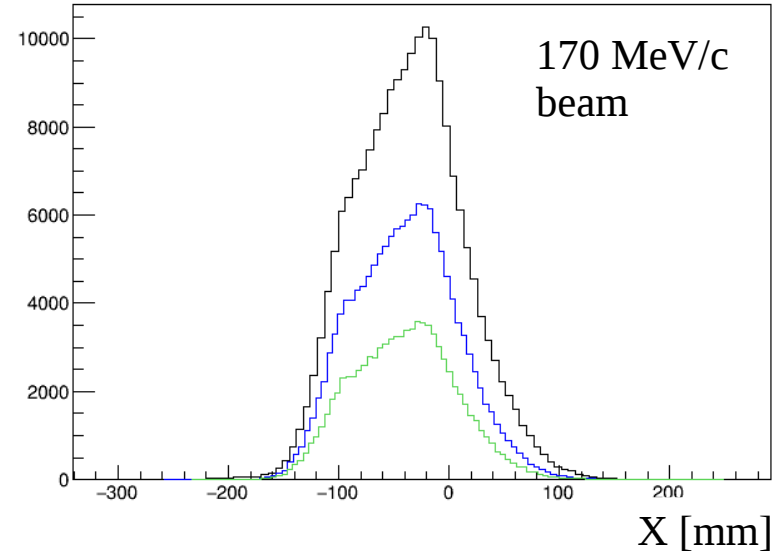
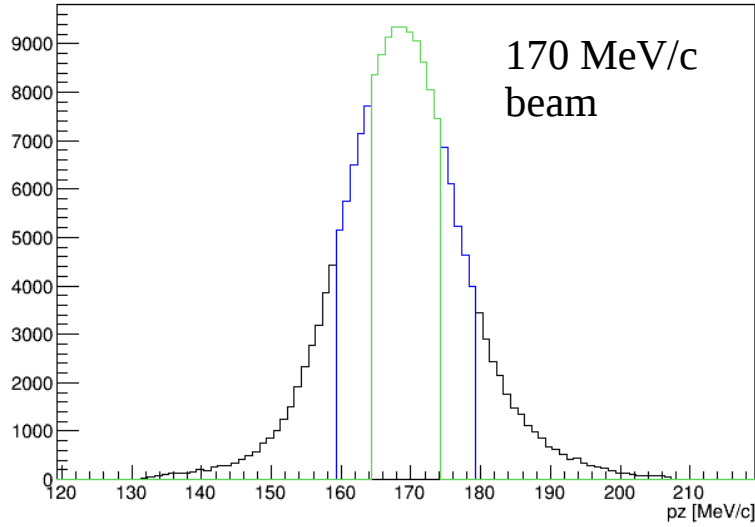
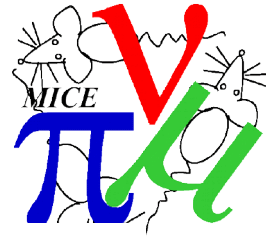
file_name	pz_peak	mean_x	mean_y	mean_px	mean_py	mean_pz	
beam_files/tof1_forward_140.gbeam	137.73		2.85	0.98	-0.89	-0.49	137.74
beam_files/tof1_forward_170.gbeam	169.29		-40.85	2.24	2.09	1.86	169.19
beam_files/tof1_forward_200.gbeam	195.97		6.46	1.82	-3.10	-0.51	195.89
beam_files/tof1_forward_240.gbeam	239.89		-17.55	5.89	6.84	2.83	239.71

file_name	4D_emittance	4D_beta	4D_alpha
beam_files/tof1_forward_140.gbeam	2.52	810.61	0.45
beam_files/tof1_forward_170.gbeam	2.74	1,085.79	0.67
beam_files/tof1_forward_200.gbeam	3.06	2,137.70	0.53
beam_files/tof1_forward_240.gbeam	2.67	1,232.87	-0.09

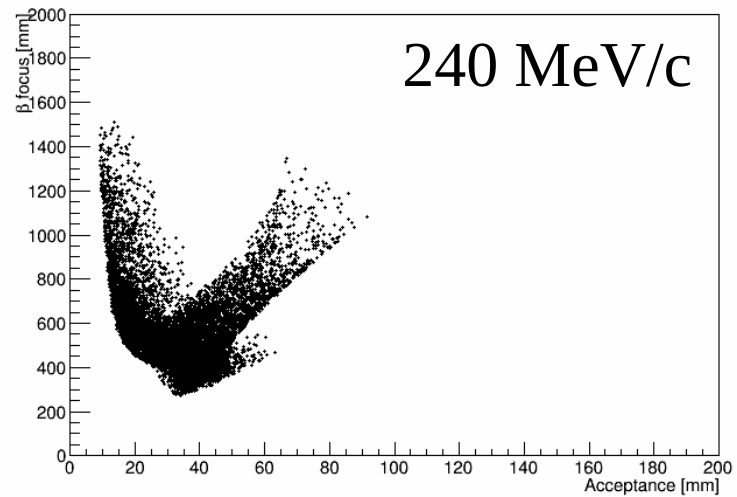
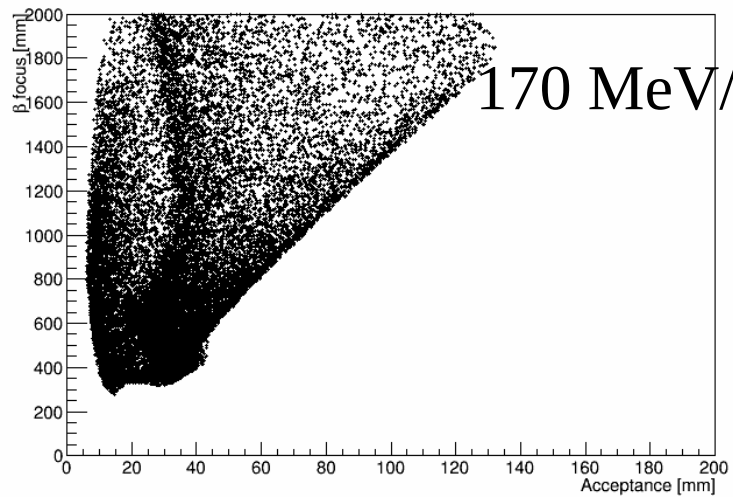
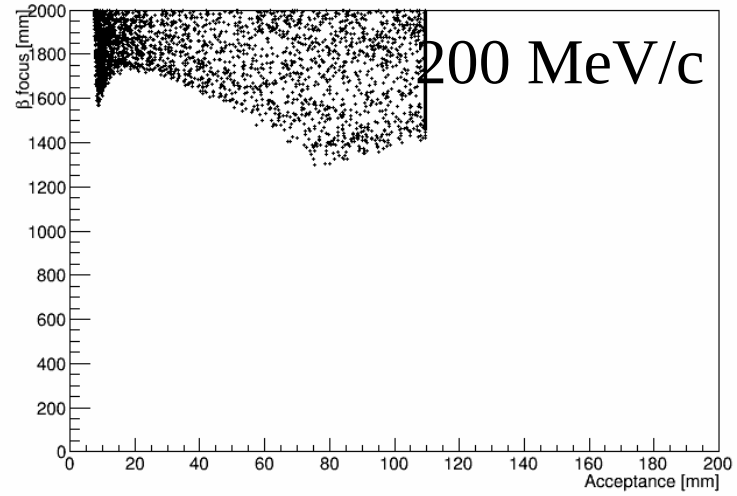
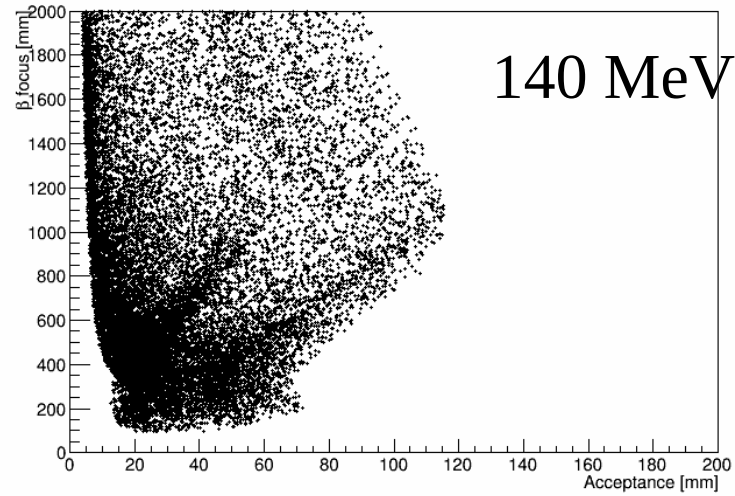
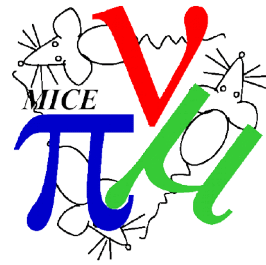
file_name	2D_emittance_x	2D_beta_x	2D_alpha_x	2D_emittance_y	2D_beta_y	2D_alpha_y
beam_files/tof1_forward_140.gbeam	3.02	831.39	0.65	2.11	744.91	0.15
beam_files/tof1_forward_170.gbeam	3.17	1,096.72	0.95	2.40	1,027.24	0.26
beam_files/tof1_forward_200.gbeam	3.47	2,315.80	0.86	2.78	1,810.18	0.09
beam_files/tof1_forward_240.gbeam	3.38	1,063.21	0.35	2.14	1,397.97	-0.78

- Use the measured beam from 2016/03 as input
 - Ao extrapolates back to TOF1 and then we track forwards
- For linear optics I assume cylindrical symmetry
 - Can be a bad approximation in some cases

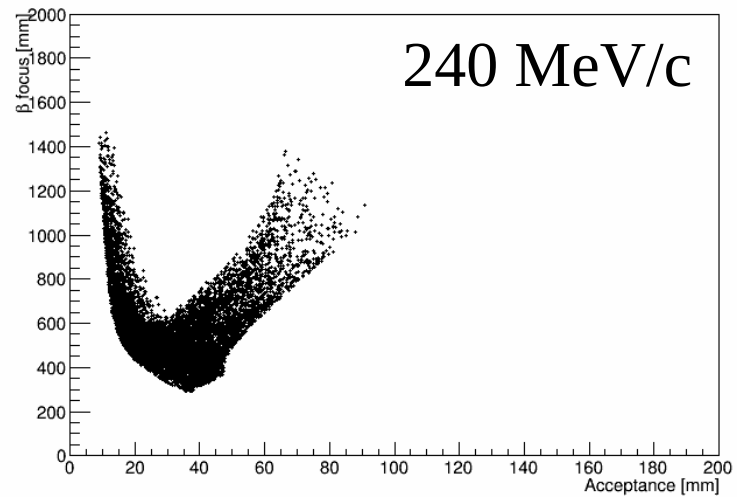
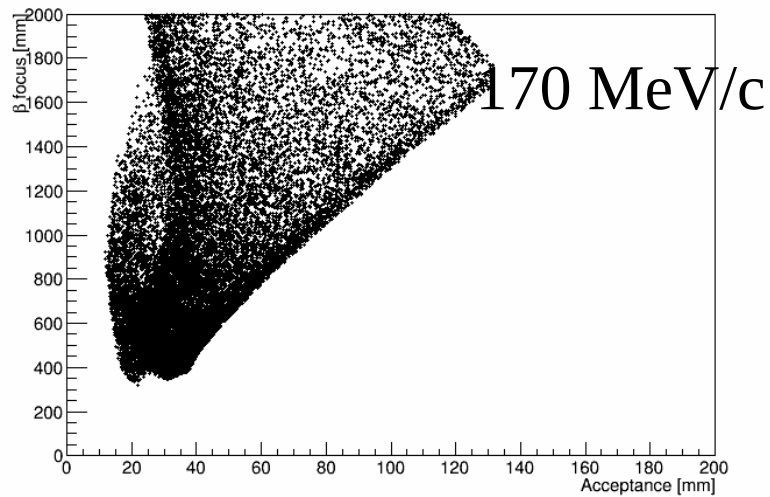
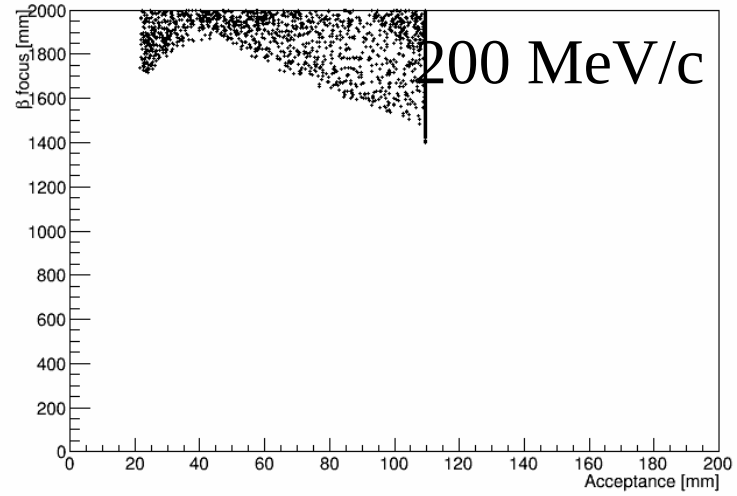
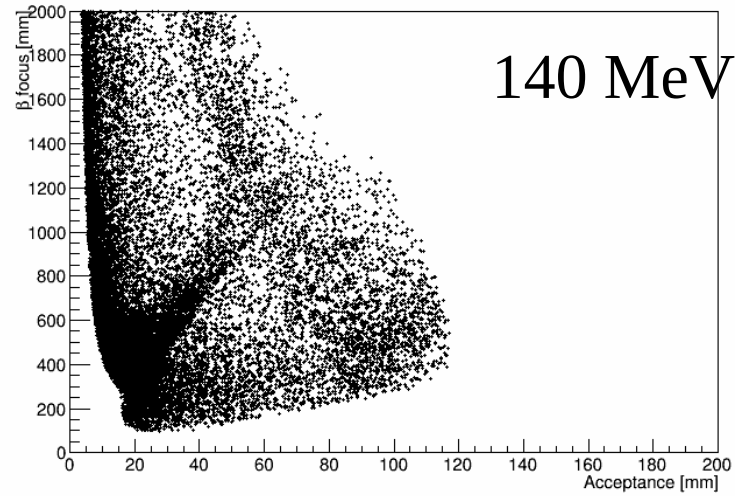
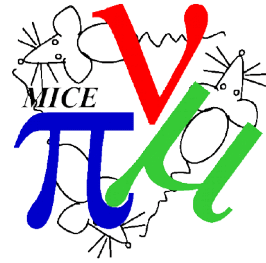
Input Beam (2)



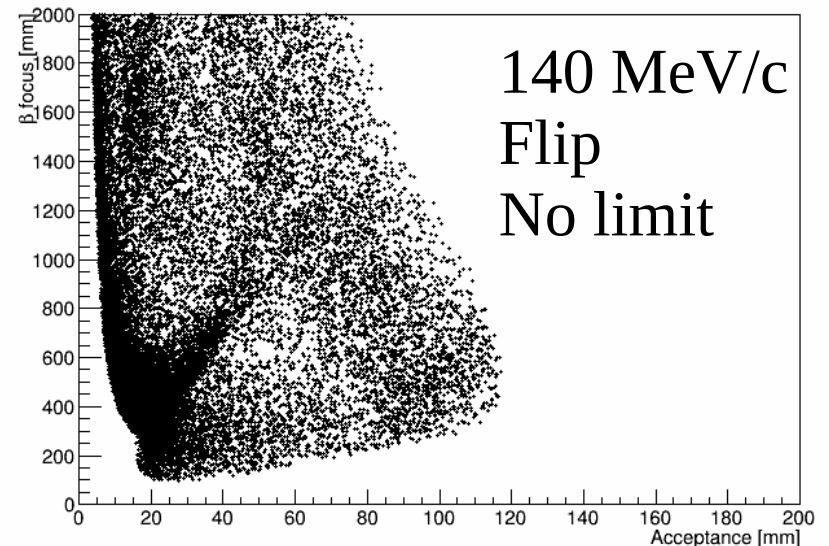
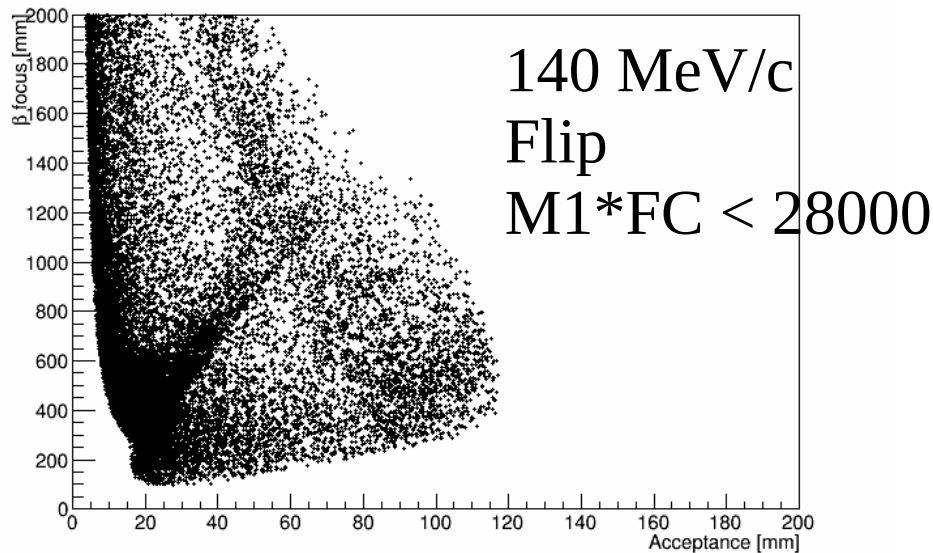
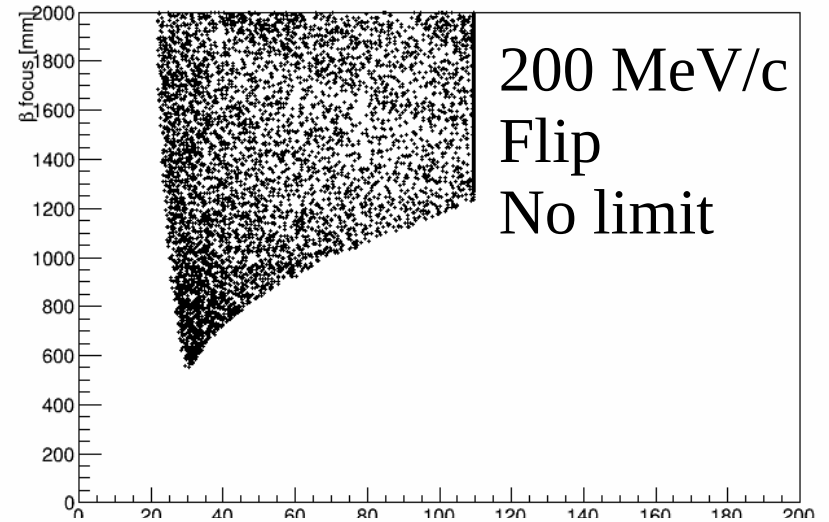
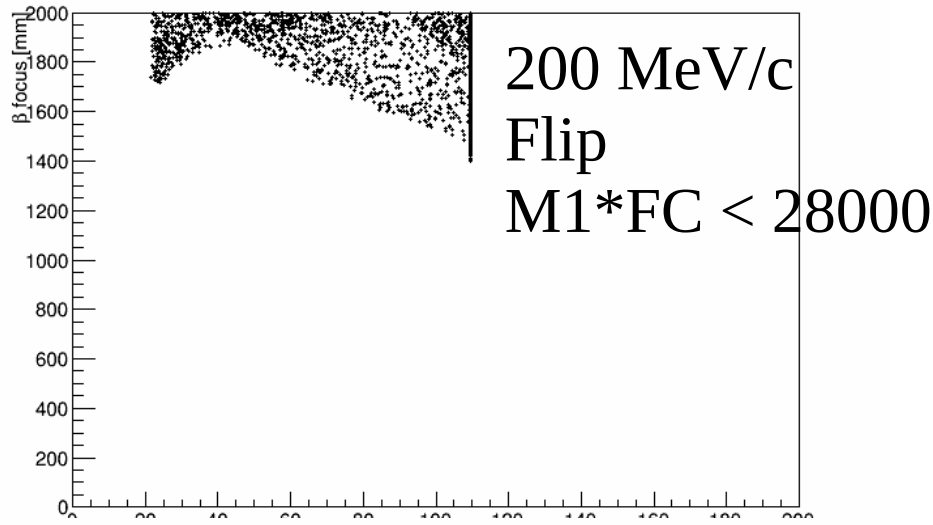
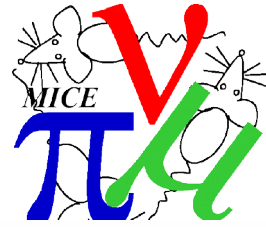
$M1 * FC < 18500$ (solenoid)



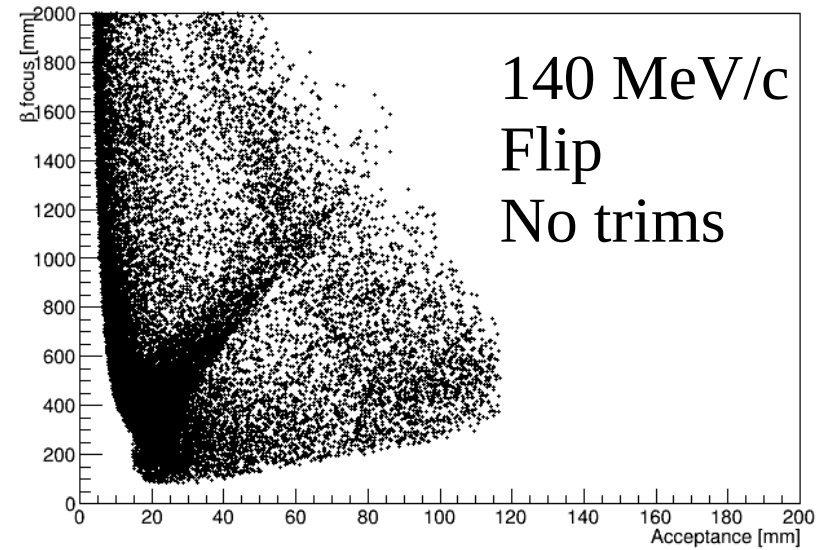
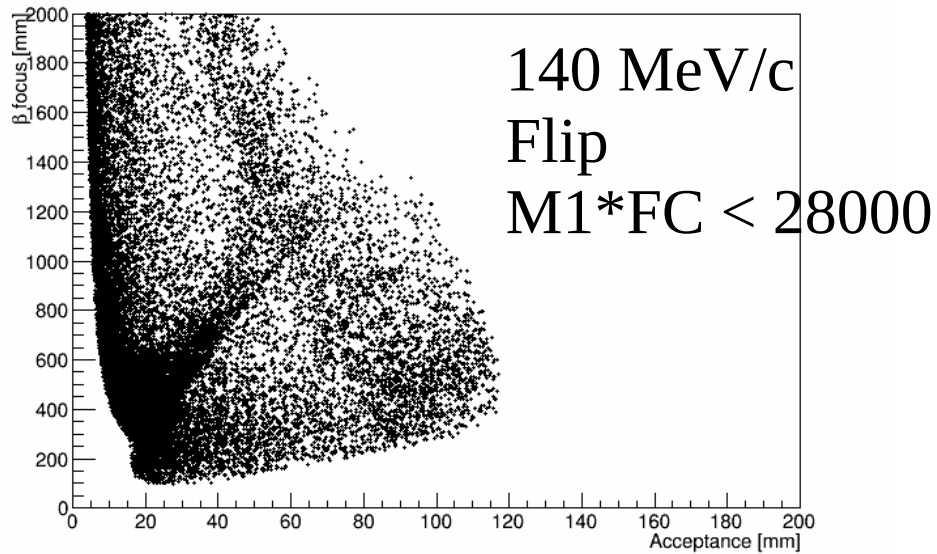
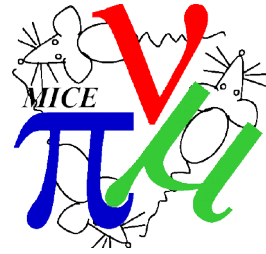
$M1*FC < 28000$ (flip)



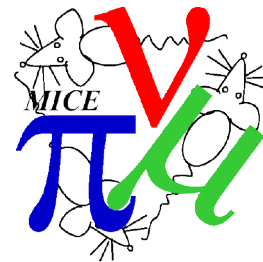
Effect of force limit



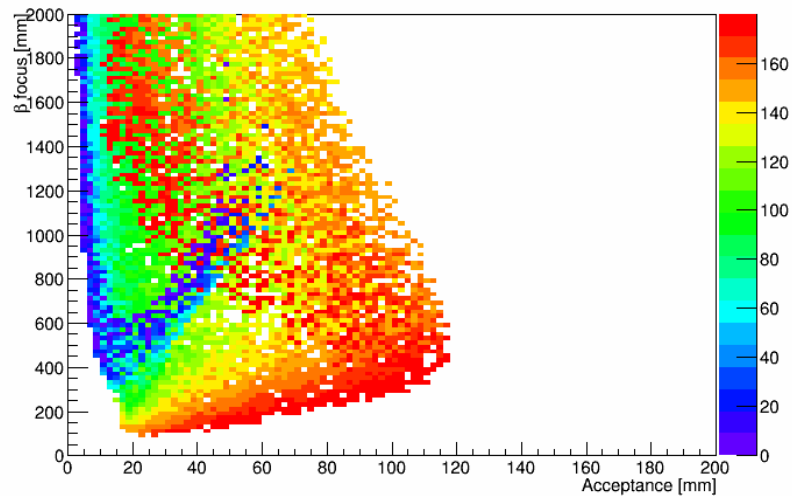
Effect of trim coils



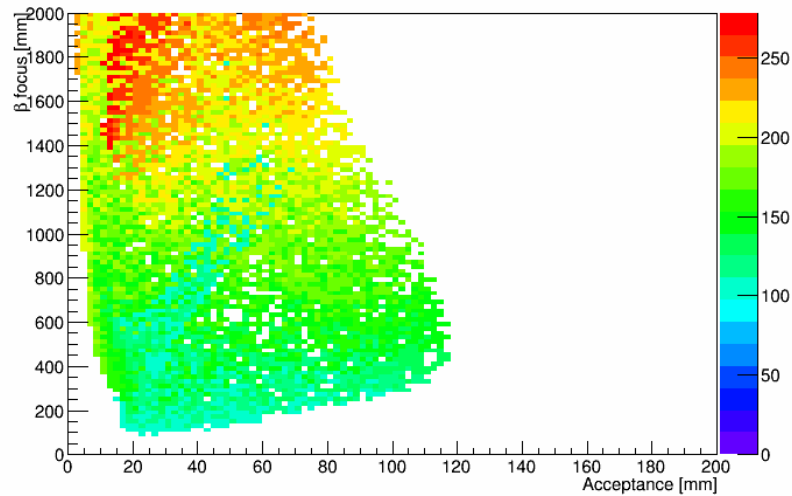
140 MeV/c flip



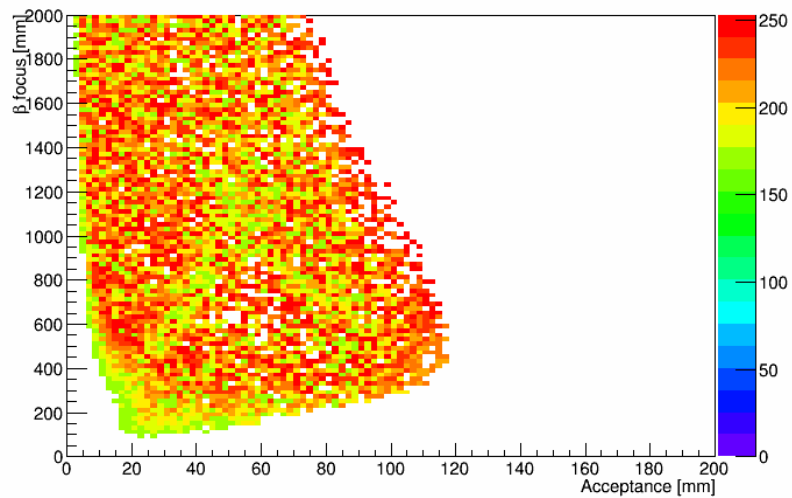
FocusCoil_US



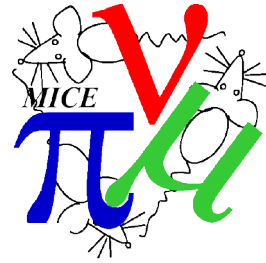
MatchCoil1_US



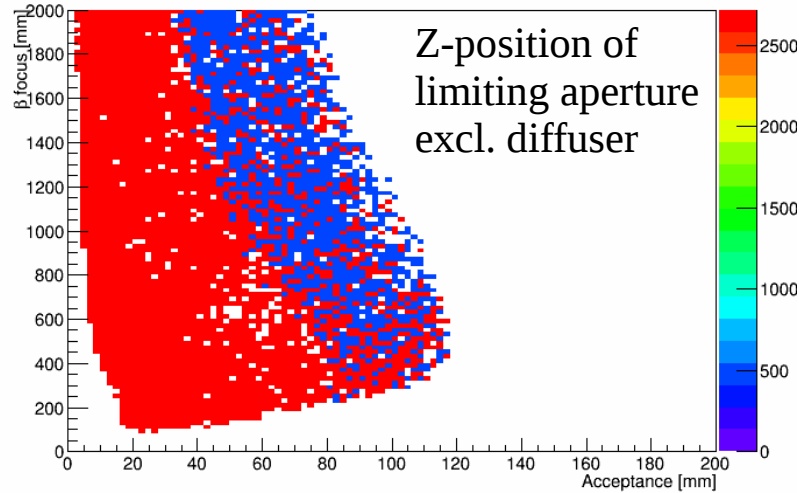
MatchCoil2_US



140 MeV/c flip

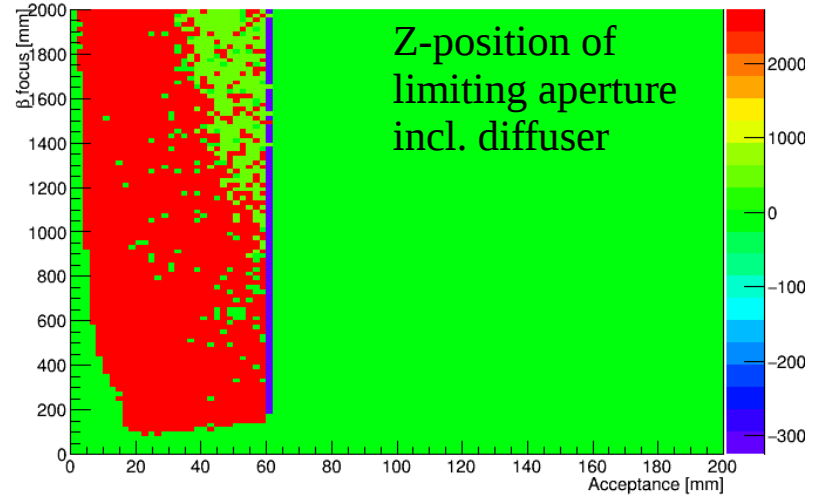


acceptance_z



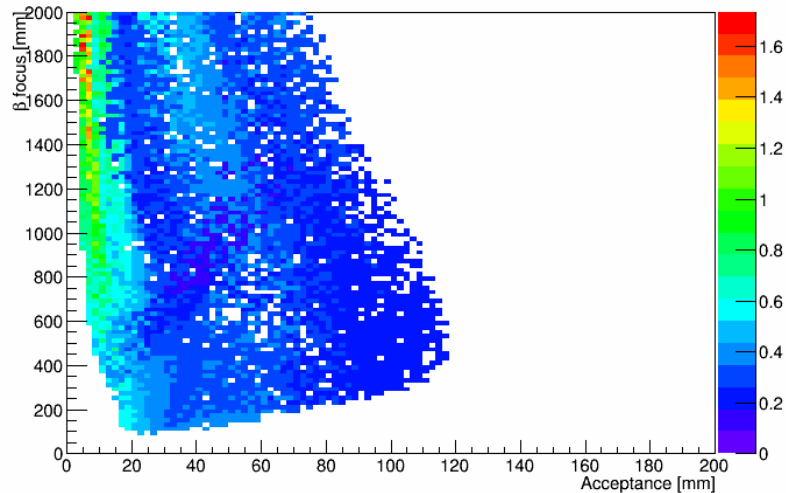
Z-position of
limiting aperture
excl. diffuser

acceptance_z



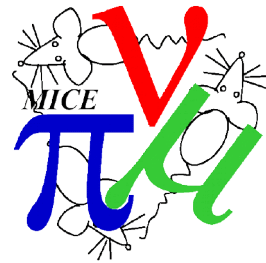
Z-position of
limiting aperture
incl. diffuser

max_dbeta



Maximum value for $1/\beta(d\beta/dp)$
i.e. strength of chromatic aberrations

Flip mode – potential run plan



Momentum scan for cooling

p	FC beta	FC alpha	Accept.	TOF1 beta	TOF1 alpha
137.73	795.55	-0.99	112.43	810.6	0.45
169.29	800.6	0.25	61.87	1085.8	0.67
195.97	800.01	0.72	45.65	2137.7	0.53
239.89	799.01	0.43	70.11	1232.9	-0.09

Beta scan for cooling

p	FC beta	FC alpha	Accept.	TOF1 beta	TOF1 alpha
137.73	203.59	-0.77	75.47	810.6	0.45
137.73	403.58	-1.03	115.59	810.6	0.45
137.73	598.85	-1.05	116.66	810.6	0.45
137.73	795.55	-0.99	112.43	810.6	0.45
137.73	999.91	-1.11	103.77	810.6	0.45

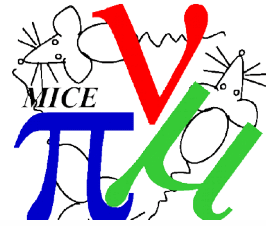
Momentum scan for cooling

E2	CC	E1	M2	M1	FC	FC	M2	E1	CC	E2	Force on M1 from Focus Coils
193.4	207.55	173.76	246.15	153.86	152.74	-152.74	0	-210.1	-209.31	-190.26	12.34
193.52	207.49	172.27	252.83	189.15	92.78	-92.78	0	-210.93	-209.42	-190.08	9.21
193.6	207.38	176.23	182.9	276.75	154.94	-154.94	0	-210.25	-209.35	-190.22	22.51
192.44	208.06	184.72	175.75	106.05	112.25	-112.25	0	-210.49	-209.34	-190.17	6.25

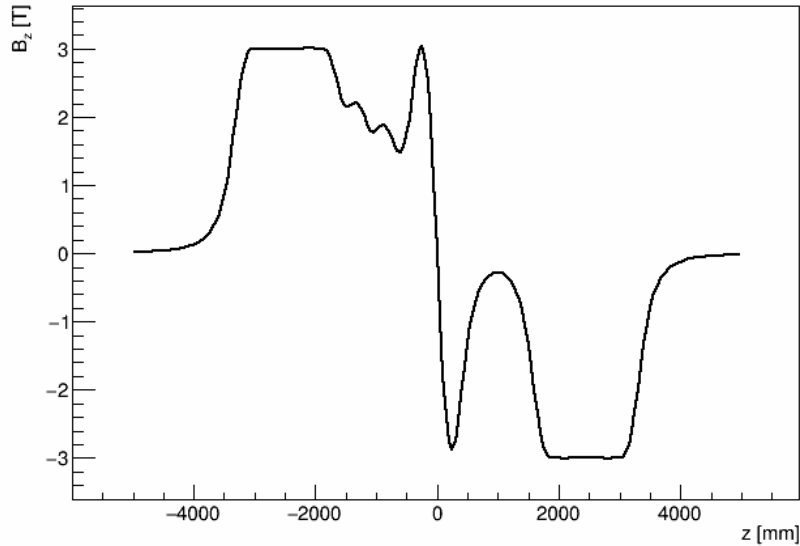
Beta scan for cooling

E2	CC	E1	M2	M1	FC	FC	M2	E1	CC	E2	Force on M1 from Focus Coils
192.85	207.84	180.12	207.73	103.39	178.9	-178.9	0	-209.66	-209.24	-190.35	9.71
193.07	207.72	178.12	215.5	129.88	176.94	-176.94	0	-209.73	-209.26	-190.33	12.07
193.22	207.64	176.44	224.69	147.64	164.73	-164.73	0	-209.93	-209.29	-190.29	12.77
193.4	207.55	173.76	246.15	153.86	152.74	-152.74	0	-210.1	-209.31	-190.26	12.34
193.42	207.53	174.58	230.85	177.5	155.38	-155.38	0	-210.1	-209.32	-190.26	14.48

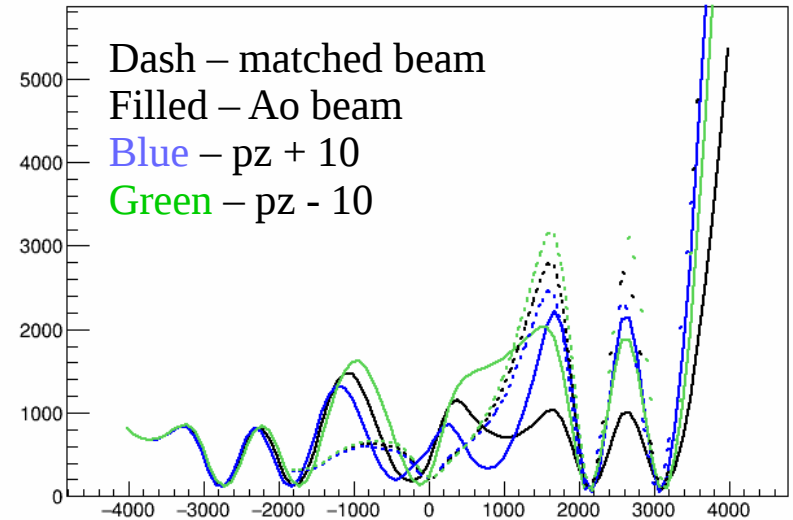
Linear optics



$p=137.73$ MeV/c, FC=176.94, M1_DS=0.0, M2_DS=0.0, M1_US=129.88, M2_US=215.5 A

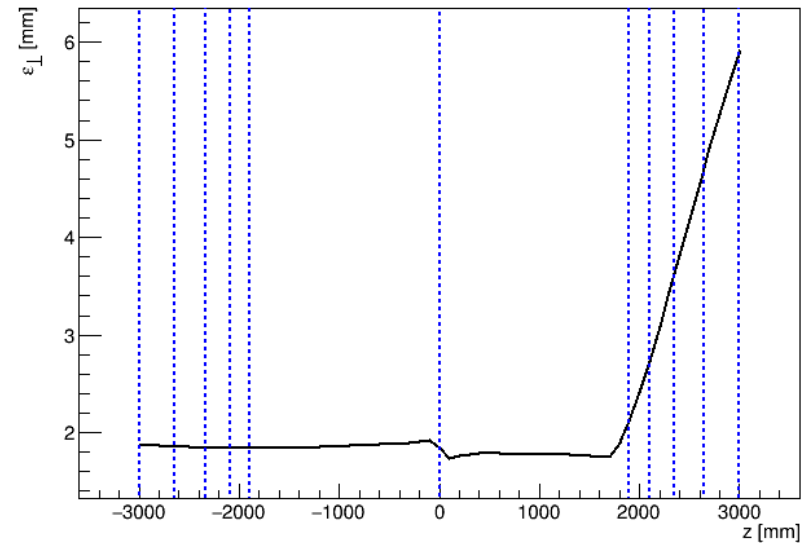
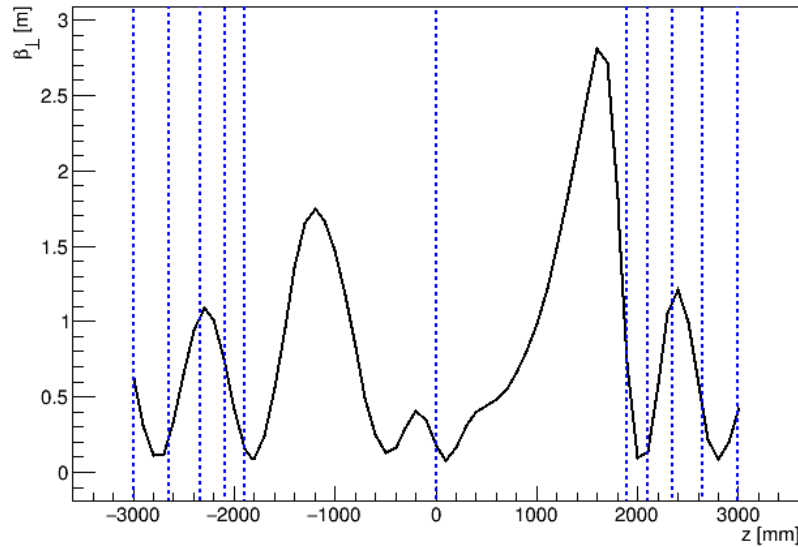
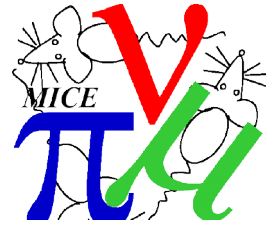


$p=137.73$ MeV/c, FC=176.94, M1_DS=0.0, M2_DS=0.0, M1_US=129.88, M2_US=215.5 A



- Good focusing in the FC region
- Good focus with “matched” beam and “raw” beam

Tracking



- Need to clean up my analysis
 - Introduce AFC aperture
 - Look at emittance change for not good muons
 - Scraping bias is introduced in this analysis
 - Emittance is below equilibrium here
 - Don't expect emittance reduction!
- Need to study higher emittance beam...