Run Settings

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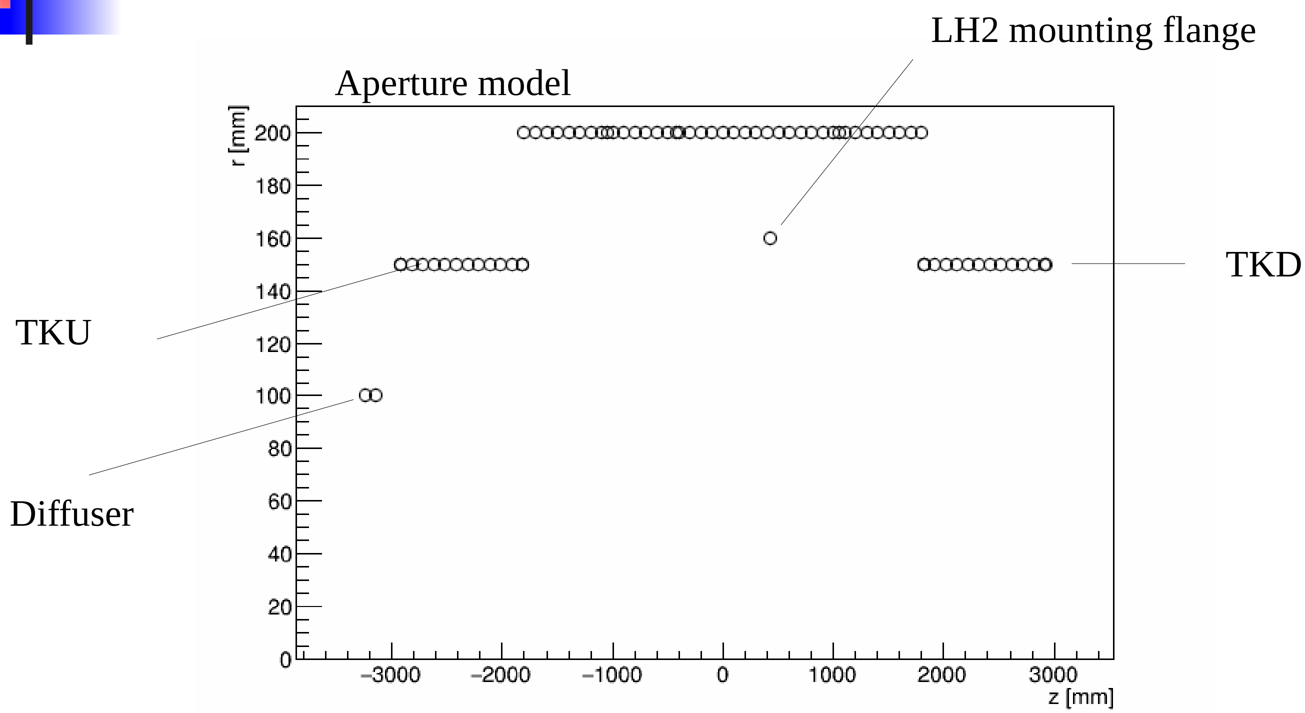
Algorithm

- 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*0.66 < M2U < 253 A
- 100 < M1U < 278 A
- 0 < FC < 114 A
- M1D = M2D = 0 A
- M1U * FC < 7500
- Solenoid mode, 3 T in ECE
- Require match in SSU (beta = 444 mm, alpha = 0)

Trim coils

- Seek to minimise the deviations of Bz from uniform in the tracker region
- Assume superposition of fields from adjacent coils is correct

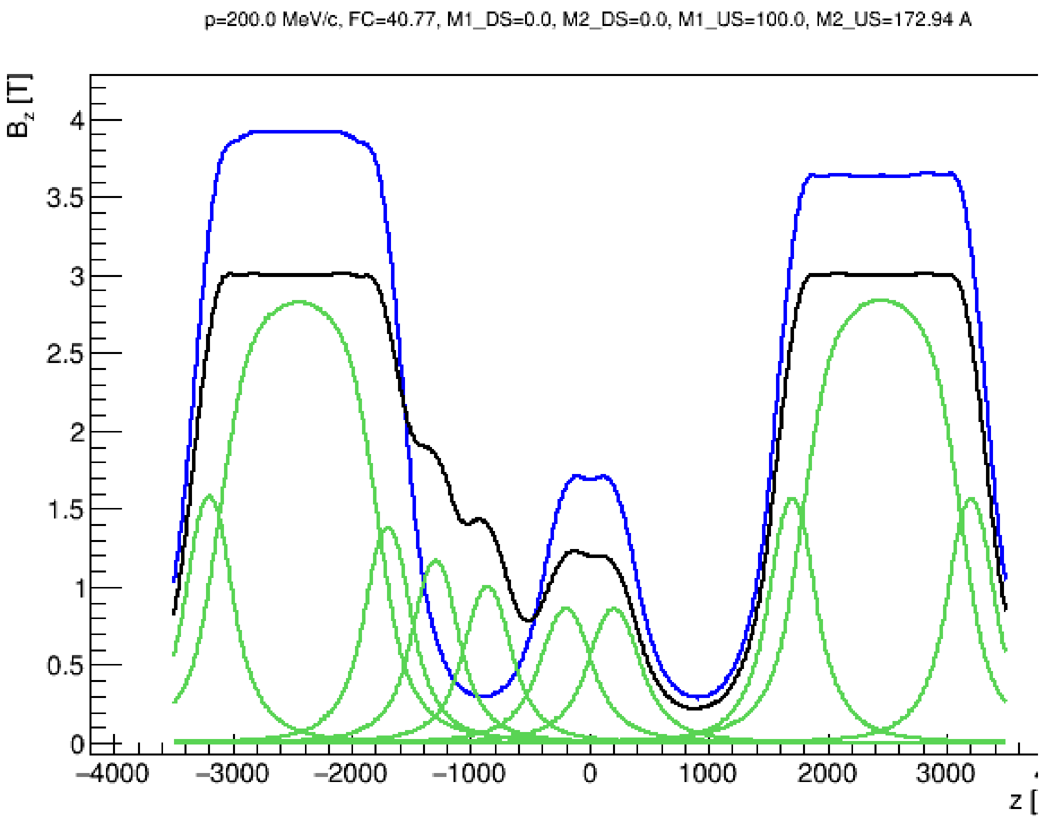
  $$B(z) = J_{E1} B_{E1}(z) + J_{CC} B_{CC}(z) + J_{E2} B_{E2}(z) + B_M(z)$$

- Seek to minimise square of residuals between B(z) and nominal field B_0
- Consider linear least squares solution of

  $$B_0 - B_M(z) = J_{E1} B_{E1}(z) + J_{CC} B_{CC}(z) + J_{E2} B_{E2}(z)$$

  - Segmentation every 10 mm
- Example – run settings v5 setting 6.1.1

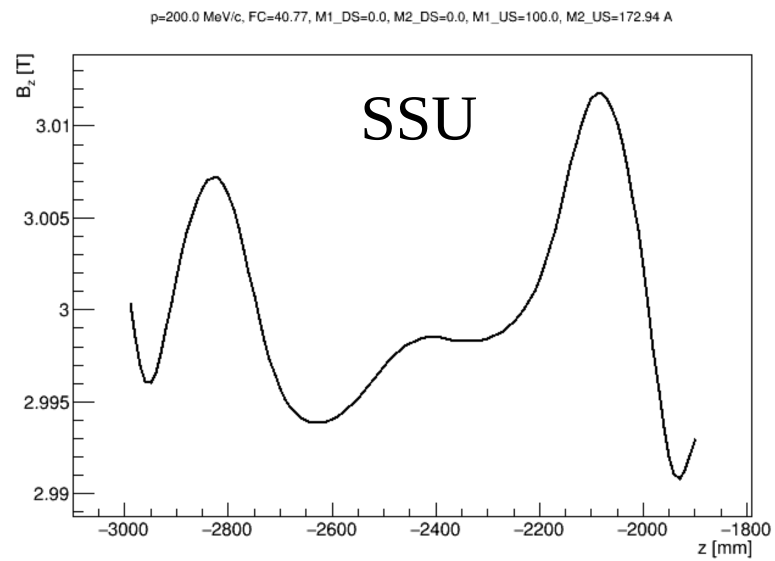
Trim coils

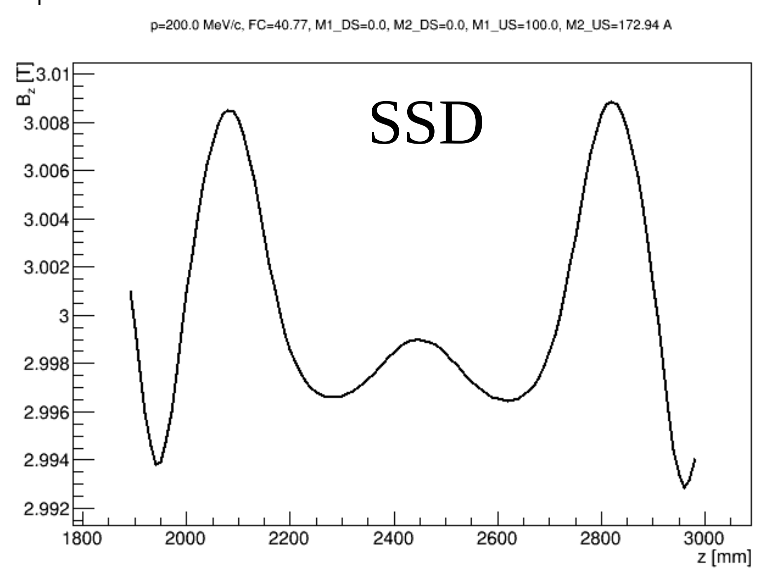


Before fit

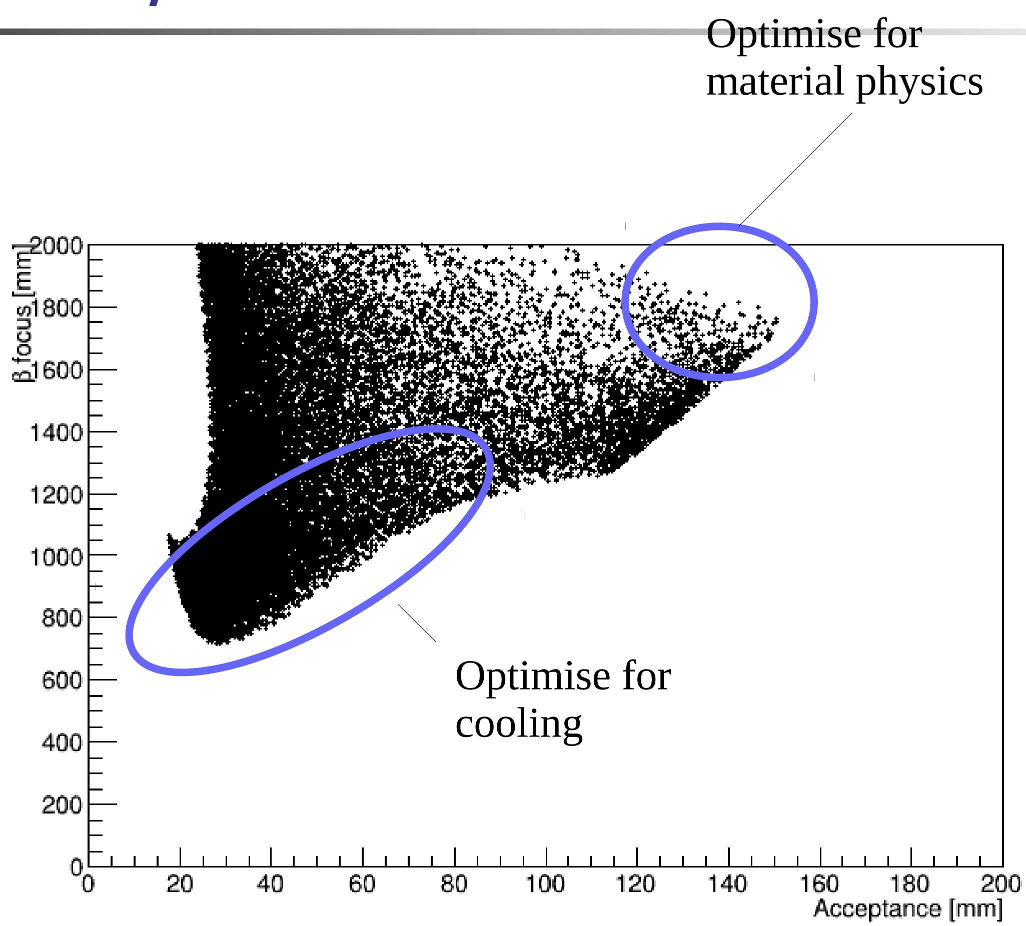
After fit

Individual coils



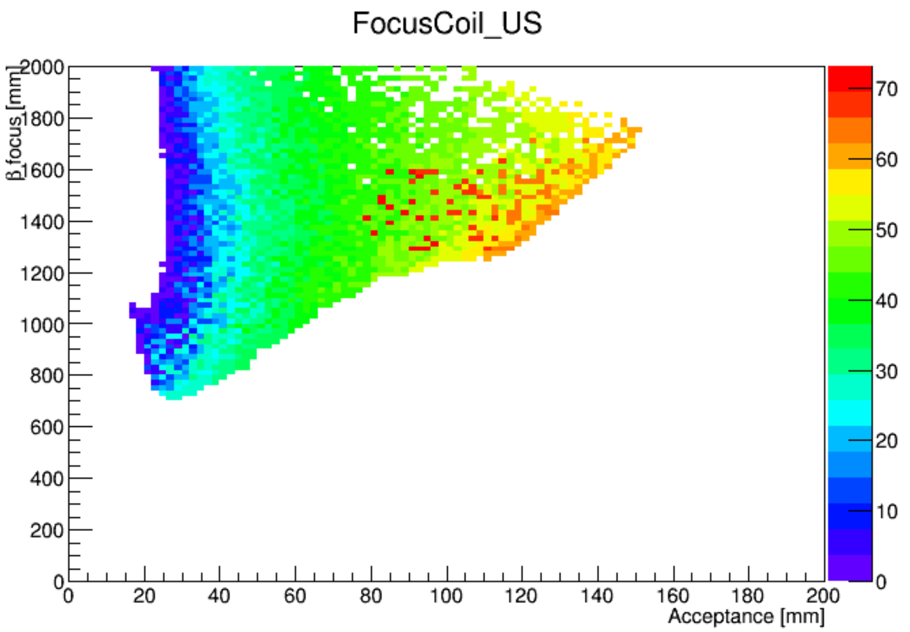


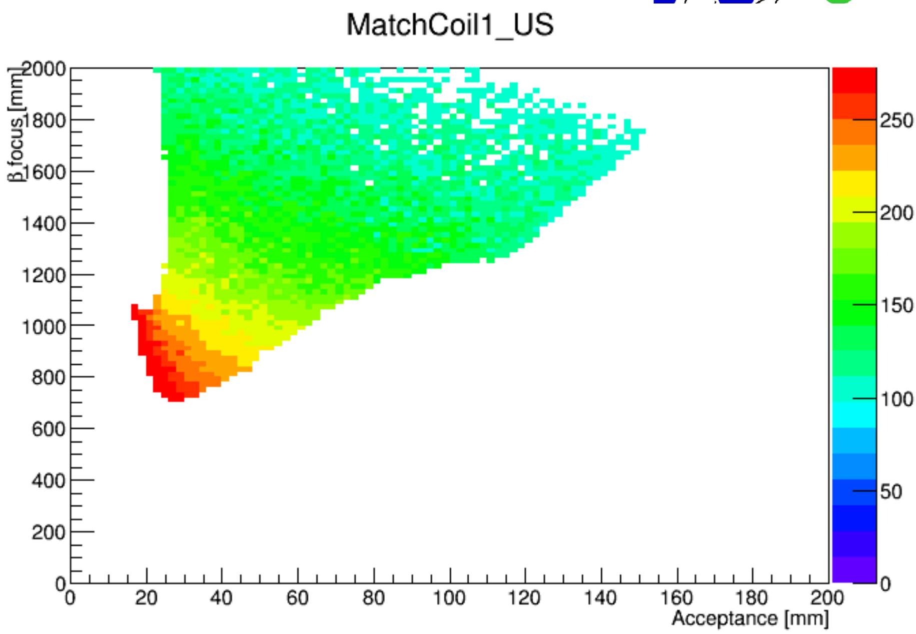
200 MeV/c



- Family of solutions
  - Higher acceptance is always best
  - Low beta is best for cooling

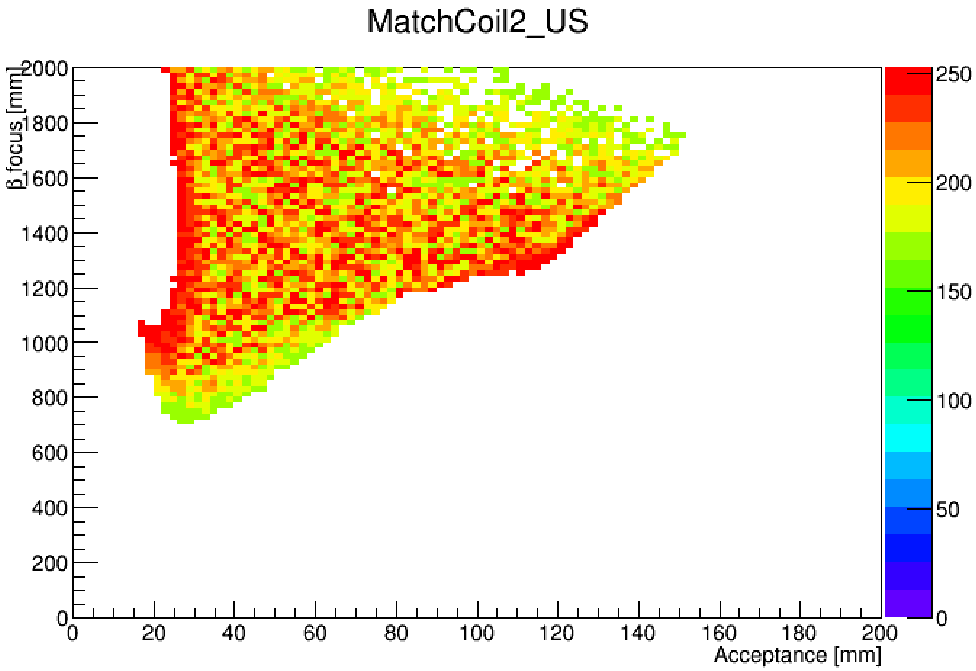
M1U, FC, 200 MeV/c





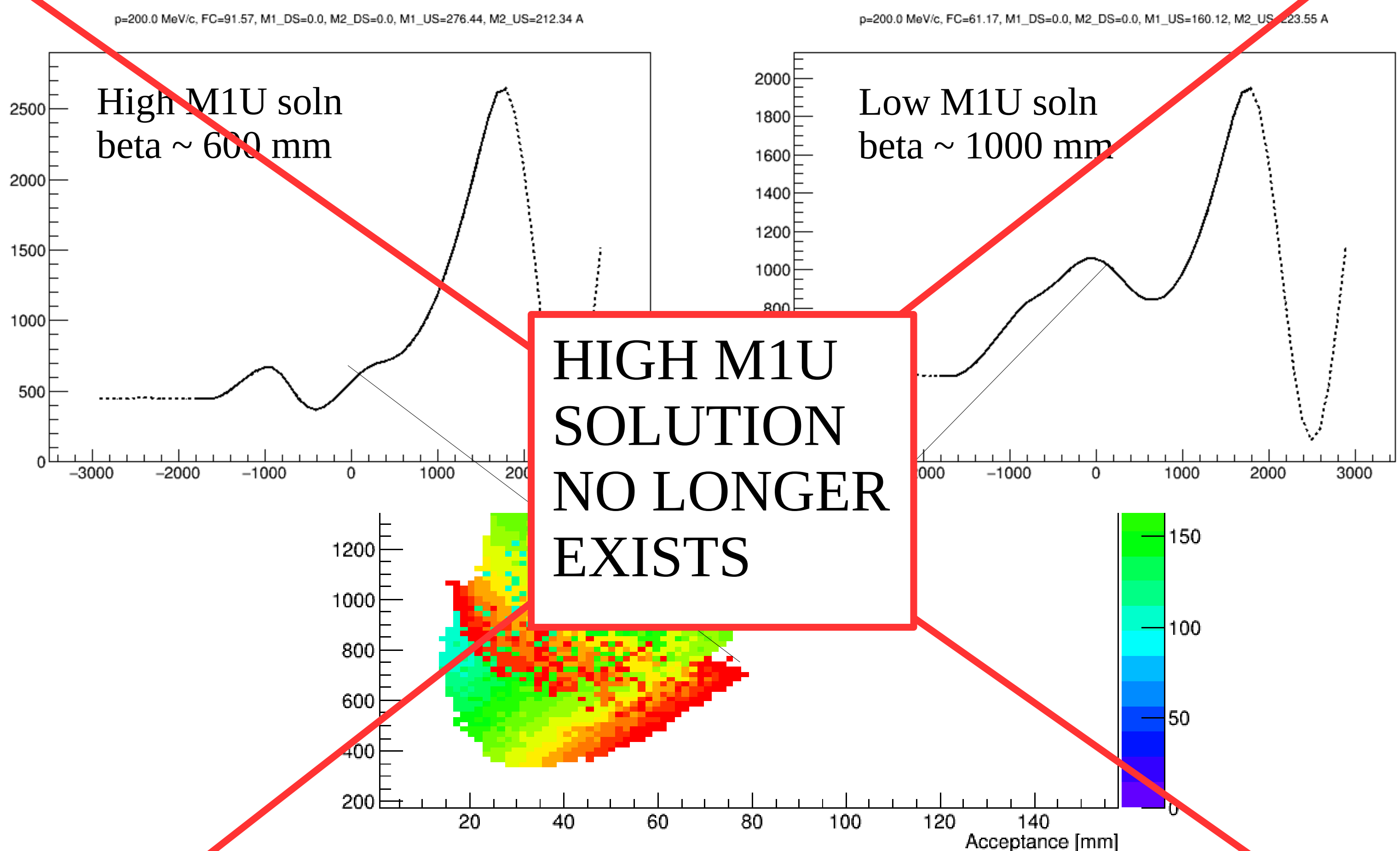
- Force proportional to M1*FC

M2U



- M2 – for reference

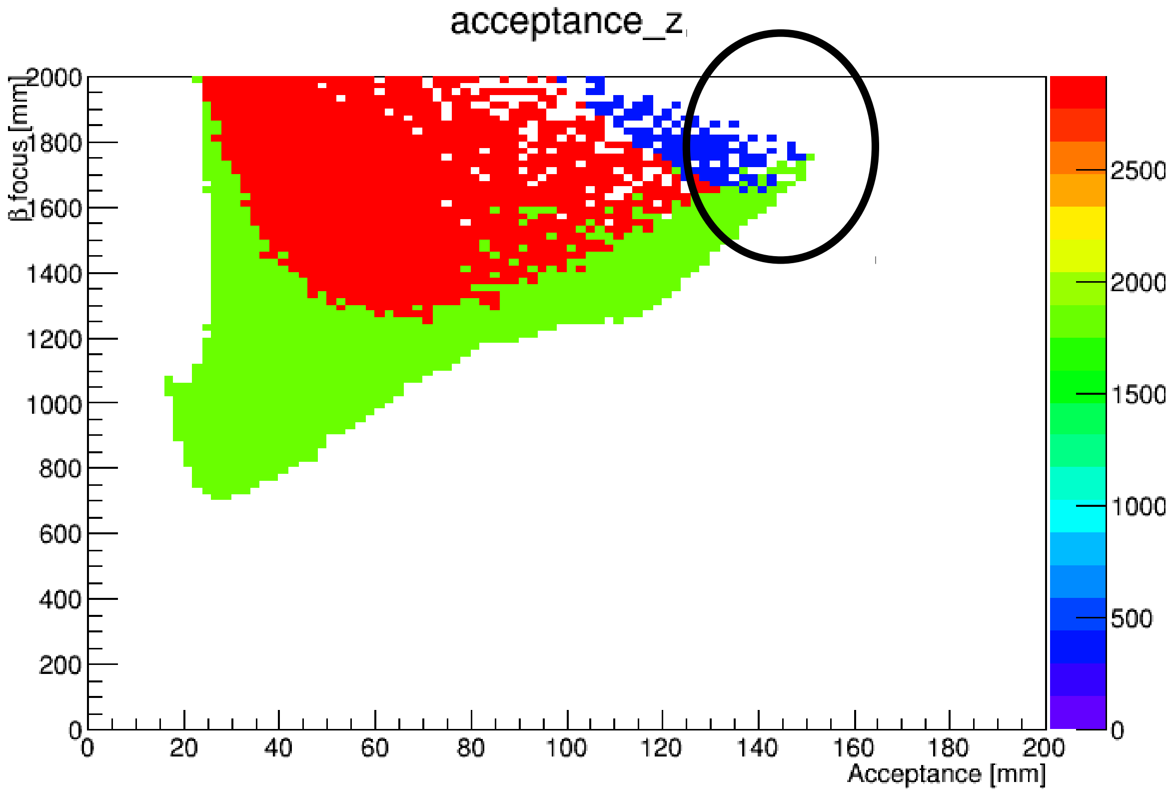
M2U



HIGH M1U SOLUTION NO LONGER EXISTS

- Two families of solutions
  - High M1U solution has focus upstream of FC
  - Low M1U solution has focus downstream of FC

Z position of aperture

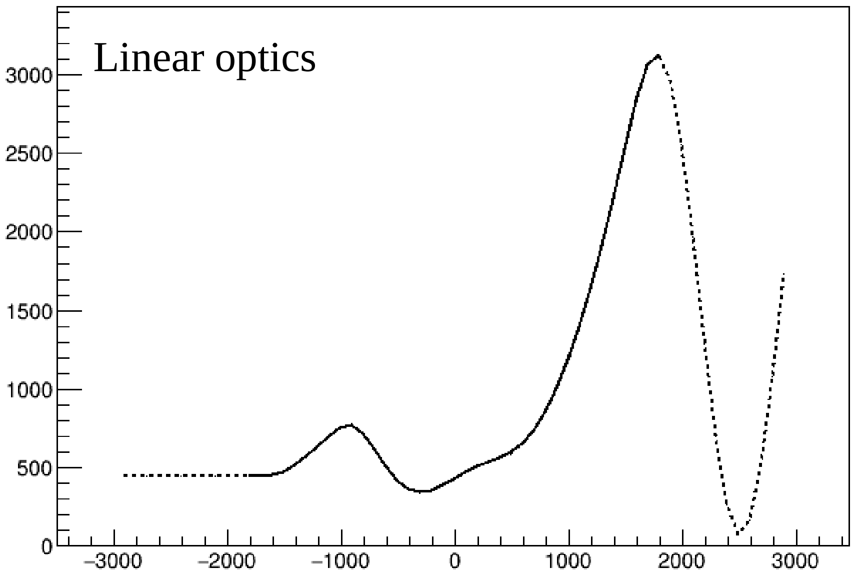


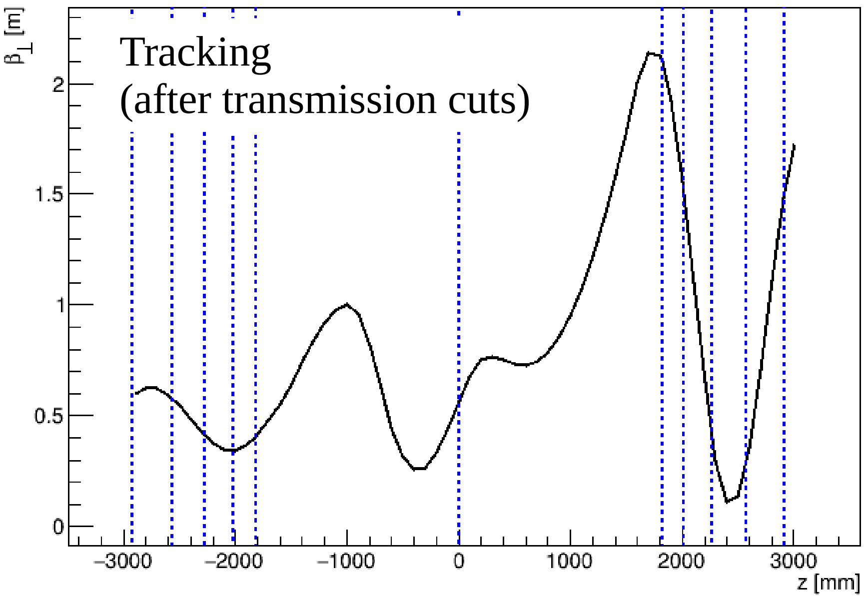
- "Roundness" of the nose is a real feature
  - Colours indicate z position of the limiting aperture [mm]
  - Aperture at high beta$_{focus}$ becomes the FC mounting flange
  - Aperture at low beta$_{focus}$ is the tracker start

Tracking

THIS MAGNET SETTING
IS NOW EXCLUDED

p=200.0 MeV/c, FC=107.76, M1_DS=0.0, M2_DS=0.0, M1_US=277.63, M2_US=169.35 A

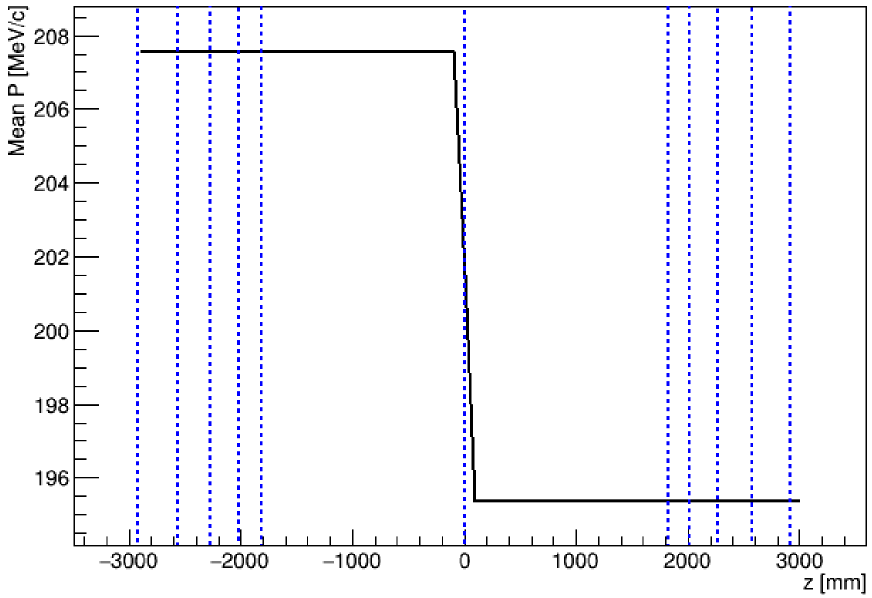


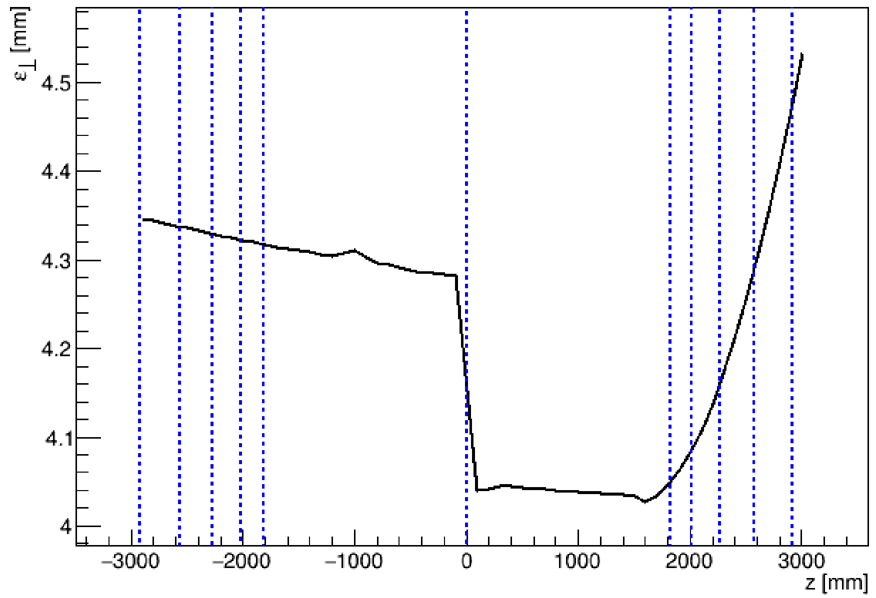


- Try tracking a "cooling" beam – look at performance
  - M2U = 277.63 A
  - M1U = 169.35 A
  - FC = 107.76 A
- Simple channel model

Tracking

THIS MAGNET SETTING IS NOW EXCLUDED

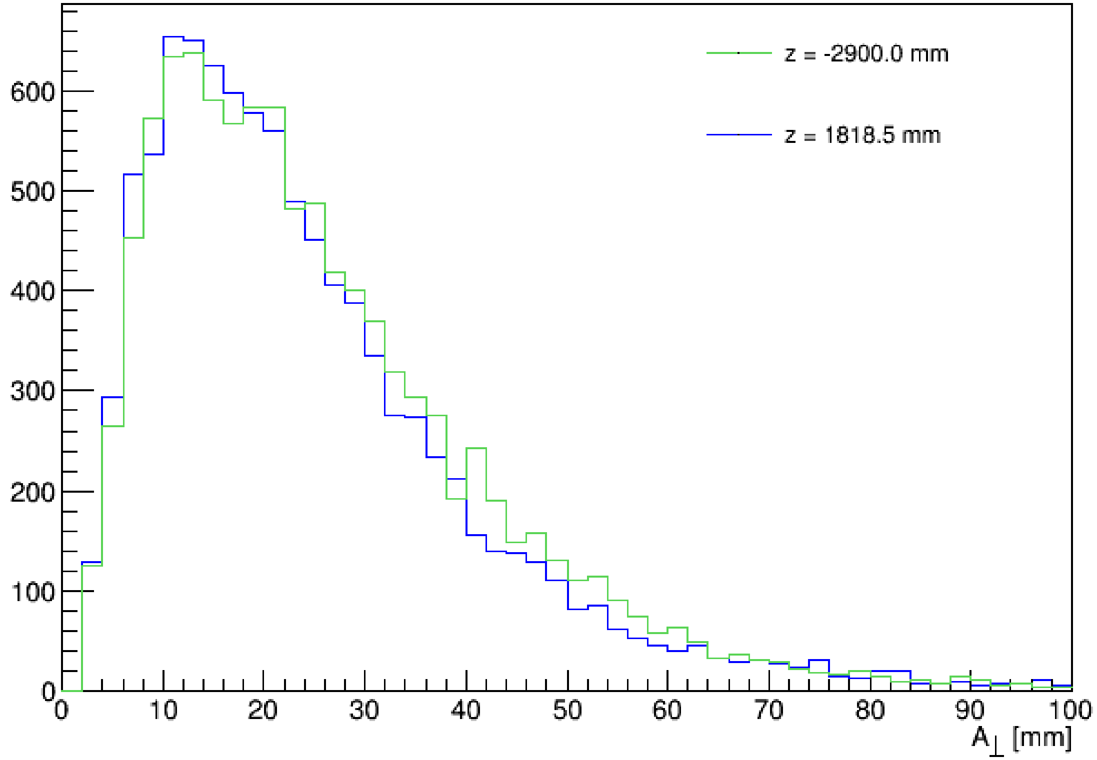




- 69.8 % transmission

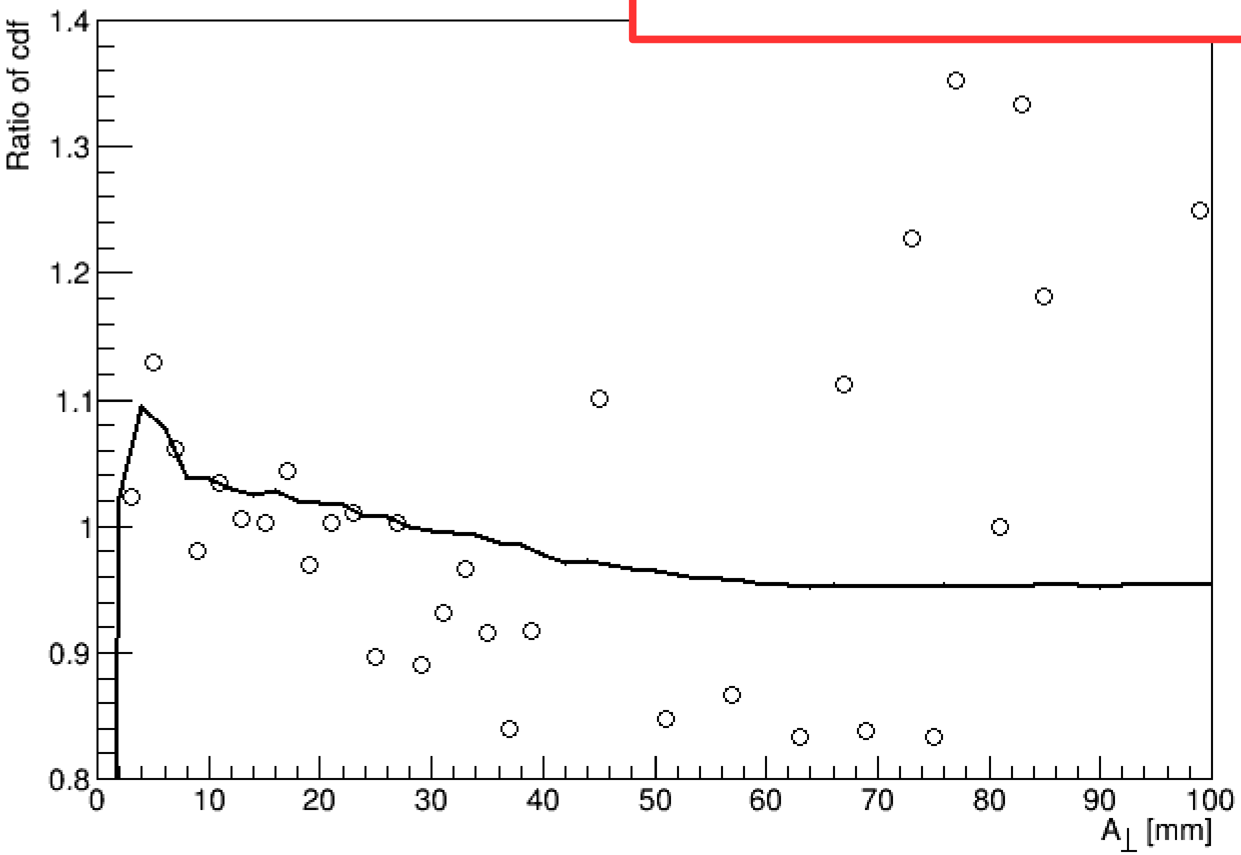
Tracking

THIS MAGNET SETTING
IS NOW EXCLUDED



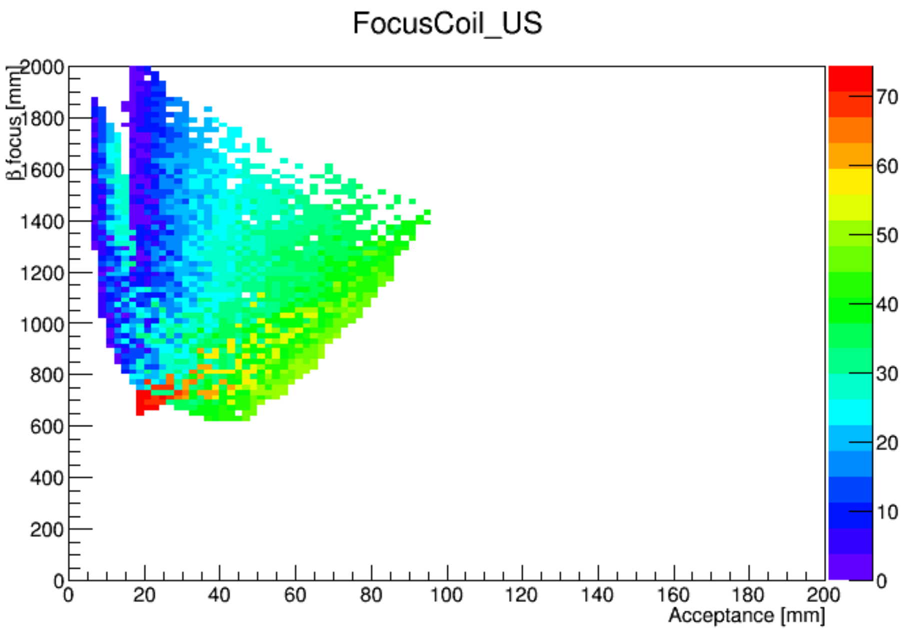
Tracking

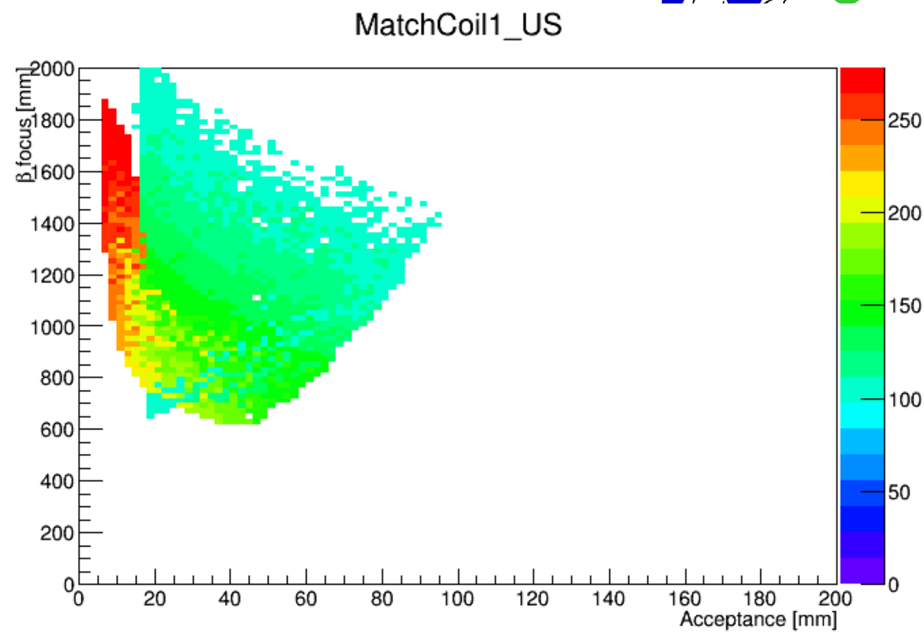
THIS MAGNET SETTING IS NOW EXCLUDED



- Points show ratio of each bin
- Line shows ratio of cdf

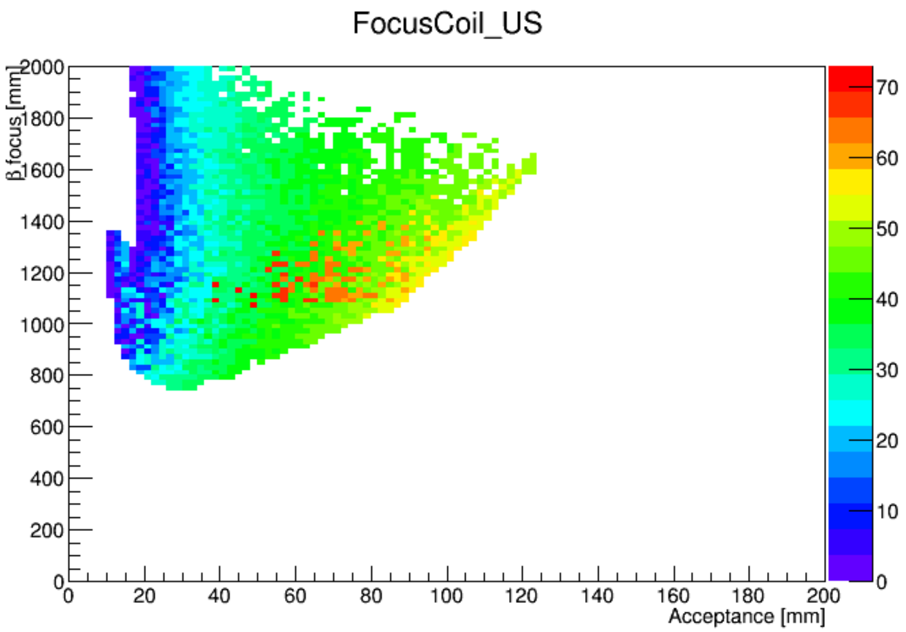
140 MeV/c

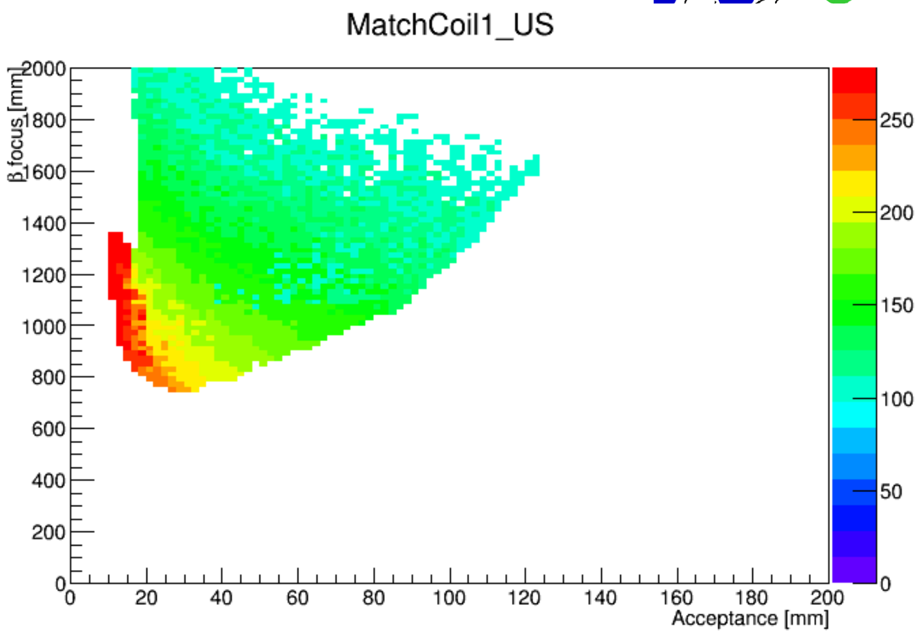




- Force proportional to M1*FC

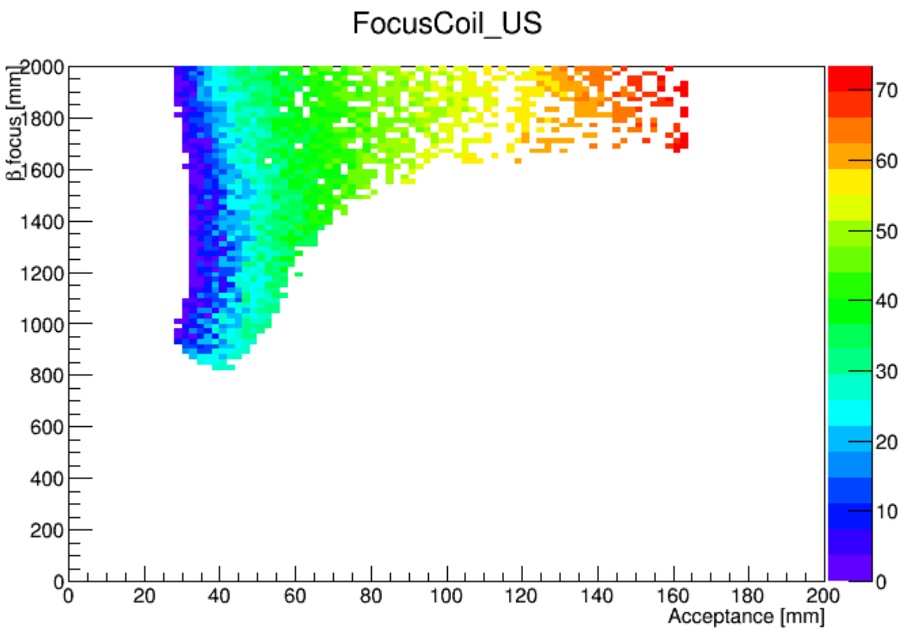
170 MeV/c

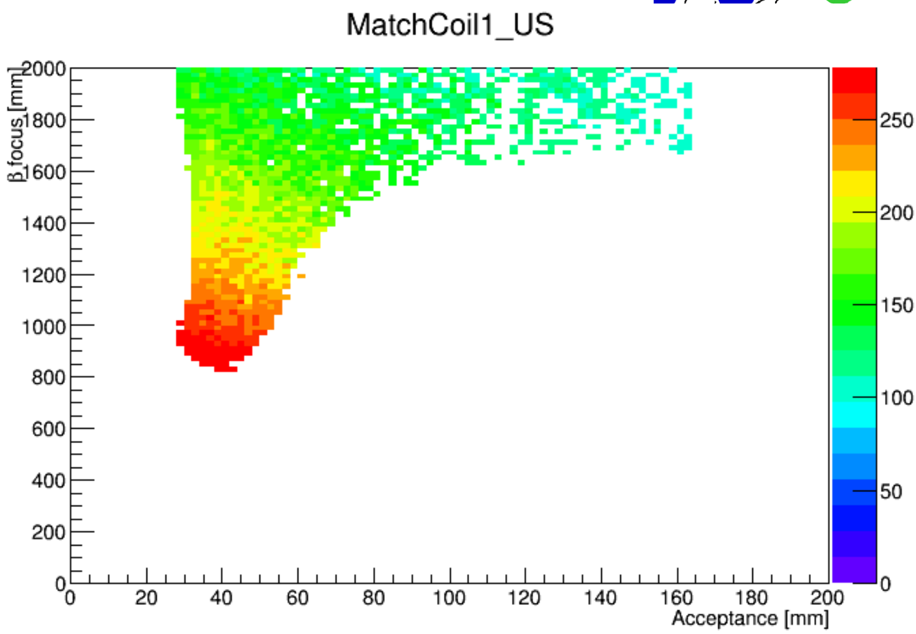




- Force proportional to M1*FC

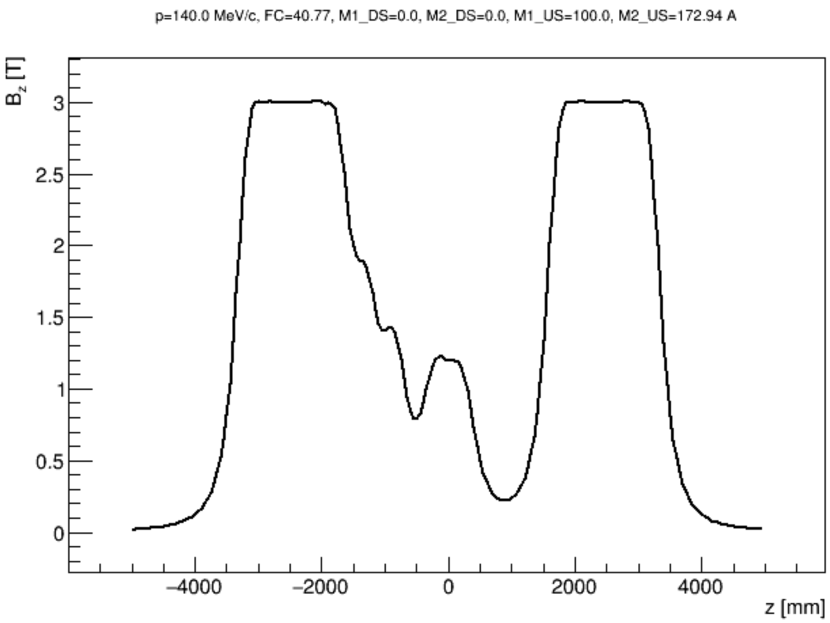
240 MeV/c

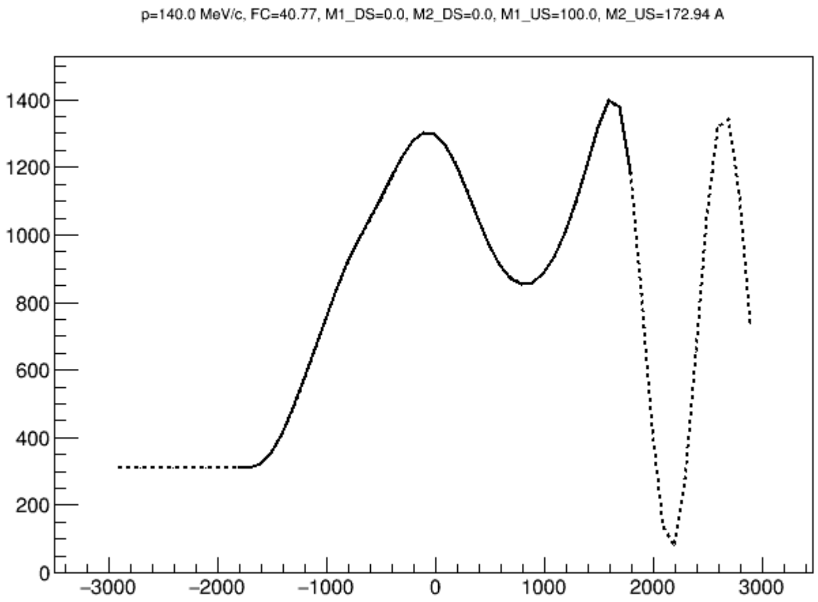




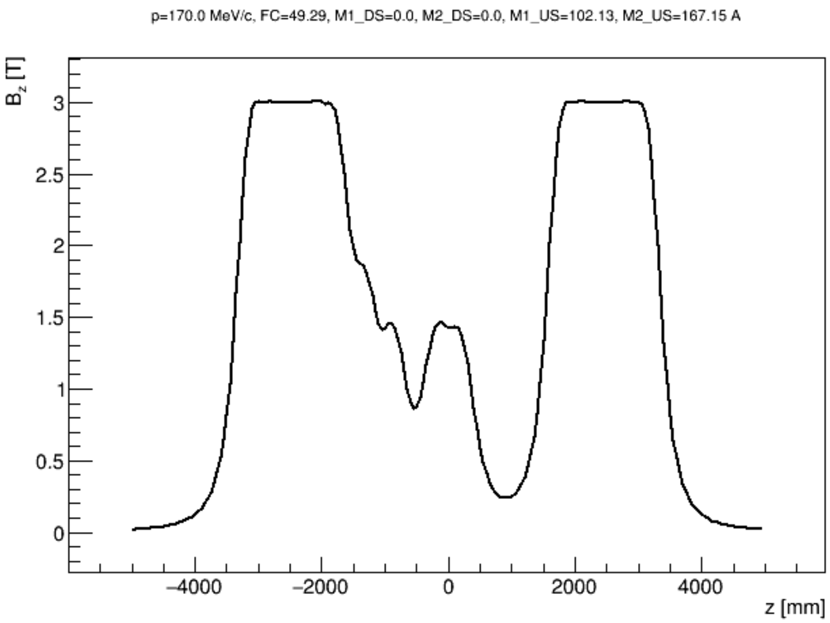
- Force proportional to M1*FC

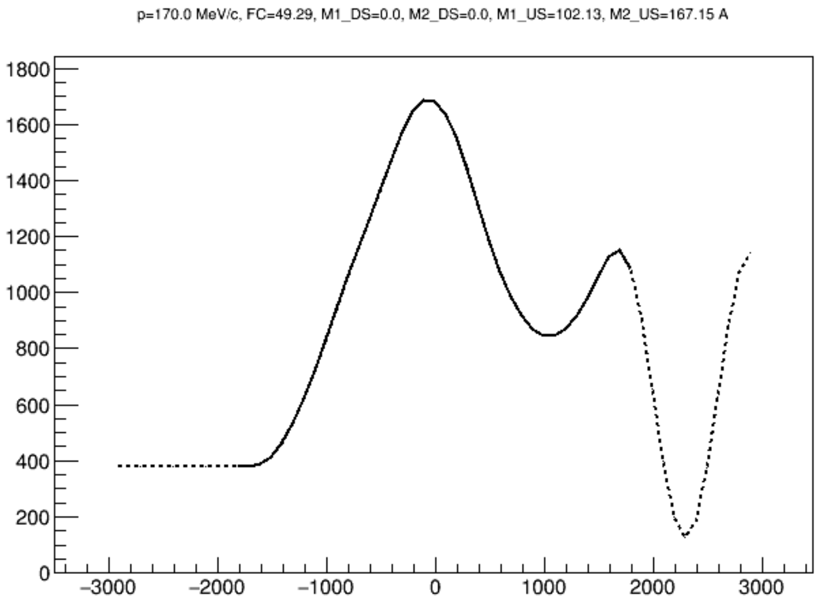
Optics – 140 MeV/c



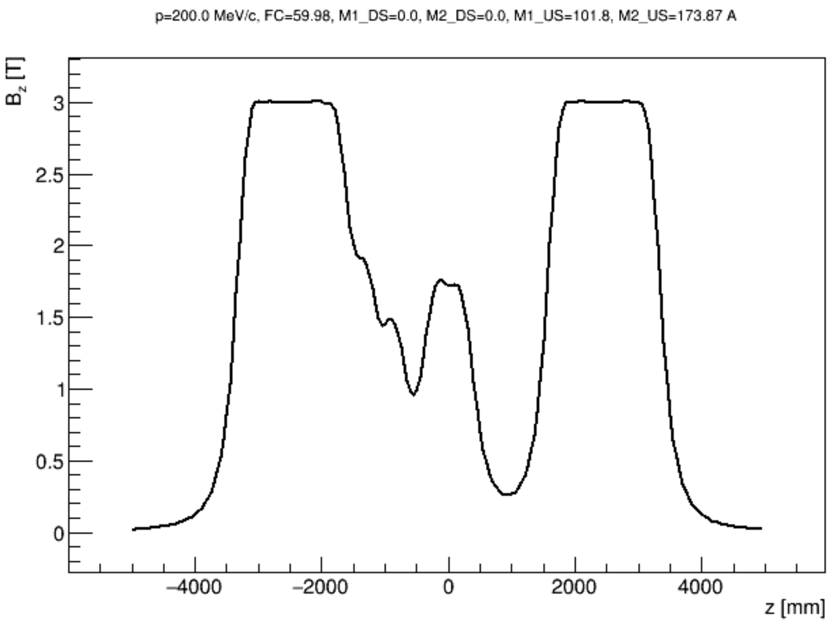


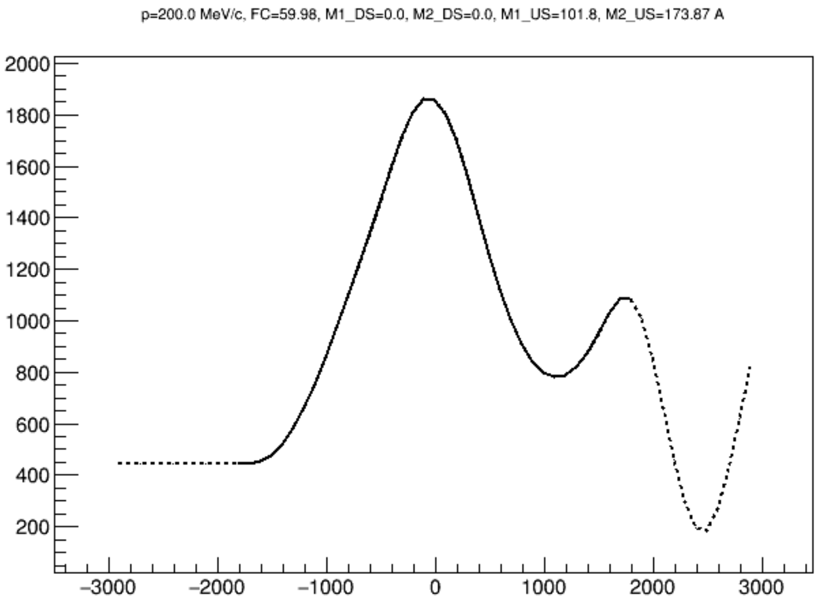
Optics – 170 MeV/c



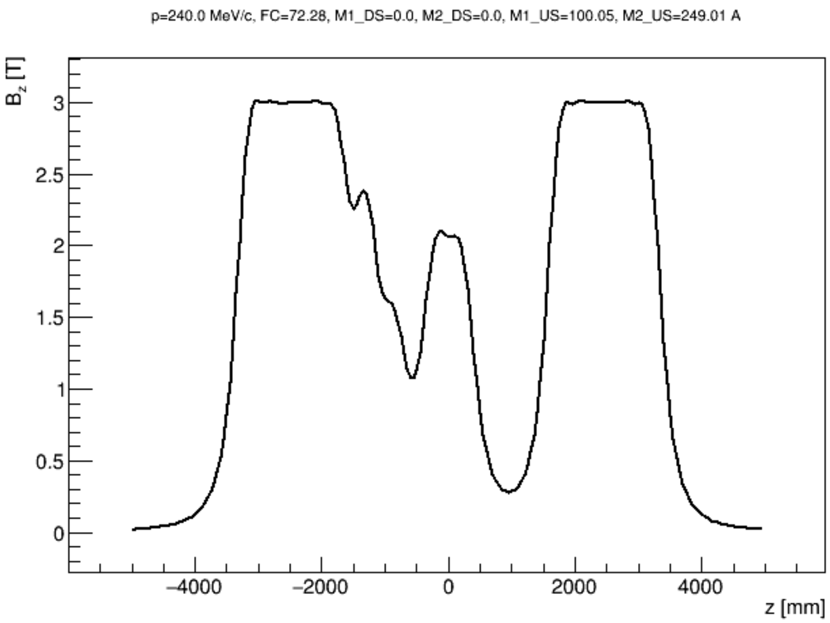


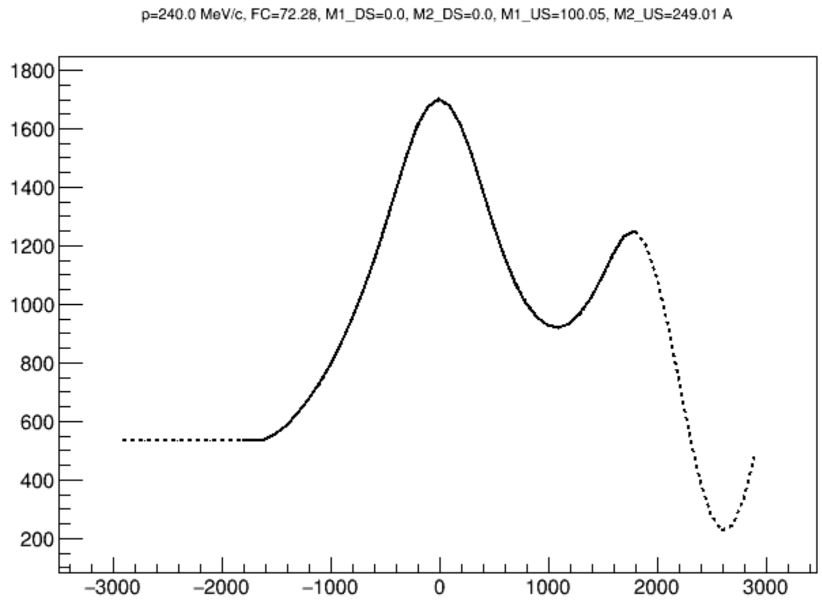
Optics – 200 MeV/c





Optics – 240 MeV/c





Thoughts/To do

- If M1U * FC < 7500 is a real constraint, we need to be creative to observe cooling
- Remove constraint of "match" in SSU
- Work at 140 MeV/c as "baseline"
- Go to "flip mode"
- Go to 2 T in SSU or SSD

Thoughts/To do

- Other options:
  - Should we choose something intermediate and run with it for material physics?
    - e.g. M2: 150; M1: 150; FC: 60
    - Transmission would still be quite good, but not “optimal”
  - Would 140 MeV/c as “cooling baseline” be better?
    - What is the resolution at 200 or 140 MeV/c and 3 T?
    - What is the expected cooling performance?
    - What is the width of scattering distribution (for magnet alignment etc)
- To do:
  - ~~Add “optics validation” current scans~~
  - ~~Trim the trim coils~~
  - ~~Stare at “beta function” scans~~ **beta scans withdrawn**
    - ~~Some from “high M1U” series; some from “low M1U” series~~
  - ~~Include PRY effects~~
  - Check magnet geometry is okay – cold shrinkage? Cobb analysis?
  - Full MC

Data taking plan

- Data taking plan, following discussion with magnet folks
  - Commission to, and run, the material physics settings (6.x.y) with no absorber
  - Then review and decide on next move
  - We could, for example, install LiH and do material physics with LiH
  - Or we could do emittance reduction with no absorber (7.x.y)