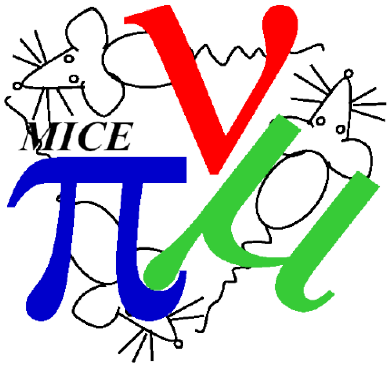
# Derating MICE magnets

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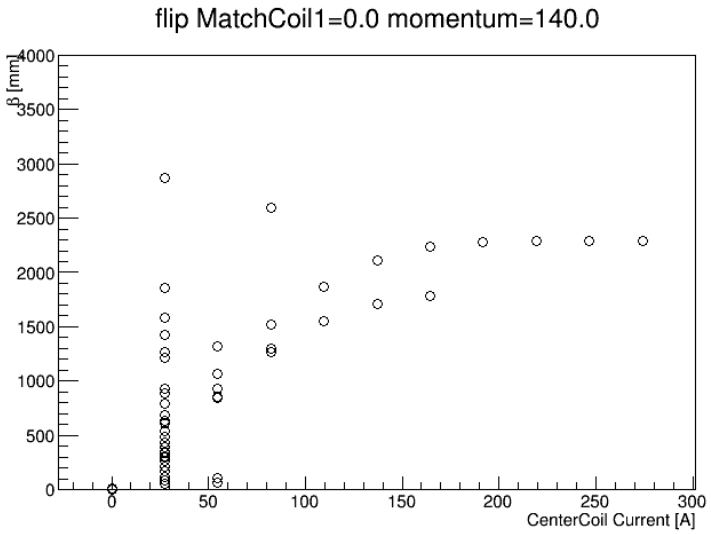
# Intro

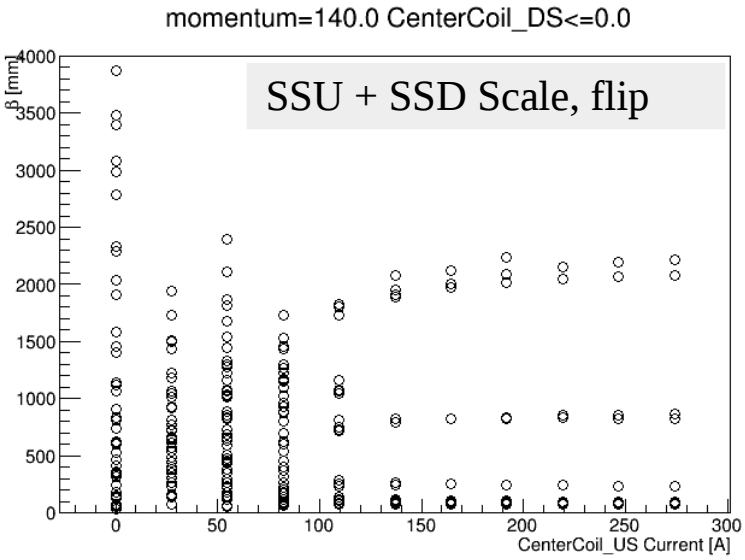
- Last time
  - Showed that symmetric solutions (w/o M1) require SS currents at ~ 60 A
  - Indicated that asymmetric solutions w/o M1 may allow more wiggle room
- This time
  - Look at asymmetric solutions w/o M1 in more detail
  - Look at the effect of using E1 for matching
  - Start to look at tracking through the asymmetric solutions
- Nb:
  - Algorithm as before
  - Using “dumb beta evolver” - integrating d.e. for β''

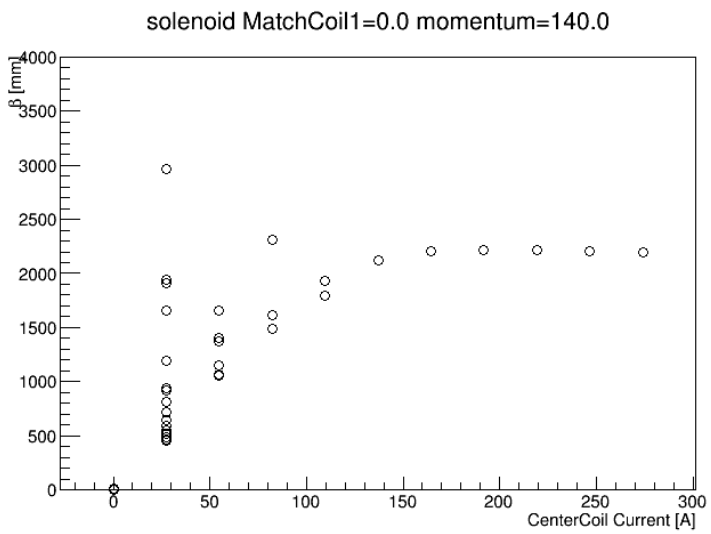
# Question

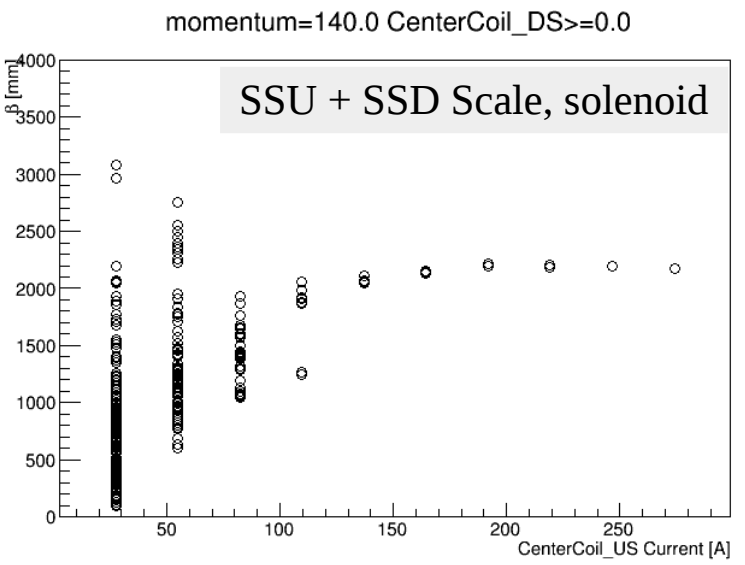
- Can we get more solutions with asymmetric optics? If so, how much better is it?
  - Keep boundary condition of beta = constant in constant 4 T field region
- Right hand plot has asymmetric optics
- Left hand plot has symmetric optics

# Scale SS – 140 MeV/c

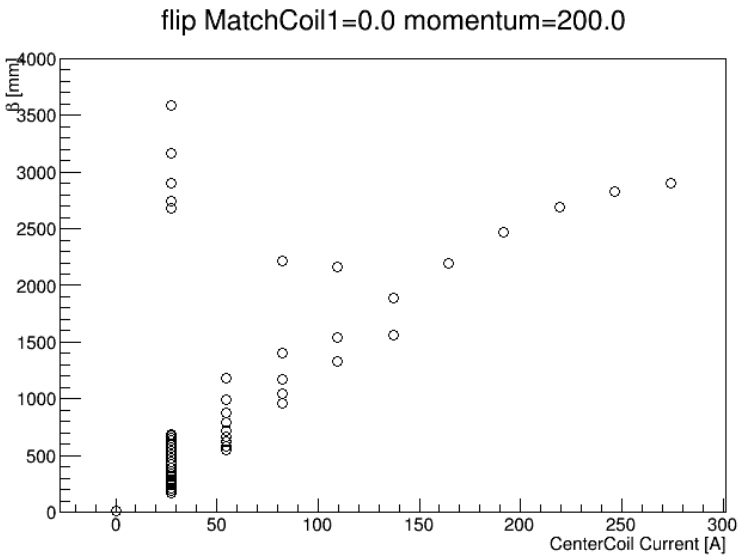


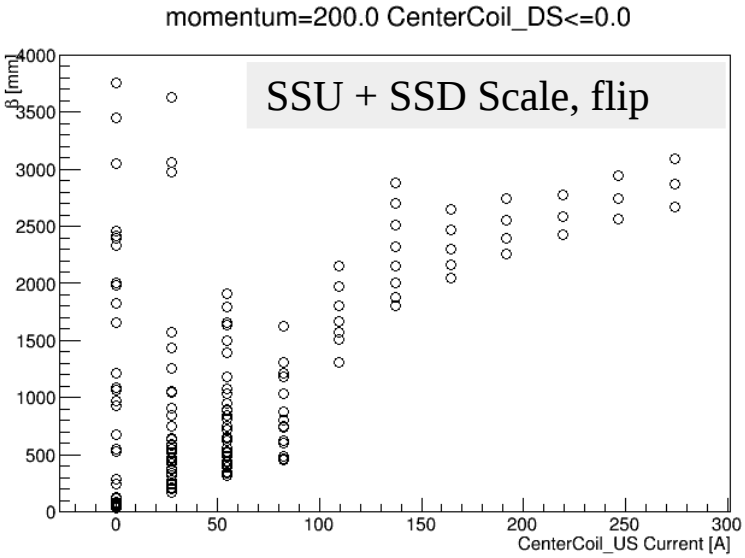



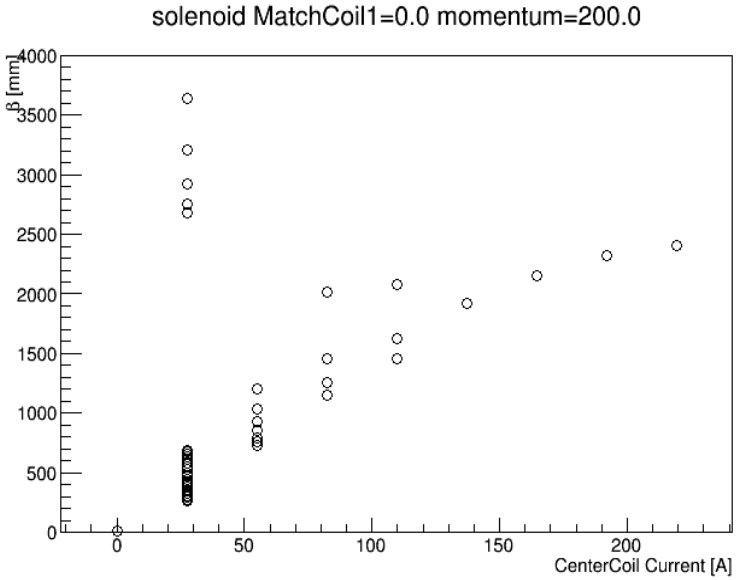



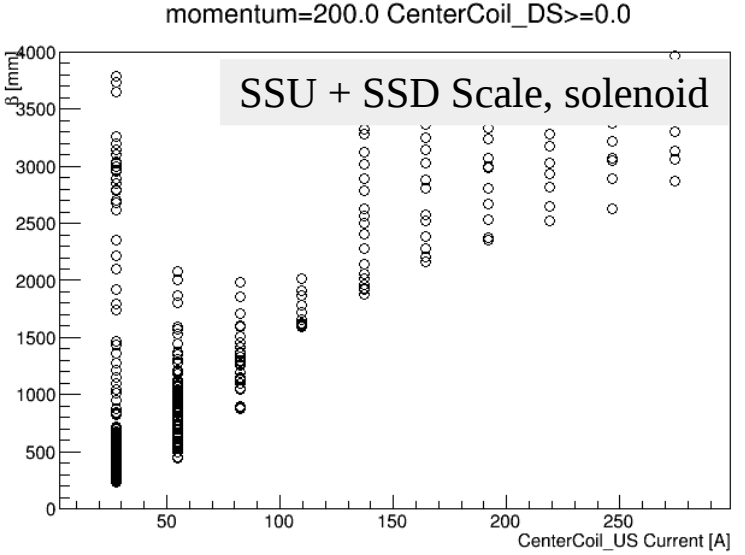



# Scale SS – 200 MeV/c

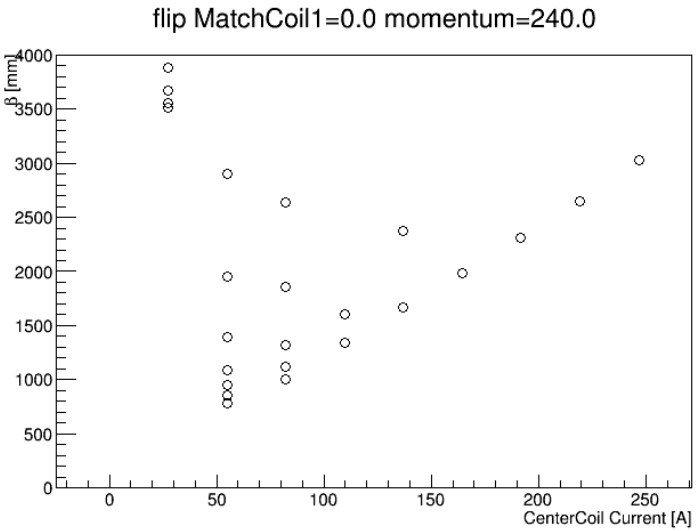


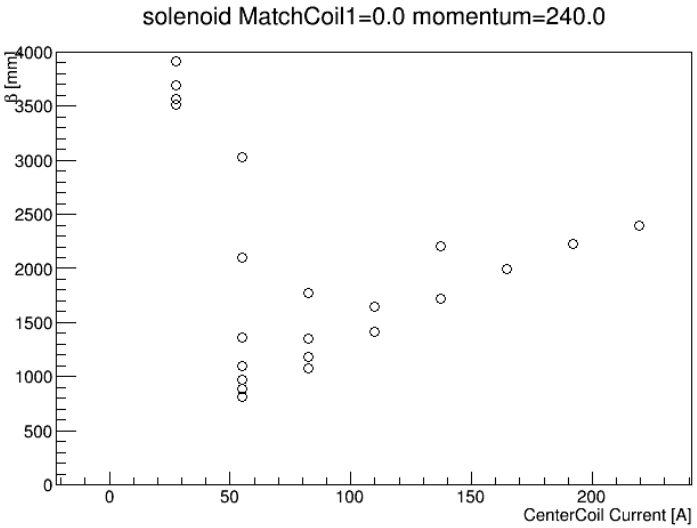



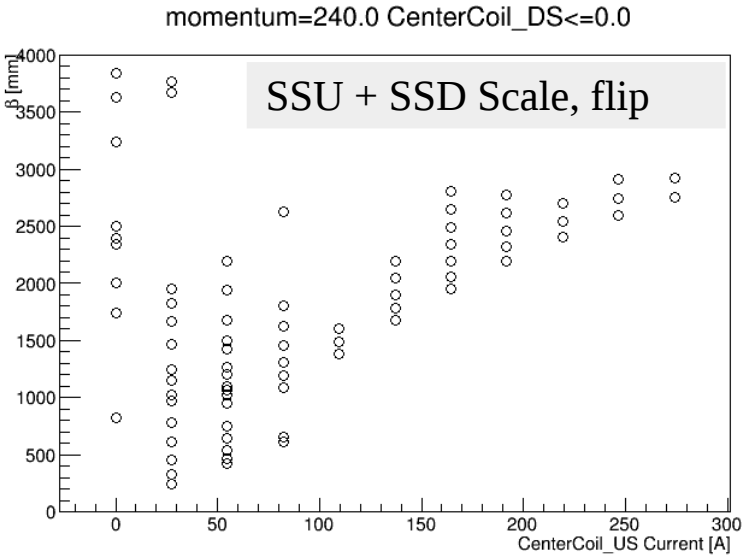



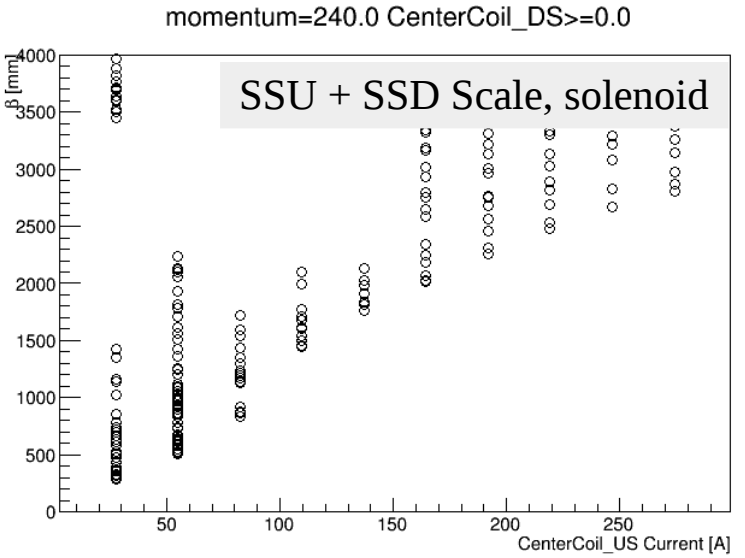



# Scale SS – 240 MeV/c



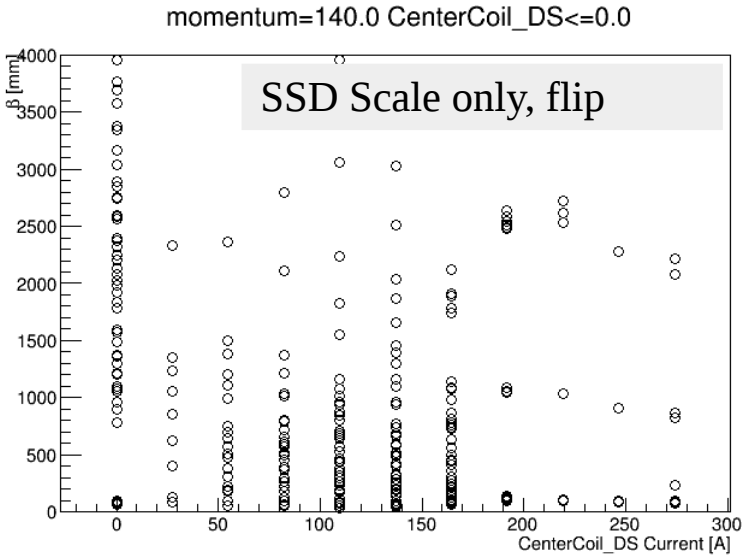



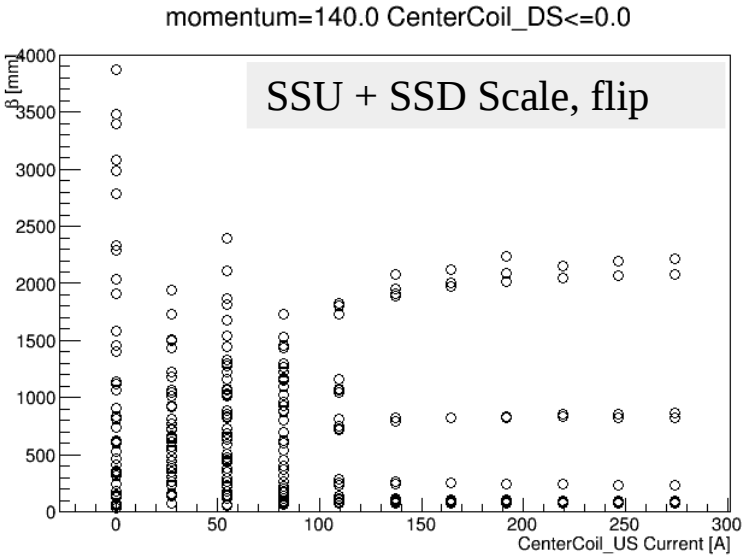



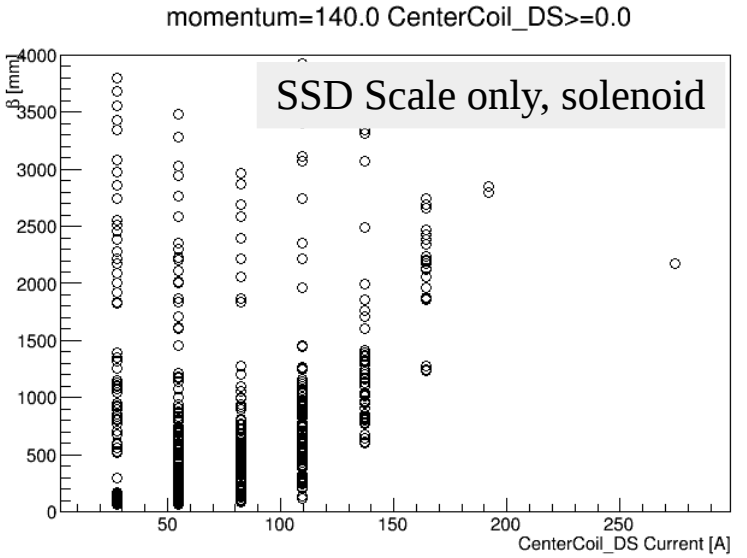
# Question

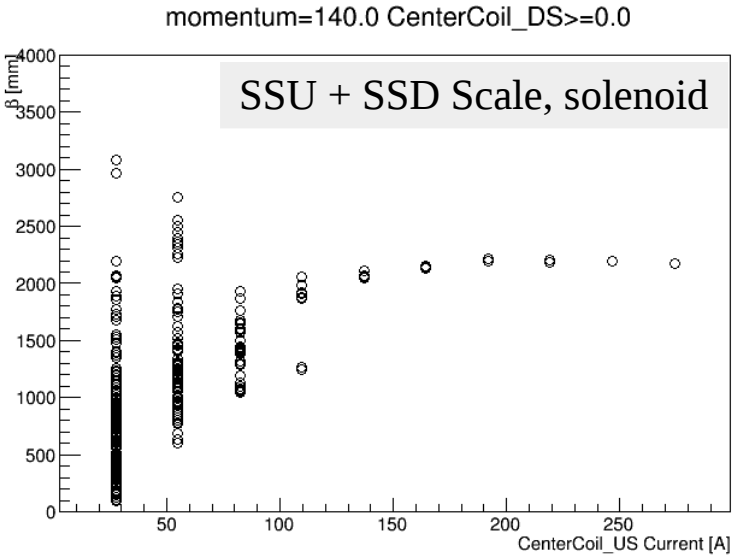
- Can we leave SSU at 4 T and only scale SSD?
  - Asymmetric
  - Better resolution in SSU

# Asymmetric solution, 140 MeV/c

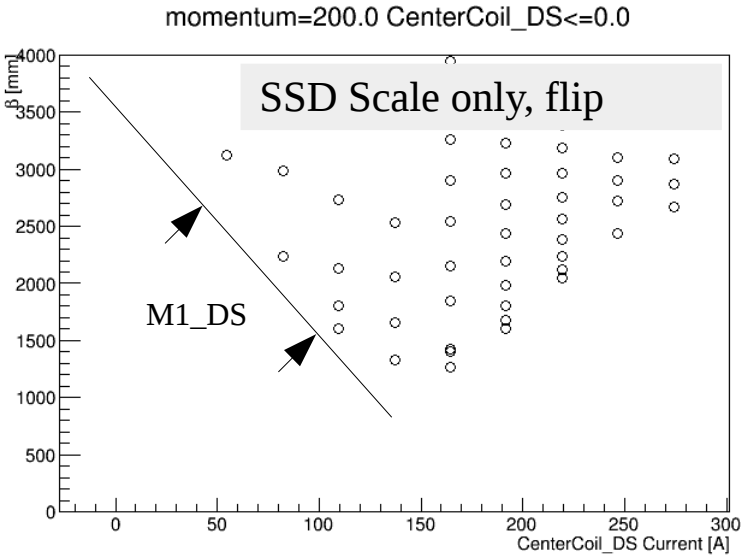


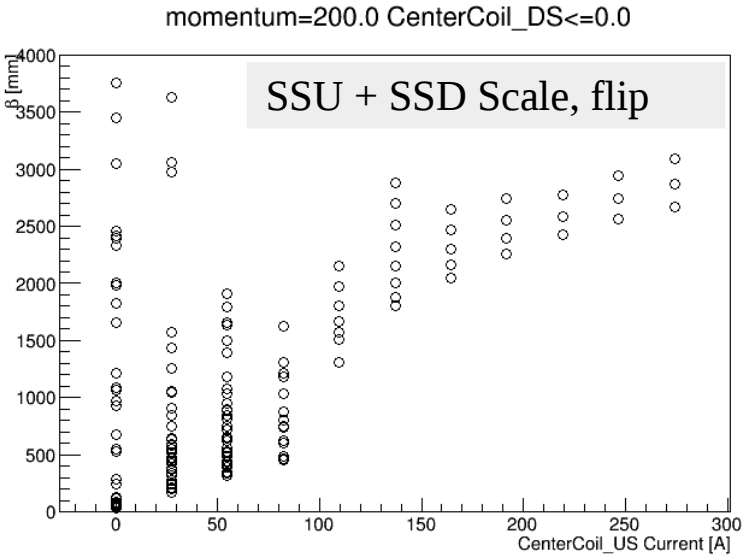



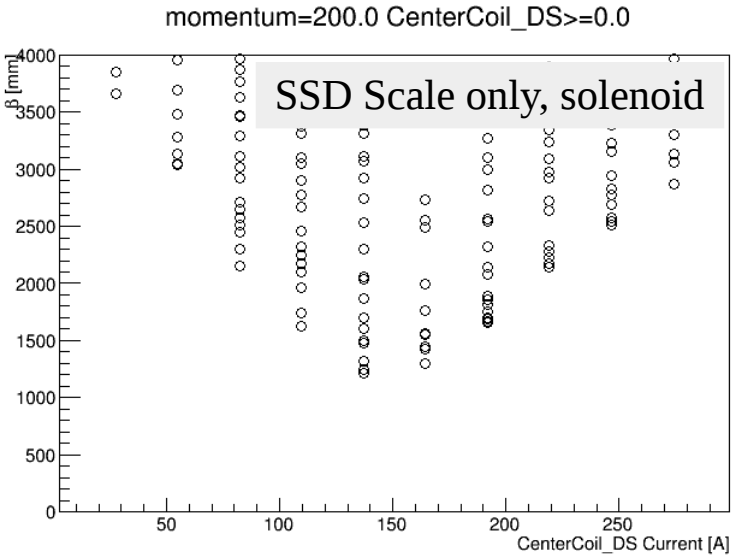



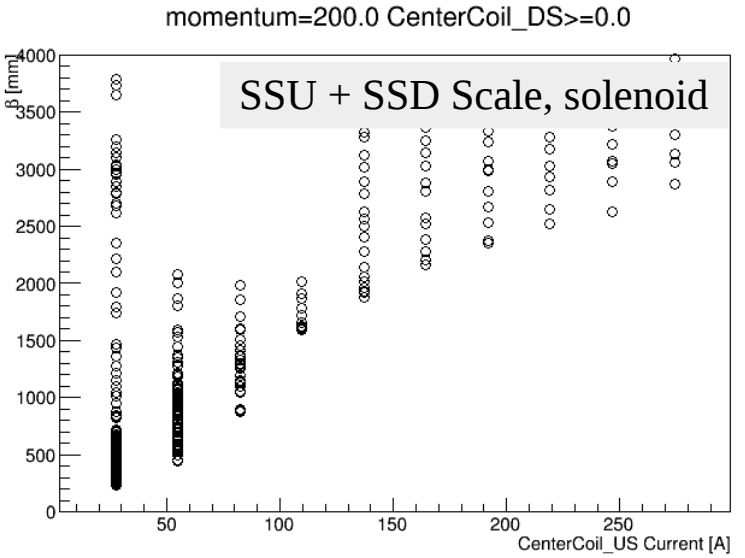



# Intro

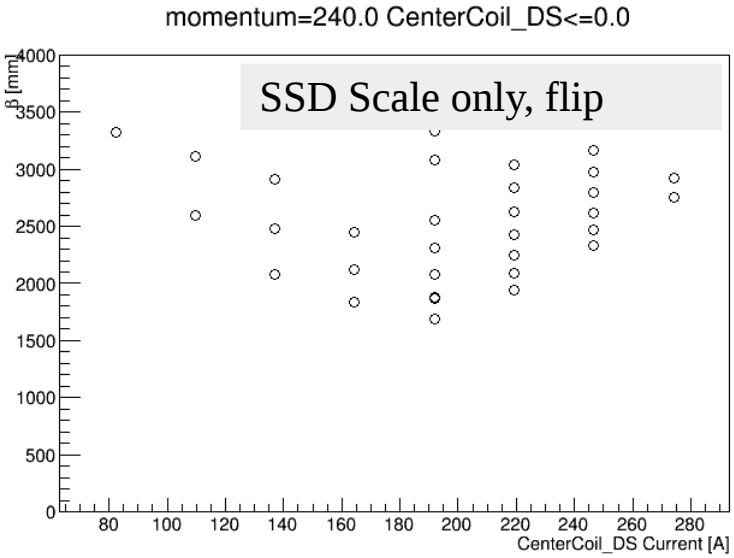

momentum=200.0 CenterCoil_DS<=0.0
SSD Scale only, flip
M1_DS
β [mm]
CenterCoil_DS Current [A]

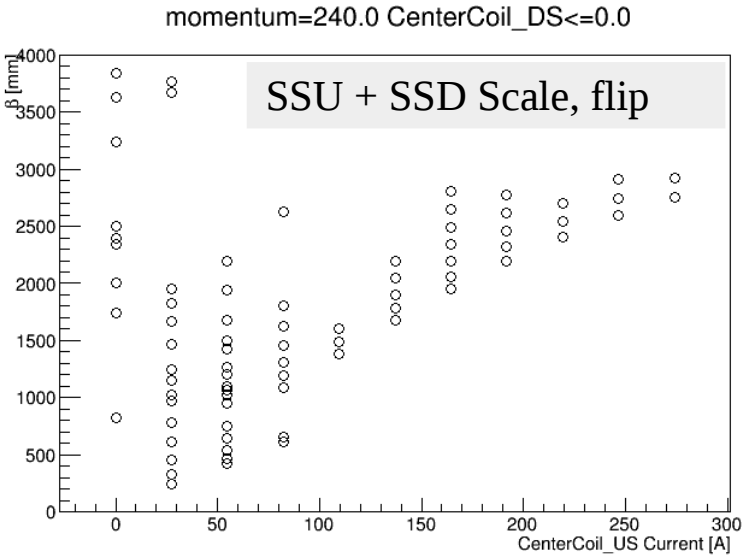

momentum=200.0 CenterCoil_DS<=0.0
SSU + SSD Scale, flip
β [mm]
CenterCoil_US Current [A]

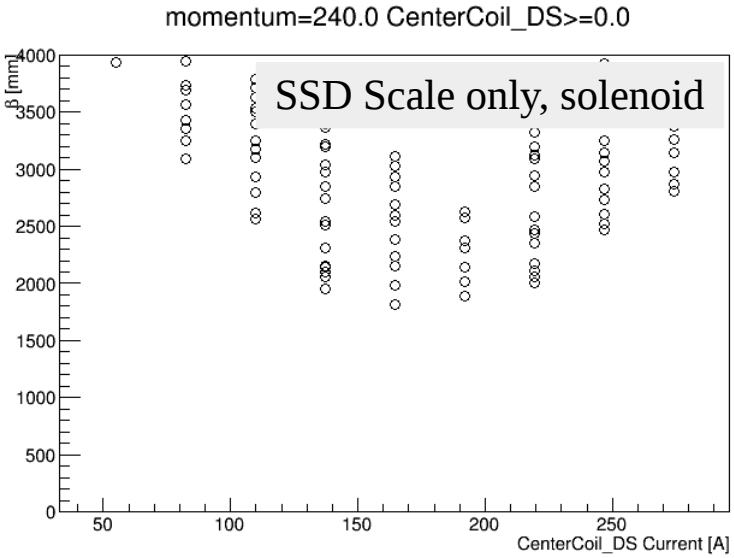

momentum=200.0 CenterCoil_DS>=0.0
SSD Scale only, solenoid
β [mm]
CenterCoil_DS Current [A]

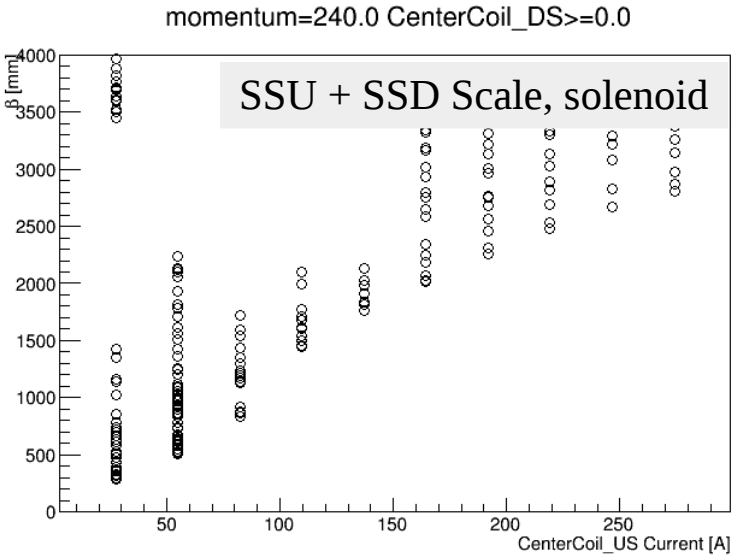

momentum=200.0 CenterCoil_DS>=0.0
SSU + SSD Scale, solenoid
β [mm]
CenterCoil_US Current [A]

# Intro


momentum=240.0 CenterCoil_DS<=0.0
SSD Scale only, flip
β [mm]
CenterCoil_DS Current [A]


momentum=240.0 CenterCoil_DS<=0.0
SSU + SSD Scale, flip
β [mm]
CenterCoil_US Current [A]

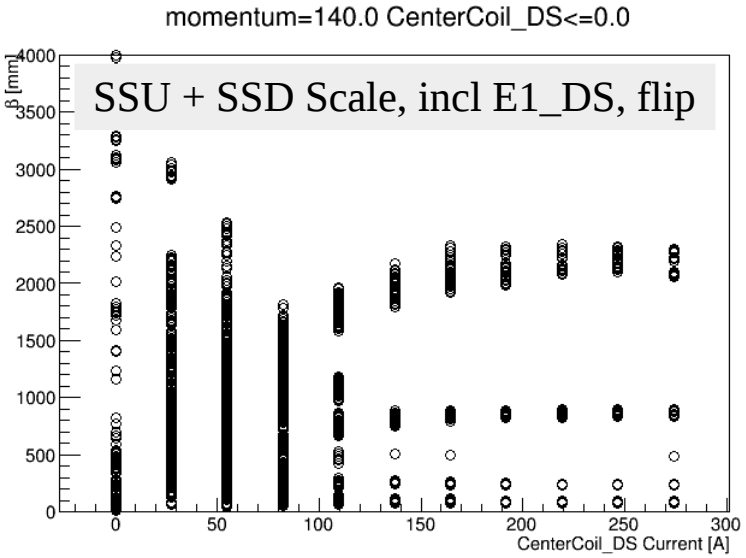

momentum=240.0 CenterCoil_DS>=0.0
SSD Scale only, solenoid
β [mm]
CenterCoil_DS Current [A]

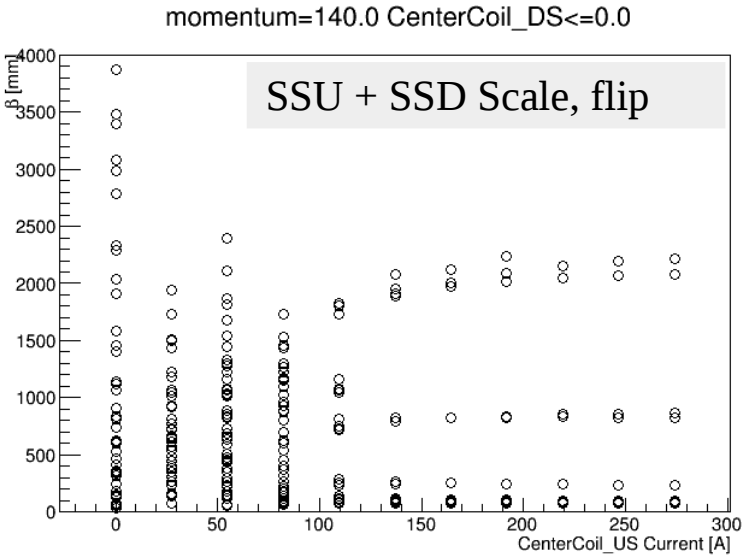

momentum=240.0 CenterCoil_DS>=0.0
SSU + SSD Scale, solenoid
β [mm]
CenterCoil_US Current [A]

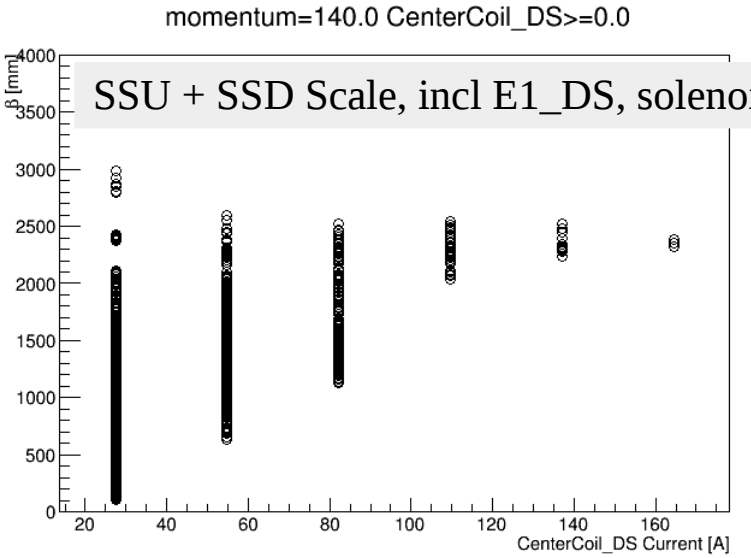
# Question

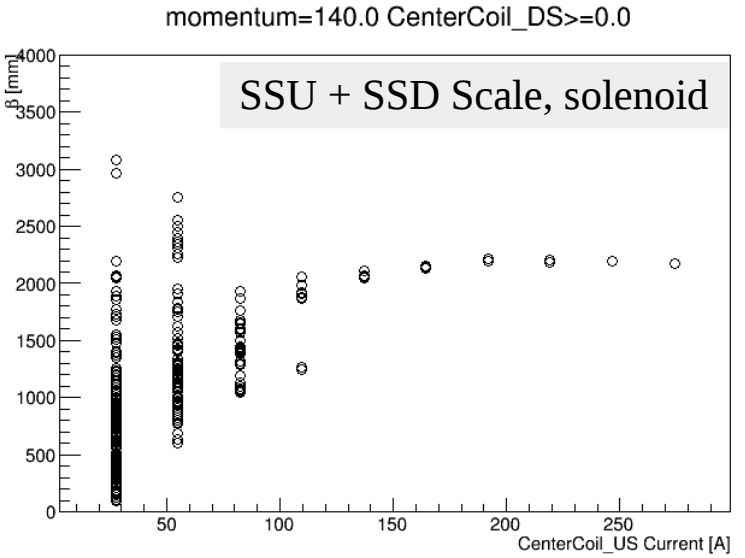
- Can we get more solutions by using End1 in SSD as a trim coil?

# End1 matching, 140 MeV/c

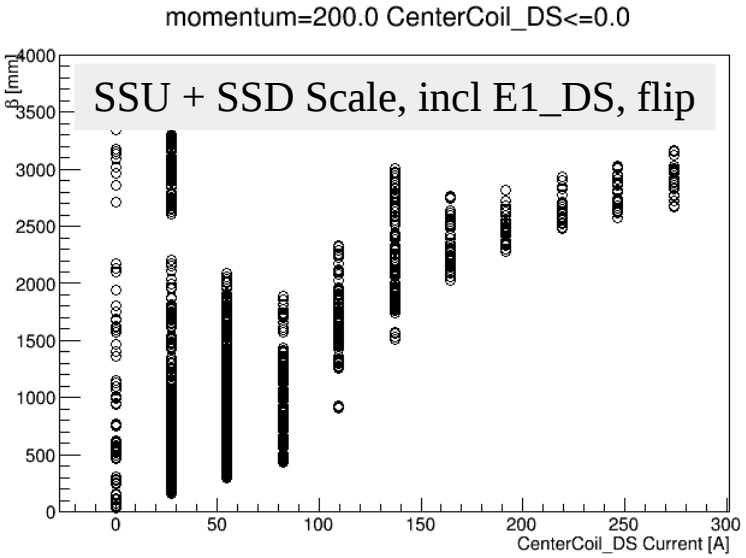


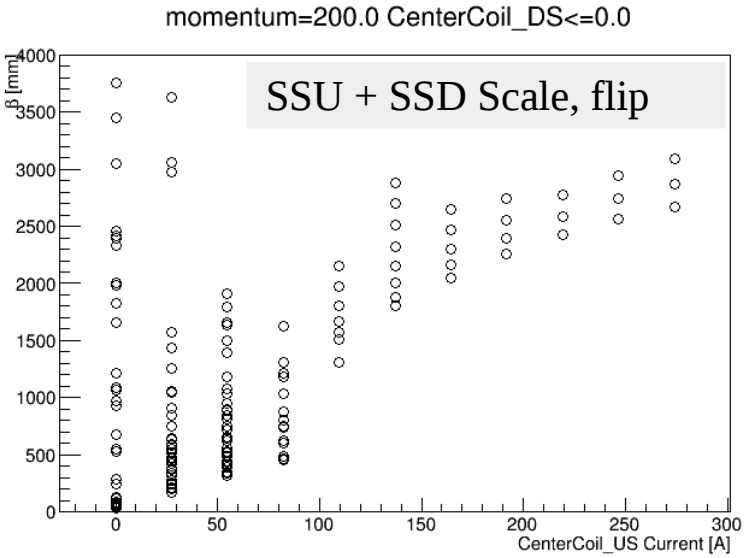



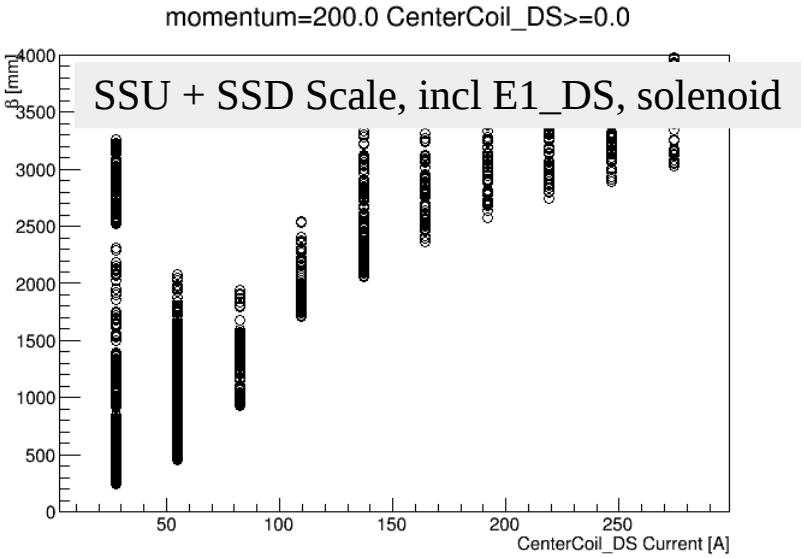



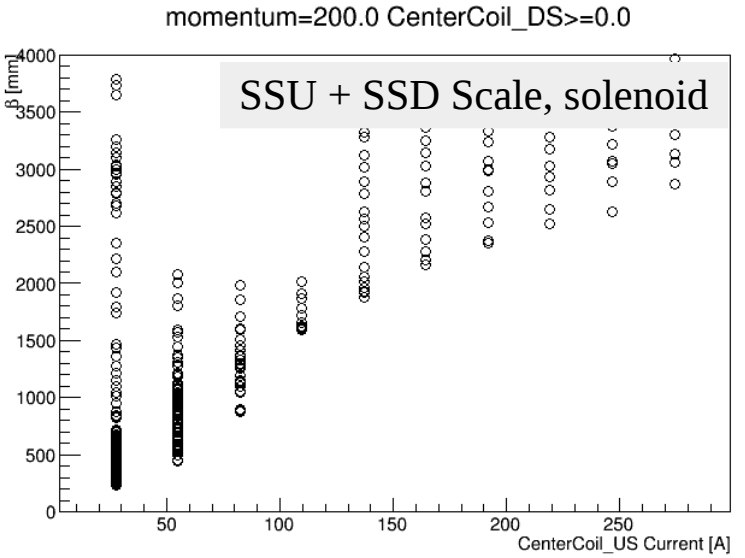



# End1 matching, 200 MeV/c

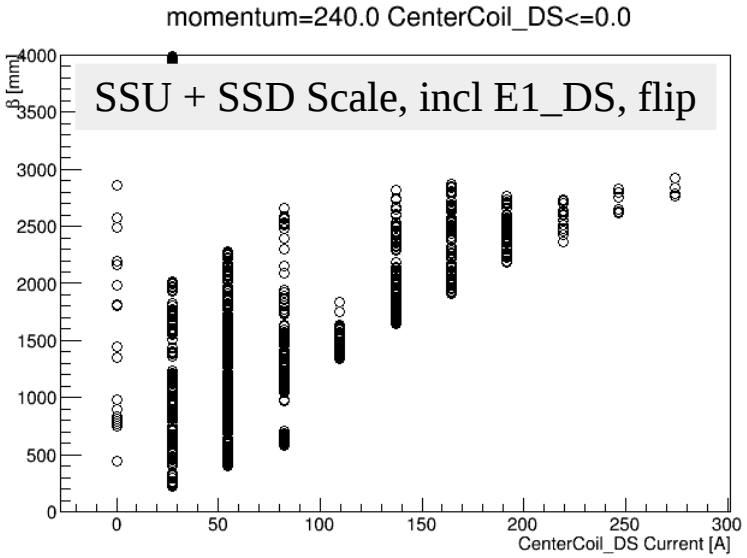


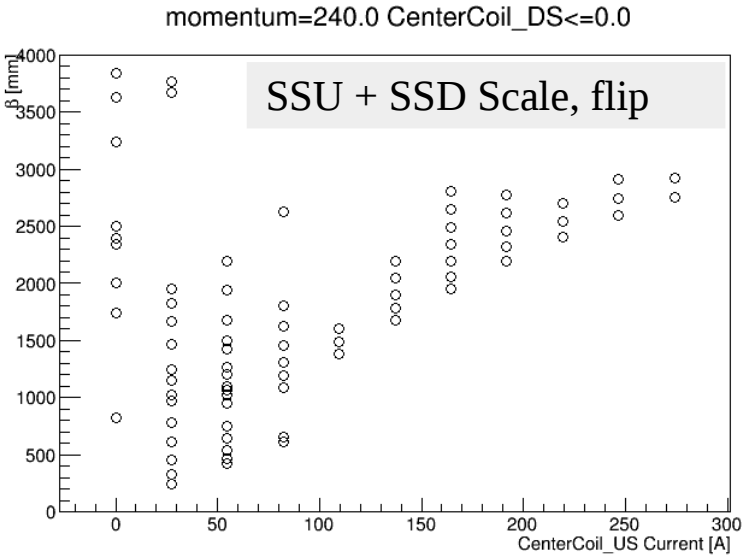



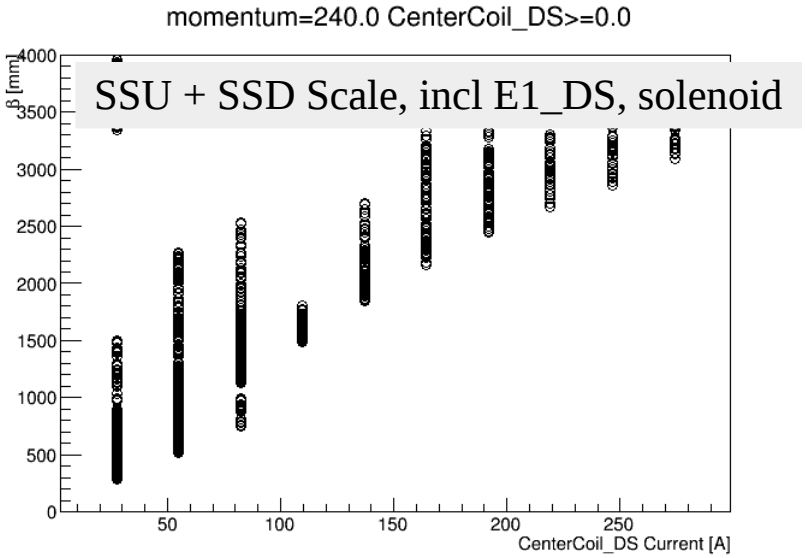



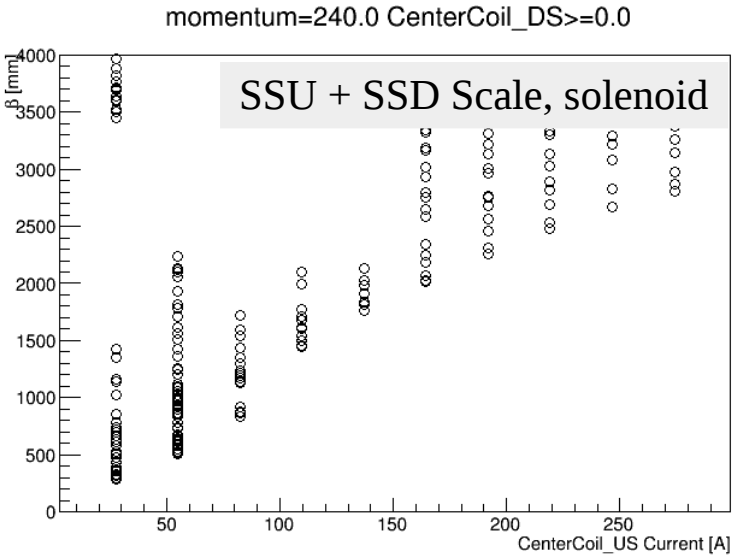



# End1 matching, 240 MeV/c

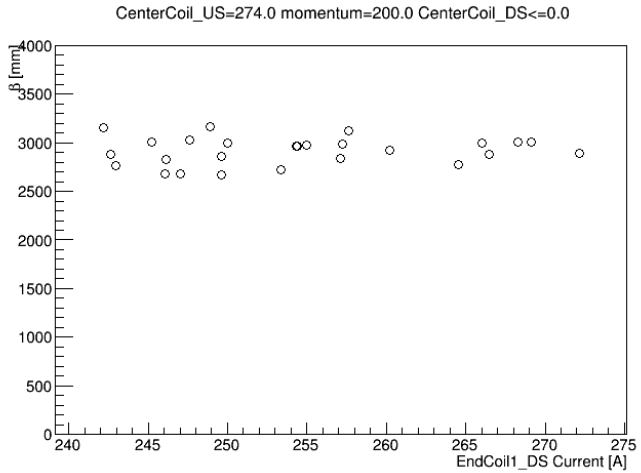


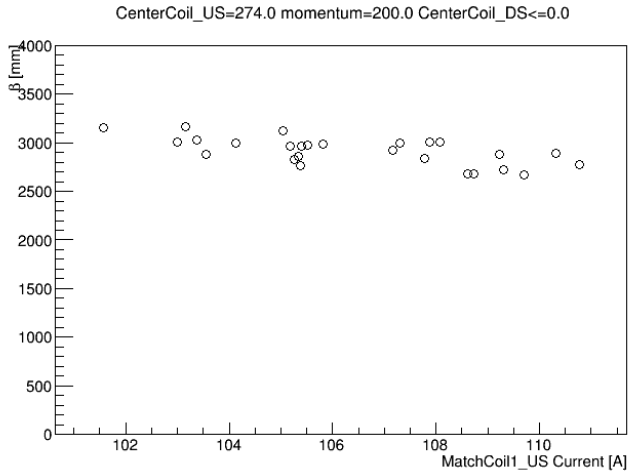



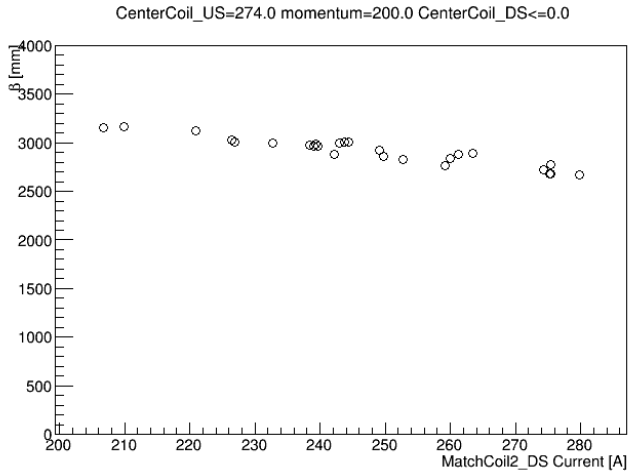



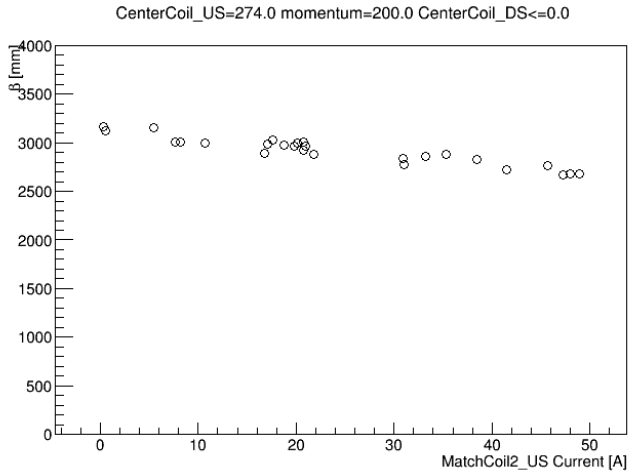



# What is limiting?



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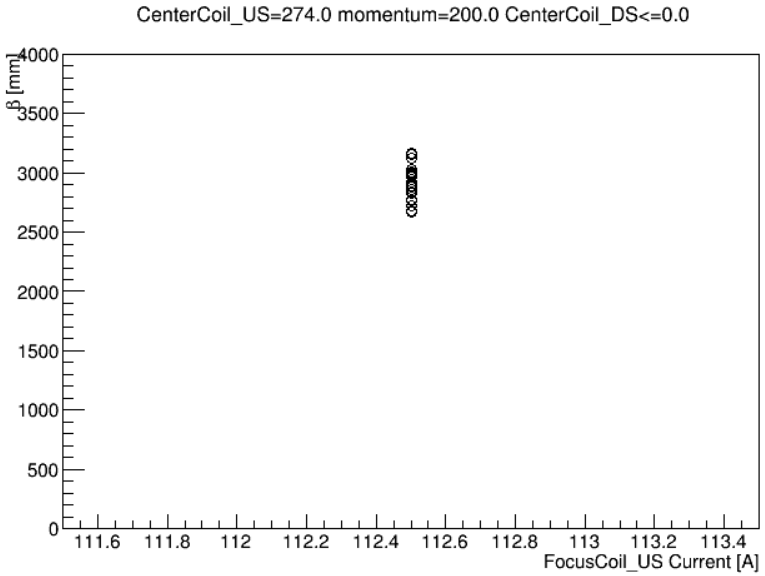
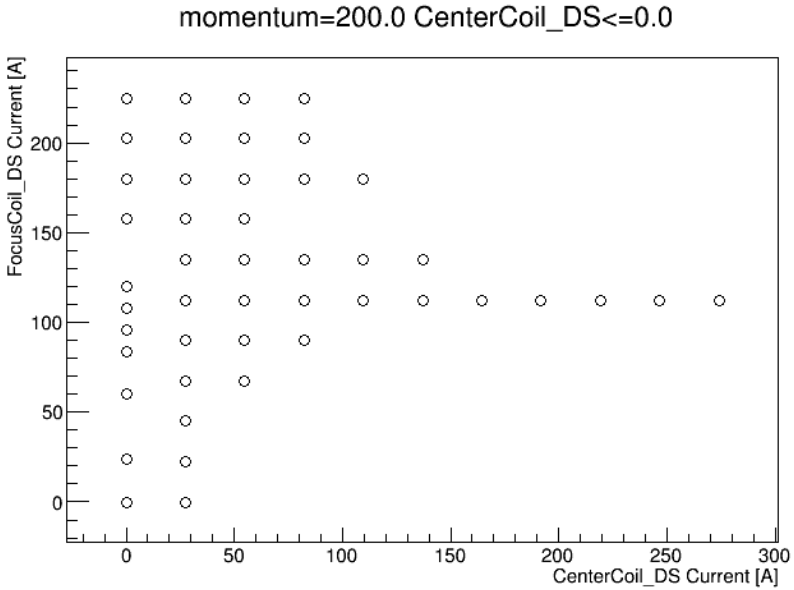
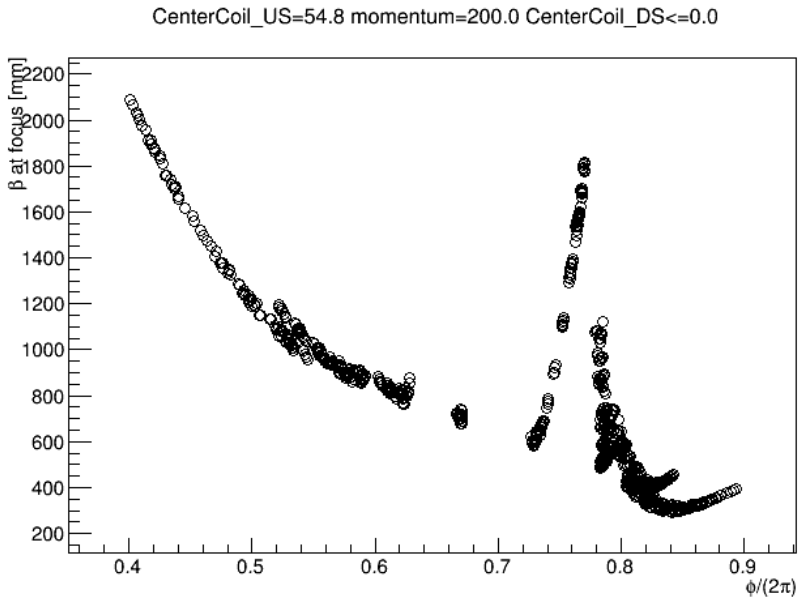
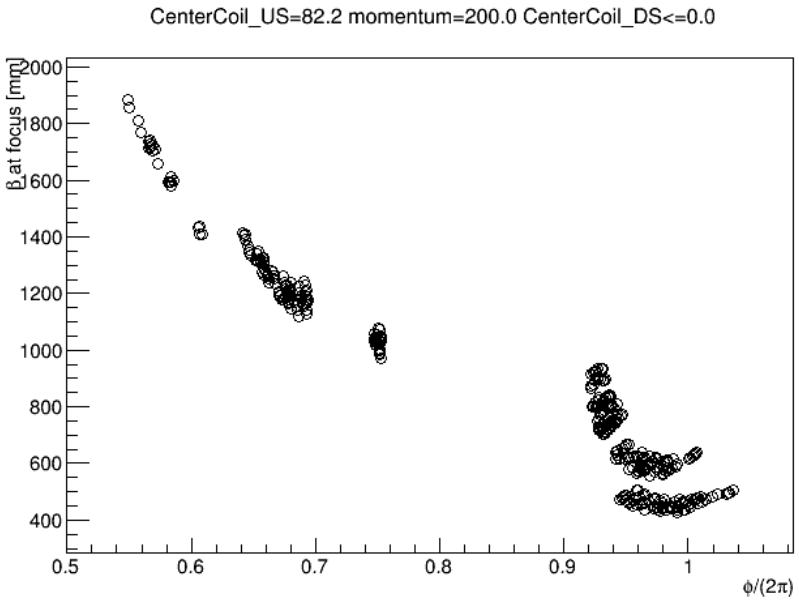
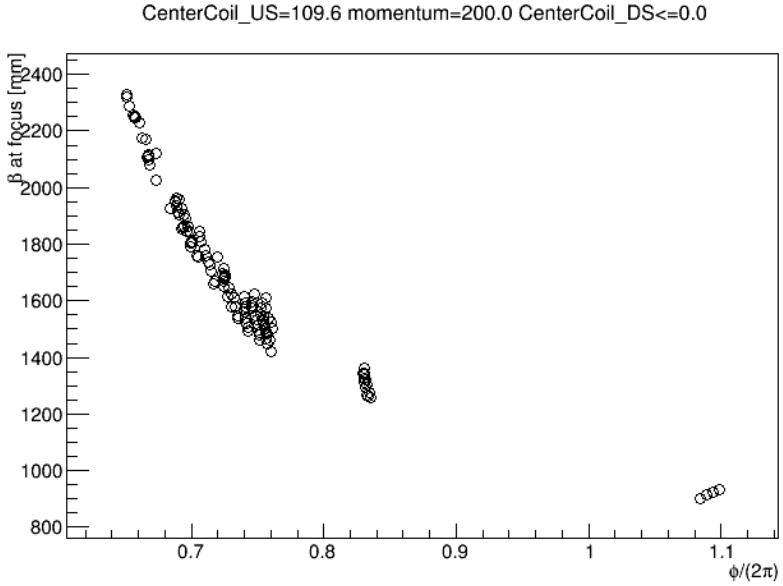


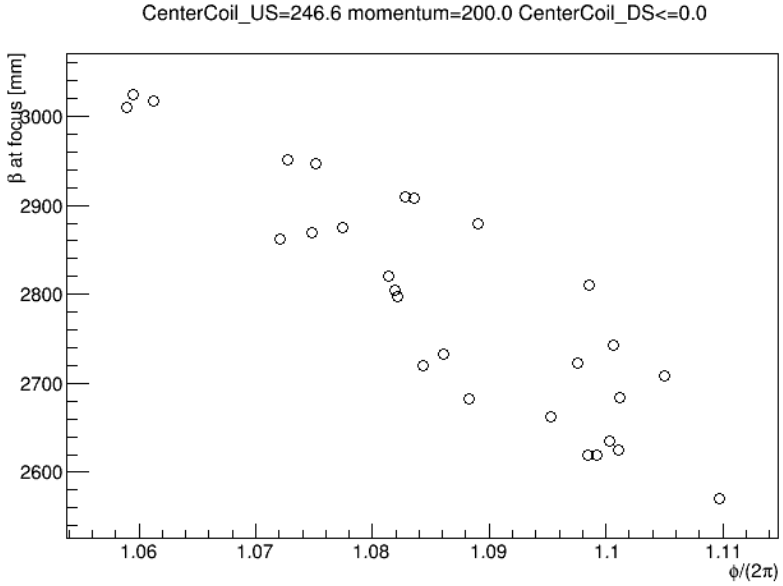



# Phase Advance



# Tracker Resolution in Reduced $B_z$

- Helix in constant $B_z$
  - Wavenumber $k = q B_z/p_z$
  - Radius $r = p_t/(qB_z)$
- If $B_z$ is reduced
  - Radius bigger => $p_t$ resolution improves
  - Wavelength longer => $p_t$, $p_z$ resolution gets worse
- Worst case
  - Combined TOF+EMR resolution gives $p_z$ measurement ~ few MeV/c
  - Scattering dominates in straight track limit ~ 5.3 mrad (quote Tim Carlisle thesis)

# Job List

- Optics
  - ~~Symmetric solutions~~
  - ~~Asymmetric solutions~~
  - ~~Scale down SSD only~~
    - Better at p = 140 MeV/c
    - Worse at p >= 200 MeV/c
    - Partial scaling of SSU would help at p >= 200 MeV/c
  - ~~Solutions using E1 to match~~
    - No real improvement
  - Partial scaling of SSU
  - Solutions using asymmetric FC (may be hardware issues)
  - Solutions without “constant beta in solenoid” boundary condition

# Job List

- Tracking
  - Tracker resolution vs $B_z$
  - Emittance growth – spherical aberrations
  - Emittance growth – chromatic aberrations
  - Full 6D study
- Demonstration of Ionisation Cooling options
  - Baseline here is “fix M1”; may need to justify