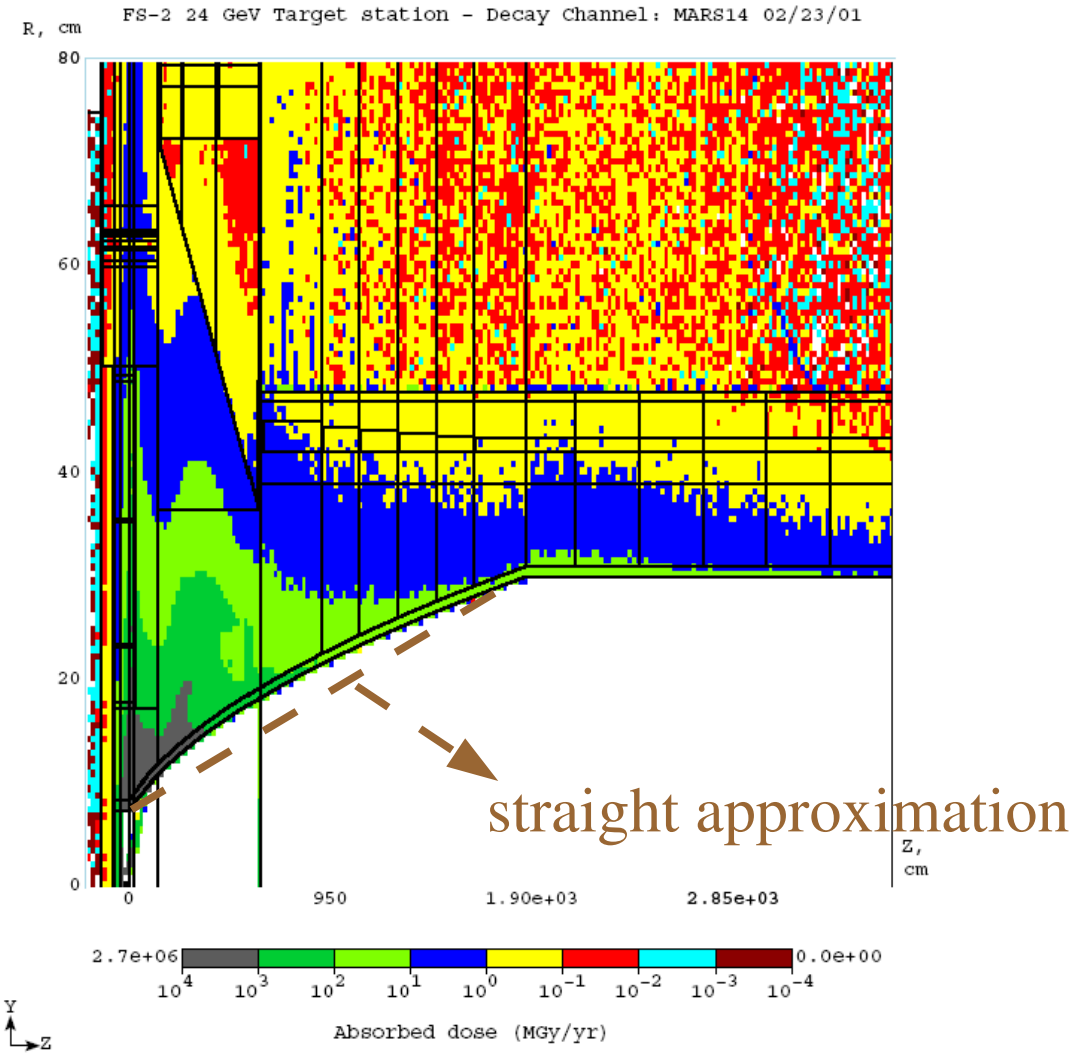
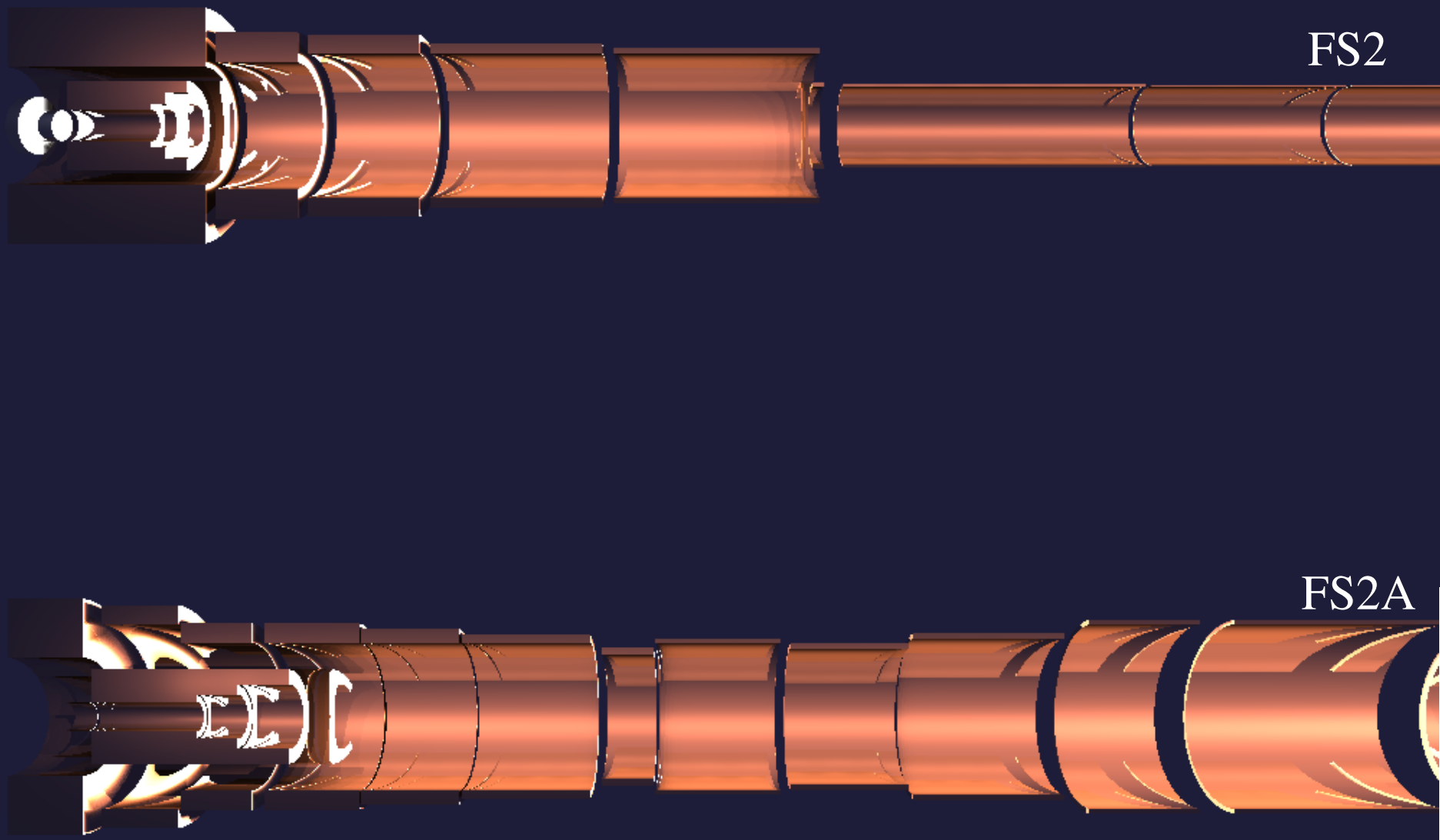
Pion Capture Region - FS2 vs FS2A

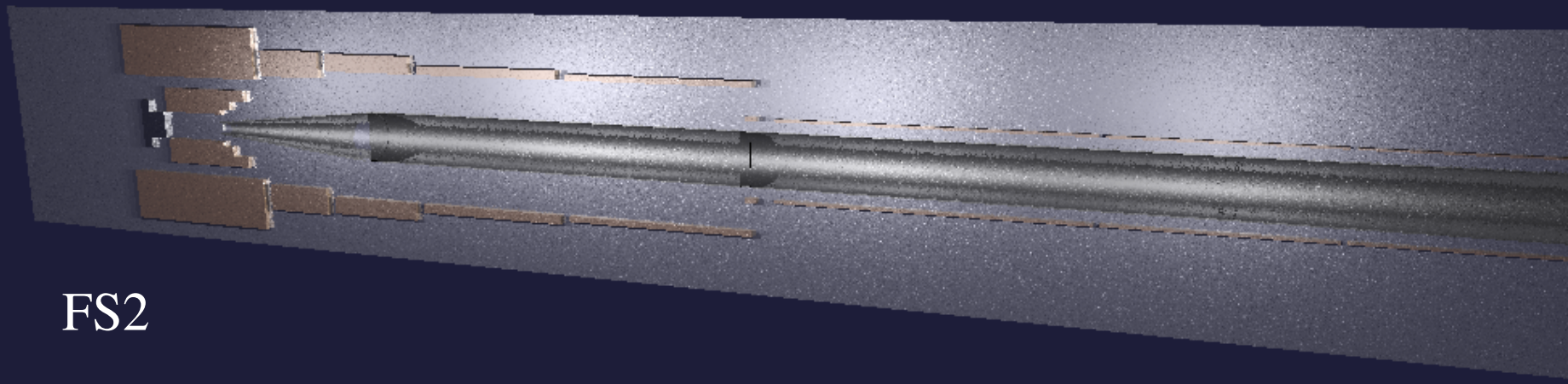
Pion Capture Region

- Comparison of pion capture from FS2 vs FS2A
  - Simulated in my GEANT4 code G4MICE
- FS2 has more reasonable coil currents
  - Assume low current density, rad-hard superconductor
- FS2A claims better capture rate
  - Argument ito keeping field lines in the solenoid bore or something
- Details
  - Approximate curved opening cone by a straight cone
    - I can do the curved cone in G4MICE if I know the functional form
  - Use beam generated in MARS by Harold Kirk
    - Possibly not using optimal beam->Hg set-up
    - I can do this in G4MICE but need to check appropriate physics models are switched on
  - Coils are all copper, apertures are all Tungsten
- Working also with target group
  - Apologies to those who have seen these slides already!

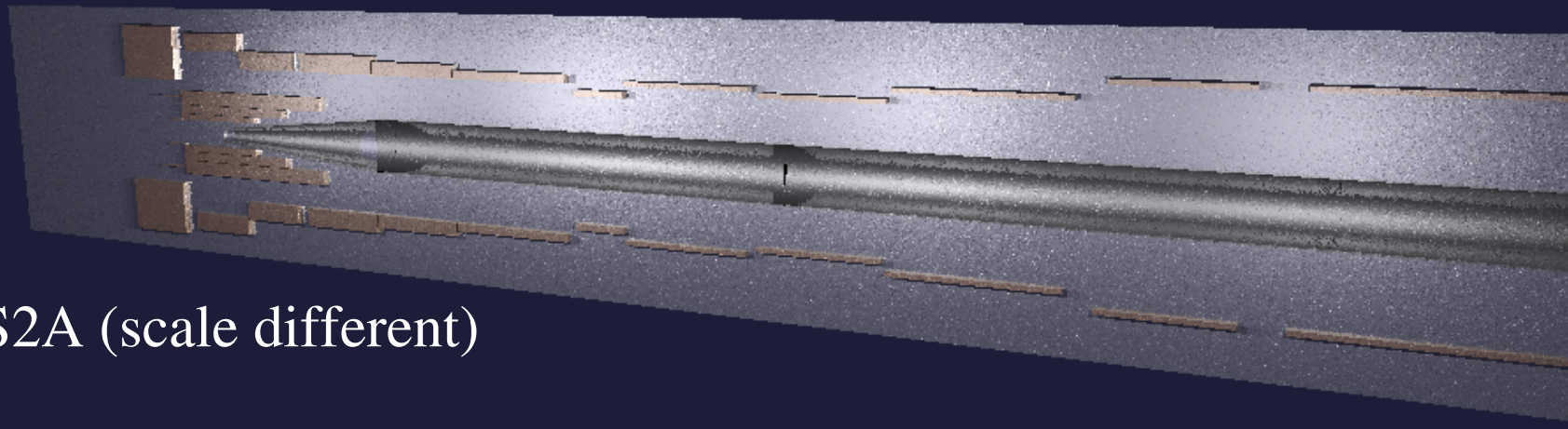
Pion Capture Region



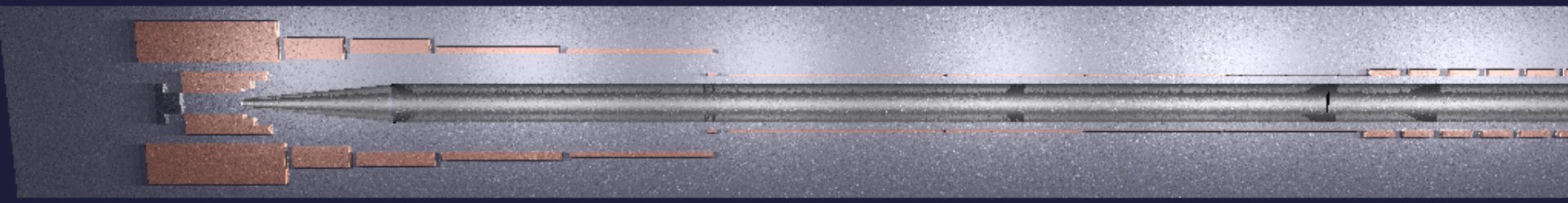

FS2
FS2A



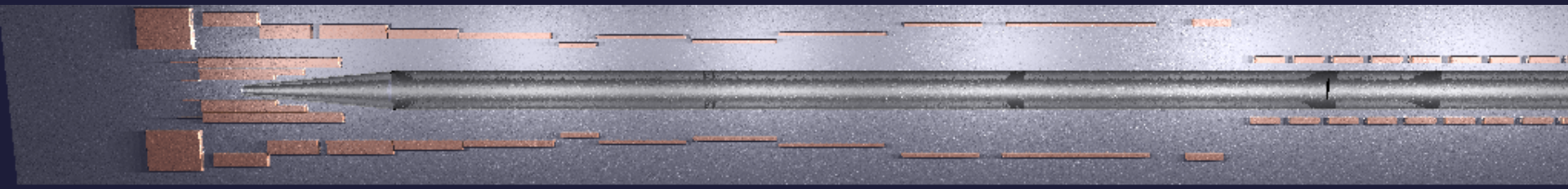
FS2



FS2A (scale different)

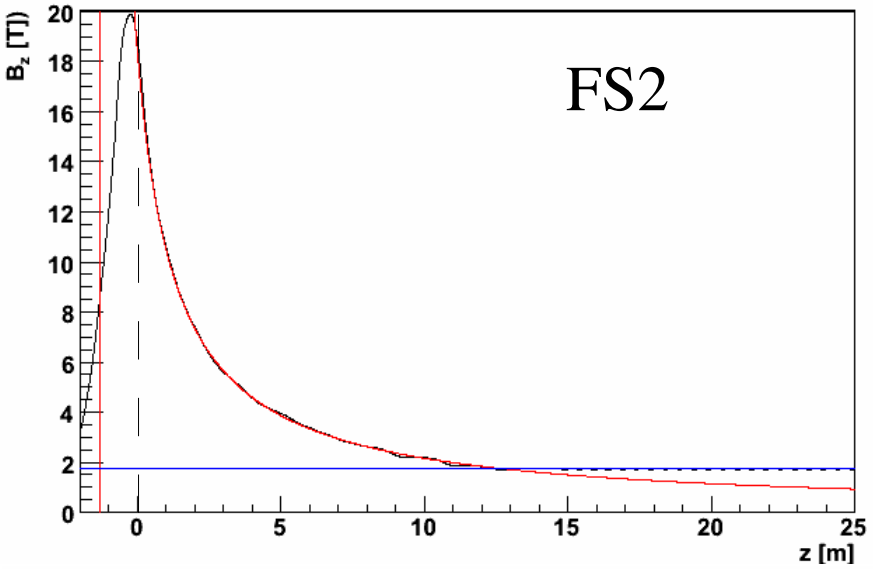


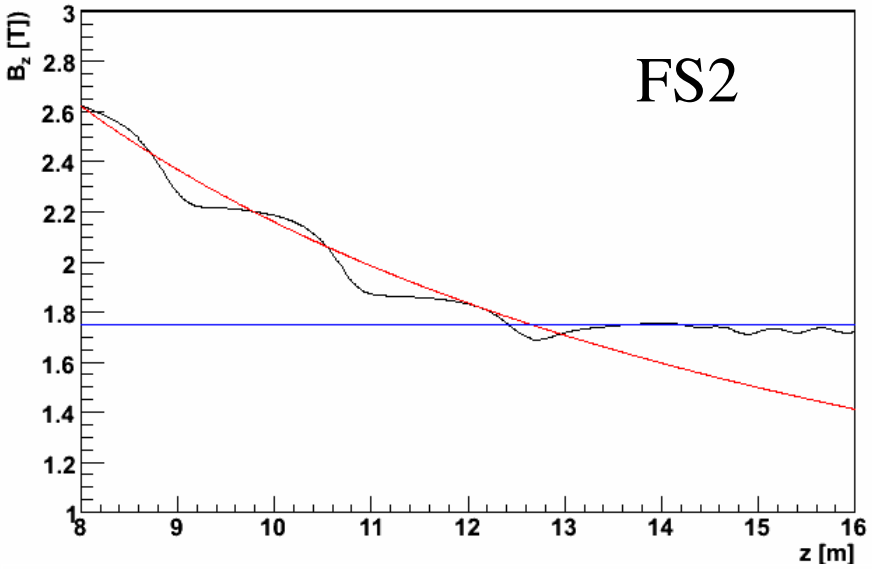
FS2

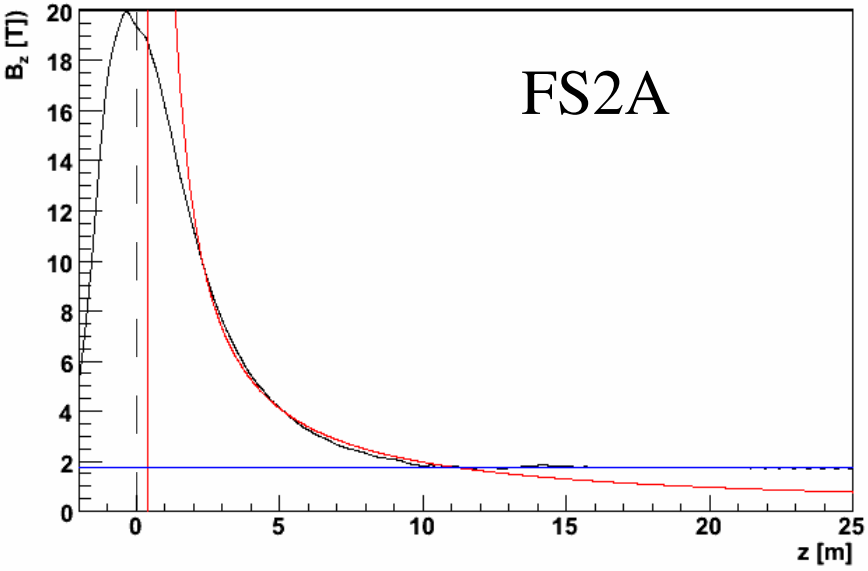


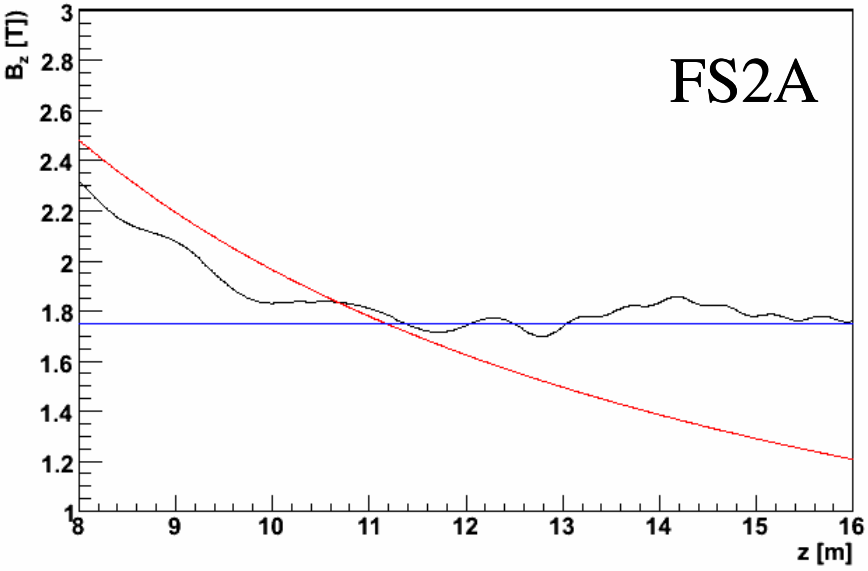
FS2A

Field on axis

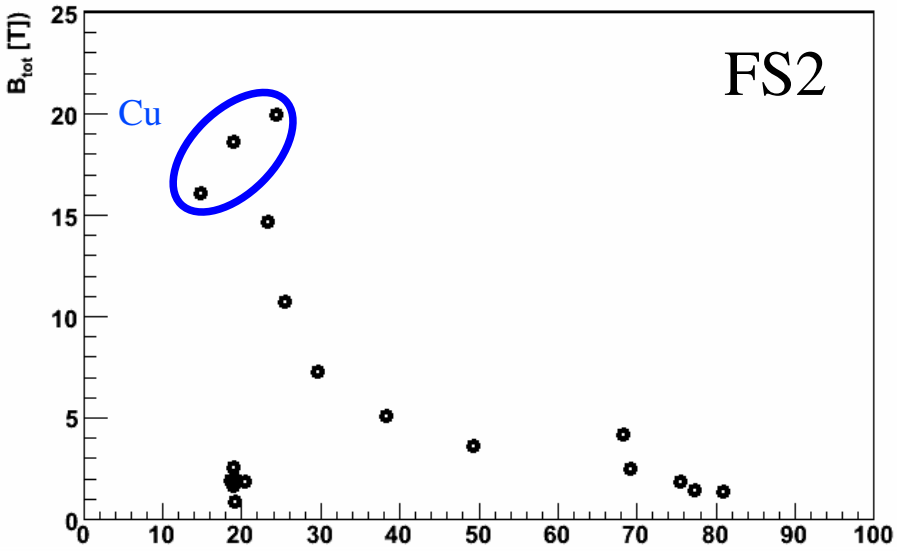


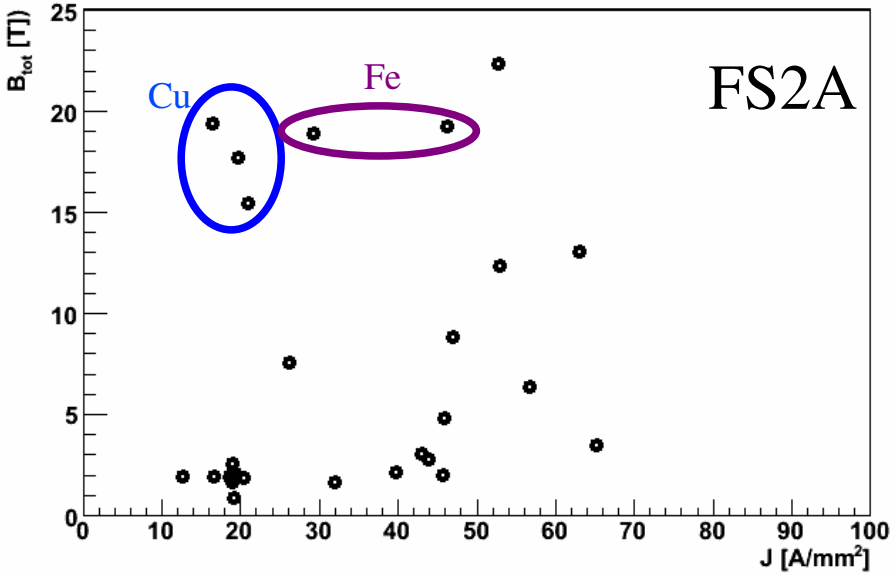






J/B Plots

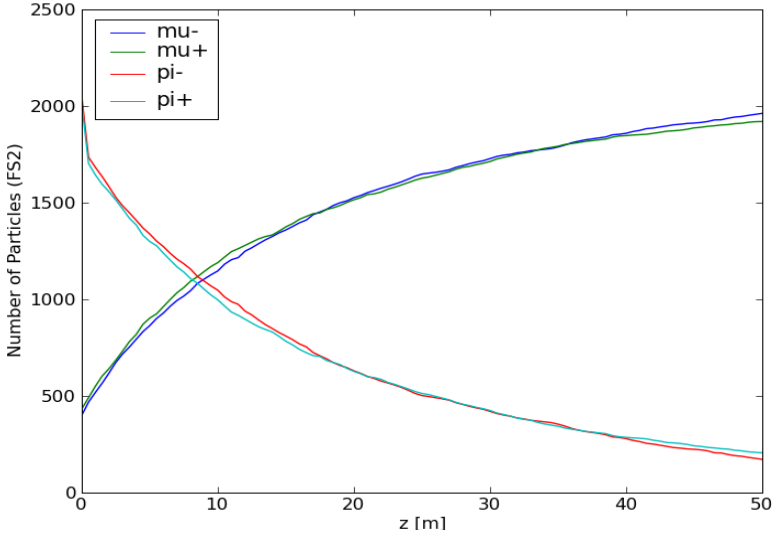

FS2
Cu
B_{tot} [T]
0
5
10
15
20
25
0
10
20
30
40
50
60
70
80
90
100


FS2A
Cu
Fe
B_{tot} [T]
0
5
10
15
20
25
0
10
20
30
40
50
60
70
80
90
100
J [A/mm^2]

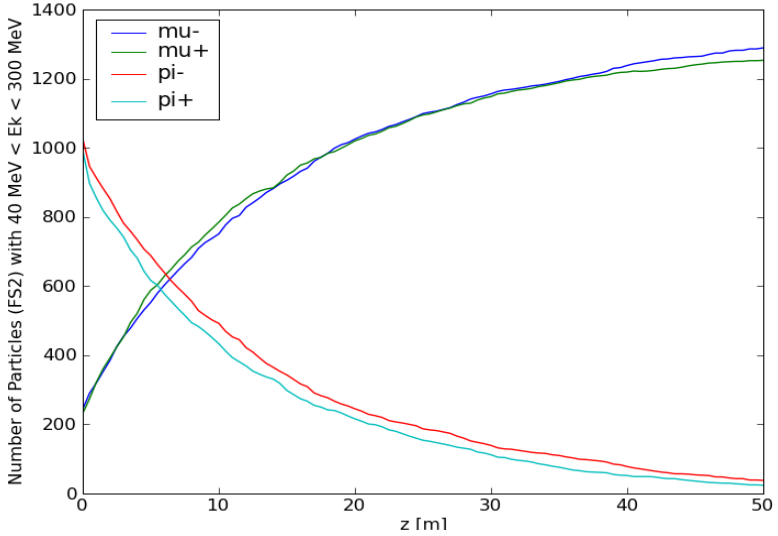
Transmission (No Apertures, 5k)

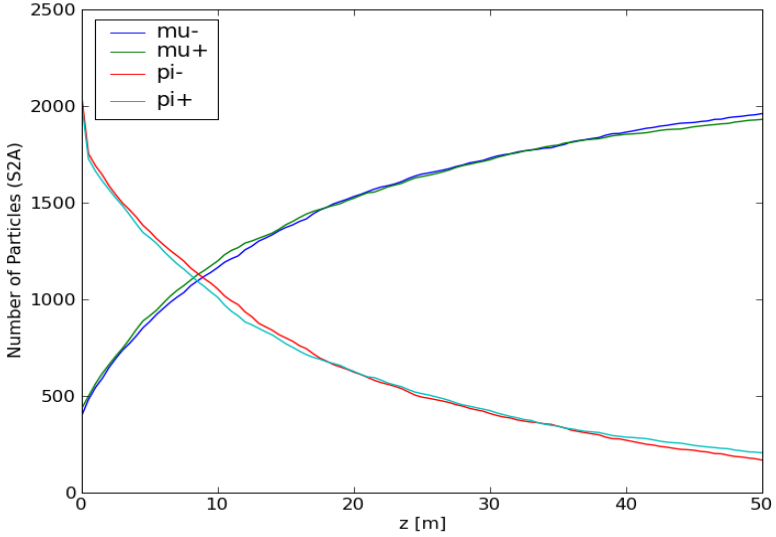
No Cut

40 < KE < 300

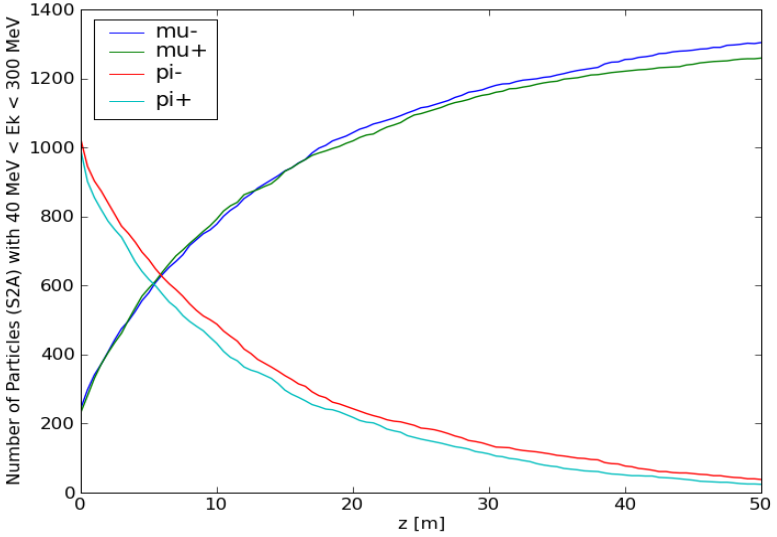


FS2



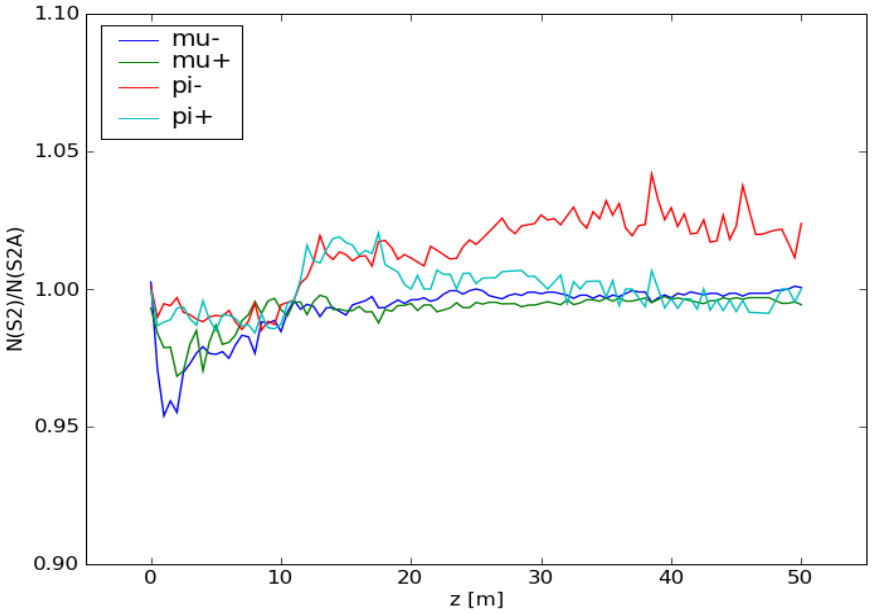


FS2A

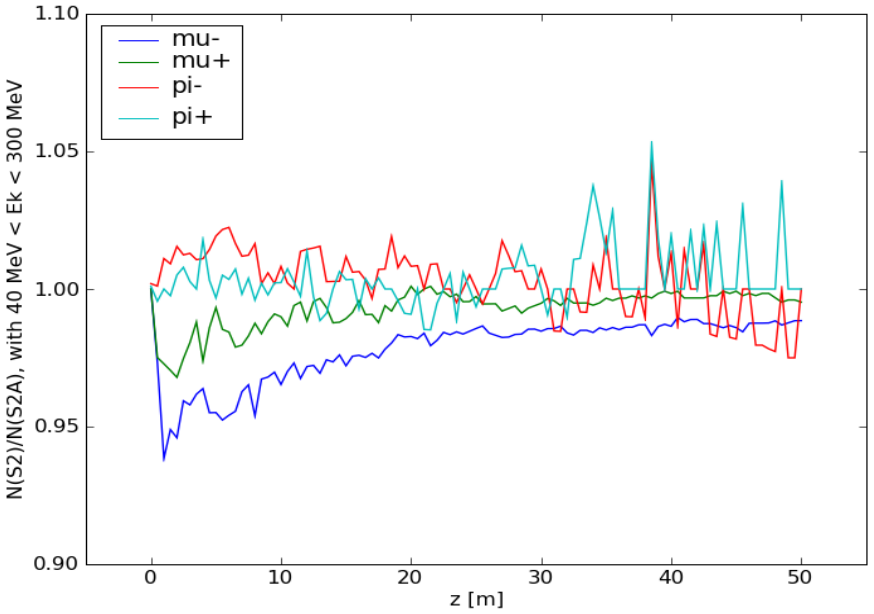


Transmission - Ratio (No aperture)

No Cut

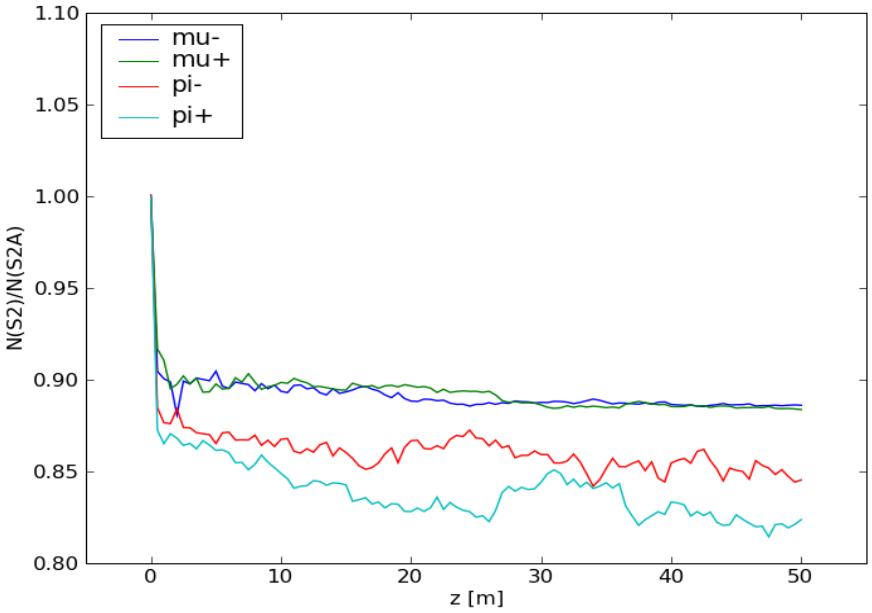


40 < KE < 300

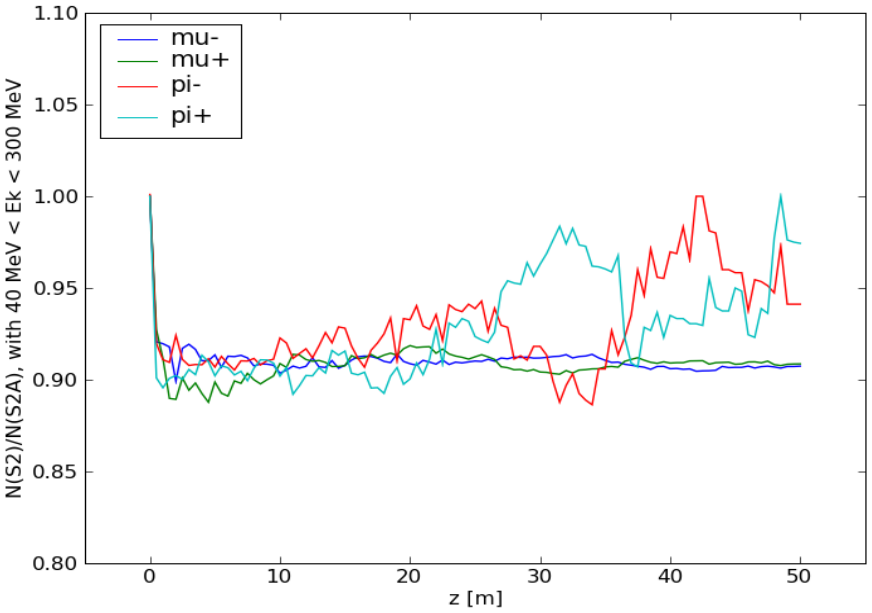


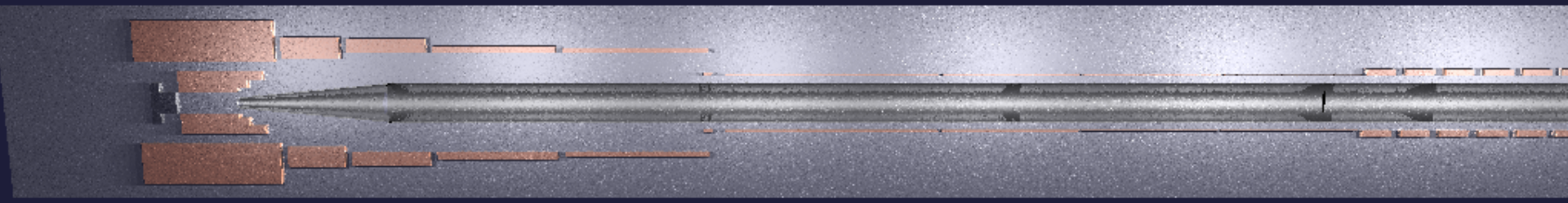
Transmission - Ratio (with aperture)

No Cut

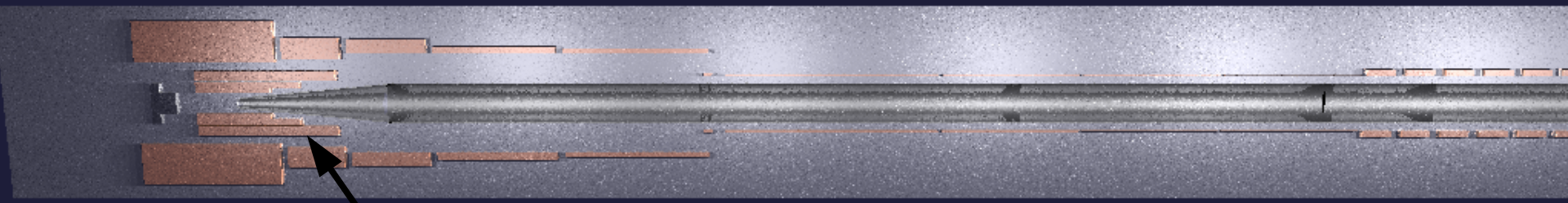


40 < KE < 300



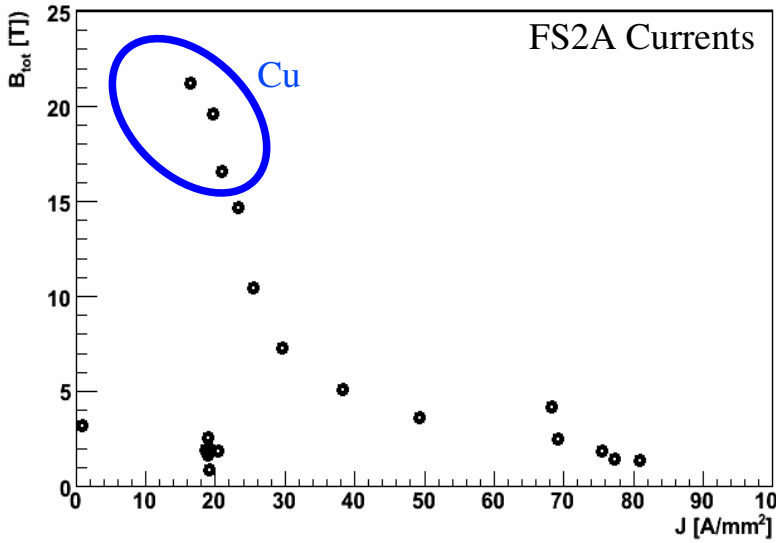


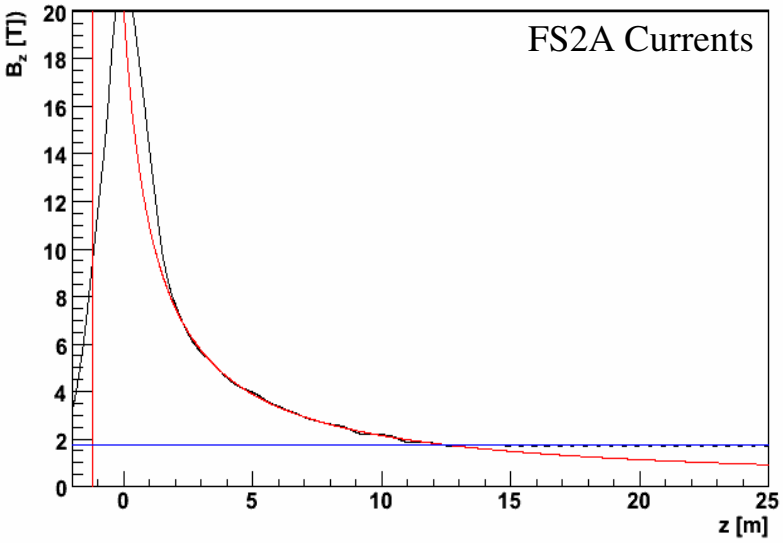
FS2

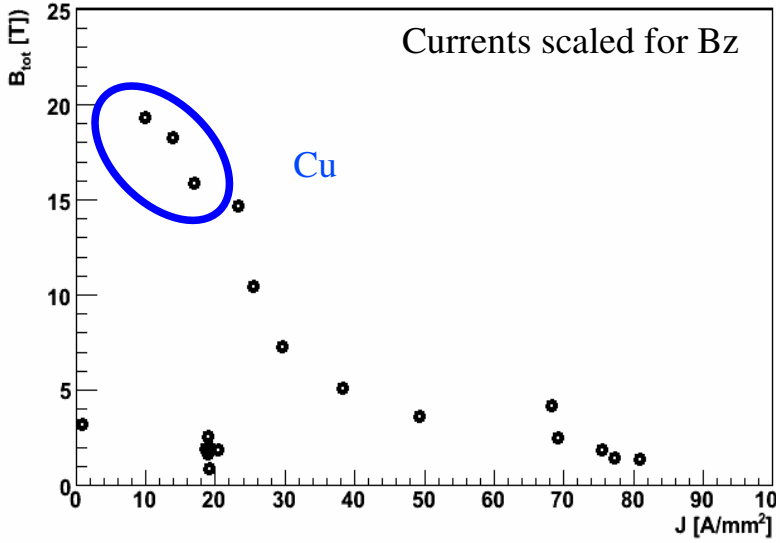


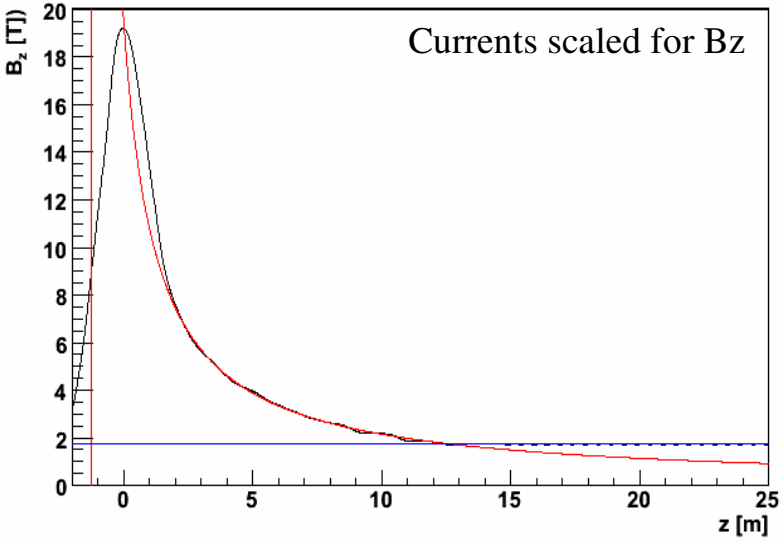
Modified FS2 - Import Copper Inserts from FS2A

Two Coil Current Settings



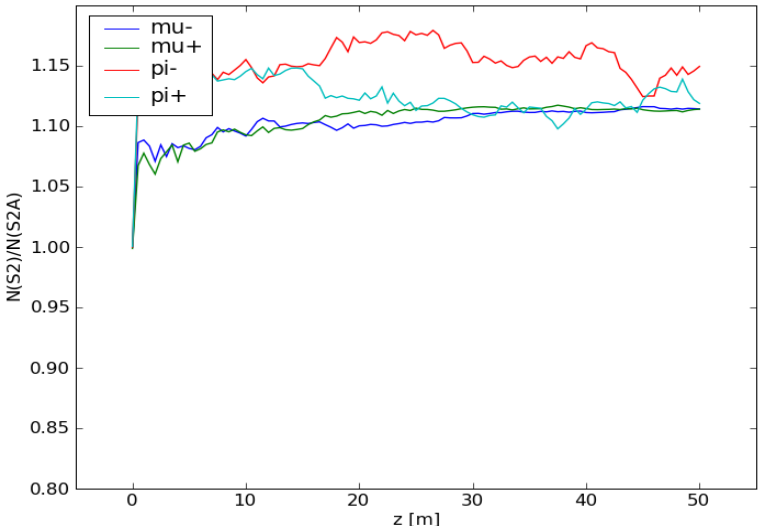




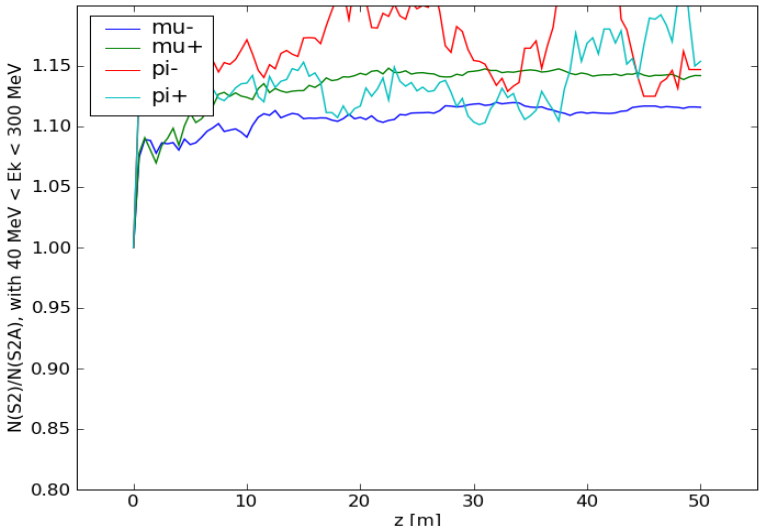


Transmission (No Apertures, 5k)

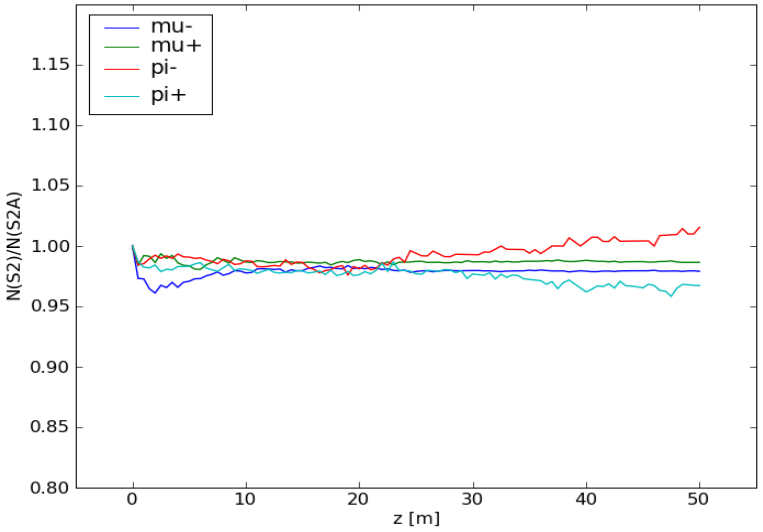
No Cut

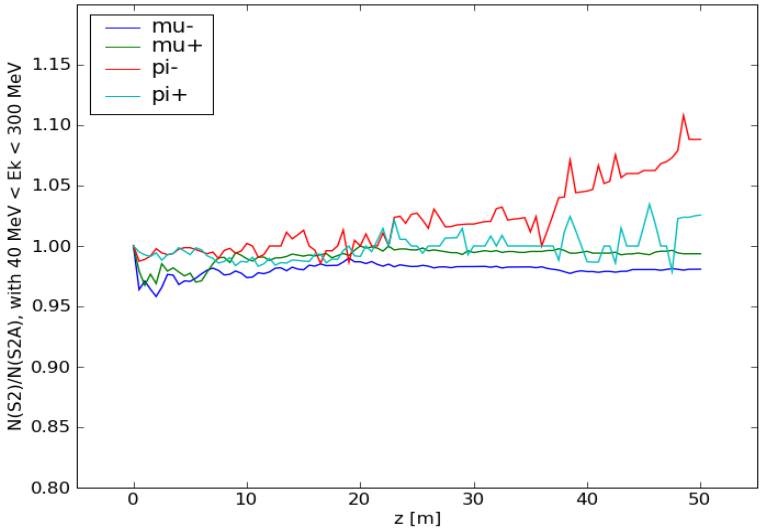


40 < KE < 300



Modified FS2





Modified FS2 and Scaled Currents

Summary

- Reasonable model of pion capture region implemented in geant4
- Compared muon capture of FS2 and FS2A
- FS2 has more reasonable coil currents
  - Assume low current density, rad-hard superconductor
- Arguably a bit more space for Hg drain in FS2A
- Looks like FS2A captures about 10% more muons
- We can fix this by using FS2A copper inserts in FS2 solenoid
  - May even be able to improve
  - But angular momentum not conserved
- Need to tidy simulations
  - Particle production in correct field map (esp angular momentum)
  - Correct aperture
  - Target Window
  - Convolution with cooling channel transmission

FS2A Coils (Suppressed Repeats)

	Length [mm]	Inner Radius [mm]	Radial Thickness [mm]	Outer Radius [mm]	Central Z [mm]	Upstream Z [mm]	Downstream Z [mm]	Current [A/mm^2]
	683.00	640.00	640.00	1280.00	-910.50	-1252.00	-569.00	52.87
Fe	326.00	430.00	10.00	440.00	-683.00	-846.00	-520.00	29.29
Fe	206.00	150.00	10.00	160.00	-623.00	-726.00	-520.00	46.36
	690.00	1000.00	210.00	1210.00	-55.00	-400.00	290.00	26.23
Cu	948.00	160.00	70.00	230.00	-26.00	-500.00	448.00	16.52
Cu	1320.00	240.00	100.00	340.00	160.00	-500.00	820.00	19.69
Cu	1791.00	350.00	160.00	510.00	395.50	-500.00	1291.00	20.96
	640.00	800.00	210.00	1010.00	630.00	310.00	950.00	52.95
	850.00	800.00	210.00	1010.00	1495.00	1070.00	1920.00	63.02
	880.00	800.00	150.00	950.00	2380.00	1940.00	2820.00	47.09
	1160.00	800.00	90.00	890.00	3420.00	2840.00	4000.00	56.74
	470.00	673.00	70.00	743.00	4335.00	4100.00	4570.00	45.97
	1127.00	800.00	50.00	850.00	5153.50	4590.00	5717.00	65.18
	1070.00	740.00	50.00	790.00	6338.00	5803.00	6873.00	44.00
	1360.00	849.00	50.00	899.00	7590.00	6910.00	8270.00	39.77
	990.00	1000.00	50.00	1050.00	8995.00	8500.00	9490.00	45.69
	1900.00	1000.00	50.00	1050.00	10750.00	9800.00	11700.00	32.01
	470.00	1000.00	100.00	1100.00	12415.00	12180.00	12650.00	42.96
	360.00	430.00	100.00	530.00	13180.00	13000.00	13360.00	12.63
	360.00	430.00	100.00	530.00	13680.00	13500.00	13860.00	16.74
	360.00	430.00	100.00	530.00	14180.00	14000.00	14360.00	19.42
	360.00	430.00	100.00	530.00	14680.00	14500.00	14860.00	19.06
	360.00	430.00	100.00	530.00	15180.00	15000.00	15360.00	18.84
	360.00	430.00	100.00	530.00	16180.00	16000.00	16360.00	19.22
	360.00	430.00	100.00	530.00	37180.00	18410.00	37360.00	18.76
	355.00	450.00	100.00	550.00	37640.00	18642.50	37817.50	20.39
	364.00	377.00	100.00	477.00	38130.00	18883.00	38312.00	18.67
	389.00	352.00	100.00	452.00	38640.00	19125.50	38834.50	19.16

FS2 Coils (Suppressed Repeats)

	Length [mm]	Inner Radius [mm]	Radial Thickness [mm]	Outer Radius [mm]	Central Z [mm]	Upstream Z [mm]	Downstream Z [mm]	Current [A/mm^2]
Cu	749.00	178.00	54.00	232.00	-337.50	-712.00	37.00	24.37
Cu	877.00	231.00	122.00	353.00	-273.50	-712.00	165.00	19.07
Cu	1073.00	353.00	137.00	490.00	-175.50	-712.00	361.00	14.87
	1781.00	636.00	642.00	1278.00	-362.50	-1253.00	528.00	23.39
	729.00	686.00	325.00	1011.00	992.50	628.00	1357.00	25.48
	999.00	776.00	212.00	988.00	1956.50	1457.00	2456.00	29.73
	1550.00	776.00	107.00	883.00	3331.00	2556.00	4106.00	38.26
	1859.00	776.00	66.00	842.00	5135.50	4206.00	6065.00	49.39
	103.00	416.00	51.00	467.00	6051.50	6000.00	6103.00	68.32
	2728.00	422.00	29.00	451.00	7639.00	6275.00	9003.00	69.27
	1749.00	422.00	23.00	445.00	9927.50	9053.00	10802.00	75.62
	1750.00	422.00	19.00	441.00	11727.00	10852.00	12602.00	77.37
	1749.00	422.00	17.00	439.00	13526.00	12651.50	14400.50	81.00
Match by CR	360.00	430.00	100.00	530.00	14650.00	14470.00	14830.00	19.40
Match by CR	360.00	430.00	100.00	530.00	15150.00	14970.00	15330.00	19.40
	360.00	430.00	100.00	530.00	16150.00	15970.00	16330.00	19.22
	360.00	430.00	100.00	530.00	37150.00	36970.00	37330.00	18.76
	355.00	450.00	100.00	550.00	37610.00	37432.50	37787.50	20.39
	364.00	377.00	100.00	477.00	38100.00	37918.00	38282.00	18.67
	389.00	352.00	100.00	452.00	38610.00	38415.50	38804.50	19.16
	360.00	320.00	100.00	420.00	39150.00	38970.00	39330.00	18.91

Modified FS2 Coils

	Length [mm]	Inner Radius [mm]	Radial Thickness [mm]	Outer Radius [mm]	Central Z [mm]	Upstream Z [mm]	Downstream Z [mm]	Current [A/mm^2]
	1781.00	636.00	642.00	1278.00	-362.50	-1253.00	528.00	23.39
Cu	948.00	160.00	70.00	230.00	-26.00	-500.00	448.00	16.52/10.00
Cu	1320.00	240.00	100.00	340.00	160.00	-500.00	820.00	19.69/14.00
Cu	1791.00	350.00	160.00	510.00	395.50	-500.00	1291.00	20.96/17.00
	729.00	686.00	325.00	1011.00	992.50	628.00	1357.00	25.48
	999.00	776.00	212.00	988.00	1956.50	1457.00	2456.00	29.73
	1550.00	776.00	107.00	883.00	3331.00	2556.00	4106.00	38.26
	1859.00	776.00	66.00	842.00	5135.50	4206.00	6065.00	49.39
	103.00	416.00	51.00	467.00	6051.50	6000.00	6103.00	68.32
	2728.00	422.00	29.00	451.00	7639.00	6275.00	9003.00	69.27
	1749.00	422.00	23.00	445.00	9927.50	9053.00	10802.00	75.62
	1750.00	422.00	19.00	441.00	11727.00	10852.00	12602.00	77.37
	1749.00	422.00	17.00	439.00	13526.00	12651.50	14400.50	81.00
Match by CR	360.00	430.00	100.00	530.00	14650.00	14470.00	14830.00	19.40
Match by CR	360.00	430.00	100.00	530.00	15150.00	14970.00	15330.00	19.40
	360.00	430.00	100.00	530.00	16150.00	15970.00	16330.00	19.22
	360.00	430.00	100.00	530.00	37150.00	36970.00	37330.00	18.76
	355.00	450.00	100.00	550.00	37610.00	37432.50	37787.50	20.39
	364.00	377.00	100.00	477.00	38100.00	37918.00	38282.00	18.67
	389.00	352.00	100.00	452.00	38610.00	38415.50	38804.50	19.16
	360.00	320.00	100.00	420.00	39150.00	38970.00	39330.00	18.91