IDS120h GEOMETRY WITH MODIFIED Hg POOL VESSEL

SIMULATIONS FOR 60% W + 40% He SHIELDING (P11/P12 'POINTS') (CONT.)

DETAILED STUDY FOR DP IN SC#8 AND SC#9

Nicholas Souchlas, PBL (12/13/2011)

IDS120hm: (m IS FOR) modified Hg pool vessel IN IDS120h.

 # 1E5 AND 5E5 SIMULATIONS COMPARISON.

 # DETAIL ANALYSIS OF TDP IN SC#8 AND SC#9.

 # PROTECTING THE SC's IN THE "STAIRS"

 # P11/P12 INITIAL PROTON BEAM POSITION SIMULATIONS.

>mars1510/MCNP

>10^{-11} MeV NEUTRON ENERGY CUTOFF

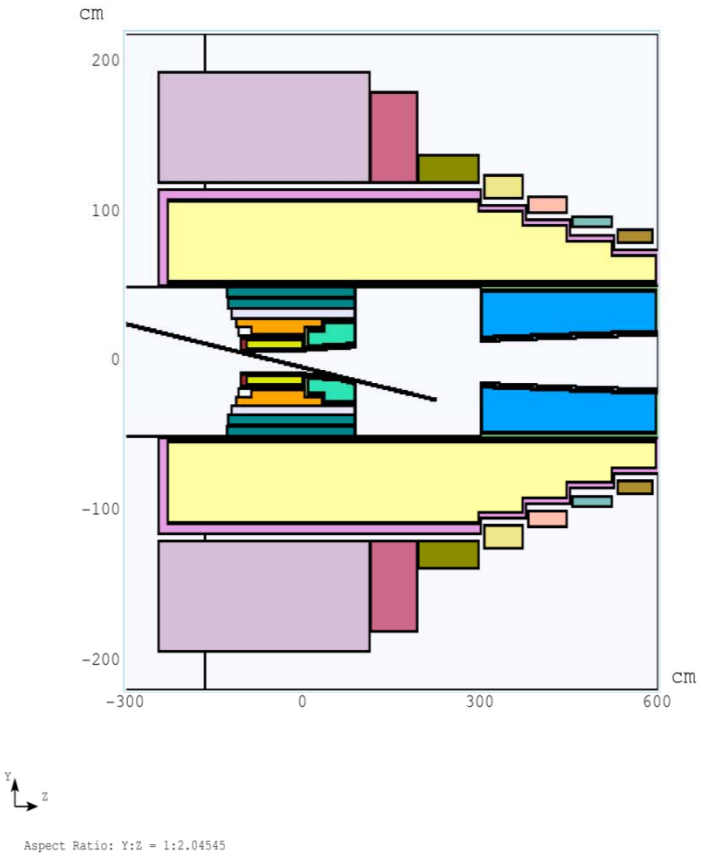
>SHIELDING: 60% W + 40% He (WITH W VESSELS)

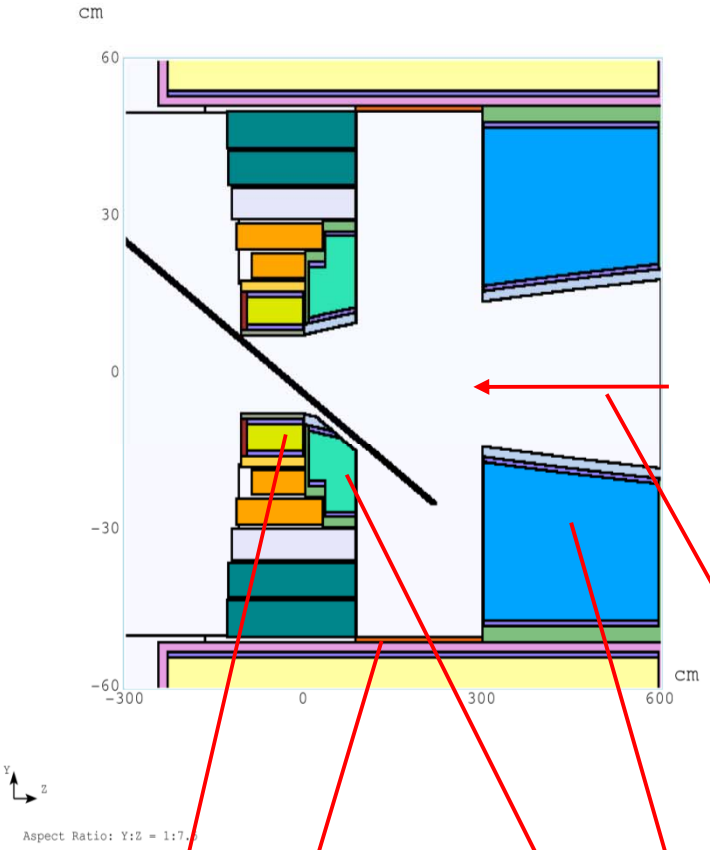
>4 MW proton beam, Np = 100,000/500,000 events.

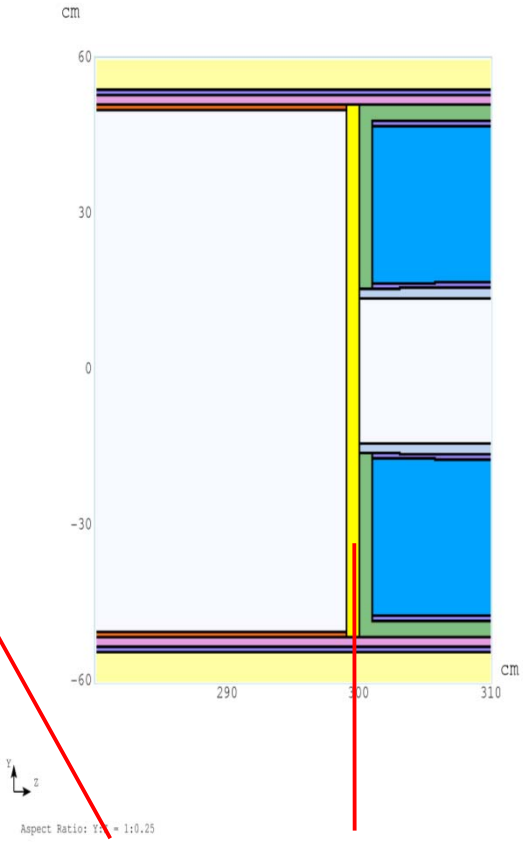
>PROTONS ENERGY E = 8 GeV.

>GAUSSIAN PROFILE: $\sigma_x = \sigma_y = 0.12$ cm.

IDS120hm GEOMETRY = IDS120h WITH MODIFIED Hg POOL VESSEL AND SHIFTED Be WIDOW FROM 600 cm (0.6 cm THICK) TO 300 cm (1 cm THICK).







SH1-->SH1A

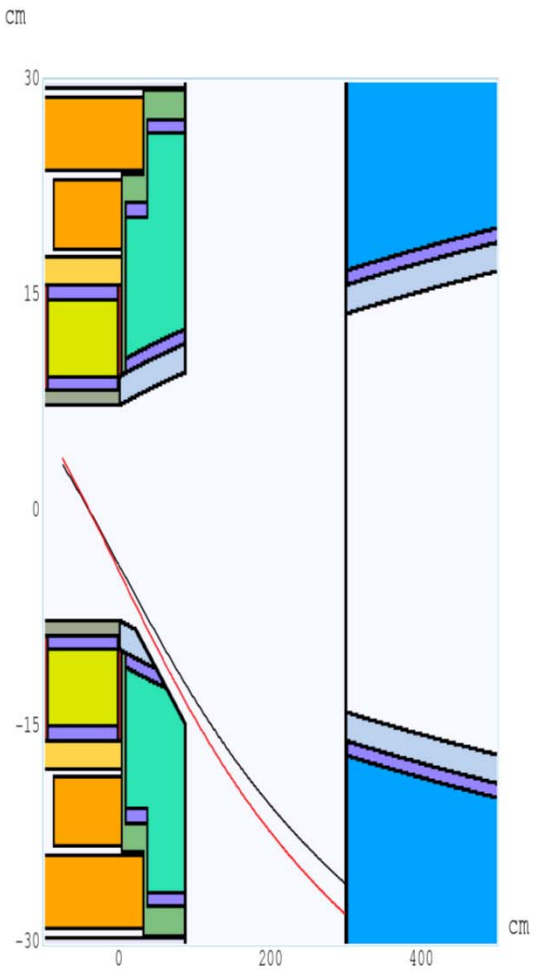
SH2-->SH1B + SH2

1 cm THICK Be WINDOW IS LOCATED AT 300 cm (ORIGINALLY 0.6 cm THICK PLACED AT 600 cm)

MODIFIED Hg POOL EXTENTS FROM 86 cm TO ~ 300 cm ALONG THE z-AXIS AND UP ~ 50 cm RADIALLY

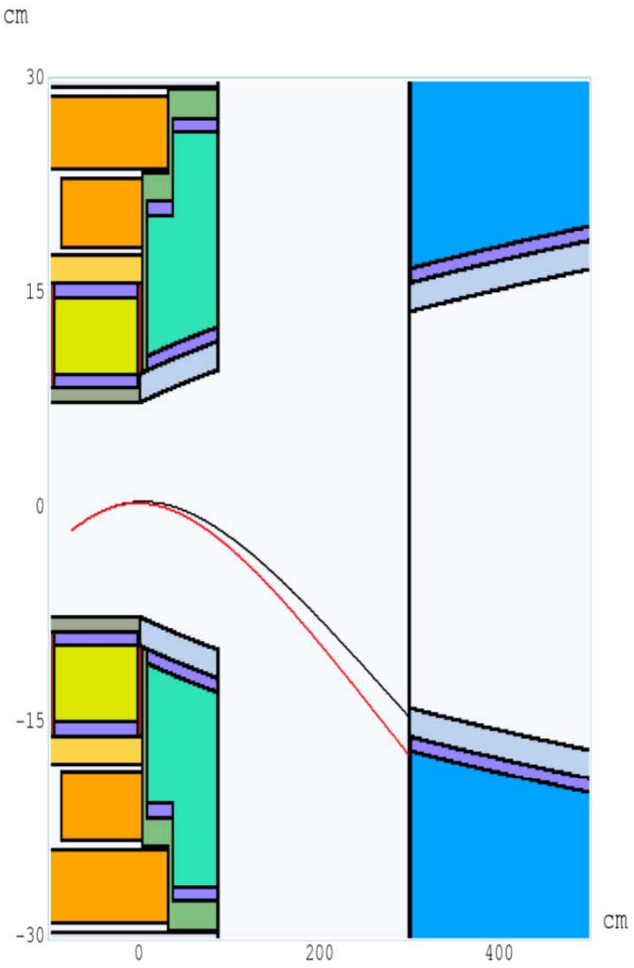
1 cm THICK STST WALLS USED FOR THE Hg POOL VESSEL

P11 AND P12 INITIAL PROTONS BEAM POSITION POINTS WILL BE USED FOR THE SIMULATIONS.
PROJECTION OF P11 (BLACK) AND P12 (RED) PROTONS TRAJECTORY PLOTS.



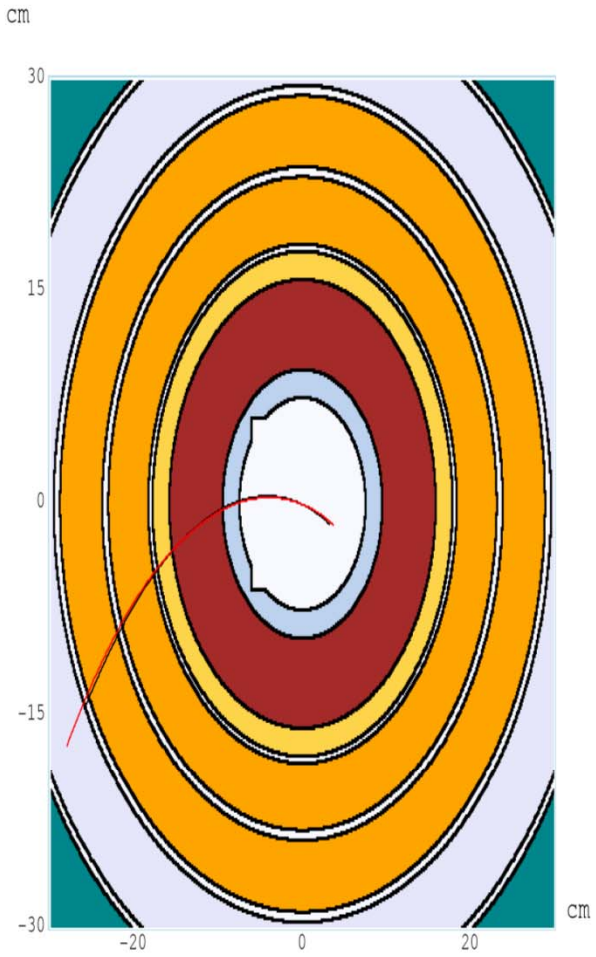
YZ PROJECTION

Aspect Ratio: Y:Z = 1:10.0



XZ PROJECTION

Ratio: X:Z = 1:10.0

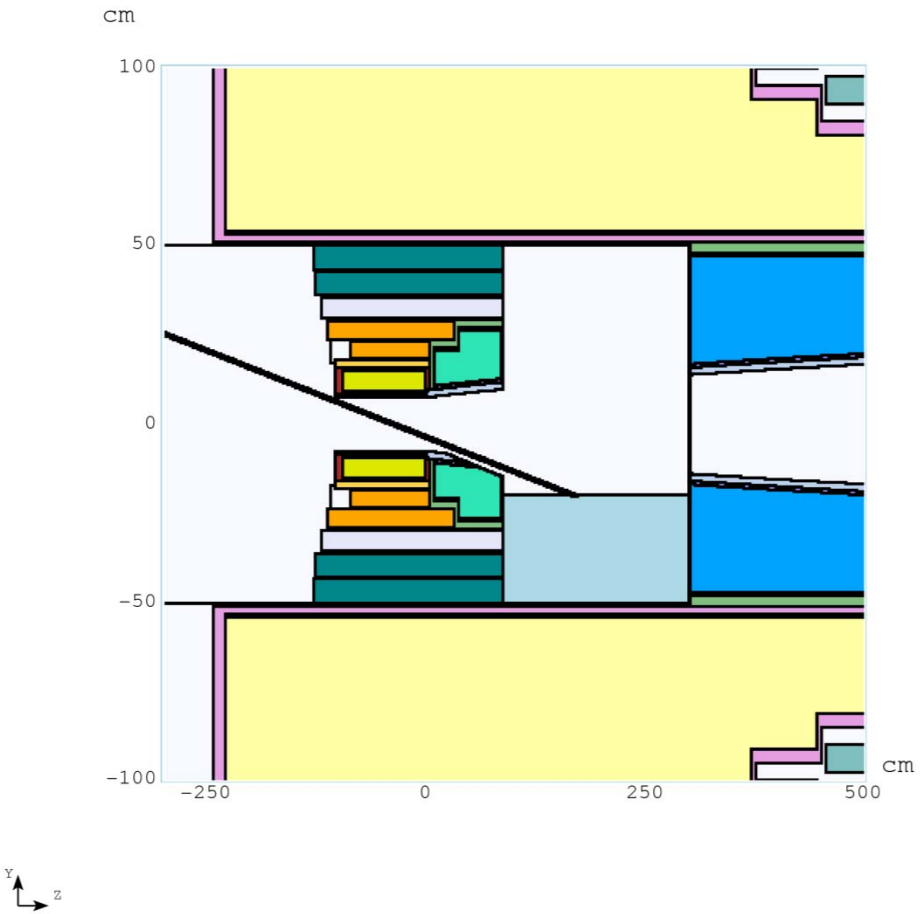


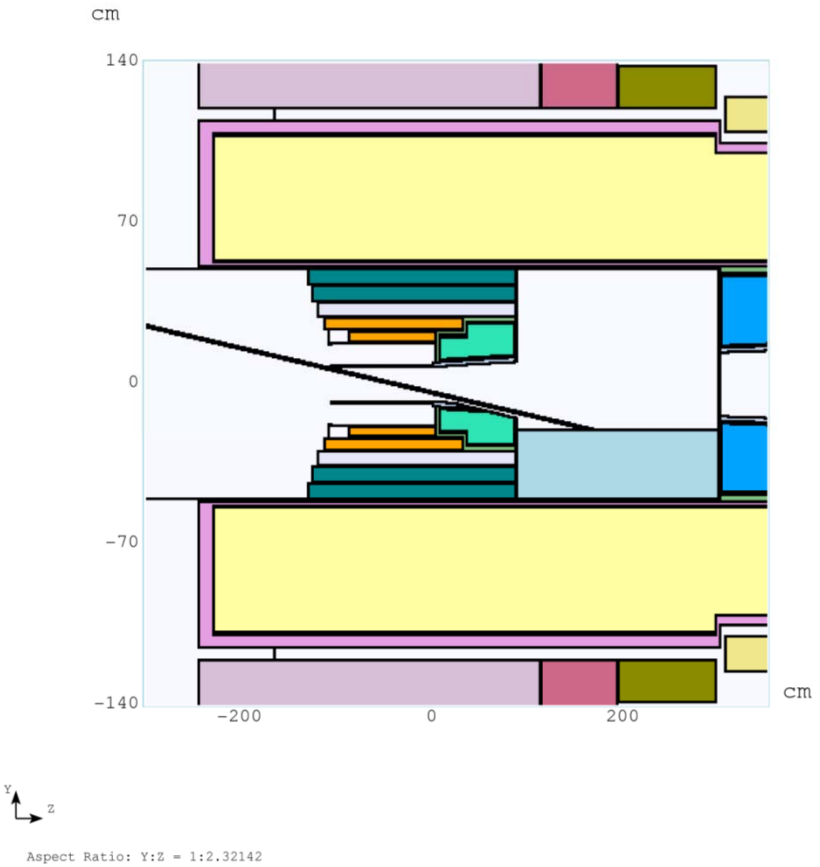
XY PROJECTION

Aspect Ratio: X:Y = 1:1.0

P12 PROTONS ENTER THE Hg POOL SOONER AND THEREFORE HAVE A LONGER TRAJECTORY.

IDS120hm WITH Hg IN THE POOL UP TO y = - 20 cm WITH SH1 (LEFT) AND WITHOUT SH1 (RIGHT)





TABLES NOTATION: C2(P11/P12)A/B = IDS120hm WITH Hg IN THE POOL VESSEL, SURFACE AT y = - 20 cm (A = 1E5, B = 5E5 EVENTS)

C3(P11/P12) = IDS120hm WITHOUT SH#1, Hg POOL SURFACE AT y = - 20 cm

FOR EACH CASE BOTH P11 / P12 INITIAL PROTON BEAM POSITIONS EXAMINED

POWER DEPOSITED IN THE SC COILS

NiSn/NiTi	C2(P11)A	C2(P11)B	C2(P12)A	C2(P12)B
SC#1	0.209	0.200	0.160	0.204
SC#2	0.042	0.041	0.044	0.060
SC#3	0.042	0.053	0.044	0.043
SC#4	0.028	0.032	0.026	0.025
SC#5	0.004	0.005	0.007	0.005
SC#6	0.001	0.002	0.001	0.002
SC#1-6	0.326	0.333	0.282	0.339
SC#7-9	0.060	0.058	0.050	0.062
SC#10-12	0.070	0.066	0.050	0.055
SC#13-15	0.026	0.038	0.044	0.038
SC#16-19	0.063	0.070	0.070	0.064
SC#1-19	0.545	0.565	0.496	0.558

SC1: ~ 0.2 kW SC1-6: ~ 0.33 kW SC#1-19: > 0.5 kW

MOST SIGNIFICANT DIFFERENCES IN SC's TDP OBSERVED FOR P12 POINT.

POWER DEPOSITED IN THE SHIELDING (SH#), SHIELDING VESSELS (SHVS#), AND SH1 W TUBE 2 (SH1T2)

–	C2(P11)A	C2(P11)B	C2(P12)A	C2(P12)B
SH#1A	560.50	558.00	560.50	559.50
SH#1B	340.70	341.50	391.70	389.90
SH#2	244.20	242.55	181.45	184.35
SH#3	24.08	24.11	22.18	22.73
SH#4	79.15	79.35	82.55	81.45
SH#1-4	1248.63	1246.01	1238.38	1237.93

P11, P12 AGREEMENT WITHIN ~ 1-2 kW

–	C2(P11)A	C2(P11)B	C2(P12)A	C2(P12)B
SHVS#1	61.80	57.05	49.74	58.30
SHVS#2	93.55	93.10	92.90	94.20
SHVS#3	0.83	0.88	0.77	0.85
SHVS#4	41.23	41.76	44.94	44.11
SHVS#1-4	197.41	192.79	188.35	197.46
SH1T2(W)	69.85	69.50	69.30	69.95

SHVS#1: MOST SIGNIFICANT DIFFERENCE, ESPECIALLY FOR P12

POWER DEPOSITED IN RESISTIVE MAGNETS (RS#) AND BEAM PIPE (BP#).

Cu	C2(P11)A	C2(P11)B	C2(P12)A	C2(P12)B
RS#1+2	110.85	110.50	111.40	111.05
RS#3	46.61	47.71	49.11	48.81
RS#4+5	63.65	63.35	65.25	64.45
RS#1-5	222.11	221.56	225.76	224.31

VERY SMALL DIFFERENCES FOR BOTH P11, P12

BP	C2(P11)A	C2(P11)B	C2(P12)A	C2(P12)B
BP#1(W)	439.97	438.25	434.50	437.15
BP#2(ST)	247.85	247.00	242.40	246.80
BP#3(ST)	9.46	9.51	8.66	8.75
BP#1-3	697.28	694.76	685.56	692.70

MOST SIGNIFICANT DIFFERENCES OBSERVED FOR BP#1 AND BP#2 FOR P12

SUMMARY FOR TOTAL POWER DEPOSITED IN DIFFERENT AREAS AND ENERGY FLOW.

TOTALS	C2(P11)A	C2(P11)B	C2(P12)A	C2(P12)B
SC#1-19	0.55	0.57	0.50	0.56
SH#1-4	1248.63	1246.01	1238.38	1237.93
SHVS#1-4	197.41	192.79	188.35	197.46
RS#1-5	222.11	221.56	225.76	224.31
BP#1-3	697.28	694.76	685.56	692.70
Hg TARG.	412.25	412.00	407.90	408.80
Hg POOL	317.50	323.40	333.35	327.70
HgP.WALLS	11.83	11.79	13.00	12.87
Be WIND.	7.63	7.53	7.40	7.39
TOTAL	3185.04	3179.91	3169.50	3179.67

TDP FLOW (kW)	C2(P11)A	C2(P11)B	C2(P12)A	C2(P12)B
R=200 cm	156.68	156.09	145.23	151.72
z=-250 cm	177.55	178.90	176.50	173.39
z=1900 cm	404.06	406.60	396.34	400.55
TOTAL FLOW	738.29	741.59	718.07	725.66
TOTAL	3923.33	3921.50	3887.57	3905.33
(TOTAL-4 MW)	-76.68	-78.50	-114.43	-94.67

SC#1-19: ~ SAME FOR ALL CASES
SH#1-4: ~ ABOUT SAME FOR BOTH P11, P12
RS#1-5: ~ ABOUT SAME FOR BOTH P11, P12
BP#1-3: ~ -2.52 kW (P11) / ~ -7.14 kW (P12)
BeWind: ~ 7.4-7.6 kW

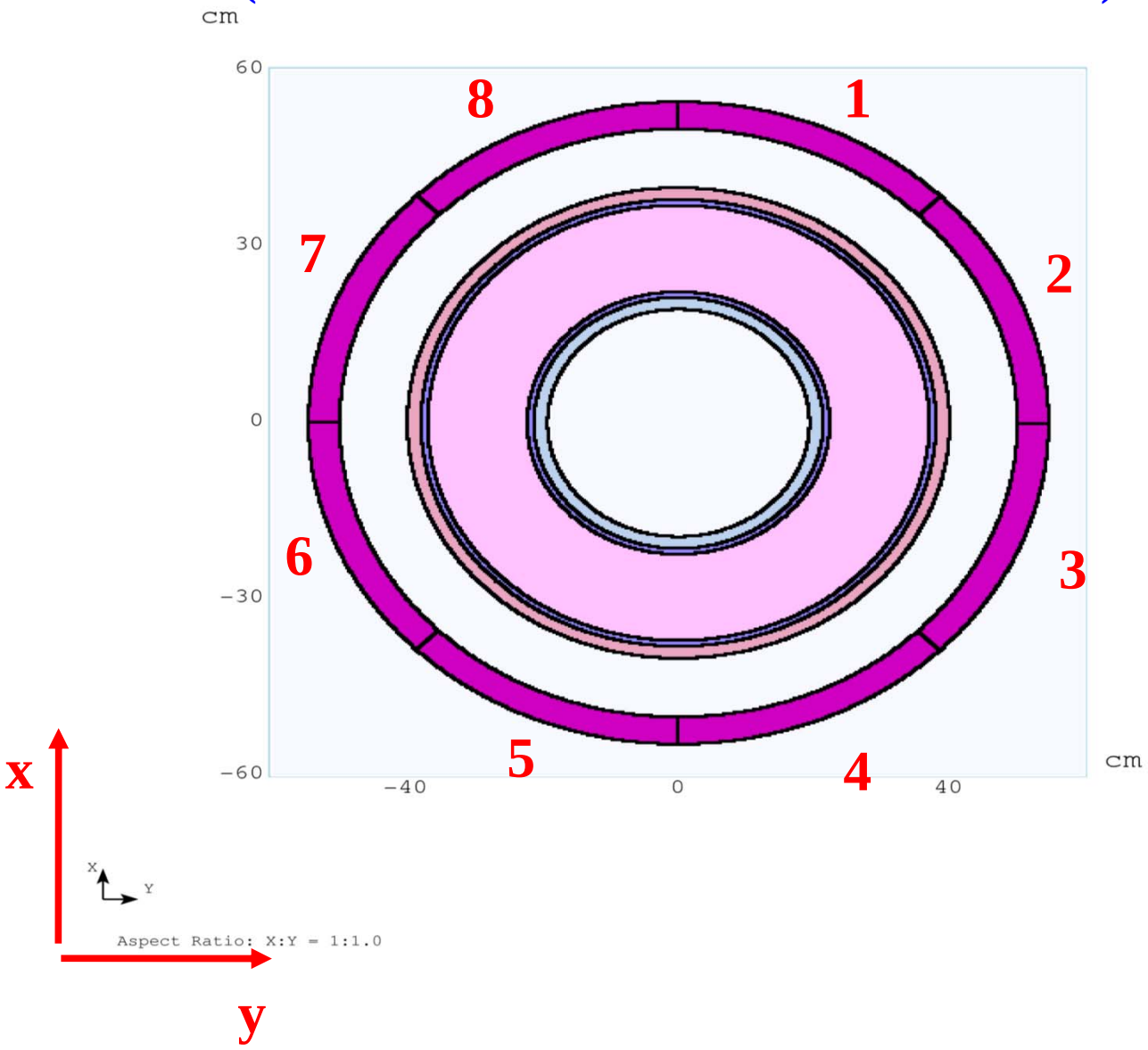
LARGER DIFFERENCES IN P12 POINT AND ENERGY 'GAPS' MORE THAN THOSE IN P11 CASES.

SC#1-11 PEAK VALUES.

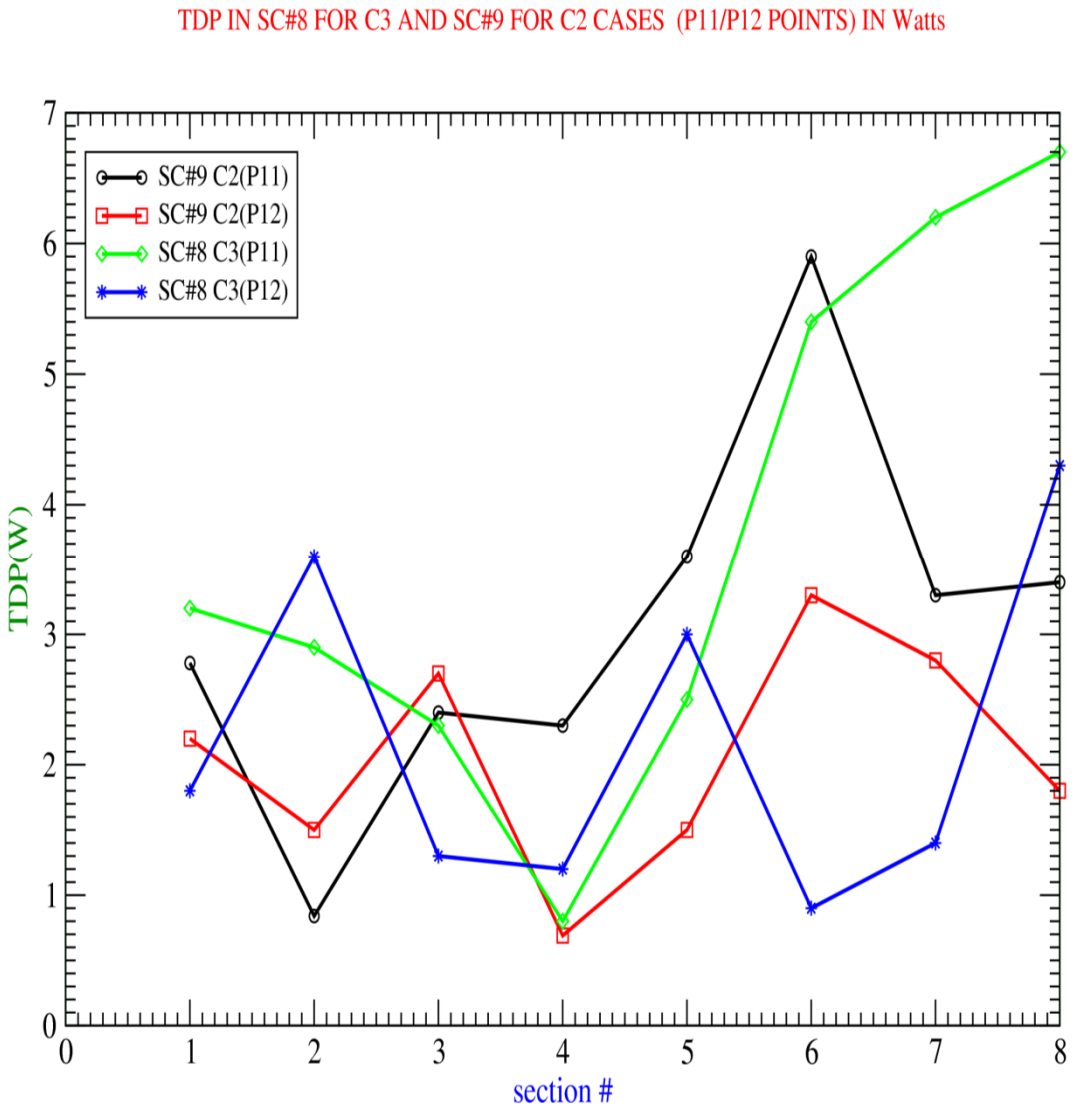
PEAK(mW/g)	C2(P11)A	C2(P11)B	C2(P12)A	C2(P12)B
SC#1	0.028	0.018	0.027	0.016
SC#2	0.018	0.090	0.016	0.014
SC#3	0.012	0.016	0.016	0.008
SC#4	0.013	0.020	0.012	0.012
SC#5	0.004	0.003	0.005	0.003
SC#6	0.006	0.003	0.002	0.001
SC#7	0.005	0.003	0.014	0.001
SC#8	0.054	0.040	0.050	0.055
SC#9	0.070	0.060	0.140	0.060
SC#10	0.006	0.055	0.070	0.045
SC#11	0.040	0.048	0.042	0.035

SC#9: C2(P12) CASE APPEAR TO BE ESPECIALLY SENSITIVE TO STATISTICAL UNCERTAINTIES.

SC#9 ANGULAR SEGMENTATION FOR TDP DETAILED STUDIES:
8 SECTIONS EXTENDING OVER THE WHOLE LENGTH OF THE COIL.
(MANY THANKS TO SERGEI STRIGANOV)



PLOT AND DATA TABLE FOR DP IN 8 SECTIONS OF SC#8 OR SC#9 FOR C2 OR C3 CASE.



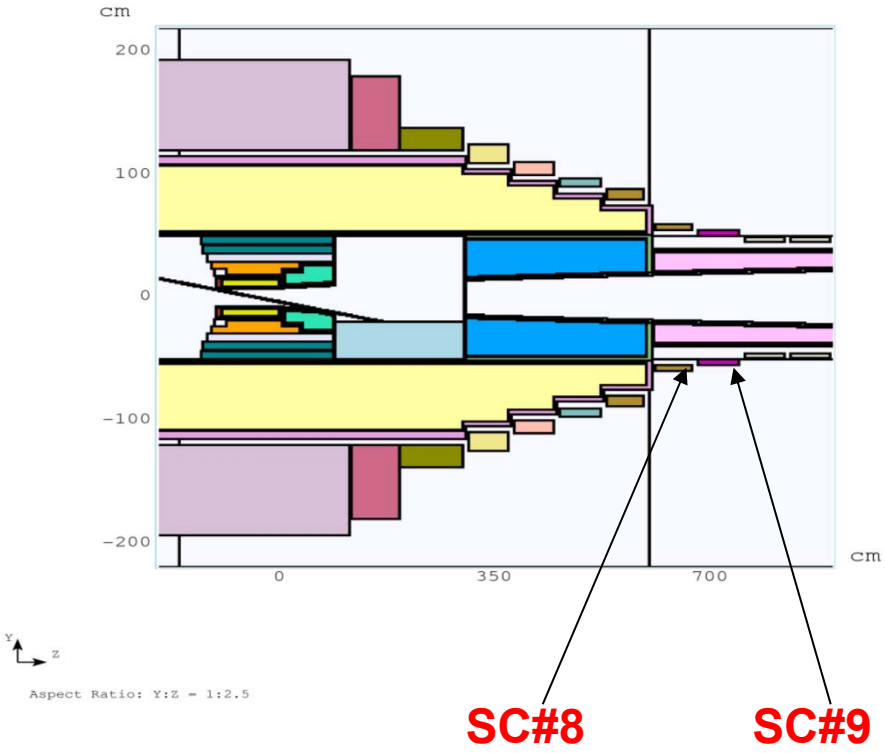
DATA TABLE FOR DP(W) IN 8 SECTIONS

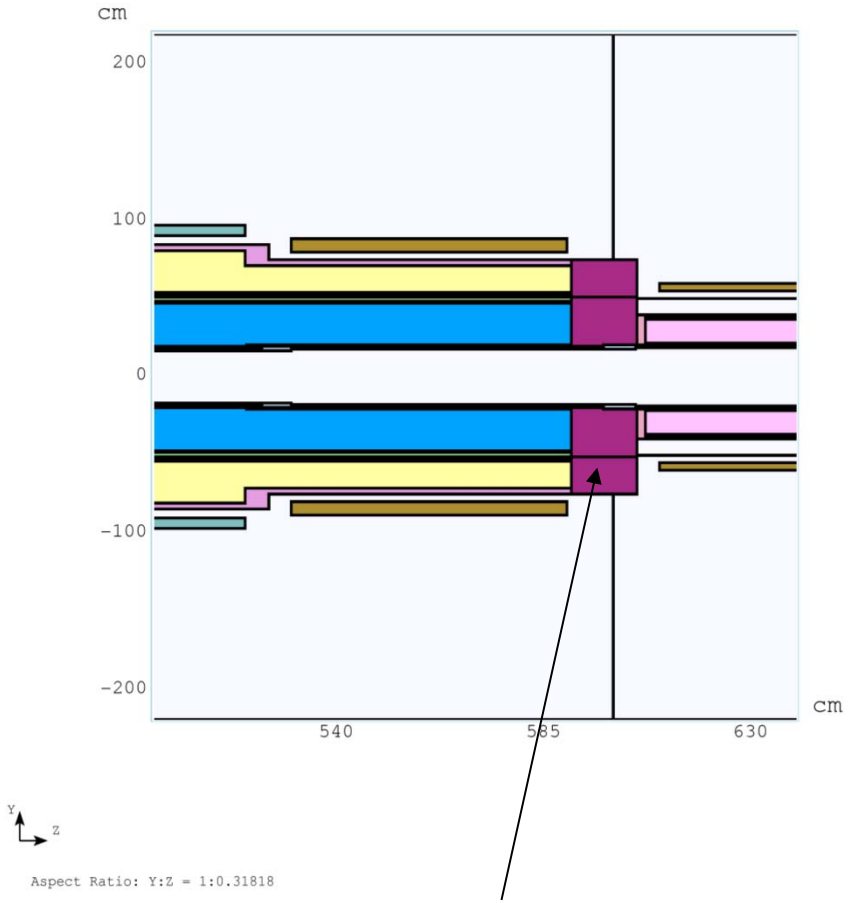
SECTION	C2(P11)	C2(P12)	C3(P11)	C3(P12)
#1	2.78	2.20	3.20	1.80
#2	0.84	1.50	2.90	3.60
#3	2.40	2.70	2.30	1.30
#4	2.30	0.69	0.80	1.20
#5	3.60	1.50	2.50	3.00
#6	5.90	3.30	5.40	0.90
#7	3.30	2.80	6.20	1.40
#8	3.40	1.80	6.70	4.30
TOTAL	24.52	16.49	30.00	17.50
SC#7+8	43.00	24.00	–	–
SC#7+9	–	–	25.00	28.00
SC#7-9(N)	67.52	40.49	55.00	45.50
SC#7-9(B)	60.00	50.00	47.00	49.00

N = DP IN SC#7-9 FROM SEGMENTATION STUDIES
B = DP IN SC#7-9 FROM ORIGINAL SIMULATION

C2(P11/P12): S#6 RECEIVES MOST OF DP (5.9/3.3 W)
C3(P11/P12): S#8 RECEIVES MOST OF DP (6.7/4.3 W)

DEALING WITH THE PROBLEM OF SH#8 AND SC#9 PEAK VALUES





BEFORE: TDP SC#7-9 (0.049 kW), PEAK SC#7/8/9 (0.001/0.170/0.040 mW/g)
AFTER: TDP SC#7-9 (0.005 kW), PEAK SC#7/8/9 (0.001/0.027/0.100 mW/g)
TDP SHVS2RFL/SHVS4RFL (0.773/0.010 kW)