IDS120h GEOMETRY WITH SHIELDING VESSELS

ENERGY FLOW ANALYSIS CONTINUED

SHIELDING MATERIAL: 60% W + 40% He vs. 80% W + 20% He vs. 88% W + 12% He

N_p= 100,000 and N_p= 500,000 SIMULATIONS

SH1, SH2, BP1, BP2 PEAK VALUES FOR He COOLING STUDIES

Nicholas Souchlas, PBL (11/1/2011)

IDS120h with shielding vessels.

Different cases of shielding material.

N = 100,000 AND N = 500,000 events simulations

Peak values in SH1, SH2, BP1, BP2 FOR He COOLING STUDIES.

>mars1510/MCNP

>10^{-11} MeV NEUTRON ENERGY CUTOFF

>SHIELDING: 60% W + 40% He , 80% W + 20% He, 88% W + 12% He (WITH W VESSELS)

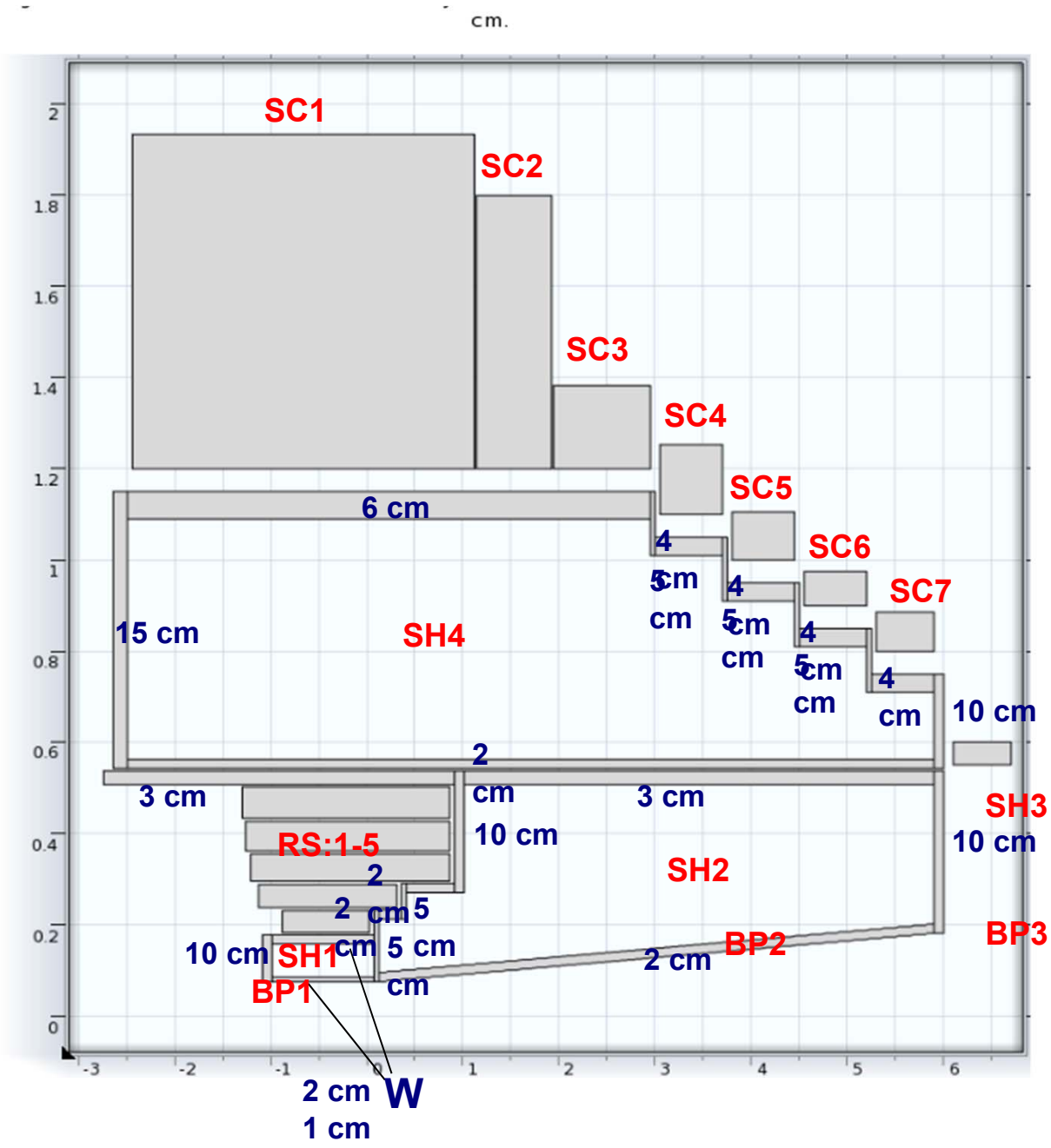
>4 MW proton beam, Np = 100,000/500,000

>PROTONS ENERGY E = 8 GeV.

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

IDS120h:SHIELDING VESSELS (USING W).

Bob Weggel(7/26/11)



BEAM PIPE

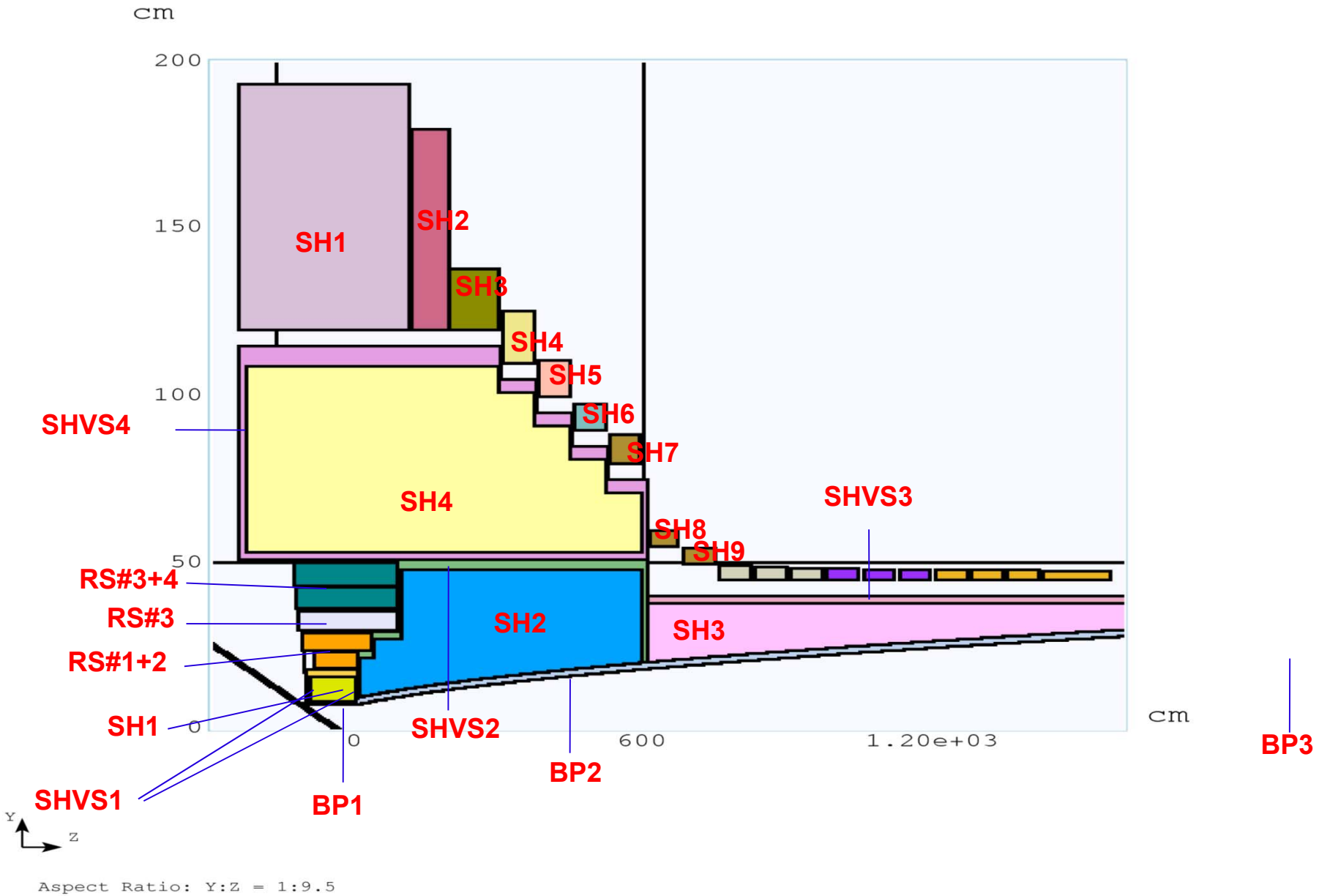
BP1: 1 cm STST → 1 cm W
BP2/BP3: 1 cm STST → 2 cm STST

TUBE 1(= BP1) AND TUBE 2 WITH 1 cm AND 2 cm THIKNESS IN THE SH1 VESSEL ARE MADE OF W TO FURTHER REDUCE THE POWER DEPOSITED IN THE RESISTIVE COILS.

5 cm DISTANCE BETWEEN VESSELS AND SC COILS FOR CRYOGENIC COOLING COMPONENTS

0.5 cm SPACE BETWEEN TUBE 2 OF SH1 AND RS1,
AND 1.0 cm BETWEEN TUBE 1 OF SH4 AND RS5

IDS120h: SHIELDING VESSELS DETAIL PLOTS.



TOTAL POWER DEPOSITED IN DIFFERENT AREAS Np = 100,000 AND 500,000 EVENTS

Np = 100,000 (1)

TOTALS	60/40	80/20	88/12
SC#1-19	0.292	0.189	0.146
SH#1-4	1684.27	1629.68	1603.54
SHVS#1-4	132.81	149.41	155.90
RS#1-5	164.90	148.67	146.34
BP#1-3	715.99	712.27	702.42
Hg TARG.	409.55	408.05	408.05
Hg POOL	219.50	213.90	211.80
HgP.WALLS	0.32	0.30	0.28
Be WIND.	0.86	0.85	0.85
TOTAL	3374.31	3297.66	3261.88

Np = 500,000 (2)

TOTALS	60/40	80/20	88/12
SC#1-19	0.307	0.176	0.147
SH#1-4	1666.85	1639.76	1585.89
SHVS#1-4	134.29	149.60	154.68
RS#1-5	164.68	147.78	146.52
BP#1-3	715.19	707.61	704.40
Hg TARG.	409.85	409.20	409.20
Hg POOL	218.40	215.15	213.35
HgP.WALLS	0.299	0.300	0.297
Be WIND.	0.866	0.861	0.868
TOTAL	3356.06	3304.73	3247.83

(1) SH#1-4: 1684.27 kW --> 1603.54 kW (-80.73 kW)
(2) SH#1-4: 1666.85 kW --> 1585.89 kW (-80.96 kW) (2-1): (-17.42 kW) --> (-17.65 kW)
(1) SHVS#1-4: 132.81 kW --> 155.90 kW (+23.09 kW)
(2) SHVS#1-4: 134.29 kW --> 154.68 kW (+20.39 kW) (2-1): (-1.48 kW) --> (-1.22 kW)
(1,2) RS#1-4: ~165.0 kW --> ~146.0 kW (~ -19.0 kW)
(1,2) BP#1-3: ~715.0 kW --> ~703.0 kW (~ -12.0 kW)
(1) TOTAL: ~3374.31 kW --> ~3261.88 kW (~ -112.43 kW)
(2) TOTAL: ~3356.06 kW --> ~3247.83 kW (~ -108.23.43 kW)
(2-1): (-18.25 kW) --> (-15.05 kW)

ENERGY FLOW FOR SH=60/40, 80/20, 88/18 W/He Np = 100,000 AND 500,000 EVENTS

Np = 100,000

TDP FLOW (kW)	60/40	80/20	88/12
R=200 cm	114.33	105.14	108.14
z=-250 cm	156.57	156.66	159.12
z=1900 cm	436.04	433.09	432.39
TOTAL FLOW	706.94	694.89	699.65
TOTAL	4081.25	3992.55	3961.53
(TOTAL-4 MW)	+81.25	-7.45	-38.47

Np = 500,000

TDP FLOW (kW)	60/40	80/20	88/12
R=200 cm	113.57	106.76	108.18
z=-250 cm	156.27	157.4	161.17
z=1900 cm	433.68	433.59	435.89
TOTAL FLOW	703.52	697.73	705.24
TOTAL	4059.58	4002.46	3953.07
(TOTAL-4 MW)	+59.58	+2.46	-47.00

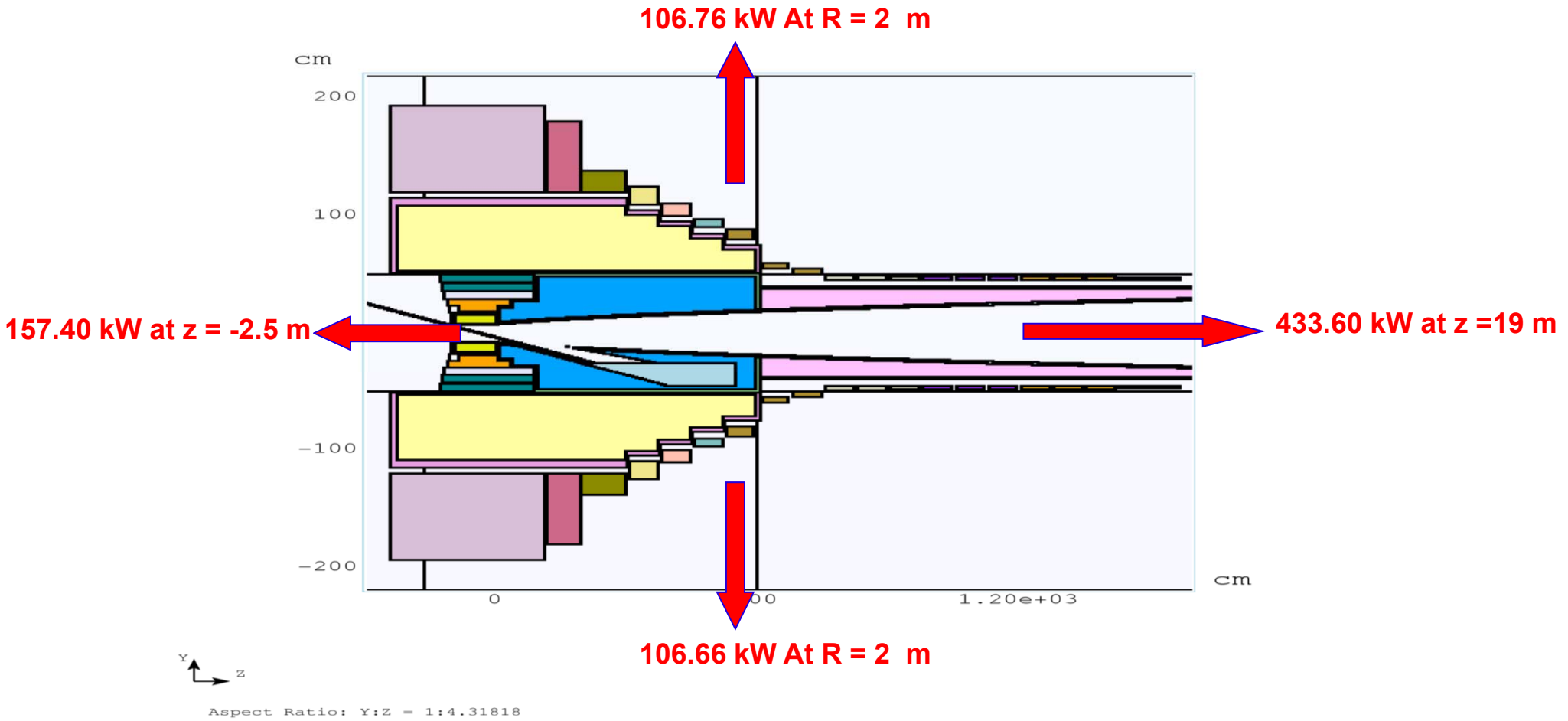
DIFFERENCES BETWEEN TWO SIMULATIONS CAN UP TO 3.5 kW, ESPECIALLY SENSITIVE APPEARS TO BE THE DOWNSTREAM FLOW FOR THE 60/40 AND 88/12 CASES.

THE GAP DECREASES FOR THE 60/40 AND 80/20 CASE BUT WIDENS FOR THE 88/12. OTHER FACTORS SHOULD BE CONSIDERED IN THE STUDIES.

THE DENSE MATERIAL OF 88/12 CASE MAY REQUIRE DIFFERENT (SMALLER) STEP PARAMETER.

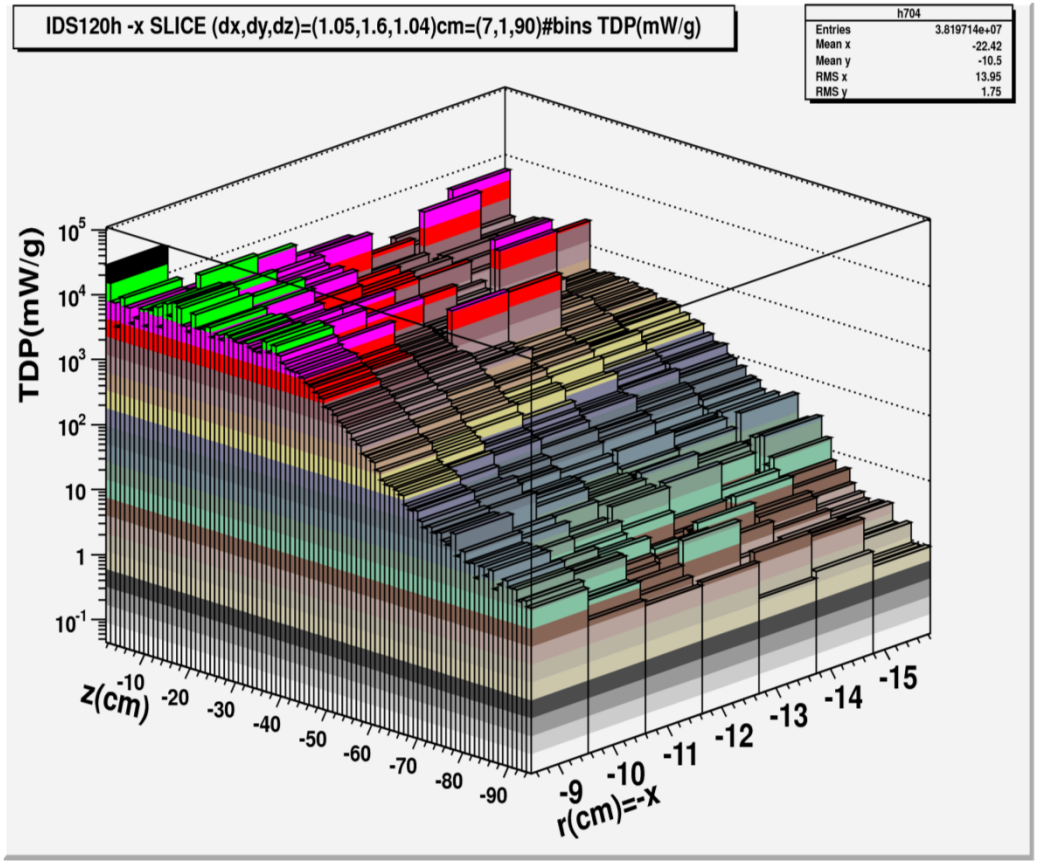
STATISTICAL FLUCTUATION IS ALSO EXPECTED DUE TO RANDOMIZATION (SEED) OF THE PROTONS INITIAL CONDITIONS IN THE BEAM.

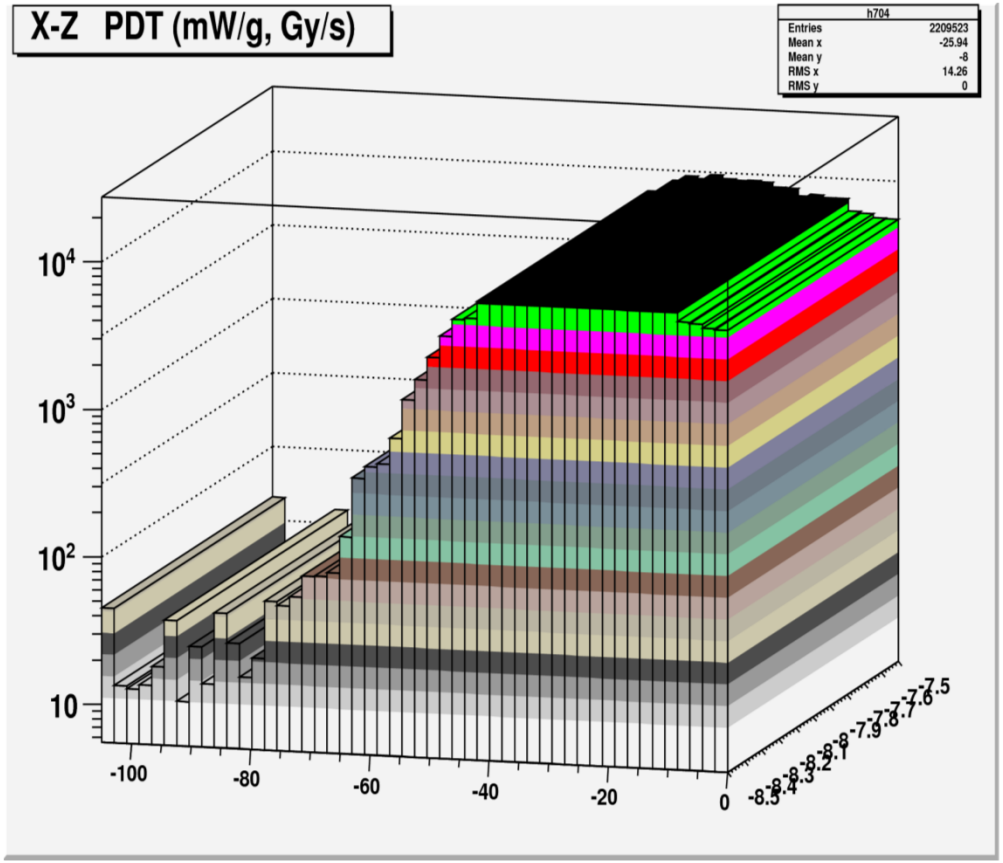
ENERGY FLOW FOR IDS120h FOR 80% W + 20% He SHIELDING FROM 500,000 EVENTS



TOTAL POWER GOING THROUGH THE SURFACES: 697.73 kW
TOTAL POWER DEPOSITED IN TARGET STATION: 3,304.73 kW
2.46 kW ABOVE 4 MW DUE TO Be WINDOW ~5.46 kW OVER 4 MW

SH1 (LEFT) AND BP1 (RIGHT) TDP DENSITY DISTRIBUTION FOR A 1.6 cm SLAB ALONG -x AXIS.





PEAK VALUE OF ~10 W/g IS ISOLATED IN THE REGION: ~ -40 < z < 0 cm AND ~ 8.5 < r < 9.8 cm.

 # DIFFERENT MATERIALS CAN BE USED TO REDUCE THE DENSITY TO MANAGEABLE LEVELS.

 # ANOTHER SOLUTION CAN BE CONCENTRIC TUBES OF W (OR DIFFERENT MATERIALS) OF VARYING THIKNESS INSTEAD OF BEADS.

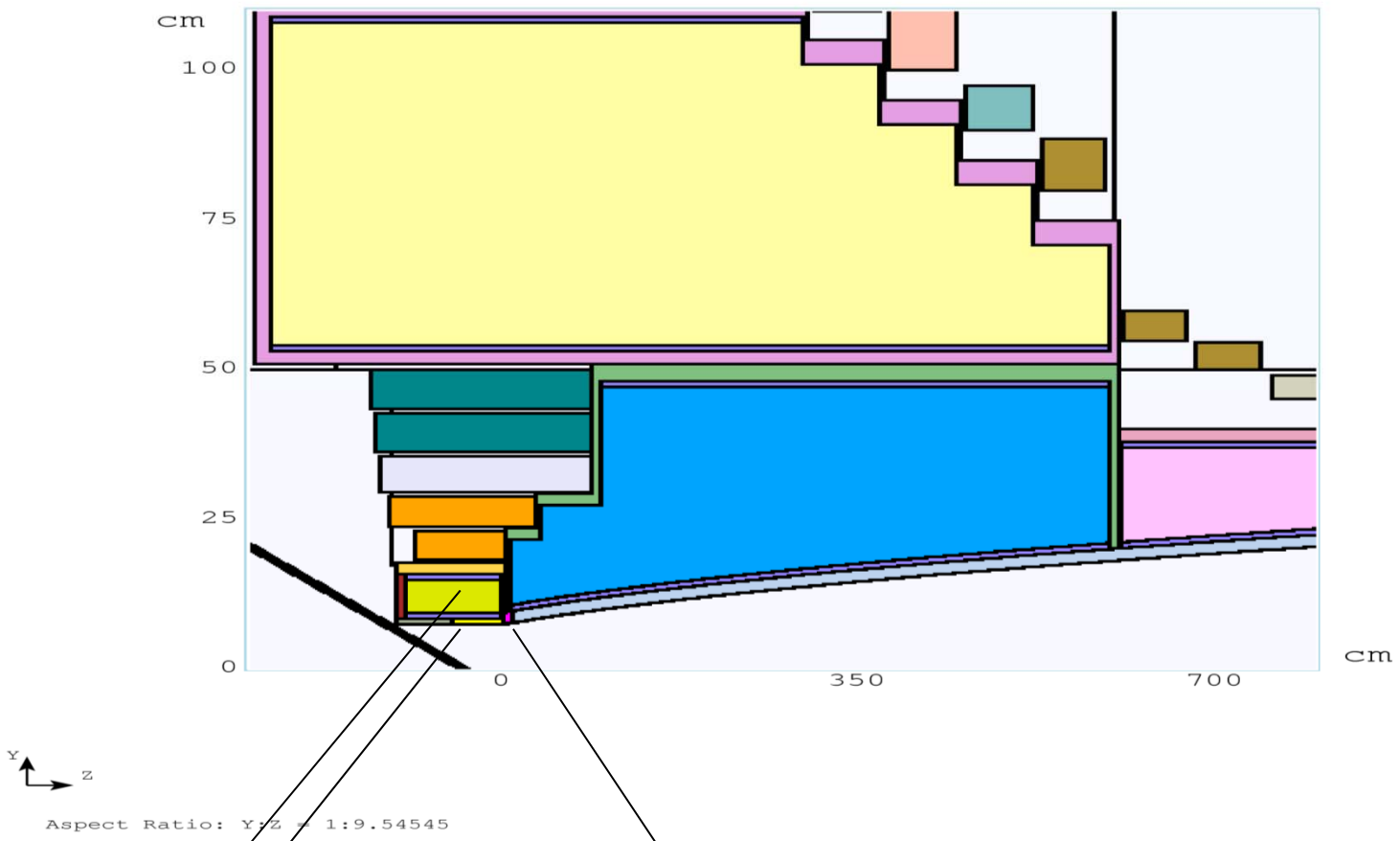
 # SH2 REGION HAS ONLY A SMALL REGION ALONG -x AXIS NEAR THE SH1 REGION WITH ~10 W/g PEAK

PEAK VALUE OF ~10 W/g IS ISOLATED IN THE REGION: ~ -50 < z < 0 cm AND ~ 7.5 < r <8.5 cm.

 # BP2 HAS ALSO ~10 W/g PEAK VALUE FOR 8-10 cm LENGTH JUST AFTER BP1 SECTION, BUT IT IS ISOLATED ONLY ALONG -x AXIS REGION.

 # Be OR Al COULD BE USED FOR THE LAST 50 cm OF BP1 AND THE FIRST ~10 cm OF BP2 TO LOWER THE DENSITY TO MAKE He COOLING POSSIBLE.

IDS120h: SHIELDING VESSELS WITH 1 cm He COOLING.



He COOLING ANNULUS FOR W BEADS/He SHIELDING.

BP1 (~50 cm), BP2 (~10 cm) Be SECTIONS

WORK STILL IN PROGRESS.