IDS120j WITH GAPS

SC#3 AZIMUTHAL DPD DISTRIBUTION ANALYSIS WITH MAX GAPS

SC#3, SC#4 AZIMUTHAL DPD DISTRIBUTION ANALYSIS, DP AND SC TOTAL DP WITH VARYING GAPS SIZE (ALL GAPS, SYMMETRIC WAY)

Nicholas Souchlas, PBL (4/3/2012)

IDS120j GEOMETRY: WITH GAPS

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 # SC#3 AZIMUTHAL DPD DISTRIBUTION STUDIES FOR MAX SIZE GAPS.

 # SC#3, SC#4 AZIMUTHAL DPD DISTRIBUTION STUDIES WITH SYMMETRICALLY VARYING GAPS SIZE.

 # SC#3, SC#4, SC#7 DP AND SC TOTAL DP WITH VARYING GAPS SIZE.

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>SIMULATIONS CODE: mars1510 / MCNP

>NEUTRON ENERGY CUTOFF: 10^{-11} MeV

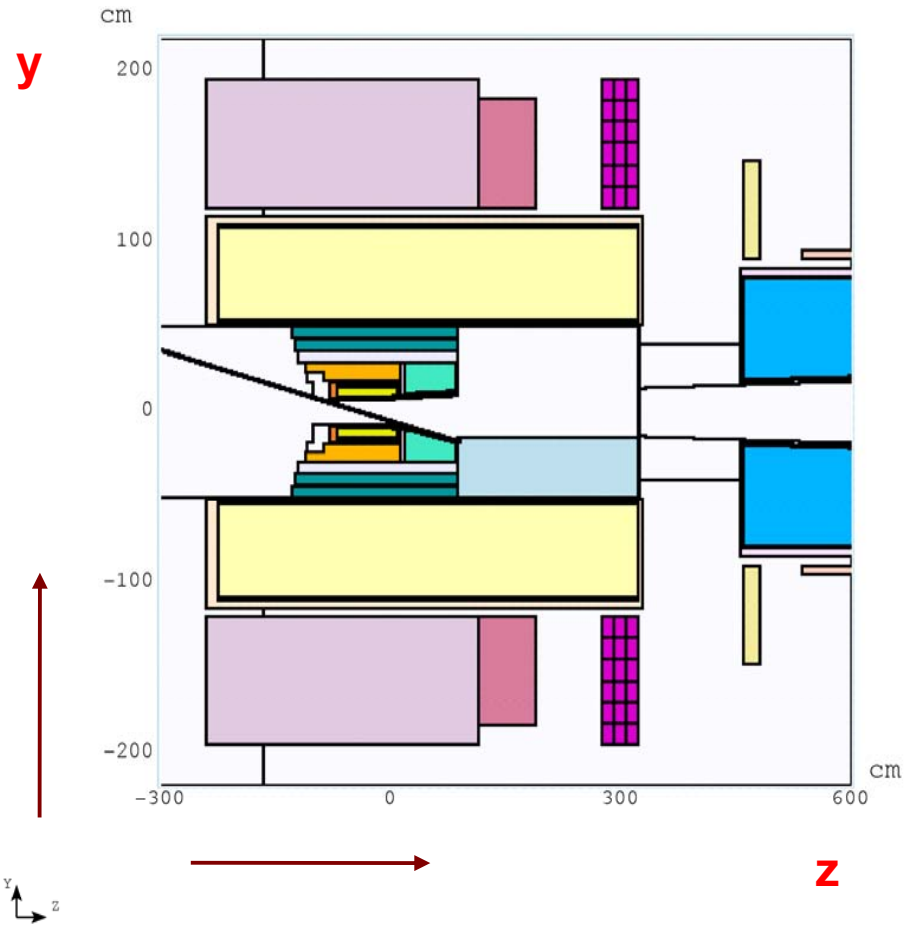
>SHIELDING: 60% W + 40% He (WITH STST VESSELS)

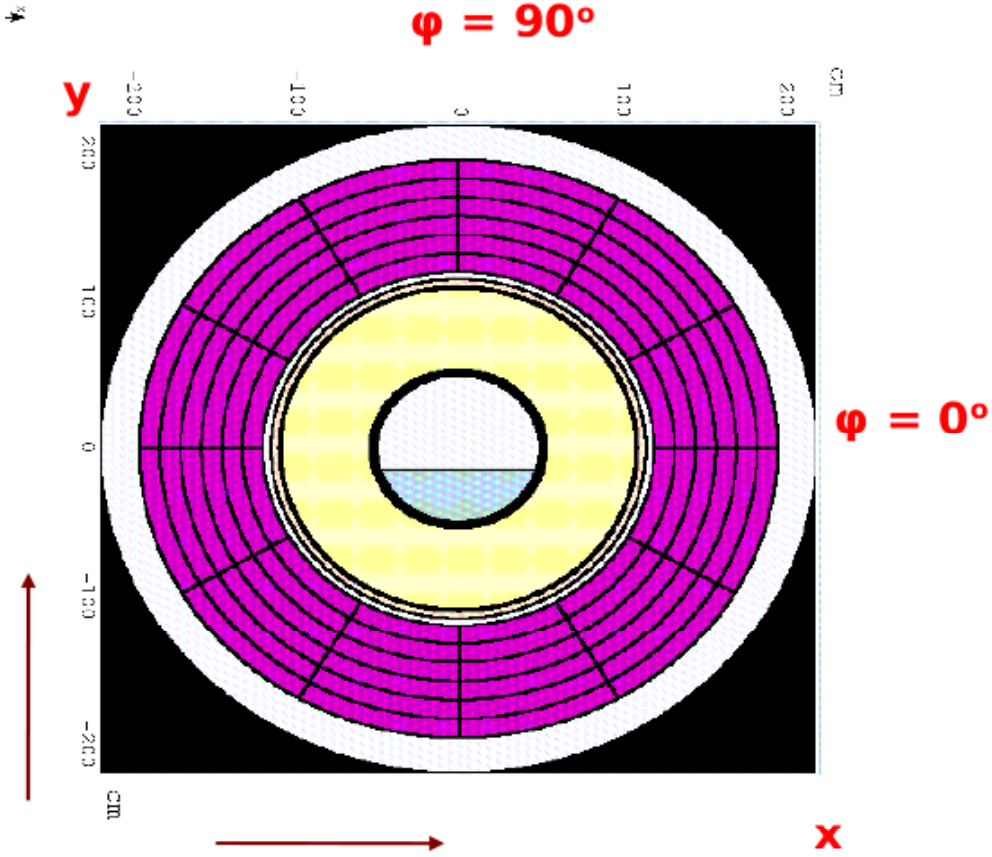
>PROTON BEAM POWER: 4 MW

>PROTON ENERGY: E = 8 GeV

>PROTON BEAM PROFILE: GAUSSIAN, $\sigma_x = \sigma_y = 0.12$ cm

IDS120j: SC#3 SEGMENTATION DETAILS





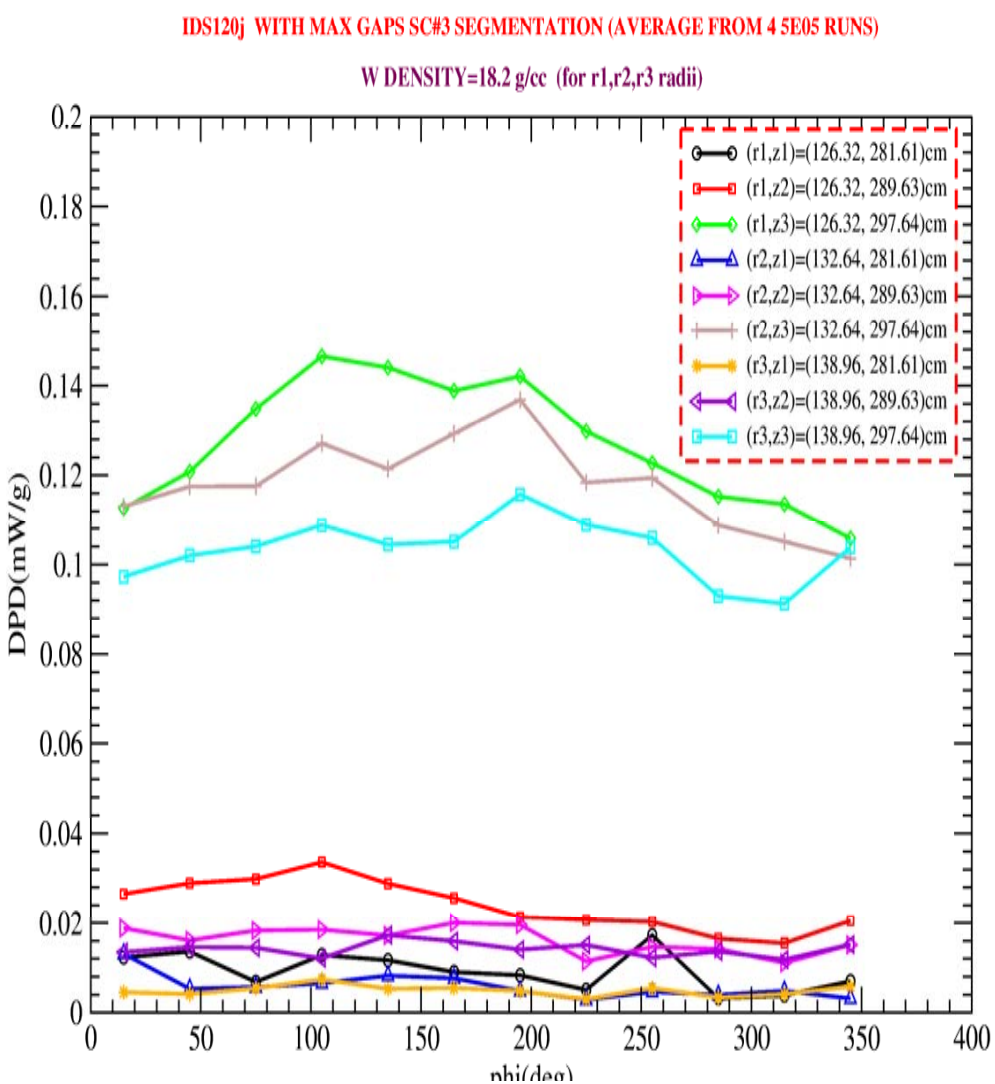
120 < r < 195.83 cm dr = 12.64 cm N_r = 6 bins

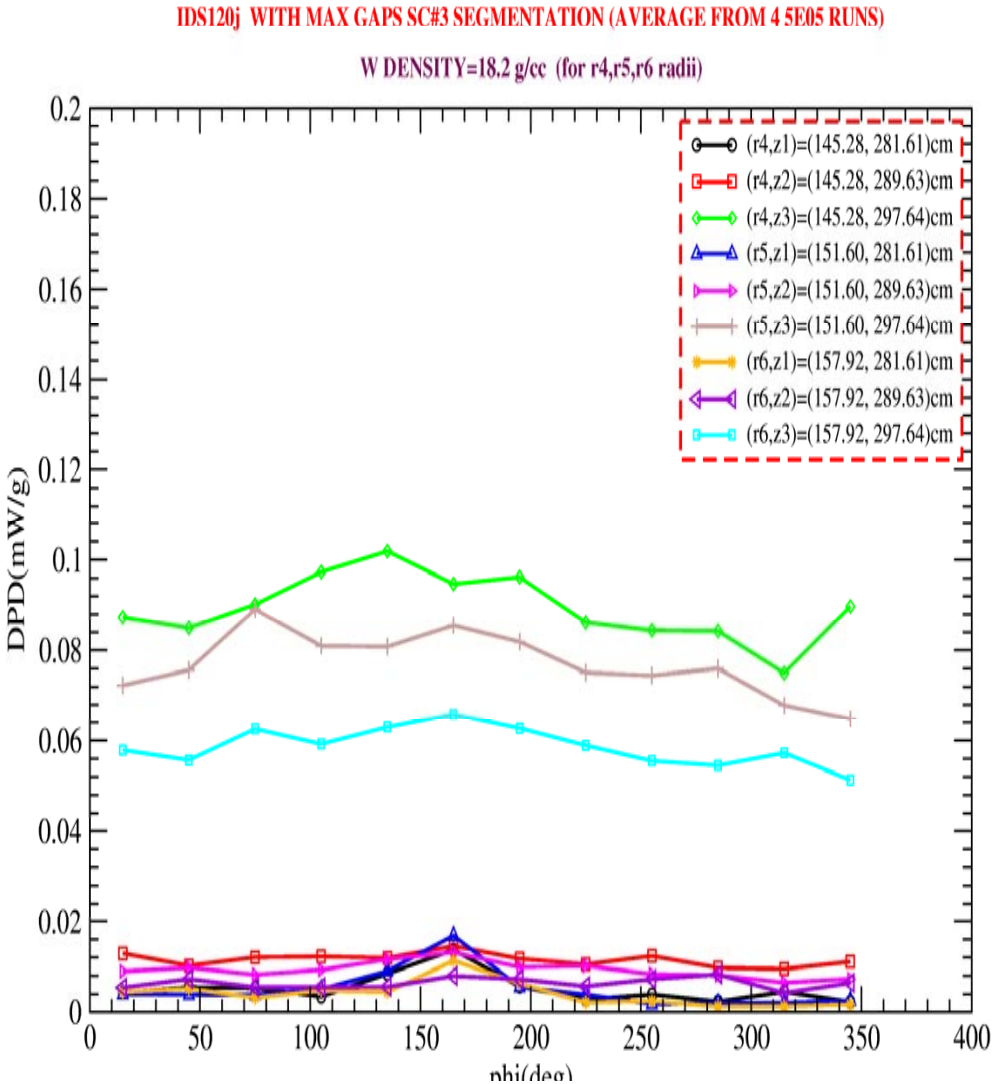
273.6 < z < 321.68 cm dz = 16.03 cm N_z = 3 bins

0.0 < φ < 360.0 deg. dφ = 30 deg. N_φ = 12 bins

N_{tot} = 216 "pieces"

SC#3: DPD AZIMUTHAL DISTRIBUTION WITH MAX GAPS: 18.2 g/cc W DENSITY (AVERAGE FROM 4 5E05 EVENT SIMULATIONS).





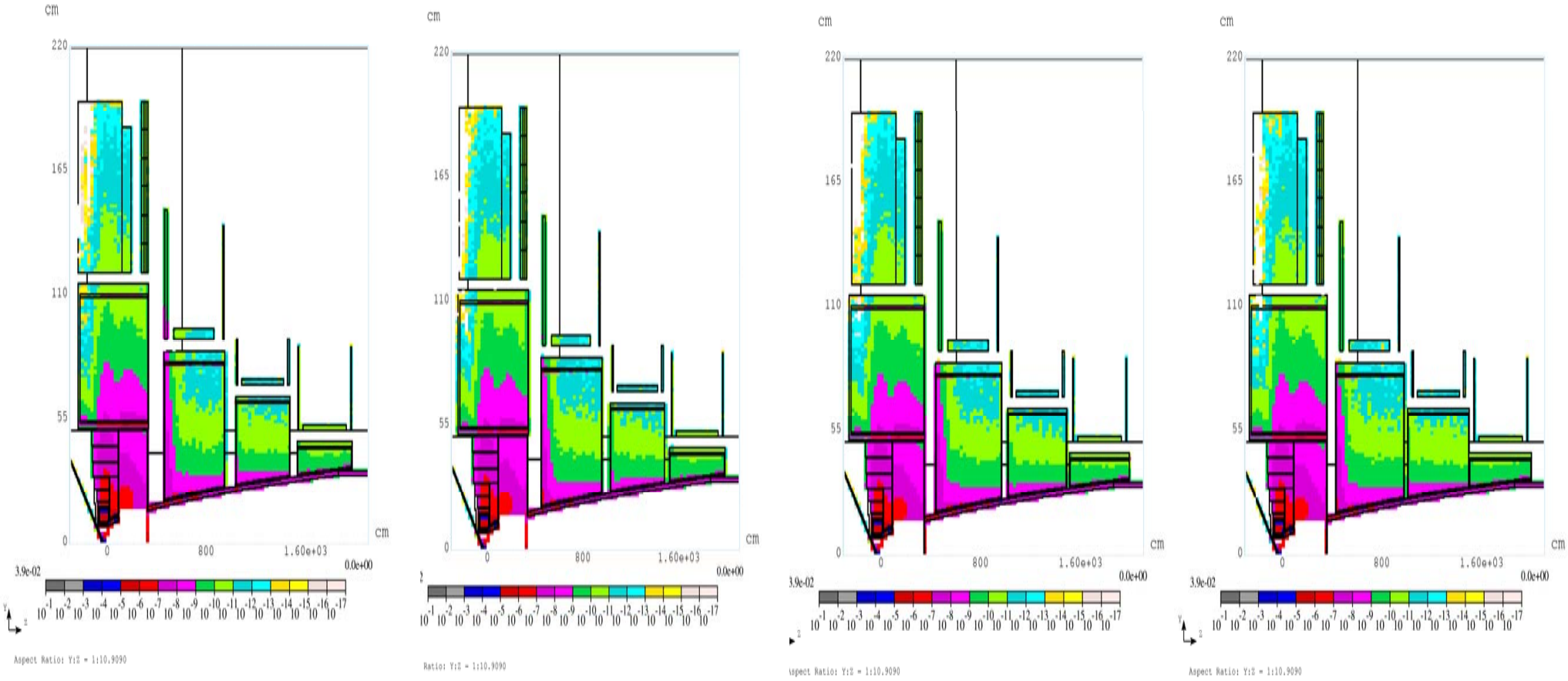
DPD $\lesssim$ 0.15 mW/g (sum 0.91 kW vs. 0.81 kW without segmentation)

PEAKS APPEAR TO BE IN THE UPPER HALF, RIGHT LOWER CORNER AND TOWARDS -x AXIS

~ (120 < r $\lesssim$ 138 cm, 300 $\lesssim$ z $\lesssim$ 322 cm, 90 $\lesssim$ φ $\lesssim$ 130 deg).

IDS120j: AZIMUTHALLY AVERAGE DP DISTRIBUTION WITH SYMMETRIC DECREASE OF GAPS SIZE (YZ CROSS SECTIONS).

MAX GAPS (~ 120, 84, 60) cm - 20 cm - 40 cm -60 cm

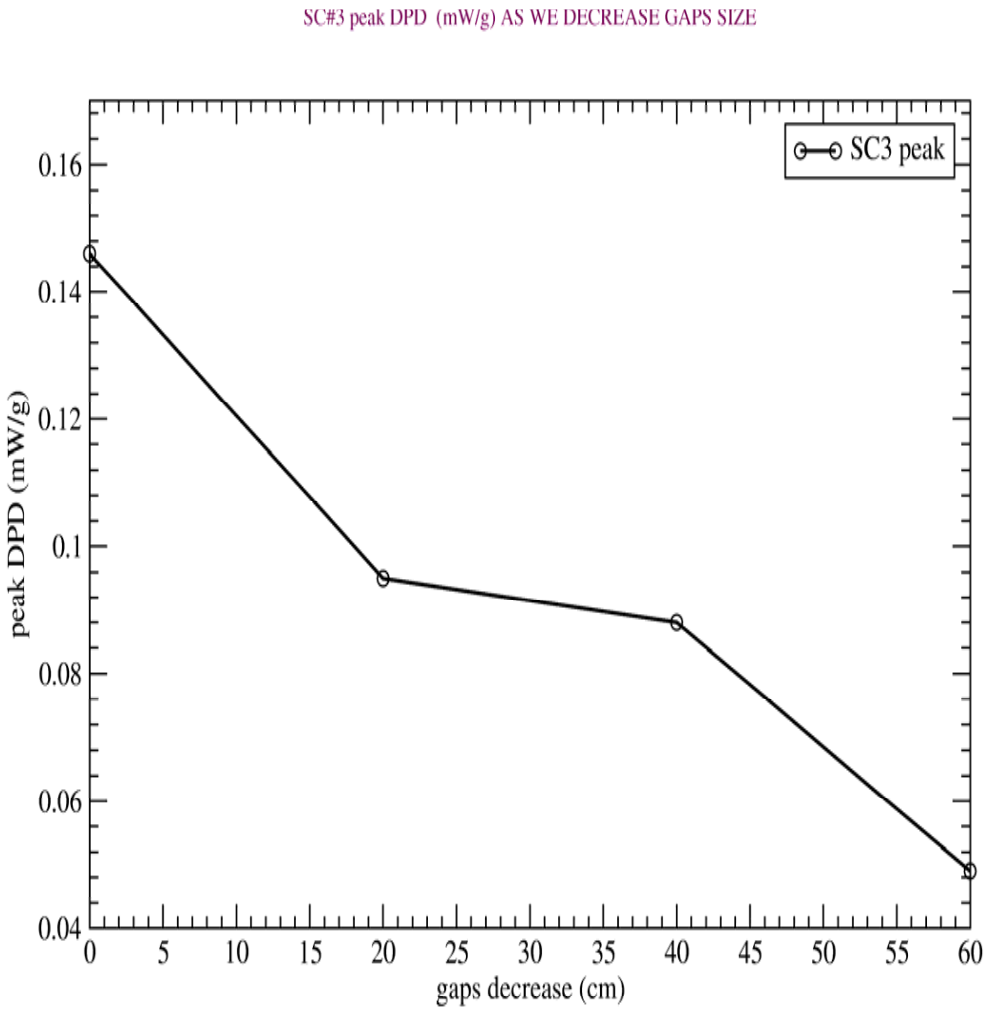


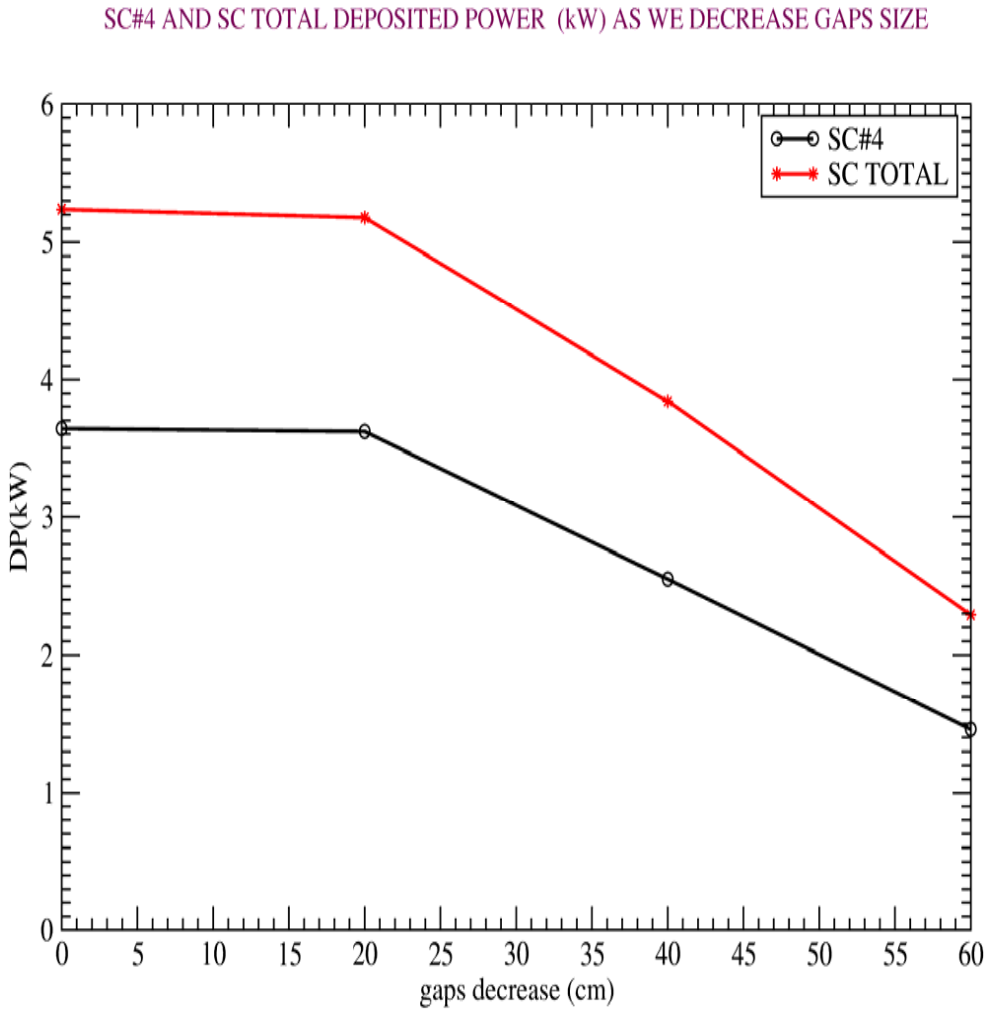
FIRST LOOK: SITUATION FOR BOTH SC#3 AND SC#7 IS ABOUT THE SAME (SAME DPD K ~ 0.15 mW/g) AND CAN IMPROVE QUITE FAST WITH THE DECREASE OF THE GAPS SIZE (ESPECIALLY THAT BETWEEN CRYO #1 AND CRYO #2).

ON THE OTHER HAND FROM THE SO FAR SC#4 DP RESULTS IT LOOKS LIKE THAT BY DECREASING THE FIRST GAP IN HALF WILL NOT REDUCE THE DPD TO THE DESIRABLE LEVELS

THAT IN PART IS DUE TO THE FACT THAT AT THE SAME TIME WE EXTEND THE POOL ALL THE WAY TO THE END OF THE SHIELDING SH#4, AND MOST IMPORTANT WE HAVE VACUUM IN THE UPPER HALF OF THE POOL VESSEL.

SC#3 PEAK DPD (LEFT), SC#4 AND SC TOTAL DP (RIGHT) WITH DECREASING GAPS SIZE (FROM 4 x 5E05 EVENTS, 18.2 g/cc W DENSITY)

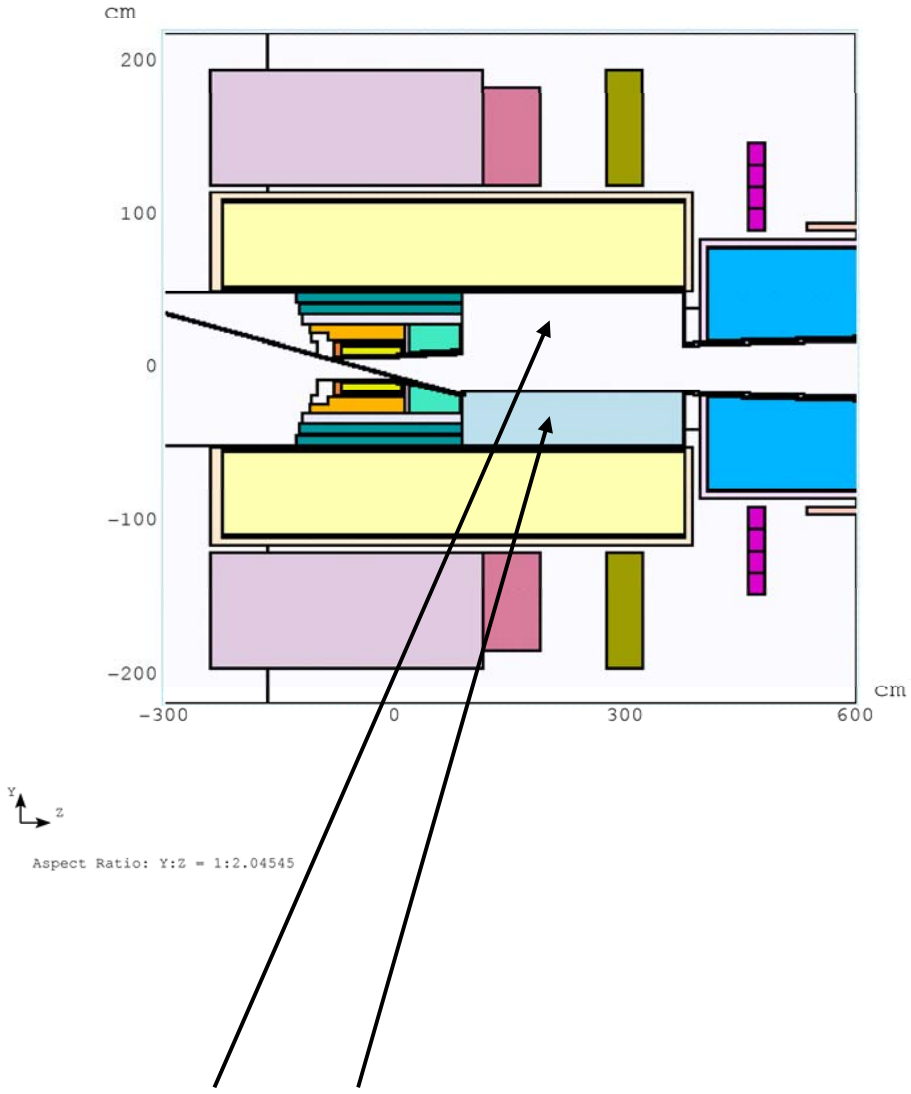


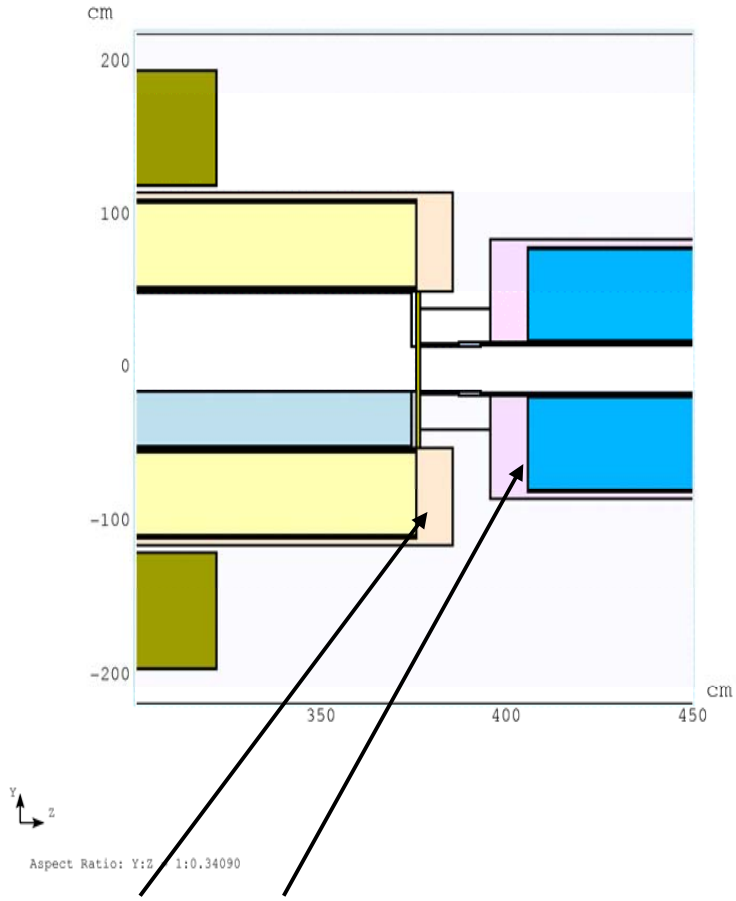


SC#3: DPD PEAK $\lesssim$ 0.06 mW/g AFTER ~ 60 cm GAPS DECREASE.

RIGHT PLOT: SC#4 AND TOTAL DP STILL OVER 1 kW AFTER 60 cm GAPS DECREASE.

IDS120j: GAP 1 DETAIL PLOTS FOR 10 cm SYMMETRIC INCREASE OF GAPS SIZE (YZ CROSS SECTIONS).



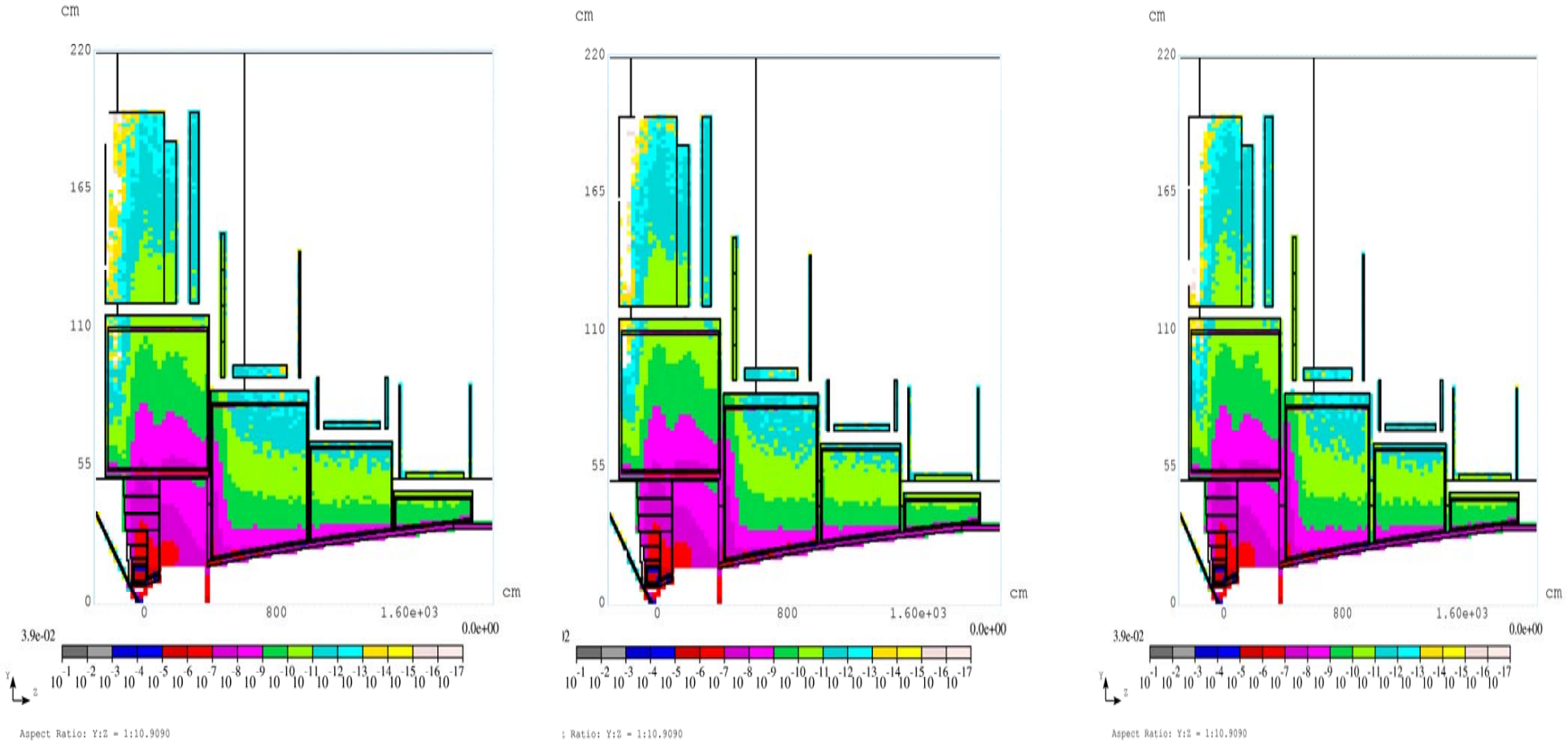


POOL IS EXTENDED ALL THE WAY TO THE END OF THE LENGTH OF SH#4 REGION. UPPER HALF IS VACUUM.

10 cm STST THICK FLANGES ARE USED FOR THE DOWNSTREAM SIDE OF THE UPSTREAM VESSEL SHVS#4, AND THE UPSTREAM SIDE OF THE DOWNSTREAM VESSEL SHVS#2 IN GAP 1.

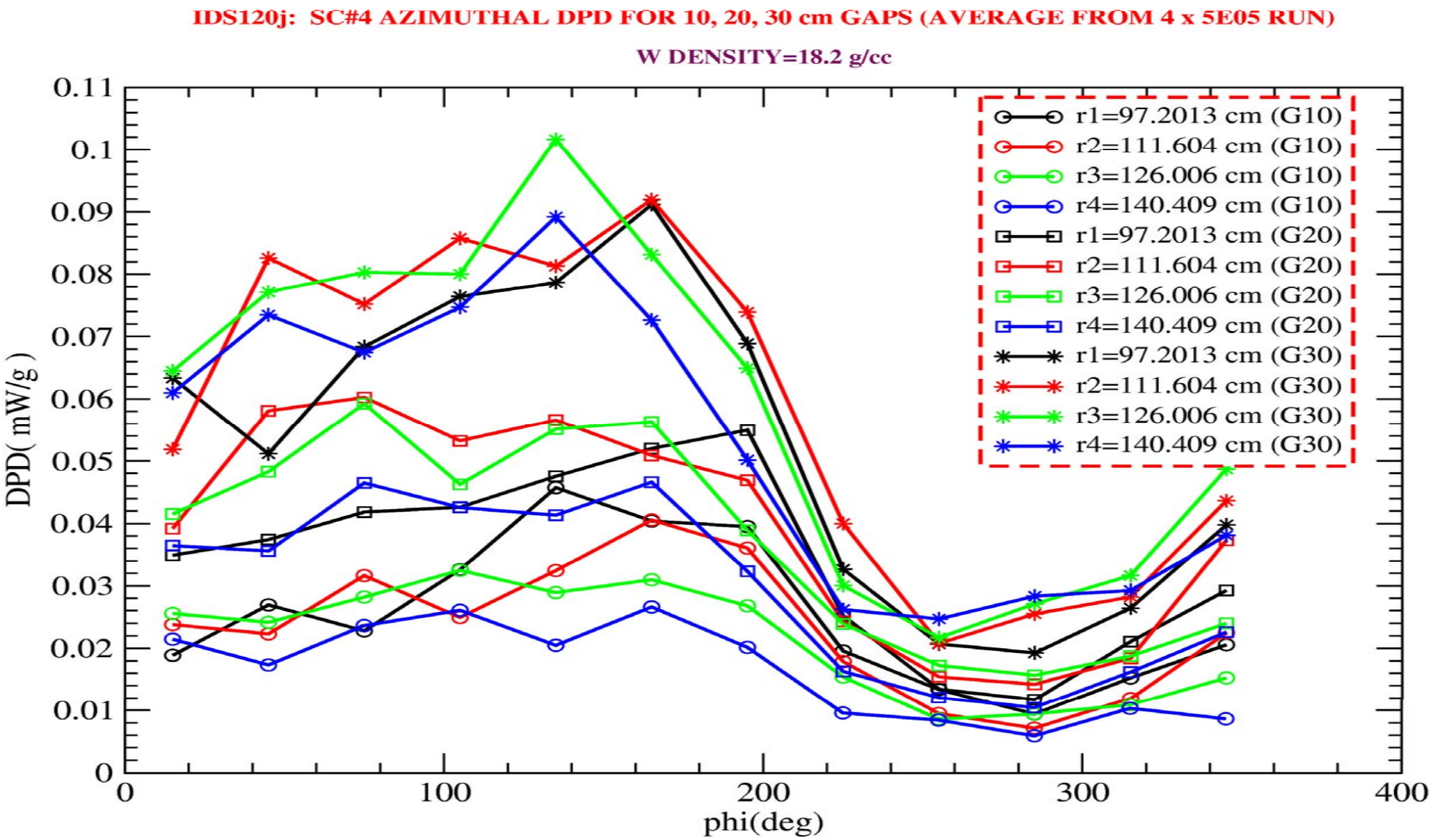
IDS120j: AZIMUTHALLY AVERAGE DP DISTRIBUTION WITH SYMMETRIC INCREASE OF GAPS SIZE (YZ CROSS SECTIONS).

GAPS SIZE: 10.0 cm 20.0 cm 30.0 cm

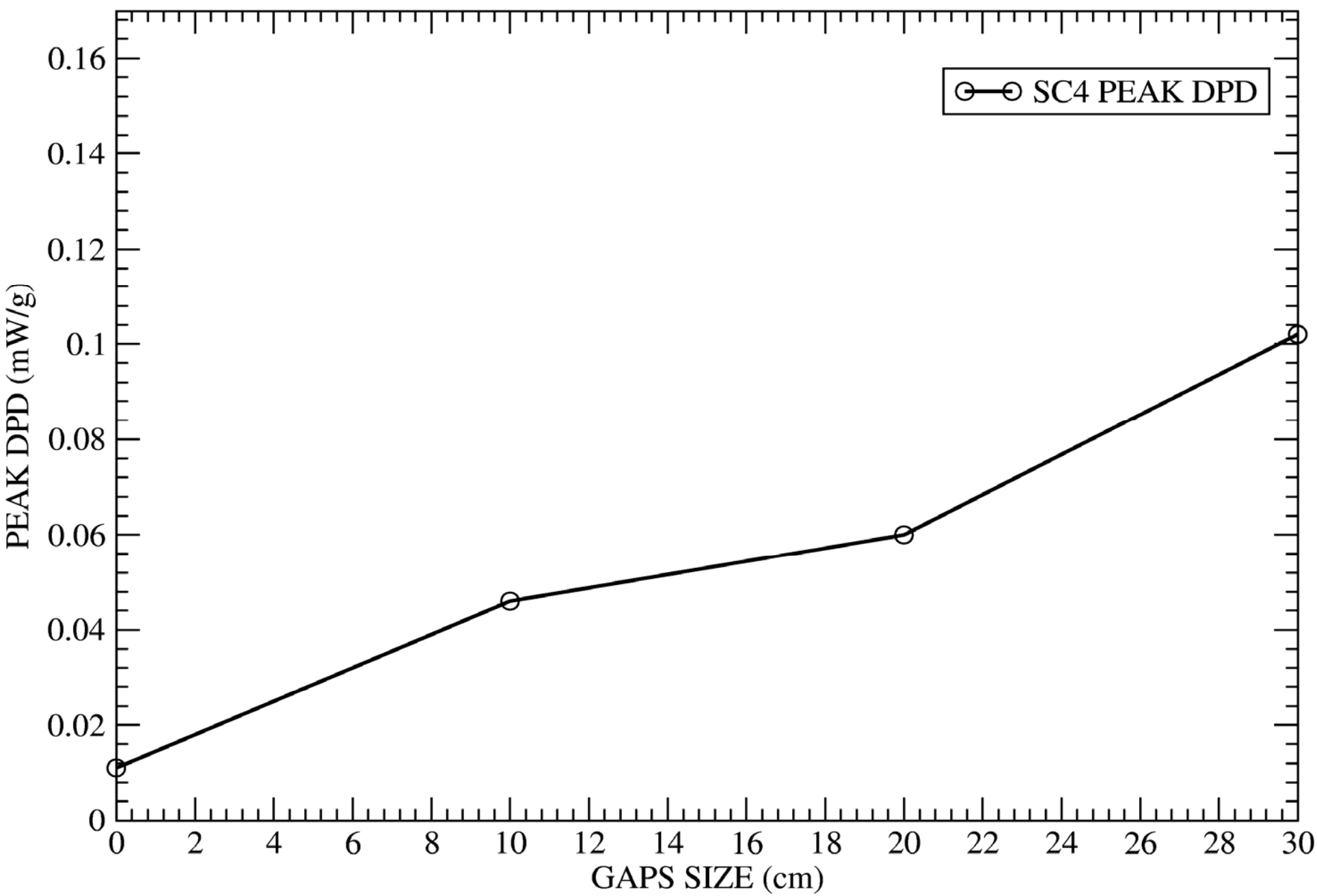


FIRST LOOK: UP TO 30 cm GAPS LOOKS LIKE ARE INSIGNIFICANT PERTURBATION FOR THE AZIMUTHALY AVERAGE DPD.

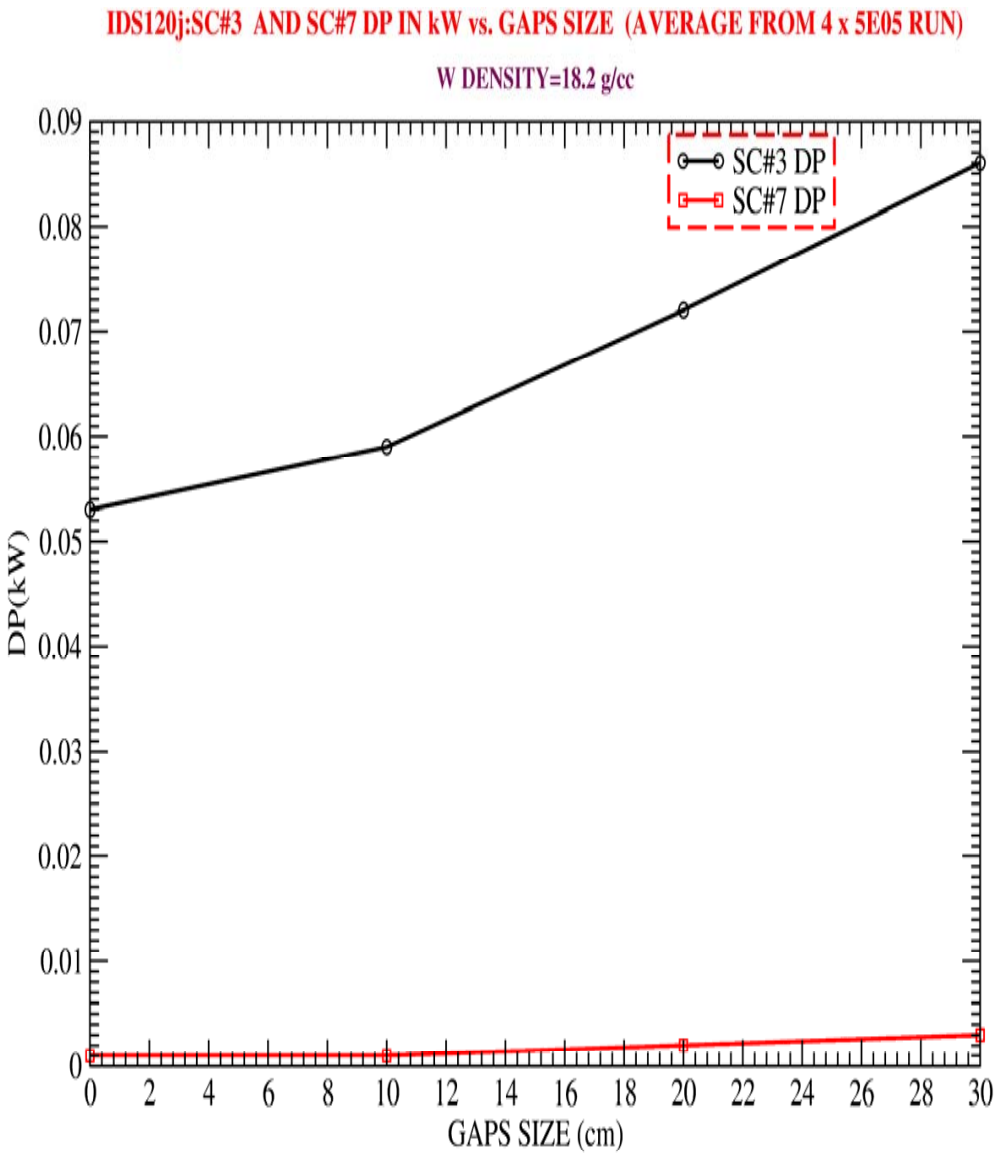
IDS120j: SC#4 DPD AZIMUTHAL DISTRIBUTIONS FOR 10, 20, 30 cm GAPS (FROM 4 x 5E05 EVENTS, 18.2 g/cc W DENSITY)

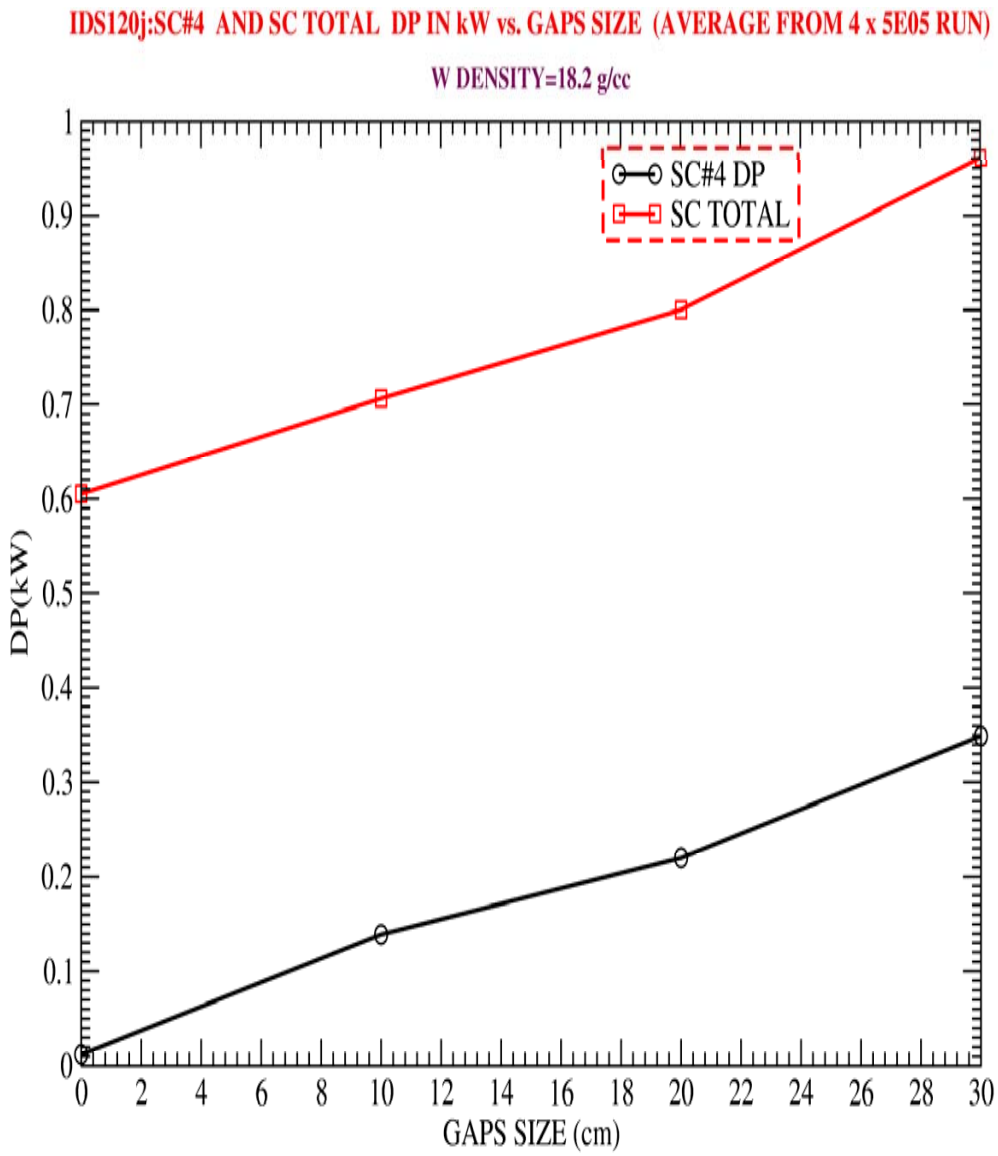


30-40 cm GAPS APPEAR TO BE THE CRITICAL GAPS SIZE FOR THE SC#4 DPD PEAK VALUES TO REACH OR EXCEED THE "ITER LIMIT" .


IDS120j:SC#4 PEAK DP IN mW/g vs. GAPS SIZE (AVERAGE FROM 4 x 5E05 RUN)
W DENSITY=18.2 g/cc
SC4 PEAK DPD
PEAK DPD (mW/g)
GAPS SIZE (cm)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30

IDS120j: SC#3, SC#7 (LEFT) AND SC#4, SC TOTAL (RIGHT) DP vs. GAPS SIZE (FROM 4 x 5E05 EVENTS, 18.2 g/cc W DENSITY)





SC#3, SC#7: EVEN WITH 30 cm GAPS VERY LITTLE DP
SC TOTAL ~ 1 kW FOR 30 cm GAPS, ALMOST HALF OF THAT IS DEPOSITED IN SC#4