IDS120j WITHOUT GAPS AND WITH MAXIMUM SIZE GAPS (aka "NIGHTMARE" SCENARIO)

SC#4, SC#7 AZIMUTHAL DPD DISTRIBUTION ANALYSIS.

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IDS120j  GEOMETRY: WITHOUT GAPS/WITH MAX SIZE GAPS
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# DP SIMULATIONS.
# SC#4, SC#7 AZIMUTHAL DPD DISTRIBUTION STUDIES.
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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, \( \sigma_x = \sigma_y = 0.12 \text{ cm} \)
IDS120j WITHOUT (LEFT) AND WITH GAPS (TWO SHIELDING CONFIGURATIONS RIGHT)

YZ CROSS SECTION PLOTS.

RIGHT PLOT SHIELDING CONFIGURATION:

SH#2 REGION (BLUE): LENGTH ~ 5 m, AVERAGE RADIAL THICKNESS ~ 0.6 m WEIGHT ~ 32 TONNS

SH#3 REGION (PINK): LENGTH ~ 4 m, AVERAGE RADIAL THICKNESS ~ 0.4 m WEIGHT ~ 14 TONNS

SH#4 REGION (YELLOW): LENGTH ~ 5.4 m, AVERAGE RADIAL THICKNESS ~ 0.55 m WEIGHT ~ 52 TONNS
(FOR 18.2 g/cc W DENSITY)
FIRST LOOK: GAPS AFFECT MOSTLY SC#3, SC#4 AND SC#7, SC#4 WITH MOST SERIOUS PROBLEM. GAP BETWEEN CRYO #1 AND #2 HAS THE MOST SIGNIFICANT EFFECT NOT ONLY IN THE NEIGHBORING SCs BUT ALSO IN THE SCs FURTHER DOWNSTREAM.
IDS120j: GAP BETWEEN CRYO 1-2 AND SC#4 SEGMENTATION DETAILS.

- $90 < r < 147.61$ cm
- $459.0 < z < 480.31$ cm
- $0.0 < \varphi < 360.0$ deg.

- $dr = 14.40$ cm
- $dz = 21.31$ cm
- $d\varphi = 30$ deg.

- $N_r = 4$ bins
- $N_z = 1$ bin
- $N_\varphi = 12$ bins
- $N_{\text{tot}} = 48$ "pieces"
SC#4 DPD AZIMUTHAL DISTRIBUTION WITHOUT GAPS: 15.8 g/cc (LEFT) AND 18.2 g/cc (RIGHT) W DENSITY (AVERAGE FROM 4 5E05 EVENT SIMULATIONS).

DPD $\approx 0.008$ mW/g (sum 0.023 kW)  
PEAKS APPEAR TO BE IN THE UPPER HALF OF SC#4, TOWARD $-x$ AXIS.

DPD $\approx 0.011$ mW/g (sum 0.012 kW)
SC#4: DPD \( \lesssim 2.4 \text{ mW/g} \) (sum = 3.64 kW vs. 3.73 kW without segm.) DPD \( \lesssim 0.7 \text{ mW/g} \)

PEAKS APPEAR TO BE ALONG THE +y AND -x DIRECTION.

FROM RIGHT PLOT: DOES THAT MEAN THE STUDY II GEOMETRY SC#1 PEAK IS IN REALITY > 19 mW/g ?!!
CRYO #2 AND #3  GAP AND SC#7 AZIMUTHAL SEGMENTATION DETAILS.

- $70 < r < 89.97$ cm, $dr = 9.985$ cm, $N_r = 2$ bins
- $1036.0 < z < 1046.67$ cm, $dz = 10.67$ cm, $N_z = 1$ bin
- $0.0 < \varphi < 360.0$ deg, $d\varphi = 30$ deg, $N_\varphi = 12$ bins
- $N_{tot} = 24$ "pieces"
SC#7: DPD AZIMUTHAL DISTRIBUTION WITH GAPS FROM 4 x 5E05 EVENTS (18.2 g/cc W DENSITY).

SC#4: DPD ≤ 0.15 mW/g (sum = 0.060 kW vs. 0.061 kW without segm.) PEAK APPEAR TO BE ALONG THE + y AND - x DIRECTION AS IN SC#4. PROBLEM IN SC#4 LOOKS LIKE IS MANAGEABLE. SC#3 SEGMENTATION ANALYSIS IN PROGRESS.

NO GAPS                      GAPS
SC#1 : 0.383 kW -------------> 0.368 kW
SC#2 : 0.105 kW -------------> 0.120 kW
SC#3 : 0.053 kW -------------> 0.799 kW
SC#4 : 0.012 kW -------------> 3.700 kW
SC#5 : 0.003 kW -------------> 0.080 kW
SC#6 : 0.001 kW -------------> 0.052 kW
SC#7 : 0.003 kW -------------> 0.061 kW
SC#8 : 0.008 kW -------------> 0.006 kW
SC#9 : 0.002 kW -------------> 0.006 kW
SC#11-12 : 0.035 kW ---------> 0.052 kW
SC#1-12 : 0.605 kW ---------> 5.244 kW
RADIAL DP FLOW : 74.15 kW -------> 531.78 kW

GAP BETWEEN CRYO #1 AND #2 IS THE MAJOR PROBLEM IN THE GAPS CONFIGURATION. AT THE SAME TIME THAT FIRST GAP SHOULD BE BIGGER THAN THE OTHERS TO SATISFY THE NEEDS FOR Hg POOL VESSEL + BEAM PIPE + Be WINDOW + SHIELDING MATERIAL COOLING, AS WEL AS OTHER ENGINEERING COMPONENTS THERE. AT LEAST ~ 20 cm WILL BE DEDICATED TO THE UPSTREAM AND DOWNSTREAM STST FLANGES OF THE NEIGHBORING SHIELDING VESSELS AND MORE THAN ~ 20 - 30 cm FOR THE DIFFERENT COMPONENTS, THEREFORE SHIELDING GAP ≥ 50 - 60 cm. A VIABLE SOLUTION (BUT NOT NECESSARILY ENGINEERINGLY FAVORABLE) CAN INCLUDE:

A. INTRODUCTION OF SHIELDING IN THE UPPER HALF OF THE Hg POOL VESSEL,
B. NOT EXTENDING THE POOL ALL THE WAY TO THE END OF THE #1 CRYOSTAT LENGTH,
C. ASYMMETRIC EXTENSION OF THE SHIELDING FROM CRYO #1 TOWARDS CRYO #2,
D. SC IR INCREASE MAYBE EVEN TO 120 cm.