IDS120h GEOMETRY WITH SHIELDING VESSELS

ENERGY FLOW ANALYSIS

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 FOR 80% W + 20% He SHIELDING

Nicholas Souchlas, PBL (10/18/2011)

IDS120h with shielding vessels.

Different cases of shielding material.

N = 100,000 AND N=500,000 events simulation for 80% W + 20% He SHIELDING

Energy counting for N=500,000 events simulation for 80% W + 20% He SHIELDING

>mars1510/MCNP

>10^{-11} MeV NEUTRON ENERGY CUTOFF

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

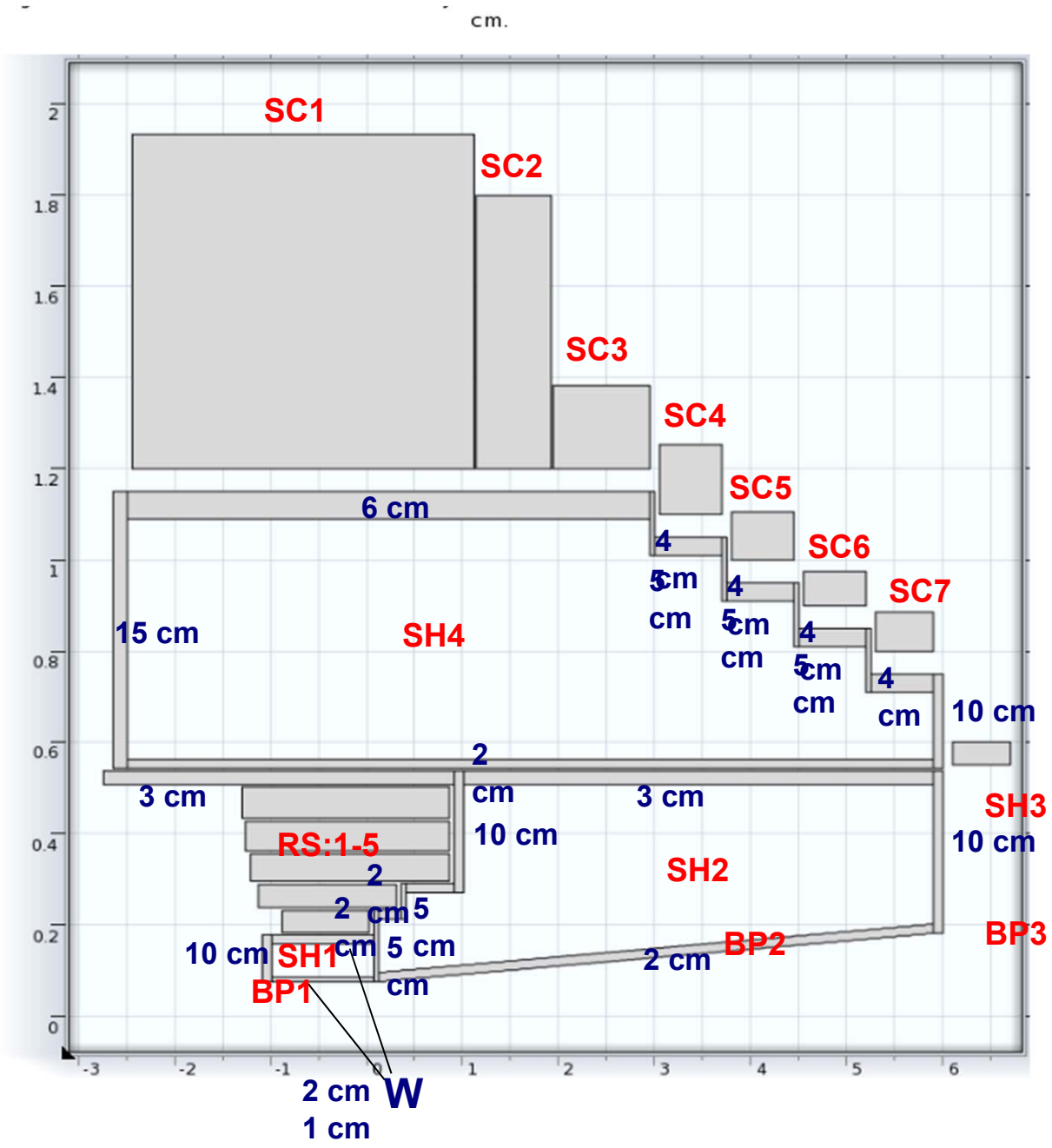
>4 MW proton beam, Np = 100,000/500,000

>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

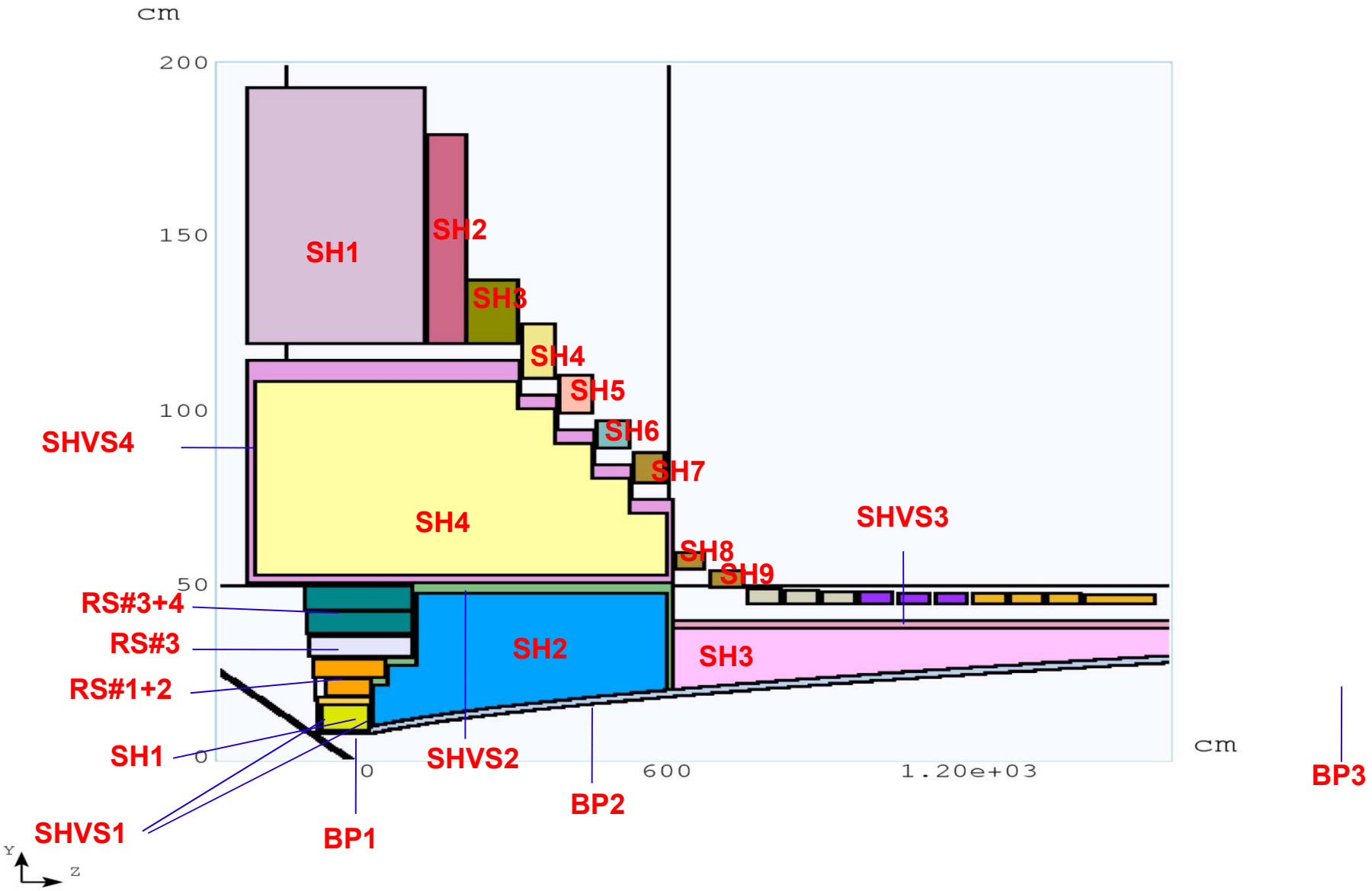
BP1: 1 cm STST → 1 cm W
BP2/BP3: 1 cm STST → 2 cm STST

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.



POWER DEPOSITED IN THE SC COILS

NiSn/NiTi	60/40	80/20	88/12
SC#1	0.128	0.060	0.047
SC#2	0.009	0.003	0.001
SC#3	0.008	0.005	0.0003
SC#4	0.010	0.003	0.0002
SC#5	0.004	0.003	0.006
SC#6	0.001	0.003	0.002
SC#1-6	0.160	0.074	0.056
SC#7-9	0.045	0.031	0.032
SC#10-12	0.043	0.030	0.026
SC#13-15	0.020	0.014	0.020
SC#16-19	0.048	0.035	0.031
SC#1-19	0.316	0.184	0.165

SC1: 0.128 kW --> 0.047 kW SC1-6: 0.160 kW --> 0.056 kW SC#1-19 :0.316 kW --> 0.165 kW.

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

—	60/40	80/20	88/12
SH#1	874.50	854.50	848.50
SH#2	750.50	717.50	704.50
SH#3	22.34	20.96	20.21
SH#4	32.27	24.26	22.87
SH#1-4	1679.61	1617.22	1595.28

SURPRISE!

LESS POWER IN SH1, SH2 !!!!

SH1: 874.50 kW --> 848.50 kW (-26.0 kW)

SH2: 750.50 kW --> 704.50 kW (-46.0 kW)

SH#1-4: 1679.615 kW --> 1595.28 kW (-84.33 kW)

—	60/40	80/20	88/12
SHVS#1	59.15	79.95	85.05
SHVS#2	66.80	56.05	55.15
SHVS#3	0.531	0.35	0.238
SHVS#4	7.17	6.42	6.44
SHVS#1-4	133.65	142.77	146.92
SH1T2(W)	45.38	33.45	32.05

TWO SH1 STST FLANGES: 59.15 kW --> 85.05 kW (+25.9 kW)

SH1 2 cm W TUBE#2: 45.38 kW --> 32.05 kW (-13.33 kW)

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

Cu	60/40	80/20	88/12
RS#1+2	79.05	70.50	71.25
RS#3	36.70	33.01	32.84
RS#4+5	49.49	45.39	44.58
RS#1-5	165.24	148.90	148.67

LESS POWER IN RS#1+2

RS#1+2: 79.05 kW --> 71.25 kW (-7.8 kW)

RS#1-5: 165.24 kW --> 148.67 kW (-16.57 kW)

BP	60/40	80/20	88/12
BP#1(W)	428.90	423.35	423.25
BP#2(ST)	280.45	272.60	271.05
BP#3(ST)	8.46	8.56	8.47
BP#1-3	717.81	704.51	702.77

LESS POWER IN BP#1,BP2

BP#1: 428.90 kW --> 423.25 kW (-5.65 kW)

BP#2: 280.45 kW --> 271.05 kW (-9.4 kW)

BP#1-3: 717.81 kW --> 702.77 kW (-15.04 kW)

TOTAL POWER DEPOSITED IN DIFFERENT AREAS AND SC#1-11 PEAK VALUES.

TOTALS	60/40	80/20	88/12
SC#1-19	0.316	0.184	0.165
SH#1-4	1679.61	1617.22	1595.28
SHVS#1-4	133.65	142.77	146.92
RS#1-5	165.24	148.90	148.67
BP#1-3	717.81	704.51	702.77
Hg TARG.	408.10	408.70	408.15
Hg POOL	219.70	215.00	214.10
HgP.WALLS	0.31	0.30	0.296
Be WIND.	0.86	0.85	0.865
TOTAL	3370.97	3271.89	3249.26

LESS POWER IN SC#1-19: 0.316 kW --> 0.165 kW (-0.151 kW)
LESS POWER IN SH#1-4: 1679.61 kW --> 1595.28 kW (-84.33 kW)
LESS POWER IN RS#1-5: 165.24 kW --> 148.67 kW (-16.57 kW)
LESS POWER IN BP#1-3: 717.81 kW --> 702.77 kW (-15.40 kW)
TOTAL POWER IS TRG STATION: 3370.97 kW --> 3249.26 kW (-121.71)
--> MORE ENERGY FLOWING DOWNSTREAM

PEAK TDP(mW/g)	60/40	80/20	88/12
SC#1	0.015	0.018	0.016
SC#2	0.006	0.016	0.002
SC#3	0.005	0.004	0.006
SC#4	0.005	0.002	0.003
SC#5	0.005	0.002	0.001
SC#6	0.0014	0.001	0.005
SC#7	0.009	0.001	0.001
SC#8	0.040	0.025	**0.100**
SC#9	0.065	0.046	0.040
SC#10	0.060	0.014	0.022
SC#11	0.030	0.060	0.040

BAD SURPRISE

SC#1 PEAK: 0.015 --> 0.016 mW/g NO CHANGE
SC#8 PEAK: 0.040 --> 0.100 mW/g MORE ENERGY IS GOING THROUGH THE "STAIRS"

TOTAL POWER DEPOSITED IN DIFFERENT AREAS AND SC#1-11 PEAK VALUES FOR 100,000 AND 500,000 EVENTS SIMULATIONS FOR 80%W+20%He SHIELDING

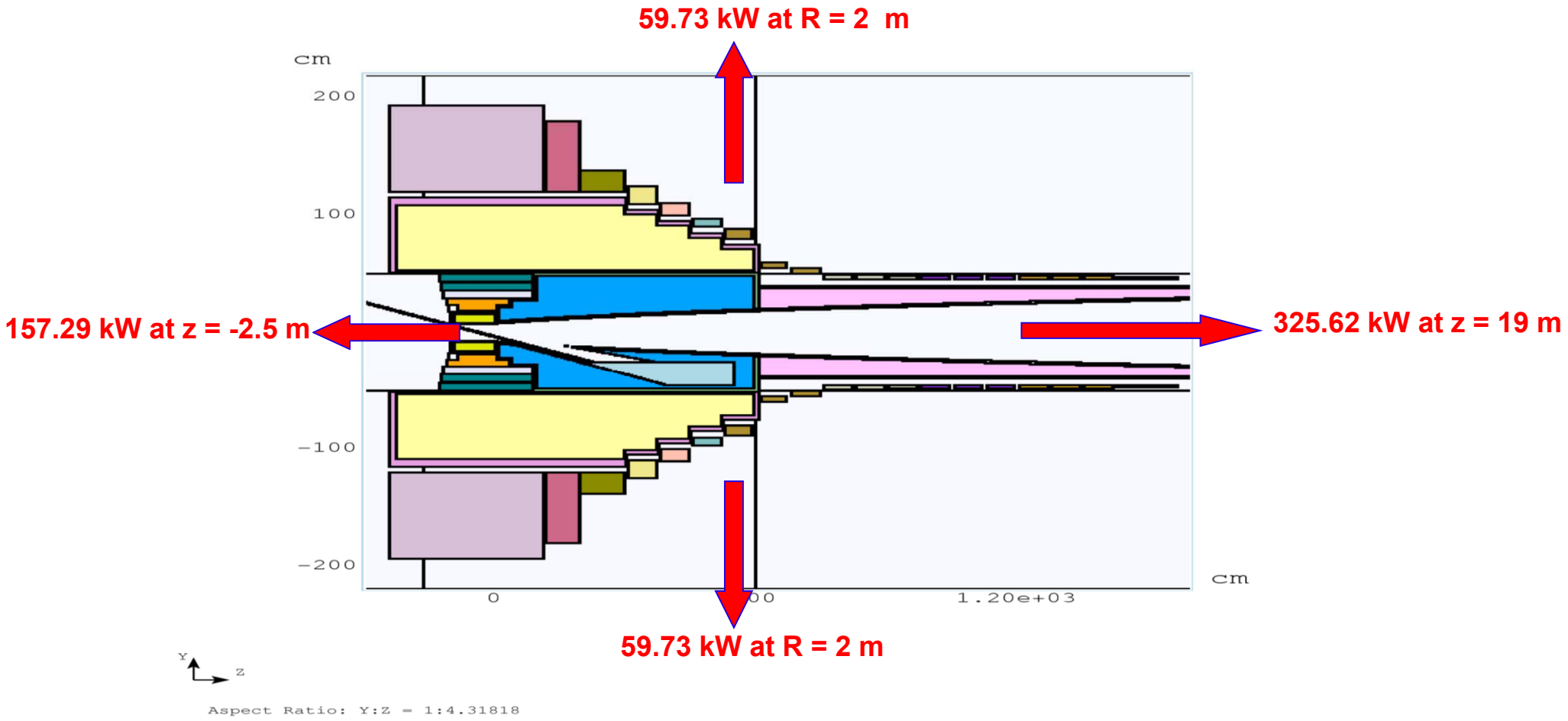
TOTALS	1E5 EVNTS	5E5 EVNTS
SC#1-19	0.184	0.172
SH#1-4	1617.22	1637.14
SHVS#1-4	142.77	149.40
RS#1-5	148.90	146.74
BP#1-3	704.51	706.02
Hg TARG.	408.70	408.80
Hg POOL	215.00	217.00
HgP.WALLS	0.30	0.299
Be WIND.	0.85	0.858
TOTAL	3271.89	3301.02

NO DIFFERENCES IN DEPOSITED POWER. ABOUT 20 kW MORE POWER IN SHIELDING ESPECIALLY IN SH1 WAS ESTIMATED WITH 500,000 EVENTS

PEAK TDP(mW/g)	1E5 EVNTS	5E5 EVNTS
SC#1	0.018	0.0068
SC#2	0.016	0.0008
SC#3	0.004	0.0025
SC#4	0.002	0.0015
SC#5	0.002	0.0020
SC#6	0.001	0.0018
SC#7	0.001	0.0007
SC#8	0.025	0.0019
SC#9	0.046	0.0230
SC#10	0.014	0.0430
SC#11	0.060	0.0470

SC#1 PEAK: 0.018 --> 0.0068 mW/g SMALLER PEAK VALUE
IN GENERAL SMALLER PEAK VALUES ESTIMATED WITH 500,000 EVENTS

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



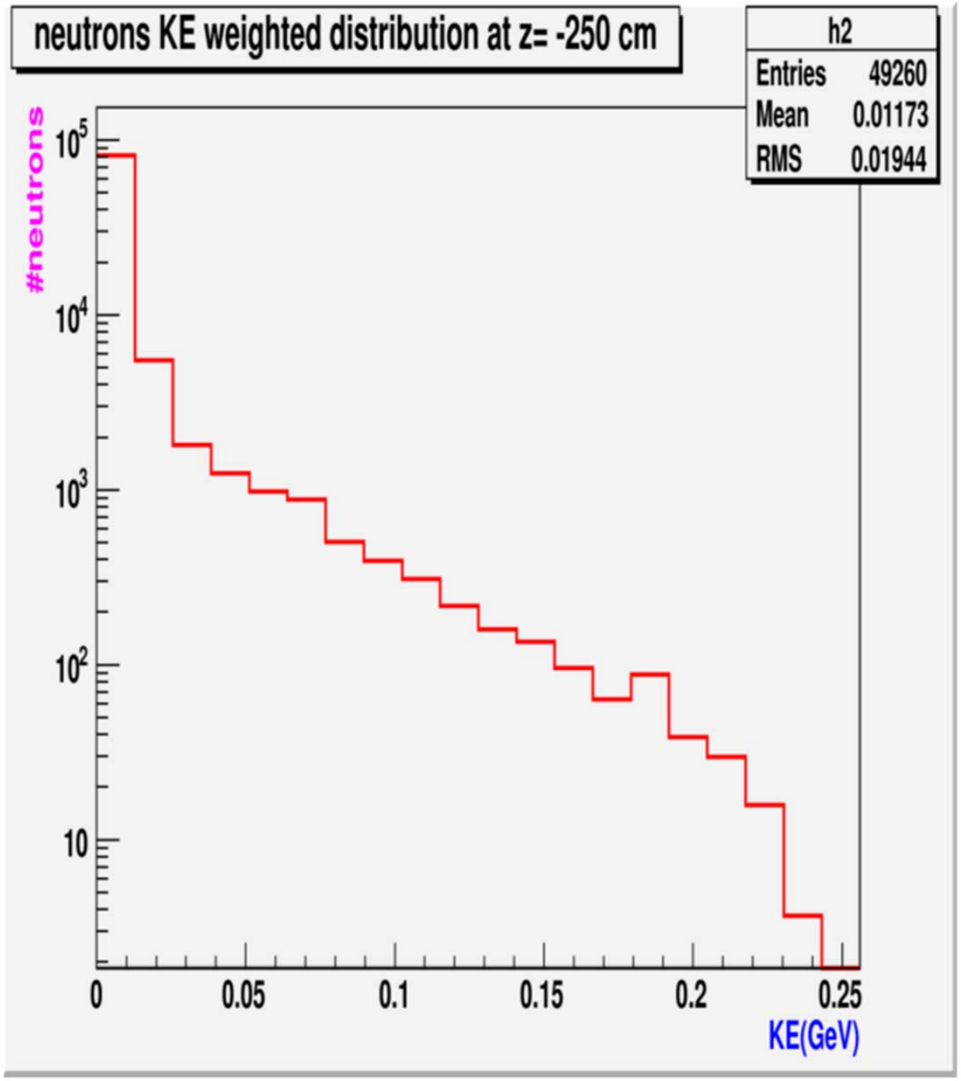
TOTAL POWER GOING THROUGH THE SURFACES: 542.64 kW
TOTAL POWER DEPOSITED IN TARGET STATION: 3,301.02 kW
POWER MISSING ~ 155 kW --> DUE TO Be WINDOW ~ 152 kW

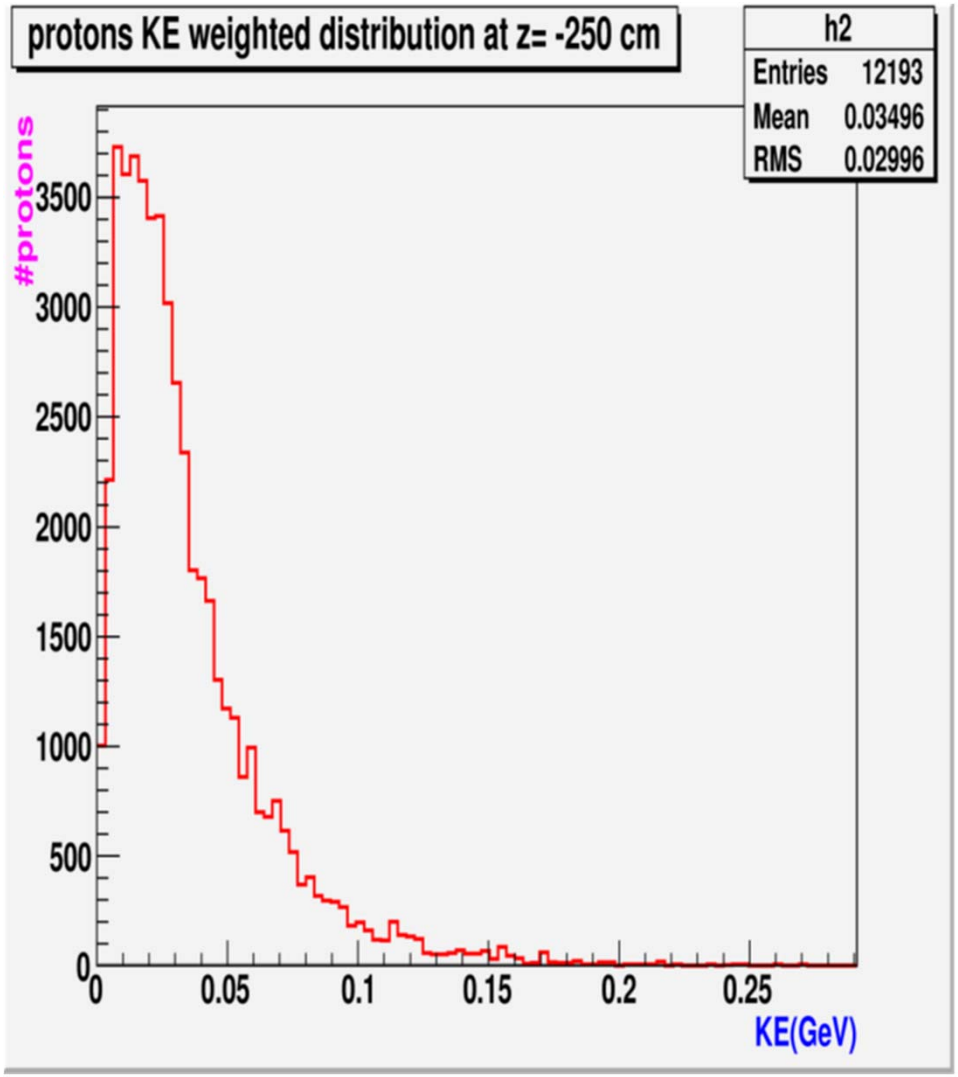
DETAILS OF THE ENERGY FLOW THROUGH EACH SURFACE p1

#PROTONS, NEUTRONS, TOTAL POWER, KINETIC ENERGY SPECTRA z = -250 cm

N(n) = 93,765
TP(n) = 88.84 kW

N(p) = 50,873
TP(p) = 49.51 kW





DETAILS OF THE ENERGY FLOW THROUGH EACH SURFACE p2

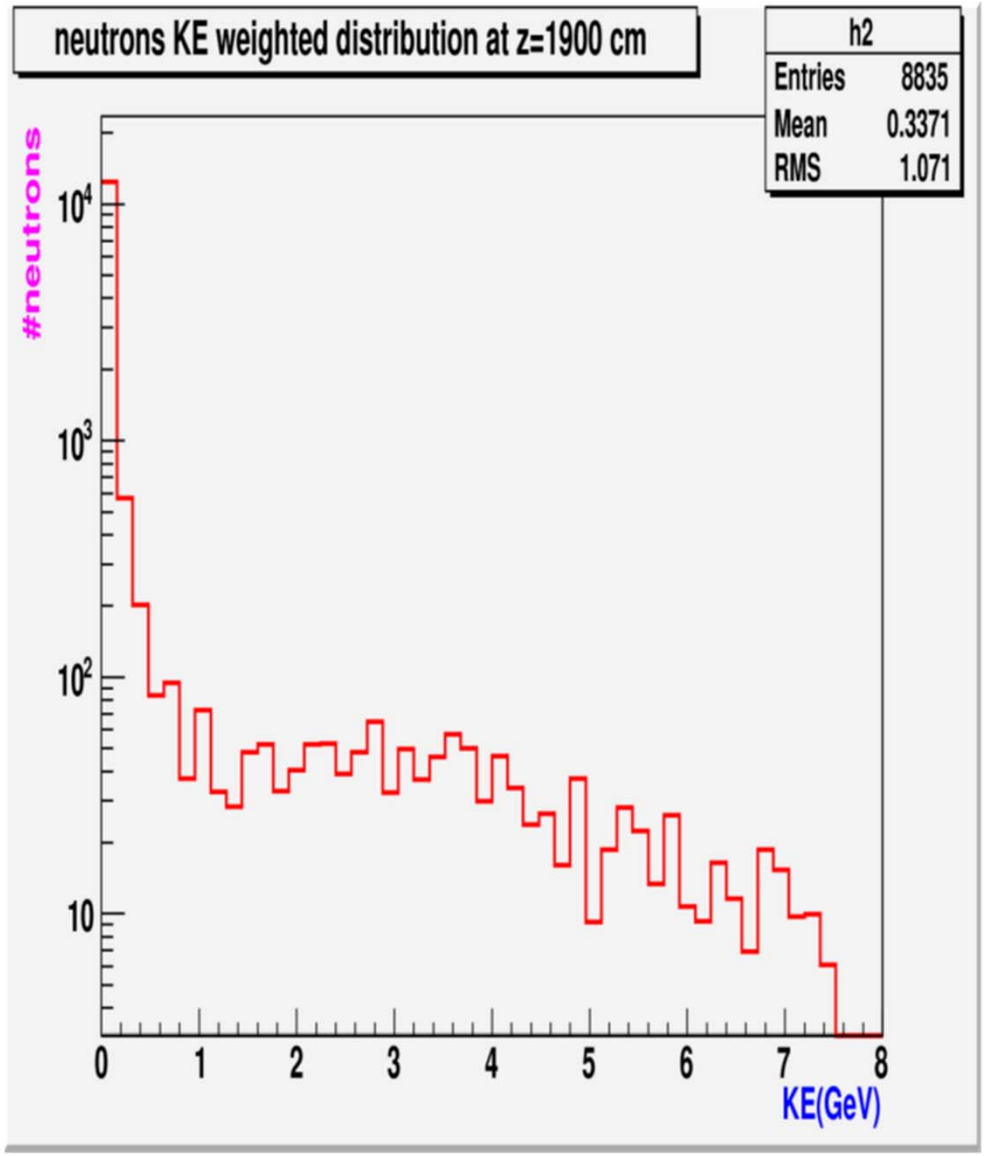
#PROTONS, NEUTRONS, TOTAL POWER, KINETIC ENERGY SPECTRA z = 1900 cm

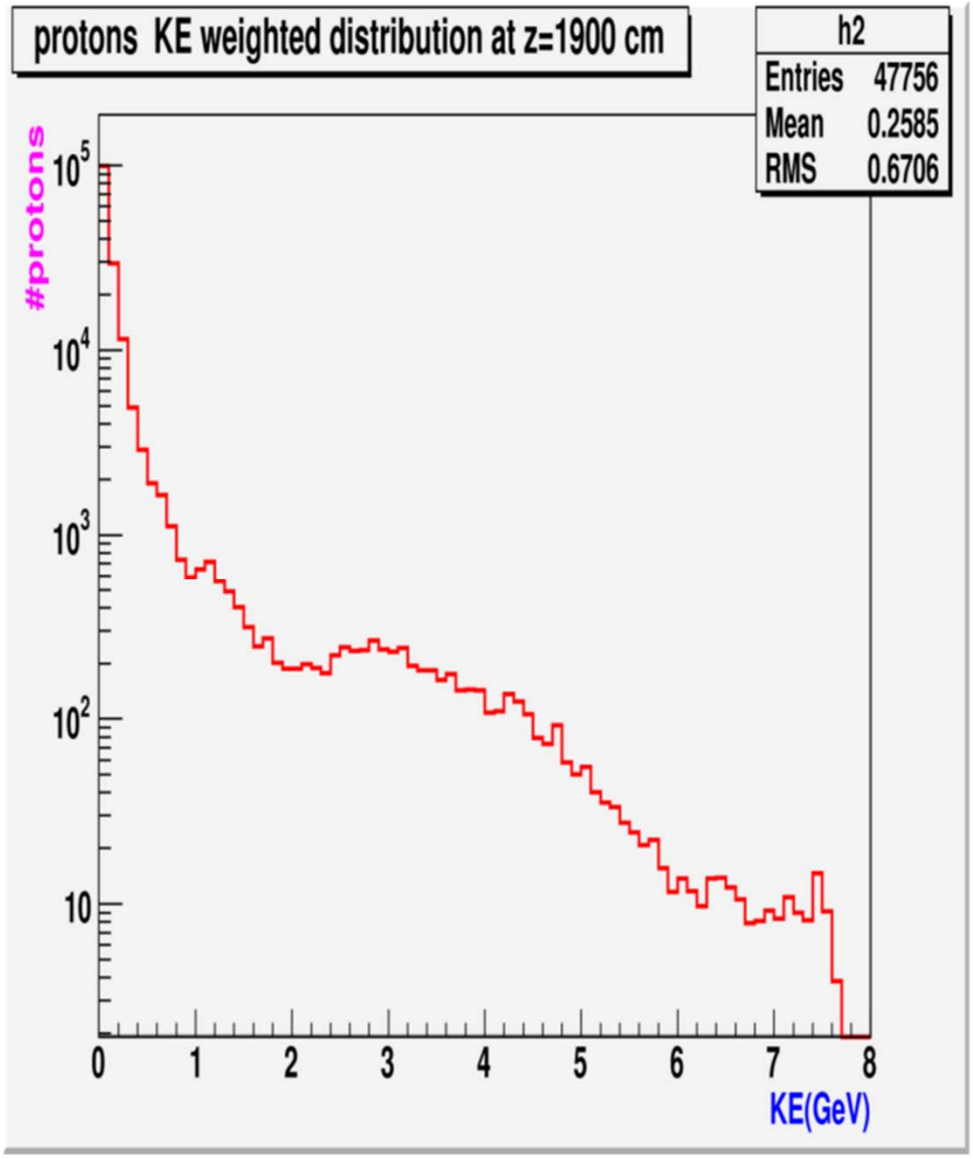
N(n) = 14,651

TP(n) = 18.71 kW

N(p) = 163,008

TP(p) = 195.08 kW



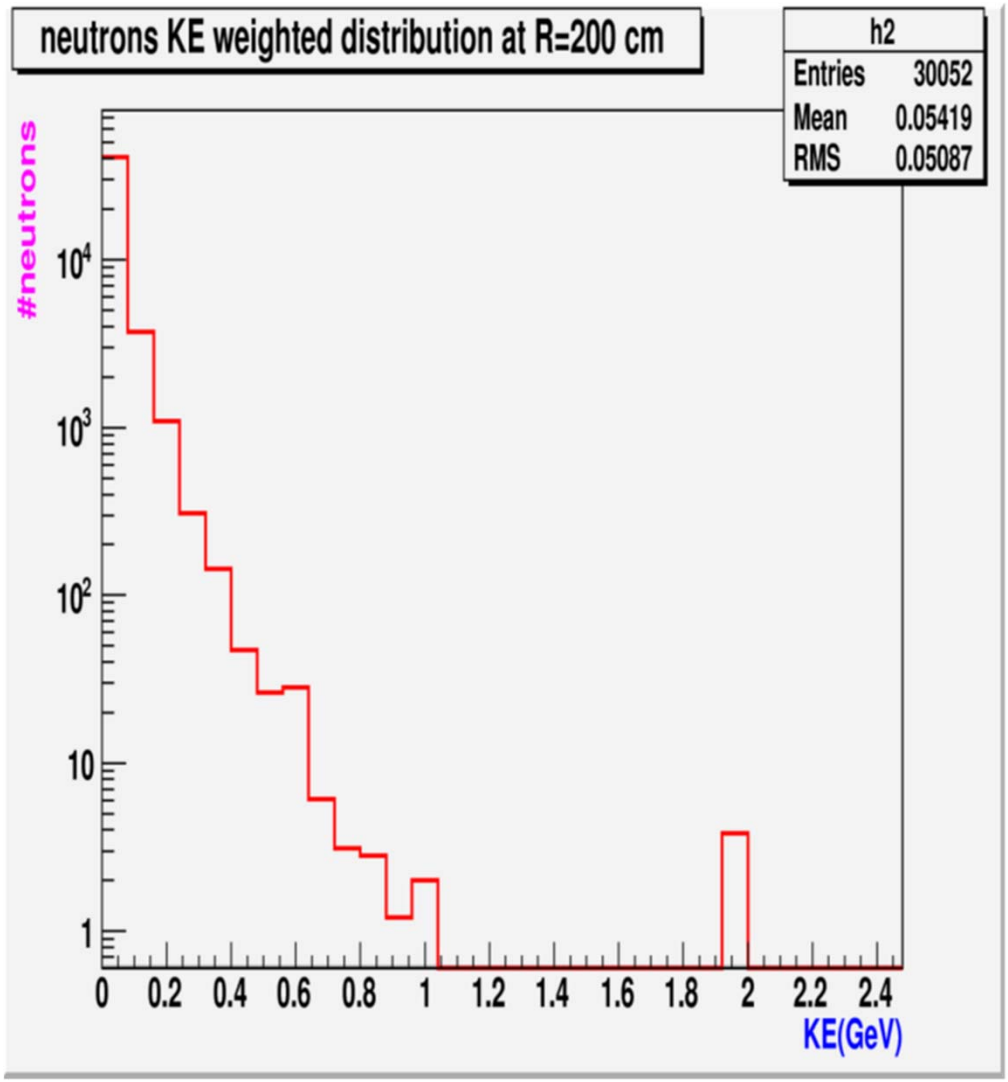


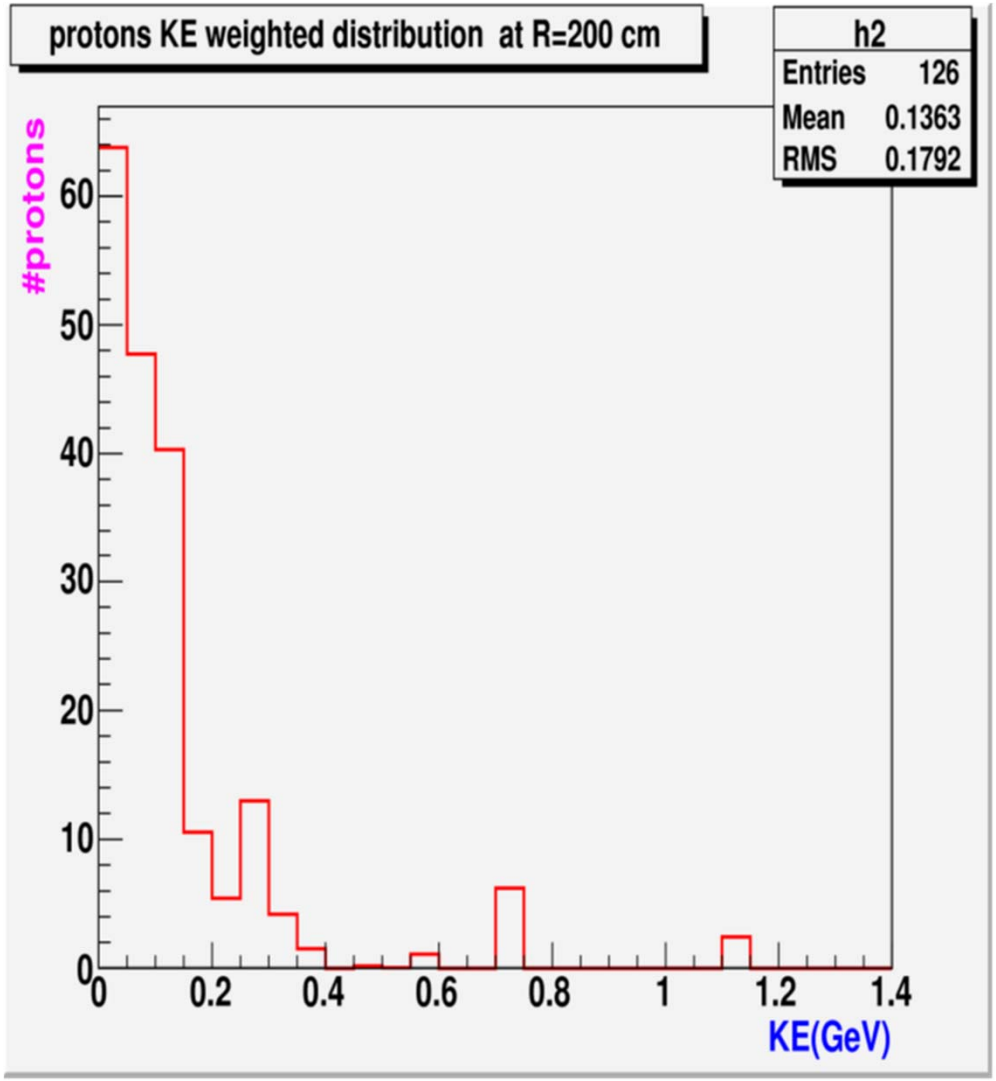
DETAILS OF THE ENERGY FLOW THROUGH EACH SURFACE p3

#PROTONS, NEUTRONS, TOTAL POWER, KINETIC ENERGY SPECTRA R = 200 cm

N(n) = 46,391
TP(n) = 44.93 kW

N(p) = 196
TP(p) = 0.211 kW





DETAILS OF THE ENERGY FLOW THROUGH EACH SURFACE p4

of $\pi^{\pm}$, $\mu^{\pm}$ and the total energies through surface at z = -250. cm

$N(\pi^+)$ = 9,516 $TP(\pi^+)$ = 2.10 kW

$N(\pi^-)$ = 16,527 $TP(\pi^-)$ = 3.58 kW

$N(\mu^+)$ = 5,067 $TP(\mu^+)$ = 0.82 kW

$N(\mu^-)$ = 9,001 $TP(\mu^-)$ = 1,41 kW

of $\pi^{\pm}$, $\mu^{\pm}$ and the total energies through surface at z = 1900. cm

$N(\pi^+)$ = 64,420 $TP(\pi^+)$ = 49.78 kW

$N(\pi^-)$ = 54,984 $TP(\pi^-)$ = 37.96 kW

$N(\mu^+)$ = 92,721 $TP(\mu^+)$ = 29.76 kW

$N(\mu^-)$ = 95,030 $TP(\mu^-)$ = 27.54 kW

of $\pi^{\pm}$, $\mu^{\pm}$ with 0.04 < T < 0.18 GeV through surface at z = -250. cm

$N(\pi^+)$ = 7,465 $N(\pi^-)$ = 13,189

$N(\mu^+)$ = 2,944 $N(\mu^-)$ = 4,954

of $\pi^{\pm}$, $\mu^{\pm}$ with 0.04 < T < 0.18 GeV through surface at z = 1900. cm

$N(\pi^+)$ = 8,977 $N(\pi^-)$ = 9,962

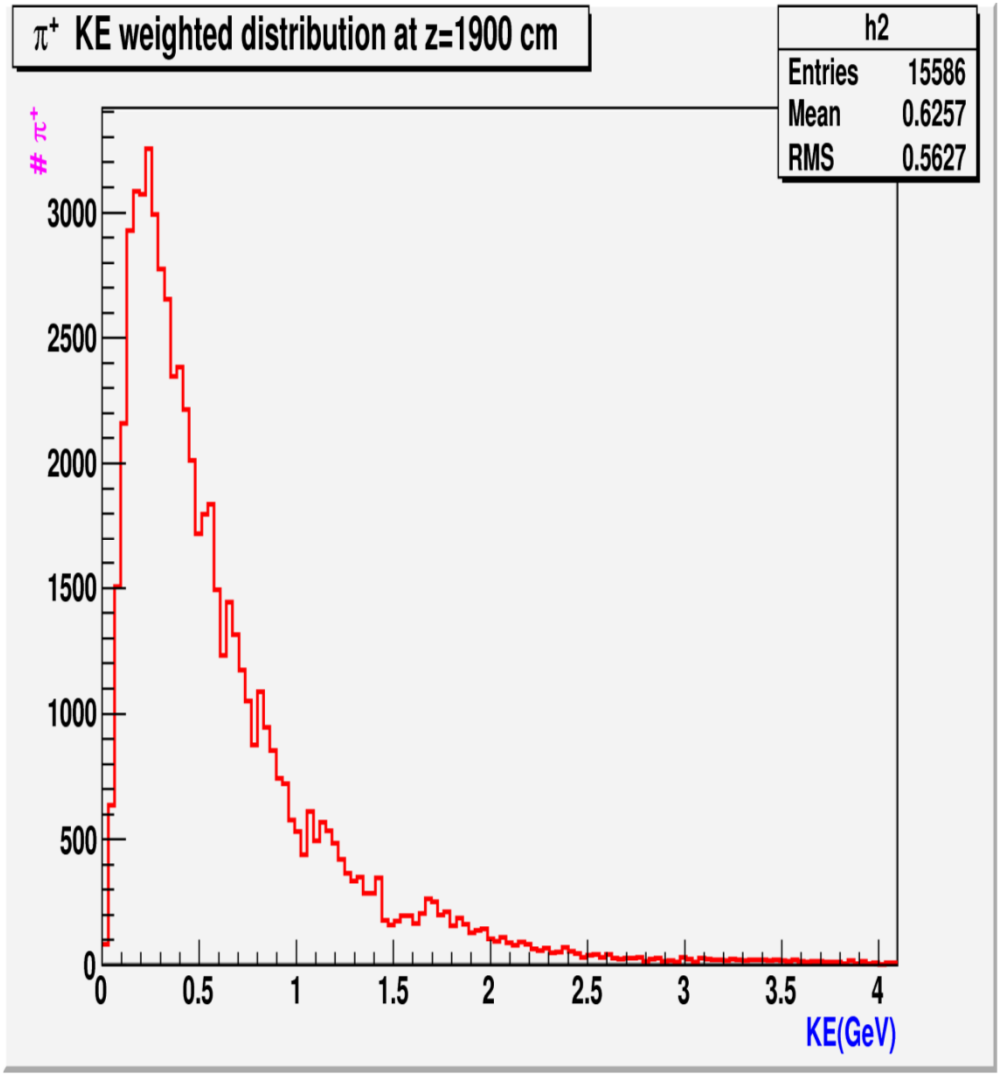
$N(\mu^+)$ = 46,720 $N(\mu^-)$ = 51,095

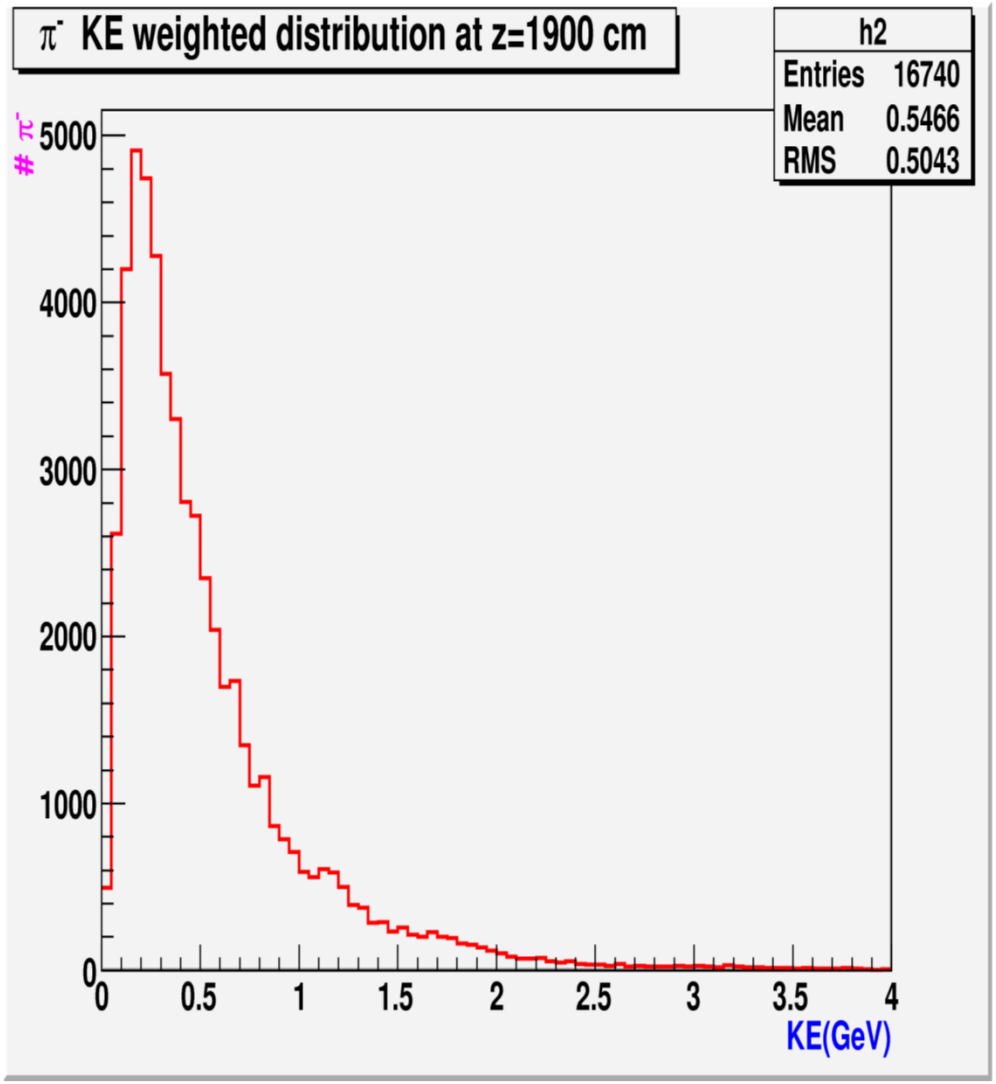
DETAILS OF THE ENERGY FLOW THROUGH EACH SURFACE p6

$\pi^{\pm}$ kinetic energies spectra for surface at z = 1900. cm

$N(\pi^+)$ = 496,420 $N(\pi^-)$ = 54,984

$TP(\pi^+)$ = 49.78 kW $TP(\pi^-)$ = 37.96 kW





DETAILS OF THE ENERGY FLOW THROUGH EACH SURFACE p7

$\mu^{\pm}$ kinetic energies spectra for surface at z = 1900. cm

$N(\mu^+) =$ 92,721 $N(\mu^-) =$ 95,030

$TP(\mu^+) =$ 29.76 kW $TP(\mu^-) =$ 27.54 kW