Energy Deposition of 4MW Beam Power in a Mercury Jet Target

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Introduction (I)

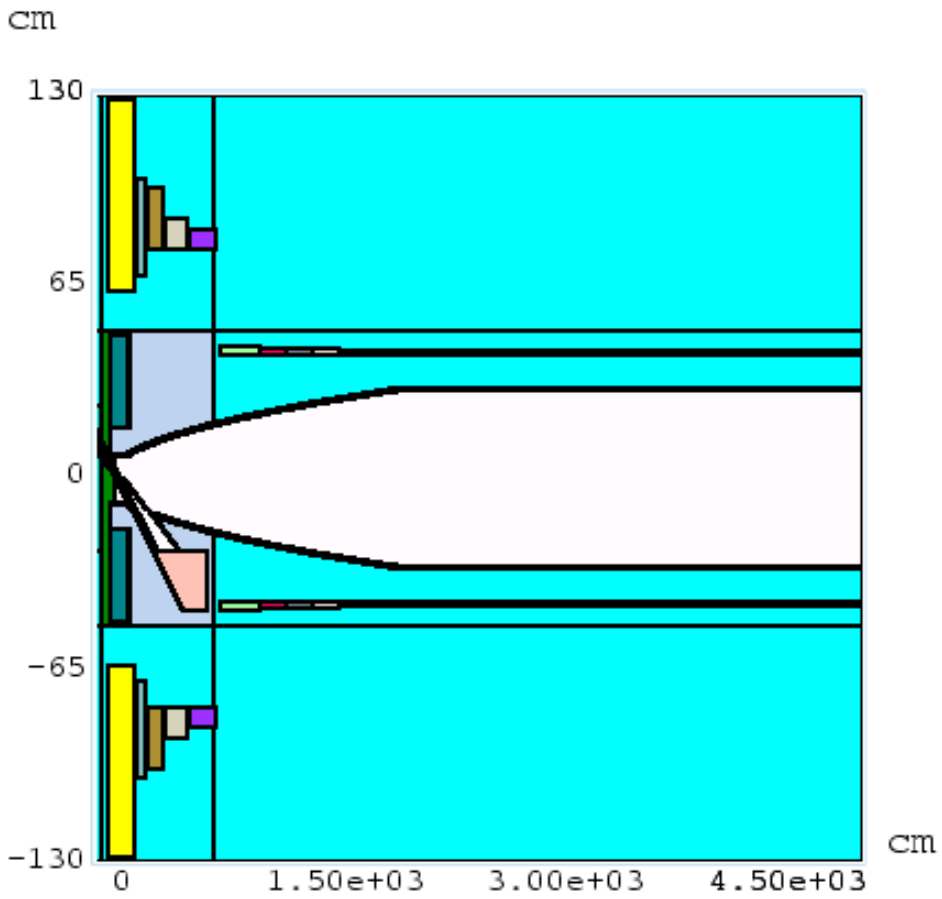
- Using MARS15 to study energy deposition.
- Study II geometry and magnetic field map.
- Hg jet: r=0.5cm, tilt 100mrad to sol. axis.
- Proton beam (simple Gaussian distribution): r=0.15cm, tilt 67mrad to sol. axis.

Introduction (II)

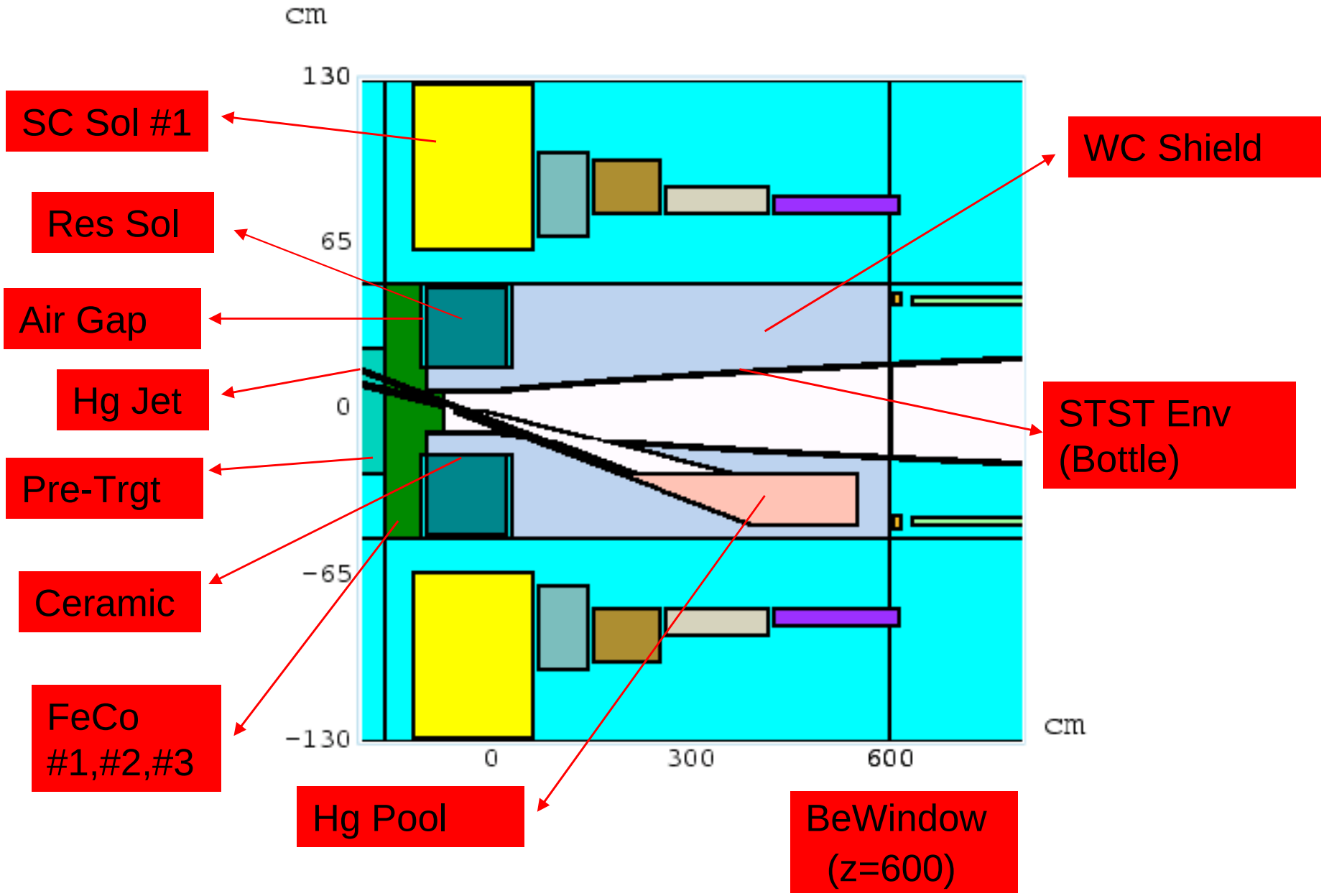
- The unit of direct energy deposition is GeV/g p.p (GeV per gram per incident primary particle) or GeV.
- The number of particles in a given pulse of beam (4MW, 10GeV) is $2.5*10^{15}$ [s^{-1}] (an average beam intensity in particles per second).

  $(2.5*10^{15})*(10*10^{9})*[1.6*10^{-19}]=4*10^{6}$ [W]

Target Geometry



Target Geometry (Zoom)



Map of Region Numbers and Material Indices in the Standard Geometry Sector

	Z range (-200cm,-165cm)	Z range (-165cm,600cm)	Z range (600cm,5000cm)
R range (50cm,130cm)	**No. 4** Region IM=(1) air	**No. 5** Region IM=(-1)	**No. 6** Region IM=(1) air
R range (0cm,50cm)	**No. 1** Region IM=(-1)	**No. 2** Region IM=(15) tungsten-carbide & Water shielding	**No. 3** Region IM=(-1)

(IM=-1 are for the regions redefined in non-standard geometry)

Regional Energy Deposition of 4MW Beam Power

Regional Name	ED [GeV]	P [kW]	P/P_{beam} [%]
No. 1	0	0	0
No. 2 (WC shield)	4.594	1837.6	45.94
No. 3	$1.20 *10^{-4}$	0.0482	0.0012
No. 4	$3.8 *10^{-8}$	~ 0	~ 0
No. 5 (air)	$1.46*10^{-5}$	0.0058	0.00015
No. 6 (air)	$1.49*10^{-4}$	0.0596	0.00149

In WC shield, the energy deposited by EMS (electro-magnetic shower) is 1.825GeV and 2.111 GeV through DEX (ionization losses from all charged hadrons and muons).

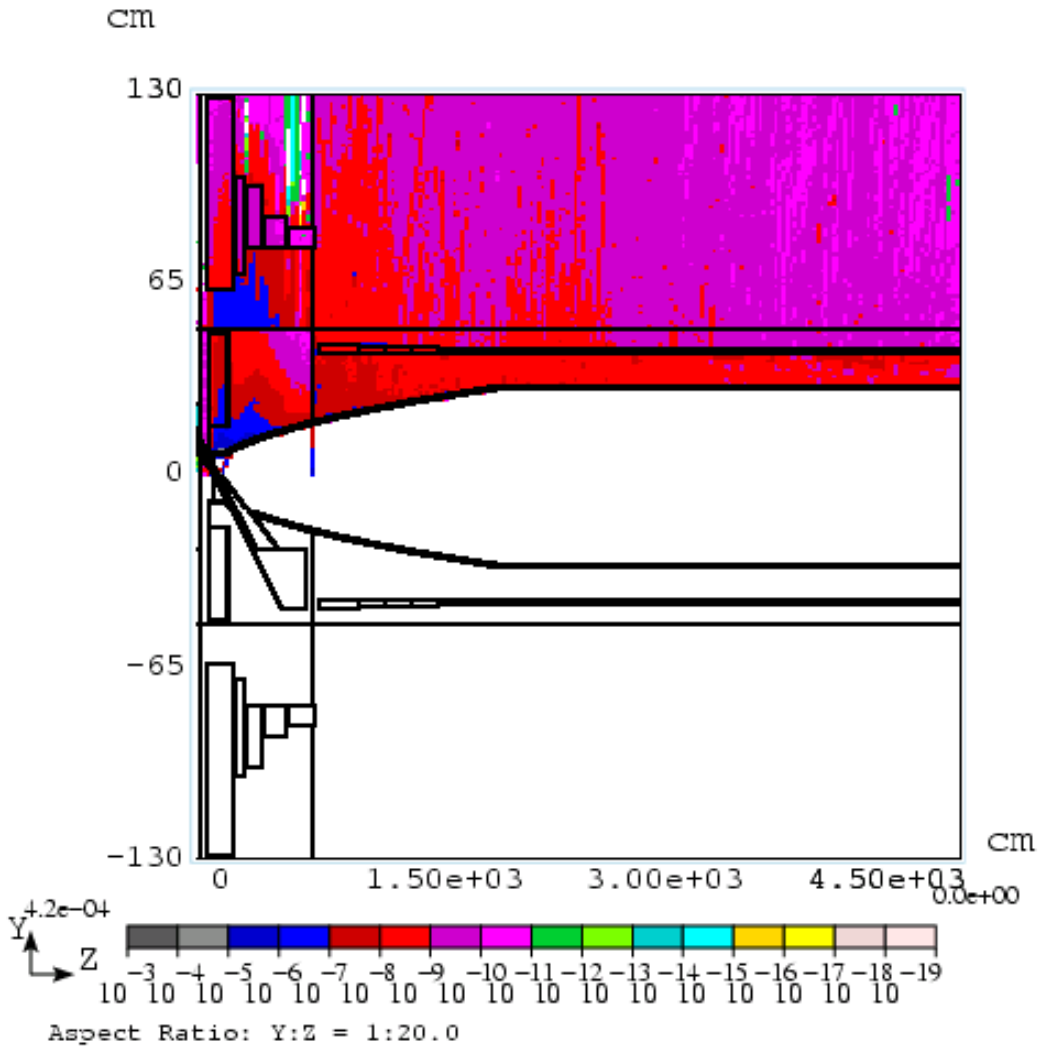
Regional Energy Deposition of 4MW Beam Power

Regional Name	ED [GeV]	P [kW]	P/P_{beam} [%]
Air Gap	$8.731*10^{-6}$	0.0031	~ 0
Pre Trgt	$4.041*10^{-7}$	0.00016	~ 0
Hg Pool	$4.881*10^{-2}$	19.52	0.488
Hg Jet	1.065	426.0	10.65
Be Window	$6.217*10^{-3}$	2.487	0.062
STST Env	1.0772	430.88	10.772
Res Sol	$2.615*10^{-1}$	104.6	2.615
Ceramic	$6.801*10^{-3}$	2.73	0.068
FeCo #1,#2,#3	$2.249*10^{-2}$	8.996	0.225

Regional Energy Deposition of 4MW Beam Power

Regional Name	ED [GeV]	P [kW]	P/P_{beam} [%]
SCSol #1	$5.520*10^{-2}$	22.08	0.552
SCSol #2	$5.988*10^{-3}$	2.3952	0.05988
SCSol #3	$3.304*10^{-3}$	1.3216	0.03304
SCSol #4	$1.186*10^{-3}$	0.4744	0.01186
SCSol #5	$2.871*10^{-4}$	0.11484	0.00287
SCSol #6	$1.980*10^{-4}$	0.0792	0.00198
SCSol #7	$8.702*10^{-3}$	3.4808	0.08702
SCSol #8	$3.708*10^{-3}$	1.4832	0.03708
SCSol #9	$2.181*10^{-3}$	0.8724	0.02181
SCSol #10	$1.809*10^{-3}$	0.7236	0.01809
SCSol #11	$1.330*10^{-3}$	0.532	0.0133
SCSol #12	$8.690*10^{-4}$	0.3476	0.00869
SCSol #13	$6.506*10^{-3}$	2.6024	0.06506

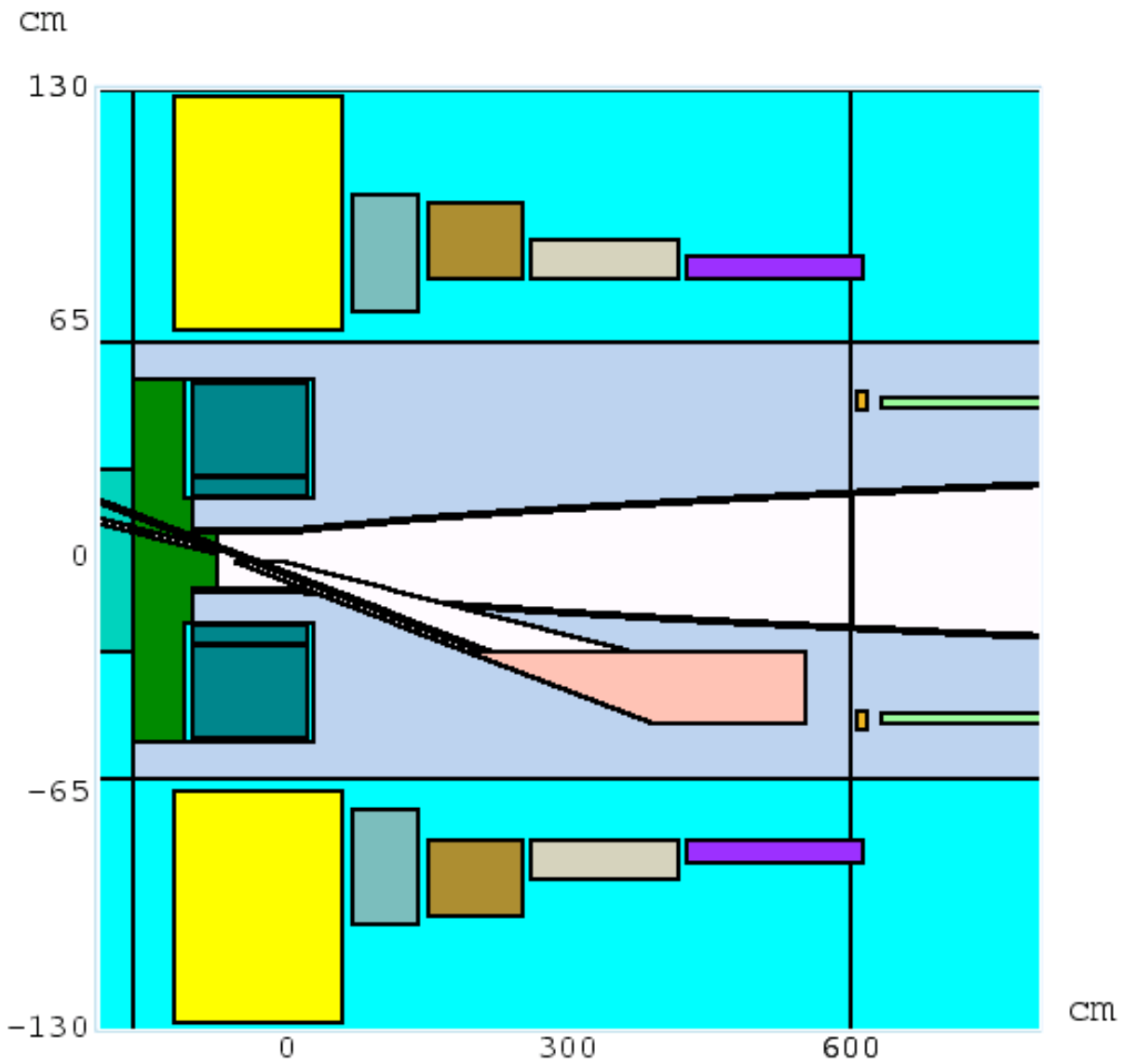
Visual Display of Energy Deposition



The max. energy deposition at the SC coil is 10^{-8} [GeV/g per 1ppp]. So the energy deposition at SC coil is$10^{-8}*(10^{9})*(1.6*10^{-19})*$ $2.5*10^{15}$ [W/g] or 0.004 [W/g].

Enhanced Shield for SC Coils

(No. 1 ,2 and 3 region are extended from R=50 to R=60 cm. WC shield is introduced in No. 3 region.)



Regional Energy Deposition

(4MW beam, enhanced shield)

Regional Name	ED [GeV]	P [kW]	P/P_{beam} [%]
No. 1	0	0	0
No. 2 (WC shield)	4.656	1882.4	46.56
No. 3	$1.05 * 10^{-1}$	42	1.05
No. 4	$2.4 * 10^{-9}$	~ 0	~ 0
No. 5 (air)	$6.04 * 10^{-6}$	~ 0	~ 0
No. 6 (air)	$9.23 * 10^{-8}$	~ 0	~ 0

Regional Energy Deposition

(4MW beam, enhanced shield)

Regional Name	ED [GeV]	P [kW]	P/P_{beam} [%]
Air Gap	$1.184*10^{-8}$	0.0031	~ 0
Pre Trgt	$1.373*10^{-6}$	0.00016	~ 0
Hg Pool	$5.1*10^{-2}$	20.4	0.51
Hg Jet	1.065	426.0	10.65
Be Window	$6.287*10^{-3}$	2.515	0.063
STST Env	1.072	428.8	10.72
Res Sol	$2.602*10^{-1}$	104.1	2.602
Ceramic	$6.507*10^{-3}$	2.603	0.065
FeCo #1,#2,#3	$2.068*10^{-2}$	8.272	0.207

Regional Energy Deposition

(4MW beam, enhanced shield)

Regional Name	ED [GeV]	P [kW]	P/P_{beam} [%]
SCSol #1	$2.379*10^{-2}$	9.516	0.2379
SCSol #2	$2.025*10^{-3}$	0.81	0.0203
SCSol #3	$1.339*10^{-3}$	0.5356	0.0134
SCSol #4	$4.212*10^{-4}$	0.1685	0.0042
SCSol #5	$1.028*10^{-4}$	0.0411	0.0010
SCSol #6	$4.208*10^{-6}$	0.0017	~ 0
SCSol #7	$7.835*10^{-5}$	0.0031	0.0008
SCSol #8	$6.482*10^{-5}$	0.0026	0.0007
SCSol #9	$3.758*10^{-5}$	0.0015	0.0004
SCSol #10	$3.213*10^{-5}$	0.0013	0.0003
SCSol #11	$3.460*10^{-5}$	0.0013	0.0003
SCSol #12	$2.189*10^{-5}$	0.0009	0.0002
SCSol #13	$2.153*10^{-4}$	0.0086	0.0022