Target System Update

IDS-NF Plenary Meeting

Arlington, VA

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BROOKHAVEN NATIONAL LABORATORY

Harold G. Kirk
Brookhaven National Laboratory

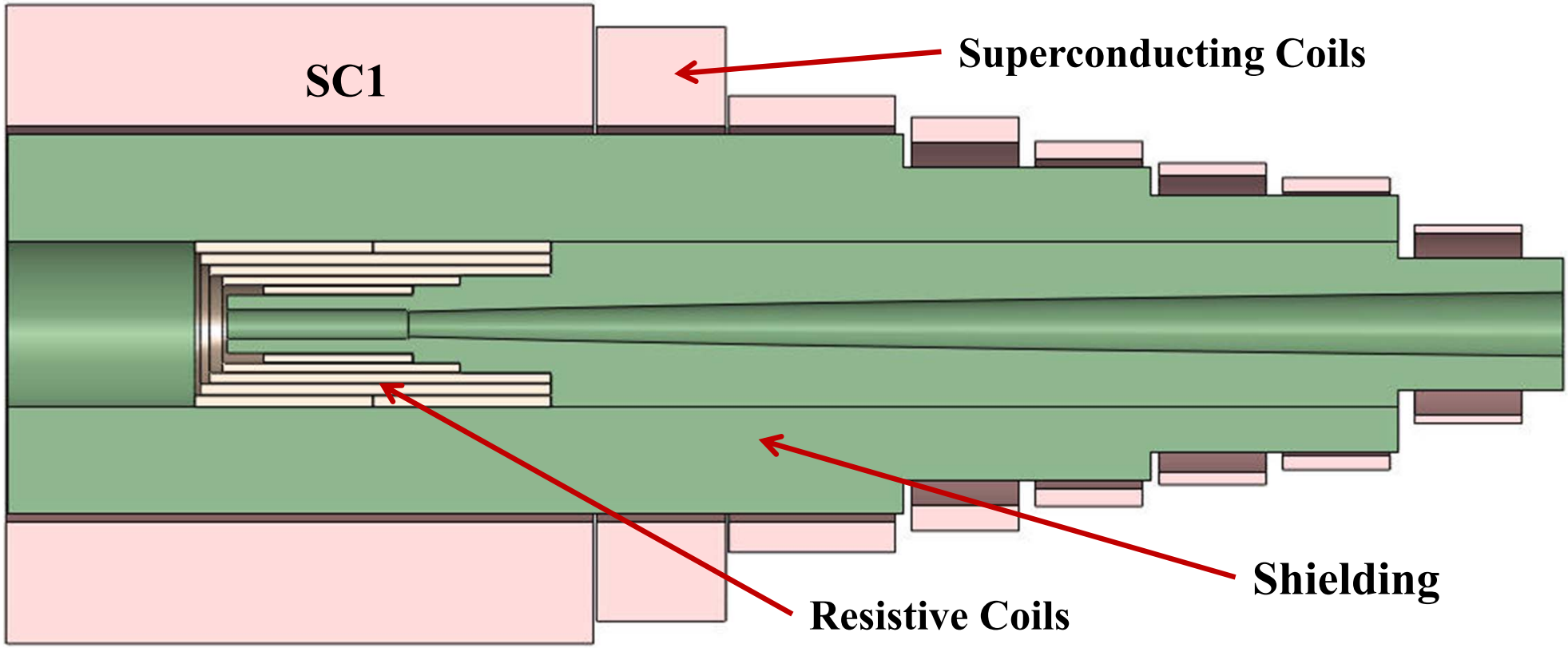
Target Baseline: Proton Beam Assumptions

Proton Beam Energy	**8 GeV**
Rep Rate	**50 Hz**
Bunch Structure	**3 bunches, 240 μsec total**
Bunch Width	**2 ± 1 ns**
Beam Radius	**1.2 mm (rms)**
Beam β^*	**≥ 30 cm**
Beam Power	**4 MW (3.125×10^{15} protons/sec)**

Target System Baseline

Target type	Free mercury jet
Jet diameter	8 mm
Jet velocity	20 m/s
Jet/Solenoid Axis Angle	96 mrad
Proton Beam/Solenoid Axis Angle	96 mrad
Proton Beam/Jet Angle	27 mrad
Capture Solenoid Field Strength	20 T

Coil and Shielding Concept (IDS120h)

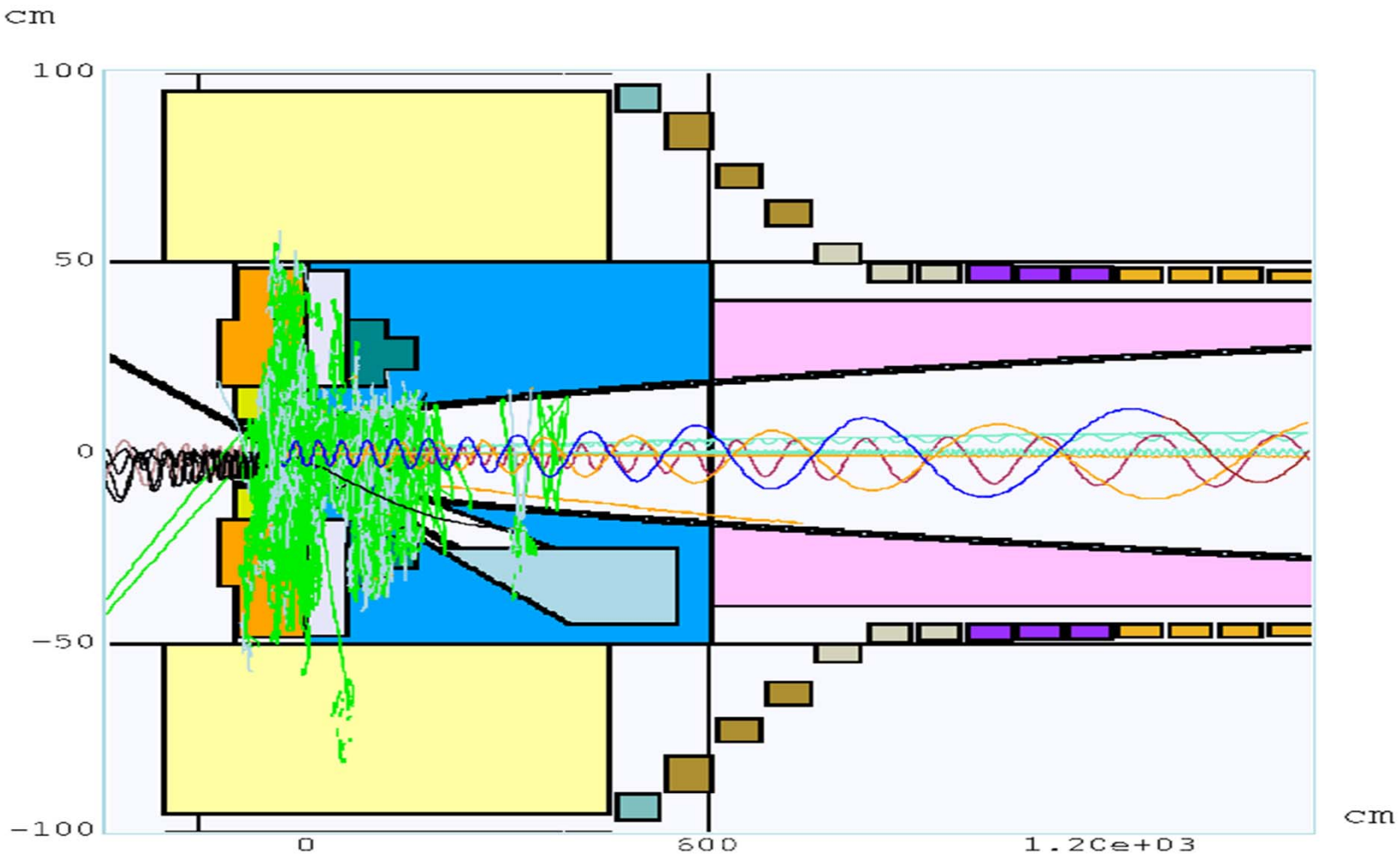


Key Parameters: SC1 IR = 120 cm Stored Energy 3 GJ

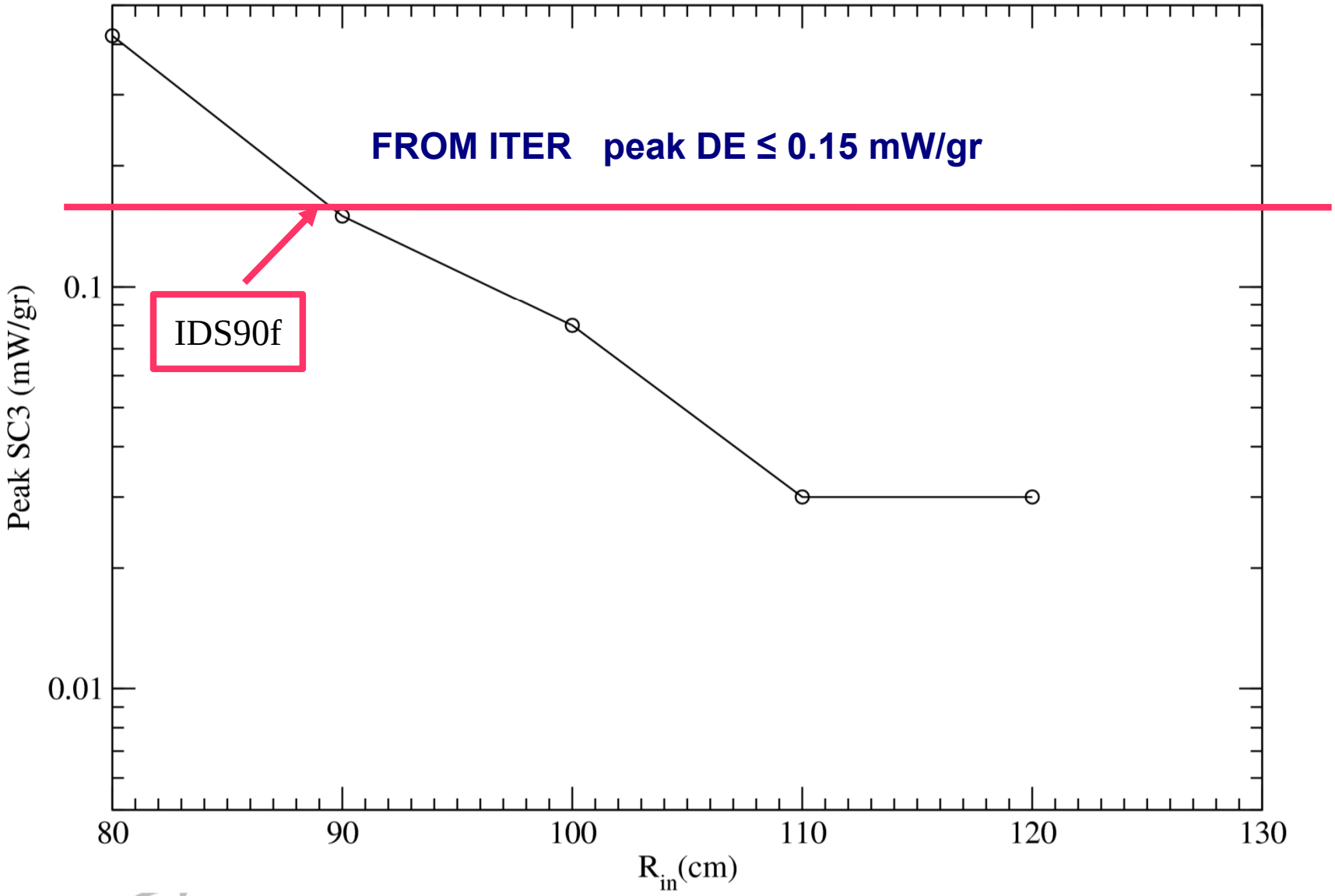
B = 20 T

Secondary Particle Production

Black=p, Green=n, Red/Blue=$\pi^{\pm}$, Orange/Turquoise=$e^{\pm}$, Gray=γ.



PEAK ENERGY DEPOSITION (mW/g)



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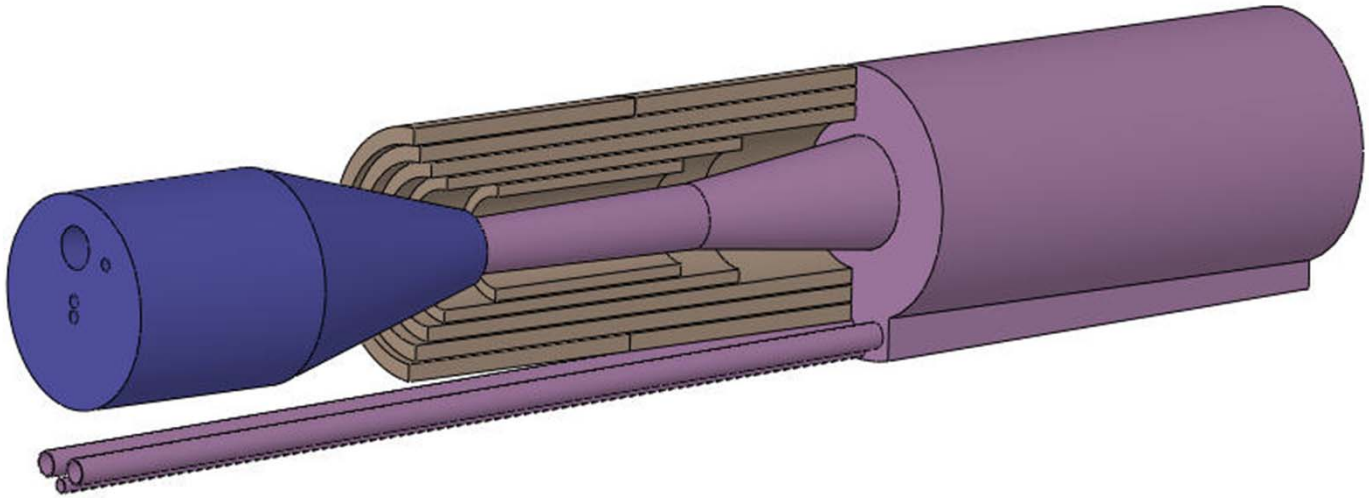
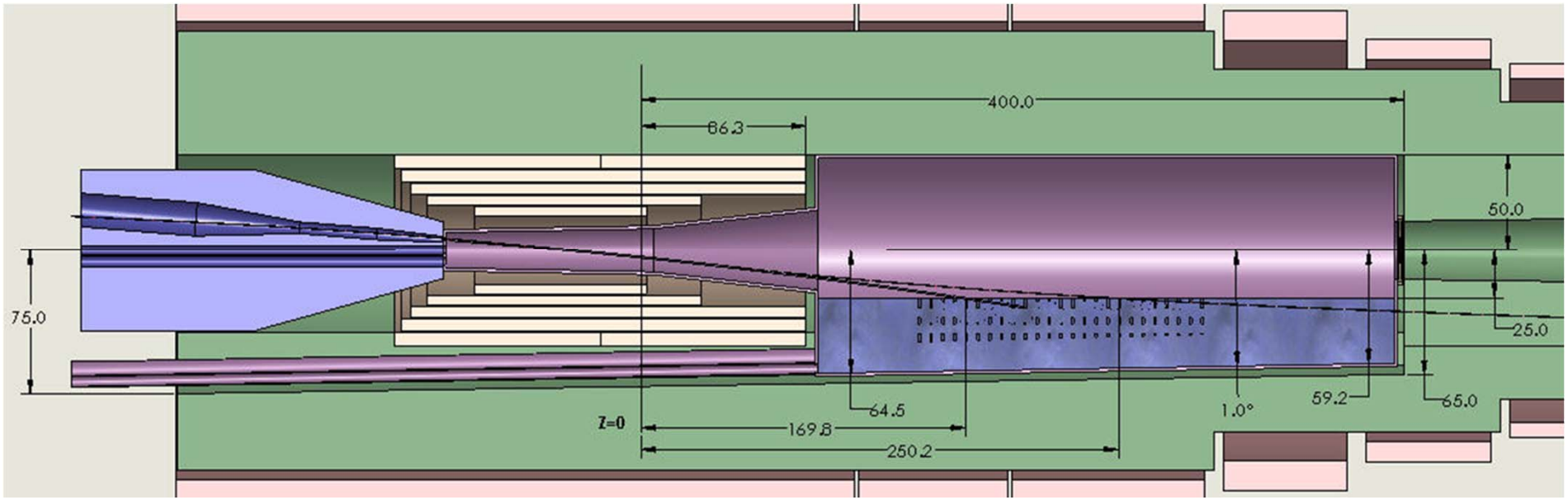
The Target Module Concept – V. Graves



Target Module consists of:

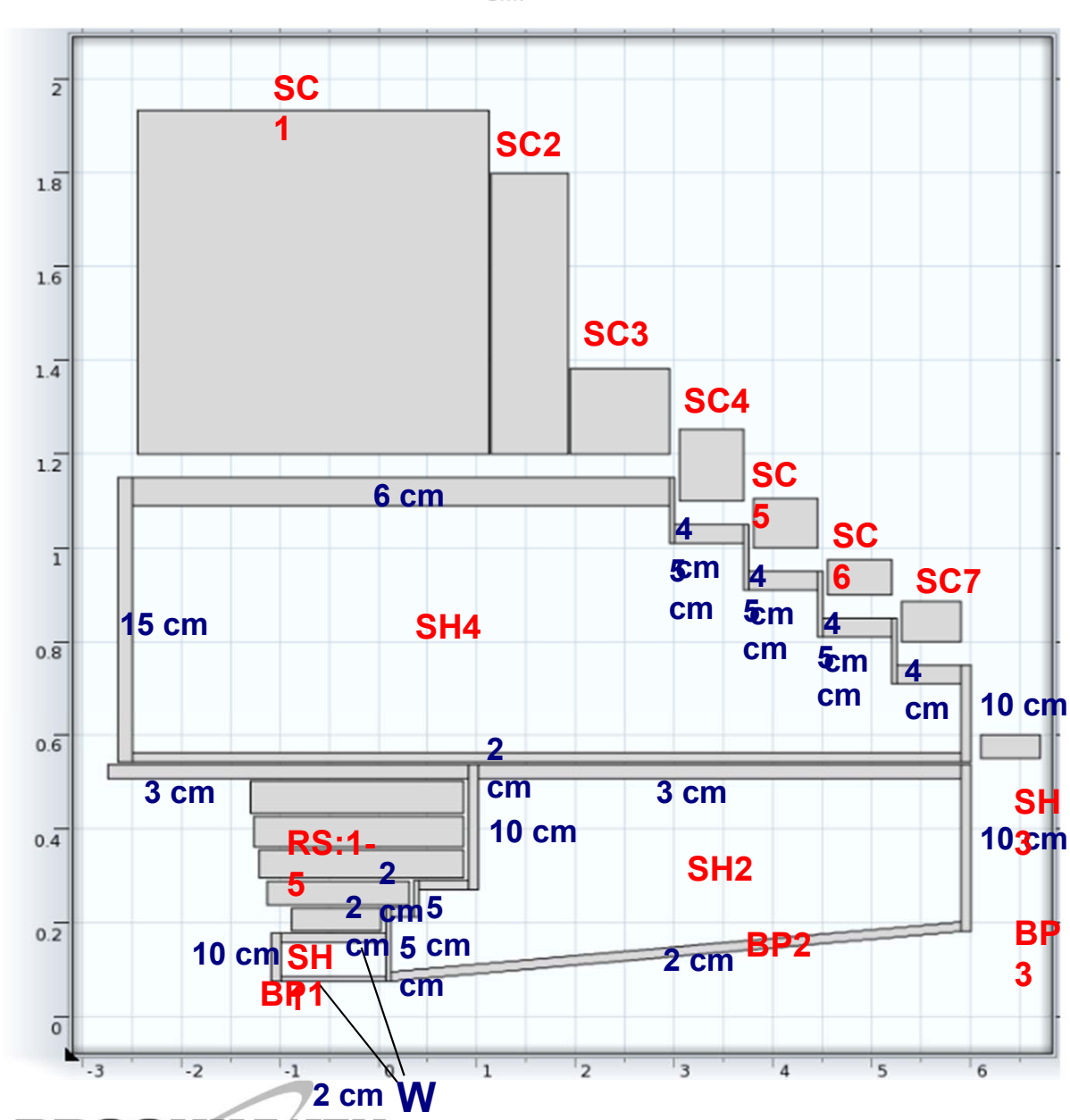
- **Beam/Jet Delivery Cartridge**
- **Resistive Coil Package**
- **Primary Containment Vessel**
- **Hg Collection/Beam Dump**

Inserting the Hg System – V. Graves, ORNL



Dimensions in cm

Shielding Studies: Bob Weggel, N. Souchlas



BEAM PIPES

BP1: Surrounding Target
BP2/BP3: Field Taper Section

5 cm gap between vessels and SC coils reserved for cryogenic shields

SHIELFONG VOLUMES

SH1: Surrounding Target
SH2, 3: Surrounding Decay Pipe
SH4: Inside SC Coils SC1-7

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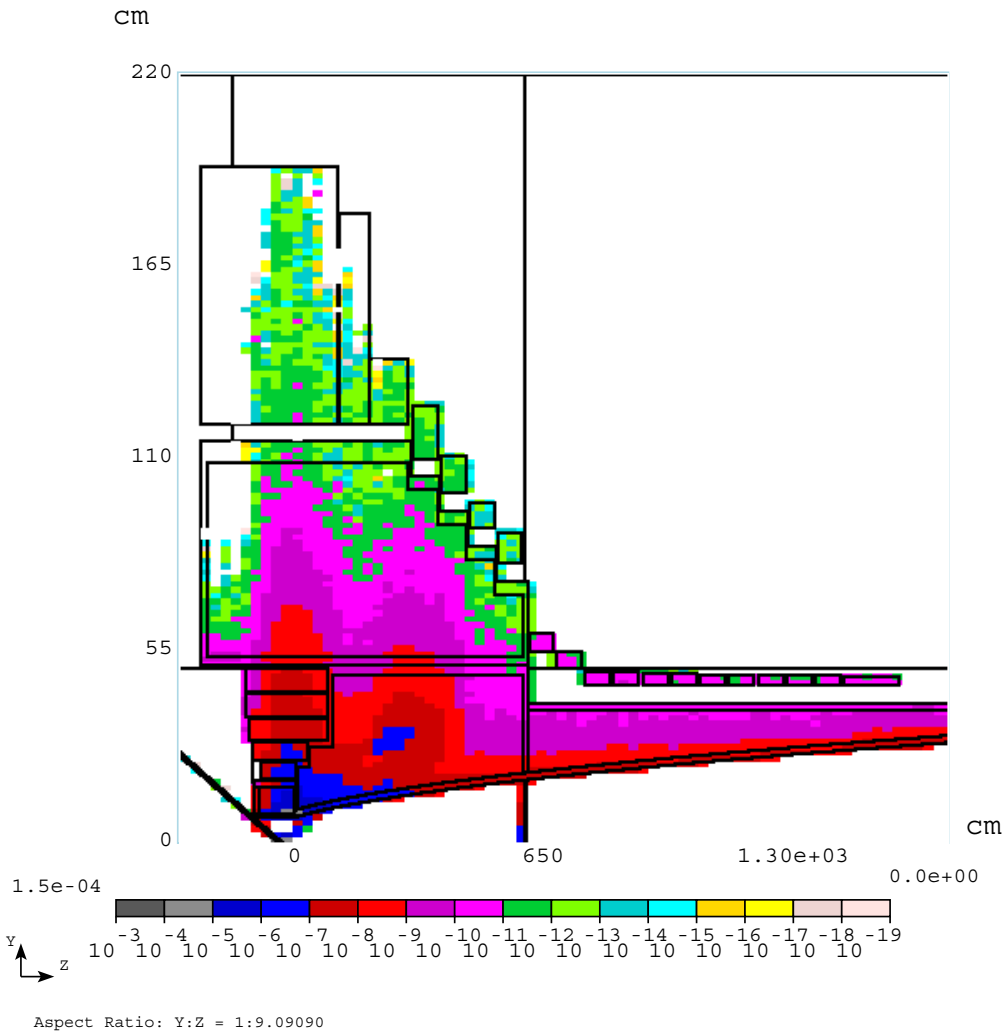
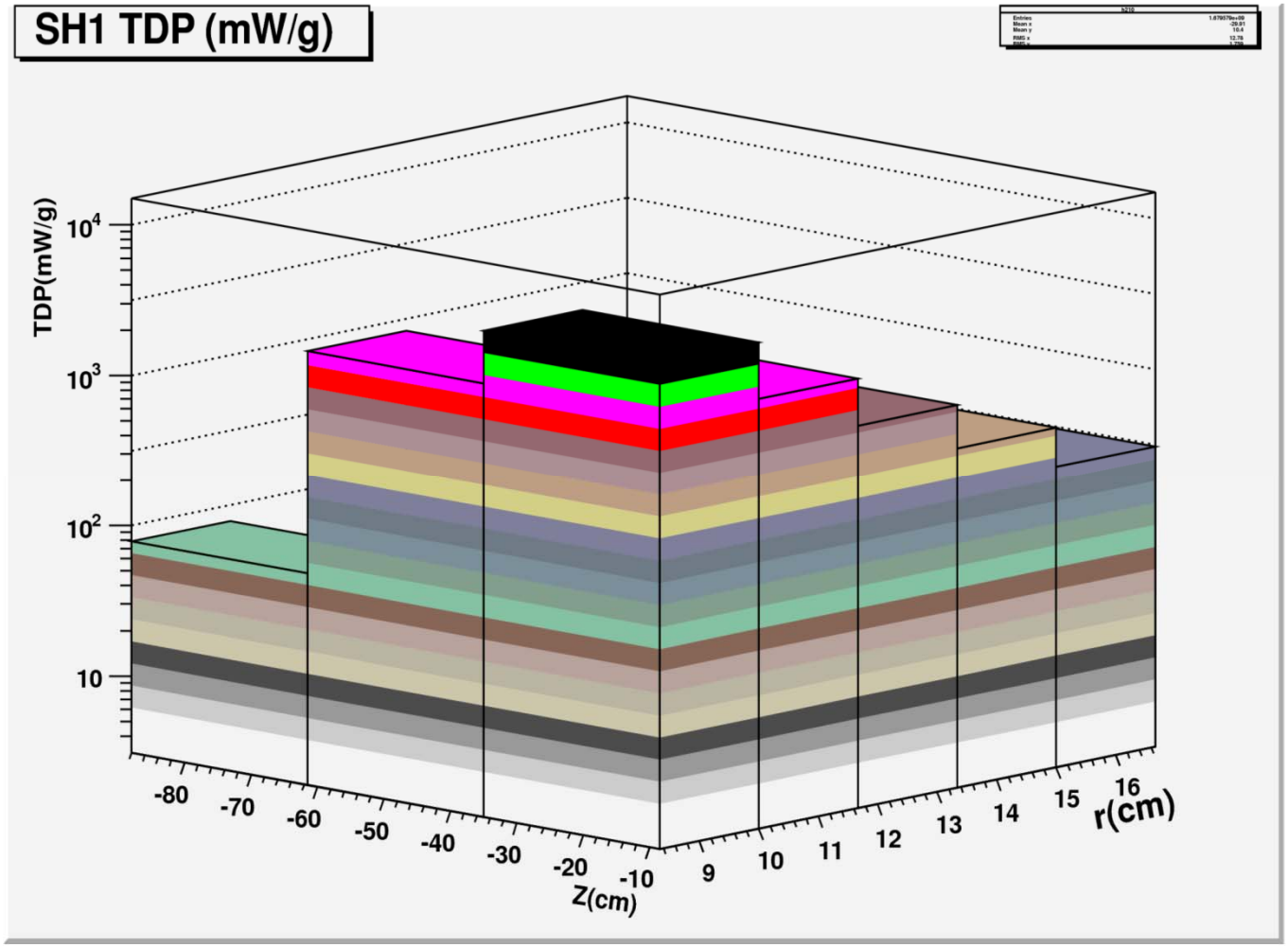
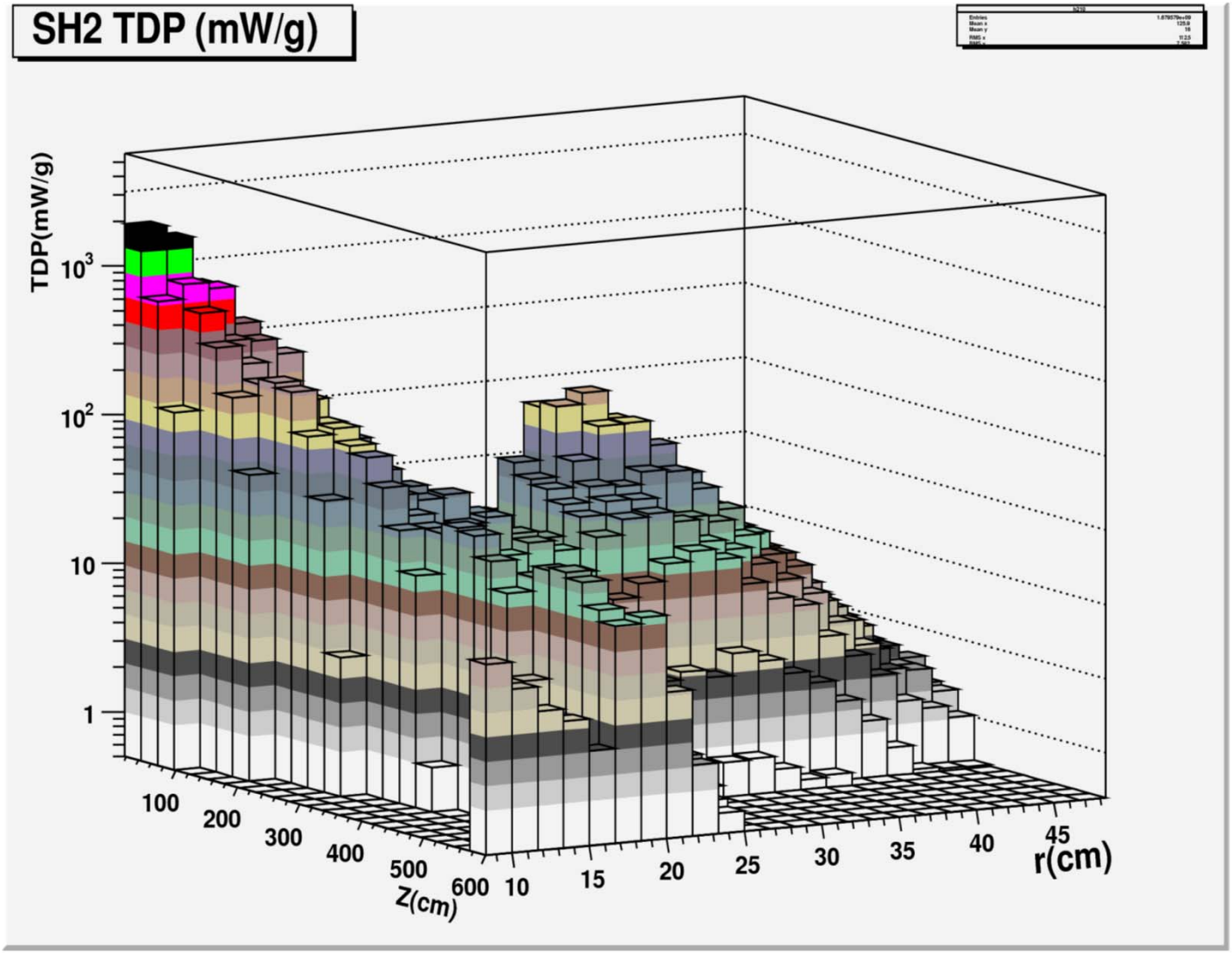
Energy Deposition (N. Souchlas)



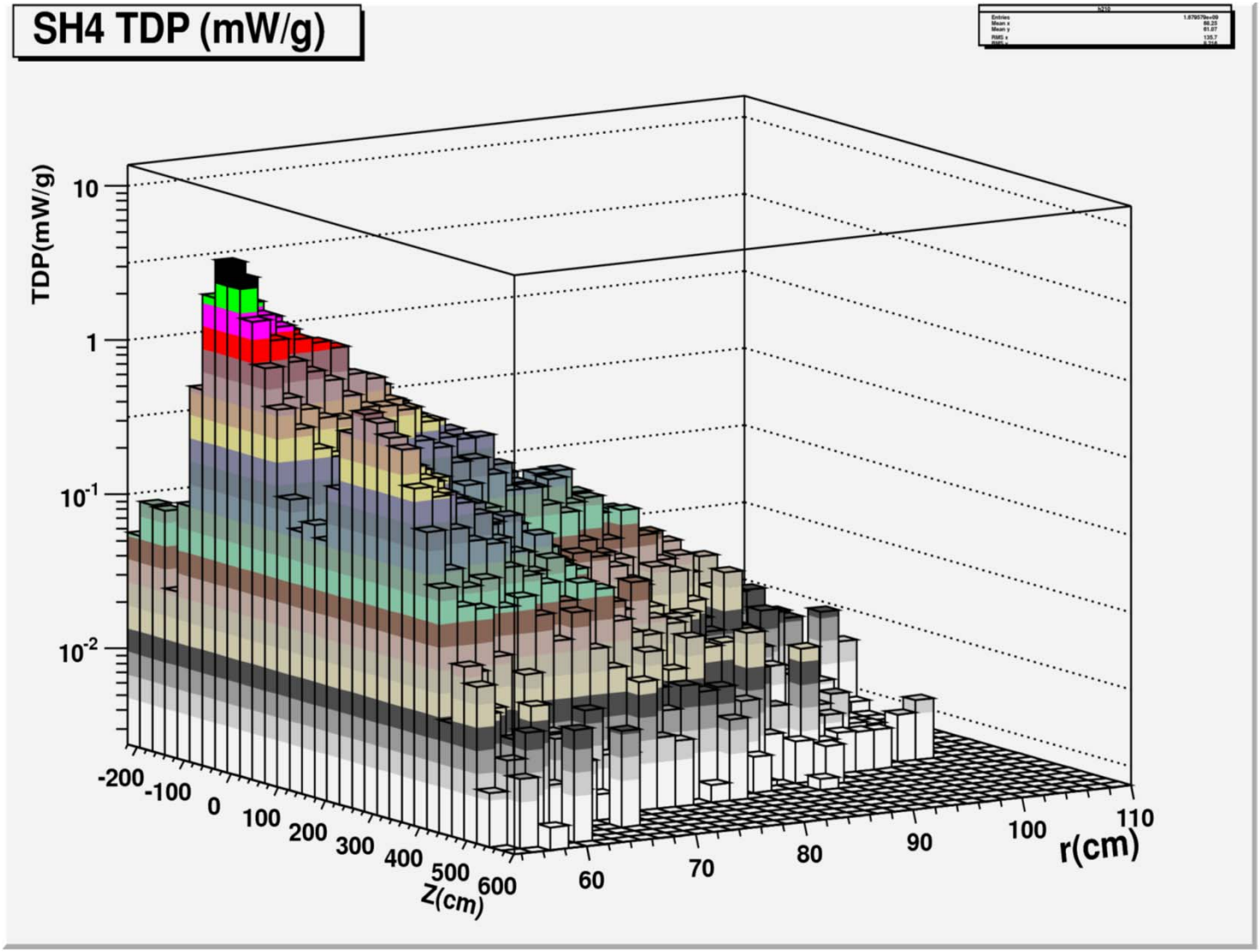
SH1 Peak Energy Deposition 5 W/g



SH2 Peak Energy Deposition 2 W/g



SH4 Peak Energy Deposition 5 mW/g



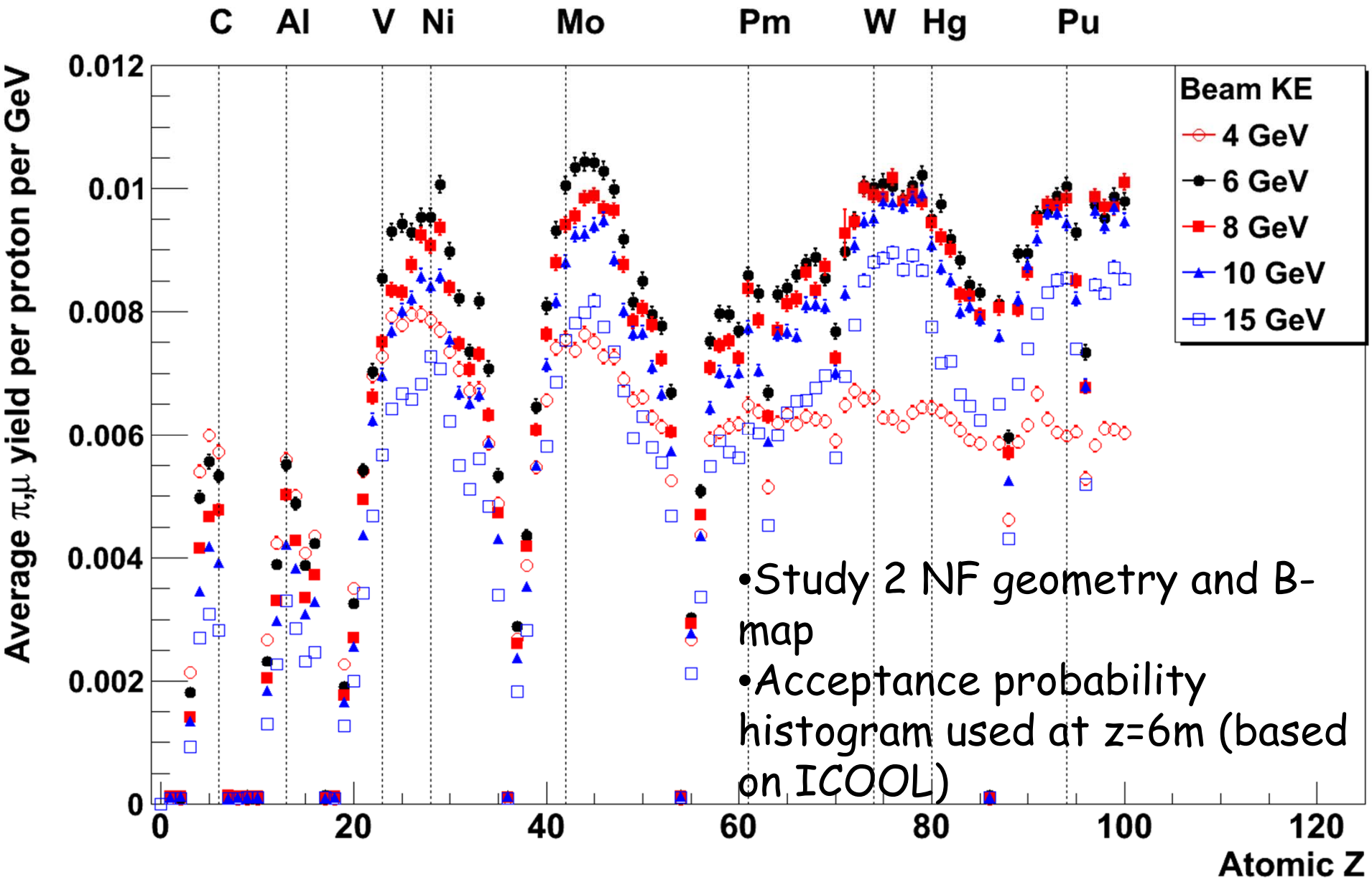
Shielding Cooling Scenario - Bob Weggel

Current Baseline: 60% WC beads + 40% H_2O

Evaluate gas cooling—then can consider W instead of WC

	V(%)	v(m/s)	Press. Drop (atmos)	
SF_6	5.8	55	0.4	
Air	7.9	140	0.4	
H_2	12.0	190	0.1	
Ar	10,4	130	0.4	
He	12.0	190	0.1	
Hg	6.9	4.5		(If Hg is considered)

Pion/muon yields for different atomic Z's and beam energies (J.Back)



What about Gallium?

Ga (Z=31) is near the Cu (Z=29) peak.

Gallium is a metal (chemically like Al)

Physical Properties:

ρ = 6.1 g/cm^3 (as a liquid)

Melting Point = 29.8^0 C

Boiling Point = 2403^0 C

Optimized Target Geometry –X. Ding

Gallium

r = 4.2cm

Beam angle = 77 mrad

Beam/Jet crossing angle = 9 mrad

Meson Production: 15% less than Hg

Targetry Tasks for 2012

In progress

- Iterate Coils/Shielding configuration
- Design Hg Handling System
- Finalize Coil/Shielding Configuration

What needs yet to be done before costing exercise

- Define Beam Windows (Up and Down Stream)
- Define Remote Handling System
- Define Target Hall configuration

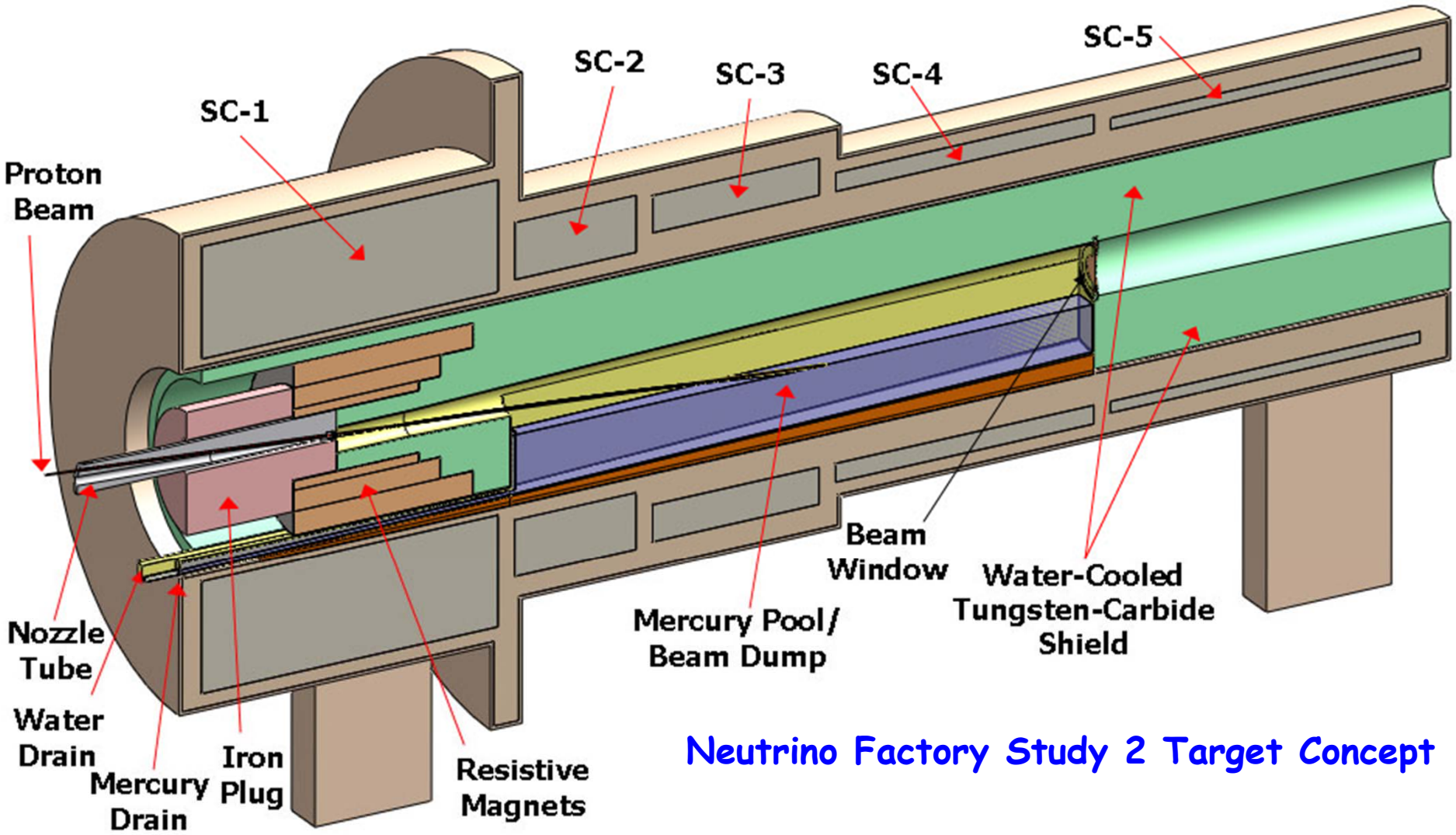
Begin Costing (July 2012)

SUMMARY

- Coil configuration baseline is IDS120h
- Baseline shielding is 60% WC + 40% H_2O
- Current target activities focus on:
  - Establishing a Hg system configuration
  - Establish a thermal management shielding scenario (gas cooling is being considered)
- We are exploring Ga as a possible target alternative

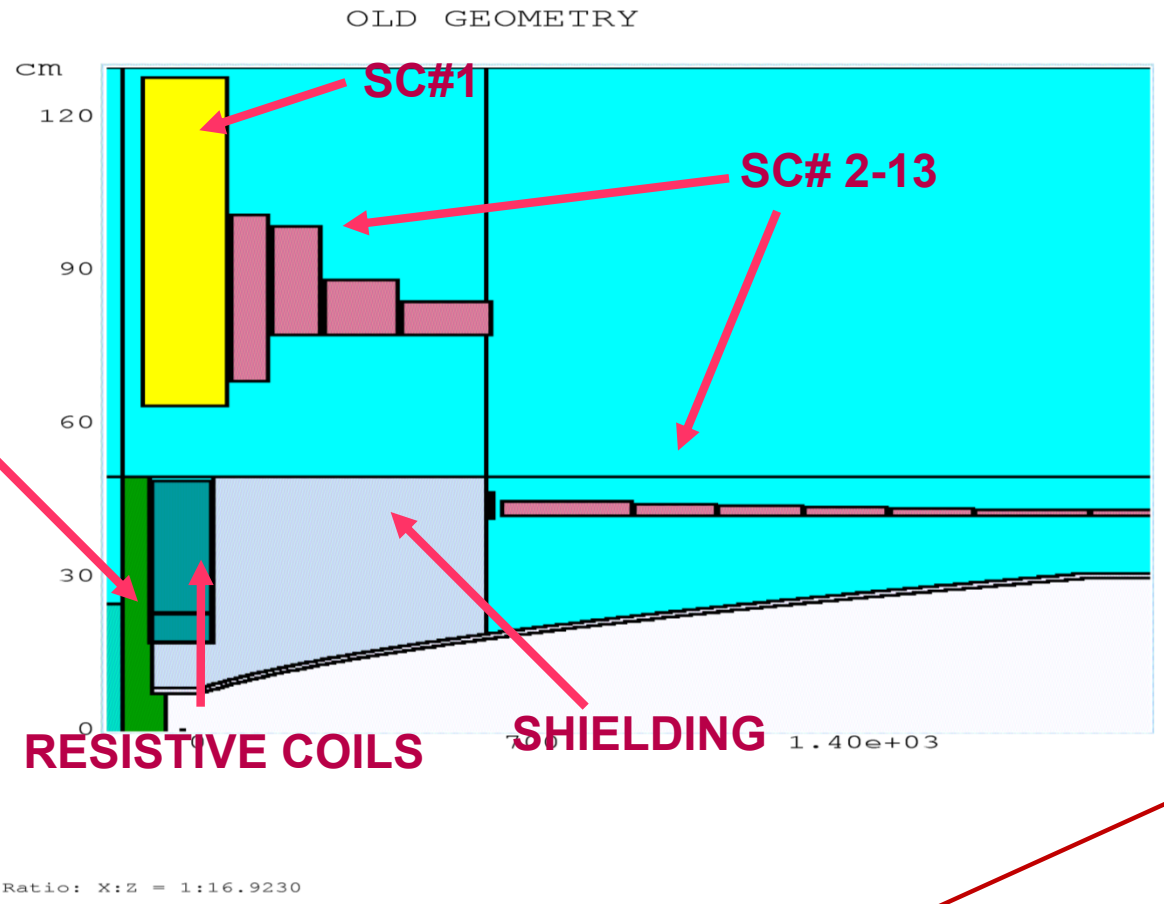
Backup Slides

The Study 2 Target System



Neutrino Factory Study 2 Target Concept

STUDY II SOLENOID GEOMETRY

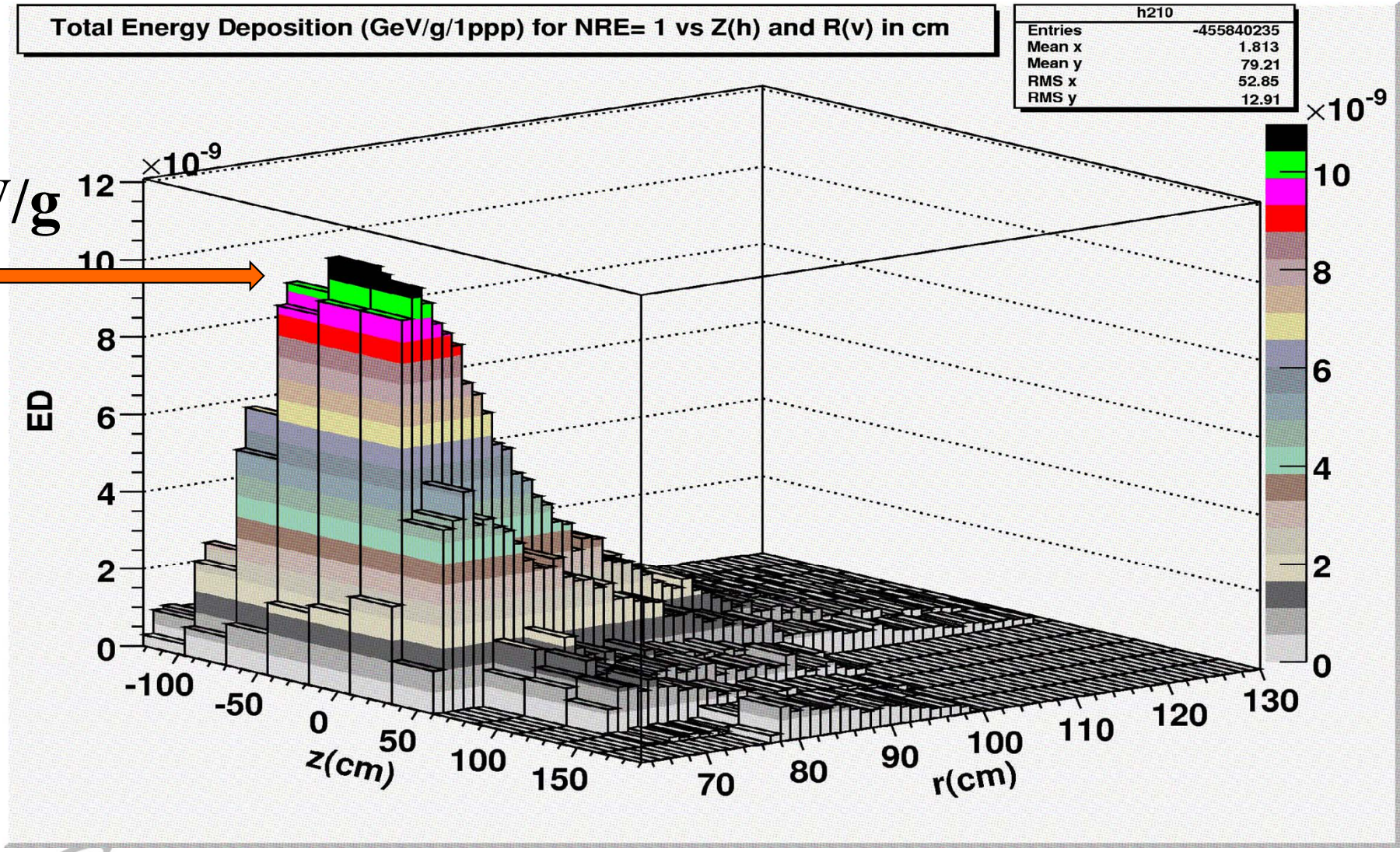


SC #1 IR

SC#1 -120<z<57.8 cm R_{in}=63.3 cm R_{out}=127.8 cm
SC#2 67.8<z<140.7 cm R_{in}=68.6 cm R_{out}=101.1 cm
SC#6-13 632.5<z<218.7 cm R_{in}=42.2 cm R_{out}=45.1-->43.4 cm (TOTAL # SC=13)

Peak Energy Deposition

5.5 mW/g



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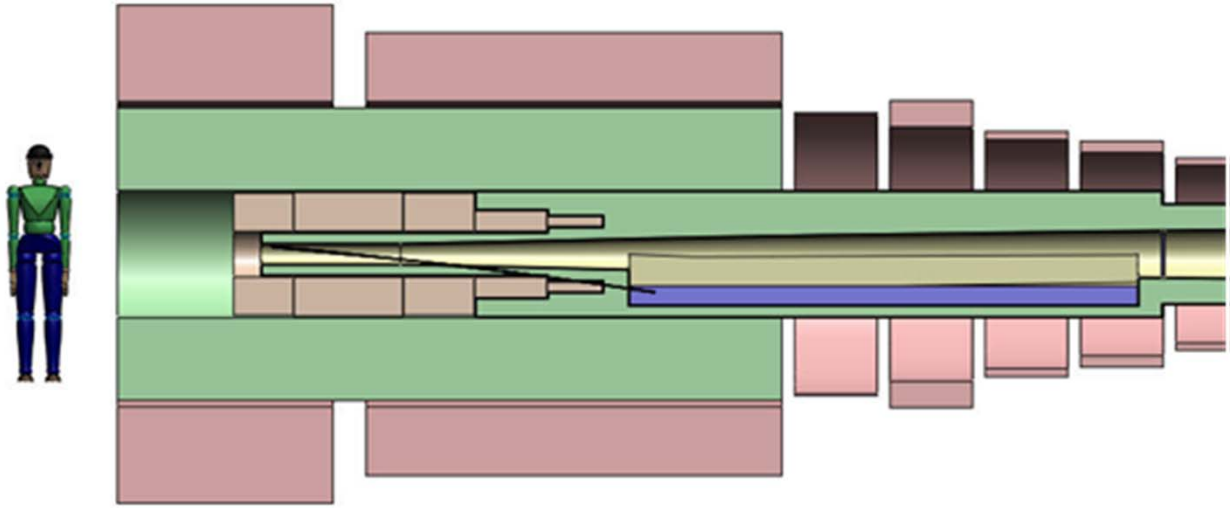
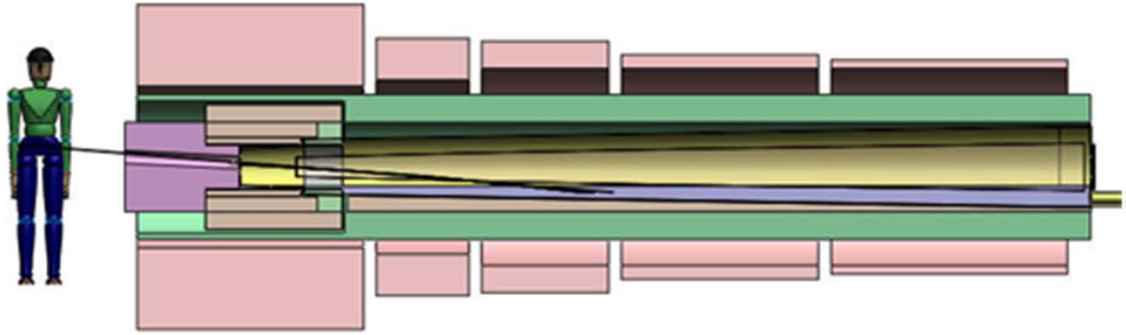
ITER Limit: 1m W/cc → 0.15 mW/g

Capture Systems Comparisons

IDS-120



Study 2



Key Target Challenges

General Target Issues

- Thermal management (~3 MW power deposited)
- Shielding (SC solenoids required)
- Target integrity (thermal shock)
- Target regeneration (50 Hz rep-rate)
- 20T environment

Liquid Hg specific issues

- Stable fluid flow (Nnzzle performance)
- Hg handling system