Energy deposition on secondary collimators at IR7

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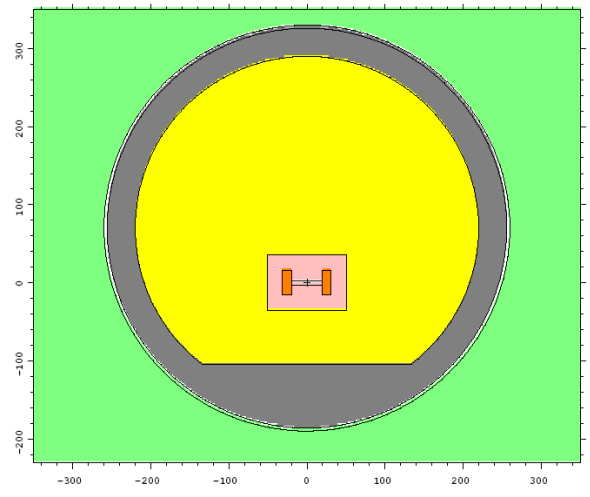
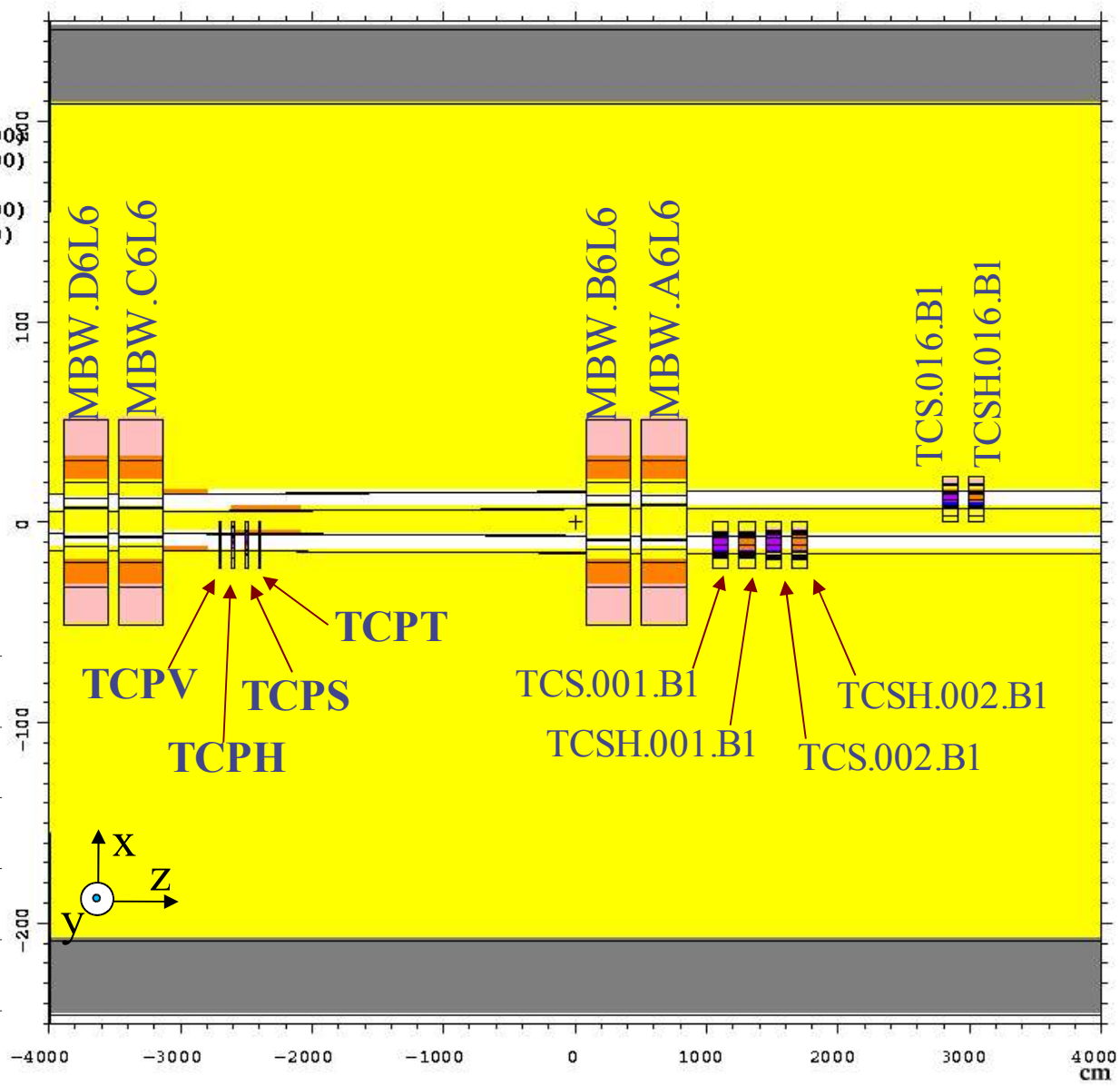
CERN Fri 6/2/2004

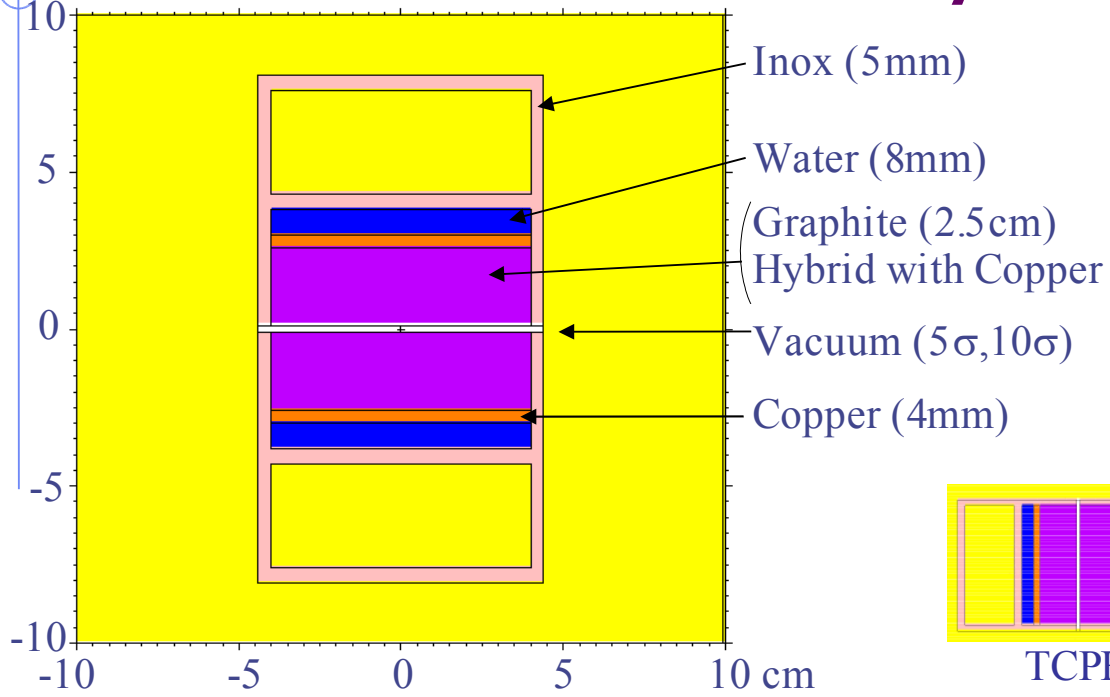
IR7 Geometry

```
  01/05/04 11:39:28
IR7 LHC Collimator - energy
 deposition on secondary
 collimators
probid =   01/05/04 11:39:26
basis:
( 0.000000, 0.000000, 1.000000)
( 1.000000, 0.000000, 0.000000)
origin:
(     0.00,     0.00, 37000.00)
extent = (  4000.00,   250.00)
```

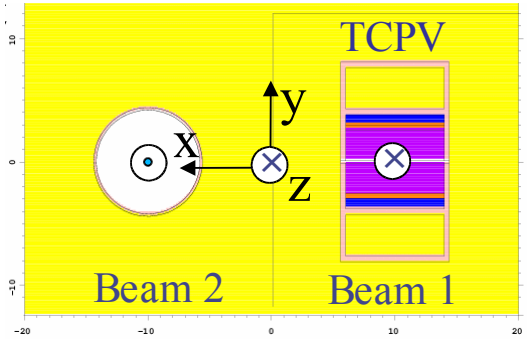




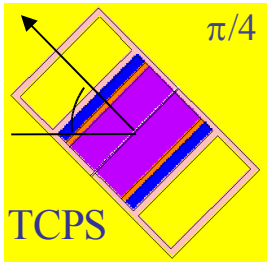
Collimator Geometry

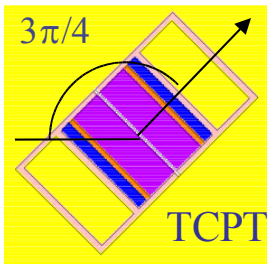


Primary Collimators



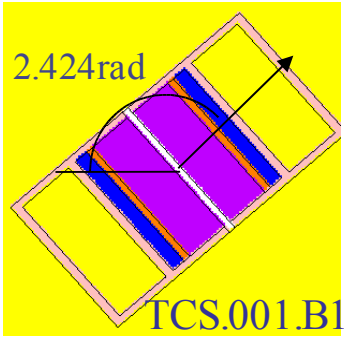
TCPH

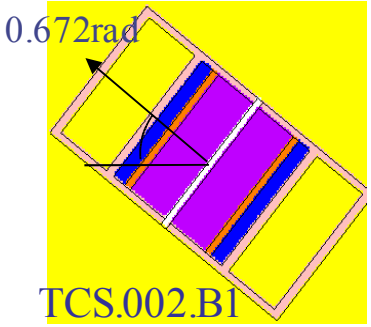




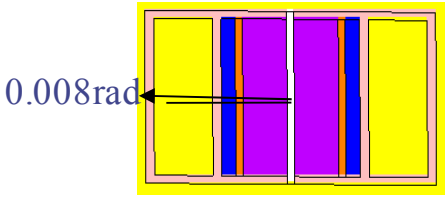
Length 20 cm

Secondary Collimators



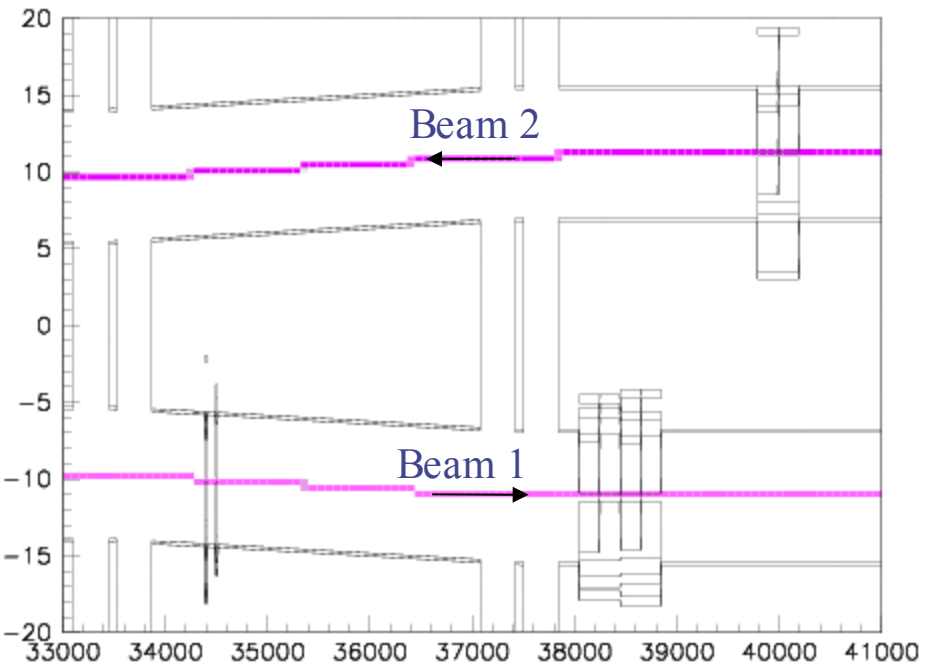


Length 120 cm



Other items

- **Beam Tube**
  - Material: Copper
  - Inner radius: 4.2 cm
  - Outer radius: 4.4 cm
  - Inside MBW
    - R_{in}: 2.6 cm
    - R_{out}: 2.4 cm
- **Dogleg Bends**
  - Modules: 4
    - MBW.A6L7
    - MBW.B6L7
    - MBW.C6L7
    - MBW.D6L7
  - Dimensions: 1.00 x 0.7 x 3.4m^3
  - Aperture: 52mm
  - Magnetic Field: 1.287 T
  - Kick angle: 0.38 mrad



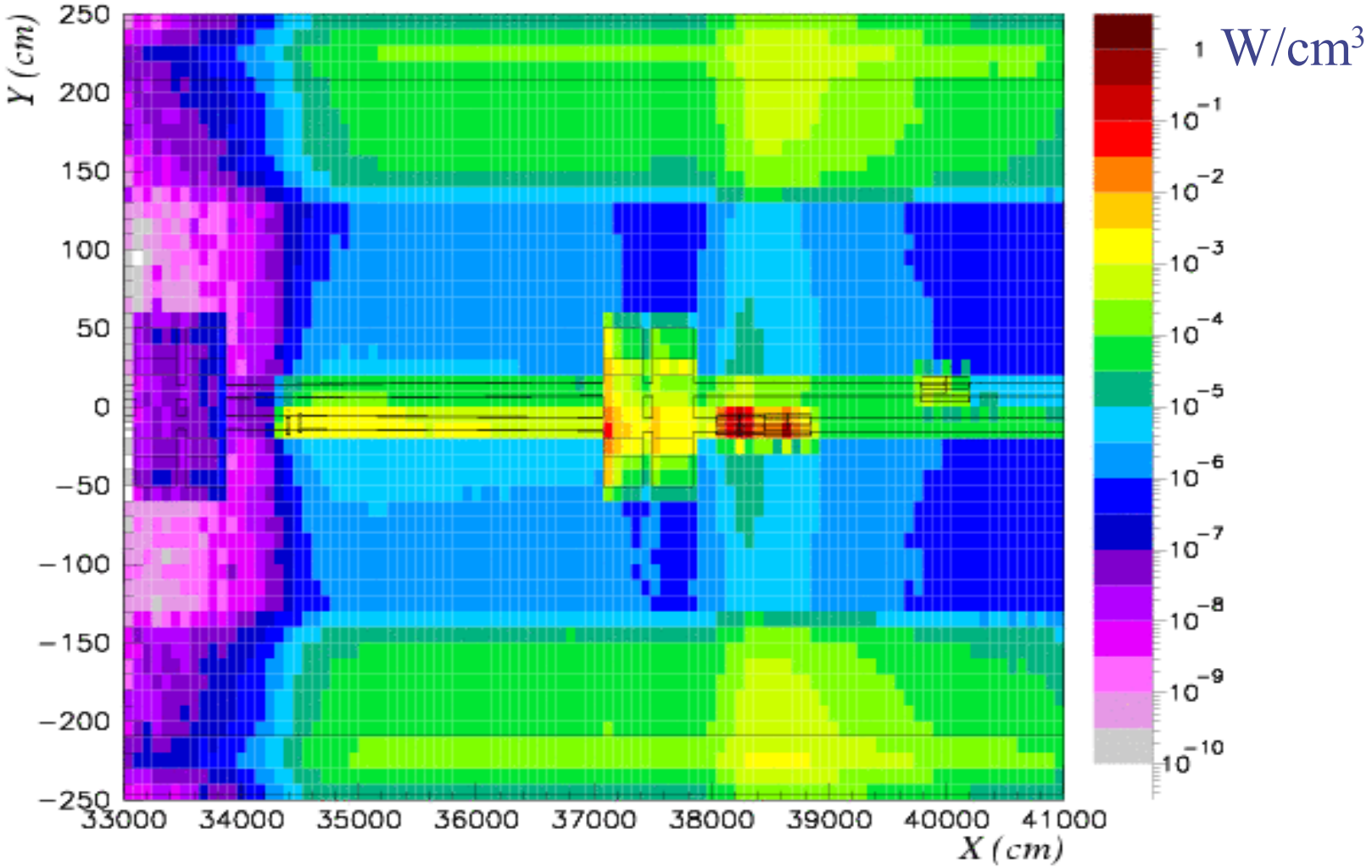
Cases Studied

- Proton beam:
  - Momentum 7 TeV/c
  - Impact parameter: 200nm
  - Pencil-beam on Primaries 1cm before the end (misaligned ~25 urad)
  - Pencil-beam on Secondaries at the front face (perfectly aligned)
- 1st phase system (no hybrid collimators)
  - Results are weighted with the loss maps provided by R.Assmann for 3 cases

Case	Div.x [urad]	Div.y [urad]	Aperture [mm]
TCP1 $\theta=\pi/2$	0	17	1.22
TCP2 $\theta=0$	-22.44	0	1.63
TCP1 $\theta=3\pi/2$	-15.79	12.39	1.44

- 2nd phase system (with hybrid collimators)

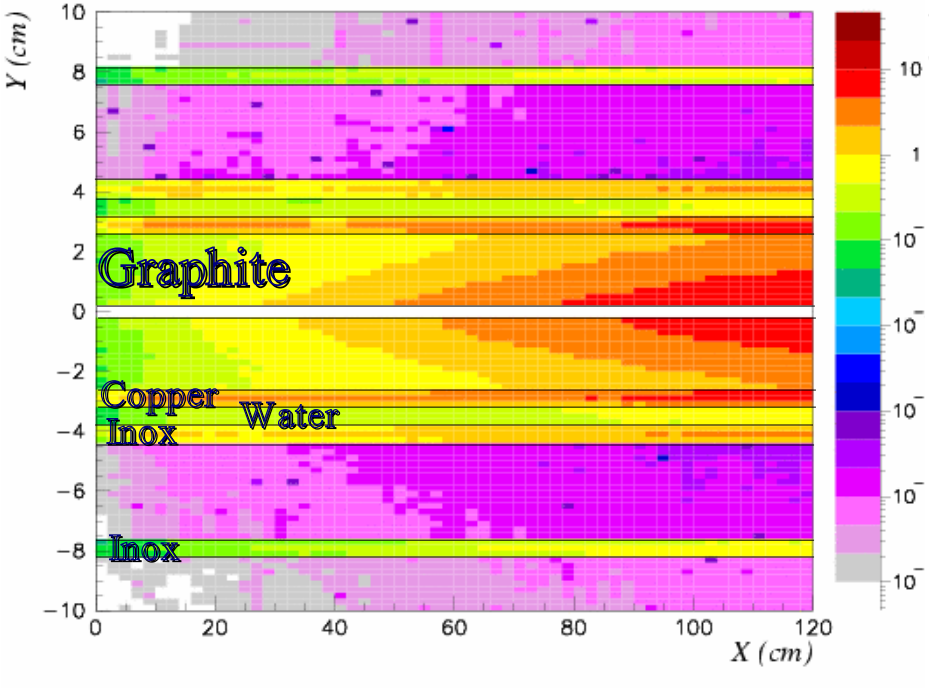
TCPV - Energy deposition

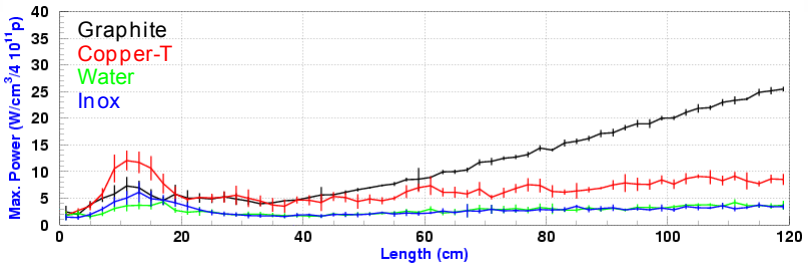


Average energy deposition per 4 10^{11}p/s on tunnel and beam elements for -1 < Y < 1m

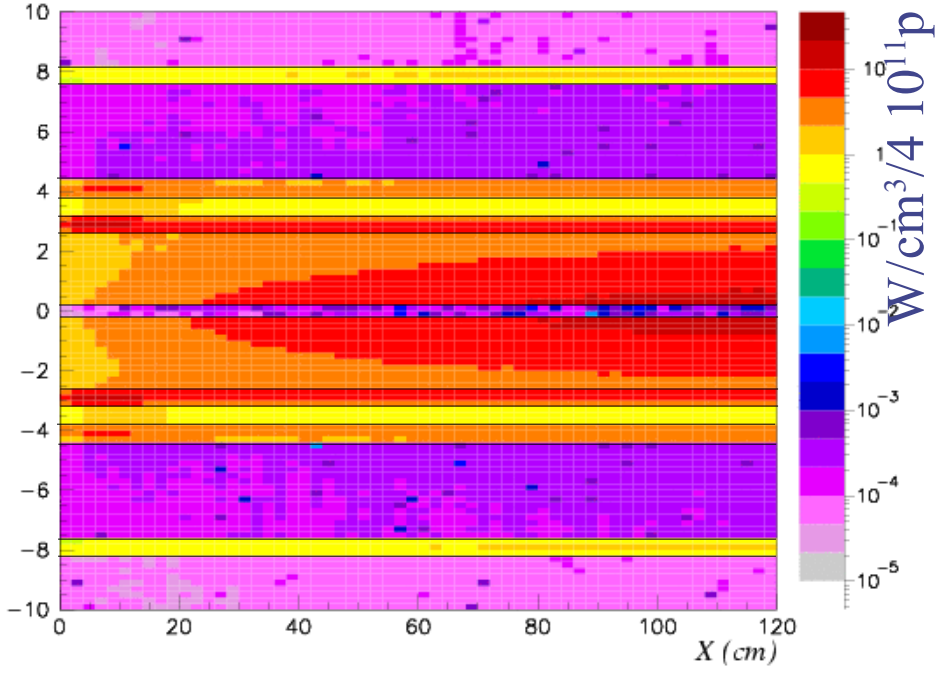
Phase #1: Case TCP1

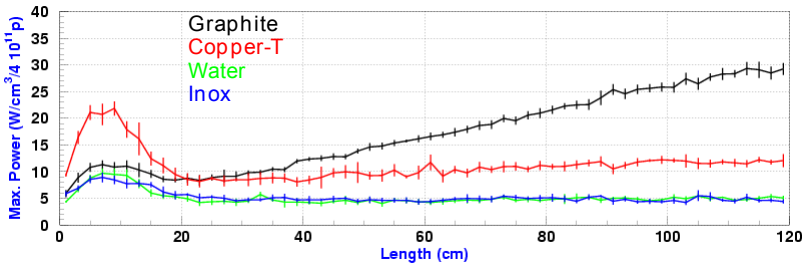
TCS.001.B1





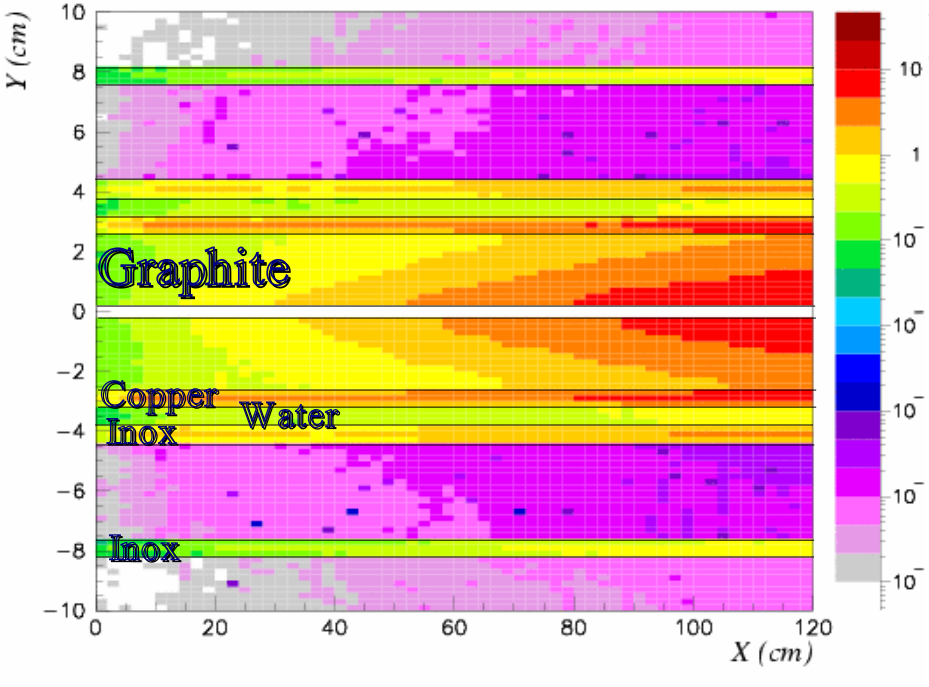
TCS.002.B1





Phase #1: Case TCP2

TCS.001.B1



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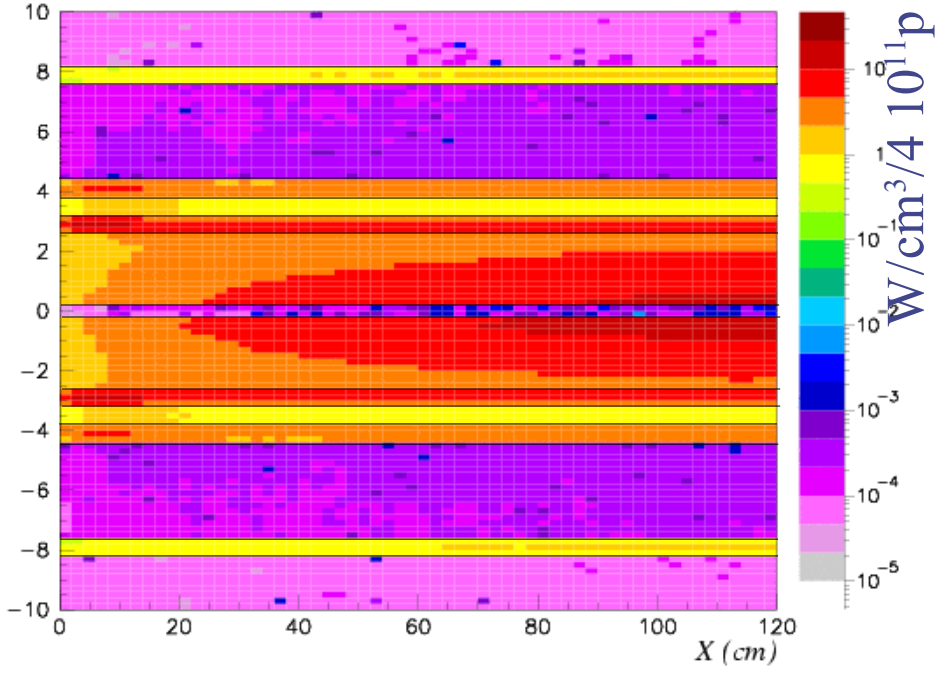
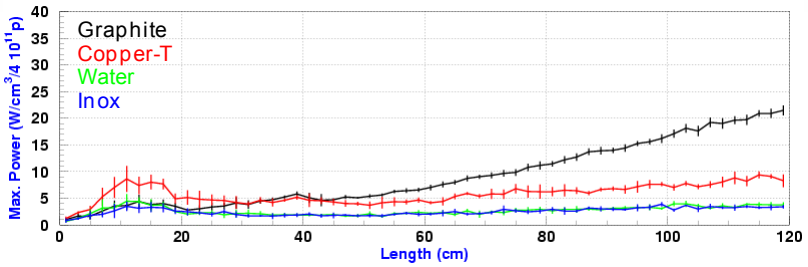
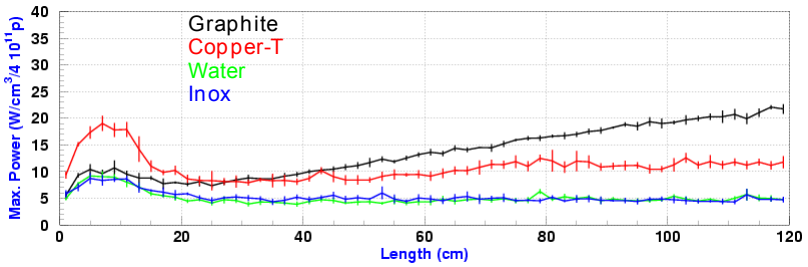
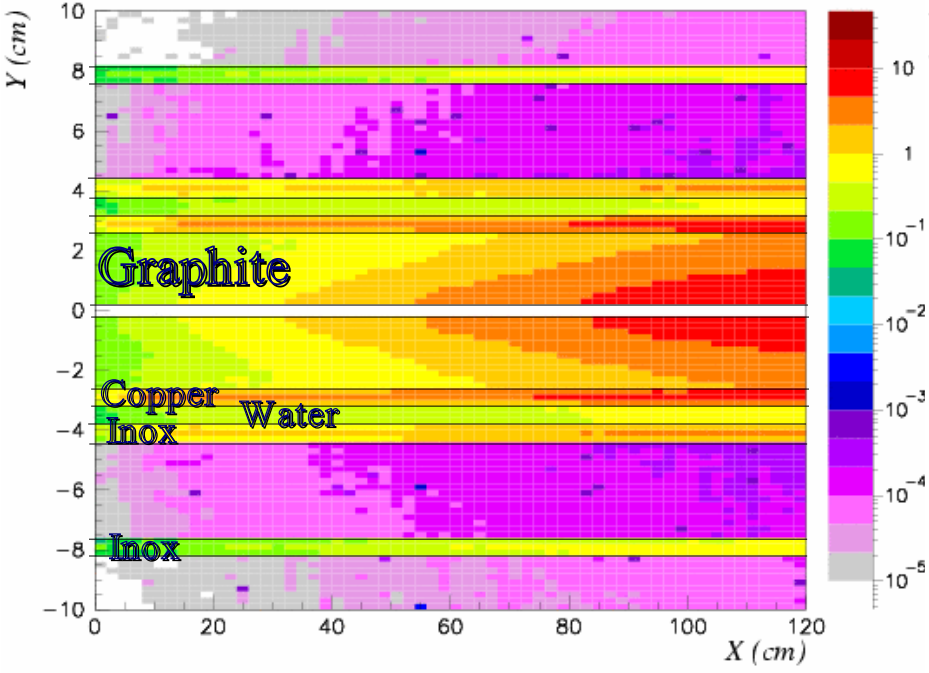


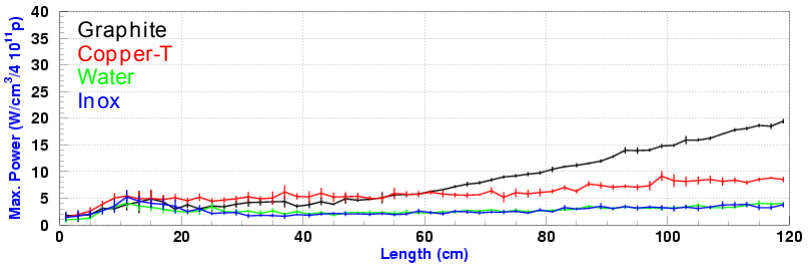




Phase #1: Case TCP3

TCS.001.B1





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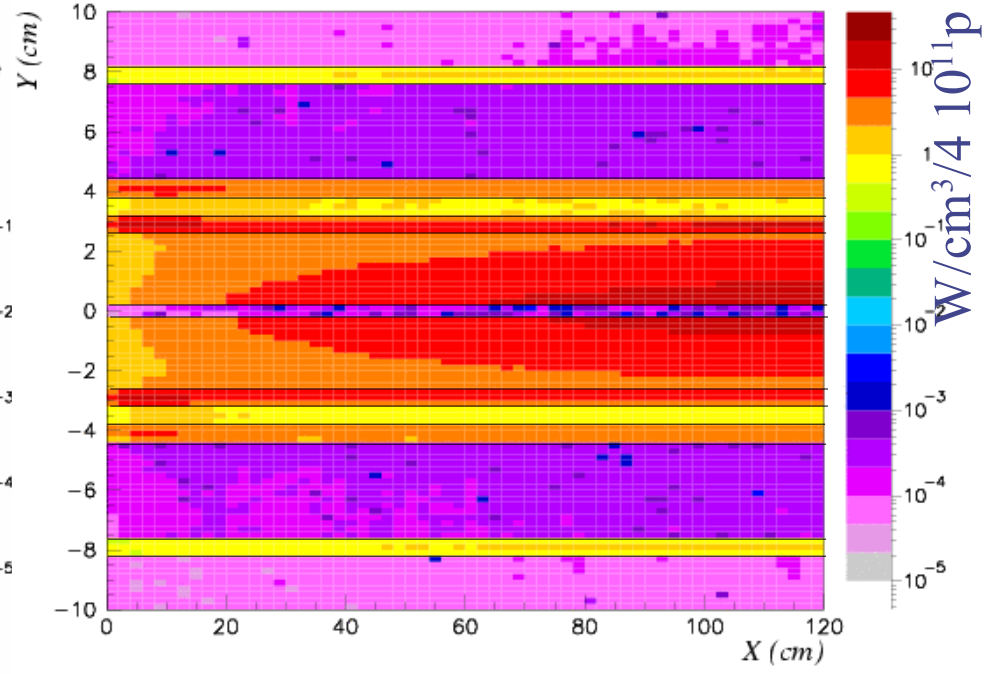
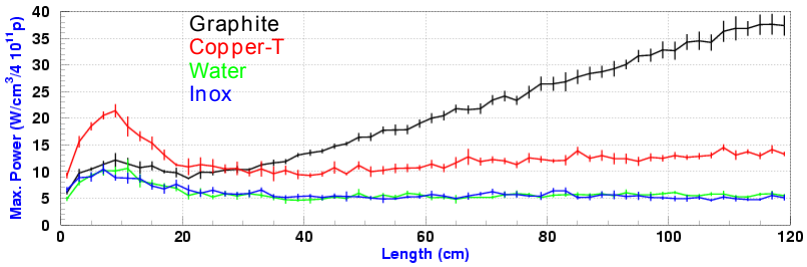
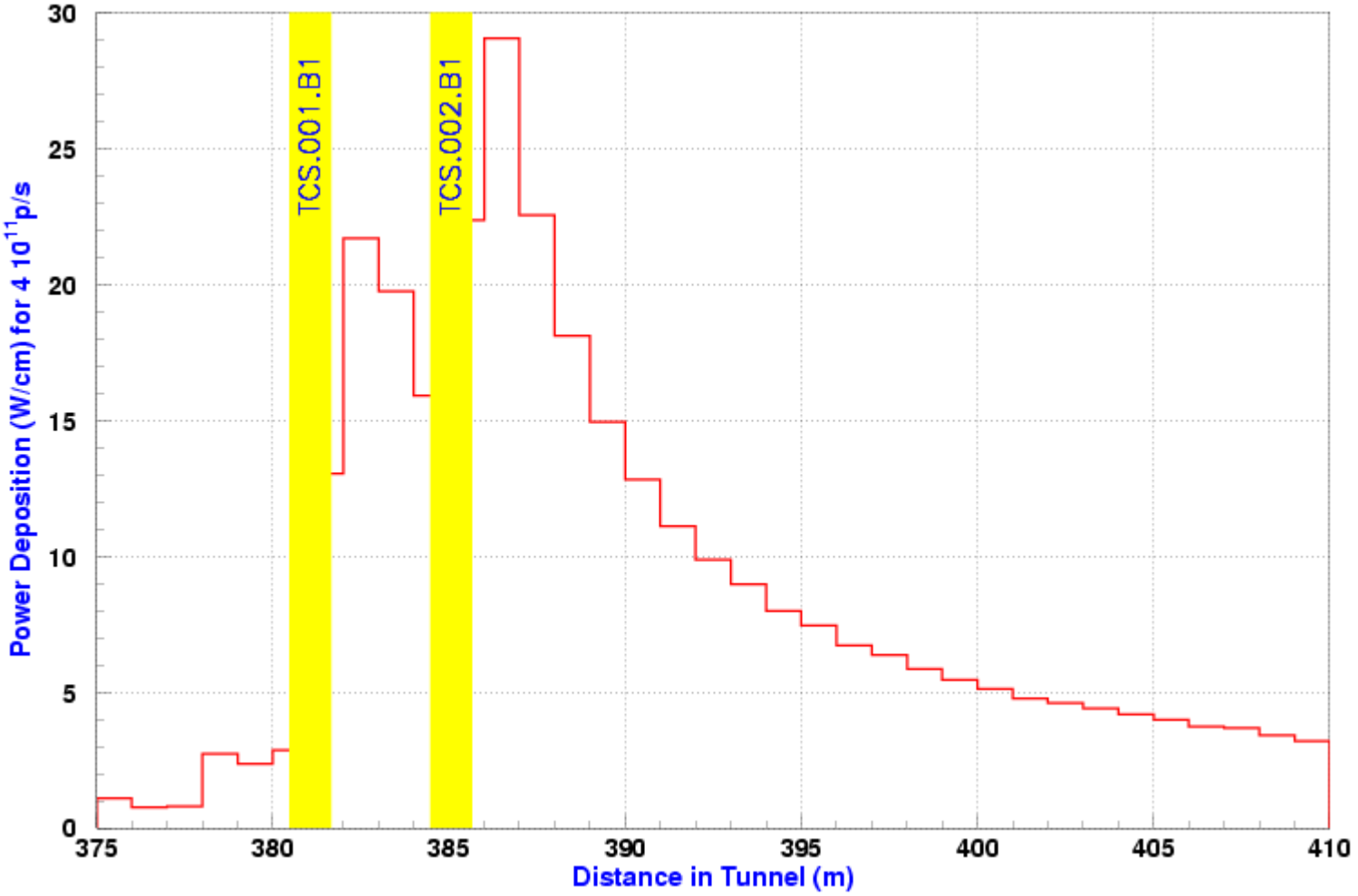




Phase #1: Beam tube



* Not weighted with the loss map

Phase #1: Power Deposition

TCP1

Collimator	Element	kW/4e11 p	Total
TCS.001.B1	Graphite	6.20	12
	Copper-T	2.26	
	Water	0.42	
	Inox	2.68	
TCS.002.B1	Graphite	17.06	29
	Copper-T	5.00	
	Water	1.02	
	Inox	5.70	
TCS.016.B2	Graphite	0.00	0
	Copper-T	0.00	
	Water	0.00	
	Inox	0.17	

Loss Map

Collimator	# Absorbed	Fraction
Total Abs.	**597493**	
TCPV	462179	77.35%
TCPH	94	0.02%
TCPS	2079	0.35%
TCPT	2573	0.43%
TCS.001.B1	33867	5.67%
TCS.002.B1	29276	4.90%

TCP2

Collimator	Element	kW/4e11 p	Total
TCS.001.B1	Graphite	6.13	11
	Copper-T	2.18	
	Water	0.41	
	Inox	2.66	
TCS.002.B1	Graphite	17.50	29
	Copper-T	5.03	
	Water	1.05	
	Inox	5.76	
TCS.016.B2	Graphite	0.00	0
	Copper-T	0.00	
	Water	0.00	
	Inox	0.16	

Collimator	# Absorbed	Fraction
Total Abs.	**582142**	
TCPV	106	0.02%
TCPH	449885	77.28%
TCPS	3980	0.68%
TCPT	3641	0.63%
TCS.001.B1	12518	2.15%
TCS.002.B1	11719	2.01%

TCP3

Collimator	Element	kW/4e11 p	Total
TCS.001.B1	Graphite	6.20	12
	Copper-T	2.25	
	Water	0.48	
	Inox	2.73	
TCS.002.B1	Graphite	18.43	31
	Copper-T	5.36	
	Water	1.13	
	Inox	6.10	
TCS.016.B2	Graphite	0.08	0
	Copper-T	0.08	
	Water	0.00	
	Inox	0.17	

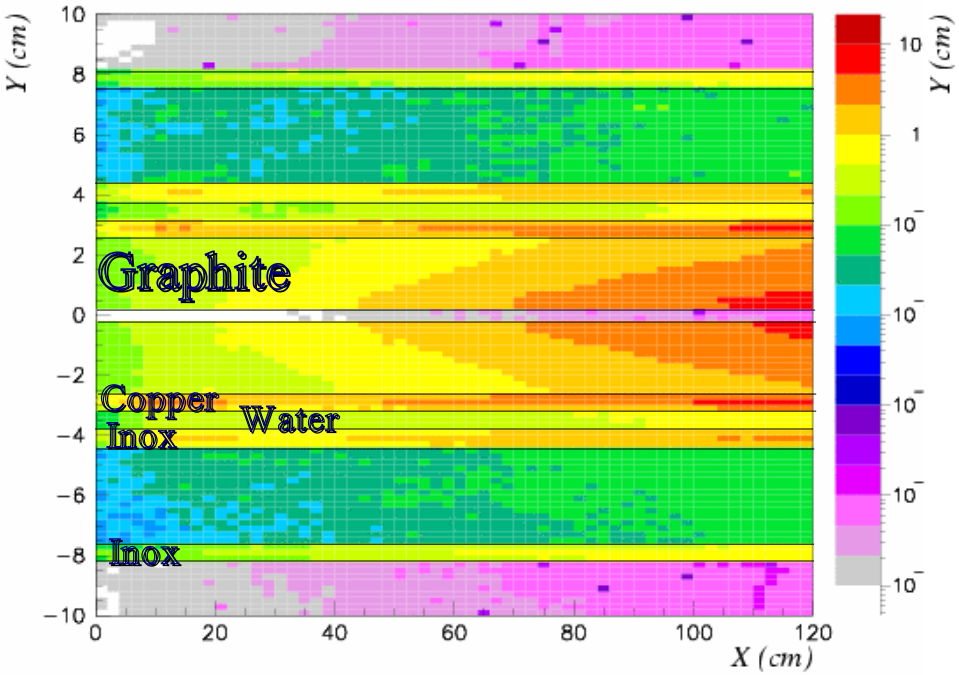
Collimator	# Absorbed	Fraction
Total Abs.	**460088**	
TCPV	193	0.04%
TCPH	424	0.09%
TCPS	307274	66.79%
TCPT	51799	11.26%
TCS.001.B1	11050	2.40%
TCS.002.B1	23888	5.19%

Phase #1: Power Distribution

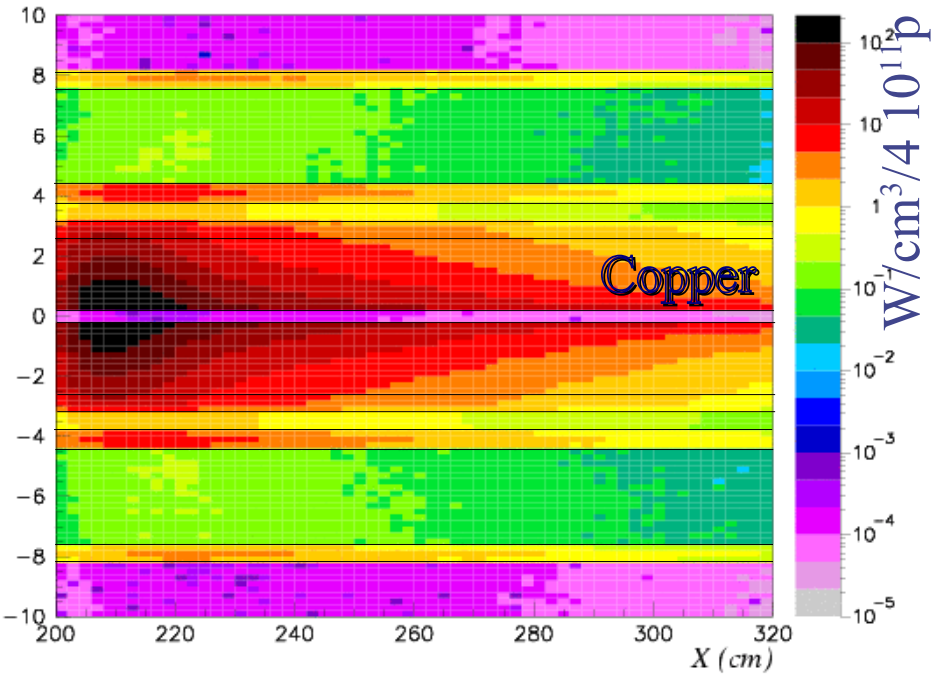
- TCP1 Loss scenario
- Total power intercepted 233 kW (52 %)
-
- MBW
  - Iron: 21 kW, 9.5 kW
  - Copper 6 kW, 1.5 kW
- Beam Tubes
  - Beam1: 34 kW
  - Beam2: 2.4 kW
- Primary Collimators
  - TCPV: 10 W
  - TCPH: 290 W
  - TCPS: 700 W
  - TCPT: 1.7 kW
- Secondary Collimators
  - TCS.001.B1 12 kW
  - TCS.002.B1 27 kW
  - TCS.003.B1 245 W
- Motors
  - < 200 W

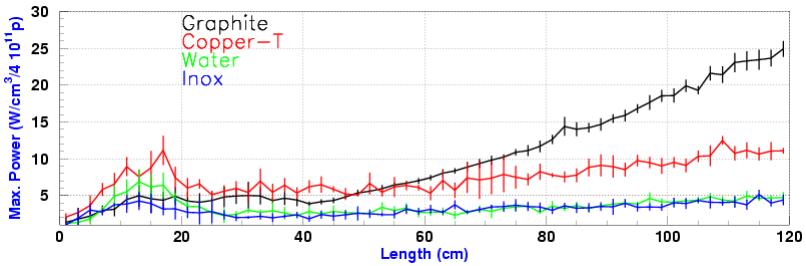
Phase #2: With Hybrid

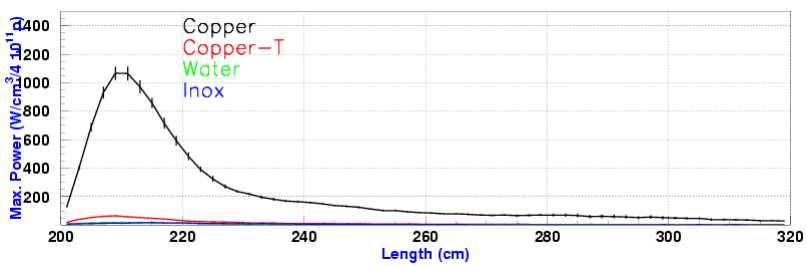
TCS.001.B1



TCSH.001.B1

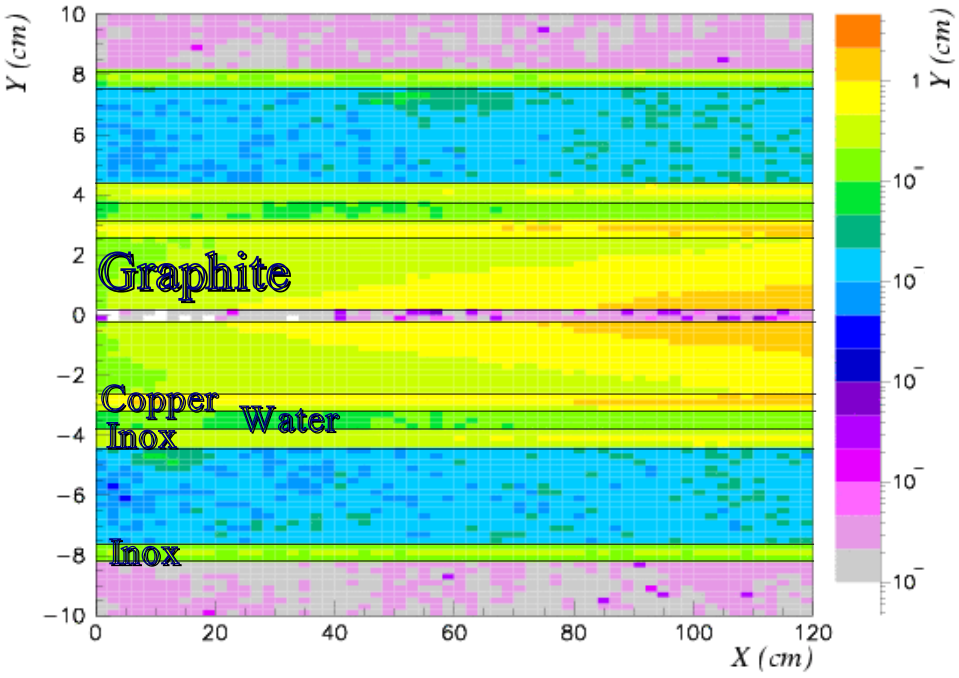






Phase #2: With Hybrid (cont)

TCS.002.B1



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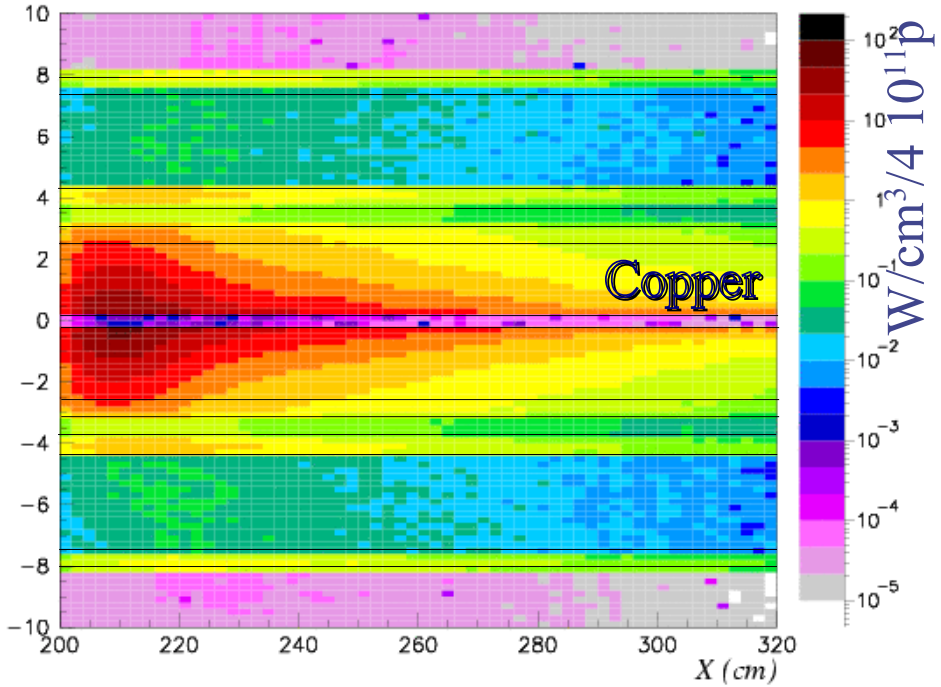

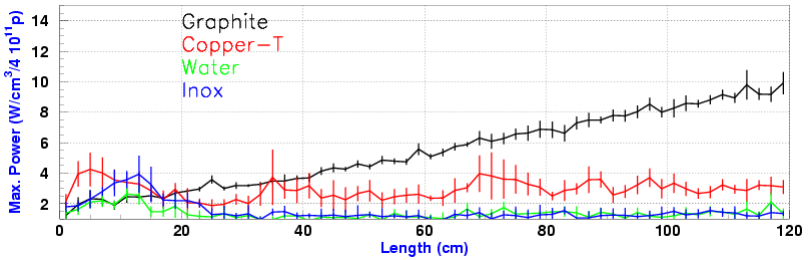

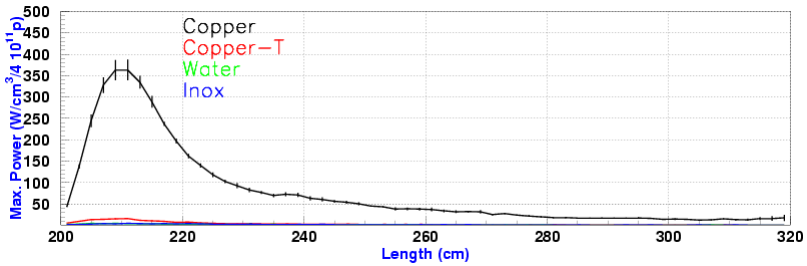

Phase #2: Power Deposition

Collimator	Element	GeV/p	%	kW/4e11 p	Total
TCS.001.B1	Graphite	2.77	0.54	7.50	14
	Copper-T	1.01	1.41	2.70	
	Water	0.2	1.69	0.50	
	Inox	1.22	0.77	3.30	
TCSH.001.B1	Copper	42.97	0.69	116.60	130
	Copper-T	1.71	0.50	4.70	
	Water	0.41	0.79	1.10	
	Inox	2.73	0.52	7.40	
TCS.002.B1	Graphite	1.06	1.98	2.90	5
	Copper-T	0.32	2.00	0.90	
	Water	0.07	1.29	0.20	
	Inox	0.44	1.42	1.20	
TCSH.002.B1	Copper	9.83	2.64	26.70	30
	Copper-T	0.35	1.90	1.00	
	Water	0.09	2.31	0.20	
	Inox	6.05E-001	2.03	1.60	
TCS.016.B2	Graphite	8.23E-003	8.45	0.00	0
	Copper-T	8.44E-003	9.38	0.00	
	Water	2.20E-003	4.92	0.00	
	Inox	2.14E-002	6.76	0.10	
TCSH.016.B2	Copper	1.66E-002	16.13	0.00	0
	Copper-T	2.94E-003	5.80	0.00	
	Water	1.13E-003	6.93	0.00	
	Inox	1.23E-002	4.03	0.00	

Results

- Collimators intercept the largest fraction of the energy
  - For hadron-nucleon interaction at these energies one expect a Pt=350 MeV/c
  - For hadron-nucleus interaction we have Pt=400-500 MeV/c thus Pt/P=100 urad (4mm at 40m)
  - Structural elements (like MBW, tube…) around the beam pipe do not affect much the shower
- Phase #1
  - Results are weighted with the loss map
  - TCS.002.B1 ~30 kW
  - No significant difference between the various cases
  - Energy deposition on beam pipe peaks ~30 W/cm
- Phase #2
  - TCSH.001.B1 130 kW
  - Loss map weighting still pending