Energy deposition in TCSD and MSD during an asynchronous beam dump with HL beams

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Follow-up TCDS and MSD Meeting

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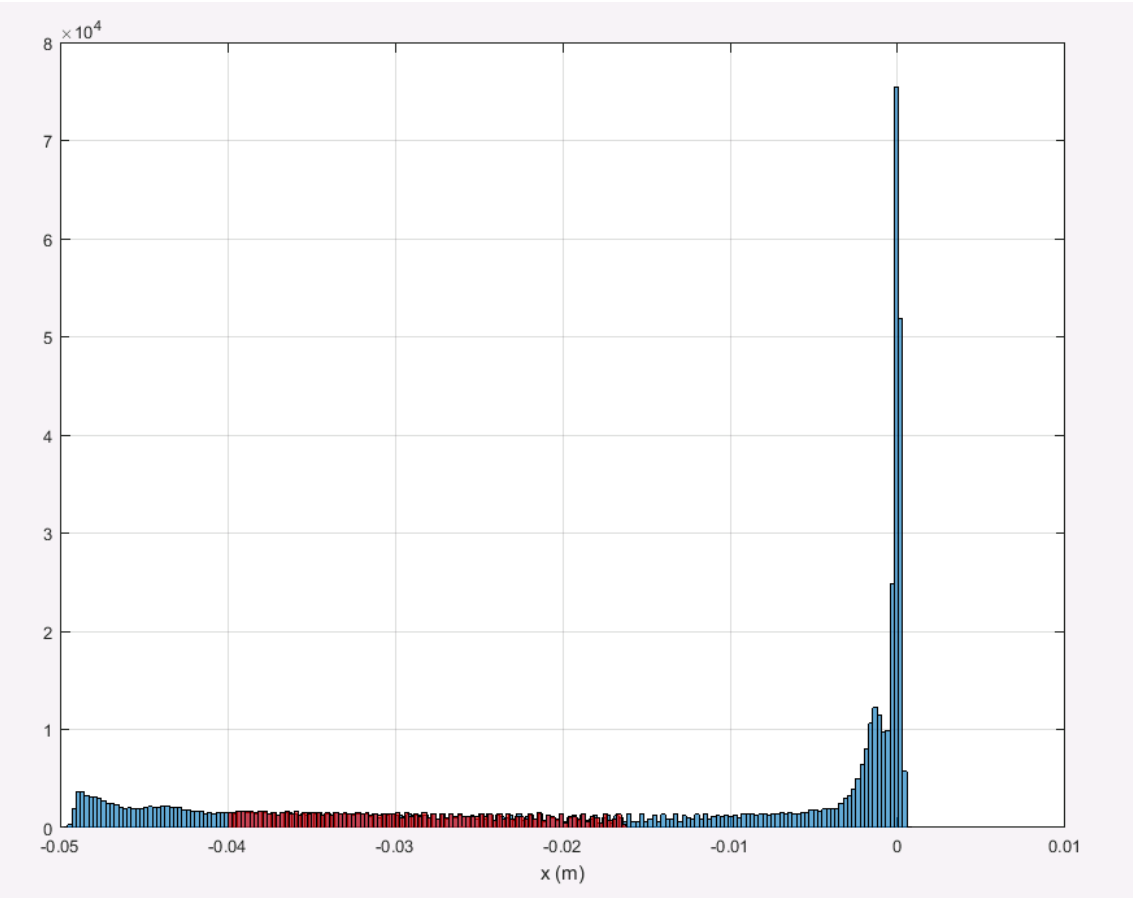
Contents

Introduction

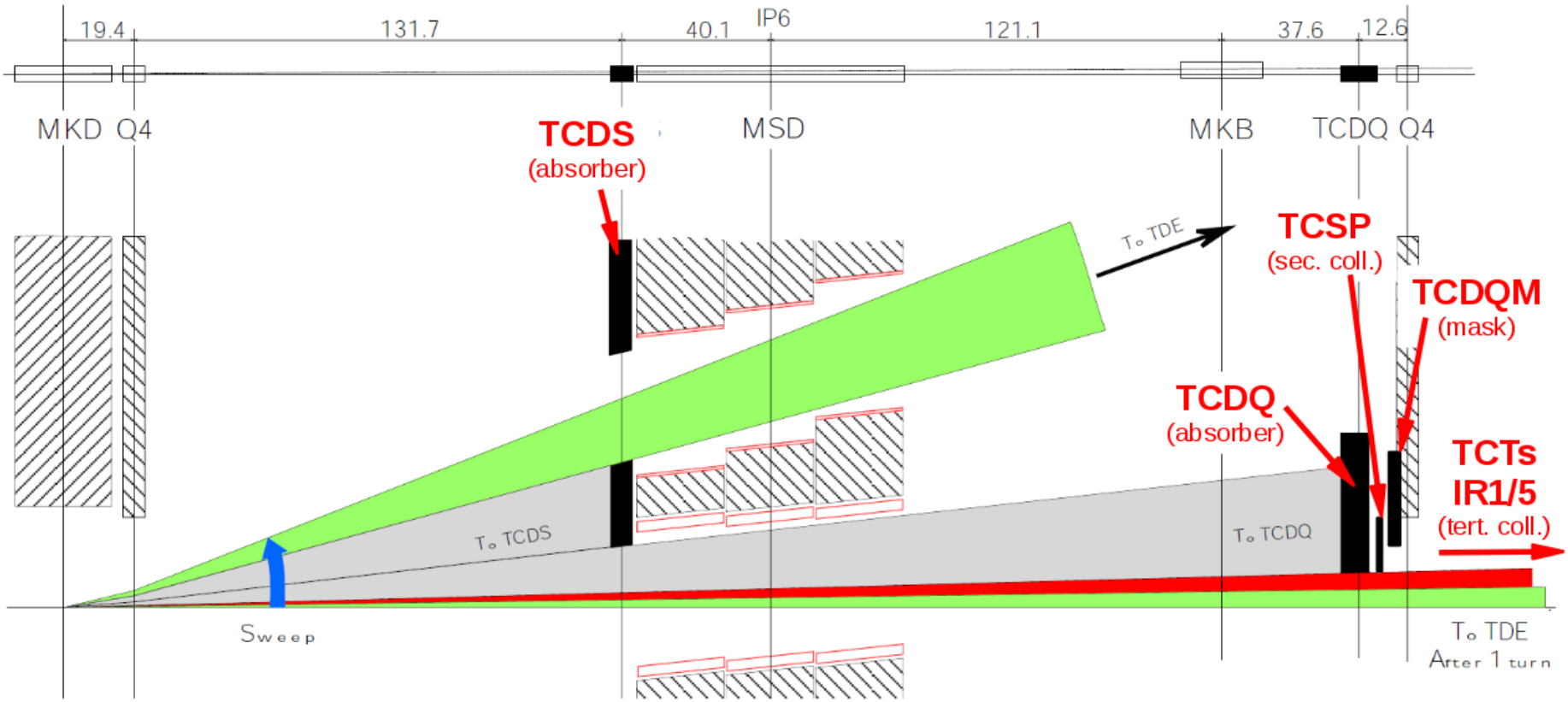
- FLUKA simulation of the energy deposition in the TCDS absorber blocks and in the MSDA
- Particle distribution for an asynchronous beam dump (type 2) provided by M. Fraser
- BCMS beam considered (1.37 μm·rad, 2.3×10^{11} ppb)
- MSDA angle: 0.0144°
- TCDS alignment according to LHC-TCDS-ES-0003-10-10

Particle Distribution

- Source consits of 200 bunches
- About 23 % or 45 bunches hit the front face of the inner TCDSU-jaw



Asynchronous beam dump



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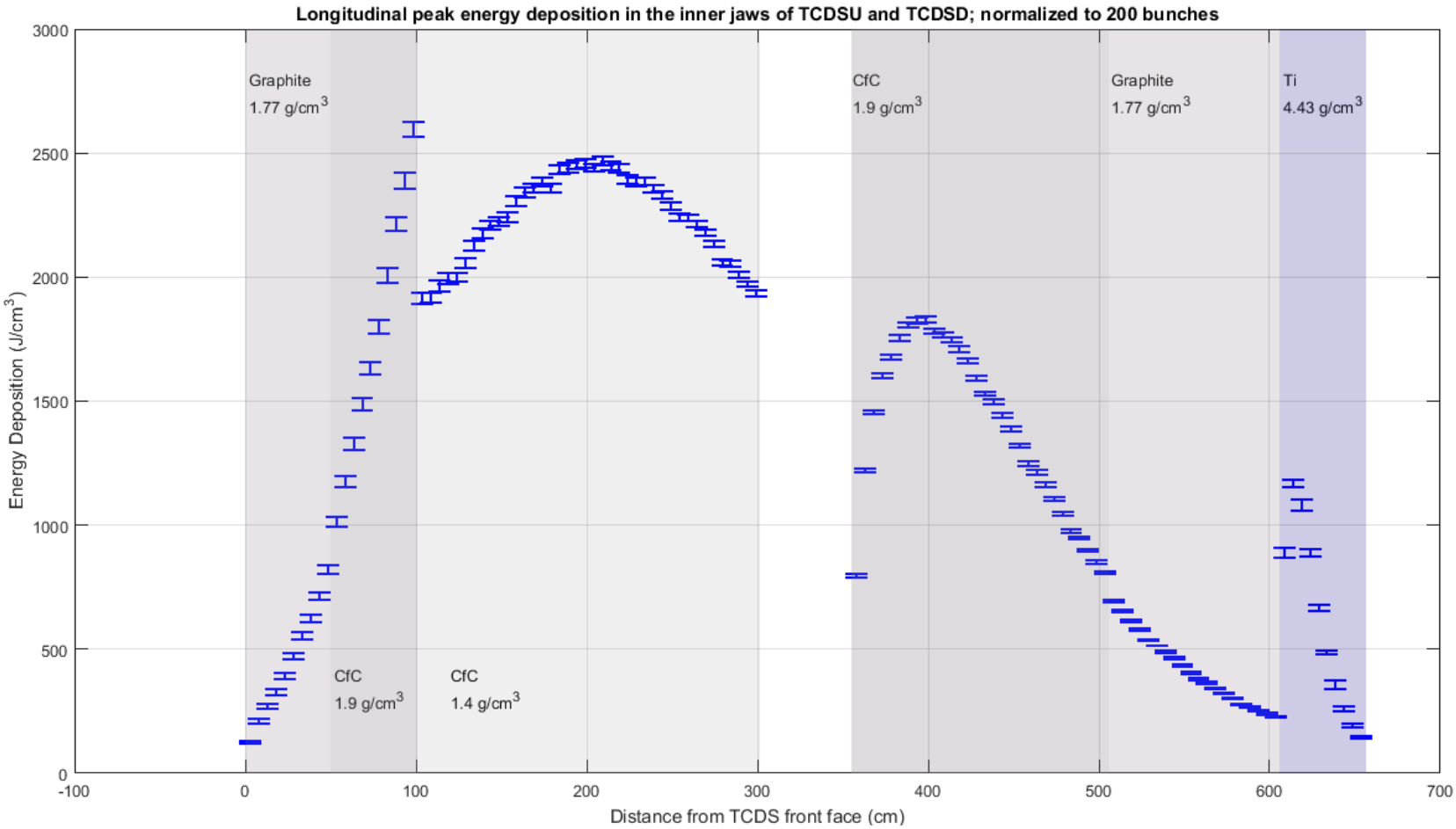
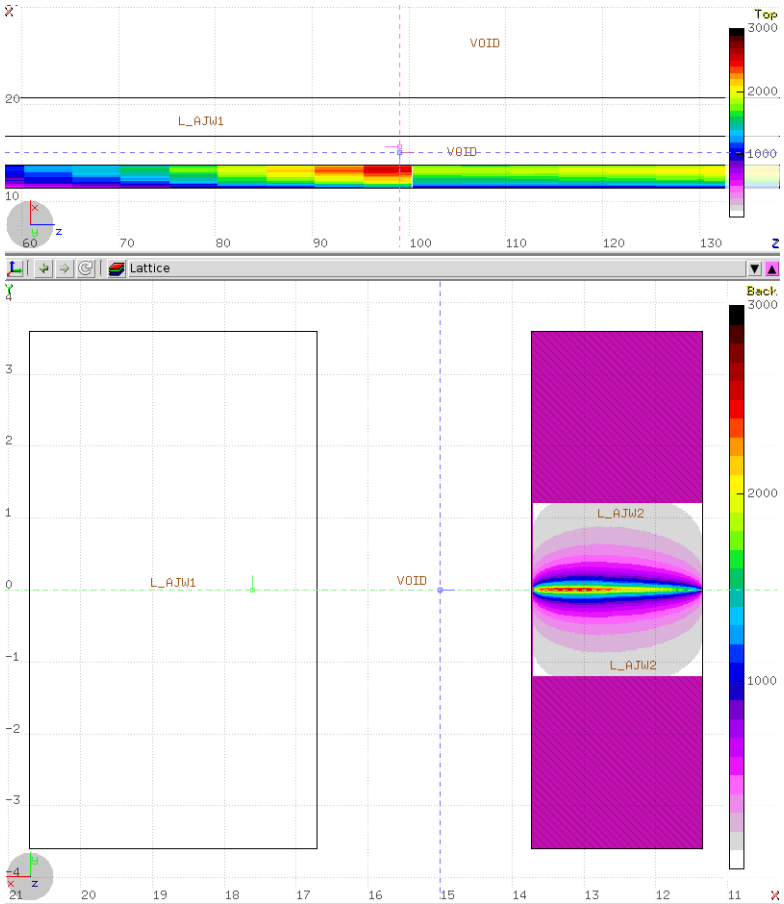
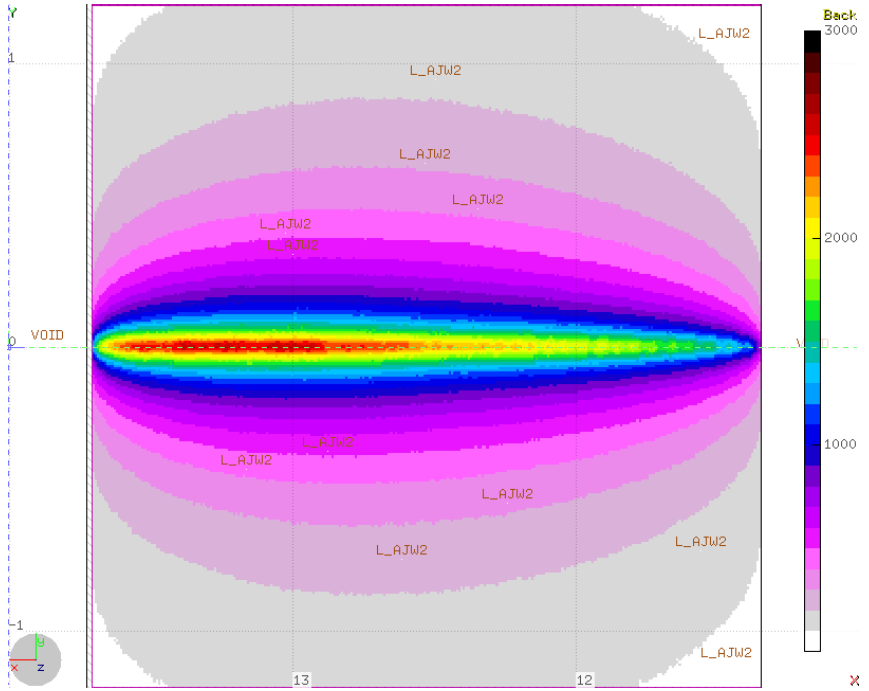
Longitudinal Peak Energy Deposition along TCDS blocks



Peak Energy Deposition in high-density CfC-block

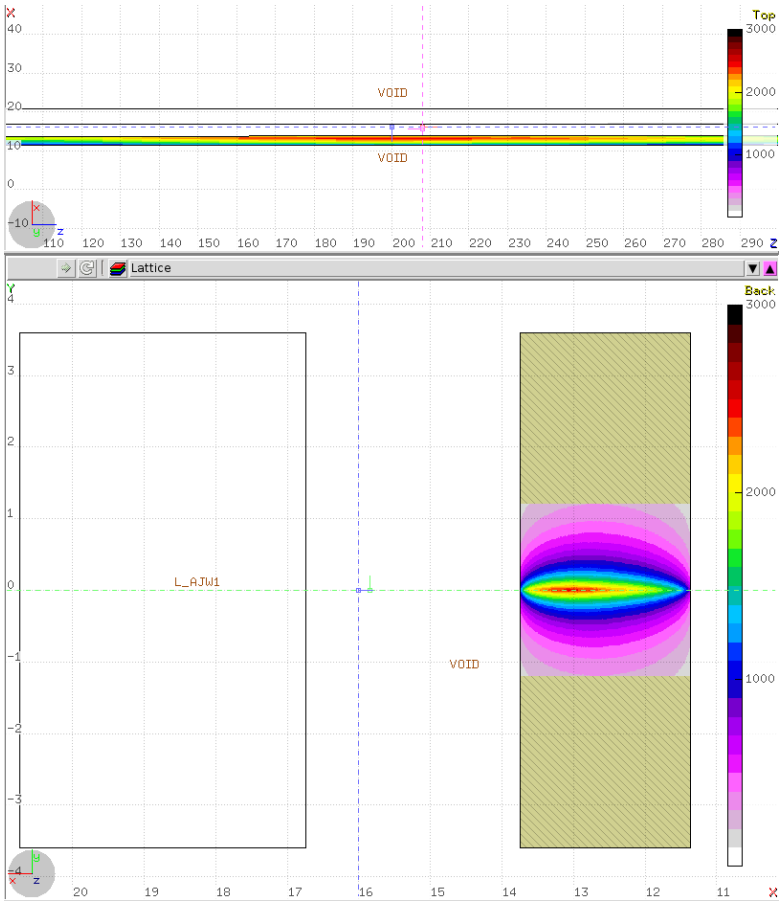
- Peak energy deposition of **2596 J/cm^3** at end of high-density CfC absorber blocks

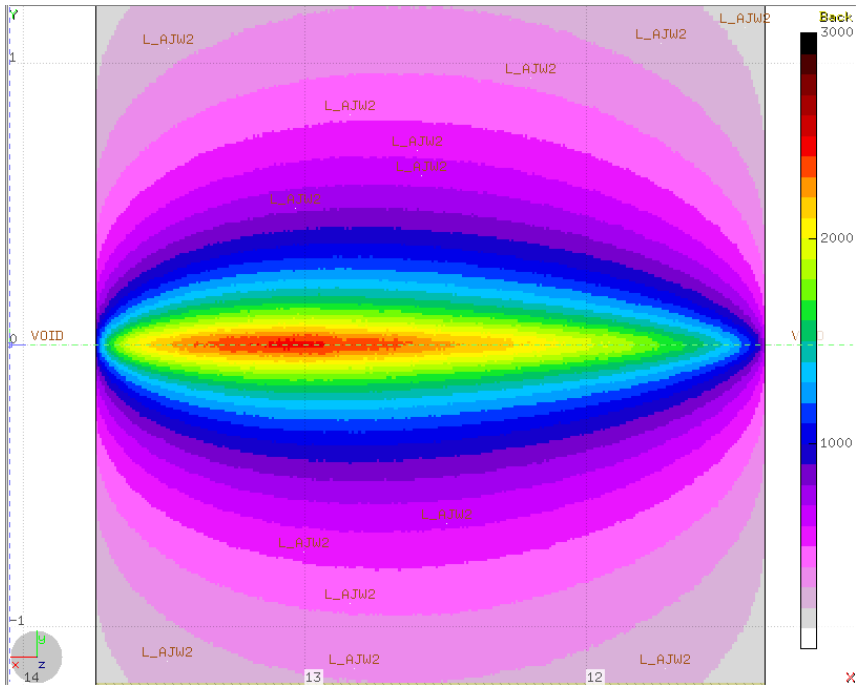




Peak Energy Deposition in low-density CfC-block

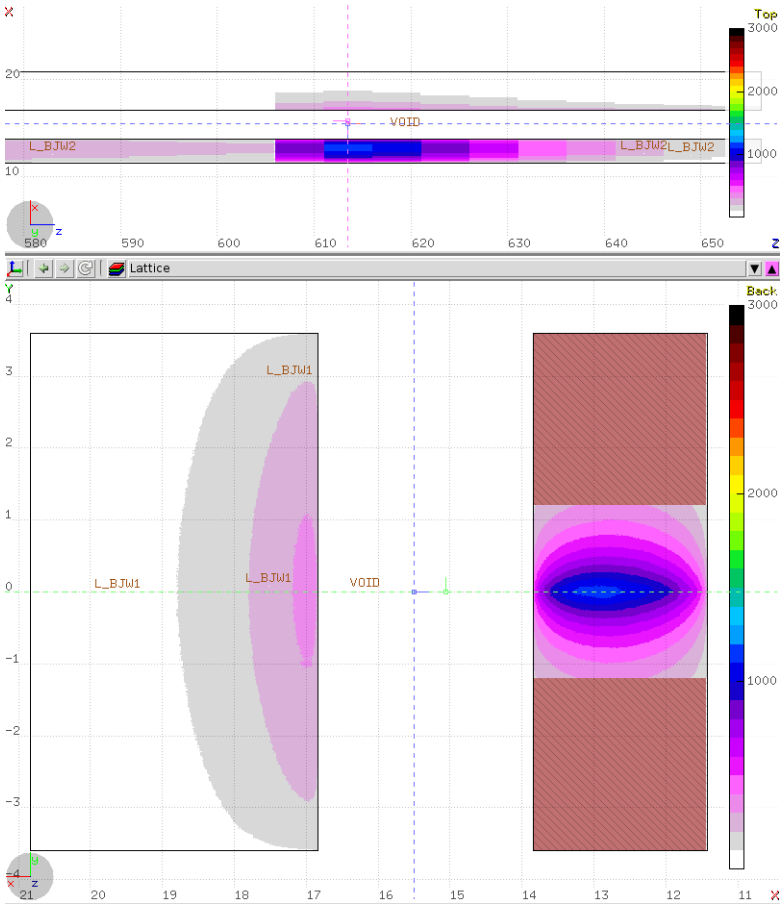
- Peak energy deposition of **2470 J/cm^3** in the middle of low-density CfC absorber blocks

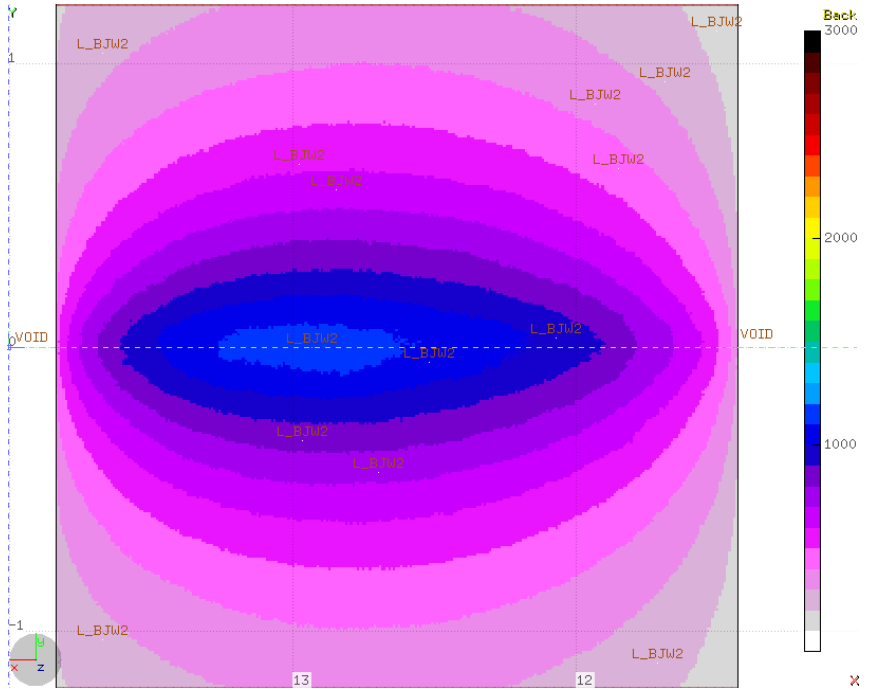




Peak Energy Deposition in Ti-block

- Peak energy deposition of $\mathbf{1168\,J/cm^3}$ in the Titanium absorber blocks





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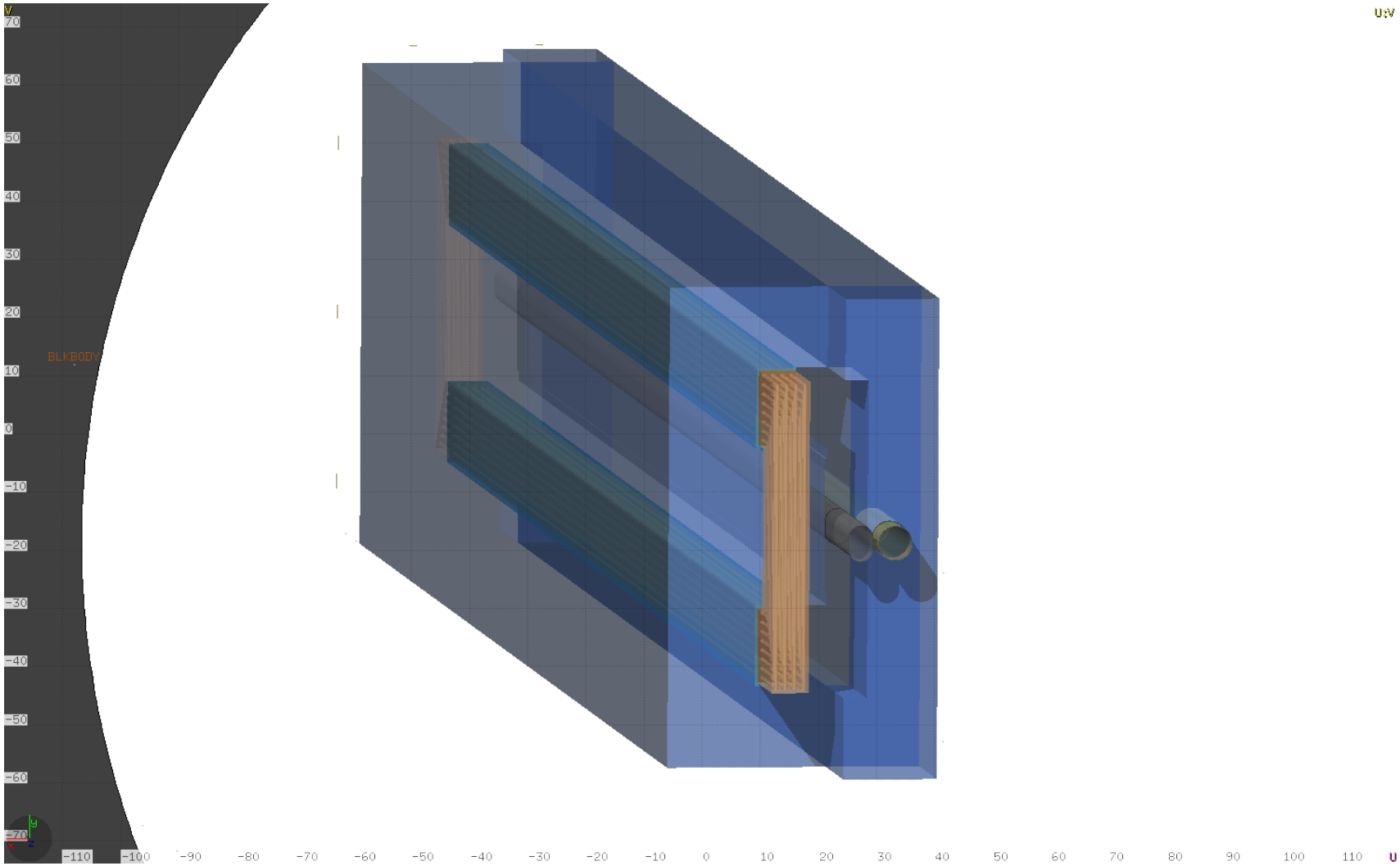
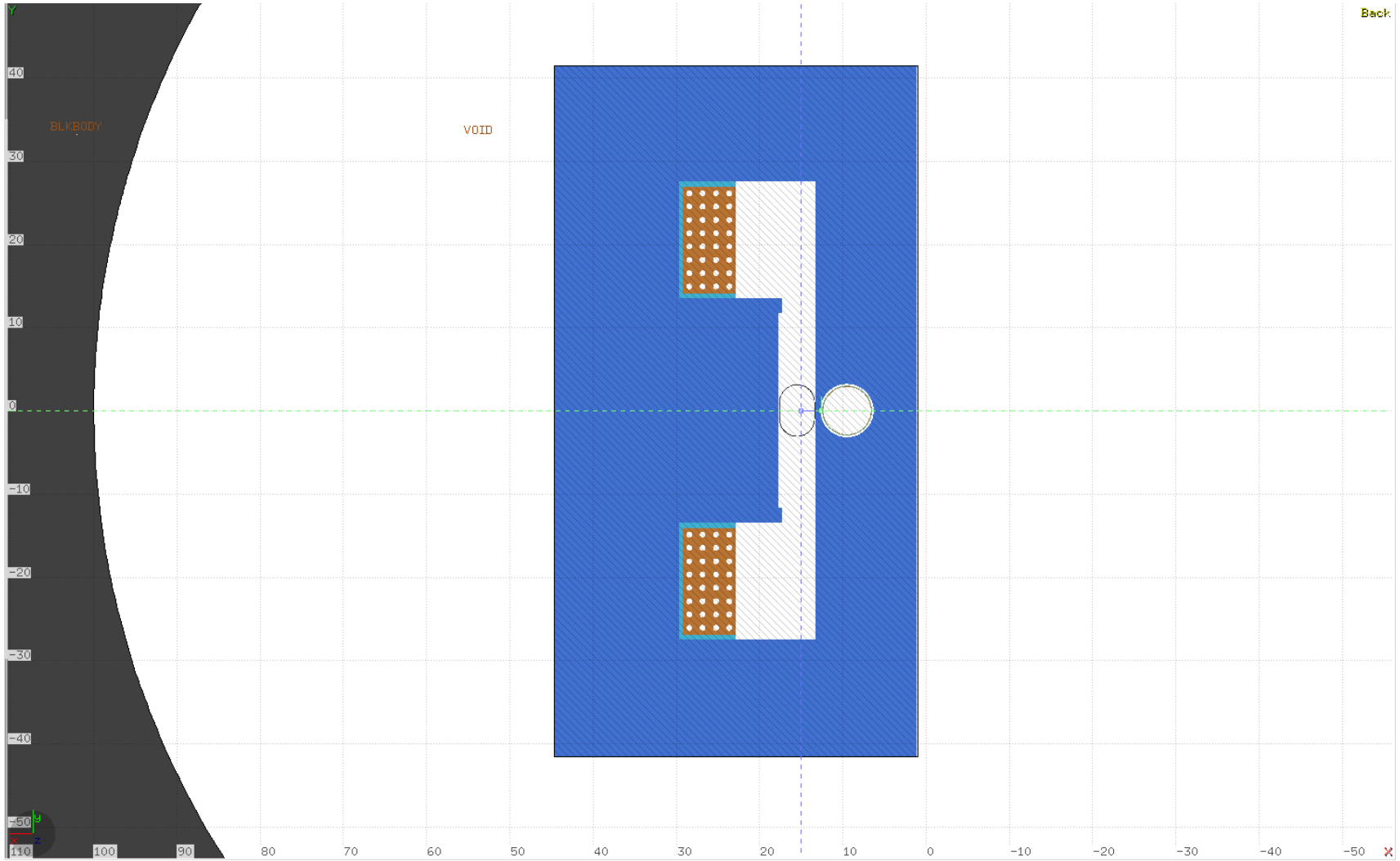
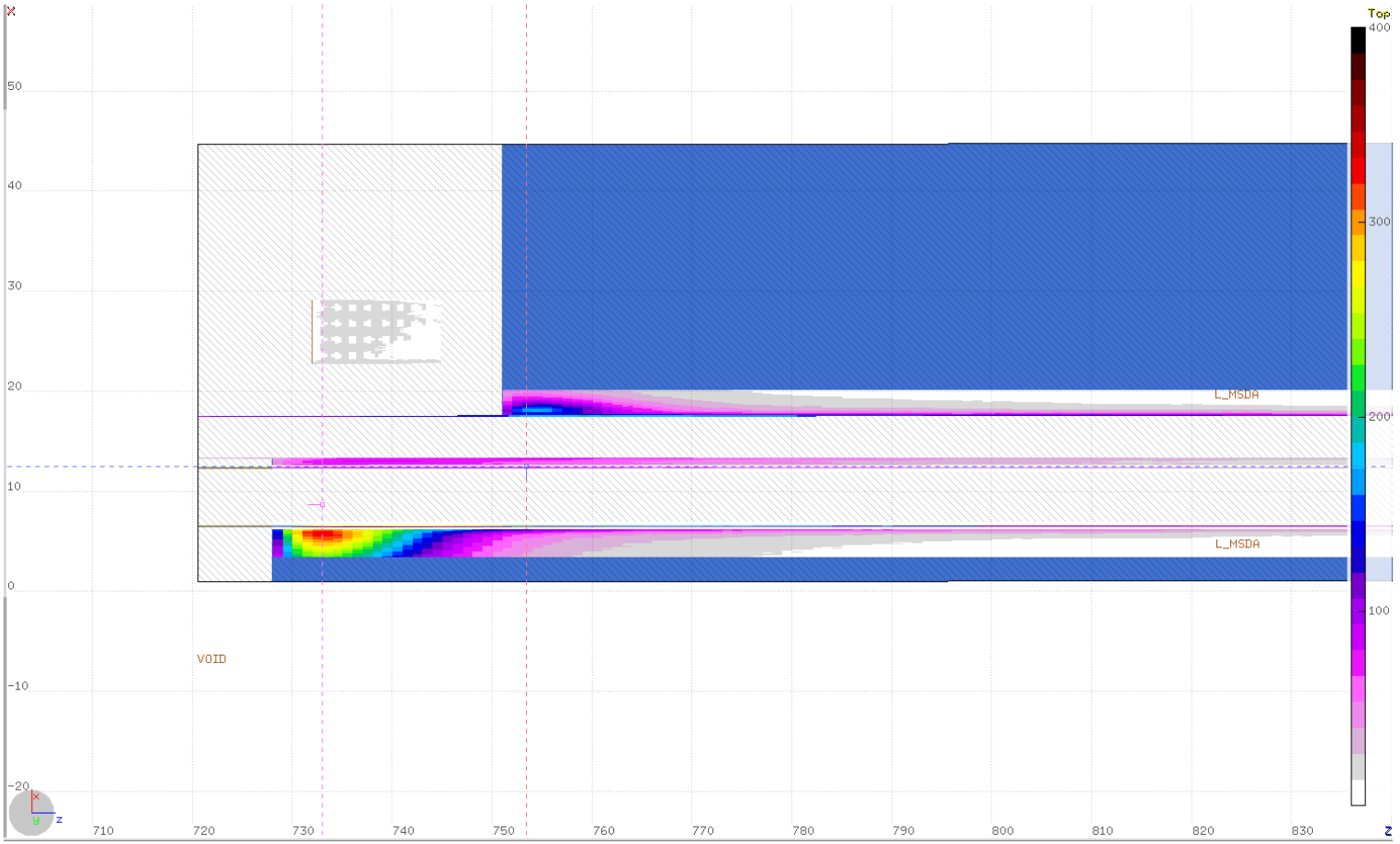
MSDA Geometry (1/2)



MSDA Geometry (2/2)

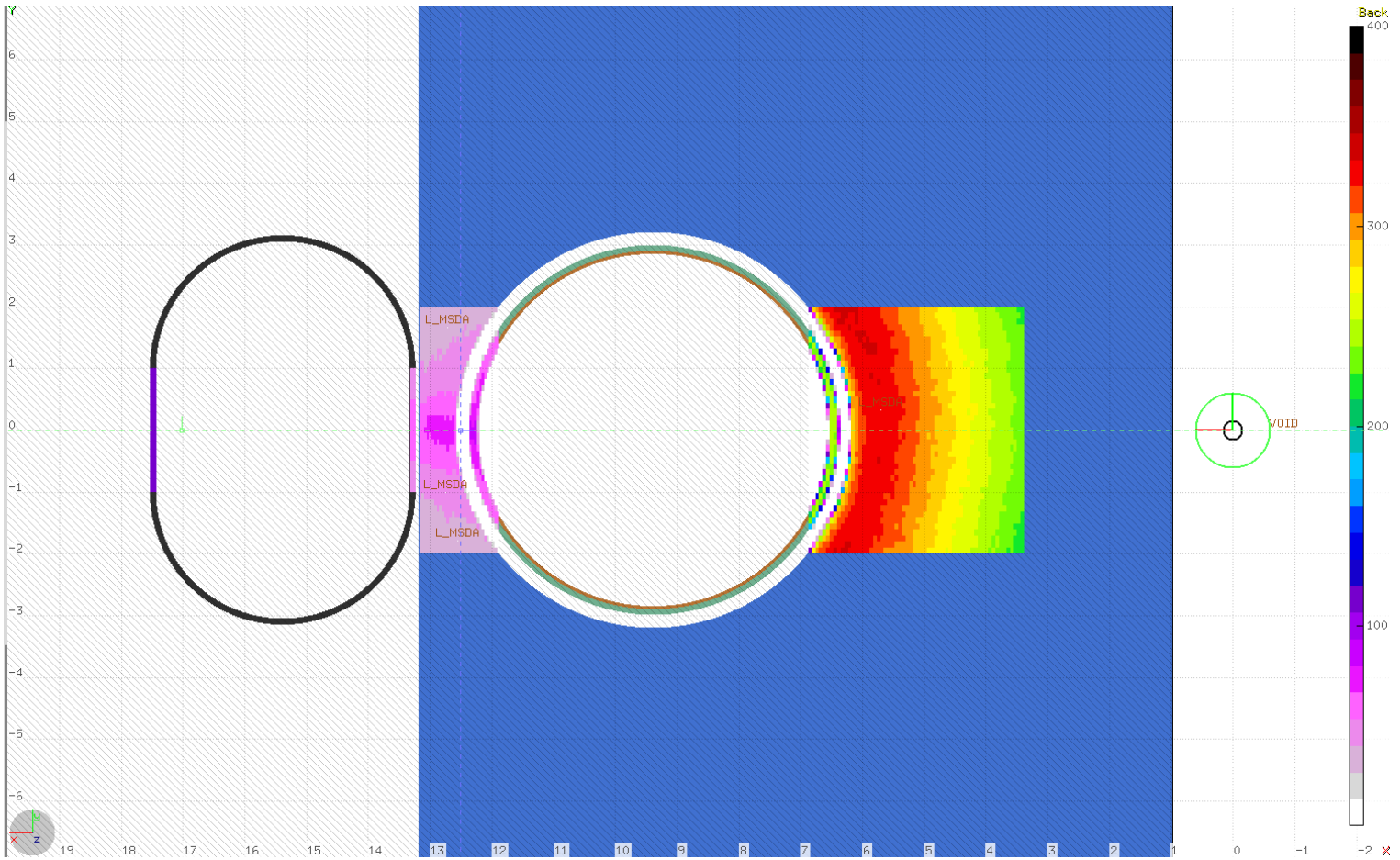


Energy Deposition (J/cm^3) in the MSDA Yoke

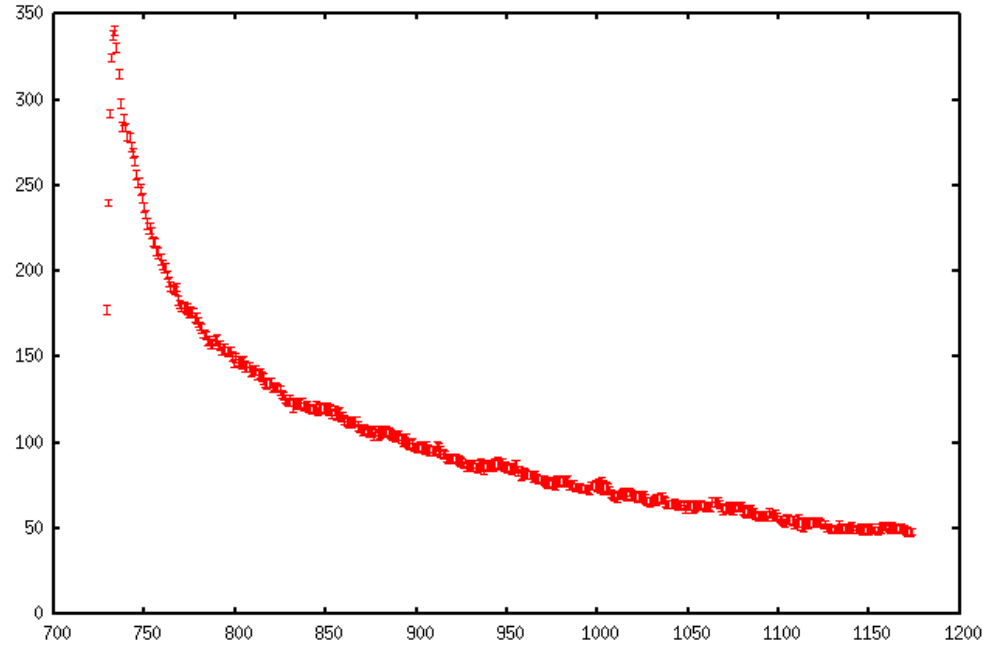


- Peak energy deposition of **341 J/cm^3** next to the circulating beam

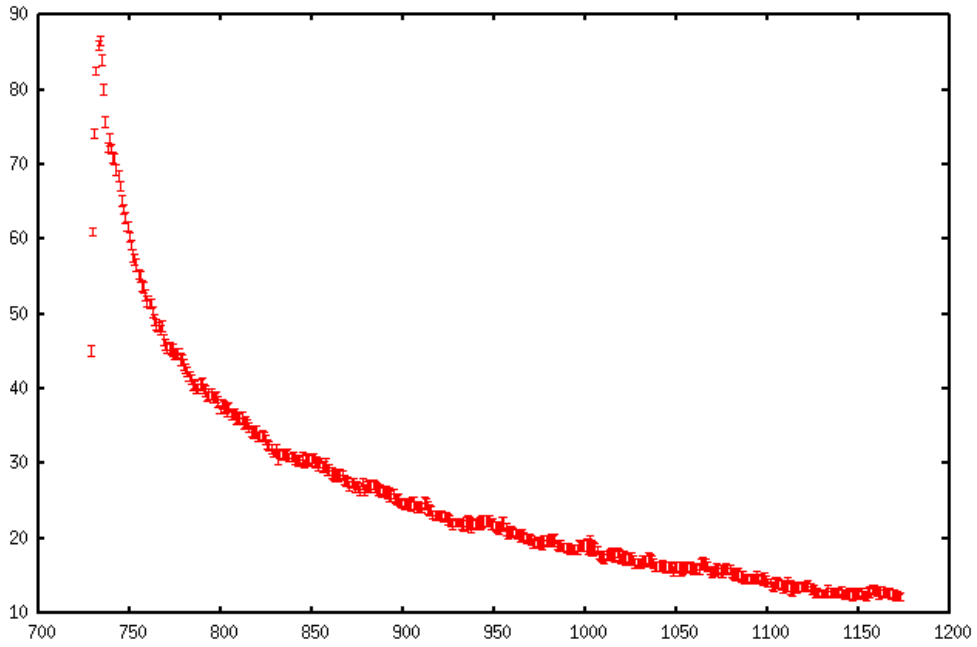
Energy Deposition (J/cm^3) in the MSDA Yoke: Transverse Profile at Peak



Longitudinal Peak Energy and Temperature Distribution: MSDA Yoke



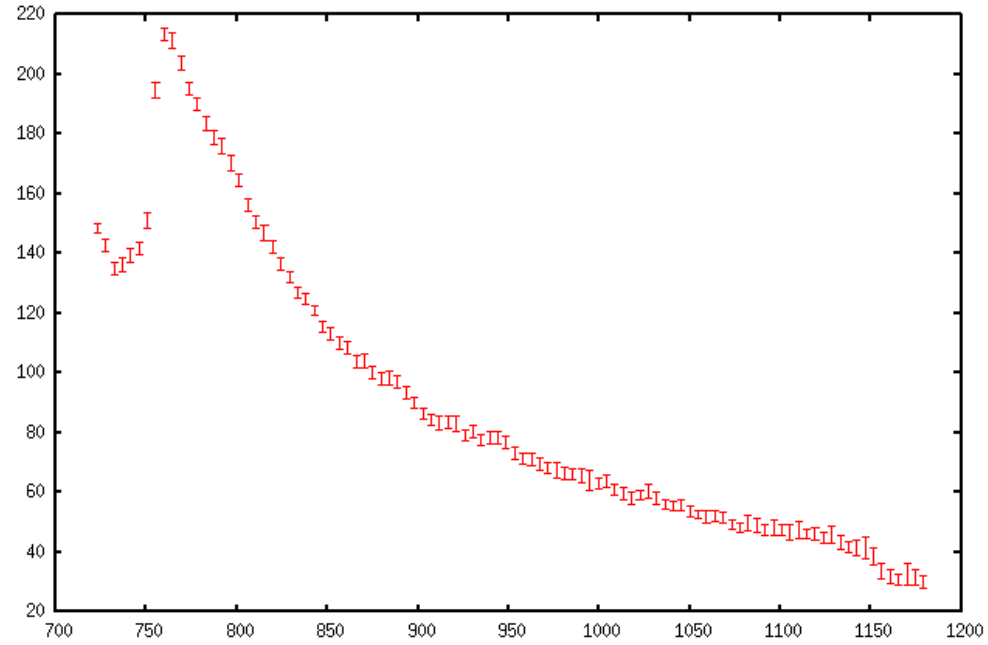
Peak energy deposition (J/cm^3)



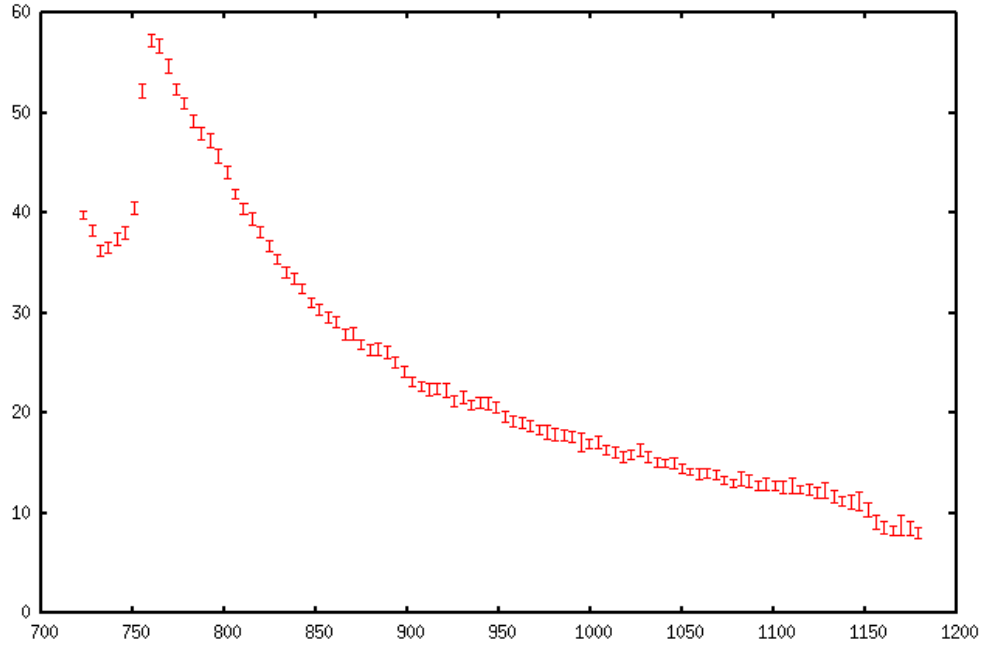
Temperature increase (K)

- Peak energy deposition of **341 J/cm^3**
- Corresponds to a maximal temperature increase of **87 K**
- LowCSTL, 7.87 g/cm^3, 0.5 J/g·K

Longitudinal Peak Energy and Temperature Distribution: Vacuum chamber extracted beam



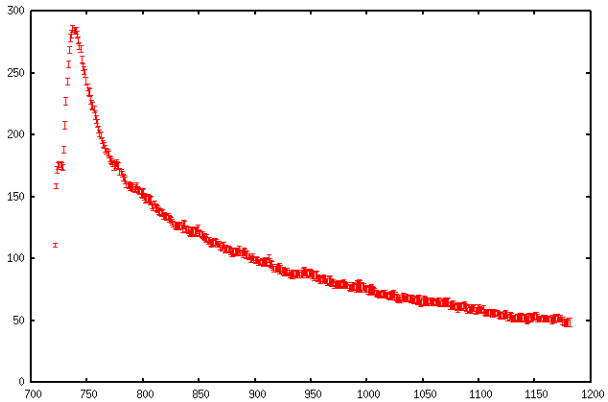
Peak energy deposition (J/cm^3)



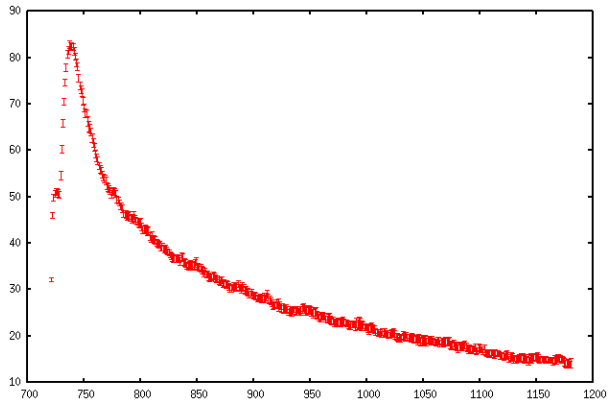
Temperature increase (K)

- Peak energy deposition of **213 J/cm^3**
- Corresponds to a maximal temperature increase of **57 K**
- SS316L, 8.0 g/cm^3, 0.466 J/g·K

Longitudinal Peak Energy and Temperature Distribution: Vacuum chamber stored beam

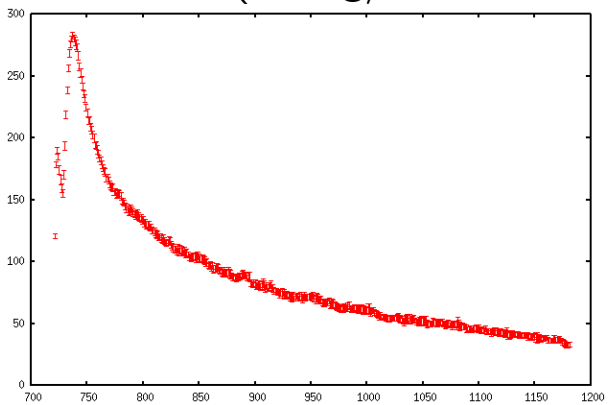


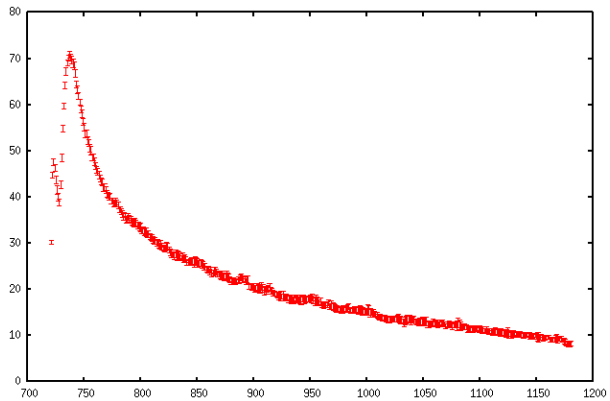
Peak energy deposition (J/cm^3)



Temperature increase (K)

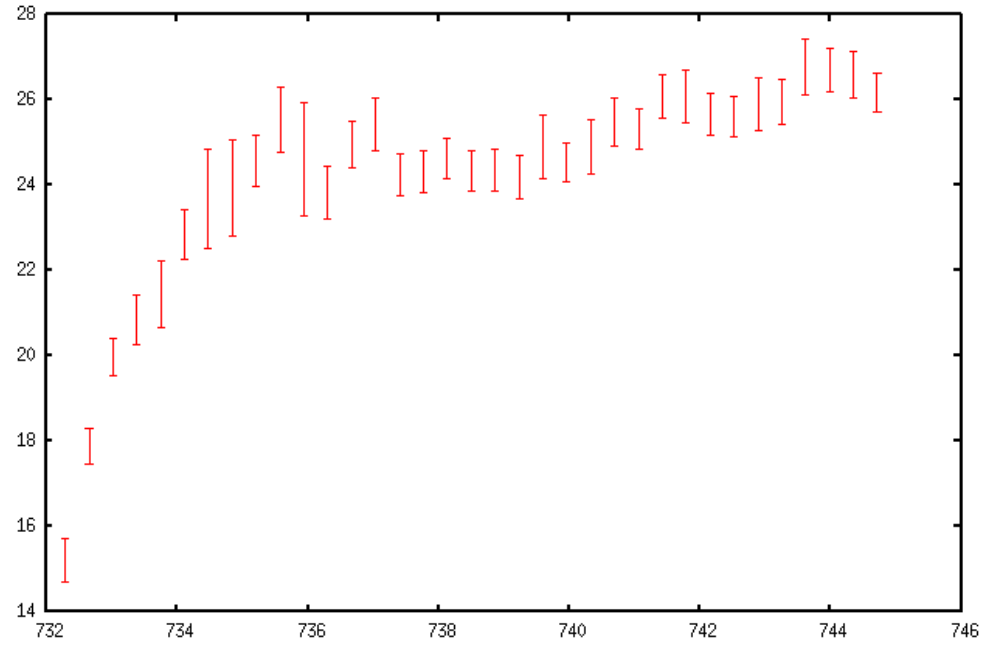
- Peak energy deposition of **286 J/cm^3** in Copper layer corresponding to **83 K** temperature increase (8.96 g/cm^3, 0.385 J/g·K)



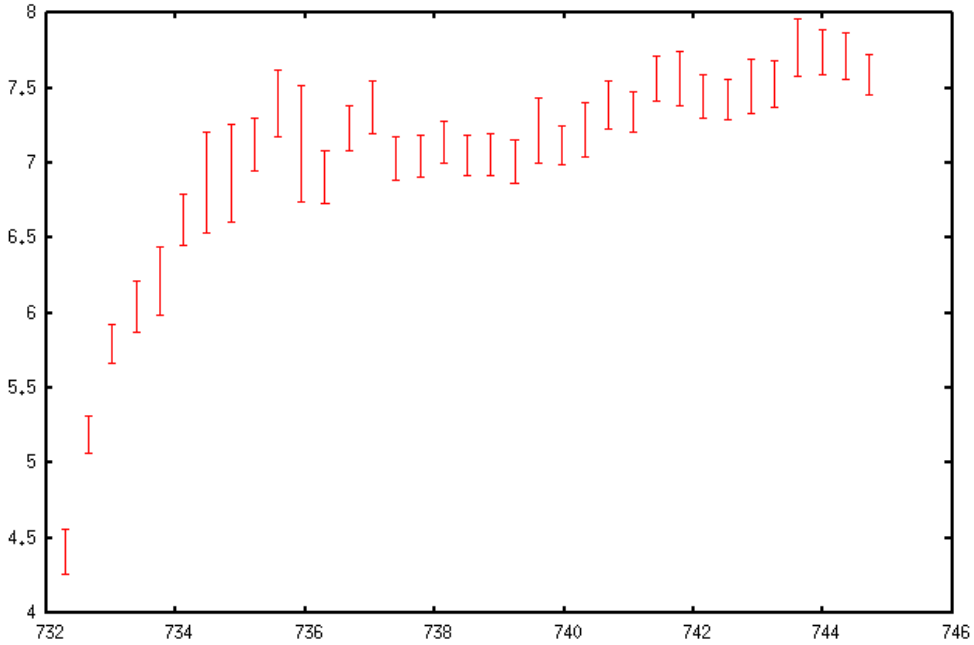


- Peak of **283 J/cm^3** in Mu-Metal layer corresponding to **71 K** temperature increase (8.6821 g/cm^3, 0.46 J/g·K)

Longitudinal Peak Energy and Temperature Distribution: Coil front



Peak energy deposition (J/cm^3)



Temperature increase (K)

- Peak energy deposition of **27 J/cm^3**
- Corresponds to a maximal temperature increase of **8 K**
- Copper, 8.96 g/cm^3, 0.385 J/g·K

Contents

Summary & Conclusions

- With the observed temperature increase in the MSDA yoke we arrive around the proposed limit of 100°C
- No risk imposed to the vacuum chambers with an assumed temperature limit of 300°C
- No risk imposed to the coils