updates to simulation of the ILD forward region

- material
- fields

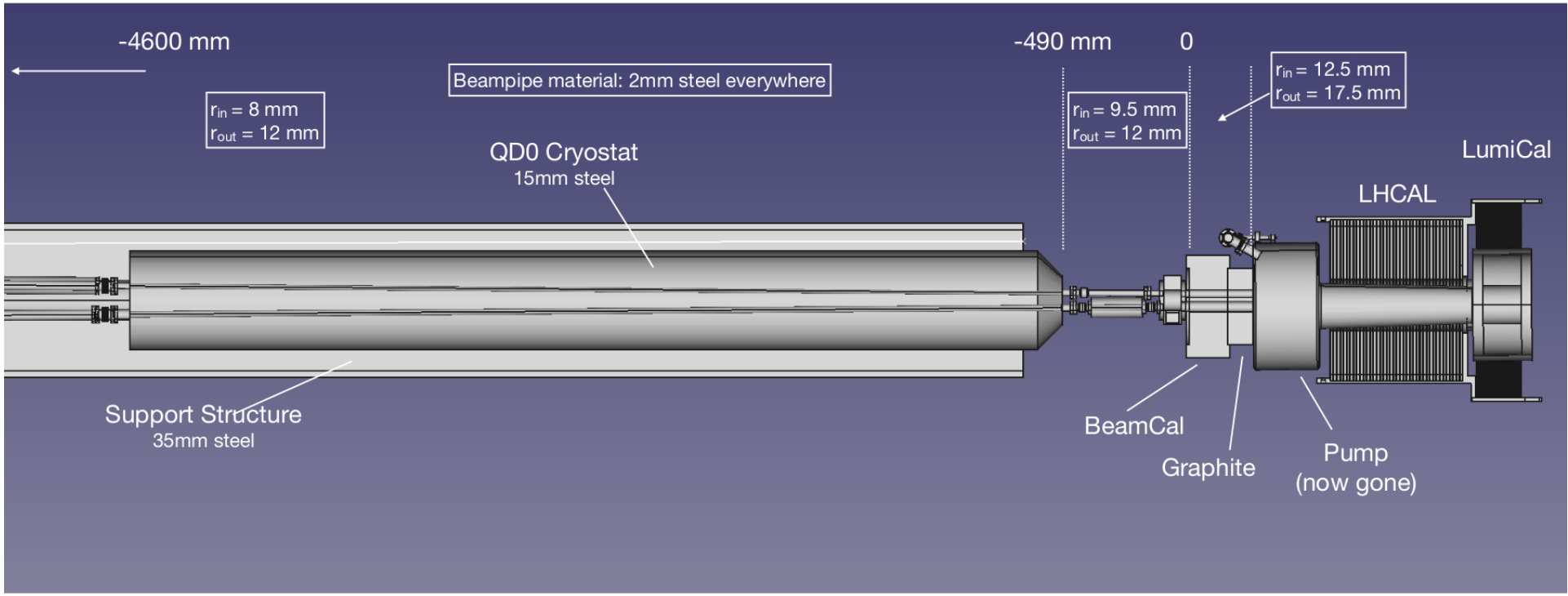
Daniel Jeans / KEK

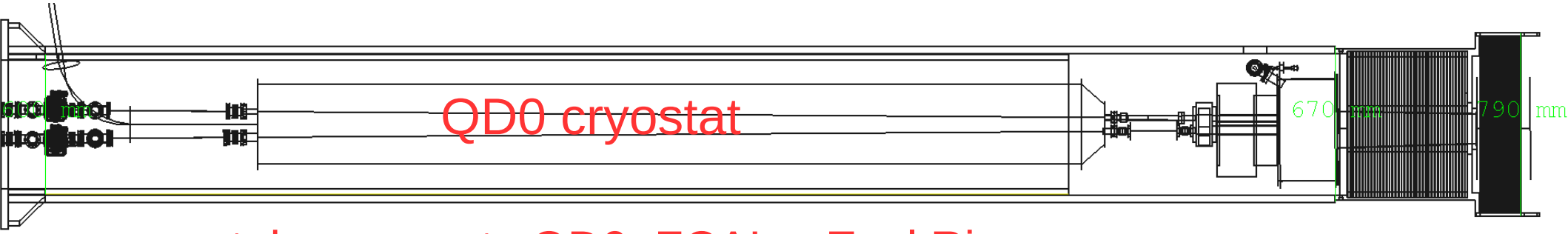
ILD sw-ana mtg

21 Mar 2018

material in forward region

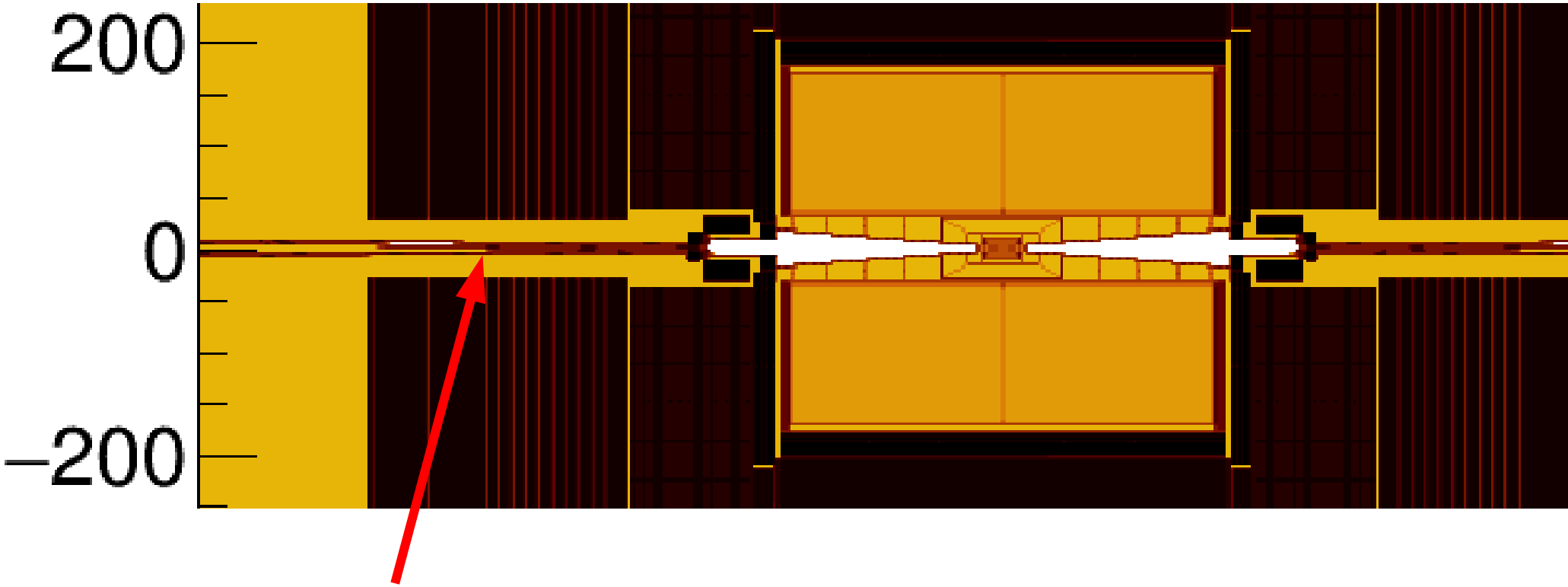
- detailed information (with old L*) from Karsten





tube supports QD0, FCALs, Ecal Ring

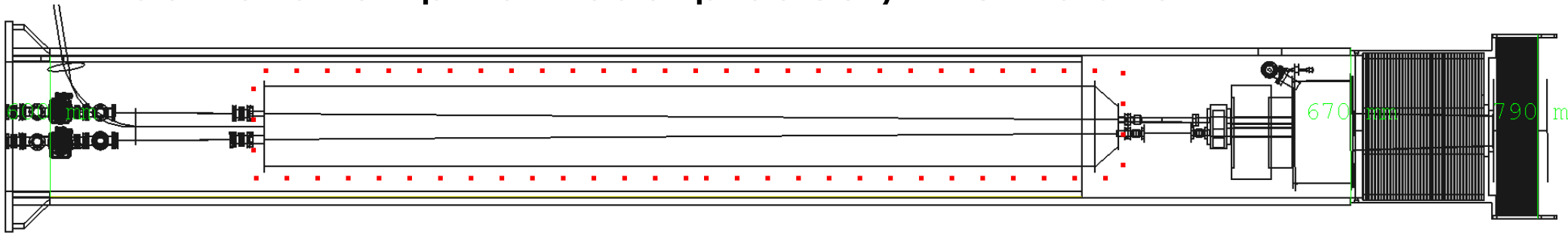
ILD_l5_v02 simulation model in ilcsoft v01-19-05

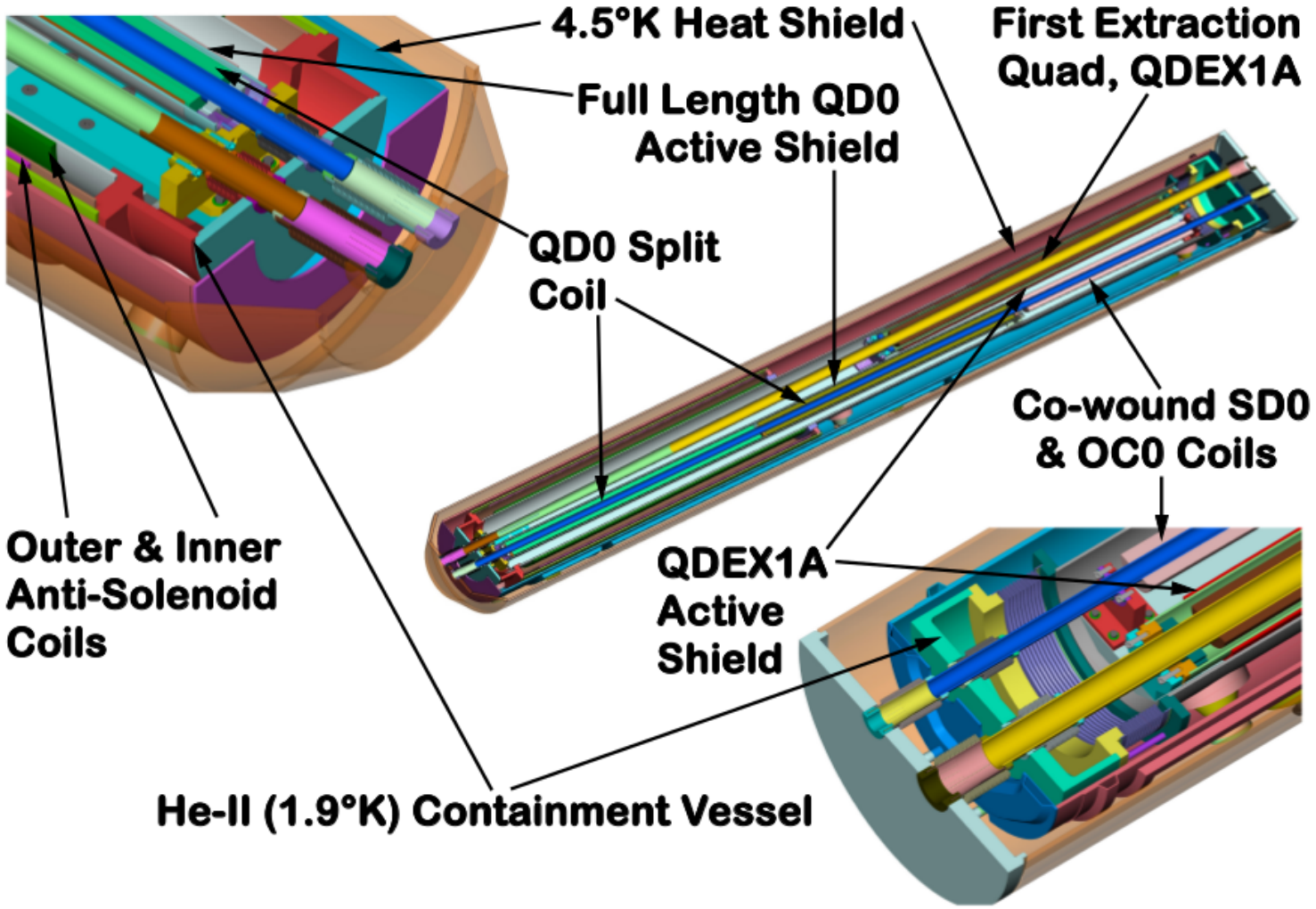


beam pipes were simulated,
but no magnets, supports, etc in forward region

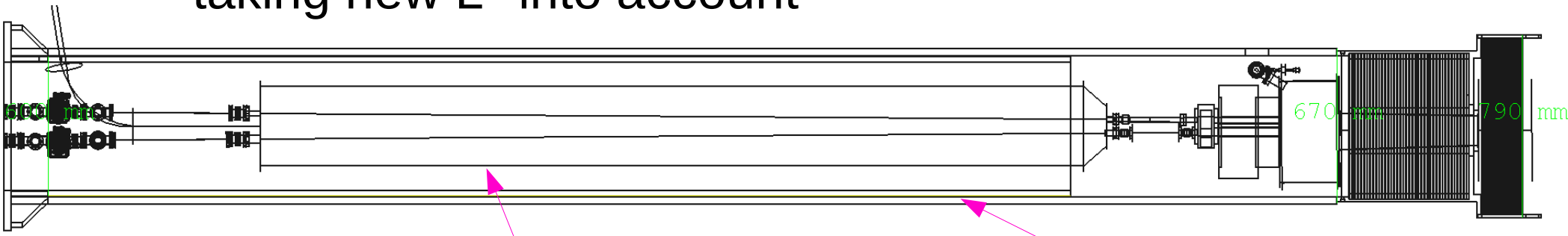
this region probably has a significant influence on
backscattered backgrounds

very detailed design of QD0 cryostat, magnets, cryogenics
do not attempt to model precisely in simulation





update model: simulate most material in detailed model, taking new L* into account

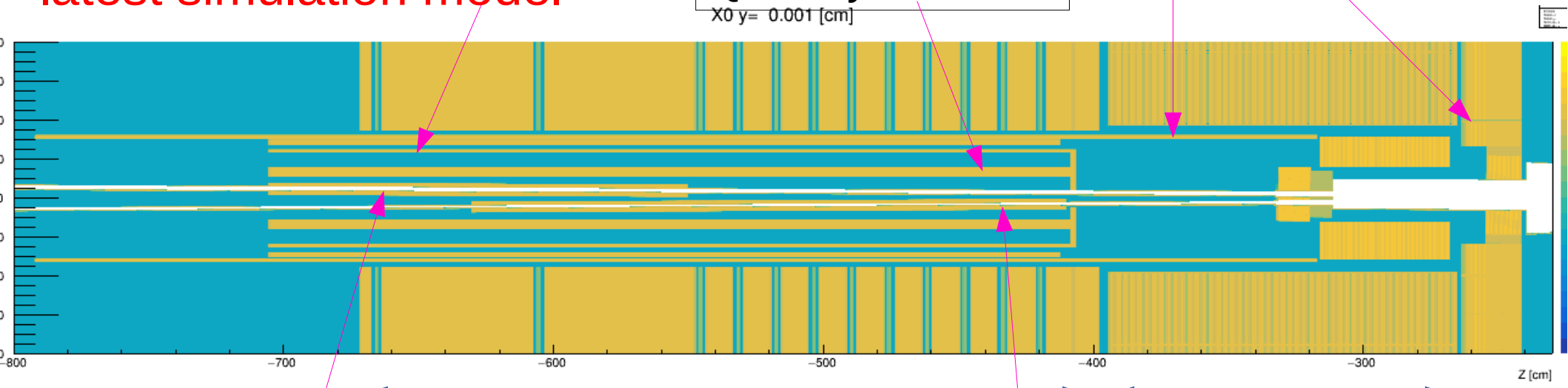


cryostat wall, support

outer support tube

other materials in QD0 cryostat

latest simulation model



yoke

HCAL endcap

ECAL ring

QDEX1A magnet (outgoing beam)

QD0 magnet (incoming beam)

summary of recent changes for forward region in simulation:

- hole in Yoke endcap: dodecahedron → square; increased size
  [to fit support tube]

- implemented QD0/QDEX1A magnet material, QD0 cryostat, support tubes

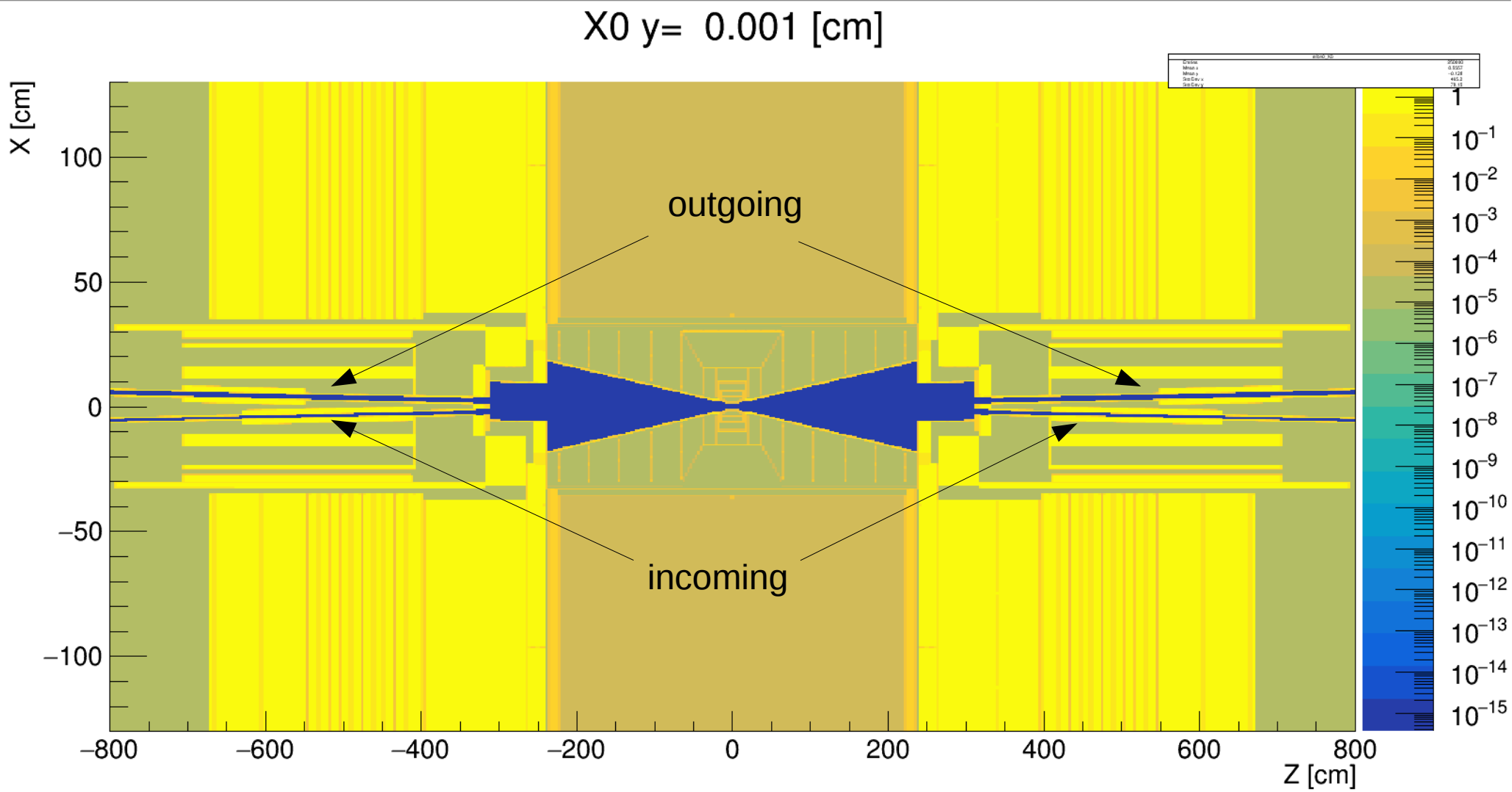
- some adjustment of up/down-stream beampipe radii and thicknesses

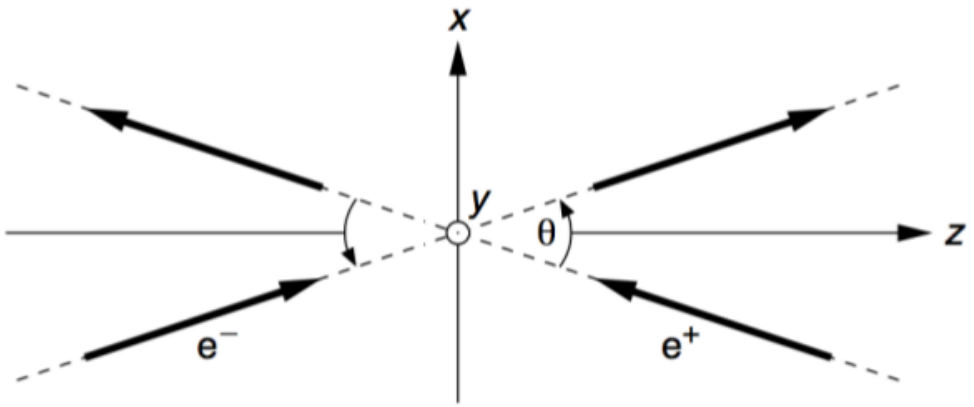
- remove magnets further out: QF1, …
  [should have no effect on ILD]

- DD4hep bug fix: multipole fields definition

- implement ideal quadrupole fields in forward magnets QD0, QDEX1A

- update DD4hep scanning utility (“graphicalScan”) to visualise fields





beam pipe orientation consistent with ILD conventions & rules document

Figure 1: Top view of a coordinate system with a crossing angle geometry with $\theta_{cr} > 0$. The y-axis in pointing towards the viewer. In this picture, both beams are in the horizontal plane. The figure is taken from EDMS Document D*914315 .

Magnetic Fields

To correctly model the trajectories of low energy backscattered particles, should model magnetic fields relatively accurately

Simulated fields now defined in “ILD_common_v02” directory: consistent application across different models

Ideal Solenoid:	Field_Solenoid_Ideal.xml
Realistic Solenoid:	Field_Solenoid_Map.xml
Anti-DID:	Field_AntiDID_Map.xml
Ideal quadrupole fwd magnets:	Field_FwdMagnets_Ideal_500GeV.xml
	Field_FwdMagnets_Ideal_250GeV.xml

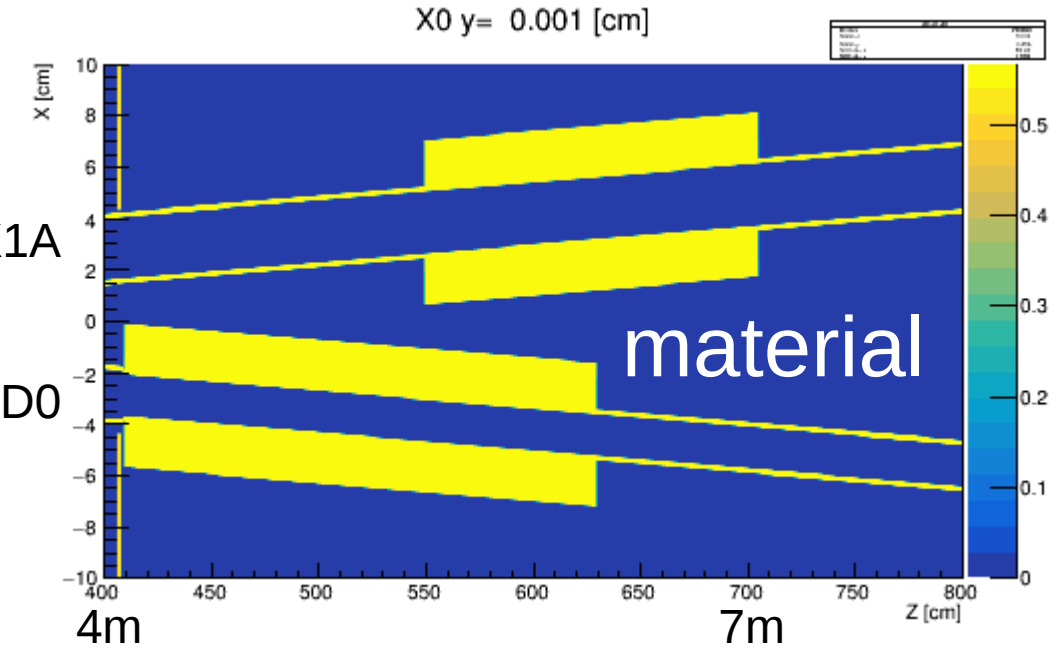
forward magnets: ideal quadrupole fields inside beampipe

precise field strengths for QD0 from KEK accel. expert Okugi-san

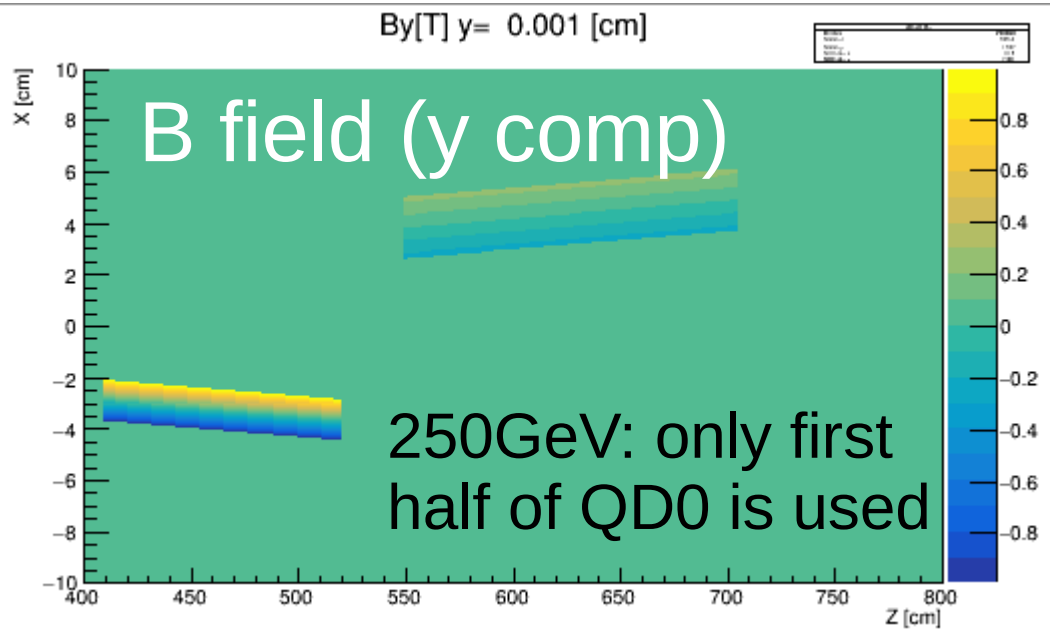
linear extrapolation from old 1 TeV design for extraction magnet QDEX1A

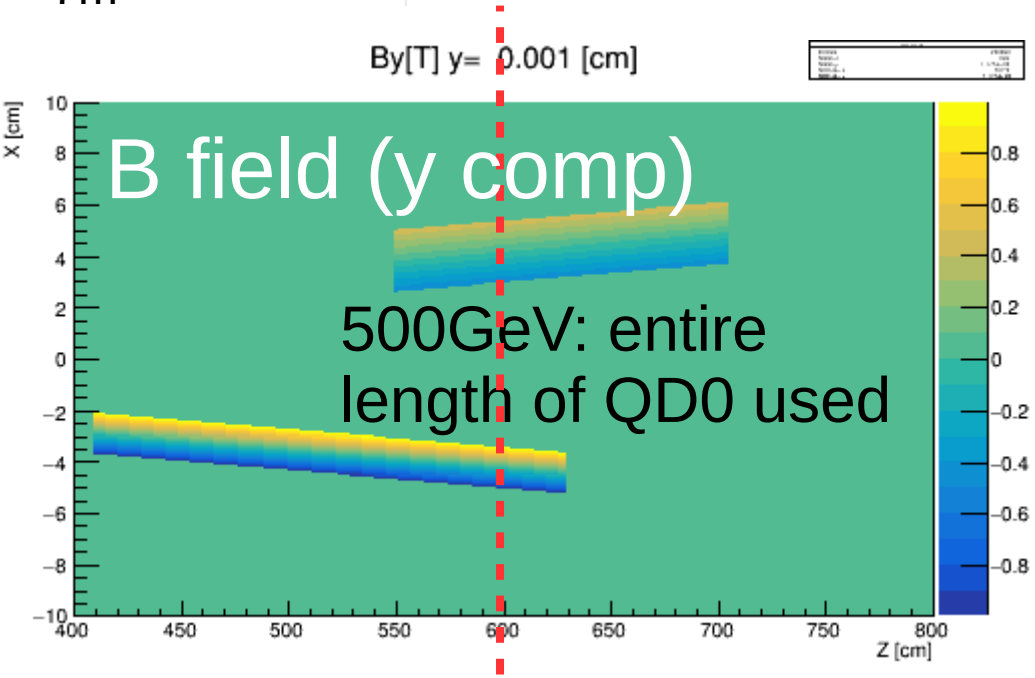
outgoing, QDEX1A

incoming, QD0

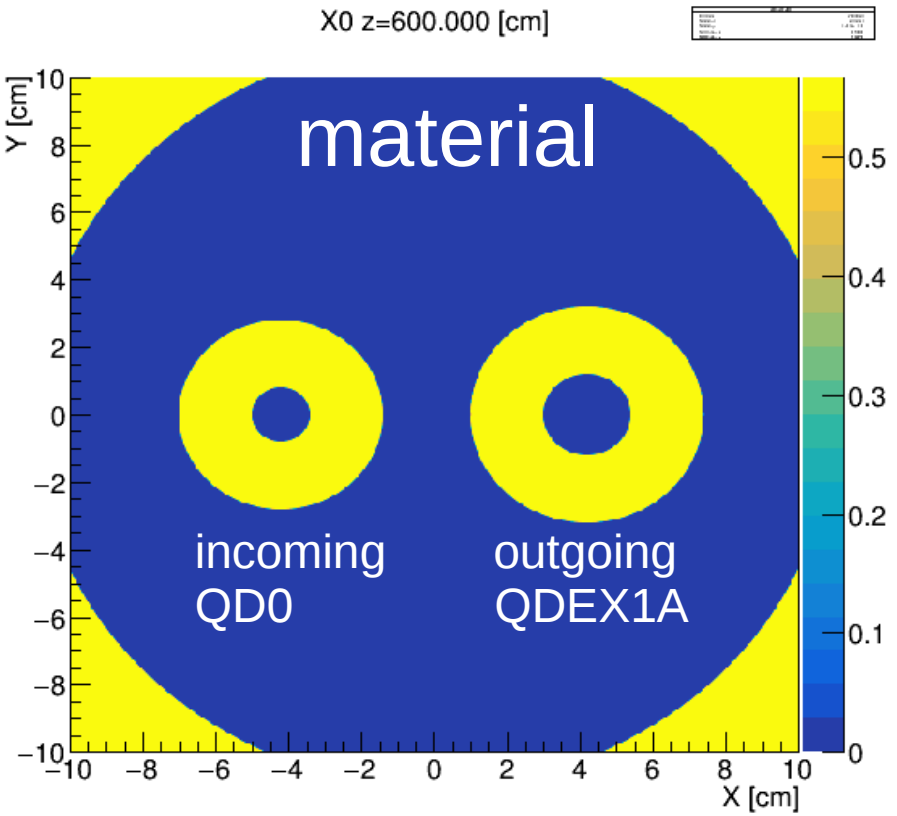


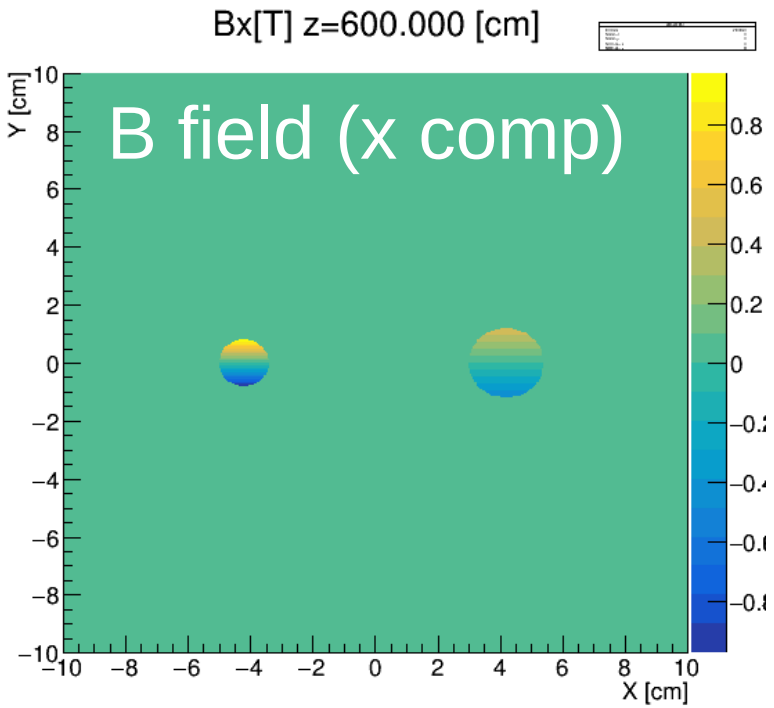
[no leakage fields from forward magnets]

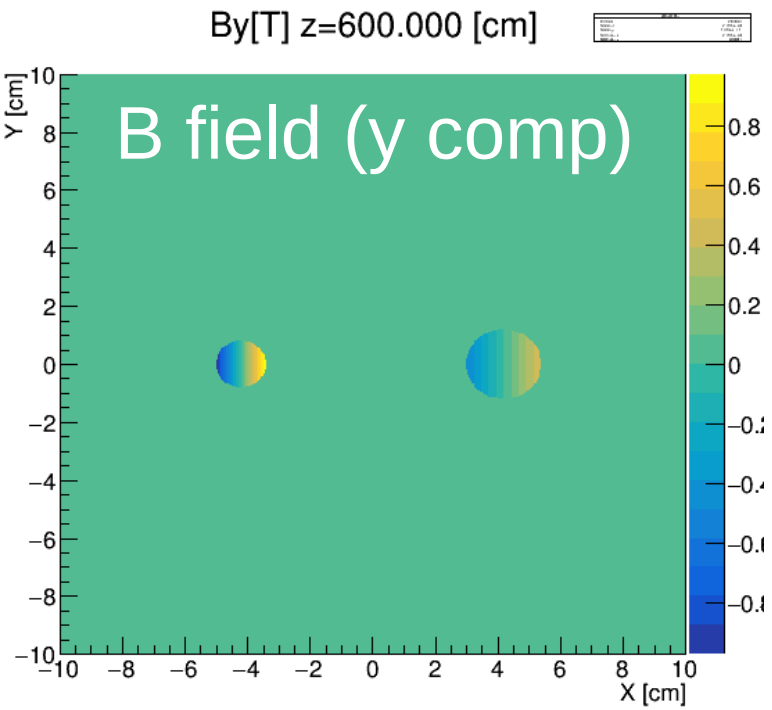




forward magnets:
ideal quadrupole fields
@ z = 6 m, 500 GeV

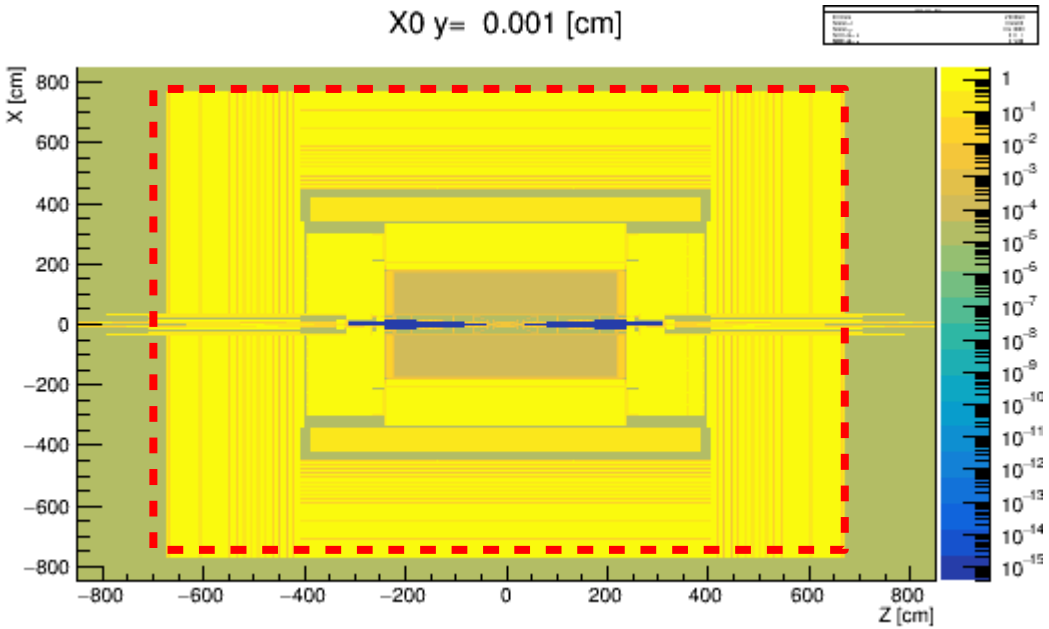




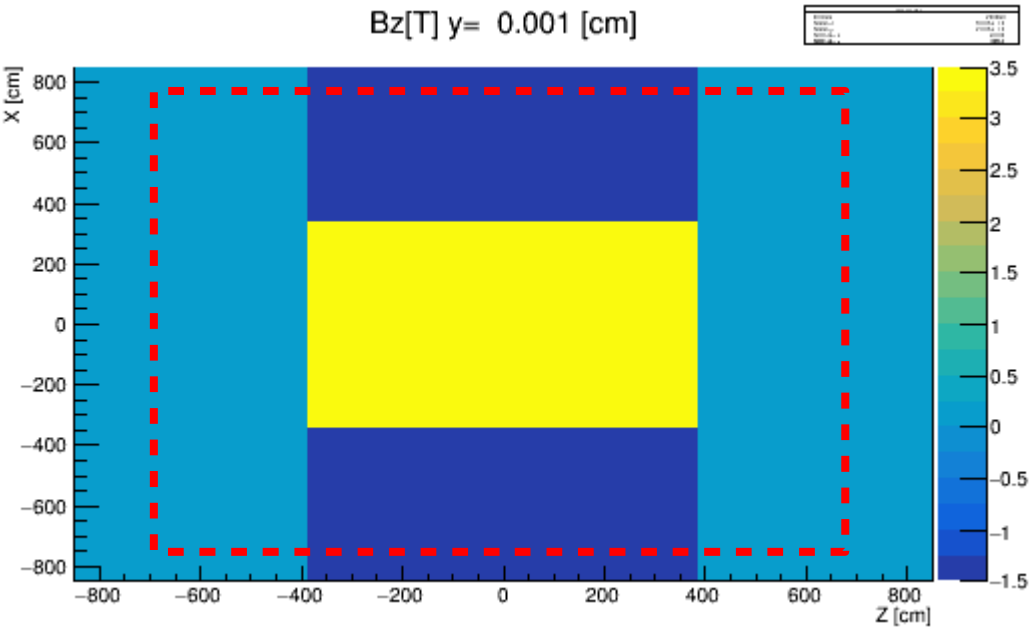


ideal solenoid field

material



B_z



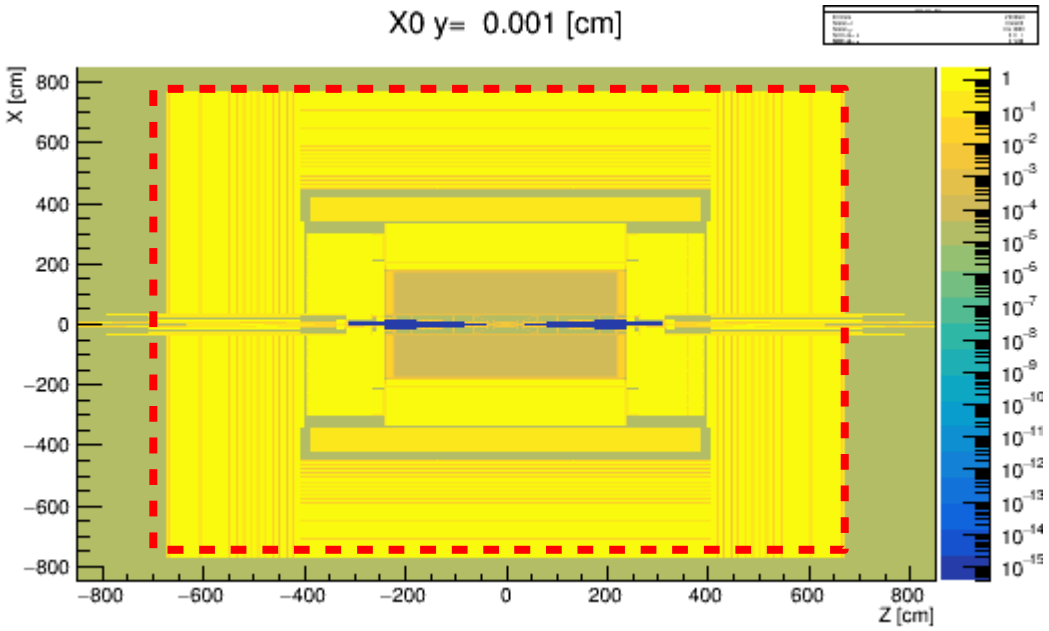
+ 3.5 T

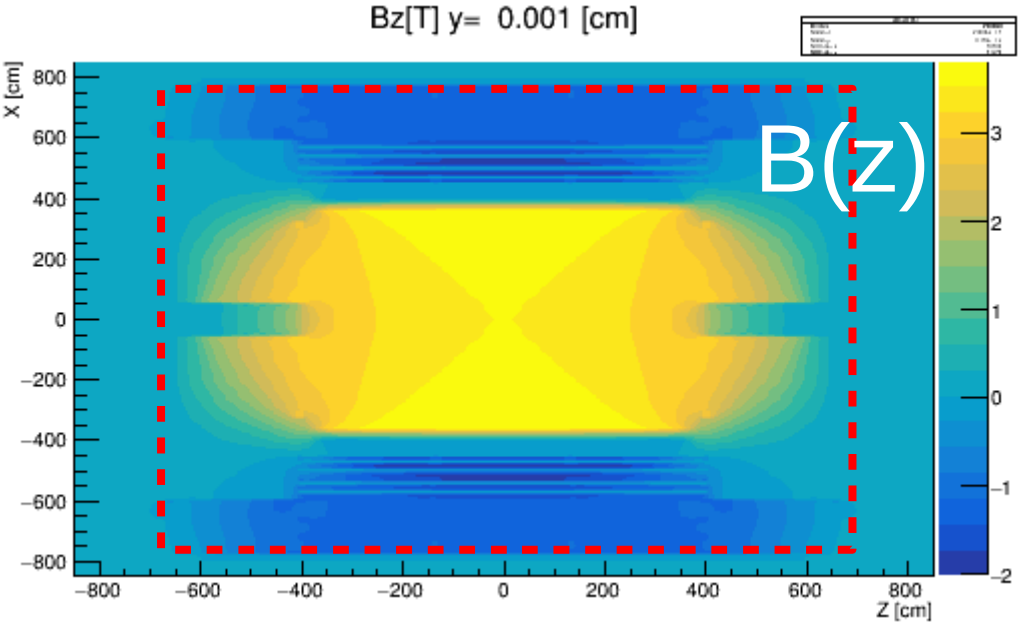
- 1.5 T

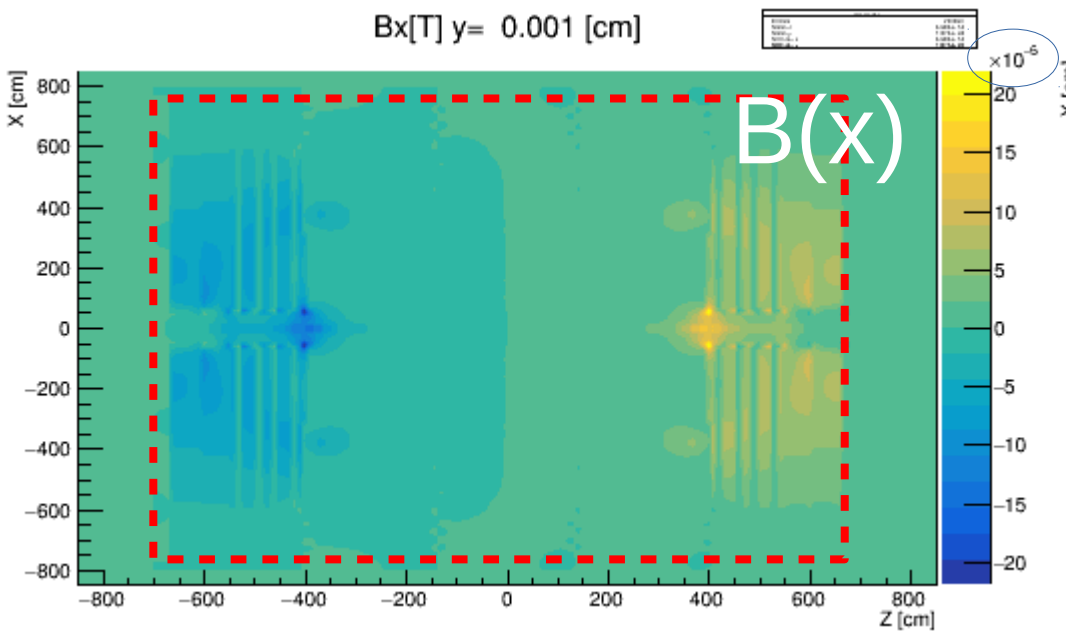
0 T

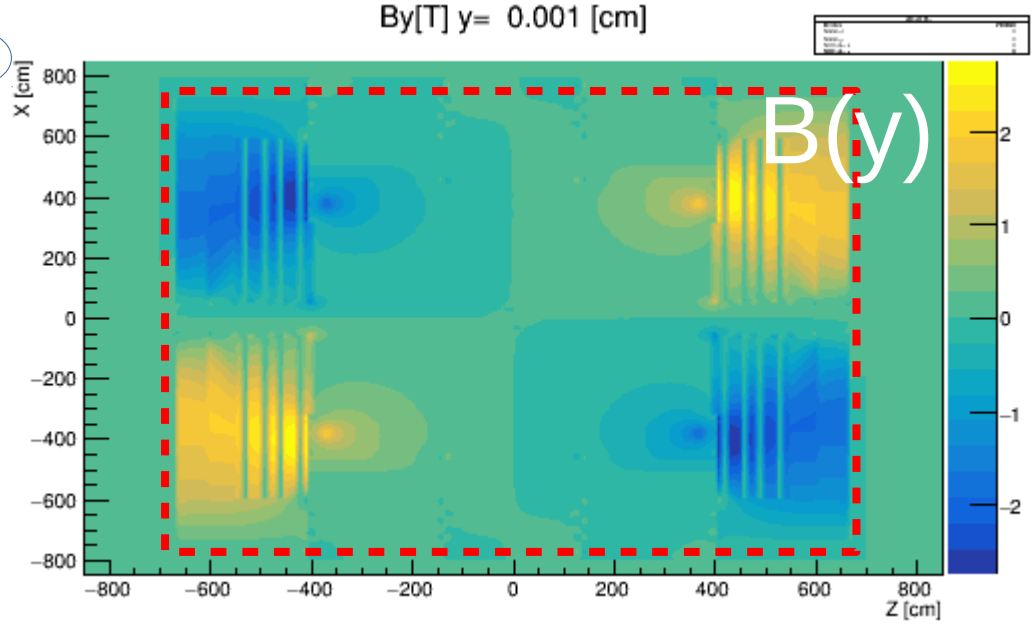
detailed solenoid field map

${lcgeo_DIR}/fieldmaps/ild_fieldMap_Solenoid3.5T_StandardYoke_10cm_v1_20170223.root



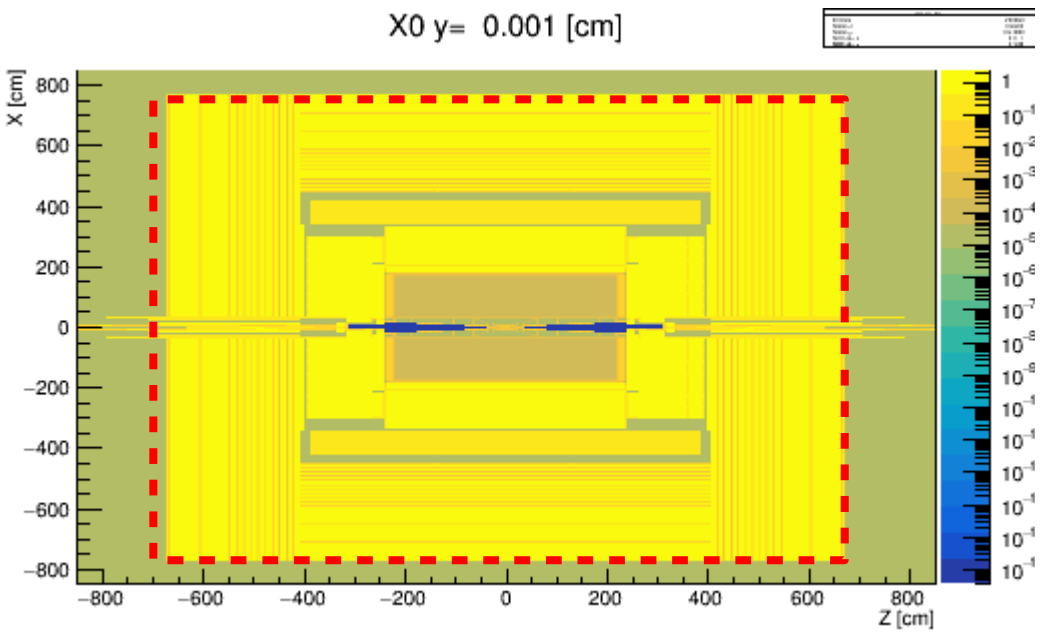


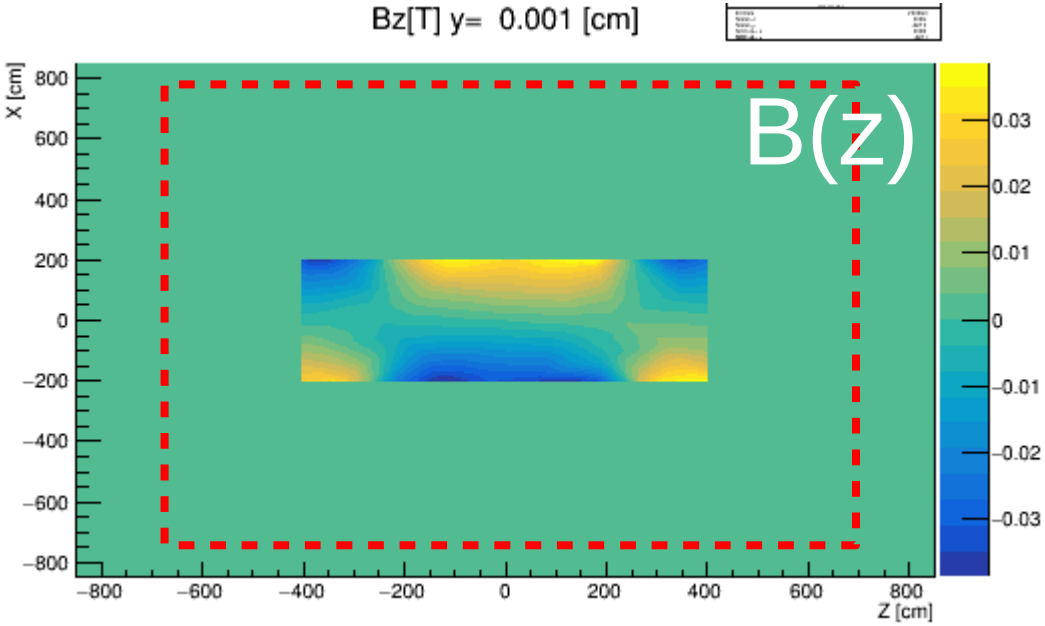


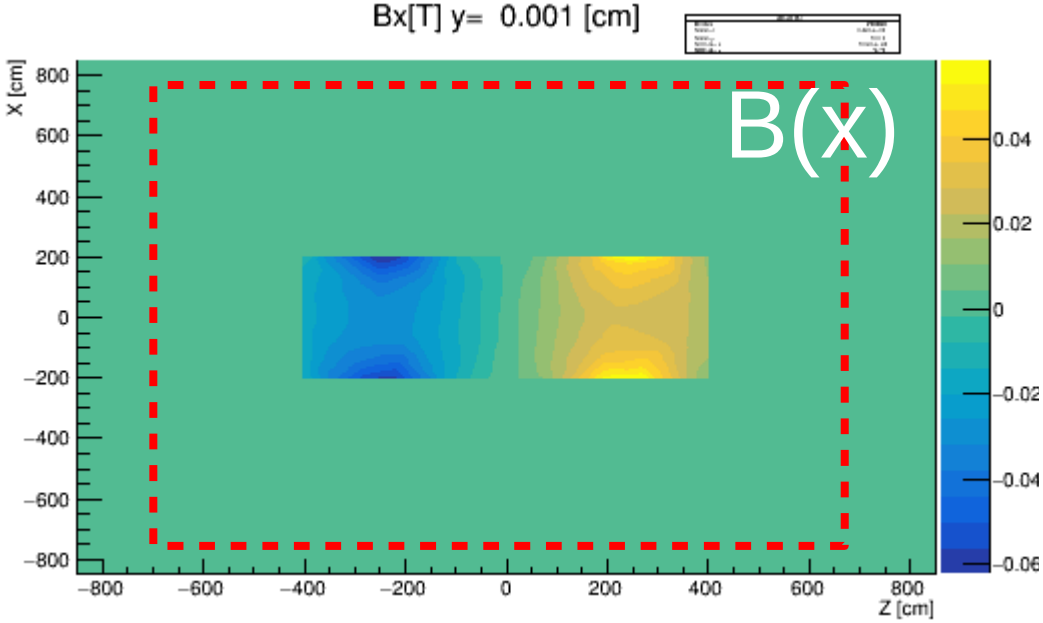


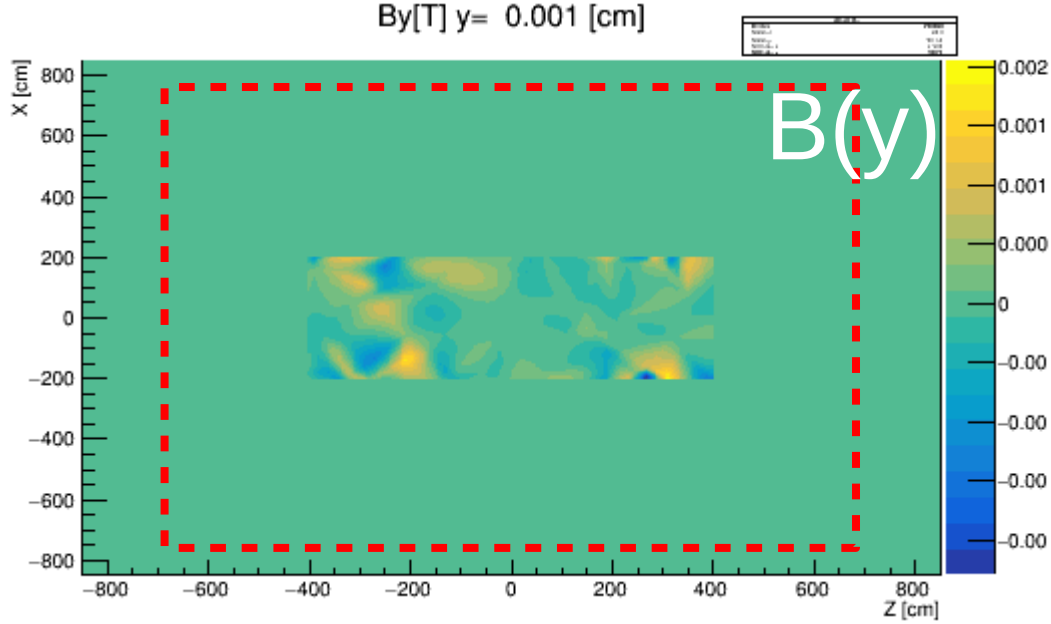
detailed antiDID field map

${lcgeo_DIR}/fieldmaps/ild_fieldMap_antiDID_10cm_v1_20170223.root

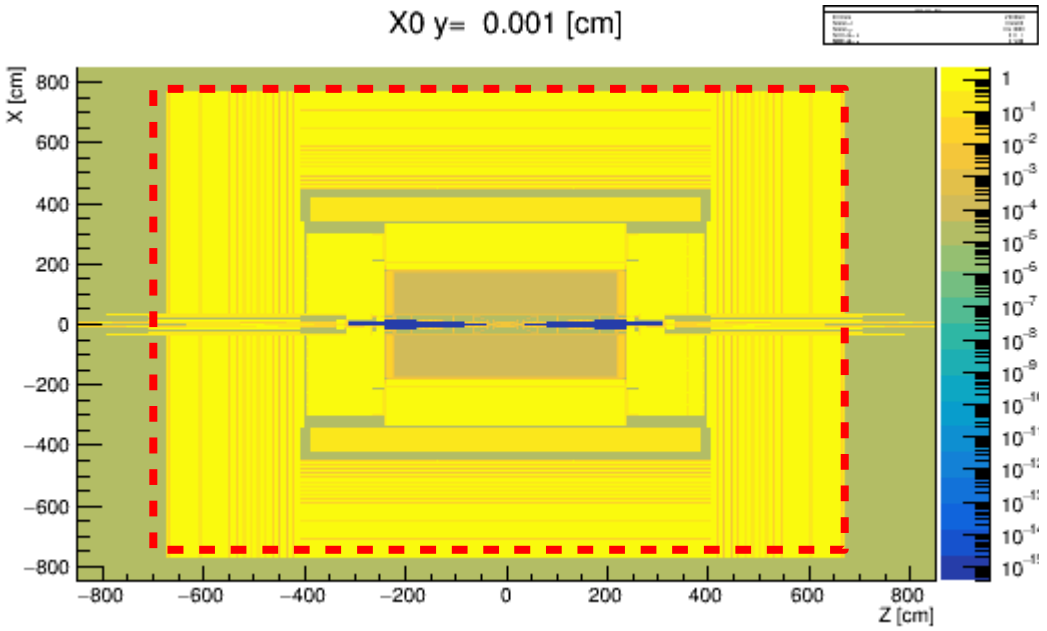


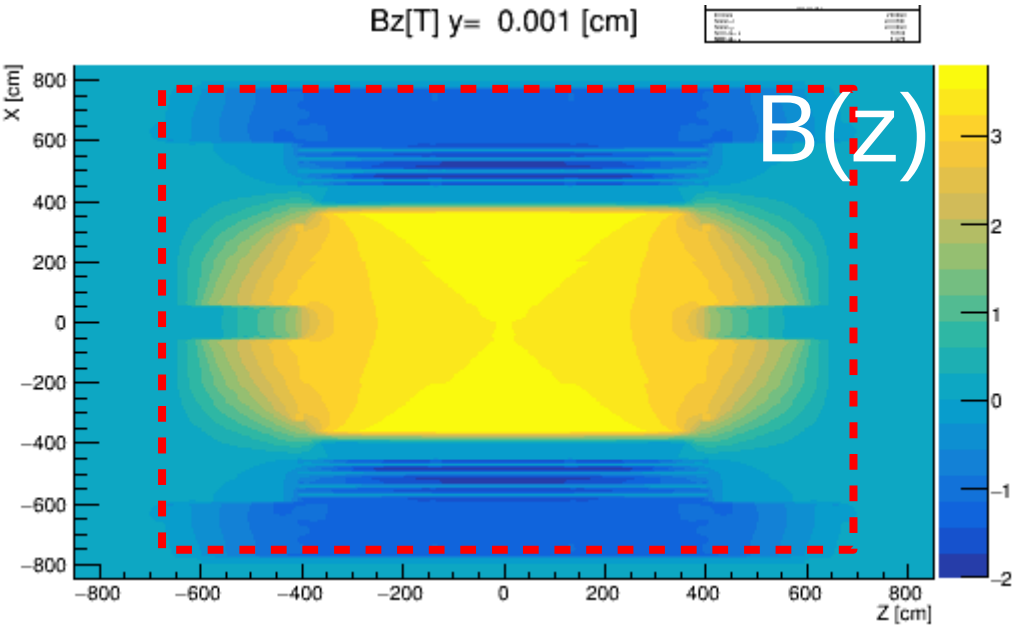


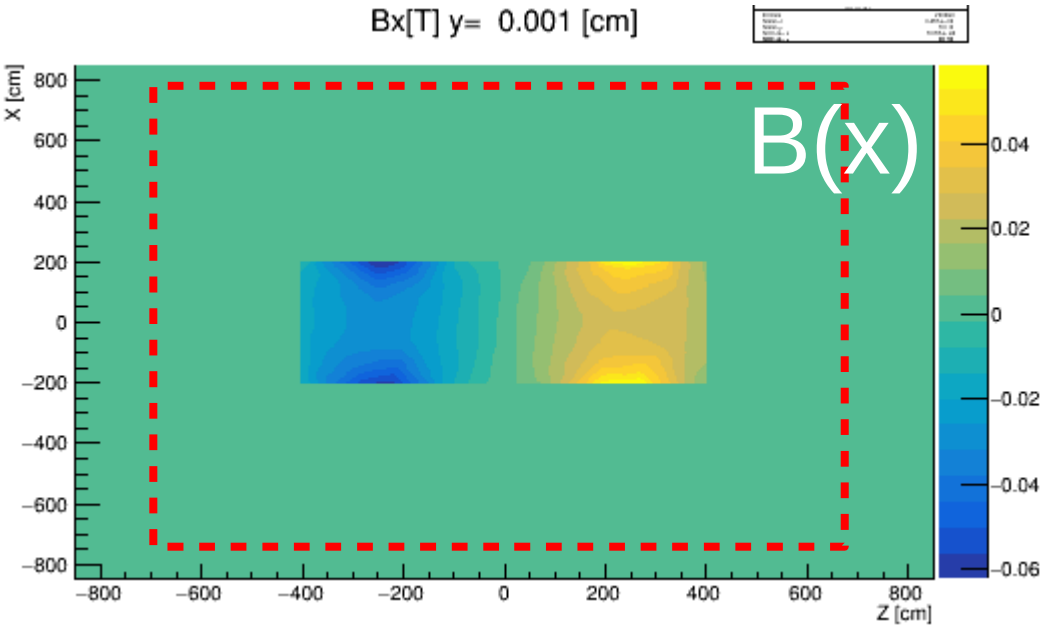


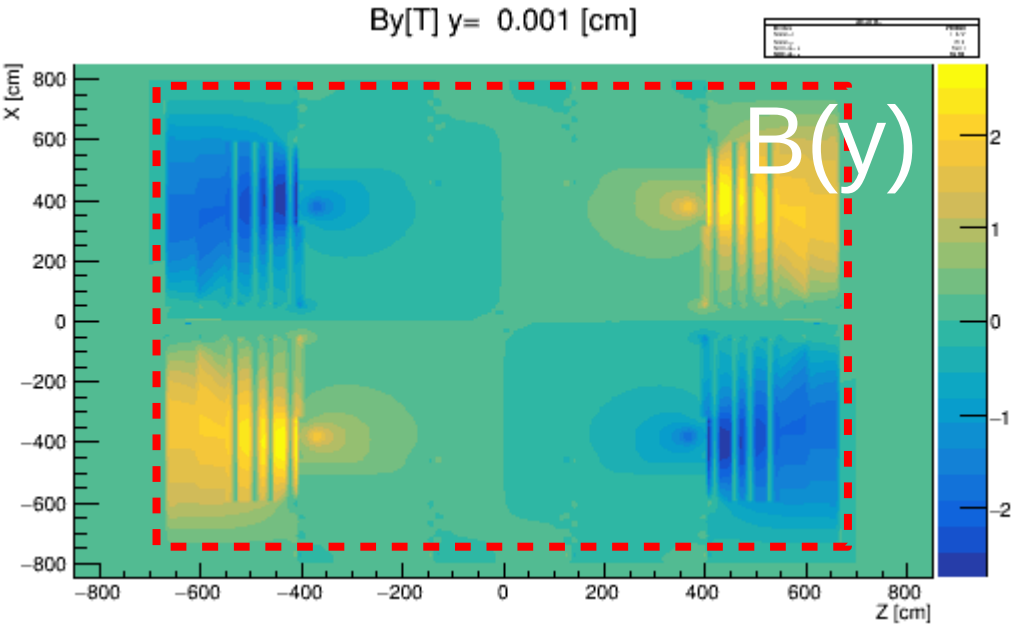


solenoid map + antiDID map + fwd fields









proposal for new ILD model versions

For general physics studies:

ILD_l5_v02	large DBD-like model, hybrid calo simulation, ideal solenoid
ILD_l5_o(1→4) _v02	the above simulation, reconstructed with particular calo options
ILD_s5_[o(1→4)]_v02	same, but for small ILD model

For detailed background studies:

ILD_[l/s]5_[o(1→4)]_v03 same, but with detailed solenoid map, forward fields for 250 GeV

ILD_[l/s]5_[o(1→4)]_v04 same, but with detailed solenoid map, forward fields for 500 GeV

ILD_[l/s]5_[o(1→4)]_v05 same, but with detailed solenoid + antiDID map, forward fields for 250 GeV

ILD_[l/s]5_[o(1→4)]_v06 same, but with detailed solenoid + antiDID map, forward fields for 500 GeV

Summary

updated description of forward region
- important for understanding beam backgrounds, need for anti-DID

significant extra material: QD0 cryostat, support tubes

description of fields:
- ideal solenoid → general simulation
- detailed field map : solenoid, anti-DID → bg studies
- ideal fields in forward magnets

detailed field maps now available for large ILD model and are being prepared for the small model.

all of the above is in a lcgeo pull request

open issues:

- main physics simulations done with uniform solenoid field
  - should we include the forward fields?
  - I suggest not, since:
    - they depend on energy → model proliferation
    - (I guess) ~no effect on physics samples
  - [current pull request does include these fwd fields, for 250 GeV]

- I don't see field maps for small detector in the expected place ${lcgeo_DIR}/fieldmaps/

- naming convention for models with realistic fields (no/Antidid, 250/500)
  - ILD_(ls)5_o(123)_v03..4..5..6

  - but the detector material, drivers identical…
  - ILD_(ls)5_o(123)_v02_realField_250
  - ILD_(ls)5_o(123)_v02_realFieldAntiDID_250
    - …. ?

- now a lot of duplication between model descriptions
  - prepare template + script to automatise, avoid inconsistencies ?

I think none of these need hold up the large-scale production