E-JADE is a Marie Sklodowska-Curie Research and Innovation Staff Exchange (RISE) action, funded by the EU under Horizon2020

E-JADE

Anti-DID Task Force Meeting - Introduction

Karsten Buesser

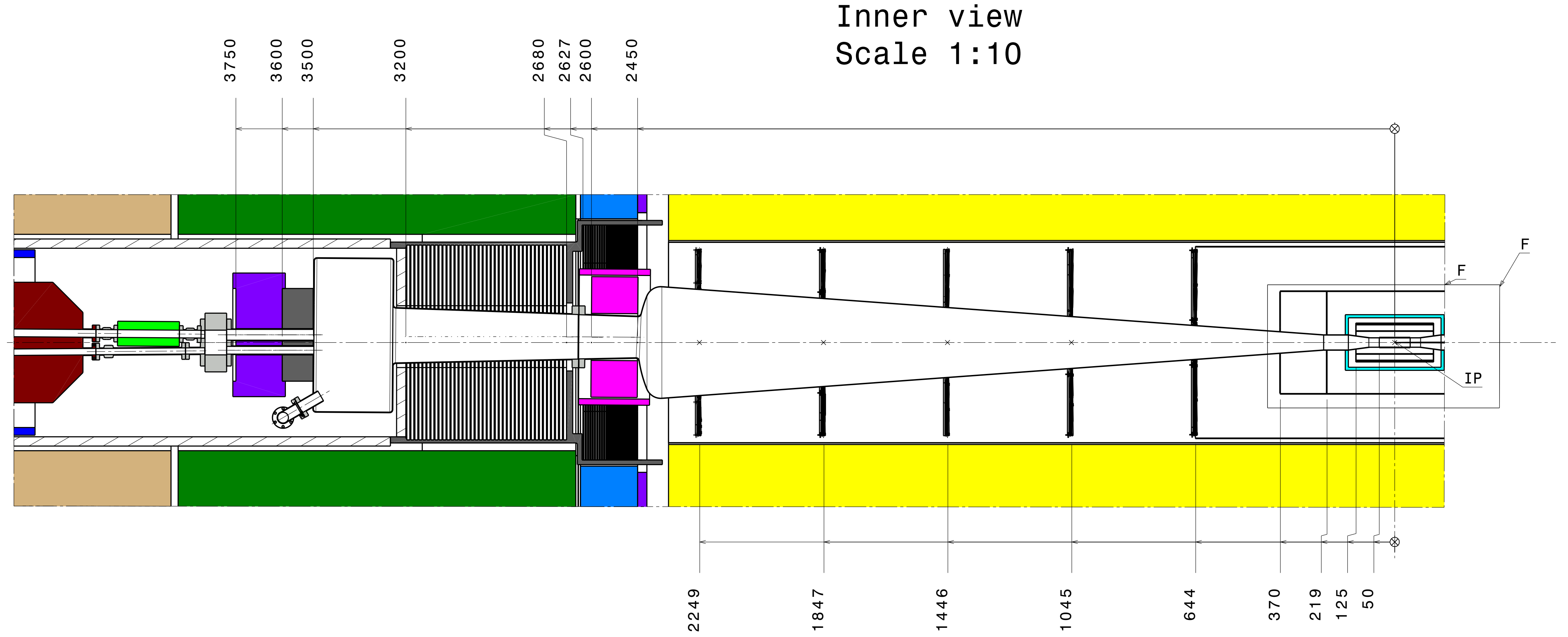
ILD Task Force Meetings

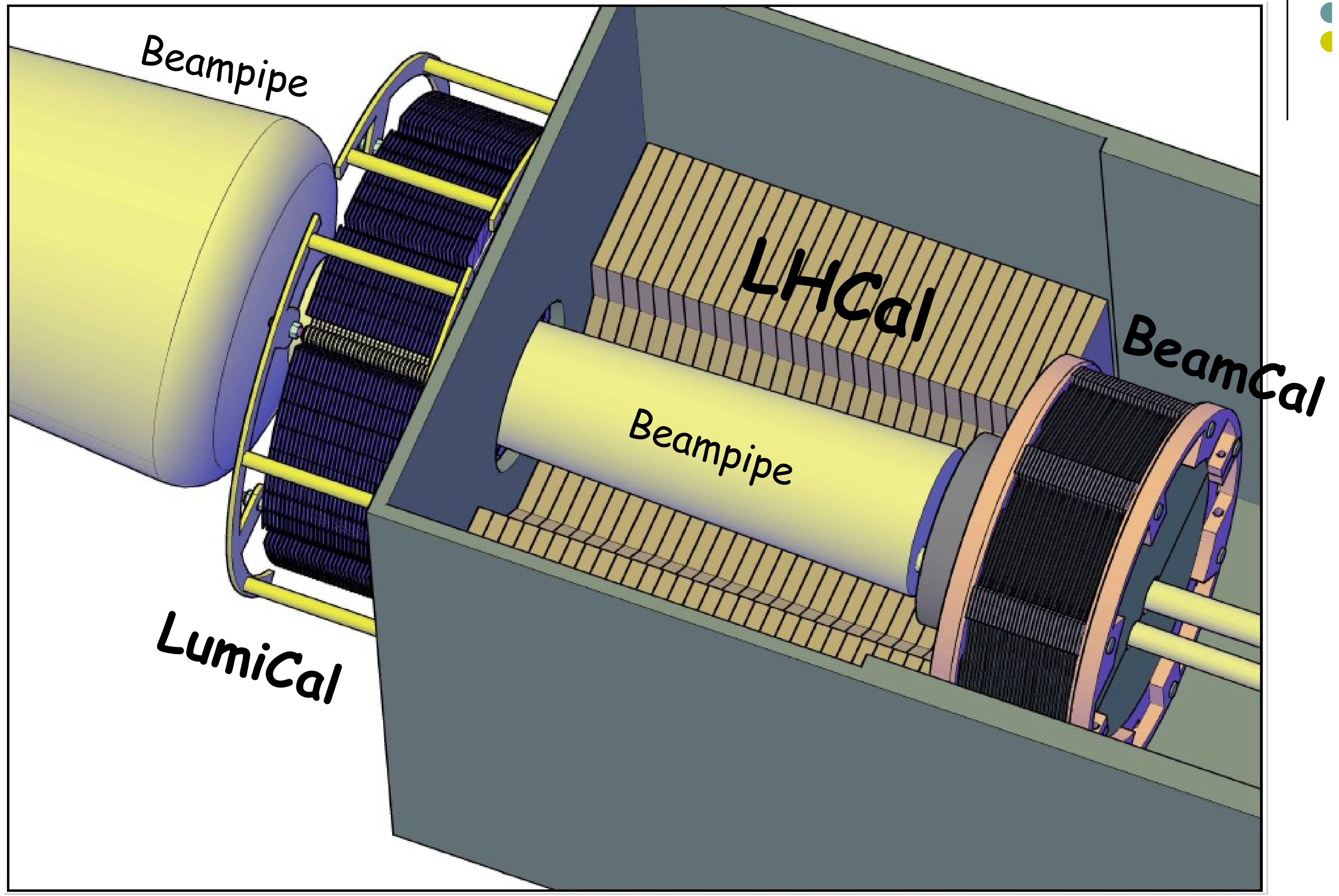
LAL
07.11.2016

L*

Forward Region Changes

- ILD had L*=4.4m
- Change Request for L*=4.1m accepted
  - plus additional 10cm for BPM on incoming beam
- Now:
  - remove vacuum pump (30cm)
    - beam-gas scattering under control (R. Karl)
    - new vacuum solutions under study (LAL)
  - re-design LHCAL/BeamCal
    - work done in FCAL collaboration (S. Schuwalow)
- Need to study:
  - impact on backgrounds
  - magnetic field configurations
  - integration scheme with realistic LHCAL





Anti-DID

Detector Integrated Dipole DID

- Paper from B. Parker and A. Seryi: PR ST 8, 041001 (2005)
- At this time ILC had still 20 mrad crossing angle
- Conclusion:

Compensation of the effects of a detector solenoid on the vertical beam orbit in a linear collider

Brett Parker*

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Andrei Seryi†

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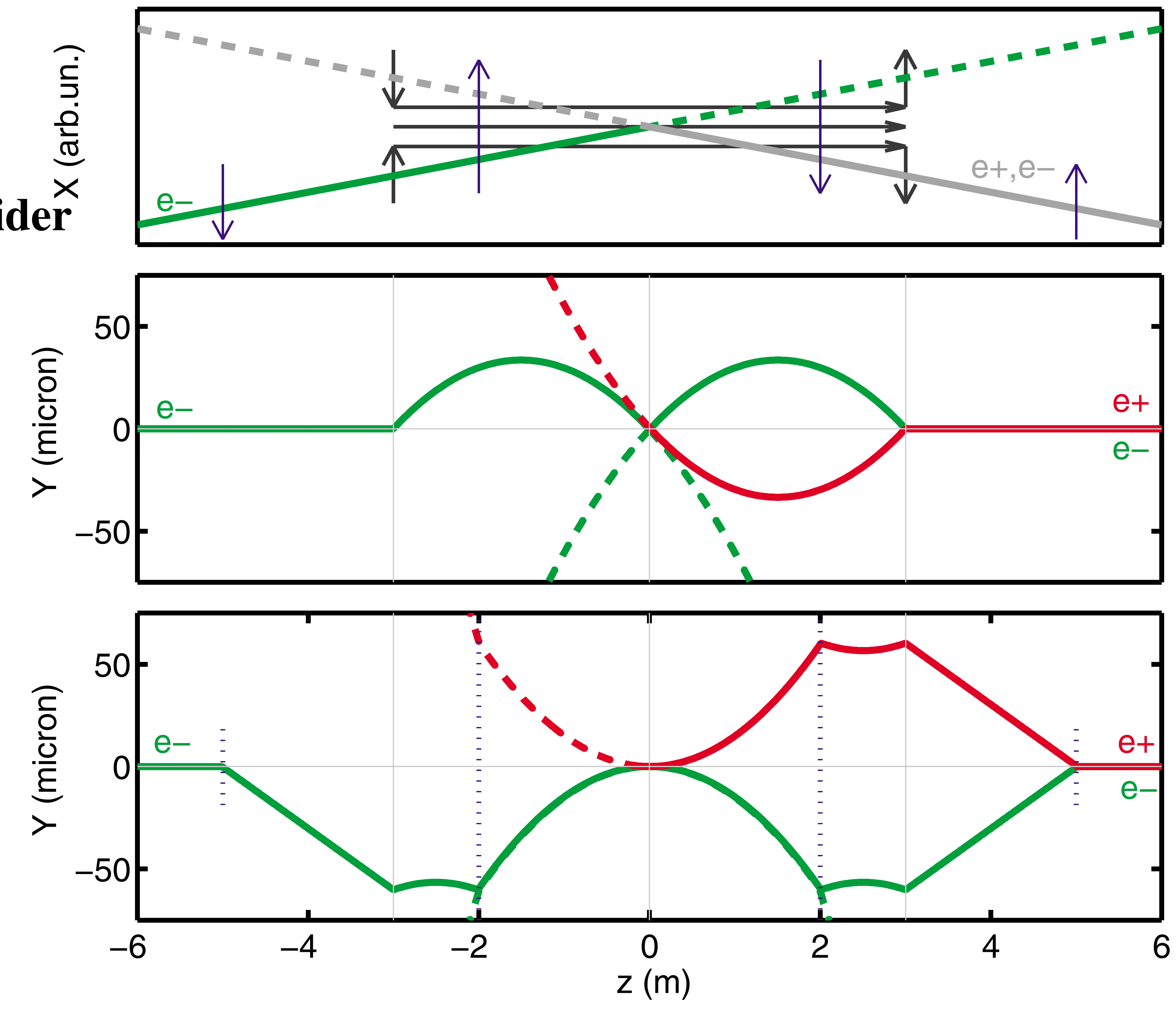
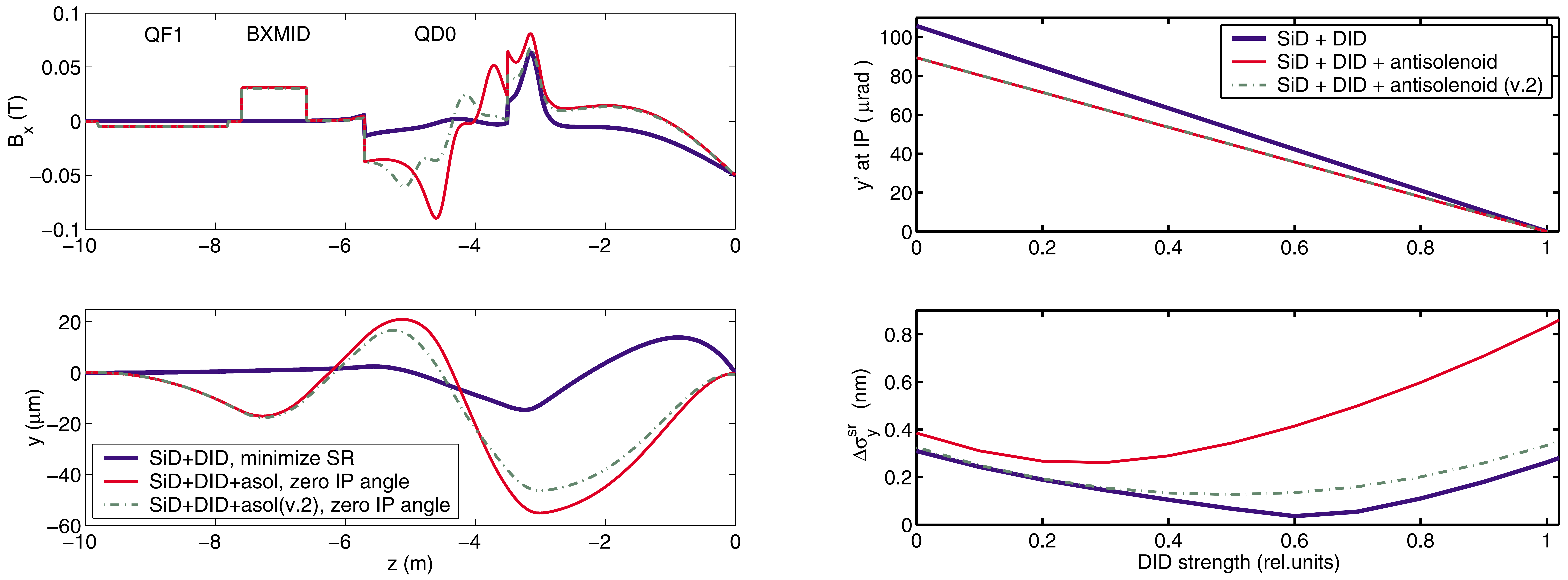
(Received 19 January 2005; published 1 April 2005)

This paper presents a method for compensating the vertical orbit change through the interaction region that arises when the beam enters the linear collider detector solenoid at a crossing angle. Such compensation is required because any deviation of the vertical orbit causes degradation of the beam size due to synchrotron radiation, and also because the nonzero total vertical angle causes rotation of the polarization vector of the bunch. Compensation is necessary to preserve the luminosity or to guarantee knowledge of the polarization at the interaction point. The most effective compensation is done locally with a special dipole coil arrangement incorporated into the detector (detector integrated dipole). The compensation is effective for both e^+e^- and e^-e^- beams, and the technique is compatible with transverse-coupling compensation either by the standard method, using skew quadrupoles, or by a more effective method using weak antisolenoids.



DID

- Correction of beam collision angle and minimisation of beam blow-up by synchrotron radiation:



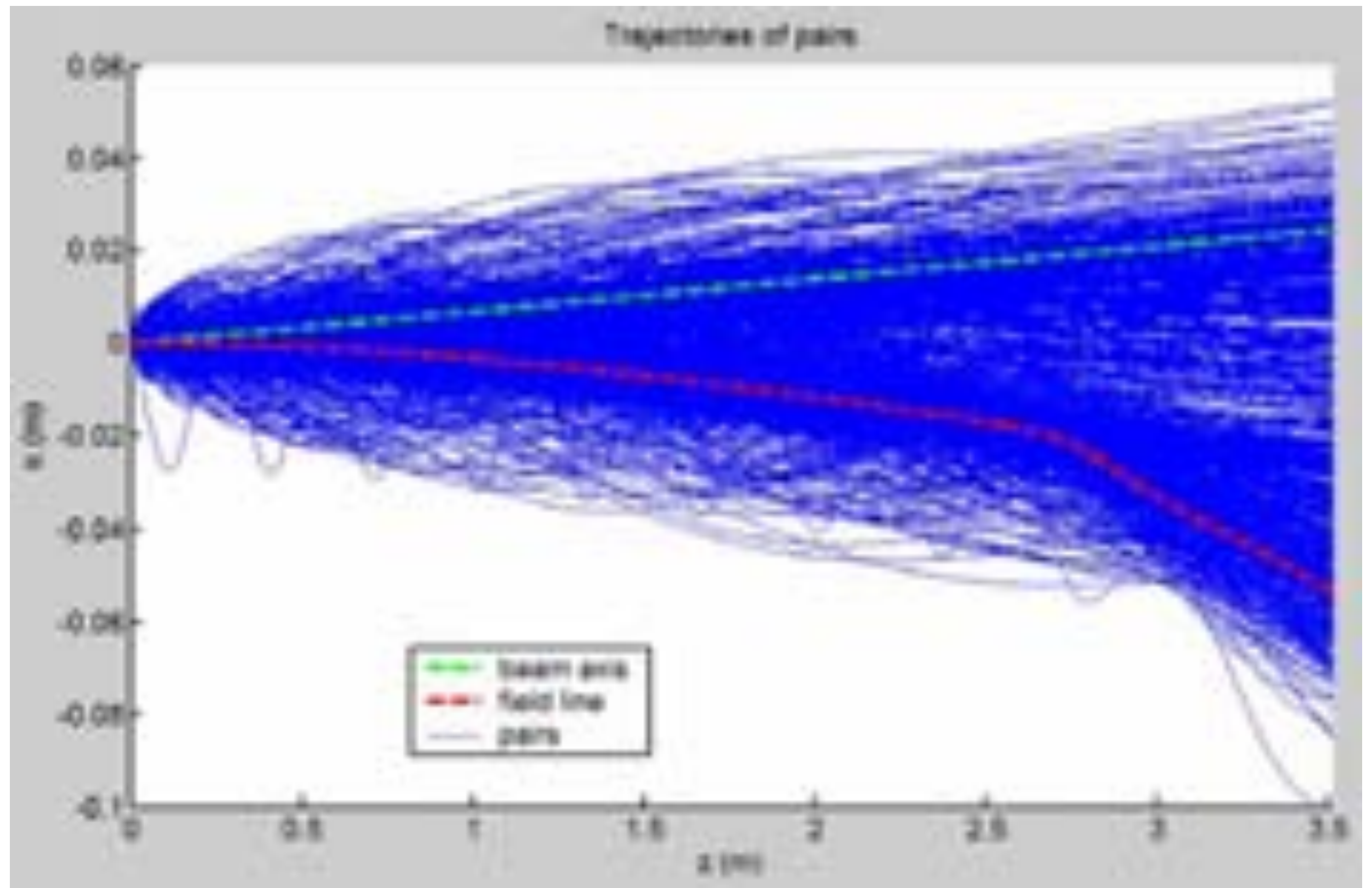
- Unfortunately this DID created large backgrounds from backscattered pairs from BeamCal….

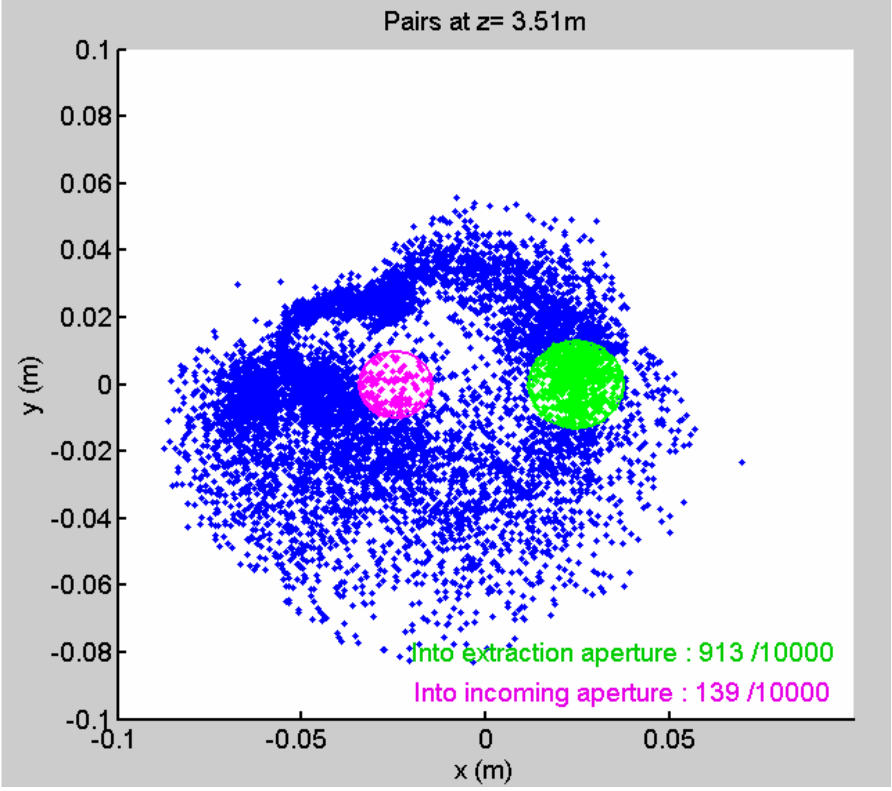
From DID to Anti-DID

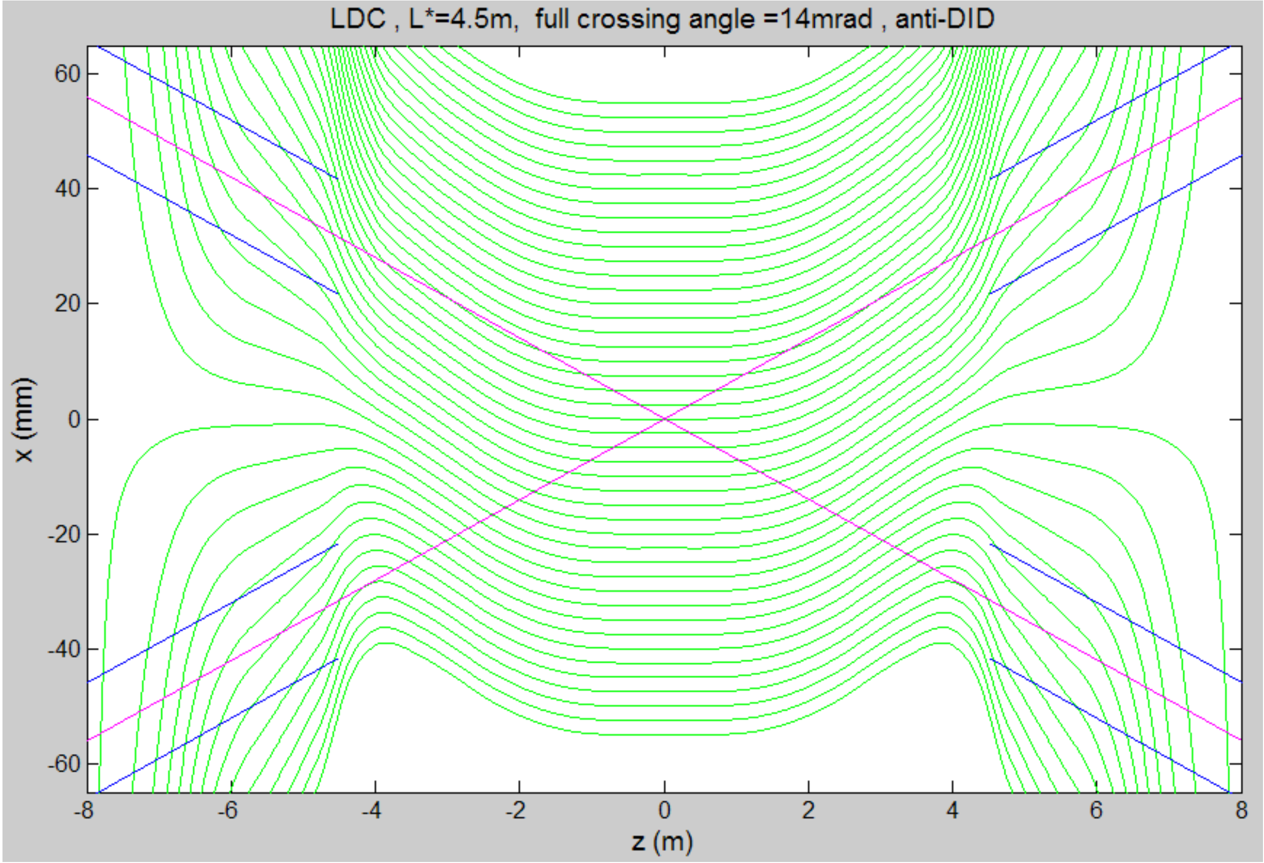
- Parker/Seryi reacted quickly to the Snowmass discussions on detector backgrounds: SLAC-PUB-11662
- Crossing angle was reduced to 14mrad
  - SR effects were strongly reduced
  - beam angle could be corrected with other magnets in the final focus
- Changing the polarity of the DID to Anti-DID turns the device from a „machine requirement“ to a „nice-to have for the detectors“
- Significant reduction of energy deposited on BeamCal

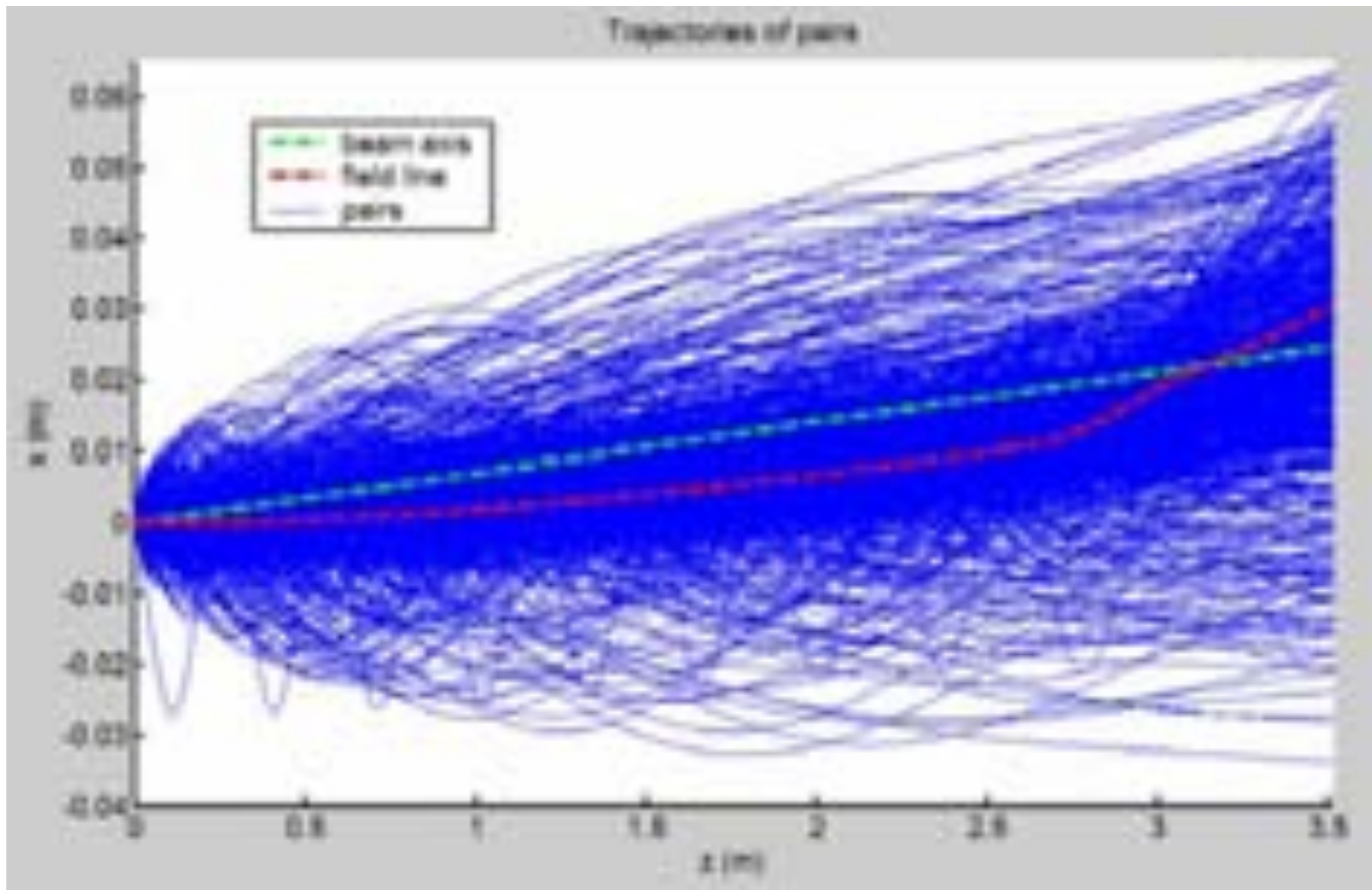
IR OPTIMIZATION, DID AND ANTI-DID*

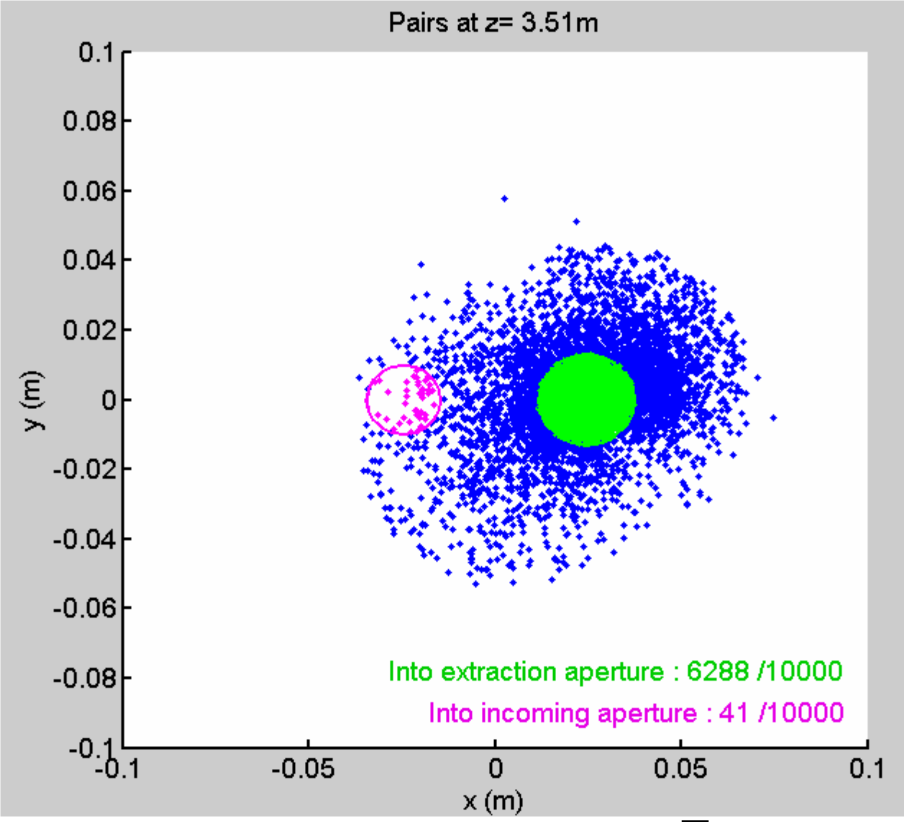
Andrei Seryi, Takashi Maruyama, SLAC, Stanford, CA, USA
Brett Parker, BNL, Upton, NY 11973, USA.





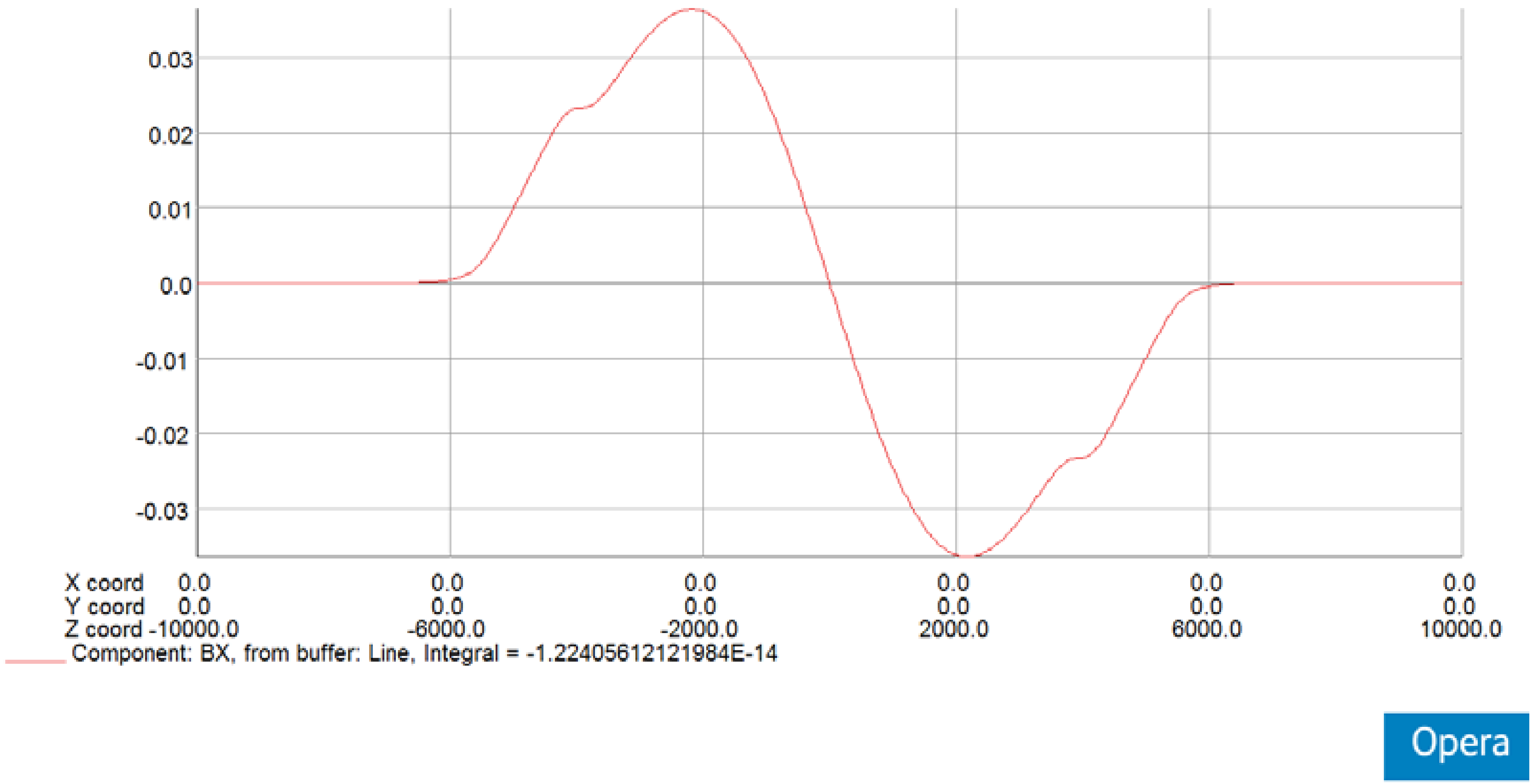






Anti-DID

- Detector Integrated Dipole
- Aligns integral magnetic field along outgoing beam (crossing angle)
- Mainly to reduce backgrounds on BeamCal
- Dipole windings around main solenoid
- this version is in the DBD:



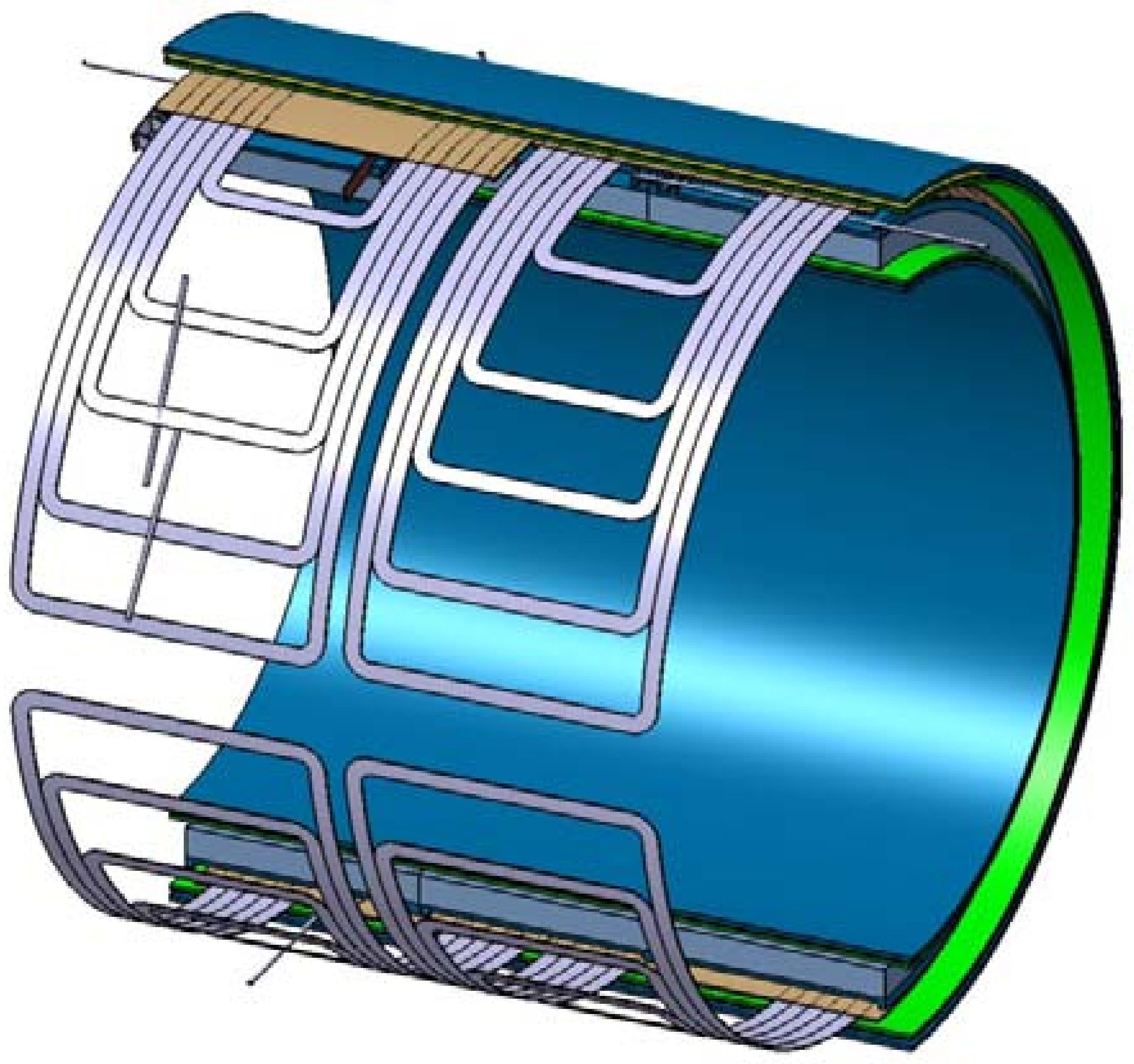
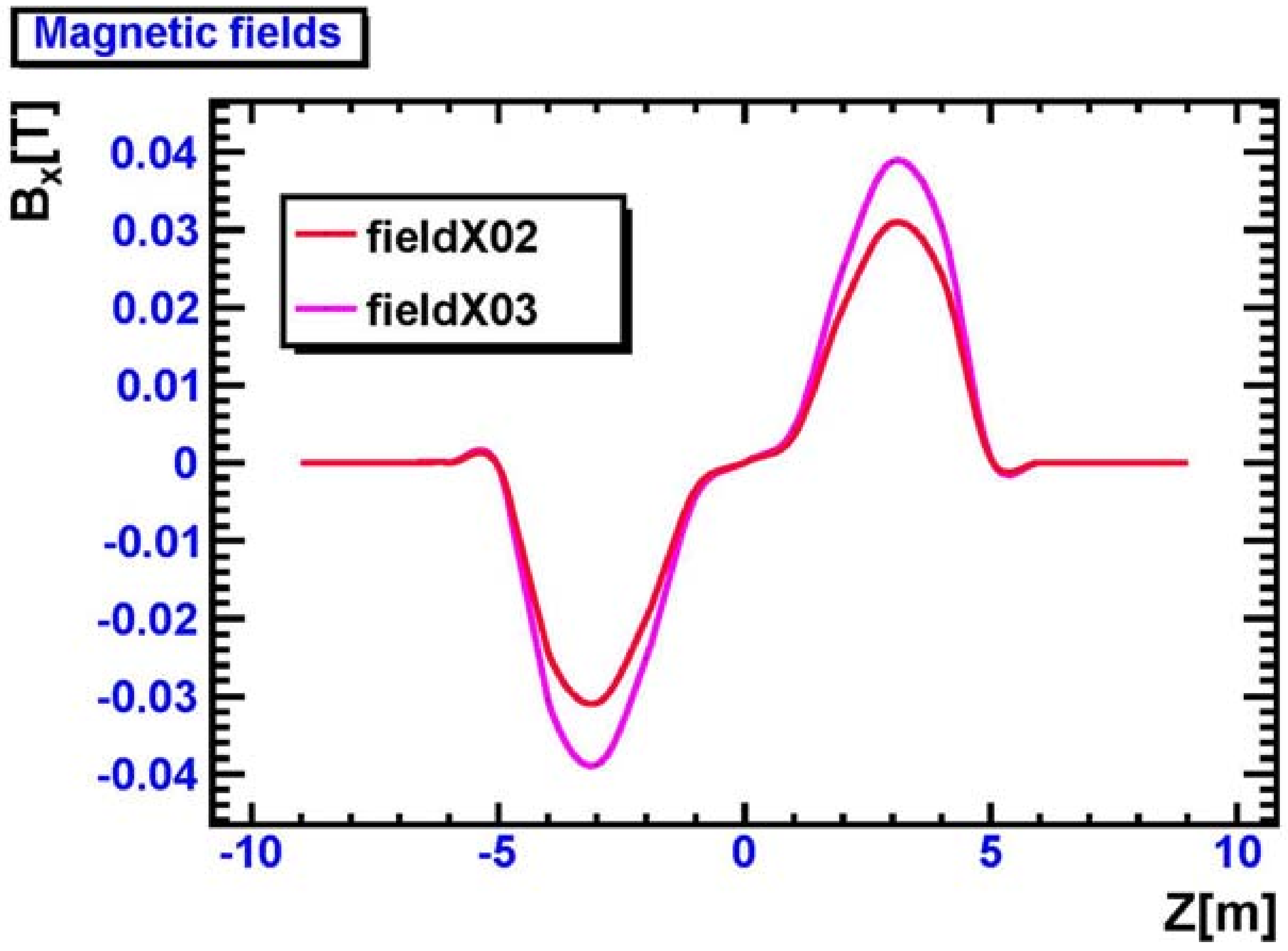


Figure 13: 3D view of the anti-DID (version 1).

LC-DET-2012-081

Anti-DID

- Field versions used in full detector simulations are significantly different
  - typically hand-tuned to minimise background levels on BeamCal
- maximum field at ~3m from IP
- nearly flat-top zone at IP
- Different designs have been used in studies of beam induced backgrounds:



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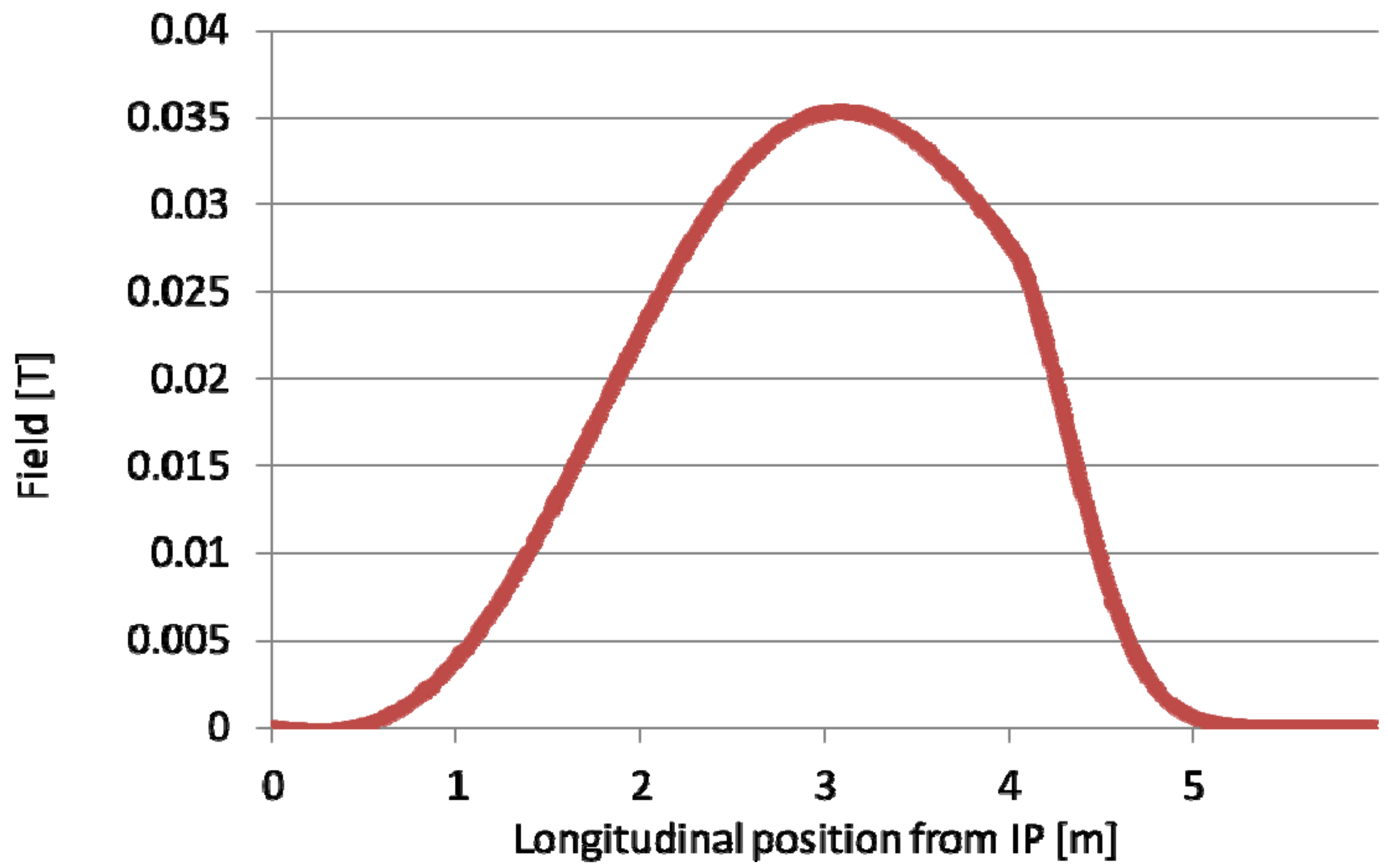
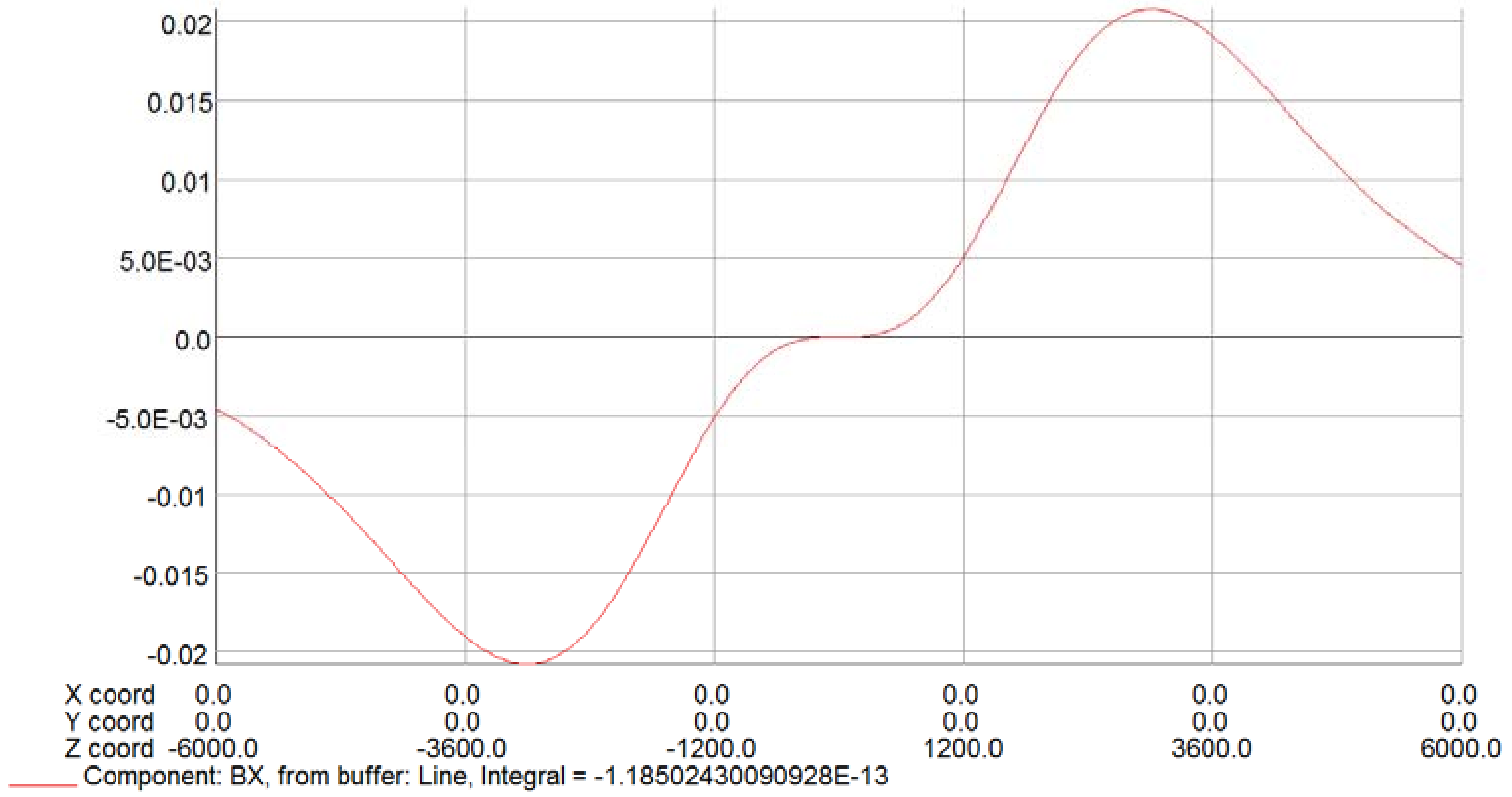
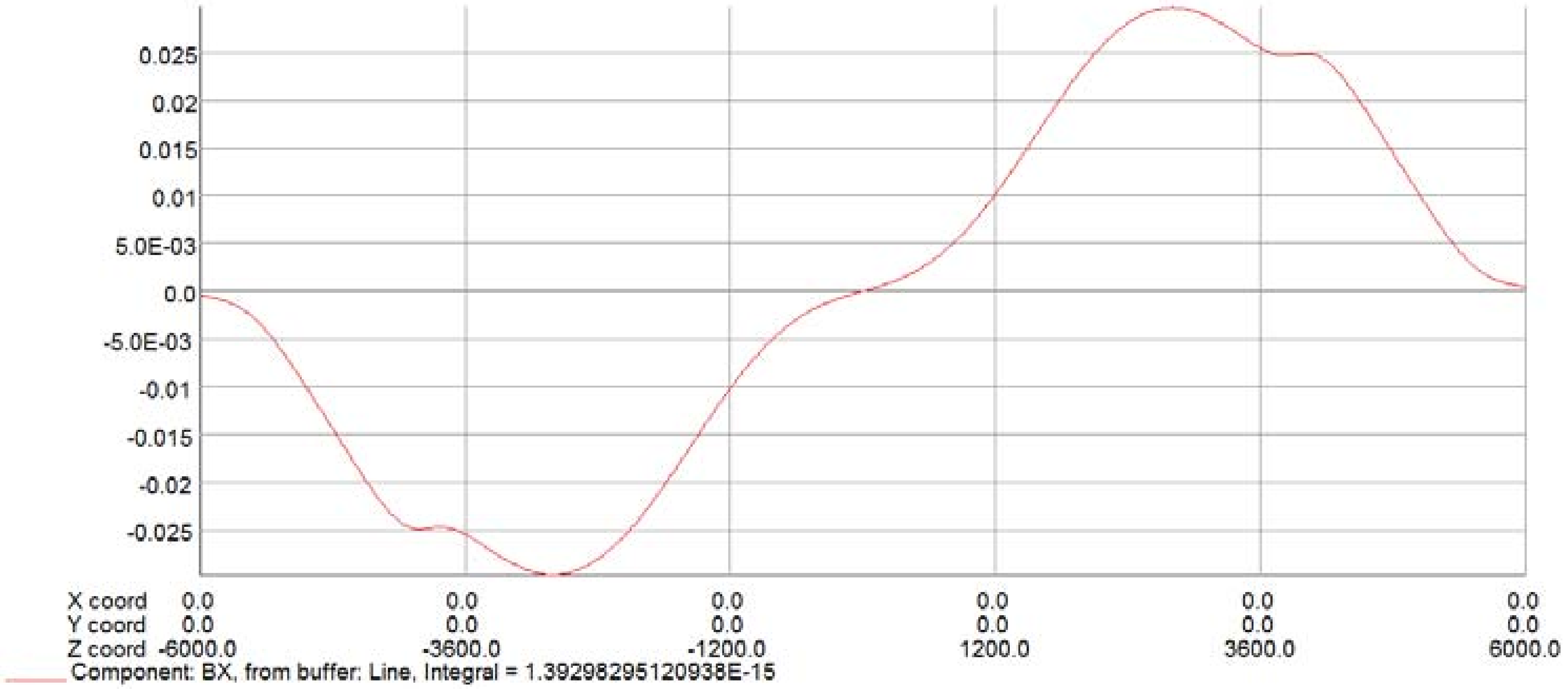


Realistic Anti-DID

- Requirement: maximum field at 3m from IP and zero field up to 0.5m from IP (as in simulations)
- Technically extremely complicated
  - dipoles need to be split in two parts
  - much higher currents
- Realistic field with yoke and solenoid is far from perfect
- Need round of optimisation between simulation group and magnet experts on how the DID should look like
  - FYI: SiD considers to abandon DID as „it cannot be built“



Top: Anti-DID alone;
bottom: Anti-DID, Solenoid within Yoke



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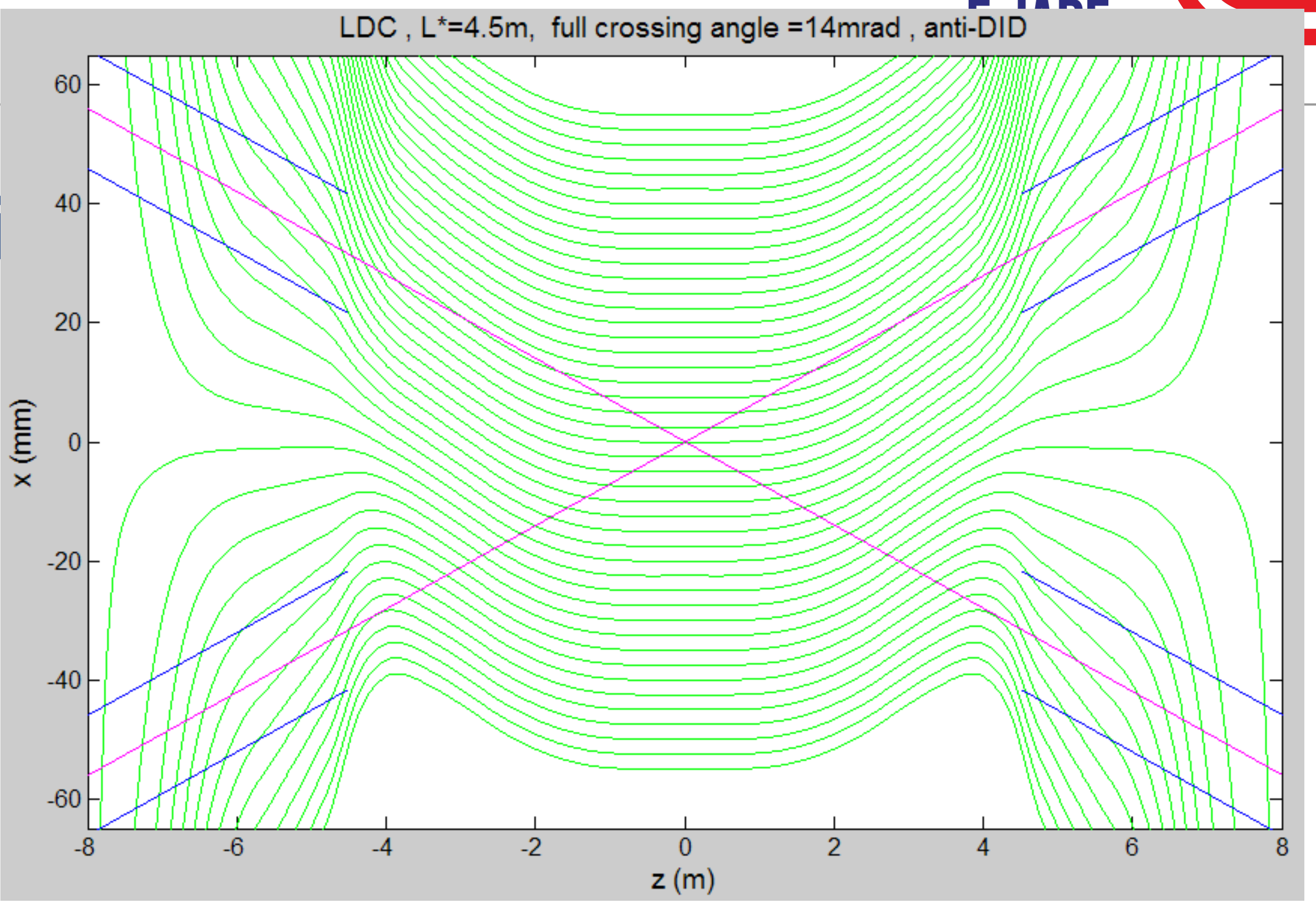
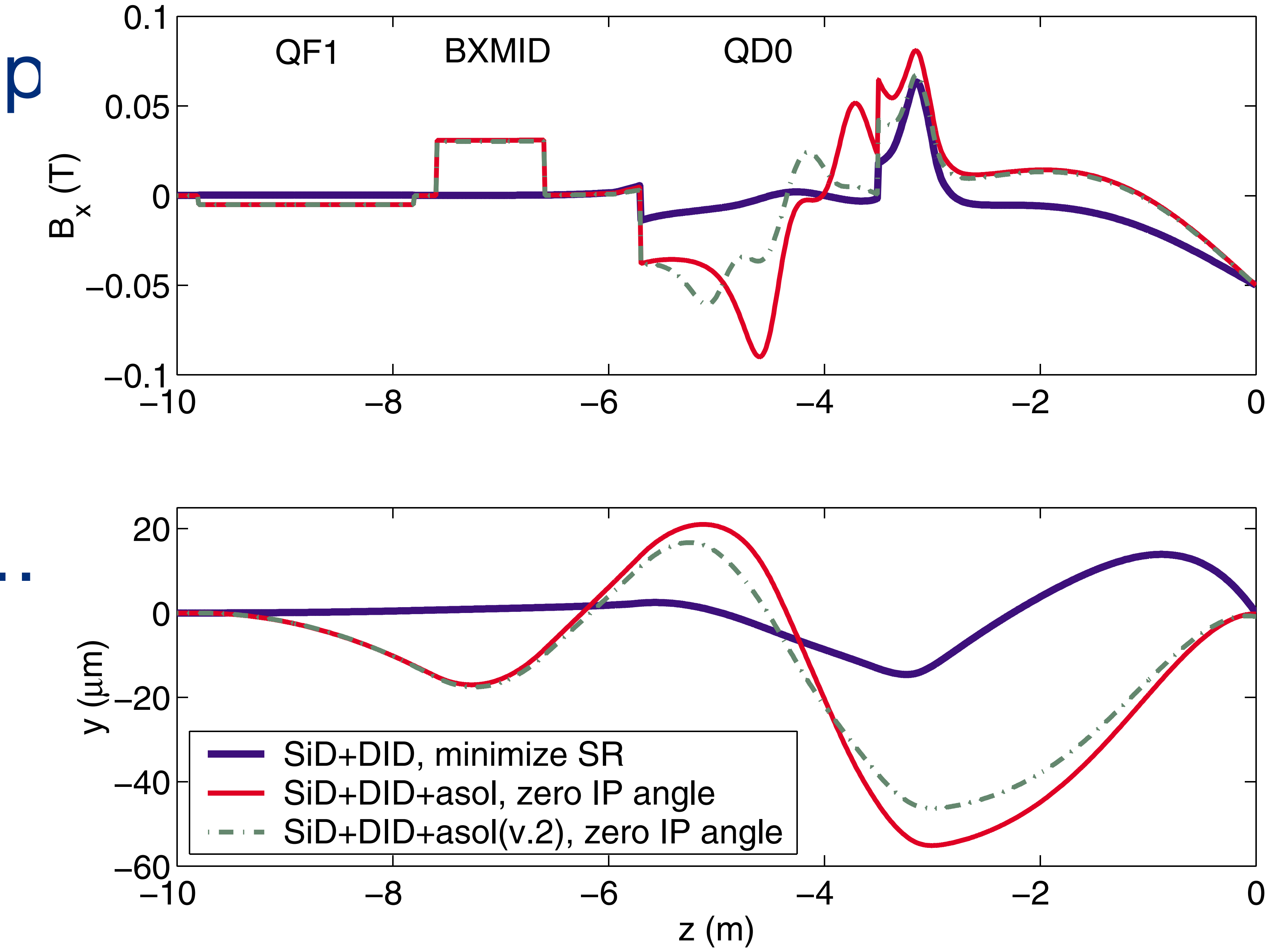
Forward Region Magnetic Fields

Seryi et al. SLAC-PUB-11662



- The magnetic fields that determine the background distribution i complicated overlays:
  - Detector solenoid (fringe) fields
  - QD0 quadrupole (fringe) fields
  - Anti-solenoid (fringe) fields
  - Anti-DID (fringe) fields
- A detailed 3D model of all fields would be needed to do prop

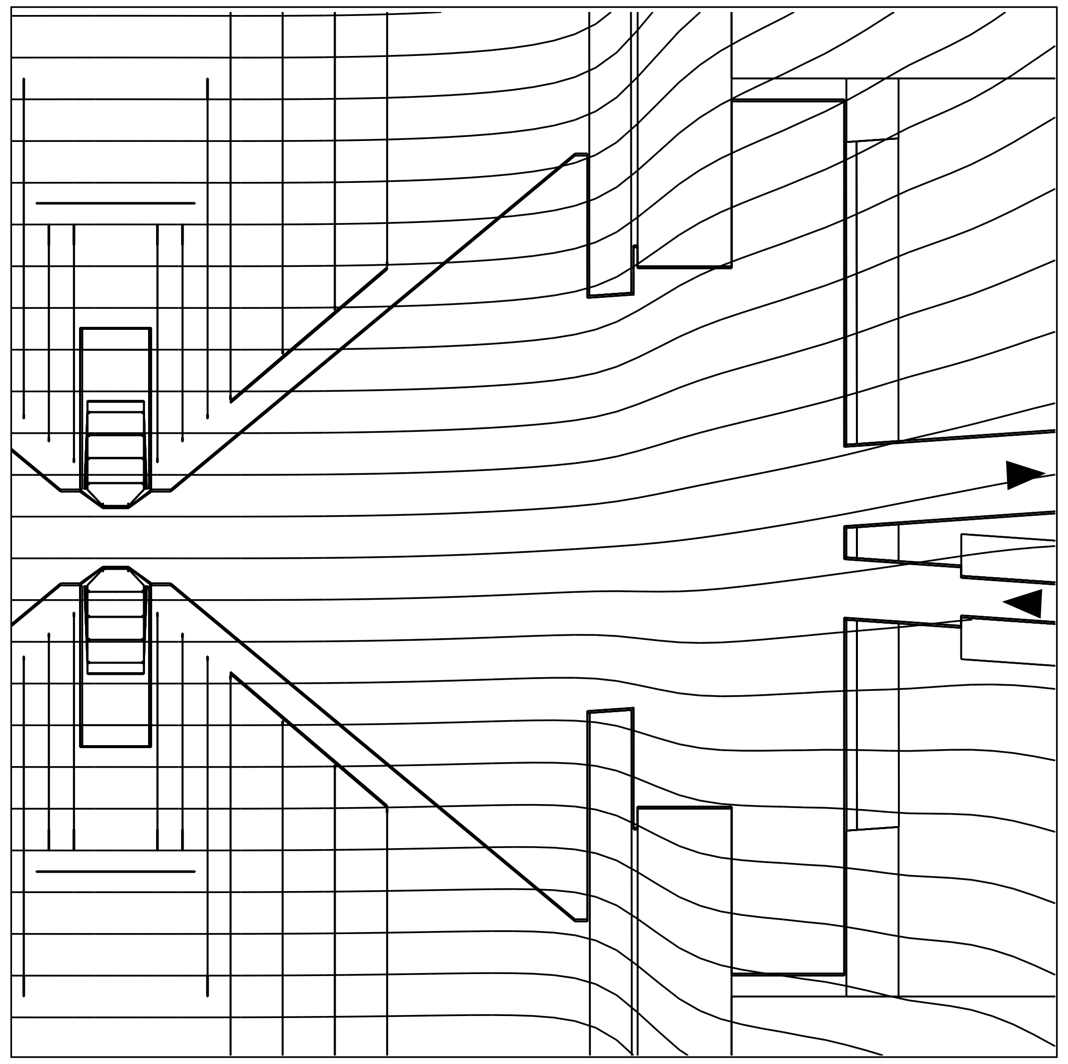
- This needs to be done anyhow for the new L* geometries
  - collaboration with machine experts required
  - probably hard to get in view of resources at machine groups..



Parker, Seryi, PR STAB 8.041001

Anti-DID Impact on Detector

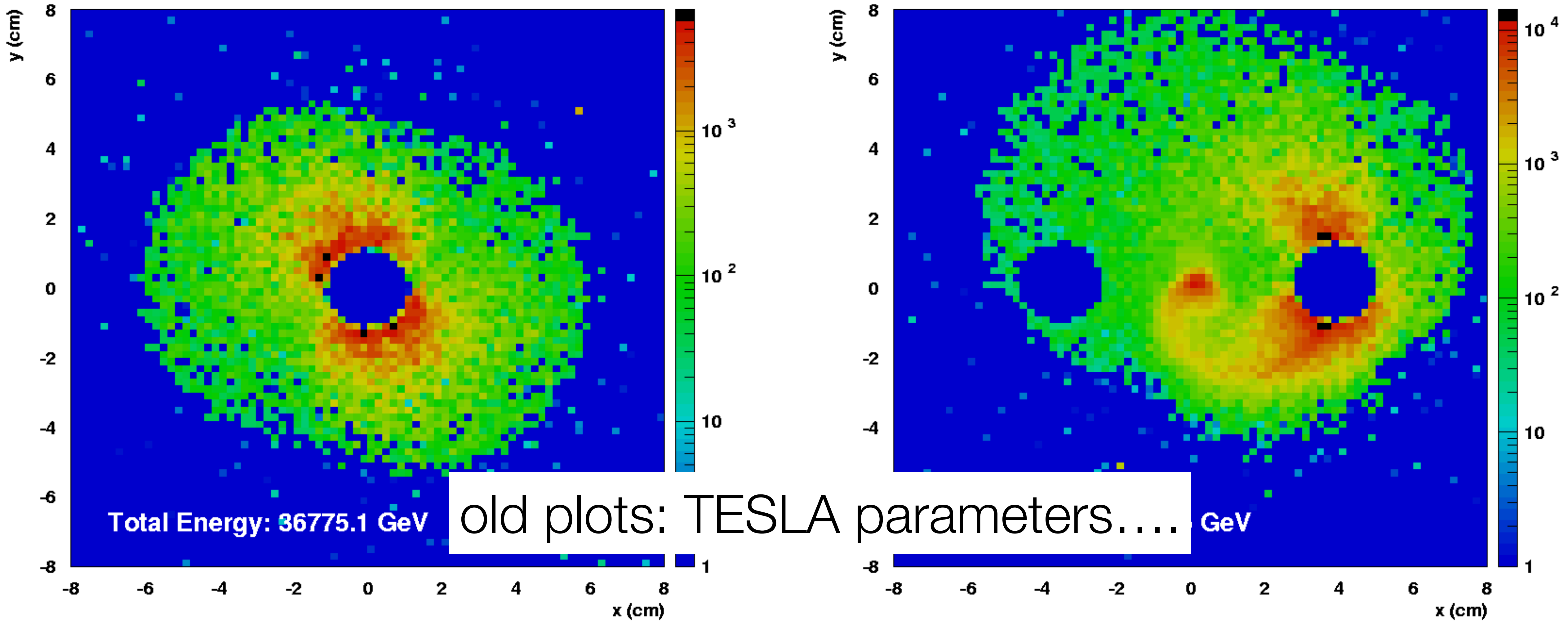
- ILD party line:
  - Anti-DID is needed to reduce background on BeamCal for searches and reduced backscattering
- less energy on BeamCal
  - easier reconstruction of beam parameters
  - better efficiency for tagging of high energetic electrons at low angles
    - WIMP searches
- less backscattering into the tracking system
- backscatters are guided through the VTX aperture



Adrian Vogel

no x-angle

x-angle 20 mrad

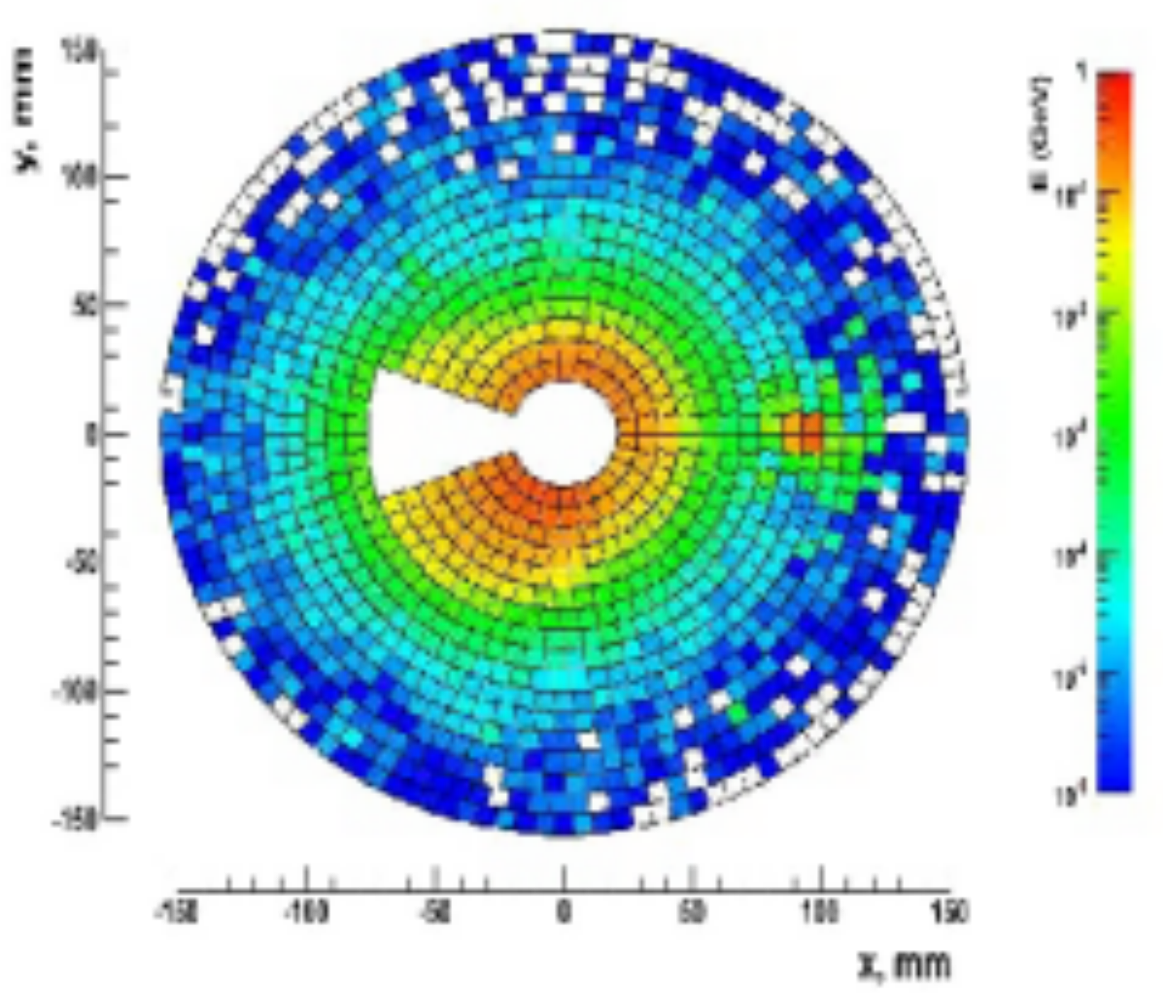


old plots: TESLA parameters….

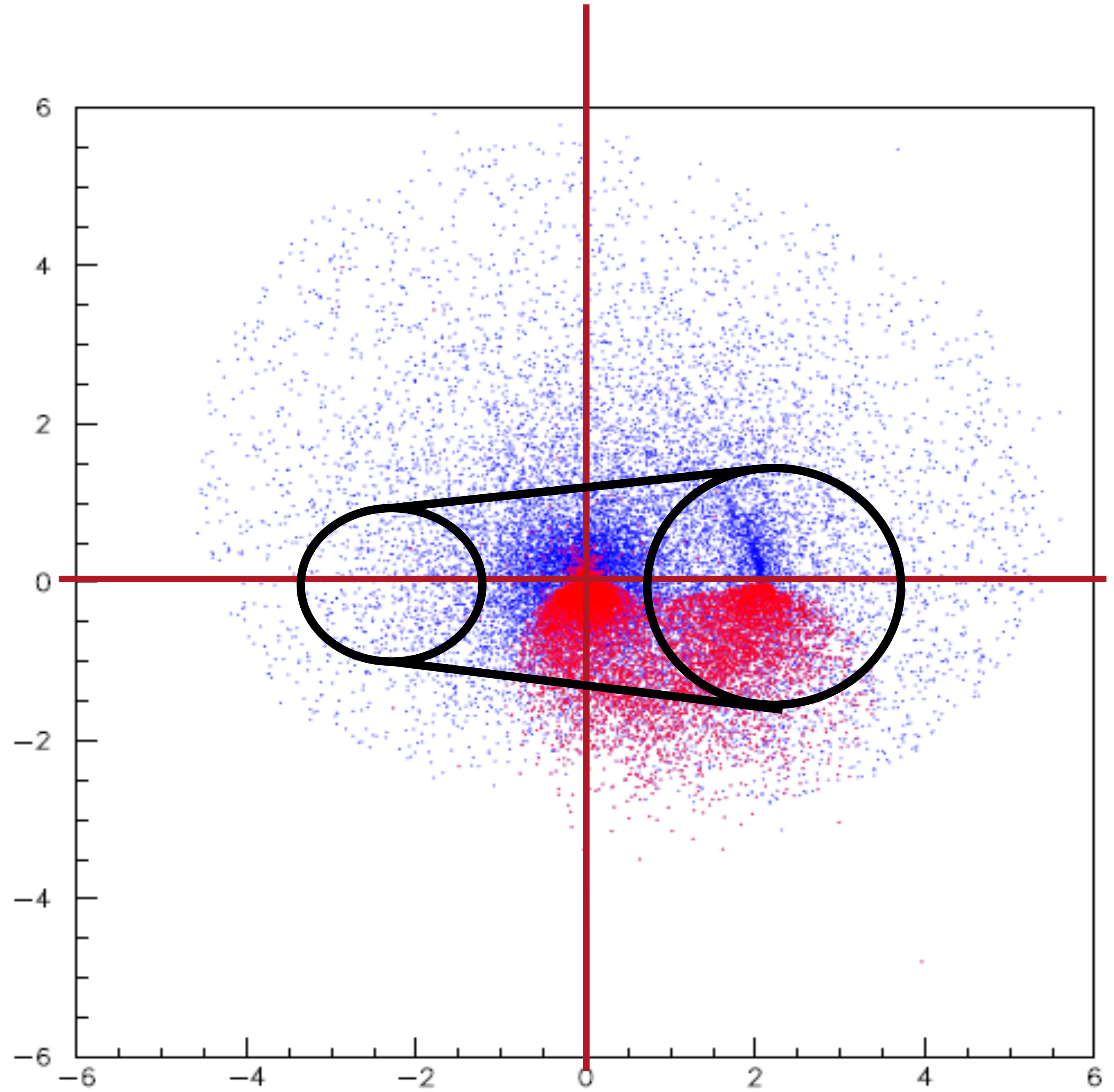
SiD and Anti-DID

- SiD has started initiative to understand impact of Anti-DID on detector effects
- Started to study energy distributions on their BeamCal
- For us to do:
  - understand backscattering
  - impact of BeamCal energy distributions on searches

ILD BeamCal Beampipe



Proposed SiD BeamCal Beampipe



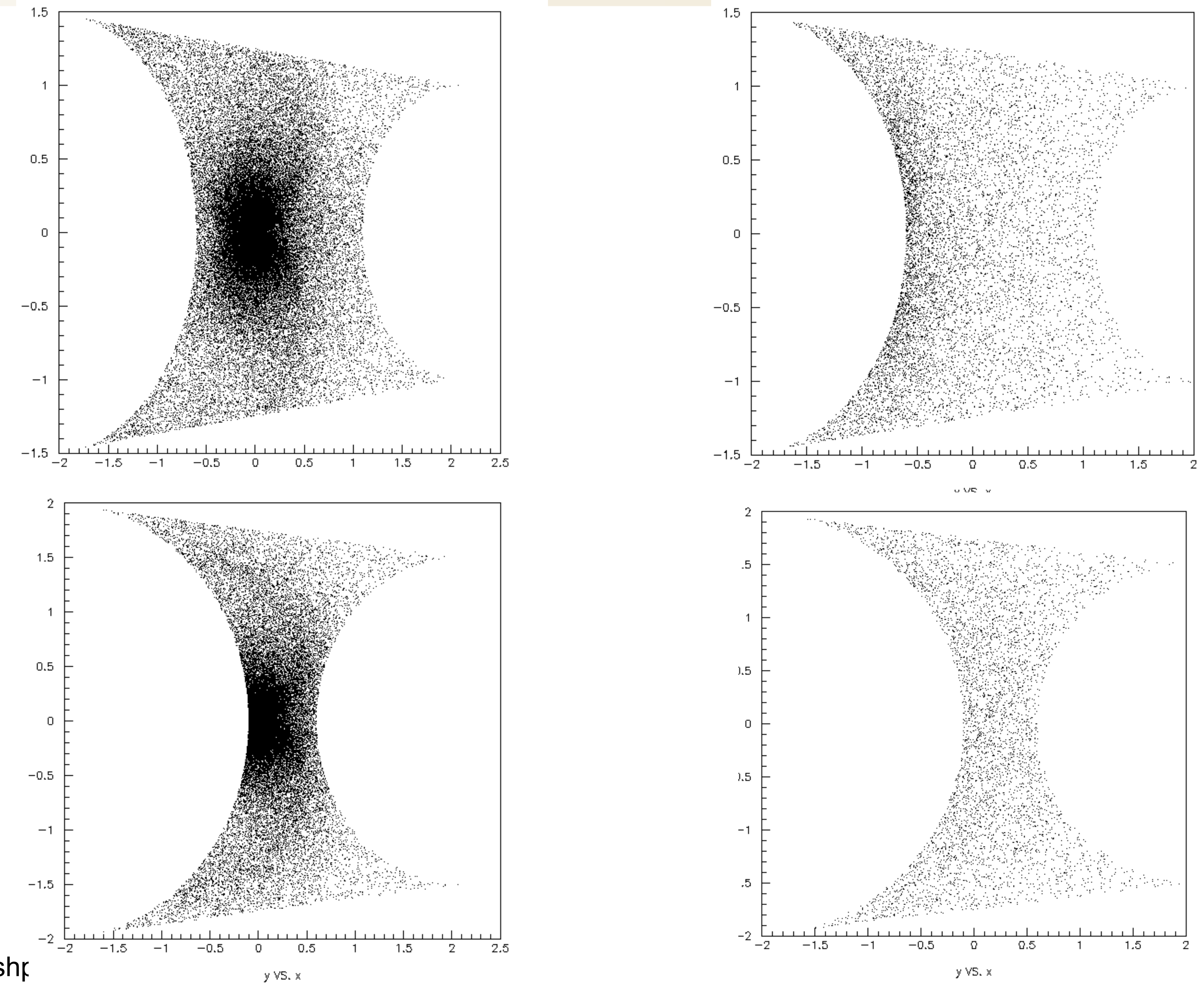
Marcel Stanitzki

SiD and Anti-DID

- Only limited improvement in the „plug section“ of BeamCal

Do We Really Need a Anti-DID Coil
Hits in the Plug Region

SLAC



SBWO2_pairs0001.dat (2009 IP w/o TF)
174k particles, 409.2TeV

SLAC

Where to the e+e- pairs go

15,20mm	No DID		AntiDID	
	# Hits	Energy	#Hits	Energy
Go out 4cm exit hole	32.1%	85.2%	87.9%	90.3%
Go out 3cm entrance	4.5%	0.8%	1.5%	0.7%
Hit the plug	54.6%	5.3%	3.0%	1.4%
Outside the plug in “physics” region	8.8%	8.7%	7.6%	7.7%

- The Anti-DID really only helps the plug region between the beam pipes
- The Anti-DID buys you 1% less energy in the region outside the plug and the 40mm/30mm exit/entrance apertures in the BeamCal silicon
- Simulation studies ongoing

Marcel Stanitzki

Things to Discuss

- Main question: Do we want to include the Anti-DID in the full ILD detector simulation for the main production runs?
  - Is the Anti-DID technically feasible?
  - What are the requirements on field homogeneities from the tracking detectors?
  - What are the differences in backgrounds from direct and backscattered particles in ILD?
  - What is the impact on the subdetectors (occupancies, etc.)?
  - What are the effects on physics?
  - How can this be best modelled in the ILD full detector simulations?

- This workshop should not give answers to all of this questions now!
- Try to find out what information is available and discuss a possible working plan including time lines