Readout Update

Justin Stevens

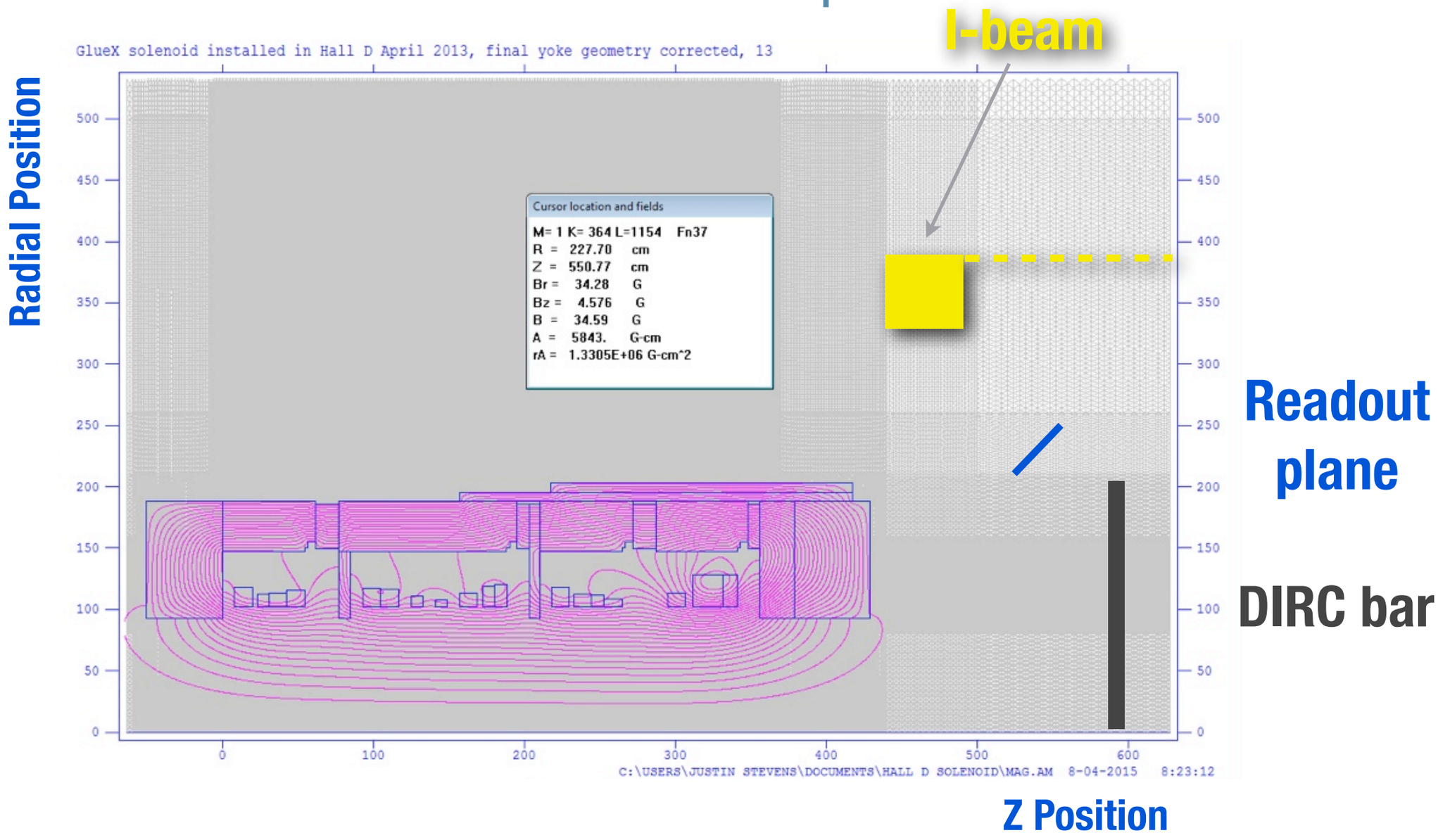
PID Upgrade Meeting: 8.7.15

DIRC space in Hall D

~3.8 m

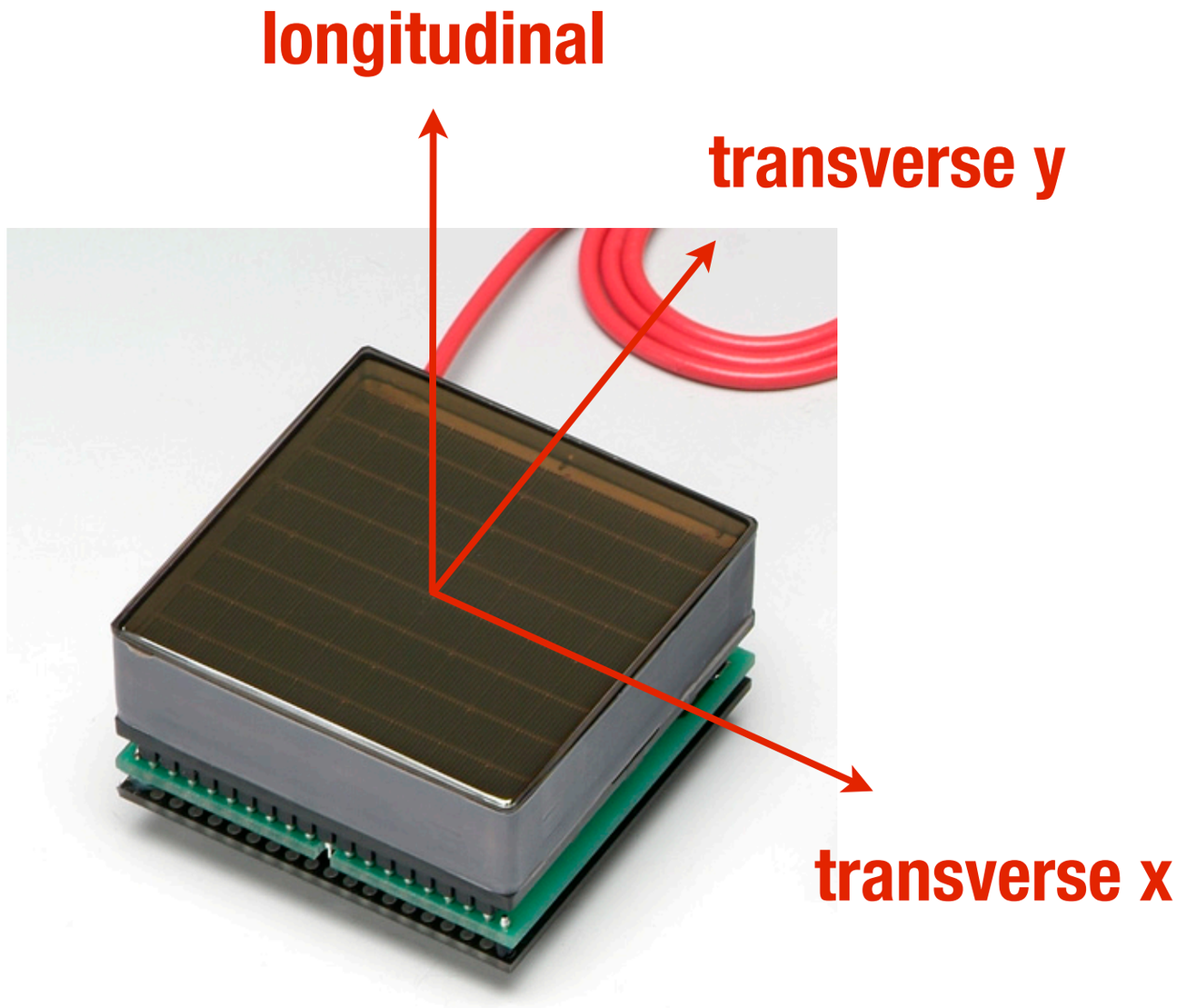
- Ideally keep DIRC within solenoid support I-beam ~3.8 m from beamline in x
- Tim and Tom both agreed there is space to store the DIRC in Hall D before installation: likely same place as TOF construction was done

1300A Poisson field map



- Poisson maps from Eugene with the right boundary conditions
- Field drops by another factor of ~2 if readout plane moved out closer to the I-beam from the solenoid support structure

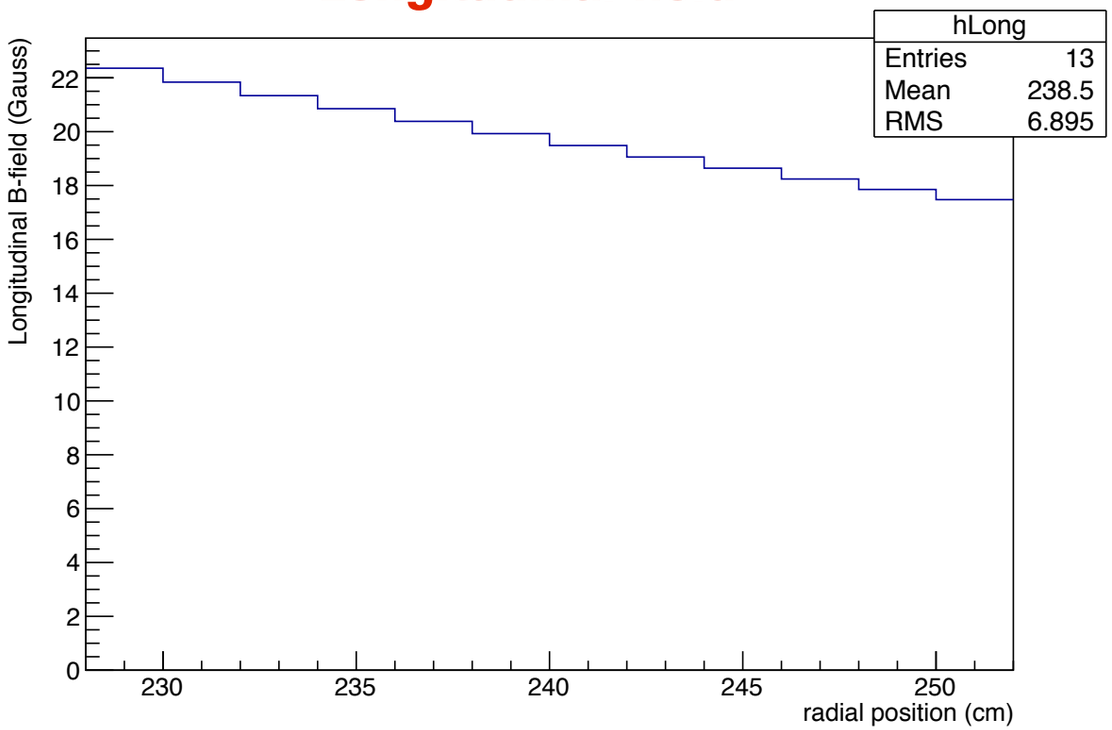
Field definitions



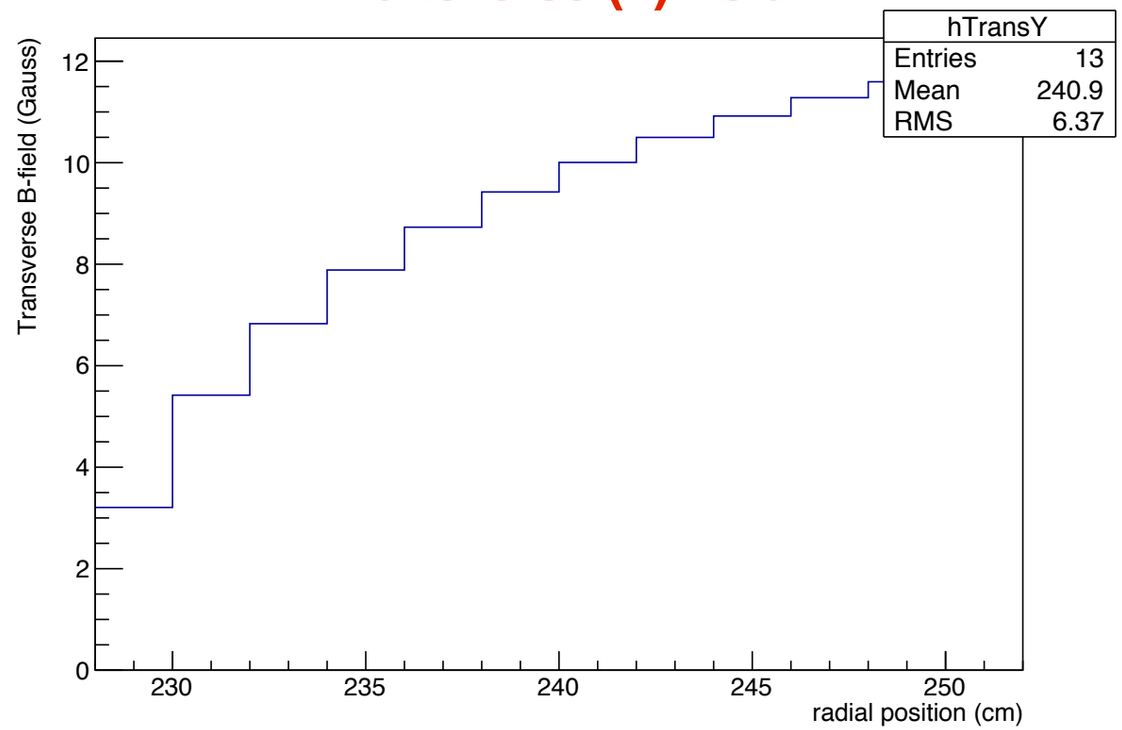
- Fields longitudinal and transverse to PMT plane
- Doesn't easily translate to Hall D coordinate system since PMT plane at an angle, but next slide shows components

DIRC readout plane field components

Longitudinal field

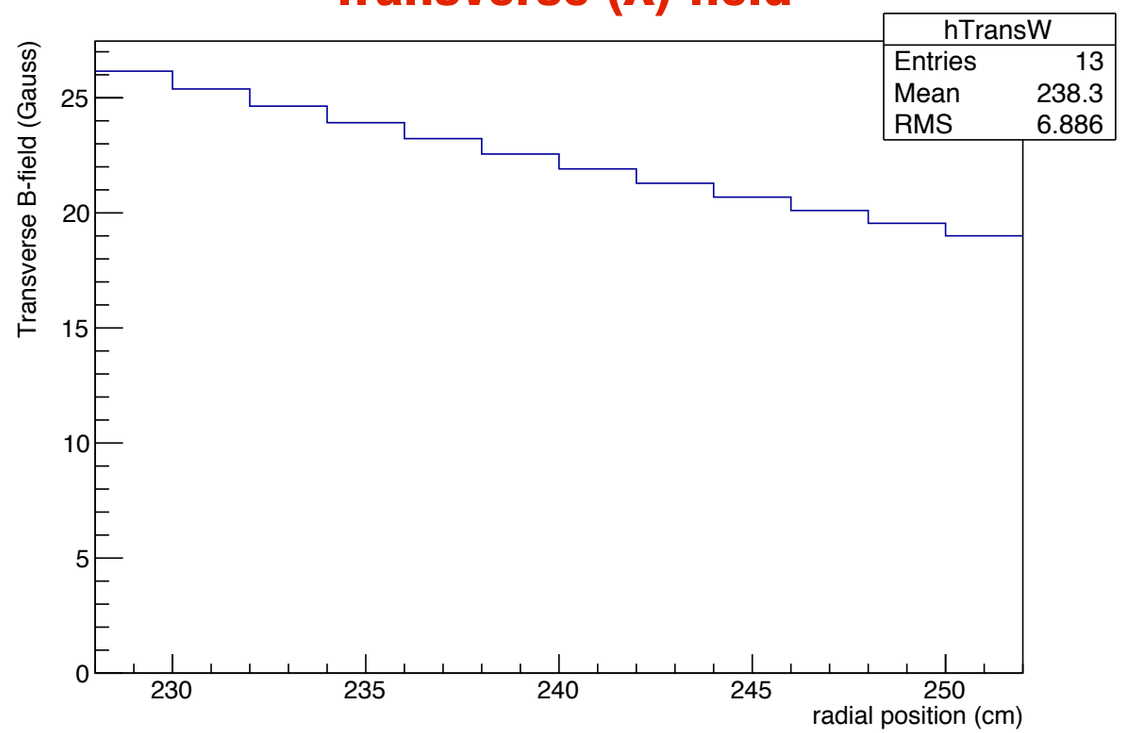


Transverse (Y) field



- There are both transverse and longitudinal fields at the readout plane
- Below ~25 Gauss

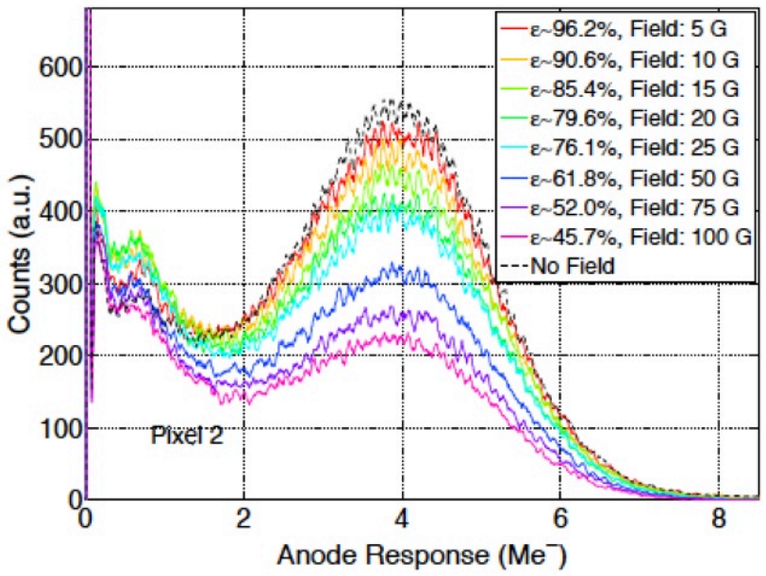
Transverse (X) field

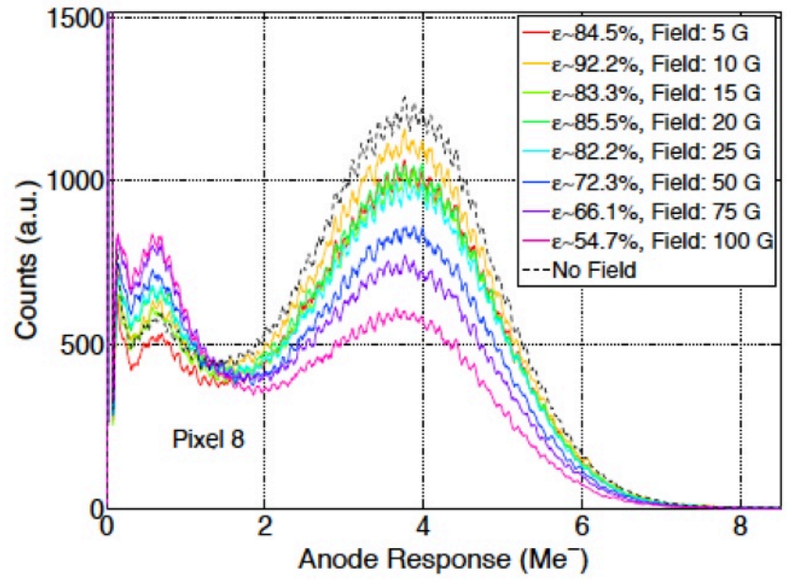


H12700 study for LHCb RICH

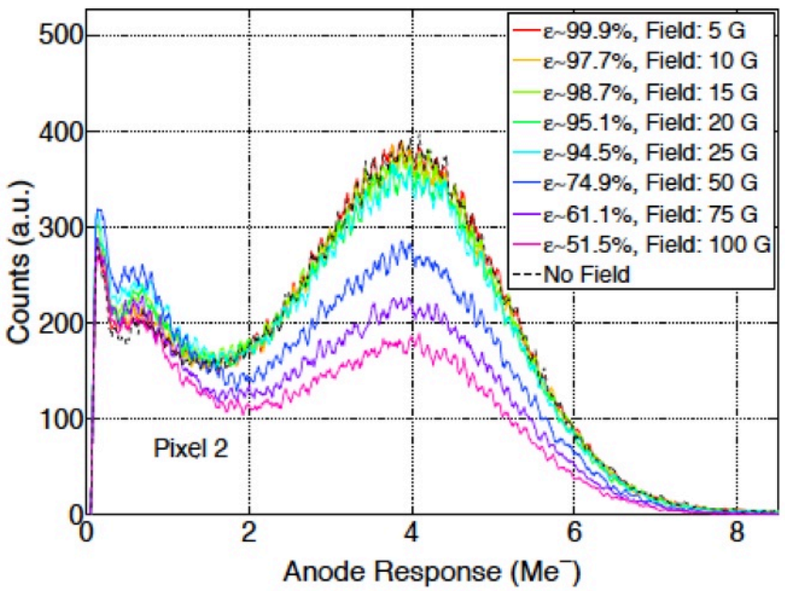
arXiv:1506.04302

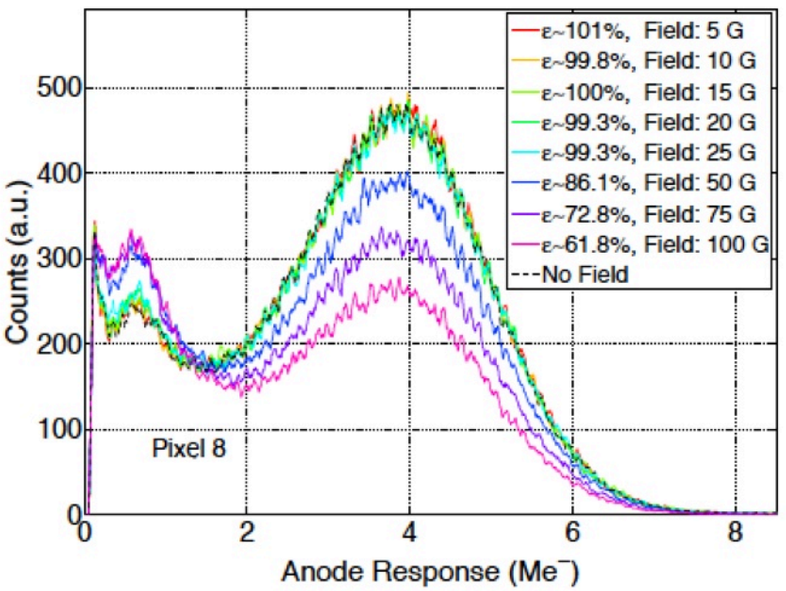
Edge pixels: No Shielding





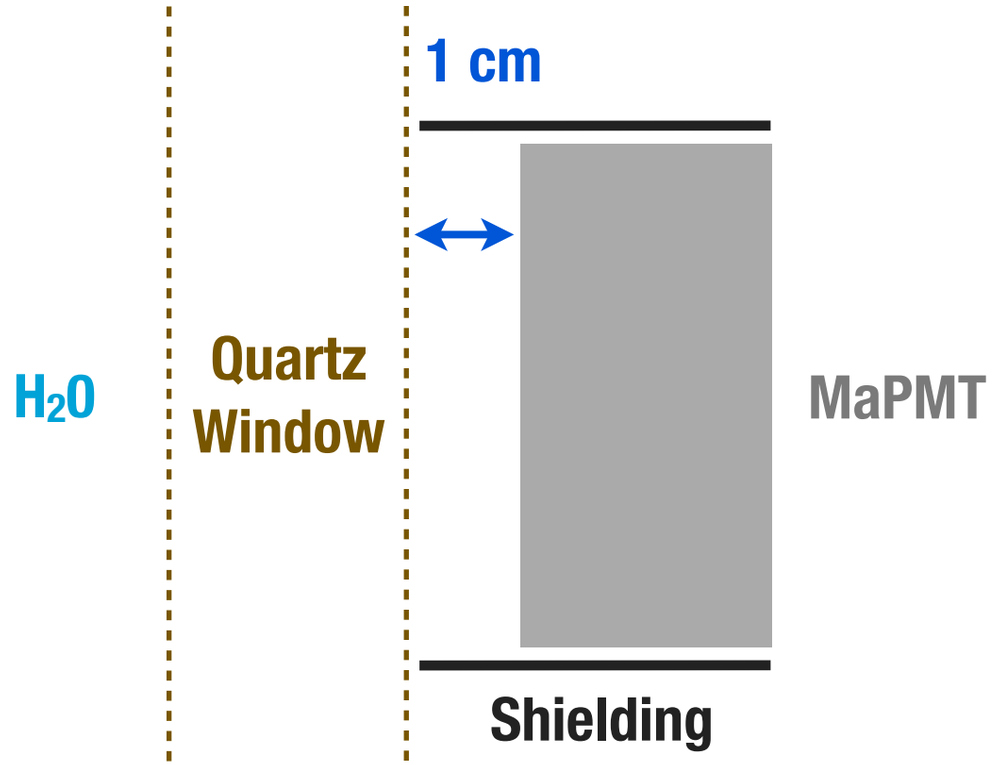
Edge pixels: 200 µm layer of Skudotech (similar to MuMetal)





- Only studied longitudinal since its harder to shield than transverse
- Central pixels hardly effected, so focus on edge pixels and restore efficiency with shielding

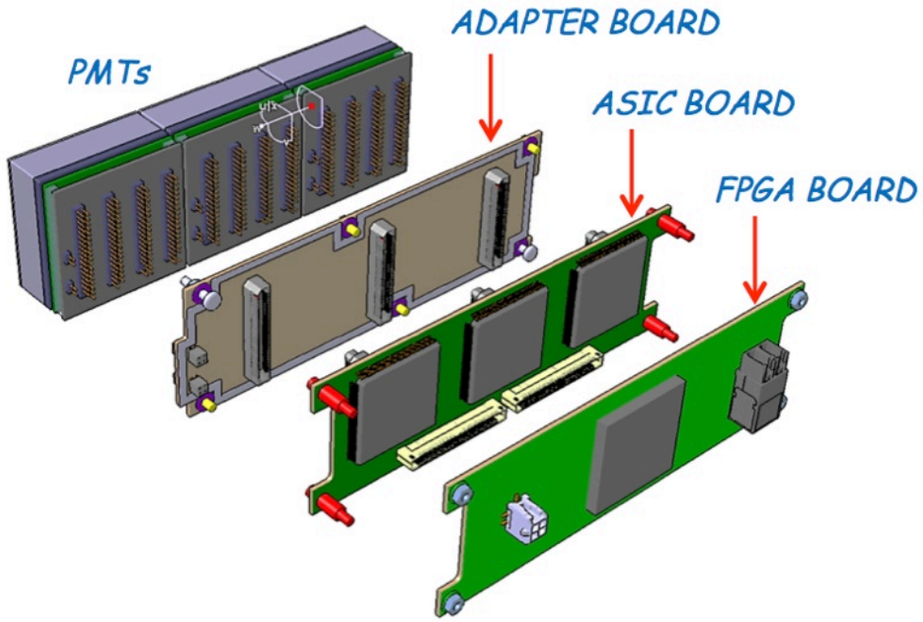
More on shielding

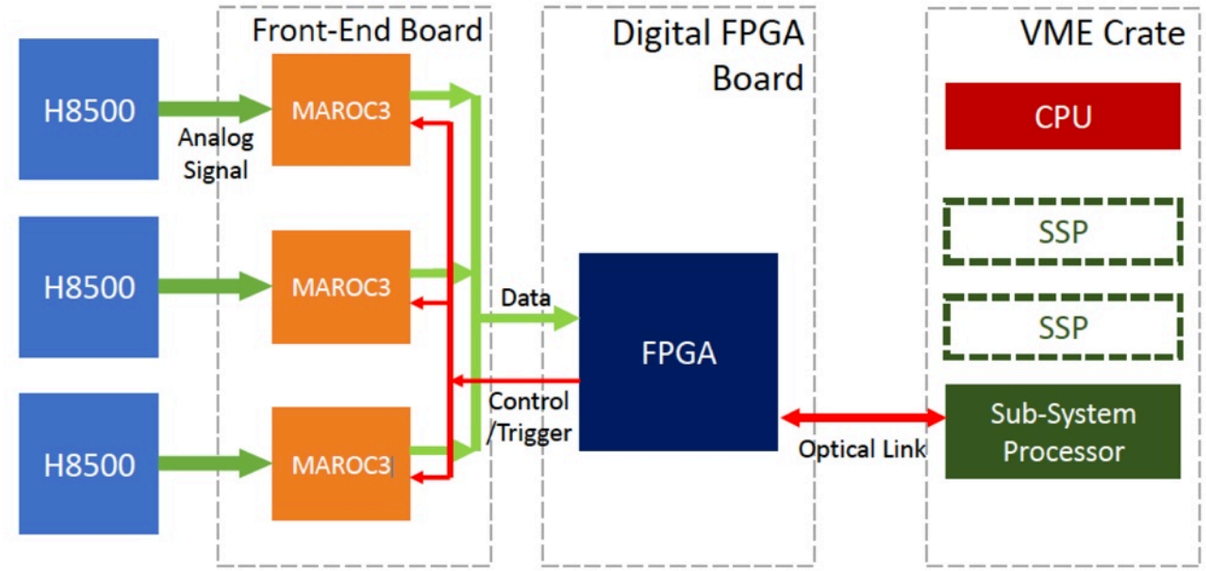


- LHCb study extended the shield by 1 cm past the photocathode, presumably to help shield the longitudinal field
- For the DIRC this would introduce a gap between the window of the focusing box and the MaPMT
- Need more study as to what impact this has, but could imagine some fused silica “cookies” between the MaPMT and the window

Data rates and live times

- MAROC to SSP limited to 2.5 Gb/s serial link
- Use similar formula as CLAS12 RICH to compute readout time





Highest occupancy chip

Readout time = [(19 bits x 64 channels + 17 bits x 8 sums) x 0.007 occupancy + 12 bits] x 3 MAROC / 2 Gbps

Readout time ~ 32 ns ⇒ **less than 1% deadtime at 200 kHz**

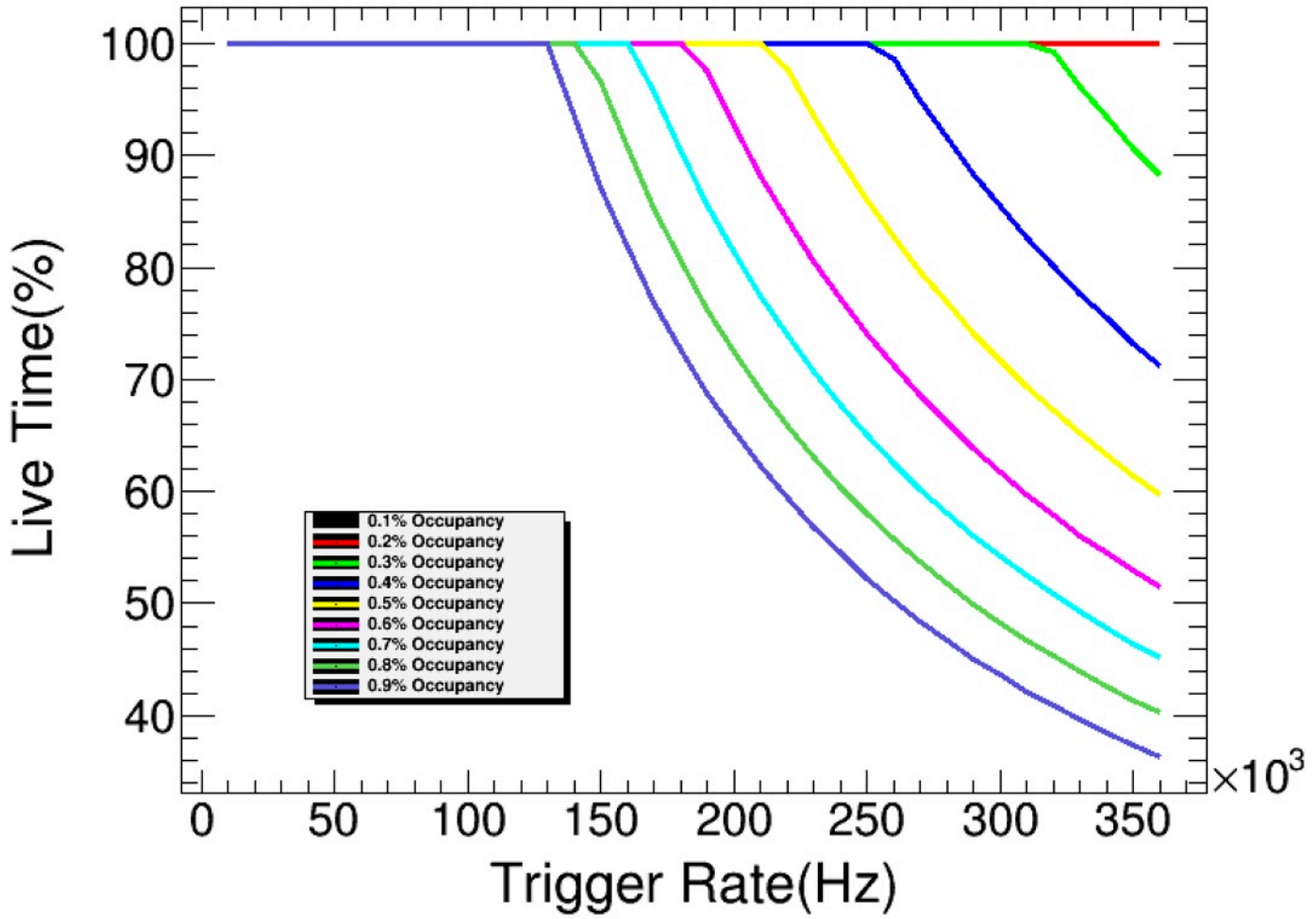
Data rates and live times

RICH Event Structure

Structure Element	Size (bytes)	Element Information
Block Header	4	Block Number: 11bits VME Slot: 5bits EventsPerBlock: 11bits
Event Header	4	Event number: 27bits
Trigger Timestamp	8	Timestamp: 48bits (~13 day rollover)
RICH TDC Hit	4	Hit time: 13bits Edge (rise/fall): 1bit PMT Channel ID: 6bits MAROC Chip ID: 2bits Fiber Port ID: 3bits
RICH TDC Hit	4	
…		
RICH TDC Hit	4	
…		
Event Header	4	
Trigger Timestamp	8	
RICH TDC Hit	4	
Block Trailer	4	Block Word Count: 22bits VME Slot: 5bits

* Redundant information used for consistency checking

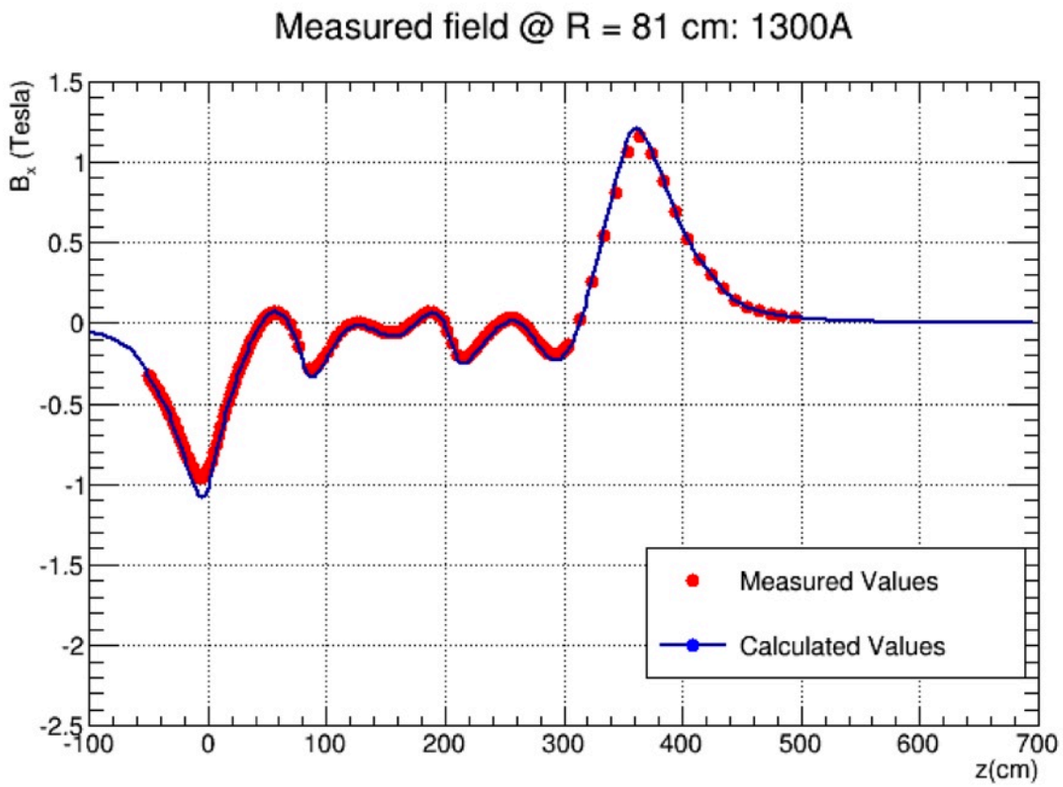
C. Cuevas and B. Raydo

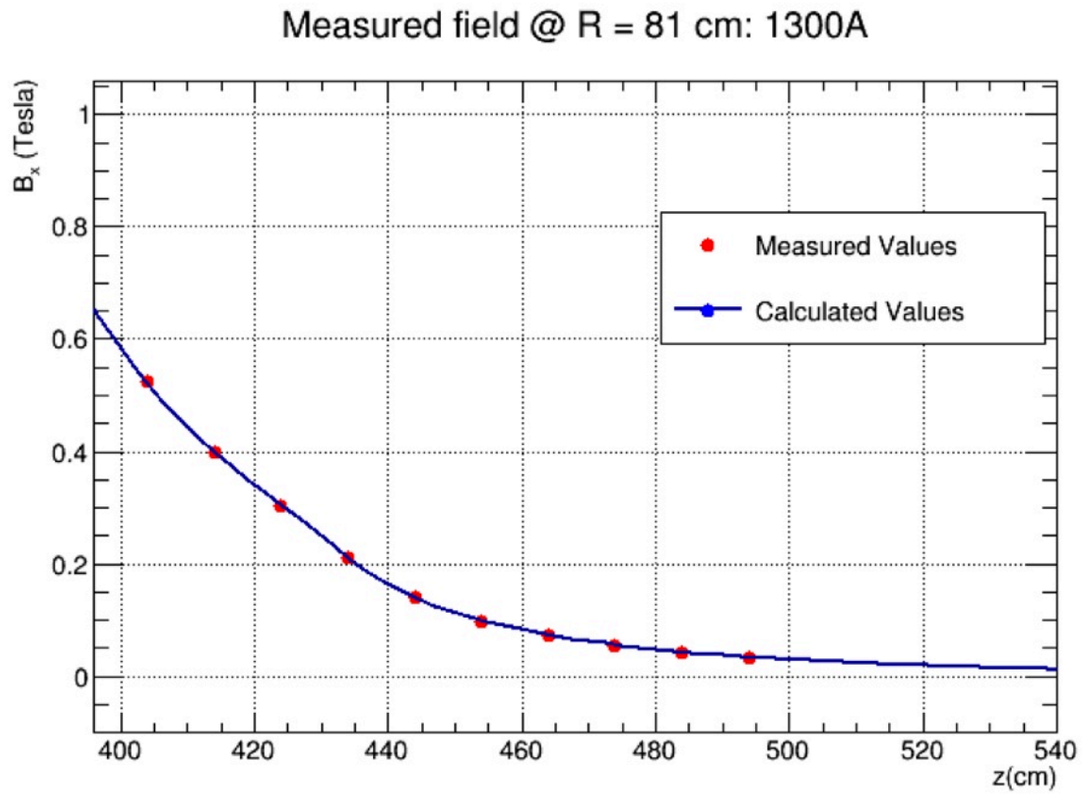


- Each hit is a 32-bit word, need to see how this fits in 1Gb Ethernet from crate
- Have ~15000 channels and occupancy is ~0.35% over the whole detector
- 10Gb Ethernet is an option if necessary

Backup

Field comparison

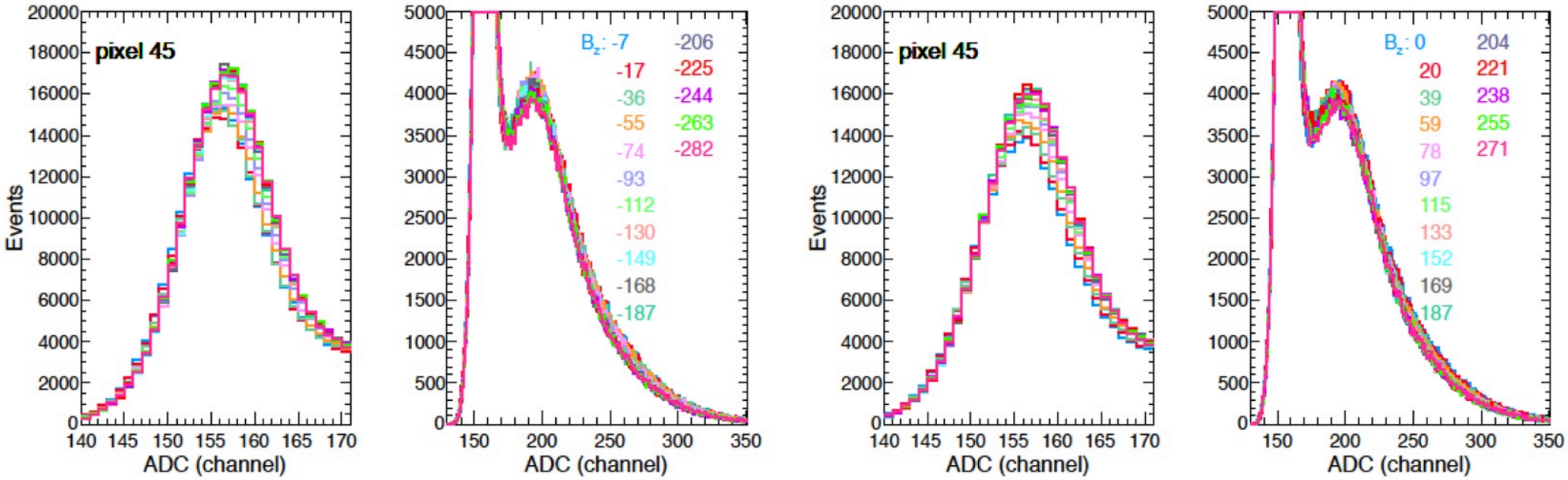




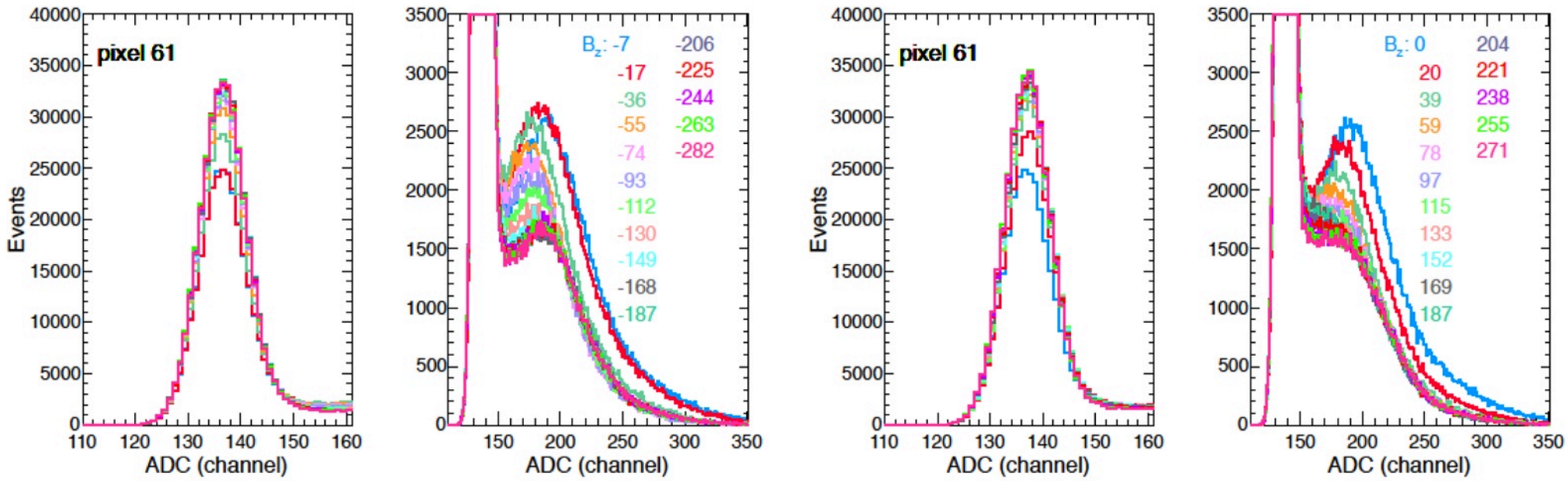
- POISSON model of solenoid field provides good description at large radii for up to z = 500 cm

SOLID longitudinal field tests

Central pixel



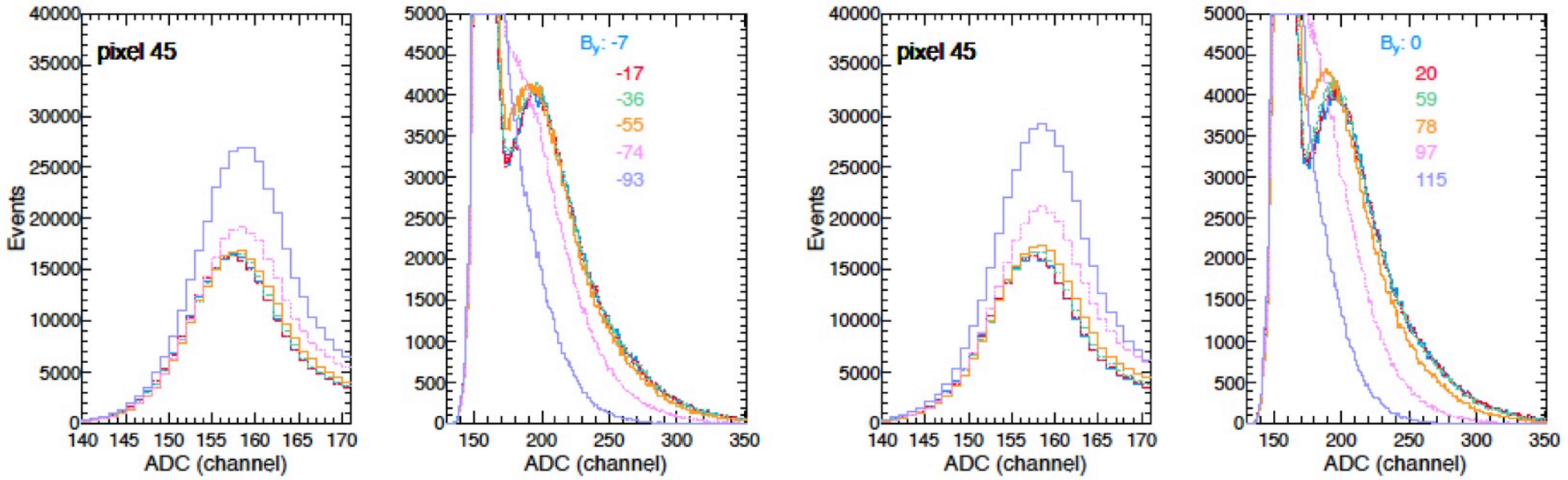
Edge pixel



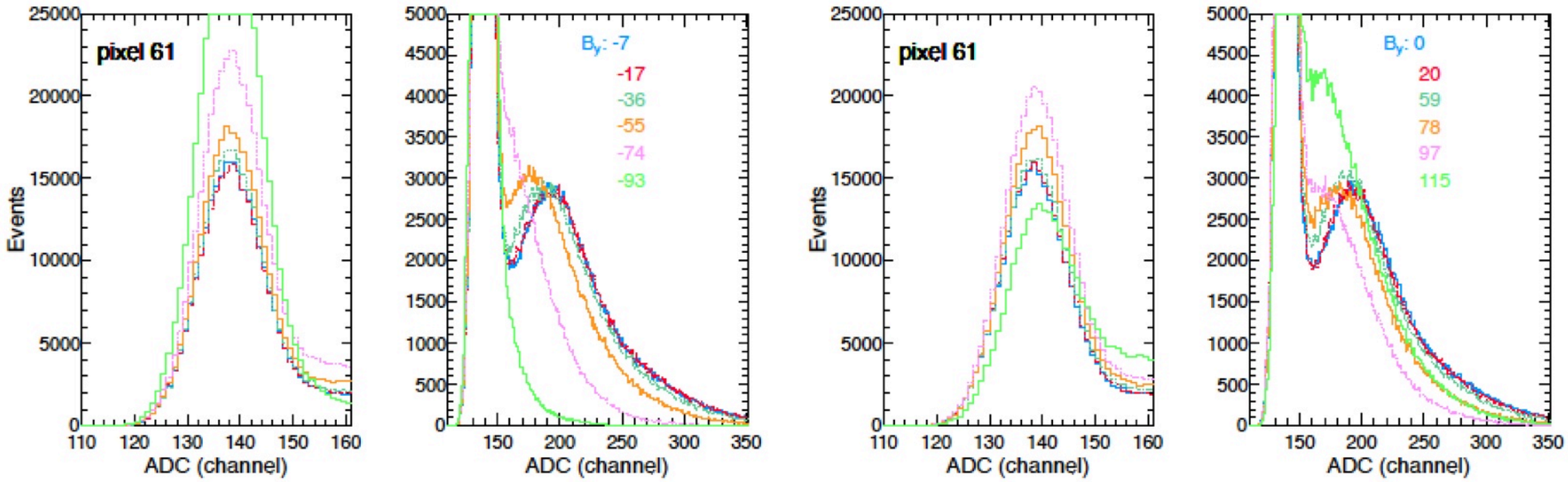
- Test of one older model H8500 for SOLID Cherenkov 2013 JINST 8 P09004
- Evaluated performance for central pixel and edge pixel

SOLID transverse field tests

Central pixel



Edge pixel



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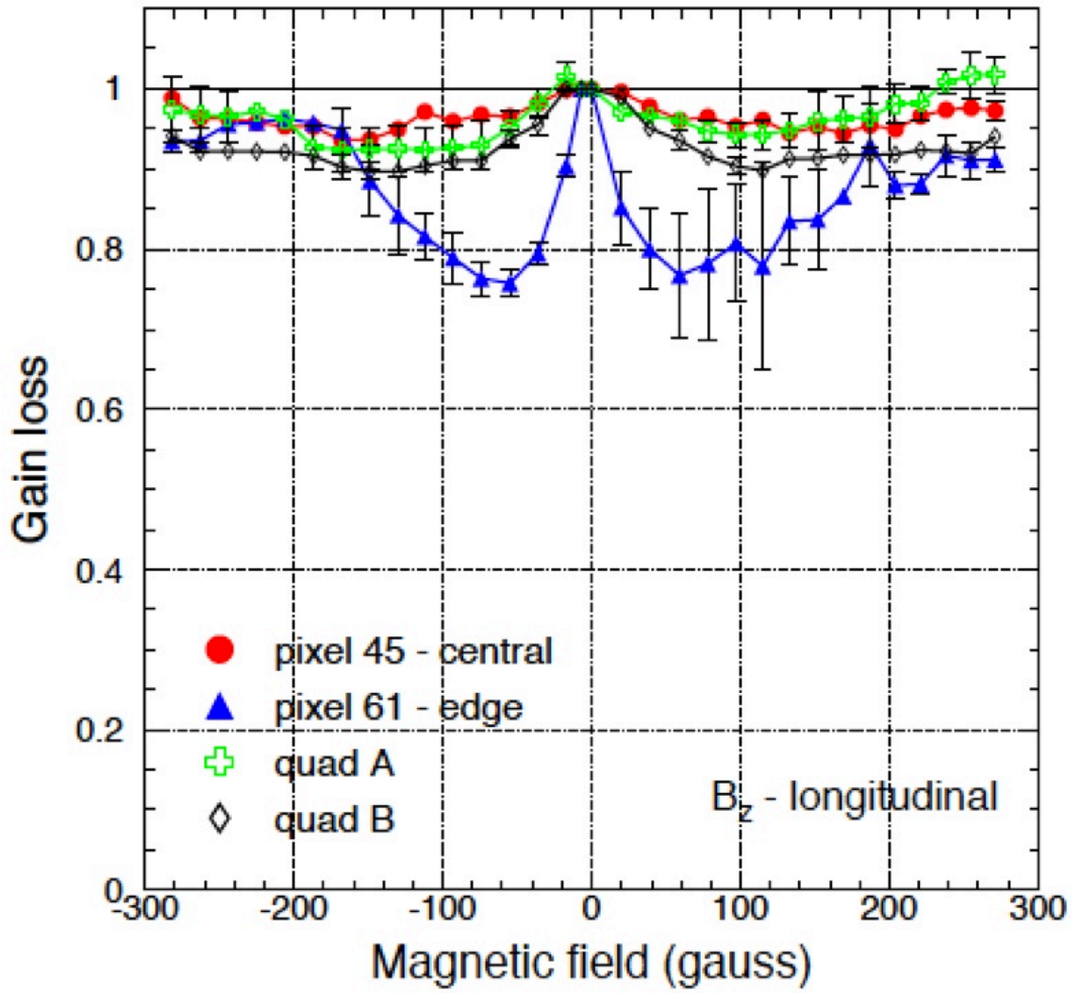
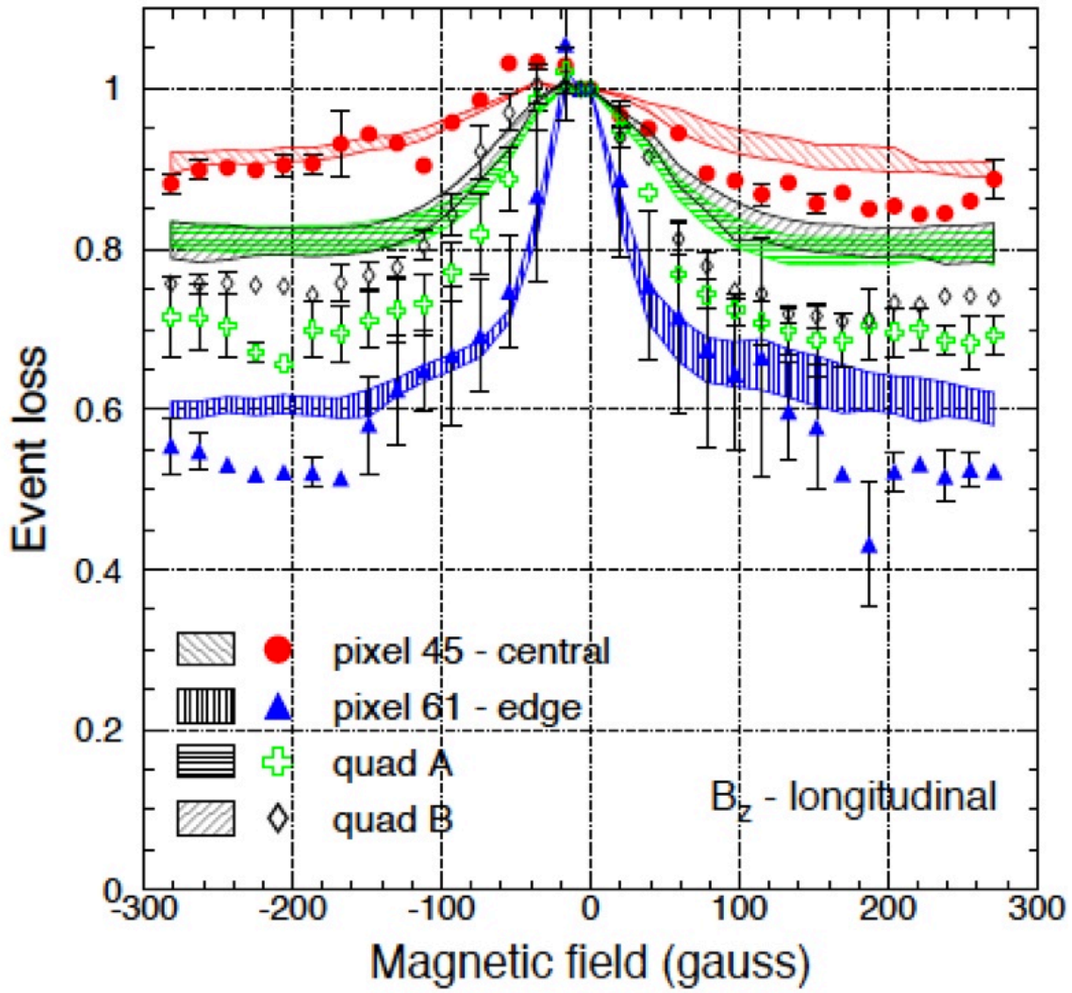
- Evaluated performance for central pixel and edge pixel

Longitudinal field summary





- Test of one older model H8500 for SOLID Cherenkov 2013 JINST 8 P09004
- Evaluated performance for central pixel and edge pixel

CLAS12 field tests

- Expect small fields (<5 Gauss) in region of RICH readout
- Tested of H8500 in arXiv:1409.3622
- Only transverse field settings
- Planning for tests with H12700?