FDIRC background report

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LNF SuperB Collaboration Meeting

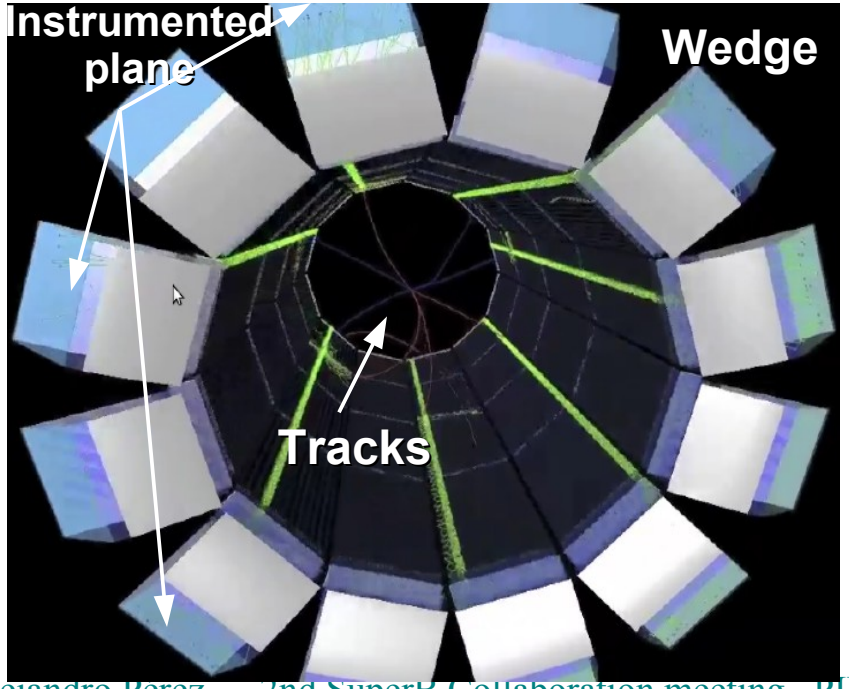
Outline

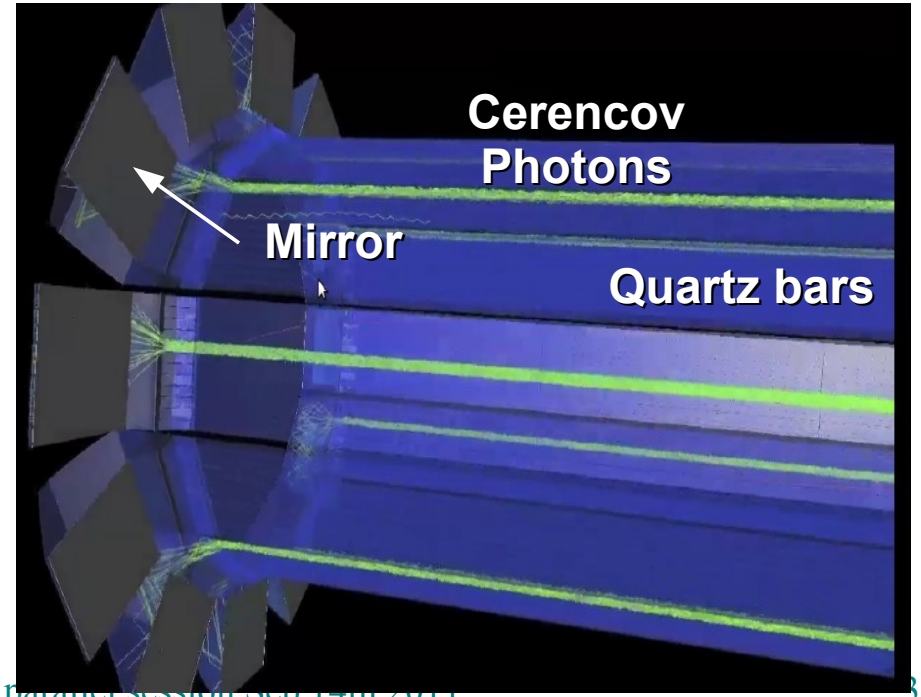
- **New BRN developments**
  - FDIRC implementation inside Bruno
- **New final focus (FF) model**
  - Geometry: Super-conducting magnets and Cryostat
  - Magnetic model: detector solenoidal field inside FF
- **November 2011 full-simulation production**
  - Requested samples and production summary
- **Background rates on the FDRIC**
  - The method
  - Results
- **Summary**

FDIRC implementation inside BRN (I)

- **Previously:**
  - Only a standalone model of FDIRC (Doug Roberts)
  - In Bruno:
    - Only a model of FDIRC geometry
    - No Cherenkov (optical) photons activated
    - No instrumentation

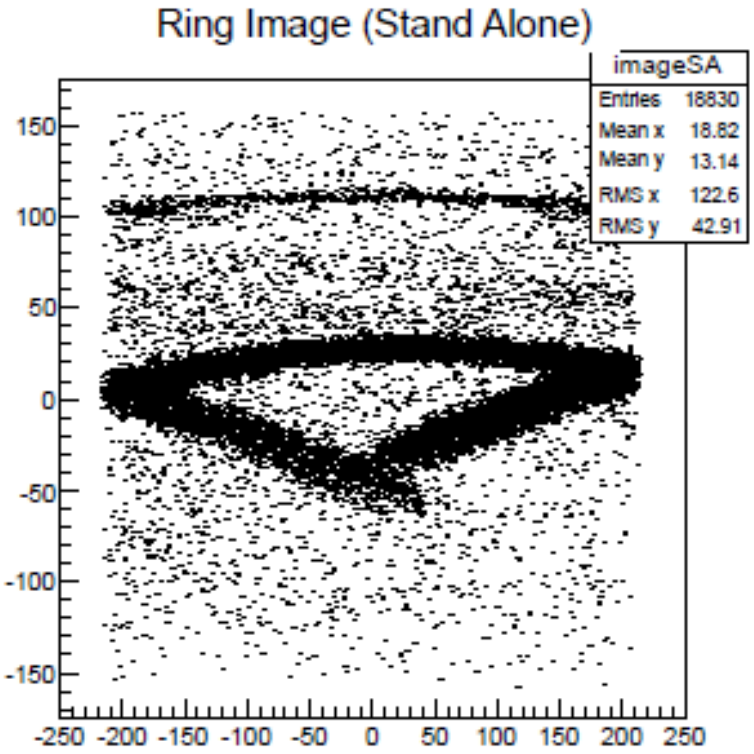
Doug Standalone model of FDIRC

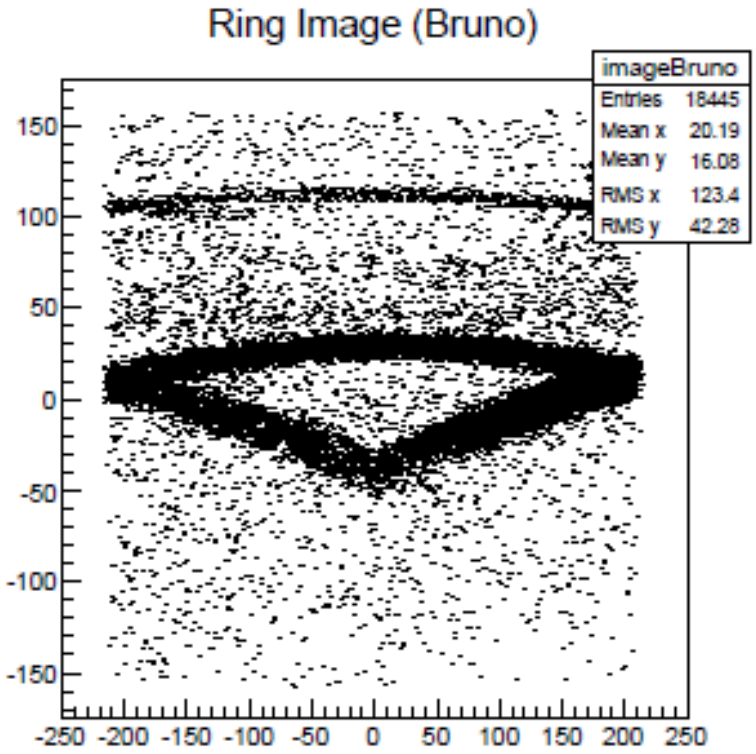




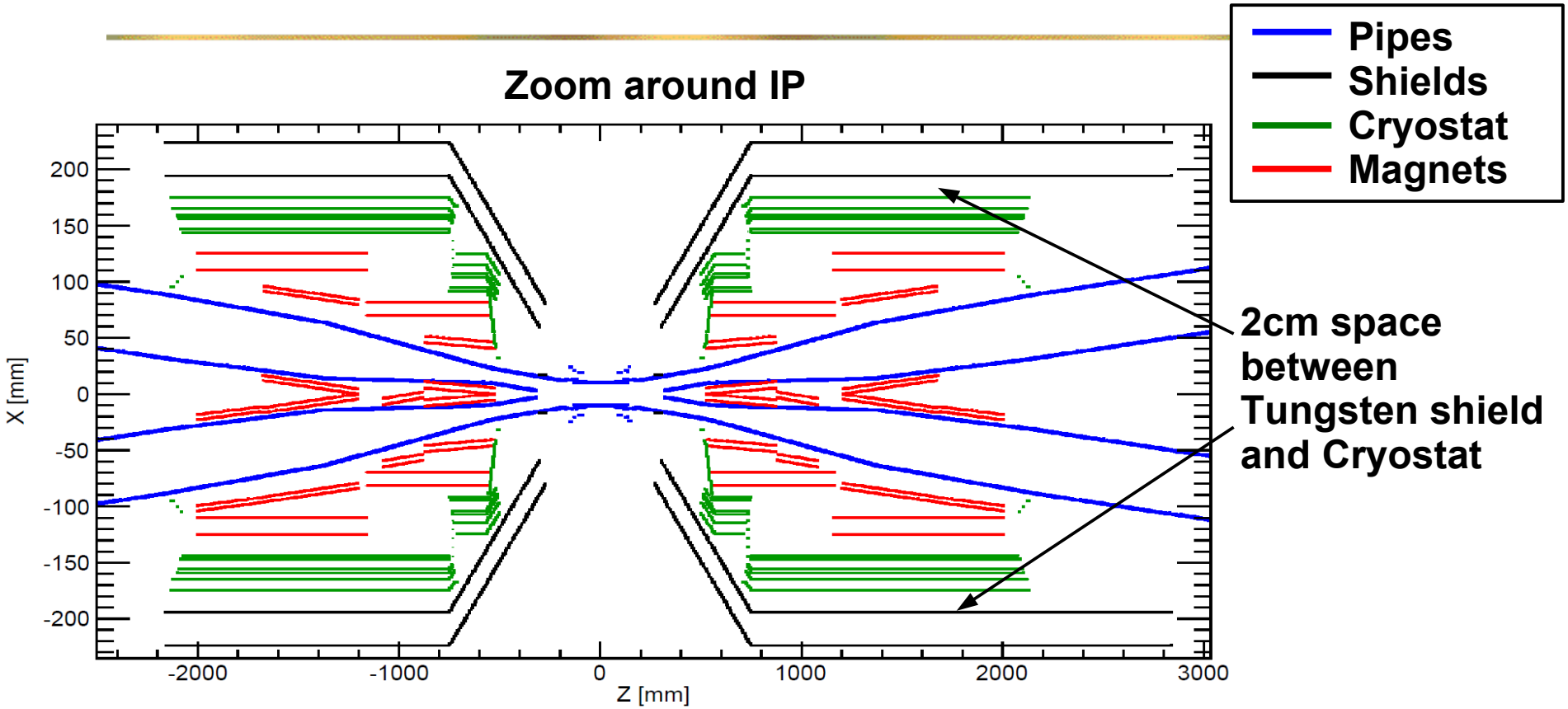
FDIRC implementation inside BRN (II)

- **But now:**
  - Doug and Andrea worked hard to insert standalone model inside Bruno
  - All the required features are in place:
    - Cherenkov photons activated
    - Photo-camera: the whole photo-camera plane is instrumented. Quantum efficiency already taken into account





New FF model: Cryostat and Magnets



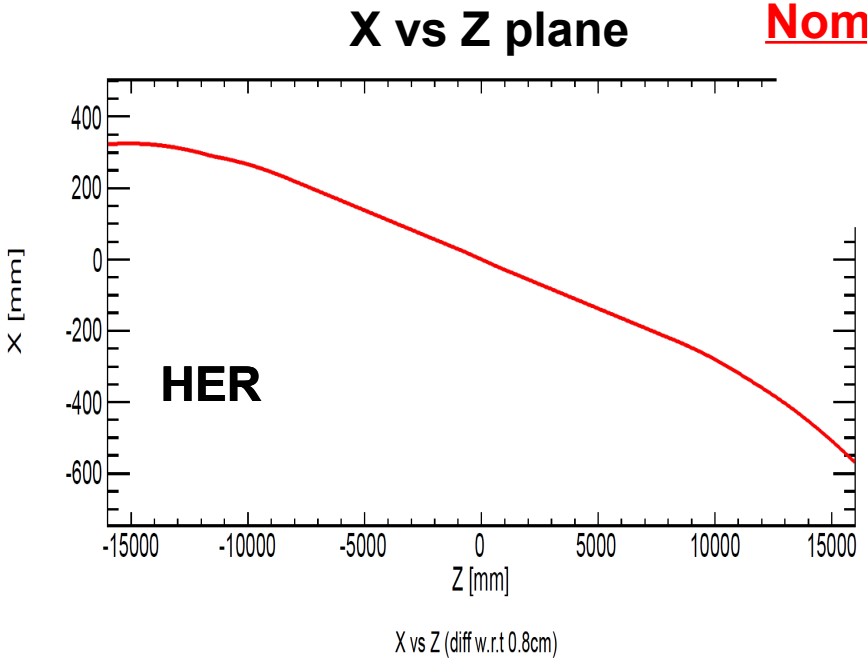
- Space free between cryostat and shield will likely be used for SVT cabling and piping
- Space free between shield and DCH likely used as mechanical clearance
- No much room to increase Tungsten shield. Only possibility is to reduce DCH internal radius

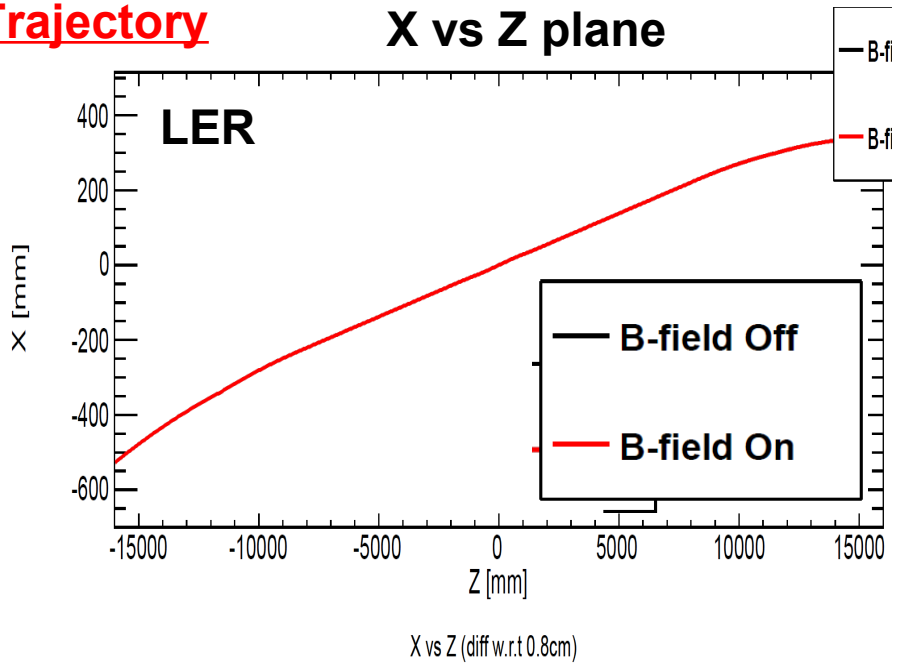
New FF model: Magnetic model (I)

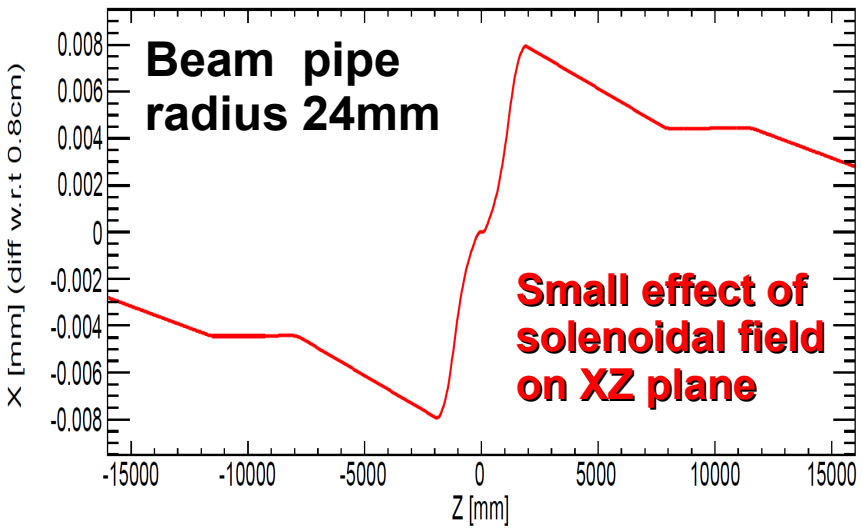
- **Previously:**
  - detector solenoidal field turned off in final focus magnetic model
- **This field is important for an accurate model of two-photon (pairs) backgrounds on SVT. Less important for Rad-Bhaha and Touschek**
- **Implementation:**
  - Magnitud: 1.5 Tesla
  - Direction: Z>0 (0.0,0.0,1.0)
  - Volume: field different from zero only inside a cylinder of length 40cm and radius 40cm.

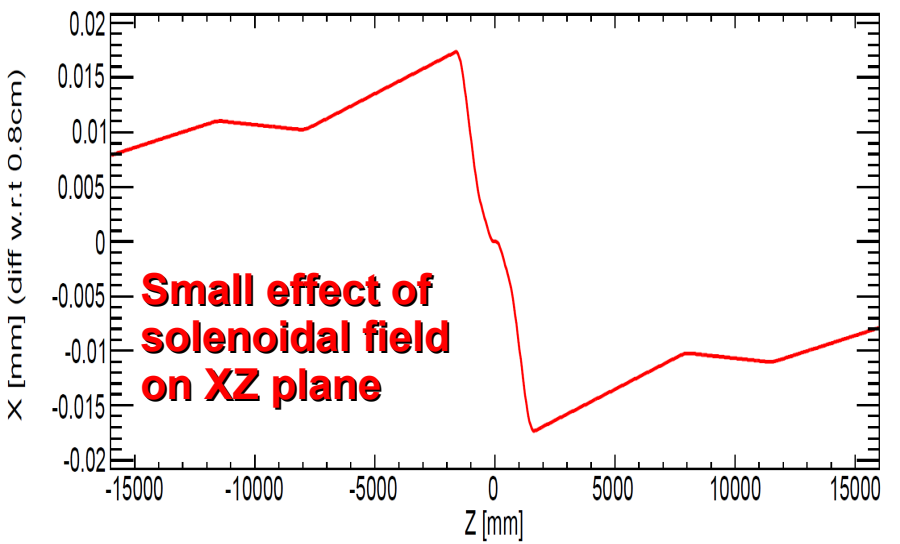
New FF model: Magnetic model (II)

Nominal Trajectory





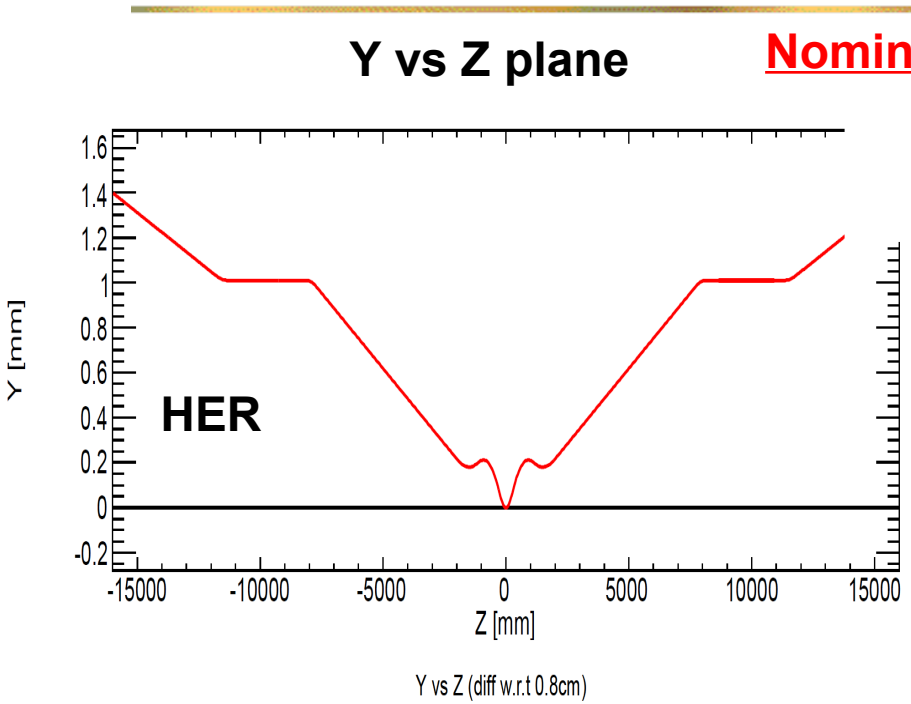


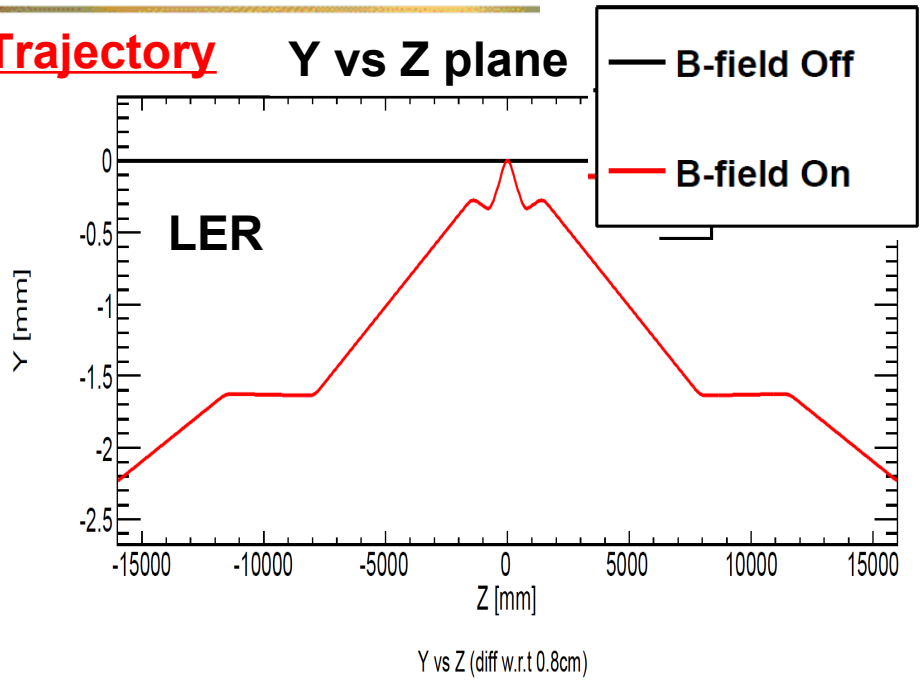


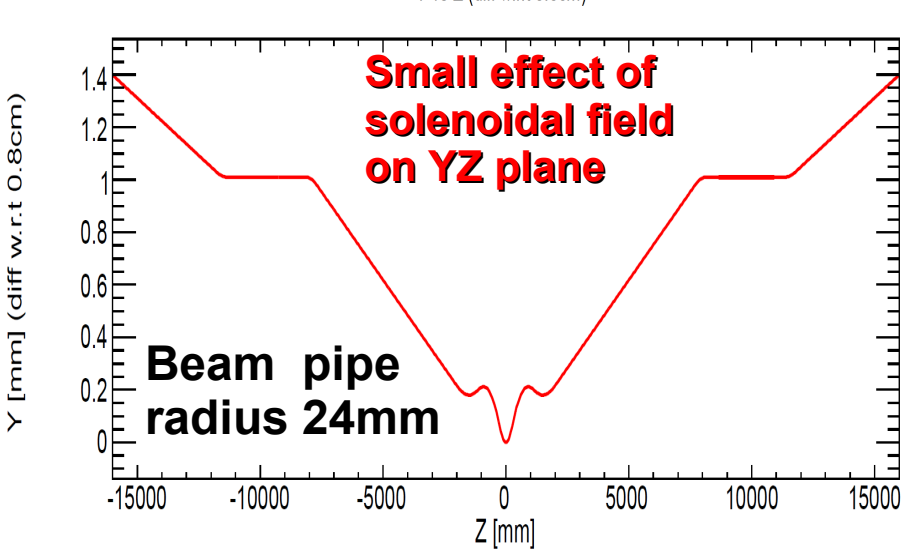
pai

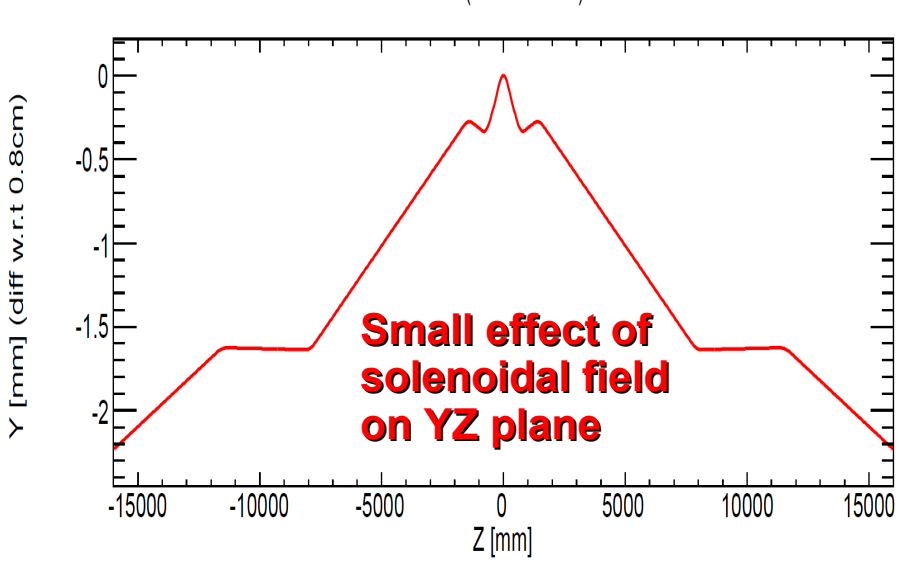
New FF model: Magnetic model (III)

Nominal Trajectory







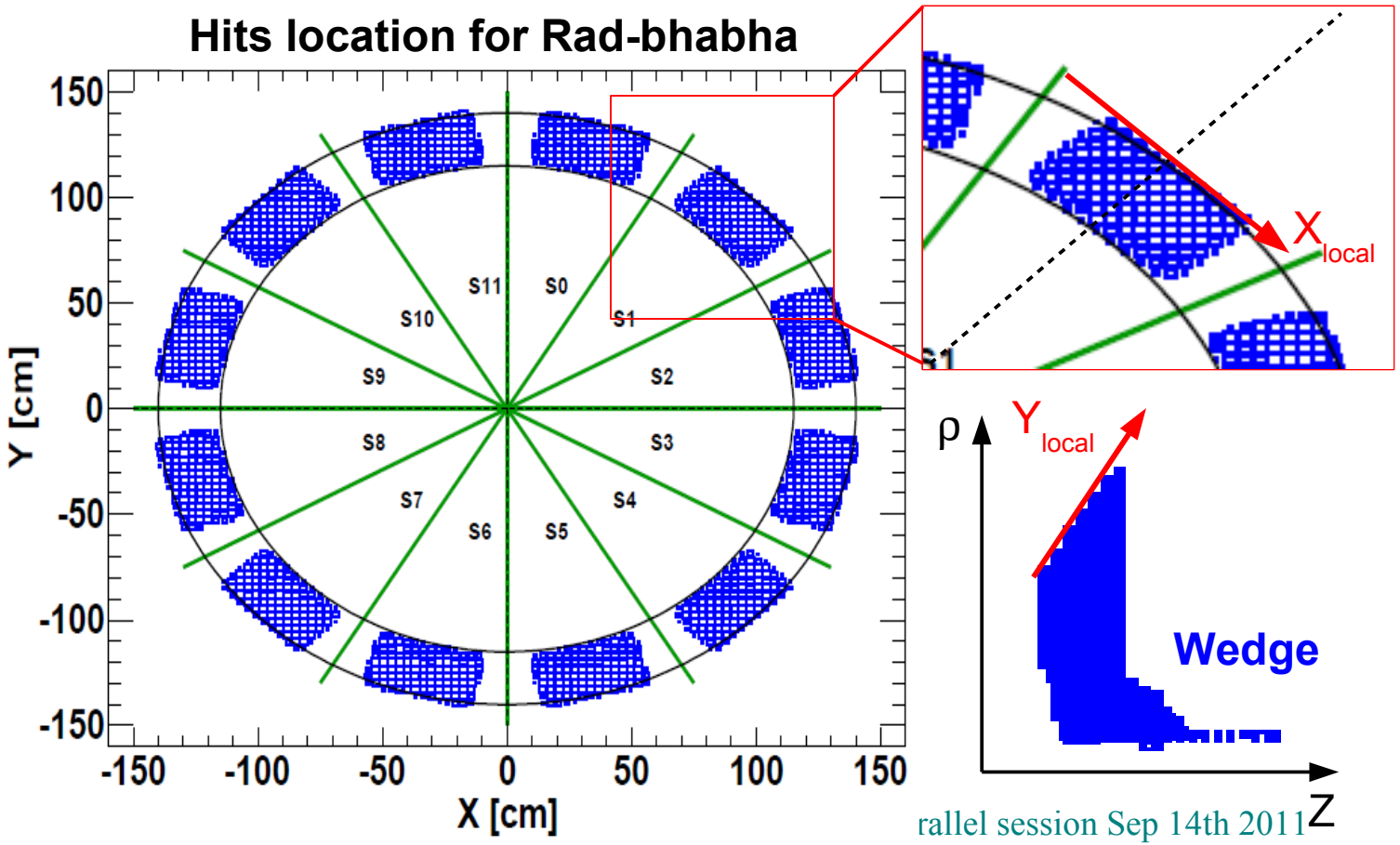


November 2011 Full-simulation production

- **Rad-bhabha:** ~10k bunch crossings
- **Pairs:** ~100k bunch crossings
- **Touschek:**
  - LER: ~180k primaries (losses at beam pipe)
  - HER: ~85k primaries (losses at beam pipe)
- **See more details about these samples in my report at Parallel VII: Computing – FullSim & Background (Thursday, 15/12/11 at 9am)**

Bkg rates on the FDIRC: Strategy (I)

- **Use same sector labelling as in BABAR**
- **Determine the photo-electron (p.e.) rates per pixel** (see next slide) **for every sector and for all available background sources**
- **Use a "local" coordinate system in the instrumented plane:** X_{local} vs Y_{local}



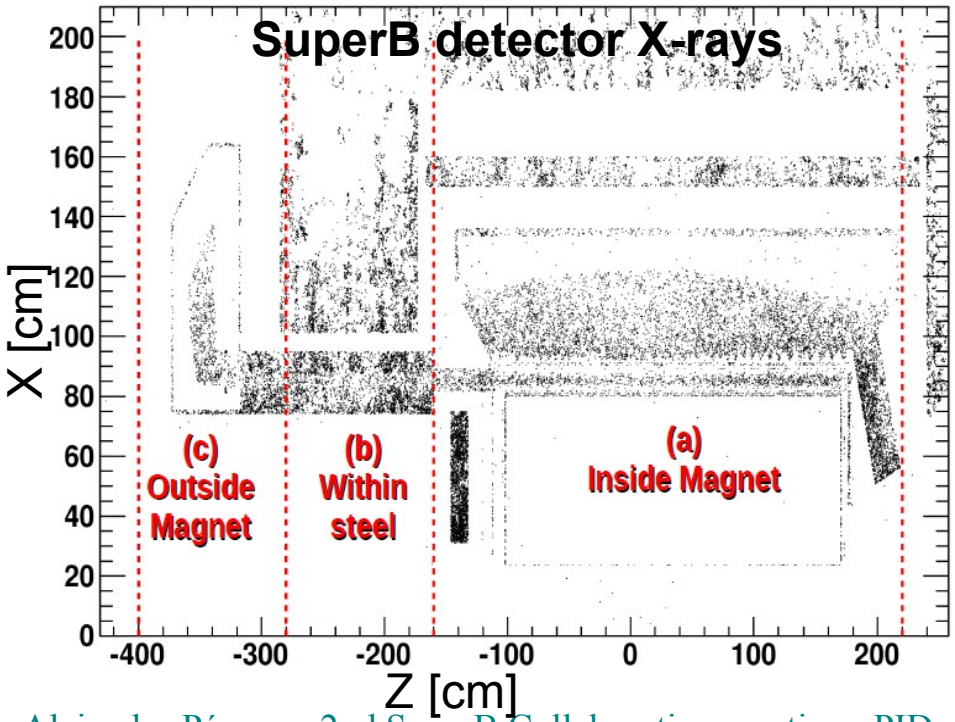
X_{local}:
From -width/2
up to width/2

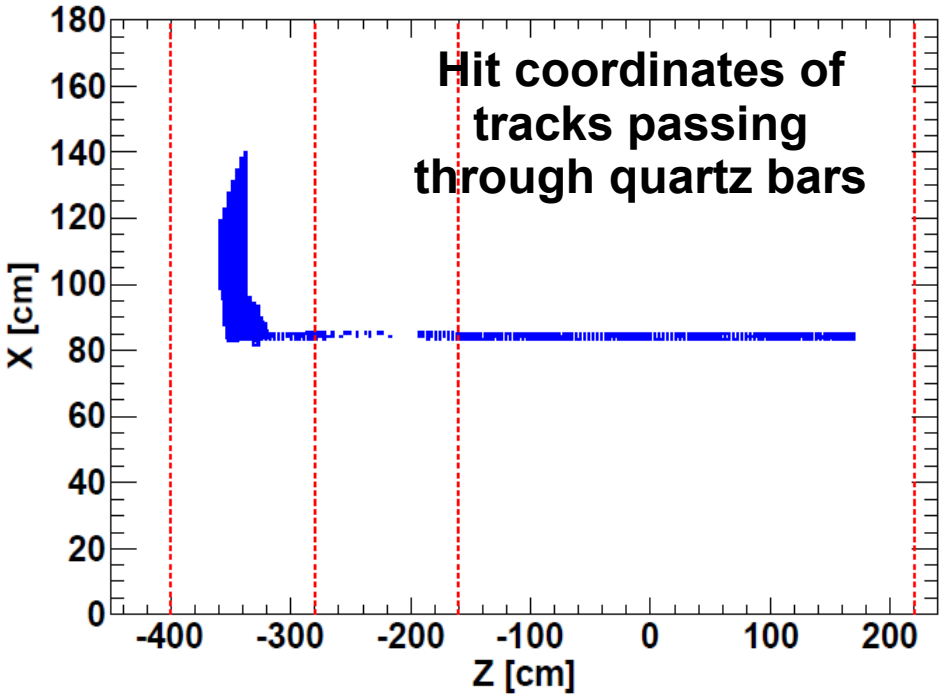
Y_{local}:
From 0.0
up to Length

Bkg rates on the FDIRC: Strategy (II)

- **Study the pixel rate for different regions were the tracks hit the quartz bar:**
  - (a) Inside magnet: -160 < Z < 220 cm
  - (b) Within steel: -280 < Z < -160 cm
  - (c) Outside magnet: -280 < Z < -400 cm
- **If main contribution comes from outside magnet**

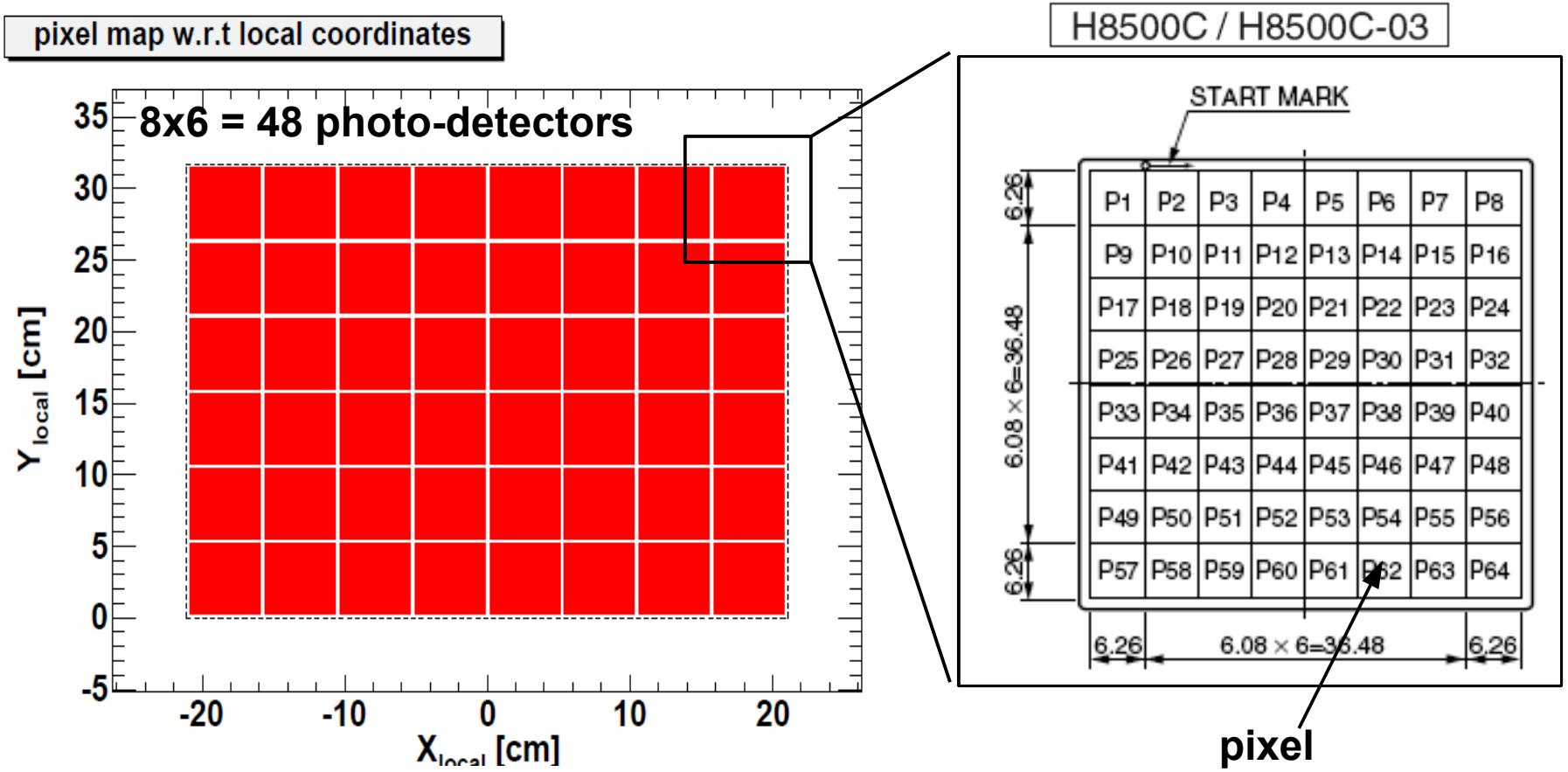
  ⇒ can reduce backgrounds by increasing shields





Bkg rates on the FDIRC: Pixel map

- For each sector have an array 8x6 = 48 photo-detectors
- Each detector is an 8x8 = 64 array of PMTs (pixels) with ~6.08mm pitch



Results

- **Will show the results for one representative FDIRC sector (sector 6) only just to show the format**
- **The full set of plots can be found at the web,**
  - Rad-bhabha:

http://www.slac.stanford.edu/~aperez/SuperB/SuperB_Pisa/FDIRC_Bkg_Studies/Plots_RadBhabha_background_FDIRC.pdf

  - Pairs:

http://www.slac.stanford.edu/~aperez/SuperB/SuperB_Pisa/FDIRC_Bkg_Studies/Plots_Pairs_background_FDIRC.pdf

  - Touschek LER:

http://www.slac.stanford.edu/~aperez/SuperB/SuperB_Pisa/FDIRC_Bkg_Studies/Plots_Touschek_LER_background_FDIRC.pdf

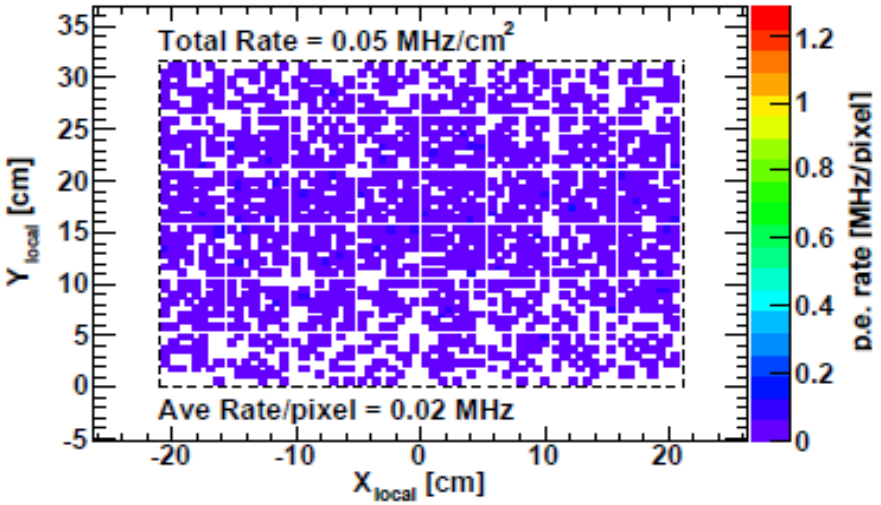
  - Touschek HER:

http://www.slac.stanford.edu/~aperez/SuperB/SuperB_Pisa/FDIRC_Bkg_Studies/Plots_Touschek_HER_background_FDIRC.pdf

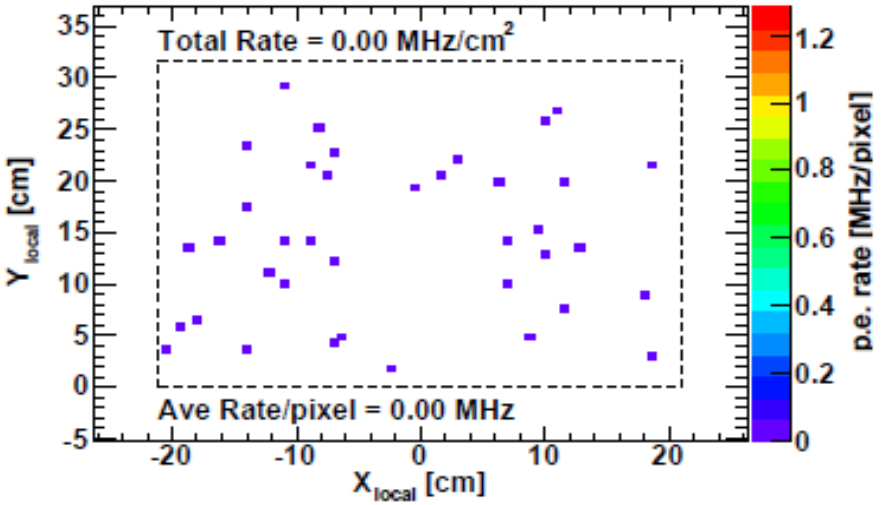
Results: FDIRC Bkg rates from Rad-Bhabha (I)

Sector 6

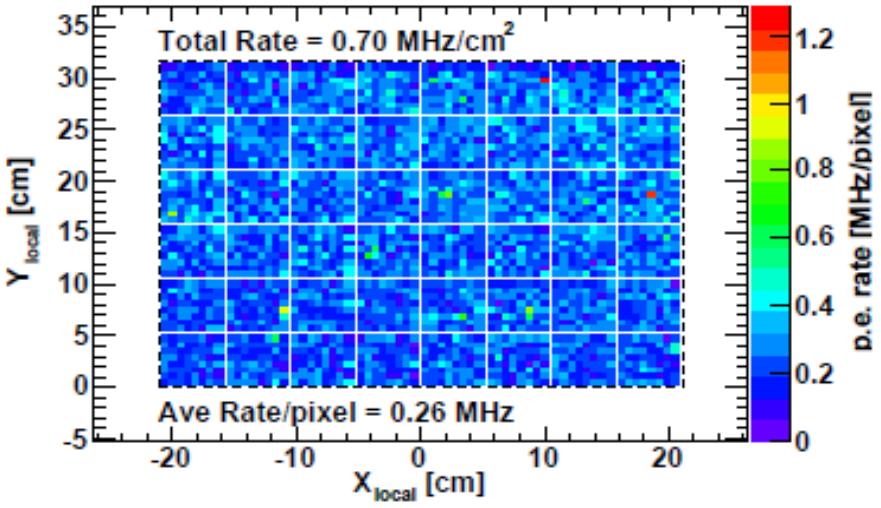
Inside Magnet



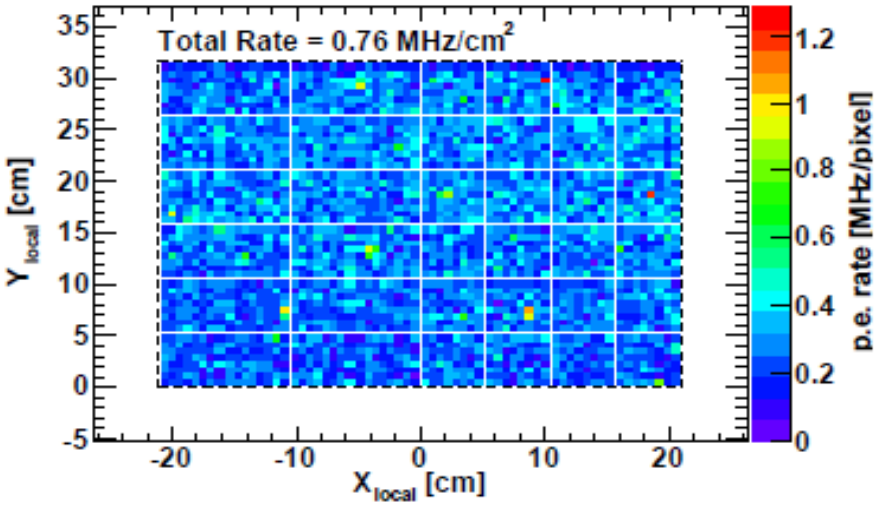
Within Steel



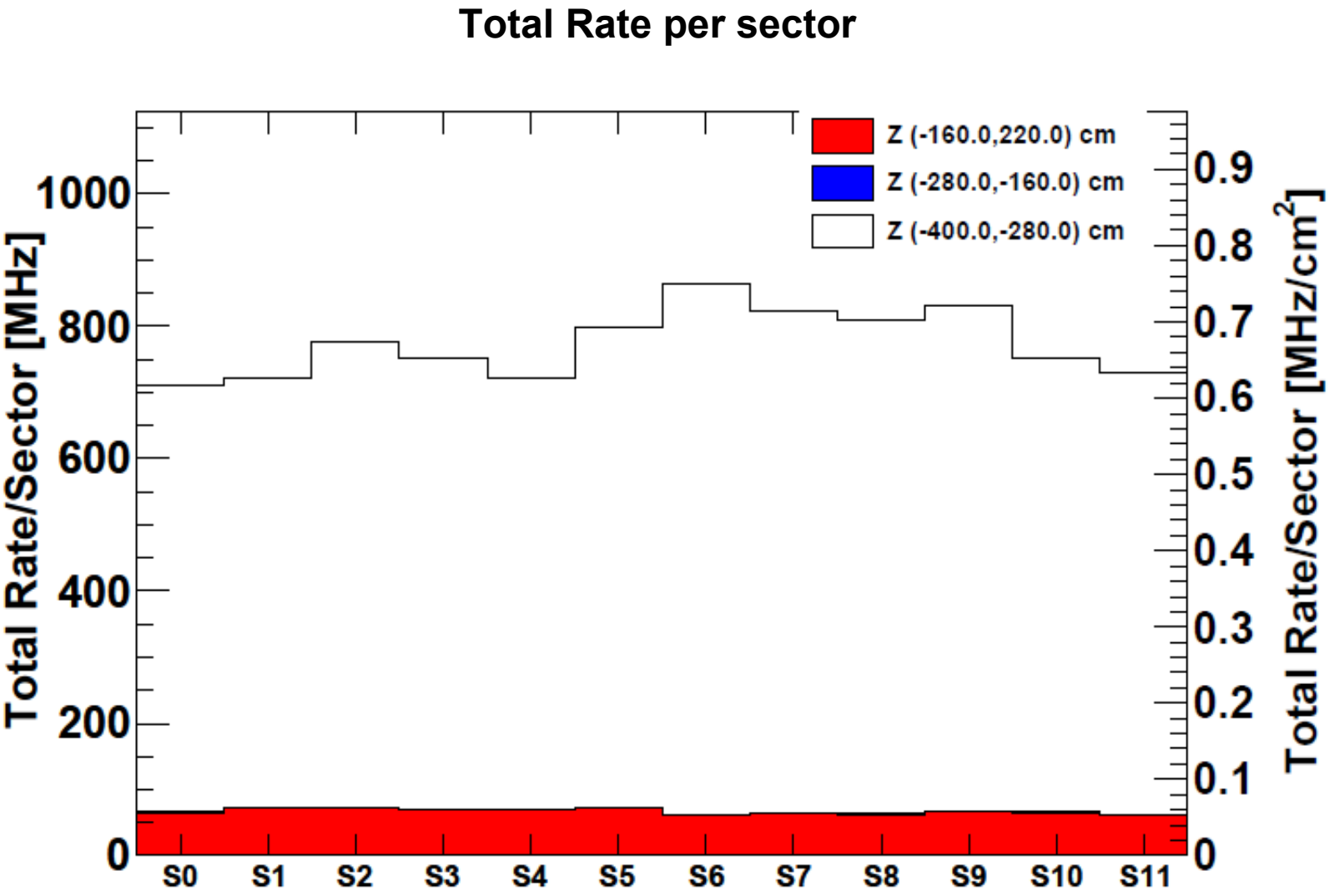
Outside Magnet



Total Rate



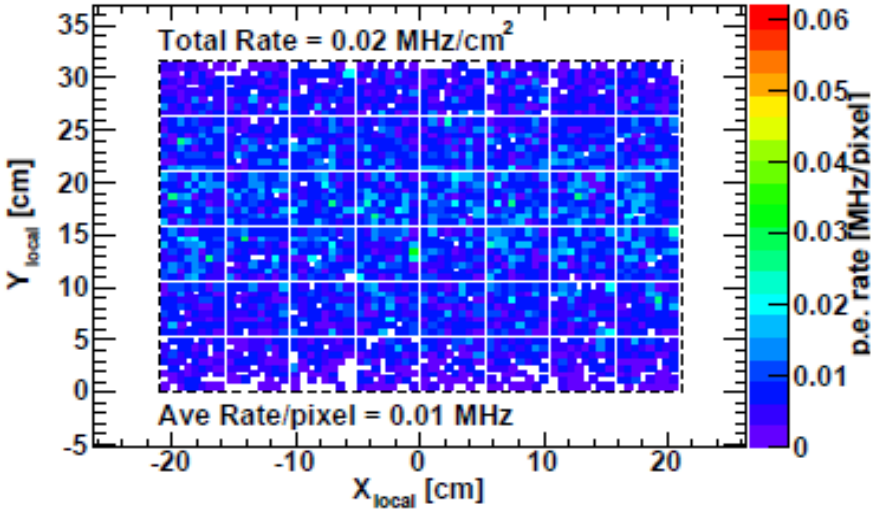
Results: FDIRC Bkg rates from Rad-Bhabha (II)



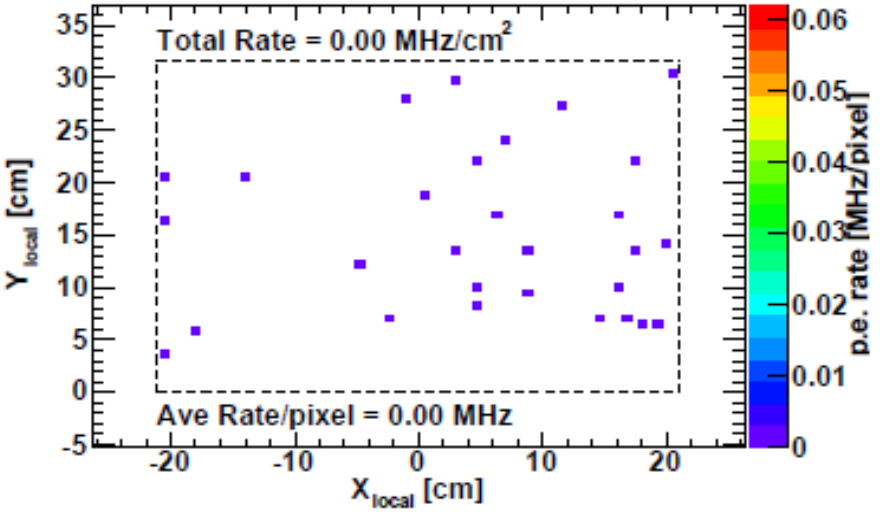
Results: FDIRC Bkg rates from Pairs (I)

Sector 6

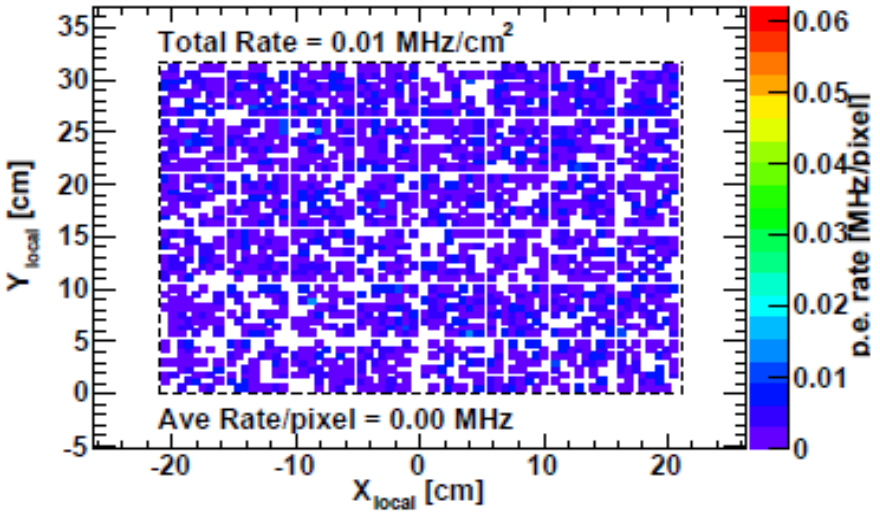
Inside Magnet



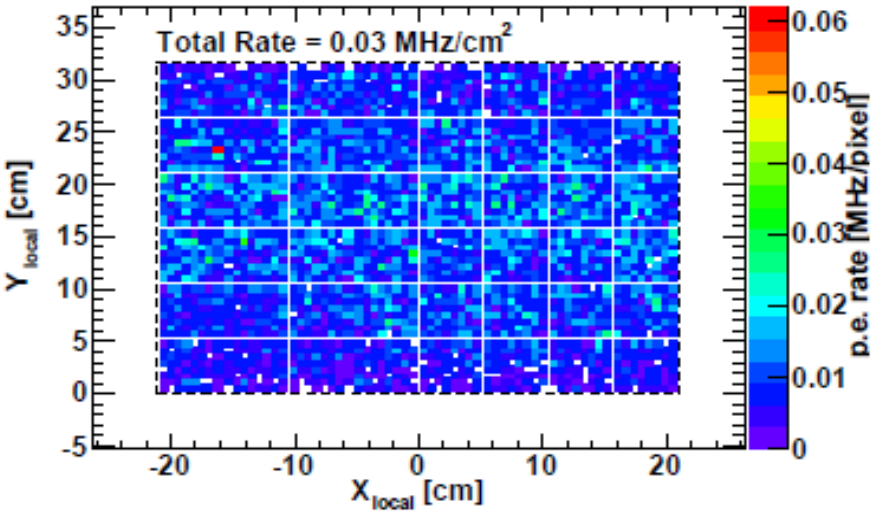
Within Steel



Outside Magnet

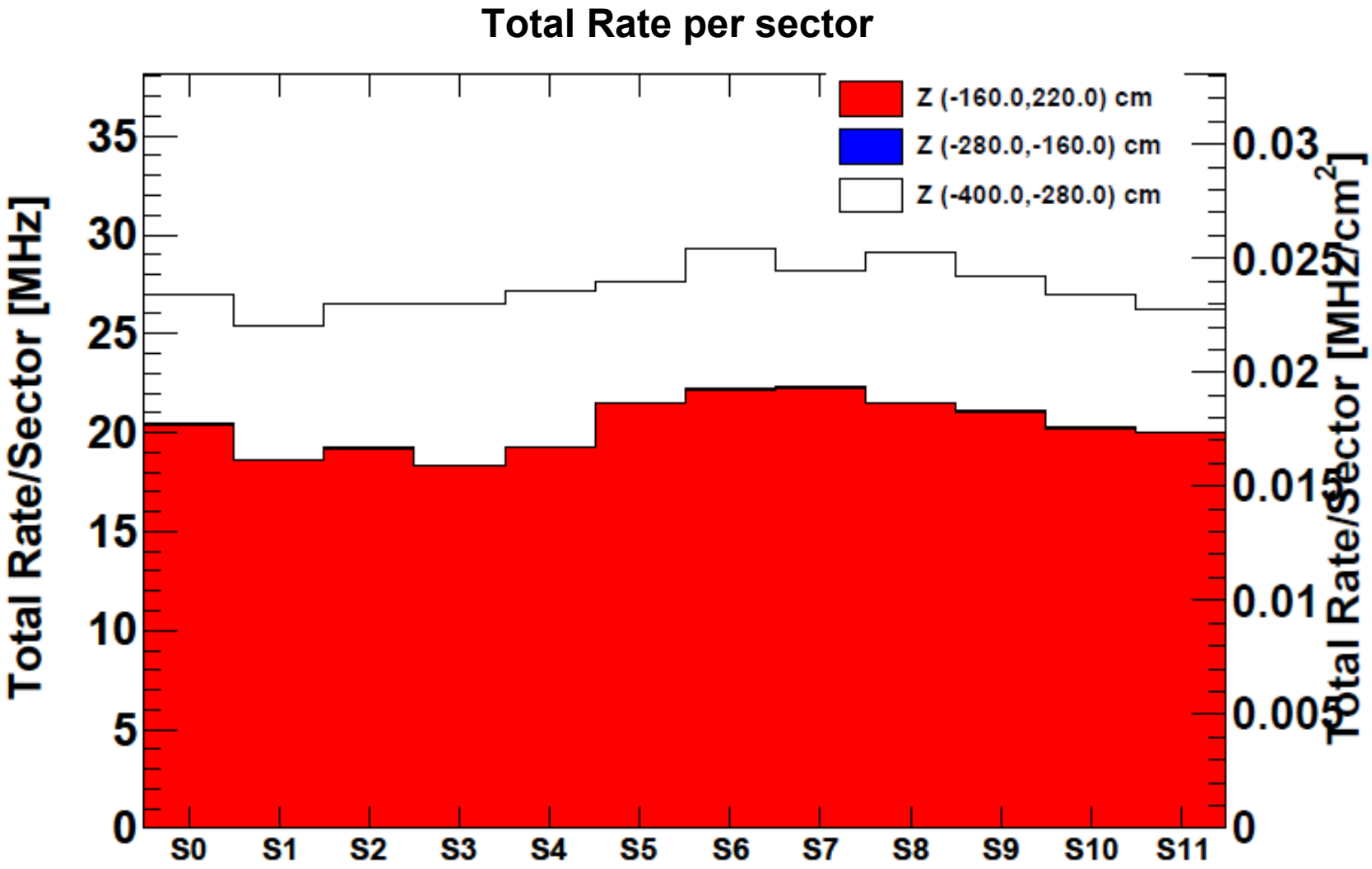


Total Rate



A

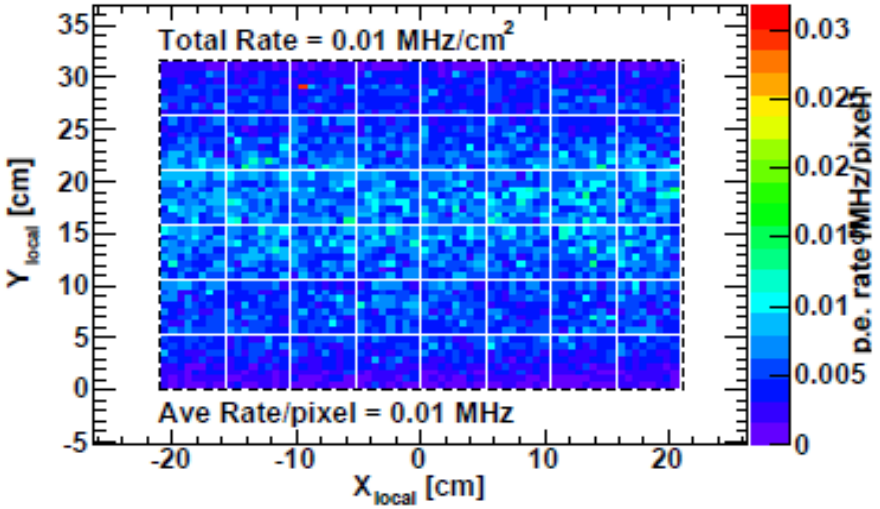
Results: FDIRC Bkg rates from Pairs (II)



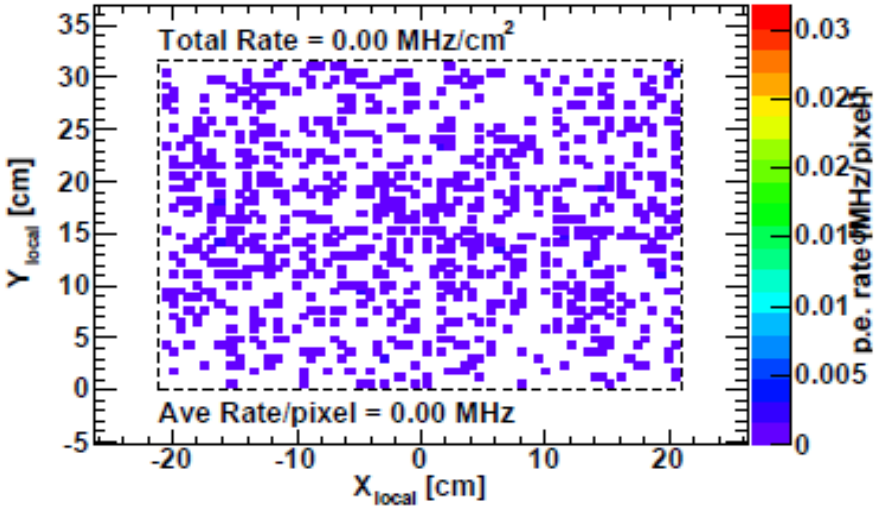
Results: FDIRC Bkg rates from Touschek LER (I)

Sector 6

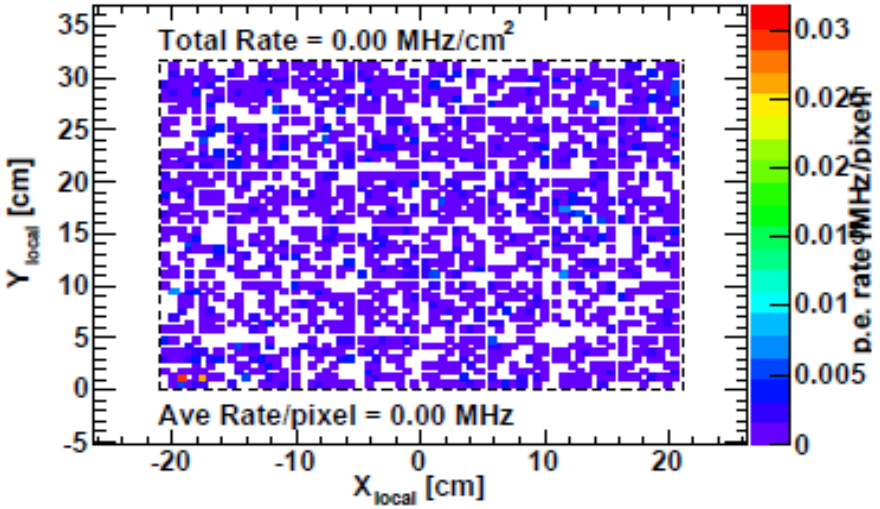
Inside Magnet



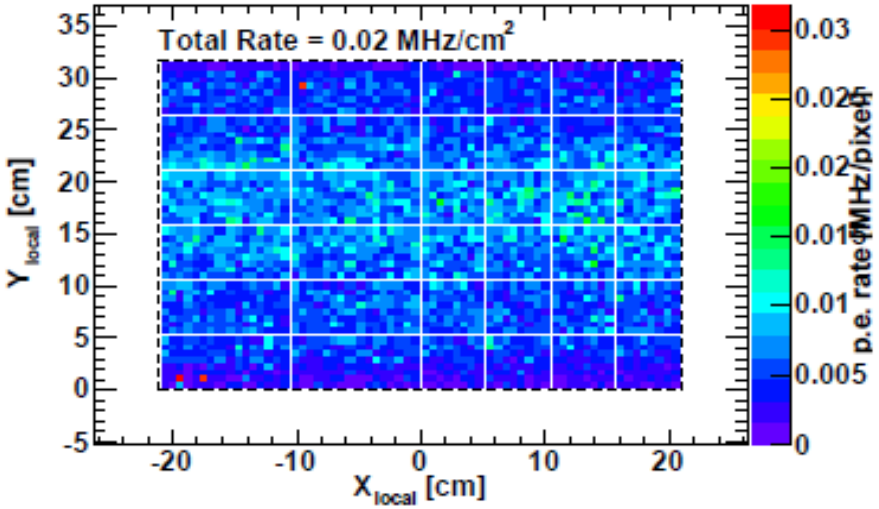
Within Steel



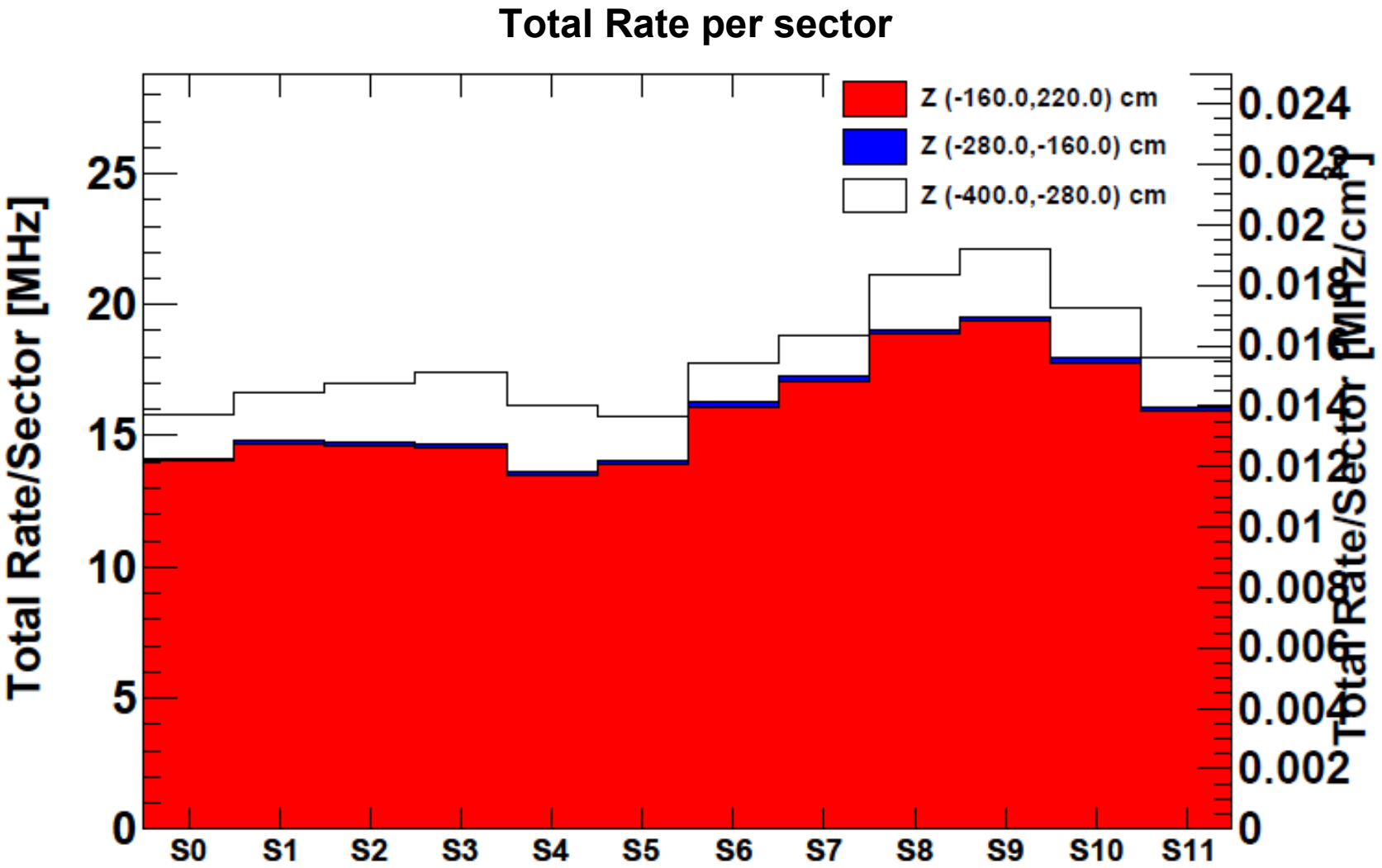
Outside Magnet



Total Rate



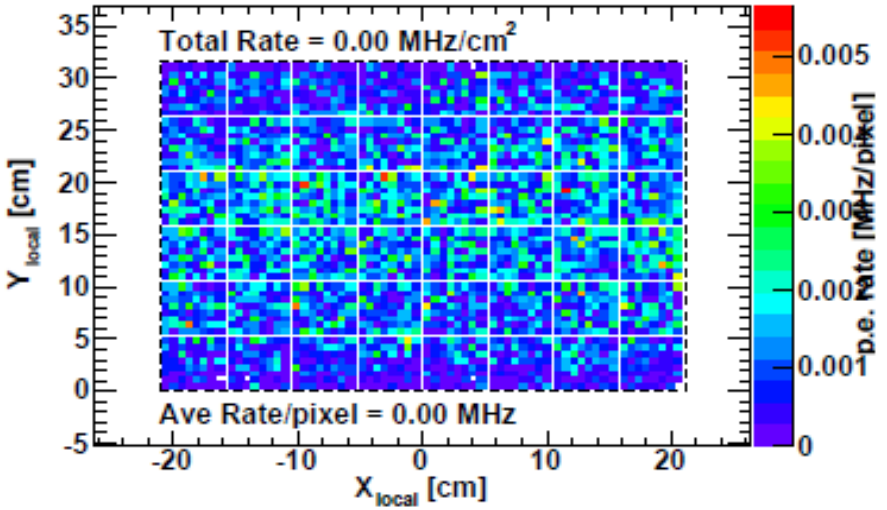
Results: FDIRC Bkg rates from Touschek LER (II)



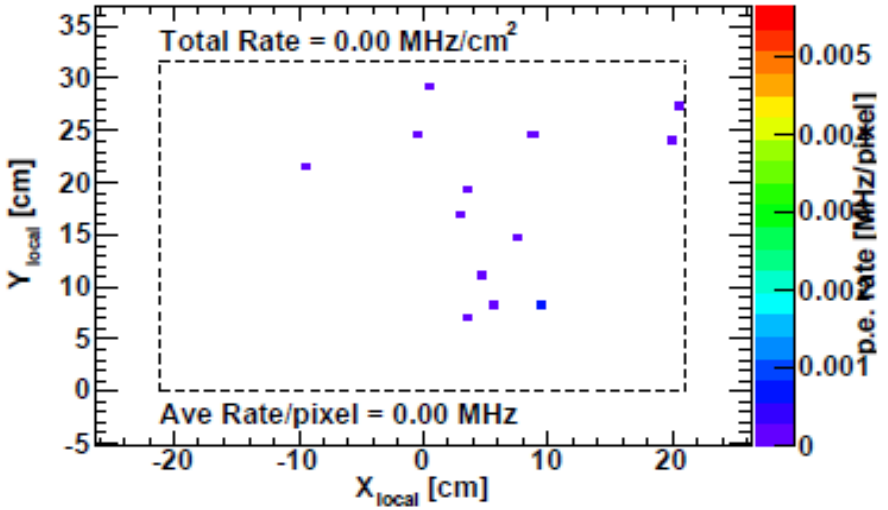
Results: FDIRC Bkg rates from Touschek HER (I)

Sector 6

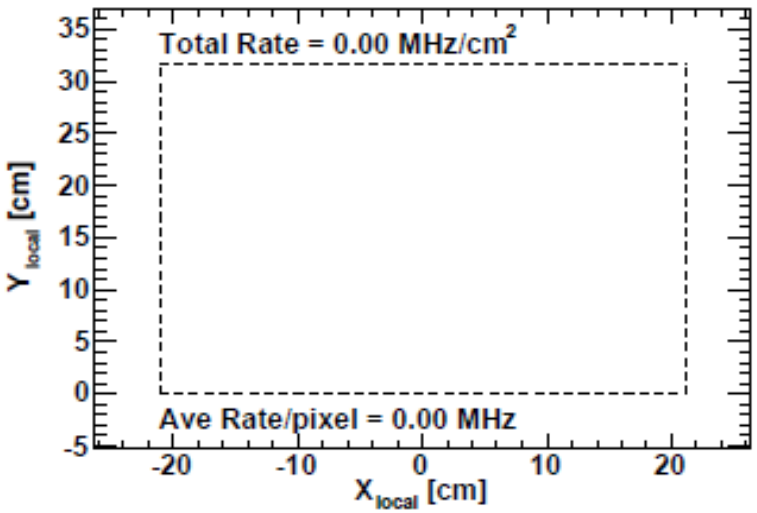
Inside Magnet



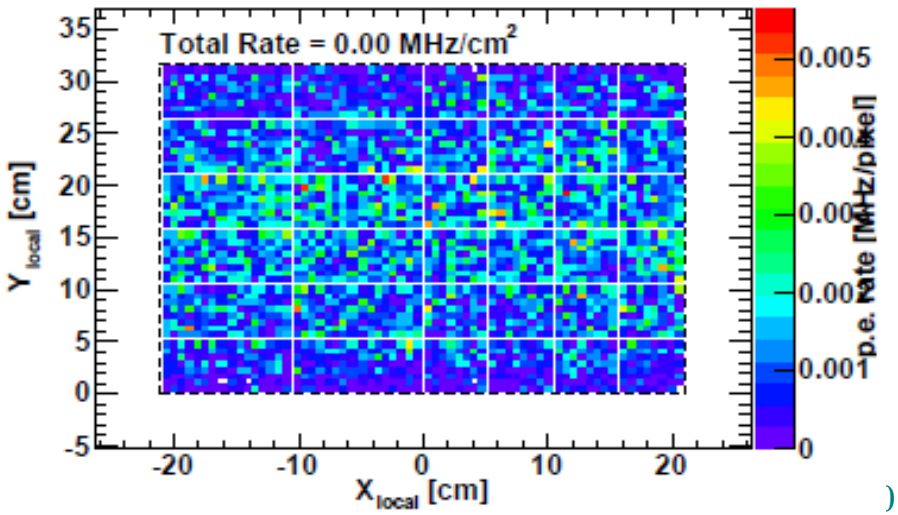
Within Steel



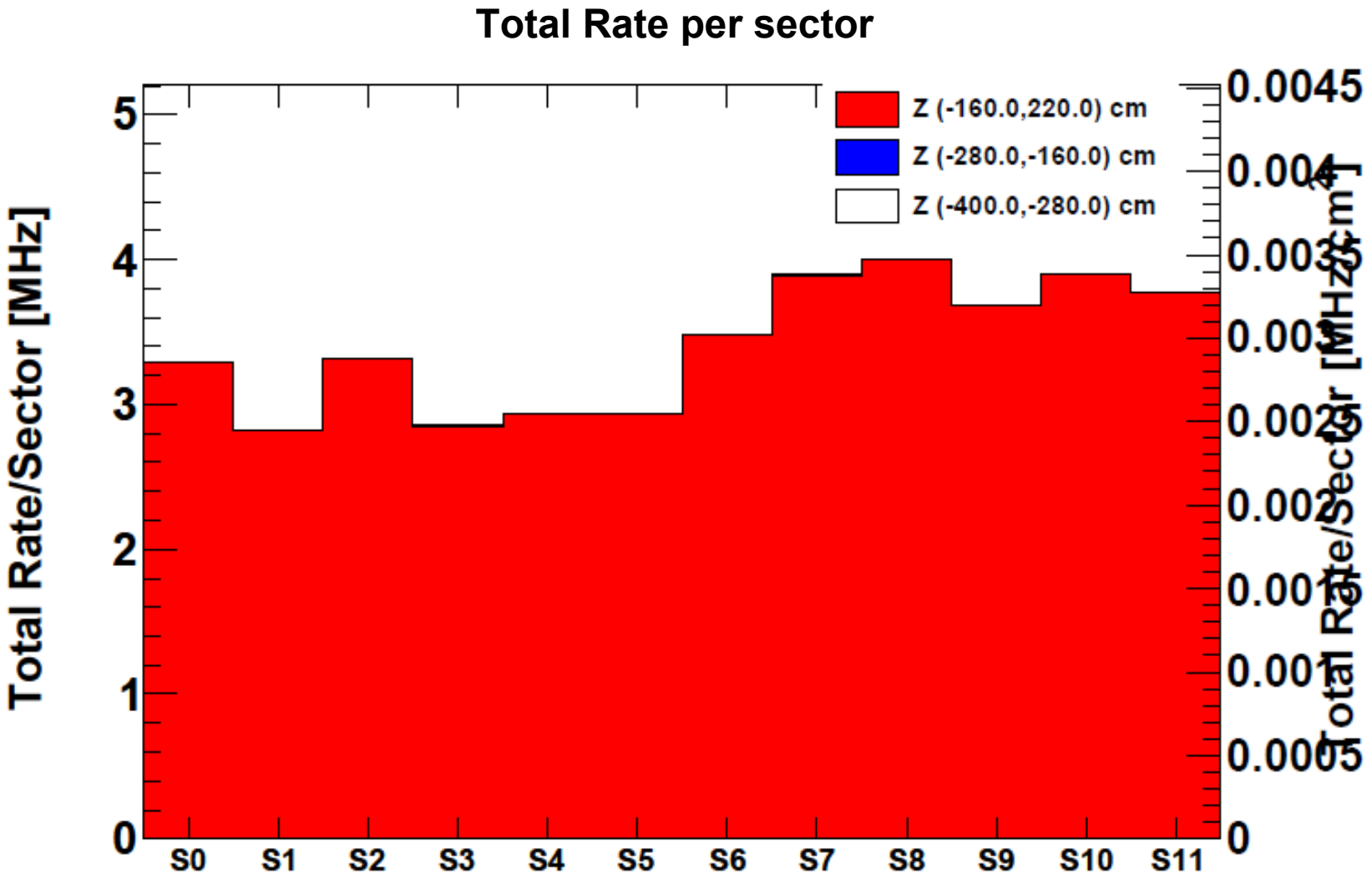
Outside Magnet



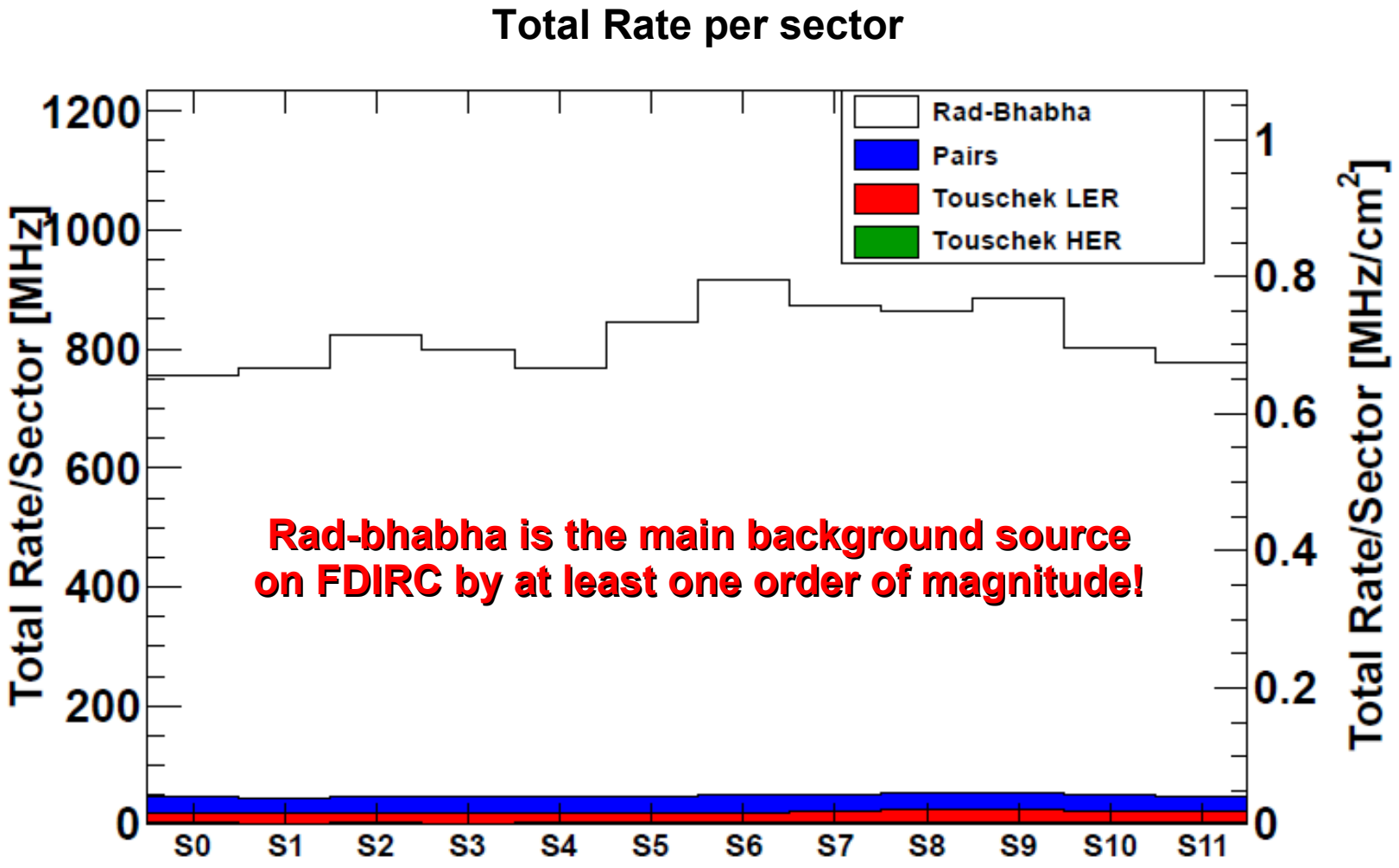
Total Rate



Results: FDIRC Bkg rates from Touschek HER (II)



Results: total bkg rates on FDIRC



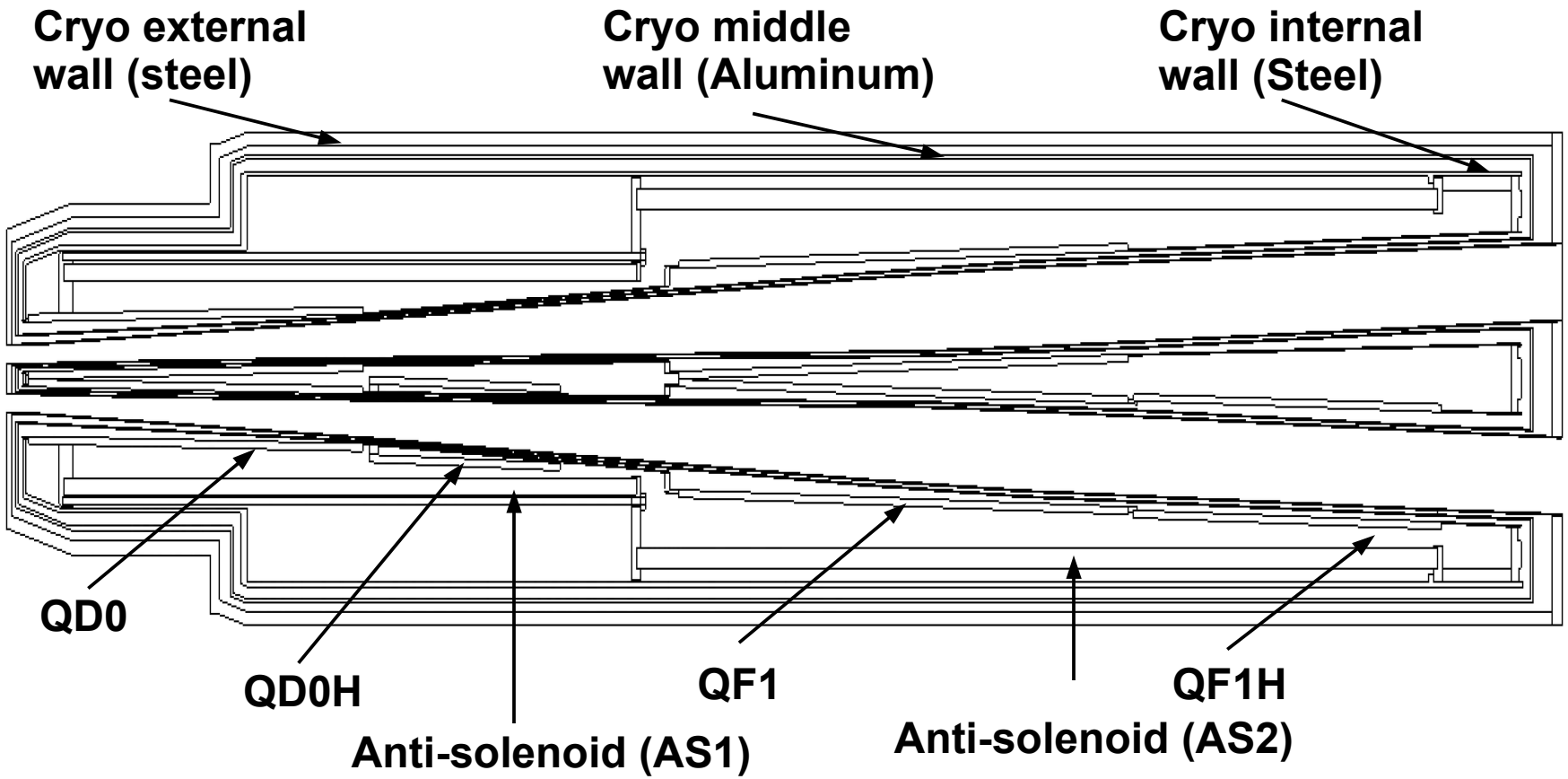
Summary

- **FDIRC is fully implemented in Bruno**
  - Cherenkov photons activated
  - Detector instrumented
- **Analysed the latest background samples from November 2011 full-simulation production**
- **Main background source is Rad-bhabha (by at least one orders of magnitude)**
- **Backgrounds are mainly from tracks hitting the quartz bar segment outside the field ⇒ possibility to increase shielding to reduce backgrounds**


Backup

New FF model: Cryostat and Magnets (I)

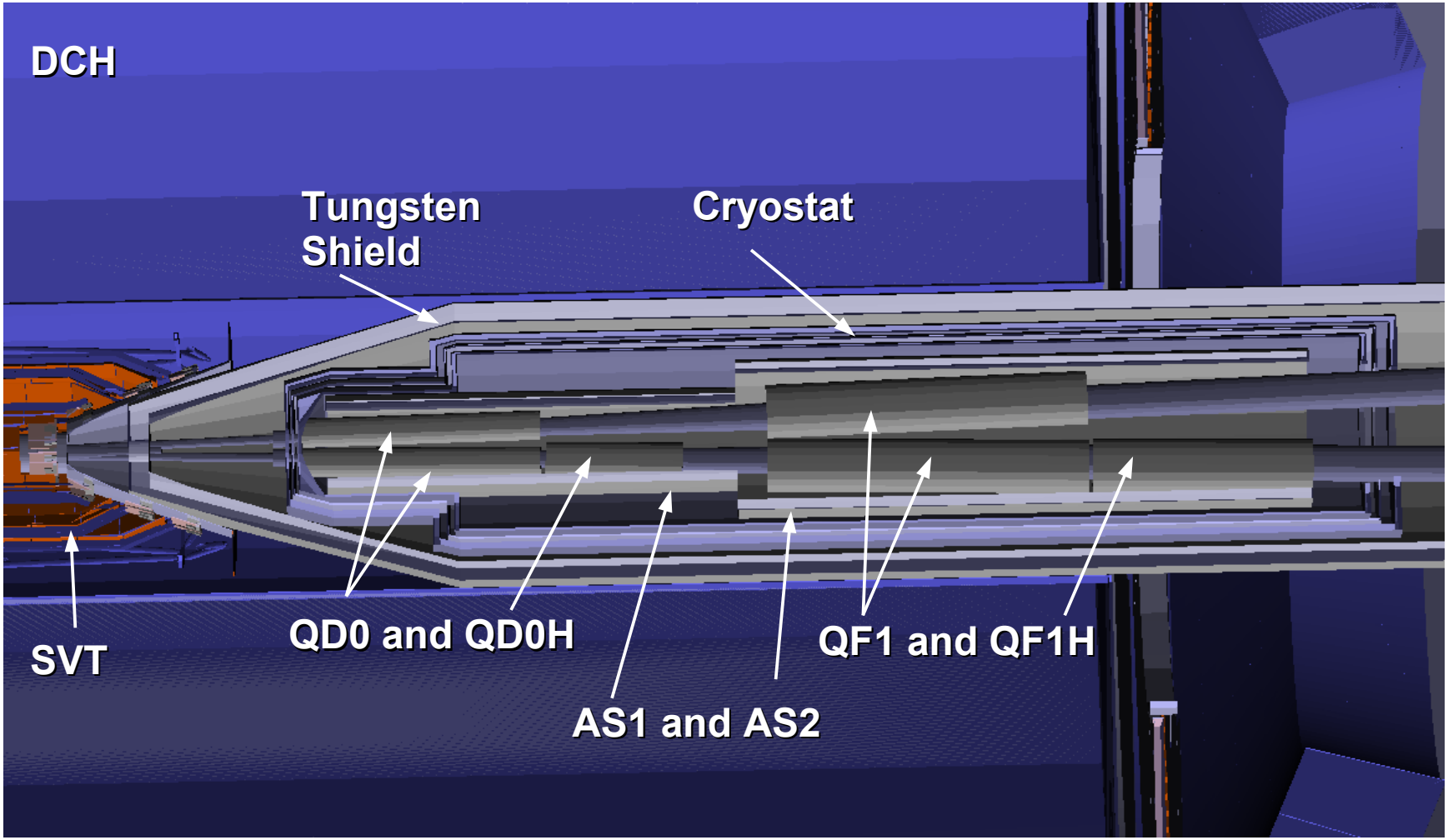
Filippo Bosi Drawings



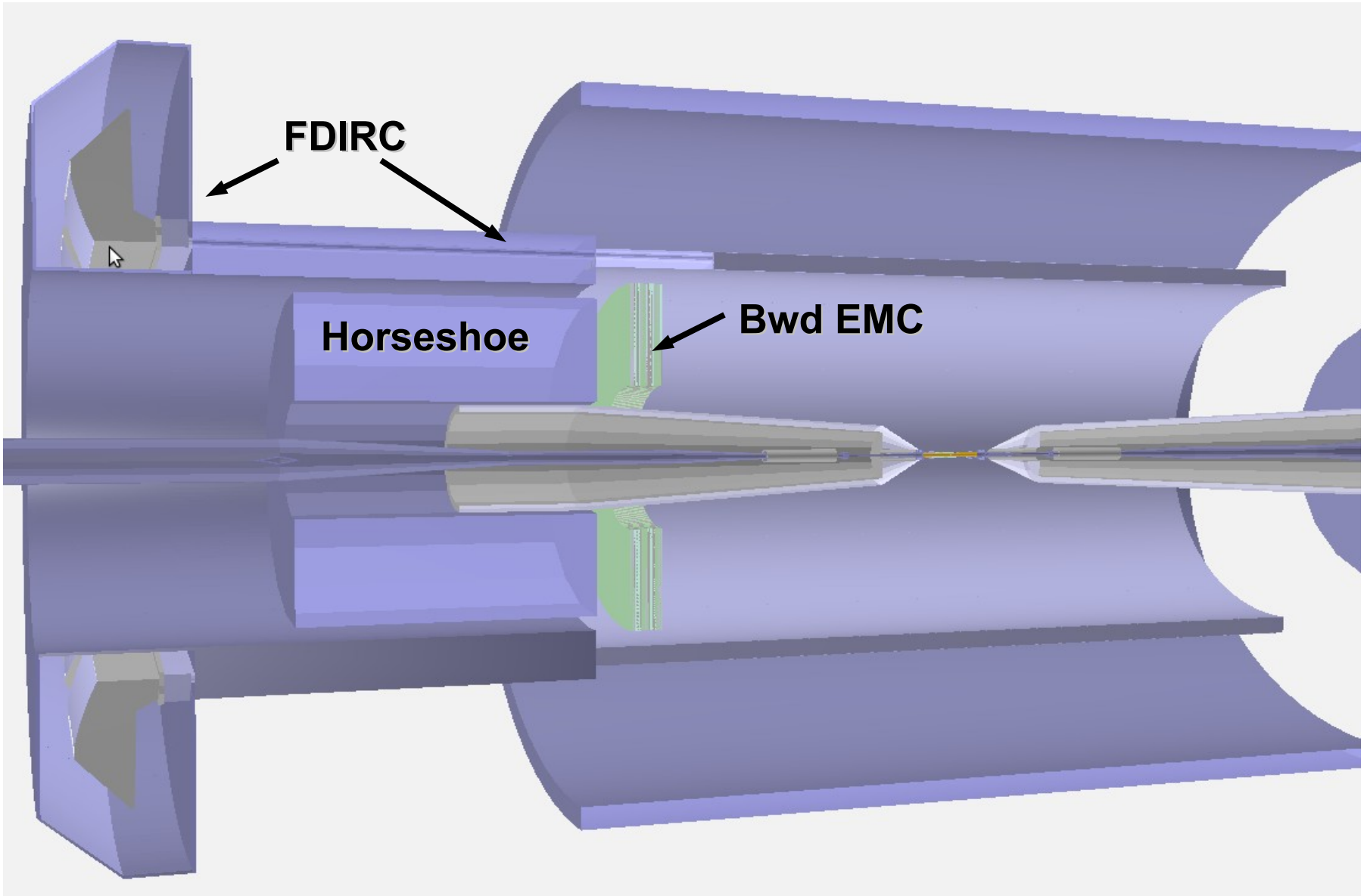
- **All magnetic elements are made of the same material (QD0_mixture):**
  - Density: 7.57 gr/cm^3
  - Composition: Niobium (0.106), Titanium (0.119), Cooper (0.347) and Iron (0.428)

New FF model: Cryostat and Magnets (II)

BRN implementation

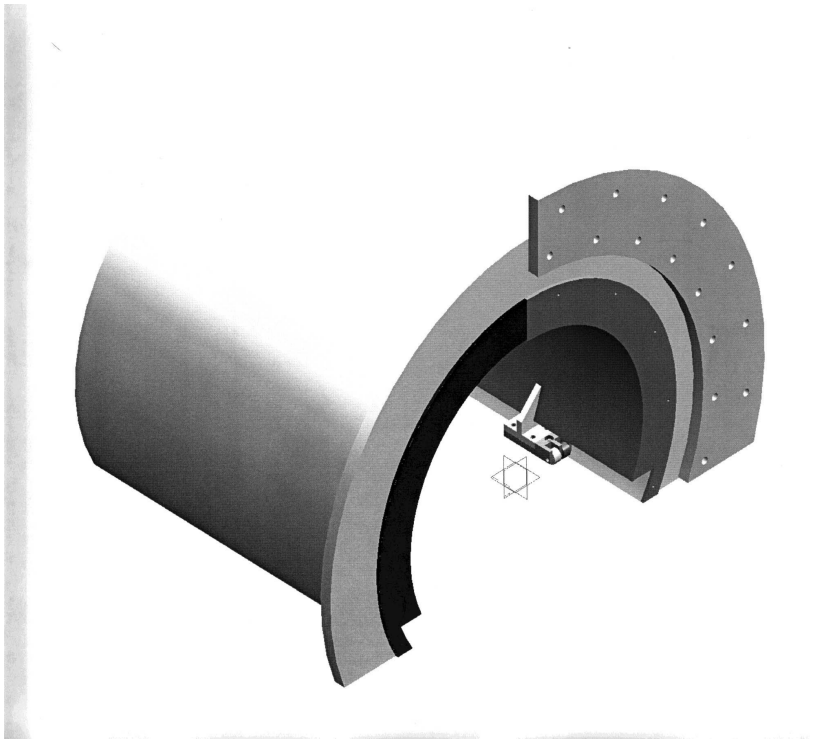


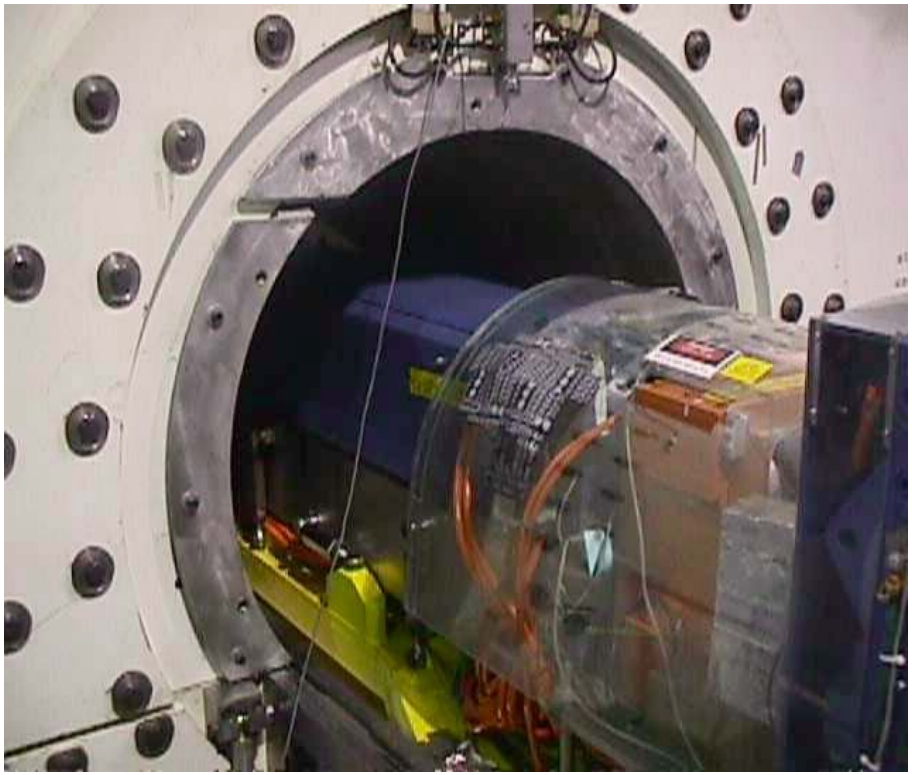
Bwd Horseshoe BRN implementation



Additional shield under photo-camera

Additional shield at BABAR





- **Need the characteristics of this shield**
  - Material
  - Dimensions