M.D.I.

Summary

E.P.
for
Riccardo Cenci, Dana Lindemann, Stefano Germani, Leonid Burmistrov, Jerry Va'vra, Nicolas Arnaud, Mauro Munerato, Gigi Cibinetto, Mike Sullivan, Andrea di Simone, and the computing team

General Considerations

- **13** talks on background on the meeting agenda
  - 8 speakers + several coworkers
    - Critical mass reached by many subsystems
- **1** Fast Sim to Bruno event converter (Dana)
  - Bruno will be shortly able to simulate generic BBar events
- **5** talks on the IR side of the MDI
  - 1 speaker
- **4** talks on the MDI
  - 1 speaker

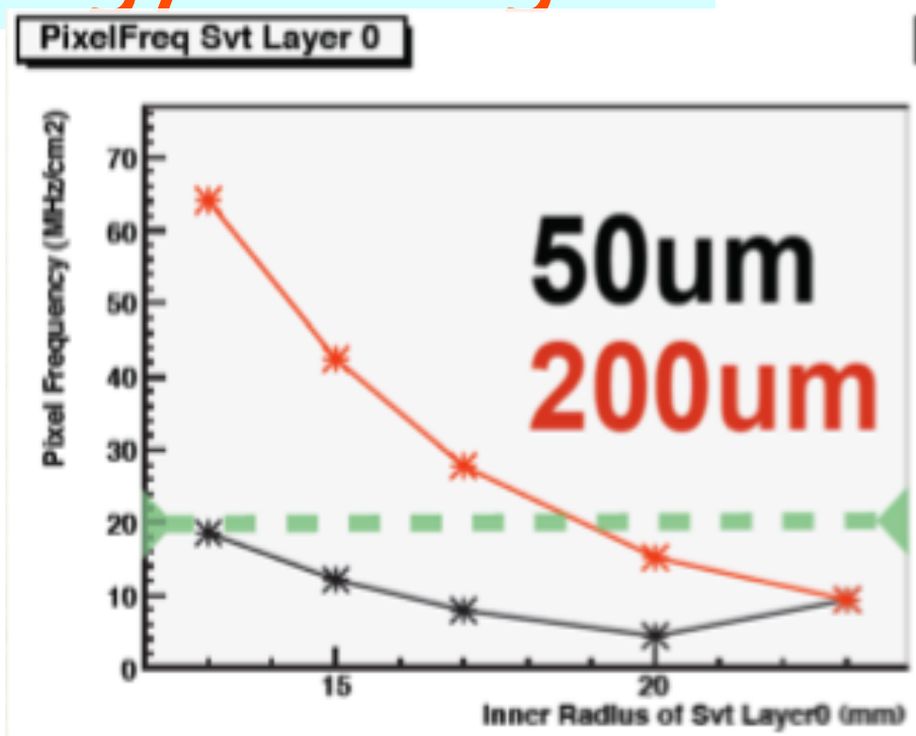
General Considerations II

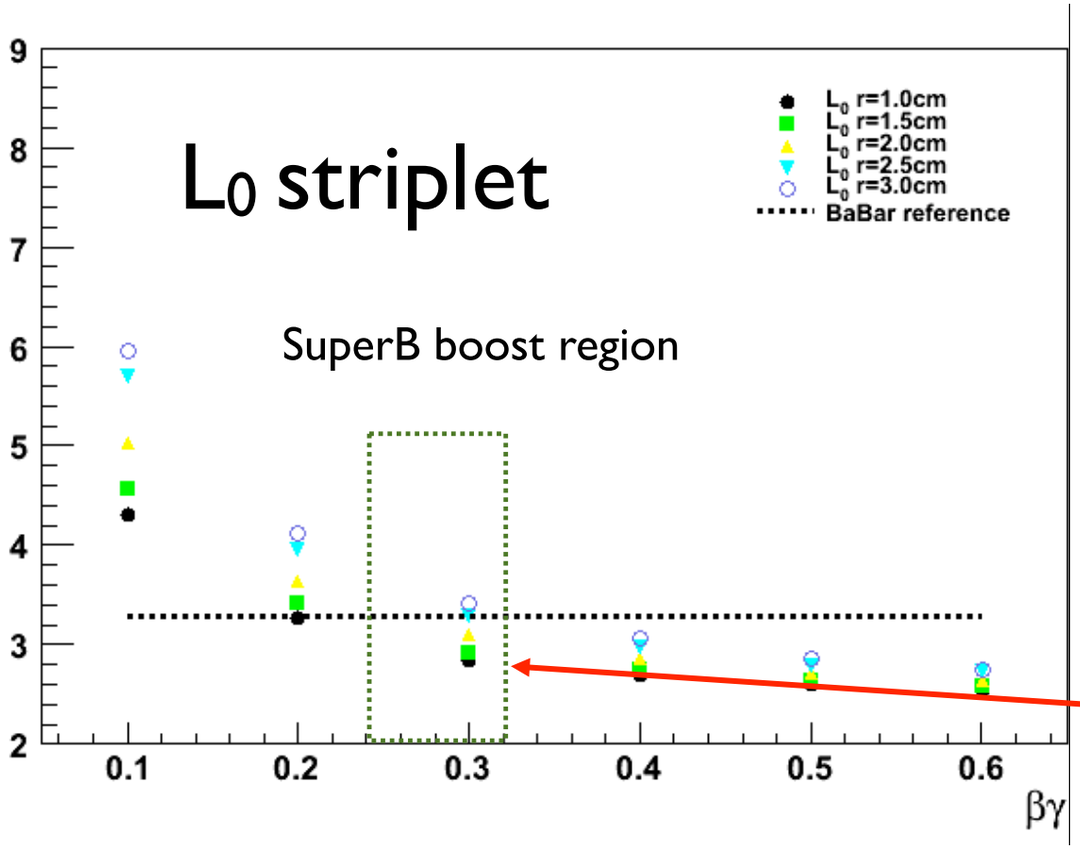
- **Up to now the MDI Detector Side focused his attention on background simulation, lot of progresses**
  - **Simulation Software**
  - **Computing Infrastructure**
  - **First steps toward Candidate Reconstruction**
- **Time to aggress the MDI from the IR Detector Side**
  - **Negotiation of the Machine, Detector vital spaces**
  - **Current assumption**
    - **Machine: r < 24 cm and |theta| < 0.300 radiant**
    - **Detector: r > 25 cm or |theta| > 0.300 radiant**
  - **Many missing elements: SVT read out, services, radiation monitors, luminosity monitors etc...**

Layer0 radius & technology vs bkg.

Update on background:

- Hit rate vs Layer0 radius from pairs production depends strongly on sensor thickness:
  - on thick sensor larger cluster width for low momentum tracks with large crossing angle
- Large difference for thin pixels (50 um) and striplets (200 um)
- Hybrid pixel with 200 um sensor will be like striplets, unless thinner sensor can be used





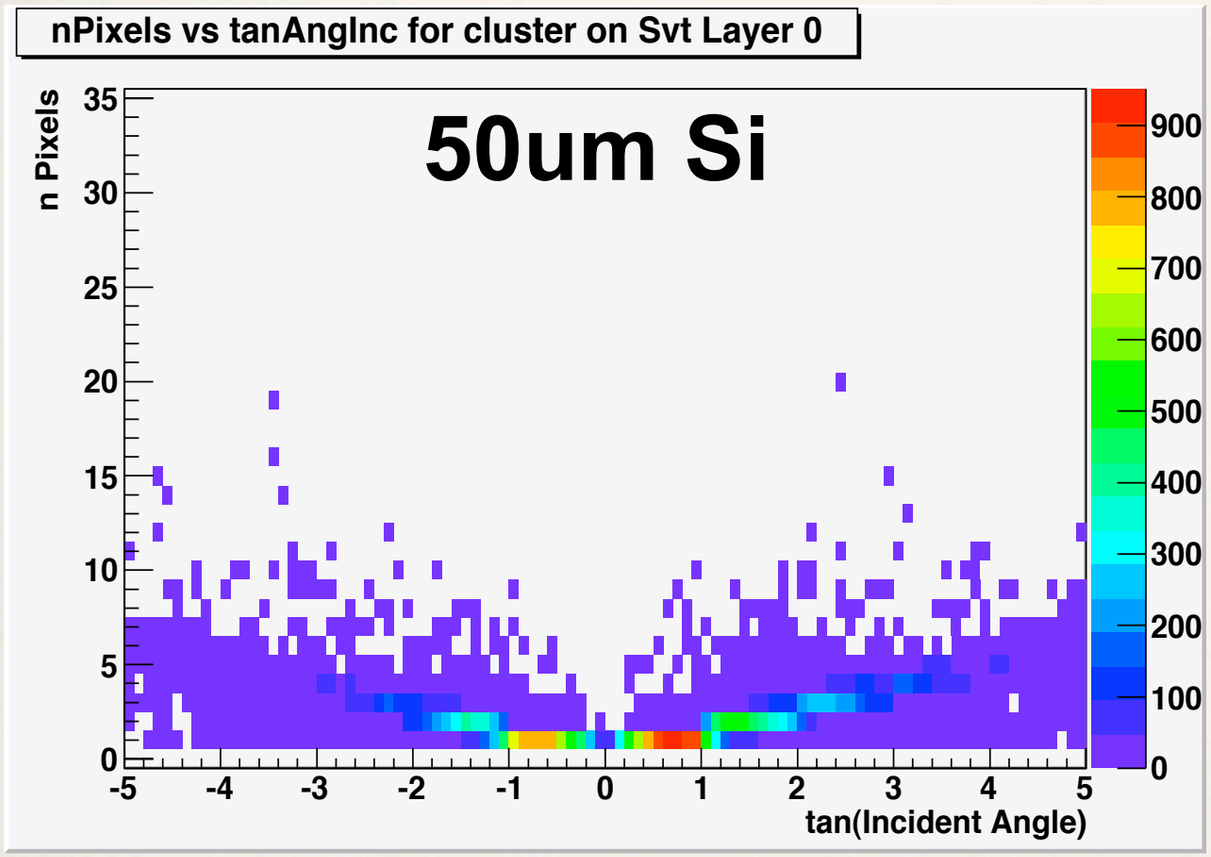
Sustainable background hit rate (radius) depends on technology: striplets vs pixel area and readout chip.

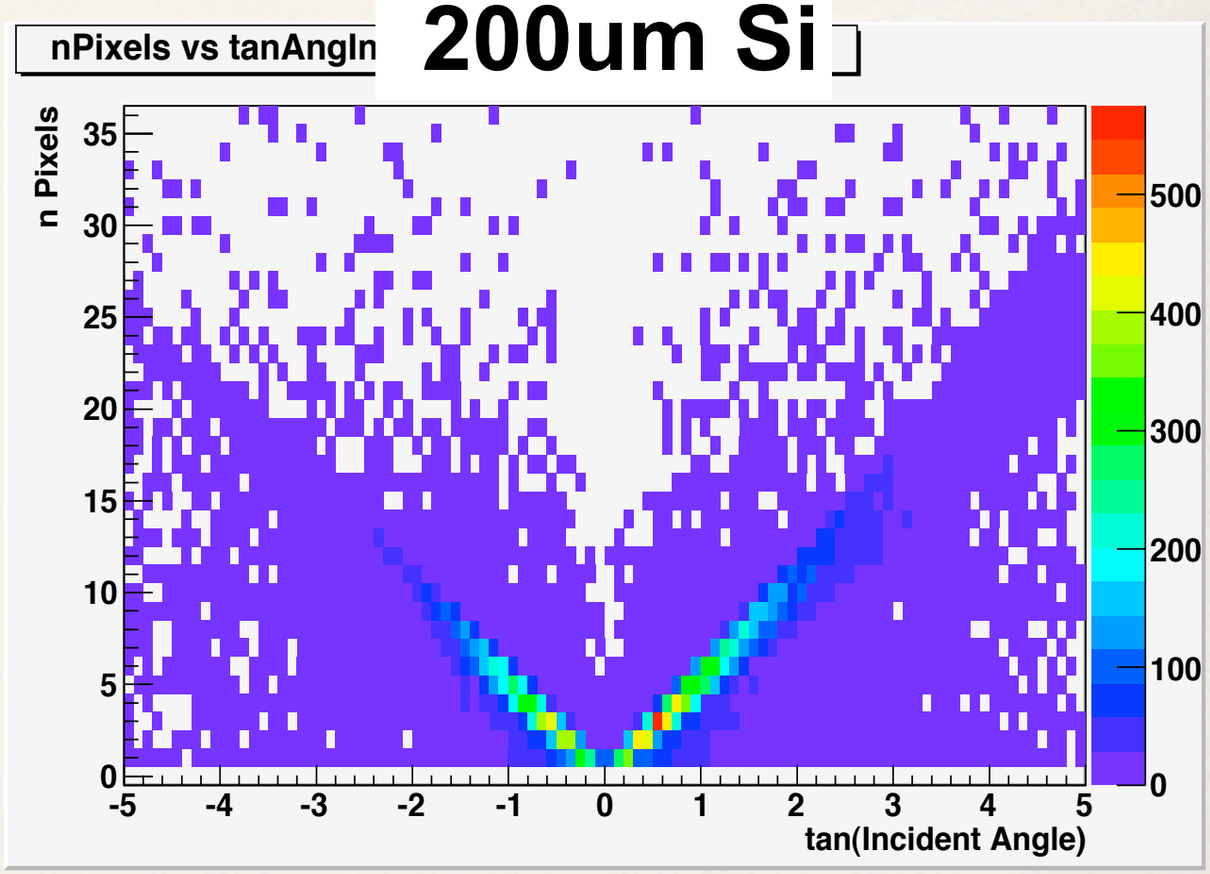
- Development of thin pixel chip readout architecture continue: data push and triggered with target 100MHz/cm2 (safety x5 included) with timestamp 100 ns. → R~1.3cm
  - Still to demonstrate: scaling to large matrix, rad hardness for MAPS,
- Assumed 100MHz/cm2 hard limit for striplets (~ 10% occupancy in 100 ns, area~10^{-2} cm^{-2}) → R~2 cm
  - performance similar to BaBar and thin pixel at lower radius. No margin left!

Pixel multiplicity

Will be compared with test beam real data

- Multiplicity proportional to tangent of incident angle on Si
- Simulation with different thickness of L0 silicon:
  - 50um, monolithic pixels device
  - 200 um, striplets device

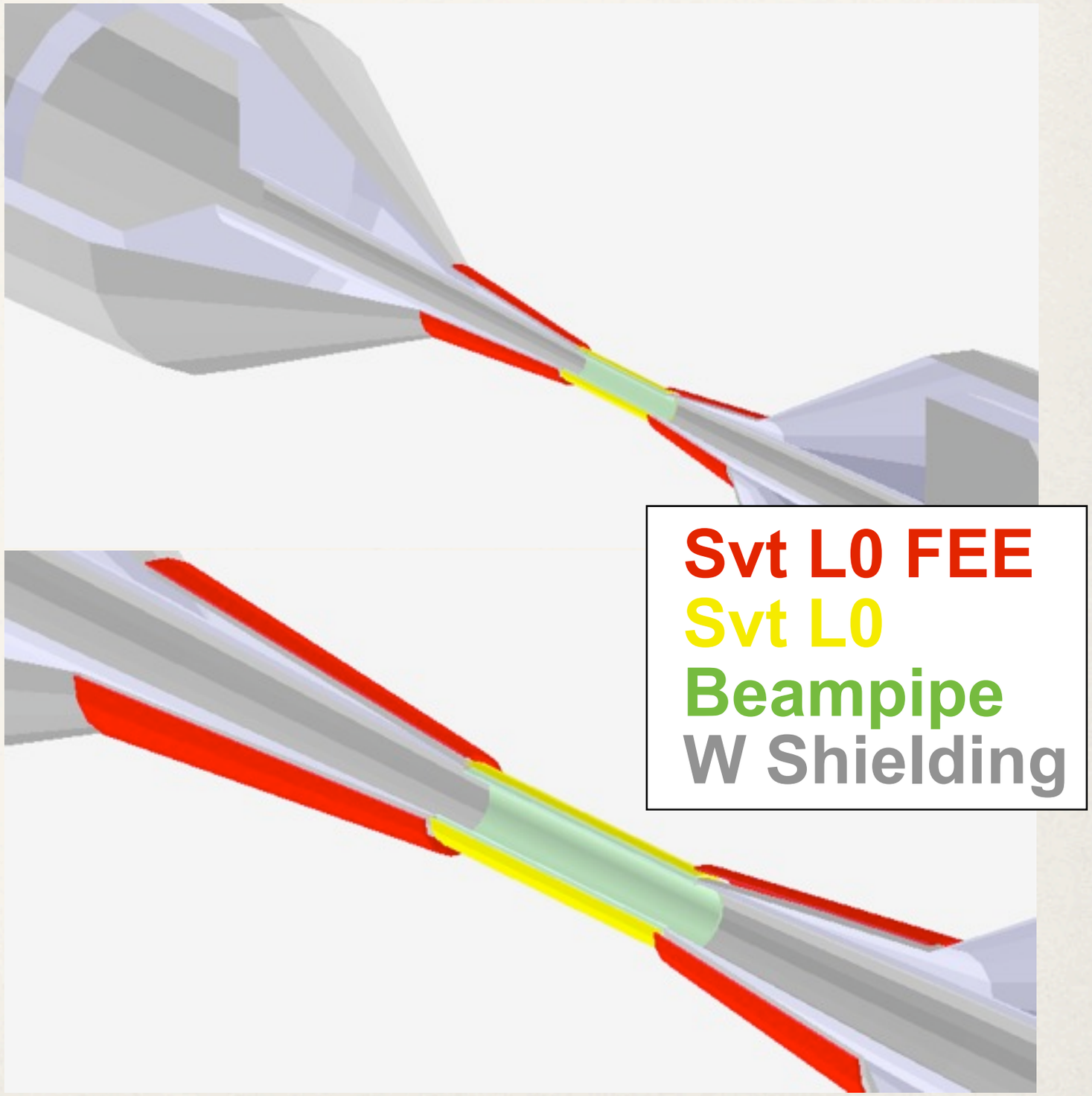




- Tan < 0 when particle is going from outside to inside L0

L0 electronics position

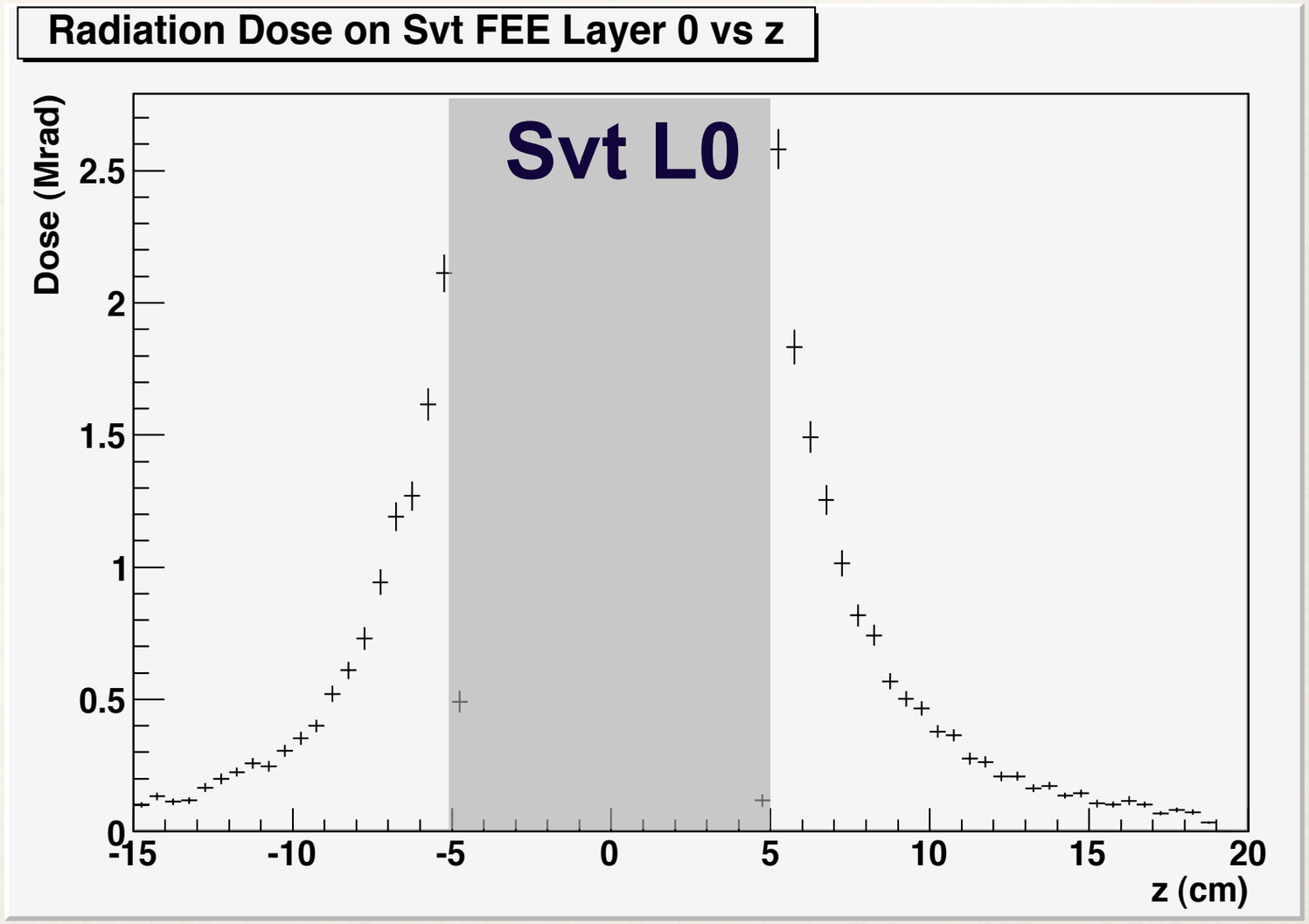
- Additional 2 volumes
  - Cones around IR tungsten shielding close to L0
  - 1mm of Si at 2mm from shields (radiation probes)
- Sensitive volumes: additional BrnRootHits list dumped by RooEvt object



Radiation on L0 electronics

- Relevant information: Integrated Dose (1 nominal year)
- First test with pairs bkg (40k evts)

- Average dose:
  460 krad
- Much higher close to L0 edges: >2 Mrad
- Same technique can be used for other areas or using also more realistic materials

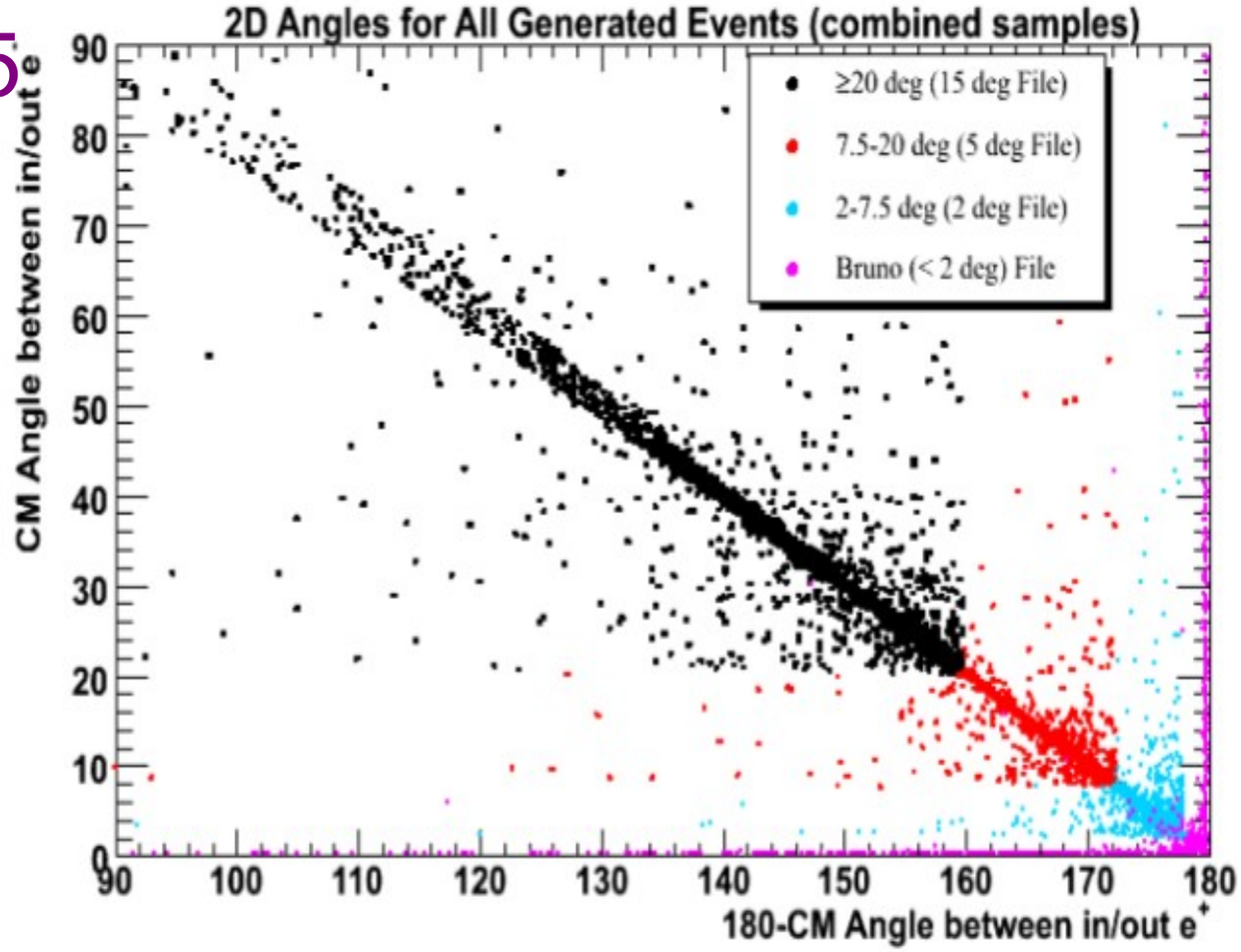


Drift Chamber

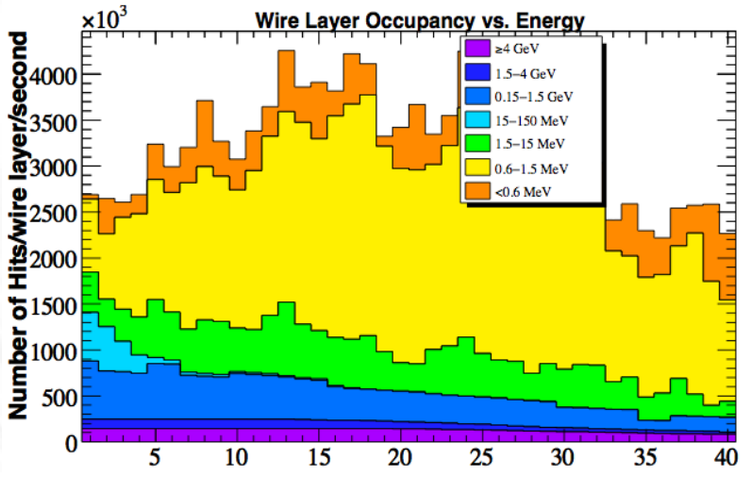
- Bhwide generator in FastSim (No Bhwide with Bruno)
- Transfer events to FullSim by converting StdHepAsciiDump output to guinea generator input
- Create tuples with e+e- at 2-178, 5-175, 15-165 degrees (CM frame)

Degrees	Cross-Section (nb)
2-178	7171.77
5-175	876.348
15-165	81.6761

- Combine with tuples created using Bruno's Bbbrem generator. weight = 4.644 ns^{-1}



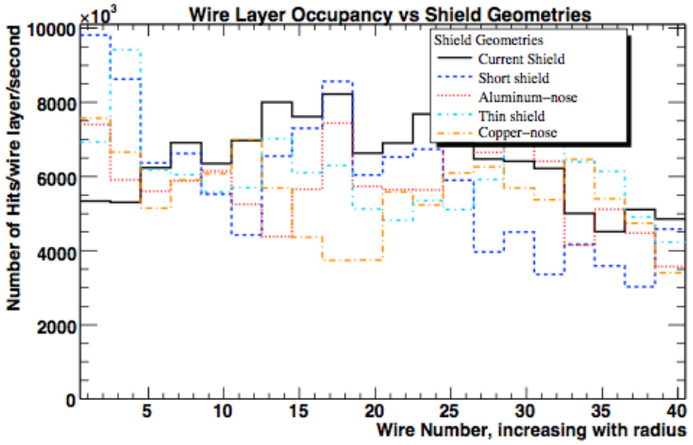
Track reco.!! Shield optimization

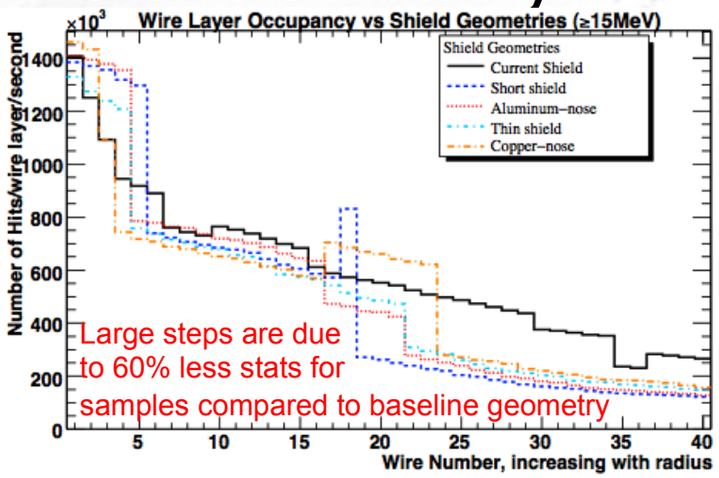


Tracking Algorithm

- Bruno only provides deposited energy (hit) information within a chamber that's void of wires. All wires are assumed to be axial and uniformly spaced.
- Using the TrackID of time-ordered hits, I define a track and extrapolate the number of wires the track would cross.

Occupancy vs. Shield Geometry





ne where track enters/exits DCH:

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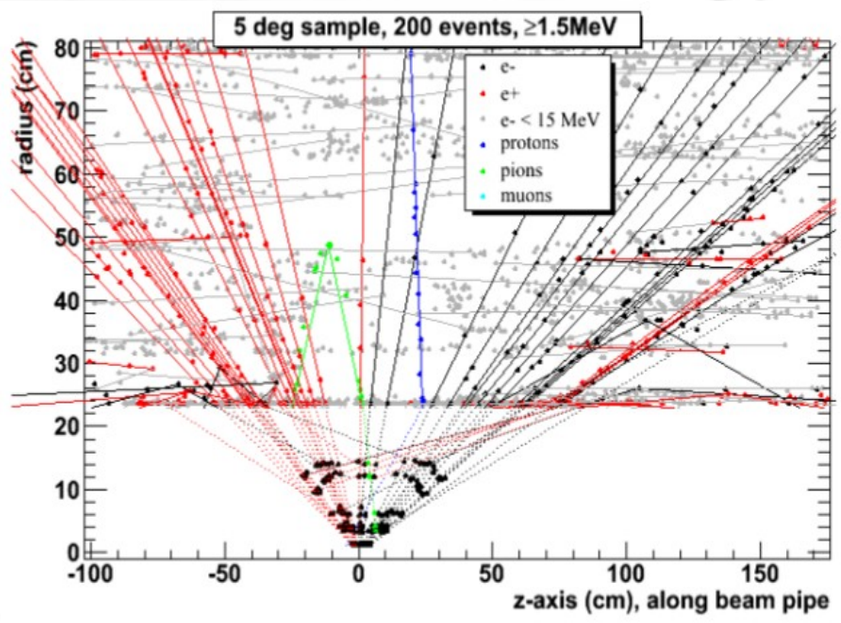
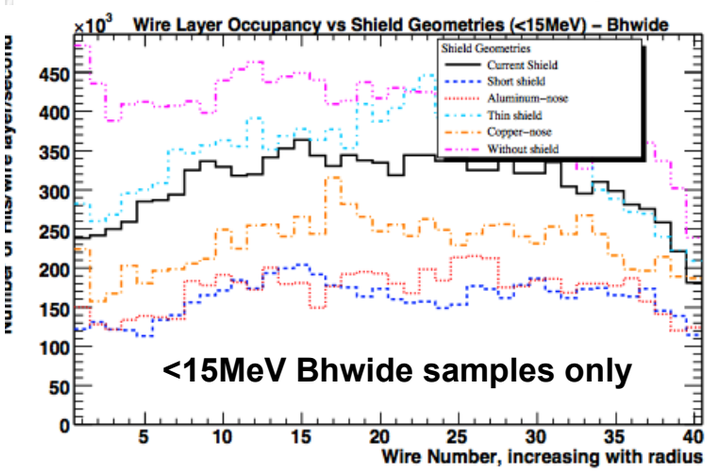
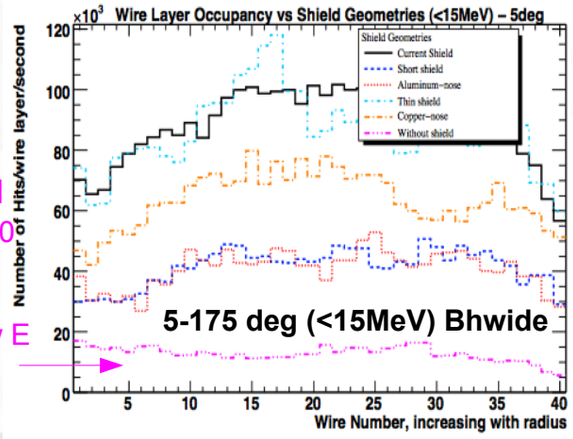


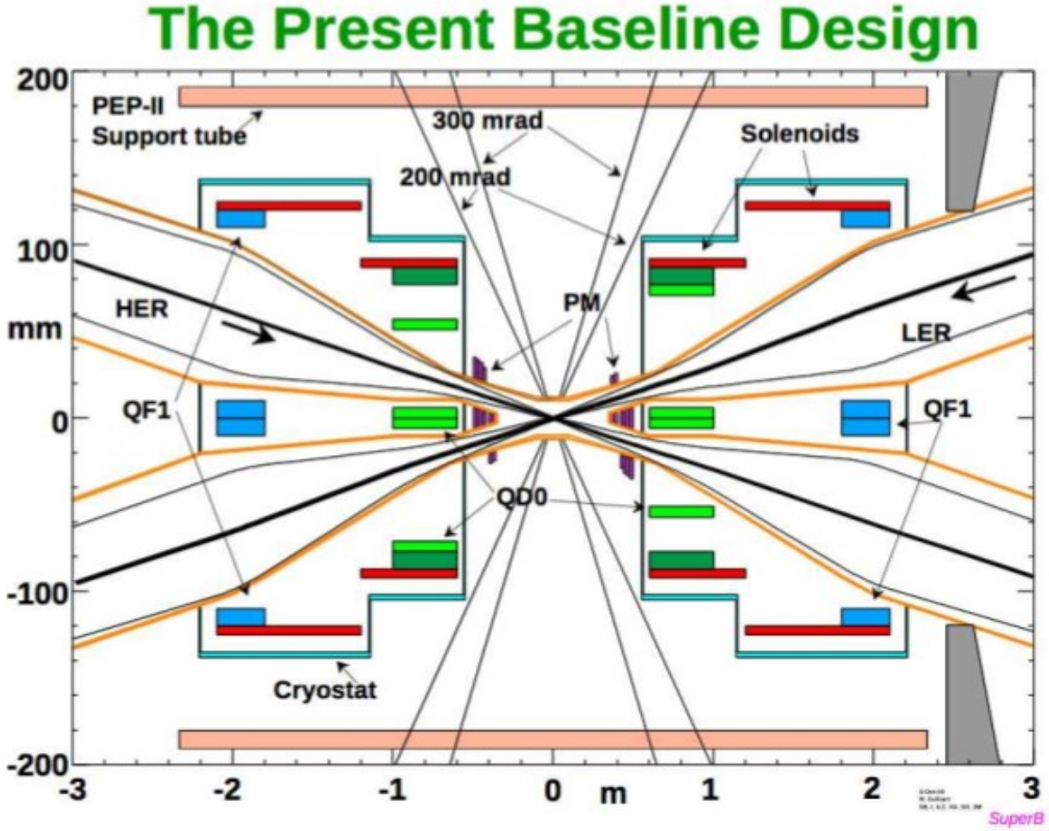


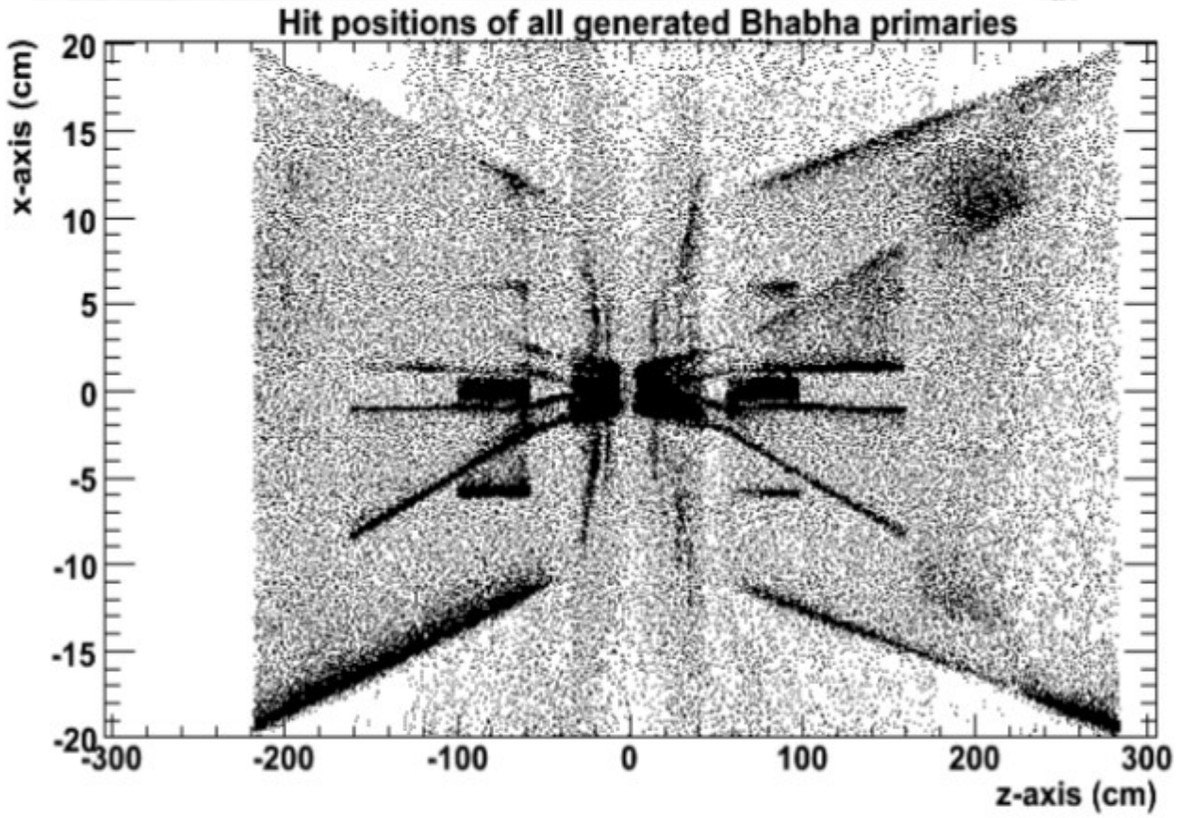
unshielded ≥5 deg (QD0 coil radius) does not produce low E background

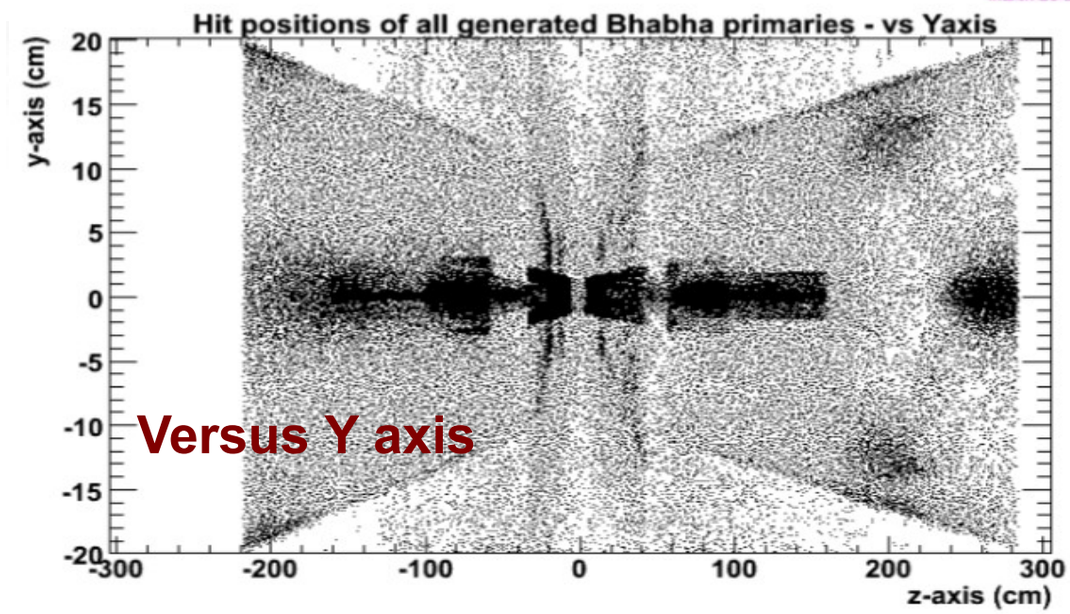


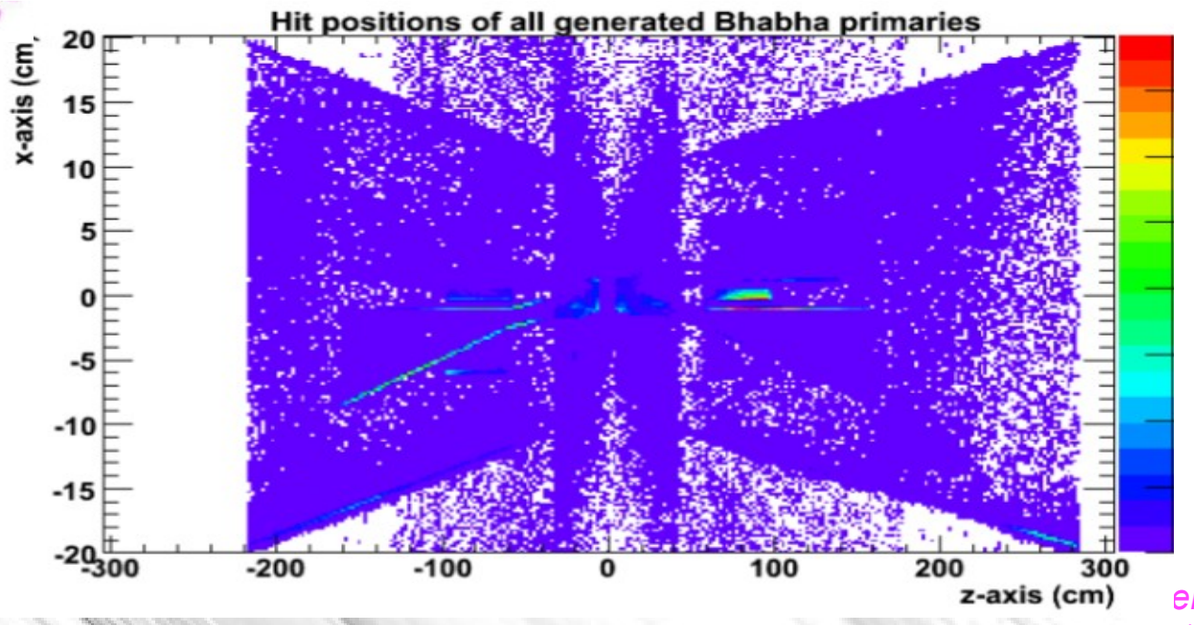
Hot Spots along the beam line

All Daughter vertices of All Bhabhas









SuperB Workshop
March 16-19, 2010

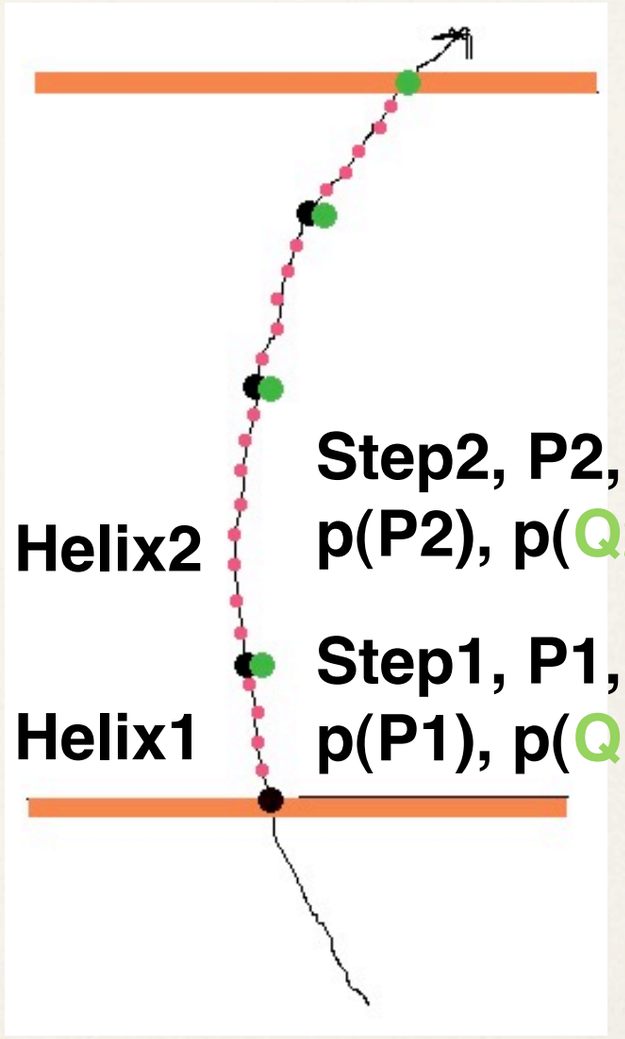
SuperB XIII
June 1-4, 2010

Track Reconstruction II

	Old method	New Method
Occ (no step limit)	2.9%	4.7%
Occ (max step 5cm)	2.9%	3.3%
Occ (max step 1mm)	1.35%	1.36%

Tracking in a B field

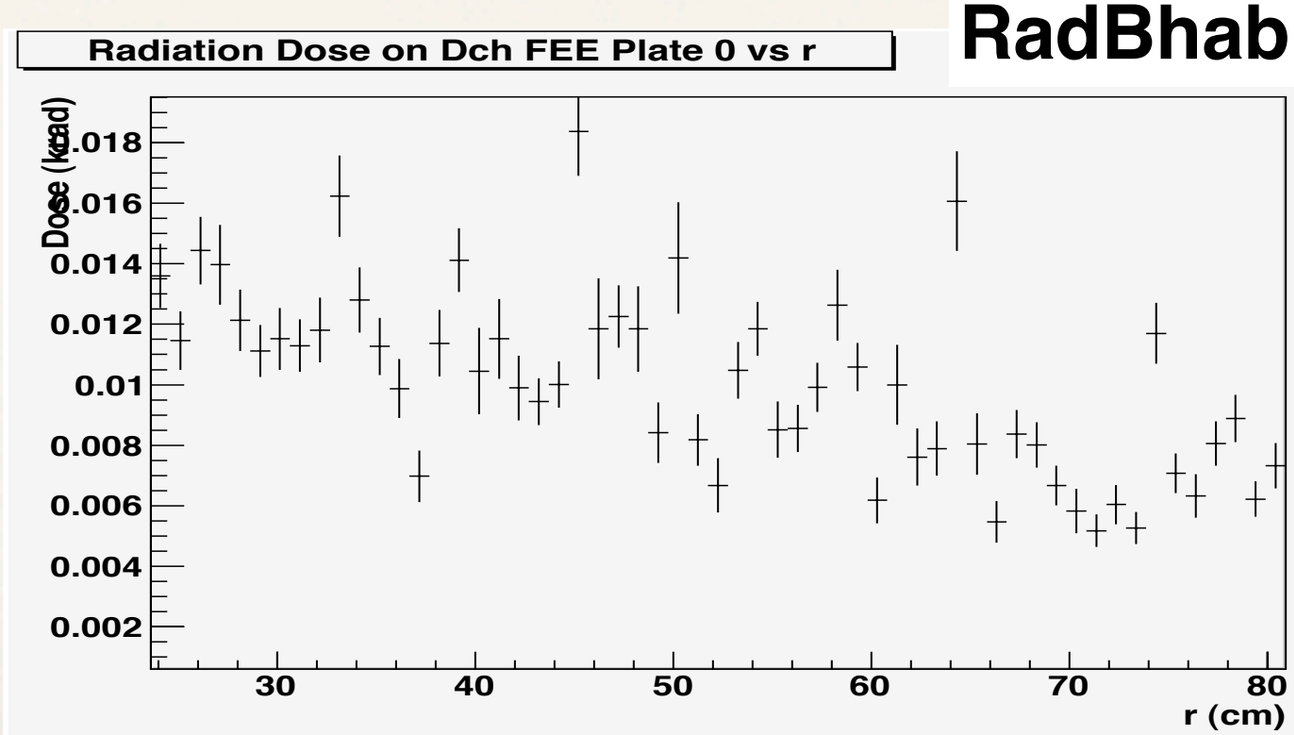
- **Start** and **end point** are not enough for Dch hits, trajectories are helix
- Using the momentum direction and particle charge the helix parameters can be computed (standalone macro after the simulation)
- Then the helix can be **sampled** at a smaller sub-step (3 mm) and we got all the cells crossed by the particle in the step (sub-step energy is assigned to each cell)
- Steps that are shorter than 3 mm or with radius less than 6 mm are approximated with straight lines and sampled as well
- Last point of helix not always exactly match with step end point (multiple scattering), additional sampling of straight line again that connect them



Radiation dose on electronics

- 3 Aluminum plates behind backward endcap by Giuseppe
- Change to make them sensitive, additional list of hits, DCHFEEHits
- Radiation Dose in kRad, 1 nominal year
  - RadBhabha, P0 **0.57** krad, P1 **0.60** krad, P2 **0.69** krad
  - 2photons, < 50 rad for all the plates
- Any number from Babar for check the consistency?

RadBhabha



To be normalized by the volume

DIRC

Scaling from Belle-I

Blair's idea:

- **Perhaps, we could scale the total quartz rate in DIRC-like TOF counter from the known Belle endcap Aerogel PMT's window rate by using (a) luminosity ratio, and (b) glass/quartz volume ratios.**

Does it make sense to scale it from Belle-I ? We do not know for sure. But they have single pe response Aerogel detectors around the IP, which can be used for scaling. Most of the background is caused by soft a few MeV gammas, which deposit a few photoelectrons in the in windows, quartz, Aerogel, etc. One needs a single photoelectron detector to see it. Background in EMC, drift chamber or Si will not help us.

- 2 scenarii investigated:
  - Background scales like luminosity
  - Background scales like luminosity / 4 [Belle's current assumption]

  → Next slide shows results for this second hypothesis

  → Jerry is in contact with Japanese collegues to find out where their assumption is coming from

DIRC

Scaling from Belle-I (cont'd)

- **Contribution from bars in active volume only, and using the scaling from the rate in Belle Forward Aerogel PMT at large radius and using 1/4 of the Lumi increase, one gets a rate per single H-8500 PMT of ~2.2 MHz/PMT, or ~69 kHz/double-pixel.**

- **We neglect the FBLOCK contribution because we can shield it well. We cannot shield the bar box inside the Magnet.**
- **We also neglect bar section located inside the steel, as it is well shielded. This is about ~1.2 meter length.**

⇒ Results agree within a factor 2 with Riccardo's calculations!

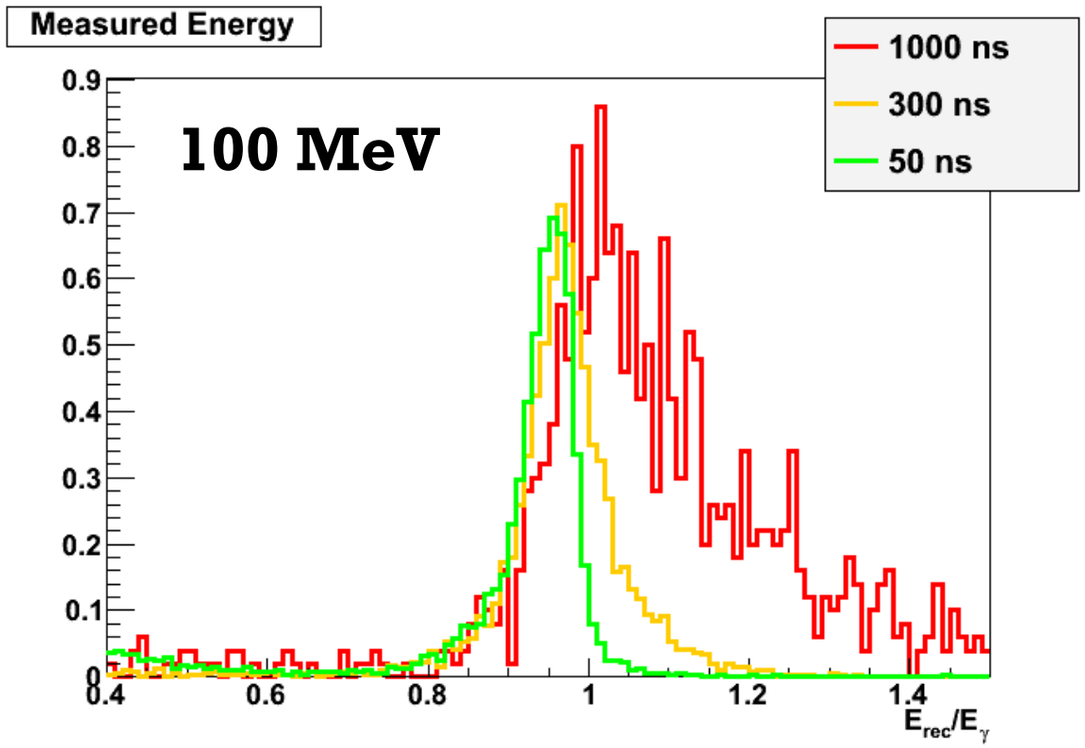
- Integrated charge:

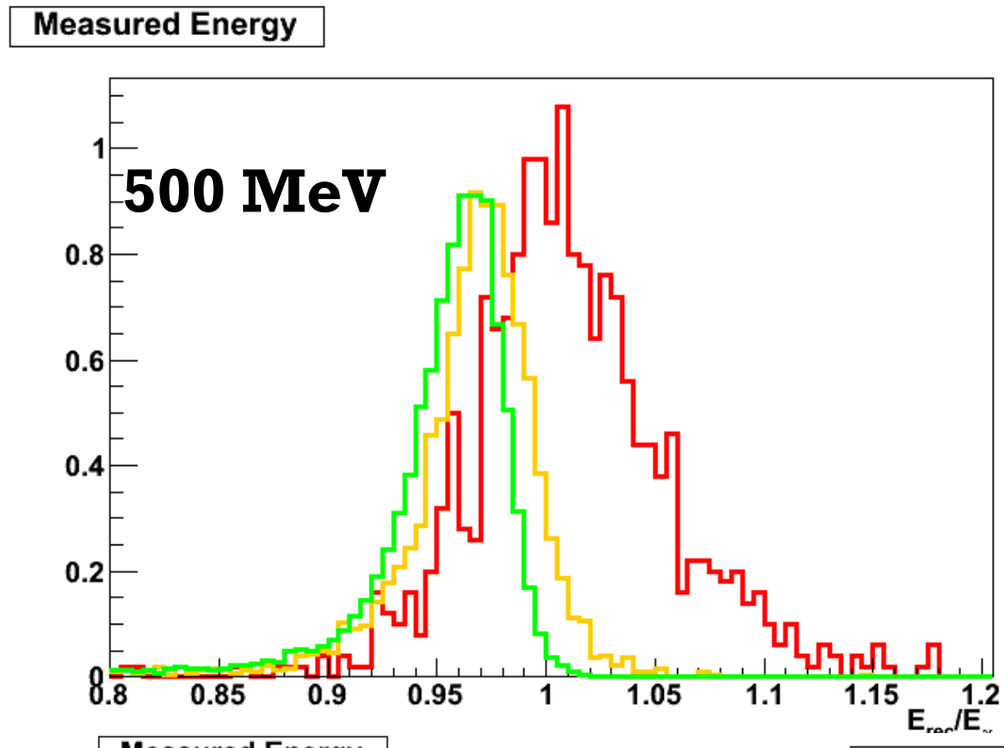
$$Q_{\text{FDIRC PMT}} = \underset{\text{(years)}}{10} \times \underset{\text{(Hz)}}{2.2\times10^{6}} \times \underset{\text{(sec/year)}}{2\times10^{7}} \times \underset{\text{(gain)}}{5\times10^{5}} \times \underset{\text{(MaPMT active size)}}{1.6\times10^{-19}/(5^{2})} \sim 14.7\ \text{C/cm}^2\text{/10 years !!!}$$

→ High number! Long-term consequences (ageing, etc.) will have to be studied

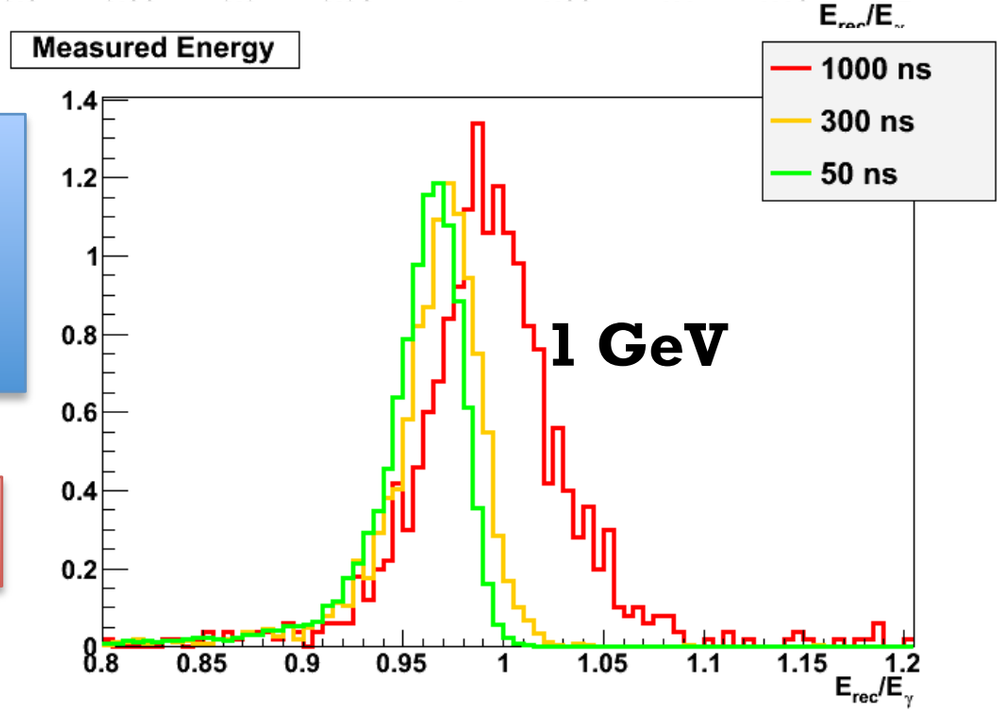
EMC

Time Window Width





For large windows resolution and distribution shape entirely dominated by background



From Now On Time Window = 300 ns

EMC II

Conclusions

- Background has not negligible effect on reconstructed energy distribution

- Clustering optimization has an impact on the resolution and on the number of clusters
  - Emax cut affects heavily the number of clusters

- Time window width has a dominant effect at all energies

- BaBar Time Window is 240 ns
  - Already a tradeoff between light yield and background reduction
  - Something similar may be needed again
    - Readout chain simulation has to be more realistic

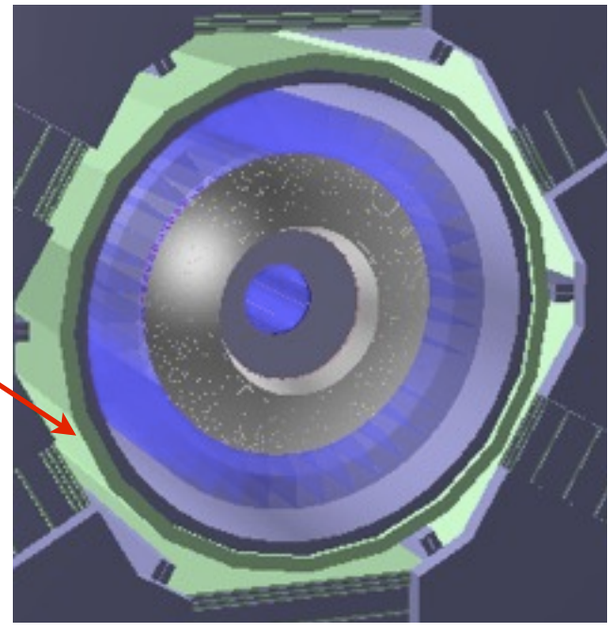
EMC III

- **Present Bruno Digi structure for EMC does not provide enough information to model the time response of the detector**
- **Plan to write the relevant information for the next round of simulation**
- **General comment**
  - **From now on we do not want to reenvent the wheel. Please read BaBar internal notes, ask BaBar expert the way things get done in the good od times.**

IFR

SHIELD SETUP

A polyethylene
shield has been inserted between
solenoid magnet and barrel.
We want study the impact of this shield
on barrel rate.



We compare the previous production in february, with a 100k events RadBhabha produced with polyethylene shield

~Factor 10 reduction as expected

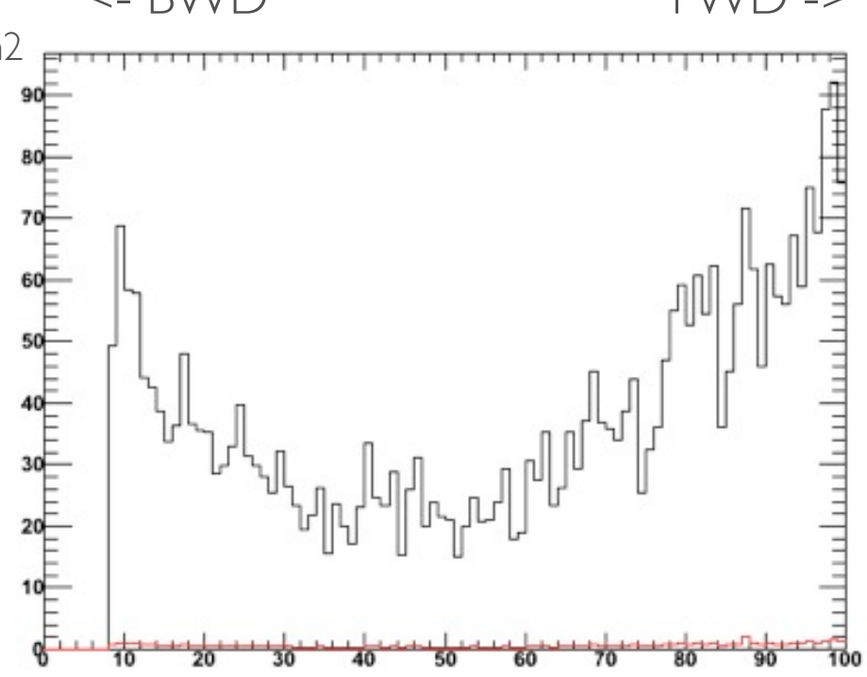
IFR SHIELD VS NO SHIELD

Wolfram-Shielded
QGSP_BERT

Barrel Rate vs Z-Strips

<- BWD FWD ->

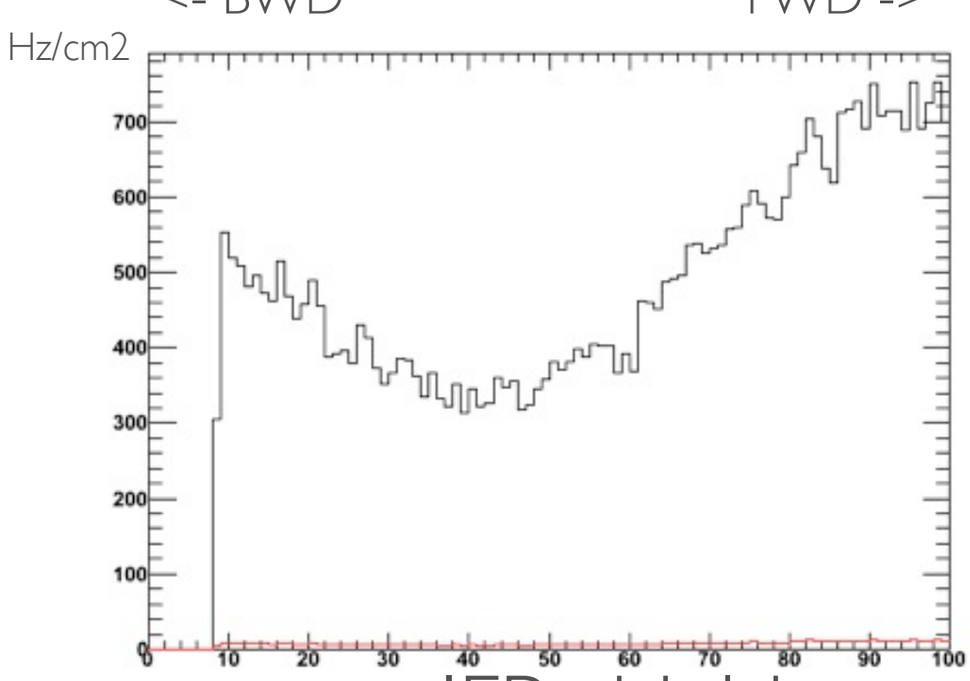
Hz/cm2



Polyethylene shield

<- BWD FWD ->

Hz/cm2



no IFR shield

Single Beam simulation

- **Manuela Boscolo simulated and cured the Touschek, Coulomb and brehmstralung single beam backgrounds**
- **Single beam backgrounds still negligible with respect to lumi terms (need to be verified with Bruno)**
- **Beam tails from her simulation in fairly good agreement with Mike Synchrotron radiation assumptions**
- **Please take your time to read her beautiful results.**

Conclusions

- **Things are proceedings smoothly on the background side of the MDI**
- **We are still learning**
- **We have to improve the bkg. rates optimizing the Shield**
- **Bring young peoples and their enthusiasm into this superb project**
-