



Background Study with FullSim Feb 2010 Production

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Production configuration

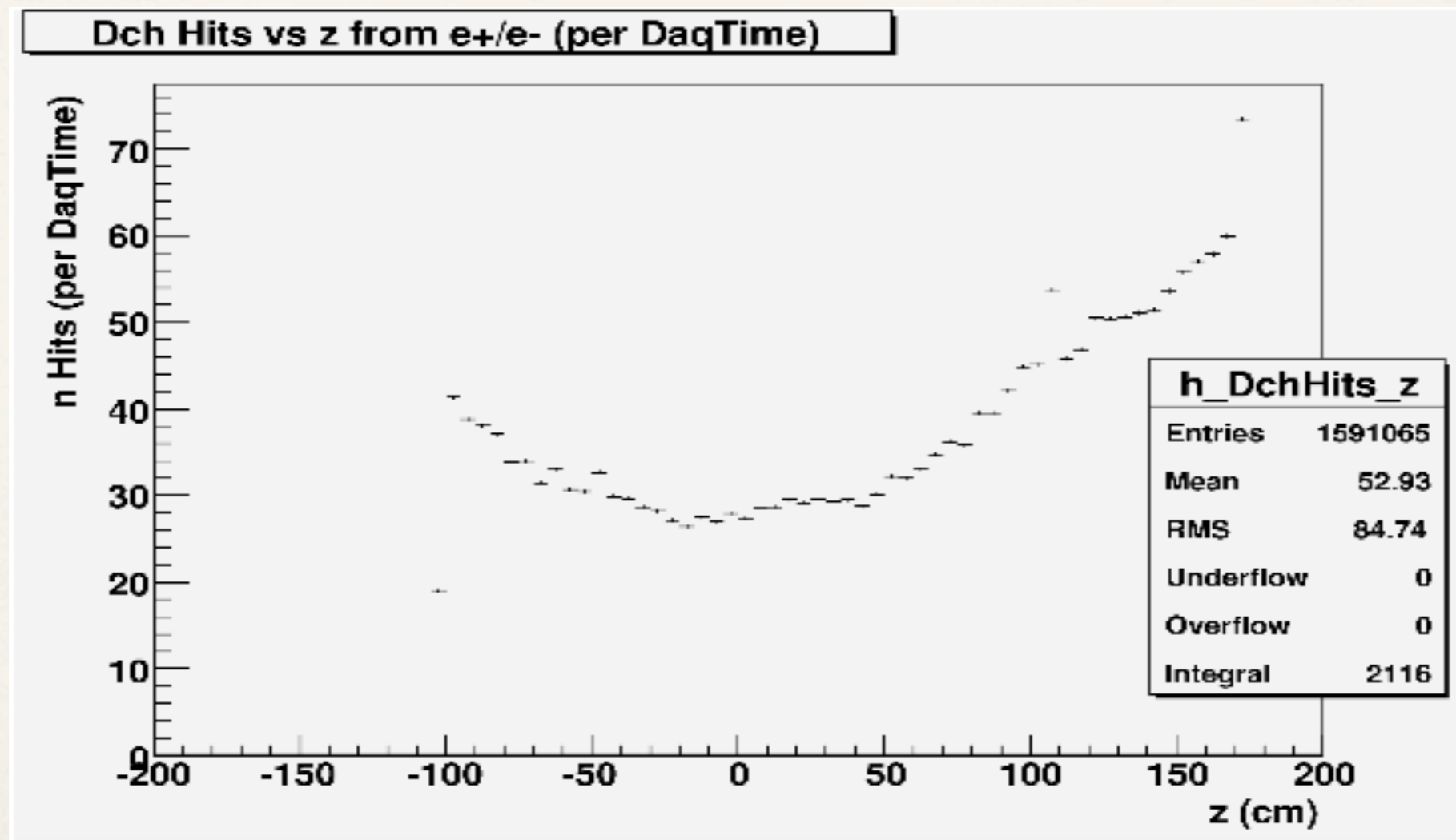
- Modified geometry from previous studies:
 - Additional Dch endplate to simulate electronics
 - Dirc and Bwd Cal added
- 5 configurations for Radiative Bhabha:
 - Default (DeltaE 10%), 200k evts
 - Unshielded, 200k evts
 - Lower DeltaE: 1%, 200k evts
 - Lower DeltaE: 0.2%, 200k evts
 - High precision neutron tracking, 100k evts (not so interesting for us)
- Note: Delta E is the minimum energy variation of the radiating particle

Background study details

- Dch structure
 - Minimum radius 24 cm (chamber starts at 23cm)
 - Cells 1.3x1.3 cm
 - Only Axial, Babar, SuperB layers structure
- Still no cut on cells accumulated energy
- Important issue
 - for this production the Geant step size has not been limited in DCH volumes
 - A single step can go across two cells or more, under-estimation of rate
 - But average step is small 2.6cm, with few cases of 1m step and more
 - Trying to get a correction factor, more later

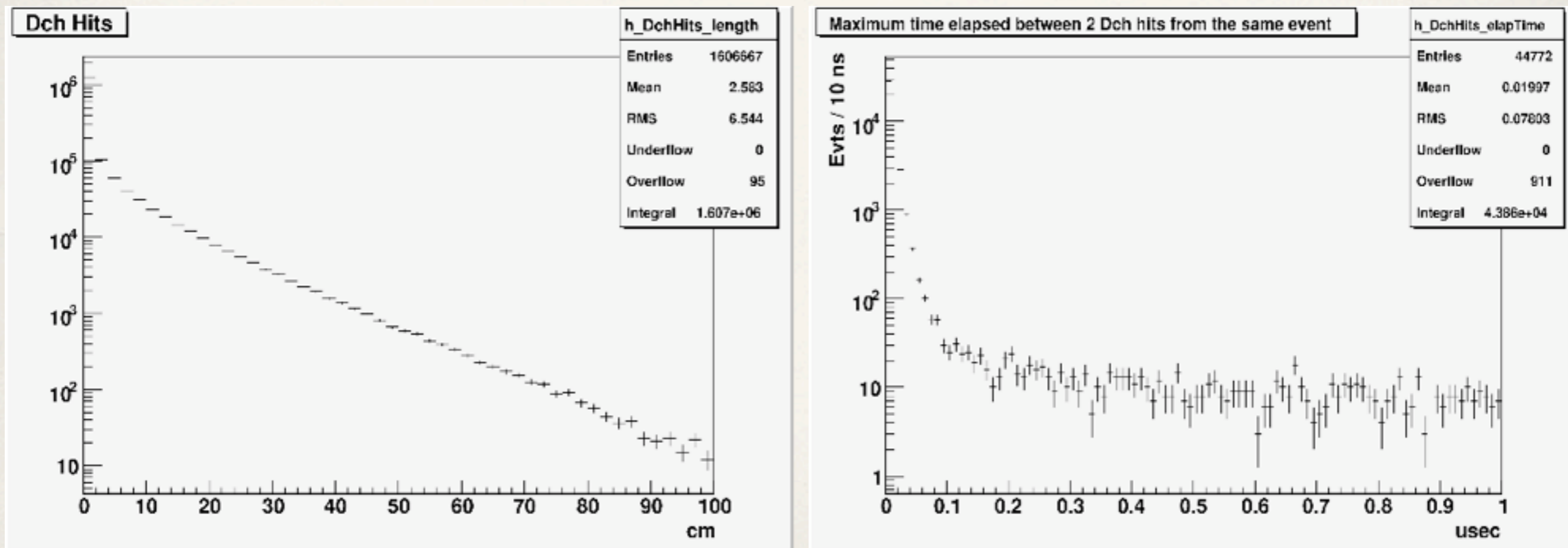
Hits distribution (z coordinate)

- Note: those are Geant4 hits
- Z distribution confirms that most part of the hits is coming from the endplates



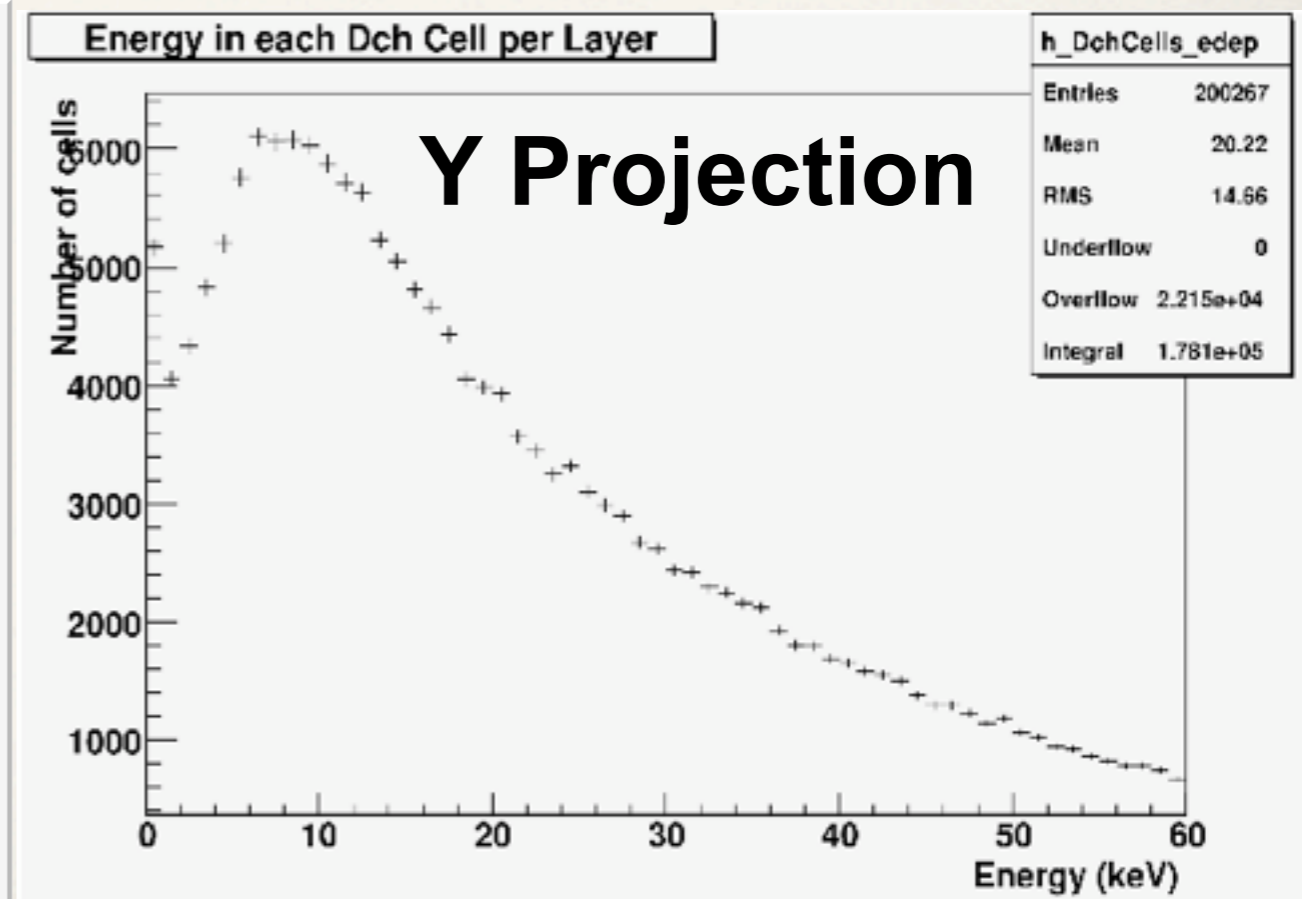
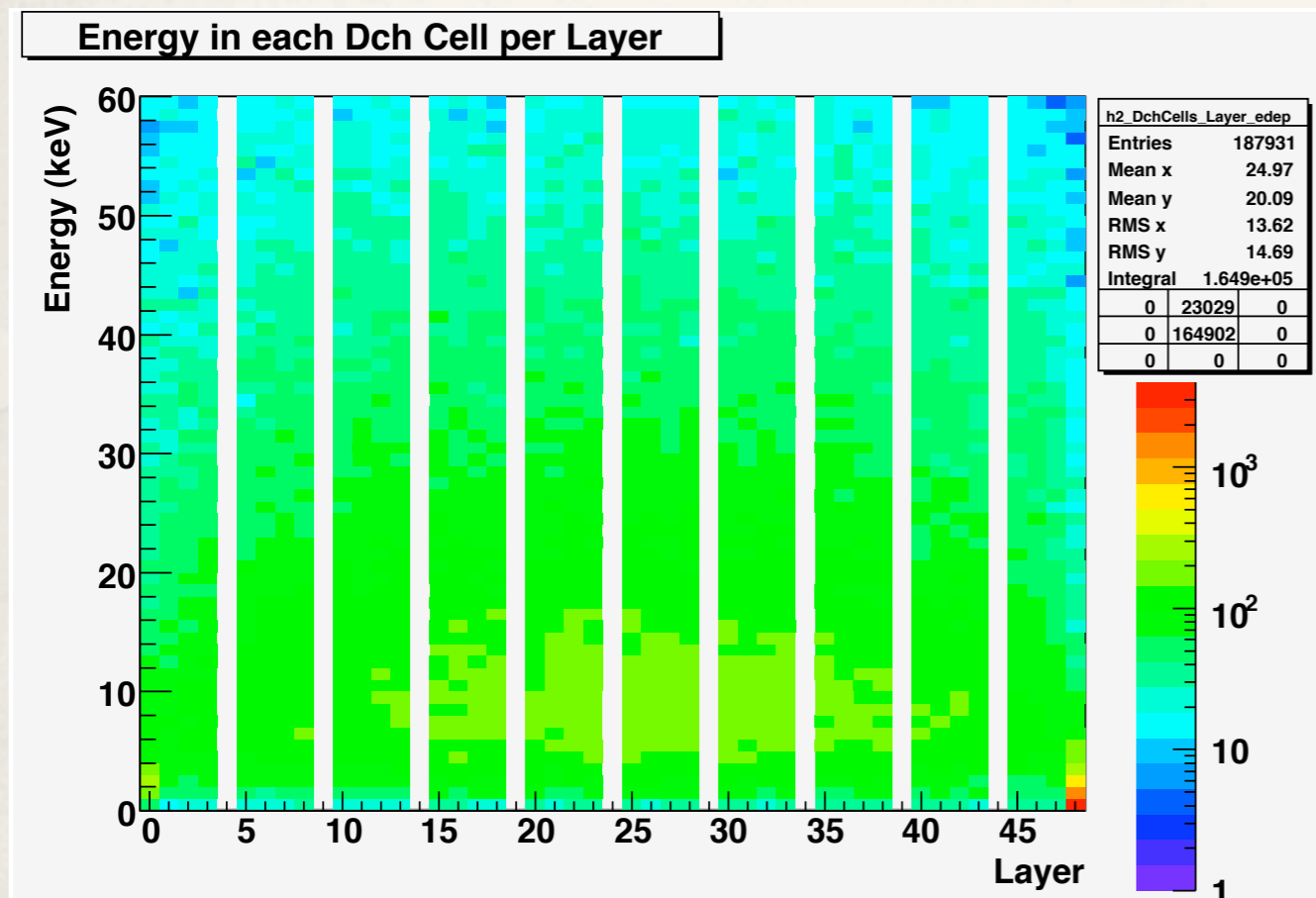
Hits distribution (step length, elap time)

- 80% of the hits has a step length of less than 2cm, mean value is 2.6cm
- ElapTime = The max time between two dch hits in the same evt is less than 50ns for 95% of evts
- Effects from hits from other bunch-crossings in the same daq time are negligible



Cells Energy

- Energy released in each cell peaks around 10keV for central layers and lower for first and last layers
- A lot of cells with energy lower than 5 keV in the last layer: no space between chamber wall and the cell (1cm of space for the first layer)



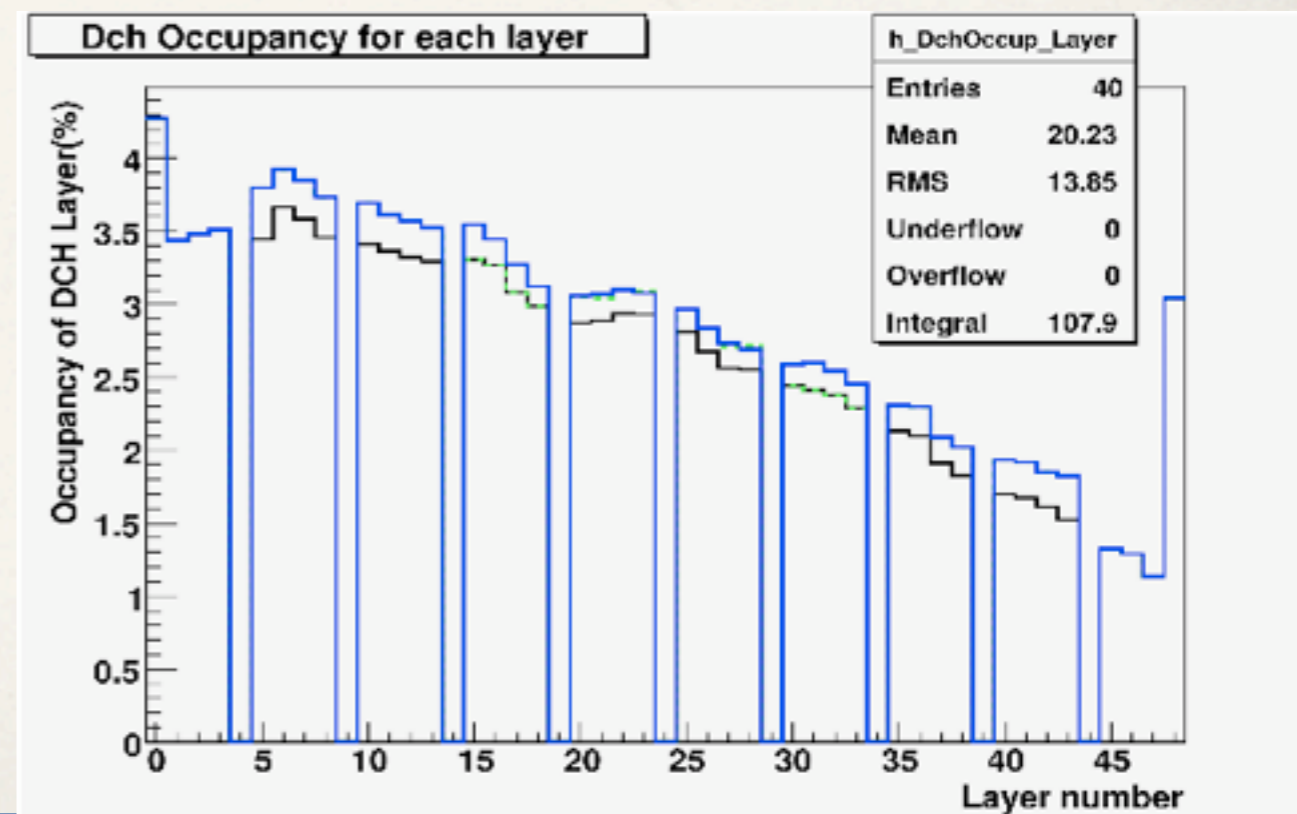
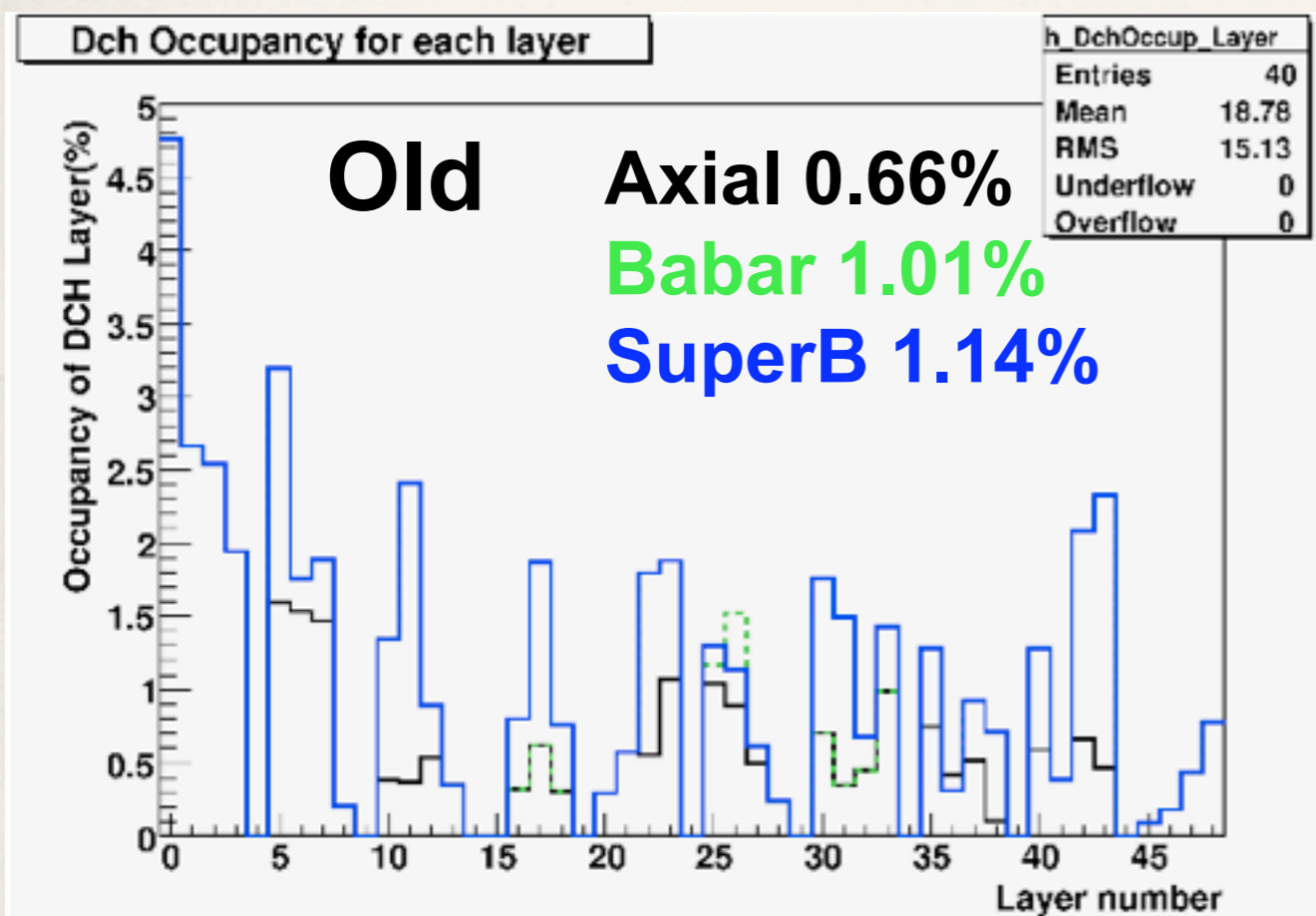
Occupancy

- Higher stat, total occupancy: 2.5% with an RMS $\sim 0.6\%$
- New results not exactly compatible with old ones
- Again stereo layers does not make so much difference for bkg, less than 0.5%

Axial 2.48%

Babar 2.60%

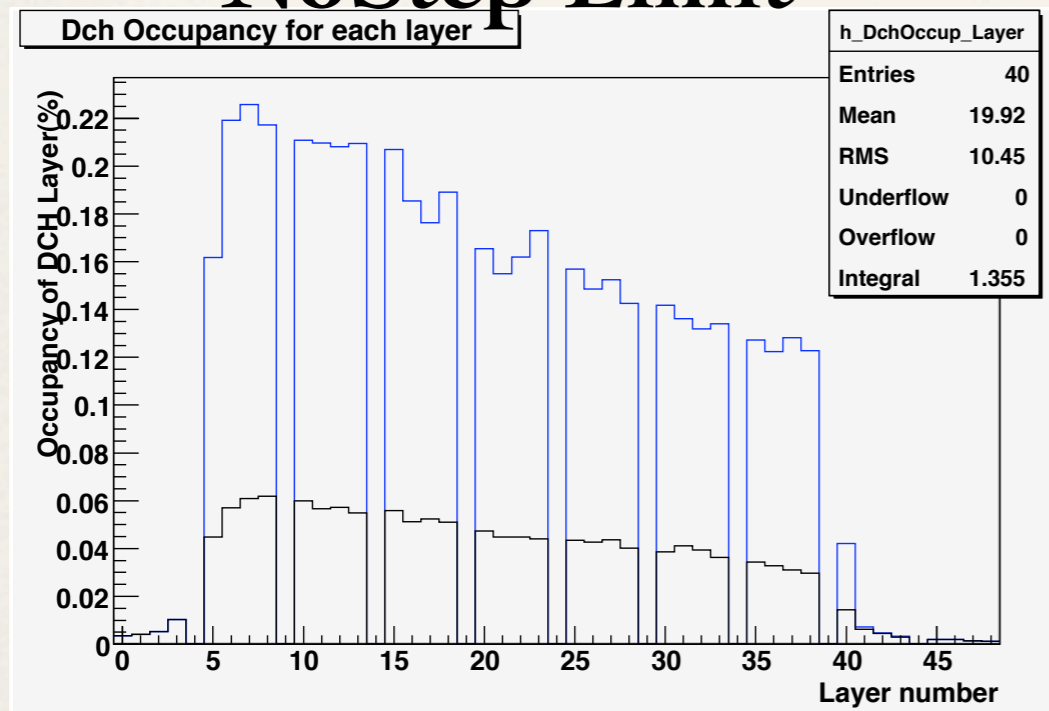
SuperB 2.64%



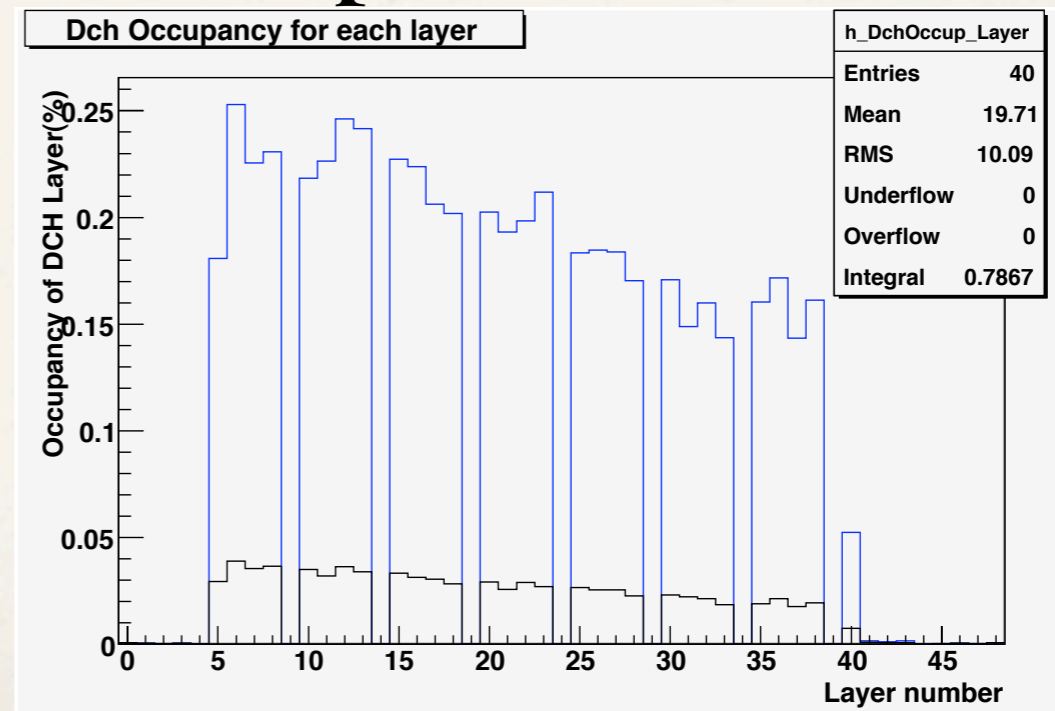
Additional test on stereo algorithm

- Single electron along z through the whole chamber
- Step limit matters here:
 - No G4 step limit, stereo layers increase occupancy a factor 3/3.5x (Babar/SuperB config)
 - Step limit at 0.5cm, increase factor 5.4x / 7.1x, better agreement with Giuseppe rough estimation (9x)

NoStep Limit

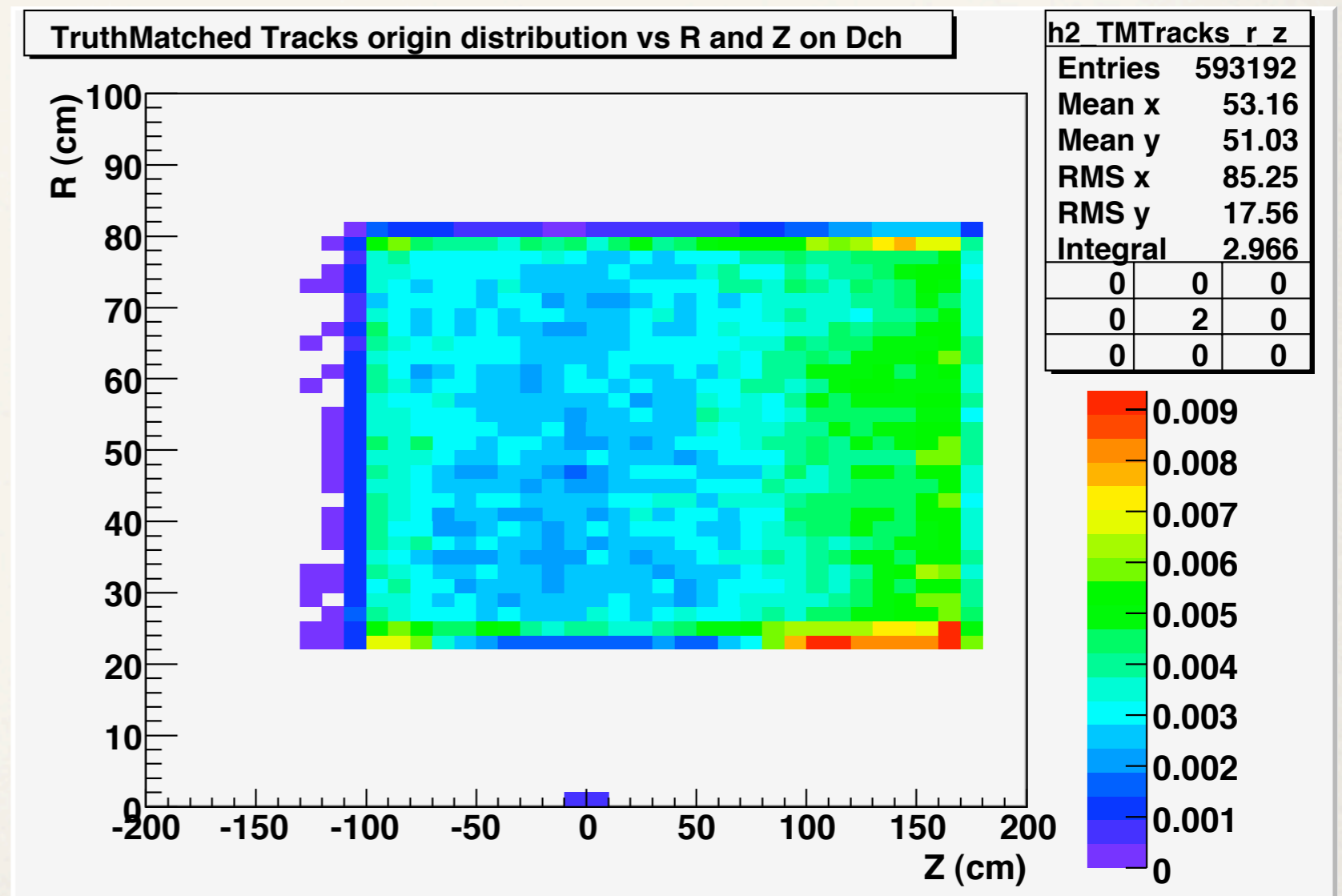


Step Limit 0.5cm



New tracks information from boundary

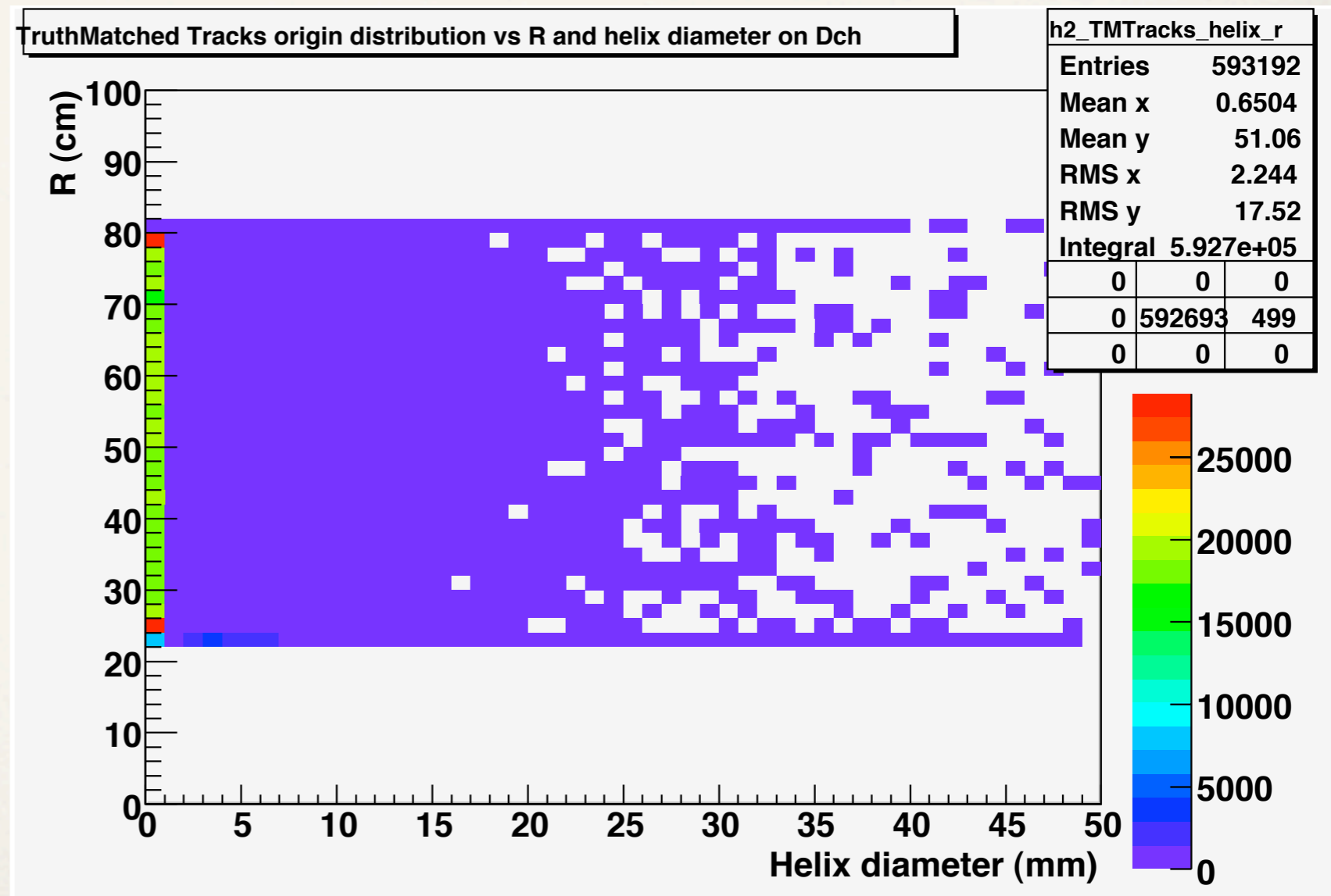
- So, why no big effect in RadBhabha evts?
- Additional information
 - Vertex or entrance point in Dch volume, R and Z in the plot
- Hot spots on fwd inner and outer wall
- On fwd, secondary particles generated inside the chamber [+100,+150cm]



New tracks information from boundary

- So, why no big effect in RadBhabha evts?
- Additional information for this production
 - Transverse momentum \rightarrow Helix diameter (1mm = 225keV), vertex radius (cm)

- Most of tracks has small transverse momentum, $< 1\text{mm}$
- Overall momentum is also small
- Only few tracks are going through the whole chamber? other interactions?

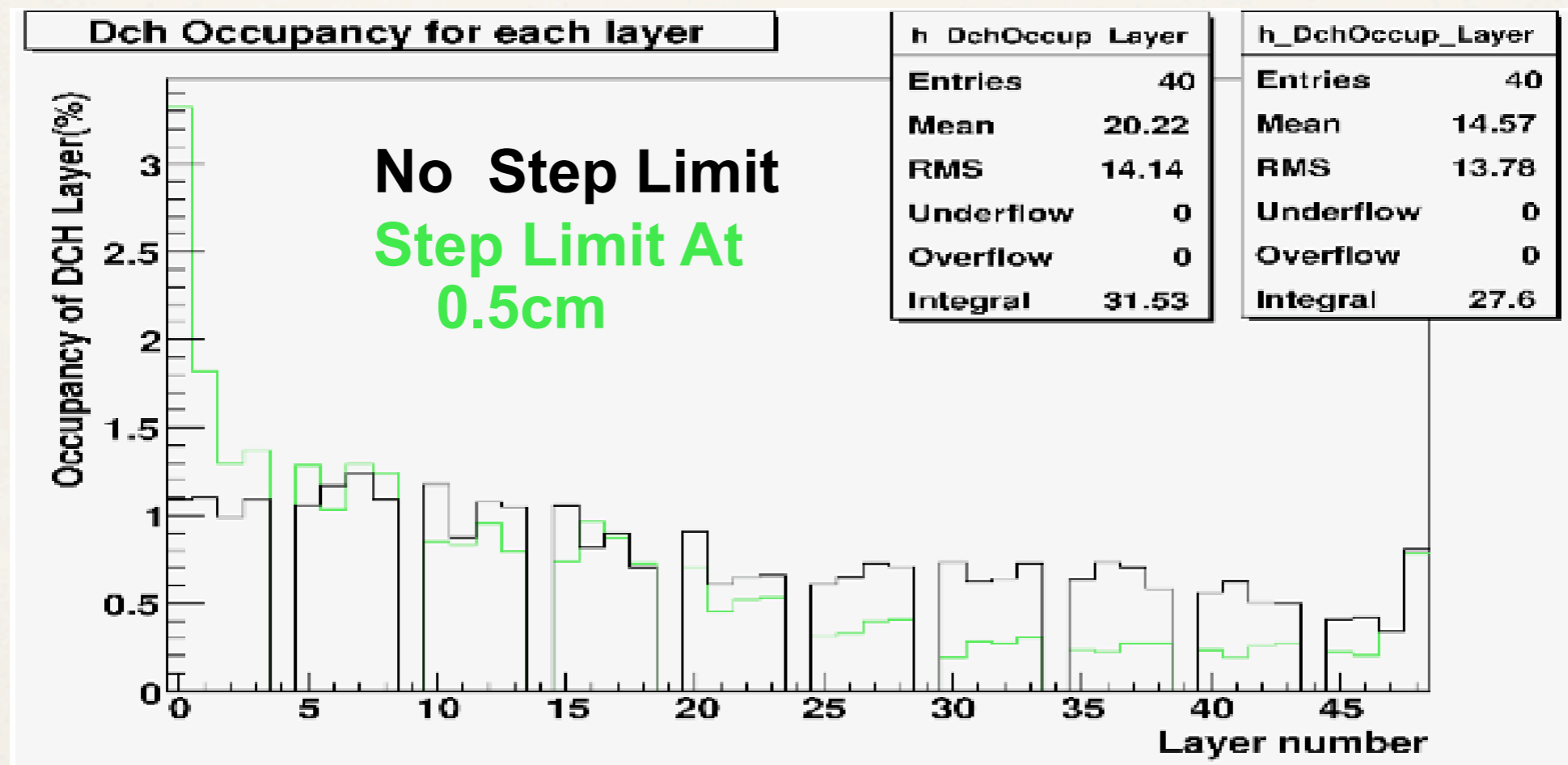


Other configurations

- Unshielded (more a test than a real option)
 - Occupancy up to $31.4 \pm 1.4\%$, really not feasible
- Lower DeltaE minimum
 - DeltaE $> 5\%$, Occup 2.48% \rightarrow 2.54%
 - DeltaE $> 0.2\%$, Occup 2.48% \rightarrow 2.82%
 - Small differences
- High precision for neutrons
 - Negligible differences, Occup 2.48% \rightarrow 2.50%

2photons (aka Pairs) bkg

- I simulate again with the new geometry the 2photons bkg (40k evts)
- I tried to understand any difference using different step size
- Weird difference, total occupancy is similar anyway
- Excess on first layers is understood: w/o step limit you have hits with long step starting on chamber wall not assigned to right cells



Conclusions

- Production allows us to have statistically significant plots for RadBhaBha bkg
- Significant increase in occupancy, still not yet understood
- Step size issue, need to be fixed. Better add more information on Dch hits, than limiting the step size (cpu time consuming)

FullSim version and geometry

- **Bruno r353**
- **Geometry:**
 - Beampipe (BP): 1mm thick, Rmin 10mm
 - Gold foil inside BP: 3um
 - SVT L0 length 10 cm, thickness 300um, Rmin 1.3cm
 - BaBar SVT
 - Cylindrical drift chamber
 - Rmin 230mm, Rmax 800mm but **layers from 240 through 805mm**
 - Length 2775mm, centered at $z = +367$ mm
 - Carbon fiber structure filled by material with density averaged from gas and wires

DCH configurations

- **Dch cell configuration:**
 - Inner radius: **24 cm**, Outer radius: **80.5cm**
 - 1.3 (r) x 1.3 (phi) cm, cell size
 - Superlayer made by 4 layers
 - 10 superlayers (spaced 0.5 cm), **~10k cells**
 - Cells are not staggered
- **Superlayer configuration**
 - **Axial only** version
 - AAA AAA AAA A
 - **Babar** version
 - AUV AUV AUV A
 - **SuperB** version
 - A UV UV UV UV A
- Stereo angles like Babar

BaBar NIM Paper

SL	# of Cells	Radius (mm)	Width (mm)	Angle (mrad)
1	96	260.4	17.0-19.4	0
2	112	312.4	17.5-19.5	45-50
3	128	363.4	17.8-19.6	-(52-57)
4	144	422.7	18.4-20.0	0
5	176	476.6	16.9-18.2	56-60
6	192	526.1	17.2-18.3	-(63-57)
7	208	585.4	17.7-18.8	0
8	224	636.7	17.8-18.8	65-69
9	240	688.0	18.0-18.9	-(72-76)
10	256	747.2	18.3-19.2	0