



DCH Background Study with Bruno

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SuperB General Meeting, La Biodola (ITALY)

June 1st, 2010

Updates and issues

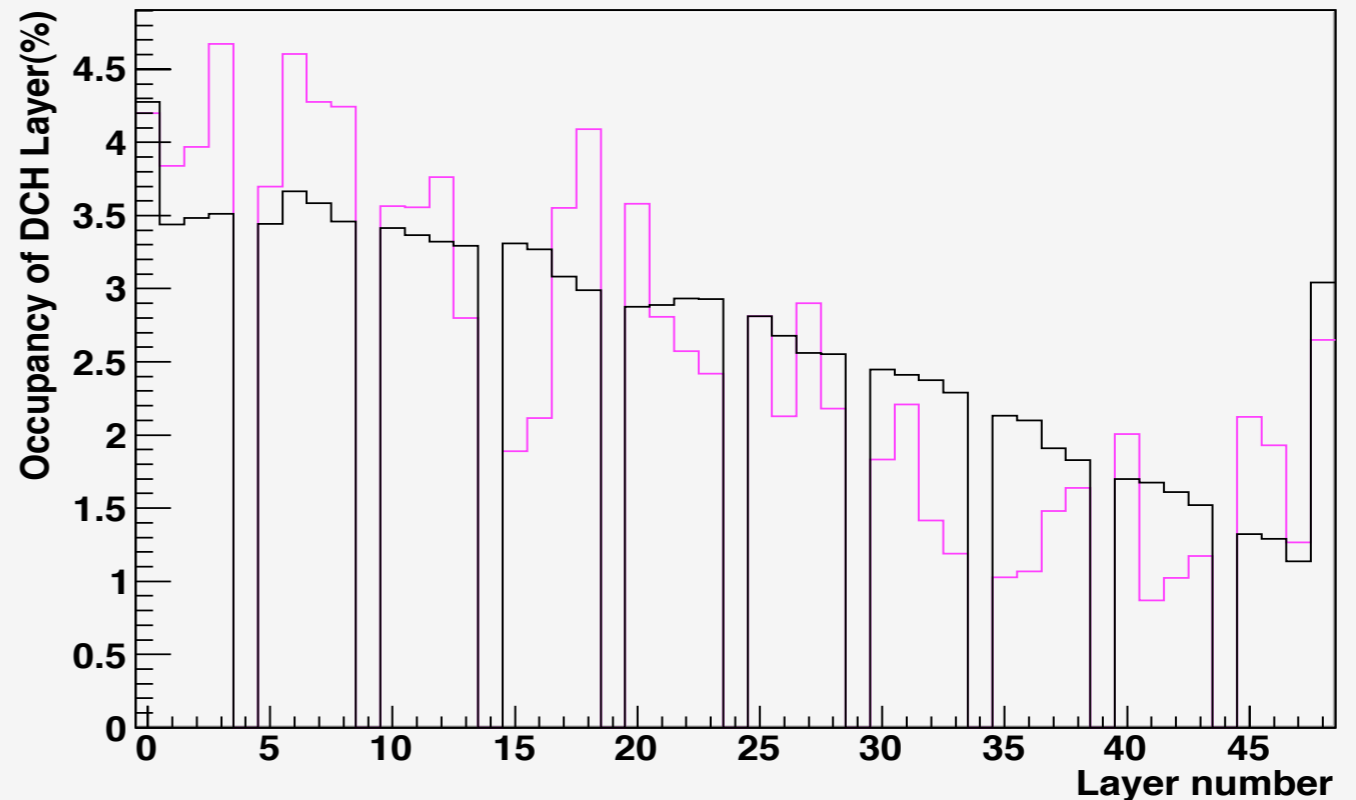
- Checks: Dana's ntuple, IR magnetic field
- Problem: occupancy depends from G4 simulation max step length, already happened for Svt hits
 - Underestimating the occupancy
 - Not enough information on Dch hits
- Comparison with results from Dana
- Updated layer configurations, more realistic
- Estimation on radiation dose on electronics

- **Note: results here with r356, no diffs comparing to Feb production**

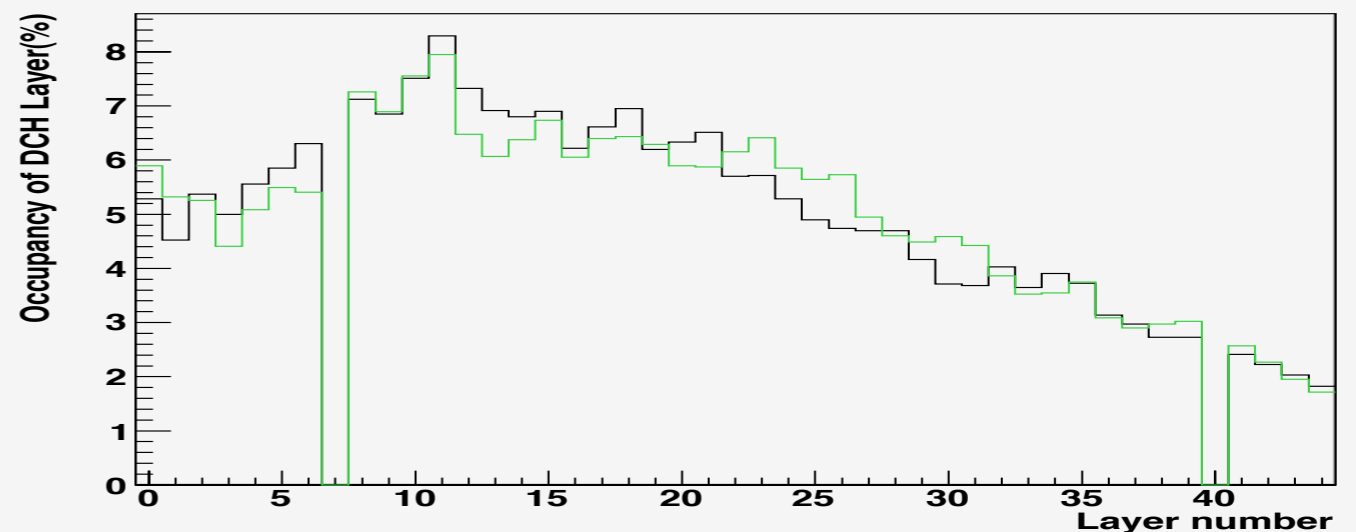
Checks

- Dana's ntuple: 1500 evts, **RadBhabha+Bh Wide, short shield configuration**
- Occupancy does not change too much from Feb production: average 2.48% -> 2.33%
- IR magnetic field configuration not yet defined:
 - Pairs, B field Off
 - RadBhabha, B field On
- No substantial difference in occupancy for **RadBhabha with B field On** (new samples and new Dch config, see below)

Dch Occupancy for each layer

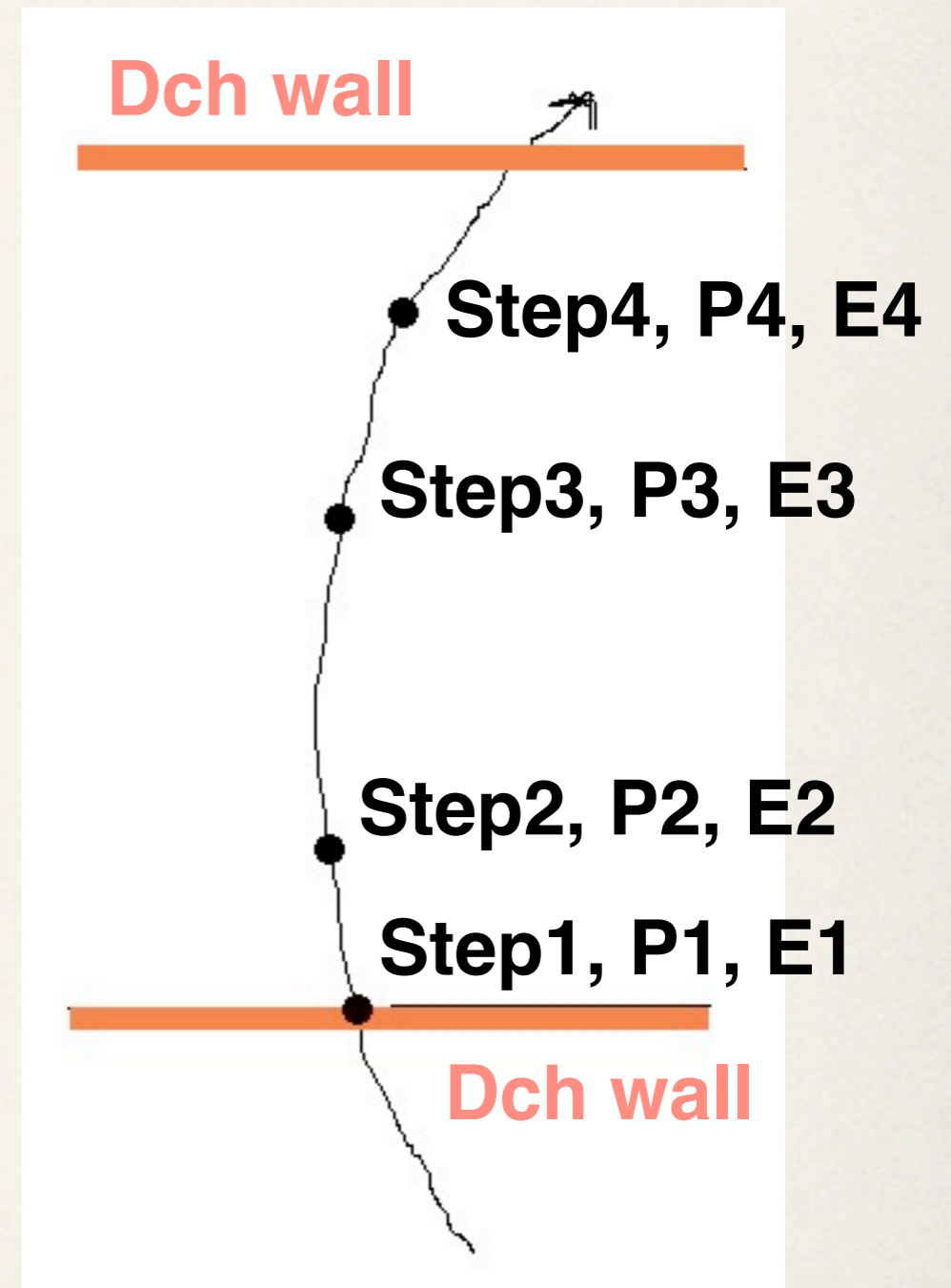


Dch Occupancy for each layer



Geant4 simulation details

- Particle interaction with materials is simulated in steps
- A step ends when the particle exits the volume or has a point interaction (decay, emit a photon, etc...)
- Ionization and trajectory in a B field are computed along the step, easy to have also 10-100cm steps in Dch gas volume
- Maximum step length can be limited, this does not affect the physics simulation. Bruno has no limits applied by default
- Bruno dumps only some information for each step:
 - incident energy of the particle
 - deposited energy in this step
 - step begin point

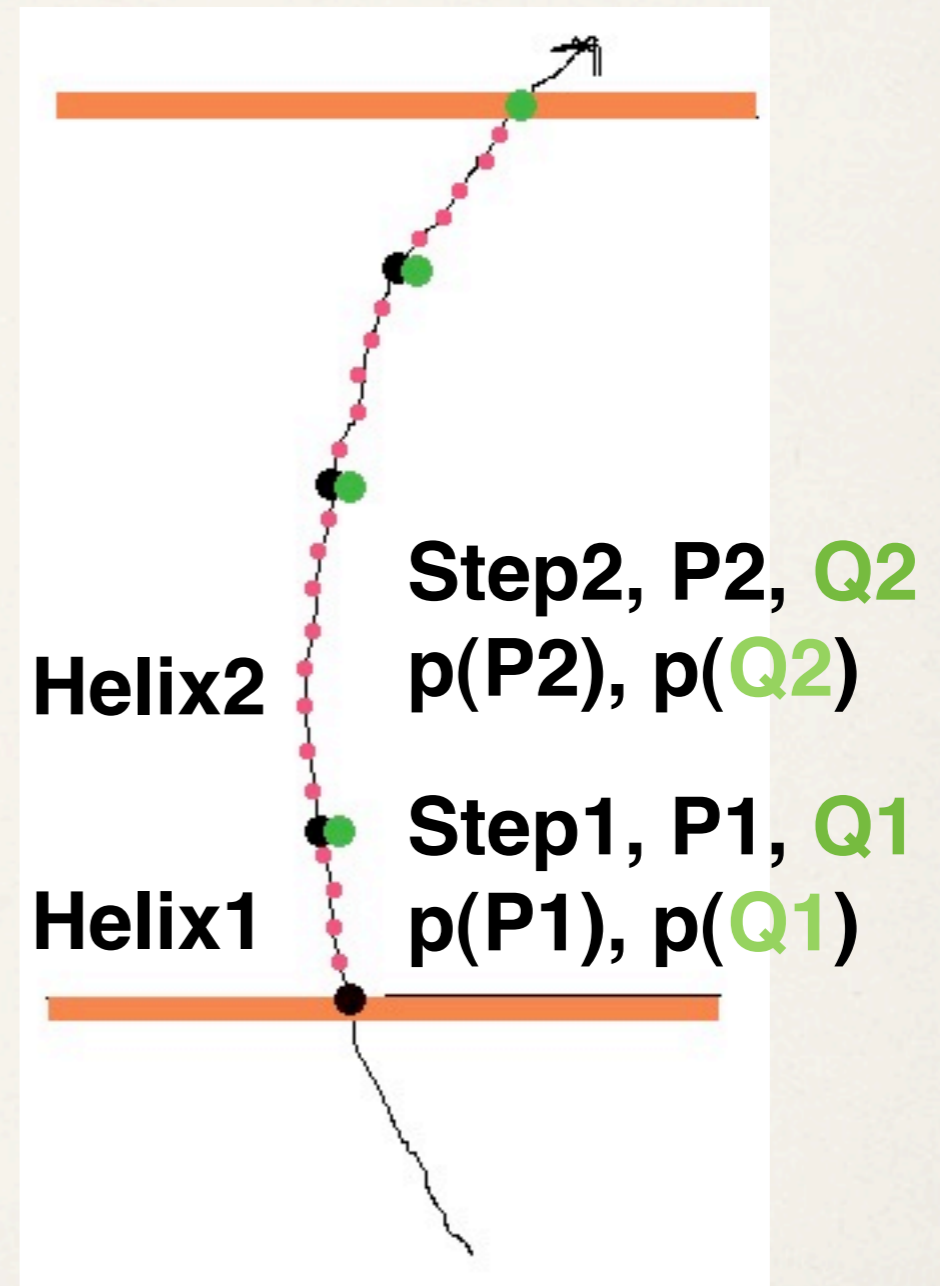


Missing cells...

- Problem: if a step starts in a cell and ends in another one, we have no way to know which cells it went through, so the following cells are not counted, underestimation of the occupancy
- Test using smaller step size shows significative change in the occupancy
- **Solution 1:** limit the step size to be smaller than cell
 - Cons: increased computing time, big ntuples, which is the optimal one?
- **Solution 2 (Dana?):** use the begin point of the next step as end point
 - Cons: does not work with the last step before exiting the volume
- **Solution 3:** add information on each step (end point, momentum direction). Already use for solve the same problem in SvT background study, no overhead in the simulation
- Note: found boundary information not accurate, discrepancy in particle energy due to materials outside the gas volume

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

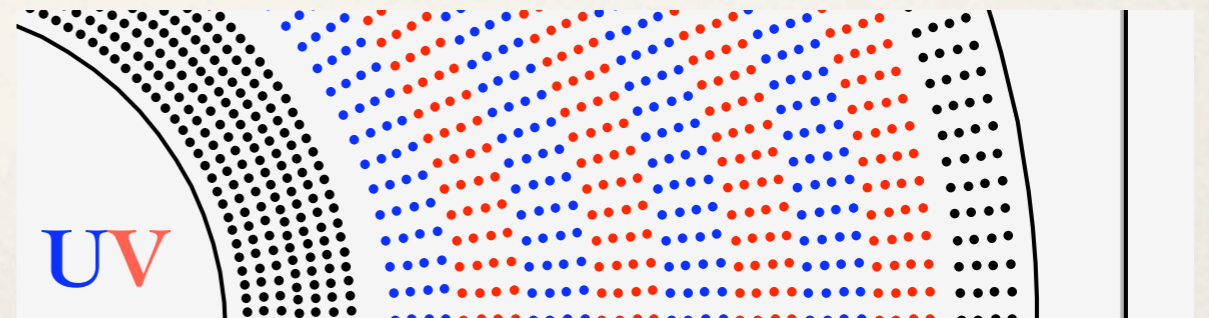
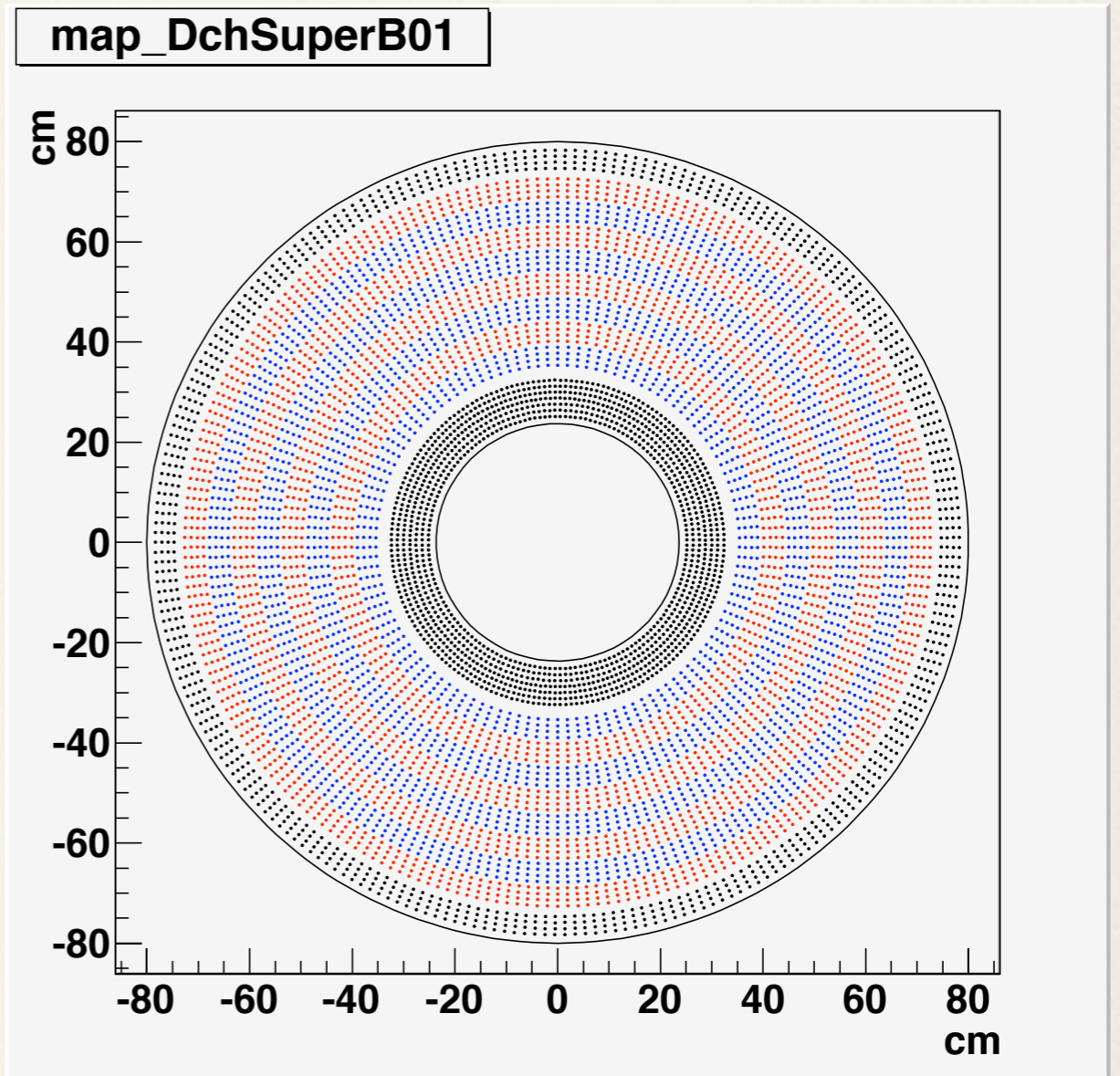


Private mini-production

- Bruno code modified for dumping the additional info
- RadBhabha, mini-production, samples of 10k evts
 - Default configuration
 - Step length limited at 5cm
 - Step length limited at 1mm
 - Default configuration with B field on inside the IR
- Available to everyone at CNAF:
 - 500 evts x 20 root files for each sample
 - `/storage/gpfs6/cenci/bkg_ntuple/bbbrems/r356/`

Updated cell configurations

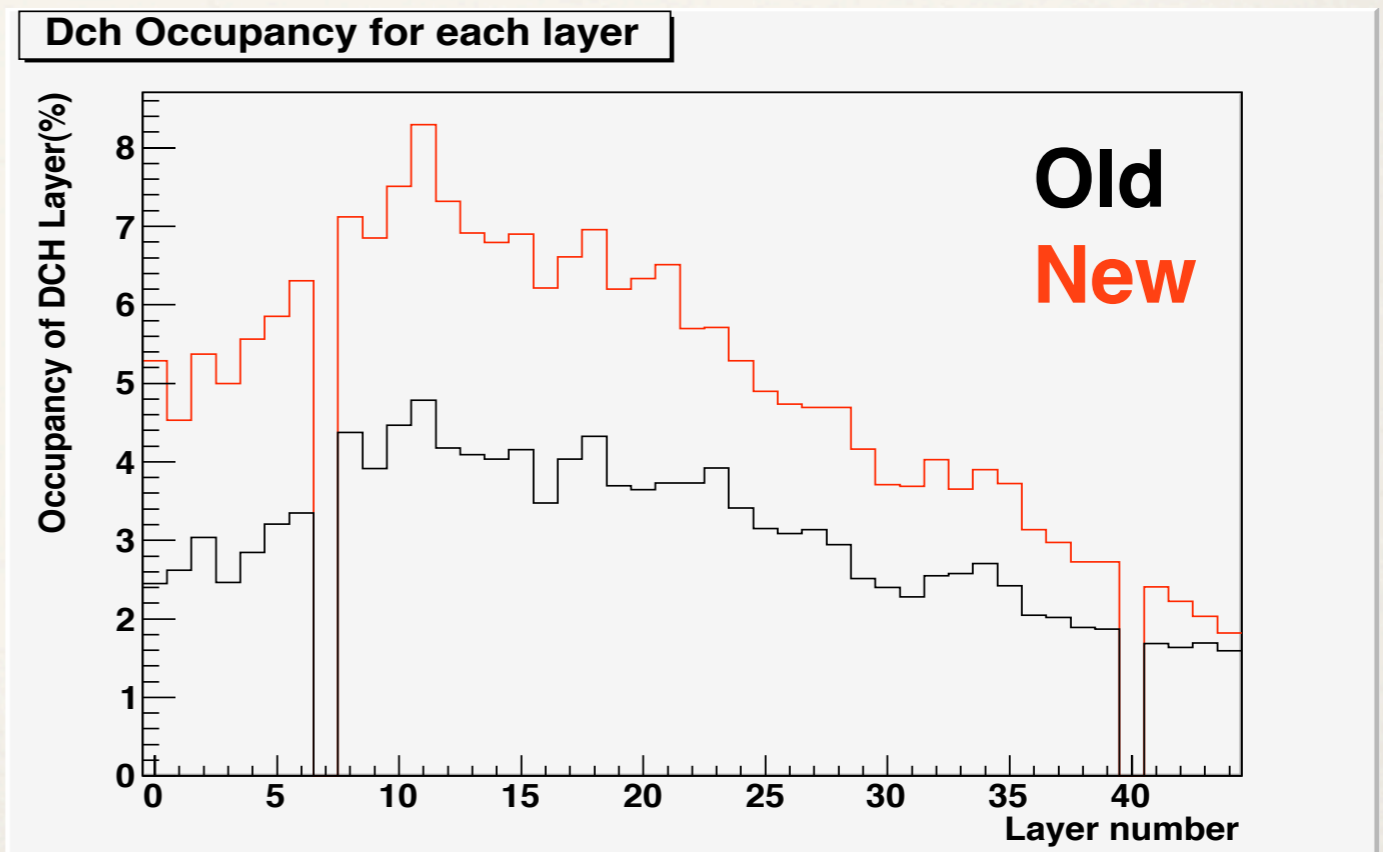
- Dch gas volume:
 - Inner radius: 23.7 cm
 - Outer radius: 80 cm
- Dch cell configuration
 - Inner radius first layer: **24.6 cm**
 - Outer radius last layer: **78.9 cm**
 - **1.2 cm** size on r, variable on phi (**120-250 cells** per layer)
 - 11 Superlayer made by 4 layers (apart first one made by 3)
 - Total of **8k cells**
 - Note: cells are not staggered
- Superlayer configuration
 - Axial01 version
 - AA-AAAAAAAAAA-A
 - **SuperB01** version
 - AA-UVUVUVUV-A
- Stereo angles like Babar



Occupancy vs max step length

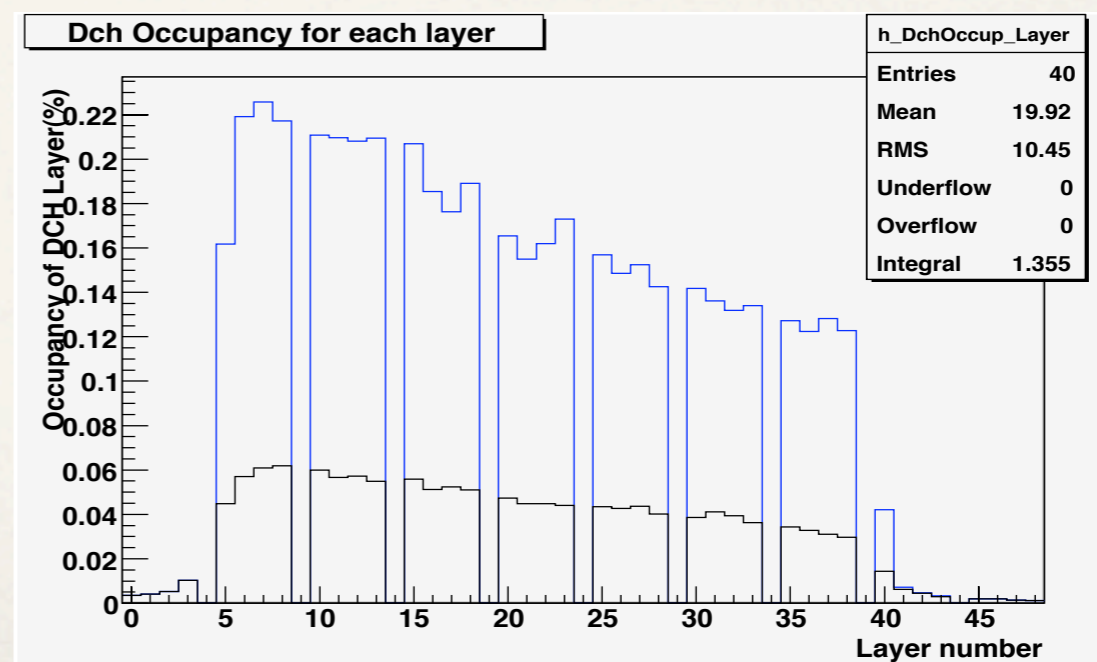
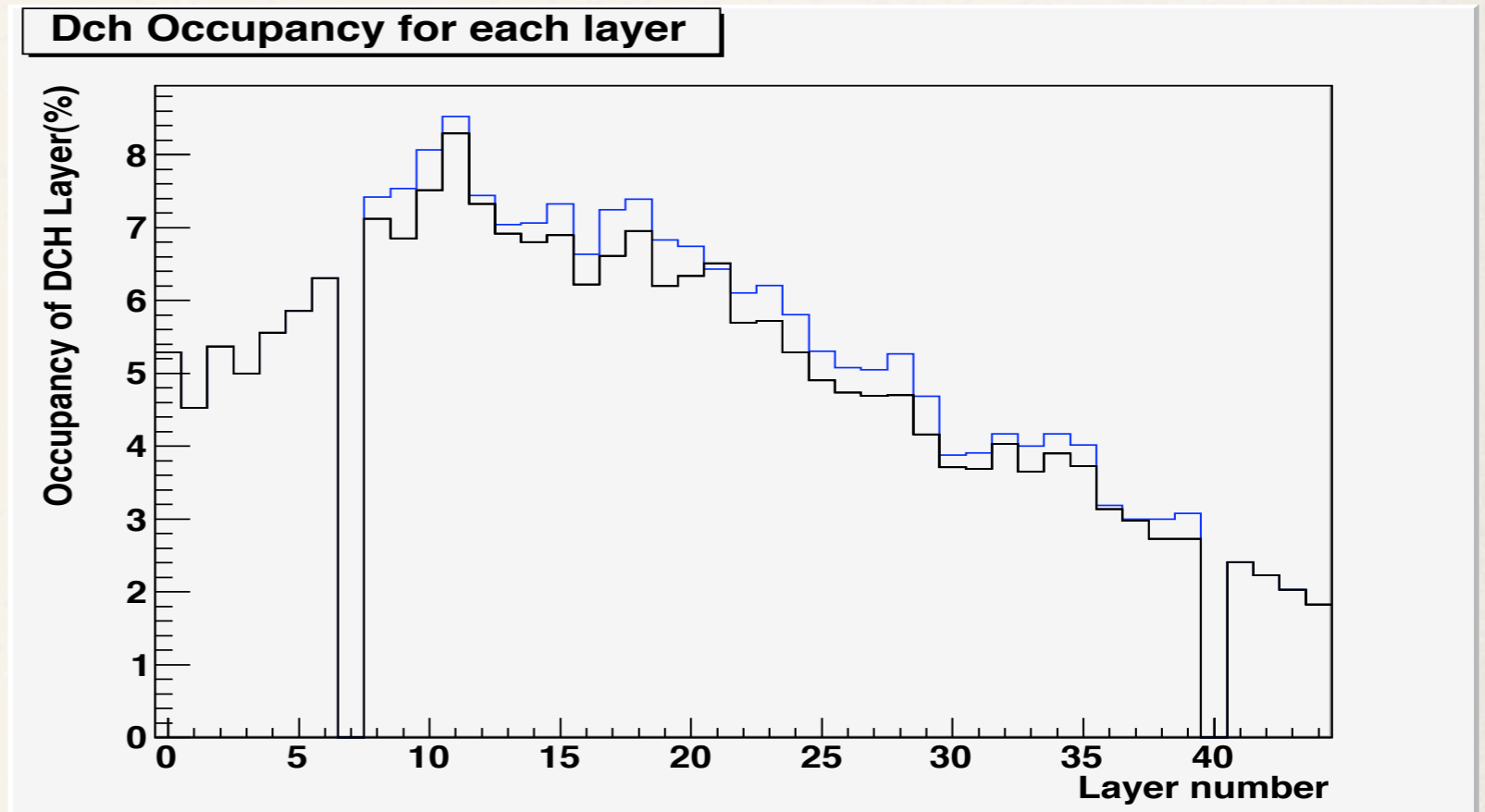
- Occupancy old method, counting only cells at step begin point
- New axial configuration
- New method occupancy should be the same for the 3 step limit setting
- Problem in the code to be understood (missing hits in the final counting?)

	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%



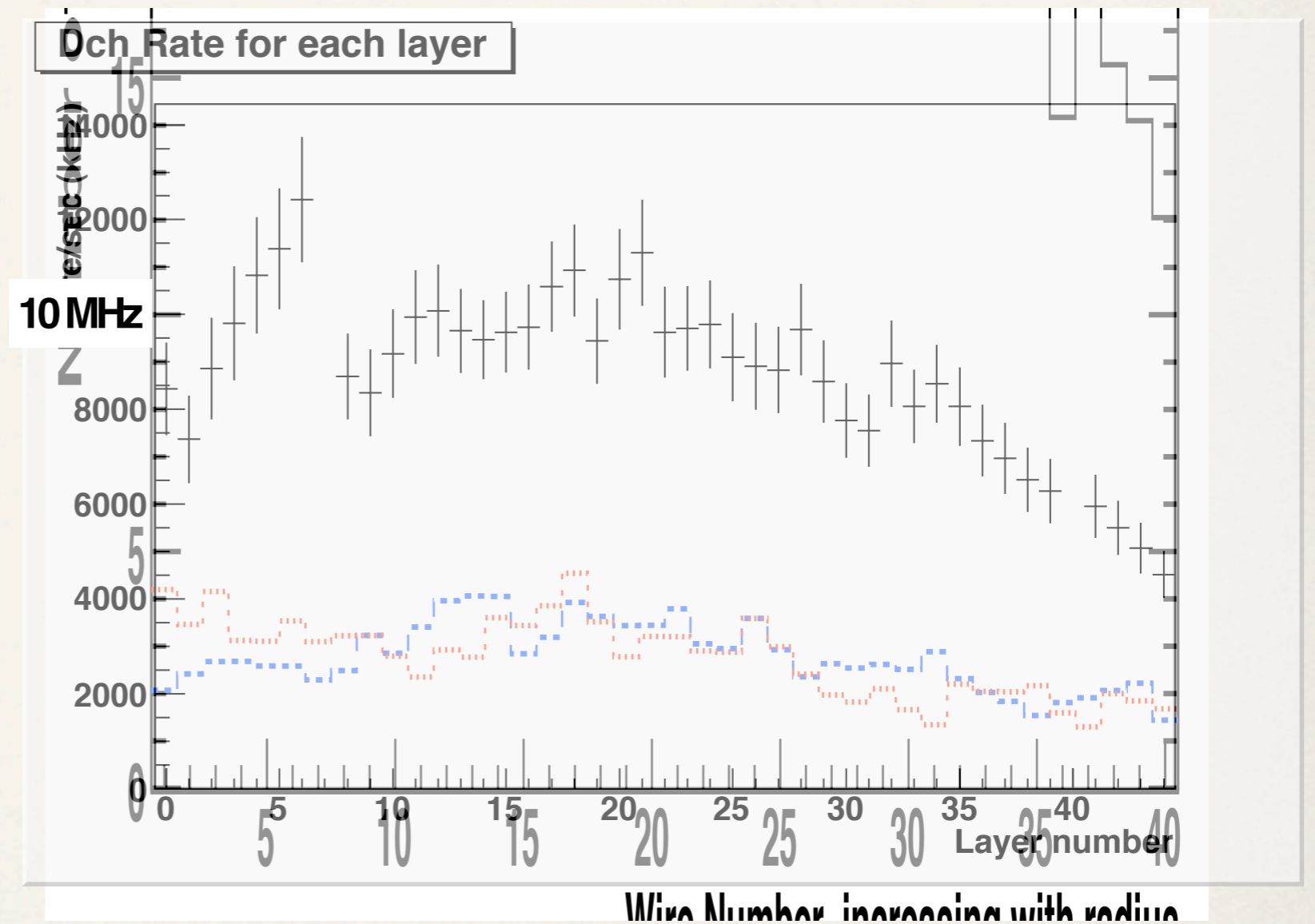
Axial vs Stereo

- Occupancy using the new configuration, SuperB01 (and new method)
- Again, adding **stereo layers** does change occupancy too much
- Test on occupancy only from tracks with $R < 1\text{cm}$, $z\text{Len} > 20\text{cm}$, still not the expected factor
- Remember: test with single particle along z axis was fine



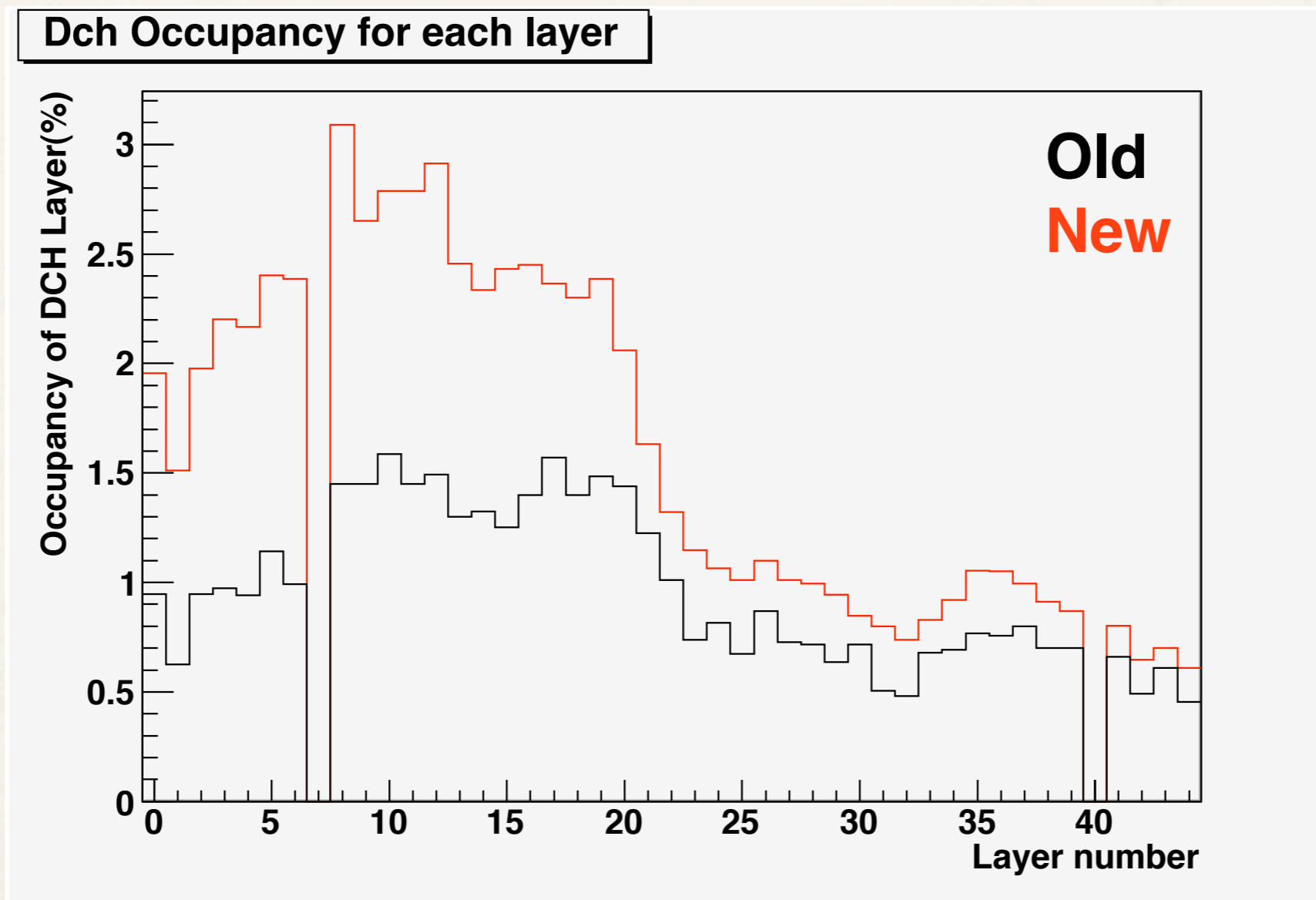
Rate vs Occupancy

- Rate per layer (new hit counting method)
- Apart from a scaling factor, rate is different from occupancy:
 - higher number of cells in outer layers
 - if a cells is crossed by more than one particle
- Dana is measuring rate not occupancy (plot in transparency, blue and red)



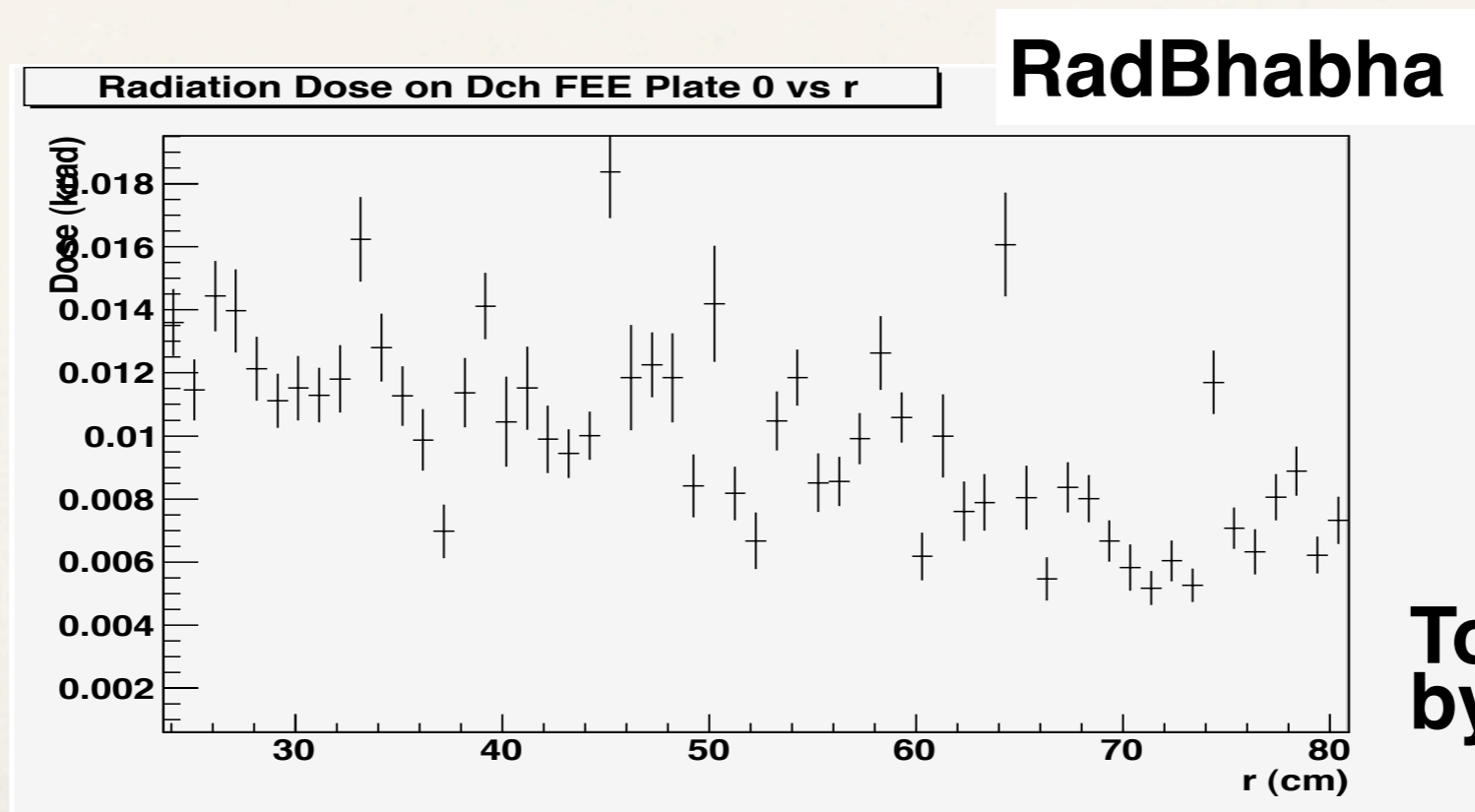
2photons (aka Pairs) bkg

- Occupancy increased also for 2photons background
- Axial01 configuration: 0.9% -> 1.5%



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
 - 2 photons, < 50 rad for all the plates
- Any number from Babar for check the consistency?



**To be normalized
by the volume**

Conclusions

- No big difference with short shielding, from Dana's ntuples
- New method to compute the occupancy, helix almost-full reconstruction. Not yet fully validated...
 - To do: cells staggering and threshold on energy
- Anyway occupancy should increase because of missing information in previous ntuples
 - RadBhabha 4.7%, 2photons 1.5% (preliminary)
- First estimation of radiation dose on FEE is really small, < 1krad
- In general more statistics is needed and maybe other background sources evts

FullSim version and geometry

- **Bruno r356**
- **Geometry:**
 - Beampipe (BP): 1mm thick, Rmin 10mm
 - Gold foil inside BP: 3um
 - SVT L0 length 10 cm, thickness 200um, Rmin 1.3cm
 - BaBar SVT
 - Cylindrical drift chamber
 - Gas volume, Rmin 237mm, Rmax 800mm
 - Length 2775mm, centered at $z = +367$ mm
 - Carbon fiber structure filled by material with density averaged from gas and wires