Update on Svt and Dch Full simulation

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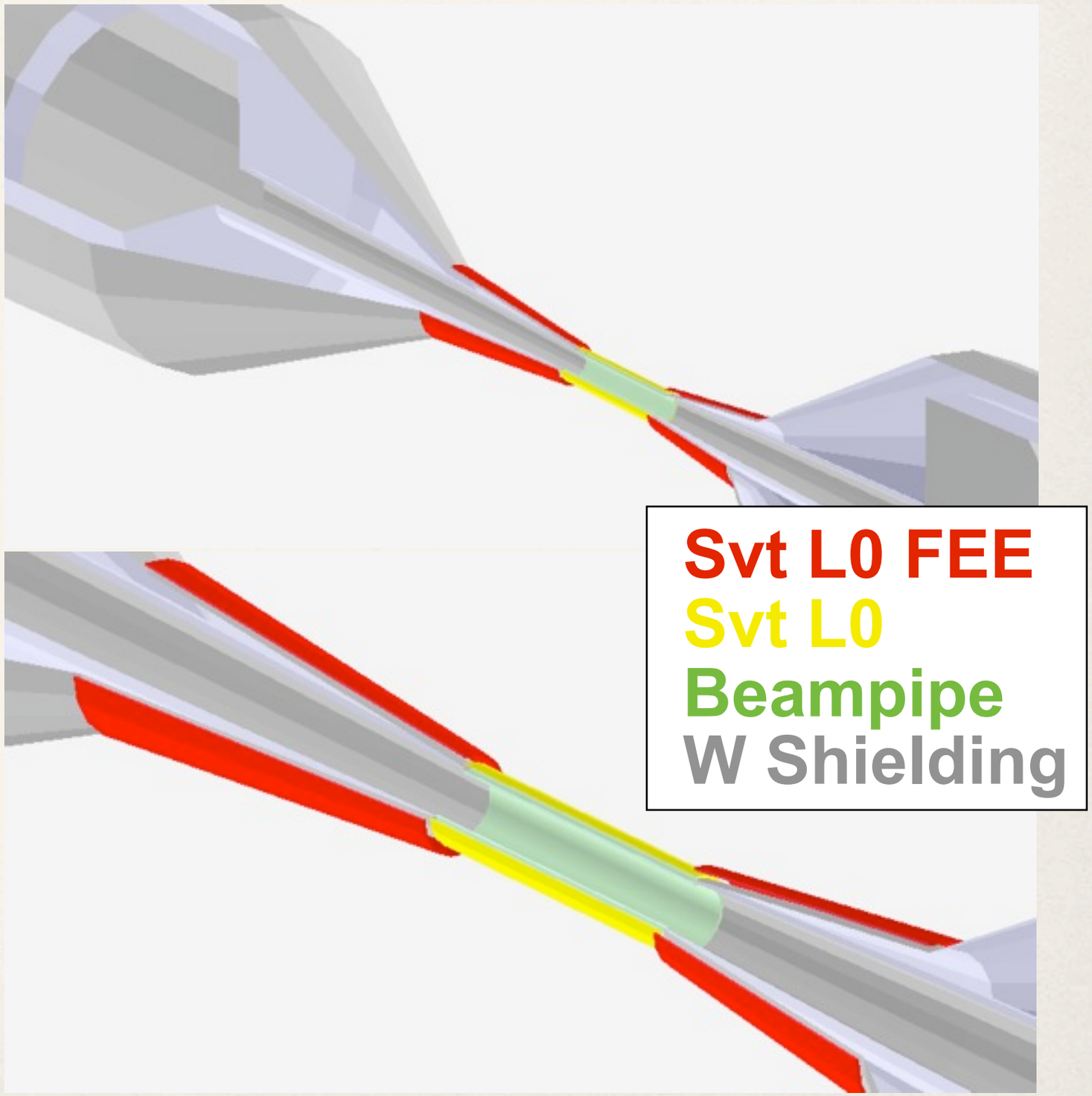
What this talk is about

- Brief description of changes and improvement to Bruno code
  - Geometry: additional probe volumes at Svt L0 and Dch electronics location, 2 more hit lists dumped
  - B field configuration: not well defined, default for radiative Bhabha is IR B field **Off**, for Pairs bkg is **On**
    - Added information on Dch hits to have a better estimation of occupancy
- For more details on physics results see parallel detector sessions
- **Note: results here with r356, no diffs comparing to Feb production**

L0 electronics position

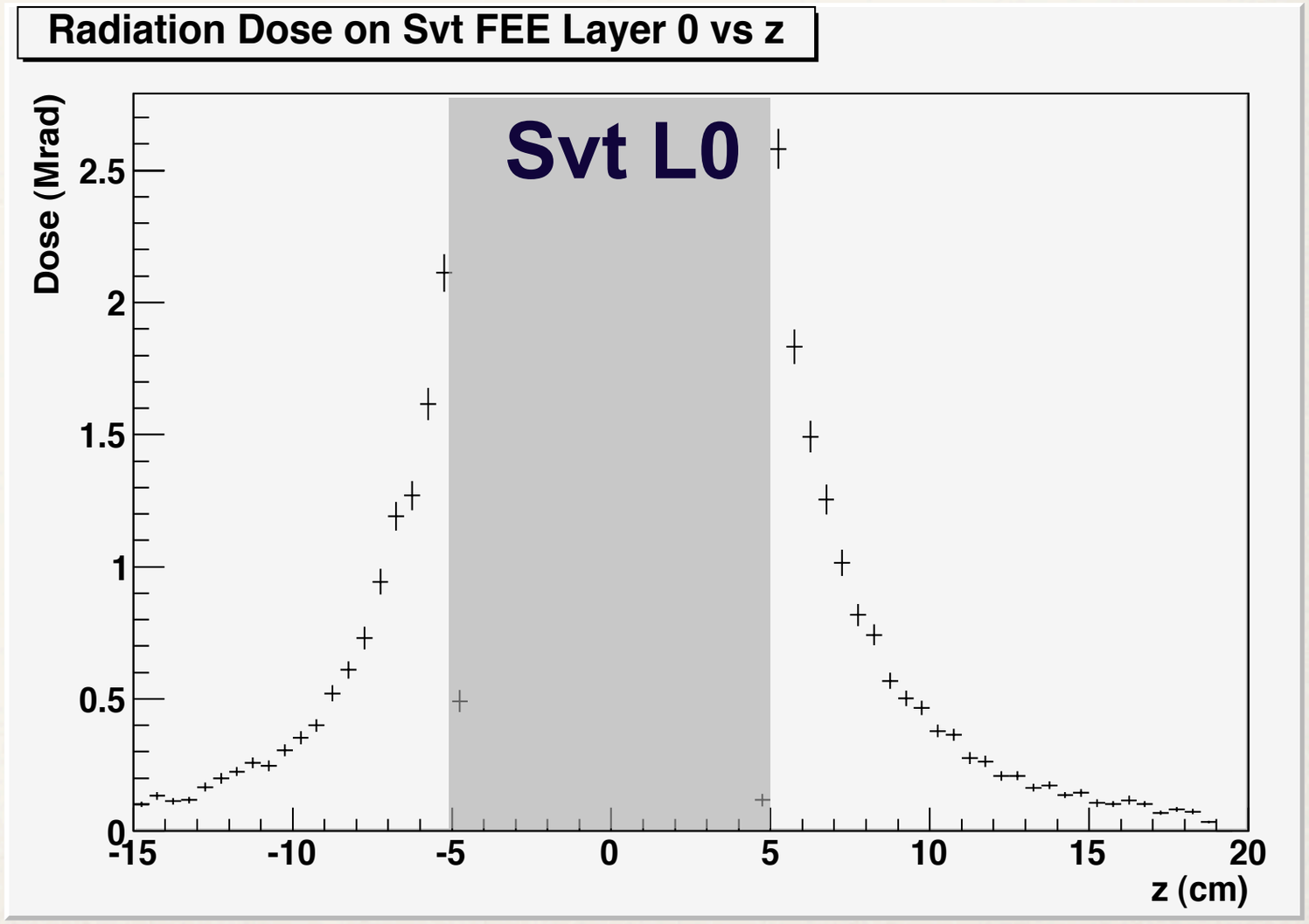
- Additional 2 volumes
  - Cones around IR tungsten shielding close to L0
  - 1mm of Si at 2mm from shields (radiation probes)
- Sensitive volumes: additional BrnRootHits list dumped by RooEvt object



Radiation dose on L0 electronics

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

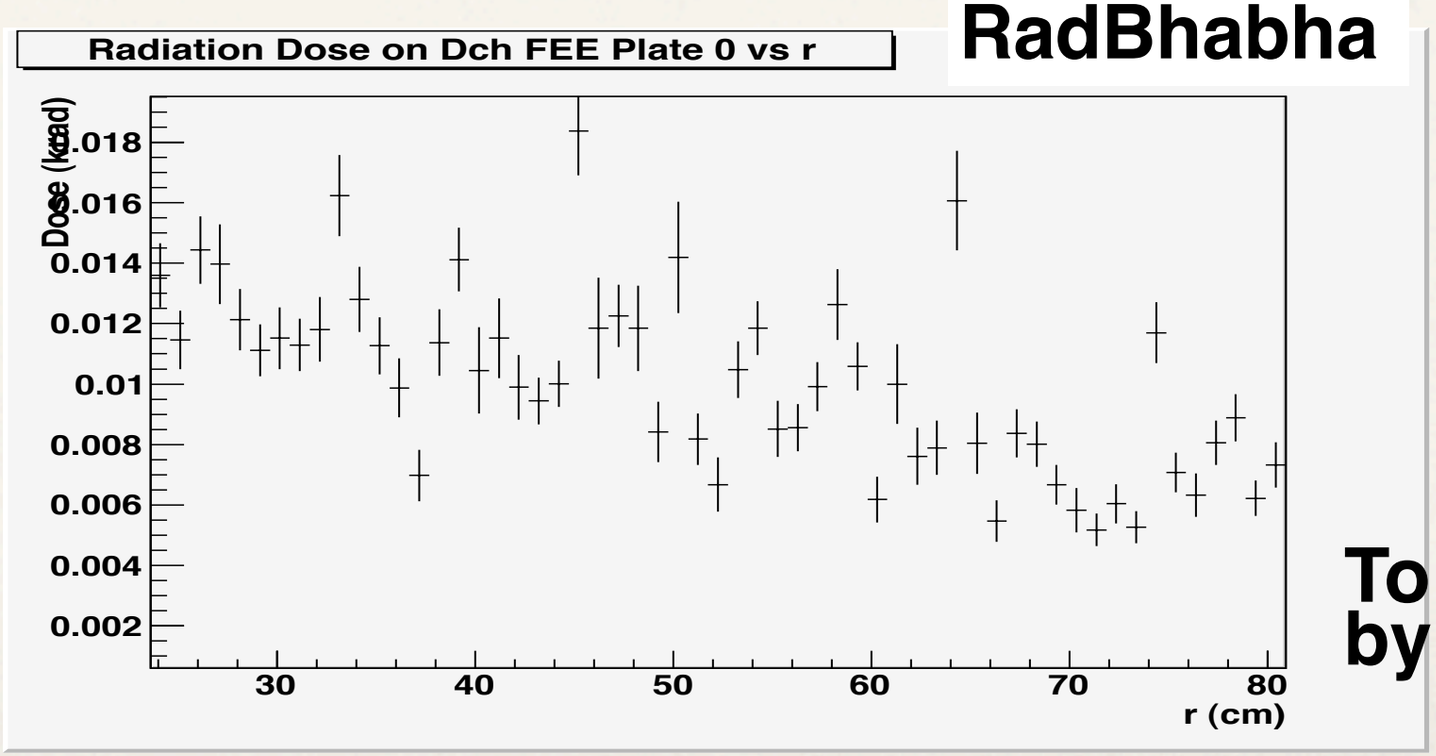
- Average dose:
  460 krad
- Much higher close to L0 edges: >2 Mrad
- Same technique can be used for other areas or using also more realistic materials



Radiation dose on Dch 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?

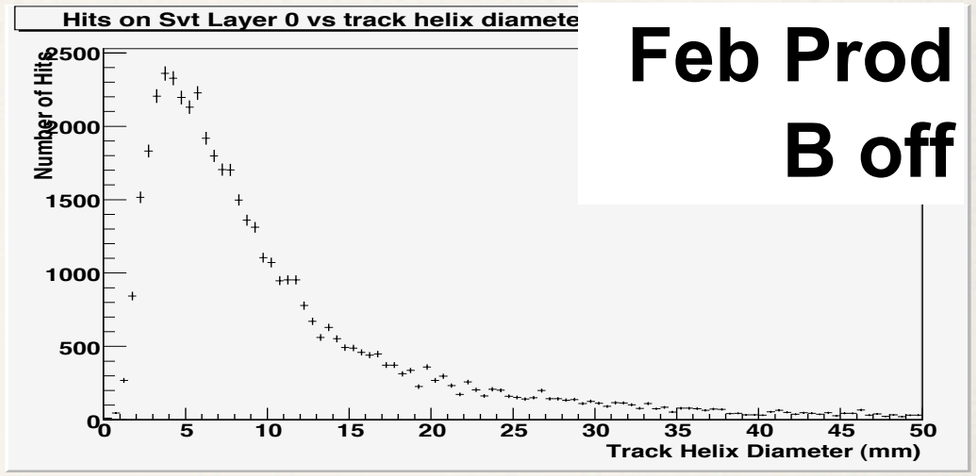
RadBhabha

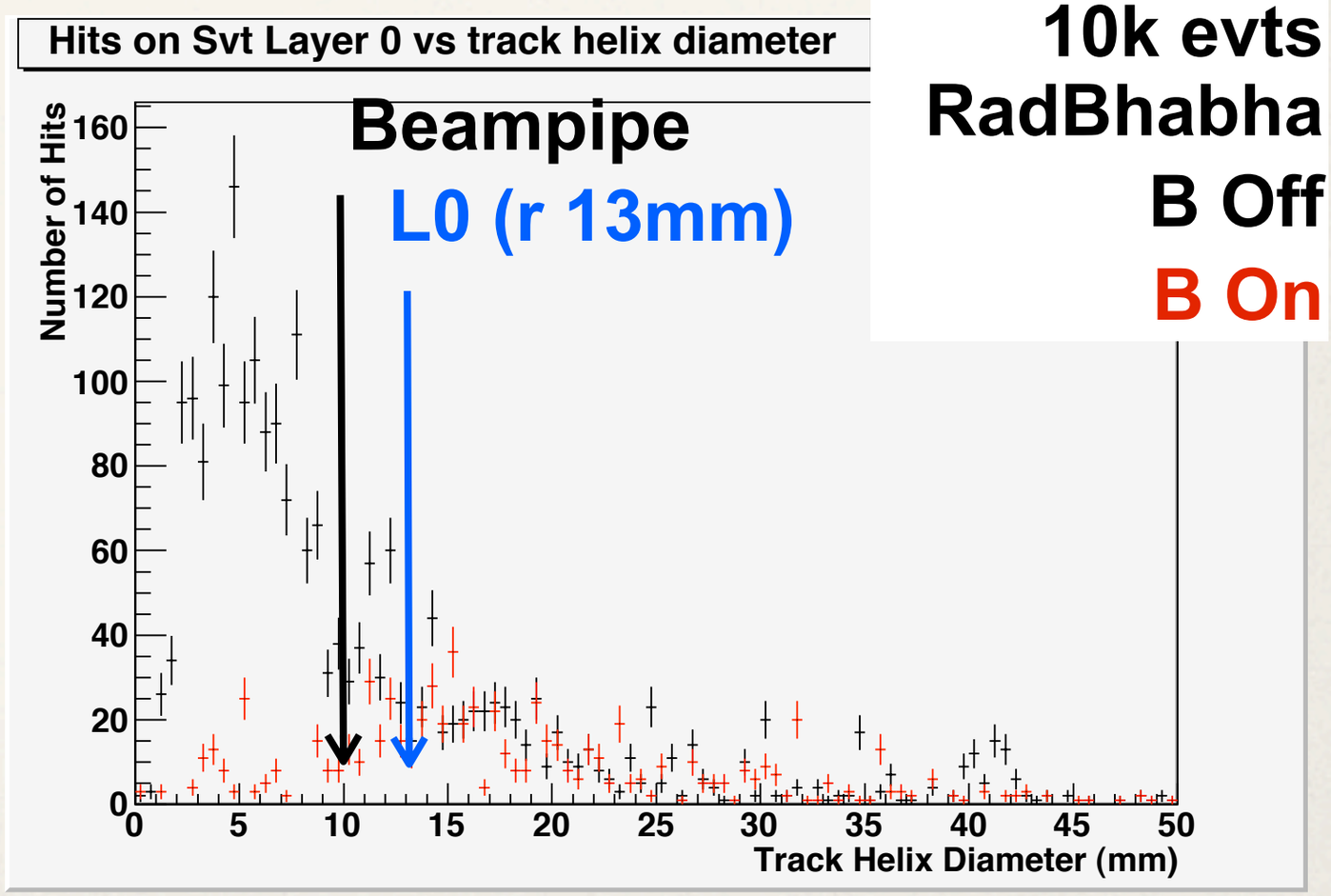


To be normalized by the volume

Interaction region B field saga

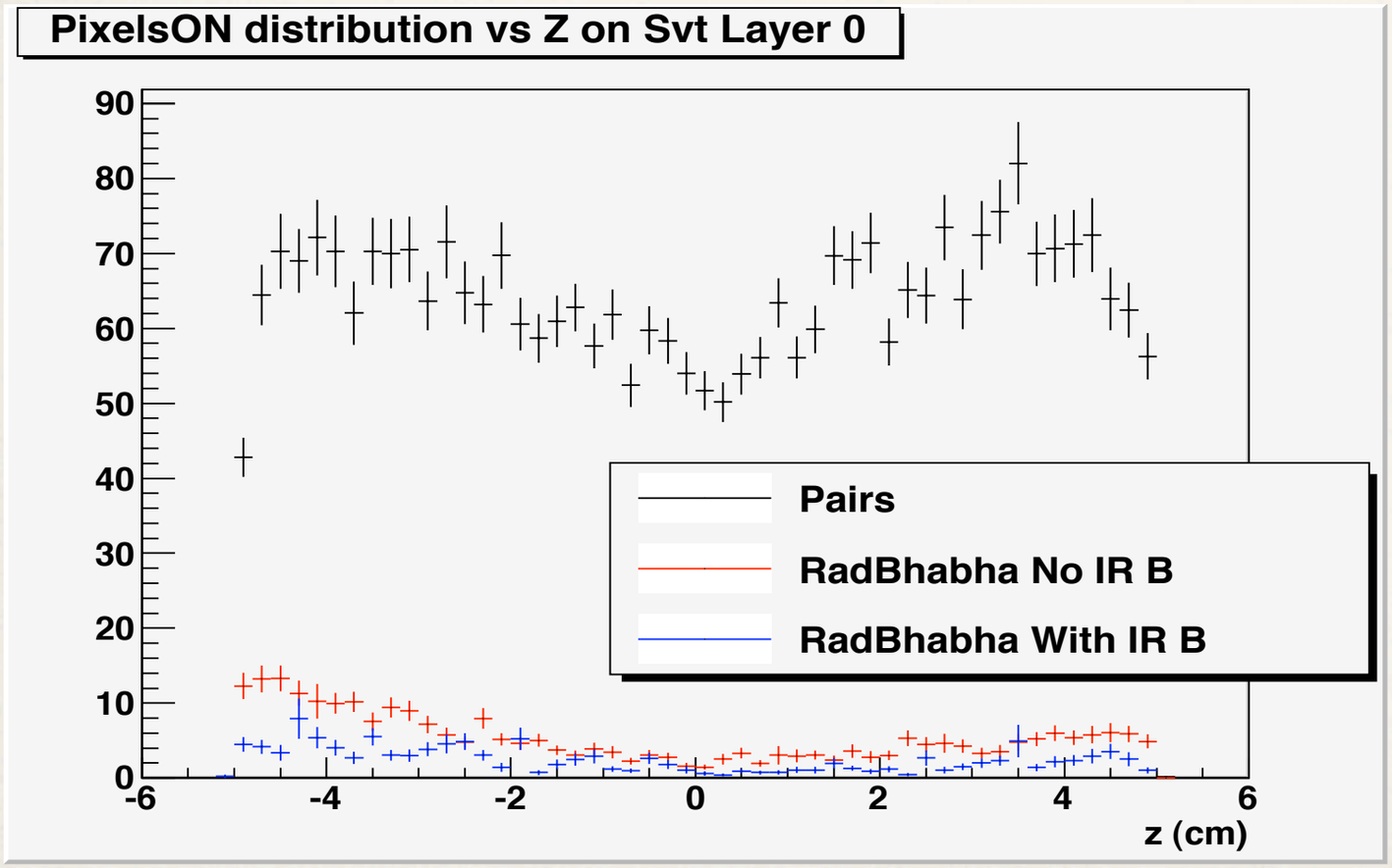
- For more realistic results with Bruno, IR B field should be turned on for pairs bkg and off for RadBhabha
  - Compensation: field on inside L0 but not upstream and downstream to avoid off energy particles to be driven into the shielding
- This setting is hardcoded in Bruno (off in svn release r356 and Feb prod)
- This solution works fine for Dch, but not for Svt: low transverse momentum tracks get to L0





Layer 0 pixel rate vs Z

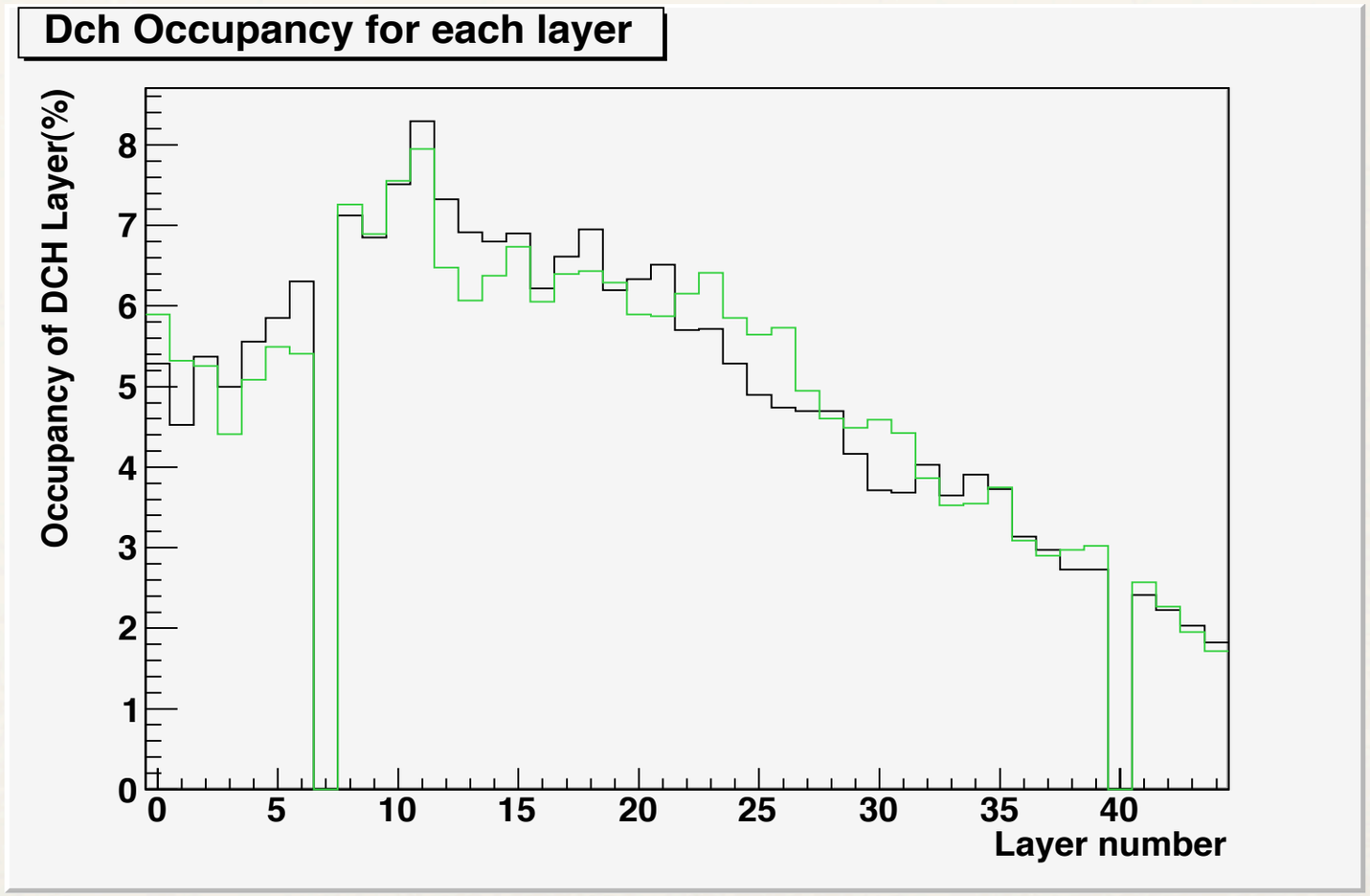
- Z distribution for pixel rates on layer 0, radius 13mm, 200um Si
  - Pairs bkg (40k evts)
  - RadBhabha w/o B field (200k evts)
  - RadBhabha with B field (10k evts)
- RadBhabha is a small fraction of Pairs bkg
  - B field Off 9%, B field On 4%
- All rates are supposed to scale with radius



Pairs L0 rate **64** MHz/cm²	RadBhabha Pixel Rate (kHz/cm²)	
B field	**B off**	**B on**
Layer 0	5413	2593
Layer 1	130	86
Layer 2	62	50
Layer 3	32	21
Layer 4	5.0	4.6
Layer 5	2.5	2.3

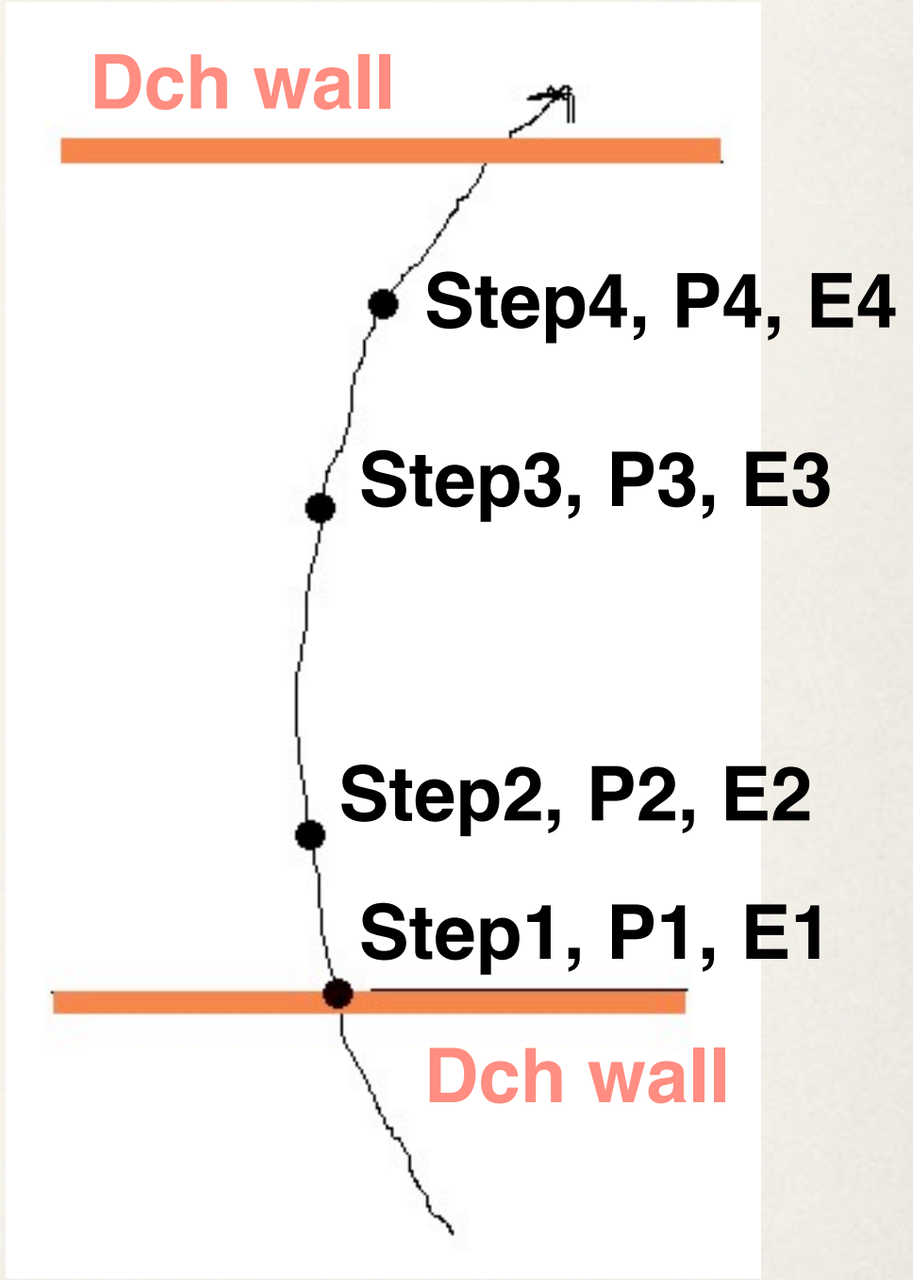
IR B field on other detector

- No substantial difference in occupancy for **RadBhabha with B field On** (new samples and new Dch config, see below)
- Probably not issue also for other detector, but it always better to check it



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

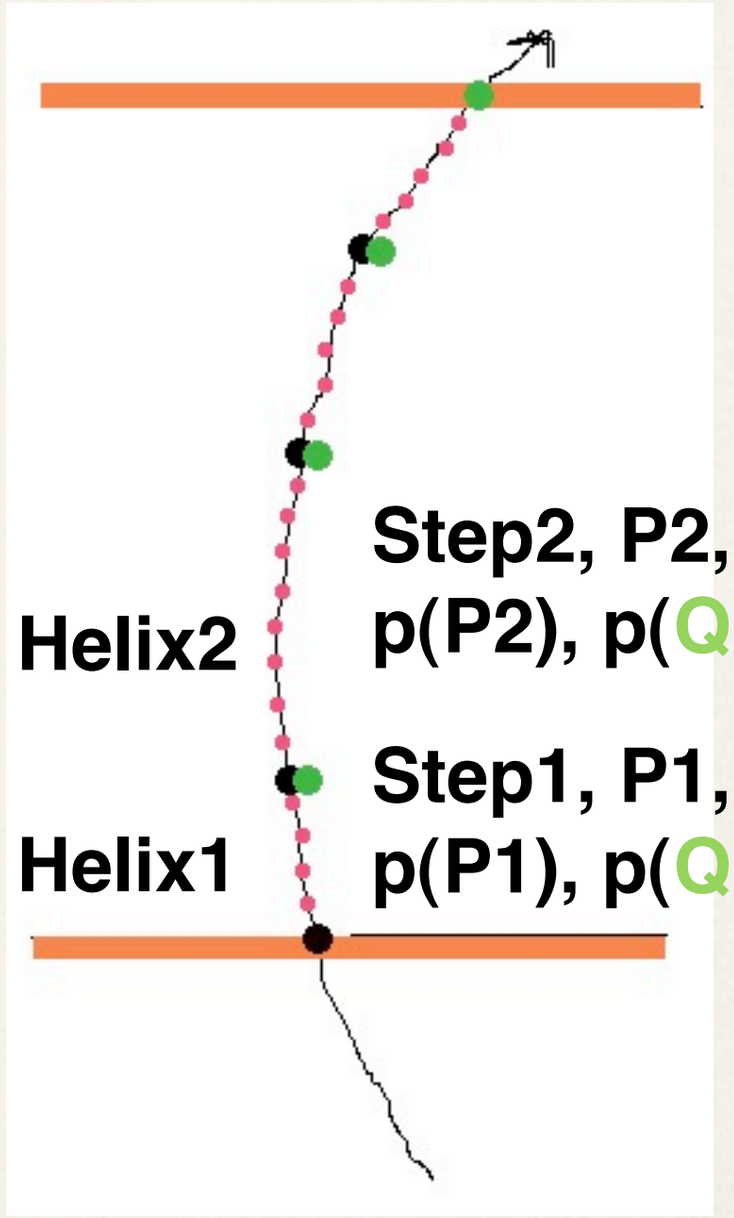


Missing cells...

- 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

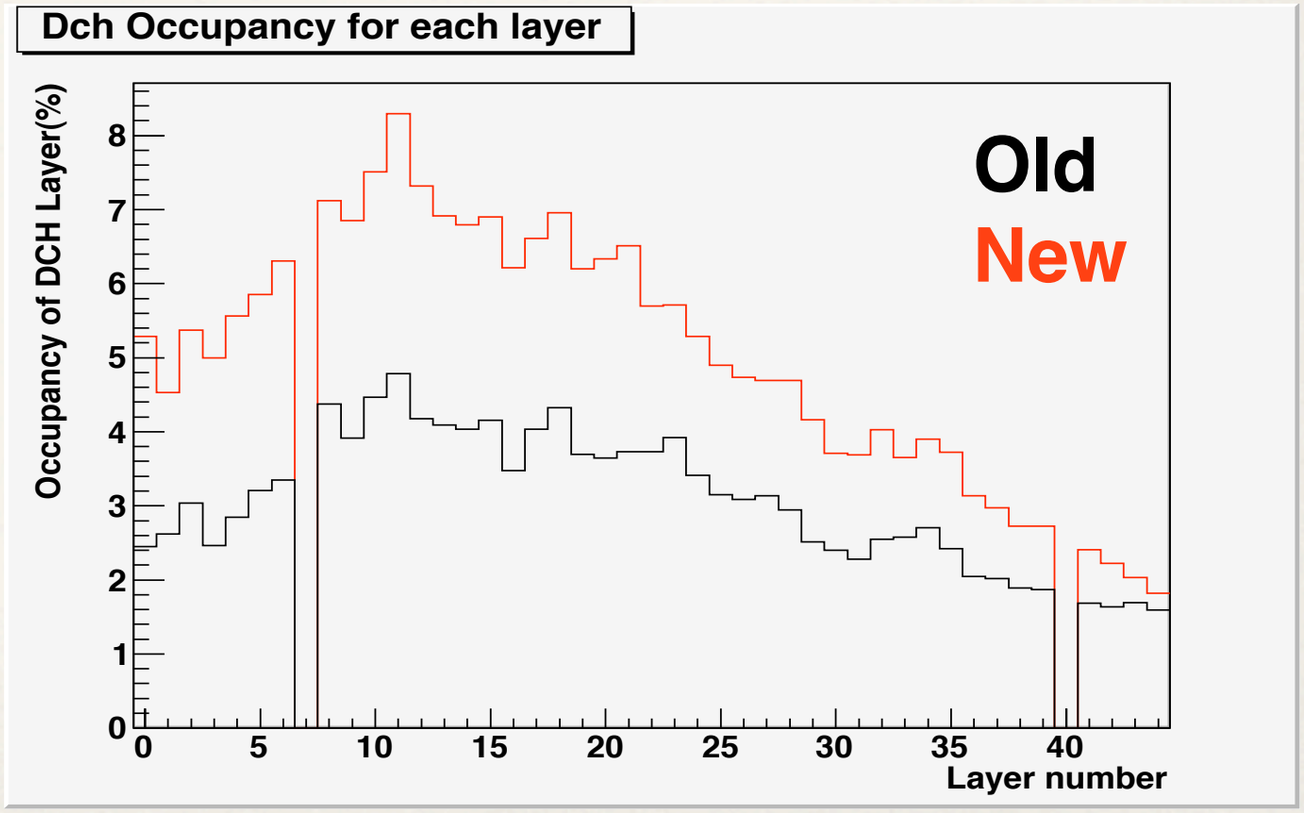
- **Start** and **end point** are not enough for Dch hits, trajectories are helix
- Using the momentum direction and particle charge the helix parameters can be computed (standalone macro after the simulation)
- Then the helix can be **sampled** at a smaller sub-step (3 mm) and we got all the cells crossed 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



Occupancy vs max step length

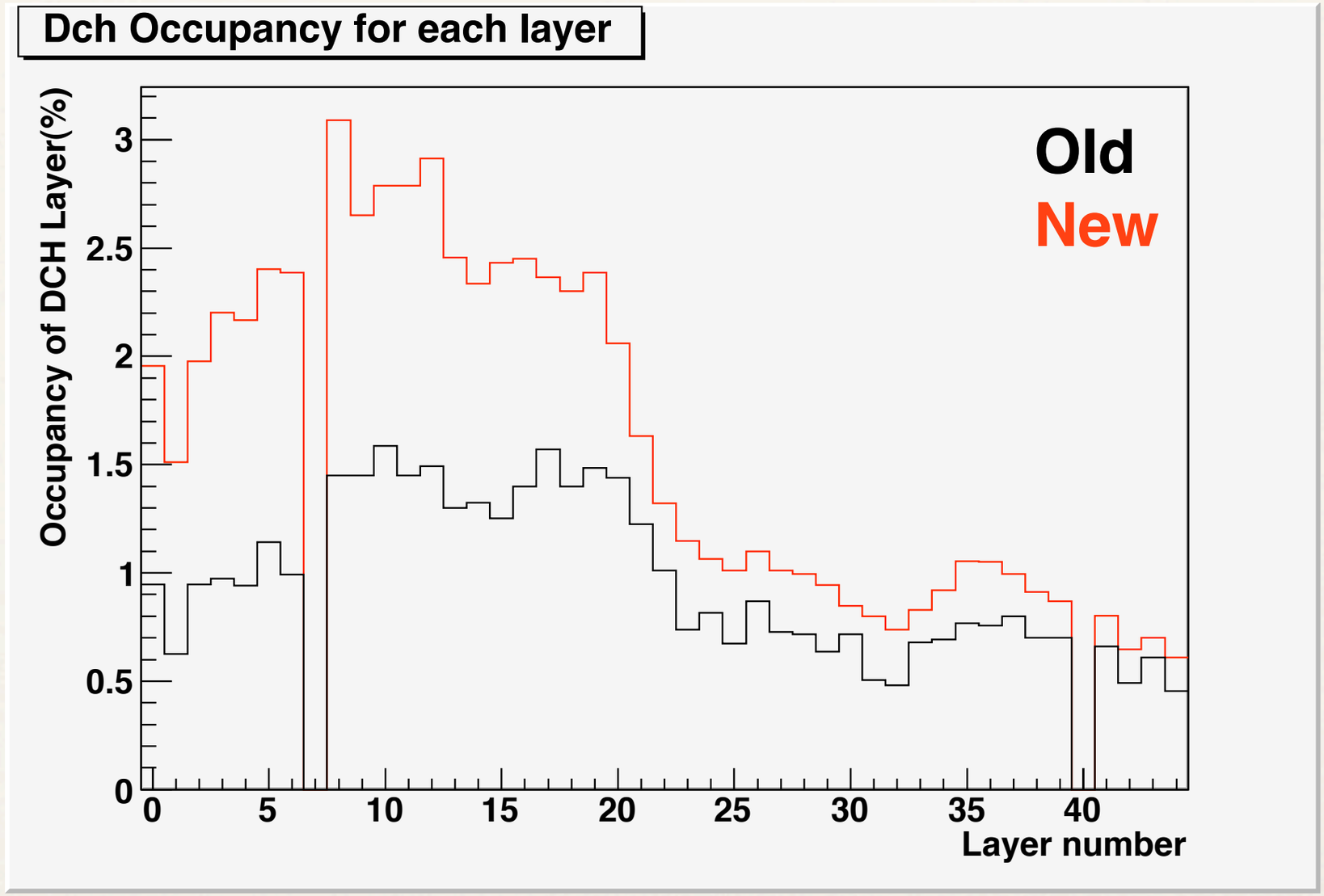
- Occupancy old method, counting only cells at step begin point
- New axial configuration
- New method occupancy should be the same for the 3 step limit setting
- Problem in the code to be understood (missing hits in the final counting?)

	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%



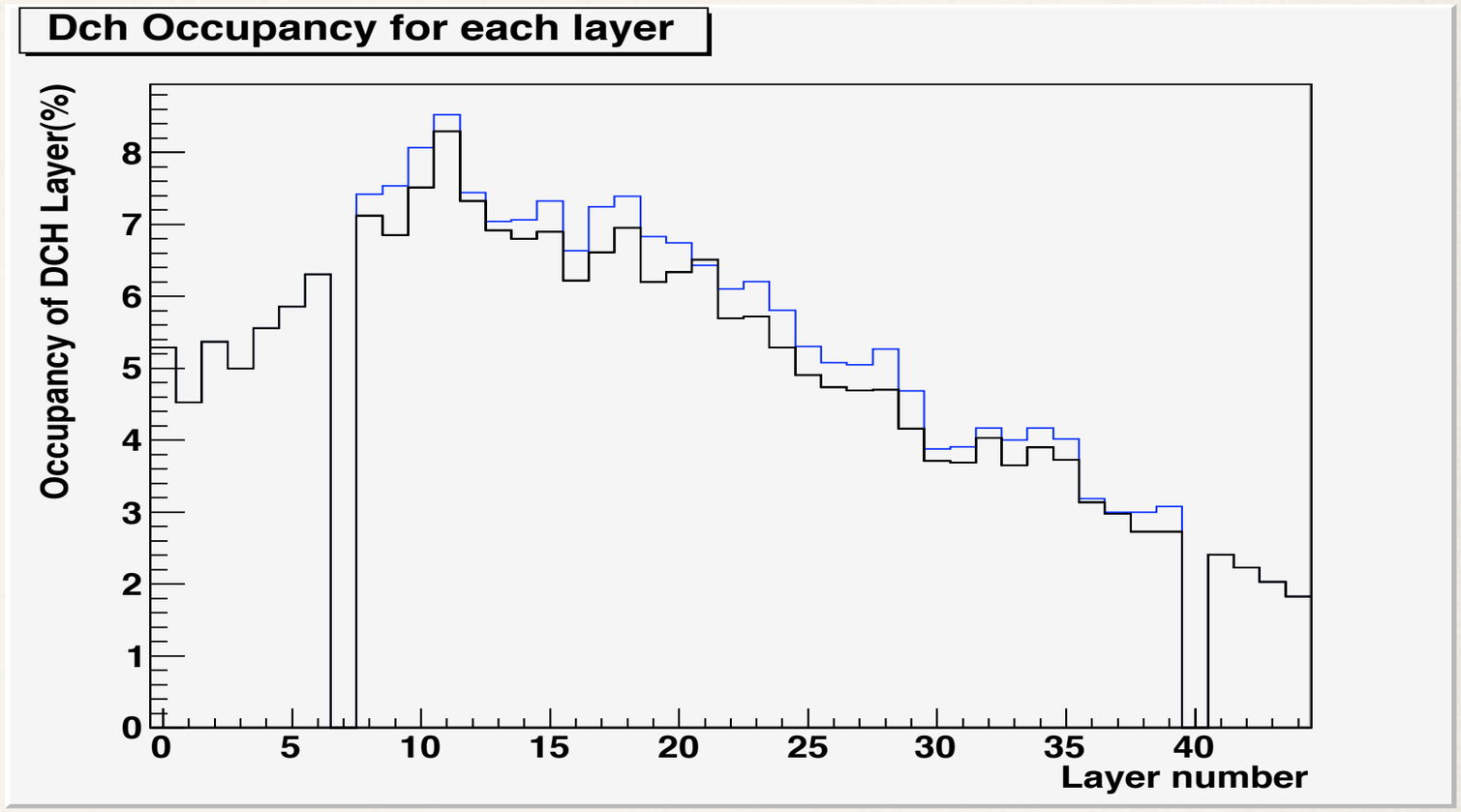
2photons (aka Pairs) bkg

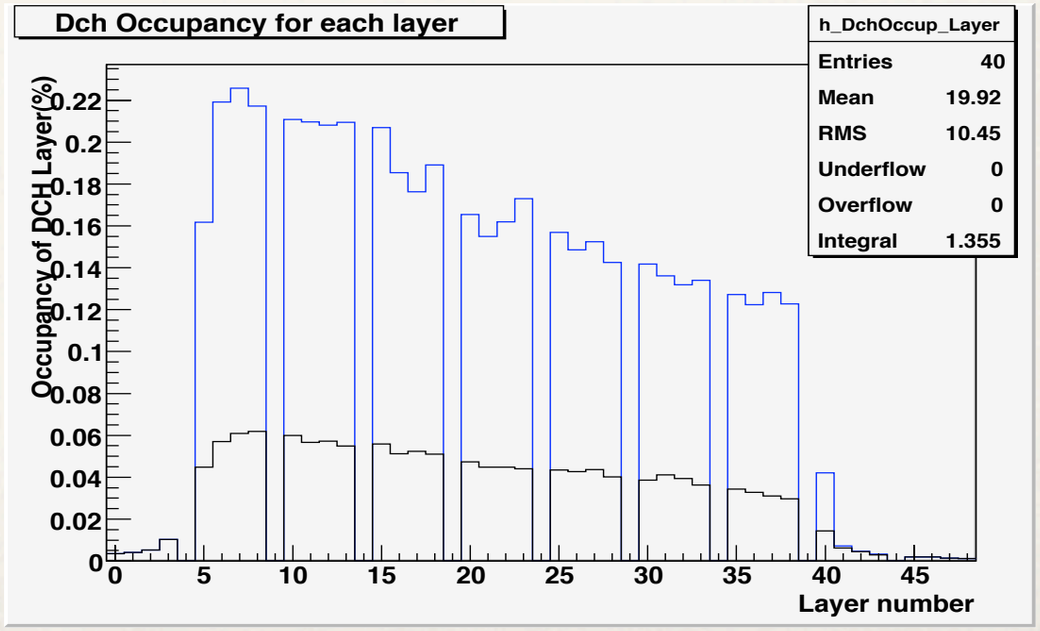
- Occupancy increased also for 2photons background
- Axial01 configuration: 0.9% -> **1.5%**



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 < 1cm, zLen > 20cm, still not the expected factor
- Remember: test with single particle along z axis was fine





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/

Conclusions

- New pieces added to the geometry, first estimation of radiation dose on FEE for Svt and Dch
- IR B field is needed for Svt. I think we have green light to have it on as default
- New method to compute the Dch occupancy, helix almost-full reconstruction:
  - Not yet fully validated (missing hits…?)
  - Axial-Stereo layers behaviour not fully understood
  - To do: cells staggering and threshold on energy
- In general more statistics is needed, but also other background sources evts