Update on Background studies using FullSim

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SuperB Workshop and Kick-Off Meeting

May 30th, 2011

Outline

- Lot of stuff done in the last few weeks (bugs fixed, updated plots, and more), not enough time to cover everything. For more details see my other talks during this meeting
- SVT
  - Bug in the geometry of outer layers
  - Strip rate and multiplicity with realistic pitches
- DCH
  - Updated occupancy estimation
  - Rate map
- ETD
  - Radiation dose monitoring and fluxes on eletronics
- Conclusions & To do List

Productions and other data

- RadBhabha, new productions
  - **Elba**, RadBabha (20k evts): new final focus and new magnetic configuration, 1mm step limit for Dch, full Truth Info
    - Issues when processing such a big ntuples, really slow, need to disable some minor features in my macro to run faster, but still slow
  - **Elba-Light**, RadBhabha (10k evts), same configuration but no full Truth, as previous productions
    - All the following plots are made using this production
  - Less events than previous productions, but also less background, so statistics is not so great
- 2photon (aka pairs): I was not able to simulate smoothly 2photon bkg with the last revisions of Bruno (r491): simulation stuck on some events (new FinalFocus and magnetic configuration)
- Many fixes after that, I will try again with the last rev and also with the new packaged version next week
- In the following SVT results using events simulated with a more recent version of Bruno (r465) and the December geometry
- Fixed memory leak when writing TClonesArray and information added on TParticle's on boundaries (ID of primary that generates the particle and code for bkg type)

SVT: geometry bug

- Sensitive volumes for **layers 1-5** were wrong
- Cluster rate is lower, but pixel rate, fluncy, and dose are higher (factor ~2.5/3)

LAYER 1	Dec2010	May2011	
Cluster rate	0.43	0.22	MHz/cm2
Cluster multip	2.12	10.88	
Pixel rate	0.91	2.56	MHz/cm2
Fluency	5.40E+10	1.80E+11	cm-2
Dose	0.03	0.11	MRad

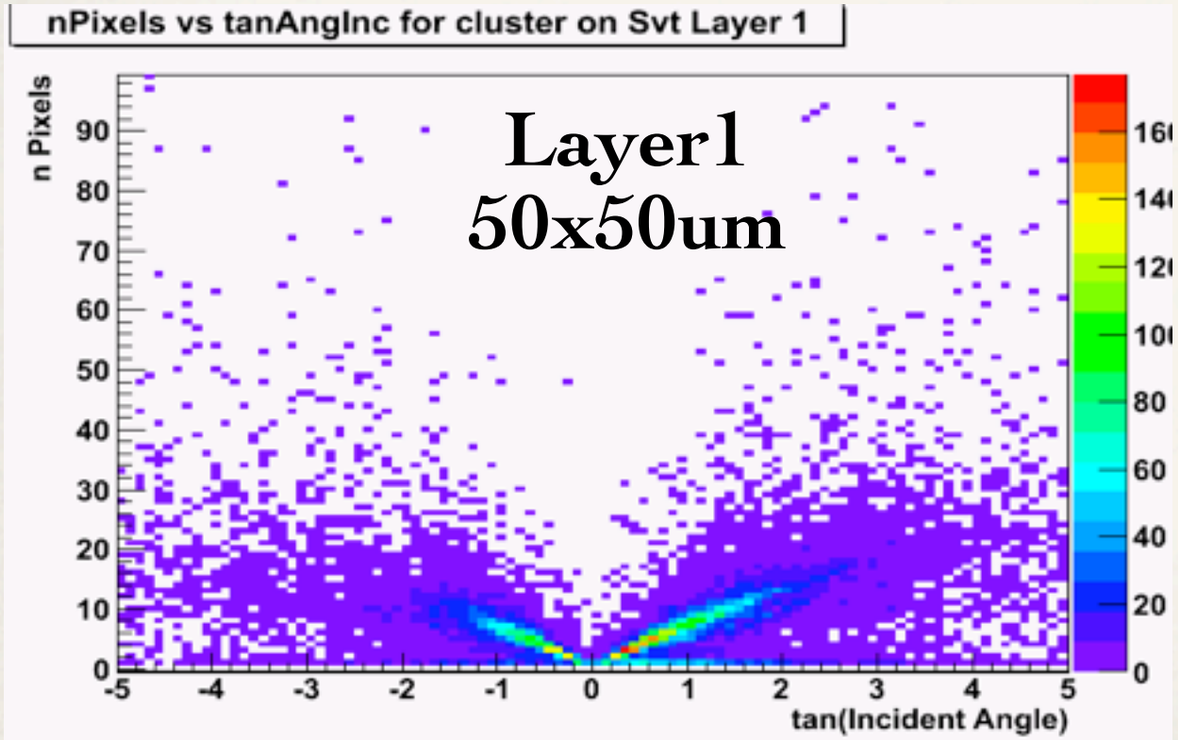
LAYER 0	Dec2010	May2011	
Cluster rate	6.44	6.37	MHz/cm2
Cluster multip	8.1	8.1	
Pixel rate	56.1	55.6	MHz/cm2
Fluency	4.79E+12	4.73E+12	cm-2
Dose	3.61	3.58	MRad

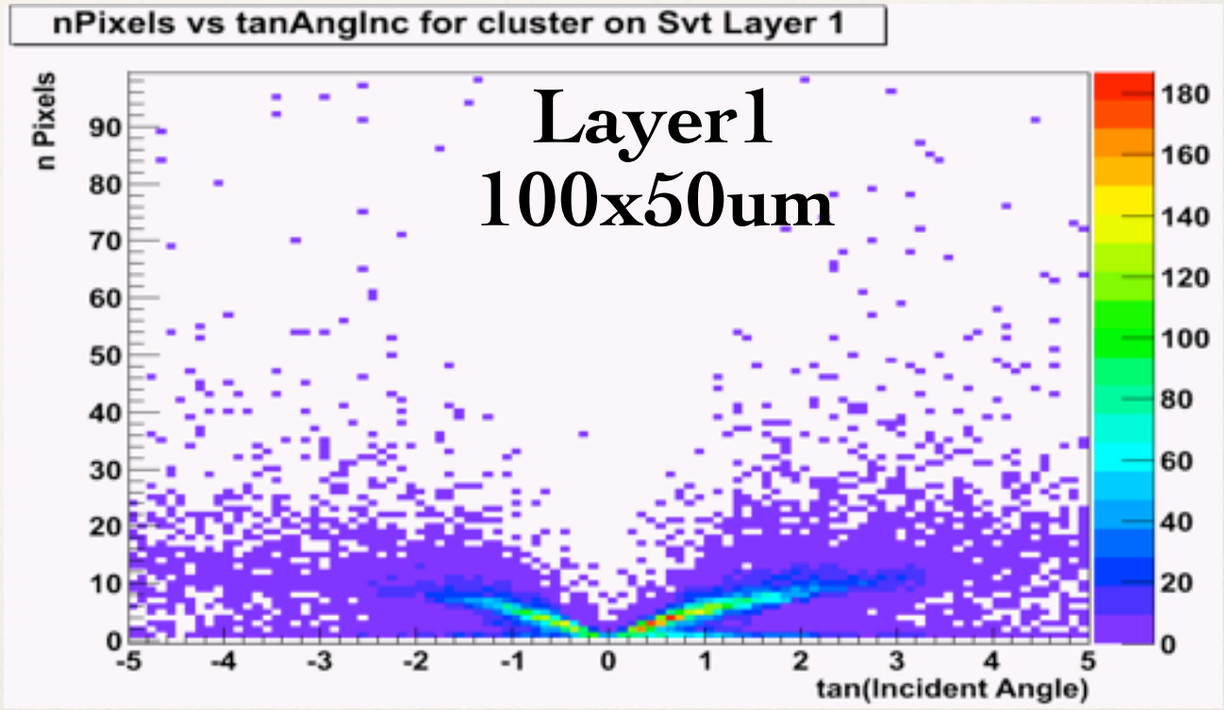
LAYER 2	Dec2010	May2011	
Cluster rate	0.23	0.12	MHz/cm2
Cluster multip	1.98	10.54	
Pixel rate	0.48	1.31	MHz/cm2
Fluency	2.91E+10	9.80E+10	cm-2
Dose	0.017	0.057	MRad

SVT: Checks on pixel algorithm (1)

- Fired pixels vs tangent of incident angle, linear correlation
- One entry per cluster, negative values are for particle going inwards
- Approx: cylindric layer instead of modules Same plots with different pitches
- Different slopes for different thickness and pitches

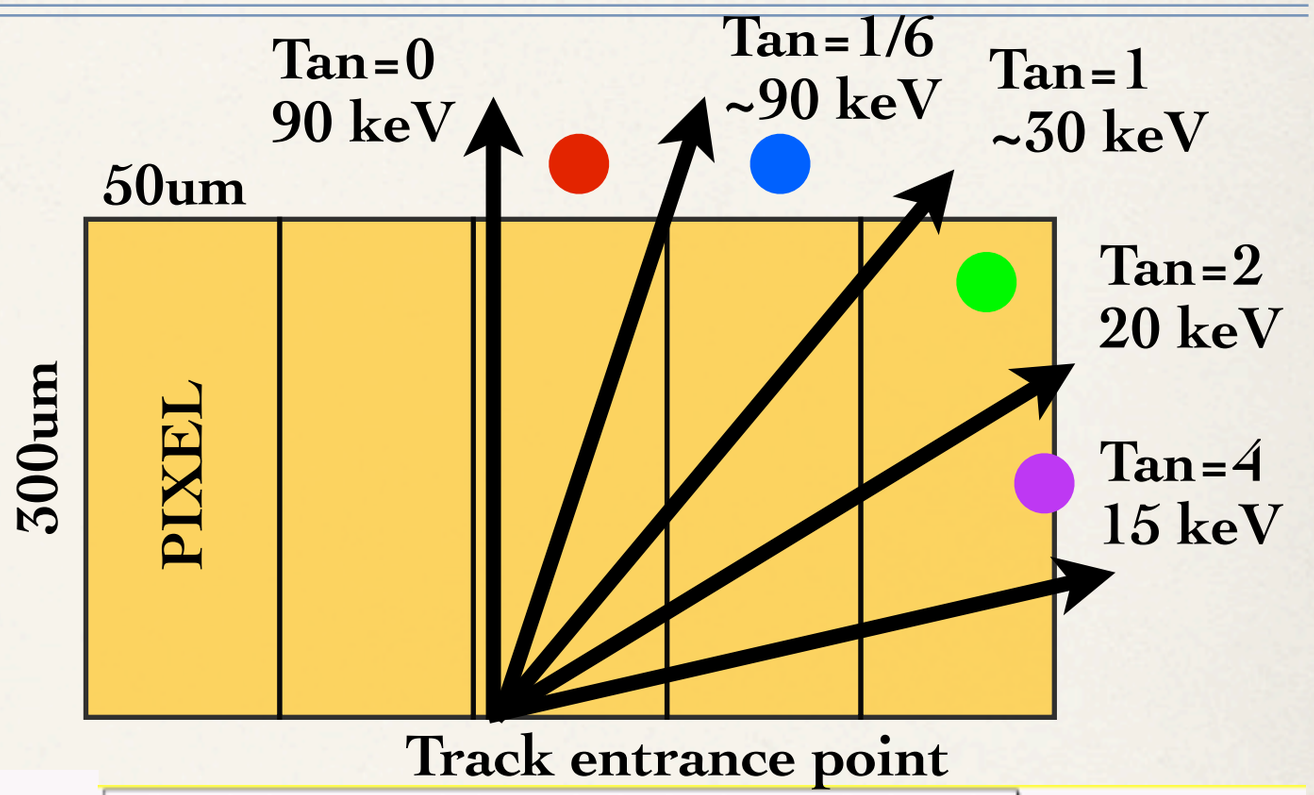
[um]	L0	L1	L2	L3	L4	L5
Z	50	100	100	100	210	210
Phi	50	50	55	55	100	100

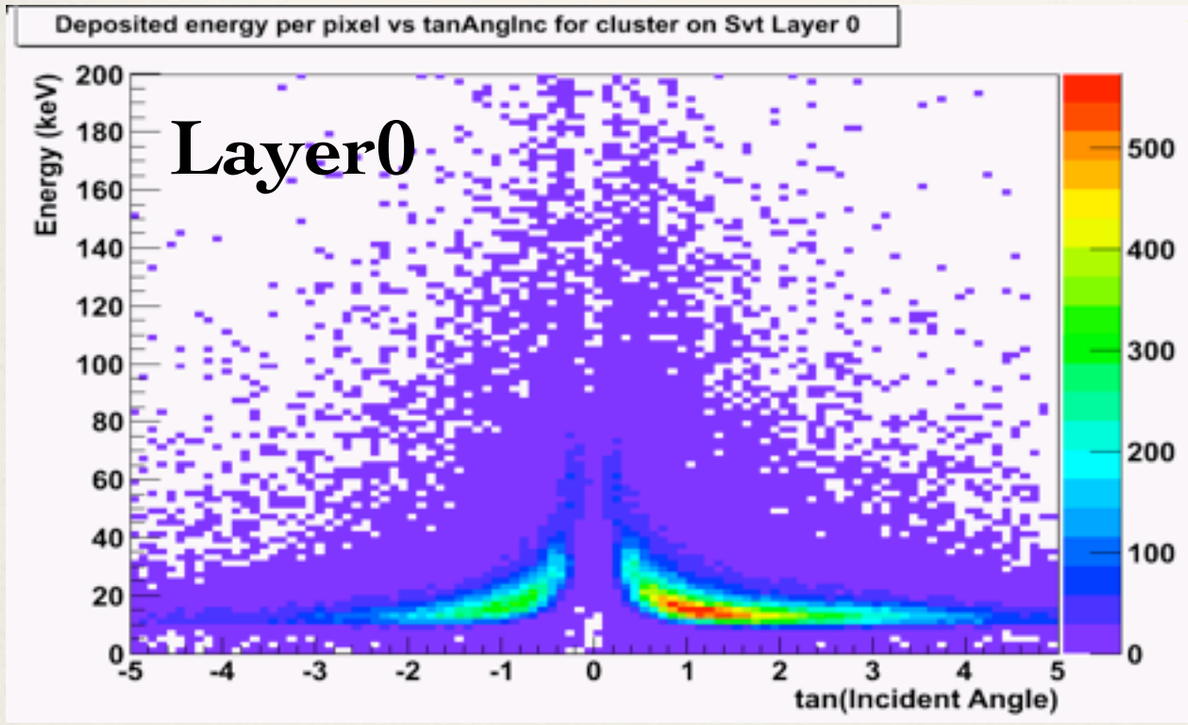


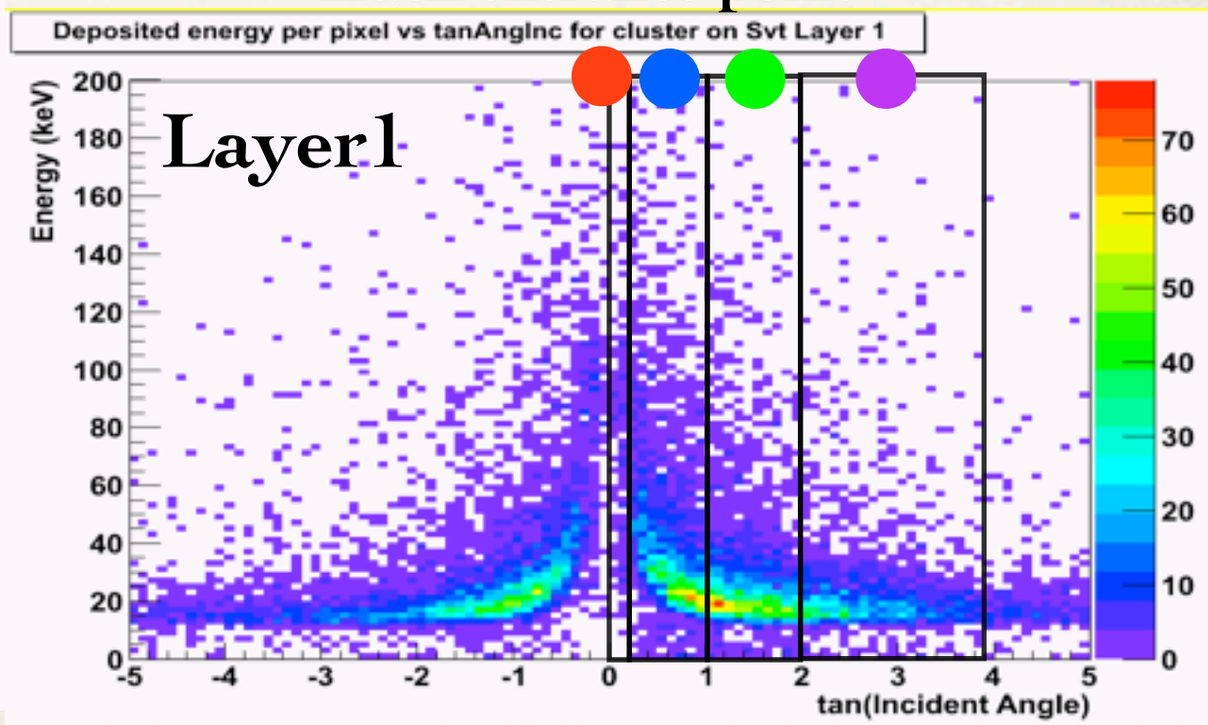


SVT: Checks on pixel algorithm (2)

- Deposited energy per pixel vs tangent of incident angle
- One entry per cluster, negative values are for particle going inwards
- For most of the clusters track is entering at large angle (tan=1 - 45 degrees)







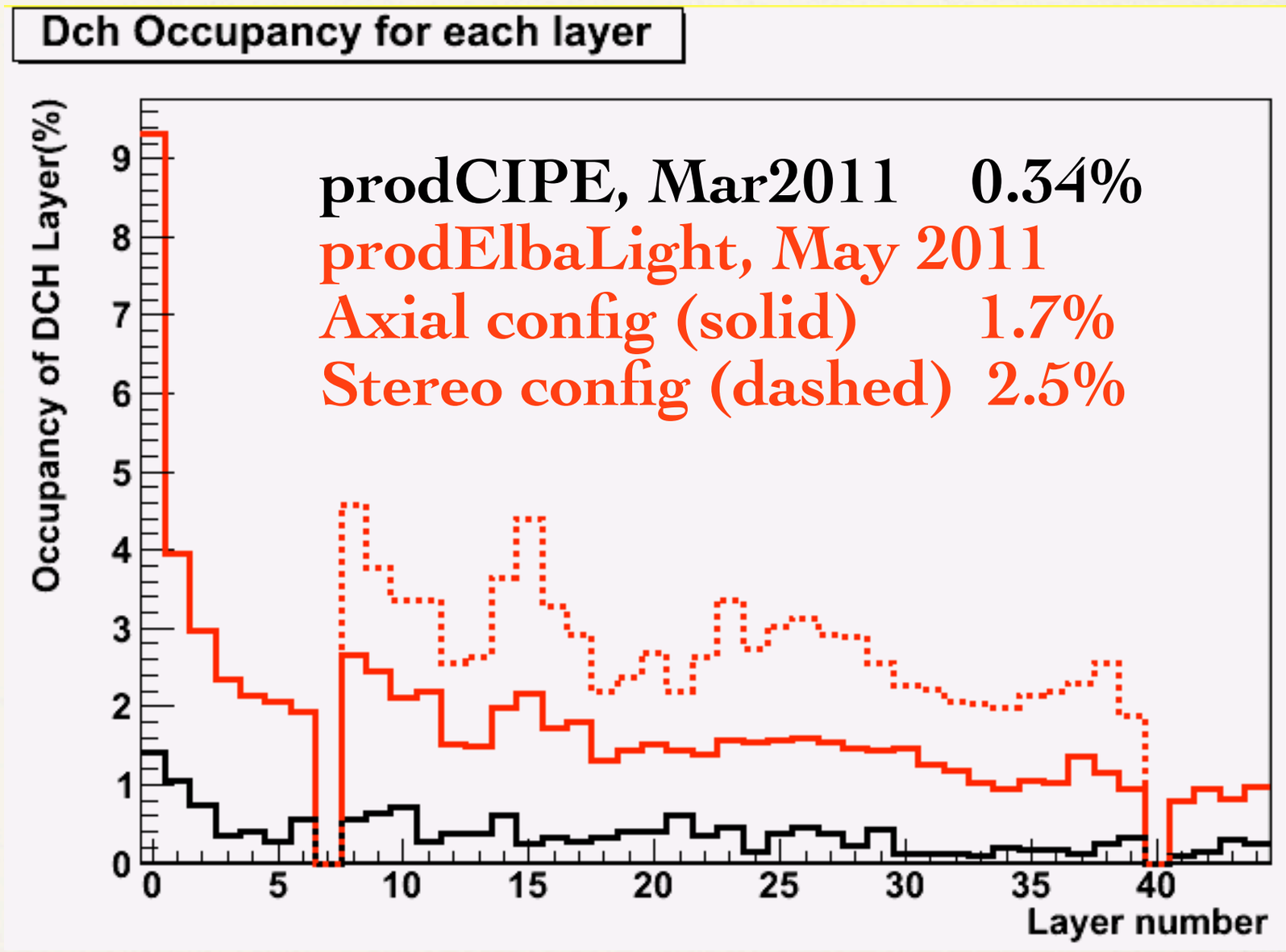
SVT: Strip multiplicity and rate

- Comparison with values from Trieste (Apr 2011), all our rates are lower than theirs
- Factor between strip and pixel rate is not an easy sqrt(2)

LAYERS	Old geometry Apr2011 (Trieste) Multipl.	May2011 Multipl.	May2011 Rates [MHz/cm2]	May2011 Pixel rate [MHz/cm2]
L0 phi	5.3	4.1	23.3	55.5
L0 z	5.2	5.1	29.9	
L1 phi	7.3	6.5	1.5	2.0
L1 z	3.8	3.2	0.7	
L2 phi	7.1	5.9	0.72	0.96
L2 z	3.7	2.9	0.35	
L3 phi	8.2	4.9	0.194	0.25
L3 z	3.9	2.6	0.097	
L4 phi	3.9	2.0	0.012	0.014
L4 z	1.6	1.3	0.0076	
L5 phi	3.1	1.8	0.006	0.007
L5 z	1.9	1.3	0.0041	

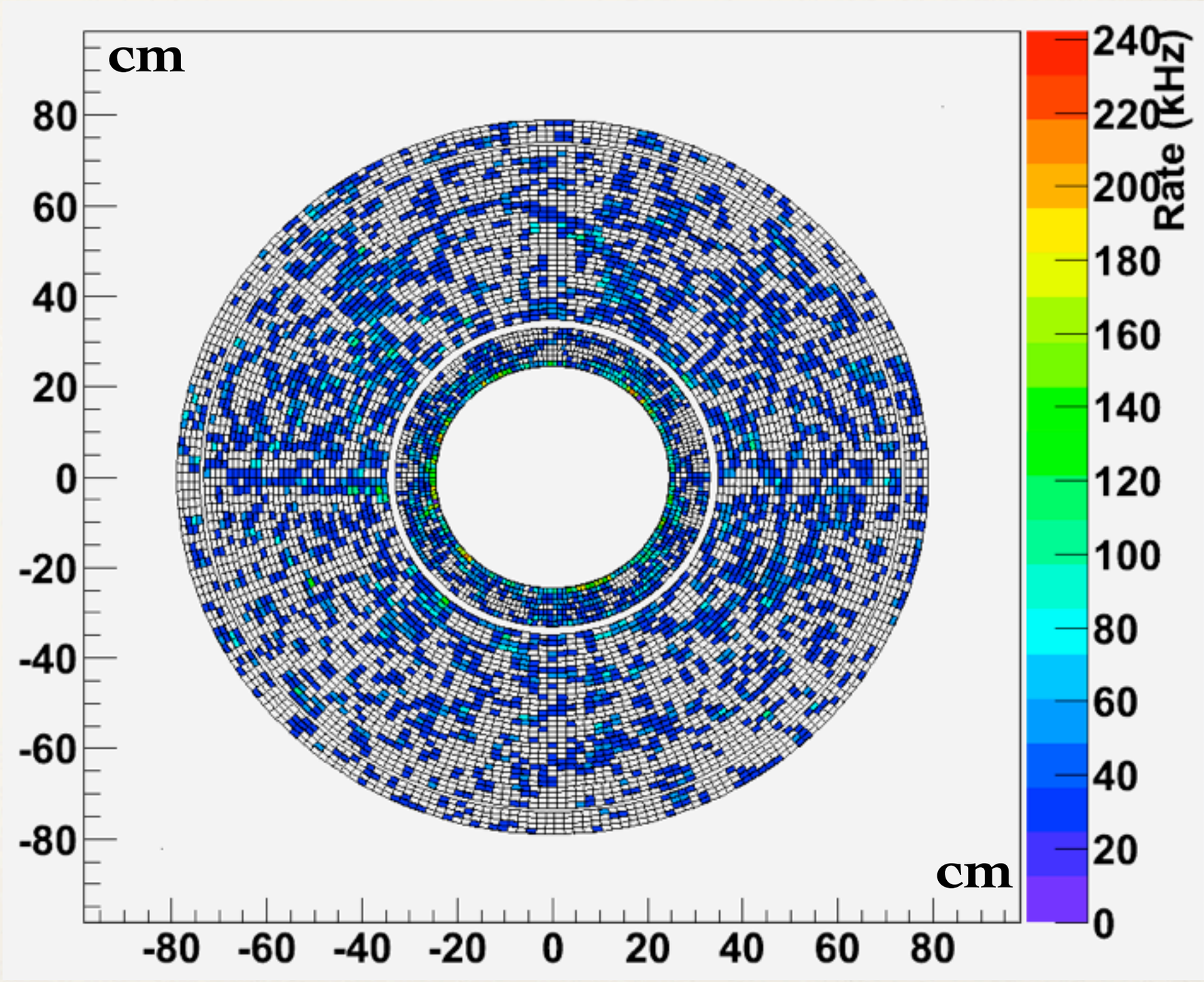
DCH: Occupancy

- Comparing only productions with 1mm step limit
- Occupancy back to Dec2010 value (but it was w/o 1mm step limit)
- Bug in simulation was fixed before this prodution
- Stereo contribution is now evident



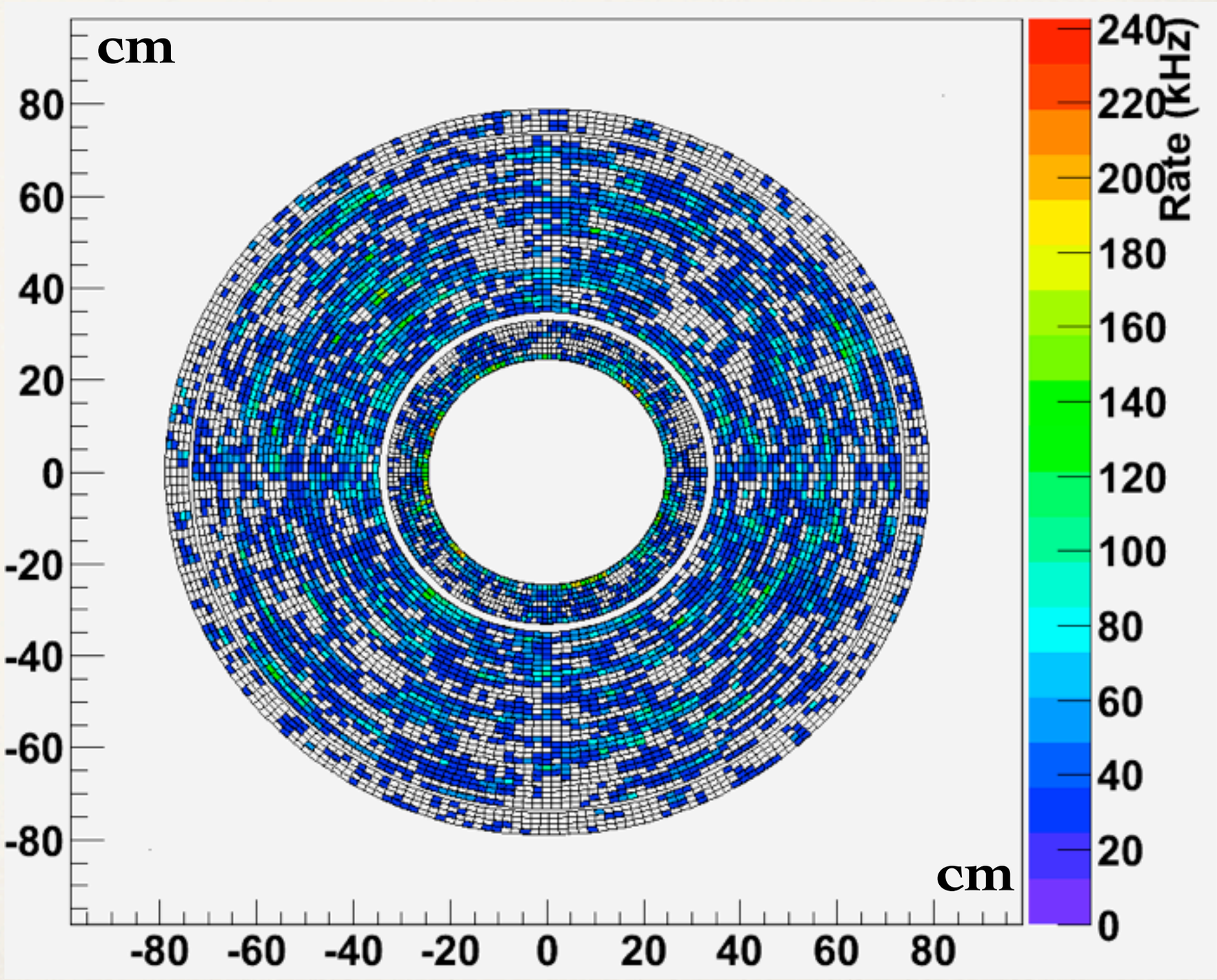
DCH: New map for cell rate

- Idea from Darren's plot
- Fill the map with rate for each cell
- Many cells are empty, low statistics:
- 10k evts = 38us
- A cell fired once during 38us = **26kHz**
- Most of the cell are fired only once in this sample
- Higher statistics needed to spot which ones are the hot areas



DCH: New map for cell rate (stereo)

- Stereo configuration
- For stereo layers also neighbor cells are fired, as expected
- Some green areas, higher rate due to overlapping
- Again, more useful having higher statistics



DCH: First look at disappeared photons

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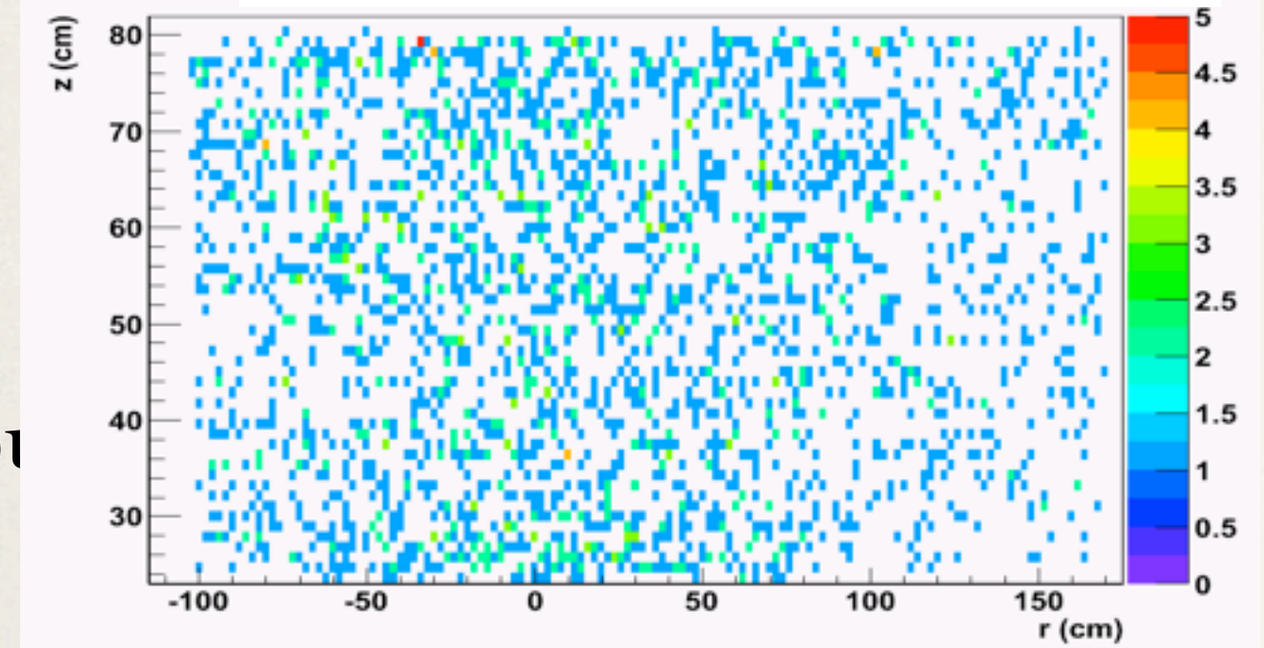
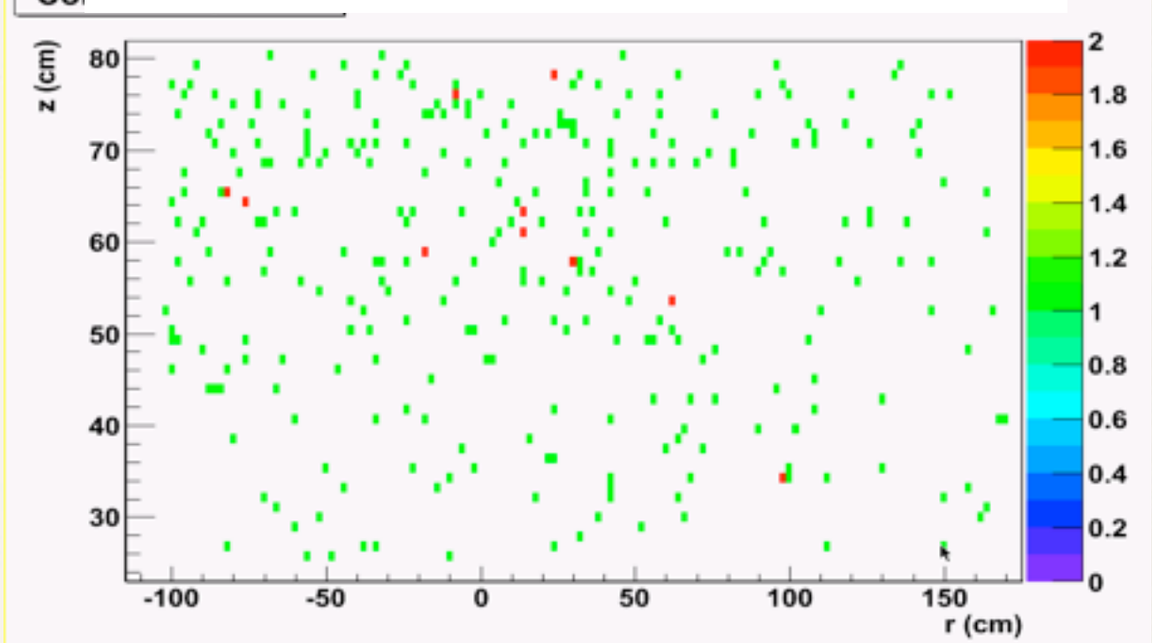
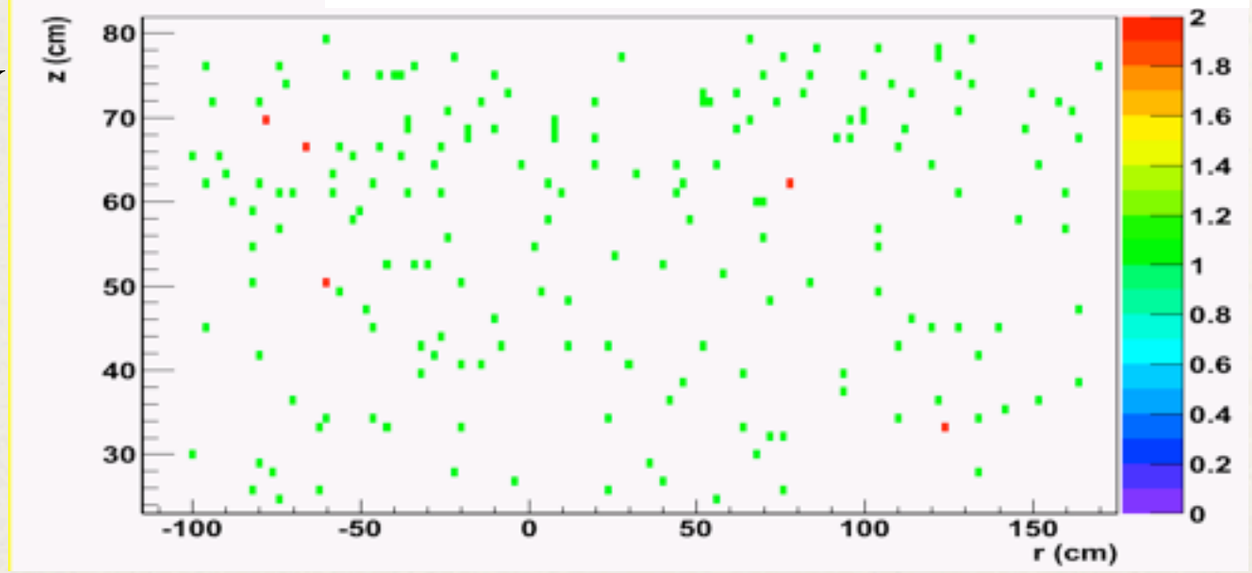
100 keV, 1M evts, 0.25%



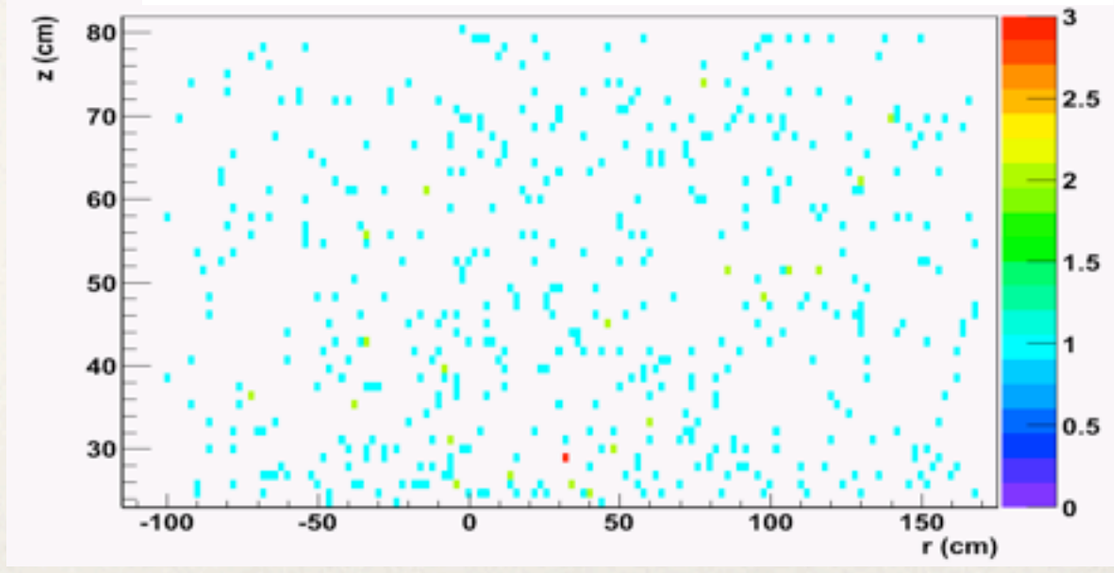
500 keV, 1M evts, 0.03%



2 MeV, 1M evts, 0.02%



10 MeV, 1M evts, 0.05%



ETD: radiation dose in the electronics

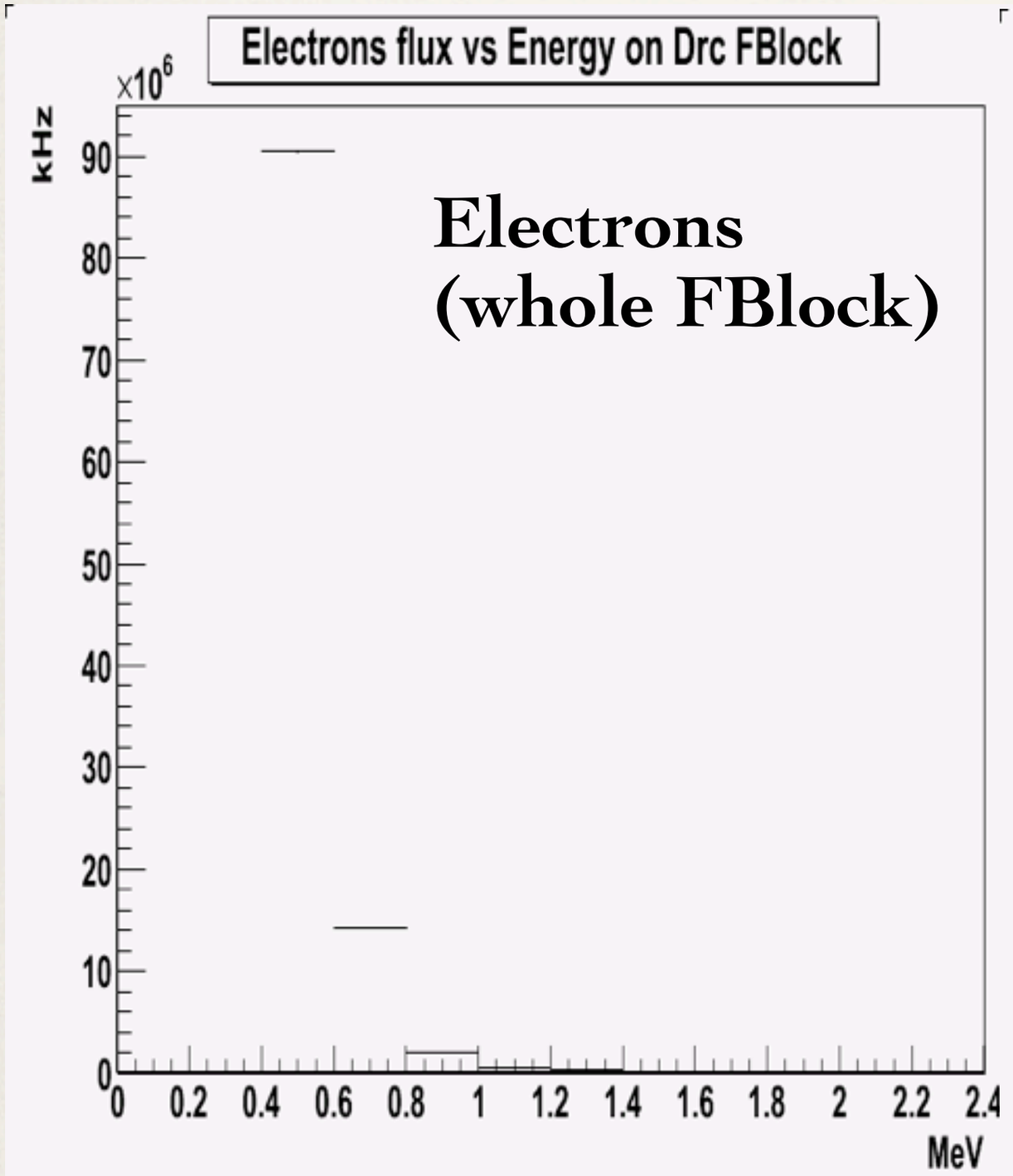
- Svt L0 electronic dose: 319 -> 346 krad (2photon) 72->85 krad (RadBhabha)

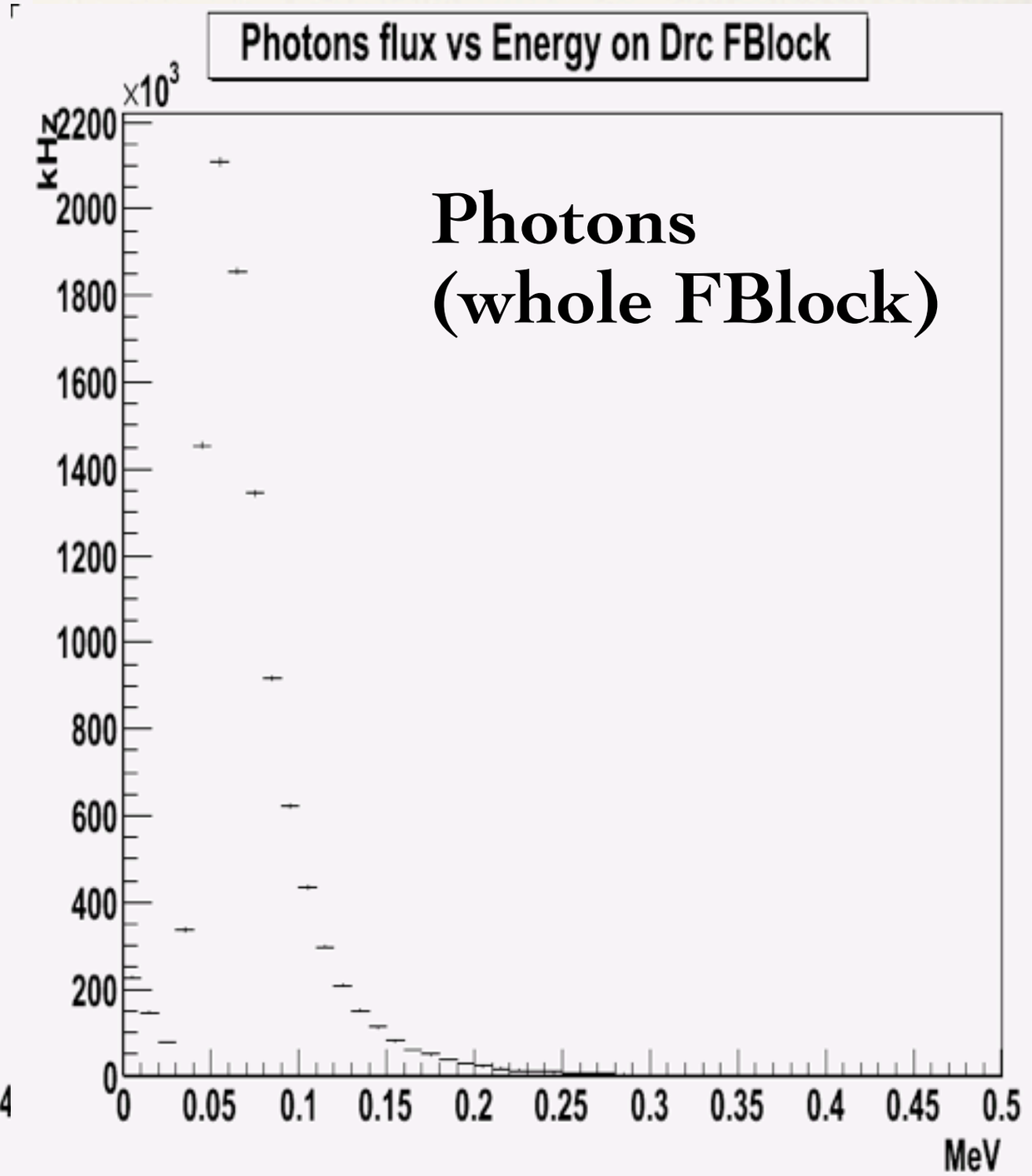
- Dch electronic dose: ~1 krad for each plate

- SVT and SOB fluxes: start providing flux distribution vs energy for SEE estimation

  - SOB: (RadBhabha) only electron and photons (100GHz on the whole volume), one or two event for protons and nuclear fragments

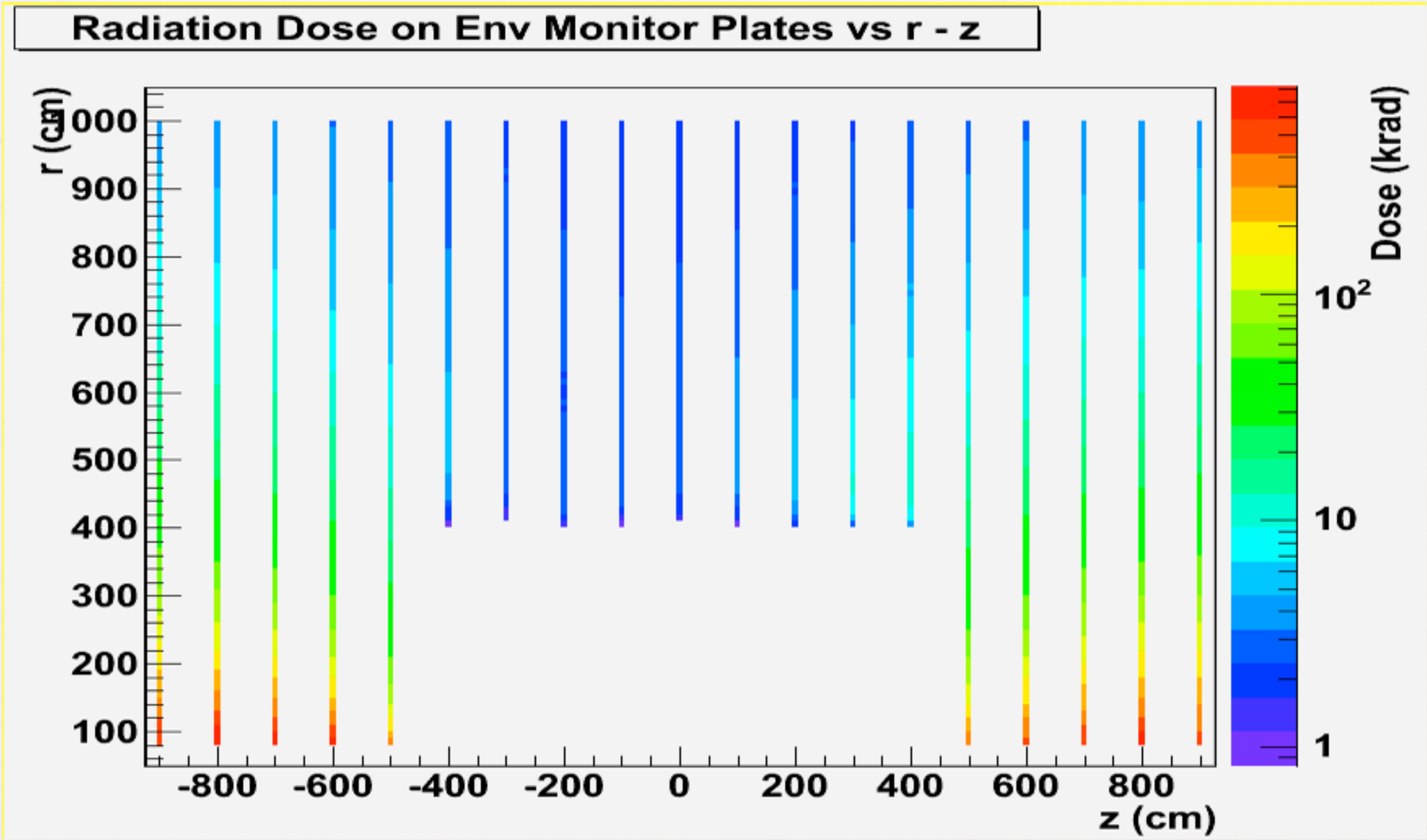
ETD: radiation dose in the electronics





ETD: radiation dose in the hall

- Hot areas only around beams



Conclusions

- SVT
  - Pixel rate, fluency and dose higher than previous estimation due to a bug in the sensitive volumes, factor 3-4
  - Rates and multiplicities estimation using real pitches and strips, slightly lower than Trieste results
- DCH
  - Occupancy has increased in the last production
  - New map of Dch rate, Study of photon disappearing rate has been started
- DRC
- ETD: hot areas only around the beams

Tentative list of things to do...

- Need first version of packaged Bruno with all the changes from last revisions, to be validated against the last production
- Merging Bruno hit classes and set naming rules
- Unified application to get default background plots?
- SVT:
  - remove cylindrical approximation. Add module information on simulation output and evaluate rates module by module
  - New L0 striplets geometry from Filippo B. to be implemented using gdml
- DCH: understand increase in occupancy
- ETD: add dummy silicon volumes around SOB to estimates radiation dose

Productions and other data

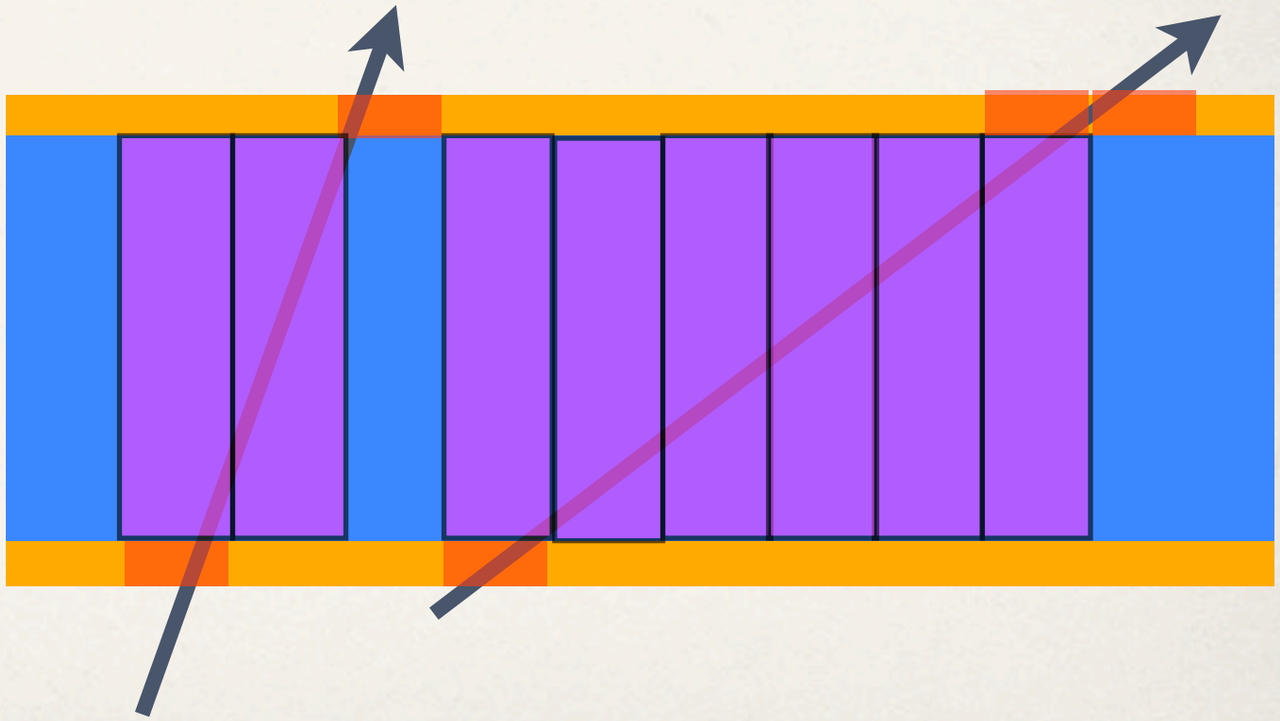
- New productions
  - RadBhabha, 20k evts, new final focus and magnetic configuration, 1mm step limit for Dch, full Truth Info
  - Issues when processing such a big ntuples, really slow, need to disable some minor features in my macro to run faster
  - Light version, 10k, no full Truth: much better...
- First look at the data, more plots in Elba talks

Bruno

- Long list of changes and fixes comparing to Frascati meeting (2 months ago)
  - Big memory leak when using TClonesArray (fixed by Eugenio)
  - After r430 the simulation is not running smoothly as before: hanging forever on some events, not only geometry dependent (same behavior using r465 with old geometry). More checks later, together with transition to packaged version...

A little bit of G4 geometry...

- L0 layer is 200um thick, made of **svtSilicon**
- L1-5 layers taken from Babar geometry: 366um thick, with only 300um sensitive/active, made of **svtActiveSilicon**, with two 33um layer (below and above) made of **svtSilicon**
- In Bruno only svtSilicon material was sensitive (<r460), so in L1-5 only hit in the surrounding layer were recorded
- Effects:
  - 2 clusters per track instead of one
  - Lower pixel rate due to thickness
  - Volume estimated larger than the real sensitive one, lower estimation of fluency and dose



Results L3-5

- Same values for L0
- Lower cluster rate, but higher pixel rate, fluency and dose for other layers

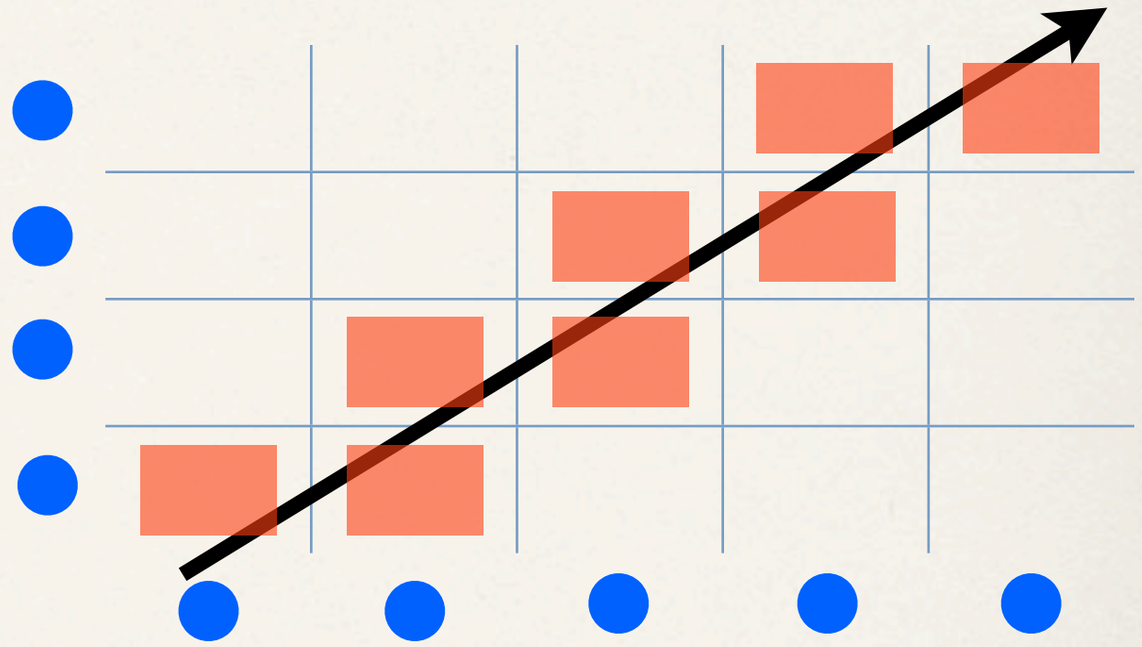
LAYER 3	Dec2010	May2011	
Cluster rate	67.2	37.6	kHz/cm2
Cluster multip	1.91	9.96	
Pixel rate	131	342	kHz/cm2
Fluency	7.95E+09	2.57E+10	cm-2
Dose	5	15	kRad

LAYER 4	Dec2010	May2011	
Cluster rate	7.2	5.8	kHz/cm2
Cluster multip	1.63	7.68	
Pixel rate	11.9	31.6	kHz/cm2
Fluency	5.90E+08	1.88E+09	cm-2
Dose	0.5	1.8	kRad

LAYER 5	Dec2010	May2011	
Cluster rate	3.8	3.4	kHz/cm2
Cluster multip	1.66	6.97	
Pixel rate	6.1	15.3	kHz/cm2
Fluency	2.18E+08	7.00E+08	cm-2
Dose	0.3	1.0	kRad

How we estimate the rate?

- Geant4 hits in each layer from the same track are merged into clusters
- A number of Svt pixels/strips is assigned to each cluster based on the size of the cluster in z and phi coordinates
- Factor is not sqrt(2) due to finiteness of pixels
- Svt pixels/strips are calculated using real z/Phi pitches, before was only 50x50um everywhere

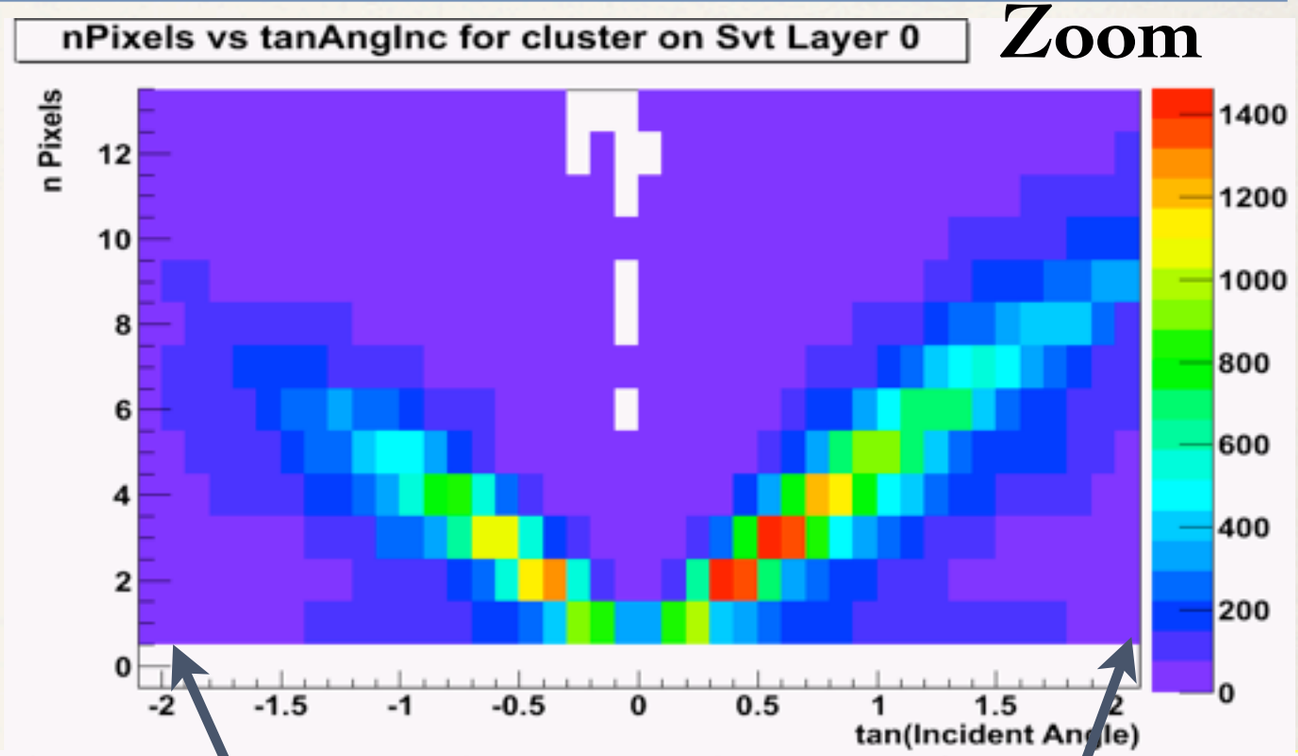


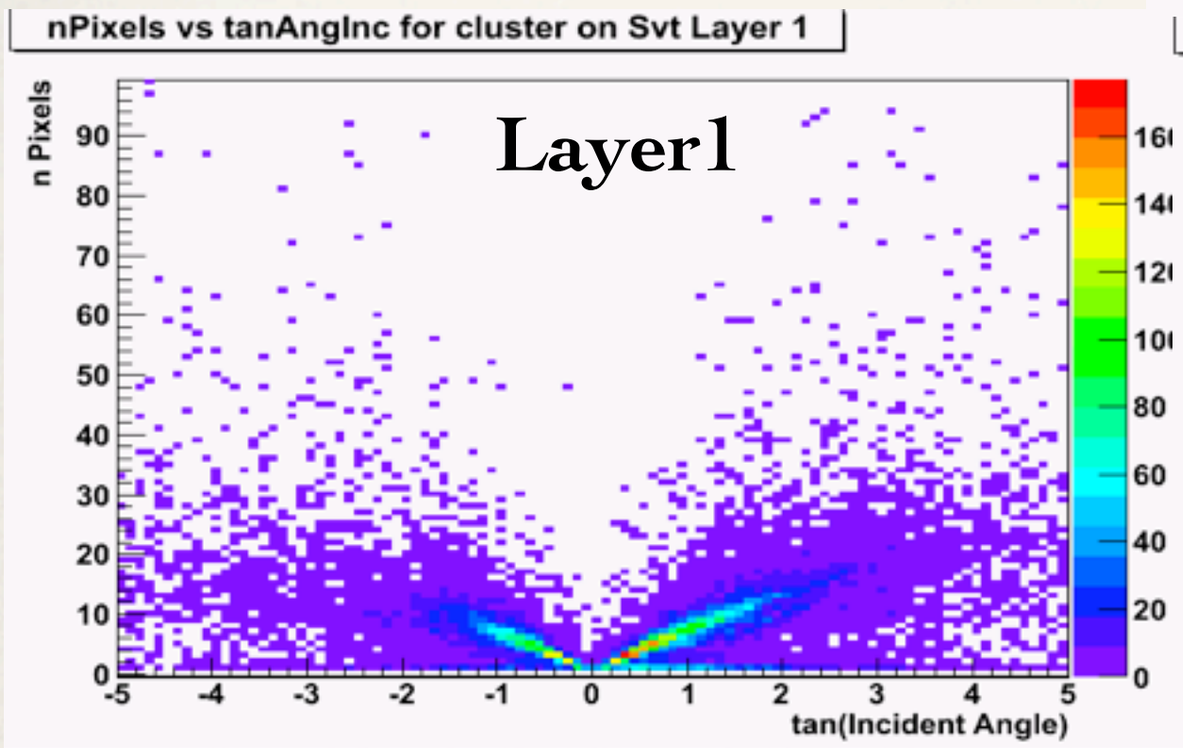
- **8 pixels**, but ***4+5 strip***
- Mean factor is (n+1)/2

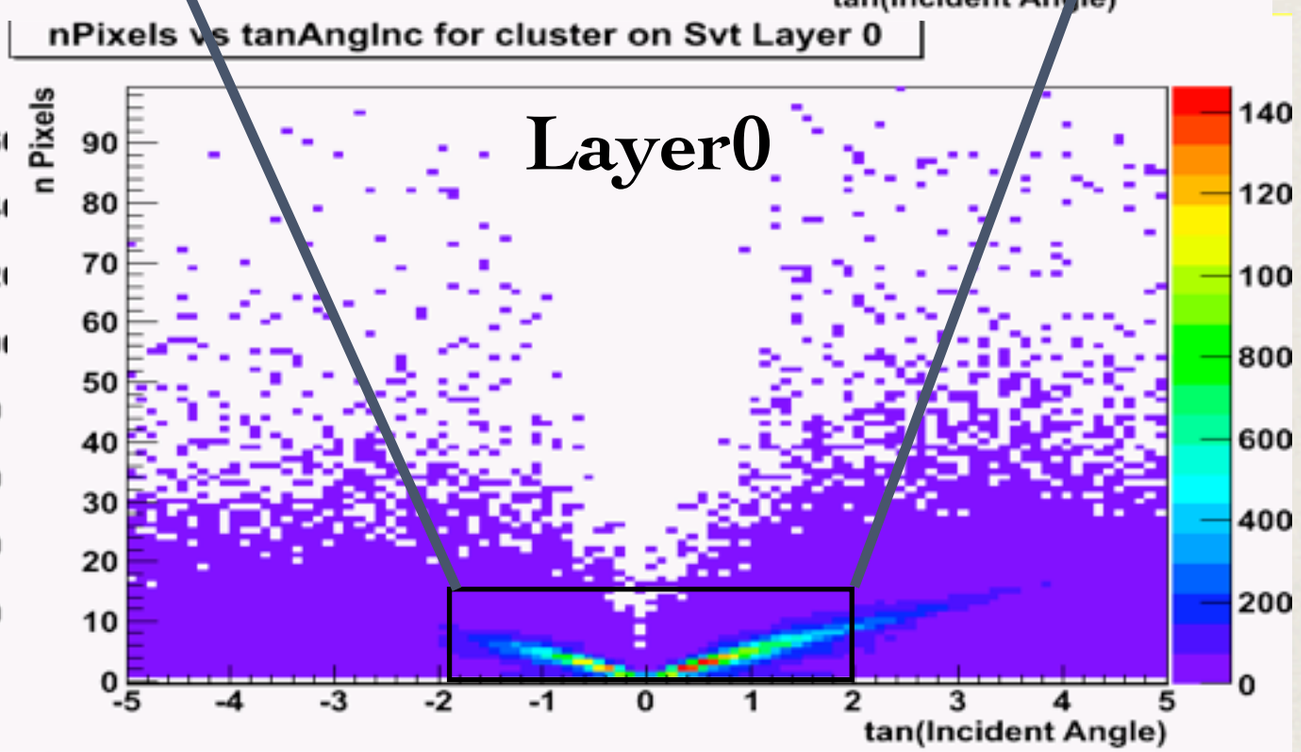
- Approximations:
  - No information on the position is considered, so two tracks crossing the same pixel or strip are counted twice. This includes daughter tracks are accounted as a cluster separate from the mother cluster
  - Areas and volumes are approximated with a cylinder of radius corresponding to the average radius of modules
  - Most of these approximations cannot be removed without consistent modifications, both in the simulation and analysis code

Check 1: # Pixels vs Angle [50x50um]

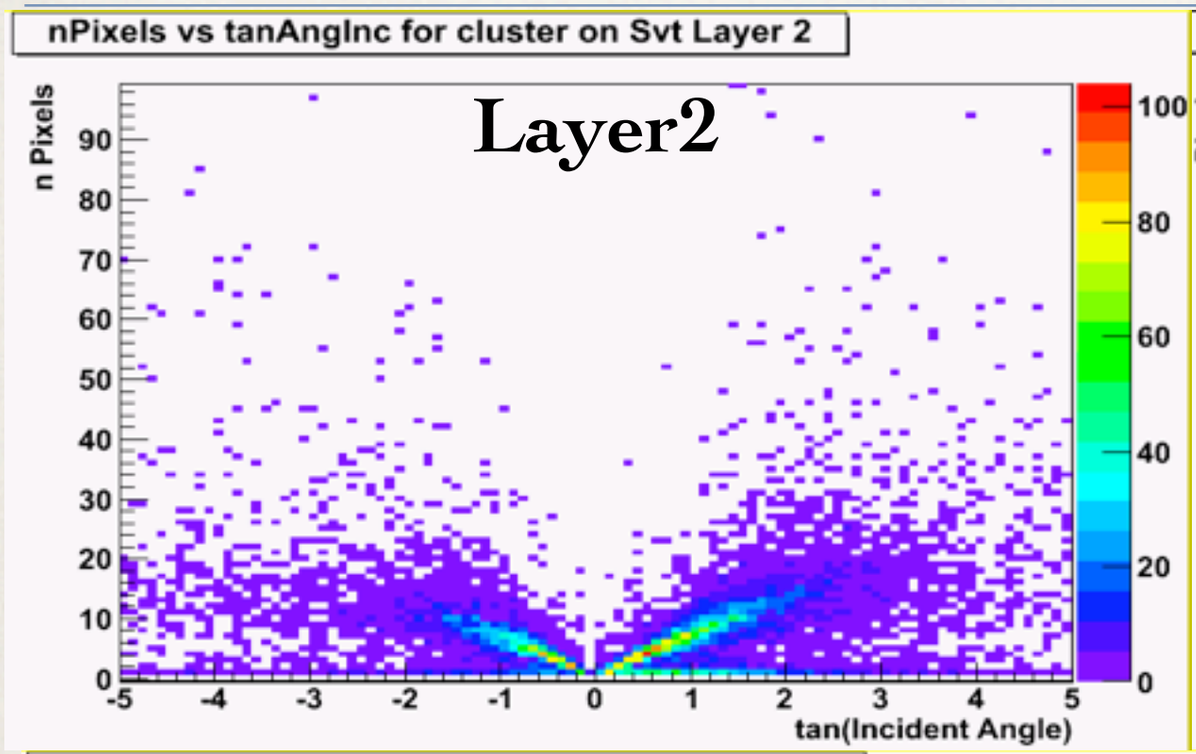
- Fired pixels vs tangent of incident angle, linear correlation
- One entry per cluster, negative values are for particle going inwards
- One pixel cluster at all angles (see also next slide)? probably low energy particles that stop inside the layer, from inside
- Approx: cylindric layer instead of modules
- L0 slope is lower, smaller thickness

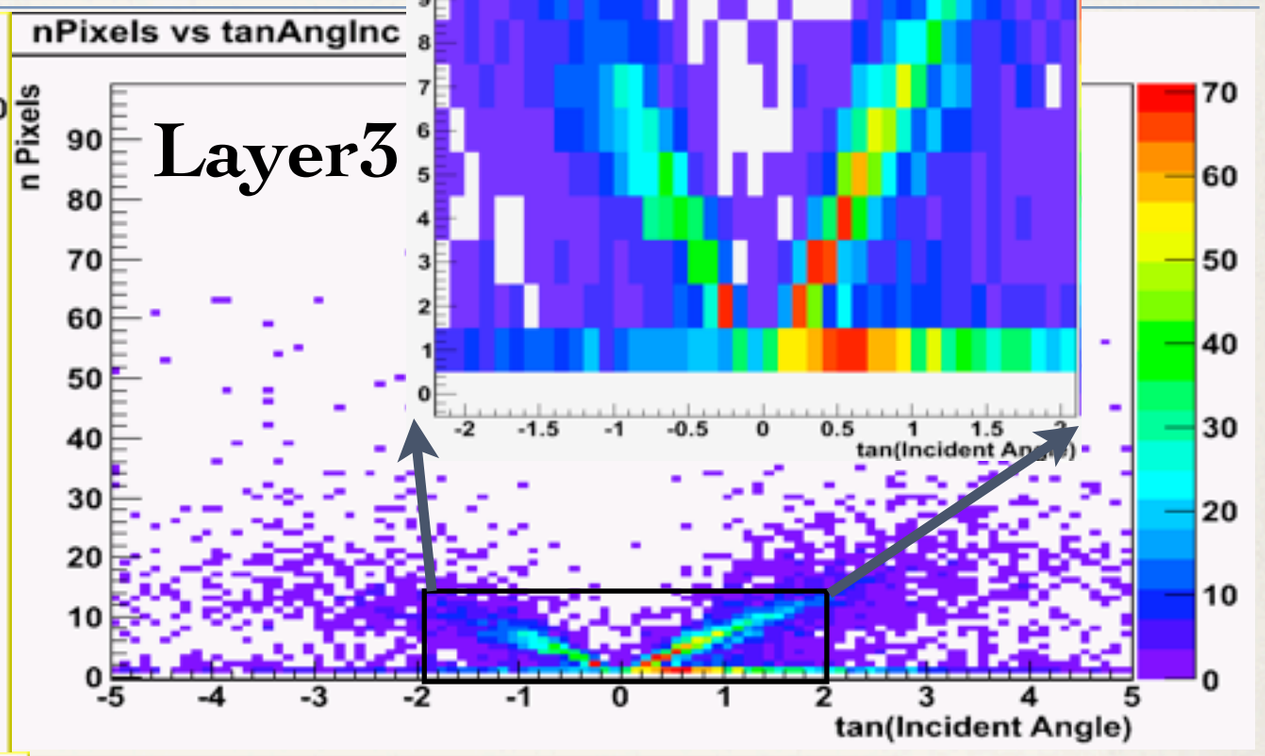


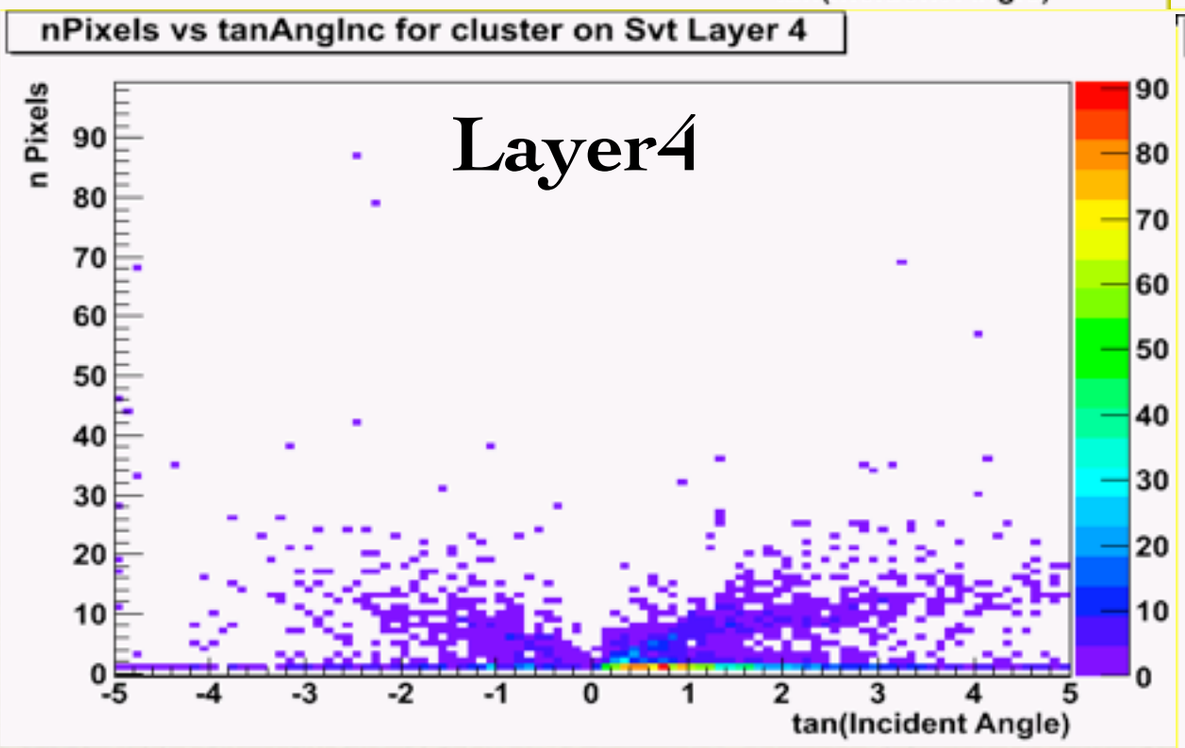


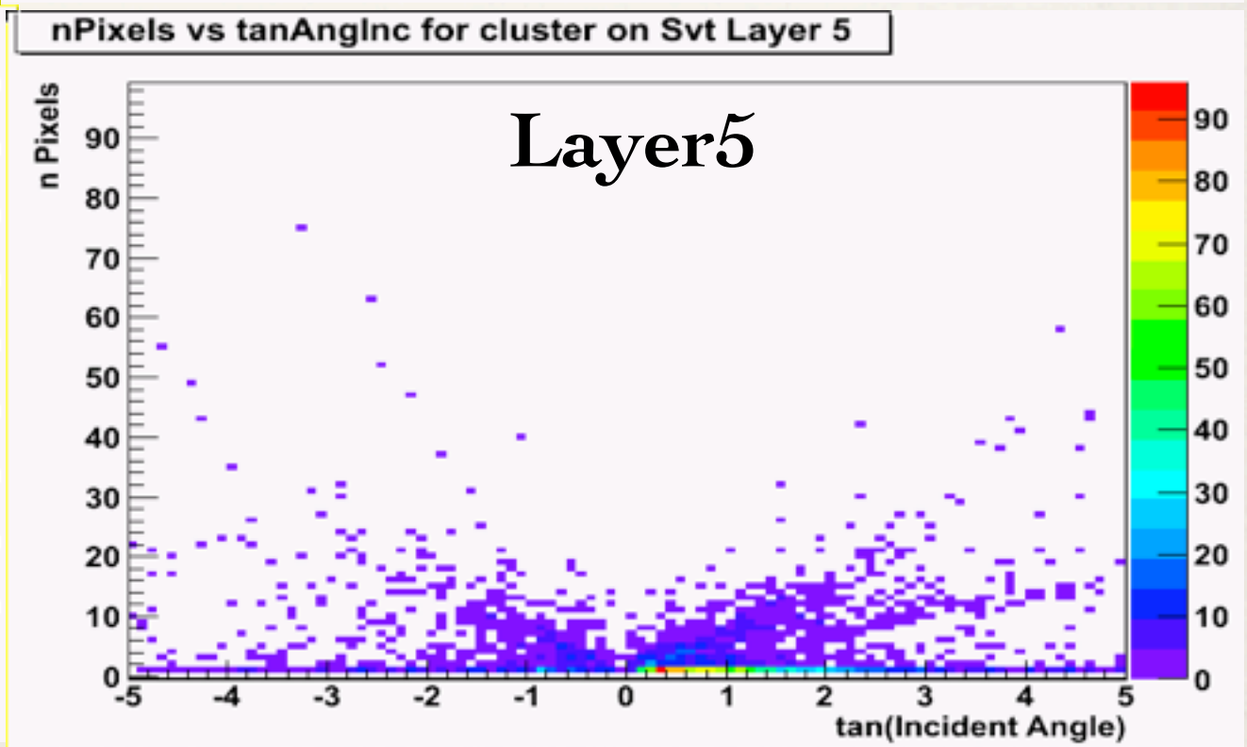


Check 1: # Pixels vs Angle [50x50um]

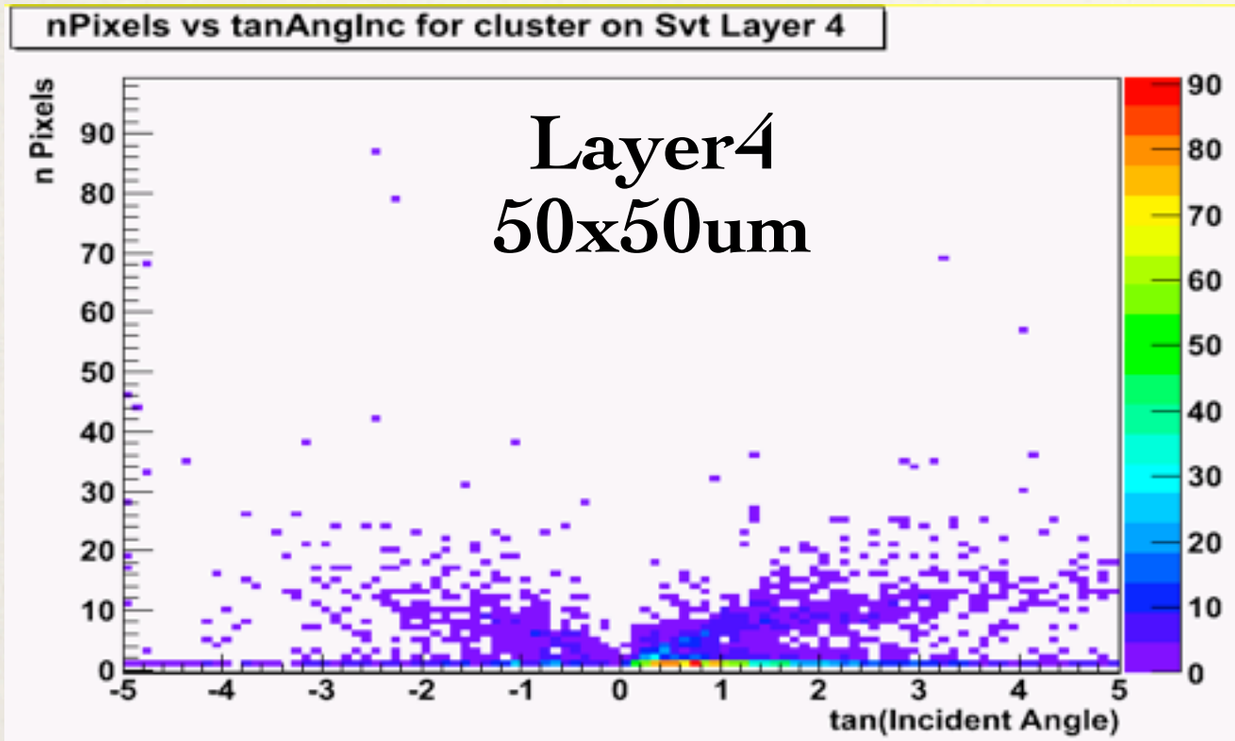


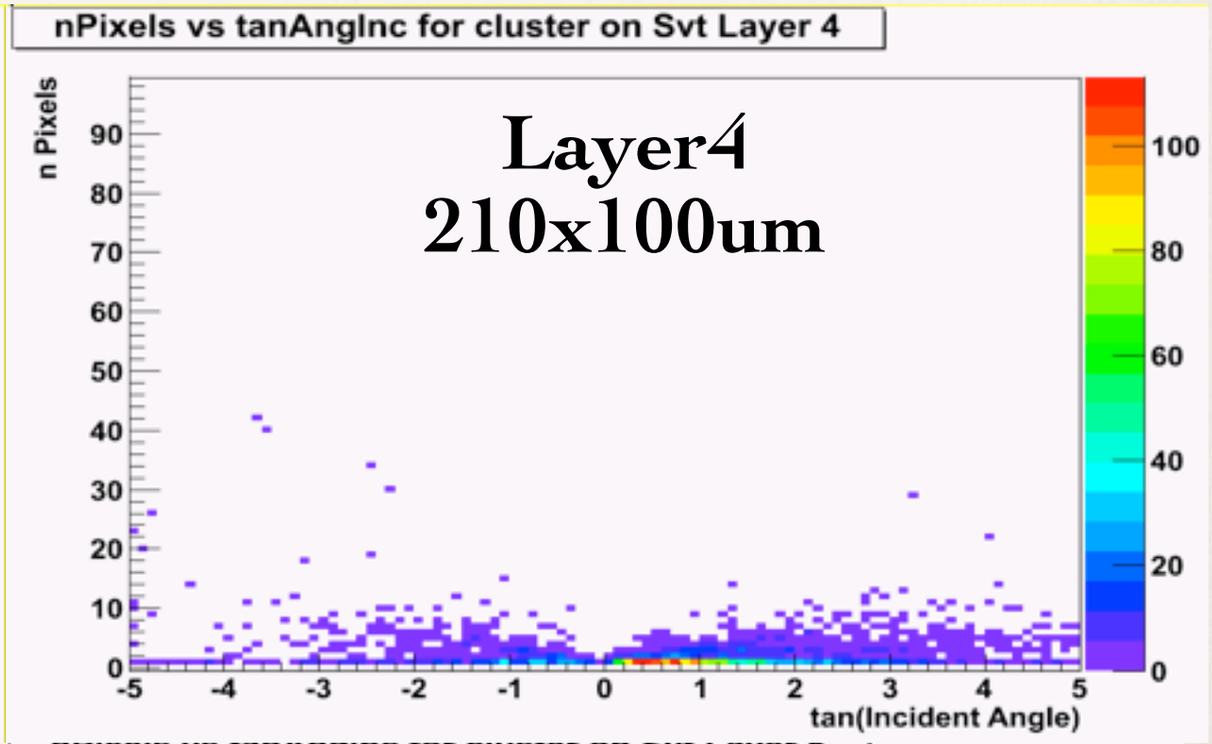


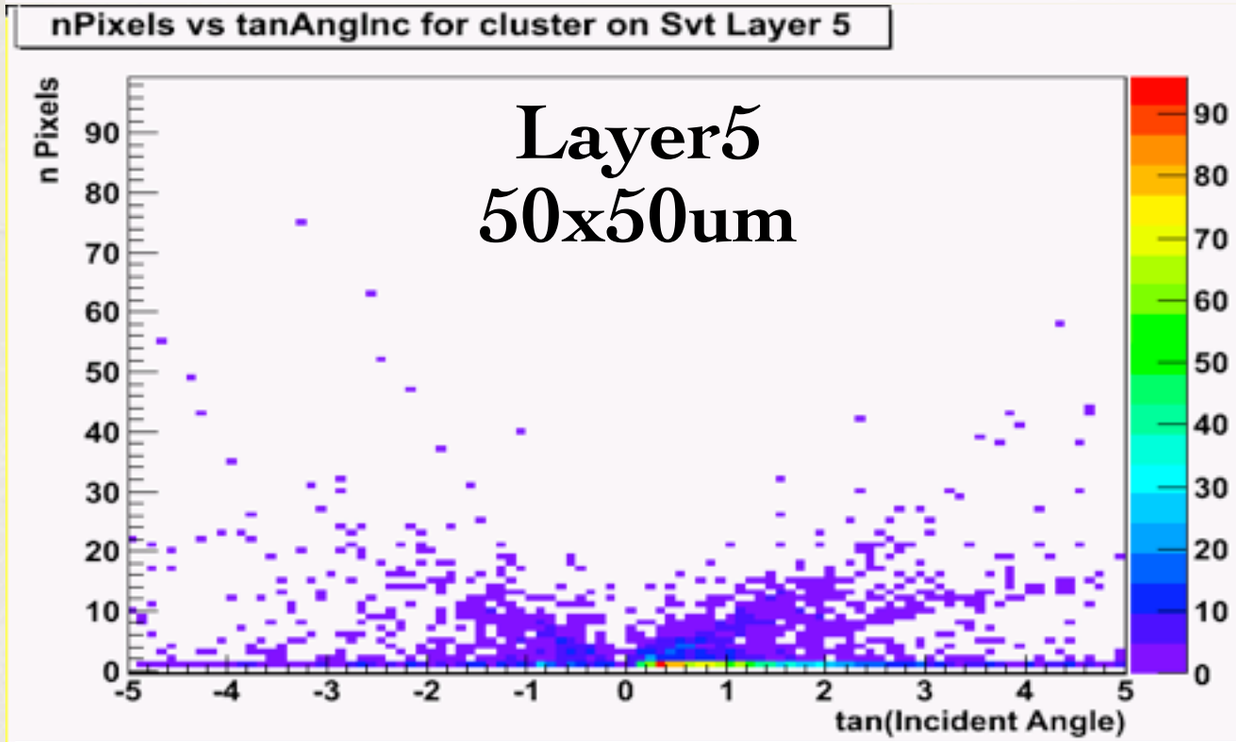


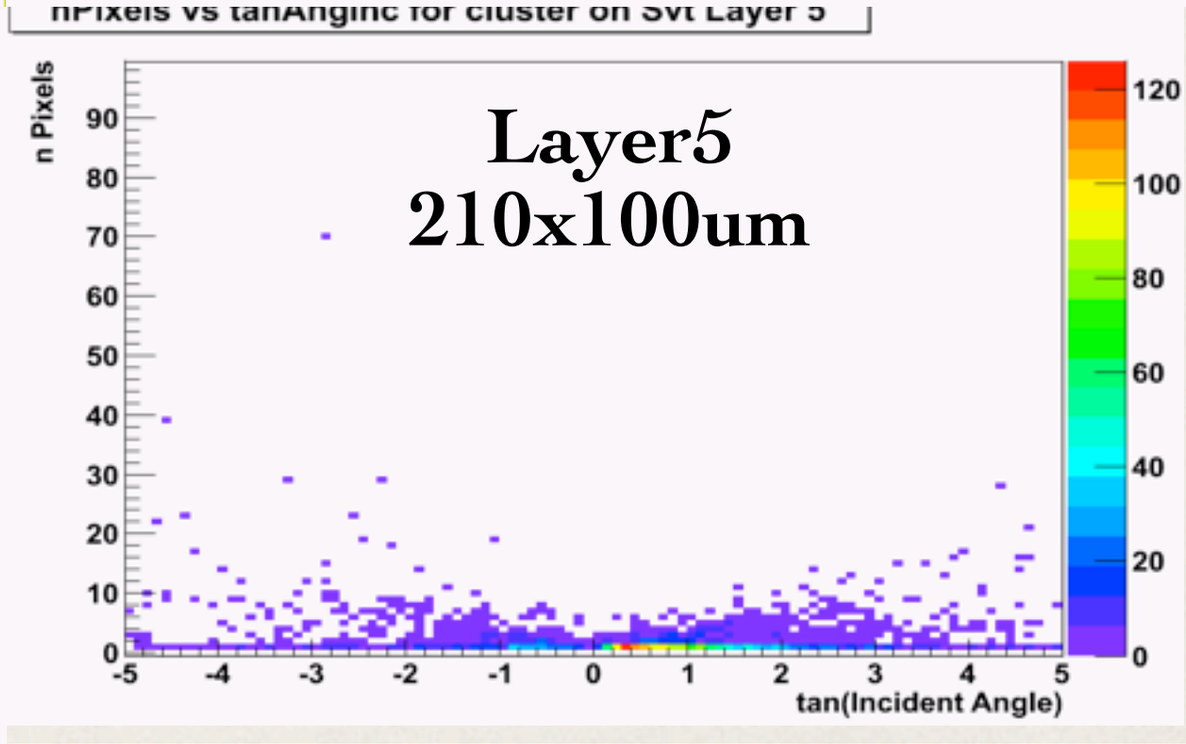


Check 1: # Pixels vs Angle [real pitches]



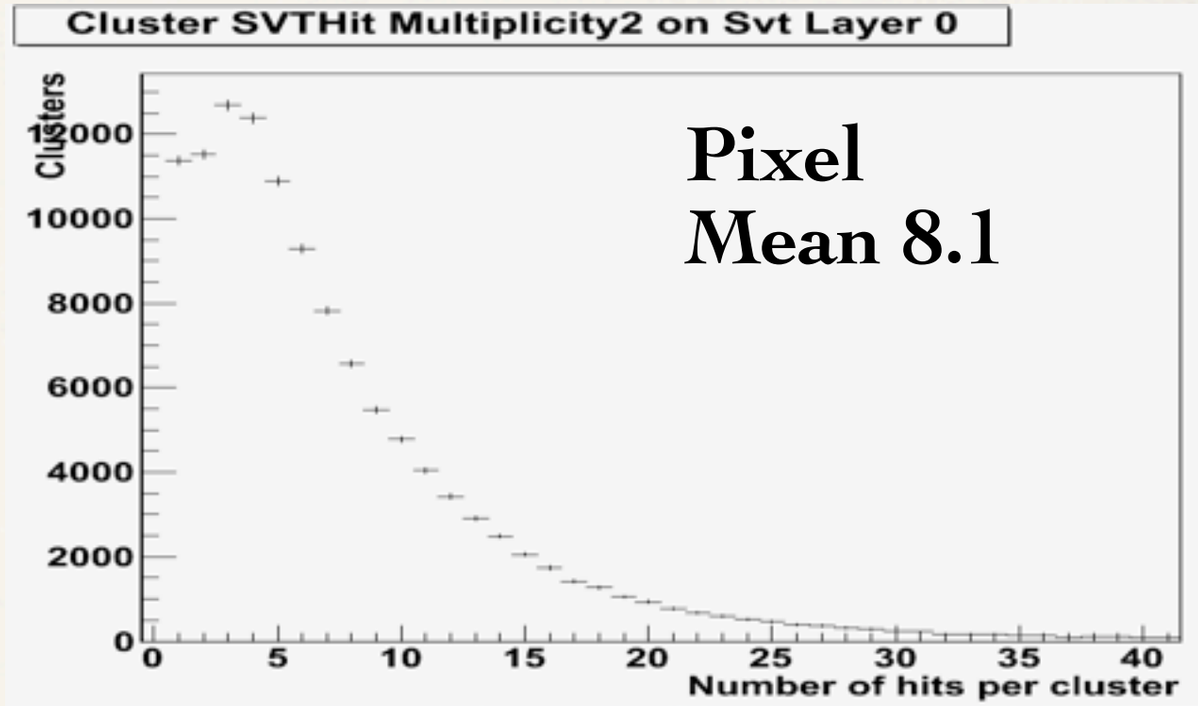


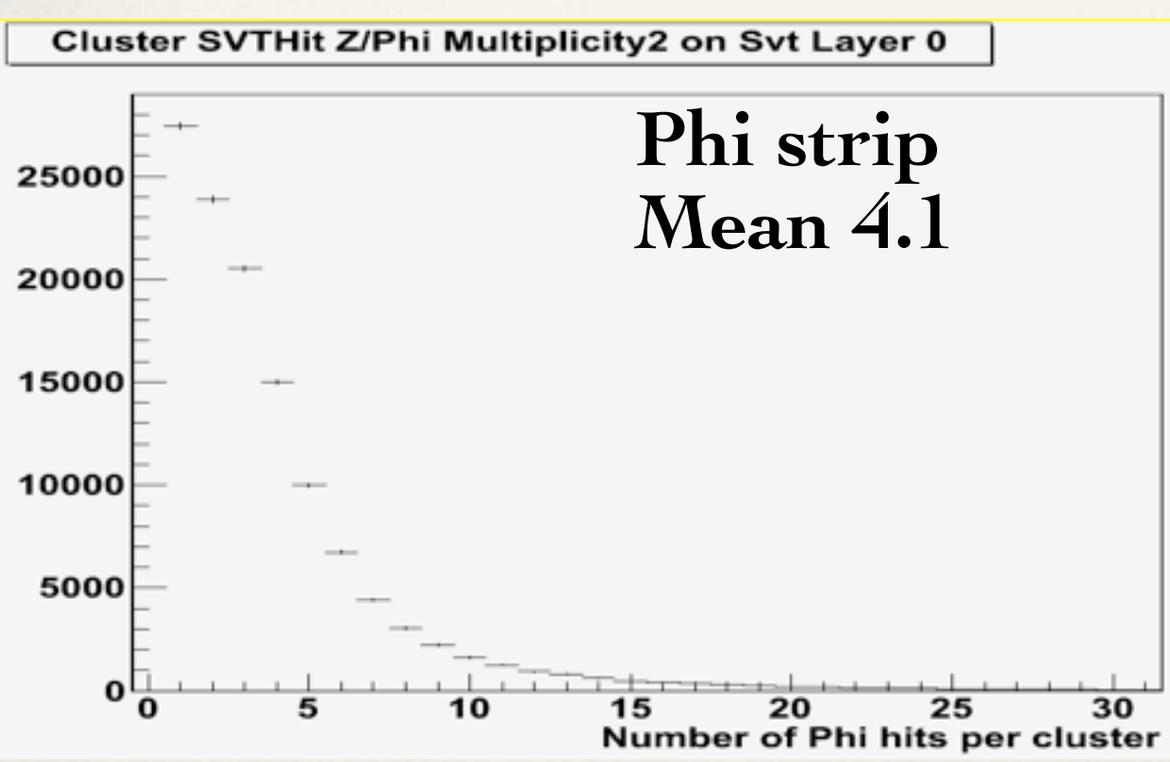


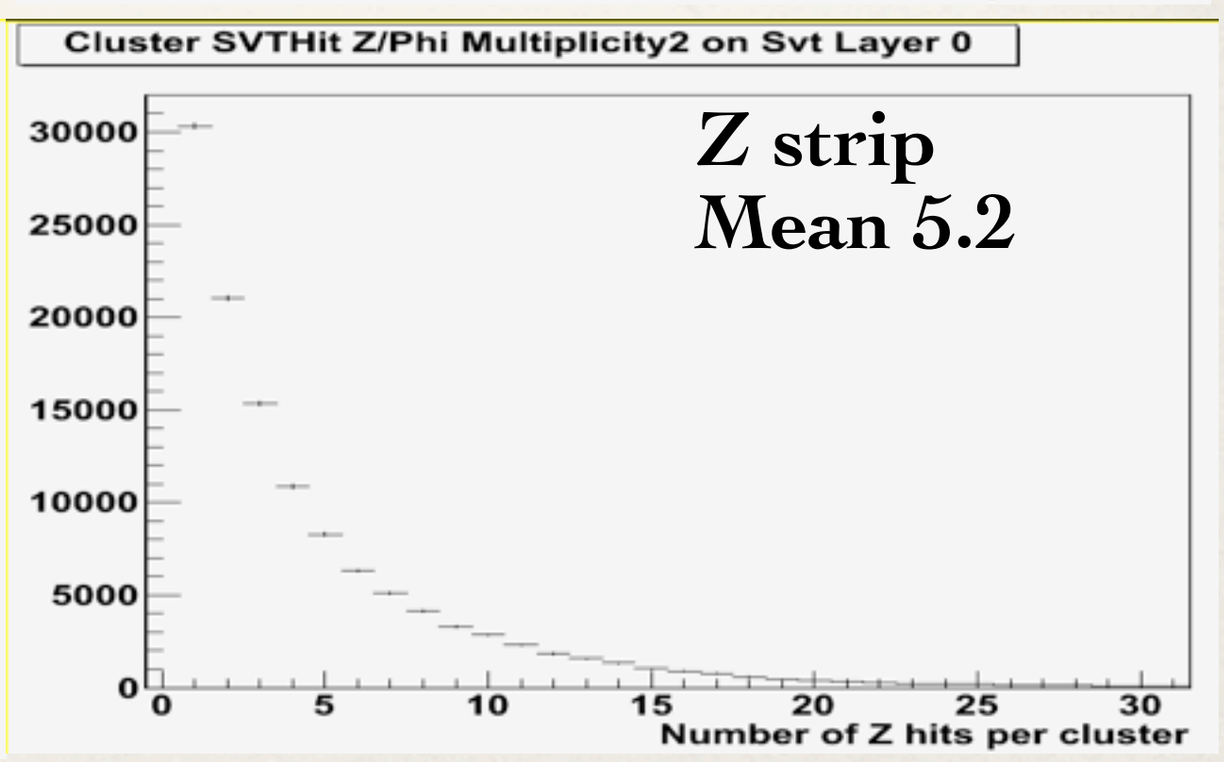


Layer0 multiplicities

- Same values for L0
- Lower cluster rate, but higher pixel rate, fluency and dose for other layers

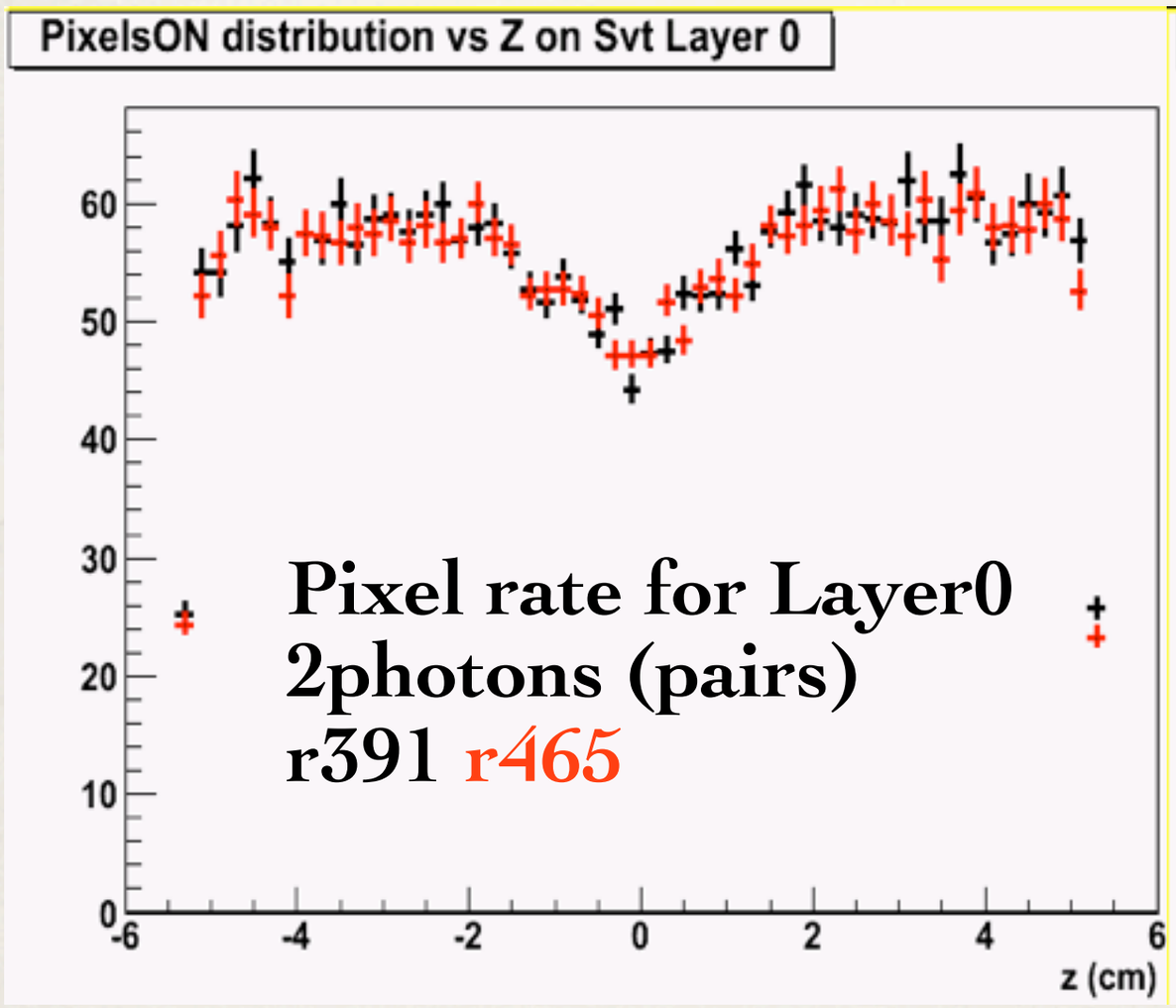


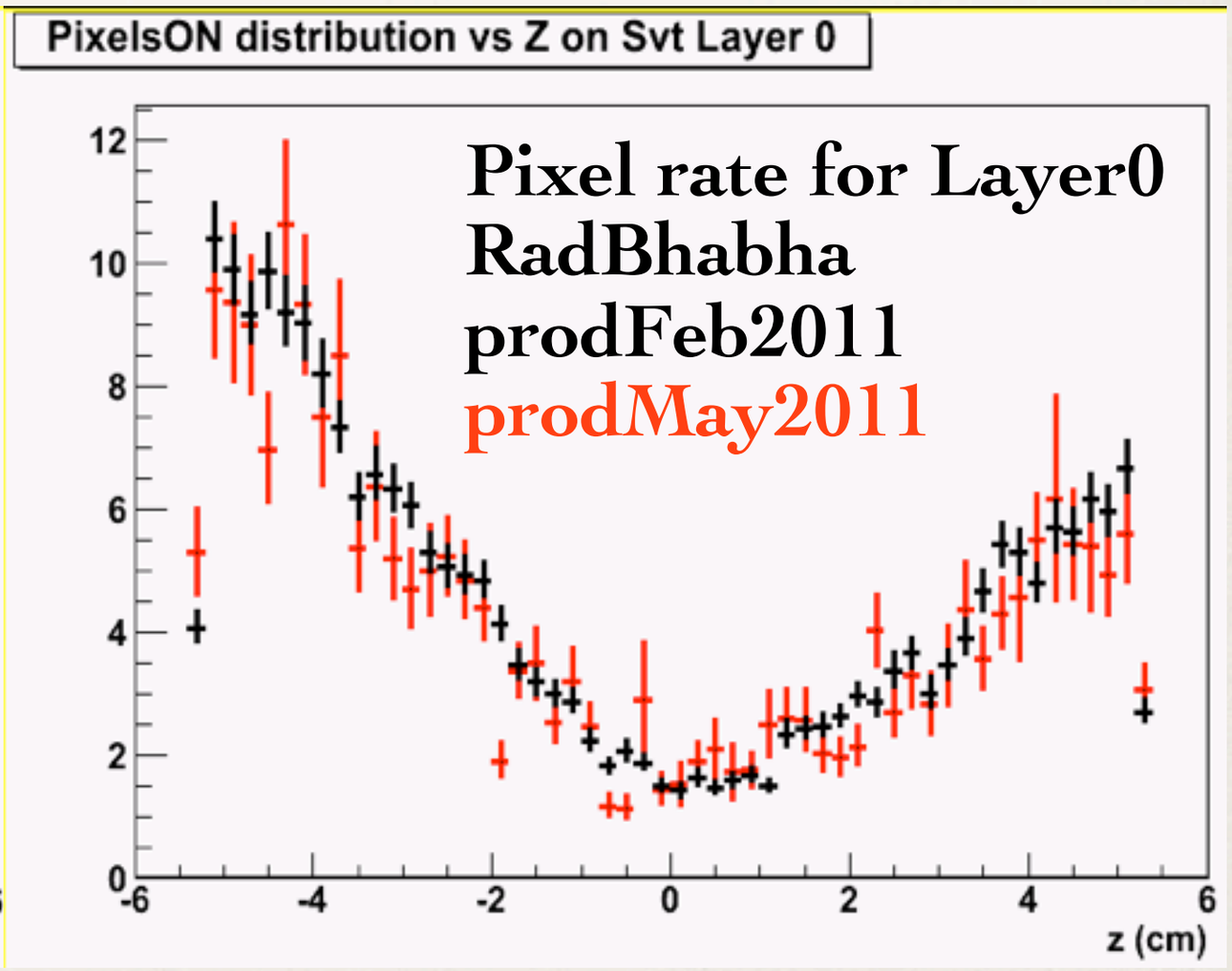




Svt Rates

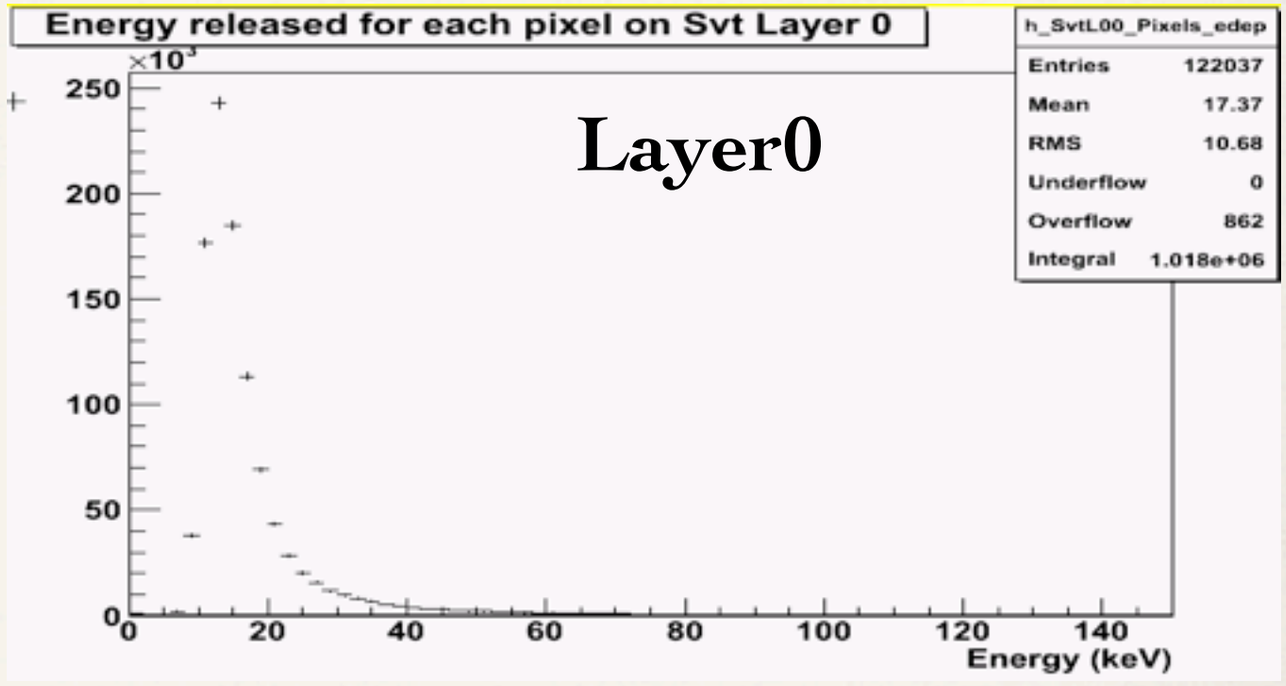
- Not able to run the simulation using last revision for 2photon bkg (pairs)
  - Old geometry (pre-CIPE, V12-SF10 + plug and horse-shoe) and r465
- No significative changes in general

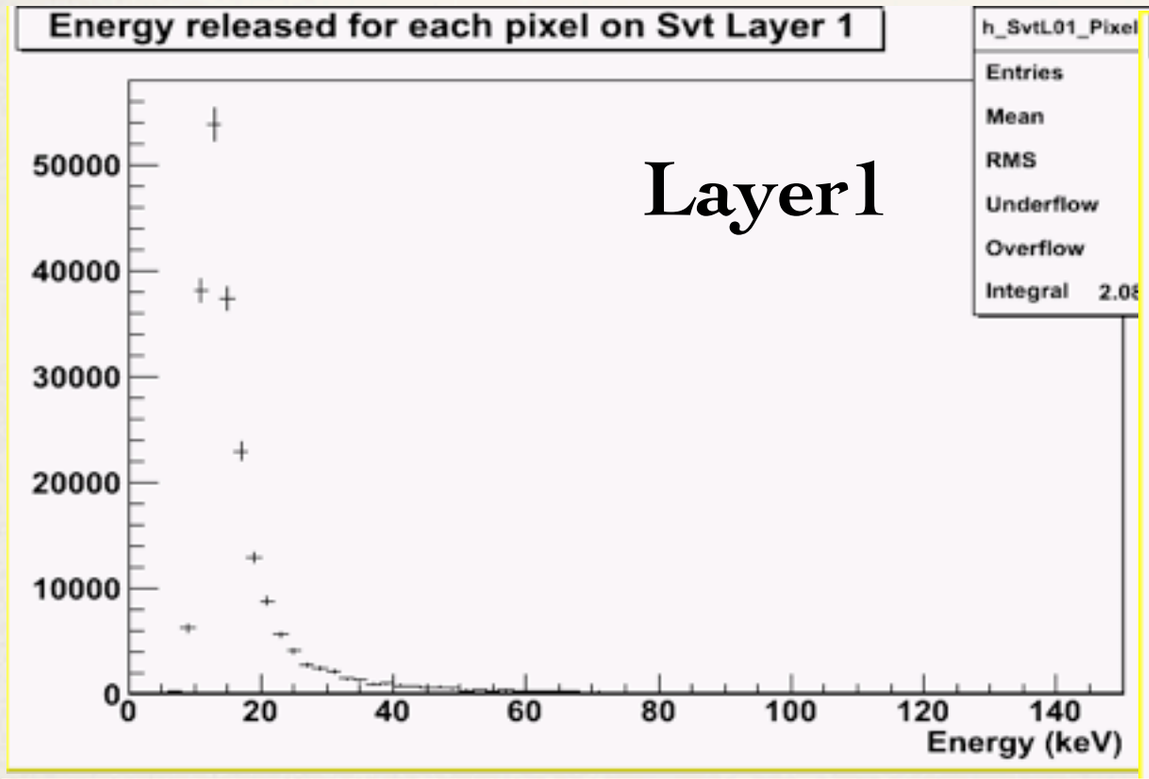


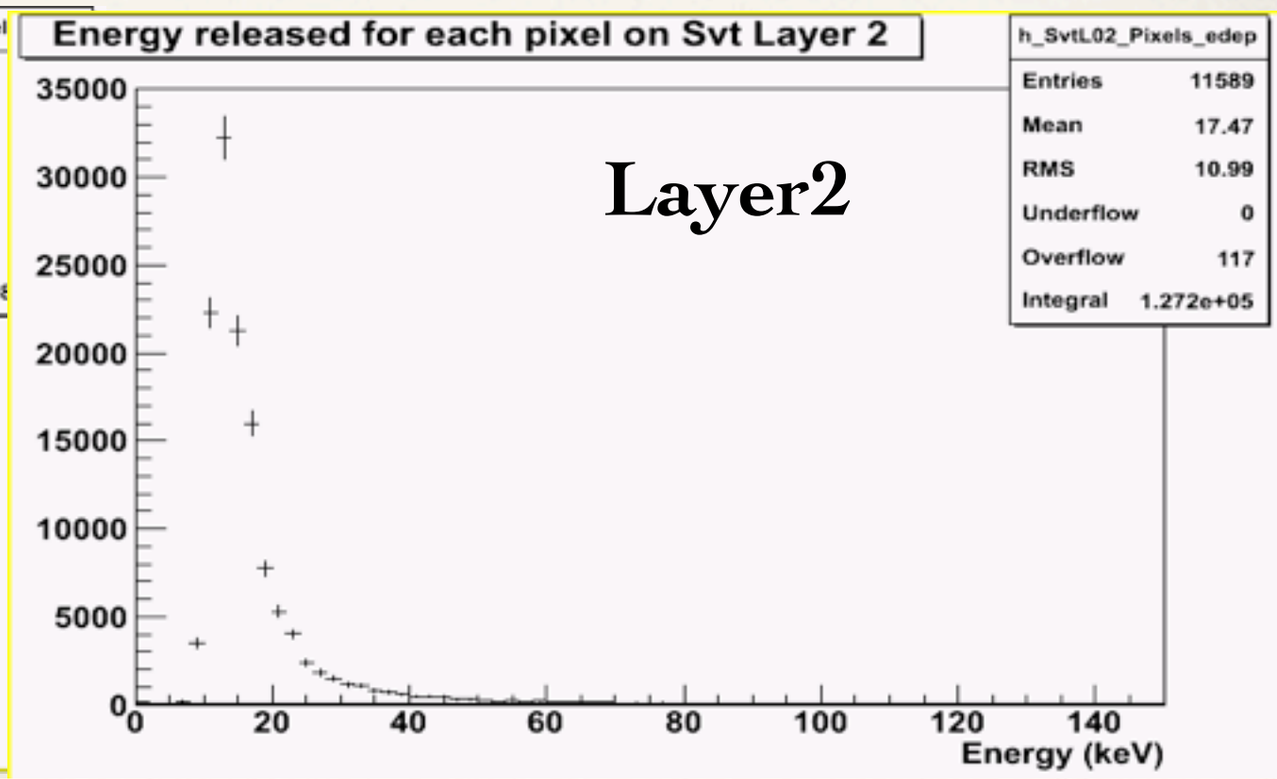


Check 2: Deposited energy per pixel

- Energy release in one pixel ($50x50um^2$)
- Approx: energy released by a cluster divided by the number of pixels
- MIP on 50um Si: ~15 keV
- MIP on 300um Si: ~90 keV
- Peak at 15 keV for inner layers

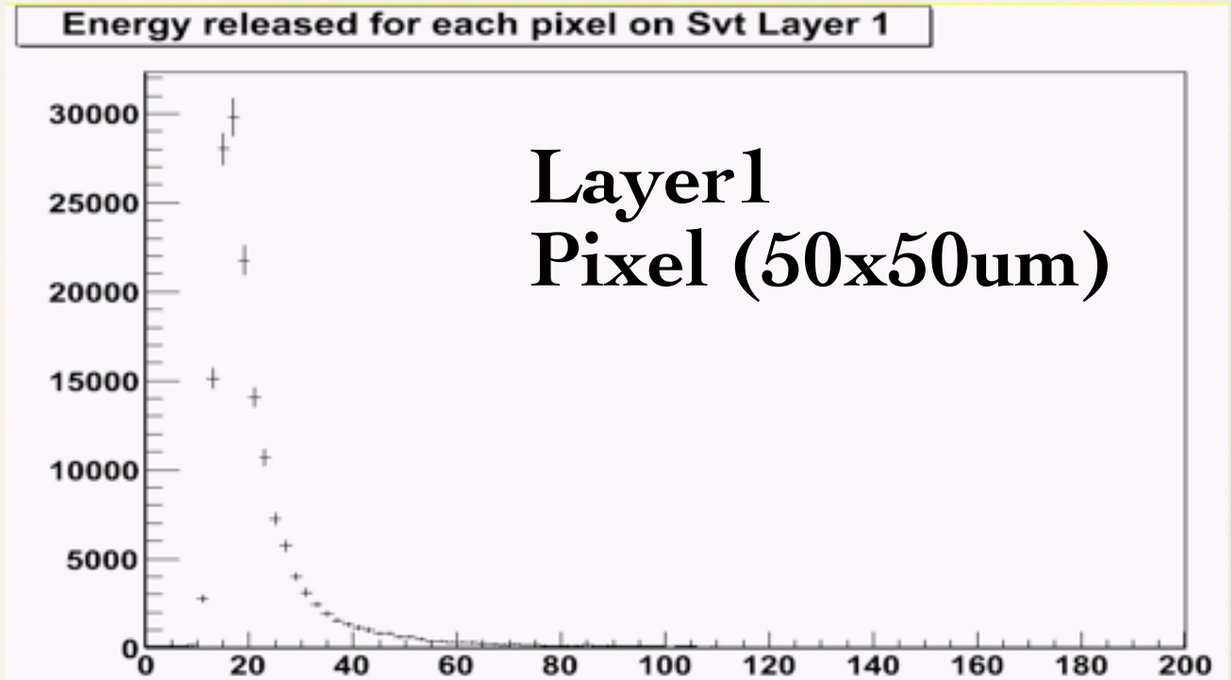


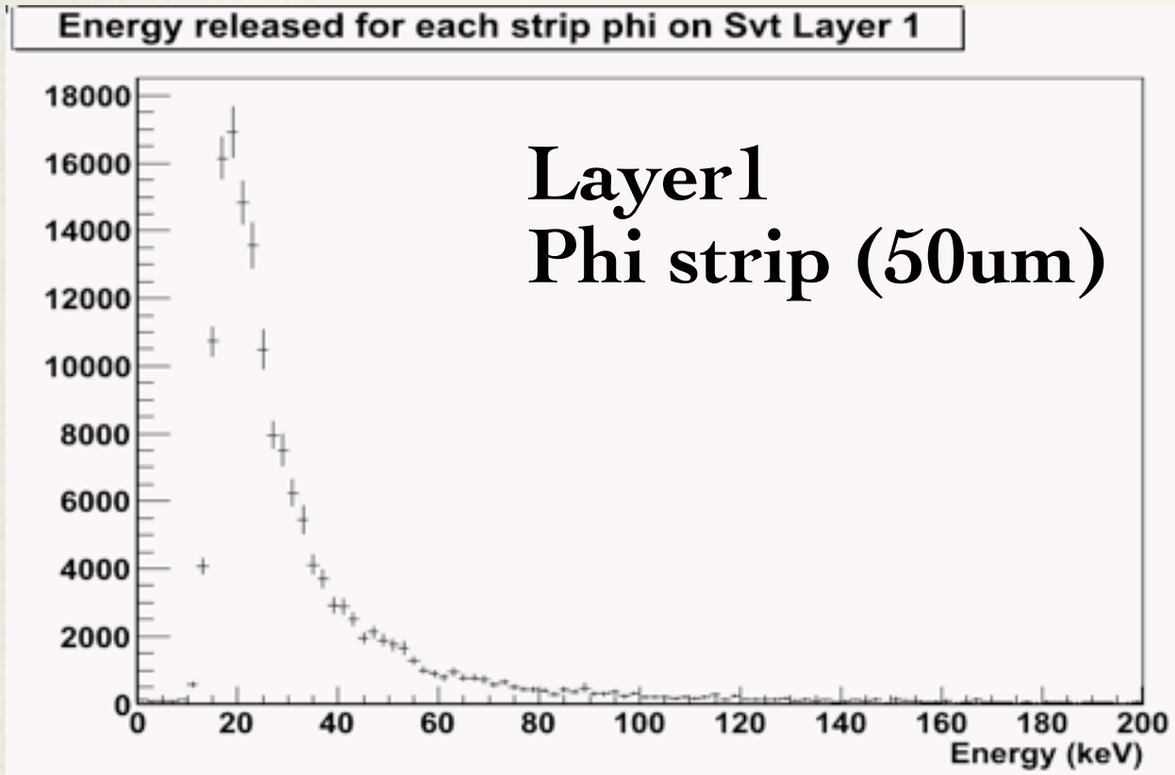


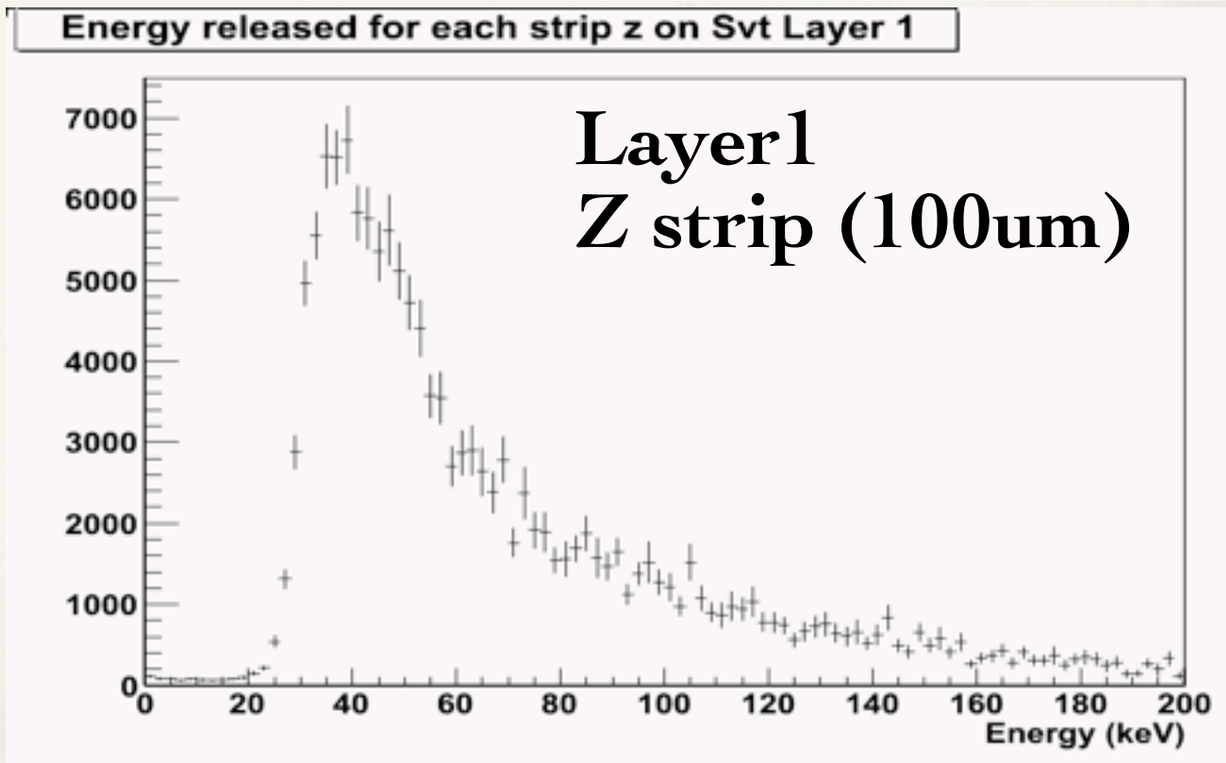


Check 3: Deposited energy per strip

- Approx: energy released by a cluster divided by the estimated number of pixel and strips (Z or Phi)

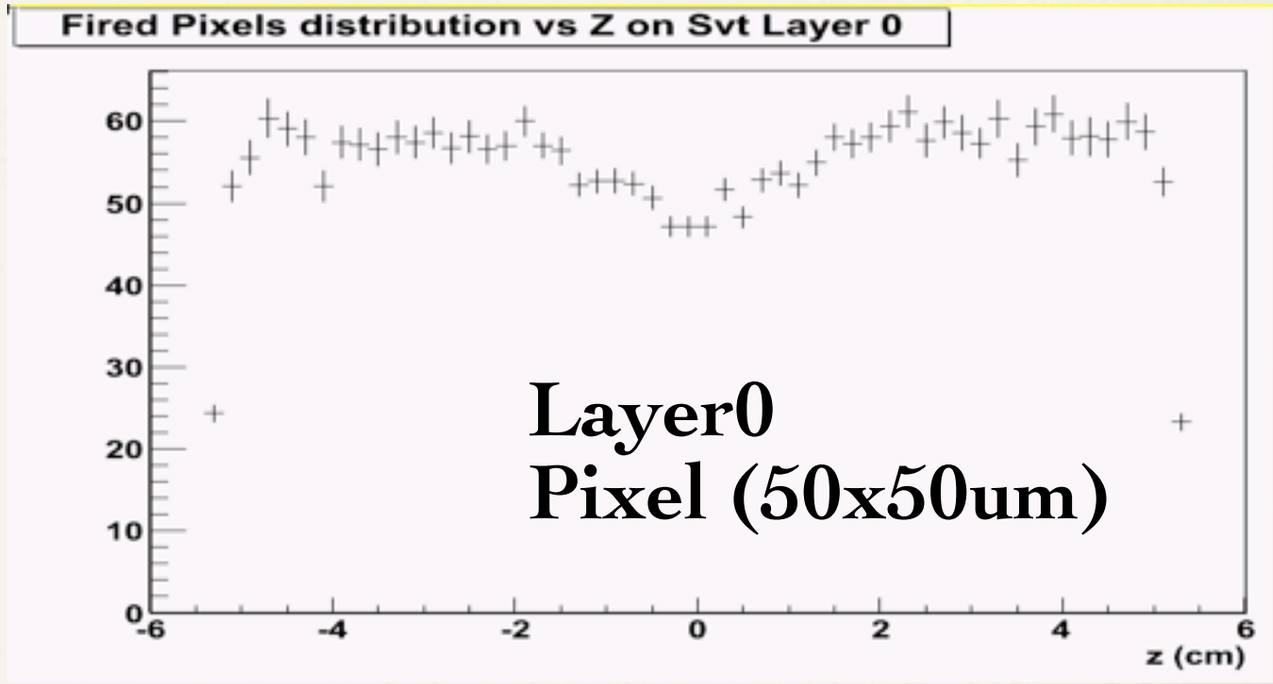


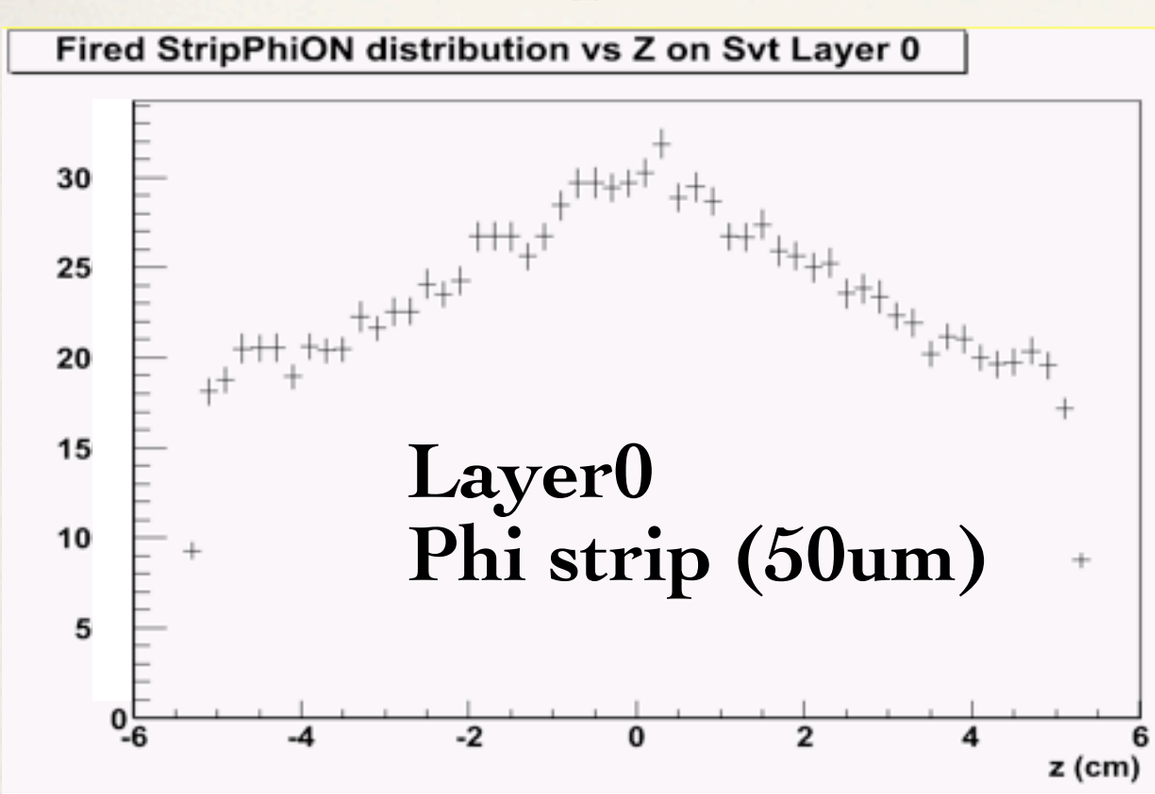


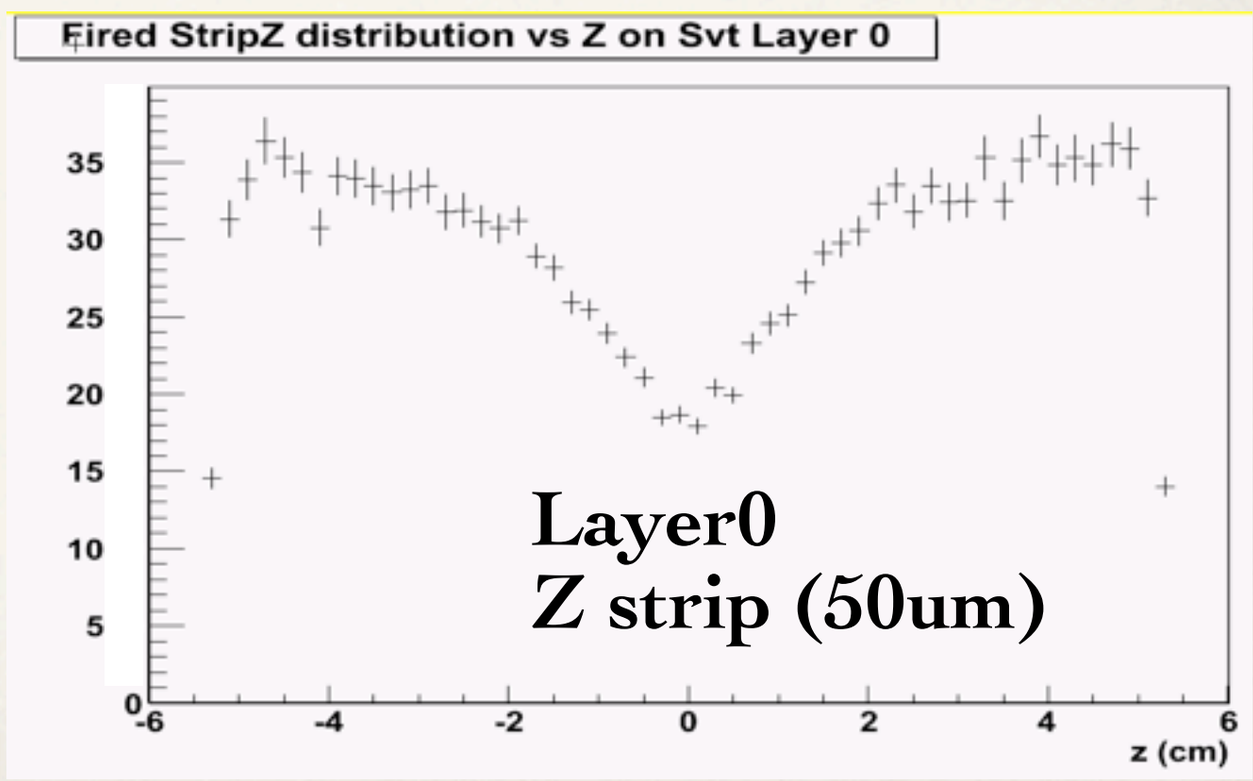


Layer0 rates

- Rates for pixel and strip
- Particles are from IP
  - Small angle, more z strips, less Phi strips
  - Large angle, more Phi strips, less z strips
- Factor is not sqrt(2)

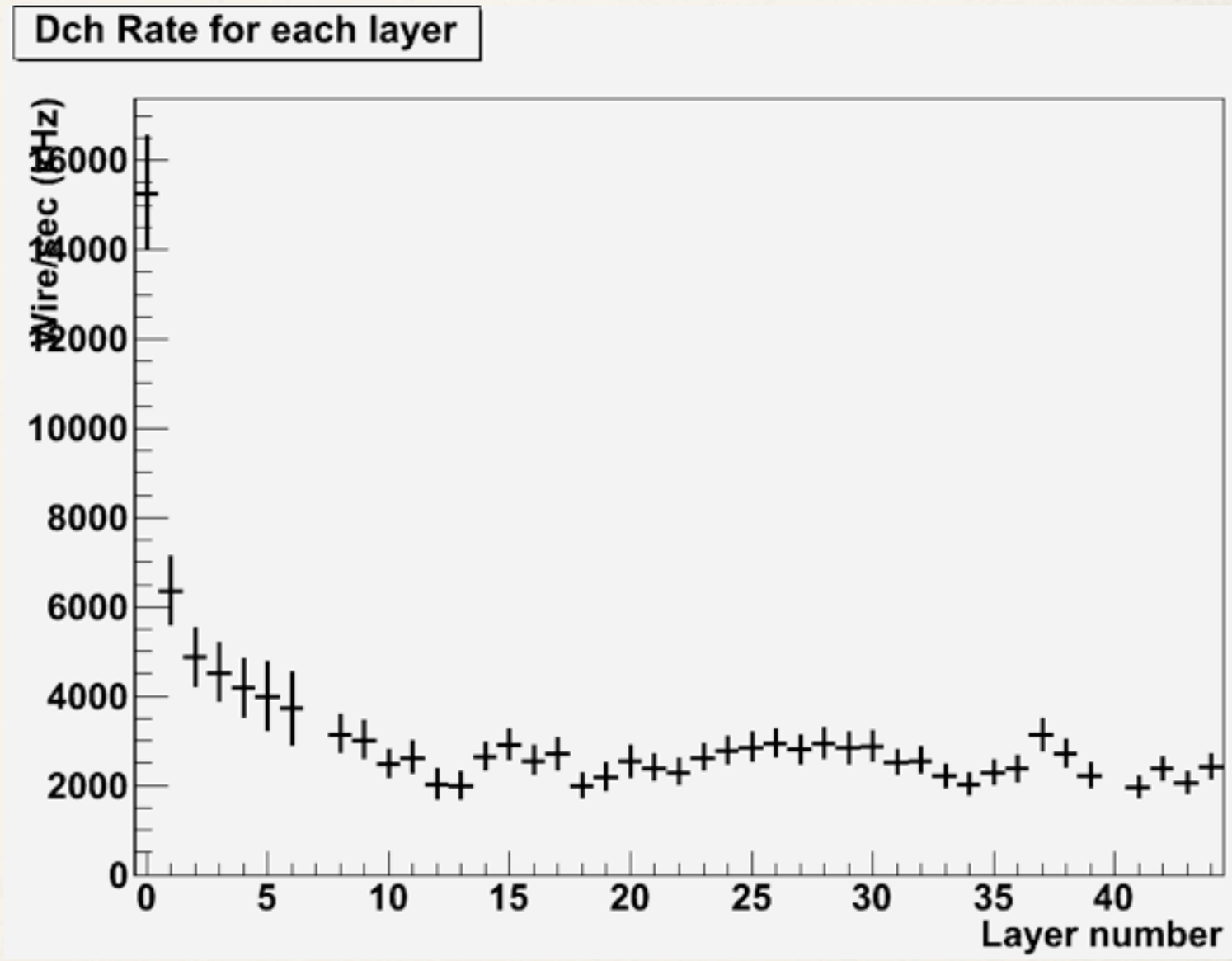






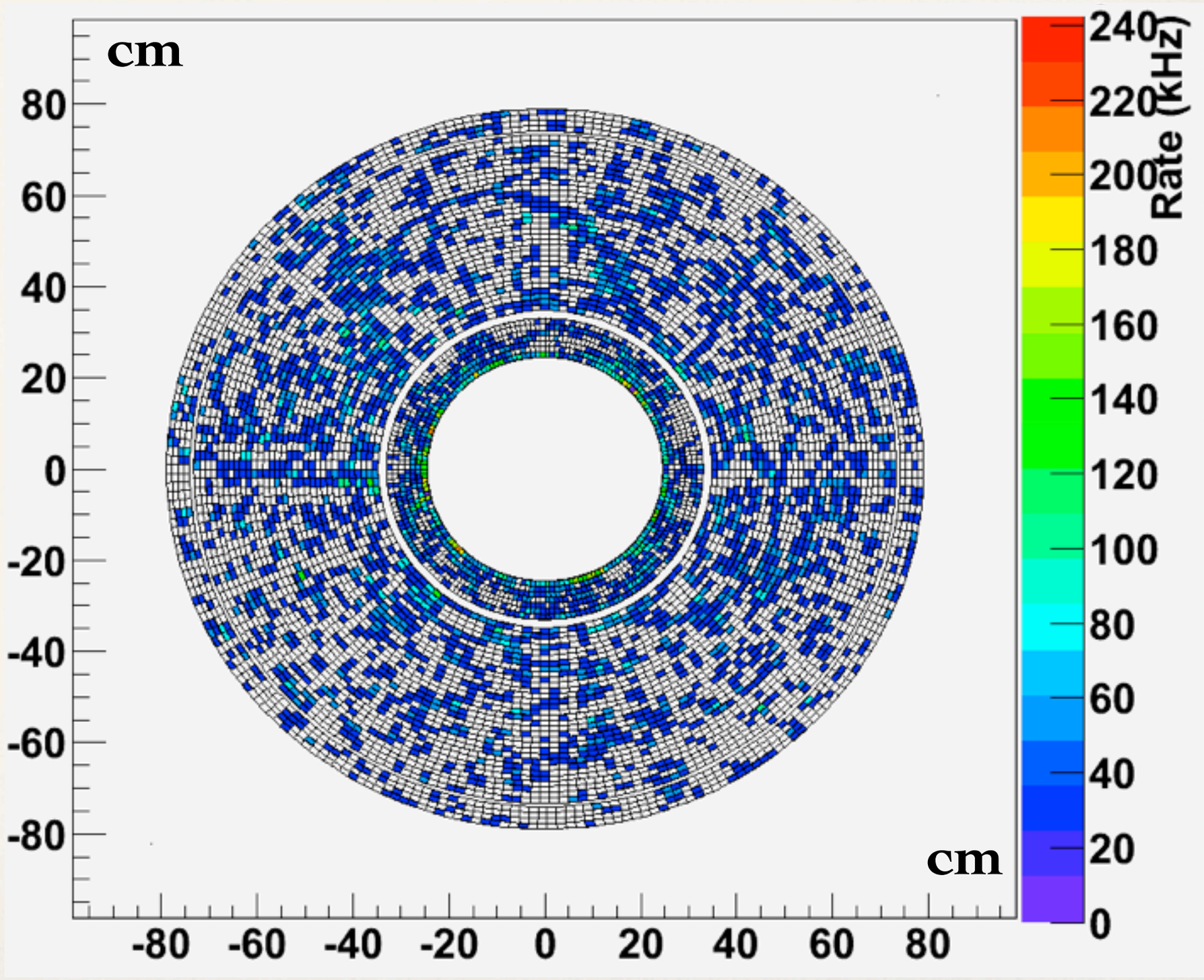
Dch rate

- Rate per layer, all the tracks passing through the layer divided by time
- If we are looking for hot areas, this plot is not easy to read, how we can improve it?



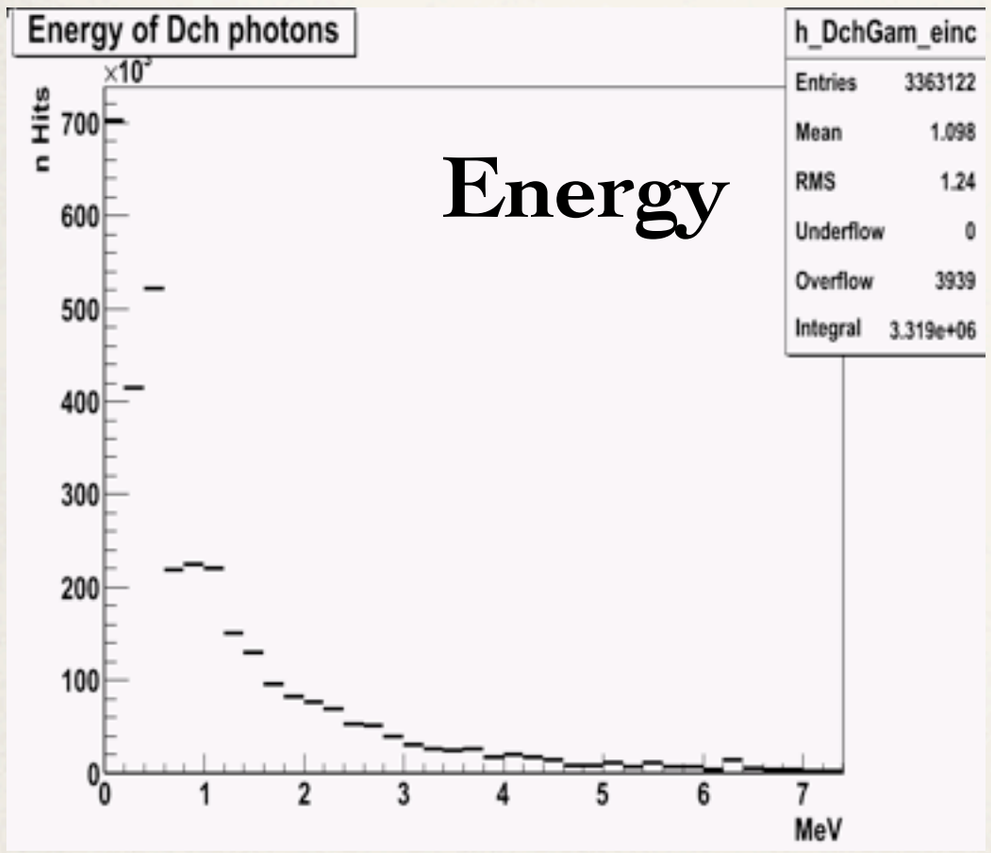
New map for cell rate

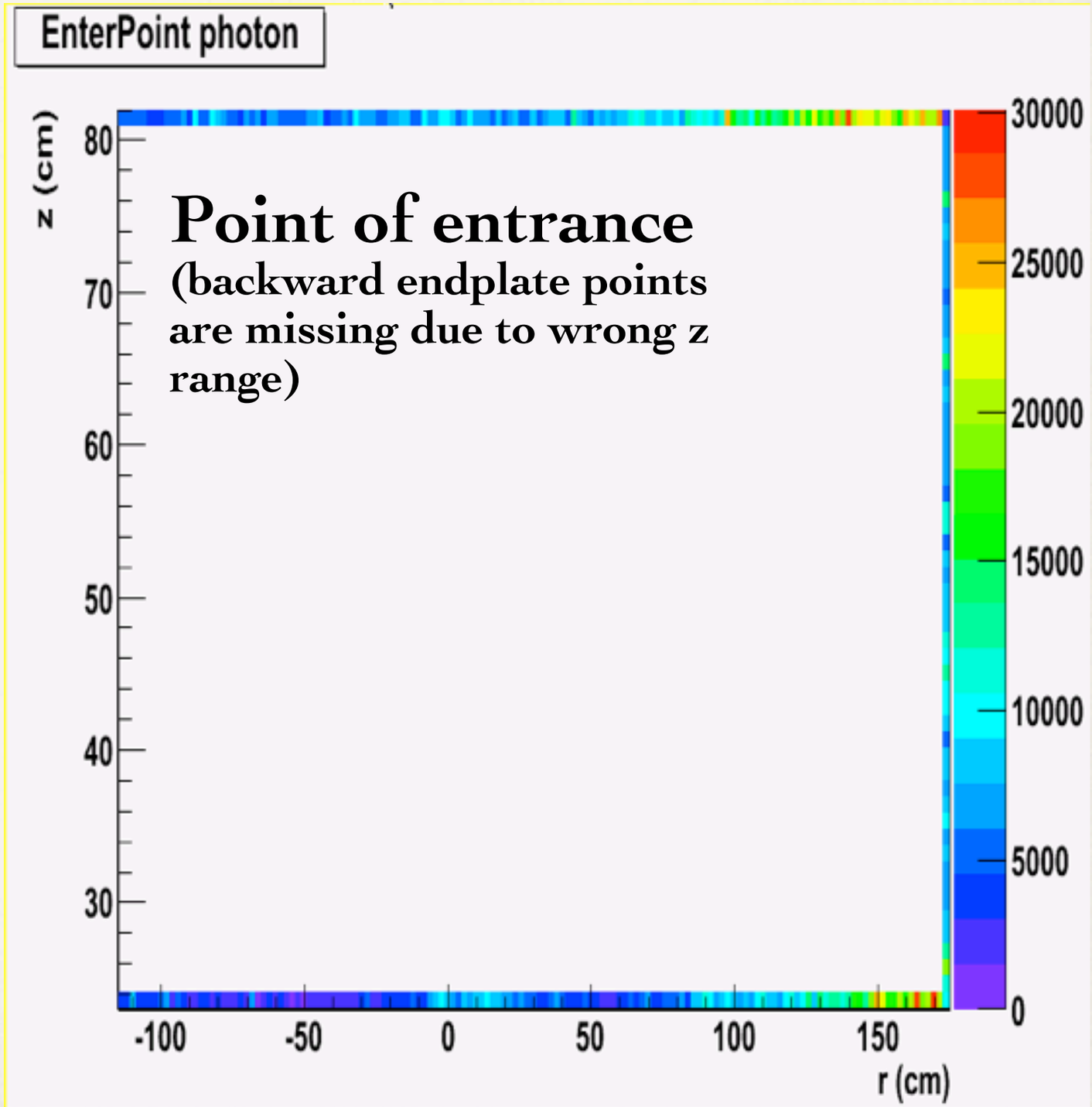
- Dch does not distinguish tracks in the same trigger window (1us)
- Rate merging all the hit in the same trigger window
- Small difference, maybe



Photon spectrum study

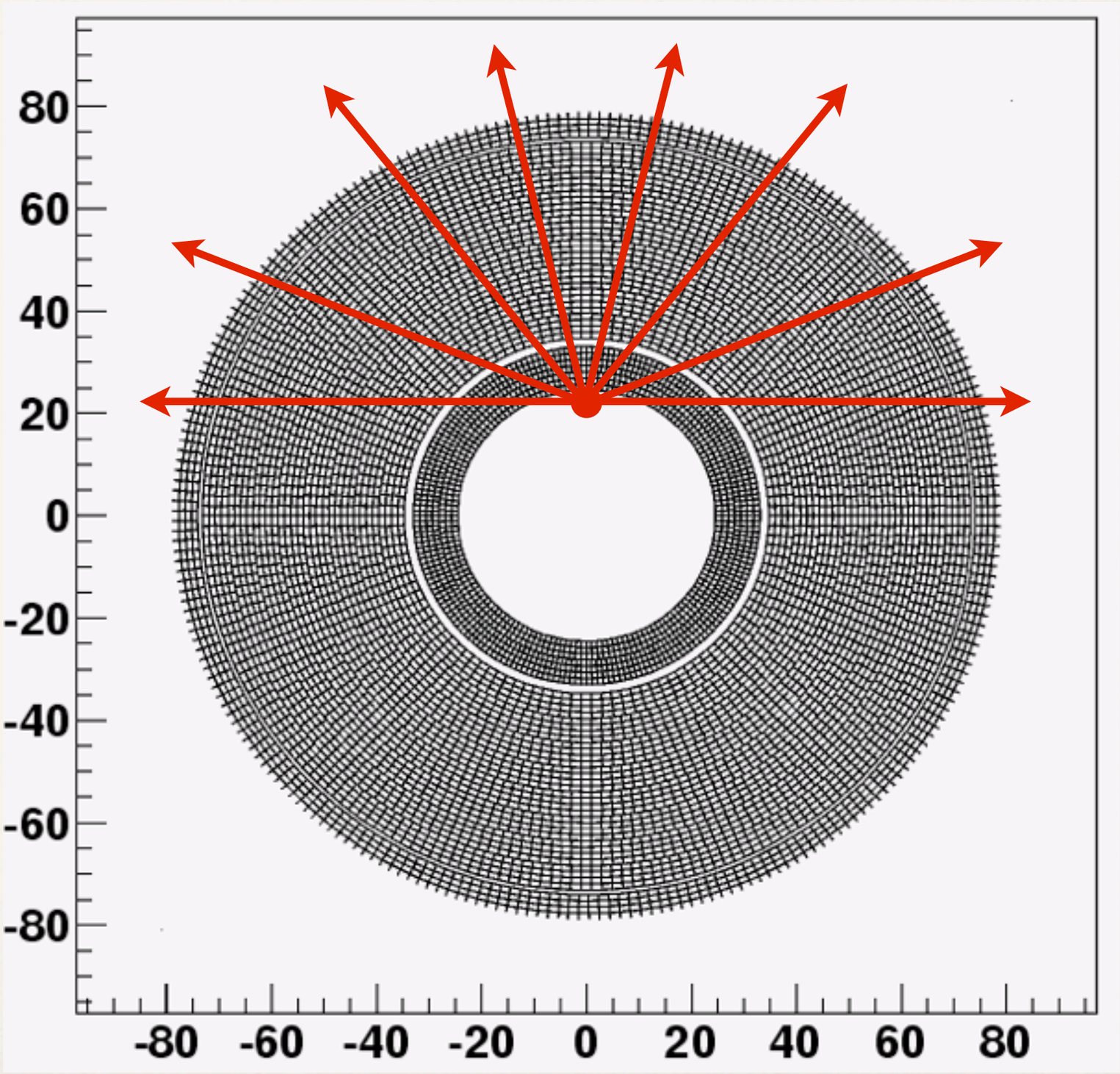
- RadBhabha (10k)
- Boundary particles
- Energy
- Enter point





Photon spectrum study

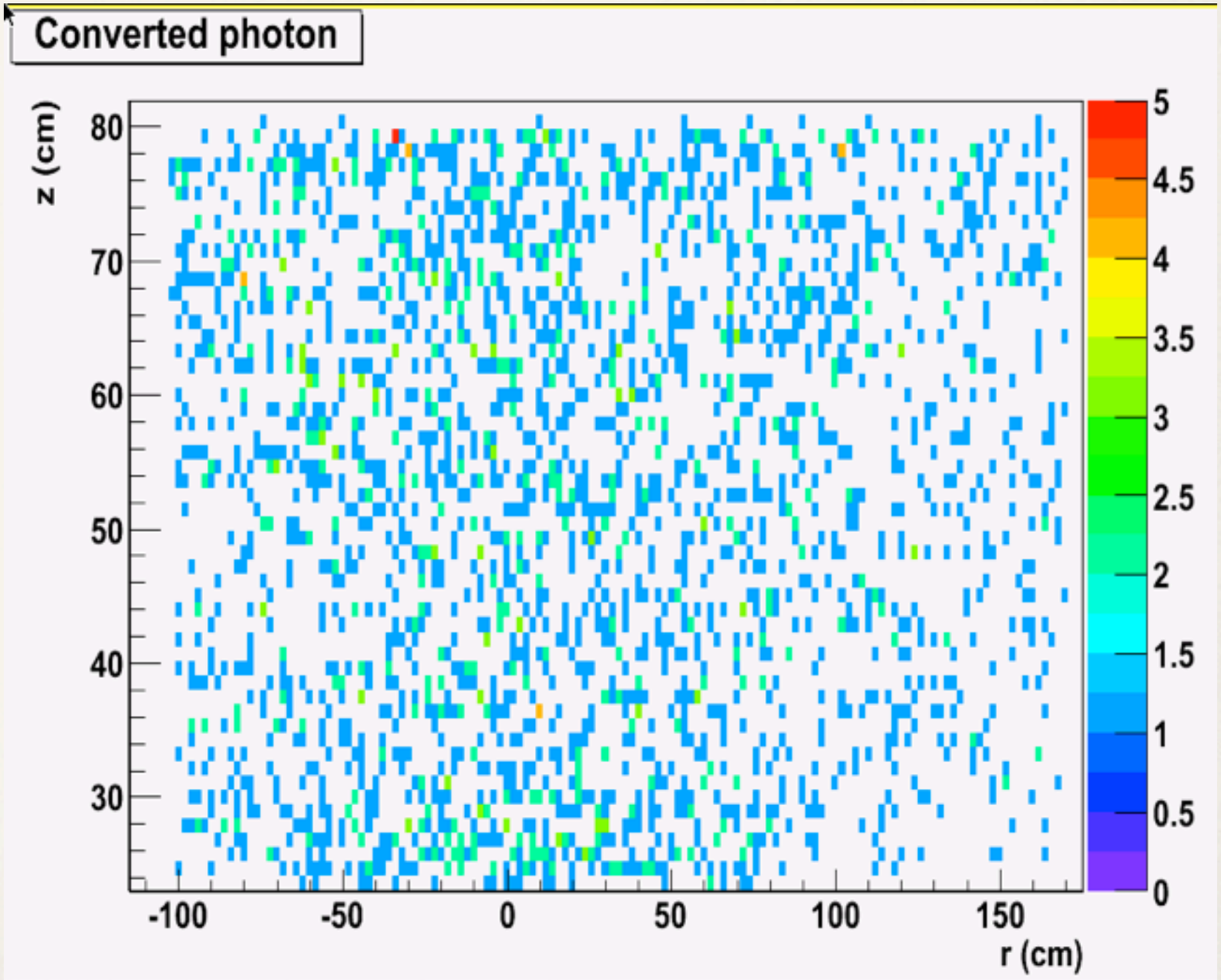
- Single photon
- Position:
  - x=0,
  - y=+22cm
  - z=[-110,175]cm
- Energy:
  - 100 keV
  - 500 keV
  - 2 MeV
  - 10 MeV
- Vector momentum:
  - Phi=[0, pi] (up)
  - Theta=[0, pi]



Photon spectrum study

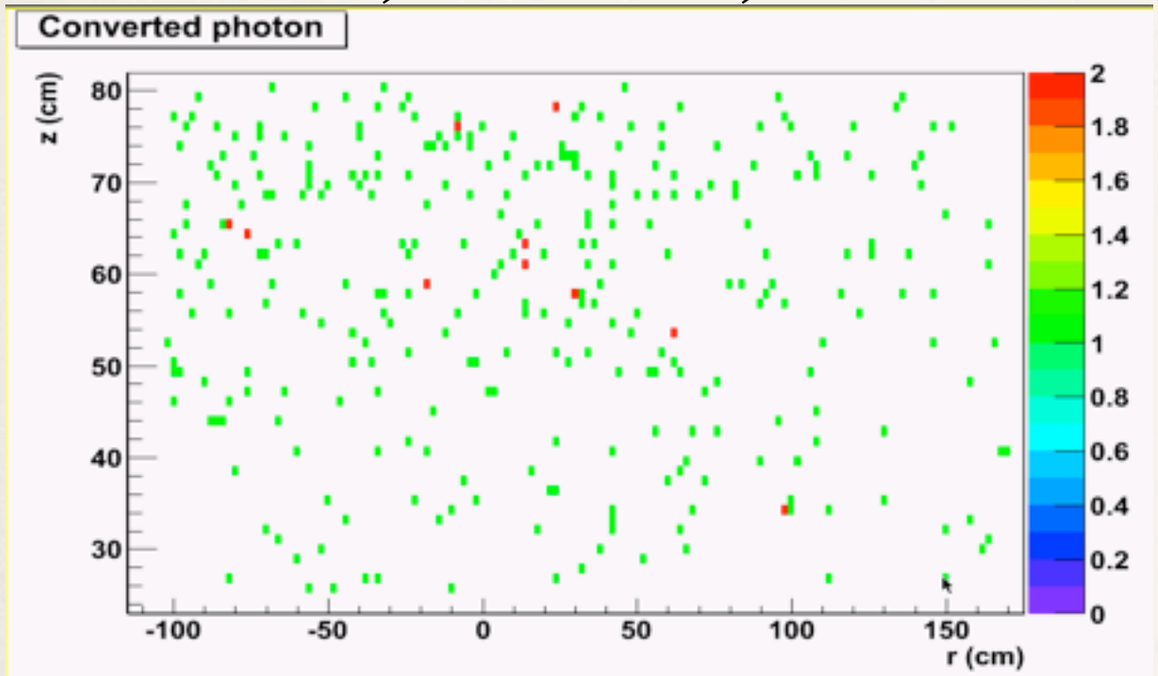
- Looking at photons hits where the photon does not exit the volume
- No information about how the photon disappear, which is the process (Geant4 knows but it is not stored)
- Plot of r-z coordinates of the last hit of the photon before disappearing
- **Disappearing rate** = disappeared photon divided by total number of events

100 keV, 1M evts, 0.25%

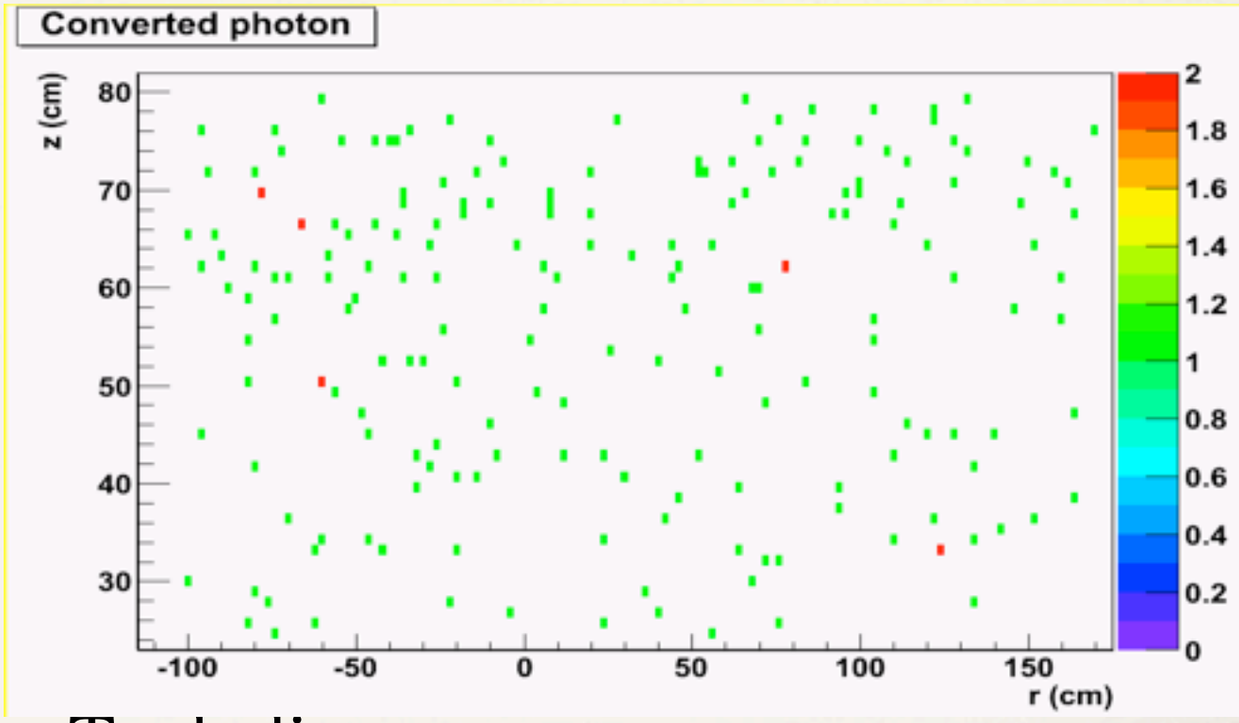


Photon spectrum study

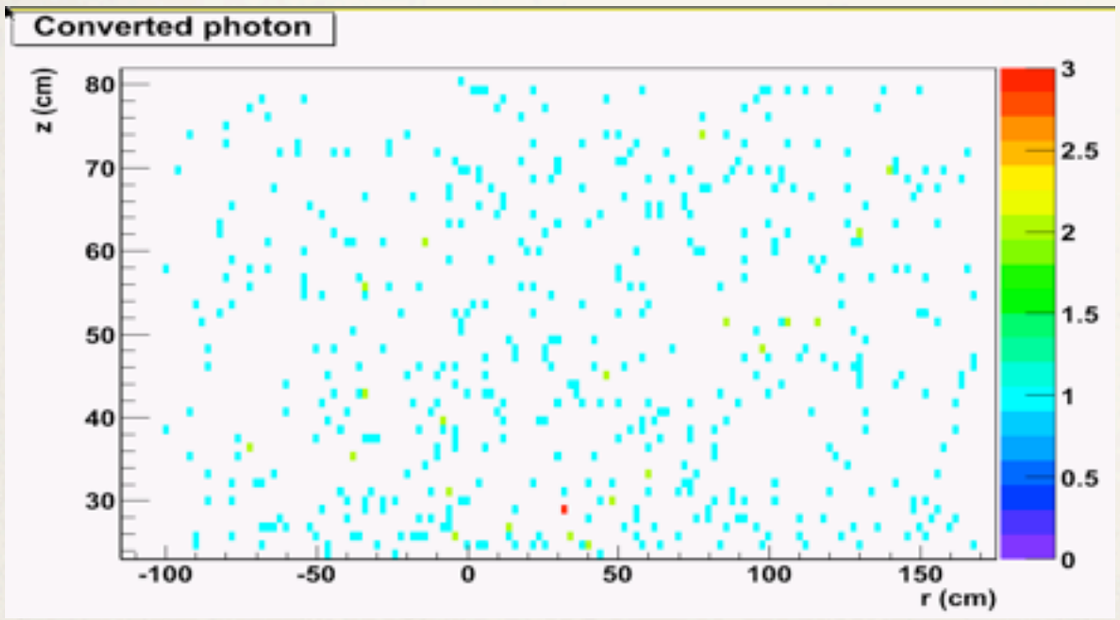
500 keV, 1M evts, 0.03%



2 MeV, 1M evts, 0.02%



10 MeV, 1M evts, 0.05%



- To do list:
- Shoot photons from other position (outside the barrel, end-plates)
- Other energies
- Add information on the process (only for this study)