Svt Background simulation with Bruno

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SuperB Workshop and Kick-Off Meeting

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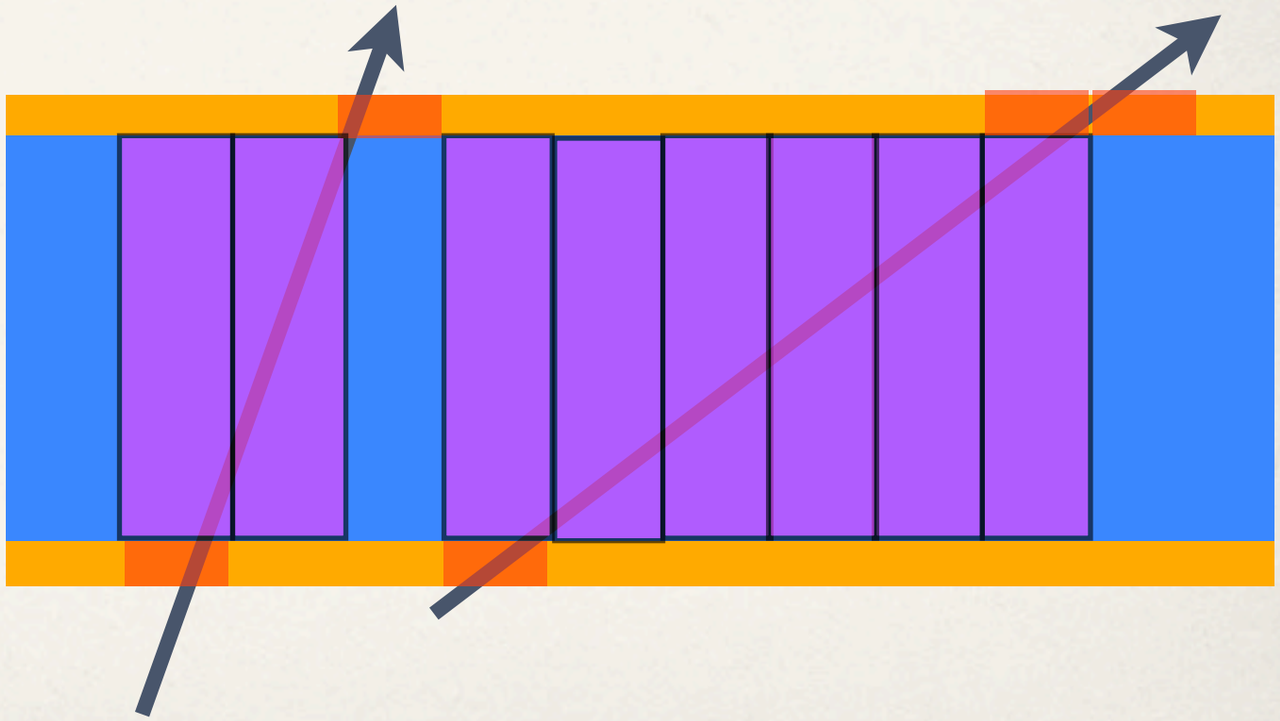
Introduction

- Last update for Svt background last December using new geometry for pixel layer plus cooling and support
- Dedicated studies from Trieste bring us to discover a bug in the sensitive volumes: dose and fluency estimation in L1-5 were underestimated (the fix is already in the svn repo, r461)
- Trying to reproduce results from Trieste using strip instead of pixels and the last values for pitches
- I was not able to simulate 2photon bkg with the last revisions of Bruno (r491): simulation was 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
- In the following new results using events simulated with a more recent version of Bruno (r465) and the December geometry

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 L0,1,2

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

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 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 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

Results L3-5

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

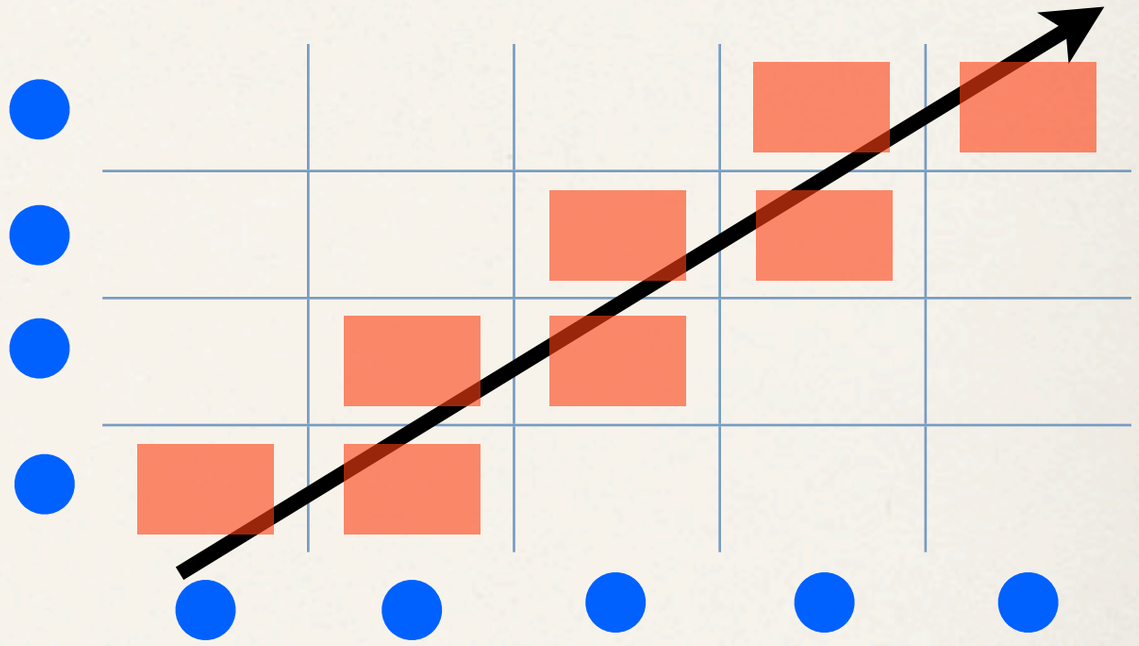
LAYER 3	Dec2010	May2011	
Cluster rate	67.2	37.6	kHz/cm2
Cluster multip	1.91	9.96	
Pixel rate	131	342	kHz/cm2
Fluency	7.95E+09	2.57E+10	cm-2
Dose	5	15	kRad

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

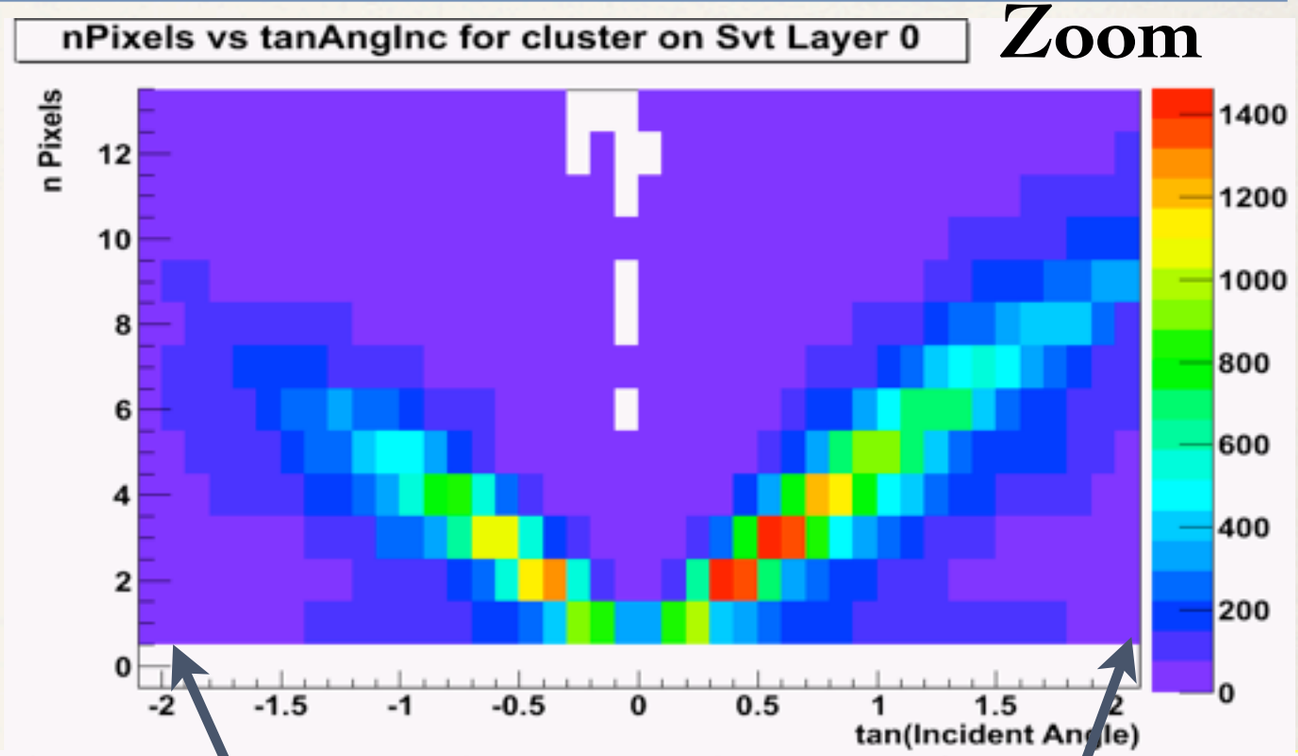


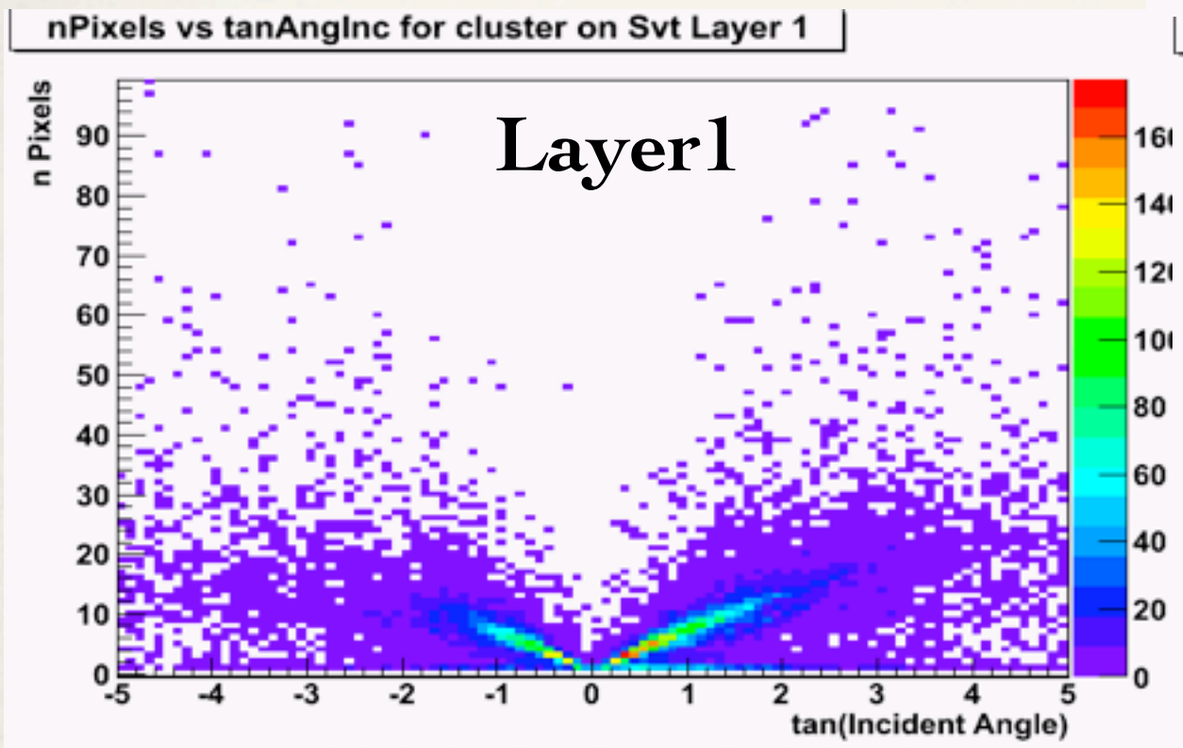
- **8 pixels**, but ***4+5 strip***
- Mean factor is (n+1)/2

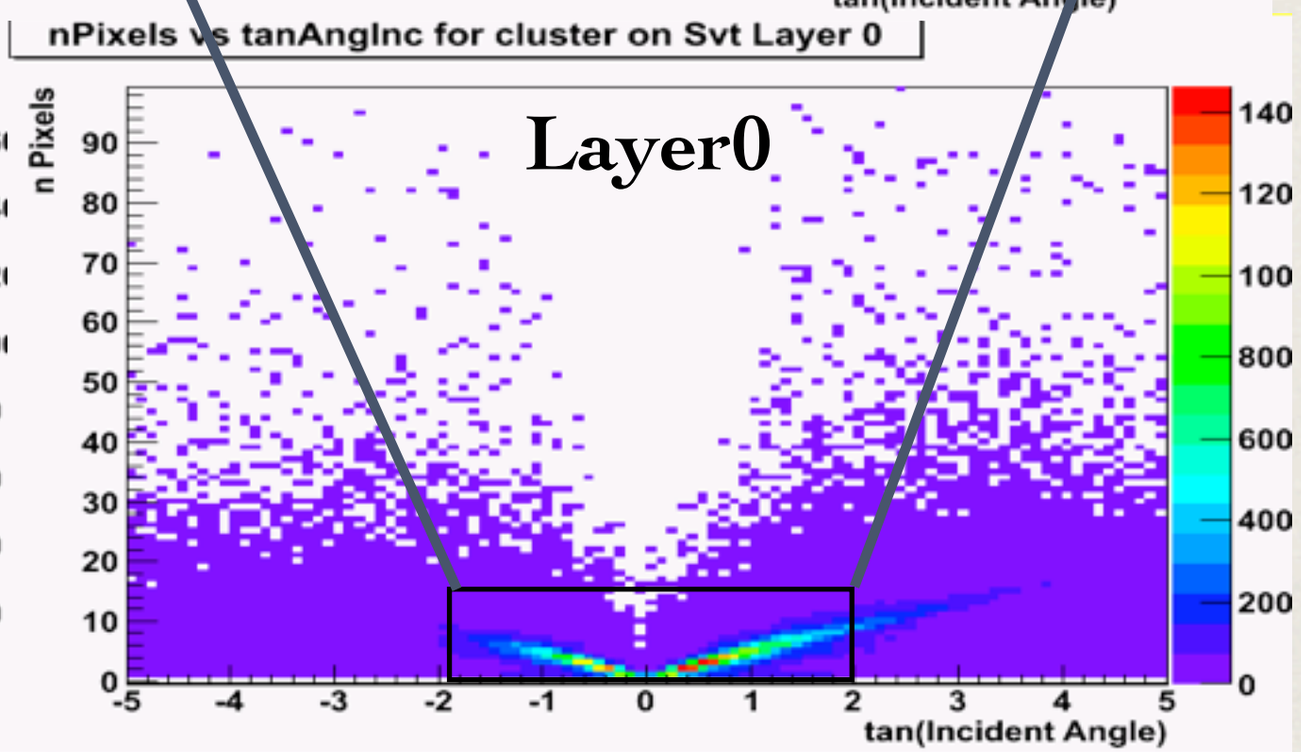
- Approximations:
  - No information on the position is considered, so two tracks crossing the same pixel or strip are counted twice. This includes daughter tracks are accounted as a cluster separate from the mother cluster
  - Areas and volumes are approximated with a cylinder of radius corresponding 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]

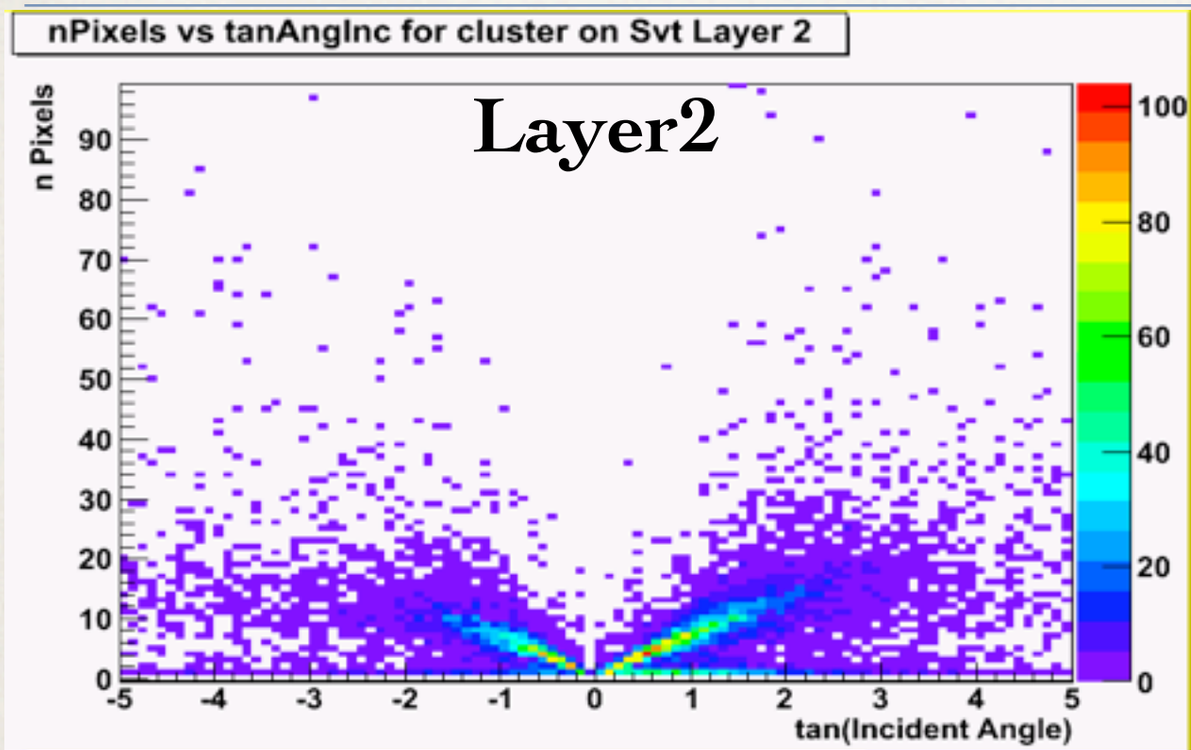
- Fired pixels vs tangent of incident angle, linear correlation
- One entry per cluster, negative values are for particle going inwards
- One pixel cluster at all angles (see also next slide)? probably low energy particles that stop inside the layer, from inside
- Approx: cylindric layer instead of modules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

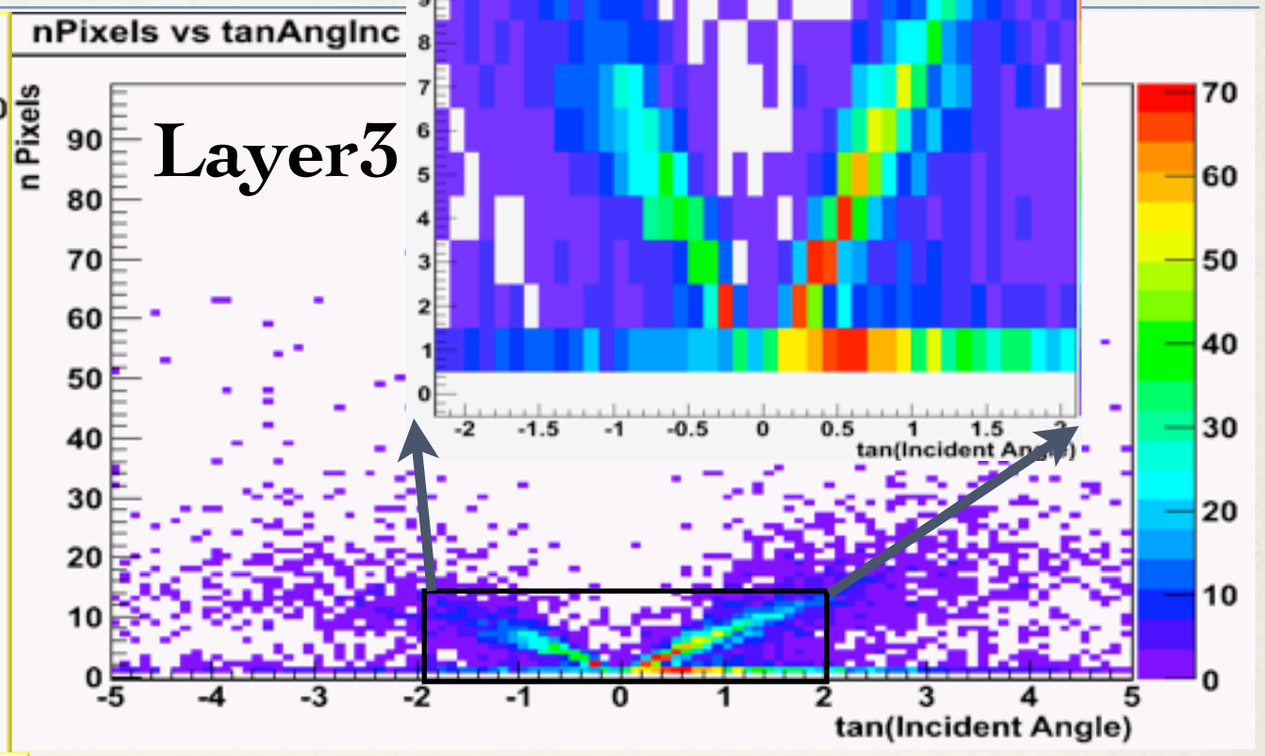


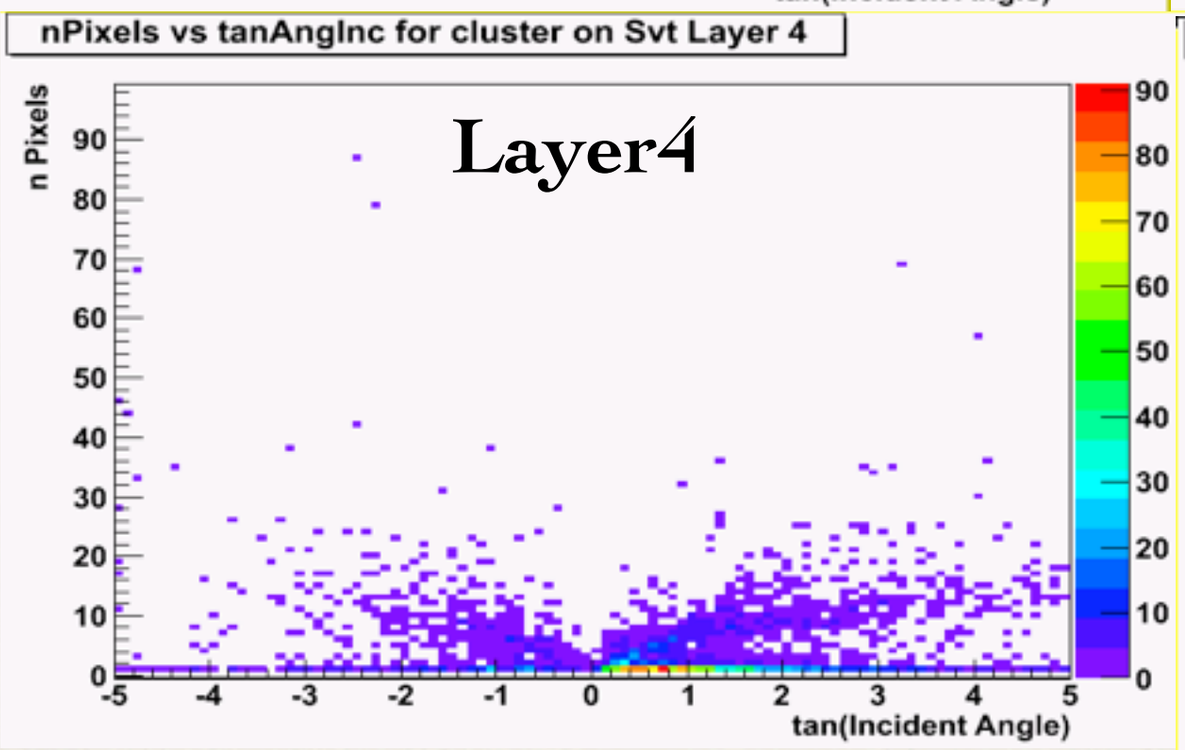


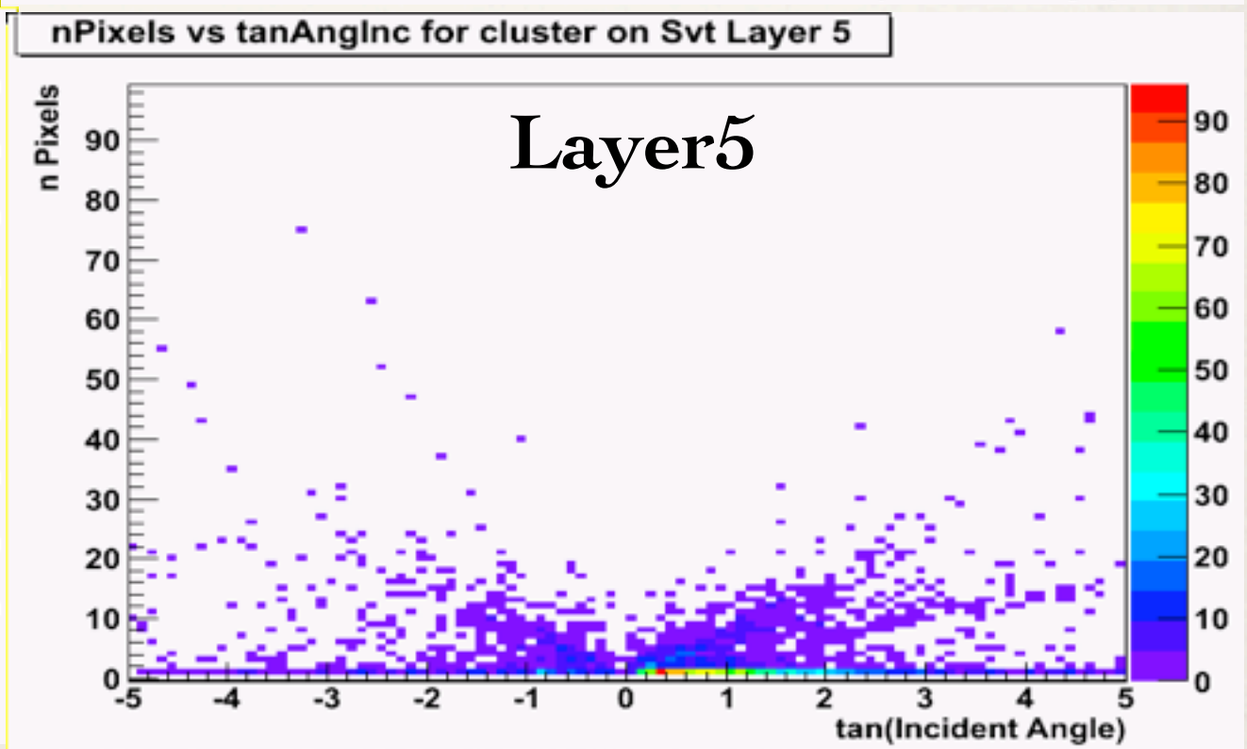


Check 1: # Pixels vs Angle [50x50um]





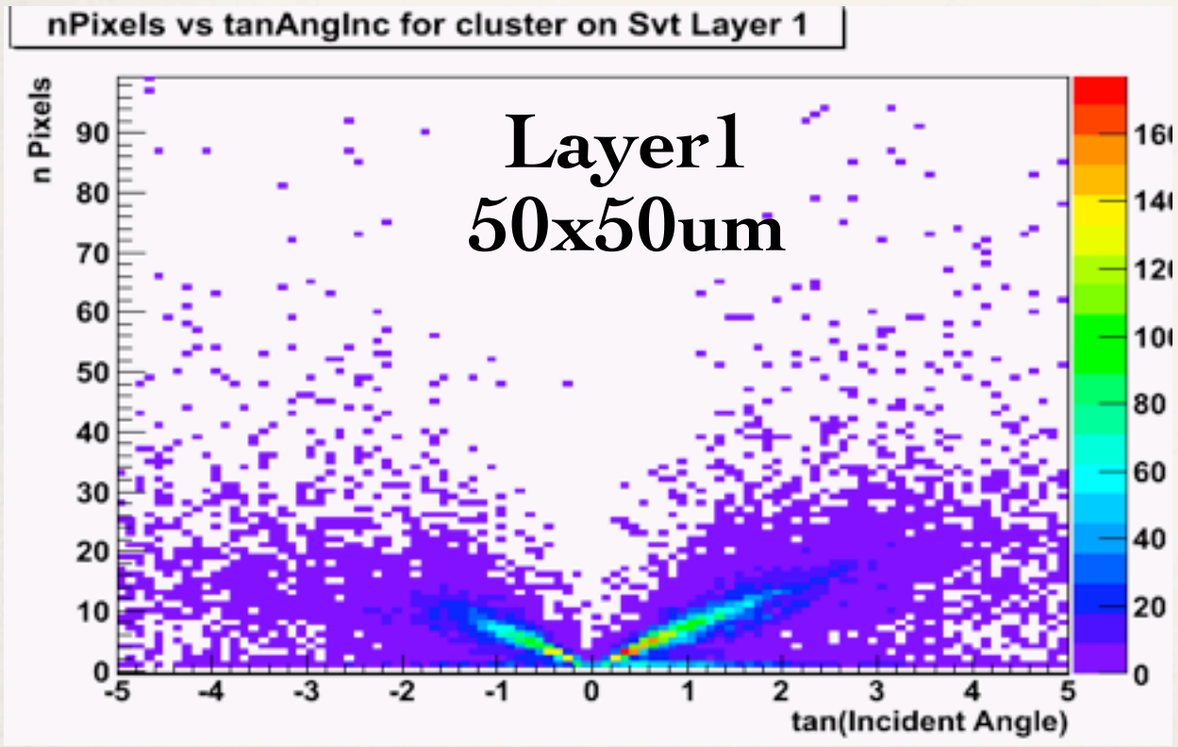


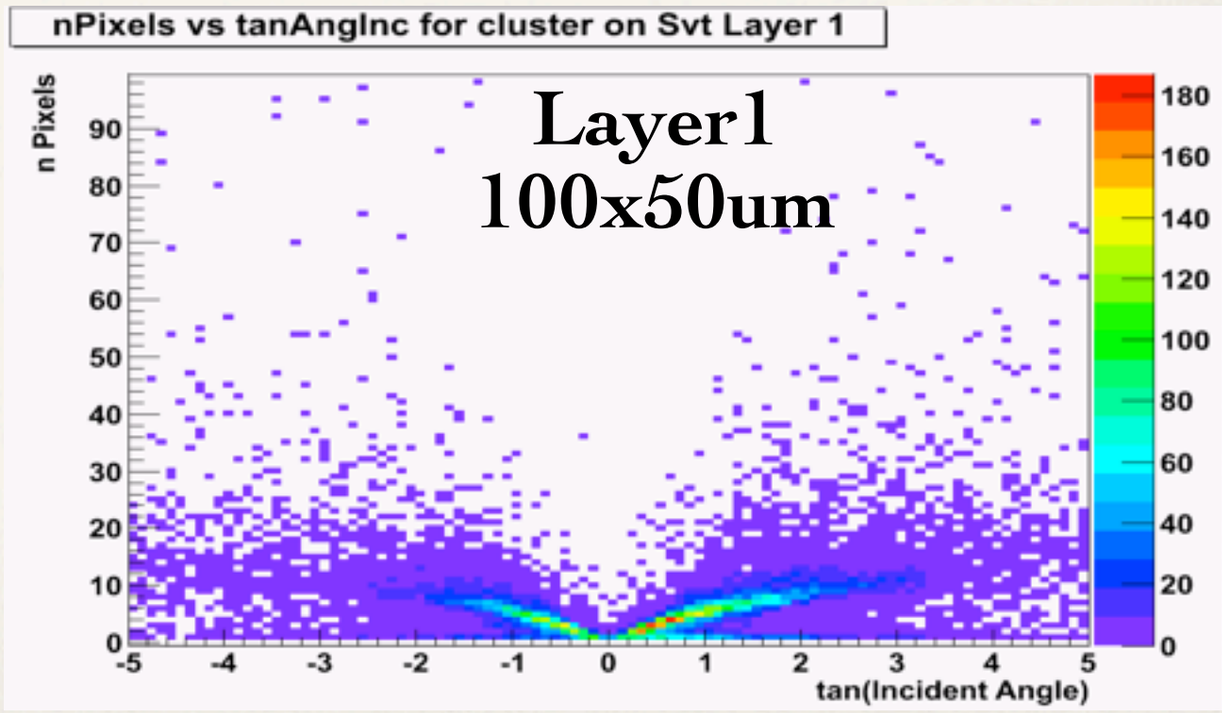


Check 1: # Pixels vs Angle [real pitches]

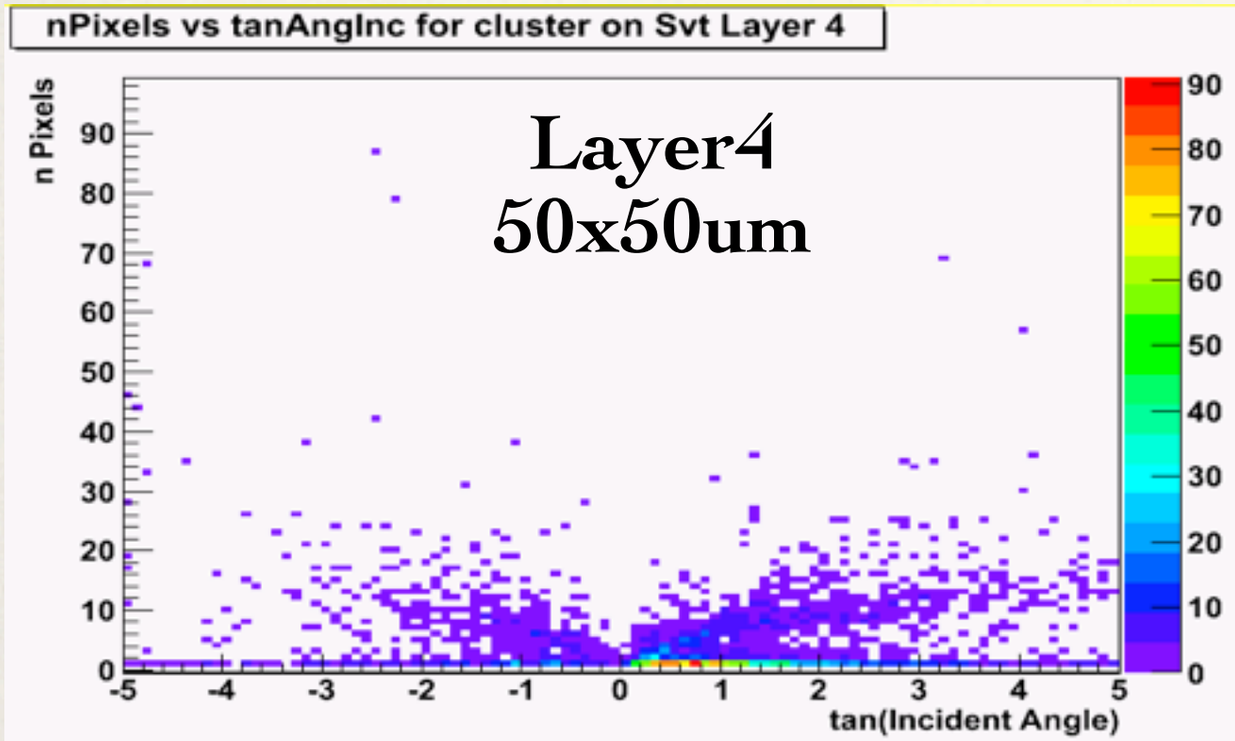
- Same plots with different pitches
- Slope is expected different, as it is
- Effect more evident for outermost layers

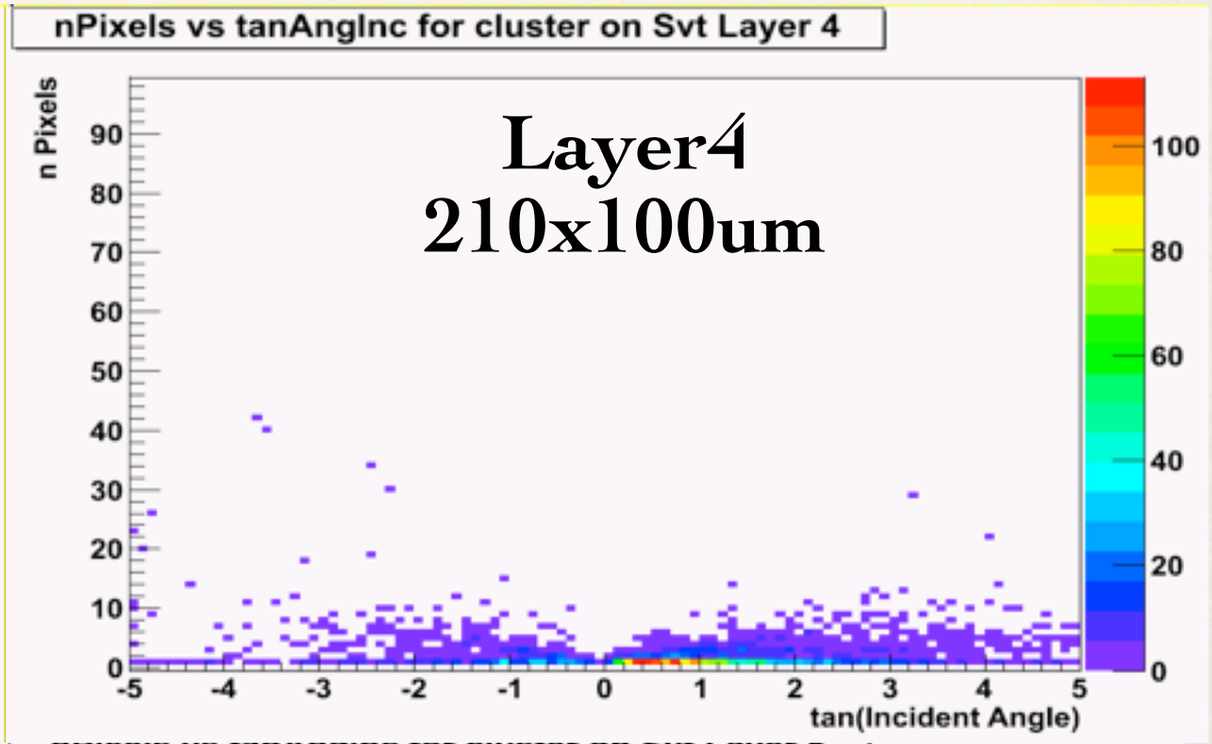
[um]	L0	L1	L2	L3	L4	L5
Z	50	100	100	100	210	210
Phi	50	50	55	55	100	100

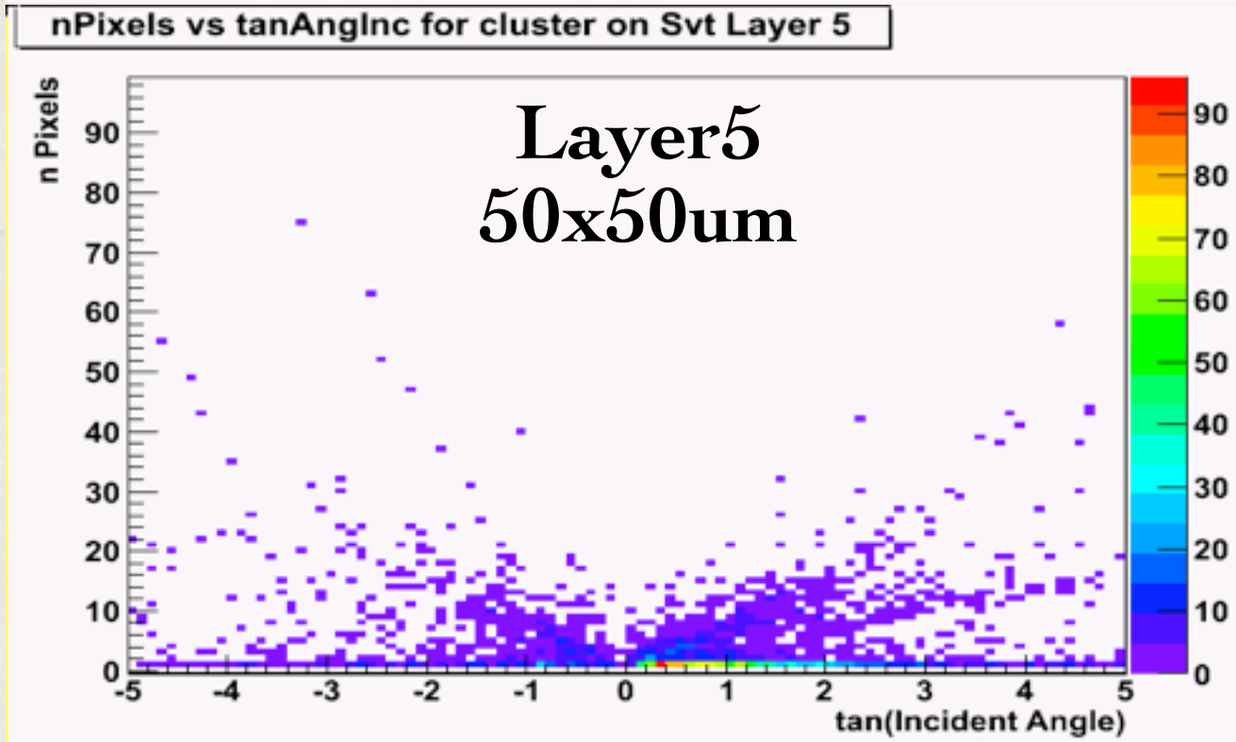


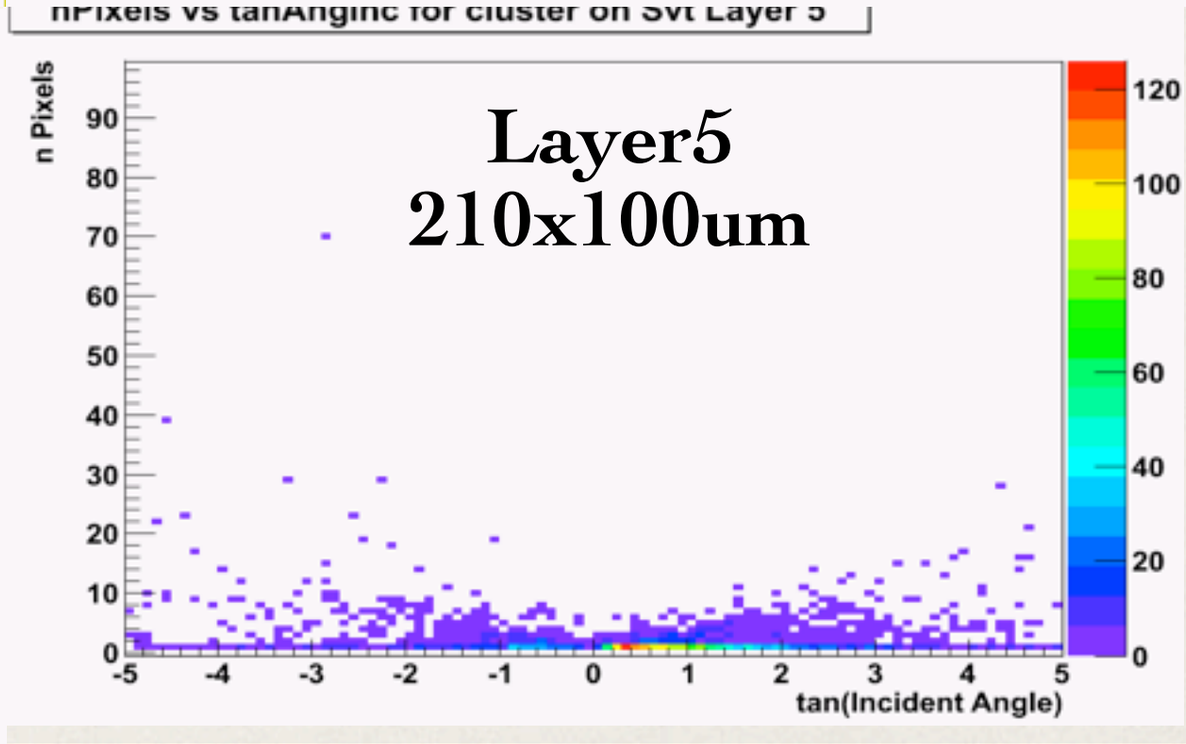


Check 1: # Pixels vs Angle [real pitches]



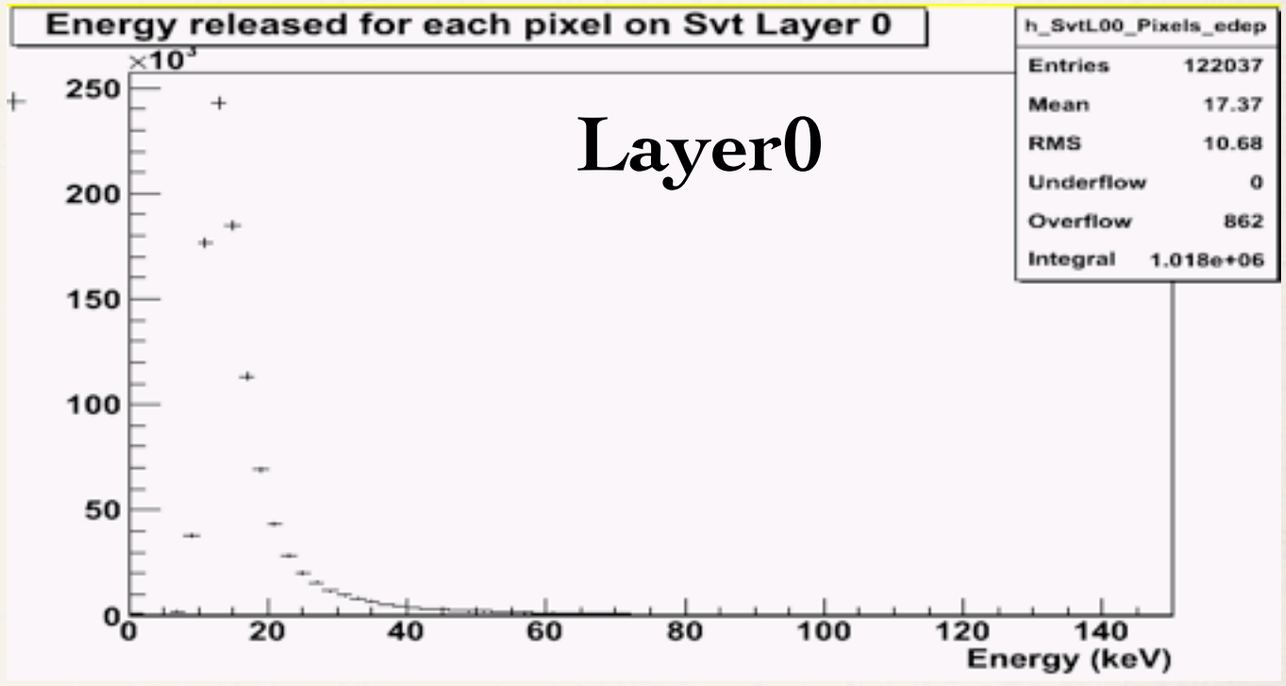


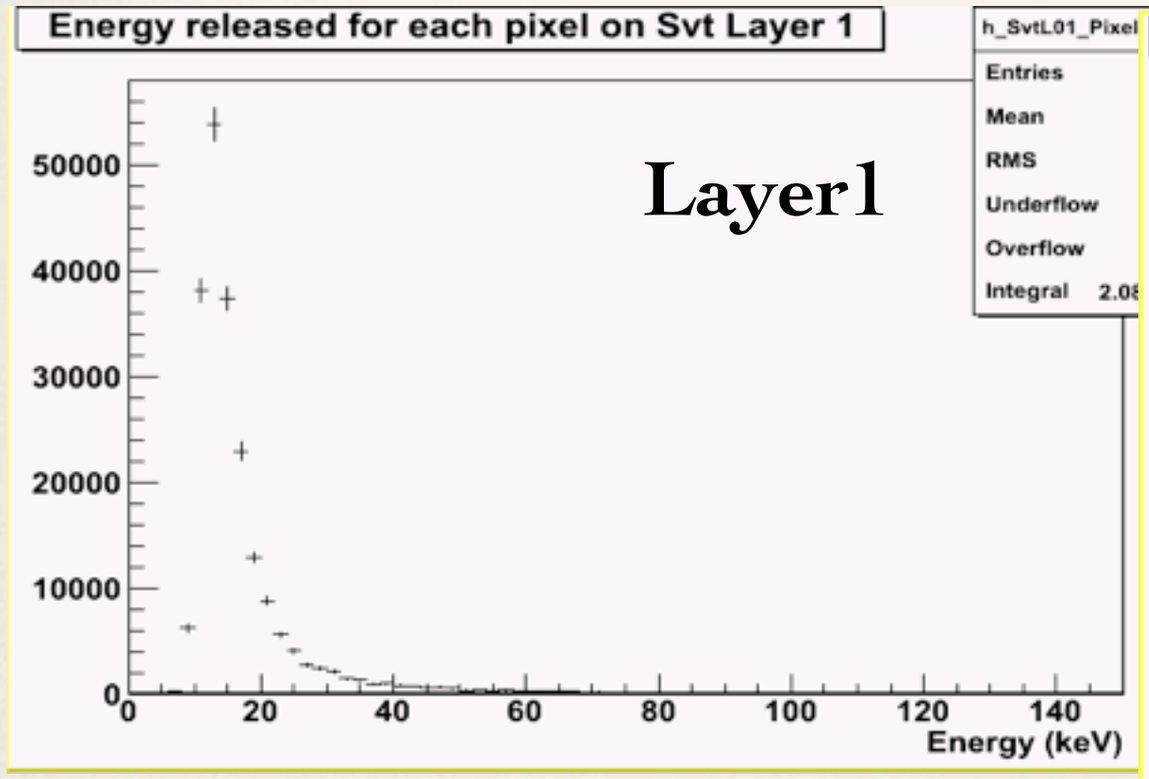


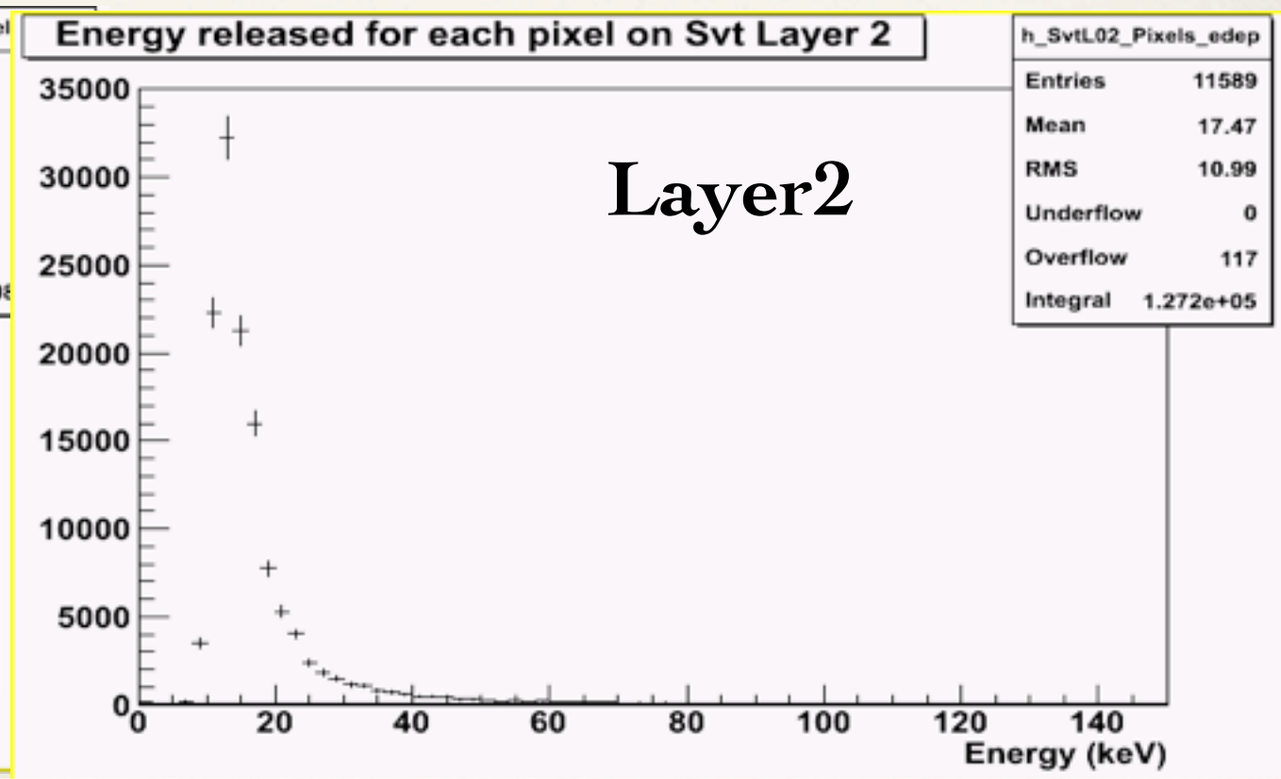


Check 2: Deposited energy per pixel

- 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

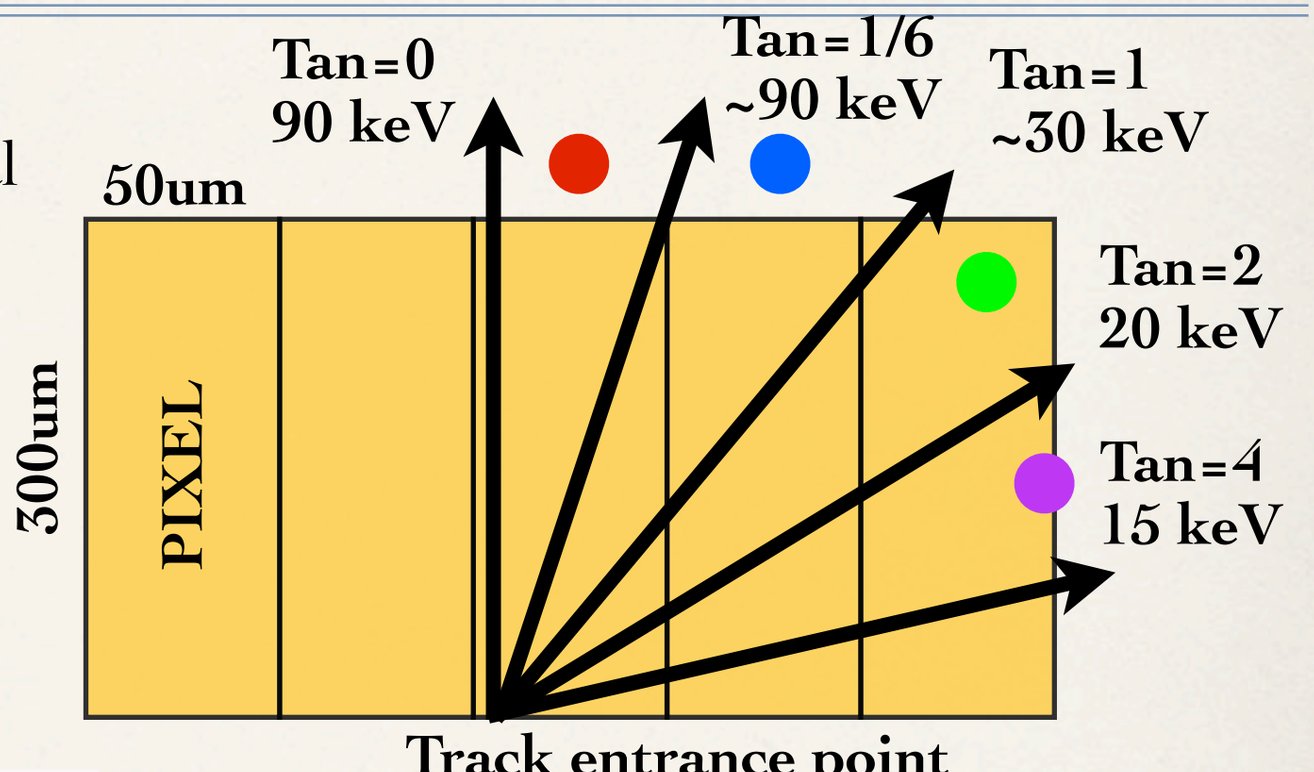


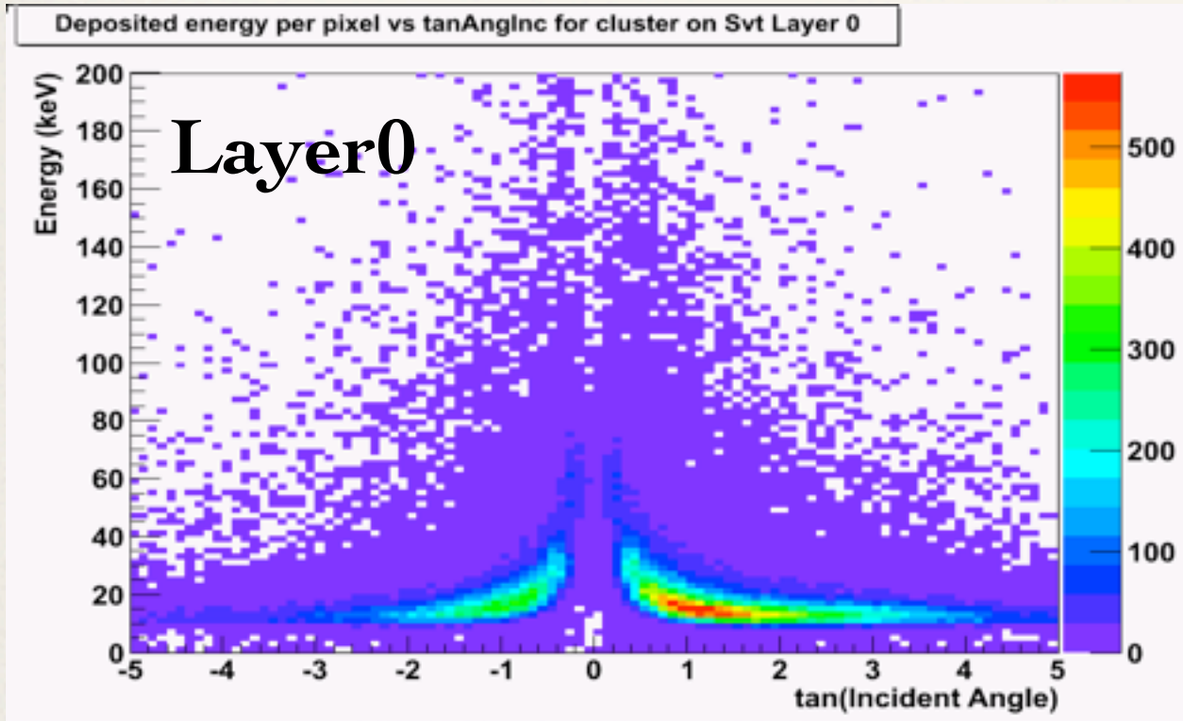


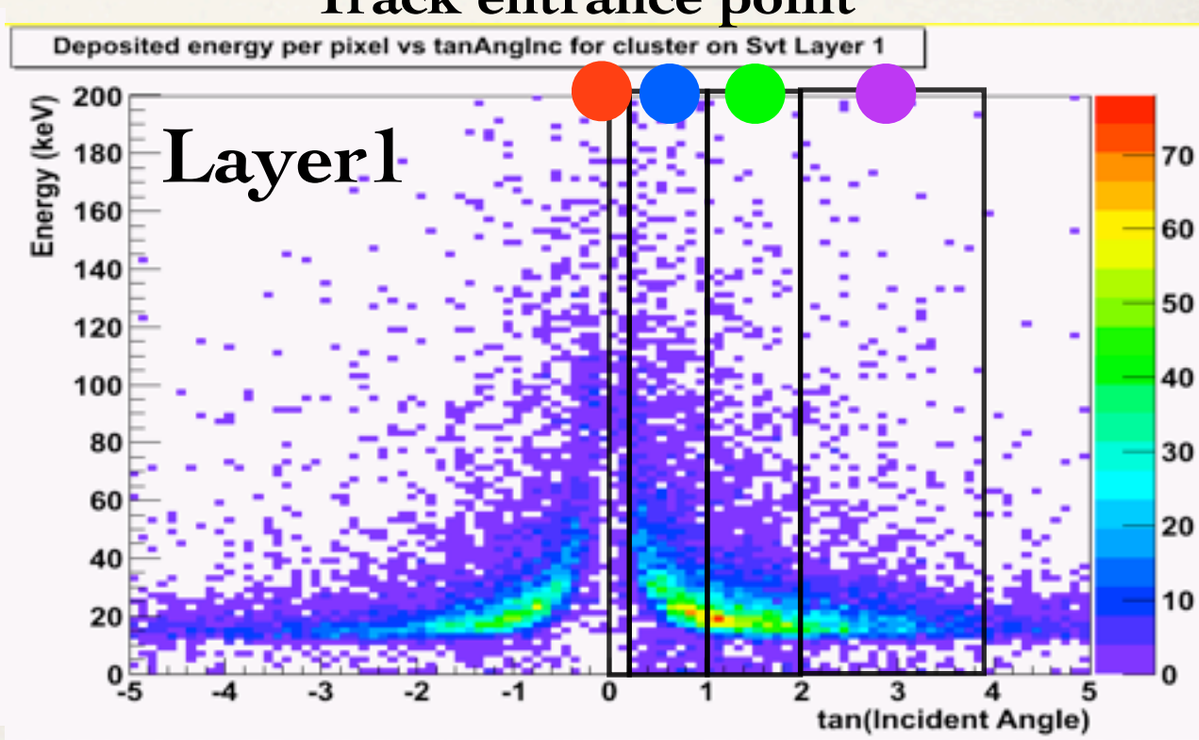


Check 2: Deposited energy per pixel

- Deposited energy per pixel vs tangent of incident angle, inversely proportional
- One entry per cluster, negative values are for particle going inwards
- For most of the clusters track is entering at large angle (45 degrees)
- Deposited energies are lower than expected, but they depends from entrance point

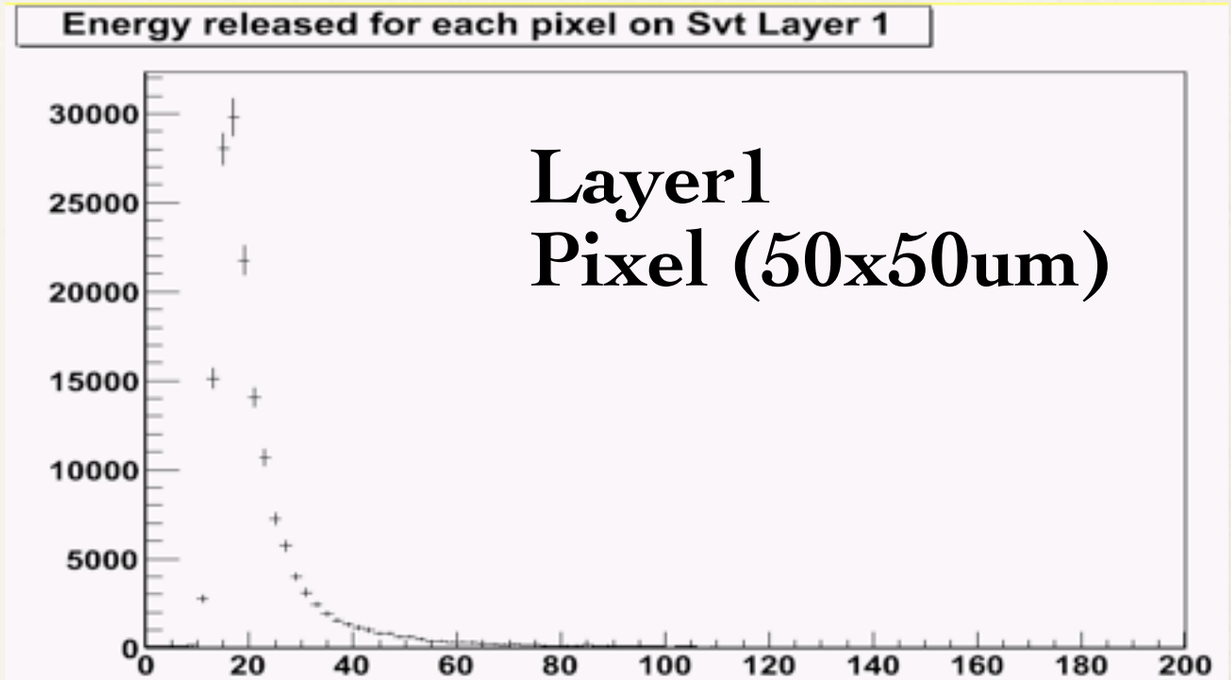


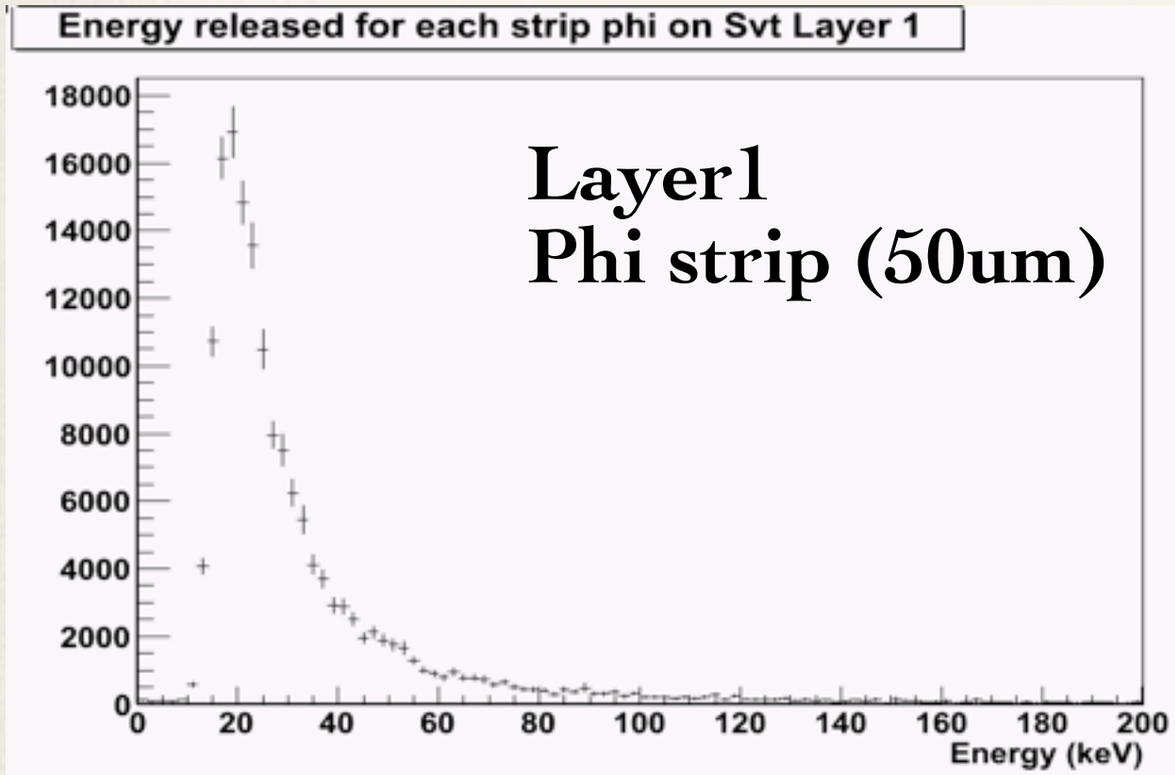


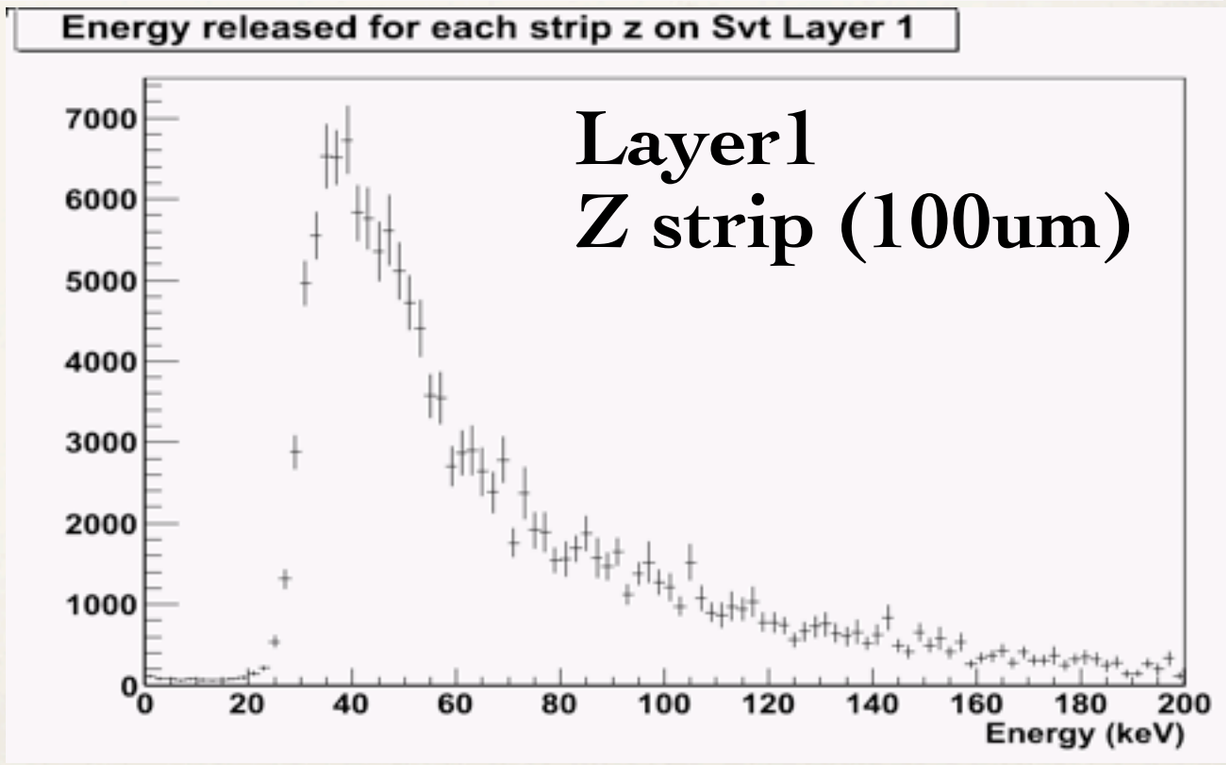


Check 3: Deposited energy per strip

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

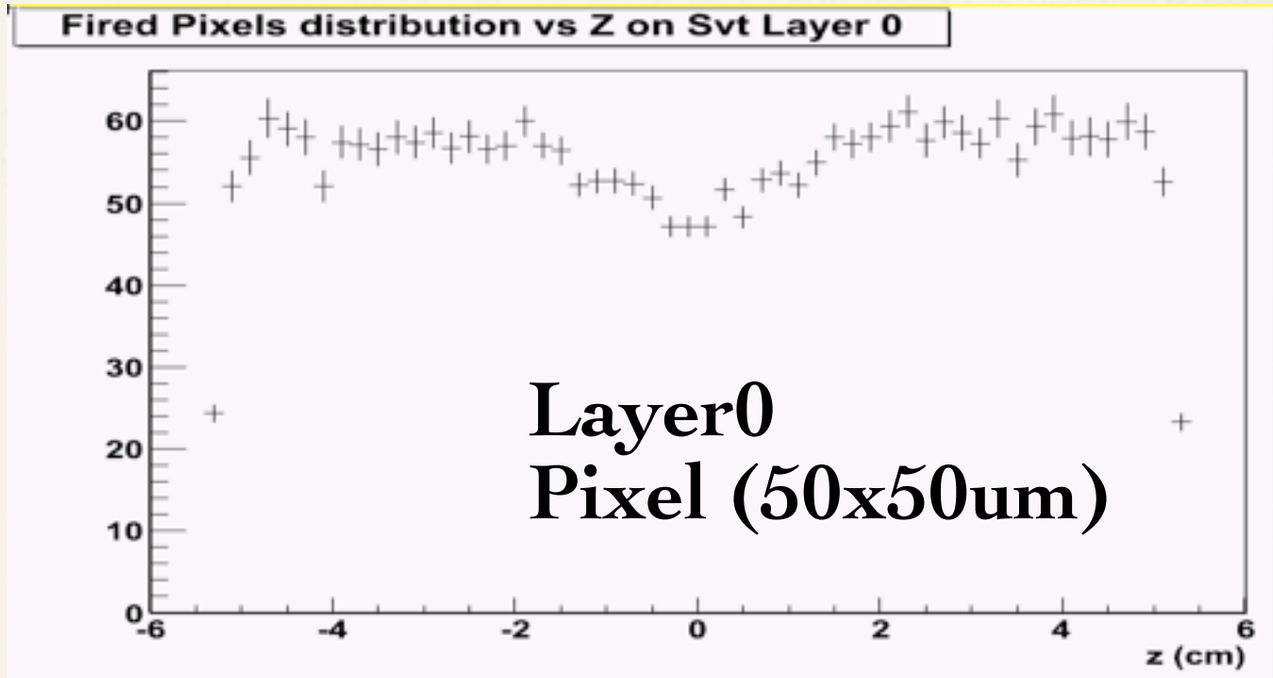


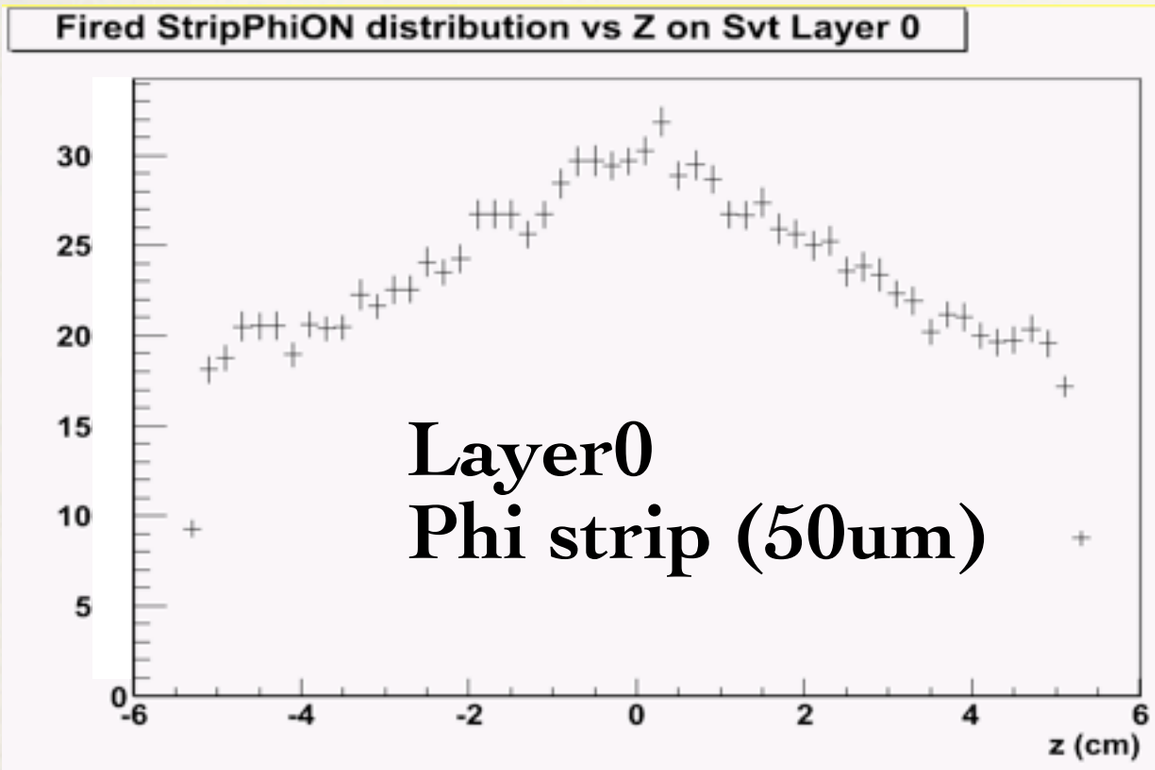


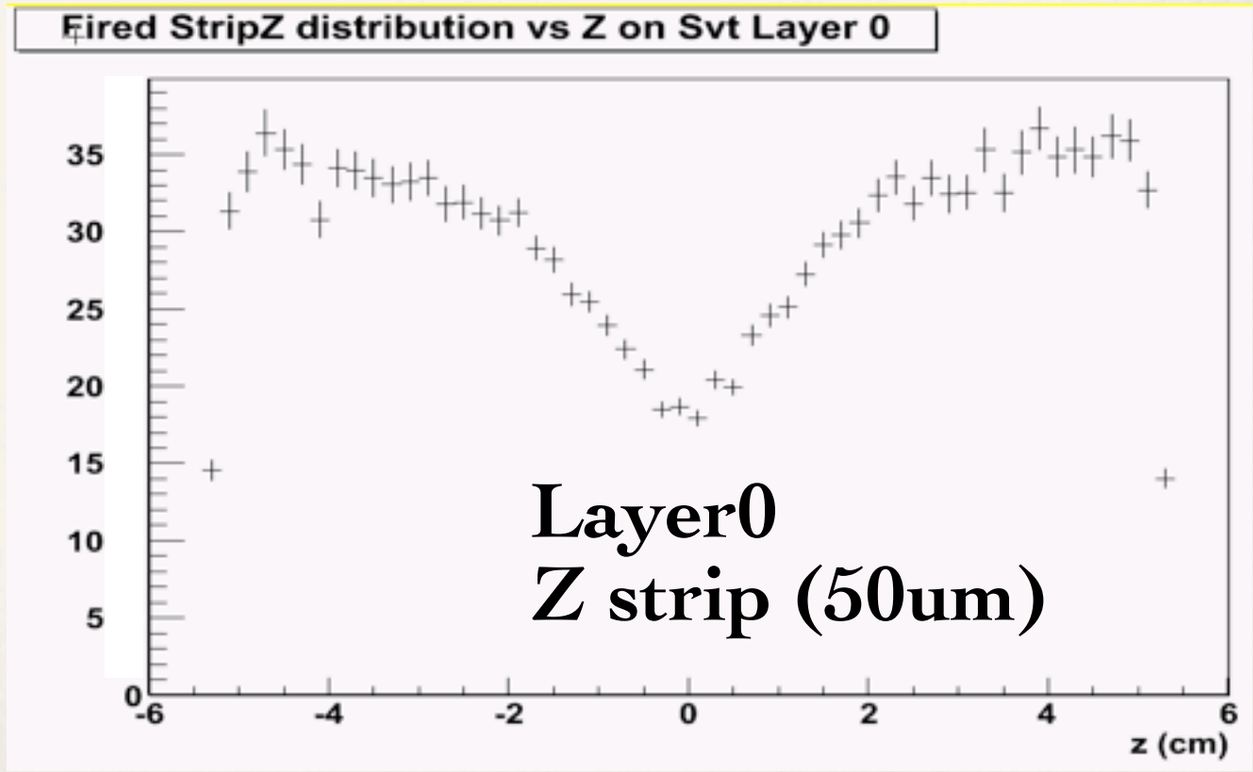


Layer0 rates

- 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)

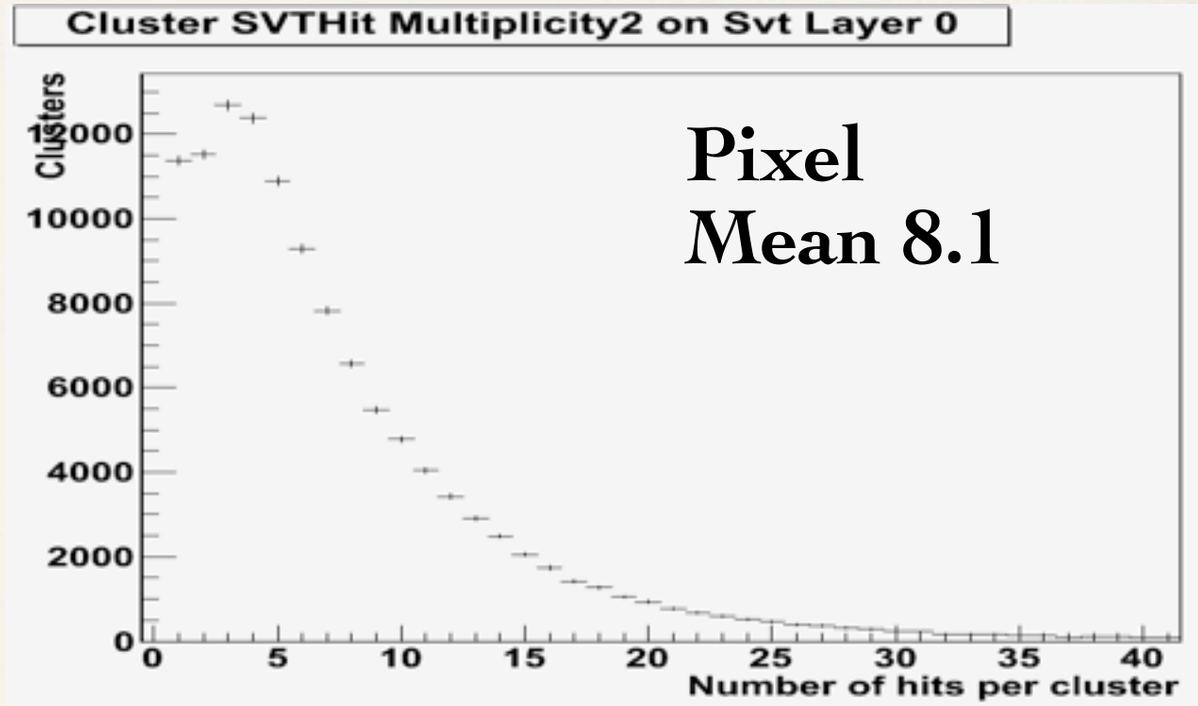


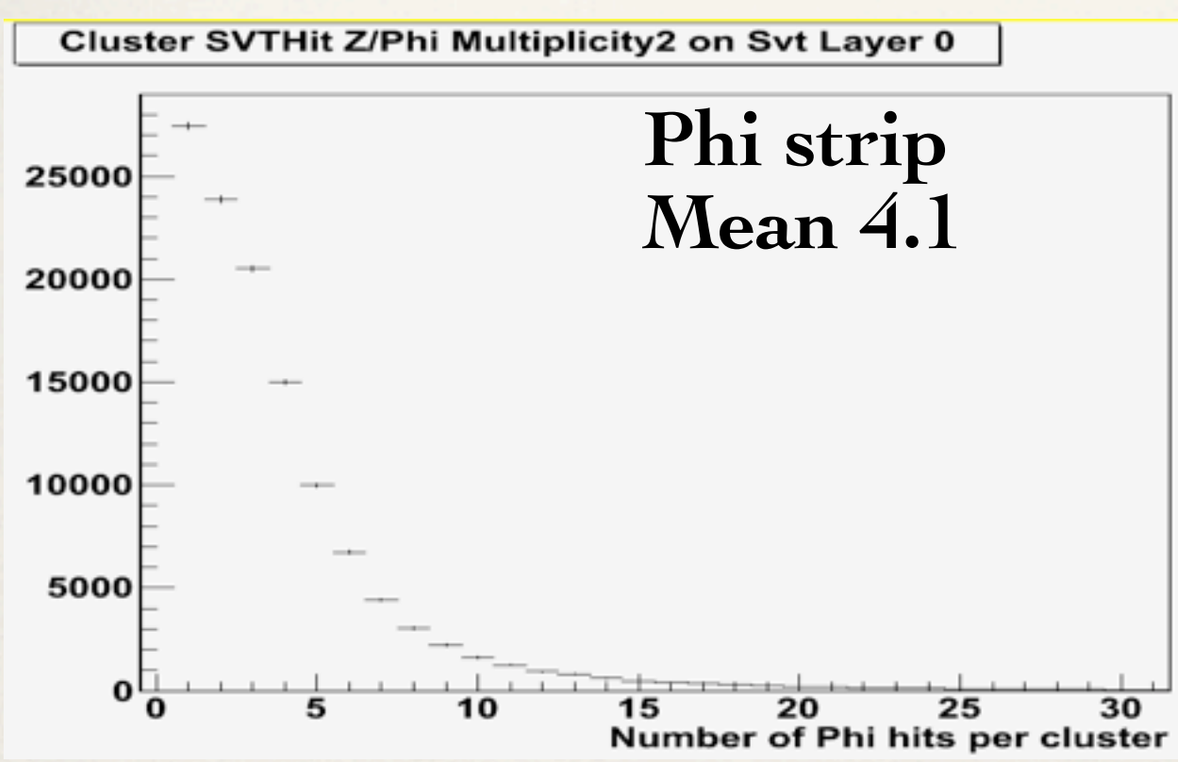


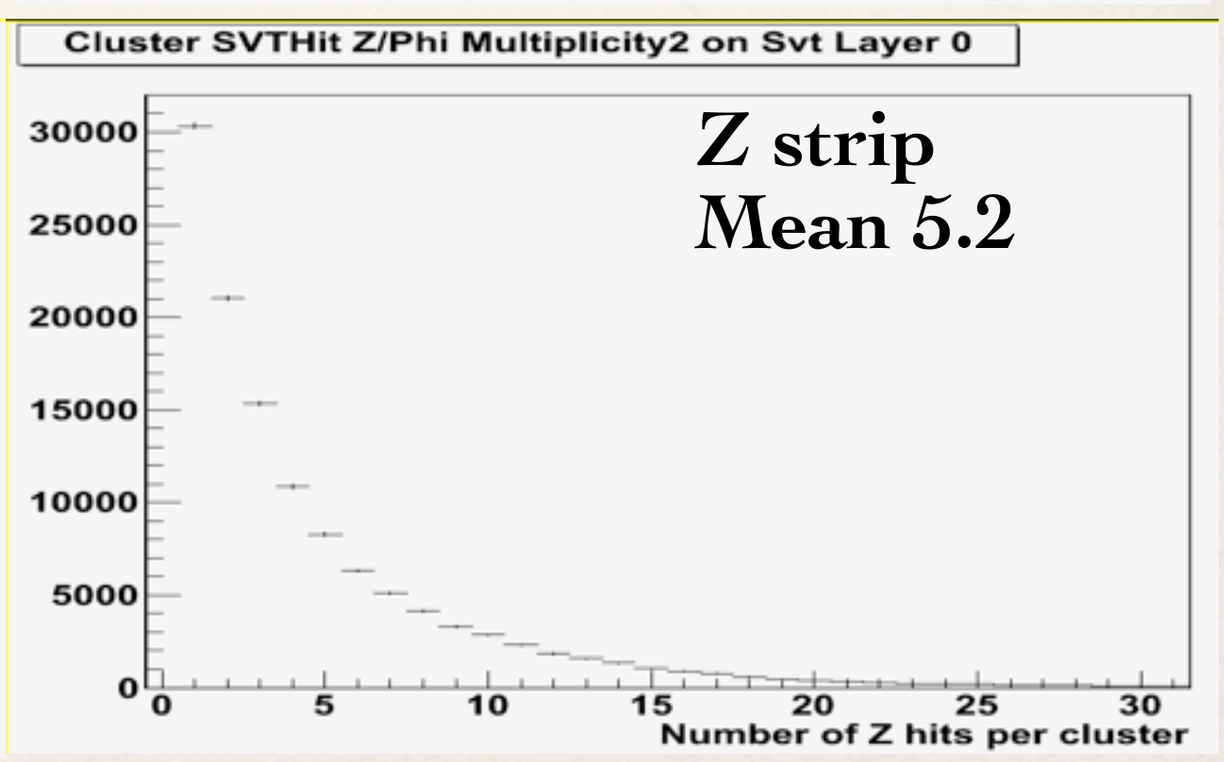


Layer0 multiplicities

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







Multiplicity comparison

- Comparison with values from Trieste (Apr 2011)
- Different geometry, but now same pitches
- Updated results from Trieste should be presented tomorrow by Lorenzo V.

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	

Conclusions

- Pixel rate, fluency and dose higher than previous estimation due to a bug in the sensitive volumes, factor 3-4
- Checks on pixel/strip count algorithm
- Rates and multiplicities estimation using real pitches and strips
- Comparison with Trieste multiplicities, we see lower values for all the layers
- Next step: remove cylindrical approximation. Add module information on simulation output and evaluate rates module by module. Other things with higher priority?
- New L0 geometry from Filippo B. to be implemented using gdml?

Cluster multiplicity

- Many **one pixel/strip cluster** for L4-5, easy to be removed by threshold
- Average multiplicity can be higher with Trieste approach
- Not yet look at energy released per pixel/strip