Analysis Meeting – 08/10/2012

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CALICE Calorimeter for ILC

LABORATOIRE DE L'ACCÉLÉRATEUR LINÉAIRE

AGENCE NATIONALE DE LA RECHERCHE ANR

Software status

https://forge.in2p3.fr/projects/calice/wiki/DESY_2012-07_Analysis
(installed on LLR DAQ PC since June, on forge since August !!)

- **Raw files conversion:** Raw2Root.C
  - 1 ROOT file per layer
  - No cut (Keep all informations)
  - Flag BCID+1 events
- **ROOT files Merging:** mergeRootFiles.C
  - Keep all informations
- **Reconstruction:** ObjectBuilder.C
  - Group hits with the same BCID (tolerance +1 in others chips)
  - Cut BCID+1 events
  - Flag plane events (Nhits in 1 chip > 20)
  - File content:
    - Hit: energy, position (pad position, channel number, chip number)
    - Time (spill number + BCID)
    - Nhits
    - EventType
- **Event Display:** Plot3D_Obj.C

To do: pedestal substraction

Simulation Status

- **Geometry:**
  - Detailed description of the detector geometry
  - Simple script to modify configuration
- **Beam:**
  - Direction: almost OK
  - To do : check position
  - Correlation between particle position and beam direction?
- **Output:** same root file structure (1 chip, 1 column, 324 channels)

  ==> same analysis tools
- **Simple digitization**

==> waiting for feedback

Energy measurement in simulation - Digitization

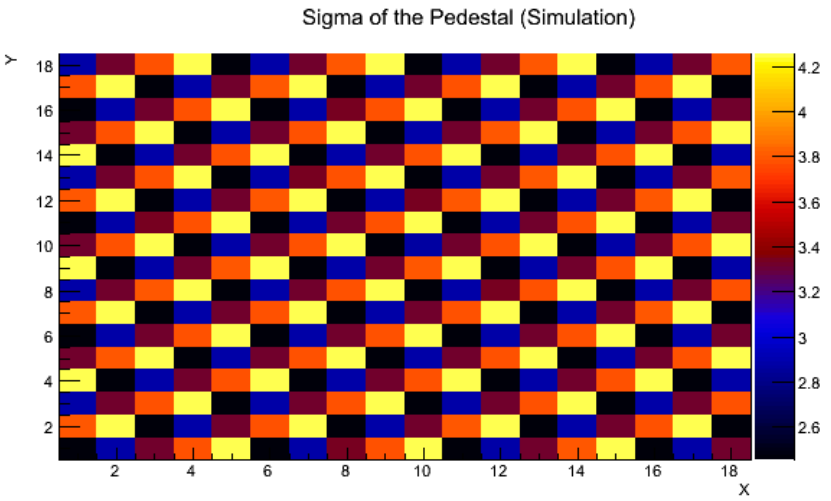
Keep all informations in the ROOT file!!

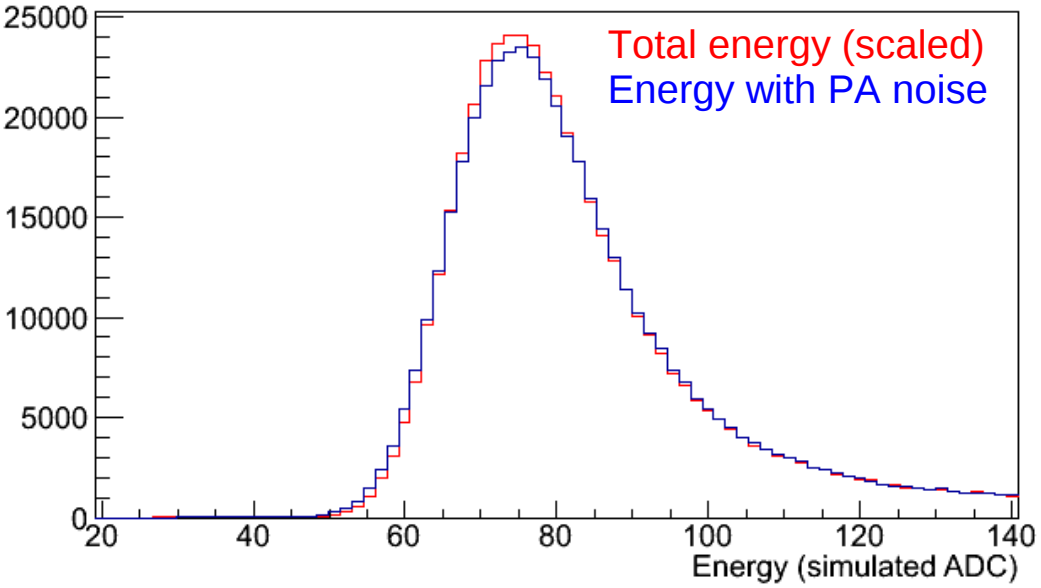
- Total energy deposited in one pixel (in keV)
- Gemetrical cuts (inter-pixel gap) (in keV)
- Electron-hole prair production fluctuation (in keV)
- Electron-hole transport diffusion (in keV)
- Scaling using the landau MPV (1/1.27 -> in ADC)

  + Add PA noise (sigma from 2 to 4 ADC)

    - Apply trigger threshold (scan trigger threshold -> detection efficiency...)

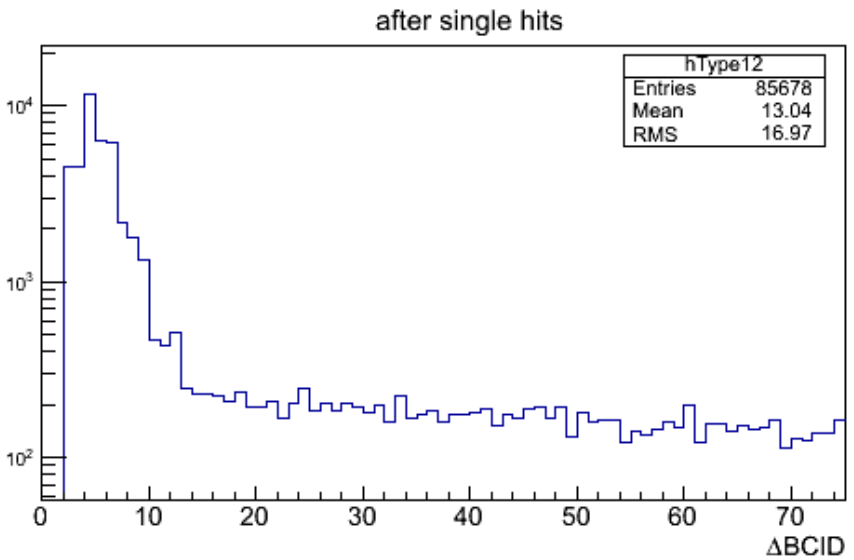
- Add SS noise (sigma = 1.4 ADC)
- Add pedestal (+300 ADC)

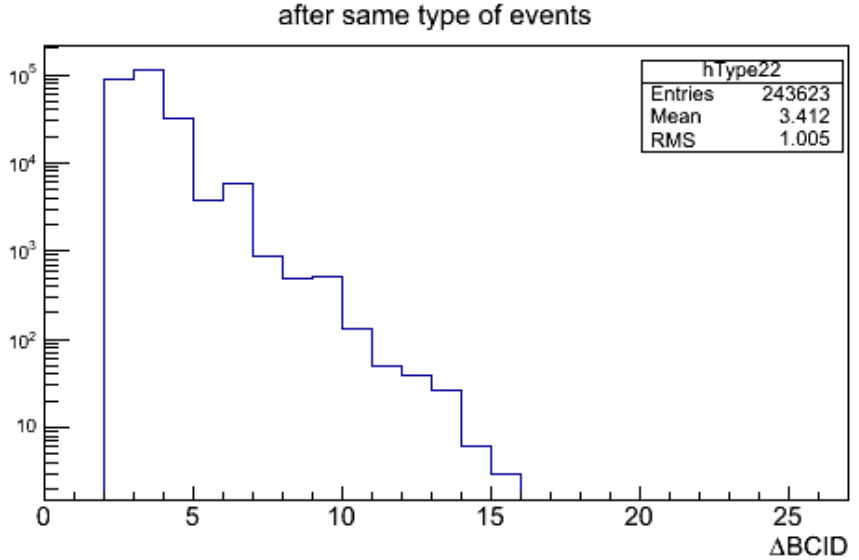


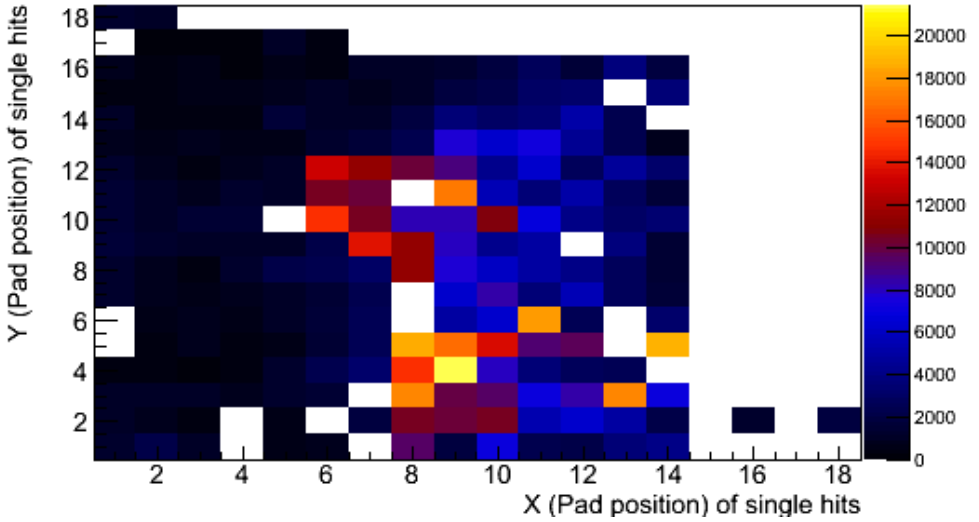


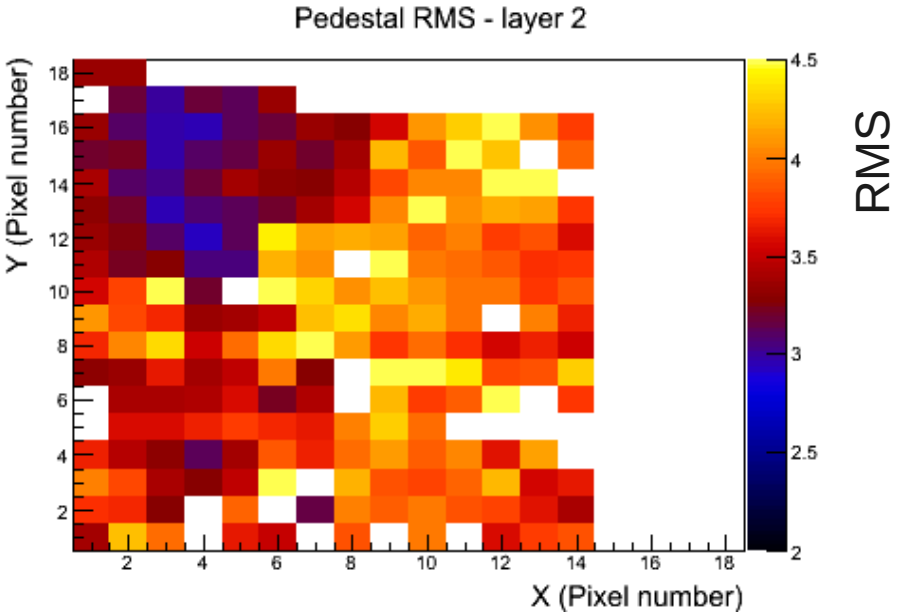
Data quality

Plane events









Is it just a map of noisy channels?
Is some channels induced plane events?

Need further investigations!

BCID+1 and Plane events

BCID+1
Plane Evts

- 2 acquisitions, centered, no W

  0: chip M1: 30% – 20-25% , others chips 10-15% – 6-9%

  1: chip M1: 40% – 25-30% , others chips 10-15% – 6-9%

  2: chip M1: 43% – 30% , others chips 12-20% – 10-15%

  3: chip M1: 45% – 40% , others chips 30-40% – 20-30%

  4: chip M1: 53% – 20-25% , others chips 20-30% – 15-18%

  5: chip M1: 52% – 20-25% , others chips 20-30% – 15-18%

  More bad events

  ==> increase from 0 to 4, 1 ~ 2, 5 ~ 3 or 4

- % of bad events compared with Nevt in the chip

  --> not appropriated (plane events does not occur in the same chip than previous hits)

  - chip= 1 Evt= 17475 - 39.6% - 26.9%
  - chip= 2 Evt= 125130 - 9.6% - 3.1%
  - chip=3 Evt= 17325 - 40.7% - 26.6%
  - chip= 4 Evt= 121305 - 8.9% - 4.0%

Some events are plane and BCID+1

BCID+1 and Plane events

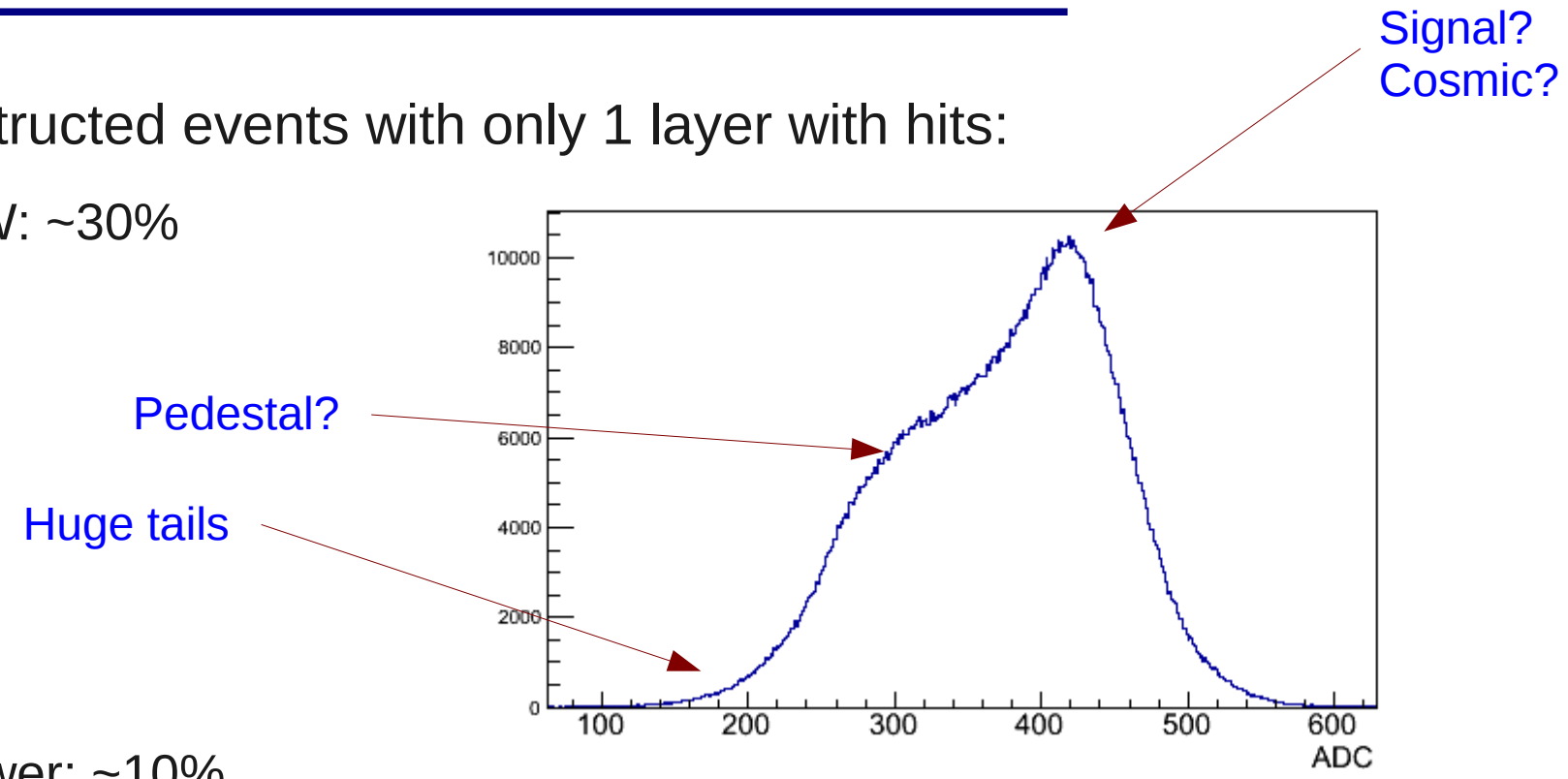
BCID+1
Plane Evts

- Increase with shower developpement
  - Ex: 5 GeV – 6X0 in front of the detector + W plates - layer 4
    - chip= 1 Evt= 240300 - 71.7% - 43.2%
    - chip= 2 Evt= 244185 - 57.7% - 64.7%
    - chip= 3 Evt= 246015 - 72.8% - 53.8%
    - chip= 4 Evt= 231495 - 66.0% - 64.8%

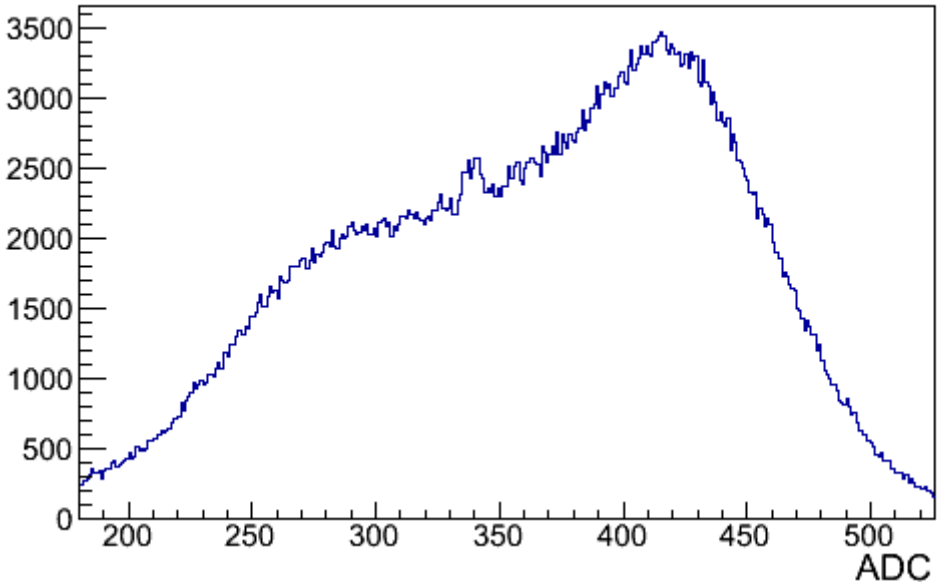
Some events are plane and BCID+1

Isolated hits

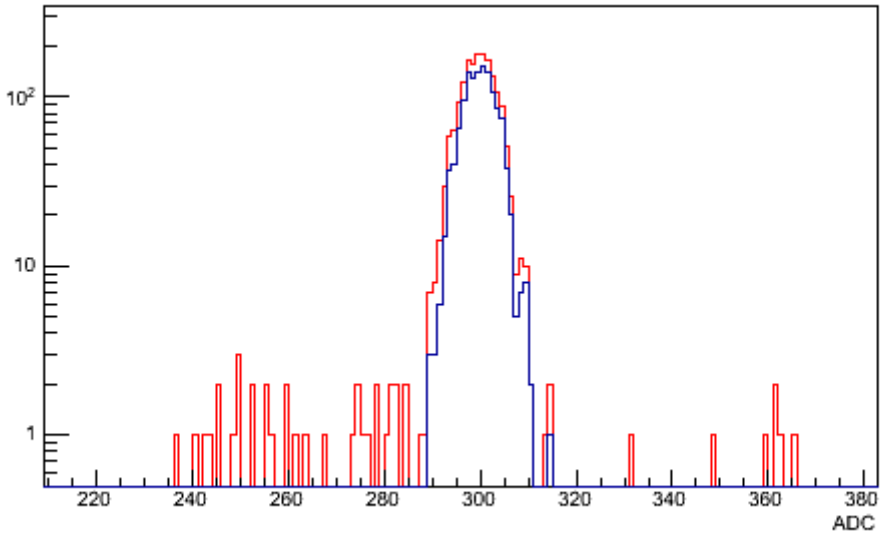
- Reconstructed events with only 1 layer with hits:
  - No W: ~30%



  - Shower: ~10%



Pedestal filtering



Same channel
Red: all events
Blue: remove all events of the spill if 1 plane event in the spill
==> Plane event at BCID=1000 correlated with bad pedestal at BCID 500 ???

MIP Reconstruction – Beam studies

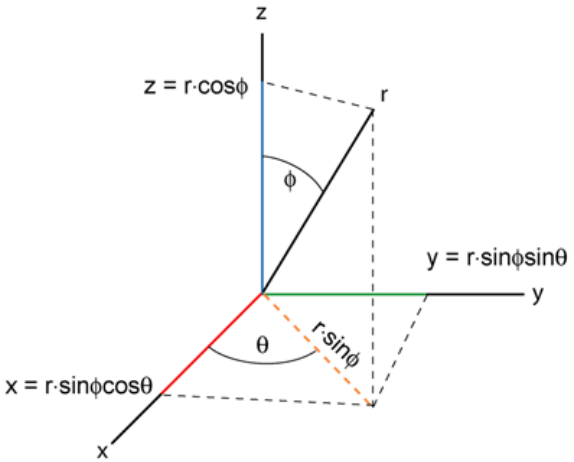
MIP reconstruction - Beam studies

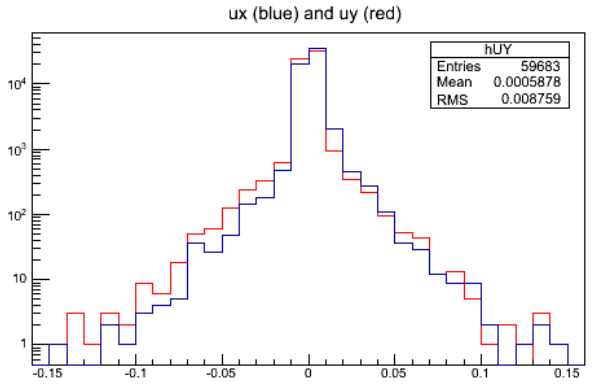
Fit function:

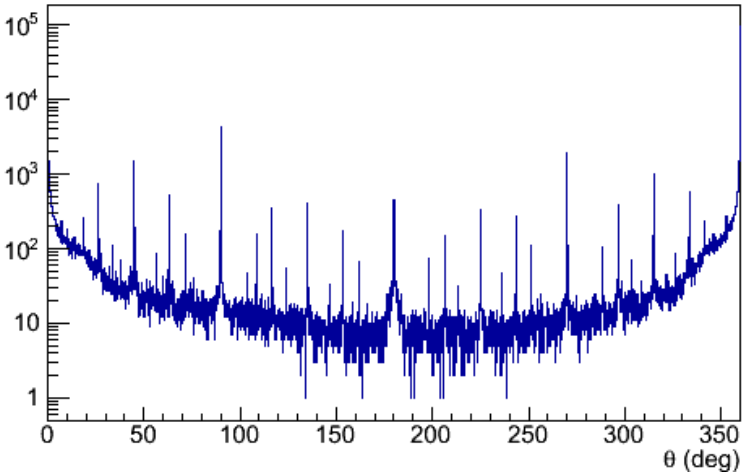
$x = x_0 + k.u_x$

$y = y_0 + k.u_y$ ==> spherical coordinates

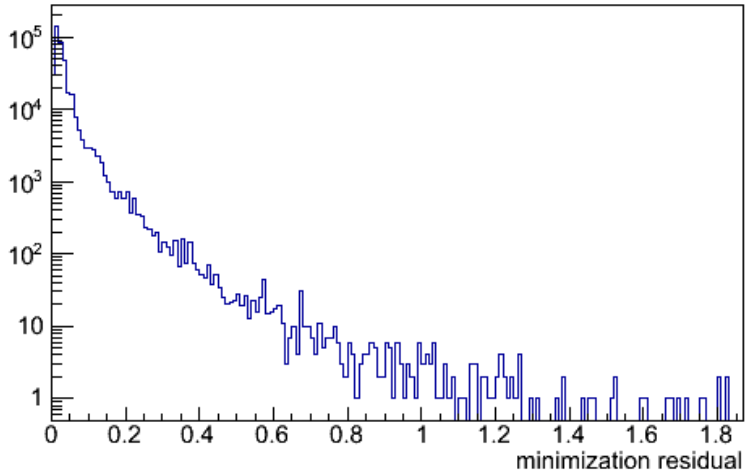
$z = k.u_z$



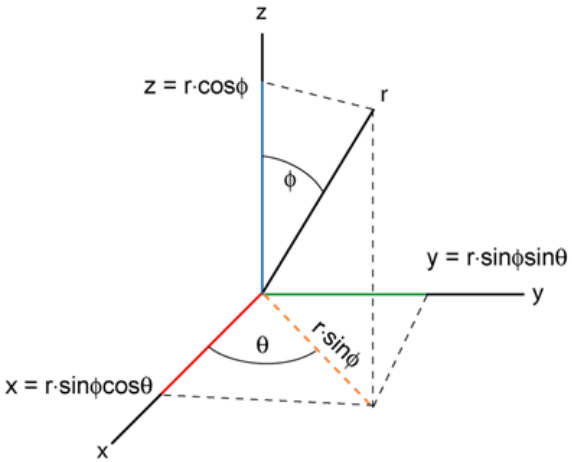




D = distance (Track – hit) ==> minimize: Sum(D x Exp(D-pixelEdge)

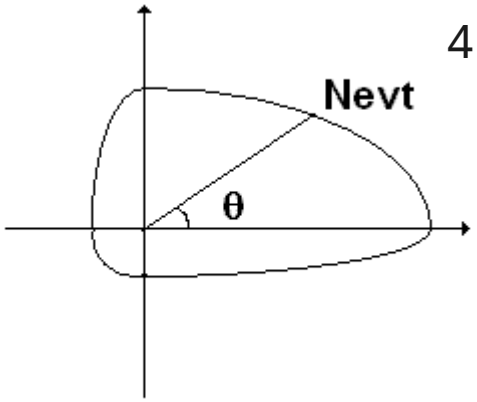


MIP reconstruction - Beam studies



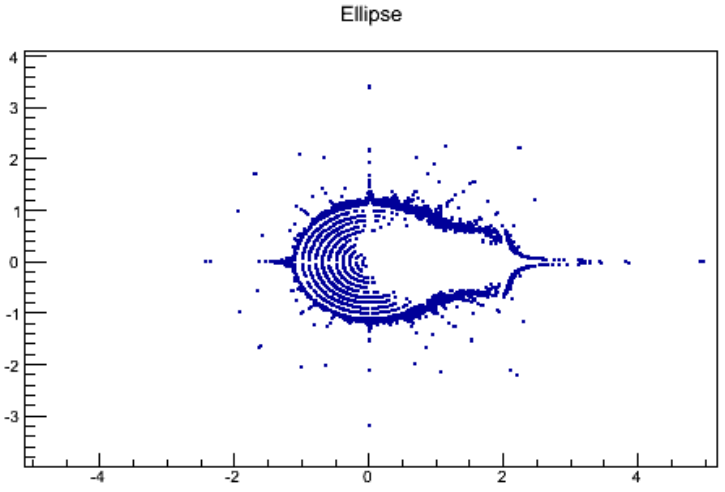
Beam reconstruction

- Theta:
  beam slightly deflected in X direction
  => detector alignment?, fake effect due to layer alignment?

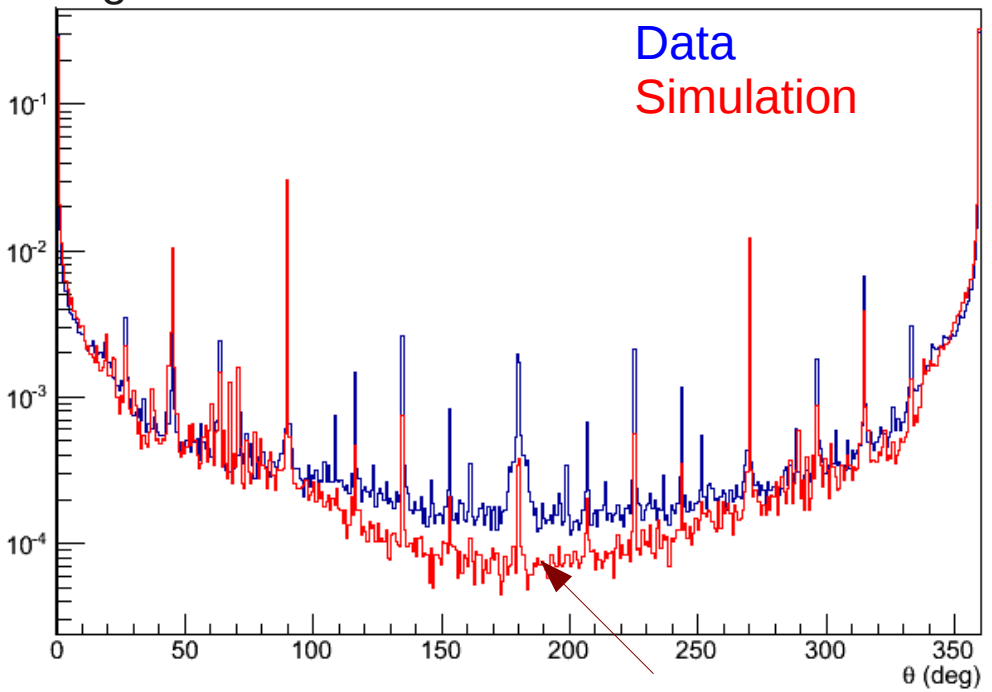


4 part ellipse:

- Construct using main axis
- Randomly choosen using area



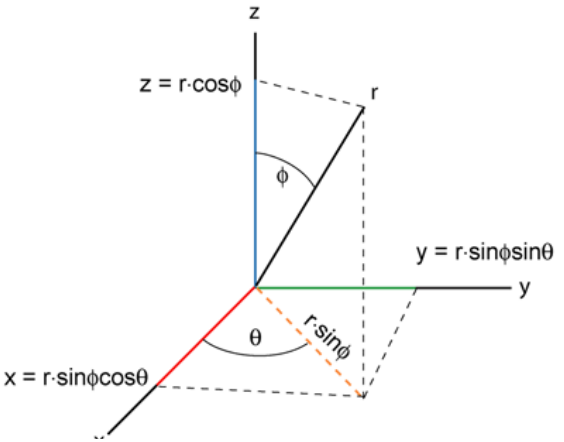
Log scales !!



Typo in code

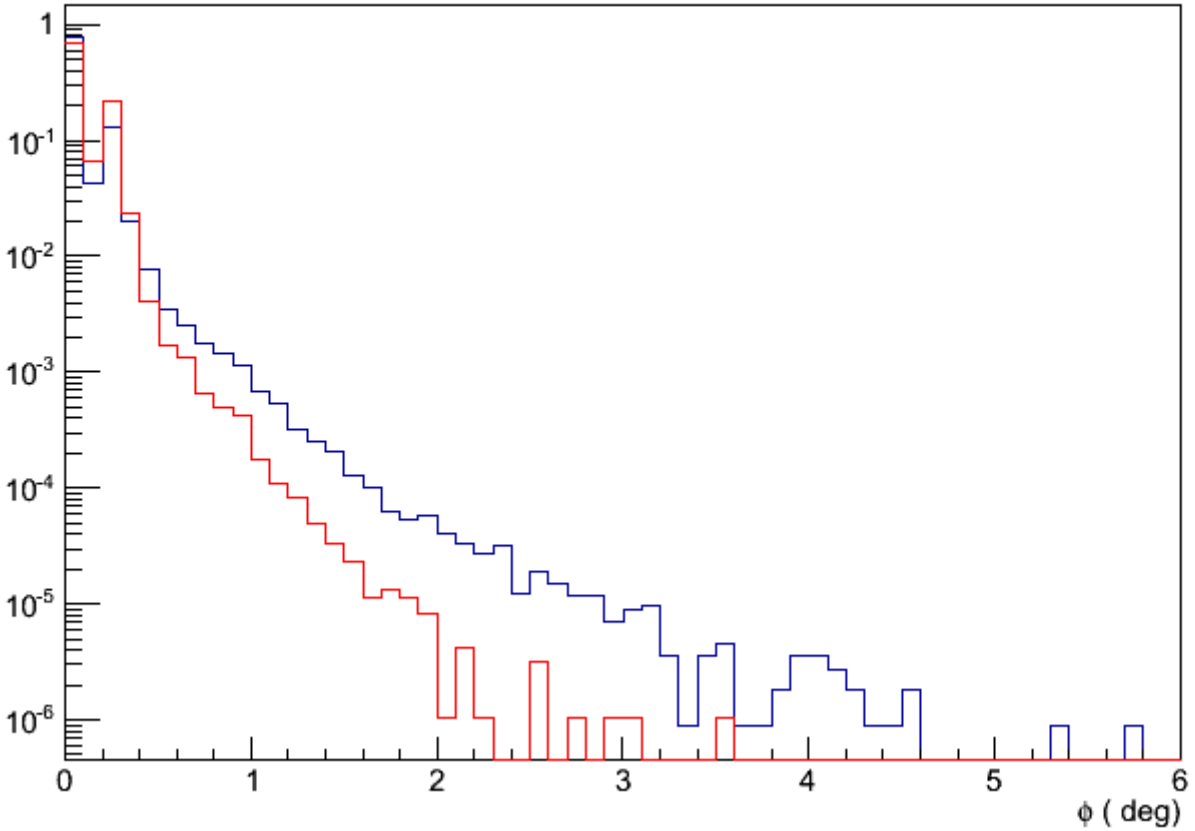
To do trigger scan!

MIP reconstruction - Beam studies



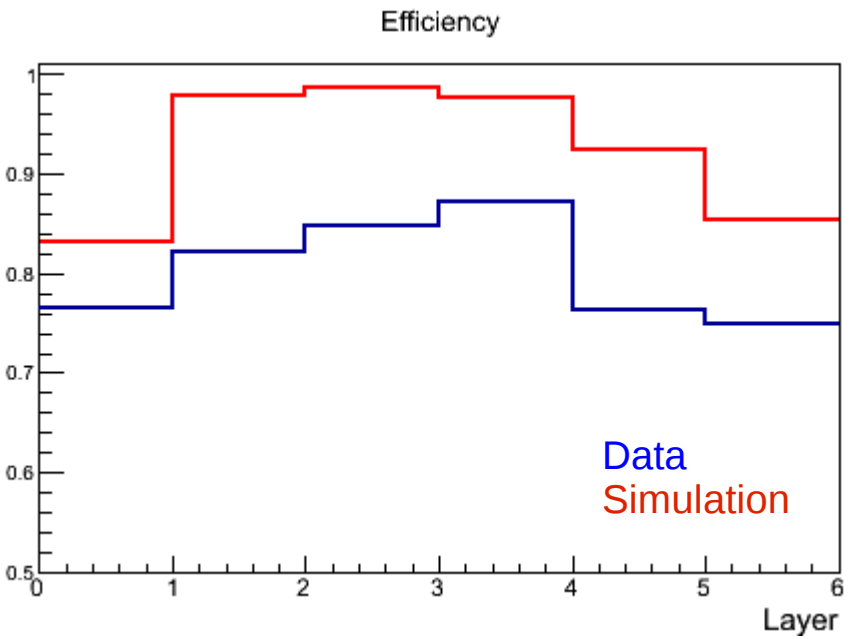
Beam reconstruction

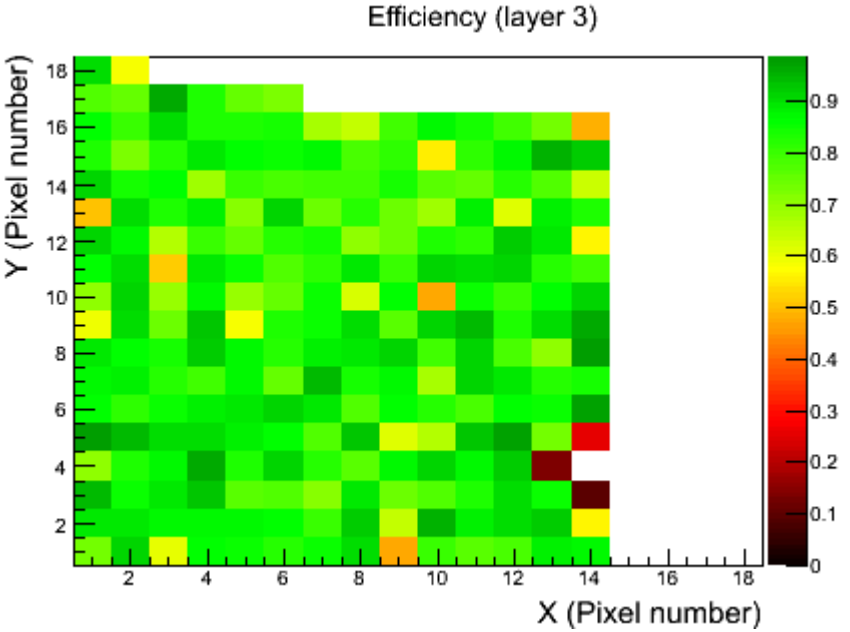
- Phi: gaussian distribution, sigma = 1°



To do trigger scan!

Detection efficiency





- Low efficiency close to switched off channels
  But some isolated low efficiency channels (to be investigated)

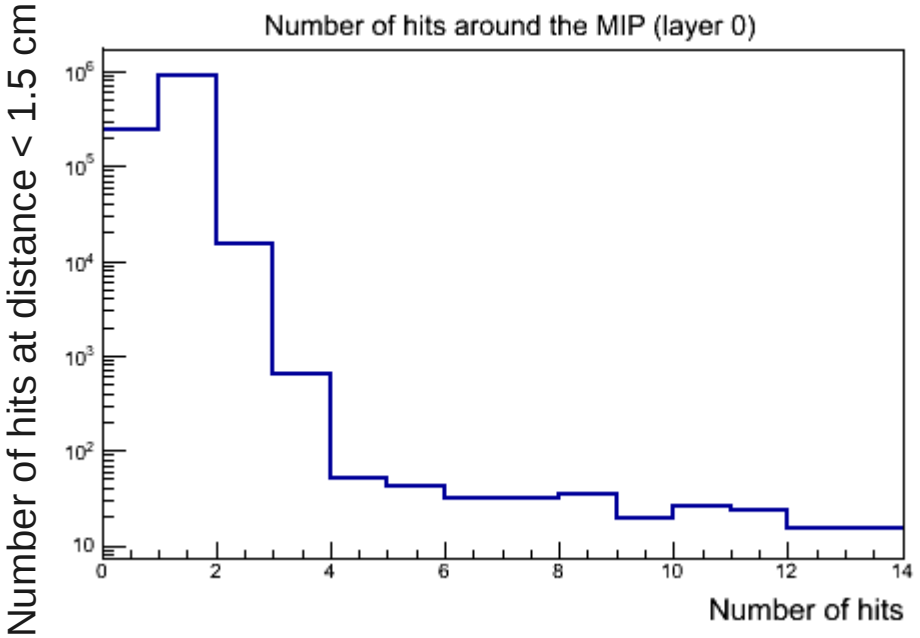
- Efficiency depends on the beam parameters (angle)
  ~~Need real beam parameters in simulation~~ --> DONE

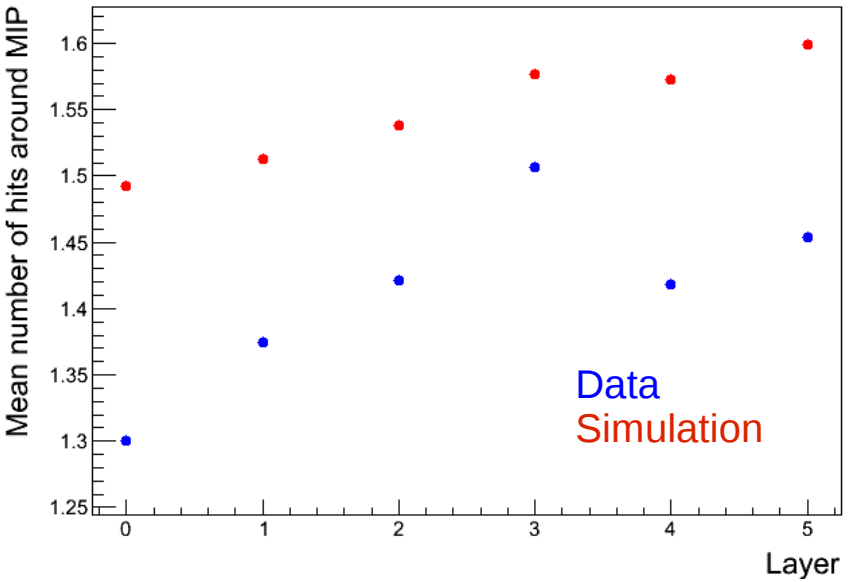
- Some effects not yet in the simulation (noise, trigger...)

To do trigger scan!

On going analysis!

Number of hits around MIP





- Some effects not yet in the simulation (noise, trigger...) To do trigger scan!
- Check correlation between the number of hits around MIP and the trigger threshold

On going analysis!

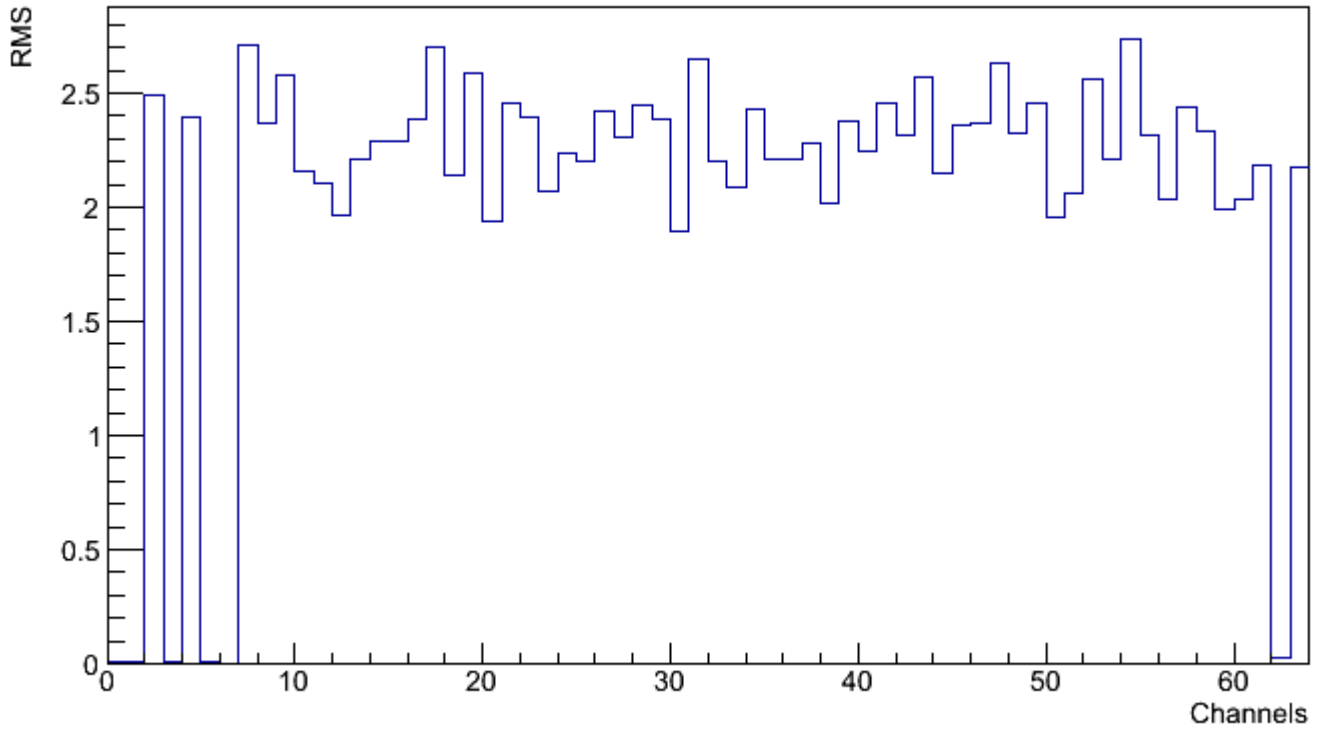
Correlation studies

Correlation studies

- Extract coherent noise source + intensity

  Chip M1: Sigma total ~ 3.5 ADC

  ==> 1 source for all layers (<sigma> ~ 2.3 – 2.5)

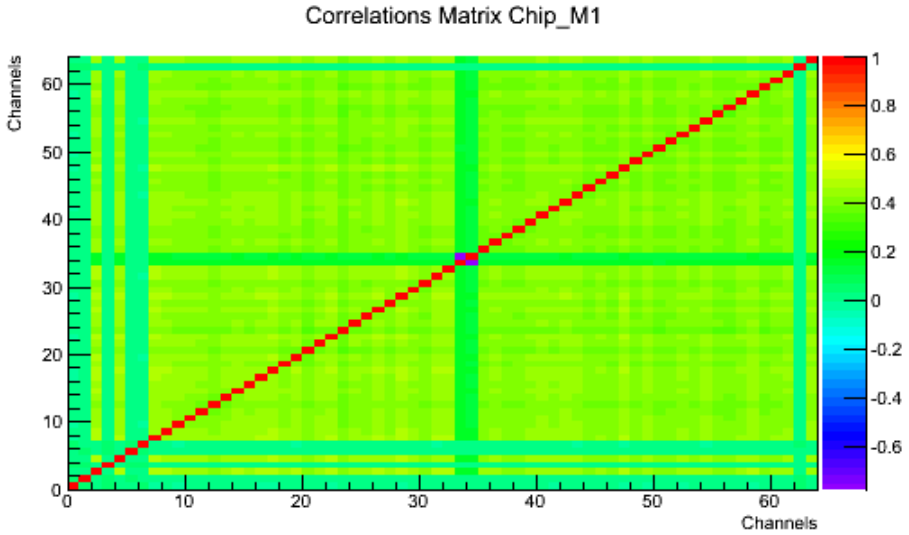


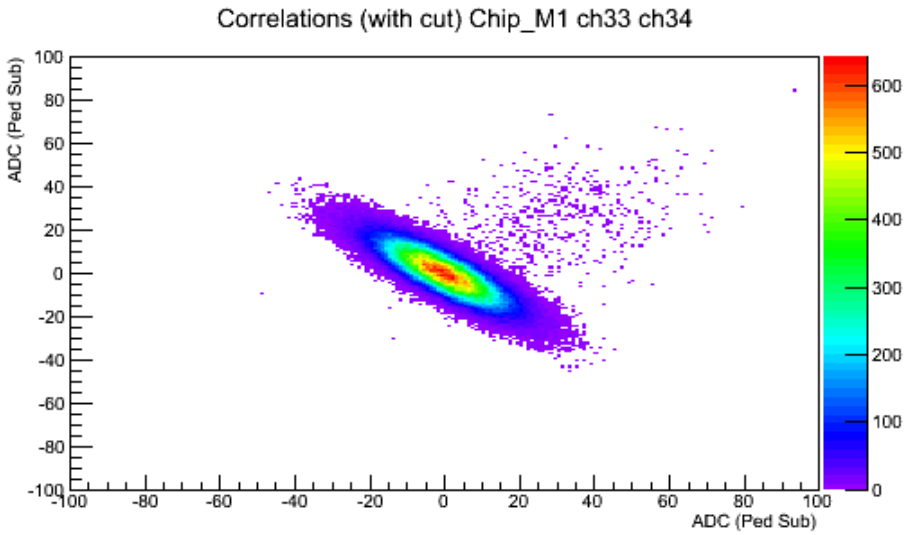
To do: check fluctuations with XY channel position

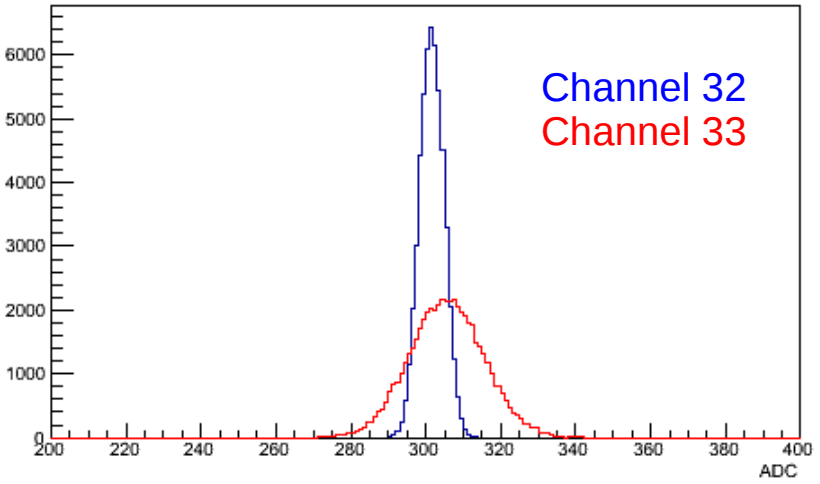
Correlation studies

- Chip M1: Sigma total ~ 3.5 ADC

  ==> Layer 2



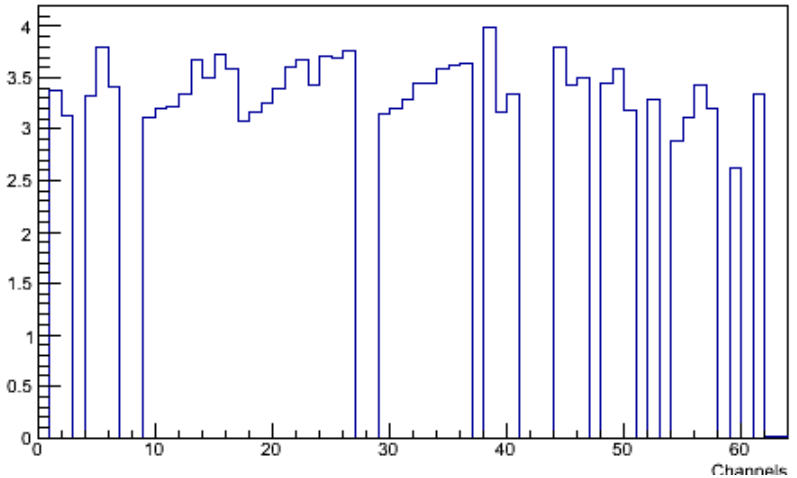


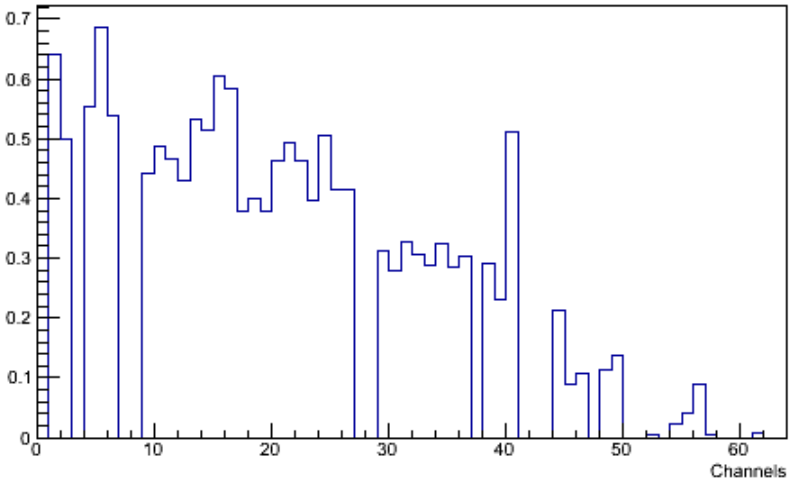


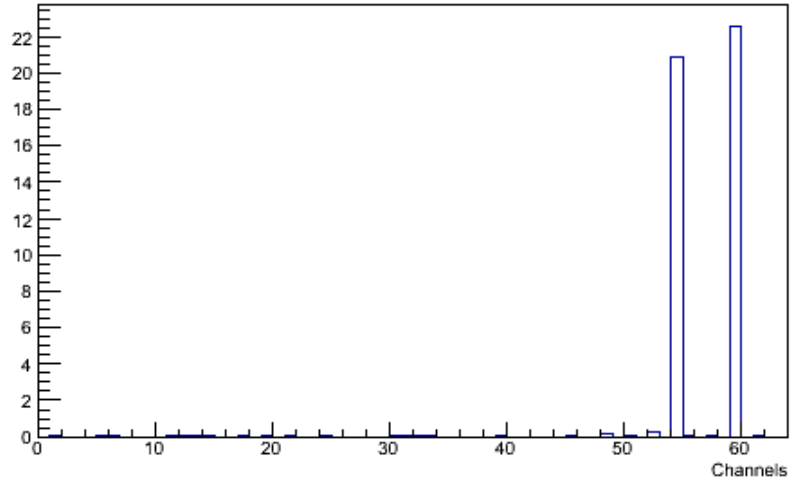
Correlation studies

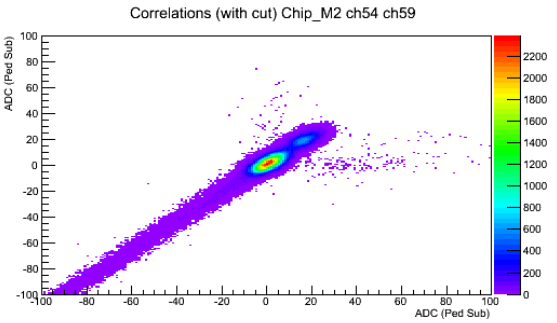
Chip M2: Sigma total ~ 4-5 ADC

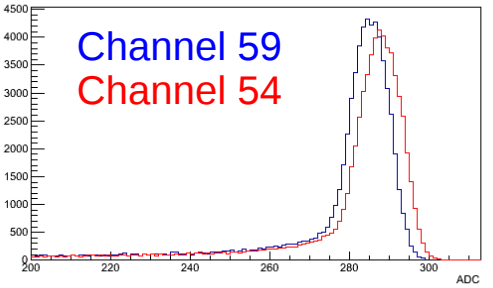
==> 3 sources for all layers







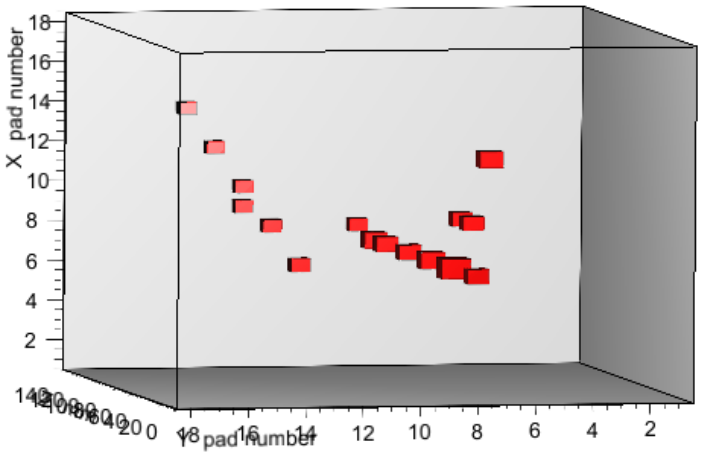


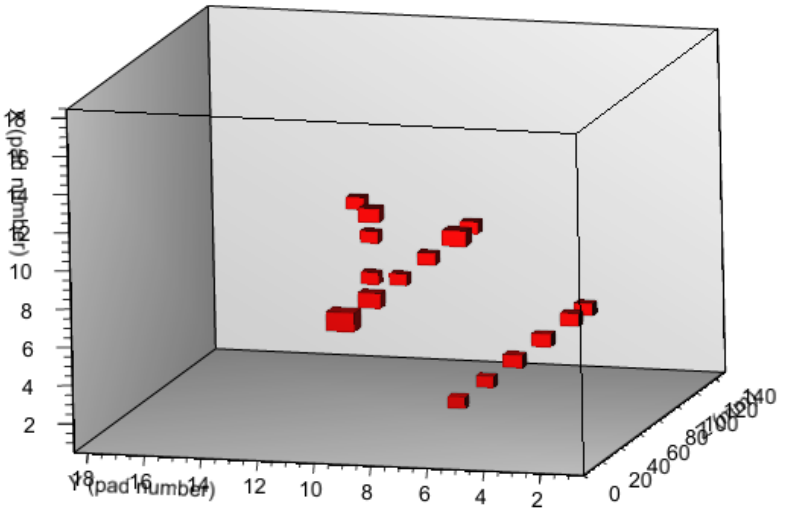


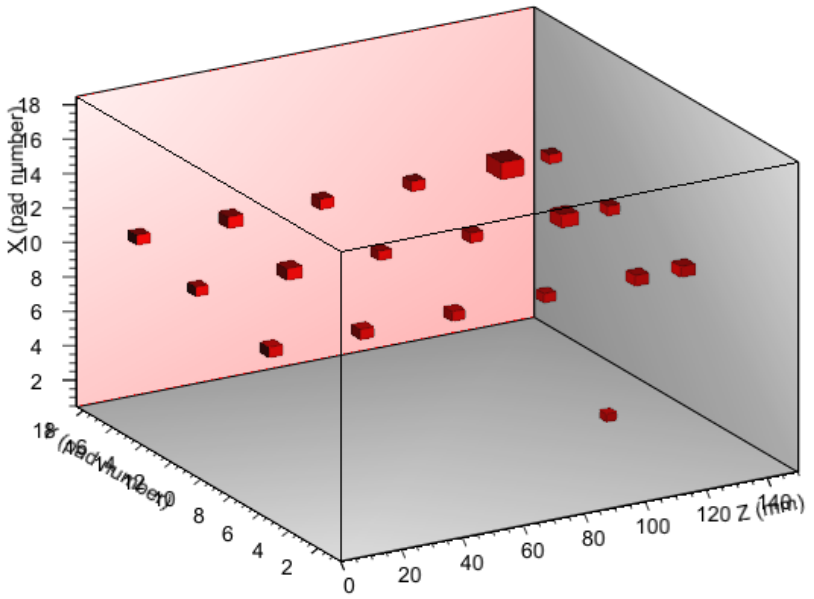
To do: check intensity varaitions with XY channel position
Is higher sigma total only due to higher coherent noise?

Event display

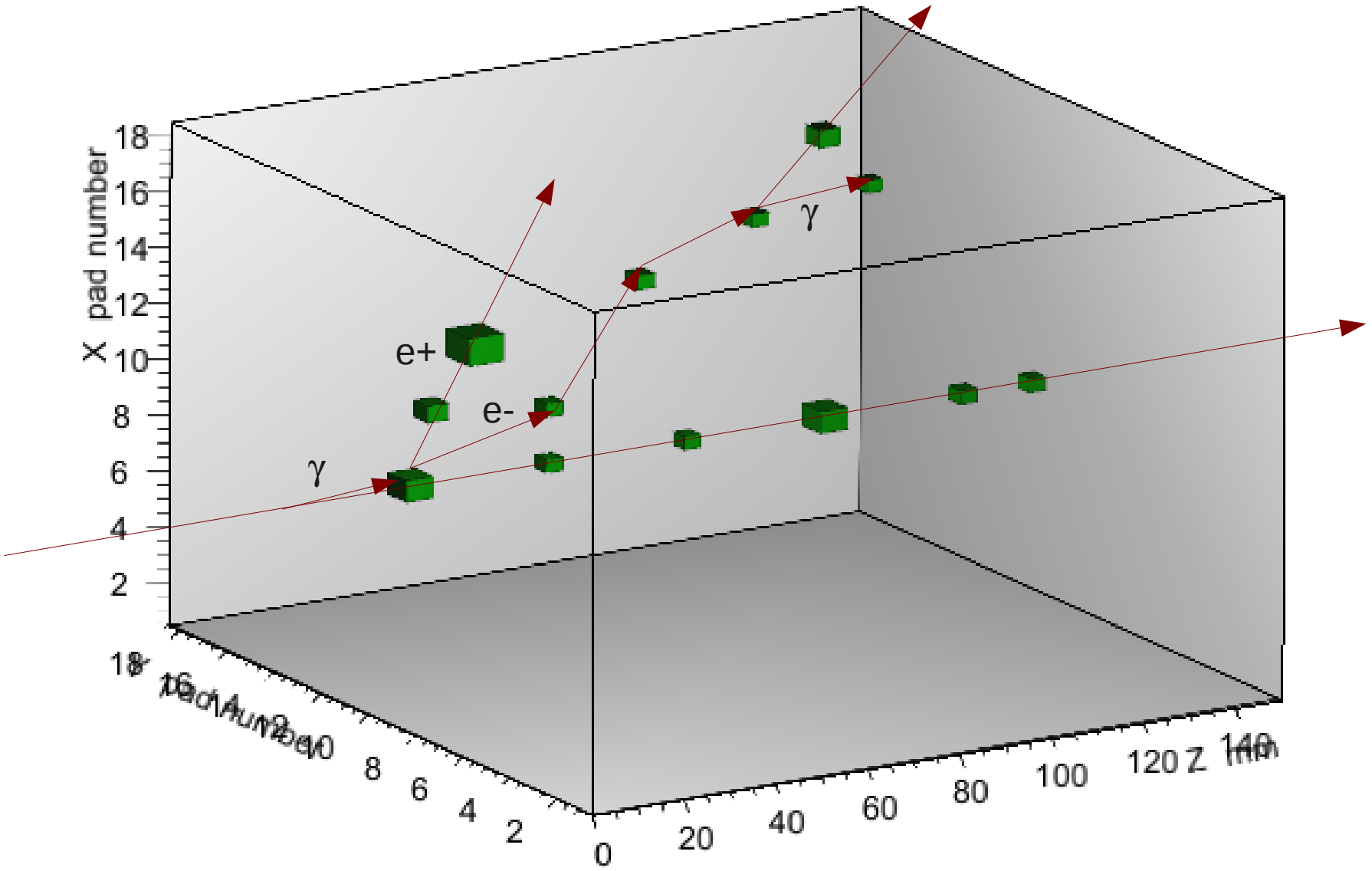
Event display







Event display



Summary

- Analysis in progress:

  - Beam reconstruction
  - MIP studies --> Trigger threshold scan: efficiency
  - Crosstalk --> on going, to be check with special runs
  - BCID+1, plane events.... on going

  - Energy calibration + Homogeneity of response : DONE
  - Determine signal over noise ratio of the detector: DONE

  See Jeremy's talk

  - Study of showers

  See Elmaddin's talk

Back up

Setup

- wafer 9x9 cm^2, 324 pixels 5x5 mm^2
- 6 FEV8 (4 SKIROCs per FEV)
  - 4 SKIROCs x 64 channels = 256 channels

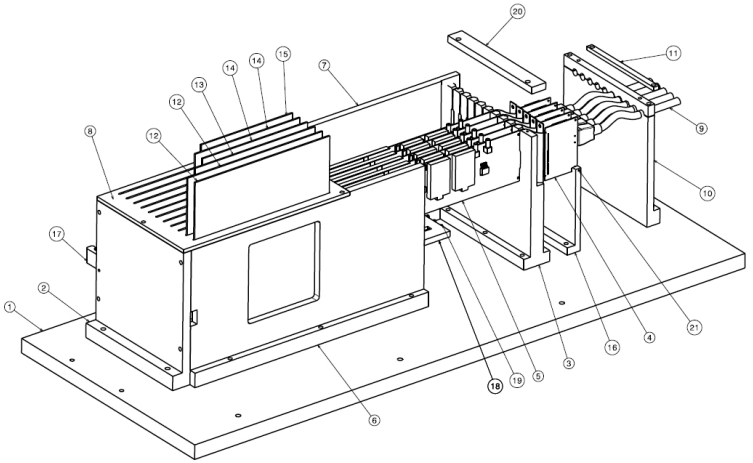
    (2 channels with 2 pixels and 22 channels with 4 pixels)

Total = 1536 channels

PreAmplifiers of noisy channels are switched off

total active channels = 1278

- PVC structure with position for tungsten plates (2.1 mm)



Rep	Désignation	N°Plan	Nbre	Matière	Traitement	Observation
21	Goupille DIF		1	Stubbe		
20	Couvercle Peigne 2	CAL-12-03-11	1	PVC		
19	Piston	CAL-12-03-06		Laiton		
18	Support Piston	CAL-12-03-07	1	AU4G		
17	Came de Position	CAL-12-03-14	1	Delrin		
16	Support DIF	CAL-12-03-12	1	PVC		
15	Tungstene 141 2.1		1	W		
14	Tungstene 162 2.1		2	W		
13	Tungstene 185 2.1		1	W		
12	Tungstene 209 2.1		2	W		
11	Barreau Presseur Cable	CAL-12-03-18	1	PVC		
10	Support Cable	CAL-12-03-17	1	PVC		En 2 pièces
9	Connecteur HDMI					avec Cable Rond
8	Barreau Cale H	CAL-12-03-16		PVC		
7	Plaque Coté Droit	CAL-12-03-15	1	PVC		
6	Plaque Coté Gauche	CAL-12-03-13	1	PVC		
5	Slab U Court					
4	DIF Group					
3	Peigne 2	CAL-12-03-10	1	PVC		
2	Peigne 1	CAL-12-03-09	1	PVC		
1	Plaque Support_2	CAL-12-03-08	1	PVC		