SiW ECAL
2017 Beam Test preliminary results

(Analysis BT2017 working group)

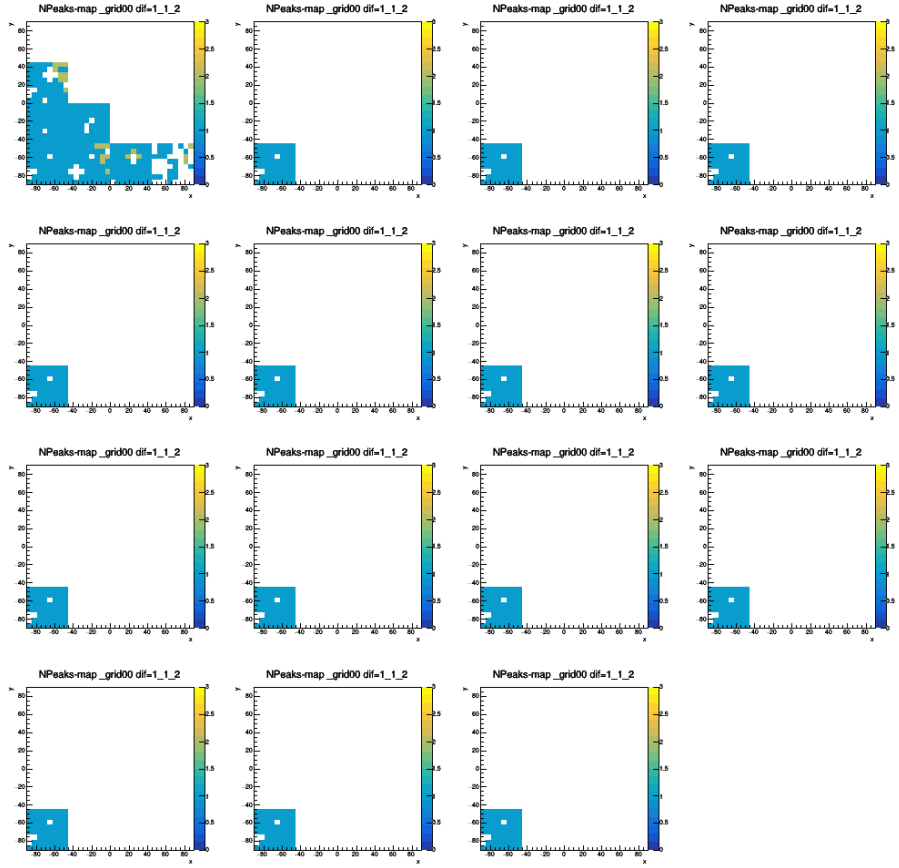
A. Irles, 14th September 2017

Outline

- Single slab analysis
  - Pedestal
  - MIP & S/N for the 7 slabs
  - MIP & S/N for a tilted detector run (~45 degrees)
  - Pedestal & MIP & S/N in magnetic fields
- Full proto analysis (event built analysis)
  - MIP analysis
  - Electromagnetic showers

Pedestal estimation

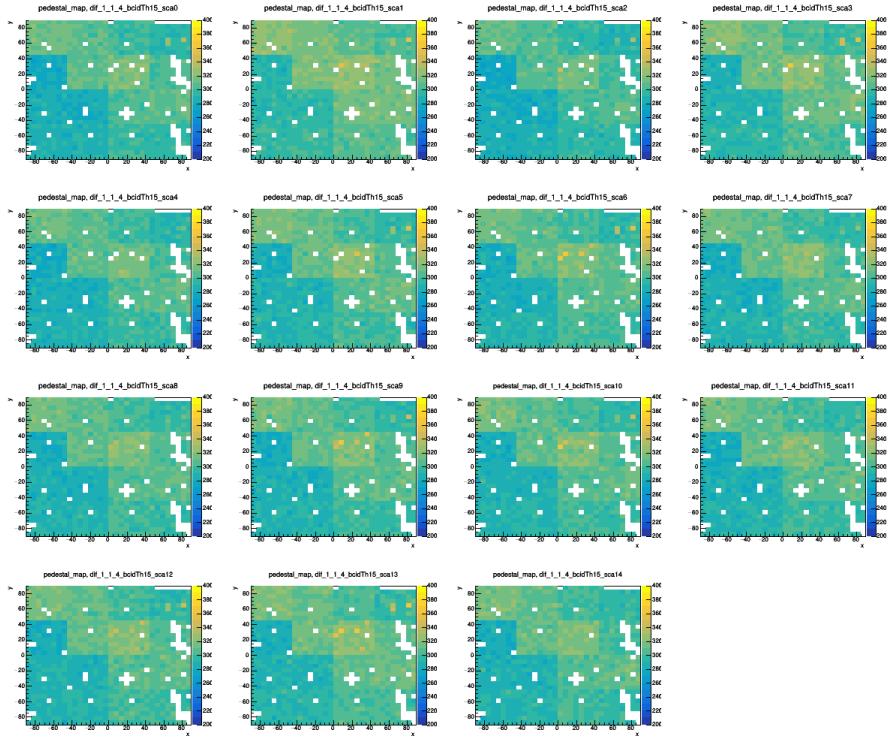
- Example: shooting the beam in the bottom left corner:
  - The canvas shows 15 maps (15 SCA) of the number of peaks of the pedestal distributions.
  - The pedestal distribution is well shaped (one single peak) In the chi were we shot.
  - In the others, we only have events that pass the filtering in the first SCA
  - And even those give wrong distributions (double peak distributions)
- The pedestal distribution is calculated, therefore, only on the chips were we shoot.
  - If a chip is shoted in two positions, the most precise pedestal determination is taken.



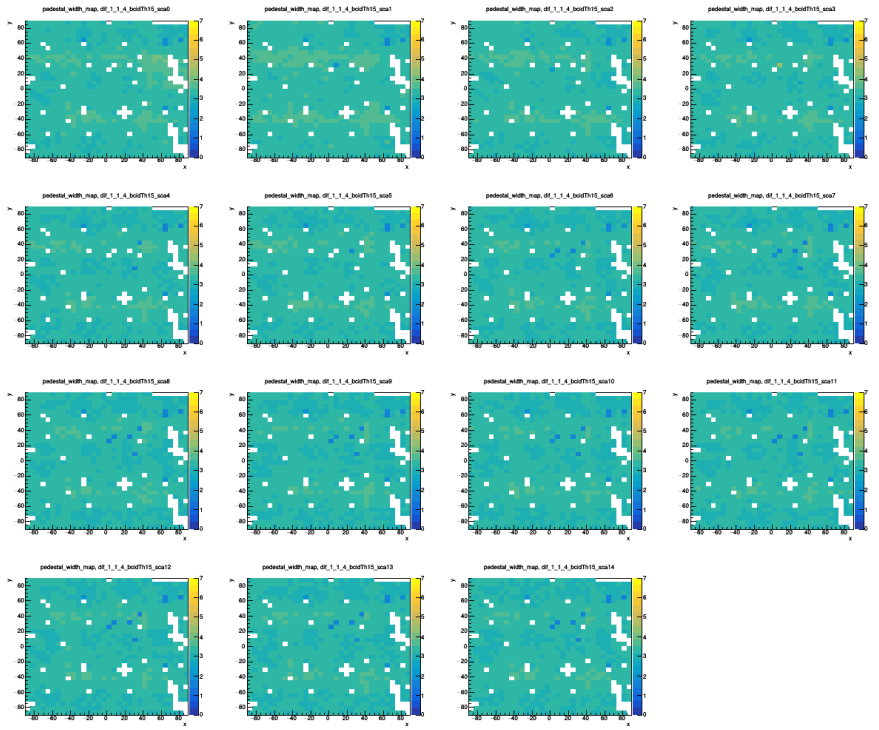
Pedestal estimation

- Pedestals are calculated for all channels, all SCAs using data from the 81 points of the MIP scan.
- These values are used for now on in all analysis
  - Some pedestal comparisons will be presented in order to prove pedestal stability
  - For magnetic field tests, we also calculate the pedestal on the fly.

- Example: 6th layer.
  - Leftmost plot: pedestal average map for 15 SCAs z-scale from 200-400 ADC

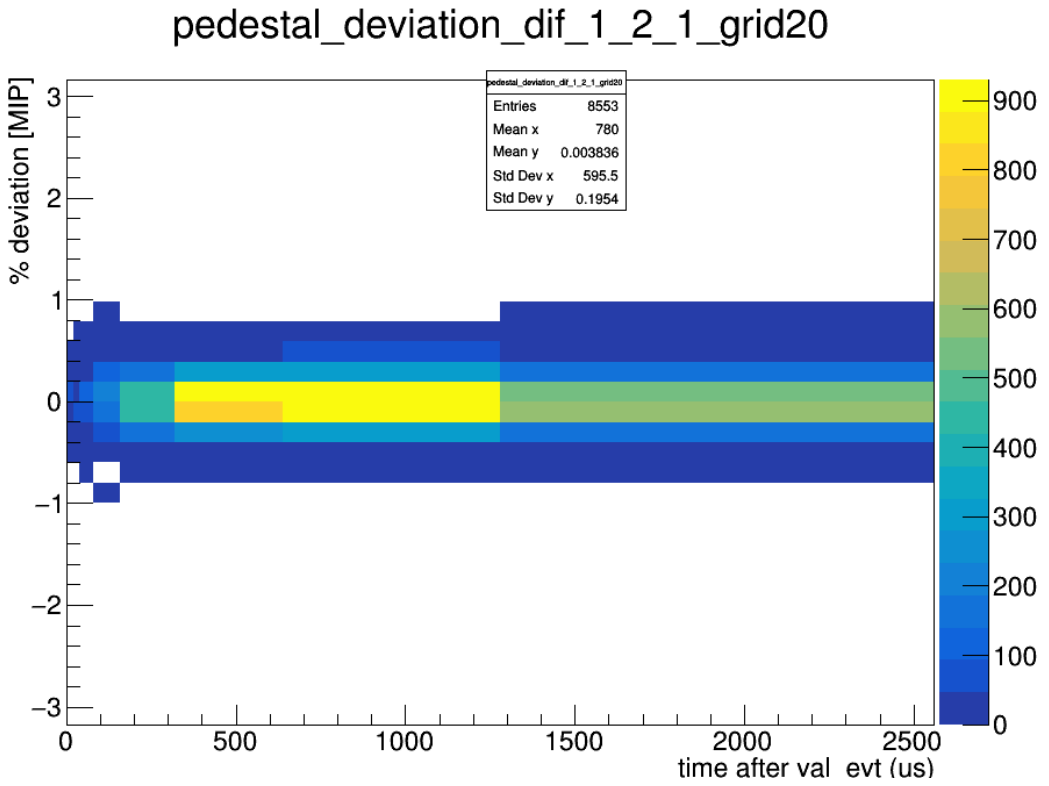


  - Rightmost plot: pedestal width map for 15 SCAs z-scale: from 0-7 ADC



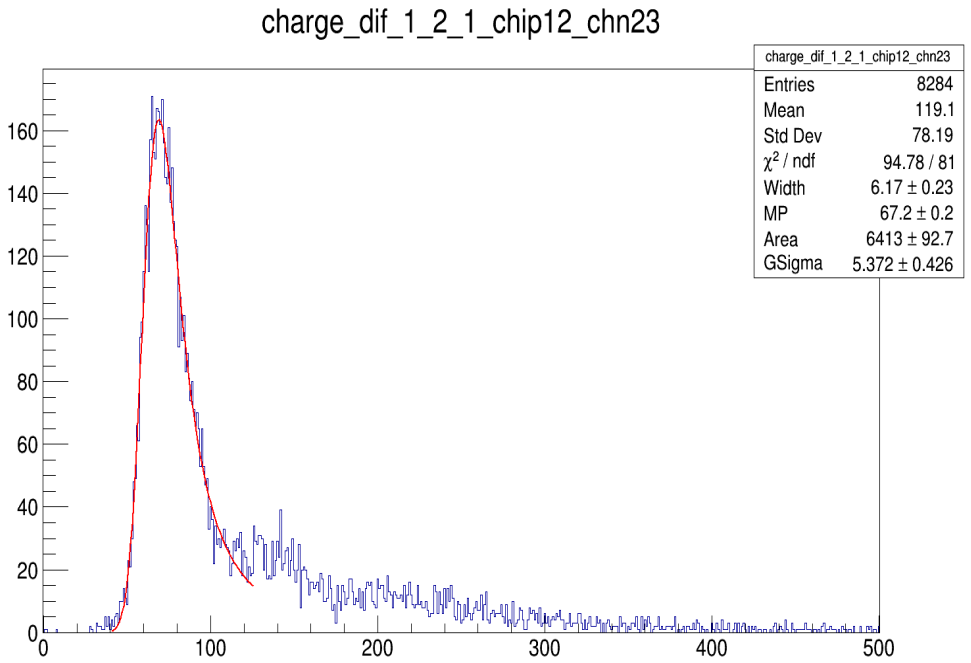
Pedestal mean position for different times within a spill

- Deviation is shown in units of ~MIP
  - assumming MIP at ~65ADC, (which is a reasonable value)
  - One entry per channel and SCA.
- The chip/sca, chip/chn & chn/sca maps show only the cases were the deviation is larger than |2%|
- Pedestal value remains constant within 0.5%MIPs
  - Similar results for all slabs/grid points



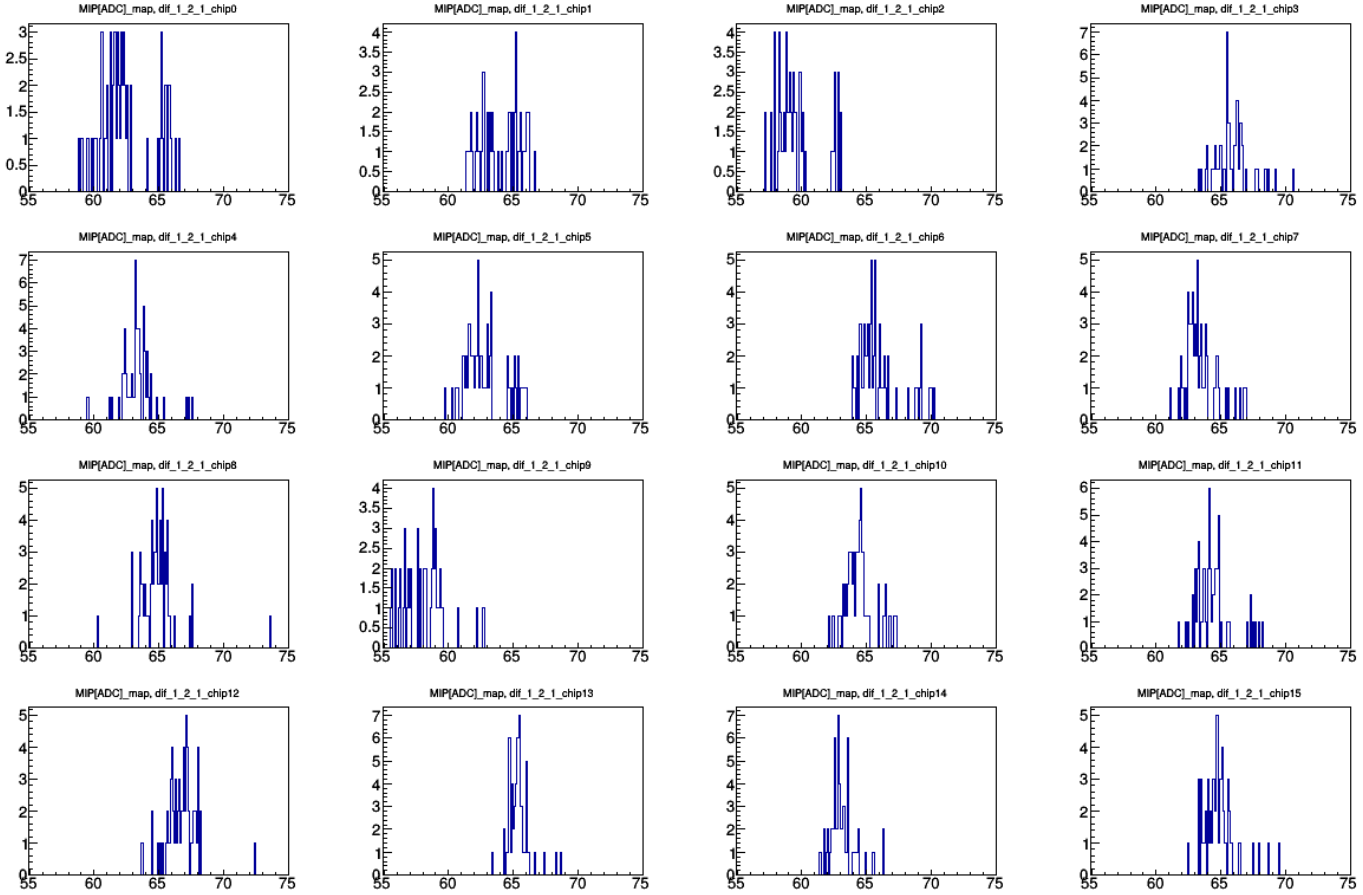
MIP and S/N calculation

- Simple selection:
  - Basic filtering chip based (not even building)
  - cut in bcid to avoid noise bursts
  - No coincidences required !!



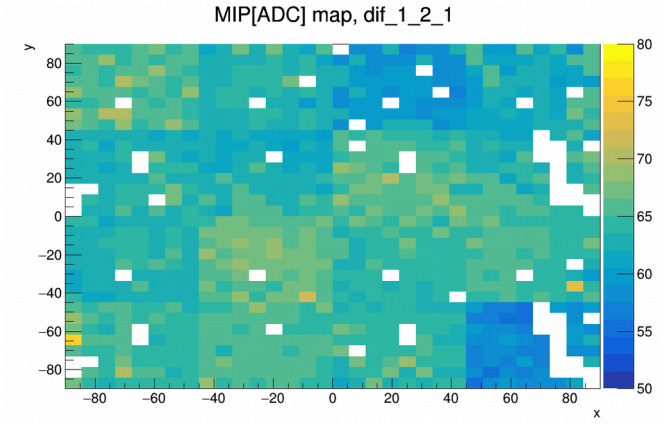
MIP scan results: (6th layer)

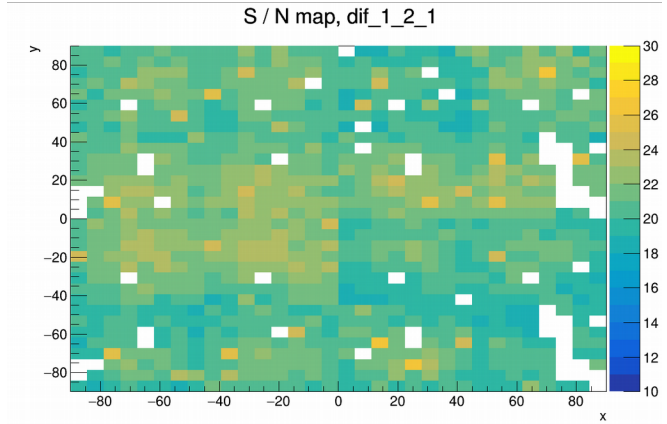
- MPV per chip (pedestal subtracted)

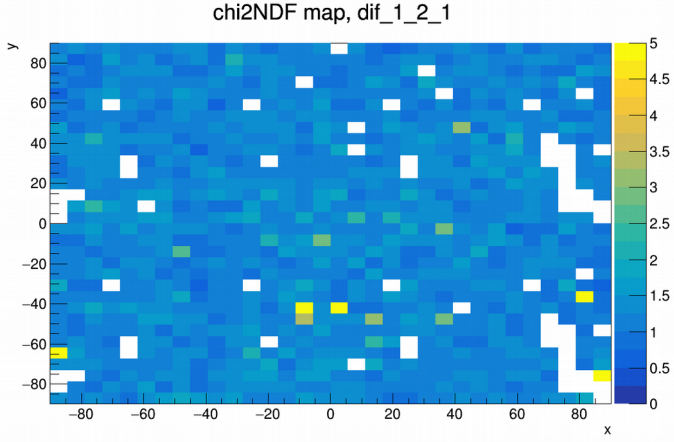


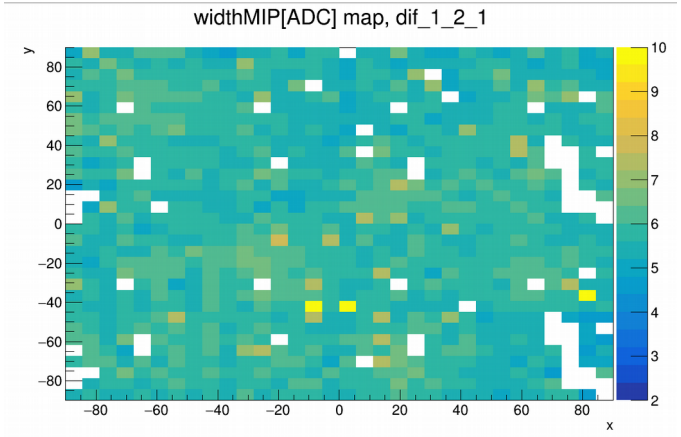
MIP scan results:(6th layer)

- Signal analysis maps (pedestal subtracted)

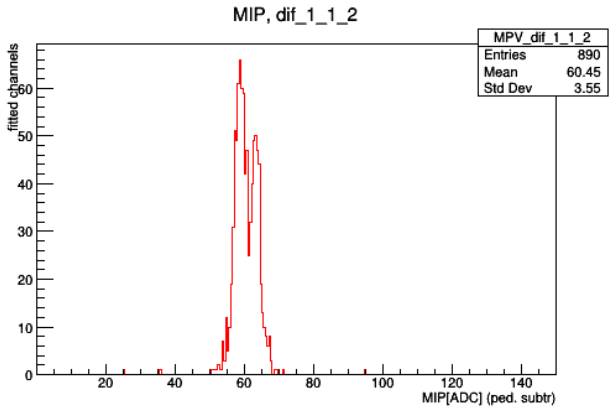


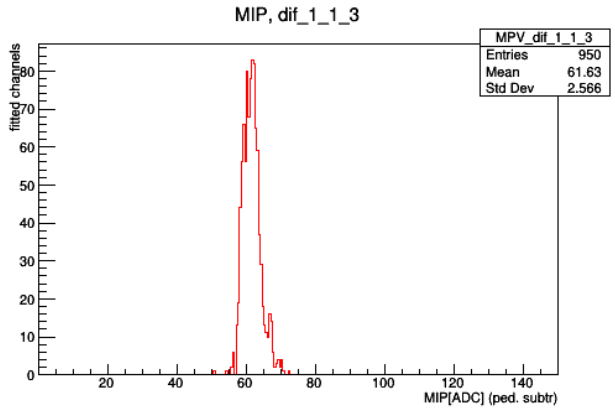


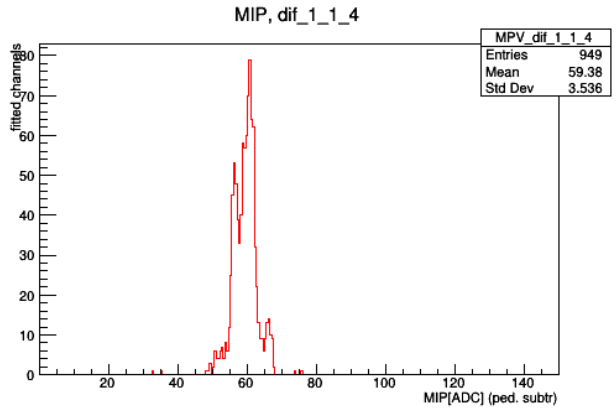


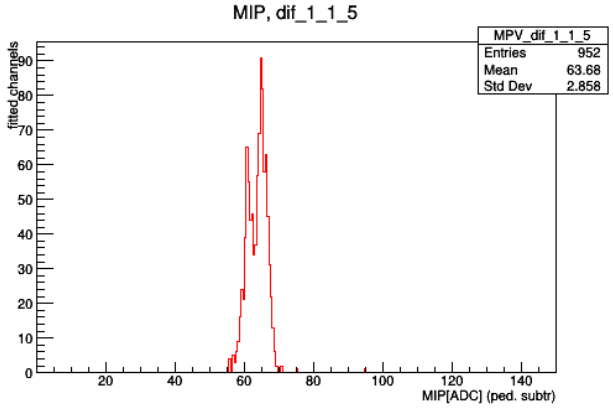


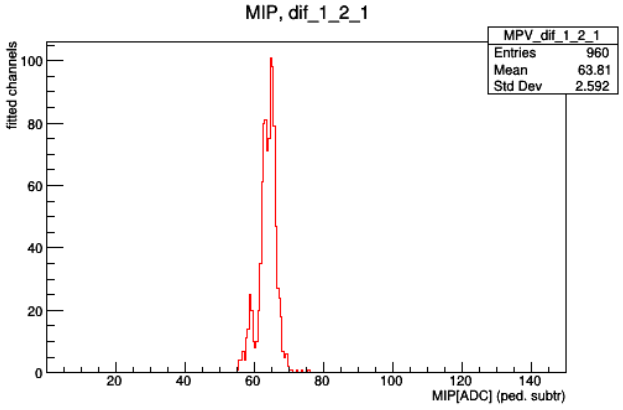
MIP scan results: summary I

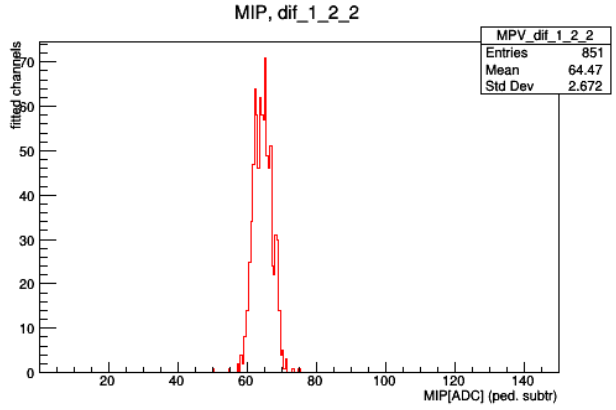






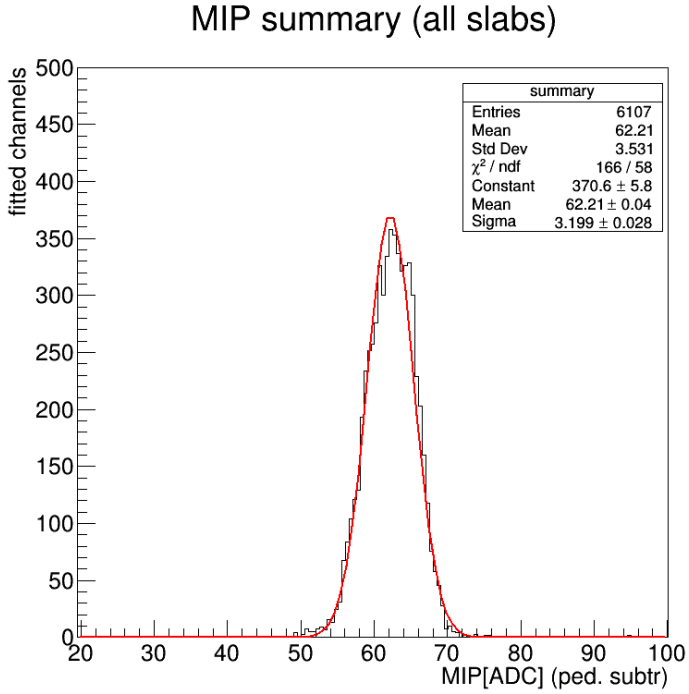


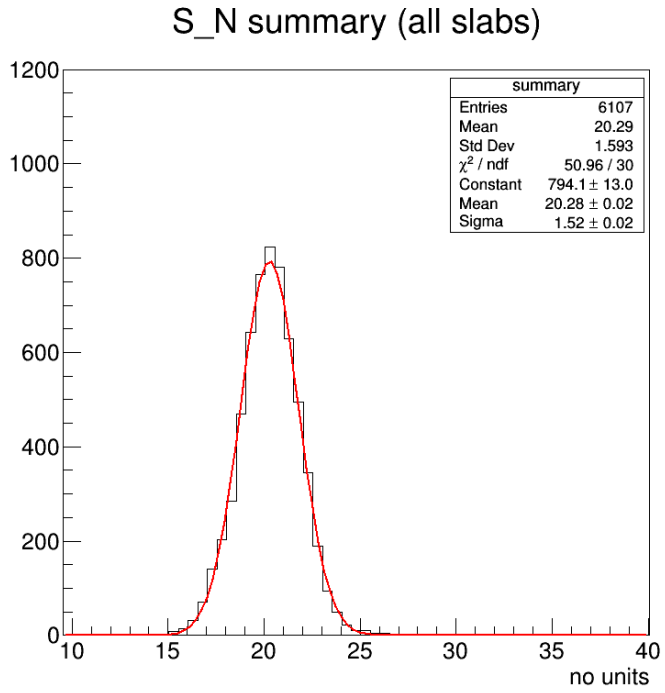




MIP scan results: summary II

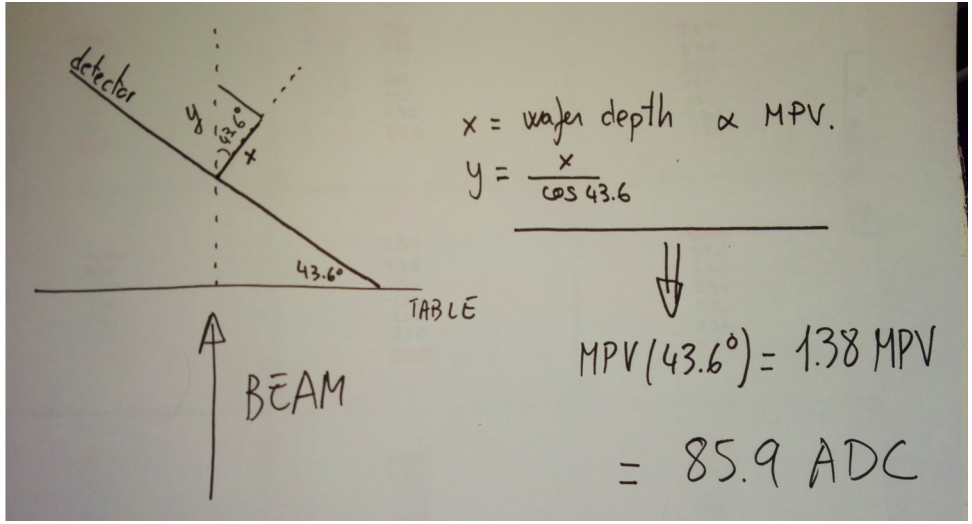
- We fit the 98% of available channels
- MPV = 62.2 ADC, sigma= 3.2 ADC (dispersion of 5.1 %)
- S/N = 20.3, sigma = 1.52
- Not really good gaussian fit : inhomogeneities

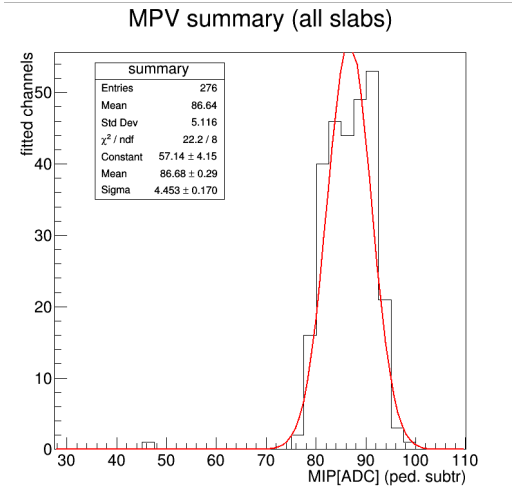


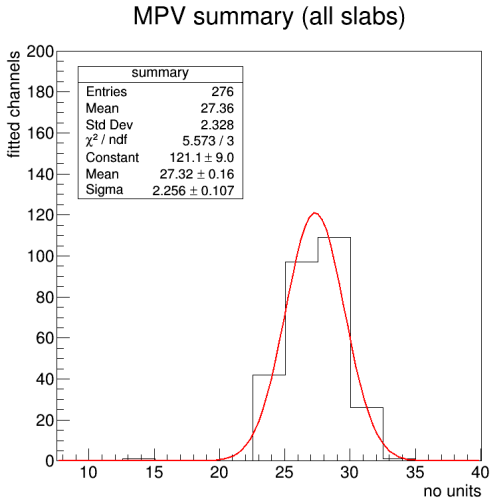


MIP electrons shooted at 43.6degrees

- Detector tilted by 43.6 degrees, only one position shoted by the beam.
- Better MIP spectra expected (although with less stats)
- The MIP is where expected: 86.7 ADC

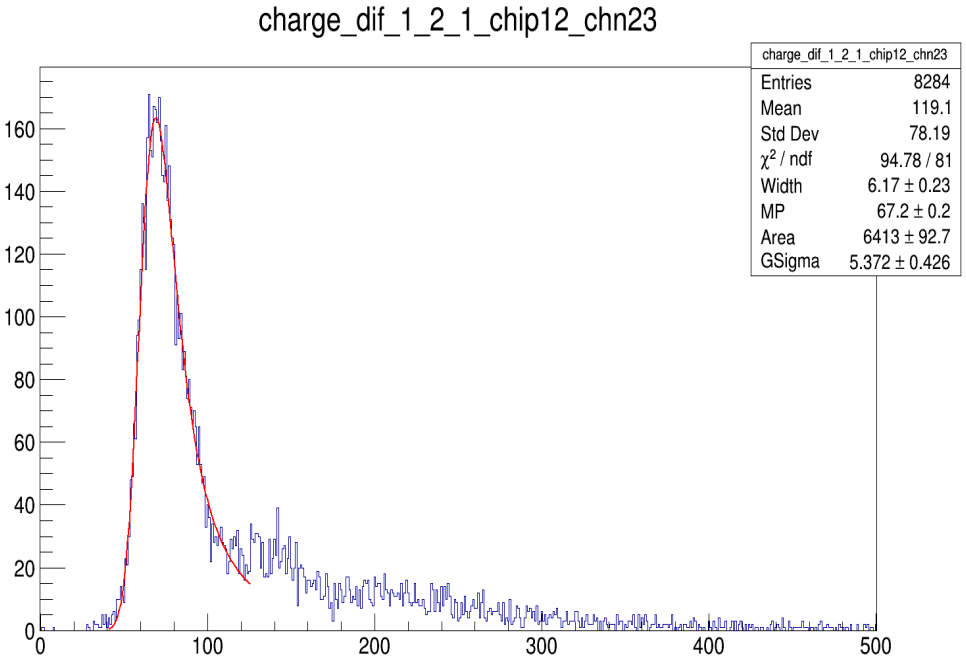


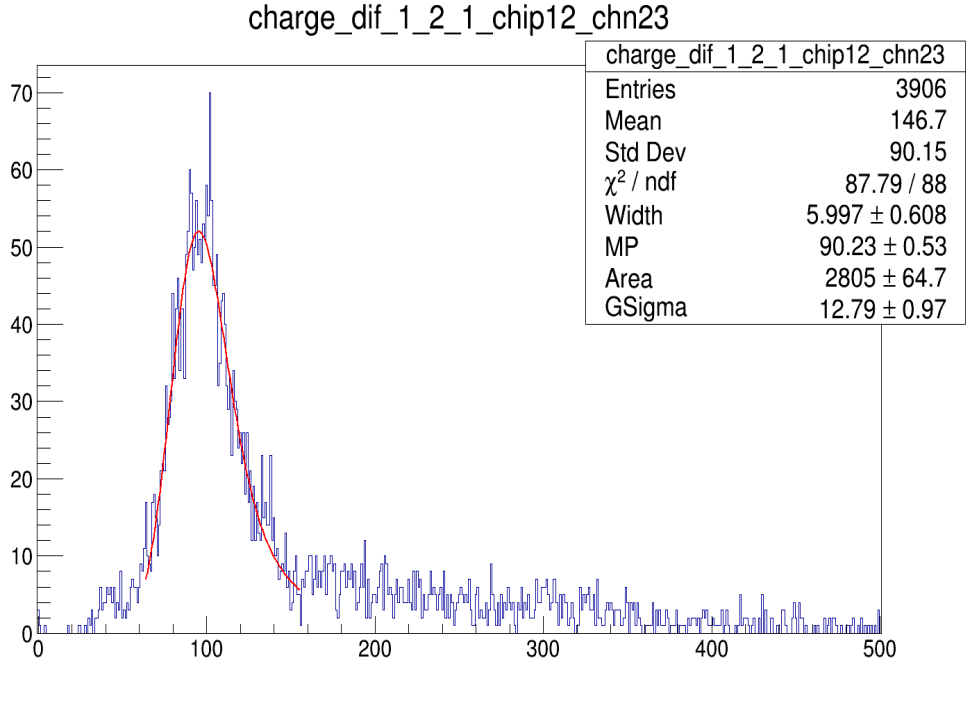




MIP electrons shooted at 43.6degrees

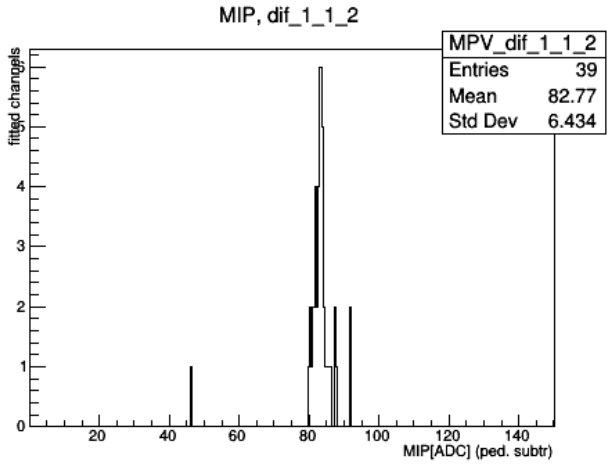
- Perpendicular beam (left) vs angled (right)

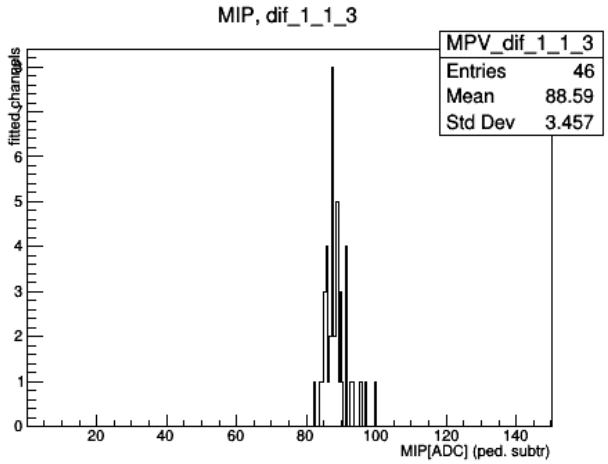


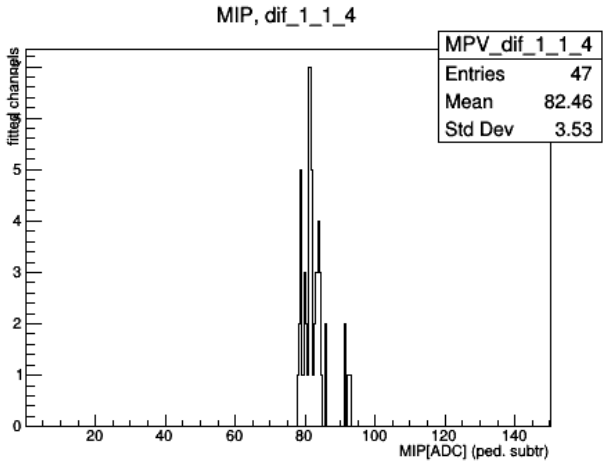


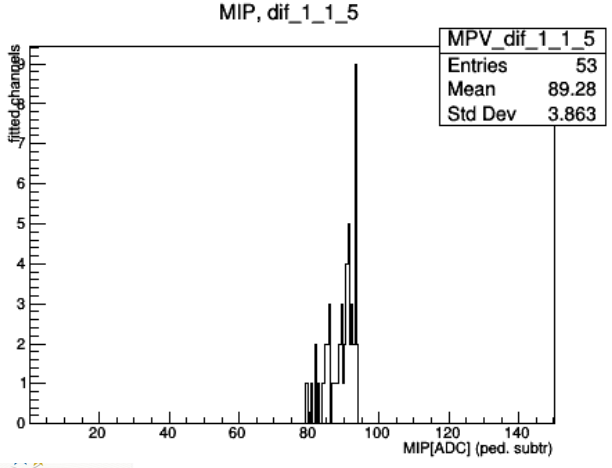
- MIPs are well reconstructed at both configurations → reasonable thresholds

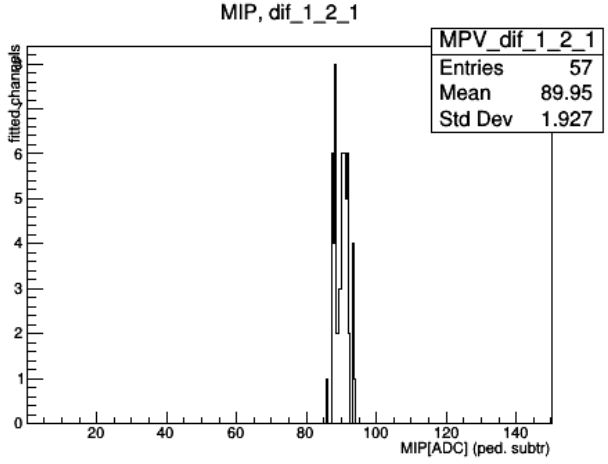
MIP electrons shooted at 43.6degrees

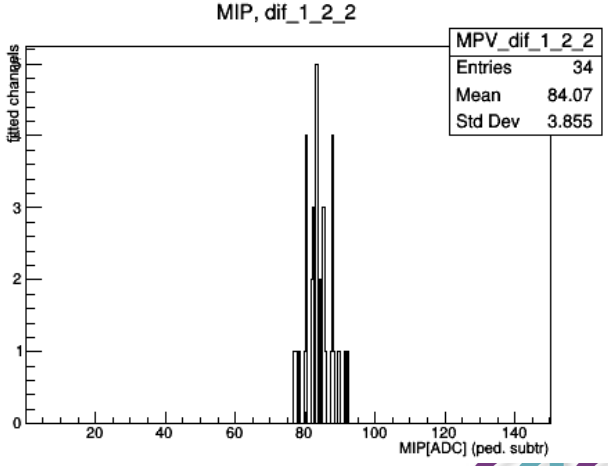




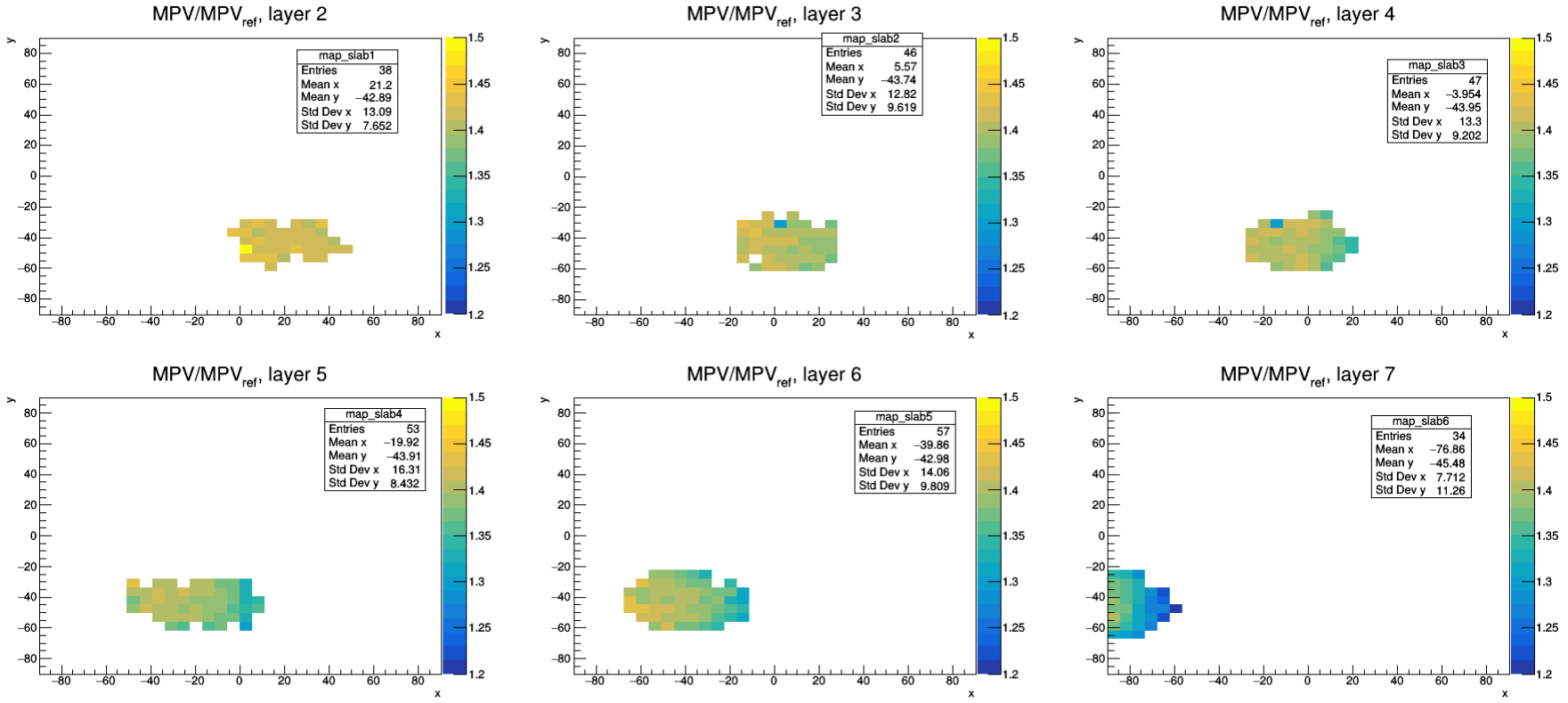








MIP electrons shooted at 43.6degrees

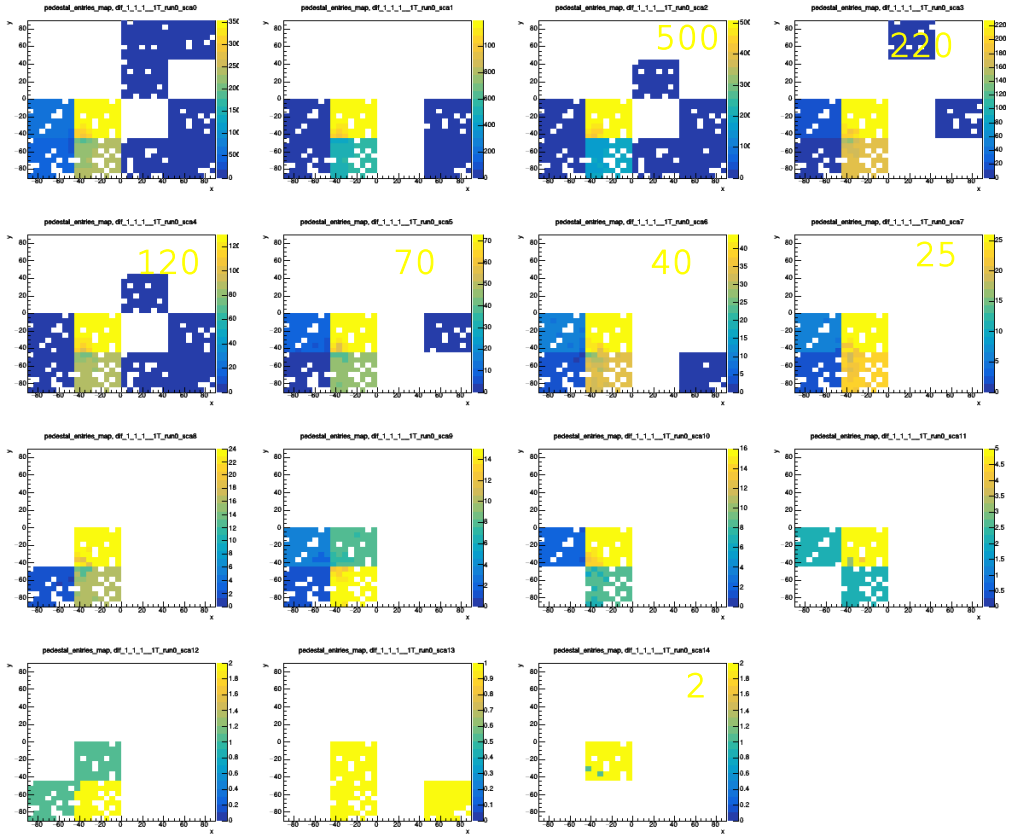


MIP electrons shooted at 43.6degrees

- Conclusion:
  - Seems that we had set nice thresholds from the beginning as the signal proportionates as expected :)

MIP electrons in magnetic field

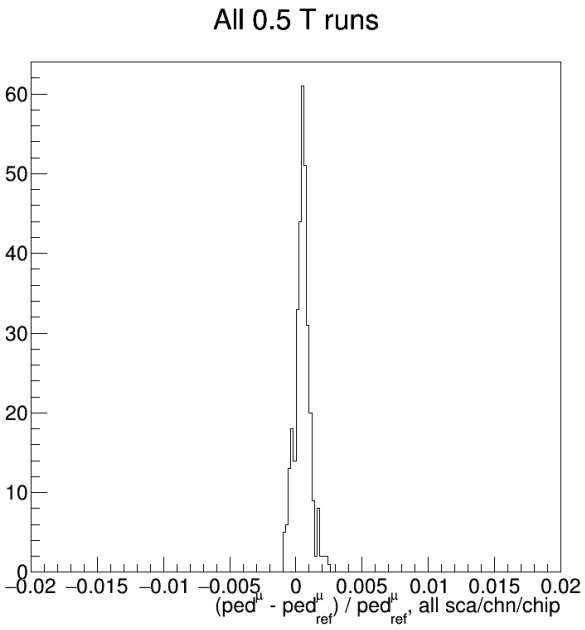
- Slab 21, (dif_1_1_1)
  - 1 run of reference at 0T
  - 13 runs at 1 T
  - 3 runs at 0.5 T
  - Another run at 0T
- Lower occupancy:
  - lower rates due to spread of beam and second collimator between 24 & 24/1
  - More silent configuration ?
- Analysis approach: calculate pedestals and MIPS on the fly.
  - Only few SCAs available for MIP/pedestal analysis

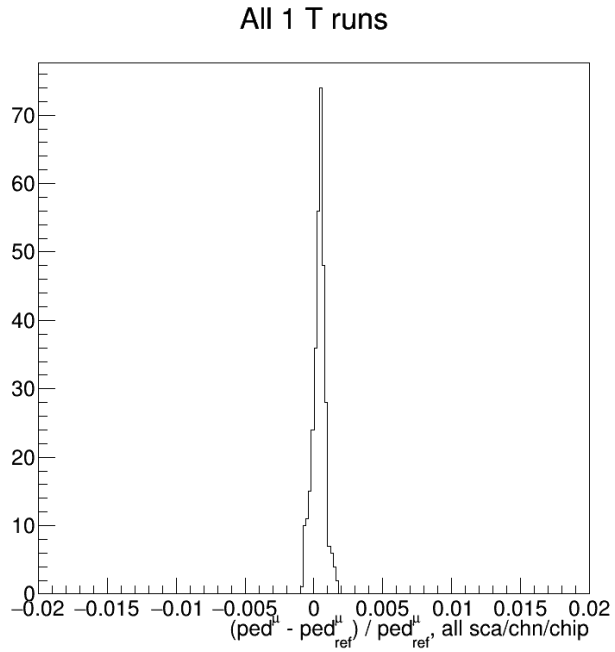


- 15 Maps (one per each SCA) of number of entries in pedestal histogram. In yellow, the maximum scale.

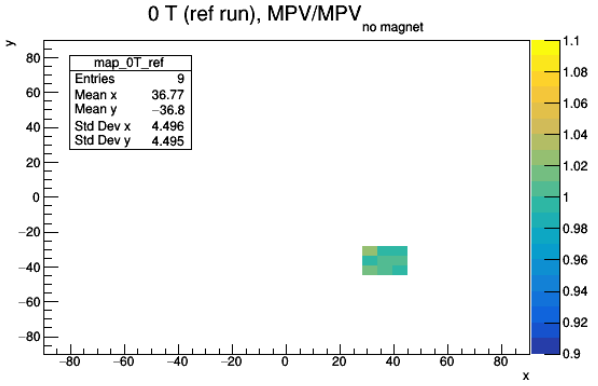
MIP electrons in magnetic field

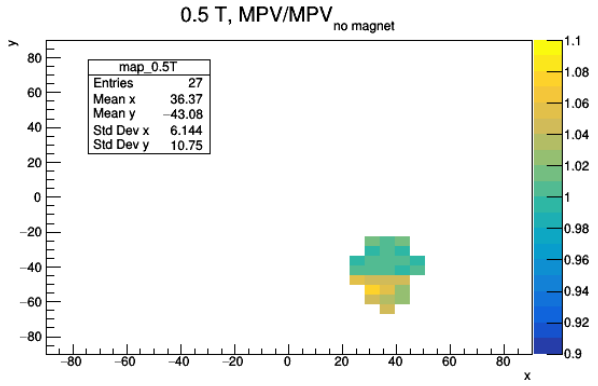
- Analysis approach: calculate pedestals and MIPS on the fly.
- But first: check pedestal stability comparing the values with the reference run.
  - Compare pedestal mean and pedestal width using "pull-like distributions"

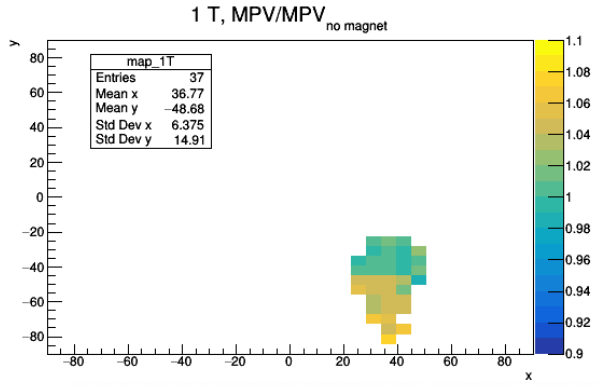


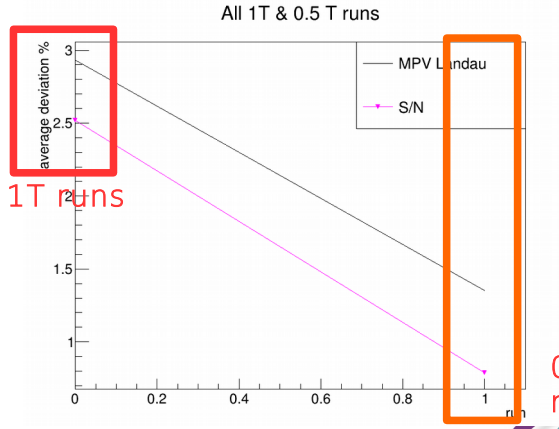


- Repeat the MIP analysis for both runs (0.5 T and 1T)
  - Linear increase of MPV (and S/N) under magnetic field → Due to angle of incidence









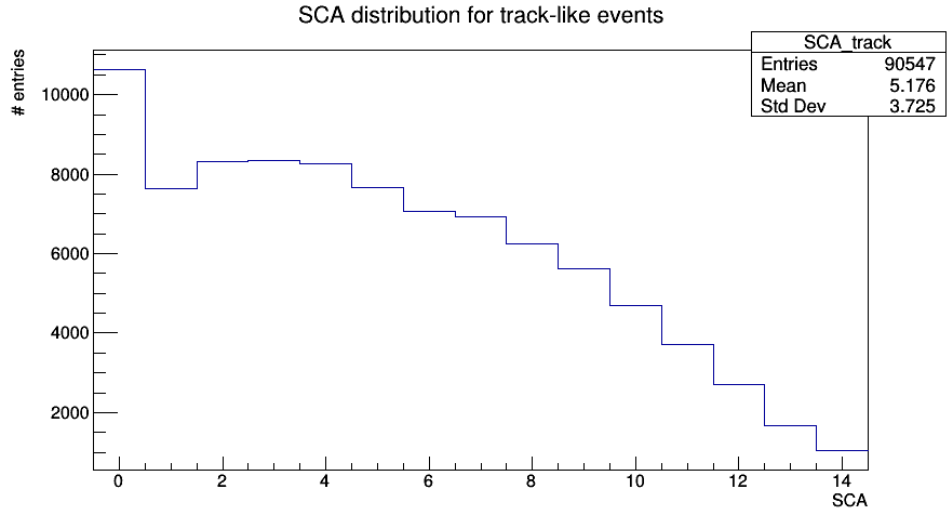
Full prototype analysis

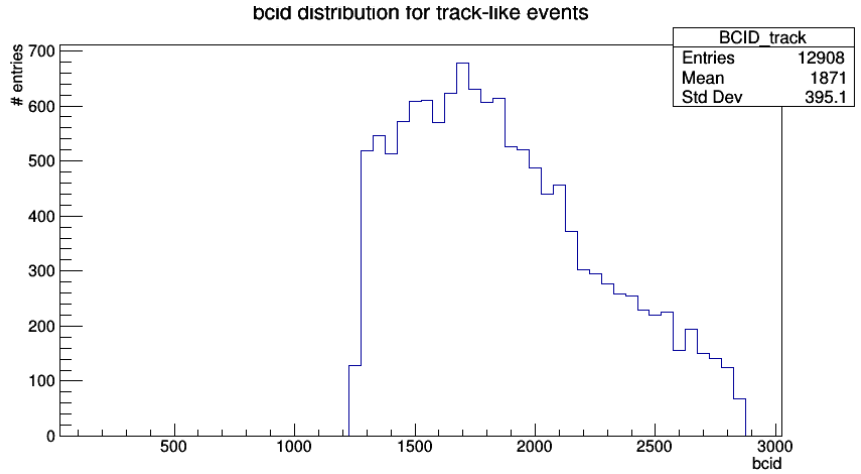
- Analysis after event building based in bcid.
- Pedestal subtracted (chip/chn/sca wise)
- MIP calibration results applied (chip/chn wise)

- First analysis: check that the MIP calibration is correct

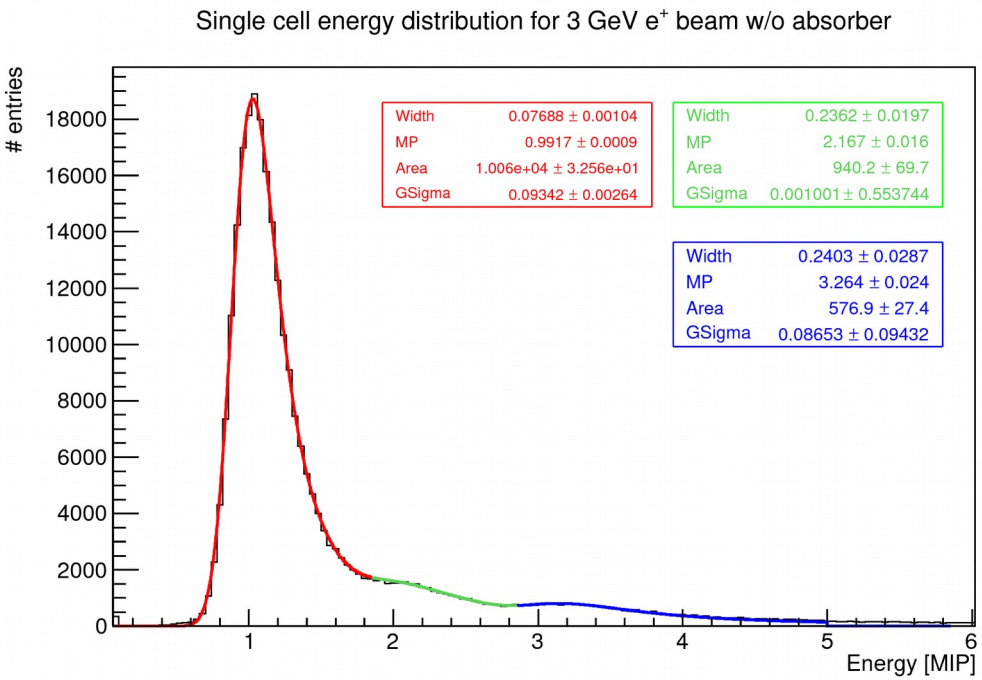
MIP calibration using tracks

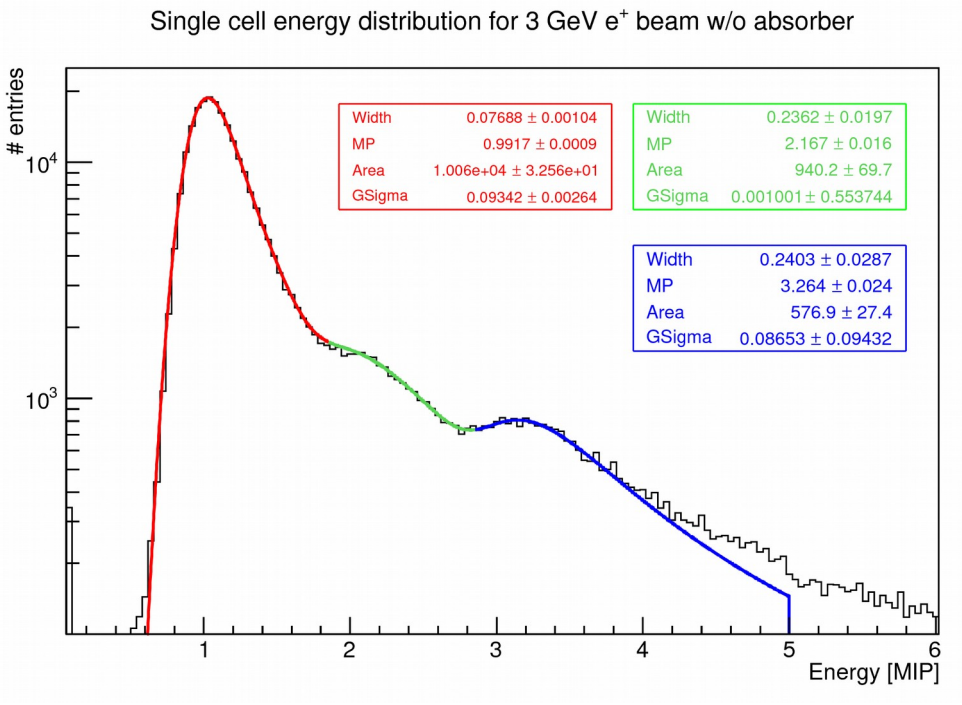
- First analysis: check that the MIP calibration is right
- Tracks are perpendicular to the wafers.
- Basic selection:
  - 7 slabs with in the same x,y position (6 or 5 if one or two channels are masked)
  - Cut in bcid to avoid noise sources.
  - No cut in energy per hit.



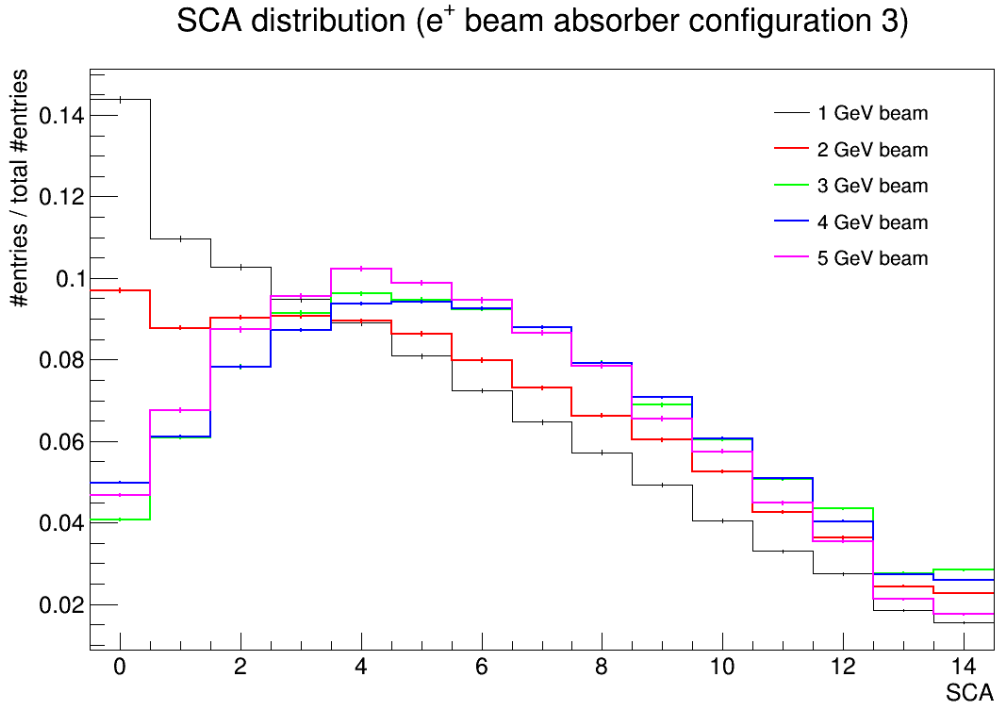


- Three peaks fitted with good agreement within expected values.

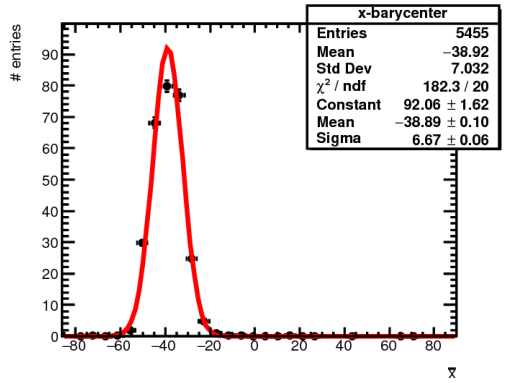


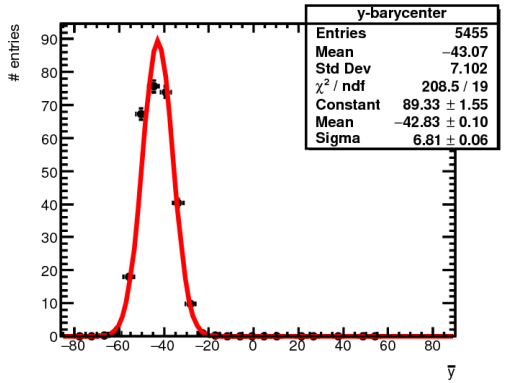


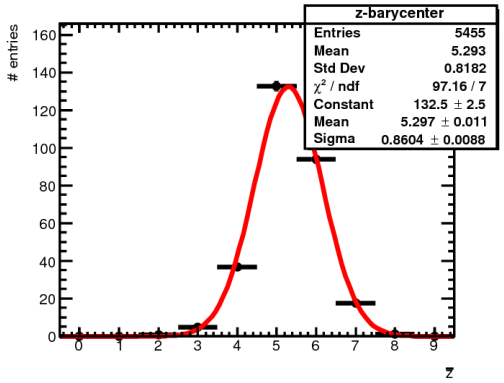
- Three different tungsten configurations
  - Conf1:
  - Conf2:
  - Conf3:
- Selection:
  - Require hits with energy > 0.5 MIPs
  - Isolated hit are removed
  - All slabs should have at least one hit.

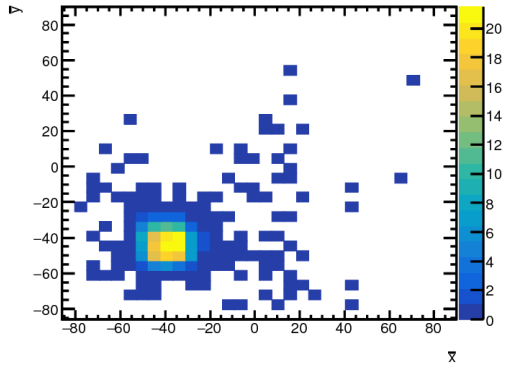


- Conf1 (4GeV)


x-barycenter
Entries 5455
Mean −38.92
Std Dev 7.032
χ² / ndf 182.3 / 20
Constant 92.06 ± 1.62
Mean −38.89 ± 0.10
Sigma 6.67 ± 0.06
entries
x̄


y-barycenter
Entries 5455
Mean −43.07
Std Dev 7.102
χ² / ndf 208.5 / 19
Constant 89.33 ± 1.55
Mean −42.83 ± 0.10
Sigma 6.81 ± 0.06
entries
ȳ


z-barycenter
Entries 5455
Mean 5.293
Std Dev 0.8182
χ² / ndf 97.16 / 7
Constant 132.5 ± 2.5
Mean 5.297 ± 0.011
Sigma 0.8604 ± 0.0088
entries
z̄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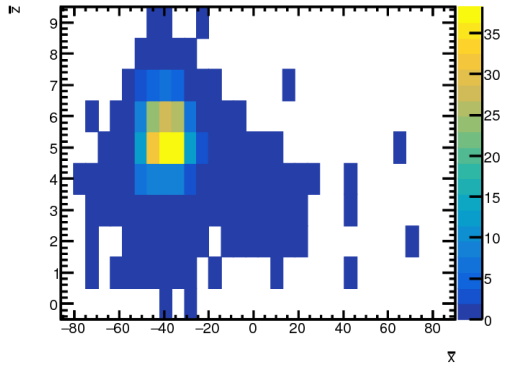
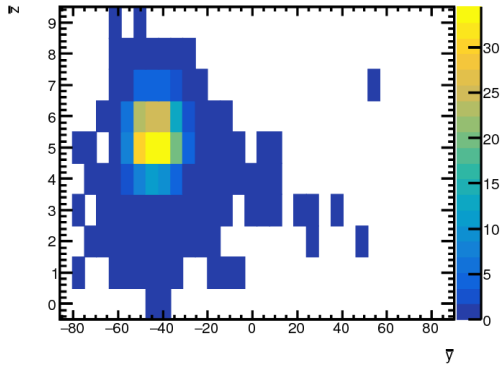
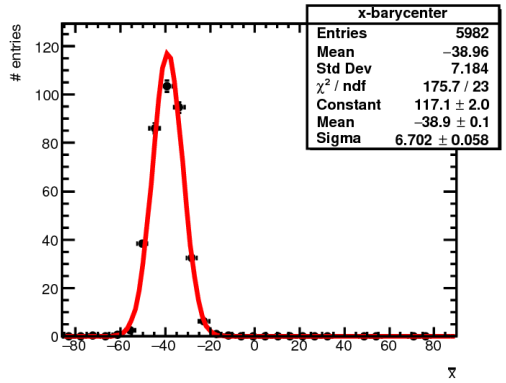
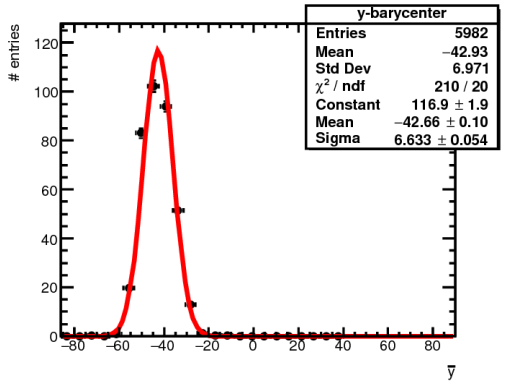
x̄

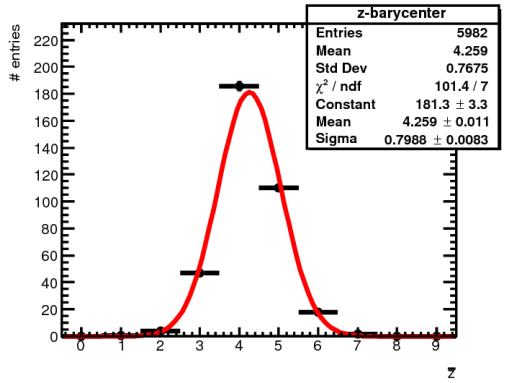

z̄
x̄

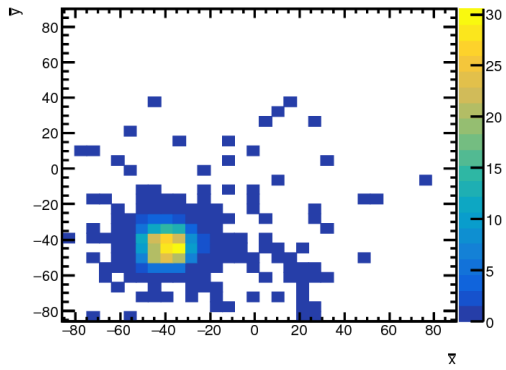

z̄
ȳ

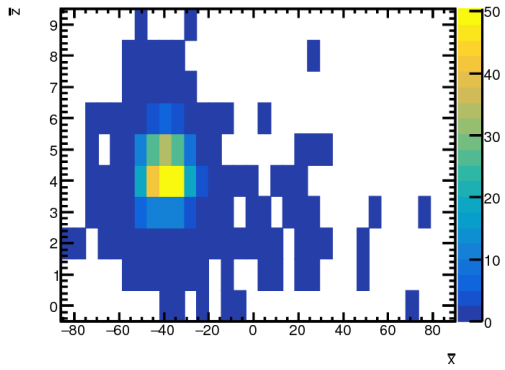
- conf2 (4GeV)

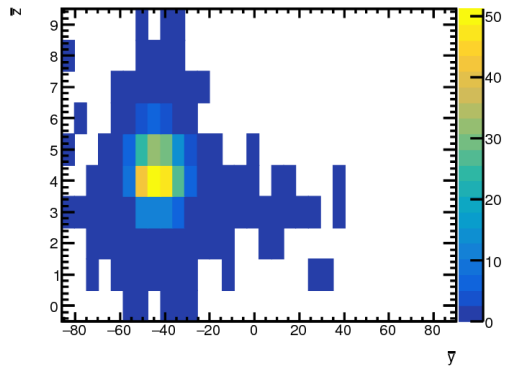

x-barycenter
Entries 5982
Mean −38.96
Std Dev 7.184
χ² / ndf 175.7 / 23
Constant 117.1 ± 2.0
Mean −38.9 ± 0.1
Sigma 6.702 ± 0.058
entries
x̄


y-barycenter
Entries 5982
Mean −42.93
Std Dev 6.971
χ² / ndf 210 / 20
Constant 116.9 ± 1.9
Mean −42.66 ± 0.10
Sigma 6.633 ± 0.054
entries
ȳ

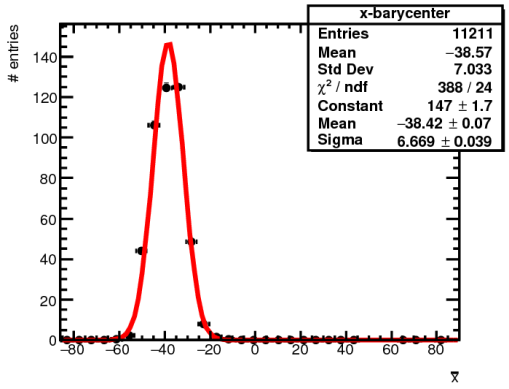

z-barycenter
Entries 5982
Mean 4.259
Std Dev 0.7675
χ² / ndf 101.4 / 7
Constant 181.3 ± 3.3
Mean 4.259 ± 0.011
Sigma 0.7988 ± 0.0083
entries
z̄

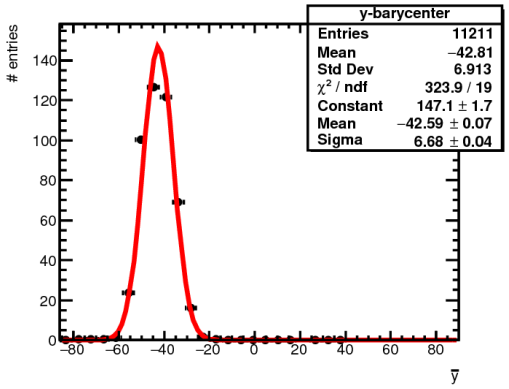

ȳ
x̄

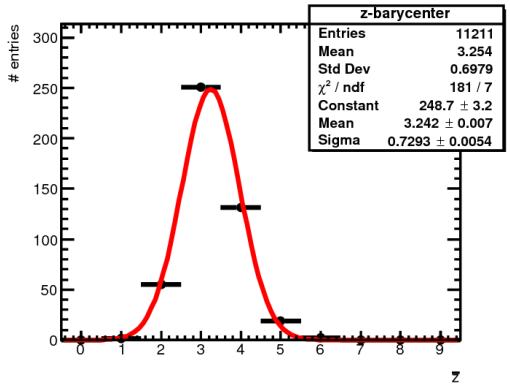

z̄
x̄

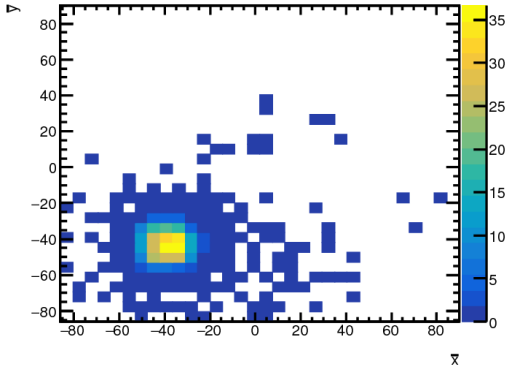

z̄
ȳ

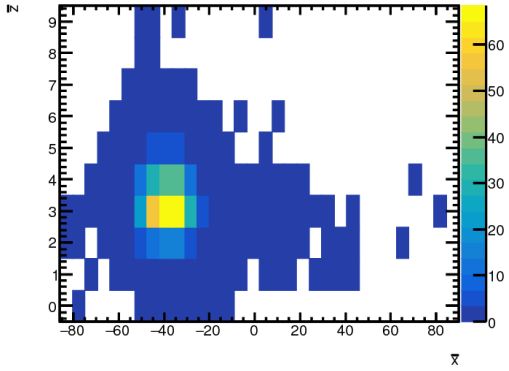
- conf3 (4GeV)

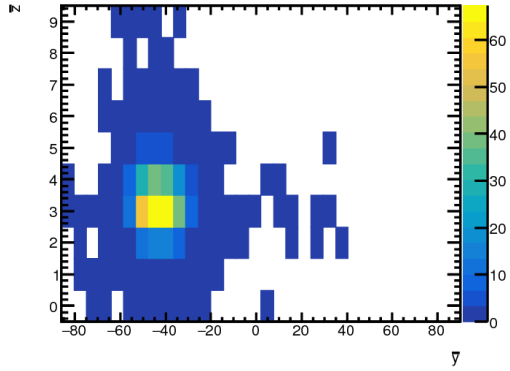

x-barycenter
Entries 11211
Mean −38.57
Std Dev 7.033
χ² / ndf 388 / 24
Constant 147 ± 1.7
Mean −38.42 ± 0.07
Sigma 6.669 ± 0.039
entries
x̄


y-barycenter
Entries 11211
Mean −42.81
Std Dev 6.913
χ² / ndf 323.9 / 19
Constant 147.1 ± 1.7
Mean −42.59 ± 0.07
Sigma 6.68 ± 0.04
entries
ȳ


z-barycenter
Entries 11211
Mean 3.254
Std Dev 0.6979
χ² / ndf 181 / 7
Constant 248.7 ± 3.2
Mean 3.242 ± 0.007
Sigma 0.7293 ± 0.0054
entries
z̄

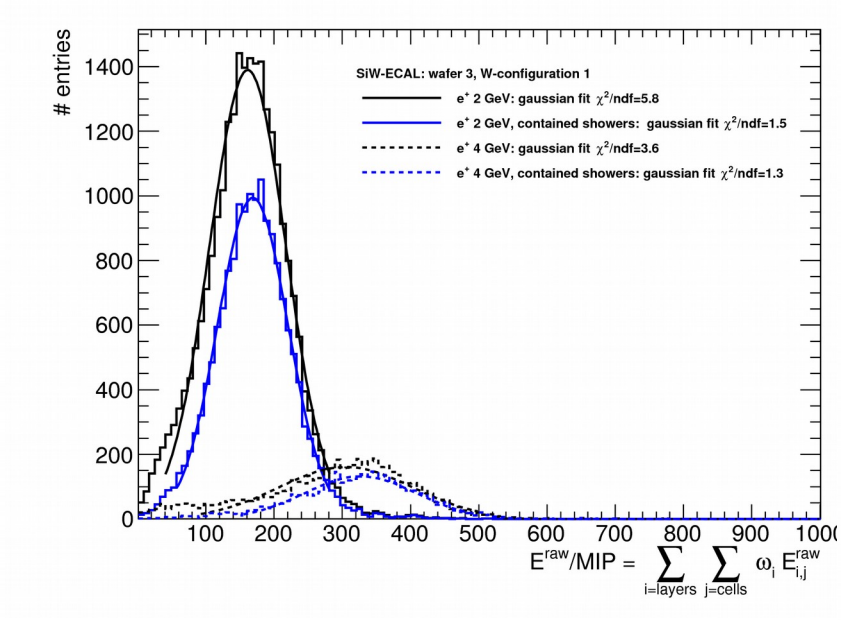

ȳ
x̄

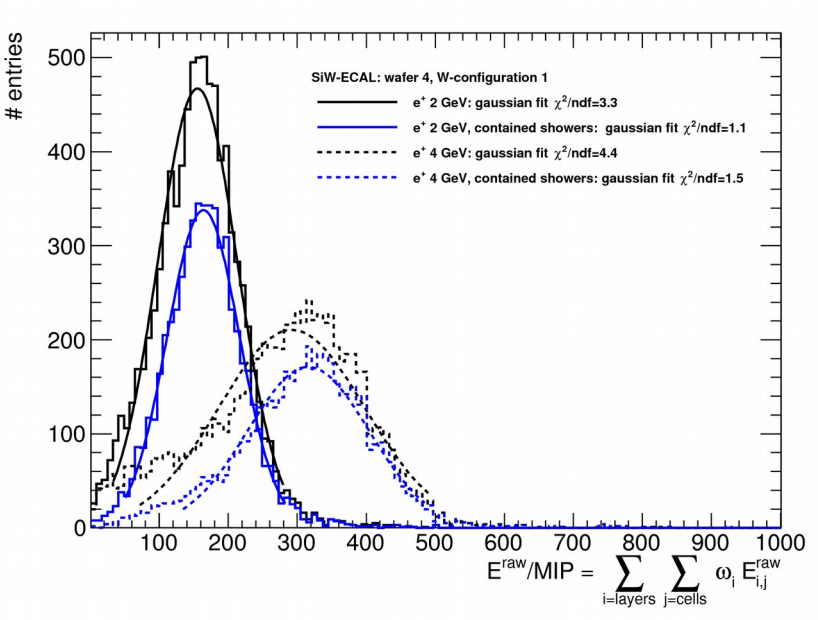

z̄
x̄


z̄
ȳ

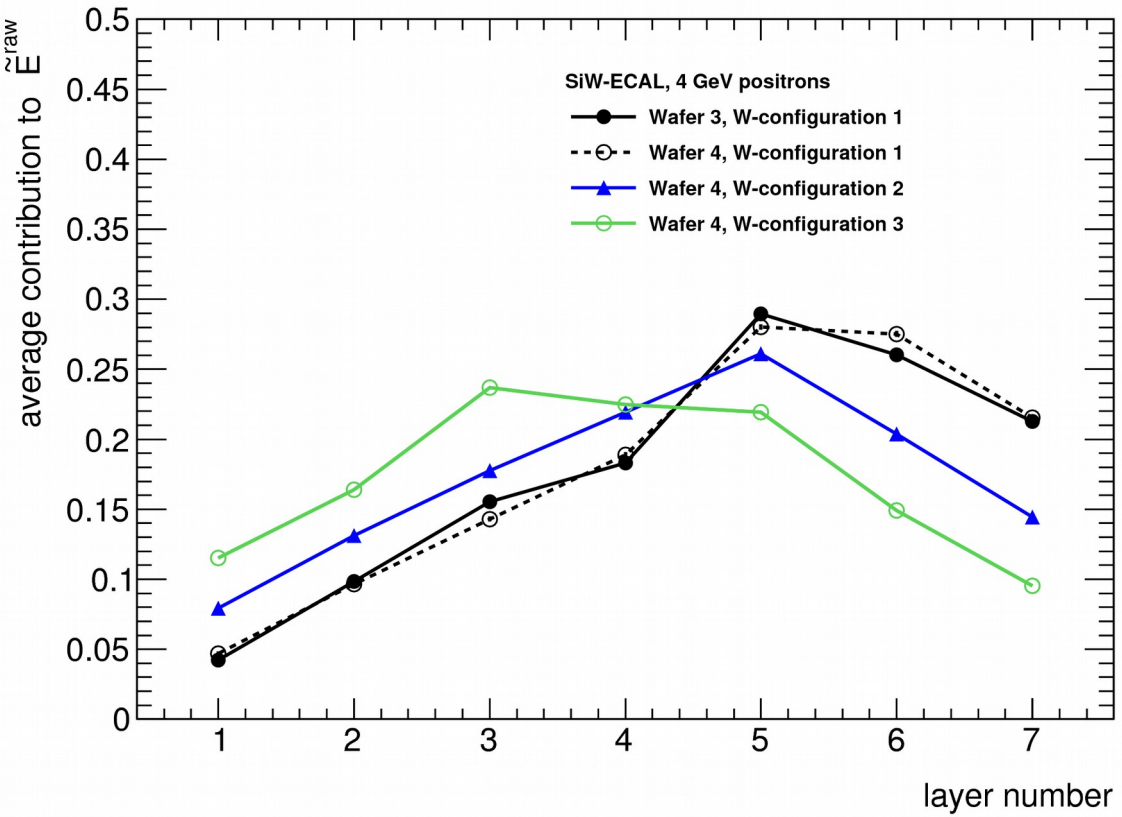
Energy reconstruction

- Compare to points, same tungsten configuration
- Using contained showers (contained in +-1 sigma of barycenter $\bar{z}$ variable) improves the "gaussianity" y of the Energy distribution





- $\tilde{E}^{raw}$ = hit energy sum for all channels with e>0.5 MIP in event.
  - non weighted with Xo
- The cut in $\bar{z}$ is applied



- $\tilde{E}^{raw}$ = hit energy sum for all channels with e>0.5 MIP in a event.
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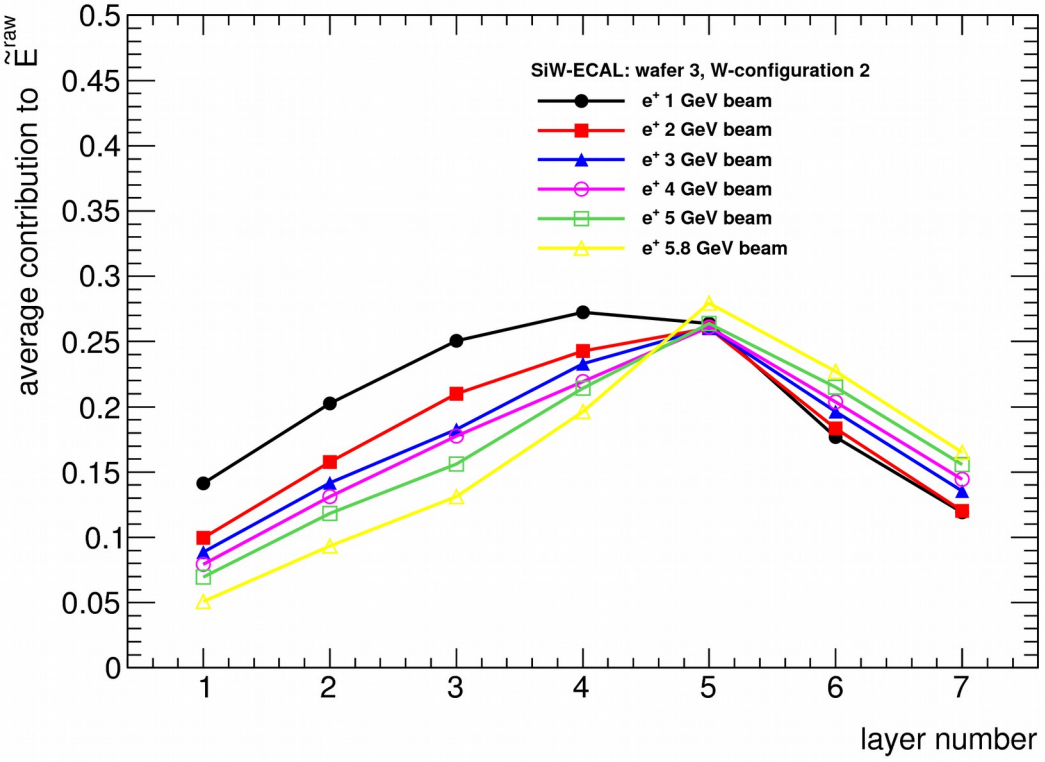
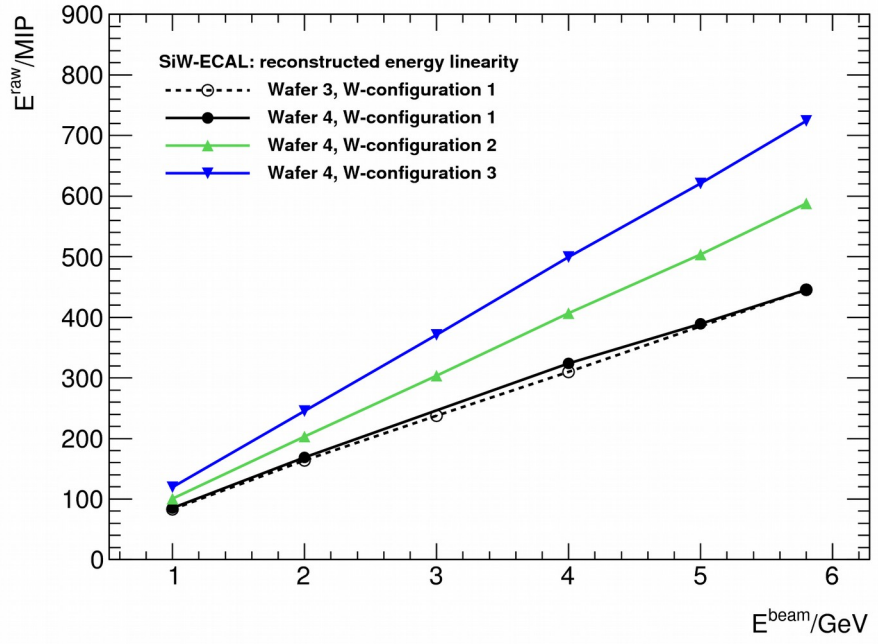
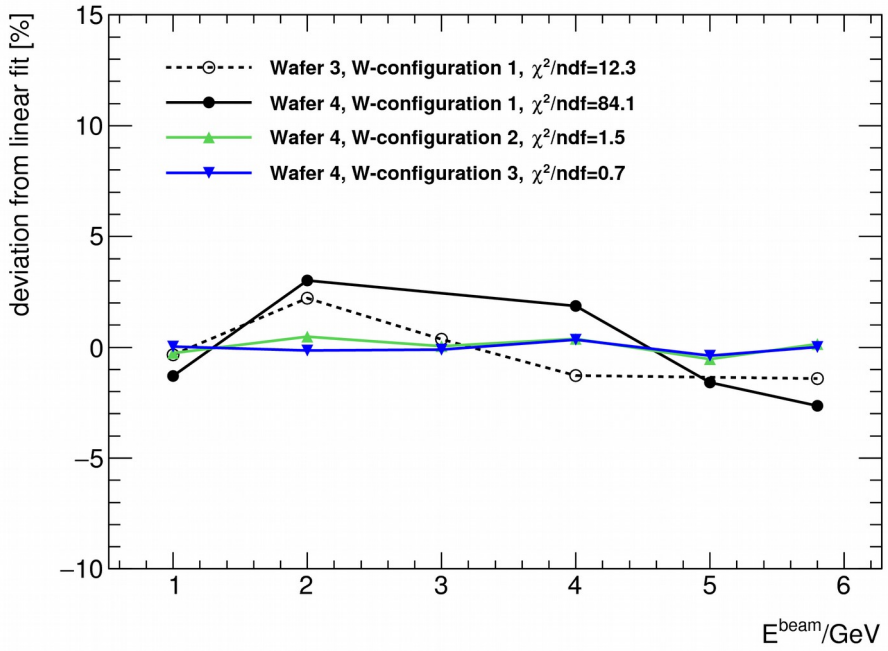
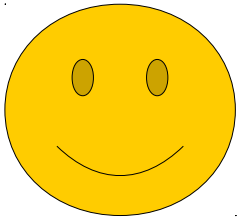


- Good linearity, specially for configurations 2 and 3 → better contained showers.





- In general…



Back up slides

MIP electrons in magnetic field

- Analysis approach: calculate pedestals and MIPS on the fly.
- But first: check pedestal stability comparing the values with the reference run.
  - Compare pedestal mean and pedestal width using "pull-like distributions"