·Cluster charge distributions in Barrel Pixel Read Out Chips
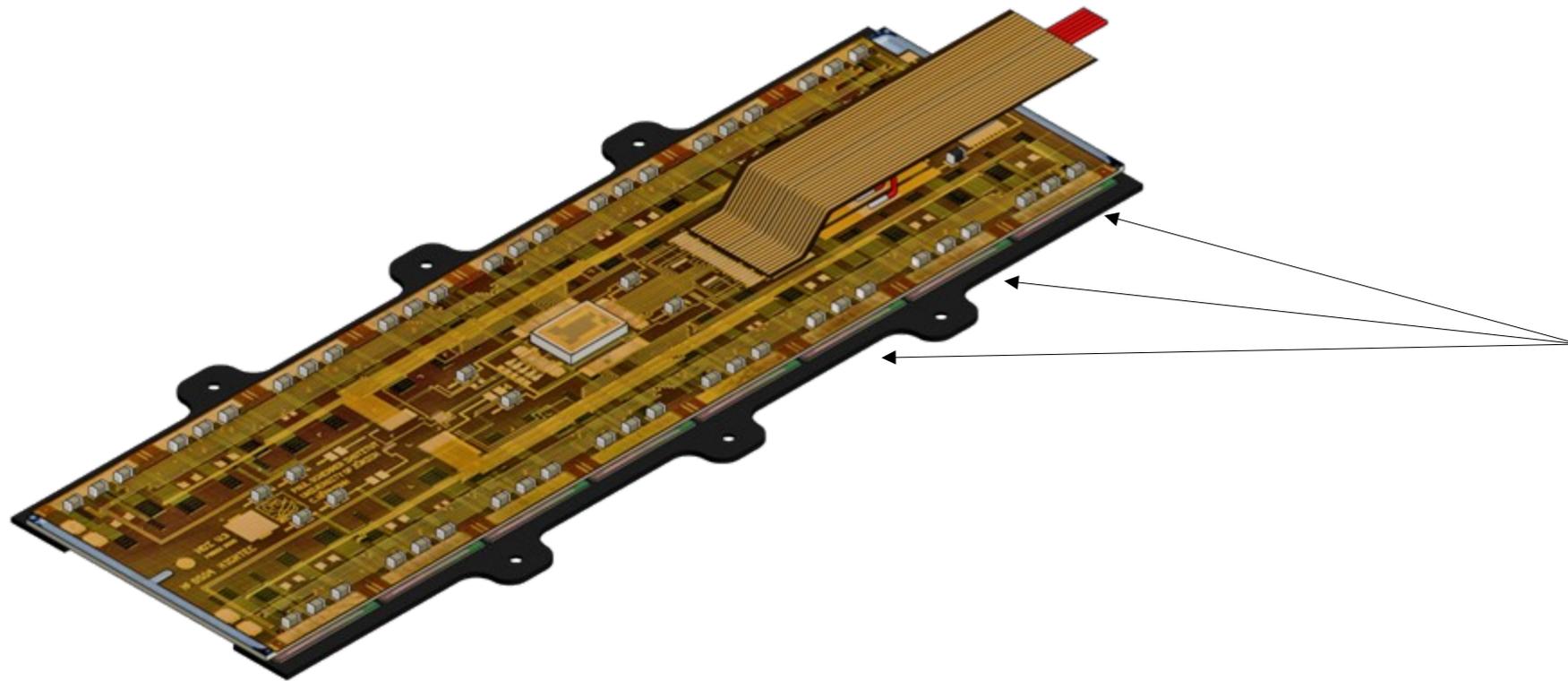
·Balint Radics (KFKI RMKI),
·Viktor Veszpremi (ATOMKI),
·Janos Karancsi (ATOMKI)

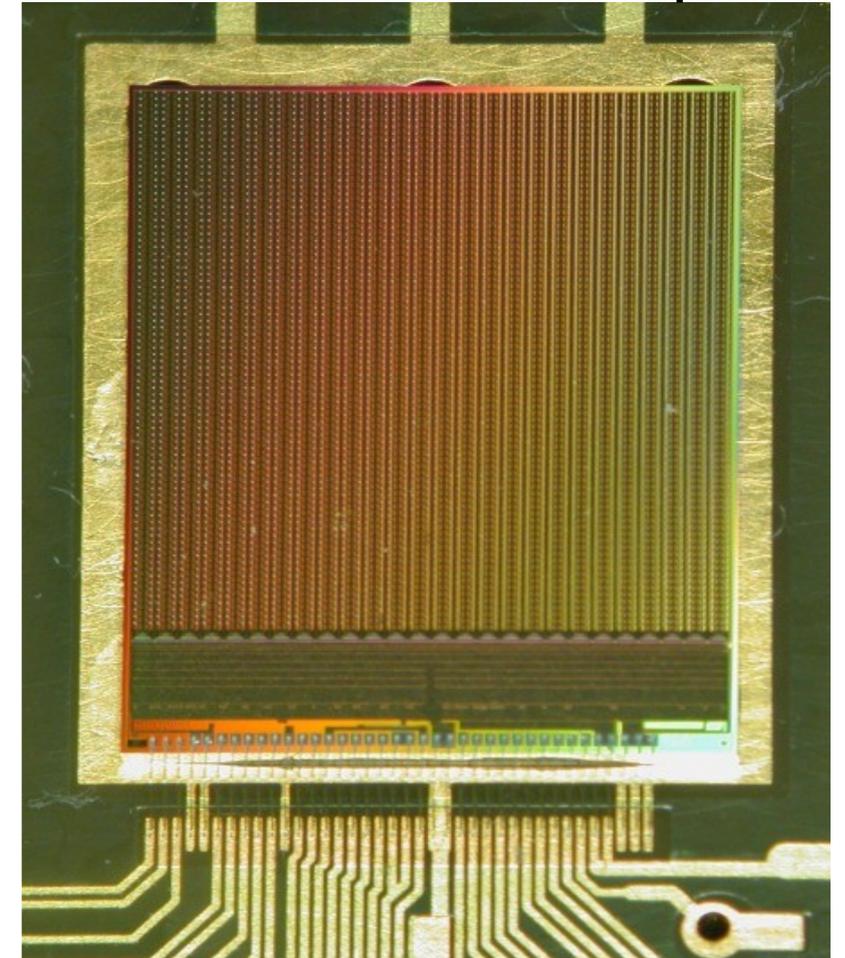·11 April 2011

Pixel detector components

Barrel layer

A module

Barrel → Half Shell → Layer → Ladder → Module

Pixel

ROC

Endcap → Half Cylinder → Half Disk → Blade → Panel → Module

http://grid.kfki.hu/twiki/bin/view/CMS/DetectorComponents

·Pixel detector components (Barrel)

·A module with 2x8 ROCs

·Read Out Chip

- A ladder consists of 8 modules along the Barrel.
- A module has either 8 or 16 readout chips (ROC) arranged in a 1 × 8 (for half-ladders) or 2 × 8 (for full-ladders) configuration.
- A readout chip (ROC) is an array of 80 × 52 pixels, each of size 100 μm × 150 μm.

·Method

- Ionizing particle creates electron-hole pairs.
- Signal is conversed and amplified by the ROCs.
- Hit clusters = overall collection of hit pixels.
- Select hit clusters associated to Reconstructed Trajectory Hits in the Barrel.
- Look at cluster charge distribution per Read Out Chip for these clusters.

·Dataset

- Dataset:
  – /MinimumBias/Run2010B-Dec22ReReco
- CMSSW version:
  – CMSSW_3_8_6
- Lumi selection from JSON files:
 – Cert_136033-149442_7TeV_Dec22ReReco_Collisions10_JSON.txt

·Fitting per ROC

- Use normalized cluster charge, i.e. cluster charge corrected by the incident angle of the trajectory, so that all tracks appear to enter perpendicularly to the detector.
- The cluster charge distribution is a superposition of smeared Landau distributions.
- Fit with a Landau+Gaussian in two steps:

➡ <u>First</u>: fit with L+G with some reasonable parameters/limits,

➡ <u>Second</u>: constrain the mean of the Gaussian to be within ~1 sigma of the Landau MPV fit and fit again.
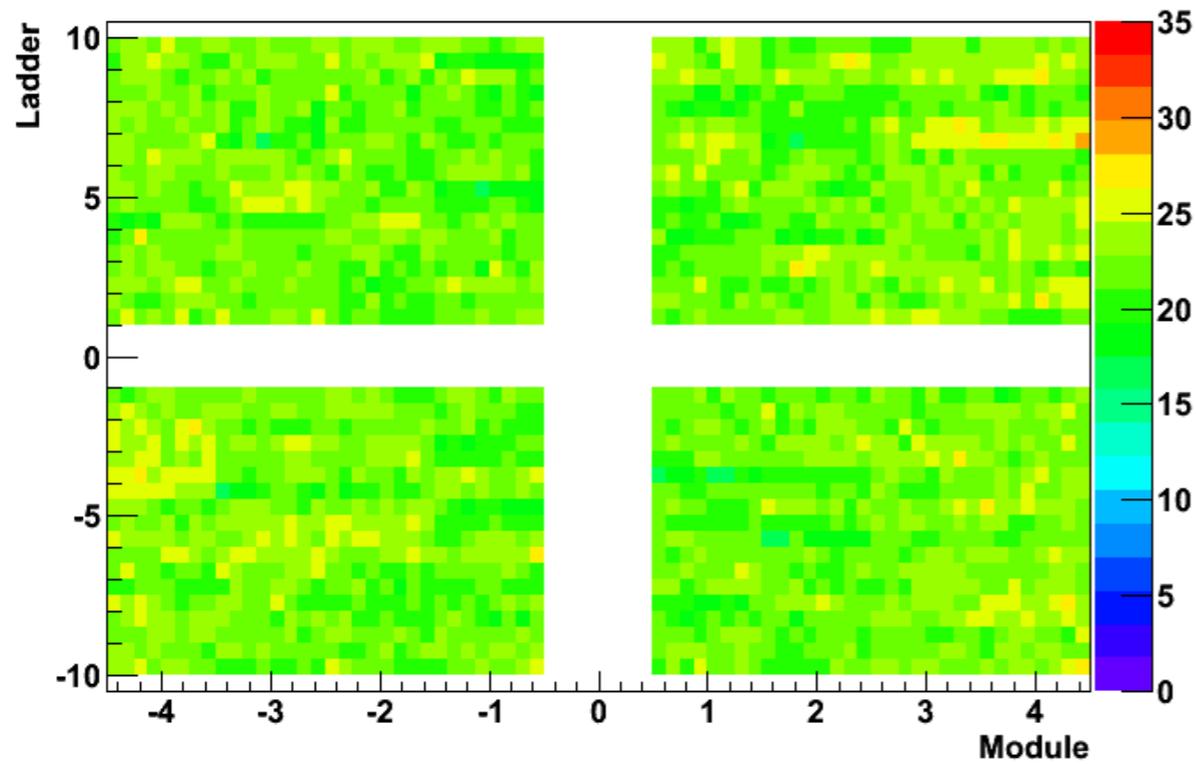

·χ2 , Ndof: 19
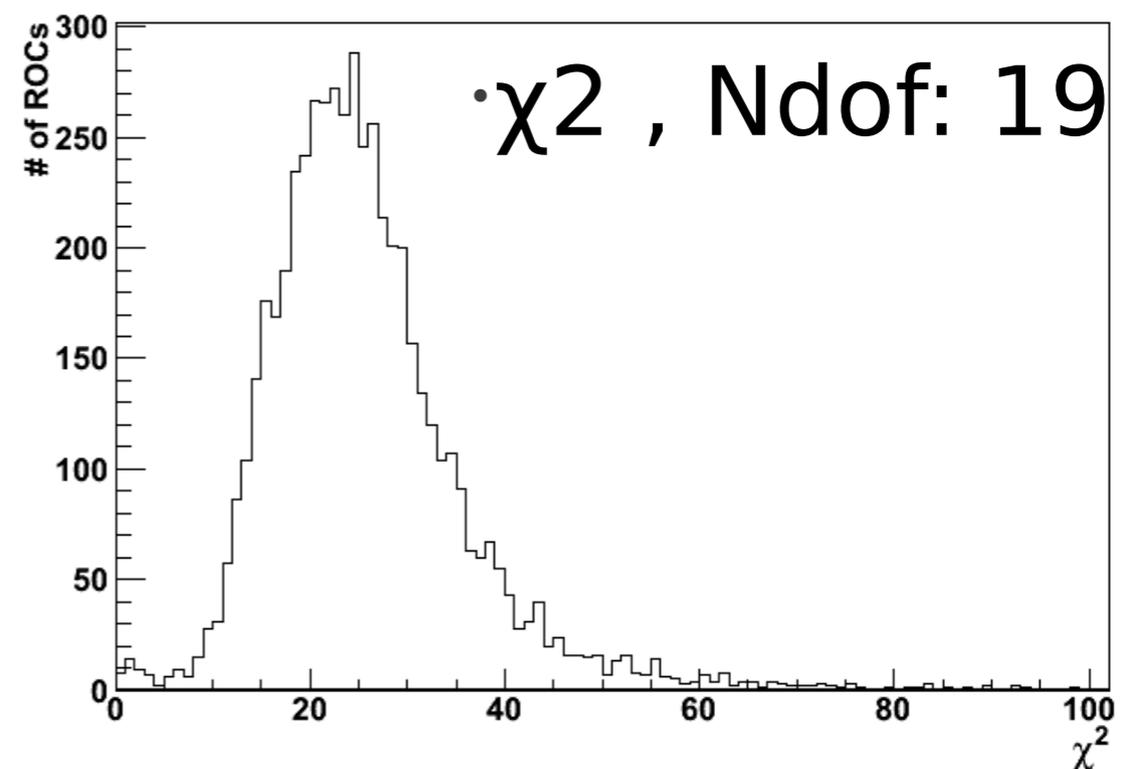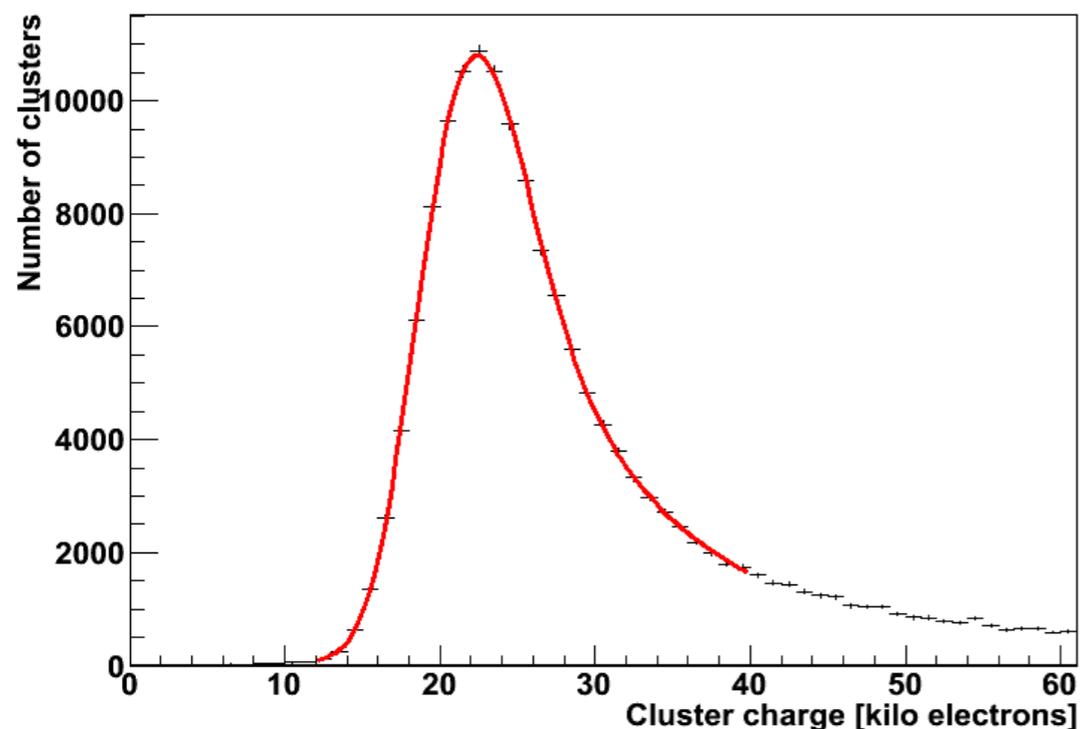
·Fit results

- In general Gaussian behavior of the Mean fits of ROCs.
- Shift of the Mean average between the Layer 1 and Layer 2,3 is clearly visible in the average of the Mean.
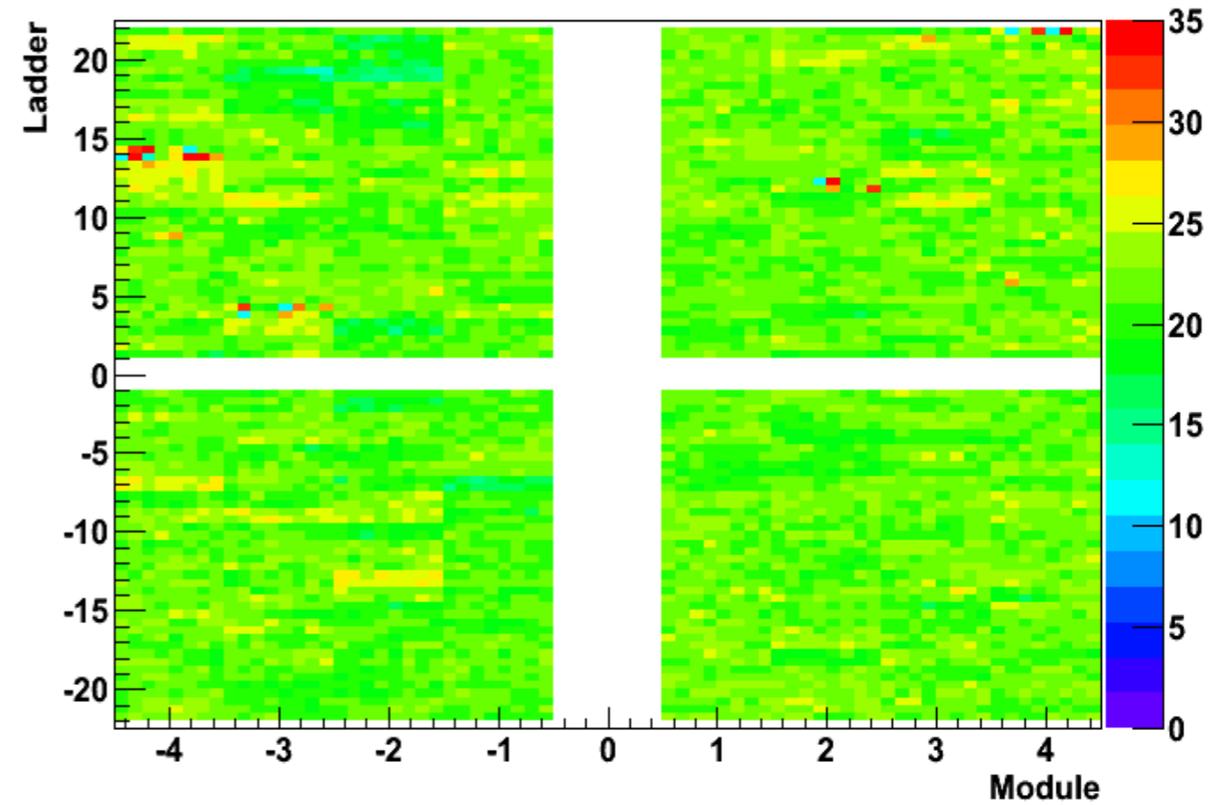- The width seems to be compatible between the Layers.
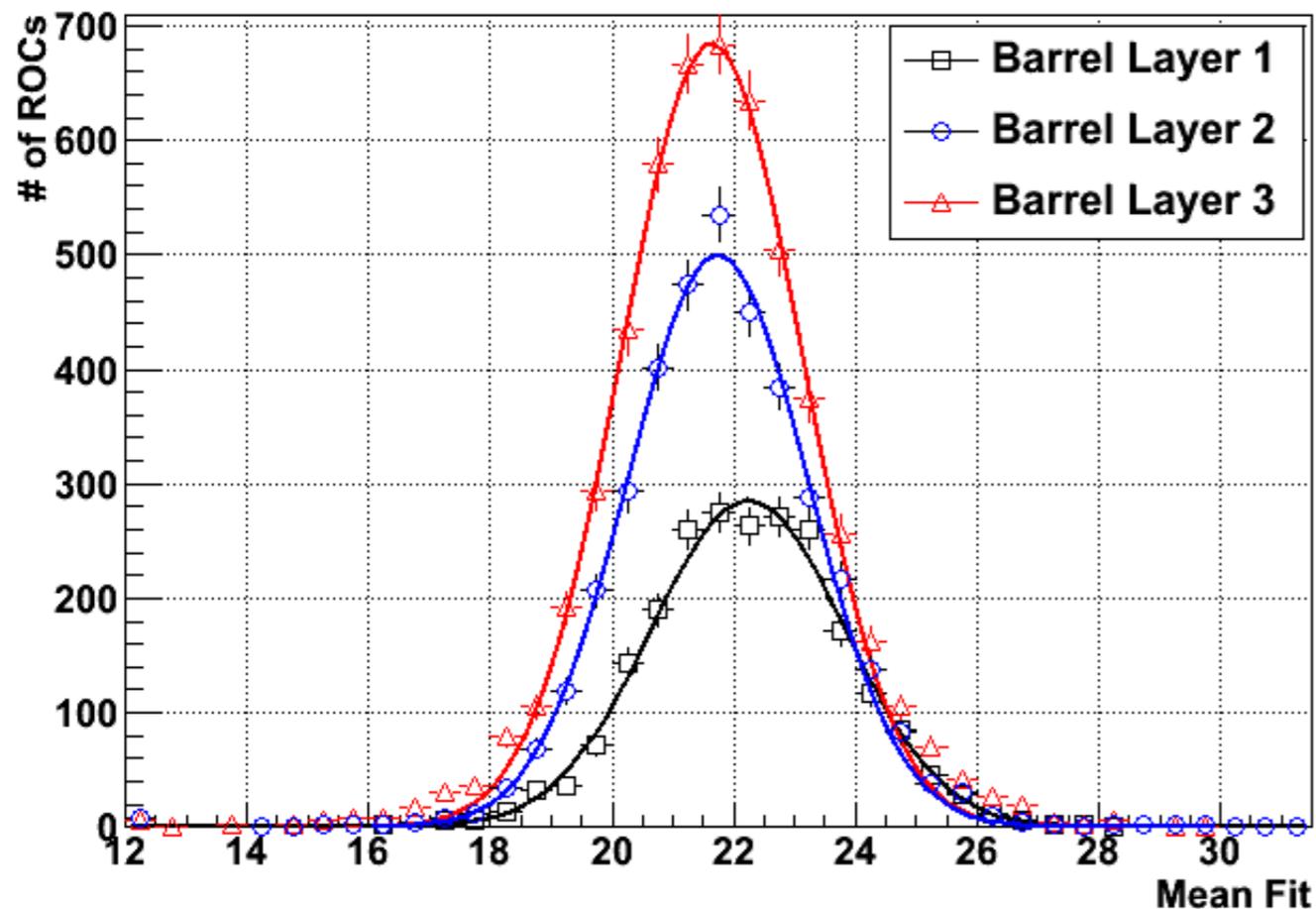
·ROC quality
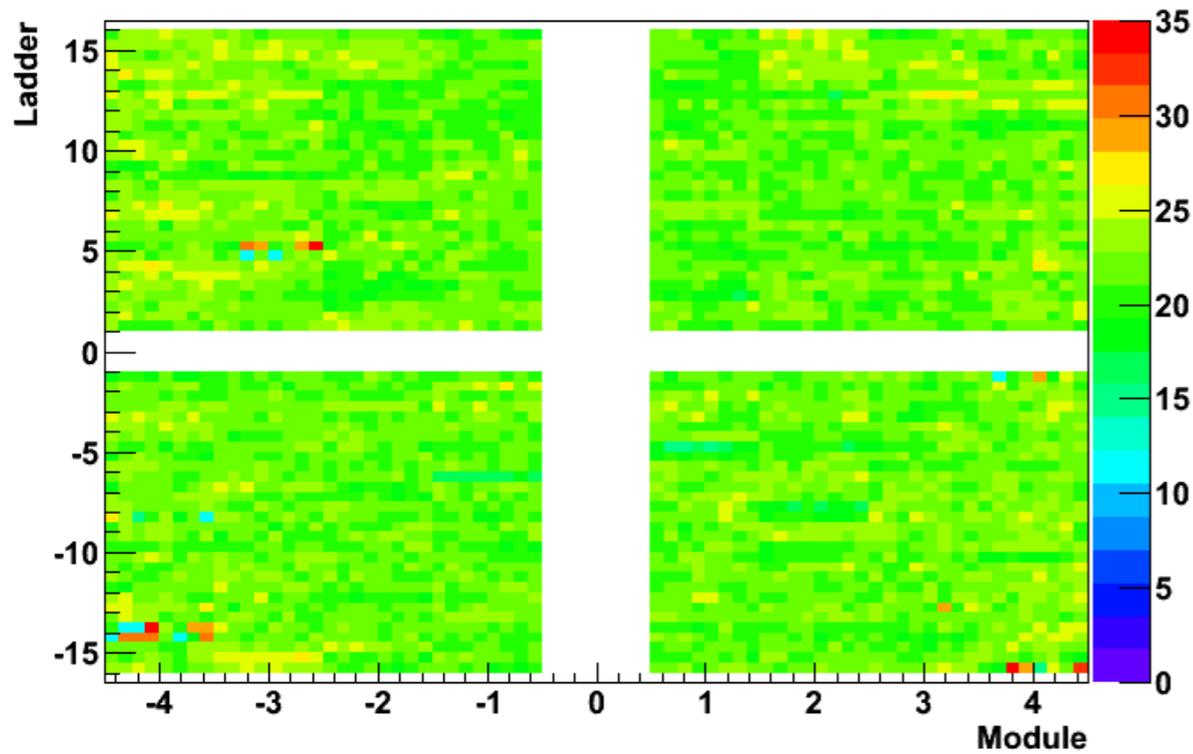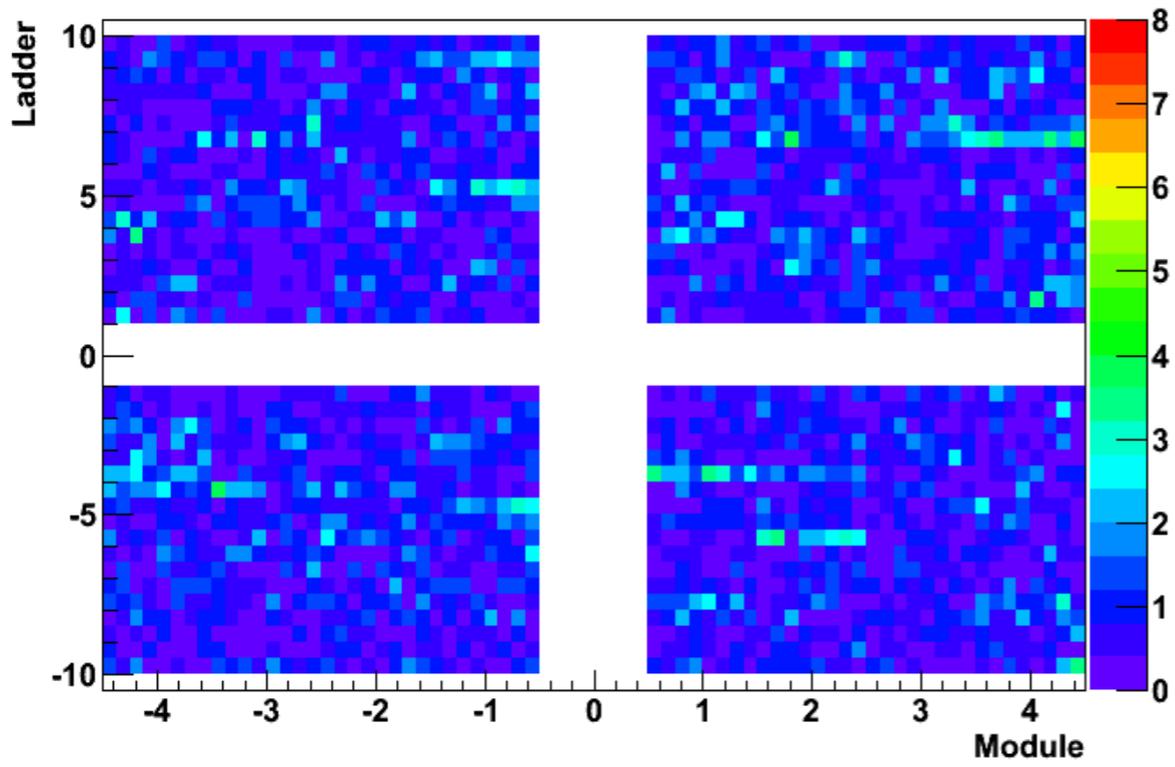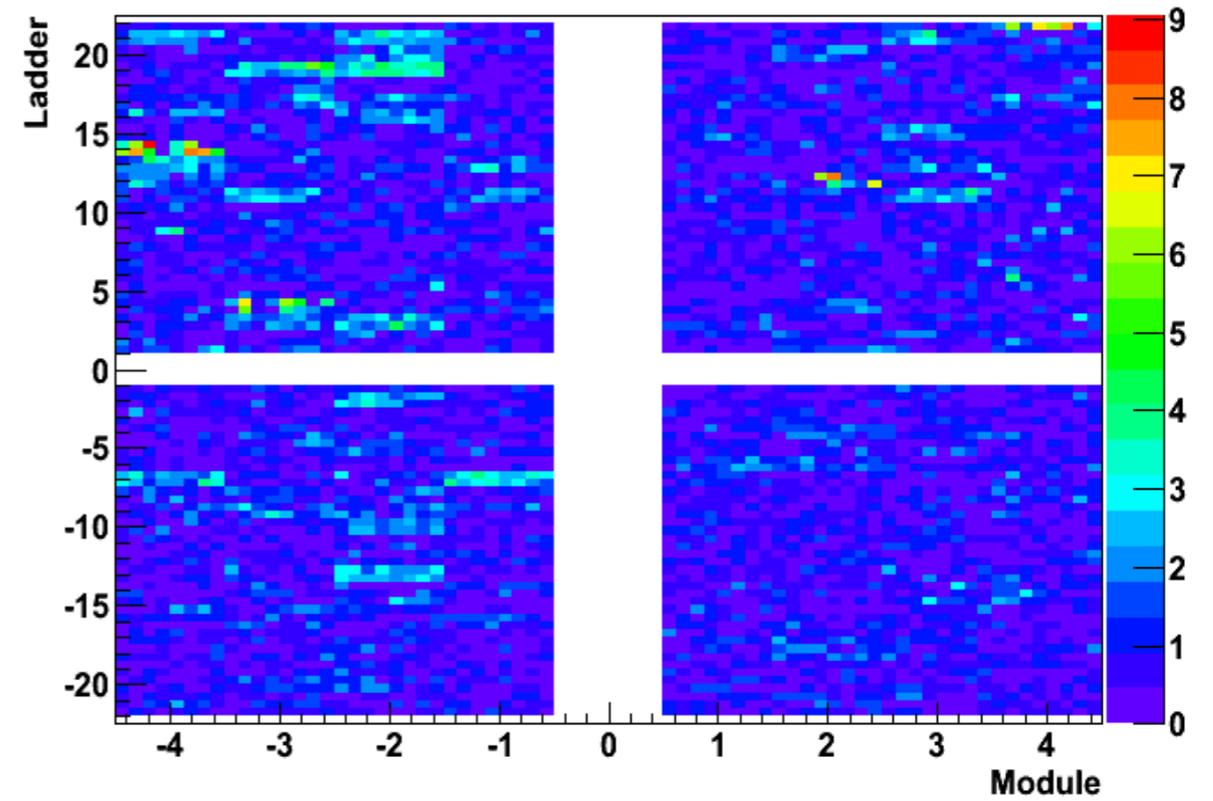
Fit results - MPV of Landau

Layer 1

Layer 3

Layer 2

Fit results - Significance
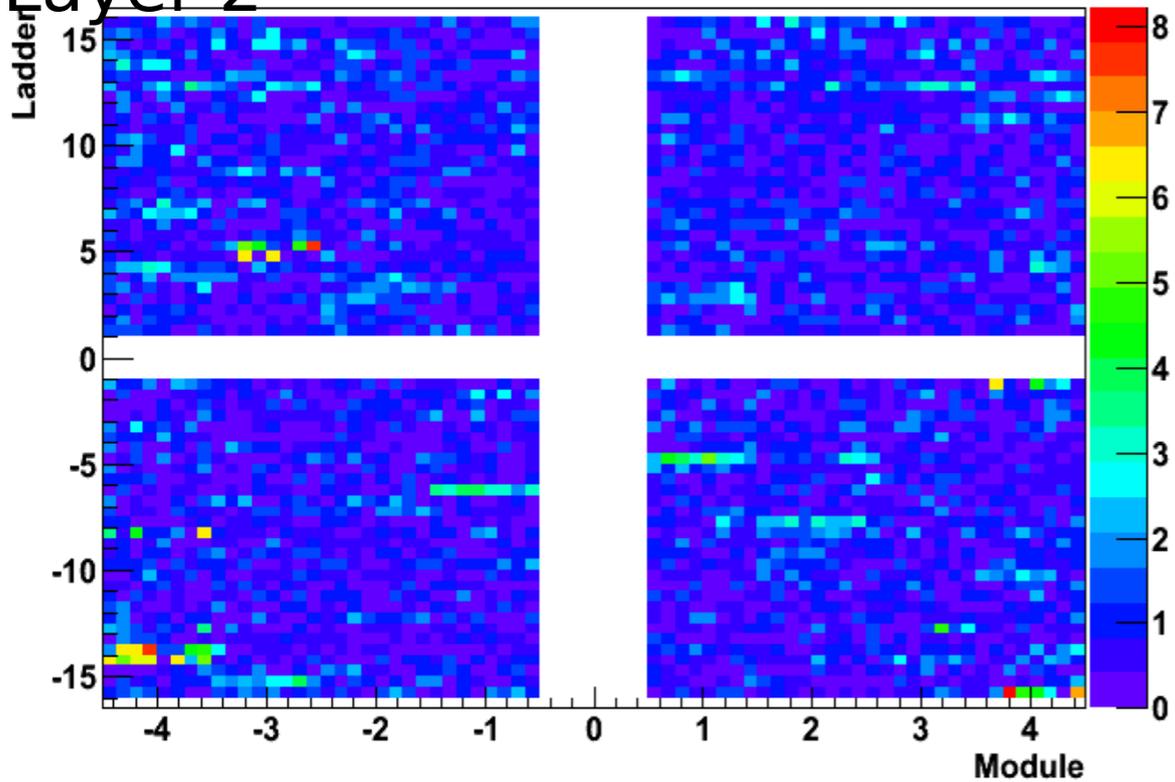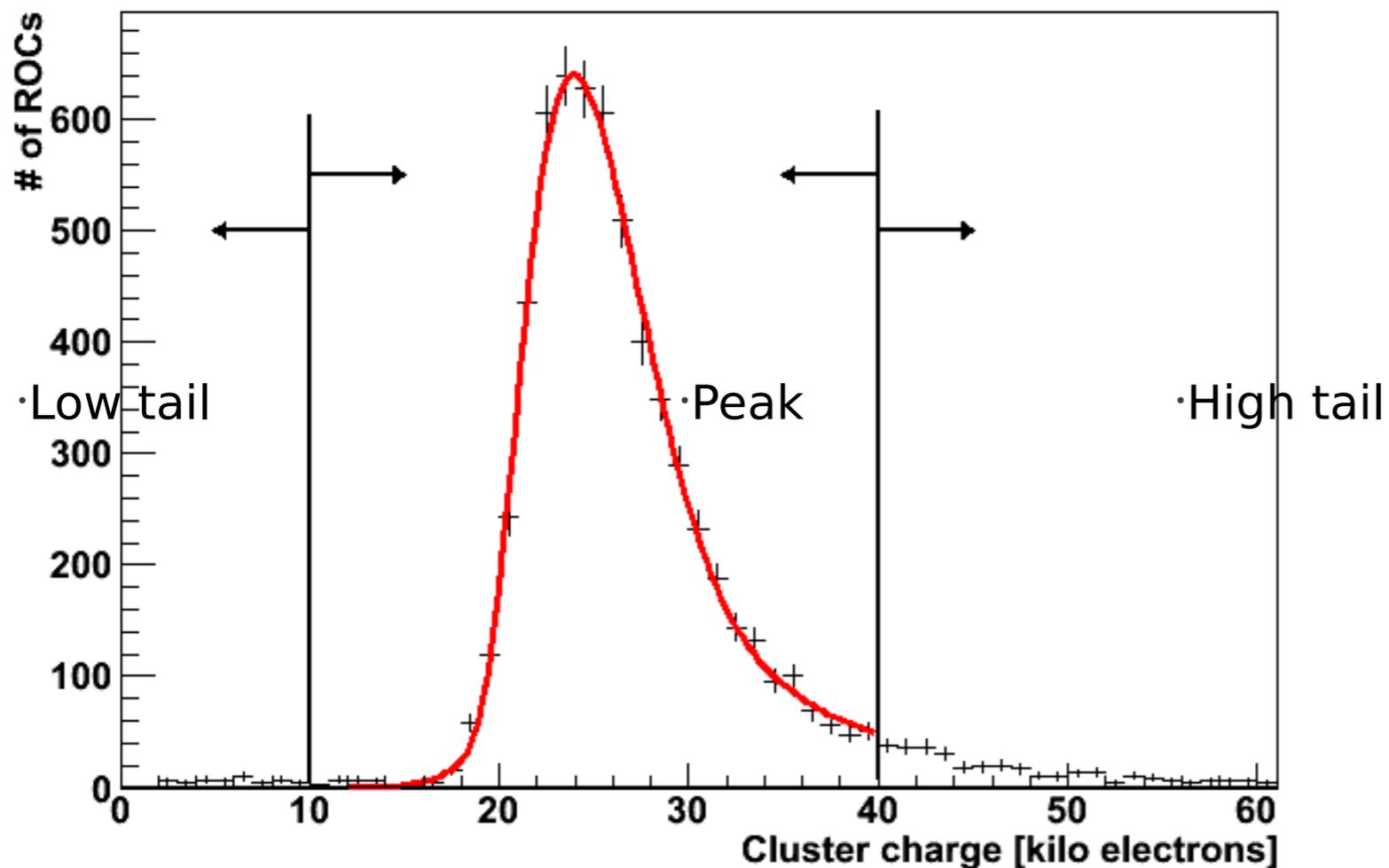
Layer 1

Layer 3
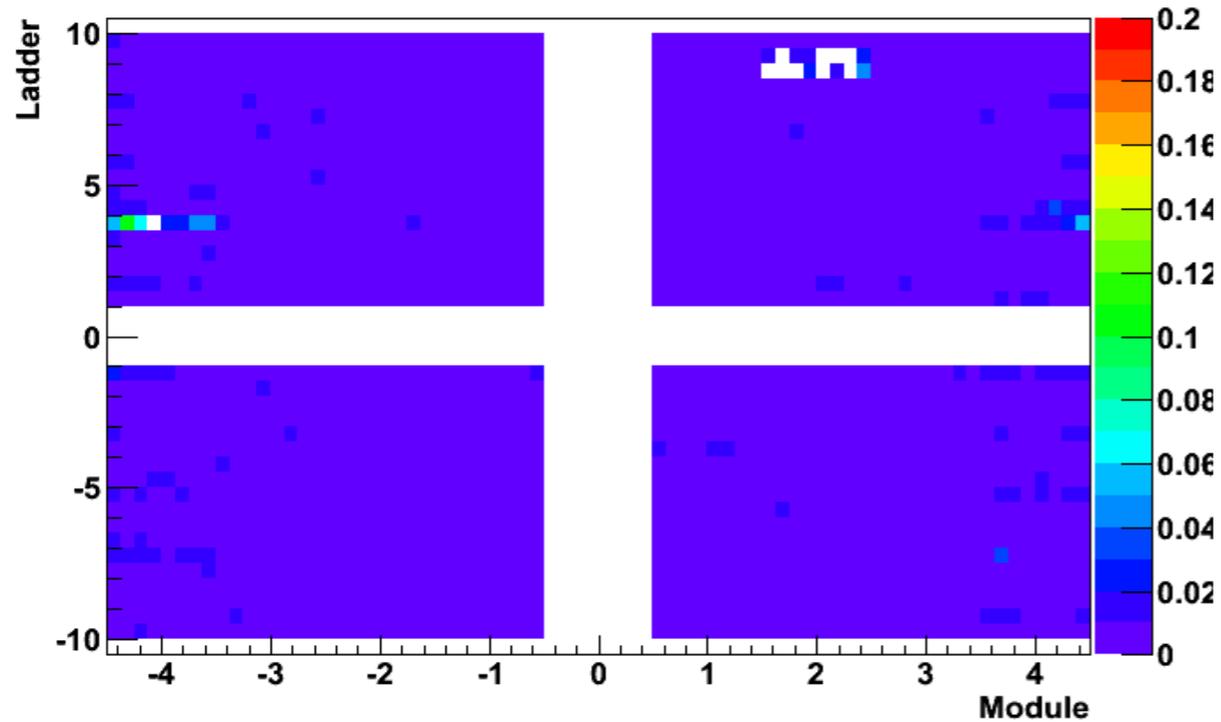
Layer 2

- Significance:
(MPV Fit - MPV Mean)|/Sigma

Tail of the cluster charge distributions

- Observation: bad ROCs have something going on in the tails
- Look at the tail of the cluster charge distribution
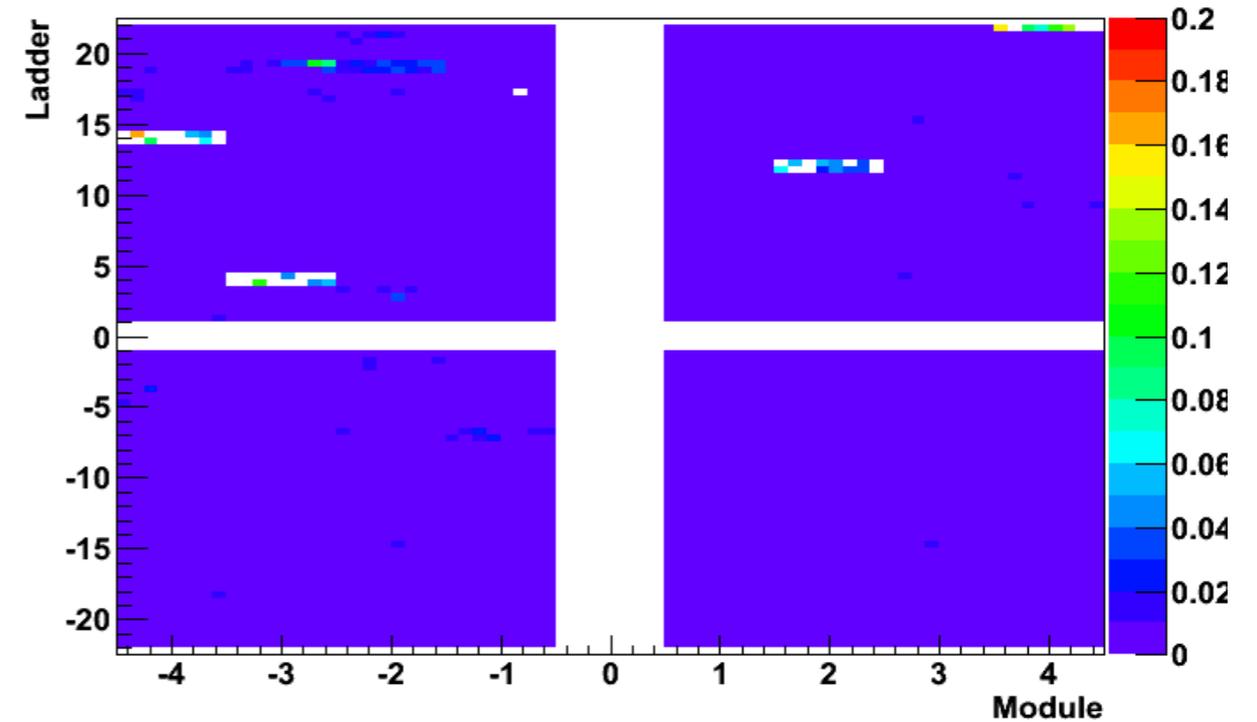- Plot the fraction of the charge in the tails w.r.t. the total charge per ROC

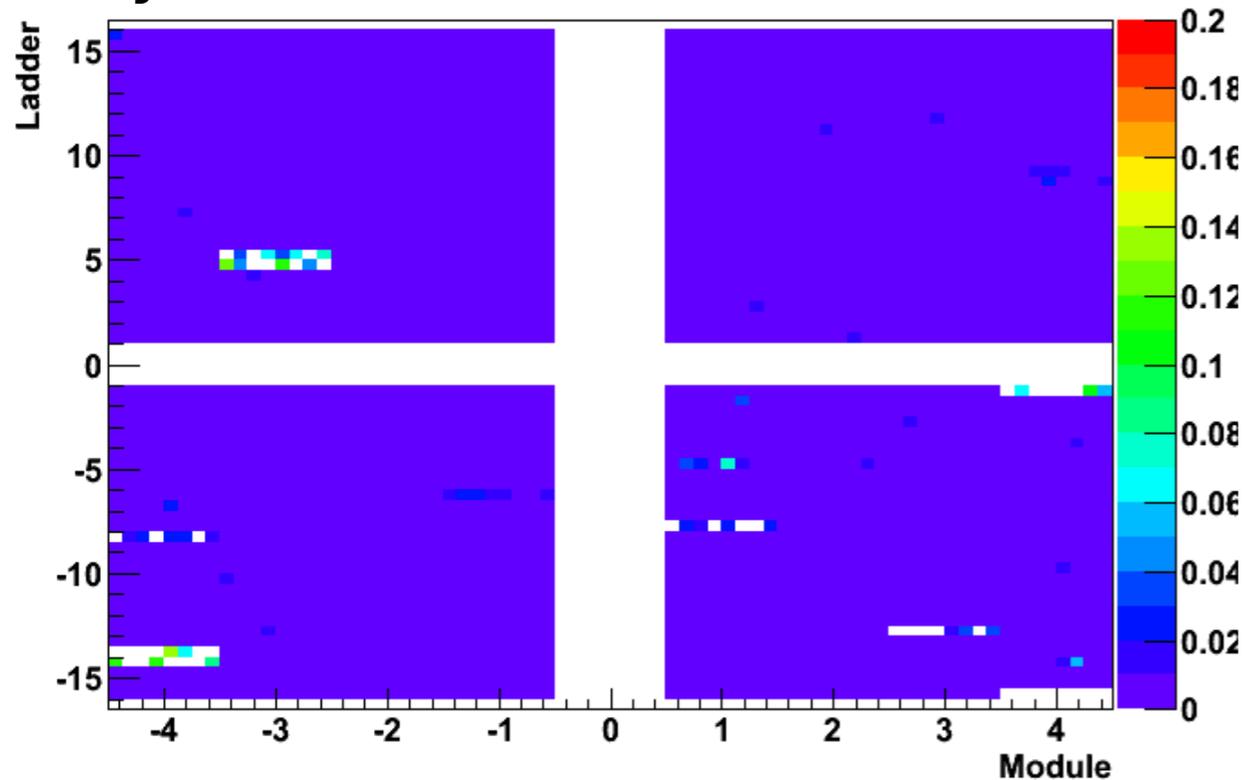# Fraction of entries in lower tail of the cluster charge distributions

Layer 1

Layer 3

Layer 2

- The modules became visible
- But some full or half modules are pronounced in Layers 2 and 3

Impact of Time Delay on Landau MPV mean (2011 MinBias Run)

- Using the mean MPV of all ROCs per BPix layer.
- At the correct timing the average cluster charge MPV is expected to be at maximum.
- Timing of all 3 layers consistent with each other.
- Uncertainties are the standard errors on the MPV mean fits.
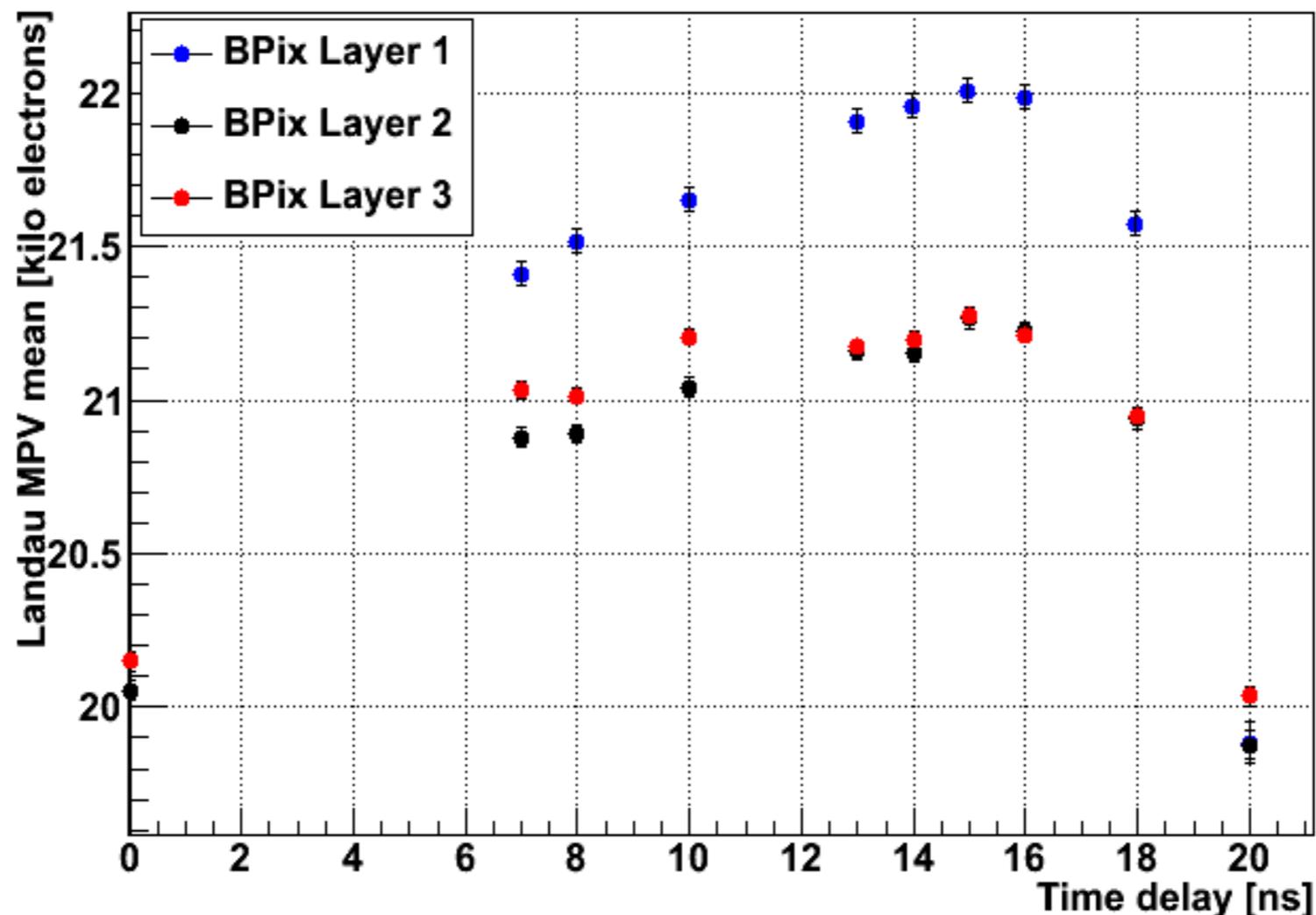
·Conclusions

- ROC quality monitoring in Barrel Pixel
- Fit cluster charge distribution from multi-pixel RecHits associated to track segments per ROC
- Mainly Gaussian distribution of cluster charge mean
- ~ 1 % Bad ROCs, dominated by > 3 sigma cases
- Tasks:
  - Impact of HV bias on cluster charge distribution
  - Bad ROC into prompt calibration loop
  - FED error propagation