Update
Apsel3D_TC chip characterization

Alejandro Pérez
INFN – Sezione di Pisa

INFN
Istituto Nazionale
di Fisica Nucleare
SEZIONE DI PISA

Outline

- **More about Noise scans**
  - Chip5
  - Chip6
- **Differential spectrum with the Fe55 source**
  - Chip5
  - Chip6
- **Noise occupancy for realistic observation time (5µs)**
  - Chip5
  - Chip6

Noise Scans

Noise scans: the fit function

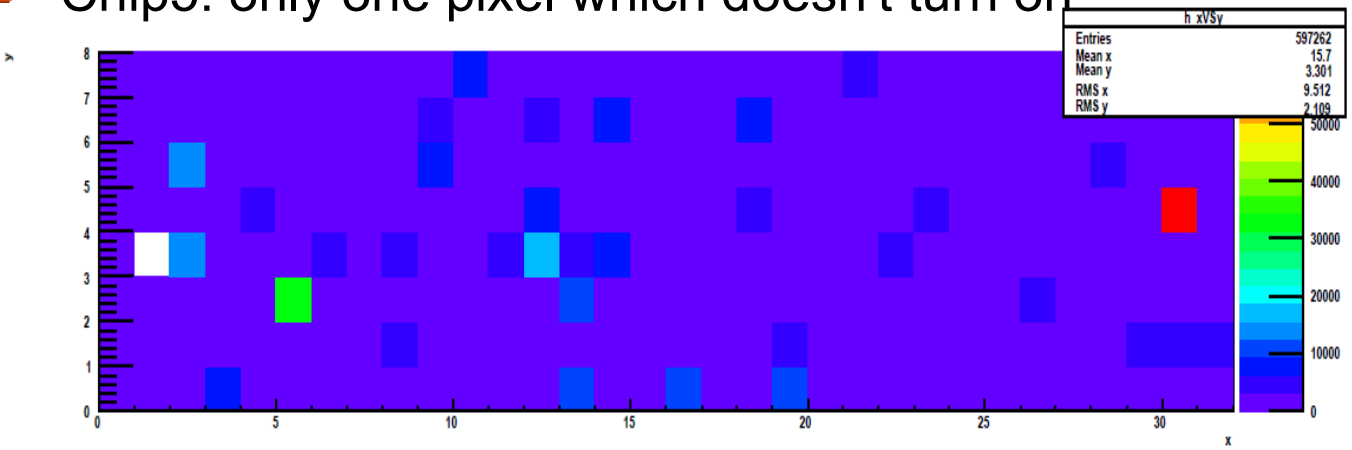
- Previously used a physics motivated function to describe the occupancies of the noise scans

$$\textbf{Occupancy} = 1.0 - \exp\{-\nu_0 t_{obs} \exp(-(thr - \mu)^2/2\sigma^2)\}$$

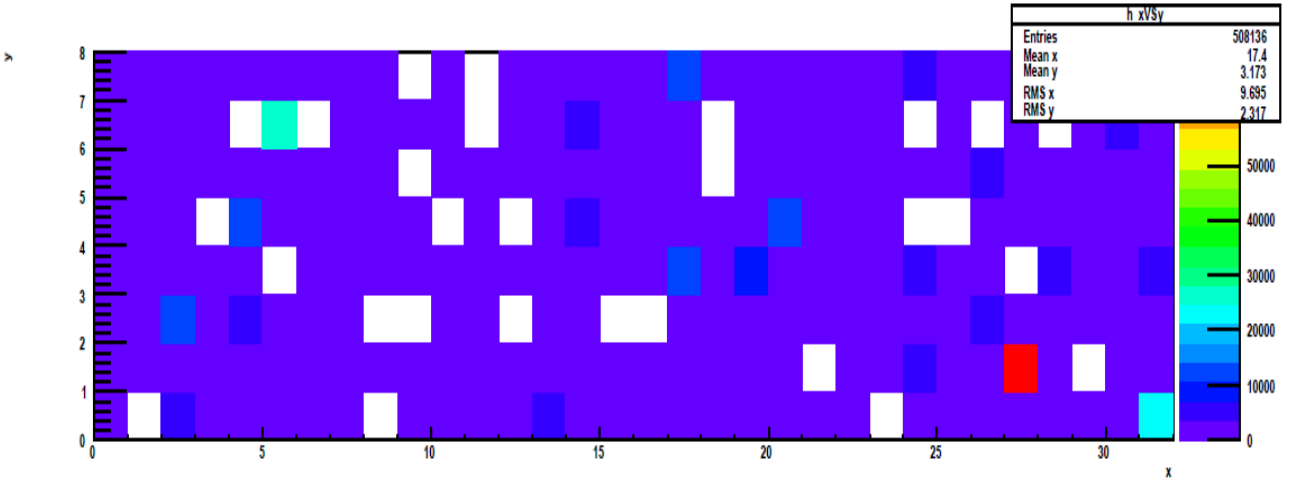
- Where, σ is the noise, the μ baseline, ν_0 the trip rate at zero threshold, t_{obs} the observation time. This expression is only valid if t_{obs} >> worst death-time. We used t_{obs} = 2ms (worst death time ~ 4*50ns*16 = 3.2μs).
- Using this function a significant fraction of the fits didn't converge (~28% for chip-5)
- Decided to used an asymmetric function with a different $\sigma(\mu)$ to the left/right of μ. $\sigma(\mu) = \sigma_L$ (σ_R) for thr – μ < 0 (thr – μ > 0)
- With this function the failed fit reduces significantly (~12.8% for chip-5)
- The noise scan fits are used to extract the pixel base-line, which will be used to estimate the gain from Fe55 spectra

Noise scans: Chip5 and Chip6

- Performed noise scans from 1250 up to 1500 DAC (100 steps of 4 DAC) with t_{obs} = 2ms
- Chip5: only one pixel which doesn't turn on

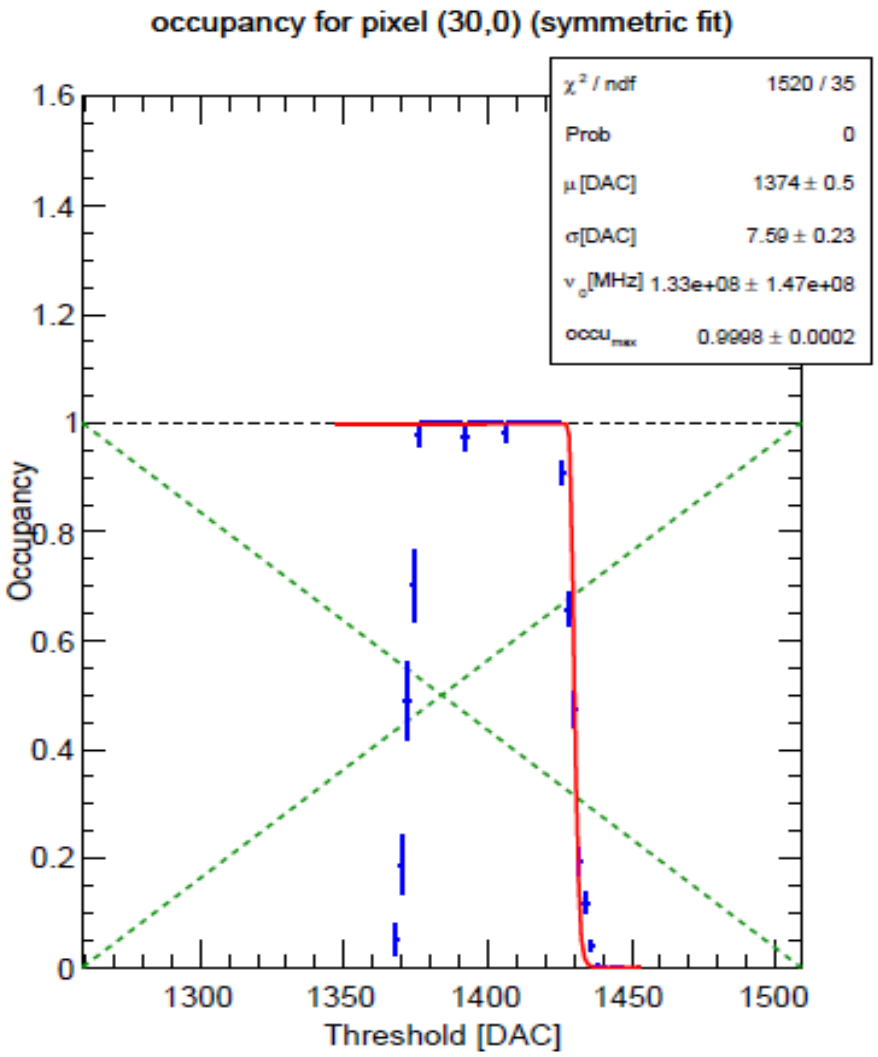


- Chip6: a significant amount of dead pixels (28 ⇒ 11%)

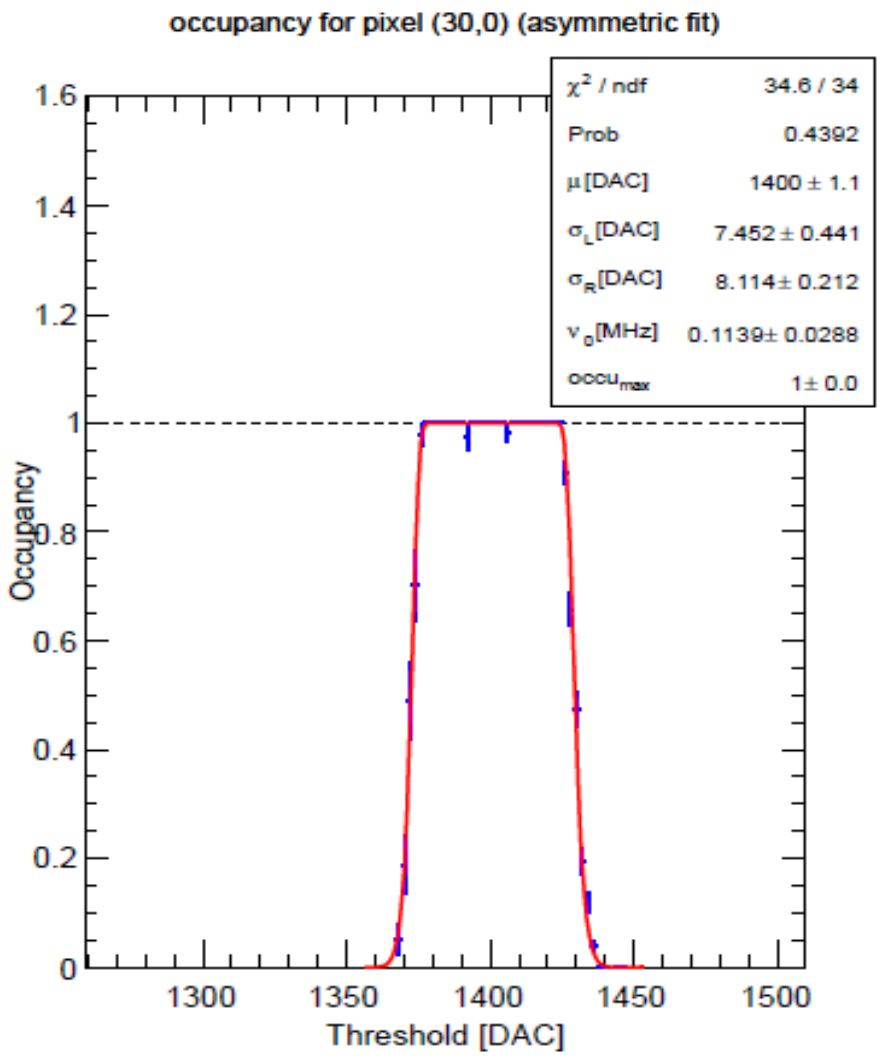


Noise fit: Chip5

Symmetric fit

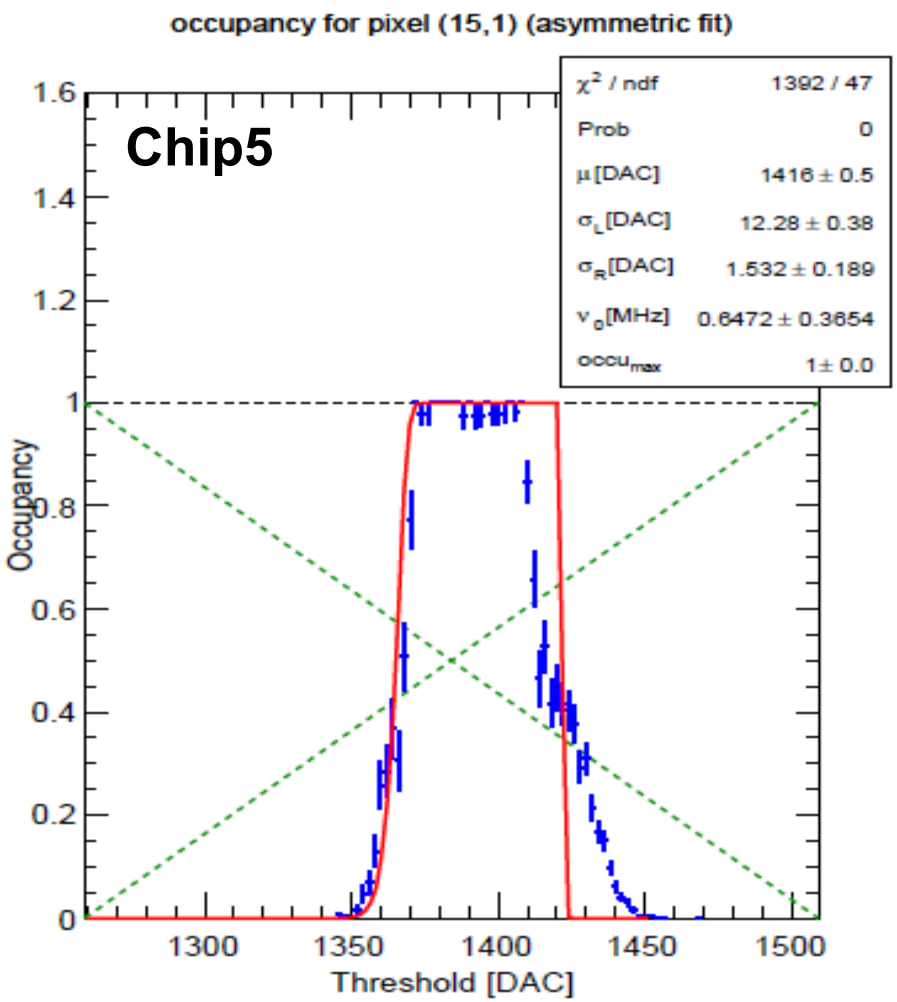


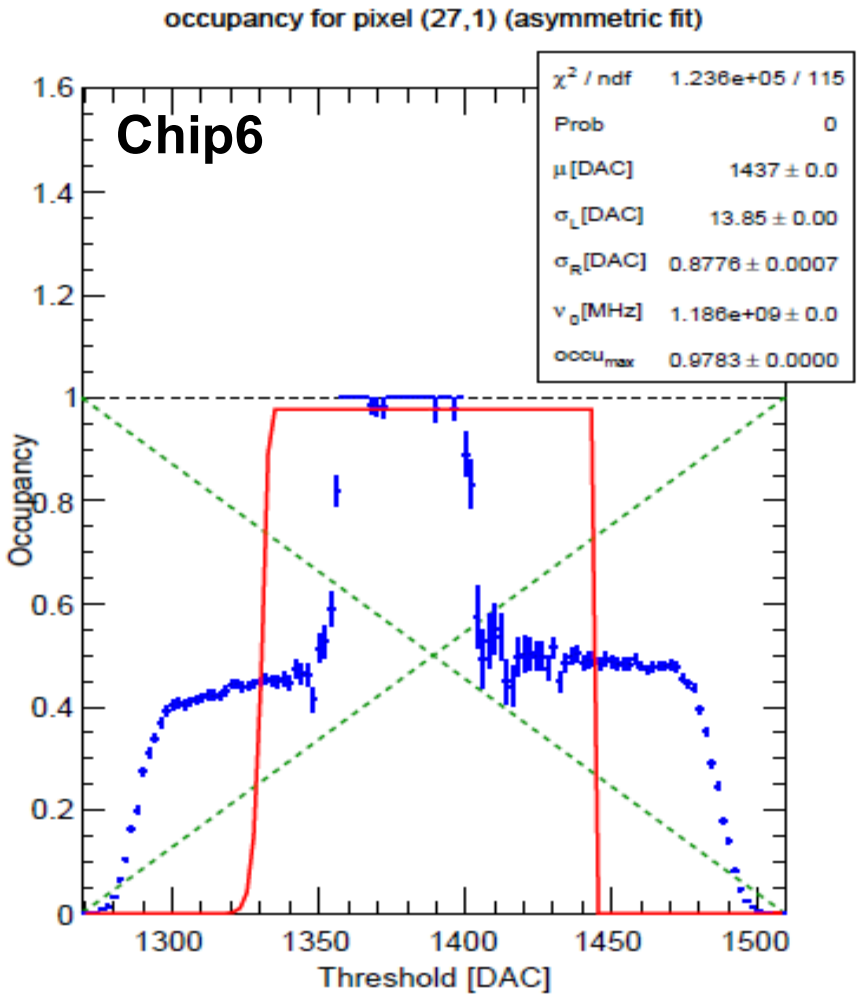
Asymmetric fit



Noise scans: Chip5 and Chip6

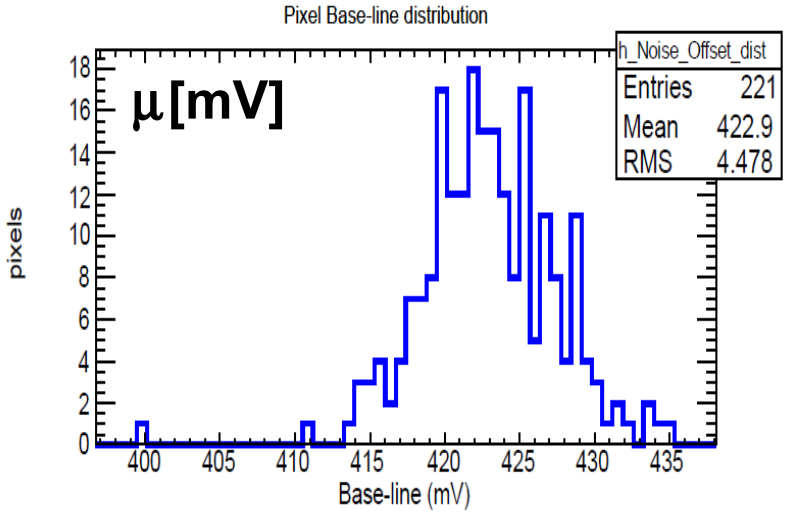
- Some pixels for both chips show strange features
- The fit poorly converges in those cases

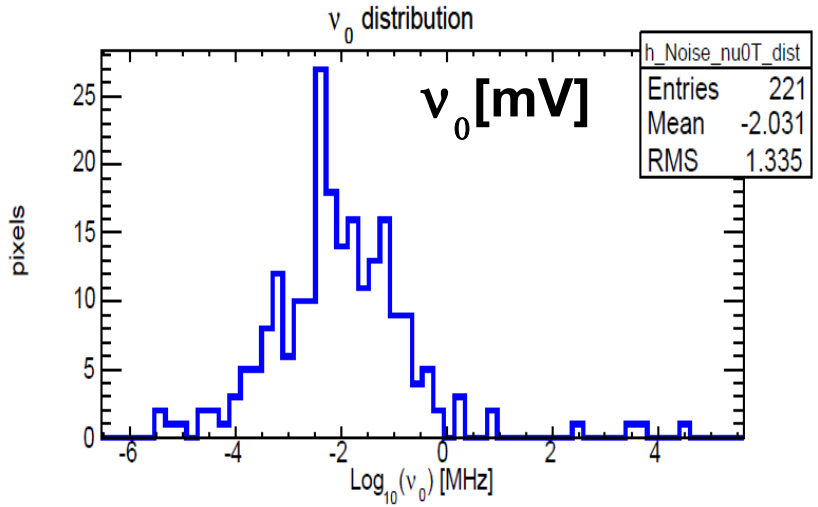


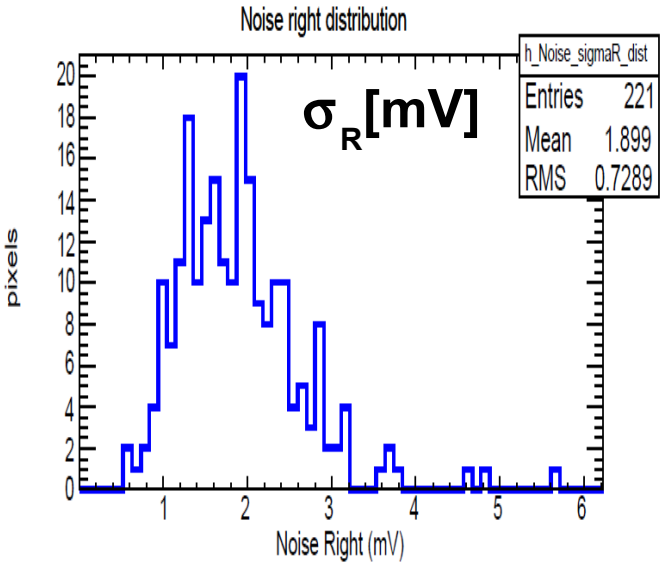


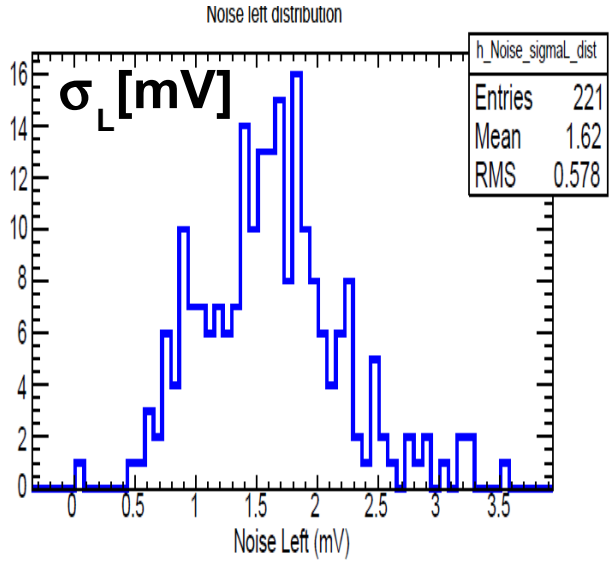
Noise scans: Chip5

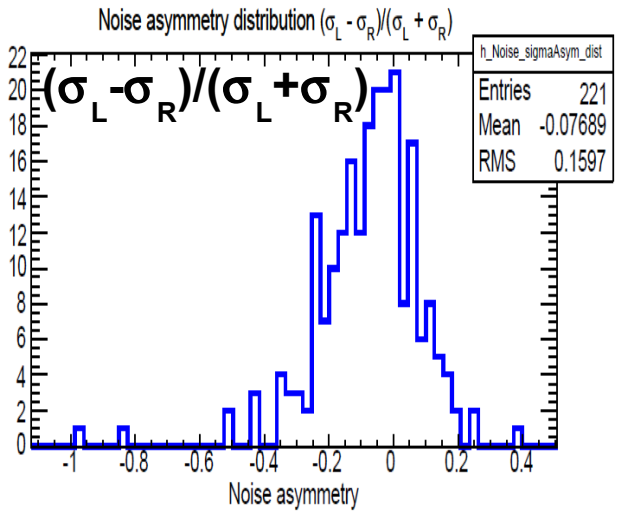
- In some cases the fit doesn't converge properly. Those pixels are not used for the plots below. 221 fits converged (there is 1 dead pixel).





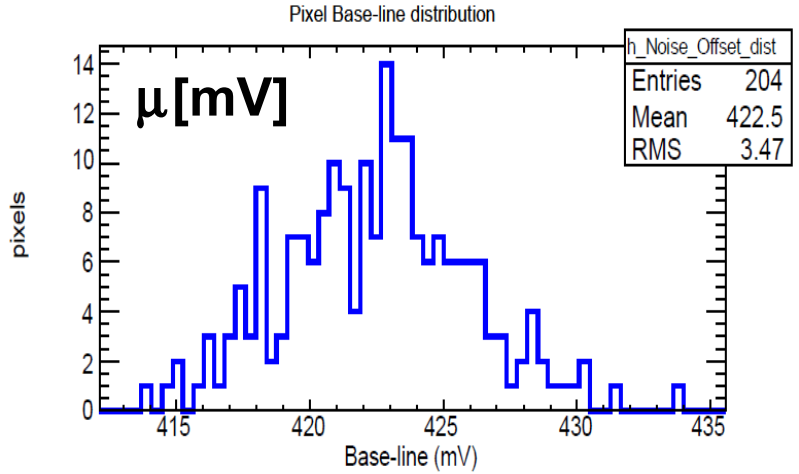


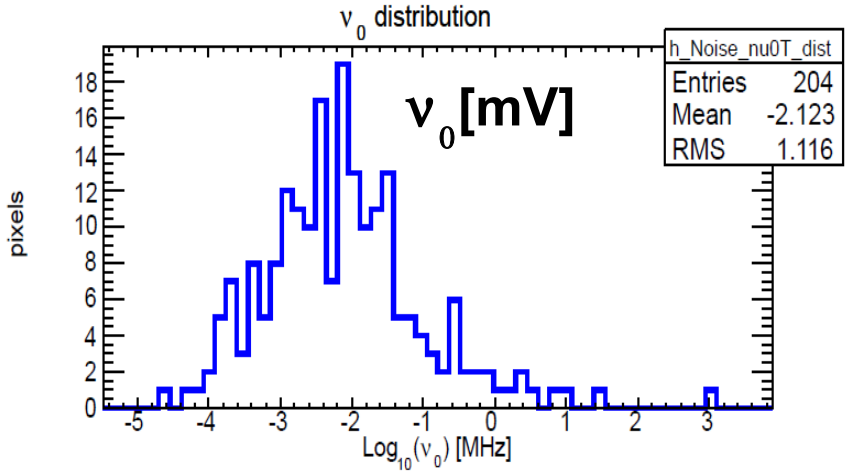


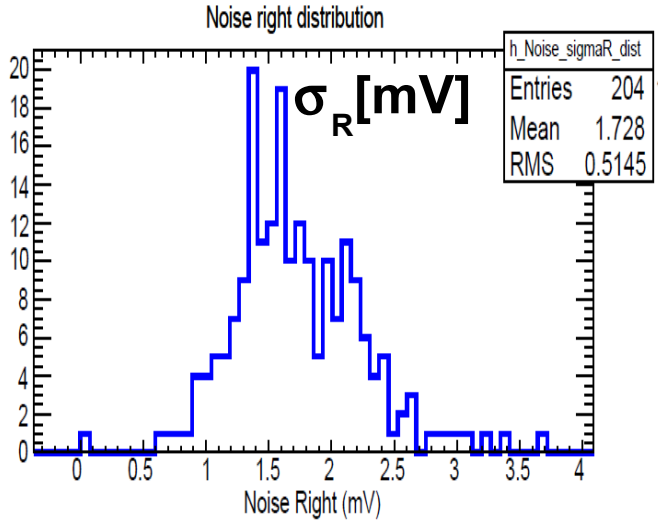


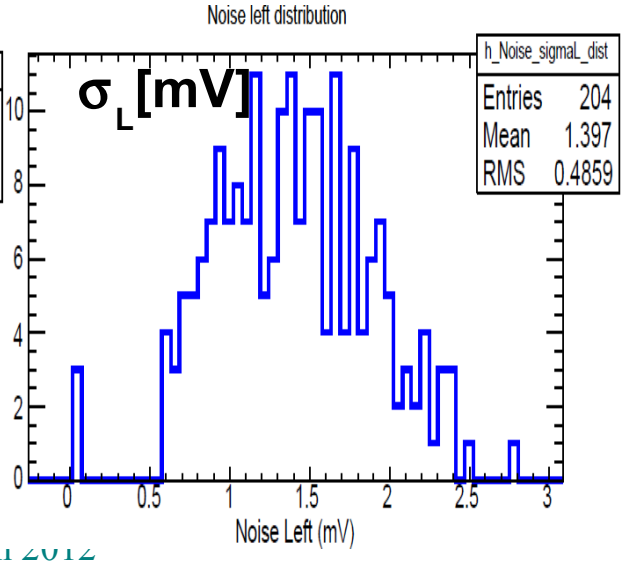
Noise scans: Chip6

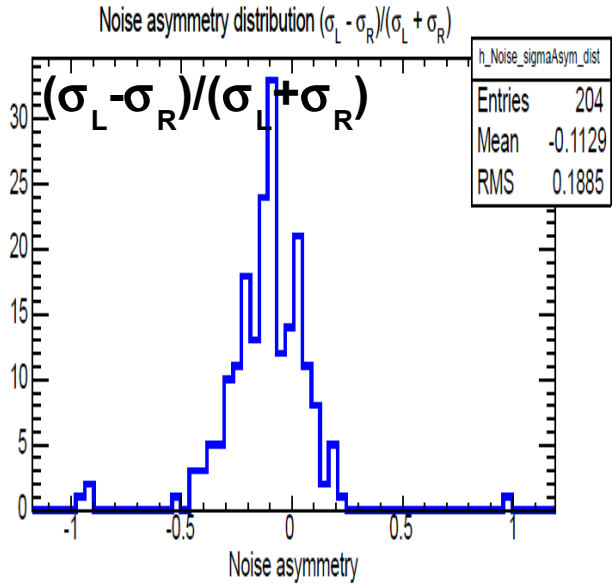
- In some cases the fit doesn't converge properly. Those pixels are not used for the plots below. 204 fits converged (there is 28 dead pixel).









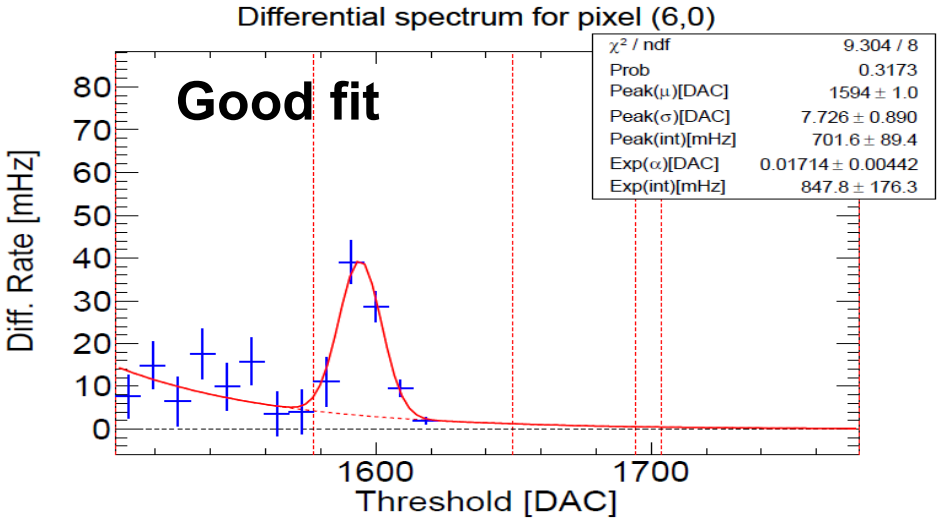


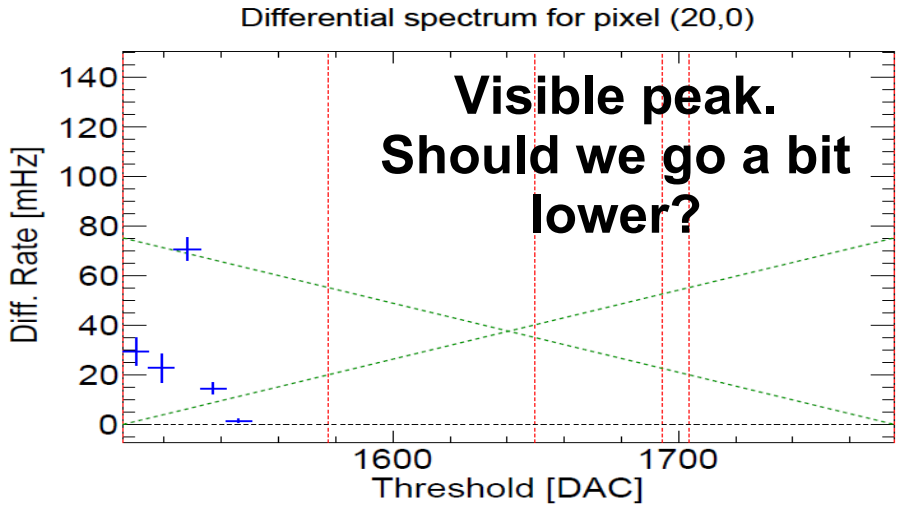
Data-taking with Fe55 source

Data with Fe55 source

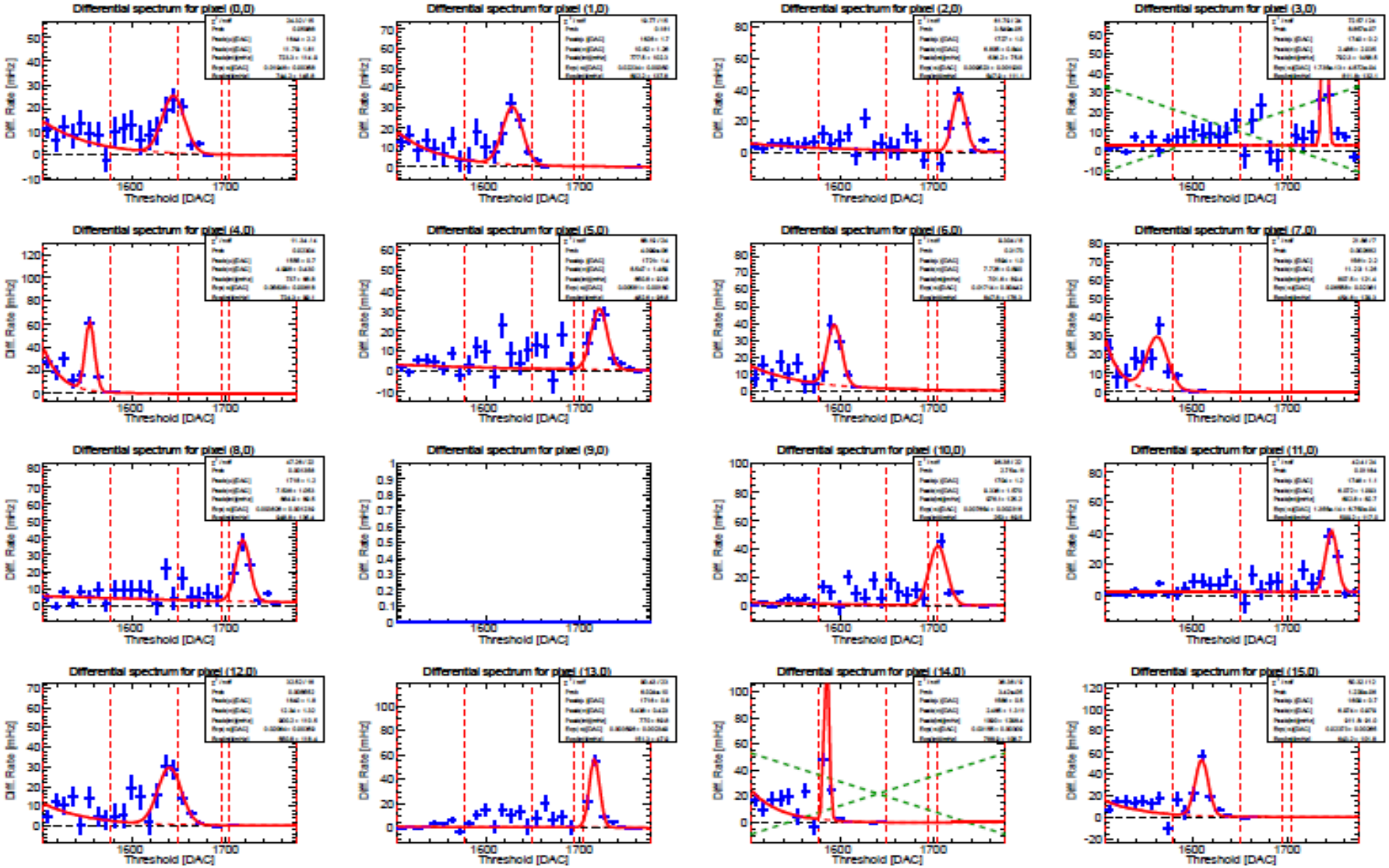
- With the Fe55 source took data varying the threshold,
  - Chip5: 1510 to 1780 in steps of 9 (units in DAC)
  - Chip6: 1591 to 1789 in steps of 9
- Out of the integral spectrum calculated the differential spectrum (bin_i+1 – bin_i on the integral spectrum)
- Put together the differential spectrum of all the runs
- Tried to look for the Fe55 peak and fit it ⇒ Guassian+exponential
- For many pixels the Fe55 peak is visible, but for some others it seems that the scan window didn't go low enough. There are some which are completely empty

Chip5

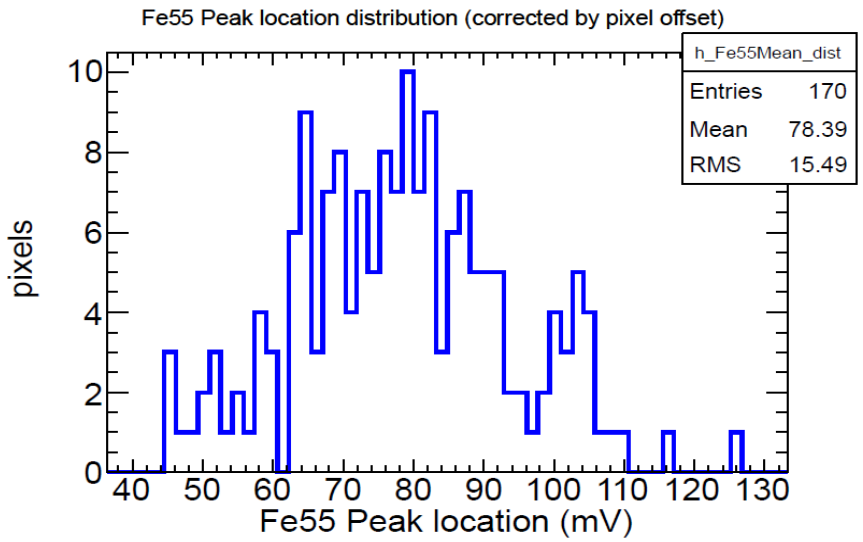


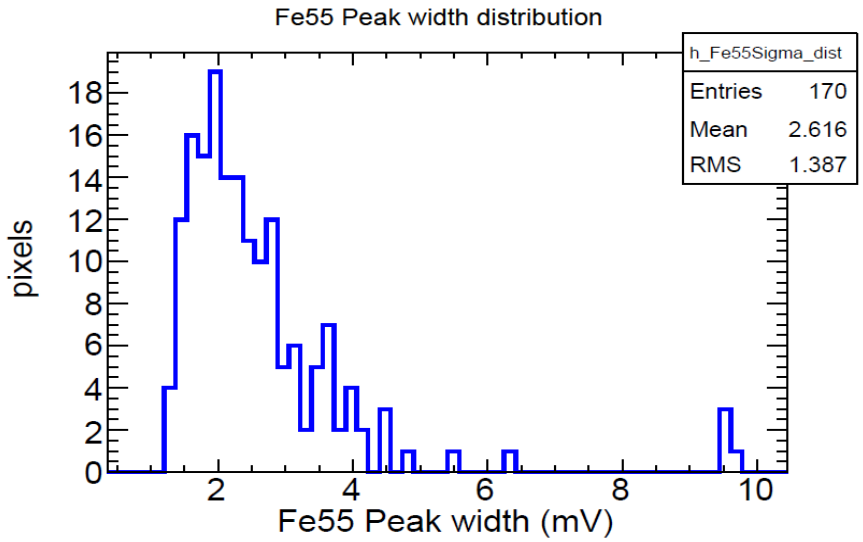


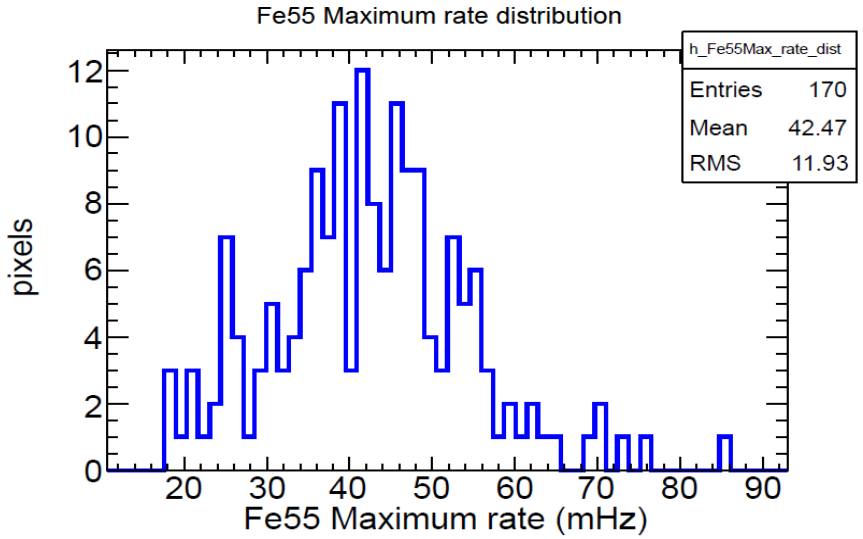
Fe55 source: Chip5 fit example



Fe55 source: Chip5 fit results





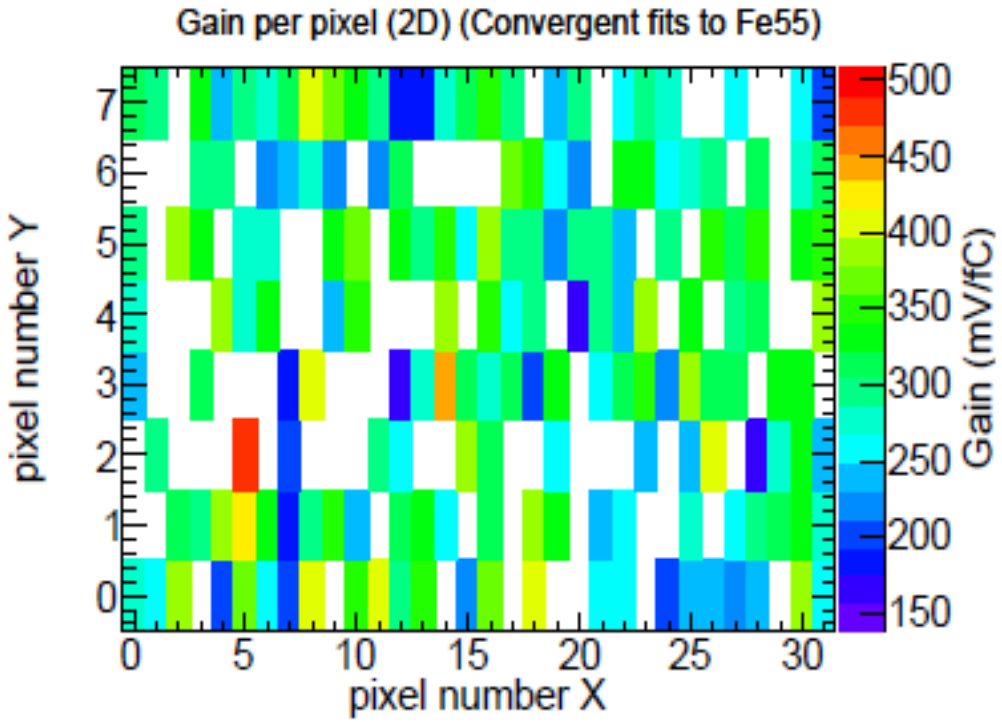


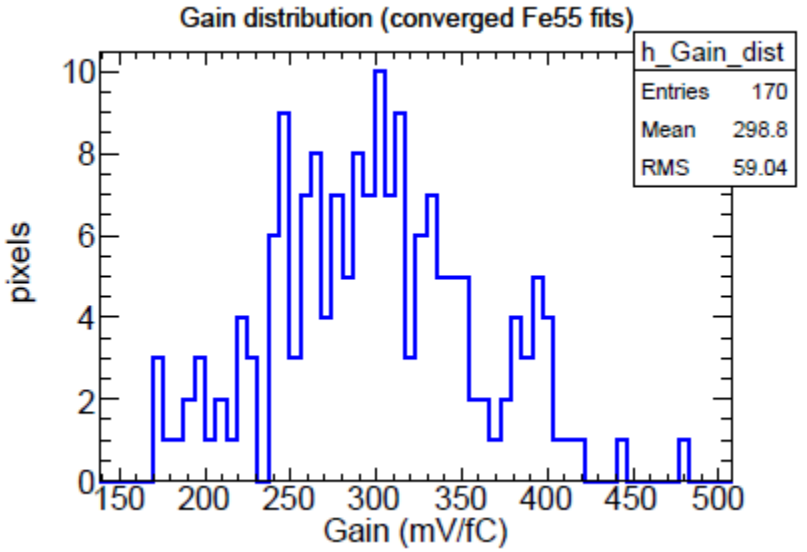
- Subtracted pixel base-line from peak mean
- Mean and width of the peak has been converted from DAC to mV

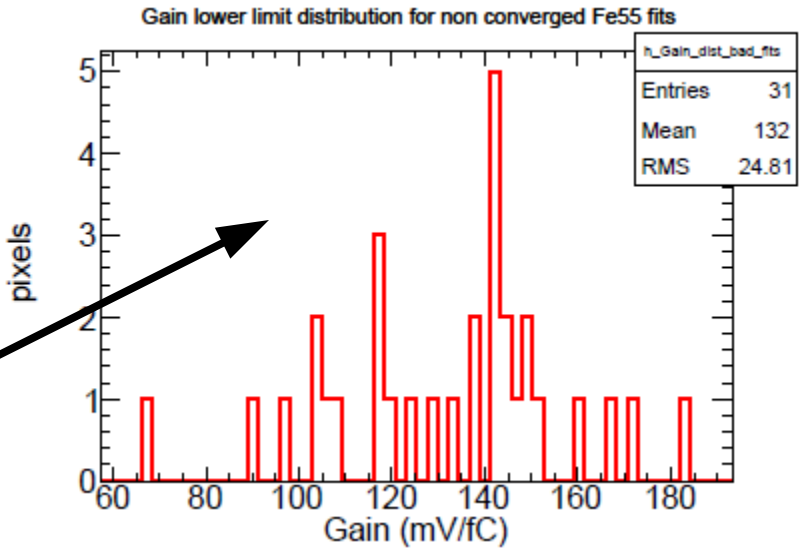
Fe55 source: Chip5 the gain

- Use the peak base-line subtracted mean to estimate the gain

  gain = mean/charge (charge = 1640 e^-)





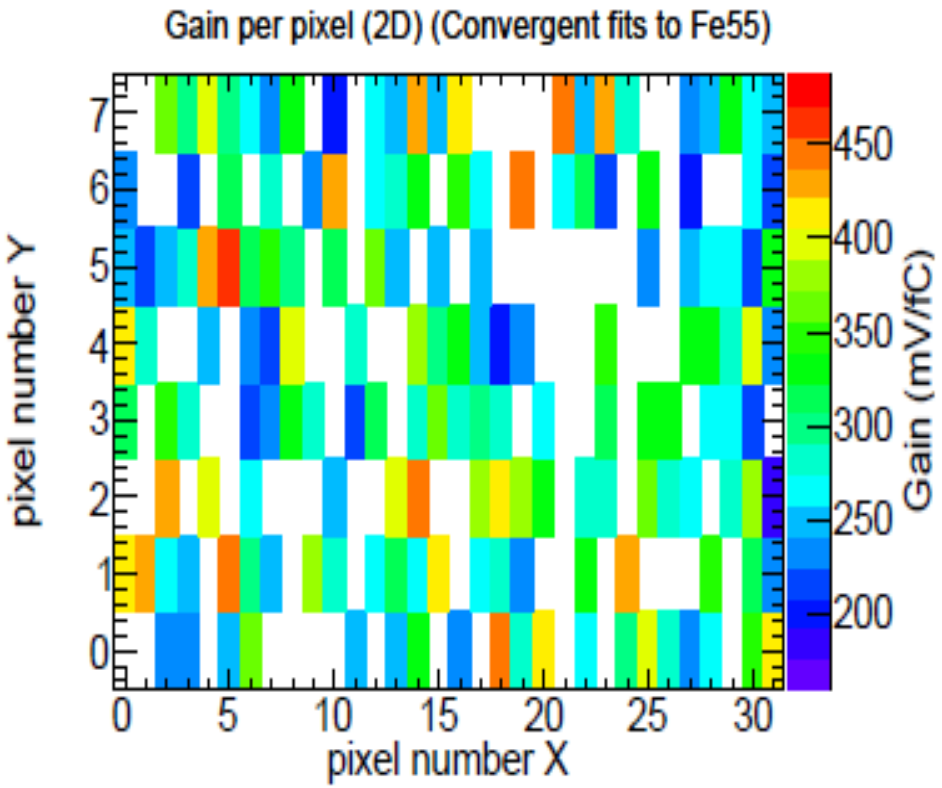


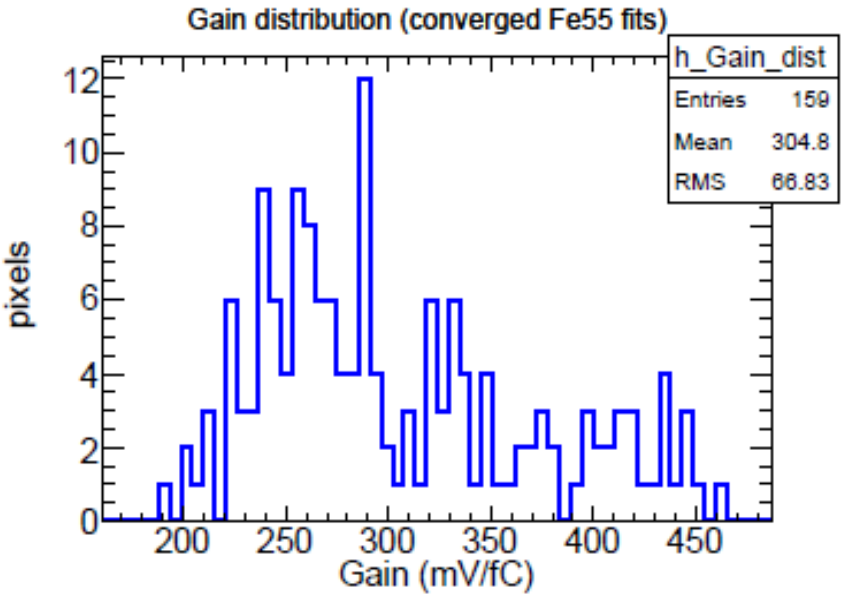
- For pixels for which the the fit doesn't converge estimate a lower-limit of the gain

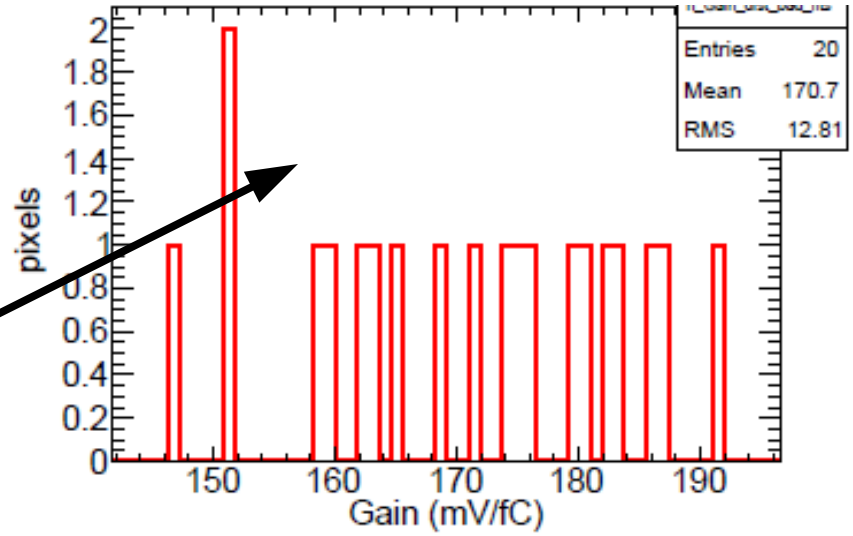
Fe55 source: Chip6 the gain

- Use the peak base-line subtracted mean to estimate the gain

  gain = mean/charge (charge = 1640 e^-)







- For pixels for which the the fit doesn't converge estimate a lower-limit of the gain

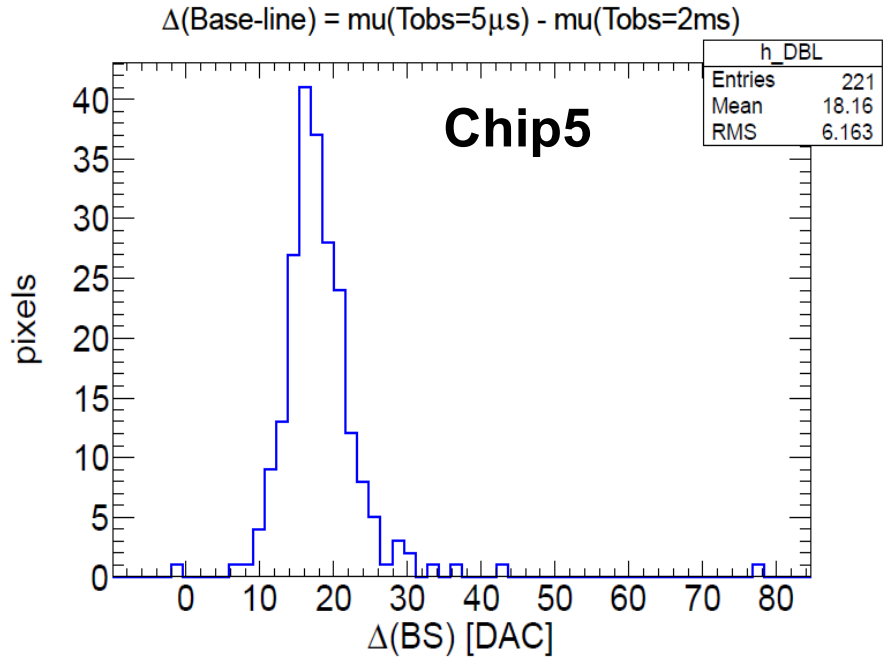
Noise occupancy with realistic t_{obs} (5µs)

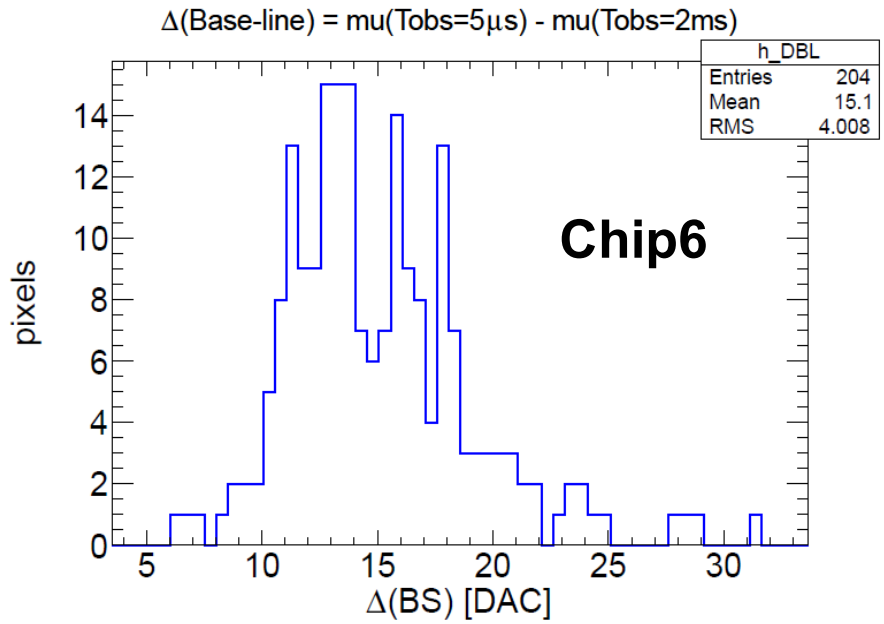
Realistic t_{obs} (5μs)

- Wants to evaluate what is the matrix occupancy due to noise for realistic observation times (5μs) and for different thresholds
- Also wants to have an idea of the death time as a function of the threshold
- Did noise scans from 1388 to 1504 in steps of 4 (units in DAC)
- Prediction function: use the results from the high t_{obs} (2ms) noise scans (μ,ν_0,σ_R and σ_L) and scale to the current t_{obs} $\Rightarrow$ use the same noise function with the current t_{obs}
- Use this function to try to predict the occupancies for the current t_{obs}. Don't expect good description as death-time is non negligible
- Also estimate the matrix occupancy (fraction of pixel of the matrix that fired due to noise)

Realistic t_{obs} (5µs): variation of the base-line

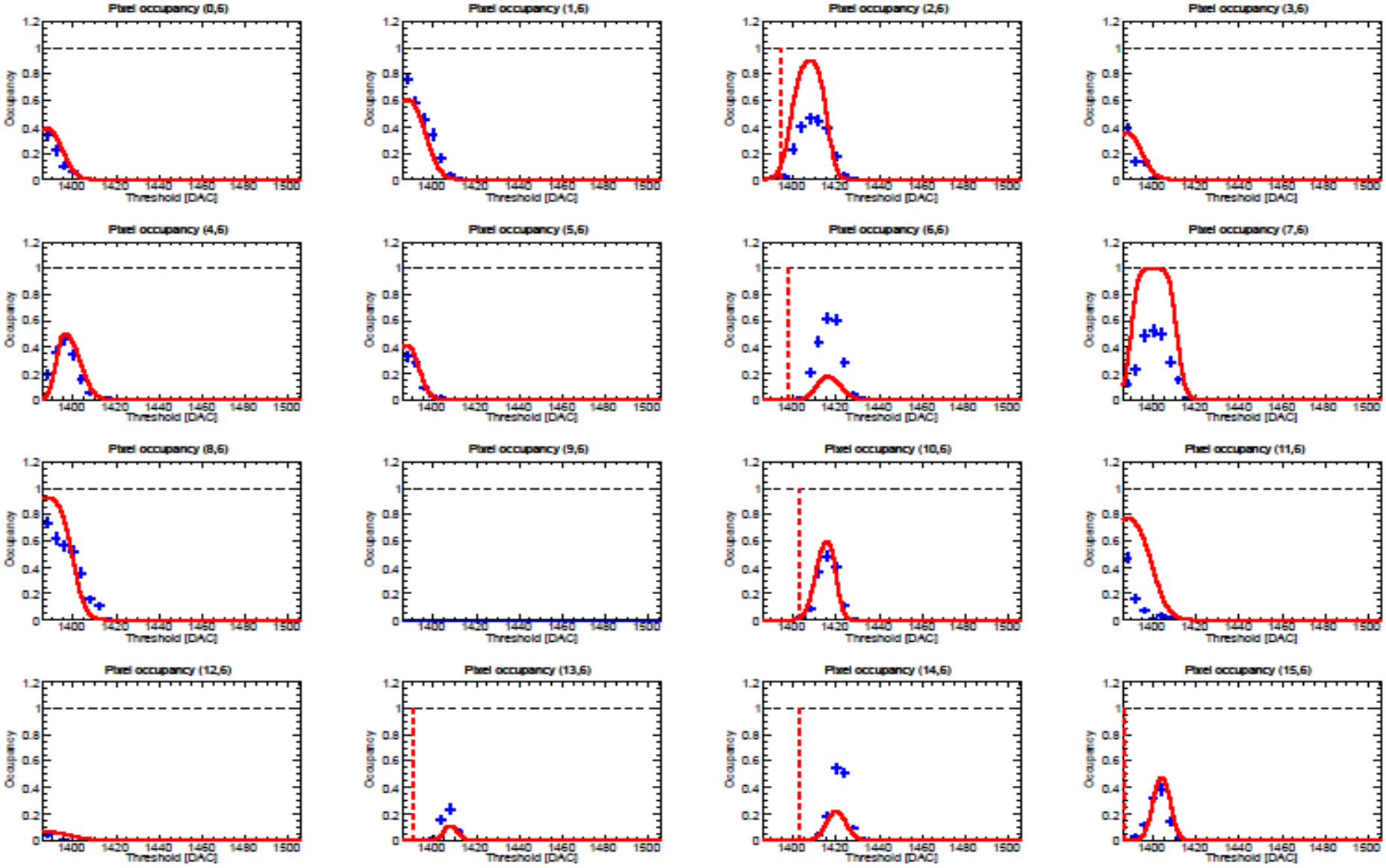
- Base-line of noise scans for t_{obs} = 5µs is different than the one for t_{obs} = 2ms
- Is this an effect of the temperature?
- To predict the pixel and matrix occupancy used the base-line for t_{obs} = 5µs and the other parameters (ν_0,σ_R,σ_L) extracted for the noise scans with t_{obs} = 2ms





Realistic t_{obs} (5µs): occupancies per pixel (Chip5)

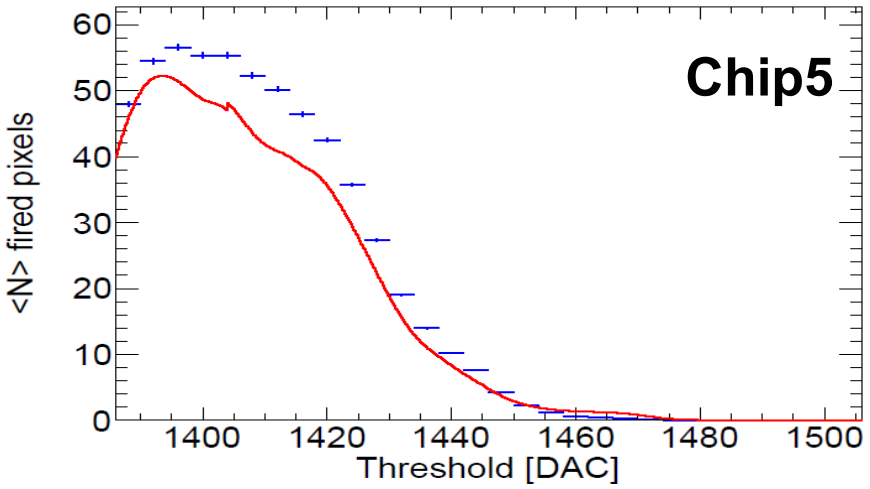
Measurement
Prediction

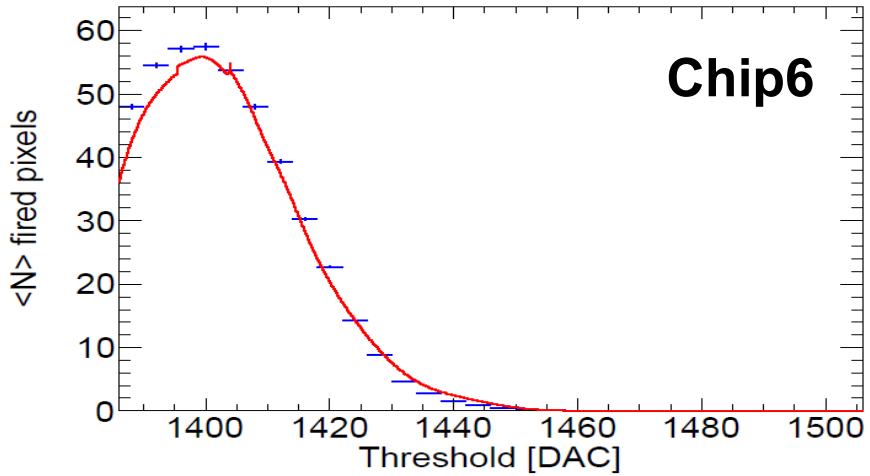


Realistic t_{obs} (5µs): matrix occupancy

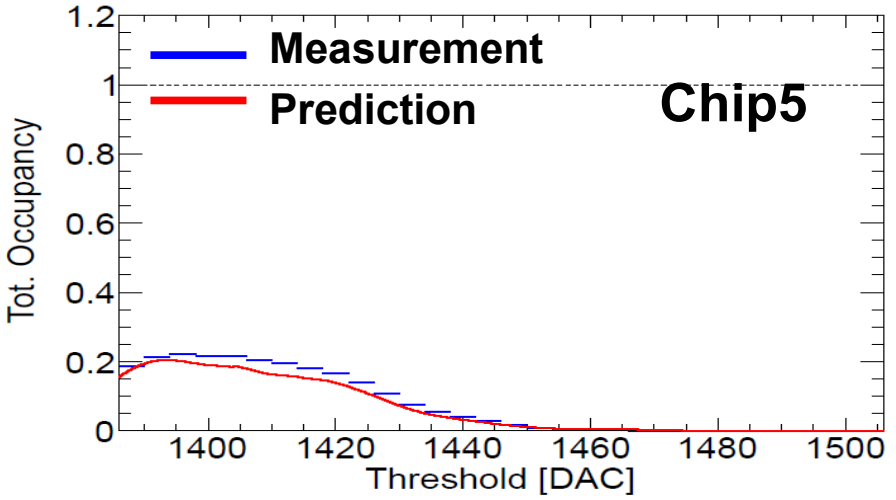
- Wants to evaluate what is the matrix occupancy due to noise for realistic observation times (5µs) for different thresholds

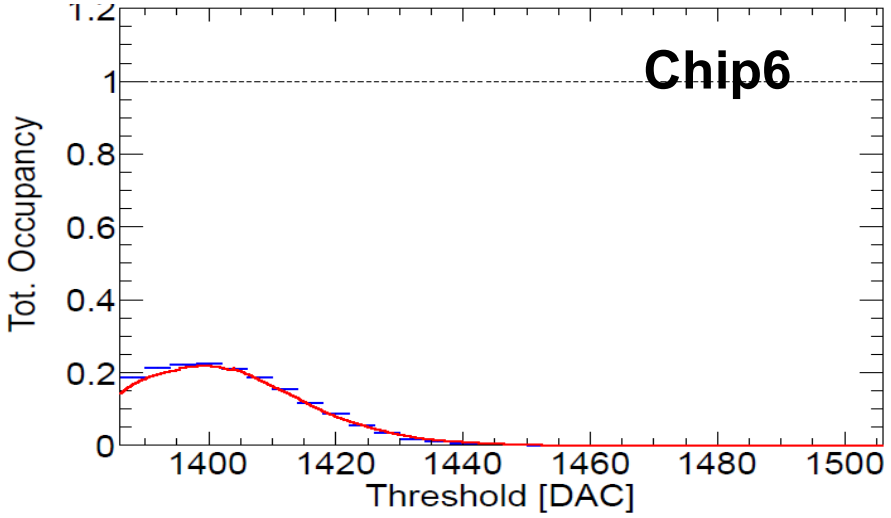
Mean number of turned pixels





Matrix occupancy

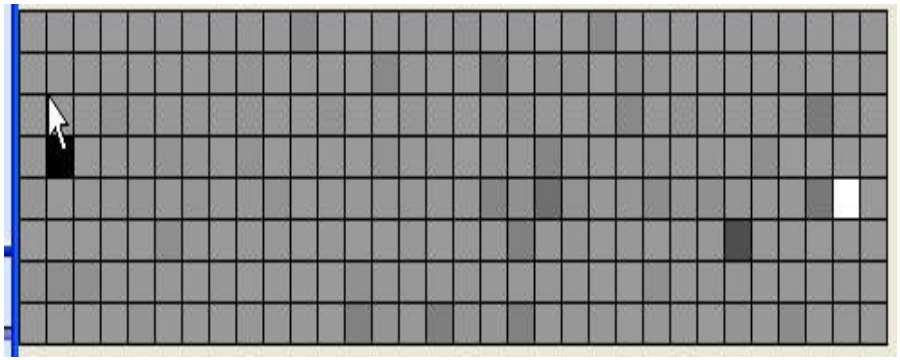




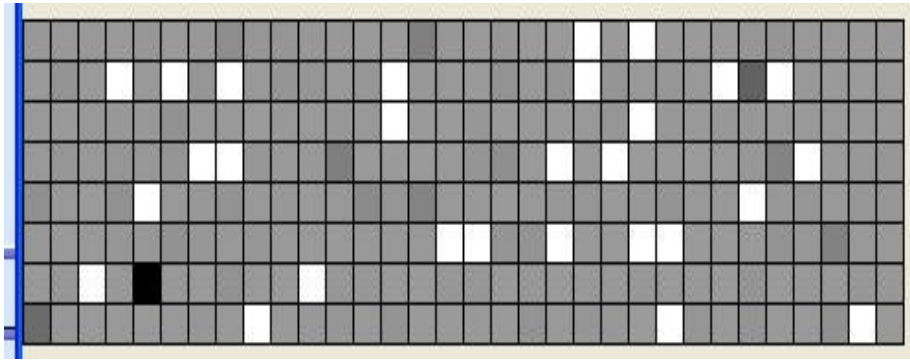

Backup

Fe55 source: Chip5

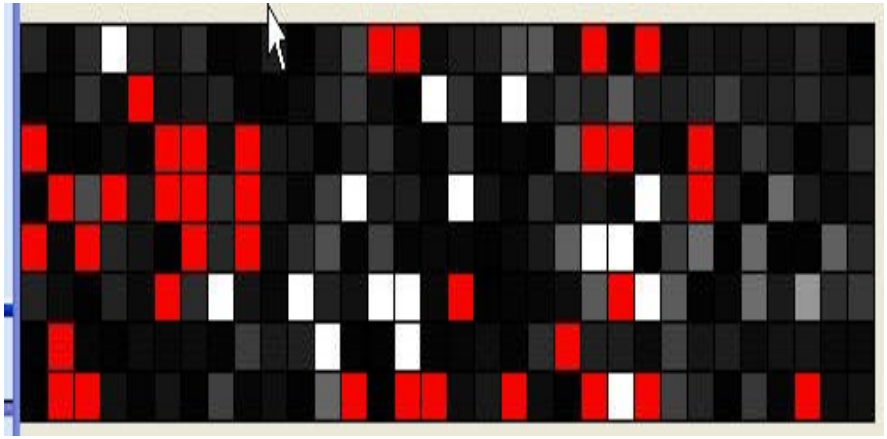
Noise scan Chip5



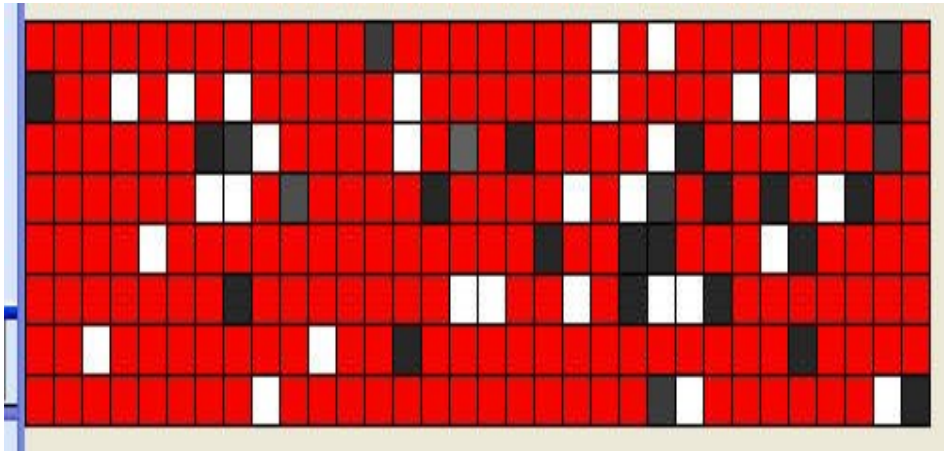
Noise scan Chip6



Fe55 at 1520
DAC Thr Chip5



Fe55 at 1477
DAC Thr Chip6



Fe55 source: Chip5 and Chip6

- For every pixel plot the maximum rate. Wants to check if source irradiates uniformly the matrix