INMAPS testbeam data
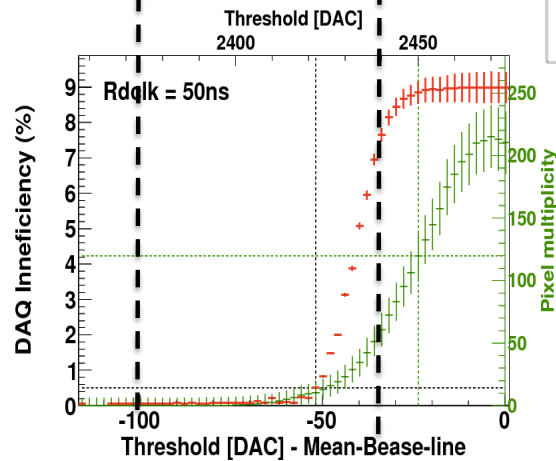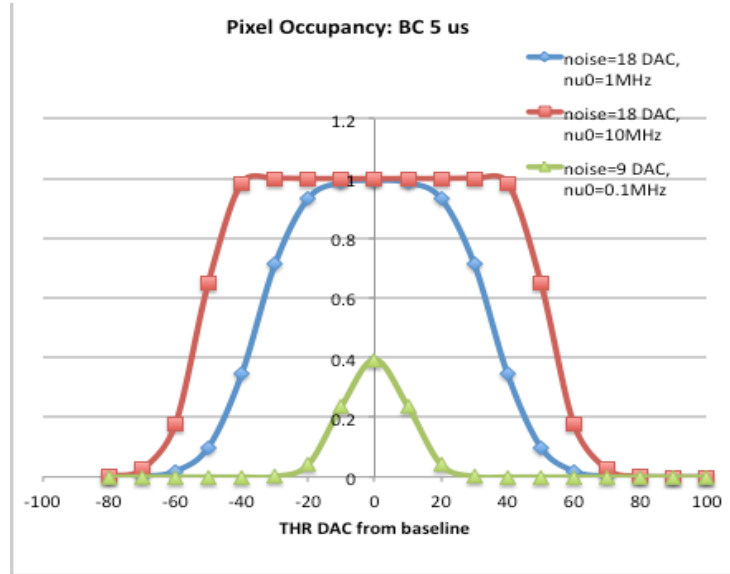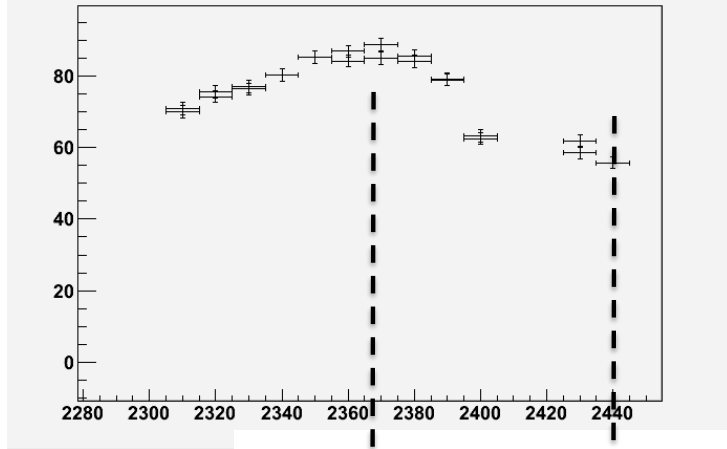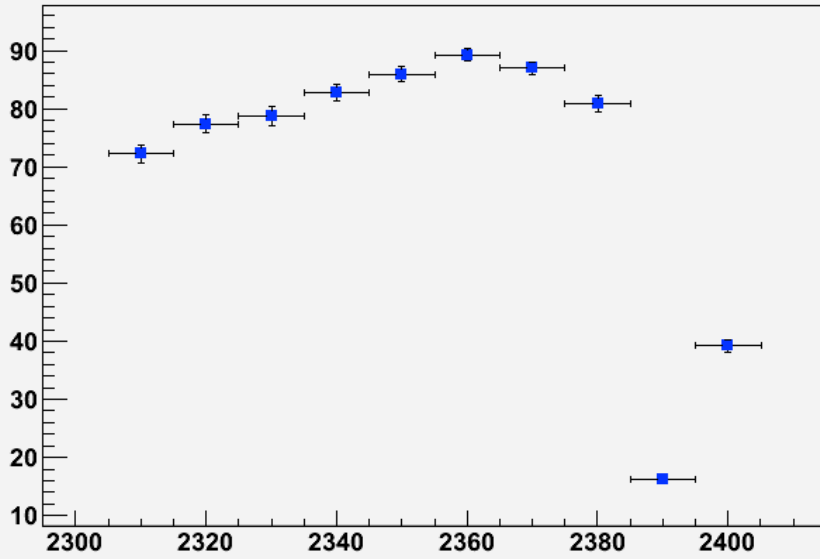
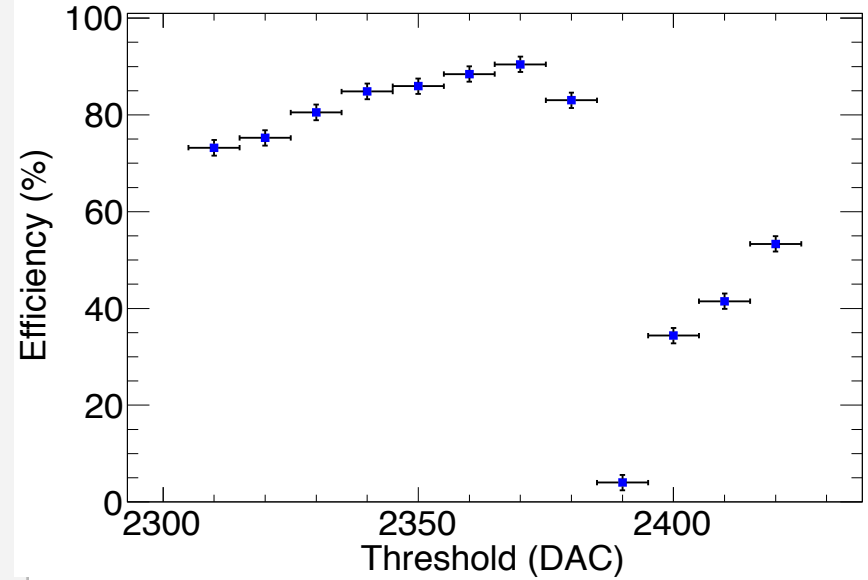# Chip 15 tau baseline 15 us

Efficiecy vs threshold chip13
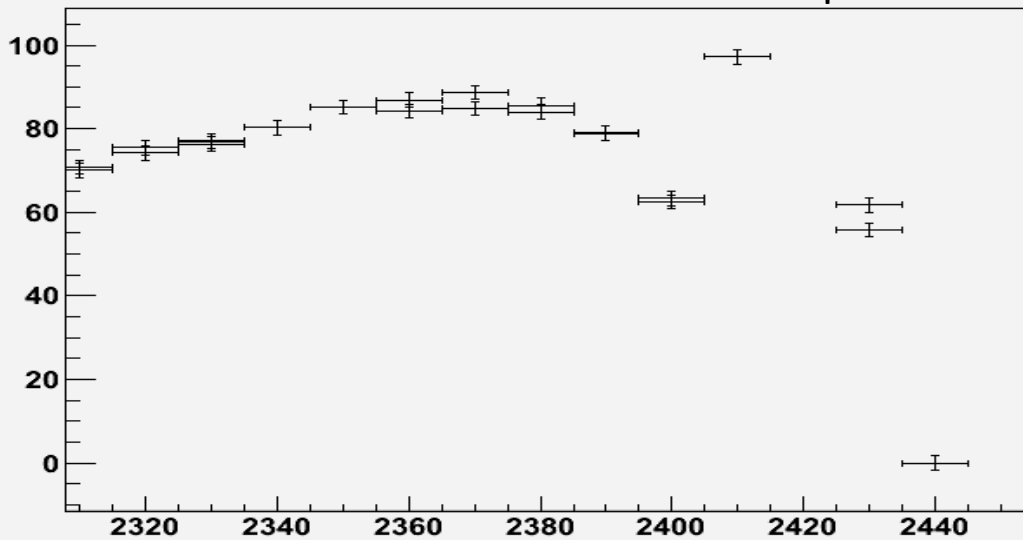
Effic vs Thr-DAC INMAPS Chip-14
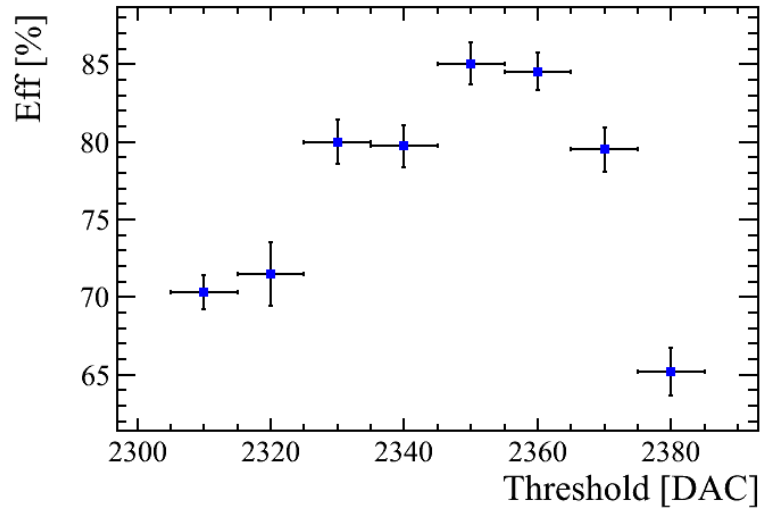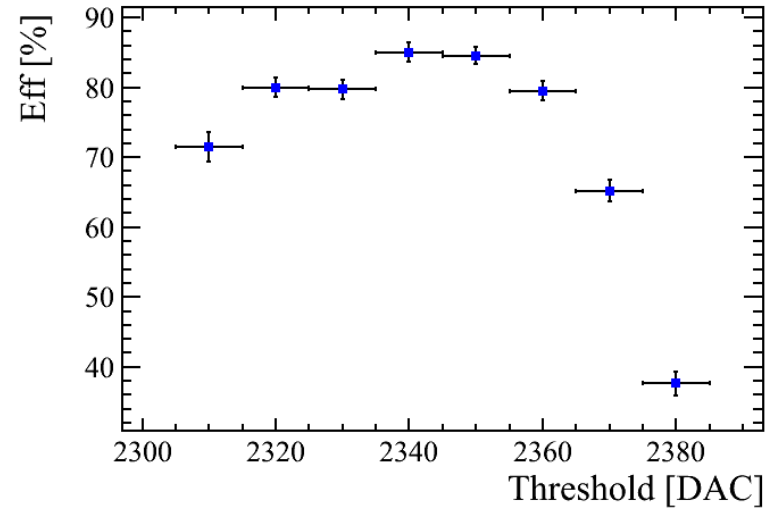
Chip 15

Drop of efficiency due to induction?

CHIP 13
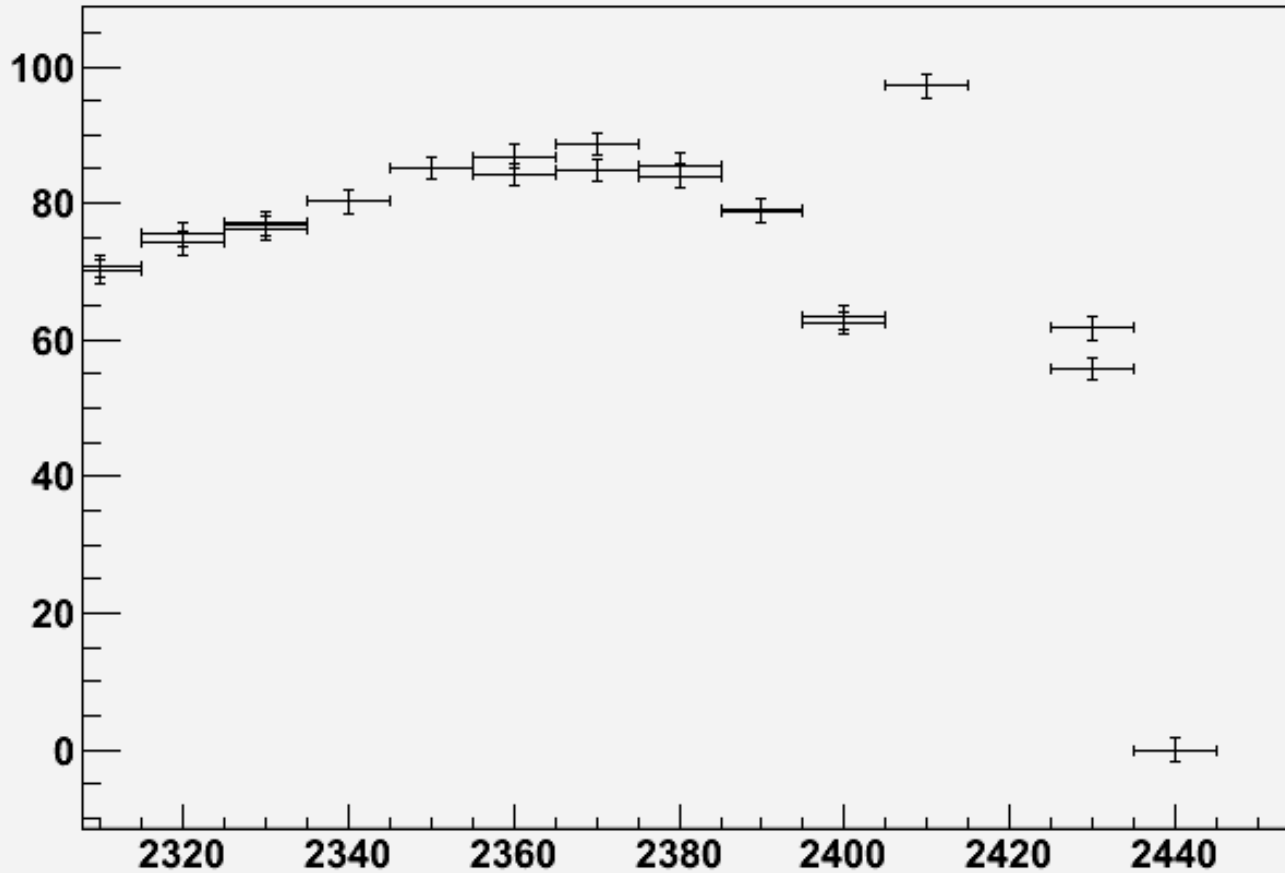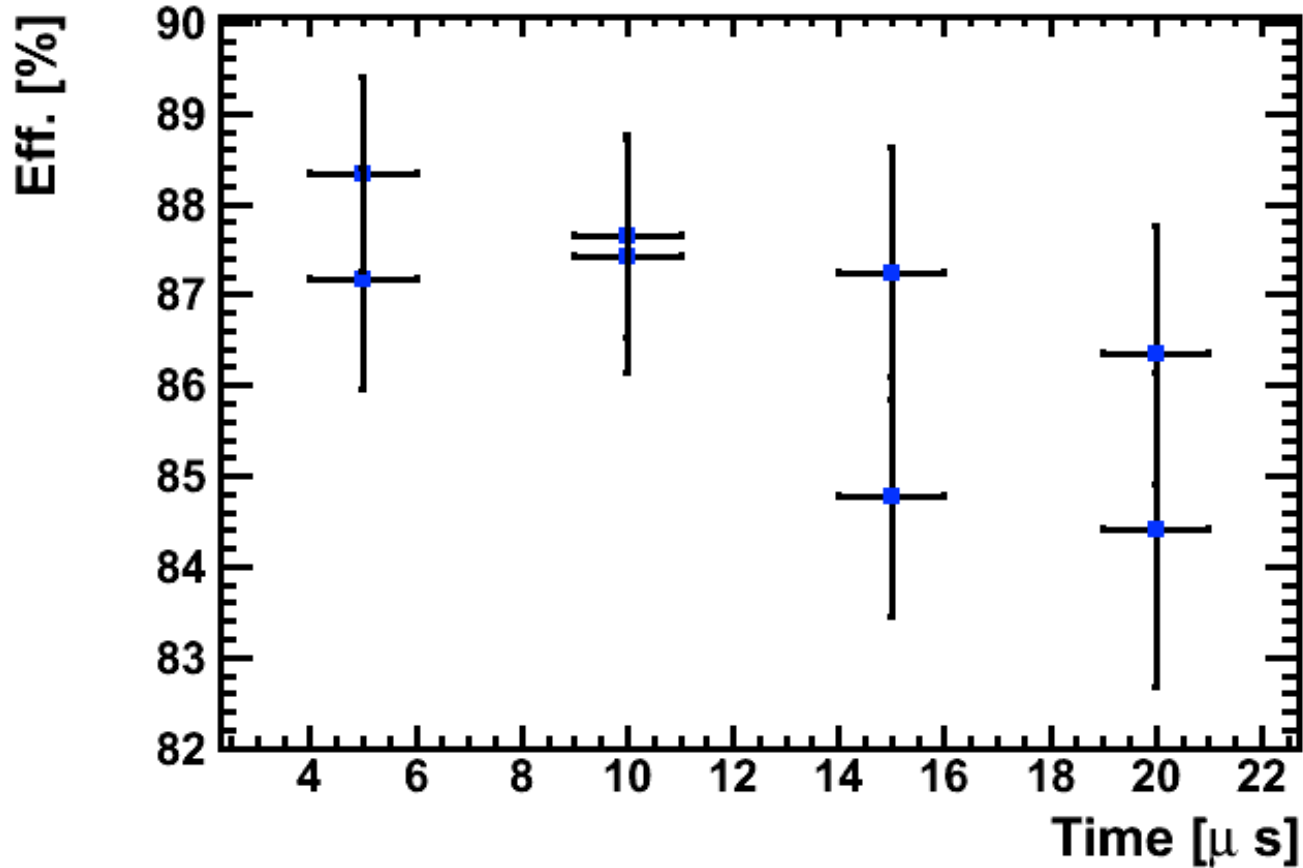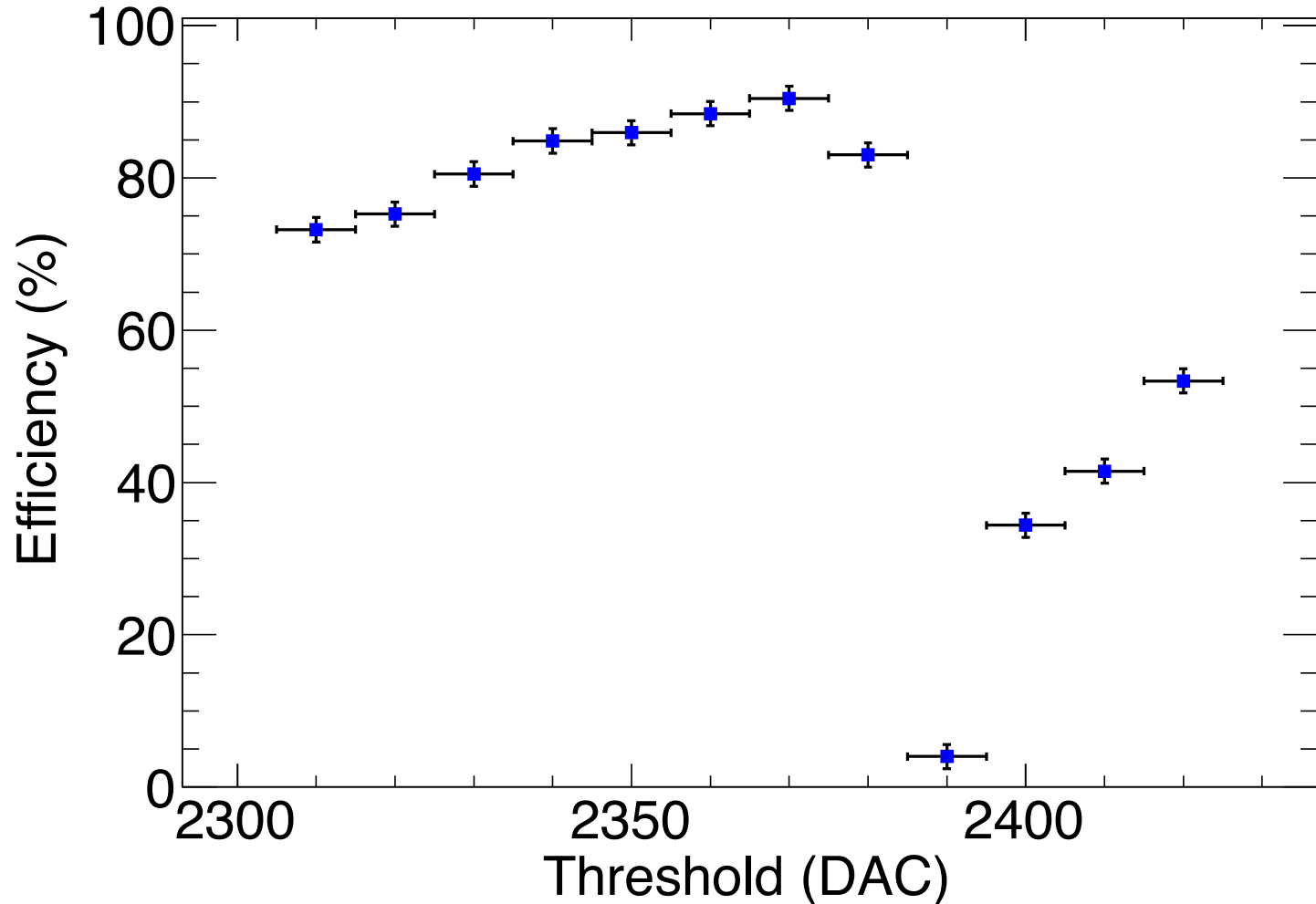
CHIP 14

Chip 15 tau baseline 15 us
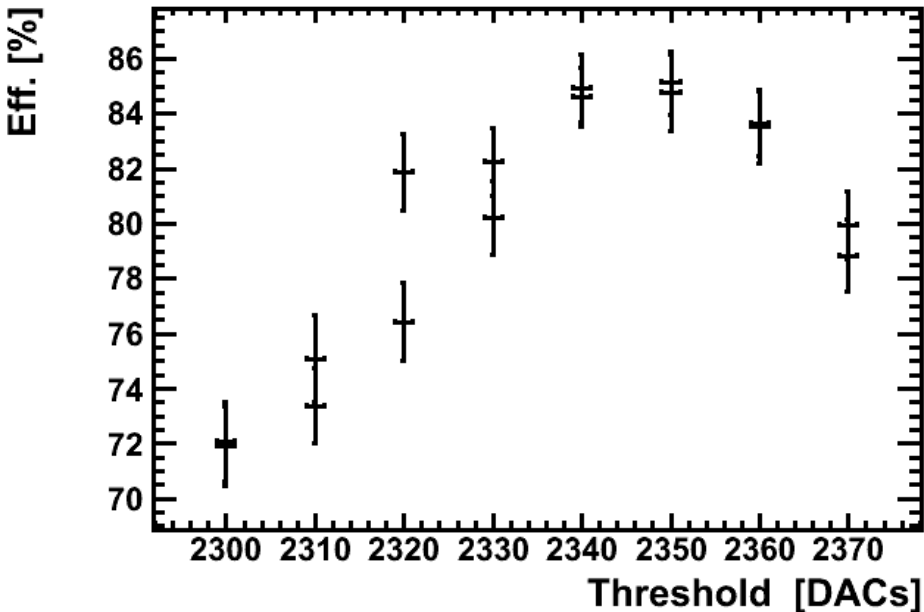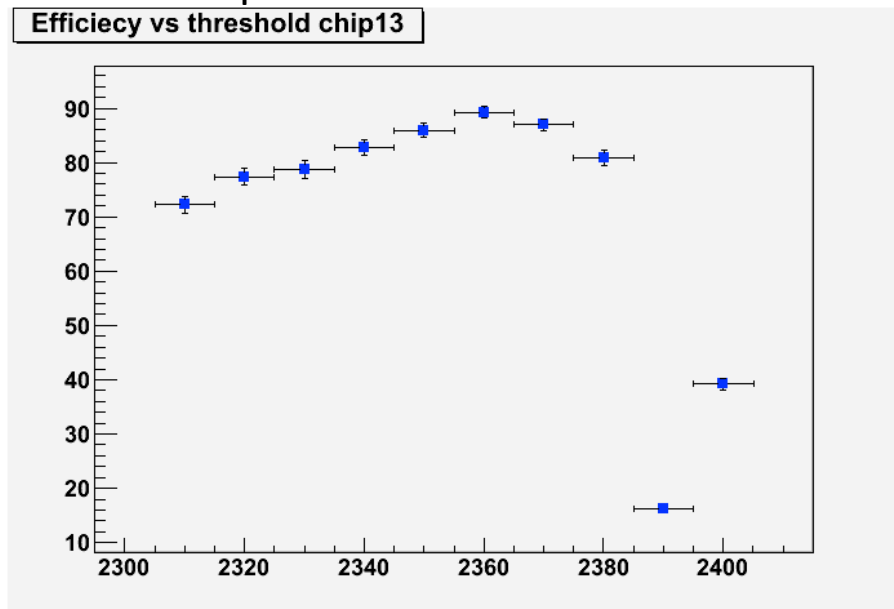
Chip 14? tau baseline 15 us

Chip 14 tau baseline 15 us

Effic vs Thr-DAC INMAPS Chip-14

Chip 13 tau baseline 10 us

Chip 13 tau baseline 15 us

Efficiecy vs threshold chip13
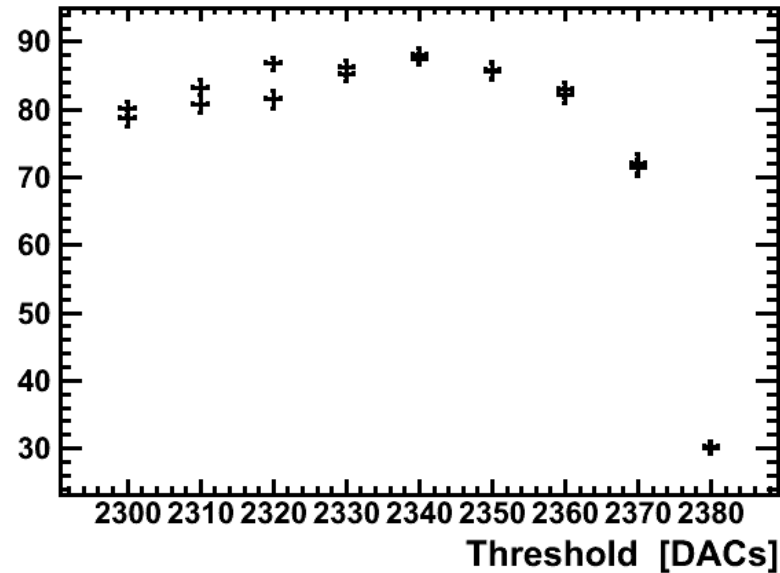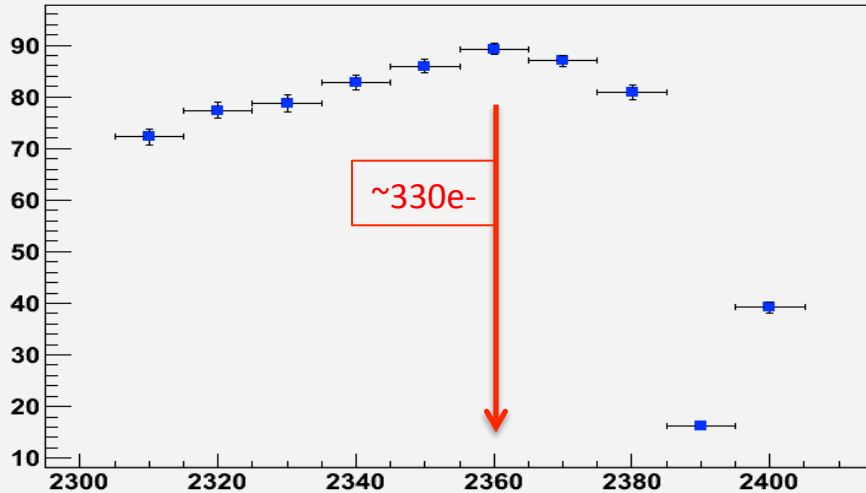
Chip 13 tau baseline 5 us
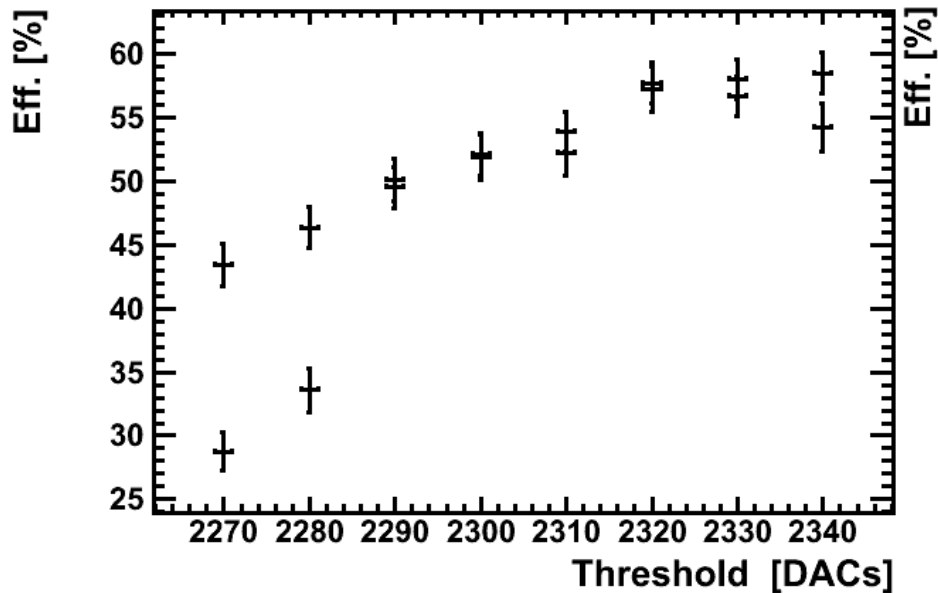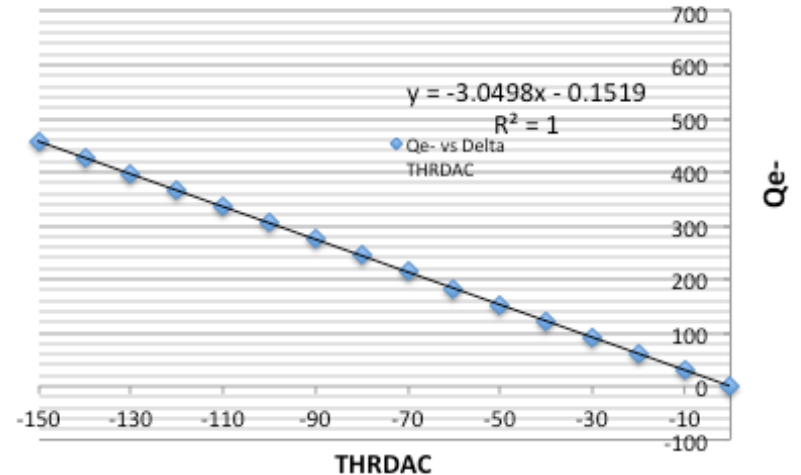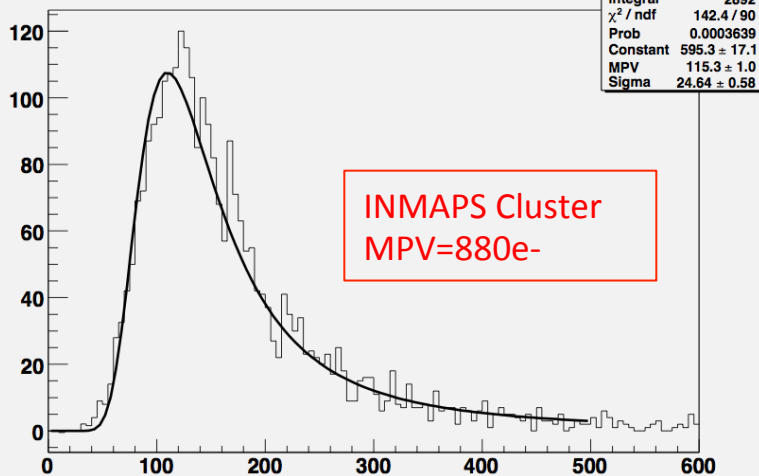
Chip 13 tau baseline 20 us

Chip 13 tau baseline 15 us

Efficiecy vs threshold chip13

~330e-

**Chip 13 - Calib done in Pisa with 15 us tau baseline
Qe- vs THR DAC from baseline (pixel i,j)**

$y = -3.0498x - 0.1519$
$R^2 = 1$

Qe- vs Delta THRDAC

THRDAC

Qe-

M1//QclusterTrgseed_all_sub1

M1//QclusterTrgseed_all_sub1	
Mean	171.3
Integral	2892
χ^2 / ndf	142.4 / 90
Prob	0.0003639
Constant	595.3 ± 17.1
MPV	115.3 ± 1.0
Sigma	24.64 ± 0.58

INMAPS Cluster
MPV=880e-

- 1 MIP gives a cluster of 115 mV=880e-
- Which fraction of the cluster charge is collected from central pixel ?
- Assuming ~70% → 615e-= MPV of the landau collected by the central pixel.
- Assuming the central pixel has the same shape of the landau for the cluster: 90% efficiency correspond to a cut of about 400 e- on the central pixel.

TMath::Landau(x,[0],[1],0)

Central Pixel Landau assuming 70% of the cluster charge:
MPV=615e-
90% hit efficiency with 400 e- cut on pixel
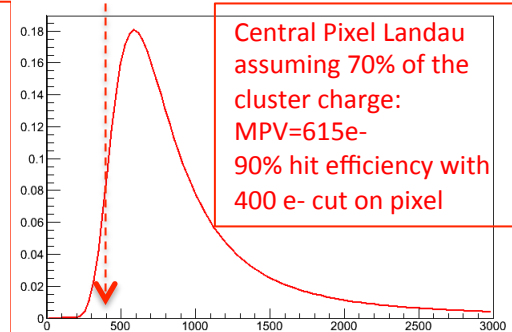
Spectrum after noise subtraction
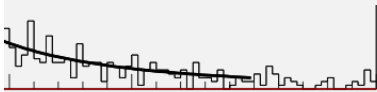
Drop of efficiency due to induction?

CHIP 13

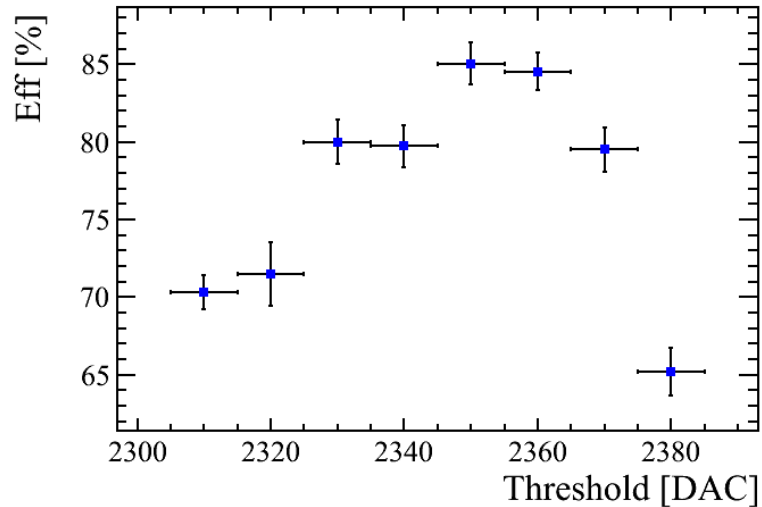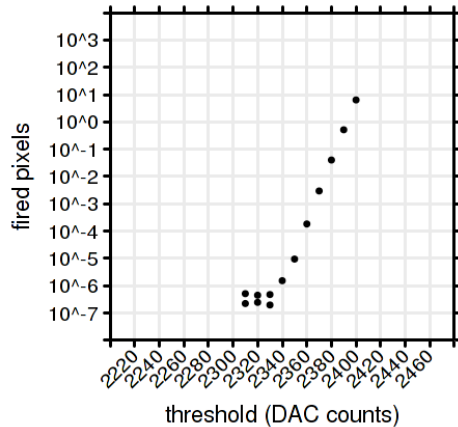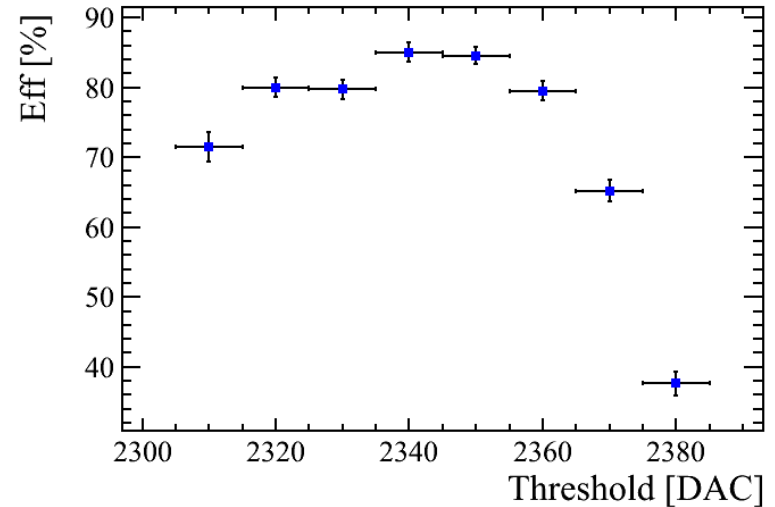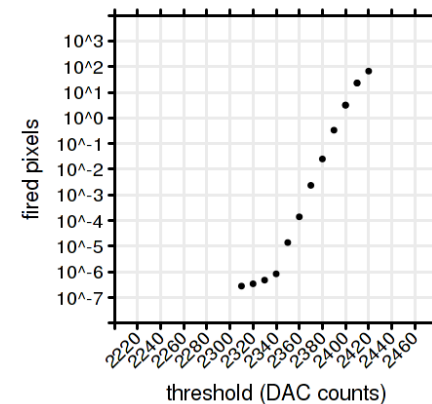chip #13, fired pixels vs. thr

CHIP 14
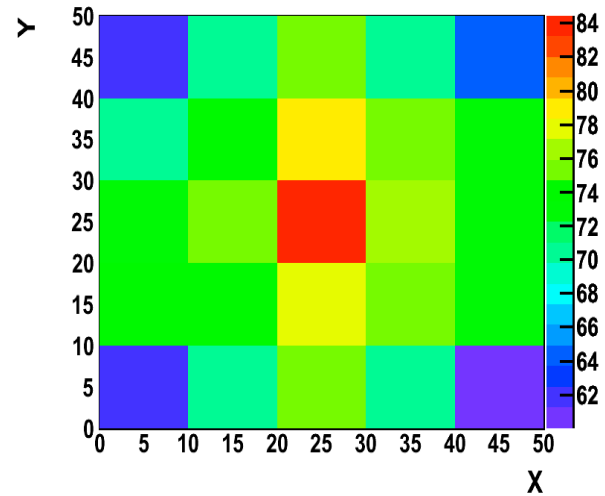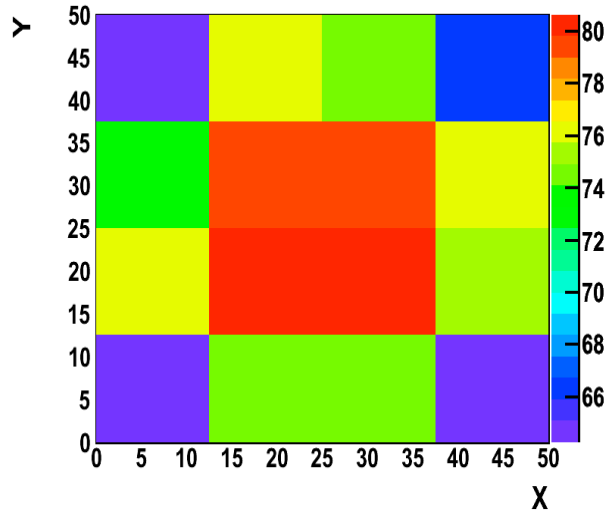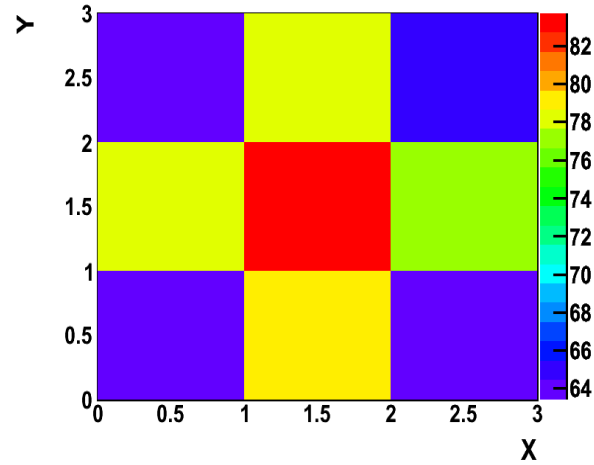

chip #14, fired pixels vs. thr

Indicazioni dagli studi di induzione in Lab.

- Le calibrazioni con la sequenza di data taking e RDCLK=60 ns (simile ai 50 ns di testbeam) indicano un numero di pixel scattati simile a quello visto in testbeam e si notano induzioni sull'uscita analogica sia positive che negative MA non induzioni da colonna.

- Il numero di pixel che scattano quando la soglia e' ~ 2370 DAC (inizio del calo di efficienza) sembra troppo piccolo per causare inefficienza legata al fatto che un pixel e' gia' scattato prima su induzione e quindi non riscatta sul passaggio della traccia.

- Le indicazioni dai test in lab sembrano far pensare ad un'inefficienza legata al fatto che ci sono segnali indotti positivi che durano 1-2 us (quando il data valid va alto per far passare le parole TS anche senza pixel scattati) creando inefficienza quando una traccia passa mentre il segnale e' positivo.

- Questi tempi positivi (e le inefficienze) aumentano se scattano piu' pixel, quando la soglia si avvicina alla baseline
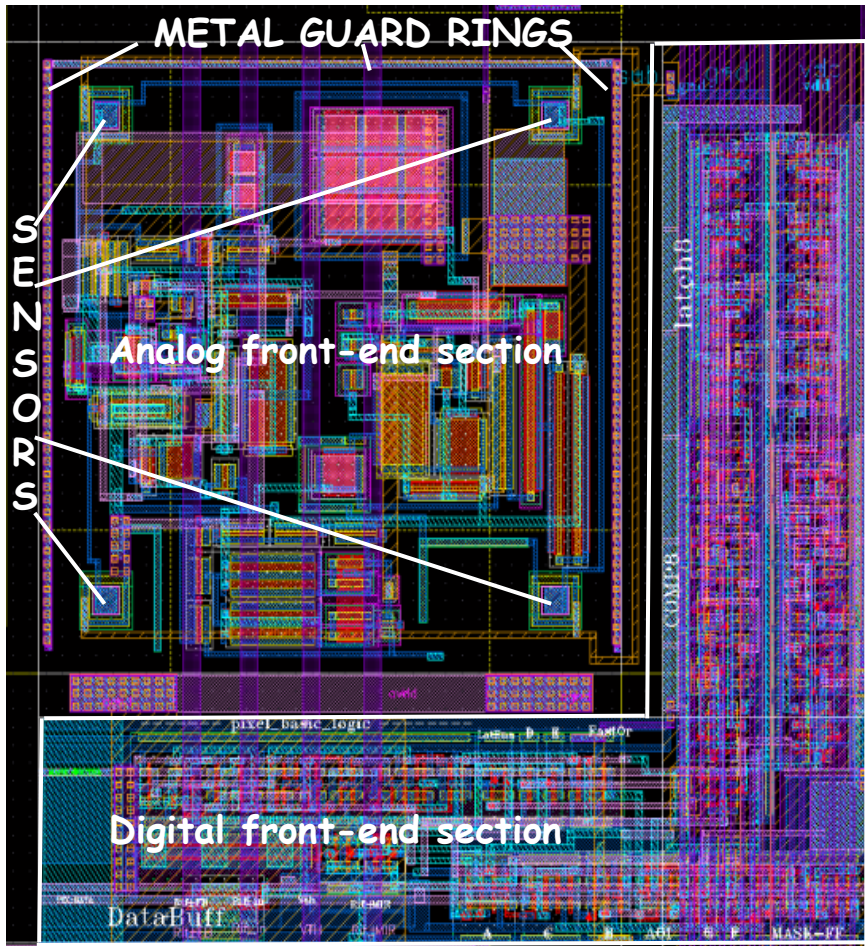
In-pixel efficiency map
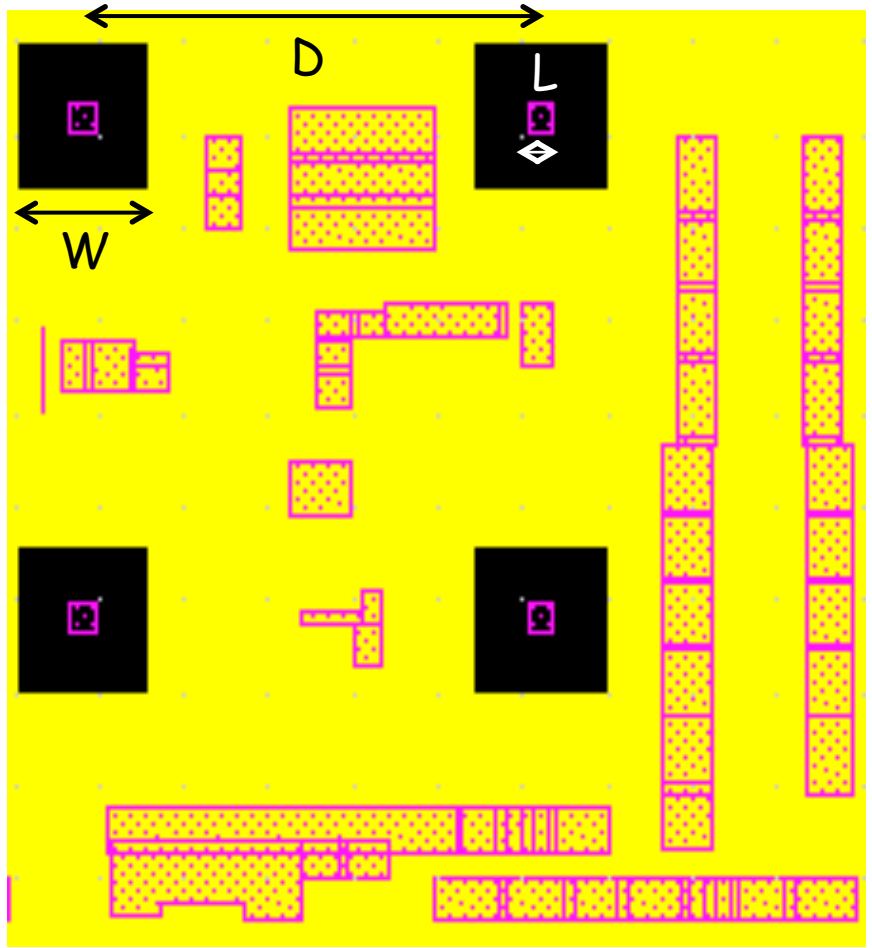## chip 13 THR=2360 DAC

pitch 50x50

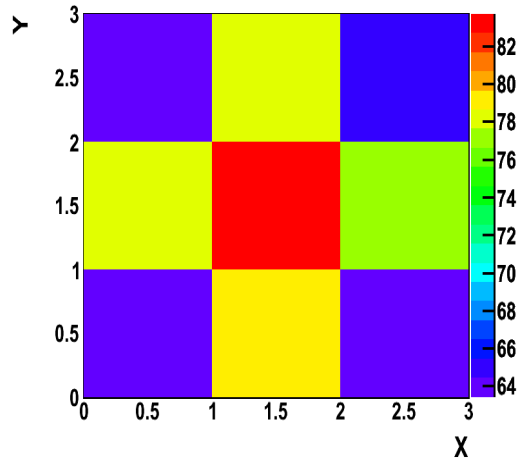# Apsel4well pixel layout

Pixel layout w/o DPW layer

METAL GUARD RINGS

SENSORS

Analog front-end section

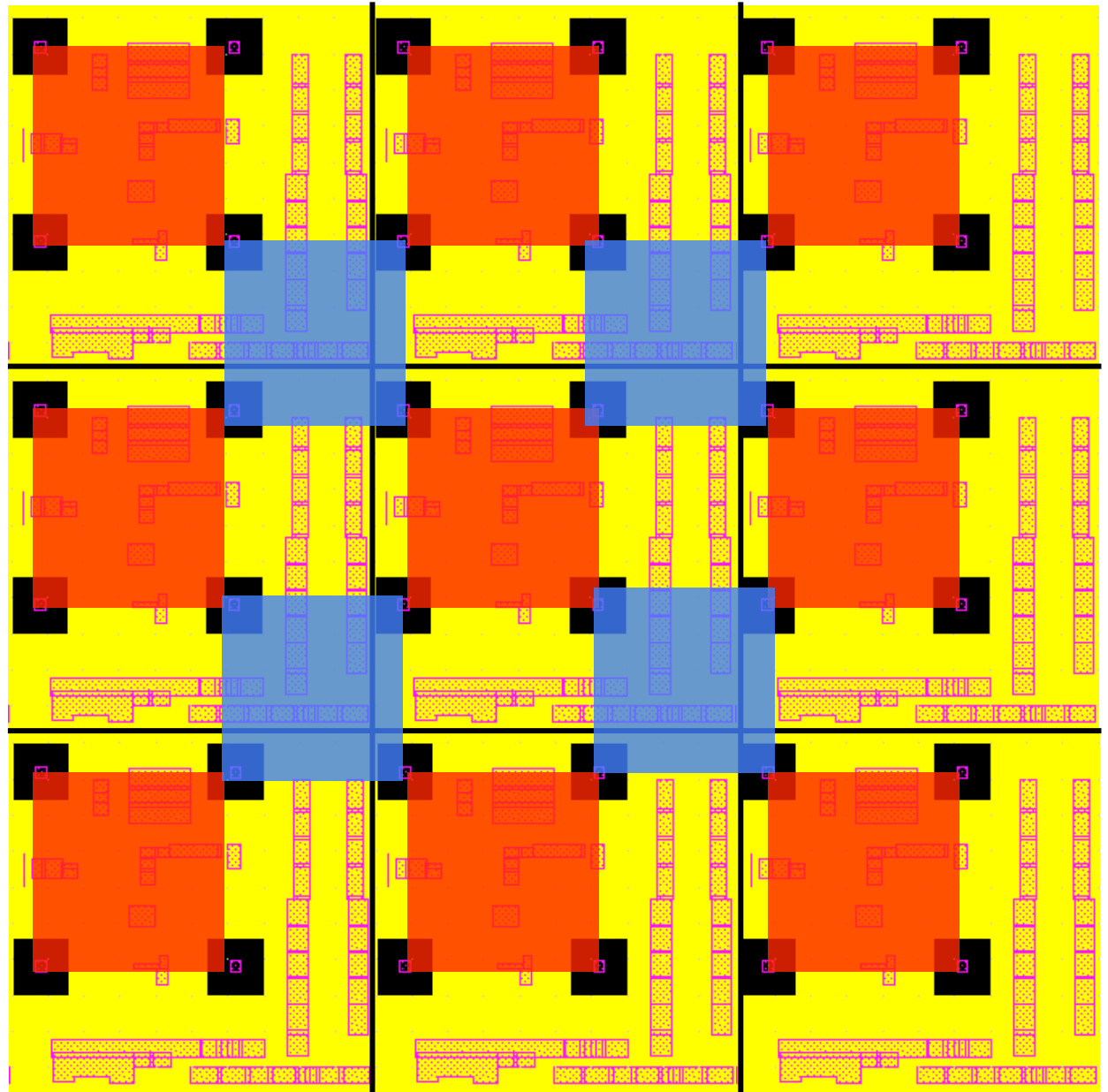Digital front-end section

50 μm

DPW and NW layers
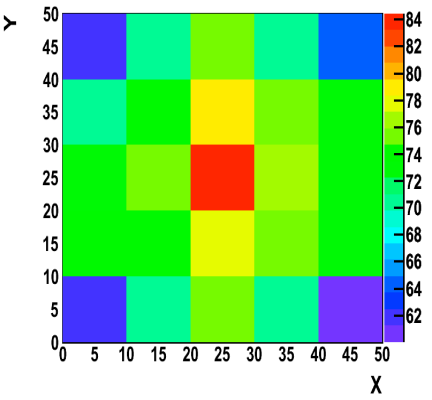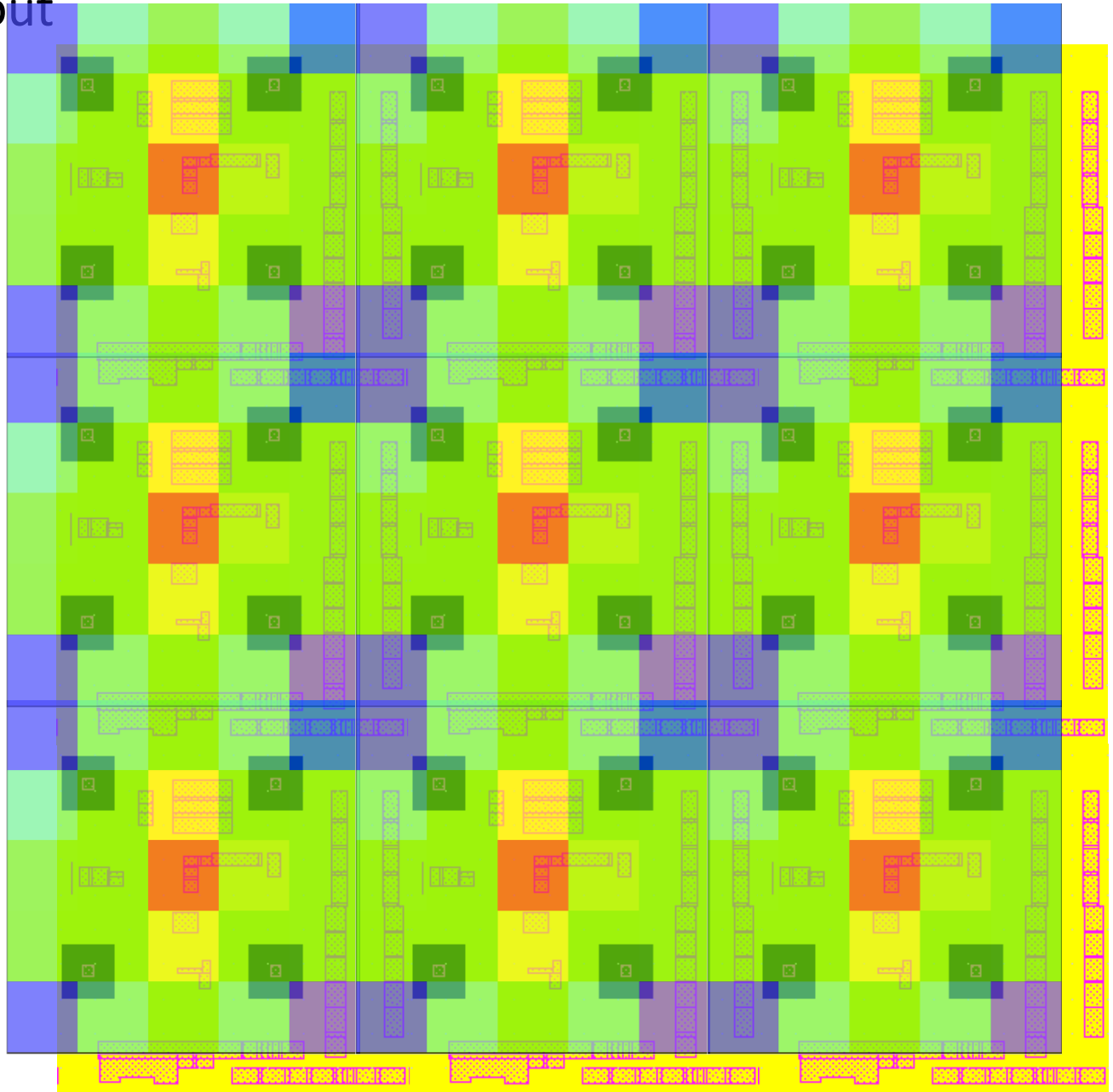

W=8 μm   L=1.5 μm   D=27 μm

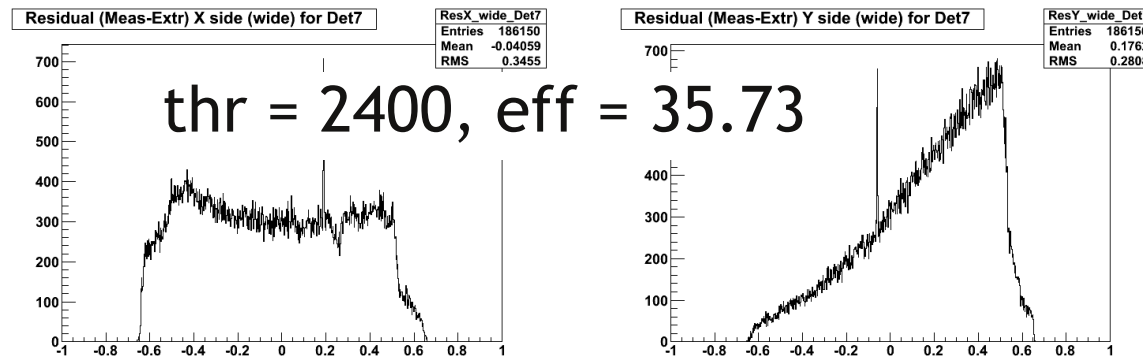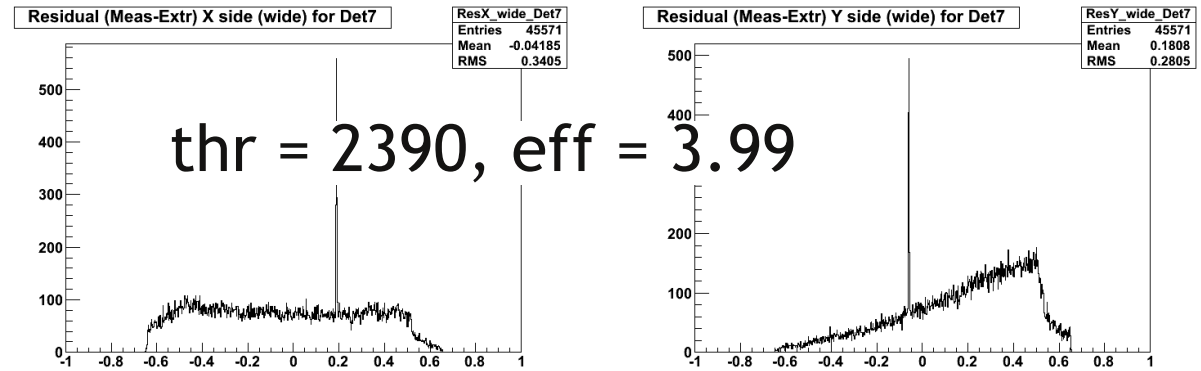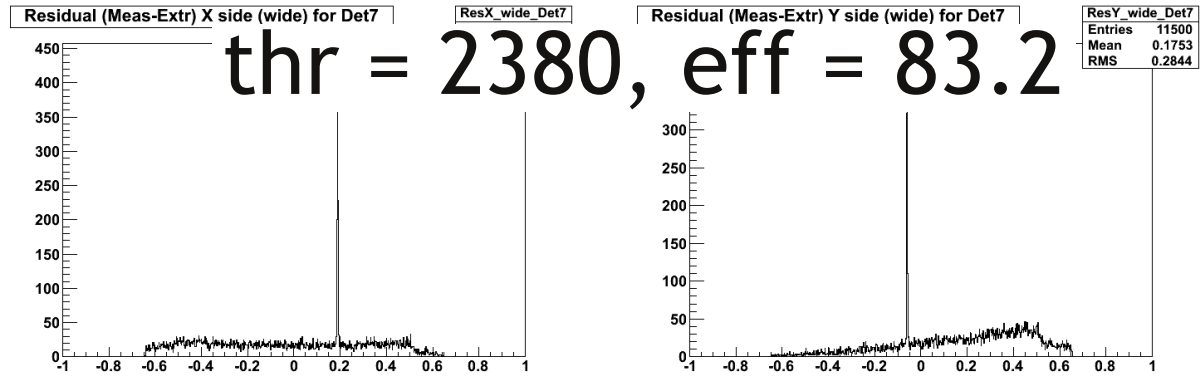# Apsel4well pixel layout

In-pixel efficiency map

Apsel4well pixel layout
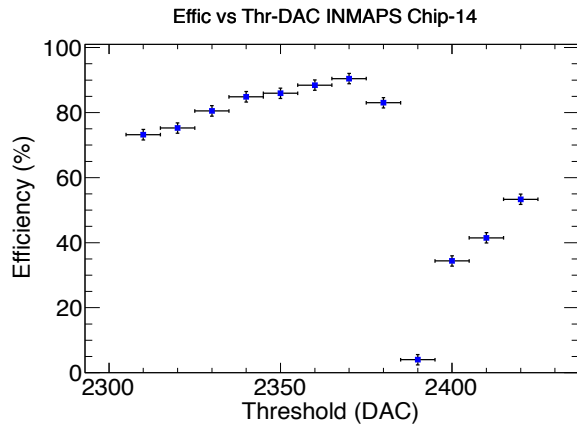

In-pixel efficiency map

backup

Induzione da colonna?

Effic vs Thr-DAC INMAPS Chip-14

thr = 2380, eff = 83.2

thr = 2390, eff = 3.99

thr = 2400, eff = 35.73
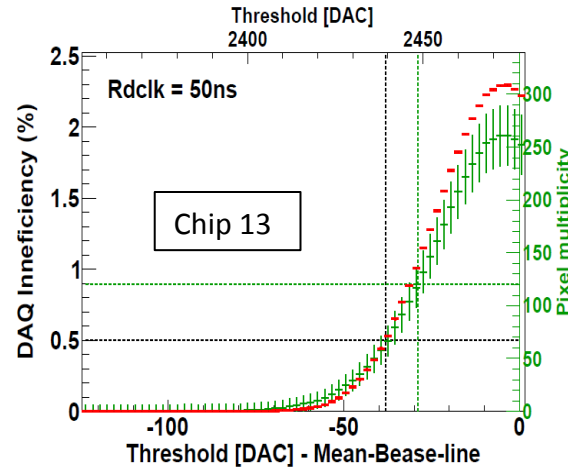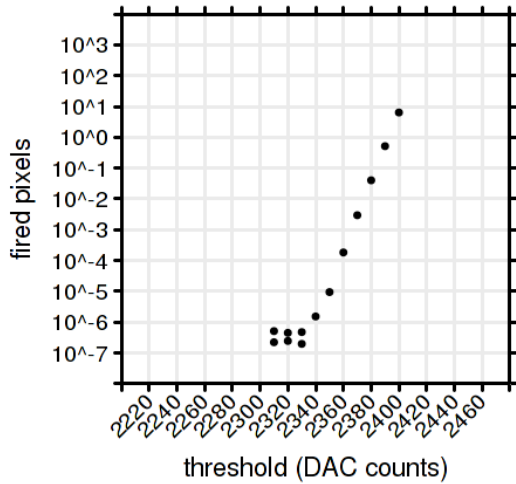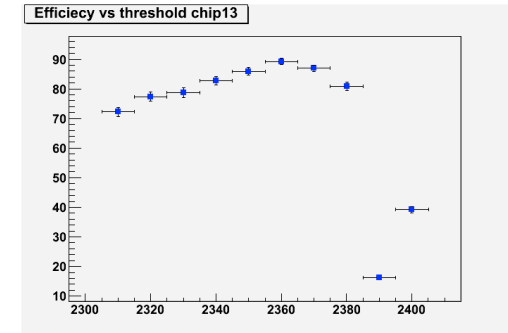
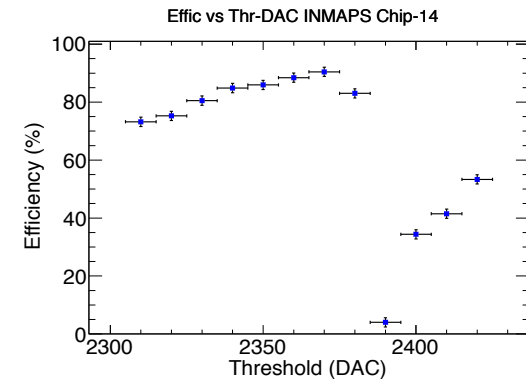- Number of pixel fired in calibration mode (right plot in green) and in data taking mode (left) very different
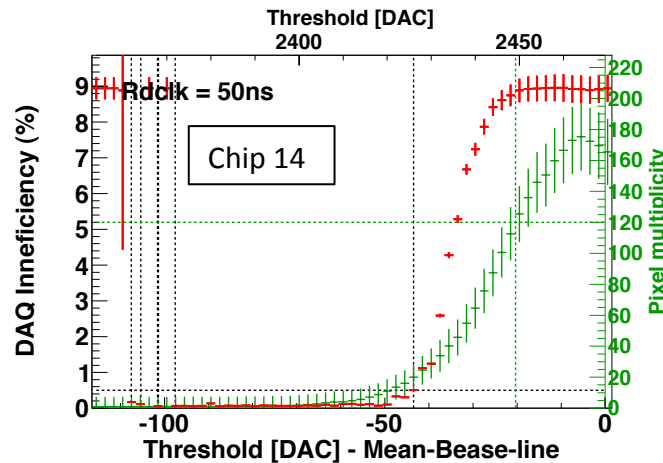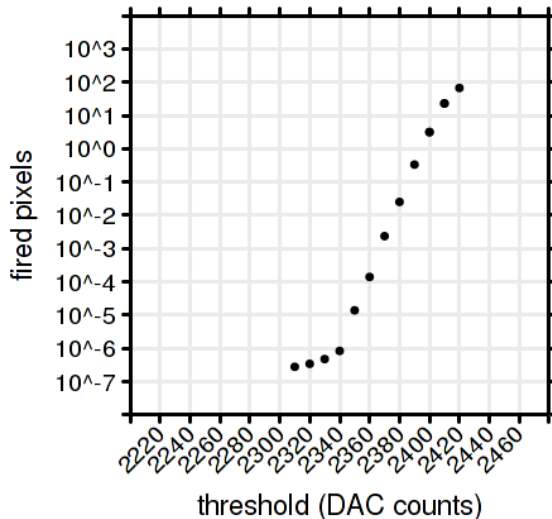
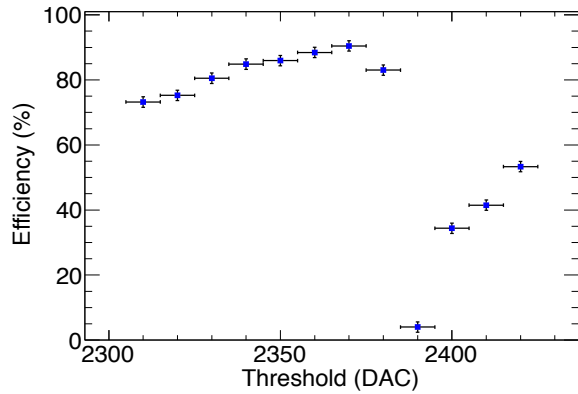chip #13, fired pixels vs. thr

FIFO overflow above 2440
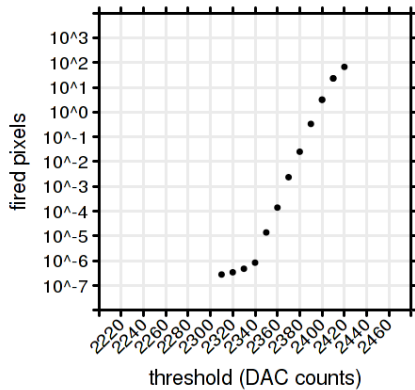
chip #14, fired pixels vs. thr

Induzione da colonna?
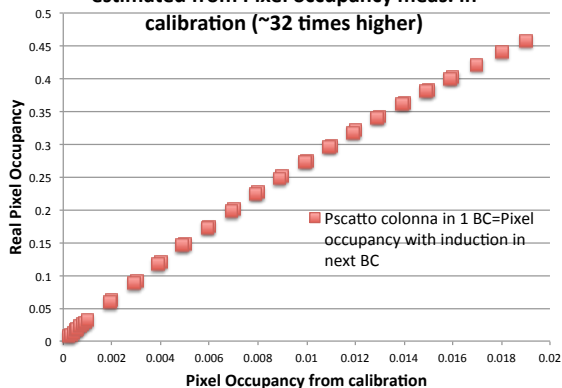
Effic vs Thr-DAC INMAPS Chip-14
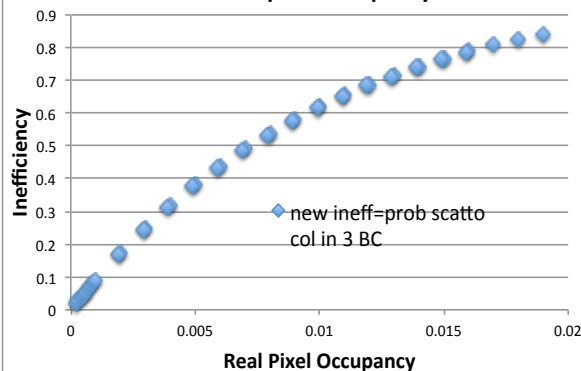

chip #14, fired pixels vs. thr

- Induction: when a pixel fires (for noise) assume that all the pixel of the same column (below the one fired) see a signal due to induction by the vertical linea activated (fastor of other vertical signals?) crossing the pixel below the fired one. This effect starts to be visible only when the threshold is at the level of the induced signal.
- If the induced signal is due to readout it is visible only in data taking (readout active every BC) and not visible in calibration mode.
- This can increase significantly the number of noise hit w.r.t to what is seen in calibration (a factor 32) and can cause the drop in efficiency: real pixel occupancy estimated from pixel occupancy in calibration is shown in the left plot (last row)
- <u>Inefficiency:</u> The return in baseline is 15 us, so the pixel fired on the column activated by induction remain freezed (cannot fire again) for ~ 3 BC after the induction and this can cause inefficiency on the hit from track.
- Inefficiency ~ probability to have the column that has already fired 1-2-3 BC before the arrival of the track= Prob_scatto_col in 3 BC
- Inefficiency = Prob_scatto col in 3 BC can be calculated from a given real pixel occupancy and it's shown in the central plot below.
- The hit inefficiency as a function of the pixel occupancy measured in calibration is also shown in the right plot.
  - 90% inefficiency possible with 0.001 pixel occupancy (1 noise hit in the 1024 pixel matrix)
- Is this the effect that causes the efficiency drop?