SuperPix0 characterization
- first results -

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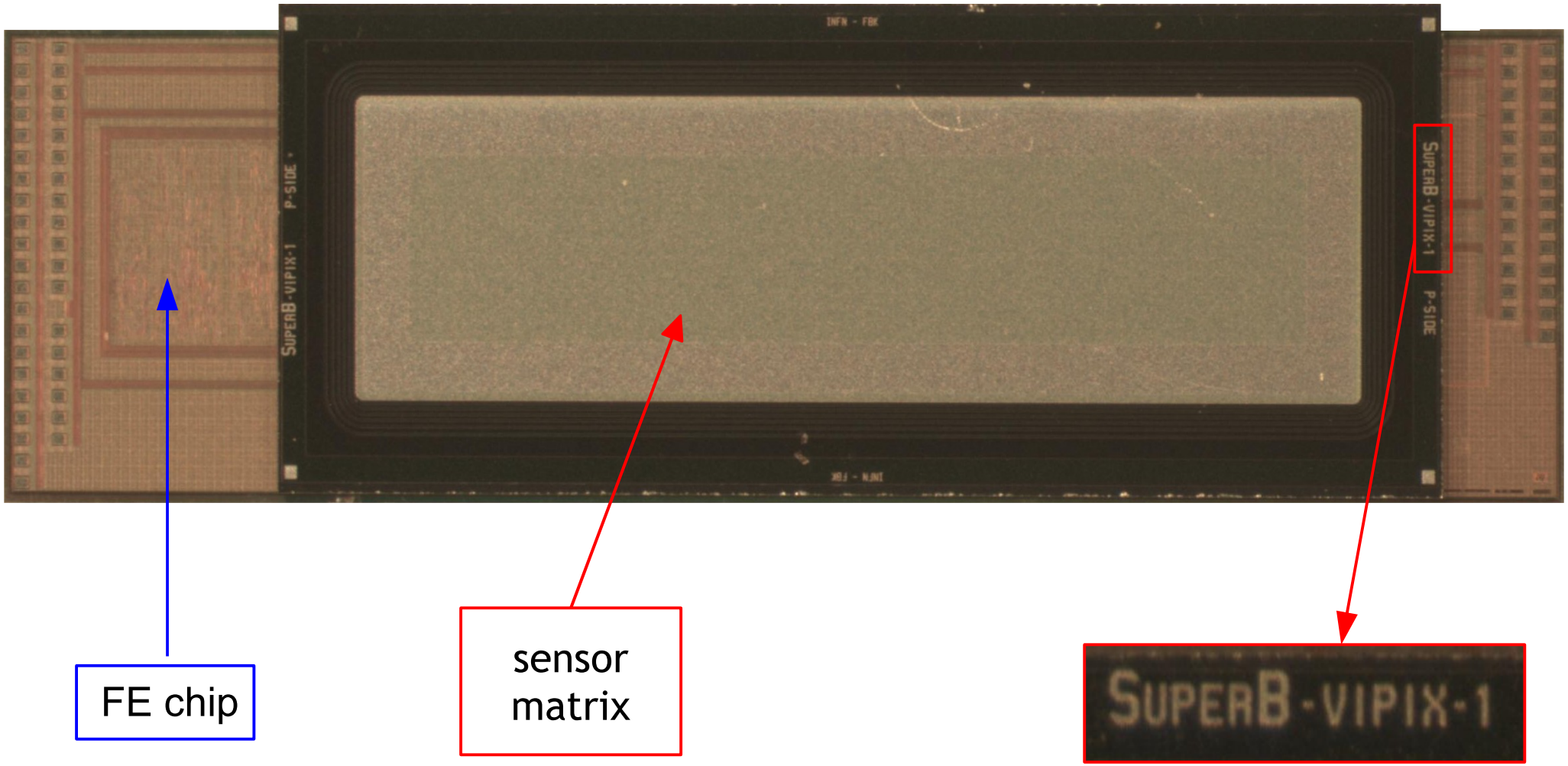
Stefano Bettarini, Giulia Casarosa,
Fabio Morsani, Giuliana Rizzo

outline

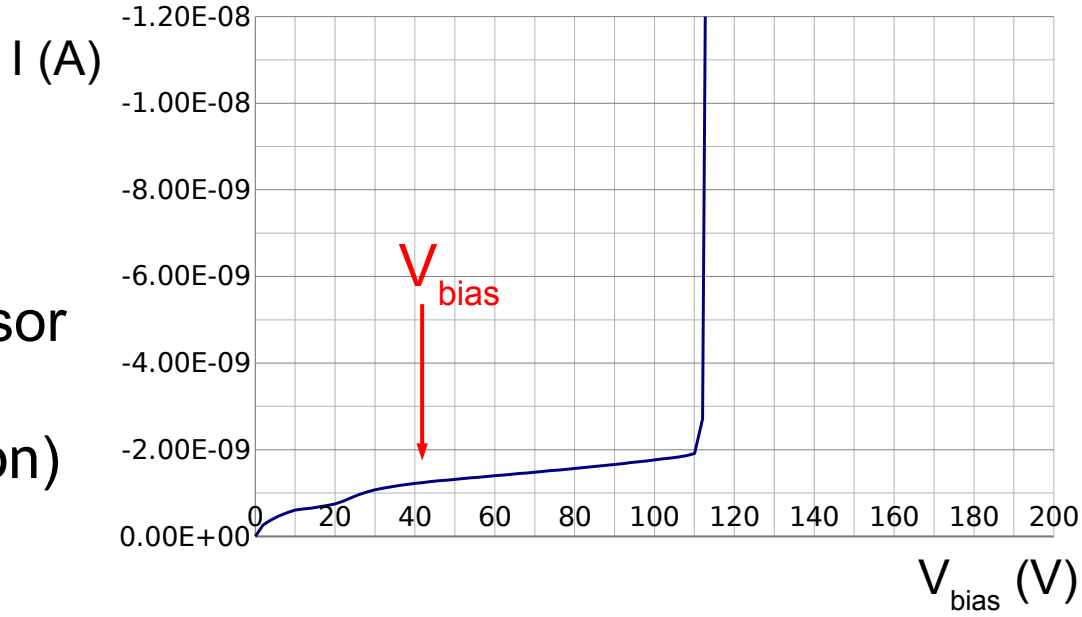
- First look at FE4D bump bonded to the sensor matrix
- Noise Scan results and gain estimation
- Response to Sr90 source
  - hit rate
- Look at the analogic output
  - gain estimation

very first look to SuperPix0



Sensor19

- ➔ w/o metal
- ➔ V_{bias} = - 40 V
- ➔ we are not sensitive to the sensor current consumption:
  order of nA vs μA (our resolution)



First look:

- Without the source, varying the bias from 0V to -20V (step of 5V) we see data coming out from the matrix (sensor not depleted), from -25V to -40V no hit is detected. OK!
- The sensor is sensitive to light → need a proper coverage to perform measurements

reminder: scans results on FE chips

CHIP	MC	baseline mV	thres. disp.	noise mV	noise disp.	ENC e-	gain mV/fC	gain disp.
1	6	208.4 ± 0.3	490e-	0.466 ± 0.005	17%	70 ± 1	41.8 ± 0.4	7%
	20	207.7 ± 0.3	540e-	0.453 ± 0.006	15%	67 ± 1	42.5 ± 0.3	6%
	30	208.1 ± 0.3	460e-	0.466 ± 0.007	17%	69 ± 1	42.0 ± 0.4	6%
2	6	214.6 ± 0.3	480e-	0.36 ± 0.01	34%	55 ± 2	40.2 ± 0.4	8%
	20	213.7 ± 0.3	460e-	0.38 ± 0.01	34%	58 ± 2	40.9 ± 0.2	5%
	30	213.2 ± 0.3	550e-	0.41 ± 0.01	40%	60 ± 2	41.2 ± 0.3	7%
3	6	211.4 ± 0.3	460e-	0.327 ± 0.006	19%	51 ± 1	39.7 ± 0.2	5%
	20	211.8 ± 0.2	410e-	0.366 ± 0.007	22%	57 ± 1	40.0 ± 0.3	6%
	30	210.5 ± 0.3	460e-	0.359 ± 0.008	23%	56 ± 1	40.1 ± 0.3	6%
4	6	214.8 ± 0.3	1.4%	0.31 ± 0.02	57%	-	-	-
	20	216.1 ± 0.2	1.3%	0.29 ± 0.02	74%	-	-	-
	30	208.0 ± 0.3	1.4%	0.355 ± 0.008	23%	-	-	-

Noise Scans results on CHIP5 (FE only)

➔ same FE chip (no sensor) on two different test-boards:

1) FE4D: used for previous scans (results in slide 5)

2) Apsel4D: to be used with the bump-bonded chips

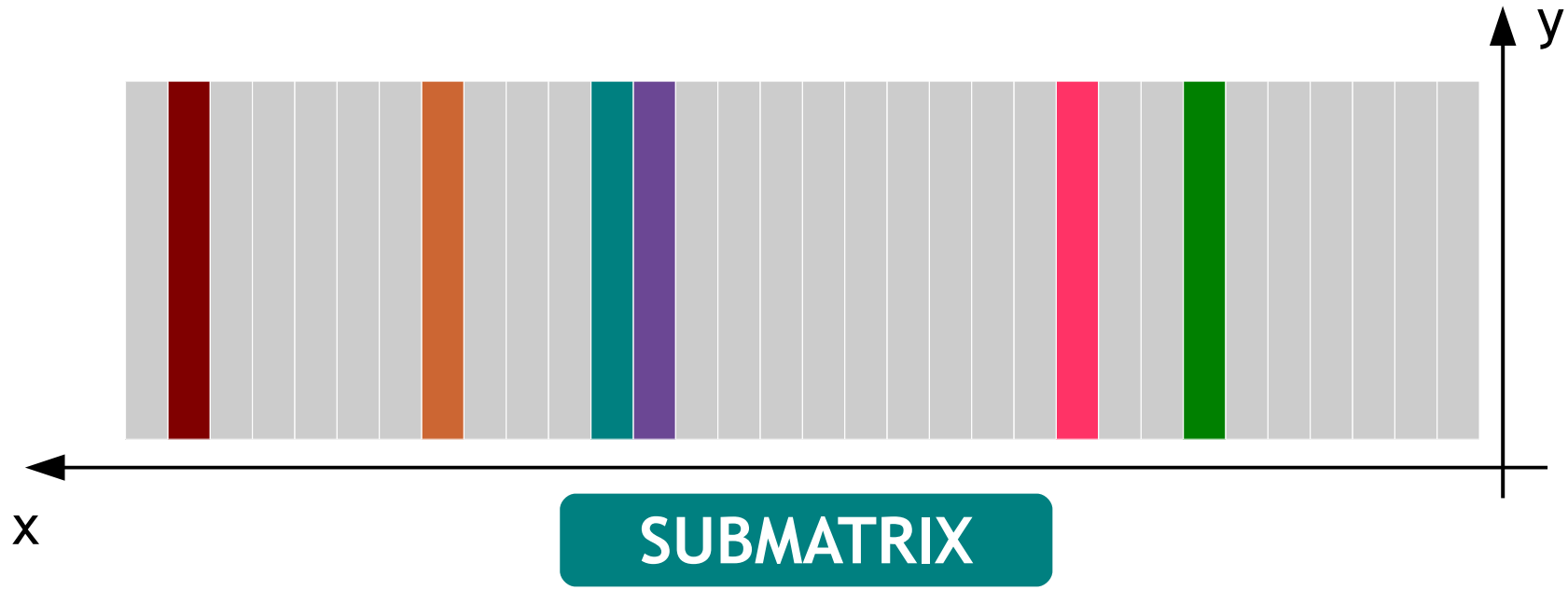
test board	MC	baseline mV	thres. disp.	noise mV	noise disp.	ENC e-	gain mV/fC	gain disp.
FE4D	6	212.2 ± 0.3	1.3%	0.297 ± 0.007	25%	-	-	-
apsel 4D	6	214.5 ± 0.3	1.3%	0.301 ± 0.007	25%	-	-	-
	20	214.7 ± 0.3	1.6%	0.32 ± 0.01	40%	-	-	-
	30	213.8 ± 0.3	1.4%	0.285 ± 0.009	34%	-	-	-

➔ very good agreement on the noise (MC = 6, 128 pixels...)

Scans on CHIP19

(with sensor)

- V_{bias} = -40V is applied
- MacroColumns analyzed: 6 for each submatrix
  - MC = 6, MC = 9, MC = 19, MC = 20, MC = 24, MC = 30



PRELIMINARY

scans results on CHIP19

(with sensor)

MC	baseline mV	thres. disp.	noise mV	noise disp.	ENC e-	gain mV/fC	gain disp.
6	210.4 ± 0.2	1.3%	0.397 ± 0.009	26%	-	-	-
9	209.2 ± 0.3	1.4%	0.436 ± 0.009	44%	-	-	-
19	207.6 ± 0.3	470e-	0.470 ± 0.009	20%	76 ± 1	38.9 ± 0.3	6%
20	208.4 ± 0.3	1.5%	0.436 ± 0.009	23%	-	-	-
24	206.9 ± 0.3	1.5%	0.497 ± 0.009	21%	-	-	-
30	210.6 ± 0.3	1.6%	0.382 ± 0.009	27%	-	-	-

PRELIMINARY

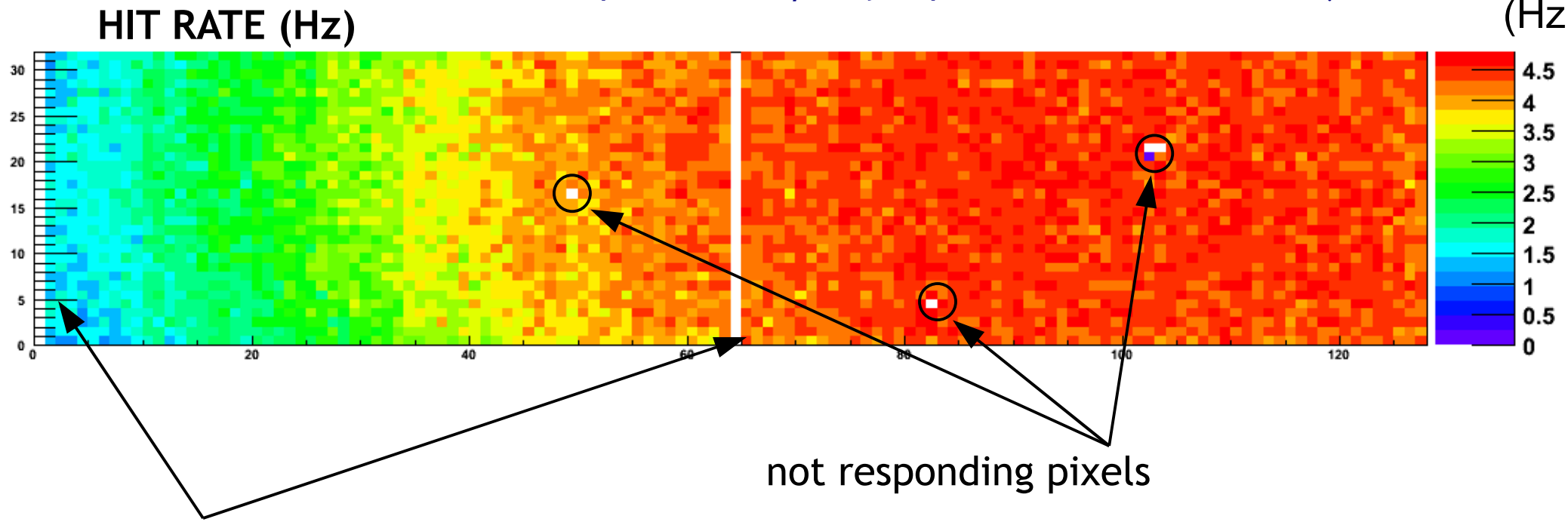
CHIP19 vs FE chips

CHIP	thres. disp.	ENC e-	gain mV/fC
1	(490 ± 30)e- (-4%)	69 ± 1 (+10%)	42.1 ± 0.3 (-8%)
2	(490 ± 30)e- (-4%)	58 ± 1 (+31%)	40.8 ± 0.3 (-5%)
3	(440 ± 30)e- (+7%)	55 ± 1 (+38%)	39.9 ± 0.3 (-3%)
19	(470 ± 30)e-	76 ± 1	38.9 ± 0.3

$$\frac{\text{CHIP19 - FE4D}}{\text{FE4D}}$$

response to a Sr90 source

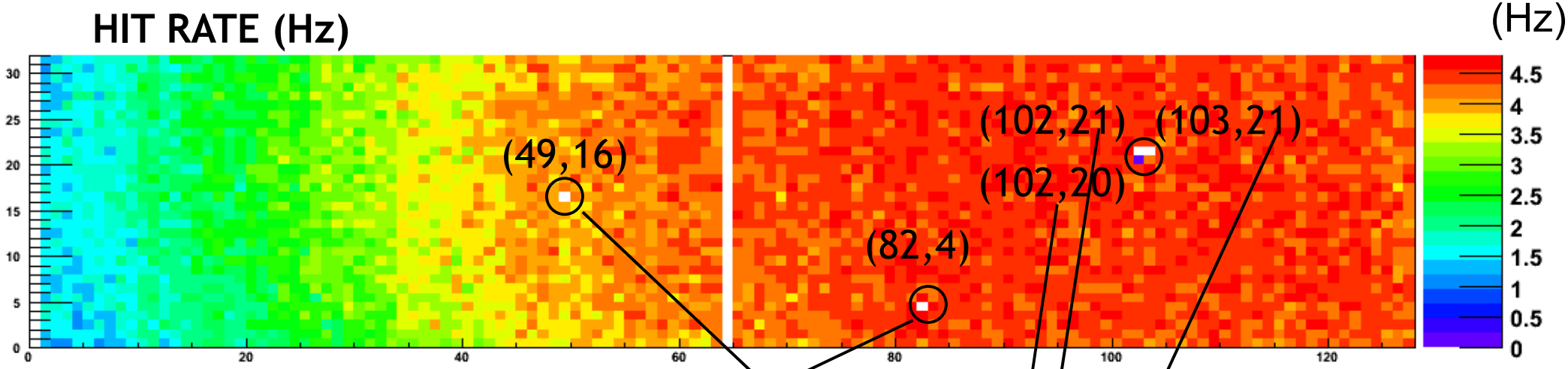
continuous spectrum of β^- rays up to 2.2 MeV, MIP on 200μm Si ~ 60keV



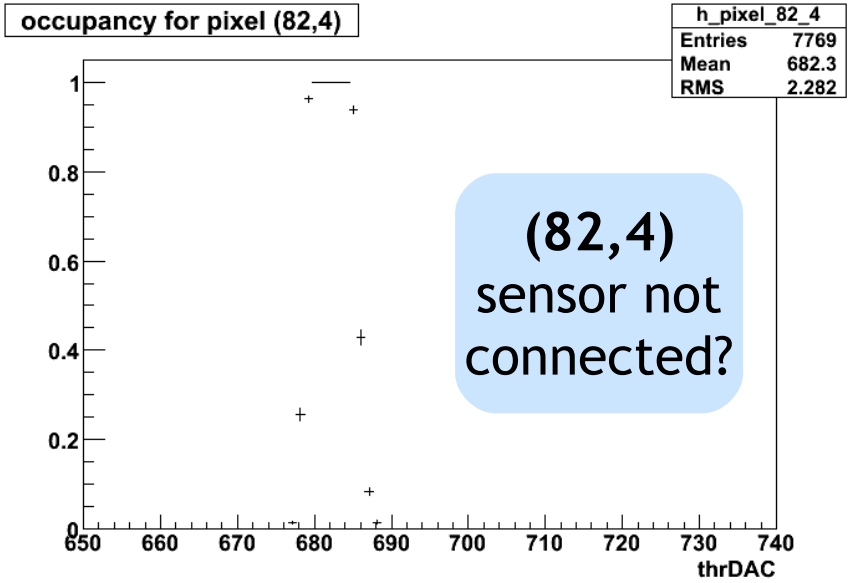
DAQ conditions:

- V_{bias} = - 40 V
- T_{obs} = 200 ms (MLE=1)
- threshold = 237 mV (= baseline + 60 σ noise)

not responding pixels



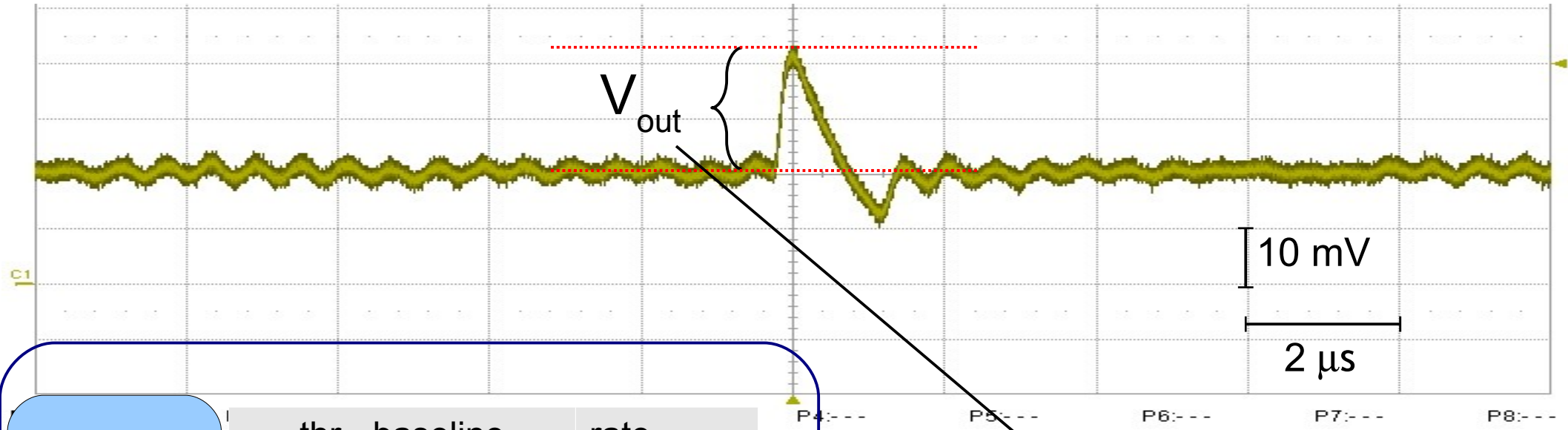
responding to the Noise Scan:



(82,4) sensor not connected?

dead also in the Noise Scans and Injection Scans (3, 4.5, 6 fC)

look at the analogic output



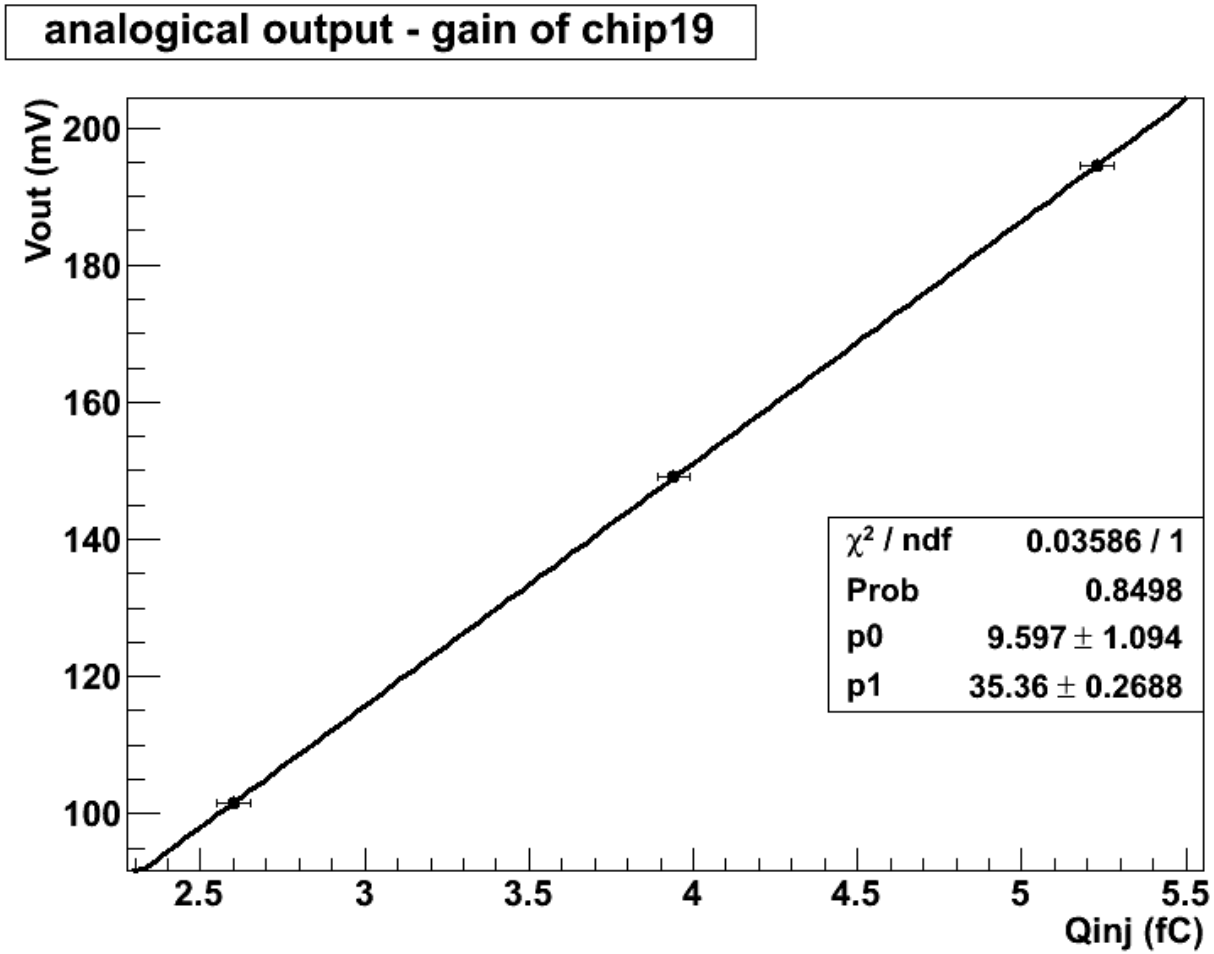
Sr90 looking at analogical output

thr - baseline	rate
50 mV	1.5 Hz
100 mV	0.25 Hz
150 mV	0.1 Hz
200 mV	0.017 Hz
50 w/o source	0 Hz

rate is compatible with what seen from digital output of readout (2-4Hz @30mV)

gain measurement from the analogic output is possible

gain using analogical output



- analogical output gain:
  - (35.4 ± 0.3) mV/fC
- digital output gain (InjScan):
  - (38.9 ± 0.3) mV/fC

10% difference among the two ways

Note:

- Qinj = Vinj * 10 fF, Vinj generated by PG
- Vout and Ving measured on the oscilloscope

backup slides

FE chips shipped to Pavia

➔ results of the Noise Scans made in Pisa on the chips now in Pavia:

CHIP	MC	baseline mV	thres. disp.	noise mV	noise disp.	NOTE
4	6	215.0 ± 0.2	0.9%	0.30 ± 0.2	53%	(RUN5) step 1 DAC
	6	214.5 ± 0.2	1%	0.48 ± 0.02	35%	(RUN6) step 5 DAC
	6	213.6 ± 0.2	1%	0.54 ± 0.03	17%	(RUN8) step 5 DAC + TB Pavia
6	6	212.1 ± 0.2	1%	0.47 ± 0.02	42%	(RUN1) step 5 DAC + TB Pavia?
7	6	211.8 ± 0.2	1%	0.47 ± 0.02	45%	(RUN1) step 5 DAC + TB Pavia?

Simulazione ApselVI

- Test andati a buon fine (arch. data push):
  - Ad ogni TS scatta una colonna che è letta al TS successivo richiedendo TS_DATA = TS -1
  - Ad ogni TS scatta una riga che è letta al TS successivo richiedendo TS_DATA = TS-1
  - Scatto di 100 pixel random a TS = 1 e due letture successive
  - Scatto di 100 pixel random a TS = 1 e lettura di 100 TS random
  - Nessun pixel scattato e lettura di 100 TS random
- Da fare:
  - Testare l'architettura “triggerata”