UNIVERSITA' DEGLI STUDI DI PAVIA
Laboratorio di Strumentazione Elettronica

Characterization of Superpix0 chips
Noise scan results and inject scan results

A. Manazza, G. Traversi, L. Ratti
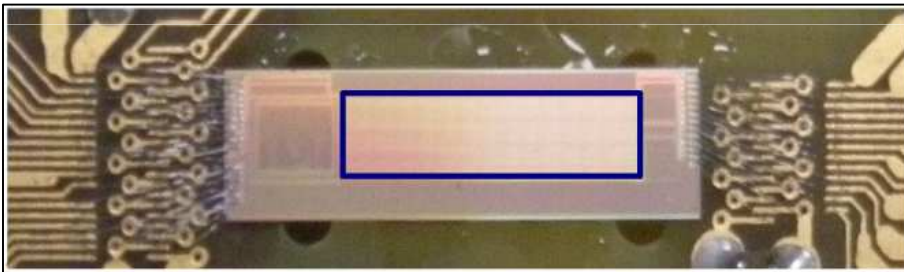
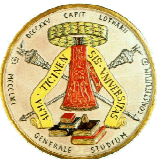*Electronic Instrumentation Laboratory*
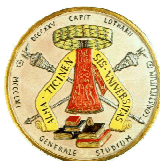
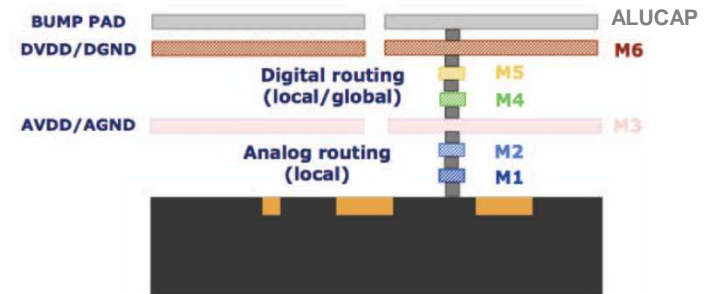# SuperPix0 - Fine Pitch Hybrid Pixel Sensor
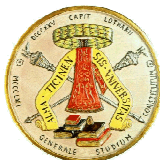
SuperPix0 layout
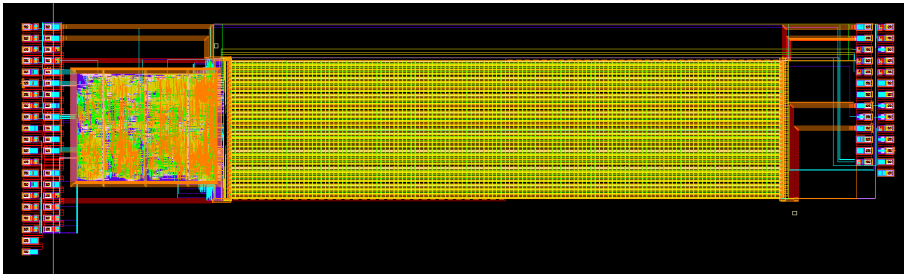
Photograph of the prototype

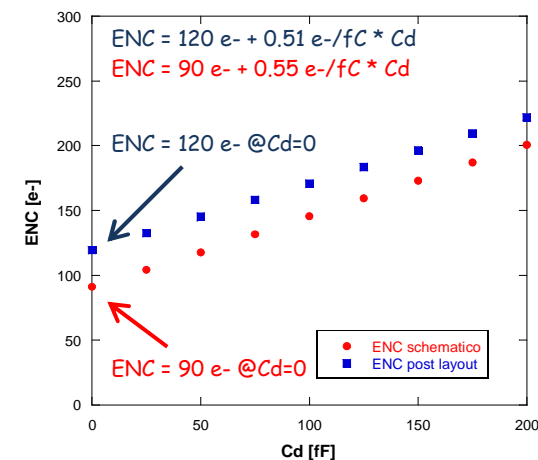- CHIP1 could not be tested because some bonding wires were damaged

- The prototype chip contains 4096 readout cells of 50 μm × 50 μm arranged in a 32 × 128 matrix and organized in MacroPixels (MP)

- We have tested 3 chips with no sensor connected:
  - CHIP4
  - CHIP6
  - CHIP7

Cross sectional view of the metal layers used in the layout of the SuperPix0 chip

Electronic
Instrumentation
Laboratory

SuperPix0 - Analog Cell

Pixel layout integrated in the SuperPix0 chip

Electronic
Instrumentation
Laboratory
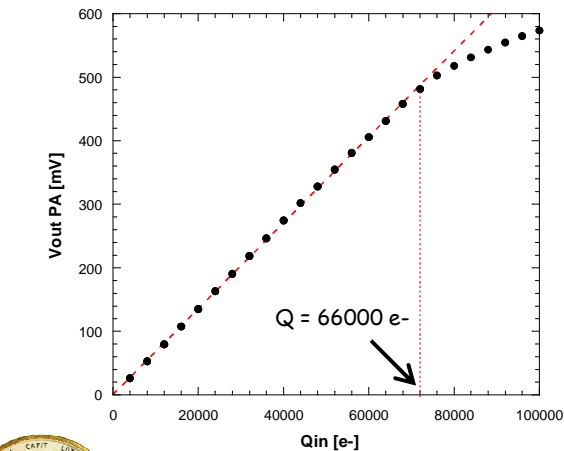
Noise Scan Measurements
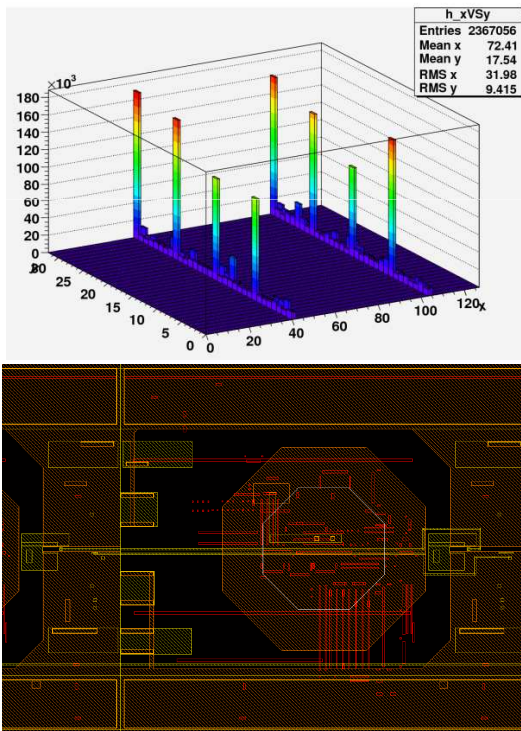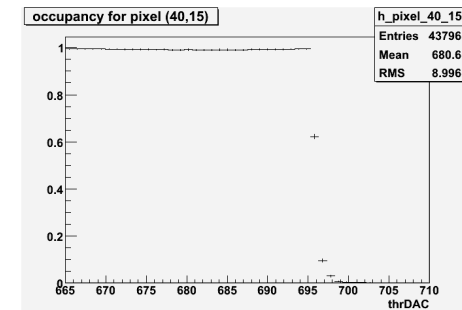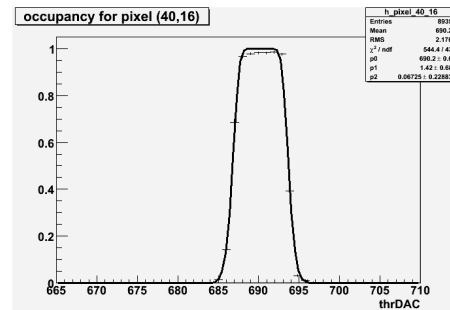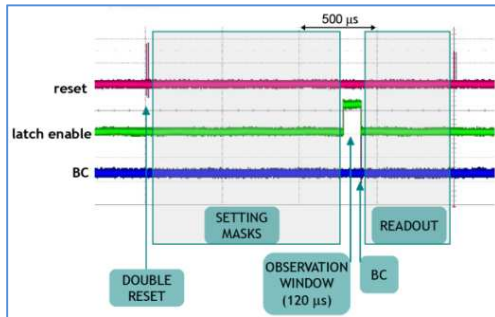
- We measured the occupancy as a function of the comparator threshold and we fitted the histogram and extracted noise and dispersion parameters with the function:

$$O(V_{th} - V_{bl}) = 1 - \exp[- T_{oss}\, v_o \exp(-(V_{th} - V_{bl})/2\, \sigma^2)]$$

Observation window (120 µs)

Frequency at zero threshold

Baseline voltage

Noise

- There are 8 pixels that have larger occupancy than the others. This happens only for pixels in a particular position in the MP
- The fastOR and the latch enable lines run below the bump bonding pad and when they change state it is like the pixel is injected

Electronic Instrumentation Laboratory
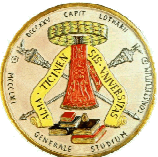
Noise scan results

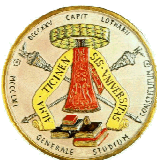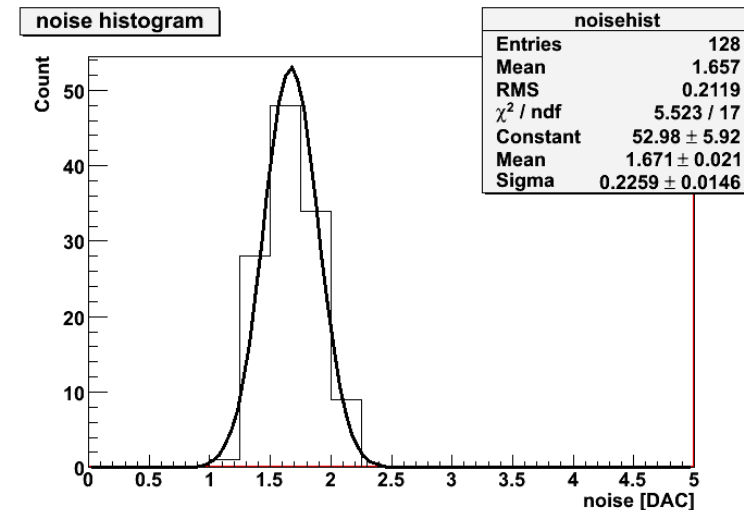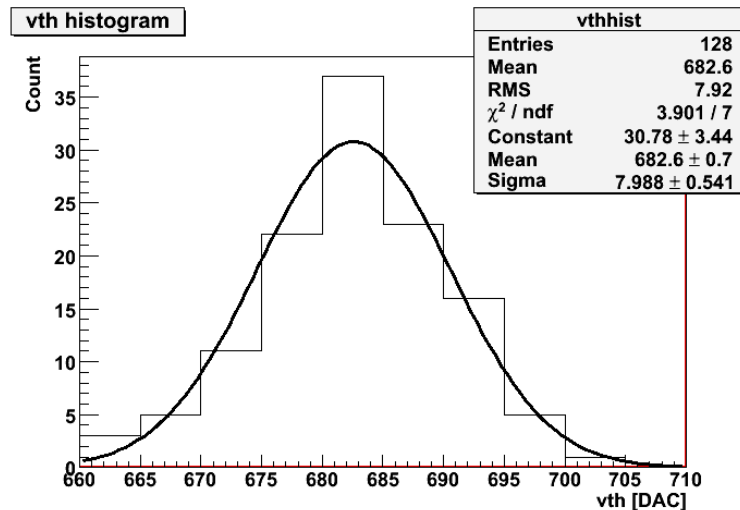|	Simulations	CHIP 4	CHIP 6	CHIP 7
THRESHOLD [mV]	180	208.3 ± 0.2	207.3 ± 0.2	207.8 ± 0.2
THRESHOLD DISPERSION [mV]	2.52 (350 e-)	2.43 ± 0.17	2.19 ± 0.15	1.98 ± 0.13
NOISE [mV]	0.63 (90 e-)	0.51 ± 0.01	0.503 ± 0.01	0.504 ± 0.01

- The threshold dispersion and the ENC parameters are calculated with post-layout charge sensitivity (Gq = 44 mV/fC)

- The threshold and noise histograms are referred to chip 4

vthhist	
Entries	128
Mean	682.6
RMS	7.92
χ^2 / ndf	3.901 / 7
Constant	30.78 ± 3.44
Mean	682.6 ± 0.7
Sigma	7.988 ± 0.541

noisehist	
Entries	128
Mean	1.657
RMS	0.2119
χ^2 / ndf	5.523 / 17
Constant	52.98 ± 5.92
Mean	1.671 ± 0.021
Sigma	0.2259 ± 0.0146

Electronic
Instrumentation
Laboratory

Inject scan results

- The charge sensitivity histogram is referred to chip 6

- Gq = 38.61 mV/fC

- The threshold dispersion and the ENC parameters are recalculated with measured charge sensitivity:

  Noise = 81 e-

  Threshold dispersion = 354 e-

gain histogram

Entries	128
χ^2 / ndf	39.12 / 97
Constant	11.38 ± 1.24
Mean	38.61 ± 0.16
Sigma	1.766 ± 0.111
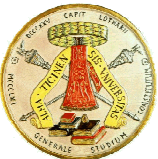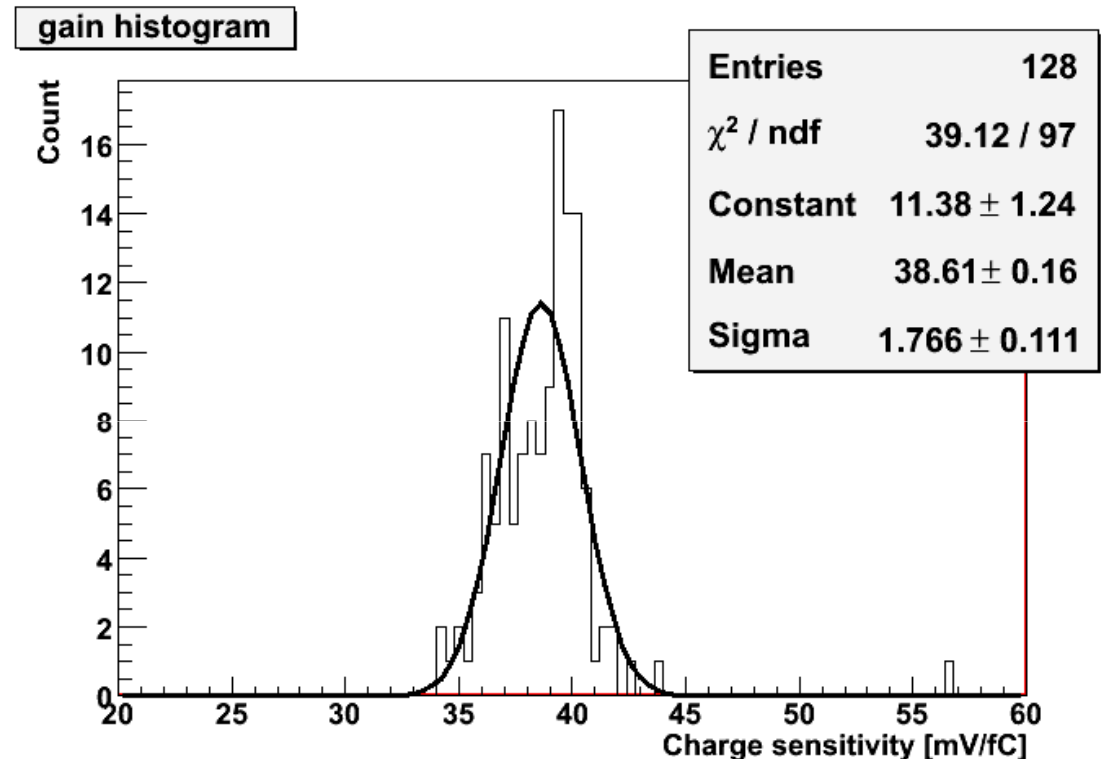
Inject scan results

- The charge sensitivity histogram is referred to chip 6

- Gq = 37.16 mV/fC

- The threshold dispersion and the ENC parameters are recalculated with measured charge sensitivity:

  Noise = 85 e-

  Threshold dispersion = 333 e-

Gain histogram

Entries	128
χ^2 / ndf	41.88 / 97
Constant	9.505 ± 1.029
Mean	37.16 ± 0.19
Sigma	2.149 ± 0.134

Electronic Instrumentation Laboratory