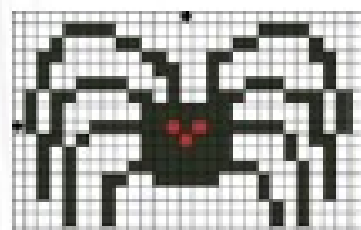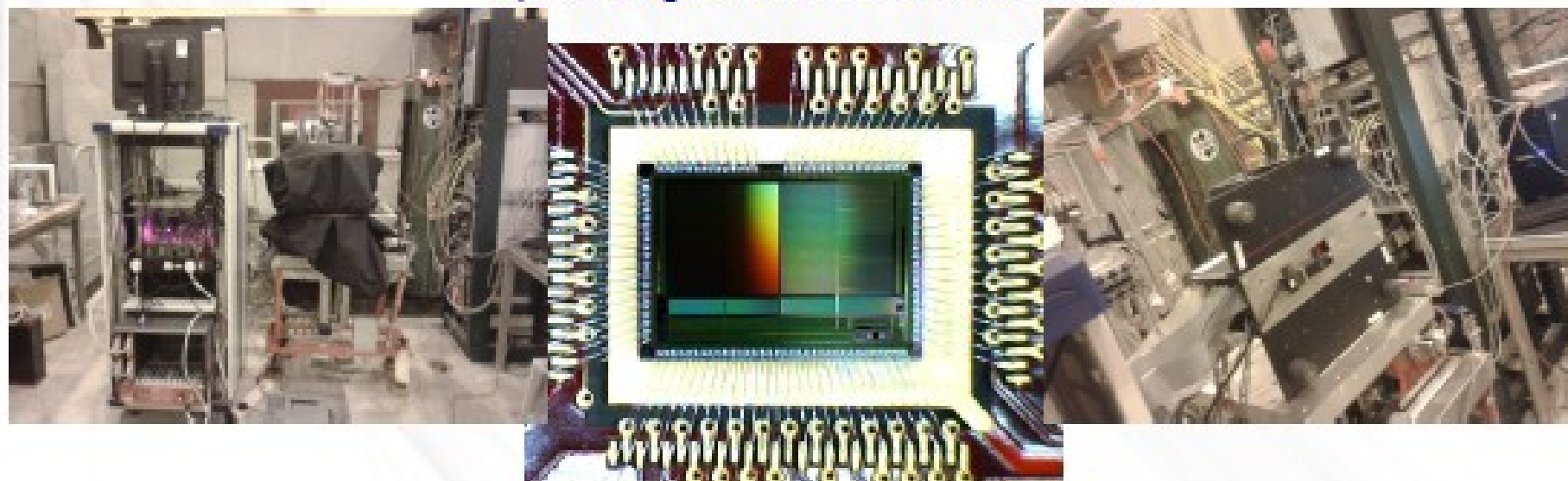# TESTS OF THE CHERWELL MONOLITHIC ACTIVE PIXEL SENSOR: PRELIMINARY RESULTS

12/12/12

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Arachnid

Queen Mary
University of London

SuperB

Results recently shown by James MyIroie-Smith (ARACHNID COLLABORATION)

Outline

- CMOS & CHERWELL

- CHERWELL TEST
  - Photon Transfer Curve
  - Noise & Gain
  - 55-Fe Irradiation
  - Pedestals

- Test Beam at CERN-SPS
  - The H6 Experimental Area and the Set Up
  - Firsts Data: observing hits on the sensors
  - Correlation Plots

- Future Plans and Conclusions

What's a Complementary metal–oxide–semiconductor (CMOS)?

* Epitaxial layer 10s of μm thick

* Substrate can be thinned to 10s of μm thick

* Smaller depletion region around the diode

* No strong field

* Circuitry can be embedded within the pixel
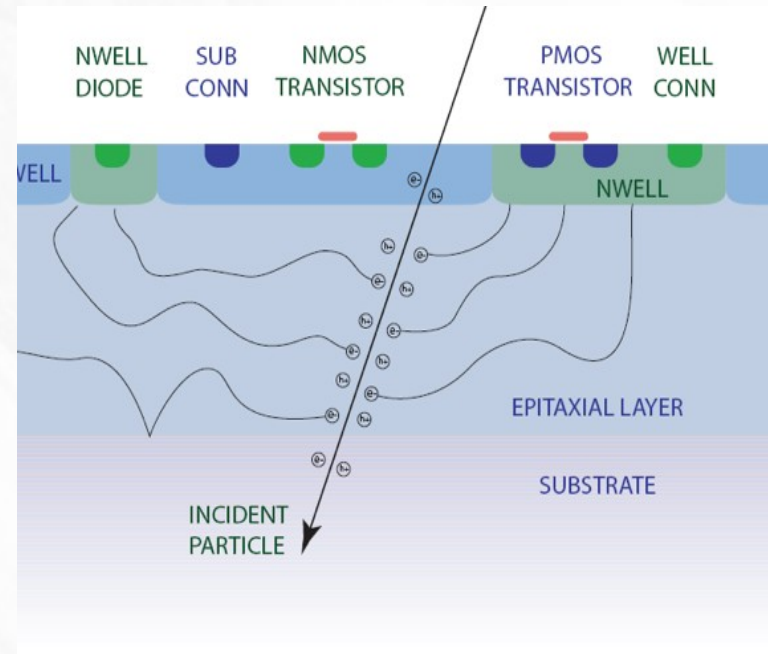
CHERWELL

- For tracking/vertexing and calorimetetry
- 180nm CMOS image sensor
- 4 types of pixel:
  - DECAL25
  - DECAL50
  - Reference Pixel
  - Strixel
- Internal, column-parallel ADC
- 12um thick epitaxial layer
- Standard and High resistivity
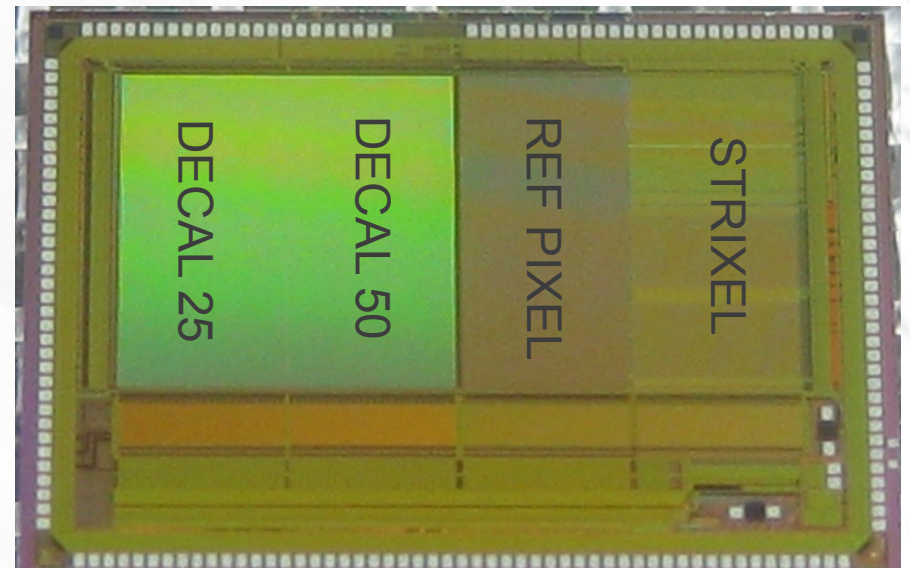
Photon Transfer Curve (PTC) Scan

- PTC scan controlled by computer
- IR LED uses programmable generator to give uniform illumination
- Sensor read back to computer and data complied into PTC and results plotted
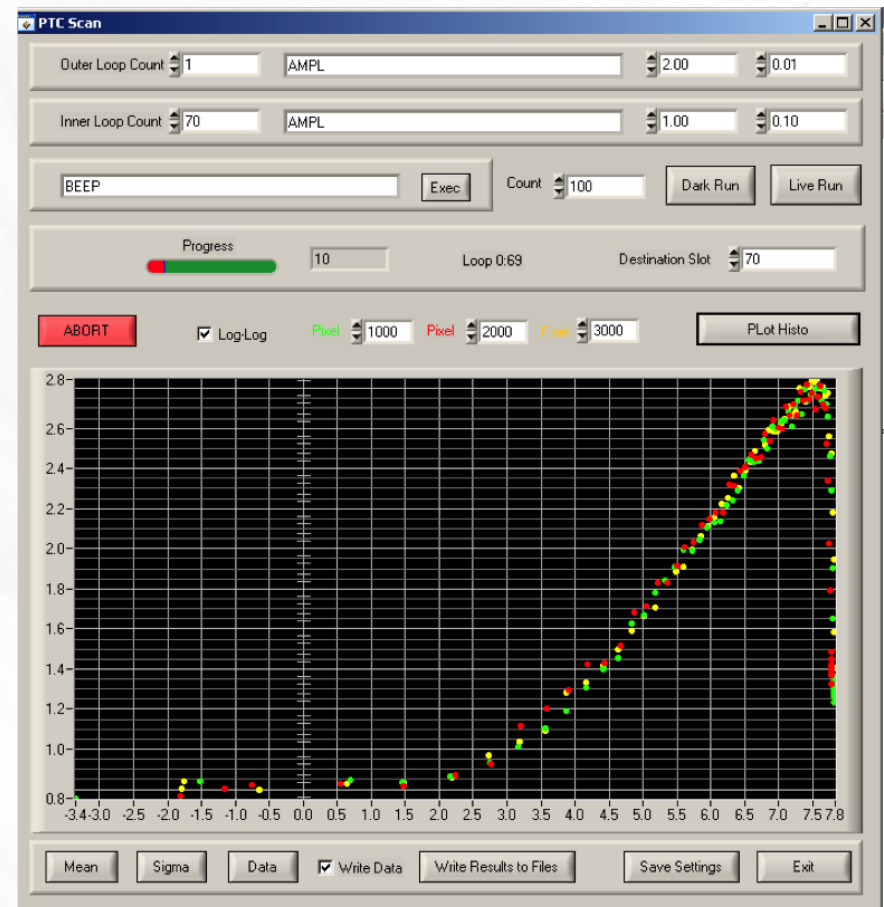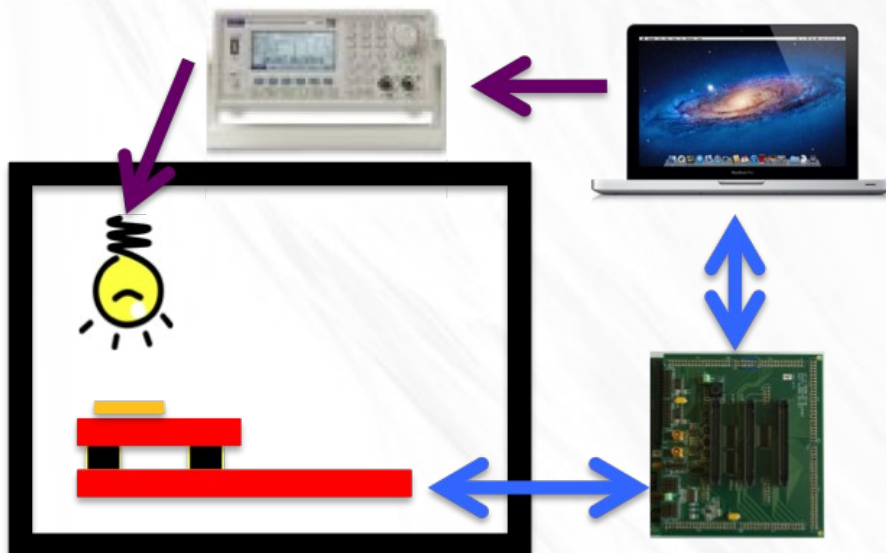
PTC Scan Results

- PTC performed using IR illumination
- Results show good uniformity across the pixels
- Gain ≈ 0.17 ADC/e

- Noise ≈ 12e rms
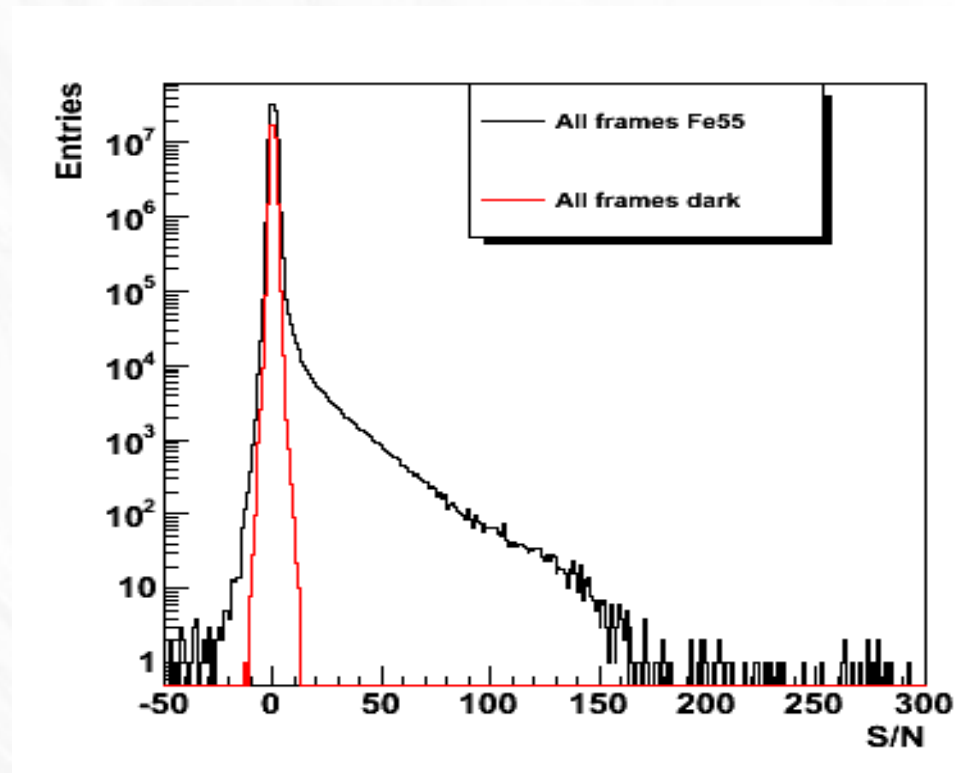- Linear full well ≈ 11500e
- Maximum full well ≈ 14700e
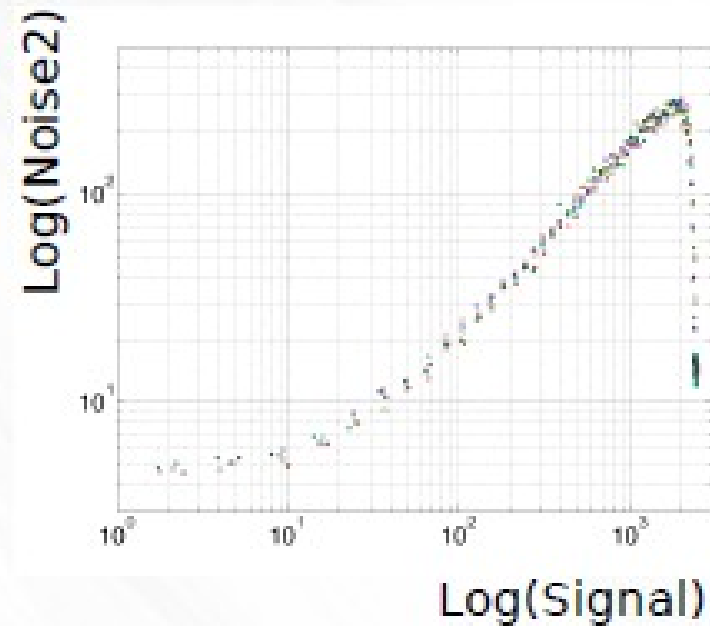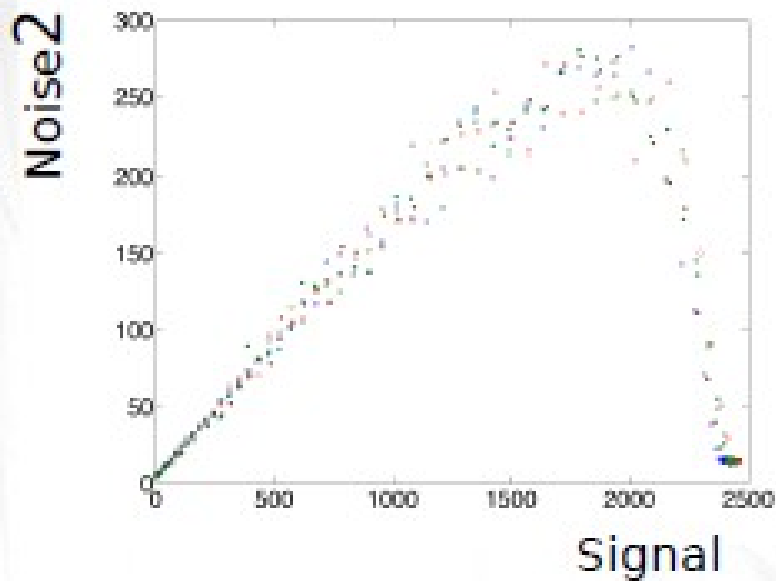
Evaluation of Noise and Gain

- Noise and gain are uniform across the sensor
- Average noise value ~12 e rms
- Average gain value 0.17 => 51μV/e
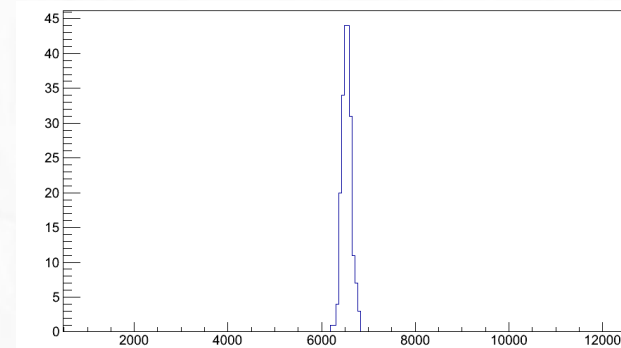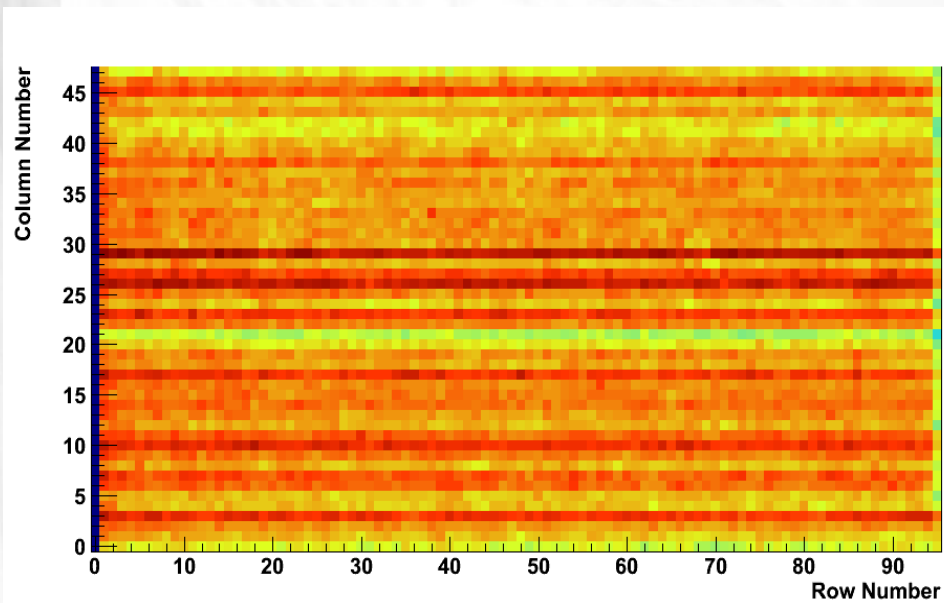

Noise from each pixel

Gain from each pixel
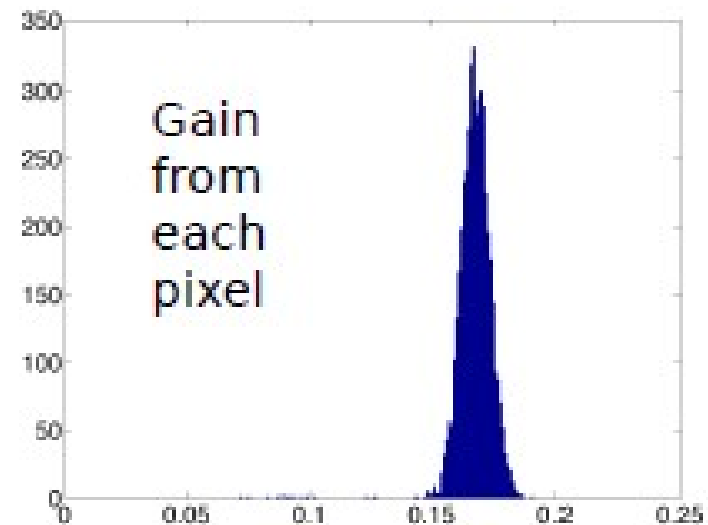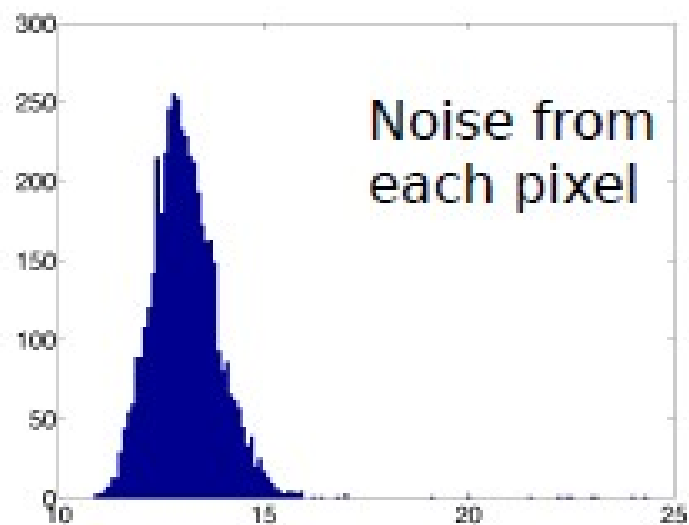
Test with radioactive sources: Fe55

* Sharp cut-off

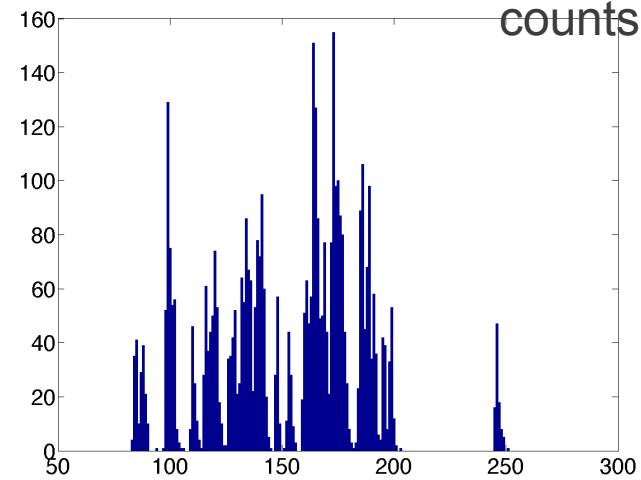* Consistent with noise/gain from PTC

* Good S/N up to 150

Pedestal value

* Readout is performed on a column by column basis
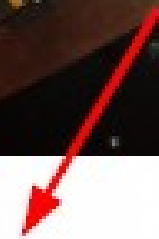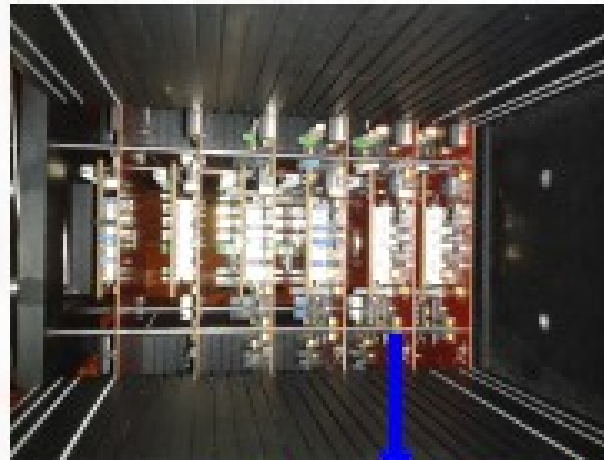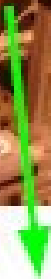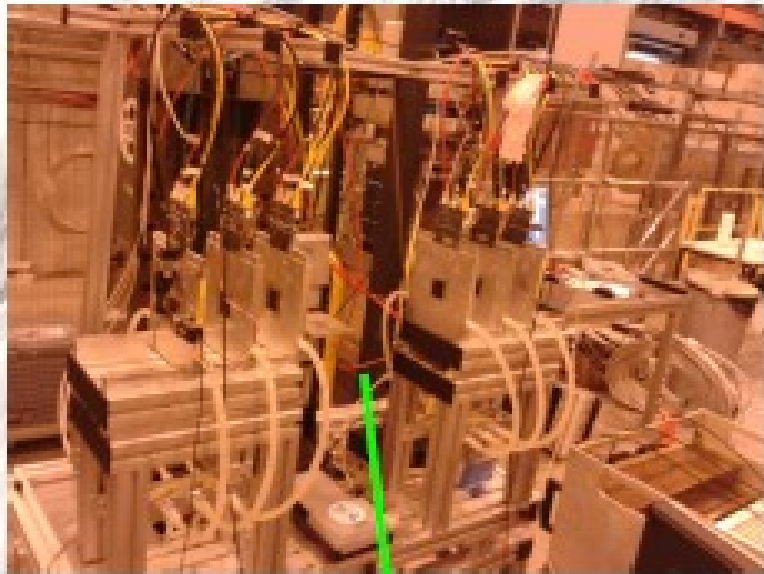* Shows common readout in columns
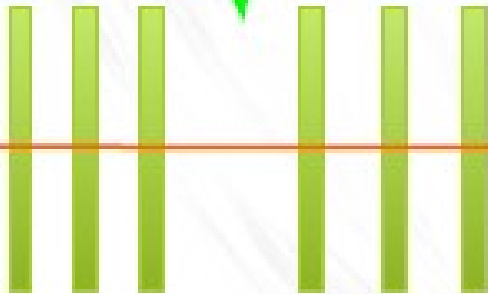

ADC counts

ADC counts

8

Teast Beam at CERN-SPS H6 Area

Irradiation with 120 GeV/c pions
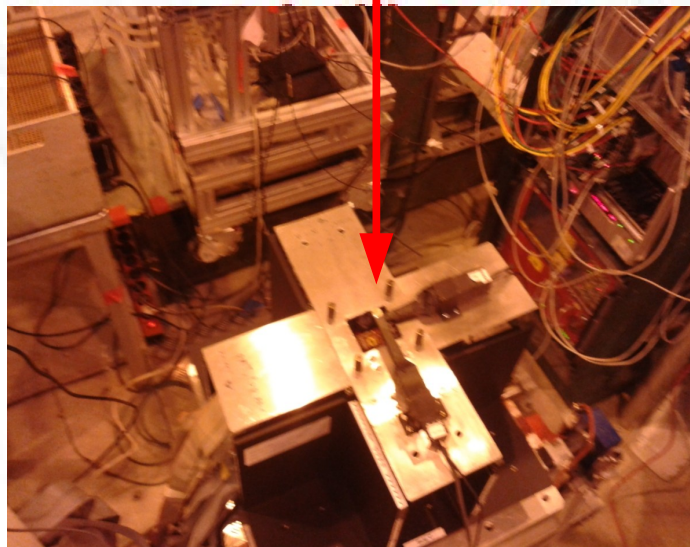## *7-13 November 2012*

Cherwell Stack

EUDET

Scintillators

10
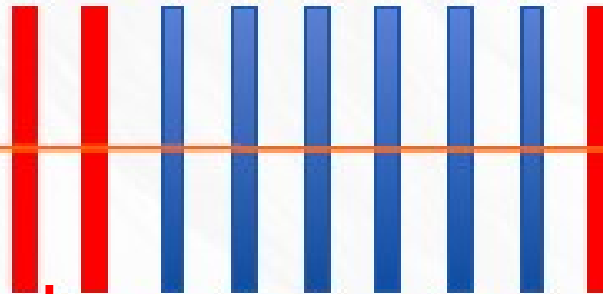
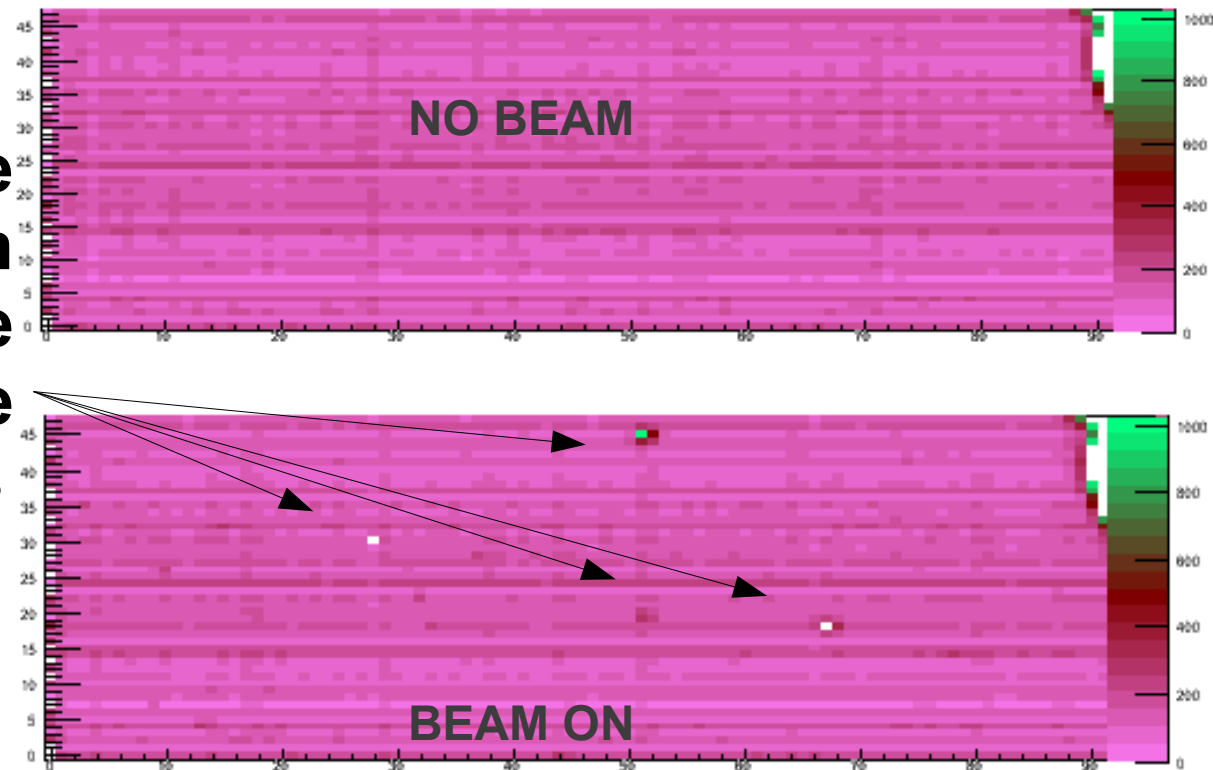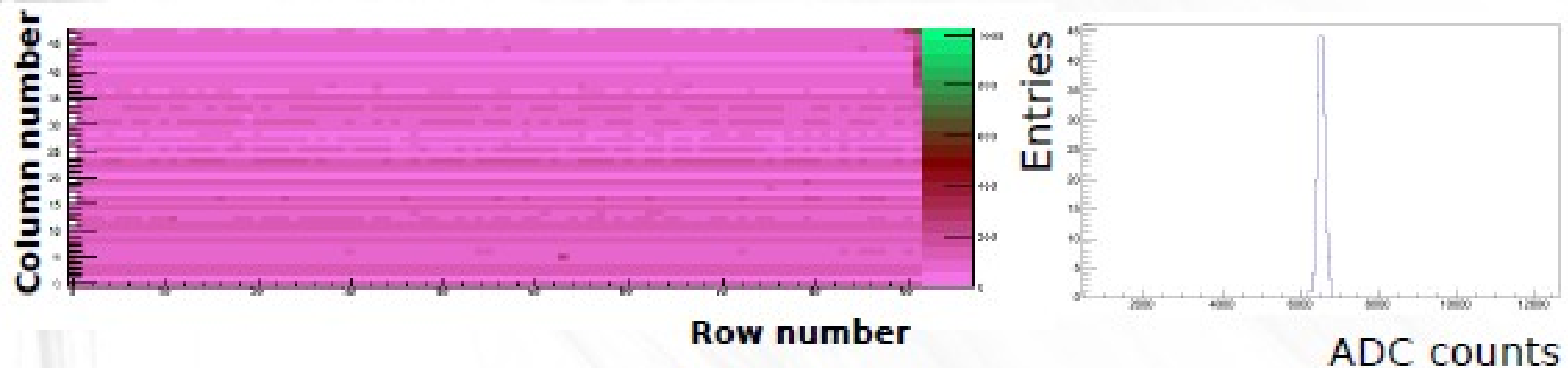# *Firsts Data*

Looking at the raw image which comes from the sensor, we see hits when there is beam.

Raw Image

- Raw image from the sensor
- Shows common bands in the readout columns
- An average of 200 events is used to give the pedestal value for each pixel
- The sigma of the Gaussian distribution is classed as the noise
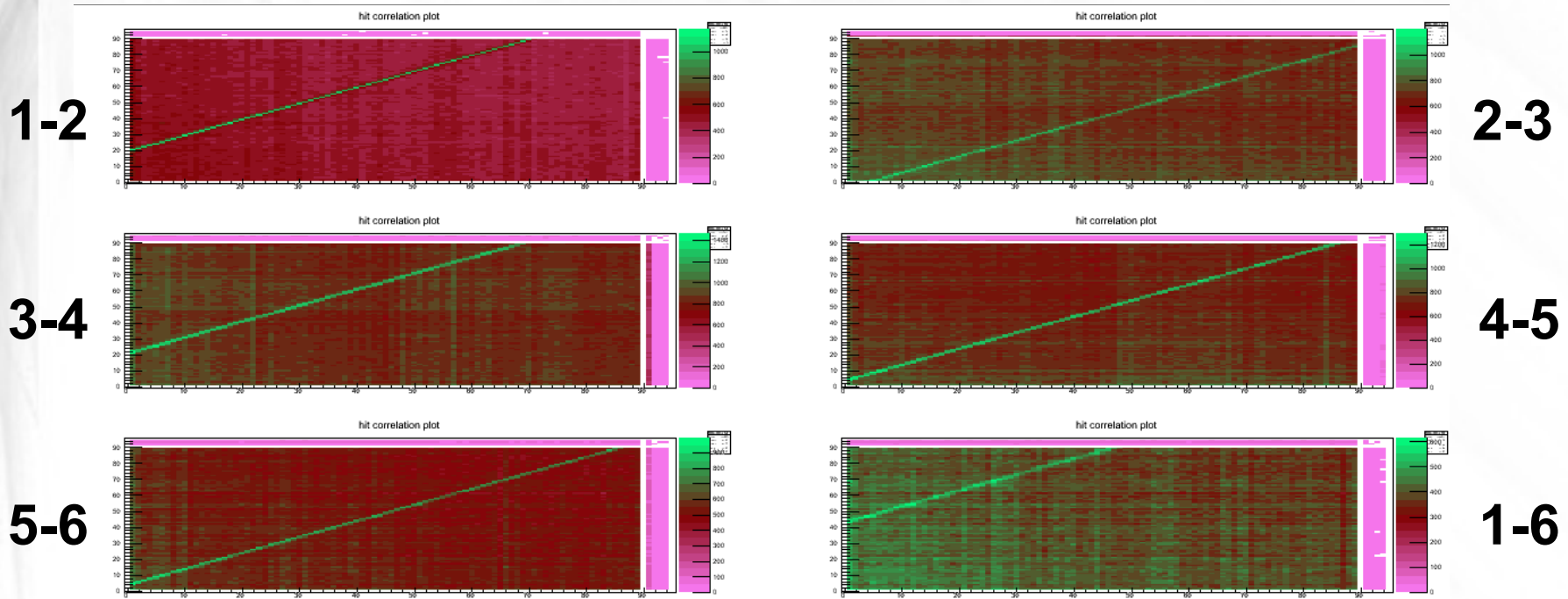

Row number

ADC counts

Pedestal + Common Mode Subtraction

* Pedestal and common mode subtracted

* Low level random noise across most of sensor

* Hits cause large mean and remove some of the noise/smaller hits

Correlation plots

1-2

2-3

3-4

4-5

5-6

1-6
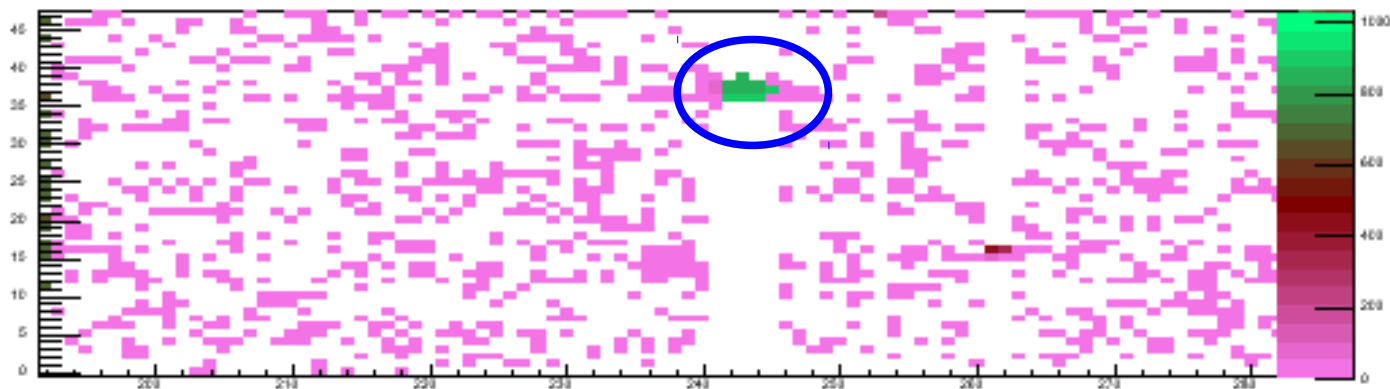
Correlation between different sensors as expected

Conclusions and Future Plans

We are starting to understand the CHERWELL sensors ant test the performances.

Time for the analysis of test beam data is needed.

Need to understand and characterise the whole component (DECAL, STRIXEL...)

The possibility to perform a test beam with electrons at DESY is being considered...

Other tests are ongoing (temperature, bending..)

News to come soon

...Many Thanks...