Mohammed Imran Ahmed

1 Some past background:

1. Graduated in July 2009 at Faculty of Biomedical, University of Luebeck, Germany
2. Master thesis topic: Volume estimation of object from an image using 3D Time Of Flight Camera.
3. Home country: India

2 Present status:

1. Host Institute: IFJ-PAN and AGH-UST
2. MC-PAD project: P10- Monolithic Detector
3. Supervisor: Dr. Henryk Palka and Dr. Marek Idzik
4. Thesis advisor and University: Dr. Marek Idzik, AGH-UST

Contents

- Own work and Technical progress
- Milestones and Deliverables
- Back-gate effect
- INTPIX3 Monolithic SOI test results
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Own Work and Technical Progress

- Test and Analysis of monolithic SOI pixel detector prototype INTPIX3 using ROOT (software developed at CERN)
- Test of back-gate effect on front-end electronics and confirmation that BPW(buried P-well) eliminate the effect.
- Test and measurement the detector with Am-241 source.

Milestones and Deliverables

(M)Milestones

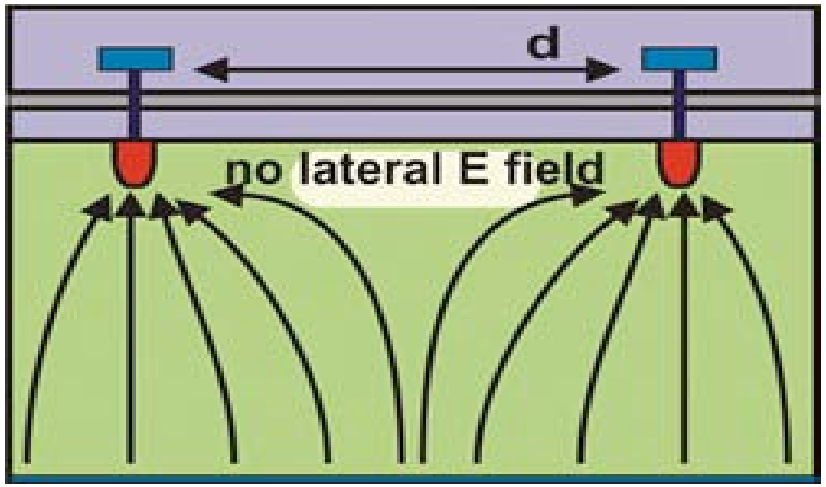
- MAPS SOI functionality (m25)
- MAPS SOI radiation hardness test (m31)

(D)Deliverables

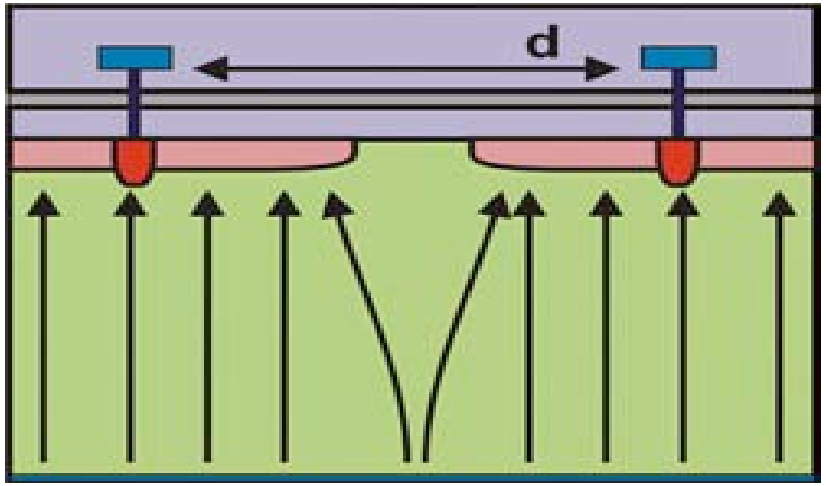
- MAPS SOI technology assessment (m12)
- Characterization of MAPS SOI prototypes (m24)

BACK GATE EFFECT

- **Back-gate effect:** The top silicon circuitry is influenced by back potential, when back voltage is increased.
- As back gate voltage is increased the threshold voltage of NMOS transistors are decreased and PMOS are increased.



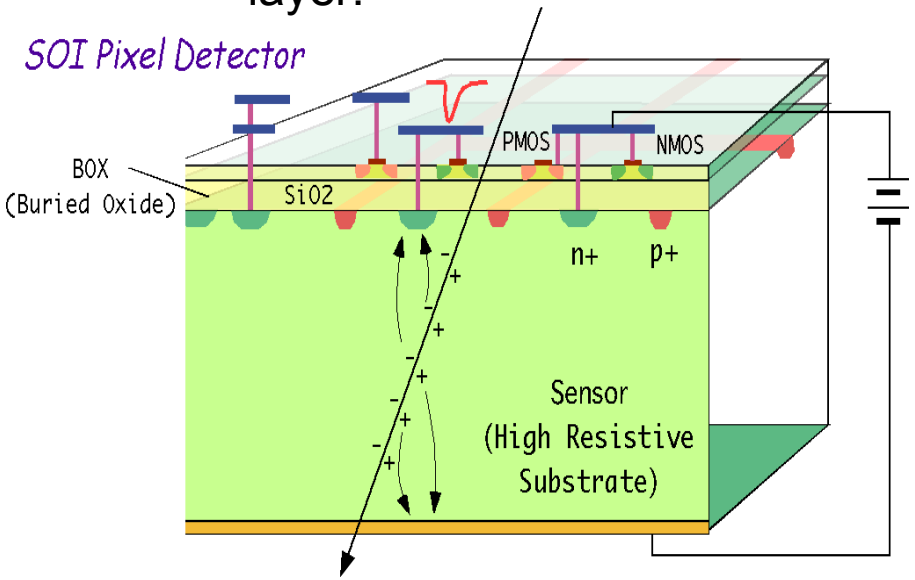
- **Buried P Well (BPW)**
- Introduction of BPW eliminate the Back-gate effect(can be seen in results).



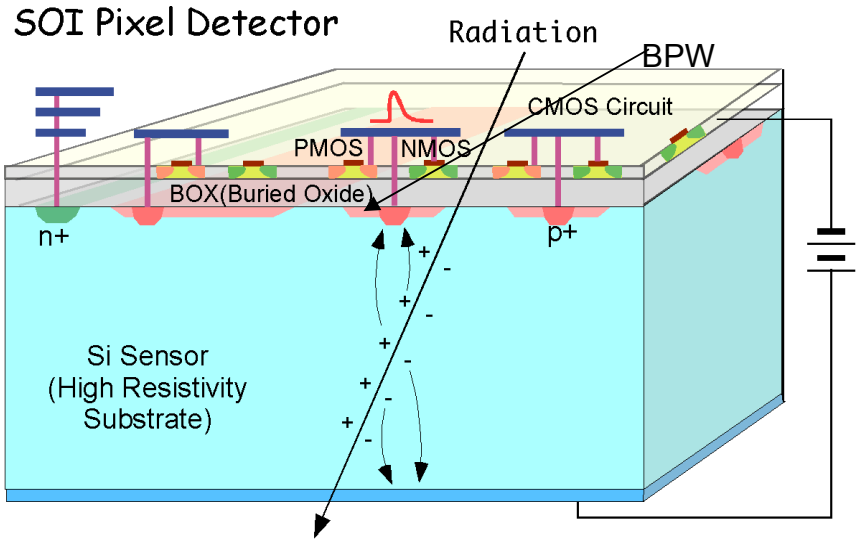
Results

(D)MAPS SOI technology assessment

- The back-gate effect was investigated in the last MPW run with INTPIX2 which effect the top Silicon i.e. front-end electronics of the detector.
- A Buried P-Well is introduce underneath the BOX(Buried Oxide) layer.



INTPIX2 without BPW



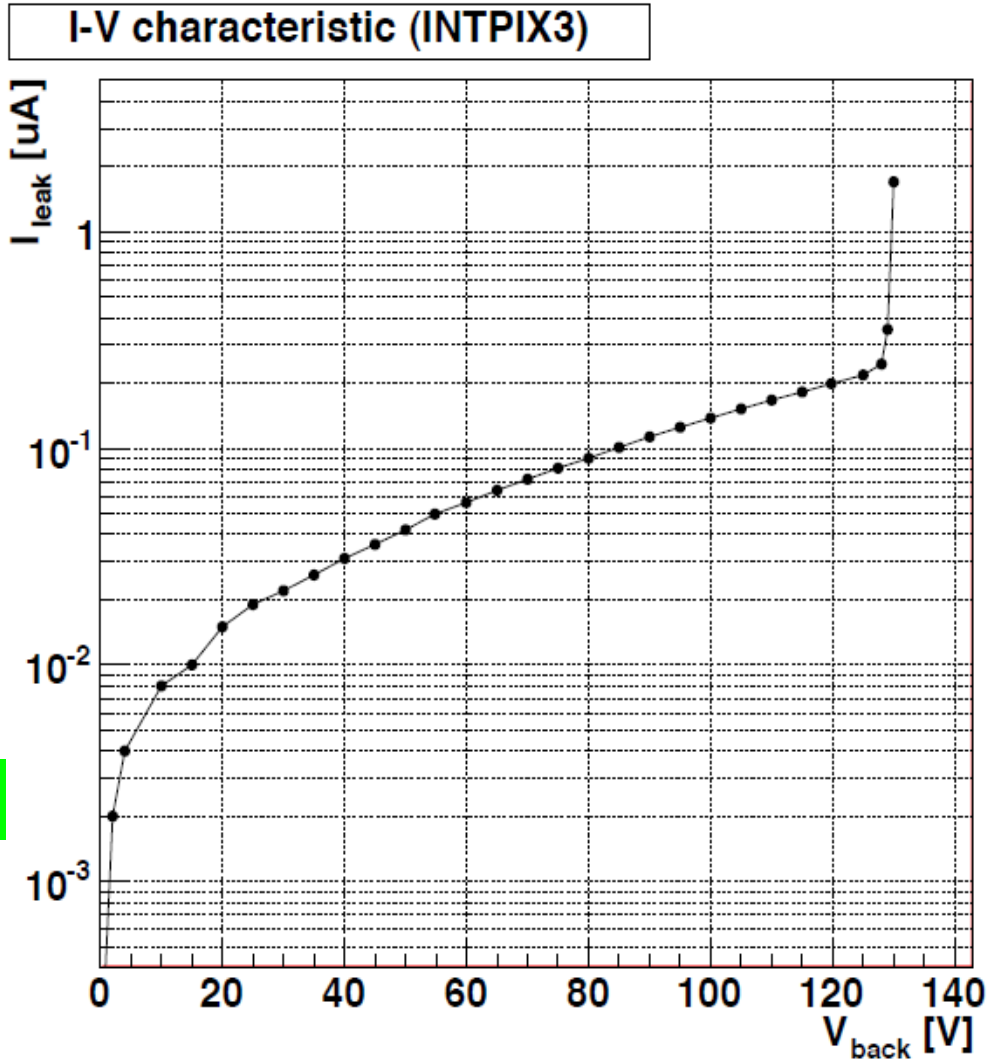
INTPIX3 with BPW

Leakage Current

$$W_{calc} = \sqrt{2\varepsilon_S (V_{bi} + V_{back})\rho\mu_n} = \sqrt{\frac{2\varepsilon_S (V_{bi} + V_{back})}{qN_B}}$$

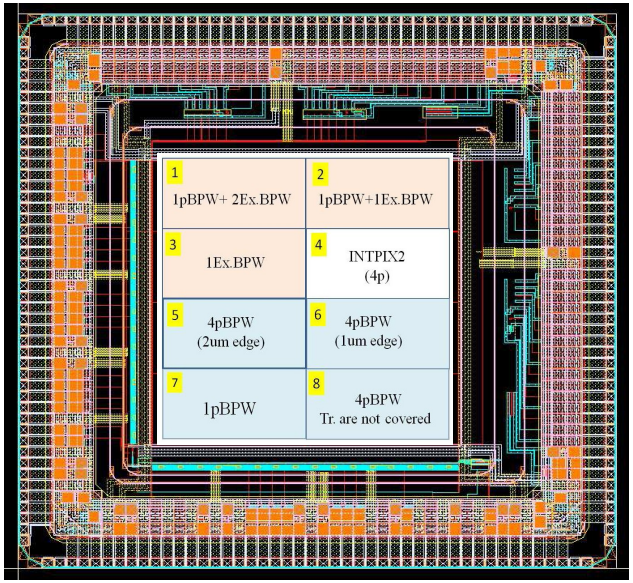
μ_n: electrons mobility
ε_S: silicon permittivity
N_B = doping
V_{bi} = V built-in
ρ = Resistivity

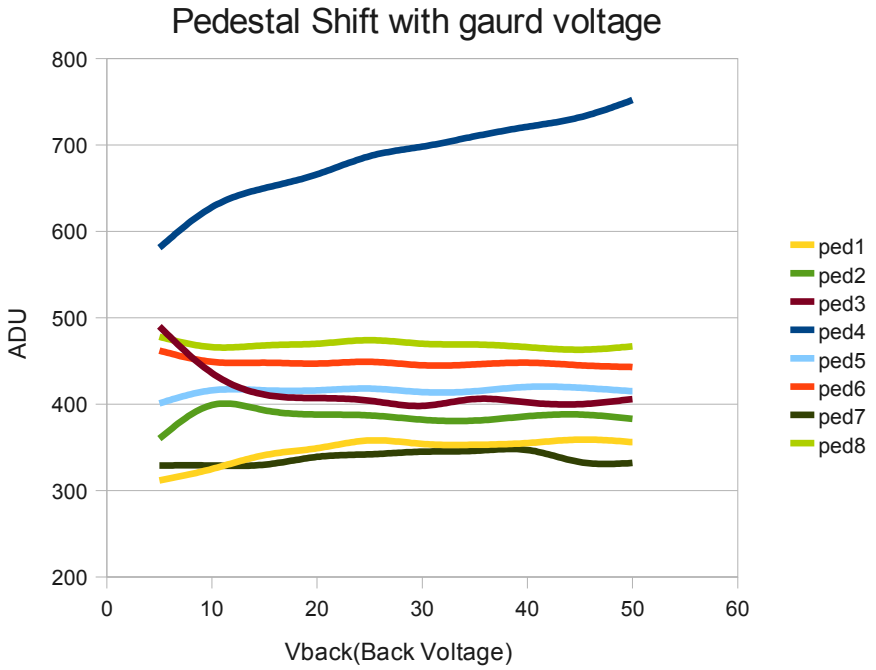
V_{back}(V)	W_{dep}(μm)
0	10
10	45
20	64
30	78
50	100
100	141
120	154
200	199
250	223
300	244



Pedestal Shift

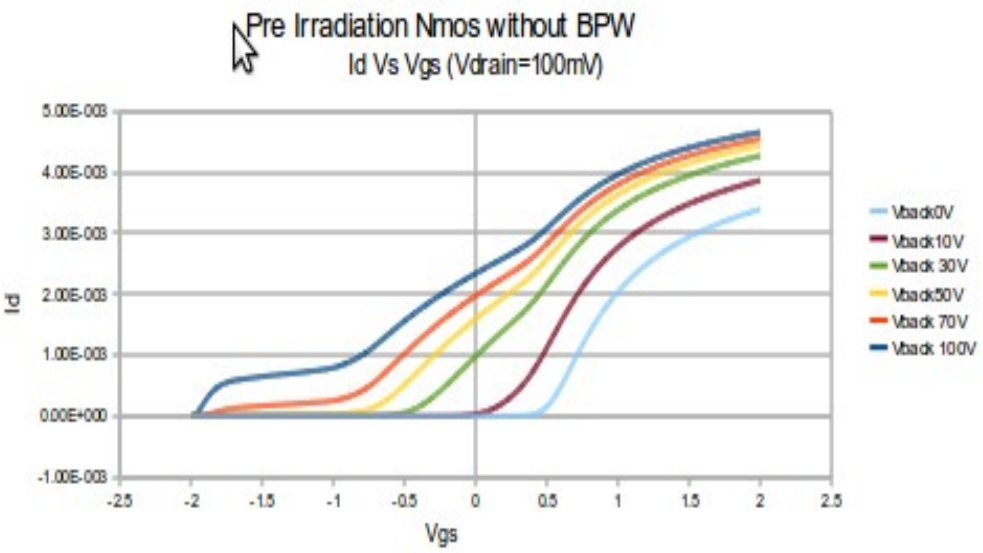
- Chip size 5x5mm, 128x128 pixels each of 20x20 μm.
- 8 regions, 32x64 pixel each
- Each pixel has about 5um square “no metal” window enable us to test with visible light laser.

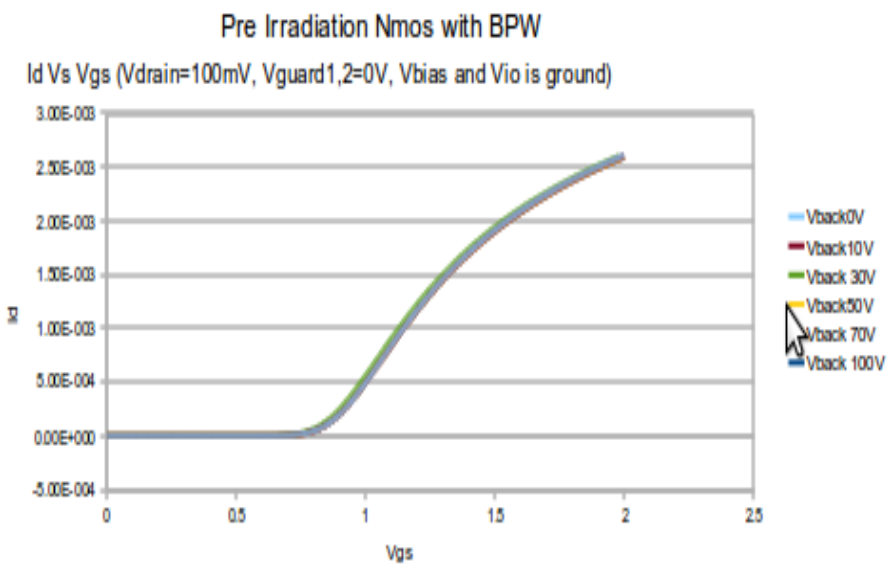




Transistor Characteristic

- I_d vs V_{gs} characteristic of test transistor which shows the back-gate effect with and without BPW.





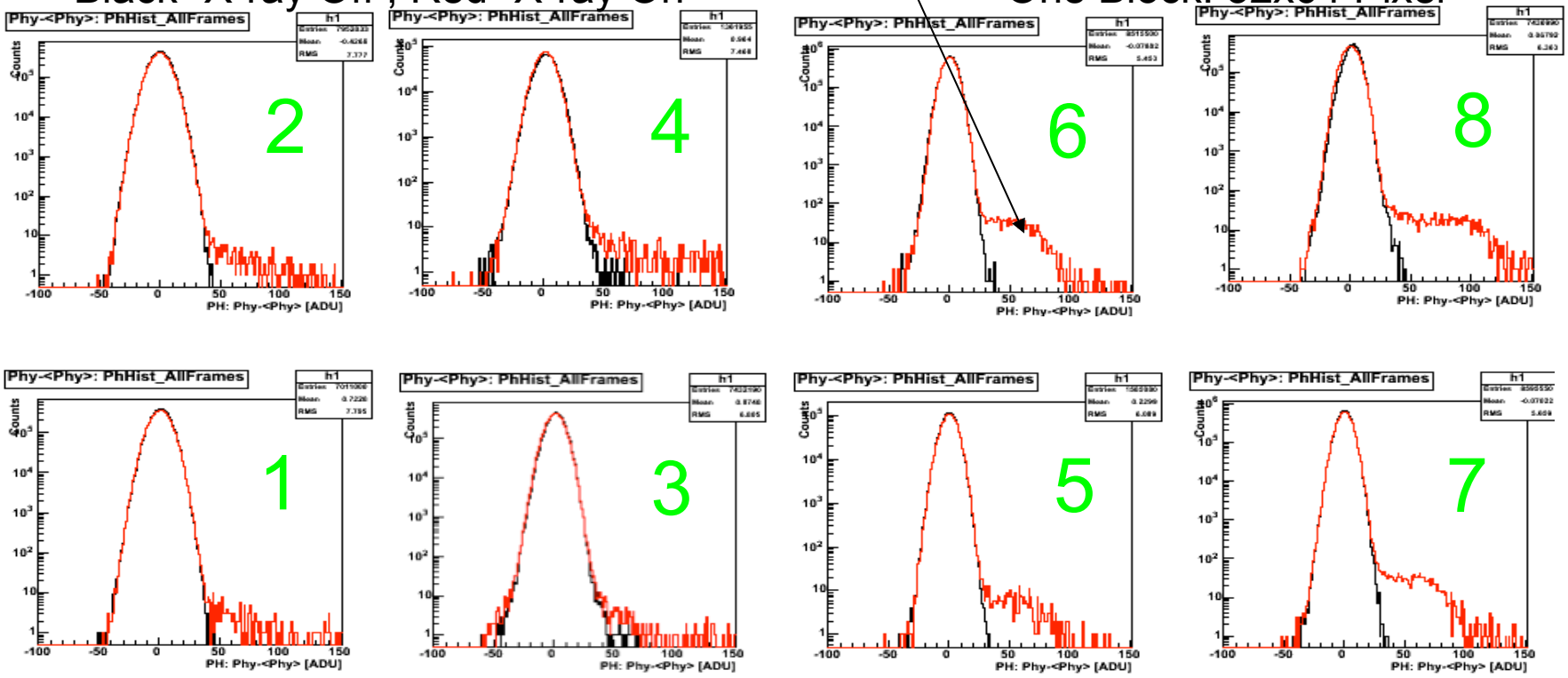
- BPW removes the decrease in threshold with respect to back voltage.

Americium (Am-241)

INTPIX3: Am-241(13.9keV)

Black- X-ray Off ; Red- X-ray On

One Block: 32x64 Pixel



V_{back}/RSTV	Exposure Time	X-ray Source
100V/750mV	0.5ms/frm x 4900 frm	Am-241 (13.9KeV)

Impact of my work

- **On me:** I learned new detector technology (SOI), got familiar with FPGA based readout electronics and learned ROOT
- **Science:** Monolithic SOI pixel detector is being developed to construct high granularity and thin vertex detector layers for Belle II experiment (starting from 2014) and for other experiment.

Overview
Training and Presentation

- **Courses:**
  - Polish language course
  - PhD related course work

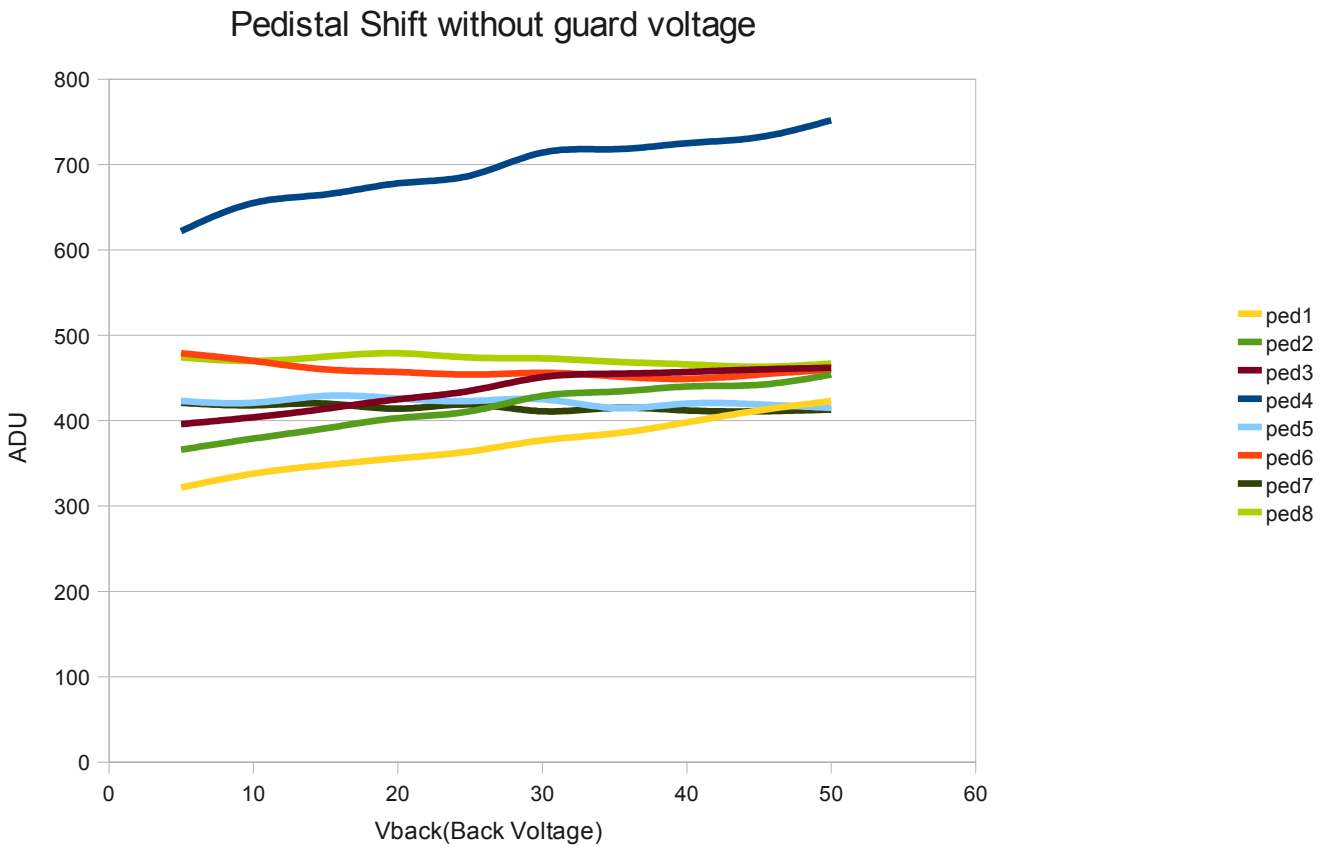
- **Training Events:**
  - MC-PAD Training
  1. Readout Electronics in Krakow Poland
  2. Simulation and Data analysis in Hamburg Germany

- **Other Activity:**
  - Cloud Computing workshop in Krakow Poland

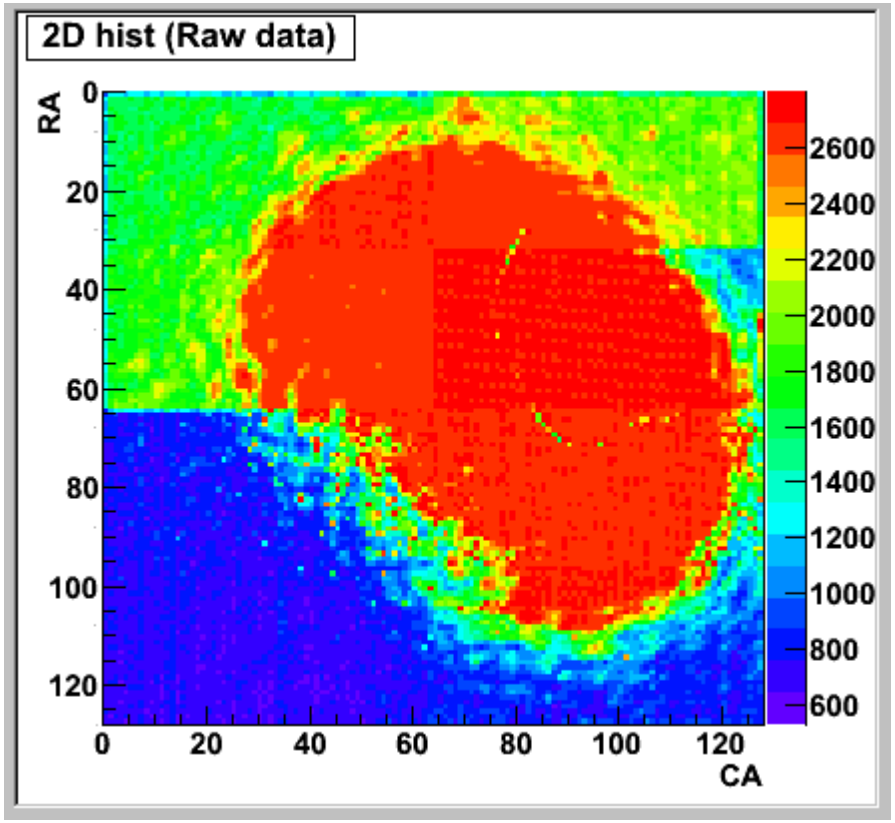
- **Presentations:**
  - FNAL SOI Collaboration Meeting 5th march 2010, talk on INTPIX3 back-gate effect test results. (http://www.fnal.gov/pub/today/archive_2010/today10-03-18.html)
  - AGH-UST weekly group meeting talk on test results of INTPIX3.

Thank you for your attention

Backup

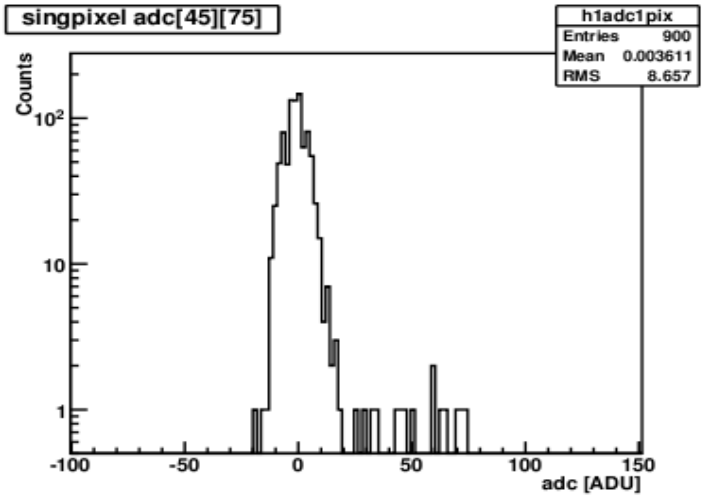

Pedistal Shift without guard voltage
800
700
600
500
400
300
200
100
0
ADU
0
10
20
30
40
50
60
Vback(Back Voltage)
ped1
ped2
ped3
ped4
ped5
ped6
ped7
ped8

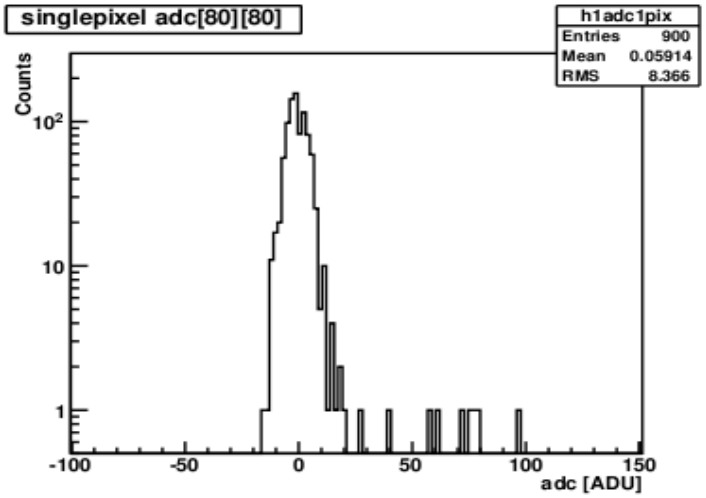
Backup



Application of guard Voltages

Backup


singpixel adc[45][75]
h1adc1pix
Entries 900
Mean 0.003611
RMS 8.657
Counts
adc [ADU]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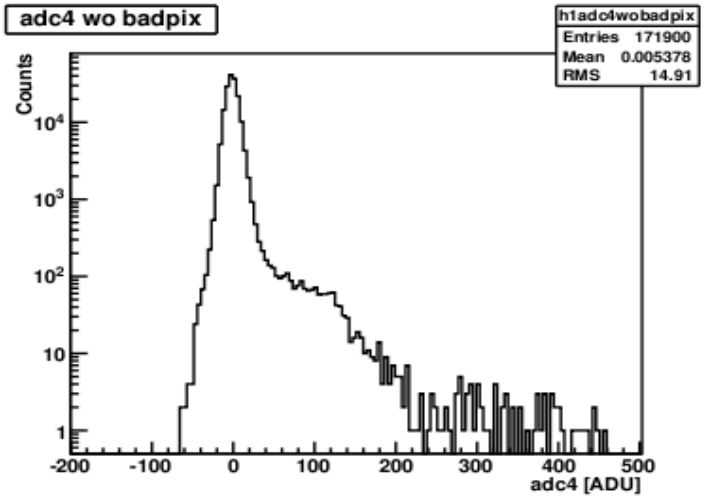
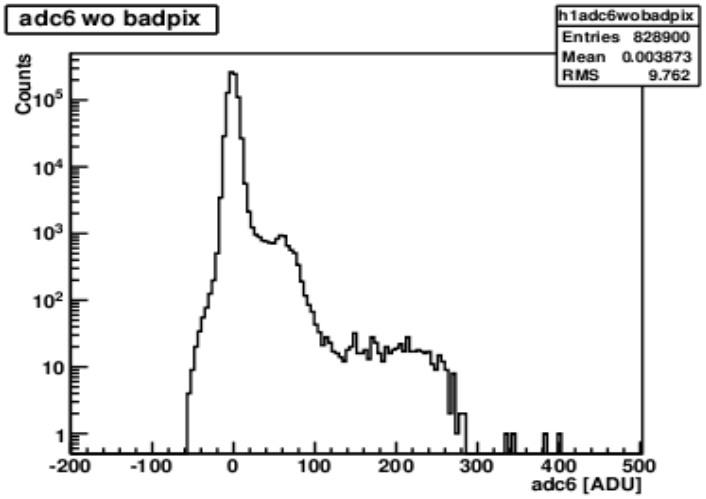
h1adc1pix
Entries 900
Mean 0.05914
RMS 8.366
Counts
adc [ADU]


adc4 wo badpix
h1adc4wobadpix
Entries 171900
Mean 0.005378
RMS 14.91
Counts
adc4 [ADU]


adc6 wo badpix
h1adc6wobadpix
Entries 828900
Mean 0.003873
RMS 9.762
Counts
adc6 [ADU]