# Amplitude Method for Sensor Data Analysis

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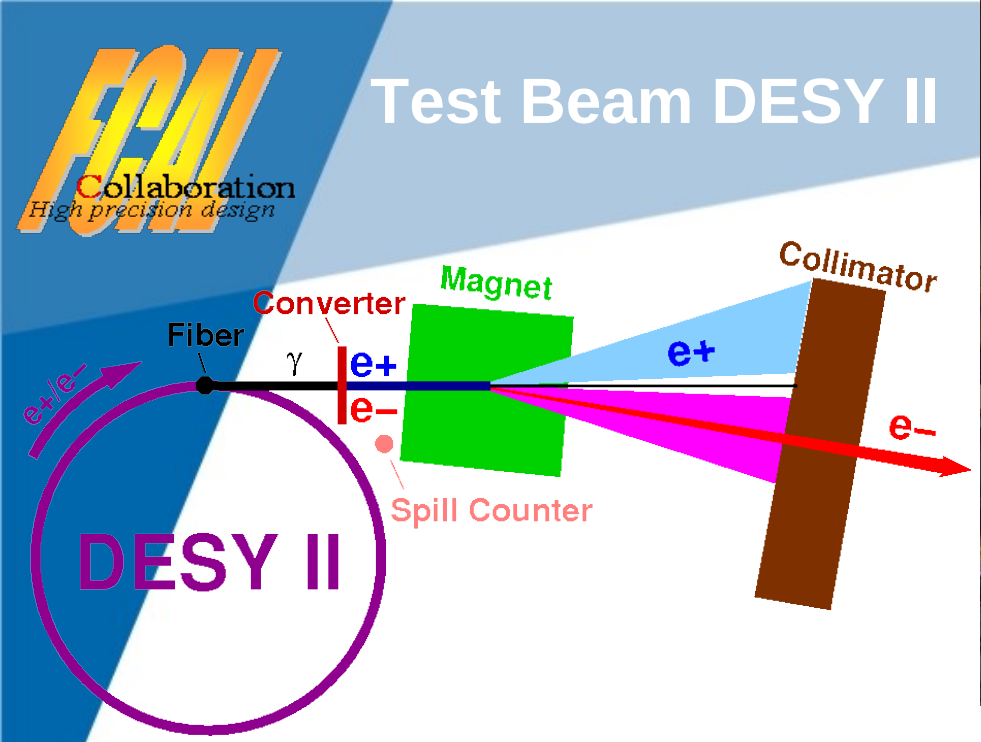
# Outline

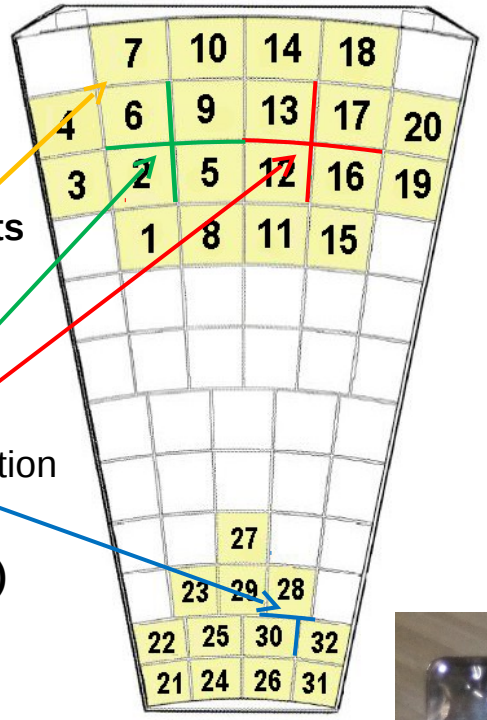
- ✓ Test Beam set-up
- ✓ Amplitude Method (MAX), Analysis Methodology
- ✓ Discrimination of Signal – Noise by MAX Method
- ✓ Results:
  - Dependence of MPV on the runs
  - Dependence of MPVs on the pads (uniformity studies)
- ✓ Conclusions

# Test Beam DESY II




- DESY II Synchrotron provide electrons with up to 1000 particles per cm² and second, energies from 1 to 6 GeV;
- Test Beam took place in beam line 22 of DESY II ring in Hamburg, from 04.11.2011 to 22.11.2011;
- Used 2 GeV electron beam;

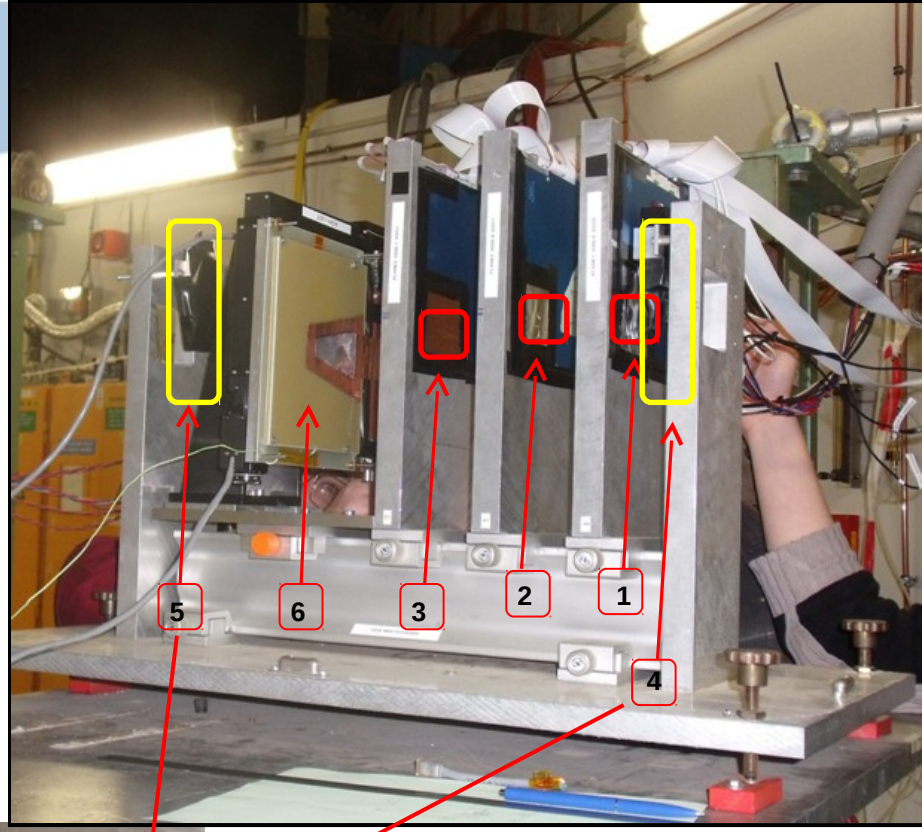
# Set-up




$N_{tr}$ ~ 200k events (uniformity )

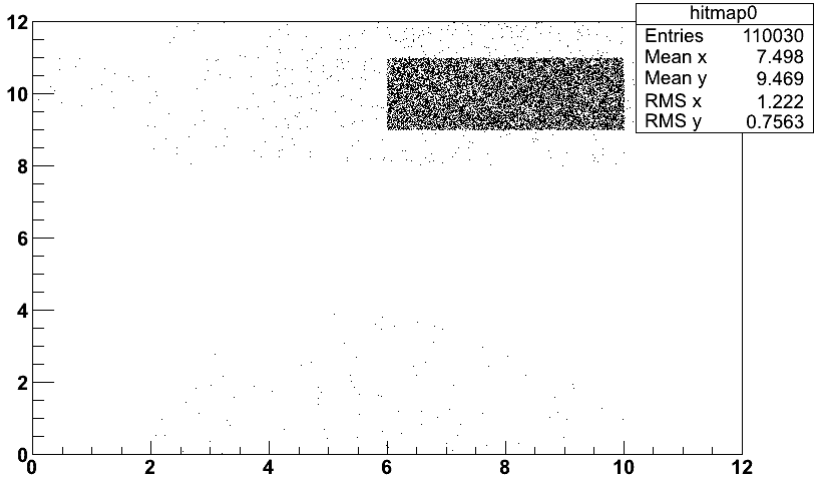
Edges between pads irradiation

$N_{tr}$ ~ 2M events (edge)

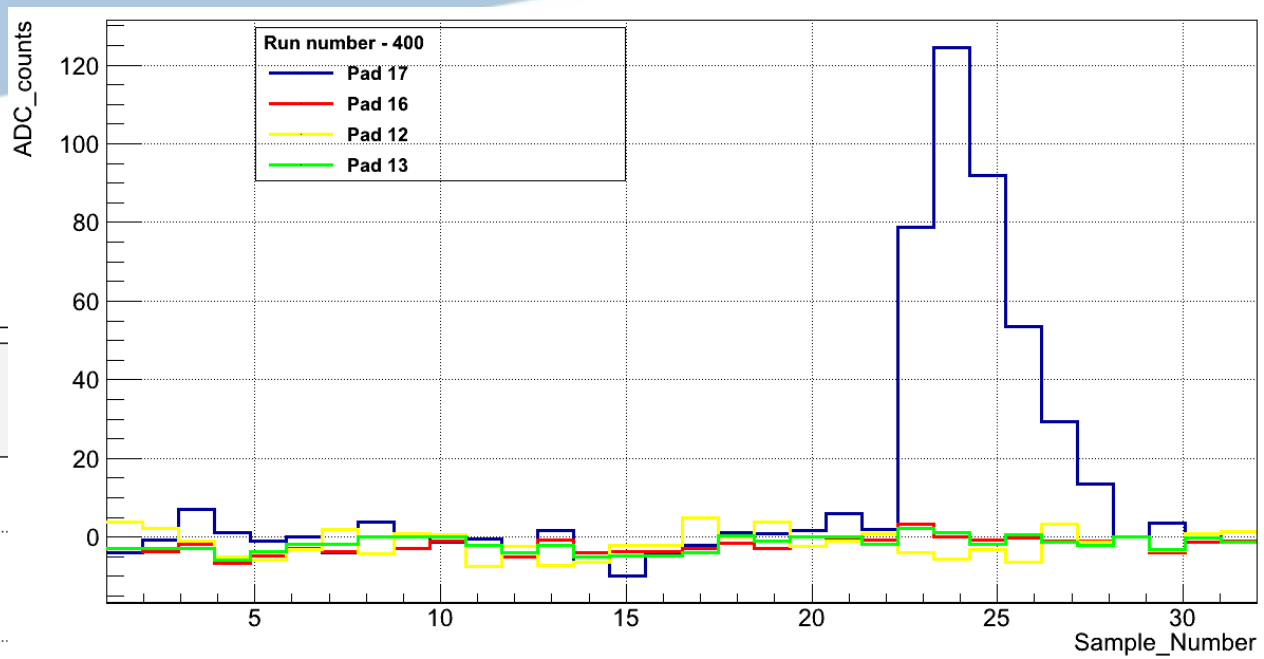


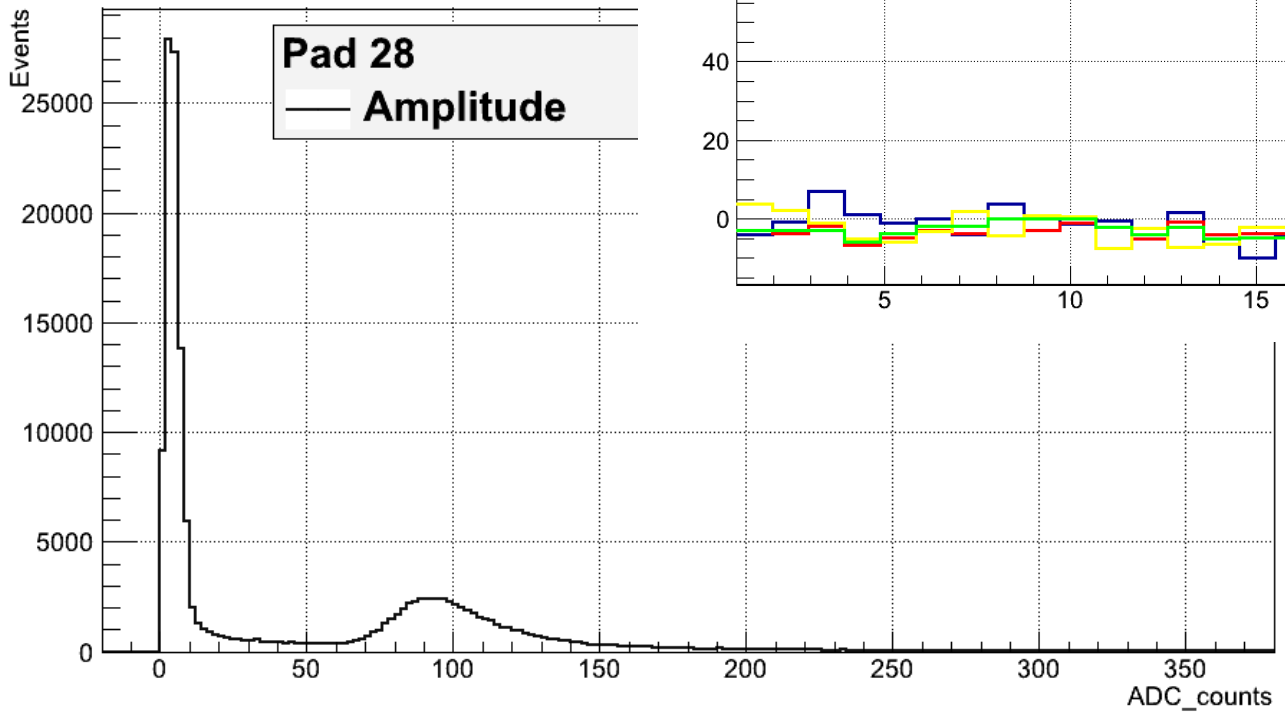

- ZEUS telescope planes (1, 2, 3):
  - Si planes: 300 μm thick
  - Active area: 32 x 32mm²
  - Double perpendicular layers,
  - 640 strip channels (50μm)
- Trigger scintillators (4,5) :
  - Trigger window: 7 x 7mm²
- BeamCal Sensor (6)
  - GaAs:Cr sensor

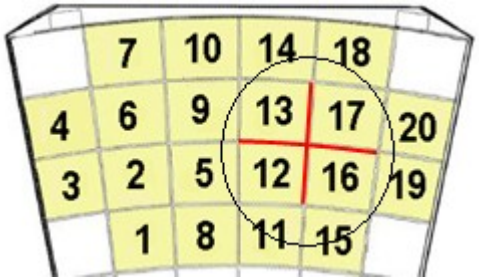
Hit map



# Amplitude method (MAX)

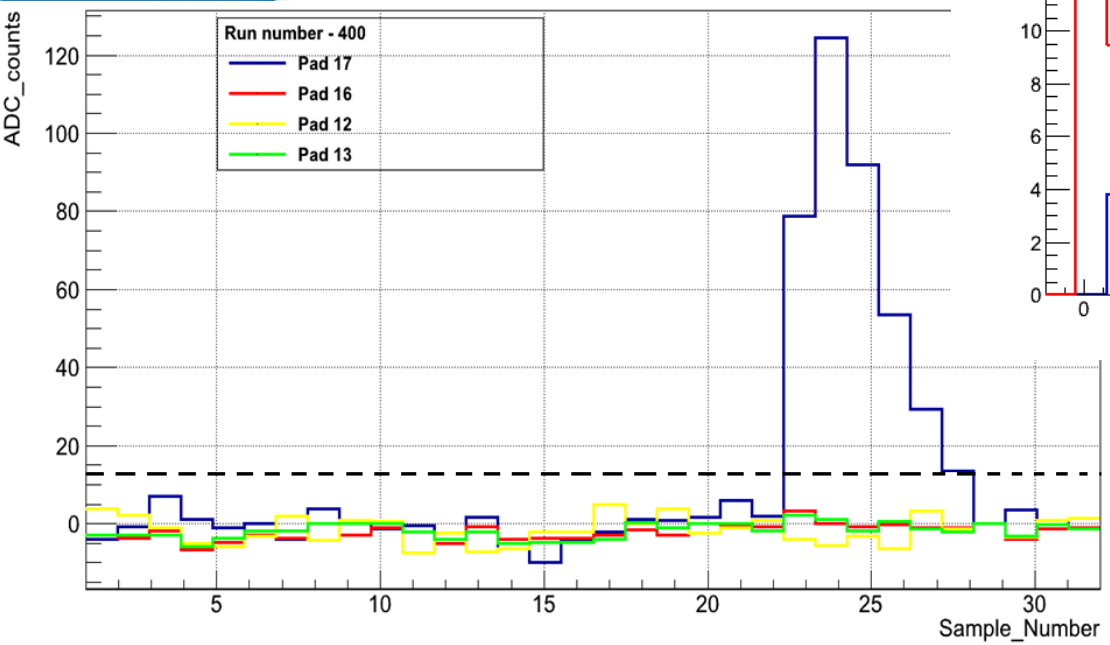


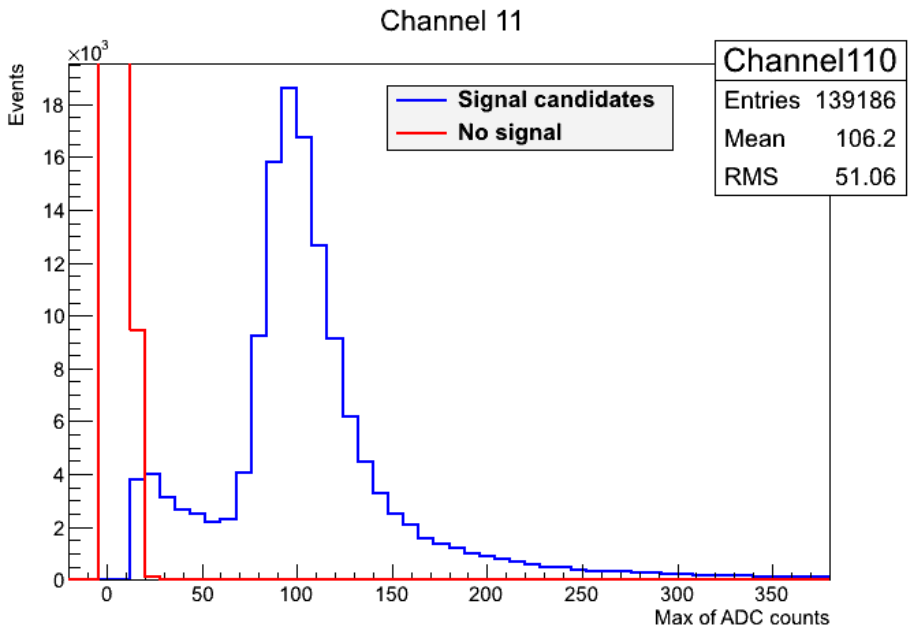




- **Amplitude = MAXC = MAX (adc_$s_1$, adc_$s_2$, …, adc_$s_n$)**, for sample ∈ [$s_1$, $s_n$]
- Pedestal was calculated in the window before the signal coming (samples < 20);
- Signal Amplitude was calculated for samples > 20;

# Analysis Methodology




## Conditions for signal:

- The maximum count has to satisfy:

  ***MAXC(pad_nr) > Eped(pad_nr) + coef*RMS(pad_nr), we used*** *coef = 3*

- At least one of the nearest samples has the count:

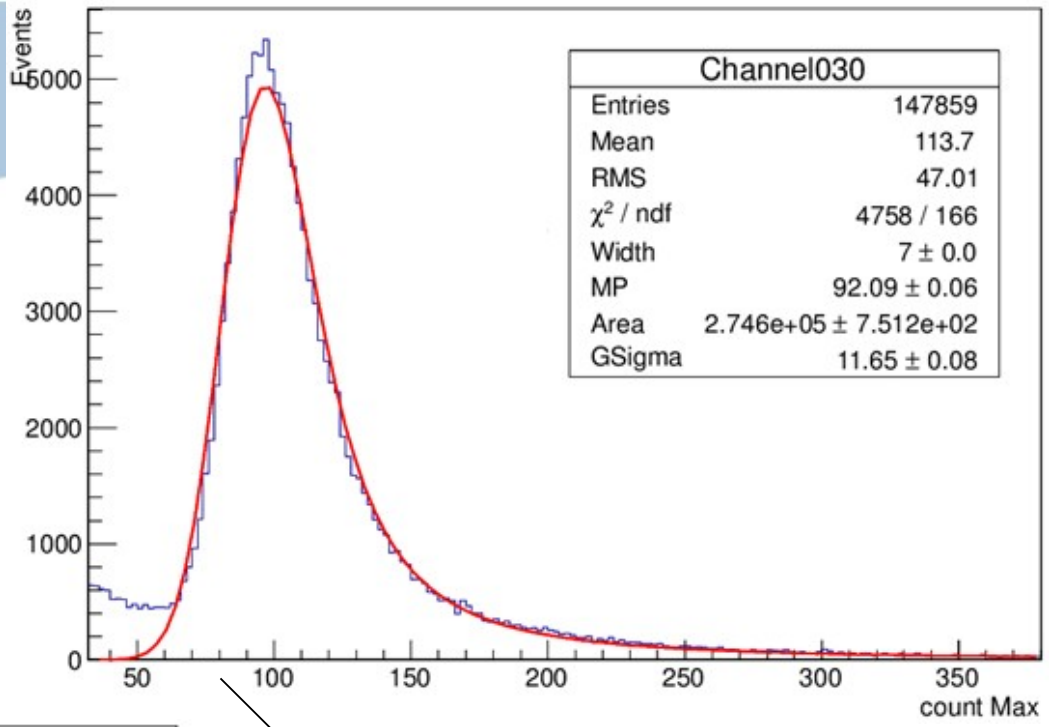
  ***adc(pad_nr, smax-1)*** or ***adc(pad_nr, smax+1) > Eped (pad_nr) + coef*RMS(pad_nr),***

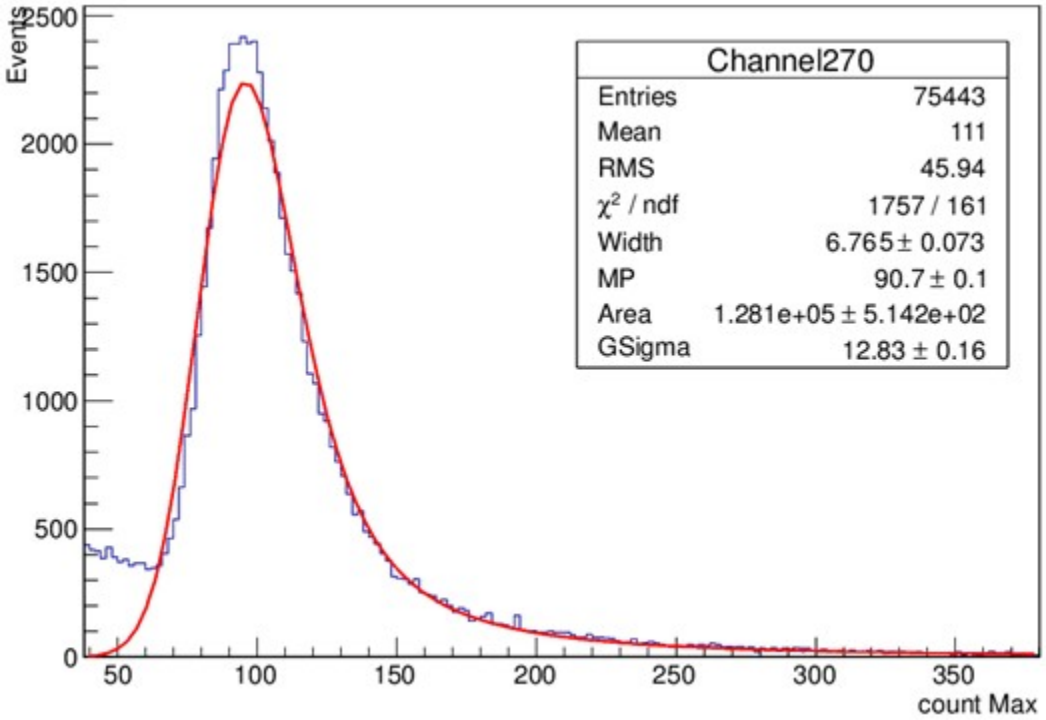
- The Signal Amplitude is:

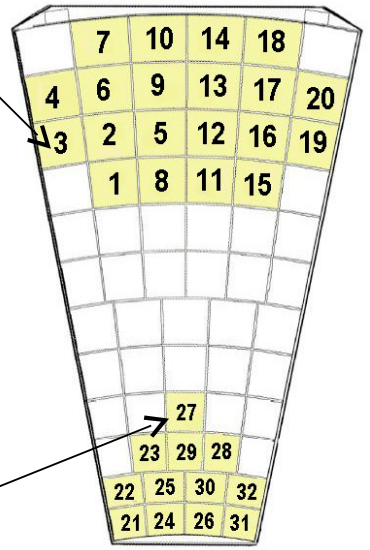
  ***Sign = MAXC(pad_nr) – Eped(pad_nr),***

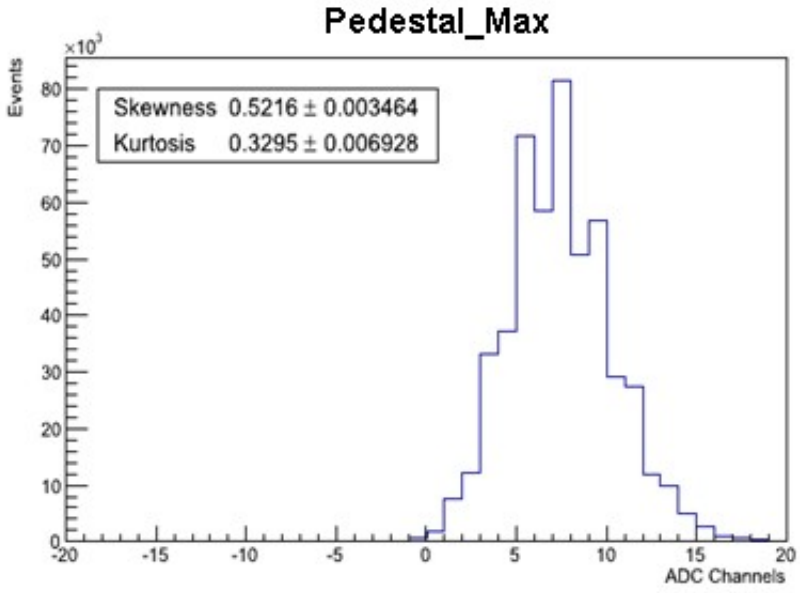
# Signal analysis

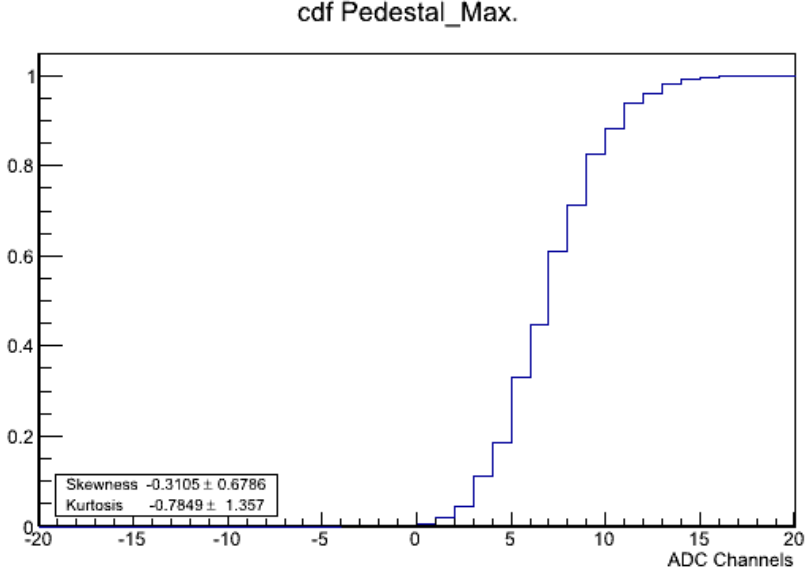
Amplitude spectrum, fitted by LG convoluted function for two sensor area



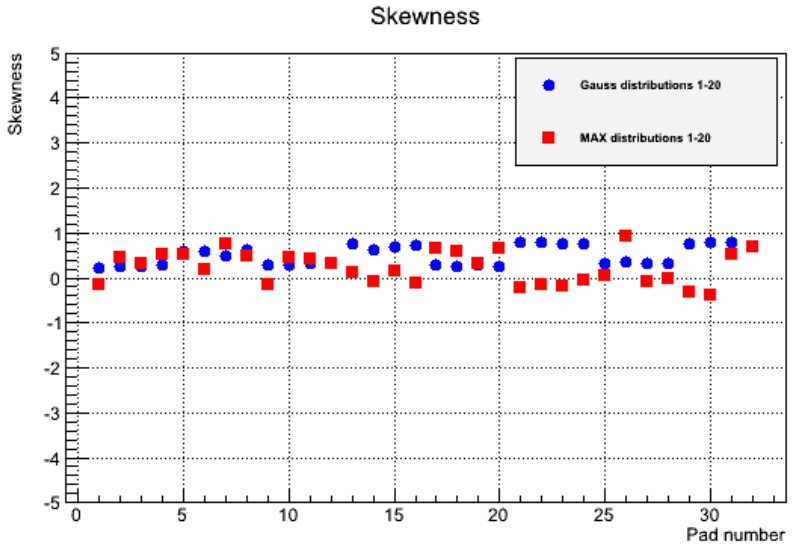



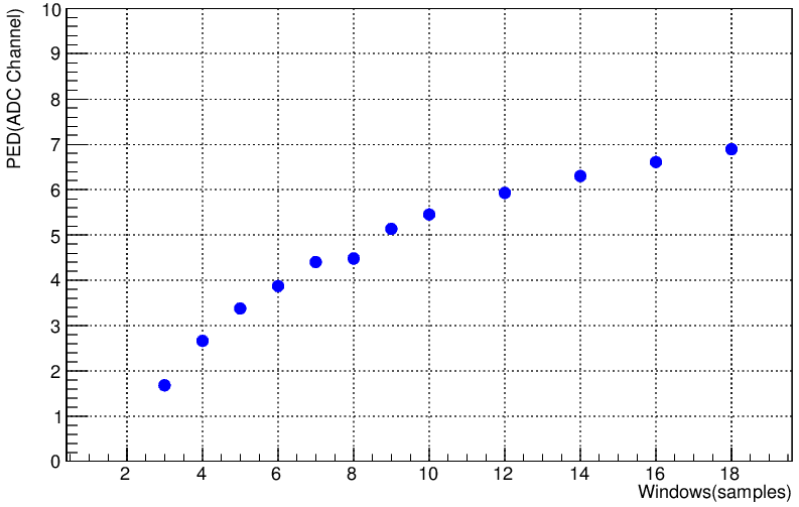





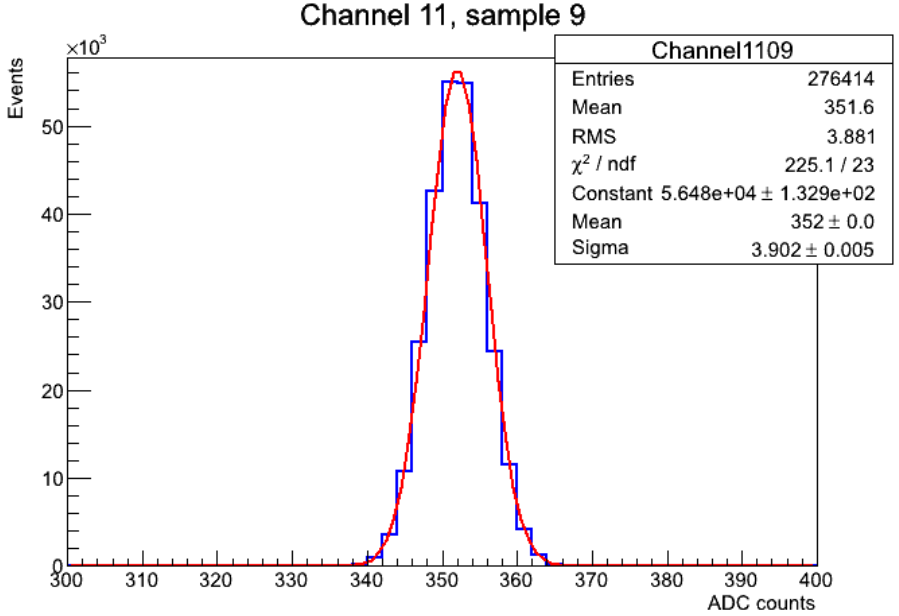

Sample < 20: ***HM (pad, sample) – Resemble Gauss Distribution;*** ***HM (pad) – with MAX operator***




- HM distributions are symmetrical ones, resembles Gauss distributions
- HM expectation values depends on sample windows

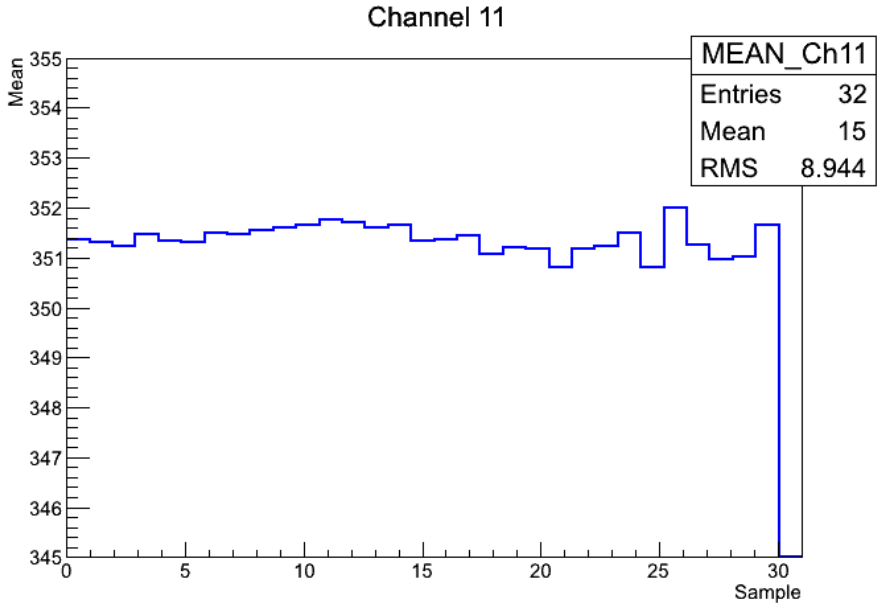
# Pedestal analysis

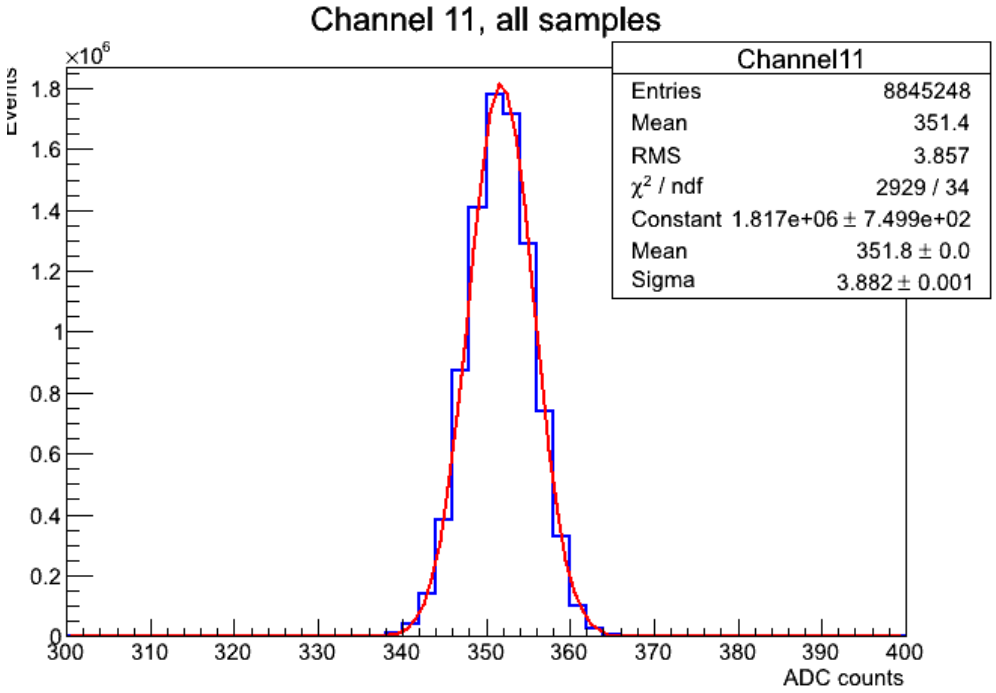



***H (pad, sample) - Gauss Distribution;***

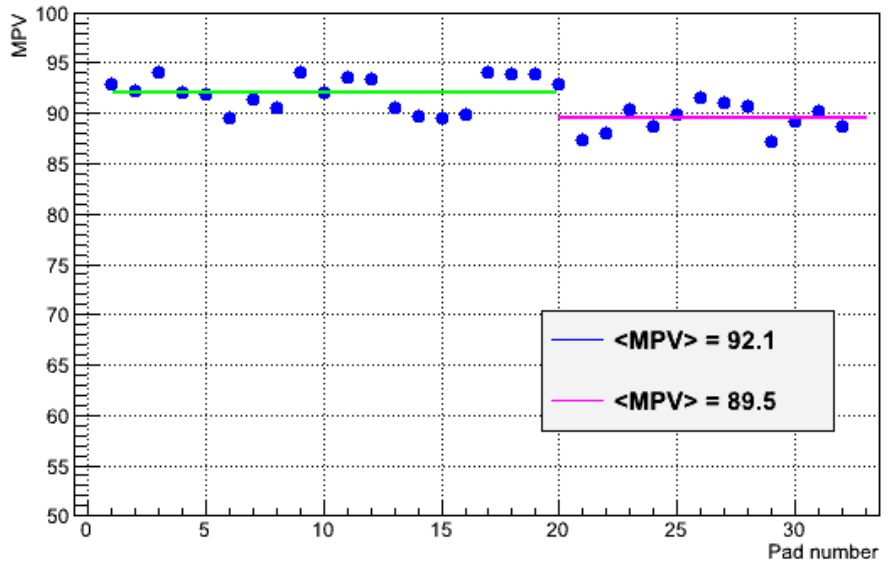
***E(pad, sample) – Expectation value of H Distribution***

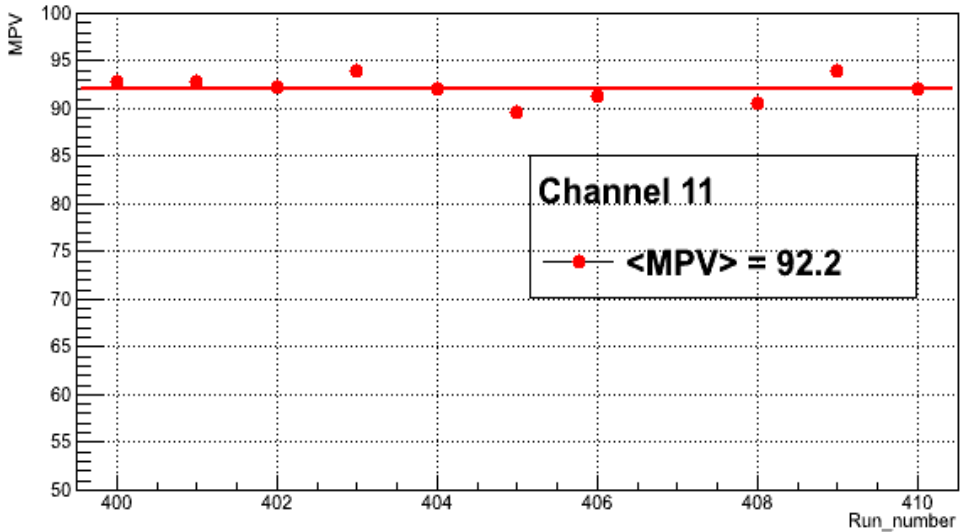
***RMS (pad, sample) – RMS of H Distribution***

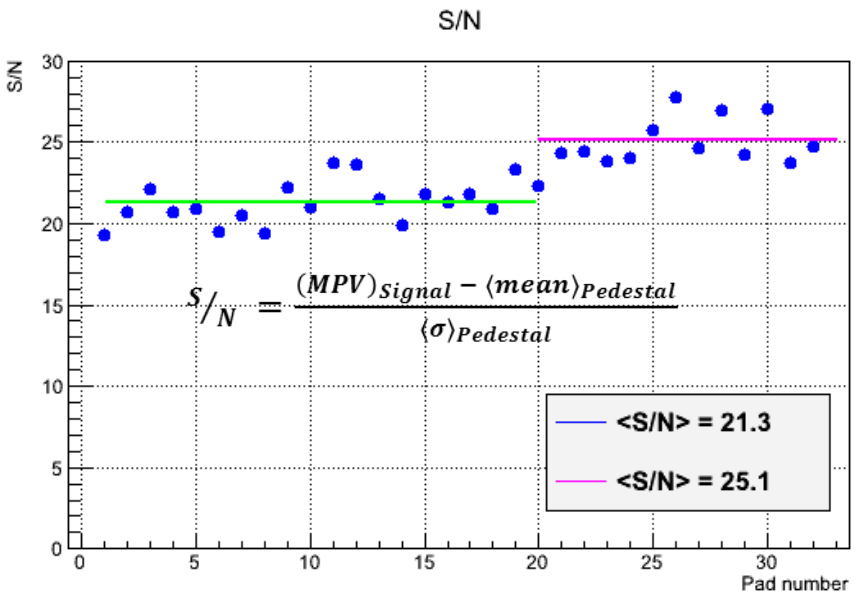


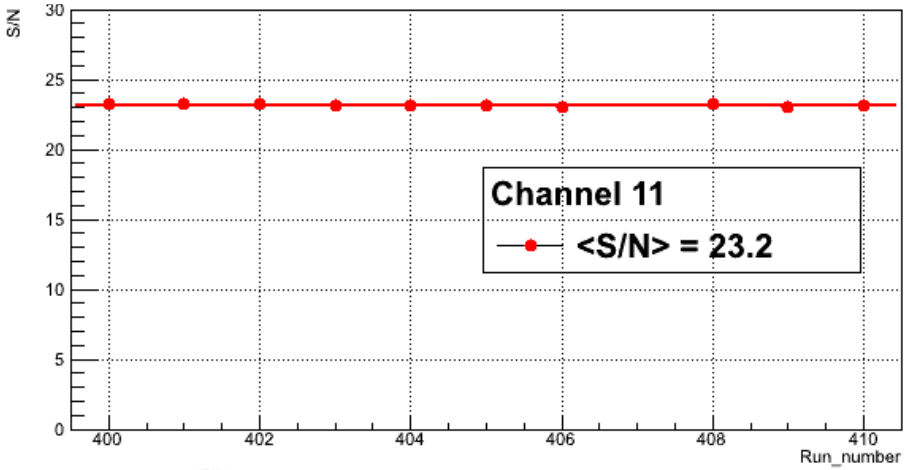



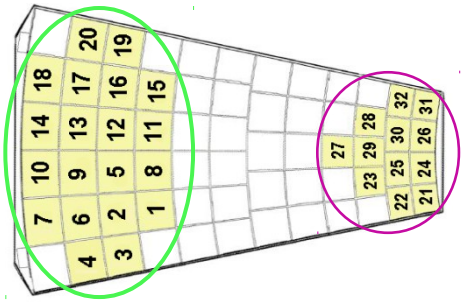
# Uniformity analysis



# Conclusions

- Amplitude Method with Max operator was developed in applied for Signal Noise discrimination;
- MPV values have a constant behavior on runs and are almost constant on each sensor area;
- It is necessary to include calibration in our data analysis;
- S/N ratio is about 23 and is slightly larger on inferior area of sensor.

FCAL Collaboration
High precision design

**THANK YOU FOR ATTENTION!**

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