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JÜLICH FORSCHUNGSZENTRUM

Summary of Beamtime

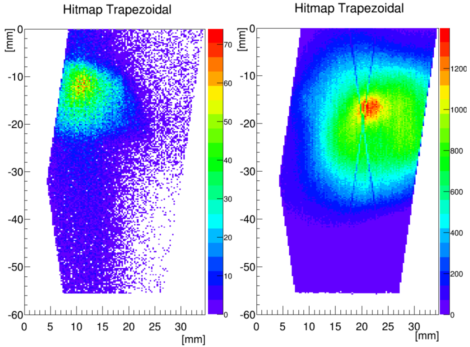
June 10, 2014 | Dariusch Deermann, $\overline{\text{P}}$ANDA collaboration meeting, GSI

Beamtime

Two *p*-beam momenta: 2.95 GeV/c and 0.8 GeV/c

- Hitmap
- Energy loss
- Cluster Charge Correlation
- SNR and HV scan
- η distribution

Hitmap

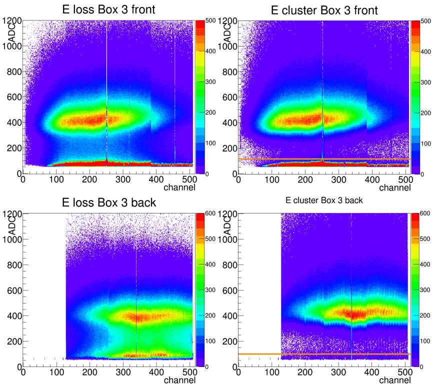


December: Lower statistic for Hitmap in readout due to broken cable

January: Readout works just fine

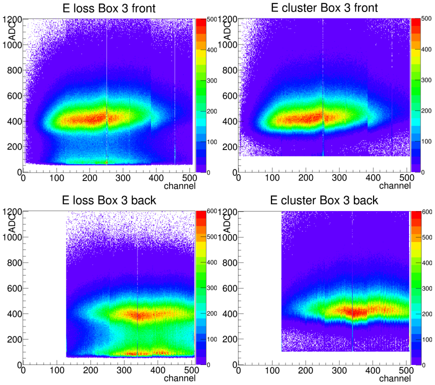
Both: 1 broken APV25, beam spot clearly visible.

Energy Loss



The threshold for strips to be considered a hit was 50 ADC. Which is $\sim$ 2 times Noise.
Orange lines indicate cut on cluster sum ADC.
Cut removes most of the noise entries.

Energy Loss



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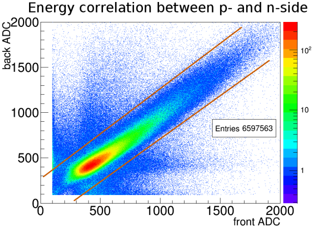
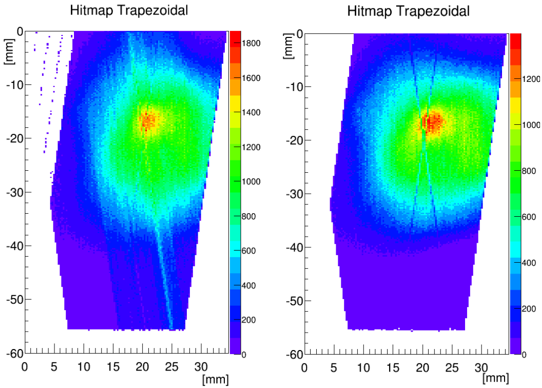
Cluster charge correlation



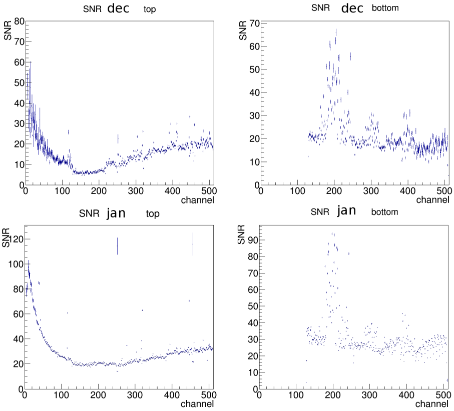
Correlation Cut to get further rid of noise and ghost hits.

Improvements from Cuts on the Hitmap



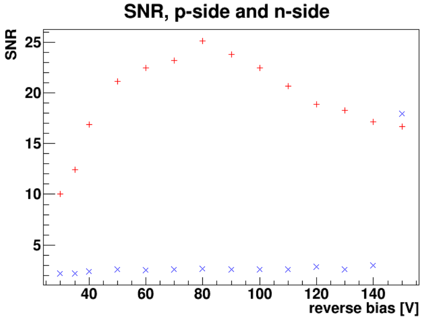
Combined Cuts reduce entries in hitmap from 8493549 to 6477874, we had 23.7% noise and ghost entries.

SNR



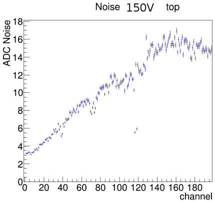
Due to lower beam momentum the January data have a higher signal, with similar noise.

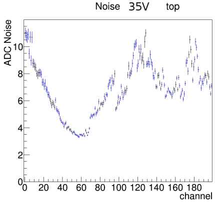
SNR - HV Scan



- p-side shows a maximum
- n-side only works at full depletion

Noise - Short Strips





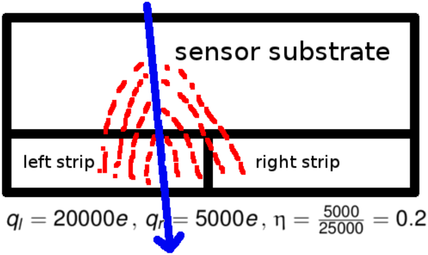
- At full depletion it looks just as expected $\rightarrow$ longer strips $\triangleq$ more noise
- At low depletion voltages we can see a minimum point for noise(strip length)

η distribution

The η distribution is a helpful tool to reconstruct the original hit point from two strip entries.

Definition of η

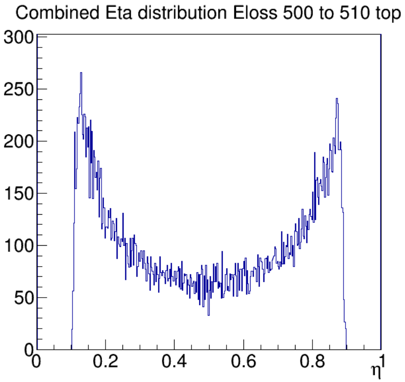
$\eta = \frac{q_r}{q_r+q_l}$, where q_r and q_l are the deposited charges in the right strip and left strip.



$q_l = 20000e$, $q_r = 5000e$, $\eta = \frac{5000}{25000} = 0.2$

Figure : Two strips getting hit by a particle and resulting η value

To use the η value for hit reconstruction it is necessary to determine the distribution of η values for evenly spread hits on the sensor.

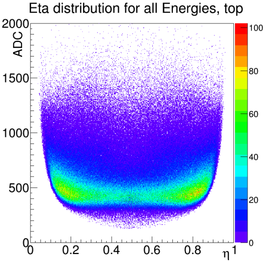


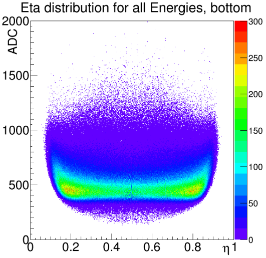
Hit position x:

$$x = x_l + \frac{1}{N_0} \int_0^{\eta} \frac{dN}{d\eta}$$

In that equation x_l is the left strip number and N_0 is the number of entries in the η distribution.

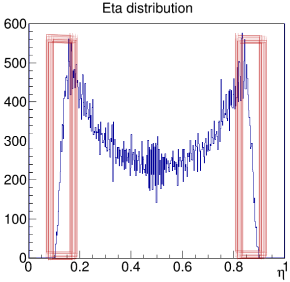
η Distribution from Beamtime





- Shape of the η distribution varies with energy
- To use it for position reconstruction a projection on X-axis has to be done for each energy range
- Hits that only fired one strip have to be considered as either 0 or 1

Improving η Distribution



The marked area shows the border of the η distribution. Here it is possible that noise shifts the smaller strips entry below threshold.

Considering Noise and Threshold

With the measured Noise Values, we can calculate the noise distribution as a Gaussian function e^{-kx^2}.
The measured Noise values resemble the average distance from the pedestal line (zero-line).

$$\text{measured noise} = \frac{\int x \cdot e^{-kx^2} dx}{\int e^{-kx^2} dx}$$

$\rightarrow$derive k and we know the noise distribution.

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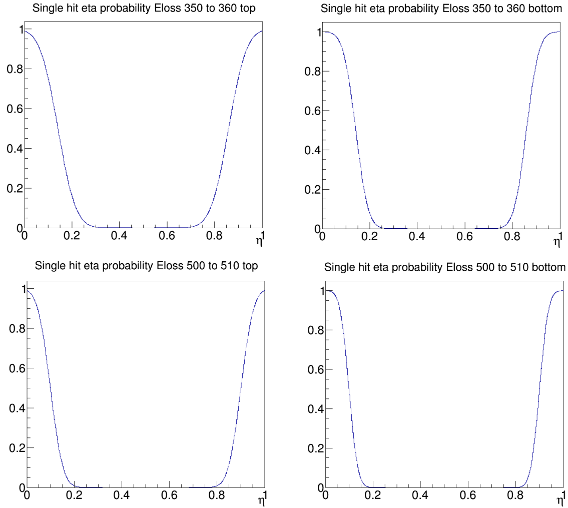
Probability Function for η Contribution

$$\frac{\int_{-\infty}^{50-q_r} e^{-kx^2}\,dx}{\int_{-\infty}^{\infty} e^{-kx^2}\,dx} + \frac{\int_{ADC-q_r-50}^{\infty} e^{-kx^2}\,dx}{\int_{-\infty}^{\infty} e^{-kx^2}\,dx}$$

$P(\eta)$ = one strip does not reach threshold

- The red part is the probability that within a certain ADC cluster sum the right strip fails to reach threshold
- The blue part is the probability that within a certain ADC cluster sum the left strip fails to reach threshold

$P(\eta)$ = one strip does not reach threshold

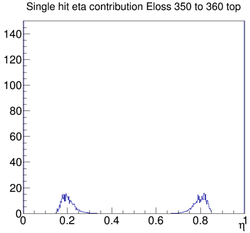


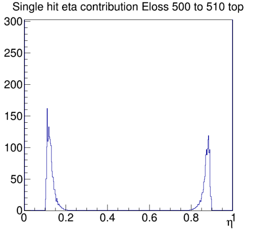
Using $P(\eta)$ for η Distribution Improvement

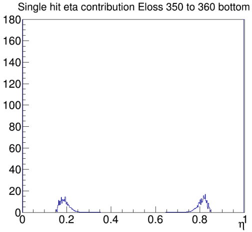
I added $N(\eta) \cdot \frac{P(\eta)}{1-P(\eta)}$ to the η distribution ($N(\eta)$).

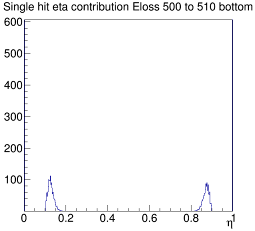
The same amount of hits was then subtracted from the single hit contributions ($\eta = 0$ or 1), in order to keep the total amount of entries constant.

Combined η Distribution









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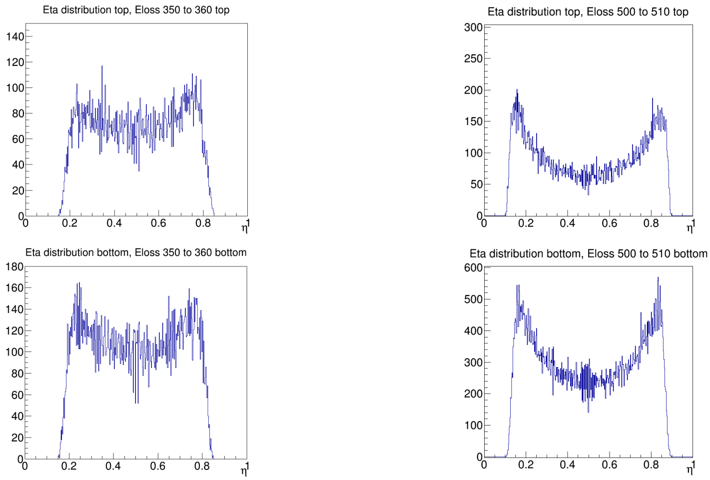

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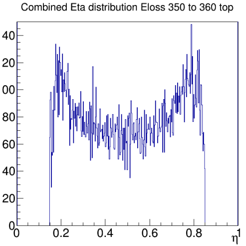

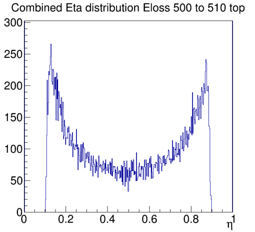

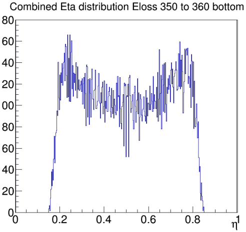

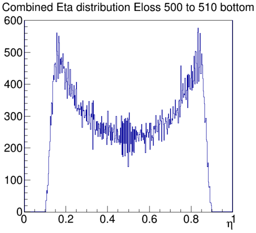

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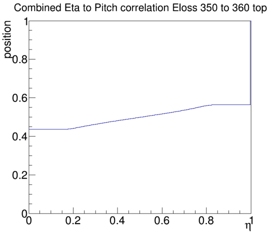
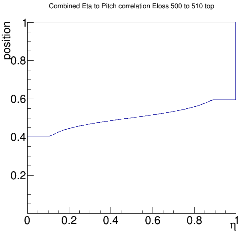
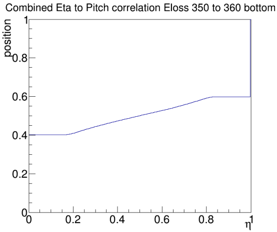
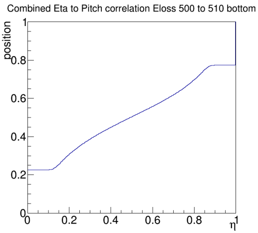






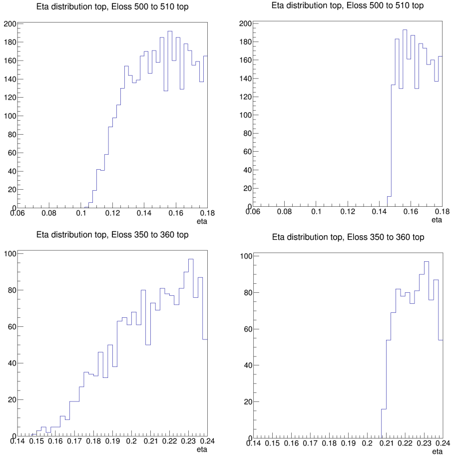


Summary

- First beamtime for trapezoidal sensor was successful
- Too much noise, but a revised sensor board is soon available
- η distributions were analysed and (slightly) improved

Thank you for your attention!

backup


Eta distribution top, Eloss 500 to 510 top
eta
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