ALPIDE

Threshold Scans and Noise Occupancy

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Threshold Scan

Inject well-defined amount of charge in a selected number of pixels
$\rightarrow$ Then read out hits and repeat

- Injections are performed multiple times per pixel
- Use only a representative fraction of the Chip (~1-5%)

Parameters used:

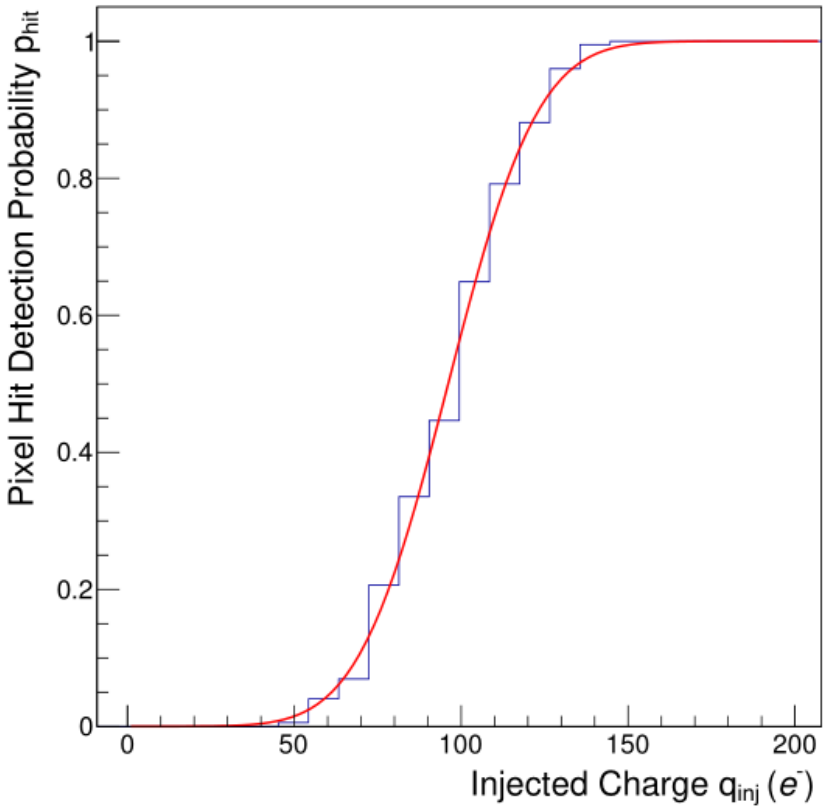
- `PIXPERREGION 1`
- `NMASKSTAGES 164`

} Corresponds to $32 \cdot 164 = 5248$ Pixels (1% of the chip)

Threshold Scan

For each charge point on the x-axis, perform 50 Injections, then plot hit probability. (S-Curve scan)

Example:



$$p_{\text{Hit}}(q_{\text{inj}}) = \frac{1}{2}\left(1 + \text{Erf}\left[\frac{q_{\text{inj}} - \mu}{\sqrt{2}\sigma}\right]\right)$$

← Corresponds to a threshold value of roughly 100 e^-

Definition of Threshold:

The Threshold is the minimum amount of charge to be deposited inside the sensitive region of the chip to create a sufficiently strong signal in order for the readout electronics to register an event

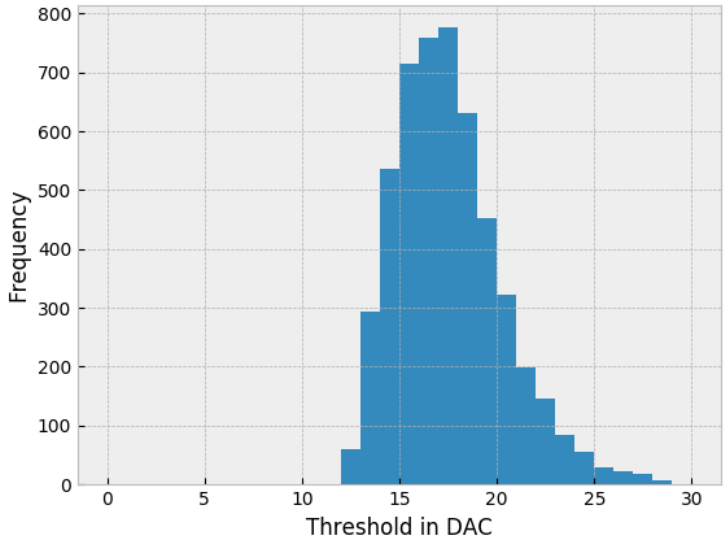
On ALPIDE: Threshold is defined mainly by two parameters: `VCASN` and `ITHR`. While increasing `ITHR` increases the Threshold, augmenting `VCASN` decreases it.

Threshold Scan

After Scan has completed:

Distribution of Thresholds

- Extract mean of all pixels

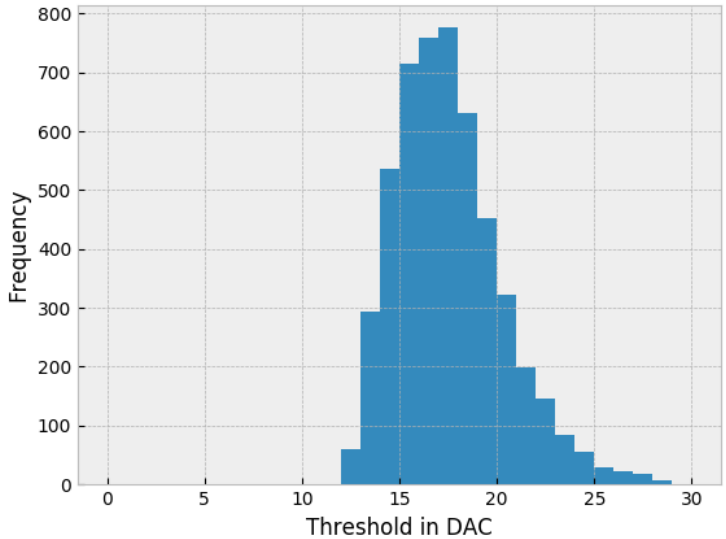


The Plot shows Thresholds of pixels in DAC, where one DAC value corresponds to 10 electrons, i.e. most pixels will register a hit, if the charge injected is higher than 150 electrons

Threshold Scan

After Scan has completed:

Distribution of Thresholds



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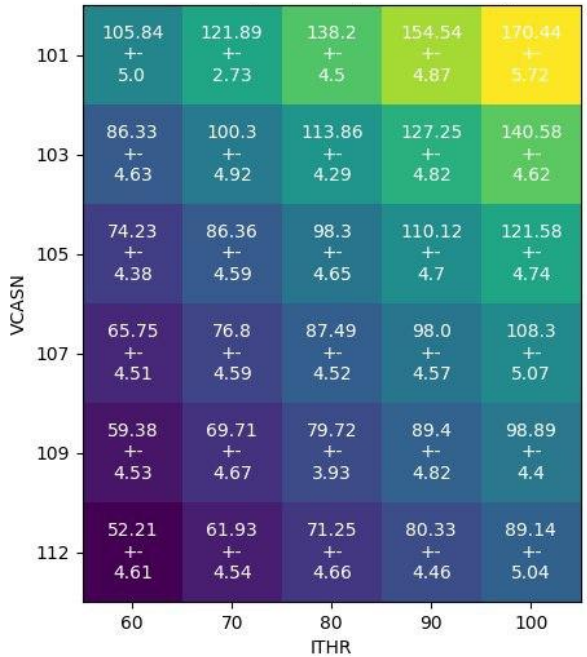
- Extract mean of all pixels
- Repeat with different settings and compare

Charge Threshold for different configurations of the main parameters VCASN and ITHR



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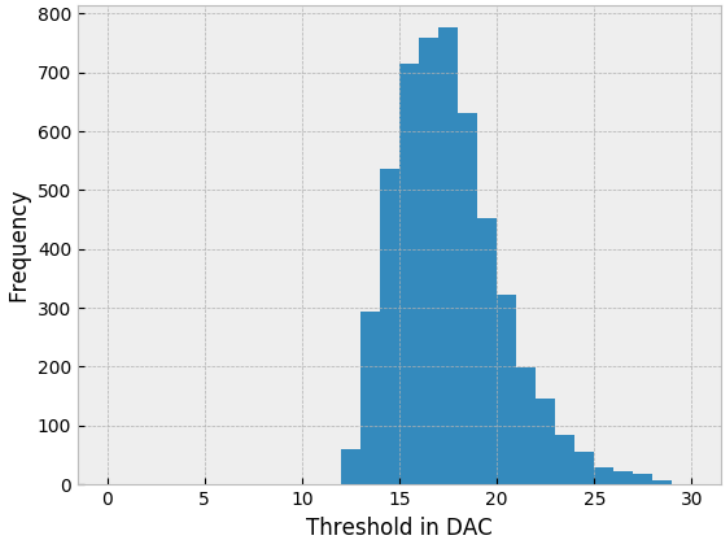

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For cosmic muons at 50 GeV: Energy Deposit ~0.0286 MeV

7900 e-h-pairs

Noiseoccupancy Scan

Trigger the whole pixel matrix (!) without any input of charge, and return the number of hits.

- If Threshold is low enough for electronic noise to produce a hit, measurements taken will be affected by a fake hit rate.

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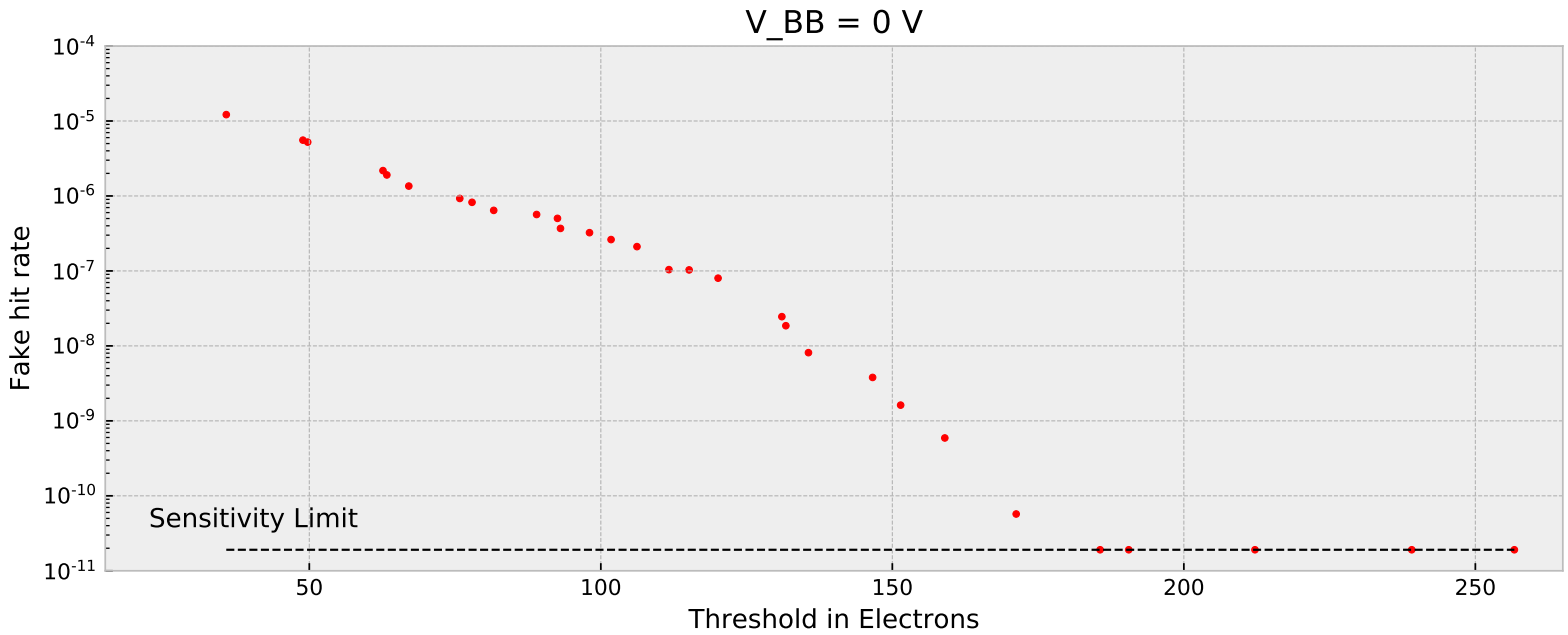

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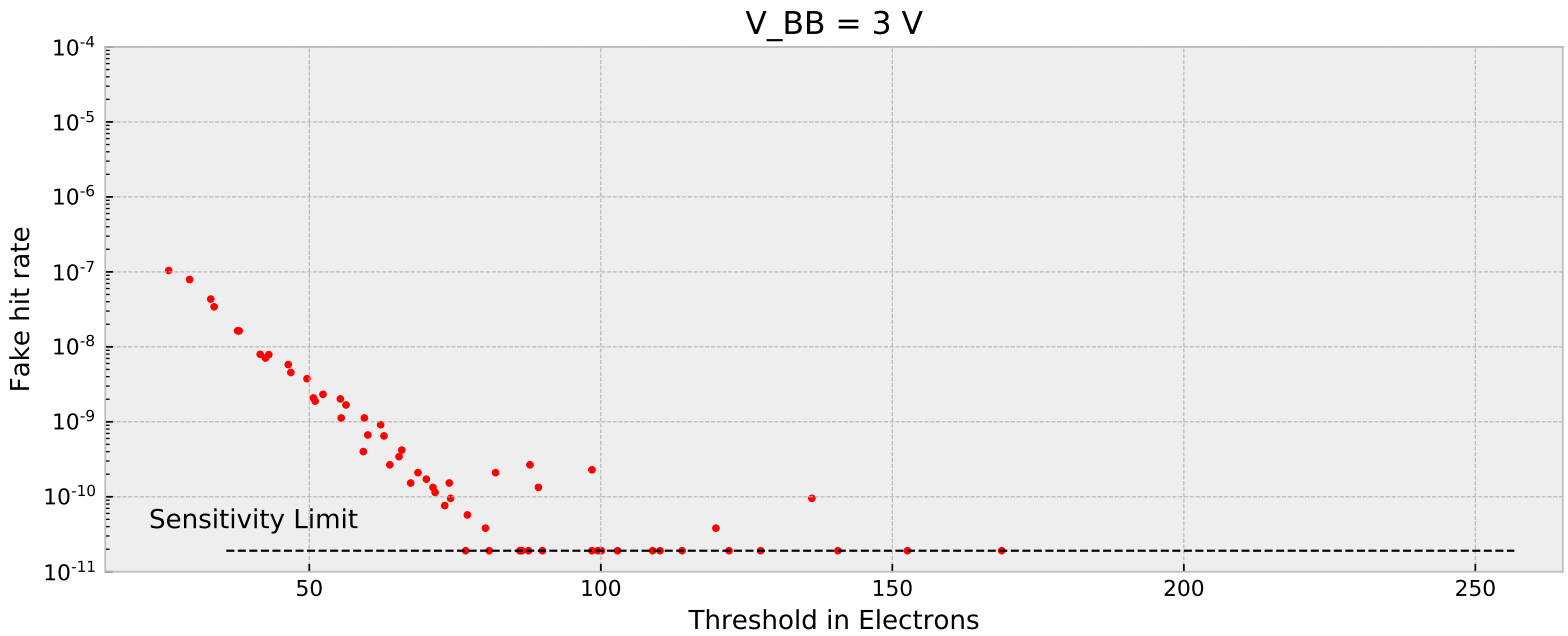

Enlarging the depletion zone by applying a Back-Bias voltage, will have a significant effect on Noise, as is typical for semiconductor detectors

Progress on Cosmics

- Event Plotting
  - Trying to create nice Looking (correctly scaled) 3D- Plots of cosmic tracks
  - Writing an Event oranizer for the huge amount of measurements performed
- Track analysis
  - Fitting lines to cosmics to determine valid and invalid tracks
- Plane Alignment
  - Using Tracks to align the Telescope based on cosmic data
  - Comparing results to Testbeam Data from 2019 and 2020
  - Investigating differences in alignment after Transport