

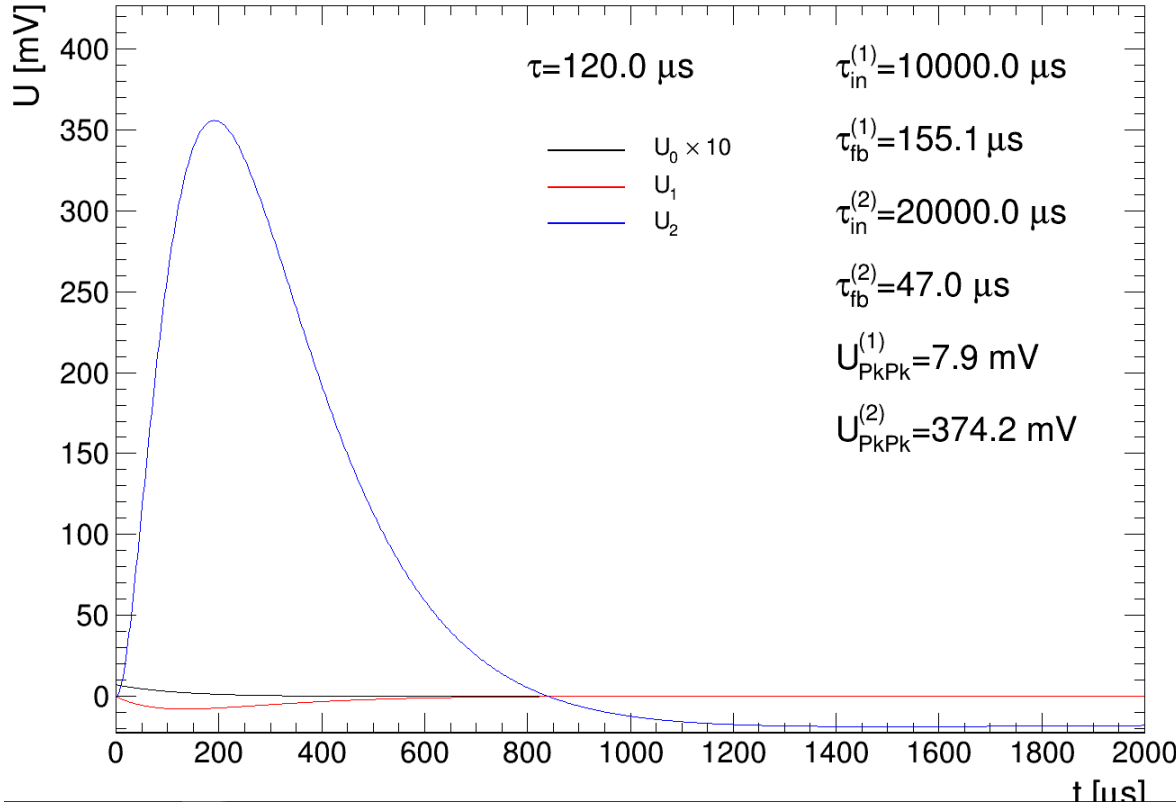


JFETs and coincidences

Hendrik Borrás

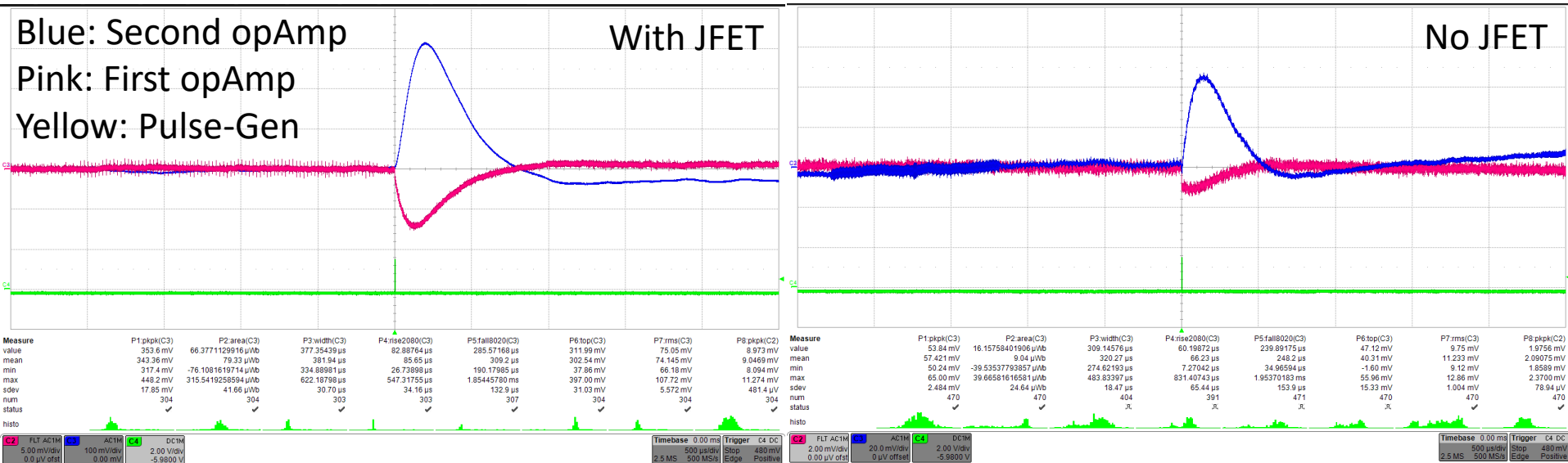
Supervisor: Michael Schmelling

Fixed opAmp values



- Signals
 - Black: JFET output
 - Red: First opAmp
 - Blue: Second opAmp
- Simulation by Michael
- 1. opAmp:
 - At Input: $10 \text{ k}\Omega + 1 \mu\text{F}$
 - In feedback: $330 \Omega + 470 \text{ pF}$
- 2. opAmp:
 - At Input: $20 \text{ k}\Omega + 1 \mu\text{F}$
 - In feedback: $1 \text{ M}\Omega + 47 \text{ pF}$
- Small undershoot at 2. opAmp
- Final pulse length: $\sim 825 \mu\text{s}$

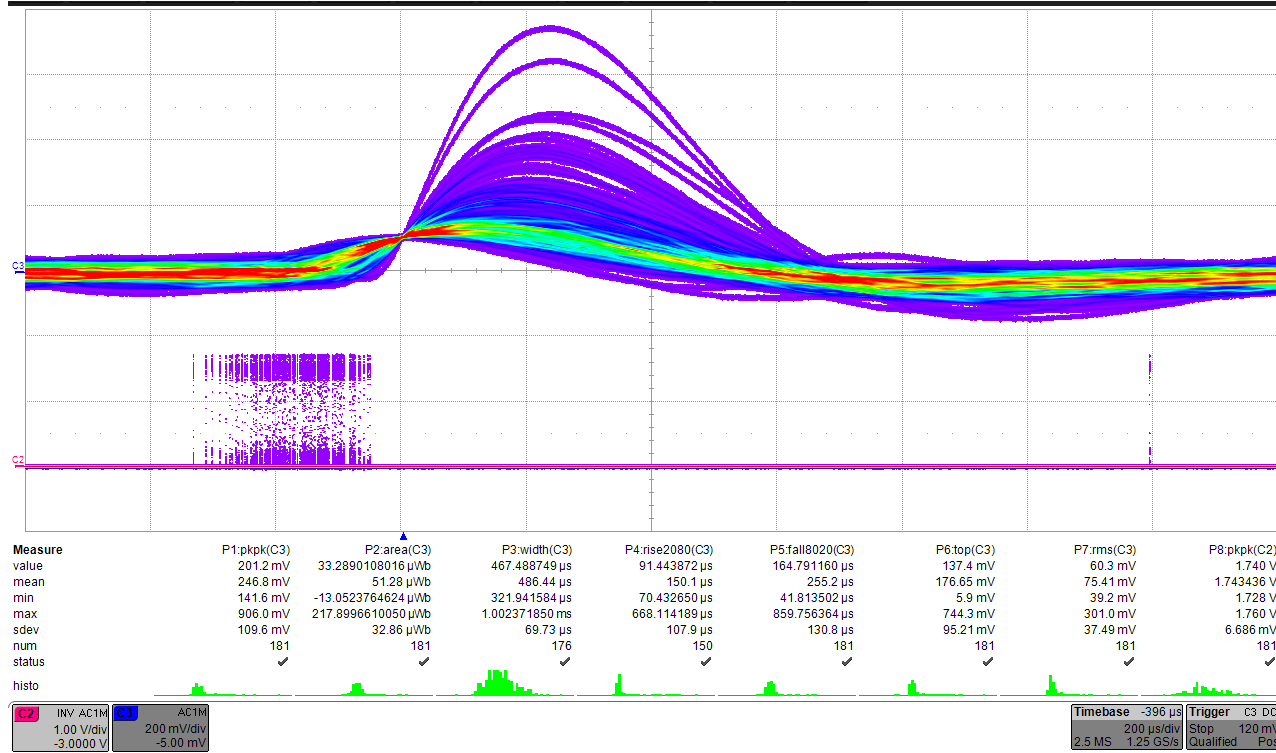
Characterizing the JFET



- Signal top at second opAmp: ~ 300 mV
- Signal length at second opAmp: ~ 800 us
- Input from the same Signal-Generation circuit for both settings

- Signal top at second opAmp: ~ 40 mV
 - Signal length at second opAmp: ~ 600 us
- => **Significant amplification and impedance decoupling is done by the JFET**

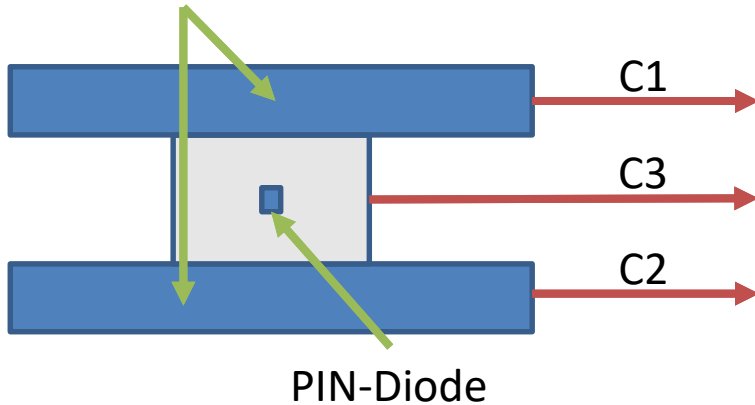
Coincidence measurements



- Signals
 - Upper: PIN-Diode
 - Lower: CosMo-detector
- Measurement over 63h
- Coincidences between the two detectors are clearly visible
- Corresponds to an active area of the diode of about: $2.44 \times 2.44 \text{ mm}^2$
- Photo sensitive area as given by the datasheet: $2.72 \times 2.72 \text{ mm}^2$
 - $\pm 0.1 \text{ mm}$ tolerances

Coincidence measurements

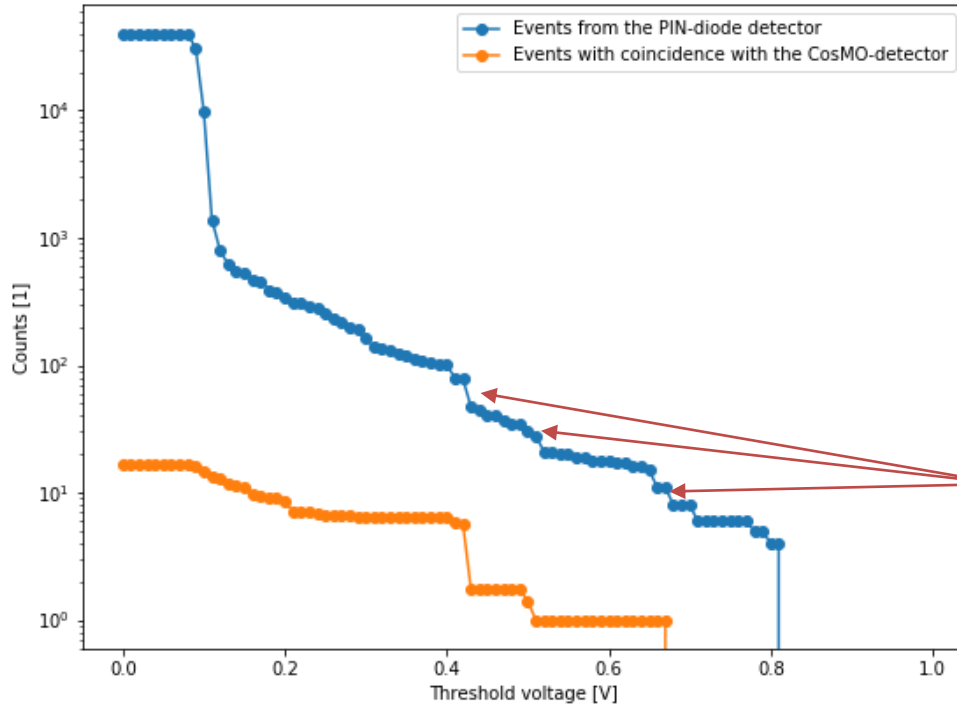
CosMO-scintillators



- Signals:
 - C1: Upper CosMO-detector scintillator
 - C2: Lower CosMO-detector scintillator
 - C3: PIN-Diode after pre-amp
- C1, C2 and C3 recorded at an oscilloscope
- Oscilloscope trigger on: Rising edge of C3 at a low threshold
- On trigger:
 - All waveforms are read out and saved to disk
- In-depth analysis of signals is possible
- Data taken so far: 4 days (~480 GB)

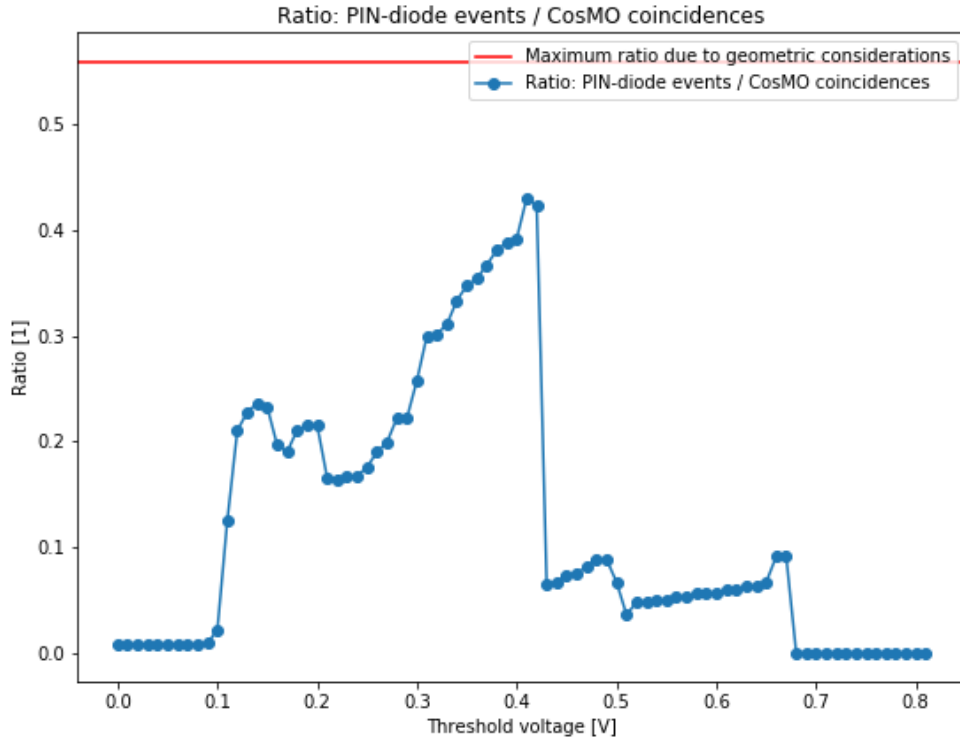
Coincidence measurements

PIN-diode number of selected events at given threshold



- Curves
 - Blue: Number of events recorded by the PIN-diode above a certain threshold
 - Orange: From the number of events which also had a coincidence from the CosMO-detector
- Number of events decreases with higher threshold as expected
- Sudden cut offs at certain voltages
- Cut offs are also seen at the CosMO-detector, since the data is effectively a subset of the PIN-diode data
- No error estimate done so far
- Notice: y-axis in log-scale

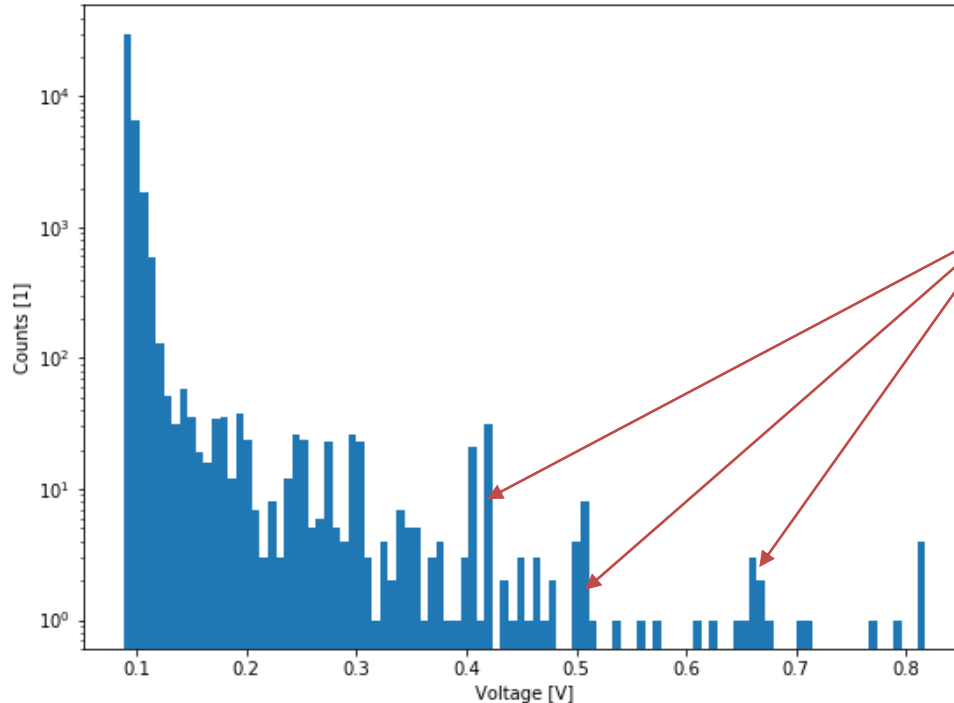
Coincidence measurements



- Curves:
 - Blue: Ratio between the number of events recorded by the PIN-diode and number of events from the CosMO detector (e.g. the two curves before)
 - Red: Theoretical maximum, since the CosMO-detector can not see all particles that pass the PIN-diode
- Until 0.4 V: Increase in valid events, as expected since more noise is filtered
- After 0.4 V: Sudden cut off as seen before
- => Where might this cutoff come from?

Coincidence measurements

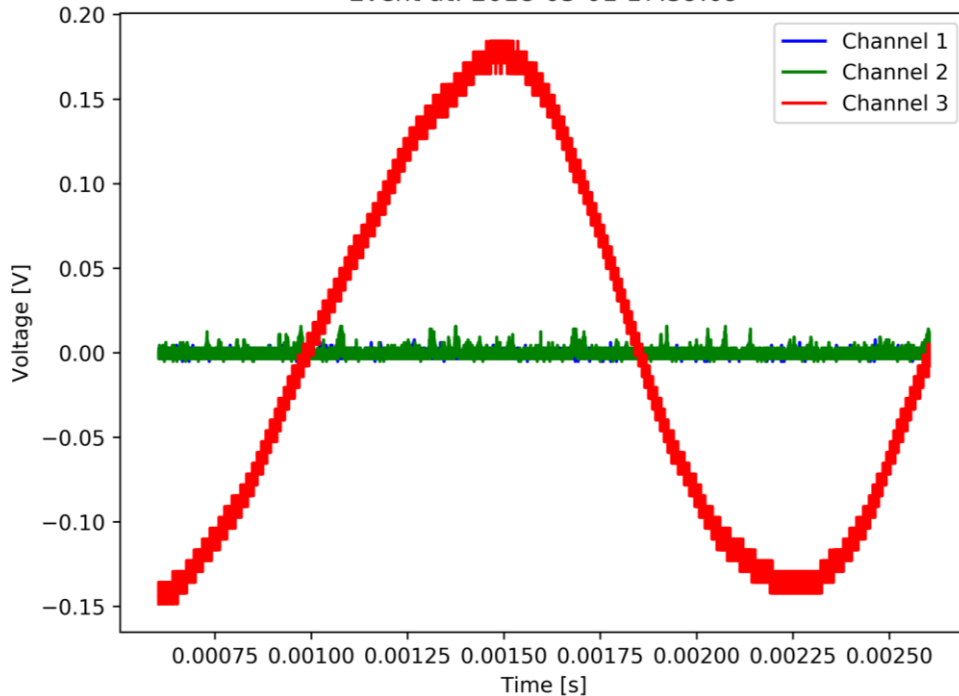
Distribution of waveform maxima for C3



- Histogram: Distribution of waveform maxima for the PIN-diode detector
- As expected: number of events decreases with higher voltage
- Significant spikes are visible where the sudden cut of is visible in the plot before
 - These are spikes are too characteristic to be normal signals
 - Need further investigation
 - Might come from vibrations induced from outside
- Notice: y-axis in log-scale

What would vibrations look like?

Event at: 2018-03-01 17:59:09



- Example of having a screw driver fall on the experiment table
- Signals:
 - Channel 1 and 2: CosMO detector
 - Channel 3: PIN-diode
- An oscillation instead of a pulse is visible
- Signal does not start at 0 but significantly low
- If these are the problematic signals, then the readout can easily filter these out

Next steps

- Experiment:
 - Investigate where the peaks in the distribution of waveform heights come from
 - Do a valid error estimate by means of bootstrap
- Thesis:
 - Finish second revision on the findings concerning the angular distribution of cosmic muons
 - Finish first revision on the PIN-diode detector