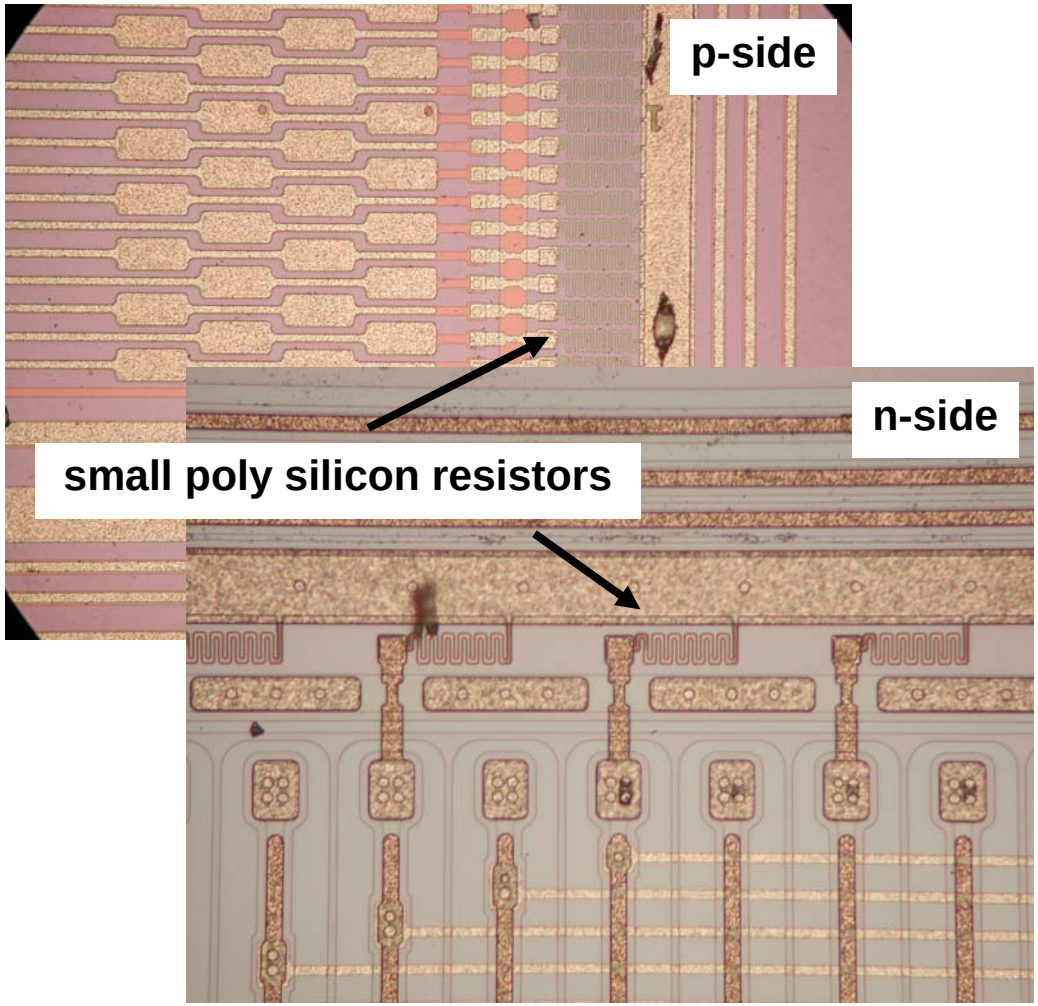
Results of the SPS Beam Test @ CERN

C. Irmler (HEPHY Vienna)

- **Micron Sensor**
- **Beam Test Setup**
- **Results**

Micron Sensor - Overview



Type: DDD5
used for D0 @ Fermilab

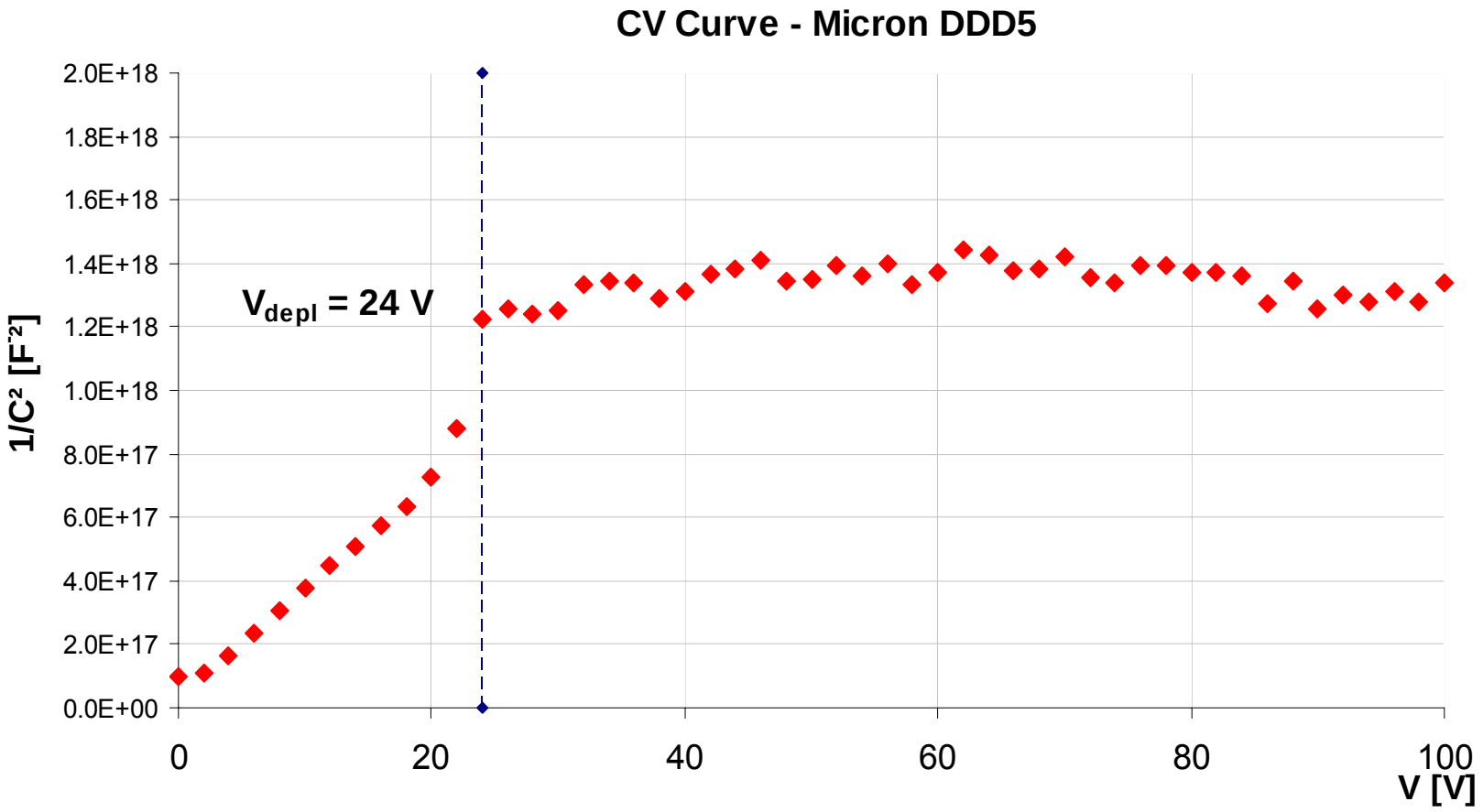
Size: 120 mm x 21 mm
300 µm thick
V_{depl} = max. 50 V
R_{poly} = 2.5 MΩ

p-side: 384 strips
50 µm pitch
w/o intermediate strip

n-side: 768 strips
153.5 µm pitch

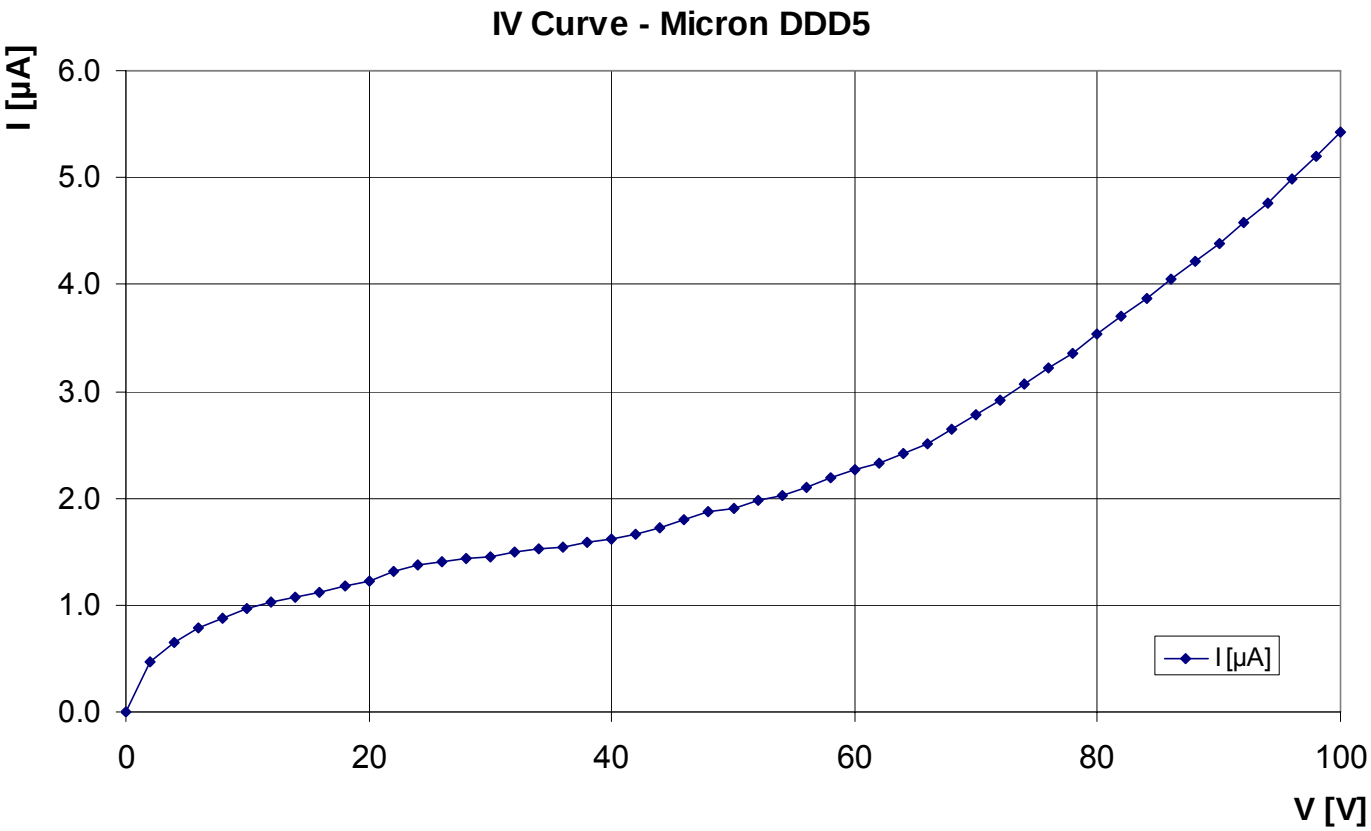
double metal layer
384 readout strips
40.5 µm readout pitch

Micron Sensor – CV Curve



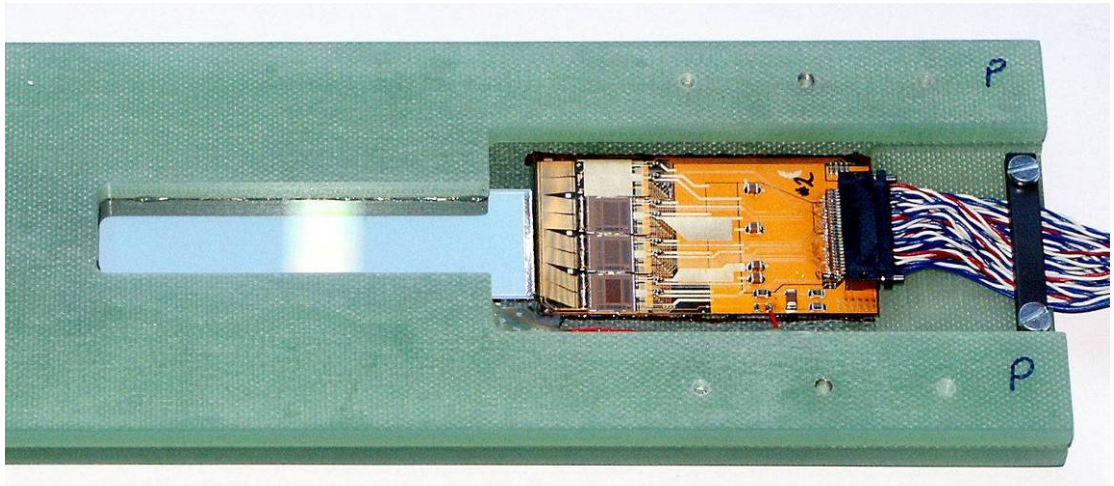
⌦ V_{depl} = **24 V** (step before depletion, linear fit does not work)

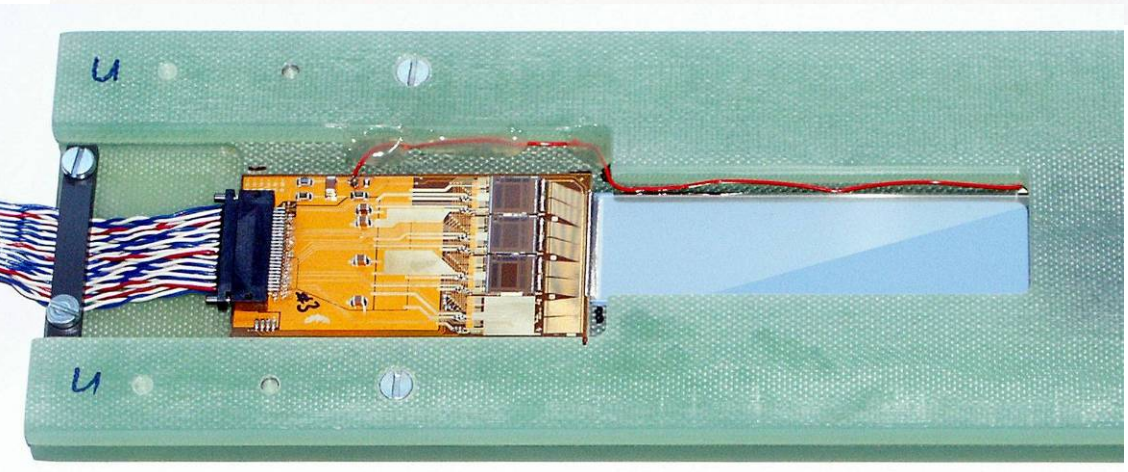
Micron Sensor – IV Curve



- High I_{bias}
- 1.38 µA @ V_{depl}
- Slope increases above 60 V

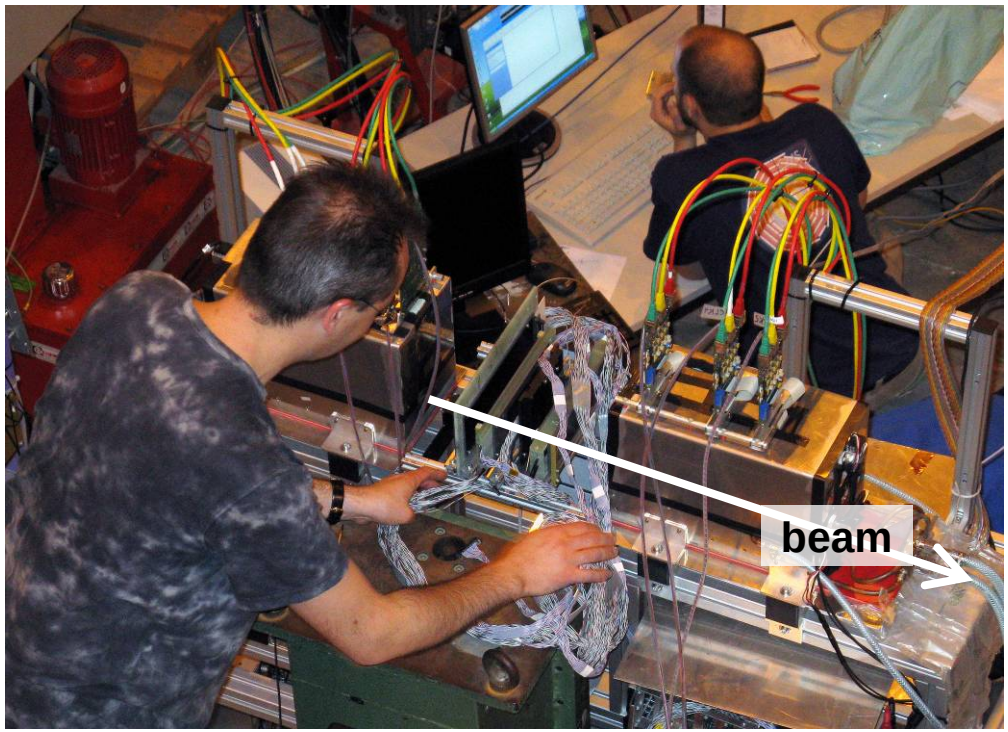
Micron Sensor Module





- Micron DDD5
- Each side read out by three APV25 chips (384 channels)
- Flex hybrids with integrated pitch adaptor
- On n-side the hybrid is glued onto the sensor.

Beam Test Setup



Beam test was performed @ CERN together with the SiLC beam test of our semiconducter group
→ see yesterday´s talk by T. Bergauer.

Beam setup:

- 120 GeV/c
- π^+ / p / K^+
  (55.67% / 38.95% / 5.38%)

Readout:

- SVD3 readout system
  → see previous talk by M. Friedl

Installed Modules:

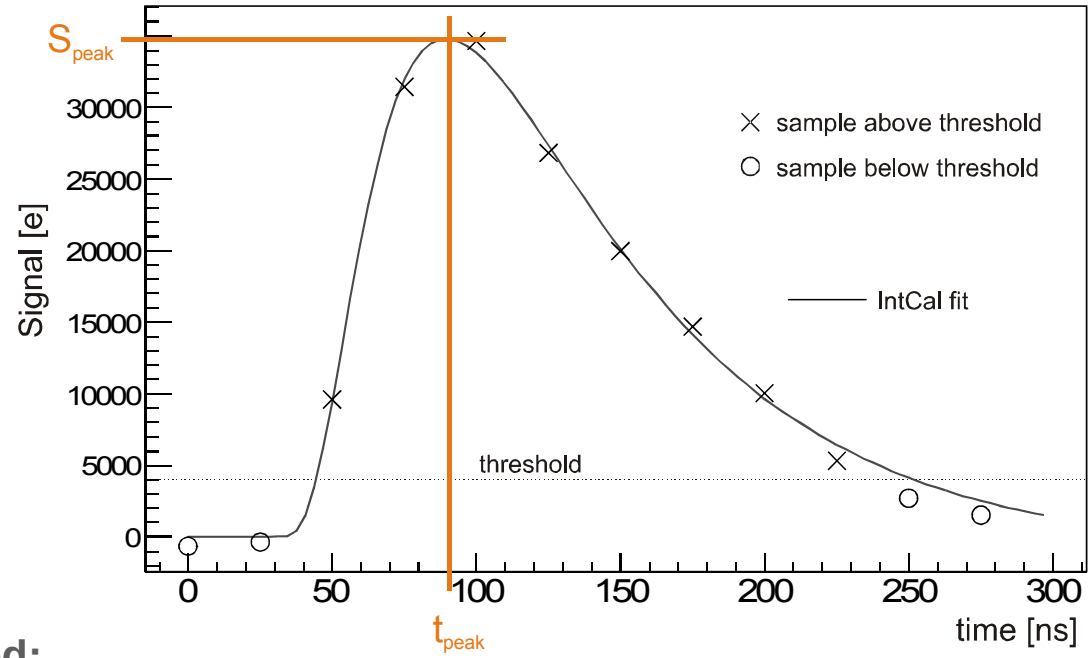
- JP module (2007)
  2 x SVD3 DSSD (partially ganged)
- **Micron module** (new)
- UV module
  UV striplet sensor (2005)
- Flex module (2006)
  SVD3 DSSD (chip on sensor)
- EUDET telescope

Analysis Chain

- ☒ Pedestal subtraction
- ☒ Common mode correction
- ☒ 2D-clustering (space and time)
- ☒ Calculate cluster signal for each sample

- ☒ Perform hit time reconstruction
  → see previous talk by M. Friedl
- ☒ Obtain timing, signal and noise

Hit Time Reconstruction



Method:

- Multiple samples arround the peak are recorded (6 samples at this beam test) .
- Cluster signal for each sample is calculated.
- Fit function is applied to each waveform to optain amplitude and timing.
- Reference waveform is taken from internal calibration of the APV25 chip.
- **Already explained by M. Friedl**

Beam Test Results (Preliminary)

	Micron		JP single		JP ganged		UV		Flex	
	p-side	**n-side**	p-side	n-side	p-side	n-side	p-side	n-side	p-side	n-side
Average cluster width	**1.67**	**1.13**	2.31	1.92	2.10	1.76	2.21	1.88	2.28	1.91
Cluster SNR	**12.6**	**15.1**	12.7	13.9	8.5	10.5	23.6	24.0	13.8	18.4
Single SNR	**16.3**	**16.0**	19.3	19.2	12.3	13.9	35.1	32.8	20.9	25.4
Time resolution [ns]	**3.89**	**3.04**	3.49	2.74	5.24	4.30	2.55	1.16	3.50	1.90

Definitions:

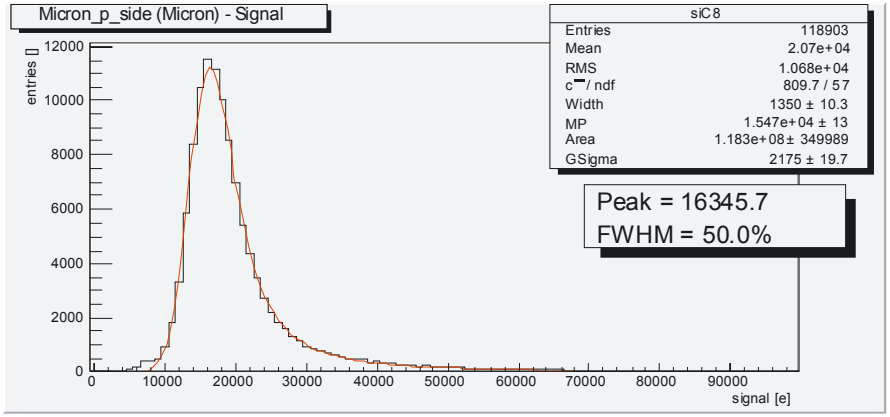
- Cluster SNR := Cluster Signal / (Strip Noise * sqrt (Cluster width))
- Single SNR := Cluster Signal / Strip Noise

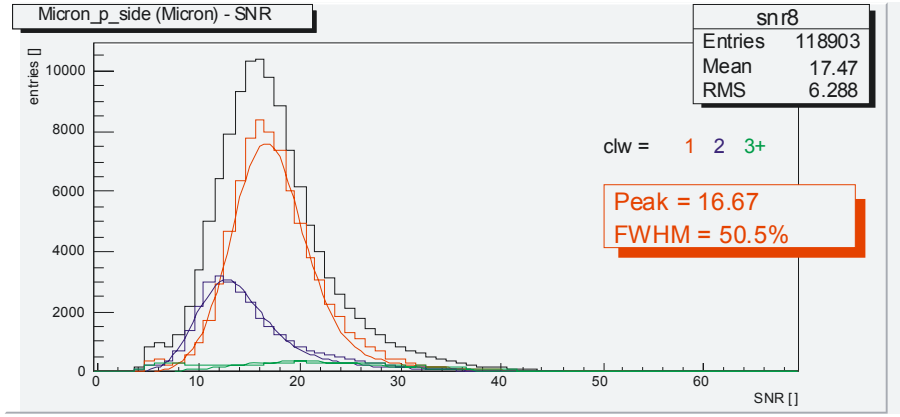
Results:

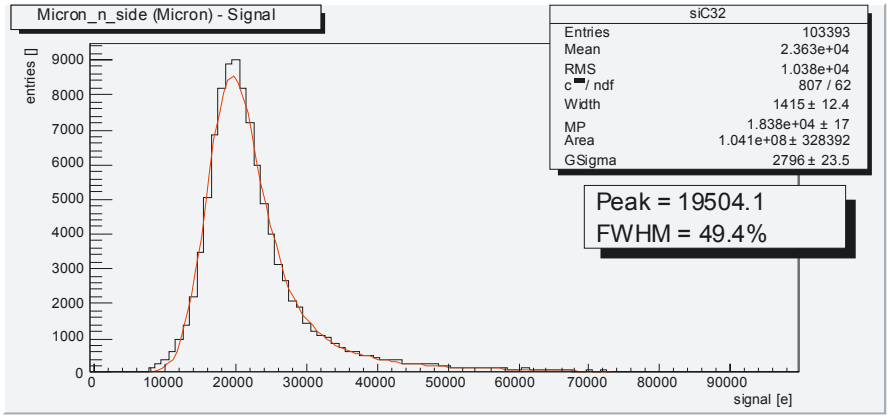
- SNR of the Micron module is good and within the range of the other modules.
- Micron has lower cluster width (no intermediate strips).
- Effect of the 2nd metal layer on n-side is less than that of the long strips on p-side.

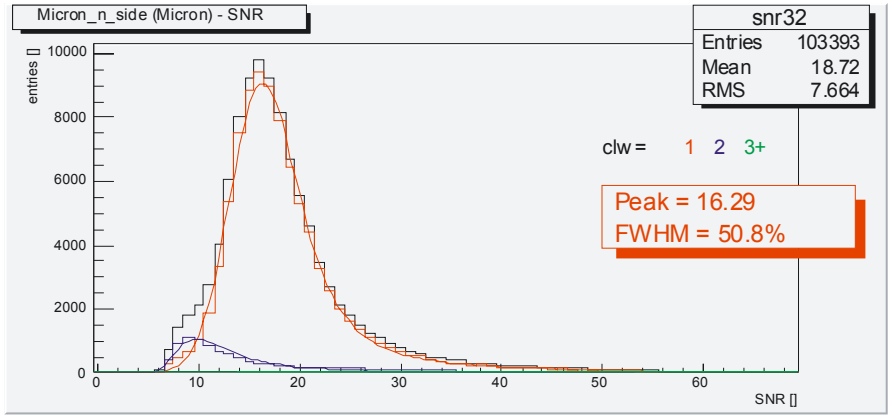
- Poor SNR for JP module with ganged sensors → chip on sensor (M. Friedl).

Micron Module - Signal Distribution



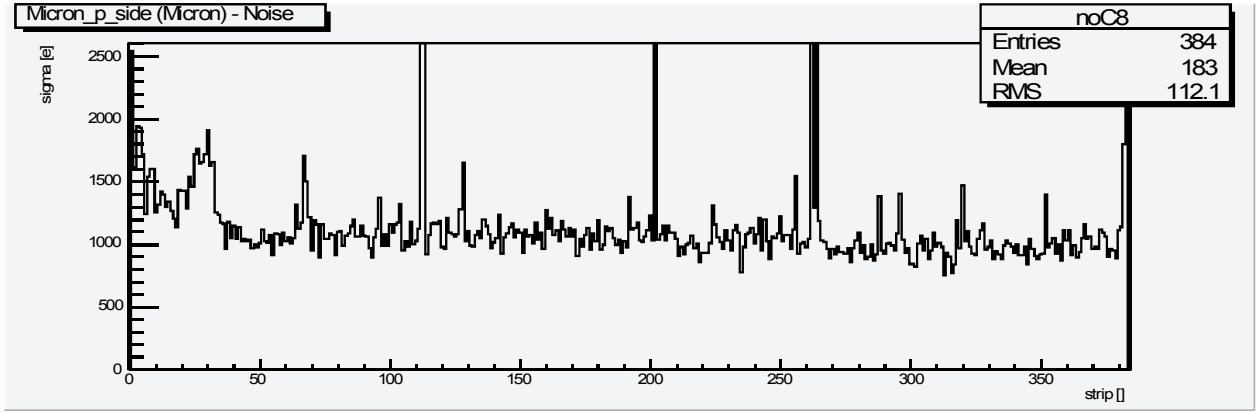


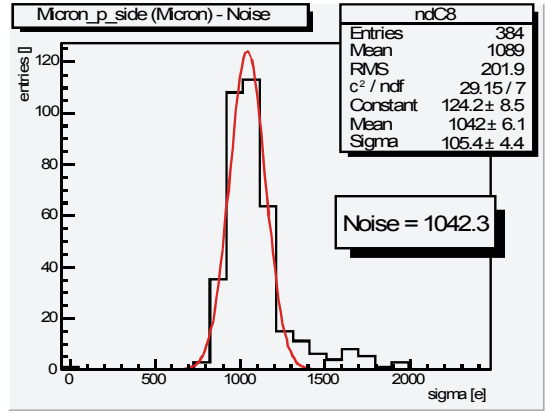


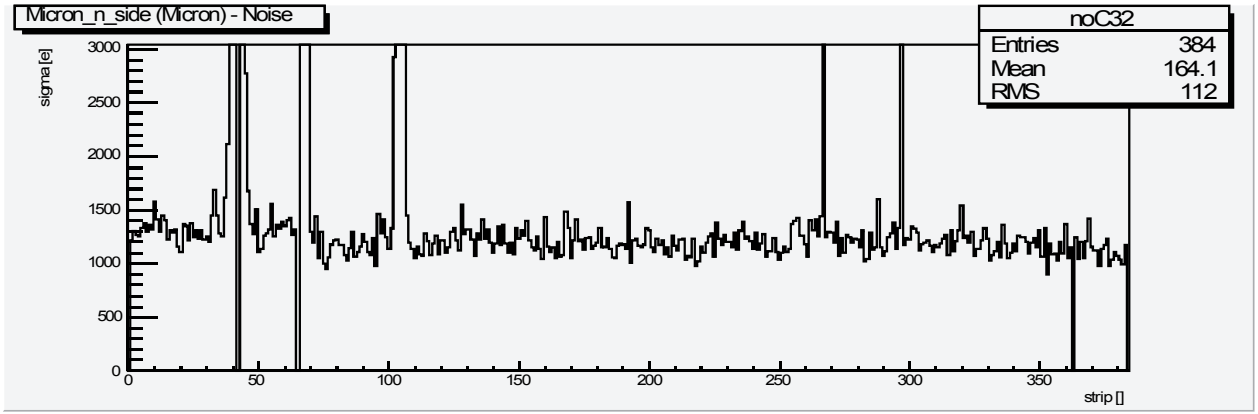


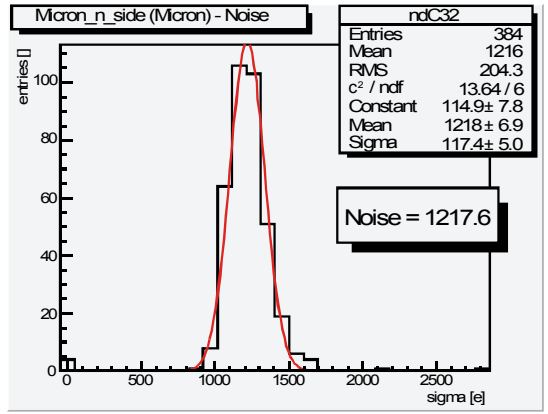
- Signal has pretty Landau distribution; SNR depends on cluster width

Micron Module - Noise



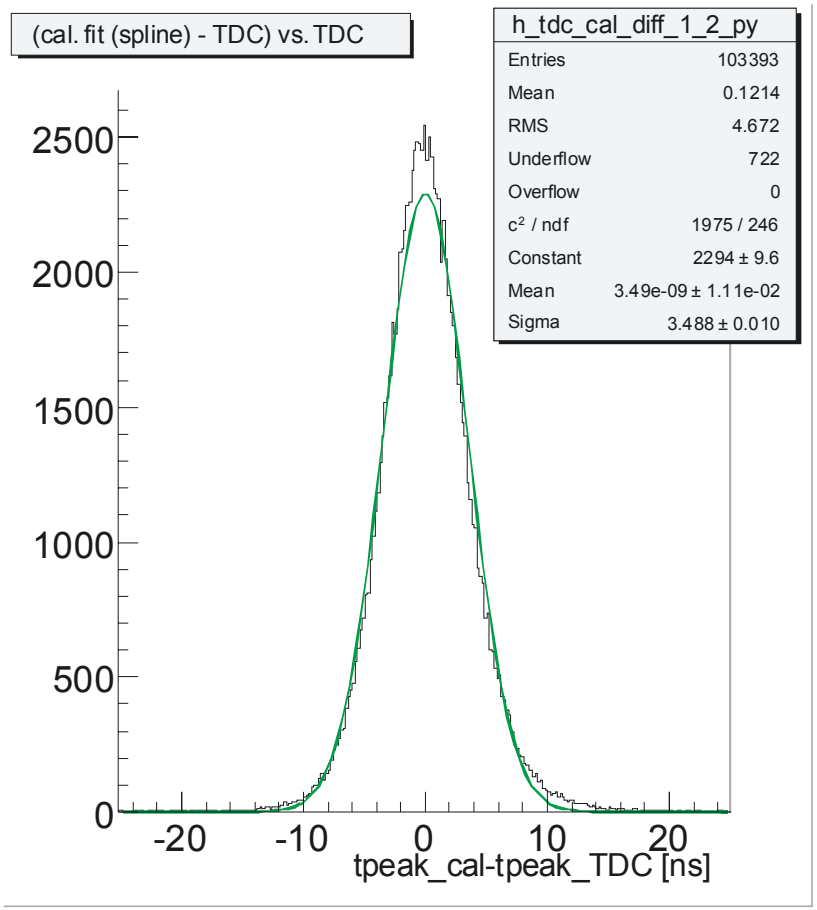




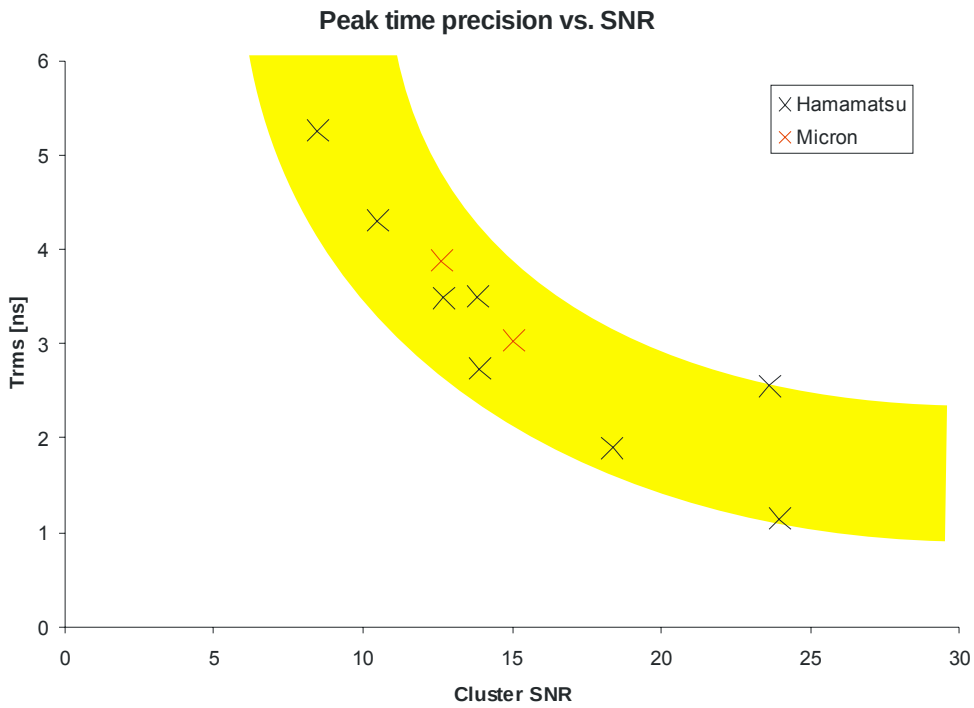


- Few noisy strips on both sides of the sensor.

Micron Module – Time Resolution (Preliminary)



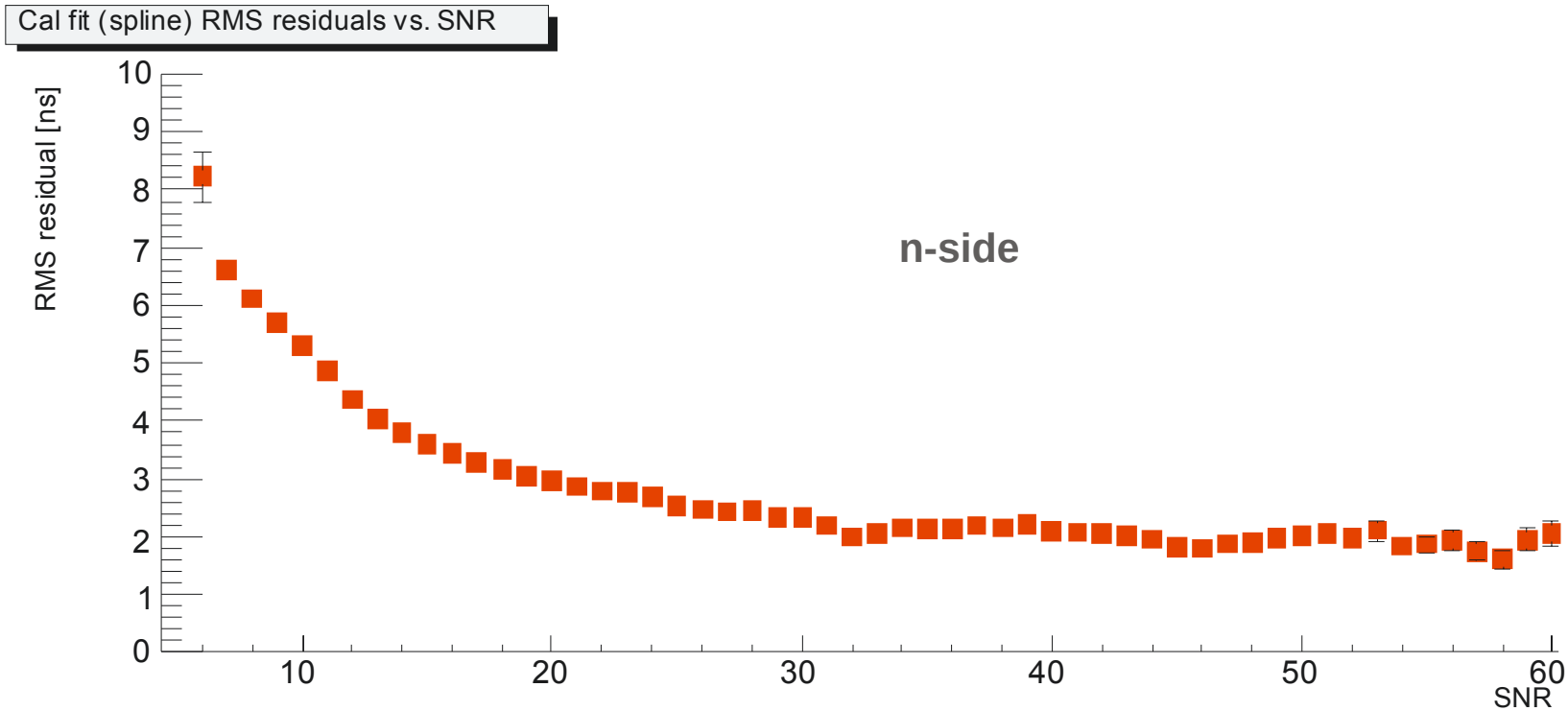
TDC error ~ 1.71 ns



- p-side: 3.89 ns
- n-side: 3.04 ns

- strongly depends on SNR

Micron Module – Time Resolution vs. SNR



Summary

- Testbeam performed to evaluate Micron DDD5 sensor.

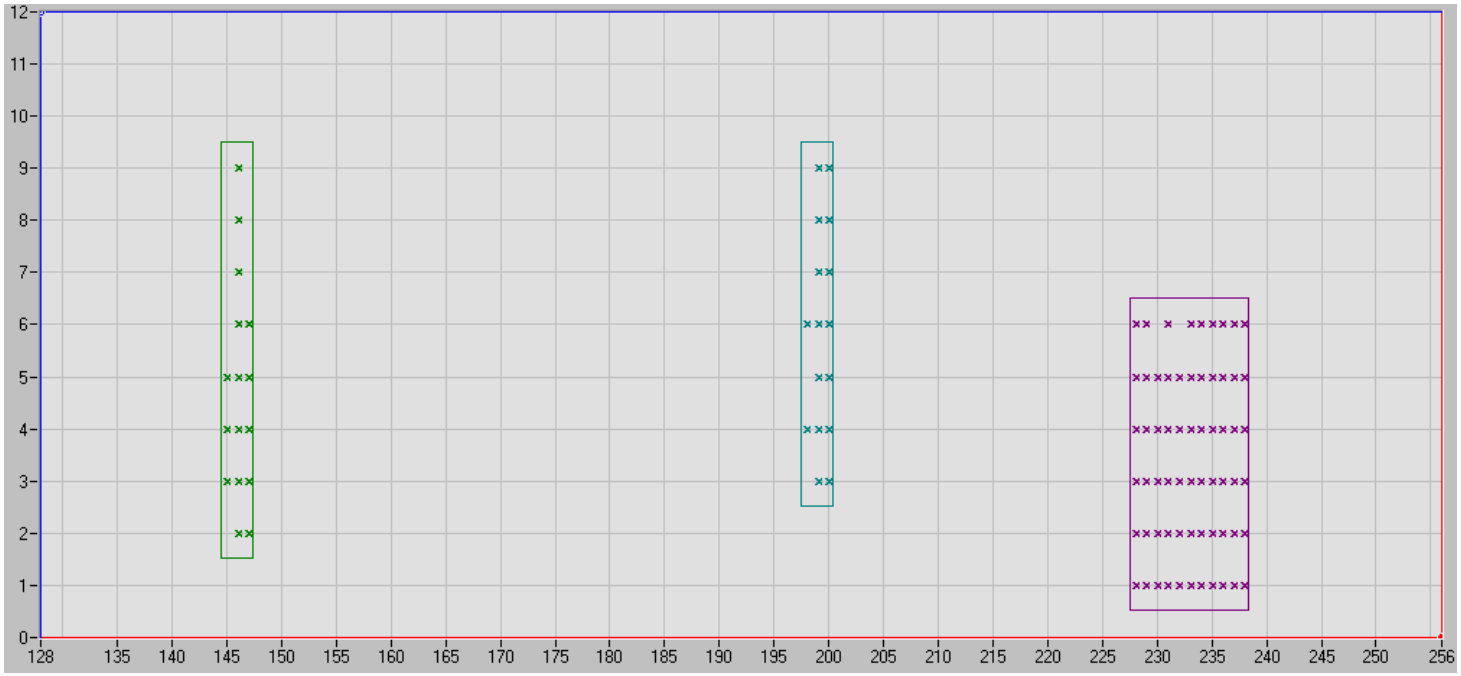
- Minor deviations of CV and IV curve observed.
- I_{bias} above 1 µA
- Few noisy strips detected.

- SNR within the expected range.
- Time resolution corresponds to SNR.
- Noise contribution of the second metal layer is less than expected.

Thank you for your attention

BACKUP SLIDES

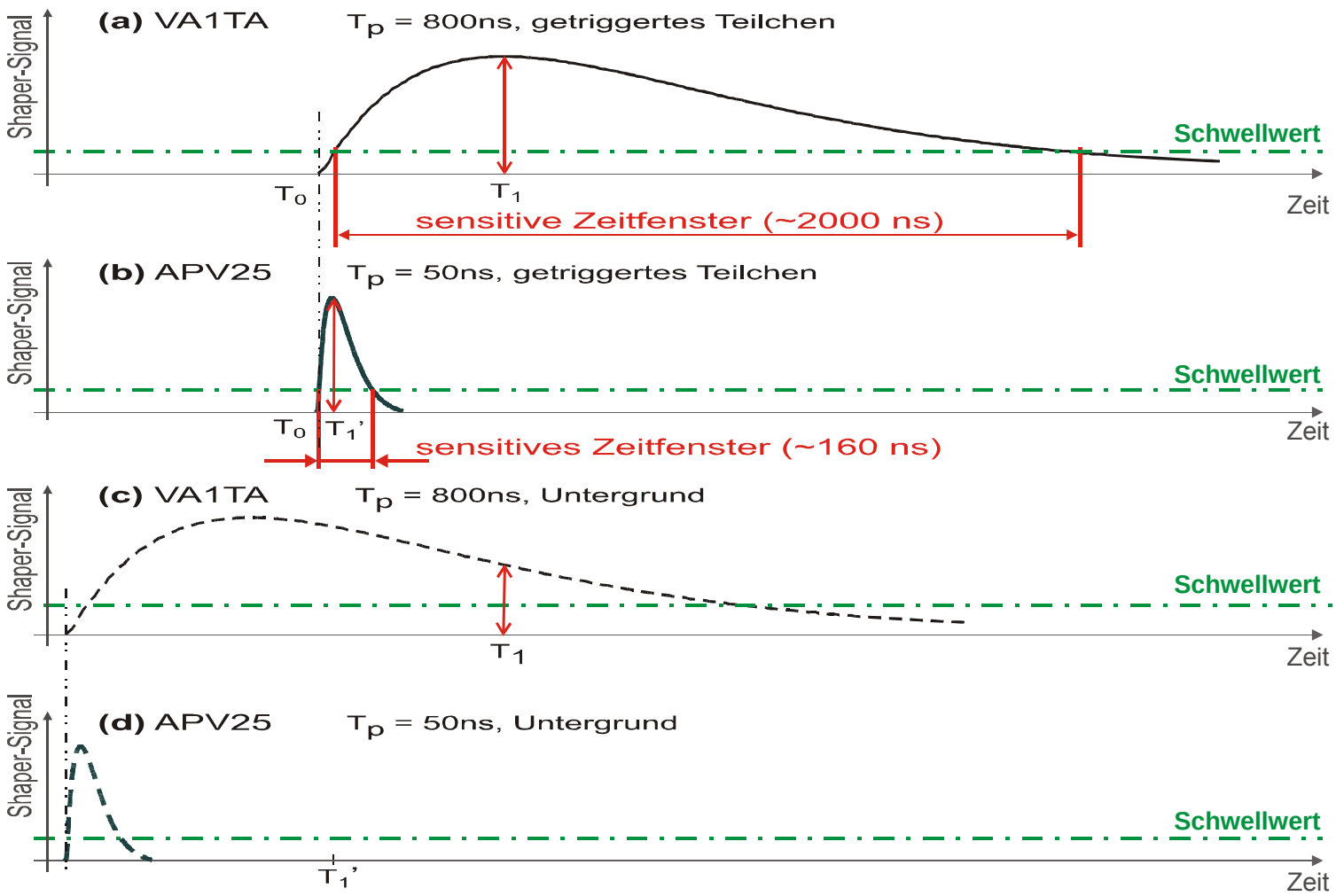
2D-Clustering



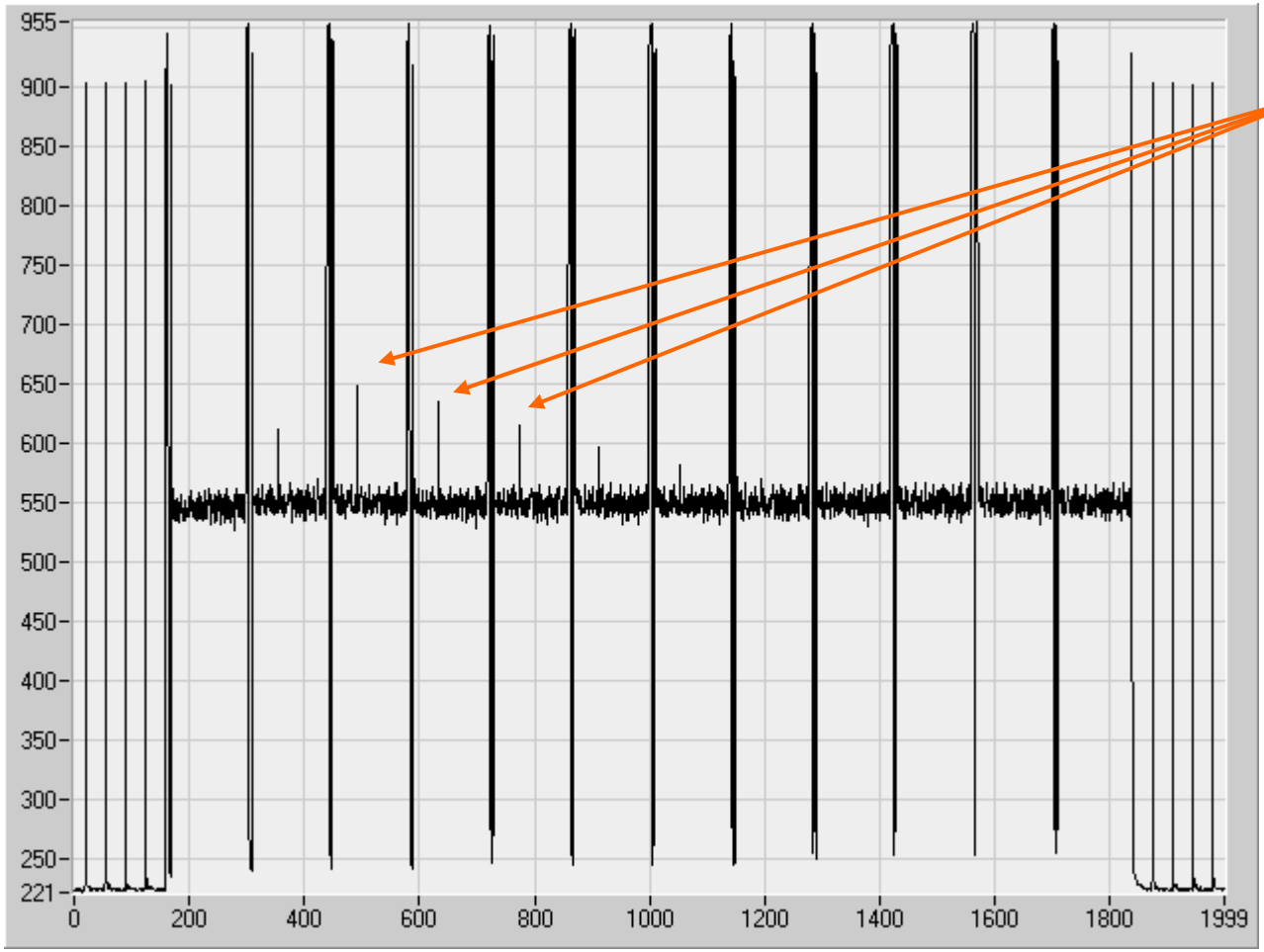
2 Steps:

- Search for neighbouring strips above threshold and mark them in a hit map.
- Search continuous areas (clumps) and calculate outline.

Occupancy-Reduktion – Principle

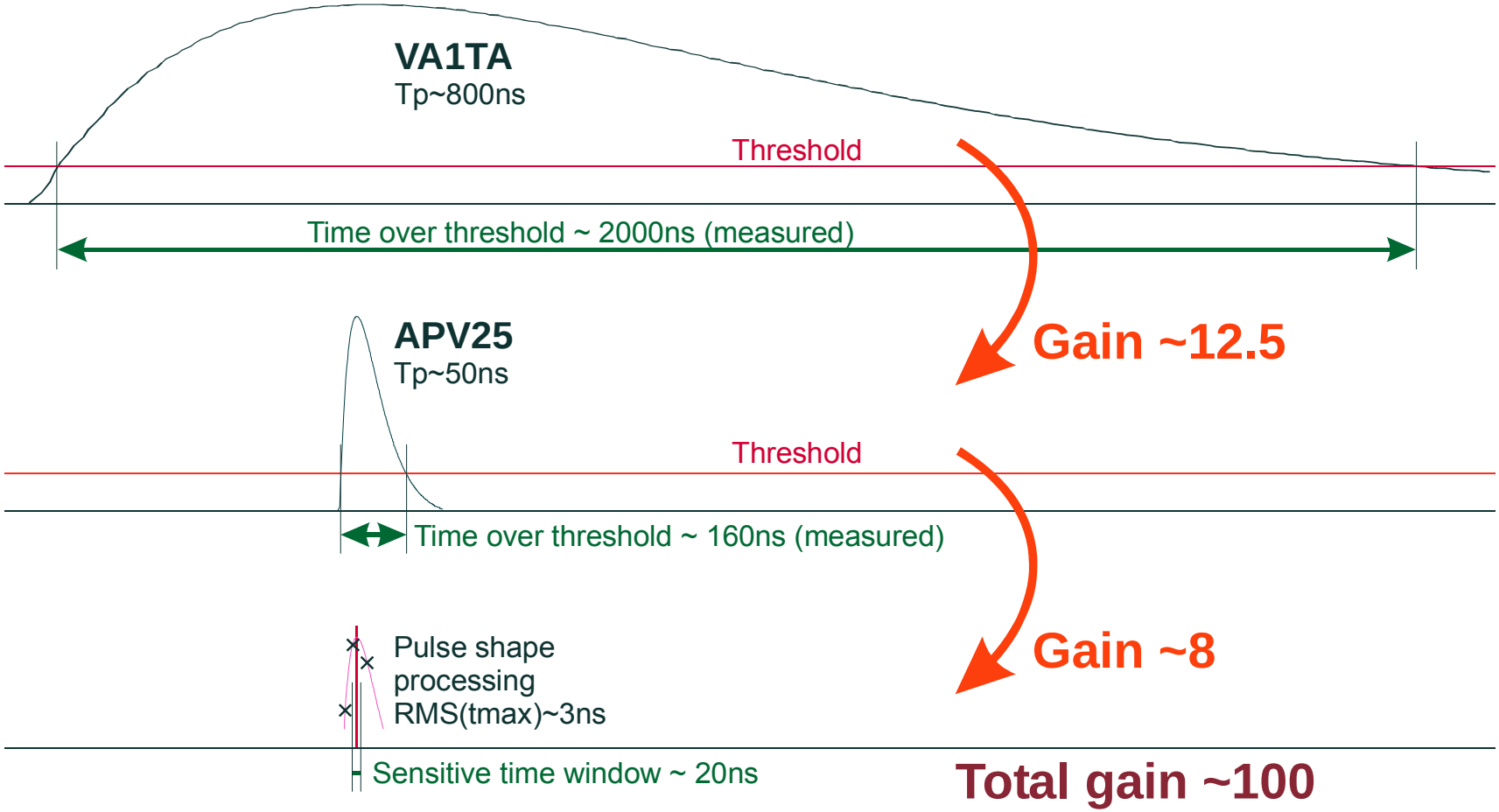


Multipeak Mode

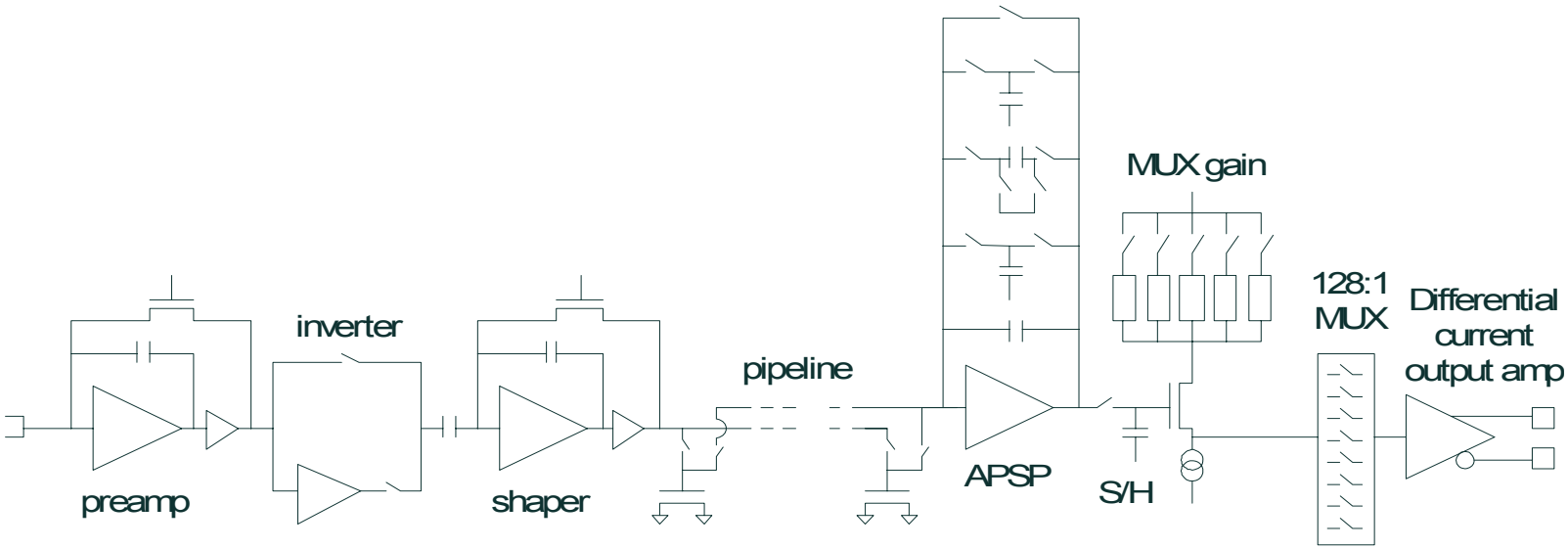


Particle signal

Occupancy-Reduktion – Hit Time Reconstruction



APV25


preamp
inverter
shaper
pipeline
APSP
S/H
MUX gain
128:1
MUX
Differential
current
output amp