ÖAW AUSTRIAN ACADEMY OF SCIENCES

HEPHY INSTITUTE OF HIGH ENERGY PHYSICS

RD50 HV-CMOS Meeting 19.09.2024

MedAuston-TB results

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Overview

When: 25.08.2024
Where: MedAustron (Austria)

Measured Sensors
MPW4
- topside biased (w8)
- Backside processed, biased from top (w14)

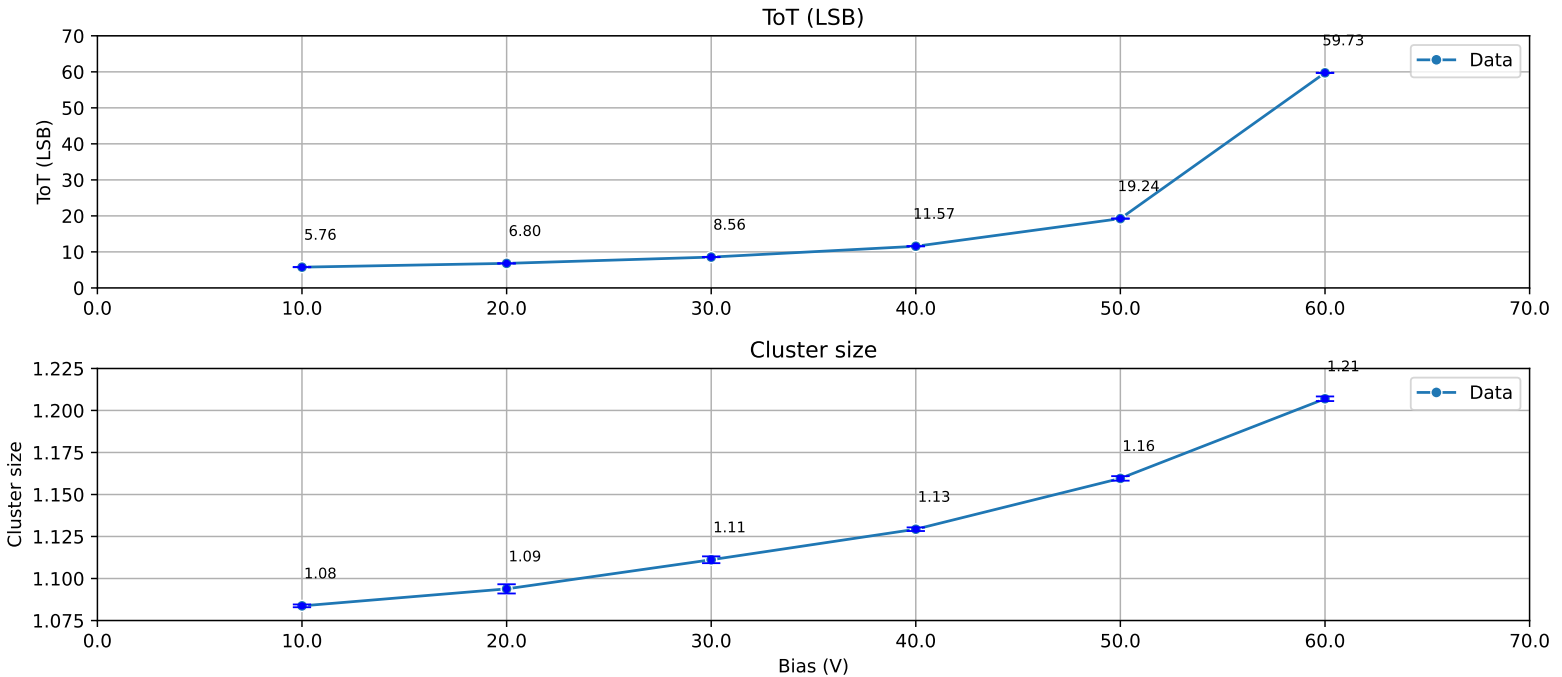
Beam
Particles: protons
Energy: 62.4 - 800 MeV

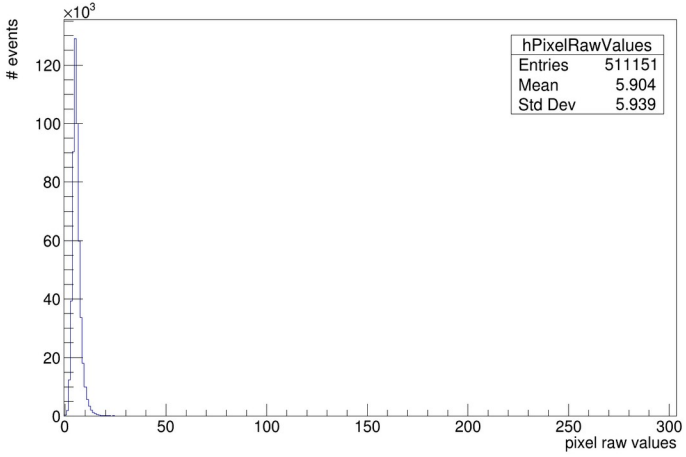
Performed Measurements
- piggy board test
- vnfb Scan
- Energy Scan

Vnfb Scan

vnfb
Default: 18 DAC
Scan: 10 – 60 DAC

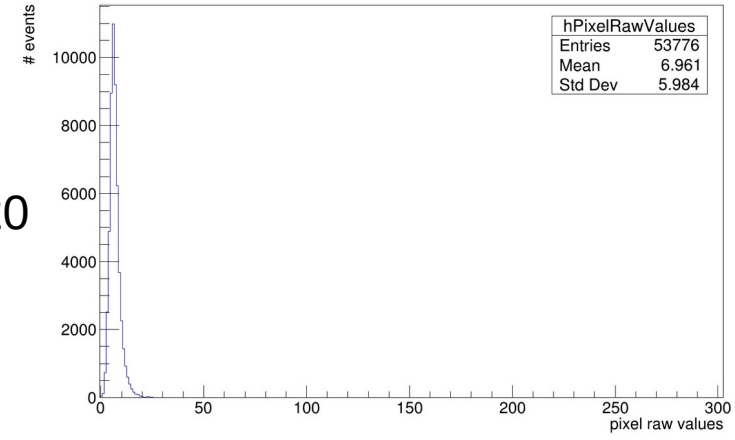
Motivation
increase ToT for better charge weighting

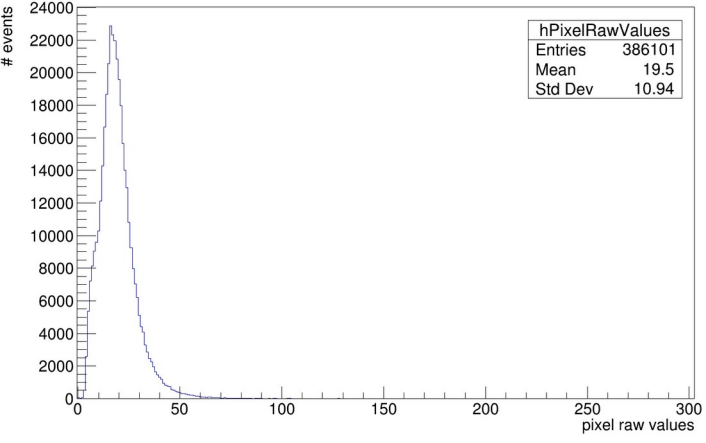




vnfb = 10

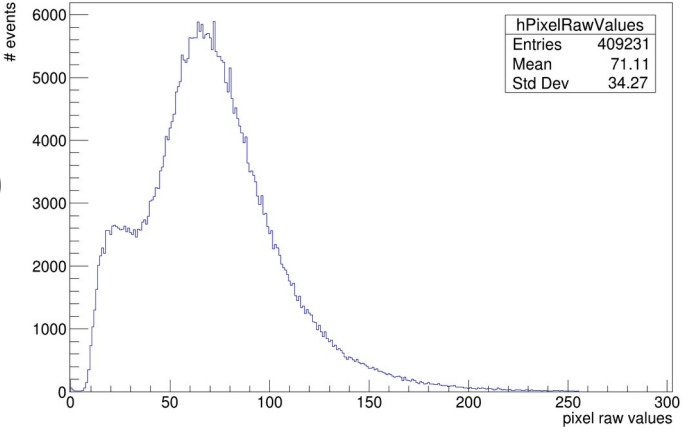
vnfb = 20





vnfb = 50

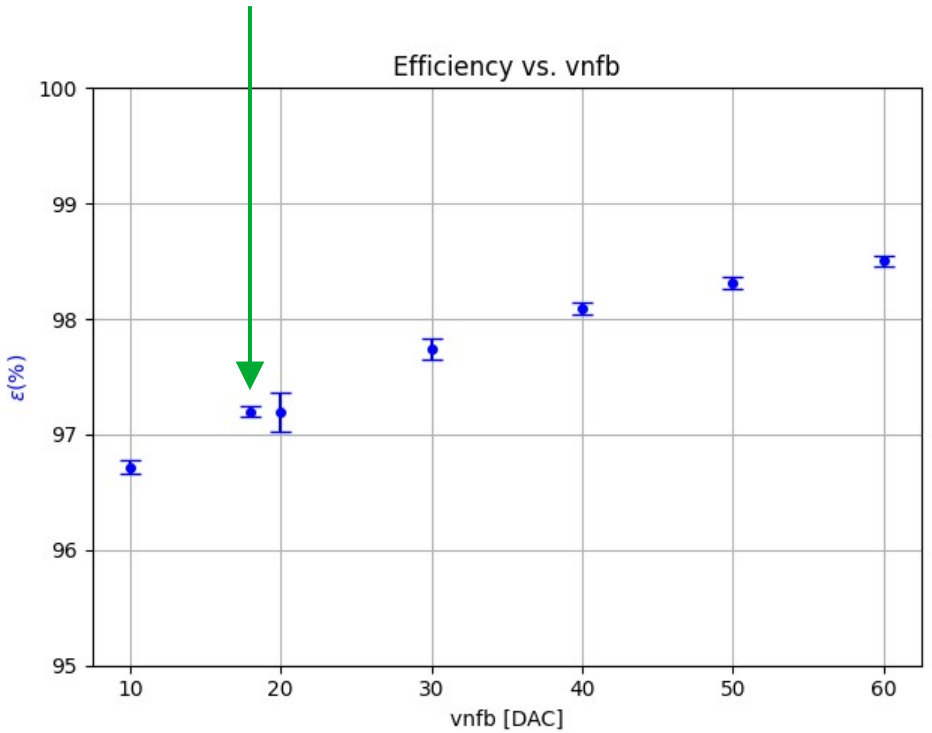
vnfb = 60

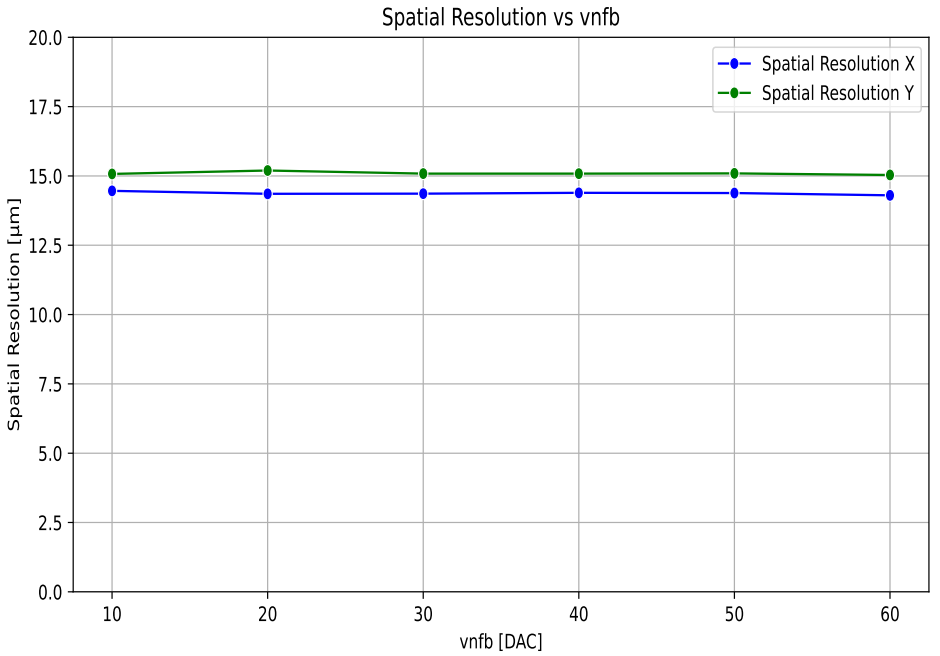


Vnfb Scan

no impact of vnfb on spatial resolution visible (rel_cut_dut_association = 5)

default settings





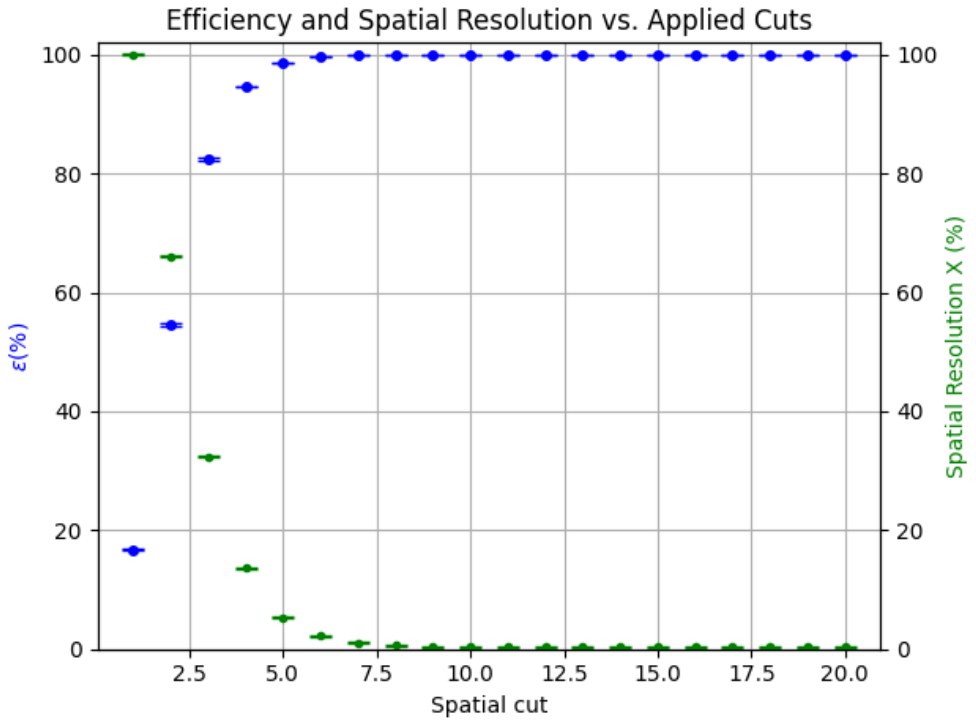
Impact of Spatial Cuts

Spatial resolution: $y = \left(2 - \frac{x}{x_{min}}\right) * 100$

→ 100% spatial resolution equal to best measured resolution

Relative spatial cut DUT association

- Parameter to associate cluster on DUT to intersecting track
- Given in multiples of binary resolution (17.898µm)
- Trade off between efficiency and spatial resolution
- Used cuts for analysis: 5



Spatial resolution

Spatial cut = 5	**Unbiased Residuals x [µm]**	**Biased Residuals x [µm]**	**Resolution [µm]**	**Binary resolution [µm]**
Baseboard with piggy board	26.48	7.81	14.38	17.89
Baseboard only	26.18	4.40	10.73	17.89

Biased residuals seem to be too low and differ for usage of piggy board while unbiased residuals are equal
→ obtained spatial resolution is not trustworthy!
→ problem in the analysis?

Experimental DAC Settings

Motivation
Measurements by Bernhard showed a lower minimal effective threshold (~1970e) for the experimental DAC settings than the standard settings (~2700e)

Run	Efficiency [%]	Cluster Size	ToT [LSB]
66 (experimental)	98.64	1.284	25.79
61 (standard)	98.61	1.282	7.53

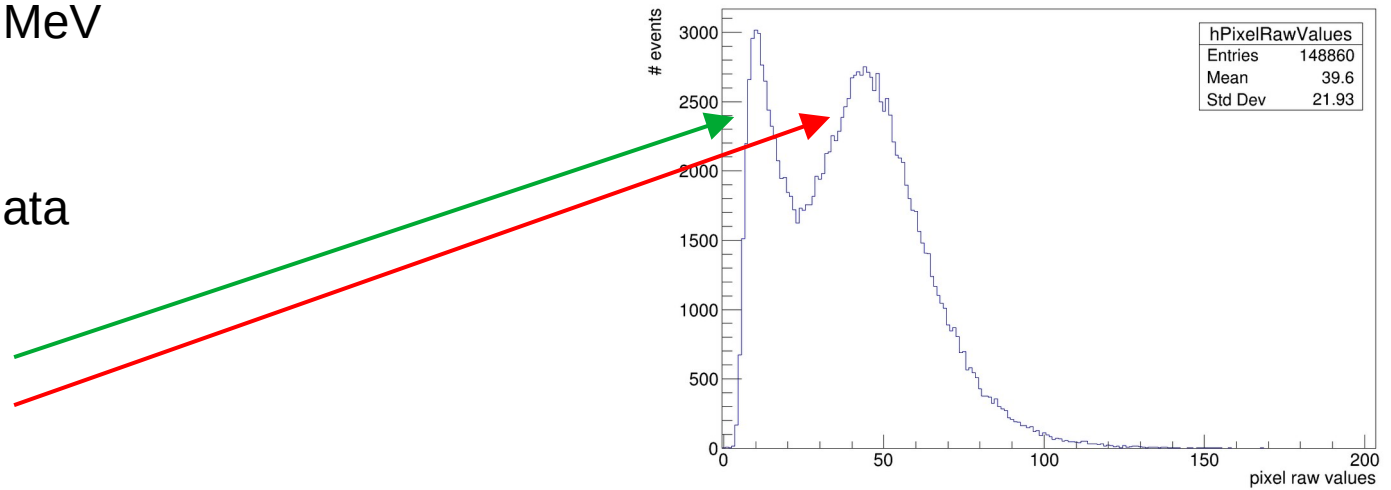
	experimental	standard
vn	21	45
vnfb	18	52
vnsf	45	52
vpbias	37	55

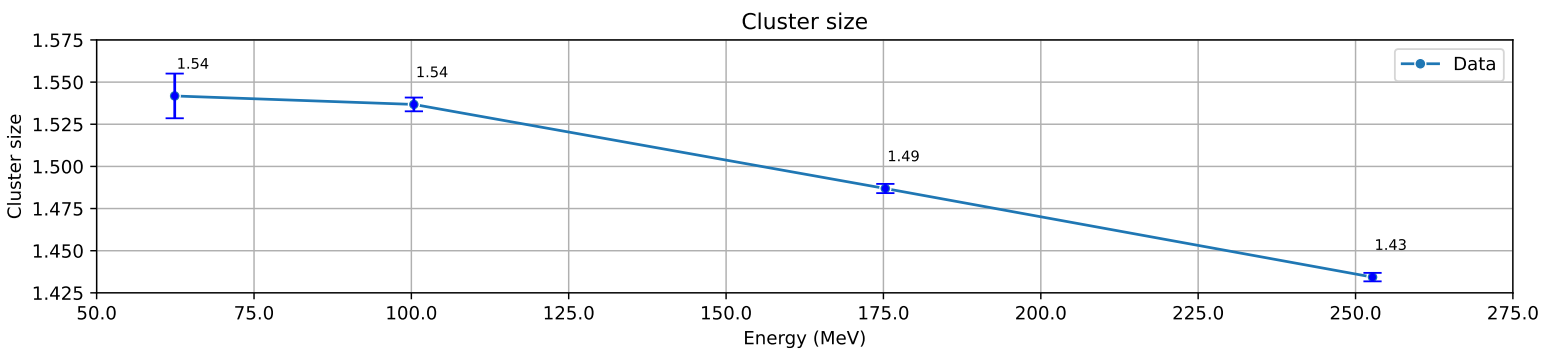
Energy Scan

Energies
252.7, 175.3, 100.4, 62.4 MeV

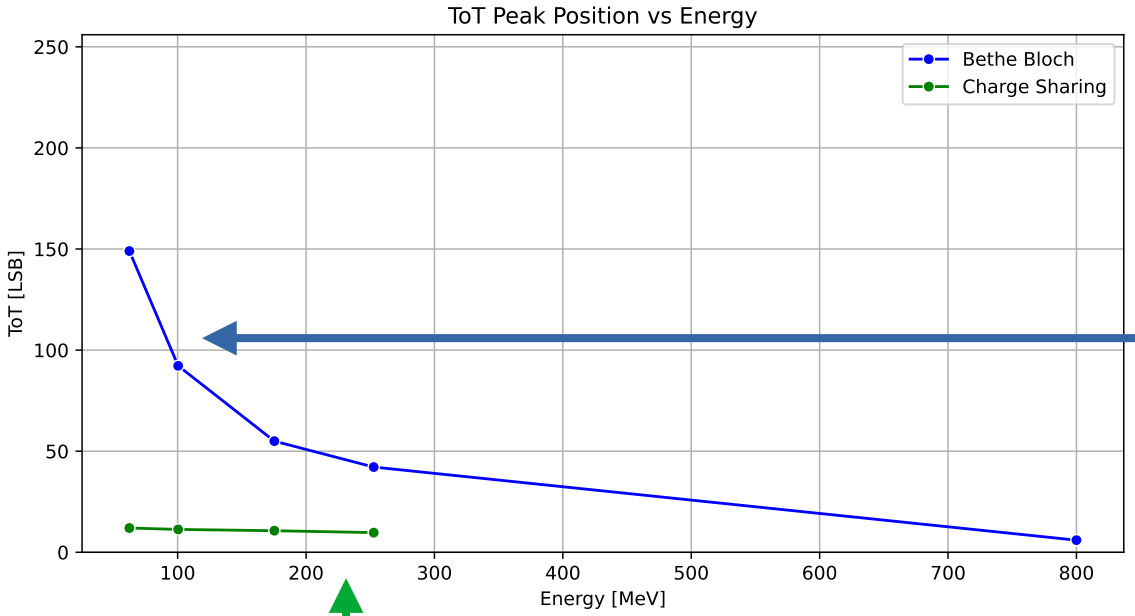
ToT
Two peaks visible in the data resulting from

- charge sharing effects
- Bethe Bloch





Impact of Energy on ToT Peak Position



- Position of charge sharing peak is not sensitive to beam energy
- No charge sharing peak visible for 800 MeV