


ÖAW


AUSTRIAN
ACADEMY OF
SCIENCES



HVCMOS Meeting 31.10.2024

DESY TB Results

Harald Handerkas, Bernhard Pils

Overview

When: 30.09.-7.10.2024

Where: DESY test beam facility

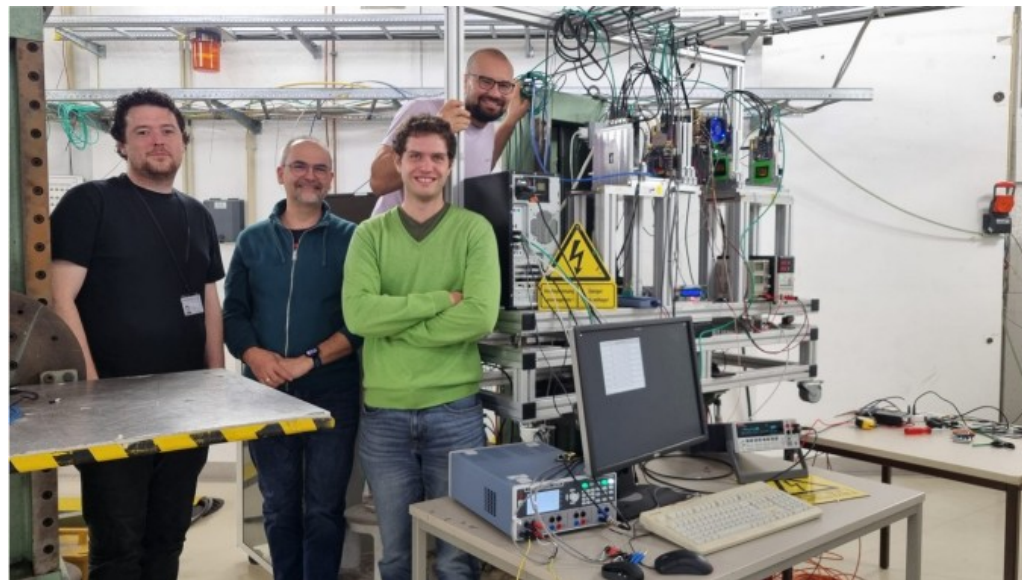
Measure Samples

- Non-Irradiated W8 (W8-0E0)
- W3-1E14
- W3-3E14
- W8-1E15
- W3-1E16

Beam

Particles: electrons

Energy: 4.2 GeV



Setup

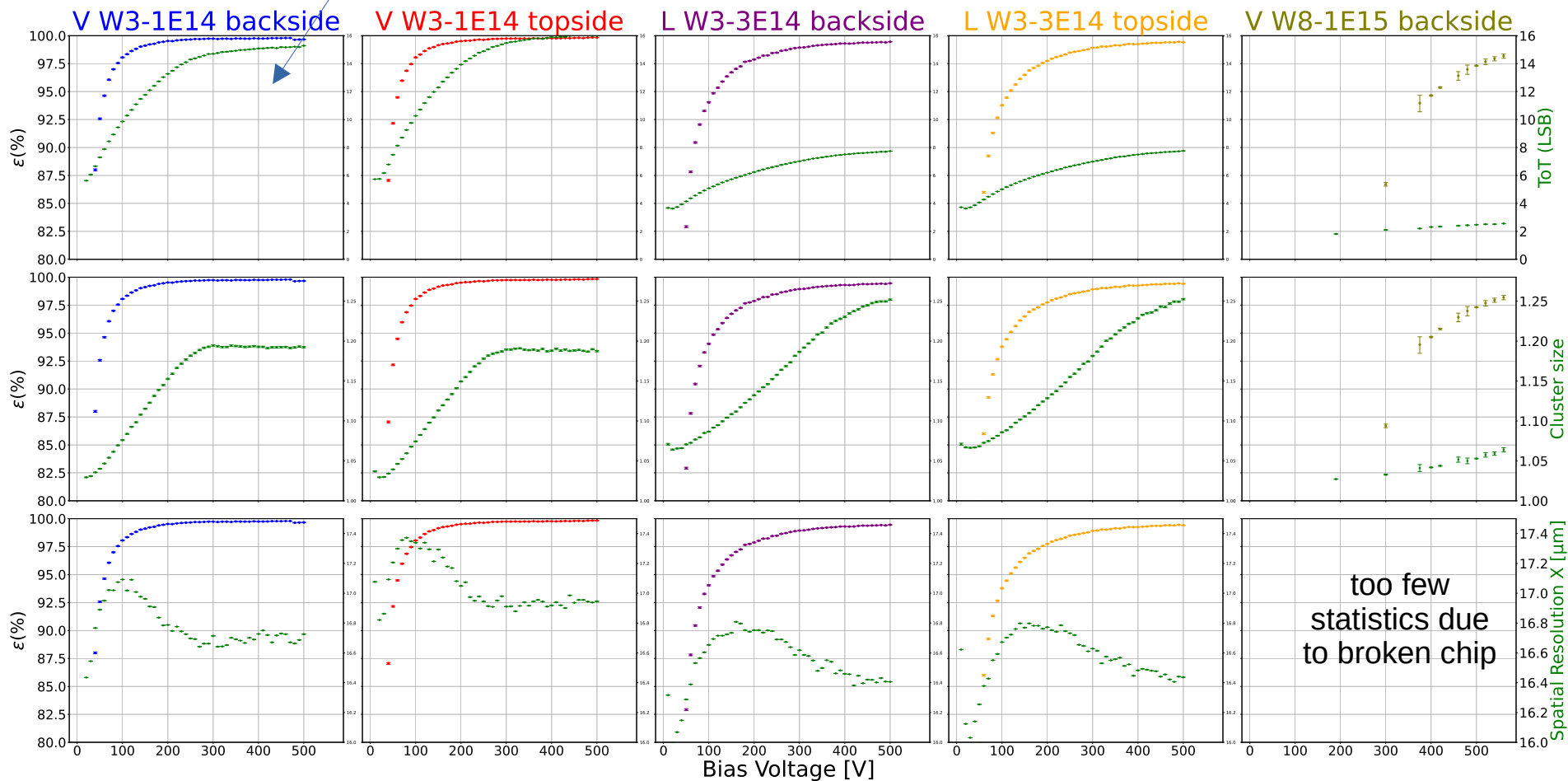
Telescope: 6 Adenium planes

Telepix2 as ROI trigger

Cooling setup ($\sim -15\text{C}^\circ$)

Settings Bias Voltage Scans

	W8-0E0 topside	W3-1E14 backside	W3-1E14 topside	W3-3E14 backside	W3-3E14 topside	W8-1E15 topside
Thr [V]	1	1.1	1.1	0.95	0.95	0.97
Range [V]	10-280	20-500	10-500	10-500	10-500	190-560

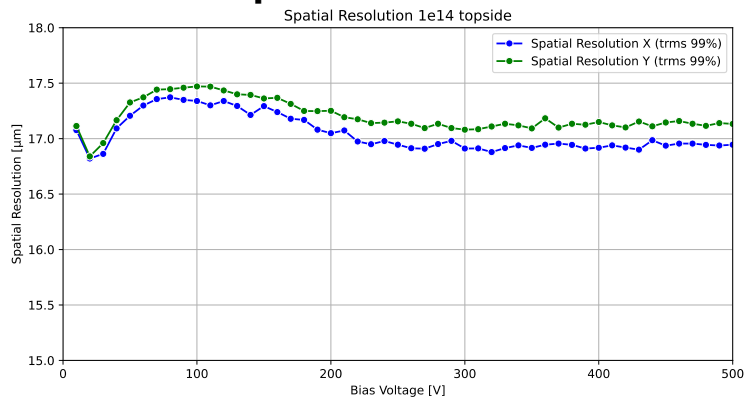


Results of high Bias Voltage Settings

Chip	Thr [V]	Bias Voltage [V]	ToT [LSB]	Cluster Size	Spatial Resolution [μm]
W8-0E0	1.0	280	7.07	1.16	17.12
W3-1E14 topside	1.1	500	15.99	1.19	16.95
W3-1E14 backside	1.1	500	15.28	1.19	16.73
W3-3E14 topside	0.95	500	7.81	1.25	16.44
W3-3E14 backside	0.95	500	7.79	1.25	16.41
W8-1E15	0.97	560	6.56	1.06	-----

Spatial Resolution (X/Y vs HV)

Topside biased

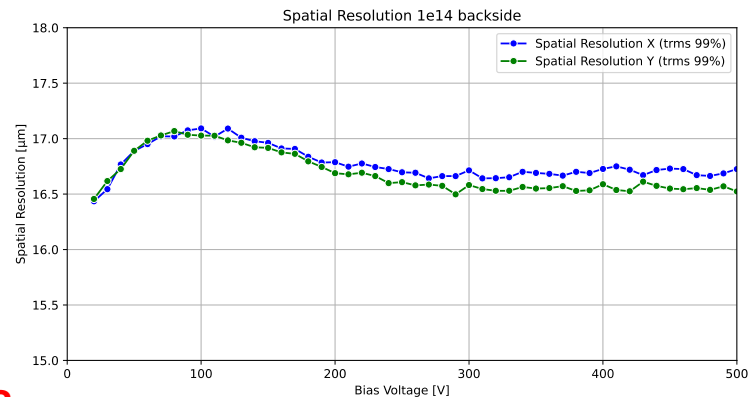


Topside biased
worse by 0.5 μm

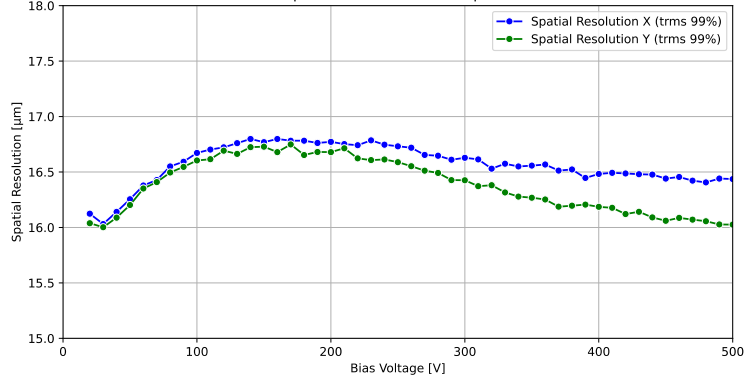


Difference between
X/Y increases with
bias voltage → why?

Backside biased



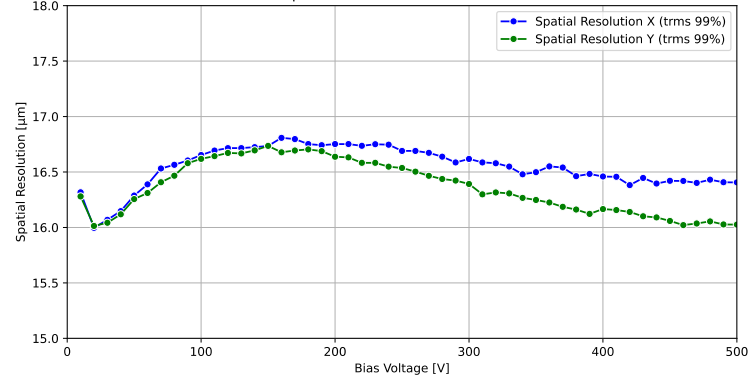
Spatial Resolution 3e14 topside



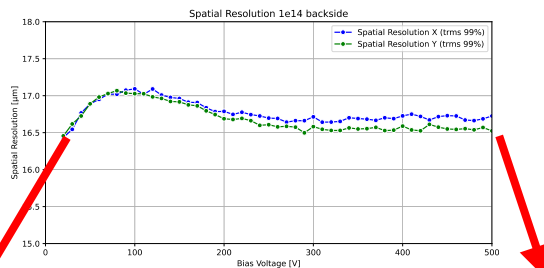
Both perform
equally



Spatial Resolution 3e14 backside



In-Pixel Efficiency W3-1E14 backside

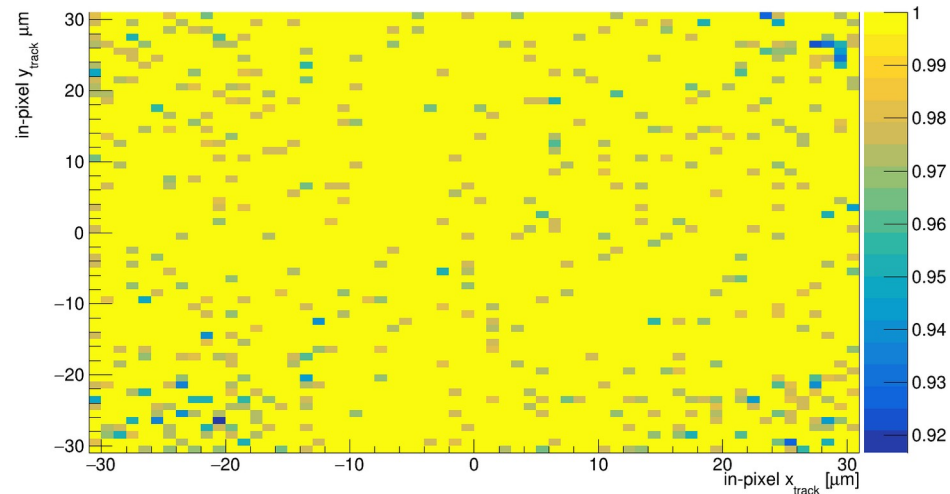
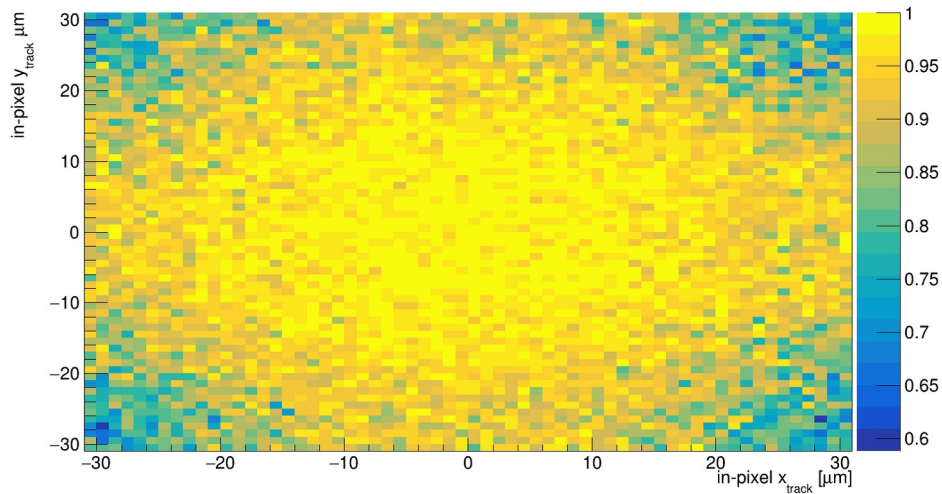


Bias Voltage: 50V

Bias Voltage: 500V

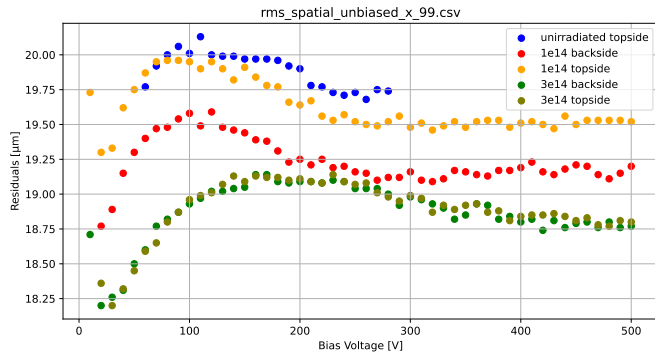
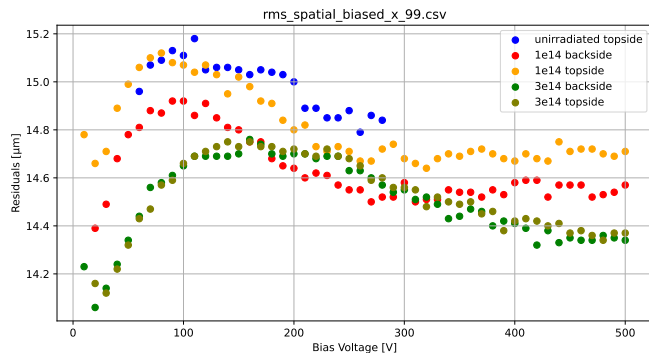
RD50_MPWx_0 Pixel efficiency map

RD50_MPWx_0 Pixel efficiency map



Residuals (X/Y vs HV)

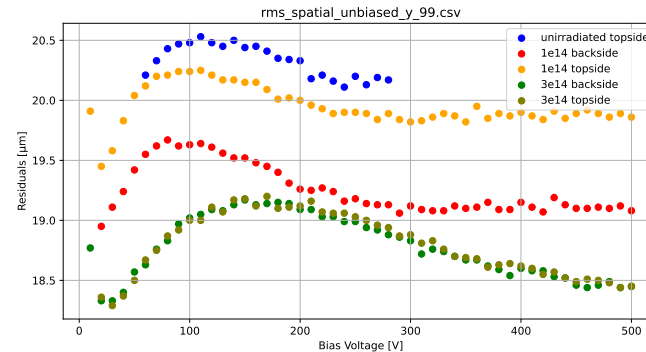
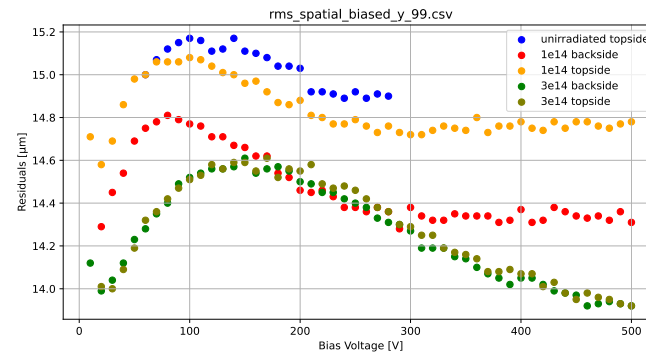
Residuals X



**Biased truncated
RMS (99%)**

**Unbiased
truncated RMS
(99%)**

Residuals Y



VNFB Scans

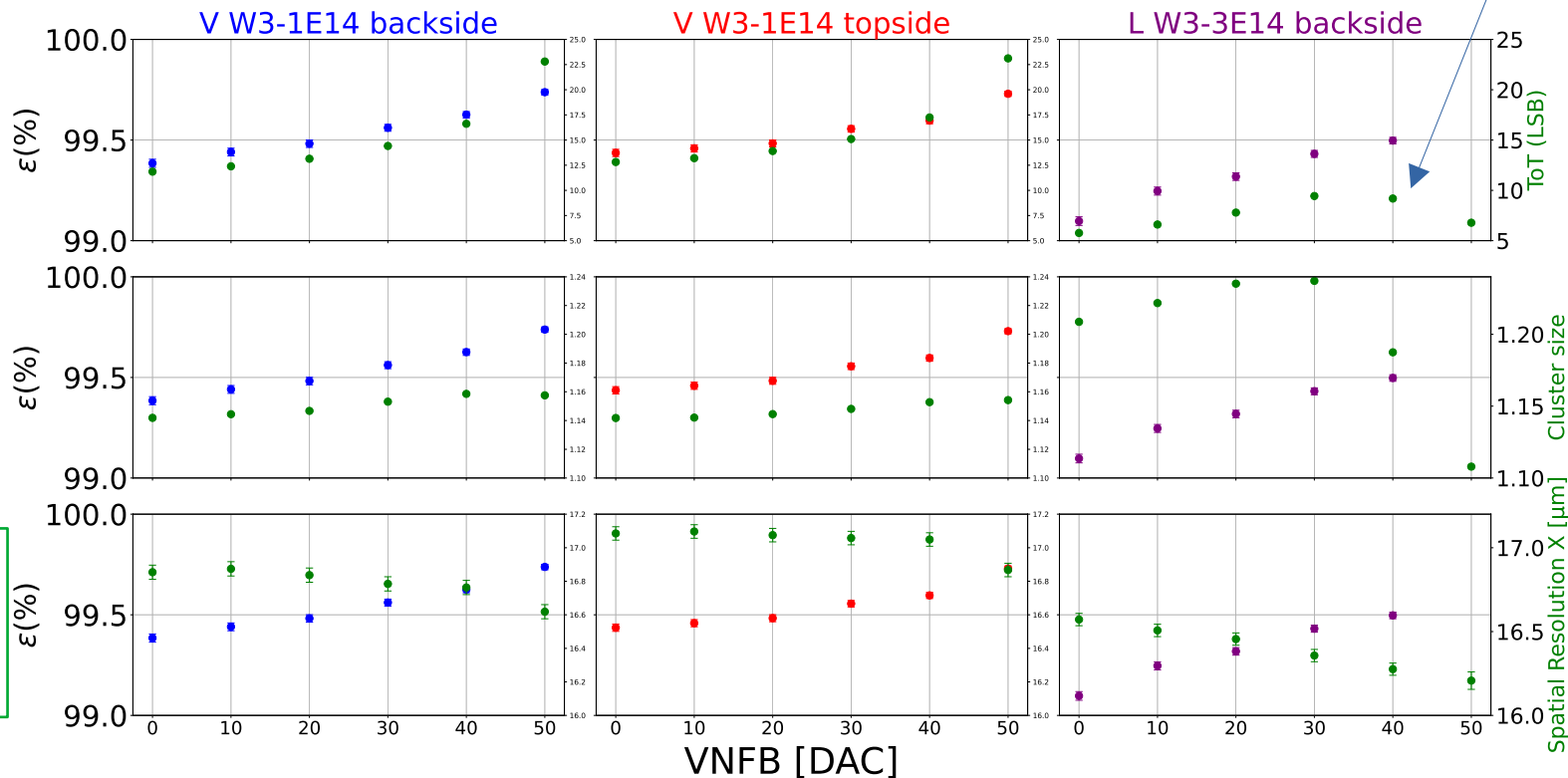
Thr/HV:

1.1V/190V

1.1V/190V

0.95V/400V

Decrease:
-> see next slide



Spatial Resolution improves with vnfb

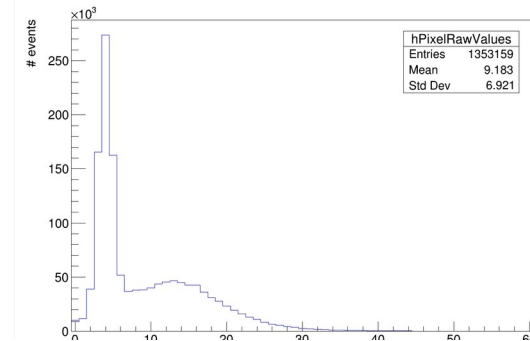
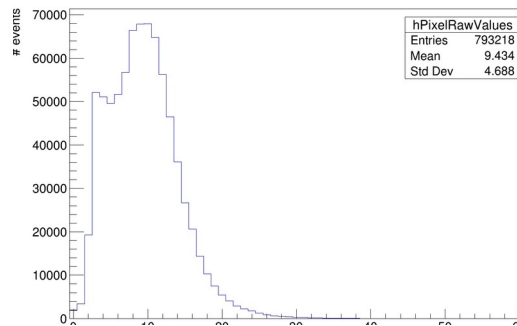
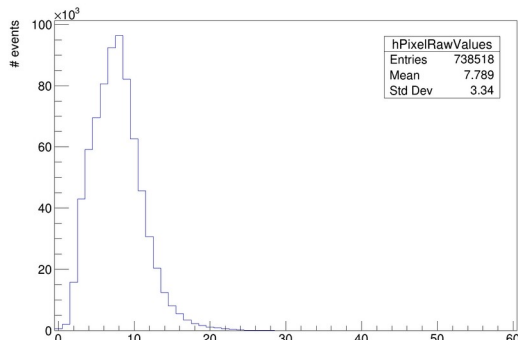
ToT comparison

vnfb = 30

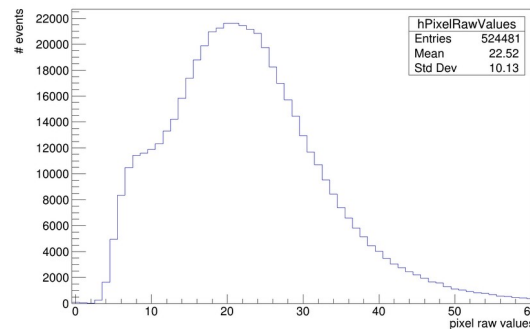
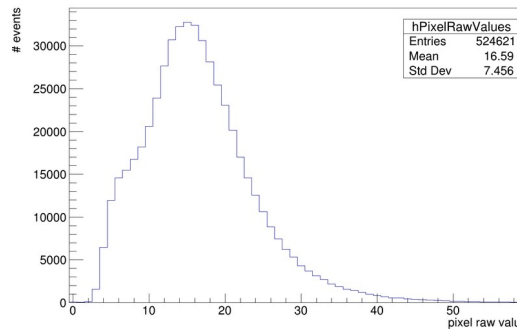
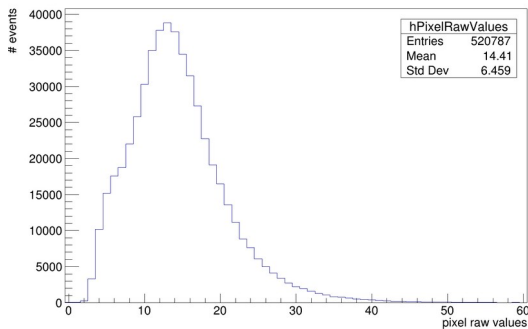
vnfb = 40

vnfb = 50

W3-3E14
backside



W3-1E14
backside



Vnfb Direct Comparison

W3-1E14 backside	Vnfb = 20	Vnfb = 50
ToT [LSB]	13.14	22.80
Cluster Size	1.15	1.16
Spatial Resolution [μm]	16.84	16.62
Efficiency [%]	99.48	99.74

W3-3E14 backside	Vnfb = 20	Vnfb = 40
ToT [LSB]	7.79	9.19
Cluster Size	1.24	1.19
Spatial Resolution [μm]	16.46	16.28
Efficiency [%]	99.32	99.50

Summary

- HV Scan: Saturation of cluster size matches steady state of spatial resolution
- Spatial Resolution improves with higher v_{fb} ($\sim 0.2 \mu\text{m}$)
- Efficiency improves slightly with v_{fb} ($\sim 0.2\%$)

Open Questions

- ToT of **W3-1E14** is higher than ToT of **W8-0E0** (15.27/7.07 LSB)
- Cluster Size of **W3-3E14 (1.25)** > **W3-1E14 (1.19)** > **W8-0E0 (1.16)**
- Difference between X/Y resolution increases with bias voltage