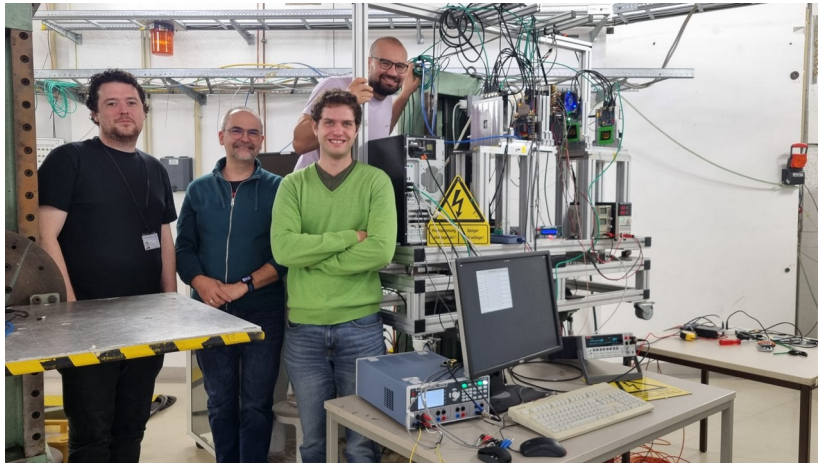# DESY Test Beam Oct. 2024

First results

Bernhard Pilsl

Setup

- Telescope: 6 *Adenium* planes

- Telepix2 as ROI trigger
  - Input to TLU

- Operated with 4.2 GeV electrons

- Improved cooling setup (Thanks to Sam and Christian!) able to go down to ~-15°C
  - Operated all samples at this temperature

- Samples in luggage:
  - Non-Irradiated W8 (W8-0E0)
  - W3-1E14
  - W3-3E14
  - W8-1E15
  - W3-1E16

# What got measured?

- Each sample measured with „standard" settings
  - V_{Bias} = 190V
  - V_{Thr} = 1.1V

- Best settings
  - Minimized threshold (as low as possible without noise)
  - Maximized Bias voltage

- Bias Voltage Scans (at safe threshold)
  - Going from 0V → 500V in 10V steps

- **All done for both biasing schemes (backside and topside)**

> Analysis is not done yet!
> You are about to see **very preliminary** plots
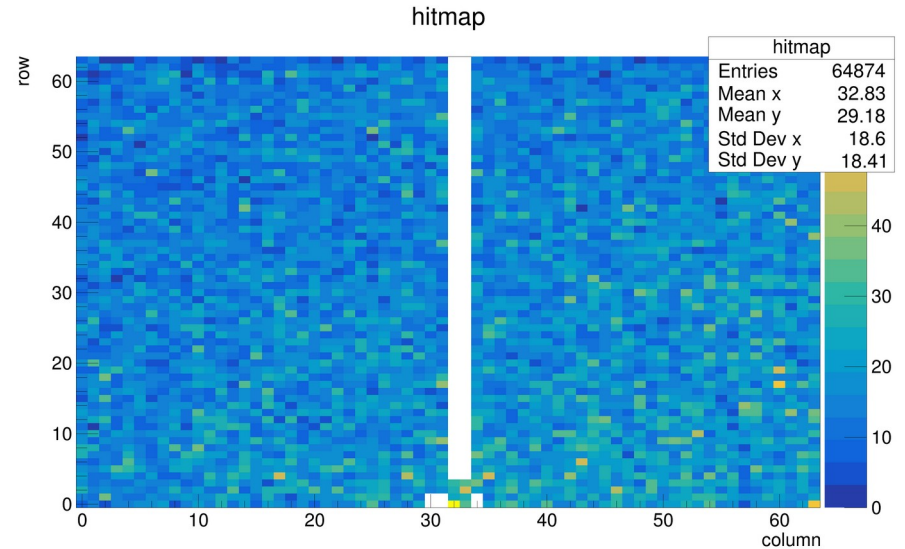> This is a first glance, do not present elsewhere

- One „damaged" double column (columns #44 + #45 → double column #22)

- 1 noisy pixel
  - Masked during data taking
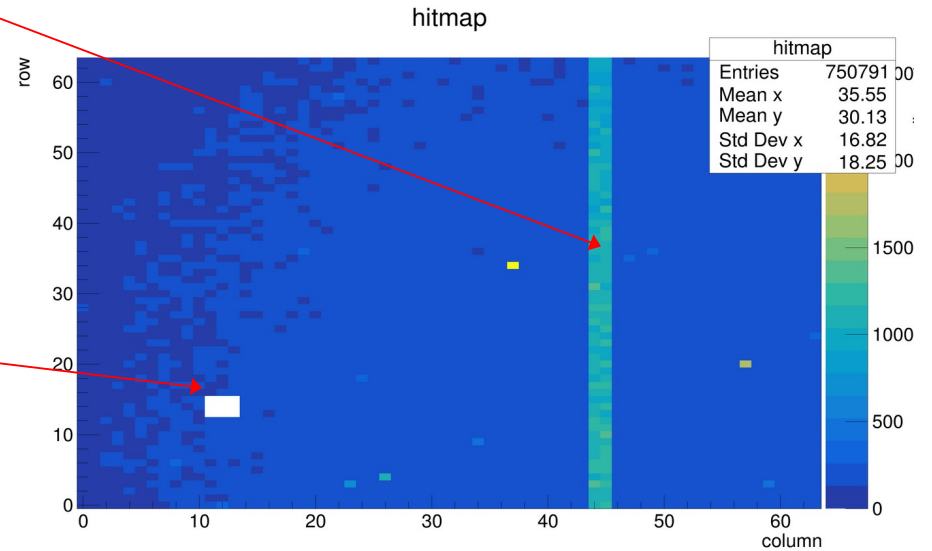
- 1 dead double column (#16)
    - Reason for (upcoming) masking

- TS-overflow not counting → had to use TLU timestamp → No proper timing analysis possible
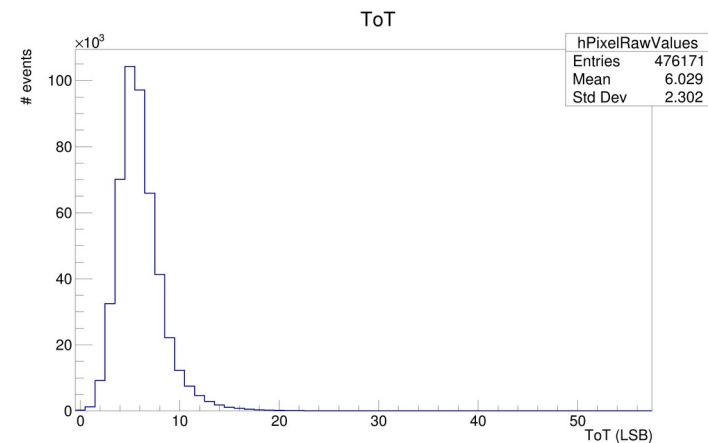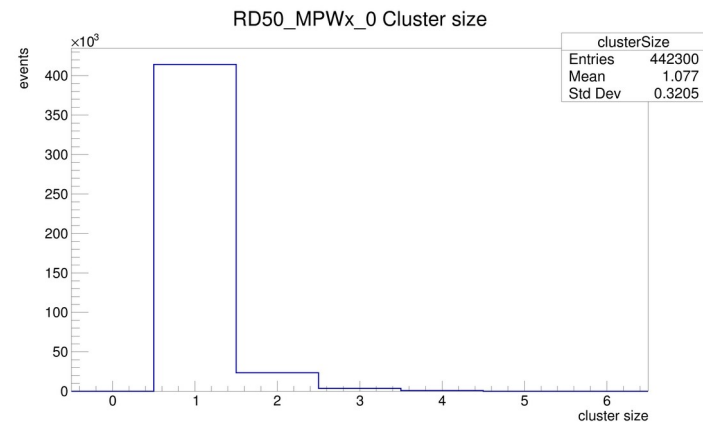
- Died at V_{Bias} = 600V at the testbeam

5

- Is talking to I2C and delivering data (a little bit)

- Increased noise

- Correlations observed

- Track based characterization difficult (not managed to so far)

RD50_MPWx_0: correlation X

correlationX	
Entries	24213
Mean	−0.7392
Std Dev	2.56
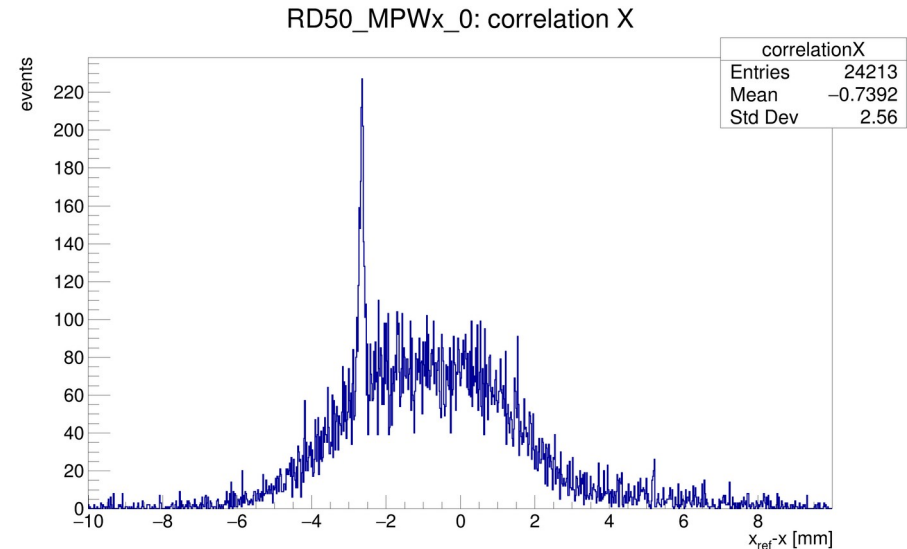
Standard Settings (1)

Coloring: Biasing   Topside   Backside

DUT	ClusterSize	ToT	
W8-0E0	1.07	6.02	Fishy
W3-1E14	1.15	13.62	
W3-1E14	1.16	13.78	
W3-3E14	1.12	4.99	
W3-3E14	1.12	4.97	
W8-1E15	1.04	2.09	
W3-1E16	1.36	73.68	

RD50_MPWx_0 Cluster size

clusterSize	
Entries	442300
Mean	1.077
Std Dev	0.3205

ToT

hPixelRawValues	
Entries	476171
Mean	6.029
Std Dev	2.302

Standard Settings (2)

Coloring: Biasing   Topside   Backside

DUT	σ X-Residuals [μm]	σ T-Residuals [ns]
W8-0E0	20.51	11.05
W3-1E14	20.79	10.04
W3-1E14	TODO	
W3-3E14	19.14	11.23
W3-3E14	19.2	10.68
W8-1E15	21.51	-
W3-1E16	-	-

Residual in local X

residualsX	
Entries	70328
Mean	0.2323
Std Dev	20.1

Time residual

residualsTime	
Entries	70328
Mean	145.2
Std Dev	9.624
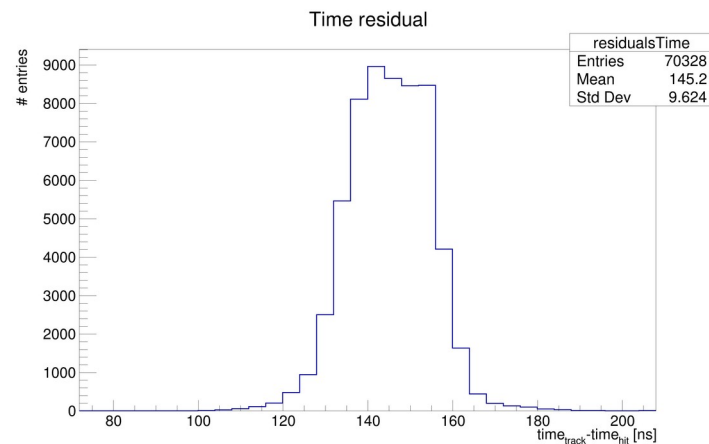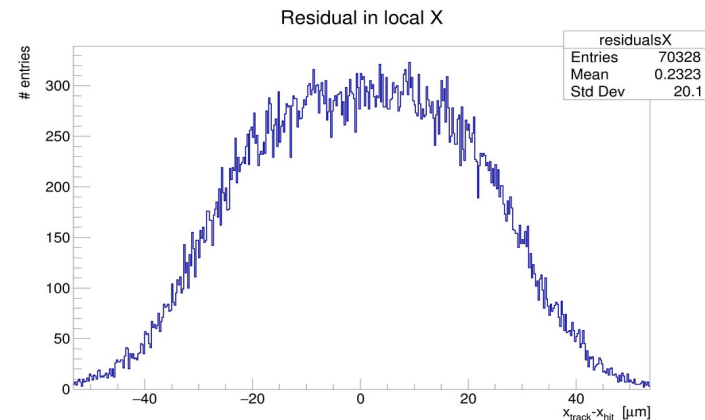
Standard Settings (3)

Coloring: Biasing Topside Backside

DUT	Efficiency [%]	
W8-0E0	97.5%	Fishy
W3-1E14	99.5%	
W3-1E14	TODO	
W3-3E14	84.7%	
W3-3E14	85.5%	
W8-1E15	8.9%	
W3-1E16	-	

RD50_MPWx_0 Pixel efficiency map

0E0
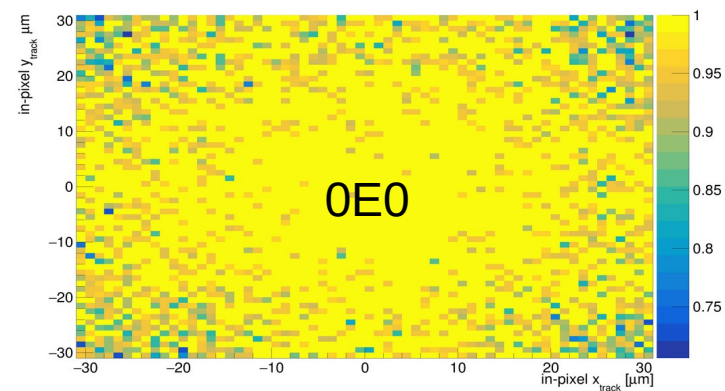
RD50_MPWx_0 Pixel efficiency map
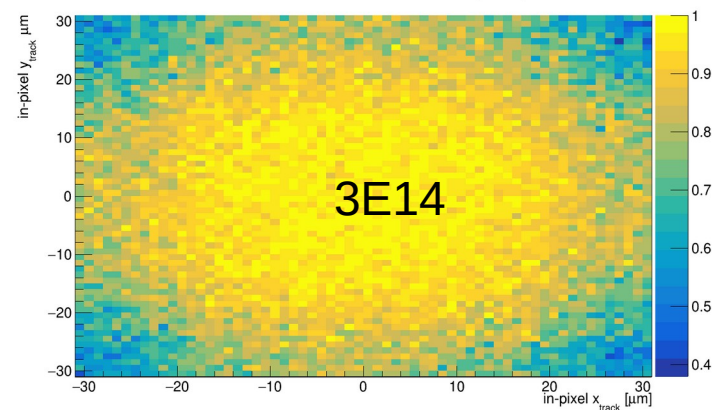
3E14

Minimizing thresholds

| DUT	V_{Thr}	V_{Bias}	Efficiency	Comment
0E0	960mV	190V	99.9%	Lower V_{Thr} at higher V_{Bias} done in April
1E14	1.02V	190V	99.8%	
3E14	950mV	190V	97.9%	No masking of hurt double column
1E15	970mV	190V	51.3%	No masking of broken double column, we'll see HV is key anyways
1E16	1.05V	300V	-	You already know the problem

- Minimum thresholds were not always usable for higher bias voltages
- Higher leakage current → higher noise

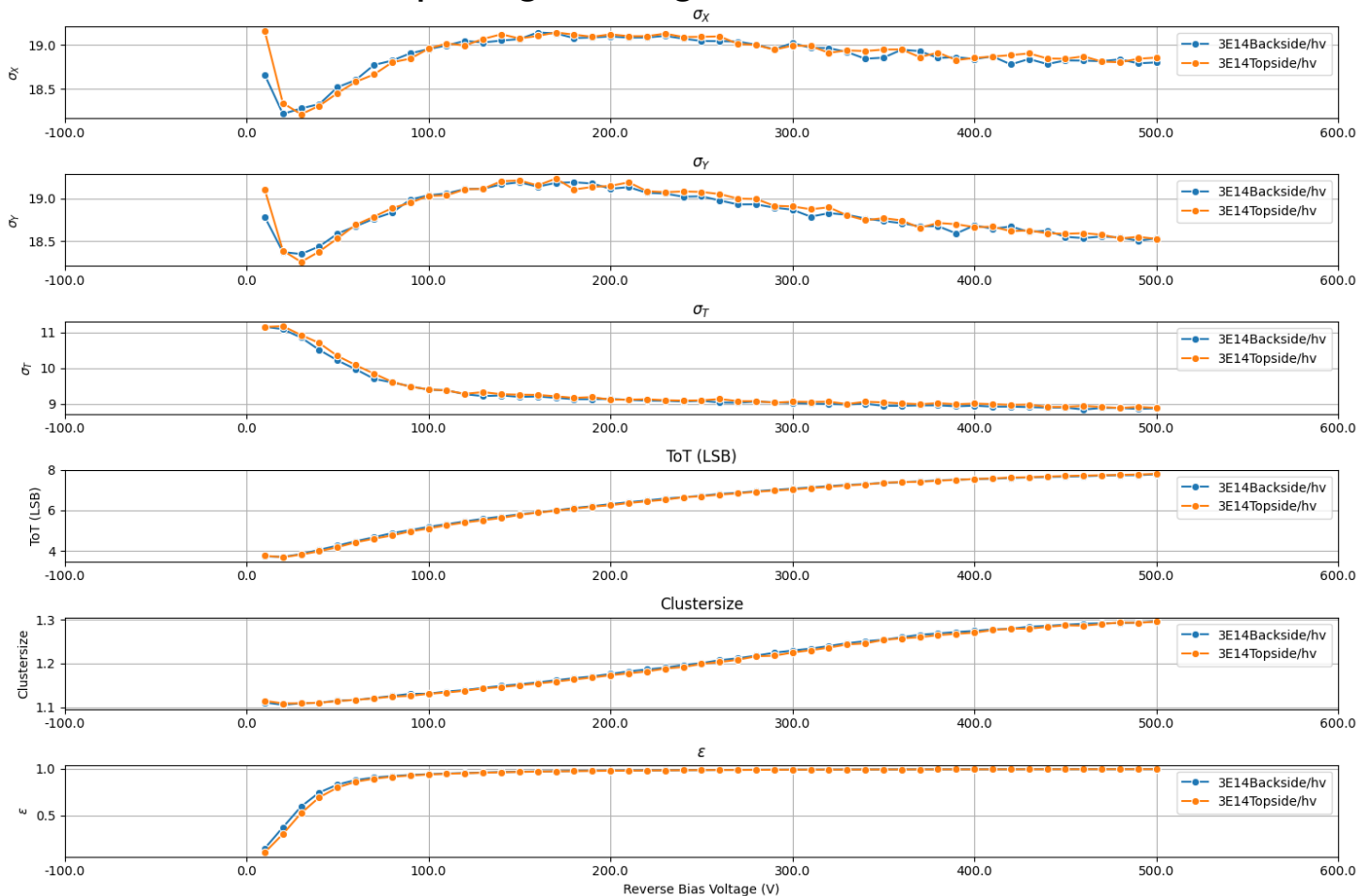# Comparing biasing schemes 1E14

Differences observed

Reason unclear (atm)

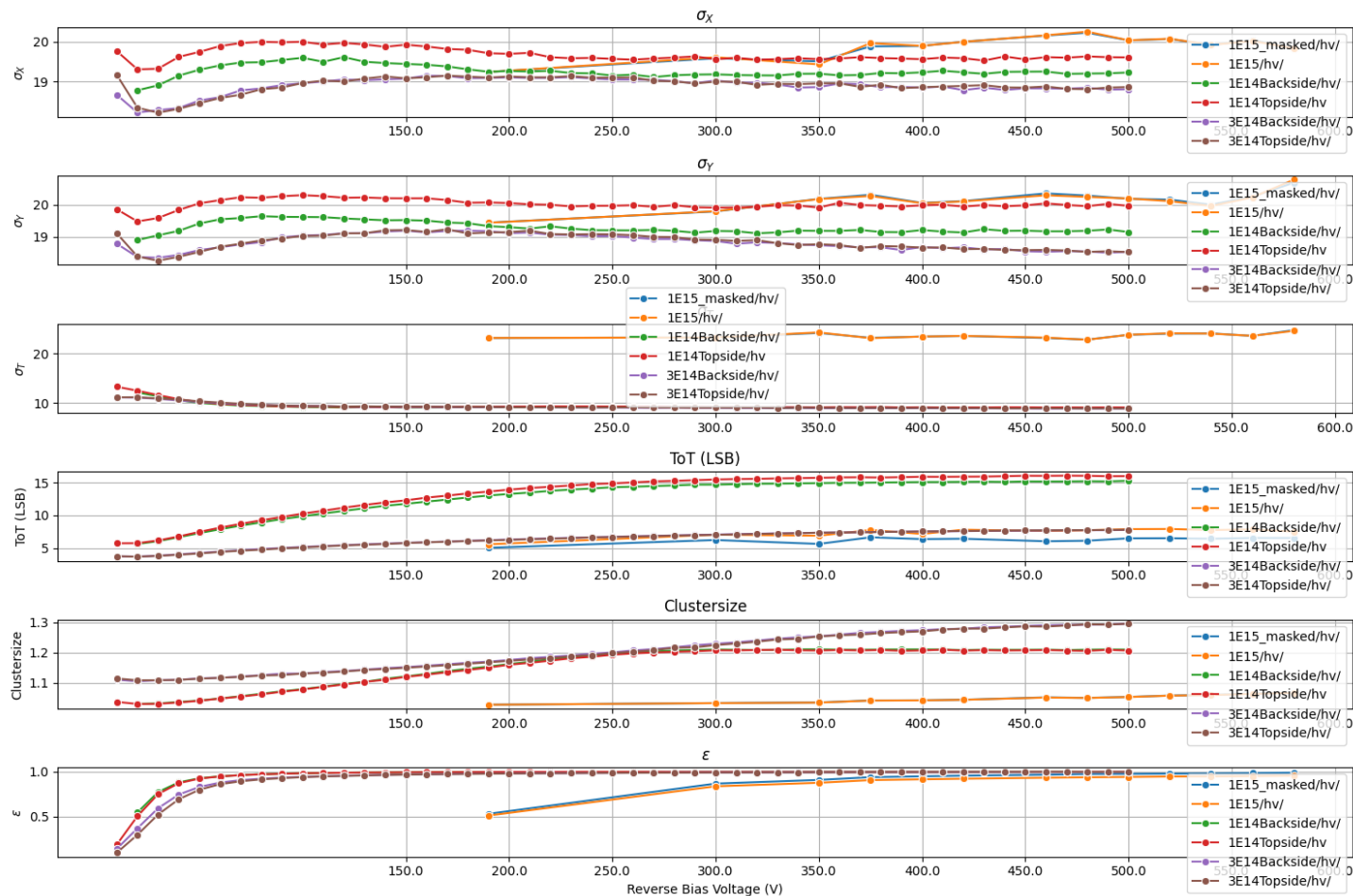No noteworthy differences encountered

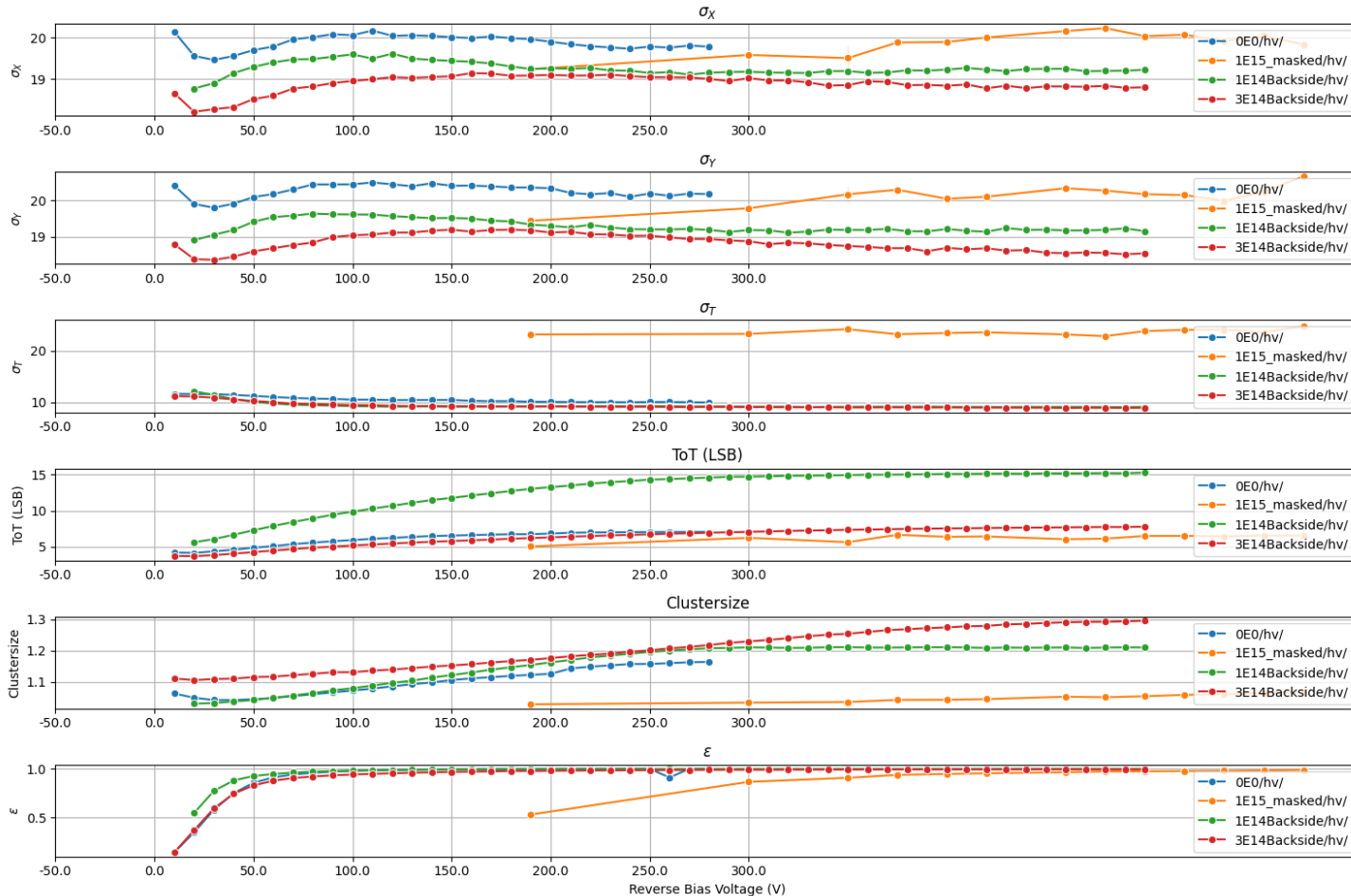11
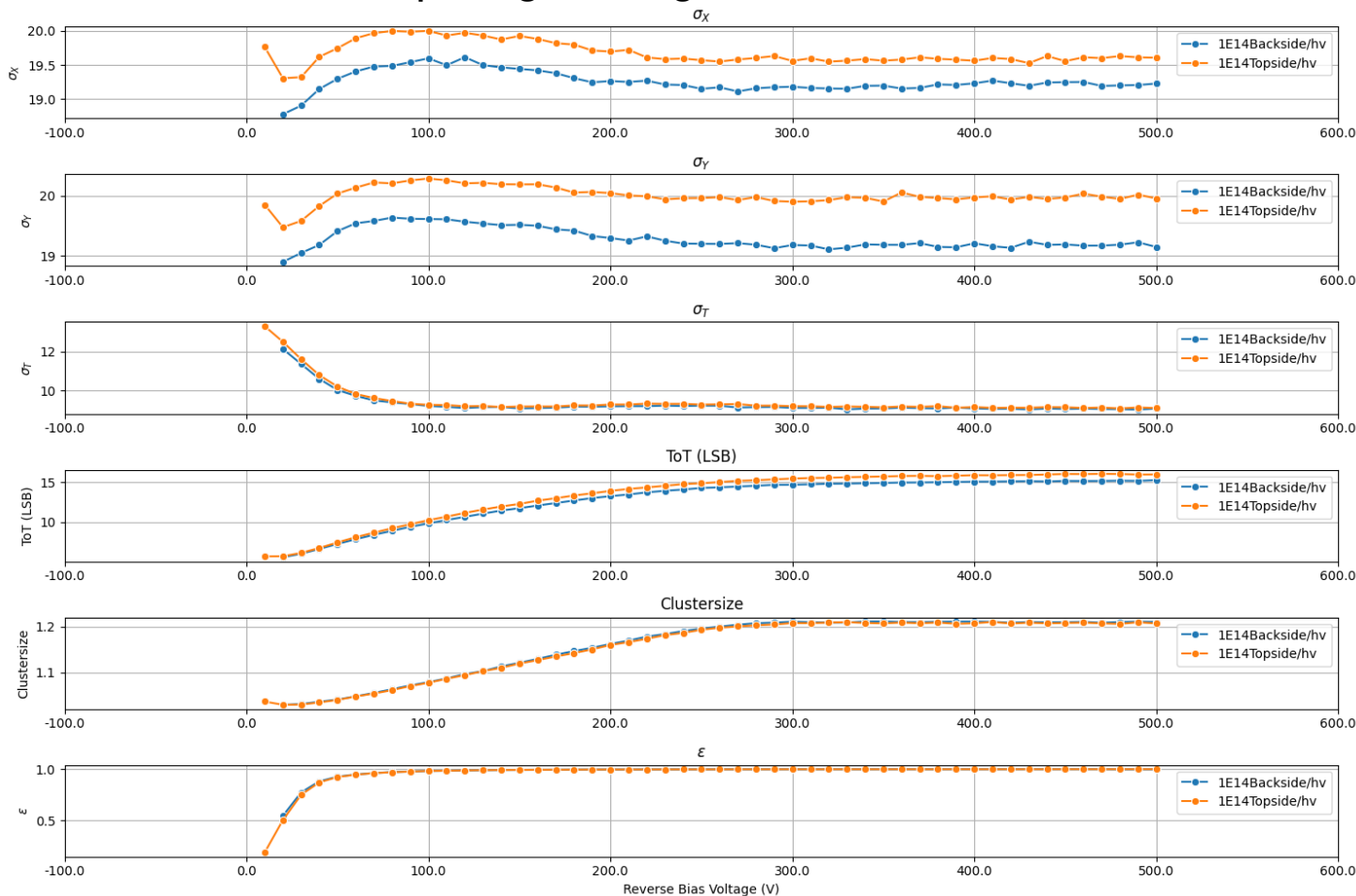
Comparing biasing schemes 3E14

No noteworthy differences encountered

The entire testbeam in 1 figure

Just fluences

Spatial resolution effects:
3E14 better 1E14 better 1E15
Not understood yet

Timing resolution of 1E15 invalid
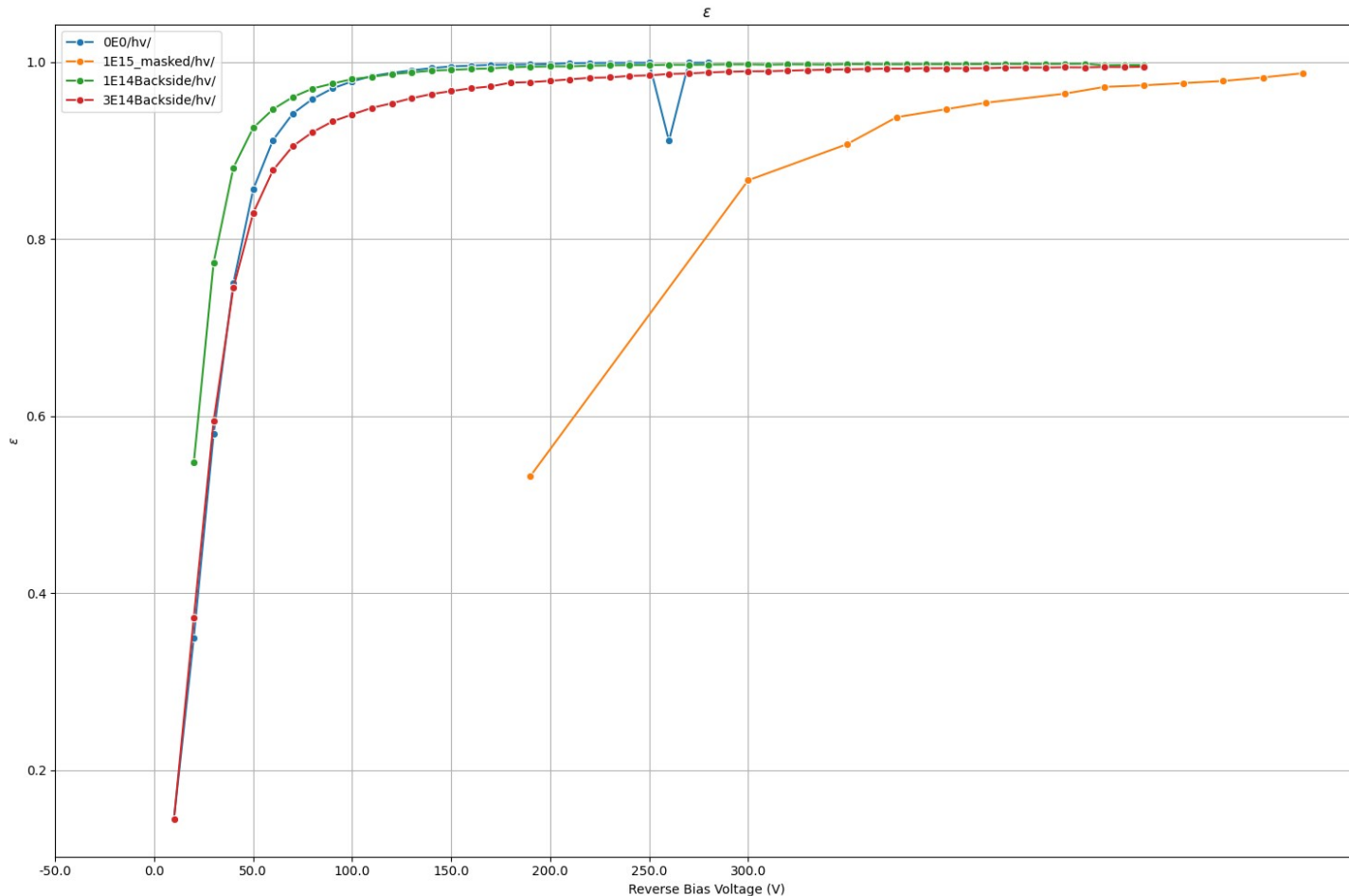(see "Problems")

Significant ToT drop
from 1E14 → 3E14

3E14 → 1E15 not
so much more

Significant cluster size
drop at 1E15
3E14 > 1 E14??
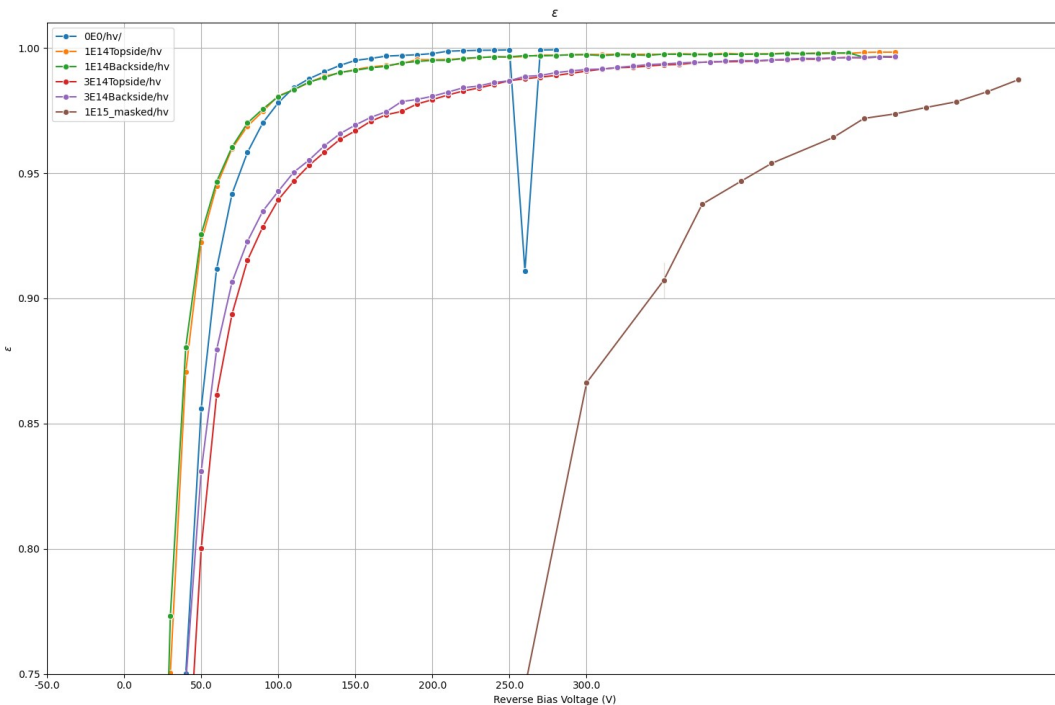
Larger fluence →
larger bias needed

Just Efficiencies

Fewer points for
1E15 due to
it's destruction :(

DUT	V_{Thr}
0E0	1.0V
1E14	1.1V
3E14	950mV
1E15	970mV

Used threshold as low
as possible without noise

- Only minimal differences between top and backside biasing
- Minimal but backside seems to be better at lower bias voltages

Best Efficiencies

DUT / Fluence	Biasing	VThr	VBias	Efficiency	Comment
0E0	Top	1.1V	210V	99.9%	
1E14	Top	1.05V	600V	99.9%	Lower V_{Thr} available
3E14	Back	950mV	500V	99.6%	Masked noisy pixel but not the hurt double column
1E15	Top	970mV	580V	95.4% / 98.7%	Full / Masked
1E16	Back	1.05V	300V	-	
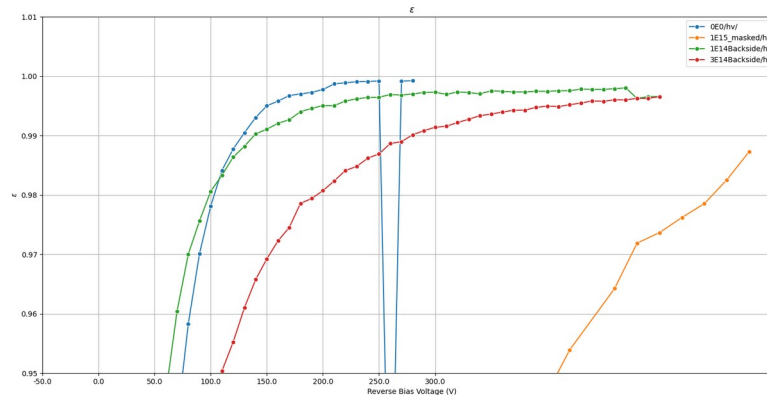
- # 1E14 and 3E14 achieving full efficiency
  - Higher bias voltages needed though (The HV-CMOS approach works)
  - Biasing scheme top- vs. backside not showing major differences
- # 1E15 still performing good
  - If it did not die, we would have achieved full efficiency
  - Backside biasing was not possible (W8)
- # 1E16 is basically not working anymore

ToDo

- Clean up some plots

- Why is unirradiated sample behaving so bad? Investigate!

- VNFB scans

- Mask pixels which were masked in the config

- More stuff will definitely come up

- Future testbeam?

- New samples (multiple per fluence) in range 5E14 → 5E15 (all backside processed) needed