

First Timing Measurements with RD50-MPW2

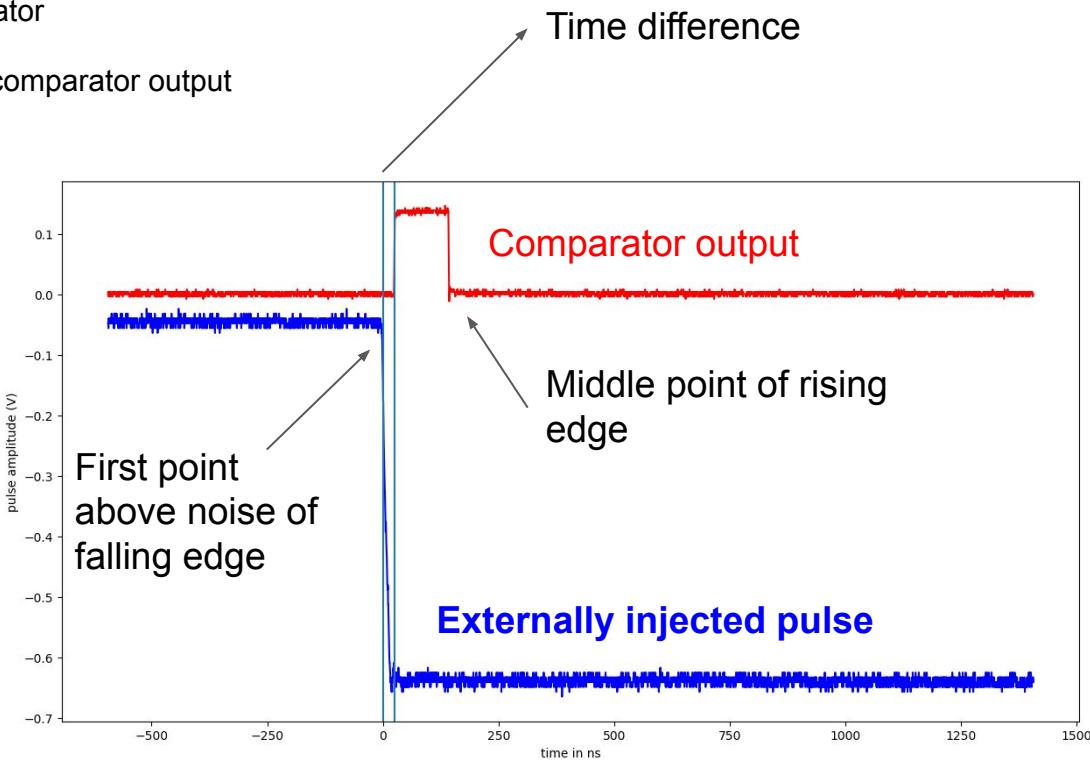
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Overview

- Measurements of time resolution using a pulse generator
- Measure time difference between injected pulse and comparator output
- Obtain time resolution from the spread
- Change parameters:
 - amplitude of pulse
 - pixel flavour, threshold and bias voltage

Also:

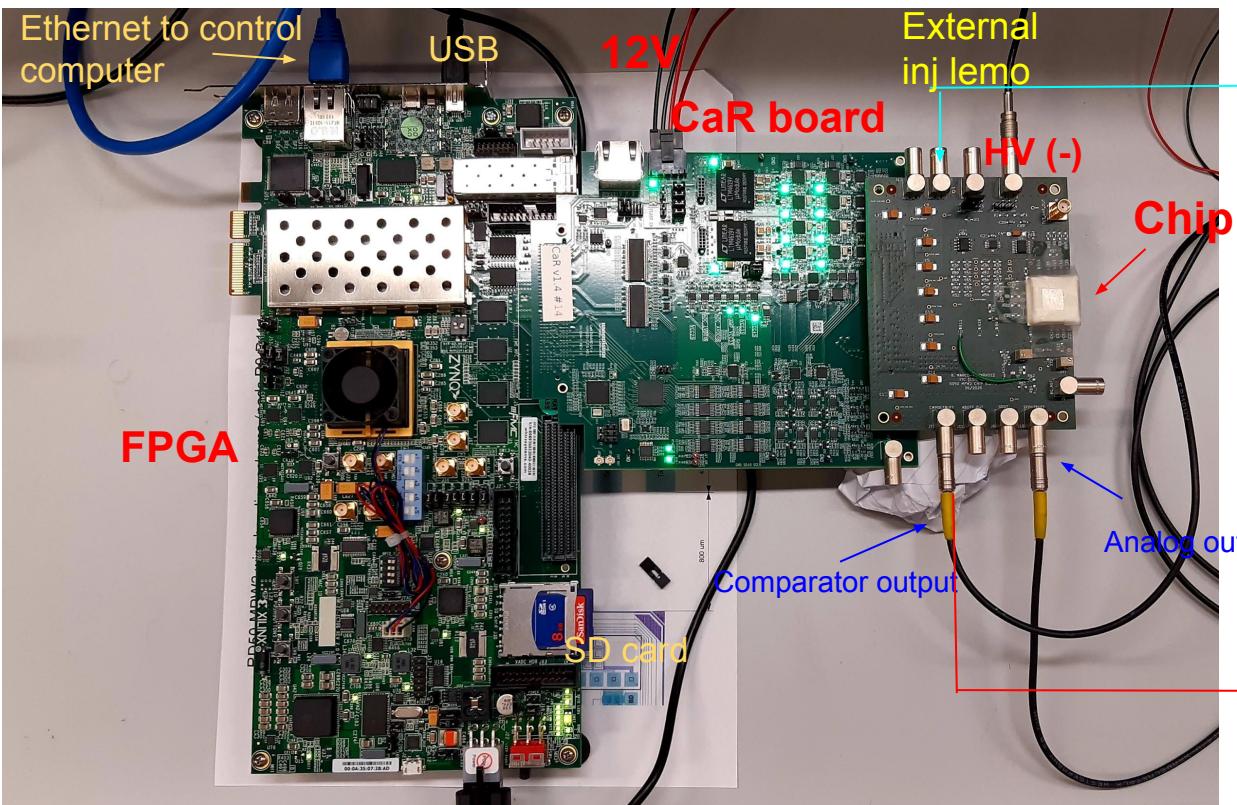
- Hitmap plot using a Str90 radioactive source
- IV Curve
- sCurve with TrimDac for all pixels



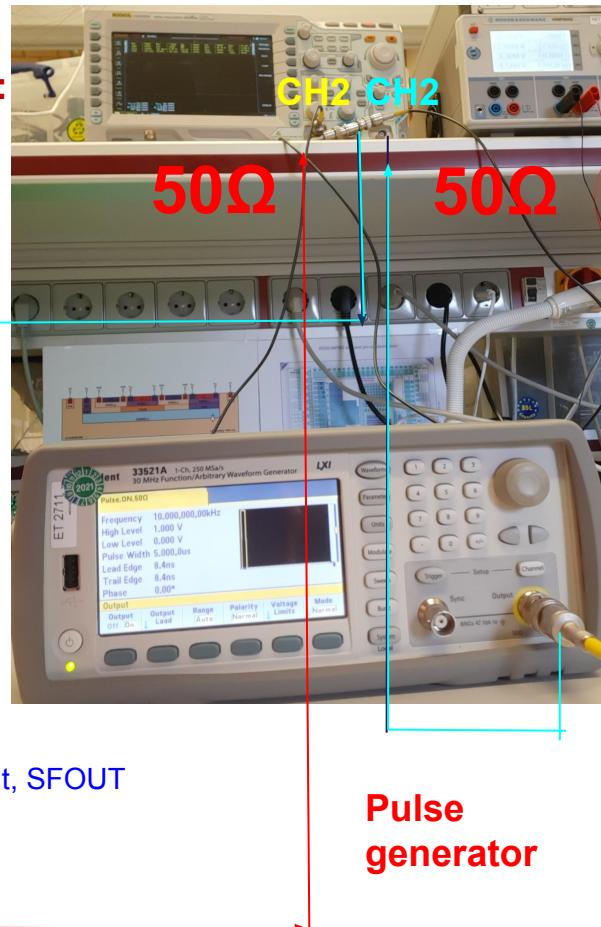
Two unirradiated chips: w10 and w13

- First timing measurements done with chip w10 of resistivity $1.9\text{k}\Omega \cdot \text{cm}$
- Problem with power to comparators on Caribou
- Replace a U89 gate on Caribou and
- Wire bond new chip: w13 of resistivity $\geq 2\text{k}\Omega \cdot \text{cm}$
- Chip w10? Trouble configuring, there is some output, further investigation needed

Setup - External pulse injection



Oscilloscope:
500MHz
10GSa/s



Setup - Interface

-Interface by Samuel Powell, Liverpool

- Configure the chip, pick pixels, set threshold

- Default Threshold: 1000, Baseline 900

- Hitmpas and sCurve data

- Internal injection

- Hitmap with a radioactive source

Injection point

- Two pixel “flavours”: continuous and switched reset
- Columns 0 - 3 are continuous, 4 - 7 switched
- Reading the COMPOUT readout

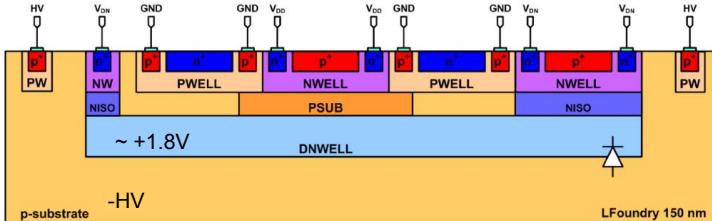


Figure 5.1. Simplified cross-section of one pixel

External injection

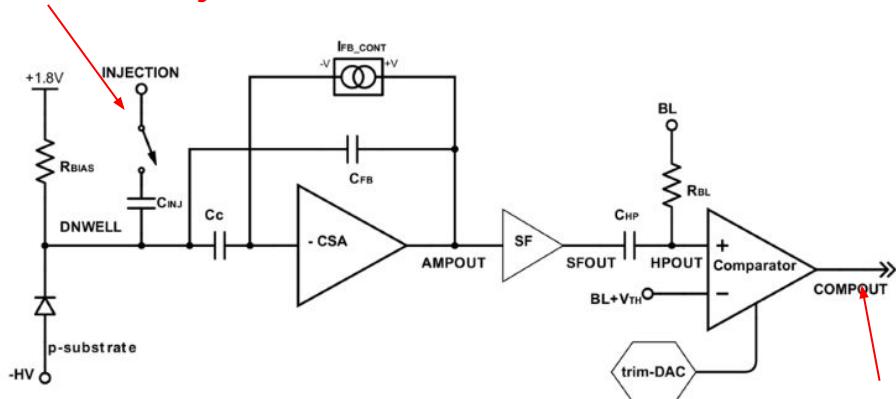


Figure 5.2. Schematic diagram of the continuous-reset pixel

Comparator output

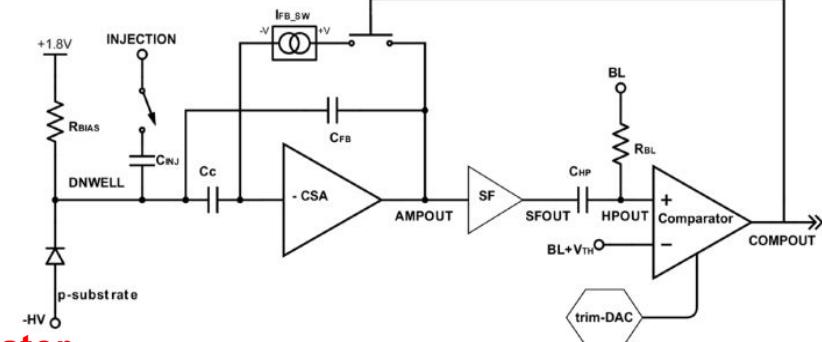
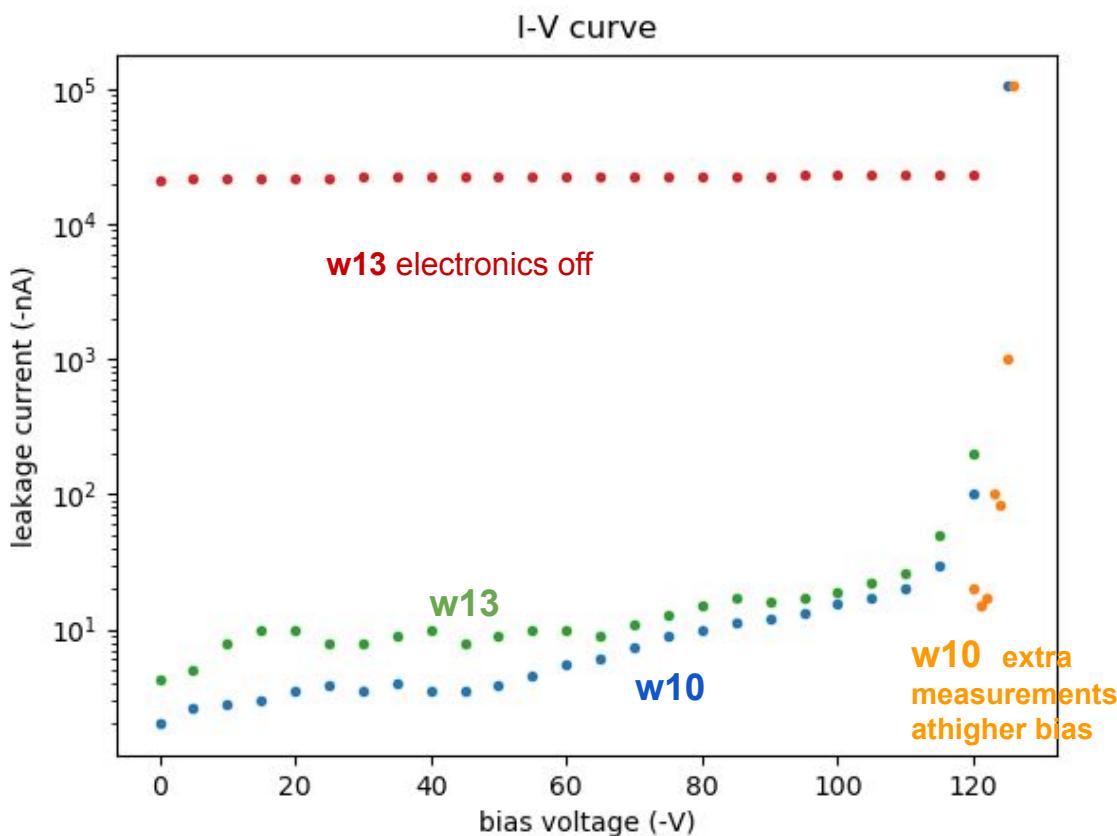


Figure 5.9. Schematic diagram of the switched-reset pixel

IV curves for chip w10 and w13



Red: Caribou electronics powered off for chip w13

Green: Chip w13

Blue/Yellow: Chip w10 (older measurement)

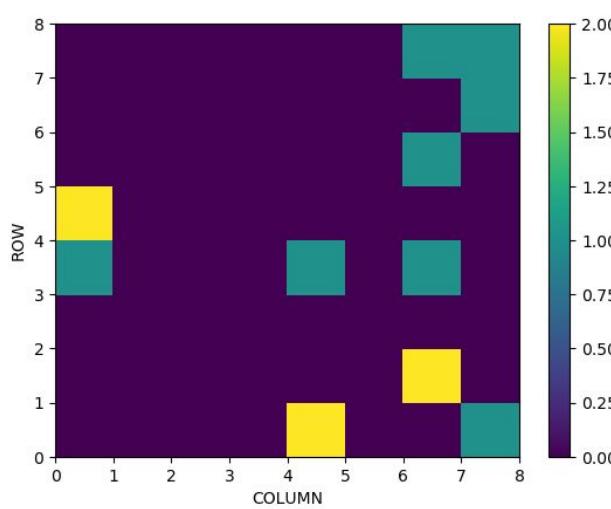
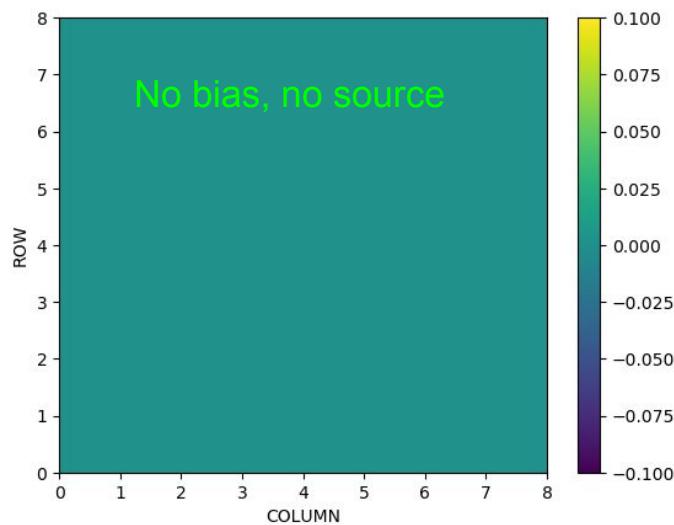
Steps of 5V

Yellow: step of 1V

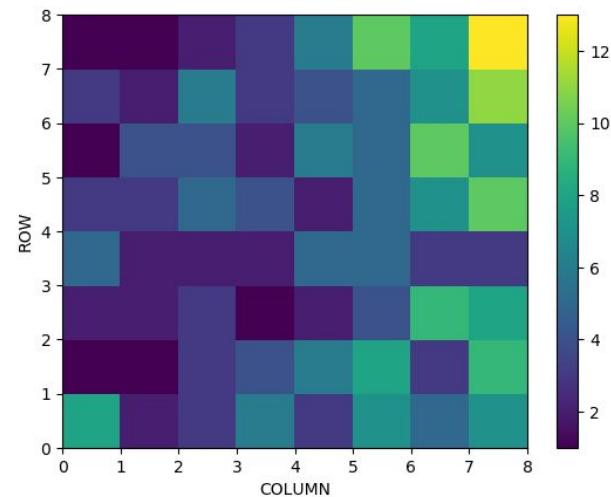
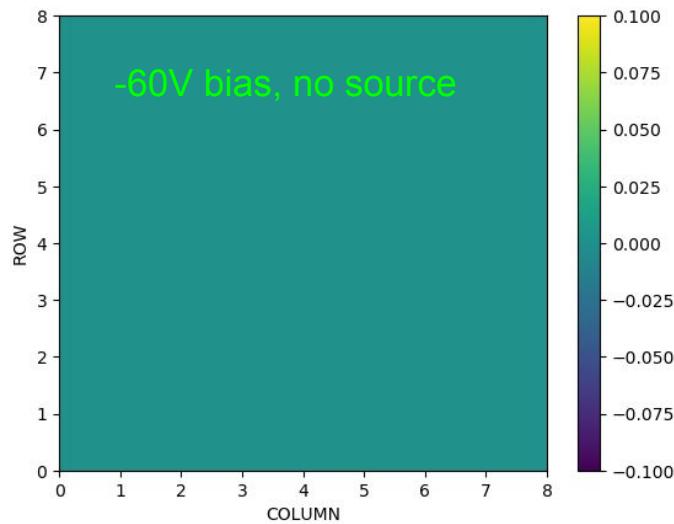
-IV curves for both chips are similar,

-Approaching breakdown at minus 125V

Str90 source Hitmaps

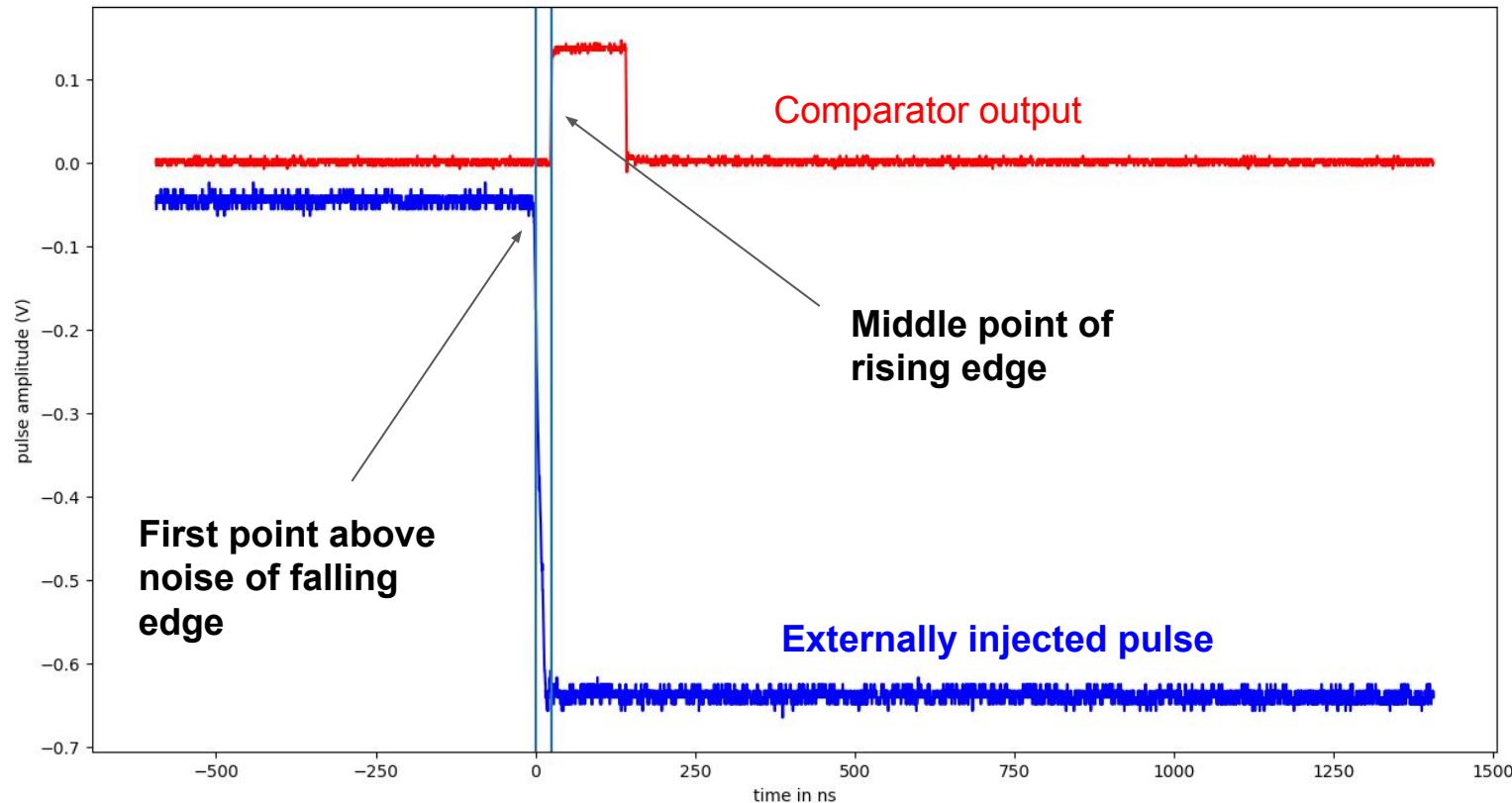


No bias



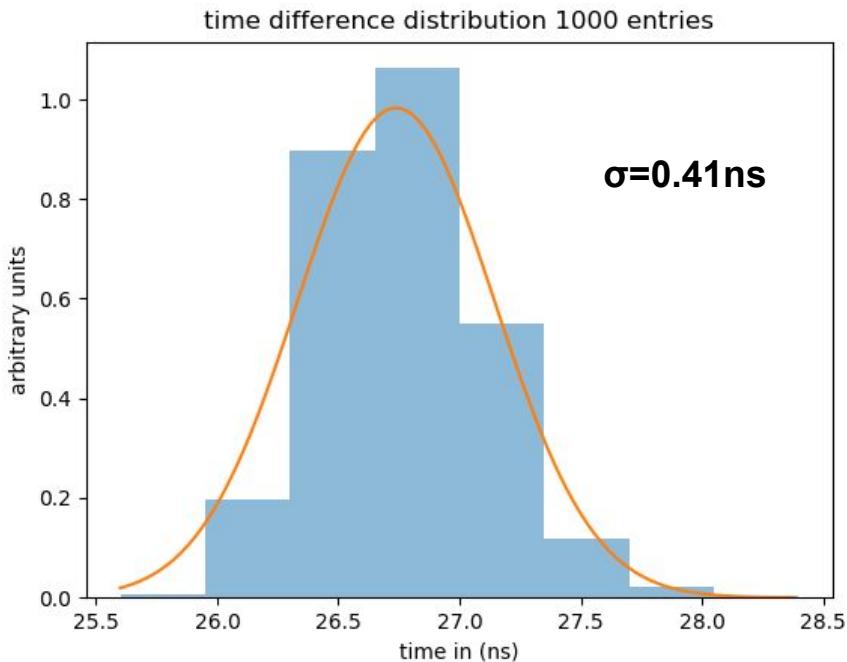
-60V bias

Time difference between injected pulse and COMPOUT

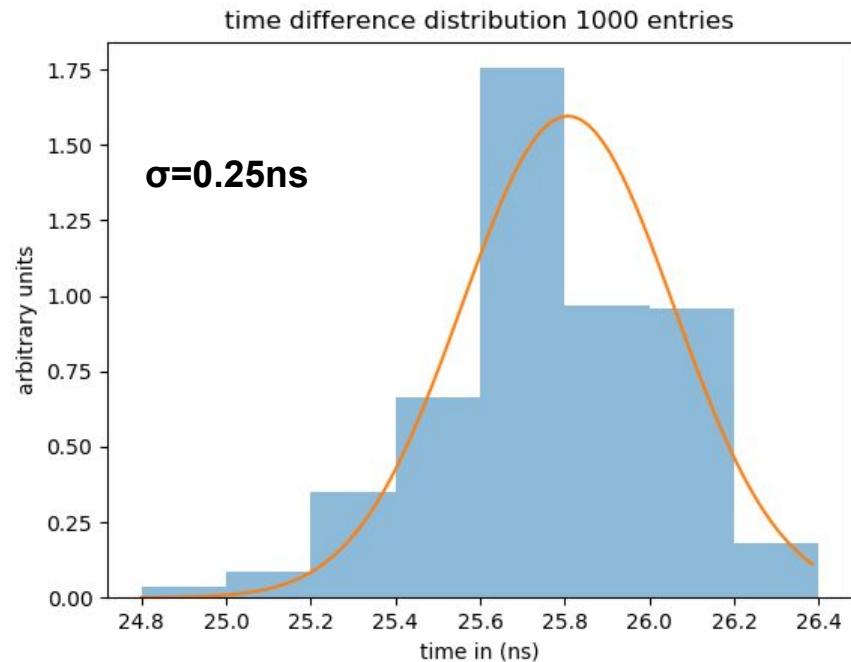


Time resolution - different injected pulses - chip w10

One pixel

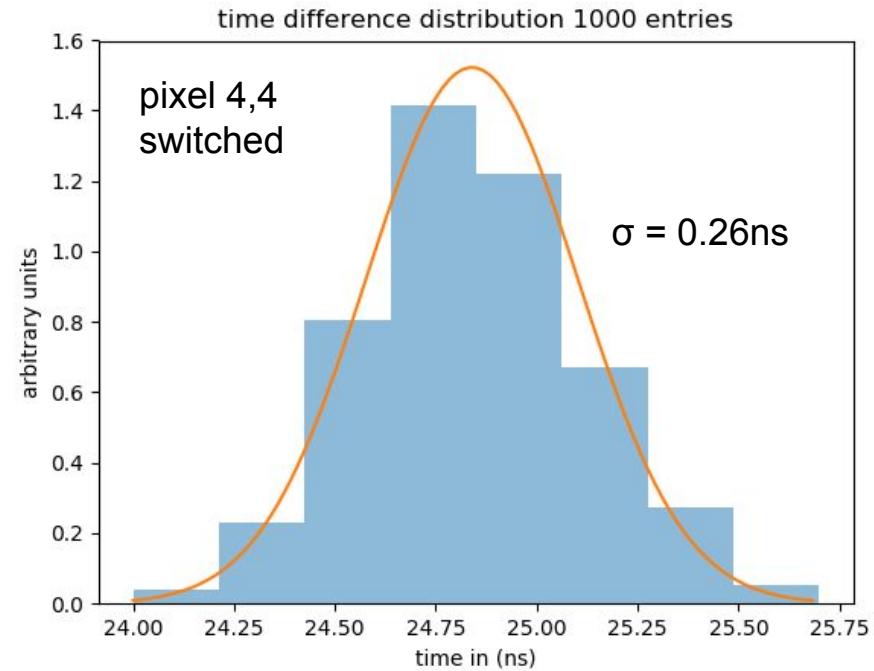
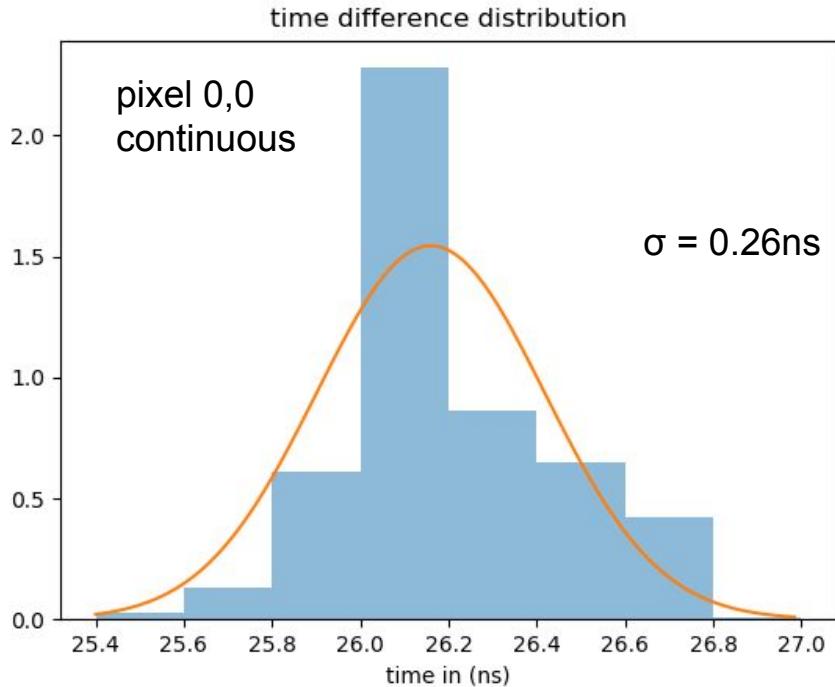


Injected pulse: 1.2V



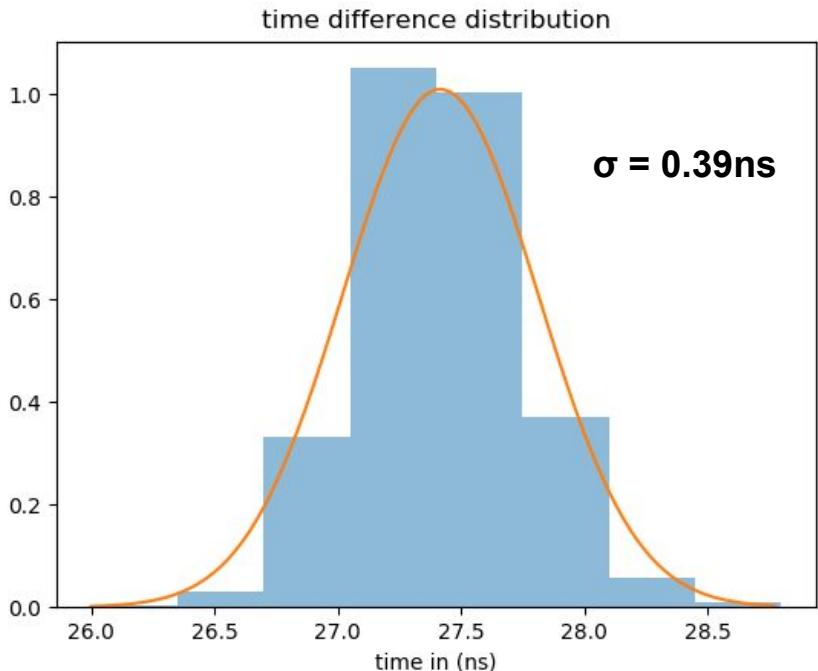
Injected pulse: 1.8V

Time resolution -Two flavour pixels - chip w13

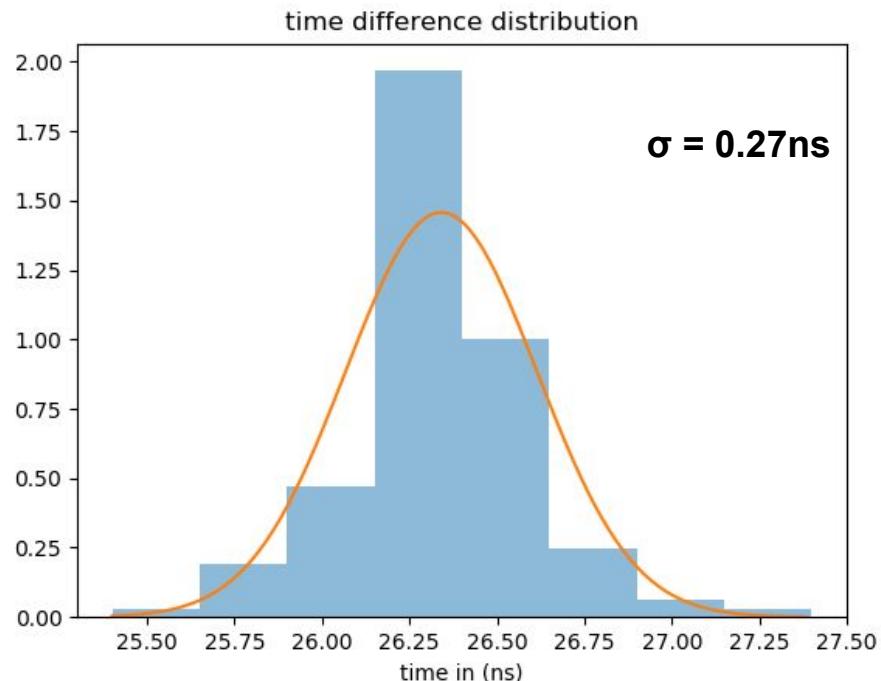


Injected pulse: 1.6V on both

Time resolution for different inj. amplitude - chip w13 pixel 0,0 (continuous)

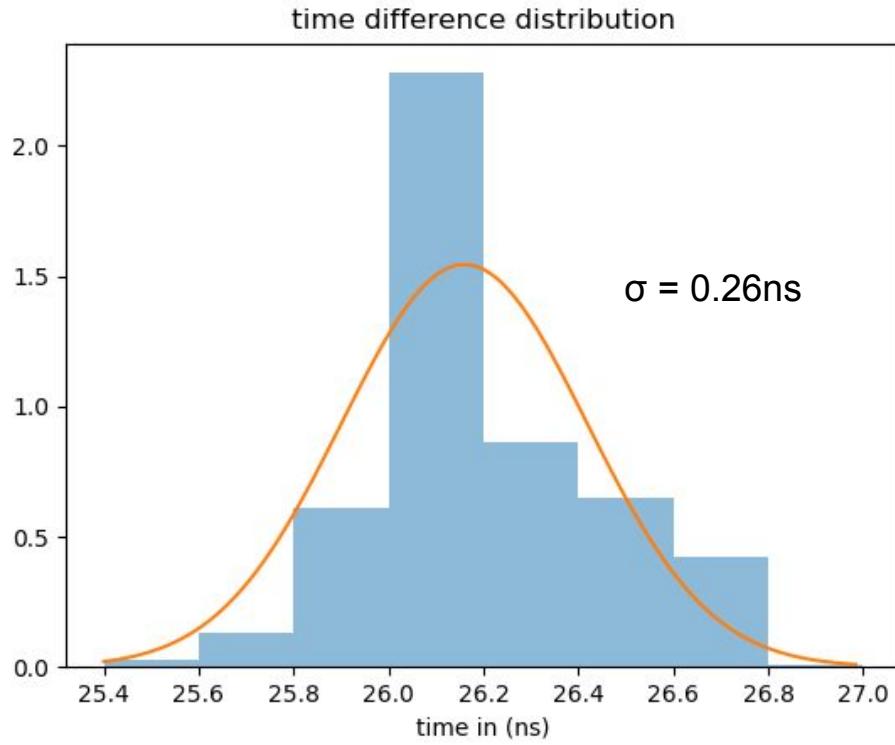


Injected pulse: 1V



Injected pulse: 1.3V

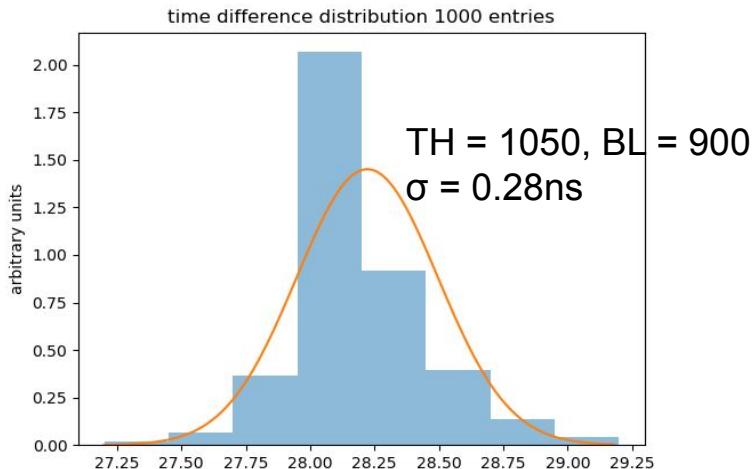
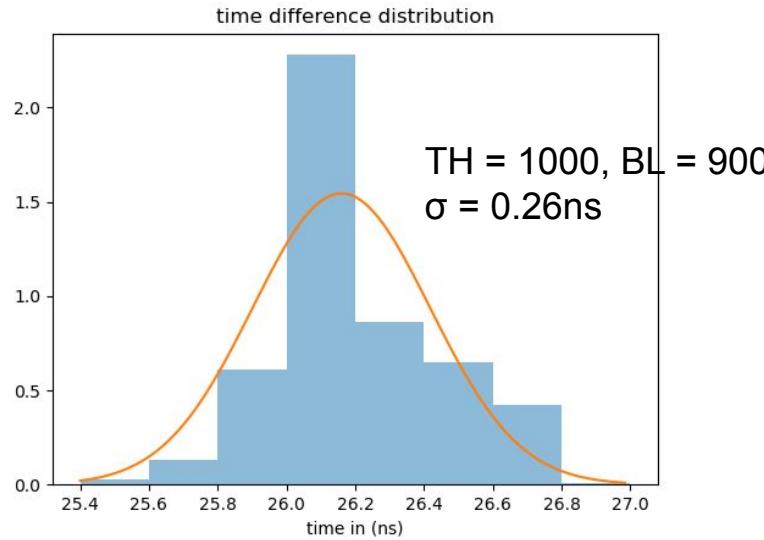
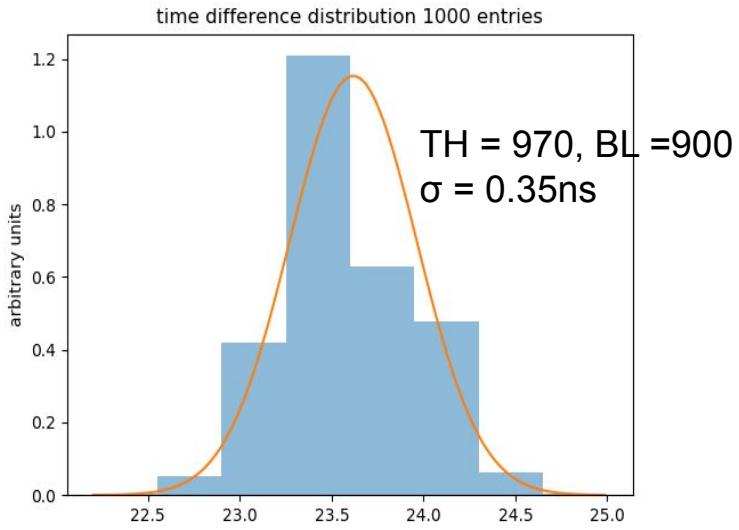
Time resolution for different inj. amplitude - chip w13 pixel 0,0 (continuous)



Injected pulse: 1.6V

As with chip w10

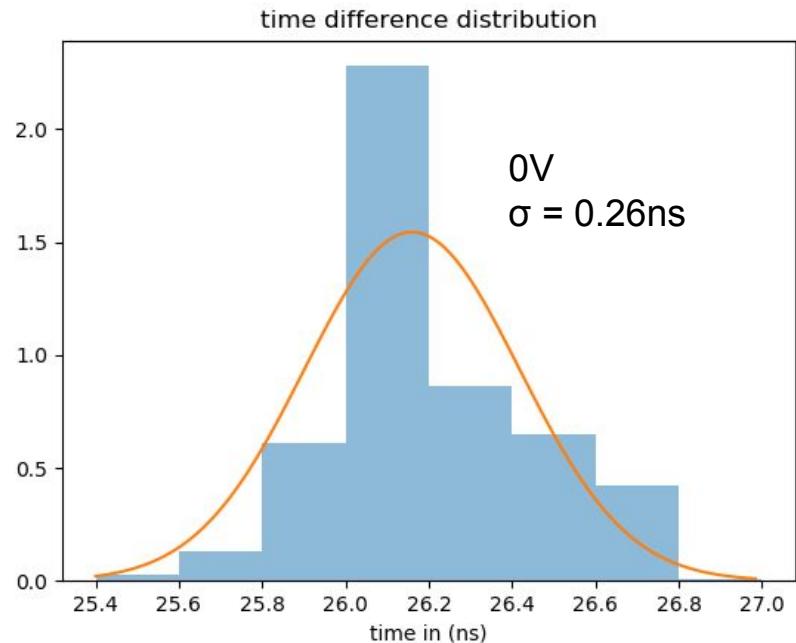
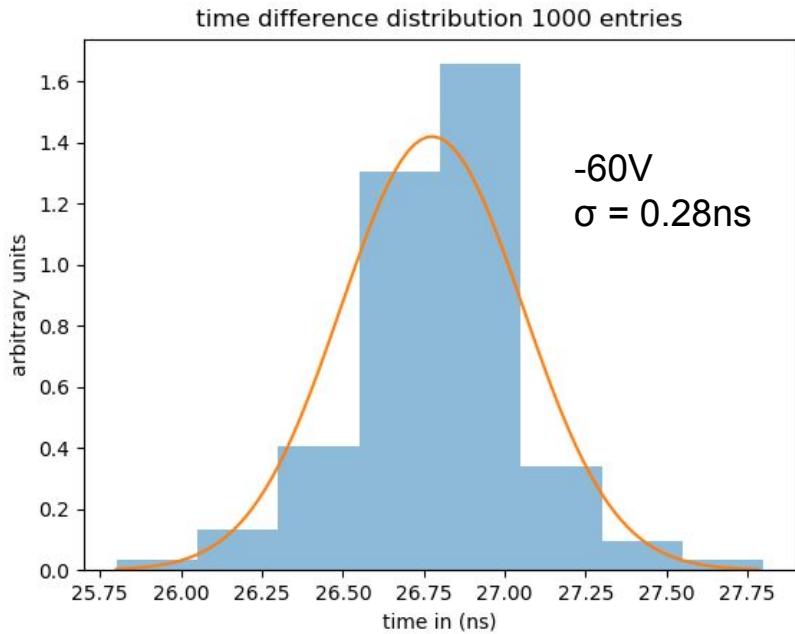
Time resolution improves at
higher injected amplitude



Timing resolution - varying threshold - chip w13 - pixel 0,0

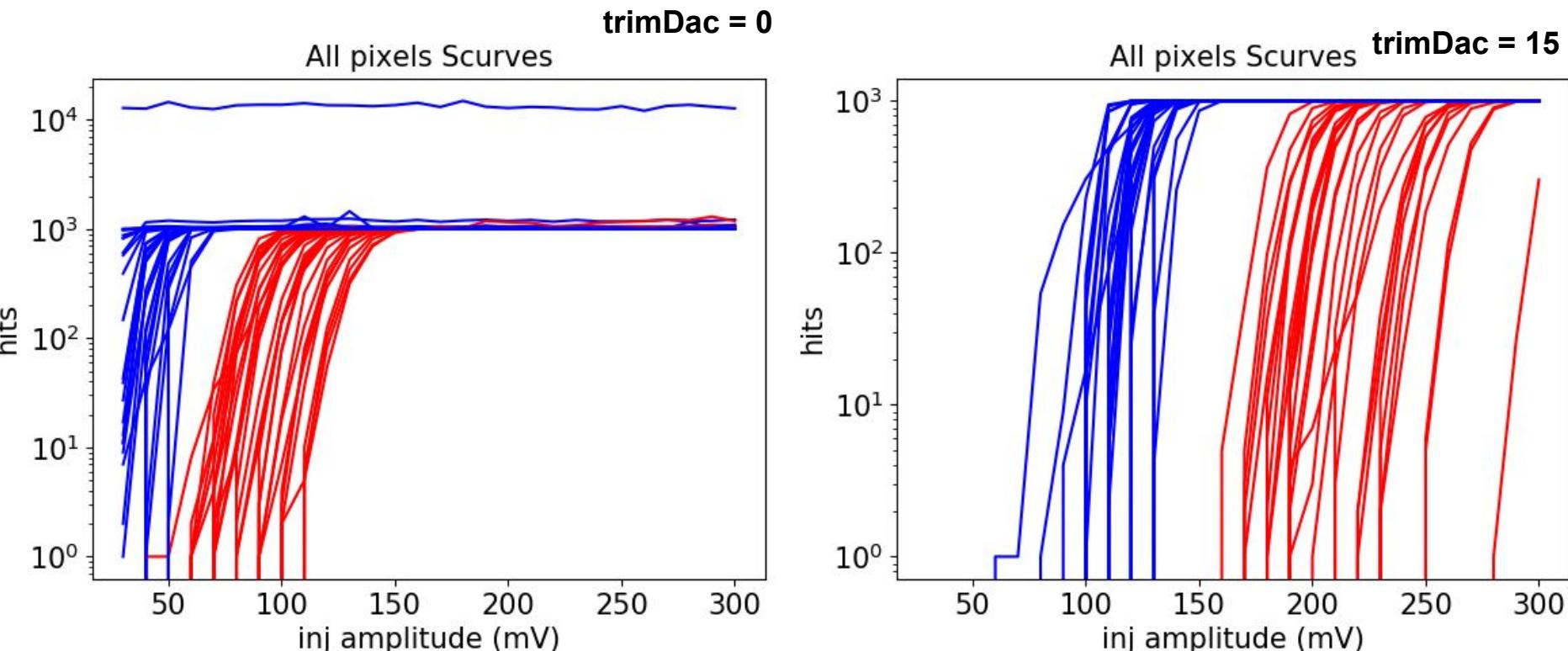
Injected pulse: 1.6V to all
Pixel 0,0

Timing measurement with bias voltage -60V - chip w13



Injected pulse: 1.6V, TH =1000, BL= 900, pixel 0,0

sCurves with TrimDac for all pixels - Threshold 1000



Results summary

- Both chips show same IV curve behavior and reach breakdown voltage close to -125V
- Signal with a radioactive Str90 source is detected using the interface and magnified when applying bias voltage -60V, as expected

Time resolution:

- Best: 0.25ns, Worse: 0.41ns
- Best for pulse amplitudes 1.3V and higher, Worse for lower pulse amplitudes (1V, 1.2V)
- Worse for lower threshold due to noise
- No significant difference between different chip flavours, different resistivities or application of bias voltage

Next steps

- Make the timing measurements more precise (faster oscilloscope)
- Adjust individual pixel trimDacs
- Single photon laser timing measurements
- Investigate chip w10

Thank you!

Questions and/or Suggestions?