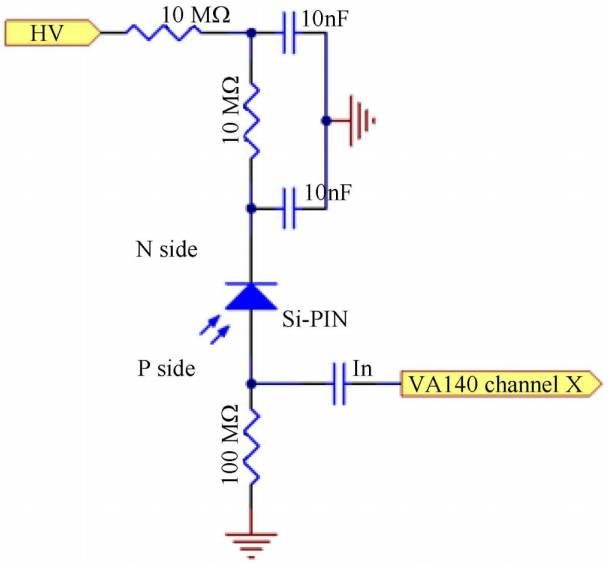
SMIC laser test

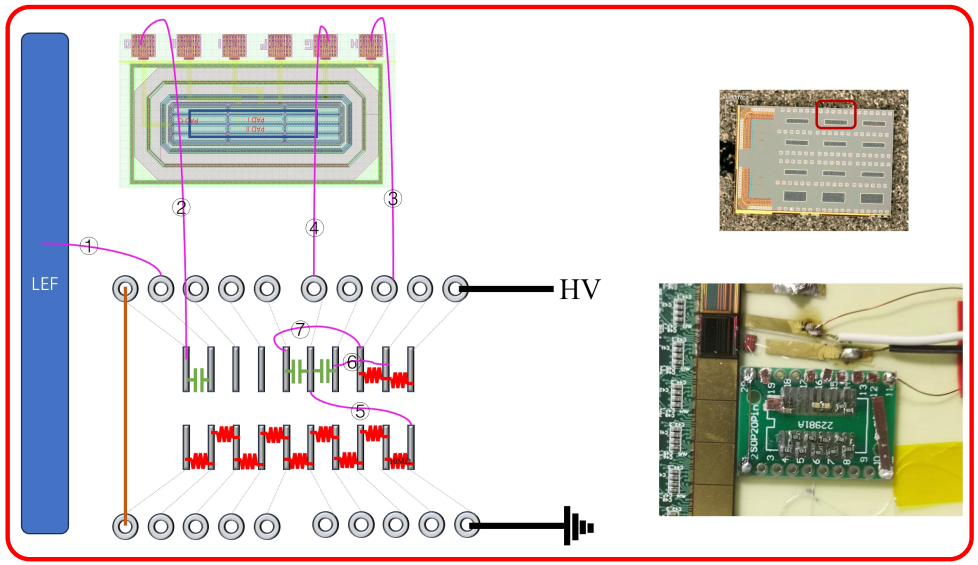
Yiming Li, Zhiyu Xiang, Zijun Xu

December 19, 2023

Setup

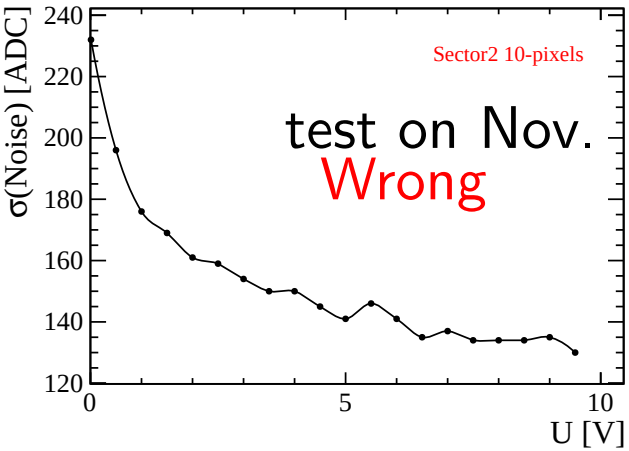
- Low pass fiter conected to source meter, large ground resistor to sample signal charge, AC readout.
- Only 1 channel is allowed to be bonded due to space limitation.

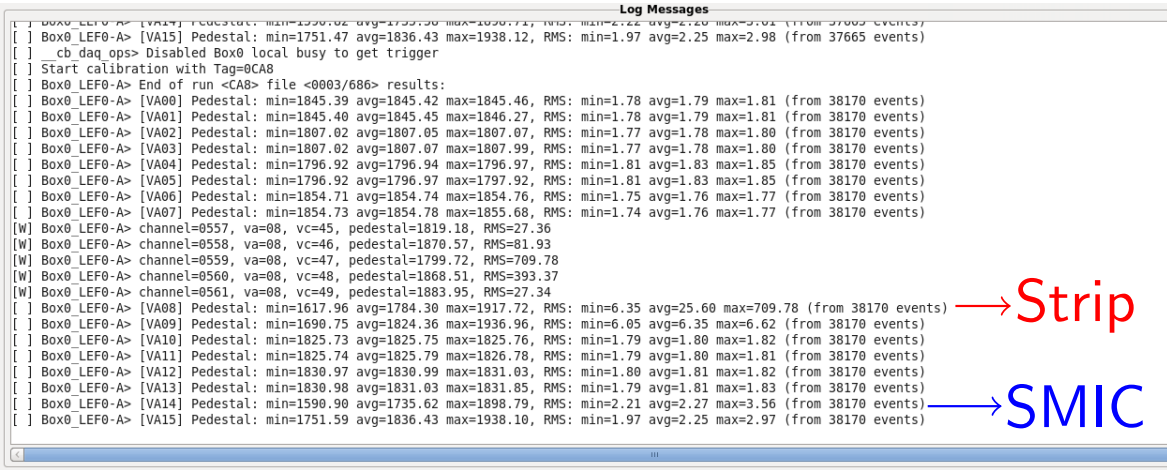




Noise

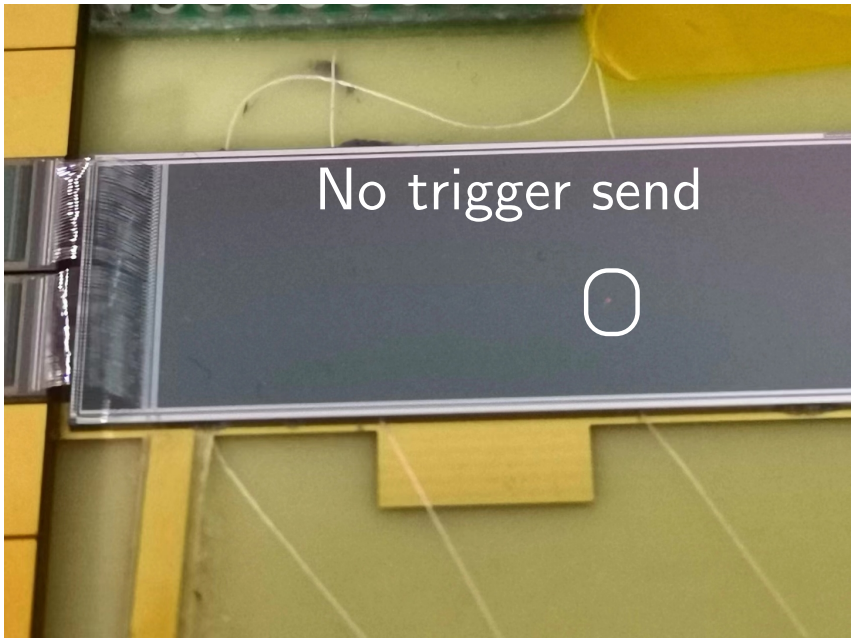
- Tested SMIC channel $\sigma(Noise) \sim 3.7$ (same level as strip channel). With such low noise can there be a chance to search signal.
  - Took wrong value in Nov. test. Si strip and SMIC share the same electronics (LEF) and DAQ system, they were common grounding.
  - The reverse voltage, which apply to SMIC, would affect the strip noise. Mistakenly thought an "anomalous" strip channel was the SMIC channel.





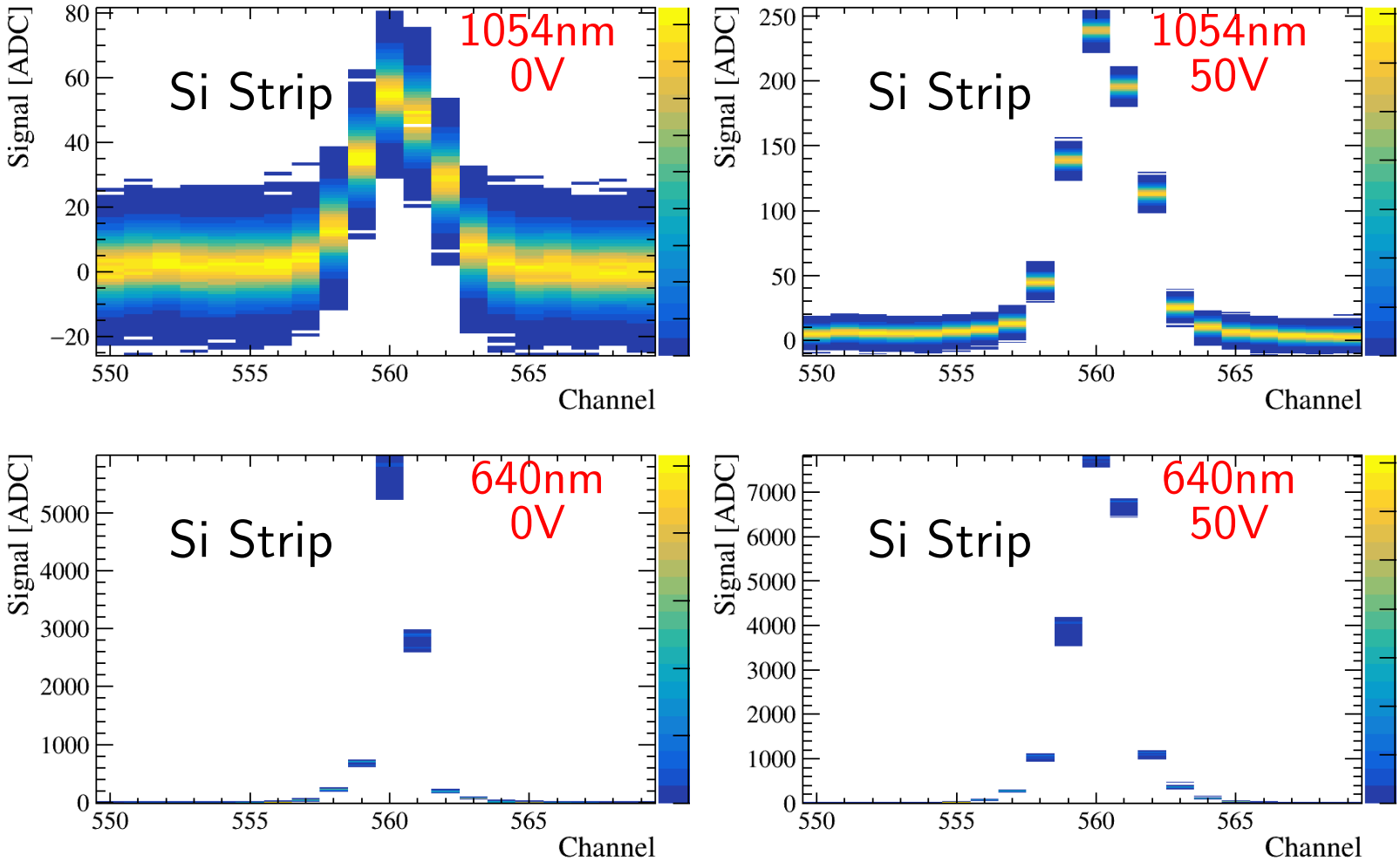
Why "anomalous" strip sensor noise

- Only found the "anomaly" occasionally, appears or disappear, would not be a bad channel.
- Reason is the laser not exactly poweroff even if no trigger send.
  - Cloud explain large $\sigma(Noise)$ of SMIC was seen. Even possible that baseline/pedestal was wrong, so signal around ~ 0 in most past cases.
- Need shutdown/poweroff the laser when measure noise.



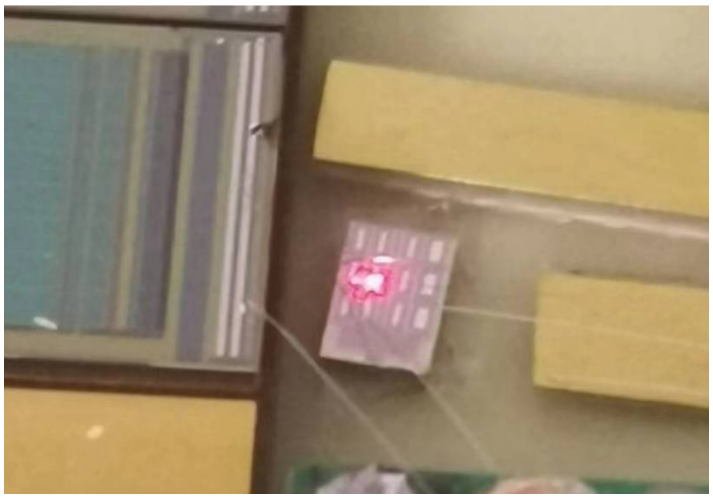
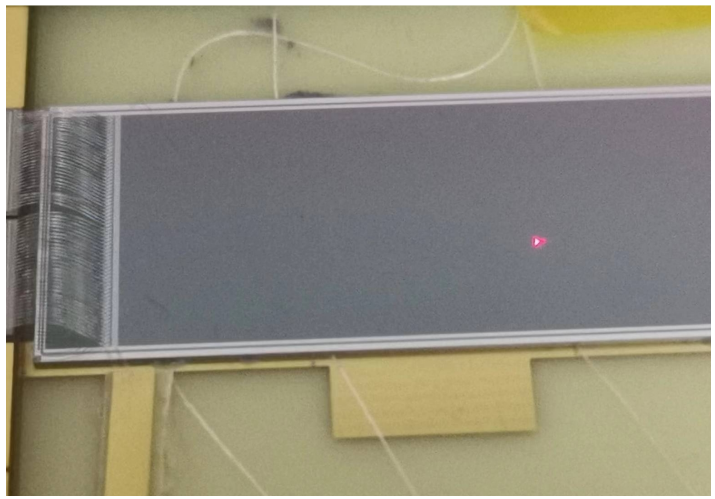
Laser type

- Infrared laser ($\sim 800\mu m$) is more permeable than red laser ($< 10\mu m$) to silicon (FERMILAB-TM-2643-E).
- Confirmed with Si strip det. Choose 640nm laser as source.

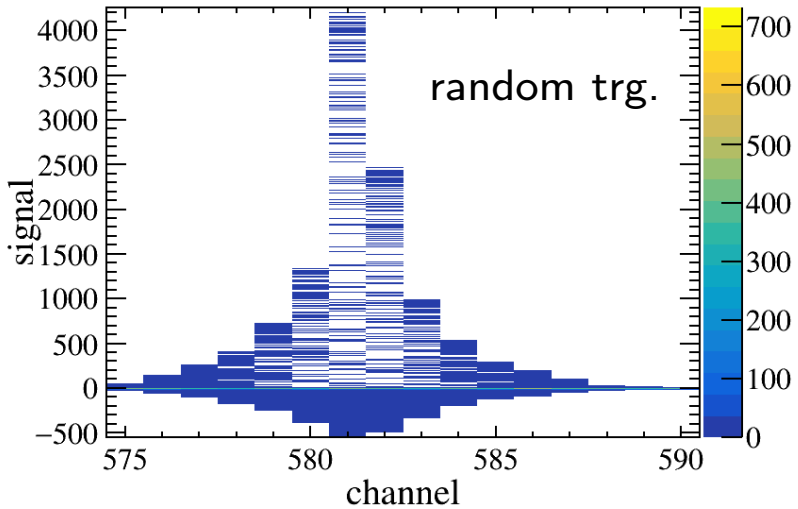


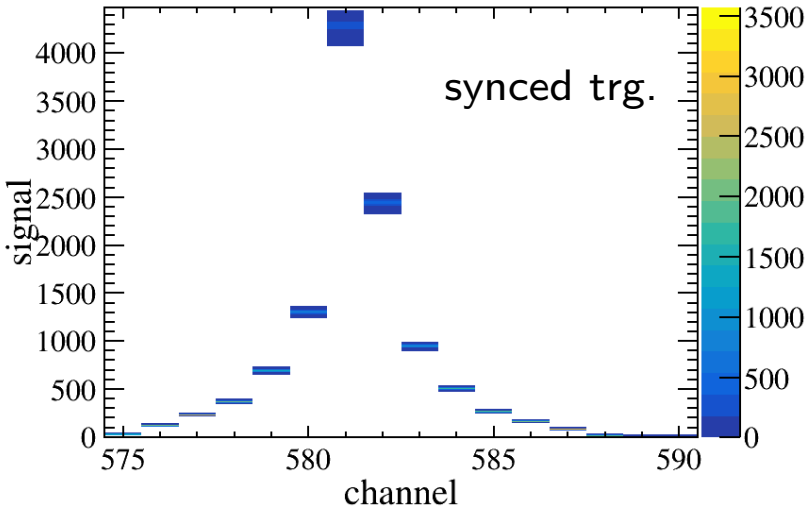
Laser spot

- Laser system receives (inter or exter) trigger signal, send narrow pulse emits light and then foucused on the SMIC or strip sensor.

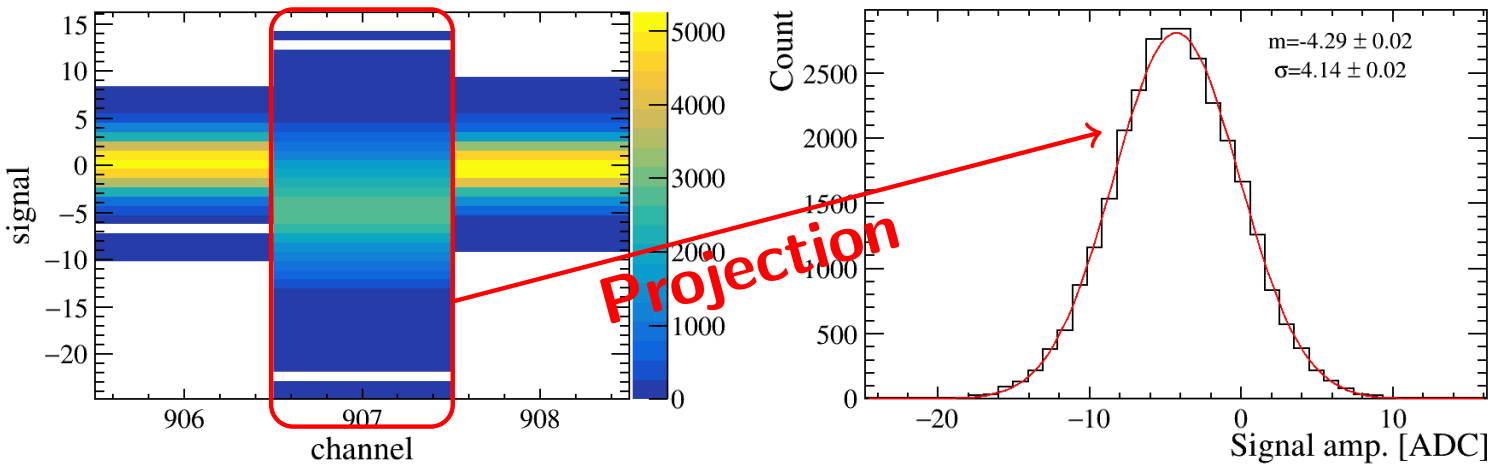
- Works on strip sensor for both random trigger or synced trigger.





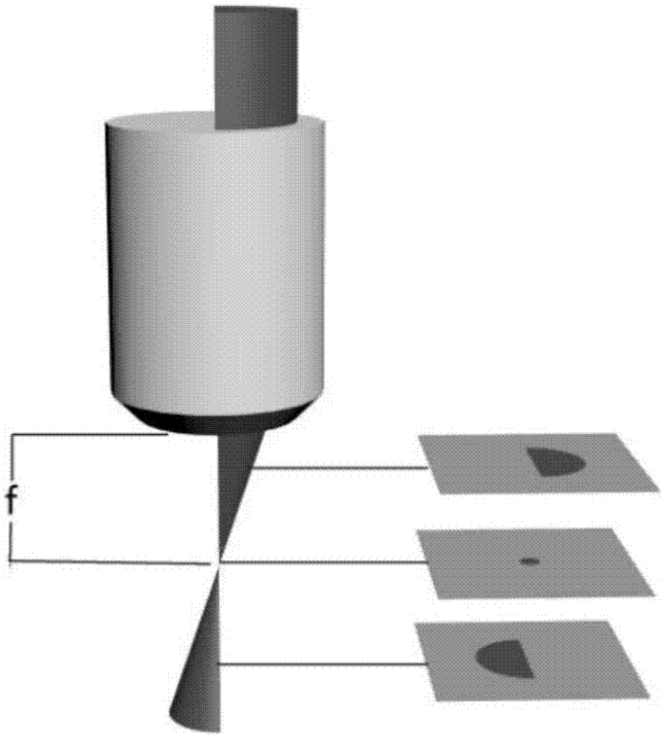
Signal behavior for SMIC?

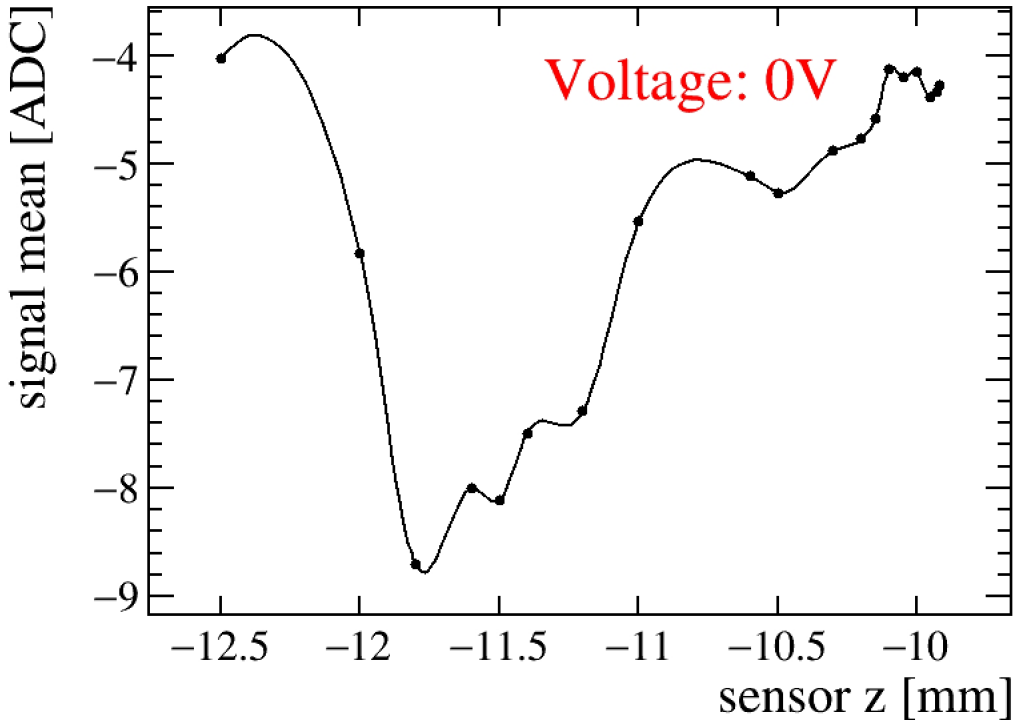
- SMIC channel number: 907. Others are empty channel.
- Hopefully, negative signal appears and drop clearly.
- Seems a slight drop for SMIC channel with laser irradiated with laser.
- Signal behavior??? scanning on foucus length and sensor window.



Scan in foucusing

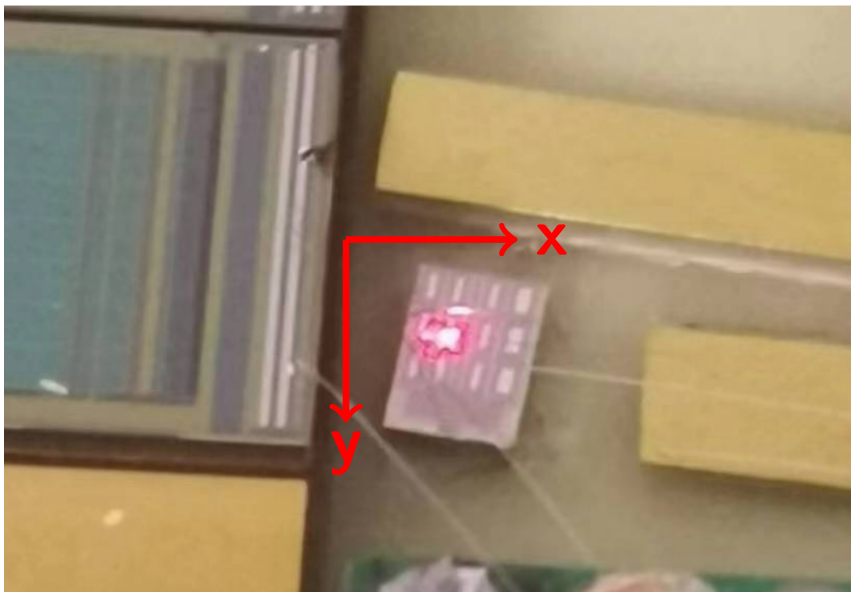
- Scan in focusing axis with 200μm step, fix the optimal z position.
- max(Signal mean):-8.7 ADC.

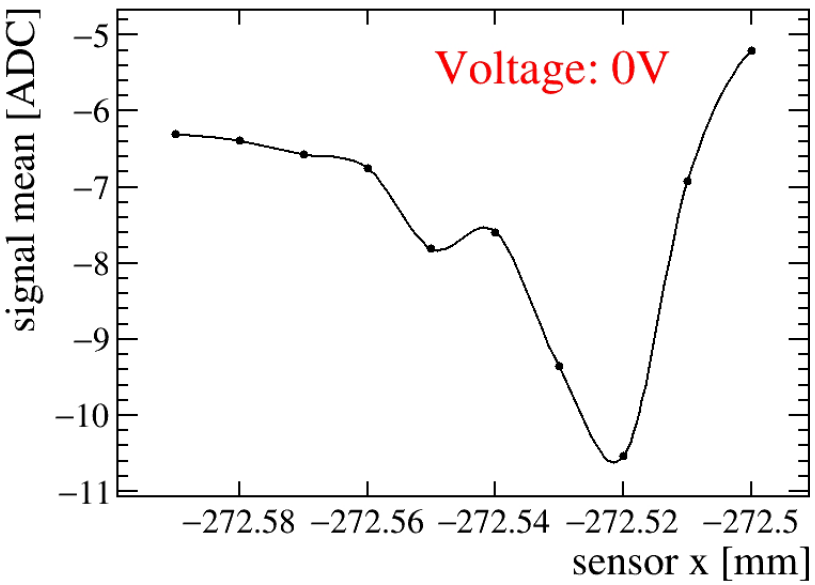




Scan on sensor window

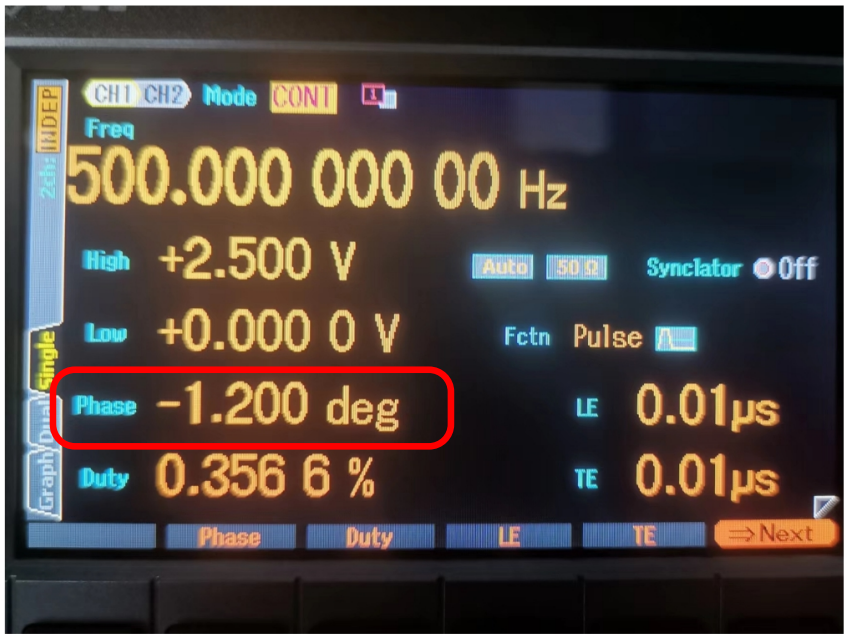
- Scan on sensor window (only in x direction) with $10\mu\mathrm{m}$ step, fix the optimal x position.
  - Although in y direction may not optimal, but sensor window is sufficient to cover laser spot.
  - Next plan to do 2D scan.
- max(Signal mean):-10.6 ADC.

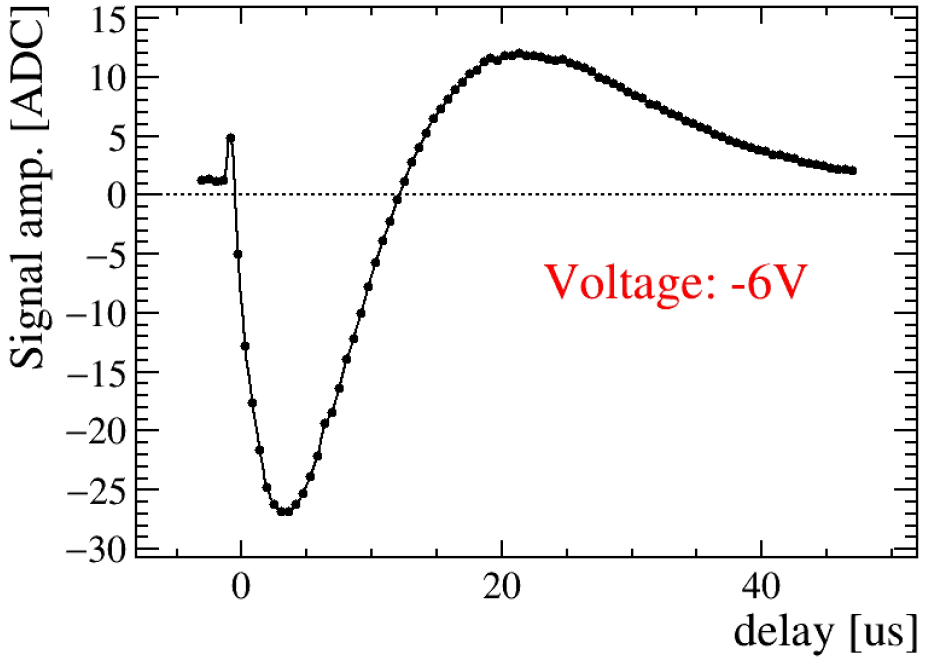




Scan on delay time

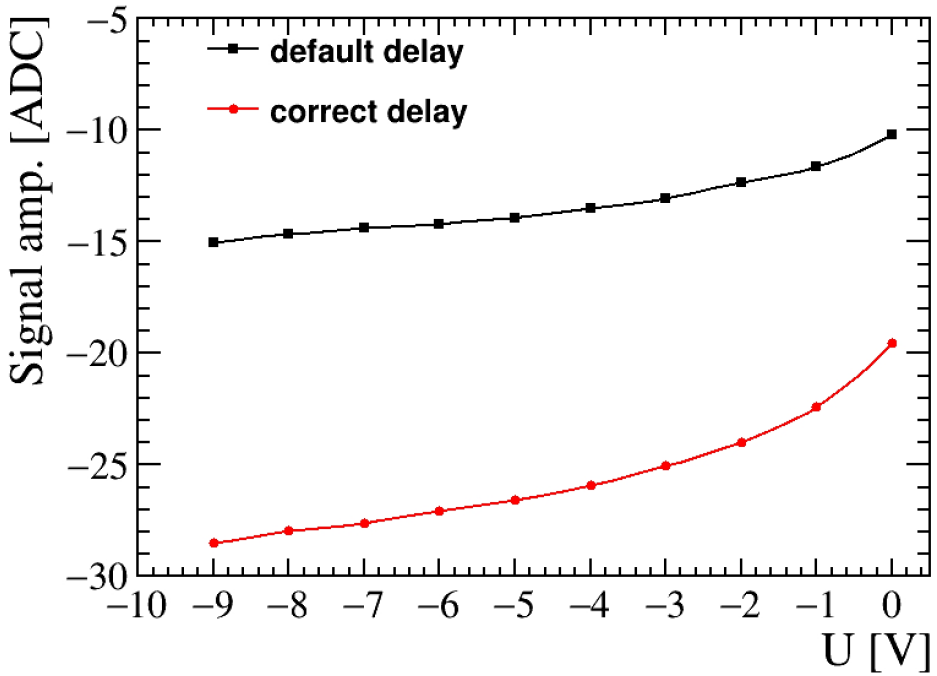
- The default setting of delay time for strip sensor is 8 μs, may not the case of SMIC.
- Scan with step of 0.5μs, fix to 3 μs
- max(Signal mean):-26.9 ADC.





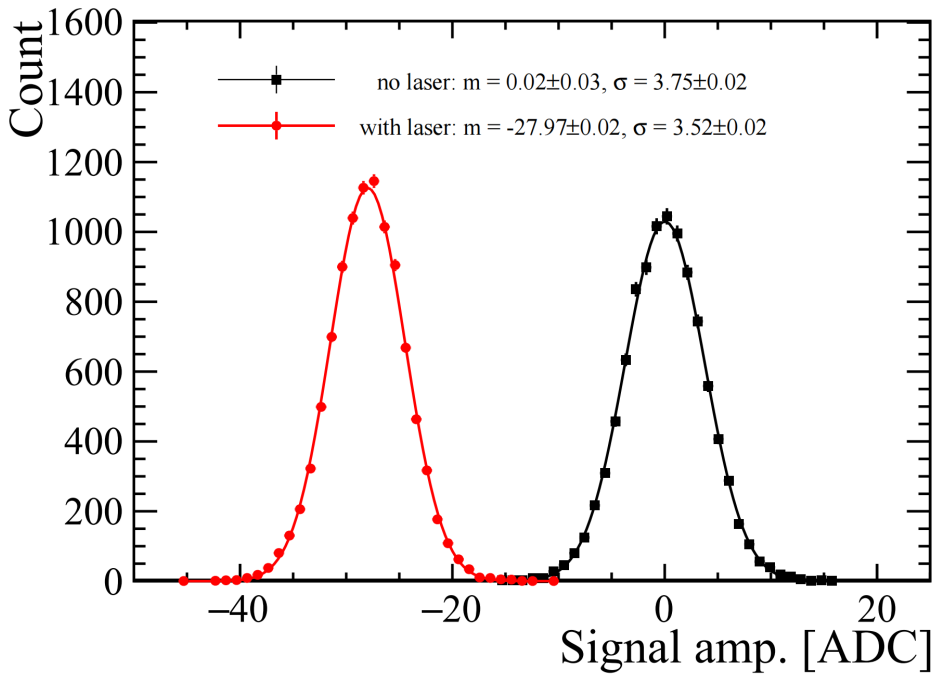
Scan on reverse voltage

- Higer reverse voltage, larger signal.



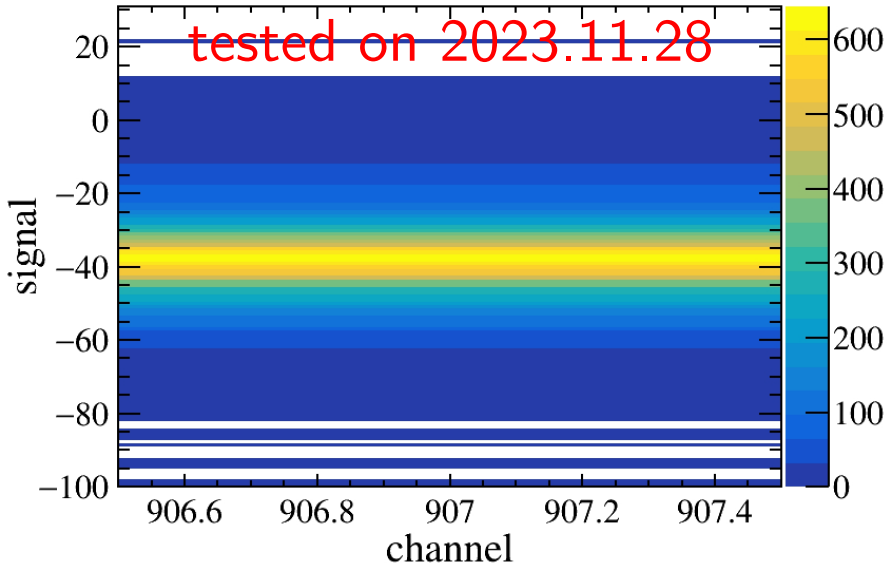
Convincing result

- The response signal of the SMIC sensor to the laser is not large, but very clear.
- Confirmed for the first time (but not for seeing), i.e. Clear distinction with/without laser emitting.



Actually...

- We saw the exact signal sign 2 weeks ago, but didn't realize it. Because:
  - No contrast to the empty channel so that the obvious drop is not noticed.
  - Thought signal would be large as strip channel, or, 100 $\sim$ 1000 ADC at least.
  - At the time, thought the $\sigma(\mathit{Noise})$ should be around 100 ADC (actually an "anomalous" strip channel), maybe just a fluctuation.



Plan

- Design a specific board for SMIC to readout all channels by IDE1140 or Alibava.
- Preparing the pre-amplifier for analog signal testing, a simple case: