

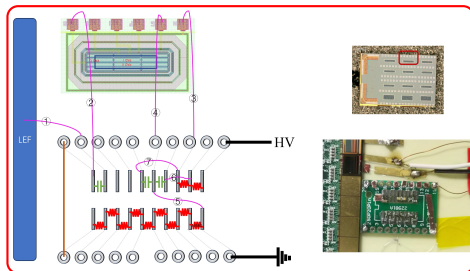
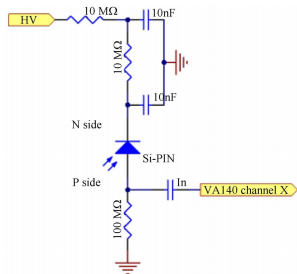
# SMIC laser test

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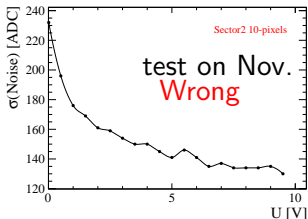
# Setup

- Low pass filter connected 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  $\sigma(\text{Noise}) \sim 3.7$  (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.



Log Messages	
[ ]	Box0 LEF0-A0 (VA15) Pedestal: min=1751.47 avg=1836.43 max=1938.12, RMS: min=1.97 avg=2.25 max=2.98 (from 37605 events)
[ ]	Ch daq app: Disabled Box0 local busy to get trigger
[ ]	Start calibration with Tag=OCAB
[ ]	Box0 LEF0-A0 End of run <CAB> file <0003/000> results:
[ ]	Box0 LEF0-A0 (VA08) Pedestal: min=1845.39 avg=1845.42 max=1845.46, RMS: min=1.78 avg=1.79 max=1.81 (from 38178 events)
[ ]	Box0 LEF0-A0 (VA01) Pedestal: min=1845.40 avg=1845.45 max=1846.27, RMS: min=1.78 avg=1.79 max=1.81 (from 38178 events)
[ ]	Box0 LEF0-A0 (VA02) Pedestal: min=1887.02 avg=1887.05 max=1887.07, RMS: min=1.77 avg=1.78 max=1.80 (from 38178 events)
[ ]	Box0 LEF0-A0 (VA03) Pedestal: min=1887.02 avg=1887.07 max=1887.99, RMS: min=1.77 avg=1.78 max=1.80 (from 38178 events)
[ ]	Box0 LEF0-A0 (VA04) Pedestal: min=1796.92 avg=1796.94 max=1796.97, RMS: min=1.81 avg=1.83 max=1.85 (from 38178 events)
[ ]	Box0 LEF0-A0 (VA05) Pedestal: min=1796.92 avg=1796.97 max=1797.92, RMS: min=1.81 avg=1.83 max=1.85 (from 38178 events)
[ ]	Box0 LEF0-A0 (VA06) Pedestal: min=1854.71 avg=1854.74 max=1854.76, RMS: min=1.75 avg=1.76 max=1.77 (from 38178 events)
[ ]	Box0 LEF0-A0 (VA07) Pedestal: min=1854.73 avg=1854.78 max=1855.68, RMS: min=1.74 avg=1.76 max=1.77 (from 38178 events)
[ ]	Box0 LEF0-A0 channel=0557, va=08, vc=45, pedestal=1819.18, RMS=27.36
[ ]	Box0 LEF0-A0 channel=0558, va=08, vc=46, pedestal=1870.57, RMS=81.93
[ ]	Box0 LEF0-A0 channel=0559, va=08, vc=47, pedestal=1799.72, RMS=709.78
[ ]	Box0 LEF0-A0 channel=0560, va=08, vc=48, pedestal=1888.51, RMS=393.37
[ ]	Box0 LEF0-A0 channel=0561, va=08, vc=49, pedestal=1883.95, RMS=27.34
[ ]	Box0 LEF0-A0 (VA08) Pedestal: min=1817.96 avg=1818.38 max=1817.72, RMS: min=6.35 avg=25.68 max=789.78 (from 38178 events)
[ ]	Box0 LEF0-A0 (VA09) Pedestal: min=1690.75 avg=1824.36 max=1936.96, RMS: min=6.05 avg=6.35 max=6.62 (from 38178 events)
[ ]	Box0 LEF0-A0 (VA10) Pedestal: min=1825.73 avg=1825.75 max=1825.76, RMS: min=1.79 avg=1.80 max=1.82 (from 38178 events)
[ ]	Box0 LEF0-A0 (VA11) Pedestal: min=1825.74 avg=1825.79 max=1826.76, RMS: min=1.79 avg=1.80 max=1.81 (from 38178 events)
[ ]	Box0 LEF0-A0 (VA12) Pedestal: min=1830.97 avg=1830.99 max=1831.03, RMS: min=1.88 avg=1.81 max=1.82 (from 38178 events)
[ ]	Box0 LEF0-A0 (VA13) Pedestal: min=1830.98 avg=1831.03 max=1831.05, RMS: min=1.79 avg=1.81 max=1.83 (from 38178 events)
[ ]	Box0 LEF0-A0 (VA14) Pedestal: min=1930.98 avg=1725.62 max=1898.79, RMS: min=1.21 avg=2.27 max=3.56 (from 38178 events)
[ ]	Box0 LEF0-A0 (VA15) Pedestal: min=1751.59 avg=1836.43 max=1938.10, RMS: min=1.97 avg=2.25 max=2.97 (from 38178 events)

→ Strip

→ SMIC

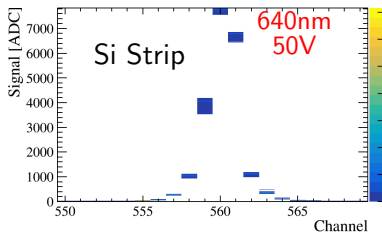
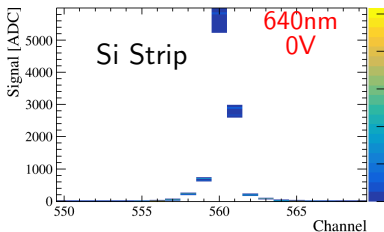
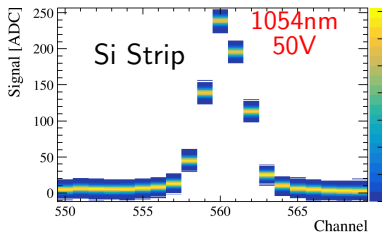
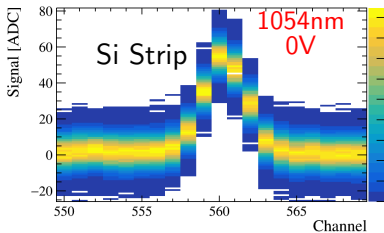
# Why “anomalous” strip sensor noise

- 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  $\sigma(\text{Noise})$  of SMIC was seen. Even possible that baseline/pedestal was wrong, so signal around  $\sim 0$  in most past cases.
- Need shutdown/poweroff the laser when measure noise.



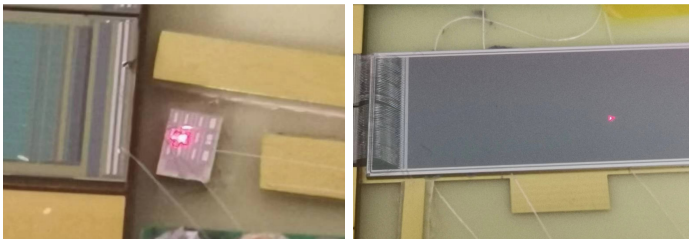
## Laser type

- 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.

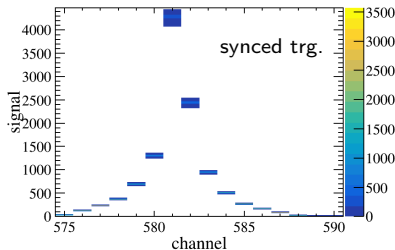
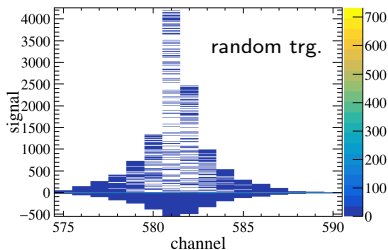


## Laser spot

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

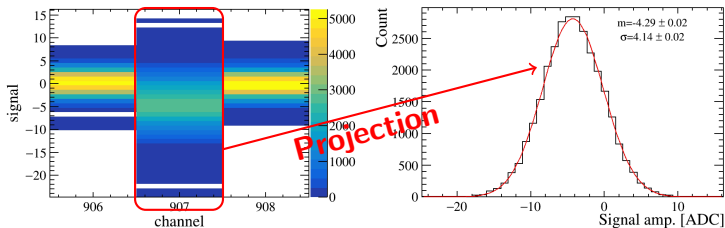


- Works on strip sensor for both random trigger or synced trigger.



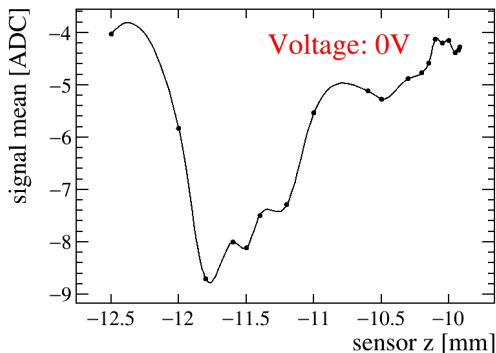
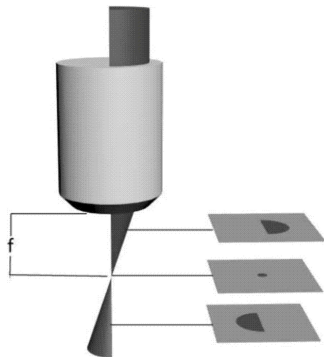
# Signal behavior for SMIC?

- 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 focus length and sensor window.



## Scan in focusing

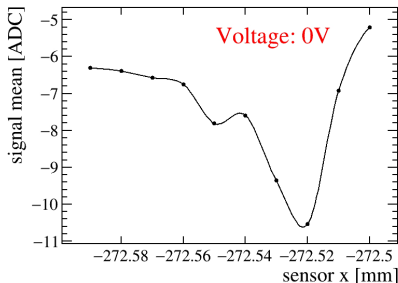
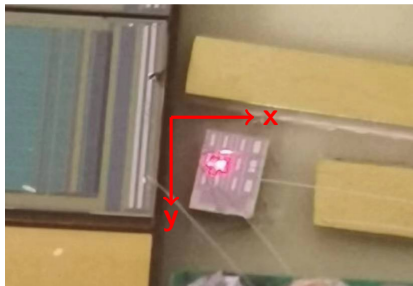
- Scan in focusing axis with  $200\mu\text{m}$  step, fix the optimal  $z$  position.
- $\max(\text{Signal mean})$ :  $-8.7$  ADC.





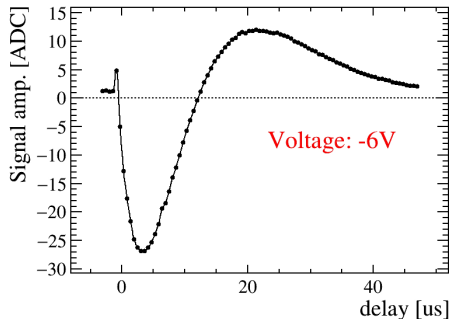
# Scan on sensor window

- Scan on sensor window (only in x direction) with  $10\mu\text{m}$  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.
- $\max(\text{Signal mean})$ :  $-10.6$  ADC.



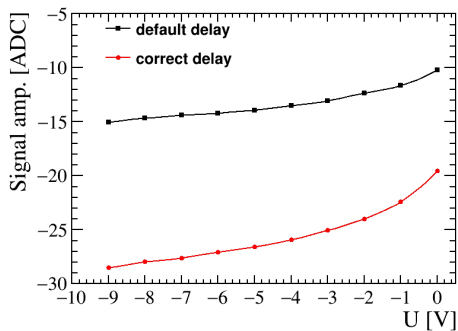
# Scan on delay time

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



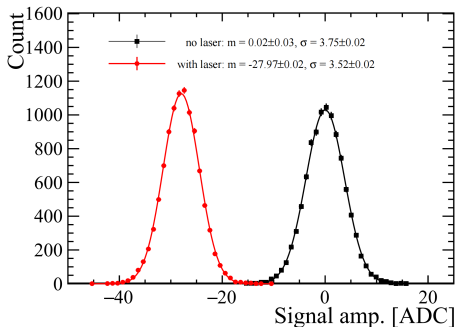
# Scan on reverse voltage

- Higher reverse voltage, larger signal.



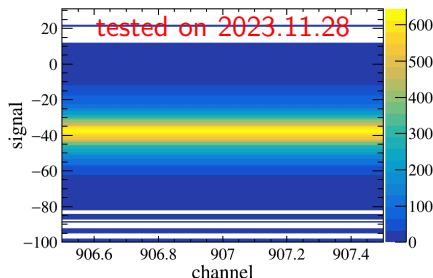
## Convincing result

- 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  $\sigma(\text{Noise})$  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](#):

