Silicon sensor studies in Kyushu

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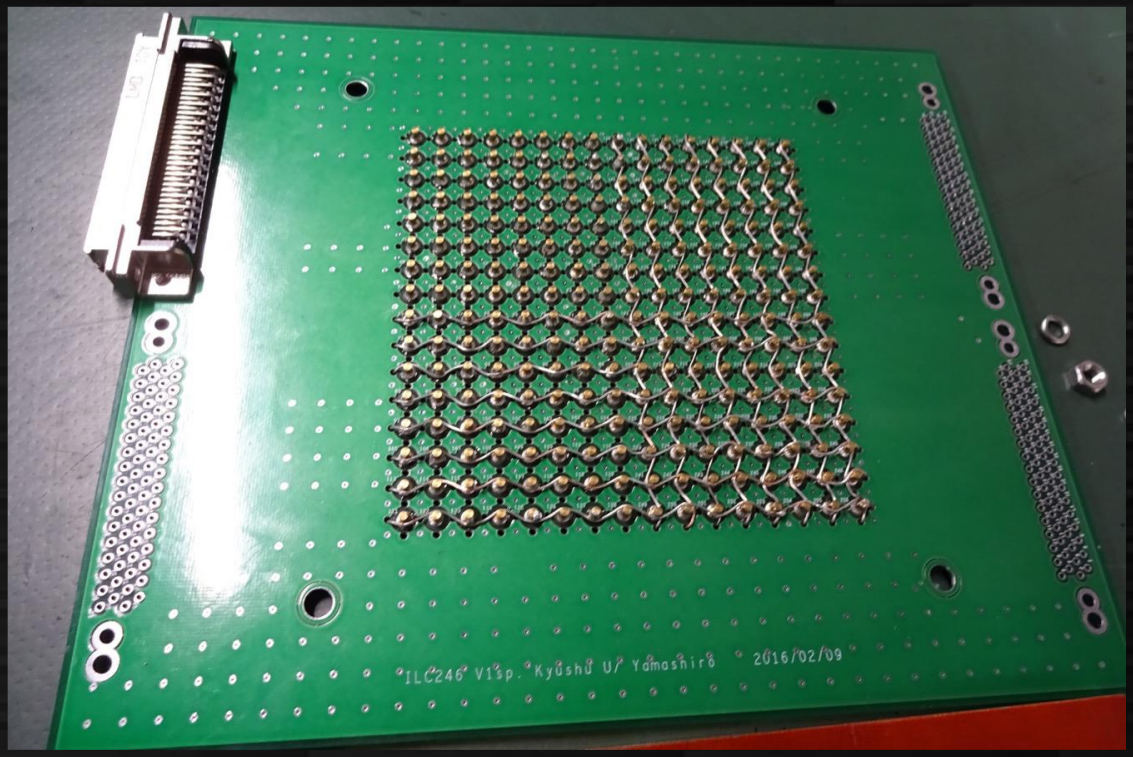
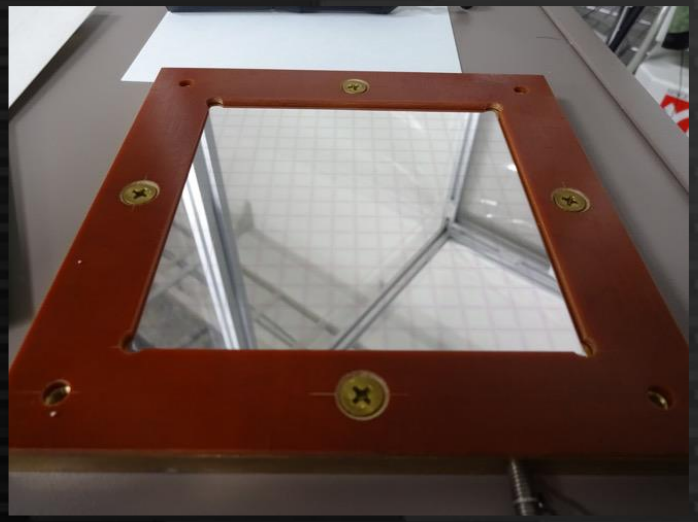
Topics

- Setup of full-sensor test
- First test of PSD
- Small DAQ setup

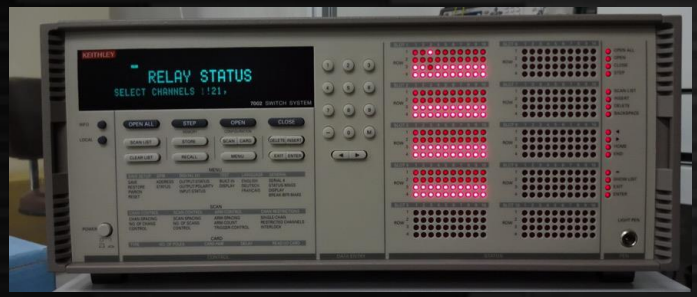
Full-sensor measurement



PCB with 256 ch independent readout designed (64 ch + 196 ch common implemented in the picture)

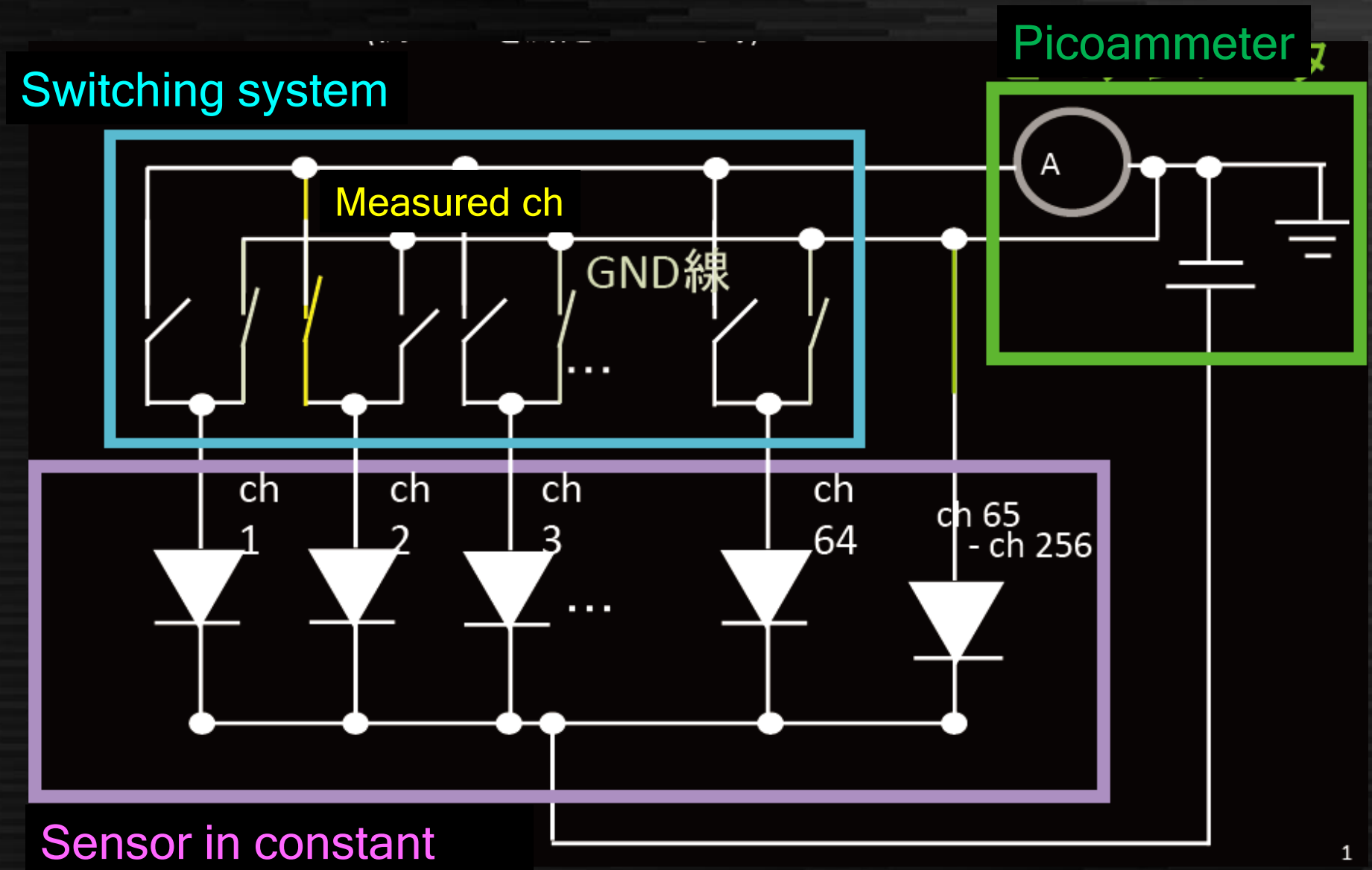


Base plate with silicon sensor

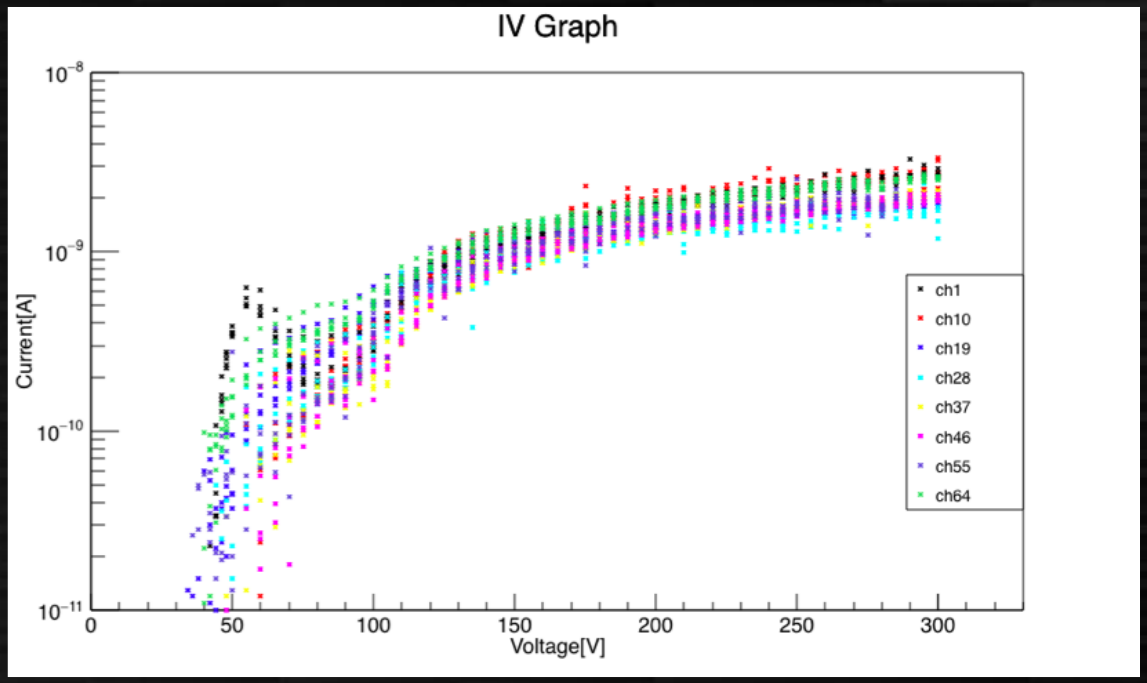


10 x 40 ch switching system for IV/CV measurement

Overview of curcuit



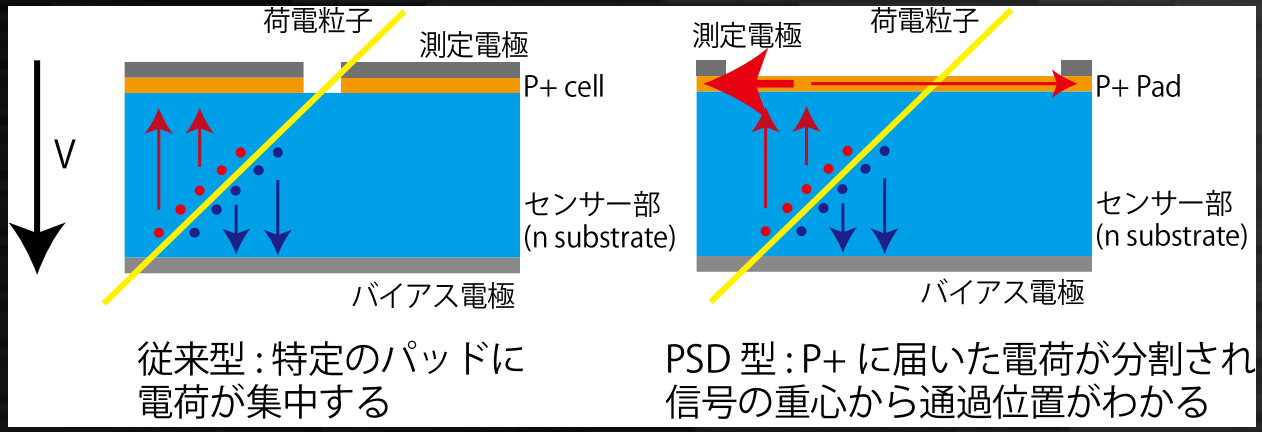
I/V measurement status



1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64

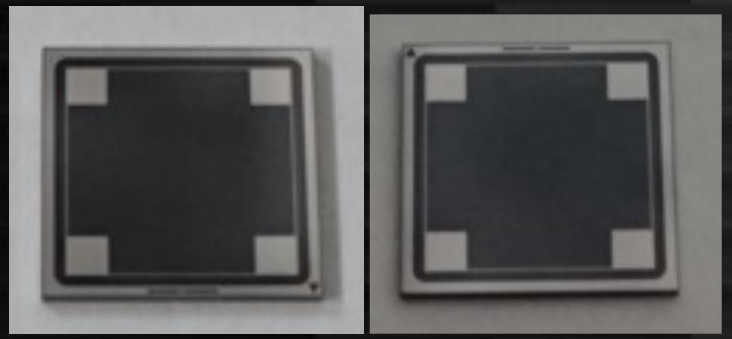
Single pixel readout is confirmed
Need more careful shielding
Mechanical problem occurred
(PCB bent by pressure of springs)
→ adjusting setup

Position Sensitive Detector



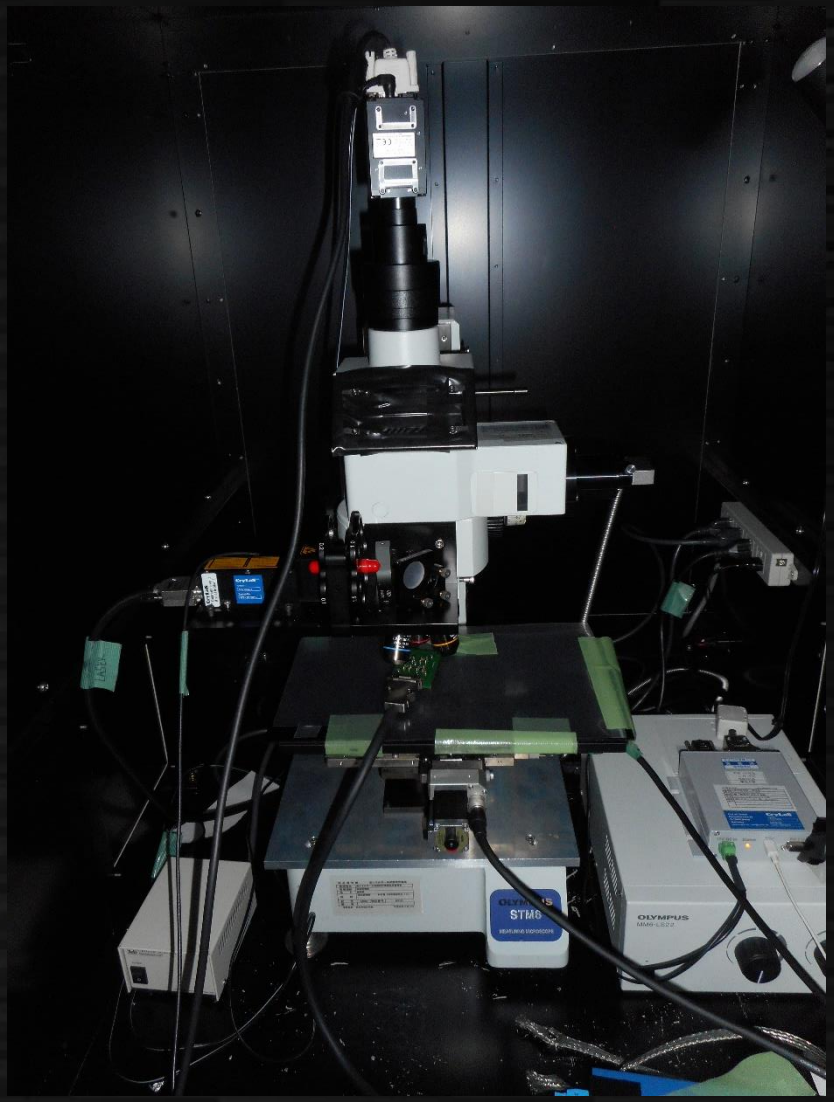
Multiple electrodes in one cell
to obtain particle position
Popular technique in laser optics
Used also in heavy-ion detectors

Possible for tagging photon
position at innermost layer of
ECAL by PSD array

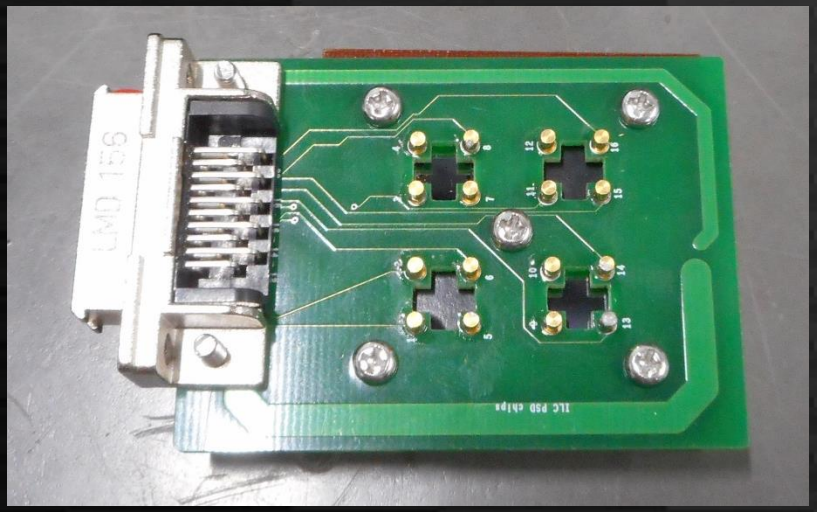


First PSD sample in Kyushu
meshed (left) and unmeshed
8 mm one side, 1 mm electrodes

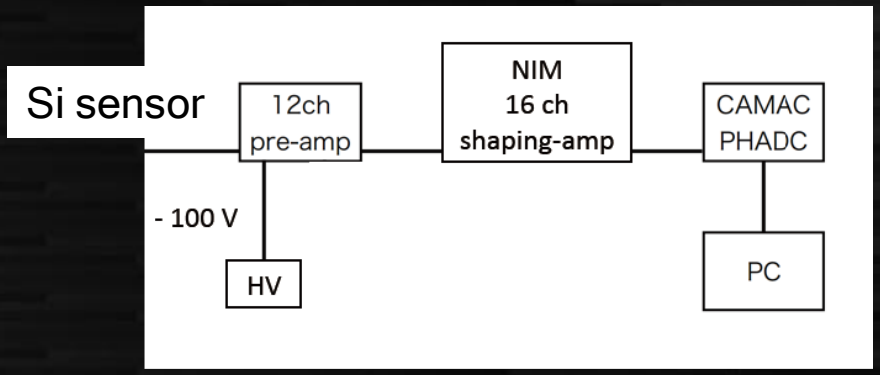
PSD study with infrared laser



1064 nm Pulsed YAG laser

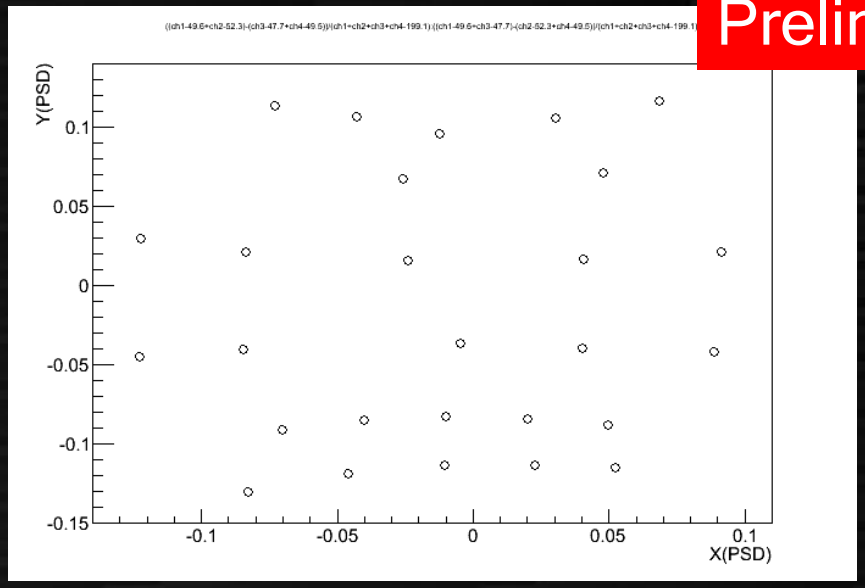


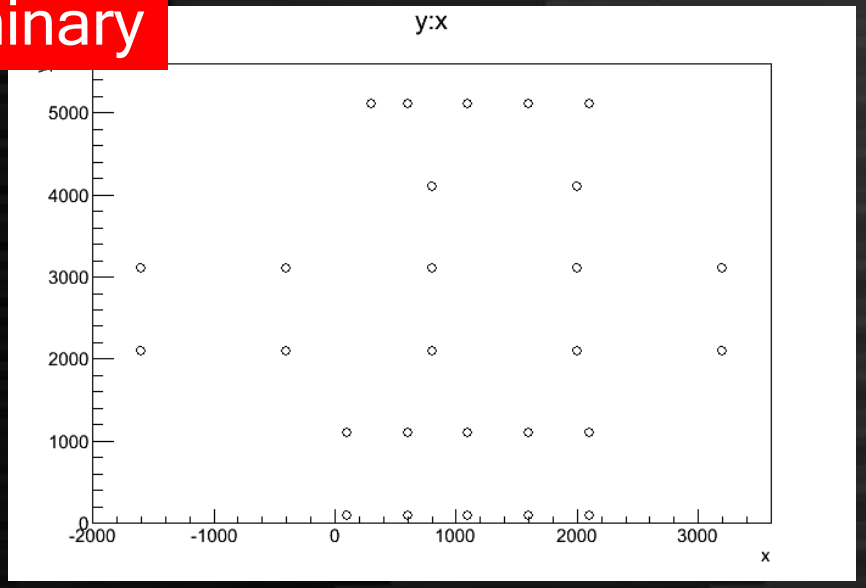
PSD holder to be connected to
DAQ (CAMAC / testboard)
Cross-shape holes to inject laser



Distortion study with laser/CAMAC

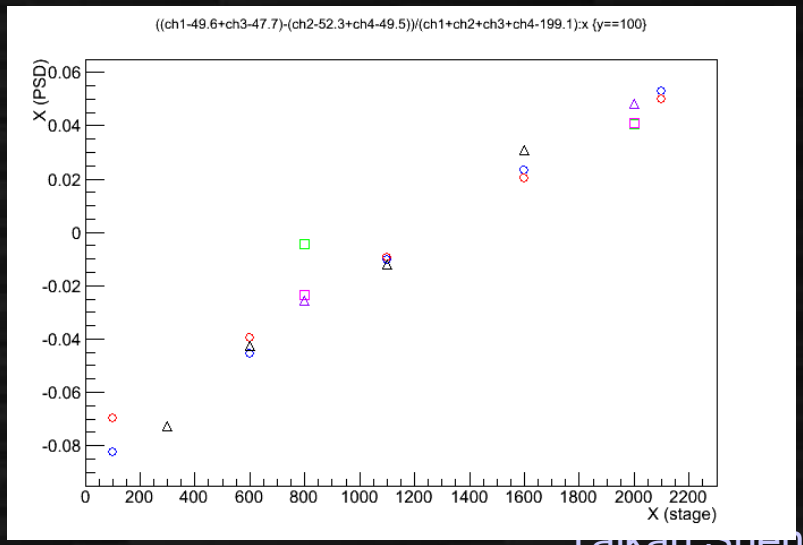
Preliminary





Calculated position from charge-sharing

Measured positions



Good correlation of measured and true position obtained
Some distortion observed (as expected)

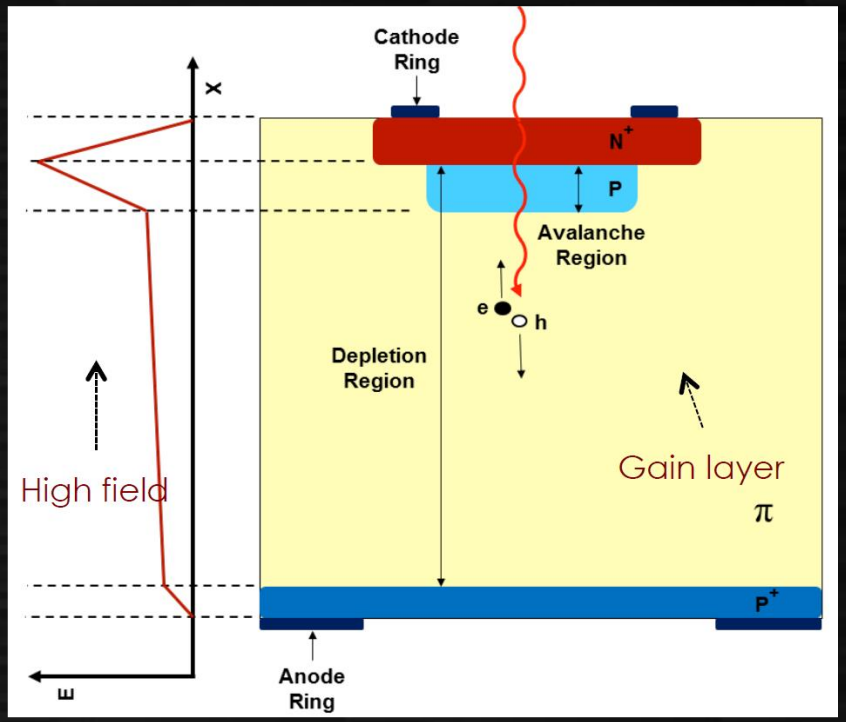
→ To study with realistic signal

PSD - Next steps

- Noise study with DAQ (next topic)
  - Position resolution should be obtained
- Compare structures
  - Production with different parameters (resistance, mesh parameters, …) need budget
- New ideas (next slide) need budget
- Simulation studies to estimate impact on physics

Will be applied for next competitive budget application

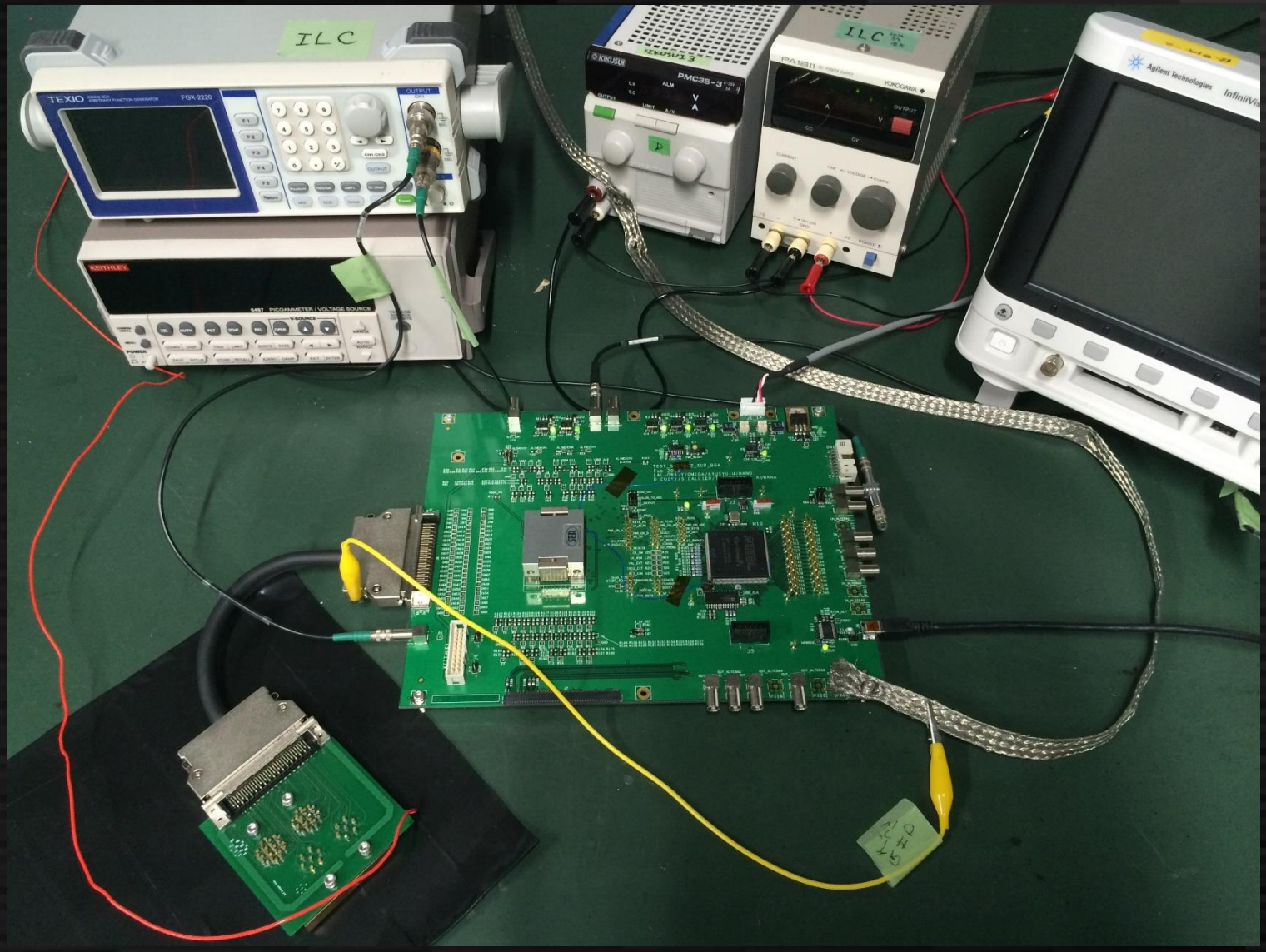
Low gain avalanche diode (LGAD)



- Si sensor with avalanche amplification
- Being studied by CMS for bunch tagging by Si sensor (~ 20 ps required)
- Hamamatsu is also investigating (first result will come in ~ a year)

- Possible usage
  - PID in SET or ECAL
  - Improve position resolution if combined to PSD tech.

Small DAQ


ILC
TEXIO
FGX-2220
KEITHLEY
6487 PICOAMMETER / VOLTAGE SOURCE
KIKUSUI
PMC35-3
ILC
YOKOGAWA
Agilent Technologies

Overview of small DAQ

Targets

- Realistic noise estimation with sensors
- Test of baby sensors of various specs

Hardware

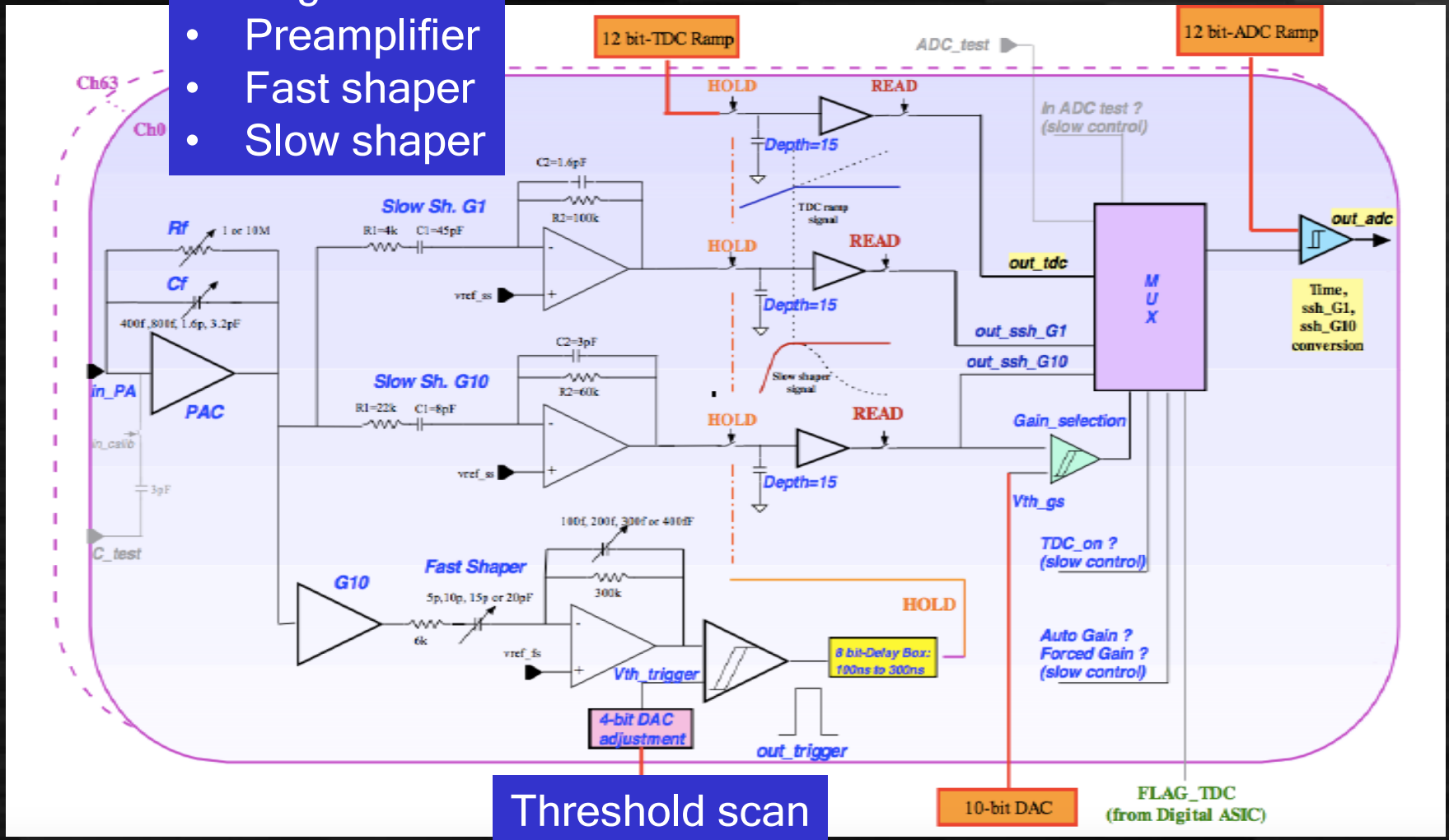
- SKIROC2 testboard with a 64ch cable

Software

- Firmware: no modification from testboard
- Labview for config & s-curve
- Original DAQ (C++) for DIF-compatible output

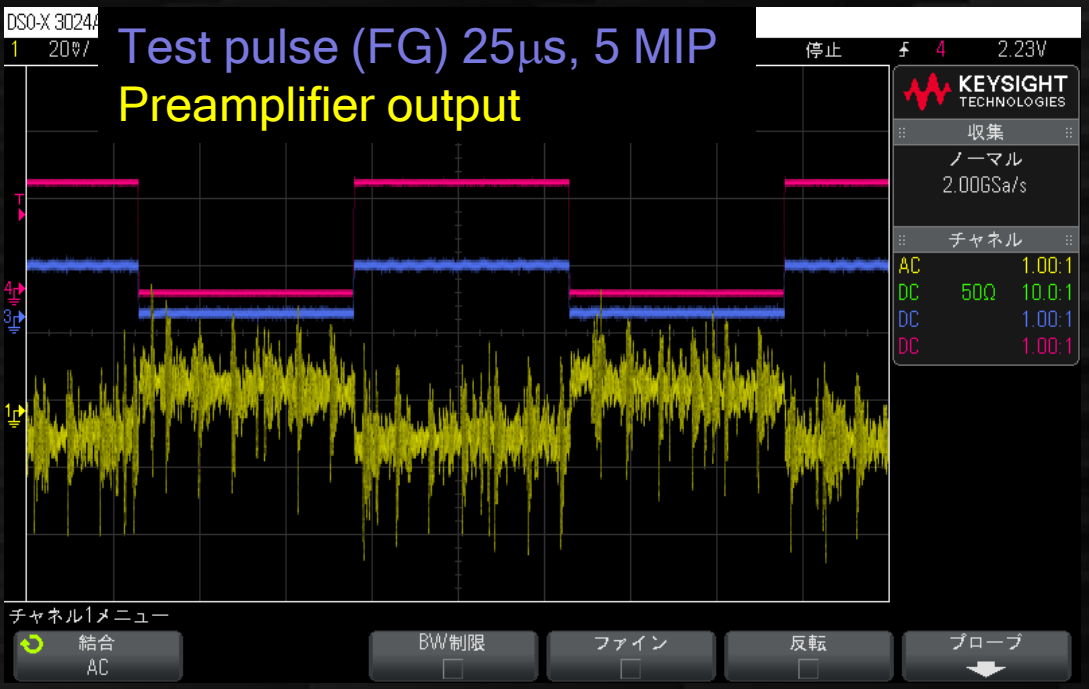
SKIROC2

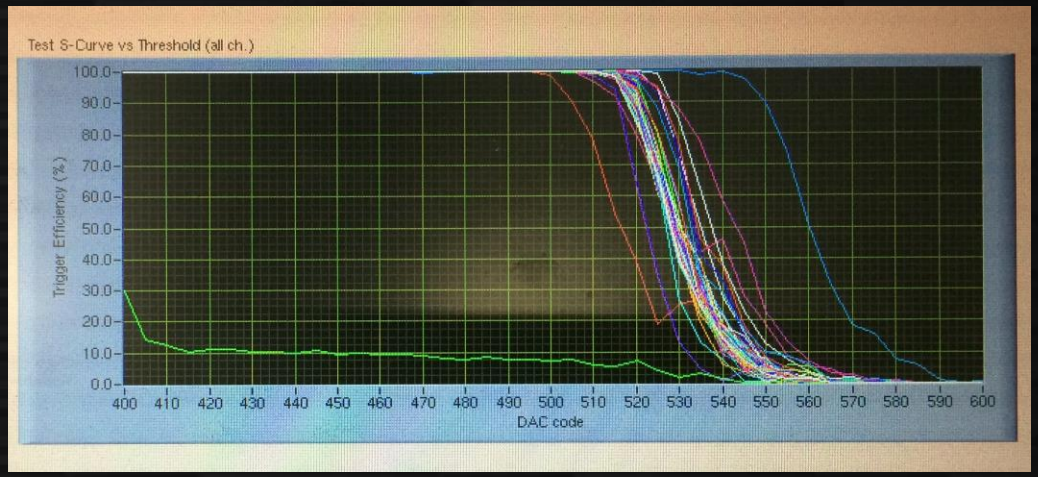
Analog monitor
- Preamplifier
- Fast shaper
- Slow shaper



Threshold scan
(S-curve)

Noise studies



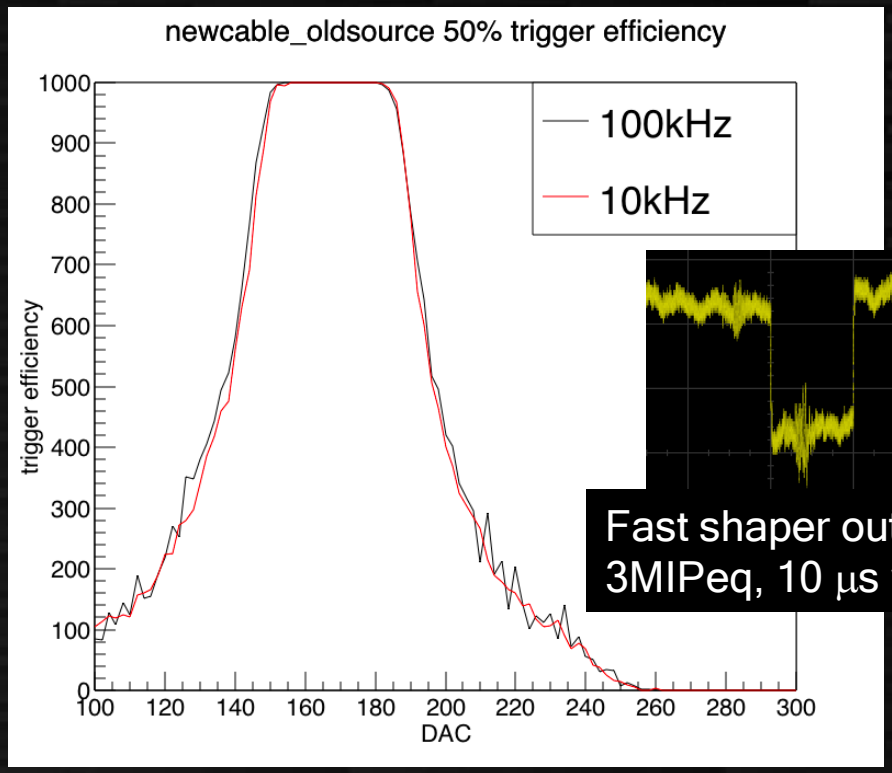


Noise > MIP
if we connect sensors

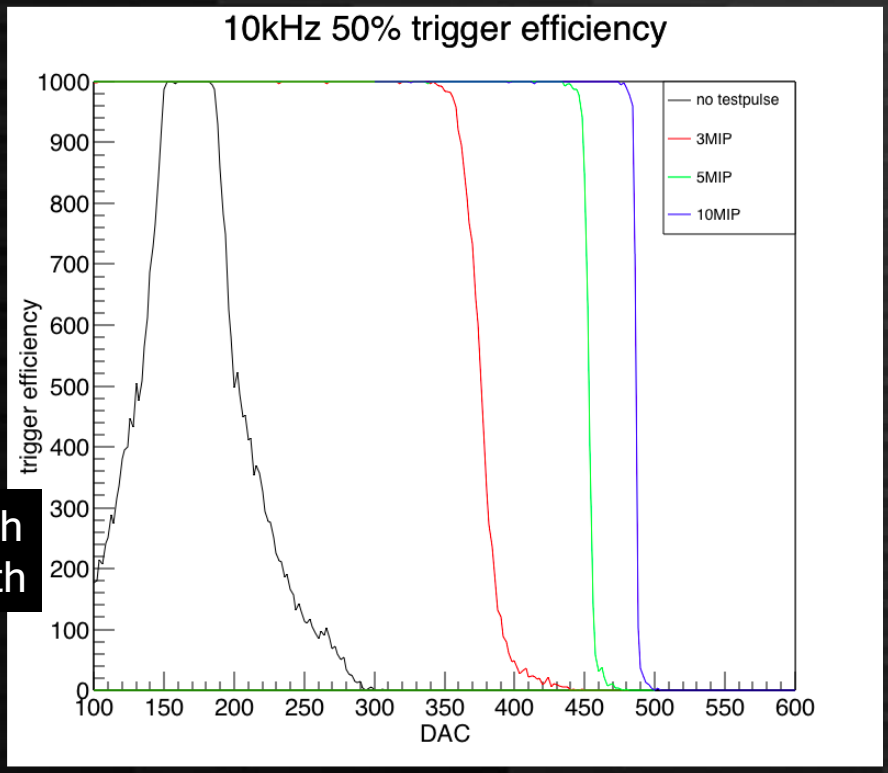
- Capacitance?
- Noise from sensor?
- Power/GND lines?

- Trying to shield the sensor lines
- Remove GND loop
- Shield of sensor cable to GND
- etc.

< 1 MIP noise achieved



Fast shaper out with 3MIPeq, 10 μs width

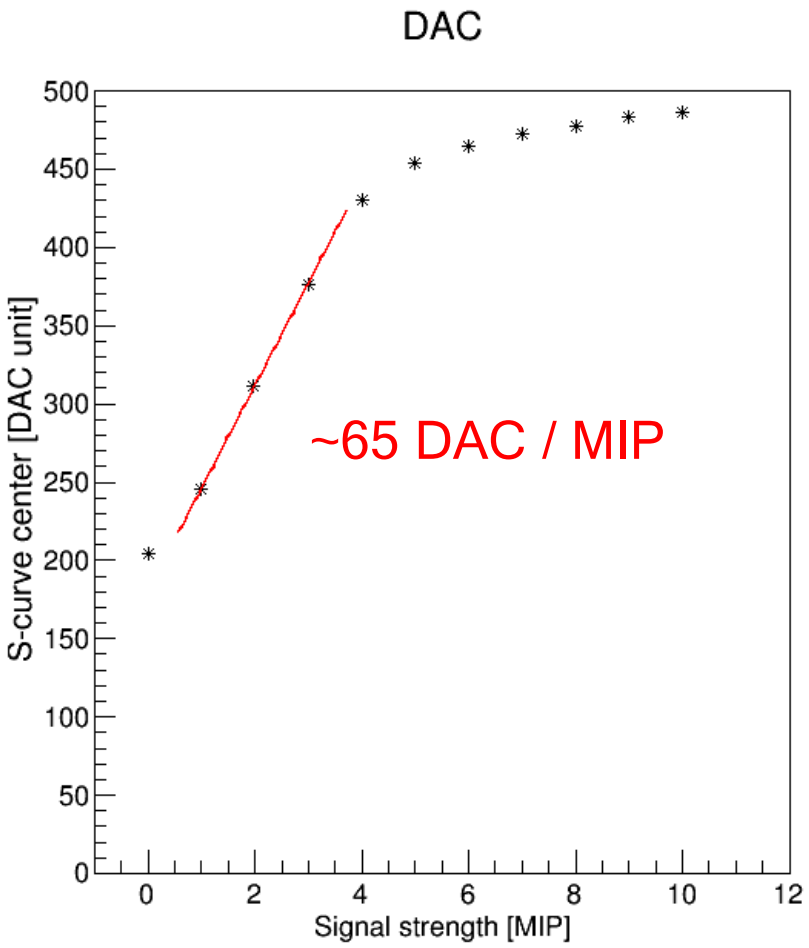


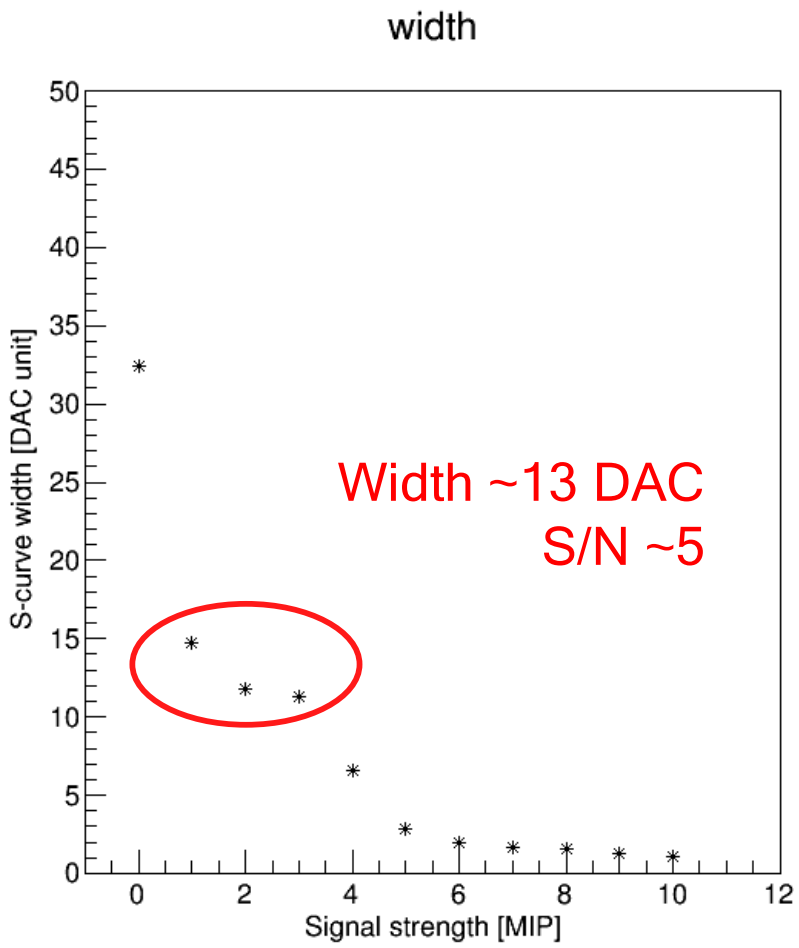
S-curve without test pulse at around 200 obtained (with some of events up to 250)
→ possible to see a MIP

S-curve with test pulse of 0/3/5/10 MIPs

Working to measure true MIPs

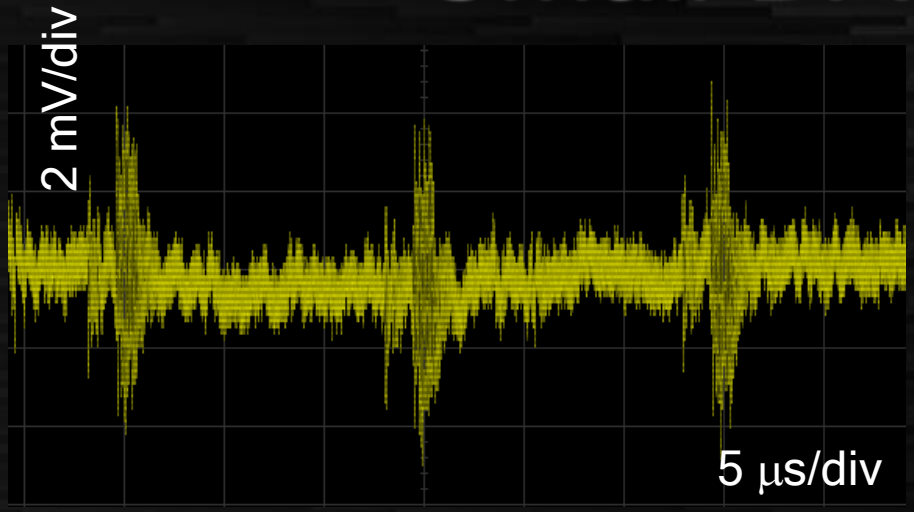
MIP vs. S-curve results (1.2 pF)

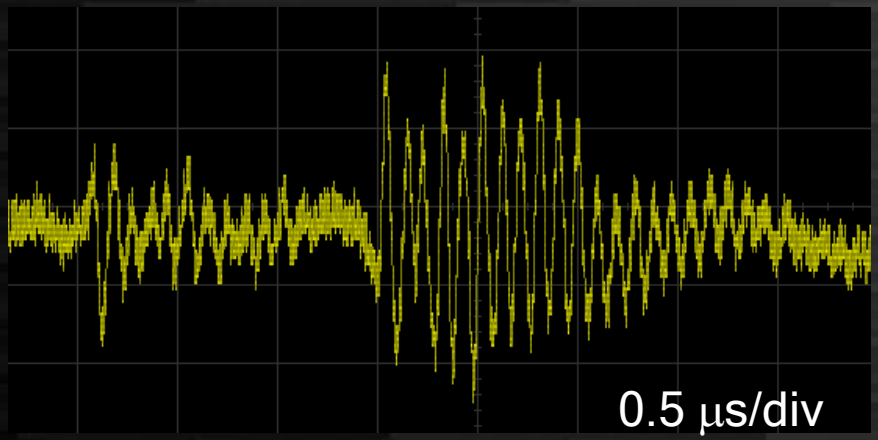




Reasonable S/N, but still larger than TB setup (~20)
(slightly different criteria from that of real MIP)

Small DAQ: To Do





- Periodic noise still exists
  → more effort reducing noise needed
- Apply to real MIP (cosmic, RI, …)
- Compare sensors (PSD, …)

→ Towards generic Si-sensor test setup

Summary

- Full-sensor test for IV/CV by each pixel
  - Setup assembled
  - Several issues to be solved
- Position sensitive detector
  - First measurement started
  - Proceed to detailed design
- Small DAQ for baby sensors
  - Noise reduction to < 1 MIP succeeded
  - Ready to measure real MIPs