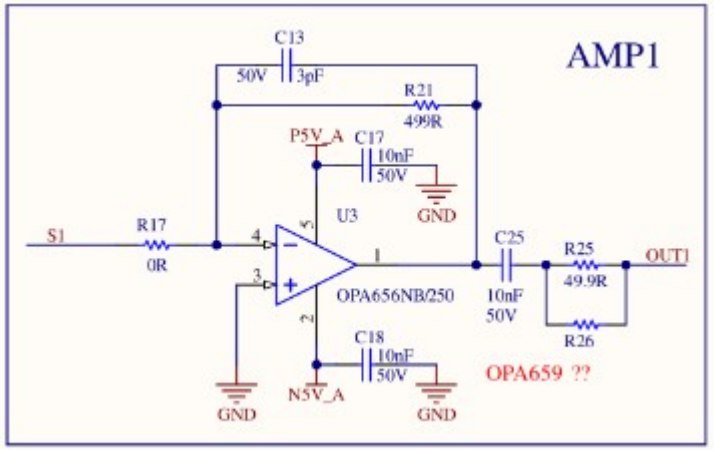
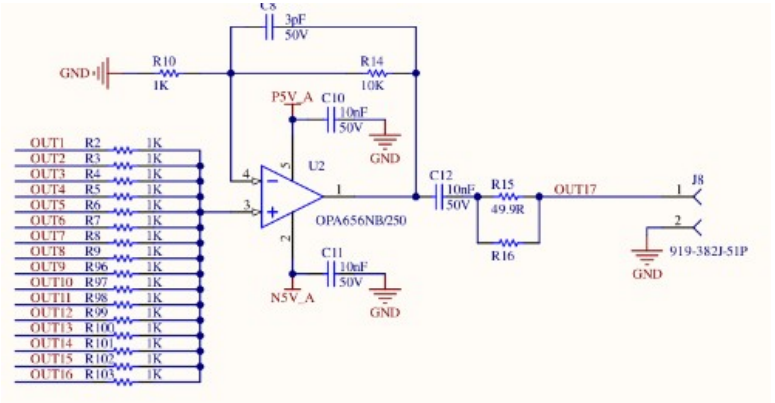
ESB Amplification/Summing Boards

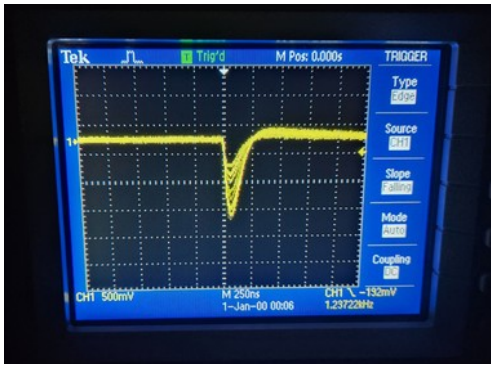
5th BIC Workshop

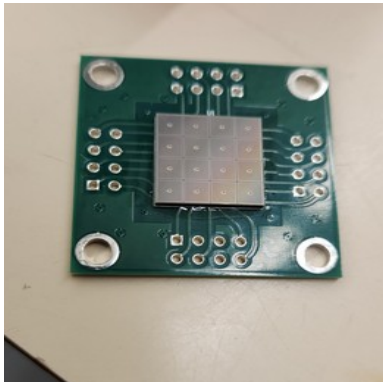
Jun 17, 2026

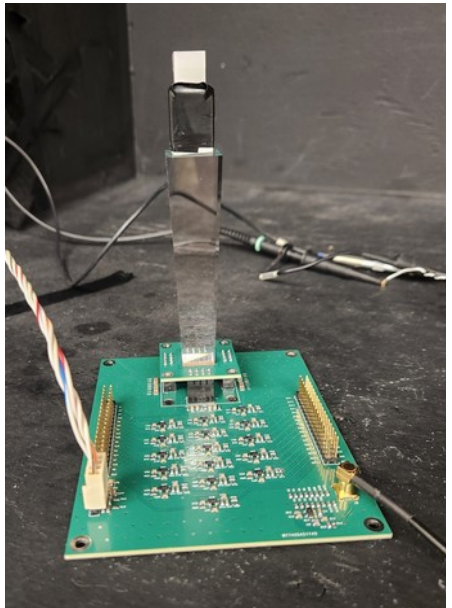
SipM 16 channel readout

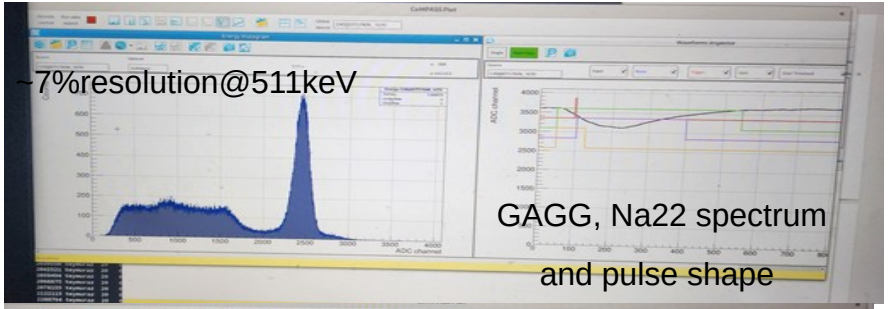


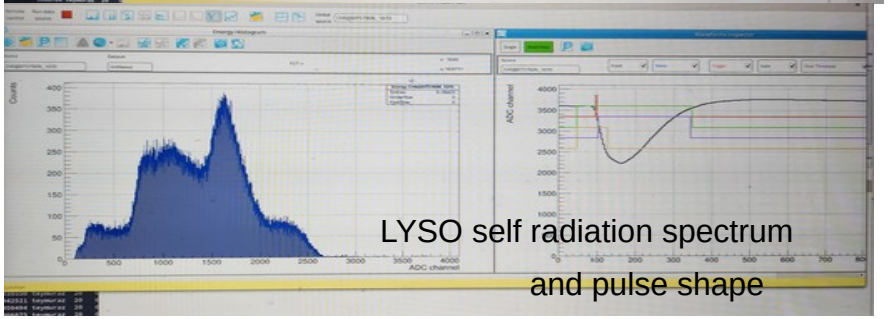




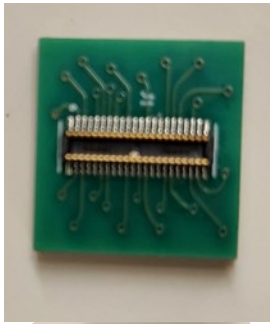






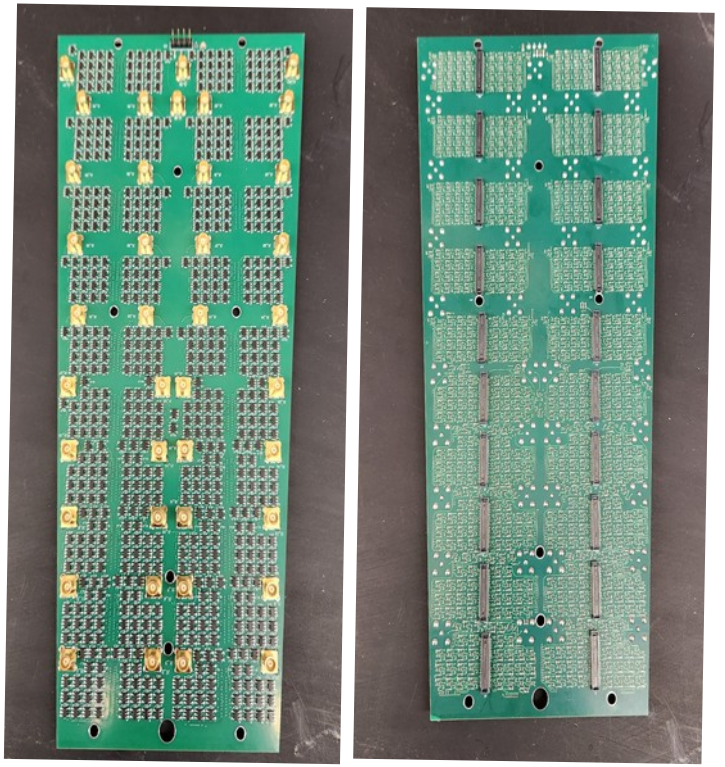


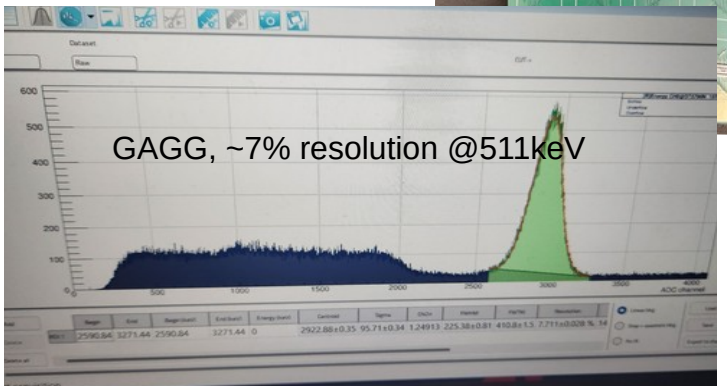
Baby BCAL readout based on 16 channel readout



Mini-board

Window board

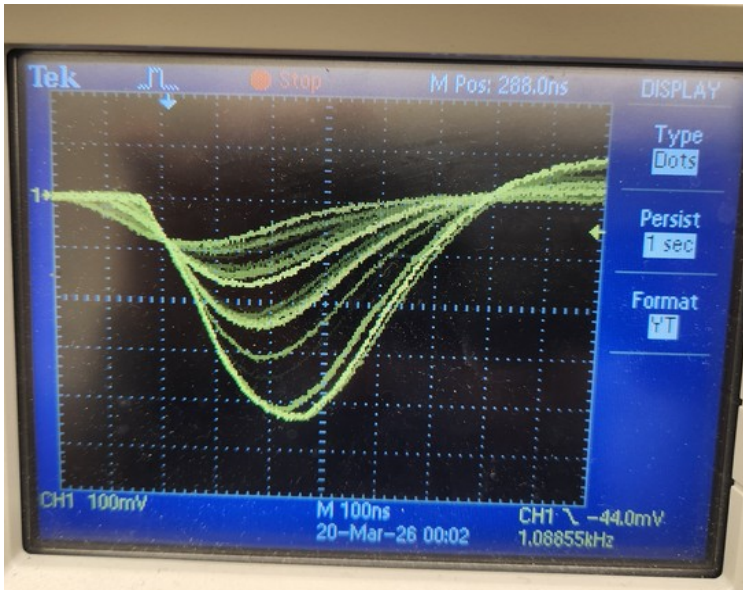




Amplifier board for 40 sipm arrays
16 channels each.

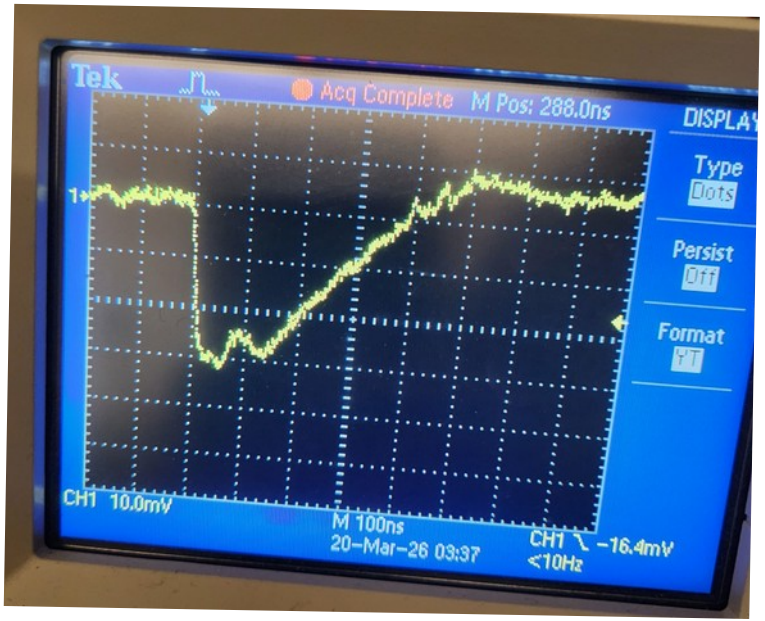
Only ~8W! For entire board

Baby BCAL readout based on 16 channel readout



GAGG, pulse shape of 16 sipm SUM with ^{22}Na source

- Pulses are ~500-600ns at the base
- Rise time ~130ns (88ns is the scintillator)



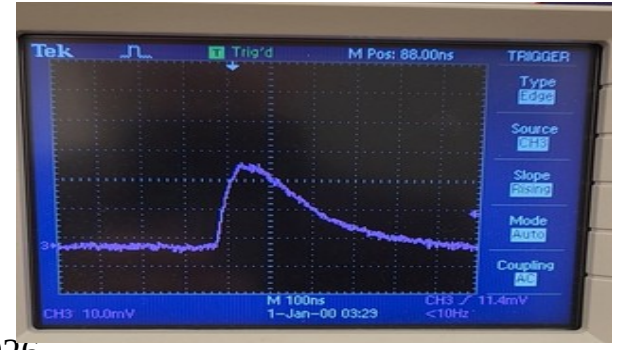
Pulse shape of a scintillating fiber matrix in LEAD (small piece of a GlueX detector prototype)-- poor optical contact

- Very fast rise time!
- Pulses are <400ns at the base

Currently aim is to further reduce the power consumption

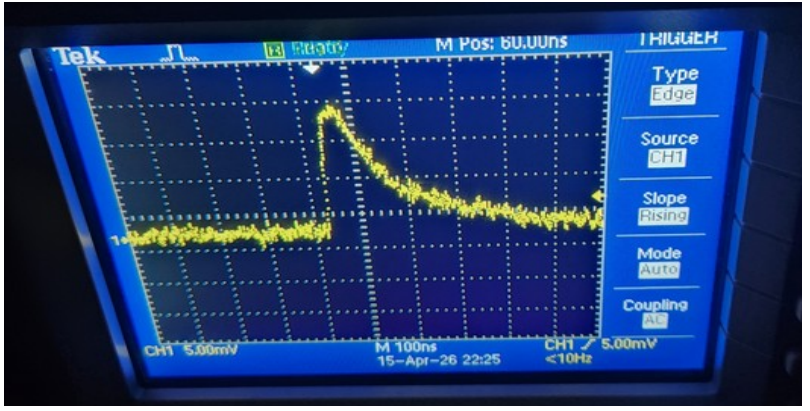
1- Resisitive /passive first stage per SiPM pixel followed by a summing/amplification stage

- Low power consumption
- Decent timing properties
- Potentially prone to crosstalk between pixels

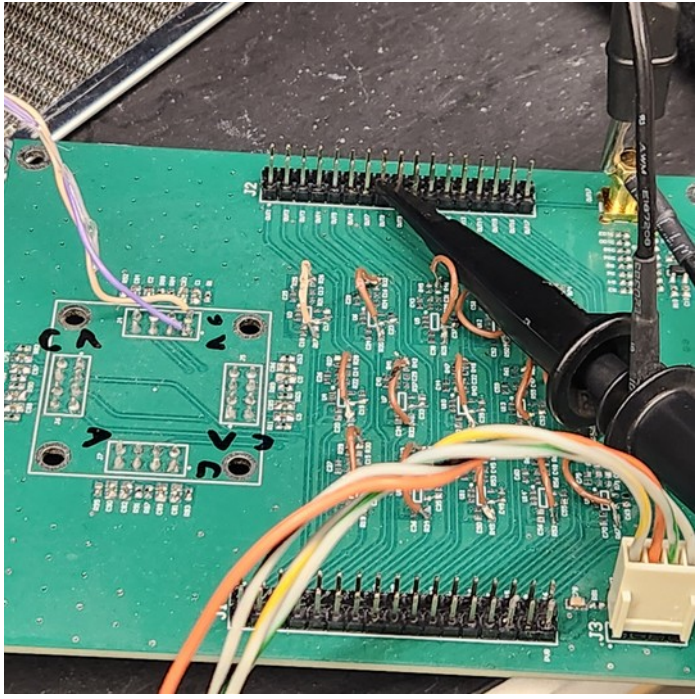


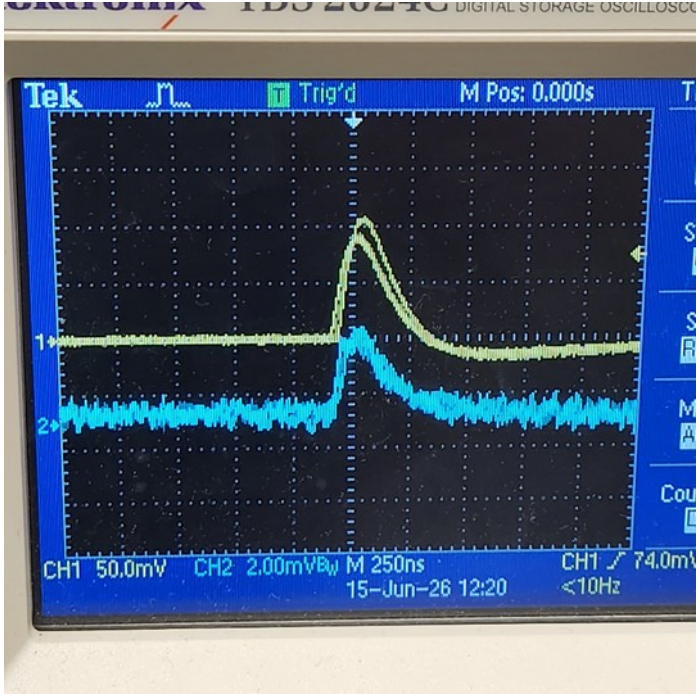
2 - Diode coupled first stage per SiPM pixel followed by a summing/amplification stage

- Low power consumption
- Decent timing properties
- Almost completely eliminates crosstalk between pixels

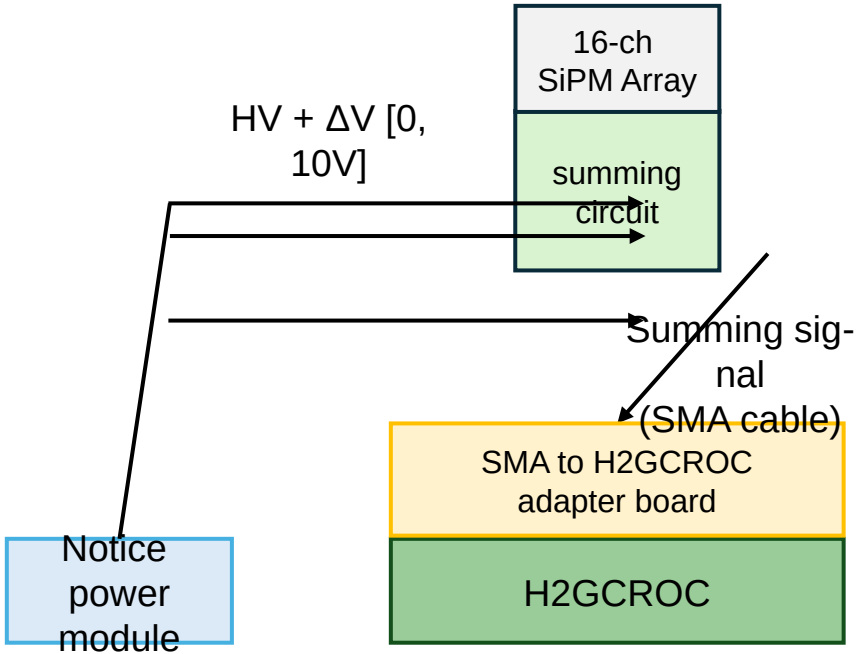


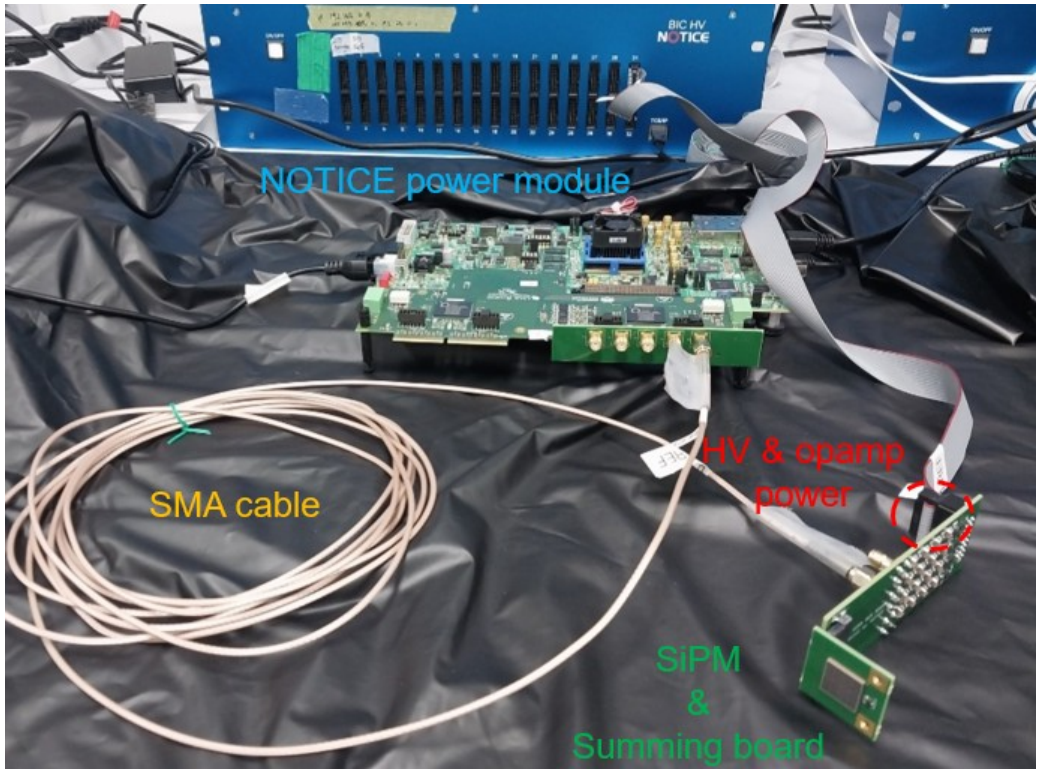
Cross talk within resistive readout scheme





Summing Board Design

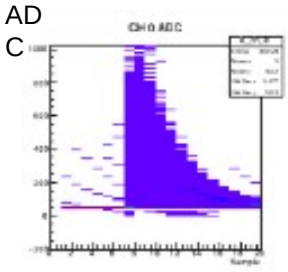




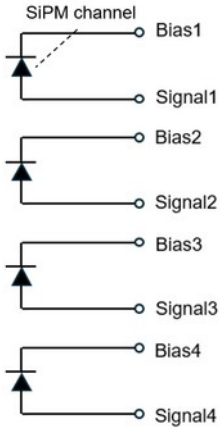
- Independent HV control via NOTICE power module
- 12-bit DAC per-channel ΔV adjustment [0,10 V]
- **Requires only 1 H2GCROC channel per a 16-ch SiPM array**

Electron Beam Test at KEK PF-AR

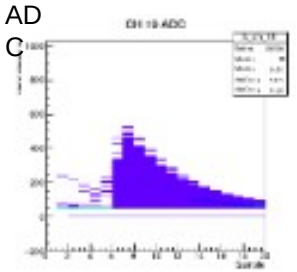
Individual readout



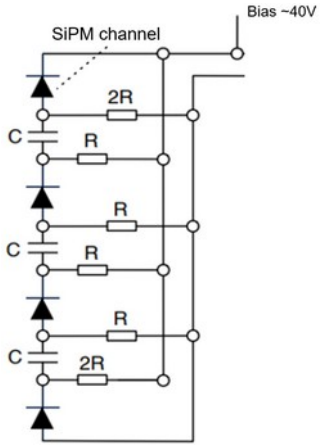
H2GCROC param:
(R_f:8, C_f:10, gain:12, C_f comp: 10)



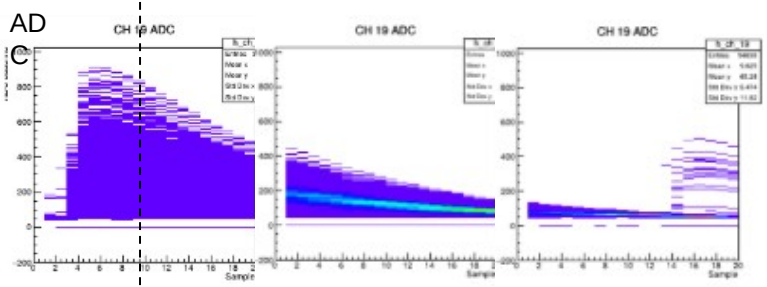
Hybrid summing



(15-1-15-15)



Parallel summing



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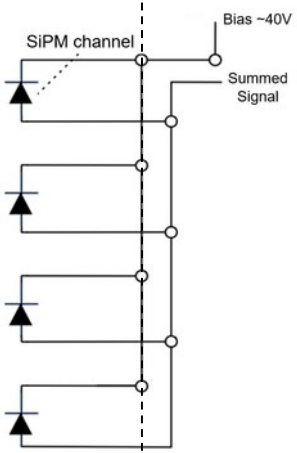

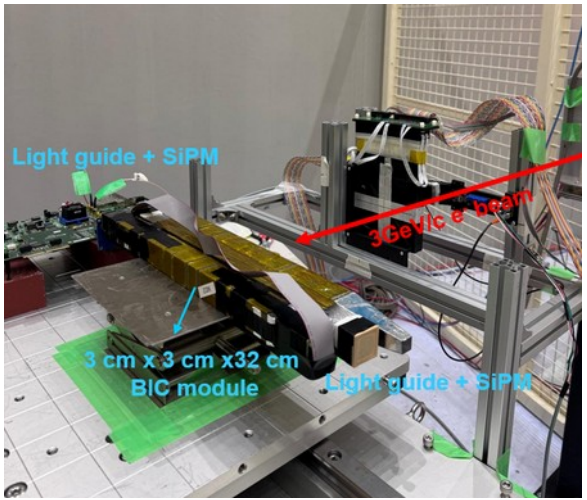

KEK beam test setup

Detailed circuit in backup slides.

Thoughts

- A number of summing schemes are available at various levels of maturity/testing (~7 total)

- Need unified benchmarking of the summing schemes against each other and when interfaced to HDCROC/CALROC