



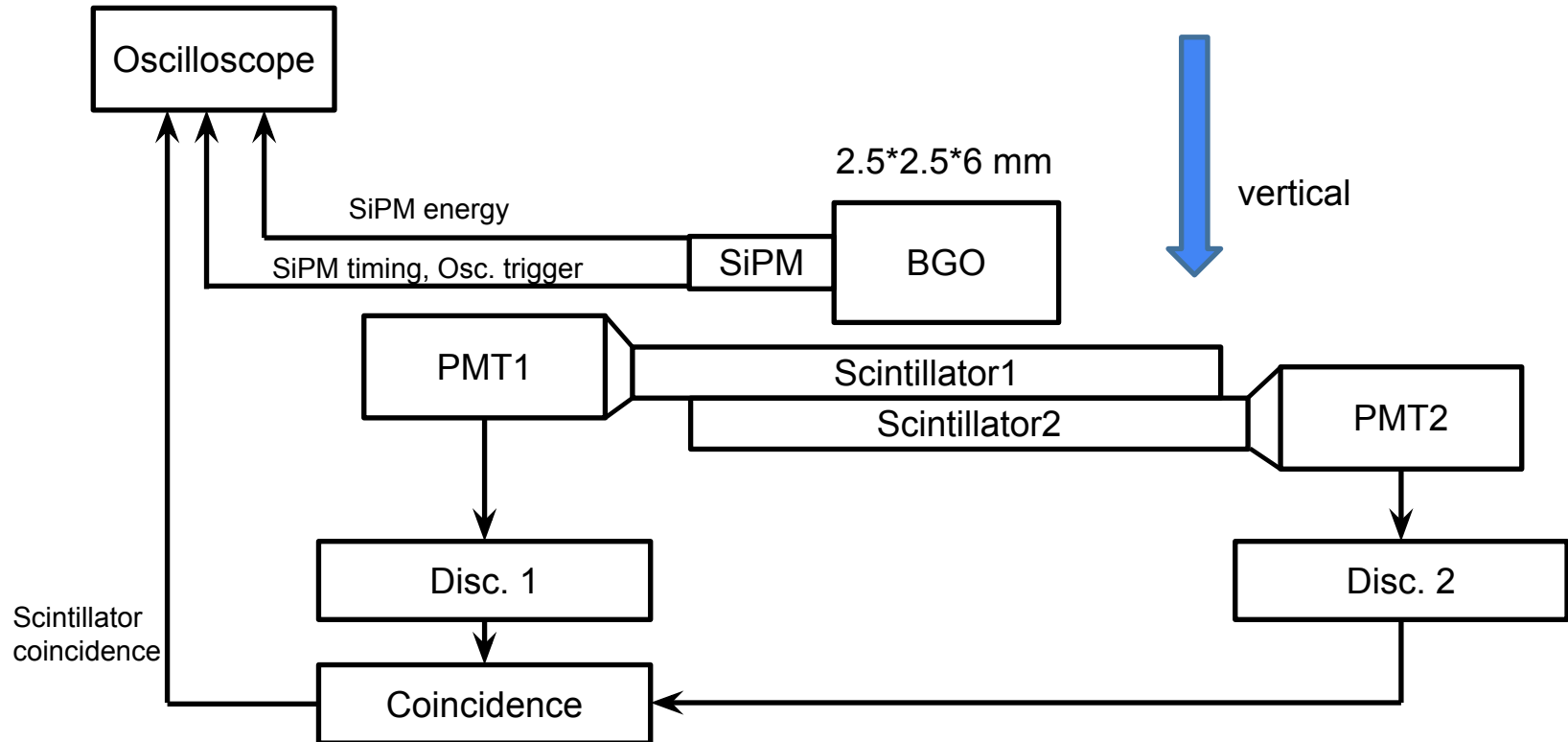
# SiPM readout update

**Sept. 14, 2022**

Yuxiang Guo, University of Michigan

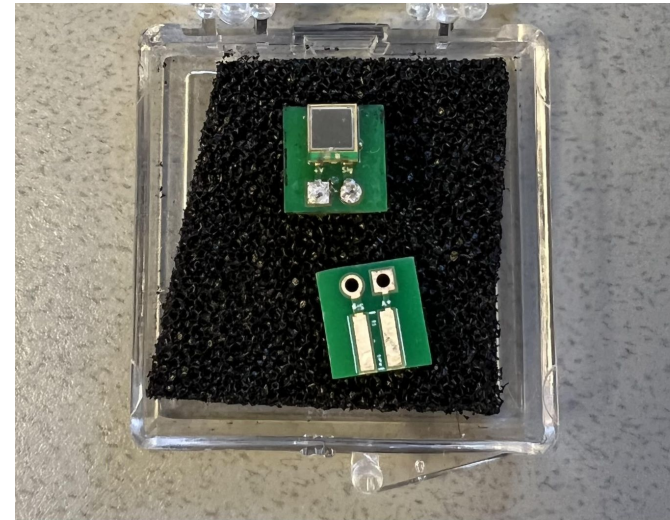
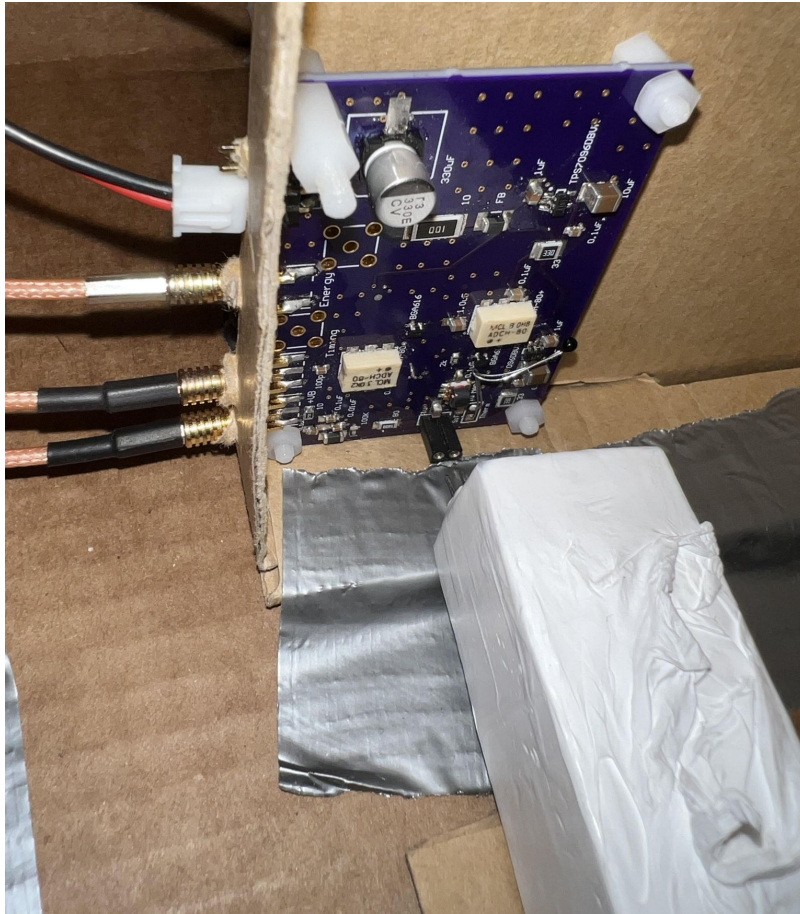
# Cosmic ray test setup

- 3mm\*3mm SiPM ([S14160-3015](#))  $V_{br}=38$  V,  $V_{op}=42$  V
- Scintillator overlapping area = 14\*15 cm
- Direct trigger from SiPM timing. Scintillator coincidence signal recorded for software trigger.



# Readout setup

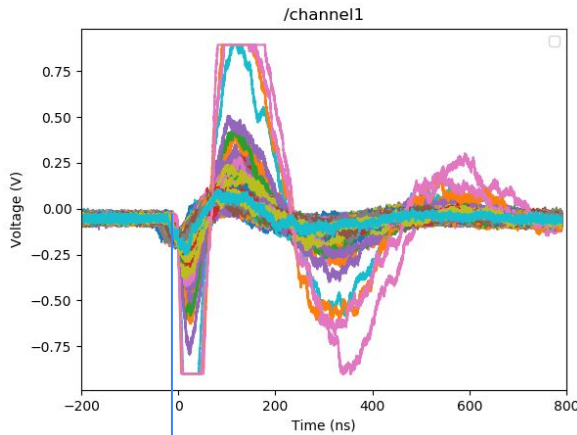
- 1 channel SiPM amplifier board from U. VA
- 2.5\*2.5\*6 cm BGO, wrapped, SiPM attached with silicon oil
- Oscilloscope 3 inputs: SiPM timing (trigger), SiPM charge, scintillator coincidence



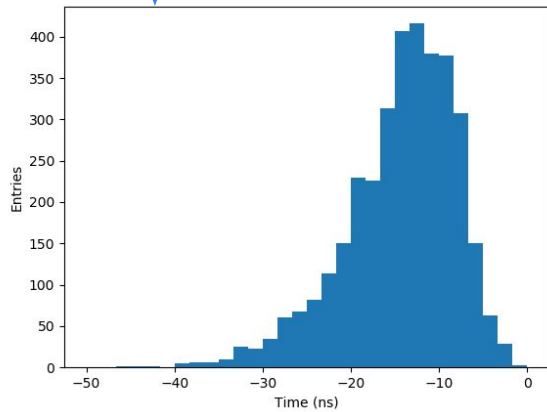
SiPM soldered on a small PCB

# Cosmic ray test setup

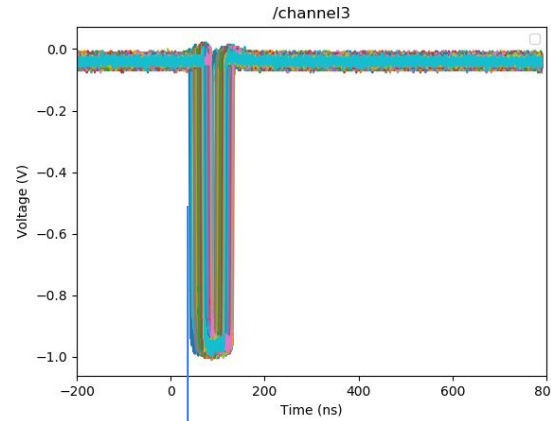
- 6110 SiPM direct triggers in 12.5 h. Average rate = 7.36 s/event.
- Among all SiPM triggers, 3492 events have scintillator coincidence.



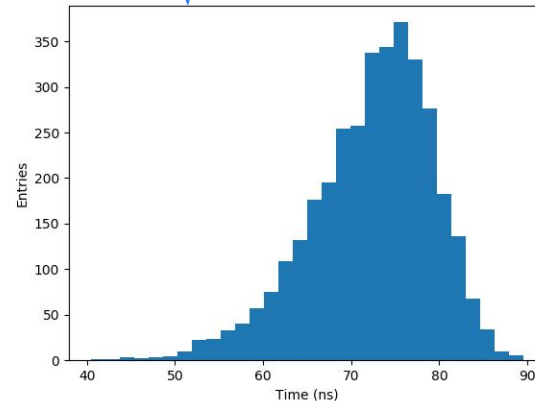
SiPM timing



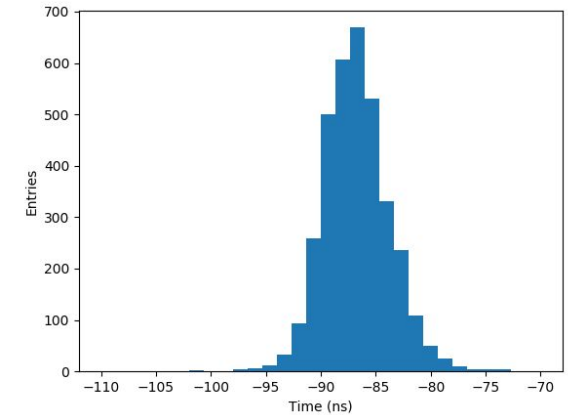
SiPM timing hist  
(first edge crossing -0.1 V)



Scintillator coincidence



Scintillator timing hist  
(first edge crossing -0.5 V)

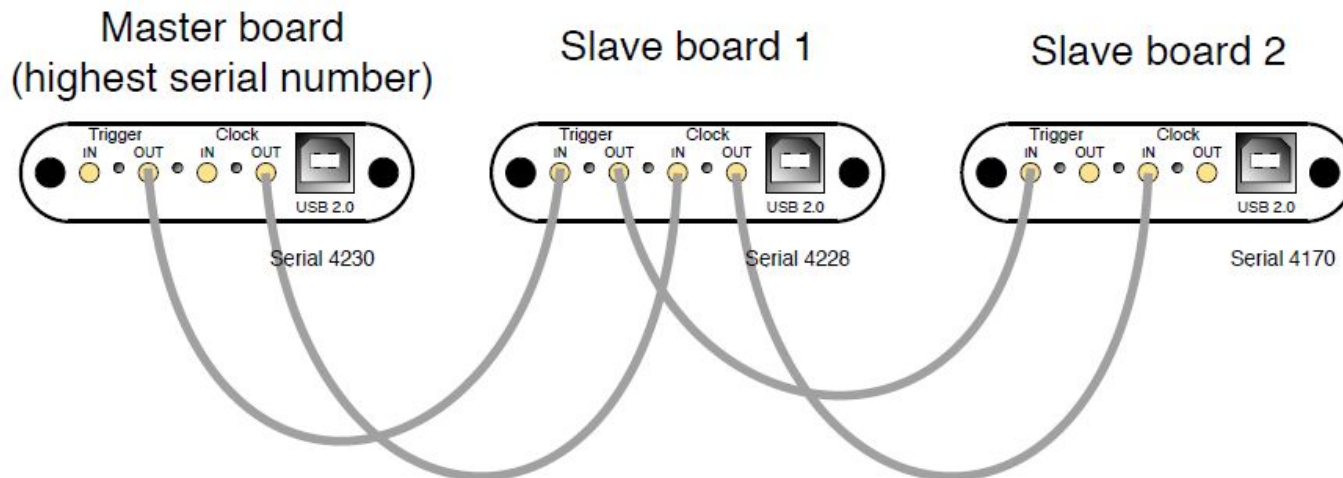


BGO time spectrum for cosmic?  
SiPM timing signal comes ~87 ns  
earlier than the coincidence  
signal. Delay: Cosmic to PMT (?)  
+ PMT to NIM output (~36 ns)

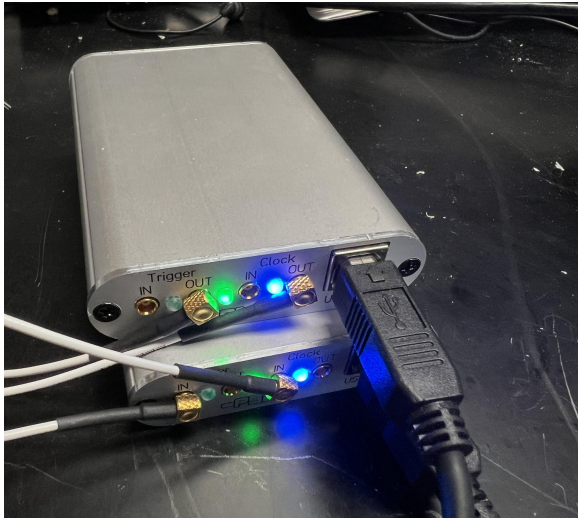
# Multi-channel readout

DRS4 GUI supports multi-board configuration:

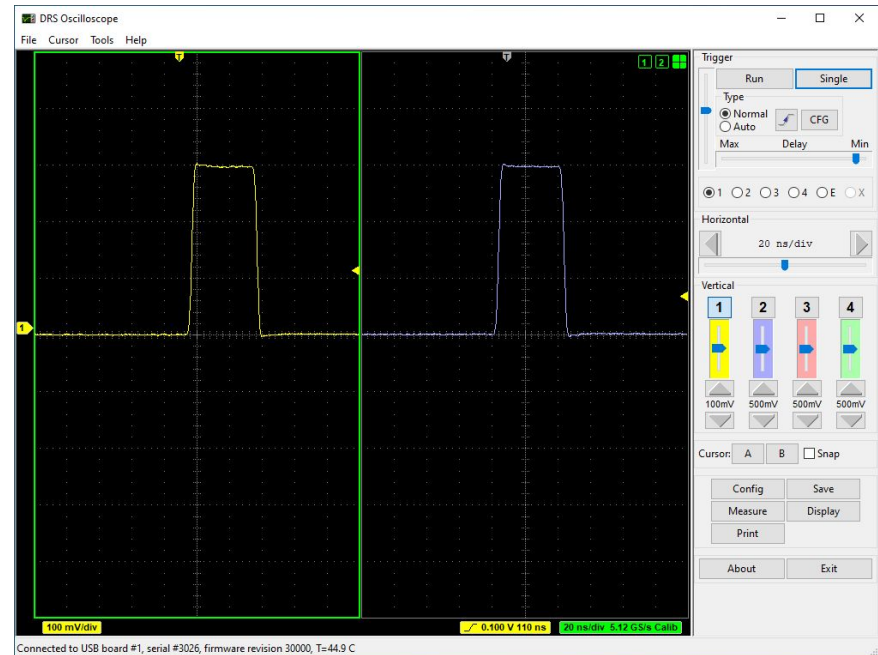
- Up to 16 boards
- Daisy-chain connection with board serial number descending
- Limitation:
  - Max event rate: 500 Hz/board
  - Trigger delay: 16 ns per board
  - Timing between boards: 400 ps in daisy-chain, 60 ps with dedicated clock distribution, 10 ps for multi-chip on the same board
- Waiting for the readout boards from Virginia



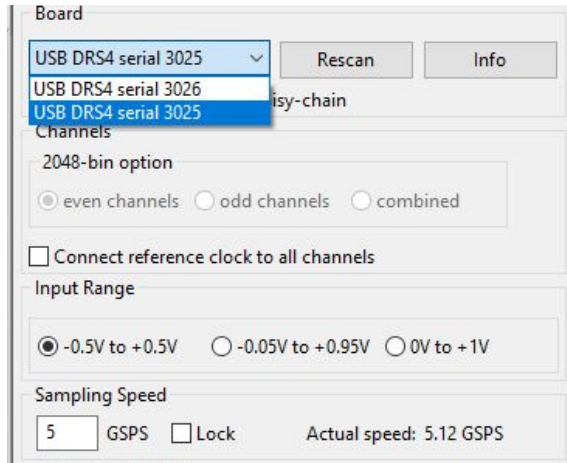
# Multi-channel readout



2 evaluation boards in daisy-chain, recognized by the DRS4 GUI

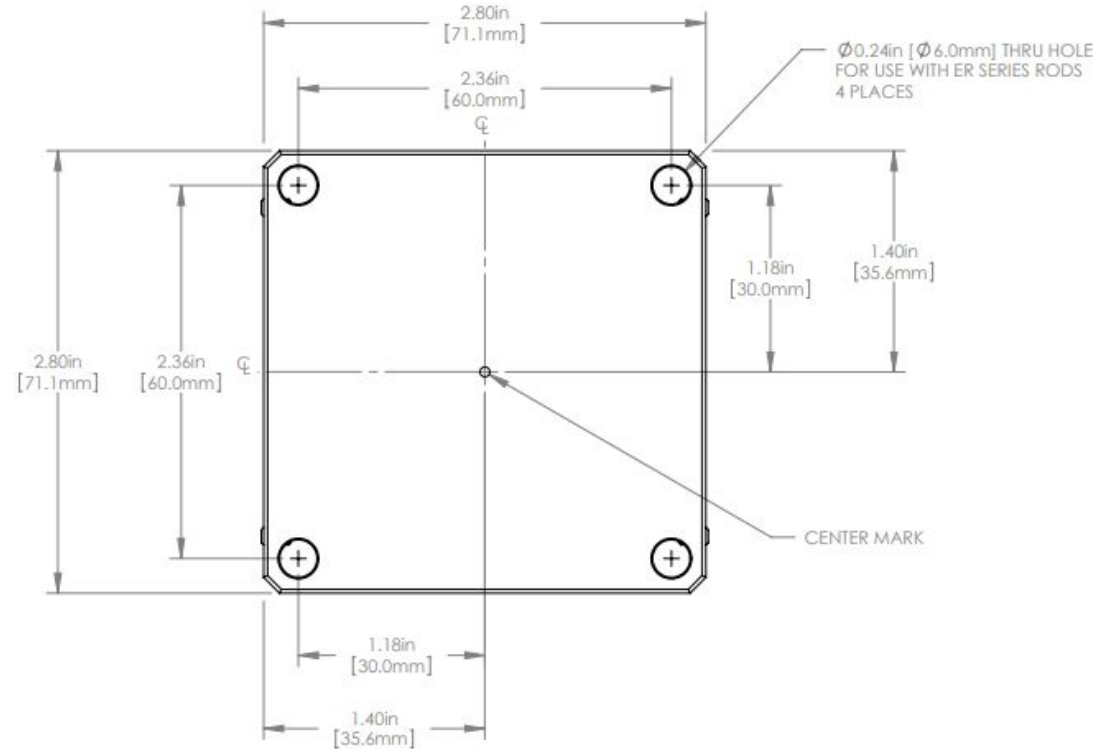
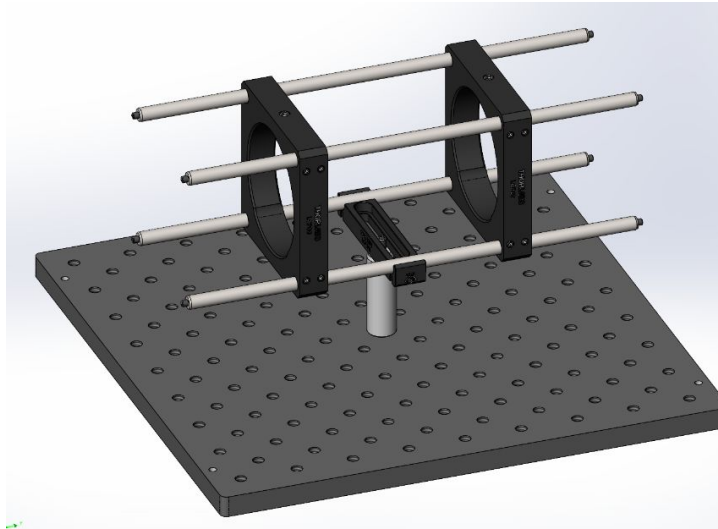


- Synced pulses feeding to 2 boards.
- ~16 ns trigger latency observed.
- Binary data saved simultaneously.
- Python script to decode the DRS4 binary data.

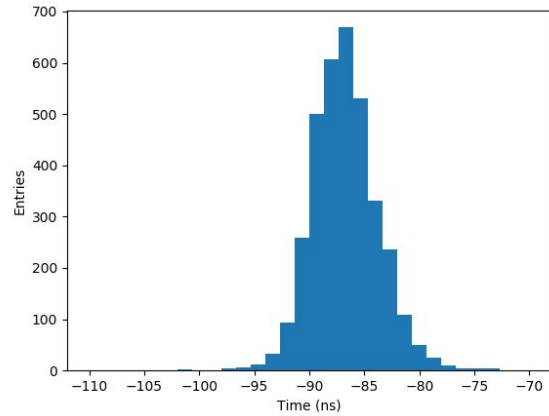


# Planned supporting platform in the dark box

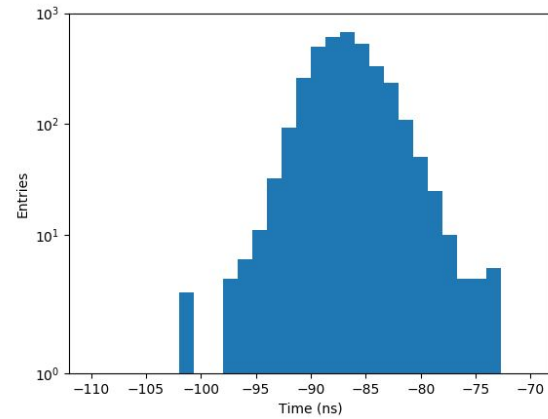
- Supporting platform received, waiting for the dark box



Cage plate dimensions



BGO time spectrum for cosmic



BGO time spectrum for cosmic in  
log scale