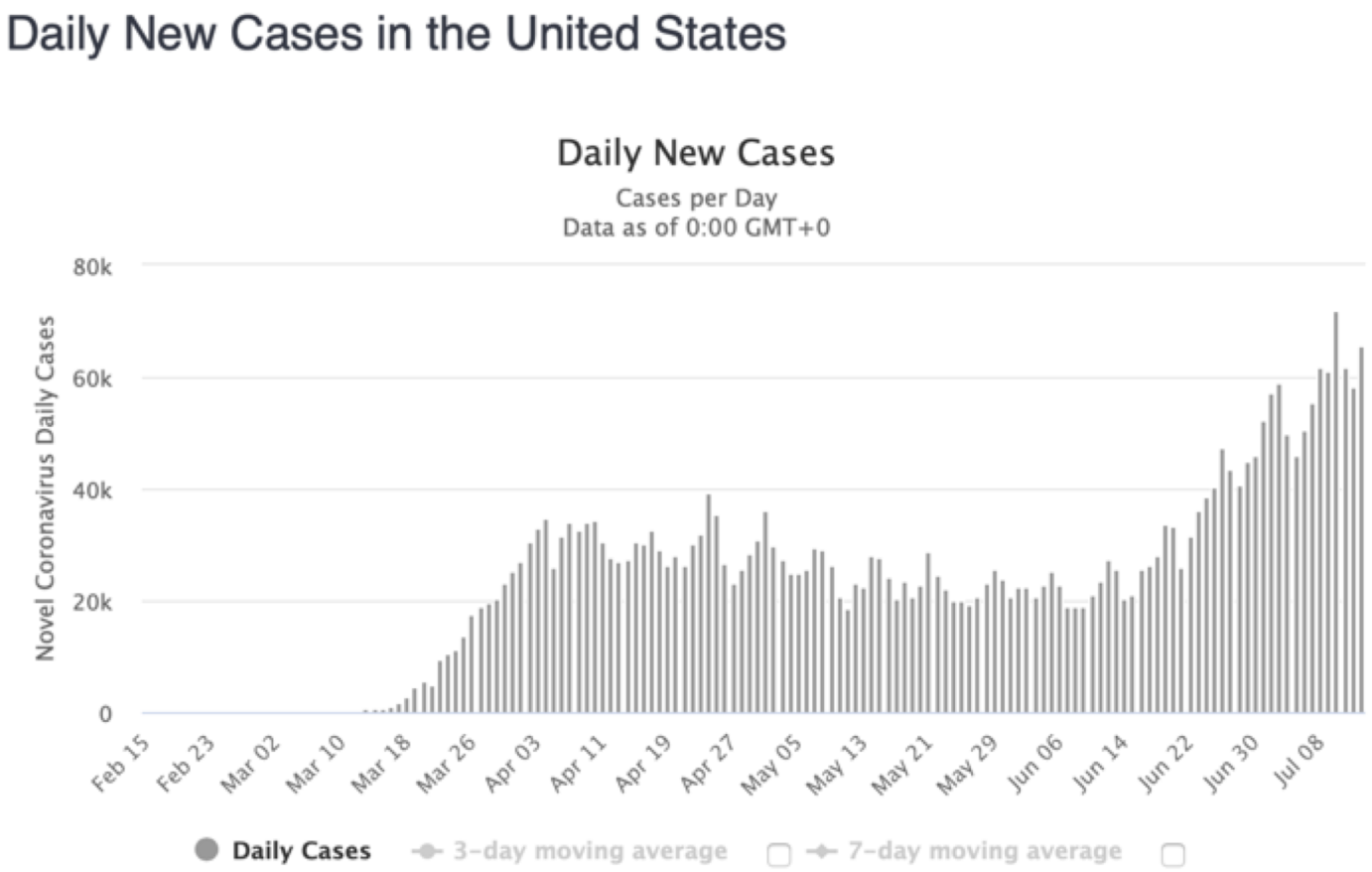
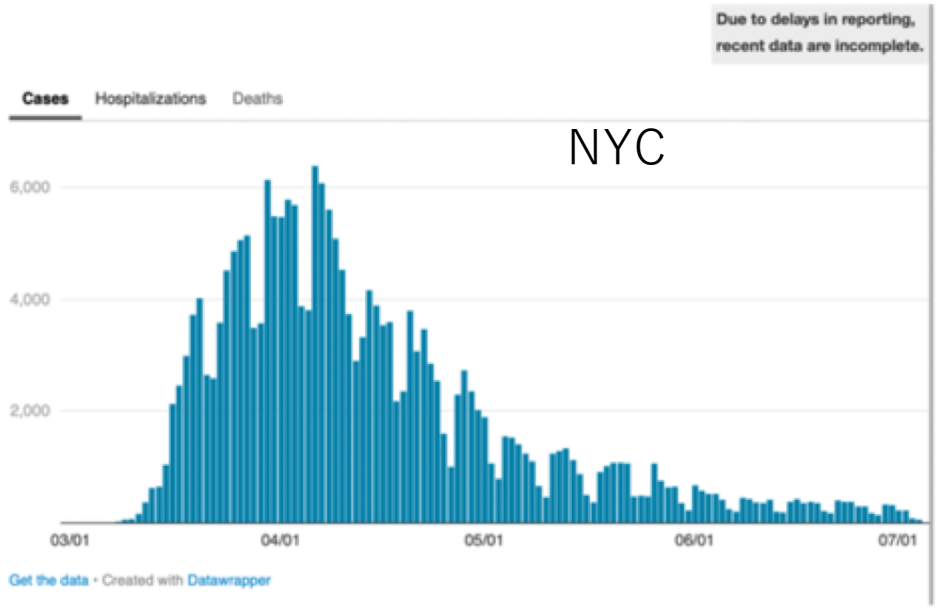
Production Status and Ladder Test Plans

RIKEN/RBRC

Itaru Nakagawa

Y2020 3rd Beam Test?





We may need to prepare the scenario to proceed without 3rd beam test in near future

Schedule

	Year	2020												2021													
Scenario	Month	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	Quantity	ladder
Scenario A	Silicon	bacth-II (150)																								250	125
	HDI	bacth-I (150)						batch-II (90)																		240	120
	Stave	prototype-IV							batch-I (75)			batch-II (75														150	150
	Assembly											56		56												112	
Scenario B	Silicon	bacth-II (150)																								250	
	HDI	bacth-I (150)						batch-II (90)																		240	
	Stave								batch(150)																	150	
	Assembly												112													112	

The ultimate goal is to produce 56 x 2 = 112 functioning ladders.
Number of spare silicons 125-112 = 13 may not be sufficient.

Executive Summary

- Silicon Sensors
  - Requesting quote to HPK for another 20 sets sillicon sensors in stock.
- FPHX
  - ~1500 good FPHX chips are delivered to NCU on April 29th.
  - Will arranged w/ Rachid another bag (1500 FPHX) to be shipped to NCU.
- HDI
  - Shipped 39 HDI's to BNL and are delivered today.
  - Move on to 2nd batch once new design around bias connectors are confirmed in BNL
- Stave
  - Final tweak of the specification in flow test criteria.
  - 75 Stave production contract is now under process in RIKEN's contract department. Expected PO in next week.
- Trigger Scintillators and PMTs
  - Placed order 2 x ladder size and 2 x single cell scintillators and light guides to G-tech. Lead time is 2 weeks.
  - Placed PO of 4 PMTs to Hamamatsu.

Performance Check for Ladders

Ladder Test Proposal

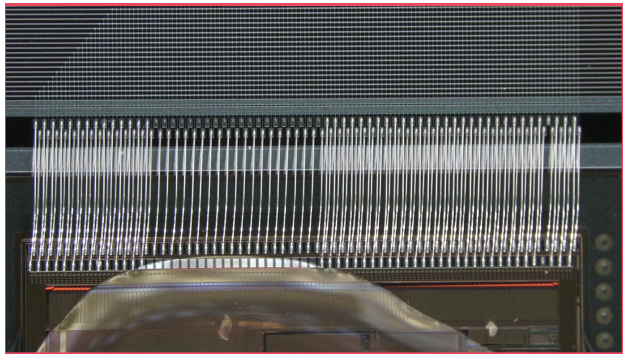
- Since the best ladder testing knowhow resides in NWU, I propose to send one of early assembled NCU and BNL ladder suppose to be shipped to NWU and tested there.
- One by one comparison of both ladders.
- Any difference in the performance between them suppose to be further investigated and feedback to the rest of assembly.

Ladder Performance Check Procedure

STEP	Test	Condition	Purpose	Status
1	Visual Inspection		Check all components and wirebondings with micro scope	
2	Calibration	Bias on	Wirebonding btwn FPHX and HDI. FPHX health check.	
		Bias off		
3	Bias Scan	Bias on HV vs. Current	Wire bonding btwn FPHX and Silicon. Ground contact/short.	
4	Noise	Bias on, self-trigger	Noise distribution and rate	
5	Source	Bias on, external trigger by a scintillator	Find dead channel in silicon sensor	
6	Cosmic Ray	Bias on, external trigger by sandwich scintillators. Multi-layered ladders.	Uniformity of the entire area and MIP observation. Long term stability,	

Newly assembled ladder supposes to go through these performance checks.

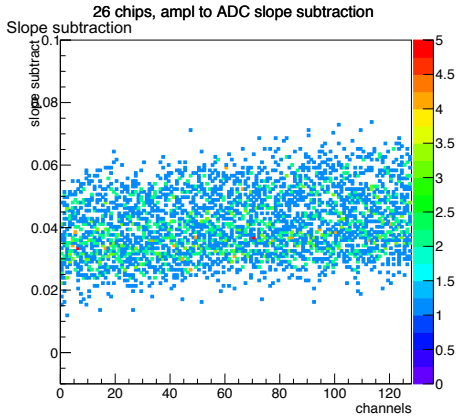
1. Visual Inspection



- Take photos to prove following check list
- Are all FPHX chips aligned in the right position?
- Are there any spilt silver epoxy?
- Do wirebondings look OK between FPHX and HDI?
- Do wirebondings look OK between FPHX and Silicon?
- Are there two wires bonded between guard ring and GND pad on HDI in 4 corners?
- Are there two wires bonded between bias ring and GND pad on HDI in 4 corners?

2. Calibration

1. Run calibration without bias voltage.
2. Run calibration with bias voltage. Record leakage current at 50V and 100V.
3. Check if FPHX chips responses OK to each slow control commands of start run sequence
4. Check masking feature of FPHX chip (may need to develop the firmware)
5. Evaluate number of dead channel (or missing wirebonding btwn silicon and FPHX) for each chip
    1. Amplitude vs. ADC slope difference btwn bias on/off ch-by-ch
    2. Channel vs. ADC?
6. misc

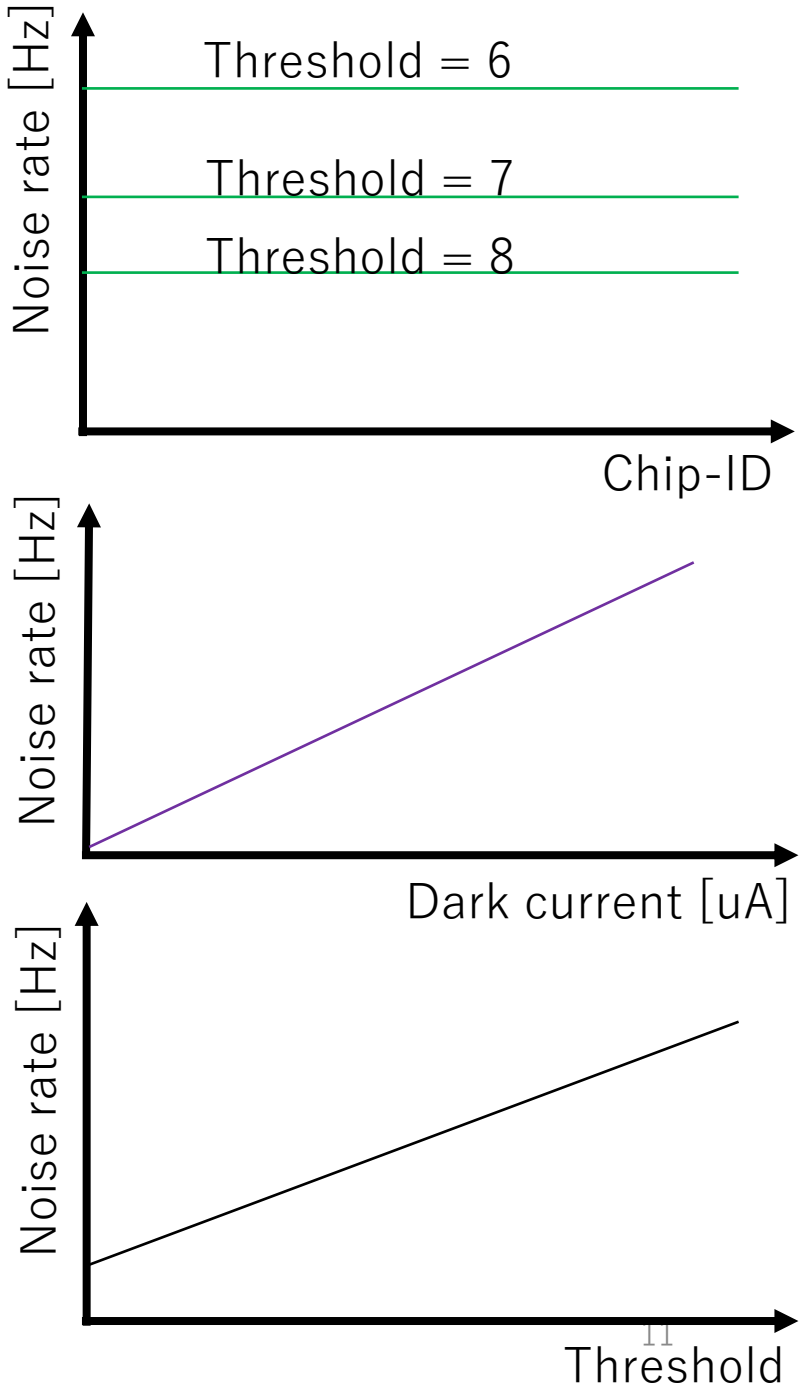


3. Bias Scan

- Make sure the bias connection is firm.
- Make sure there is no additional current induced by the bias supply line.
- If the current fluctuates, better try different bias cable.

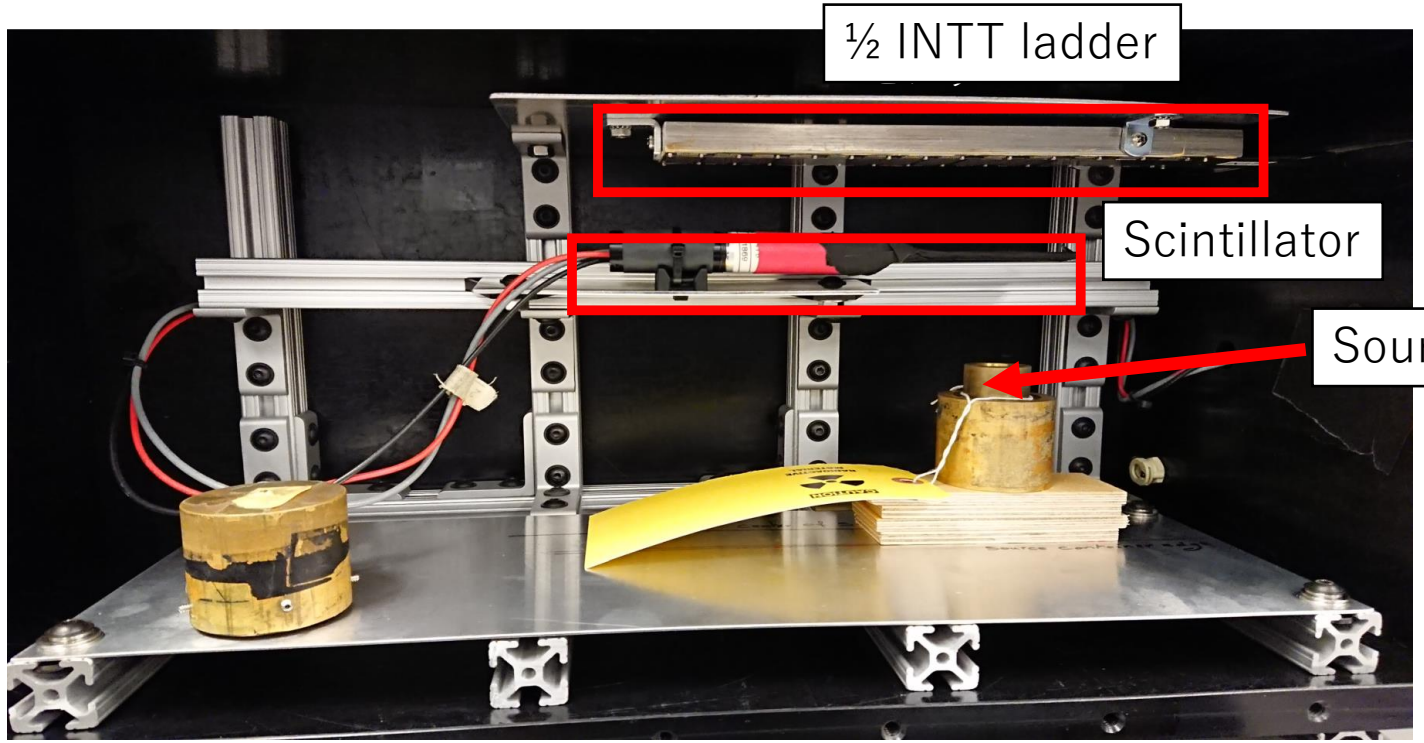
4. Noise performance

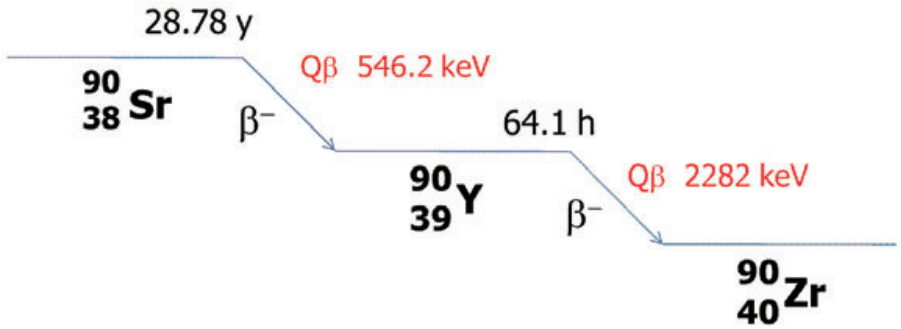
- Can be done in the test bench, but we have never introduced this DAQ mode.
- Set DAQ0 threshold around 8 instead of 20. 8 is standard threshold for the beam test. 20 is the standard for the calibration.
- Take data with external trigger mode with clock trigger as a function of threshold.
- This way DAQ accumulates just noise. Correlate noise rate with the dark current.
- Ultimately, the vertical noise rate suppose to be translated to fake hit rates per BCLK per ladder/INTT. To be used to optimize the threshold optimization of the INTT operation.



Source Test Setup in 2017

H. Masuda Master Thesis
Section 4.2.3.





ADC Setup

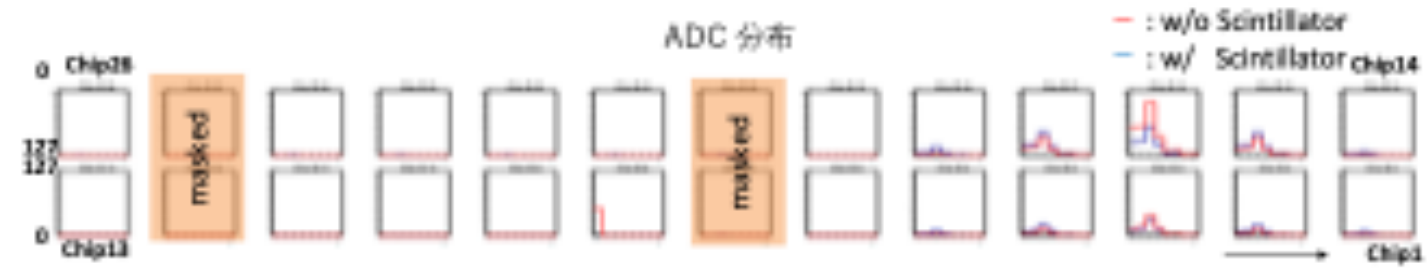
ADC	設定値	対応電圧	Note
ADC0	25	310mV	
ADC1	35	350mV	
ADC2	48	400mV	2strip shared peak(MIP)
ADC3	98	600mV	
ADC4	148	800mV	
ADC5	172	900mV	1strip peak(MIP)
ADC6	223	1100mV	
ADC7	248	1200mV	

Note: since the thickness of the scintillator @ NCU is 12.5mm, the layout suppose to be source-ladder-scintillator.

Measurements with self-trigger mode

Hit distribution without scintillator

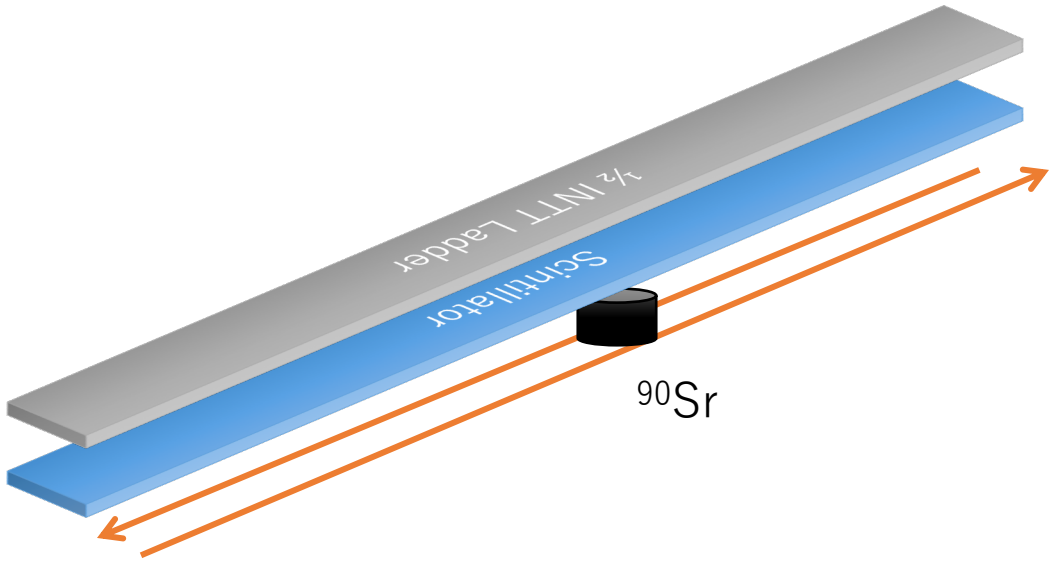
Hit distribution with scintillator as a quenching material.



This figure indicates we still expect finite ADC ~400mV or so.

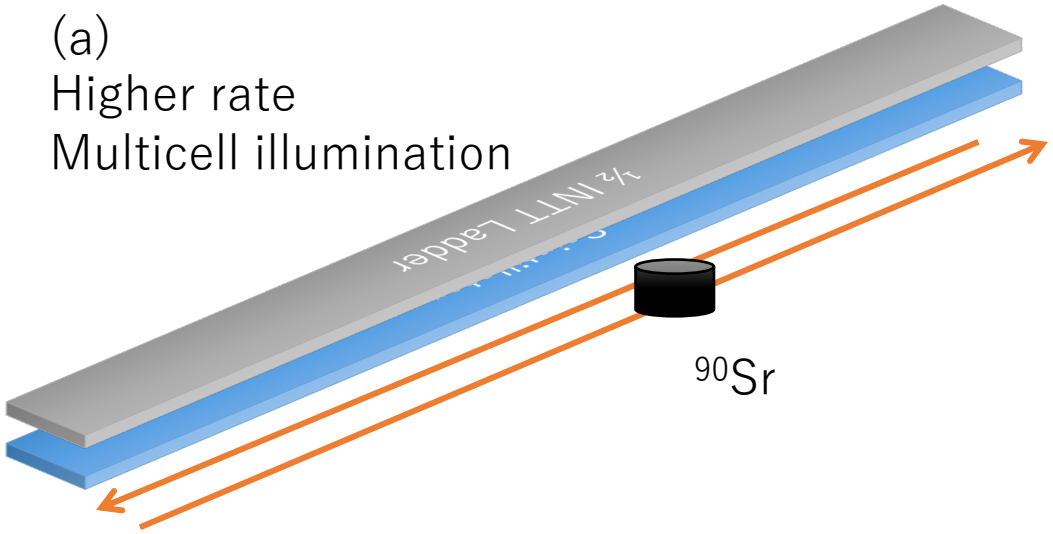
What is needed?

- Frame and support structure in a dark box for the setup.
- Somewhat (semi)-automated source position control to scan through each INTT cell. The record of the source position is to be integrated with data.
- These system can be also be applied to BNL as well.

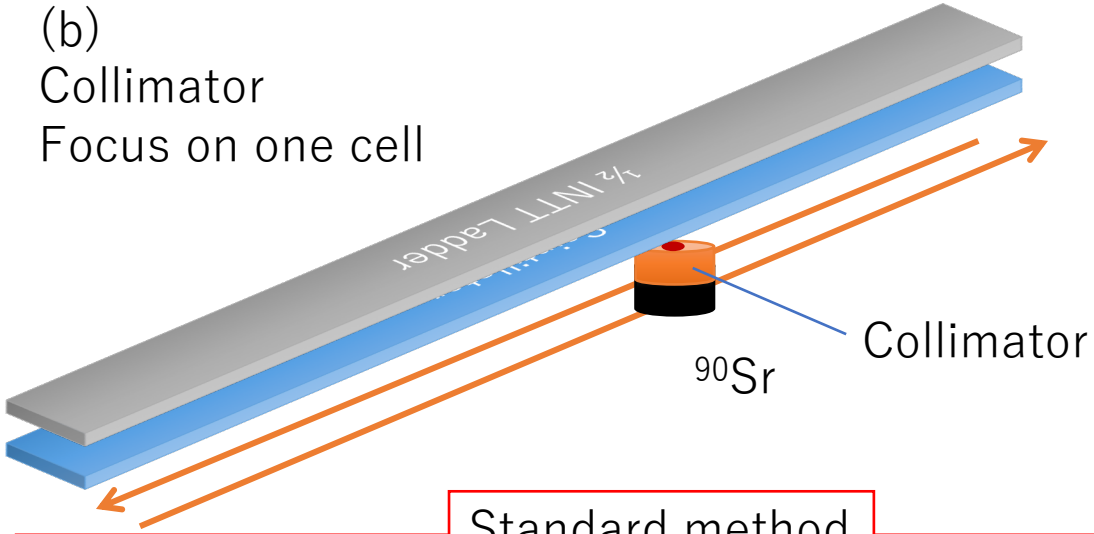


Options

(a)
Higher rate
Multicell illumination

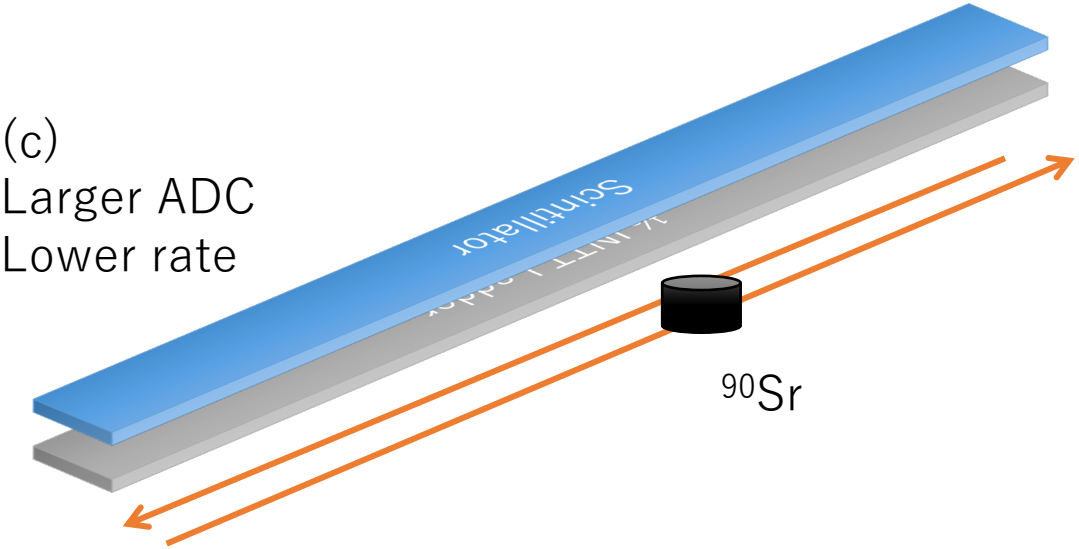


(b)
Collimator
Focus on one cell

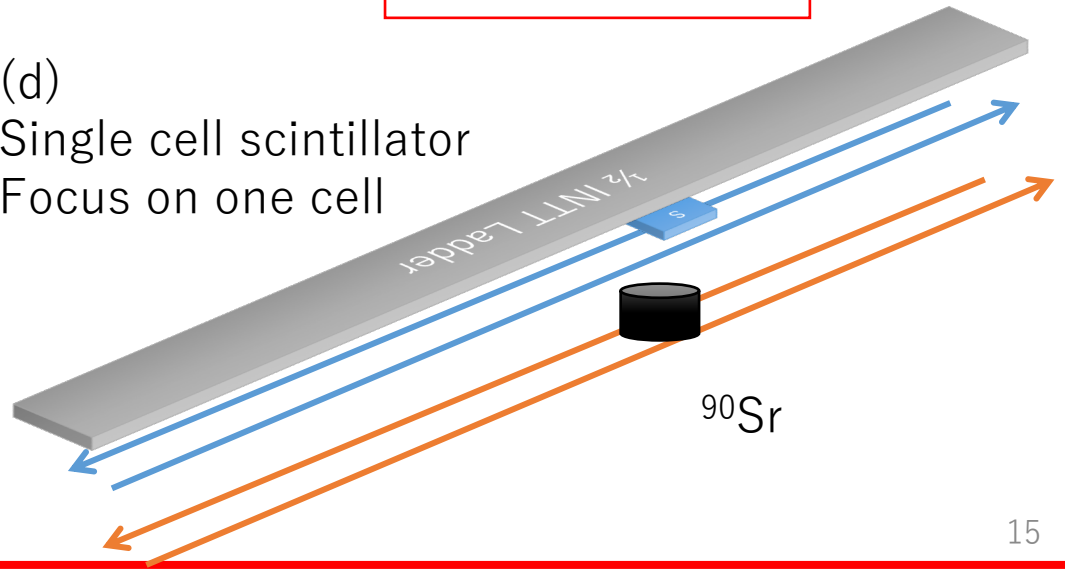


Standard method

(c)
Larger ADC
Lower rate

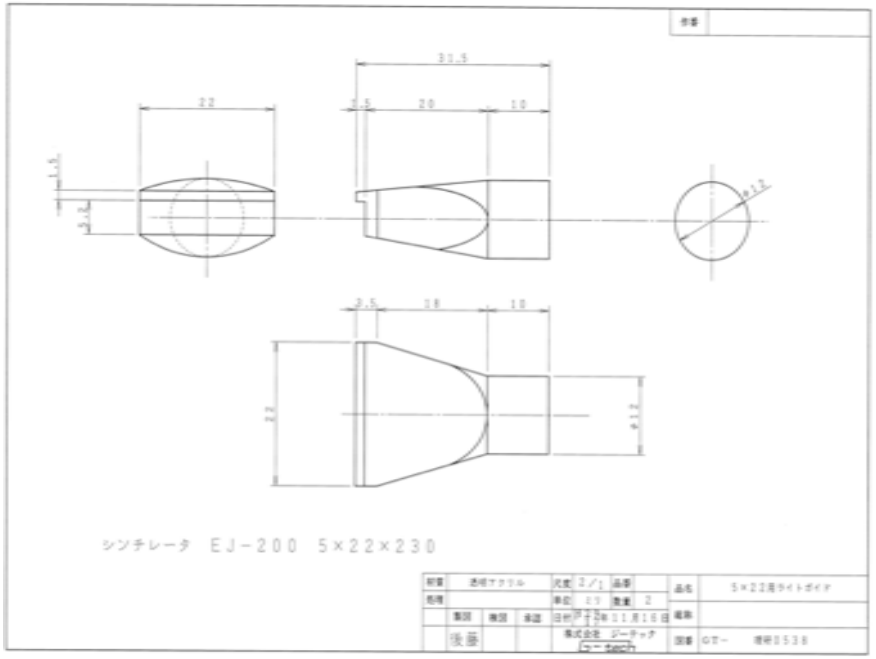


(d)
Single cell scintillator
Focus on one cell

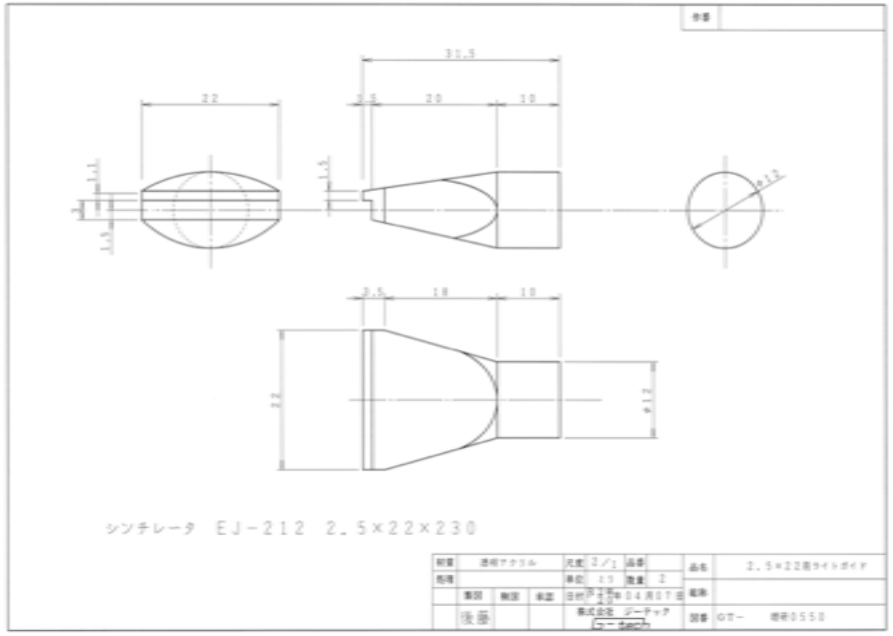


Thinner Scintillator

- Placed an order of thin (2.5mm thick) scintillators to G-Tech co. Lead time is 2 weeks.
  - 2 x long ladder size scintillators
  - 2 x single cell size scintillators



Light guide for 5mm thick



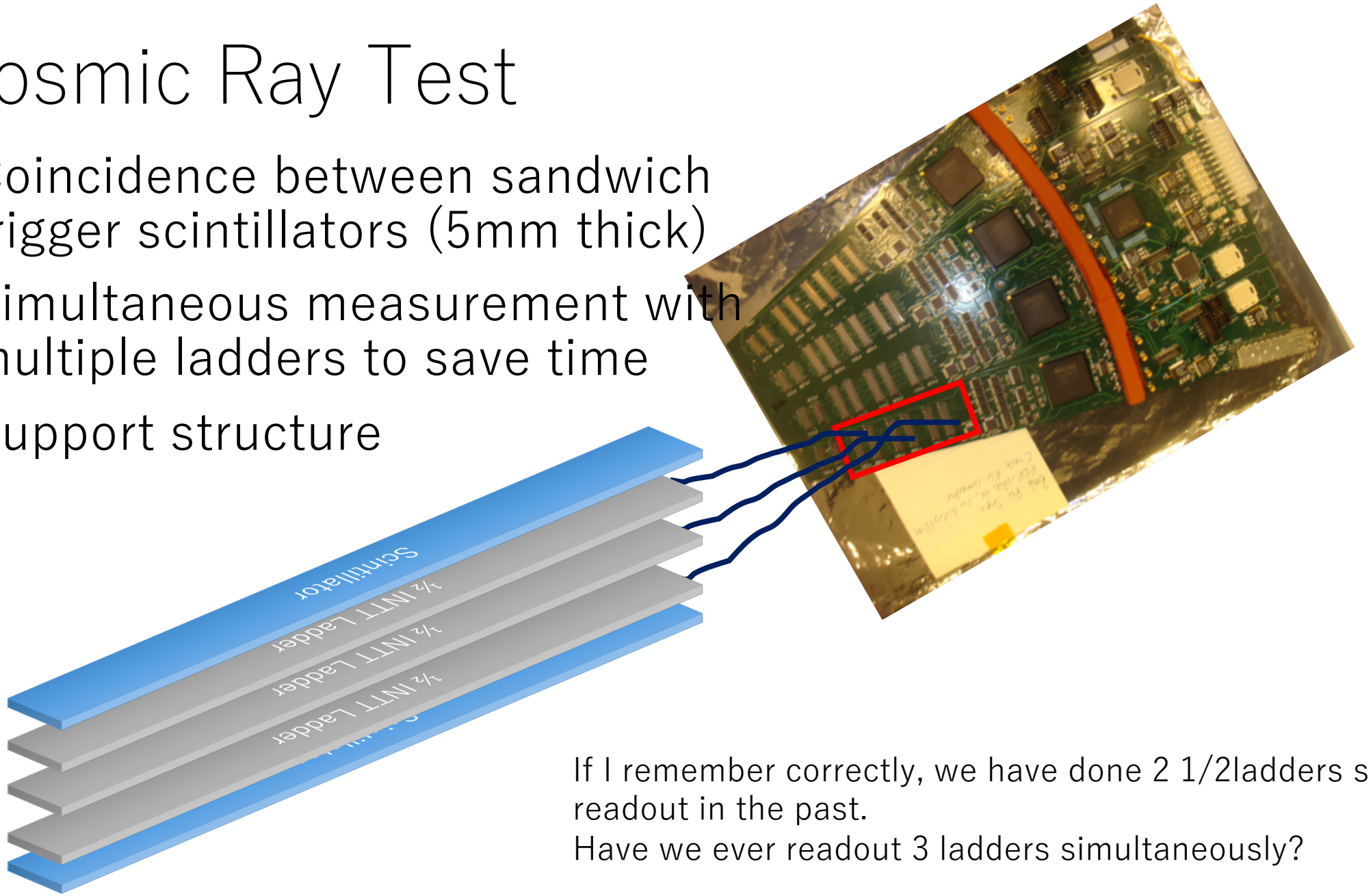
Light guide for 2.5mm thick

Leadtime

- 2 weeks for Scintillator and lightguide from G-tech co.
- 2.5 months for PMT (H3165-10) from Hamamatsu co.
- There may be a spare PMT in RIKEN test bench, but I vaguely remember.
- How many PMTs are necessary?
  - 3 for NCU/NWU
  - 3 for BNL?

Cosmic Ray Test

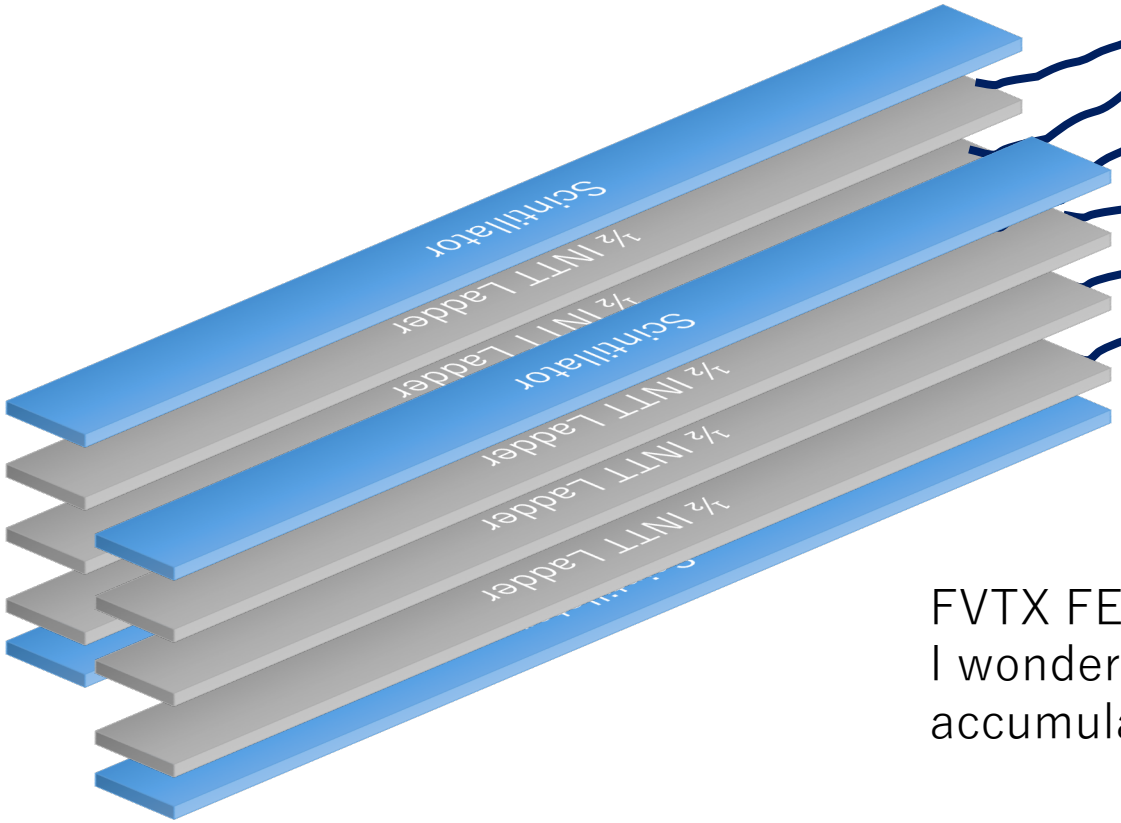
- Coincidence between sandwich trigger scintillators (5mm thick)
- Simultaneous measurement with multiple ladders to save time
- Support structure

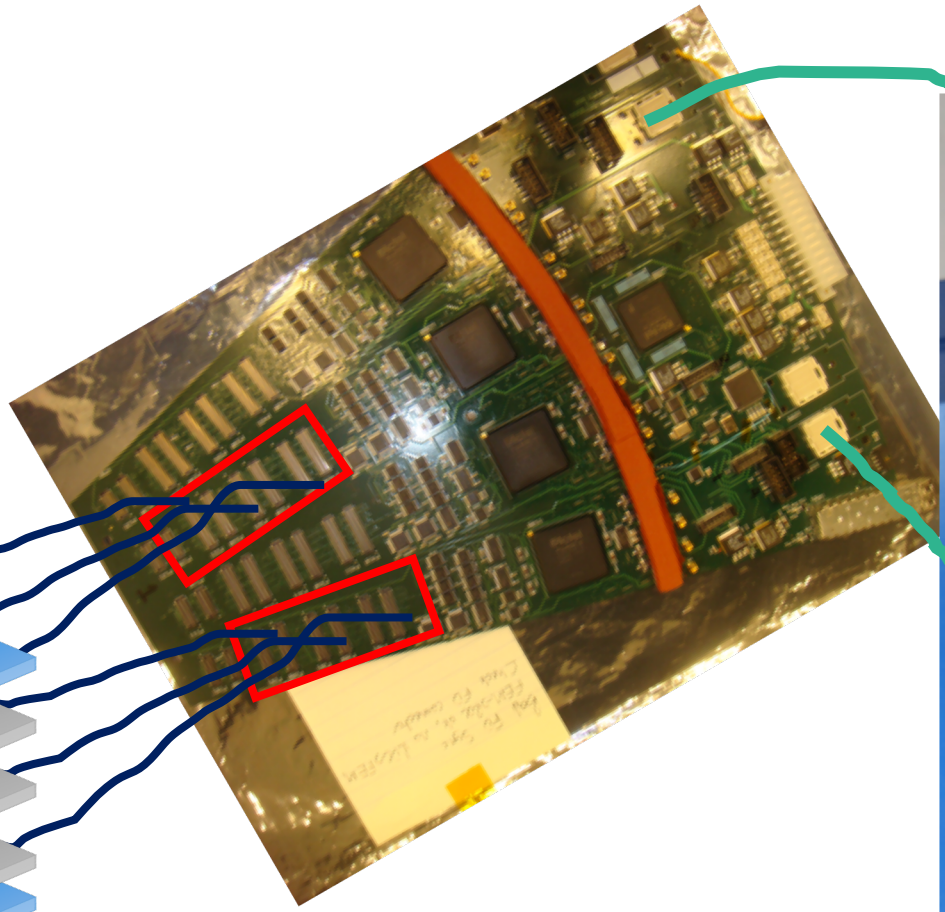


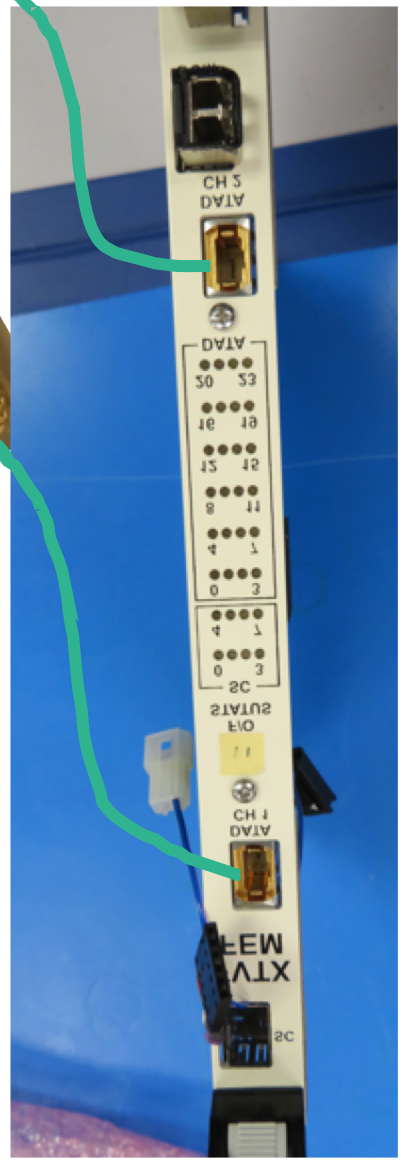
If I remember correctly, we have done 2 1/2ladders simultaneous readout in the past.
Have we ever readout 3 ladders simultaneously?

Cosmic Ray Test

- Double column readout?
- If this works, 6 ladders can be tested simultaneously.







FVTX FEM has two data fiber inputs.
I wonder if standalone firmware is designed to accumulate both simultaneously