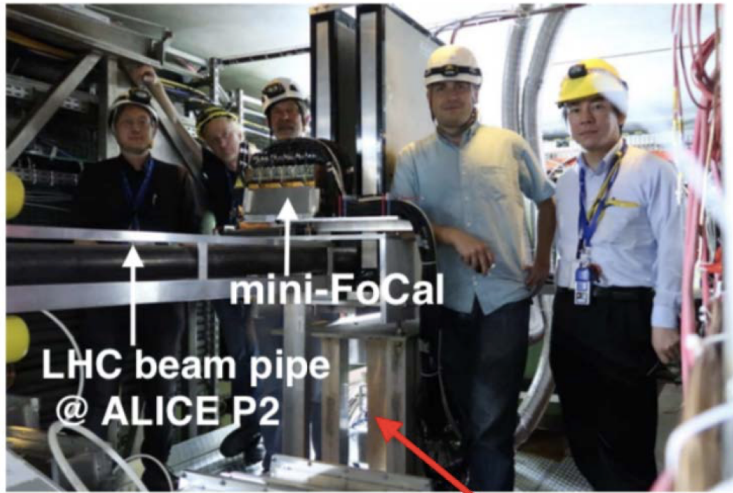


Mini-FoCAL Discussion with Tsukuba Group

RIKEN/RBRC
Itaru Nakagawa

mini-FoCal in ALICE (2018)

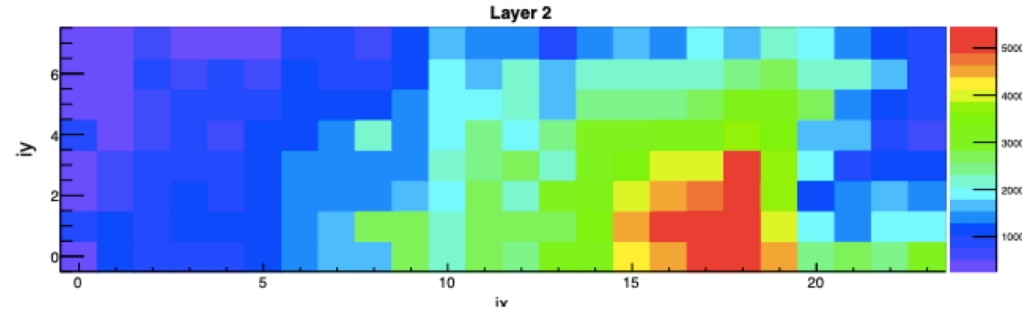


SRS system under the table

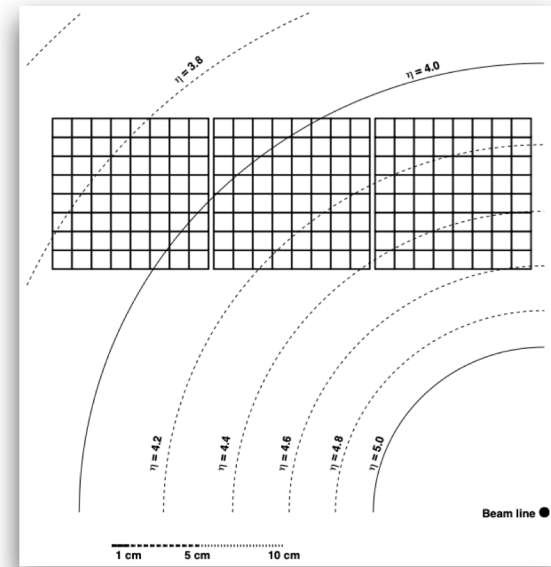
Goal: measure/verify backgrounds in situ with p+p @ $\sqrt{s} = 13$ TeV collisions in ALICE

- Calibration based on test beam
- Comparison to MC (cluster spectrum, slid lines)

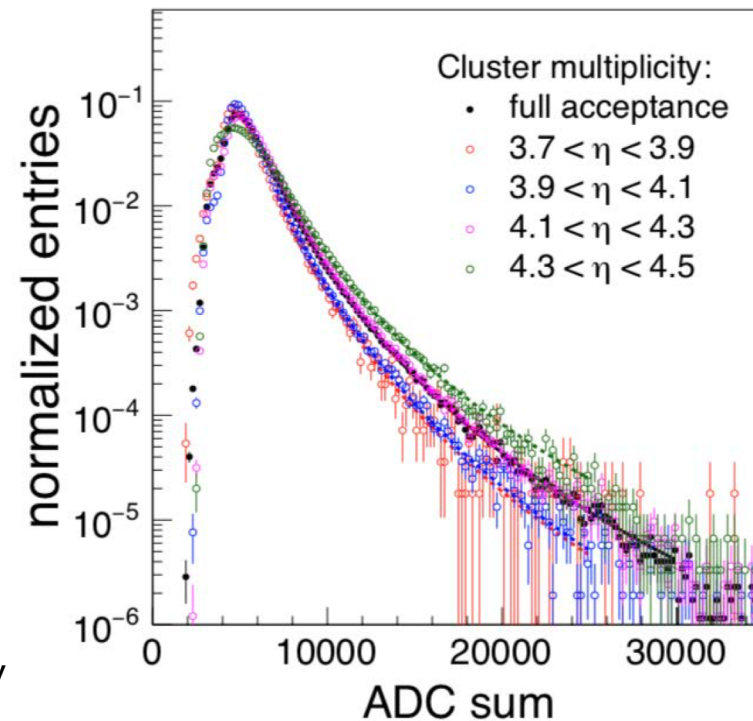
Hit Map of mini-FoCal in ALICE



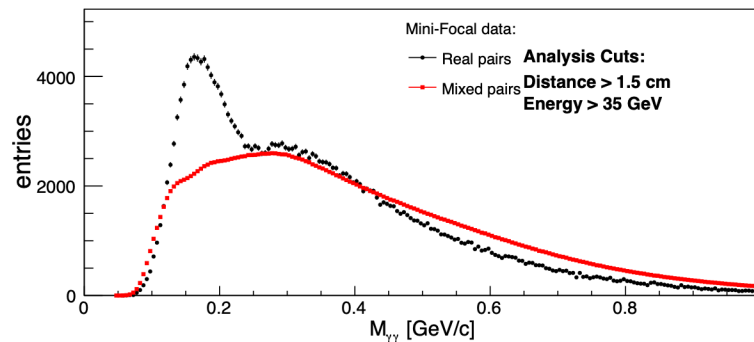
Acceptance



Cluster spectrum



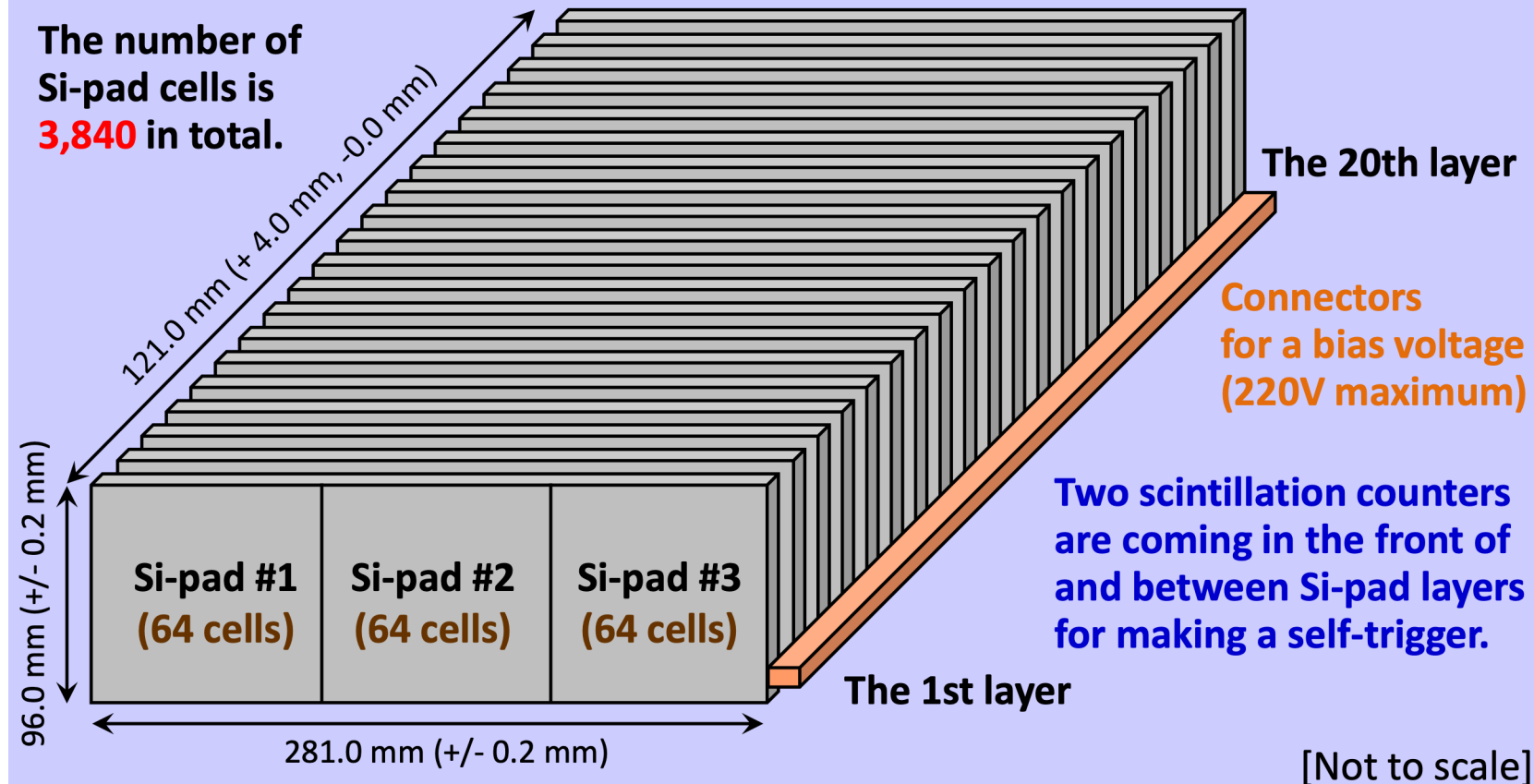
π^0 peak



N. Novitzky

A design of the FoCal-E pad detector

A tower of the FoCal-E pad detector prototype, called “**mini-FoCal**”, has **20 silicon-pad layers with Tungsten alloy plates**. The front-end electronics would be attached on the top side of the tower.



A new Si-pad sensor

A size of the sensor:
93.0 mm x 93.0 mm

The number of cells: 64

A size of the cells:
11.25 mm x 11.25 mm

The cell pitch: 11.30 mm

A thickness of the sensor:
500 μm \Rightarrow 320 μm

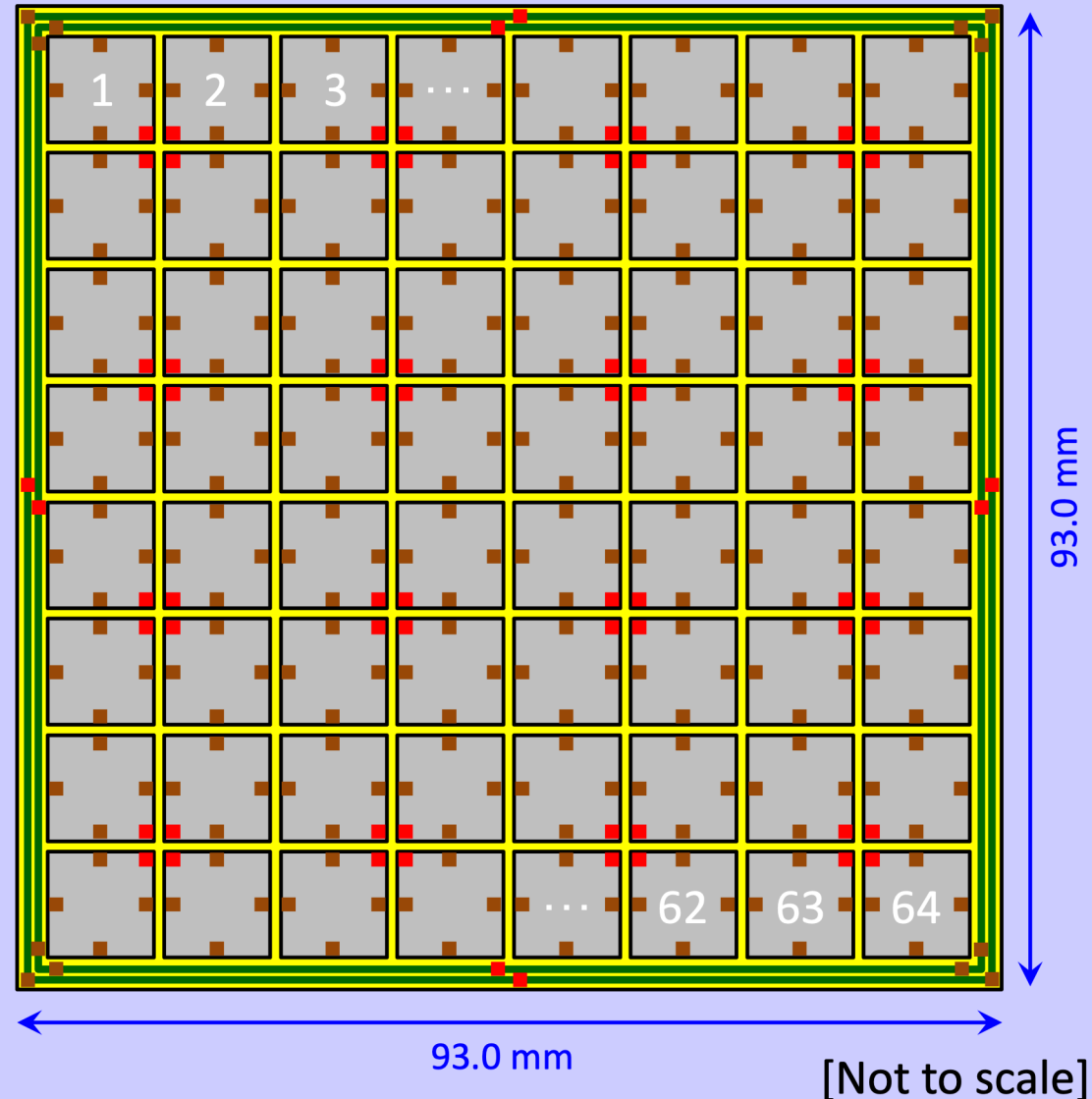
A surface of the sensor:
open \Rightarrow Aluminum plating
(for a light-tight design)

The number of wire bonding pads: 276 \Rightarrow 340

The back side plating: Au

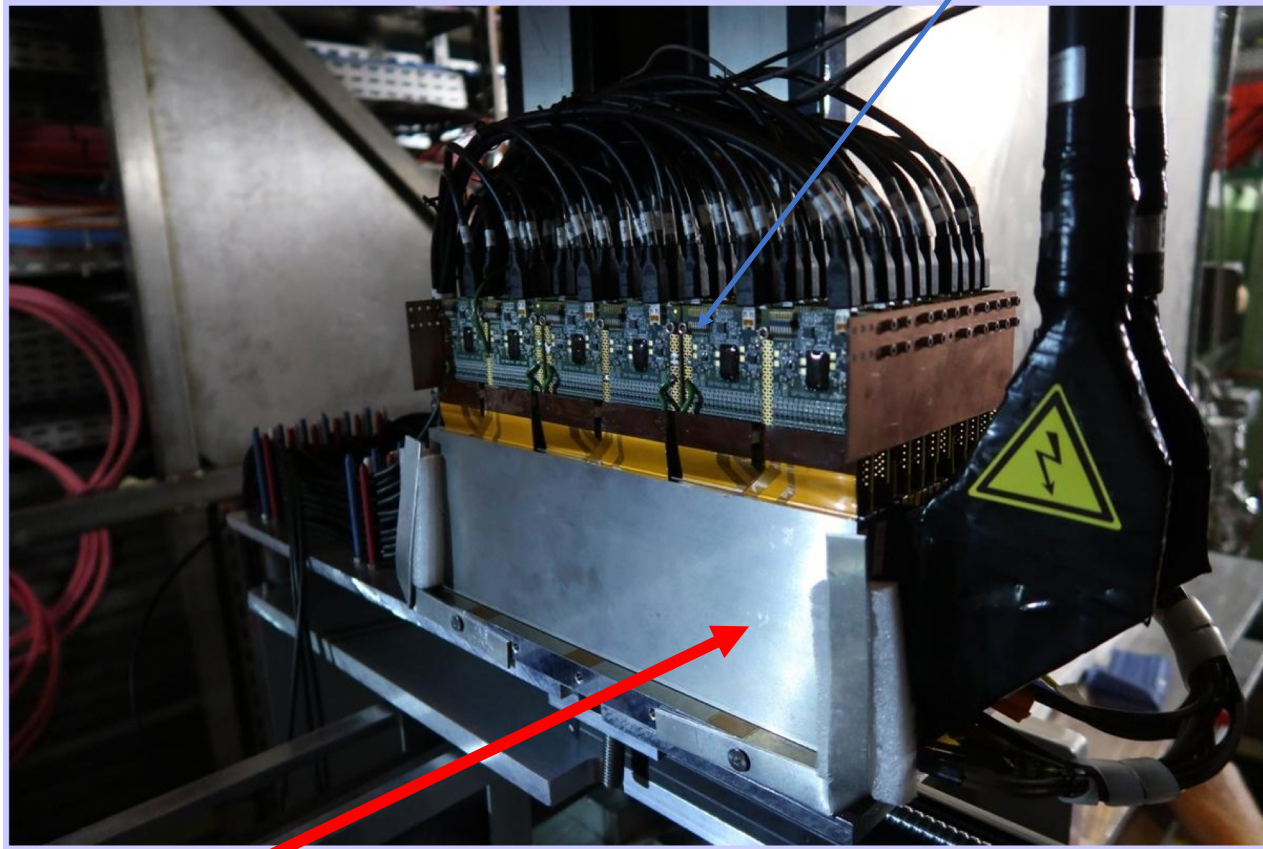
The guard ring: Yes

72 wire-bonding-pads in red were used.



Mini-FoCAL

Readout from the top



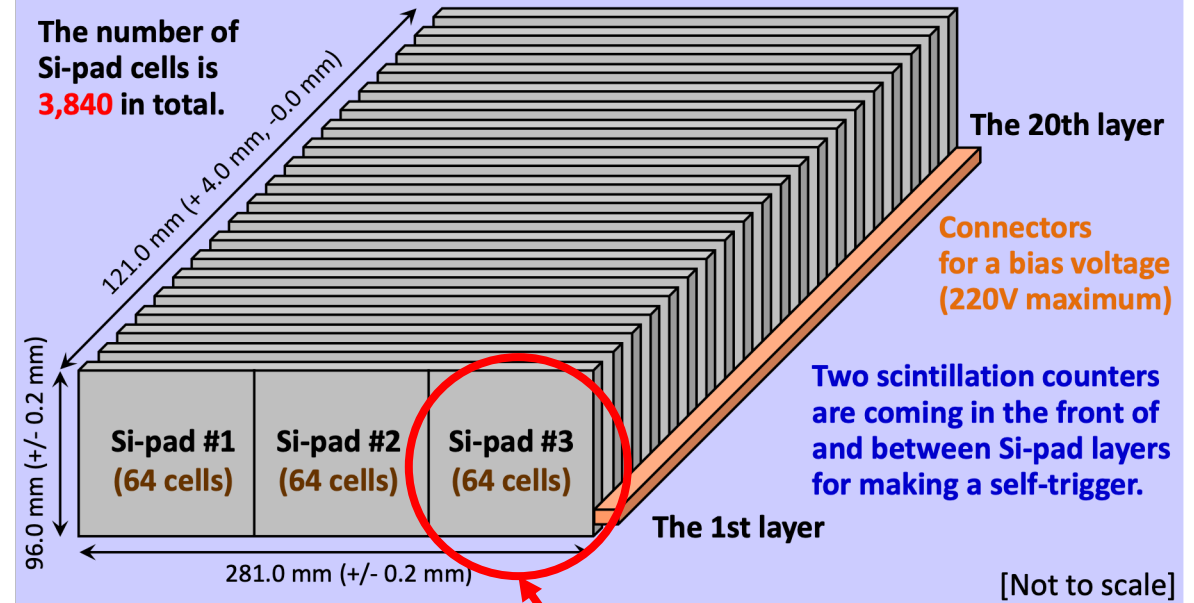
beam

A design of the FoCal-E pad detector

P.3 of 25

A tower of the FoCal-E pad detector prototype, called “**mini-FoCal**”, has **20 silicon-pad layers with Tungsten alloy plates**. The front-end electronics would be attached on the top side of the tower.

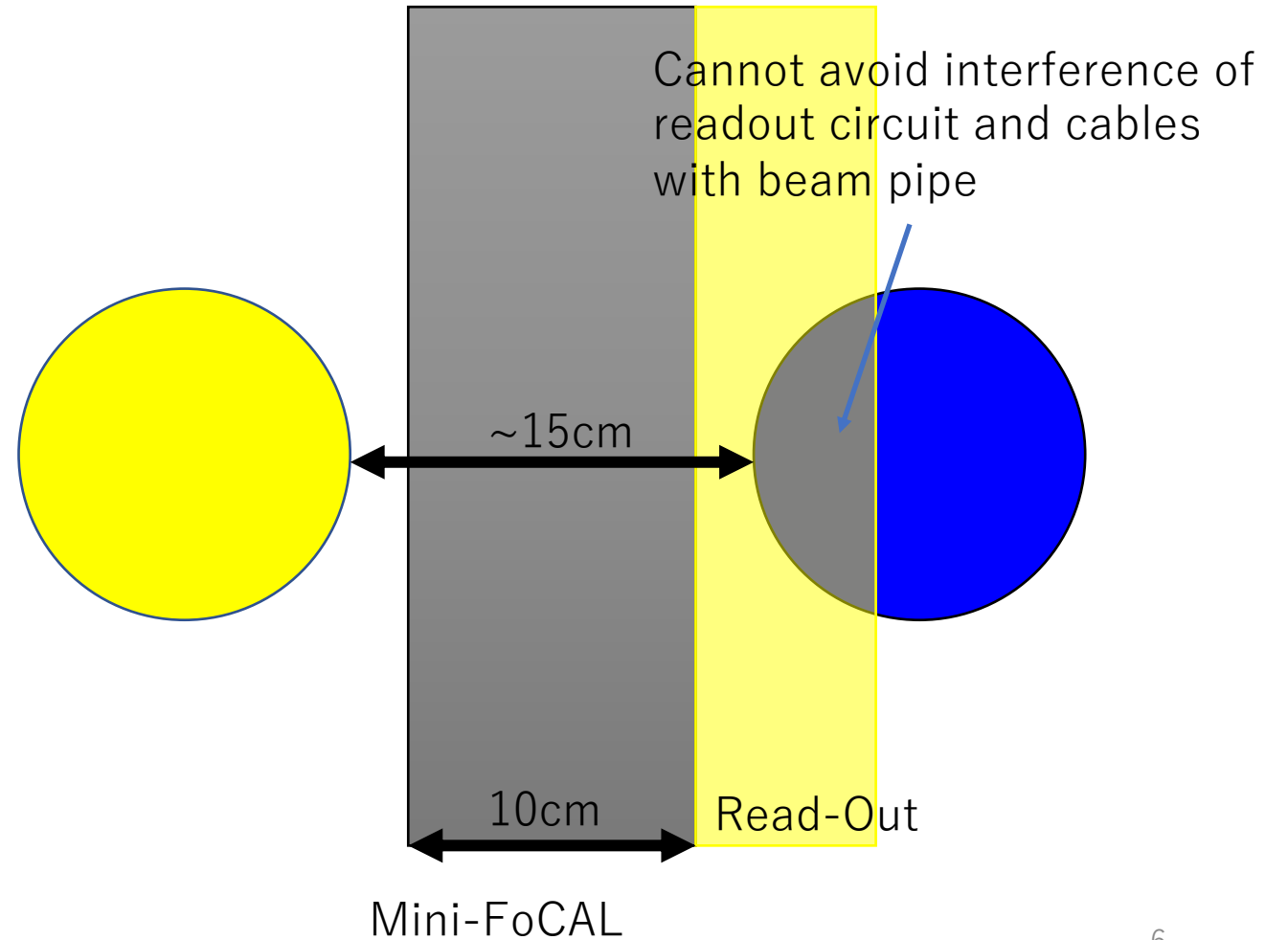
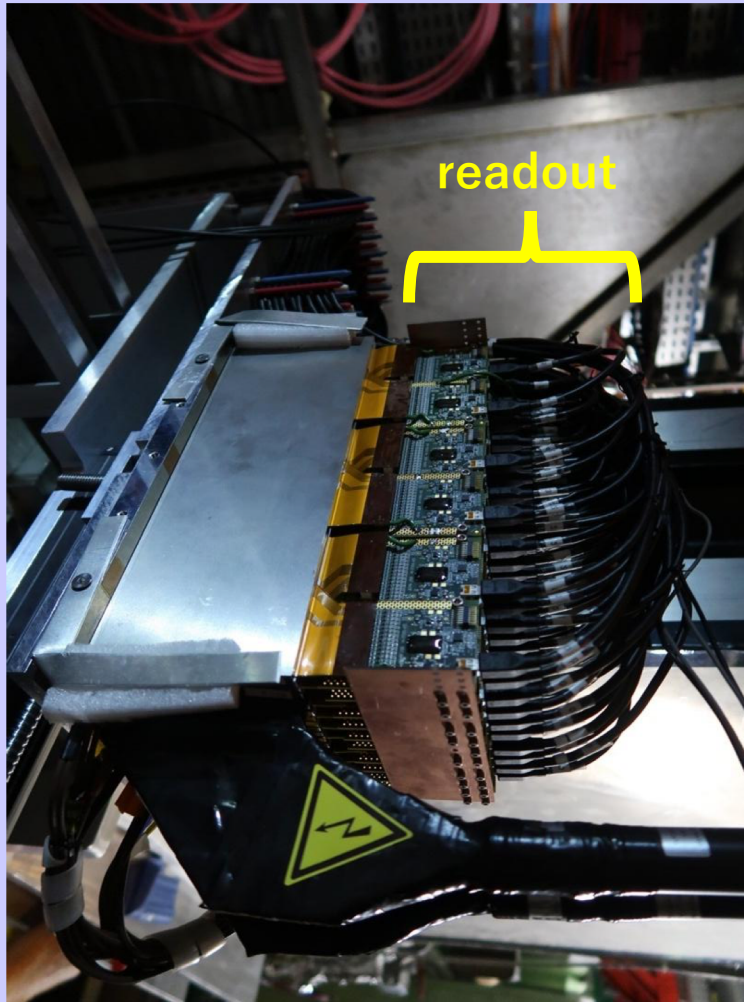
The number of Si-pad cells is **3,840** in total.



Unit of interest for RHICf-II

Can we reuse Mini-FoCAL for RHICf-II?

Need to align mini-FoCAL vertically to fit in the ZDC space



Difficulties to customize mini-FoCAL?

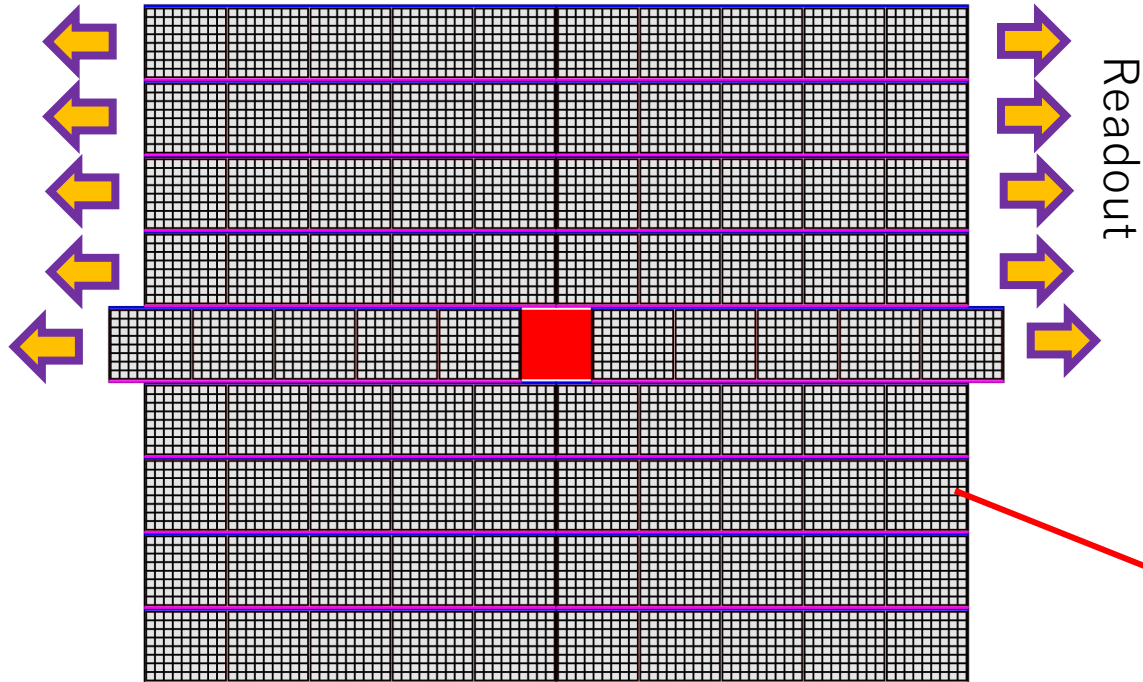
Customizing the mini-Focal to fit-in ZDC space at RHIC

- Cut Tungsten plates into 10cm x 10cm pieces
- Disassemble silicon pads and tungsten plates by resolving glue
- New frame structure to assemble the 10cm x 10cm tower

These are already big deal and risky operation. Not sure if we can take advantage of reuse of mini-FoCAL.

Alternative Solution ~ Next Round Prototyping

FULL FoCAL

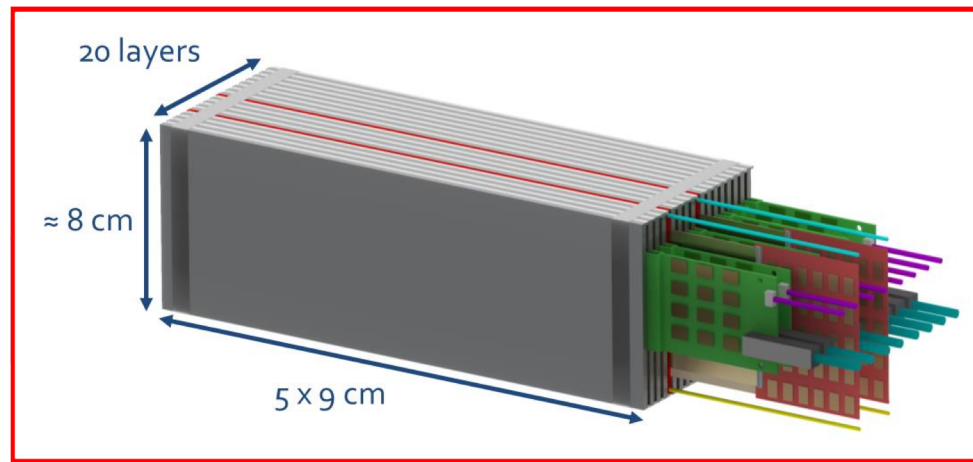


Module:

- 5 Si (individual wafer)
- 9x8 per sensor 1 cm² design
- 360 channel/module = 5 HGCR0C

Cost: 2000kCHF PAD, 550kCHF ROC

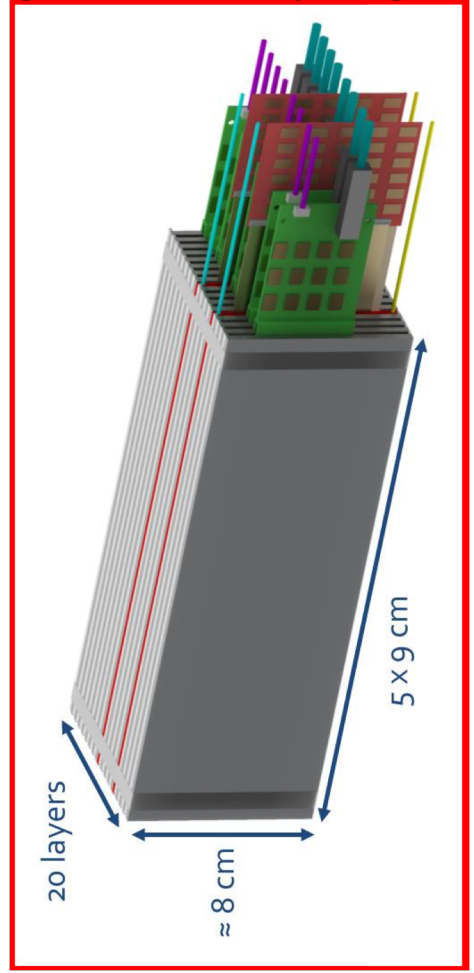
Prototype is to be made in 2020 (~ 2021)?



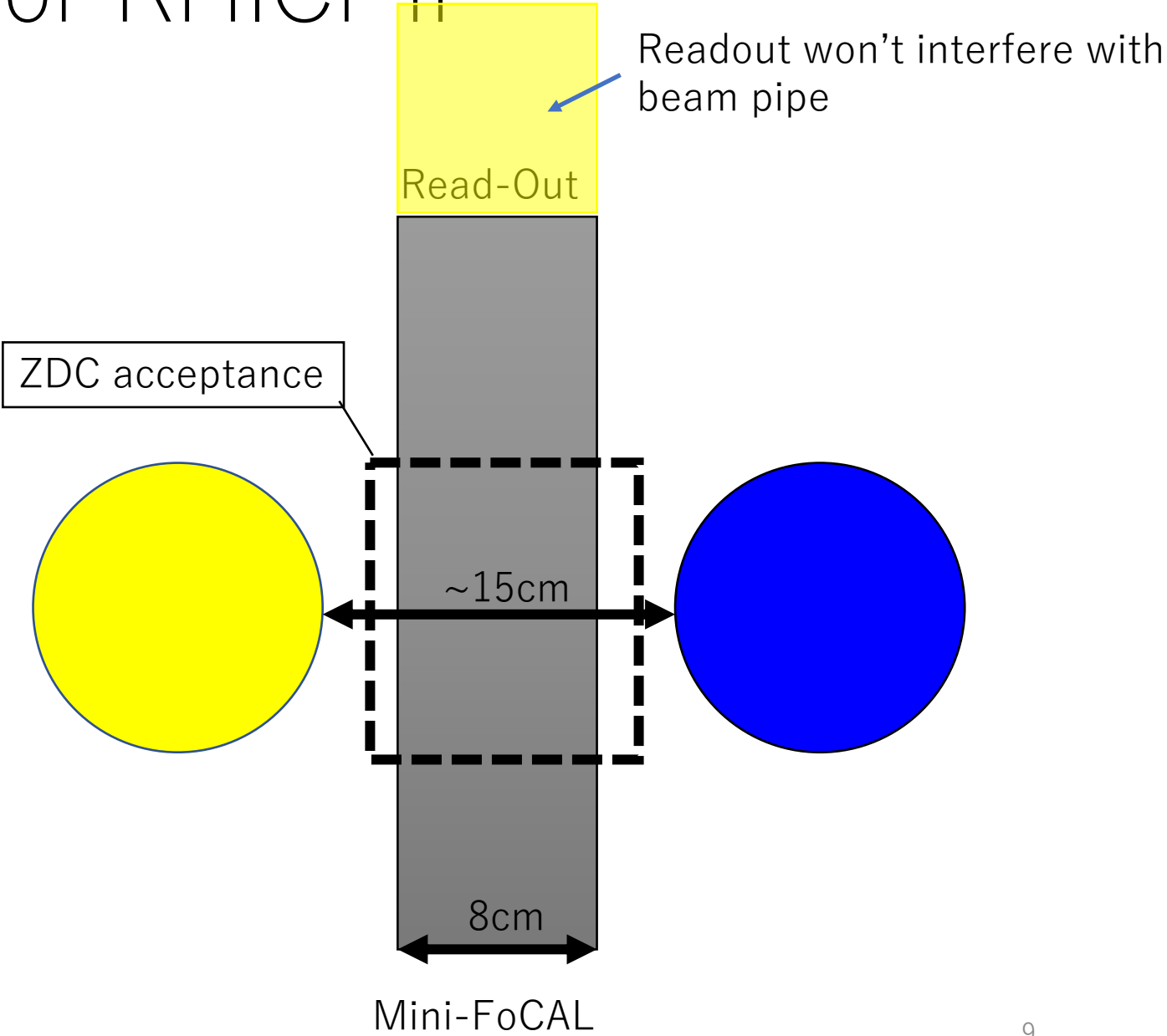
Readout from the side

Apply next prototype for RHICf-II

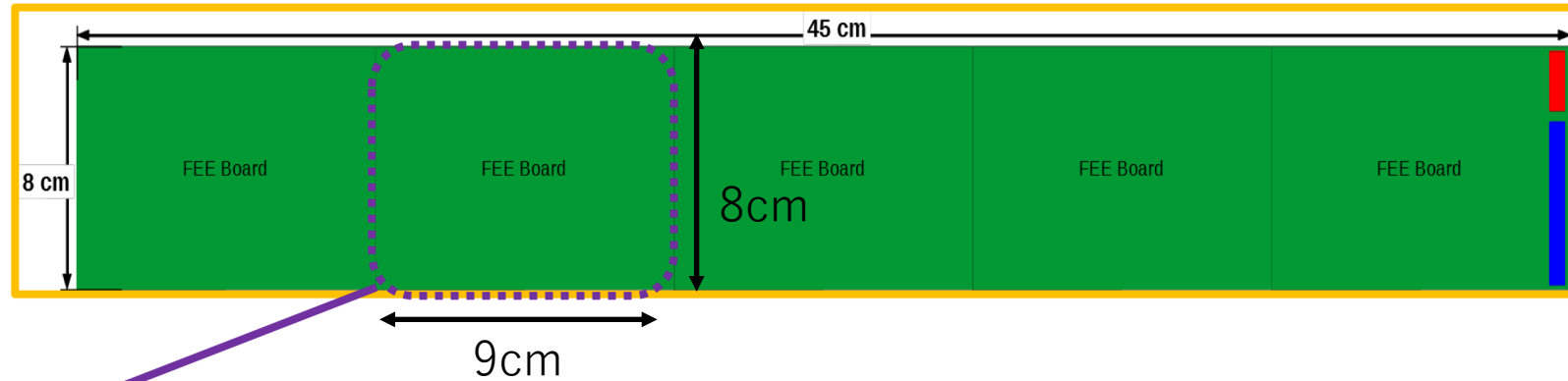
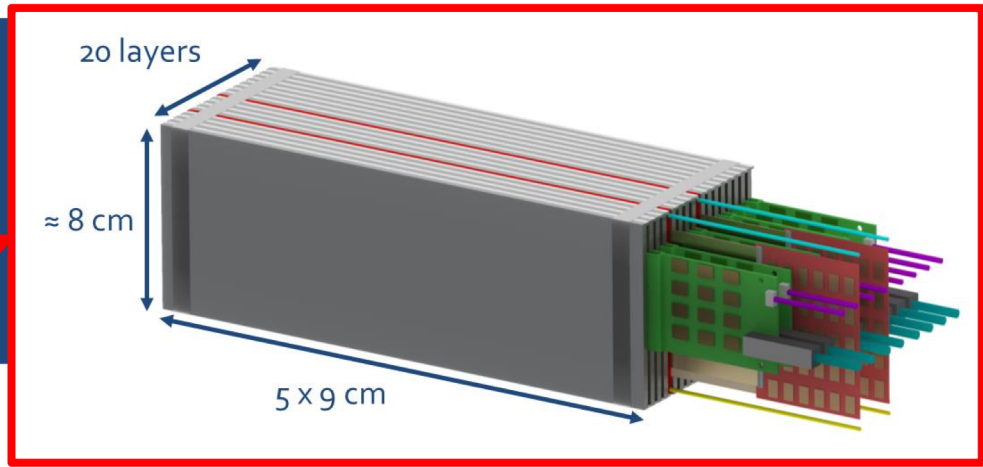
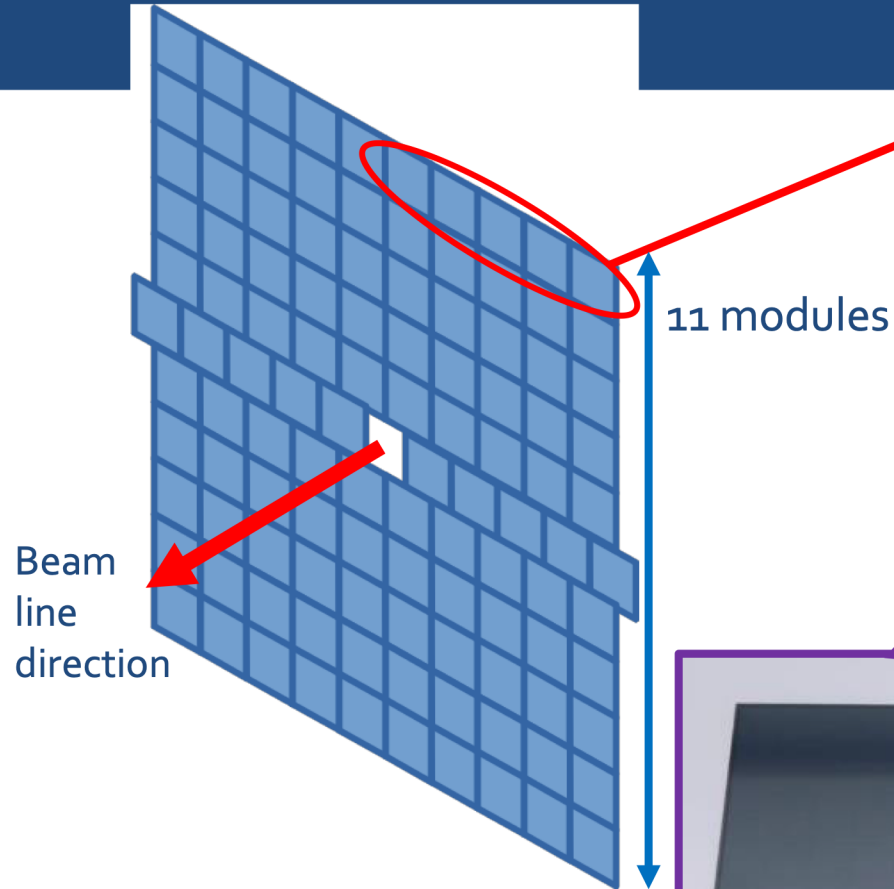
Again vertically aligned



Looks like this fits better as RHICf-II



FEW DEFINITIONS



Module:

Composed of 18 **pad-layers** + 2 MAPS layer

Pad layers:

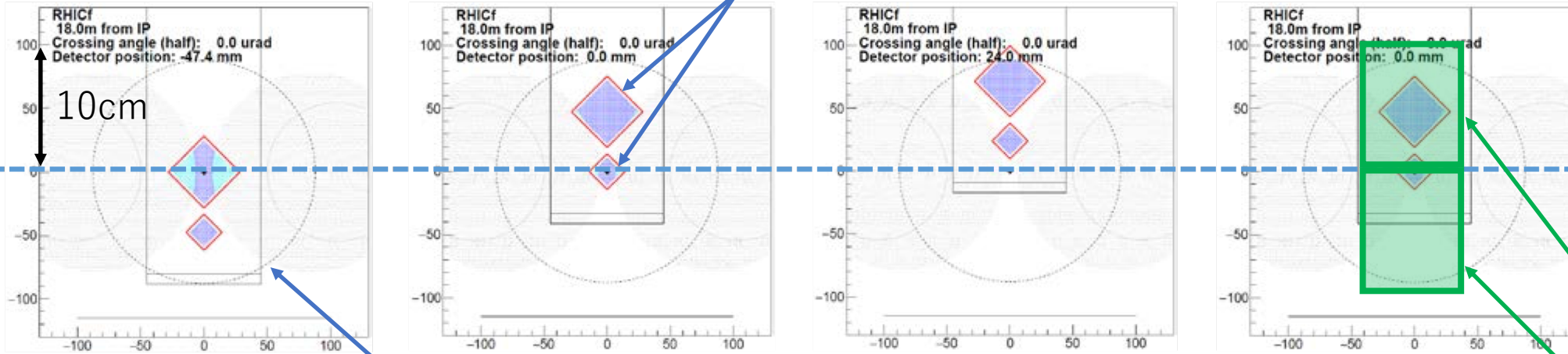
Composed of 5 **pads sensors** + associated FEE-PCB
1 FEE-PCB linked to readout PCB (Aggregator board)

Si-pad:

Built up from silicon pad sensors with a granularity of $1 \times 1 \text{ cm}^2$
Sensitive area of $9 \times 8 \text{ cm}^2$ for each sensor: total of **72 pixels**

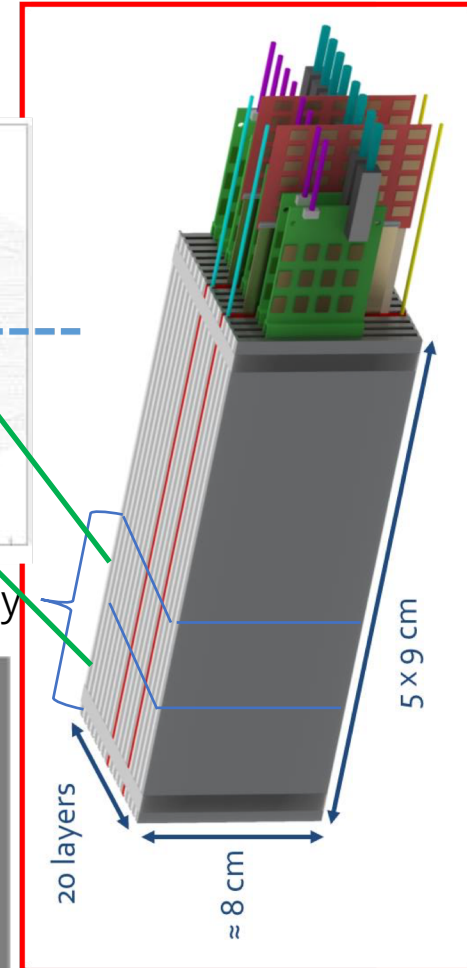
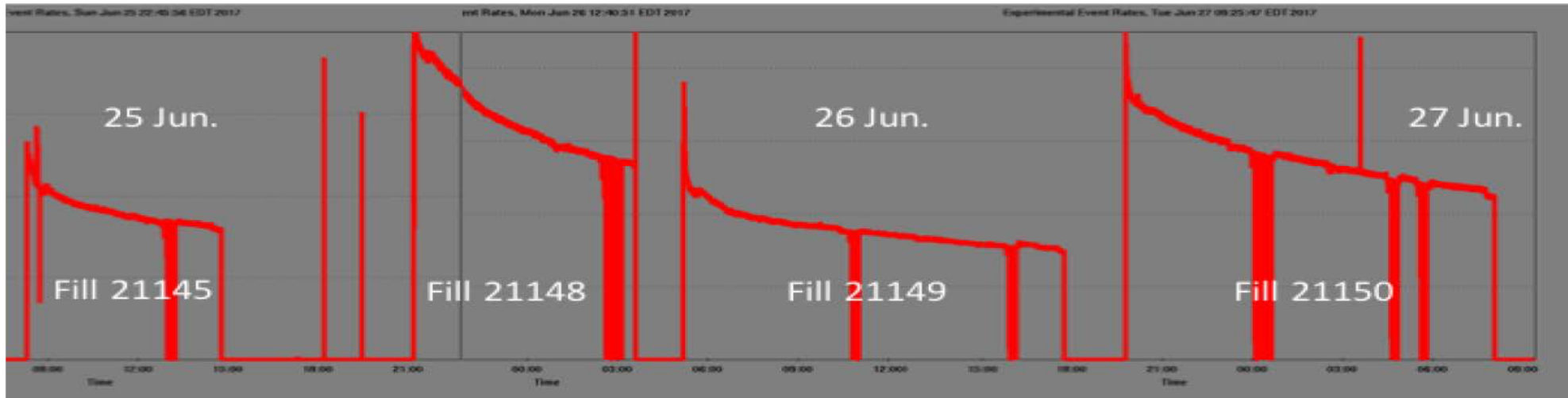
Acceptance Gain Compared to RHICf

RHICf acceptance



Beam pipe size

Full installation only two units is necessary

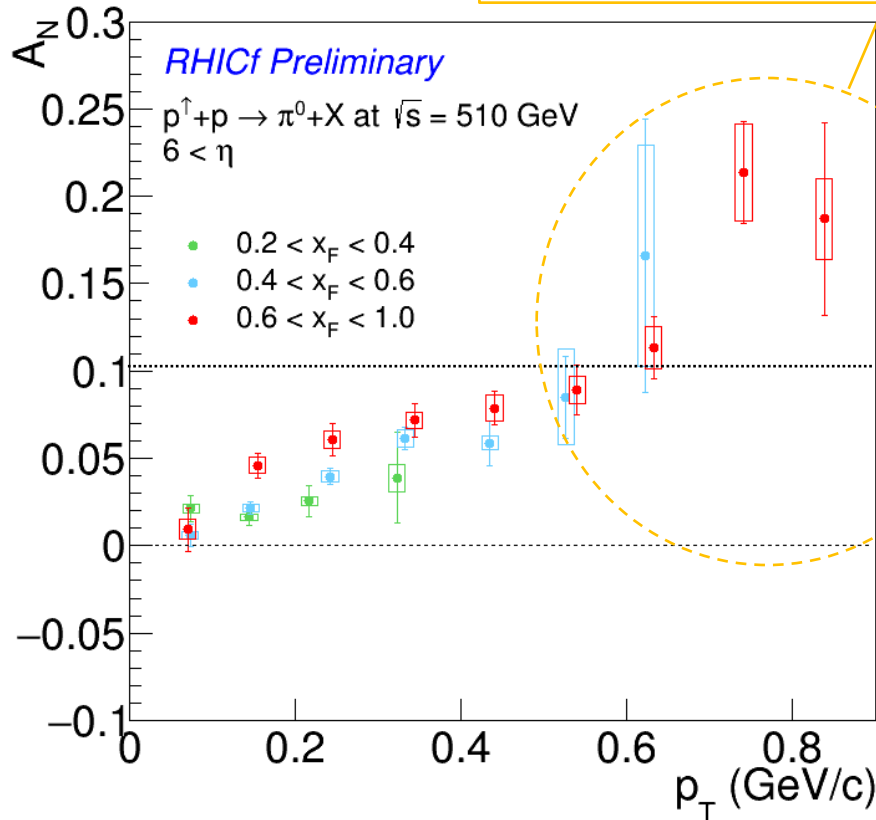


→ Series of dedicated position measurement becomes one shot measurement!

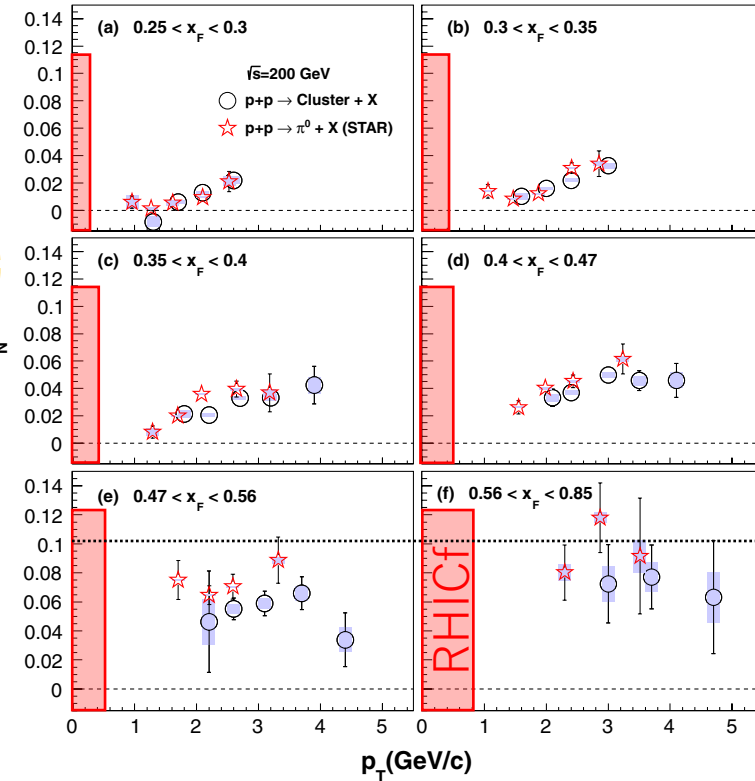
π^0 Asymmetry Preliminary Results

Improve statistical error drastically

Phys. Rev. D **90**, 012006



Non-pQCD domain



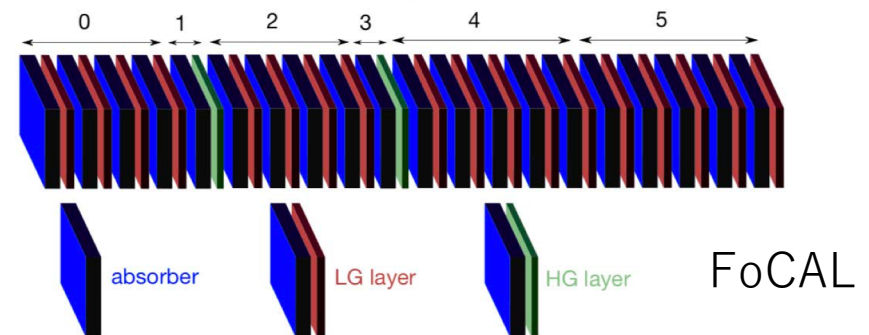
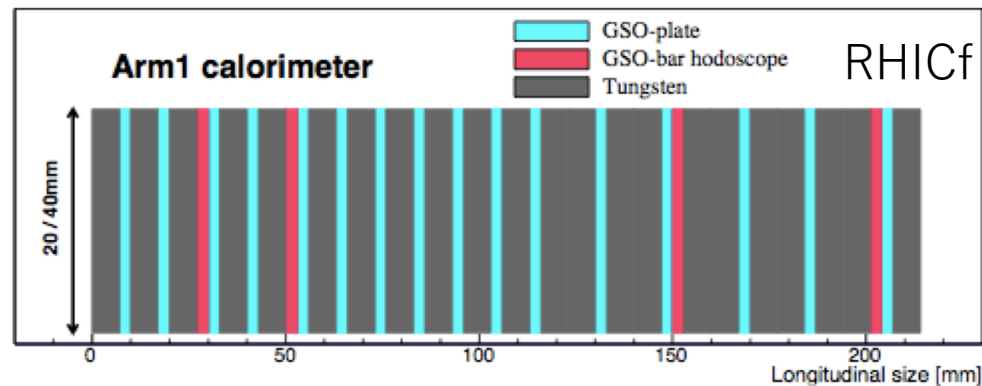
Non-pQCD

pQCD

Large Asymmetry was observed $p_T < 1$ GeV

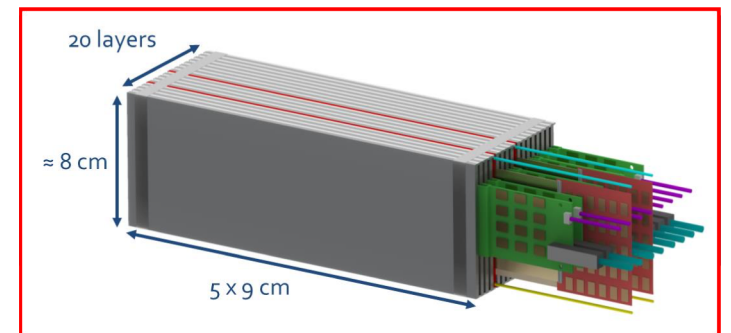
RHICf vs FoCAL Summary

	RHICf	FoCAL Prototype
Acceptance	4cm x 4cm + 2cm x 2cm	8cm x 9cm x 2 units
Radiation Length	$44X_0$	$20X_0$
Interaction Length	$1.6 \lambda_{int}$	$\sim 0.8 \lambda_{int} ?$
Position Layer Resolution	100 μ m	$\sim 10\mu$ m?
Energy Resolution	<3%	3.6%
Position Detector	GSO-bar	MAPS(Under development)



Production Cost

	Unit price / layer	Per Module
Silicon Pads	95,000 JPY	
Tungsten	110,000 JPY	



Summary

- Mini-FoCAL prototype detector is available in Tsukuba, but it is not feasible to reuse for RHIC—II running.
- Post mini-FoCAL prototype which is under development fits nicely to large acceptance RHICf-II demand without interference with beam pipe.
- Statistical advantage of FoCAL prototype is significant.
- Position detector MAPS is underdevelopment as of now? Can it be in time for RHICf-II run?