

Barrel TOF Layout (v0)

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EIC Detector-1 Reference Design

Tracking:

- Si MAPS
- **AC-LGAD**
- μ RWELL

PID:

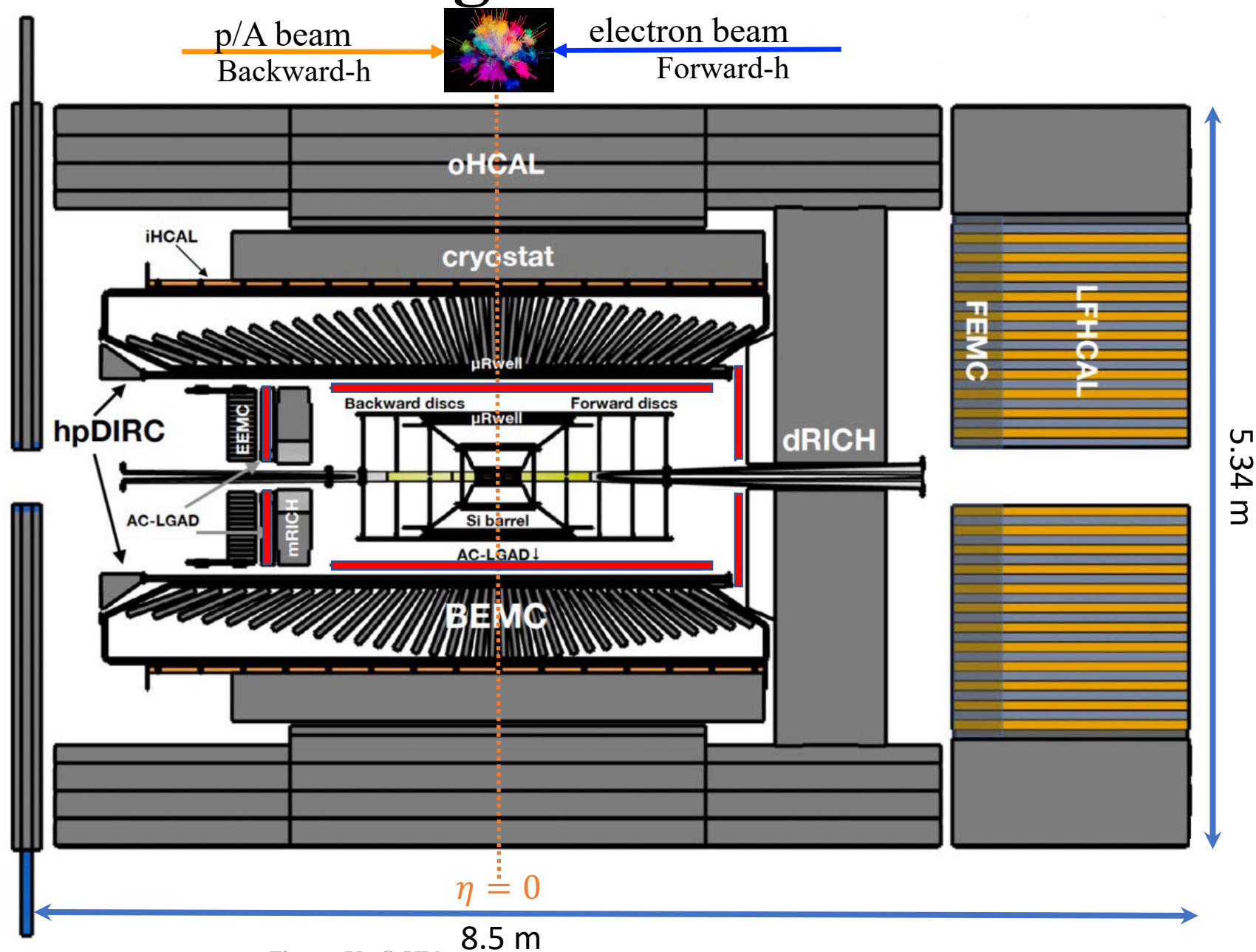
- hp-DIRC
- mRICH
- dRICH
- **AC-LGAD**

Calorimetry:

- SciGlass Barrel EMCal
- PbWO EEMCal
- Longitudinally separated EM+Hcal
- Inner HCal (instrumented frame)
- Outer HCal (sPHENIX re-use)

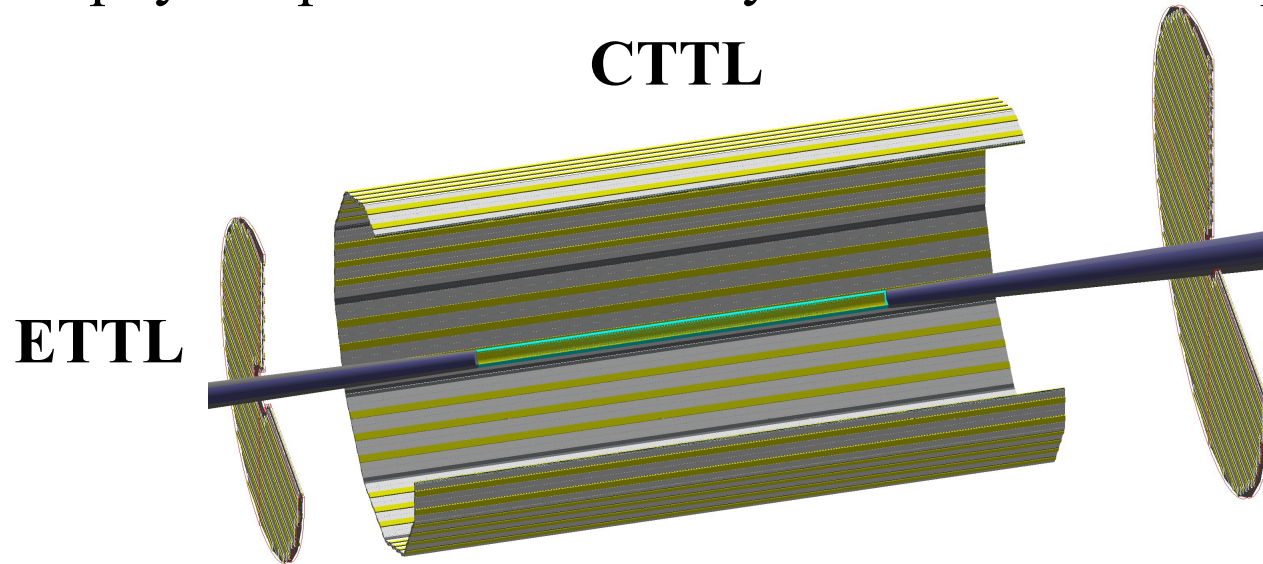
Different to LHC

- lower momentum
- lower occupancy
- less irradiation



AC-LGAD Layer for TOF PID + Tracking

- The goal is to conceive a reference layout and technical design (v0) as inputs to GD/I group to advance the detector integration (service routing etc.)
- However, there are still on-going studies to investigate the optimal channel granularity based on physics performance so by no means this is a proposal for final design.



FTTL

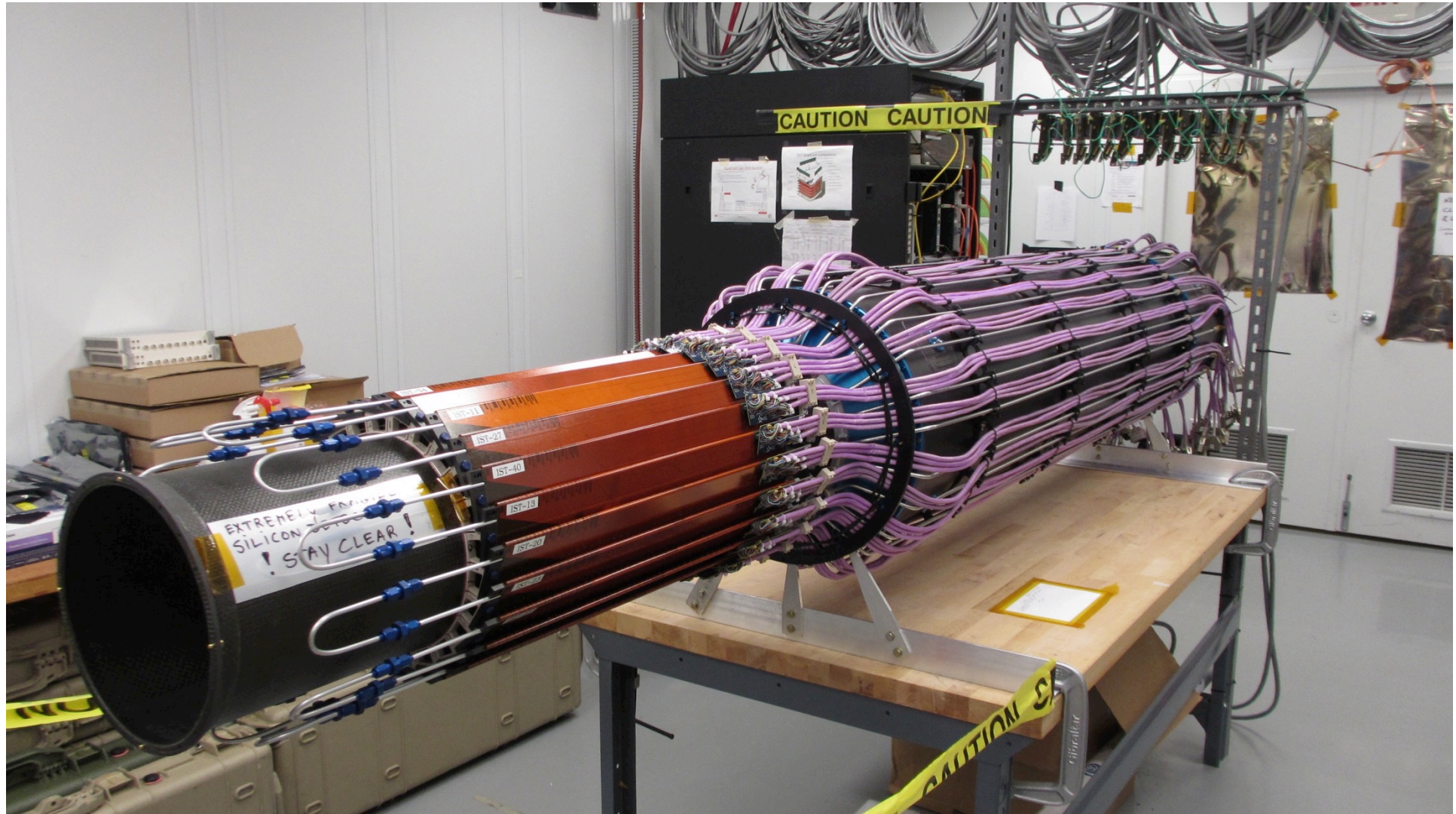
For v0 design, we propose:

- **Barrel: $0.5 \times 10 \text{ mm}^2$ strips**
- Endcap: pixels [1]

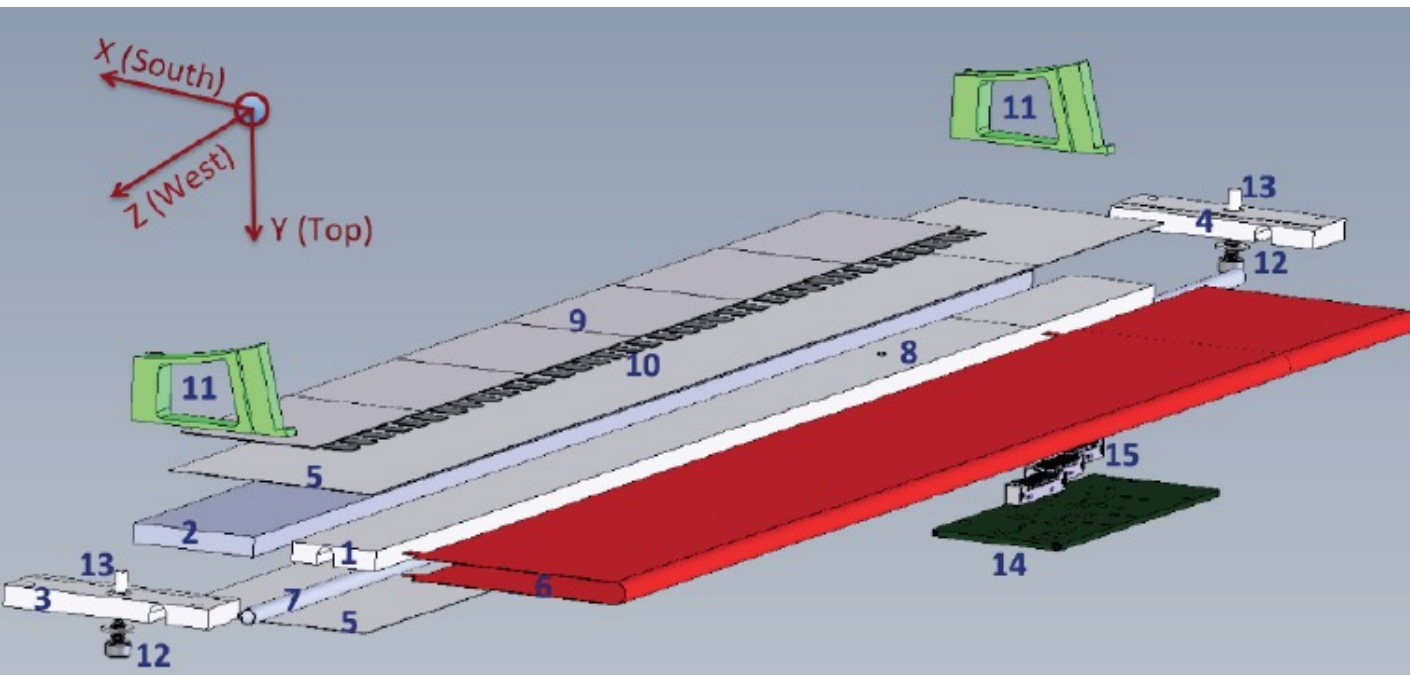
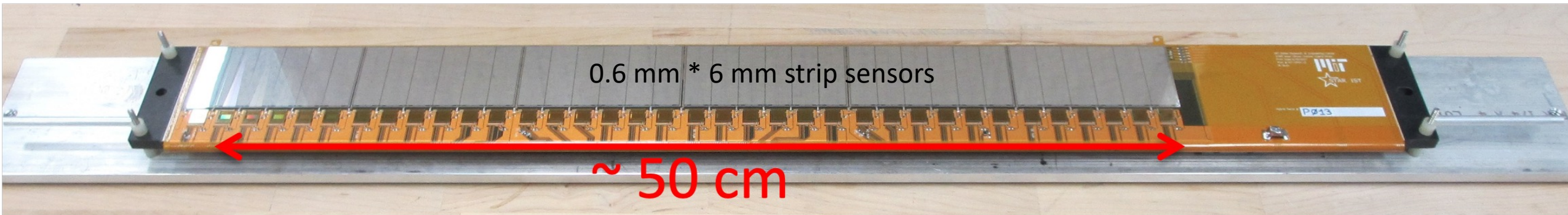
[1] see Wei's talk

	acceptance	Z (m)	Radius (m)	Area (m^2)	Channel size (mm^2)	# of Channels
ETTL	$-3.7 < \eta < -1.74$	-1.61 to -1.71	0.12 to 0.63	1.20	$0.5 \times 0.5 \rightarrow$ larger	4.8M
CTTL	$ \eta < 1.4$	-1.2 to 1.5	0.625 to 0.655	10.9	0.5×10	2.4M
FTTL	$1.5 < \eta < 3.5$	1.555 to 1.705	0.12 to 0.85	2.22	$0.5 \times 0.5 \rightarrow$ larger	8.8M

STAR Intermediate Silicon Tracker



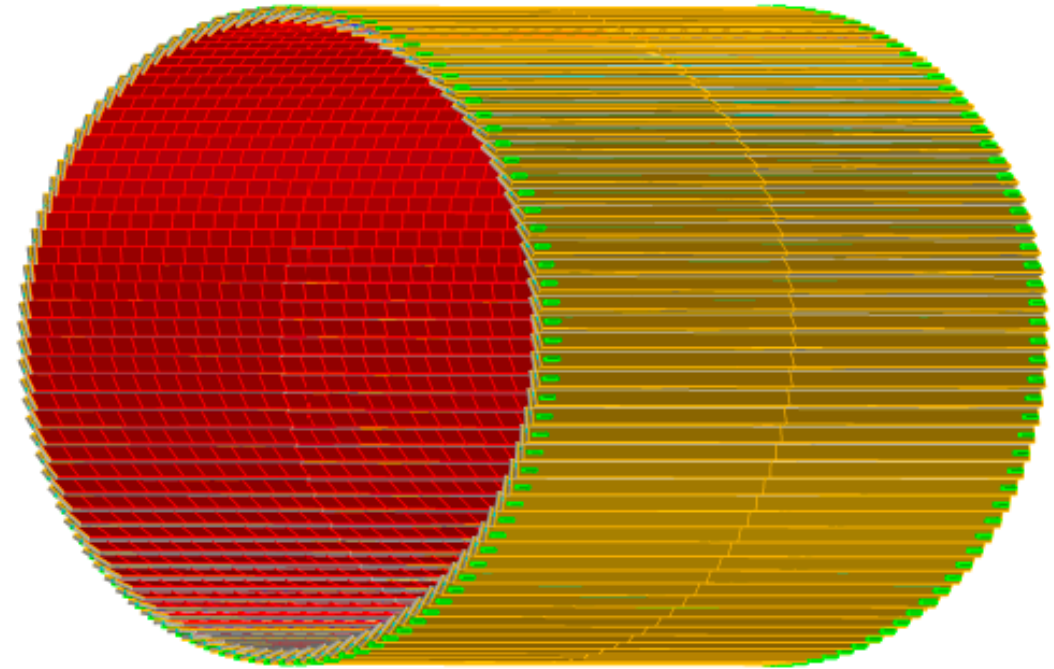
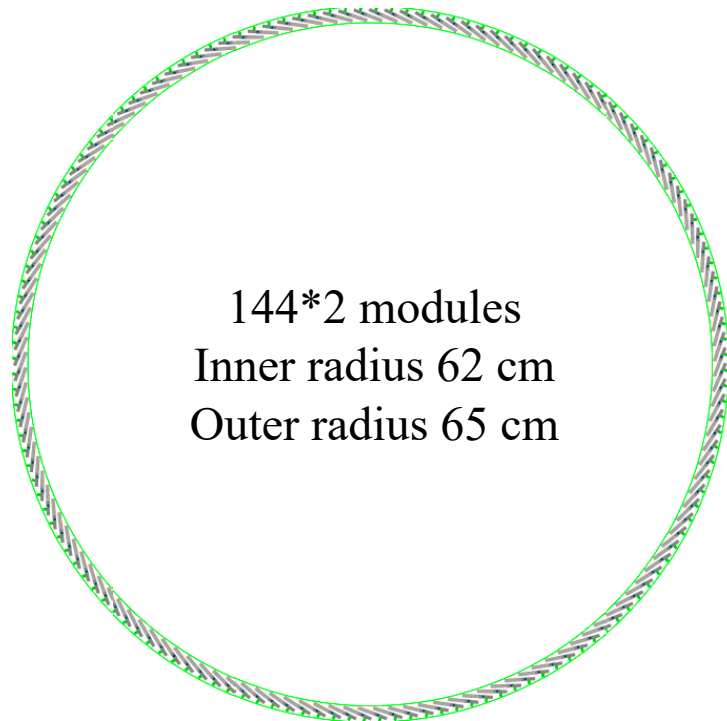
STAR Intermediate Silicon Tracker



- 1) carbon foam
- 2) carbon honeycomb
- 3) west carbon end-cap
- 4) east Al end-cap
- 5) carbon fiber skins
- 6) Kapton hybrid
- 7) Al cooling tube with cooling liquid inside
- 8) thermal sensor
- 9) silicon sensors
- 10) APV chips
- 11) support blocks
- 12) screws with washers
- 13) spacers
- 14) transition board
- 15) readout connectors.

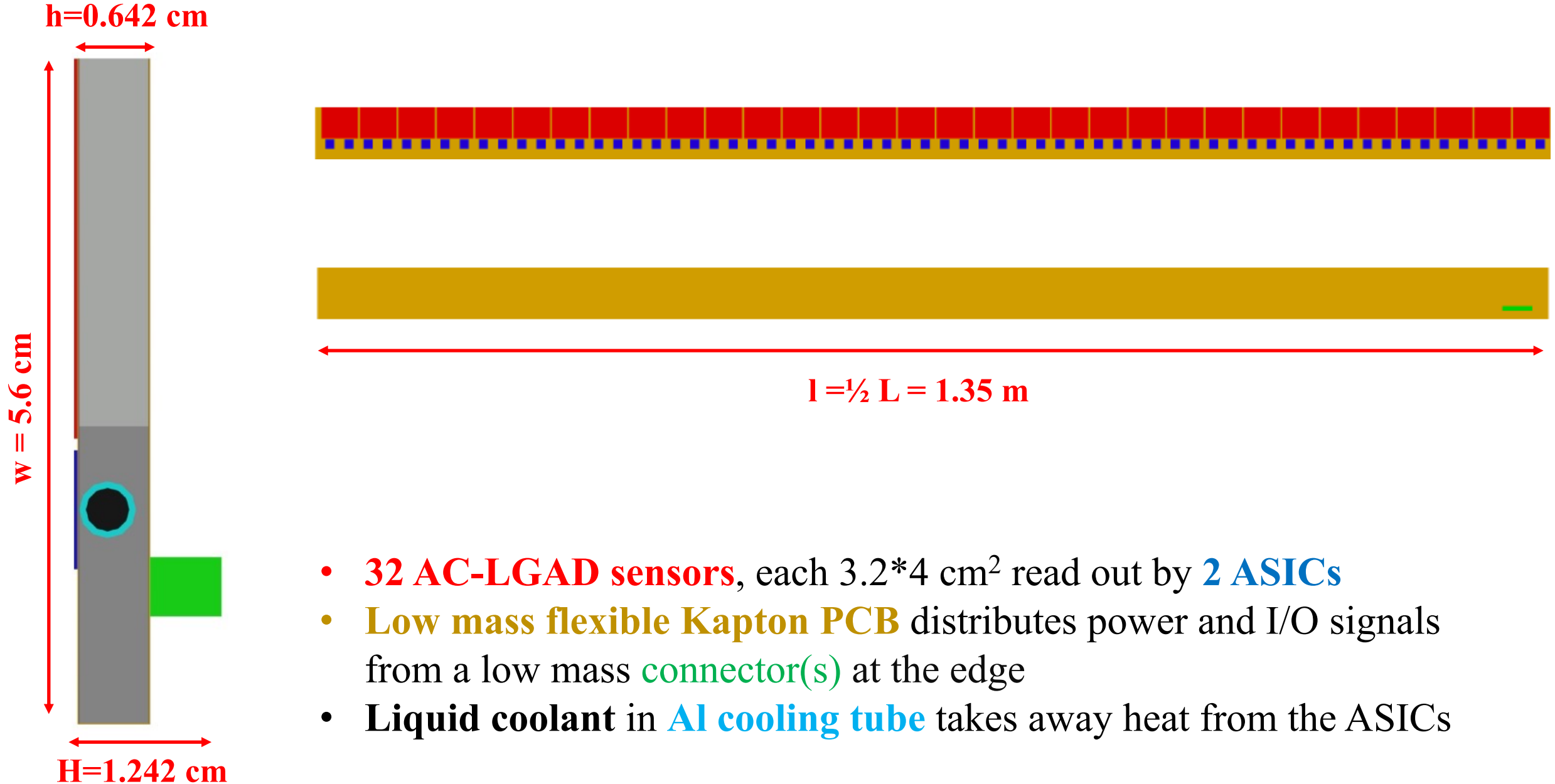
Barrel TOF Layout and Specification

- **Single layer of strip AC-LGAD sensors**
 - $62 < R < 65$ cm, 2.7 m long, ~ 11 m² area
 - **Strip metal electrodes, with $500 \mu\text{m}$ pitch in $r\phi$ and 1 cm^* in z**
 - Minimal material budget and power consumption compared to pixels
- * Will look into longer strips with sensor R&D



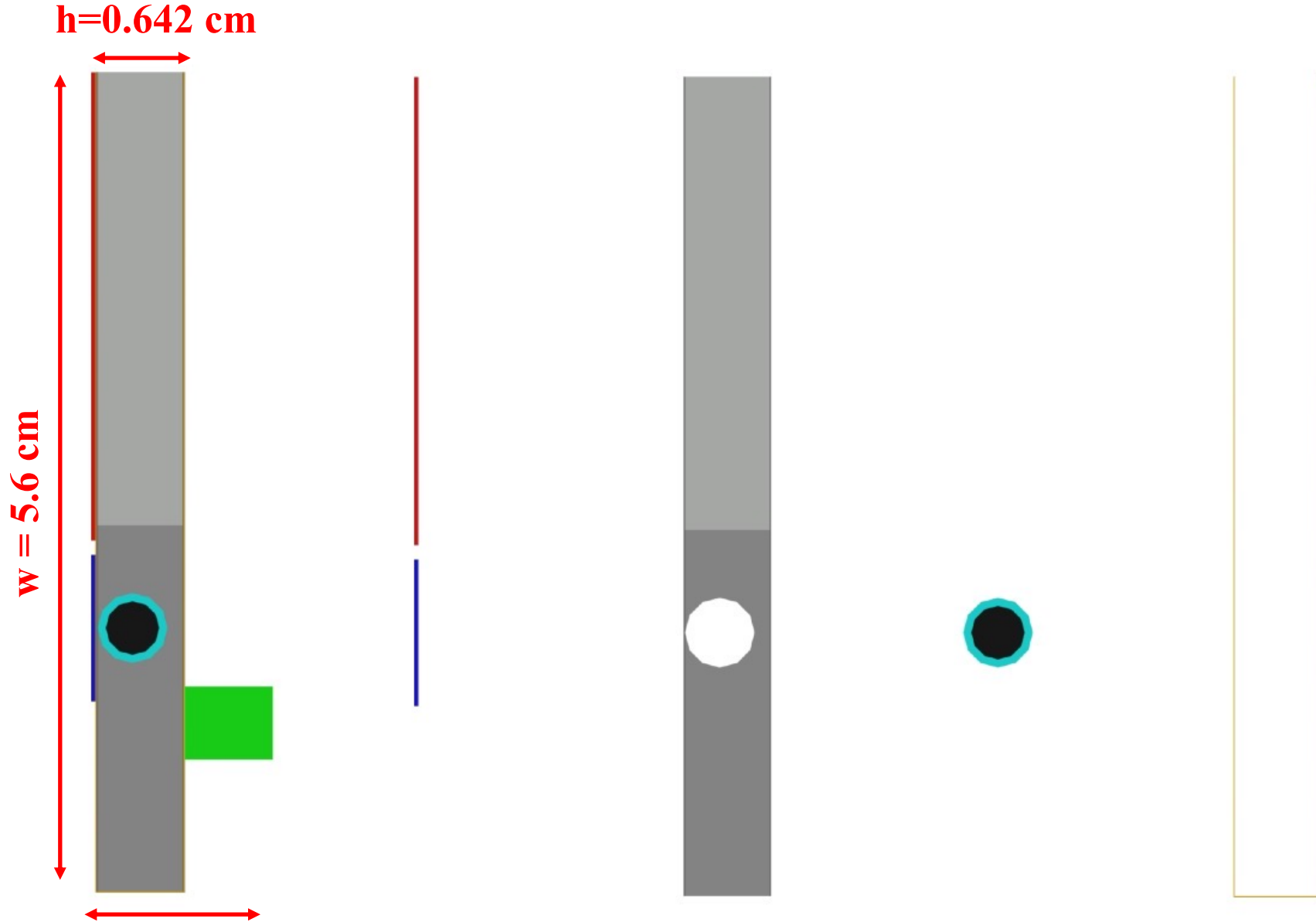
EPIC Barrel TOF Module

>95% coverage in Z



- **32 AC-LGAD sensors**, each 3.2×4 cm² read out by **2 ASICs**
- **Low mass flexible Kapton PCB** distributes power and I/O signals from a low mass **connector(s)** at the edge
- **Liquid coolant in Al cooling tube** takes away heat from the ASICs

EPIC Barrel TOF Module

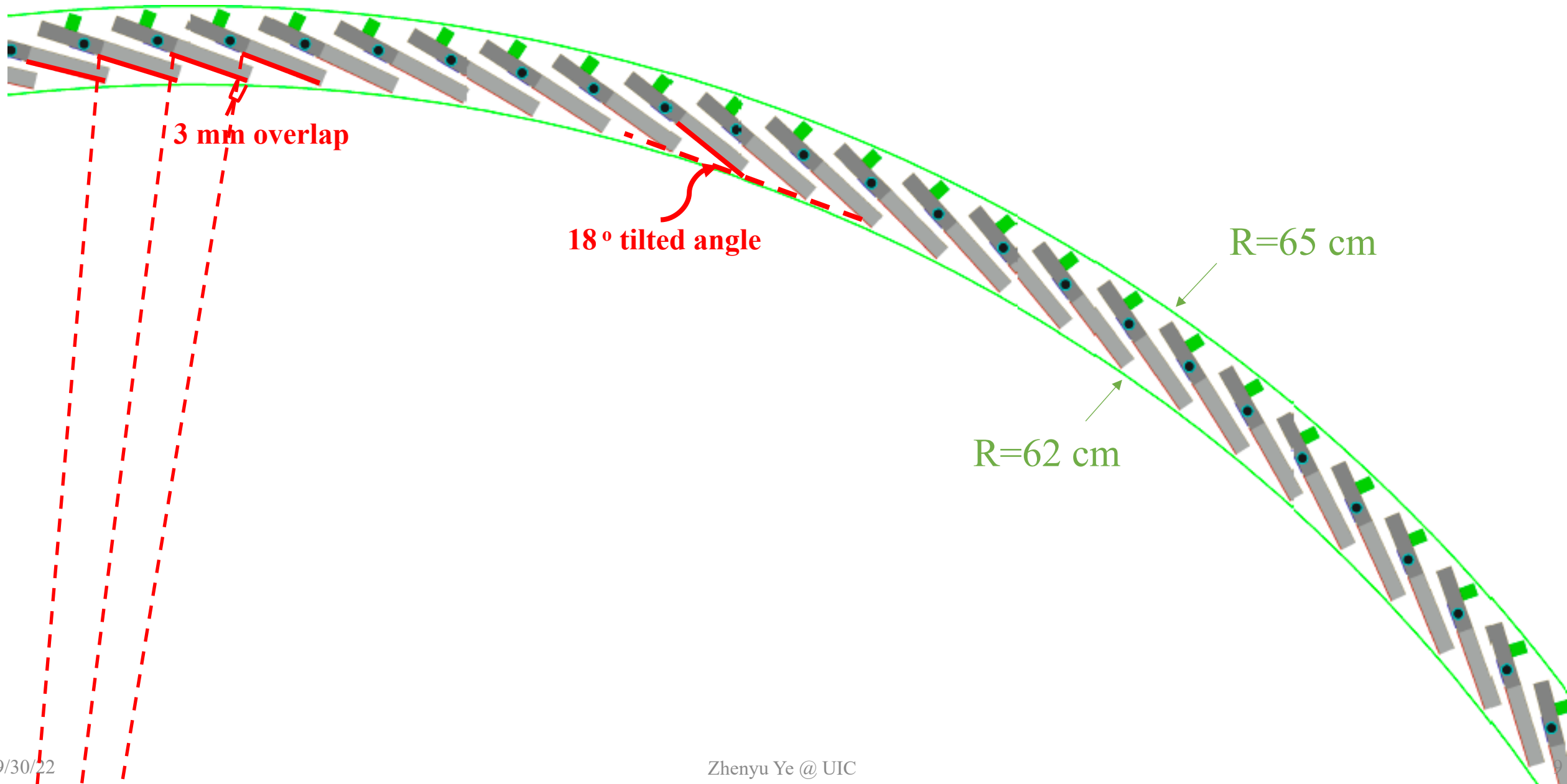


- **AC-LGAD sensor**
- **Frontend ASICs**
- Carbon foam+
Carbon honeycomb+
CF skins
- **Al cooling tube**
- **Liquid coolant**
- **Kapton PCB**
- **Connector**

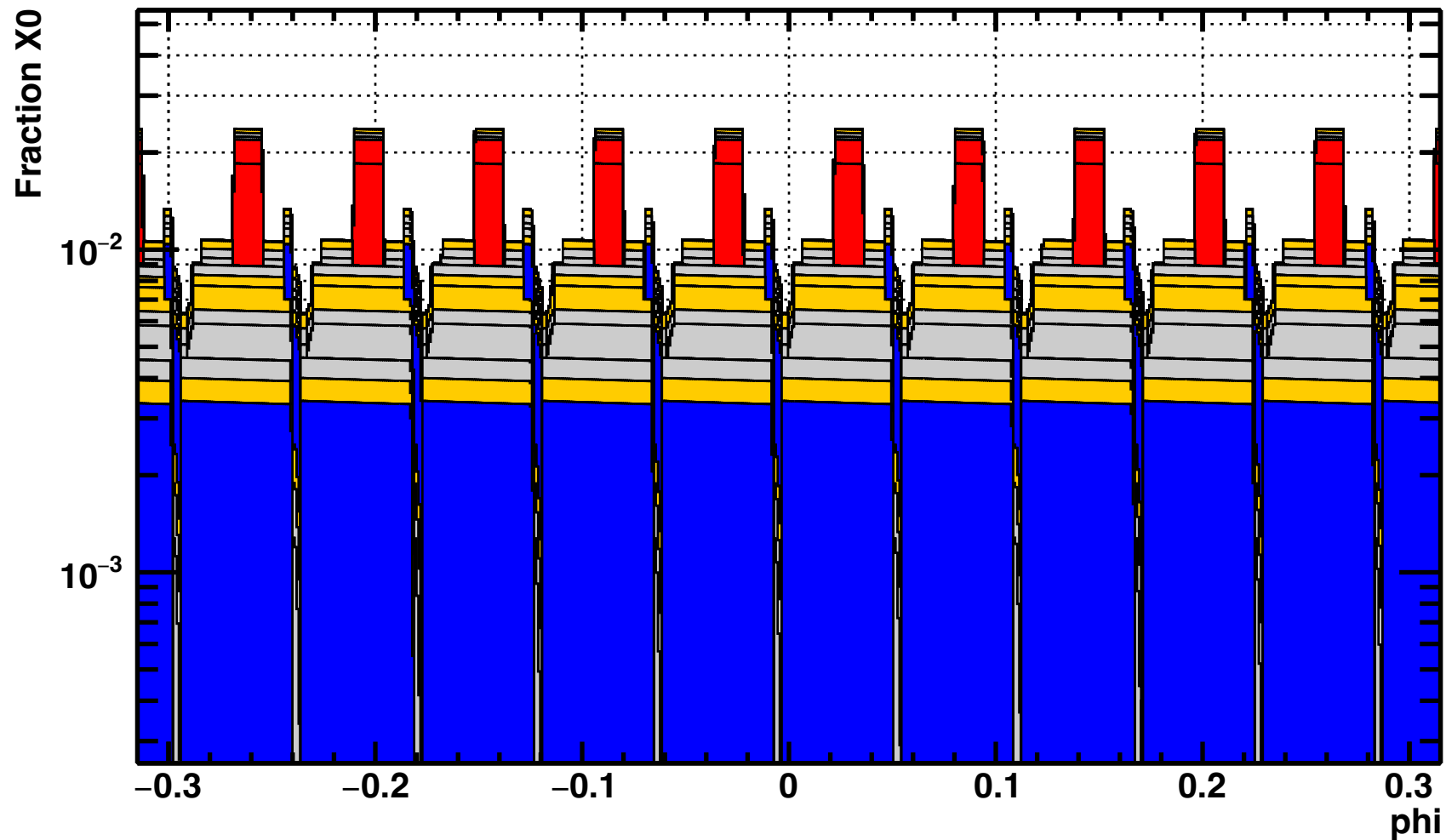


EPIC Barrel TOF Detector Layout

Full azimuthal coverage



Barrel TOF Material Budget



Average material budget $\sim 1\% X_0$

Services

- In total 288 modules,
 - 9216 sensors, 18,432 ASICs, 2.4 M channels
 - 70 kG, ~4 kW (2.4kW for ASIC, 1.0kW for DC-DC, 0.6kW for sensors+cables+RB)
- On each module:
 - 32 sensors, 64 frontend ASIC
 - Powered and read out by 1 service board
 - 1 fiber to DAQ
 - 1 LV+HV cable (HV: ~200V, 10 uA, LV: 12V before DC-DC, 1.2V after)
 - 1 liquid cooling line