Use of small-strip thin gap chambers and silicon strip detectors for EIC?

Prithwish Tribedy

Daniel Brandenburg

(BNL-CFNS)

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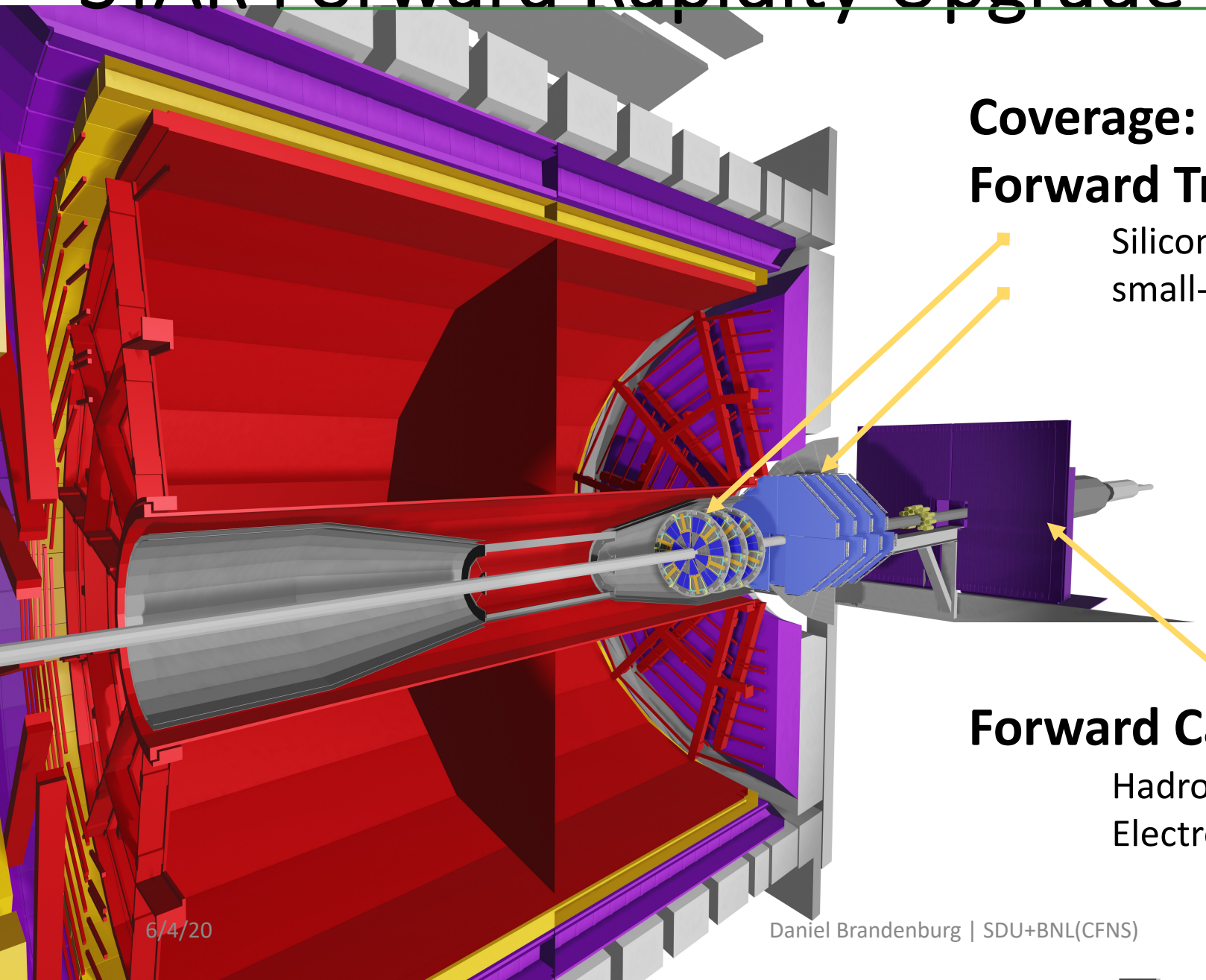
STAR Forward Rapidity Upgrade



Coverage: $2.5 < \eta < 4.0$

Forward Tracking System

Silicon microstrip detector
small-Strip Thin Gap Chambers

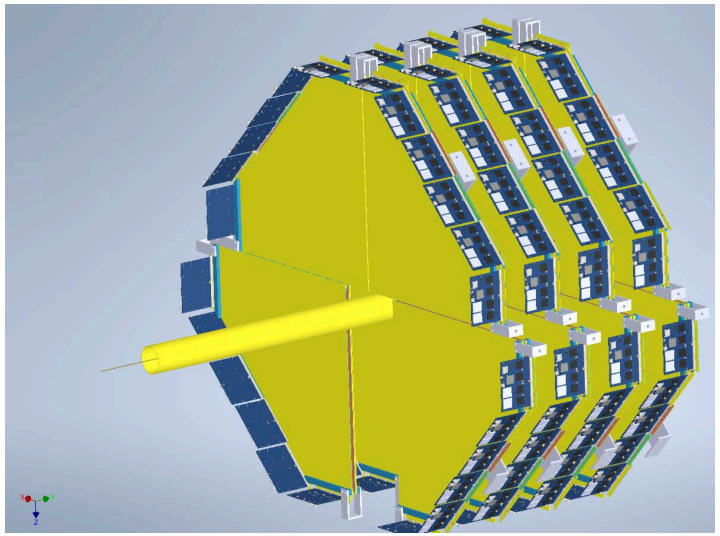
Forward Calorimetry System

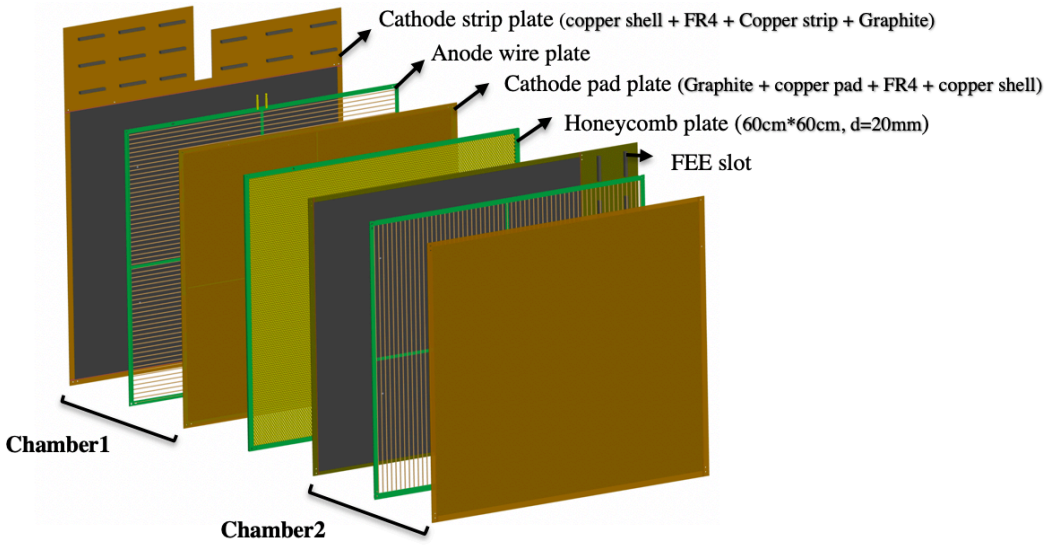
Hadronic Calorimeter
Electromagnetic Calorimeter

Small-Strip Thin Gap Chambers (sTGC)

Detector:

- Based on ATLAS sTGC design but physically smaller
- 4 layers in total (~22,000 readout channels)
  - 4 modules/layer
  - 2 chambers/module
- Pentagon shape formed from identical modules
- Provide X/Y and diagonal strips
- Shandong University : sTGC R&D and production
- Position resolution: ~100 μm



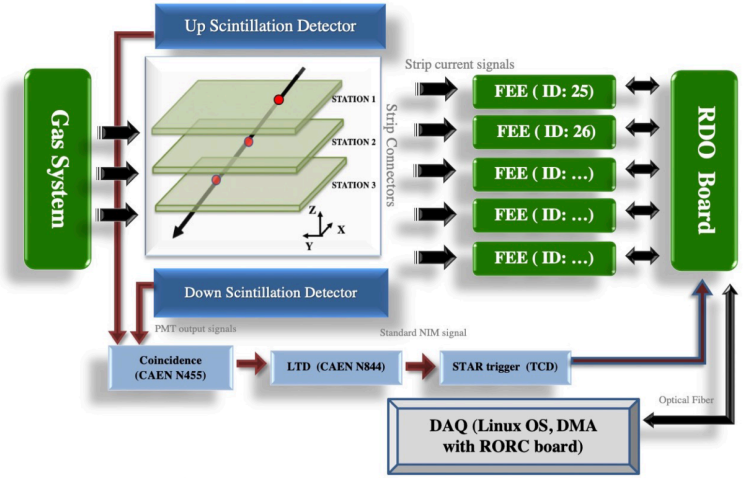


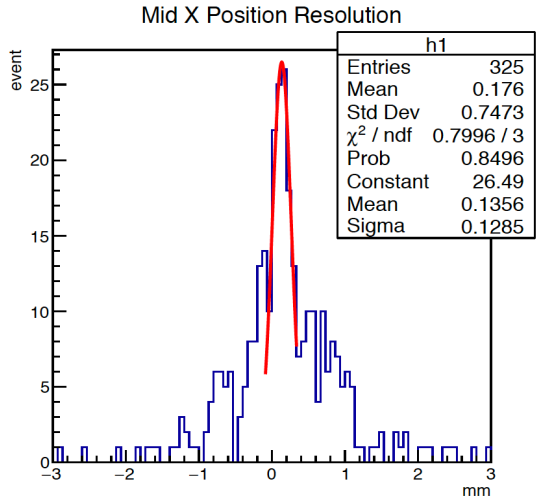
Wire: Au-plated tungsten wire
ø 50μm, 1.8mm pitch
Copper strip: 3.2mm pitch
Height of one layer: 5.8mm
Gas: 55% n-pentane+45%CO2
HV: 2900V

Requires dedicated gas system

R&D + Production at Shandong University

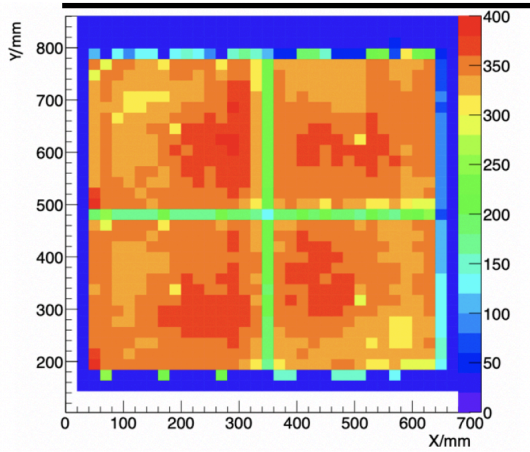
Performance test of prototype using cosmic ray stand

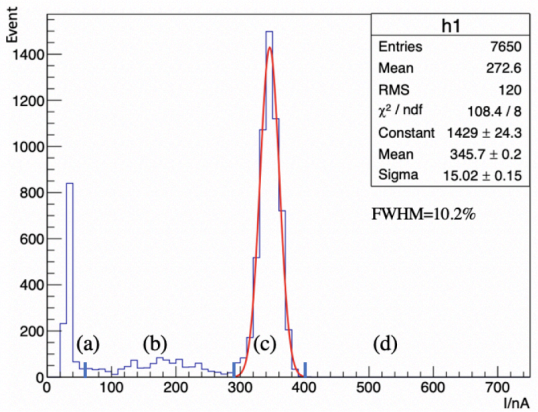




✓ **Position Resolution**
Performance meets expectation

Module flatness and quality control





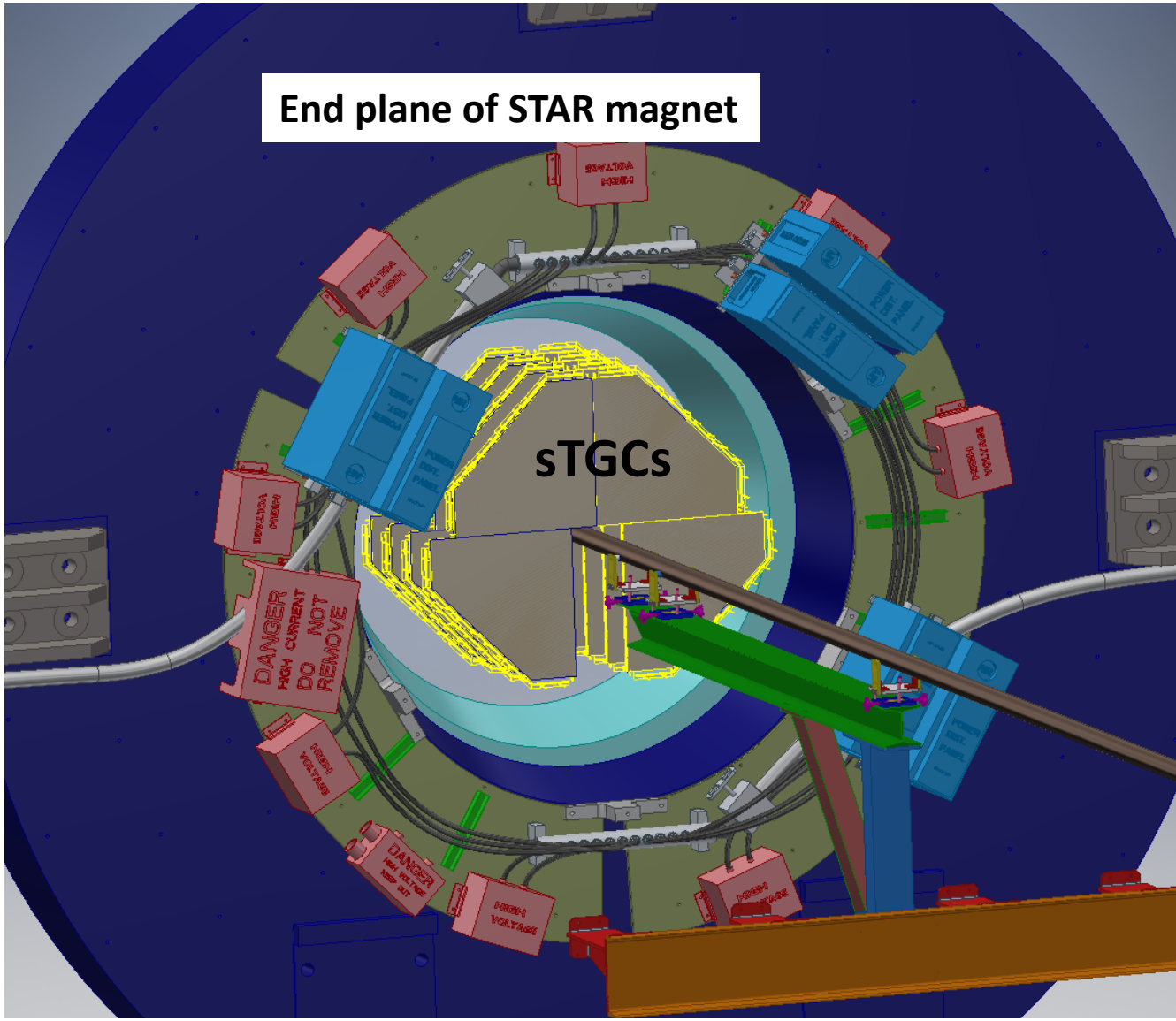
✓ 60cm x 60cm prototype
Finished in Jan 2020, will be delivered to BNL
✓Planned: in-beam testing at BNL

Pentagonal sTGC disks in STAR

- View of final sTGCs in STAR endcap region

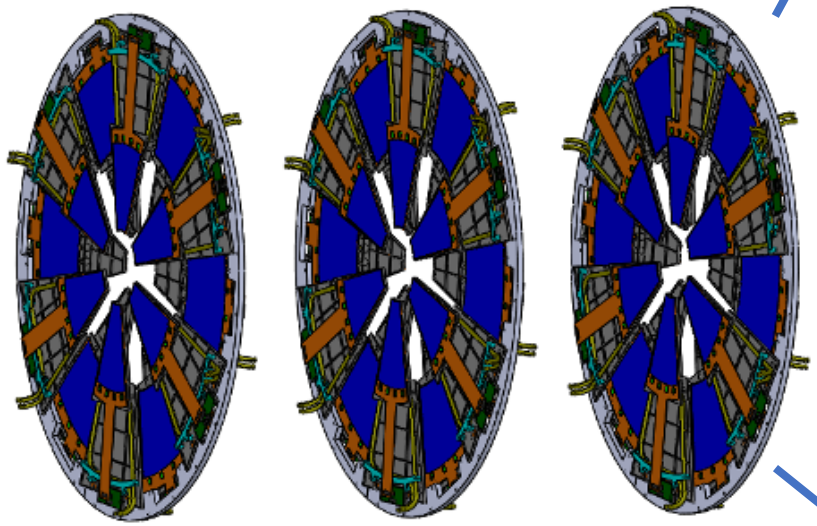
✓Detectors provide large coverage in a compact space

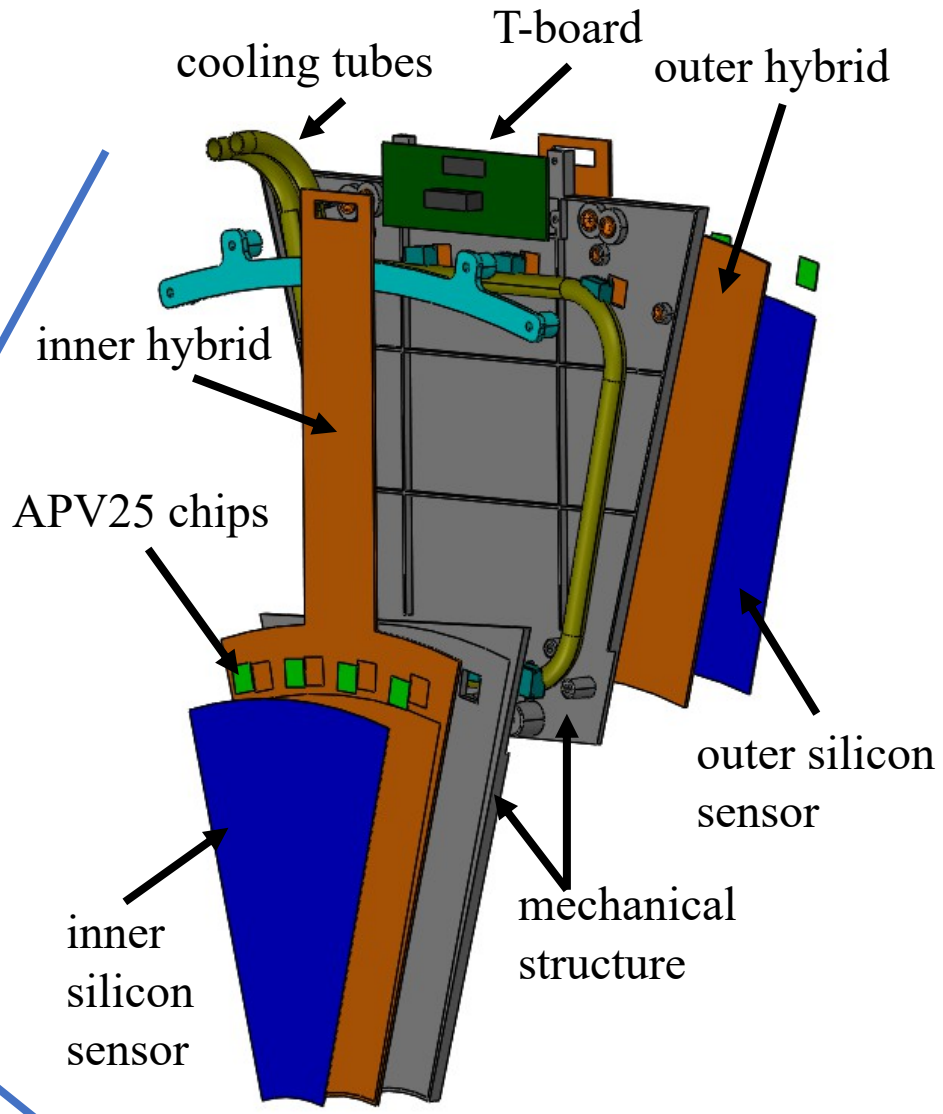
✓Provide competitive position resolution $\sigma_{XY} \approx 100\mu m$



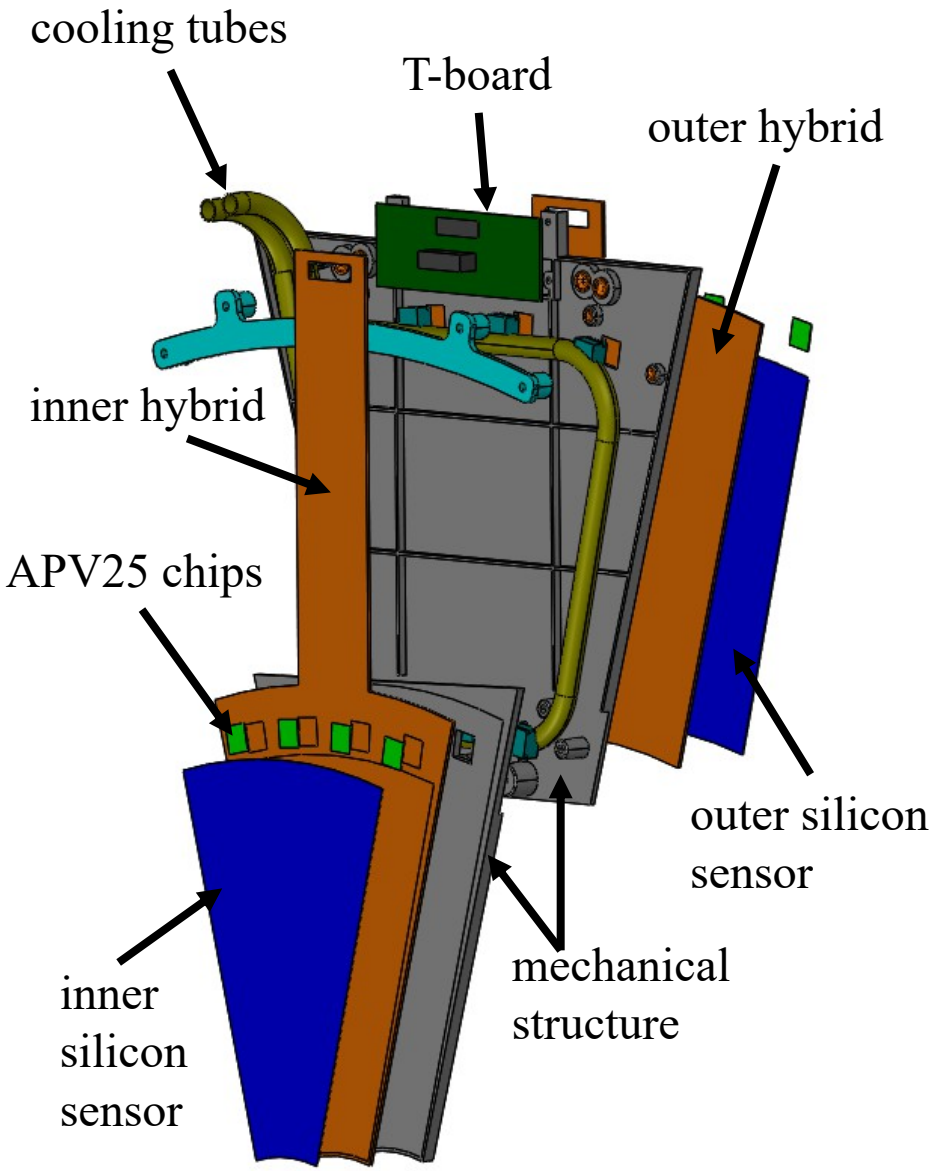
STAR Forward Silicon Tracker

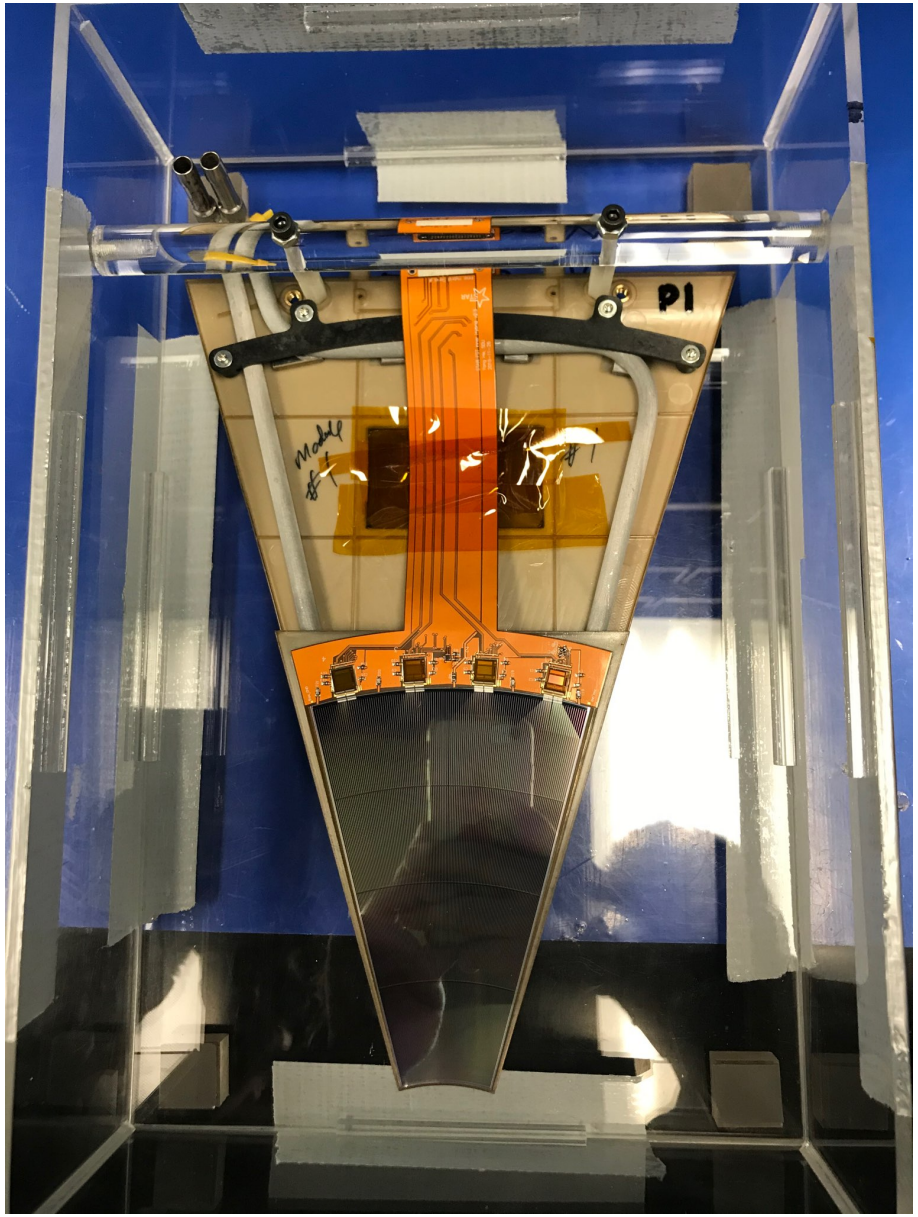
- Full installation: 3 identical disks
  - Acceptance:
  - $0 < \phi < 2\pi, \quad 2.5 < \eta < 4.0$
- 12 wedge modules / disk
- APV25 frontend readout chips
- Flexible hybrid





STAR Forward Silicon Tracker - Prototype Module

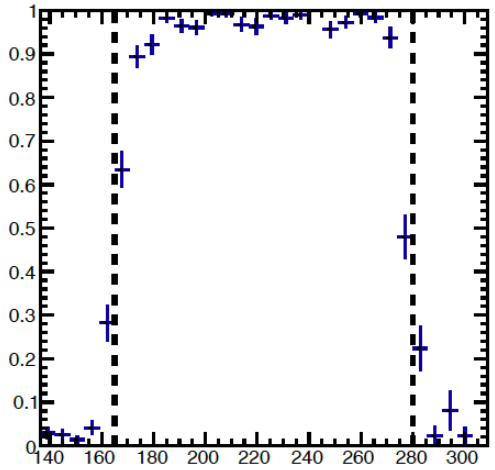




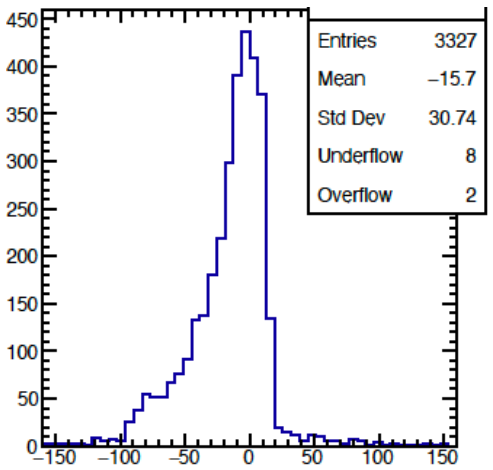
Prototype Testing & Integration Plans

✓Ongoing cosmic ray test of prototype outer sensor

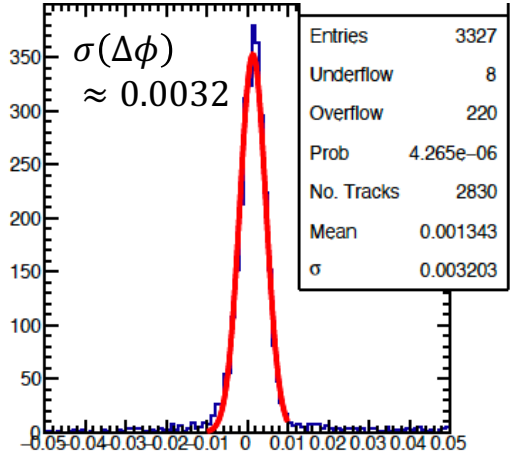
Hit Efficiency



Residual in R

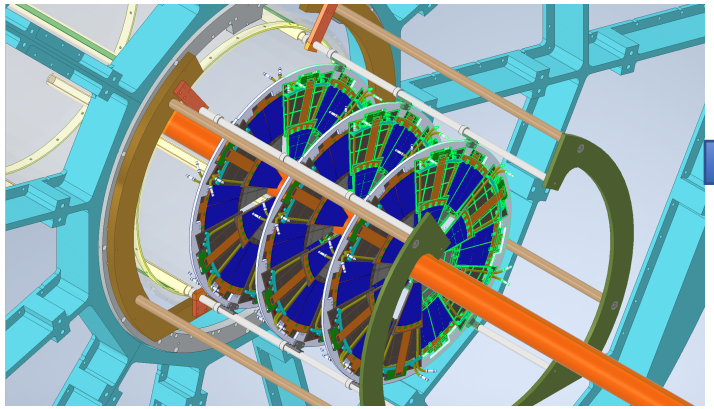


Residual in ϕ

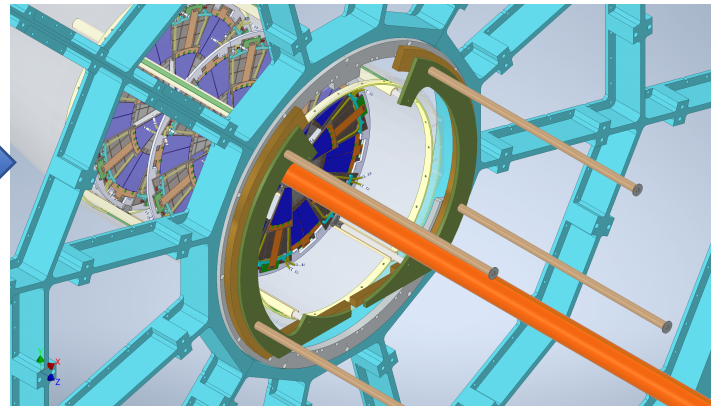


✓Special tool being designed for precision insertion into STAR

Before Insertion



After Insertion



Feasibility Study for EIC

- How to get started?
  - Which framework to use?
  - How to get started modifying geometry?

- Study Feasibility of
  - Small-strip thin gap chambers for endcap tracking
  - Silicon microstrip in forward direction