Los Alamos NATIONAL LABORATORY

Update on FST detector

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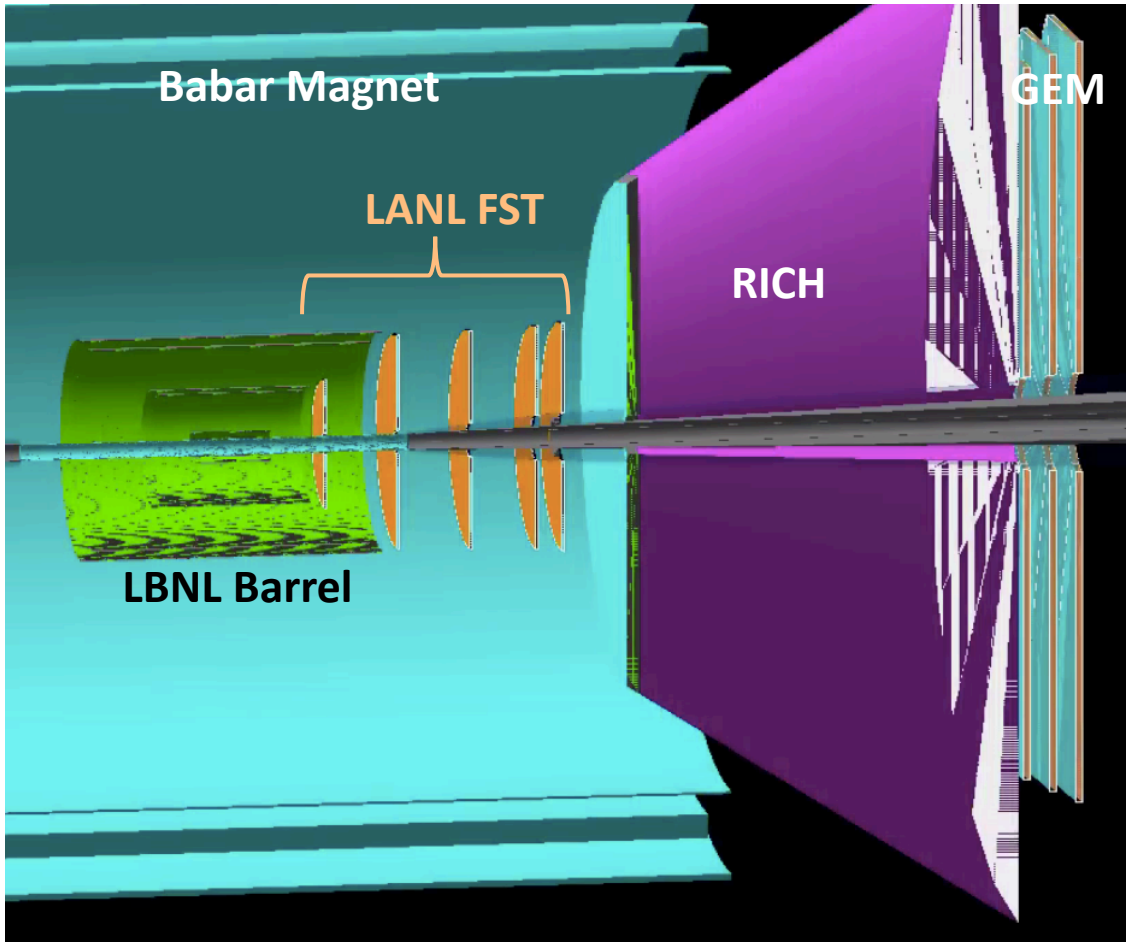
06-04-2021

Outline

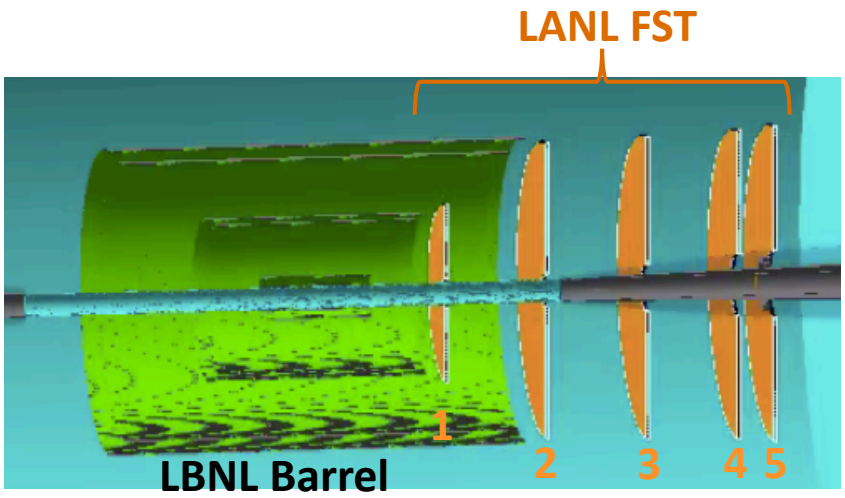
- Update on the Integrated detector setup with the simplified FST design
- Tracking performance of the integrated setup
- Implementation of a **detailed** FST design in Fun4All
- Summary and plan

Update on the Integrated Detector Setup



Replace LANL barrel with LBNL barrel

Detector Setup



LANL barrel has a max radius of 27 cm (see back up slide) [arXiv:2009.02888]

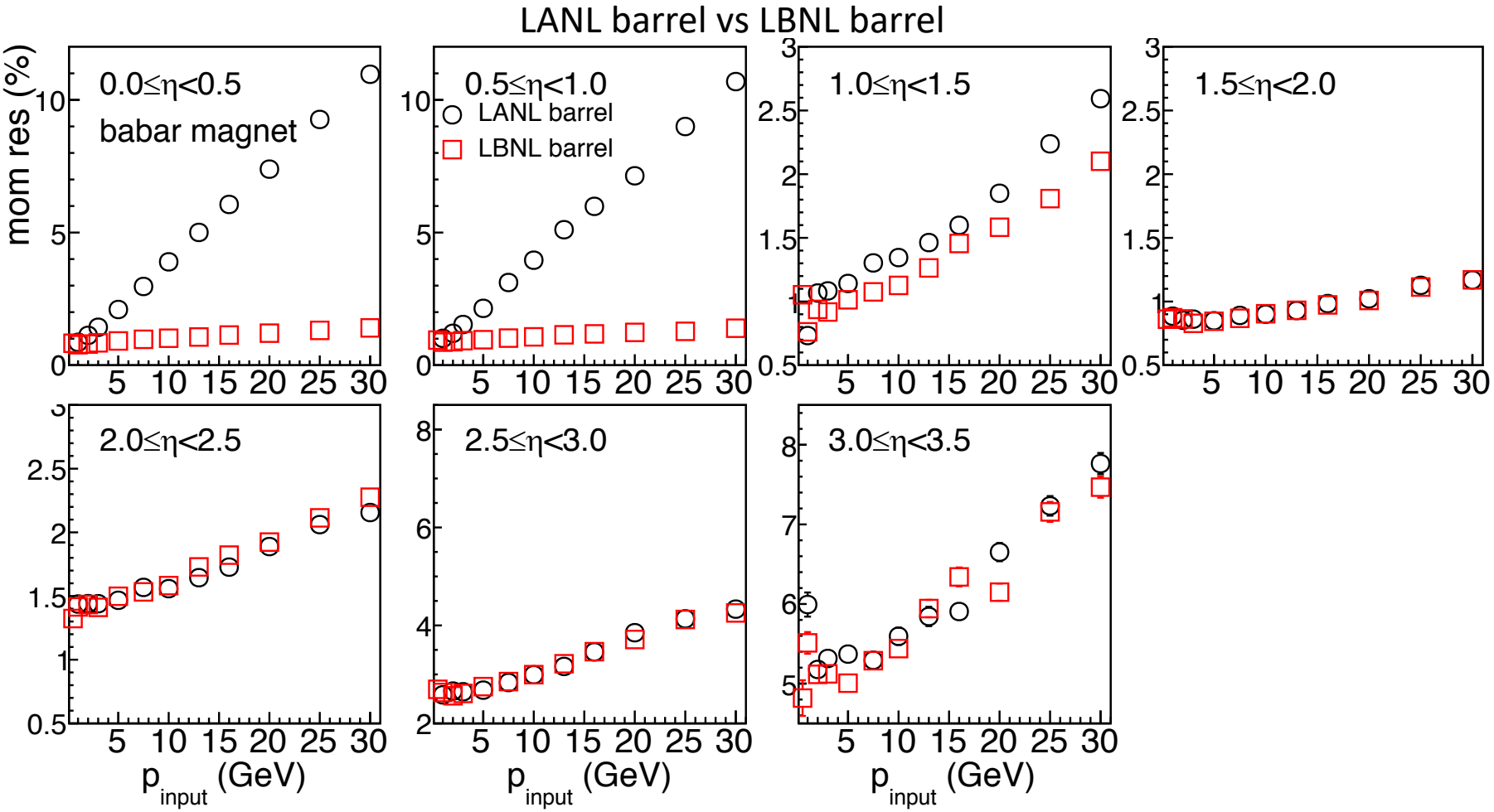
LBNL Barrel [arXiv:2102.08337v1]

Pixel pitch=10 μm

Barrel layer	radius [cm]	length along z(Full length) [cm]
1	3.30	30
2	5.70	30
3	21.00	54
4	22.68	60
5	39.30	105
6	43.23	114

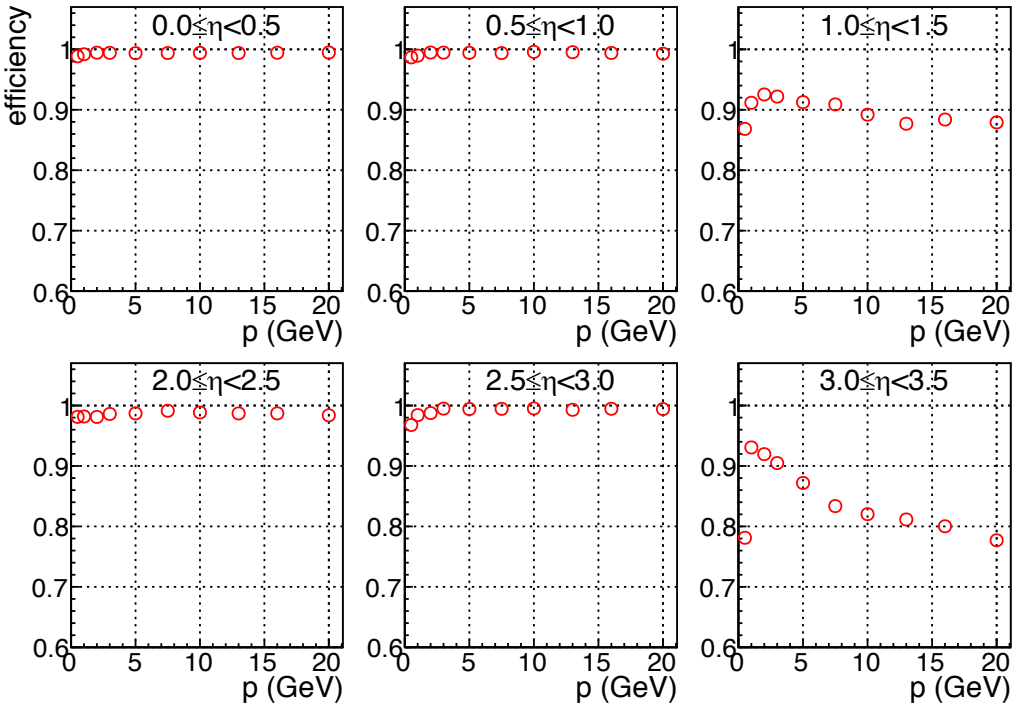
FST Plane	z (cm)	r_{in} (cm)	r_{out} (cm)	Pixel pitch (um)	Silicon thickness (um)
1	35	4	25	20	50
2	62.3	4.5	42	20	50
3	90	6.5	43	20	50
4	115	8.9	44	36.4	100
5	125	9.5	45	36.4	100

Momentum Resolution Comparison (Babar)

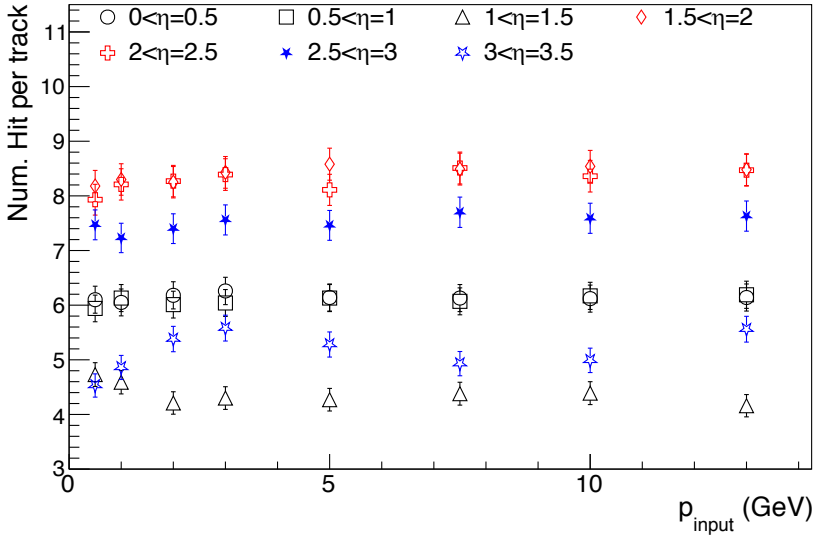


- $\eta < 1.5$: improved momentum resolution with the use of LBNL barrel tracker
- $\eta > 1.5$: no significant changes

Track Reconstruction Efficiency (Babar)



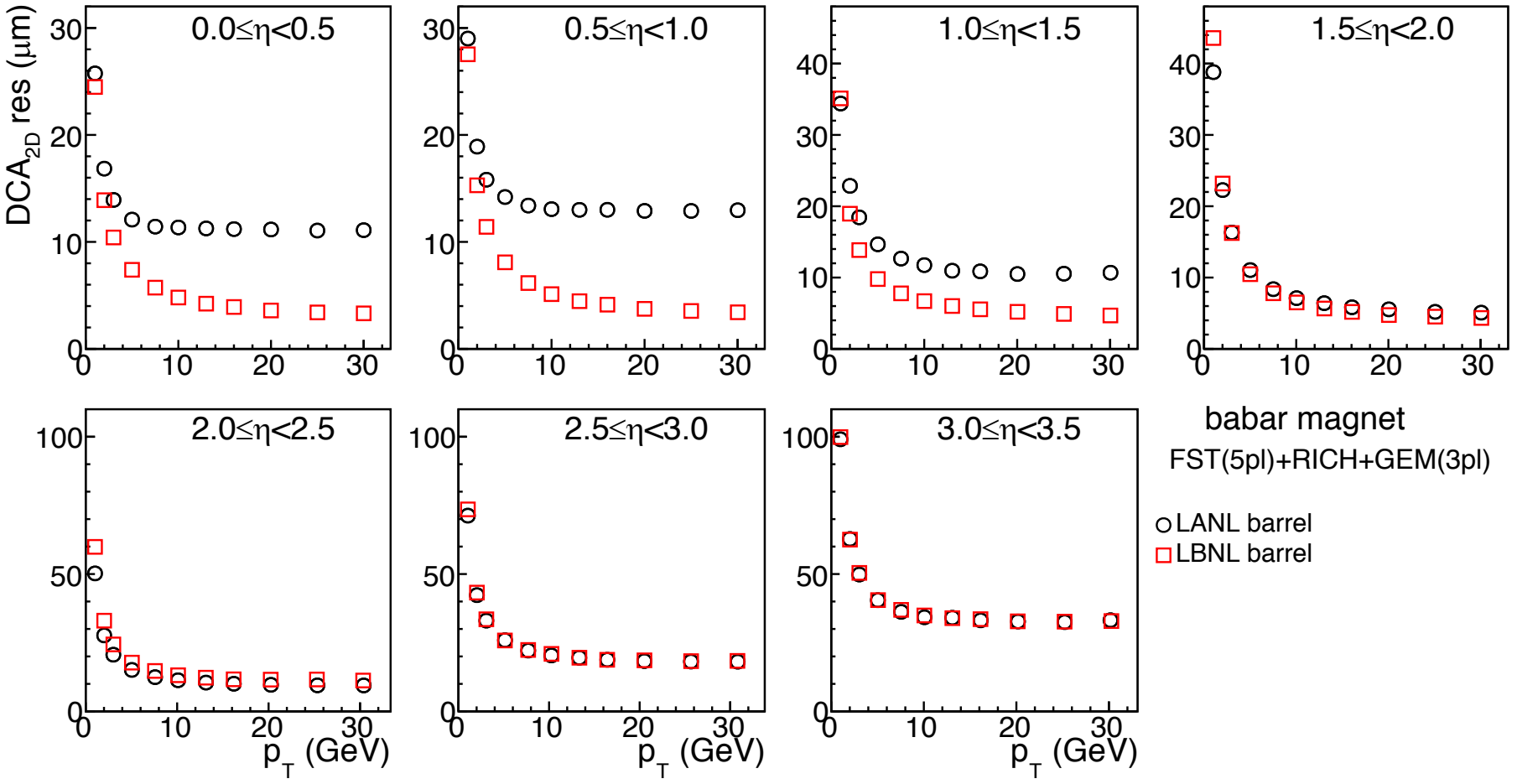
Integral of $\pm 5\sigma$ is used to calculate the efficiency



- Reconstruction efficiency is above 96% at p >1 GeV in most of the pseudorapidity bins
- Fewer hits in $1 < \eta < 1.5$ and $3 < \eta < 3.5$ leads to lower efficiencies in these two pseudorapidity bins

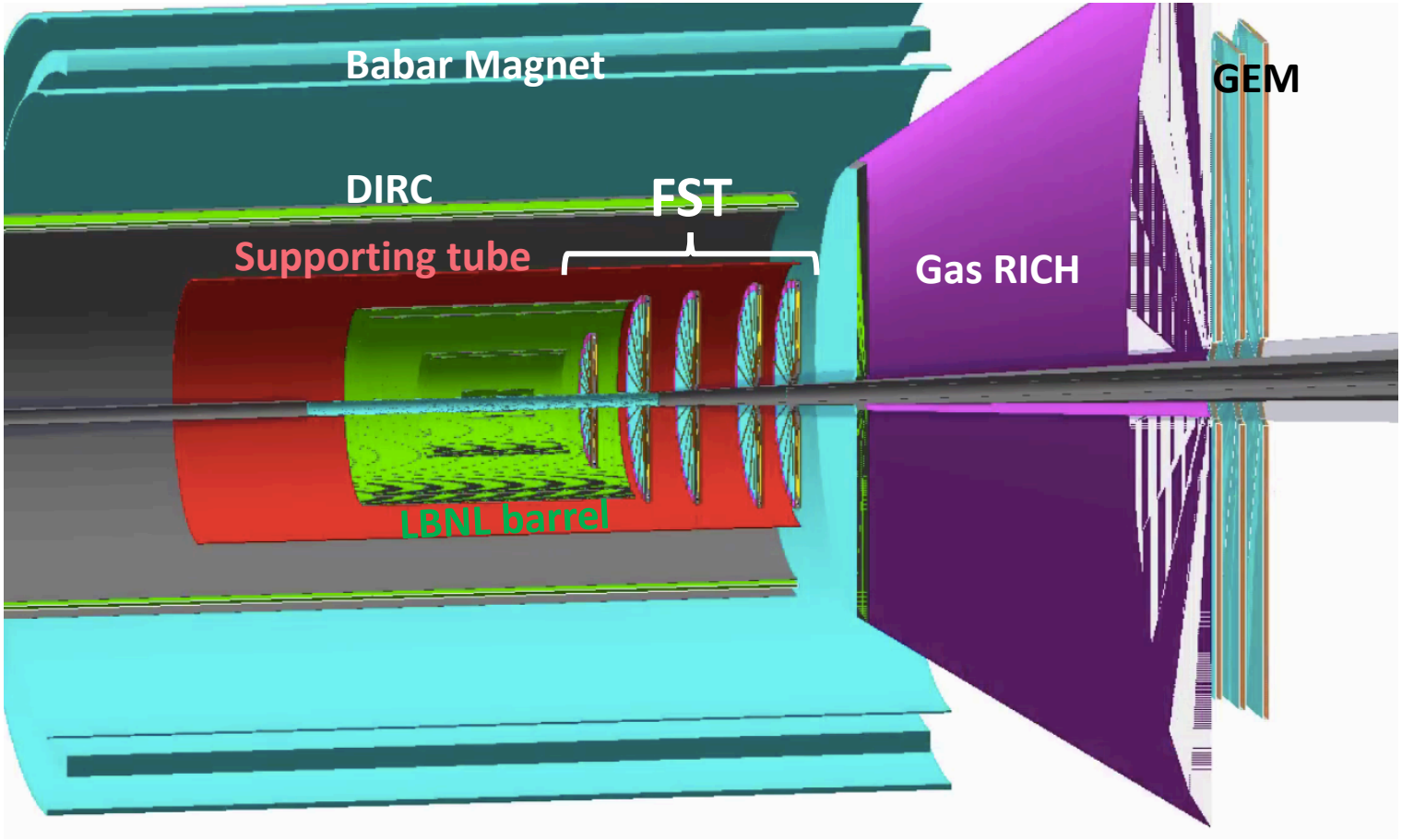
DCA_{2D} Resolution Comparison (Babar)

LANL barrel vs LBNL barrel



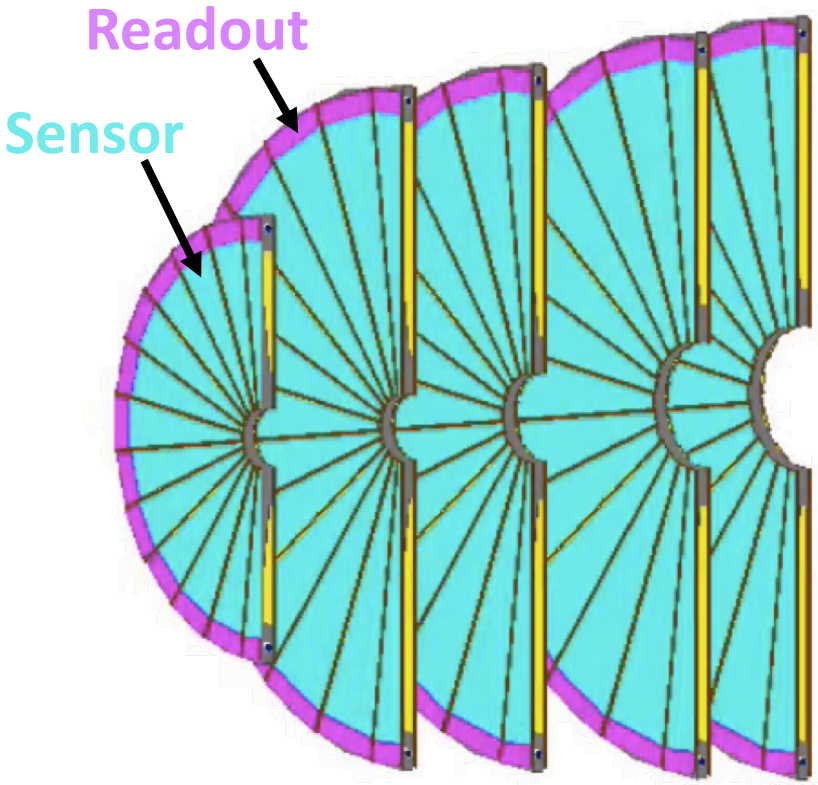
- $\eta < 1.5$: improved DCA_{2D} resolution with the use of LBNL barrel tracker
- $\eta > 1.5$: no significant changes

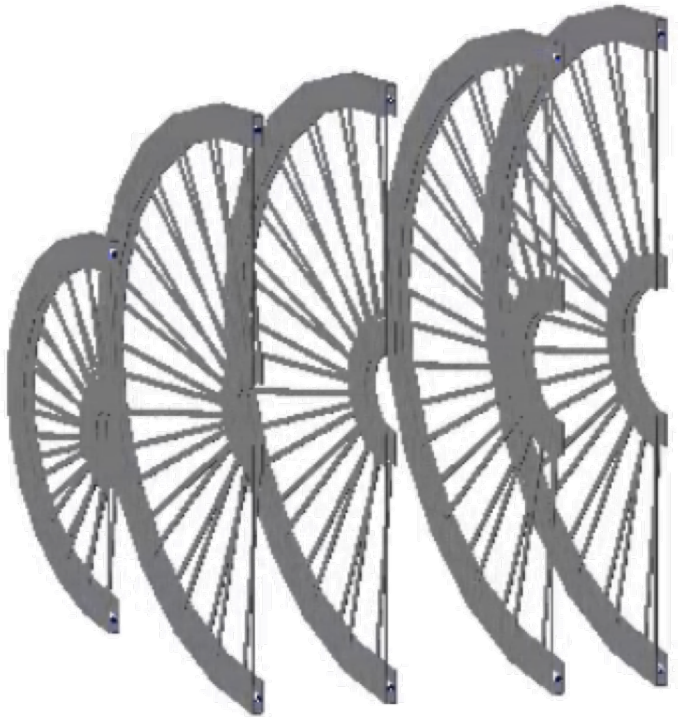
Plan for Detailed FST Implementation in Fun4All



Goal: tracking performance study with the detailed FST implemented in the integrated detector setup

Detailed FST Implementation (Work in Progress)

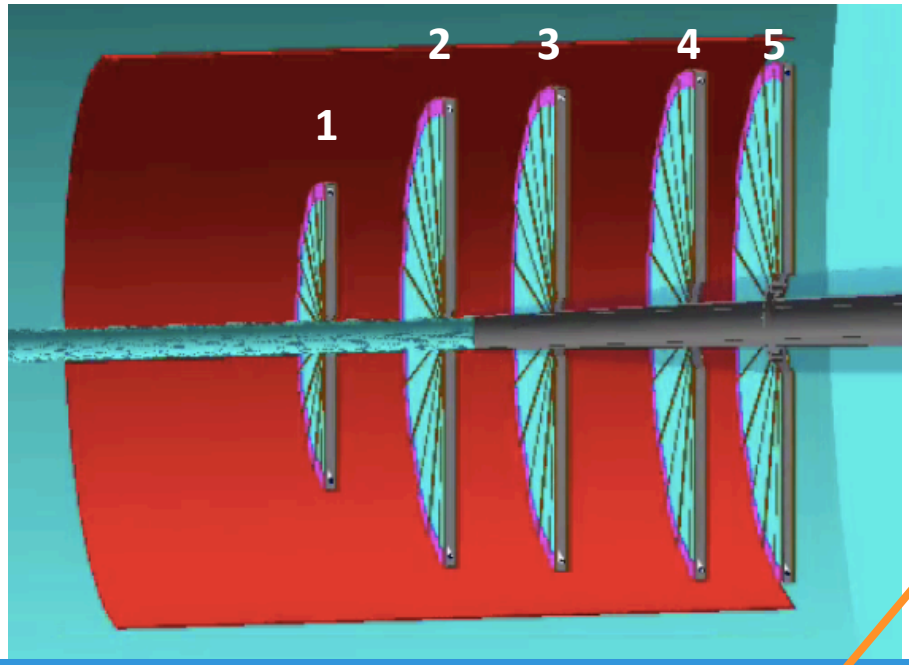




- Sensor wedges (cyan) and readout electronics (purple) on both sides of a plane
- Sensor wedges include silicon wafer, Al foil and HDI (yellow)

- Graphite supporting base for each plane
- Cooling tube and liquid on the outer edge

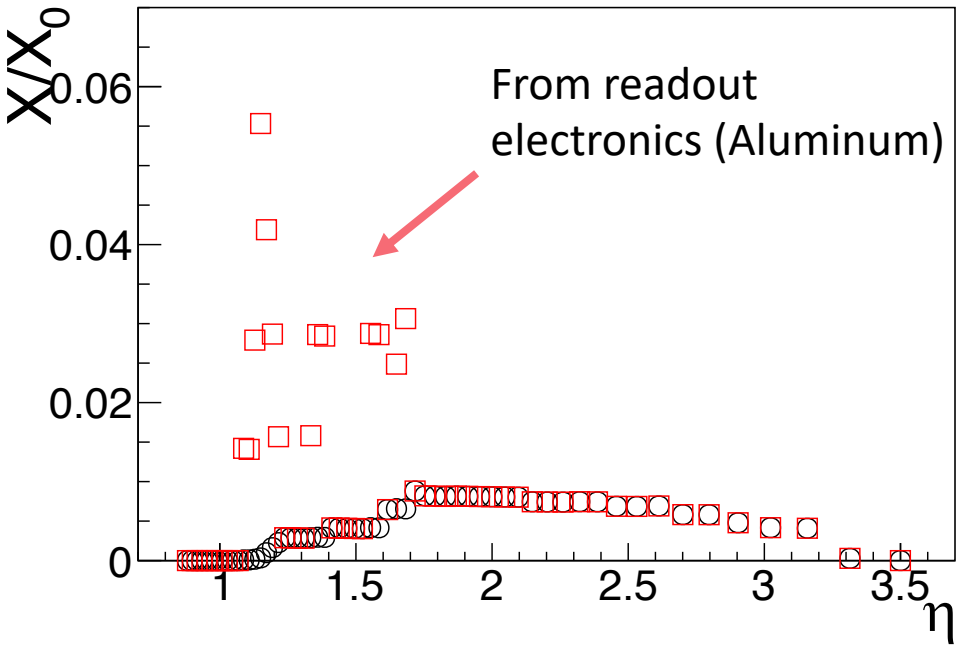
FST Dimensions

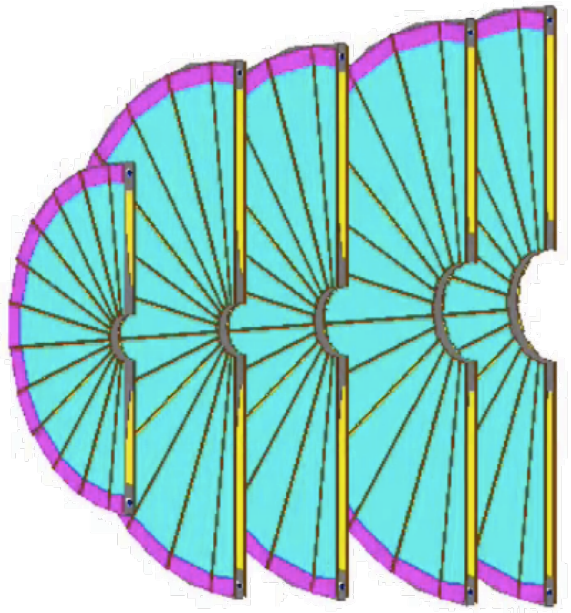


Extra space for readout electronics

Plane	Z (cm)	r_{inner} (cm)	Sensor wedge r_{outer} (cm)	Base outer r_{outer} (cm)	Silicon wafer Thickness (μm)
1	40	4	26.5	29.5	35
2	62.3	4.5	42	45	35
3	83	6	43.5	46.5	35
4	109	8.5	46	49	85
5	125	9.6	47.1	50.1	85

Material Scan of the Detailed FST Design



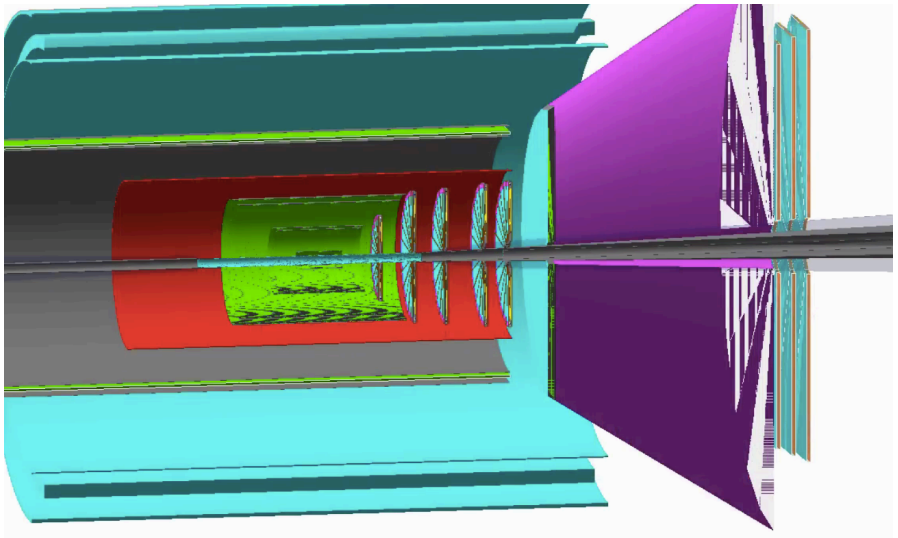


Optimization of the service parts is under way
we welcome any inputs!

Summary & Plan

- The LBNL barrel improves the momentum and DCA_{2D} resolutions at the $\eta < 1.5$ compared to the LANL barrel
- Track reconstruction efficiency $\geq 96\%$. The efficiency is lower in $1 < \eta < 1.5$ and $3 < \eta < 3.5$ due to fewer hits
- A more detailed design of FST is implemented in Fun4All framework

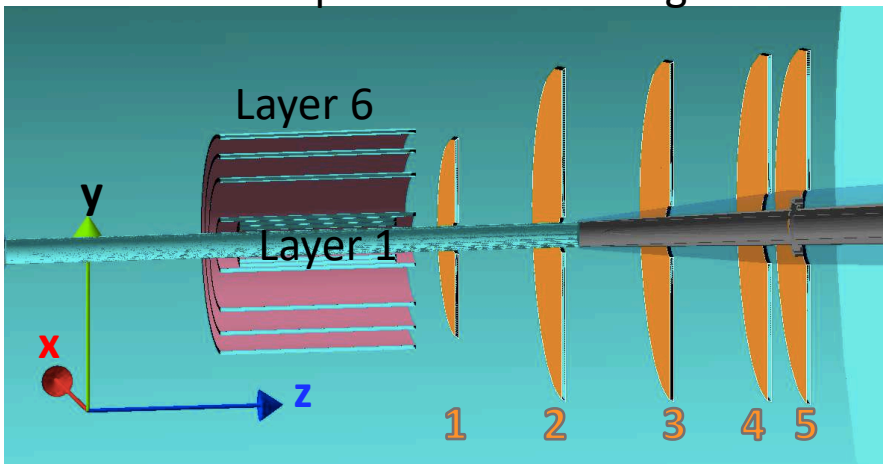
- Plan
  - Fine tune the detailed FST design
  - Replace simplified FST with the detailed FST implementation in the integrated detector setup and study tracking performance



Back Up

LANL Barrel and FST Dimension

Using barrel setup in version 4 design,
And FST setup in version 5 design



Barrel Layer	Half length (cm)	r (cm)	Pixel pitch (um)	Silicon thickness (um)
1	20	3.64	20	50
2	20	4.81	20	50
3	25	5.98	20	50
4	25	16	36.4	100
5	25	22	36.4	100
6	25	27	36.4	100

FST Plane	z (cm)	r_{in} (cm)	r_{out} (cm)	Pixel pitch (um)	Silicon thickness (um)
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Magnetic Fields vs z