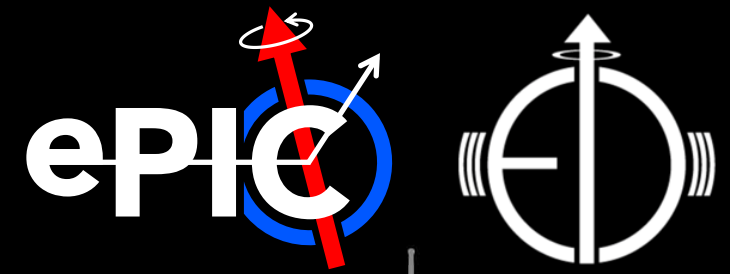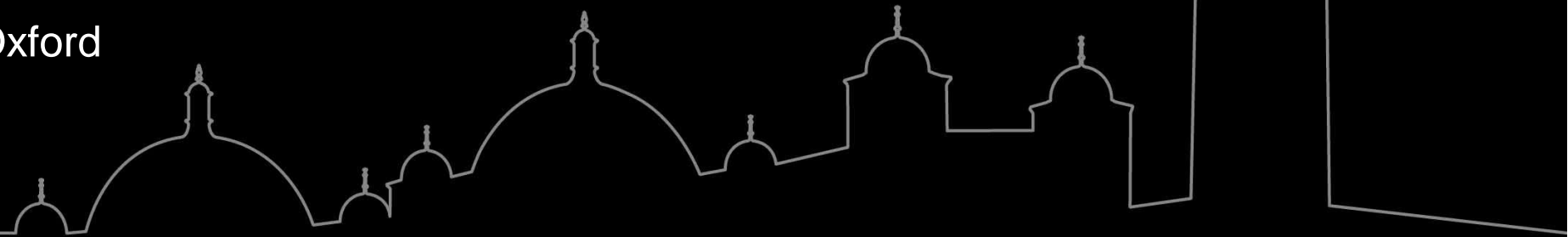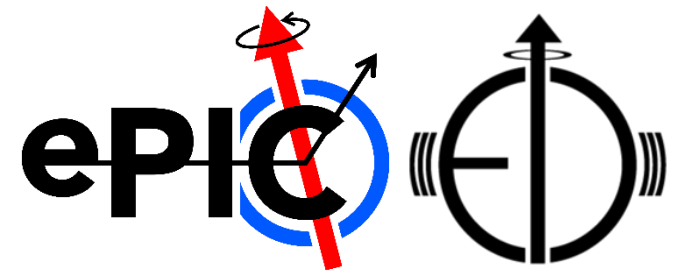# ePIC SVT Outer Barrel Layout

James Glover

EIC-UK WP1 (MAPS)
Face-to-Face meeting @ Oxford

Thu, 3rd October 2024

ePIC Silicon Vertex Tracker (SVT)

- **The ePIC SVT will be the combination of 5 barrel layers and 10 endcap discs.**
  - 3 Inner Barrel (IB) layers – same curved, wafer-scale stitched MAPS used within ITS3.
  - 2 Outer Barrel (OB) layers – longer than IB, optimised sensor for EIC.
    - Focus of EIC-UK WP1 (MAPS).
  - 5 discs for Electron and Hadron (going) Endcaps (EE/HE).
    - Same optimised sensor as OB.

(MAPS – Monolithic Active Pixel Sensor)
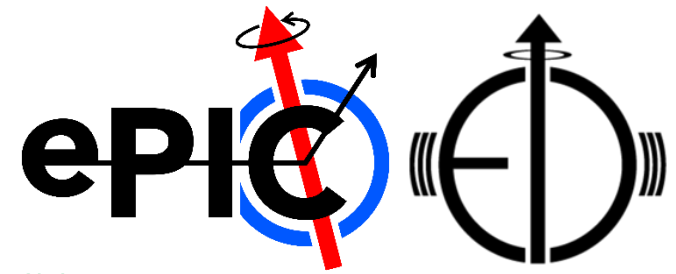
Inner Barrel (IB)
3 curved layers
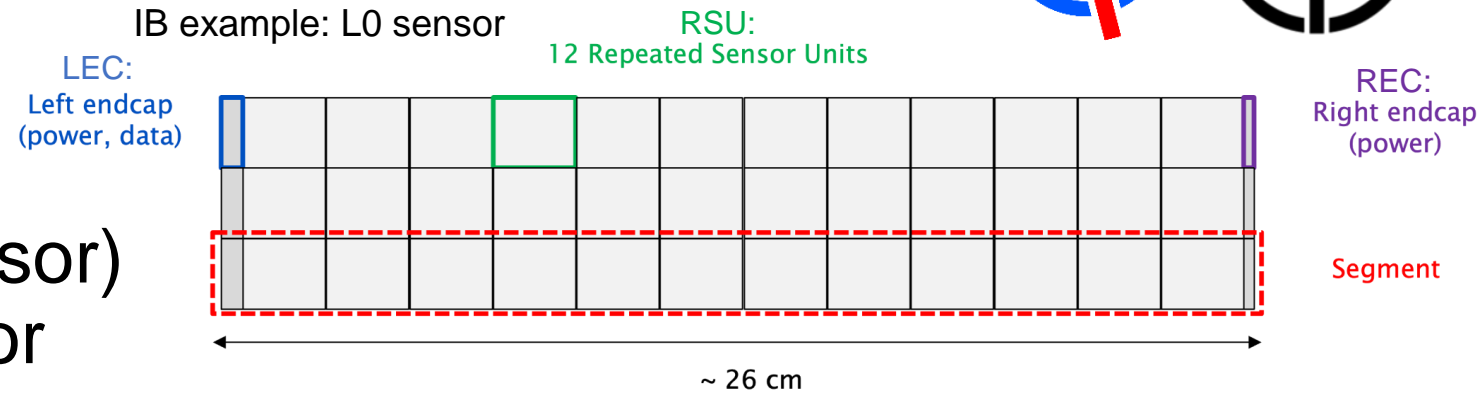
Outer Barrel (OB)
2 stave-based layers
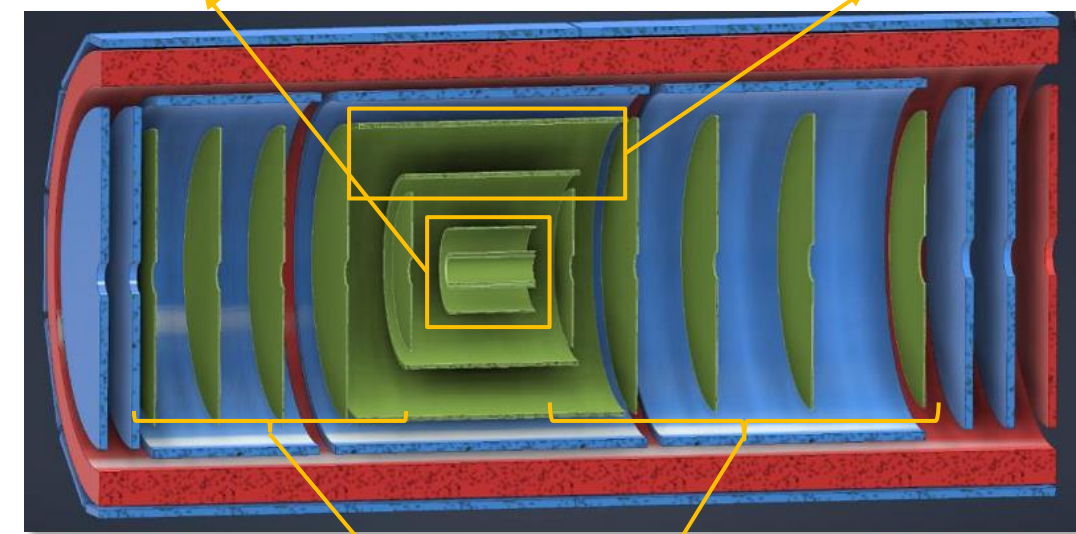
SVT   MPGDs   ToF (fiducial volume)

Electron/Hadron Endcaps (EE, HE)
5 discs on either side of the IP

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MAPS for EIC

- Wafer-scale sensor used in IB.

- EIC-LAS (Large Area Sensor) is the EIC optimised sensor variant to help minimise the material required due to service (data/power/control) connections and improve yield for large area coverage.
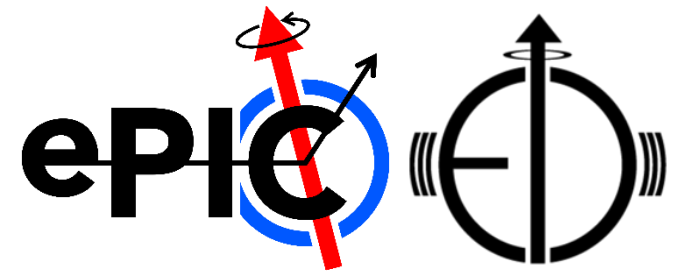 - For OB, EE, and HE of SVT.

IB example: L0 sensor

RSU:
12 Repeated Sensor Units

LEC:
Left endcap
(power, data)

REC:
Right endcap
(power)

Segment

~ 26 cm

From: https://wiki.bnl.gov/EPIC/index.php?title=Si_Vertex_Tracker

IB	–	Inner Barrel
OB	–	Outer Barrel
EE	–	Electron Endcap
HE	–	Hadron Endcap
SVT	–	Silicon Vertex Tracker

LEC:
Left endcap
(power, data)

n RSU

REC:
Right endcap
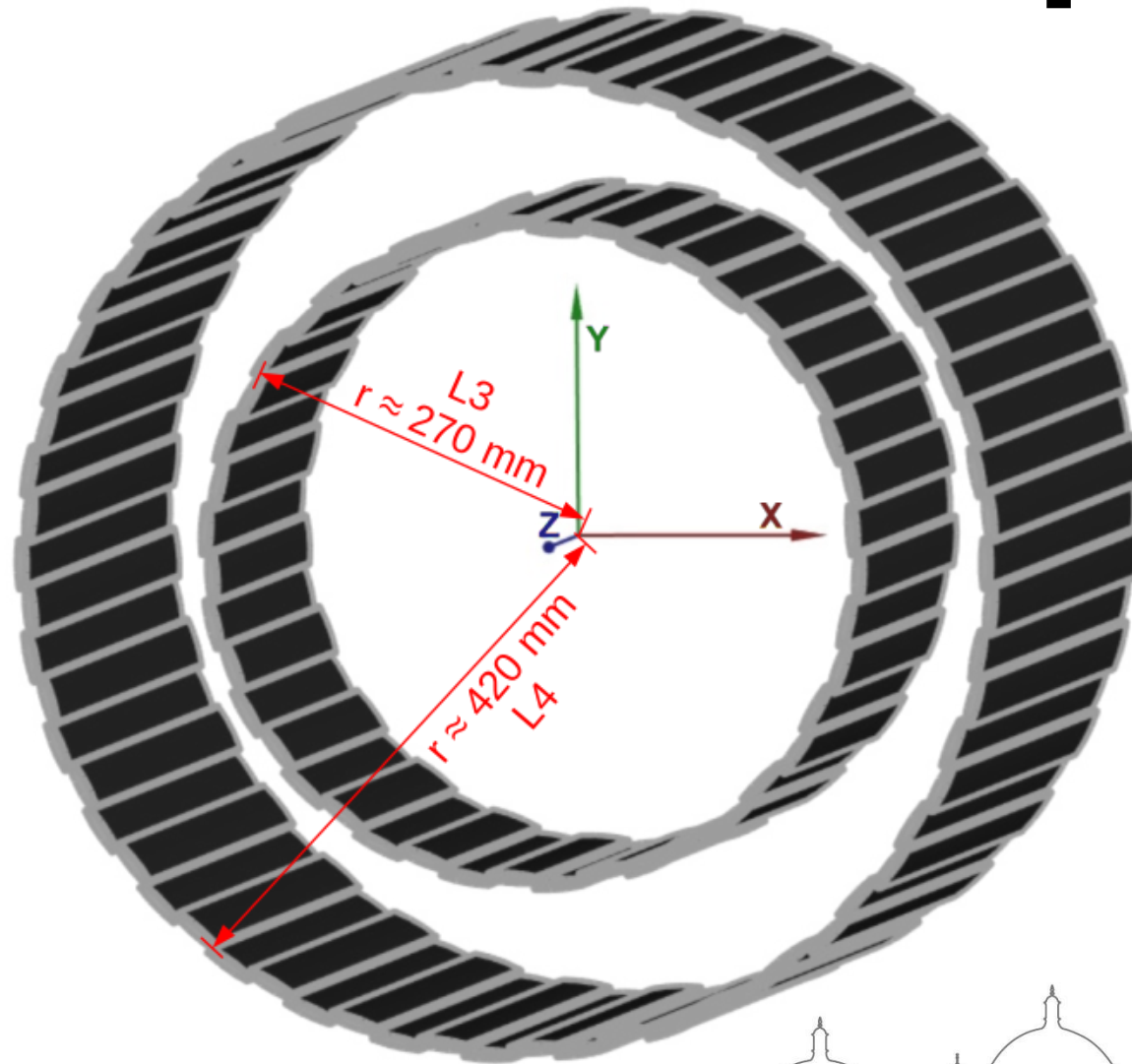(power) (stitching plan termination)
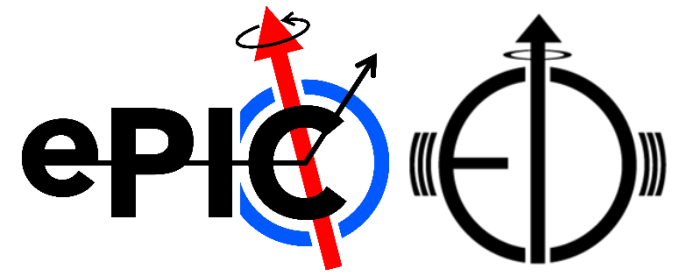
EIC-LAS

...

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Outer barrel

- 2 stave-based layers (L3 and L4) of stitched MAPS.

- Stave repeated around the Z-axis until (active silicon of) staves fully cover the circumference (at target radii).
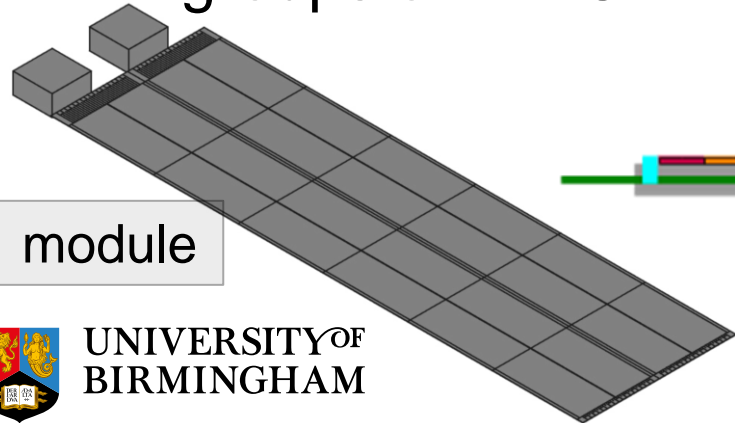
Construction of staves

Outer Barrel – Layer3

- Double-sided staves

- Using EIC-LAS with 6 RSUs

- 2 EIC-LAS wide (1 module)
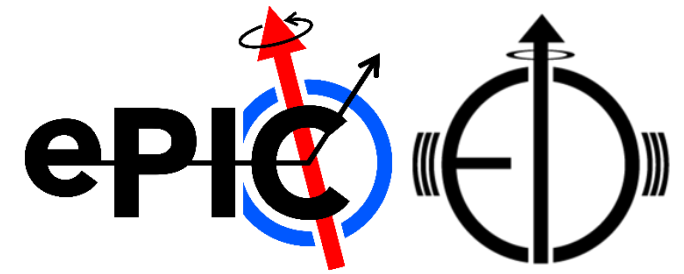
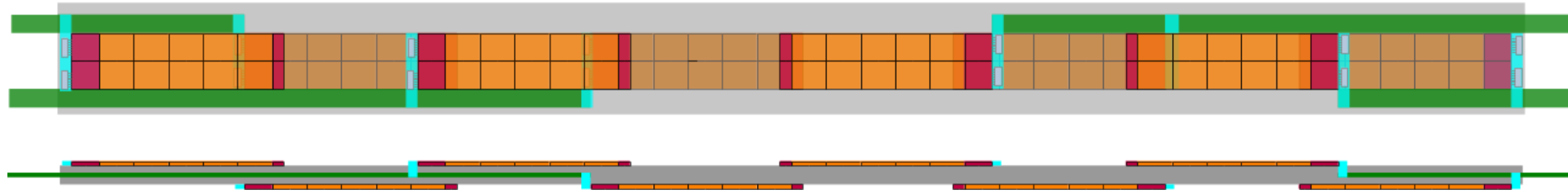- 4 modules long

- 2 groups of 4 EIC-LAS (8 total)

Outer Barrel – Layer4

- Double-sided staves

- Using EIC-LAS with 5 RSUs

- 2 EIC-LAS wide (1 module)
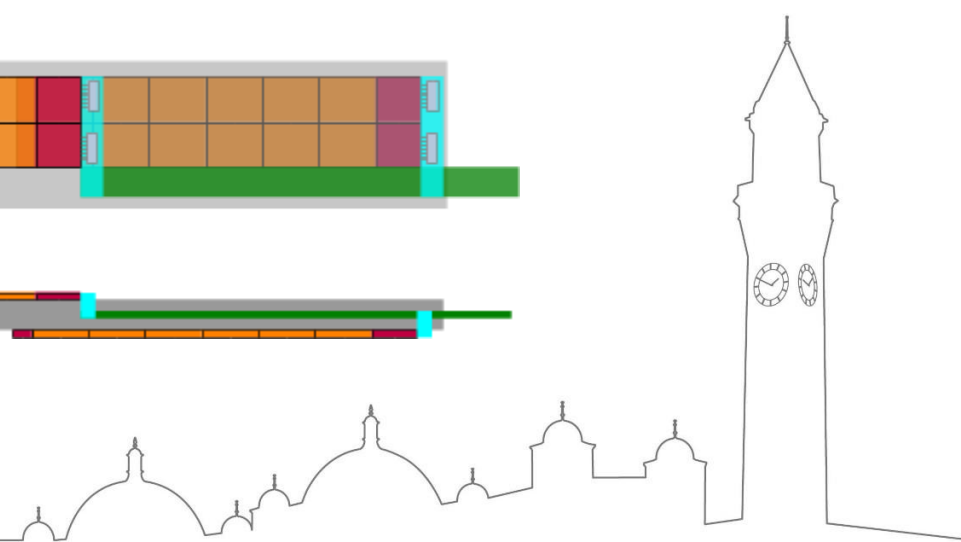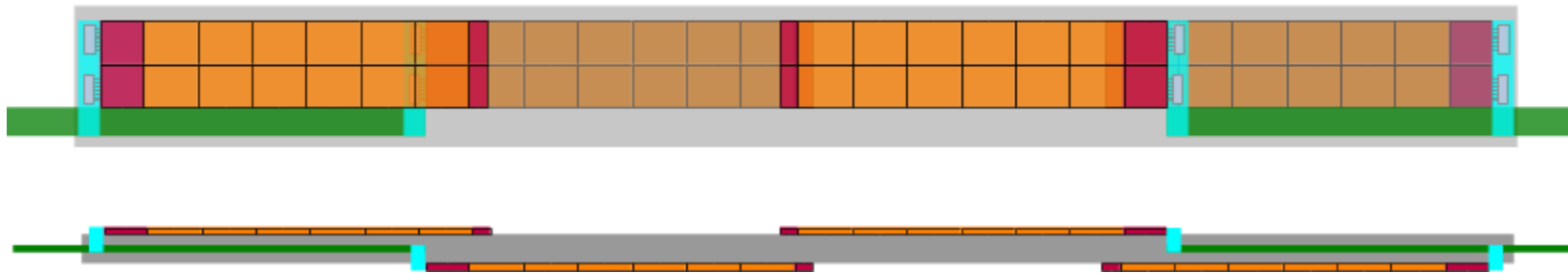
- 8 modules long

- 4 groups of 4 EIC-LAS (16 total)

OB L3 (EIC-LAS with 6 RSUs)
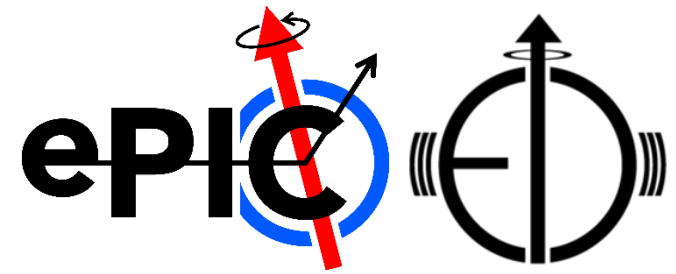
1 module

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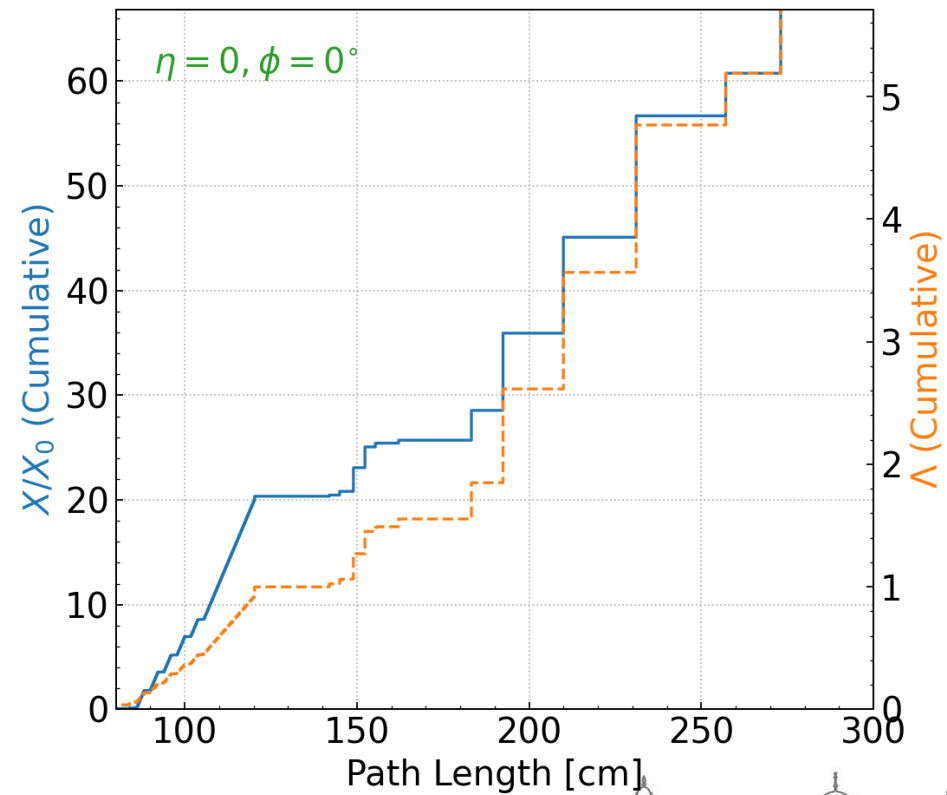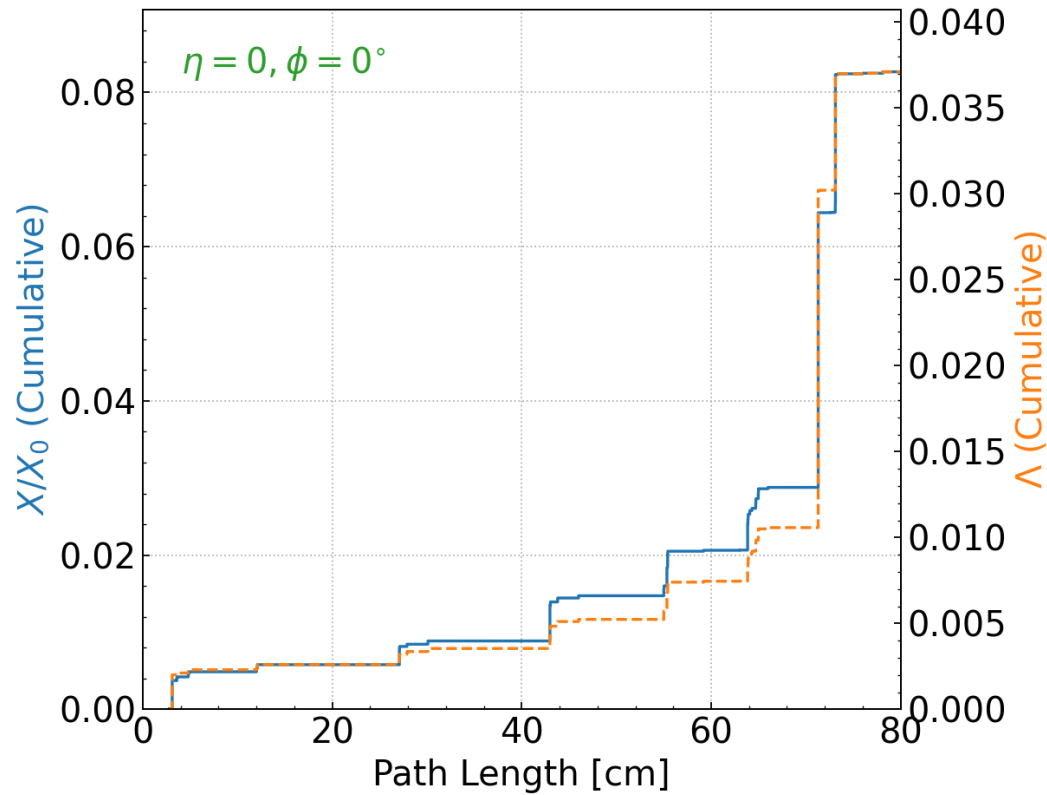# Stave per SVT layer (cartoon)

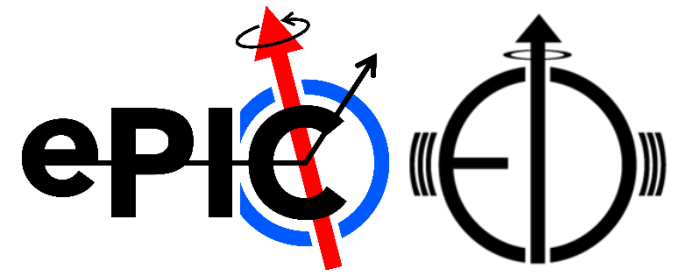Layer 4 (EIC-LAS w. 5*RSU)

Layer 3 (EIC-LAS w. 6*RSU)

Current Material (for simulations)

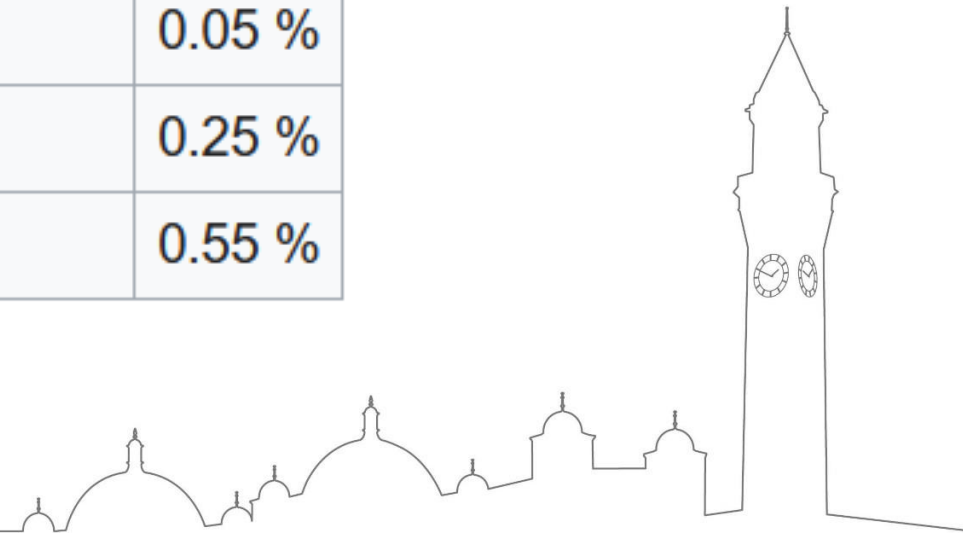Recent [general meeting](#) showed how the material is positioned in the simulation framework:

Ideal Layer Radii (from twiki)

The ideal radii for each SVT layer is documented on the ePIC twiki:

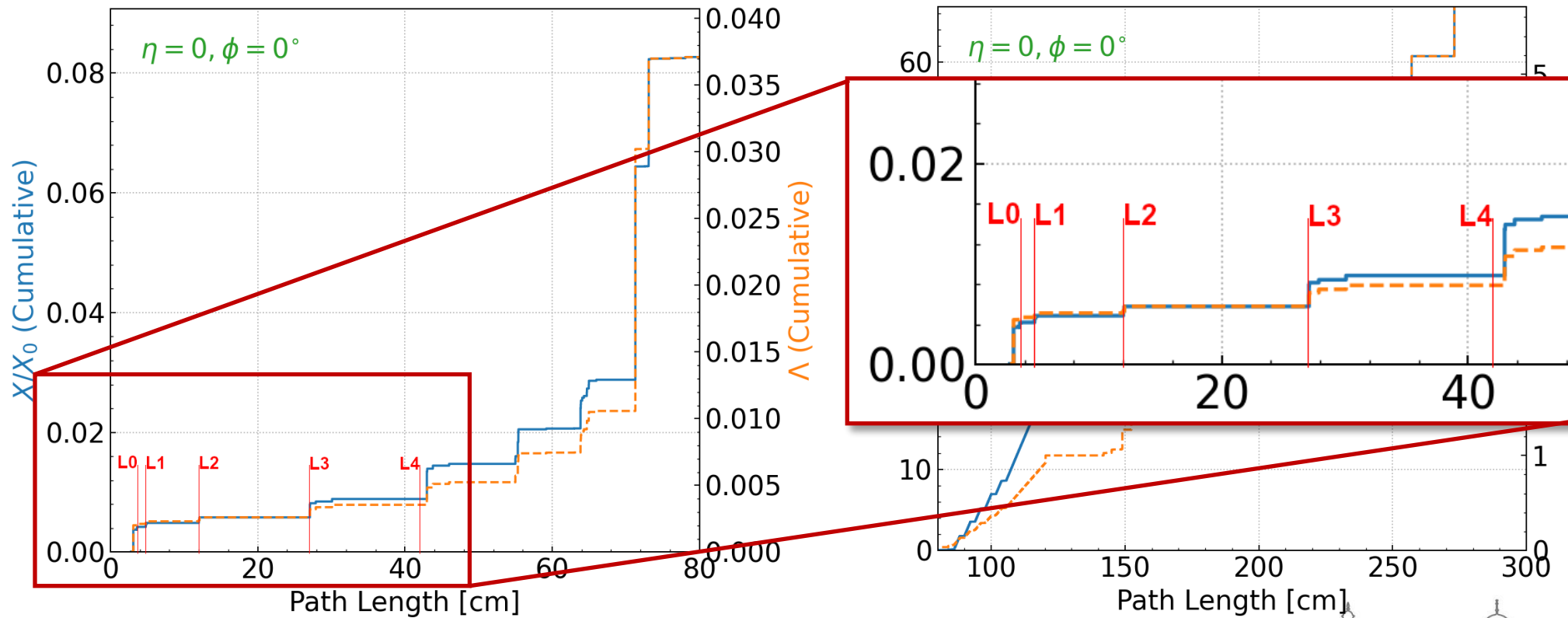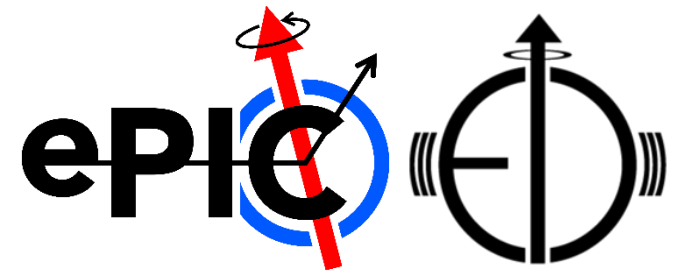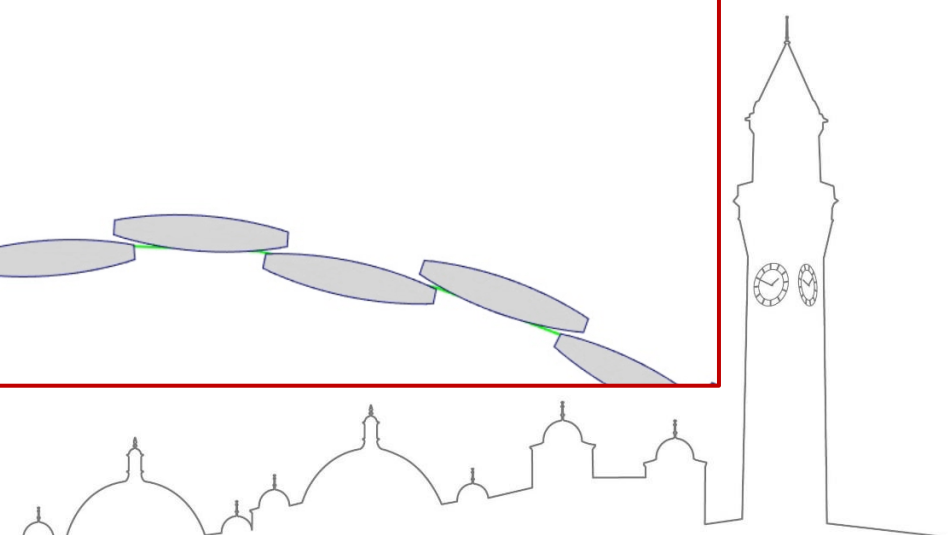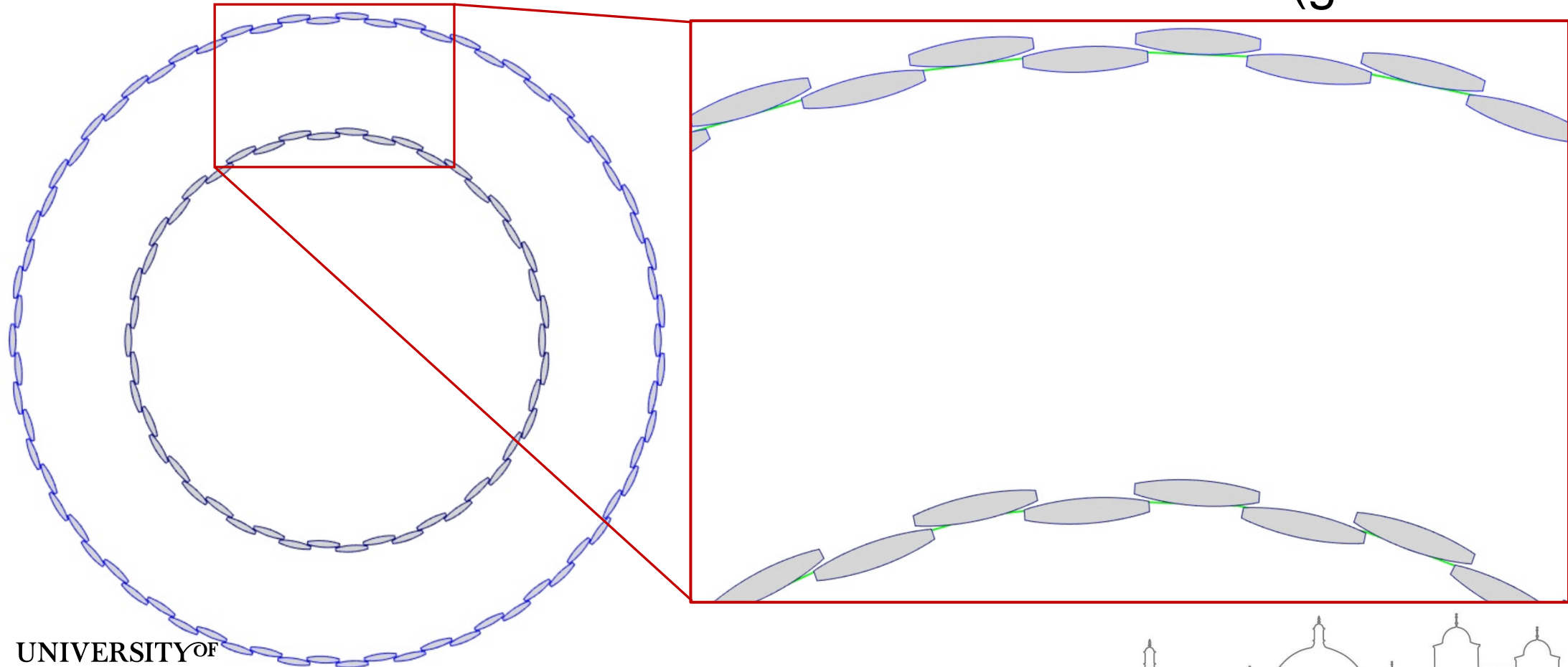| Region	Layer	radius [mm]	length [mm]	X/X0
IB	L0	36	270	0.05 %
	L1	48	270	0.05 %
	L2	120	270	0.05 %
OB	L3	270	540	0.25 %
	L4	420	840	0.55 %

Current Material (with SVT radii)

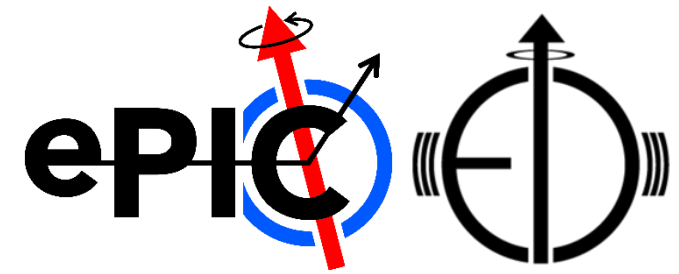The material **starts** at the ideal radii (apart from L4):

Current OB layout

CAD models have stated a COM radius for L3 and L4 (green lines):

Current OB dimensions

Layer	Radial Aim	Inner most Radii	Outer most Radii	#RSU per EIC-LAS	#Staves per layer	#EIC-LAS per layer
L3	272 mm	264.75 mm	279.25 mm	6RSU-LAS	46	368
L4	424 mm	416.75 mm	431.25 mm	5RSU-LAS	70	1,120

6 mm spacing from inner to outer sub-layer radius
(±3 mm from radii of 272 and 424).

- This spacing may need to be increased to guarantee good, mechanical clearance between sub-layers.
- ∴ Overlaps between staves would need to increase.
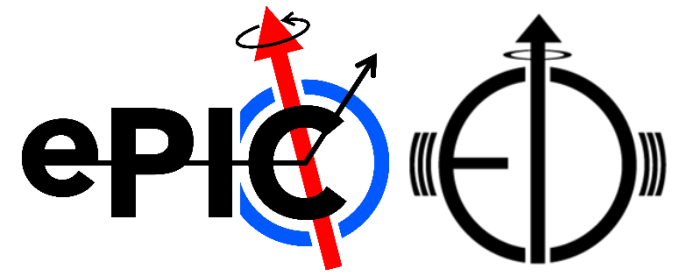- Best achieved by reducing the radius.

JLab documented envelop
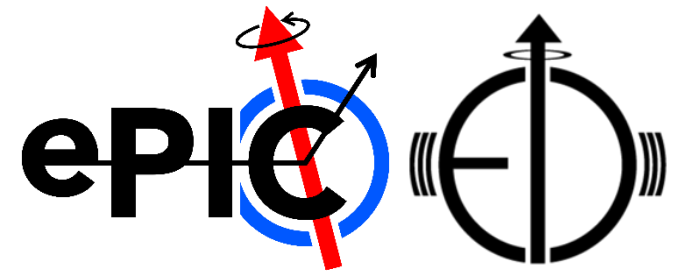
JLab have a repository of the ePIC detector geometries [here](#).

- Currently the outer-most SVT radius is 430 mm (for Endcap Disks) – in line with (draft) TDR wording.

- The next layer (Micromegas barrel) starts at a radius of 550 mm.

- SVT support cylinder needs to exist somewhere between, but at what radius?
  - Limits the outermost radius of L4.
 - Current layout already has L4's outer radius at ~432 mm!

Summary

- No current change to the OB layout.

- Notes and caveats to remember when comparing the simulations and mechanical designs.

- Mechanical limitations are likely to reduce the radii of L3 and L4.
  - This may need to be fed into the simulation work to verify performance.
  - Do we just recommend an average radius for the material per layer?
  - We also need a more accurate estimate of material per layer (L3 and L4 will be closer together than the estimated 0.25 and 0.55 % X/X_0).
    - Sam is already looking into this.
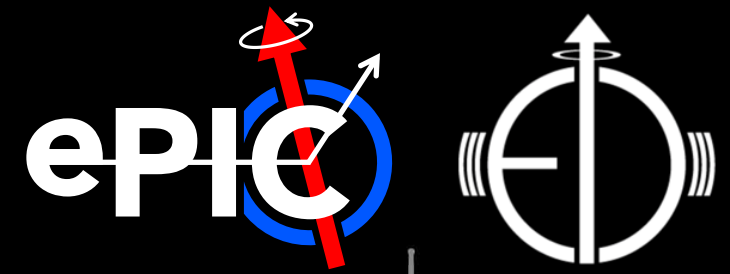
Thank you very much!
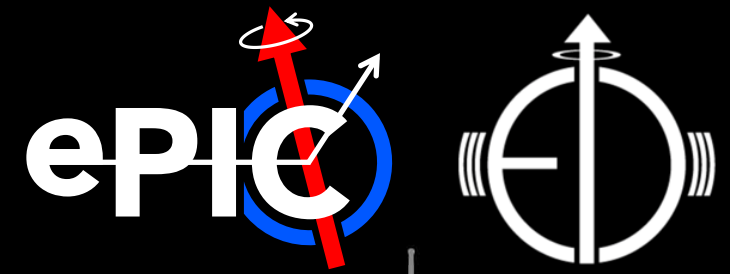
Any questions?

Additional (support) slides
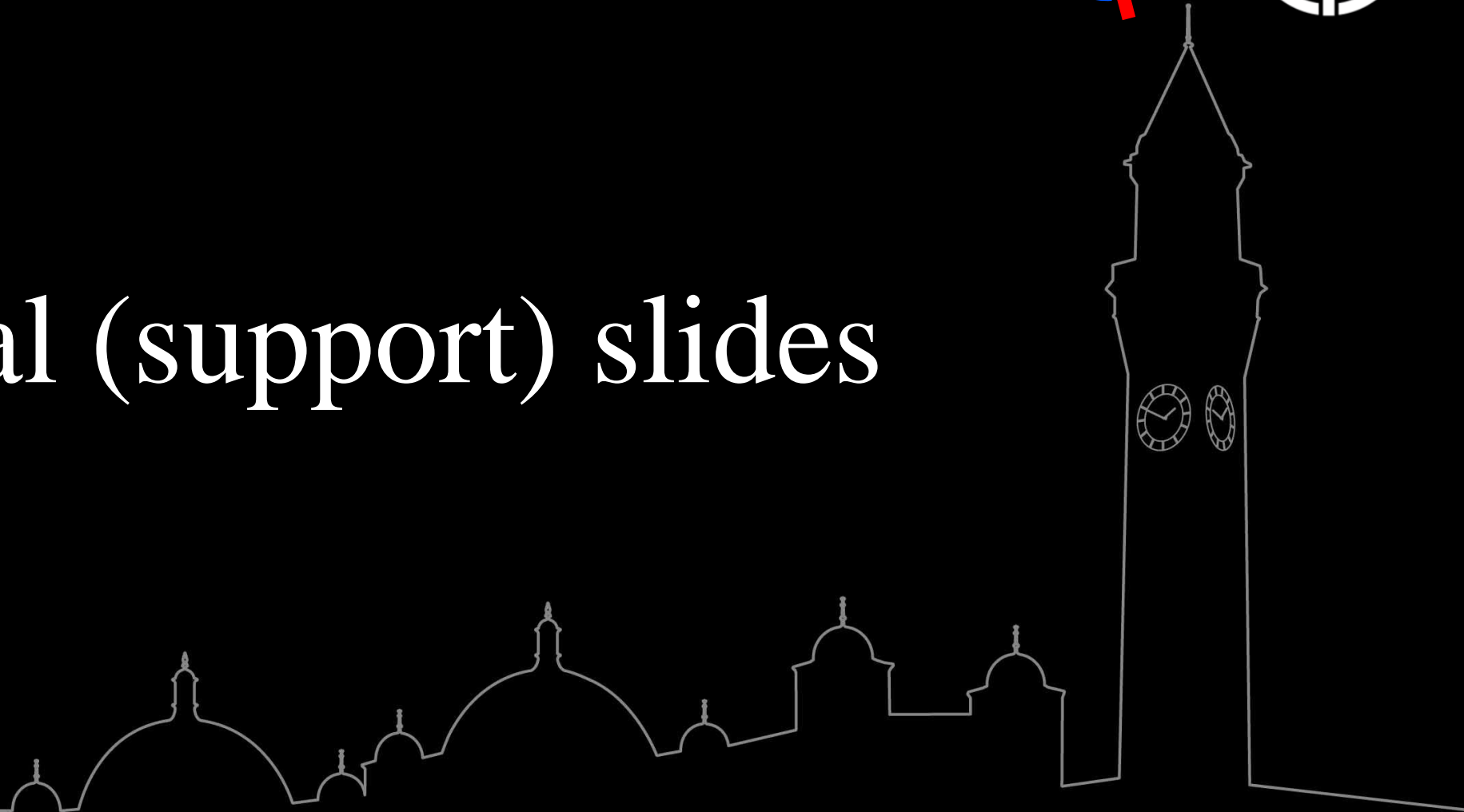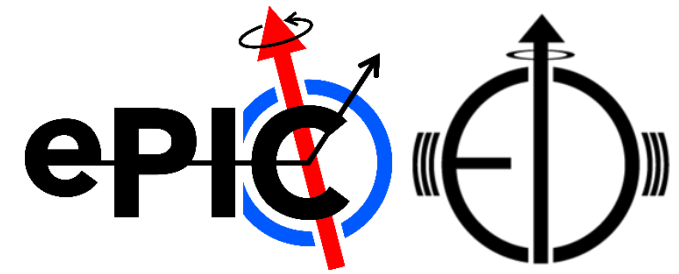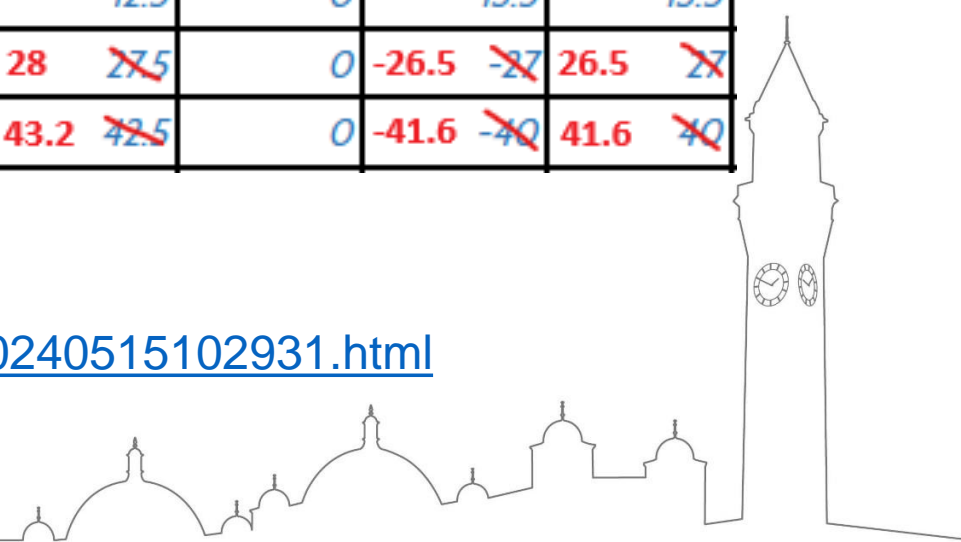
Edits to JLab envelop

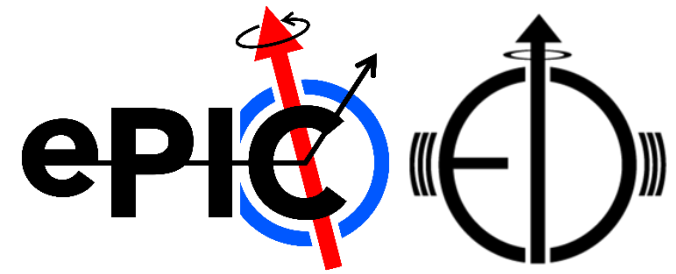| Component	Sub-Component	WBS	Length (cm)	Inner Radius (cm)	Outer Radius (cm)	Offset from Center (cm)	Physical Start (cm)	Physical End (cm)
Inner Tracker (Si Barrel)		6.10.03	~~80~~	3.6	~~42.5~~	0	~~-40~~	~~40~~
	Si Layer 0		27	3.6	4.1	0	-13.5	13.5
	Si Layer 1		27	4.8	5.3	0	-13.5	13.5
	Si Layer 2		27	12	12.5	0	-13.5	13.5
	Si Layer 3		53 ~~54~~	26.5 ~~27~~	28 ~~27.5~~	0	-26.5 ~~-27~~	26.5 ~~27~~
	Si Layer 4		83.2 ~~80~~	41.6 ~~42~~	43.2 ~~42.5~~	0	-41.6 ~~-40~~	41.6 ~~40~~

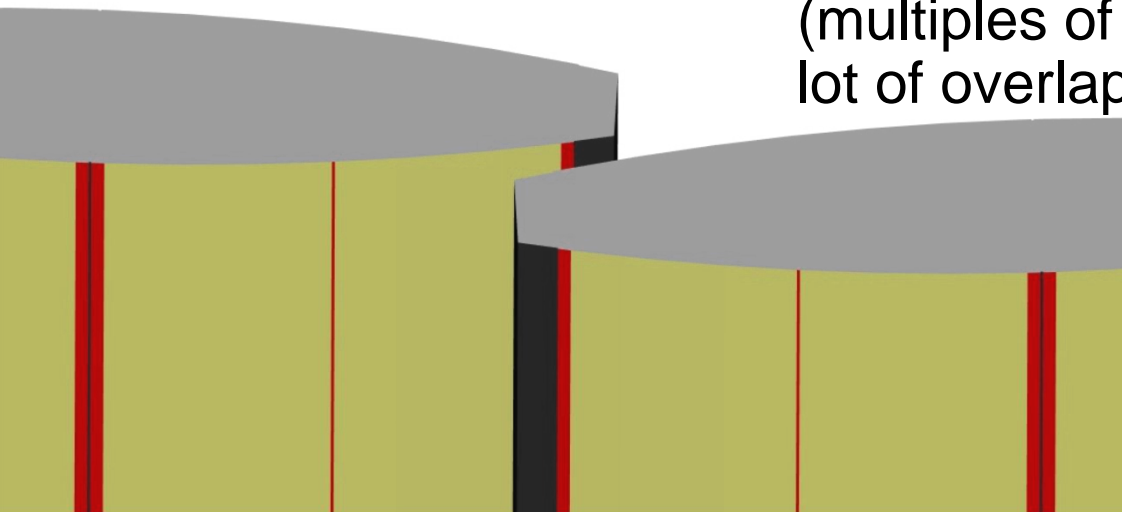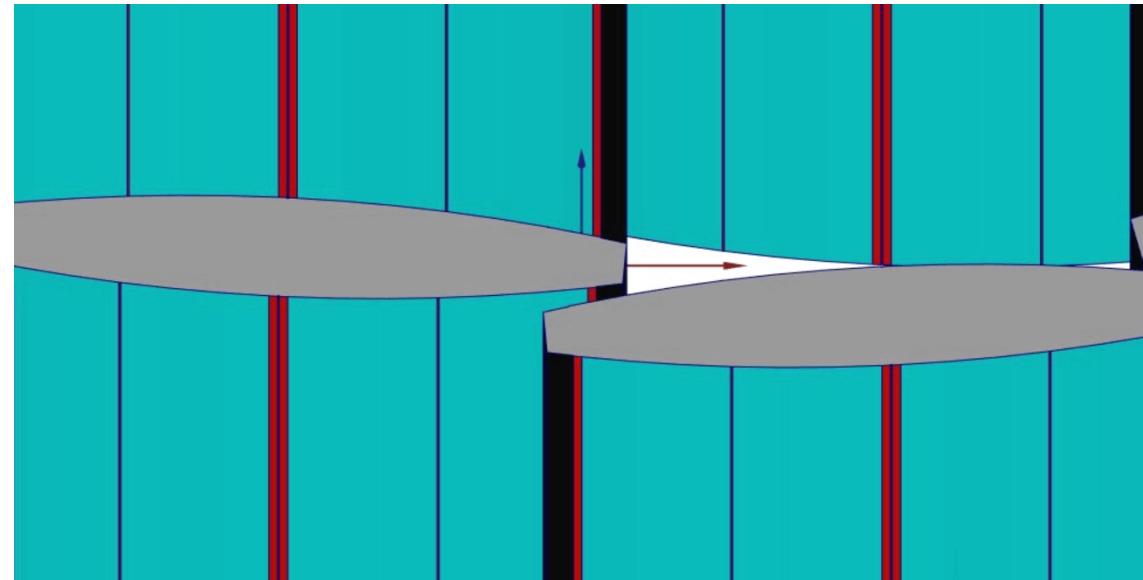https://eic.jlab.org/Geometry/Detector/Detector-20240515102931.html

Overlaps yet to be defined

- Overlaps are still to be (fully) accounted for.

- Fine tuning of overlaps will be done with adjustments to radii.

- Adding more staves (multiples of 2) adds a lot of overlap.

Started to look at minimum p_t to estimate worst case curvature of track (WIP).

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