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Update on endcaps (disks) tiling study

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Update on endcaps (disks) tiling study

- Aim of this study

  Determine the combination of EIC-LAS sensors gives that best coverage in the forward/backward disks

- Assumptions

  Repeated Sensor Unit (RSU) size = 19.564 x 21.666 mm^2 (current ITS3 ER2 design)

  Limit of 6 stitched RSUs per sensor to enable powering from one end only

  Sensor endcaps (digital periphery) at both ends = 4.5 mm and 1.5 mm in length

  Maximum of two sensor variants to 1x6 RSUs, plus one other (1x5, 1x4 or 1x3 RSUs)

  Allow sensors to overlap; requires mounting sensors on both sides of the disk

  Try to minimise the number of sensors (fewer connections) and number of overlapping RSUs (lower material)

- Layout strategies

  Two approaches:

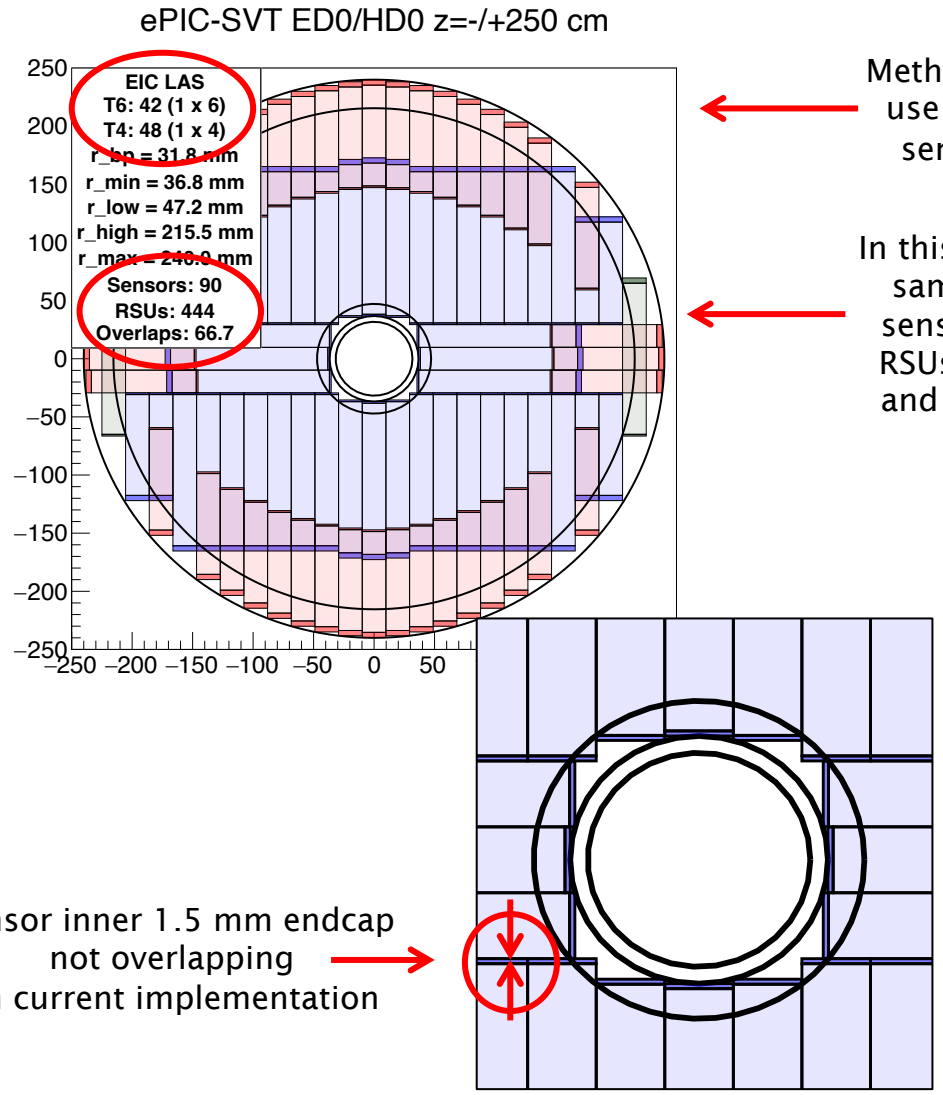
  Method #1: Prioritise use of 1x6 sensors to keep connections at larger radii

  Method #2: Use sensors in combinations that minimise overlap, favours use of smaller sensors

  New feature: move outer sensors to outer radius if there is overlap to maximise coverage

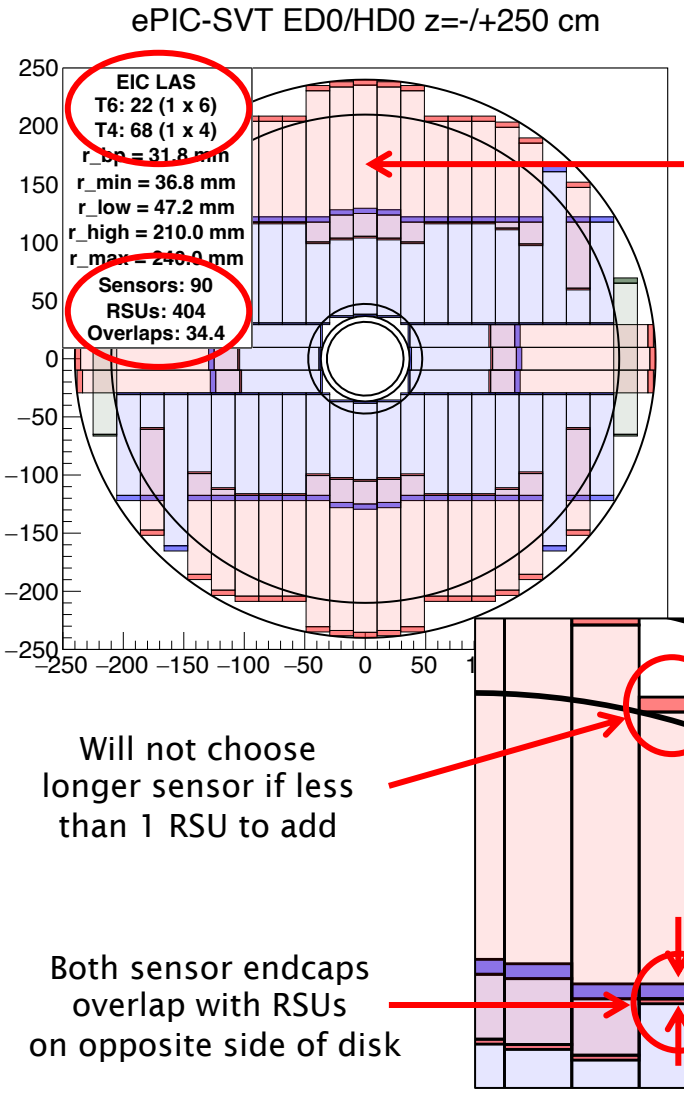
Disk tiling approaches – example Disk ED0/HD0

- Method #1



Sensor inner 1.5 mm endcap not overlapping in current implementation

- Method #2



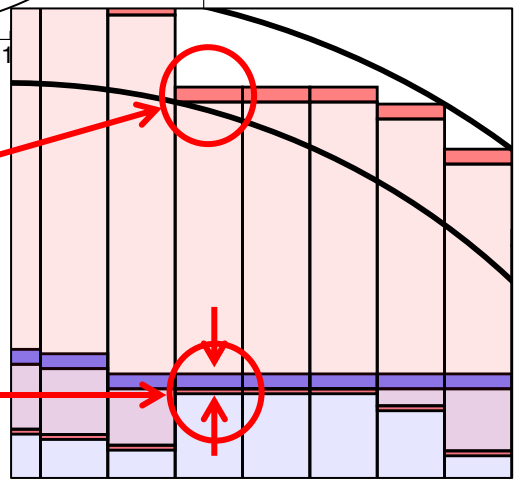
Method #2 tends to use more shorter sensor variants

In this example, find same number of sensors but fewer RSUs, less overlap and less coverage

Longer sensor at outer radius is a consequence of algorithm used; in practice longer sensor would be moved to inner radius

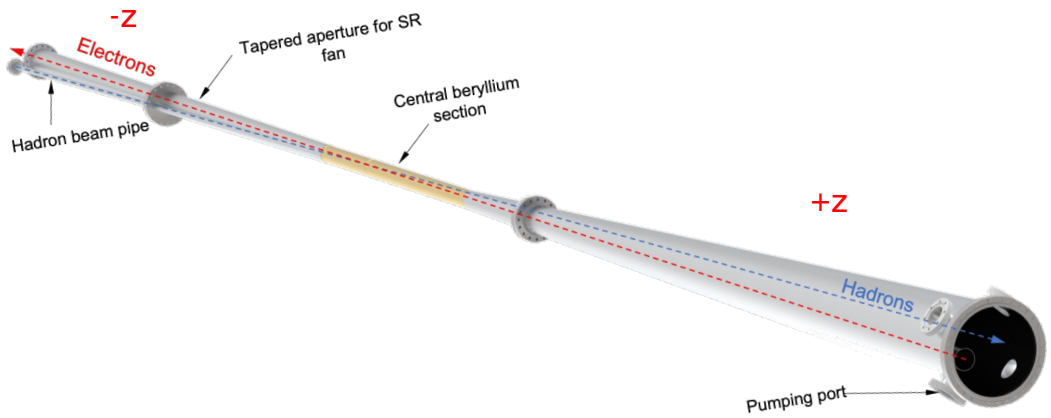
Will not choose longer sensor if less than 1 RSU to add

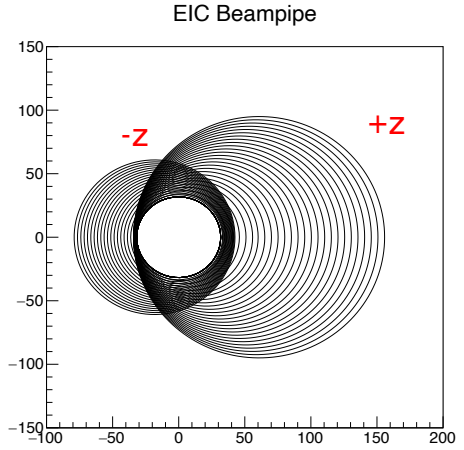
Both sensor endcaps overlap with RSUs on opposite side of disk



Note on disk geometry

- Updated disk locations and inner/outer radii



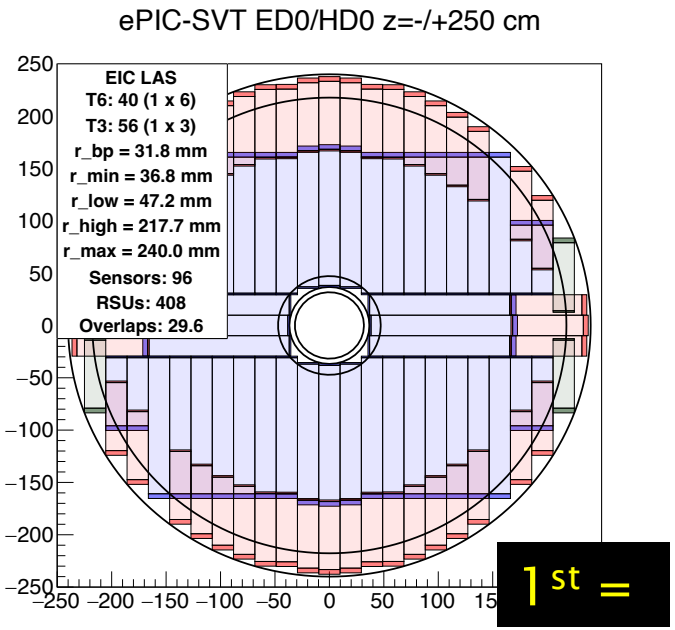


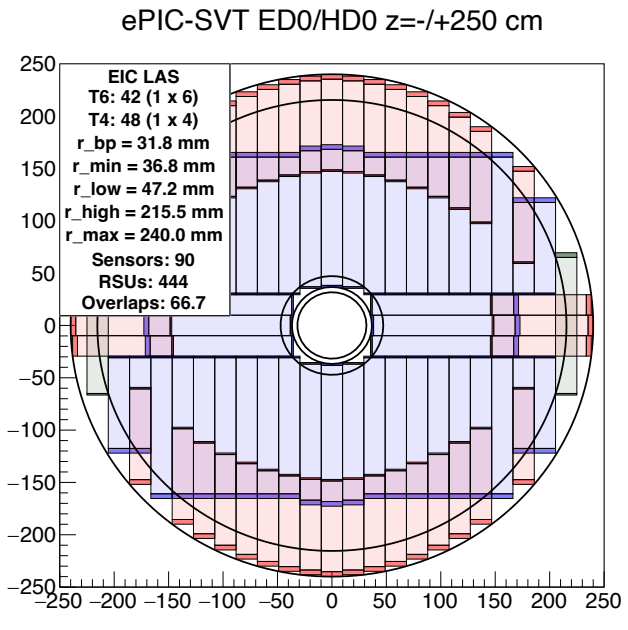
Two options considered:
Offset or **centred** inner aperture

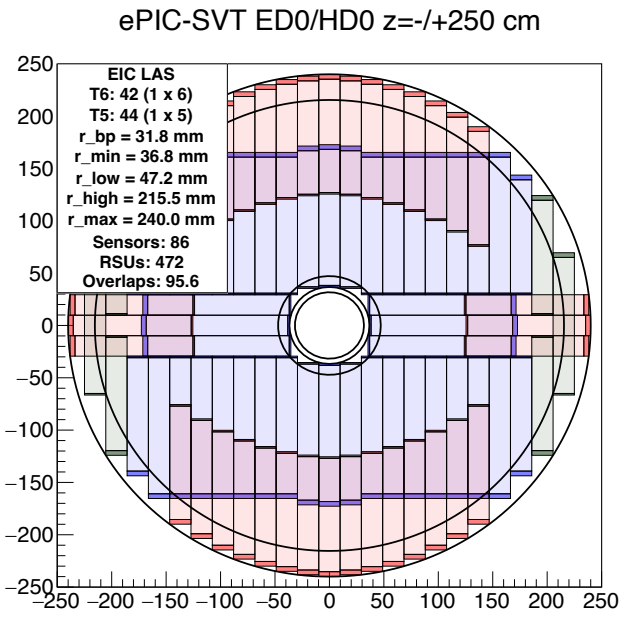
	SVT Wiki					
Disk	**r_in (mm)**	**r_out (mm)**	**x_offset (mm)**	**r_bpipe (mm)**	**r_offset (mm)**	**r_centre (mm)**
HD4	70.14	421.4	16.02	49.12	54.12	70.14
HD3	53.43	421.4	7.85	40.58	45.58	53.43
HD2	38.46	421.4	0.56	32.86	37.86	38.42
HD1/ED1	36.76	415.0	0.00	31.76	36.76	36.76
HD0/ED0	36.76	240.0	0.00	31.76	36.76	36.76
ED2	36.76	421.4	0.00	31.76	36.76	36.76
ED3	40.00	421.4	-0.32	33.48	38.48	38.80
ED4	46.35	421.4	-2.31	36.52	41.52	43.83

Some discrepancy between my calculated central inner radii and those on the SVT wiki

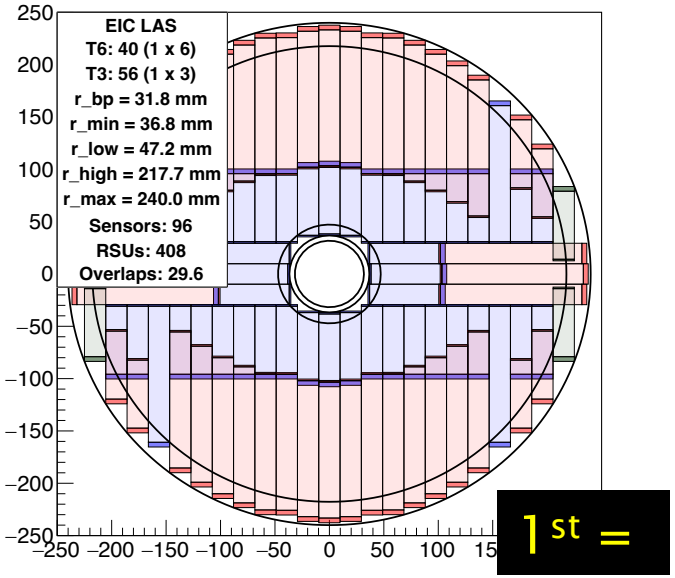
ePIC Disk Layout Studies – Disk 0 (ED0/HD0)

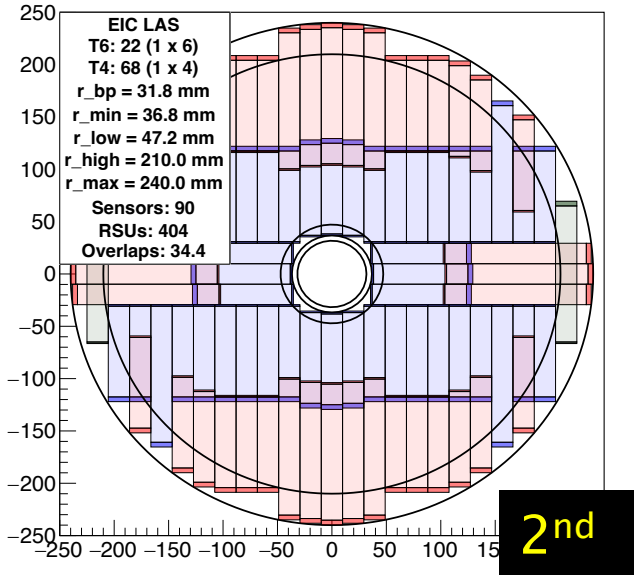


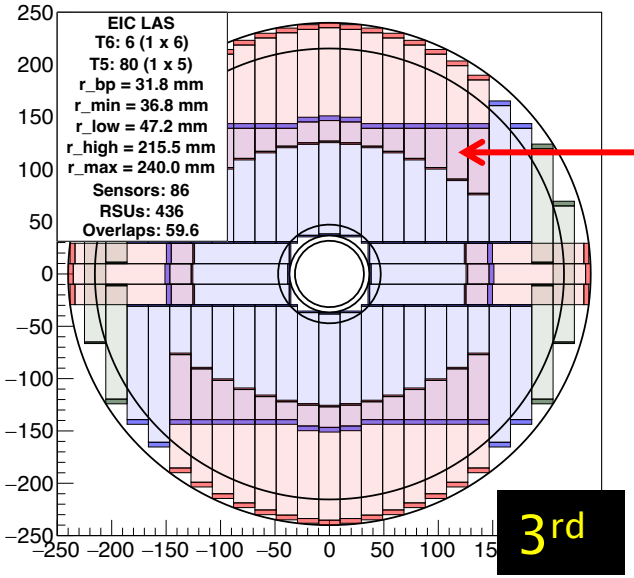




Method #1



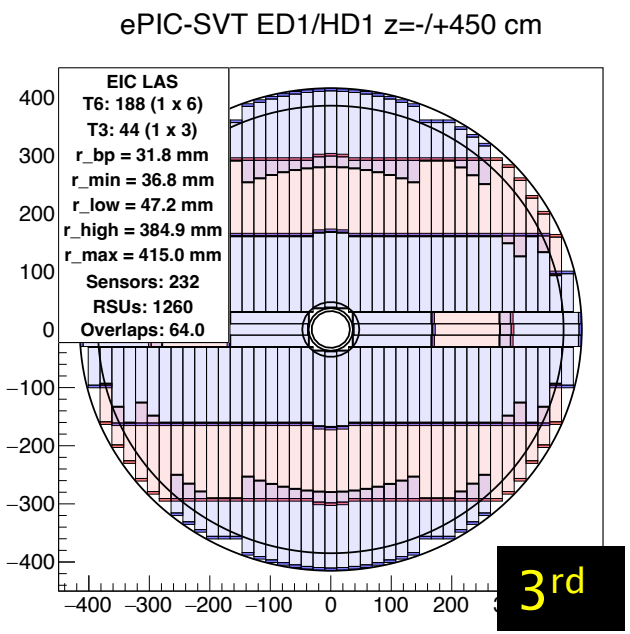


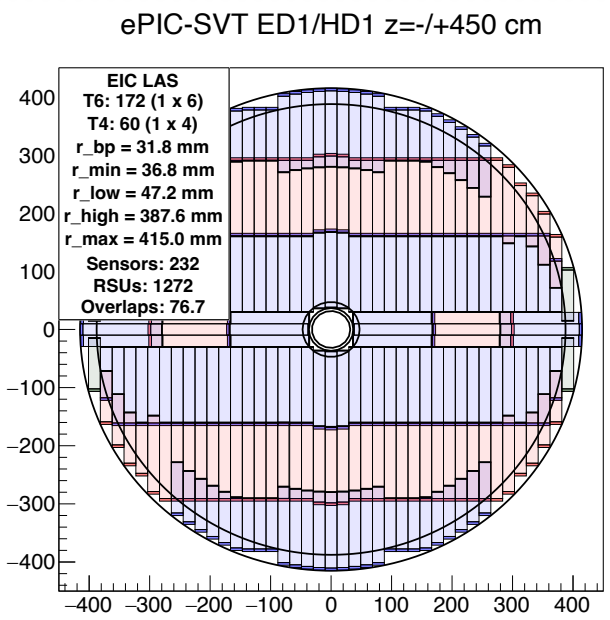


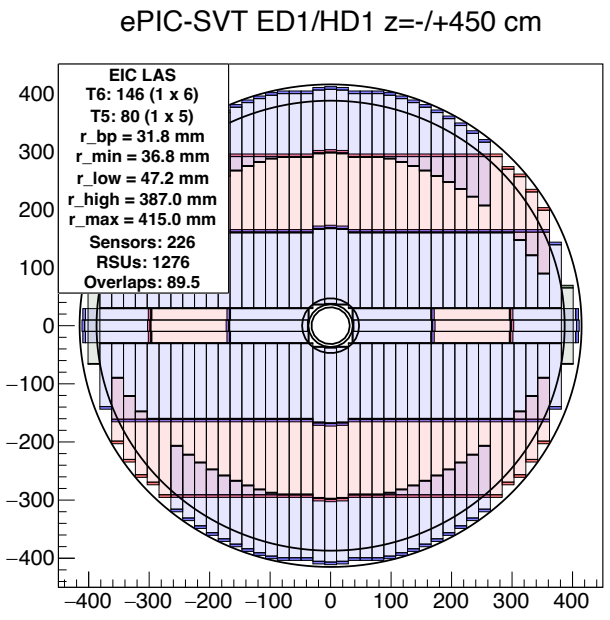
15.8% of active area is composed of overlapping sensors compared to 7.8% with 1x3 sensors

Method #2

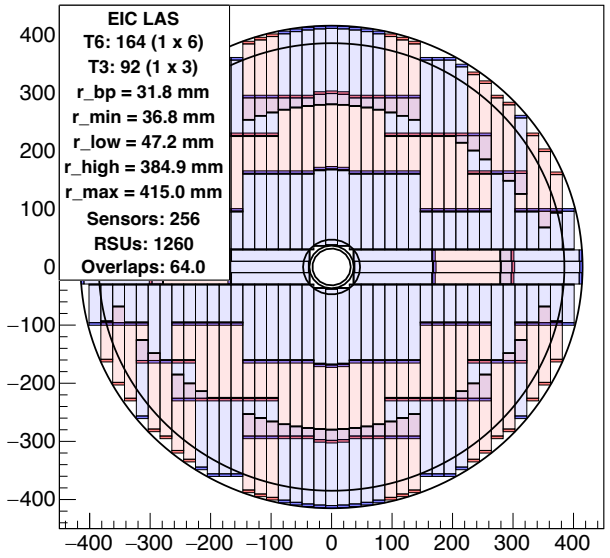
ePIC Disk Layout Studies – Disk 1 (ED1/HD1)

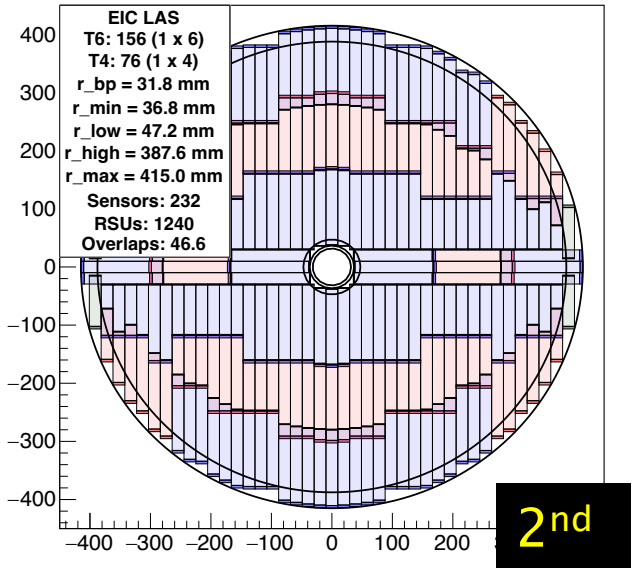


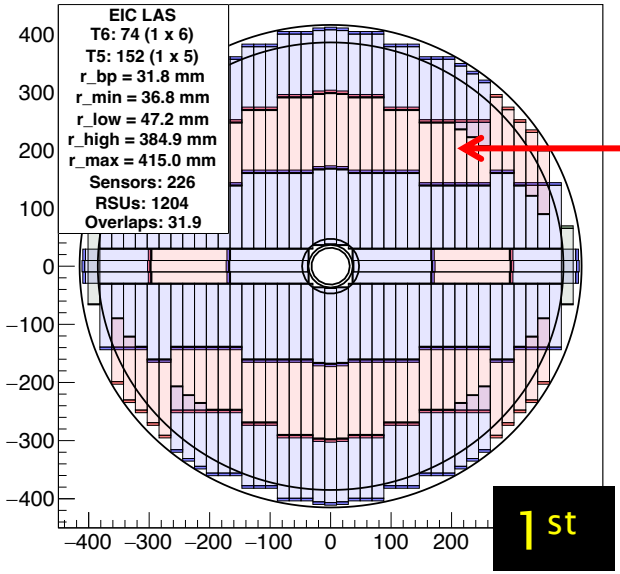




Method #1



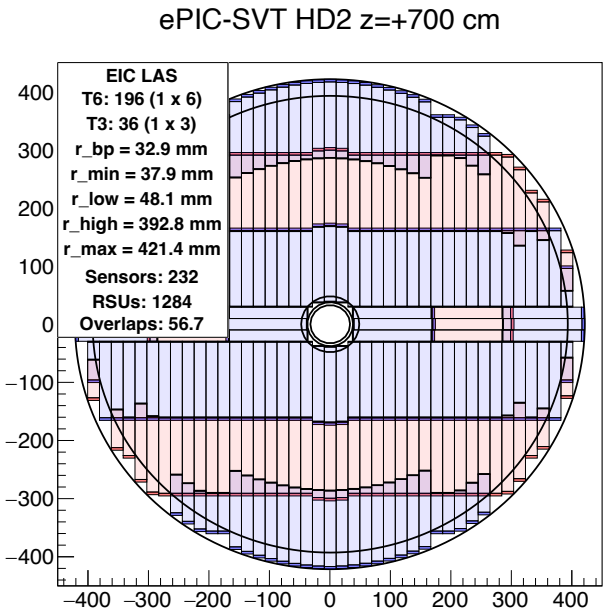


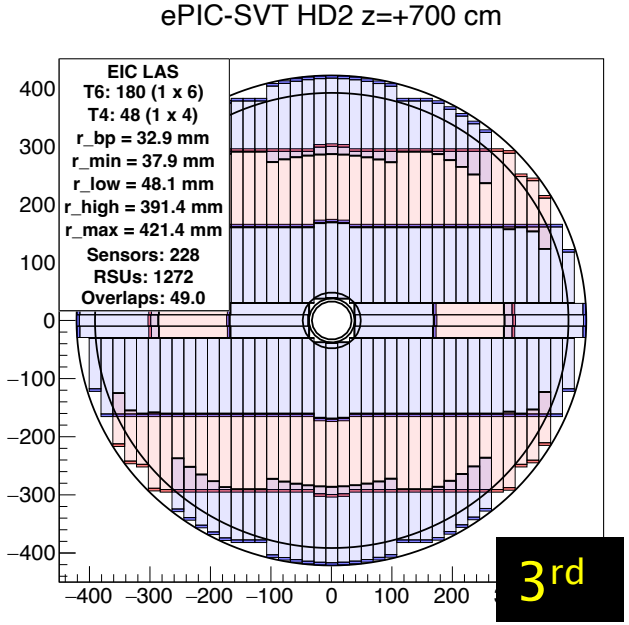


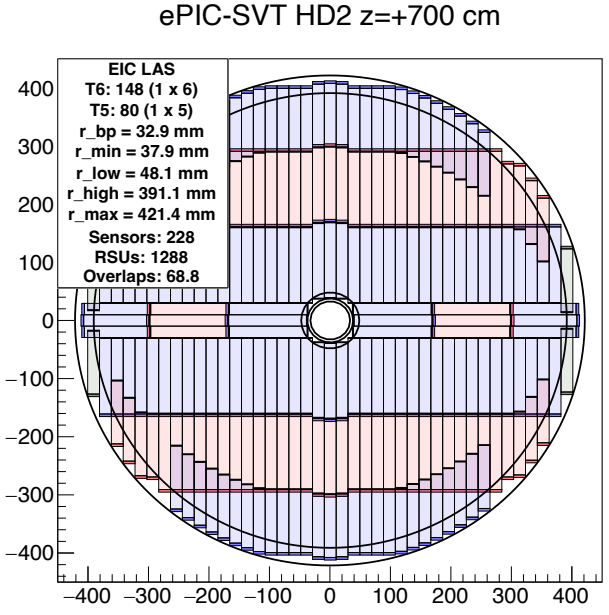
2.7% of active area is composed of overlapping sensors compared to 5.4% with 1x3 sensors

Method #2

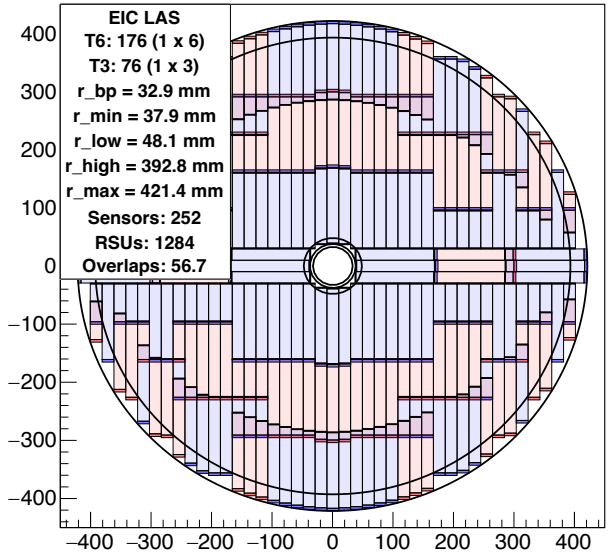
ePIC Disk Layout Studies – Disk 2h (HD2)

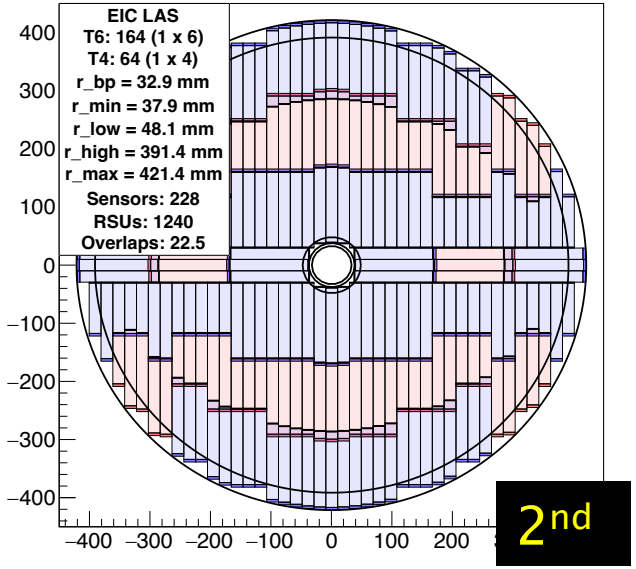


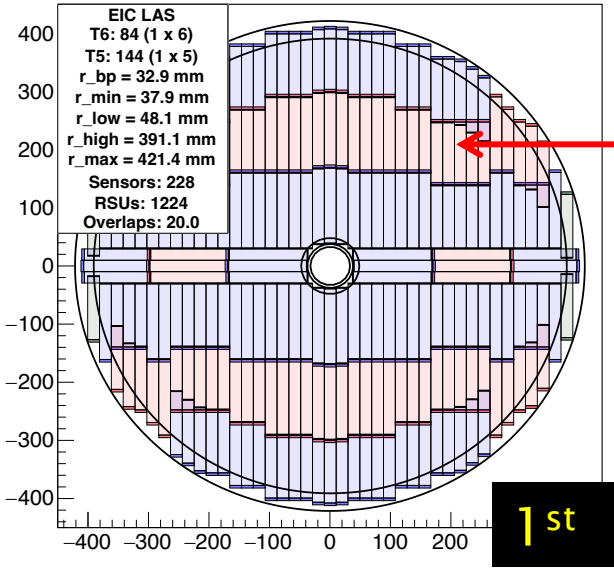




Method #1



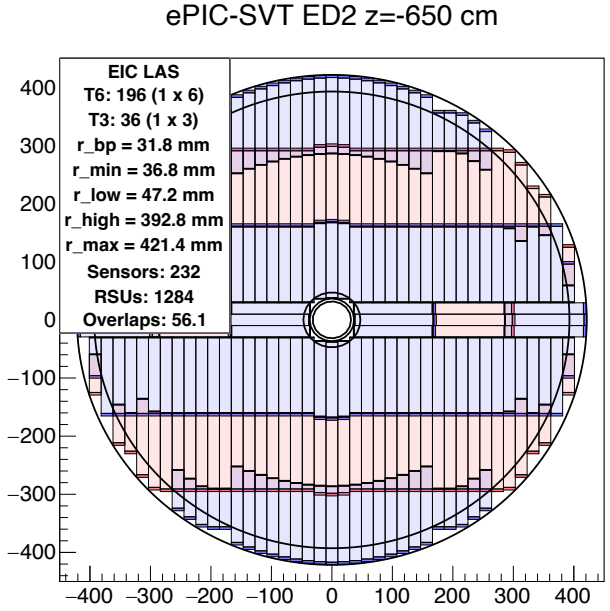


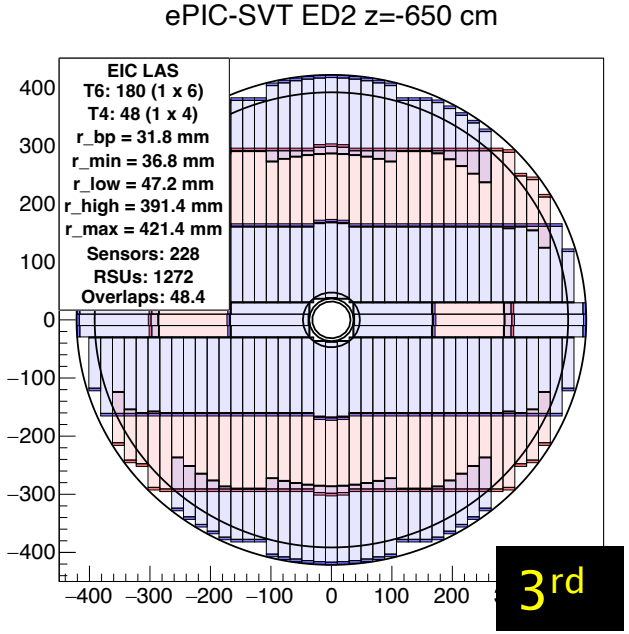


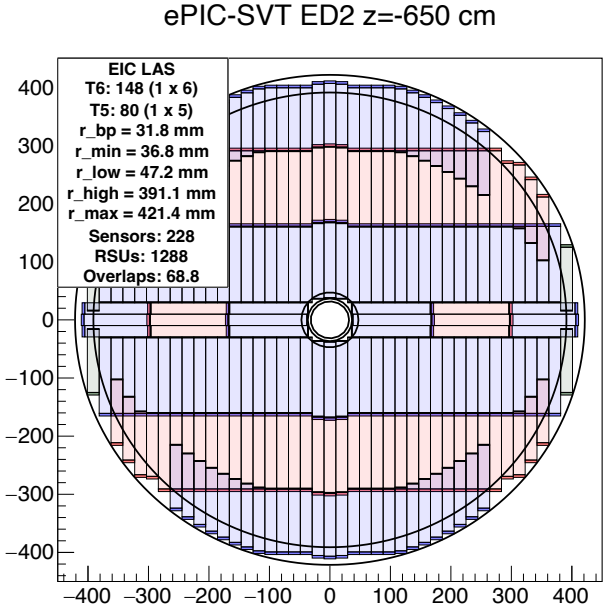
1.7% of active area is composed of overlapping sensors compared to 4.6% with 1x3 sensors

Method #2

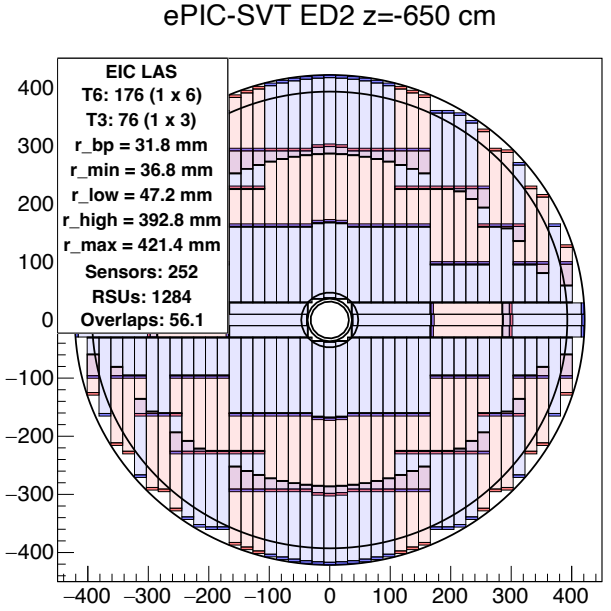
ePIC Disk Layout Studies – Disk 2e (ED2)

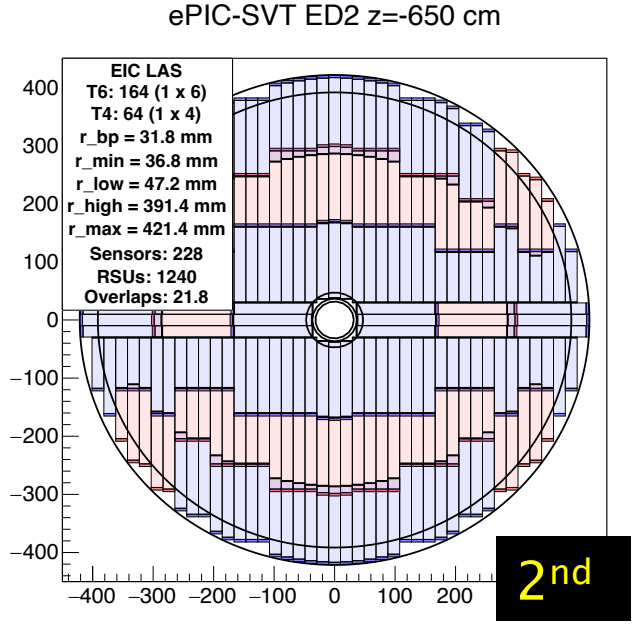


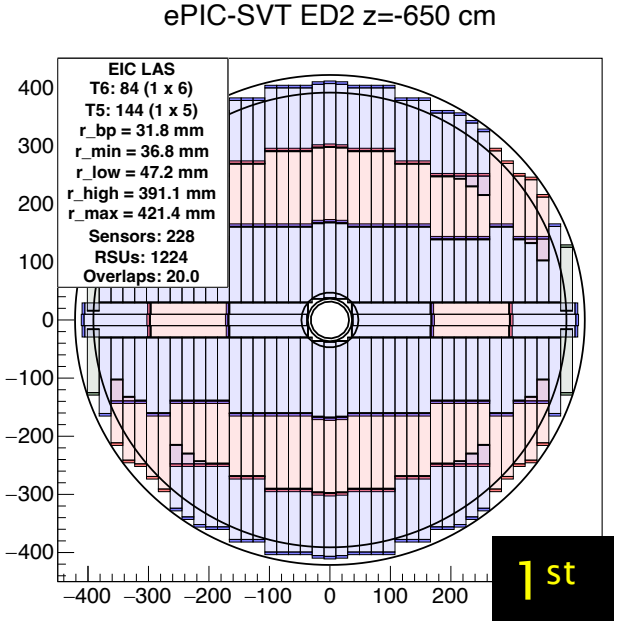




Method #1

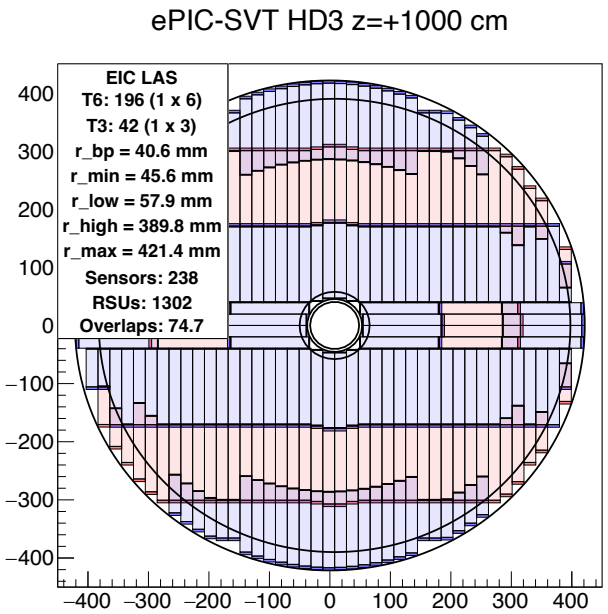


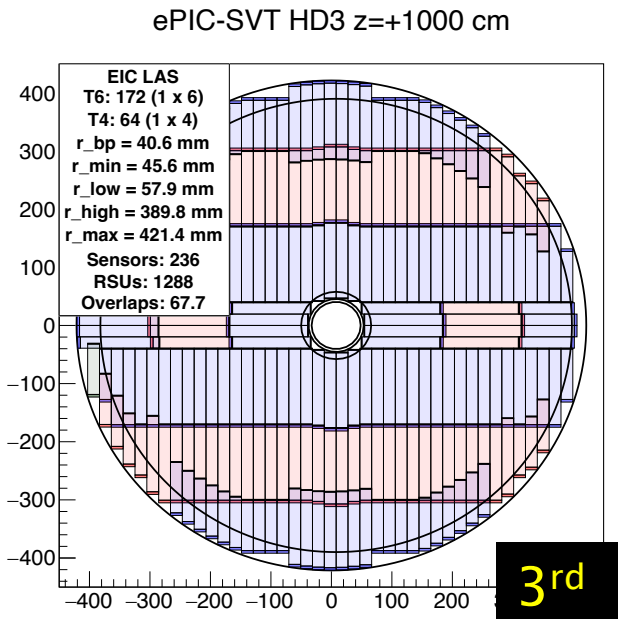


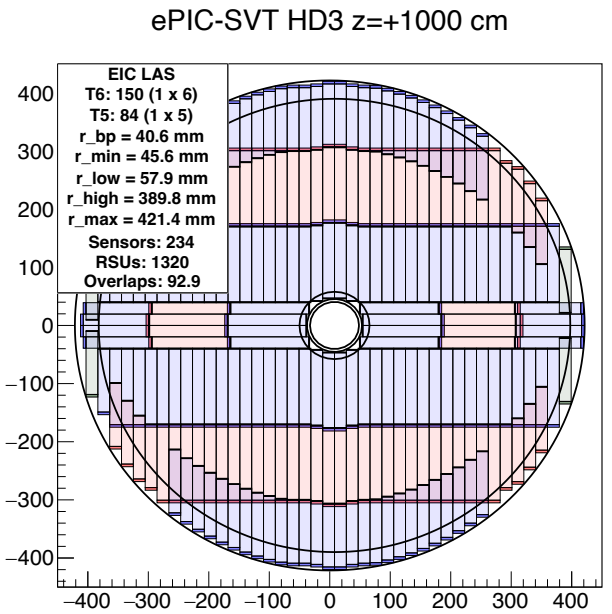


Method #2

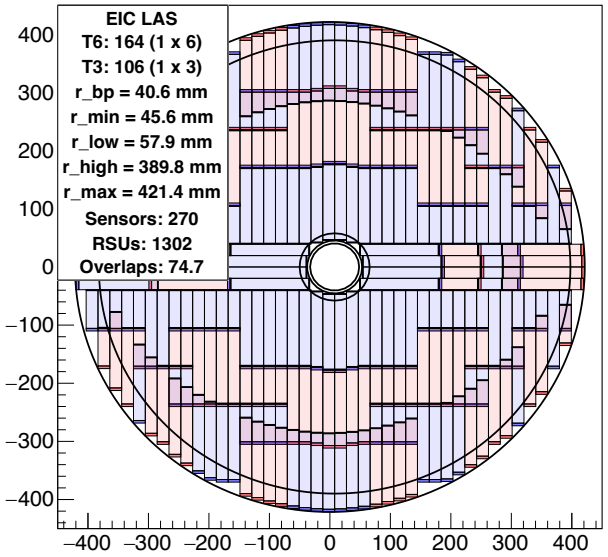
ePIC Disk Layout Studies – Disk 3h (HD3)

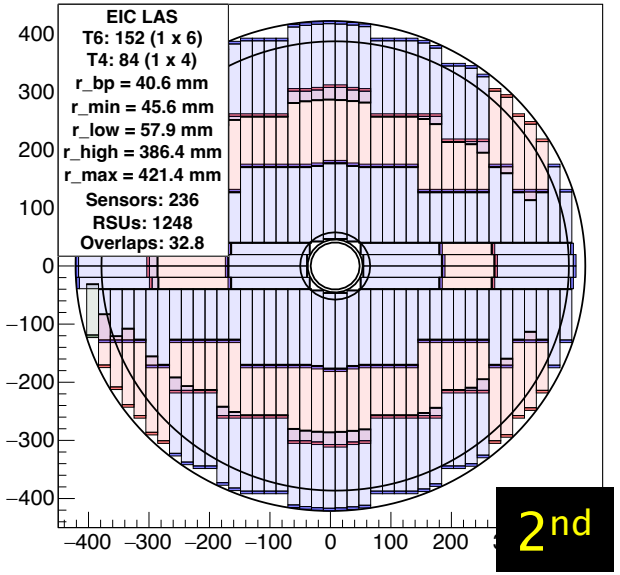


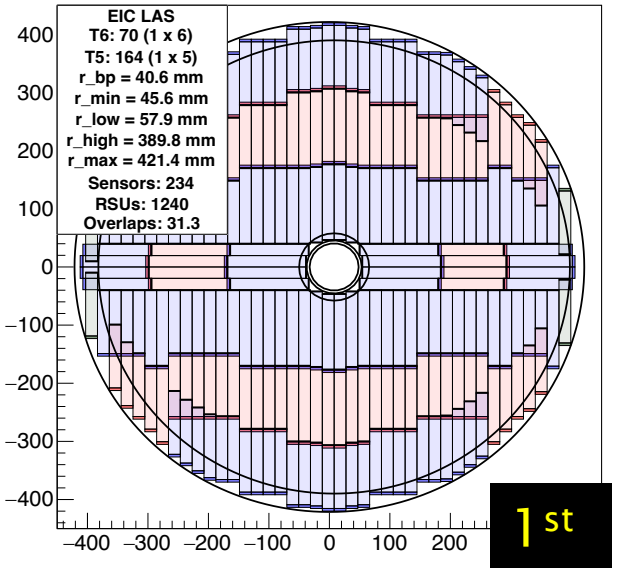




Method #1

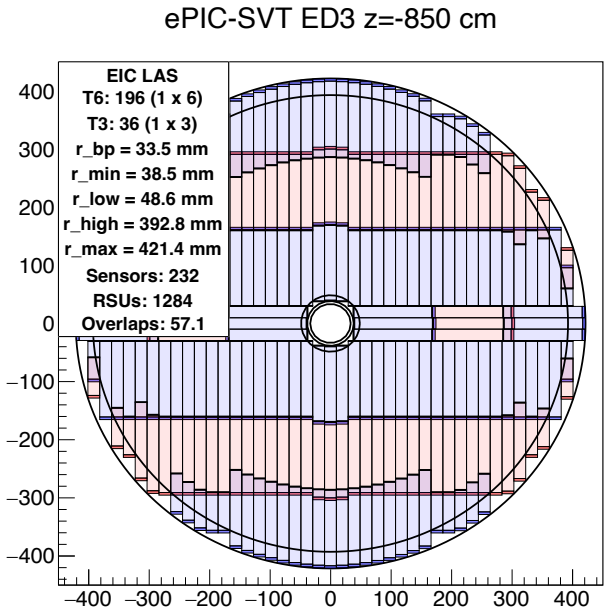


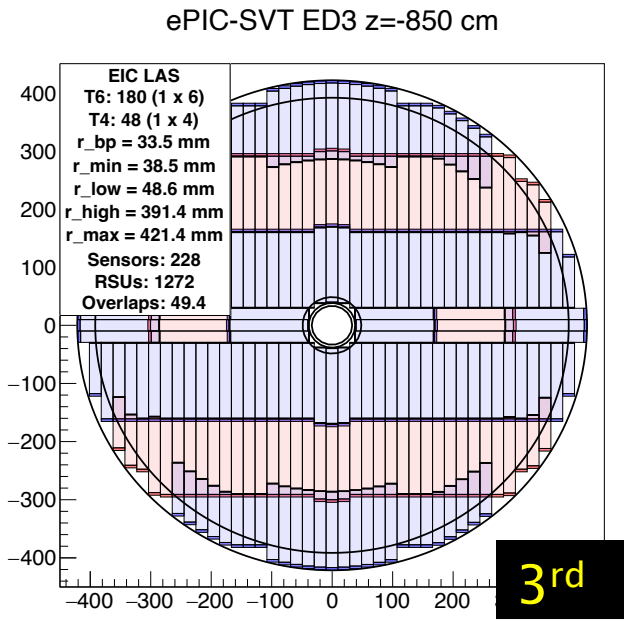


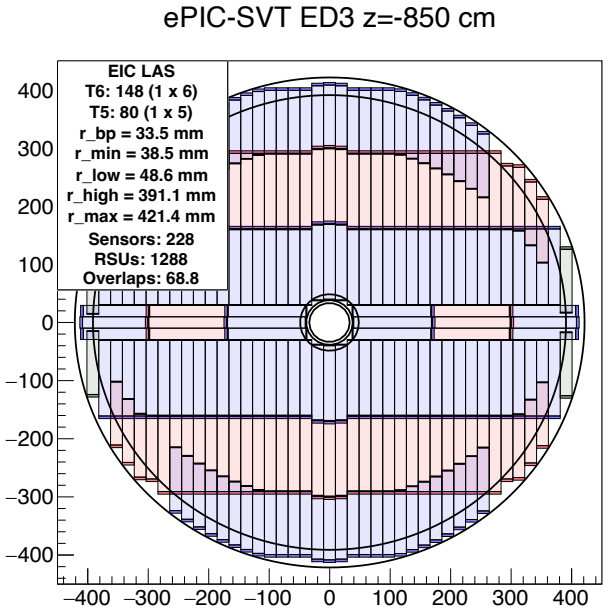


Method #2

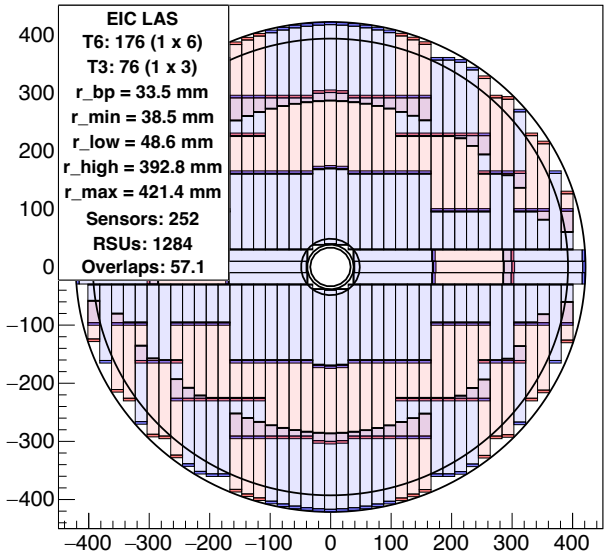
ePIC Disk Layout Studies – Disk 3e (ED3)

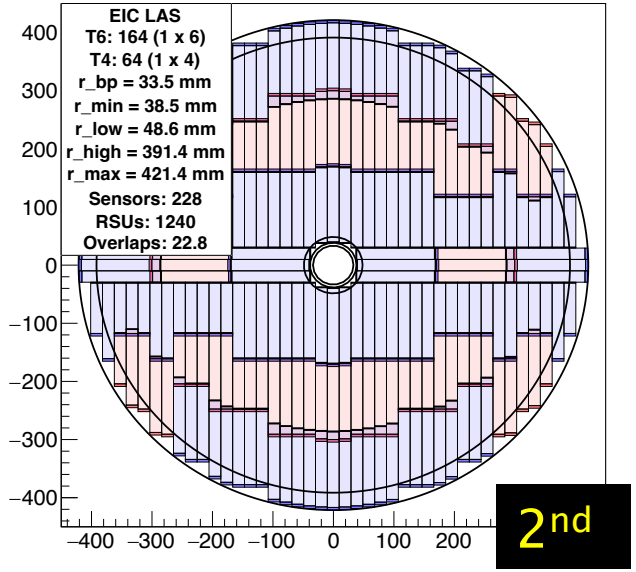


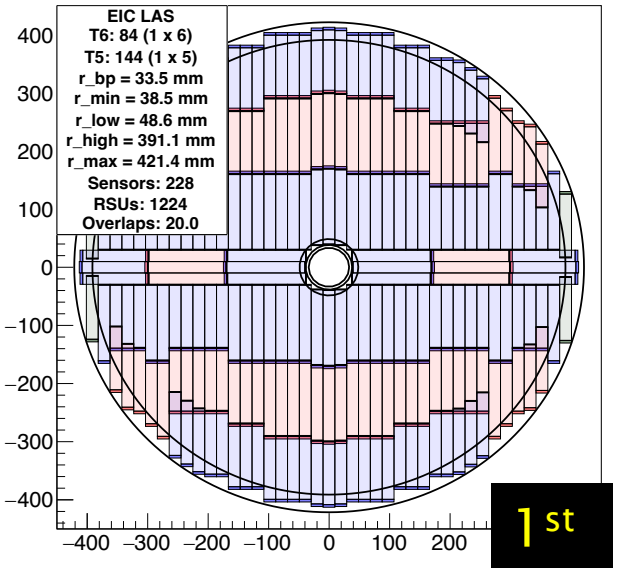




Method #1

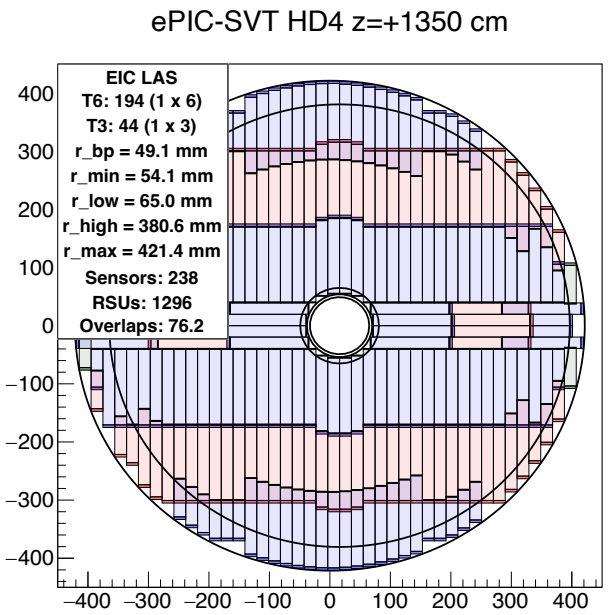


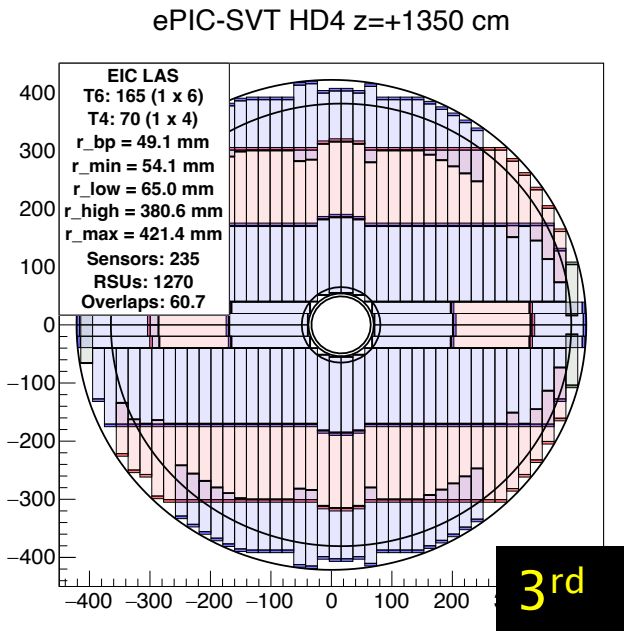


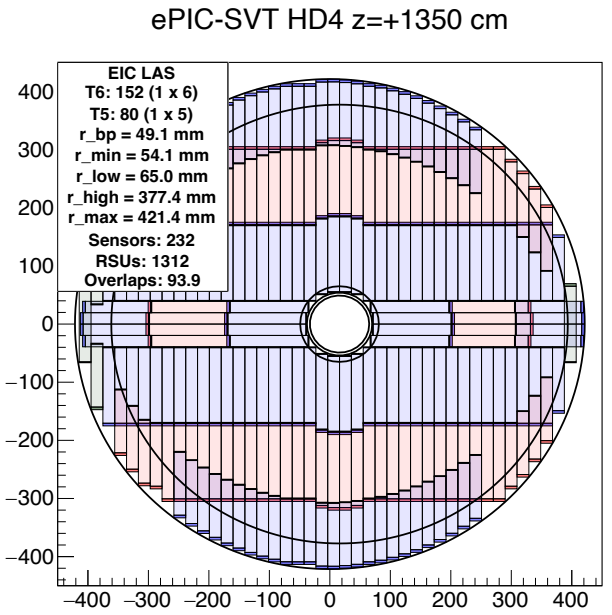


Method #2

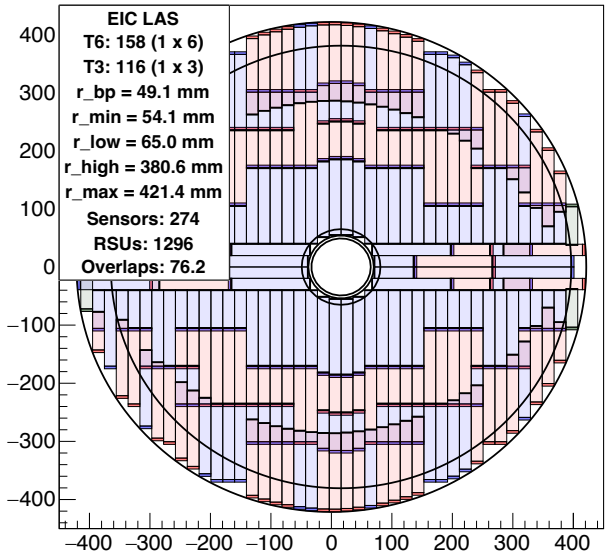
ePIC Disk Layout Studies – Disk 4h (HD4)

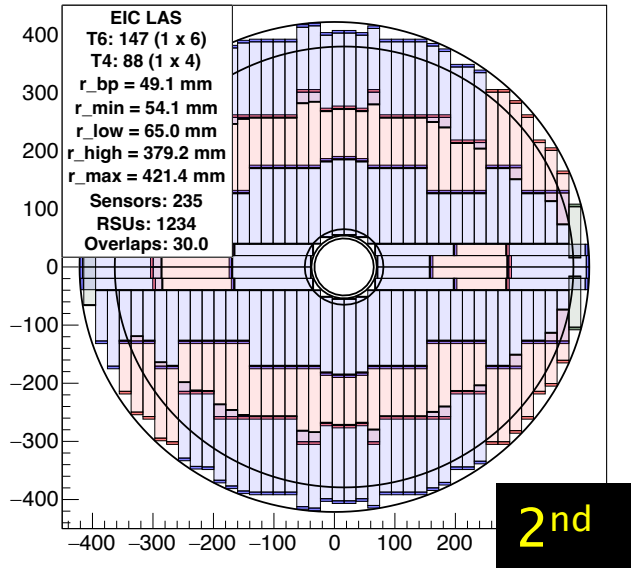


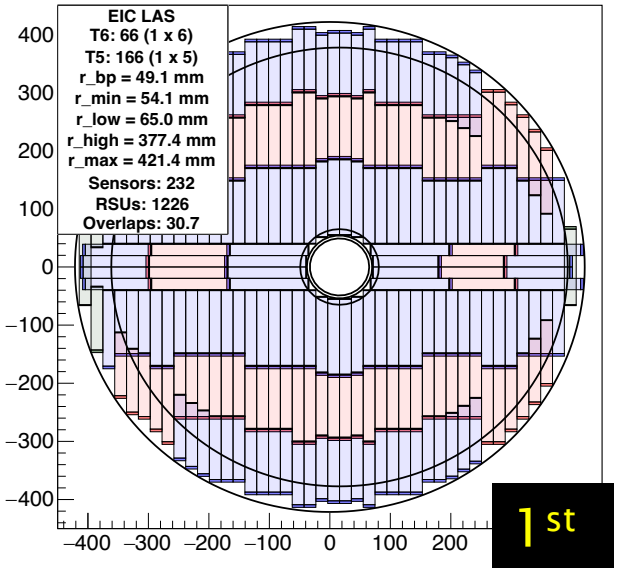




Method #1

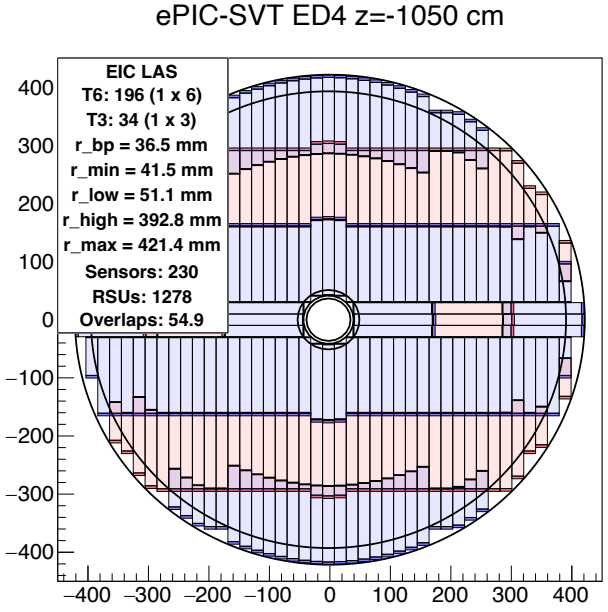


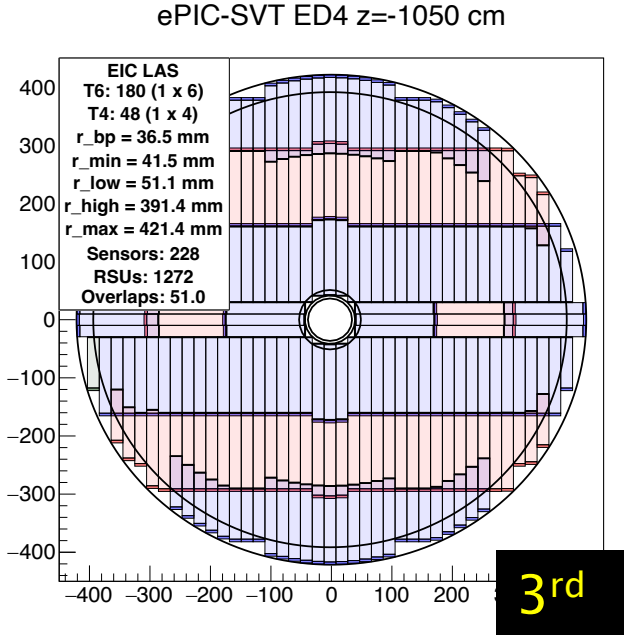


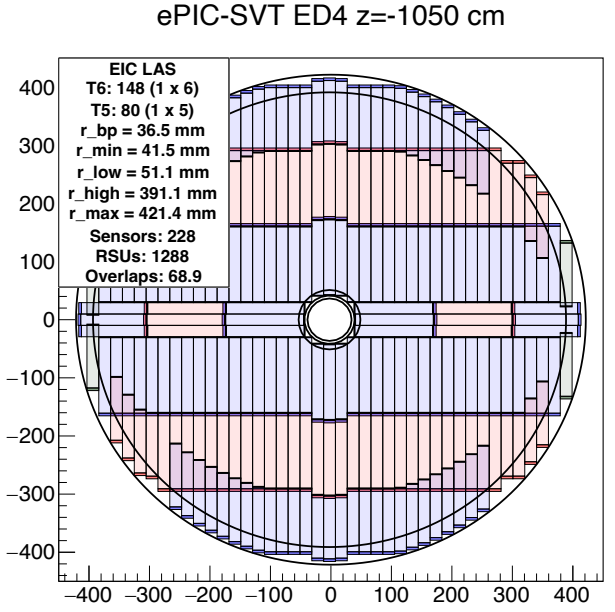


Method #2

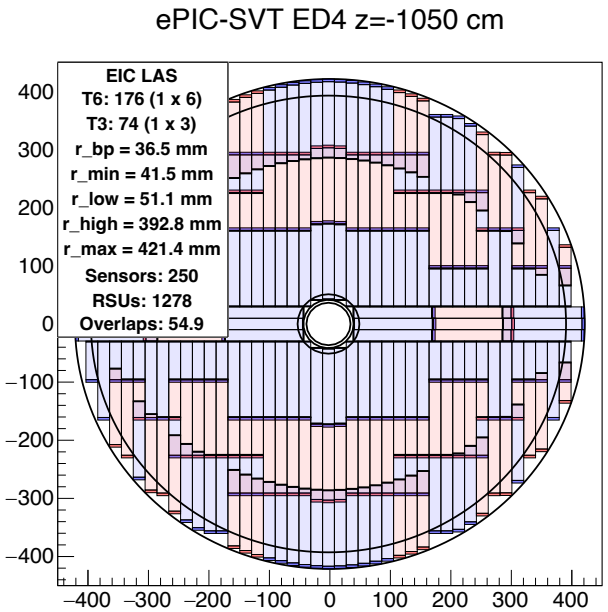
ePIC Disk Layout Studies – Disk 4e (ED4)

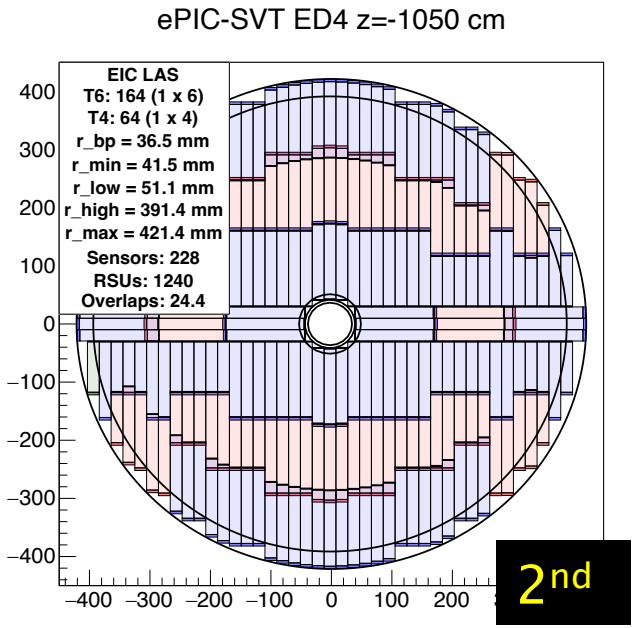


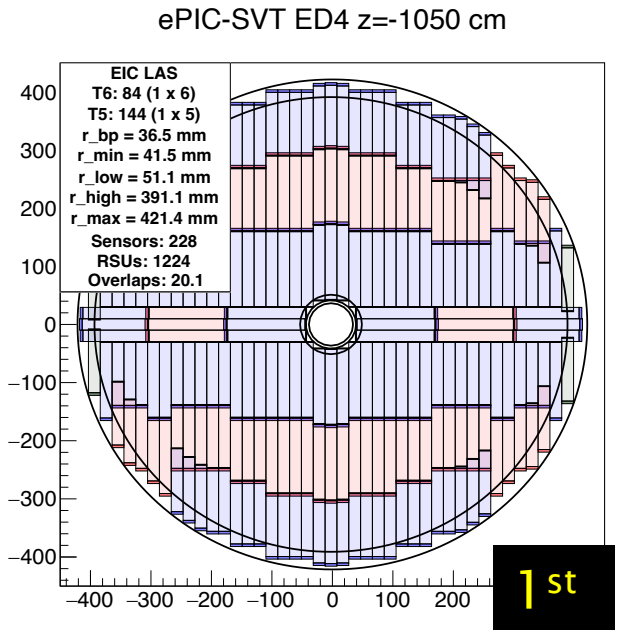




Method #1







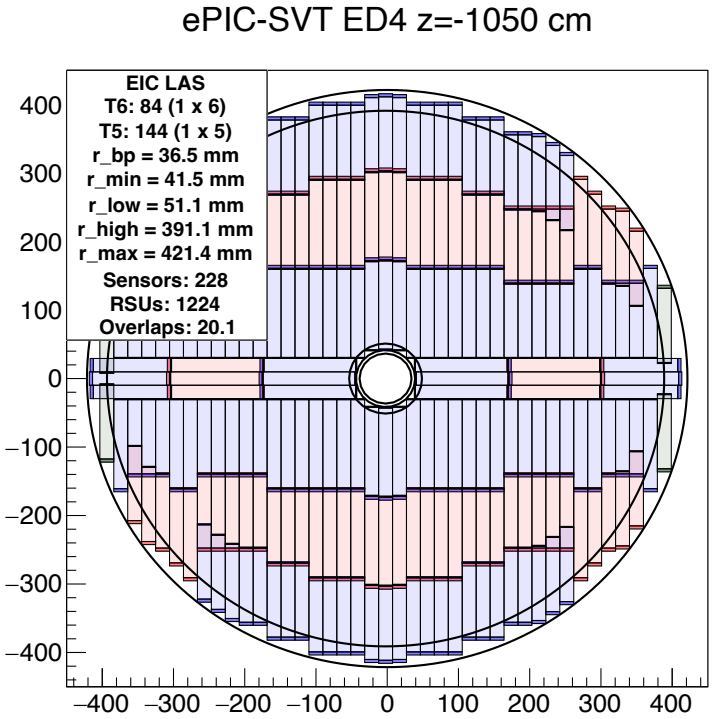
Method #2

Summary and comments

- EIC-LAS sensor variants
  - A combination of 1x6 and 1x5 sensors results in optimal tiling of all but the innermost disks
  - Optimal criteria = fewer sensors and less sensor overlap
  - Method #2 – minimising sensor overlap – provides best solution (not surprising)
  - Approximately twice the number of 1x5 sensors required compared to 1x6 sensors

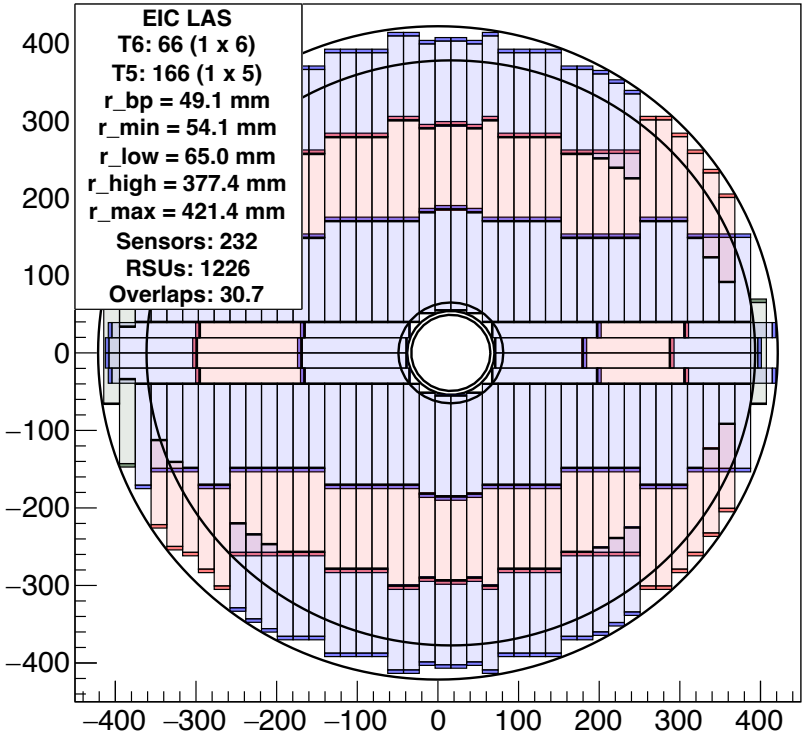
- Comments
  - Calculated overlaps are in units of RSUs and do not include endcaps
  - Pixel matrix is 91.7% of RSU in current design (approx. 8% dead area)

- Questions
  - Is tiling sensors on both sides of the disk practical?
  - Is the location of endcaps optimal for bringing in services?
  - Can an offset central aperture be accommodated?

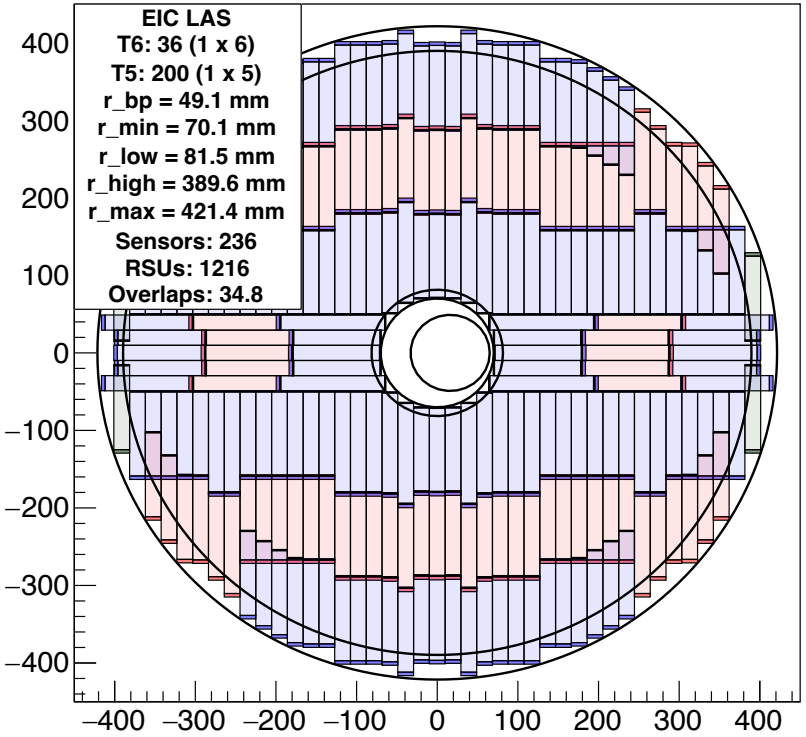


Offset opening compared to central opening – Disk 4h (HD4)

ePIC-SVT HD4 z=+1350 cm

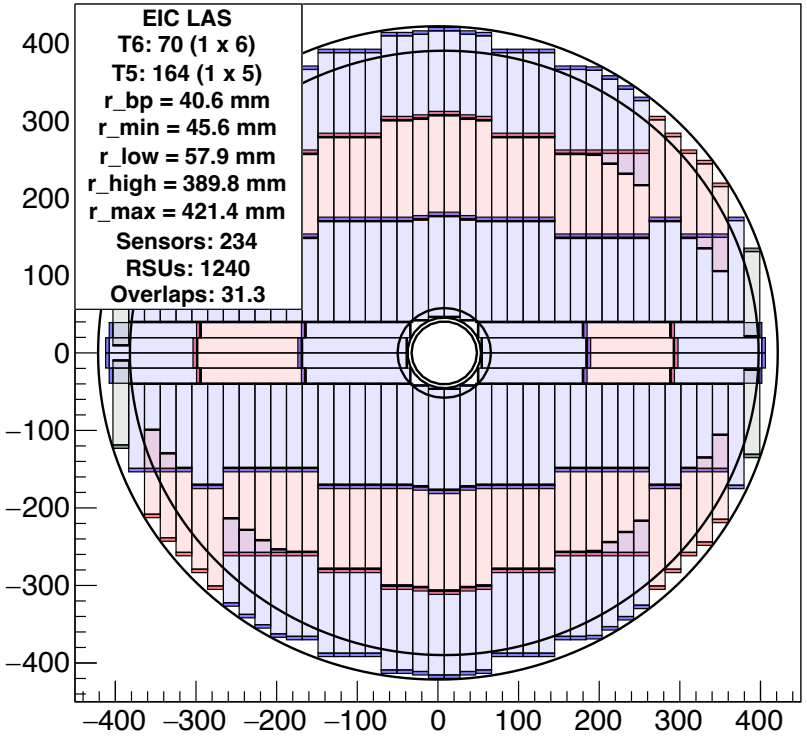


ePIC-SVT HD4 z=+1350 cm

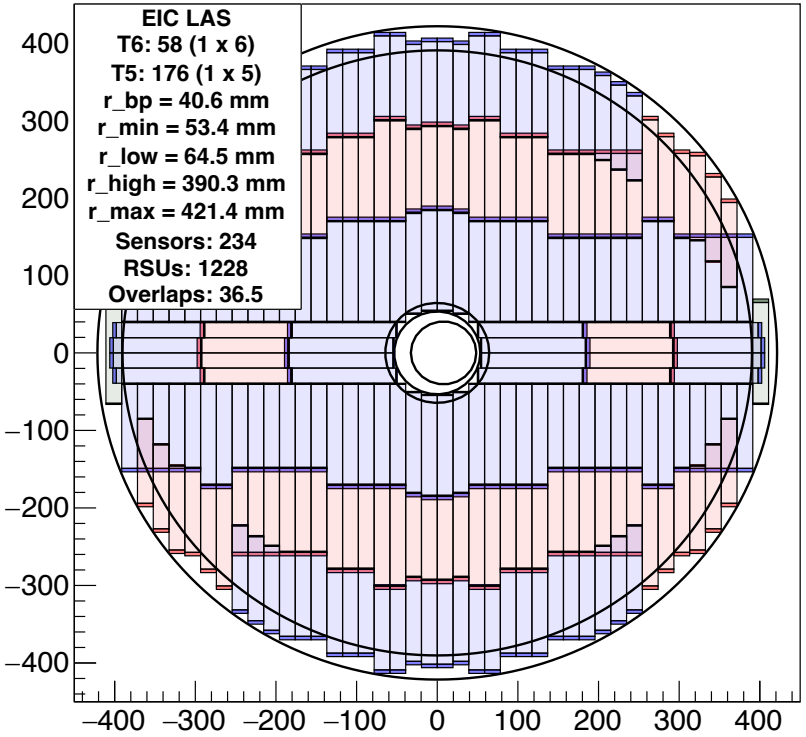


Offset opening compared to central opening – Disk 3h (HD3)

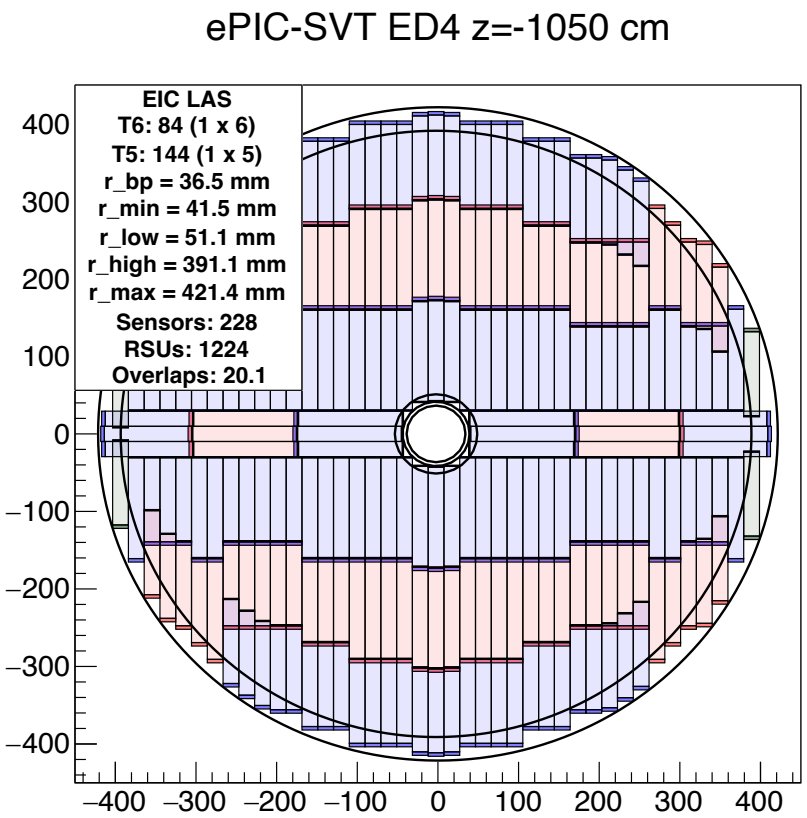
ePIC-SVT HD3 z=+1000 cm

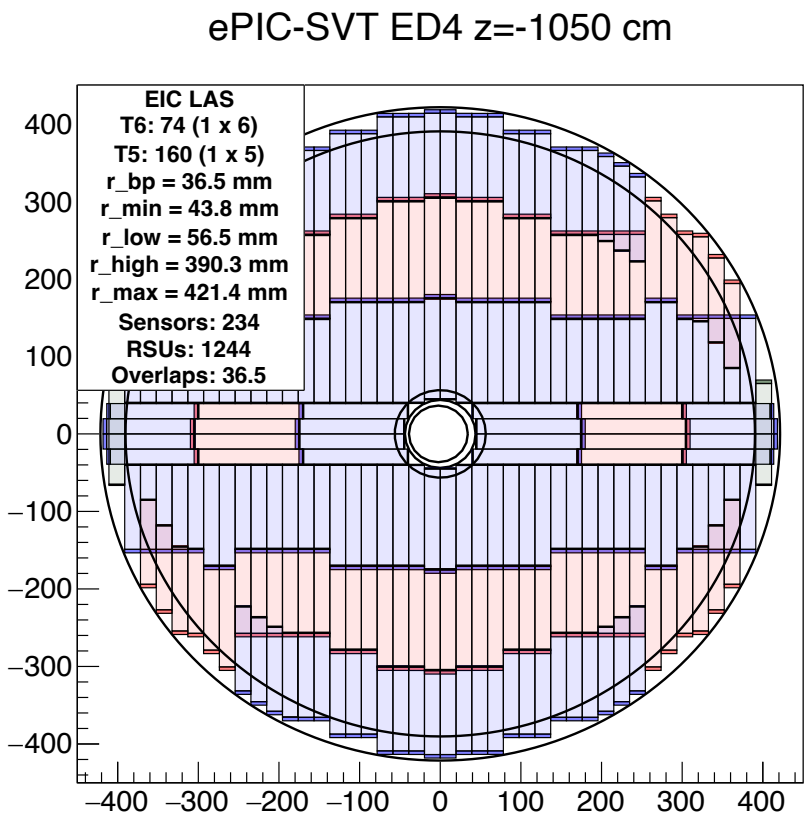


ePIC-SVT HD3 z=+1000 cm



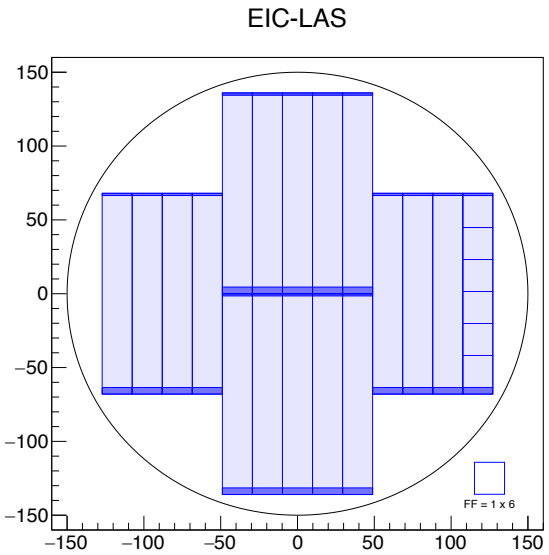
Offset opening compared to central opening – Disk 4e (ED4)



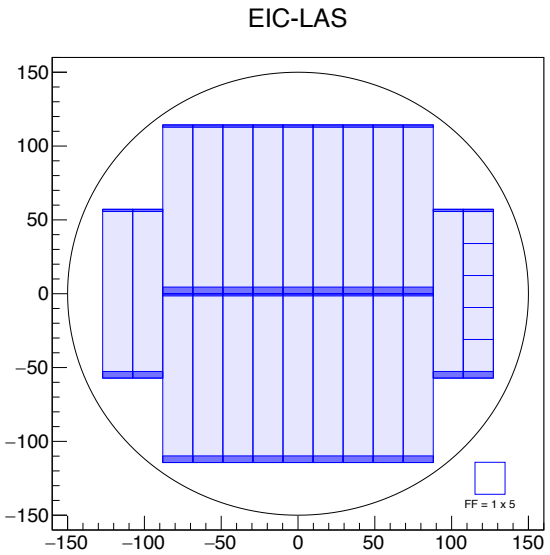


EIC-LAS Sensor Variants

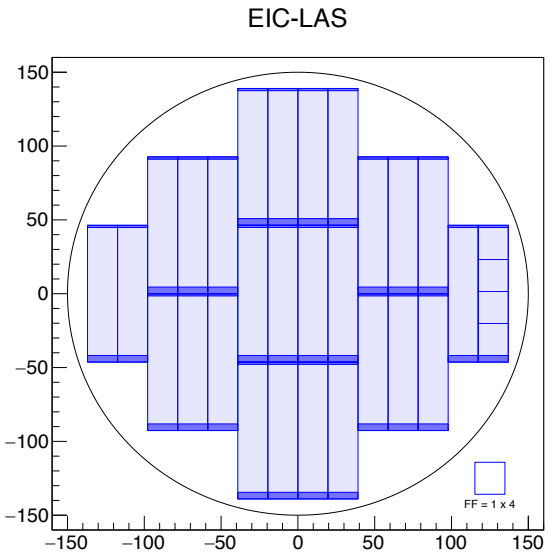
- Sensor layout on wafer (<u>one</u> sensor variant per wafer)



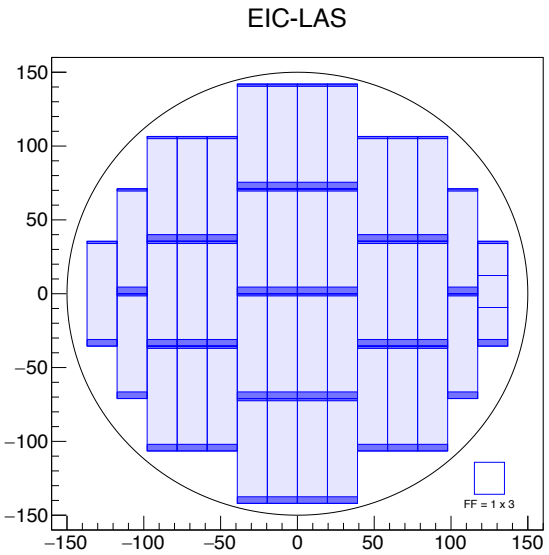
1x6 LAS
18 sensors
108 RSUs



1x5 LAS
22 sensors
110 RSUs



1x4 LAS
28 sensors
112 RSUs



1x3 LAS
40 sensors
120 RSUs

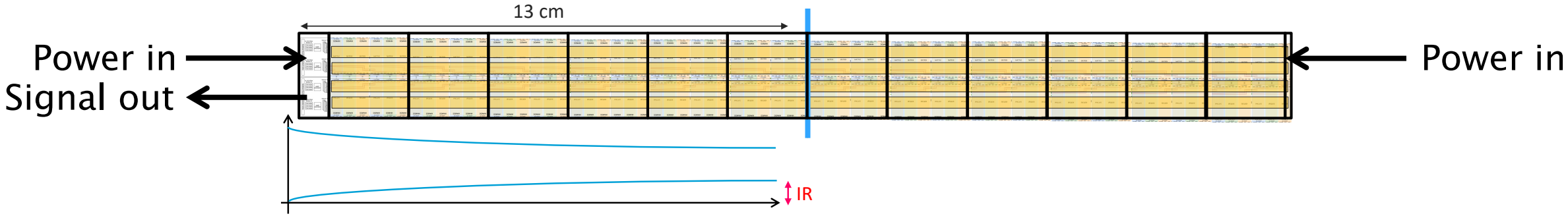
ITS3 – Stitched Sensor

- Sensor length considerations for Outer Barrel and Endcaps

  Concern over IR drop over the length of the stitched sensor

  Mitigation is to supply power from both ends of the sensor; readout at one end

  Need to allow for endcaps (periphery) at both ends (4.5 mm and 1.5 mm, respectively)



If we restrict the EIC LAS to a maximum of 6 RSUs, it should be possible to power from one end only