CEPC Silicon Tracker Progress Report (8)

Qi Yan *on behalf of the Silicon Tracker Group*

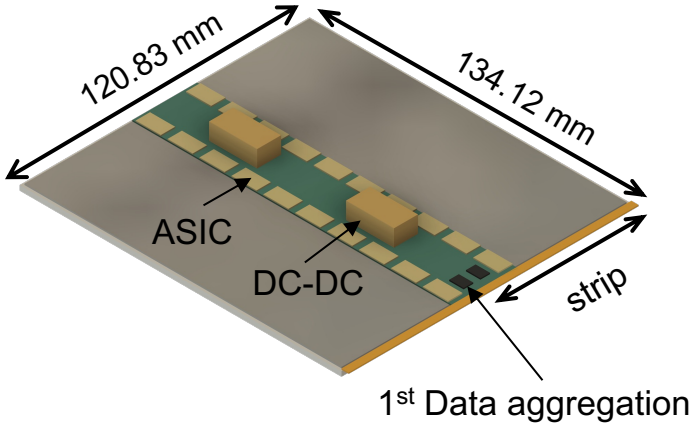
Sep 24, 2024, IHEP

Change of OTK Sensor Power Supply Plan

The power consumption of one OTK sensor: 20mW/channel×1280 channel=25.6 W
Given that the low voltage (LV) is 1.2 V, the current will be ~21 A.
To keep the voltage drop below 0.1 V, the resistance of the pow cable must be 0.005 Ω

Considering the thickness of power cable in the FPC is 35 μm, and the length of 1 m, and using Cu with resistivity of 1.75×10^{-8} Ω ·m, the width of FPC power cable must be >10 cm, which is not acceptable!

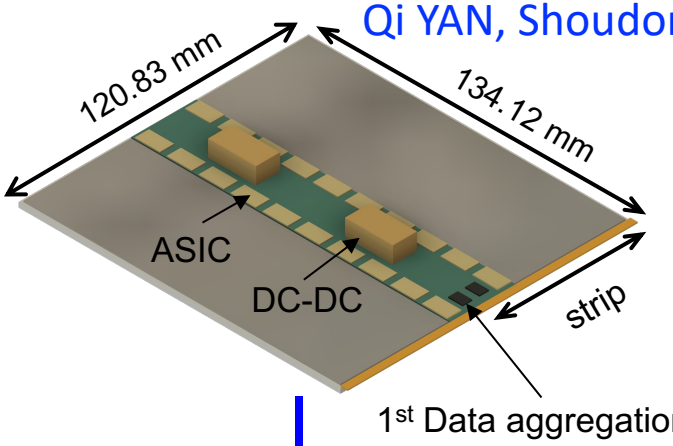
In view all the above, transmitting LV through FPC is not feasible. DC-DC converter must be distributed to each sensor.

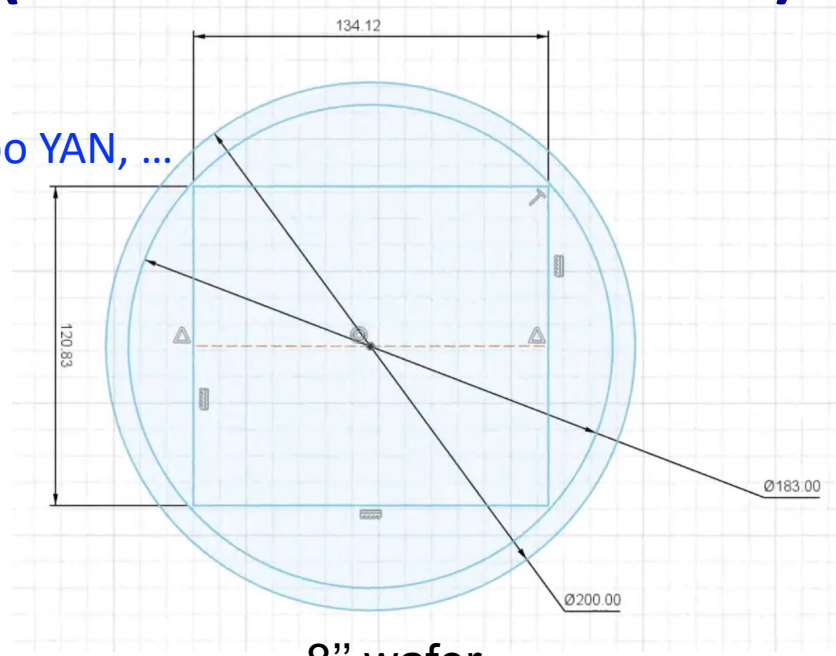


OTK Barrel New Design Plan 1 (One Sensor Per Wafer)

Sensor (2 sub-sensors)

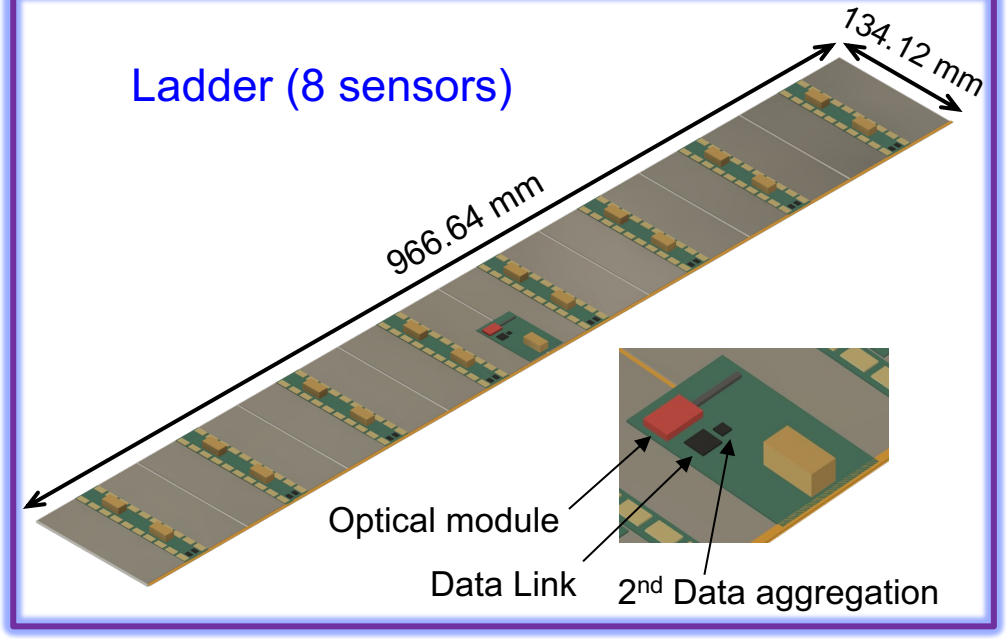
Qi YAN, Shoudong LUO, Xiongbo YAN, …





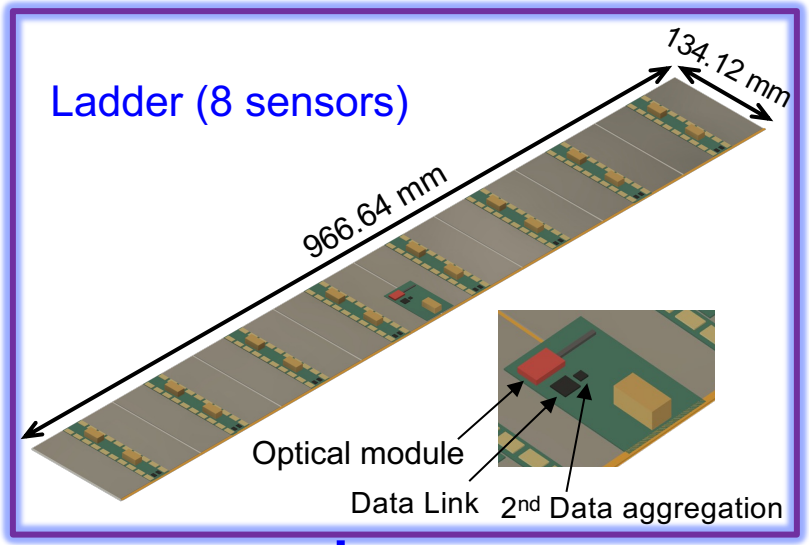
8” wafer

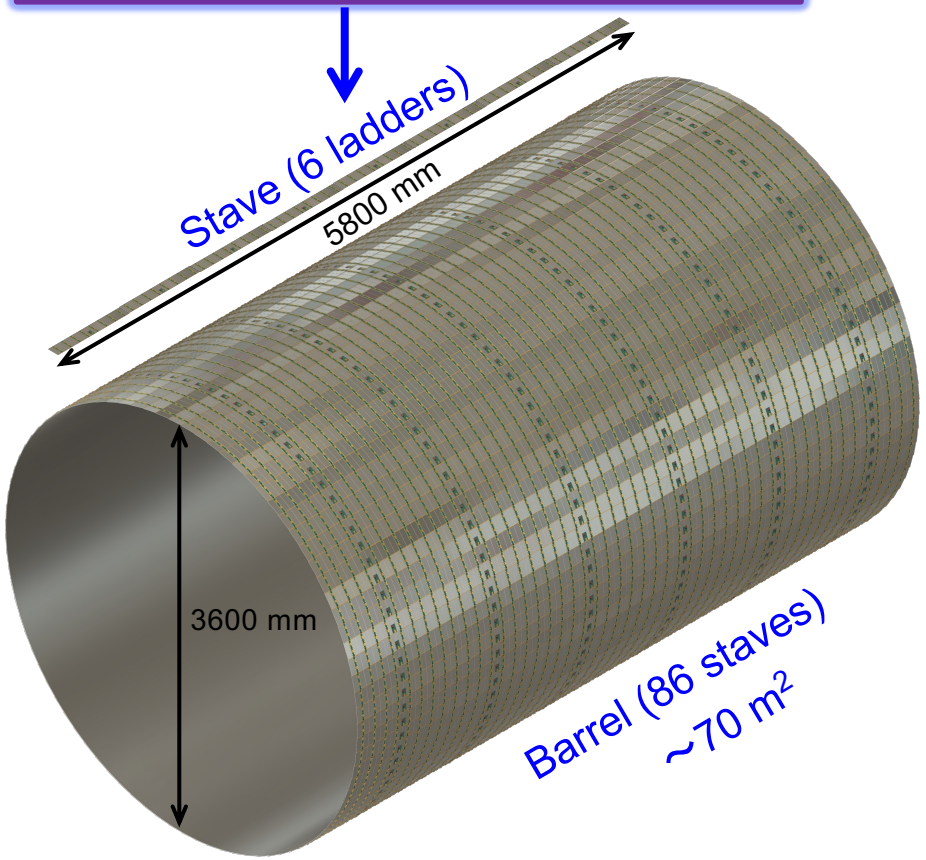
Ladder (8 sensors)



OTK barrel AC-LGAD sensors:

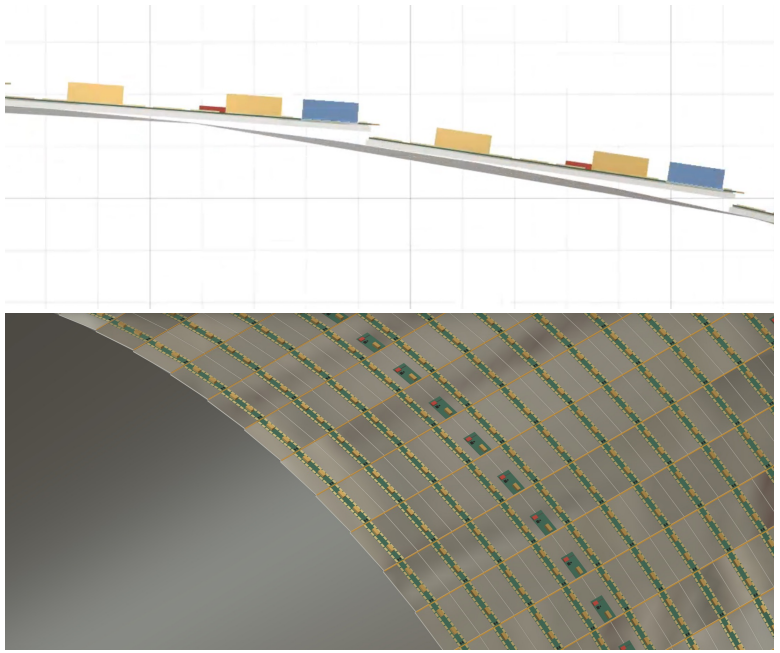
- Sensor size (physical): 13.412 cm × 12.083 cm
- Sensor size (redout): 13.412 cm × 6.0415 cm
- Strip number per sensor: 1280
- Strip pitch size: 104 µm
- Spatial resolution: 10 µm





OTK barrel AC-LGAD:

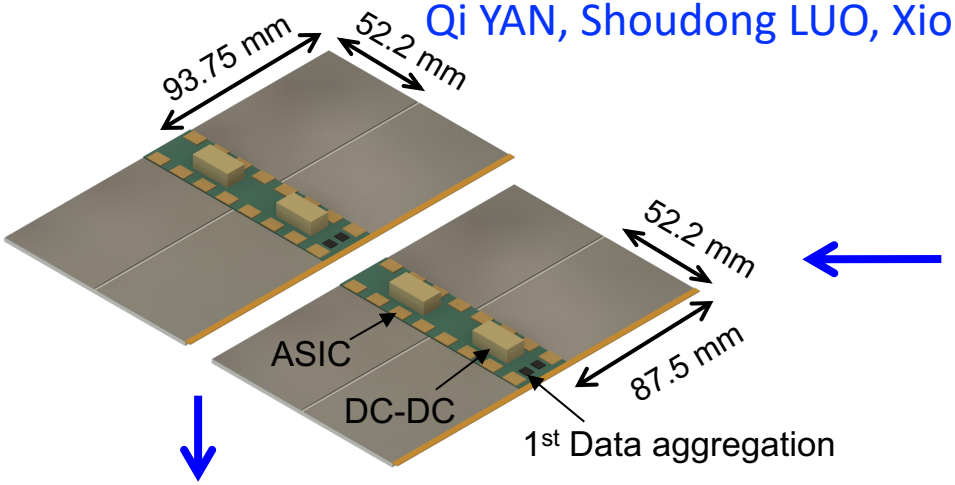
- Sensors per ladder (physical): 8
- Sensors per ladder (redout): 16
- Ladders per stave: 6
- Staves: 86
- Wafer total number: 4128

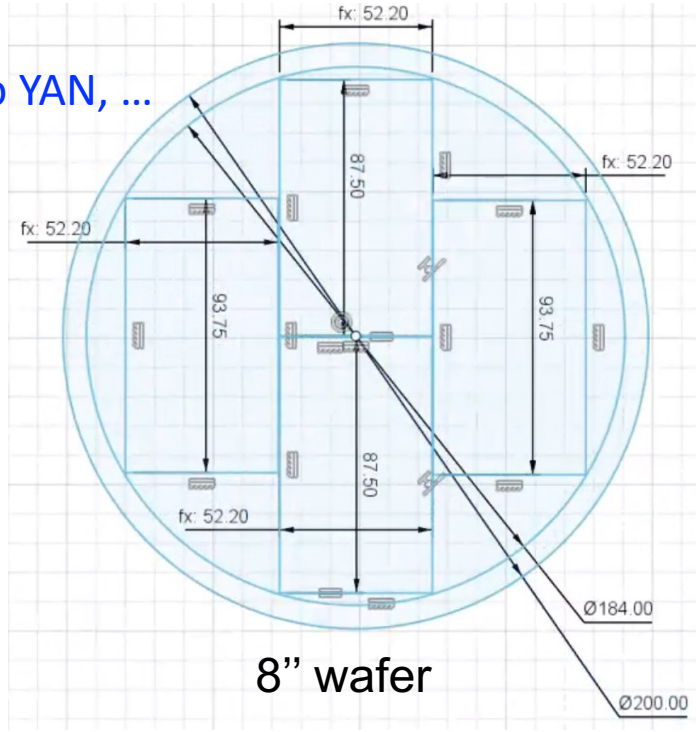


OTK Barrel New Design Plan 2 (Minimal Wafer Usage)

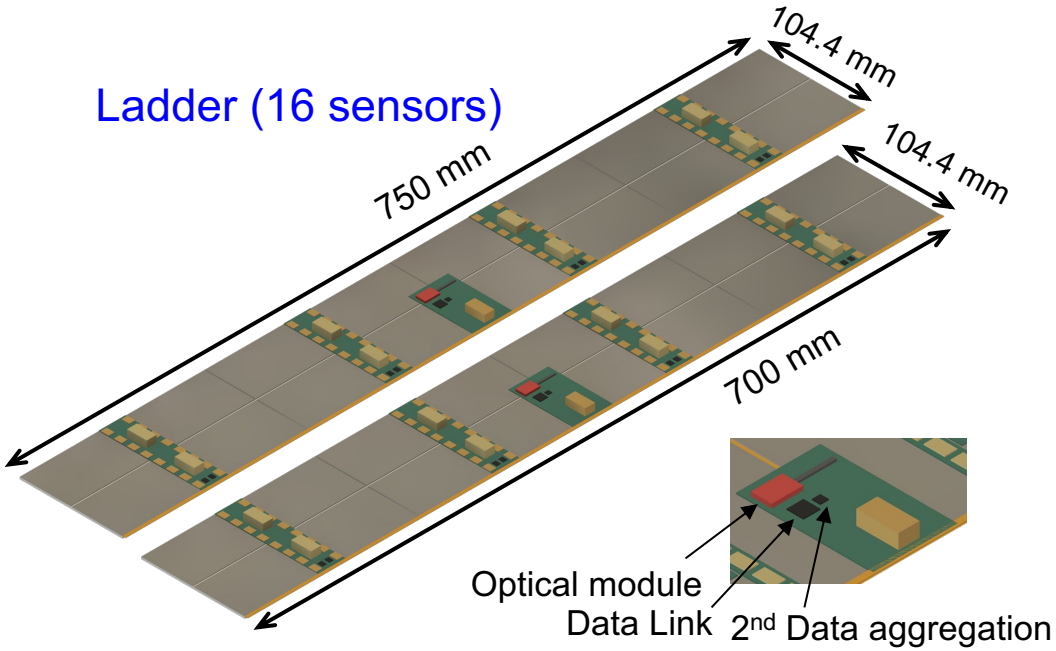
Module (2×2 sensors)

Qi YAN, Shoudong LUO, Xiongbo YAN, …



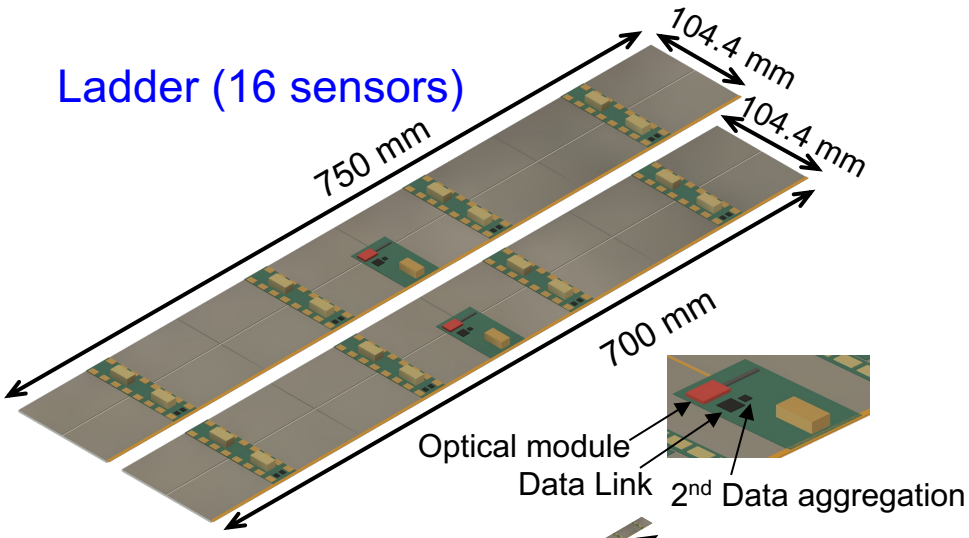


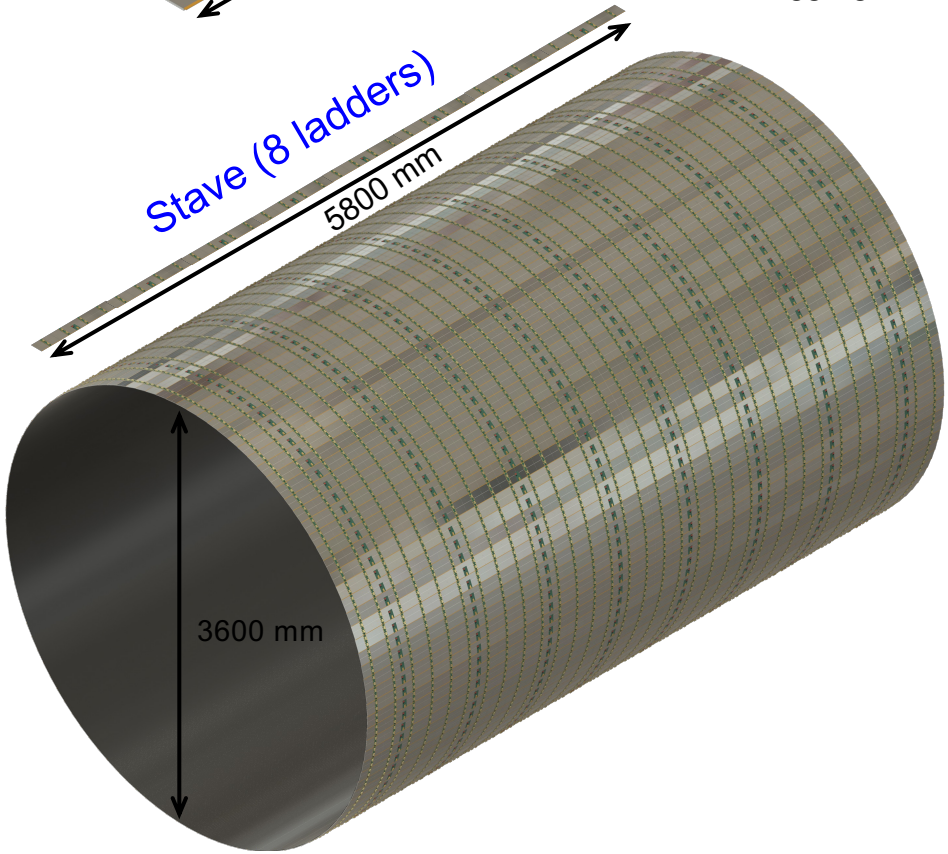
Ladder (16 sensors)



OTK barrel AC-LGAD sensors:

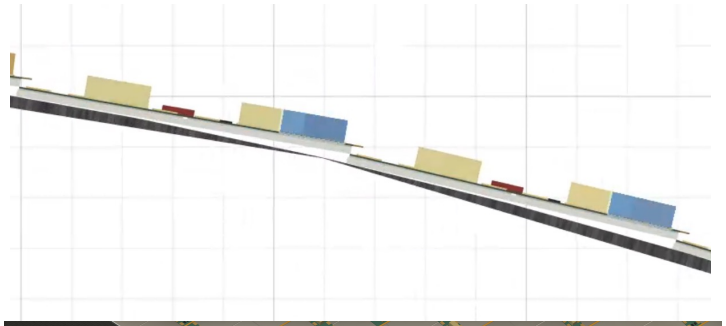
- Sensor size: 9.375 cm × 5.22 cm
  8.75 cm × 5.22 cm
- Strip number per sensor: 512
- Strip pitch size: 100 μm
- Spatial resolution: 10 μm

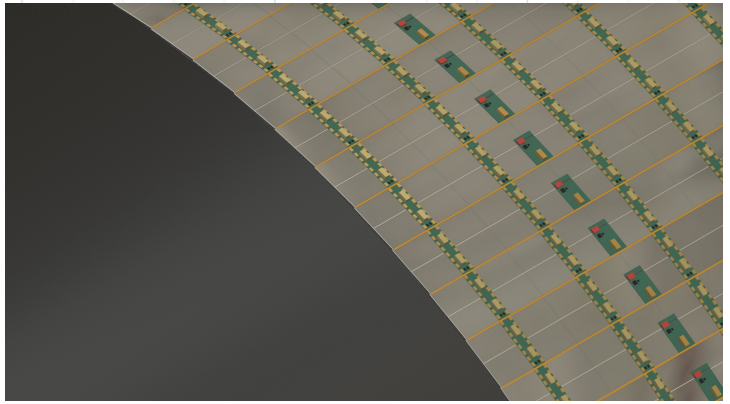




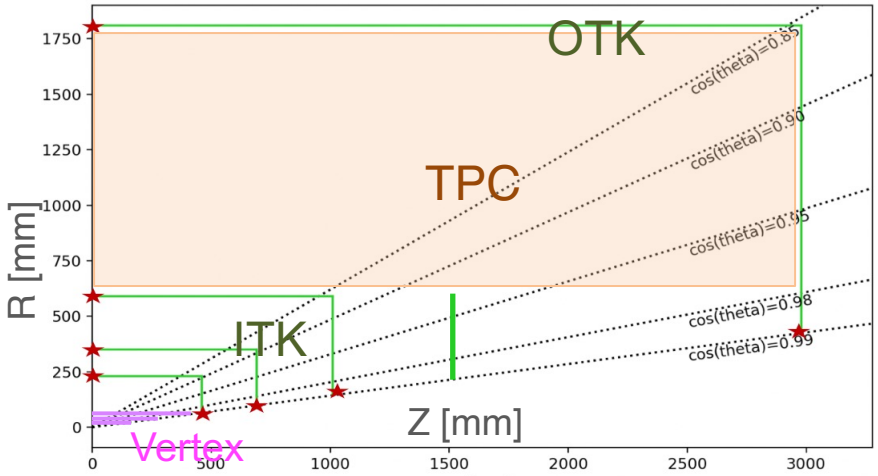
OTK barrel AC-LGAD:

- Sensors per ladder: 16
- Ladders per stave: 8
  (4 short@middle +4 long@edge)
- Staves: 110
- Wafer total number: 3520
  (85% compared with Plan 1)



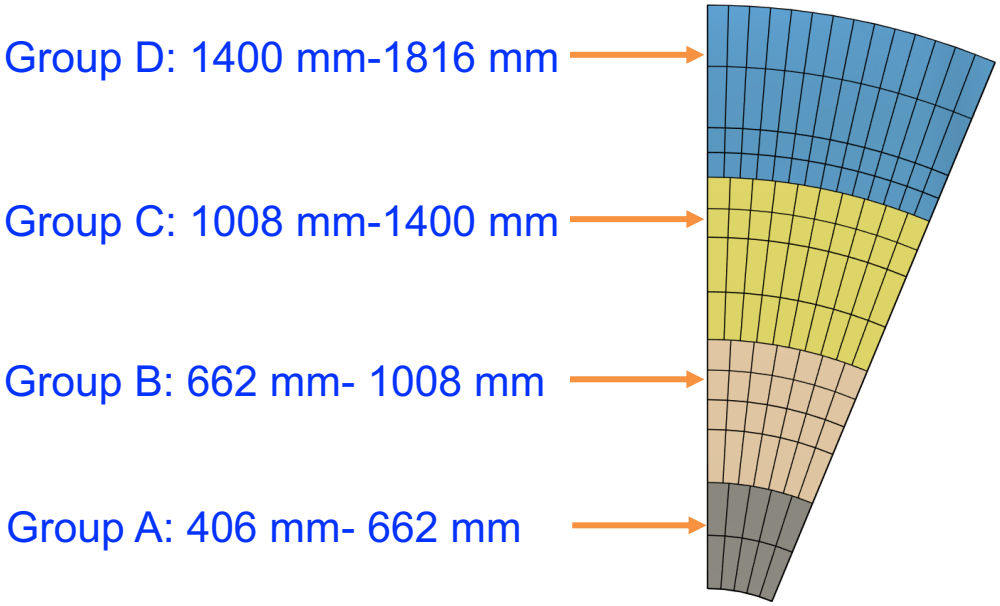


OTK Endcap Update with Trapezoid Sensors



Qi YAN, Yihan ZHANG, *and* Shoudong LUO

cos(θ)=0.99 corresponds to OTK endcap:
R_{min}≈410 mm

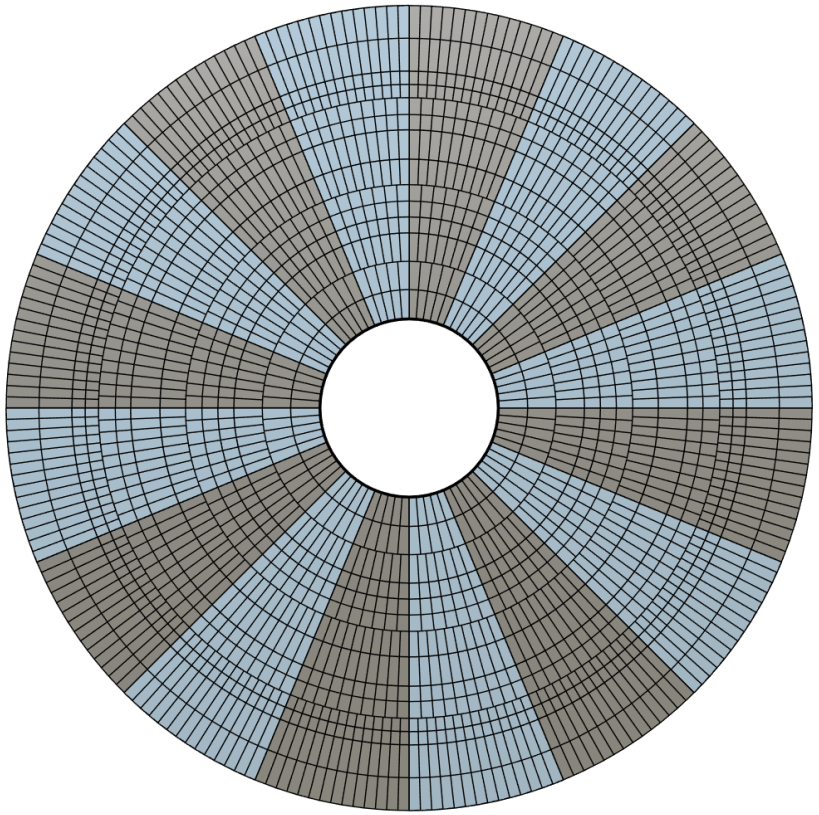


- 14 rings, 4 groups.
- Each group contains 2-4 types of trapezoid sensors, which can be fitted to one silicon wafer.
- Each group of sensors can be aligned to a 1/16 sector.
- The long sensor contains 2 sets of short-strip sensors

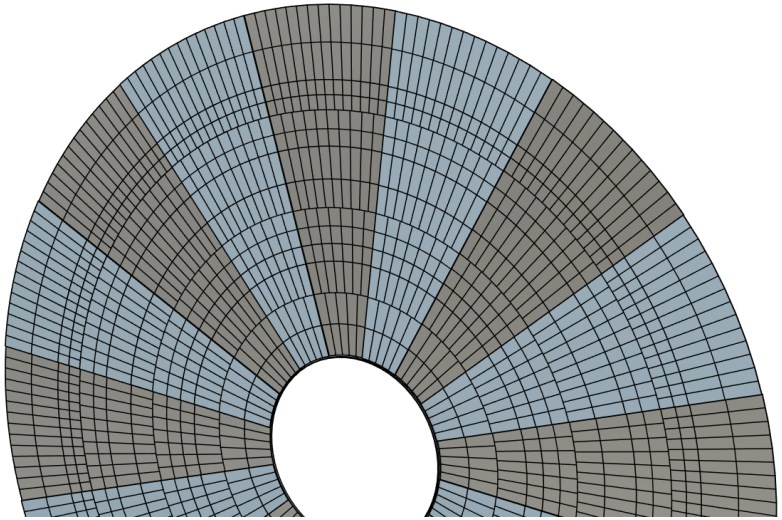
Mechanical Assembly Consideration

Qi YAN, Yihan ZHANG, *and* Shoudong LUO

To simplify installation, adjacent sectors are spaced 3 mm apart.



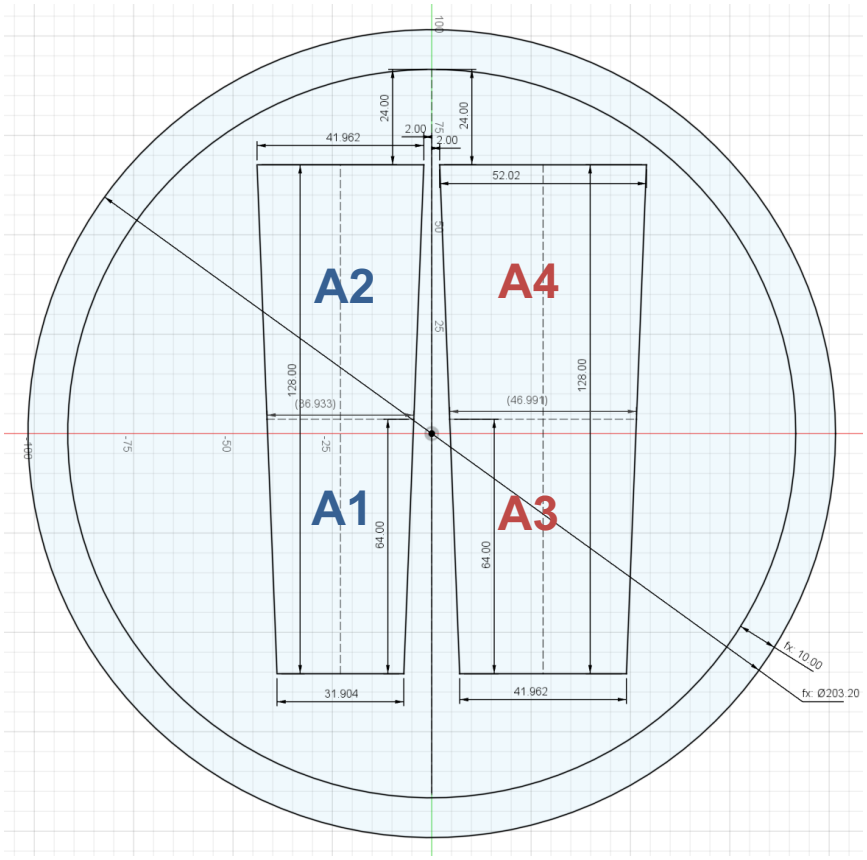
~10 m^2 per endcap

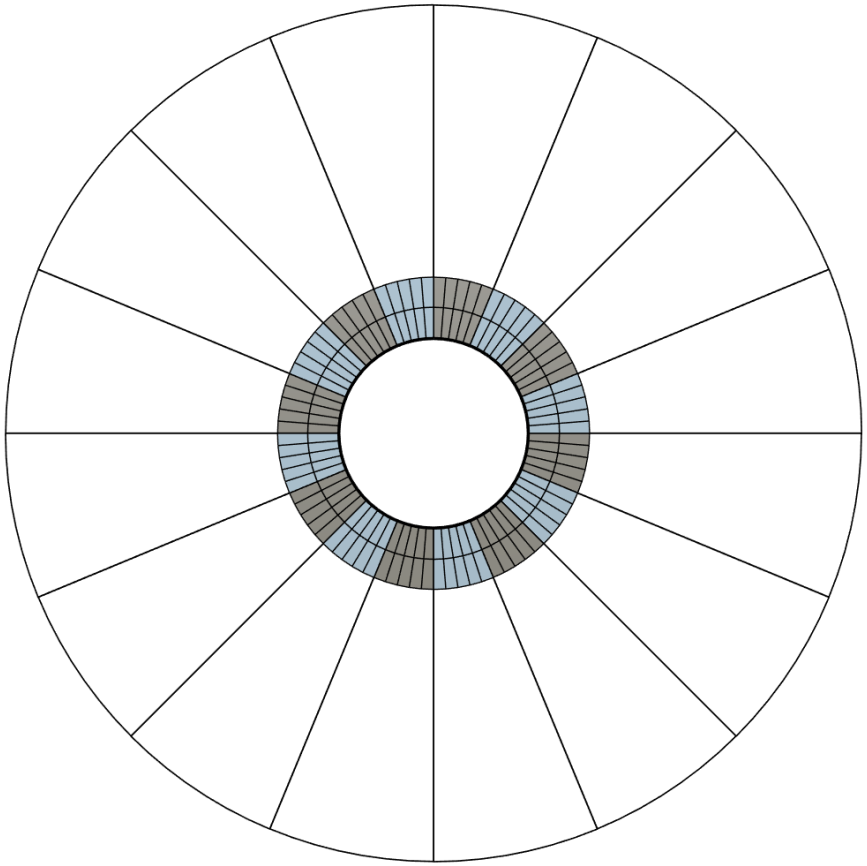


Each sensor has ~3% inactive area, assuming a 300 μm guard ring.100 μm gap between groups considering tolerance can be reserved for assembly.

R: 406 mm-662 mm (Group A)

8’’ wafer

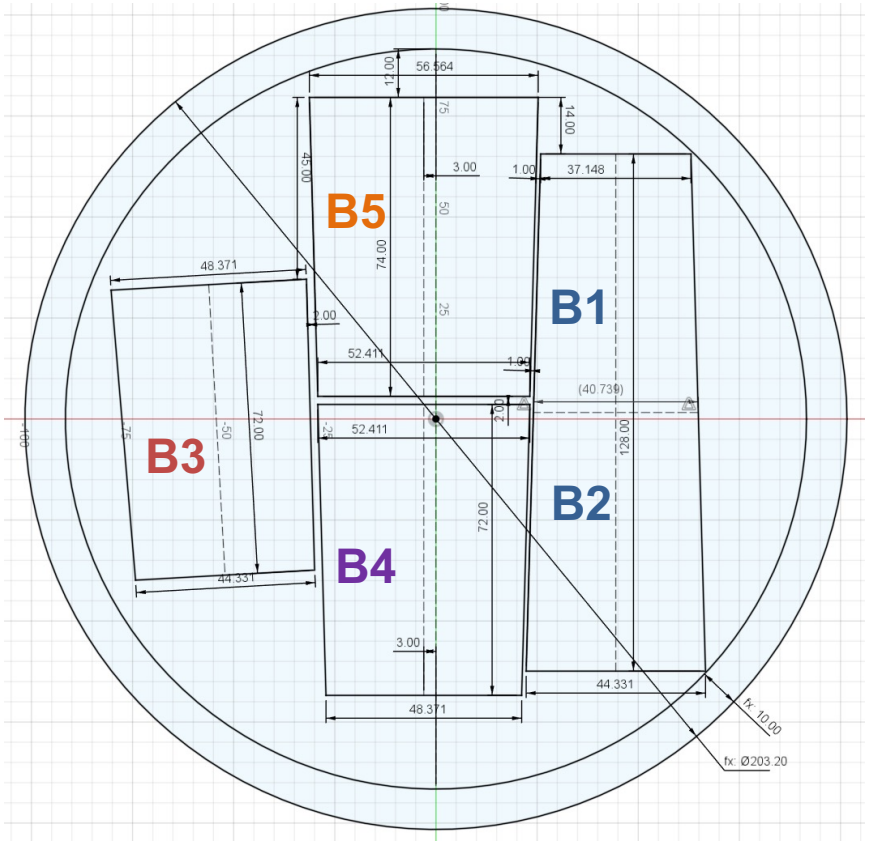


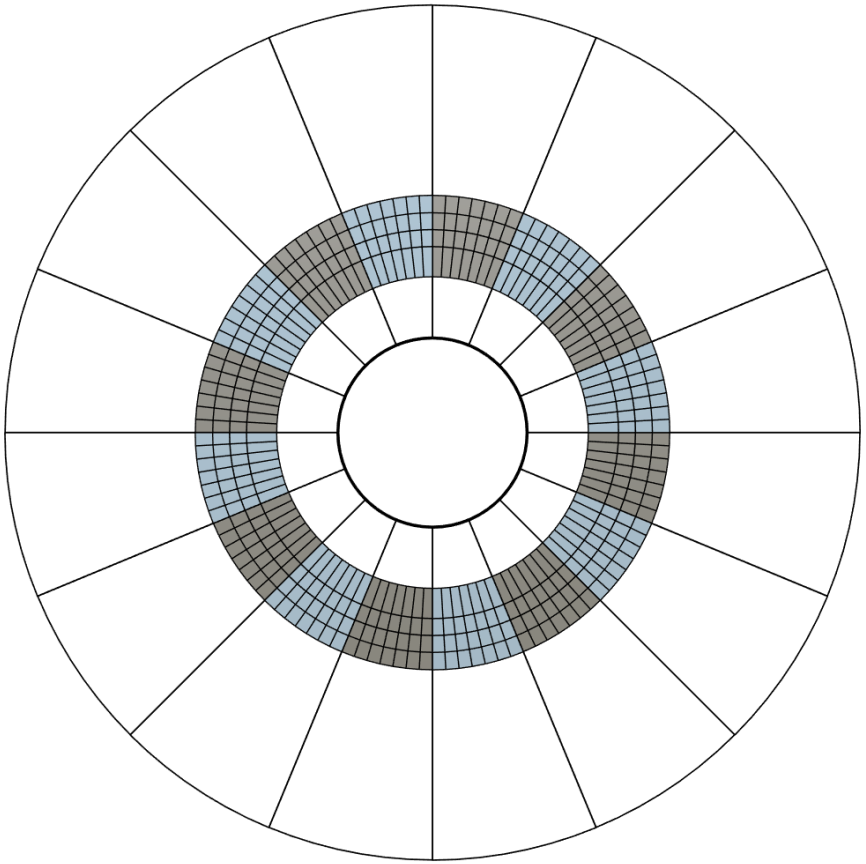


Type of sensors	1	2	3	4		
N sensors	80	80	80	80	80	N wafers

R: 662 mm-1008 mm (Group B)

8’’ wafer

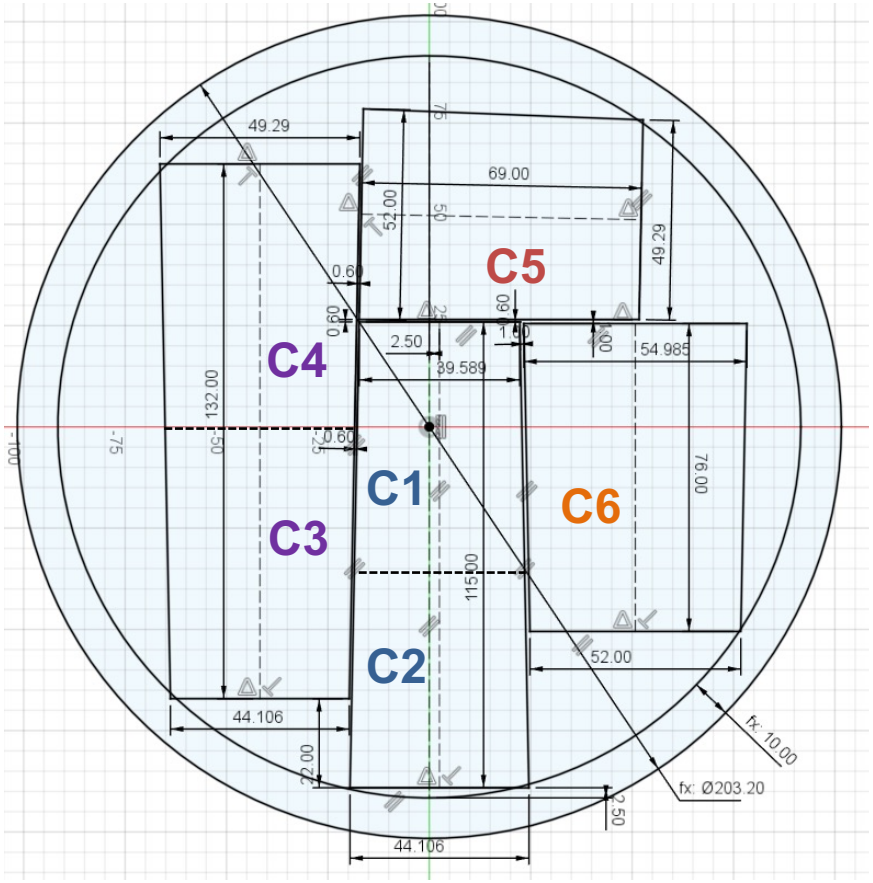


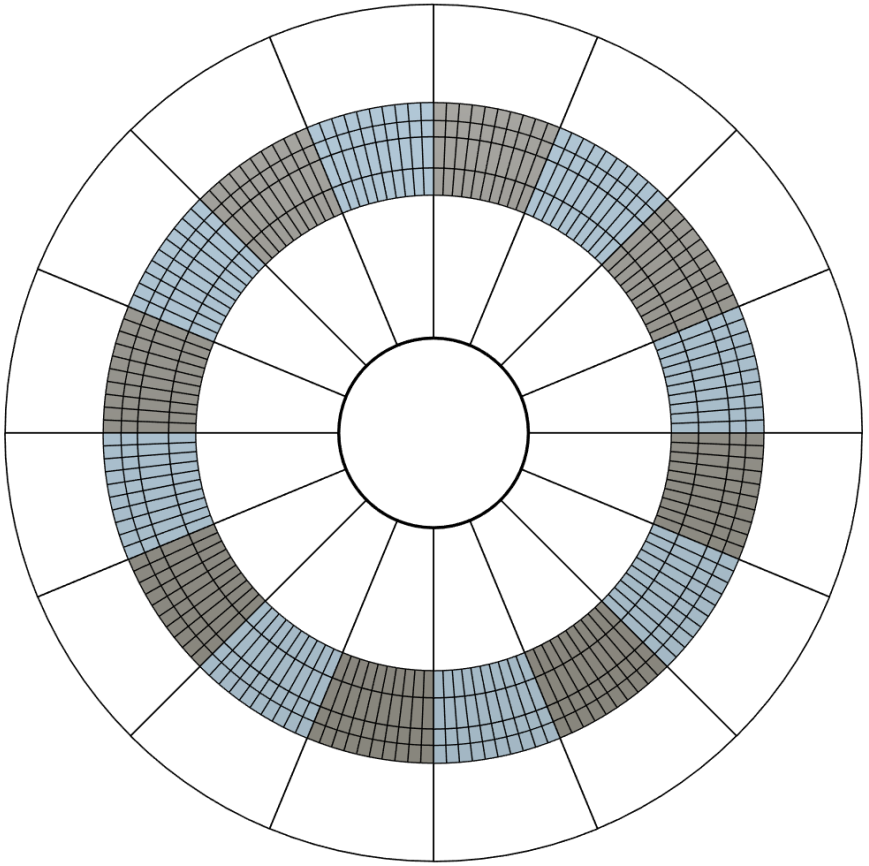


Type of sensors	1	2	3	4	5		
N sensors	112	112	112	112	112	112	N wafers

R: 1008 mm-1400 mm (Group C)

8’’ wafer

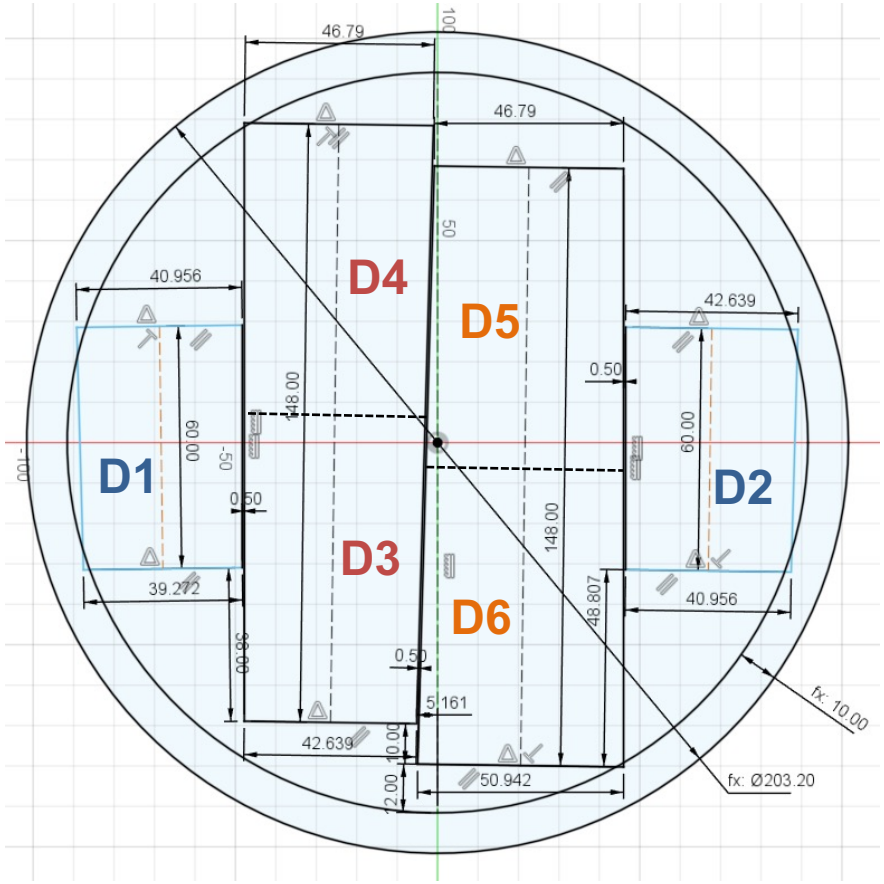


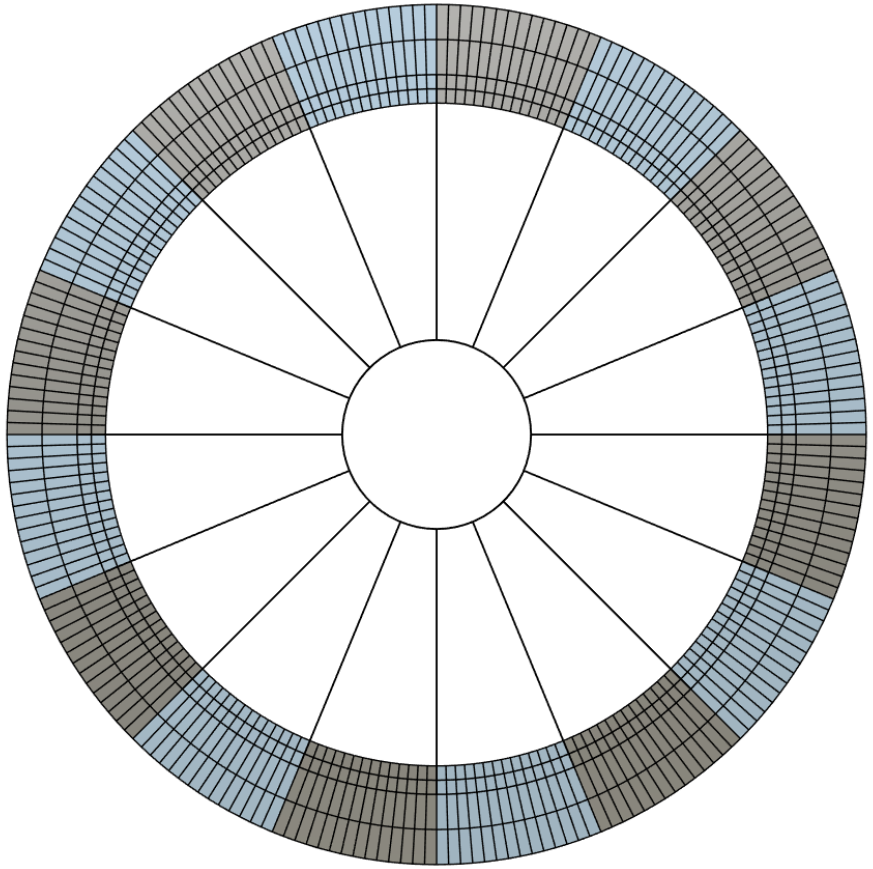


Type of sensors	1	2	3	4	5	6		
N sensors	160	160	160	160	160	160	160	N wafers

R: 1400 mm-1816 mm (Group D)

8’’ wafer



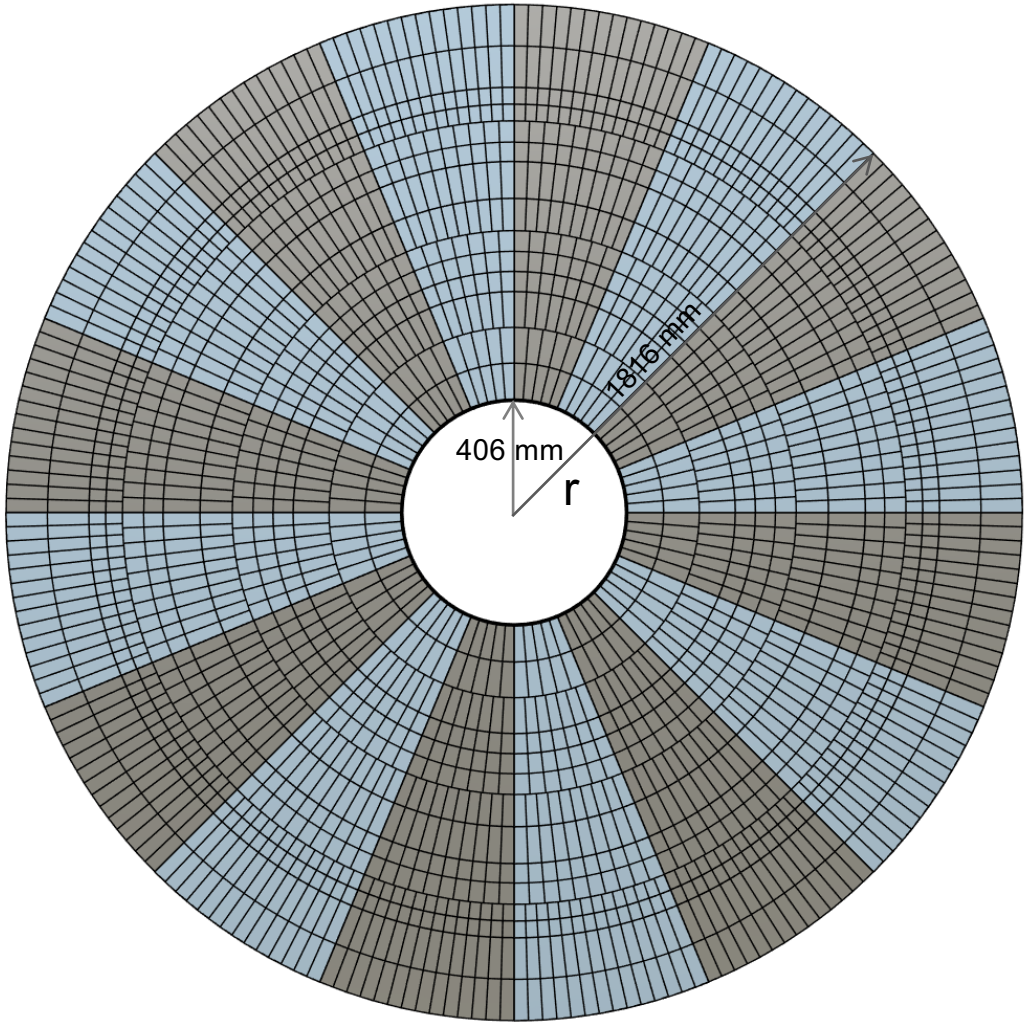


Type of sensors	1	2	3	4	5	6		
N sensors	224	224	224	224	224	224	224	N wafers

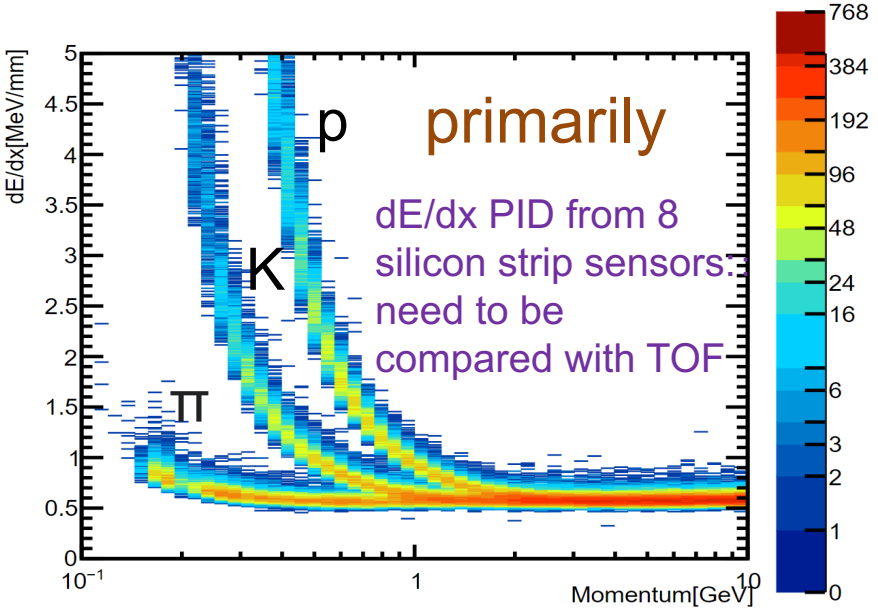
OTK Towards TDR

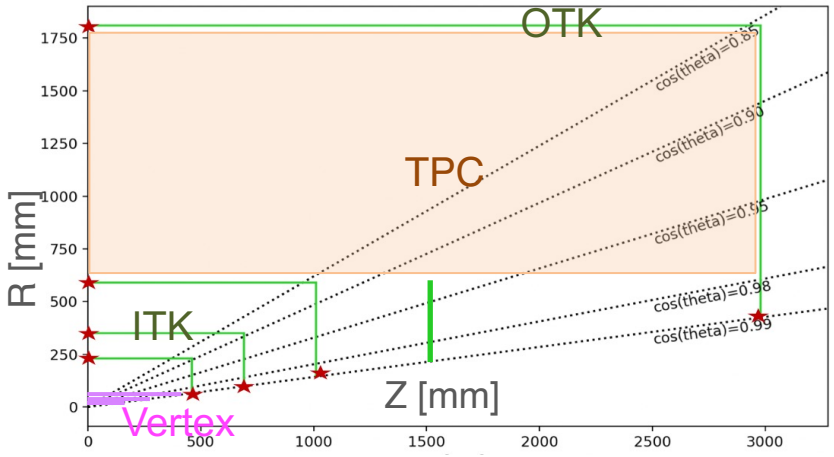
1) The power and readout design for the new OTK endcaps will be ready in a few days, similar to the barrels.

2) Meanwhile, we will complete the full OTK mechanical design covering both the barrels and endcaps, in a short time. Quan JI will assist in speeding up the mechanical work.



The dE/dx for PID performance using CMOS silicon strips, and design of pixels for ITK endcaps and CMOS strips for ITK barrels, will be discussed in next detector meeting.





provided by Yiming LI