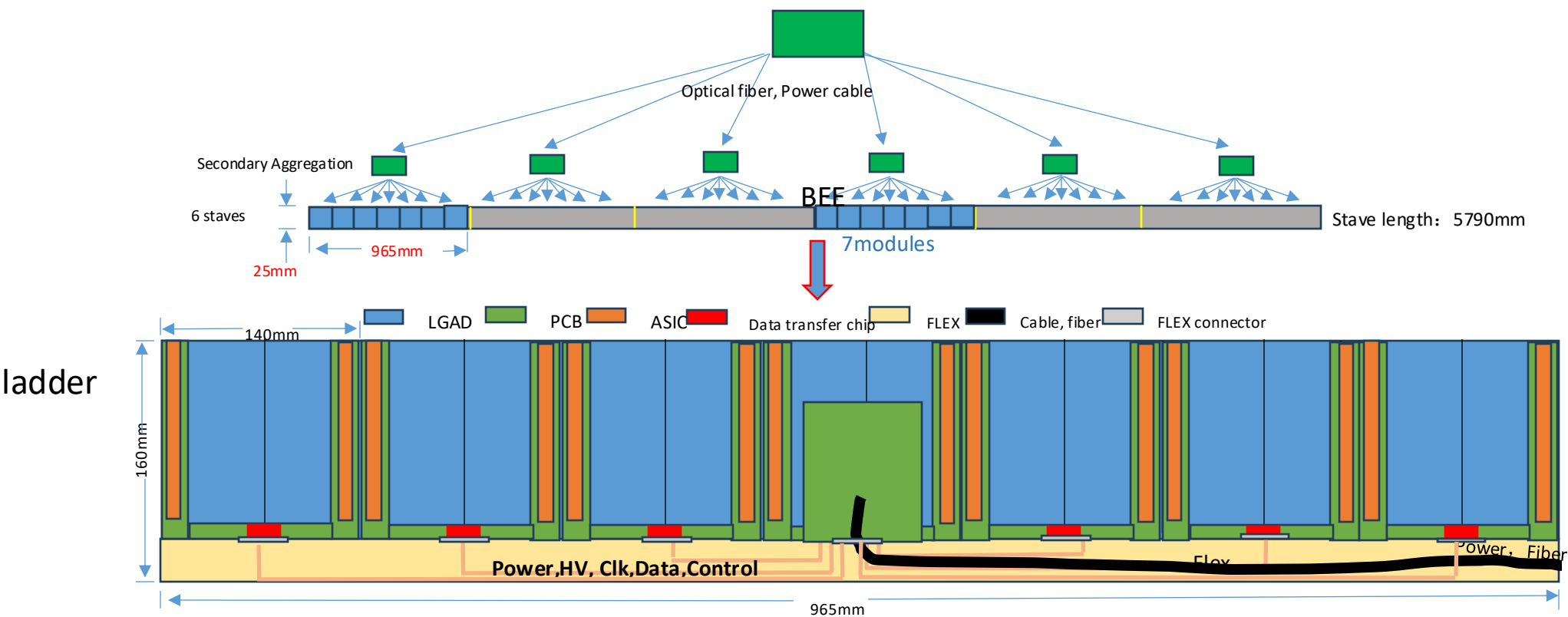
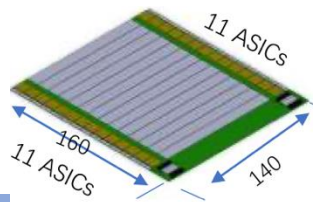

General talk

Electronics layout for LGAD ToF & oTracker



Module
140mm x 160mm



Barrel for OTK

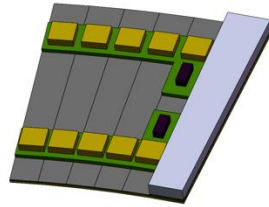
- Stave: 90 total
- Ladder: 6 x90 total, (6 ladder/stave)
- Module: $6 \times 90 \times 7 = 3780$, (7 module/ladder)
- Chips (ASIC) : $6 \times 90 \times 7 \times 22 = 83160$ (22ASIC/module)

Barrel	
stave	90
module	3780
chip	83160
Average hit rate	140 Hz/cm ²
Maximum hit rate	140 Hz/cm ²
Data rate/stave	~1.14e6HZ
Total data rate	~1.02e8 HZ

Endcap design

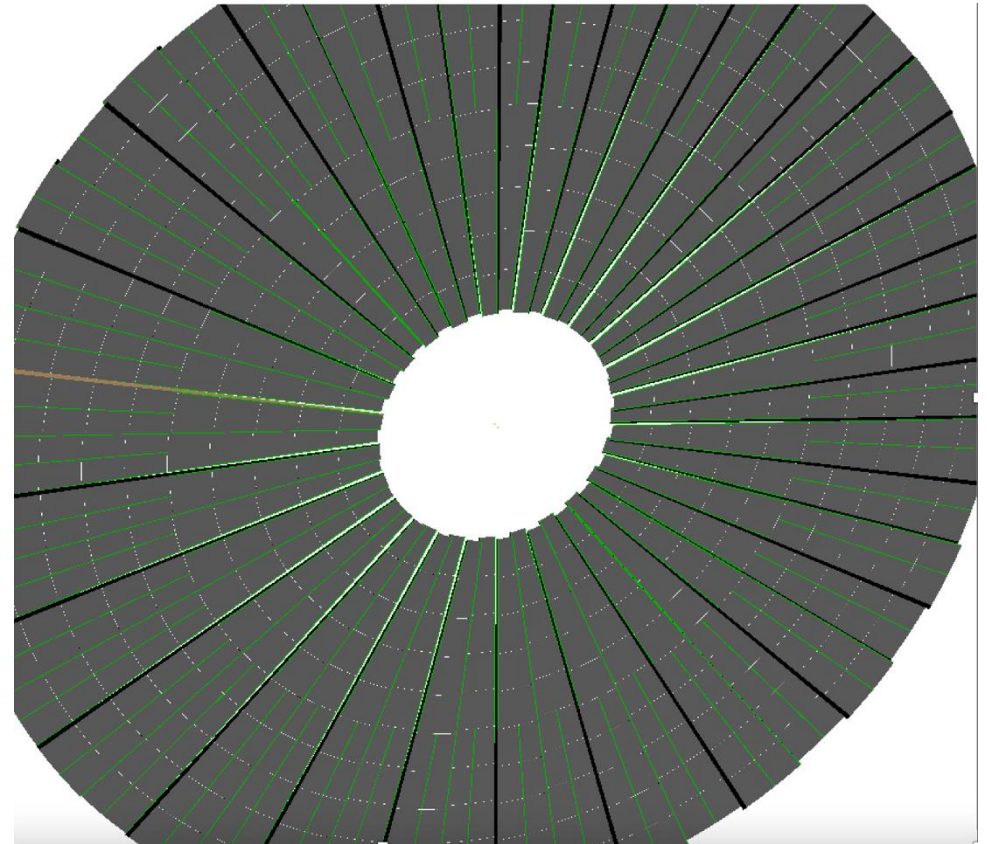
- Hit rate estimation: maximum $\sim 35\text{k Hz/cm}^2$
- Update the sector module design with new HS design
- 400mm - 1800mm: 720 modules
 - ✓ 5 inner rows with 1 sector module
 - ✓ 5 out rows with 2 sector modules

Sector Module



- Overlap to reduce the dead area
 - ✓ 24 petals/layer
 - ✓ 10 rows/petal,
 - ✓ 7.5° per petal,
 - ✓ Overlap 0.5°/petal
- 140 mm / row at R direction

Endcap design in the CEPCSW



Endcap for ToF&OTK

Petal: 48

Modules: 480 module (10 module/petal)

Chips: 11520 (240 chips/petal)

Endcap	
Petal	48
module	480
Chip (ASIC)	11520
Average hit rate	~3k Hz/cm ²
Maximum hit rate	~35k Hz/cm ²
Data rate/ petal	~7.34e6 HZ
Total data rate:	~3.53e8 HZ

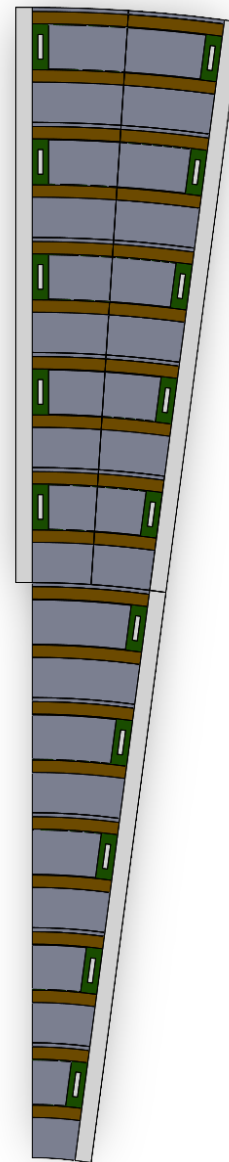
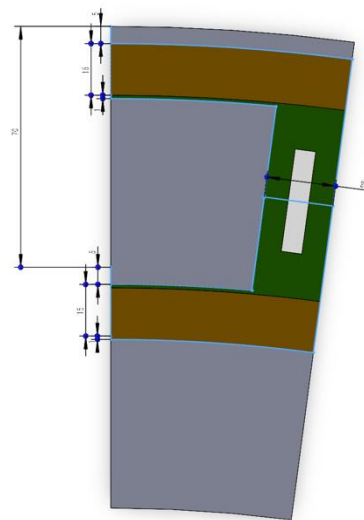
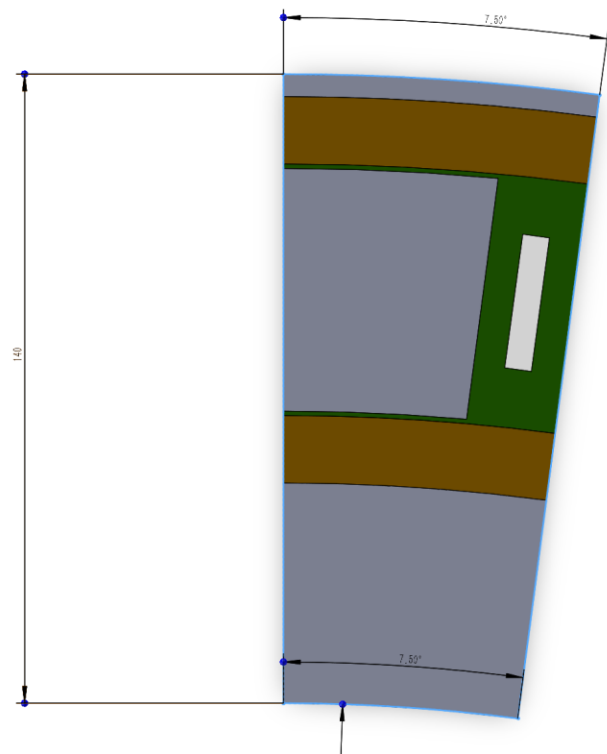
Row (140 mm/rwo)	Chip per row	Date rate (HZ)
R0 (400-540)	11	1533882.59
R1: 540-680	14	335365.01
R2: 680-820	17	412334.029
R3:	19	489303.047
R4	23	566272.066
R5	25	643241.085
R6	29	720210.104
R7	31	797179.122
R8	34	874148.141
R9: 1660-1800	37	951117.16

Total data rate:
 $\sim 7.34e6$ HZ

R0-R4:
 $\sim 3.05e6$ HZ

R5-R9:
 $\sim 4.29e6$ HZ

- 二级汇总版位置?
- 一级汇总芯片大小



Wafer optimization

ITk strips - endcaps

Endcaps:

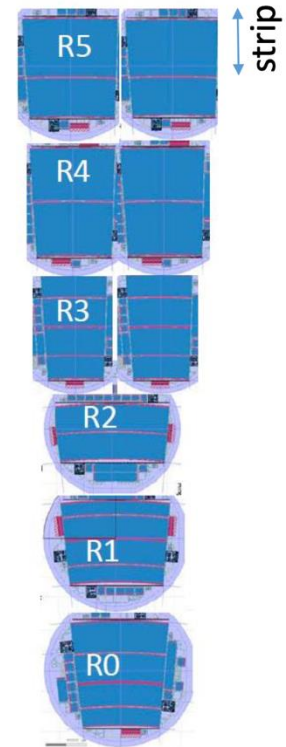
- 2 endcaps
- 6 disks per endcap
- 32 petals per disk
- 6 modules per petal-side
→ **4608** modules

Petal:

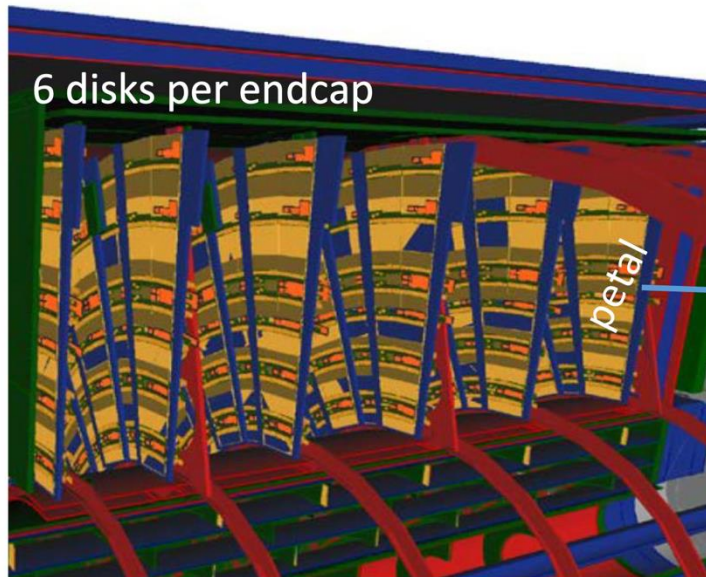
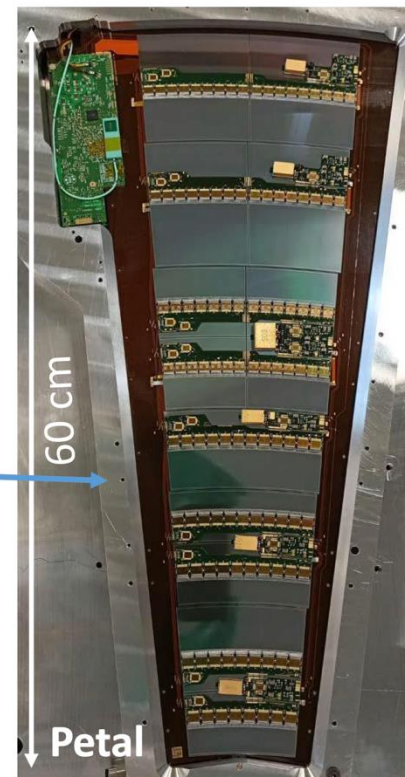
- 6 sensor geometries
- R0,R1,R2 one sensor/module
- R3, R4, R5 two sensors
- strip length: 1.4 –6



Sensor geometries

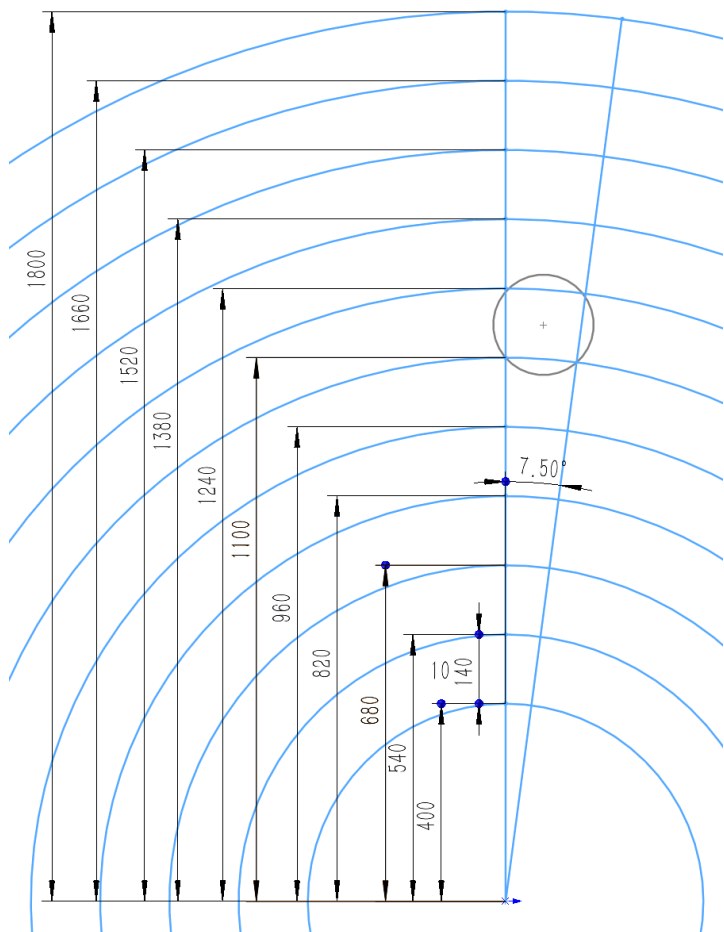


6 modules on each side

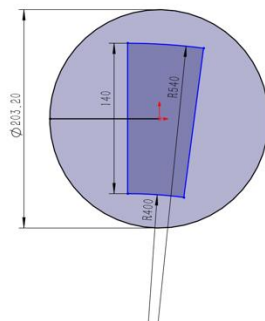


<https://cds.cern.ch/record/2876966/files/ATL-ITK-SLIDE-2023-596.pdf>

Sensor Arrangement and the readout channel



Sensor in the 8 inch wafer



Old number

		Maximum Arc (mm)	Readout channel number	Sensor number	Hit Rate Hz/cm ²
R0 (400-540)	52.36	70.686	707	1	10 ⁵
R1: 540-680	70.69	89.012	891	1	10 ³
R2: 680-820	89.012	107.338	1074	1	10 ²
R3:		125.664	1257	1	20
R4	125.664	143.990	1440	1	20
R5		162.316	1624	2	20
R6		180.642	1807	2	20
R7		198.968	1990	2	20
R8		217.294	2173	2	20
R9: 1660-1800		235.620	2357	2	20

位置分辨: 10 um (最大pitch 100 um)

LGAD ToF & outTracker

	CEPC TOF barrel	CEPC TOF endcap
Area (m ²)	~ 70	~9.7
Granularity	70mm × 0.1mm (10平方厘米, 每个芯片128道)	70mm × 0.1mm (10平方厘米, 每个芯片128道)
Capacitance	~10 pF	~10 pF
Charge	>15fC	>15fC
Channel number	~ 1 × 10⁷ (10644480)	~ 1 × 10⁶
Module assembly	Wire bonding at strip	Wire bonding at strip
MIP Time resolution	~50 ps	~50 ps
Spatial resolution	~ 10 μm	~ 10 μm (r or φ)
Number of Module	3780 (14cm*14cm)	~ 450 (14cm*) (一个扇形8° × 扇形数45 = 360°)
Number of channels per module	2816 (22 芯片, 128道)	2816 (22 芯片, 128道)
Data size	16 bit (9 TOT, 7 TOA) + channel(7bit, 128) +bunch ID(8bit) + chip ID (4-5 bit) ~40-48 bits	16 bit (9 TOT, 7 TOA) + channel(7bit, 128) +bunch ID(8bit) + chip ID (4-5 bit) ~40-48 bits
Data rate	5Hz/ cm2	?Hz/ cm2