

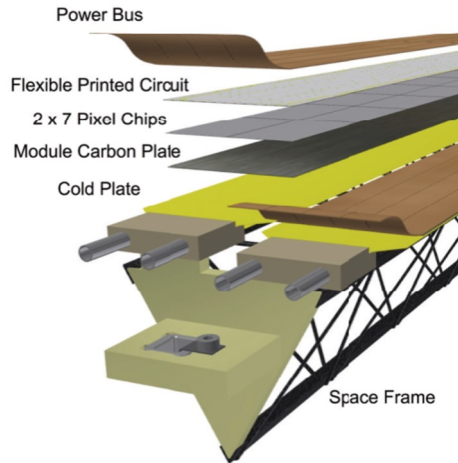
CEPC Silicon Tracker Progress Report (16)

Qi Yan on behalf of the Silicon Tracker Group

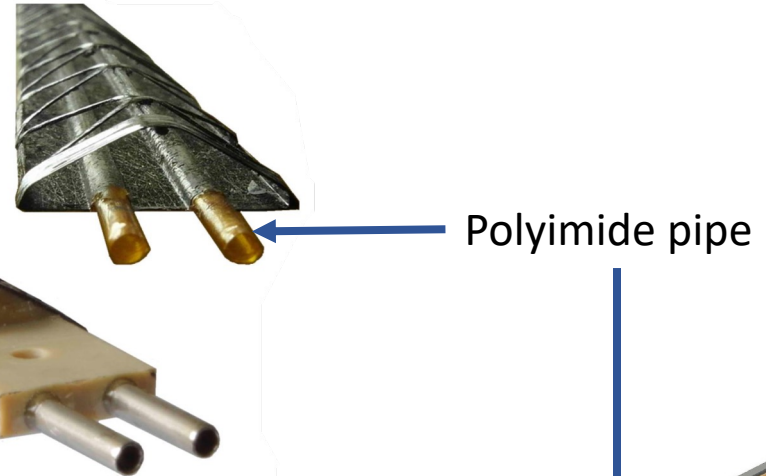
Dec 24, 2024, IHEP

Improvement of the ITK Stave Support and Cooling Design

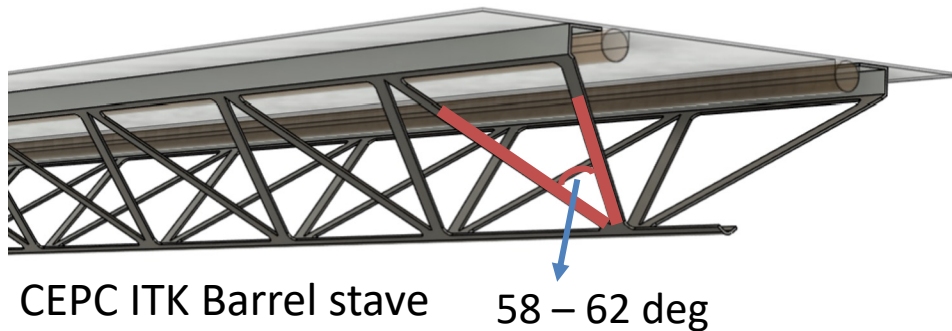
ITS2 Outer Barrel stave



ITS2 Inner Barrel stave

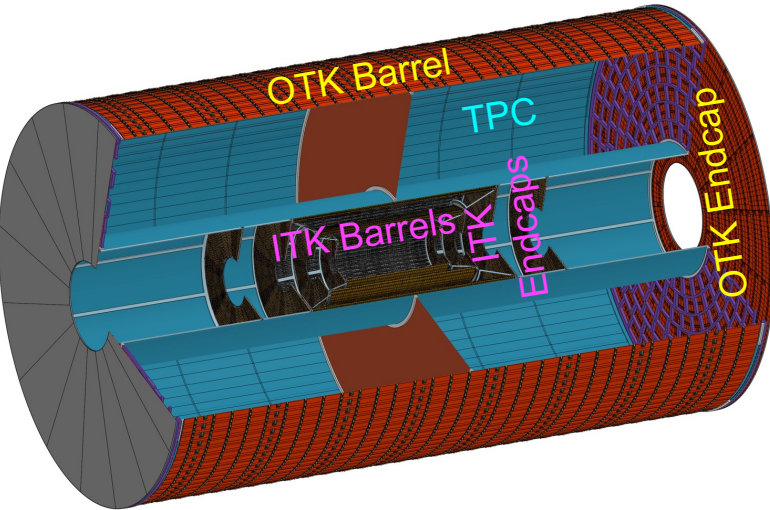


Yujie Li, Quan Ji, Yihan Zhang, and Qi Yan

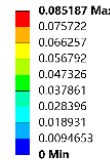


Water with polyimide cooling pipe was used as cooling medium for the ITK. Polyimide possesses outstanding properties such as low mass, high temperature resistance, corrosion resistance, radiation resistance, and high strength.

ITK Stave Deformation and First Natural Frequency



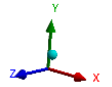
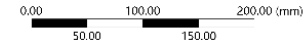
A: Static Structural
Total Deformation
Type: Total Deformation
Unit: mm
Time: 1



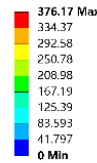
ITKB1 stave deformation



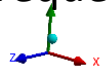
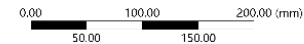
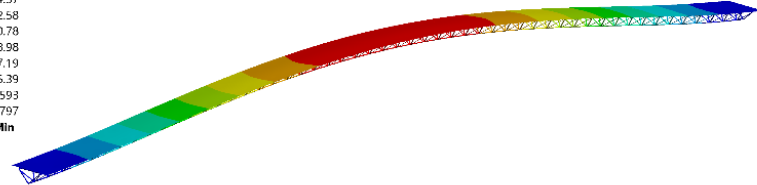
Yujie Li and Quan Ji



Type: Total Deformation
Frequency: 126.17355 Hz
Unit: mm



First order mode and first natural frequency



ITK Stave	ITKB1	ITKB2	ITKB3
Stave length [mm]	987	1410	1974
Maximum sag [μm]	85	289	896
First natural frequency [Hz]	126	69	34

The first natural frequency indicates the frequency at which an external impulse can induce resonance phenomena in the structure, resulting in oscillations of the sensor positions.

Ongoing Tasks for the Silicon Tracker TDR (Highlighted in Blue)

Chapter 5 Silicon Trackers

5.1	Requirements		✓
5.2	Overview of ITK and OTK	(a)	✓
5.2.1	Tracker system layout optimization		✓
5.2.2	Technology Options and Boundary Conditions		✓
5.2.3	Optimization Tools		✓
5.2.4	Layout Optimization		✓
5.2.5	Layout and Performance		✓
5.2.6	Summary		✓
5.3	Inner silicon tracker (ITK)		✓
5.3.1	CMOS chip R&D		✓
5.3.1.1	HV-CMOS pixel R&D		✓
5.3.1.1.1	Technology survey for silicon pixel detectors		✓
5.3.1.1.2	Development of HVCMOS pixel sensor for CEPC		✓
5.3.1.1.3	COFFEE1		✓
5.3.1.1.4	COFFEE2		✓
5.3.1.2	CMOS strip R&D		✓
5.3.2	ITK design		✓
5.3.2.1	ITK barrel design		✓
5.3.2.2	ITK endcap design		✓
5.3.2.3	Backup design for the ITK		✓
5.3.3	Readout electronics		✓
5.3.4	Mechanical and cooling design		✓
5.3.4.1	Barrel local support		✓
5.3.4.1.1	Materials		✓
5.3.4.1.2	Structural characterisation		✓
5.3.4.1.3	Thermal characterisation		✓
5.3.4.2	Endcap local support		✓
5.3.4.2.1	Materials		✓
5.3.4.2.2	Structural characterisation	(b)	✓
5.3.4.2.3	Thermal characterisation		✓
5.3.5	Prospects and plan		✓

5.4	Outer silicon tracker (OTK) with TOF		✓
5.4.1	AC-LGAD sensor and ASIC R&D		✓
5.4.1.1	AC-LGAD Sensor R&D		✓
5.4.1.1.1	AC-LGAD development at IHEP		✓
5.4.1.2	AC-LGAD ASIC R&D		✓
5.4.1.2.1	General requirements		✓
5.4.1.2.2	Data transmission bandwidth requirements		✓
5.4.1.2.3	ASIC architecture		✓
5.4.1.2.4	Single-channel readout electronics		✓
5.4.1.2.5	Prototype		✓
5.4.1.2.6	Power distribution and grounding		✓
5.4.1.2.7	Radiation tolerance		✓
5.4.1.2.8	Monitoring		✓
5.4.1.2.9	Development plan and schedule		✓
5.4.2	OTK design		✓
5.4.2.1	OTK barrel design		✓
5.4.2.2	OTK endcap design		✓
5.4.3	Readout electronics		✓
5.4.3.1	Front-end board		✓
5.4.3.2	Concentrator card and power distribution		✓
5.4.3.3	Slow control and monitoring		✓
5.4.3.4	Clock distribution		✓
5.4.4	Mechanical and cooling design		✓
5.4.4.1	Barrel local support		✓
5.4.4.1.1	Materials		✓
5.4.4.1.2	Structural characterisation		✓
5.4.4.1.3	Thermal characterisation		✓
5.4.4.2	Endcap local support		✓
5.4.4.2.1	Materials		✓
5.4.4.2.2	Structural characterisation	(d)	✓
5.4.4.2.3	Thermal characterisation		✓
5.4.5	Prospects and plan		✓
5.5	Beam background estimation	(f)	✓
5.6	Performance	(g)	✓
5.6.1	The global performance of the tracking system		✓
5.6.2	The performance of silicon tracker (barrel)		✓
5.6.3	The performance of the transition zone (barrel+end-cap)		✓
5.6.4	The performance of forward tracking (end-cap)		✓

We are working on!

Plan for the Silicon Tracker Ref-TDR

We need to converge on the writing of the Silicon Tracker Ref-TDR:

- Starting this Friday, regardless of the current progress, our group meeting will begin weekly global readings, reviews, and revisions of the Silicon Tracker Ref-TDR.
- From next week, I will start systematically revising the entire chapters of the Silicon Tracker Ref-TDR.
- The following topics will be strengthened:
 - Overview of ITK and OTK
 - Mechanical and thermal analysis of the endcap
 - Background estimation
 - Performance