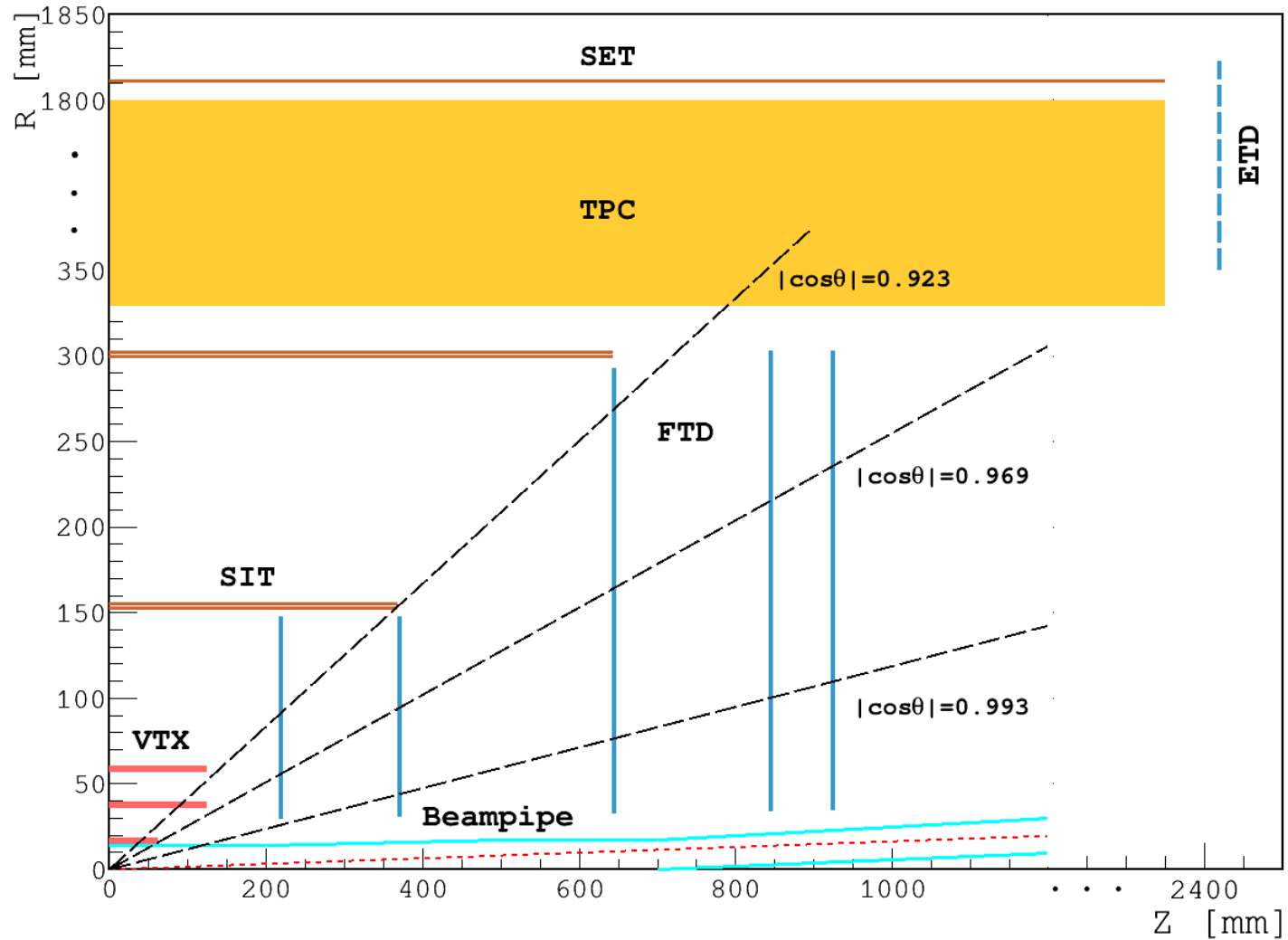


VERTEX & SILICON TRACKER COST ESTIMATION

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TRACKER LAYOUT



VERTEX

Cost scales with area ($\sim r^2$) at the first order, but also depends considerably on the sensor technology

	R (mm)	$ z $ (mm)	$ \cos \theta $	σ (μm)
Layer 1	16	62.5	0.97	2.8
Layer 2	18	62.5	0.96	6
Layer 3	37	125.0	0.96	4
Layer 4	39	125.0	0.95	4
Layer 5	58	125.0	0.91	4
Layer 6	60	125.0	0.90	4


	R_{in}	R_{out}	
Disk 1	39	151.9	220
Disk 2	49.6	151.9	371.3

- Total area of barrel + two forward disks: $0.331 \text{ m}^2 + 0.265 \text{ m}^2$, CLIC vertex $\sim 0.487 \text{ m}^2 + 0.351 \text{ m}^2$
- 3.4 M as estimated for the ILD VTX based on the cost of the STAR HFT PXL (CLIC ~ 12.76 M with **hybrid pixel**)
- Leading costing items: **pixel sensors, off-detector electronics + cables, HV/LV power supplies, mechanics + cooling, assembly + integration**

TRACKER

Cost scales with area ($\sim r^2$) at the first order, but also depends considerably on the sensor technology and shall be less demanding for the outer layers.

Detector		Radius R [mm]	$\pm z$ [mm]	Material budget [X_0]
SIT	Layer 1	153	371.3	0.65%
	Layer 2	300	664.9	0.65%
SET	Layer 3	1811	2350	0.65%

		R_{in}	R_{out}		
					
FTD	Disk 3	70.1	298.9	644.9	0.65%
	Disk 4	79.3	309	846	0.65%
	Disk 5	92.7	309	1057.5	0.65%
ETD	Disk	419.3	1822.7	2420	0.65%

- Total area of barrel + 3 forward disks: $59.92 \text{ m}^2 + 6.54 \text{ m}^2$, **CLIC silicon tracker**: $\sim 62.58 \text{ m}^2 + 210.93 \text{ m}^2$, **ATLAS ITk-Strip**: $104.86 \text{ m}^2 + 60.4 \text{ m}^2$
- 23.3 M as estimated for the ILD tracker and **driven by SET**; CLIC $\sim 43.23 \text{ M}$, 1/3 by ITD1 with pixels; ATLAS $\sim 60.75 \text{ M}$ + common
- Conventional micro-strip sensors assumed, considerable cost reduction foreseen with monolithic pixelated sensors

CLIC VERTEX & TRACKER

LCD-Note-2018-005

Sensors	2.28
F/E electronics	1.61
Bonding, thinning	2.2
Mechanical supports	0.76
Module integration	0.4
Off-detector electronics + cables	3.11
HV/LV power supplies	1.53
Cooling system	0.42
Assembly, integration and testing	0.45
Vertex Detector Total	12.76
Mechanics	2.82
Sensors Inner Tracker (ITB and ITD)	1.15
Sensors Outer Tracker (OTB and OTD)	6.55
Integration	1.88
Electronics for Tracker (inner and outer)	14.12
ITD1 (pixels)	16.71
Tracking (Barrel+Endcap) Total	43.23
Inner Detectors Total	55.98

Strip Detector		
WBS	Description	CORE cost [MCHF]
2.2.1	Sensors	23.58
2.2.2	FE electronics read-out chips	3.52
2.2.3	Modules	9.80
2.2.4	Local support electronics	3.55
2.2.5	Local support assemblies	6.73
2.2.6	Global mechanics	4.95
2.2.7	Services	3.54
2.2.8	Integratoin	0.70
2.2.9	Off detector electronics (incl PS + DCS)	3.86
	Shipping	0.50
	Sub-total	60.75
Pixel Detector		
2.1.1	Sensors	7.87
2.1.2	FE chips	3.11
2.1.3	Hybridisation and module assembly	10.39
2.1.4	Services	6.67
2.1.5	Local supports	5.27
2.1.7	Integration and system test	2.52
2.1.8	Off detector electronics	7.24
	Sub-total	43.07
ITk common items		
2.3	Common mechanics	12.80
2.4	Common electronics	3.45
	Sub-total	16.25
	Grant total	120.07