LDC Silicon tracker elements

summary table – April 30, 2008

The main aim of this document is to provide a reference for the Monte Carlo simulation of the LDC performance. The most important parameters for the four silicon tracker subsystems envisaged for the baseline LDC detector are summarized.
Choices of these numbers are in many cases based on "educated guesswork" and should only be considered to be the starting point for detailed studies to be undertaken towards the ILD Letter Of Intent and beyond.

Silicon Intermediate Tracker (SIT)

The SIT consists of two detector layers located between the outermost vertex detector layer (R=6cm) and the TPC inner radius (R=30 cm). It thus provides two precise space points at intermediate radii In the simulation framework Mokka SIT is represented by two cylindrical detector layers. The geometrical parameters of both are given in the table:

	radius	half-length	thickness	R-ϕ resolution	z-resolution	Read-out time
SIT layer 1	160 mm	380 mm	275 μm Si + 1 mm C	4 μm	50 μm	1 BX
SIT layer 2	270 mm	660 mm	275 μm Si + 1 mm C	4 μm	50 μm	1 BX

Each of these detector layers consists of active material (275 mmSi), and a second cylinder – closely spaced to the active material - that represents the detector support structure and services (1 mm C). Each layer thus presents 0.5 % of a radiation length to perpendicularly incident tracks.
In the baseline option, the SIT layers are to be equipped with double-sided micro-strip detectors, where strips of both sides are placed at a small stereo angle (baseline option). The detector design should aim for an excellent R-ϕ resolution, as good as 4 μm. The requirement on the precision of the z-measurement is somewhat more relaxed. The possibility of using pixel sensors is being investigated, which would lead to a much improved resolution in this second coordinate. The default values for the R-ϕ and z-resolution to be used in the digitization of simulated data are given in the table.

Silicon External Tracker (SET)

The SET consists of two detector layers located between the outer envelope of the TPC and the calorimeter, closely following the geometry of the face of the ECAL barrel. It is to provide a precise space point (R φ measurement) at large lever arm, instrumental to reach the ultimate transverse momentum resolution for high momentum tracks and a great anchor to calibrate the TPC z-measurement.
In the simulation framework Mokka SET is represented by two cylindrical detector layers. The geometrical parameters of both are given in the table:

	radius	half-length	thickness	R-ϕ resolution	z-resolution	Read-out time
SET layer 1	1587.5 mm	1500.0 mm	275 μm Si + 1 mm C	7 μm	100 μm	1 BX
SET layer 2	1592.5 mm	1500.0 mm	275 μm Si + 1 mm C	7 μm	100 μm	1 BX

Each of these detector layers consists of active material (275 mmSi), and a second cylinder – closely spaced to the active material - that represents the detector support structure and services (1 mm C). The combination of two single-sided strip detectors should provide excellent precision in R-ϕ, while attaining an adequate resolution in Z.

Forward Tracking Disks (FTD)

The FTD complements the central tracking system, extending the angular coverage down to 5 degrees. In the default LDC layout seven disks are foreseen on each side, extending along the full length of the tracking volume.

	z-value	Inner radius	Outer radius	thickness	R-ϕ resolution	z-resolution	Read-out time
FTD disk 1	220 mm	29.0 mm	140.0	50 µm	7 µm	100 µm	~ 10s BX
FTD disk 2	350 mm	32.0 mm	210.0	50 µm	7 µm	100 µm	~ 10s BX
FTD disk 3	500 mm	35.0 mm	270.0	50 µm	7 µm	100 µm	~ 10x BX
FTD disk 4	850 mm	51.0 mm	290.0	275 µm	7 µm	1000 µm	1 BX
FTD disk 5	1200 mm	72.0 mm	290.0	275 µm	7 µm	1000 µm	1 BX
FTD disk 6	1550 mm	93.0 mm	290.0	275 µm	7 µm	1000 µm	1 BX
FTD disk 7	1900 mm	113.0 mm	290.0	275 µm	7 µm	1000 µm	1 BX

The properties of the disks reflect the several detector technology options considered for the FTD. Good R-ϕ resolution is required throughout the detector, while the material budget should be limited to the bare minimum in this detector region with an abundance of low-momentum tracks.

The outermost disks are to be equipped with double-sided silicon micro-strip detector. Therefore, disks four through seven are to be simulated as 275 µ m of silicon active material plus 1 mm of Carbon to account for the support material. To keep the rate of ghost hits low the two coordinates are measured at a very small stereo-angle. The very modest precision in the R-measurement is deemed adequate for pattern recognition.

In the innermost layer, the robust pattern recognition of pixel detectors is preferred. The parameters of these disks reflect the performance that one can hope to obtain with novel detector technologies. Material for services and support is located on a cylinder enclosing the innermost three disks. The R-resolution and integration time are the result of a trade-off to maximize the pattern recognition performance.

The fall-back option for the innermost disks are hybrid pixel detectors, which could provide single bunch-crossing read-out, but are expected to have a much larger impact on the material budget.

End-cap Tracking Disks (ETD)

The ETD provides a precise measurement betweenthe instrumented TPC end-plate and the face of the end-cap calorimeter. The purpose of this measurement is twofold. On the one hand a precise space point at large lever arm is instrumental in reaching the transverse momentum resolution requirement for charged tracks at large momentum, particularly challenging in the forward region of LDC. On the other hand, the ETD measurement provides a means to "recover" from the material in the TPC end-plate.

	z-value	Inner radius	Outer radius	thickness	resolution	Read-out time
ETD disk 1	2368 mm	305.0 mm	1500.0?	275 µm Si + 1 mm C	7 µm U	1 BX
ETD disk 2	2368 mm	305.0 mm	1500.0?	275 µm Si + 1 mm C	7 µm V	1 BX
ETD disk 3	2368 mm	305.0 mm	1500.0?	275 µm Si + 1 mm C	7 µm X	1 BX

The baseline design for ETD proposes threeclosely spaced layers equipped with single sided micro-strip detectors. While in the final experiment the ETD geometry should match the ECAL end-cap shape, in the simulation ETD is represented by three disks. In each disk all micro-strips are parallel to one another. The strip orientation in the each disk is rotated by 60^{o} with respect to the other two.