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The interaction region of the large detector concept

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Abstract. The recently optimised interaction region of the LDC detector is presented in this paper together with the requirements for the planned detector hall.

Keywords. Interaction region; linear collider.

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1. The large detector concept

The large detector concept (LDC) is one of the detector concepts which are currently under study for the international linear collider (ILC). The LDC has its roots in the well-studied TESLA detector [1] and is described in detail in the LDC detector outline document [2].

1.1 *Interaction region design*

The recently optimised interaction region of the LDC detector is shown in figure 1. The most important task of the forward region is the suppression of beam-related backgrounds where the dominant sources are the electron–positron pairs from beam–beam interactions. Most of the pairs exit the detector through the beam pipe and produce showers inside the final focus quadrupoles. A tungsten pipe surrounds this area to capture secondary particles from these processes. A fraction of the pairs hits the surface of the very forward calorimeter BCAL. This calorimeter fulfills two purposes: it increases the hermeticity of the calorimeter system down to polar angles below 5 mrad and serves as a device for fast relative luminosity measurements [3]. As significant backscattering of secondary particles occurs from the BCAL surface, the forward region has to follow a design which minimises the backscattering into the tracking and calorimeter systems of the detector. The design of the LDC forward region foresees a large space between the BCAL and the LCAL which minimises the solid angle seen from the hot surface of the BCAL back into the tracking system of the detector.

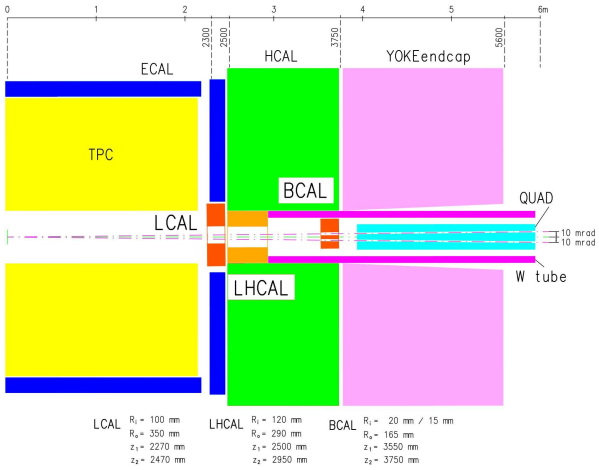

Figure 1. Forward region of the LDC detector for a 20 mrad crossing angle. TPC: time projection chamber, ECAL: electromagnetic calorimeter, HCAL: hadronic calorimeter, LCAL: luminosity calorimeter, LHCAL: low angle hadronic calorimeter, BCAL: beam calorimeter. The LCAL and BCAL are centred around the outgoing beam.

The purpose of the luminosity calorimeter (LCAL) is the precision measurement of the luminosity using Bhabha events and it therefore must not suffer from pair background. Thus the inner aperture of the LCAL has to be larger than the outer envelope of the pair particle trajectories for all configurations of the magnetic fields of the detector solenoids including the detector integrated dipole (DID) [4].

The background situation in the LDC detector has been studied in detail with older designs of the forward region [5]. The new design of the LDC forward region has just recently been implemented into the LDC full detector simulation and only preliminary results are available [6].

1.2 *Detector opening scheme*

The opening scheme for the LDC detector follows the ideas which have been developed for the TESLA detector. First, the iron yoke endcap will be opened in two halves and removed perpendicular to the beam pipe. The hadronic and electromagnetic endcap calorimeter will be moved along the beam pipe allowing them to be extracted out of the detector solenoid. After clearing roughly 1.75 m in longitudinal direction, the endcaps can be opened in two halves and be moved away in transversal direction. The LCAL can be dismounted afterwards. Finally, the TPC can be moved back sliding outside the tungsten tube and giving access to the silicon tracking detectors. The boundary conditions for the machine elements are two-fold: a longitudinal clearance of 1.75 m is needed behind the detector to allow for the removal of the calorimeter endcaps, and all beamline elemets near the detector (about ±6 m around the interaction point) have to fit into the tungsten mask tube with a diameter of 40 cm.

Interaction region of the LDC

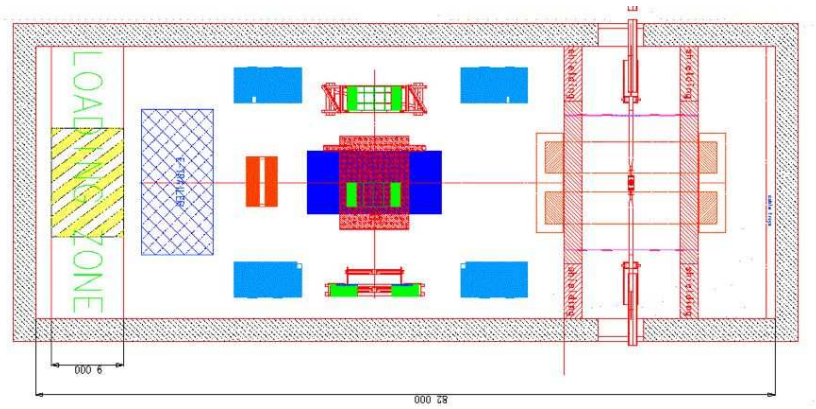

Figure 2. The LDC detector hall.

1.3 *Detector hall design*

The detector hall design for the LDC is adapted from the TESLA detector hall [7]. It is designed to allow convenient detector installation, maintenance and upgrade procedures for the whole lifetime of the experiment. Figure 2 shows a sketch of the current hall design. The hall has a size of 82 × 30 m with a beam height of 8 m and a crane hook at 19 m above floor level. The access shaft has a size of 9 × 16 m and is shown on the left in the figure. The beam line passes through the hall at the right side, 66 m away from the left and 16 m away from the right wall. The space between the loading zone around the access shaft and the beamline – which is shielded by a system of moveable concrete blocks – is needed for detector assembly and maintenance which can happen completely independent of machine operations. Two cranes with a capacity of 80 t each are foreseen for the handling of heavy items in the hall.

2. Outlook

While the background suppression of the LDC interaction region is expected to be good, the detailed simulations and fine tuning of the geometries are still under way. The detector hall concept for the LDC has been derived from the detailed studies of the TESLA detector. New developments for the ILC might need to revisit this design to study alternatives, e.g. the surface assembly of the detector.

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