Planning for ILD until 2012

Detector Baseline Document (DBD)

The ILD Detector Baseline Document will be the next step after the Letter of Intent. Compared to the LOI the scope will be extended to include:

- The physics reach of the ILD detector concept for high energies, in particular 1 TeV
- A detector model which is more realistic and which in particular contains a realistic model of services, dead materials and cables, and its impact on the detector performance.
- A more complete treatment of backgrounds in the detector

The evaluation of the physics case at 1 TeV implies that a significant sample of event be simulated, which allow the study of a number of physics processes with physics backgrounds. Judging from the LOI production around 50 Million events will need to be produced for a realistic estimate of backgrounds. A more clever pre-selection mechanism might reduce this number to around 10 Mio events.

The ILD Baseline

ILD will define two potentially different baselines for the DBD: a simulation baseline, and a detector baseline.

The detector baseline will contain realistic technical solutions for each subdetector. For a technology to be accepted as a baseline option it has to pass a review by the ILD group. It is possible that more than one technology is declared part of the baseline, if all options pass the review. In addition ILD will define a list of alternatives. Technologies, which are not yet ready to pass all ILD requirements, but which are considered promising, will be included in the list of alternatives. This list is meant to express the interest of ILD to profit from ongoing technological developments, and eventually be able to choose the best possible technology. The requirement for a technology to pass the ILD review will be defined in advance. They might be different from subdetector to subdetector.

The simulation baseline will contain a unique set of models of the different sub detectors, which will represent the best knowledge and most realistic performance estimates. The simulation models might correspond to a baseline option, or might be a simplified version which might represent the performance of more than one option.

The detector baseline will be defined as late as possible, to profit from the ongoing R&D and to include as many results as possible. We envision that the detector baseline will be fixed in the summer of 2012.

The simulation baseline will need to be defined much earlier. We envision that the simulation baseline be defined at the end of 2010.

Development of the ILD simulation

The current ILD simulation has a number of significant shortcomings:

- The tracking software cannot easily handle high multiplicity events and the superposition of background events. The tracking code is old and not maintainable
- The treatment of backgrounds has not been done systematically. Significant problems exist in the forward direction.
- The level of detail for the different subdetectors is very different. In particular in the tracker dead material from services, cables etc are either missing or very optimistic.
- The types of tracking detectors – pixels, strips – are not properly simulated. No ghost tracks are simulated, which might in particular in the forward direction impact the tracking performance.
- The detail of the calorimeter simulation is different for the different options.

The ILD reconstruction has a number of significant problems:

- The tracking code is not able to handle full backgrounds reliably.
- The forward tracking code is not well developed, and is not stable against backgrounds.
- The TPC digitization is very simplified, and results probably in an optimistic estimate of the performance.
- The reconstruction is capable of handling a realistic magnetic field.
- The particle flow and calorimeter reconstruction is not really tuned to the different technologies.

To address these issues the following significant software projects are proposed:

- Development of more realistic MOKKA drivers for the different subdetectors.
- Development of a completely new tracking code, which will do individual and combined tracking in the TPC and the different Silicon tracking systems.
- Extension of the particle flow code to include more fully different technologies, in particular in the calorimeter.

The core software system should be further developed to make the above developments possible:

- The data model needs to be evolved. LCIO-V2 should be finalized and made the default. This is particularly important to ease the exchange of information and algorithms between the pure simulation studies and the test beam work.
- A more powerful geometry system is needed, to ensure the geometrical integrity of the simulation and the reconstruction.
- Access to the events should be made easier by providing a more powerful interface and by extending LCIO to direct access.

At the moment it is not clear how many of these goals can be reached on a timescale appropriate for the DBD. We propose the following approach:

- Over the next months we will try to better define the work plan, identify resources, and define priorities.
- In July 2010 we will review the state of the software.

- If it is probable that a significantly improved simulation and reconstruction can be available in time for a significant production run before mid 2012, we will wait with the production and do it using the improved software.
- If it seems unlikely that a significantly improved software system will be available in time for the production, we will do the production with the LOI software.
- In either case we will update and extend the MOKKA drivers to reflect the improved understanding of the detector.
- The simulation will be adjusted to reflect the evolution of the overall ILD parameters, as discussed in the next section.
- The review will be done at a dedicated ILD meeting in the summer of 2010.

Definition of the ILD Baseline

The ILD detector will need to evolve in a number of areas over the next years:

- The technologies proposed for the subdetectors will mature, and allow a definition of "ready" technologies.
- The integration model and the simulation model need to be brought together on a consistent basis.
- A first estimate of dead material, including cables, services and possible cooling systems, needs to be developed.

To arrive at a consistent ILD detector model the detector integration group needs to learn about the latest developments in the subdetectors, and develop together with the subdetectors and the optimization group a integrated picture of the detector. It needs to be ensured that the integration model, kept as a CAD model, and the simulation model, defined in MOKKA, is consistent.
To reach this goal, ILD will setup a working group on integration issues. This group should contain members from the MDI/ integration group, from the optimization group, and from the relevant subdetectors. The group should

- Define the geometrical boundaries of the subdetectors (bounding boxes);
- Define the space requirements between subdetectors, and develop first estimates for the amount of material present in these spaces;
- Develop a first model of the cooling of the detector, including services and cooling strategies;
- Develop a first model of the power distribution inside the detector, including an estimate of the material this will introduce.

The goal of the groups should be twofold: develop the above questions for inclusion in the detailed CAD model of the detector, and develop a simplified version which can be used in the simulation model.

Backgrounds

Backgrounds play an important role in the definition and further evolution of the ILD baseline. They impact many of the sub-systems, and need to be studied for each of the proposed machine layouts. Issues in connection with the background are:

- Calculations for the beam-beam background for SB2009 need to be finalized.
- Two-photon background needs to be studied for the different energies
- Synchroton radiation background needs to be included in the studies.
- Muons originating in the BDS might produce background in the detector. Older studies indicate that the problem can be controlled, but should be re-done to confirm these findings.