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The Forward Calorimeter Group
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R & D for the TESLA-Detector: Instrumentation of the very forward region

W. Lohmann [a] on behalf of the Collaboration

[a] DESY Zeuthen

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Wolfgang Lohmann, wlo@ifh.de
Achim Stahl, Achim.Stahl@desy.de

Abstract

The first year of research work of the Forward Detector Group is reviewed. Monte Carlo simulations to optimise the shape and segmentation of the calorimeters are improved and are ongoing. The first sensor prototypes are investigated and some results will be presented to this PRC meeting. The milestones given to the PRC in the fall of 2002 are matched. The only exception is the progress in the hardware studies for heavy scintillators.

The goal of the R&D program is to find an optimal solution for the instrumentation of the forward region of the TESLA detector and to determine the achievable performance. Due to the high level of beamstrahlung, this region is particularly challenging and it is uncertain what kind of performance is feasible. Novel detector technologies need to be developed to fullfil the goals.

1 Luminosity Measurement

The goal is to work out a detector design that enables us to measure luminosity on the 10^{-4} level of precision.

- A list of the required precision for the reconstruction of the particles in the detector has been determined (position reconstruction, mechanical tolerances).
- The design of the LAT in the TDR has been studied and found insufficient for the required precision. A new preliminary design is now under investigation (see figure attached).
- A state-of-the-art Bhabha Monte Carlo program (BHWIDE by Jadach/Was) is now used for performance studies.
- Different segmentations and reconstruction algorithms are investigated. First results on angular and energy resolution have been obtained.
- Work on a precise laser alignment system has started. We have found a collaborating laser institute for this work (Inst. of Photonics, Jagiellonian University Cracow).
- The design of silicon sensors for the calorimeter is ongoing. A test sample (single diode) was delivered october 9. A first structured prototype is expected before the end of the year.

2 Beam Calorimeter

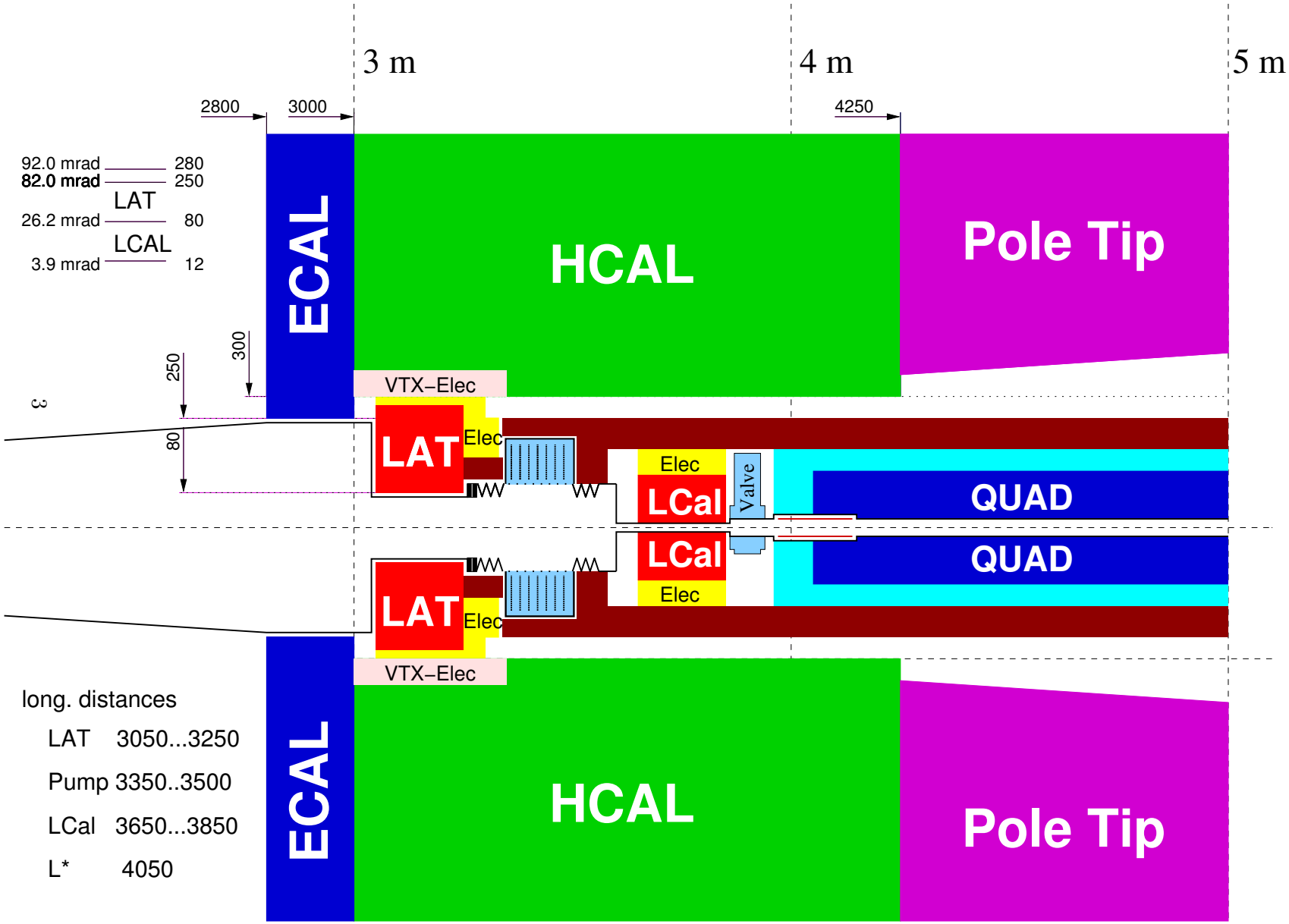
The goal is to investigate potential technologies for this calorimeter and to identify the most suitable one. This calorimeter is particularly challenging due to the high energy deposition from beamstrahlung (several 10 TeV per bunch crossing and side, summing up to 20 MGy per year of accelerator operation).

- A first analysis of simulated distributions of the beamstrahlung depositions has been performed. The results show a sensitivity to the beam parameters of the collisions and the potential to use this information in order to optimize the machine settings.
- It has been shown from Monte Carlo simulations that it is possible even in the presence of a large background from beamstrahlung to detect single high energy electrons in order to veto 2-photon-events. These results have been verified with real beam simulations including seismic movements and the reaction of the feedback system.
  Simulations have been done for the tungsten/diamond sampling calorimeter and the Xtal/fiber option. The results are comparable with somewhat better performance of the tungsten/diamond option.

The following 5 technological solutions are under investigation:

- **Tungsten/silicon sampling calorimeter:**
  Awaiting development of sufficiently radiation hard sensors. No work was foreseen to be done within this project.
- **Tungsten/diamond sampling calorimeter:**
  Diamond sensor prototypes are available from the Fraunhofer Institute Freiburg (12 sensors with different surface treatments), the GPI Moscow (2 sensors), and Minsk University (1 mono-crystal sensor). At Minsk University and at DESY Zeuthen the infrastructure to characterize sensors is installed and working, JINR Dubna is currently installing the hardware.
  The electrical features of all sensors have been measured. The response of the sensors to minimum ionizing particles and alpha-particles has been determined. Several sensors show the expected signals with charge collection distances of up to 60 μm.
- **Tungsten/sampling calorimeter with gas ioninsation chambers:**
  Beam tests have been done demonstrating the principle functionality of the technology. It has been understood that this is a very promising device to measure directly the photon component of the beamstrahlung at one of the downstream collimators. This application will be worked out in more details.
- **Crystal calorimeter with fiber readout:**
  Despite the recommendation of the PRC the project has not been sufficiently funded at DESY Zeuthen and hardware development will be terminated. We are trying to find a new collaborator to cover this topic.
- **Crystal calorimeter with ultrathin photo-triodes:**
  The group of UCL has submitted a proposal to the British funding agency and is awaiting approval.

All groups having signed the proposal have contributed to the progress made in the first year. The only exception is one of the two groups from IHEP Protvino. The collaboration will discuss and decide in the near future how to proceed with this group. A group from Lebedev Institute Moscow has expressed the interest to participate in the collaboration. A meeting will be with these people beginning of november to discuss their possible contributions.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