Construction and test of an ElectroMagnetic Calorimeter prototype

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A new Electromagnetic Calorimeter prototype to be used at a future Linear Collider is proposed. The prototype is an absorber-scintillator sandwich with lateral W.L.S. fiber read-out with the addition of three Si-pad planes. The Si planes are inserted in order to optimize the measurement of the shower development and the shower-to-shower separation.

1 Introduction

The recent studies [1] for the Physics at a future Linear Collider pointed-out that an excellent jet energy reconstruction is one of the must important requirements for a Linear Collider Detector. The best solution for the jet measurement is given by the capability to separate the contribution due to charged particle (which are well measured in the tracking system) from the one coming from neutral particles detected in the calorimeters. In particular showers produced by photons and electrons in the electromagnetic calorimeter must be distinguished w.r.t. the ones generated by charged hadron interactions. It is then necessary to design an ElectroMagnetic Calorimeter with the higest possible granularity (compatible with costs and a reasonable number of channels) both in the lateral and in the longitudinal direction.

Recently [2], it has been shown that such a detector can be built using the shashlik technique with longitudinal segmentation. The present proposal concerns a different technique which improves the granularity with a geometry simplfying the mechanics and minimizing the dead regions between the electromagnetic and the hadronic calorimeter of a LC Detector.

2 Prototype

A sampling calorimeter (realized already in CDF [3]) can be made by absorber and scintillator layers with wavelength shiting fibers inserted in a way which maximizes the light collection.

Here it is proposed to realize a prototype consisting of 50 layers of lead (Tungstene) absorber $25 \times 25 \times 0.3$ cm^3 ($25 \times 25 \times 0.2$ cm^3) coupled to 50 layers of scintillator subdiveded in cells of $5 \times 5 \times 0.3$ cm^3 (fig. 1) with a green WLS fiber inserted following the "sigma tail" scheme (fig.

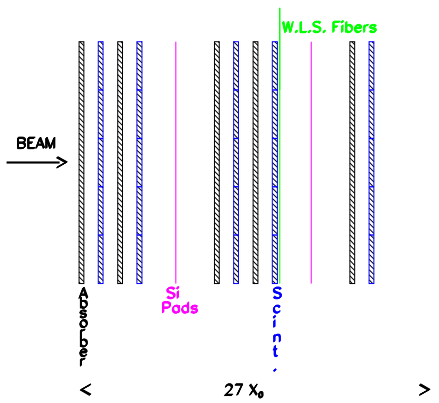

Figure 1: Layout of the calorimeter prototype.

2). The total depth is about 27 X0. The WLS fibers can be connected to clean fibers with long attenuation length in order to transport the light signal at large distance.

It is also proposed to insert 3 planes of 625 silicon diode pads (1×1 cm^2) at the depth of 2, 6 and 12 X0 from the calorimeter front face, respectively. These planes allow to obtain detailed information on the tranversal shower profile at different positions in the shower development and then they should provide a powerful tool to separate showers from different particles. In addition, the fact of reading separately the signals (or groups of them) from the fibers should guarantee an excellent granularity. A Tungstene absorber is foreseen in order to reduce the

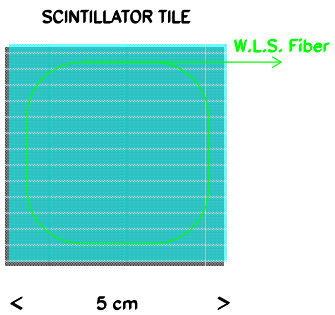

Figure 2: Layout of the scintillator tile with the WLS fiber.

shower Moliere radius with a further improvement in the shower-to-shower separation.

3 Production and test Plan

Studies for the optimization of fiber insertion will be done both in Padova and in LNF. The scintillator cell production with the fiber insertion will be done in LNF. The silicon plane production will be followed by the Padova group. The calorimeter mounting will be done in the LAB where for the first time a beam test will be performed (likely LNF). The support mechanics will be realized in Padova.

Concerning the beam tests, the 800 MeV e^+/e^- beam facility expected to be available from 2001 at LNF is indicated for a first step of measurements. In a second time it is expected to use the DESY and CERN beams in order to reach higher energies and to use pion beams.

References

[1] ECFA 1997-182; DESY 1997-048,
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[3] "The CDF 2 Detector. Technical Design Report" Fermilab-pub-96/390-E