LC Muon Detector Development Overview

Hardware R&D Goals
Hardware Configuration
Design Issues
Procurement, Engineering, Manpower
Additional Development Issues
R&D Goals

• Understand how physics goals affect muon detector hardware choices; e.g. hit density, hadronic punch-through, backup calor., etc.

• Determine LC muon system scintillator prototype parameters: strip dimensions, expected p.e.s, mult. scatt. implications, tracking vs. hits, ..

• Develop specs, construction details and costs. Understand prototype detectors, electronics, DAQ, their interplay, etc. Do analysis => reports, etc.

• Consider how the LC muon system, the largest LC detector, impacts the overall LC detector design.

• Consider alternative technologies to be sure we are developing the best possible muon system vs. $$

• Have you ever worked with/built a muon system that was perfect?
Fe Cross Section

Steel Cross-section

Fe Thickness = 10 cm
Gap = 5 cm

Gap View

μ

5 cm

1.5 cm
Design Issues

- **Choice of scintillator or other medium:** λ spectrum, speed, light yield, scint. chemistry, WLS specs, cost, aging causes and remedies, mechanical pkg, positional accuracy, robustness, coverage, ..

- **Photon detector:** Photo diode, PMT, mounted on scintillator or is the signal piped to detectors; influence of B field, susceptibility to noise sources, cross-talk; S/N, calibration methods and associated database size & complexity, allowed drift, re-calibration schemes; PS and ps specs, ...

- **FE electronics:** Philosophical design approach, general specifications (bandwidth, gain, power, ..) and how to get the right numbers, prototype goals and costs, engineering manpower requirements, coherent noise, S/N, output data = pulse ht, timing, ?, how many bits?

- **DAQ scheme, pedestals, calib. signals, calib. scheme**
Prototype Planes: Procurement, Engr. and Manpower

- To generate muon system specifications we have procured material to build 7 planes: 3-u, 3-v and 1 spare. => z-u line, z-v line, 1 ambiguity resolving plane.

  MINOS style extruded strips, Kuraray 1.2mm dia. WLS fiber, 1.2mm dia clear fiber and a few MAPMTs (64/16)

- Notre Dame working on fiber issues: splicing of WLS to clear and routing, light-tightening of bundles, mechanical treatment of edges, etc. A few drawings exist.

- Wayne State - MAPMT tests, calibration, and FE specs.

- UC Davis working on FE electronics and bare-bones digitization and readout.

- Will progress deliberately: 1m strips => 3.5 m strips,

- NIU/Fermilab, others: Continue simulation studies.
Module Prototype Configuration
Fiber Routes I.

All fibers to this corner.
Fiber Routes II.
Additional Development Issues

- **Analysis**: Isolation of muon candidates in b, b\_bar events: Count hits in cells around the projected muon: 1 = pass; g.e. 2 = fail.
- **Track fitting** from vertex through the muon system.
- **Need for precise tracking at the beginning of muon system?**
- **Impact of muon calorimetry on physics?**
- **CMS method of capturing the WLS fiber.**
- **Forward muon system & muon backgrounds.**
CMS HO Tile design

- Light from individual tile is collected using WLS fiber.
- Fibers are held inside the tile in keyhole type grooves.
- There will be 4 identical σ shaped grooves per tile.
- HO has 95 different tile dimensions, 75 for layer 1 and 20 for layer 0.

Jasbir Singh - 11/2003
LC Muon Detector Studies 1/7/2004

- **GEANT4 Global Simulation Software Development-Related to Muon Detectors**
  - **A. Maciel** NIU 15’
- **Muon Tracking and ID Analysis w/Single Particle b-b_bar Events**
  - **C. Milstene** NIU/FNAL 20’
- **ALC Muon Detector Development Overview**
  - **G. Fisk** FNAL 10’
- **Wavelength-shifting and Clear Fiber Routing/Splicing R&D**
  - **M. Wayne** Notre Dame 10’
- **Multi-anode PMT Tests, Calibration and FE Electronics Issues**
  - **P. Karchin** Wayne State 15’
- **Digitization and Readout Electronics**
  - **M. Tripathi** UC Davis 15’
- **Development of Geiger Mode Avalanche Photodiodes for Muon System Readout**
  - **R. Wilson** Colorado State 10’
- **Status of RPC Muon System Development**
  - **M. Piccolo** Frascati 20’