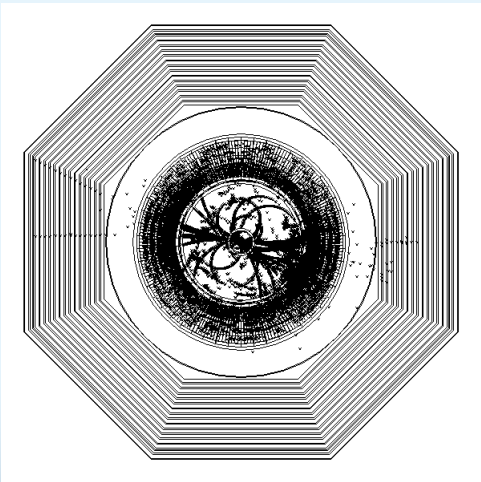
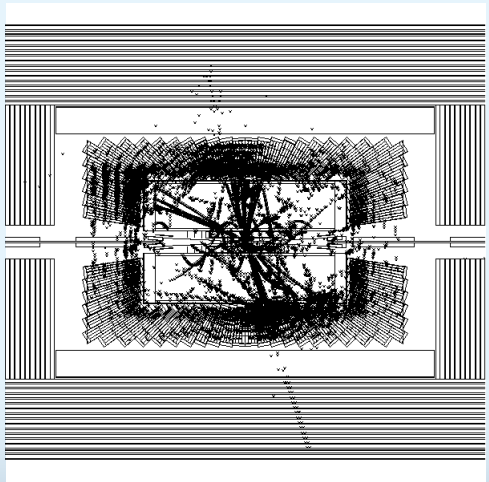
Test beam for muon detector





Marcello Piccolo

SNOWMASS, August 2004

Anything peculiar for μ-detectors?

- The μ-system is part of an integrated calorimetric device.
- Should one shoot for a dedicated beam time ?
  - Answers from test beam run:
    1. Muon identification efficiency
    2. Hadron misidentification probability
    3. Energy leakage measurement.
- #1 and #2 might give us info on performances of the system, however, full calorimetry would yield different answers (…and more relevant)

Anything peculiar for μ-detectors? (cont.)

- Should one have the cals in front of the muon identifier one could see many features:
  - Calorimetric capabilities
  - μ-identification with single μ
  - μ-identification in jets
    - Just superimposing single μ with single hadrons.
  - …….

Detector specific questions

- Can be probably answered either by means of *non organized* efforts.
- Cosmic ray test stands and or (small) prototypes exposed to available beams could provide the sought out answers.
- Specific questions related to (quasi) full scale prototypes might even obtained in the *non organized* mode.

Proposed Detectors and specific R&D

- Scintillator (extruded) strips
  - Light yield vs. coordinate
  - Light yield vs. time (different conditions)
  - Timing and amplitude stability (vs. strip length)
  - Calorimetric read-out
- Gas Detectors
- Gas mixes studies
  - Life tests
  - Neutron sensitivity
- Local rate capability
  - Different regimes (bears also on first question)
    - Electrodes geometry
- Calorimetric readout
  - Here too geometry plays an important role.

Paris 2004
ALC Muon Detector Test Beam Plans
(an example of organized effort, courtesy of G. Fisk)

- Set-up: 7 scintillator planes 2.5m (H) X 5m (W) (3-u, 3-v, 1-x); ~ 600 strips 4.1 cm (W) X 1 cm (T); Read-out both ends of the 43 - 3.5m long strips (86 channels) and one end of 21 + 21 next longest strips for a total of 128 channels per plane. 4" Fe between planes. 7 planes => 896 channels previously tested with cosmic rays.
- Objectives: Muons – Check timing, pedestals, pulse height, etc. for minimum ionizing particles. Measure efficiencies, (u,v) tracking, multiple hit capability, etc.

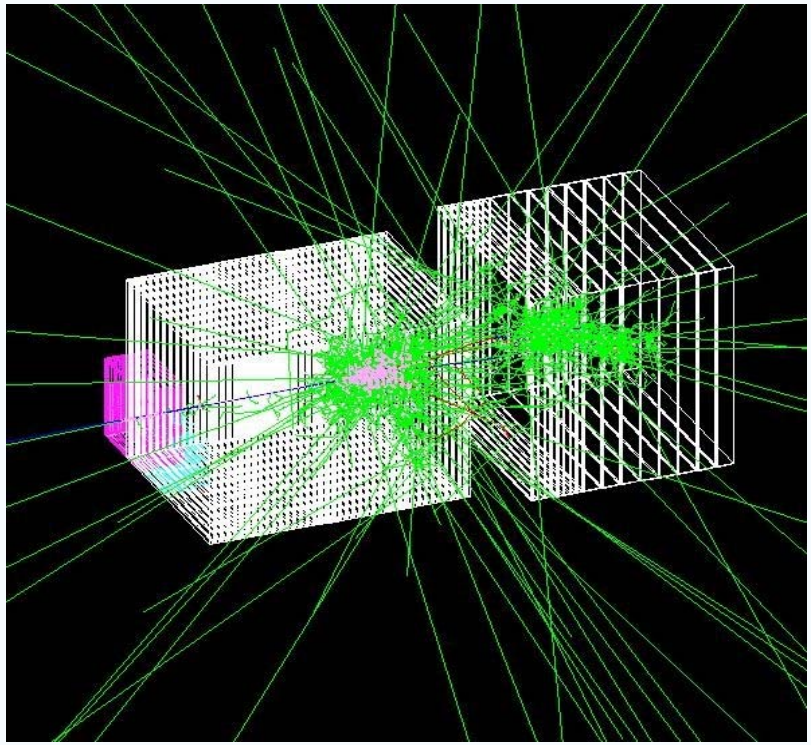
  Hadrons: Measure calorimetry capabilities with other calorimeters upstream (utility as a shower tail-catcher).
- Beam Conditions: E = few – 100 GeV; e, π, p, μ. Beam rate < 10^6 Hz.
- DAQ: FE will be custom development with FPGA logic and digitization, using CAMAC and LINUX software debugged in cosmic ray running.
- Dates: Earliest is probably late 2005.
- Where: Fermilab – Mtest.

A first completely organized effort

- The DESY FermiLab NIU/NICADD groups broke grounds on tail catchers/μ-detectors
- Now within CALICE there is a muon device in the making.
- The design of the radiator is practically frozen.
- Detectors (sci-strips) are being built
- Electronics is being developed in the framework of the CALICE standard.

Goals for TCMT Prototype (court. from Jerry Blazey)

- Study tail end of hadronic shower and validate simulations
- Prototype detector for generic LCD
  - Promote both eflow and muon identification
  - Correct for leakage
  - Understand and address impact of coil
  - Control fake rates



Vitals for TCMT prototype (court. from Jerry Blazey

Mechanical Structure/Absorber

- **"Fine" section (8 layers)**
  - **2 cm thick steel**
- **"Coarse" section (8 layers)**
  - **10 cm thick steel**

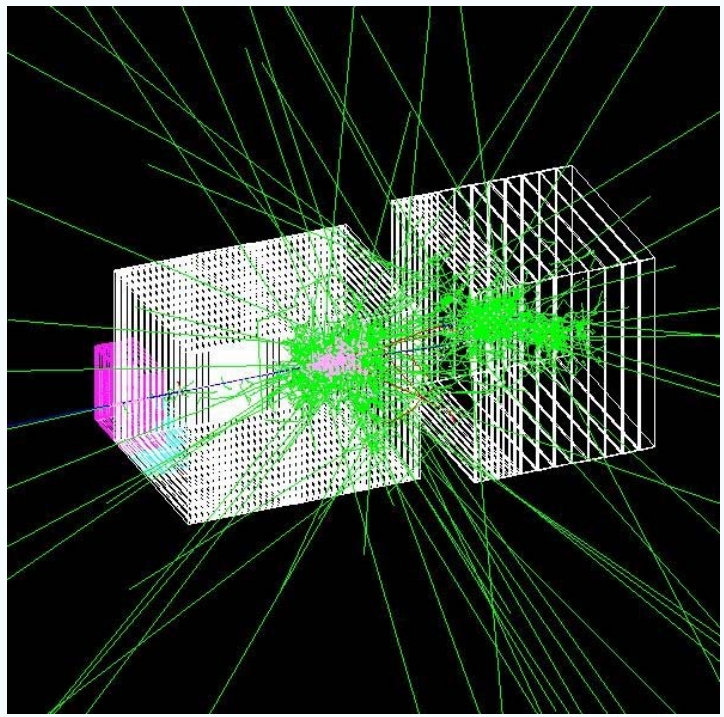
16 Cassettes:

- **Scintillator Strips**
  - **5mm thick**
  - **5cm wide strips**
  - **Tyvek/VM2000 wrapping**
  - **Alternating x-y orientation**
- **Readout**
  - **WLS Fiber**
  - **SiPM photo detection**
  - **Common readout with HCAL**

Dimensions:

- **Length (along beam) - 142 cm**
- **Height - 109 cm**

Weight ~10 tons



Design complete
Construction Starting Soon
Thanks to Fermilab

Conclusions

- Test beams for μ-system should be seen as a concerted effort:
  - Muon detector should be considered a part of the calorimetric system for the detector.
- Apart from detector specific answers, that will be obtained in a *non organized* way, my opinion is that the calorimeter for the LC detector should be designed and tested as a single system.
- Some flexibility in the radiator design might allow to test different solutions both for segmentation and type of detectors.
- Target date might well be 2006.