US Muon Beam Test Activities and Plans

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Outline

- Test Beam Facilties – User's perspectve
- Muon Detector Testing Activities
  - ILC Prototype Muon Scintillation Counters
  - Tail Catcher Muon Tracker (TCMT)

Operation/Experience in Fermilab Test Beam (A user's perspective)

- Proposal/approval procedure straightforward
- Scheduling is by calendar weeks (irrespective of whether the accelerator runs).
- Accelerator operations regularly turn off test beam for 1-3 hours to send beam to Tevatron.
- Test area is secured – important to limit accesses or to provide remote control, particularly with multiple users
- Beam mode can vary – spill length, frequency of spills, intensity, sign, momentum – negotiable
- Overall, a positive recommendation for users

User's Perspective (Cont'd)

- Working environment not very good
  - Hot in Summer, cold in Winter in Meson Detector Building.
  - Roof leaks, but experimental areas are covered to protect equipment. Humidity can be a problem.
  - Two rooms in Users area, control and electronics. Control area small, can accommodate about 6 people, not much desk space or work space.
  - Electronics room even smaller, not much rack space. Many cables not terminated at patch panels.
  - Temperatures in electronics room fluctuate over wide range - from warm to cold. Bring warm sweater, even in hot weather.
  - Housekeeping can be a problem, too many "temporary" users
  - Bring your own tools and supplies.
  - Screws, nuts, and bolts, Unistrut parts hard to find.
  - No mechanical shop or power tools available

Positives

- Fermilab, especially Erik Ramberg, provides good support to Users.
- Beam is good
- Running as secondary user, one may be able to operate in conjunction with primary user, and get more beam time.

Muon Prototype Scintillation Counter Testing

- Collaboration of Fermilab, Notre Dame, Wayne State, Indiana, UC Davis
- Detector is in place in Meson Test Beam Facility at Fermilab
- Initial Tests done in February, 2006
- Testing is in Progress in July, 2006
- Additional tests are planned for August, 2006, and November-December, 2006
- Anticipate continued testing in 2007

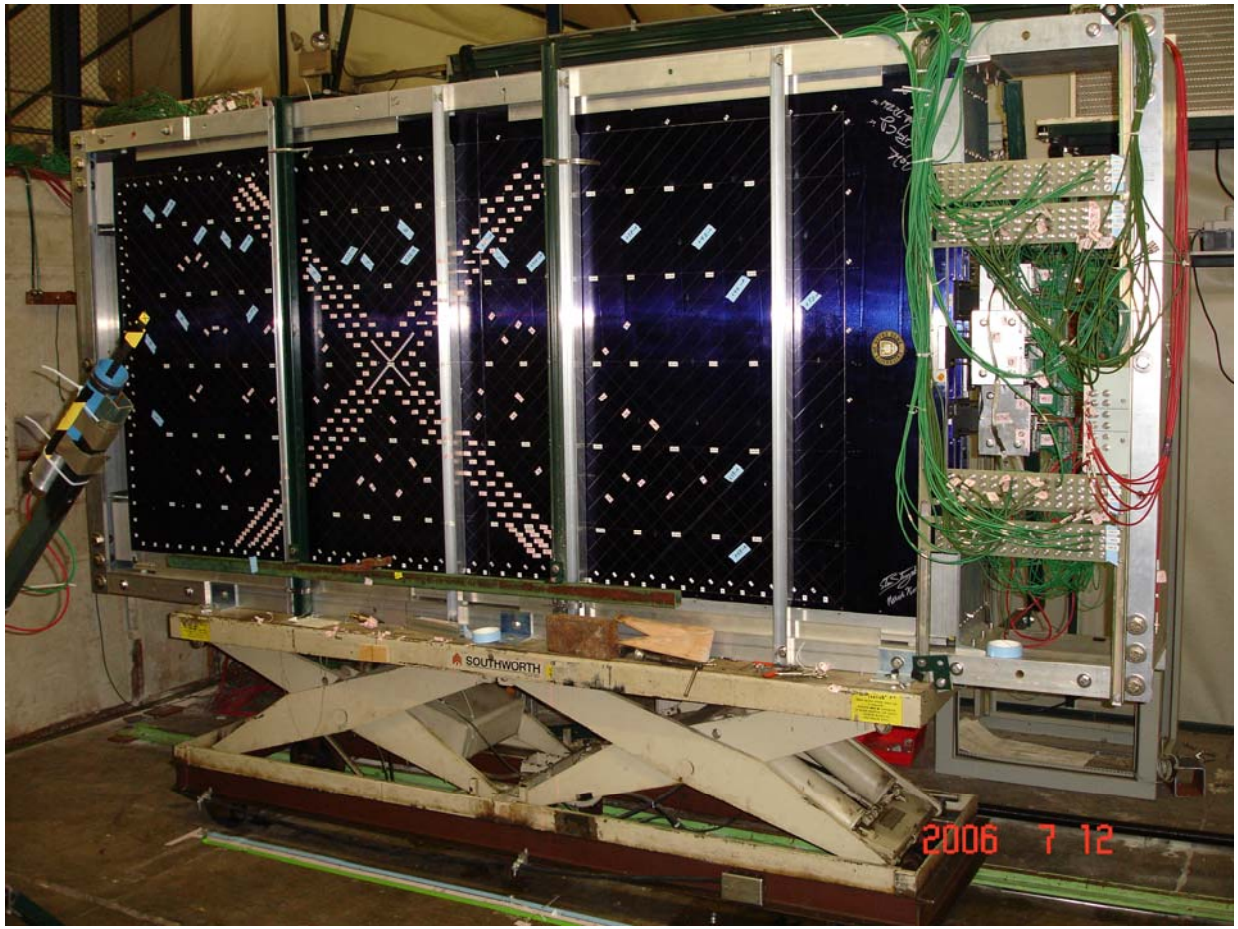
Review of Recent Activities

- Initial ¼ scale pre-prototype was built in 2004. Source tests were reported at Stanford LCWS05 in March, 2005.
- Two single readout ½ scale prototypes were built in 2005, and were tested with sources and cosmic rays. Reported at Snowmass in July, 2005.
- Two double readout ½ scale modules were built in late 2005 and initial beam tests were reported at LCWS06 in March, 2006.
- Tests of the 4 modules are in progress at the Fermilab Meson Beam Test Facility. Preliminary results are presented at this meeting.

Detector Description

- Each prototype module is rectangular, 1.25m x 2.5m, half of the anticipated full 2.5m x 5m size.
- Modules have 64 scintillator strips at 45˚ relative to the long side of the rectangle.
- Two of the four modules (S±) have a single 64-anode Hamamatsu 7346B MAPMT. The other two have two MAPMTs (D±a and D±b)

Muon Detector Setup



Operating conditions

- We trigger on beam signal.
- As prime user we can run at low intensity, ~ 1000/sec during spill, two 1-sec spills/minute, 12 hours/day.
- As secondary user we operated at ~20,000/sec.
- Beam spot at +120 GeV/c ~ 1 cm FWHM
- We observed “bunching”, or additional beam particles within 40ns to 800 ns after beam particle, 30% even at low rates ~ 1000/sec.

Current Status of Testing

- Four (1.25X2.5m) prototype modules built at Notre Dame in 2005
- Detector is set up in Fermilab test beam (MTEST or MTBF)
- Short test run in February, some preliminary results presented at LCWS06 in Bangalore in March.
- Just finished a run, from end of June to mid-July.
- There have been some problems, mainly DAQ-related. Significant time spent investigating source of problem.
- Respectable amounts of data collected, not all analyzed yet.
- Plan to request another week in August, and more testing toward the end of 2006.

Improvements Planned

- Working with FNAL Electronics Dept to
  - develop amplifier circuit for LED/PIN signal processing
  - Adapt MINERVA digitizers for processing MAPMT signals at detector to replace Lecroy ADCs and eliminate long cable runs that degrade signals
  - Goal is to test the new electronics by EOY06
- Begin SiPMT efforts. Considering joining forces with NICADD and /or INFN.

TCMT Test Beam Activities and Plans

- In October 2005, a TCMT cassette was tested in a 3 GeV/c electron test beam at DESY
- In February, 2006 a TCMT module was tested in the Fermilab MBTF, with good results
- Took data with 120 GeV/c protons, 16 GeV/c (mostly pions) and some beam dump muons
- Calice DAQ Electronics chain reproduced and tested
- Plan to participate in a combined test with the CALICE ECAL and HCAL in the test beam at CERN for 1 month in August-September, 2006.
- In 2007, plan to run longer tests at Fermilab.

CALICE TCMT Description

- Scintillating Strips
- Wavelength-shifter fibers
- Silicon PMTs
- Cassette 1m X 1m size, shown as installed at MTBF.