Wednesday, 30 September 2009

[45] **Introduction and Status of Fermilab test beam facility**  
by Dr. Erik RAMBERG (Fermi National Accelerator Laboratory)  
(Trailblazer: 08:30 - 08:50)

[46] **Proposal for a SLAC end station test beam**  
by John JAROS (SLAC)  
(Trailblazer: 08:50 - 09:05)

[47] **Status of Asian test beam facilities**  
by Katsuhide KOTERA (Shinshu University, Faculty of Science,)  
(Tailblazer: 09:05 - 09:20)

[48] **European test beam facilities**  
by Dr. Erik RAMBERG (Fermi National Accelerator Laboratory)  
(Tailblazer: 09:20 - 09:35)

[54] **ATF and Beamline Instrumentation Testing Plans**  
by Nobuhiro TERUNUMA (KEK)  
(Trailblazer: 09:35 - 09:50)

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[50] **Vertex Detector Test Beam Issues**  
by Carlos MARINAS (valencia)  
(Trailblazer: 13:30 - 13:50)

[51] **Tracking Detector Plans for Test Beam**  
by Dr. Ron SETTLES (Max-Planck-Institut fuer Physik)  
(Trailblazer: 13:50 - 14:10)

[52] **ILC Calorimetry in Test Beams**  
by Dr. Lei XIA (Argonne National Laboratory)  
(Tailblazer: 14:10 - 14:30)

[53] **Muon Detector Test Beam Plans**  
by Dr. Paul RUBINO (Fermilab)  
(Tailblazer: 14:30 - 14:50)

[49] **2nd ILC Test Beam Workshop information**  
by Roman POESCHL  
(Trailblazer: 14:50 - 15:00)
The Status of Fermilab’s Meson Test Beam Facility

Erik Ramberg
Fermilab

30 September, 2009
ALCPG09
Extraction of beam from Main Injector:

- Load 1 batch from Booster to the Main Injector
- The batch length ranges from 0.2 to 1.6 μsec in length – Full batch equals 2E11 protons
- A fraction of the beam is resonantly extracted in a slow spill for each Main Injector rotation
Spill options available at MTest

- Daily hours: 04:00 to 18:00
- Spills per min: One 4 second spill/minute, or Two 1 second spills/minute
- # Pulse trains: ~80,000 ‘batches’/second (1 microsecond train, followed by 11 microsecond void)
- # Pulses: from 5-60 ‘bunches’ per ‘batch’ (each bunch is 19 nsec long)
The Accelerator Division has installed pulsed quadrupole extraction hardware that can deliver beam within 1 to 5 millisecond short spills, or ‘pings’. Several of these pings can be delivered within the assigned 1 second spill time.
The Airfly collaboration (T988) has built a DAQ that can resolve the bunch spacing of beam arrival (19 nsec) within the entire macroscopic 4 second spill. The population distribution is relatively uniform in each batch, as shown here.
Beam Delivery to MTest User Facility

Movable upstream 25 cm Al target

Movable downstream target location

Mtest secondary beamline

Meson Test Beam Facility

Proton Mode: 120 GeV protons transmitted through upstream target

Pion Mode: 8-66 GeV beam tuned for secondaries from upstream target

Low Energy Pion Mode: 1-32 GeV beam tuned for secondaries from downstream target
User Facility

Spacious control room

Signal and HV cables

Gas delivery to 6 locations

4 station MWPC spectrometer

Two motion tables

MT6 Test Beam User Areas

Gas area

= Concrete  = Enclosed climate control areas  = Controlled access gate

23 October, 2008         E. Ramberg          Fermilab's Test Beam Facility
# Beam Rates and Electron Content

## Measured rates* without lead scatterer

<table>
<thead>
<tr>
<th>Beam Energy (GeV)</th>
<th>Rate at Entrance to Facility (per spill)</th>
<th>Rate at Exit of Facility (per spill)</th>
<th>%Pions, Muons**</th>
<th>% Electrons**</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>132,000</td>
<td>95,000</td>
<td>87%</td>
<td>13%</td>
</tr>
<tr>
<td>8</td>
<td>89,000</td>
<td>65,000</td>
<td>55%</td>
<td>45%</td>
</tr>
<tr>
<td>4</td>
<td>56,000</td>
<td>31,000</td>
<td>31%</td>
<td>67%</td>
</tr>
<tr>
<td>2</td>
<td>68,000</td>
<td>28,000</td>
<td>&lt;30%</td>
<td>&gt;70%</td>
</tr>
<tr>
<td>1</td>
<td>69,000</td>
<td>21,000</td>
<td>&lt;30%</td>
<td>&gt;70%</td>
</tr>
</tbody>
</table>

*Rates here are normalized to 1E11 at MW1SEM

## Measured rates* with 1/4” lead scatterer

<table>
<thead>
<tr>
<th>Beam Energy (GeV)</th>
<th>Rate at Entrance to Facility (per spill)</th>
<th>Rate at Exit of Facility (per spill)</th>
<th>%Pions, Muons**</th>
<th>% Electrons**</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>86,000</td>
<td>59,000</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>8</td>
<td>31,000</td>
<td>18,000</td>
<td>98%</td>
<td>2%</td>
</tr>
<tr>
<td>4</td>
<td>5,400</td>
<td>1,300</td>
<td>74%</td>
<td>15%</td>
</tr>
<tr>
<td>2</td>
<td>4,100</td>
<td>250</td>
<td>&lt;30%</td>
<td>&gt;70%</td>
</tr>
<tr>
<td>1</td>
<td>4,900</td>
<td>120</td>
<td>&lt;30%</td>
<td>&gt;70%</td>
</tr>
</tbody>
</table>

*Rates here are normalized to 1E11 at MW1SEM

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23 October, 2008        E. Ramberg        Fermilab's Test Beam Facility
The CALICE experiment (T978) has been the most comprehensive detector system to be installed at MTest and has summarized their results for beam composition.

The Fermilab Accelerator Division has created beam tunes for CALICE as follows:

**Negative**
1, 2, 3, 4, 6, 8, 10, 12, 15, 20, 30 GeV

**Positive**
32 GeV (high rate muon mode),
120 GeV (proton mode)
CALICE runs continue to be analyzed
Next step for CALICE

- Exchange the active layers of the AHCAL with the DHCAL ones
- Go for the final test beam campaign

- Compare technologies for ECAL / HCAL with data from the same test beam

expected to be ready by end of 2009 for installation in absorber frame
Muon beam at MTest

- Can maximize muon flux by running high intensity at 32 GeV, and inserting 2.5 meter beamstop just before the user area.
- Broad-band muon flux can be delivered at >5 kHz over a square meter, as shown by CALICE.
2 New Pixel Tracker telescopes in MTest

BTeV/PHENIX SENSOR TELESCOPE:

- Sensors are spares from BTeV project, read out with FPIX chip
- Pixel size is 50 x 400 micron$^2$
- Total active area per X-Y station is 6x6 cm$^2$
- Two stations currently, which should give 6 micron resolution
Beam spot (last quads off)

120 GeV proton beam:
1-track events; 3-4 spills
at low intensity
(5 Booster buckets)
93k tracks
3/20/09
New CMS Sensor Pixel Telescope

Sensors are B-grade, but functional at low intensity.

Overlap area is 2 cm x 2 cm

4 stations of 100x150 $\mu$m$^2$ pixels gives 4 $\mu$m resolution

Clever vertically integrated DAQ, called “CAPTAN”, has node processing boards and data conversion boards. Horizontal connectivity for output. Multi-threaded application software running on Windows.
Fast Timing Detectors at MTest

• Use Photek 210 (10 mm area) and 240 (40 mm) devices
• Several different configurations tested in last run
• In-line configuration gives astonishing 6 psec resolution with the 240 device
• Configuration with quartz bars at Cerenkov angle minimizes material at first measurement position
Extreme Time-of-Flight System

Start = Double-Q-bar
Stop = Photek 240
Start-stop dist. = 8.7 m

24 psec resolution positron peak, using average of A & B times

We can measure momentum of a high-energy proton using this system.
The MINERVA experiment requested space to create a new tertiary beamline that could deliver pions down to 300 MeV/c momentum.

The Particle Physics Division and Accelerator Division have agreed to help and are proceeding on installation.

Full tracking and TOF will allow for momentum measurement and particle i.d.

Target station rolls away for other users.

The full spectrometer will be tested in November, 2009.
A proposal for a test beam area in MCenter

Make this section of beam pipe easily removable.
Put concrete blocks for user stands there.

Current MTest control room

A small control room in the MWest alcove

Have test beam users use walkway in this area

Small, temporary stand for users who need Cerenkov i.d.

Cable route
For users
A possible future program at MCenter

- MIPP experiment performs measurements with updated tracking and a repaired JGG magnet.
- Use the MIPP apparatus to create a tagged neutron facility.
- Import a large bore solenoid for TPC tests
- Use the MCenter spectrometer to simulate jet physics for advanced calorimetry.
- The status of a future run of MIPP and MCenter as a test beam will be reviewed Oct. 9

Creating a 'jet' in the Jolly Green Giant

Programs possible at MCenter
Summary

- The MTest facility continues to support a large variety of advanced detector tests.
- The beamline is quite versatile, delivering secondary beams from 1 to 64 GeV, and a primary beam of 120 GeV protons. Electrons are dominant at low energies. Muons can be selected for with a beam stop.
- A new tertiary beam is being developed, which should deliver tagged pions down to 300 MeV/c.
- Two new pixel telescope systems have been created for the facility, with resolutions of 5-10 microns.
- A new TOF system has been tested, with a resolution of 24 psec. Individual measurements on a 4 cm MCP/PMT show 6 psec resolution.
- A proposal is being studied at Fermilab to support test beam activities in the MCenter beamline, perhaps in conjunction with the MIPP experiment.