Status of the Fermilab Test Beam Facility

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Snowmass – 22 August, 2005

- Review of facility
- New spill structure
- Beam rates
- Schedule and future

Web page for MTBF: http://www-ppd.fnal.gov/MTBF-w or Fermilab-at-Work → MTBF
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Meson Test Beam Facility

Introduction

The Meson Test Beam Facility is a versatile beamline in which users can test equipment or detectors in a beam of moderate energy particles (5-120 GeV) at moderate intensities (<1 MHz). Beamtime is available to qualified users as discussed below.

Weekly schedule for primary user

Assignment of user areas

MT6 Phone Numbers

Beamline and experimental area details

How to become a test beam user

Resources available for approved test beam users

"How to..." Pages

Meson Test Beam Facility MOU's

Meetings and Talks

Email archive for test_beam@fnal.gov

Useful links to Beams Division status and logs

Pictures

Details of beamline and user areas:

A layout of the Meson Lab, MTest beamline elements and MTest user areas can be found here:

- MTest User Areas Rough Outline (ps,ppt)
- Meson Lab Drawings (pdf) (ps)
- Meson Lab Autocad file (AutoCad) (IDEAS)
- MTest User Areas with radiation survey data (ps)
- MTest Beamline Elements (pdf)
- All SY120 Beamline Elements (pdf)
- Electrical system at Mtest (pdf)

A description of the time structure of the beam: (txt)

Results on composition of beam using Cerenkov detectors:

- Threshold plots: 120 GeV , 66 GeV , 33 GeV , 16 GeV , 8 GeV
- Threshold pressures vs momentum (Excel)
- Documentation of threshold curves

Study of multiple tracks as a function of rate and gate width: (postscript)

Tune parameters:

- 120 Gev, narrow beam (pdf)
- 120 Gev, recent tune (pdf)
- 66 Gev (pdf)

A spreadsheet has been made by the beamline physicist, Tom Kobilarcik. Here is the latest version of this spreadsheet and the resulting predicted rates as a function of momentum. (pdf,word)

MTest beam sheet and data file

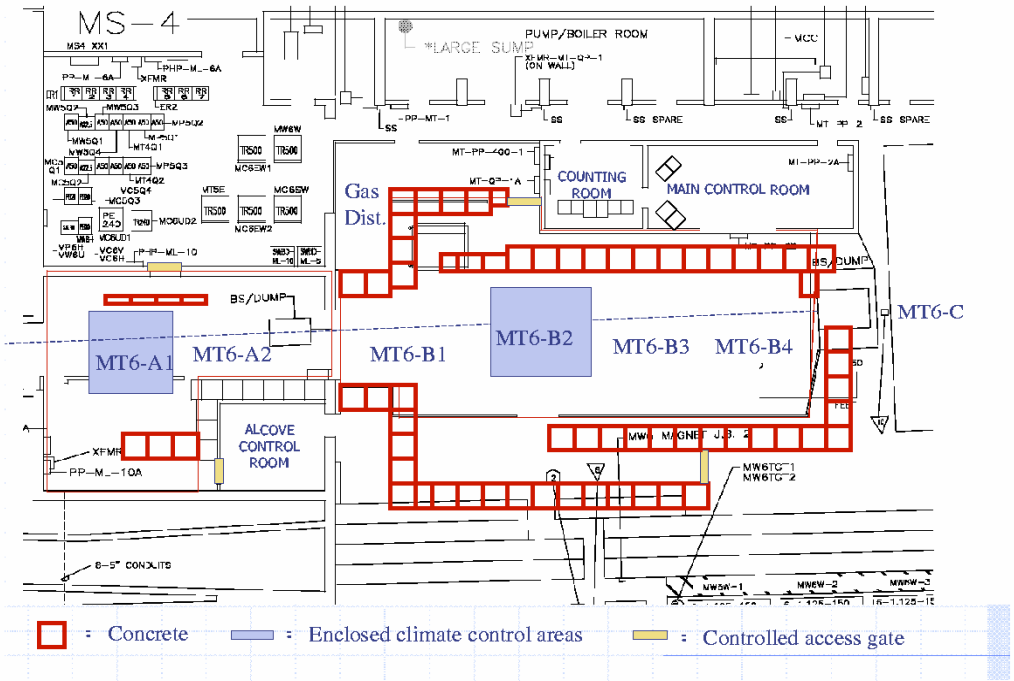
Safety documents related to the MTest facility are here:

- PPD Safety Assessment Document/Readiness Review (doc)
- MTest User Areas Radiation Assessment Calculation (ps)
- Radiation Shielding Assessment for the MT6 area (doc)

The MTest beamline was operated in 1999 for test purposes with an 800 GeV primary energy and a description of the operation of that run is in this memo:

- A New MTest Beamline for the 1999 Fixed Target Run
  T. Kobilarcik, C. Brown (ps, pdf)

MT6 Test Beam User Areas



Scale:

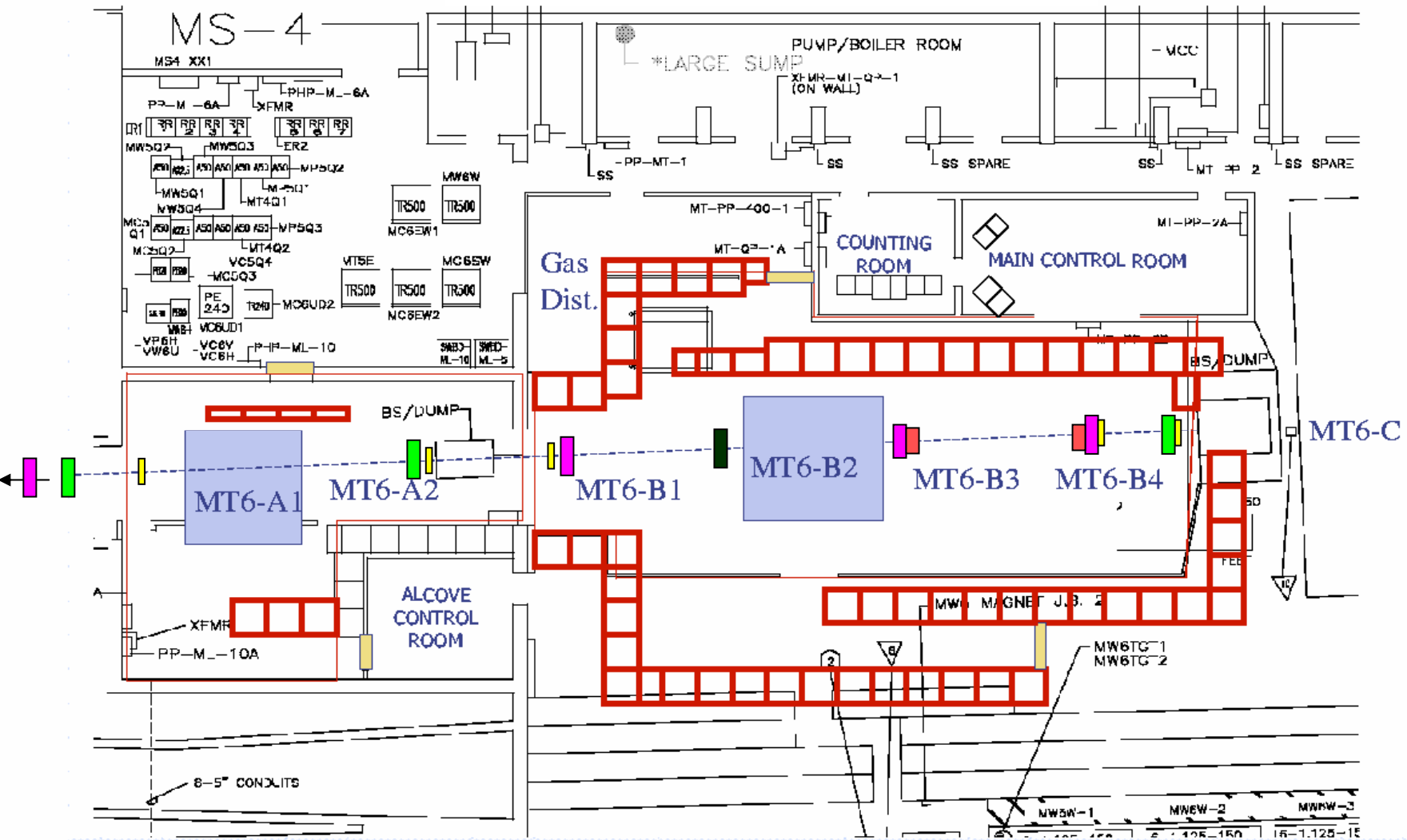
~6 m

- 2 beam enclosures, but currently operate as a single one.
- 6 user stations, with a 7th downstream of the beam dump. An experiment can take up more than one station.
- 2 climate stabilized huts with air conditioning.
- 2 separate control rooms.
- Outside gas shed + inside gas delivery system brings 2 generic gas lines, 1 nitrogen line and 2 exhaust lines to each of the user areas
- Lockable work area with 3 offices for small scale staging or repairs, plus 2 open work areas.

Facility Detectors

- Two beamline threshold Cerenkov counters can be operated independently for good particle i.d. (50’ and 80’ long)
- Two stations of X,Y silicon strip detectors are installed.
- One 0.5 mm pitch MWPC and two 1.0 mm pitch MWPC into DAQ
- Three 1.0 mm pitch MWPC into the accelerator ACNET control system.
- DAQ accepts custom triggers and dead time veto. The data from scintillators, Cerenkov counters, silicon and MWPC go into event buffers. Buffers are read out during and after the spill and this data is accessible to experimenters. (Three bit event i.d. number is included in each event.)

MTBF Detectors

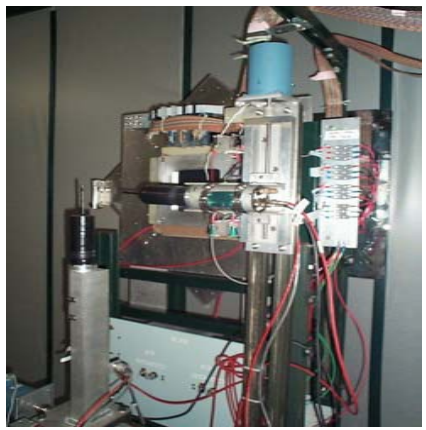


: Concrete : Enclosed climate control areas : Controlled access gate

Scint. PWC Finger counters Swic SSD

One of the two beamline Cerenkov counters

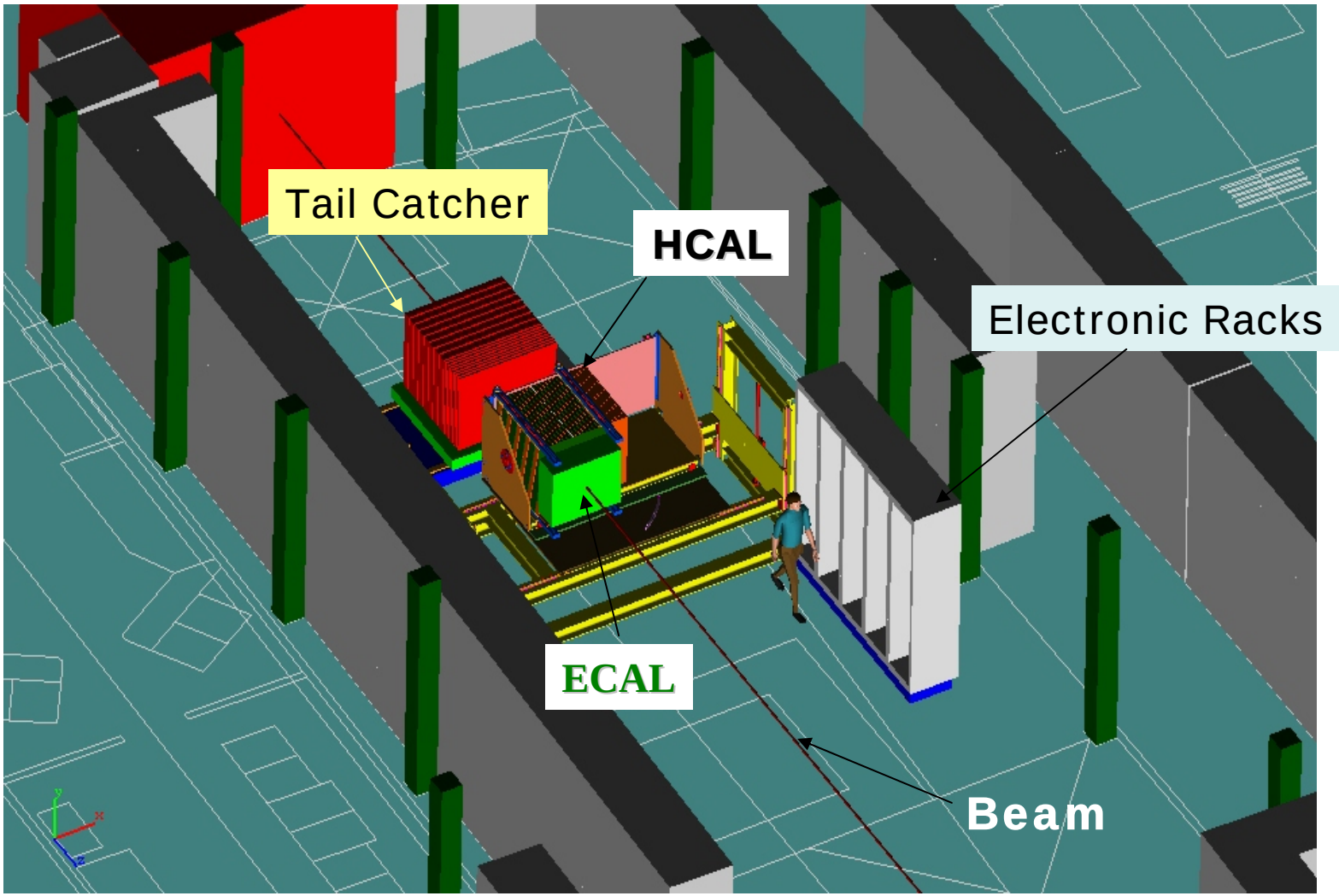
One of three MWPC stations

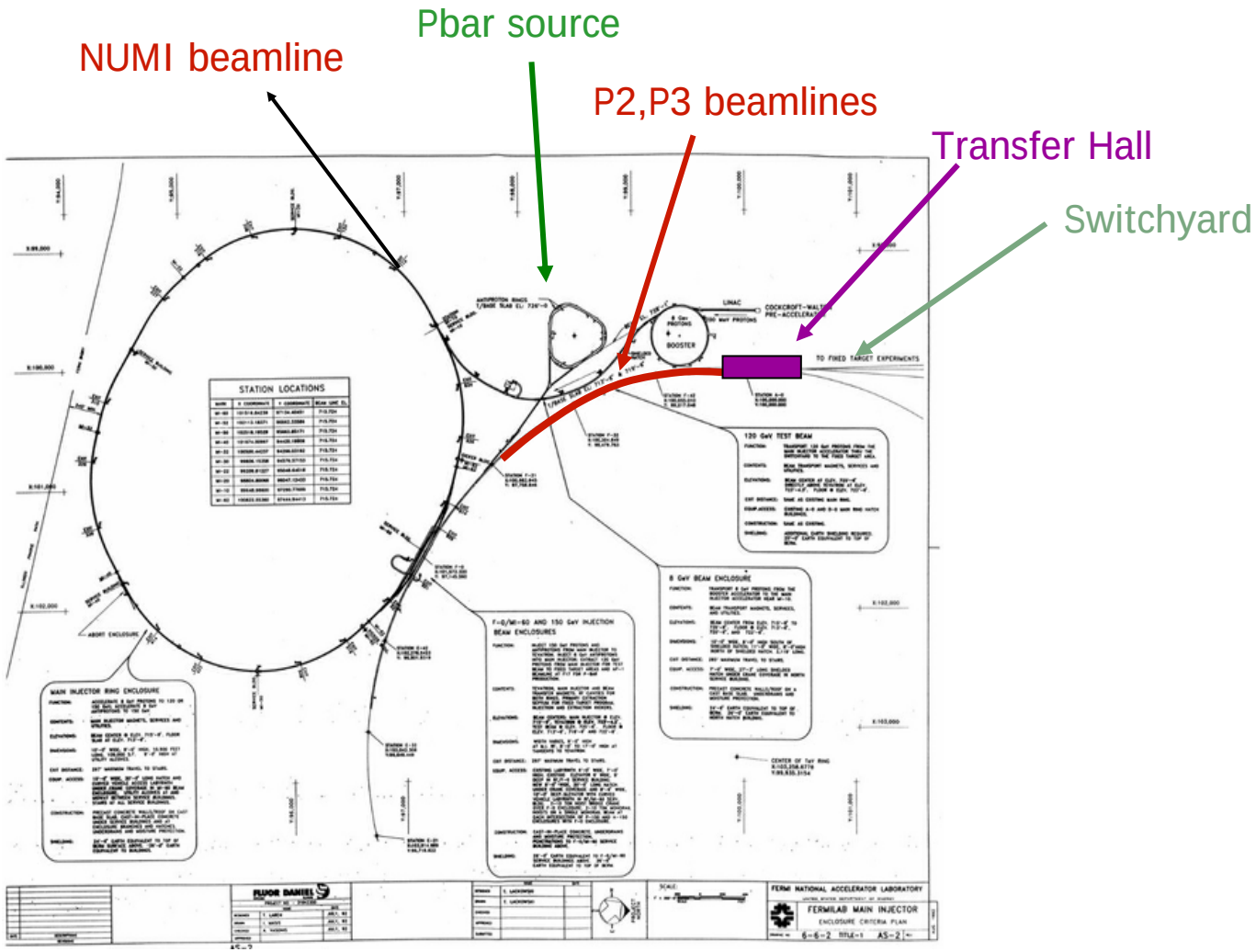


Remote controlled scintillator finger counters

Silicon tracker

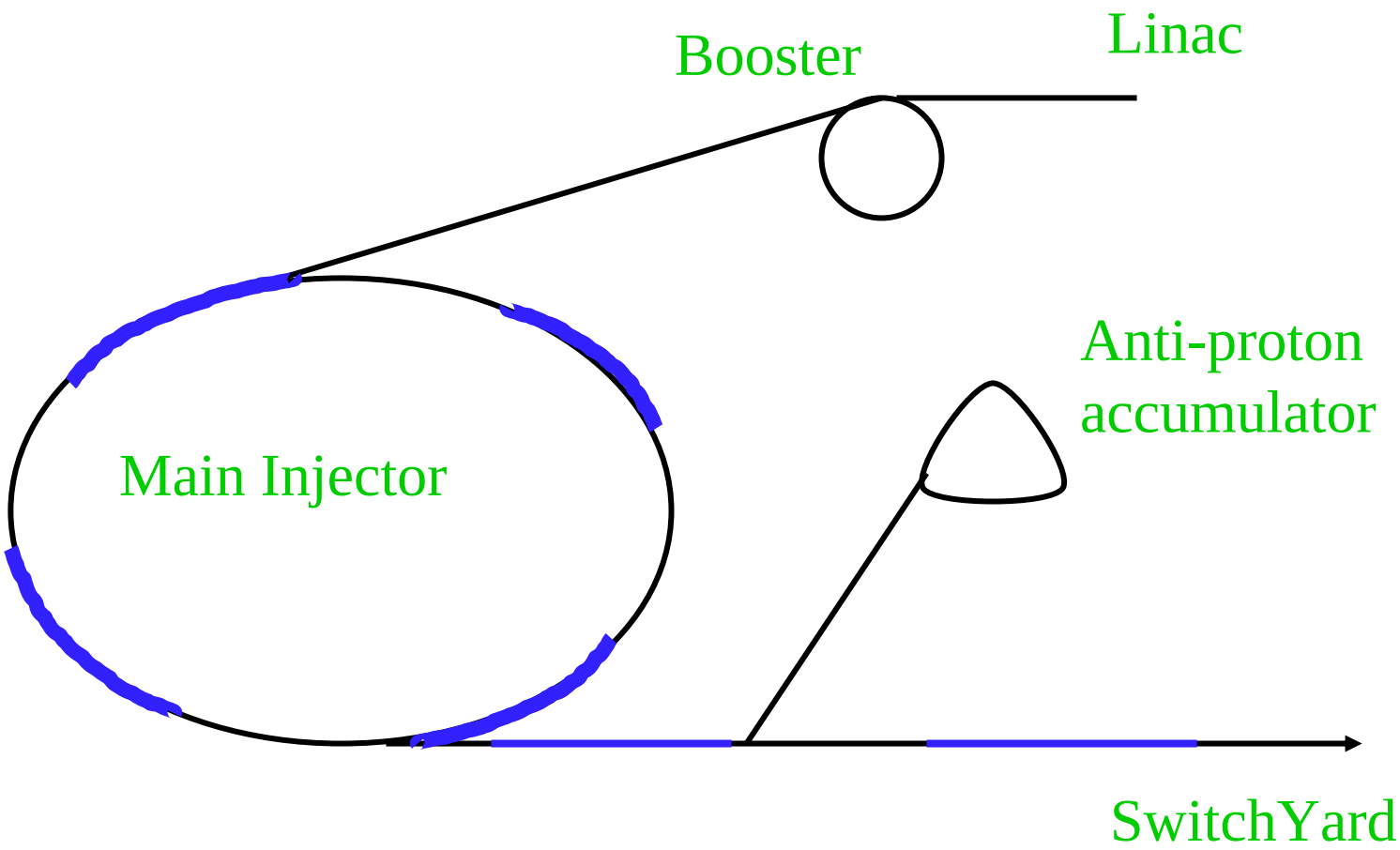
Example of CALICE Setup at MTBF





'SwitchYard 120' Beam:

- Delivers Main Injector beam to Meson Detector Building
- Runs in conjunction with protons delivered to pbar source and NUMI
- Spills to SY120 can impact NUMI and pbar production by no more than 5%



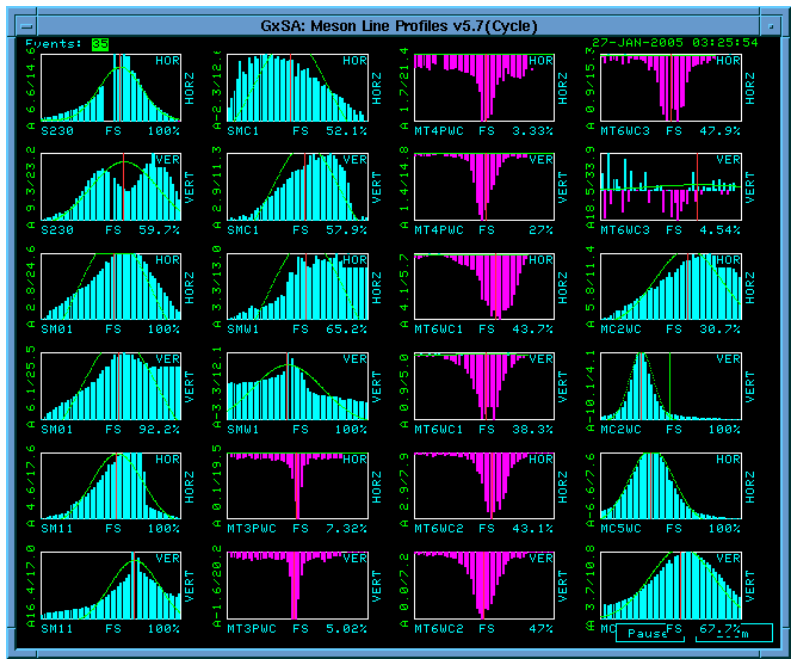
Extraction of beam from Main Injector:

- From 1 to 6 batches in the Main Injector
- Each identical batch from 0.2 to 1.6 μsec
- A fraction of the beam is resonantly extracted in a slow spill for each MI rotation
- 6 batches equals 2.4E12 protons
- Intensity per batch can be doubled, but losses start to become significant at 5 batches, 2 turns

- Program Planning determines spill structure
- Slow spill program competes for time with NUMI
- Currently spill structure is 4 second spill every 2 minutes.
- This maximizes overall duty cycle for MIPP experiment.

Operational Characteristics of Test Beam Line

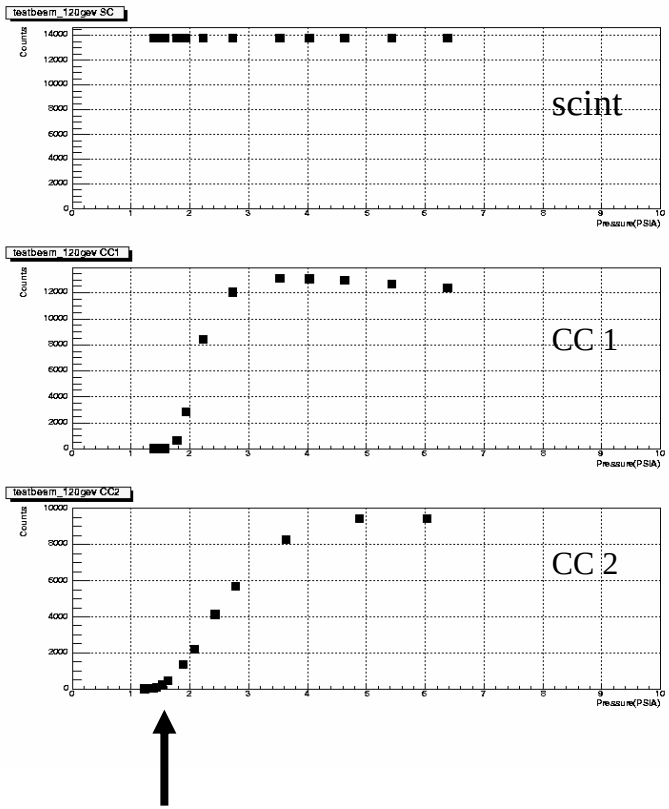
- 120 GeV protons impact on 40 cm long block of Aluminum as a production target.
- There are two operational modes of the test beamline:
  - Proton Mode: Tune beamline for 120 GeV protons that get transmitted through the target
  - Secondary Mode: Vary the tune of the beamline according to the momentum desired. Maximum momentum is 66 GeV while minimum momentum achieved so far is 3.7GeV. Lower momenta are conceivable, but pion rate will be quite low and electron scattering will probably be quite high.
- Spot sizes can be made as small as 3-5 mm square (with 120 GeV protons) and as large as 5 cm square.



Typical SWIC profiles while delivering 120 GeV beam (1 mm wire spacing: ~ 7 mm RMS)

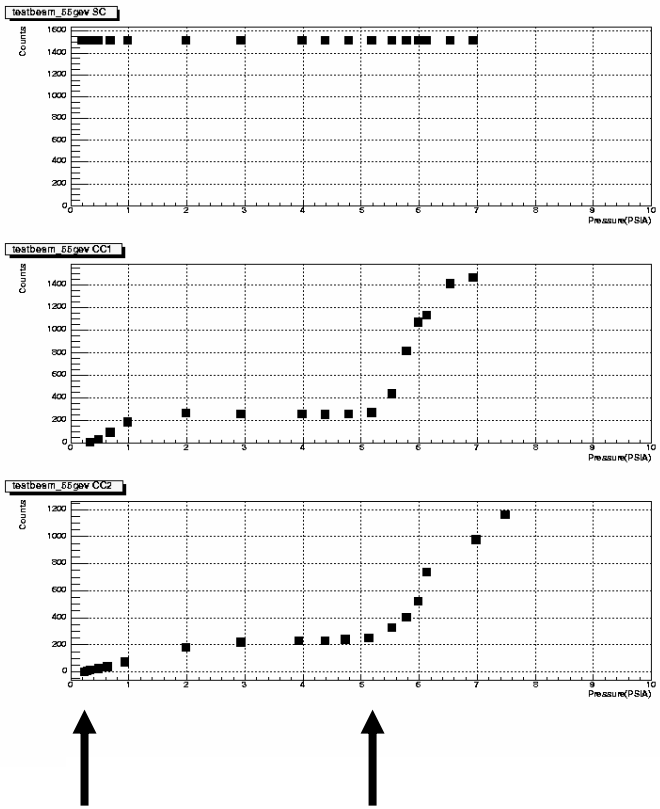
Beamline Cerenkov results

120 GeV



p threshold

66 GeV

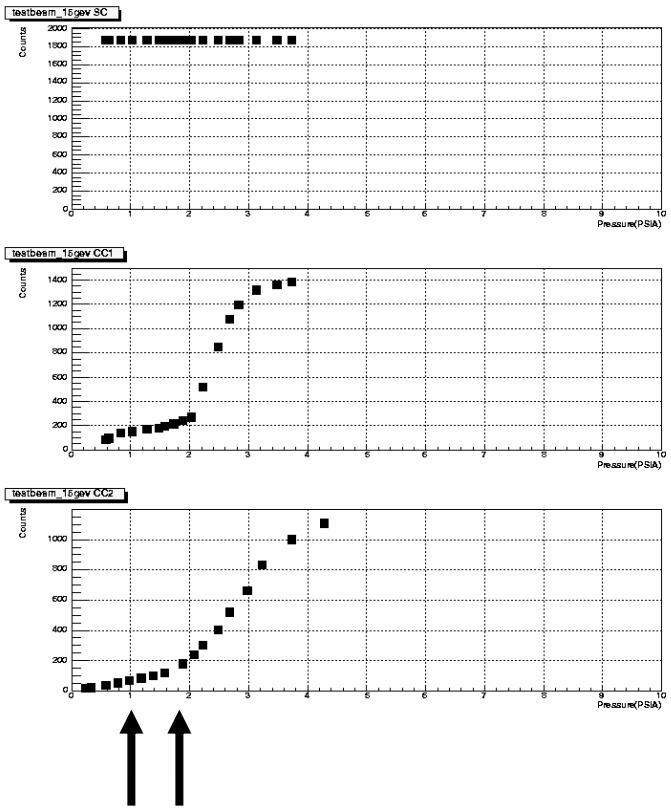


π threshold

p threshold

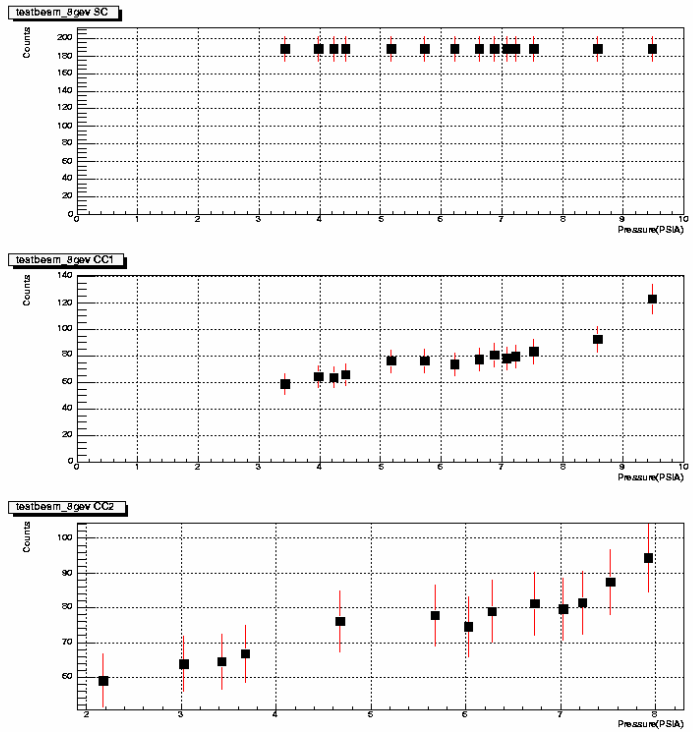
Cerenkov results (cont)

16 GeV



μ π threshold

8 GeV

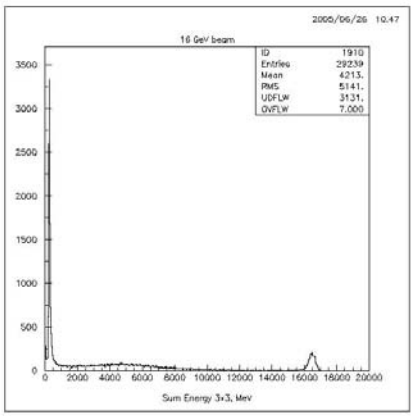


μ threshold

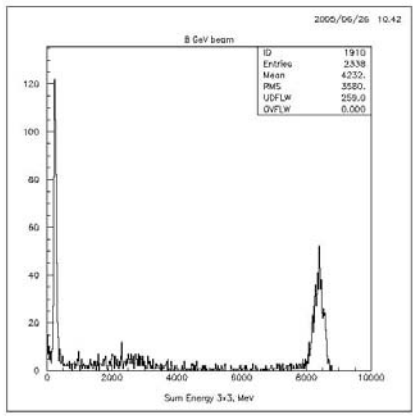
π threshold

Electrons at MTBF

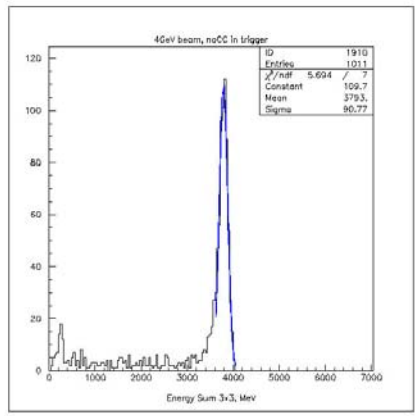
- During the last run of the BTeV EMCAL group in June, the lead tungstate calorimeter was calibrated using MIP peaks.
- Momentum selected electrons were easily identified in the 4, 8, 16 and 33 GeV tunes.
- Improvements in the beamline (better vacuum and reduction of material) made for a better electron peak.
- Rates can probably be doubled rather easily.
- The Cerenkov trigger worked very well but, of course, introduces material in the beam.



16 GeV tune



8 GeV tune



4 GeV tune

Rates in the MTBF beamline

Tune (GeV)	Rate in MT6/spill*	e^- fraction	Resolution in ECAL
120	800,000	0	-
66	90,000	0	-
33	40,000	0.7 %	1.0 %
16	14,000	10 %	1.2 %
8	5,000	30 %	-
4	500	60 %	2.4 %

* (Rates are normalized to 2.4E12 protons in Main Injector)

Schedule and future possibilities

- Current schedule has a 14 week shutdown starting on Oct. 31, 2005. Fermilab Directorate is debating now on whether to postpone that shutdown to perhaps March, 2006. A decision will be made on Sept 1.
- MIPP (MCenter beamline) is taking data now and is scheduled to complete on Oct 31, 2005. The experiment has proposed an extension of their run, using an updated DAQ. No decision has been made on this.
- If MIPP is not running, then switching from a 4 sec/2 minute duty cycle to a 1 sec/minute duty cycle should be easy. This would be advantageous at MTest if rates are data acquisition limited (i.e. >2000 events/spill for CALICE)
- Some thought has been given to moving the MTest target downstream to improve low momentum rates.
- MCenter beamline is significantly shorter than MTest beamline and could give higher rates per spill at lower momentum. But the current status of MIPP as a running experiment has higher priority than test beam.
- The maximum duty cycle of 5% for SY120 beam will likely not change in the near future.