Fermilab U.S. DEPARTMENT OF ENERGY Office of Science

Fermilab Test Beam Facility: Past Uses and Future Directions

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Neutrino R&D Facilities Workshop

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Outline

- How to access the facility and infrastructure
- Past uses
- Future plans for the facility

Procedure for Getting Beam and Typical Setup

- First step is to write the TSW (Technical Scope of Work) and contact facility manager (me)
  - Agreement between test beam collaboration and the lab over what resources are used.
    - Do you need significant engineering or tech support? Computing support?
    - Will you have enough users to cover your shifts?
  - TSW information can be found here: http://ftbf.fnal.gov/tsw-how-to-write/
    - Can be a broad document, cover multiple years and uses
    - Approval process typically takes 4-6 weeks, but can be faster, depending on needs.
  - **My job is to help you with this, don't hesitate to ask**
    - We are currently redoing this process to make it easier on everyone involved. Final product should be out later this year.

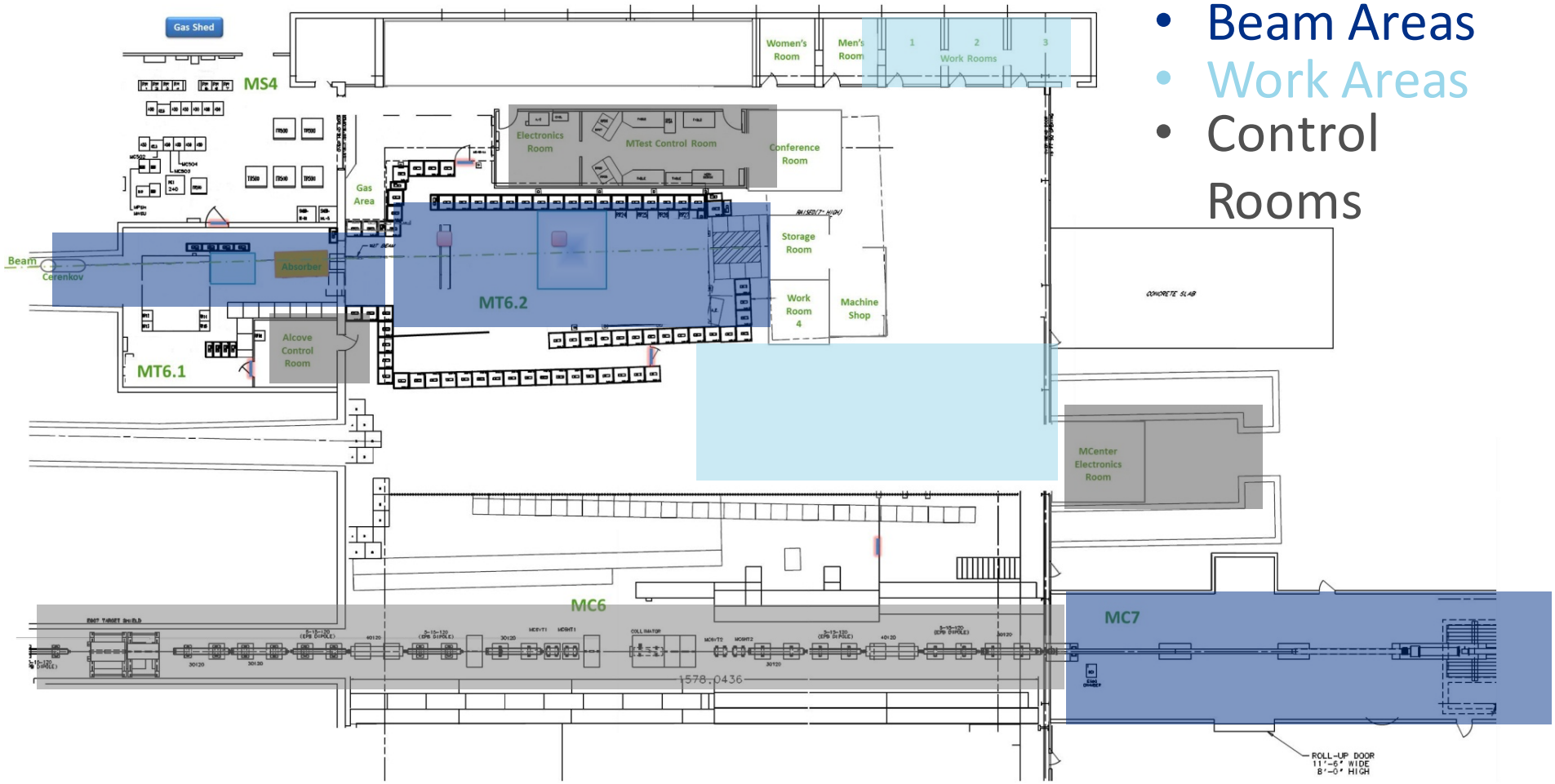
Running a Test Beam Experiment

- Running at the test beam
  - We change over experiments on Wednesdays. It's best to get here the Monday before if you can
    - Take care of training (we can arrange special classes and many can be done online before you come)
    - start staging equipment, get computing access.
  - Install on Wednesday, plan for an Operational Readiness Clearance walk through.
    - A committee of safety experts review equipment, decide it's safe to operate in the beam environment.
    - Walkthroughs can be quick, but sometimes signatures can take time.
    - Advance electronic drawings are very helpful

Tips for a smooth run

- When planning run times – take into account that we can only guarantee 80% up time of the accelerator. Also, might lose a day to ORC signature gathering
  - This is also being overhauled, so should improve
- We can help in advance with DAQ integration, building support structures…
- Provide detailed electrical drawings. Will make the walkthrough go faster.

Facility Layout



- Beam Areas
- Work Areas
- Control Rooms

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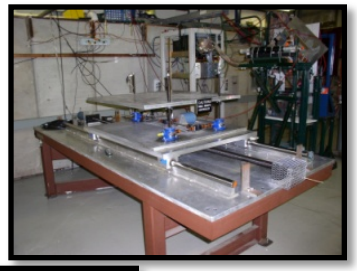
Beam Details

- Full details can be found: http://ftbf.fnal.gov/beam-overview/
  - 4 sec spill every minute
  - Tunable rate, beam available 24/7
- MTest Beam line
  - Best for high energy experiments
  - 120 GeV protons
    - Primary beam
  - 2 – 60 GeV secondary beam
  - Spot size about 2cm
- MCenter Beam line
  - Tertiary beamline down to 200 MeV
  - Currently have cryogenic support for LArIAT

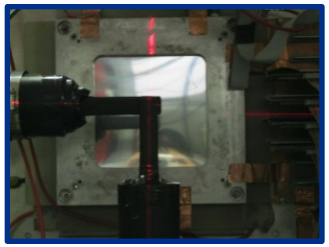
MCenter Beamline

- MCenter now delivering beam to the LArIAT experiment.
- Will further develop this beamline for future users
- Can provide cryogenic support for future users
- Possible magnetic field?

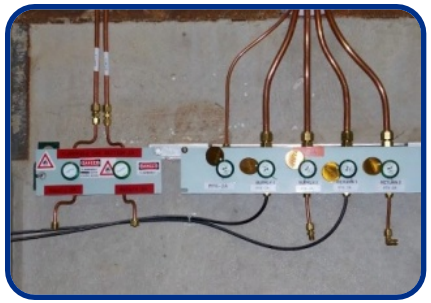
Infrastructure at MTest



- ACNET controlled Motion Tables
- Laser Alignment
- Helium Tubes

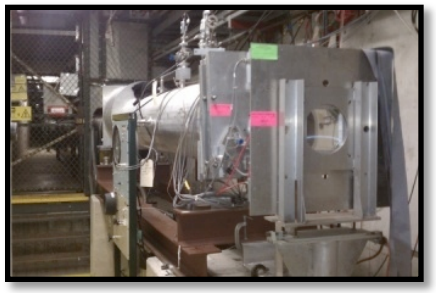


- Web-based Cameras
- Crane Coverage (30 tons)
- Climate controlled Huts
- Gas Patch panels
- Signal, Network, & High Voltage cable patch panels



Facility Instrumentation

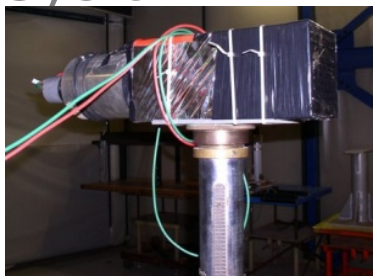
- 2 Cerenkov Detectors



- 1 Pixel Telescope

- 4 MWPC Tracking Chambers

- Time of Flight System



- Lead Glass Calorimeters

- Assorted Trigger scintillators

- **Possible upgrade over the summer shutdown with more beam instrumentation

Past Uses of the Test Beam

- Broad use of the facility over the years
  - Neutrino physics, muon physics, collider physics, general R&D, student training
- We can accommodate a variety of needs
  - High energy hadrons (120 GeV Protons)
  - Medium energy (~60 GeV)
  - Low energy (< 500 MeV, tertiary only)
- Cryogenics support (still in progress)
- Tech support

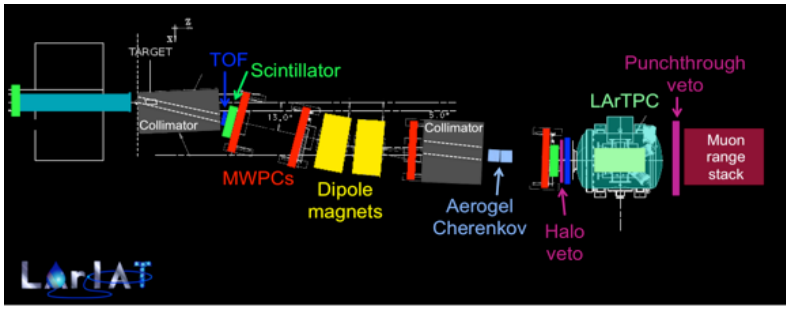
Neutrino Physics at the Test Beam

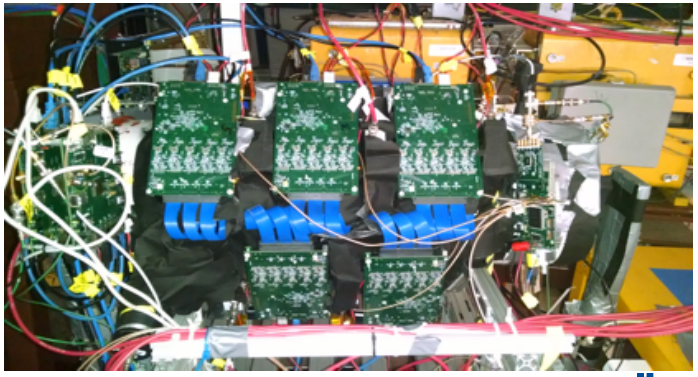
- MINERvA, LArIAT, T1059 all had runs in FY15
- MINERvA
  - Measured the energy response to pions in different parts of the detector (and provided feedback to the facility about beam energy spread).
  - Tested many versions of firmware
  - Test beam program very important to scientific goals of the full experiment

The MINERvA Detector

Neutrino Physics in MCenter

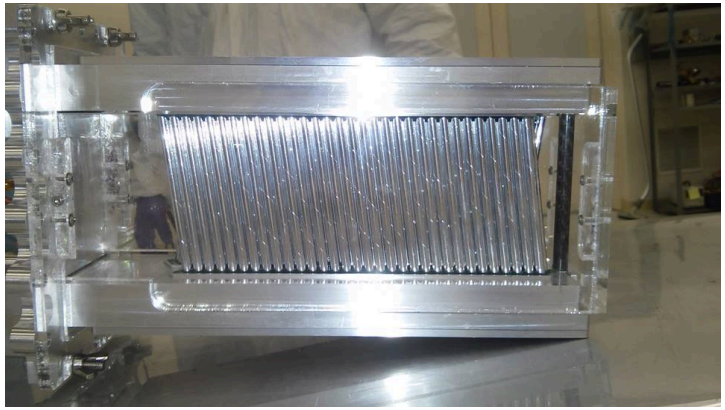
- First physics taken with MCenter beam line
- LArIAT
  - Liquid argon detector, installed cryogenics
  - Characterize performance of liquid argon
  - Took physics data this run
- T1059
  - Optical TPC
  - Reconstructing 3D tracks



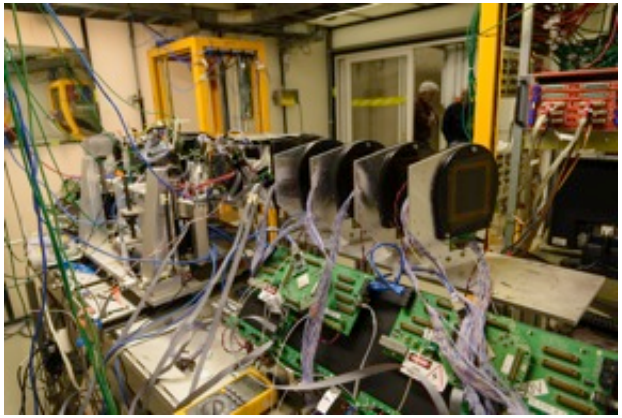


General R&D, Muon Physics, Collider Physics

- Hosted 2 muon groups (g-2, Mu2E)
  - g-2 tested their straw tracker
  - Mu2e tested their cosmic ray veto
- Hosted many collider physics groups
  - CMS and ATLAS groups, along with future collider groups
- General R&D groups
  - Testing characteristics of new detectors



g-2 Straw Tracker



Training for Students

- In addition to Detector R&D, the test beam is a great place to train future generations of students.
- T1059 was designed, built, and executed by a UChicago grad student, who earned his Ph.D. on the project.
- We hosted a large group of HS students this past summer
  - One group doing QuarkNet work
  - One group doing radiation students for nuclear power plants
- Great way to get hands on experience with detectors and running an experiment.

Current Projects and Future upgrade plans

- Currently adding a DAQ to the test beam.
- Want to add more instrumentation
- Beam studies to understand the dynamics
- Simulations of the beamline and the detectors
- Slow Controls, monitoring.
- We plan to continue to optimize both the MTest and MCenter beamlines.
- Interest from Japan on emulsion handling and developing facility
  - Looking for collaborators.
- Interest in irradiation facility
- Interest in magnetic fields