Fermilab U.S. DEPARTMENT OF ENERGY Office of Science

Fermilab Test Beam Facility

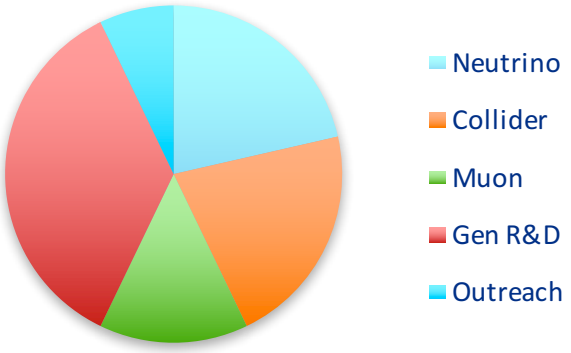
Mandy Rominsky

49th Annual Users Meeting

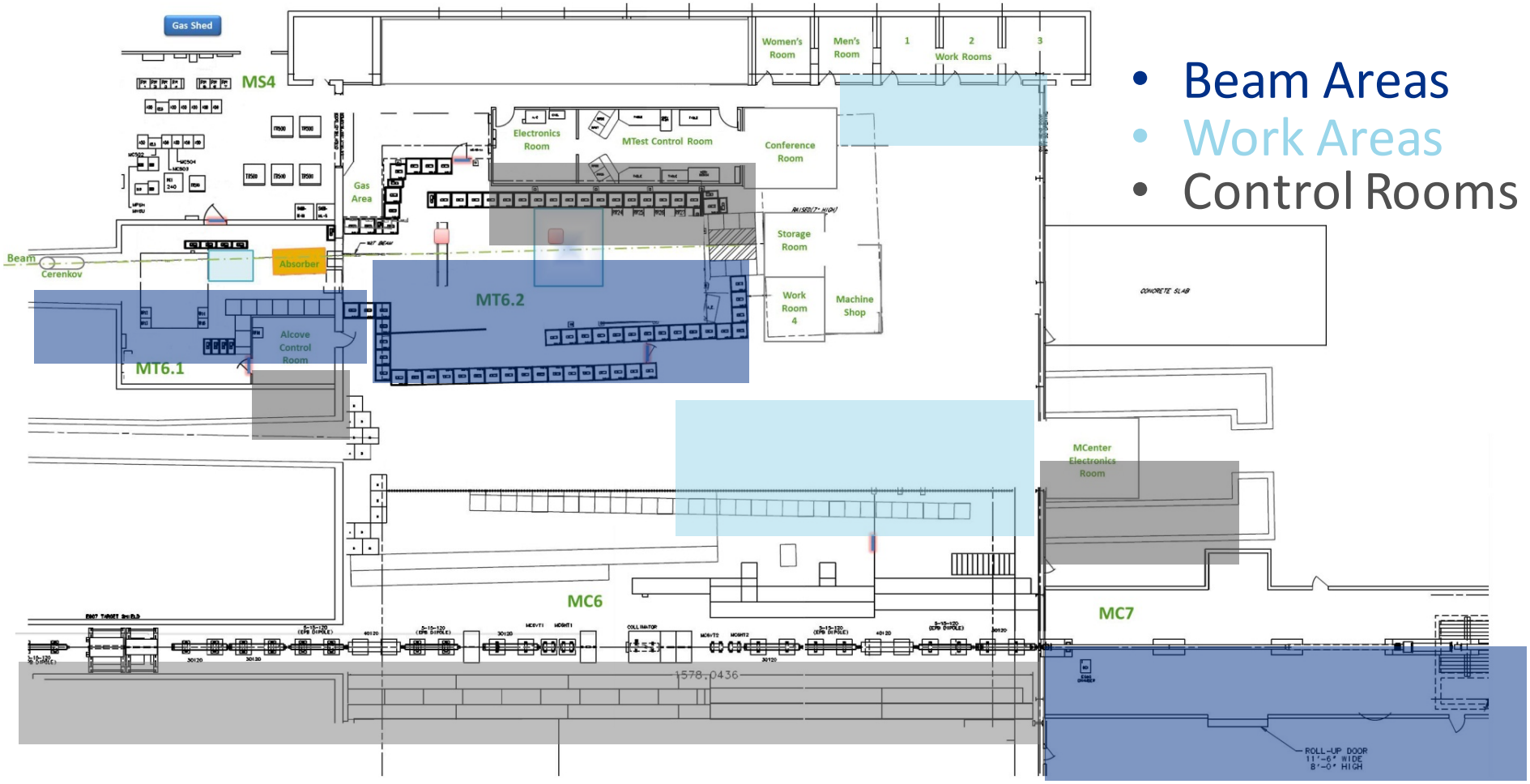
16 June 2016

The Fermilab Test Beam Facility

- Since 2005, we've had 835 users from 177 institutions and 30 countries
  - Broad range of research topics
- Two beamlines
  - MTest: 120 Gev protons, 2-80 GeV mix
  - MCenter: 200 MeV to 80 GeV mix



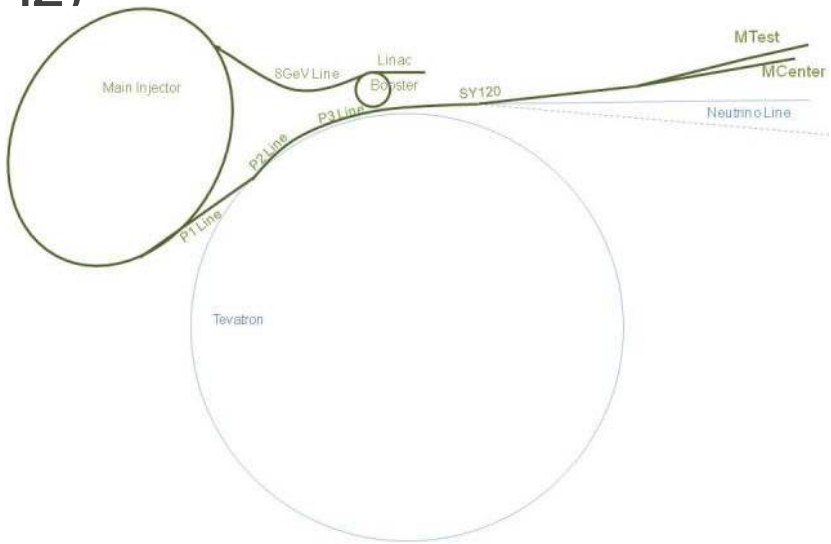
Facility Layout



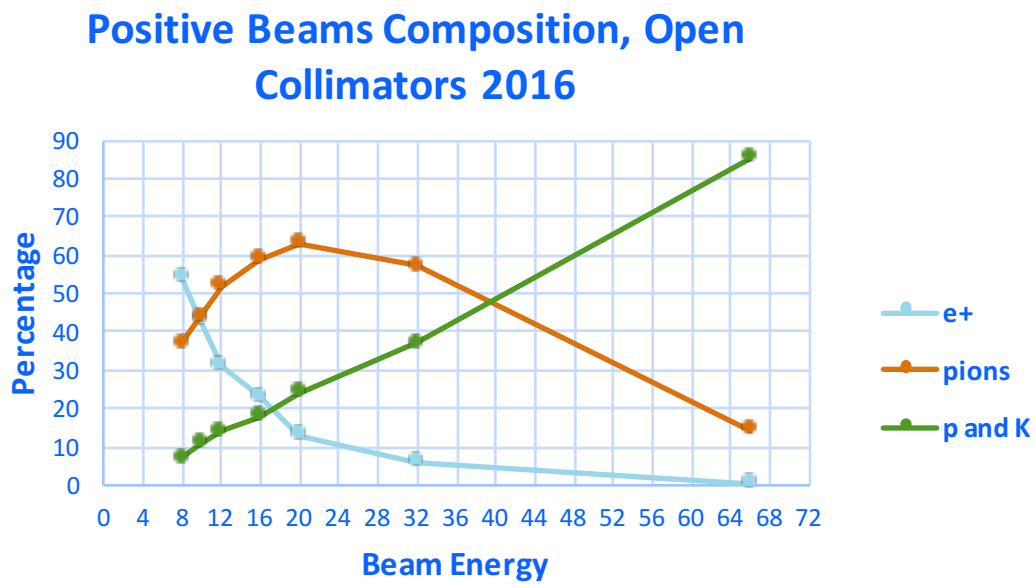
- Beam Areas
- Work Areas
- Control Rooms

Beam Details

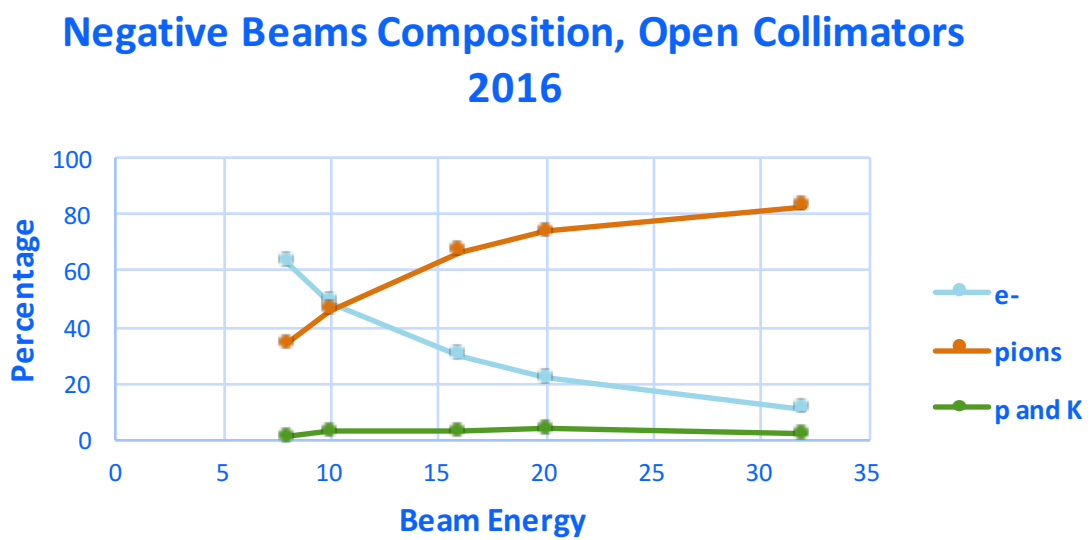
- Full details can be found: http://ftbf.fnal.gov/beam-overview/
  - 4 sec spill every 60 seconds
  - Tunable rate (100 Hz – 100,000 Hz)
  - Beam available 24/7
- MTest Beam line
  - 120 GeV protons (primary)
  - 1 – 60 GeV secondary beam
  - Spot size about 2cm
- MCenter Beam line
  - Tertiary beamline down to 200 MeV
  - Currently have cryogenic support for LArIAT (Liquid Argon In A Test Beam)



Beam Composition Studies – In Progress



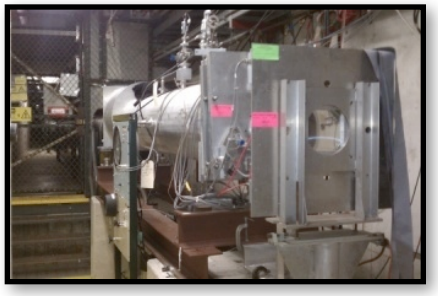
Studies done by E. Skup and D. Jensen



- Plans to continue this study as schedule allows
- Put into a database with all running conditions recorded

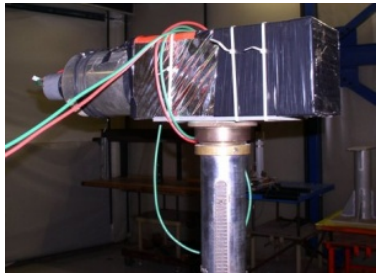
Facility Instrumentation

- 2 Cerenkov Detectors



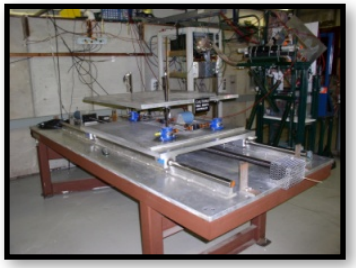
- 1 Pixel Telescope

- 4 MWPC Tracking Chambers
- Lead Glass Calorimeters

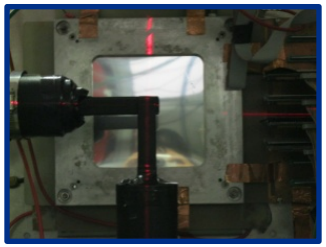


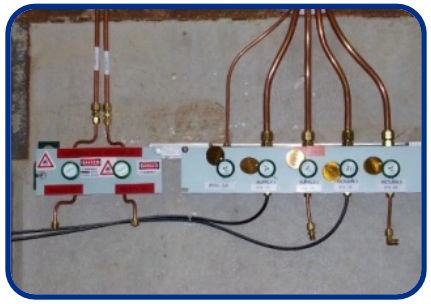
- Assorted Trigger scintillators

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 pane

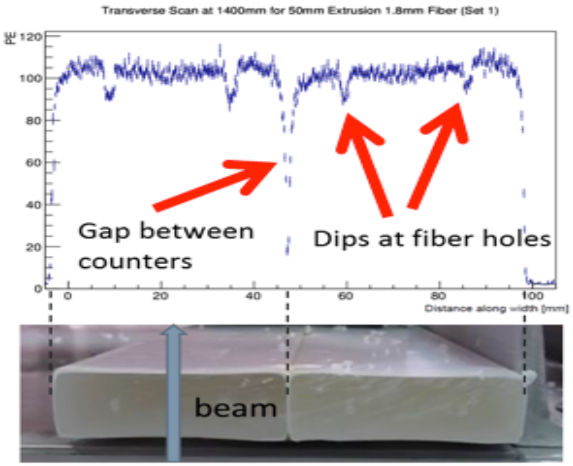




Muon Physics

- g-2 tested their straw tracker
  - Full system test
- Mu2e tested their cosmic ray veto
  - Measured PE yields in their scintillation counters
  - Took results to DPF
- Muon Systems for future colliders
  - Very good results for first few tests
  - Able to run parasitically

g-2 Straw Tracker



Mu2e detector and results

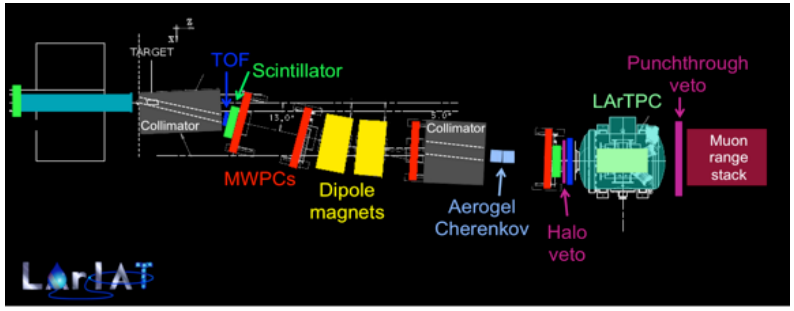
Neutrino Physics – MTest

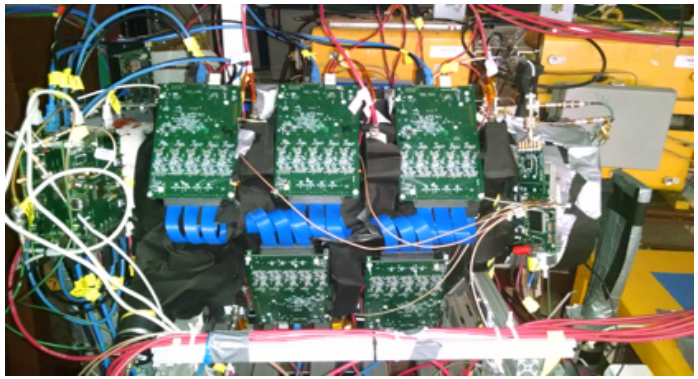
- MINERvA, LArIAT, T1059 all had runs in the past year
- MINERvA
  - Measured the energy response to pions in different parts of the detector (and provided feedback to the facility about beam energy spread).
  - Tested many versions of firmware
  - Test beam program very important to scientific goals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

The MINERvA Detector

Neutrino Physics - MCenter

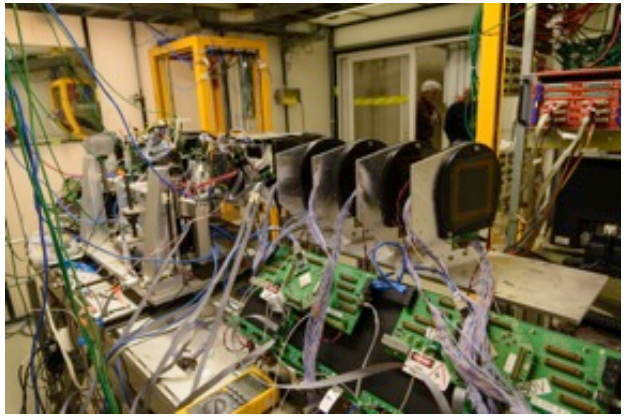
- First physics taken with MCenter beam line
- LArIAT
  - Liquid argon detector, installed cryogenics
  - Characterize performance of liquid argon
  - Took physics data this run
- T1059
  - **Student built, tested and analyzed data for an optical TPC.**
  - Ph.D. awarded based on this work

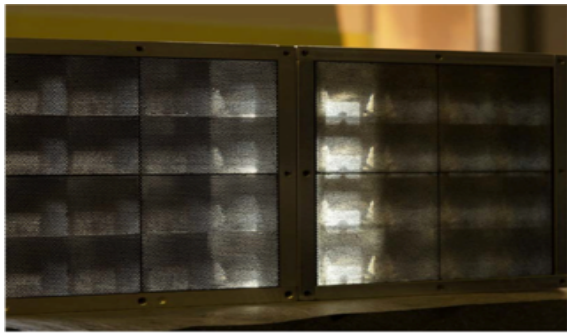


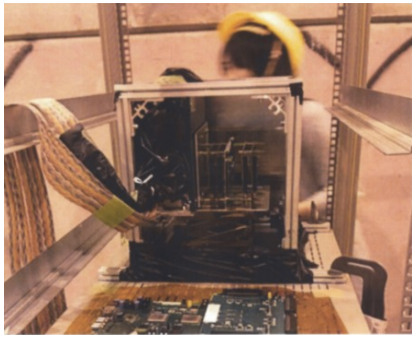


Collider Physics – A sampling

- Groups came in for LHC, ILC, RHIC
- T992
  - Testing radiation hard sensors for SLHC
  - Developed a silicon strip/pixel telescope that will stay at test beam once they are done
- T1018, T1048, T1037, T1044 (RHIC, EIC)
  - Developing W powder SciFi technology for use in RHIC and EIC
  - Tests of calorimeters, Time of Flight systems
  - Ongoing program continues to test different options
- T1068
  - ATLAS group testing telescope for sensors

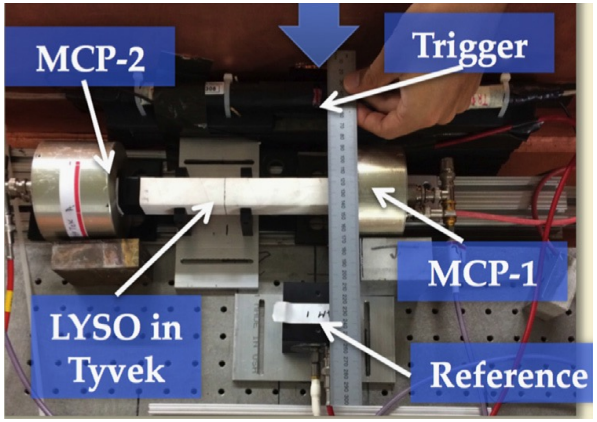


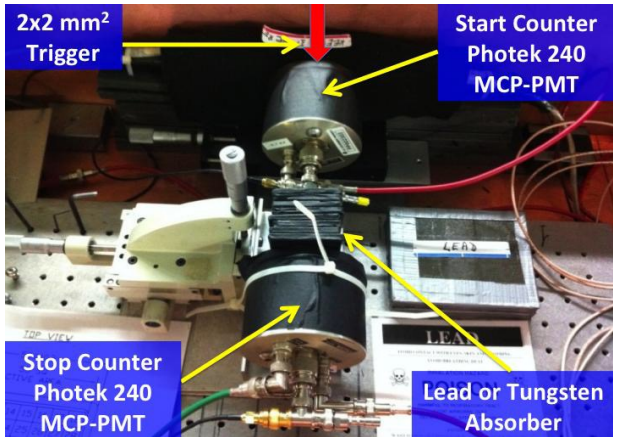




General R&D – A sampling

- Many groups came to test general R&D concepts
- T1058
  - Testing time properties for LYSO calorimeters
  - Full module gives 30 picosecond timing
- T1065
  - Testing time and position resolution of fast, radiation hard, low cost calorimeters
  - 13 ps timing resolution demonstrated
  - Coming back for continued studies.





Training Ground 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.
- We participate in the EDIT school

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.

Conclusions

- The Test Beam facility is a world class facility dedicated to detector R&D
- We are excited to help our users achieve their goals and make their test beam run as smooth as possible.
- Please contact me for information on scheduling time (rominsky@fnal.gov, http://goo.gl/forms/GECh9hSoXjt6jUeU2)

Backups

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

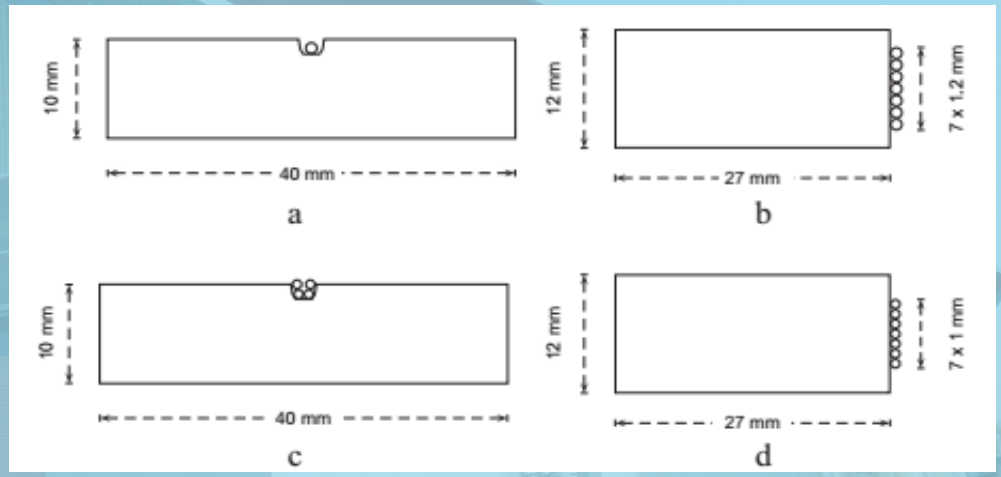
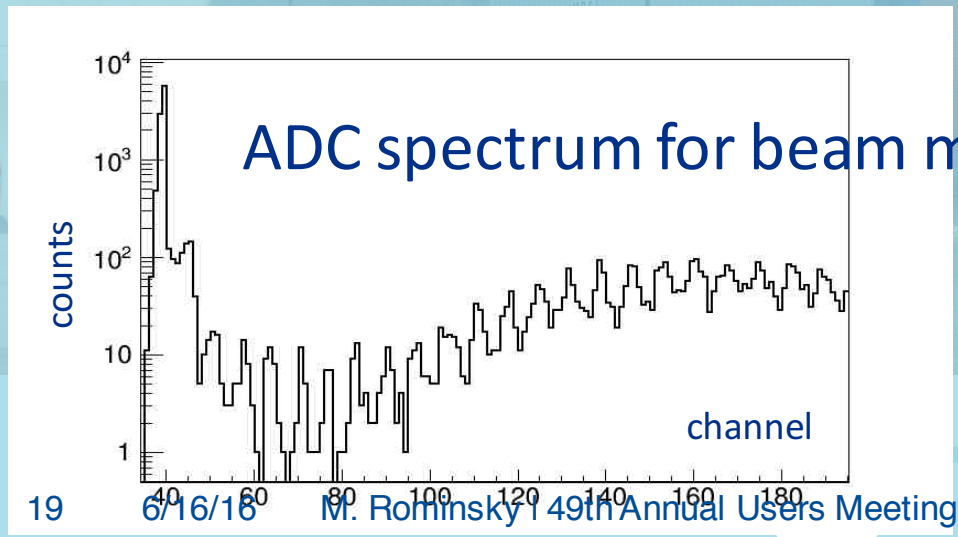
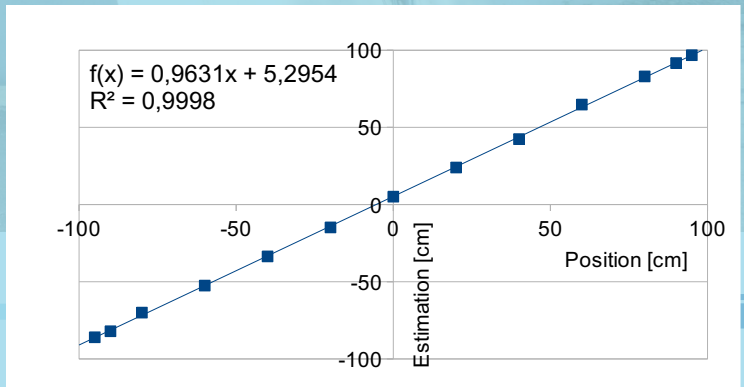
Tips for a smooth run

- 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.

Test Beam Studies of the Muon System Detectors for Future Colliders - Vinca (Belgrade)/IHEP (Protvino)/Fermilab

- Intense beam of muons after beam dump used
- Data collected and analyzed within six weeks
- Scinitllator strips of various configuration with WLS readout and SiPMs are studied
- **Record longitudnal coordinate resolution of ~5 cm for counters up to ~2 m long obtained!**

SiPMs provide excellent photoelectron counting simplifying calibration and amplitude measurments



High linearity of time vs coordinate response observed