Status of the Fermilab Test Beam

Mandy Rominsky

FTBF Committee Meeting

03 November 2017

Recommendations from last year

- Prepare and plan for a spike in requests at the FTBF during the next long CERN shutdown. The period during 2019/2020 will be crucial for the LHC HL-LHC upgrades, and a time where the CERN facility will be unavailable.
  - Develop criteria ahead of time to deal with the expected increase of requests and deal with possible over-subscription
  - Ask the large experiments (CMS, ATLAS, mu2e, PHENIX) to bundle their requests with prioritization to ensure that the received beam time is in line with the priorities of the experiments.
- This is an ongoing conversation. The groups are aware of this as a problem and we'll continue to discuss this.
  - We would appreciate committee help (especially other test beam coordinators) with criteria

Recommendations

- Formalize the procedure for getting credit for the FTBF in papers and conference with FNAL PUB numbers.
  - Each user who submitted a paper to us this year was also pointed to the FNAL website to get a number
  - Will send this information to users throughout the year this year
  - Finish FTBF paper and put on ArXiv to provide actual reference
    - This is ongoing

Recommendations

- Consider increasing dedicated FTBF labor
  - Augment the FTBF staff with another physicist for six months
  - lab should provide labor not “as needed” but dedicated to facility. “As needed” allows facility to run but prevents any improvements to be done.
- Recently submitted a job requisition to hire a new full time applications physicist.
- Were given some time with engineering physicist, but unable to get some of the assigned projects done (due to his working on other high priority projects)

Recommendation

- Continue to work on the characterization of the beam, and understand from user community if the purity and resolution of the beam is adequate for user needs
- Discussed in future slides
  - Beam characterization continues to be a joint effort between ourselves and our users

Recommendation

- Start tracking user needs for the “proton tax” discussion that will occur in the future. For instance, are users sensitive to total number of protons or beam time? How would “proton tax” changes be implemented?
- See FY18 portion for information

Recommendation

- Continue to focus on the MIDAS platform and integrate the Si telescope into this platform.
- Continues to be a back and forth but the computing division has come up with a DAQ and are willing to develop and support it.
  - See next section for FY17 progress for details

Recommendation

- Consider increasing the M&S budget for smoother running of the facility, and include both ongoing maintenance and future upgrades in this budget
- M&S budget steady from previous years, but did request more
- This past year we purchased DRS4 boards, 3 new DAQ servers, and more control room computers

Recommendation

- FNAL management should consider defining its Accelerator Safety Envelope such that routine FTBF activities do not constitute a change of this document
- While we haven't visited this issue recently, we are finding that the ORCs go more quickly with the new tool. We've also started inviting inspections earlier in the process, this seems to be making the issues less of a problem.

Questions?

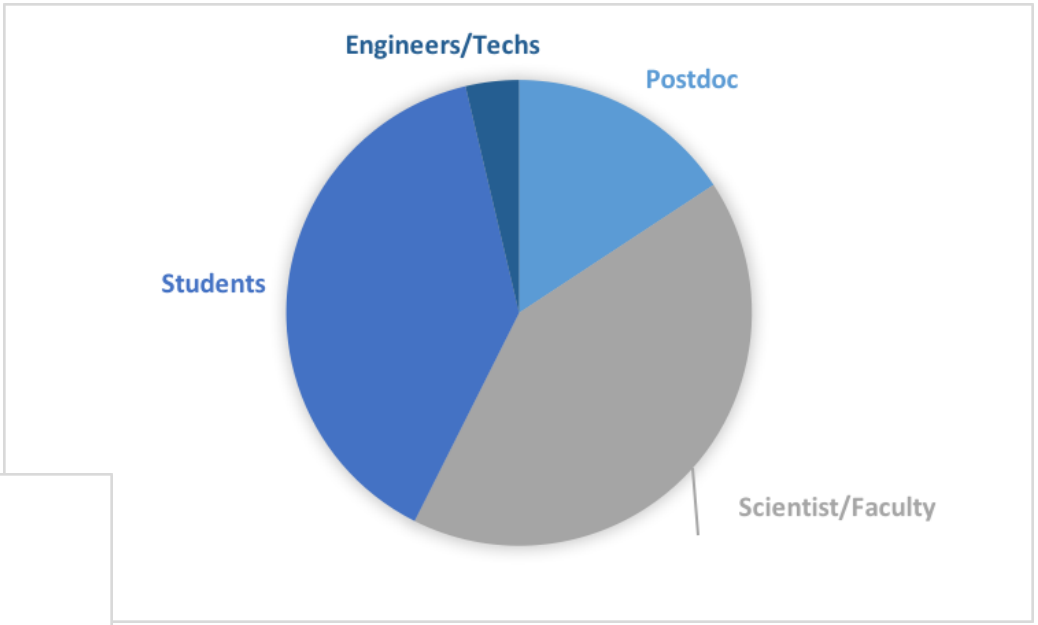
Comments?

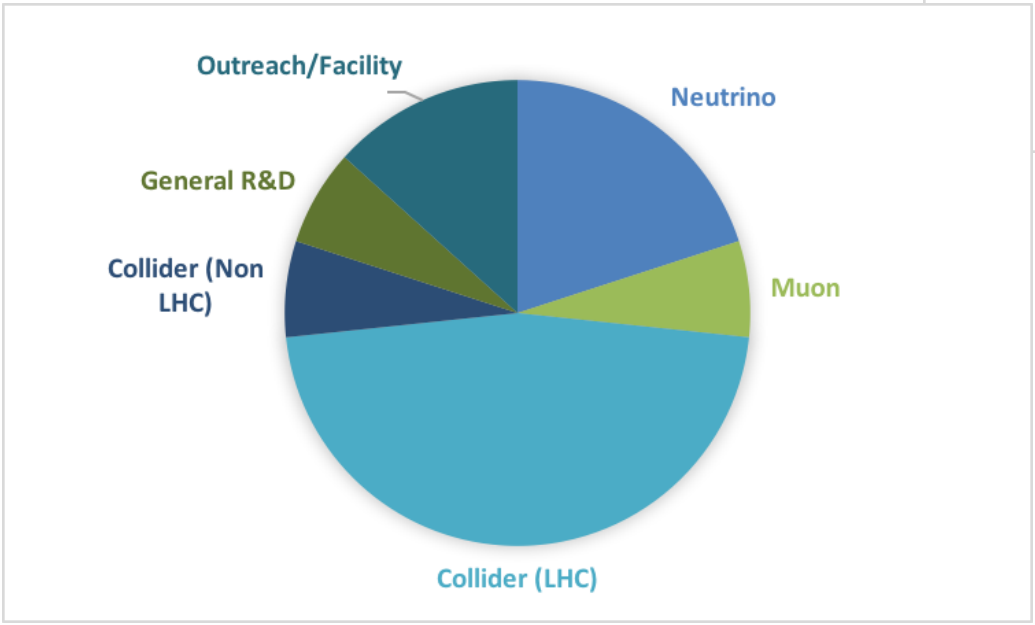
FY17 Report

- General statistics
- Specific users
- Facility projects

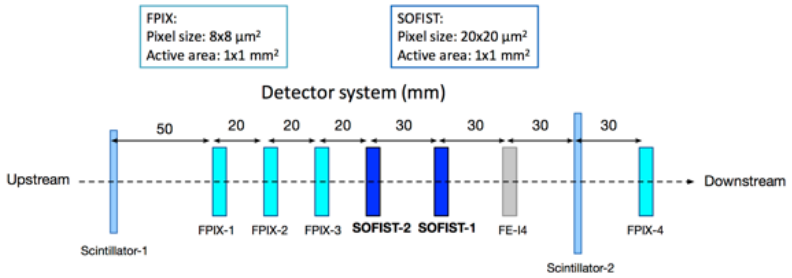
FY17 Users

- Continued to have a broad base of users and research topics.
  - Many students came this year
  - Users from 3 out of 4 LHC experiments

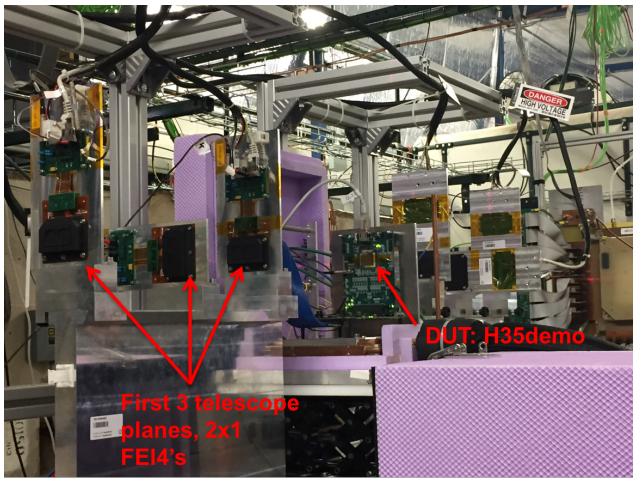


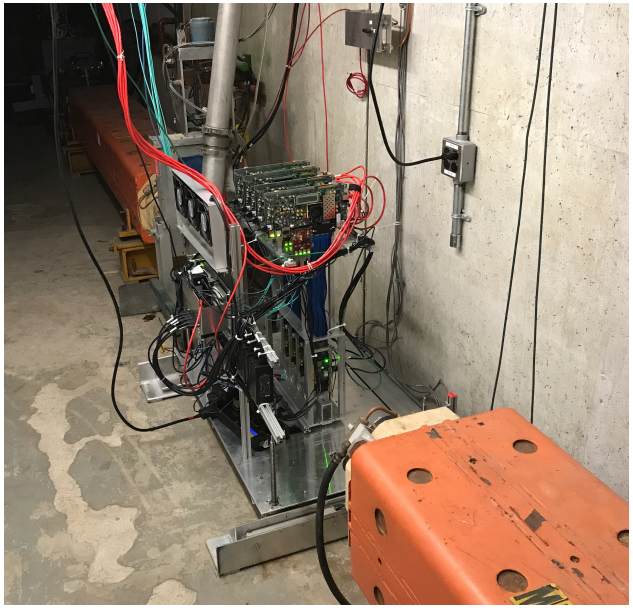


LHC Groups



- ATLAS (T1068 and T1224)
  - Both groups testing radiation effects on sensors for the HL-LHC upgrade
  - Results from the test beams are used for selection of appropriate technology
  - T1224 intends to build a telescope at FTBF for future use over the next few years.





- LHCb
  - Testing irradiated sensors

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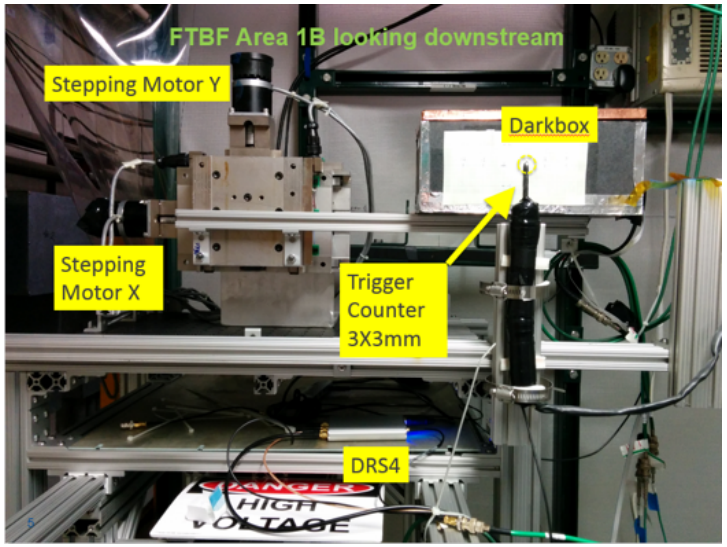
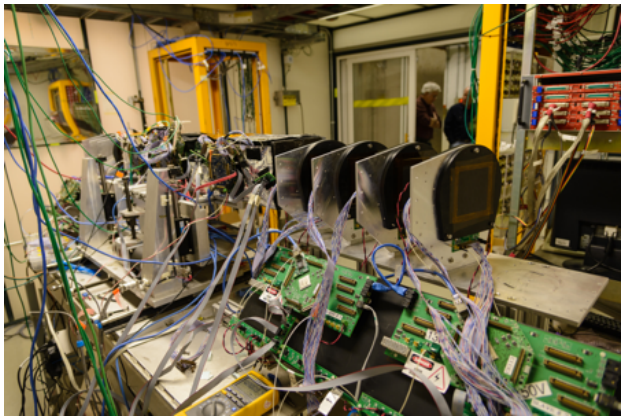
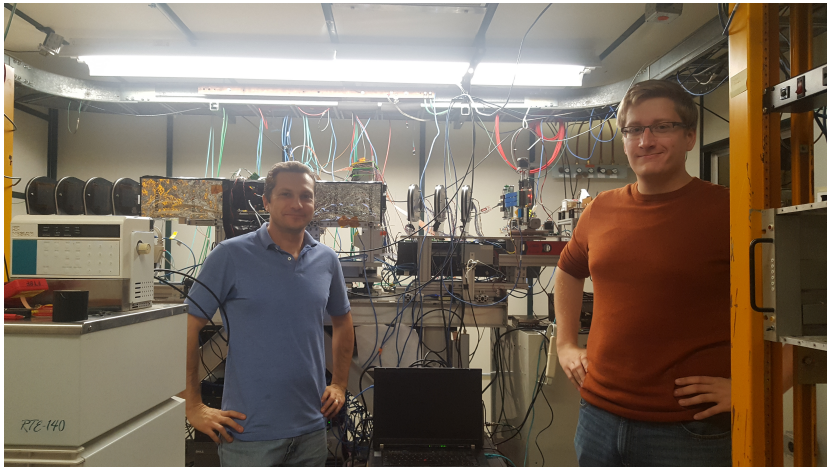
LHC

- CMS
  - Testing irradiated sensors
  - Testing Outer Tracker readout chip
  - Testing properties for SiPMs and scintillator for HGCal

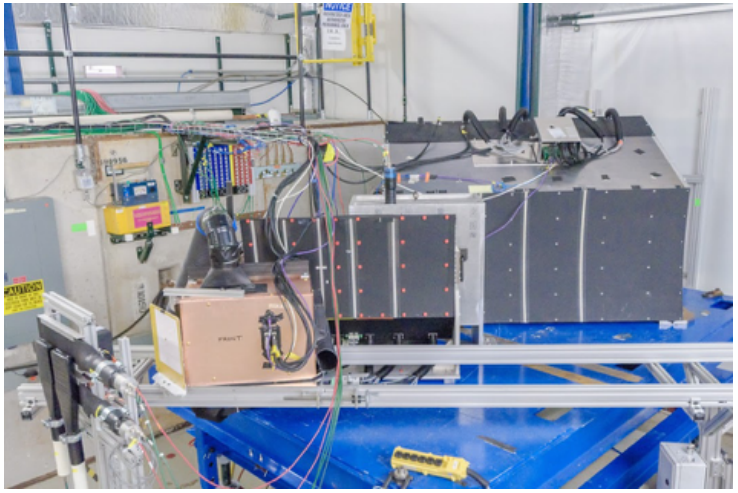




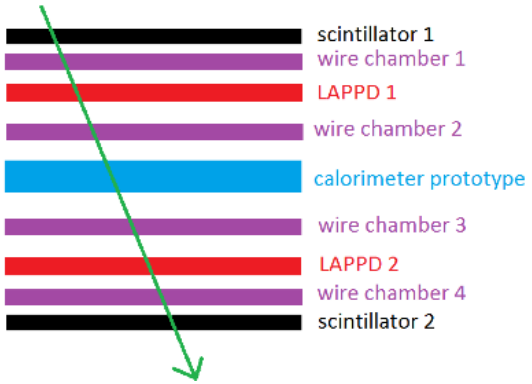


Non LHC Collider

- sPHENIX
  - Continuing tests of EMCal and Hadronic calorimeter including new readout electronics
  - Using this information for their upcoming CD review
  - Will be returning this year for last test
  - Continues to send other users our way as well.

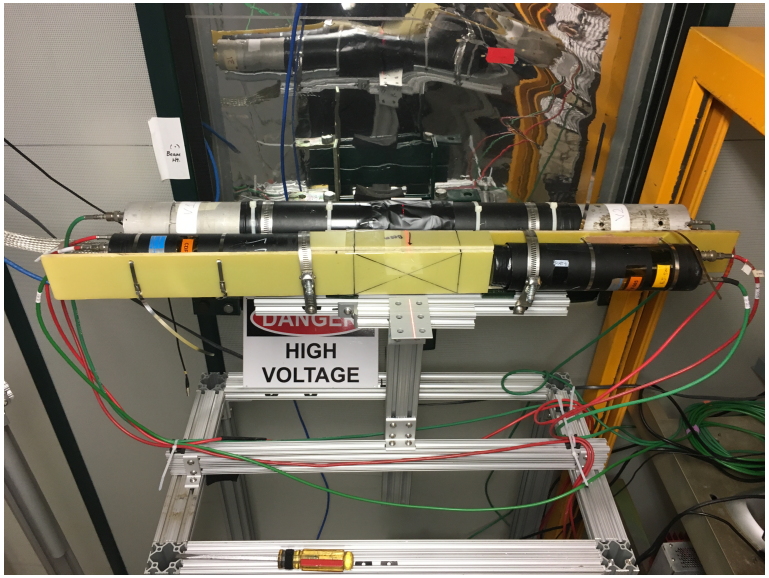


Neutrino experiments

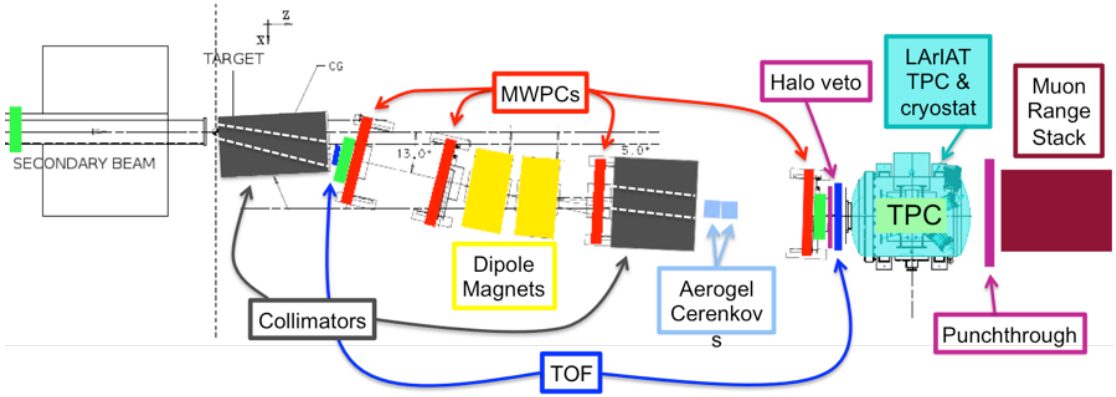


- LAFTBFToF for ProtoDUNE
  - Testing in and out of beam
  - Possible ToF detector for ProtoDUNE

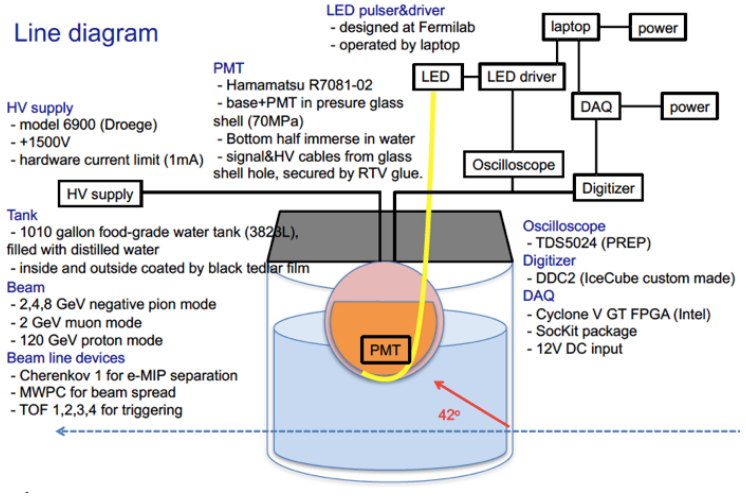
- LBNF Spectrometer
  - Testing DAQ duty cycle
  - Prelimiary R&D for a LBNF horn testing facility
  - Understanding available beam for future studies



Neutrino Experiments



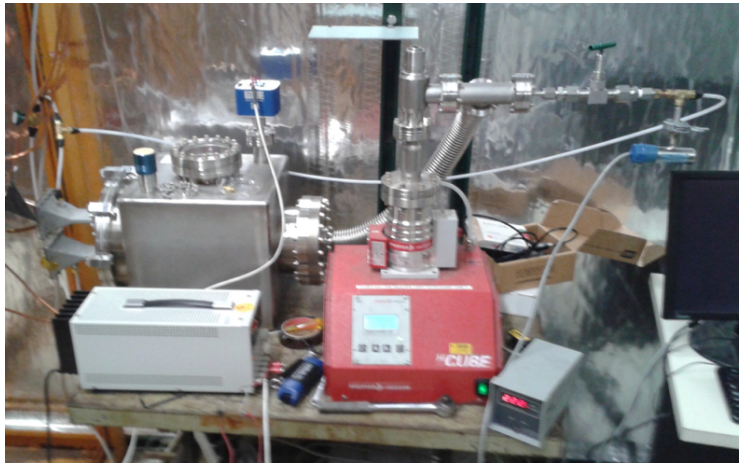
- LArIAT
  - Continued their program
  - Did R&D for other experiments during their run (SBND, DUNE)
  - Running for a few weeks this fall with a pixel detector
- IceCUBE
  - Studying electronics for their 10 inch DOM
  - Interesting challenge to locate 1000 gallons of DI water
  - Successful test for this group



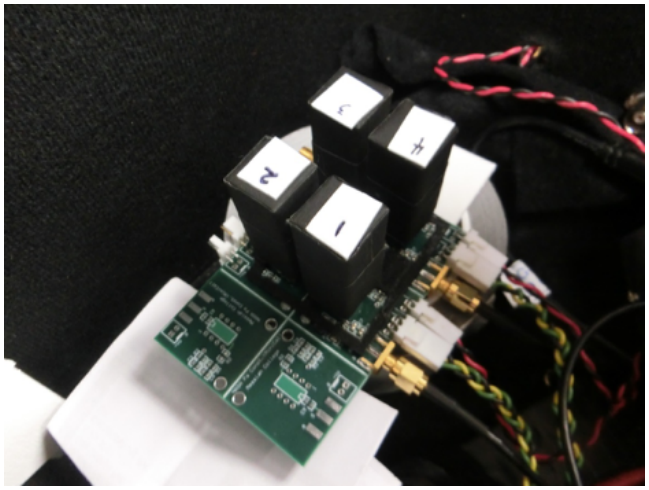
Muon Experiments

- Mu2e
  - Final test for CRV
  - Integration of all components
  - Results will be used in upcoming TDR

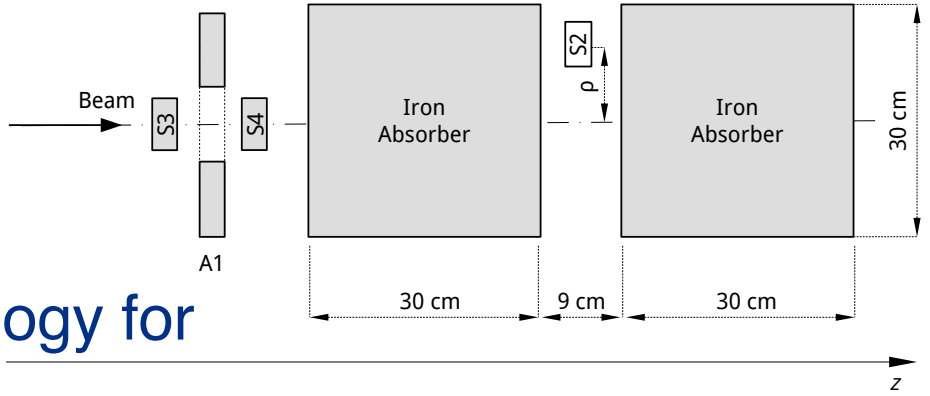
- g-2 no beam
  - Testing modules for leaks in vacuum
  - All modules installed tested first at FTBF



General R&D



- Mini EM Calorimeter
  - Located in the MT6.2b area
  - Testing construction and readout for mini calorimeter to be used in space.
  - Small college group, mostly students



- FastHCal muon stuff
  - Located in MT6.2c
  - Testing muon counter technology for future colliders
  - Have used the facility before and will continue program for the new few years.

FY17 Facility improvements

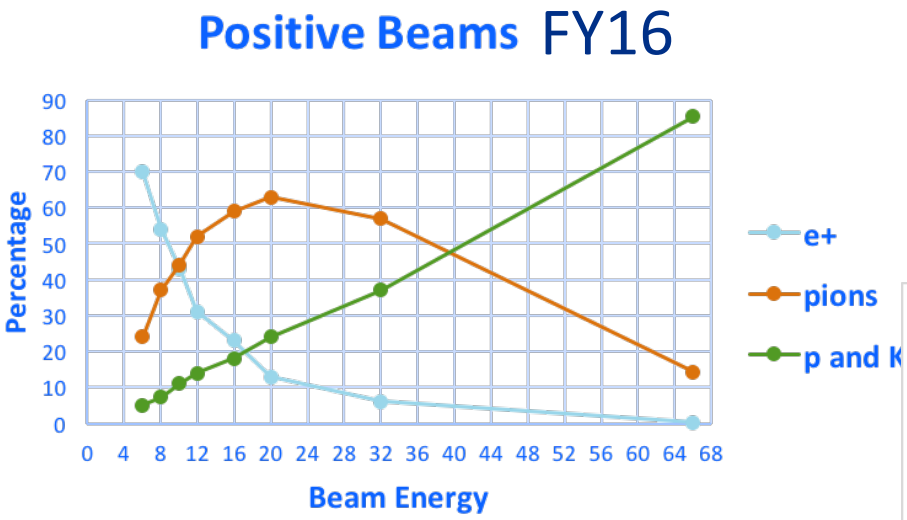
- Built up our office space area for users
  - Heavily used for staging
  - Had racks in there ready to go, users would set up equipment
  - Allowed for preliminary electrical safety inspections
- Bought DRS4 boards
  - Initially on recommendation for EDIT school
  - Used by 2 separate experiments as their primary DAQ system
  - Plan to buy more
- Summer projects
  - Leveraged our student helpers
  - Slides follow with information about our projects

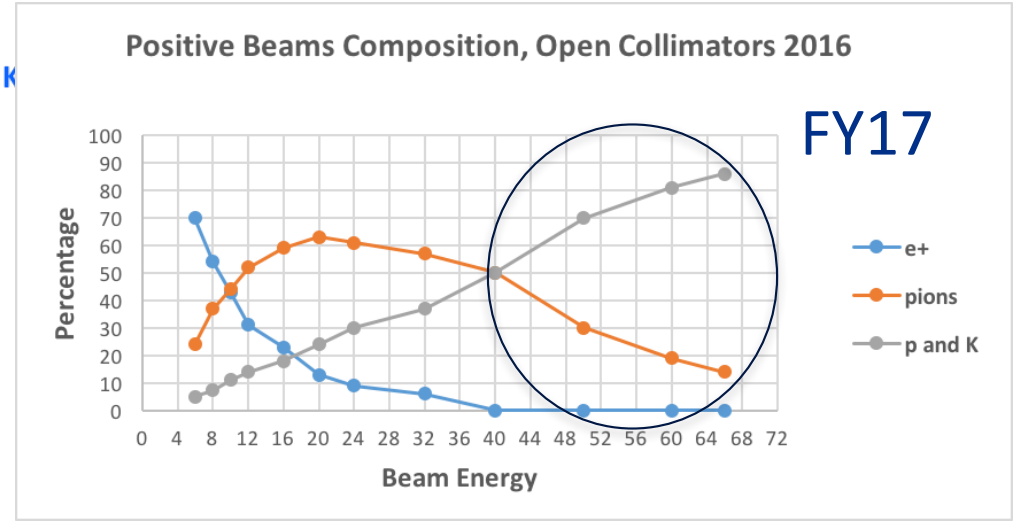
Summer Projects: Computing access for offsite users

- Users need to register nodes and have Kerberized machines
  - This is complicated
  - Computing division developed a virtual machine to provide a Kerberized environment.
- 2 Summer students (Bella and Violet) refined the instructions and the procedure
- All the subsequent students tested it (17!)
    - Windows 7, Windows 10, Ubuntu, Mac all tested
    - Instructions: https://docs.google.com/document/d/1z2ZofJoA7z24dXkFr7L5XARK71rE6cjVexukrlTYKro/edit?usp=sharing
    - Will upload more instructions for other operating systems this year

Summer Projects: Beam Studies

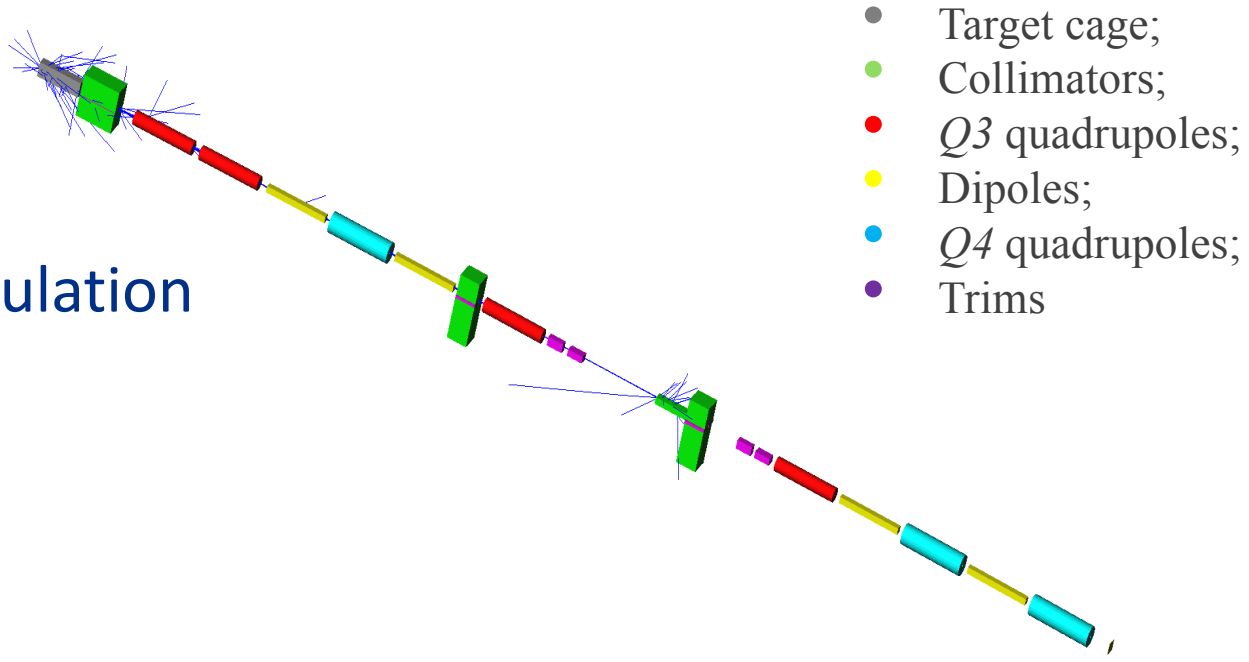
- Spent the last few weeks of the beam sneaking in studies
  - Karla (Summer Student) was able to take data and produce updated plots





Summer Projects: Simulations

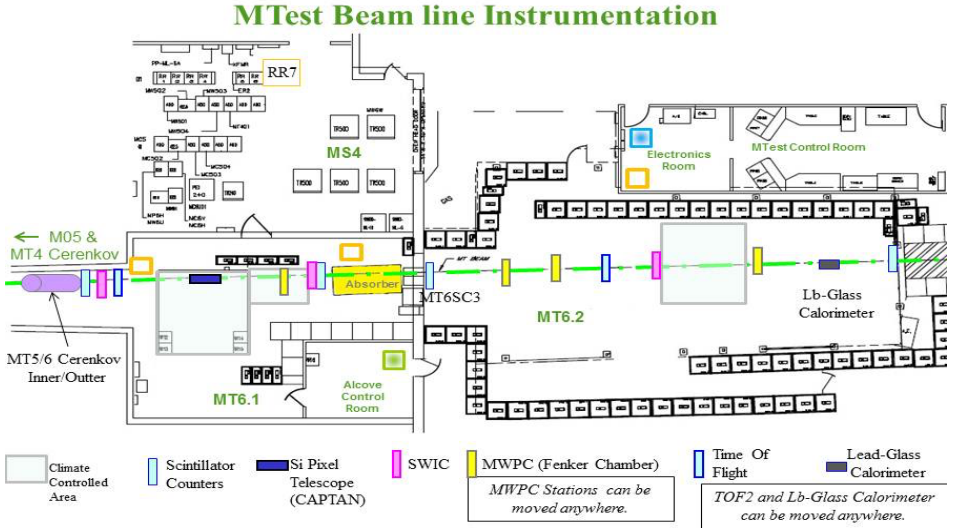
- Livio (Italian Summer student) worked on simulating the MCenter beamline wit G4Beamline
  - Already have some work done on MTest as well
  - Working to get information in a format easy for users to access



MC6 Simulation

FTBF Facility DAQ

- MTest beamline is instrumented with scintillator counters, MWPCs, a lead-glass calorimeter, and the CMS strip telescope.
- The goal of the Facility DAQ is to create a single DAQ system integrating all these detectors, with particle path reconstruction and synchronized readout
- The Facility DAQ serves as black-box source of MTest detector data and reconstructed objects to FTBF experiments
- FTBF DAQ is based on the *otsdaq* toolkit, leveraging *artdaq, art,* and CMS XDAQ, demonstrating SCD common DAQ strategy
- Showcases DAQ toolkit functionality and *otsdaq* capabilities
- MWPCs and Strip Telescope will be integrated into the DAQ first, with the other detectors following later



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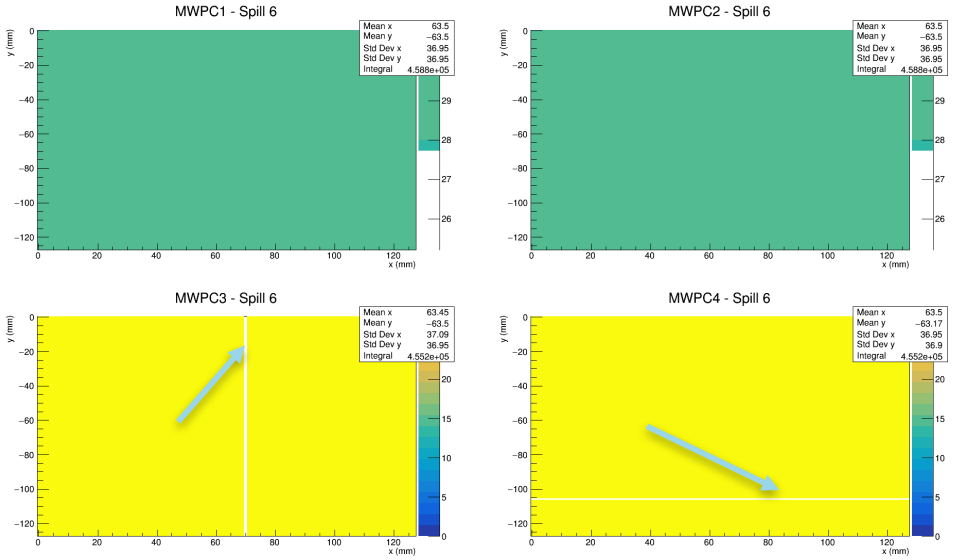
Facilty DAQ - Readout

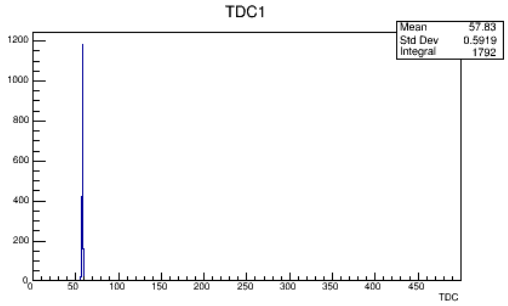
- Detectors readout is performed on a spill-by-spill basis
- *art* software splits data trigger-by-trigger, performing analysis on each trigger
- NIM+ from the PREP Modernization project allows trigger signal fan-out
  - Essential for event synchronization

Facility DAQ - MWPC DQM



Hit profile DQM image from MTest MWPCs. White lines on lower plots indicate bad TDC channel/broken wire.

- *otsdaq* uses *art* to generate DQM images on a spill-by-spill basis, then displays them on a web-based control room desktop, accessible anywhere on-site



TDC distribution DQM image from MTest MWPCs.

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Facility DAQ - Status and Plans

- October Milestone (Complete)
  - Read out MWPC planes using *otsdaq*
  - Recreate MWPC analysis in *art* modules
  - Demonstrate Facility DAQ using all FTBF DAQ servers
- November Milestone (In Progress)
  - Integrate Strip Telescope DAQ
  - Create initial event data server for FTBF experiments
  - Install trigger fan-out to detectors
- December Milestone
  - Create user-level tutorials and instructions
  - Implement reconstruction code and make reconstructed data available to experiments
- Future Plans
  - Use NOvA TDU to provide GPS timestamps to beam triggers
  - Integrate Scintillator Counter, Lead glass calorimeter and muon wall readout
  - Integrate Slow Controls data into DAQ stream

Questions?

Comments?

FY18 Schedule and Plans

- Reminder – during FY17, we receive 10% of the time line ***when we request beam***
  - This is a negotiated amount between program planning and SeaQuest.
  - When we change experiments or are otherwise down, that beam goes to the rest of the complex
- ***Restricting Switchyard (MTest and MCenter) to 12 hours a day is detrimental to our program***
  - Severe restriction on how many users we can have
  - Impacts cost as users will need to stay longer to get the amount of necessary beam.

Our Schedule so far

- ***We currently have at least one user per week for the FY18 running period***
  - Many users (but not all) have requested 24 hour running and have the manpower to staff that
  - Users that make sense to double up have doubled up already (2 or users during the same 12 hour period)
- Started requesting users for FY18 in May of 2017
  - MTest Schedule: https://web.fnal.gov/experiment/FTBF/Mtest/2018_schedule.aspx
  - MCenter Schedule: https://web.fnal.gov/experiment/FTBF/Mcenter/2018_schedule.aspx
  - More requests are coming in (and this will likely continue)

FY18 Users

- CMS: Timing, Pixels, Outer tracker
  - This is both a high priority at the lab and time critical
  - Results are needed by the end of the year
- ATLAS
  - Ramping up US test beam efforts
  - Argonne group building telescope to stay at facility
- NOvA
  - Ramping up their test beam efforts
  - Will be commissioning in the spring, running next Fall/Winter
- US/Japan funded groups
  - One ATLAS group
  - One group working on Hadron measurements for Neutrinos using emulsion detectors

FY18 Plans

- Will continue to support our current groups
- Will work to implement DAQ system
- We have 2 groups working on facility ToF
- We built a muon tagger wall
- Working on fast trigger for the facility and users
- We will continue to work with users to plan for the LHC shutdown in a few years.