The Fermilab Test Beam Facility

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Beam Telescopes and Test Beams Workshop 2018

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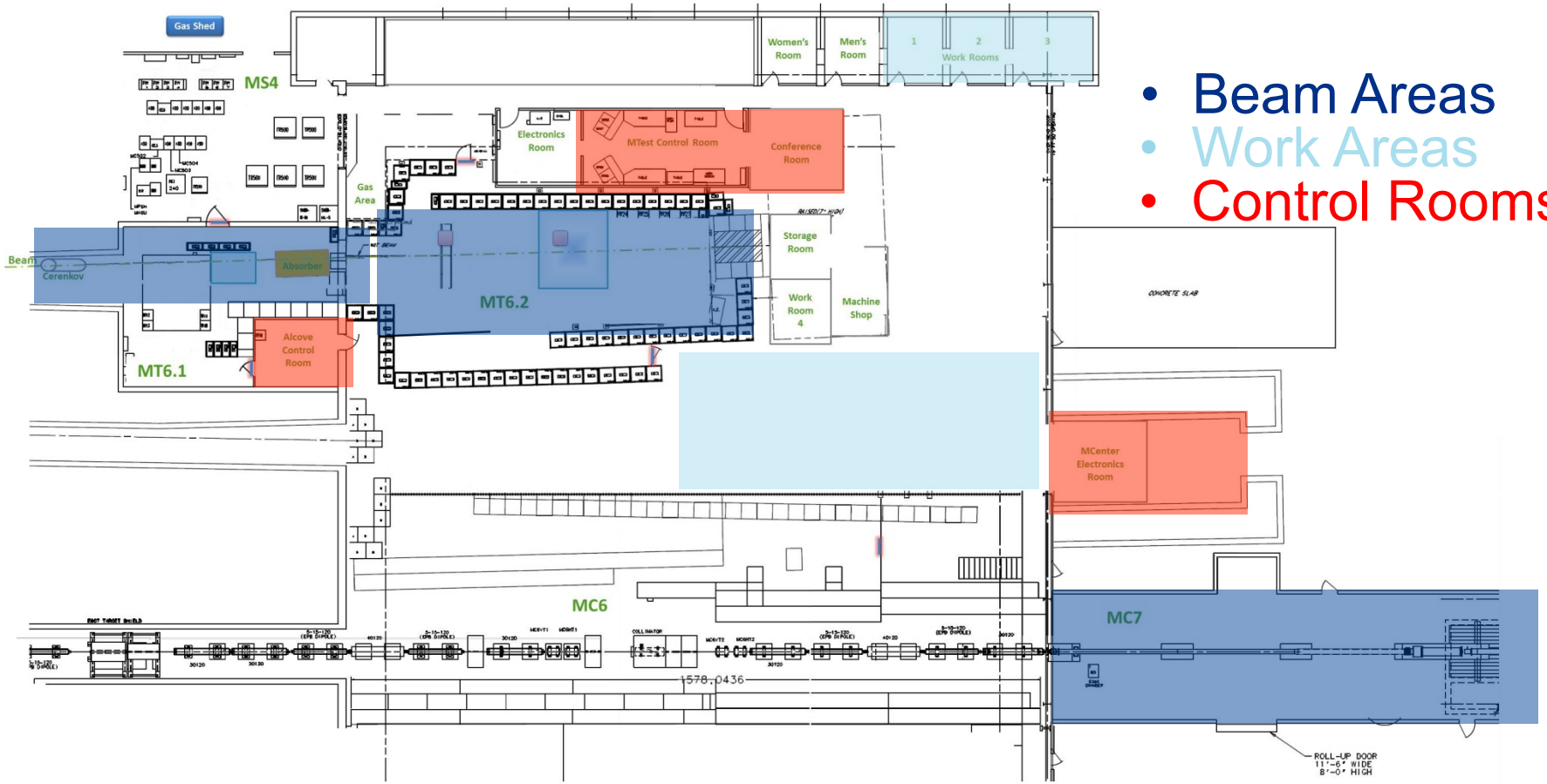
Introduction

- Fermilab Test Beam Facility has been in operation since 2005
  - Over 1000 users from over 30 different countries
  - Broad program spanning multiple research topics
- 2 Beamlines (MTest and MCenter)
  - Energies range from 120 GeV protons in the primary line down to 200 MeV particles in the tertiary line
- Available typically from October to June (~9 months/year)

Facility Layout



- Beam Areas
- Work Areas
- Control Rooms

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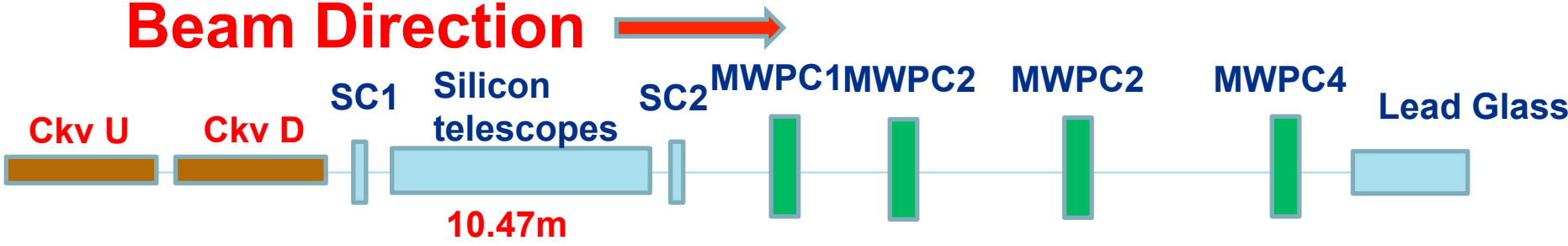
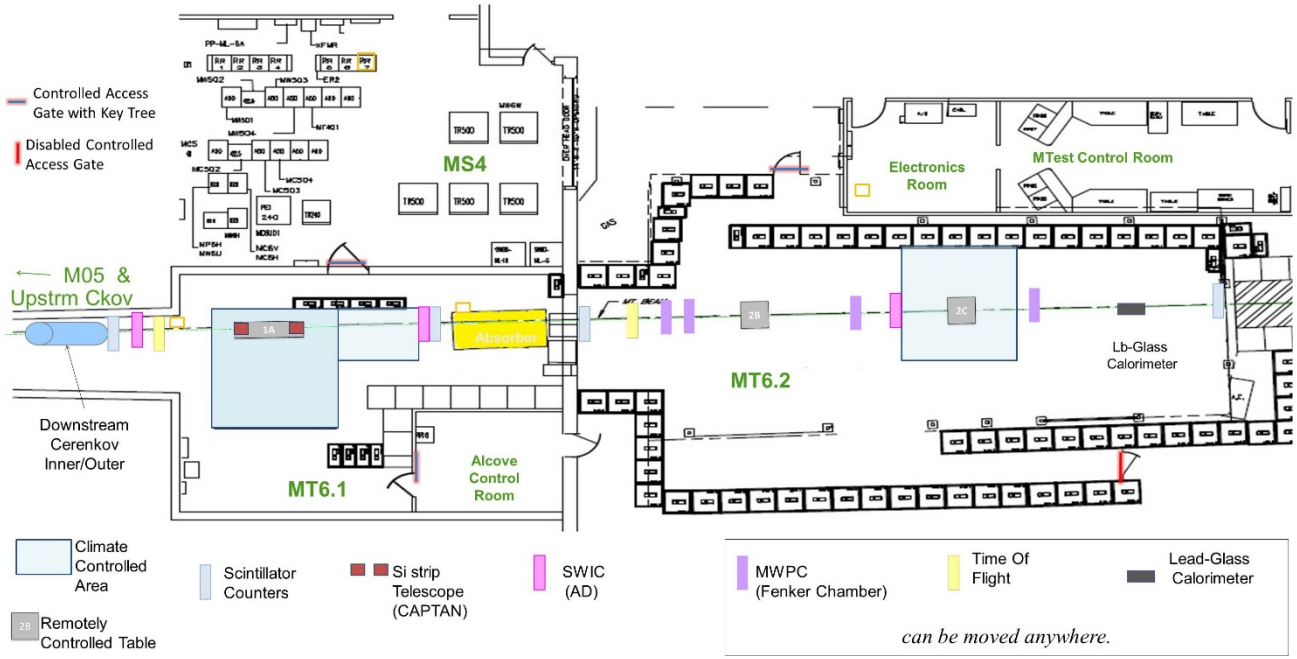
Beam Instrumentation Layout – MTest





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Beam Details and Infrastructure

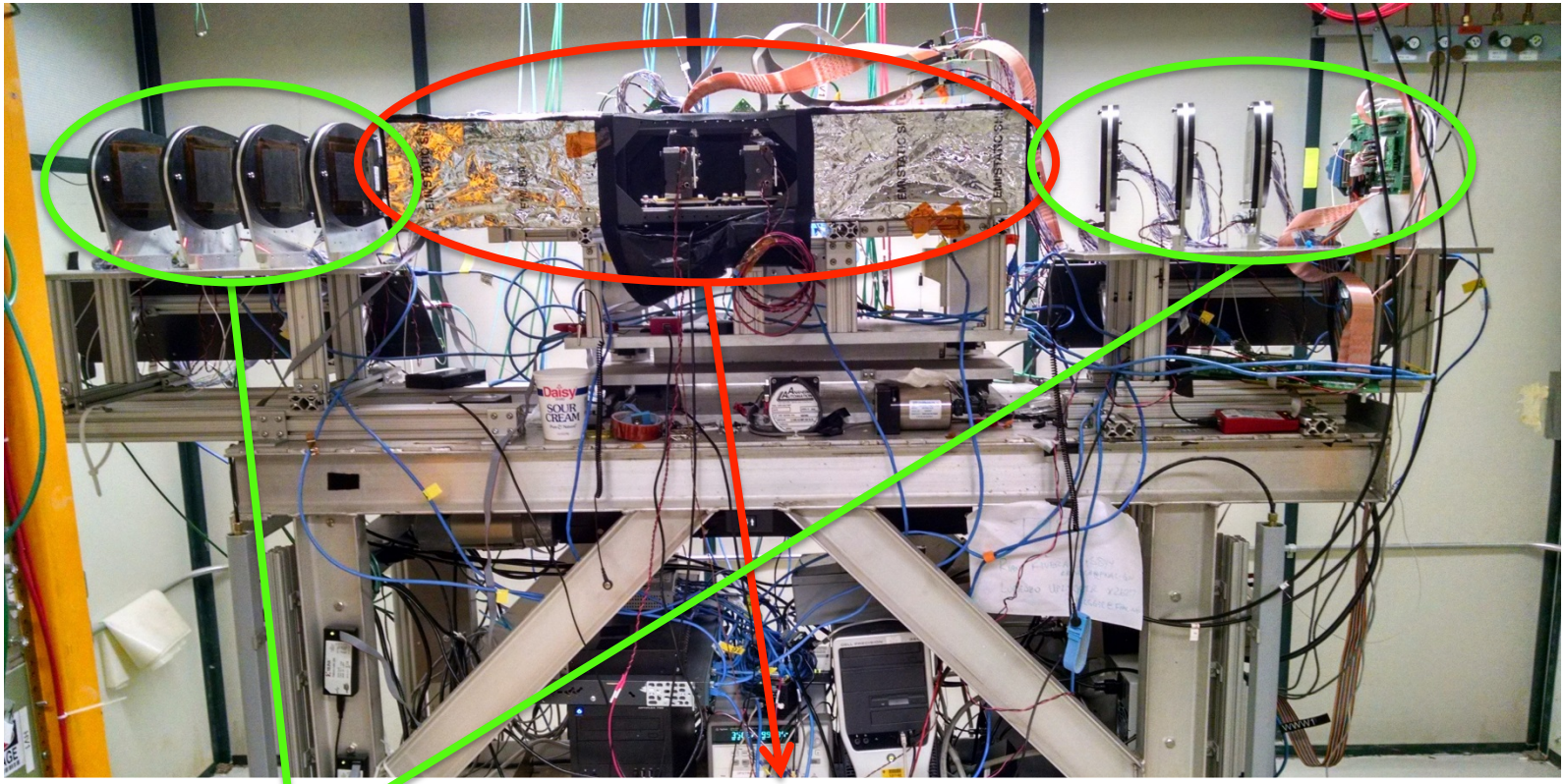
- MTest Beam line
  - 120 GeV protons (primary)
  - 1 – 60 GeV secondary beam
  - Spot size about 2cm
  - Energy can be changed in just a few minutes

- MCenter Beam line
  - Tertiary beamline down to 200 MeV
  - Mainly used for longer term (~months) experiments
- Infrastructure available
  - Remote controlled motion tables, Gas hookups (including flammable) cameras, signal/HV/ethernet patch panels
  - Cables, supplies, test benches for prep work
  - Much more, just ask!

Tracking at FTBF

- At present 2 tracking telescopes are installed:
  - The legacy pixel telescope built using leftover CMS modules
  - The new strip based telescope

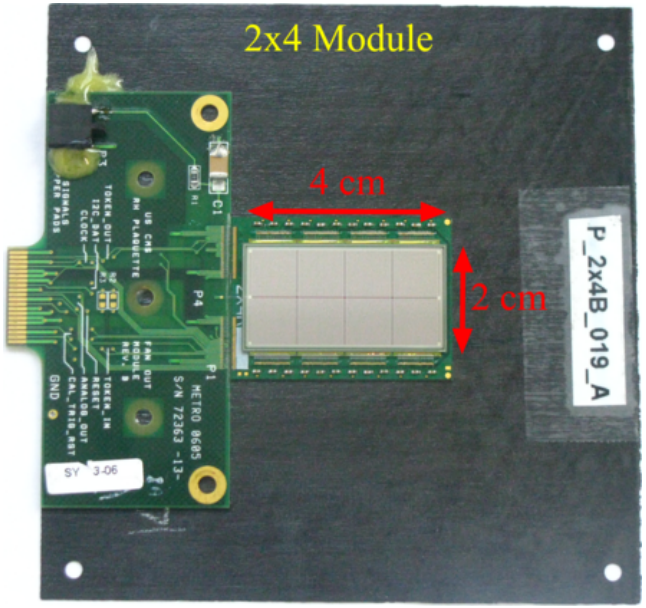
http://www.sciencedirect.com/science/article/pii/S0168900215015521

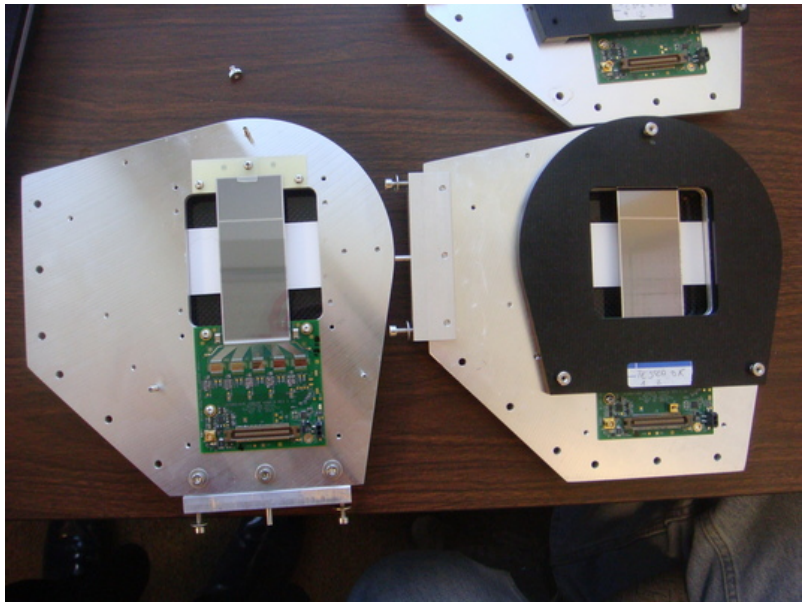


Pixel Telescope

Strip telescope

Silicon pixel and strip telescope station





- The pixel telescope has a coverage of ~1.6 x 1.6 cm^2
- Resolution on the DUT ~8µm, achieved tilting the stations
- Minimal material in the path of the beam
- 8 stations (XY) are currently installed

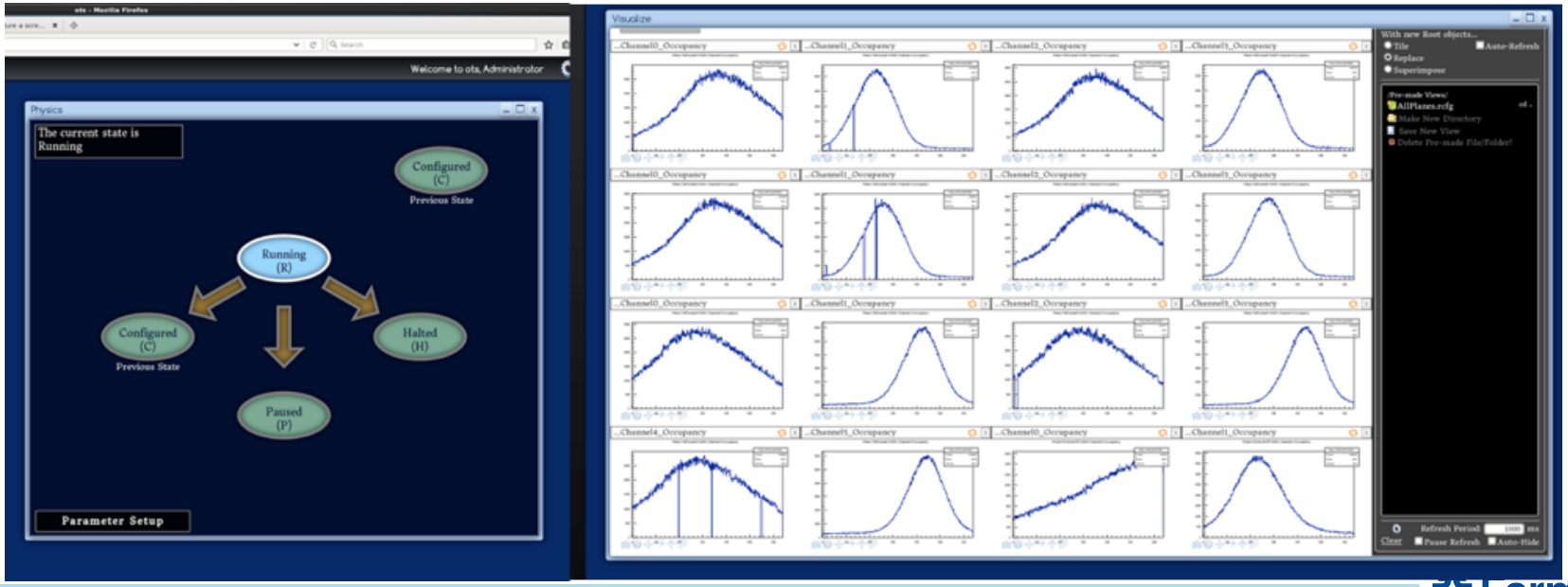
- The strip telescope has a coverage of ~3.8 x 3.8 cm^2
- Improved resolution with a 30 µm strip pitch (expected on DUT ~5µm)
- Minimal material in the path of the beam
- 10 stations (XY) have already been built but only 7 are currently installed

OTSDAQ

- The Fermilab computing division is developing an Off The Shelf Data Acquisition (OTSDAQ), based on XDAQ (CMS) and ArtDAQ (Fermilab)
- OTSDAQ is used to take data with the silicon strip telescope and MWPCs
- It allows an easy integration with any other device, provided the low level C++ interface to the device
- Few experimenters, CMS Outer Tracker and CMS Timing, have been fully integrated in OTSDAQ and took data synchronized with the strip telescope
- We are planning to support the RD53 chip

http://otsdaq.fnal.gov/

https://cdcvs.fnal.gov/redmine/projects/otsdaq/wiki



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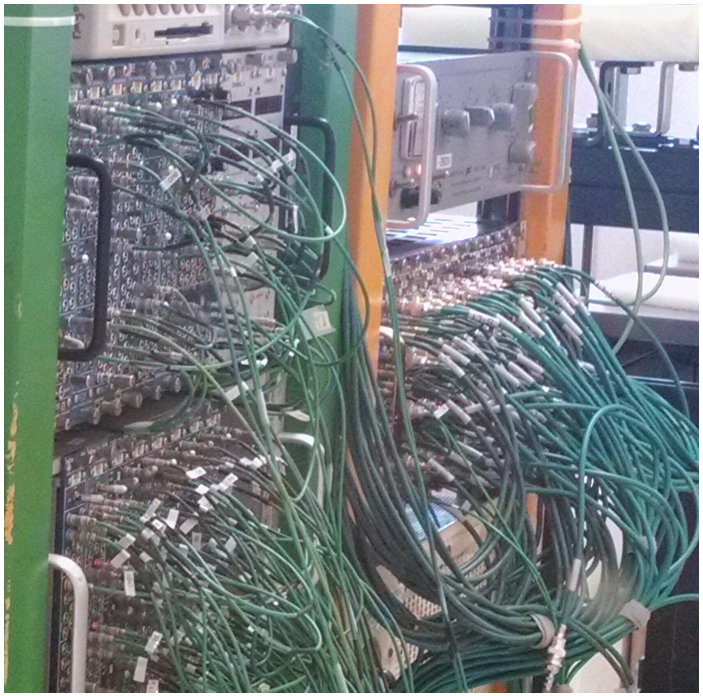
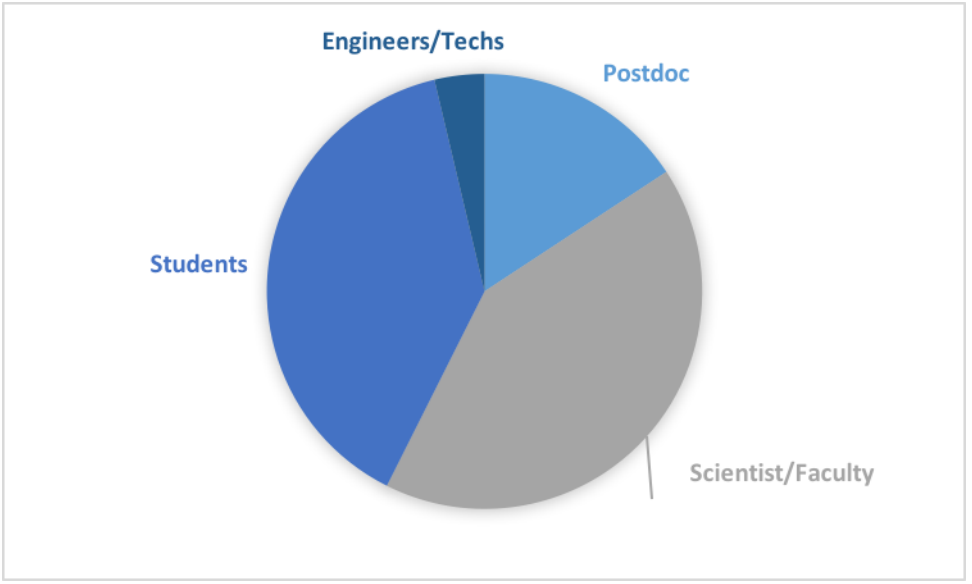
NIM upgrade

- Fermilab built a board (NIM+) that accept NIM/TTL signals and it can be plugged in any FPGA board that has standard FMC connectors
- Firmware written to allow sync with a 40Mhz clock (LHC)
- Already used by multiple experiments
- Ethernet controlled can stay in enclosures

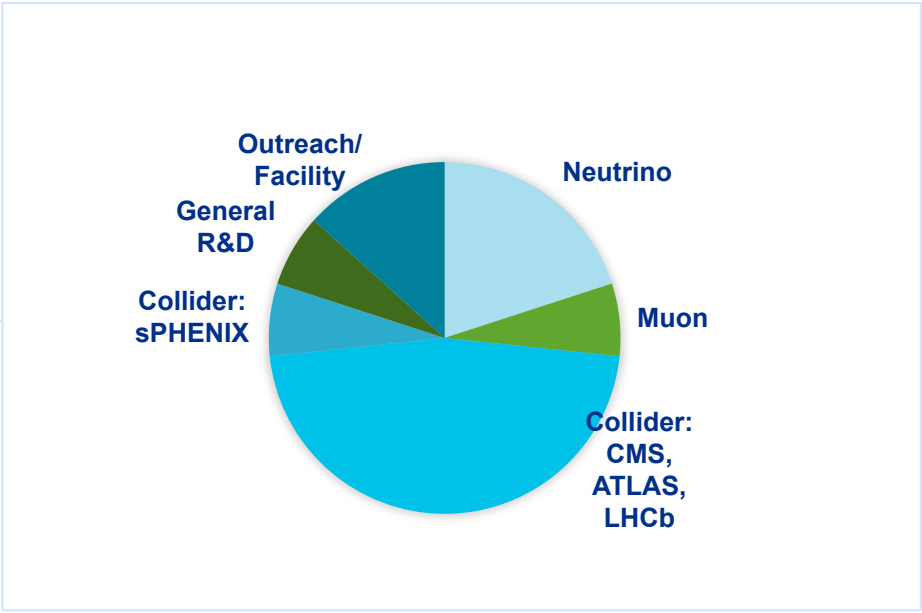


Who Uses Our Facility?

- All kinds of people!
  - ~15 publications the past year
  - Plus conferences/posters
  - Total of ~200 users in FY17

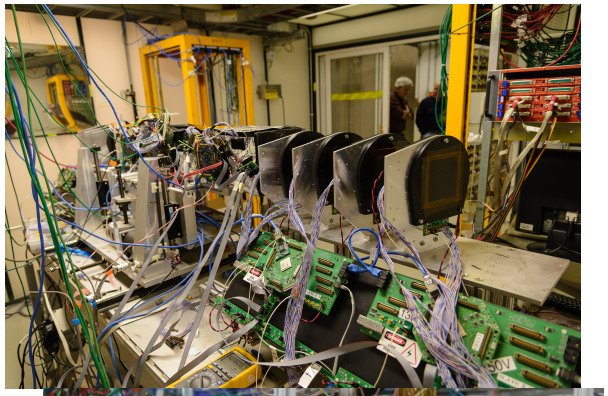


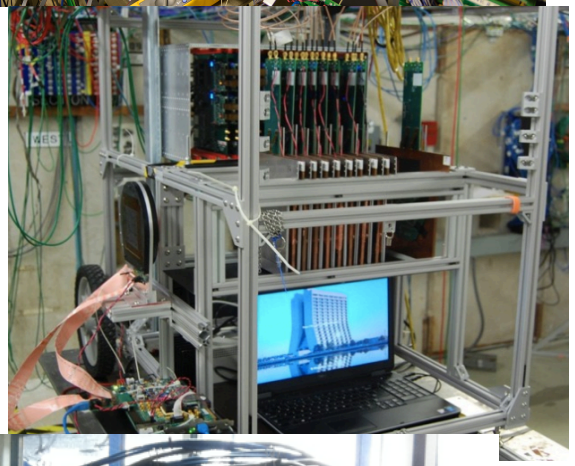
- Broad research topics too
  - We encourage student participation
  - We host interns from a variety of programs over the summer

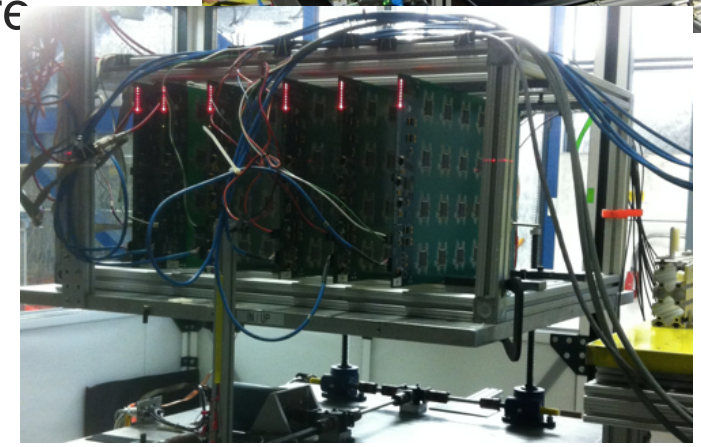


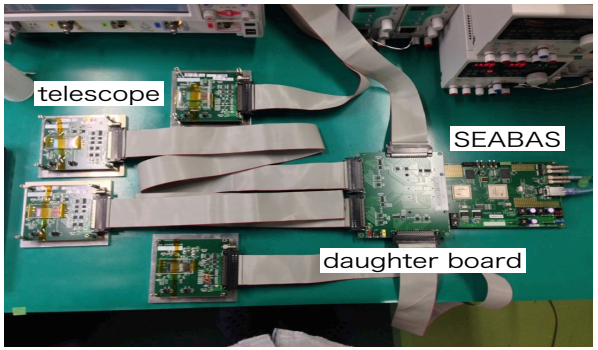
LHC studies

- CMS (T992, T1041, T1409)
  - T992: Testing rad hard sensors for the HL-LHC (Pixels, Outer tracker)
  - T1209: Outer tracker MAPSA
  - T1409: Timing, LGAD, SiPM+LYSO
  - T1041: HGCAL
- ATLAS (T1224, T1068)
  - T1224: Building a new pixel telescope for ATLAS studies
  - T1068: Testing telescopes for future radiated samples tests









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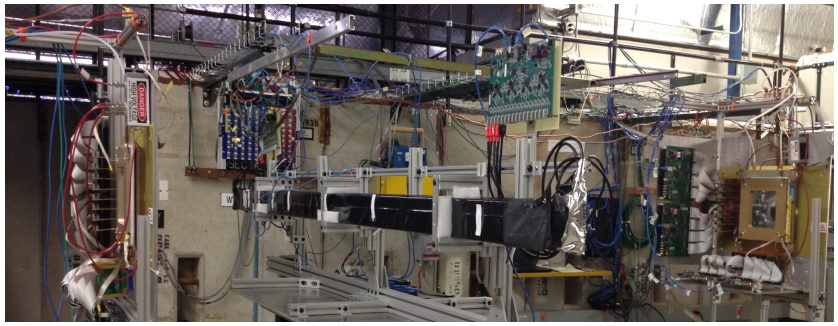
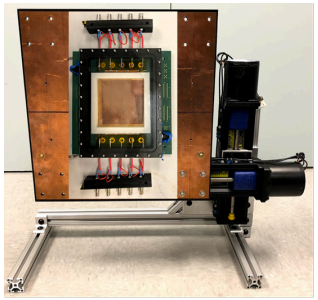
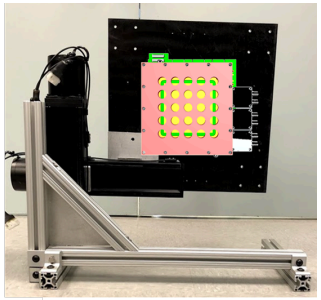
Mu2e, RHIC

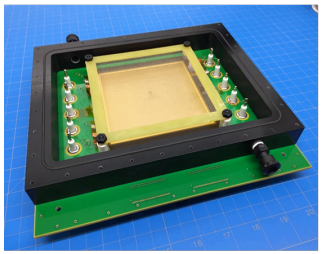


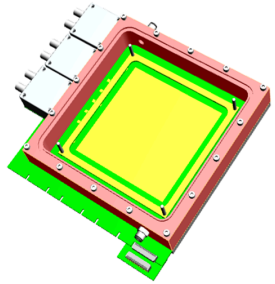
- Mu2e Cosmic Ray Veto Tests (T1043)
  - Testing PE yields for a variety of configurations
  - Results shown at conferences

- RHIC GEM and MM (T1429)
  - Testing 2 gaseous planar detectors (GEM and micro-megas)
  - Reconstructing tracklets using the timing information









EDIT School 2018

- EDIT (Excellence in Detectors and Instrumentation Technologies)
  - March 5-16
  - 8 days of test beam experience
  - Give students hands on experience with a variety of detectors
  - http://EDIT2018.fnal.gov

Procedure for Getting Beam and Typical Setup

- First step is to write the TSW (Technical Scope of Work) and contact facility manager (Mandy Rominsky)
  - 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://programplanning.fnal.gov/tsw_orc/
    - Email: rominsky@fnal.gov
    - Can be a broad document, cover multiple years and uses
    - Approval process typically takes 4-6 weeks, but can be faster, depending on needs.

Conclusions

- We continue to work to improve infrastructure and information for users
  - Suggestions welcomed!
- We are dedicated to helping users with their experiments.
- A big part of our mission is outreach, we encourage students to come and we support interns over the summer.
  - This year (2018) we will have EDIT at Fermilab
- We look forward to seeing you at Fermilab!