



The Fermilab Test Beam Facility

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Beam Telescopes and Test Beams Workshop 2019

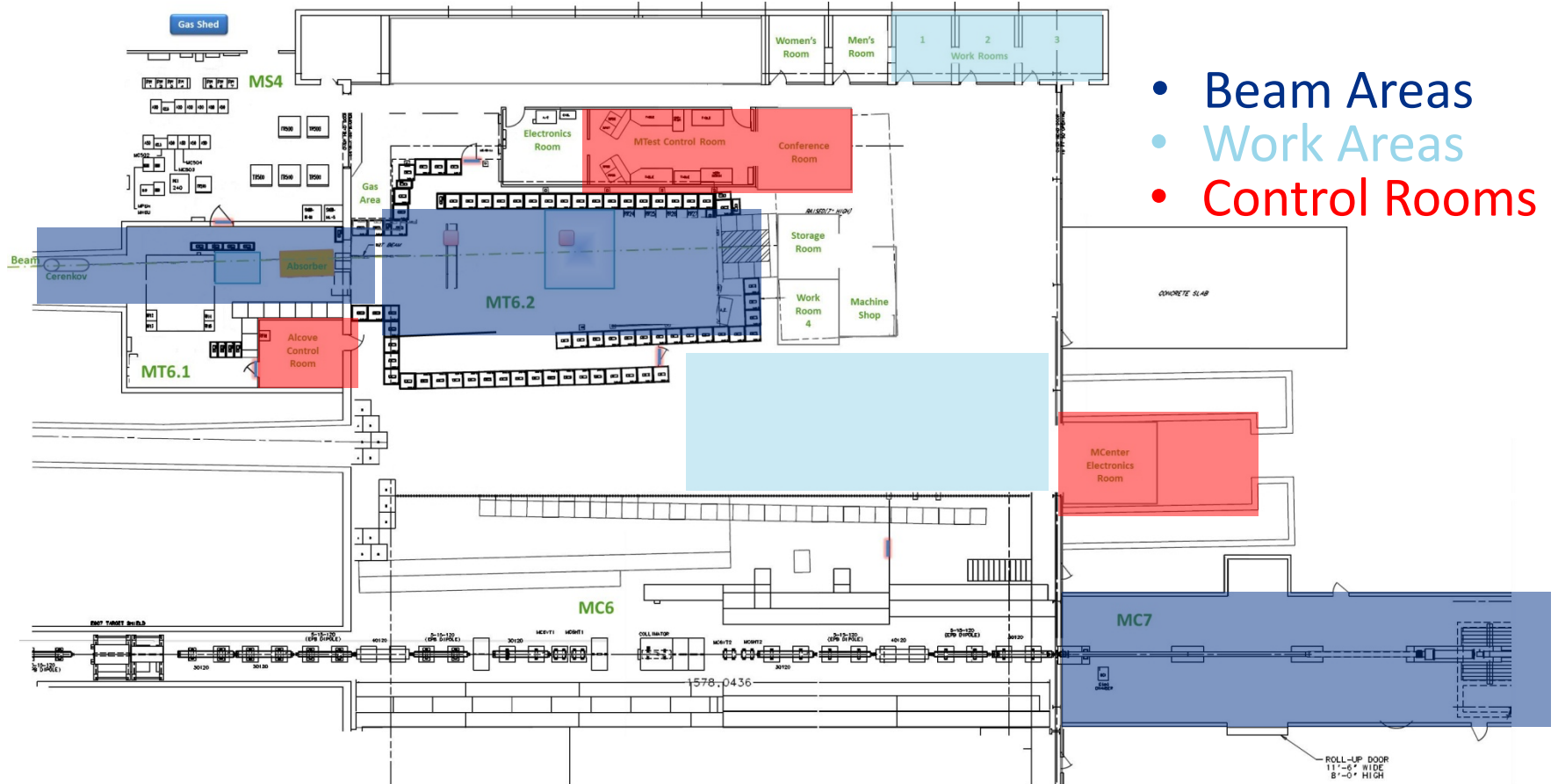
16 January 2019

Introduction

- The 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)

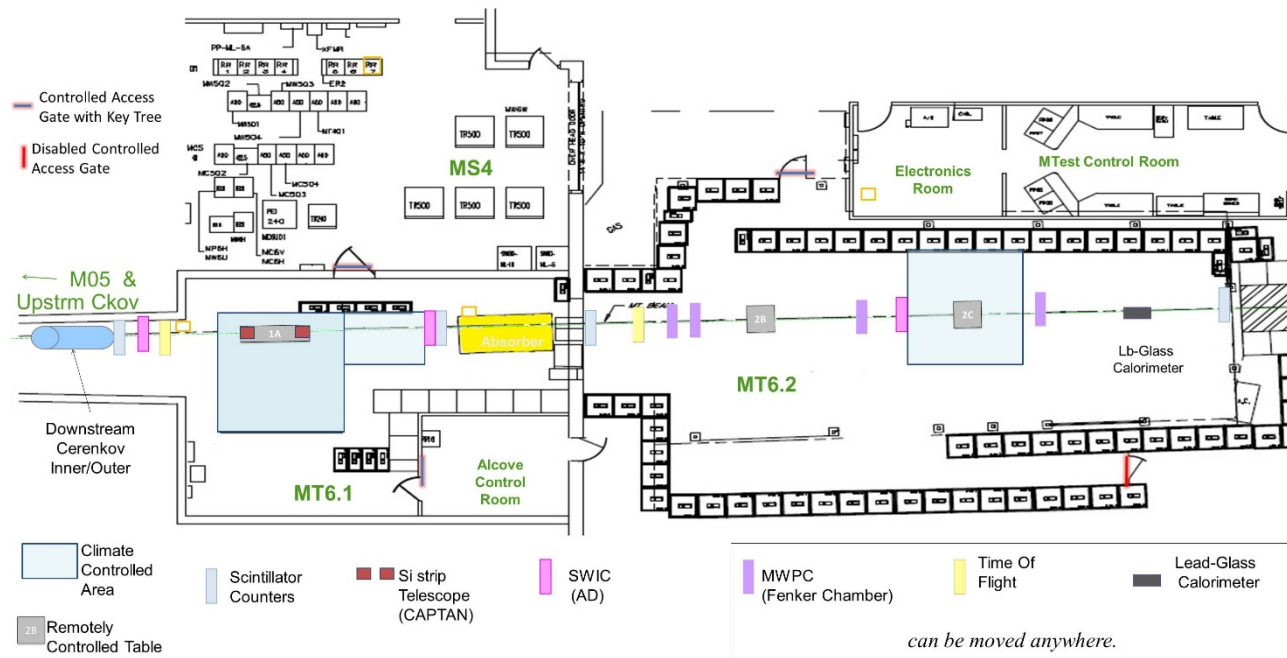
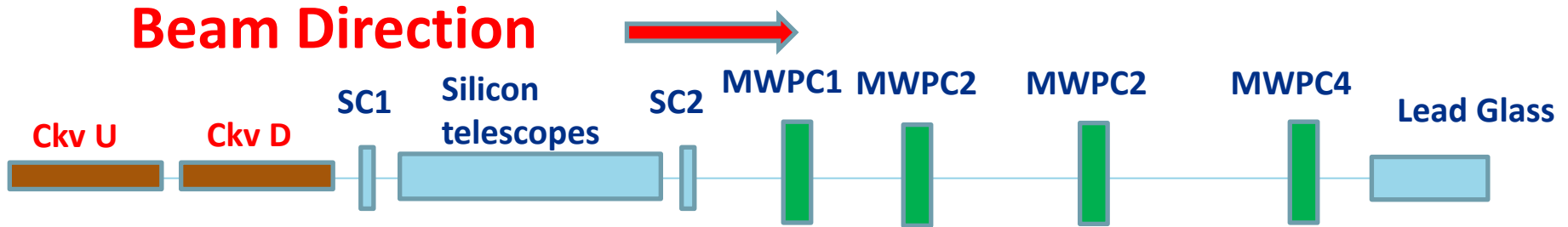


Facility Layout



- Beam Areas
- Work Areas
- Control Rooms

Beam Instrumentation Layout – MTest



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 (Section 6.1A)

- At present a tracking telescope based on silicon strips and pixel Planes, for hit confirmation, is installed

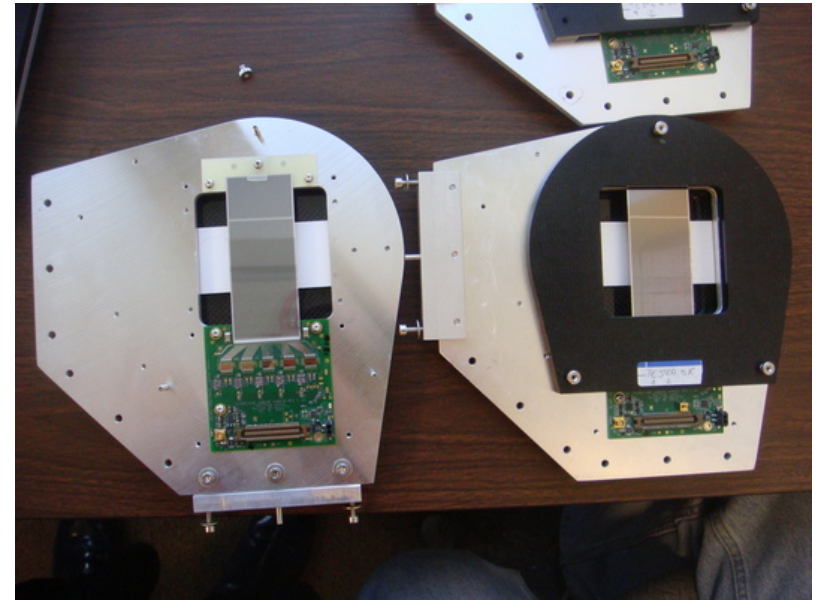
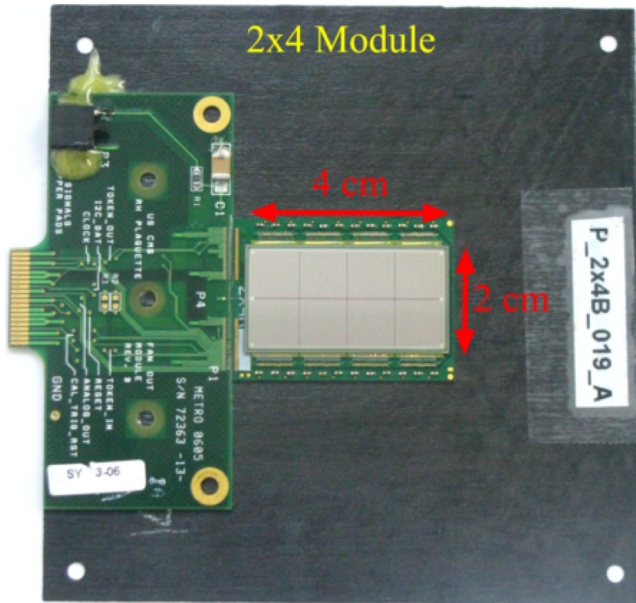
<http://www.sciencedirect.com/science/article/pii/S0168900215015521>

Strip telescope
(2 movable arms
can leave enough
space for any
device to be
mounted on a
remotely
controlled moving
table)



Pixel planes for
hit confirmation

Silicon pixel and strip telescope station



- The pixel telescope has a coverage of $\sim 1.6 \times 1.6 \text{ cm}^2$
- Minimal material in the path of the beam
- 4 stations (XY) are currently installed

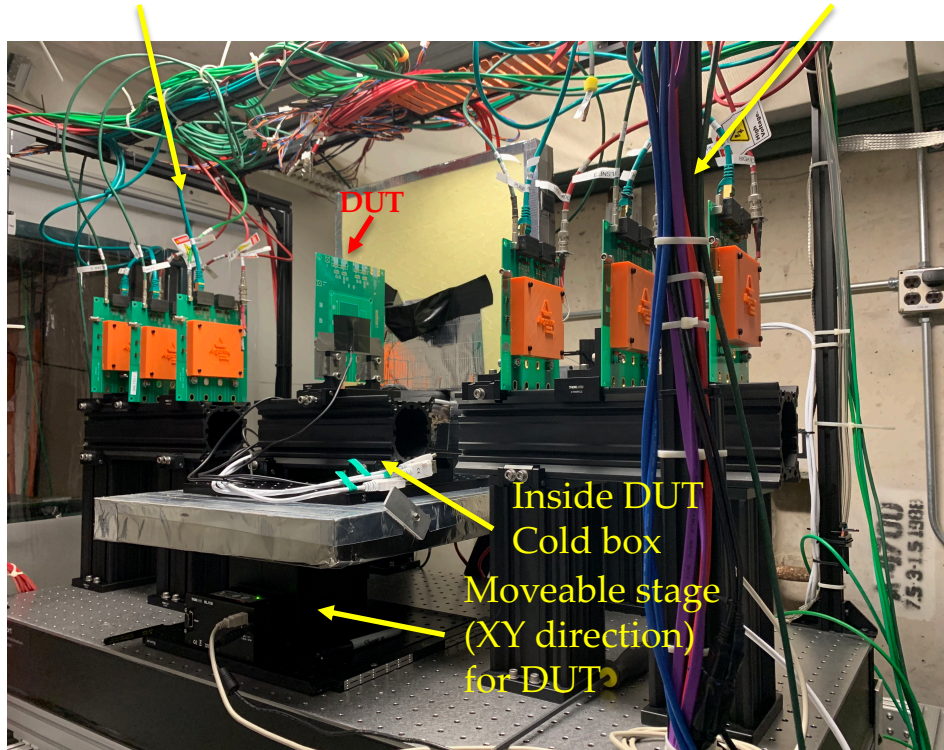
- The strip telescope has a coverage of $\sim 3.8 \times 3.8 \text{ cm}^2$
- Minimal material in the path of the beam
- 10 stations (XY) have already been built but only 7 are currently installed

Resolution on DUT $\sim 5 \mu\text{m}$

Tracking at FTBF (Section 6.1B) Argonne - Apollo

Upstream 3 FEI4B quad modules

Downstream 3 FEI4B quad modules



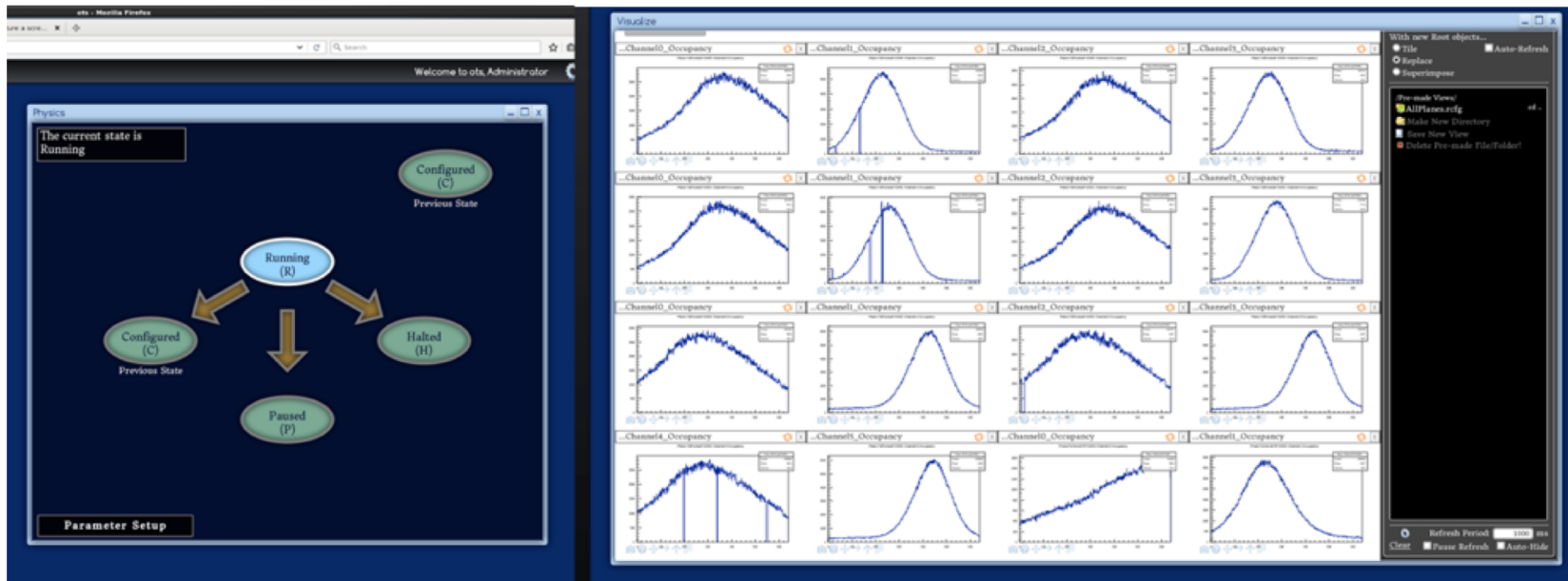
- 6 FEI4B quad modules with pixel size $(50 \times 250) \mu\text{m}^2$
- Telescope DAQ System: RCE/HSIO2
- DUT DAQ (YARR available)
- DCS computer for remote access
- Trigger: HitOR signal from 1st and 6th telescope plane with AND logic
- Also external scintillator trigger is available
- **Commissioning starts from this Wednesday (16 Jan 2019)**

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, MWPCs and Cherenkov
- It allows an easy integration with any other device, provided the low level C++ interface to the device
- Few experimenters, CMS Outer Tracker, CMS Timing and RD53 chip, have been fully integrated in OTSDAQ and took data synchronized with the strip telescope

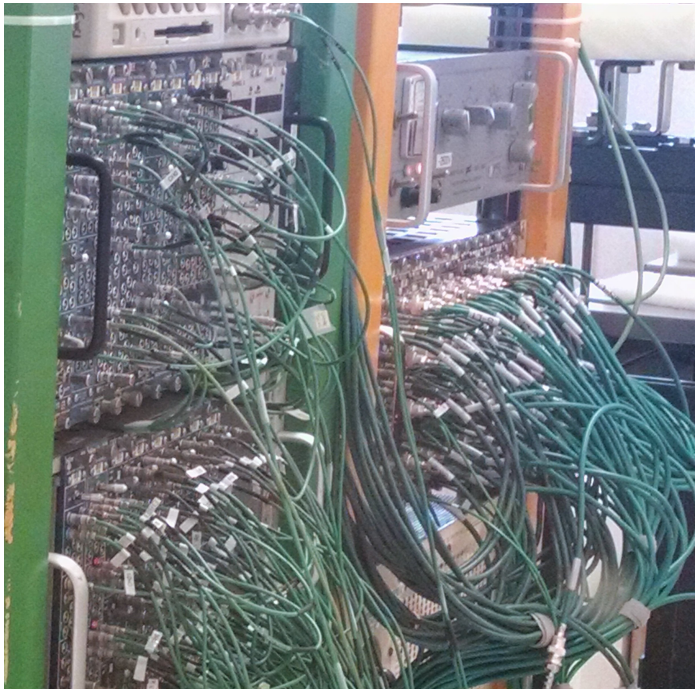
<http://otsdaq.fnal.gov/>

<https://cdcv.s.fnal.gov/redmine/projects/otsdaq/wiki>



NIM upgrade

- Fermilab built a board (NIM+) that accept NIM/TTL signals and it can be plugged in any FPGA board that has a standard FMC connector
- Firmware written to allow sync with a 40Mhz clock (LHC)
- Already used by multiple experiments
- Ethernet controlled can stay in enclosures
- Streams trigger data allowing multiple users to run at the same time with different trigger rates

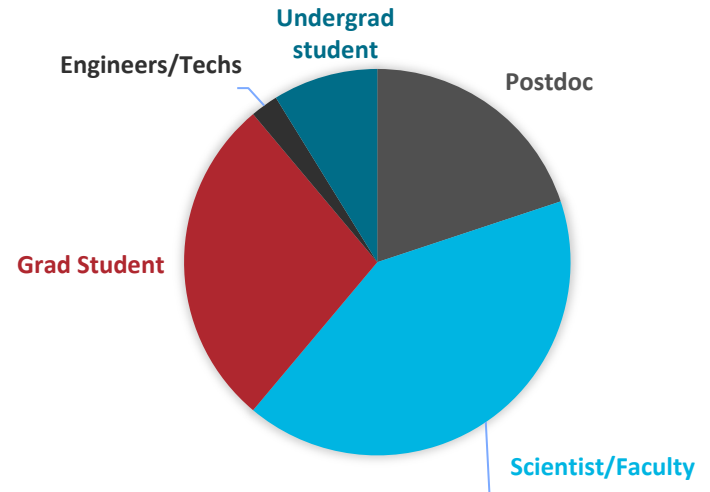


Who Uses Our Facility?

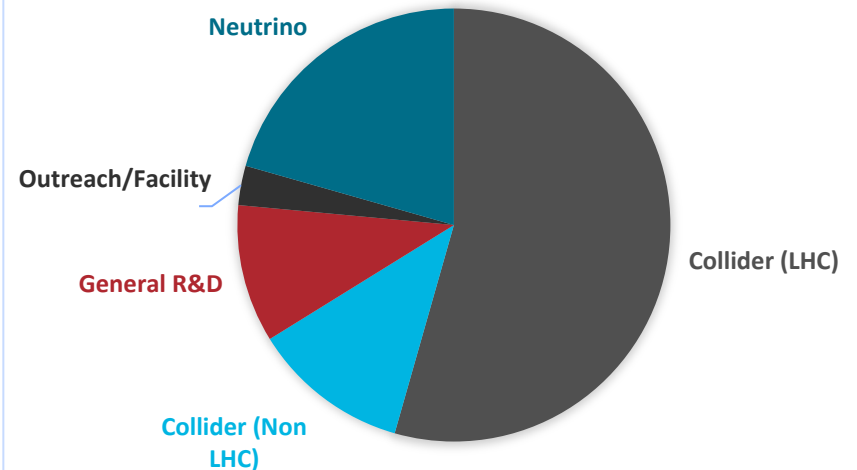
- All kinds of people!
 - Total of 264 users in FY18

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

FY18 USERS BY JOB TYPE

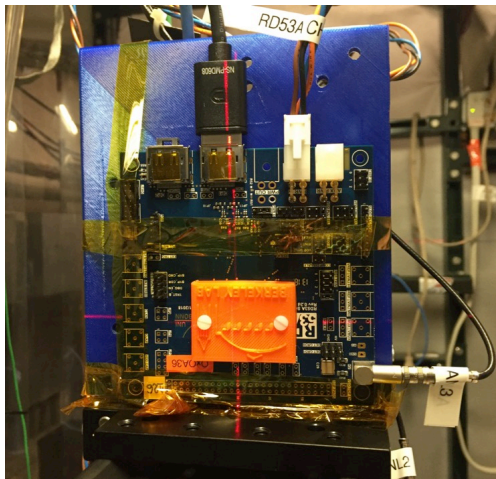
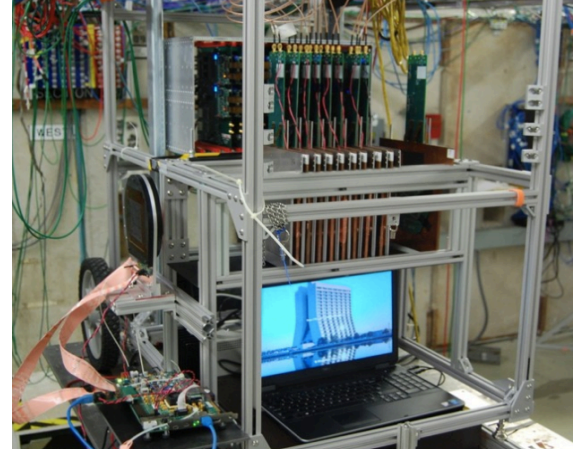
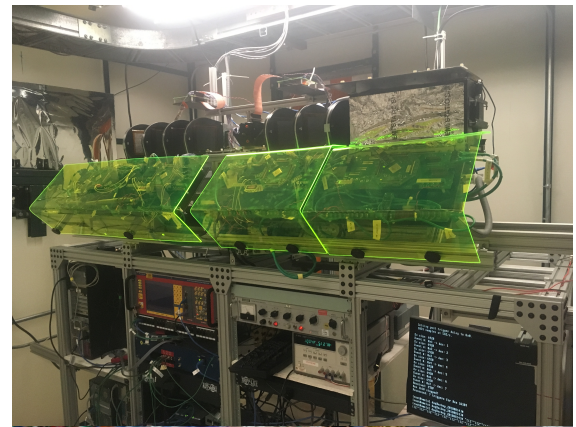


FY18 USER GROUP BY RESEARCH FOCUS



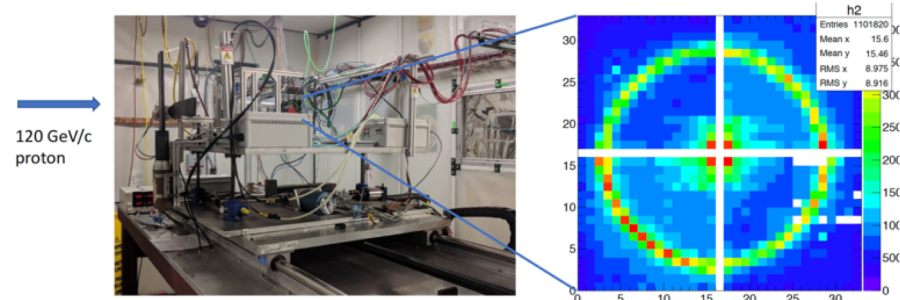
LHC studies

- CMS (T992, T1041, T1409)
 - T992: Testing rad hard sensors for the HL-LHC (Pixels, Outer tracker, RD53)
 - T1209: Outer tracker MAPSA
 - T1409: Timing, LGAD, SiPM+LYSO
- ATLAS (T1224)
 - T1224: Building a new pixel telescope for ATLAS studies and testing the RD53 ROC



LAPPD, GEM, Micromegas

- EIC PID groups (Argonne, Hawaii, Georgia)
 - Using LAPPD Style MCP-PMTs
 - Looking at imaging detectors (RICHs, DIRCs)
- RHIC GEM and MM (T1429)
 - Testing 2 gaseous planar detectors (GEM and micromegas)
 - Testing different type of zigzags



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.
- We look forward to seeing you at Fermilab!

