The Fermilab Test Beam Facility

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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 Direction

- CkV U
- CkV D
- SC1
- Silicon telescopes
- MWPC1
- MWPC2
- MWPC2
- MWPC4
- Lead Glass

- Controlled Access Gate with Key Tree
- Disabled Controlled Access Gate

- MS4
- Downstream Cerenkov Inner/Outer

- MT6.1
- MT6.2
- MT6.3
- MT6.4

- Electronics Room
- MTest Control Room

- MWPC (Fenker Chamber)
- Time Of Flight
- Lead-Glass Calorimeter

*can be moved anywhere.*
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


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 ~1.6 x 1.6 cm²
- Minimal material in the path of the beam
- 4 stations (XY) are currently installed

- The strip telescope has a coverage of ~3.8 x 3.8 cm²
- Minimal material in the path of the beam
- 10 stations (XY) have already been built but only 7 are currently installed

Resolution on DUT ~5μm
Tracking at FTBF (Section 6.1B) Argonne - Apollo

- 6 FEI4B quad modules with pixel size $(50 \times 250) \mu m^2$
- Telescope DAQ System: RCE/HSIO2
- DUT DAQ (YARR available)
- DCS computer for remote access
- Trigger: HitOR signal from 1$^{st}$ and 6$^{th}$ 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://cdcvs.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 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
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 micro-megas)
  - 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!