Fermilab **BENERGY** Office of Science



Impact of Reduced Running on the Test Beam

Mandy Rominsky Pre-PAC Meeting 29 June 2017

Fermilab Test Beam Facility

- A wide range of users
 - Well over 1000 users and 30 countries represented
- 2 Beamlines
 - MTest: Primary and secondary beams, 6 user stations
 - MCenter: Secondary and Tertiary beams, currently used by LArIAT, NOvA to follow up





FY17 Users

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Facility Layout



3 1/25/17 M. Rominsky I Beam Telescopes and Test Beams Workshop

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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!





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FY17 Summary

- 25 weeks of beam time
 - Problem with the septa in December/January reduced our beam time
 - Generally ran 24/7 when beam was available.
 - Last month of running had 5 experiments in the MTest Beamline
- 14 experiments
 - Broad research program
 - CMS, ATLAS, LHCb, DUNE, LArIAT, Mu2e, IceCube, Generic R&D

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- 5 new experiments
- Publications planned for many of the experiments
- Full Test Beam report out later this fall

Planned FY18 running - MTest

- Users start November 1
 - Assume 35 weeks of running time
 - Started taking FY18 requests in May
- So far, requests from repeat customers:
 - 25 weeks as primary requested (CMS, ATLAS, PHENIX)
 - We often will continue to accept requests throughout the run period.
- Typically also take a week or two of beam studies
- EDIT is scheduled for FY18 and will take up 2 weeks of beam time – Could be delayed or canceled depending on funding
- Full schedule can be found: <u>http://web.fnal.gov/experiment/FTBF/Mtest/2018_schedule.as</u>
 <u>px</u>

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FY18 Current Schedule – MTest

November						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

December						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

January						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday



FY18 Current Schedule – MTest

February						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
March						
March Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
March Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
March Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
March Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
March Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
March Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
March Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

April						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday



FY18 Current Schedule - MTest

May						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

June						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

July						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday



Planned FY18 Running – MCenter

- LArIAT will finish July 7
- Preparation for the NOvA test beam is ongoing
- LAPPDs and other small tests would happen opportunistically
- Gaseous TPC (Jen Raaf's early career) will also install through out this year
 - Possibly running if time allows
- Hadron Production studies
 - New effort between US and Japan (partially funded)
 - The hadron production measurements will help reduce neutrino flux uncertainties for T2K, NOvA, MINERvA and DUNE.
 - Plans to test in both MTest and MCenter



Overall Impacts of Reduced Running

- Looked at the scenario where beam is only available for a few months
- Looked reduced running from 10% to 5% of the timeline
- Asked currently scheduled users what the impact to their physics programs would be with reduced running
 - Also, in case they couldn't run their programs
 - Note that the CERN beam areas are off in 2019 and 2020
 - Several new groups this year from CERN were very happy and are planning extensive programs back here
 - Very happy with our high rate tracking area
 - We are working with a new group using US-Japan Funds that is supposed to start up this year.

Impacts on ATLAS Pixels – Kazunori Hanagaki

- Tests for the ATLAS pixel and ASIC upgrades
 - These can be done at CERN, but limited time as many groups from ATLAS are competing for the same beam time
- Testing SOI chips developed by KEK
 - These cannot be tested at CERN
 - The last 2 years Kazu's group received special funding to come to the test beam and work on the SOI chips. The delay this year from the septa caused significant problems for them.
 - They have funding to come again, as they were successful in the tests ultimately. Delaying their run or canceling it is incredibly detrimental to their research program.

ATLAS Pixel Detector (RD53A) – Jessica Metcalfe

- Commonly developed chip used by CMS and ATLAS
 - Critical testing period coming up this fall
- Can use either DESY or SLAC if FTBF or CERN are not available
- Planning on building a telescope at the test beam facility sometime in FY18
- Will also use this for general R&D
- Brings in new ATLAS groups to the test beam



Impacts on sPHENIX – John Haggerty/ Eric Mannel

- sPHENIX (upcoming flagship experiment for RHIC) tests for about 4 weeks each year
- They have received CD0 from the DOE Nuclear Physics funding agency and are working on testing the final design necessary for CD1 and CD2. They are funded in the FY18 PBR.
- The FY16 and FY17 test beam runs have been submitted for publication and is on arXiv (<u>https://arxiv.org/abs/1704.01461</u>)
- The final run in FY18 will be used to confirm final design and provide data to characterize the detector in a variety of beam energies

Impacts on CMS HGCal – Jim Freeman and Roger Rusack

- This is a test of the High Granularity calorimeter. Considering the possibility of bringing in 5 interaction lengths and setting up a full calorimeter test
- These tests will advance the project, but maybe not delay it.
- The beamline they use at CERN is being used by DUNE, which cuts down HGCal's beamtime in FY18
- There are no CERN test beams in 2019 and 2020.



Impact on CMS Pixels and Outer Tracker – Lorenzo Uplegger

- Testing the CMS pixel detector and Outer Tracker designs
- A spread in time is crucial for them
 - Test sensors, irradiate, then test again
 - This process takes many months
- If currently designed chip fails, it delays detector construction
 - Also means if they don't test, detector construction also is delayed
- The Outer Tracker is also divided between Fermilab and CERN.
 - Failed chips will also delay the Outer Tracker



Impact on NOvA Test Beam: Alex Sousa

- Impacts the commissioning of the new tertiary beamline for NOvA
- These tests are used to reduce the systematics for the NOvA
 - Maximum impact if the test beam can be completed before Spring 2019
- Reduced running or delays will make the test beam less valuable for the mass hierarchy measurement, but still useful for later analyses
 - However, world wide competition might be caught up by then.



Impact on Gaseous TPC: Jennifer Raaf

- Work for an Early Career Award
- Doesn't need much statistics, so a delay or reduction is not a problem
- Could possibly switch the order of the tests run in a neutrino beam first, then the test beam.



Summary

- The Fermilab Test Beam Facility impacts R&D efforts across all thrusts of the HEP program and part of the Nuclear Program
- We have a committee in place to help with prioritizing experiments in the case of reduced running but!
 - We've gotten very good at negotiating with users so many can use the beam at the same time
 - We'll ask spokespeople/project managers to help with the prioritization
- Running at a reduced rate (5%) is preferable to fewer months
 - Some experiments (CMS) need to be able to irradiate chips and then test.