



Fermilab Test Beam Facility

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Fermilab ACE Science Workshop

15 June 2023

Introduction

- Fermilab Test Beam Facility (FTBF) – Supports a wide program of research and detector R&D
 - 2 Beamlines (MTest and MCenter) – can provide particles from 120 GeV protons to secondaries of ~ 200 MeV
- Irradiation Test Area (ITA) –
 - Low energy (400 MeV protons), high rate ($\sim 2.2 \times 10^{15}$ protons/hr)
- Beam is available ~ 8 months a year (roughly November through June)



Where are FTBF and ITA?



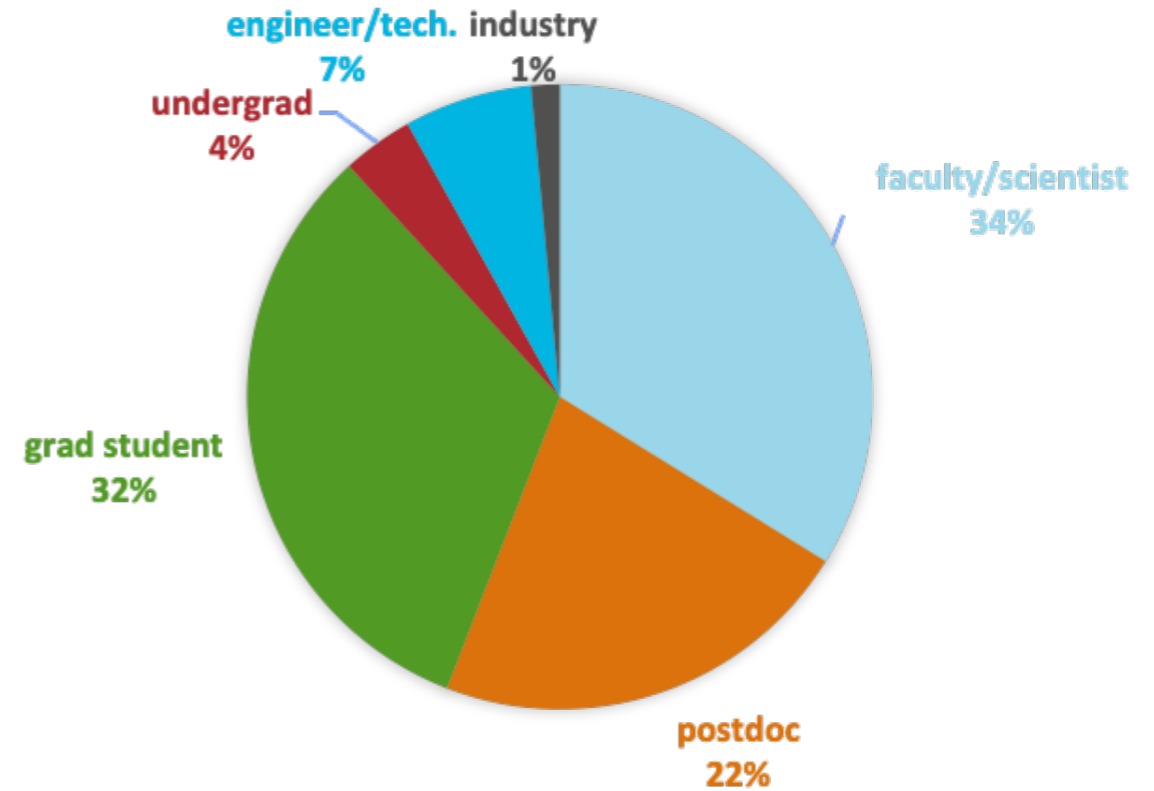
FTBF –
Meson
Detector
Building

ITA –
Irradiation
Test Area

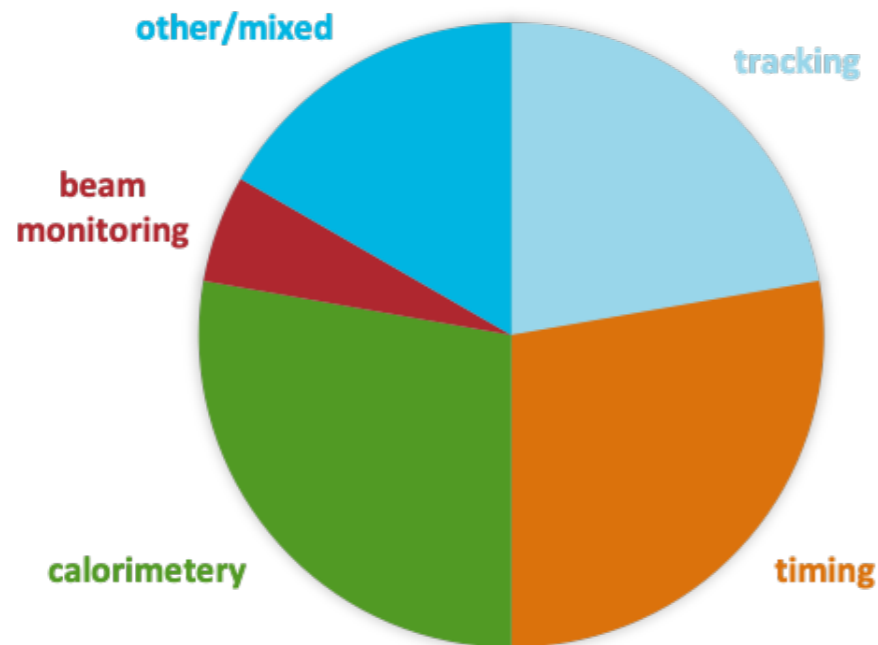
Who uses FTBF?

- 160 users from 18 different experimental efforts in FY22
- 18 Experimental efforts, 4 new efforts

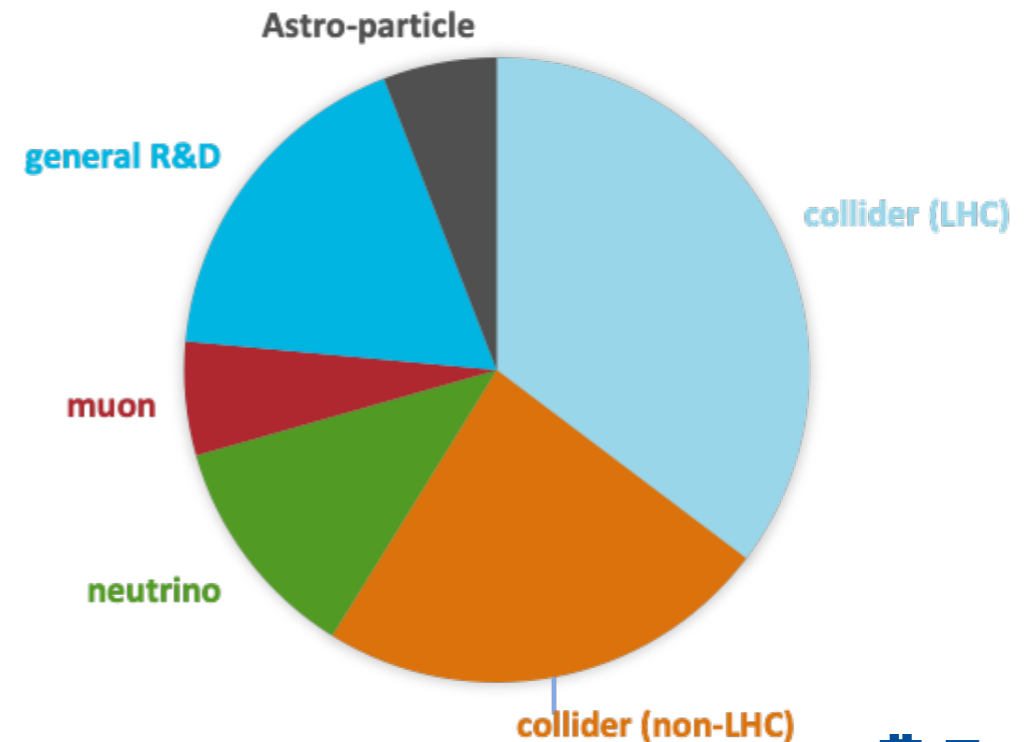
Users by professional category



Experiment by detector



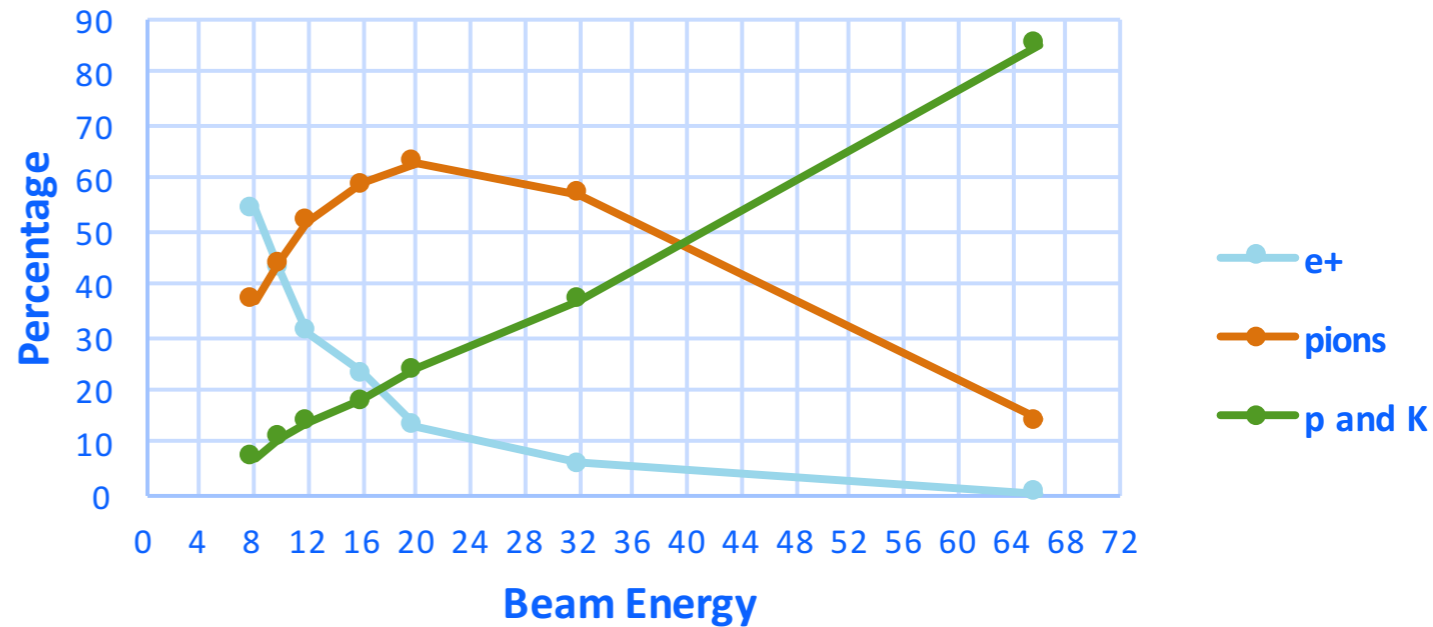
Experiment by research focus



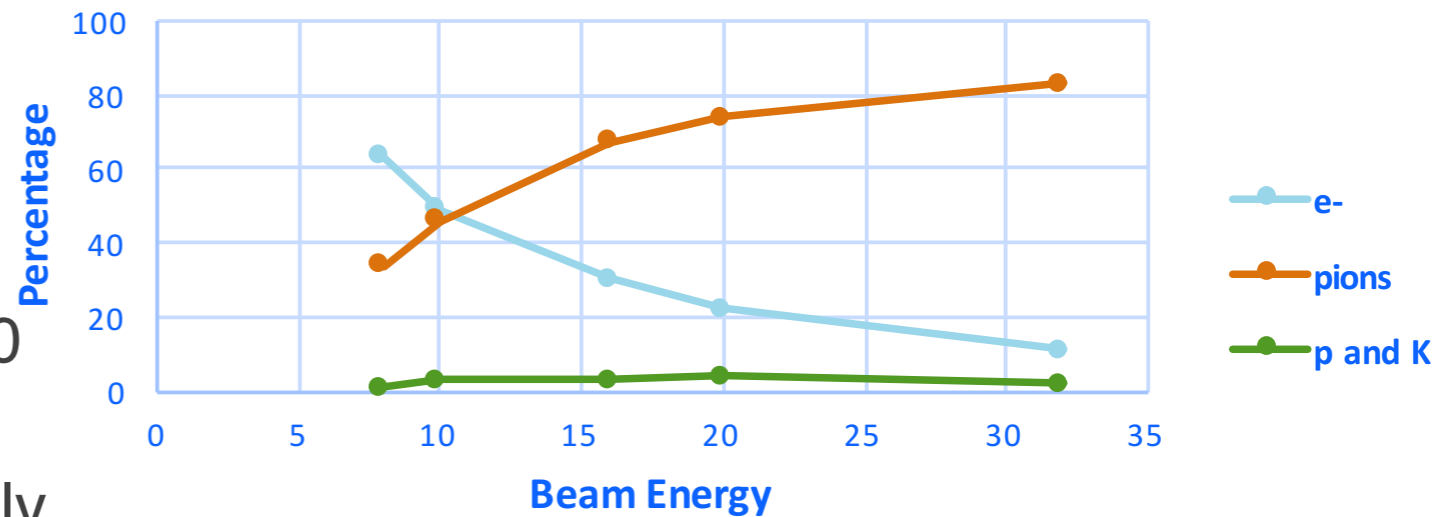
Beam Details

- 4 second slow extraction beam spill every 60 seconds from Main Injector
- ~1000 to 900,000 particles per spill
- MTest
 - 120 GeV primary protons
 - 1-66 GeV secondary beam
 - ~2cm spot size
 - typically 1-4 week runs
- MCenter
 - Secondary beam
 - Two tertiary beam stations down to 200 MeV
 - Refurbished large aperture magnet Jolly Green Giant
 - Longer term experiments

Positive Beams Composition, Open Collimators 2016



Negative Beams Composition, Open Collimators 2016

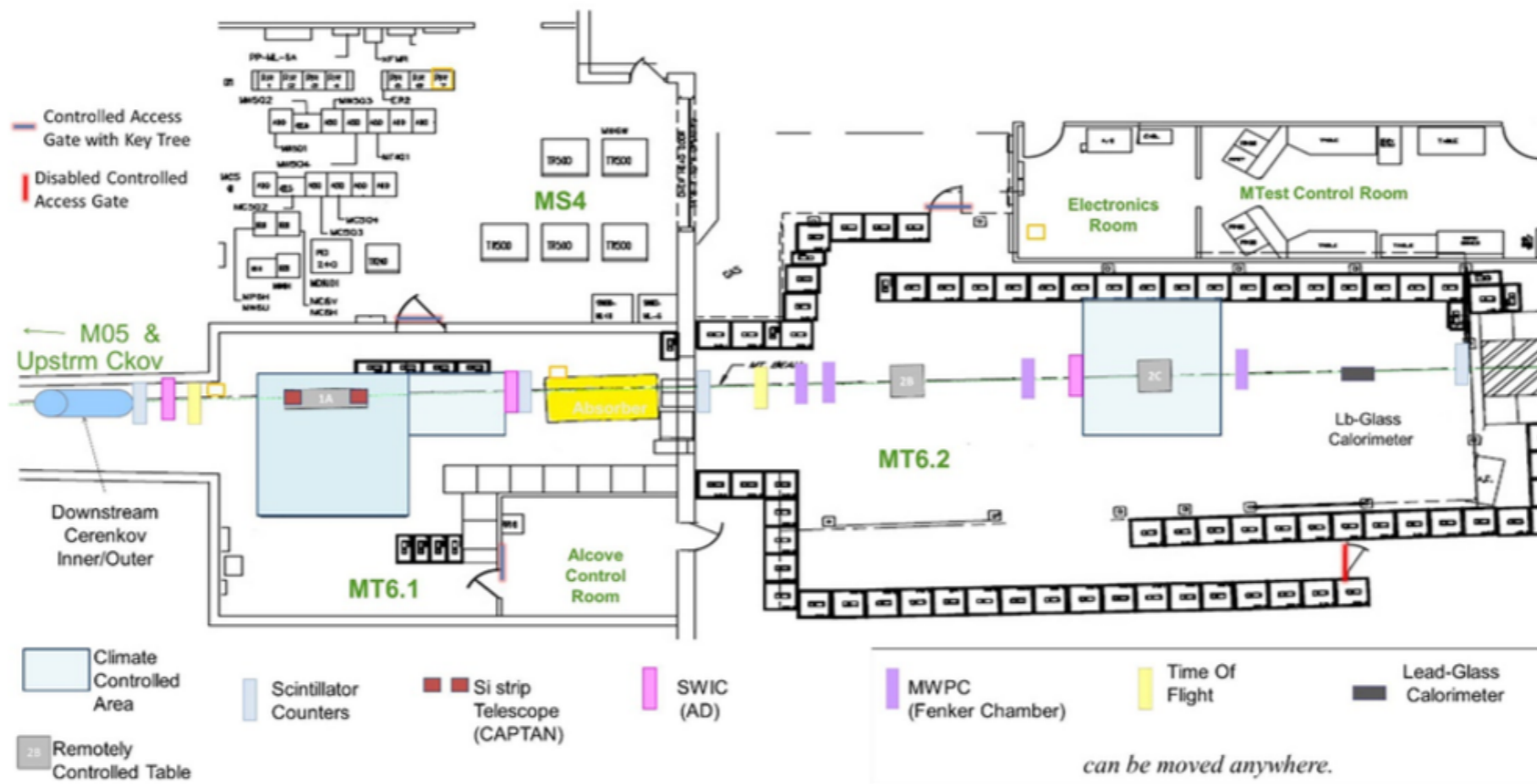


<https://ftbf.fnal.gov/beam-overview/>

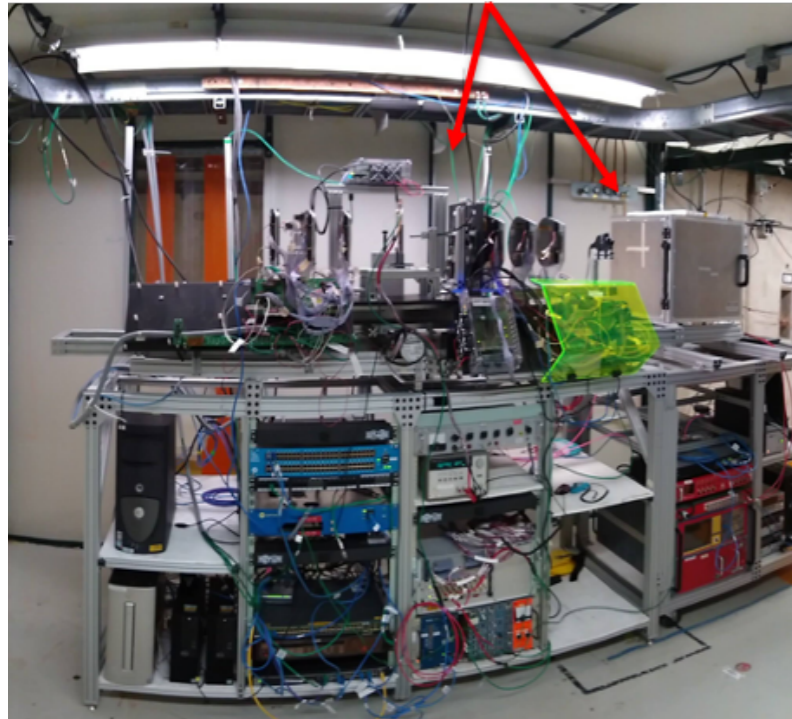
FTBF Layout



Instrumentation Layout - MTest



CMS timing



MT6.1

ATLAS pixel

Redtop calorimeter

Nanowire tracking

CMS timing

Facility LAPPD

RPC timing



MT6.2



b

FTBF Trends

- More user weeks of beam requested than available each year, ~10-20% oversubscribed
- Switchyard line is more than a mile long and rapidly aging with multiple components that have no viable spares.
 - 10+ weeks of major downtime in both FY21 and FY22 beam years which has led to some experiments receiving no beam.
- Heavy demand from CMS and ATLAS upgrade projects presently, EIC efforts ramping up. Multiple neutrino related projects making use of MCenter (TOAD, ArCS, EMPHATIC, NOvA)
- Increasing demand for clean low energy secondary beam (muons, electrons) that are difficult for current facility to accommodate
- Incompatible requests with experiments sharing the same beam line

Outlook of Test Beam Facilities

Last Update 21/04/2023

Running	1
Winter/Summer Shutdown	2
Longer Shutdown	3
Unclear	4
Likely	5
Pending Approval	6

[Calendar Link](#)

	2024												2025												2026												2027											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
DESY II Test Beam Facility	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	3	3	3	3	3	3
CERN SPS North Area	2	2	2	1	1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CERN PS East Area	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Fermilab	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PITZ (22MeV)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5	5	5	5	5	5	5	5	5	5
SLAC	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
CLEAR	2	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
PARTREC Groningen	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
DESY ARES	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2028												2029												2030												2031											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
DESY II Test Beam Facility	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
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DESY ARES	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1



Future Facilities at FNAL

- ITA will end if the LINAC does not operate in the PIP-II era
- ACE provides a great opportunity for a new test beam facility
 - PIP-II linac will provide high intensity source of 800 MeV protons
 - New location closer to accelerators makes facility more convenient and have less beamline to maintain
 - 4-6 beamlines
 - 120 GeV from MI (slow extraction)
 - 8 GeV from booster
 - High intensity 800 MeV irradiation area ($>10^{18}$ protons total dose on samples)
 - Clean secondary lines for Electrons, Muons, and Pions
 - Collocate test beam and irradiation facilities
 - Dedicated infrastructure for control rooms, experimental staging, facility infrastructure
 - Room for small medium/long term experiments
- Snowmass white paper



Courtesy T. Kobilarchik

Summary

- FTBF remains in high demand serving users from all frontiers.
- ITA is running but only through 2026.
- The test beam community needs to plan for late 2020s period when multiple international facilities face simultaneous downtime.
- Existing FTBF facility and aging switchyard beamline will struggle to meet projected user demands without significant refurbishment or a new facility. We need to be making a plan now.
- Reach out if you are interested in the FTBF and ITA facilities, scheduling this summer for FY24 season:
 - Email: ftbf_co@fnal.gov
 - Slack Team: [fnal-testbeam](#)
 - Webpages: ftbf.fnal.gov and ita.fnal.gov
 - Listserv: test_beam@fnal.gov