



Accelerator Resources for Users

Bob Zwaska

Fermilab Users Meeting

21 June 2018

Introduction

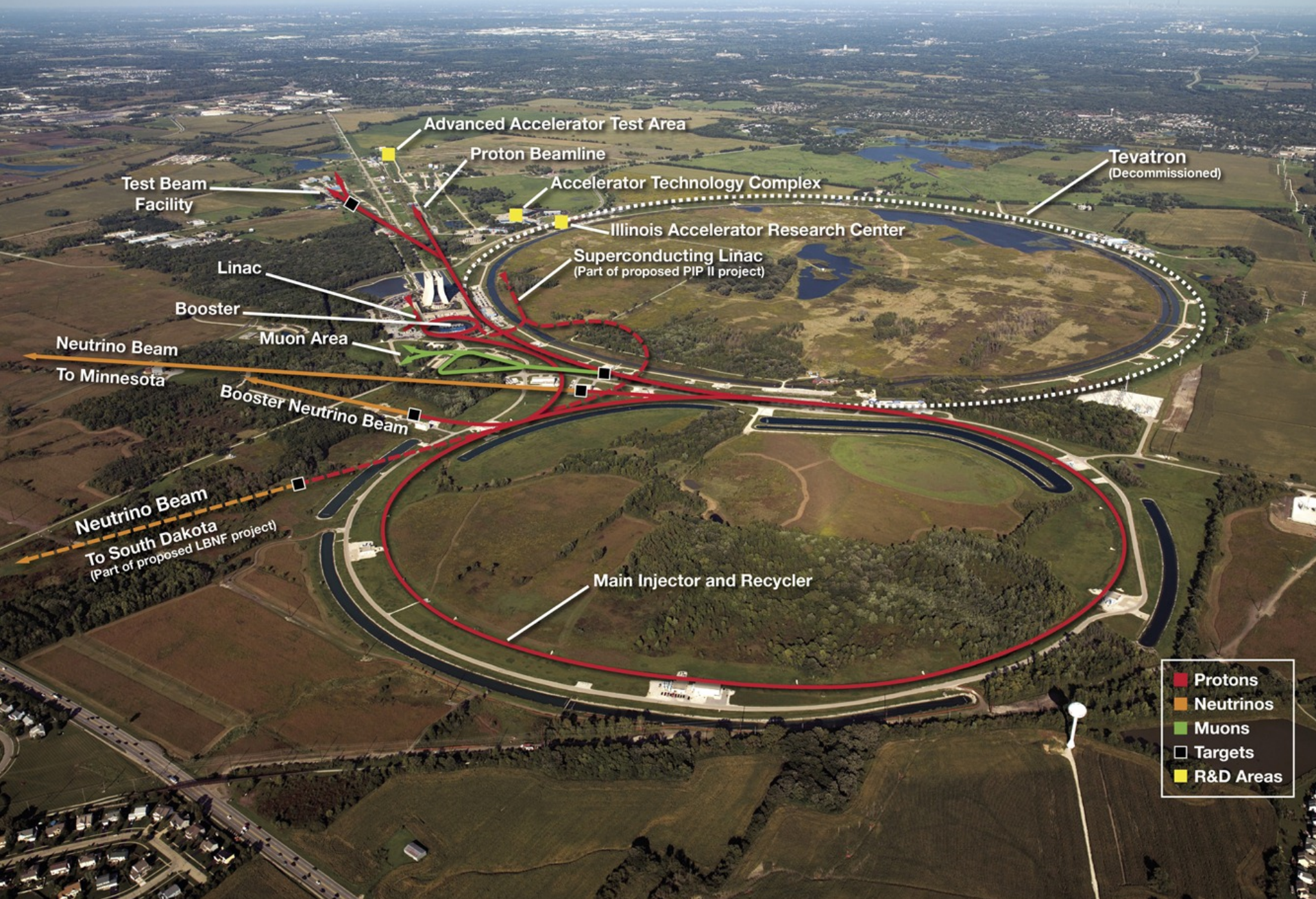
- Accelerator Division (AD)
 - Vision & Mission
 - Accelerator Complex
 - Leadership
 - Organization
- Gaining Access to AD and its Resources
- Research and Test Accelerators
- Important non-AD Resources for Accelerators

Accelerator Division (AD), by the book

<https://ad.fnal.gov/>

- Fermilab's Accelerator Division operates, maintains, and improves the laboratory's accelerator complex, beam lines and beam targets.
- Our vision is to build and operate megawatt particle beams that will enable the science goals outlined in the [2014 Particle Physics Project Prioritization Panel \(P5\) report](#).
- Our mission is to drive scientific discovery by:
 - delivering particle beams for scientific research;
 - conducting accelerator physics research;
 - designing and building accelerators to extend the scientific reach of existing facilities.

Fermilab Accelerator Complex



Role of the Accelerator Division

- Operating the Fermilab accelerator complex
 - 700 kW NuMI Neutrino beam
 - Booster Neutrino Beam
 - Muon Source for g-2
 - Switchyard program for test beams
- Improving the accelerator complex
 - Proton Improvement Plan
 - Muon Campus projects (4 Accelerator Improvement Projects)
 - 900kW – 1 MW AIPs
- Projects for the future: Mu2e, LBNF, PIP-II
- Accelerator Research
- Experimental Facility for accelerators (FAST/IOTA)
- Commercialization of accelerator technologies (IARC)

Accelerator operations priorities for the next year

- Complete the Proton Improvement Plan this shutdown
- Deliver beam to NOvA at 700+ kW beam power
- Meet beam delivery goals for the g-2 experiment
 - Mu2e beam commissioning needs to start in 2020, setting the timescale to achieve a full dataset
- Support test beam and E1039
- Deliver beam to BNB experiments
- Develop and execute Accelerator Improvement Projects (if approved) to increase beam power to NOvA to ~900 kW in 2021 and prepare for PIP-II

Program Planning - Experiments Run Schedule

Fermilab Program Planning 16-Mar-18

LONG-RANGE PLAN: WORKING DRAFT

		FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
LBNF / PIP II	SANFORD FNAL				DUNE	DUNE	DUNE	DUNE	DUNE	DUNE	DUNE	DUNE	DUNE	DUNE
						LBNF	LBNF	LBNF	LBNF	LBN F	LBNF	LBNF	LBNF	LBNF
NuMI	MI	MINERvA	MINERvA	OPEN	OPEN	OPEN	OPEN	OPEN	LONG SHUTDOWN					
		NOvA	NOvA	NOvA	NOvA	NOvA	NOvA	NOvA						
BNB	B	MicroBooNE	MicroBooNE	MicroBooNE	OPEN	OPEN	OPEN	OPEN						
		ICARUS	ICARUS	ICARUS	ICARUS	ICARUS	ICARUS	ICARUS						
		SBND	SBND	SBND	SBND	SBND	SBND	SBND						
Muon Complex		g-2	g-2	g-2	LONG SHUTDOWN						OPEN			
		Mu2e	Mu2e	Mu2e							Mu2e	Mu2e	Mu2e	Mu2e
SY 120	MT	FTBF	FTBF	FTBF	FTBF	FTBF	FTBF	FTBF	LONG SHUTDOWN	LONG SHUTDOWN	FTBF	FTBF	FTBF	FTBF
	MC	FTBF	FTBF	FTBF	FTBF	FTBF	FTBF	FTBF			FTBF	FTBF	FTBF	
	NM4	OPEN	E1039	E1039	E1039	E1039	OPEN	OPEN			OPEN	OPEN	OPEN	OPEN
		FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30

Construction / commissioningRunSubject to PAC reviewShutdown



Construction / commissioning



Run



Subject to PAC review



Shutdown

- NOvA will run until long shutdown planned for 2024-26
- MicroBooNE may continue running, ICARUS to start in 2020
- g-2 approved to run into 2020, when Mu2e starts commissioning
- E1039 (SeaQuest with polarized target) starts next year

programplanning.fnal.gov/accelerator-and-experiments-schedule/

Leadership / HQ

- Michael Lindgren
Accelerator Division Head
*Previous Chief Project Officer
and PPD Head*



- Mary Convery, Deputy Head, Accelerator Systems
- Paul Czarapata, Assoc Head, Engineering and Support
- Vaia Papadimitriou, Assoc Head, LBNF
- Vladimir Shiltsev, Assoc Head, Research, APC Director

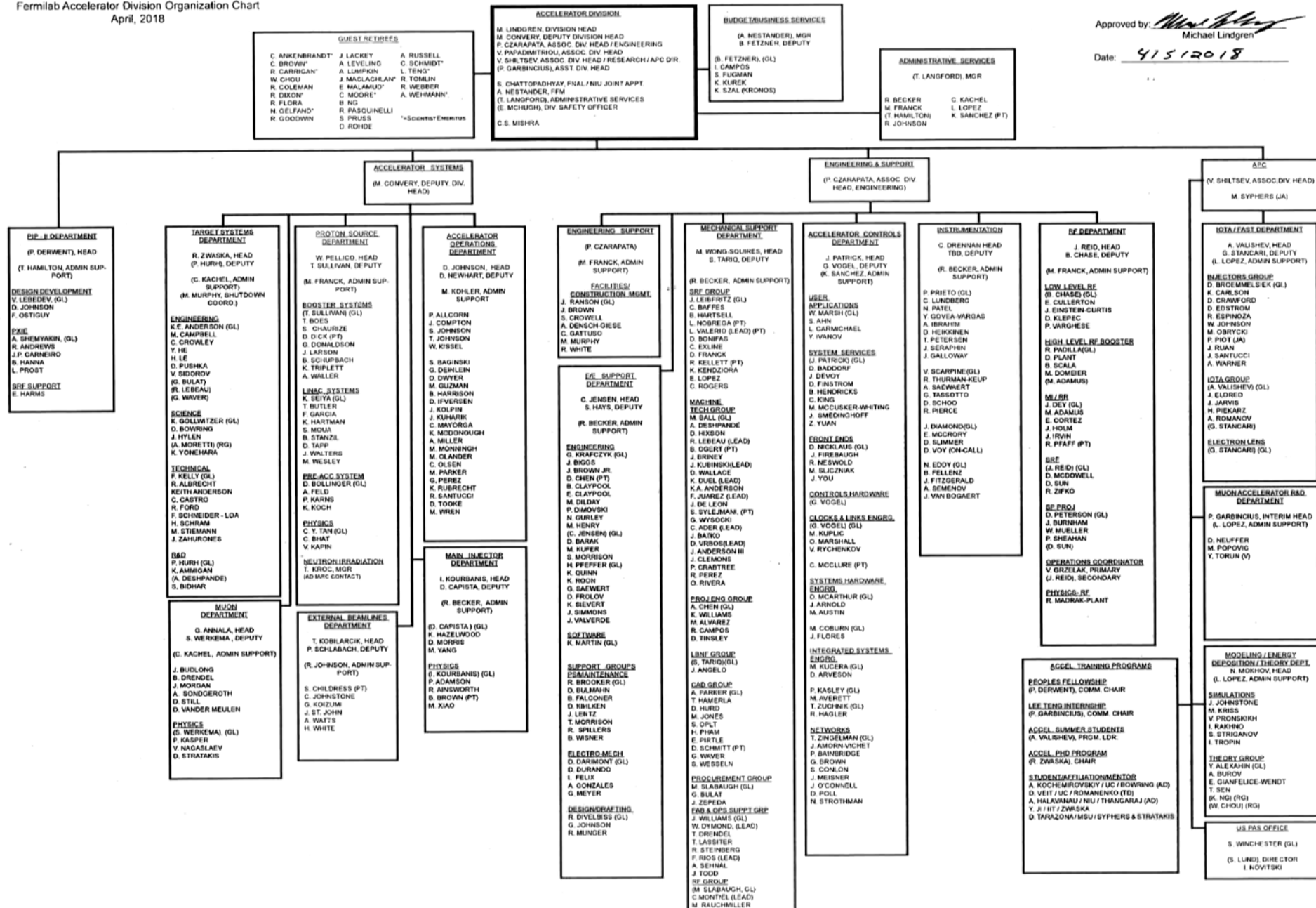
Recent all-hands meeting: indico.fnal.gov/event/17153/

Division Organization

Fermilab Accelerator Division Organization Chart
April, 2018

Approved by: 
Michael Lindgren

Date: 4/5/2018



Division Departments

- Accelerator Systems
 - [External Beamlines](#)
 - [Main Injector](#)
 - [Muon](#)
 - [Operations](#)
 - [Proton Source](#)
 - [Target Systems](#)
- [Accelerator Physics Center](#)
 - Host for FAST/IOTA, research, and physics support
- Engineering and Support
 - [Accelerator Controls](#)
 - [EE Support](#)
 - [Engineering Support](#)
 - [Instrumentation](#)
 - [Mechanical Support](#)
 - [RF](#)
- Projects mostly organized externally
 - Mu2e, LBNF, PIP-II, etc.
 - Labor matrixed into projects
 - Some shared facilities (PIP2IT)

Operations / Main Control Room

operations.fnal.gov

- Gateway to AD
 - x3721
- Key Checkout
- LOTO point
- Access forms
 - RWPs
- Best resource for up-to-date information
 - Experiments can call if they need updates
- Calendars and information on operations web page



Accelerator Division Notification

Message Archive

Schedules

- [Accelerator Operations](#)
- [Accelerator Division](#)
- [One-liners](#)
- [OPSCO Operations Coordinator](#)

[Accelerator Division Home](#)

Turn refreshing on

Notify application (restricted) (Ch13)

[Move links to bottom](#)

High Energy Physics

$$\text{SC time} = 2.9 / 60.0$$
[illegible]

Area

Current State

Last State Change

Complex

High Energy Physics

MainInjector

Operating

Recycler

Access/Shutdown

Mon Jun 18 15:44:08 CDT 2018

Temperature 73.03 F (22.79 C)					
NuMI Beam	-0.07E12	SY Total	0.0ppp	Source Beam	53.33mA
NuMI Power	689.33kW	MTest	0.0ppp	Linac Beam	19.50mA
BNB	4.77E16p/hr	MCenter	0ppp	Booster Beam	4.55E12
BNB 1D Rate	3.57Hz	NM	0ppp	Recycler	52.25E12
				MI Beam	-0.01E12
				SRC Stat	5.12
				Booster DF	13.75Hz
				Muon POT	0E12
				Muon	0.0p/hr
				Muon e+	0.0

20 Jun 2018 11:06:13

Beam to users.

...

Power outages today at NS2, NW2, NW4.

APC

Links

AAC

ESH&Q

Plots

Notify Display

Elog

Org Chart

P2MAC

Records

Summer Maintenance Period

*(Local Access)

Databases

AD Logbook

www-bd.fnal.gov/Elog

- One Logbook – click operations

Fermilab

AD Home | Worklist | Telephone | Scratchpads

Redmine | Wiki | Archive | Contact Us

Home | Charts

Actions

- Filter
- Print
- Update

Filtered

- Log: Operations [v]
- Clear

Logs

- Accelerator Projects
- Booster
- Controls
- Cryogenics
- External Beamlines
- FAST
- Instrumentation
- Linac
- Main Injector
- Muon
- Operations**
- PreAcc
- Proton Improvement Plan
- Regular

Mon 2018-06-18 14:27:28 Donovan Tooke (tooke24)

All keys (MI10, MI20-62, F-Sector, and NuMI) are back except for Delivery Ring. Preparing to hipot MI.

Logs: Operations | Id: 136971 | Memo: false | Saves: 0

Mon 2018-06-18 14:10:02 Adam Watts (awatts)

Here are "nominal" Switchyard beam positions, averaged over the spill, as reported by the BPMs. EE support did some work on HV703 today, and have told us how to compensate, so this is a reference in case our compensation isn't perfect. I highly recommend using the datalogged BPM average parameters as shown in the attached plots to tell if SY trajectories have changed significantly. This is more straightforward than trying to find a "reference" set of multiwire plots, at least as a quick check.

Mon 2018-06-18 14:13:41 Adam Watts (awatts) Matt Kufer (kufer) Dean Still (still)

Matt shared the following measurements with me that show us how to change the HV703 8 GeV and 120 GeV values to compensate for regulation work done

APC

Links

- AAC
- ESH&Q
- Plots
- Notify Display
- Elog**
- Org Chart
- P2MAC
- Records
- Summer Maintenance Period
- *(Local Access)

Databases

Date

Sort

Lim

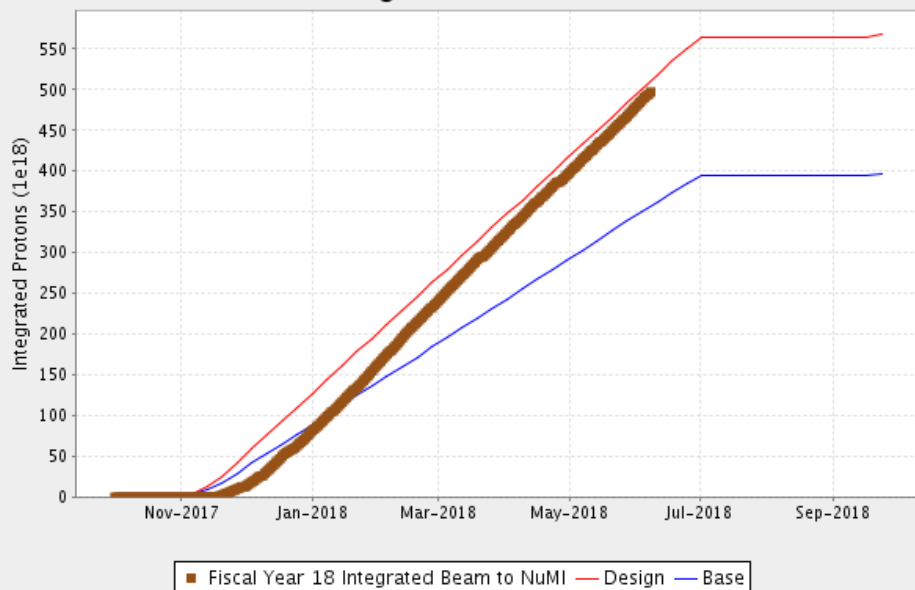
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Features +

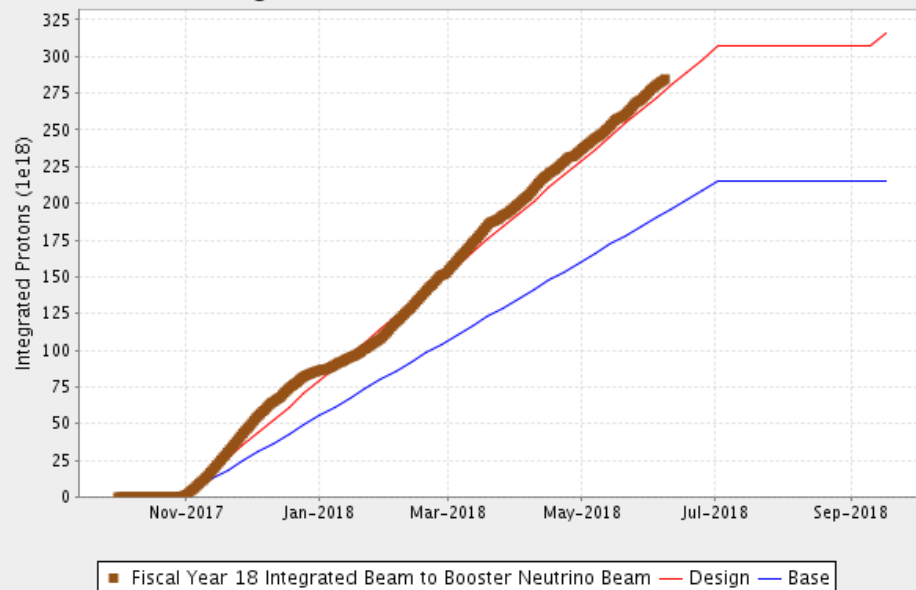
Performance Plots

www-bd.fnal.gov/FixedTargetPlots/today/ProtonPlots.html

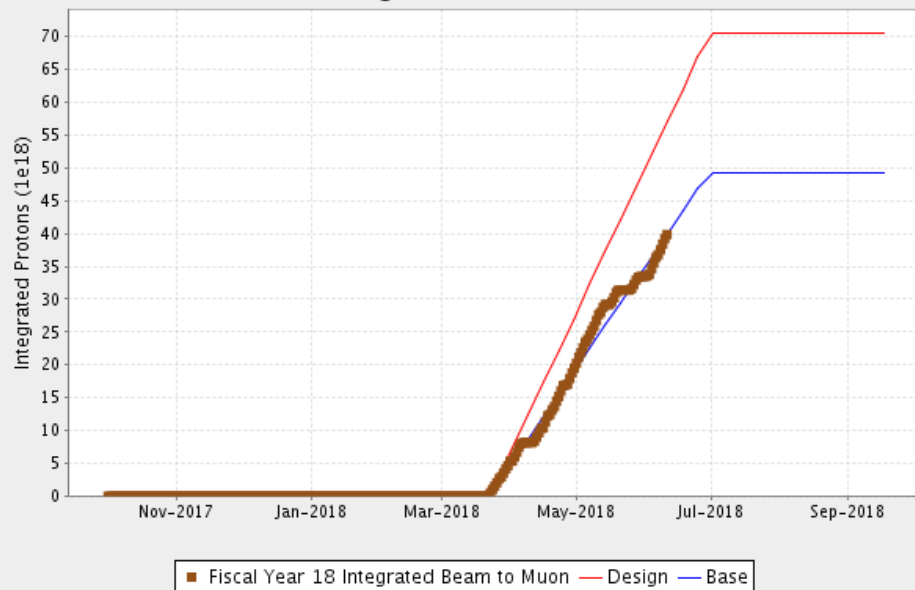
FY18 Integrated Beam to NuMI



FY18 Integrated Beam to Booster Neutrino Beam



FY18 Integrated Beam to Muon



APC

Links

AAC

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P2MAC

Records

Summer Maintenance Period
*(Local Access)

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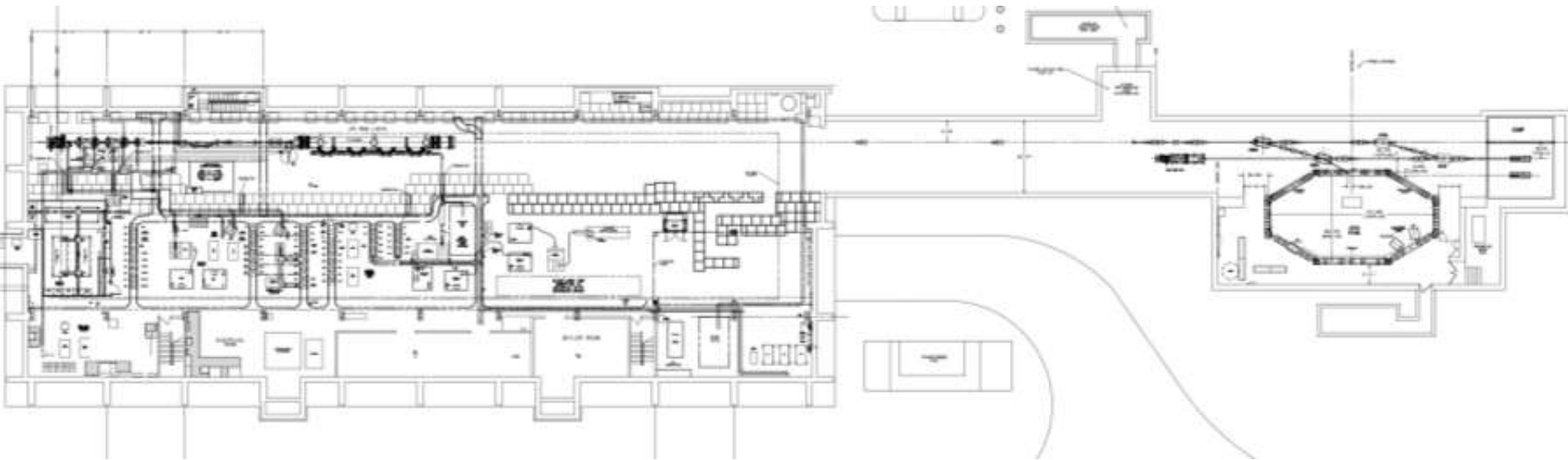
Meetings to find AD People

- AD Operations Meetings
 - indico.fnal.gov/category/42
 - Weekly open summary meeting, Fridays at 9am, 1 West (usually)
 - Internal Planning Meetings
 - During beam operations: Mondays and Wednesdays, 9am, Huddle
 - During shutdowns Tuesdays at 9am, Huddle
- All-Experimenters Meetings, Mondays at 4:00pm, Curia II
 - indico.fnal.gov/event/17358
- PMGs
 - Proton PMG organized around AD issues, 1st Thursday of the month, 1pm
 - indico.fnal.gov/category/60
 - Numerous project-specific PMGs

FAST/IOTA : Accelerator R&D Facility

fast.fnal.gov

- The Fermilab Accelerator Science and Technology (FAST) facility contains 3 components
 - 150-300 MeV Electron Injector
 - 70 MeV/c Proton Injector
 - IOTA Ring capable of operation with e^- and p^+
 - *Integrable Optics Test Accelerator*
- Platform for accelerator physics research, developing into a user facility



FAST/IOTA

fast.fnal.gov

- FAST electron linac complete in 2017, had 2-month experimental run
 - IOTA injector commissioning
 - For the first time, beam accelerated through ILC-type cryomodule to energy 150 MeV in October 2017
 - Achievement of 300 MeV beam in SRF linac
 - Collaboration-driven accelerator-physics experimental program with uptime over 85%
- IOTA construction near completion with commissioning to begin in July-August
- Annual collaboration Meeting (held in conjunction with megawatt workshop)
 - indico.fnal.gov/event/16269





R a D I A T E

Collaboration

Radiation Damage In Accelerator Target Environments

Broad aims are threefold:

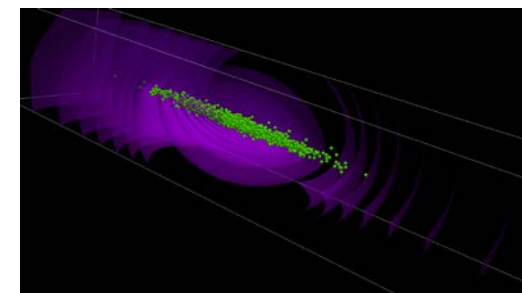
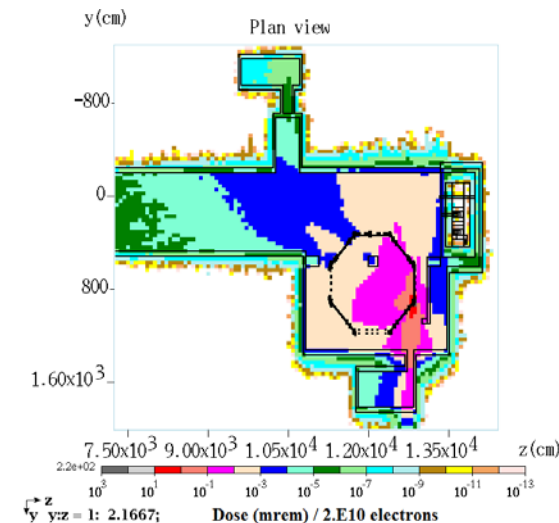
radiate.fnal.gov

- to generate new and useful materials data for application within the **accelerator** and **fission/fusion** communities
- to recruit and develop new scientific and engineering experts who can **cross the boundaries** between these communities
- to initiate and coordinate a **continuing synergy** between research in these communities, benefitting both **proton accelerator applications** in science and industry and **carbon-free energy technologies**



Computing

- Accelerator Controls Network (**ACNET**)
 - Expansive system of devices, databases, and interfaces
 - Available for experimenters to extract information from AD, or to use directly on experiments
 - www-bd.fnal.gov/controls
- **MARS**: Particle production and interaction simulation
- Actively used and developed suite for particle interaction simulations
 - mars.fnal.gov
- Accelerator Simulation
 - Many individual sources within AD and SCD
 - Synergia is a prepared package of accelerator tools
 - web.fnal.gov/sites/Synergia/SitePages/Synergia%20Home.aspx



Accelerator Science and Education

Accelerator Science initiative within the office of the Chief Research Officer

- Headed by Sergei Nagaitsev
- Coordinate Fermilab efforts on accelerator science and technology, and also reach out to non-HEP applications of accelerators
- Accelerator Physics and Technology Seminars
 - Tuesdays (and sometimes Thursdays) at 4pm in 1 West
 - www-bd.fnal.gov/ADSeminars
- United States Particle Accelerator School - uspas.fnal.gov
 - Two university-credit programs per year
- Accelerator PhD Program
 - Supports university students to become resident at Fermilab and perform accelerator research
 - Budker Seminars to hone our young accelerator professionals
- Internship Programs - ed.fnal.gov/interns
 - Lee Teng program (joint with Argonne) devoted to accelerator science and engineering

Accelerator Application Development and Demonstration (A2D2): A 9 MeV electron source at IARC

iarc.fnal.gov

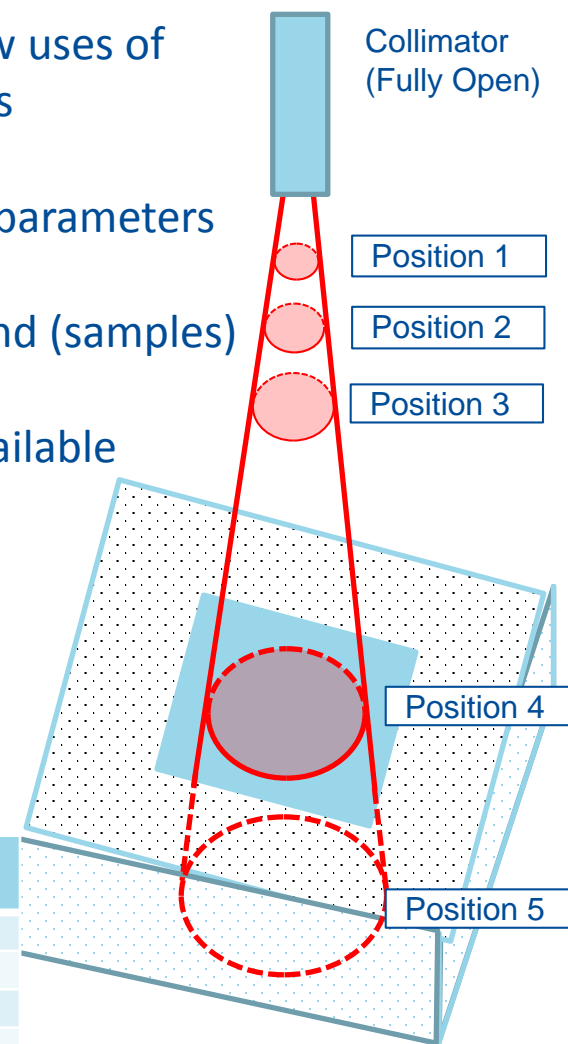


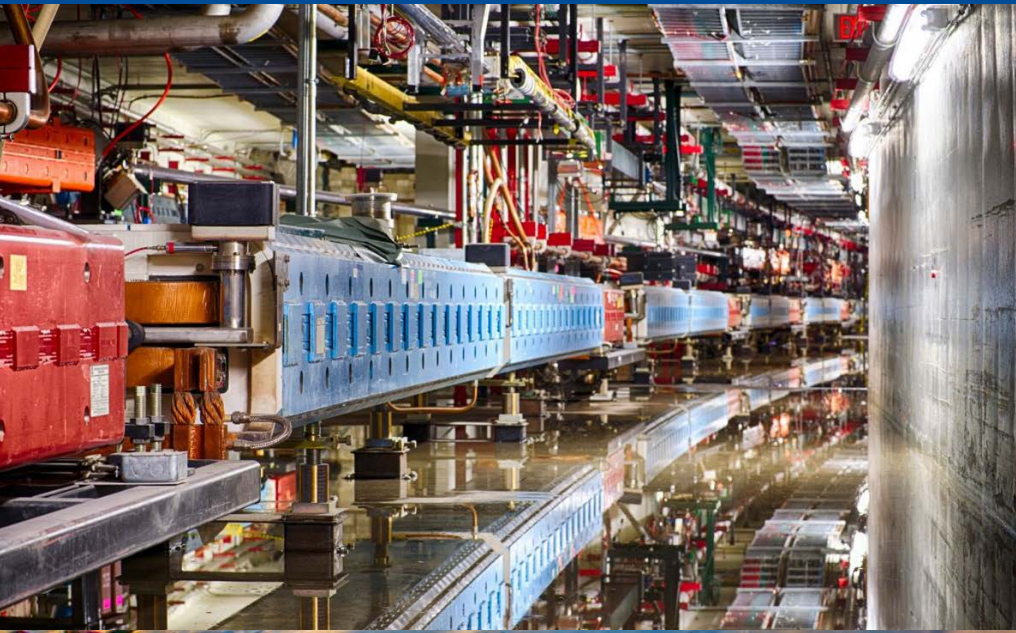
- Investigate new uses of electron beams
- Flexible beam parameters
- Fast turn-around (samples)
- X-ray mode available

- Demonstrated 1 kW operation @ 1 mA
- Contact: [Tom Kroc](#), [J. Thangaraj](#)

Setting	Power, Watts	Dose, kGy/g
1	200	0.22
2	400	0.43
3	600	0.65
4	800	0.87
5	1000	1.08
6	1200	1.3

Position	Beam Diameter, cm
1	4.8
2	5.7
3	7.1
4	10.3
5	12.6





Accelerator Resources for Users

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21 June 2018