

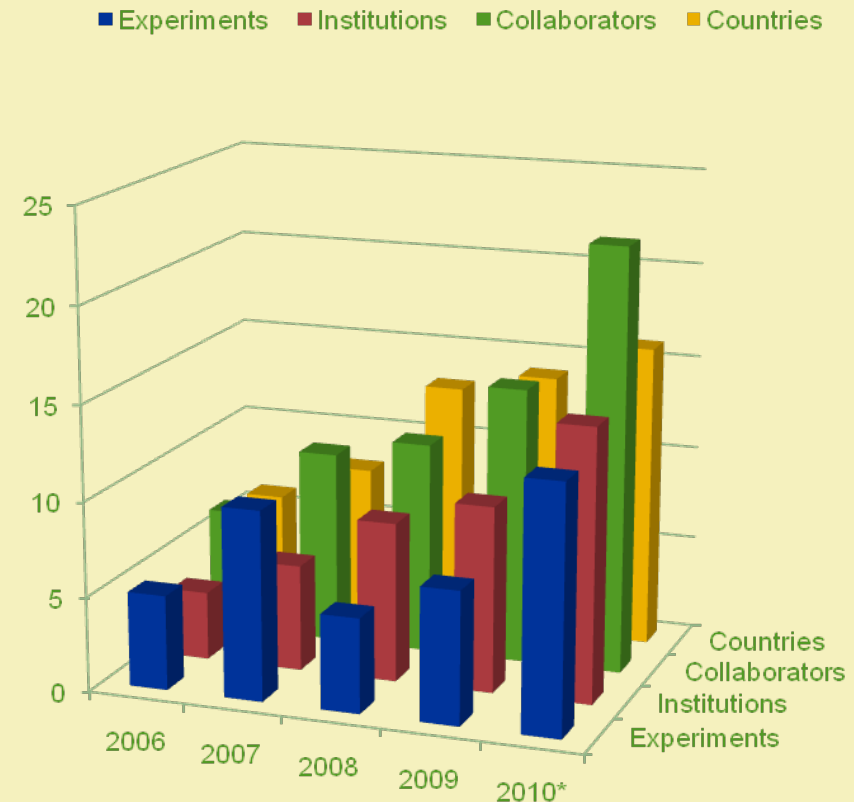
FERMILAB TEST BEAM FACILITY

Aria Soha

March 22, 2011

The Fermilab Test Beam Facility

- World Class Facility
- The only operating U.S. HEP Test Beam
- Detector R&D focus
- Since 2005:
 - 32 experiments
 - 464 collaborators
 - 108 institutions
 - 24 countries



*Data for 2010 is still being compiled

Location

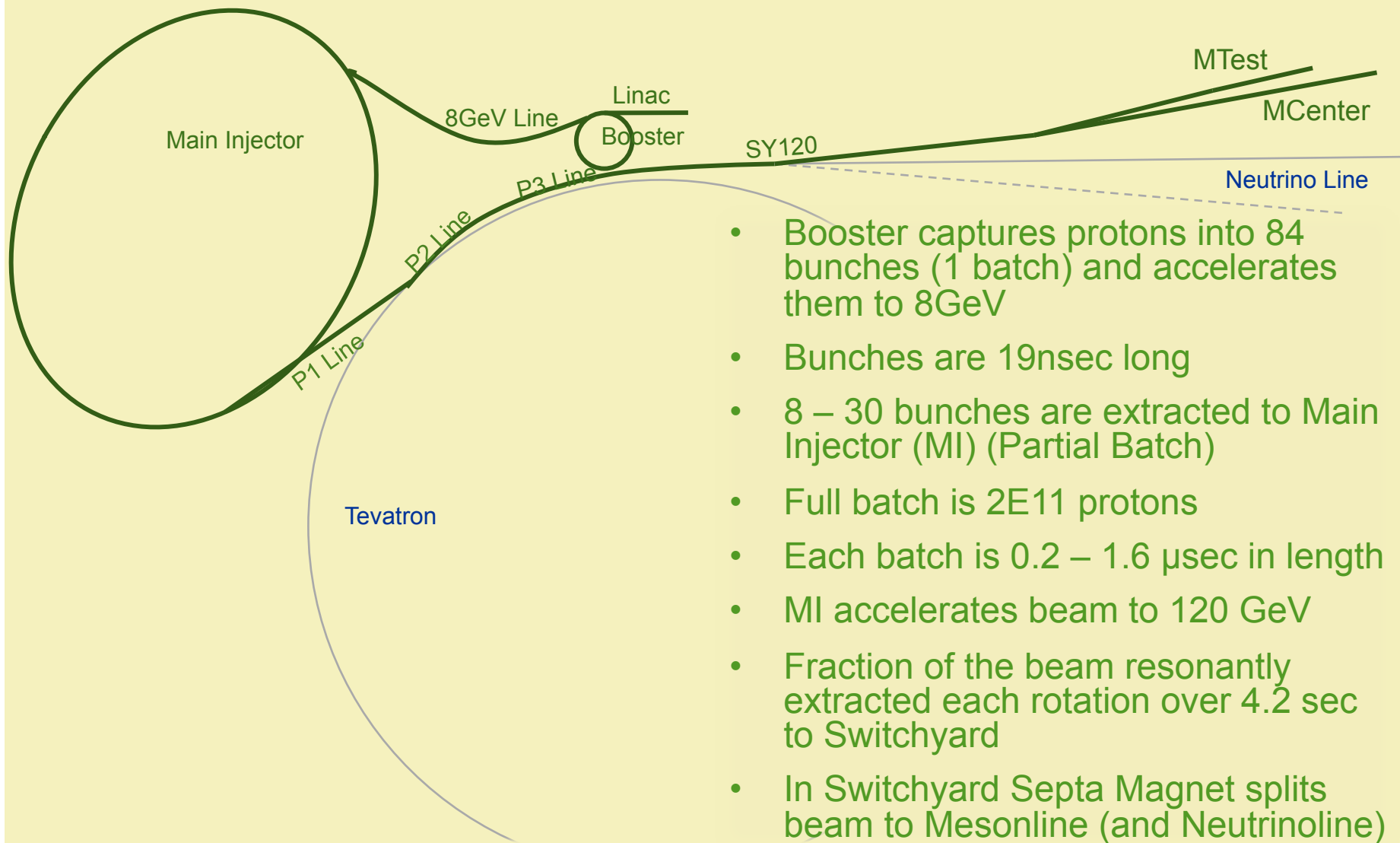
Fermi National Accelerator Laboratory



Meson Detector Building – West

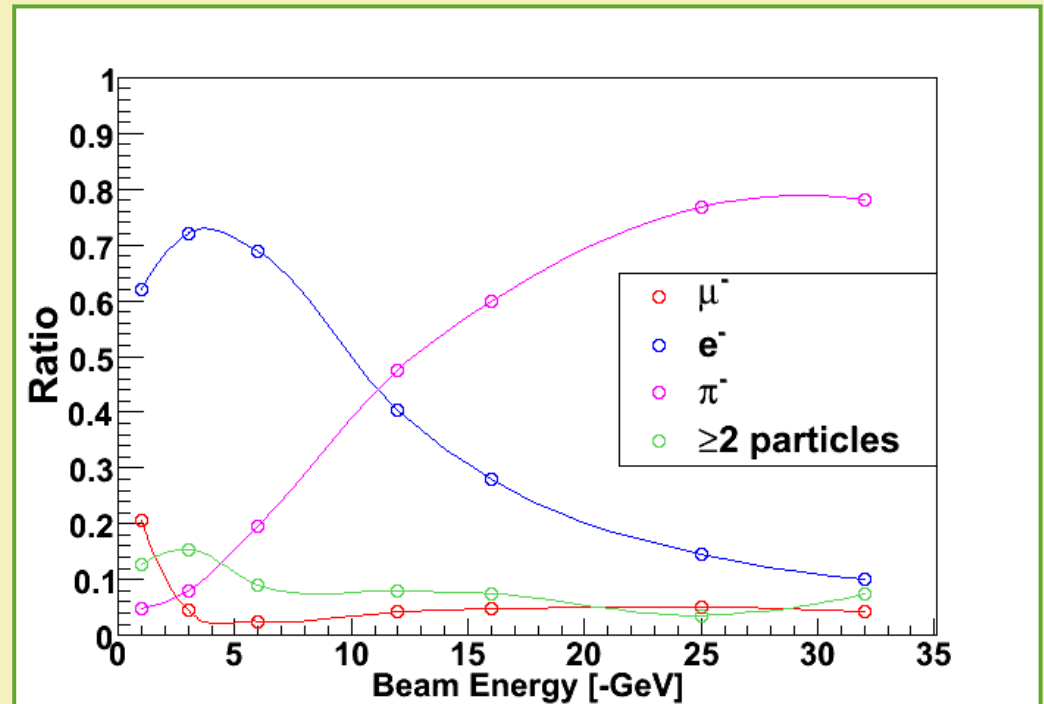


Beam Delivery



Particle Composition of Beam

- 120 GeV Protons
- 2 - 66 GeV Pions
- 0.5 – 32 GeV Electrons
- Broadband Muons



- If beam were smoothly extracted, 100 kHz or less would imply 1 particle per MI rotation would occur.
- Beam extraction is not smooth resulting in up to 35% double occupancy per MI rotation

Beam Energy (GeV)	Rate at Entrance to Facility (per spill)	Rate at Exit of Facility (per spill)	% Pions, Muons	% Electrons
16	132,000	95,000	87%	13%
8	89,000	65,000	55%	45%
4	56,000	31,000	31%	67%
2	68,000	28,000	<30%	>70%
1	69,000	21,000	<30%	>70%

Operating

- Test Beam makes up 5% of Fermilab's HEP program
- 6 sec event (4.2 sec spill) every 60 seconds for 12 hours a day
- Normal Operating Hours: 0400 – 1800
 - Stop for Tevatron Fill (2 hrs)
- Control room manned during beam hours

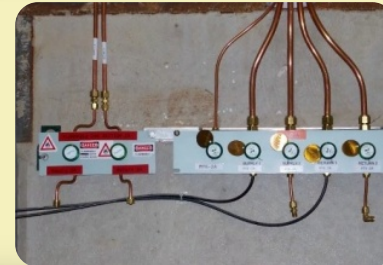
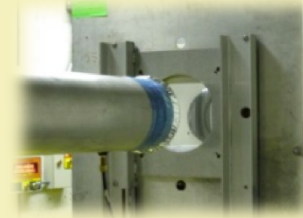
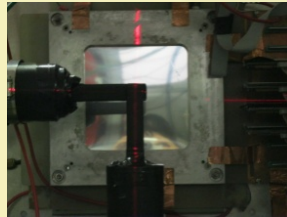
Facility Details

- Multiple Control Rooms
- Conference Room
- Climate-controlled areas for experiments
- Machine Shop
- Several Work Rooms
- Storage Rooms and Cabinets



Facility Details

- Remotely controlled Motion Tables
- Laser Alignment
- State-of-the-Art, web-based Cameras
- Helium Tubes
- Gas Delivery
- Signal and High Voltage cable patch panels

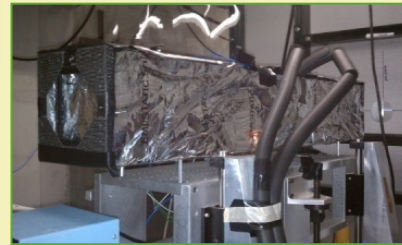


Facility Instrumentation

- 2 Cerenkov Detectors



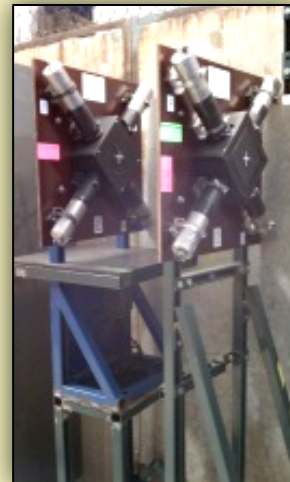
- 2 Pixel Telescopes



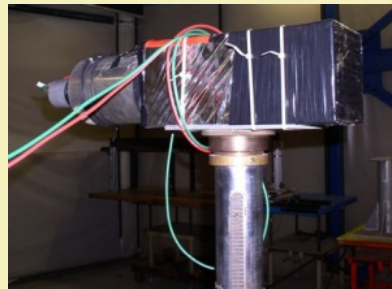
- 4 MWPC Tracking System



- Time of Flight System



- Lead Glass Calorimeters

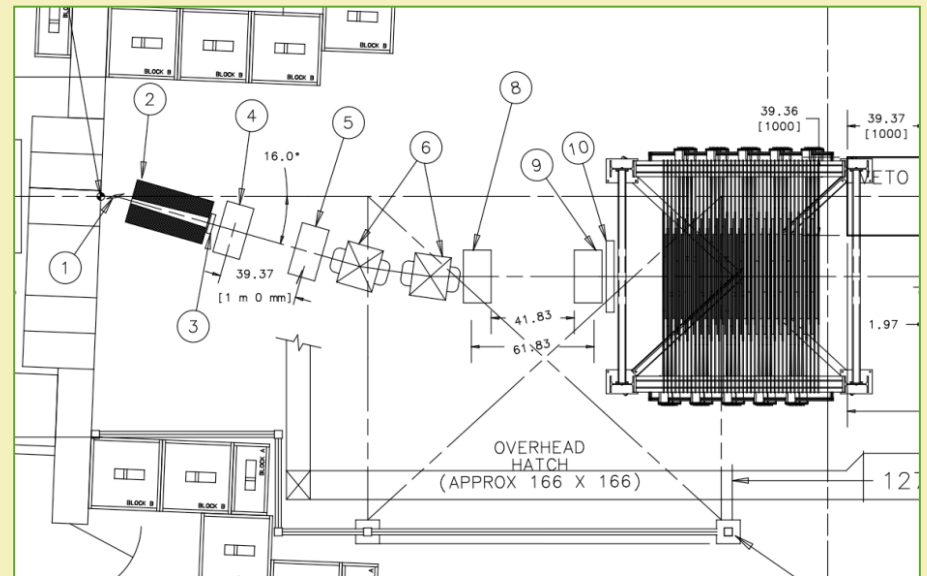


- Assorted Trigger scintillators



Accommodating Users

- In 2008, T-977 MINERvA experiment requested
 - ~200 – 1000 pions/spill,
with momentum as low as 200 MeV/c
- They requested Fermilab build another beamline...



Tertiary Beamline



Target/
Collimator

TOF 1

WC 1

WC 2

Spectrometer
Magnets

WC 3

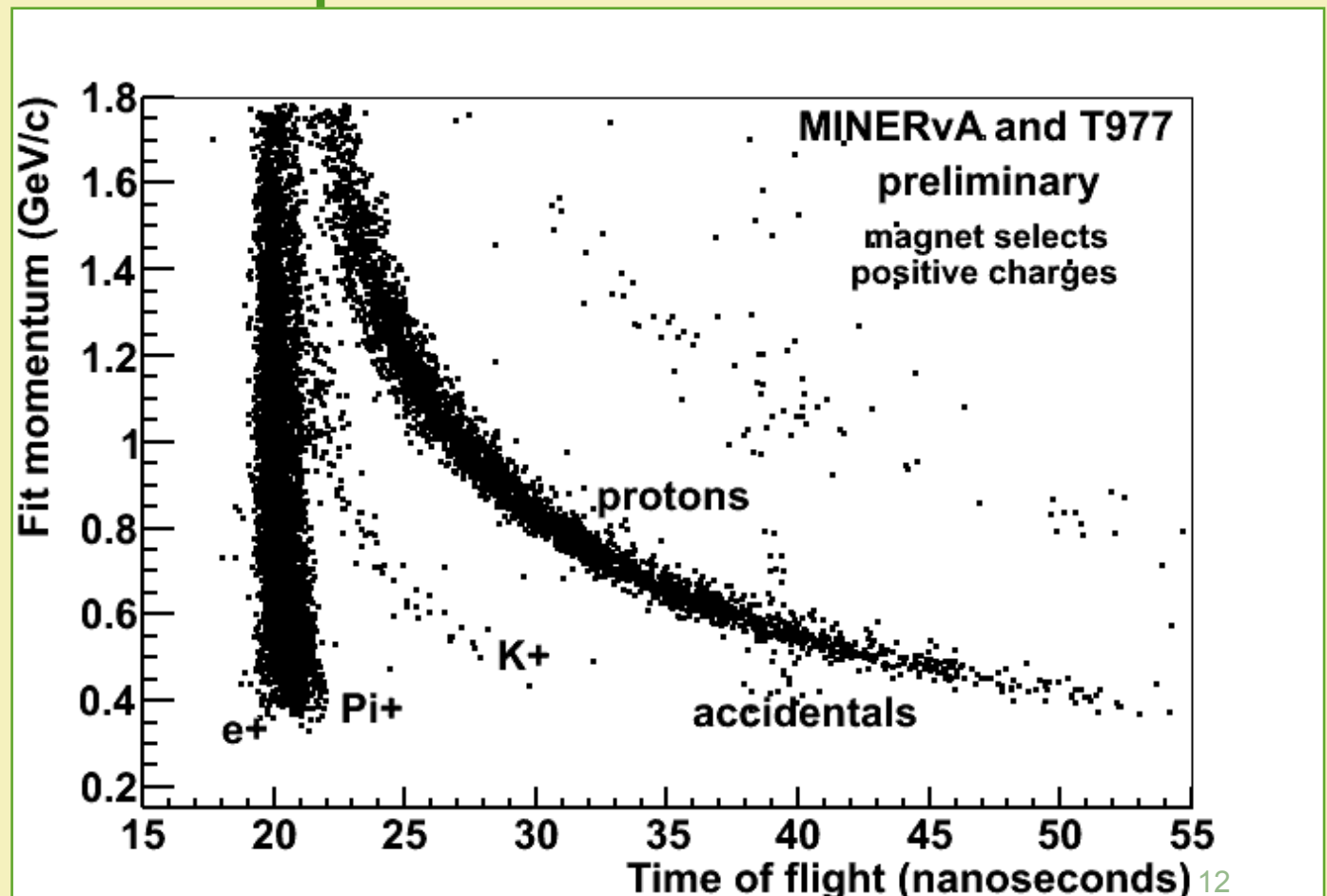
WC 4

TOF 2

Tertiary Beam Details

Plot of Fit Momentum vs. TOF;
Shows: Separation of Species and Available Momenta

- 60% pions,
- 40% protons,
- very few electrons, kaons, and deuterons.



Tertiary Beam Details

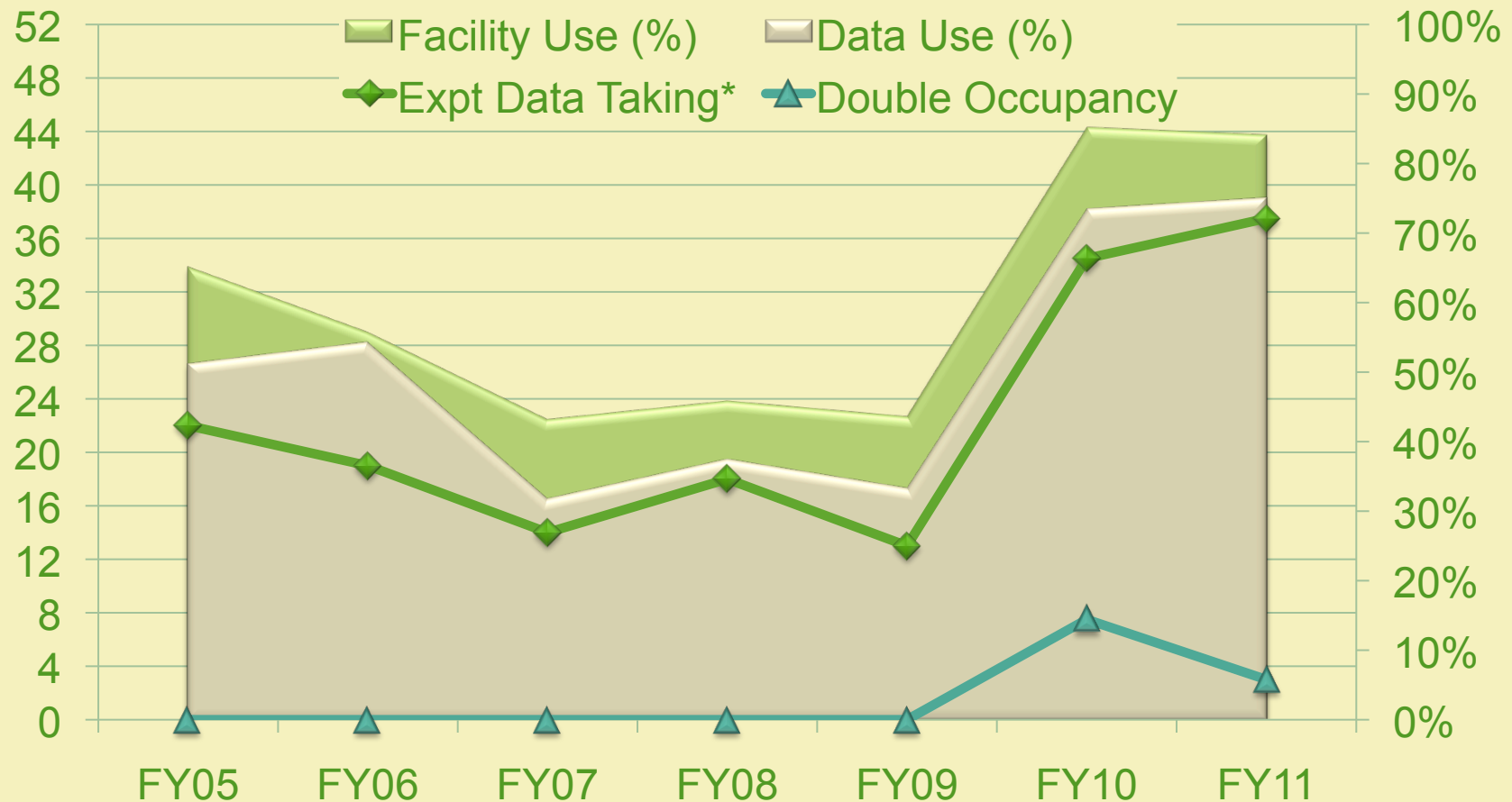
- **Rates:** about 200 particles / 4 sec spill (~50 Hz)
- **Momentum Resolution:** $dp = 3\%$
 - multiple scattering limited for this momentum range
- **Bias:**
 - MINERvA design goal for bias is $< 2\%$.
 - So far only 5% demonstrated
- WC4 can be moved to achieve lower or higher momentum
 - design momentum is 200MeV minimum

Schedule

2010					
	Dates	Experiment	Description	User	Area
1.	Oct 1 - Oct 5	Celex	CALICE Installation	Primary	2-CD
2.	Oct 6 - Oct 14	T978	CALICE Installation	Primary	2-CD
3.	Oct 7 - Oct 9	T978	CALICE Installation	Primary	2-CD
4.	Oct 15 - Oct 19	T978	CALICE Installation	Primary	2-CD
5.	Oct 20 - Oct 26	T978	CALICE Installation	Primary	2-CD
6.	Oct 27 - Nov 2	T978	CALICE Installation	Primary	2-CD
7.	Nov 3 - Nov 9	T1004	Total Absorption Dual Readout Calorimetry	Primary	2-B
8.	Nov 10 - Nov 16	T992	Radiation-hard Sensors for the SLHC	Primary	1-B
9.	Nov 17 - Nov 23	T992	Radiation-hard Sensors for the SLHC	Primary	1-B
10.	Nov 24 - Nov 30	T1008	Super B Prototype Installation	Primary	2-BC
11.	Dec 1 - Dec 7	T1008	Super B Prototype	Primary	2-BC
12.	Dec 8 - Dec 14	T994	JASMIN	Primary	2
13.	Dec 15 - Dec 21	T994	JASMIN	Primary	2
14.	Dec 22 - Dec 27	T932	The Diamond Detector Research Group	Primary	1-B
15.	Dec 28 - Dec 31	No Beam Available: Transfer Hall Access			
16.	Jan 1 - Jan 4	2011			
17.	Jan 5 - Jan 11	T978	CALICE	Primary	2-CD
18.	Jan 12 - Jan 18	T978	CALICE	Primary	2-CD
19.	Jan 19 - Jan 25	T978	CALICE	Primary	2-CD
20.	Jan 26 - Feb 1	T978	CALICE	Primary	2-CD
21.	Feb 2 - Feb 6	T978	CALICE	Primary	2-CD
22.	Feb 7 - Feb 11	No Beam Available: Accelerator Division Work in SY220			
23.	Feb 12 - Feb 15				
24.	Feb 16 - Feb 20	T953	University of Iowa CERN Light	Primary	2-B
25.	Feb 21 - Feb 22				
26.	Feb 23 - Mar 1				
27.	Mar 2 - Mar 8	T1012	TAUWER Test	Primary	2-B
28.	Mar 9 - Mar 15	No Beam Available: Accelerator Shutdown			
29.	Mar 16 - Mar 22	T992	Radiation-hard Sensors for the SLHC	Primary	1-B
30.	Mar 23 - Mar 29	T1011	Radiation-hard Silicon Microstrip Sensors	Secondary	2-B
31.	Mar 30 - Apr 5	T992	SLHC Sensor Tests	Primary	1-B
32.	Mar 31 - Apr 6	T1011	Radiation-hard Silicon Microstrip Sensors	Secondary	2-B
33.	Mar 23 - Mar 29	T992	SLHC Sensor Tests	Primary	1-B
34.	Mar 30 - Apr 5	T932	The Diamond Detector Research Group	Primary	1-B
35.	Apr 6 - Apr 12	T978	CALICE	Primary	2-CD
36.	Apr 13 - Apr 19	T978	CALICE	Primary	2-CD
37.	Apr 20 - Apr 26	T978	CALICE	Primary	2-CD
38.	Apr 27 - May 3	T978	CALICE	Primary	2-CD
39.	May 4 - May 10	T1010	GEM Chamber Characteristics Test	Primary	2-C
40.	May 11 - May 17	T979	Fast Timing Counters for PSEC	Primary	2-B
41.	May 18 - May 24				
42.	May 25 - May 31				
43.	Jun 1 - Jun 7	T978	CALICE	Primary	2-CD
44.	Jun 8 - Jun 14	T978	CALICE	Primary	2-CD
45.	Jun 15 - Jun 21	T978	CALICE	Primary	2-CD
46.	Jun 22 - Jun 28	T978	CALICE	Primary	2-CD
47.	Jun 29 - Jul 5	T1004	Total Absorption Dual Readout Calorimetry	Primary	2-B
48.	Jul 6 - Jul 12	T1004	Total Absorption Dual Readout Calorimetry	Primary	2-B
49.	Jul 13 - Jul 19	T1008	Super B Prototype Installation	Primary	2-BC
50.	Jul 20 - Jul 26	T1008	Super B Prototype	Primary	2-BC
51.	Jul 27 - Aug 2	T1008	Super B Prototype	Primary	2-BC
52.	Aug 3 - Aug 9	T1010	GEM Chamber Characteristics Test	Primary	2-C
53.	Aug 10 - Aug 16	T1010	GEM Chamber Characteristics Test	Primary	2-C
54.	Aug 17 - Aug 23				
55.	Aug 24 - Aug 30				
56.	Aug 31 - Sep 6				
57.	Sep 7 - Sep 13				
58.	Sep 14 - Sep 20				
59.	Sep 21 - Sep 27				

- Fermilab Accelerator shutdown scheduled for March 2012 through February 2013 (11 months)

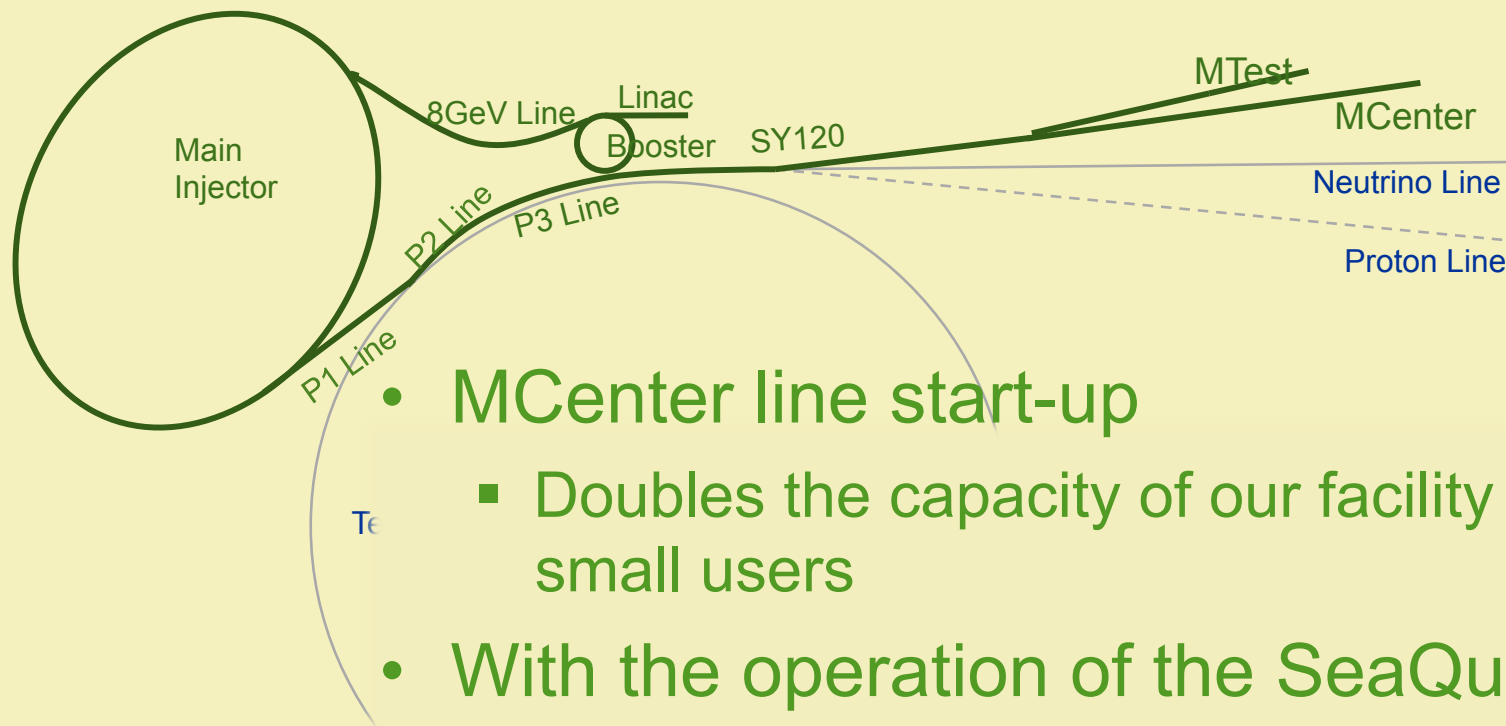
Weekly Usage



•*Experiment Data Taking Includes Double Occupancy

•Facility Use includes Experiment Installation, Facility Tests, & Data Use, and is normalized to Beam Availability

Facility Expansion



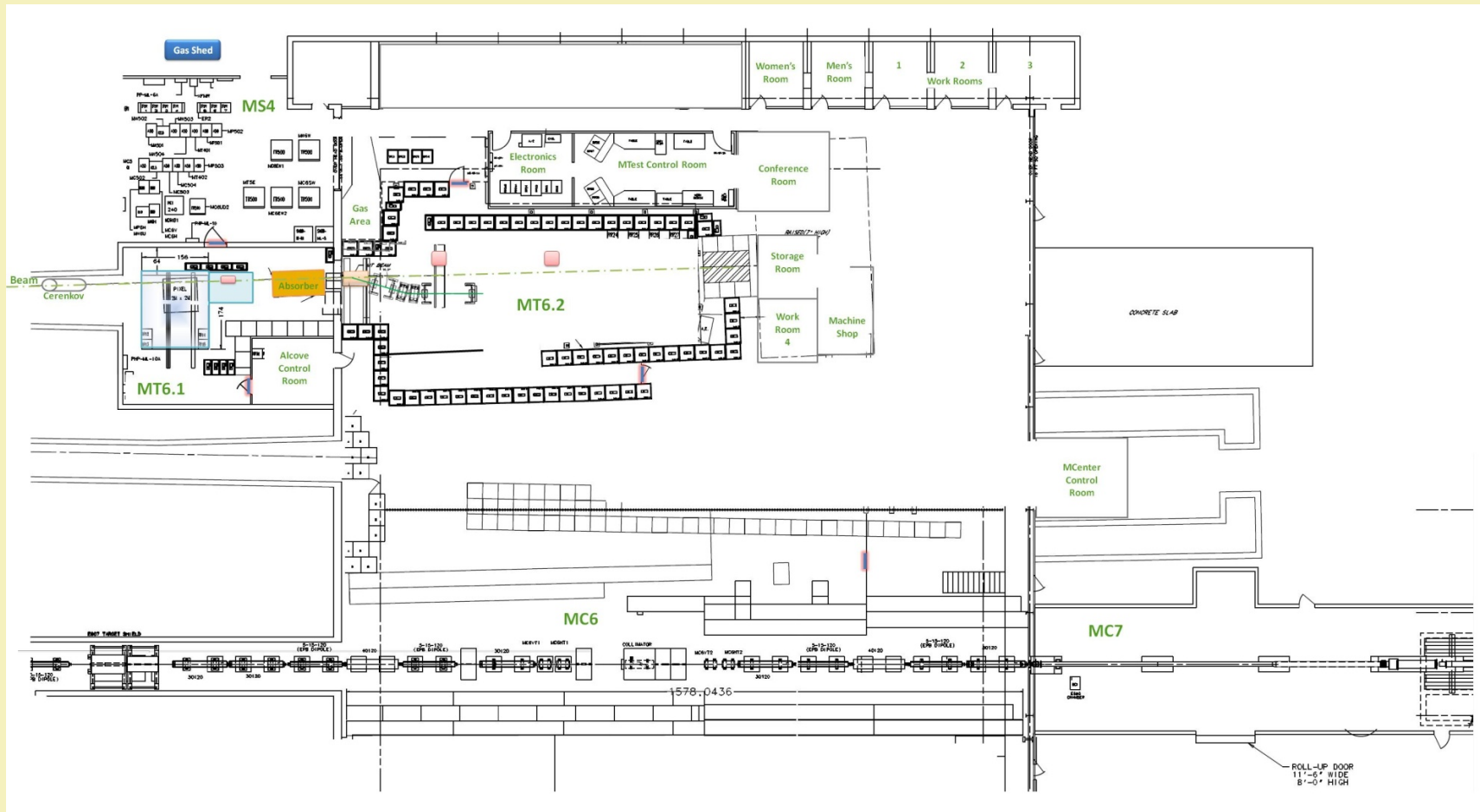
- MCenter line start-up
 - Doubles the capacity of our facility for small users
- With the operation of the SeaQuest Experiment FTBF can expect
 - 24 hours of beam time a day
 - Longer spill train, with same intensities

MCenter User Area



This section of beam pipe has been modified to have flanges and a bellows, so as to make it easily removable.

Facility Overview



FTBF Summary

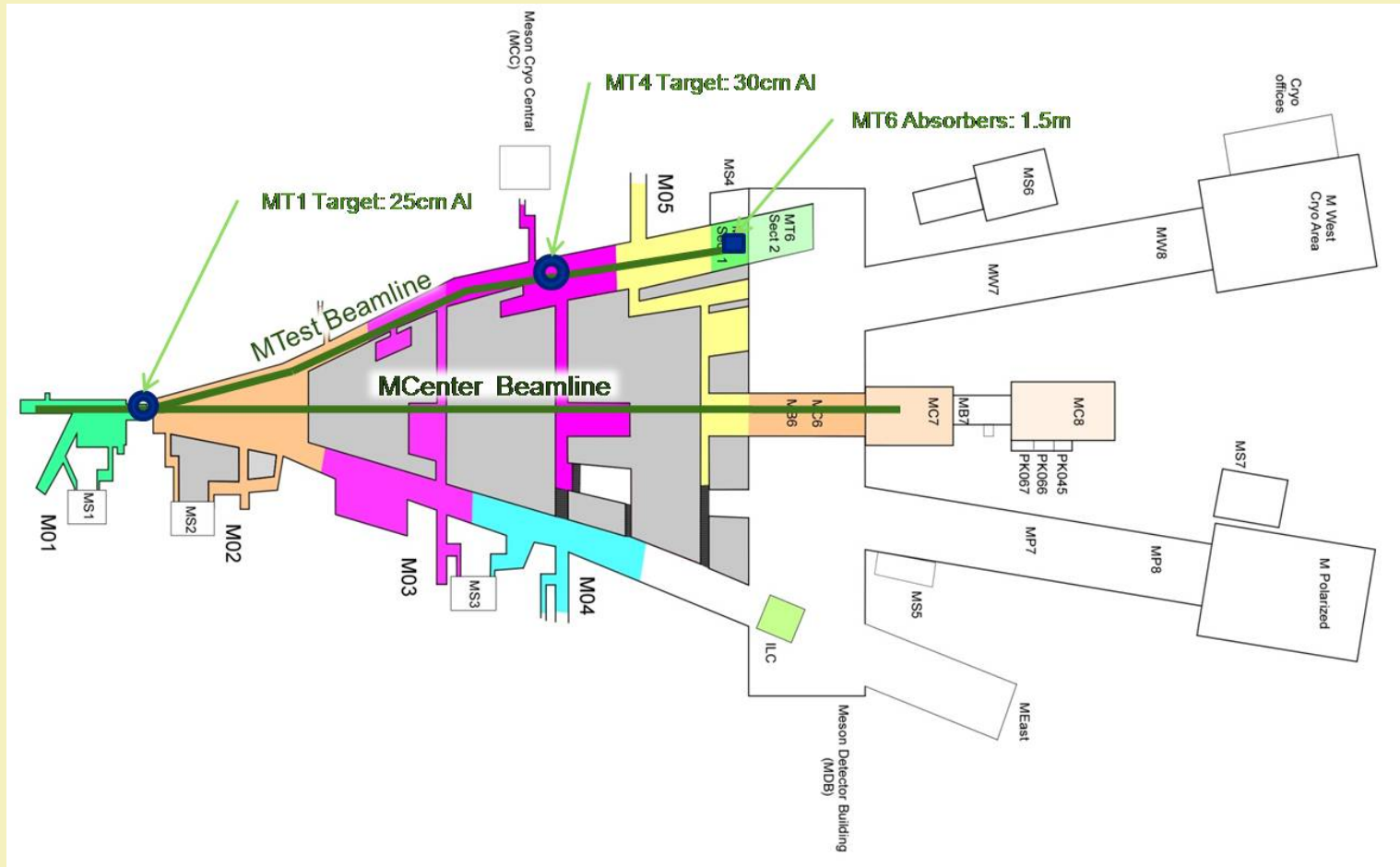
- Fermilab Test Beam Facility is an HEP Beam facility for world-wide Detector R&D
- Extensive facility infrastructure & instrumentation
- Flexible beam delivery
 - Protons, pions, muons, electrons, kaons
 - 200 MeV – 120 GeV
 - 1 – 300 kHz intensities

<http://www-ppd.fnal.gov/FTBF>

Additional Slides

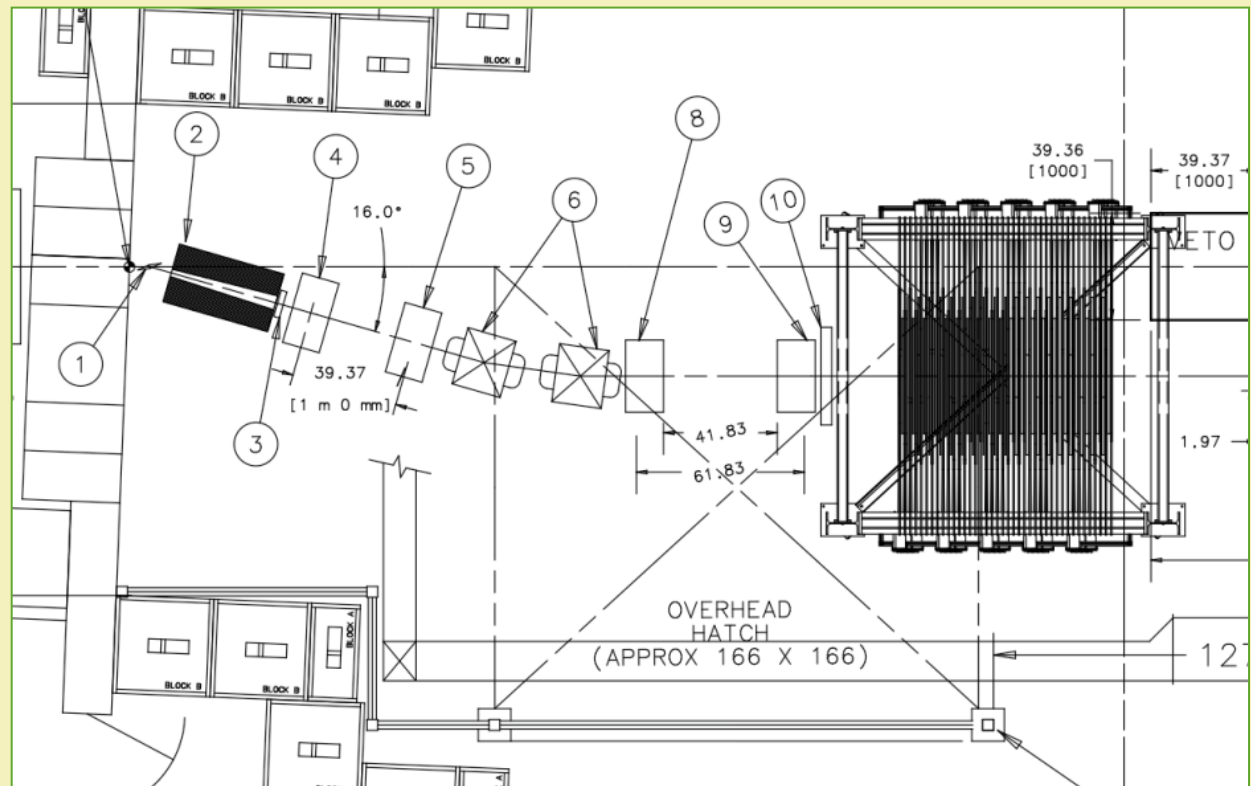
ADDITIONAL SLIDES

Meson Area Beamlines



Tertiary Beamline Proposal

1. 16 GeV pion beam hits a copper target and steel collimator at the entrance to MT6.2
2. Particles emerge at a 16° angle
3. TOF 1 (Scintillator)
4. Wire Chamber 1
5. Wire Chamber 2
6. Spectrometer magnets to straighten beam
- 7.
8. Wire Chamber 3
9. Wire Chamber 4
10. TOF 2 (Scintillator)
11. MINERvA detector



Beam Spot Size

Energy Resolution

Outreach

Grounding