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MTA Beam for ITA

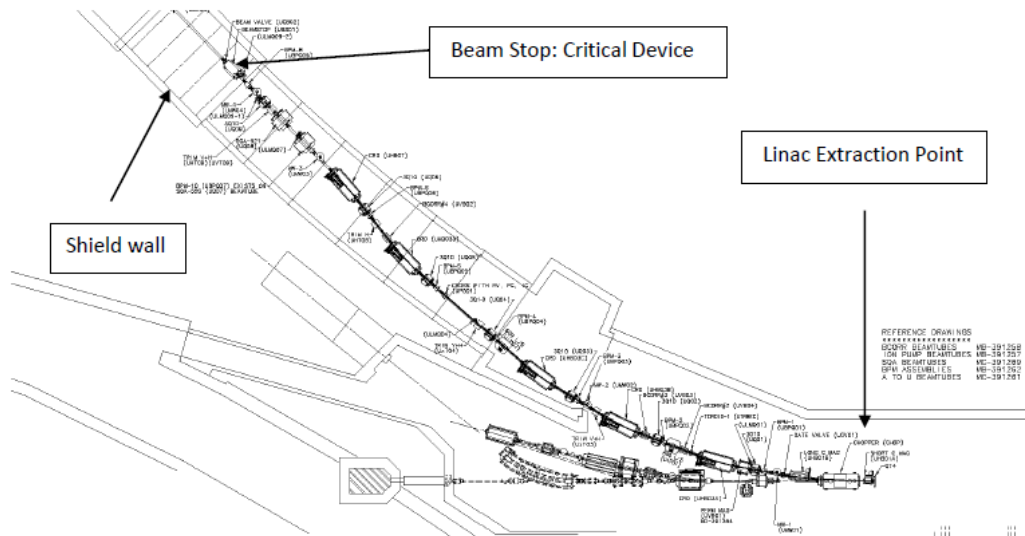
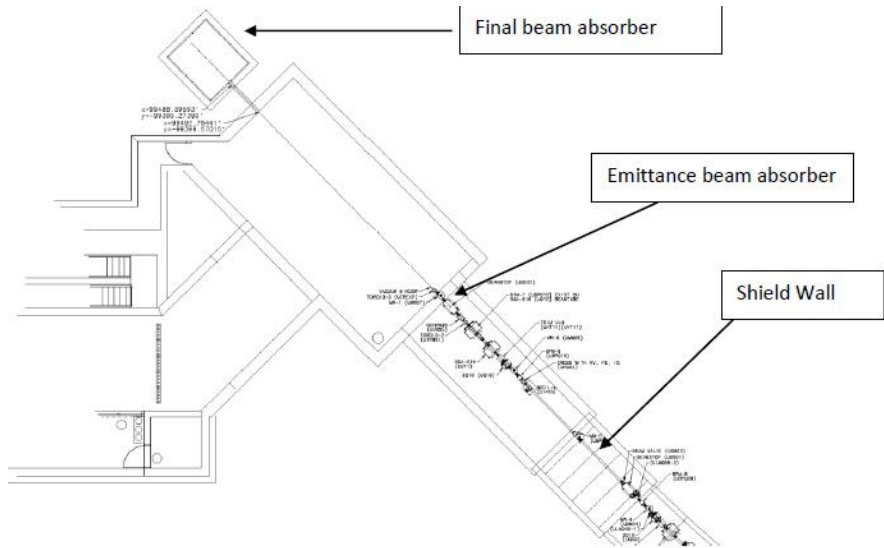
J.A. Johnstone

ITA Meeting

25 Jan 2018

Overview

- Extraction from Linac
 - Entire 400-MeV Linac pulse must be cleanly extracted
 - Pulse length/intensity can be controlled with 750-keV Linac chopper from 8 – 77 μ sec
- Shield Wall
 - Separates Linac enclosure from MTA experimental hall
 - Allows access to hall during Linac operation
 - The 12' has been utilized as part of a long (10m) magnet-free straight to measure Linac beam properties
 - This long straight is flanked by DFD quadrupole triplets to form a phase space tomography section capable of changing the phase-advance to provide progressive views of the phase space topology (Linac beam is not elliptical).
- Linac Stub
 - 30' of beamline beyond the shield wall; 2.5 step down into 40' exp. Hall.
 - Half of the phase space tomography section
 - DFD quadrupole triplet to control experimental beam parameters
 - Capable of focusing to any point along the beam direction in the experimental hall

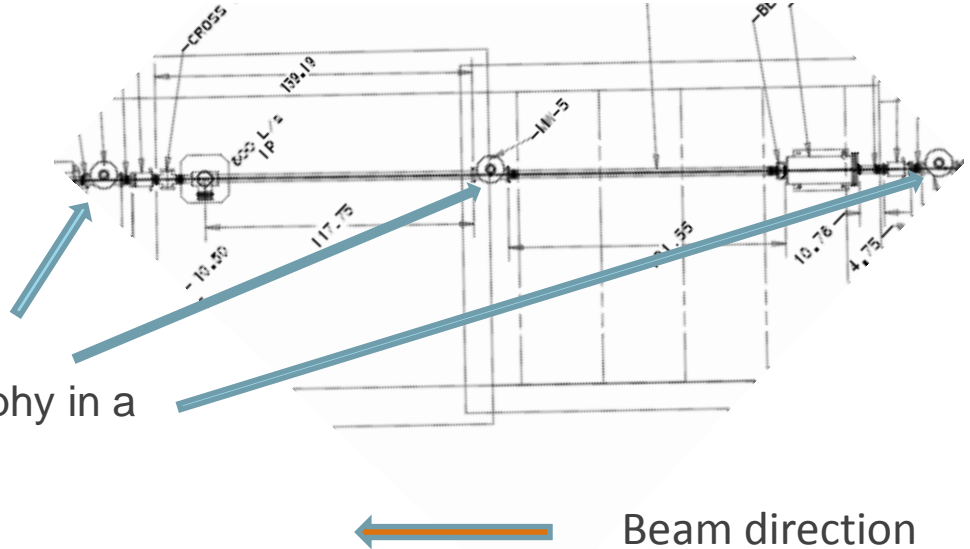
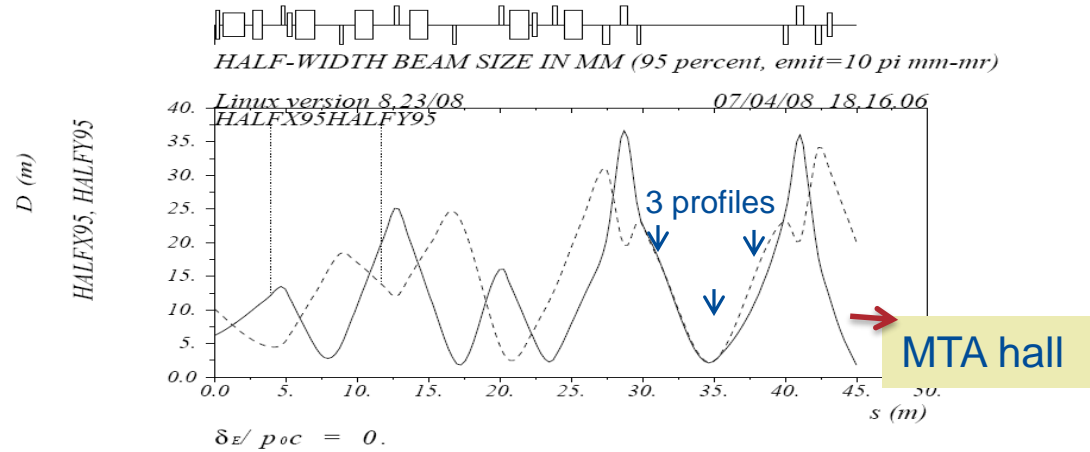
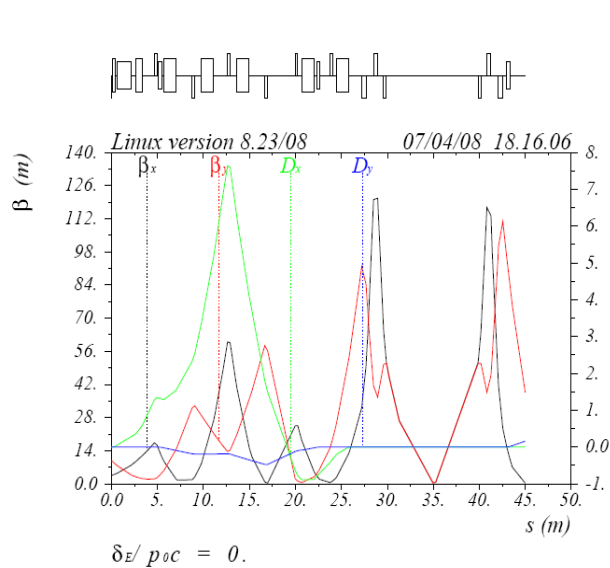


Parameter	Value	Unit
Kinetic Energy	401.5	MeV
Energy Spread	1	MeV
RF Structure	201.24	MHz
Bunch Length	0.208	ns
Pulse Length	30 - 77	μ s
Max Particles Per Bunch	1.6	10^9
Max Particles Per Pulse	1.6	10^{13}
Standard Particles Per Pulse	4.5	10^{12}
Peak Current	24	mA
Max Beam Power	15.7	kW
Beam Emittance (99%)	8	mm-mrad

Operational modes

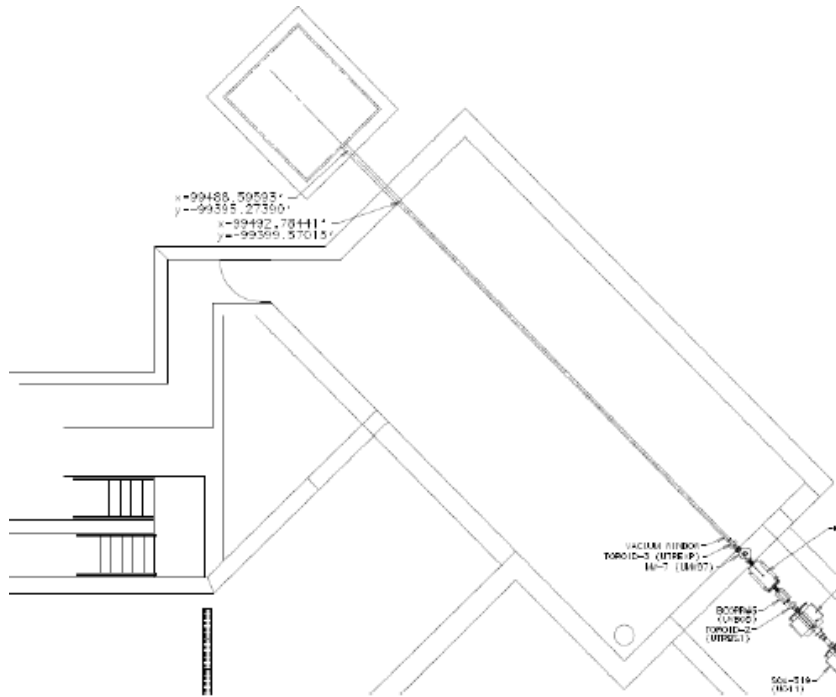
- Emittance Mode
 - 1) 600 pulses/hr of full Linac intensity (1.6×10^{13} p/pulse) to the emittance absorber
- Experimental Mode
 - 2) 60 pulses/hr to experiments in the MTA experimental hall.
 - a) Beam cleanly transported to the high intensity beam absorber
 - b) Beam fully interacts in the experimental apparatus and final absorber is not used. No downstream magnetic components are required.

Emittance mode linac beam characterization

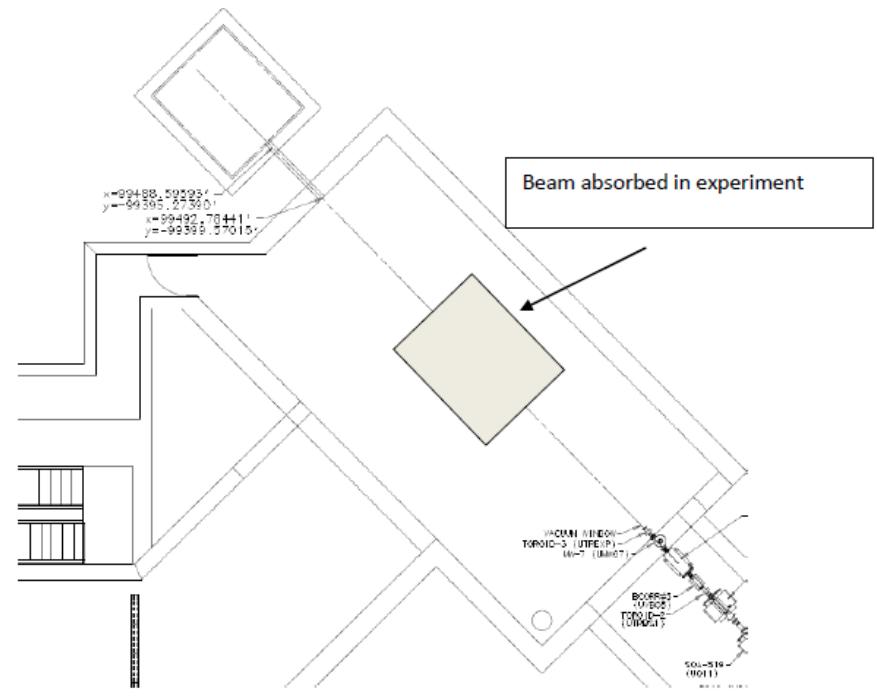


10 m straight between quads
 3 MW profile monitors for tomography in a
 dispersion-suppressed straight

Experimental modes



Beam cleanly transported to the high intensity beam absorber



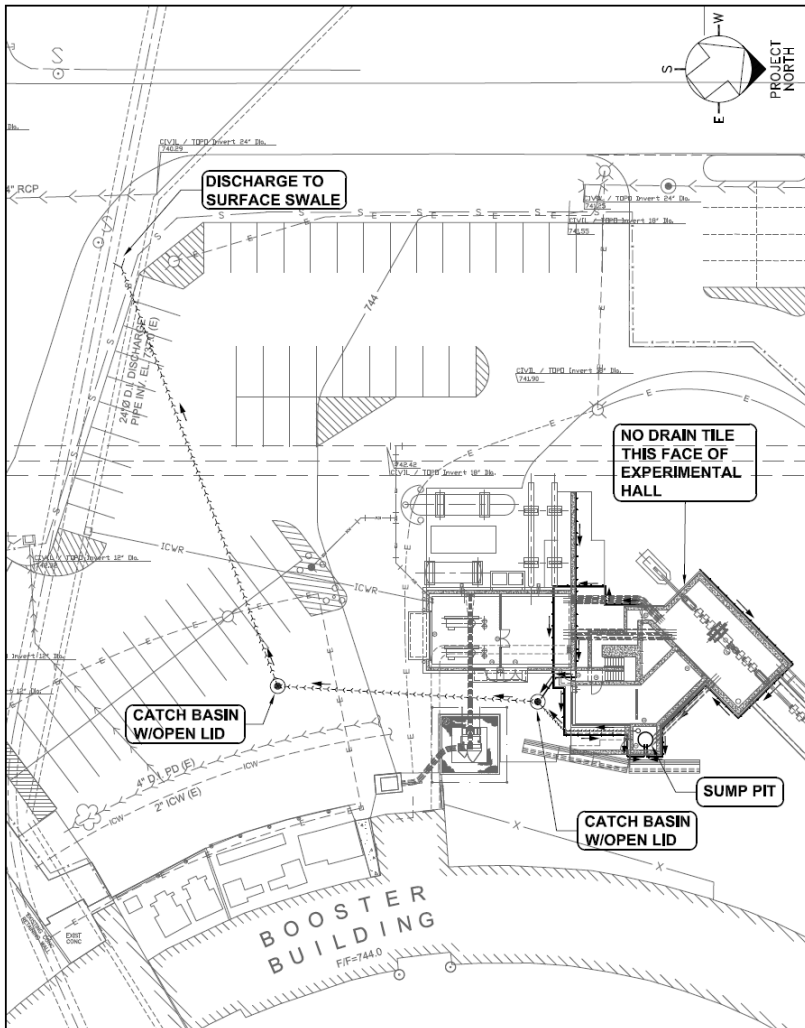
Beam fully interacts in the experimental apparatus and final absorber is not used

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- The maximum number of protons/yr that may be delivered to the experimental hall is based on air activation.



Large (up to 10") penetrations near ceiling of MTA experimental hall

RAW at high intensity dump

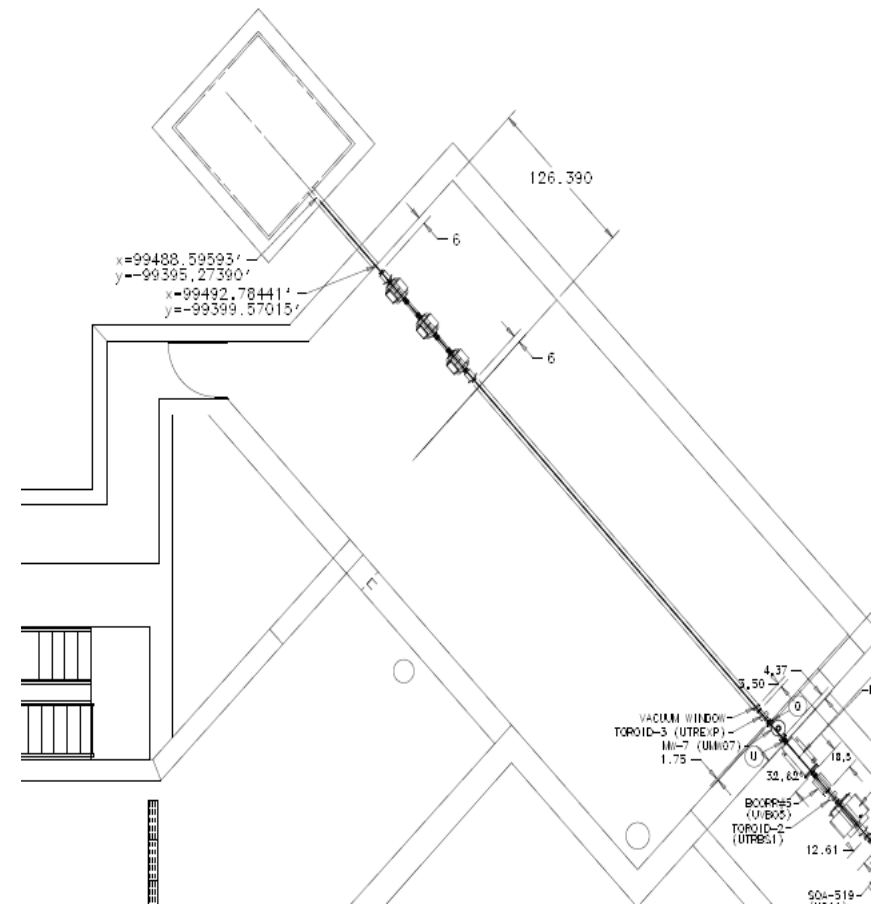


- Sump location. There is no underdrainage for the high intensity absorber – water percolates into the water table.
- The absorber itself is encased in a waterproof liner so surface water does not penetrate through the steel and the interior of the dump.

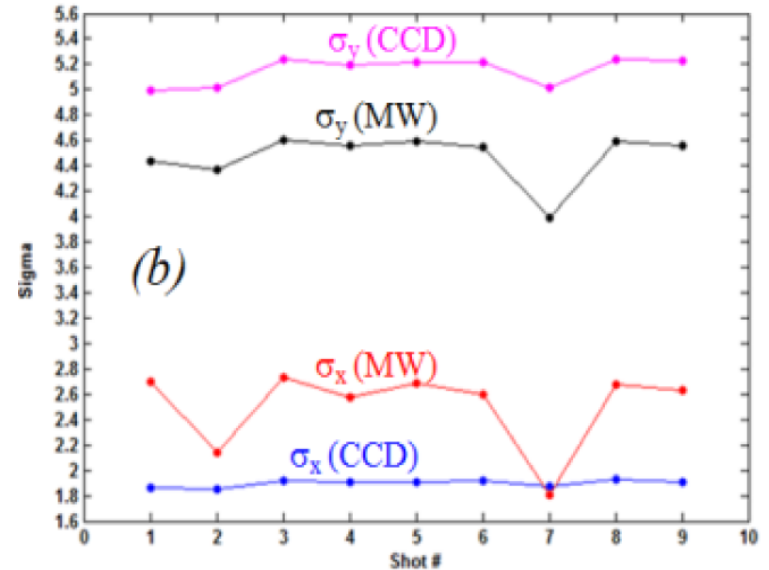
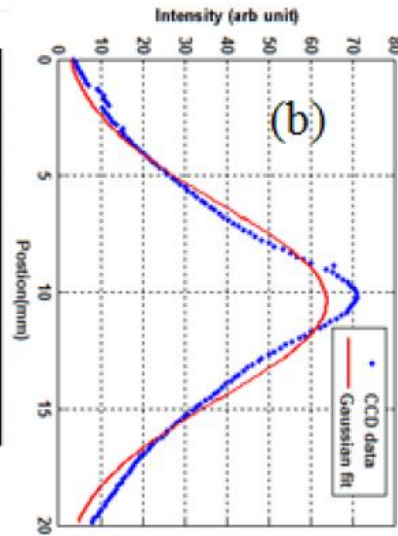
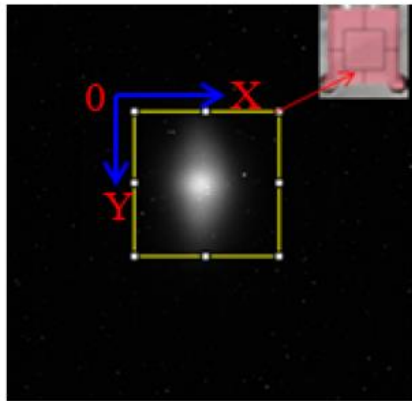
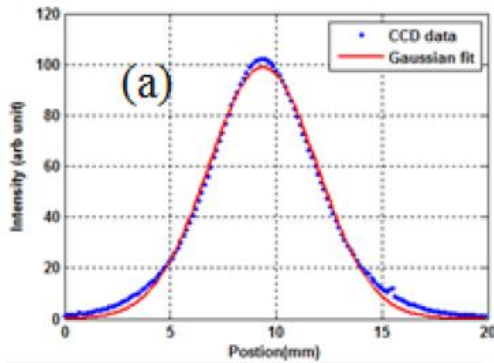
Other experiments

Any proposed experiment must fall within the two analyzed configurations. Experiments that utilize experimental apparatus with minimal rather than total beam interaction will need to demonstrate that uninteracted beam is cleanly transported to the final beam absorber or, alternatively, provide a local beam absorber and shielding to satisfy configuration b).

Downstream components, such as quadrupoles, collimators, and steering magnets, may be required to transport and deposit beam cleanly in the final absorber.



Beam profile with scintillation screen & CCD camera



Beam profile at solenoid

Comparison of beam sizes measured with MW & with CCD

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PC L48 Source Params
L48 NEW CHOPPER TIMERS          SET   D/A  A/D  Com-U  *PTools*
-<FTP>+ *SA* X-R/D  X=TIME      Y=E  UVT04F, E:UHB01, _E:UHB01I, E UVB12F
COMMAND BL-- Eng-U  I= 0        I=-1   0      0      -4
-< 2>+ r_EA 15_Hz  F= 1        F= 10  / 1000 / 1500 / 7
src a   src b  TIMERS  vacuum  toroids  t_stand  radnom  pur  sup

! *** HEP Chop Timers
-L: TCHON  HEP Chopper ON      1992.2  1992.2  US
-L: TCHOF  HEP Chopper OFF    2030.3  2030.3  US
# L: TCHOF-L: TCHON          38.100002  US

! *** NTF Chop Timers
-L: TCHON  NTF Chopper ON      1990     1990   US
-L: TCHOF  NTF Chopper OFF    2052     2052   US
# L: TCHOF-L: TCHON          62         US

! *** STUDIES Chop Timers
-L: TCHTON Tuneup Chopper ON   1992.3  1992.3  US
-L: TCHTOF Tuneup Chopper OFF  2017.3  2017.3  US
# L: TCHTOF-L: TCHTON        25         US

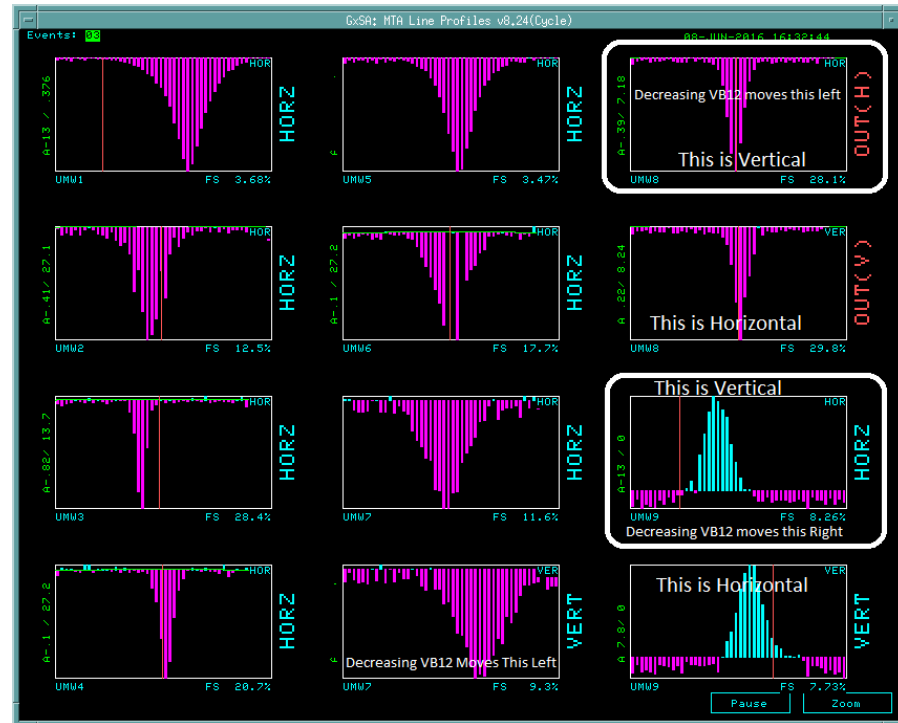
! *** STANDBY Chop Timers
-L: TCHSON Standby Chopper ON  1990.3  1990.3  US
-L: TCHSOF Standby Chopper OFF 2000.3  2000.3  US
# L: TCHSOF-L: TCHSON        10         US

! *** MTA Chop Timers
-L: TCHMON MTA Chopper ON      1990.3  1990.3  US
-L: TCHMOF MTA Chopper OFF    2000.3  2000.3  US
# L: TCHMOF-L: TCHMON        10         US

! *** RF ON TIME
-L: RFBON  Low Energy RFB ON   1765    * 1765  uSec
-L: V1LLTR RF1 LLRF Trigger    920.00001 920.00001 uSec
-L: V2LLTR RF2 LLRF Trigger    920.00001 920.00001 uSec
-L: V3LLTR RF3 LLRF Trigger    920.00001 920.00001 uSec
-L: V4LLTR RF4 LLRF Trigger    920.00001 920.00001 uSec
-L: V5LLTR RF5 LLRF Trigger    920.00001 920.00001 uSec

-L: TSHIFT Shifter Start Pulse 49.500001 49.500001 US
-L: TIDATA TDATA Pulse Backup TD 2000    * 2000  US
-L: TIDATA RF1  TIMER 0        2000    2000  US
-L: TQON   Low Energy Quad ON  17.4    17.4   US
-L: TQONW  L:TQON pulse width  1        * 1    US

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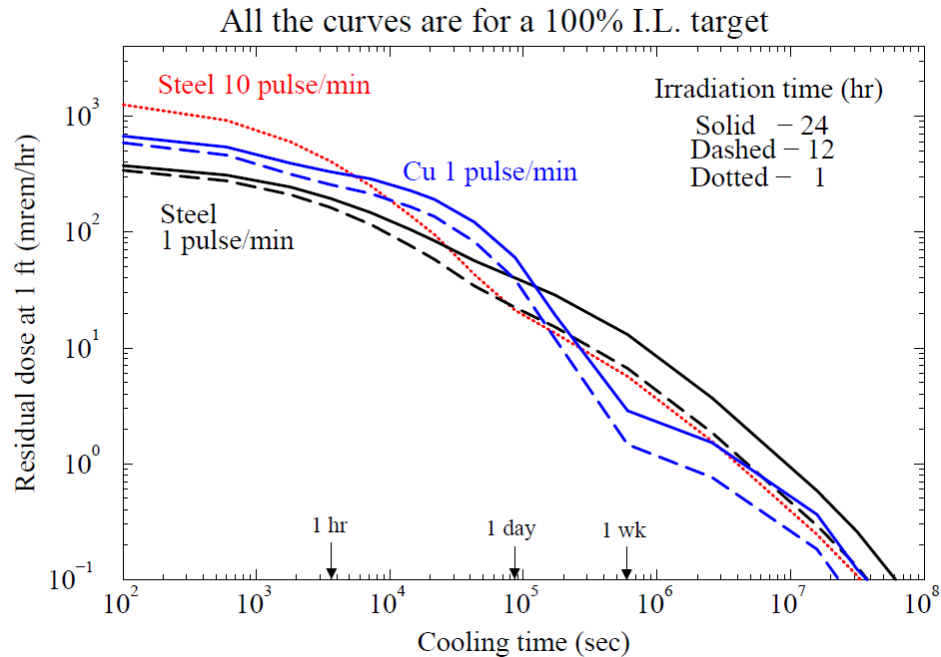


most recent profiles at MW1→9

chopper timing page

Residual dose rate estimates

- 10 pulses generate ~ 1 R on contact



Potential residual dose at one foot for Emittance & Experiment modes on 100% interaction length Cu and steel targets for 1, 12, and 24 hour periods followed by cooling down.

Current MTA experimental hall exterior configuration



Conceptual ITA configuration with appropriate shielding



Other

- Repeat shielding assessment
- Test transporting beam cleanly to the high intensity dump

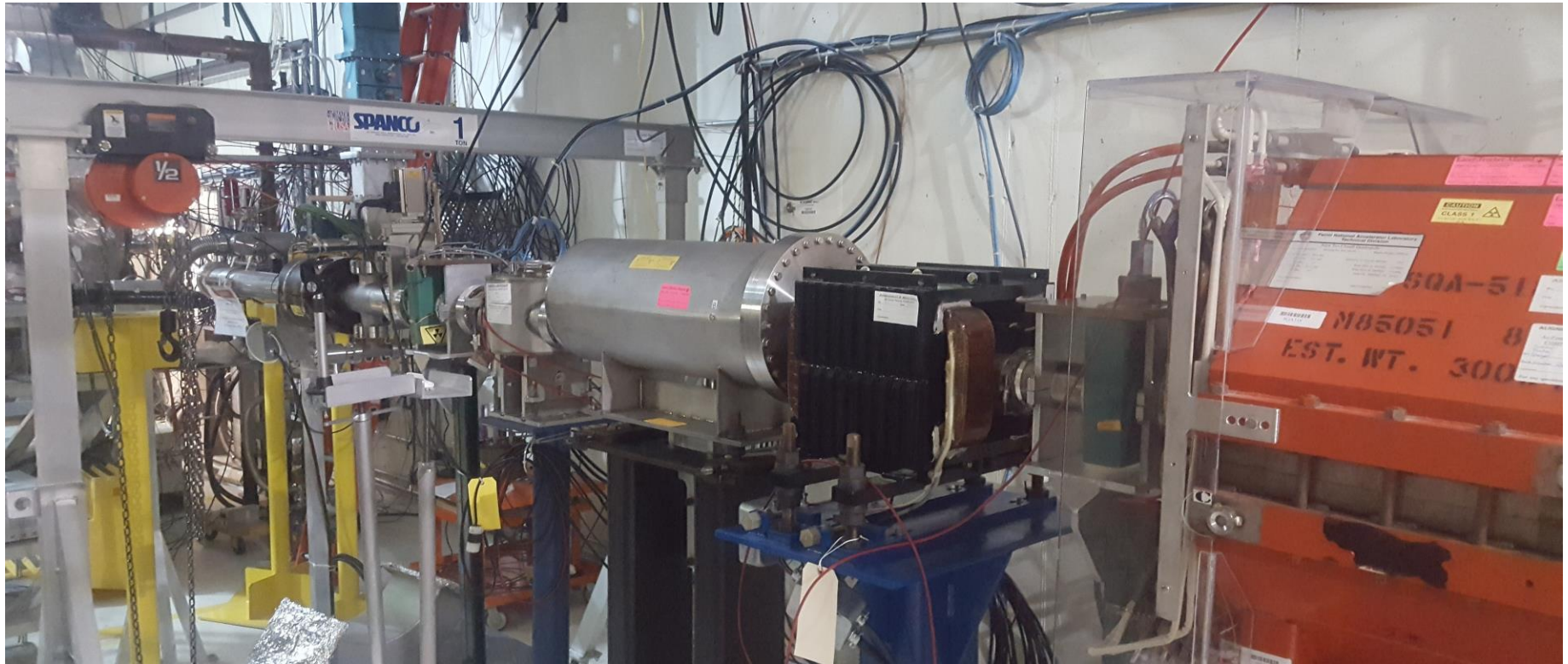


MTA Pictures





Looking u/s towards the shield wall & location of MW5



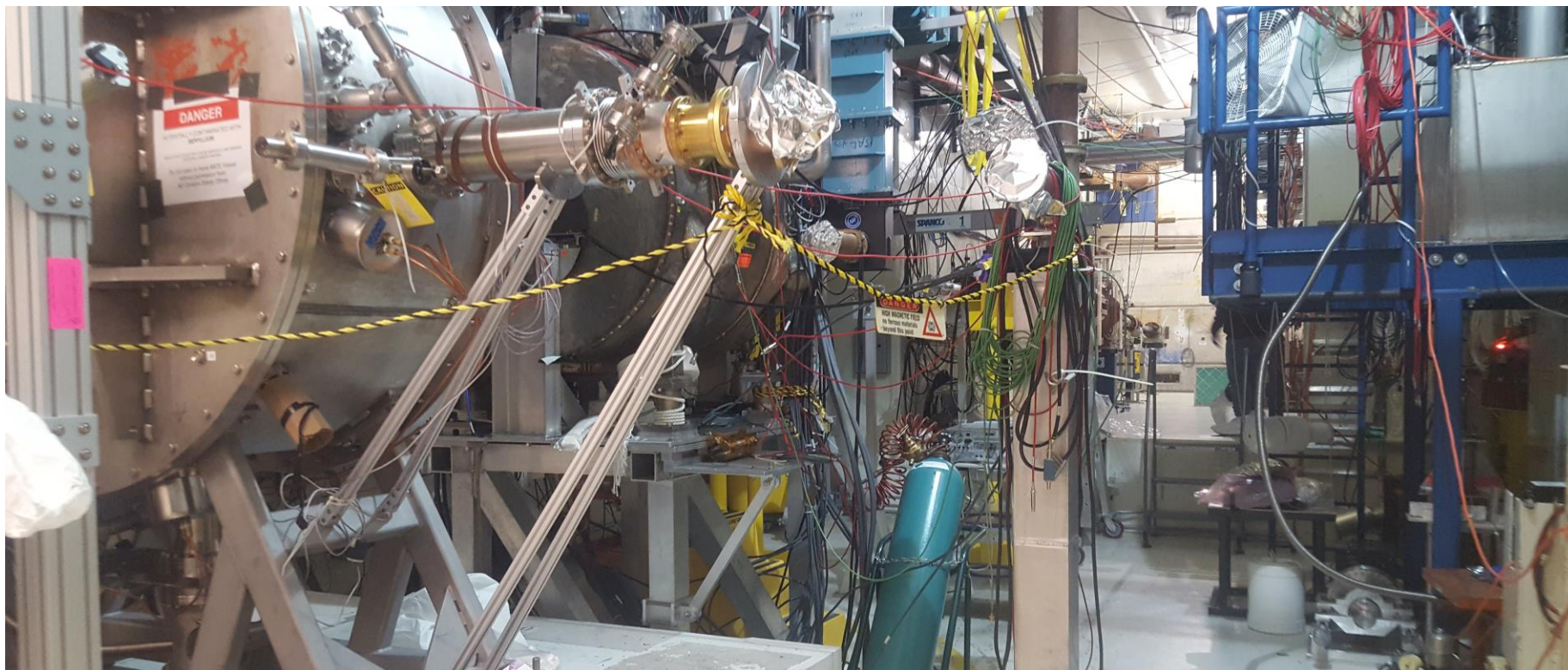
Emittance absorber



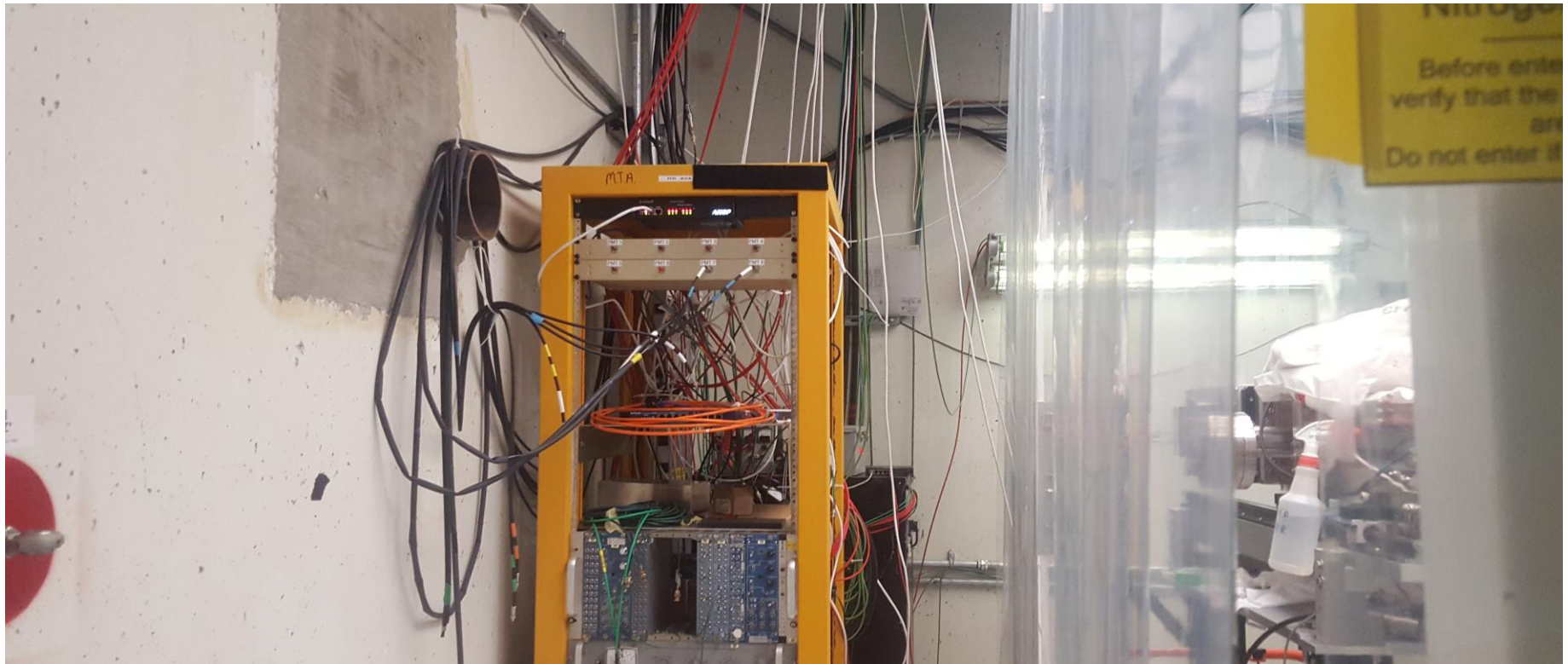
Rollup door in experimental hall to the access pit



Looking d/s in experimental hall to the solenoid



Looking u/s



Entrance to the high intensity dump