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MTA Beam for ITA

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ITA Meeting

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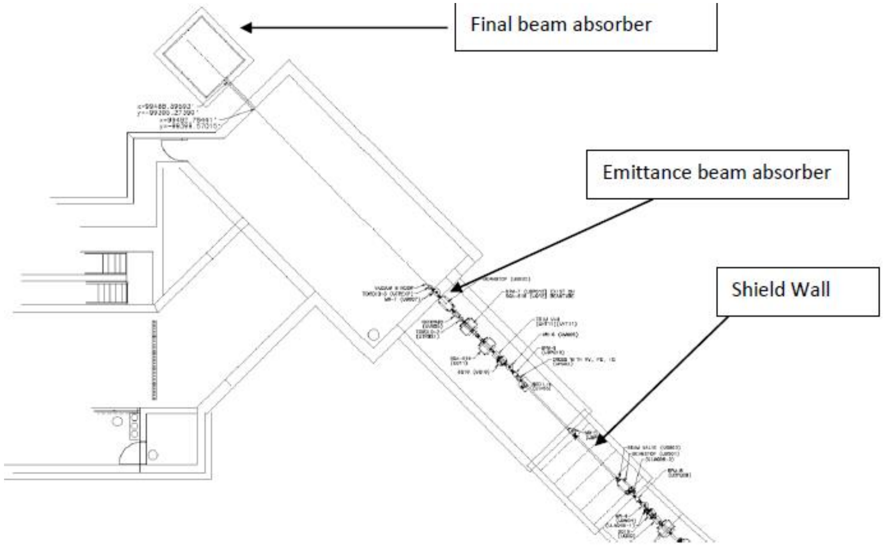
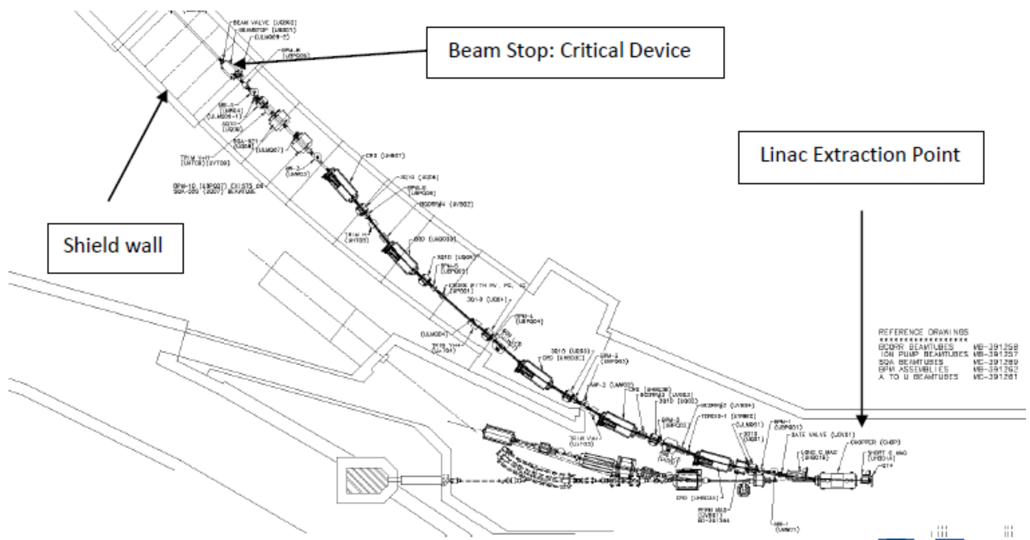
Overview

- 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 µsec
- 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



Final beam absorber
Emittance beam absorber
Shield Wall



Beam Stop: Critical Device
Linac Extraction Point
Shield wall

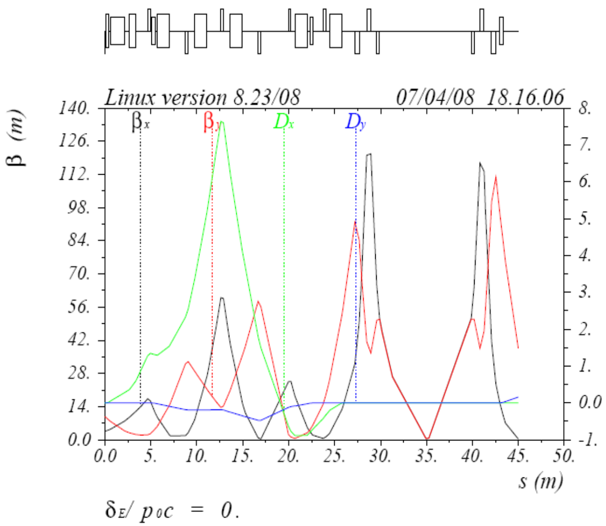
Parameter	Value	Unit
Kinetic Energy	401.5	MeV
Energy Spread	1	MeV
RF Structure	201.24	MHz
Bunch Length	0.208	ns
Pulse Length	30 - 77	µs
Max Particles Per Bunch	1.6	10^9
Max Particles Per Pulse	1.6	10^13
Standard Particles Per Pulse	4.5	10^12
Peak Current	24	mA
Max Beam Power	15.7	kW
Beam Emittance (99%)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

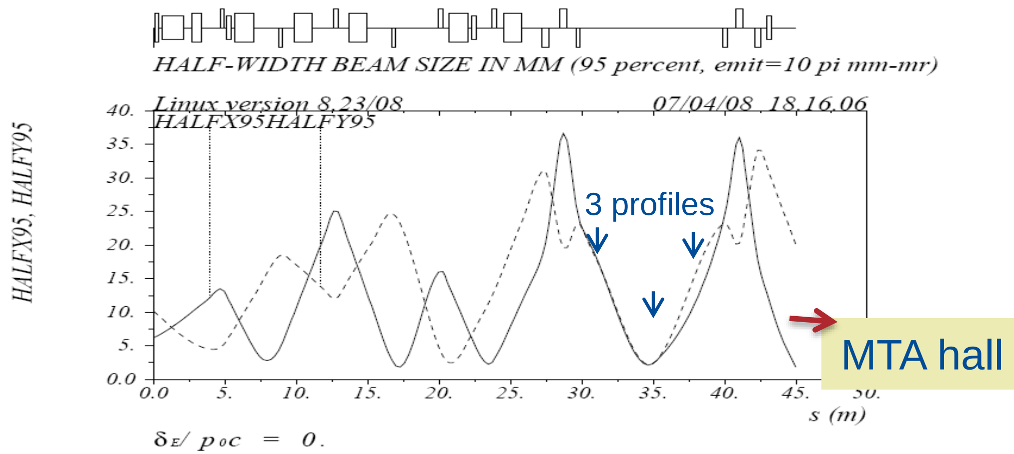
Operational modes

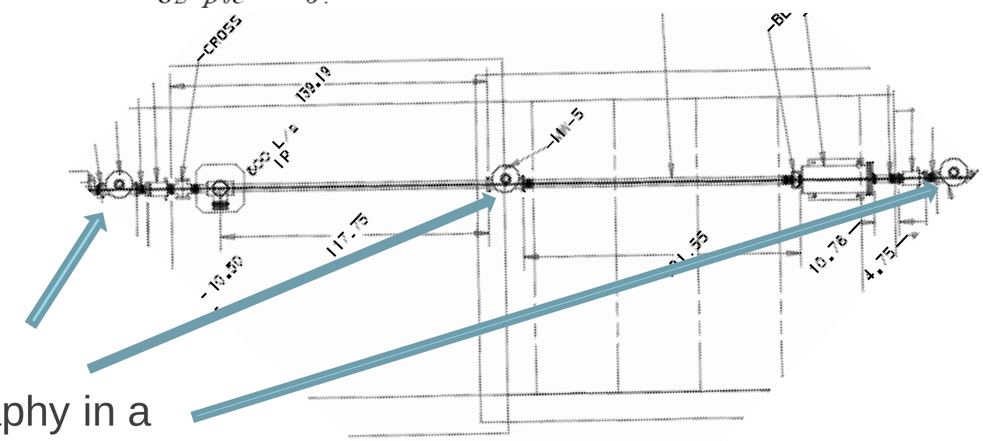
- Emittance Mode
  1) 600 pulses/hr of full Linac intensity (1.6 x 10^{13} p/pulse) to the emittance absorber

- 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



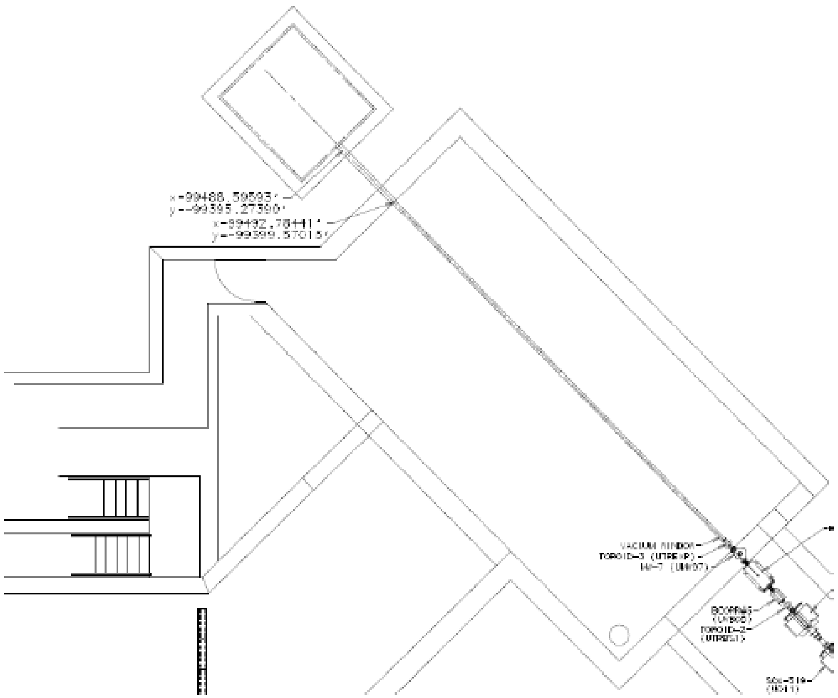


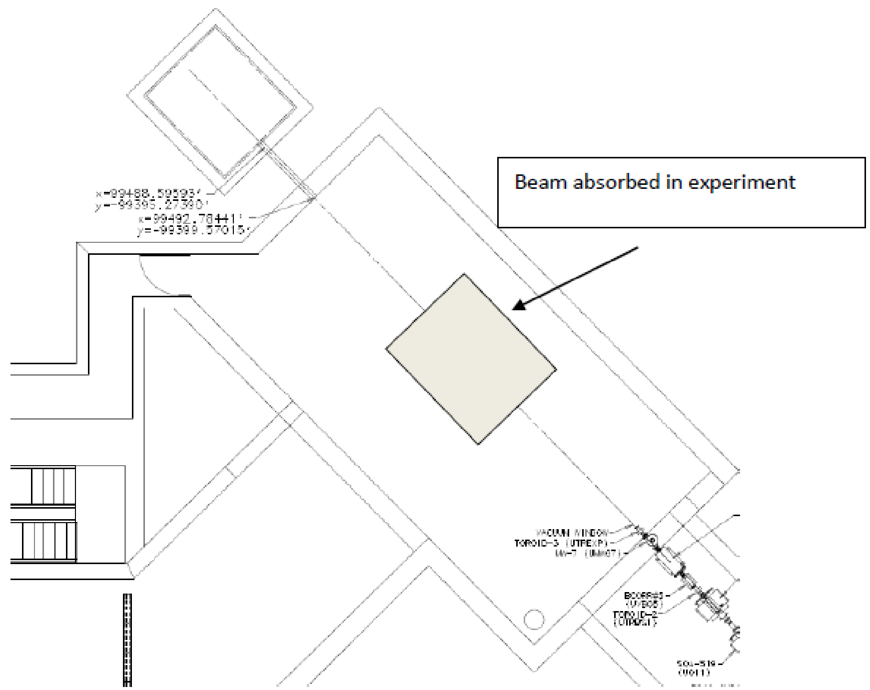


10 m straight between quads
3 MW profile monitors for tomography in a dispersion-suppressed straight

Beam direction

Experimental modes





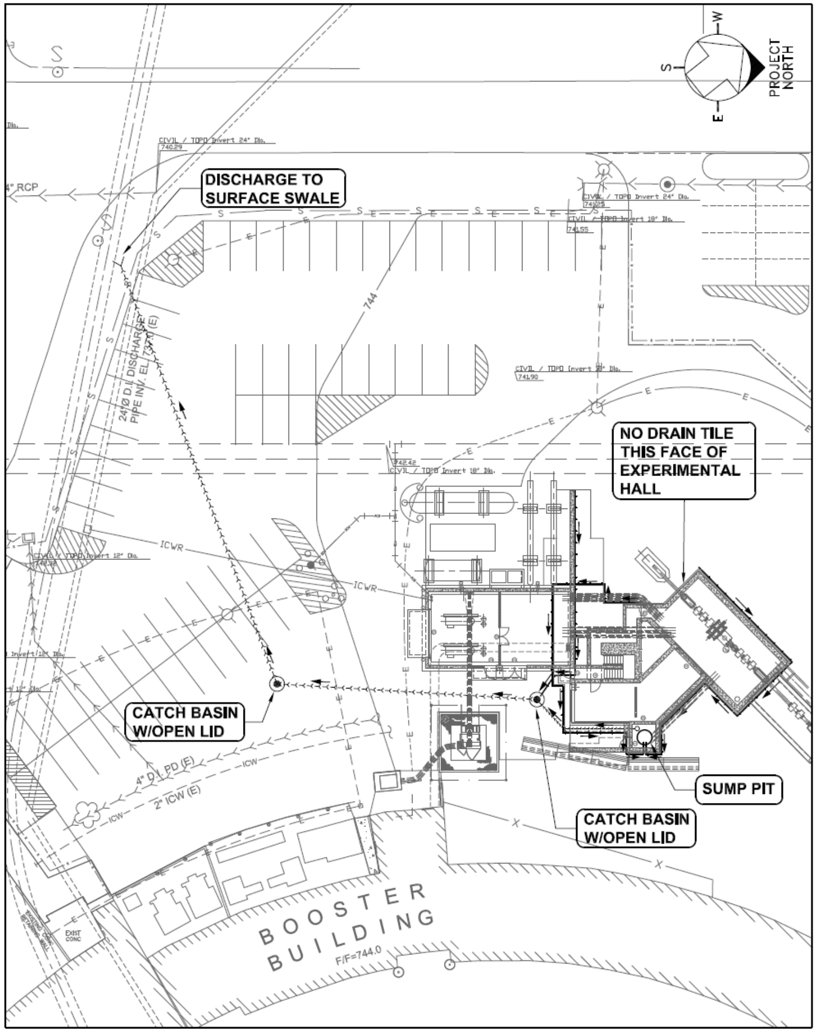
Beam cleanly transported to the high intensity beam absorber

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

- 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



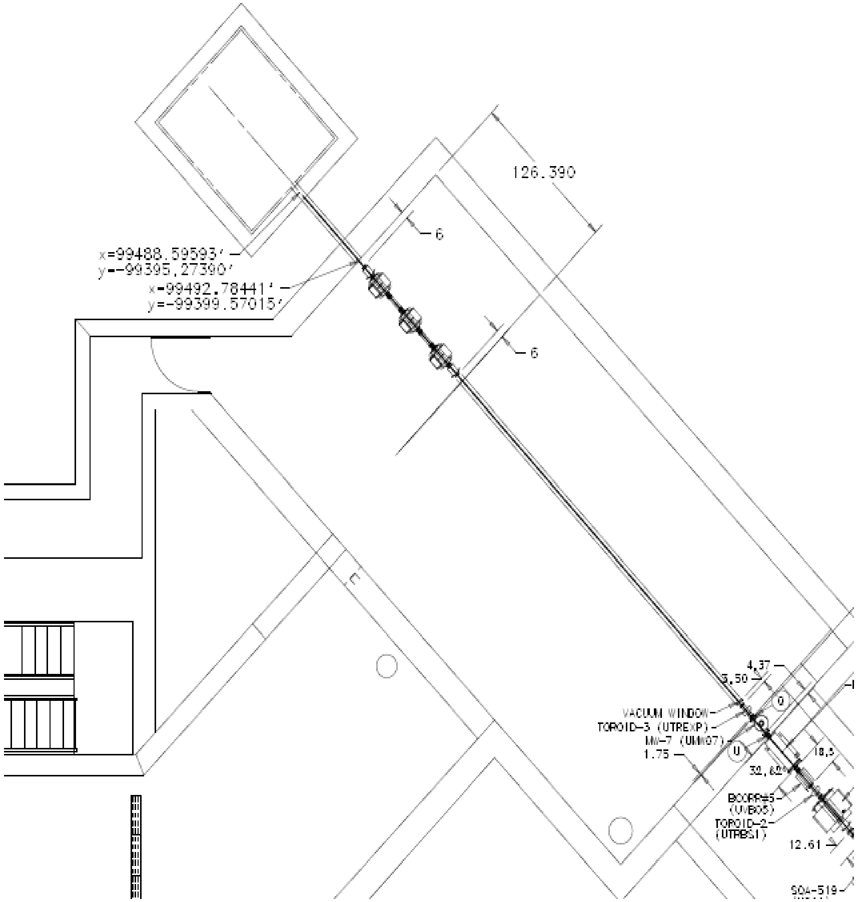
- Sump location. There is no underdrainage for the high intensity absorber – water percolates into the water table.

- The absorber itself is encased in a waterproof liner so surface water does not penetrate through the steel and the interior of the dump.

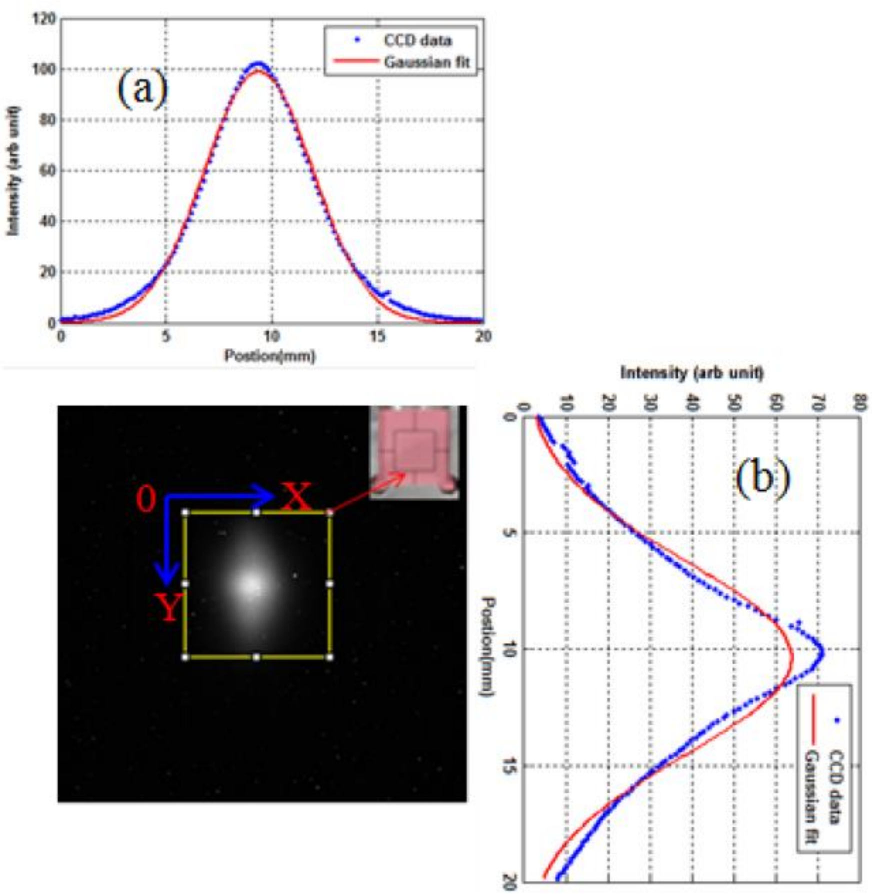
Other experiments

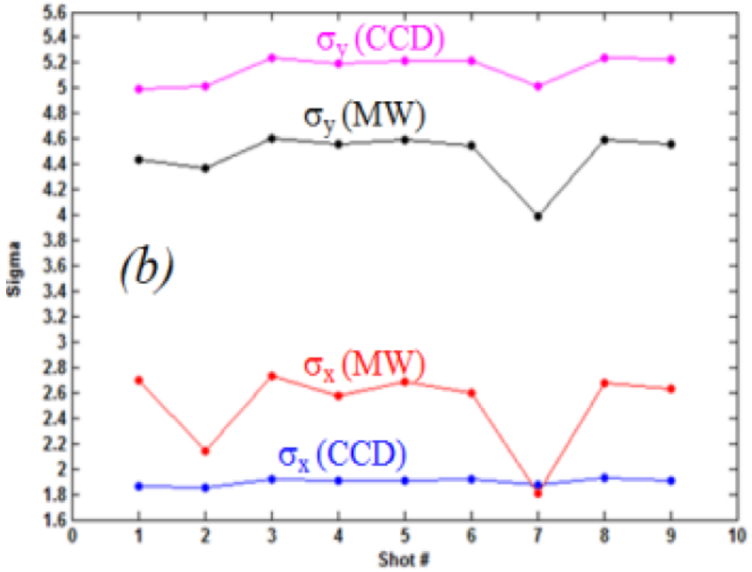
Any proposed experiment must fall within the two analyzed configurations. Experiments that utilize experimental apparatus with minimal rather than total beam interaction will need to demonstrate that uninteracted beam is cleanly transported to the final beam absorber or, alternatively, provide a local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



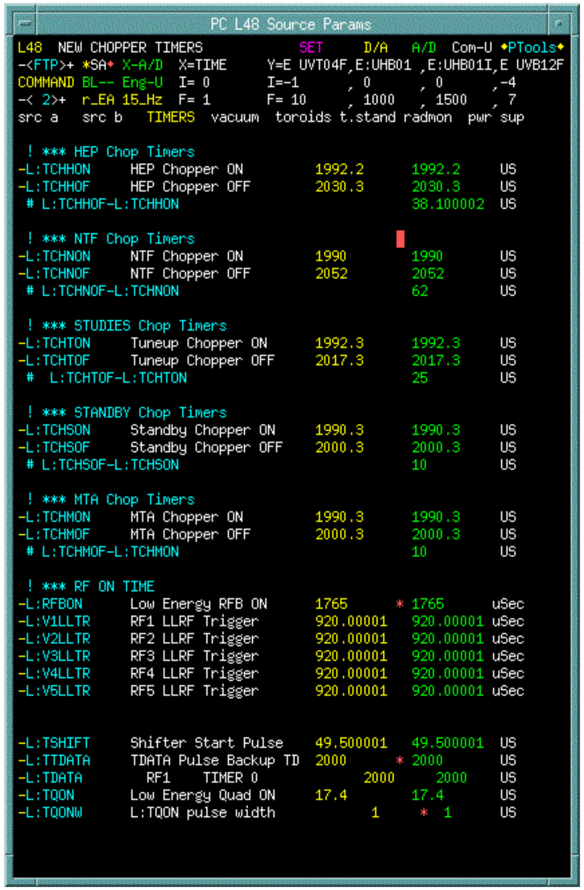
Beam profile with scintillation screen & CCD camera

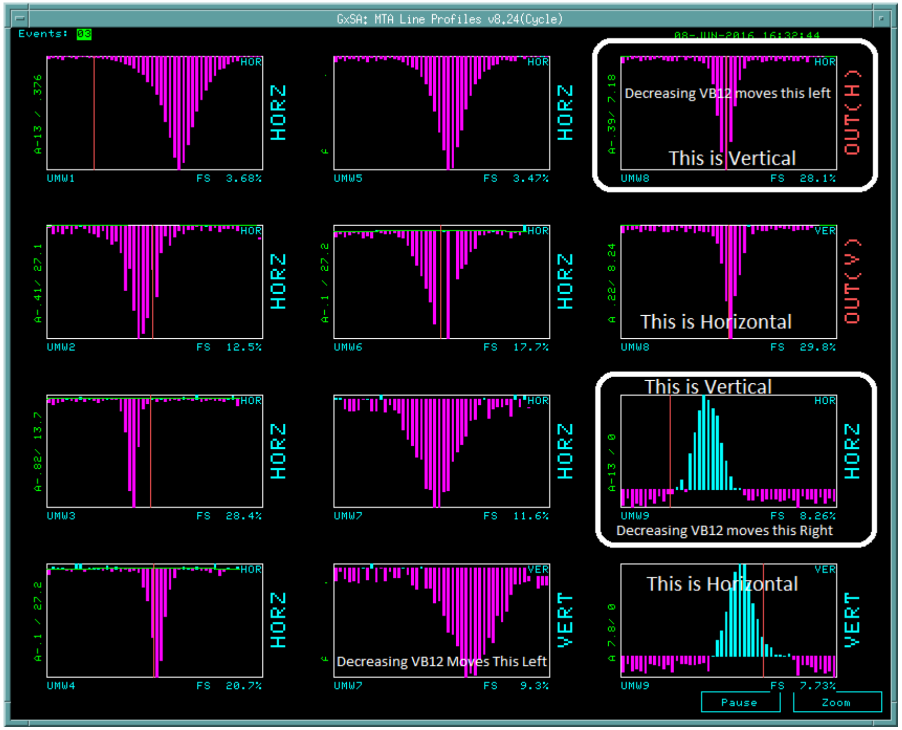




Beam profile at solenoid

Comparison of beam sizes measured with MW & with CCD



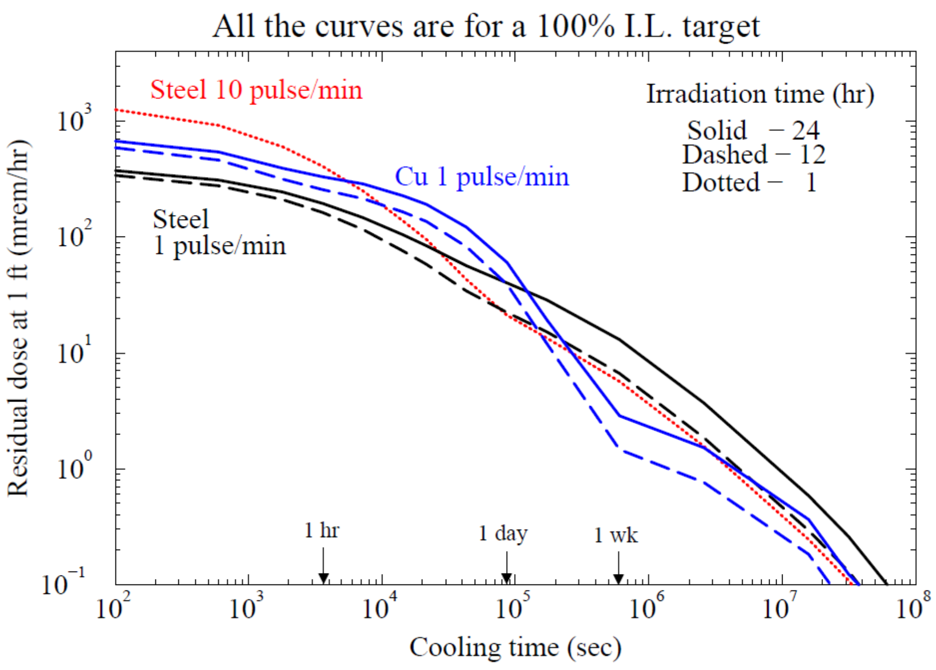


most recent profiles at MW1→9

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

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MTA Pictures

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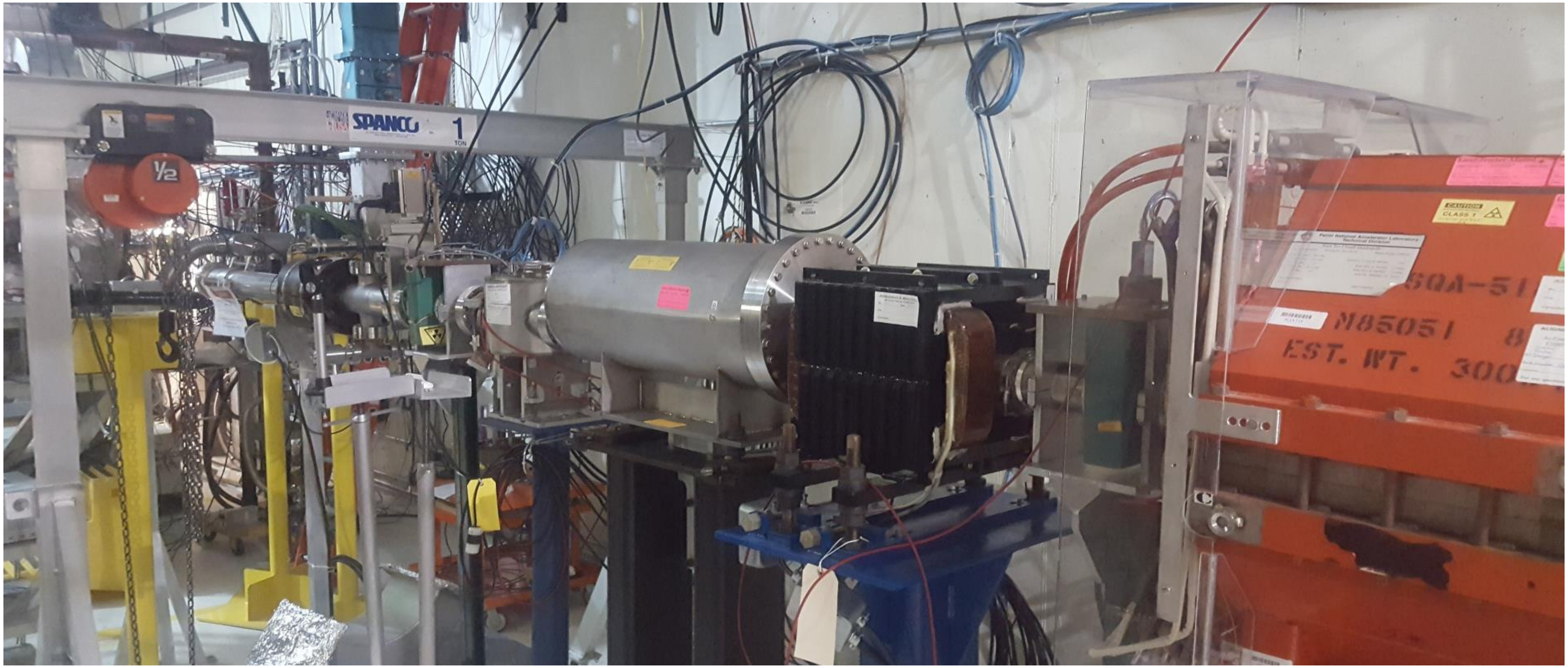
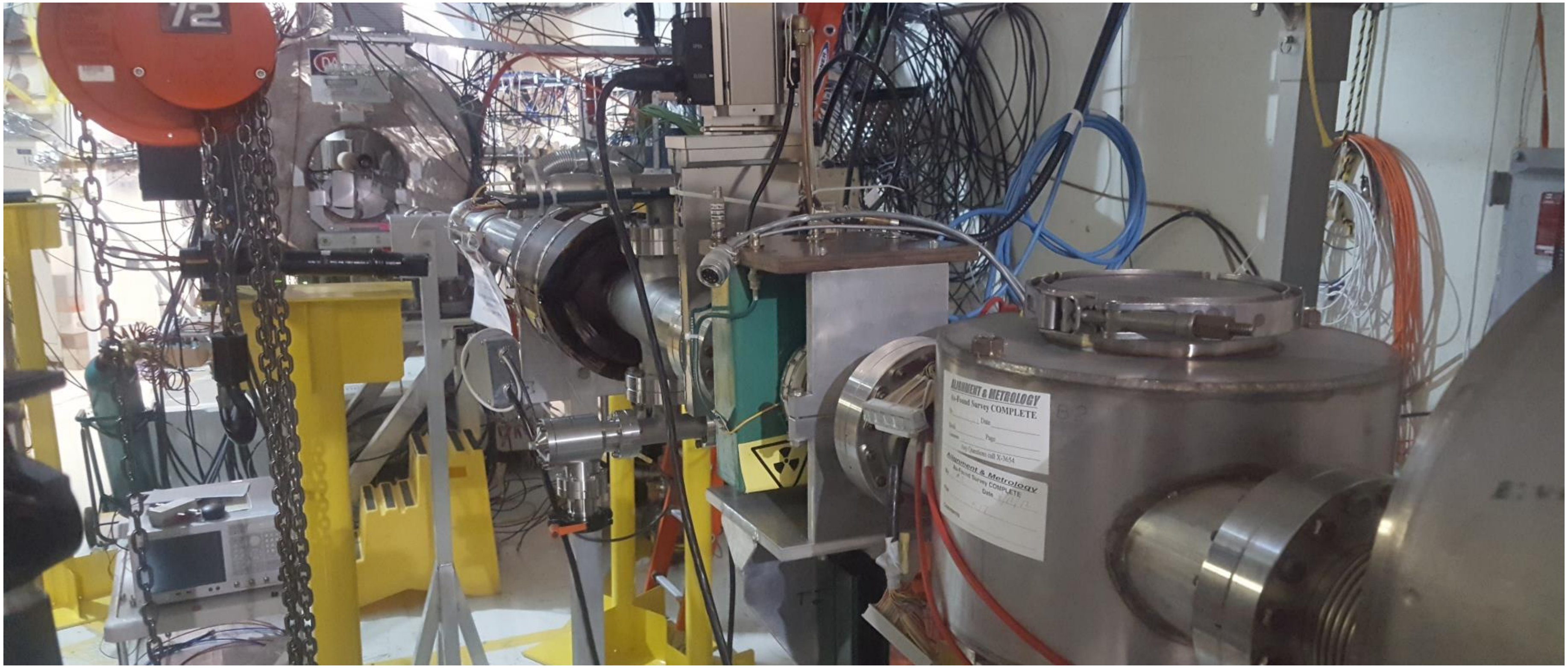
Looking u/s towards the shield wall & location of MW5

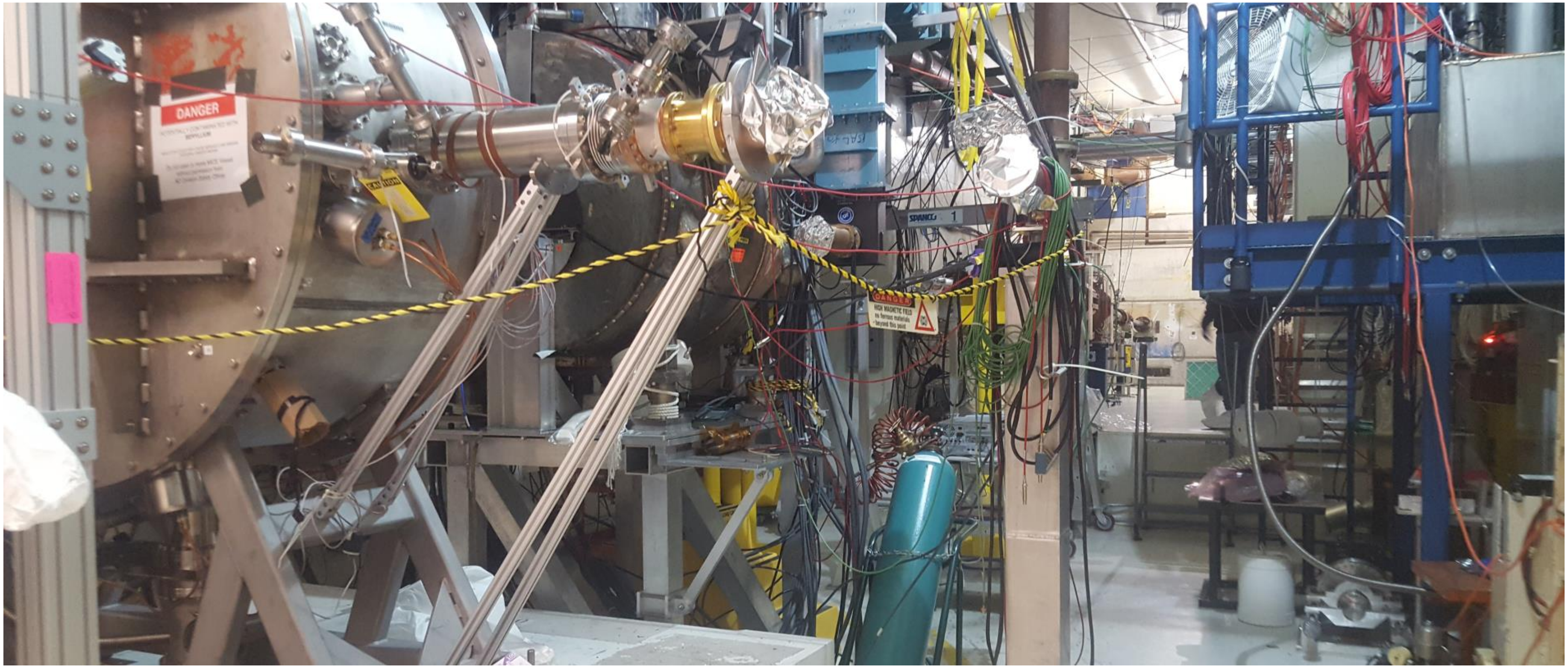


Emittance absorber

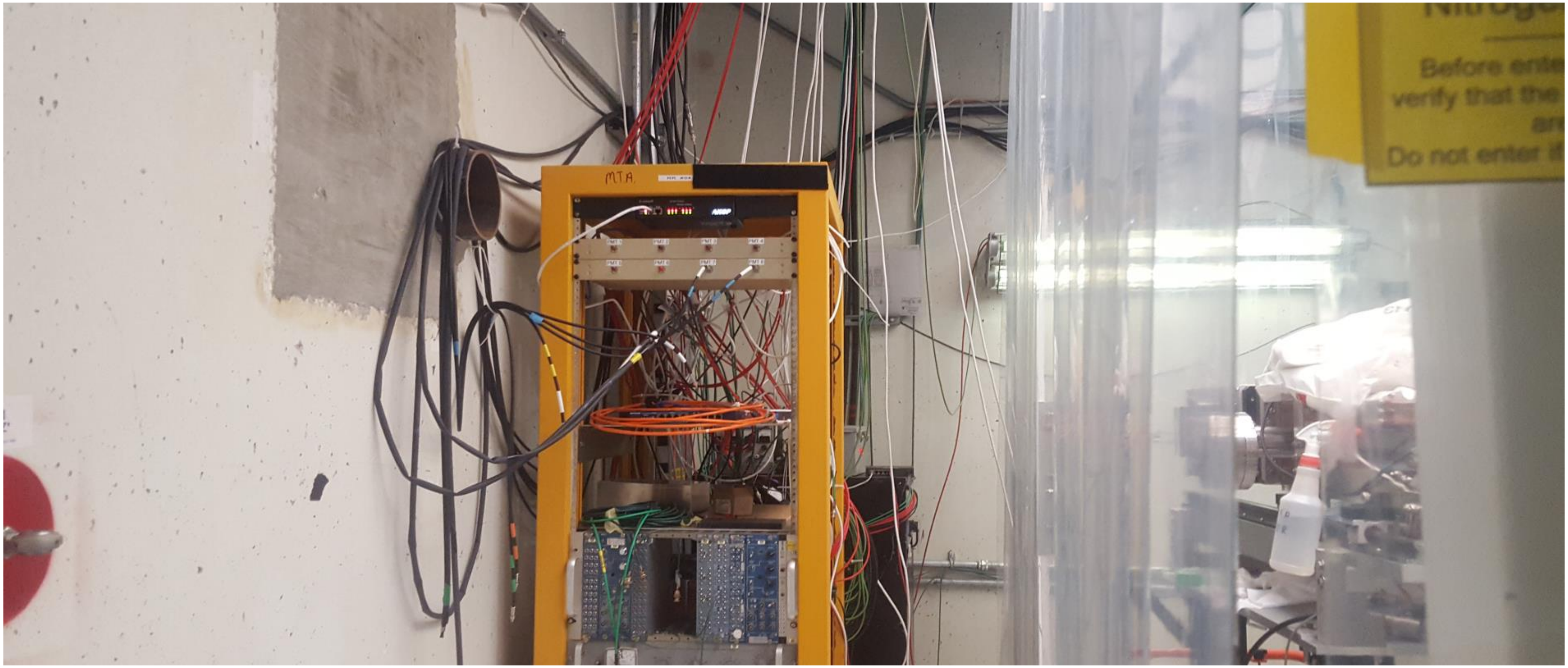
Rollup door in experimental hall to the access pit



Looking d/s in experimental hall to the solenoid



Looking u/s



Entrance to the high intensity dump