First Beam in the MTA beamline

Description, first beam and further commissioning plans

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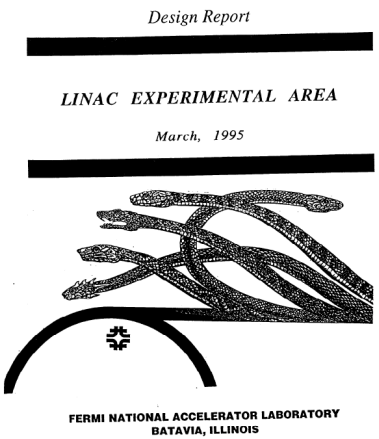
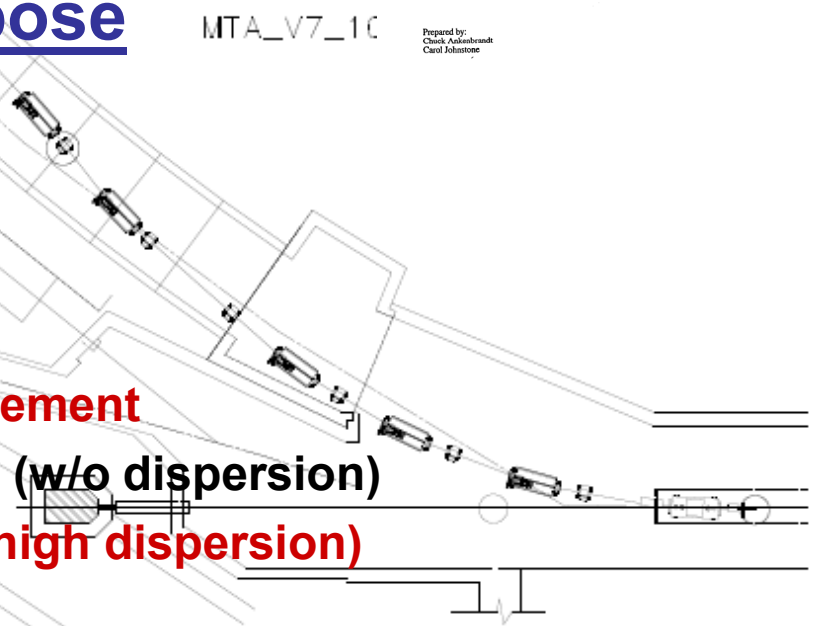
Purpose: MuCool Test Area and Beamline

- **A new experimental area, the Muon Test Area,(2003) has been constructed to develop, test, and verify muon ionization apparatus using the 400-MeV proton beam from the Fermilab Linac**
- **Since muon facilities involve the capture, collection and cooling of ~10^{13} muons at a repetition rate of 15 Hz, conclusive tests require ~10^{13} protons/pulse at 15 Hz (full Linac beam up to safety envelope)**
- **The beamline designed for MTA experiments included specialized insertions for linac beam diagnostics and beam measurements, greatly enhancing the functionality of the beamline.**
- **Installation of the beamline was complete fall, 2008.**
- **As such it represents the only facility in which experiments have direct access to a primary beam**

Background/Recent History, MTA Beamline

- **Original proposal 1995**
  - **Re-proposed for MuCool Test Area**
    - **Large-aperture (LANL) magnets**
      - **12” beam-size acceptance for cooling tests**
  - **Re-designed for dual purpose**
    - **MTA beamline**
      - **Re-use existing resources**
        - » **Modest 2” beam sizes**
    - **Linac beam diagnostic line**
      - **Transverse emittance measurement**
        - » **Phase space tomography (w/o dispersion)**
      - **Momentum spread measure (high dispersion)**





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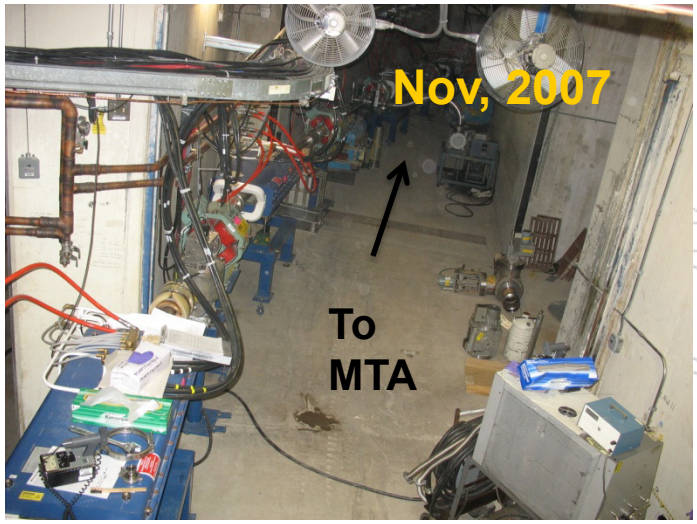
As-built MTA Beamline, Nov., 2007

Beamline installation:
F. Garcia



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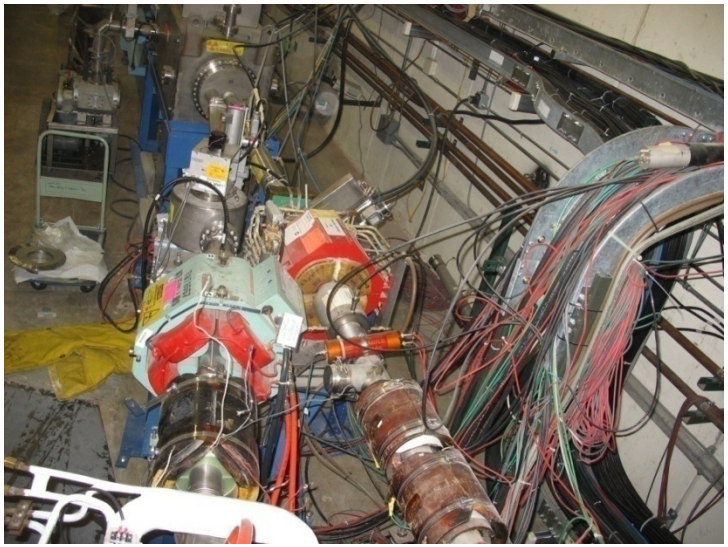
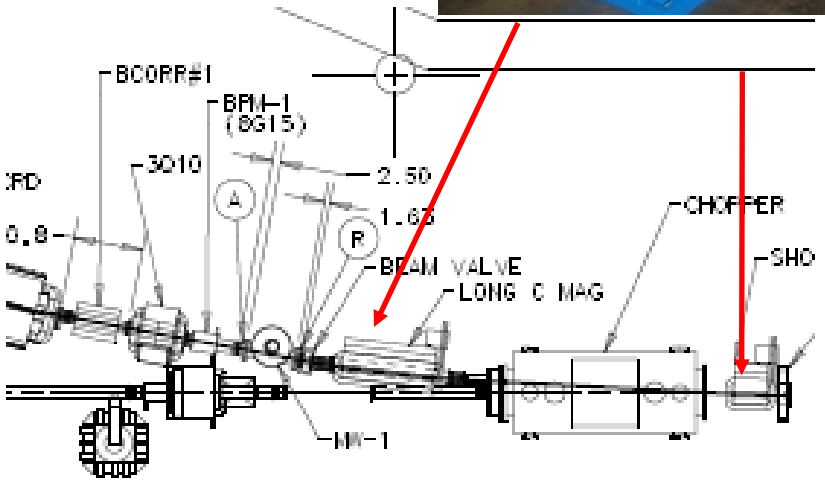
Extraction from Linac

- Pulsed C magnet – capable of 15 Hz Linac "pulse" selection
  - Entire Linac pulse is extracted
    - low loss operation





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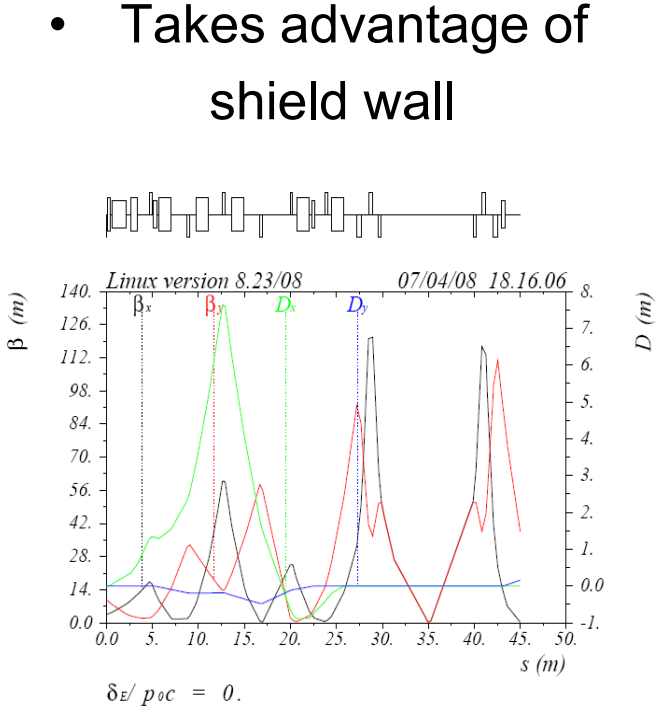
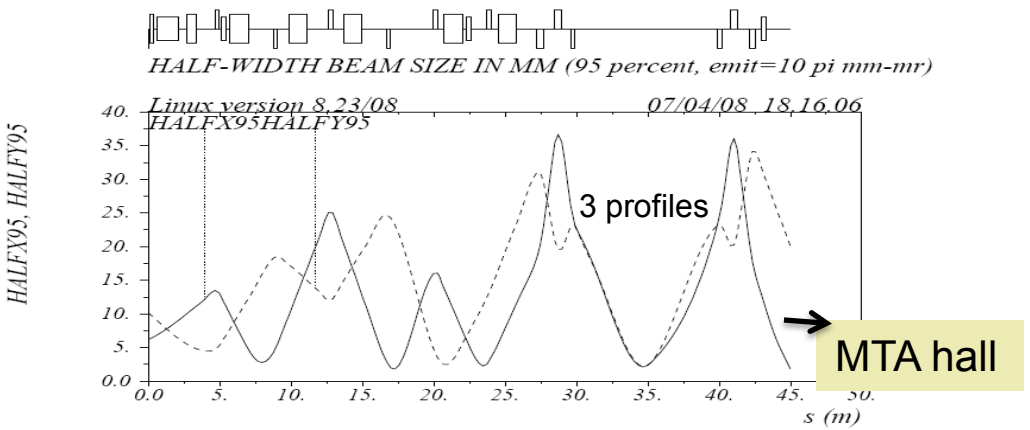
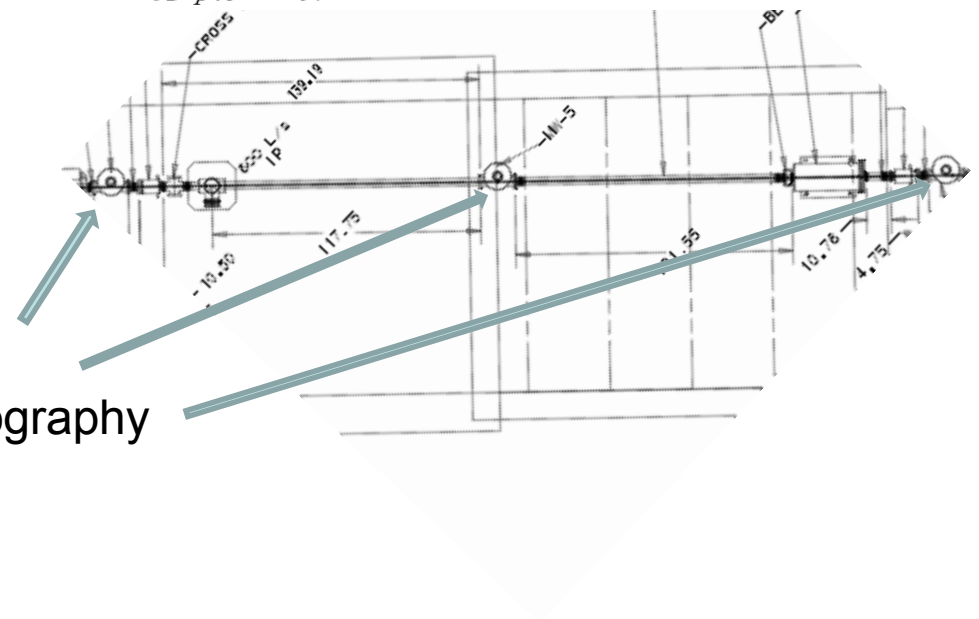
Emittance Measurement section

- Takes advantage of shield wall



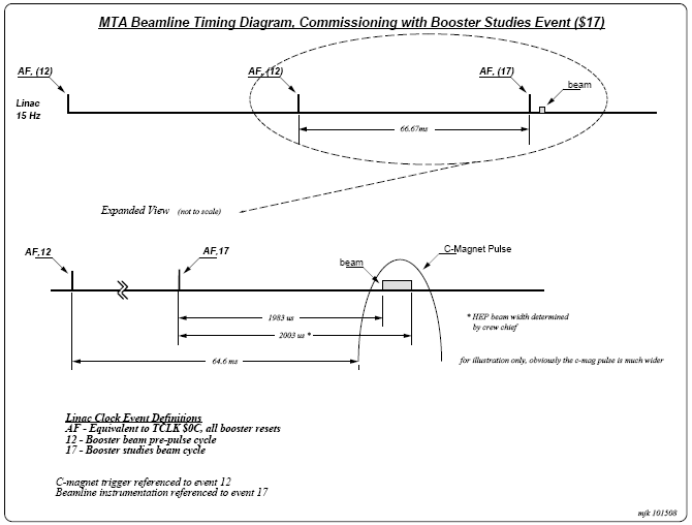


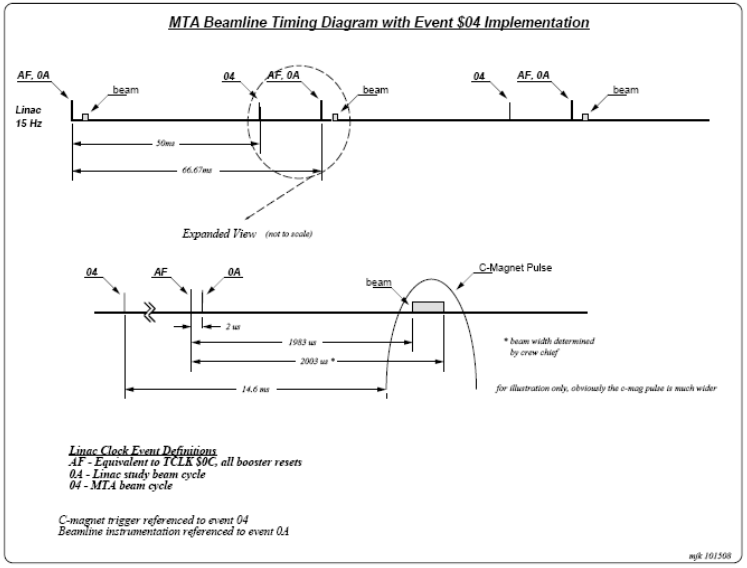


10 m straight between quads
3 MW profile monitors for tomography
disp suppressed straight

MTA beam event

- Initial startup –
  - Reuquired dedicated studies (HEP beam)
  - Booster beam event
- Interim configuration -
  - Parasitic to HEP
  - Commandeer Linac Study event
- Final configuration
  - Dedicated MTA event TLG
  - “single-pulse” extraction
  - Parasitic to HEP





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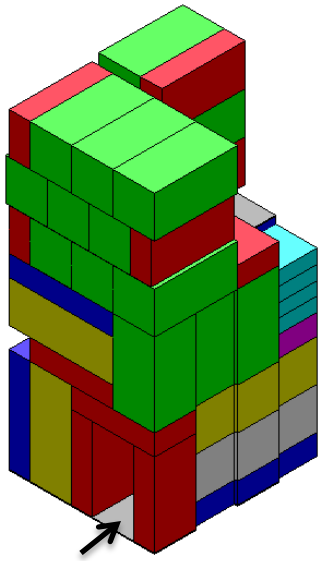
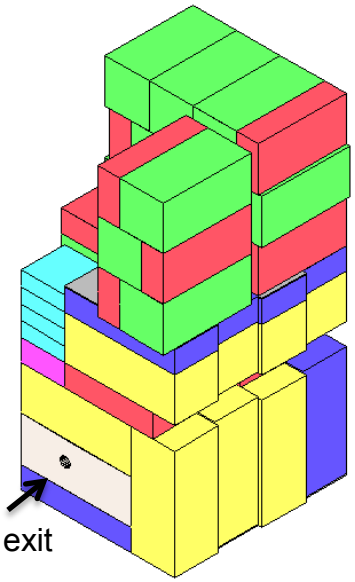
MTA Beam to 1st Beamstop

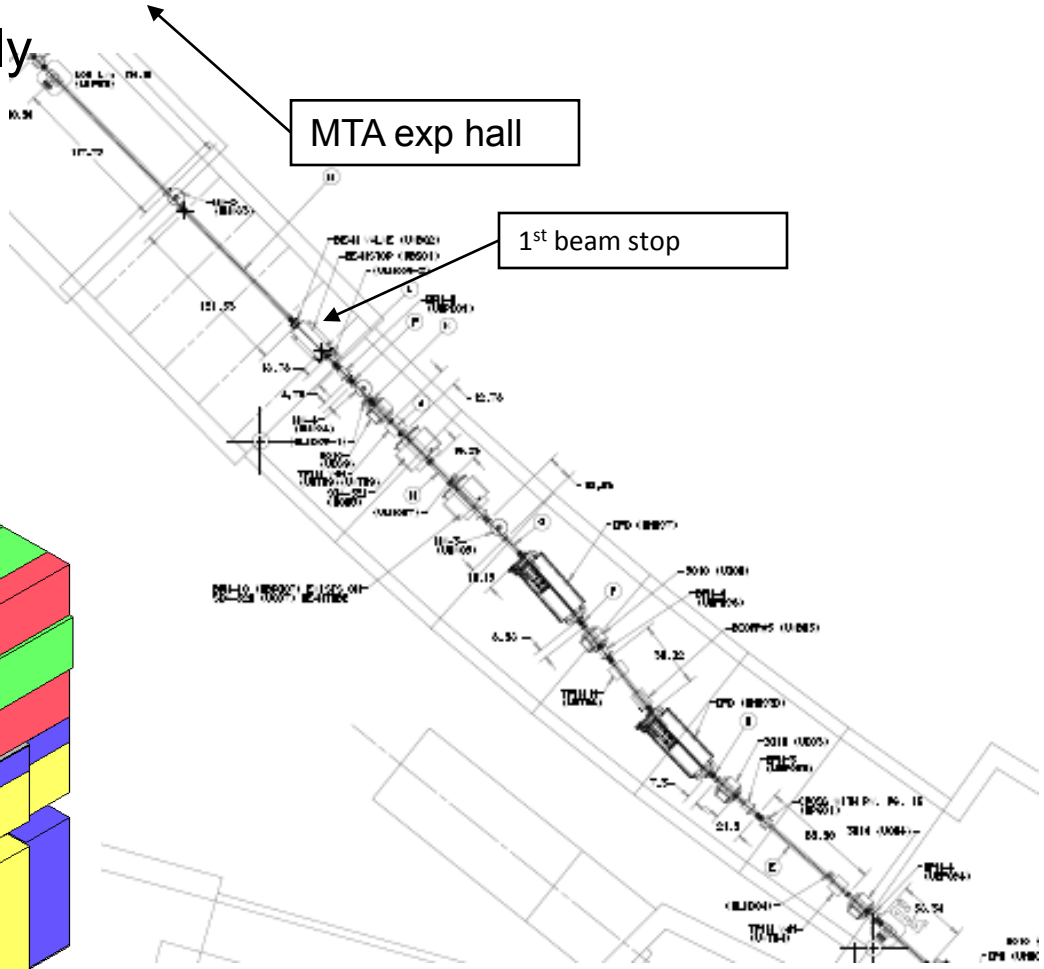
- Initial beam: linac enclosure only
  - 1st beam stop with present hatch shielding
- Beam to Exp Hall
  - Additional shielding primarily:
    - Hatch, penetrations, rollup door



Beamstop cave



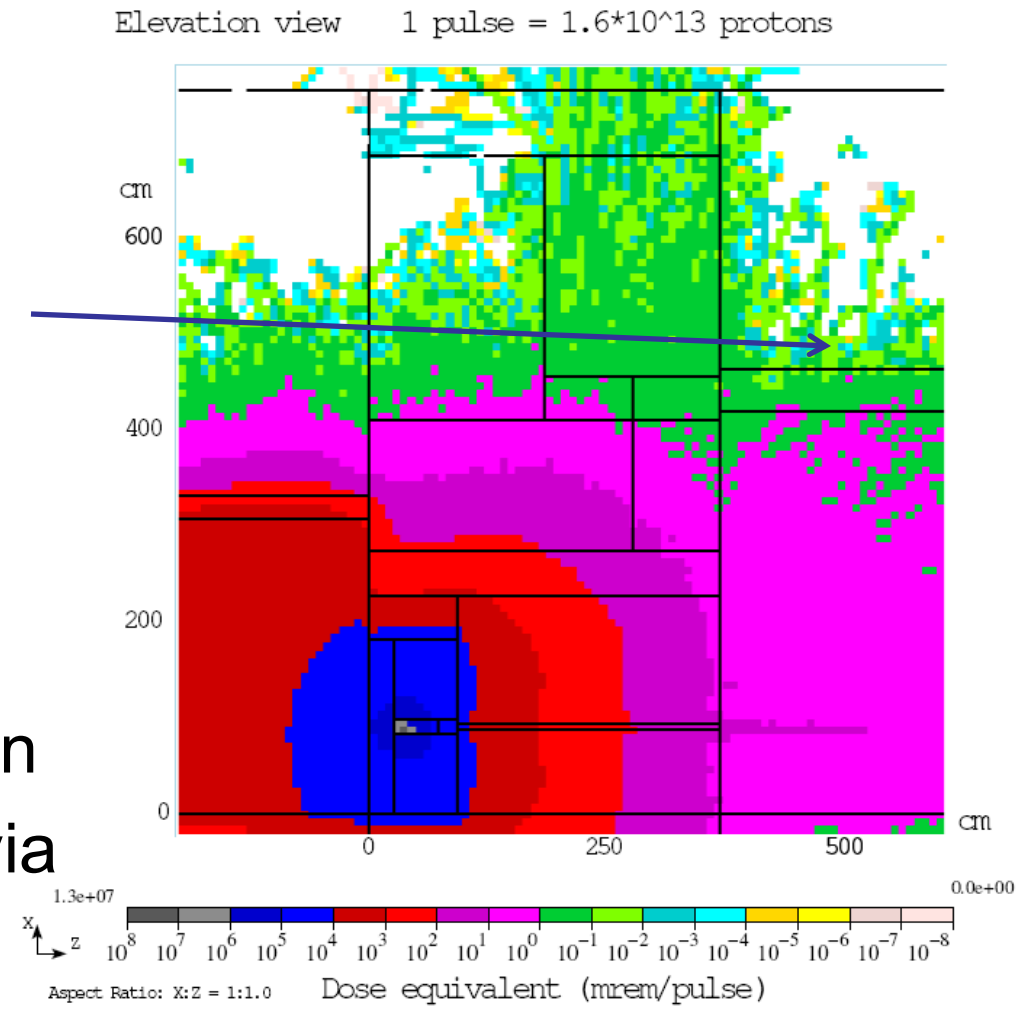
Beampipe exit



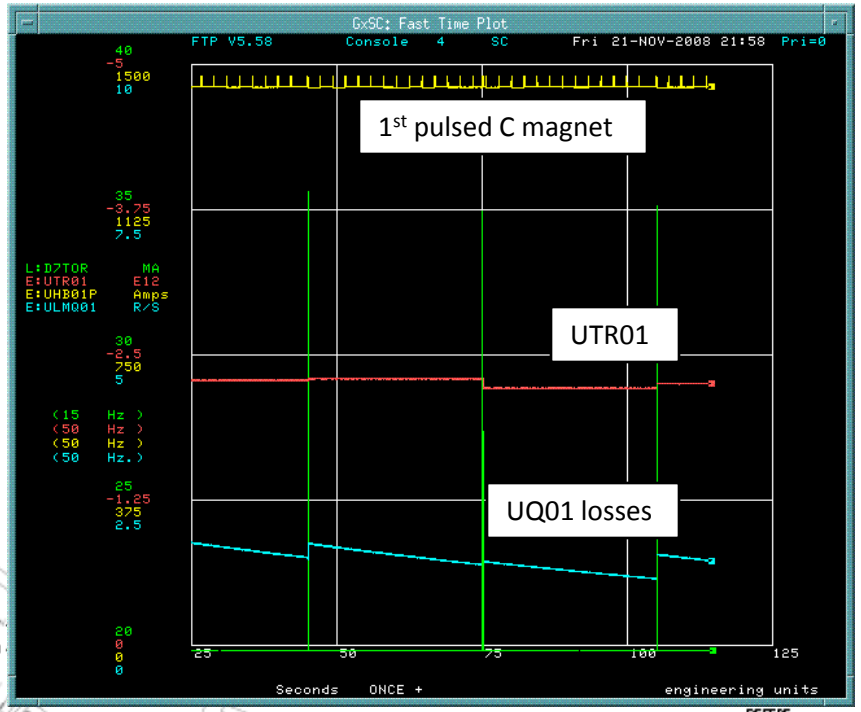
Operational limits, 1st beam stop

- Dose in shielding gap
  - Full Linac intensity
    (1.6 x 1013 p/pulse)
  - Just under 1 mrem/hour
  - With fence in place
    - Radiation Area:
      - **Limit 100 mrem/hr**
    - ~1 pulse/minute

Single pulses were taken under operator control via beam switch in MCR



- First beam observed on 5th pulse
- After C magnet tuning
  - Full beam extracted on toroid UTR01
    - $2E^{12}$protons/pulse
  - Low losses in line
  - Beam fully extinguished in 400-MeV transfer and diagnostic line



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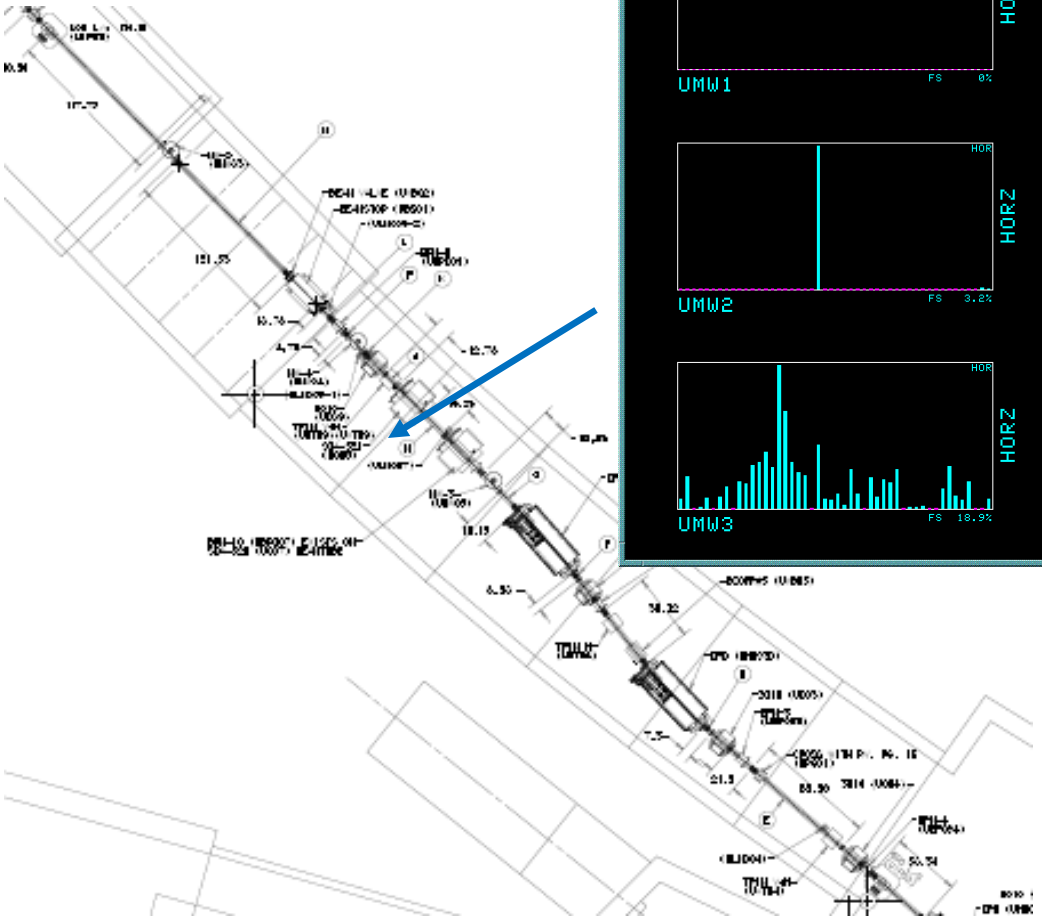
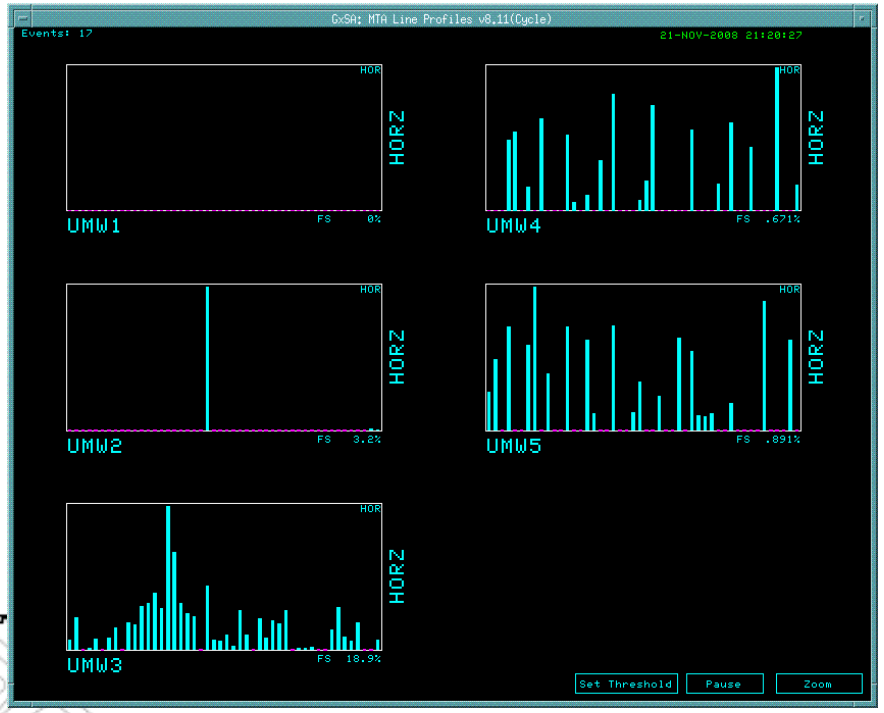
Beam profile

- MW3 profile captured
  - ~3 m upstream of beamstop





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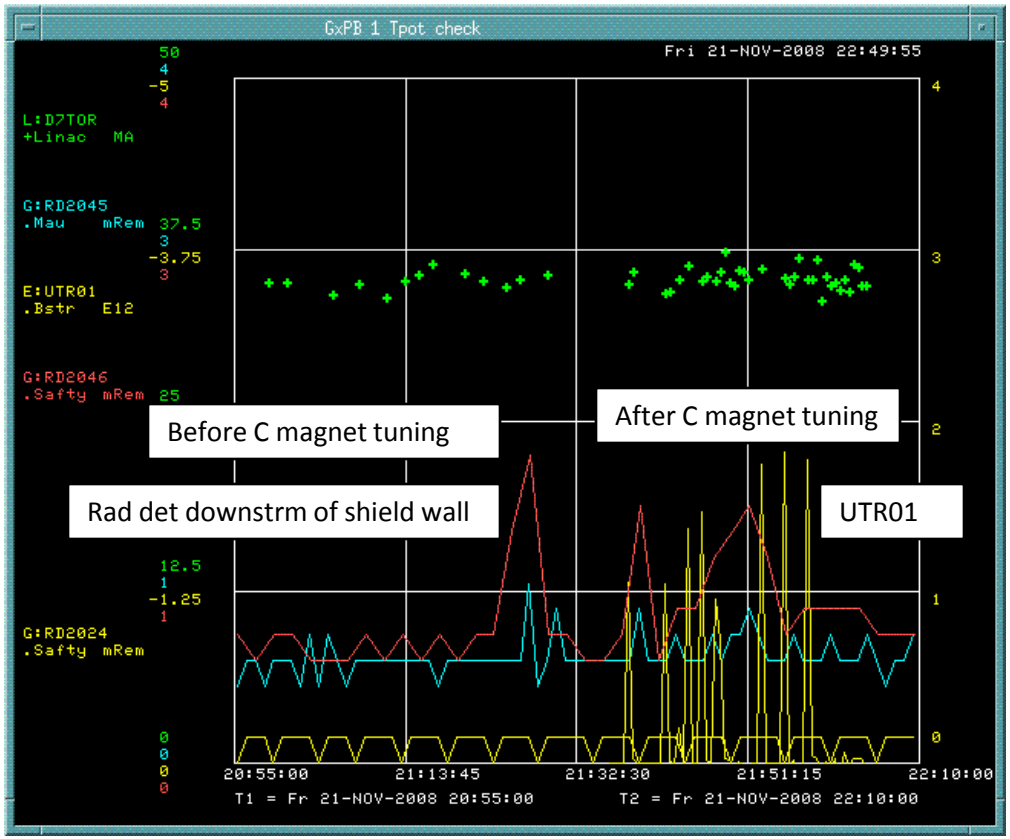
Beam to 1st beamstop

- After tuning C magnet strength and timing
  - "Secondary" radiation detected downstream of shield wall; no radiation observed prior to C magnet tuning
  - If beam is stopped upstream of beamstop, secondary radiation does not penetrate shield wall; confirms shielding simulations
  - Rad detectors are integrated; rad level cannot be extracted from single pulses
  - UTR01 was not initially data-logged, hence is not present on left side of plot



Rad det #2024, 2025, 2026 are located at rollup door, hatch, and downstream end of shield wall @beampipe, respectively. Note UTR01 was not data logged until ~21:30.

Summary

- Approved: 1 hour beam time
- Used: 47 of our 60 allocated beam pulses
- Beam: on 5th pulse
- After C magnet “tuning”
  - beam was fully extinguished in 400-MeV transfer and diagnostic lines
  - fully extracted into MTA beamline
- Diagnostic timing and trigger problems
  - 8 pm on Friday before Thanksgiving
  - BPM timing has since been resolved in principle

Present work/plans

- Supply work
  - rms current in quad bulk supply being increased
  - C-magnet droop
- BPM timing “resolved”
- Investigating MW readouts
- Ready for further commissioning beam;
  - opportunistic until interim controls complete (Jan, 2009)

- Start of beam program dependent on final Radiation Assessment and installation of the all the required shielding. Installation of the all necessary shielding still requires some simulation effort and represents a significant mechanical effort