# New Irradiation Test Area at Fermilab

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# Introduction

- We have just commenced operations of a new Irradiation Test Area at Fermilab at the end of a refurbished 400 MeV beamline.

- Will outline the facility infrastructure, beamline capabilities, and future plans.

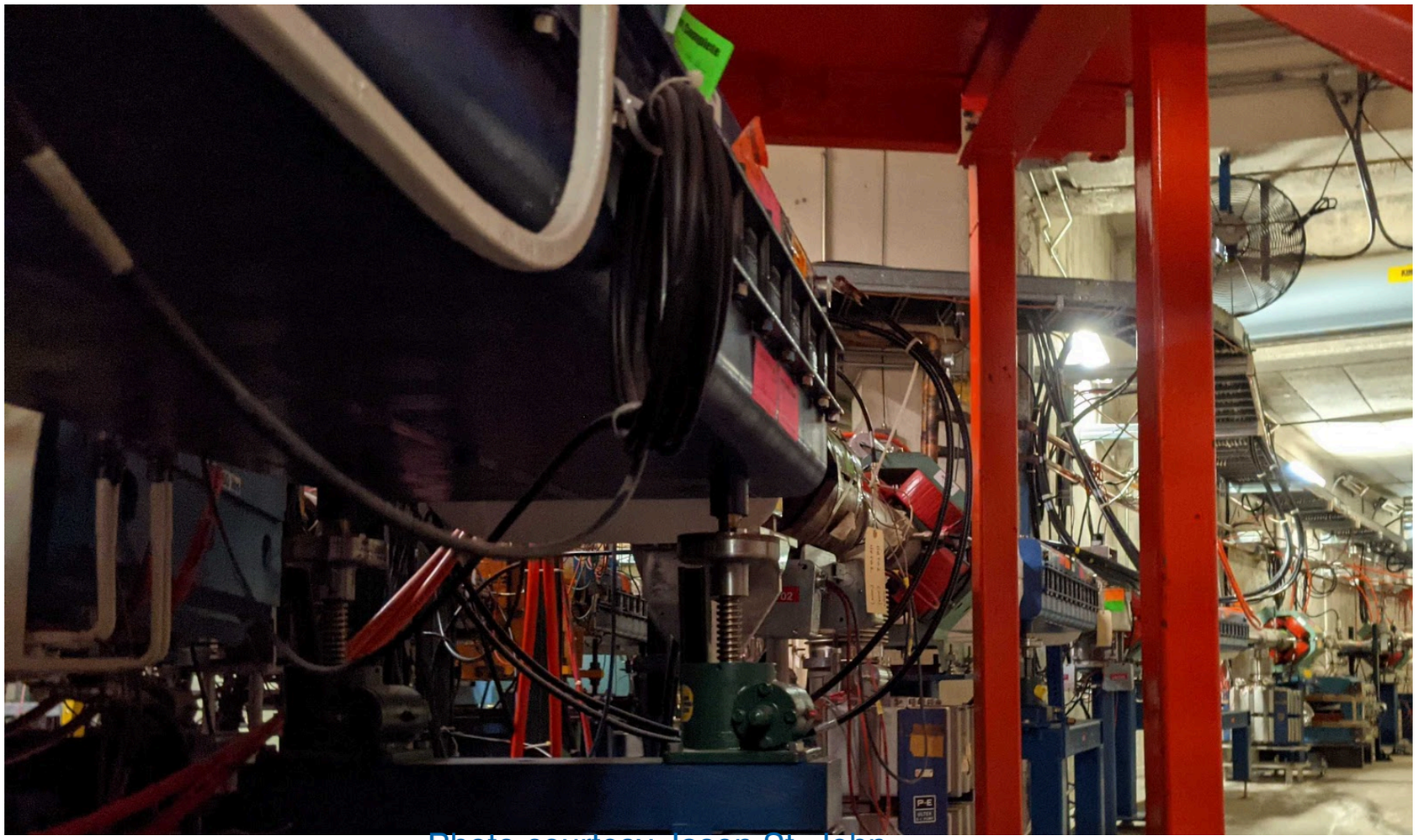

Photo courtesy Jason St. John

# Fermilab Accelerator Complex




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# Defining Terms

- **MeV Test Area (MTA) –** Beam enclosure containing the 400 MeV beam line and the experimental area.

- **Irradiation Test Area (ITA) –** The experimental shielding cave and associated infrastructure located at the end of the MTA beam line. The ITA covers the broad experimental program taking place within the MTA.




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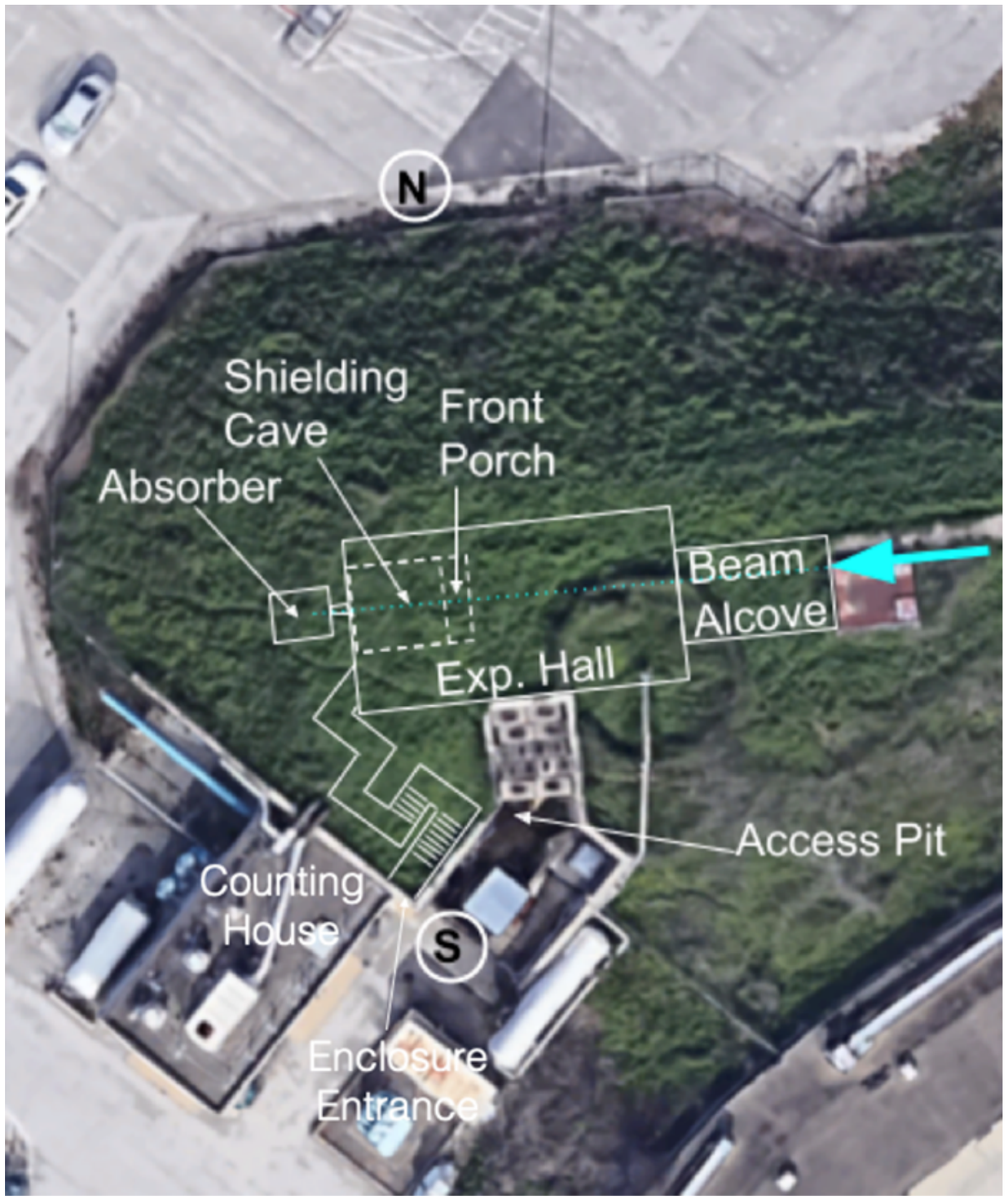
# MTA Facilities

- Counting house in service building next to beam enclosure.
  - Set of ~50’ penetrations connect the two spaces for cabling.

- Enclosure accessed by stairs directly from the parking lot.

- Equipment elevator available for use.



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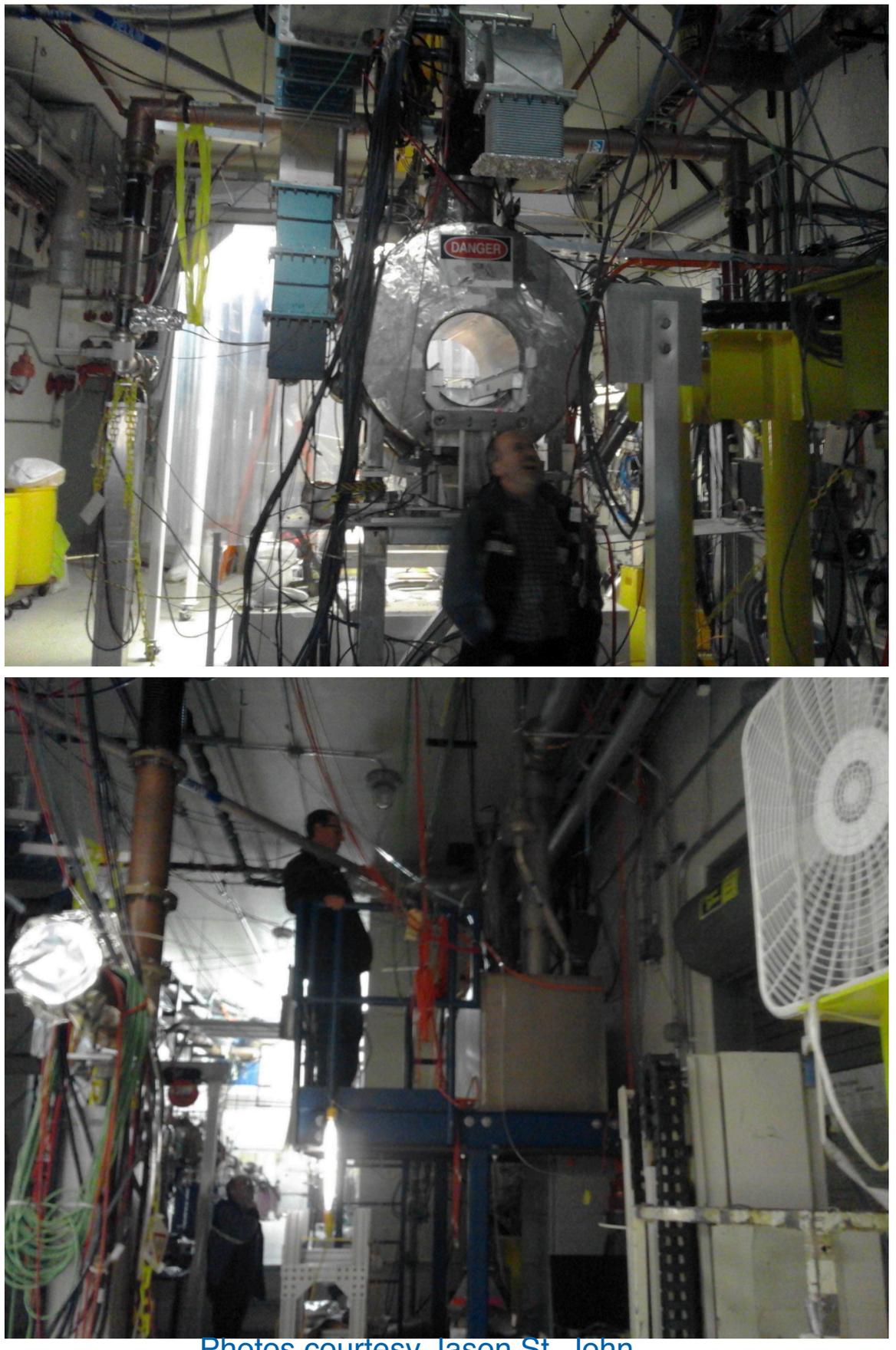
# Facility Background

- Beam line and enclosure originally constructed in 2003-2007.
- MuCool Test Area to explore ionization based beam cooling components for the Muon accelerator program.
- Hosted a range of radio frequency experiments.
- Program ended in 2016, providing a suitable beam line and enclosure for irradiations.




Photos courtesy Jason St. John

# 2019-2020 refurbishment

- Cleaned out MuCool infrastructure.
- Added moveable stripping foil at final bend in beamline to produce 400 MeV protons but retain the ability for H- beam (electrons still stripped at final vacuum window but on same trajectory as protons).
- Adjust location of final focusing triplet.
- Update beamline instrumentation and add shielding cave and experiment infrastructure.
- Improve facility shielding and update assessment.

Photo courtesy Jason St. John

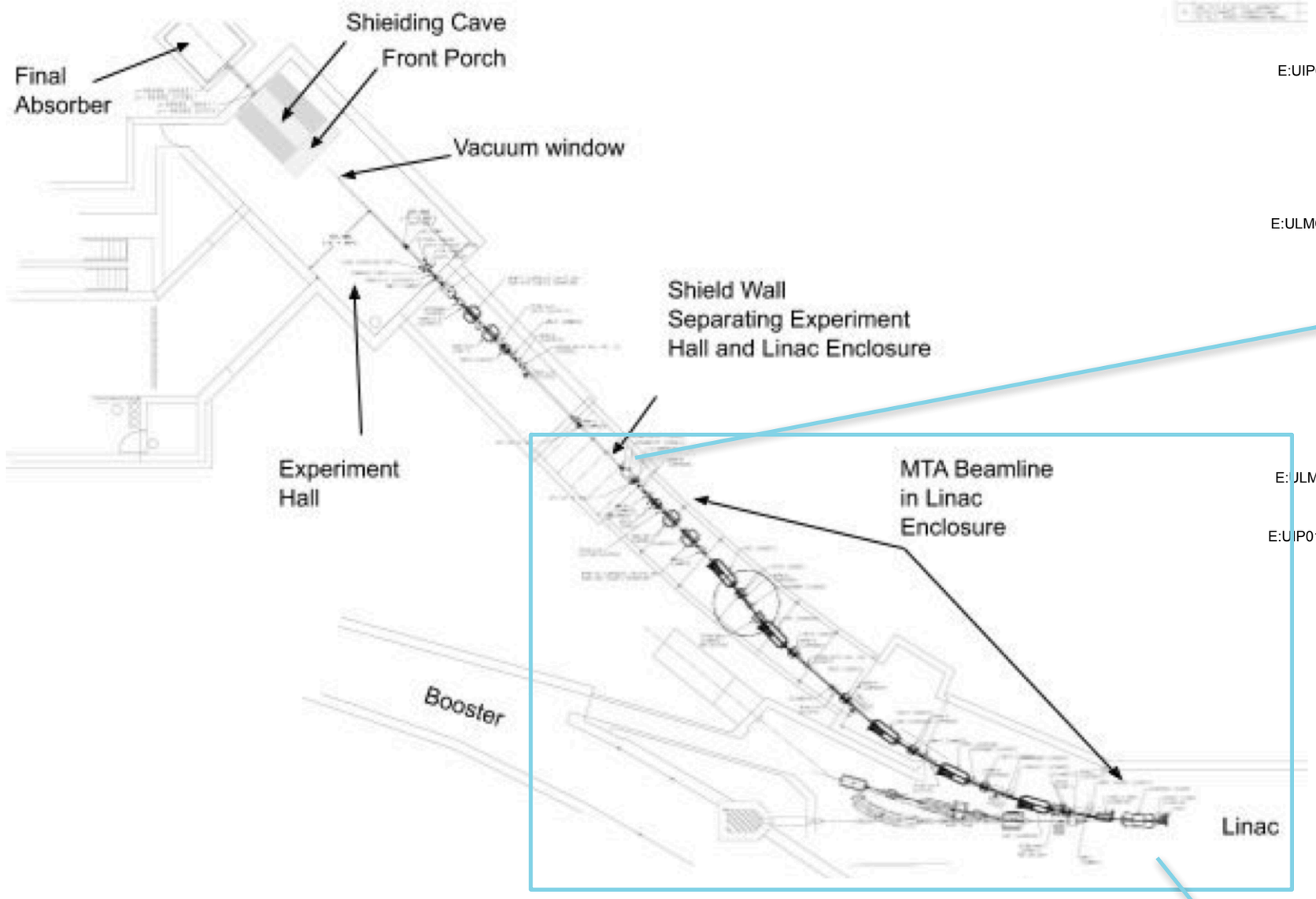
# Beam Details

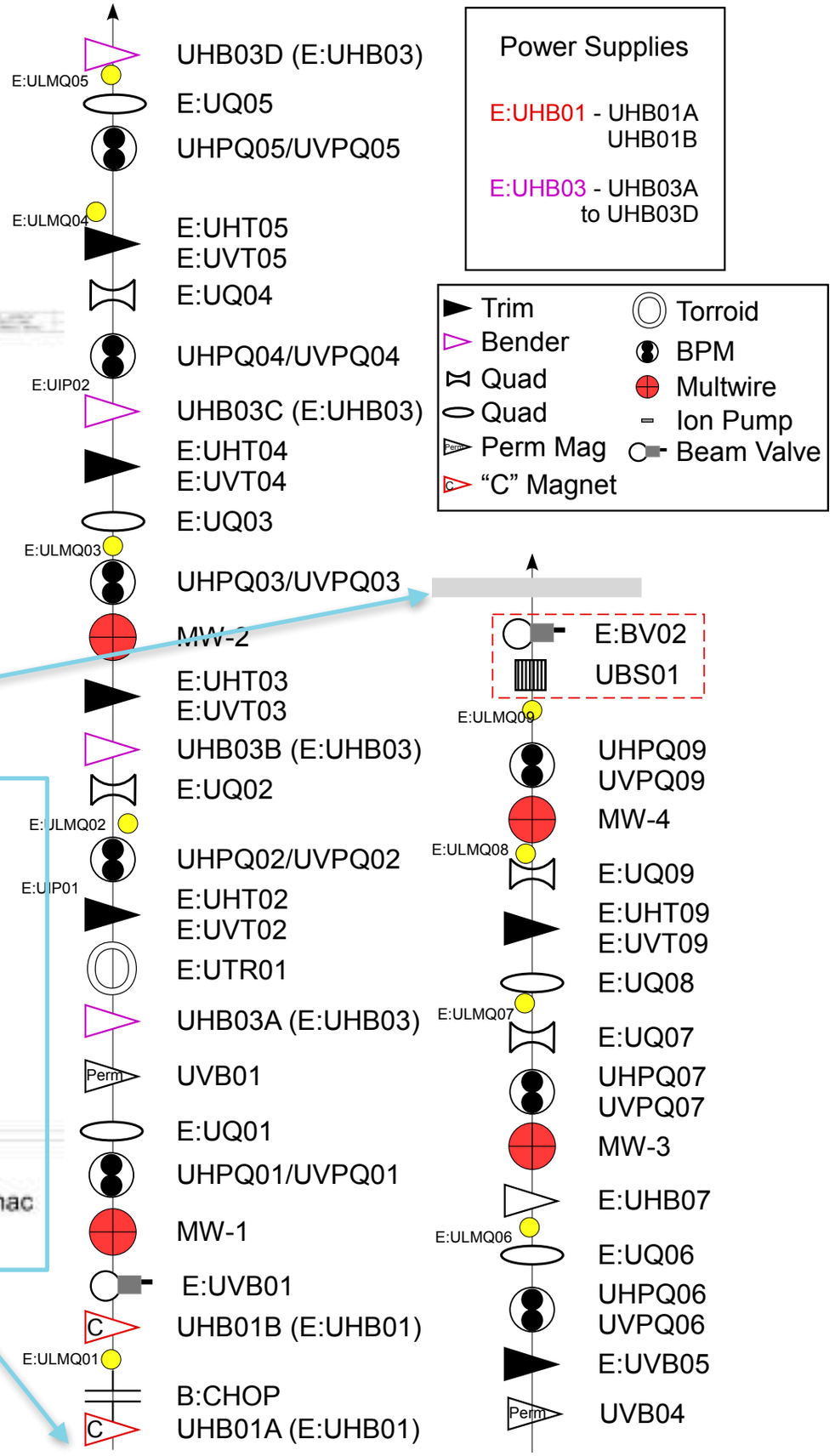
- MTA beamline is approved for a maximum intensity of 2.7e15 particles per hour per the current shielding.
  - Administrative limit of 1.3e18 particles per beam year.

- Beam delivered as one or more pulses in a 4 second window once per minute:
  - Individual pulses can be adjusted from ~6μs (~0.6e12 particles) to ~40μs (~5.4e12 particles).
  - Number of pulses can be adjusted: 1, 5, 10, or 15
  - Current beam operating at one pulse of 35μs length (~4.7e12 particles per minute). Anticipating full intensity in a few months.

- Beam spot size nominally ~1cm FWHM.
  - Magnets allow separate horizontal and vertical focusing.
  - Spot can be increased a few centimeters. (Uniformity and focusing limits have not yet been explored).
  - Multiwire chamber provides profiling at final beam window, ~2.5' from closest experiment position.

# MTA Beam Line: Linac Enclosure



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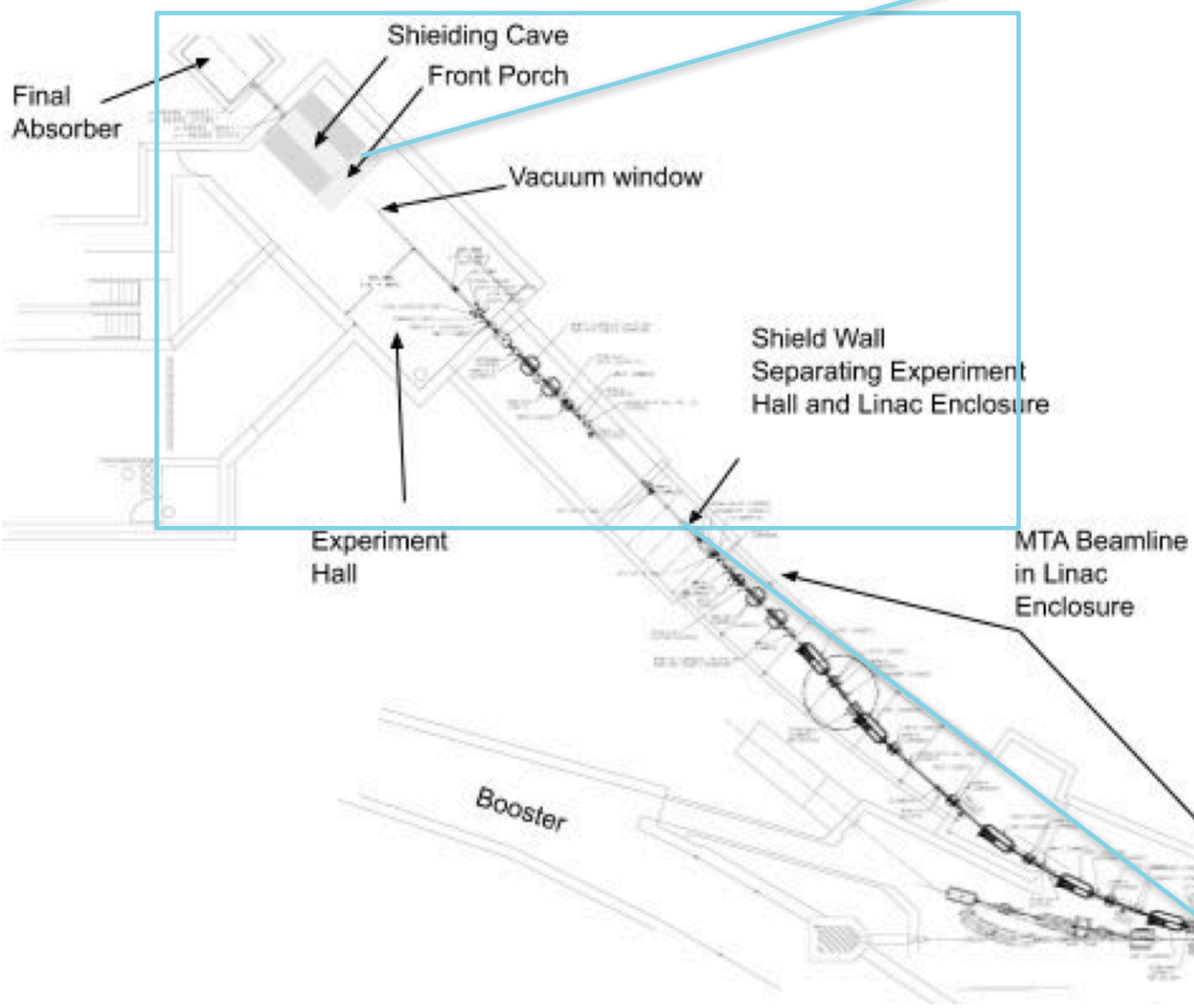
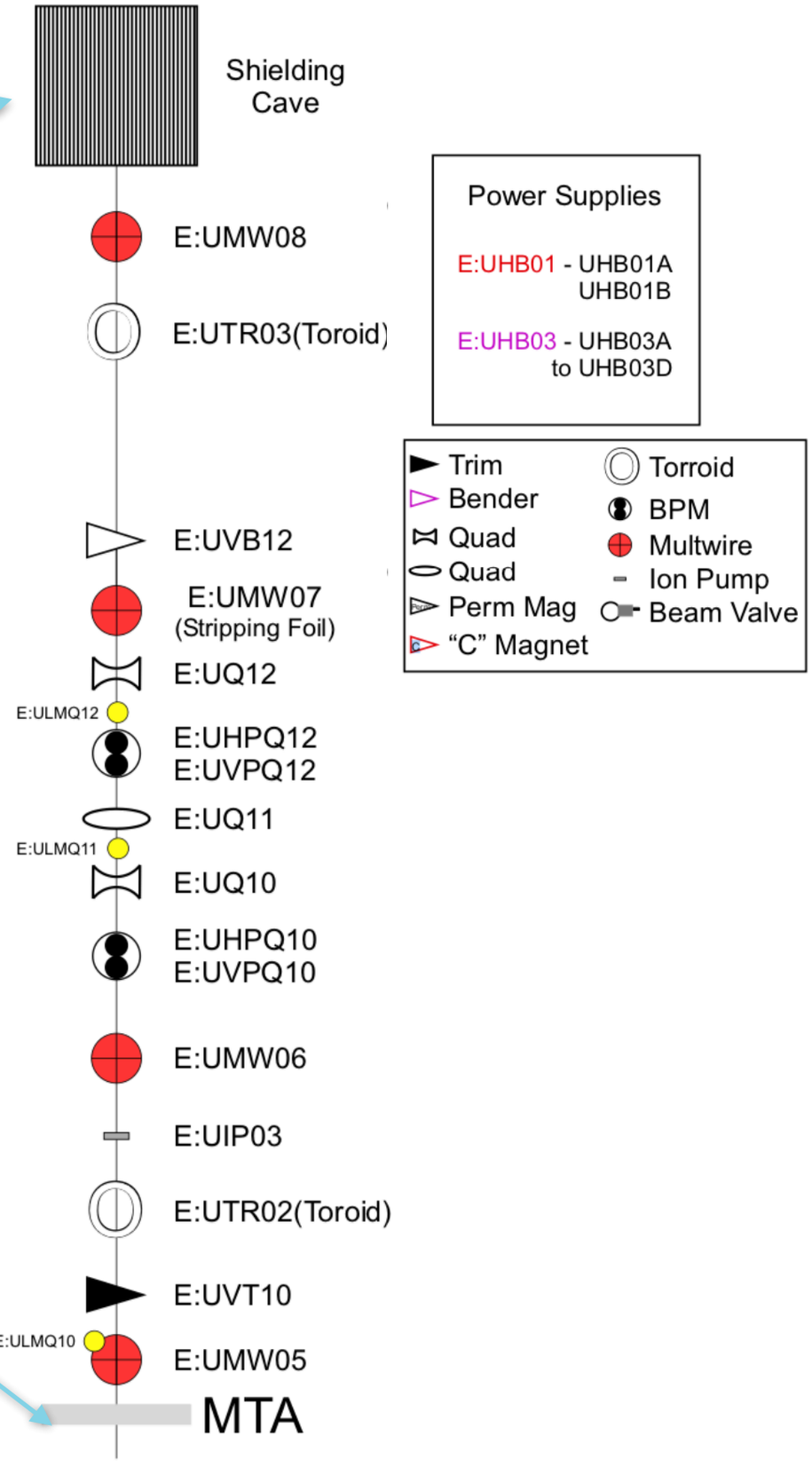
# MTA Beam Line: Experimental Hall



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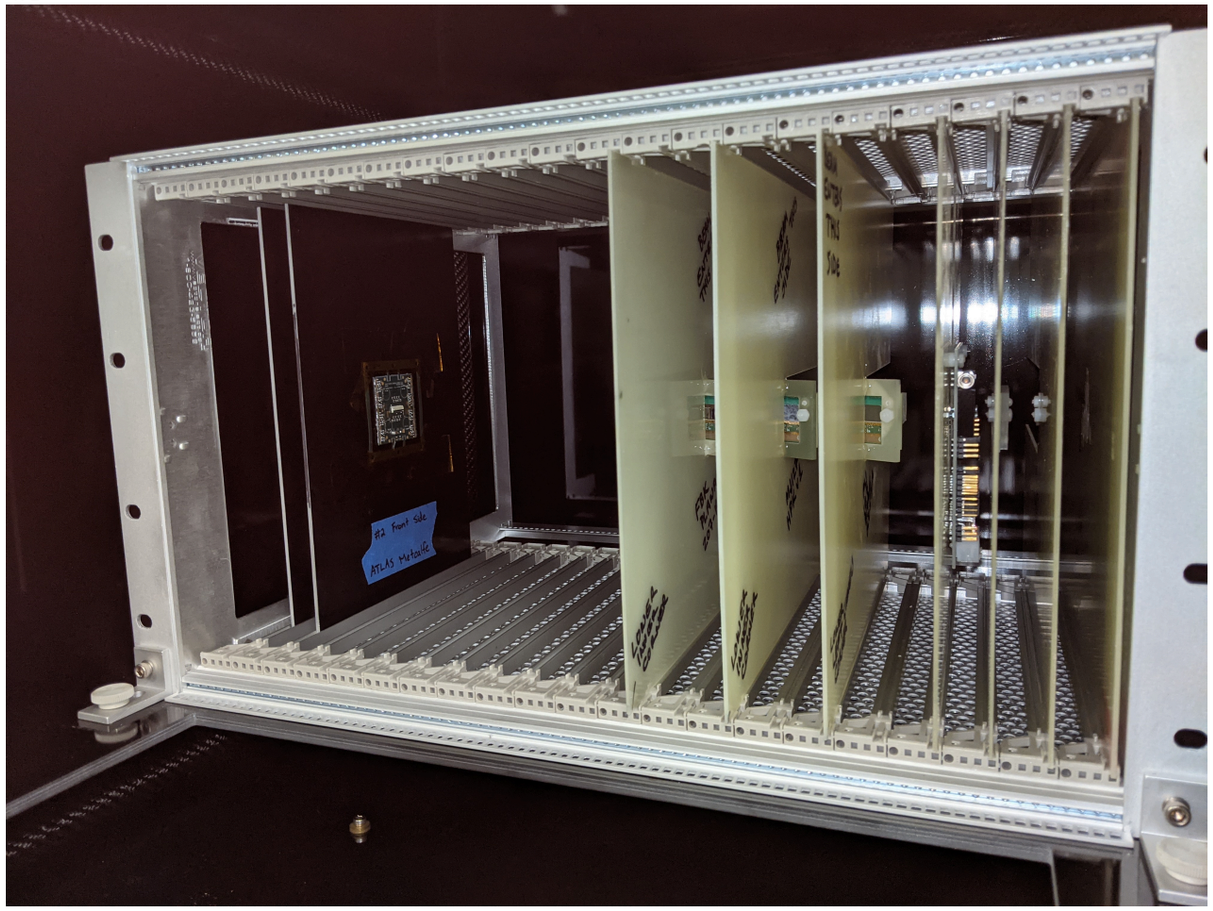
# Facility Infrastructure: Installing Samples

- Card cage available for sample installation.  Patch panel allows for possibility of cabling and cooling.

- Rear of box supports a PIN diode array for realtime dosimetry and positioning information.

- Additional mounting possible on request.

Photo courtesy Abhishek Bakshi



Very first samples from CMS and ATLAS ready for irradiation.
Photo courtesy Corrinne Mills

# Facility Infrastructure: Shielding Cave

- Cave has interior dimensions 3’x3’x9’ with an additional 3’ depth on “front porch”
- Front porch supports x-y motion table, rail system to move samples into the cave.
- Sample location dependent on materials involved.

Photo courtesy Todd Nebel

# Facility Infrastructure: Counting House

- Active monitoring of samples and data possible from remote counting house. Experimental cave viewable via remote camera.

- RG-58 BNC, RG-58 SHV, and cat6 cable patch panels connect to enclosure. Additional cabling can be pulled upon request.

- Freezer storage onsite for irradiated samples.



# Current Status

ITA enclosure camera feed on 2/3/21 with running experiment.

## Still to come

- Installing air system to support a vortex chiller for sample cooling during irradiation.

- Pneumatic table under construction to support staged dosing of samples.

- Open to additional infrastructure requests or contributions.

- Thanks to Blerina Gkotse and Federico Ravotti for providing a version of the CERN IRRAD Data Manager (IDM). We have adapted the tool to meet the needs of the ITA and will have a common system for logging samples
  - Finishing authentication protocols before going live.

- Additional beamline tuning and intensity increases ongoing.

# Becoming a User and Scheduling

- First step is to contact the facility staff for time and write the TSW (Technical Scope of Work)
  - Evan Niner: edniner@fnal.gov, Mandy Kiburg: rominsky@fnal.gov
  - Agreement between user and the lab over what resources are used; in particular the materials being irradiated and final destination.

- Support campaigns with remote or physical presence at FNAL
  - We can irradiate and ship passive samples to/from a user remotely
  - Possible to travel to FNAL, install an advanced setup in the beam enclosure and actively monitor from the counting house.

- Users can schedule ITA time concurrently with the Fermilab Test Beam Facility to test devices before/after irradiation.

- Anticipate changing over samples ~weekly once full intensity is established.

- Radionuclide Analysis Facility (RAF) available onsite to provide dosimetry.

# Summary

- We began operations in 2021 of a new irradiation facility at Fermilab.
  - First user samples from CMS and ATLAS completed irradiation in January.

- At full capacity ITA will deliver 2.7e15 protons per hour @ 400 MeV, expecting samples weekly for ~36 weeks per year.

- ITA operating through June 2021, returning in Fall after annual summer shutdown.
  - Limited scheduling this spring as we improve the beamline and facility infrastructure, working though initial user queue.
  - Contact us with your experimental proposals and needs!

- We look forward to seeing you at Fermilab! To learn more:
  - Slack Team: fnal-testbeam
  - Webpage: ita.fnal.gov
  - Listserv: test_beam@fnal.gov