Recommissioning MINERvA for 2x2

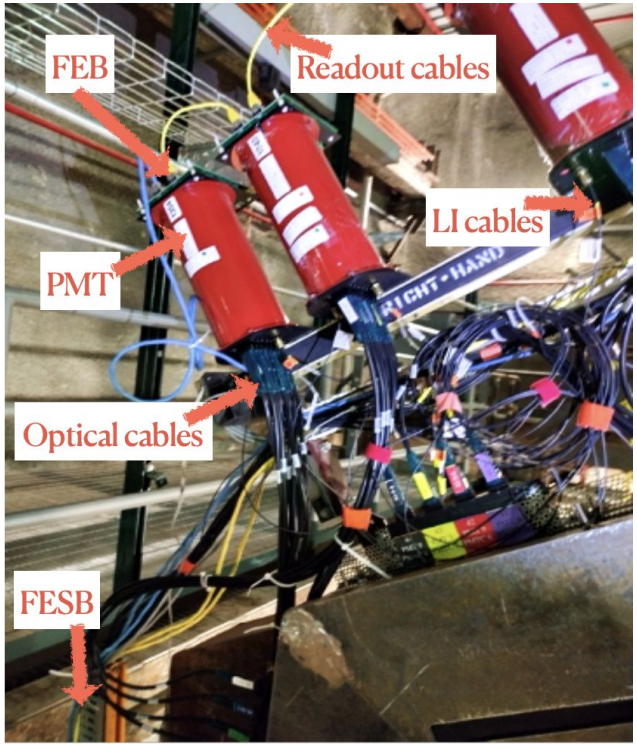
Jack Smedley

ND-LAr Consortium Meeting

Thursday, March 16, 2023

MINERνA 101

- A module has one or two planes of scintillator strips, ±60°(U,V) and vertical (X)
- Read out in sets of four modules by daisy chains of PMTs
- Most of the detector is active tracker module sets
  - (UX, VX, UX, VX) configuration, 19 PMTs
- Downstream of the tracker region are ECAL sets, which have a thin layer or lead between modules
  - (PbUX, PbVX, PbUX, PbVX), 19 PMTs
- Most downstream is HCAL, with only one instrumented plane per module and iron between
  - (FeX, FeU, FeX, FeV), 11 PMTs



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2x2 MINERvA

- ~40% of MINERvA is being repurposed for 2x2
- 12 tracker modules upstream of the cryostat for tagging rock muons
- 32 modules downstream for uncontained tracks
  - 8 tracker
  - 12 ECAL
  - 12 HCAL
- Original hardware was used wherever possible, and replacements are thoroughly documented

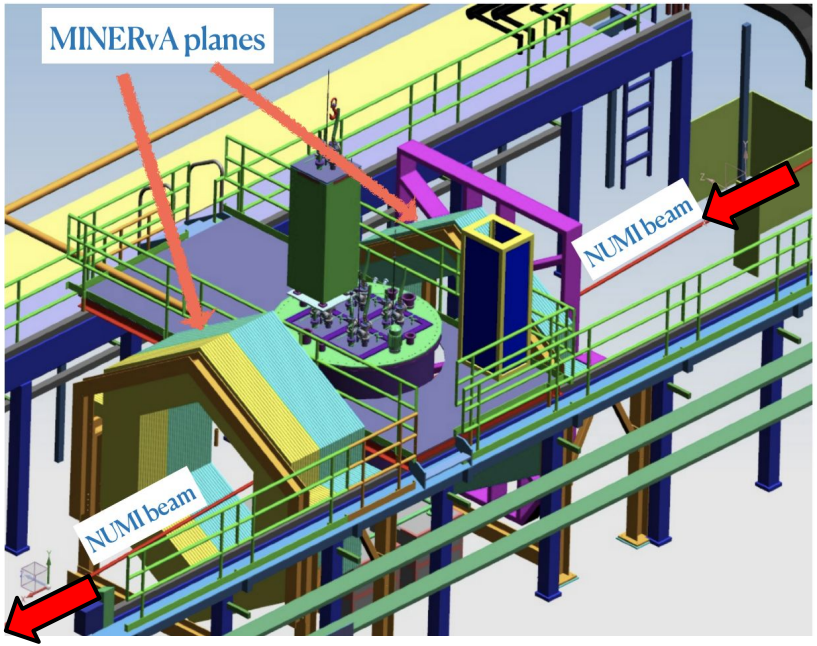

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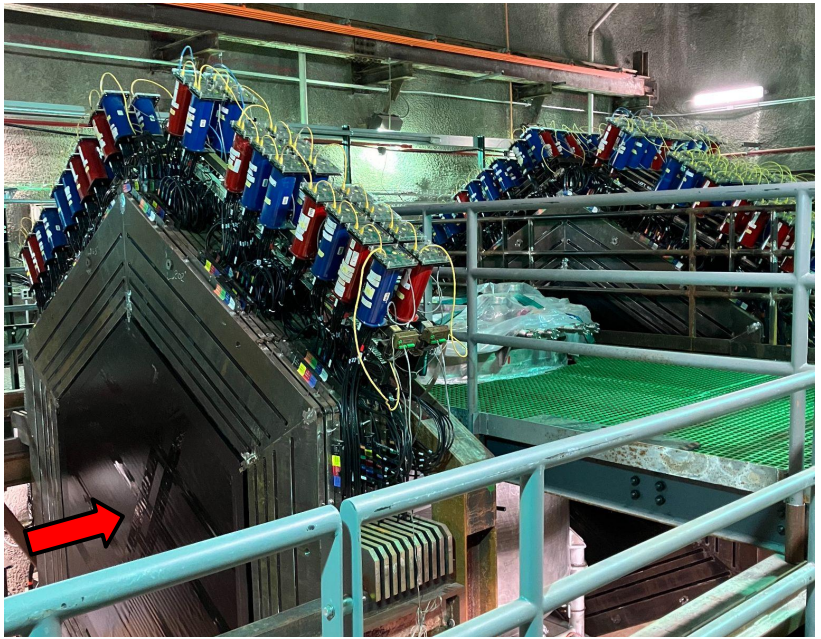
Photo taken during installation of final module set



2x2 MINERvA ≠ Original MINERvA

Hardware is matched to original electronics address, NOT to original module set! For example, the PMTs and FEBs on 2x2 MS11are from MINERvA MS11, but the planes are from MINERvA MS26.

2x2 MS#	1	2	3	4	5	6	7	8	9	10	11
MINERvA MS#	5	6	7	8	9	20	21	22	23	25	26
Type	AT	AT	AT	AT	AT	AT/ECAL	ECAL	ECAL	HCAL	HCAL	HCAL

Upstream

Downstream

Key Dates from the Installation

June 6
Passed ORC, installation begins in earnest

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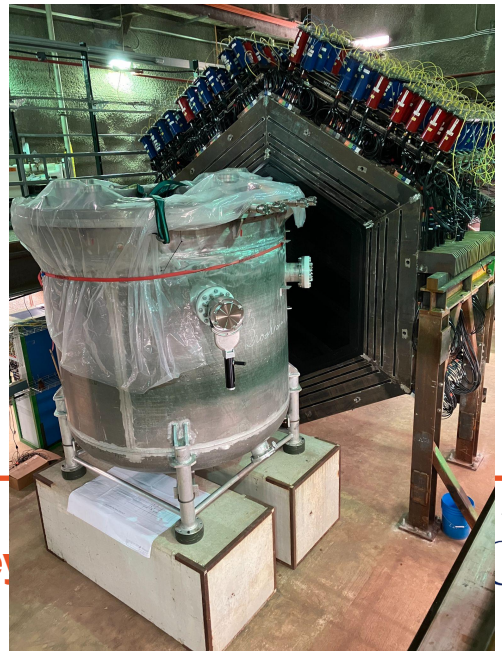

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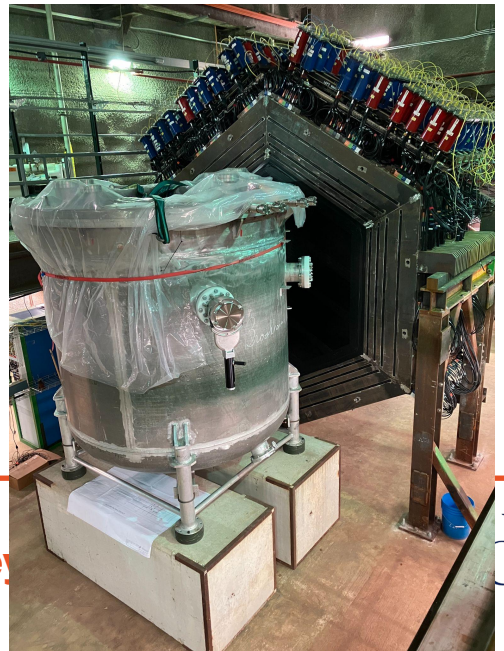
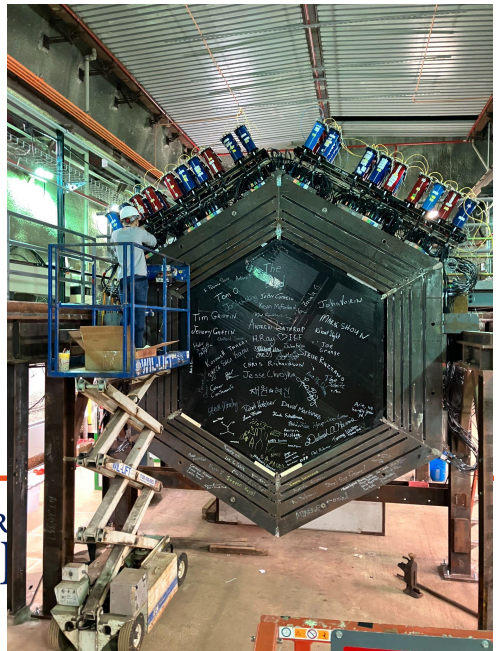
Upstream MINERvA completed

Now
Commissioning phase





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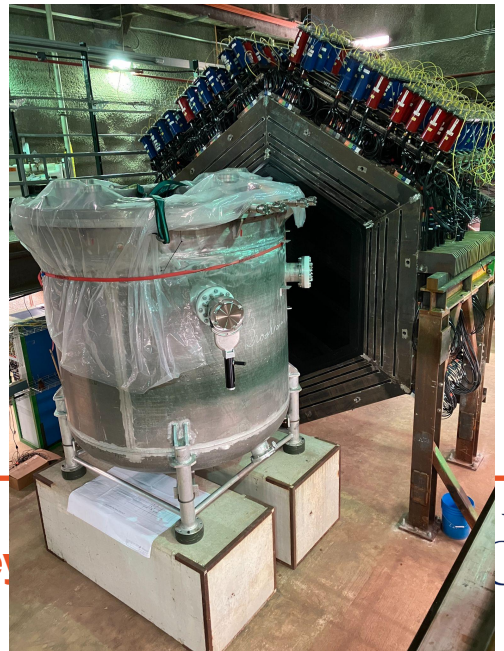
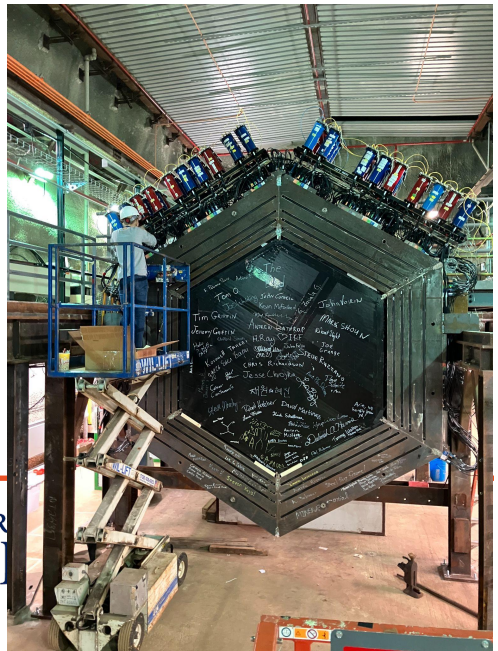
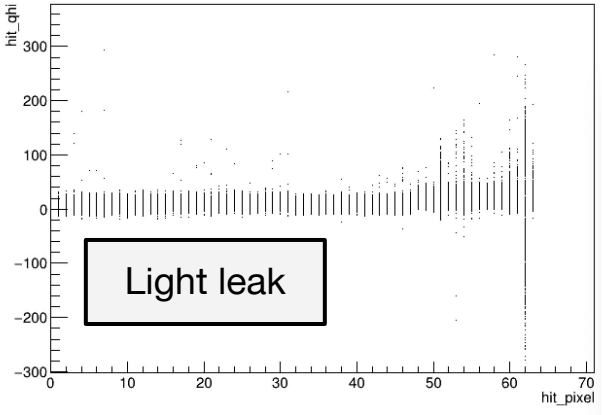
NuMI Beam

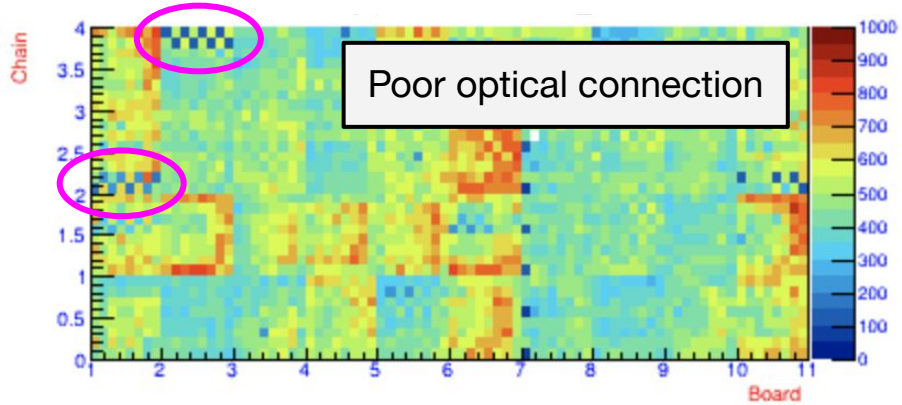


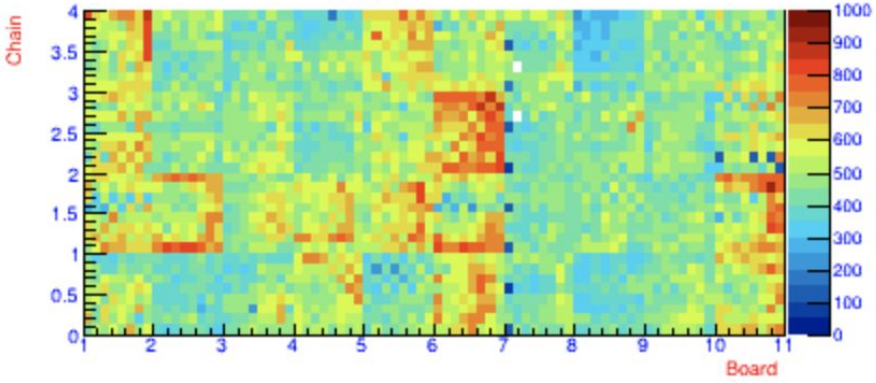


What do we need beam for?



- Without beam
  - Check PMT pedestals and light tightness
  - LED light injection into PMT
  - Monitor PMT HV stability
- With beam
  - Check optical connections between module and PMT
  - Calibration, calibration, calibration!





Calibration Tasks

- MINERvA regularly performed a variety of calibrations
- Most can be reused or feasibly reperformed, with some geometry stitching

- What sort of work is required
  - Plex (matching old files to new geometry)
  - Pedestals (rewriting production code, implementing existing calibration code, uploading regularly to DB)
  - FEB correction (matching old files to new geometry)
  - Attenuation (matching old files to new geometry)
  - Alignment (rewriting rock muon production, implementing existing calibration code)
  - Strip to strip (implementing existing calibration code, uploading to DB)
  - Absolute energy (implementing existing calibration code or writing something simpler, uploading to DB)
  - Timing (implementing existing calibration code, uploading to DB)
  - Cross talk (matching old files to new geometry)

See C. Marshall's talk from the 2x2 Analysis Workshop

Current Status: Plex

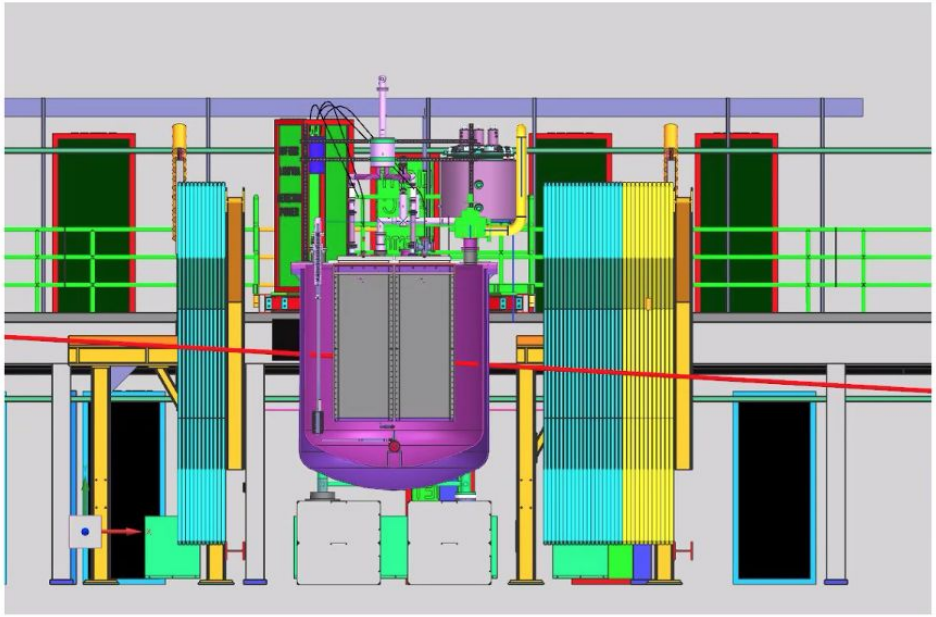
- The plex is a set of XML files that map electronics address (CROC, chain, board, pixel) to the physical detector (module, plane, strip)
- Used in calibration, reconstruction, basically everything. From Chris's talk, "Absolutely required for 2x2 for any tracking in MINERvA"
- Under development by Carlos Pernas, a graduate student at William & Mary
- Largely in working order, reviving an ancient no-reconstruction event display to check the fine details before we forge ahead

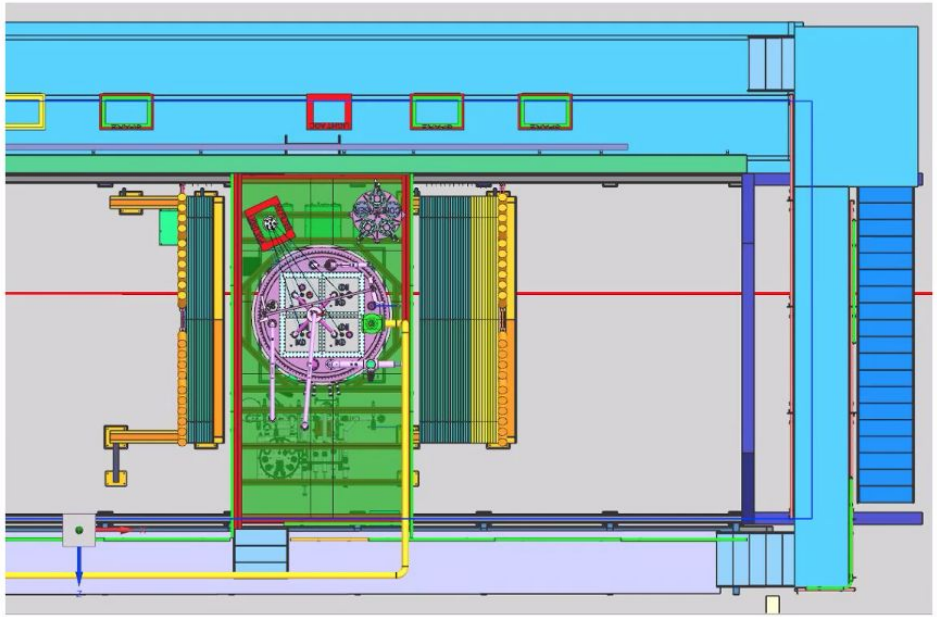
Other Ongoing Work

- Improving DAQ stability
  - Several different DAQ bugs have plagued us through the installation, preventing us from running in the nearly-continuous state MIERvA did
  - I've been doing some archaeology to better understand the DAQ code and find the source(s) of crashes
- Resurrecting MINERvA nearline monitoring
  - During operation, MINERvA automatically generated real time data quality plots, available for shifters by webpage
  - Bringing this back requires understanding and adapting some old GAUDI code
  - Alysia Marino is trying to bring this back in a "lite" version

BACKUP

More Detector Hall Models





MINERνA Racks