





MU2E OPERATIONS UPDATES FOR MARCH–JUNE 2025

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Mu2e Collaboration Meeting 12-Jun-2025

Mu2e-docdb-53134-v1



OUTLINE

- Moving towards cosmic ray test
 - In the hall
 - Installation and commissioning plan
 - Overview
 - Solenoid installation and Magnetic Region thoughts
 - DAQ overview
 - Subsystem commissioning and cosmic ray run plans
 - Shift plan
- Reviews





THE FOCUS OF THE OPERATIONS COORDINATION OVER THE NEXT FEW MONTHS WILL BE INCREMENTALLY BUILDING TOWARDS THE COSMIC RAY RUN IN THE MC-2 BUILDING

--MAR 2025 CM





AGENDA

CDT (FNAL)	Italy	Duration	Presenter	Торіс
7:30 AM	2:30 PM	0:10	Greg, Yongyi	Introduction & Operations news
7:40 AM	2:40 PM	0:20	Greg, Yongyi	Overview of activities leading towards Cosmic Ray Run
8:00 AM	3:00 PM	0:20	Matt J.	ExtMon commissioning and testing plan
8:20 AM	3:20 PM	0:20	Andrew, Giani	DAQ roadmap towards cosmic ray run
8:40 AM	3:40 PM	0:20	Luca, Simona	Calo commissioning and testing plan
9:00 AM	4:00 PM	0:20	Ed, Vincent	Tracker commissioning and testing plan
9:20 AM	4:20 PM	0:30		Buffer/break
9:50 AM	4:50 PM	0:20	Sam	CRV commissioning and testing plan
10:10 AM	5:10 PM	0:20	Alex, Nam	STM commissioning and testing plan
10:30 AM	5:30 PM	0:20	Andy	Solenoid commissioning plan
10:50 AM	5:50 PM	0:15	Joseph	DAQ room and fiber report
11:05 AM	6:05 PM	0:15	Ryan	TDAQ hardware event building status
11:20 AM	6:20 PM	1:00		Discussions
12:20 PM	7:20 PM			Lunch/supper

- Joint session with DAQ focused on commissioning / cosmic ray run test planning for the subsystems
- We acknowledge the detailed plans can be subject to change depending on the status of the in-hall work
- We appreciate the time and efforts people dedicated to this exercise. Many valuable thoughts and ideas were discussed during the session. Thank you all very much for the great input!





IN THE HALL





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SOME OF THE PROGRESS "IN THE HALL" See details in plenary talks

- TSu-TSd interconnect ~nearly complete
- TSu- & TSd-cryo interconnects complete
- Cryo full flow purifier installed at MC1
- Dump resistors installed at Mu2e
- Commissioning with beam restarted by AD using reconfigured power
- Extinction Monitor collimator installed, concrete contractor nearly ready to pour

- Water leak in ExtMon-DAQ penetration mitigated (temporarily)
- Sump level data into ACNET
- Process Controls on display in kitchen
- Hall relamped
- Tested couplers/hitches on external rails
- Completed g-block prep for KPP config



RECALL: WE ARE AIMING TOWARDS THIS CONFIGURATION OF DETECTORS



docdb-51574



OVERVIEW OF STEPS TO RECEIVE DETECTORS

- Converge on modifications to support tracker and calorimeter services on MBS, make mods, install on rails, confirm movement
 - Ready for CRV
- Install isolation barrier
- Install Calo feet and Calo cable tray
 - Ready for Calorimeter
- Install Calo, couple disk 0 and disk 1, couple to MBS, couple to IFB
- Prep IFB, attach Cable Management System to IFB, install Calo feedthroughs
- Install Tracker feet, couplers, confirm movement
- Install Tracker feedthroughs
 - Ready for Tracker
- + many, many, many details

See docdb-51574 for more complete list





SOME OF THE CHALLENGES

- Cleanliness
 - Tracker and Calo have been living in a clean room... the Mu2e hall is not
- Environment
 - Tracker and Calo want less-humid environment than Mu2e HVAC provides
- Access
 - Don't want to drop anything on Tracker or Calo
 - Extremely tight space between Calo disks
 - Conflicting desires to access detectors and also to keep them clean and dry
- Optical fibers
 - Fibers on the detector train are very, very delicate (very)
 - Concern that we are "on the edge" for optical connectivity?
- Cooling
 - Calorimeter cooling plant design still under development
- ... + many, many, many details...





INSTALLATION AND COMMISSIONING PLAN: OVERVIEW





COMMISSIONING PLAN: OVERVIEW



- Green box: Project installation schedule (hardware ready) and (begin of) Project Cosmic Ray Test dates from April 2025 working schedule
- Further efforts needed to
 - Establish cosmic ray running with entire detector system
 - Prepare run control to be ready for shifters for the extended cosmic ray run, which will extend beyond the project
- Commissioning / global run plans updated together with the systems and the DAQ coordination



COMMISSIONING PLAN: OVERVIEW



- Subsystems booked periods of DAQ sprints (previously referred to as "dedicated VSTs")
 - Undivided attention from the DAQ group
 - Iron out any remaining firmware issue on the subsystem side
- Global Run in ~Sept (Integration)
 - CRV + STM + Calo
 - Begin of RunCos
- Global Run in ~November
 Also include Tracker
- Scaling up
- Full system ramp up in Feb 2026 leading towards cosmic ray test
 - Ready for shifters?



DAQ COORDINATION RAMP-UP PLAN

See DAQ plenary talk (Norman / Pezzullo) later this session

- DAQ Coordination has laid out a roadmap towards the cosmic ray run, including
 - Work needed by core DAQ experts
 - Work needed by subsystem DAQ experts
 - "DAQ sprints" (previously known as "Dedicated VST weeks")
 - · Dedicated periods of core and subsystem DAQ experts working together
 - Global Runs with detectors at the Mu2e hall
 - Building a team of DAQ on-call experts

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JUNE – Control Room/DAQRoom Software			
June	ne/July – Control Room/ <u>DAQRoom</u> Software	July & Aug – Calo/CRV/STM Configuration @ DA	Mid September should have Calo, CRV and STM in hall and capable of being
Centralize and consolidate setup scripts <u>Automate</u> multi-system setup <u>i.e.</u> spin up the required OTS state machines in the cor machines ends etc.	Develop and deploy dashboards and "views" of subsystems - Need new OTS pages for these, expect to be iterative proces Deploy and test full data transfer paths and file registrations - Needs coordination with offline	 Deploy and test calo disc configurations Put configurations for ½ disc etc into config DE Same for CRV module and STM 	readout with DAQ cluster DAQ cluster should be @size for readout of both Calo discs, CRV module, STM – Extra capacity for early Tracker integration tests
 Reproducible startup and tear down of system Clean up the accumulated working areas Fix the access channels (i.e. move to VNC based insta Layout the correct data areas, mounts etc Deploy db instances w/ updated schema to DAQ env. Test db config unpacking & offline integration There are inconsistencies between machines in the cl Need to reconcile and "fix" everything to be the same (VST weeks for STM CRV in DAQ Room config/run/monitor	 Configure <u>DAQRoom</u> to match desired configs f Requires DTC assignments and fibering to matchelements (i.e., actual CRV install, STM location e Configure CFO and DTC chains to match longer Scale is O(30) DTCs Expect some reduced work scope in Aug. Need configs in place to run system (w/ & w/o ha Use this as "stability" testing time Need DCS integration work to have alarms, mon 	 September GR focused on readout integration of <u>Calo+CRV+STM</u> w/ common timing We really want "working" VST configurations prior to this point The GR is not intended to debug individual components, focus on cross subsystem running Identify missing "global" scope functionality (i.e. things that cross subsystem boundaries) Follow up with DAQ sprint into Oct. ← All hands on deck
13 6/11/25 DAQ I March '25 Collab Meeting I A. Norman 14	6/11/25 DAQ I March '25 Collab Meeting I A. Norman	16 6/11/25 DAQ I March '25 Collab Meeting I A. Norman	6/11/25 DAQ I March '25 Collab Meeting I A. Norman

A Norman / G Pezzullo docdb-52996

Sept/Oct- Global Integration + Sprint





REGARDING GLOBAL RUN SCHEDULING

- Prior to commissioning data collection, detector hardware has to be installed, powered on, and in a safe condition
- This implies the Global Run schedule should follow the readiness of detector hardware
 - I.e., schedule "CRV + Calo + STM Integration Global Run" when the STM, Calo, and CRV hardware is ready (and not before...)



ready (and not before...) We realize that people need to travel for Global Runs... we'll let you know the dates as soon as we can!



SOLENOID INSTALLATION & MAGNETIC REGION THOUGHTS

A Hocker docdb-52927

Done for TS

In progress for TS

- How will the Solenoid installation impact detector work in the hall?
- Solenoid installation and commissioning steps
- Detector installation and commissioning mostly unimpeded until the solenoids are ready to power up
 - Baseline schedule has
 - TS energization in June 2026 (possibility to advance)
 - PS energization in November 2026
 - DS energization in January 2027
 - Solenoid work have the priority
- We cannot afford any accident!
 - A g-2 type of near miss can easily kill our Run 1
 - Meeting in a few weeks to kick off the planning for mitigations and controls (MR plan)

- Solenoid installation and commissioning steps
 - Receive magnet at Mu2e
 - · Conduct incoming inspection tests on the loading dock
 - · Crane magnet downstairs
 - · PS only: install HRS
 - · Scoot magnet into position, align
 - · Connect magnet to its neighbor ("mechanical interconnect")
 - · Connect magnet to cryogenic transfer line ("cryo interconnect")
 - This includes splicing the transfer line superconducting bus to the magnet leads
 - · Connect magnet instrumentation (temperatures etc.) to "vacuum instrumentation line"
 - · Connect insulating vacuum pumping lines
 - Leak check
 - Cool down
 - Energize

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SUBSYSTEM STATUS & COMMISSIONING / COSMIC RAY RUN PLANS





CALORIMETER

- Full commissioning of the 2 assembled disks completed during the first Calo DAQ sprint in SiDet (last week of May)
 - Greenlight for calo transportation to MC-2
 - A large number (~0.5M) of cosmic ray tracks in few hours / disk
 - Good for calibration / testing offline
 - Tested energy equalization/calibration procedure, and time offset calibration procedure was tested successfully
- A list of firmware items that needs further work was identified. A second DAQ sprint to be requested
- Both software and firmware are evolving towards the stable config needed for KPP/CR run
- First steps after moving to MC-2 were planned
 - Possible to operate the disks within the planned September/October GR timeframe



L Morescalchi S Giovannella docdb-53008

Short Terms Plans for Commissioning

- After the installation of the final calorimeter services and DT (should happen around the middle of September/early **October**, see Stefano's presentation for details) **we will finally be ready to run the detector in the hall!**
- The final cooling station won't be ready yet, so we are going to install a temporary movable chiller:
 - 1 chiller per disk (1 new and one recicled from Sidet Lab) for both crates and FEEs cooling
 - Using demineralized water (with anti fungi additives)
 - Using flexible lines to accommodate chiller location adjustment
 - Using **separation valves** and **quick connection** to disentangle the piping if necessary
- The things to do on the DAQ side are basically to transfer the SiDet configuration to the DAQ room and scale it up
 - Ensure all the needed DAQ hardware is ready and working
 - Prepare and test the LV/HV control system







TRACKER

- Developing firmware and software on Tracker "train station" in Lab 3
 - Data flows through artdaq to disk, analyzed with standard Offline software to study Tracker performance (e.g. noise)
 - Studies somewhat limited since rate saturates at ~3 kHz in this setup
- Developing commissioning plan to establish running system
- Currently expecting 3 types of data taking prior to beam
 - Stable cosmic rays (precise calibration, alignment, "physics")
 - Charge injection (loose calibration)
 - Unstable cosmic rays (HV trip isolation)
- Identified likely pain points in scaling the system up:
 - Single-ROC timeouts should not induce latency in rest of system
 - Already see changes in time sync. b/t 2 DTCs so imagine with 36
 - Configuration: cannot just "loop over" 20k channels

Looking toward the KPP, need software convergence for integrated running

Progress from "set of frontend boards" to "a detector"

- 1. Labeling and cableing
- 2. Power cycle of all stations to characterize robustness
- 3. Verify panel locations (ROC serial #, nickname in NVM, DTC channeling)
- 4. DCS-only monitoring to verify stability
- 5. Data-path noise runs (likely iterative with grounding)
- 6. Establish dry micro-environment
- 7. Single-station burn-in to verify safety at nominal $\ensuremath{\mathsf{HV}}$
- 8. Full-detector burn-in to establish running
 - Isolate high voltage problems



S Grant docdb-53002

CRV

- Full VST using FEB-I achieved full readout chain from frontends using OTSDAQ all the way to Offline Pass1 using POMS
- Full test stand at Wideband with support structure, racks, cables, documentation, etc
- Active development of offline calibration system, online DQM, slow controls monitoring, and alarm system
- Detectors ready to be moved to MC-2
- Three phases of commissioning for cosmic run identified:
- 1. Transport and install CRV modules at Mu2e in mid-July 25
- 2. Commission CRV for integration tests ready for global runs and KPP by end of Aug 25
- 3. Commission CRV for 24/7 operations ready for Cosmic Ray Run by Apr 26
- Detailed plan for full commissioning and integration in docdb-51874



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Developing standalone STM DAQ Process online all event windows from

both LaBr3 and HPGe

- Use timing and event info from TDAQ
 - Event Window Marker & Heartbeats
- Seeing noise at Mu2e in STM DQM
 - Need clean power
- Developing slow controls
 - Including environment data from process controls
- Developing firmware
 - Plan for "DAQ sprint" in July









A Keshavarzi

docdb-53017



EXTINCTION MONITOR

- Developing standalone Pixel DAQ
 - Process online all event windows from Pixels
 - Trigger from scintillators (also give fast feedback to accelerator)
 - Use timing and event info from TDAQ
 - Emulating Event Window Marker & Heartbeats for standalone development
 - Read out cosmic rays in pixel test system (2 planes)
- Pixel interface board under production
- Slow controls interfaces (with EPICS) are mature
- Need to establish environment monitoring
 - Issues with water in Extinction Monitor room
- Plan to bring detectors to Mu2e hall after concrete pour finished







TDAQ First Mu2e subsystem in Mu2e building

- Installation preparation for subsystem arrival:
 - 33/42 servers are installed in the DAQ room.
 - Waiting for approval from g-2 to move more servers from mc-1 to mc-2.
 - 49/53 DTCs are installed in their servers.
 - Final quantity is 70 DTCs.
 - 12 DTCs to be completely ready for calorimeter testing by late June.
 - All DTCs to be completely ready by September.
 - Order more LC-LC fibers?
 - Bit Error Rate testing of 66m MTP fibers.
 - Resolve water leak issue in extinction monitor room.
- Developing (Trk+Cal) hardware event builder
 - May-2025: no dropped packets with 2 DTCs
 - Next: increase complexity of tests

BRAM Stat - Last Received Sequence Tag.	DTC mac #0 5 = 0x c 12	
BRAM Stat - Rx Missing Packet Count:	DTC_mac #0 4 = 0x 0 0	
BRAM Stat - Rx Missing Packet Count:	DTC_mac #0 5 = 0x 0 0	
BRAM Stat Received Bute Counts	DTC mag #0 1 - 0v 0 0	l
BRAM Stat - Received Byte Count:	DTC_mac #0 5 = 0x80000036 21474	8370



J Kaminski docdb-53014 R Rivera docdb-53020



SHIFT PLAN





MU2E ONLINE SHIFT PLAN

- Docdb-52522
- Drafted by OpsCo with the input from the Ops team
- Completed review by the Ops team and the Spokes
- This document outlines a plan for organizing shifts during both the Cosmic Ray Run and the subsequent physics data-taking runs:
 - Defined the roles and responsibilities of Run Coordinators (RunCos), subsystem and on-call experts, and shifters
 - Specified shift organization during different periods, and issue escalation chain
 - Defined relevant meetings





RUNCO OPPORTUNITIES

- Leadership roles organizing and overseeing daily shift operations during the upcoming cosmic ray run and data taking
 - Developing day-to-day run plans and coordinating activities
 - Supervising certain ESH&Q procedures
 - Assisting with tests and shift taking
 - Organizing meetings
 - Developing and maintaining shift instructions
- We need a pool of at least 10 qualified RunCos, and we need volunteers
- Traditionally opportunities for senior graduate students and postdocs to take on leadership roles and learn more about the experiment
- Needed as early as Fall 2025; recruitment starting soon





NEXT STEPS

- Notice there is NO shift credit / quota assignment plans at this time
- The next step: Executive Board (EB) will have discussions and make recommendations on shift credits & quota assignments
- The whole collaboration reviews the plan together with the EB recommendations (as a complete plan), and then they talk to their Institutional Board (IB) reps regarding any concerns
- The IB votes on the complete plan, as well as any amendments





REVIEWS





REVIEWS

- Independent Project Review
 - Scheduled for Oct 15-17
 - We are expecting major transitions to Operations discussions in this review
 - The ongoing commissioning plan efforts fit well into the preparation for this review. We are in a good trajectory going into this review
- Mu2e Operations Review
 - No set dates
 - Can get ready relatively fast with current planning and docs





SUMMARY

- We are making solid advancements towards the cosmic ray test
 - Preparations in MC-2 to receive detectors had unexpected issues which, as we understand, are close to resolution
 - OpsCo and DAQCo have updated the installation and commissioning plan
 - Subsystems also started developing detailed system-specific commissioning and cosmic ray test plans
 - Delay due to solenoid commissioning tasks will be limited, but Magnet safety will be crucial. Magnetic Region planning for hazard mitigations and controls will start in few weeks
- Initial online shift plan has been developed and will go through further discussions. We encourage early-career members to take on these leadership roles
- We are preparing for transitions to Ops discussions in the upcoming IPR in October



