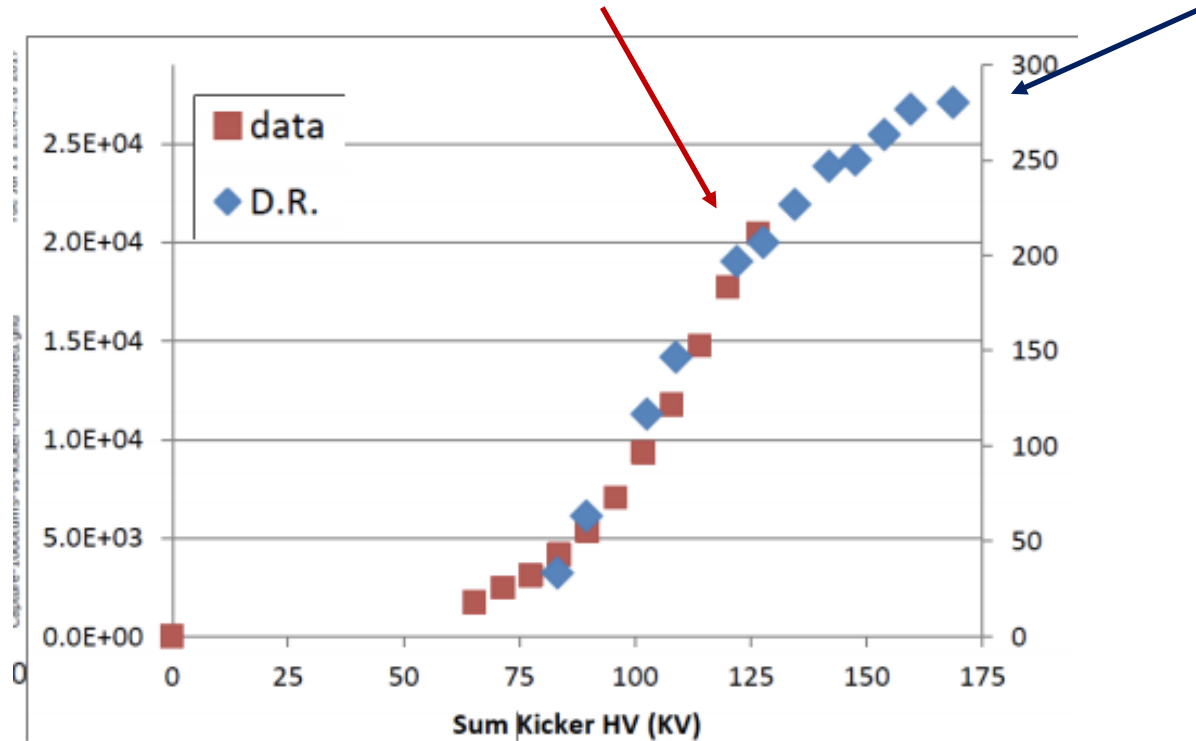


Where we are

Where we need to be



Commissioning run

Brendan Casey (FNAL), Joe Grange (ANL)

Commissioning Run Coordinators

Goals

- We expected a short, 3 week commissioning run (got 5 weeks in the end)
- Our goal was at least exercise all aspects of the experiment so we would know if there were any major problems that needed to be addressed during the shutdown
- Priorities
 1. Muon storage in the ring. (Can't demonstrate without beam.)
 2. Detector performance. (Mostly demonstrated before beam.)
 3. Magnetic field uniformity. (Does not need beam.)
 4. Beginning to end data throughput. (Expected to happen after beam.)

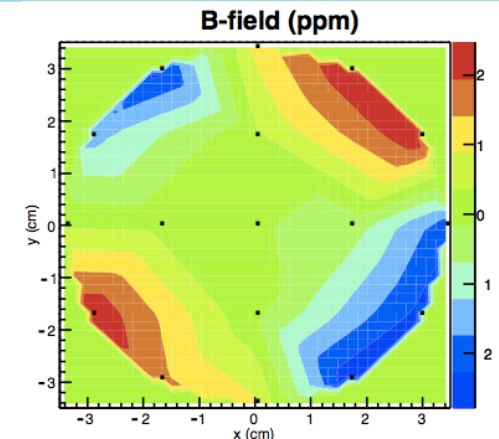
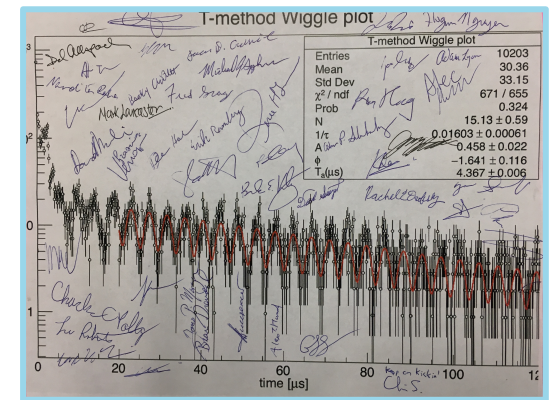
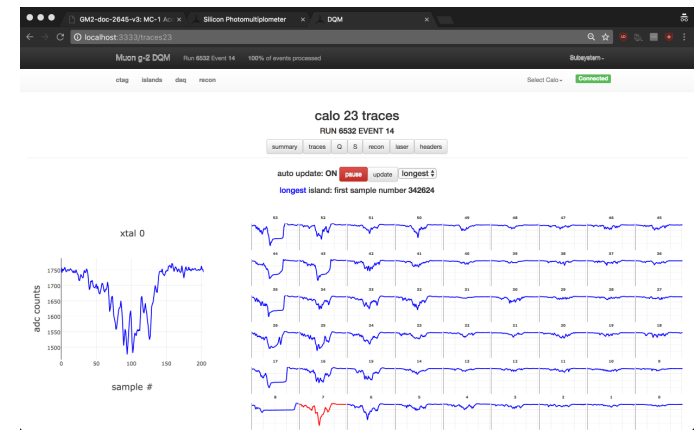
Run Schedule

		Owl	Day	Eve	
	Day 0	June 2	Run DAQ	Burp magnet	Run DAQ
week 1	Day 1	June 5	Run DAQ	CTAG, fiber harp, IBMS, T0 all see beam, all read out, DQMs in place, ACNET in place	Kicker scan
	Day 2	June 6	Run DAQ	upstream tuning using T0, IBMS, CTAG	Fiber harp tune up
	Day 3	June 7	Run DAQ	Inflector scan, final focus scan	Kicker scan / detector tune up
	Day 4	June 8	Run DAQ	Inflector scan, final focus scan	Kicker scan / detector tune up
	Day 5	June 9	Run DAQ	upstream tuning using T0, IBMS, CTAG	weekly debriefing / Run DAQ
	Day 6	June 10	Run DAQ	Burp magnet, field off work	Run DAQ
	Day 7	June 11	Run DAQ	Run DAQ	Run DAQ
	week 2	Day 8	June 12	Run DAQ	upstream tuning using T0, IBMS, CTAG
Day 9		June 13	Run DAQ	upstream tuning using T0, IBMS, CTAG	inflector scan, kicker scan, tune scan
Day 10		June 14	Run DAQ	upstream tuning using T0, IBMS, CTAG	inflector scan, kicker scan, tune scan
Day 11		June 15	Run DAQ	upstream tuning using T0, IBMS, CTAG	inflector scan, kicker scan, scraping scan
Day 12		June 16	Burp magnet	set tune point for weekend	weekly debriefing / Run DAQ
Day 13		June 17	Run DAQ	Run DAQ	Run DAQ
Day 14		June 18	Run DAQ	Run DAQ	Run DAQ
week 3	Day 15	June 19	Run DAQ	upstream tuning using T0, IBMS, CTAG	storage fraction tune up
	Day 16	June 20	Run DAQ	set final tune point	Run DAQ
	Day 17	June 21	Run DAQ	Run DAQ	Run DAQ
	Day 18	June 22	Run DAQ	Run DAQ	Run DAQ
	Day 19	June 23	Run DAQ	lost muon run	weekly debriefing

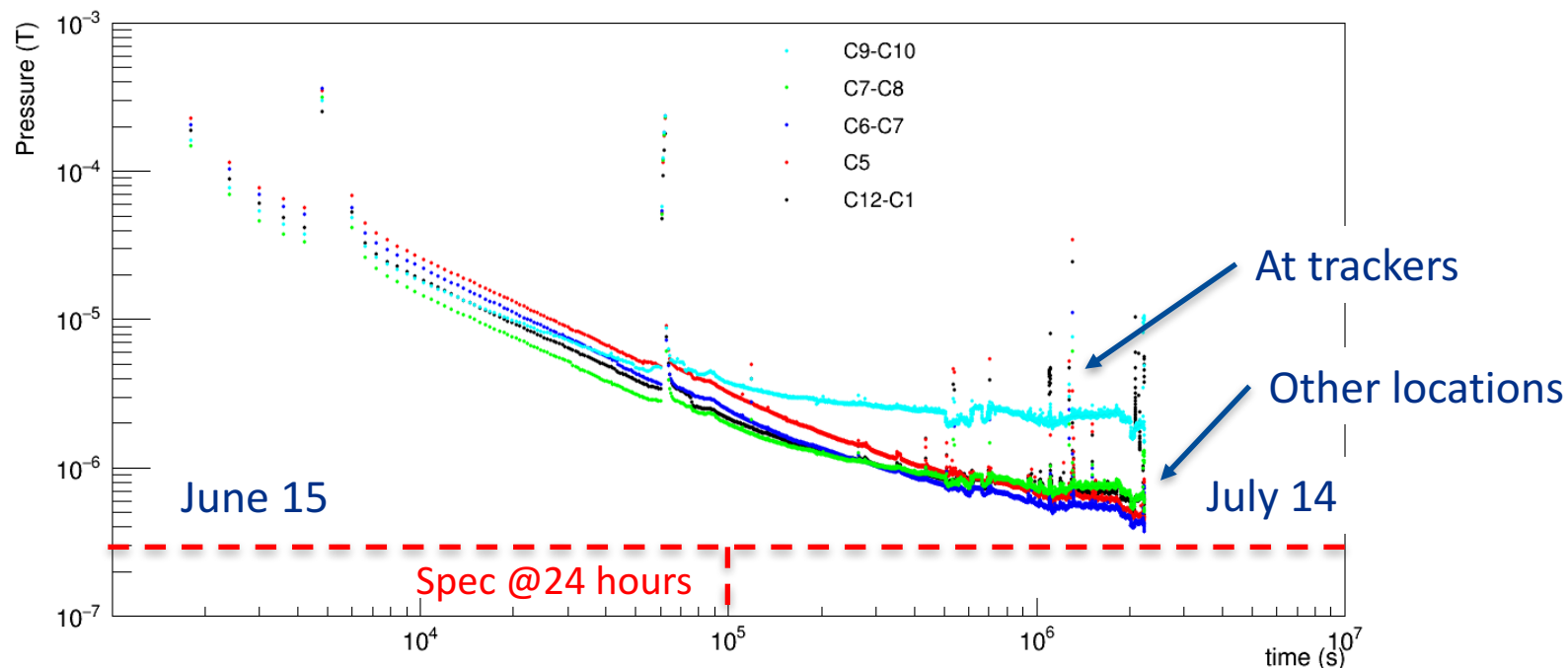
- Got almost everything done on the schedule but not in that order
- First half: beam tuning day, ring tuning evening/weekends, data taking on owl.
- Second half: tunnel work day, beam tuning evening, ring tuning on owl.

What worked (everything....)

- Beam very quickly brought to the ring
 - Detectors, DAQ, online monitoring
- Detectors could all see beam online
 - Confirmed by three detector systems
- Stored beam within a few days
 - Confirmed by three detector systems
- ‘Nearline’ machine partially reconstructed data overnight
- Offline data processing caught up to online data taking by the end of the run
- Used full simulation to help answer questions with daily turn around
- Before the end of the run, we exercised everything we wanted to exercise
 - High, medium, and low priorities
- We had at lead an order of magnitude increase in stored muons/sec before the end of the run.
- We demonstrated everything but we also found many places where performance was sub-standard
- In the 5 week period, we had no safety incidents



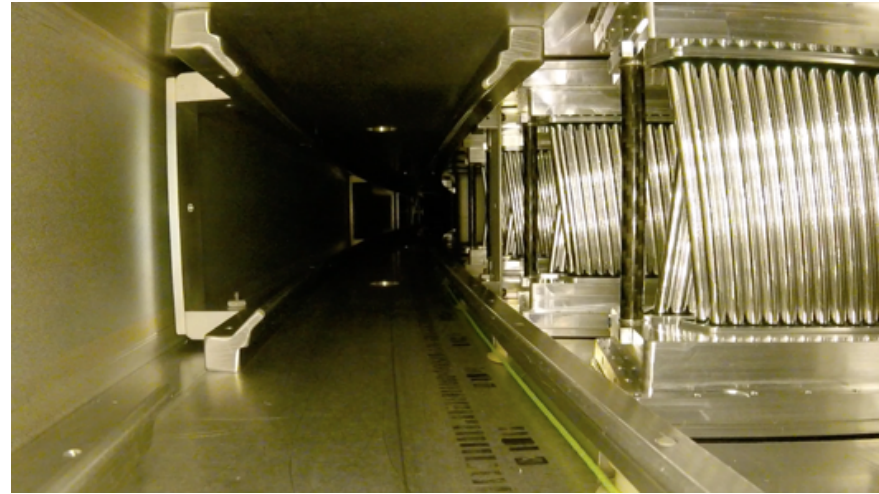
....except the storage ring vacuum



- Current status after 10 weeks of shutdown
 - Added 2 more turbo pumps (>50% increase in pumping speed)
 - Have tested a prototype cryo pump
 - Have removed trackers
- Expectation for next run
 - Installing gate valves so that cryo pumps can be added as they are built.

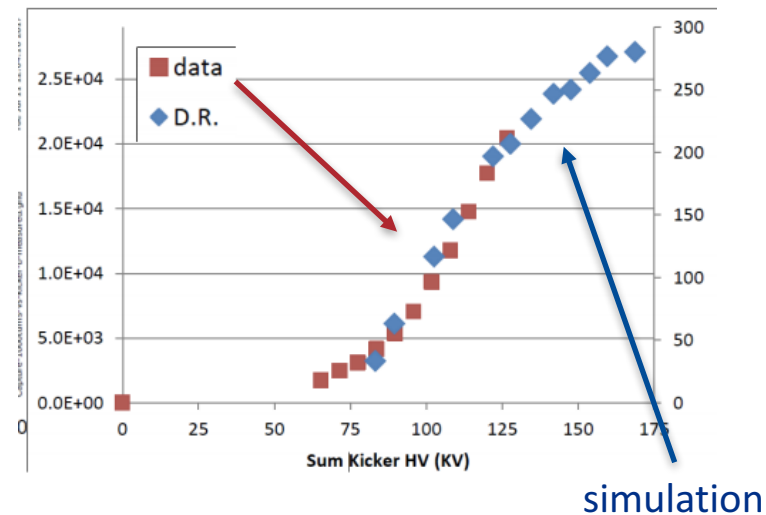
Trackers

- What worked
 - 1001/1024 channels in first tracker
- What didn't work or wasn't tested
 - 2nd tracker not installed
 - Final gas system not in place
 - Indications of noise in readout
 - Outgassing rate way too high
 - System not aligned
- Current status after 10 weeks of shutdown
 - Have received 6/8 modules for the 2nd tracker
 - Controls work underway for gas system
 - Can't reproduce noise in readout
 - 1st tracker uninstalled to reduce vacuum load and upgrade cooling system
 - Looking at unconventional ways to 'bake' system
- Expectation for next run
 - Expect to install trackers as loads are reduced and pumping speed has increased.



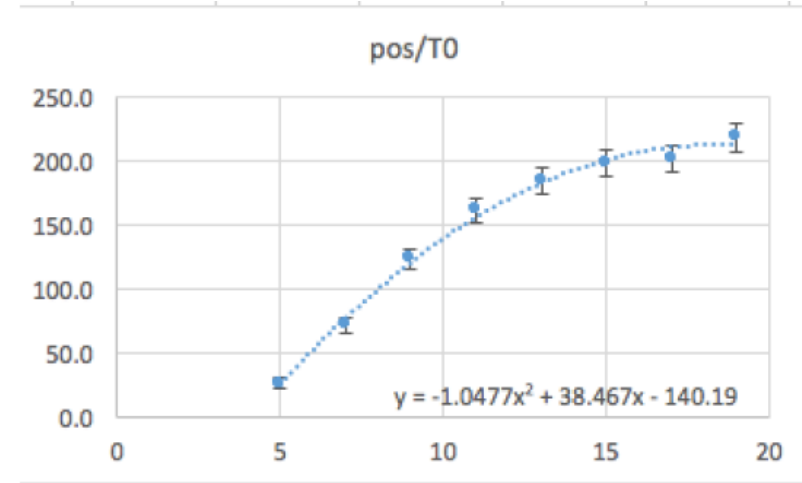
Kickers

- What worked
 - Kickers worked at about 2/3 total kick
- What didn't work or wasn't tested
 - Timing delay and HV controls kludged for the run
 - Could not plateau kickers
 - Several damaging sparks
 - Uncertainties about pulse shape, jitter, pulse to pulse variations
 - Readout not robust
 - No fulltime onsite expertise
- Current status after 10 weeks of shutdown
 - Have rebuilt feedthroughs twice
 - Now testing with better vacuum
 - Designed improved readout and controls
 - Working on pulse shape measurement
- Expectation for next run
 - 90% full kick
 - Expect improvements in readout, monitoring, pulse shape measurements to not be ready day 1

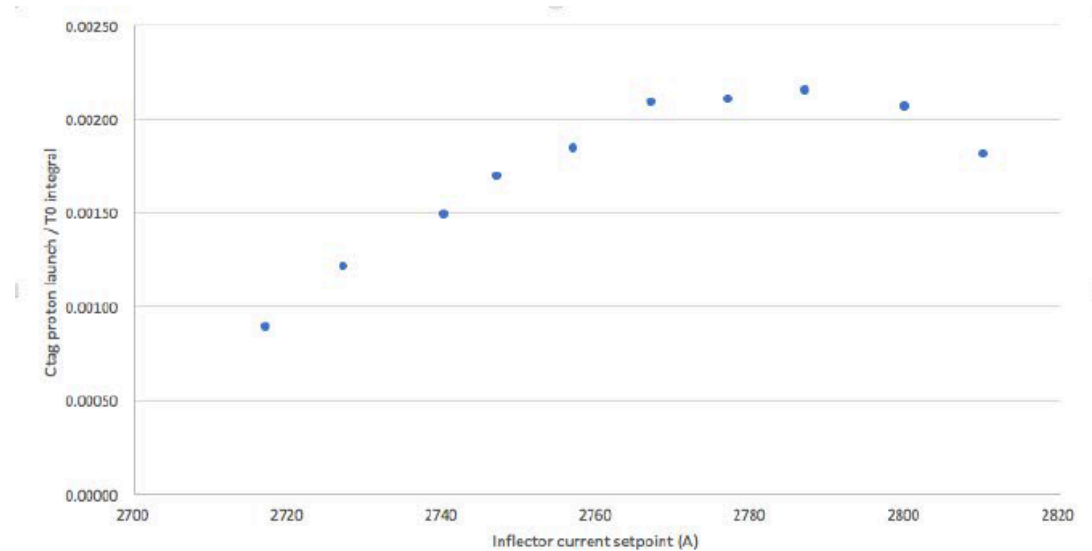


Quads

- What worked
 - Quads worked at about 2/3 optimal strength
- What didn't work or wasn't tested
 - Lots of sparking attributed to poor vacuum
 - Long spark recovery time
 - Several issues with pulsed power supplies
 - Very different behavior for different quad plates
- Current status after 10 weeks of shutdown
 - Even after improved vacuum, still having problems operating near optimal strength
- Expectation for next run
 - Expect to run at a lower operating point (~20 kV versus 27 kV)



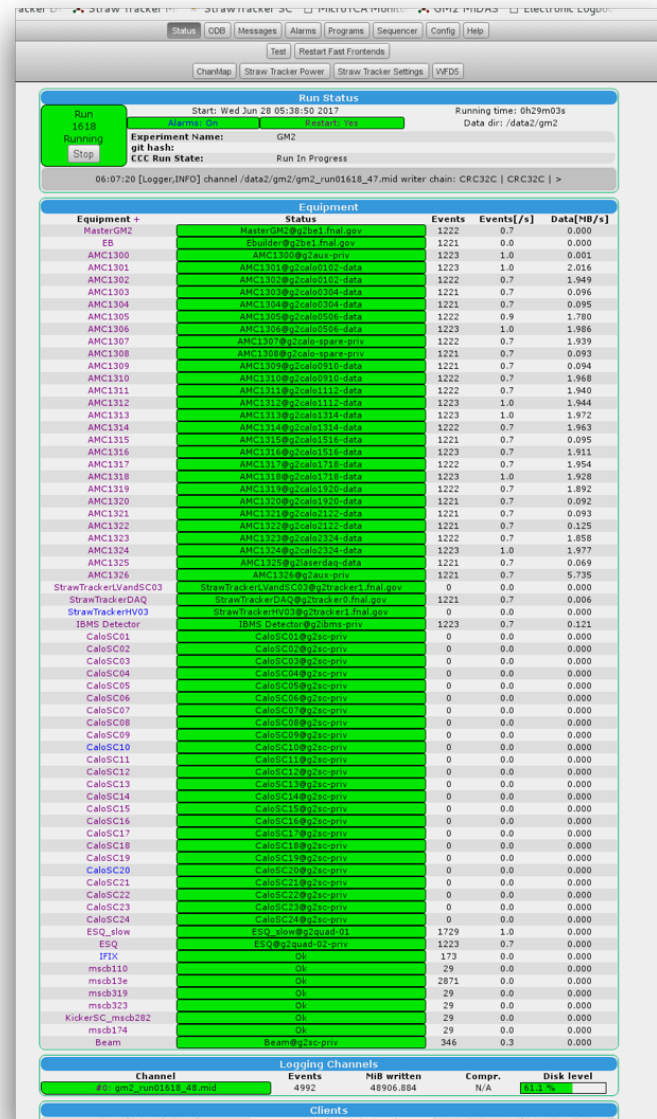
Inflector



- What worked
 - Inflector worked at operating current and tested in full operating range
- What didn't work or wasn't tested
 - Power supply failed weeks before the run started and was repaired at the last minute
- Current status after 10 weeks of shutdown
 - Have bought spare PS modules
 - PS frequently tripping off
 - Have uncovered several issues with quench detection circuits and are narrowing down the source of the trips
- Expectation for next run
 - Expect PS to be working

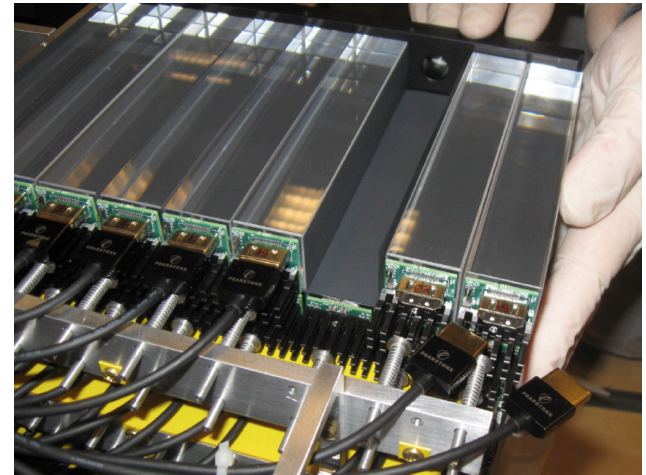
Online systems

- What worked
 - MIDAS: 32 front ends in the DAQ, 35 front ends in the slow controls
 - DQM was main tool for commissioning
- What didn't work or wasn't tested
 - Had several communication issues between DAQ, tracker, clock, laser that kept the 'full system' uptime low
 - Didn't have a full DAQ test stand for debugging
 - Complete set of alarms not fully deployed. Event display not deployed.
 - Clock fanout to some systems kludged for run
- Current status after 10 weeks of shutdown
 - Have done several weeks of full rate tests with laser
 - Have ordered parts for DAQ test stand
 - Working on improved clock fanout
- Expectation for next run
 - Test stand and new clock fanout in place
 - Plan to have all integration/communication issues solved early



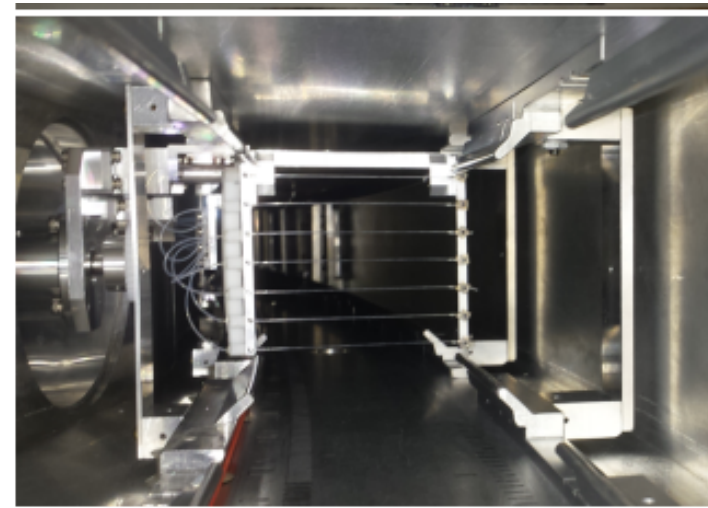
Calorimeters

- What worked
 - 1294/1296 channels calibrated and working
 - Laser calibration implemented for all calorimeters or laser heads fired 24/7 during the entire commissioning run
 - No issues with readout electronics
- What didn't work or wasn't tested
 - Not all monitoring in place for lasers and not all functionality in place (double pulsing etc.)
 - Issues with LV supplies
 - Some noise issues
- Current status after 10 weeks of shutdown
 - Laser now completely tested
 - Noise found and insulation in place
 - LV supplies repaired
- Expectation for next run
 - Fully operational on day 1



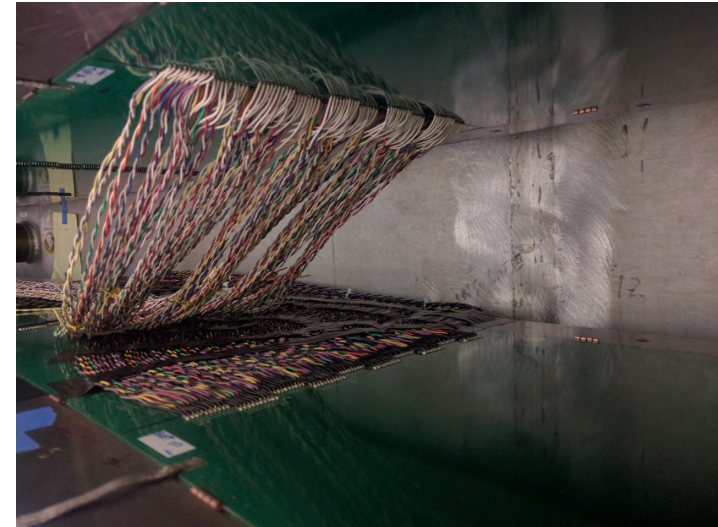
Beam profile monitors

- What worked
 - 24/28 fibers in fiber harps
 - y/y fibers in IBMS II
 - These are mainly commissioning run detectors and they successfully produced the commissioning run data
- What didn't work or wasn't tested
 - IBMS I/III not installed
 - X fiber harps had clearance problems
 - Did not have a T0 counter linear over required dynamic range
- Current status after 10 weeks of shutdown
 - Fiber harps refurbished, ready for reinstallation
 - IBMS I, II at Washington
 - New T0 components at Washington
- Expectation for next run
 - Fiber harps all working
 - IBMS I, II installed
 - Linear T0 in place



Surface coils

- What worked
 - 144/200 channels fully commissioned
 - Vertical beam steering fully demonstrated
- What didn't work or wasn't tested
 - Full system not deployed for run (1/3 of driver boards weren't ready)
- Current status after 10 weeks of shutdown
 - Full system deployed and tested (200/200).
- Expectation for next run
 - Need time to recommission and optimize full field system before run starts
 - Expect fully operational system



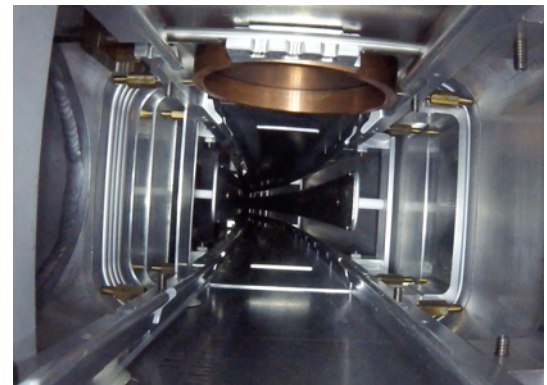
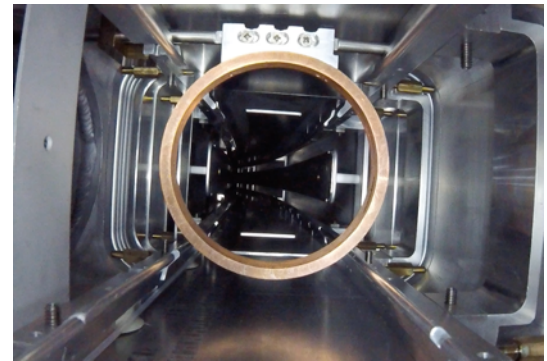
Fixed probes

- What worked
 - Field monitoring for most of the run
 - Magnet feedback worked using subset of probes
- What didn't work or wasn't tested
 - Daily DAQ instabilities/crashes
 - Field drift due to temperature stability issues in the hall
 - 5/20 multiplexors exposed to a class of pulse that damaged a component. Fix developed and implemented during run.
 - Clock is a noise source in hall
- Current status after 10 weeks of shutdown
 - Remaining 15/20 Multiplexors at Washington for protection upgrade
 - DAQ stability improved, measurement period reduced
- Expectation for next run
 - Need time to recommission and optimize full field system before run starts
 - Expect fully operational system
 - Do not expect improved temp stability at beginning of the run but we expect to install blankets before full rate running



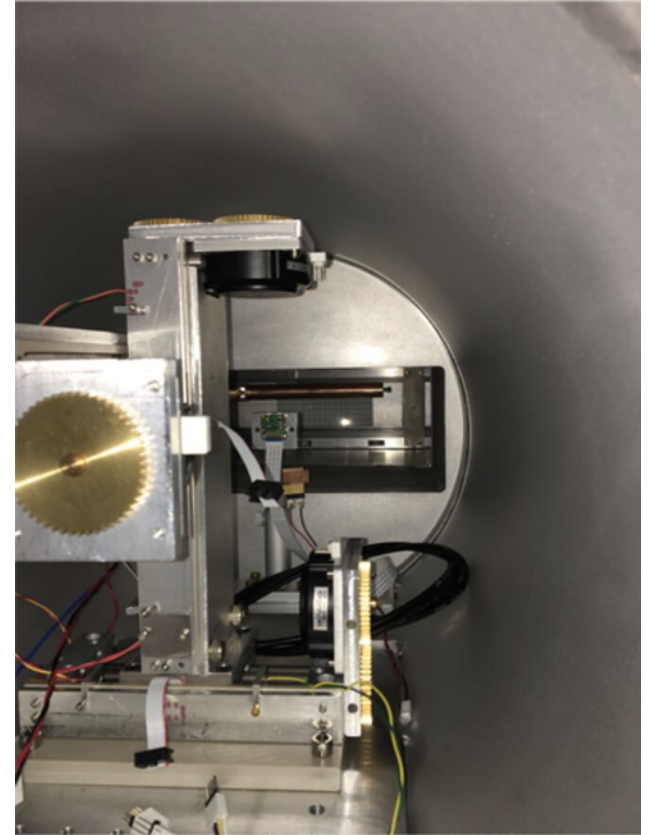
Trolley

- What worked
 - Trolley probes work
 - full electronics chain for the trolley probes+barcode reader worked
- What didn't work or wasn't tested
 - Several problems with trolley drive
 - Trolley got stuck several times
 - Lots of worry that this would require frequent vacuum letups
- Current status after 10 weeks of shutdown
 - Trolley drive refurbished.
 - Collimators (sticking points) refurbished.
 - Trolley now in test magnet ay ANL for systematics runs
- Expectation for next run
 - Need time to recommission and optimize full field system before run starts
 - Expect fully operational system

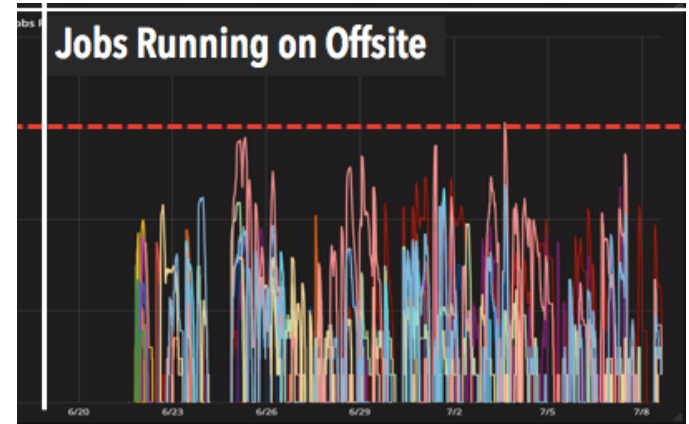
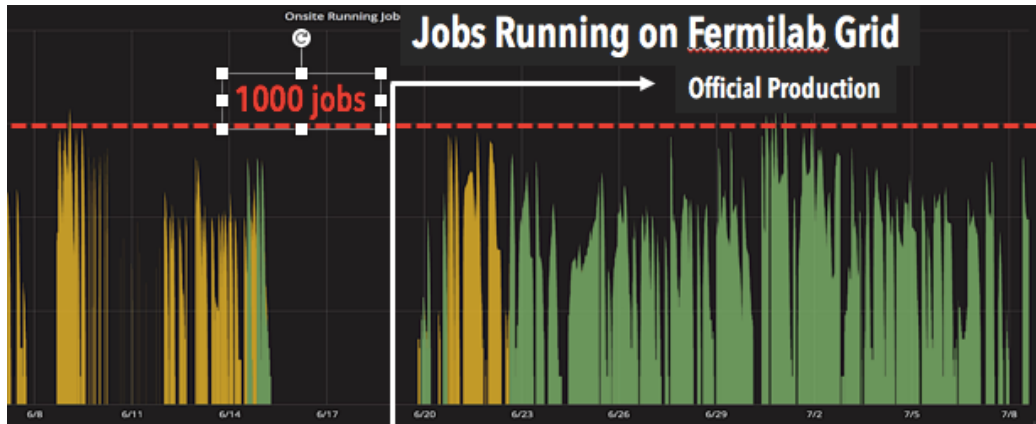


Plunging probe

- What worked
- What didn't work or wasn't tested
 - Not deployed for commissioning run
 - Required moving DAQ from ANL to FNAL
- Current status after 10 weeks of shutdown
 - Motion demonstrated
 - 'proof of principle' level trolley cross calibration demonstrated
 - Now at ANL test magnet for systematics runs
- Expectation for next run
 - Need time to recommission and optimize full field system before run starts
 - Expect fully operational system



Offline



- What worked
 - Caught up to data rate by end of run
 - Mature calorimeter algorithms deployed
- What didn't work or wasn't tested
 - Some of online/offline handshakes missing (configurations, metadata, etc)
 - Full tracking algorithms not complete and not run as part of the production (up to track finding was run)
 - Several places offline DB not being used
- Current status after 10 weeks of shutdown
 - Improved laser reconstruction algorithms
 - Now working to reconstruct 'full rate' calorimeter data
 - Starting to work on profiling code to speed it up
- Expectation for next run
 - Expect to be able to keep up with full data rate by February

Conclusions

- We demonstrated successful operations at the level required to exercise all systems during commissioning
- We made several improvements over the shutdown and continue to work on further improvements