Fermilab Muon g-2

Managed by Fermi Research Alliance, LLC for the U.S. Department of Energy Office of Science

Field DAQ Status

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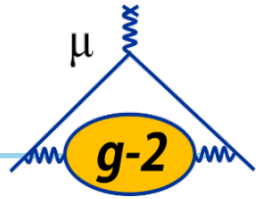
Fermilab Computing Readiness Review

November 8th 2016

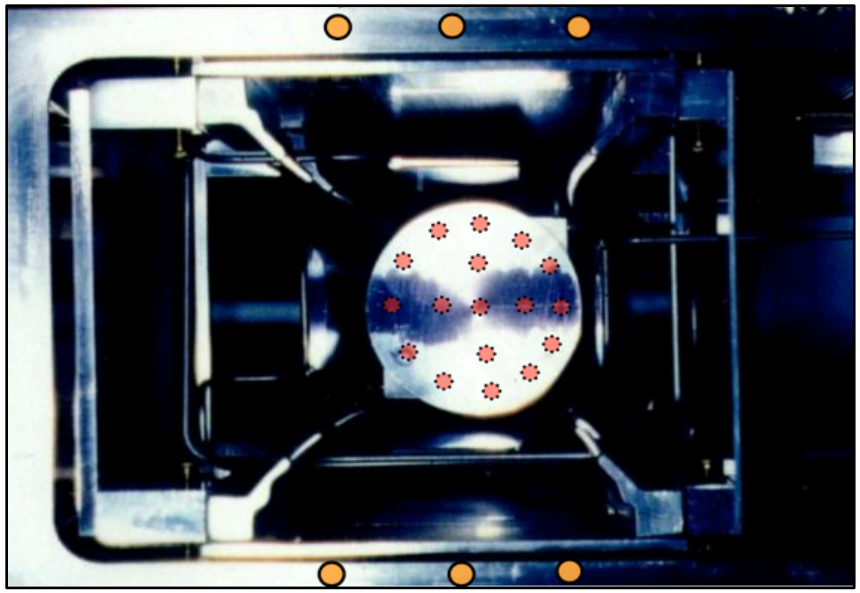
Outline of Talk

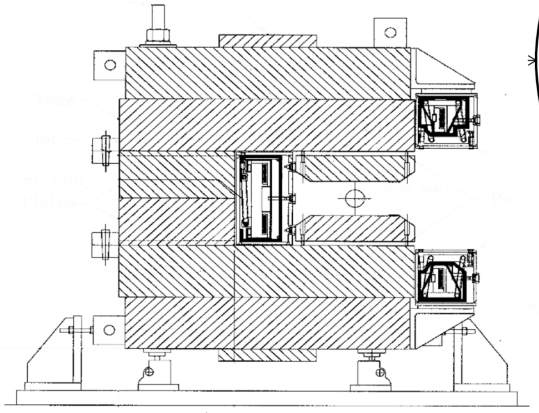


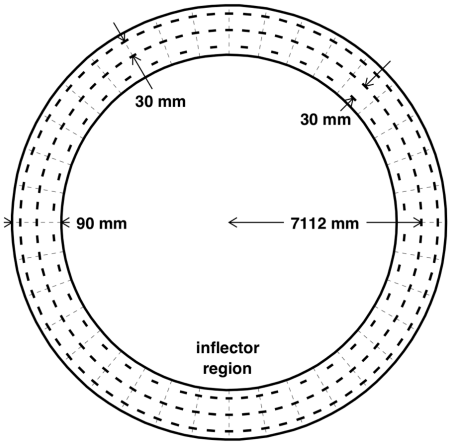
- Overview of System
- Per subsystem
  - Details
  - Current status
  - Remaining action items
- Milestones/Scheduling
- Summary

Field DAQ: Primary Measurements

- Map the magnetic field in the muon storage region
  - Trolley with array of 17 NMR probes
  - Connect trolley runs with 378 fixed probes
  - Transfer absolute calibration to the trolley using plunging probe



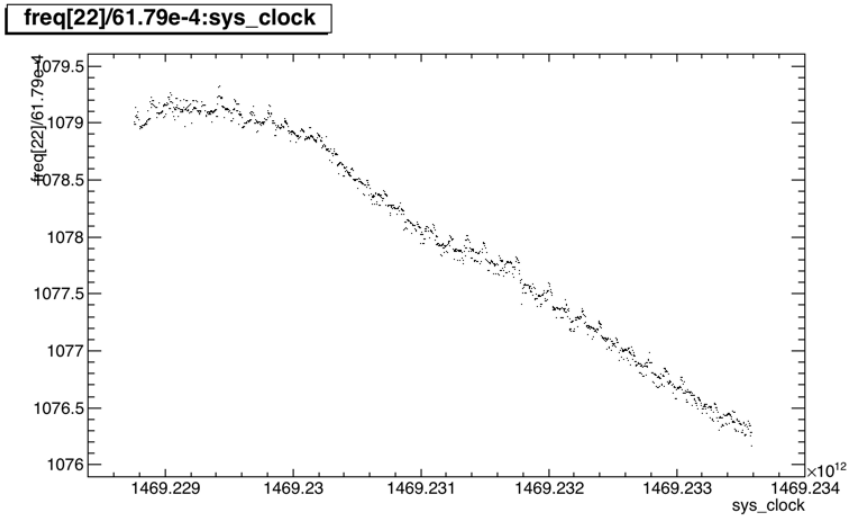




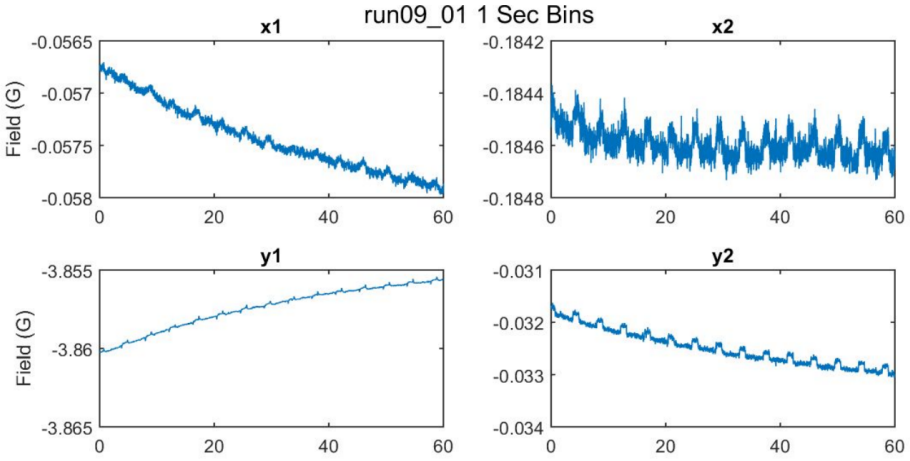
Field DAQ: Supplementary Measurements

- Feedback to the power supply to stabilize the field
- Correct azimuthal field deviations with surface coils
- Monitor transient fields with fluxgates

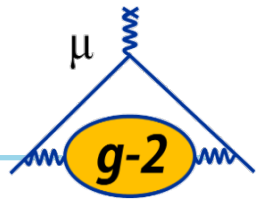
Example of fixed probe drift



Fluxgate data

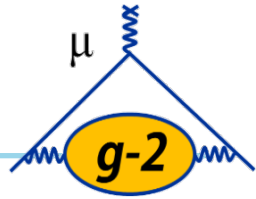


Field DAQ Component Design



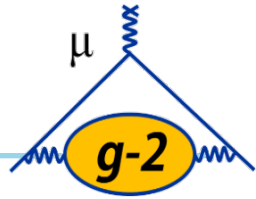
- MIDAS framework
- Each subsystem
  - Front-end to retrieve data events
  - Simulation front-end for development
  - Online sifting of events with data quality monitor (DQM)
  - Unpackers + gm2midastoart turn MIDAS file into art file
- Run art analyzers run on raw data
- Online displays and diagnostics
  - Alarm system from MIDAS
  - DQM (js + html + art)

Field DAQ Subsystems



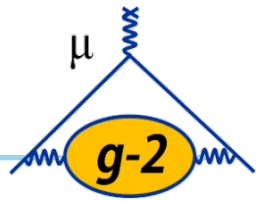
- General tasks (affecting multiple subsystems)
- Fixed probes (~ 1s)
- Trolley system (~ few days)
- Plunging probe (~ few months)
- Absolute calibration (as necessary, ~months)
- Supplementary: fluxgates (~ 2kHz), surface coils (~ 1s)

General Field DAQ Work



- Establish standards, frameworks, and guides for team
- Task list 21% completed
- Estimated 75 work days remaining
- Team
  - *Matthias Smith
  - *Ran Hong
  - Rachel Osofsky

Subsystem: Fixed NMR Probes Details



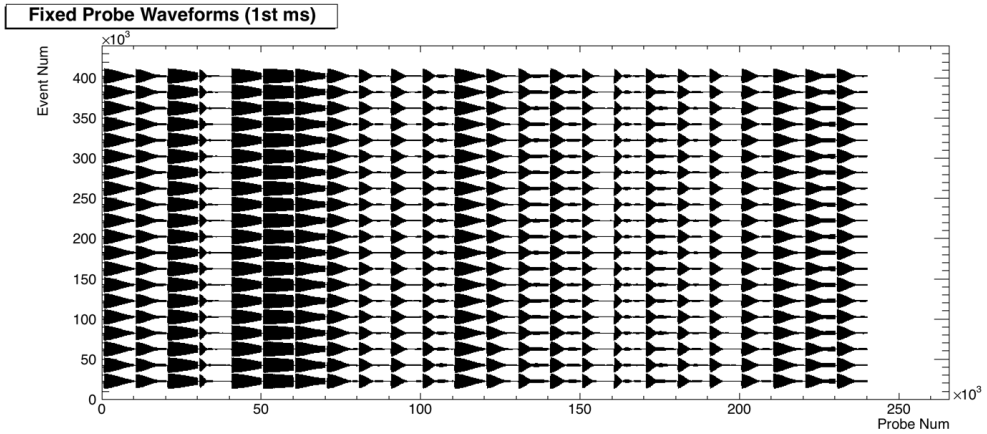
- Procedure
  - Sequence 378 NMR probes
  - Record waveforms
  - Extract frequency from signal
  - Feedback to magnet power supply
- Data rates:
  - 4 MB per event
  - At ~1 Hz
- Estimated storage 250 TB (assuming 2 years of running)

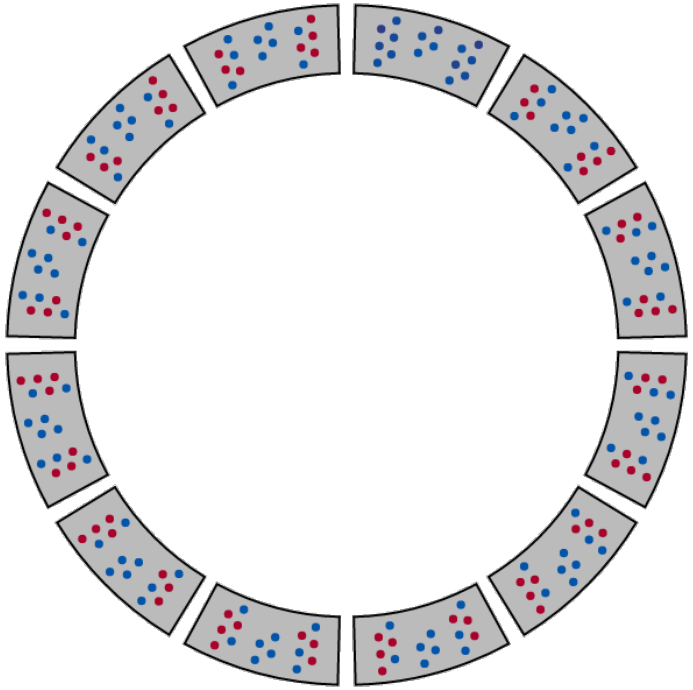
Subsystem: Fixed Probe Status

- Prototype MIDAS front-end implemented
  - Successful readout of 1/12 of probe suite
- Prototype for online display
- Overall progress 25% (including analysis work)

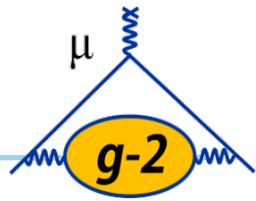
Figure (right): showing all probes and health by color

Figure (below): subset of fixed probe signals





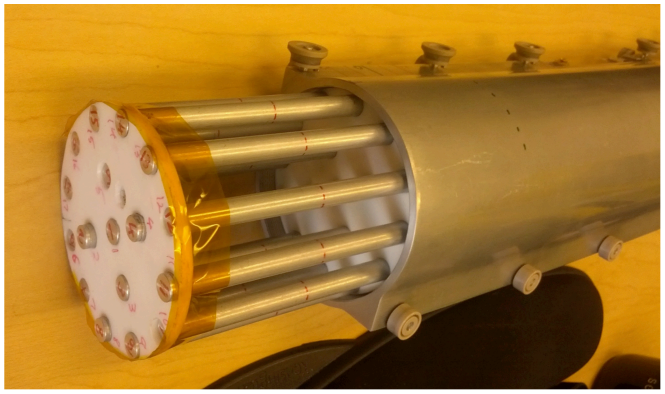
Subsystem: Fixed Probes Remaining Action Items

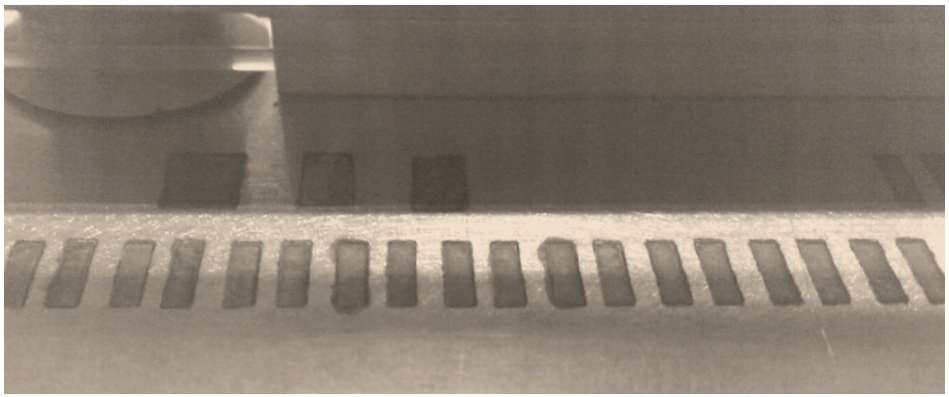


- Install all fixed probes (delays tests)
- Implement analysis on GPU to improve speed
- Test with full suite of probes
- Implement data unpacker
- Further work on displays and diagnostics
- Estimated 28 work days remaining
- Team
  - *Matthias Smith
  - Erik Swanson

Subsystem: Trolley Details

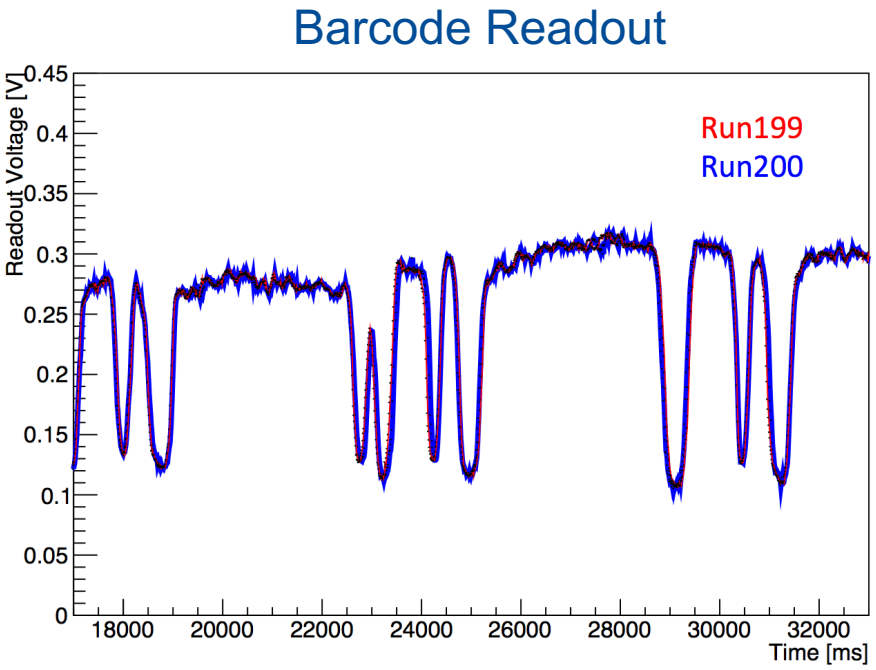
- Procedure
  - Motor system moves trolley around ring measuring 2D slices
  - Measure field with array of 17 NMR probes
  - Measure position by digitizing printed barcode
- Data rates
  - 4GB per run
  - Measure every few days
- Estimated storage 2 TB



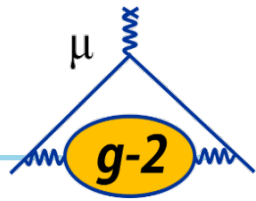


Subsystem: Trolley Status

- MIDAS front-ends implemented
  - NMR trolley
  - Barcode reader
- Overall progress 68%



Subsystem: Trolley Remaining Action Items



- Implement art data unpacker
- Implement online displays
- Implement diagnostic displays
- Estimated 37 work days remaining
- Team
  - *Ran Hong
  - Peter Winter

Subsystem: Supplementary Devices Details

- Surface coils
  - Set of tunable current sheets
  - Monitor system
- Fluxgates
  - Mobile detectors to monitor field transients
- Estimated data stored 60 TB

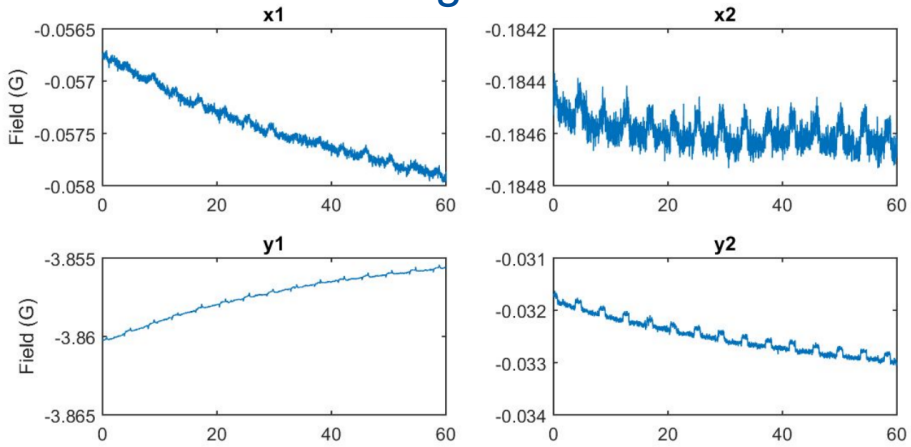
4 fluxgates + readout boards

Surface coils

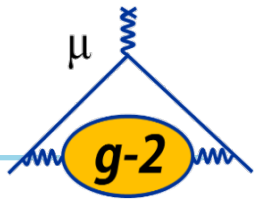
Subsystem: Supplementary Devices Status

- Surface coils
  - Hardware installation done
  - Calibration tests beginning
- Fluxgates
  - Prototype readout functional
- Progress 34%

Fluxgate data



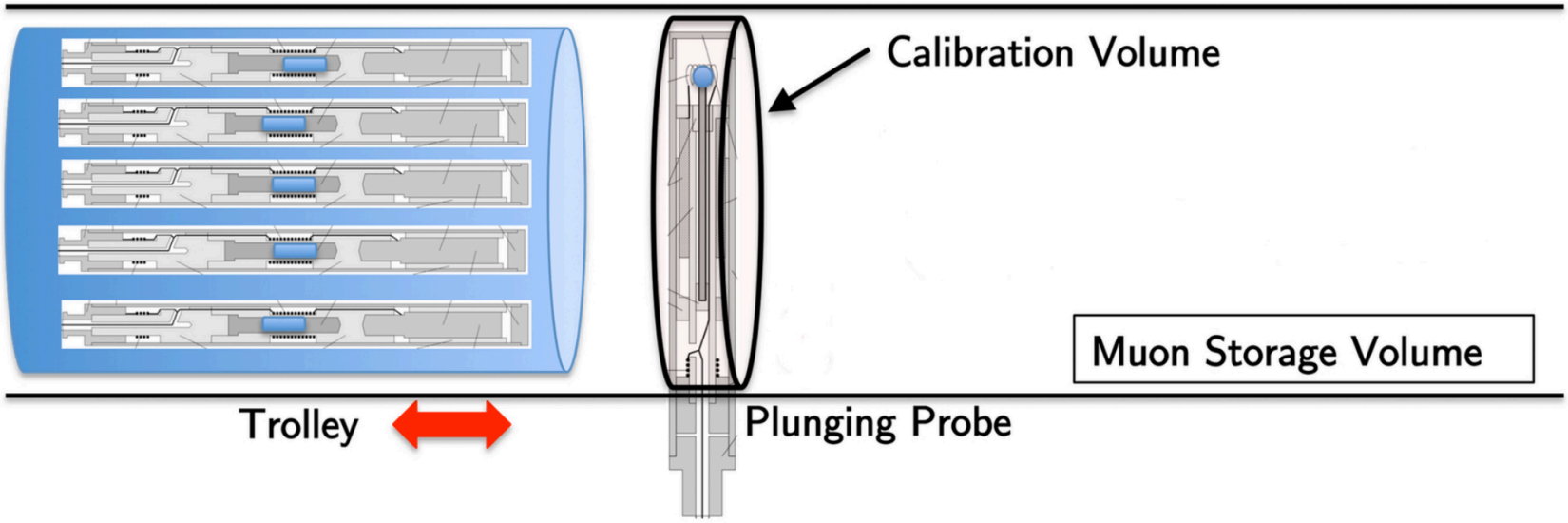
Subsystem: Supplementary Devices Remaining Action Items



- Surface coils
  - Complete software chain
- Fluxgates
  - Port to MIDAS framework
  - Finish out the software chain
- Estimated 27 work days remaining
- Team
  - *Alec Tewsley-Booth (fluxgates)
  - *Brendan Kiburg (surface coils)

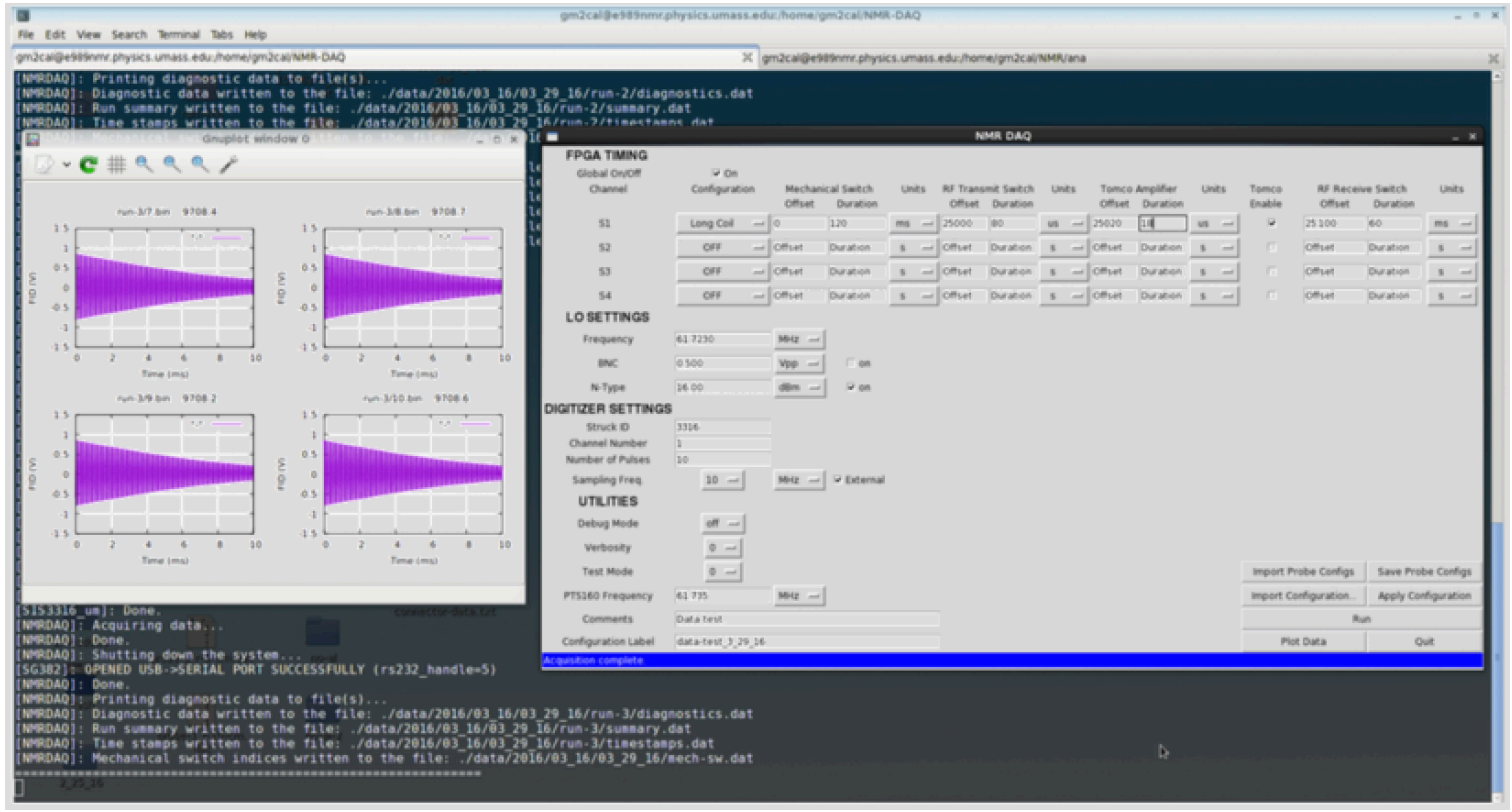
Subsystem: Absolute/Plunging Probes Details

- Procedure
  - Record waveforms from absolute calibration NMR probe
  - Extract frequency
  - Operate alignment motor (only plunging probe)
- Different experiment space than other subsystems
- Data requirements small compared to other subsystems

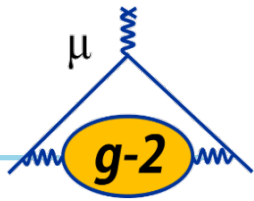


Subsystem: Absolute/Plunging Probes Status

- Working solution exists (non MIDAS) for data taking
- Will be ported to MIDAS framework
- Overall progress 66%

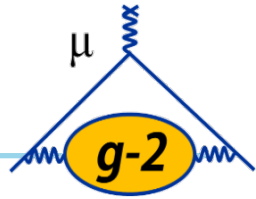


Subsystem: Absolute/Plunging Probes Remaining Action Items



- Migrate to MIDAS framework
- MIDAS-to-art unpacker
- Online displays
- Diagnostic displays
- Estimated 120 work days remaining
- Team
  - *David Flay
  - David Kawall

Schedule/Milestones



- Milestones
  - First full data chain (fixed probes or trolley)
  - Exercise data taking machinery for all subsystems
  - Implement full chain with all subsystems (up to raw data art file)
- Schedule Goals
  - First full chain finished by Dec. 1st Collaboration meeting
  - All subsystems will be taking data by end of year

Summary

Subsystem	Progress	Remaining	Notes
General Tasks	21%	75	High priority
Fixed Probes	25%	28	
Trolley System	68%	37	
Supplementary	34%	27	
Absolute/Plunging	66%	120	Lower priority