

Muon g-2

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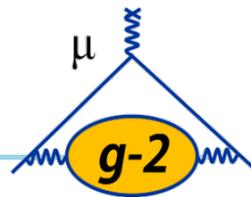
Field DAQ status

Matthias Smith

Fermilab Internal Computing Review

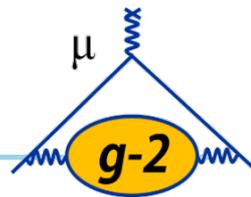
November 8th 2016

Outline of Talk

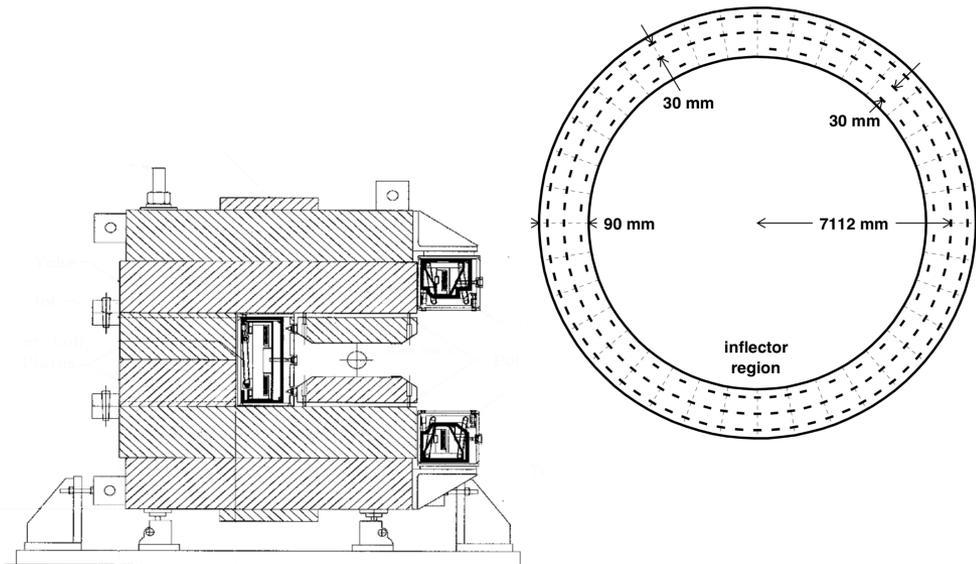
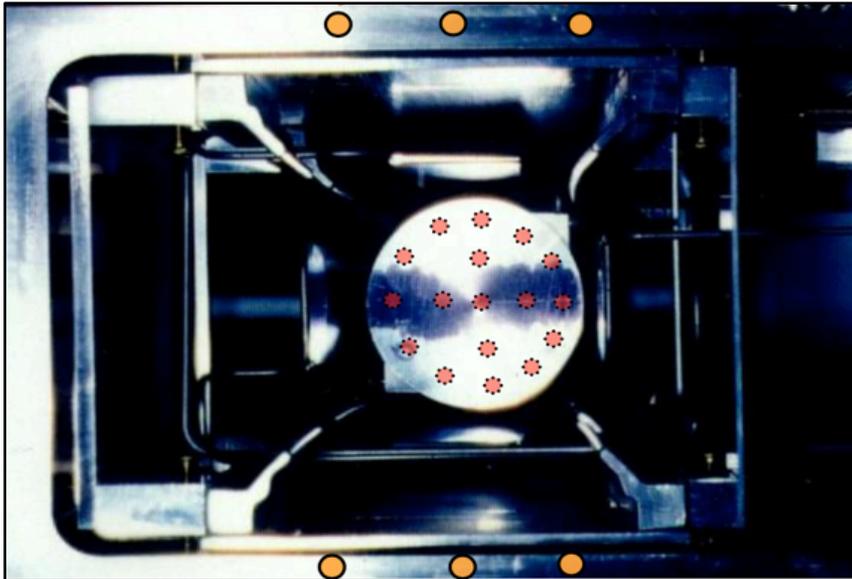


- Overview of System
- Per subsystem
 - Details
 - Current status
 - Remaining action items
- Milestones/Scheduling
- Summary

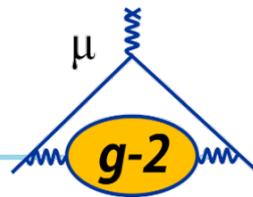
Primary Field DAQ Goals



- 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

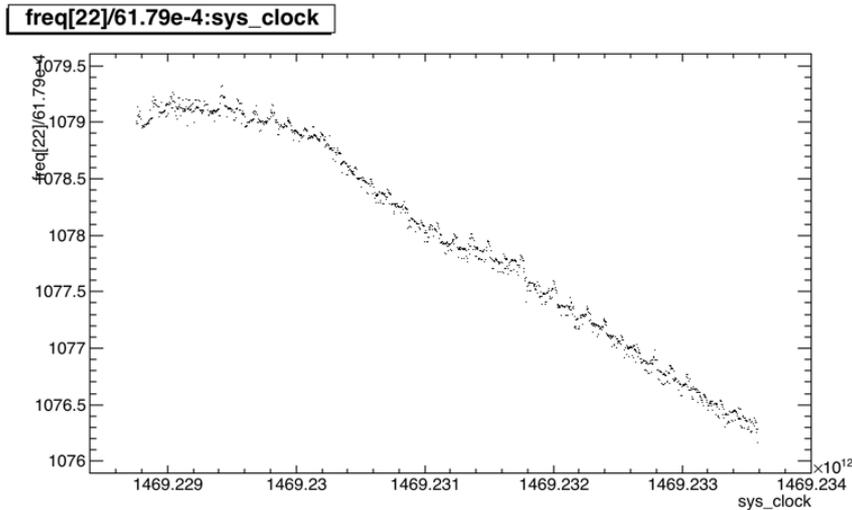


Supplementary Goals of Field DAQ

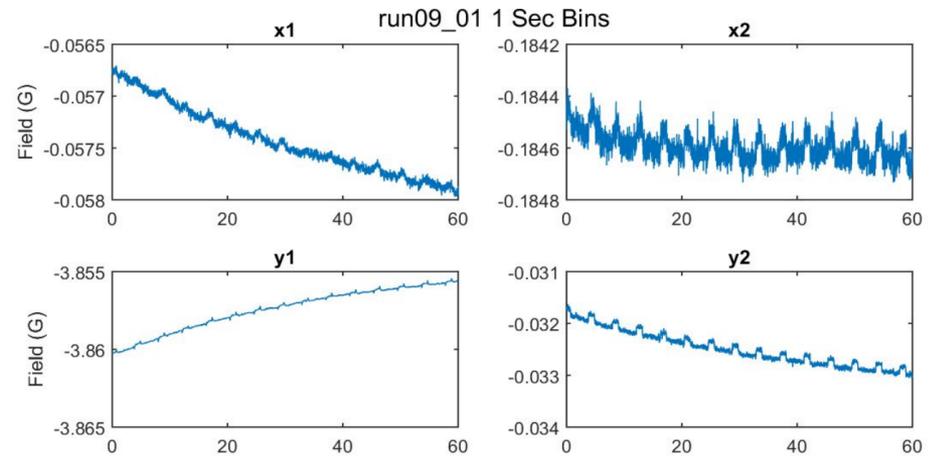


- Feedback to the power supply to stabilize the field
- Correct azimuthal field deviations with surface coils
- Monitor transient fields with fluxgates

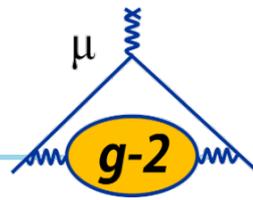
Example of fixed probe drift



Fluxgate data

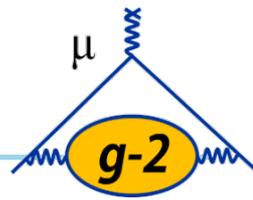


Field DAQ Component Design



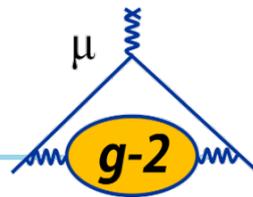
- MIDAS framework
- Each subsystem
 - Front-end to retrieve data events
 - Simulation front-end for development
 - Online sifting of events with data quality monitor (DQM)
 - Unpackers + gm2midastoart turn MIDAS file into art file
- Run art analyzers run on raw data
- Online displays and diagnostics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

Field DAQ Subsystems



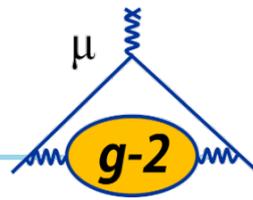
- General tasks (affecting multiple subsystems)
- Fixed probes (~ 1 s)
- Trolley system (\sim few days)
- Plunging probe (\sim few months)
- Absolute calibration (always ongoing?)
- Supplementary: fluxgates, surface coils

General Field DAQ Work



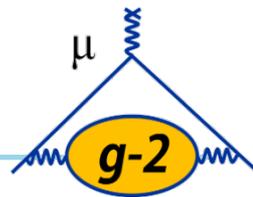
- Establish standards, frameworks, and guides for team
- Task list 21% completed
- Estimated 75 work days remaining
- Team
 - *Matthias Smith
 - *Ran Hong
 - Rachel Osofsky

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)

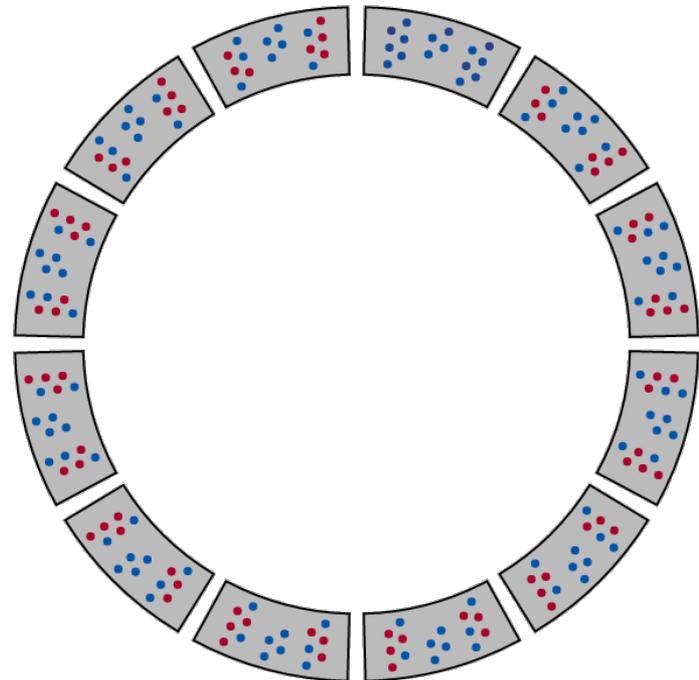
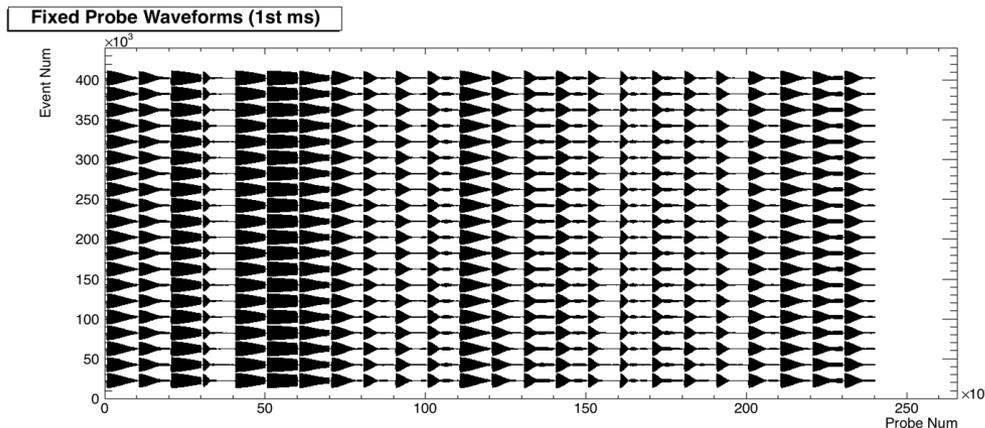
Subsystem: Fixed Probe Status



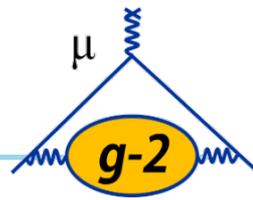
- Prototype MIDAS front-end implemented
 - Successful readout of 1/12 of probe suite
- Prototype for online display
- Overall progress 25% (including analysis work)

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

Figure (below): subset of fixed probe signals

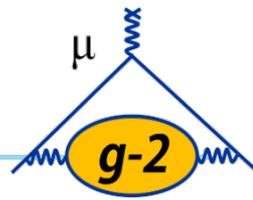


Subsystem: Fixed Probes Remaining Action Items

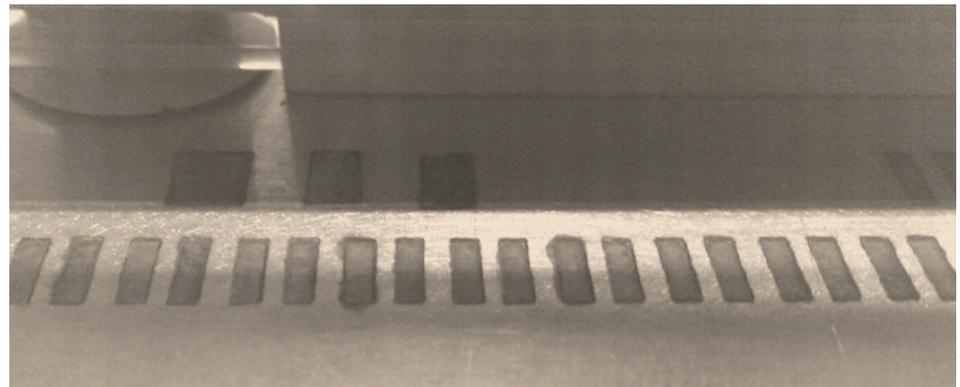


- Install all fixed probes (delays tests)
- Implement analysis on GPU to improve speed
- Test with full suite of probes
- Implement data unpacker
- Further work on displays and diagnostics
- Estimated 28 work days remaining
- Team
 - *Matthias Smith
 - Erik Swanson

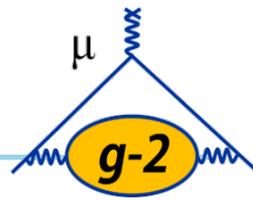
Subsystem: Trolley Details



- 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

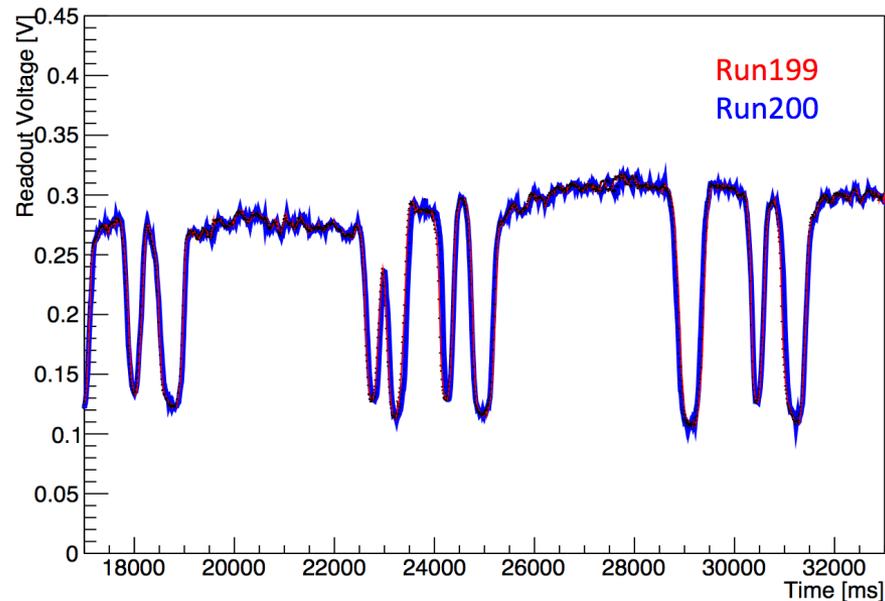


Subsystem: Trolley Status

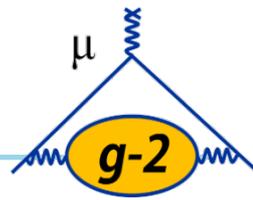


- MIDAS front-ends implemented
 - NMR trolley
 - Barcode reader
- Overall progress 68%

Barcode Readout

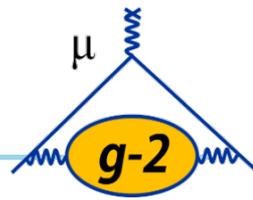


Subsystem: Trolley Remaining Action Items



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

Subsystem: Supplementary Devices Details



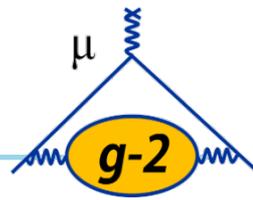
- Surface coils
 - Set of tunable current sheets
 - Monitor system
- Fluxgates
 - Mobile detectors to monitor field transients
- Estimated data stored 60 TB
 - 4 fluxgates + readout boards



Surface coils

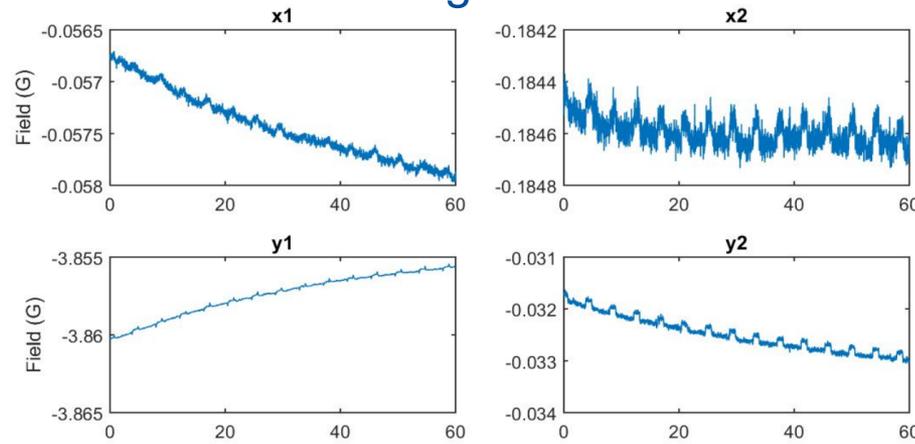


Subsystem: Supplementary Devices Status



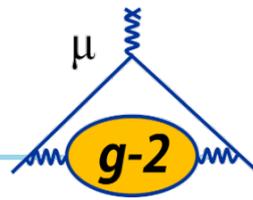
- Surface coils
 - Hardware installation done
 - Calibration tests beginning
- Fluxgates
 - Prototype readout functional
- Progress 34%

Fluxgate data



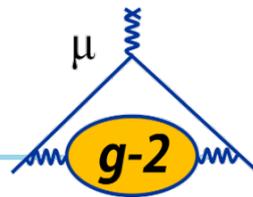
Subsystem: Supplementary Devices Remaining

Action Items

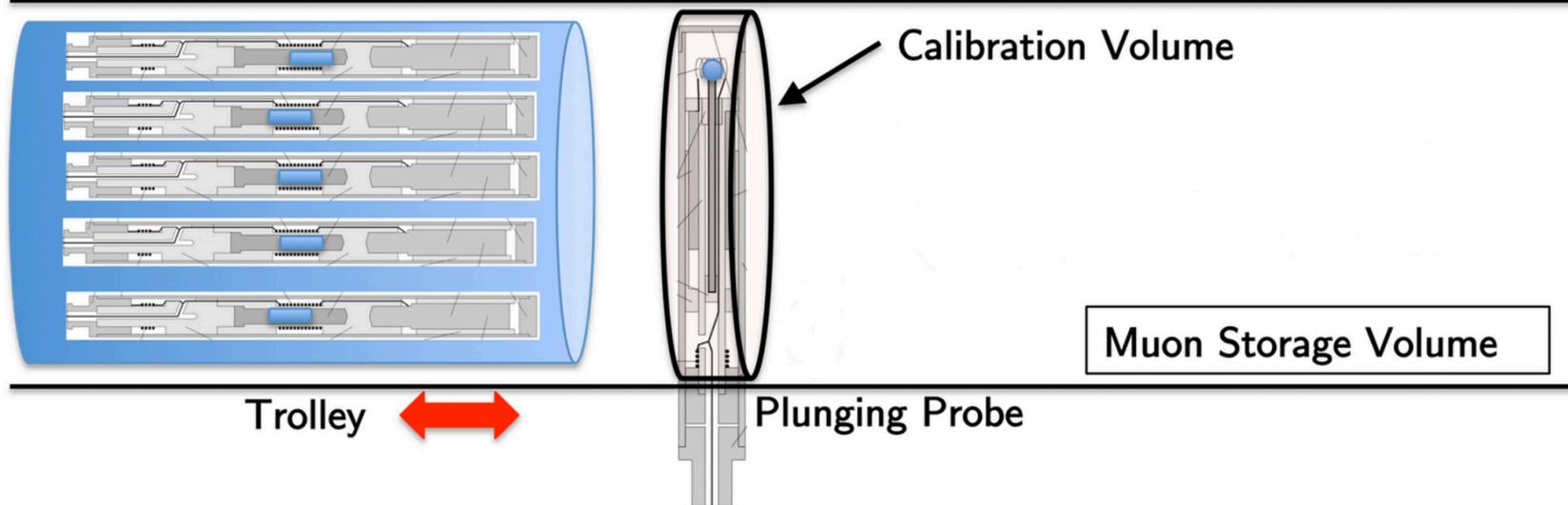


- Surface coils
 - Complete software chain
- Fluxgates
 - Port to MIDAS framework
 - Finish out the software chain
- Estimated 27 work days remaining
- Team
 - *Alec Tewsley-Booth (fluxgates)
 - *Brendan Kiburg (surface coils)

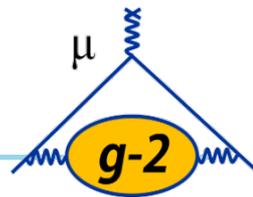
Subsystem: Absolute/Plunging Probes Details



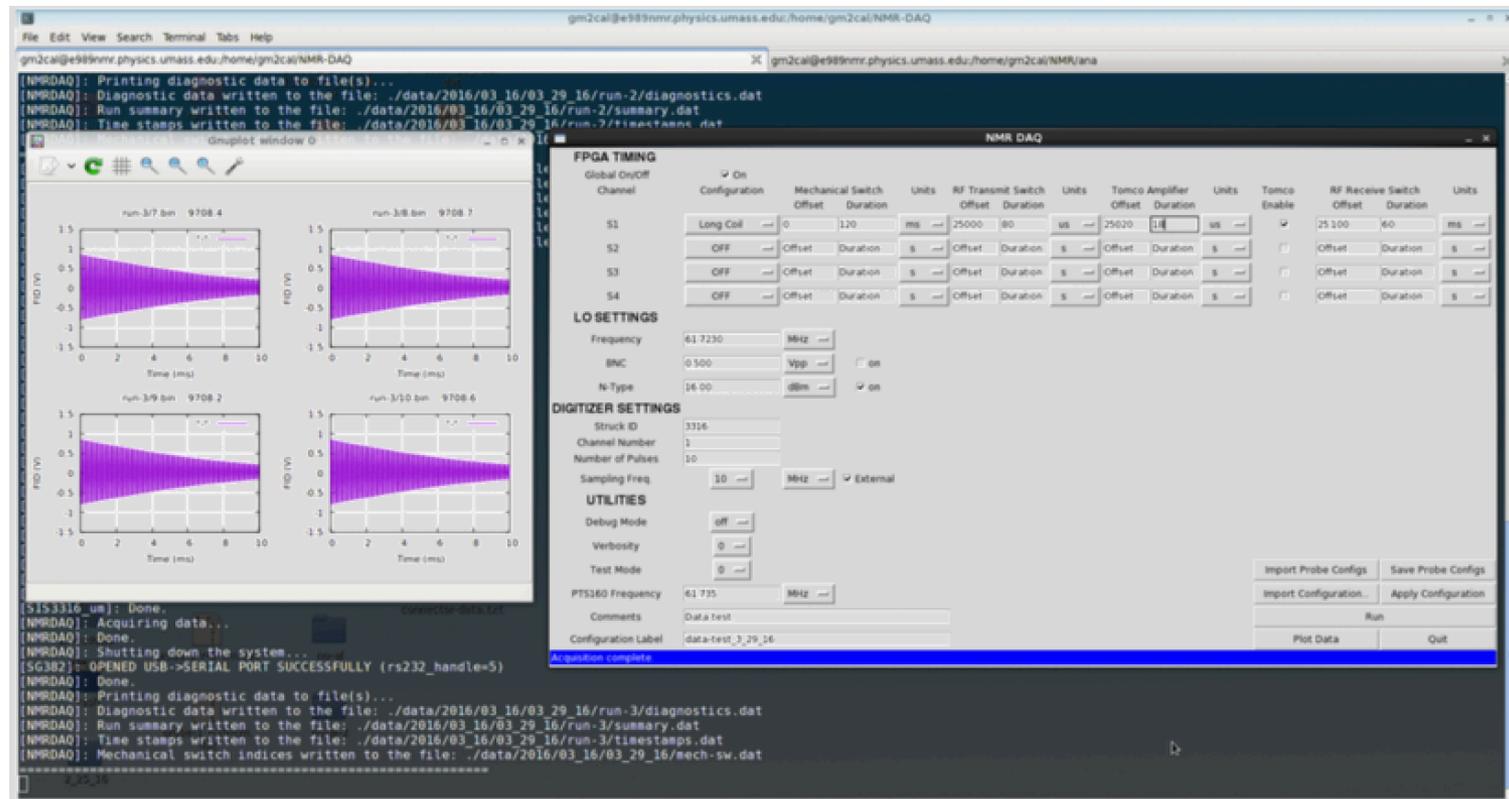
- Procedure
 - Record waveforms from absolute calibration NMR probe
 - Extract frequency
 - Operate alignment motor (only plunging probe)
- Different experiment space than other subsystems
- Data requirements small compared to other subsystems



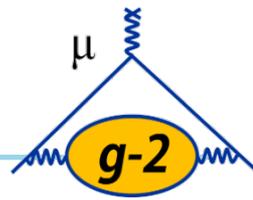
Subsystem: Absolute/Plunging Probes Status



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

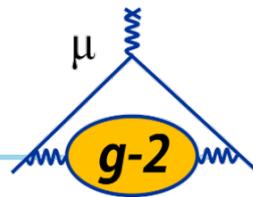


Subsystem: Absolute/Plunging Probes Remaining Action Items



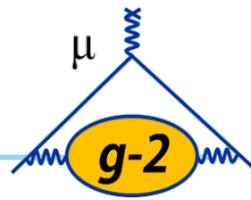
- Migrate to MIDAS framework
- MIDAS-to-art unpacker
- Online displays
- Diagnostic displays
- Estimated 120 work days remaining
- Team
 - *David Flay
 - David Kawall

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