MICE Controls & Monitoring and Quench Protection Systems

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Outline

- Where we were at the time of CM45
- State Machines
- Channel IOC
- Run Control
- Other IOC updates
- Communication Issues
- Alarm Handlers and Archivers and AutoSMS
- To Do List
- SS/FC QPS

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CM45 recap

- Much progress since CM44
- State machines – excellent progress, but more to do
- RunControl – only minor modifications remaining
- Channel IOC – biggest drive, most effort on PSUs
- C&M now at a point when lower priority items can be revisited

State Machines

- **State Machines (SM) are required to be passive**
  - Requires some sub-system IOCs: BeamLine, Detector, Channel
- **Sub-system owners populate SM parameters via "spreadsheet"**
- **Sub-systems with SMs:**
  - SSU
  - **FC – needs parameter updating**
  - SSD
  - BeamLine – needs updating
  - Detectors – needs updating
  - **DS: still in progress**
  - Tracker - complete
  - **Target: in progress – thanks to Ed Overton**
- Add dynamic alarm limits for SM "Powered" states - done

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Channel Controls

- Channel IOC integrates
  - SSU/FCU/SSD PSU control – complete, but needs testing
  - E5AC – heater/pressure control for LHe volume in SS's
  - PRY movement – now new channels on SSU/SSD OVC
  - Leybold TD20
  - B-field – internal to tracker volume & external – now polarity/mode
  - SS QPS monitoring
  - SS HTS/LTS leads and coils monitoring – now complete from QPS
  - O_2 monitoring for tracker volumes – now computes He percentage
- Feeds into SSU/FC/SSD state machines

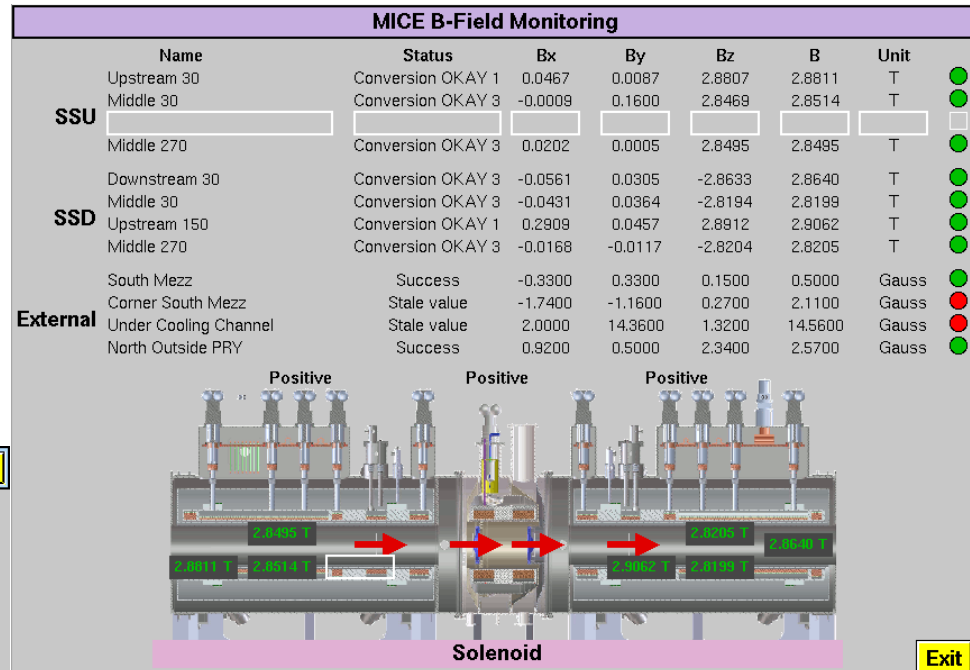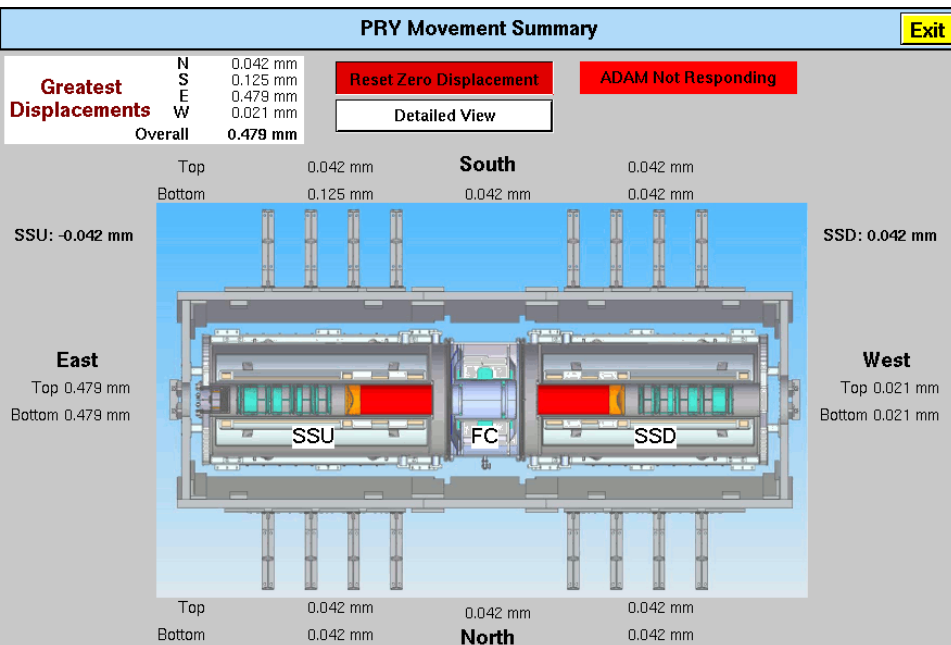Pierrick M. Hanlet – 6 October 2016

Channel Controls

- Can set PSUs individually or via CDB input (same as RC)
- Individual magnet Initialization and Set functions working
  - coding complete
  - Init functions tested for SSU, SSD, and FC
  - Set functions tested for SSU & SSD, need to test FC
  - merged to single "Channel" sequences – needs testing
- All QPS systems integrated
  - SSU/SSD complete and tested
  - need DL FC map correction
- Confirm settings & confirm buttons – tested
  - needs to be added to higher level PSU gui's
- Simplify ramp to: Pause, Zero, and Ramp (only) – tested
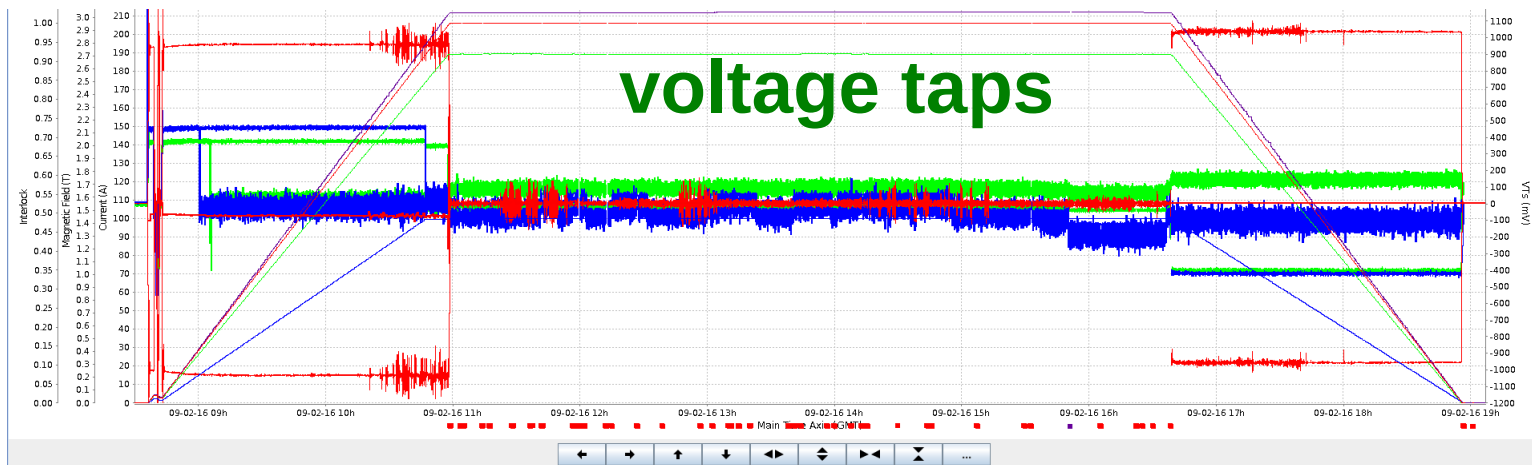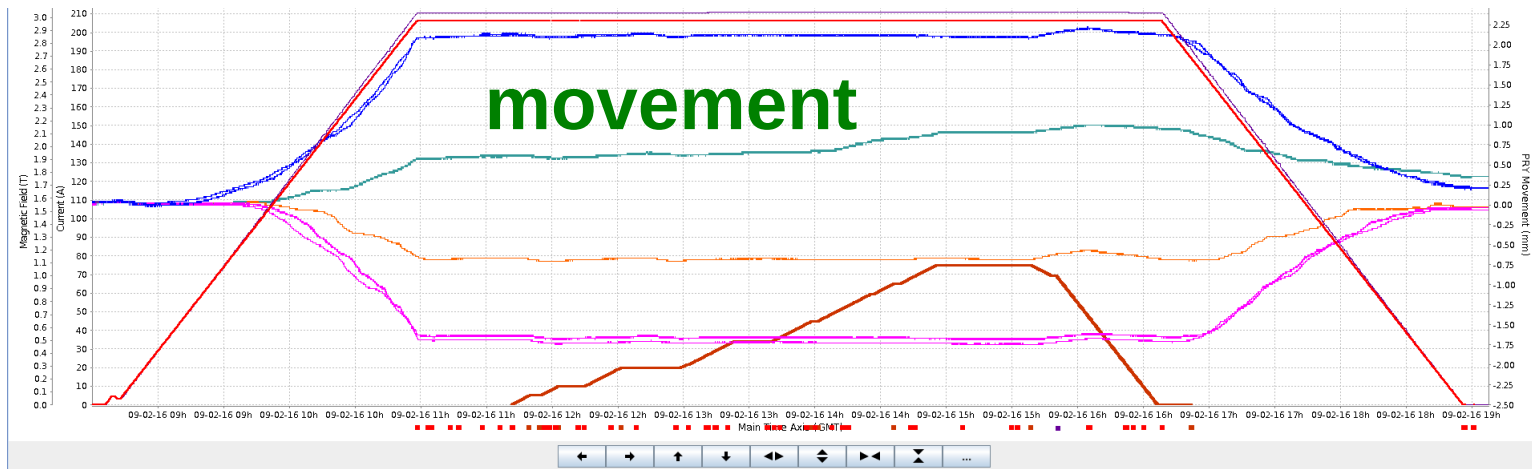 - needs to be added to higher level PSU gui's
- Need to compute heater power

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Channel Monitoring

Magnetic Fields table

	Name	Status	Bx	By	Bz	B	Unit	
SSU	Upstream 30	Conversion OKAY 1	0.0467	0.0087	2.8807	2.8811	T	🟢
	Middle 30	Conversion OKAY 3	-0.0009	0.1600	2.8469	2.8514	T	🟢
								⚪
	Middle 270	Conversion OKAY 3	0.0202	0.0005	2.8495	2.8495	T	🟢
SSD	Downstream 30	Conversion OKAY 3	-0.0561	0.0305	-2.8633	2.8640	T	🟢
	Middle 30	Conversion OKAY 3	-0.0431	0.0364	-2.8194	2.8199	T	🟢
	Upstream 150	Conversion OKAY 1	0.2909	0.0457	2.8912	2.9062	T	🟢
	Middle 270	Conversion OKAY 3	-0.0168	-0.0117	-2.8204	2.8205	T	🟢
External	South Mezz	Success	-0.3300	0.3300	0.1500	0.5000	Gauss	🟢
	Corner South Mezz	Stale value	-1.7400	-1.1600	0.2700	2.1100	Gauss	🔴
	Under Cooling Channel	Stale value	2.0000	14.3600	1.3200	14.5600	Gauss	🔴
	North Outside PRY	Success	0.9200	0.5000	2.3400	2.5700	Gauss	🟢

MICE B-Field Monitoring

PRY Movement

PRY Movement Summary — Exit

Greatest Displacements

N	0.042 mm
S	0.125 mm
E	0.479 mm
W	0.021 mm
Overall	0.479 mm

Reset Zero Displacement   ADAM Not Responding

Detailed View

SSU: -0.042 mm   SSD: 0.042 mm

South
Top 0.042 mm   0.042 mm
Bottom 0.125 mm   0.042 mm

East
Top 0.479 mm
Bottom 0.479 mm

West
Top 0.021 mm
Bottom 0.021 mm

SSU   FC   SSD

North
Top 0.042 mm   0.042 mm   0.042 mm
Bottom 0.042 mm   0.042 mm   0.042 mm

Magnetic Fields

Positive   Positive   Positive

2.8495 T   2.8205 T   2.8640 T
2.8811 T   2.8514 T   2.9062 T   2.8199 T

Solenoid   Exit

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- SSU/FCD channel ramp 2nd September

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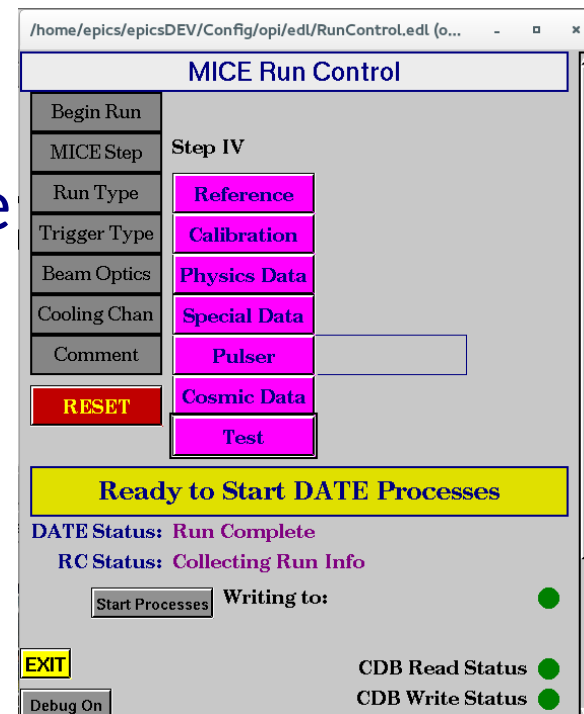
Run Control

- Revamp integration with Channel
  - necessary to ensure single point of Channel magnet control
  - broke sequence in for CDB interface
  - mostly complete
- Channel read to/from CDB – complete
- Write Channel tags to CDB – complete
- Absorber table implemented – complete

- Need to:
  - write hardware OK word – needs testing
 - implement suggestions from users
  - add Channel related sequences – next slide

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Run Control

- Complete, then broken
- modified to use Channel functions – work in progress
- To Do:
  - add sequence to read Channel TAG from CDB – done
  - add sequence to verify Channel settings before starting ramp
  - add Ramp button from Channel
 - add Skip Set Channel

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Other IOCs

- Target:
  - Ed modified RATS to be more like Tracker – done
    - reads and displays traces with each actuation
    - add beam position
    - fix logic
  - Will require a SM for proper monitoring

- Detector:
  - EMR – Ajit
  - Detector HV control and monitor – complete
  - HV error checking needs re-visiting
  - need to update SM

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Other IOCs++
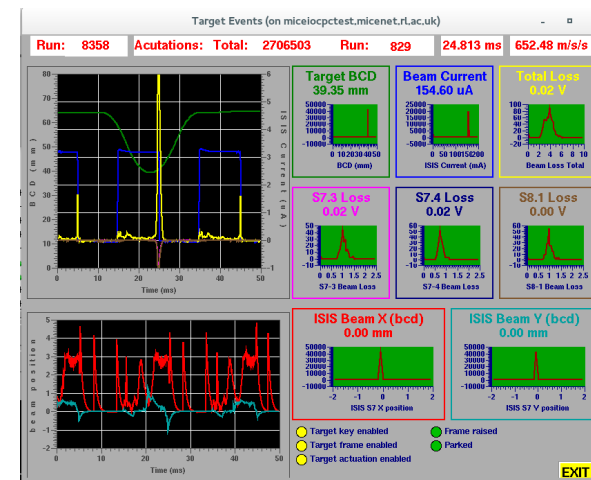
- DS – needs updating
- Facilities
  - New water control
  - Other systems need updating
- Environment – needs updating – Ajit
- BeamLine:
  - stable
  - modified to ignore devices when necessary
  - needs SM update to implement new ALH parameters and Archive

- Revamp AppLauncher

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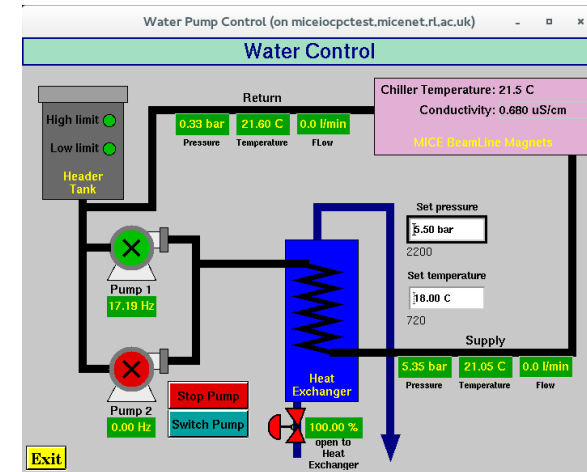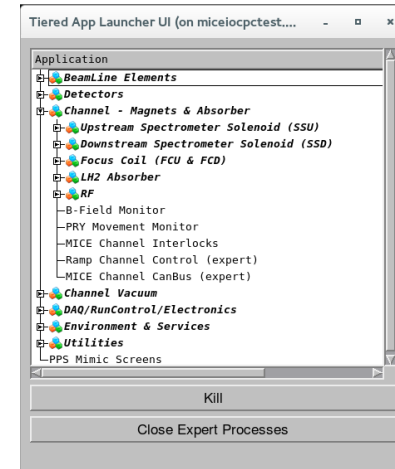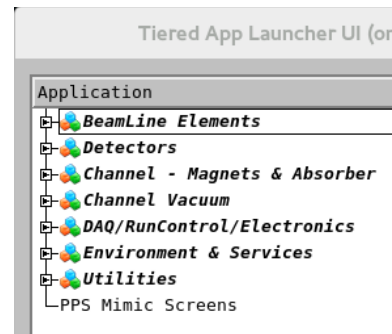
Communications Issues

- Historically referred to as "Drop outs"
- serial communication – (RS232) asynchronous
- Affects:
  - gui's – drop outs
  - Lakeshore 625 (SS trim PSUs) loss of parameters
  - alarm handlers (ALH) – spurious alarms
  - archive spikes (drop outs)
  - un-sanctioned State Machine changes – affects archiver and ALH

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Gathering Evidence

- Mike has been very helpful in focusing on problems
- Affects: Lakeshores, Archiver, ALH, gui's, SMs
- All devices read asynchronously
- No handshaking (hardware or software)
  - some devices don't have it
- Evidence:
  - PSU messages – indicates error comes from VME
    - eg. "Unrecognized Command"
    - Lakeshore 625 parameter losses
  - cannot reproduce at DL – simpler & independent tests
  - high CPU load on CS7A – 60%
  - IOC reports bad interrupt

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Addressing Problems

- Tasks to try:
  - move some load from CS7A to CS7C
  - add clear message and/or more pause time
  - sniff data flow (hard to do)
  - implement flow control when available
  - separate IOCs onto independent network
    - IOCs are on separate network
    - run EPICS gateway
    - all OPI (operator interface) machines connect via gateway

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ALHs, Archivers, AutoSMS

- Several systems have been identified require additional alarms and parameters added to the archivers
- The completion of several state machines have quieted down ALH in the MLCR => those remaining require tuning of their SM spreadsheets
  - *However, experts need to feed in new limits (now with experience)*
- New parameters need to be added to Archivers
- Revisit AutoSMS
  - Ajit to do
  - have email to SMS gateway – thanks Craig
 - one of my criteria for SS unattended operation

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To Do List

- State Machines – complete and missing
- Run Control
  - complete Channel interface
  - complete Channel "Physics" run type in gui
  - implement ssh lockout
- Channel IOC
  - complete tests
  - add SS heater power
- Other IOC updates
- Alarm Handlers and Archivers and AutoSMS
- Finalized code to epicsPRO
- DL coming in to fix communication issues
- Implement IOC access while running

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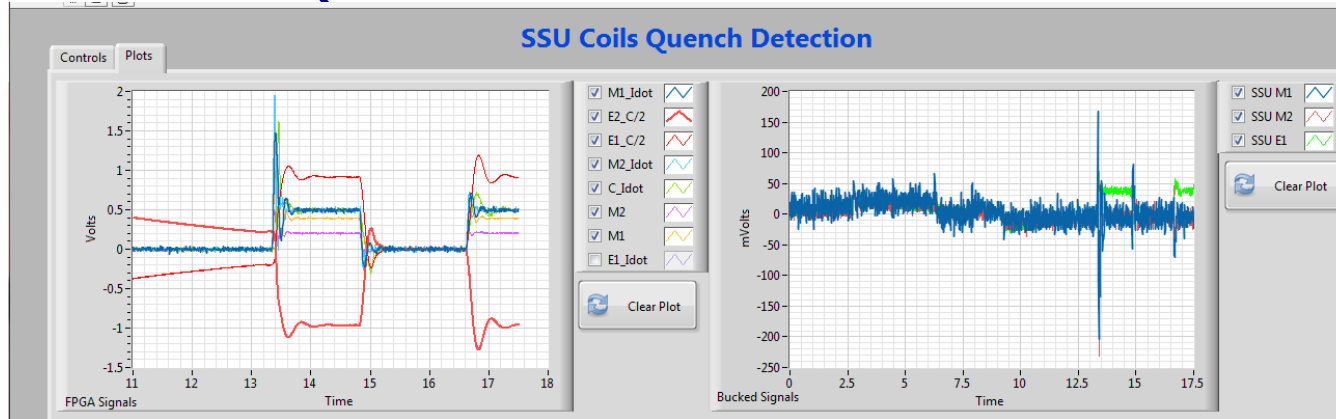# *Quench Protection*

- Roman Pilepenko (FNAL) SS QPS modifications:
  - confirm changes
  - signal over threshold requirement
  - spike catcher
  - now outputs coil quench signals to C&M

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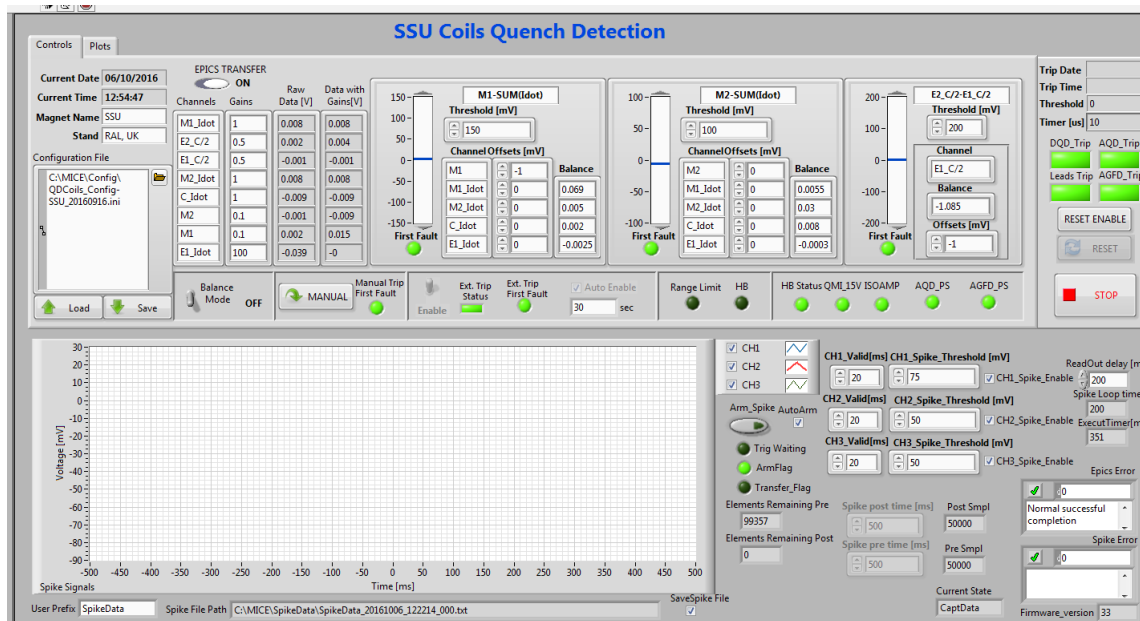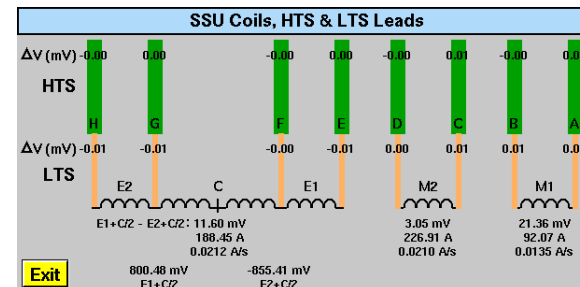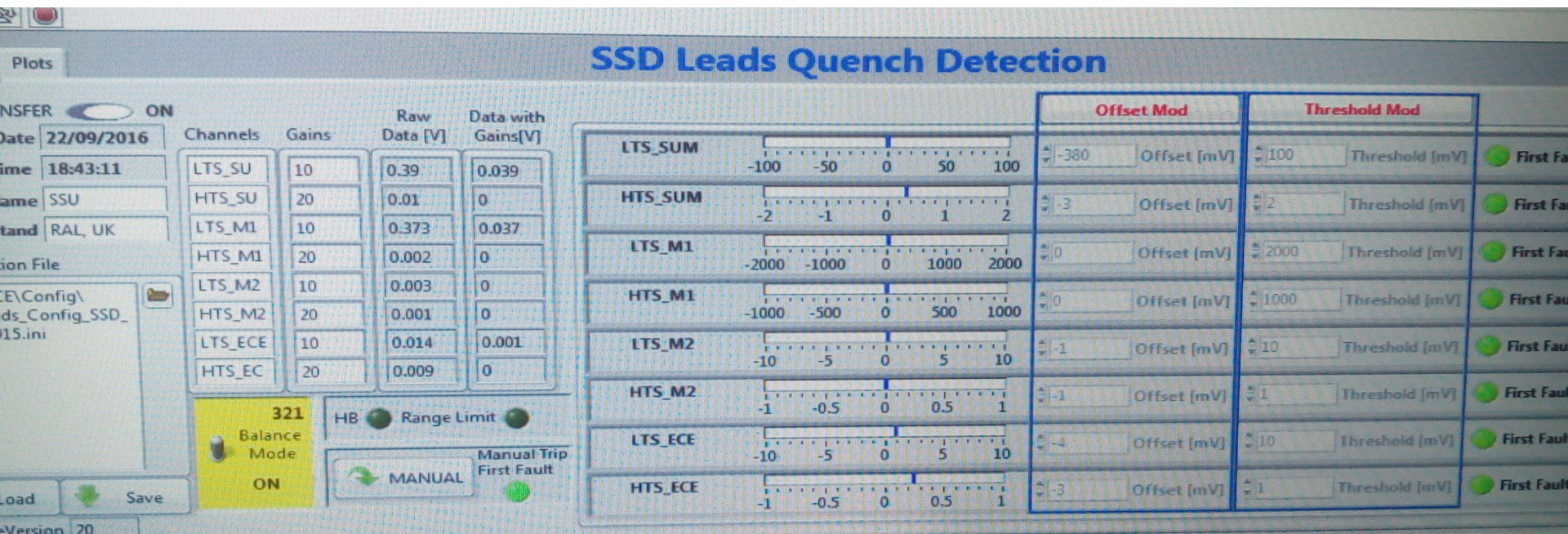
Quench Protection

- SSU plots from QPS

- SSU plots from StripTool/Archiver from QPS

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Quench Protection

- Issues:
  - Ground fault in SSD E1-C-E2 – can't use trim supplies or AGFD
  - SSD lead offsets in E1-C-E2 are significant during ramping

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Quench Protection

- James Wilson (DL) FC QPS datalogger modifications
  - new hardware – more CPU cycles and memory
  - new LabView interface for data logger
  - outputs VT signals to C&M
    - output stops after some time running
    - need updated channel map
    - need alarm limits and archive information

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Summary

- Much progress since CM45
- State machines – dragging on waiting for parameters
- Channel IOC – near completion – need time for testing
- RunControl – revamping to work with Channel
- Serial communication issues soon to be addressed
- QPS systems stable, but not perfect

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Happy Birthday Chris Rogers!!!

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