Instrumentation/Diagnostics topics - status

MDP Meeting
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## Milestones

**“Spot heater array” studies**

**Flex-QA development**

(and I’ll give the status of other relevant activities too)
QA and “cold” electronics progress

- **Flex-QA (flexible PCB quench antenna) - Joe DM, Stoyan**
  - A version of the flex-QA installed ready for testing in a magnet
  - Improved versions of QA being procured, other being drafted
  - Room-temperature test stand being procured

- **“Cold” electronics – Ryan R. (group), Steve, Stoyan (just the FNAL side)**
  - Collaboration with LBNL (Marcos)
  - Electronics components were tested in LN at APS-TD,
  - established regular activities (~ weekly)
  - Pending results, we’ll plan for LHe testing

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**QA during installation**

**Test stand (3D stage system) drawing**

**LDRD funds**

**Improved QA design**

**MDP Roadmap**

**Cryo-DAQ**
Acoustics analysis and DAQ developments

- **Acoustics (with Steve)**
  - Kiernan, a Summer student is working with us on “15 T” acoustics data analysis
  - We are after analyzing/categorizing events of interest

- **Multichannel fast DAQ (for QA, etc.) – Oliver (Darryl O.), Steve, Stoyan**
  - We upgraded hard-drives which were rate bottlenecks
  - We bought additional cards to get to 64+ differential channels
  - Tested functionality at this stage – all good
  - Software development was started, cabling discussed
  - Work halted for few months due budget constraints, resuming

Plots relate to testing of code and algorithms to find “interesting” events

Acoustic data from 15 T

One of two NI-crates
“Spot heater array”, V-I technique - stalled

- “Spot heater array” studies (no progress since last time)
  - It is also a current sharing and other diagnostics experiment
  - An initial proposal (for funding) was sent in January 2020
  - A FNAL note written in November 2020 (as requested/strongly advised earlier)
  - An updated presentation with targets and narrative prepared and given at FNAL (January-April 2021)
  - Discussion on next steps initialized with management
  - Waiting for stated support (and support)

- V-I technique development – Tom C. (Darryl O.), Stoyan /no progress/
  - First tests with borrowed multi-channel nano-voltmeter ("MUX") were successful in the “15 T”
  - We need much improved version of the MUX to accommodate our needs
  - Development of MUX started – virtually all hardware procured
  - Further development halted due to lower priority status (we don’t have an imminent magnet coming for testing) and insufficient resources
Quench detection systems

Grant applications are sought to develop quench detection systems based on machine learning techniques and FPGA electronics. While the test bed can be low temperature superconducting (LTS) magnets the goal is to have such systems suitable for high temperature superconducting (HTS) magnets. A potential system should be able to utilize multiple input sources, be at least 99% efficient without using coil voltage rise (resistance growth) and give less than 0.1% fake triggers. If used in LTS, it should be at least twice faster than standard quench detection based on differential voltage signals alone. If used in HTS, it should demonstrate fast enough quench detection to avoid burning out of the superconductor. It is understood that quench detection should cover the whole range of magnet currents up to at least the design current for the specific magnet.

References:
https://doi.org/10.3390/instruments5030027.
Cryogenics electronics

Grant applications are sought to develop electronics working at liquid helium temperatures (a.k.a. “cold” electronics). The main application is bringing signal channels from liquid helium to room temperature by digitizing the signals and transmitting them through large bandwidth connections. The main target parameters are 1 Gbps data rate, at least 14 (better 16) bits per channel and sampling rates above 200 kHz. Use of amplifiers is recommended. The power consumption should be less than 100 mW per channel and less than 30 W total, and the system should be able to start and operate in super-fluid liquid helium.

References: