HDice NMR Work Request Status Report

Detector Support Group

Monday, September 18, 2017

NMR Programming Work Requests

1. Debug NMR program issues:
   Program loses control of power supply within 1500 sweeps.
   Data missing from field graphs.
   Program freezes.
   Status: Completed.
   Verification needed from HDice Group

   Debugged and fixed intermittent (and infrequent) power supply communication errors. Revised the NRM power supply device drivers and investigated the GPIB interface hardware. A contiguous test run of 1500 sweeps was successfully completed.

2. NMR sweep pause control button hangs up program.

   Status: Completed.
   Verification needed from HDice Group

   The pause control software (written by BNL) was implemented improperly. Program was debugged and corrected by DSG.

3. Helium temperature and level sensors not working.
   Status: Completed.
   Verification needed from HDice Group

   Debugged and implemented fix for helium sensors.

4. Add an operator pop-up warning message if field value is lower/higher than limits threshold.
   Status: Completed.
   Verification needed from HDice Group

   Code written, implemented, and tested.

5. Manual control of PS on front panel not working.
   Status: Completed.
   Verification needed from HDice Group

   The pause control software (written by BNL) was implemented improperly. Program was debugged and corrected by DSG.

6. NMR Signal averaging not working.
   Status: Completed.
   Verification needed from HDice Group

   Program was debugged, corrected and tested.

7. The NMR sweep parameters for T_{down}, T_{up}, T_{wait}, T_{bot} values ignored.
   Status: Completed.
   Verification needed from HDice Group

   The NMR sweep parameters software (written by BNL) was implemented improperly. Program was debugged and corrected by DSG.

8. Bcenter value was not properly implemented for CT-Box asynchronous mode.
   Status: Completed.

   CT-Box calibration was added to program.

9. RF Box displays table settings, not actual settings from box.
   Status: Box is working properly.

   Program reads *actual* hardware settings from the box. It does not echo the parameters in the run table.

10. The Fast Resonance Scanner (FRS) program needs to updated and added to the NMR program project.
    Status: Completed.
    Verification needed from HDice Group

    FRS program was updated to LabVIEW 2016, debugged, tested, and added to NMR project file.

11. When using multiple conditions, the NRM program intermittently halts with a Windows pop-up error reporting "Ran out of Memory".

    Status: Completed.
    Verification needed from HDice Group

    Code debugged, implemented, and tested.

12. Saved files should include the magnet ID used in sweep.
    Status: Completed.

13. Add magnet type definitions to NMR program.

Status: Completed.
Verification needed from HDice Group

Code written debugged, implemented, and tested. At the start of the NMR program, the user must select to which dewar the program is connected. There are five dewars (PD-I, PD-II, SD, IBC-axial, and IBC-transverse), each with a different gauss per amp parameter.

14. Add RF instrumentation communication check at start of NMR program.
Status: Completed.
Verification needed from HDice Group

Communication check added to program.

15. Debug and finish existing NMR control codes, eg. NMR field sweep range & time. Present system is only understandable for $t_{dwn} = t_{up} = 31$ sec and range = 300 gauss;
Status: Completed.
Verification needed from HDice Group

Program errors were identified, rewritten, debugged, and tested. New code accepts input values 10 [s] – 300 [s]. Sweep range was increased from 300 [G] to 1000 [G].

16. Write a program to control two power supplies to rotate HDice target polarizations (by varying currents in both solenoid and saddle coils).
Status: Completed.
Verification needed from HDice Group

A LabVIEW program was completed in **2015** for the automatic rotation of target polarization. Features include: switching to manual operation mode after rotation, simultaneous ramping of both supplies in the manual mode, and a ramp-hold feature during operation.

17. Modify NMR control program to run NMR scans with both positive and negative current in the magnet power supply.
Status: Completed.
Verification needed from HDice Group

The section of NMR code that prevents running both positive and negative NMR scans was identified, rewritten, debugged, and tested.

18. Modify component-ID key portion of the NMR control codes to allow the VI to distinguish between cable types.
Status: Completed.

NMR control code was written to identify different cable and terminator types using component-ID keys.

19. Upgrade RF distribution and attenuation control to display current settings on attenuator box and integrate into NMR control codes so that changes are reflected in display.
    Status: Completed.

    The status of the actual RF box hardware are displayed (not the run table configuration file). The RF Splitter/Attenuator Unit controls were upgraded and integrated into the NMR code.

20. Incorporate a precision current shunt into field controls.
    Status: Completed.

    DAQ developed to read shunt directly (asynchronously) was integrated into the NMR program as an option. At the start of the program, the operator can chose between current shunt or power supply read-back for field data calculation during sweeps.

21. Synchronize the current shunt measurements with the Lock-In Amplifier data. Write the synchronized measurements to the data file.
    Status: **DSG work in progress.**

22. Update existing NMR analysis codes to the newest version of Mathematica. (e.g. Version 5 to version 8, or the most recent JLab supported version).
    Status: Incomplete. Work Stoppage.

    Required information to update to the latest version of Mathematica was not provided by BNL. DSG has stopped work on this task.

NMR Hardware Work Requests

1. Transformer box LED not working.
   Status: Fixed.

   LED ordered and replaced.

2. Repair RF distribution and attenuation Box #2.
   Status: **Completed**.

   Debugged, tested, and reinstalled RF Box in Rack #2.

3. Design, build, install, debug, and test hardware triggering system to synchronize the current shunt measurements with the Lock-In Amplifier data sampling.

Status: **DSG work in progress.**

4. Current shunt (CT-Box) reported to have noise of two Gauss.
   Status: **Completed**.

   Noise investigated in DSG control room with Oxford power supply.
   CT-box noise was within the manufacture's specifications.

5. Isolate NRM instrumentation in NMR rack #2.
   Status: **Completed**.

   Researched, procured, and installed isolation padding between the instrumentation and the metal rack frame.

6. Search for semi-flexible NMR (RF) cables with low loss or controlled temperature variation.
   Status: **Completed fabrication and installation by DSG**
   Verification testing completed by HDice Group

   After extensive research, the flexible, low loss, and temperature stable RF cable manufactured by Molex was selected; a 1,500-foot spool was purchased.
   Cables for cryostats, RF Splitter/Attenuator Units, and NMR instrumentation rack interconnects were fabricated.

7. Construct two sets of dual cables with lengths adjusted to operate on λ/2 resonance with tuned NMR circuit (RL CL).
   Status: Incomplete. DSG waiting for information on cable lengths.

Additional work performed to complete tasks:

1. Upgrading of PCs to Windows 7. After upgrading, PCs needed reconfiguring by Computer Center to disable auto-rebooting and sleep mode and to provide administrative rights to HDice group.

2. Investigation of LabVIEW for Linux; option discarded.

3. Upgrades of hardware and software for RS-485/RS-232 communication hubs.

4. Research of current measurement systems to find systems with <0.1% accuracy.

5. Replacement of HDice development PC after failure. Replacement took ~1.5 months. Initial setup done by Computer Center; DSG installed software and

LabVIEW code, configured hardware interface, and tested instrument communications.

6. HDice test stand PCs were upgraded to LabVIEW 2016 and all instrument communication drivers updated, debugged, and tested.

7. Updated of the Oxford power supplies' drivers to LabVIEW 2016 for the rotation of target polarization program.

8. Developed drivers to have the capability to use either the original Oxford power supplies or the new Oxford Mercury iPS power supplies, which do not have GPIB interface.