EPR Operator Procedures v1.1

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- EPRs will be scheduled every 4 hours and it will be the responsibility of the Target Operator to page or call the EPR expert on call (this person will be listed on the white board).

For EPR operator:

- Alert your shift leader you intend to take an EPR measurement, however, you don't need to move the target to perform an EPR.
- You can only perform EPR measurement with longitudinal lasers.
- If the 3 longitudinal lasers are on, turn 2 of them off. Using only one laser is the optimized mode to perform EPR in terms of D2 signal quality, AFP flip loss, lockin stability, according to current photodiode setting in the hall.
- If the transverse lasers are on, (hence the holding field is at 90 or 270 degrees
  - Stop data taking for both arms.
  - Turn all transverse lasers off according to the ''How to turn the lasers on and off'' section.
  - Rotate the field from 90 to 180 degrees (check $\lambda/2$ waveplates, should be IN), or from 270 to 0 degrees (check $\lambda/2$ waveplates, should be OUT). Please follow the directions in the 'How to Rotate the Holding Field section.'
  - Once the field is in the proper direction, turn on one longitudinal laser.
- Check photodiode signal, should be higher than 100 mV, but lower than 180 mV.
- If signal is lower than 80 mV, or higher than 200 mV, you will have problem locking into the resonance. Try using another laser, using two lasers etc. Remember the ideal photodiode signal is between 100 mV and 180 mV.
- Setup circuit for FM sweep, but do not perform FM Sweep labview program. Because it takes at least 3 minutes to perform a FM Sweep by LabView, it is recommended to look for the resonance by hand. Things to check:
  - Switch on RF capacitor box should be set to 'EPR';
  - 100:1 attenuator should be in 'FMSweep(short)';
  - disconnect EPR PI feedback box 'input';
  - Set EPR PI feedback box 'integration off';
  - EPR wavetek 80 output should be active (NOT in 'standby');
- Setup parameters:
  - Wavetek80 (RF) amplitude 16.0V, offset 0.0;
  - DS345 (Modulation source) amplitude 0.025Vpp, frequency 200.0Hz, offset 0.0 Vpp, phase 0.0;

Try to find resonance around 11.7 MHz manually. The number here is for target in pick-up coil position, the resonance might be slightly shifted away (but not too much!), for example, from 11.6 MHz to 11.8 MHz. D2 signal should be higher than 20 microV. Optimize lock-in amplifier reference channel phase. Keep in mind that you need to minimize the time of activating EPR RF coil, so try to do this step as quick as possible. Once you find the resonance, set wavetek 80 to be 'standby' and continue to the next step. If you have scanned from 11.6 MHz to 11.8 MHz but

cannot see the resonance, set wavetek 80 in ‘standby’ mode and page EPR on call.

- If signal looks good, setup circuit for AFP sweep. Things to check:
  - 100:1 attenuator should be in ’AFP Sweep(100:1)’;
  - Connect Lock-in output to EPR PI feedback box ’input’;
- Setup parameters:
  - Wavetek80 (RF) frequency= (resonance frequency) - 50KHz, amplitude 16.0V, offset 0.0;
  - DS345 (Modulation source) amplitude 0.7Vpp, frequency 200.0Hz, offset 0.0 Vpp, phase 0.0;
  - The system may change, so always check parameters used in the last EPR measurement. Confirm any change with the previous EPR operator, and make sure you transfer the information to the next EPR operator.
- Set EPR PI feedback box ’integration on’, try to lock into resonance frequency.
- Check if you are locking into the resonance by changing EPR wavetek 80 frequency by 20KHz. Check if the counter reading goes back to the resonance quickly (but not too quick!). If the counter reading fluctuates by more than 10KHz, or it takes longer than 2 seconds to lockin back to the resonance, it means the system is not working well and you need to adjust the parameters. Please, never try to change any setting if you are not an EPR expert.
- Once lockin into the resonance, open LabView program for AFP sweep, set paramters:
  - waiting/sweeping time = 6/16 seconds, or use the setting of previous measurement. (Please check the EPR checklist).
- If cannot lockin, or lose lockin when sweeping, do not stop the program, wait until the status window shows ‘waiting for sweeping...’. Do not change any instrument setting, call EPR expert on-call. EPR expert should adjust parameters and PI gains to optimize the system.
- After AFP spin flip, print out AFP spectrum from labview. Set EPR wavetek 80 output in ‘standby’ mode.
- Print out cell temperatures from target main controller on EPICS window.
- Fill out EPR checklist.
- Put EPR checklist, EPR AFP spectrum and cell temperatures in EPR binder.
- Set switch on RF capacitor box to be ’NMR’.
- Things to check:
  - EPR wavetek 80 output SHOULD be in ’standby’;

- Now that the EPR measurement is done. Check the original laser and holding field settings.
- If you were using longitudinal lasers, simplly turn on all 3 longitudinal lasers.
- If you were using transverse lasers and running holding field in 0 or 180 degree mode, turn off longitudinal lasers, rotate field to where you were, then turn on all 3 transverse lasers. Keep in mind that you need to be at ‘Polarized 3He target’ position for transverse lasers. Alert your shift leader when the lasers and field are in the right position.
- Alert your shift leader that you have finished EPR measurement.

- For EPR expert: If you are planning to do temperature study or any other case that need 3 lasers to be on, you should lower the Modulation source (DS345) amplitude. Currently the optimized amplitude is 0.7Vpp for 1 laser, and 0.4 or 0.5 Vpp for 3 lasers. Follow the EPR checklist or contact the latest EPR expert who performed EPR with 3 lasers.

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