APPENDIX B

"Finding the Characteristic Times, T1 and T2"

Source: Rasa Rejali (2014)

Finding the Characteristic Times, T_1 and T_2

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Determining T_1

In order to measure the spin lattice relaxation time, a 180° A pulse must be applied followed by a 90° B pulse, a time τ later. You will only use two pulses, rather than a sequence of them. Note that the spectrometer must be properly tuned and the temperature of the magnet must be perfectly stable to achieve reliable results.

1. Ensure the spectrometer has been tuned according to the manual instructions; take note of the final values for the 90° pulse length and 180° pulse length found during the calibration process.
2. Set A-len to the 180° pulse time; set B-len to the 90° pulse time
3. You will vary τ throughout the measurement of T_1, but a good starting point can be found in Table 1 for a few selected samples. However, keep in mind that these starting points are simply guidelines.
4. Adjust the period (P) according to the values in Table 1, when relevant. Otherwise, try modifying this parameter until you observe the appropriate signal.

Table 1: Data collection: τ range and period for selected samples

Sample	Start value for T_1	Start value for T_2	Period
Light mineral oil	40 ms	10 ms	1.0 s
Heavy mineral oil	20 ms	10 ms	1.0 s
Pure water	1.4s	10 ms	5.0s (for T_1), 1.0s (for T_2)

5. Set the number of B-pulses in a sequence (N) to 1.
6. Set the Sync toggle switch to B, and turn on the B Pulse toggle switch. You should observe a signal at this point; adjust the oscilliscope window as needed.

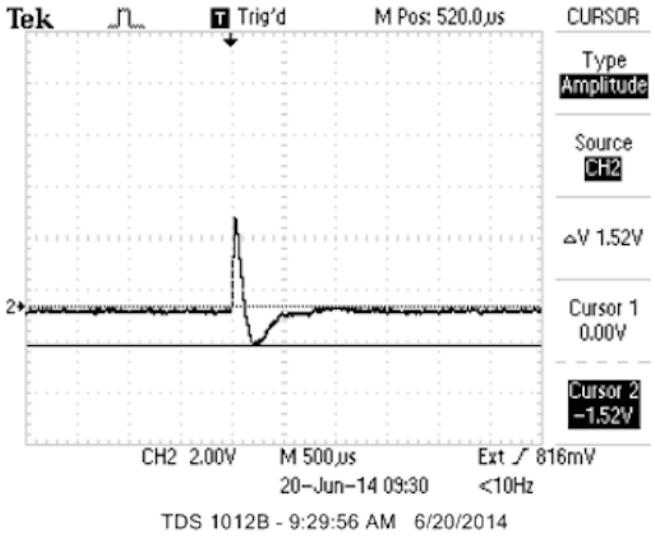

Figure 1: Observing the FID amplitude of the 180 ° pulse, following the 90 ° pulse a time $\tau = 0.1s$ later.

7. Using the Measure function on the oscilliscope, measure the peak after the 90° pulse.

8. Continue measuring the peak of the 90° pulse as you vary τ. Plot the FID amplitude as a function of τ to determine T_1. For further information, please refer to Appendix A, pg 7-8.

Determining T_2

To measure the spin-spin relaxation time, a 90° A pulse must be applied followed by a 180° B pulse, a time τ later; an echo is observed a time τ after the 180° pulse. By applying a sequence of B pulses, the characteristic time T_2 can be determined. It may be useful to think of T_2 as the time it takes for the FID echo amplitude to drop to 37%.

1. Set A-len to the 90° pulse; set B-len to the 180° pulse; adjust the period (P) according to Table 1.

2. Start with one B pulse in the sequence, and ensure the output pulse corresponds to Figure 2. You can then begin to increase the number of pulses in the sequence until you observe an exponential decay of the echo amplitude (refer to Figure 3).

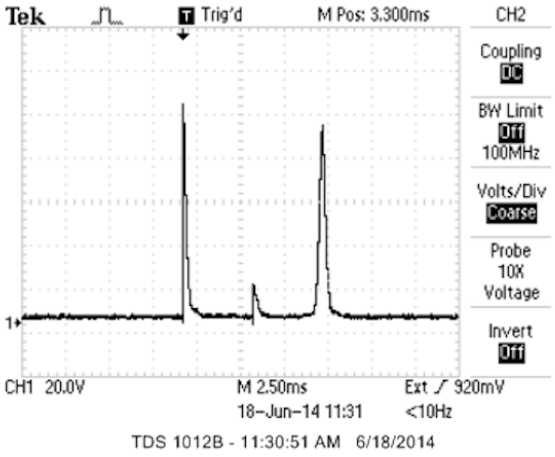

Figure 2: A 90 ° pulse, followed by a 180 ° pulse, followed by an echo; each peak is seperated by a time $\tau = 0.1s$.

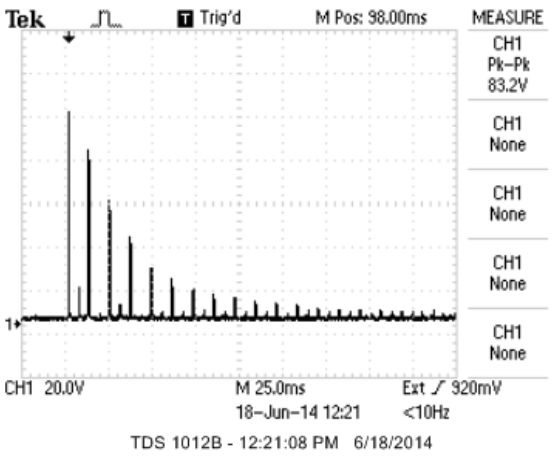

Figure 3: Carr-Purcell principle of multiple echoes, exhibiting exponential decay of the echo amplitude.

3. Ensure to apply the Meiboom-Gill correction to the Carr-Purcell sequence, such that the uncertainty does not propagate so as to create an attenuated echo.

4. Please refer to Appendix A, pg 4-7 for further instruction.