Measuring T1

T1 Measurement

The common method of measuring T1 is by an "inversion/recovery" procedure: one excites the sample with a 180° pulse, then lets the sample relax for a variable time (τ) before observing it with a 90° pulse. If the sample has relaxed completely by the end of τ, you will see the result of the 90° pulse, as if the 180° pulse had never happened (ie, full positive intensity). If the sample has relaxed halfway, the $\mathbf{M}_z$ component will be zero, so there will be no intensity to observe after the 90° pulse. Lastly, if no relaxation has occurred, the 180° and 90° pulses together will be the equivalent of a 270° pulse (full negative intensity). The procedure is repeated for a variety of τ-values, and the peak-heights are regressed vs τ.

Setup/Acquisition

1. Create a new experiment number in your dataset: "edc".
2. Recall the inversion/recovery experiment: "rpar PROTONT1 all" .
   On the "Pulse Program" tab, click the ⎍ icon, to see the pulse-sequence diagram for the experiment. Ok to close the diagram window, but don't close the text window!
3. "getprosol"
4. In the "ased" parameters, set NS = 8, and verify that DS = 4 and D1 = 10. The τ-values to be used (in seconds) are stored in the VDLIST. Click the E-button next to VDLIST, and note the length of the list. If desired, add or remove delay times to/from the list. From the command line, set L4 (# of loops) and the second field of TD (width of 2D dataset) to this value.
5. "rga" to set the receiver gain.
6. "zg" as usual, and hang out for 20 minutes. Individual 1D spectra will be acquired, but will be bundled into a pseudo-2D dataset.

Processing / Analysis

7. "xf2" to transform the second domain of the pseudo-2D data.

   Click the "mountain range" button on the second row just because it's cool. You'll probably need to adjust the vertical scale (mouse wheel). The ⌊ and ⌊ buttons will let you vary the perspective. (Drag on them, like when you manually adjust the phase.)

   [*optional:* If you wish to adjust the phase of the 2-D spectrum, click the Process / Adjust Phase tabs, then right-click at the bottom of each peak (vertical stripes) to establish places to view, then click the "phase rows" button (⟷R). Phase, then save-and-return (🖫↵ button) as usual.]
8. From the top buttons, choose Analyze : Dynamics : T1/T2 . Follow the row of buttons:
   a. Use the FID button to extract a slice from your data to phase. Either the FID or the spectrum is fine. The first slice (default) is fine. Phase the data ("apk").
   b. Use the Peaks/Ranges button to define the ranges of the spectrum to regress. Integrate the spectrum by dragging across the peaks, then export the data back to the T1/T2 routine (🖫A-button; export to Relaxation Module).
   c. Use the Relaxation button to regress the peak intensity *vs* τ data. Click the check-box icon, and verify that the Function Type is "UXNMRT1". Press ⓘ to calculate T1 for all peaks. The + and – buttons will allow you to change which peak the plot displays data for.

      You may need to delete the last data point or two (↓-button, then right-click on the peak). In this case, use the ⓘ or ⓘ button to recalculate the fit.

      If only a single point shows up for a spectrum, try switching between "FID" and "Area"

9. Note that the T1 given by the software is double the correct values — the equation used lacks a factor of 2. Thus, divide the value by 2 to get numbers that accord with the literature.