F 61: NMR

Protocol: frequency of ($\omega_{HF} - \omega_L$) at 1 kHz : 1013 ± 20 Hz , del T = 6 Hz

Puls I (Amplitude max) ( ) V
Puls II (" min) ( ) V

2.3

- Puls I has to be maximized in order to be a 90° pulse, it was set to ≈2.1.
- Puls II has to be minimized in order to be a 180° pulse, it was set to ≈2.2.
- In T1 GA500 there is after signal at $t = \tau$ another signal to be seen, because after 180°-pulse to generate anti-parallel magnetization there are some dipole moments missaligned due to them needing time to deexcite from antiparallel to parallel magnetization.
After longer spin echo time all spins are back to parallel alignment when the 90° pulse is applied, such that we have a cleaner signal.

3.5

- We aquired a data point at 900 ms echo time in the T1 GA500 measurement which was very different / higher than expected. We found the reason for this to be the sensitivity of the measurement to the background noise, because we changed the integration window at this point. Therefore we found this datapoint to be not useful.

	Ga 500	Ga 600
T_2	(99,8 ± 0,5) ms	(129 ± 1) ms
T_2 (Cp)	(124,0 ± 0,4) ms	(150,6 ± 0,6) ms
T_1	(118,8 ± 2,2) ms	(135,8 ± 1,2) ms

Table 1

- For analysis discuss
  i) T_1 vs T_2

  ii) T_2 vs T_2(Cp)

  iii) Ga500 vs Ga600

- With $T_2(Cp)$ being larger than T_1 for both substances we measured $T_2(Cp)$ again in order to find the source of this unexpected result. They were in the same range.
We afterwards checked T_1 with a narrower noise range / peak window. The new value was found to be way larger

$$T_1 = (251,9 \pm 4,7)\,ms$$

Thus, the use of the same configuration, but a slightly more narrow peak window led to a huge difference, the setup is therfore very sensitive to this change. This new value is quite huge and also larger than $T_2(Cp)$ as expected.

4] Choose washing frequency: $\nu_{wash} = (506.4 \pm 20.0)\,Hz$

Rotating the probe not fast enough leads to unusable data, rotating at order of relaxation time messes up the system.

B: $(490,0 \pm 24,7)\,Hz$, $(584,0 \pm 29,5)\,Hz$

B+: $(480.0 \pm 24,2)\,Hz$, $(574,0 \pm 29,0)\,Hz$, $(616,0 \pm 31,1)\,Hz$

C: $(373.9 \pm 18.9)\,Hz$, $(563,7 \pm 28,5)\,Hz$

C+: $(386,0 \pm 19,5)\,Hz$, $(573,9 \pm 29,0)\,Hz$, $(616,0 \pm 31,1)\,Hz$

D: $(496,0 \pm 25,1)\,Hz$, $(542,1 \pm 27,4)\,Hz$

E: $(482,0 \pm 24,3)\,Hz$, $(580,0 \pm 29,3)\,Hz$

The probes A and D+ were missing

E+: $(482,0 \pm 24,3)\,Hz$, $(580,0 \pm 29,3)\,Hz$, $(622,0 \pm 31,4)\,Hz$

A+: $(484,0 \pm 24,4)\,Hz$, $(530,0 \pm 26,8)\,Hz$, $(560,0 \pm 28,3)\,Hz$, $(606,0 \pm 30,6)\,Hz$

5.1]

0f15mm • We expect a step-function. The signal is disturbed by noise because we're only looking at the fourier transform of a discrete data set.

0f5mm • For changing to 5mm we see that the width of the signal widens. We also observe different amplitudes which is due to inhomogeneity of the magnetic field.

Oil and Teflon • For the ~~same~~ teflon oil probe we see diminished amplitudes in the middle of the signal, because there is a ~~teflon or~~ plastic ~~knob~~ stick in the middle which gives no signal.

→ Widths of teflon bags: 1.5mm ⇒ Machine resolution < 1mm because we see

the difference between oil and teflon.

⇒ The resolution of the machine is determined by
- Fourier transform of discrete set only gives an approximate representation of the signal by due to a finite signal superposition.
- Measurement/step size of magnetic field is not so small, cannot distinguish in small ranges of B.
  ⇒ Manual:

- **Oil in sand:** Start of measurement: 10:36

The signal at first is simply a step-function with some noise. One side, the one corresponding to the edge of the oil layer next to the sand layer, is gradually decreasing as this layer sinks into the sand. In this process the edge corresponding to the sinking oil layer side is also shrinking and moving towards the other edge of the signal, such that the signal is gradually transforming to a one peak signal when half of the oil layer has penetrated the sand layer.
The signal of the end should be a flat, noisy step function. We observe it not being completely flat but having some bumps, because there are maybe some tightly bound sand granules in between which do not let the oil get through to the bottom side of the glass.

⇒ Thus, the signal develops from step function to a broadened step signal as the oil gets into the sand such that we also get a signal from the sand.

5.2

- **2D image of oil:**

For horizontal slicing we expected a circle  and for left to right slicing we expect a square  .

- The back to front slice shouldn't be used, because from the image of the horizontal slice we see a distortion of the image to the front, which is due to inhomogeneities of the magnetic field intrinsic to this machine.
- The left to right slice shows a curve at the tip, which is due to surface tension of the oil and it shows a flat edge at the bottom due to the bottom side of the glass.
- The temperature in the MRI is very constant, it changed by 0.001°C during the measurement.

- **2D Image of peanut:**

We can only observe one nut ~~in a~~, because the peanut wasn't completely centered in the glass tube such that the left to right slice only slices through one of the chambers with the nut inside and only captures a part of the shell of the lower chamber.

- **2D Image of celery:**

The first image taken from celery is not usable as there is not identifiable structure.
The second image showed a horizontal slice of a clearly visible celery.