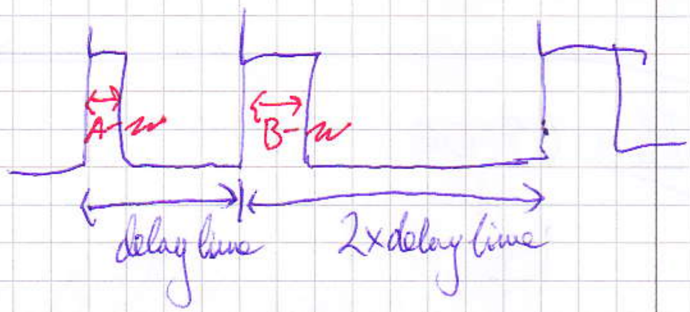
Mon 2017-10-16

10:00 Starting to look at pulses with the o-scope.

We see pulses:



10:50: $T_{\frac{\pi}{2}} = \frac{\pi}{2\gamma B_1} \approx 4{,}7\ \mu s$

$\gamma = 2{,}765 \cdot 10^4 \frac{rad}{s\,Gs}$, $B_1 = 12\ Gs$

- Connected ~~all~~ to measure the FID & mixed signal.
- Minimizing # beats @ 15,31~~60~~ MHz
- Adjusted sample pos. (o-ring) new freq 15,3162 MHz
- Maximizing FID, A-w: 7,30 μs for $\frac{\pi}{2}$ rot.
- @ rep. time 1s (~50%) the FID sign. doesn't change
- FID min. @ A-w: 15,0 μs $\sim 2 \cdot t_{\frac{\pi}{2}}$

  new max @ A-w: 22,2 μs $\sim 3 \cdot t_{\frac{\pi}{2}}$ new freq: 15,31543 MHz

11:00 ~~Ex~~ Rep. time for FID sign. to reduce to $(1-e^{-1})$ of max: 35,8 ms $\approx T_1$

New freq. 15.31374 MHz

A-pulse set to π: 15,3 μs

B-pulse set to $\frac{\pi}{2}$: ~7,6 μs

@ delay = 20 ms
we get a min B-response

i.e. $t_{1/2} \approx 20$ ms $\Rightarrow$

$$\Rightarrow T_1 = \frac{t_{1/2}}{\ln 2} \approx 29 \text{ ms}$$

- For the future: sweep τ and record FID from B-pulse as func. of τ, & do curve fit.

11:30 New freq: 15,31245 MHz

A-w: 7,8 μs
B-w: 15,1 μs
B pulses: 20, 450
delay: τ = 1,00 ms
rep. 1 s (50%)

Saving wave form
"echo_20.csv"
"echo_450.csv"

12:00 LUNCH

15:20 Back from lecture. New freq 15,30984 MHz

Changed "time constant" from 0,01 ms to 0,1 ms.

→ smoother curves (FID + mixer).

- Saved another ~~data~~ "echo_45b.csv" with new time const. otherwise the same settings as before (except freq.)
- Longer time const. reduces noise, but makes the response time slower.

15:50 T_1 $\pi - \frac{\pi}{2}$ measurement

	delay / [ms]	B-FID / [V]
	2,00	1,800
	5,00	1,438
	10,0	0,9313
	12,5	0,6750
	15,0	0,4813
	17,5	0,3663
	20,0	0,3025
	21,0	0,2863
Sweep	22,0	0,2725
	23,0	0,2650
	24,0	0,2513

del / [ms]	B-FID / [V]
25,0	0,2500
26,0	0,2638
27,0	0,3200
30,0	0,4650
35,0	0,6425
50,0	1,103

16:20 If we scrap the values between 20 and 25 ms, we get a fit:

$$FID(t) = A\cdot\left(1-2e^{-t/T_1}\right)$$

$\left\{\begin{array}{l} +\text{O-scope V for } t<25\,ms \\ -\text{O-scope V for } t>25\,ms \end{array}\right.$

MATLAB gives $A = 2{,}009\ V \pm 0{,}05V$

$T_1 = 31{,}94\ ms \pm 0{,}7ms$

95% conf.

Lesson learned

Be more careful around minimum of delay (0-transition of FID(t)).

Tue 2017-10-17

13:20 Trying to measure diffusion in water.
The distilled water we had yesterday is gone. Using tap water
(Tried acetone, but did not see any signal.)

- Water is slow, using manual triggering
- With the multipulse method we expect to se exp. decay: $e^{-t/\tau}$, where

$$\frac{1}{\tau} = \frac{1}{T_2} + K(\Delta t)^2.$$

We can get T_2 & K by varying Δt.

⇒ Do a series of multipulse meas. for different (Δt).

Cal. freq. 15,36838 MHz

$\frac{\pi}{2}$ pulse: 7,5 μs

π pulse 15,1 μs

Saving waveforms to "99echo_XX ms.csv". using 99 B pulses

Waiting 30 s between meas. doing $\Delta t = 2-20$ ms in 2 ms inc
then 25- in 5 ms inc

• 4ms looks wierd.

~~18~~ 18:30 The O-scope could not save all the data points, so we need to redo the meas. with higher time res. 20, 50 & 100 div/ms

Calibrating freq. 15,30341 MHz

Saving to "99echo_XXms_d"

Wed 2017-10-18

09:30 Tried to investigate the resonance phenomenon @ 5ms delay time. Jacob was also here, but no one got any wiser...

10:30 Tried dry paper and we did not see any signal (both small 3x5mm² pies & lots of paper jamed into the glass vial).

Wet paper (distilled water) only gave signal for a large (~2x3cm²) piece folded.

Saving to: "50echo_~~X~~_Xms_a.csv"

freq. 15,30896 MHz

11:30 checked the wet paper data. It looks like we have some difference with wet paper. Diffusion ~~const.~~ const. seem much larger for wet paper? Unless field gradient is different.

12:45 Redoing the water & wet paper (both distilled water this time) with o-ring positions at the same height & marked above the o-rings.

Saving to fiels "~~XX~~ 50 echo-X_X ms_wp_a.csv"
& " — " ~~XX~~ — _dw_a.csv"

13:30 Tried with glycerol & wet glycerol papers
~2x4 cm^2

14:00 Trying water wet tissuepaper (previously we had printer paper). Save to "... wtp_a.csv"

14:20: Trying extra wet (water) tissue paper.
"...exwp_a.csv"

With ex(tra) wet means 1 drop added to the ~~alr~~ already wet paper.
"Regular" wet means soaking the paper & then wiping it off with dry tissuse.

Thur. 2017-10-19

1020 Plan: Meas. ex wet printer paper
& ex wet glycerol.
The ex wet glycerol has soaked over night.

Also redoing the wet printer paper to see if we can replicate the previous meas.
This time with nitrile gloves when wetting the paper to not contaminate with salts from hands.

10:30 But first: sorting all the data files.

12:15 Lunch

2:45: Starting to meas. on wet printer paper.
Seeing ~~#~~ same strange artifacts in pulse echo as for pure water, but this time @ 0-1 ms delay (no clear resonance).

Doing ~~a~~ run ~~1, 1.5, 2.5~~
1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5

Turned out that M-G was set to OFF. Changing to ON.

Saved meas for 0.5 : 0.5 : 60 ms
in "90echo_X_Xms_ .csv"

wpp_c
xwpp_c
xgpp_a

DONE!