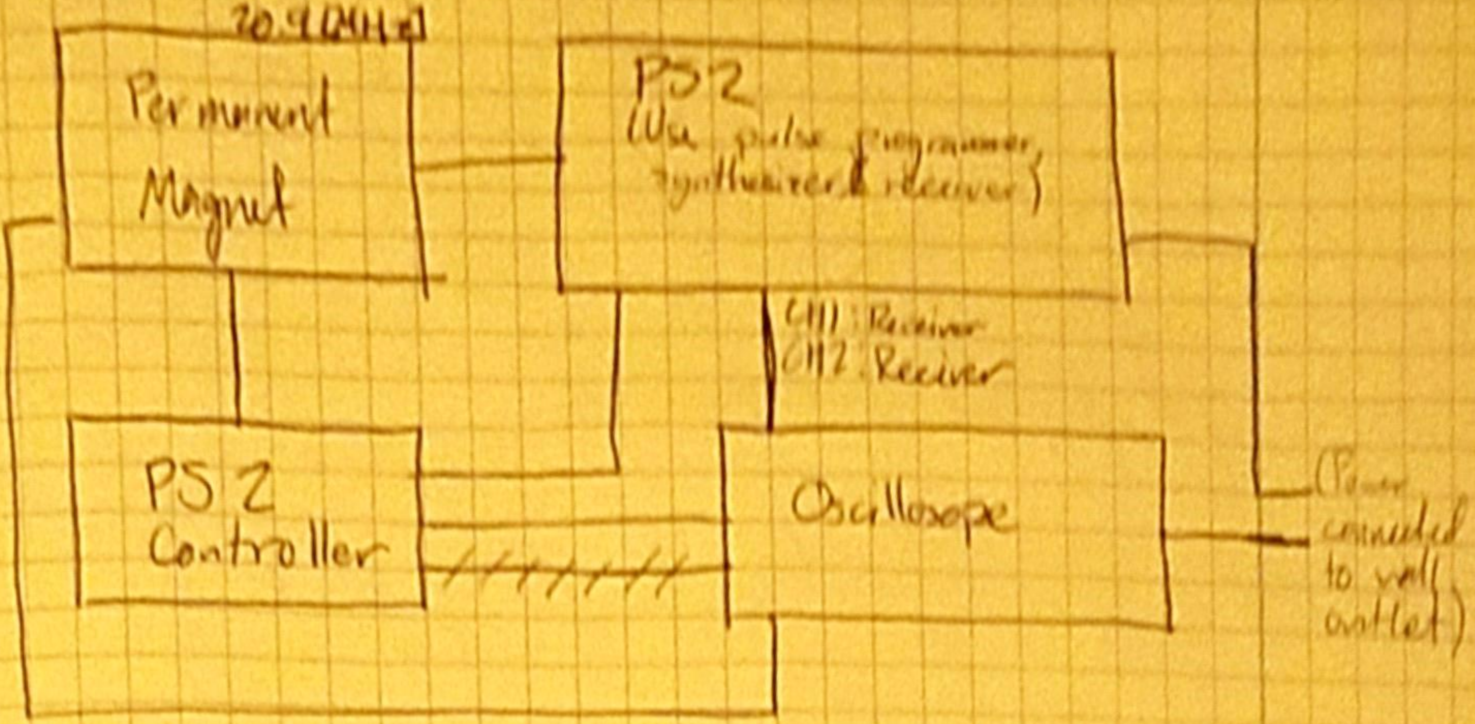
Setup



For Presenting:

Main Idea: Kitt: 2 – Spin-Lattice and Spin-Relaxation Times
Glass: 1 – Magnetic Resonance

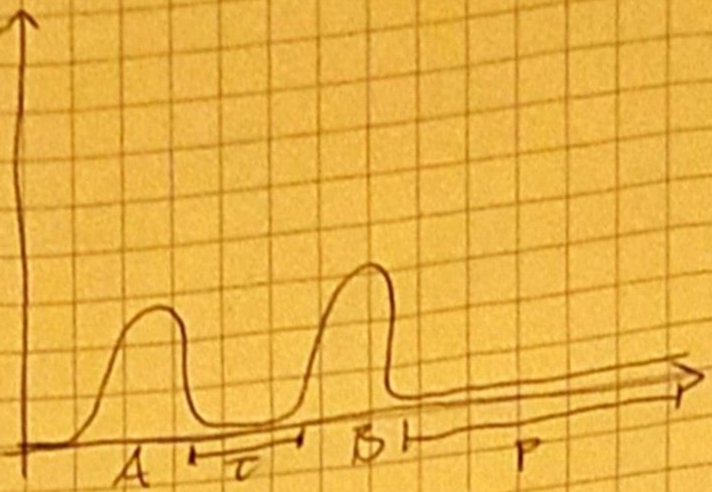
Equipment: Kitt: 2 – Delay Time
Glass: 1 – Pulsed NMR Spectroscopy

Data Analysis: Kitt: 2 – Delay must be 10x relaxation time. Why?
Glass: 1

Procedure Steps.

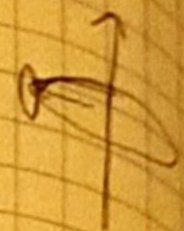
1) Power on!
2) Samples may need to be remade (week 1 only)
3) Set up oscilloscope – Vertical scale 1V, sweep 2[us]/division, rad. edge, (printout)
4) Red = too warm, green = cold. Set temp so light is off. Lock in.
5) Close loop until done. (Then resume printout)
6) Tune the magnet – pickup coil at 39 [mm] from stops, probe on CH 1 – 3.6 [V] peak to peak
7) Set magnetic field, then lock down.

NMR
Notes



$< M_z = N_0$ / V

Magnetization



If we have more than 5[mm] in the tube, the sample will see a non-uniform field (as field is uniform only over a small range).

CH1: Free Induction Decay
CH2: Beat between resonance & ~~st~~ frequency.

Larmor frequency depends on ~~frequency~~ spin and field.

(20.92646

CH1 – uniformity; CH2 – resonance

90° pulse flips spin into xy plane.
180° pulse flips spins into opposite state

TOTAL spin. If ~1/2 are up and 1/2 are down → xy pl

Spins move to xy, but continue to precess around the z-axis with the same frequency.

Over time, spins will try to realign
When all spins are xy, we have maximum signal.
A 180° pulse won't give a signal initially

Electron Larmor frequencies are high enough and anti... are small enough that electrons don't significantly c... our data.

2.1131 78786317 12e-19

NMR
Notes
Week 2 Trial 1: ~~f=20.92722 22 [MHz]~~

$X=0.9, Y=0.77$
$Z=1.14, Z^2=1.67$
$F=20.92172$ [MHz]
$A=6.34$ [μs], $B=3.14$ [μs]

$f=20.92156$
$X=0, Y=0, Z=1.05, Z^2=1.52$
180° ~~$A_{km}=3.02$ [μs]~~ 6.6

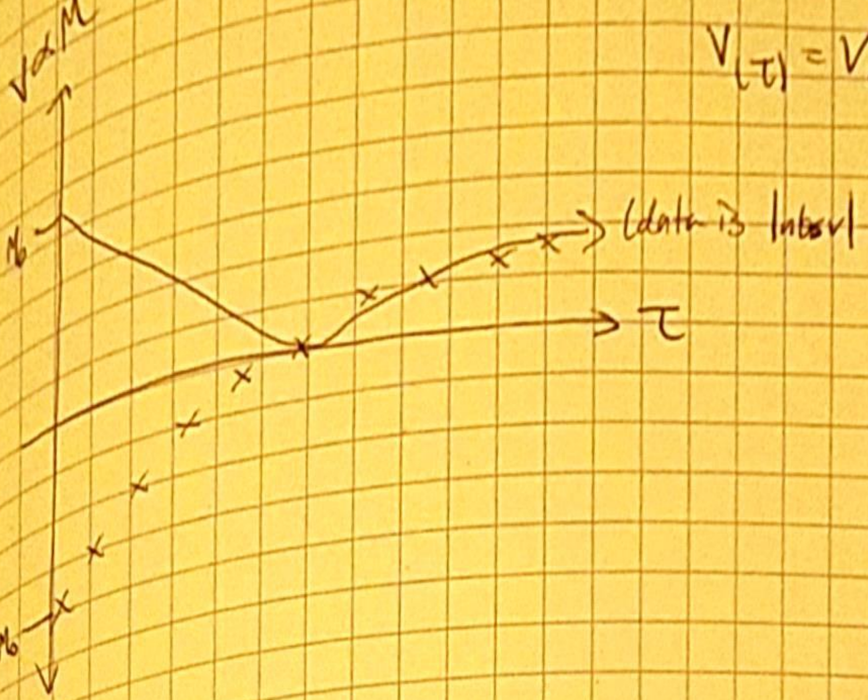
A is 180°, B is 90°

~~Same for week 3 for X, Y, Z, Z²~~

Week 3 Trial 1 (T2)
$F=20.92372$
$X=0.4, Y=-2.2, Z=1.05, Z^2=1.90$
$A=3.20$ [μs]
~~$\pi/4$~~
$B=6.30$ [μs]

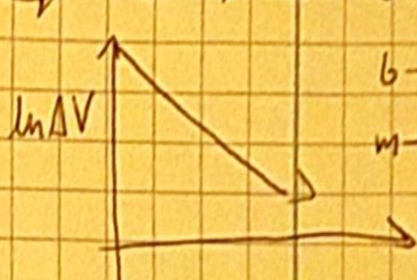
$$M_{(\tau)}=M_0\left(1-2e^{-\tau/T_1}\right)$$

$$V_{(\tau)}=V_0\left(1-2e^{-\tau/T_1}\right)$$



$$V_0-V_\tau=2e^{-\tau/T_1}$$

$$\ln(\Delta V)=\ln(2V_0)-\frac{\tau}{T_1}$$



$b \to V_0$
$m \to \frac{-1}{T_1}$

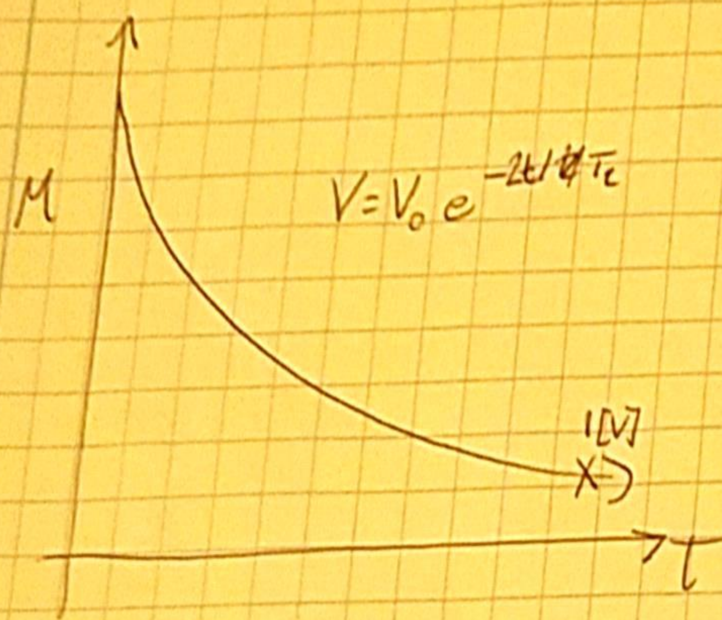
~~τ [s]~~	~~10 0.0001~~	0.0002
~~V_{pp} [V]~~	~~13.4~~	

Excel!

with graphs
~~T1:~~
~~T2: 500 [ms]~~
~~T2: 500 [ms] ±0.7 [ms]~~

NMR Notes

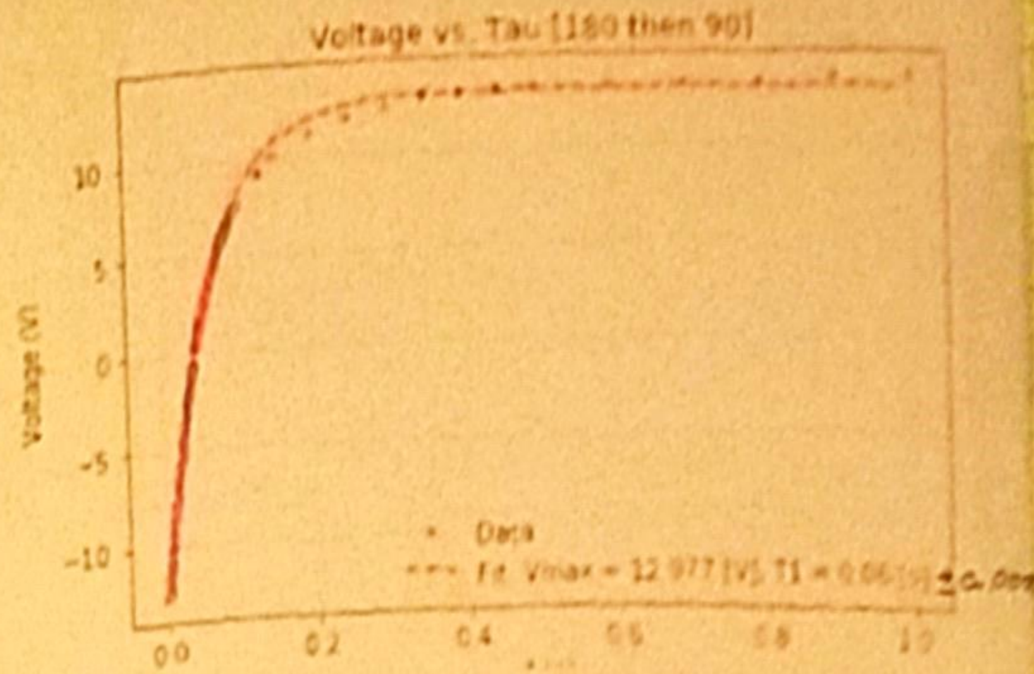
T2

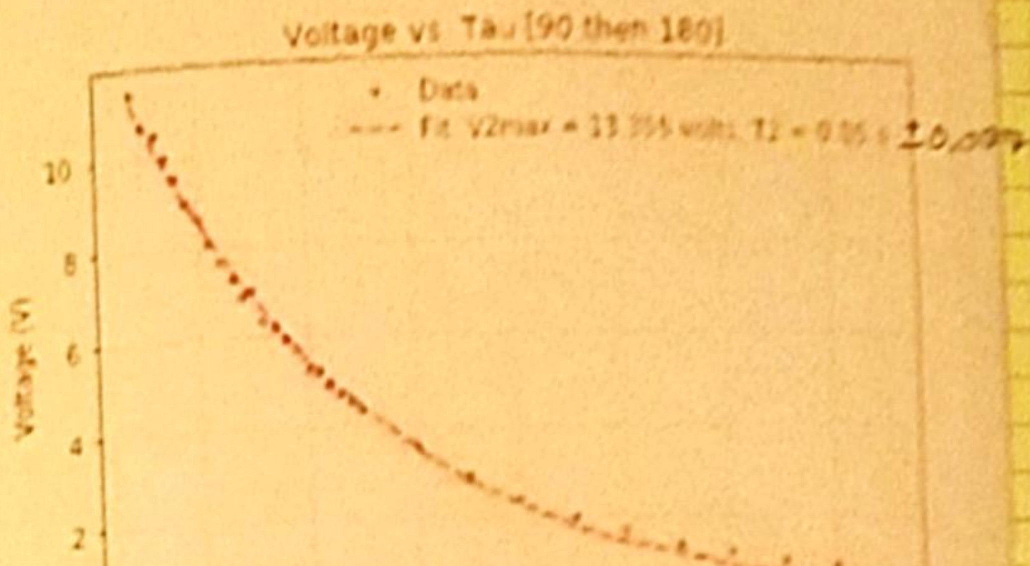


$V = V_0 e^{-2t/\cancel{\#}T_2}$

(No need for converting V to M, they're proportional

NMR Data


Voltage vs. Tau [180 then 90]
Voltage (V)
Data


Voltage vs. Tau [90 then 180]
Data
Voltage (V)
Tau (s)