

magnETHical

BUILDING A 25 MHz NMR SPECTROMETER

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“What I cannot create, I do not understand”

—Richard Feynman

WHY?

Why NMR?

- Education (Quantum Mechanics, Quantum Computing, ...)
- Research (Structure Analysis, Drug Discovery, ...)
- Medicine (Imaging, Diagnosis, ...)
- Industry (Process Control, Drug screening, ...)

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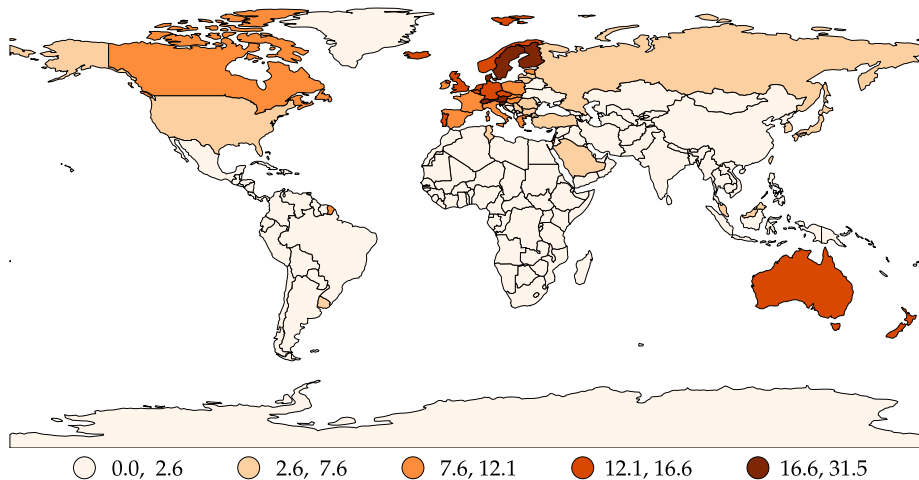
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Accessing NMR in the South is hard



NMR affiliations
million people

Our task is to build this machine ourselves!

WHAT ALREADY WORKS

The power amplifier

The switch

Our NMR is affordable ...

Part	Price incl. VAT [CHF]
Power Amplifier	36.01
Switch	20.05
Probe	≈15.00
Low-Noise Amplifier	73.11
Shim Driver	257.08
Console	741.55
Magnet	≈9000.00
Sum	10142.80

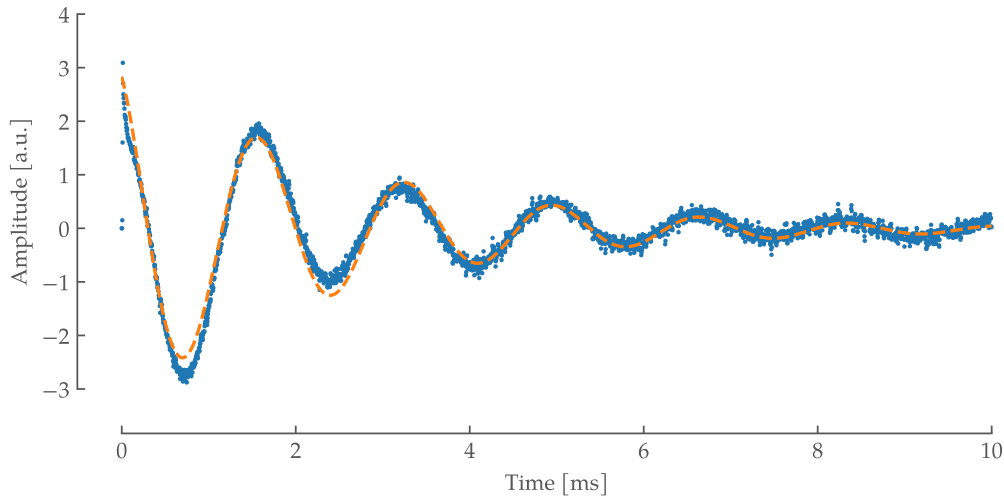
... and competitive

	Traditional	Benchtop	<i>magnETHical</i>
Price	200–18 000	60–150	≈10 k CHF
Frequency	600–1200	45–125	25 MHz
Resolution	≈1	0.2–12	≈50 [†] Hz
Weight	600–15 000	5–1000	≈5 kg

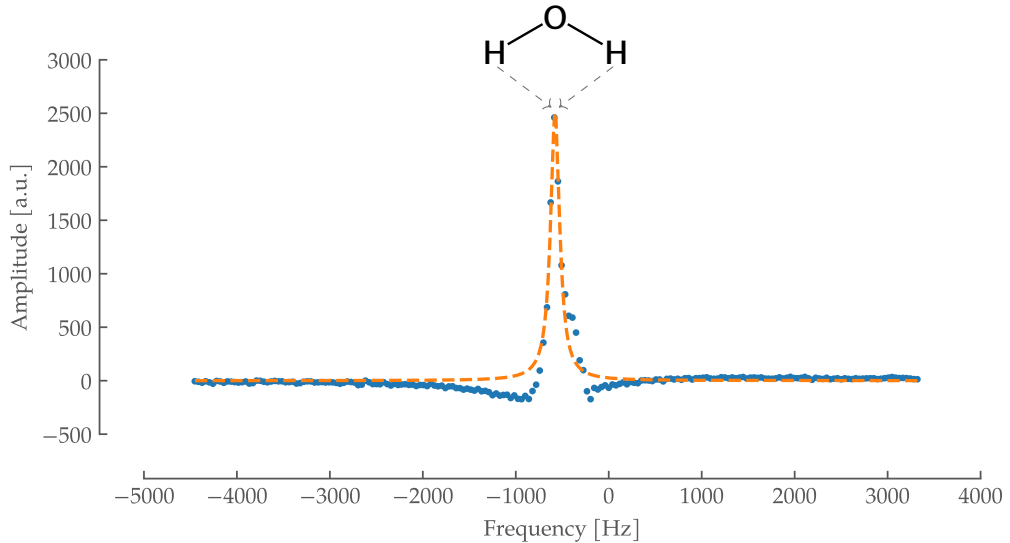
[†]without shims — 10x improvement expected with shimming

CURRENT MEASUREMENT CAPABILITIES

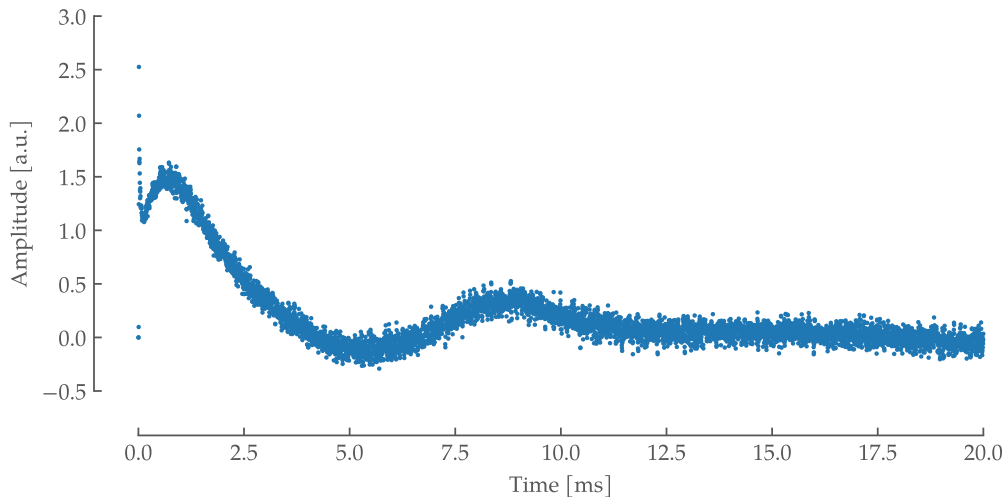
We can already see a water FID



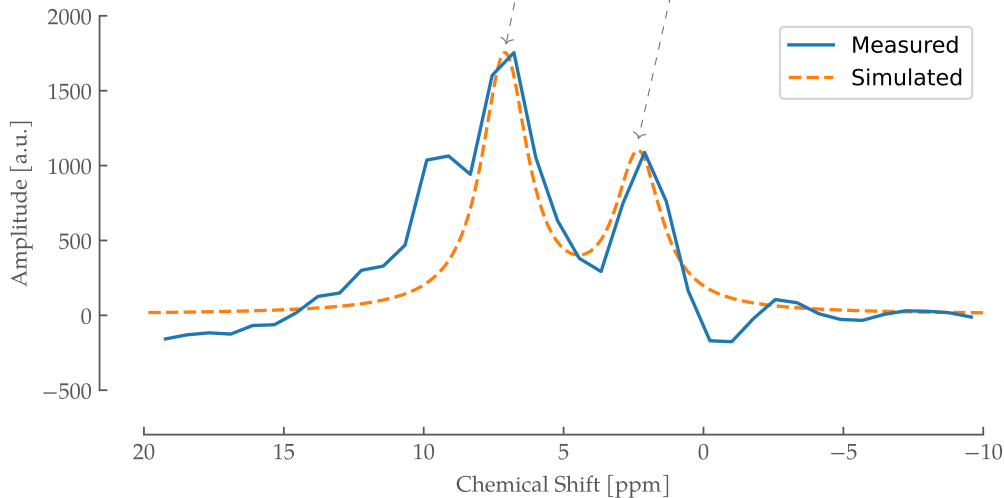
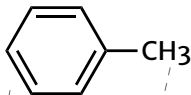
...and do a Fourier transform



Toluene also has a visible signal



We can even see the Toluene peaks!



Demo time!

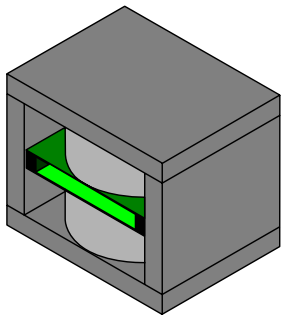
The setup is working

“I have not yet lost that sense of wonder, and of delight, that this delicate motion should reside in all ordinary things around us, revealing itself only to him who looks for it.”

“There the snow lay around my doorstep – great heaps of protons quietly precessing in the Earth’s magnetic field.”

— E.M. Purcell

Thank you!



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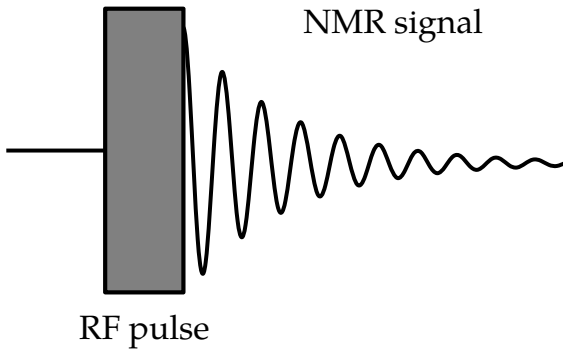
Find everything on



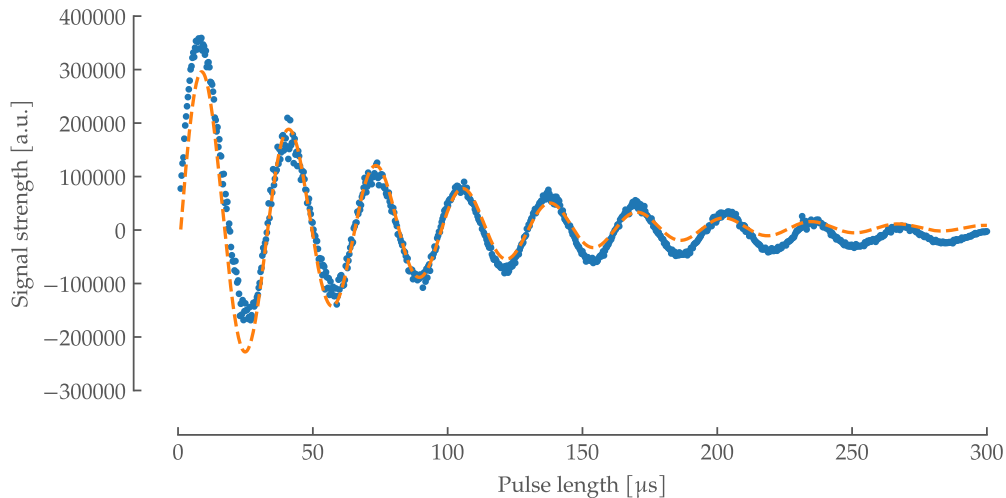
[https://gitlab.ethz.ch/mstabel/
nmr-spectrometer](https://gitlab.ethz.ch/mstabel/nmr-spectrometer)

Backup

Simple Pulse Sequence



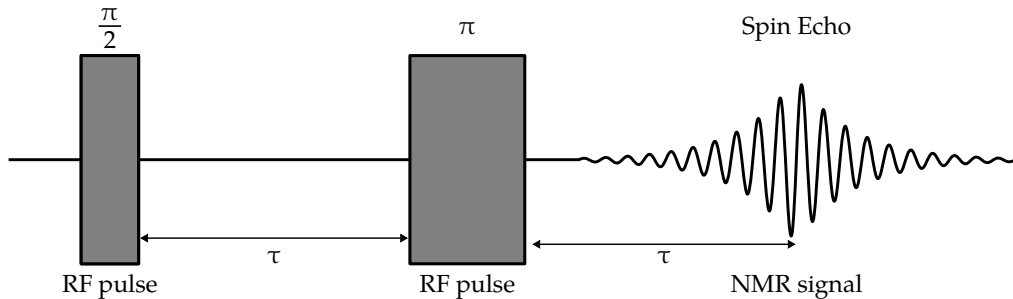
Rabi nutation of water



Spin Echo Animation

T2 Decay Animation

Spin Echo Sequence



T2 decay of water

