DEPARTMENT OF
CHEMISTRY & BIOCHEMISTRY

University of Maryland, College Park
Analytical NMR Service & Research Center

Updated by Fu Chen
January 2023

NMR Facility Safety Orientation

How to get help: Contact Us !

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How to look NMR Basic information and Training notes.

What is in a Basic Level Check Out?

How to reserve NMR time?

How to keep all of us SAFE !

How not to break NMR tubes!

https://blog.umd.edu/nmr/

NMR Spectrometers Safety Aspects

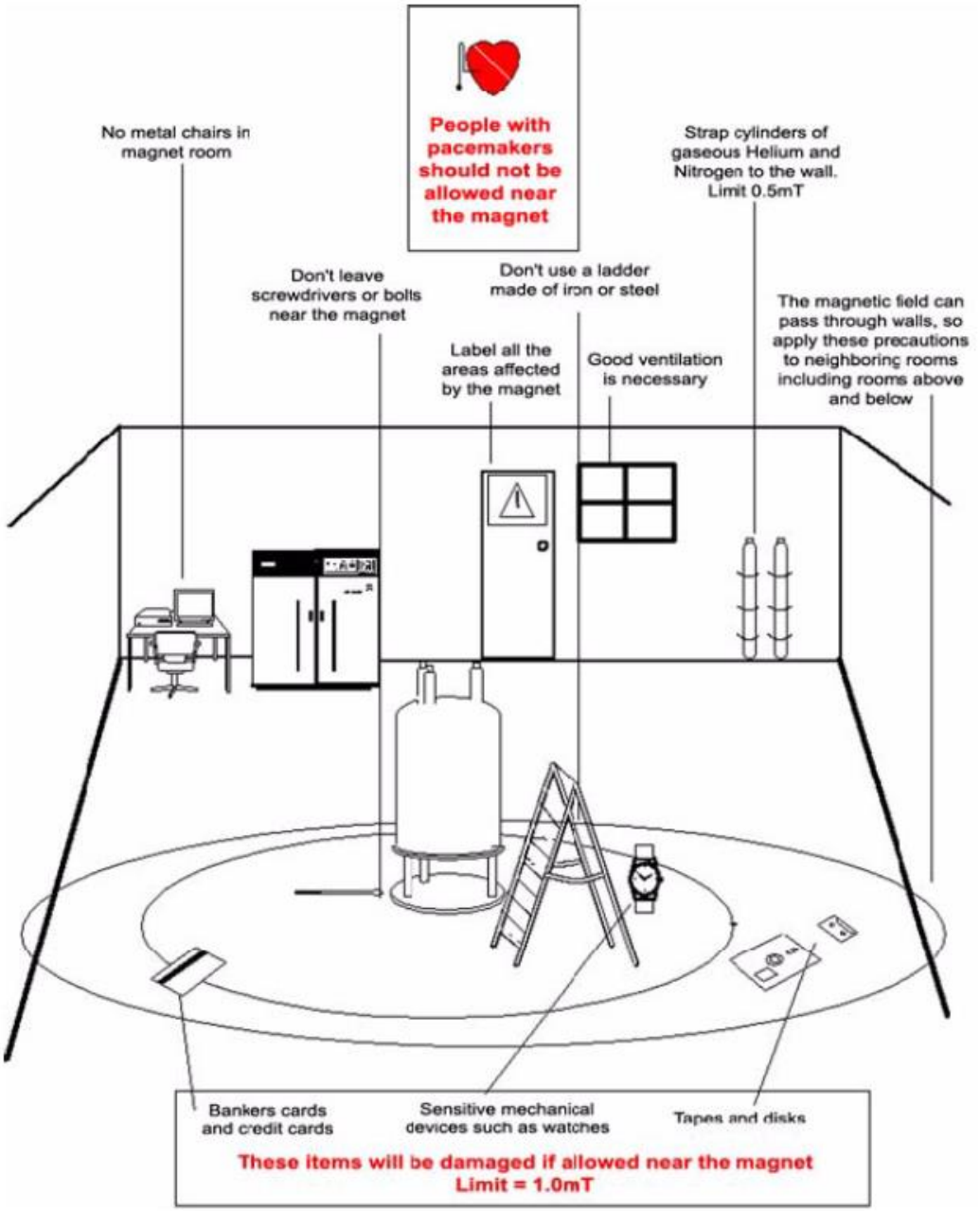
- Magnetic Safety
  - Safety Precautions within the Inner Zone
  - Safety Precautions within the Outer Zone
  - Magnetic field strength: 4.7 – 14.1 T in our NMR facility
  - Earth field strength: 25 to 65 μT

- Cryogenic Safety
  - Liquid N2 (77K) refill once a week
  - Liquid He (4.15K) refill once for a few months

- Electrical Safety
  - High voltage: 208 V

- Chemical Safety

Figure 2.1


People with pacemakers should not be allowed near the magnet
No metal chairs in magnet room
Don't leave screwdrivers or bolts near the magnet
Label all the areas affected by the magnet
Don't use a ladder made of iron or steel
Good ventilation is necessary
Strap cylinders of gaseous Helium and Nitrogen to the wall. Limit 0.5mT
The magnetic field can pass through walls, so apply these precautions to neighboring rooms including rooms above and below
Bankers cards and credit cards
Sensitive mechanical devices such as watches
Tapes and disks
These items will be damaged if allowed near the magnet
Limit = 1.0mT

Potential Risks of All Super-Conducting Magnets!

Non-shielded Magnet 1996

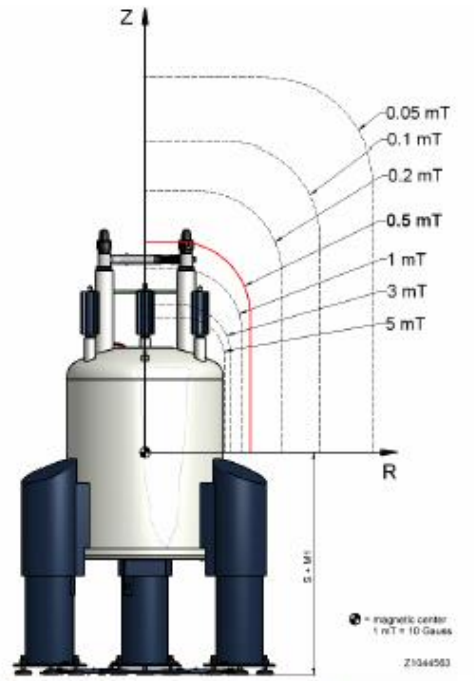
Ascend Magnet 2019

Ultra-shielded Magnet 2007

NEW BRUKER 500 MHZ NMR MAGNET: 2019

Bruker BioSpin

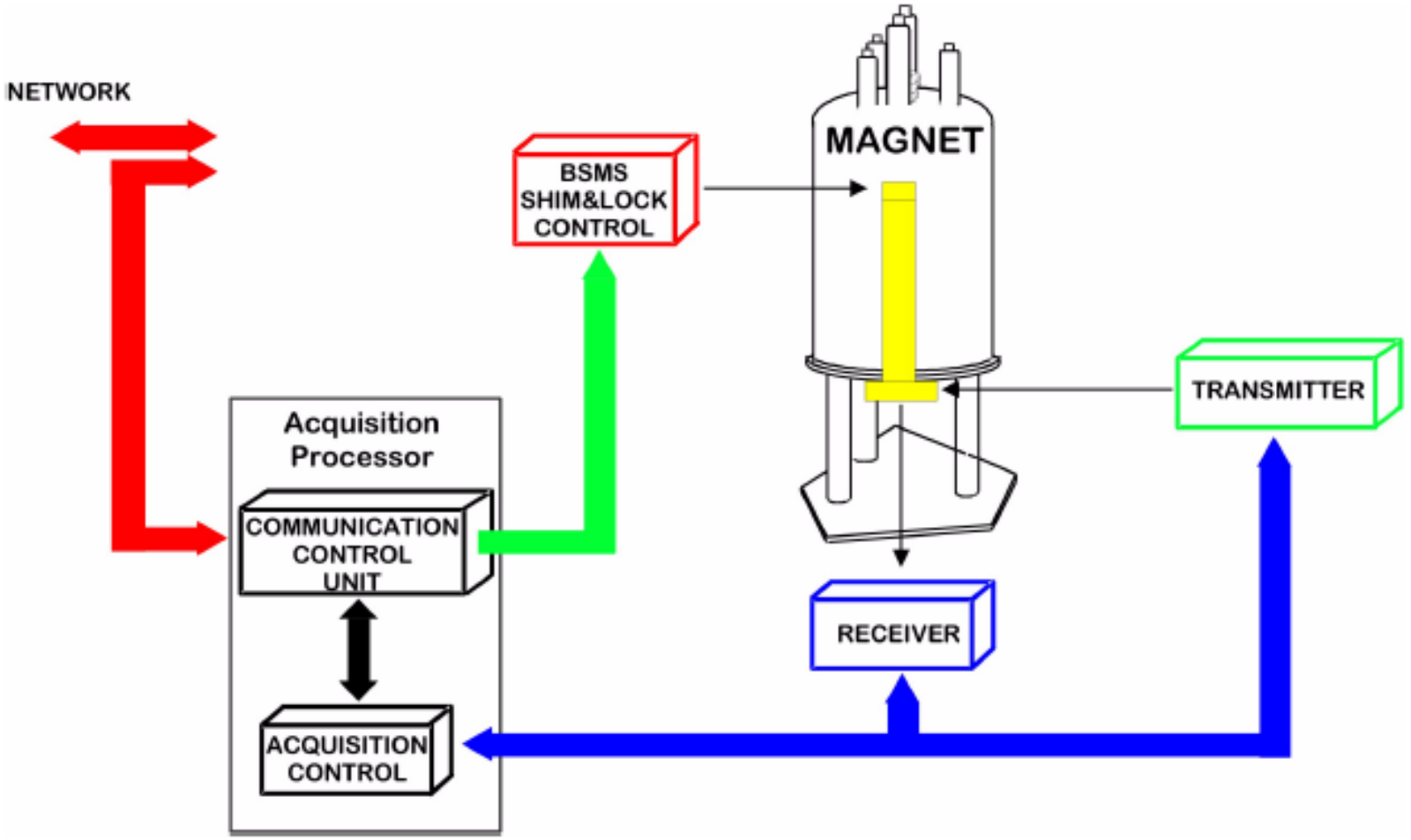
Fringe Field Plot



Fringe field contour	Radial [R]	Axial [Z]
200 mT (Directive 2004/40/EC)	Inside cryostat	Inside cryostat
5 mT	0.47 m	0.80 m
3 mT	0.50 m	0.87 m
1 mT	0.56 m	1.06 m
0.5 mT (5 Gauss)	**0.60 m**	**1.20 m**
0.2 mT	0.74 m	1.48 m
0.1 mT	0.96 m	1.75 m
0.05 mT (~Earth magnetic field)	1.26 m	2.09 m

2.7 AVANCE Architecture Overview

Figure 2.2

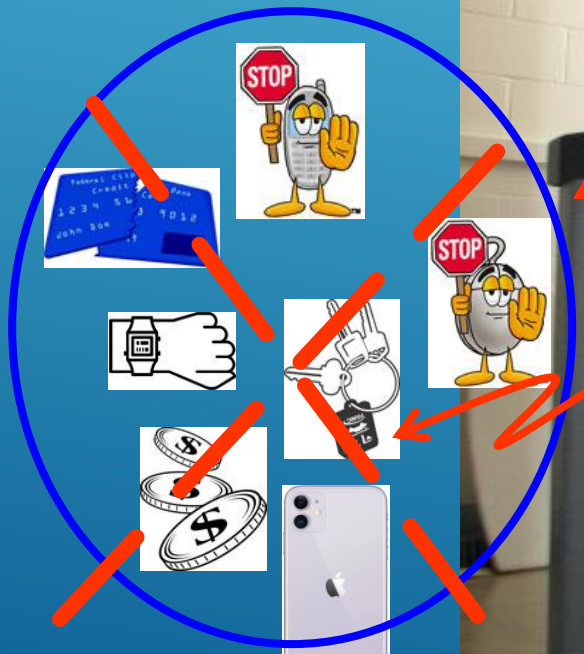


LAB SAFETY

- never go into back of spectrometer consoles (high voltages: 208V)
- use care around antivibration platform/legs
- always be vigilant with VT
  - use appropriate care with cryogens; cryogen fill rooms are intrinsically unsafe!!
  - no ice build-up on magnets; heating tape on
  - keep probes within specified VT range

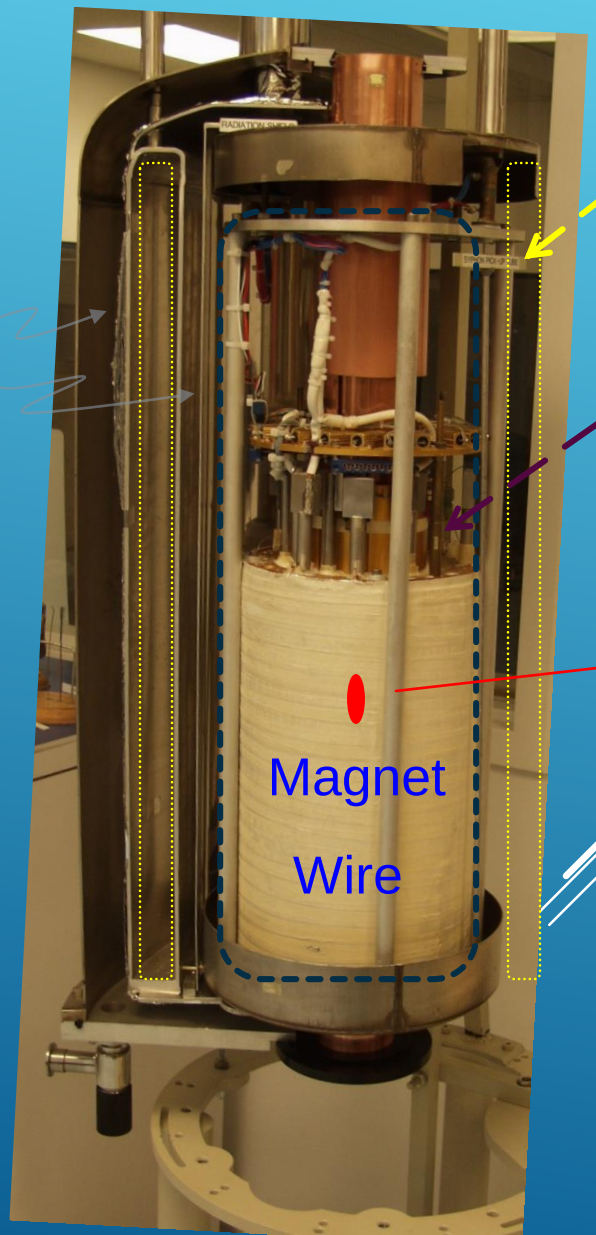
    BBFO probe: -150 °C temp +120 °C
- correct use of decoupler (watch pl1 pl ….)
- staples, paper clips, tools

STRONG MAGNET FIELD: EVEN FOR A SHIELDED MAGNET



CROSS-SECTION – SUPER CONDUCTING MAGNET

UNIVERSITY OF MARYLAND



Outer cylinder
Liquid Nitrogen

Inner tank

Liquid Helium 3K

Insulation layers
at high vacuum

Magnet
Wire

NMR sample

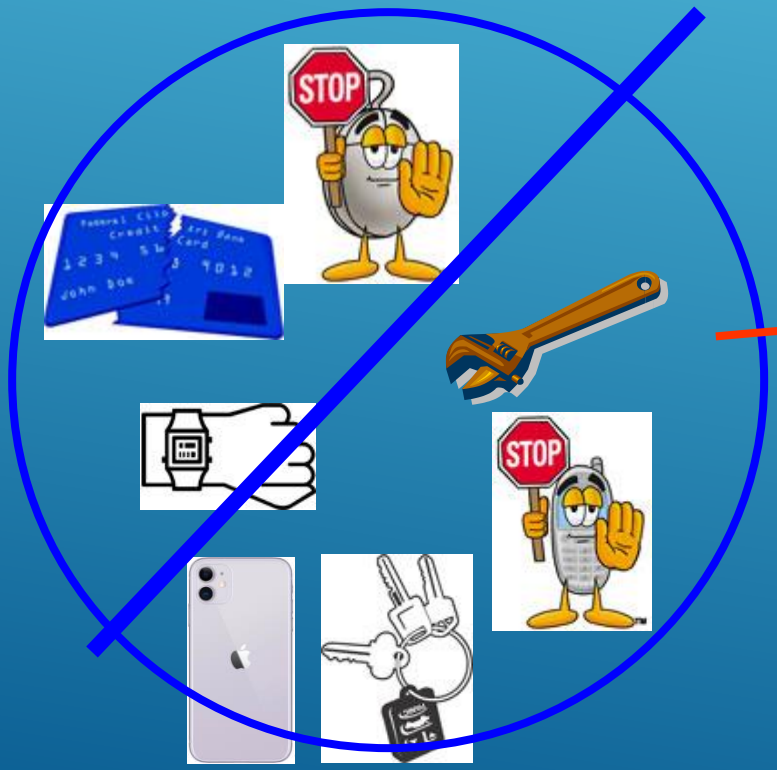
Center of strongest
magnetic field

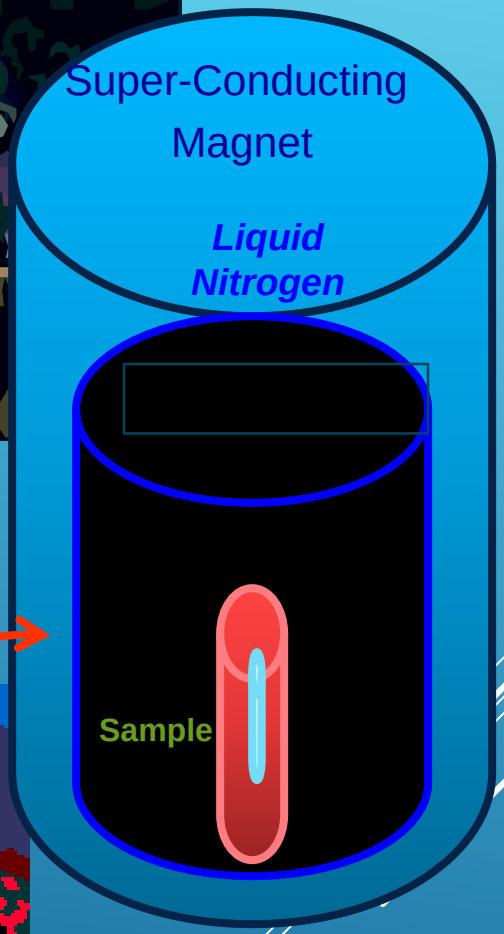
Refill Liquid Nitrogen

Refill Liquid Helium

WHEN TANKS TOUCH (SHORT) --- INSULATION IS THEN BROKEN --- CRYOGEN BOILS OFF ALL AT THE SAME TIME ---

HIGH PRESSURE BUILDS UP!

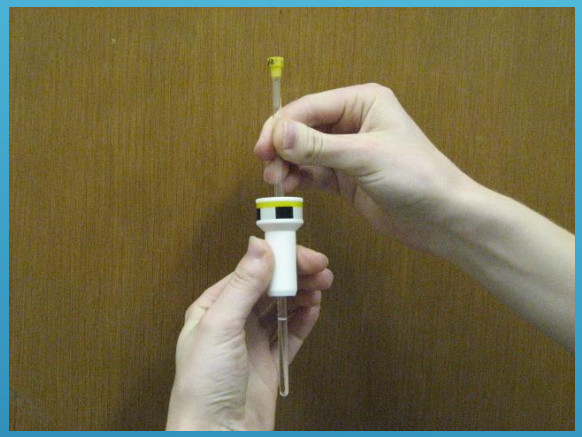




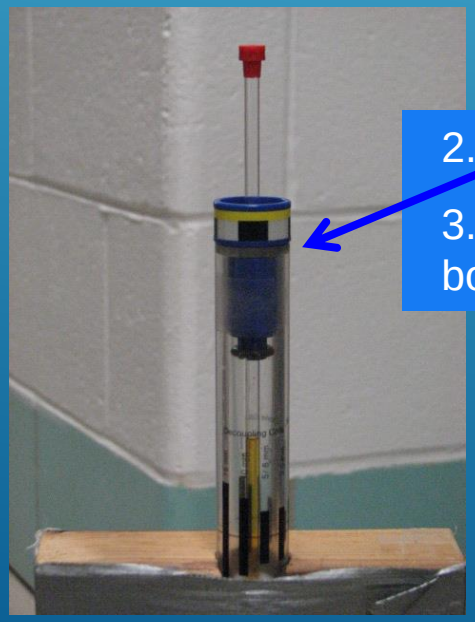
HOW TO (NOT TO) BREAK A NMR TUBE?

RECOMMENDED WAY TO ***INSTALL NMR SAMPLE INTO A ROTOR***

- Select the blue plastic spinner (rotor) from the bench

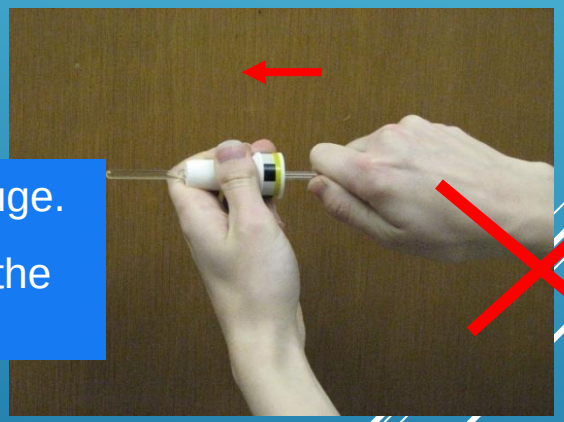


1. Hold the NMR tube steady and gently rotate the spinner & push it upward along the NMR tube!



2. Place the spinner on the depth gauge.

3. Push gently the tube till it touches the bottom of the gauge

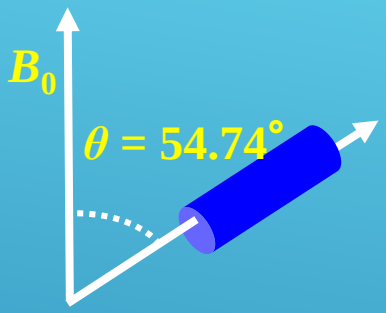


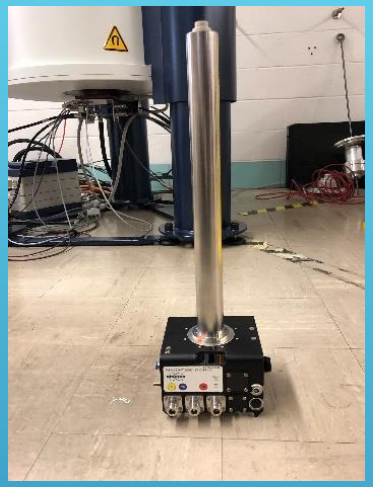
Fragile!

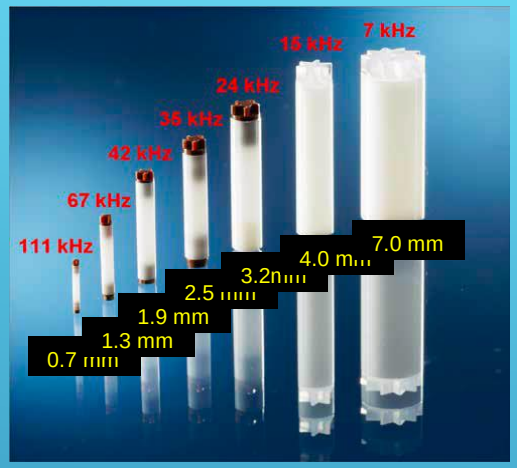
Paint on Spinner washed away by solvent

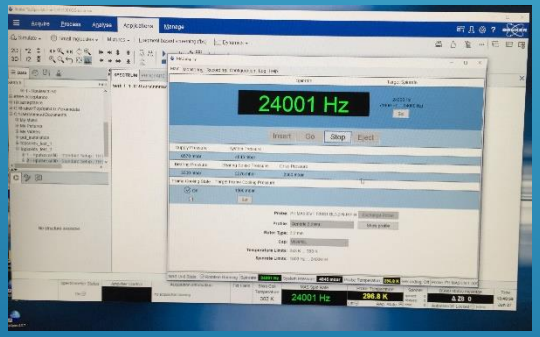
Tube broken in probe

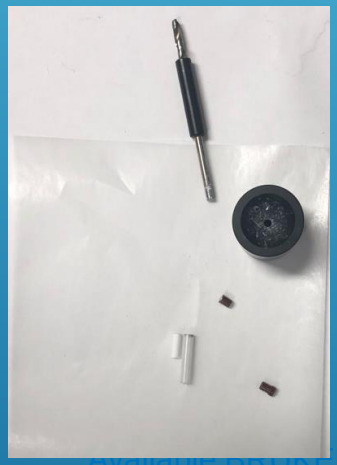
Bruker solid-state NMR spectrometers and probes

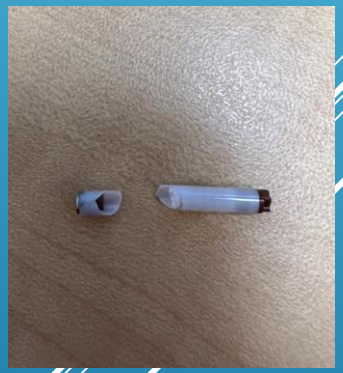












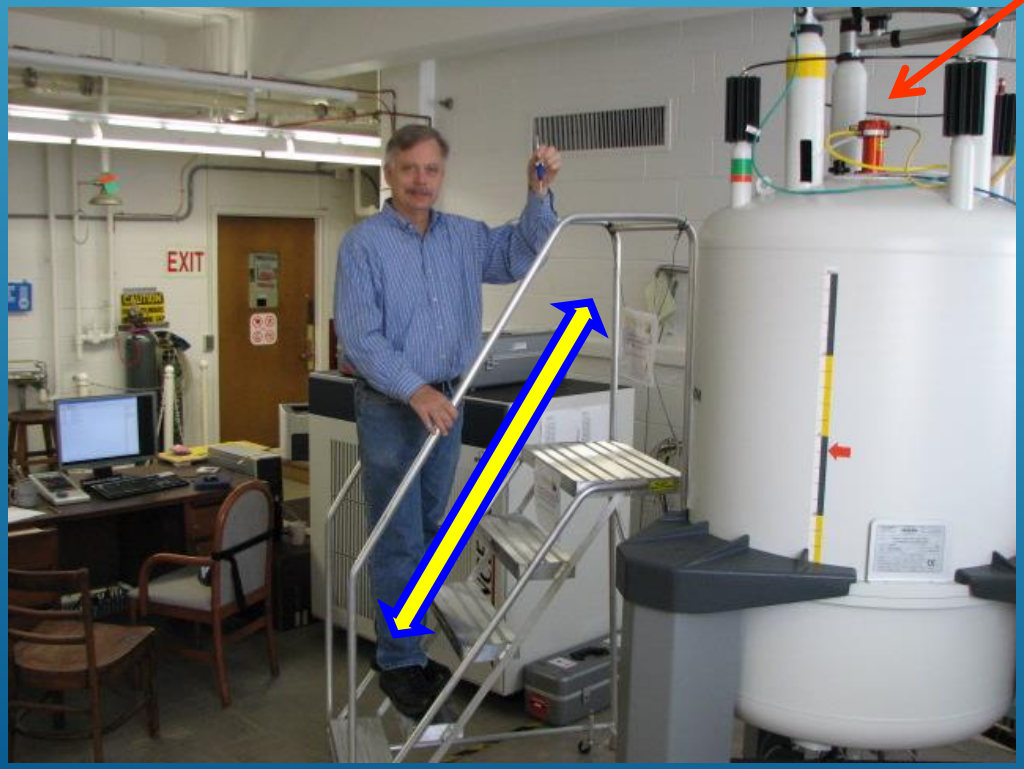
https://www.youtube.com/watch?v=VE-raM5o_Yc

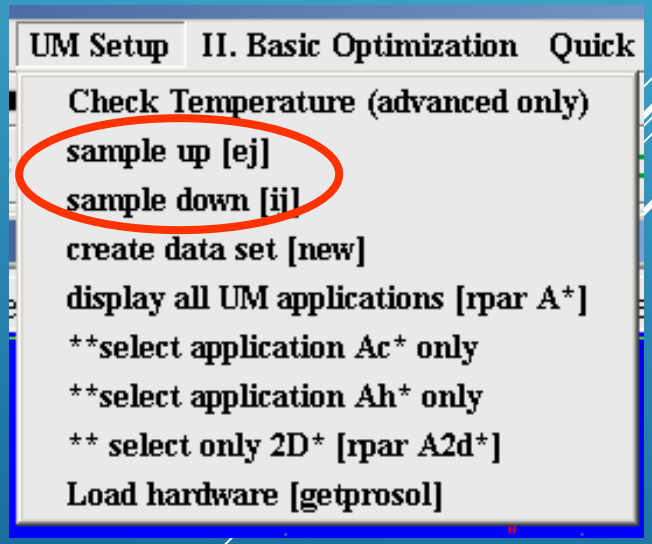
Available BRUKER MAS rotor diameter ranging from 7 mm down to 0.7 mm, providing MAS frequencies as high as 111 kHz.

HOW TO LOAD NMR SAMPLE INTO THE MAGNET !

Extreme care
when step up and/or down
(backward only) to change your
sample !

Open Topspin Software, type **ej**, it will release a strong compressed air at the top opening of the magnet.

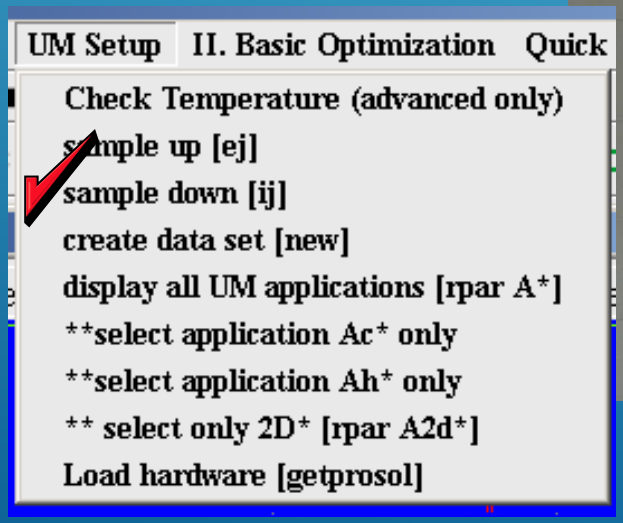




1. Take the standby dummy sample & spinner out (for basic NMR 400 only) .
2. Carefully place your sample & spinner into the opening.

Before releasing the NMR tube & spinner, ensure there is enough air pressure at the insertion port of the magnet!

3. Type **ij**, sample will slowly transfer into the magnet.



NMR sample
and spinner

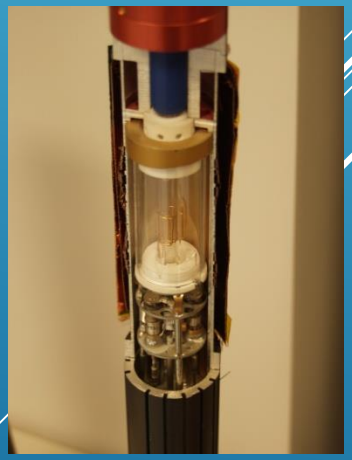
Shim stacks

~ 3 feet

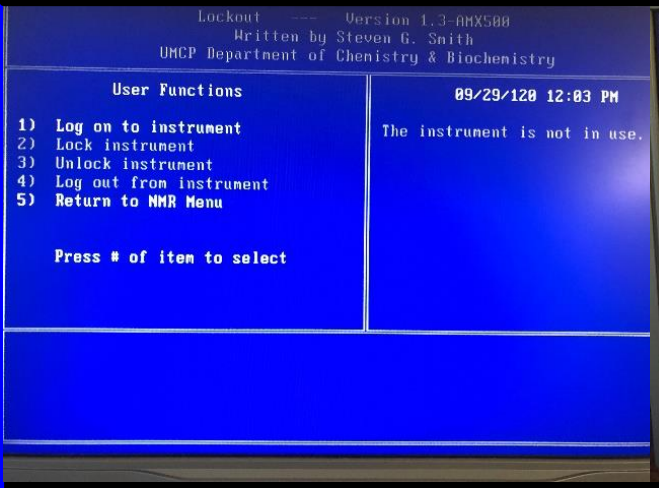
Magnet

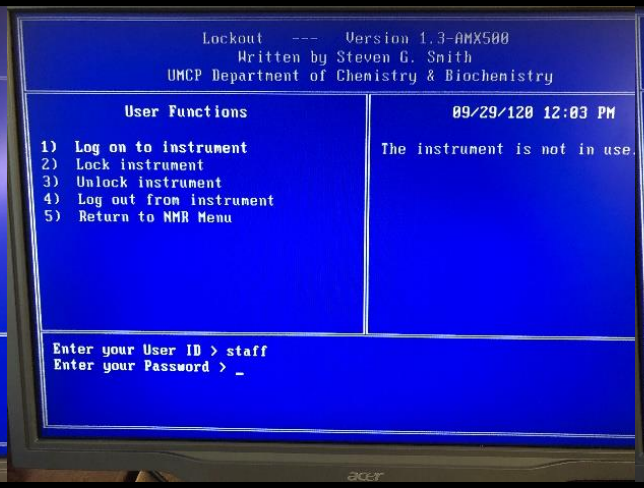
A free fall without air support will break a NMR sample !

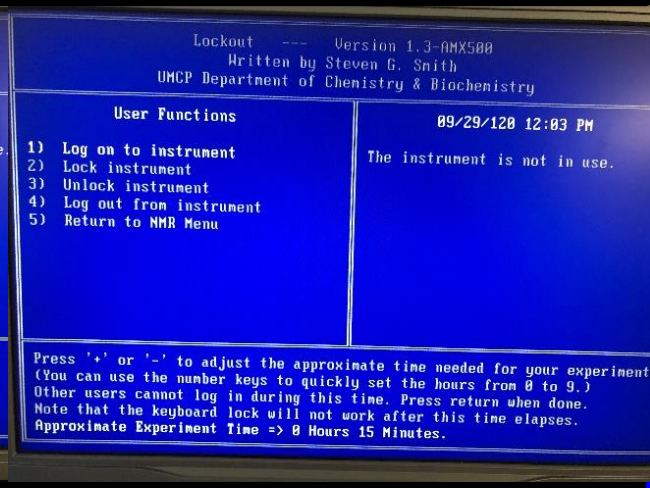
Probe cross-cut enlarged



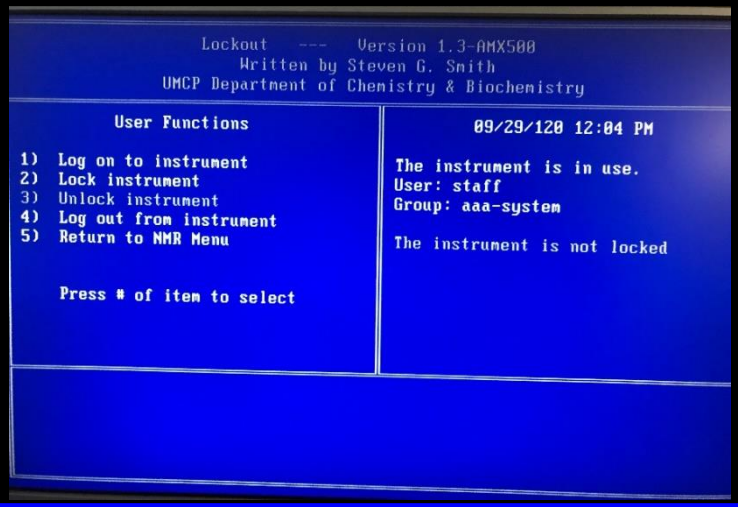
Log on

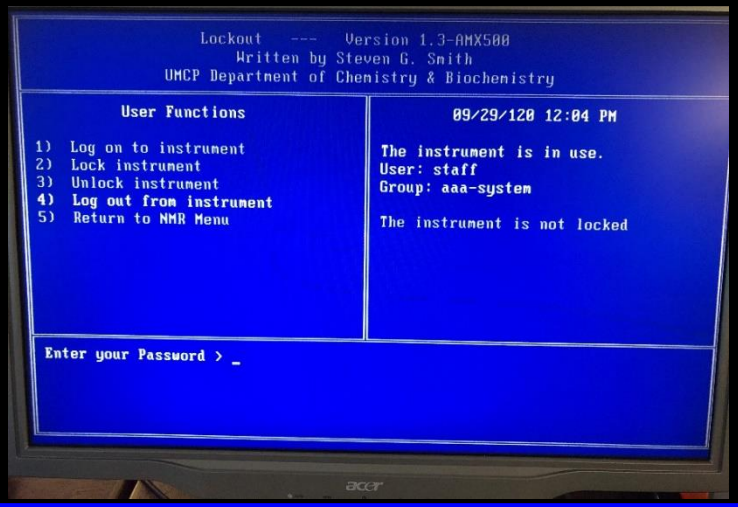






Log out





SUMMARY:
SAFETY IN NMR LABORATORY:

- Magnetic field is permanent; exists even when electric power is out.
- Pined or caught between the magnet and any external metal object could be FATAL!
- Person with heart pacer and/or metal implant cannot get access to NMR due to potential health hazard.
- Keep all metal objects at least 10 ft away from magnet.
- Keep all credit cards, watches, keys, cell phones also away from the magnet.
- Admit students taking this course only.

CONCLUSION OF NMR ORIENTATION

- Sign your liability weaver in the User registration Log!
- Criteria for basic NMR check out:
  - Proper Shimming (Manually).
  - Obtain a routine H-1 1D spectrum within ten minutes.
  - Basic processing (proper use of layouts; list parameters, shifts and integration).
  - Transfer raw data to NMR workstation.
- Dead-line for check out:
  - Four weeks from date of orientation.
  - Late penalty: $100 per user.
  - Contact me via e-mail: fchen127@umd.edu.