

NMR Lab  
C008 BNSN  
422-2054

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## Safety Information

NMR requires very strong magnetic fields and the following safety guidelines *must* be followed:

- **Individuals with medical devices (e.g. cardiac pacemakers and metal prostheses) must remain outside the 5-gauss perimeter.** The strong magnetic fields near the magnet dewar can affect the operation of some pacemakers and harm implanted or attached devices, such as prosthetic parts and metal blood vessel clips. Persons with medical concerns should contact their physicians about possible health risks before approaching the magnets.
- **Floppy disks, cards with magnetic strips, cellular phones, laptops and mechanical watches should remain outside the 5-gauss perimeter.** Strong magnetic fields can damage the strip of magnetic media found on credit cards, ATM cards, driver's licenses, and other types of cards. Floppy disks, cellular phones, and laptop computers are also susceptible to damage inside this perimeter. Mechanical wrist and pocket watches may also malfunction and be permanently damaged when exposed to a strong magnetic field.
- **Metal objects must remain outside the 5-gauss perimeter.** The strong magnetic fields near the magnet attract objects containing steel, iron, and other ferromagnetic materials. Common examples are tools, electronic equipment, compressed gas cylinders, chairs, and carts. Unless restrained, such objects can suddenly fly toward the magnet, causing personal injury and damaging the probe, dewar, and superconducting solenoid. The greater the mass of the object, the more strongly it is attracted by the magnet. Only non-ferromagnetic materials should be used near the instruments.
- **In the event of a magnet quench, leave the room immediately and contact the NMR Supervisor.** A quench refers to the sudden release of gases from the dewar. Rapid expansion of liquid helium or liquid nitrogen to the gas phase may displace breathable oxygen in an enclosed space, resulting in an asphyxiation hazard. Do not re-enter the room until the oxygen level has returned to normal.
- **Be careful with sample tubes as they are fragile and break easily.** It is easy to break the sample tube when inserting or removing it from the turbine. Be gentle.
- **Do not exceed the boiling or freezing points of your sample.** A sample subjected to a temperature change can build up excessive pressure, which can break the tube and project broken glass and chemicals out of the magnet bore. To avoid this hazard, establish the freezing and boiling points of a sample before doing a variable temperature experiment, and never rapidly heat or cool a sample. Always wear safety glasses near the magnet when performing variable temperature experiments.
- **You are responsible for following the chemical hygiene plan of your lab.** If you break any samples and/or spill any samples in the NMR facility, you must alert Dr. Burt and take appropriate steps to clean up the spill. All sample preparation and disposal should be done in your own lab. You need permission from Dr. Burt to prepare samples in the NMR facility prep room (C008B).

## Policies

You must follow these policies if you want to use the NMR facility.

- **Chemicals** – The NMR Facility is *not* a wet lab.
  - No chemical transfers are to be done in the lobby, by the computers or the magnets.
  - All samples should be prepared in an NMR tube *before* entering the lab. You must remove your sample and dispose of it properly in your own lab.
  - If your experiment requires immediate data acquisition after titrating a sample, you *must* use the preparation room (C008B). However, you should alert Dr. Burt and you must clean up after yourself.
  - Alert Dr. Burt of any chemical spills or broken NMR tubes regardless of how small it may appear. This is particularly true if the sample breaks inside the magnet; if such an incident is not immediately reported, it can lead to equipment damage costing thousands to tens of thousands of dollars to fix.
- **Samples/Clutter** – *Do not* leave your samples lying around the lab. If you are working with several samples, please label each sample with your name and the date. Sample tags are available in the desk in the lobby (the drawer marked *Sample Tags*). You have spent a lot of time and effort to make your sample, don't lose all that hard work through carelessness.
  - Unlabeled samples will be removed from the facility.
  - Labeled samples more than a week old will be removed from the facility.
  - Misc. glassware and other clutter (print outs etc.) left on the desks will be removed.
  - **If you don't want to lose your stuff, take it with you when you leave or clearly label to whom it belongs, why it has been left there, and when it will be removed.**
- **Scheduling time on the instrument** – You *must* schedule time on the Varian instruments using the scheduling page. Courses like Chem 465 have blocks of time already scheduled; students who need magnet time on the Varian instruments outside of the scheduled class hours should ask their T.A. or Dr. Burt for help scheduling the magnet.
  - If you are not scheduled to use the magnet, you may be kicked off the instrument at any time by someone who has scheduled time.
  - If your experiment runs over your allotted time and into someone else's scheduled time your experiment may be terminated.
  - If you need to run exceptionally long experiments, schedule time overnight or during the weekends.
  - Abuse of instrument time and lack of scheduling will result in termination of your NMR privileges.
  - If you require special blocks of time or very large blocks of time, please speak with Dr. Burt and he can help schedule the instrument for you.
  - If you are having trouble accessing the scheduling page, see Dr. Burt to ensure that your account has been added to the NMR user list.
- **Your data** – You are responsible for saving your own data and making your own backups. If you acquire data using the study queue, your data will be automatically saved to the network drive. If you desire to make personal backups, you may copy your data to a USB drive. If you need assistance backing up your data, please ask Dr. Burt for help.

## Equipment

- **Varian Inova 300 MHz System** – This instrument includes
  - A quad-nucleus probe, allowing straightforward collection of  $^1\text{H}$ ,  $^{13}\text{C}$ ,  $^{31}\text{P}$  and  $^{19}\text{F}$  spectra; i.e. no need to swap tuning inserts or change the tuning/matching capacitors.
  - Pulsed-field gradient capabilities to reduce artifacts in 2D experiments and improved automated gradient shimming.
  - A broadband probe is available, allowing detection of most NMR active nuclei. However, low frequency nuclei typically benefit from higher field instruments.
- **Varian NMR-S 500 MHz System** – This instrument includes
  - A OneNMR probe – this probe has several distinct advantages:
    - Auto-tuning on both the  $^1\text{H}$  and X channel. This provides access to all common heteronuclei as well as optimizing the matching/tuning for every sample, reducing artifacts and improving sensitivity.
    - Standard direct-detection  $^{13}\text{C}$  sensitivity for 1D Carbon acquisition.
    - Enhanced RF-coil homogeneity which provides  $^1\text{H}$  sensitivity similar to an indirect probe.
  - Standard direct and indirect probes are available, but require manual tuning.
  - All probes have pulsed-field gradients to reduce artifacts in 2D experiments and improve automated gradient shimming.
  - A 12 position 7510-AS sample changer is available.
- **Bruker Avance Neo 500 MHz System** – This instrument includes
  - A Prodigy cryoprobe – this probe has several distinct advantages:
    - Cryogenically (liquid  $\text{N}_2$ ) cooled RF coils and pre-amplifiers. This boosts the sensitivity of the  $^1\text{H}$  channel  $\times 2$  and the X channel  $\times 3$  vs vs the OneNMR probe on the Varian 500. This can speed up acquisition by a factor of 4 and 9, respectively.
    - Auto-tuning on both the  $^1\text{H}$  and X channel. This provides access to all common heteronuclei as well as optimizing the matching/tuning for every sample, reducing artifacts and improving sensitivity.
  - An iProbe is available. This probe has similar sensitivity as the Varian OneNMR probe and is also auto-tuning.
  - Both probes have pulsed-field gradients to reduce artifacts in 2D experiments and improve automated gradient shimming.
  - A 24 position SampleCase sample changer is installed to improve sample throughput..
- **Misc** – Several resources are available for your use in the facility
  - **NMR reference library** – a variety of NMR books are available on the shelves in the lobby. Feel free to use these books, but *please leave them in the NMR lab*.
  - **Data processing computers** – the computers in the lobby allow you to process your data without wasting instrument time.
  - **Instrument scheduling page** – you should reserve time on the Varian instruments. Check the NMR Facility webpage for the link to the scheduling page.