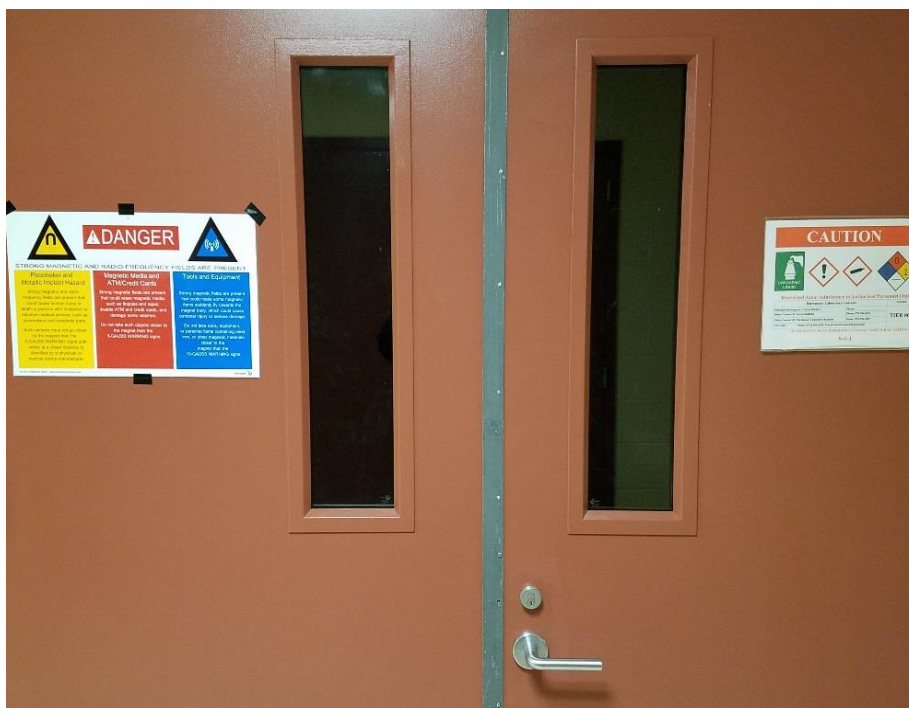


NMR Laboratory - EHS Supplement

A Nuclear Magnetic Resonance (NMR) spectroscopy laboratory has been established in Tiernan Hall room 008. This laboratory is under the direction of the Department of Chemistry and Environmental Science. The main hazards associated with the NMR laboratory include:

- I. Magnetic field hazards
- II. Cryogen hazards
- III. Oxygen depletion
- IV. Other safety considerations



Door to NMR Laboratory, room 008 Tiernan Hall

Magnetic Field Hazards:

NMR magnets will exert large attractive forces on equipment and tools made of ferromagnetic materials. Small items such as screwdrivers and wrenches may become projectiles, while larger items such as a compressed gas cylinder may present more severe hazards. Always observe the 5-Gauss line indicated by the plastic safety chain, hazard tape on the floor, and other laboratory signage. Remember, the magnets are always on. Damage may also occur to personal items such as credit cards, bank cards, university IDs, and other forms of magnetic media.

5 Gauss Exclusion Zone:

The 5-Gauss exclusion zone is indicated by hazard tape affixed to the lab floor. Ferromagnetic tools and other items, as well as bank cards and other forms of magnetic data, should be maintained outside the exclusion zone.



500 MHz NMR



300 MHz NMR

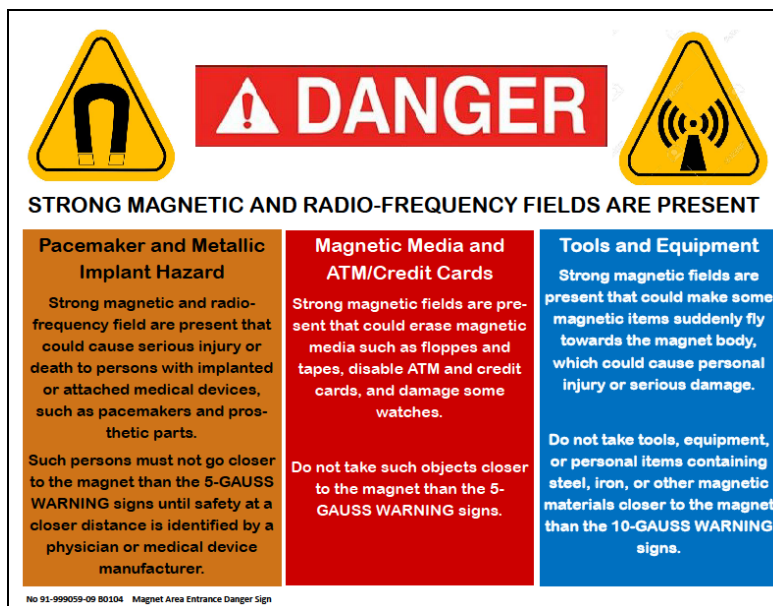
The NMR lab comprises two NMR instruments: a 500 MHz and a 300 MHz unit. The 500 MHz NMR is well shielded, and the 5-Gauss exclusion zone is measured three feet from the magnet. For the 300 MHz NMR, the 5-Gauss exclusion zone is measured five feet from the magnet. These distances are indicated by hazard tape affixed to the floor.

The NMR Spectrometer computer station is located outside the 5-Gauss line. EHS recommends that NMR end users remove personal items such as watches, jewelry, cell phones, bank cards, etc., and leave them beside the computer station before approaching the magnet.

Medical Implants:

Persons with medical implants such as pacemakers, biostimulators, neurostimulators, aneurysm clips, surgical clips should not enter the NMR laboratory. These medical implants may react to the magnetic field or be subject to the magnet's attractive forces, thereby causing injury, device failure, or even death.

Examples of NMR Warning Signs:



Cryogen Hazards:

NMR magnets utilize a large coil of superconducting wire immersed in a bath of liquid helium (temperature of 4 K). The wire passes electrical current without resistance (superconducting) only when adequately cooled by cryogenics and thereby generates the magnetic field. A sudden loss of superconducting properties can cause the NMR to quench, which is characterized by a rapid, loud, large release of cryogenic gasses from the magnet. The cryogenic liquids undergo tremendous expansion as they are vaporized into gasses and can displace the available oxygen in the lab. The cryogenic gasses themselves are inert.



During an NMR quench there is a rapid, loud, large release of cryogenic gasses from the magnet.

A cloud of water vapor can be observed created by the escaping cryogenic gasses.

If an NMR quench is observed, exit the lab immediately.

Contact the NMR Program Manager and NJIT Public Safety immediately.

Cryogenic liquids are also extremely cold and capable of causing severe burns if they contact the worker's skin. Appropriate personal protective equipment (PPE) shall be worn when handling cryogenics; including proper laboratory attire (closed-toe shoes, etc.) lab coat, eye protection (safety glasses, goggles or full face shield), and cryogenic gloves.

Oxygen Depletion Monitoring:

The NMR laboratory is equipped with an oxygen monitoring system and three oxygen sensors. Sensor number 1 is located at ceiling height, sensor number two is located close to the floor, and sensor number three is located mid-way between sensor one and sensor two.



Sensor 1 (ceiling level)



Sensor 2 (floor level)



Sensor 3 (mid level)

The oxygen monitoring system is programmed with a two-tiered alarm protocol:

1. At 19% oxygen, the system goes into a local alarm, which is both audible and visual. When the alarm sounds, the orange strobe light is illuminated, and the emergency exhaust system is activated, which exhausts room air directly to the external environment.
 - a. The oxygen monitoring system and the emergency exhaust system are hard-wired to the lab's uninterrupted power supply (UPS) designed to provide backup power for at least 30 minutes in the event of a power failure.
 - b. The system will remain in alarm until the oxygen level in the room returns to normal levels (~21% O₂) at which point the system will automatically re-set, the audible and visual alarms and the emergency exhaust fan will cease operation.
2. At 18% oxygen, the system operates as described above, but the alarm signal is also sent to the NJIT Department of Public Safety, who will dispatch an officer to respond.



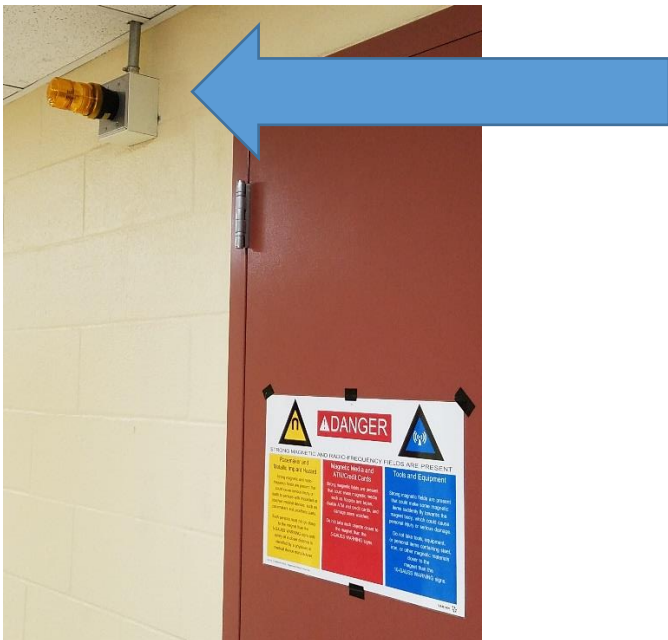
Visual orange strobe light inside lab T-008.

Note: There is an identical strobe light in the hallway directly outside room T-008.

The oxygen monitoring system in normal O₂ operating range

Emergency Response Protocol:

- When the oxygen alarm sounds, room occupants should exit the lab immediately.
- The room should not be re-entered until O₂ levels return to normal.
- If an NMR quench is observed, exit the lab immediately, contact the NMR Program Manager, and NJIT Public Safety immediately by calling 911.
- Responding Public Safety officers should look through view windows to determine if there is a lab occupant in need of assistance.
- Responding Public Safety officers should not enter the lab if the alarm is sounding and the orange strobe light outside room B008 is lit.
- In certain instances, the door to B008 may be opened to aid in the rapid dispersal of the inert cryogenic gasses.
- NJIT Public Safety should consult with the Environmental Health and Safety (EHS) Department concerning both typical and emergency NMR lab entry requirements.
- During off-hours, EHS personnel may be contacted using the NJIT Department of Public Safety emergency contact matrix.

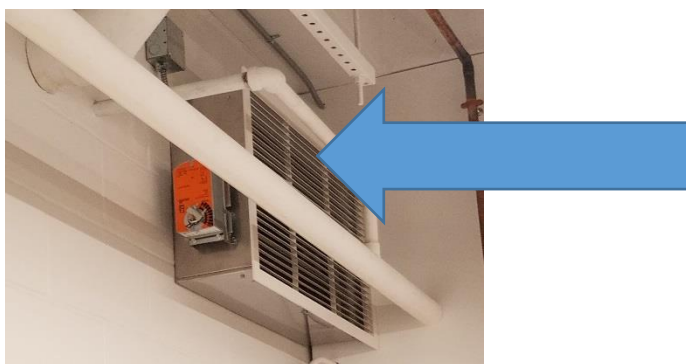


Visual orange strobe light in hallway directly outside lab T-008.

When lit, the orange strobe light indicates that there is an oxygen deficient environment inside the NMR laboratory.

Responding officers should not enter the NMR lab when the orange strobe light is lit and audible alarm is sounding.

Visual orange strobe light in the hallway directly outside lab B008



Emergency exhaust damper inside room B008

Emergency exhaust damper inside room B008.

When the oxygen monitoring system detects an oxygen level in room 008 to be below 19%, the emergency exhaust system is activated which exhausts room air directly to the external environment.

When activated this system overrides the normal HVAC system in place in room B008.

Other Safety Considerations:

- Training:
 - All individuals working in the NMR lab must be current with NJIT laboratory safety training requirements. Also, NMR lab workers must have completed hands-on NMR training provided by NMR laboratory staff.
- Electrical Safety:
 - All individuals operating the NMR equipment require appropriate training and authorization from the NMR program manager.
 - Only authorized users may access electrical panels or instrument consoles.
 - All accumulation of water on the floor of the NMR lab should be reported to NMR laboratory program staff.
- NMR Tube Safety:
 - NMR tubes must be handled carefully. They are thin-walled glass tubes that can be easily broken. NMR tubes may be filled with various NMR solvents or other potentially hazardous materials.
 - Issues concerning NMR tube handling for research purposes will be described in the NMR laboratory SOP.
 - Broken tubes containing non-hazardous materials may be cleaned and disposed of by NMR program staff.
 - EHS should be consulted regarding the clean-up broken tubes containing hazardous materials.
 - All broken NMR tubes must be disposed of in a puncture-resistant waste container and in compliance with other NJIT regulated waste disposal requirements. Please contact EHS for details.
- Periodic Replenishment of Cryogenics:
 - NMR staff will periodically replenish the magnet's cryogenics.
 - Appropriate personal protective equipment (PPE) shall be worn when handling cryogenics, including:
 - proper laboratory attire (closed-toe shoes, etc.)
 - lab coat
 - eye protection (safety glasses, goggles or full face shield)
 - cryogenic gloves
 - During the cryogen fill, keep away from the magnet's gaseous exhaust.

- Hazardous Materials Safety:
 - There is no fume hood in Tiernan, room 008. Therefore samples involving potentially hazardous substances must be prepared in the researcher's home laboratories or other laboratories under the direction of the Department of Chemistry and Environmental Science that are adequately equipped.
 - Samples were transported to the NMR laboratory must be carried in leak-proof secondary containers capable of containing any spilled materials.
 - Like all chemical samples, NMR tubes, the tube holder, or tube racks should be labeled according to sample labeling requirements.
 - Safety Data Sheets shall be available for chemicals used in the NMR laboratory.
 - All spills, injuries, incidents, contact with cryogenic materials must be reported to NJIT EHS, Public Safety, and Risk Management.
- Regulated Waste Disposal:
 - NMR solvent, unwanted samples, contaminated broken glass, and other regulated waste materials shall be handled following existing NJIT laboratory waste management guidelines.
 - <http://www.njit.edu/environmentalsafety/waste-management/>
- Emergency Contact Information:
 - Report all emergencies and injuries to NJIT Public Safety by calling 911.
 - EHS may be contacted by calling 973-596-3059.