Quantum NMR spectrometer

Health and Safety Notice

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Q.One Instruments, LTD

August 2021

Read Me

Dear users,

Thank you for choosing the Quantum Superconducting NMR spectrometer!Please read this Health and Safety Notice carefully before you receive and use the superconducting NMR spectrometer.

This Health and Safety Notice lists the known safety risks, occupational health, environmental factors of superconducting NMR spectrometers for persons who operate and approach NMR spectrometers, and advises on appropriate actions.

Throughout the life cycle of a superconducting NMR spectrometer, all persons using or near a superconducting NMR spectrometer must comply with all the terms and conditions of this Health and Safety Notice.You are responsible for managing all equipment and working environment of the NMR laboratory and ensuring that all terms of this Health and safety notice are effectively implemented.In this process, if you have any questions, please do not hesitate to contact Q.One Instruments, we will work with you to ensure the safety and health of NMR laboratory equipment, persons and environment.

The terms of this Health and Safety Notice supersede any other safety warnings in Q.One Instruments' manuals.Q.One instruments will deliver this health and safety notice to you.Q.One Instruments assumes that you are aware of the terms of this Health and Safety Notice and responsible for the implementation of this Health and Safety Notice, regardless of whether you have read the terms in this Health and Safety Notice.

Wish you enjoying the use of the great Quantum NMR spectrometer!

Q.One Instruments

August 2021

Responsibility

The user enterprise or institution of NMR spectrometer is responsible for the health and safety of NMR laboratory, and the responsibility period includes the whole life cycle of NMR spectrometer.

The NMR spectrometer life cycle covers all phases from the site preparation to NMR spectrometer destruction, including, but not limited to, site preparation, installation, use, idling, shutdown, maintenance, and obsolescence.

The user enterprise or institution is responsible for the health and safety of the spectrometer once the NMR spectrometer arrived at the installation site.

In whole responsibility period, the user enterprise or institution must ensure that all the terms in this health and safety Notice are implemented, and abide by the laws of the state regulations, the local government administrative instruction, the management requirements of the enterprise or institution, to ensure the safety of the equipment and NMR laboratory, ensure the health and safety of all persons associated with NMR laboratory, the environment are protected properly, and ensure the NMR spectrometers are used legally.

The user enterprise or institution shall control any person entering the NMR laboratory to comply with the terms of this Health and Safety Notice, the requirements of national laws and regulations, government administrative directives and the management requirements of the user enterprise or institution.Personnel includes but not limited to: NMR spectrometer administrators, teachers, students, operators, NMR spectrometer installation and maintenance personnel, installation and maintenance personnel of other equipment and facilities, property management personnel, liquid nitrogen and helium filling personnel, visitors, and people passing through areas affected by the strong magnetic field.

In the initial training process, Q.One Instruments is responsible for training the terms of this Health and Safety Notice, and the personnel who participate in the training shall be designated by the user enterprise or institution. The user enterprise or institution shall take the training responsibility for the personnel who do not participate in the training or the personnel changes occurred in the process of use.

During the responsibility period, unless other agreements in the contract, the user enterprise or institution shall be fully responsible for any personal injury, property loss and other consequences resulting from any violation of the terms of this Health and Safety Notice, requirements of national laws and regulations, government administrative instructions and management requirements of the enterprise or institution .

The Warning Icon

This health and Safety Notice uses the following warning or prompt ICONS to distinguish between different levels of safety:

Warning: This icon is used to remind you that you must strictly comply with these rules. Failure to comply with these rules may result in personal injury or death, or significant property damage.

Caution: This icon indicates the precautions that may result in device damage, minor property damage, or data loss.

Prompt: This icon prompts you for information that you can refer to.

Quantum NMR Spectrometer Health and Safety Notice

1 Overview

Superconducting nuclear magnetic resonance (NMR) spectrometer has a hazard that is not found in other experimental environments.Superconducting NMR spectrometers contain strong electromagnetic emission and superconducting magnets with a strong magnetic field and a large amount of cryogenic liquid inside.At the same time, the superconducting NMR spectrometer also includes the air compressor, UPS, grounding network, air conditioning, power distribution and other complex ancillary facilities, and these facilities are potential dangerous in varying degrees of safety, health, environmental and other risk factors.

This health and safety notice lists the known safety, health and environmental risk factors for NMR spectrometer and corresponding dealing method.

The user shall be familiar with all terms and conditions of this Health and Safety Notice and shall take appropriate actions to ensure that all terms and conditions of this Health and Safety Notice are implemented.

2 Safety

The following terms must be observed throughout the life cycle of a superconducting NMR spectrometer.Failure to comply with or willful violation of these provisions may result in life safety accidents, economic or property losses.

Persons with implanted medical devices (such as artificial limbs, implanted pacemakers, etc.) are not allowed to enter the 5-Gauss line of the magnet

The strong magnetic fields of superconducting magnets can interfere with cardiac pacemakers and damage prosthetics and other metallic implants worn.

Other implant carriers should consult a doctor or manufacturer to confirm the effects or possible risks of magnetic field on the implant.

Ferromagnetic objects are prohibited from entering in the 5 gauss line of the magnet

The strong magnetic field around the magnet is very attractive to objects containing steel, iron or other ferromagnetic materials.If these objects are not secured reliably, they

will fly towards to the magnet, causing serious damage to the magnet, affecting the homogeneity of the magnetic field, causing magnet quench, and possibly injury to human beings.The more massive the object, the more attractive the magnet is to it.

Only use non-ferromagnetic objects (such as plastic, aluminum, wood, non-ferromagnetic metals, etc.) and tools around the magnet.

It is important to note that the scope of the ferromagnetic items is very broad, such as common tools, chairs, trolley, vacuum cleaners, etc., as well as electronic equipment, storage tanks, etc., at the same time we should pay attention to personnel carrying items, such as mobile phone, camera, keys, nail clippers, pins, stapler, etc., also should pay special attention to leather belt, button, hairpin, etc.

If any item is drawn to the magnet surface and cannot be removed manually, please contact Q.One instruments.

When the magnet is energized, set a 5-Gauss warning line. During use, carefully check and maintain the 5-GAuss warning line.

WARNING *Movable ferromagnetic objects are prohibited from entering in the range of the 1 Gauss line of the magnet*

No movable ferromagnetic objects can be placed within the 1 Gauss range of magnet.Ferromagnetic objects within the a Gauss range shall be reliably fixed and non-removable.

CAUTION *Magnetic media, such as bank cards, credit cards, watches, mobile phones, cameras, computers, etc., are prohibited from entering in the 5-Gauss line of the magnet*

A strong magnetic field around a superconducting magnet may erase the magnetism of magnetic media, such as magnetic cards, bank cards, and computer hard drives, damaging them and causing data loss.Magnetic and metal components in electronic equipment will also be affected by strong magnetic fields and failure.

Please observe the range of 5 Gauss line marked around the magnet carefully. Do not enter in this range when carrying magnetic media.

WARNING *Do not work in the environment with inflammable or toxic gas*

Risk of explosion, on fire or poisoned when working in the presence of flammable or toxic gases.

NMR laboratories are prohibited from storing gas pipelines, gas cylinders, and containers that store or pass through flammable or toxic gases or liquids.

Keep liquid helium or nitrogen out of contact with any part of the body

Cryogenic liquids such as liquid nitrogen and liquid helium are abundant in the superconducting magnets of NMR spectrometers, which are safe but dangerous under certain circumstances.

Liquid helium or nitrogen in contact with the body causes the same damage as burns.When liquid nitrogen is filled, its overflowing causing severe burns when it comes into contact with skin, and blindness when it comes into contact with weak parts such as eyes.Seek immediate medical attention when liquid nitrogen or helium comes into contact with the body, especially in cases of blistering of the skin or affecting eyes.

The tubes that carry the chilled liquid are so cold that they stick to the skin when people touch them and tear the skin when they try to remove them.Liquid helium is cooler, vaporizes violently on contact with air, and is very cold near the liquid helium vent.

When filling cryogenic liquid, special care should be taken not to splash the cryogenic liquid on any part of the magnet, which will lead to magnet quench.

The filling of cryogenic liquid should be carried out by personnel with rich experience in cryogenic liquid handling. Personnel without qualifications are not allowed to contact cryogenic liquid.

Do not be near the magnet when filling cryogenic liquid

In some cases, filling cryogenic liquid (especially liquid helium) may cause the magnet quench and erupt suddenly and violently large amounts of cryogenic liquid helium. When filling cryogenic liquid, no one is allowed to get close to the top of the magnet, and do not inject or eject the sample.

Liquid nitrogen will be poured out when it is full filled. When filling liquid nitrogen, personnel should not stand in the direction of liquid nitrogen sprays.

It is forbidden to look inward from the cavity of the sample tube

When the sample is ejected from the magnet, it may prick in the eye.

Do not look in from the sample tube unless the sample has been ejected.

WARNING *It is forbidden to set the temperature beyond the boiling and freezing points of the sample while VT experiment*

When the temperature changes, the sample tube will bear too much pressure, which may cause the sample tube to burst. Splashing glass and toxic substances will also cause damage to the spectrometer or injury to personnel. Please confirm the boiling and freezing points of the sample before doing VT experiment.

WARNING *Do not hit the magnet*

The magnet has a high center of gravity, so it may tip over after being hit by an earthquake or other heavy object, causing injury to people and causing the magnet to quench.

Note that there are non-movable ferromagnetic objects within the 1 Gauss range of magnet, to prevent these objects from being sucked away by the magnet and impacting the magnet.

WARNING *Do not remove the check valves on the liquid nitrogen and helium exhaust pipes*

The function of the non-return valve is to prevent air from entering the liquid nitrogen cavity and liquid helium cavity of the magnet. If the water in the air enters the magnet, it will freeze, resulting in blockage of the cavity tube and liquefied oxygen, which may cause safety risks.Ensure that the check valve is properly tightened at all times except when liquid helium or liquid nitrogen is filled.

WARNING *Beware of electric shock*

Quantum NMR spectrometer and auxiliary equipment use 110V~380V AC power supply, high power voltage distributes in the control cabinet, UPS, air compressor, workstation, refrigerator and power cable, etc.

Most power sockets are plug-in type, and some power cables are removable.During daily use or maintenance (such as cleaning), the power socket may be unplugged or loose accidentally, and the conductor with high voltage may be exposed, resulting in potential power supply ignition or electric shock.

If the grounding cable in the laboratory is improperly connected, the cabinet may be

electrified, causing device failure, performance deterioration, and potential personal safety hazards.

The laboratory manager should always check whether the power line contact is firm, whether the insulation seal is in good condition, to ensure that the strong electric part will not be intentionally or unintentionally contact, and the grounding wire connection is reliable.

Check and record liquid helium and nitrogen levels regularly

The liquid level of liquid nitrogen and liquid helium in the superconducting magnet should not be lower than the lowest allowed level, otherwise it may lead to the quench of the magnet.

Liquid helium and liquid nitrogen levels of magnets should be regularly recorded, and the boilling rates of liquid nitrogen and liquid helium should be paid attention to. If boilling rate changes suddenly, please contact Q.One immediately.Damage to the magnet may occur if the cause of the abnormal evaporation rate is not eliminated.

Prevent magnet quench

When the superconducting magnet quench unexpectedly, a large amount of helium gas evaporates, creating a transient magnetic field that is much stronger than the magnet normally operates.NMR spectrometer manager shall take necessary actions to prevent the quenching of magnets:

a. Liquid nitrogen and helium should be injected regularly, and the liquid level should be observed continuously to prevent the magnet from quenching due to insufficient liquid nitrogen and helium level.
b. The personnel filling liquid nitrogen and liquid helium should be trained and authorized, especially to prevent helium gas from blowing into the magnet when the liquid helium level is too low, and liquid nitrogen and liquid helium should not spray on the surface of the magnet.
c. Carefully carry out high and low temperature experiments, VT experiments should ensure that the flush gas is normal, the probe is not frozen, the temperature is not increased abnormally, etc., to prevent the room temperature bore of the magnet from being damaged by high and low temperature and further magnet quenching.
d. High and low temperature experiments should be carried out only when someone is on duty.

Leave the laboratory immediately when magnet quench

If the magnet quenches(the magnetic field suddenly disappears and a large amount of air is suddenly ejected from the top of the magnet), please leave the site immediately.The sudden release of helium and nitrogen would quickly deoxygenate the area, potentially causing suffocation.Do not return to the room until oxygen is restored to normal level.

If the magnet quenches, please open doors, windows and exhaust fans for ventilation to accelerate indoor air exchange.

Be careful of hypoxia

Hypoxia is a potential hazard in NMR laboratories, especially in confined spaces.The liquid nitrogen and helium inside the superconducting magnet are constantly evaporating, which reduces the amount of oxygen in the room.When fill the liquid nitrogen and helium, the large amount of volatile liquid can significantly reduce indoor oxygen.

NMR laboratory should be ventilated, such as often open doors and windows, turn on the fan or air conditioner and other equipments to supply air to the room, to ensure that the room will not be deprived of oxygen.

When the magnet quench, a large amount of gases (liquid nitrogen and liquid helium) are rapidly ejected from the magnet, and the oxygen in the room is rapidly replaced. In this case, all person must immediately leave the room until the oxygen in the room is restored to the normal level.

It is recommended to install an oxygen monitor in the NMR laboratory.

Beware of fire

The desks, chairs, cables and curtains in the NMR laboratory are at risk of fire and combustion.Cable aging, loose power plugs, and rat infestation may cause cable fire. Smoking or using fire in the laboratory, or liquid such as mineral water and beverages spilling into sockets, cabinets, and workstations may cause short-circuit fire, and lead to serious consequences.

NMR laboratory administrators should be vigilant against fire risks.Laboratory administrators should organize fire drills regularly, do not panic when there is a fire, use non-magnetic fire extinguishers to put out the fire, and evacuate the laboratory

immediately if the magnet quenches.

In the management of NMR laboratories, administrators should:

a. Equip the laboratory with fire extinguishers and ensure that the fire extinguishers are in their expiry date.
b. Drinks, food and pets are not allowed to be brought into the laboratory.
c. Take anti-rodent measures to prevent mice and other small animals from entering the laboratory and prevent cables and air pipes from being damaged.
d. Check whether power cables are loose and cable protection layers are intact to ensure that there is no risk of fire caused by short circuit.
e. Safe use of electricity, indoor cable routing should be standardized and orderly, the power supply should have short circuit protection, leakage protection, overload protection function, do not use unqualified appliances, do not exceed the standard use of electrical appliances, prevent cable fire.

CAUTION *Prepare the site strictly according to installation preparation requirements*

Unlike common equipment, NMR laboratories have many special requirements. Please strictly follow the installation preparation requirements provided by Q.One Instruments and observe the terms and conditions of this Health and Safety Notice when preparing the site.

CAUTION *It is forbidden to open the shell of the spectrometer or adjust the inside of the spectrometer without authorization*

Maintenance personnel will be directly exposed to high voltage, which may cause accidental personal injury or spectrometer damage.

Unauthorized maintenance of spectrometers will unconditionally terminate the quality assurance agreement and contract service terms.

Only Q.One Instruments service representatives were allowed to repair and modify the Quantum NMR spectrometer.

If you need to install additional equipments or modify the spectrometer, please contact Q.One Instruments.

If it is necessary for the customer to repair or replace the parts, the maintenance personnel shall be authorized and guided by Q.One Instruments.

CAUTION *Prevent static electricity*

The static electricity of the human body may damage the electronic components of the spectrometer. The spectrometer is equipped with an electrostatic bracelet, wear the electrostatic bracelet before touching any of the components.

The spectrometer control cabinet, magnet, and UPS should be grounded reliably to avoid static electricity.

Control the temperature and humidity in the NMR laboratory, the temperature should be controlled in the range of 15℃-25℃, humidity should be controlled in the range of 40-60%, to avoid electrostatic generation.

A hygrothermograph should be placed in the NMR laboratory to help control temperature and humidity.

The spectrometer should be strictly managed during idle period

The spectrometer may be in an idle state due to damage, long time unused, etc., and the risk of the spectrometer does not decrease or disappear during the idle period.On the contrary, the risks of unauthorized intrusions, cable aging and rodent infestation increase, and the idle spectrometer must be strictly controlled.

Only authorized personnel are allowed to enter the NMR lab

NMR laboratories should set up access control and isolation measures around magnets to prevent unauthorized personnel from approaching magnets or operating wrong experimental.

If the NMR laboratory does not have access control, it is recommended to install a second guard in the direction of the path into the magnet and, if necessary, a visible movable arresting device in front of the magnet 5 Gauss line.

Temporary unauthorized personnel entering the NMR laboratory should be accompanied at all times by trained authorized personnel and are required to act in accordance with the requirements of this Health and Safety Notice.

Radio frequency radiation control

It is the responsibility of the administrator to maintain the spectrometer in a state that meets the requirements for RF radiation at all times.

Rf emission sources are present in NMR spectrometers, and the RF radiation from the spectrometers themselves is safe due to the use of wired connections and reliable cabinet shielding.However, RF radiation may be damaged if the radio cable falls off or is

damaged, or the shielding of the cabinet is incomplete.

The cabinet and enclosure of the spectrometer form a shielding net for RF radiation. Removing any part of the enclosure or modifying the internal equipment may cause greater RF interference to the internal equipment of the spectrometer or increase the RF radiation to the external equipment of the spectrometer.No one should attempt to remove or replace any cable of the spectrometer, and do not damage the integrity of the shielding of the cabinet, such as removing the cabinet door.

Laboratory administrators should check whether RF cables are connected reliably to avoid loose or detached cables. The control cabinet should also be intact.

Only when the cabinet door is closed, the cabinet forms a shield to prevent the RF field inside the cabinet from radiating out and preventing the external RF field from entering the cabinet.When the rear door of the cabinet with fans is opened, the fans at the rear door stop running, and the heat inside the cabinet gradually accumulates, which may degrade the overall performance of the spectrometer.Therefore, keep the front and rear doors of the cabinet closed to ensure RF shielding performance and normal heat dissipation of the cabinet.

Uncontrollable factor

Uncontrollable factors include earthquakes, terrorist attacks and wars.Under the condition of ensuring personal safety, the laboratory should be protected as best as possible, toxic and volatile items should be properly kept, areas with strong magnetic fields should be reliably isolated, and unauthorized personnel should be prevented from accidentally approaching magnets.

3 Sign Posting

Strong magnetic fields have potential safety hazards for certain objects and people. Anyone who has access to an NMR spectrometer should understand these hazards and take careful precautions during the spectrometer life cycle.

To warn of the presence and risks of strong magnetic fields, strong magnetic hazard labels must be posted.

RF radiation can also cause personal injury. Quantum NMR spectrometer products have taken strict precautions and undergone the necessary testing, but you still need to post RF radiation risk warning signs.

Warning sign

Q.One Instruments provides you with a certain number of warning signs and warning belts.The identification plate must be posted before the magnet been energized and meet the following requirements:

(1) Post a 5 Gauss warning sign along the 5 Gauss line of the magnetic field, ensuring that this sign is visible to anyone attempting to enter the 5 Gauss line.Note that if 5 Gauss covers an adjacent room or floor, these areas should also be marked.

(2) Post strong magnetic field area danger signs at each entrance to the magnetic field area.

(3) Each identifier should be outside the 5 Gauss range.

Note that if two or more magnetic fields overlap each other, or if the magnetic field passes through a large ferromagnetic object (such as an iron door, metal beam, etc.), the stray field will exceed the demarcated range.In this case, you should use a gauss meter to measure the actual range of the 5 Gaussian magnetic field.

If you require additional identification, please obtain it from Q.One Instruments.

Public activity area

Since magnets have magnetic fields in both horizontal and vertical directions, the effect of magnetic fields on the adjacent horizontal space, the region above and below the magnet must be considered.

Public areas on the same floor, adjacent upper or lower floors containing magnetic fields of 5 Gauss or higher should be closed or restricted, including adjacent halls, corridors, etc.If it cannot be closed, it shall be marked with strong magnetic field area.

During site planning, the 5-Gauss strong magnetic field should not cover outdoor areas.

4 Training

All personnel exposed to NMR spectrometers should be trained

You must train everyone who may access to NMR spectrometers.

In the initial training performed by Q.One Instruments, you should arrange as many relevant personnel as possible to attend the training.

When there is a change of personnel during spectrometer use, you should train the new personnel.

The training should include laboratory operations and all provisions of this Health and Safety Notice.

It is recommended that training be performed in a fixed area of the laboratory so that in an emergency they can be aware of their safety status or inform others of possible dangers.

CAUTION *New managers must be fully trained first*

As the manager of the spectrometer is generally a trainer during operation, the manager must be familiar with the operation of the spectrometer and all terms of this Health and Safety Notice.

New administrators who have not ever been trained are advised to contact Q.One Instruments for complete training.

CAUTION *The contents of the training shall include the terms of this Health and Safety Notice*

In addition to training of NMR experiment operation, the training should include all the provisions of this Health and Safety Notice, with special attention to the following training:

a. High magnetic field related risks and safety precautions.
b. The emergency handling method of the magnet quench.
c. Fire drill.
d. Environmental protection related requirements.
e. Occupational health related precautions.

CAUTION *Mental health*

NMR operators are directly exposed to high static magnetic fields, and you should train them to address their health concerns about high magnetic fields.

So far, there is no conclusive evidence that NMR magnetic fields are harmful to the human body.

Some studies suggest to establish the relationship between the magnetic field and reproductive health, but so far the medical data are not enough to prove that magnetic field has a certain effect on fertility or pregnancy, namely the current scientific

conclusion does not support the view of the static magnetic field NMR spectrometer is dangerous for fertility or pregnancy, and the magnetic field of NMR spectrometer can be thought as harmless to the human body.The article 《Threshold Limit Values and Biological Exposure Indices, 5th Ed.》 describes as follows :

- "TLVs (safety limits) is the static magnetic flux densities that do not pose a health hazard to workers frequently exposed to static magnetic fields.This value should be used as a guide for controlling exposure to static magnetic fields, but should not be used as a yardstick for measuring risk and safety."
- "The whole body should not exceed 60mT (600 Gauss) for prolonged exposure to static magnetic fields, or 600 mt (6000 Gauss) for an average working day (8 hours).The maximum flux density of the magnetic field is 2T (20,000 Gauss)."

As part of our measures to reduce psychological anxiety, we still recommend that people spend as little time as possible within the 5 Gauss line.

5 Environmental Protection

The following environmental factors exist in the Quantum NMR spectrometer, the manager of the NMR spectrometer is responsible for the maintenance of spectrometer always being qualified within the scope of the obligation in the use and management process of the spectrometer, and take necessary measures to eliminate additional impact on the environment when certain environmental factor exceeds a reasonable range.

1）Waste (garbage)

NMR spectrometers generate wastes during installation, use and scrapping. Common wastes include:

a. Wasted packing cases and packing materials generated during the dismantling of packages.
b. Used clean cloths and dust when installing.
c. Used printer paper, sample tubes, paper towels, etc., during the use of spectrometer.
d. Used printer toner cartridge, ink cartridges, etc.
e. Used batteries.
f. Damaged or eliminated air compressor, UPS, printer, computer and other parts or whole machine.
g. Obsoleted spectrometer components or whole spectrometer.

The above wastes should be properly disposed of in accordance with the environmental protection law, government administrative orders, enterprise or institution administration and other requirements. Conventional disposal suggestions are as follows:

a. Packaging materials, paper, cleaning cloth, etc., shall be treated as industrial recyclable waste.
b. The used sample tube shall be treated as glass waste after been cleaned, it is forbidden to treat the used sample tube as recyclable waste without cleaning.
c. Please contact the relevant manufacturer for recycling of printer, air compressor, computer and other components, or deal with them according to the administration of enterprise or institution.
d. Waste batteries and electrolytes that seriously pollute the environment in the UPS should be disposed of by the UPS manufacturer or recycled by the specified battery collection enterprise.
e. For recycling of the circuit board or components of NMR spectrometer, please contact Q.One Instruments, or deal with them according to the administration of enterprise or institution .

2）Waste reagents and used sample tubes

Samples used for NMR testing and reagents used for sample preparation, waste liquid of cleaning utensils and uncleaned nuclear magnetic sample tubes should be treated as toxic and harmful substances. The treatment methods are as follows:

a. Collect waste liquid and the discarded utensils according to the category of chemicals, make visible labels and take good protection.
b. Sign a contract with a qualified hazardous chemical treatment enterprise, which collects all waste liquid for post-treatment regularly.

3）Noise

NMR spectrometers produce noise in the process of installation and use. The sources of noise include:

a. Noise generated by construction during installation: electric drill and hoisting tools may be used during the installation of spectrometer, which will produce noise for a short time during the use of these tools.
b. Noise caused by abnormal fan of NMR spectrometer: the noise of the fan inside the spectrometer is small under normal circumstances, but the life of the fan is limited. When the bearing of the fan is damaged, the noise of the fan will become sharp and harsh.

c. Air compressor noise: when the non-silent air compressor runs, the noise of the compressor obviously exceeds the acceptable normal range of 60 dB.
d. Air conditioner noise: air conditioner operation will produce noise, but usually the noise comes from the outdoor part of the air conditioner.

The recommended noise range in the NMR laboratory is less than 60 dB, and necessary measures should be taken to achieve this range:

a. Avoid rest time when using electric drills and other noisy equipment during installation, and pay attention to not affect people in nearby places.
b. NMR spectrometer fans need regular maintenance, it is recommended to clean all fans at least once a year, when the noise of fans is abnormal, you can contact Q.One Instruments for replacement.
c. According to the installation preparation requirements, a separate soundproof room is required to install air compressors, and the bottom of the air compressor must be well noise isolated. At the same time, it is recommended to purchase silent air compressors as far as possible to reduce the requirements of sound insulation measures.
d. Air conditioner noise usually comes from outdoor unit, the air conditioner should not be installed near the doors and windows, in order to increase the sound insulation effect. At the same time, the outdoor unit should not affect adjacent places and people passing nearby.

4）Power consumption

NMR spectrometers and air compressors consume power when they are running. When NMR spectrometers are not in use, it is recommended to perform the following operations:

a. Set all shimming values to 0.
b. Turn off the RF power amplifier.
c. Close the air compressor.
d. Put the workstation on standby.

5）Electromagnetic radiation

High power electromagnetic waves emitted by the NMR spectrometer are transmitted through the coaxial line. Under normal circumstances, electromagnetic radiation leakage will not occur, but damage to the coaxial line or loose coaxial line connector will cause electromagnetic radiation leakage.

The administrator should periodically check the integrity of the coaxial line and the tightness of the high-power coaxial line connector.

6）Refrigerant leak

The air conditioner and VT cooler in the NMR experiment are cooled by chillers. Administrators should check regularly that the refrigeration of the air conditioner and chillers is working properly. When the refrigeration capacity decreases, there may be refrigerant leakage.

Refrigerant leaks are usually discovered later, so the NMR laboratory should be well ventilated at all times.

If possible refrigerant leaks are detected, contact the air conditioner manufacturer or Q.One Instruments.

7）Fire extinguisher

Do not discard expired fire extinguishers. They should be collected by fire equipment vendors.

In the event of a fire, dust discharged from the fire extinguisher and the remains of burning items should be disposed of according to the local requirements for garbage disposal.

6 Occupational health

The following factors that may affect the health of the user and persons close to the NMR spectrometer should be considered during the use of the NMR spectrometer. The NMR spectrometer manager is responsible for periodic inspection and maintenance of the occupational health factors of the NMR spectrometer to keep them within a acceptable range at all times.

1）Static high magnetic field

The superconducting magnet of NMR spectrometer always has static strong magnetic field. Known research results show that the superconducting magnet's strong magnetic field is not harmful to the body, but managers still need to train personnel close to the magnet and eliminate their psychological anxiety about the magnetic field.

2）Transient strong magnetic field

When the superconducting magnet quenches unexpectedly, a transient strong

magnetic field will be generated, and the strength of the strong magnetic field is much higher than the normal strength of the magnet in normal operation. The manager should train the personnel who are close to the magnet to master the measures of dealing with the quench of the magnet, and eliminate their psychological fear.

3）Electromagnetic radiation

The high power electromagnetic waves emitted by the NMR spectrometer are transmitted through the coaxial line, and there is no electromagnetic radiation leakage under normal circumstances.

Personnel close to NMR spectrometers should be trained by administrators to dispel their psychological fears about the effects of electromagnetic radiation.

4）Light pollution

The monitors of workstation and computers, direct sunlight outside the window will cause light pollution, and the manager should take necessary measures to eliminate light pollution:

a. The person operating the workstation can not look directly at the monitor for a long time, should pay attention to change the visual scene and have a rest rest from time to time.
b. Curtains should be installed for windows and doors against direct sunlight.

When planning the installation site, avoid direct sunlight through doors and windows to reduce further costs.

5）Noise

NMR spectrometers generate noise during installation and use. The sources of noise include construction noise during installation, abnormal fan noise of NMR spectrometers, air compressor noise, and air conditioner noise.

a. During installation, irrelevant personnel should be kept away to avoid the impact of noise.
b. Manager should maintain the fans of spectrometers, air conditioners, etc., to avoid additional noise.
c. The air compressor room should meet the design requirements to reduce the impact of noise, and unauthorized personnel should be prohibited from entering the air compressor room.

6）Electricity safety

If the strong electric part of the NMR laboratory is exposed, it may cause electric shock. The manager should pay attention to the maintenance of power sockets, plugs, cables and other intact, cables without aging, and power load within allowed range.

The control cabinet, workstation, air compressor, UPS, printer and other equipment of NMR spectrometer should be grounded reliably to avoid electric shock to people who contact these devices.

Periodically check whether the ground system is in good condition and the ground cables of each device are properly connected to prevent the cabinet shell from being electrified.

7）Hypoxia

The liquid nitrogen and helium in the superconducting magnet are always in a state of slow volatilization. Nitrogen and helium are non-toxic and harmless, but they will slowly replace the oxygen in the room, making the indoor personnel lack of oxygen.The large amount of nitrogen and helium produced by the magnet quench will also rapidly reduce the indoor oxygen, leading to hypoxia of indoor personnel.

The administrator should pay attention to keep the room ventilated and ensure the normal oxygen content in the room.

8）Hazardous chemicals

Samples tested by NMR spectrometer may be volatile, sample leakage due to sample tube damage, and toxic and harmful chemicals may be volatilized into the air of NMR laboratory, endangering the health of indoor personnel.

Administrators should require all test samples to be sealed to minimize sample volatilization.

Administrators should pay attention to maintain air pressure above minimal value, slow down the speed of sample injection, avoid sample damage.

If one sample is damaged, the damaged sample should be taken out immediately, and the damaged sample should be disposed of immediately, the indoor ventilation should be carried out immediately, leave the laboratory if it is toxic and harmful substances.