

Safety Notes for users of the UK 850 MHz Solid State NMR Facility

These notes contain safety information for visitors to the UK 850 MHz Solid-State NMR Facility housed in the Physics Department (Millburn House site) of the University of Warwick.

Pages 1, 2, 12 and 13 are specific to the Magnetic Resonance centre at Millburn. Other pages are taken from the Physics Departments more general Health and Safety Documents.

More Health and Safety information can be obtained from the University's "Safety in the University" documentation (SITU), <http://www.warwick.ac.uk/services/safety-office/wwwpage.htm>.

These notes have been prepared by Andrew Howes (NMR group experimental officer) and Roger Buckle (Physics Departmental Safety Officer) and the local management team of the UK 850 MHz Solid-State NMR Facility.

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Nuclear Magnetic Resonance Laboratory Safety Advice **For Research Visitors to the UK 850 Solid-State NMR Facility**

This advice supplements other University and Department documents concerning safety and good practice in Physics laboratories. It is intended to indicate potential hazards associated with the Magnetic Resonance (MR) laboratory in the Physics Department and not to replace any safety documents.

Although you are here to work at the 850 MHz spectrometer you need to be aware of the other NMR instruments at Millburn House. Listed are the main hazards of working in the Magnetic Resonance laboratory. You should be aware or seek advice on any additional hazards associated with your work. Do not leave your common sense at home and remember that this is not intended to be an exhaustive list. The MR laboratory is a safe environment. We are a large group of experienced post graduates and staff. When seeking any advice feel free to ask anyone in the group.

IF IN DOUBT ASK.

1/ Magnetic Fields

Although most of the magnetic field of a superconducting magnet is constrained inside the magnet Dewar they do have a large stray magnetic field. There is no medical evidence that a large static magnetic field is harmful. However there is a requirement to inform personnel if entering a field greater than 10 gauss (1mT). If you are in the NMR laboratory assume you are in a magnetic field greater than 10 gauss. If you have a heart pacemaker or metal implants (because of bone fractures etc.) you will need to inform a senior member of the MR group.

The magnetic field at the bottom base plate of all NMR magnets is of the order of 1 Tesla. This is enough to pull keys, screwdrivers or spanners (etc.) out of your hand before you realise. Large items such as oscilloscopes and RF amplifiers will also be pulled towards the magnet if they are positioned too close.

DO NOT TAKE ANY EQUIPMENT OR METALLIC OBJECTS THAT WILL BE ATTRACTED TO THE SUPERCONDUCTING MAGNET CLOSE TO THE MAGNET.

2/ Radio Frequency Radiation

While electromagnetic radiation has the potential to cause local heating of the body, there is sufficient shielding of the equipment and cables to screen you from this electromagnetic radiation, but check all the connections before carrying out an experiment.

MAKE SURE ALL PROBE, AMPLIFIER AND CABLE RF CONNECTIONS ARE MADE CORRECTLY.

3/ Cryogenic Hazards

Superconducting magnets contain both liquid nitrogen (at 77K) and liquid helium (at 4.2K). Refilling a magnet with either cryogen may take place without the need to stop an experiment. If you are present during a refill and need to go near the magnet take advice from those refilling the magnet.

Although rare there is the possibility of the superconducting magnet windings going normal (resistive) – this is referred to as a **quench**. This can happen spontaneously, but is usually associated with a cryogen refill or the magnet being physically disturbed. If a quench occurs liquid helium is immediately boiled off. As the helium gas warms up it expands, this expanding gas will displace air in the room causing a reduction in oxygen levels. The helium gas will be cool enough to condense water vapour in the atmosphere causing a fog. This will make it difficult to see. A quench is obvious – there will be the sound of a large volume of gas escaping and fog appearing above the magnet. In addition, there is the possibility of nitrogen gas also being released, thus adding to the reduction of oxygen levels.

Oxygen levels in the laboratory are permanently monitored. The low level oxygen alarm has two stages, 1) a low whooping sound for slightly below normal levels and 2) a high whooping sound for oxygen levels that are dangerously low. For both stages amber beacon lights in the laboratory will flash on. A panel with the oxygen concentrations is located outside the main hall - you will be shown the location of this panel.

IF EITHER ALARM SOUNDS LEAVE THE LABORATORY IMMEDIATELY.

It is not expected that facility visitors will need to work with liquid cryogenes. If you do need to use liquid cryogenes, read "Safe Handling of Cryogenic Fluids" (pages 7 to 8 of this document).

4/ Compressed gases

Magic angle spinning uses compressed gases (air or nitrogen) at a pressure of up to 6 bar. Check all gas connections to probes are made properly. Before disconnecting gas lines to probes check that spinning has stopped and that control regulators are turned to zero pressure. After first consulting the facility manager, it may rarely be necessary to spin a rotor in a probe outside of the magnet. It is possible for a rotor to jump out of the stator or to break. ***If spinning a rotor outside of the magnet wear eye protection and make sure any openings in the probe body are closed.***

5/ Chemical Hazard

Check how to safely handle your samples and take appropriate precautions. ***Users are reminded that it is a condition of use of the 850 MHz facility that a COSHH ("Control of substances hazardous to health") form must be submitted (by email to the facility manager) at least one week before the allocated experimental time.*** COSHH sheets can be consulted for "brought in" chemicals used, e.g., as setup samples. ***It is important that all rotors, sample containers etc. are clean when you have finished.*** Other users will not know how toxic a powder is if it is left in a rotor and will have to treat it as a toxic and dangerous sample when disposing of it.

REMEMBER TO CLEAN UP AFTER YOURSELF.

6/ Trip Hazards

There has to be cabling and compressed gas lines running on the floor for all spectrometers. Always watch out for this and do not stand on any cable or gas line. Carefully consider the position of oscilloscopes when tuning a probe. There may also be other small items such as frequency counters and spinning speed controllers on the floor. Note that the 850 MHz magnet sits on a raised plinth.

7/ Top of Magnet Platform

Care is to be taken when accessing the top of the magnet via the platform. In particular, avoid bumping your head on the ventilation tubing at the top of the wooden stairs.

8/ Rotor Packing

If not handled correctly, it is possible that MAS rotors can break during packing, potentially causing injury. However, damage or injury is very unlikely if the correct packing tools are correctly used. If in doubt, seek advice.

9/ Fire Exits

Millburn House is a complex building, and you will need to familiarise yourself with the **FIRE EXITS**. The fire assembly point is located at the front of the building close to Millburn Hill Road.

10/ Fire, Accidents and near misses

Should all be reported (see later pages for first aiders). Serious accidents and incidents when no one is immediately available should be reported to University Security using the emergency telephone number **999**.

11/ Magnetic Resonance laboratory address

Magnetic Resonance Centre
Millburn House
Millburn Hill Road
University of Warwick Science Park
CV4 7HS

NB: Post should NOT be sent to the laboratory address, but rather to:

Department of Physics
University of Warwick
Coventry CV4 7AL

Working out of Normal Hours

The Department has installed an automatic security system. All perimeter access doors are locked between the hours 18:30 to 07:30 during the week, all day at weekends and on official holidays.

For those wishing to enter, or leave, the Department outside of the normal working hours (0730–1830 Monday to Friday), please note you require –

- Physics Main Door – Library/Staff Card (proximity reader)
- Physical Sciences Main Door – Library/Staff Card (proximity reader)
- Physics Concourse Doors – Library/Staff Card (proximity reader)
- Physics/Physical Sciences bridge – Library/Staff Card (proximity reader)
- Millburn House - Library/Staff Card (proximity reader)

The system also logs arrivals and departures.

In the event of an emergency the door locks will release. However, if this fails to happen, there are green emergency release points near the doors in the main building and push-switches in Physical Sciences.

*All staff, students and research visitors should familiarise themselves with “**Safety in the University**” (SITU), copies of which are normally held by R. Buckle, (Departmental Health and Safety Officer), or on the safety office website:*

<http://www.warwick.ac.uk/services/safety-office/wwwpage.htm>.

Detailed regulations are in SITU Part 3 (pages 9 to 10).

University of Warwick Health and Safety

Director Safety and Occupational Health Services	Dr I MacKirdy Extn: 50824 Mobile
Assistant Safety Officer	Ms C Beament Extn: 23208 Mobile 07773 718 648
Deputy Safety Officer:	TBA
University Occupational Health Physician:	Dr Pearson Extn: 74011 Secretary 24923 / 75493
University Occupational Health Senior Advisor:	Andy Kay Extn: 74011 Secretary 24923 / 75493
University Occupational Health Advisor/Nurse:	Jane Watkin Extn: 74011 Secretary 24923 / 75493

University rules and procedures for Safety are laid down in the series of documents:
`Safety in the University' (SITU), available in booklet form or from the Website:-

http://www2.warwick.ac.uk/services/safety/health_and_safety/

The documentation also contains a copy of the **University Statement of Safety Policy**, which has been drawn up in accordance with the requirements of the Health and Safety at Work Acts.

http://www2.warwick.ac.uk/services/safety/health_and_safety/policy/

Open the PDF from "1. Health and Safety in the university"

The **University Ordinance on Safety** is printed in the **University Calendar**.
<http://www2.warwick.ac.uk/services/gov/calendar/>

Physics Department Health and Safety

Physics Departmental Safety Regulations have been published, and are available from the DHSO and the Departmental Health and Safety website.

These include: -

		<u>Document Number</u>
1	Risk Assessments	R1 General Risk R2 Experimental work R3 COSHH R4 Machinery/Equipment R5 Manual Handling R6 Fire
2	Cryogenics	D3
3	Fume Cupboards	D4
4	Handling hydrofluoric acid (HF)	D5
5	High pressure systems	D6
6	Lasers	D7
7	Handling loads, lifting	D8
8	Mechanical Workshop	D9
9	Ionising Radiation	D10
10	Teaching Laboratories	D11
11	Toxic gas systems	D12
12	COSHH Waste disposal	D13 D14
13	Smoking policy	D15
14	Working at Home	D16

Departmental Health and Safety Officer (DHSO):

Mr Roger Buckle

Room 443

Extn: 23394
Mobile: 48055

Deputy DSO (DDHSO):

Mr Keith Briggs

Room 166

Extn: 28402

Trade Union Safety Representative:

TBA

Departmental Radiation Protection Supervisor (DPRS):

Dr Jon Duffy

Room: 457

Extn: 22410

Departmental Laser Officer (DLO):

Mr Bob Day

Room: 442

Extn: 22254

Departmental COSHH Contacts:

Dr D Holland

Room: 160

Extn: 23396

or

Mr Roger Buckle

Room: 443

Extn: 23394

Departmental Safety Committee: The Committee meets at least once per term, and its brief is to monitor, regulate and discuss any safety issues, and particularly those directly relating to the Department. Anyone having a matter to be raised with the Safety Committee should notify the DHSO, or any member of the Committee (listed below):

Mr Roger Buckle (DHSO)
Professor Malcolm Cooper (Head of Department)
Dr Jon Duffy (DRPS)
Mr Tim Naylor
Mr David McIntosh
Mrs Christine Jarvis

Dr Diane Holland (COSHH)
Mr Keith Briggs (DDHSO)
Mr Bob Day (DLO)

Qualified First-Aiders at Millburn House:

Jeanette Chattaway	Room F42	Extn 50798
Julia Brown	Room F51	Extn 23005
Ian O'Donoghue	Room G03	Extn 50377

First Aid Boxes and Keepers

Magnetic Resonance Hall	Jeanette Chattaway
G03 Capital Centre	Susan Brock
F51 History of Art	Julia Brown

Procedure for reporting Accidents and Incidents:

Details of **ALL** accidents **MUST** be reported to a first-aider. The first aider will complete an accident form to describe the accident and to note any time lost.

Note: this is to ensure that we are recording and monitoring accidents as they arise. Incidents and “near misses” must also be reported to the DHSO, and to your immediate Supervisor. The incident will be recorded and logged by the DHSO, and any necessary measures to prevent repetition will be put in place.

Fire:

A fire alarm is given by sounders

Make your way to the outside of the buildings by following the fire exit signs.

The assembly points are: the car park at the front of Millburn House close to Millburn Hill Road.

FAMILIARISE YOURSELF WITH THE LAYOUT OF THE BUILDING(S) AND EXITS AS SOON AS YOU CAN.

Serious accidents and incidents must be reported to University Security using the emergency telephone number 999

Local Rules

Ref - SITU part 3 pages 33 to 36

Safe Handling of Cryogenic Fluids

Cryogenic fluids are extremely cold and will cause cold burns/frostbite if they are allowed contact with skin. In addition, the vented gases can cause local oxygen depletion, which can rapidly lead to asphyxiation.

We require that all handling of cryogenic vessels, and use of the fluids, be carried out under this local rule.

NITROGEN DEWARS

1. Filling

Physics Building

The nitrogen filling point is in the workshop lobby. The area is large and is sufficiently well ventilated to minimise depletion of oxygen levels, however, a safety device is fitted to the delivery pipework to shut off the flow if a reduction in oxygen levels is detected by the system – this will also sound a local alarm and activate a flashing beacon. If you are unfamiliar with filling Dewars, or other vessels, you must be shown the correct procedure by an experienced user. Another filling point is in the yard [open air] near the tanks.

Millburn House

The nitrogen filling point is at the tank in the yard to the rear of the building [goods-in]. The point is in the open and is accessible through the security gate in the fence. Normal filling rules apply.

All users names must be on the users register; held in the department safety office and posted on the wall near the filling point. If you are not on the register - contact the person named on the register for demonstration and training.

- **Familiarise yourself with the procedure to follow if the alarm sounds. This is posted close by the filling point.**
- Before filling, check that the decant pipe and the valve are secure.
- Use the gloves provided [**note** - gloves can be a cause of accidents if they become filled with liquid – ensure that it is not possible for this to occur].
- The Dewars must be located away from the main thoroughfare during filling.
- The silenced exhaust system must be treated with caution; the pipe becomes extremely cold during use and **MUST** be handled using the gloves provided.
- The exhaust must not be allowed to spray liquid [this can occur when the Dewar is close to being full].
- **Dewars and cryogenic vessels must not be left unattended during a fill. If you have to leave during a fill either stop the process or ask someone else to look after the filling for you.**
- On completion of the work, ensure that the pipes are stored away safely to prevent accidental contact with other people.
- Use the hot air gun to thaw out the screwed fittings if they are seized with ice. The gun is supplied through an RCD device to make it electrically safe to use in a wet environment.

PRECAUTION

The decanting pressure is designed to be low [less than 2 Barg] to prevent splashing and too rapid transfer of the liquid, **however, TAKE CARE to OPEN THE VALVE SLOWLY**, in case the pressure is greater than it should be.

2. Transporting Full Dewars

Large, full, Dewars are heavy, have a high centre of gravity and a narrow wheelbase, so they are at risk of toppling over on slopes and whilst negotiating ridges and gaps in floors.

- Move them slowly and consider the floor surface in front while moving.
- Ensure that there are no obstacles or people in front of the Dewars whilst moving.
- If you need to use the goods lift DO NOT TRAVEL in it with the Dewar or vessel – call the lift, place the warning notice on the inner gate (to ensure that no other person enters the lift), then call the lift from the floor you require.
- Do not use the passenger lift for transporting any cryogenic fluids.

3. DECANTING

- Ensure that your delivery pipe-work is secure and the vessel to be filled is ready.
- Use gloves if there is any risk of liquid splashing or coming into contact with skin.
- Use a facemask if a system at high level is being filled, or if there is any risk of liquid coming into contact with your face.

4. General Points

- If you are unfamiliar with the type of Dewar and its controls - find someone to help you.
- Do not use valves and other devices unless you are sure how to operate them safely.

HELIUM DEWARs

Physics Building and Millburn House

Liquid Helium is transported in Dewars from the Departments Helium Liquefier Plant and from delivery by BOC. Helium Dewars have controls and valves to enable the pressures to be raised to decant the helium into the receiving vessel.

It is highly dangerous to operate these valves without demonstration and training.

5. Transportation

- Take care when moving the vessels - as item 2

6. Decanting

- **Use only the correct tubing and piping.**
- **Take care with very cold pipes after decanting has been completed.**
- **Do not leave the decanting procedure unattended.**
- **Ensure that all valves are returned to the correct positions after the decant has been completed, this is to ensure that vents and safety devices do not become blocked with ice and thus lead to dangerous pressures building up in the Dewars.**



Department of Physics
RISK ASSESSMENT

TITLE/DESCRIPTION	Name of Assessment Millburn house – NMR suite
	Description - General risk assessment for the laboratory <u>Notes</u> The NMR hall has three main areas – NMR hall, EPR lab, Chemistry NMR area and prep room

Assessor	Name r buckle	Date	01/12/2008
	Position/Title DHSO		

Hazard Identification		Risk Assessment		Risk Control			
Hazard typ	List hazards	List any Control Measures already implemented	Risk Score	Describe what can be done to reduce the risk score [if necessary]	New Risk Score	Acceptable ? Y/N	Comments
PHYSICAL	Strong magnetic fields	Safe areas are clearly marked	SL 12			Y	
	Trip	Cabling between apparatus is minimised and placed carefully to reduce trip hazard	ML 17			Y	
	Radio frequency [RF]	Probes are within the shielded areas of the magnet	LL 21			Y	
	Cryogenics	Training is obligatory and exercised.	SL 12			Y	
	Compressed gas	Fixed pipework and secure flexible lines. Cylinder storage provided	SL 12			Y	
CHEMICAL	Chemical prep area	Safe storage and use – fume cupboard and waste disposal is provided	SL 12			Y	
FIRE							
ENVIRONMENTAL	Magnet “quench”	Large room volumes. Oxygen depletion monitoring provided	SVL16			Y	
PERSONAL							
OTHER							

Method

<p>1. HAZARD IDENTIFICATION List all the hazards</p> <p>2. RISK ASSESSMENT Risk is estimated by taking into account any existing safety devices or controls which are designed to reduce the risk. The risk matrix is used to provide [estimate] a figure [risk score].</p> <p><i>If the risk score is :</i></p> <p><i>1 to 6 [red numbers] further measures <u>must</u> be considered to reduce the risk.</i> <i>7 to 15 [orange numbers] further measures <u>may</u> be needed.</i> <i>16 to 25 [green numbers] the risk <u>may</u> be acceptable.</i></p> <p>3. RISK CONTROL List further control measures to reduce risk, and rescore using the matrix. Decide on acceptable or not. Note any comments.</p> <hr/> <p>Notes The matrix numbers represent the severity of the situation, with 1 being the worst, through to 25 as the least. All risk control will tend to increase the numerical value of the score – therefore tending to reduce the consequences to as low as possible.</p>	<p><u>Risk Matrix</u></p> <table border="0"> <tr> <td>H</td> <td>V. LOW VL</td> <td>15</td> <td>19</td> <td>22</td> <td>24</td> <td>25</td> </tr> <tr> <td>A</td> <td>LOW L</td> <td>10</td> <td>14</td> <td>18</td> <td>21</td> <td>23</td> </tr> <tr> <td>Z</td> <td>MINOR M</td> <td>6</td> <td>9</td> <td>13</td> <td>17</td> <td>20</td> </tr> <tr> <td>A</td> <td>SEVERE S</td> <td>3</td> <td>4</td> <td>8</td> <td>12</td> <td>16</td> </tr> <tr> <td>R</td> <td>MAJOR M</td> <td>1</td> <td>2</td> <td>5</td> <td>7</td> <td>11</td> </tr> <tr> <td>D</td> <td></td> <td>V. HIGH VH</td> <td>HIGH H</td> <td>MEDIUM M</td> <td>LOW L</td> <td>V. LOW VL</td> </tr> <tr> <td></td> <td></td> <td>R</td> <td>I</td> <td>S</td> <td>K</td> <td></td> </tr> </table>	H	V. LOW VL	15	19	22	24	25	A	LOW L	10	14	18	21	23	Z	MINOR M	6	9	13	17	20	A	SEVERE S	3	4	8	12	16	R	MAJOR M	1	2	5	7	11	D		V. HIGH VH	HIGH H	MEDIUM M	LOW L	V. LOW VL			R	I	S	K	
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