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The MARI Mini-Manual

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The MARI *mini*-manual

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PREFACE

This document is designed to get you started planning your experiment and analysing your data. More detailed information is available from other reports. Reports exist on the sample environment equipment, on some of the data analysis routines such as HOMER, FRILLS, and the S(Q,E) analysis routines, and on programs such as GENIE. A copies of these manuals can be obtained from your local contact, although copies are kept in the instrument cabin. A PUNCH manual can be found in the cabin and contains information on the Instrument Control Program (ICP) and sample environment controls via CAMAC.

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1. INTRODUCTION

The MARI spectrometer is funded by the Japanese Ministry of Education, Culture and Science (Monbusho) as part of the UK-Japan collaboration in neutron scattering. The collaboration was initiated in 1986 by the late Professor Yoshikazu Ishikawa, who unfortunately did not live to see the completion of the instrument. In the light of his pivotal role in the collaboration the spectrometer was named after his daughter 'MARI'. Appropriately 'MARI' is also the Japanese for 'Truth'.

MARI is a direct geometry chopper spectrometer. It uses a Fermi chopper to monochromatic the incident neutron beam to give incident energies in the range 10 to 2000 meV. It is very similar in design to its sister machine HET, but with a detector bank that continuously covers the angular range from 3 to 135 degrees MARI is able to map large regions of Q-E space in a single measurement. An incident flight path of 11.7 meters and a secondary flight path of 4.0 meters gives MARI an energy resolution of between 1-2% $\Delta E/E$, and with all the detectors at the same secondary flight path, this resolution is constant for all the detector banks. Two background suppression choppers are used, the first is a 50-100 Hz Nimonic chopper which is used to suppress the prompt pulse of very high energy neutrons and gammas that are produced when the proton pulse hits the target. The second is a 50 Hz disc chopper made of Boronated resin with a single hole. This is designed to suppress the flux of delayed neutrons that are a significant fraction of the background when using a depleted uranium target (see section 2.1.3).

The core of the instrument is the Fermi Chopper (section 2.1.3). This is a slit package that is magnetically suspended in a vacuum and able to rotate at speeds up to 600Hz. The incident neutron energy is selected by phasing the opening time of the slit package with respect to the neutron pulse from the target station.

Three low efficiency scintillation detectors (called monitors) are placed in the main beam. The first is placed before the background choppers to monitor the incident flux for the purposes of normalisation. The second and third are placed just after the Fermi chopper and behind the sample respectively. These are used to accurately determine the incident energy of the neutrons.

At present about 600 of the full complement of 1000 detectors are installed (see Appendix 5.1). All are 10 bar ^{3}He gas proportional counters and all come from the same manufacturer, this means that their efficiency and background are almost the same. The low angle bank consists of 8 radial arms of detectors ranging from 3 to 12 degrees. The rest are arranged vertically from 12 to 135 degrees. The detectors between 12 and 30 degrees are arranged on a Debye-Scherrer cone to improve the Q-resolution.

The beam size at the sample position is 50 by 50 mm, but motorised jaws in the Fermi chopper pit and in the sample tank can be used to reduce this size.

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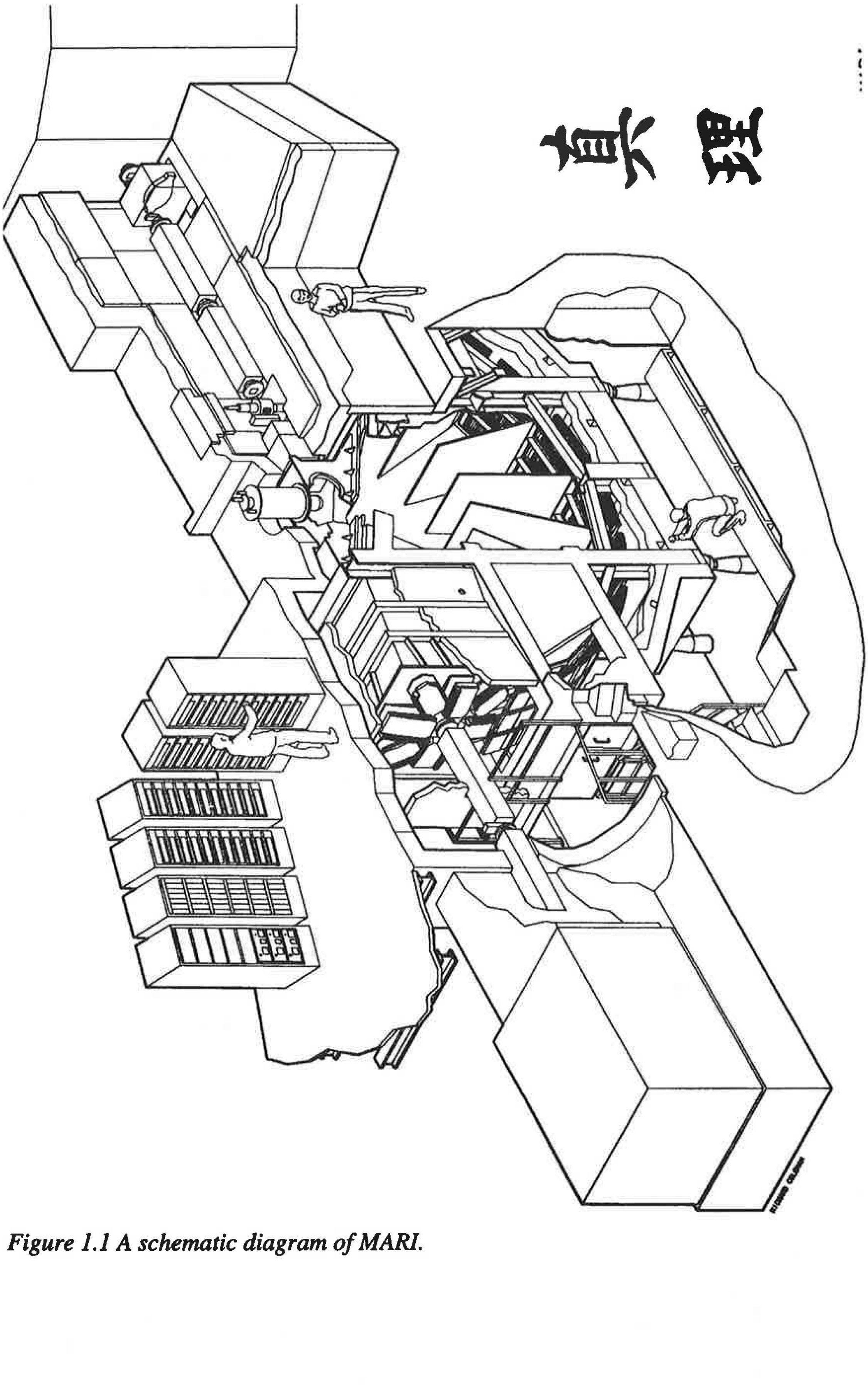

Figure 1.1 A schematic diagram of MARI.

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1.1 Sample Environment on MARI

The vertical detector geometry on MARI has profound implications for the optimal sample geometry and the design of sample environment equipment. Samples with a slab geometry require large self absorption corrections, and although these are not difficult to perform it is possible to largely avoid them completely by using samples with a cylindrical cross-section. Obviously it is advantageous to fill as much of the beam as possible, however, a solid cylinder of 50 mm diameter is impractical and so the recommended sample geometry on MARI is an annulus of 45 mm in diameter 45 mm in length and a thickness sufficient to give a 10% scatterer.

The standard sample cans used on MARI are thin walled and made from aluminium, with an external diameter of 43 mm and a wall thickness of 0.1 mm. These can be sealed with indium if necessary, and if they are to be cooled we recommend that they are sealed under helium so that they do not crush at low temperatures. The helium also acts as an efficient exchange gas.

Because of the unusual detector geometry, much of the sample environment used on MARI is unique to the instrument. The following list describes the sample environment equipment suitable for use on MARI.

Top Loading Closed Cycle Refrigerator:
This CCR is specific to MARI. An air-lock system is used to pass a sample into the MARI's cryogenic vacuum where it is bolted onto the cold head of the CCR. This has several advantages: Firstly since the only material in the beam is a piece of thin aluminium foil which is used as a 70K heat shield, the background is excellent; and secondly since it is possible to change samples without bringing the MARI vacuum tank up to atmosphere, the time taken to change samples is reduced from over an hour to a few minutes. The minimum temperature is 15K (see section 2.2.2).

Orange Cryostat:
The Orange cryostat used on MARI has aluminium domed tails especially thinned to reduce the background. Despite this there is still considerable quantities of aluminium in the main beam and the scattering from it is large. We do not recommend the use of the orange cryostat unless temperatures below 15K are required. Its base temperature is 1.2K (see section 2.2.1).

Bottom Loading Closed Cycle Refrigerator:
Although the background is small, changing samples requires the MARI vacuum tank to be brought up to atmosphere. The only advantage of the bottom loading CCR is that it is possible to have vacuum feed through to the sample for the loading of cryogenic liquids whilst cold. The minimum temperature is 15K.

The MARI Furnace:
This is special low mass furnace where the thin niobium heating element acts as the outer wall of the sample can. The geometry is horizontal and cylindrical and the background

very low. By varying the number of niobium heating elements temperatures in the range between 100°C and 1300°C are achievable with a stability of less than a degree.

The Fluid Bath:
By using an antifreeze coolant, temperatures in the region between -30°C and 100°C can be achieved. The can is thin walled, annular and made of aluminium, it is anodised inside for mildly corrosive materials. It is designed primarily for liquid samples, and can be filled whilst cold if necessary.

The ω - CCR:
This is the simplest Goniometer we have it has no arcs but almost full Omega rotation. The recommended method for single crystal experiments is to align the crystal prior to the experiment on a supplied micro-goniometer head, which can then be fitted onto the ω-CCR. This can be done with X-rays in the users home facility or with neutron at ISIS. If ISIS facilities are needed then this should be stated on the proposal form or soon after it has been accepted. The background from the ω-CCR is very low and it has a minimum temperature of 20K. The Goniometer can be installed on the top of MARI or on side port. The latter has the advantage that the rotation is in the same plane as that of the detectors.

The Frank & Heydrich Goniometer:
This is a room temperature goniometer with almost full ω-rotation and ±20° arcs. Like the ω-CCR this can be fitted on the top or side port of MARI.

Helium Pressure Cell:
By using a two-stage helium compressor 7 kbar of isostatic pressure can be generated on a sample 5 mm in diameter and 10 mm long. The usual sample cell is designed to fit inside an orange cryostat. Pressurisation can be done whilst cold and in-situ on the instrument, the only limitation is that it is not possible to go below temperatures where the helium undergoes a phase change. Although relatively easy to use the geometry is not ideal for MARI.

McWhan Clamped Cell:
The McWhan cell uses pre-stress alumina inserts to achive pressures of up to 25 kbar. The sample sizes are of the order of 4 mm in diameter and 10 mm long. The geometry is much better suited to MARI as the cylinder axis is horizontal and internal boron-nitride collimation reduces the scattering from the alumina to a reasonable level. However, it is not possible to pressurise in-situ, and it takes several hours to cool the whole cell once it is on the instrument.

2. THE HARDWARE ON MARI

The purpose of this section is to supply practical information on where things are on MARI and how they work. It also supplies information on what user the can attempt without the risk of damaging the instrument and what should be left to the instrument scientist.

2.1 The Instrument

2.1.1 The Vacuum

MARI's vacuum is separated into two; the top half, where the sample sits, is pumped with a large Turbo pump to between 10^{-6}-10^{-7} mbar. This is a cryogenic vacuum and is low enough for Closed Cycle Refrigerators with only a thin 70K heat shield. The main vacuum tank on MARI is the detector volume, this is only roughed out to about 10^{-3} mbar and is sufficient only to eliminate the air scattering of neutrons. Separating the two halves of the spectrometer is an aluminium window which is thinned to 0.1 mm at the point where the main beam passes through. To change sample environment equipment it is necessary to bring both these vacuums up to atmosphere. To keep the concentration of water vapour as low as possible the compressed air supply that is used to fill MARI is passed through high capacity air-dryers.

- The vacuum gauge is in the electronics rack by the Fermi chopper. It is the Green LED display and it gives the readings are in millibar.

- The controls for the pumps are outside the cabin directly to the right of the interlocks. There are push button controls for the pumps and the dry air valves. To start pumping it is only necessary to press the 'Start pumps button' but to bring the tank to atmosphere first stop the pumps then open the dry air valve. Two red lights on this panel indicates if the tank is under vacuum or at atmosphere. ***Under no circumstances try to remove sample environment equipment before the red light indicates the tank is at atmosphere.***

- On the same panel there is a compressor inhibit toggle switch. If the switch in set to 'ON' the CCR will automatically start at pressures below 10^{-5} mbar. If you are not using a CCR this should be set to 'INHIBIT'.

- Inside the electronics section of the cabin there is a mass spectrometer which monitors the cryogenic vacuum. This can be used to look for excess water vapour or for a leak. This will not operate at vacuums above 10^{-5} mbar.

2.1.2 Interlocks and Shutter Control

The interlocks on the instruments are there to try to make it impossible to get close to the neutron beam. There are three sets of interlock keys: The Master key, which is to be found on the side of the green box and is labelled with an 'M'; The 'S' keys which are in the top of the two racks and the 'A' keys which are the bottom set. There are two shutter control boxes: one in the cabin and one by the interlocks.

Note: *You only have control of the shutter if the Master key is in its box. If you try to use the shutters whilst the interlocks are not made you will trip off the whole ISIS beam.*

- The Master key is only released when the neutron shutter is closed. Conversely the shutter can only be opened if the key is in place in its green box.
- The 'S' keys give access to the sample pit and other doors into the instrument. They can be released by placing the Master key in the bottom right hand slot of the rack.
- The 'A' keys give access to various pieces of shielding, such as the chopper pit. They are released by using one of the 'S' keys. Under normal circumstances users should not have any need to use these keys.

2.1.3 Chopper Controls

There are three choppers on MARI: two background choppers and the monochromating Fermi chopper.

Nimonic Chopper

The first chopper is 12.5-100 Hz Nimonic Chopper, which is used to suppress the prompt neutron pulse which occurs when the protons hit the target. Without this chopper the high energy neutrons will thermalise in the spectrometer producing a sloping background that is difficult to subtract. It consists of a drum of Nimonic alloy 600 mm thick with two slabs protruding from the edge 180° apart. Thus if it is running at 50 Hz it will cut the beam twice during the 20 ms time frame. Incautious operation of the slow chopper can blow the fuses in its power supply and so we do not recommend the user attempts to control the slow chopper. However, it is possible to check to see if it is operating by looking at the electronics racks in the cabin. The controls for the nimonic chopper are in the left hand rack in the cabin at the top. The speed in Hertz should be displayed on a red LED. For most experiments we recommend using 50 Hz. However, for very low incident energies of 25 meV and below it is necessary to reduce this to 25 Hz so that it only opens once in the time frame. For energies above 500 meV then we recommend using 100 Hz, so that the arm of the chopper moves out of the way more quickly. When changing the chopper speed it is also necessary to change its phase. This can be done using the control crate in the cabin. The recomended phases are:

50 Hz $\phi = 9600$
100 Hz $\phi = 4850$

Disc Chopper
The second background chopper is a disk chopper designed to suppress the flux of fast delayed neutrons that form the majority of the background when running with a depleted uranium target. It is a 5-50 Hz disc chopper made of 60 mm of borated resin in an aluminium casing. There a single counterbalanced hole of 60 by 60 mm at a radius of 260 mm which coarsely selects a wavelength range which then shines on the Fermi-Chopper. However, it is necessary that the chopper be completely closed during the time region where the data is collected, this limits the use of the chopper to below 500 meV. Above these energies the chopper should be parked open. As with the Nimomic chopper we do not recommend that users try to control the speed of the slow chopper. However, its phase is set automatically when the Fermi-chopper phase is set (see section 3.2). The control rack for the Disc chopper is in the cabin directly beneath the controls for the Nimonic chopper.

Fermi Chopper
The Fermi Chopper rotates at speeds between 150 and 600 Hz. It is magnetically suspended in a vacuum and is phased with respect to the target pulse to select the incident neutron velocity. The slit packages used are curved and hence optimised for particular energy range. On MARI there are 5 different choppers:

Chopper A	Optimised for 500 meV	Should be used for energies above 350 meV.
Chopper B	Optimised for 200 meV	Can be used for energies between 20 and 400 meV.
Chopper C	Optimised for 100 meV	Can be used for energies between 10 and 150 meV.
Chopper D	Optimised for 50 meV	Can be used for energies between 5 and 20 meV.
Chopper S	All energies	A relaxed resolution chopper.

Changing from one chopper to another takes between one and two hours and requires the use of the crane. It is not something that can be attempted by the user. Because of the time it takes, an experiment should be organised to minimise the number of changes.

Controlling the phase and velocity of the Fermi Chopper is done via the computer using the set_ei command (see section 3.2). It is possible to check on the operation of the chopper by looking at the control crate in the electronics section of the cabin. The crate for the Fermi-Chopper is in the left hand rack and is the lowest of the three chopper control crates. A red LED display should give the speed in Hertz. To the left of this is the phase light (a small red LED), which comes on if the chopper is not phased correctly, or if it is changing its phase or velocity. If it is permanently on more than a minute after it has reached its set speed then switch the chopper phase to 'MANUAL' and press the 'ENTER' button, then switch back to 'COMP'. If the light remains on inform the local contact or instrument scientist.

2.1.4 Motorised jaws

Two sets of slits have been installed to reduce to beam size. One set is to be found just in front of the Fermi chopper and one set inside the vacuum tank just in front of the sample. In cases where scattering from the sample environment equipment is the major source of background (such as in pressure cell measurements), the slits can be used to reduce the beam size to the size of the sample. The beam can be reduced from the normal 50 by 50 mm square to 5 my 5 mm's by using controls found in the electronics section of the cabin.

2.2 Sample Environment Equipment

This section discusses the operation of the more commonly used pieces of sample environment equipment on MARI.

2.2.1 The Orange Cryostat

The use of the orange cryostat is described in RAL reports 93-006 and 92-041, copies of which are kept in the MARI cabin. The table below provides brief information concerning valve settings and flow rates. Both the warm and cold valves should only be finger tight. Over tightening them will cause damage.

Cooling to >4K	Open the cold valve 1/2 turn. Open the warm valve until the flow observed on the gas recovery flow meter is 10L/min
Constant temperature >4K	Once the required temperature has been reached reduce the flow to 6L/min using the warm valve, and the temperature will be controlled by the Eurotherm and the cryostat heater, or, if you want the temperature to remain stable at 4K, switch the heater off.
Cooling to <4K	Close the warm valve, and open the cold valve 1/2 turn. Slowly open the Rootes pump valve, never letting the pressure rise to above 10 torr. When the pump valve is fully open use the cold valve to set the flow to about 0.5 to 1Litre/min, (try to get the minium pump pressure whilst still having cooling power)

2.2.2 The Top Loading CCR

Installing the top loading CCR will have to be done by the local contact as it requires the use of the crane. However, once in position changing samples is straightforward although it demands care as there is the potential to open the sample tank to air which will destroy the thin window between the sample and detector tanks.

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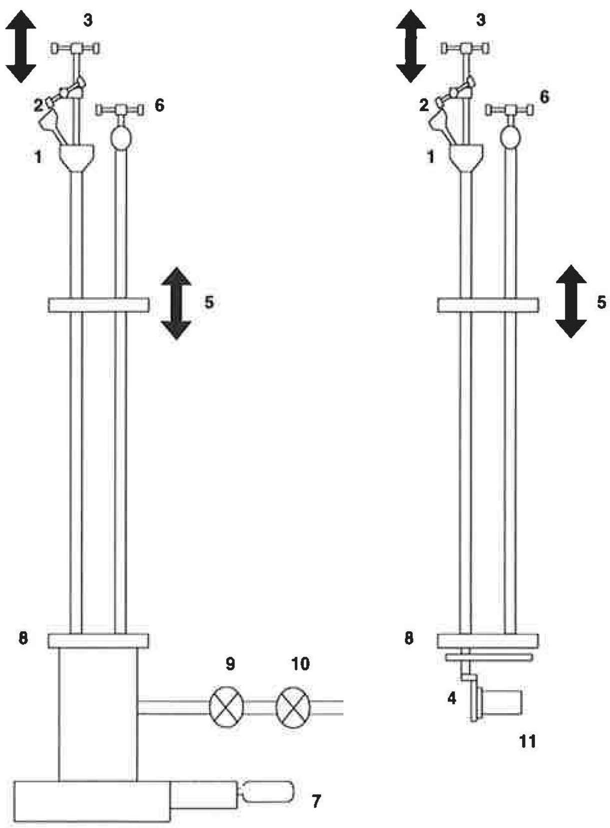
Replacing this is an operation that require over a week of effort. This section does not give all the information required to operate the top loading CCR it is meant as a check list to remind you how to do it only after you have been trained by the instrument scientist.

Removing a Sample



1. Undo the clamp (2) on the tightening rod (3), and lower it until it engages with the captive nut (4) which holds the sample holder to the cold head. Then unscrew it.
2. Lift the sample by pulling the plate (5) all the way up the two tubes and secure it at the top with the tommy bolt (6). (This is pulling against the vacuum, it is stiff and will require some effort).
3. Close the gate valve (7).
4. Heat the sample to at well above 70K, this will ensure that the can does not crush due to the pressure difference.
5. Undo the sample sensor connector from the top of the sample stick (1).
6. Let air into the sample volume by open using the speed valves (9,10).
7. Undo the bolts (8) and lift the sample stick out.

Loading a New Sample

1. Prepare the sample can (11) and fill it with helium. (If you have not loaded a sample on MARI before your local contact will show you how to do this).
2. Before replacing the sample stick place a small piece of indium wire or sheet around the bolt that secures the sample holder to the cold head (4) to improve the thermal contact.
3. Bolt the assembly onto the CCR (8).
4. Close the air-admittance speed valve (9), and open the speed valve to the pump (10).
5. WAIT for a few minutes to ensure that the air-lock has been evacuated.
6. Close the speed valve to the pump (10).
7. Open the gate valve (7) SLOWLY. If the sample tank pressure rises dramatically and the CCR stops operating there is a problem with the vacuum and you should shut the gate valve and investigate.
8. Release the tommy bolt (6) and lower the sample into position. Ensure that the plate (5) is pushed down as far as it can go.
9. Tighten the captive nut using the tightening rod (3).
10. Withdraw the rod (3) a few centemeters and fix it in position using the clamp (2).
11. Connect the sensors to the patch panal (1).

3. CONTROLLING THE INSTRUMENT

The terminal in the cabin usually has at least five windows. The dashboard provides a display of all the instrument parameters, including sample temperature goniometer angles etc. There is a MARI control window, which should only be used for control commands such as beginning, updating and ending runs, changing incident energies or temperatures, and starting instrument control command files. This terminal should be left in the `mari$disk0:[mari.run]` area at all times. There should also be at least one other MARI terminal for data analysis, a GENIE window and the GKS graphics window that goes with it. All data analysis should be performed in one of the MARI terminal windows.

Note: *Do not leave files in the mari$disk0:[mari.run] area that you want to keep. The area is periodically purged.*

3.1 Selecting the Correct Slit Package and Frequency

The program CHOP, calculates the flux and resolution expected for a given Fermi chopper running at a given frequency. It has been well documented elsewhere and will only be briefly described here. To run the program use the MARI Terminal window, and type CHOP. You will then be prompted to give the instrument name. At the arrow prompt you select a chopper and frequency using the command

```
> s c <frequency/isis><slit package>
```

For example, s c 10b selects the B chopper spinning at 500 Hz. To plot out the flux and resolution use the command

```
> p c <Ei min> <Ei max.>
```

Another chopper can now be selected using the `s c` command and plotted on the same axis using the command

```
> p o c
```

To obtain values for the resolution and flux for a particular slit package and frequency at a specific incident energy, select the slit package and frequency as before, then set the incident energy using the command

```
> set ei <Ei>
```

The flux and resolution can then be displayed using the commands

```
> d f
```

and

```
> d r
```

respectively.

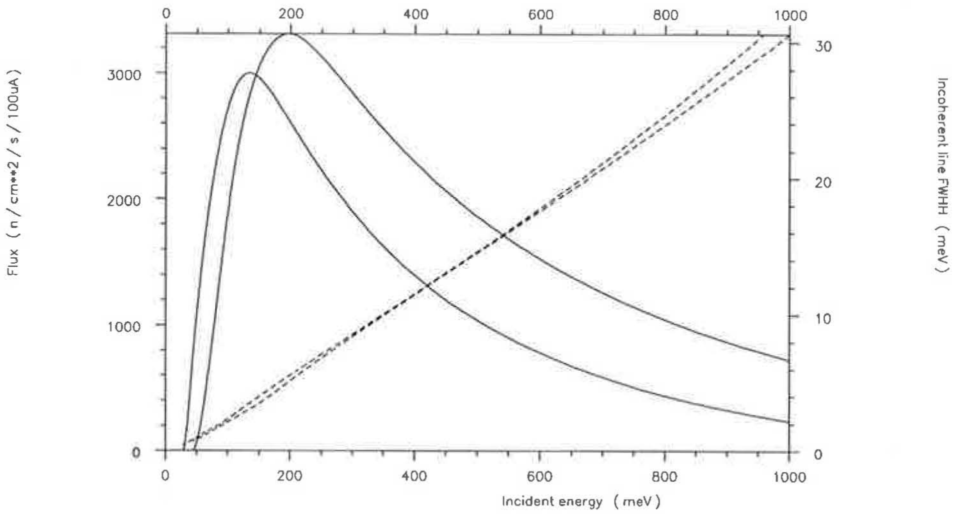


Figure 4.1 *A typical output from CHOP. The bold lines show the flux as a function of incident energy for chopper B at 500 and 600 Hz. The dashed lines show the elastic line resolution.*

It is also possible to study the resolution as a function of energy transfer using the CHOP program. First it is necessary to select as incident energy,

```
> s ei
```

After selecting the incident energy it is possible to plot the resolution as a function of energy transfer by using the command,

```
> p r
```

The command to leave chop is `ex`.

3.2 Setting the Incident Energy

To set the incident energy use the command

```
MARI> set_ei <Ei(meV)> <frequency(Hz)> <slit package>
```

This command will set the necessary phase and frequency of the Fermi chopper and disc chopper. It also calculates the time channel boundaries for this energy and writes them to the file, TCB.DAT. These will be loaded into the instrument control program (ICP) the next time a change or load command is issued.

Note: *For this reason, it is crucial that a change command is issued after the energy is set.*

Note: *It is also vital that set_ei command is issued from the MARI$DISK0:[MARI.RUN] area and that the change or load command is issued from the same area.*

The LED display on the chopper control crate in the instrument cabin displays the chopper frequency and the small LED to the left will be alight until the chopper has phased correctly. Wait until the correct chopper frequency has been established and the phase is correct before starting a run. If the phase LED is still alight more than 1 minute after the desired frequency has been set, move the small switch below the frequency display from comp. to man., press the enter data button and return the switch to the comp. position. If the light is still on inform your local contact.

Once a run has started, it is possible to check that the chopper has phased correctly to give the desired incident energy using the following commands in the Control window.

```
MARI> update
MARI> ei crpt
```

The ei command calculates Ei from the arrival of the elastic line at monitors two and three, it can also be used to find the incident energy of an earlier run by simply giving the run number rather than typing crpt.

3.3 Change and Nextrun

The change command allows the user to edit the dashboard information and to modify the ICP parameters.

Typing the command

`MARI> change` (can be abbreviated to `cha`)

will initiate the dashboard editor. Move between areas using the cursor keys and over type or toggle as instructed. The first page contains title and user information. When entering the title please follow the convention

```
<sample> <temperature> <sample environment> <Ei> <frequency/isis> <slit
package>
```

eg $YBa_2Cu_3O_7$ `T=14K CCR 100 meV 10c`

The rest of the editor is straightforward. Do not alter the spectra, detector or wiring tables. Unless you are making a white beam measurement ensure that the bar half way down the last page is toggled (the decimal point button on the numeric keypad) so that the TCB.DAT file is read rather than using the time channel information given below it.

To exit press `[PF1]` (found on the numerical keypad.
A prompt will appear at the top, to exit press `[e]`.

If you intend to set a command file running to change energy or temperature automatically the ICP parameters can be written to a file using the `nextrun <filename>` command and loaded into the ICP using the `load <filename> command.`

```
MARI> nextrun <filename>
```

will have the same effect as issuing a change command, but when you exit, the parameters will be written to `<filename>.dat`. Again, it is important to make sure that this command is issued from `mari$disk0:[mari.run]`. Examples of running the instrument using command files are given later.

3.4 Setting Sample Environment Parameters

The top right hand portion of the dashboard displays sample environment parameters such as head temperature, sample temperature and goniometer angles. To change any of these parameters the cset command is used as follows.

`MARI> cset t_head 10`	*will set the head requested value to 10K*
`MARI> cset wccr 45`	*will move the omega table to 45°*

The temperature is usually controlled using the head sensor, although limits can be set to ensure that data are only collected between specified limits.

```
MARI> cset t_samp/control/lolimit=40/hilimit=50 45
```

will ensure that data is only collected while the sample temperature lies between 40K and 50K. If the sample temperature strays out of these limits the instrument will be put into "waiting" mode.

If run control is no longer required the no control qualifier should be used

```
MARI> cset t_samp/nocontrol
```

When measurements are to be made at base temperature, the heater is usually switched off. If you want to warm up the sample, and there appears to be no response to the cset t_head command, check that the heater is switched on. The switch is on the right hand side of the Eurotherm crate, at the top of the left hand rack in the cabin. On the back of the Eurotherm crate there is a rotary switch to set the heater power. To control between 1 and 150K, a voltage of 52V is suitable, to warm up to room temperature 72V is appropriate. It is wise to always use the lowest necessary heater voltage. Use the table below for reference.

Maximum Temperature	10K	30K	50K	150K	300K
Heater Voltage	12V	24V	32V	52V	72V

3.5 Data Collection Commands

All the following instrument control commands may be abbreviated to three letters.

`begin`	Starts a run.
`update`	Stores the data collected so far in the current run parameter table (CRPT)
`store`	Stores the data collected up to the last update in the file `mari$disk0:[marmgr.data]mar0<runno.>.sav`. The store command should always be preceded by an update
`pause`	Pauses data collection.
`resume`	Resumes data collection
`abort`	Aborts the current run without saving any data.
`end`	Ends the current run and stores the data in `mari$disk0:[marmgr.data]mar0<run no.>.raw`
`change`	Used to change the details that are sent to the instrument control program (ICP), such as the title and the time channel boundaries.
`nextrun <file>`	Similar to the change command but writes the information to the file which can be loaded into the ICP at a later date with the load command.
`load <file>`	Loads the details in file into the ICP.

A command file, upd_uamp, will perform an update and a store at given intervals in total beam current. This will ensure that you will not loose all your data if there are any problems with the DAE during the run. Run upd_uamp from the Control window using the command

```
MARI> @g:upd_uamp <current at first update>
                  <interval between updates in µAmphrs>
```

To stop the command file you must type `[Ctrl]Y`

3.6 Using Command Files

Command files can be written to control the instrument. An example command file follows:

`$ set def mari$disk0:[mari.run]`	*set default directory*
`$ on error then continue`	*ensure the command file will continue after a camac error*
`$ waitfor 700 uamps`	*wait for 700µ Amps*
`$ end`	*end run*
`$ cset t_head 80`	*set the head temperature*
`$ cset t_samp/control/lolimit=75/hilimit=85 80`	*sets temperature limits*
`$ wait 00:40:00`	*wait 40 mins (temperature stabilisation)*
`$ load ndnio_80.dat`	*load the new ICP parameters*
`$ begin`	*begins run*
`$ waitfor 500 uamps`	
`$ update`	
`$ store`	
`$ waitfor 700 uamps`	
`$ end`	
`$ set_ei 100 250 c`	*sets* E_i
`$ wait 00:15:00`	*waits 15 mins (chopper phasing)*
`$ load ndnio_100.dat`	
`$ begin`	
`$ waitfor 700 uamps`	
`$ exit`	

A command file can be run from the terminal using `@<filename>`. Please run all command files from the Control window to reduce the chances of confusion.

Note:
The two commands `WAIT` and `WAITFOR` are different, and confusion over their use is one of the main causes of failures in command files.

`WAIT`	This is a VMS command that waits for a specified time. The time must be given in the `hrs:min:secs` format used by the VMS operating system.
`WAITFOR`	This is an instrument control command and can be used to get the command file to wait for certain amount of data to be collected. The most common usage of the command is to wait for a certain number of microamps, in this case the suffix `uamps` must be given after the number (see the sample command file above).

4. DATA ANALYSIS AND VISUALISATION.

Several programs and utilities exist to help you analyse your data including the FRILLS least squares fitting program. There is only scope here to provide the information required to allow you to produce S(ϕ,ω) plots of your data, more detailed information is available in another report, and copies of the FRILLS manual are available. If you are doing your data analysis in your own directory make sure that you are using the MARI LOGIN.COM. To configure your terminal for instrument type MARI after running the login command file.

The program HEAD is very useful if you want to find out the title, running time and total current of a previous run. It has the format

```
MARI> head <run no.>
```

There are two main programs for analysis on MARI:
HOMER - which creates one dimensional data sets for plotting in GENIE
SPEAL - which creates two-dimensional data set for plotting in DISPLAY

4.1 HOMER

To create one-dimensional data sets it is necessary to use HOMER. A larger and more comprehensive manual exists and a copy of it should be in the MARI portacabin. HOMER performs the following functions:

- It reads in raw data stored either in disk files (RAW or SAV files) or in the computor memory (CRPT).
- The incident energy is automatically determined from the measured monitor spectra.
- The data are grouped into workspaces defined by a mapping file.
- Noisy or unstable detectors can be eliminated from workspaces using a mask file. This feature also allows the elimination of detectors picking up Bragg or spurious scattering
- A time-modulated or time-independent background, determined from the end of the time frame, is subtracted from the workspaces.
- The data is converted to S(ϕ,ω) i.e. converted to energy transfer and corrected for k_f/k_i and detector efficiency.
- HOMER results are usually stored in a binary file in the GENIE intermediate file format, to allow subsequent analysis within GENIE. If preferred, the workspace information can be written to an ASCII file
- An ASCII diagnostics file containing details of the HOMER analysis (incident energies, monitor integrals, spectrum integrals and backgrounds etc.) can be produced.

The format of the command is

```
HOMER <data source> (<Ei> (<Emin> (<Emax> (<dE>))))
```

As with all DCL commands, the user may give the shortest unambiguous abbreviation which is usually HO. The user may modify the options used by HOMER by including qualifiers in the command line. e.g.

```
HO/MASK=MAR02420.MSK/VAN=2414/CHOP=400 2420
```

The most commonly used are described below. There is an option to extract absolute intensities using HOMER, involving the use of a monochromatic vanadium data set. Other qualifiers are normally only required in unusual circumstances.

/MAP=<map file name>
Specifies the spectrum mapping file with default extension .MAP. If not given, a default ring mapping file is used.

/MASK=<mask file name>
Specifies a spectrum masking file. Mask files are discussed later

/VAN=<vanadium sum file>
Specifies a white-beam vanadium sum file containing integrals from 20 to 40 meV for each detector, normalised to a default M1 sum. The integrals are used to normalise for the solid angle and detector efficiency prefactor for each detector. The sum file is either specified in full or just given as a run number, in which case the default file name is `MARI$DISK:MAR0<run no.>.SUM` or `SYS$SCRATCH:MAR0<run no.>.SUM`.

Note: mari_data: *is the logical name for* mari$disk0:[marmgr.data] *or* mari$disk:[marmgr.data]

/CHOP(PER_SPEED)=<chopper speed>
Specifies the speed of the chopper in Hz. This is required for the subtraction of a time modulated background.

/NORM(ALIZATION)
Determines if the data are to be normalised to the integrated monitor counts or proton current.

/OUT=<diagnostic output file name>
Specifies the name of the ASCII file containing diagnostic output. The default file specification is `SYS$SCRATCH:MAR0<run no.>.`

/ASCII
The workspace data is written to a .DAT file in ASCII format.

4.1.1. Vanadium Normalisation

The white beam vanadium sum files, required by HOMER for normalisation and by the diagnostic program to create a mask file are created by the program WHITE_VAN. The command has the format.

```
White_van/par=(<par file no.>) <vanadium run number>
```

This will create a file `SYS$SCRATCH:MAR0<run no.>.SUM`. A copy of this file will usually have been copied by the instrument scientist to mari$disk:[marmgr.data].

4.1.2 Mapping files

HOMER groups the recorded spectra into workspaces according to a mapping file, which is either specified by the `/MAP` qualifier or defined by the default value set in the current HOMER command table.

The mapping file is an ASCII file containing the following lines in free format:

1st Line: N_w

- N_w = No. of workspaces in map

2nd Line: N_{sp}, L_2, ϕ, D_t

- N_{sp} = No. of spectra in first workspace
- L_2 = Length of scattered flight path of first workspace (in m)
- ϕ = Average scattering angle of first workspace (in °)
- D_t = Electronic time delay of detectors in first workspace (in ms)

3rd Line: List of spectrum nos. in first workspace (N.B. 3-9 is read as 3,4,5,6,7,8,9)

4th line: Continuation of spectrum no. list if necessary

:

:

The pattern, from the second line onwards, is repeated for all Nw workspaces.

There is a default mapping file which is currently to be found in `MARI$DISK:[MARMGR.MAPS]RINGS_921.MAP`. This file defines the following workspaces:

W1	Low angle bank (average angle 8°)
W2	21.5°
W3	37.5°
W4	52.5°
W5	67.5°
W6	82.5°
W7	97.5°
W8	112.5°
W9	127.5°

4.1.3 Masking Files

Masking files are used to eliminate small numbers of detectors from workspaces without the need to define a new mapping file. Common reasons for masking a detector are that

- it's efficiency has varied between white beam vanadium counts
- it is relatively noisy

The masking file simply consists of a list of masked spectra in free format occupying any number of lines. If the `/MASK` the default mask file is `SYS$SCRATCH:MAR0<RUN NO.>.SUM`.

The easiest way to generate a mask file is to use the program DIAG. The format of the command is

```
$ diag-
      /v1=<vanadium run no.>-
      (/v2=<2nd vanadium run number>)-
      (/nozero)(/stab=< stability>)-
      (/factor =<factor>)-
      /out-
      <run no./crpt>
```

DIAG will compare the two vanadium sum files and identify those detectors whose efficiency has varied between the runs. It will also search for detectors that have an intensity that is a number of standard deviations (factor) away from the average. Normally DIAG will flag detectors whose background is too high or if there are no counts in it, however if the `/NOZERO` qualifier is used than detectors with no counts will be be ignored. It is advisable to use the `/NOZERO` qualifier until the data has been counted for long enough to provide reasonable statistics. By using the `/OUT` qualifier all those detectors flagged by the program will be written to a mask file.

4.1.4 HOMER output

The workspaces are stored in a binary file in the format required by the GENIE READ command. The default file name for this file is `SYS$SCRATCH:MAR<run no>.COR`. The name of this file may be changed by the `/COR` qualifier. A record of the HOMER analysis is stored in an ASCII file with the default file name `SYS$SCRATCH:MAR<run no>.OUT` if the `/OUT` qualifier is used. In both cases, the files may be directed to a different directory but with the same file names using the `/DIR` qualifier.

Note *Files stored on* scratch$disk: *will be deleted after one week, so if longer storage is required, you must use the* `/DIR` *qualifier, or rename the files after running HOMER.*

4.2 Command Files for Data Analysis

If you use a command file to analyse your data and keep it you have a record of the parameters and files used in your analysis. Also, re-analysis of your data is straightforward and you do not have to fill you quota with .cor files. A typical analysis command file is shown below.

```
$! for the NdNiO3 expt January 1994.
$! The only parameter to change is the run number (4305 in this case)
$! in the first and last lines.
$!
$ diag/v1=MAR$DISK:[MARMGR.DATA]MAR04293.SUM/out 4305
$ homer-
        /chop=500-
        /van=MAR$DISK:[MARMGR.DATA]MAR04293.SUM-
        /mask-
        /norm-
        /norebin-
        4305
```

4.3 Genie

Genie is the ISIS graphics software. A full description is included in the PUNCH user manual in the cabin and copies are available in the computer support office. Here we will briefly describe the commands which are essential for viewing HOMER data.

To run genie simply type:

```
$ genie
```

To load HOMER workspaces, which were created using the default mapping file, into genie use the `g:read` command file. This command file will read in the seven workspaces described earlier.

Note: *`g:` is the logical name for mari$disk:[marmgr.genie].*

Both command files are run in genie using the format

```
>>@g:read
```

You will then be prompted for the run number and the first workspace number

The workspaces can be displayed using the command d. The plot command, p, allows you to plot the data as markers with error bars, or to plot one workspace on top of another. For example

`>>d/m w1 -10 90 0 10`	*plots the intensity of workspace 1 from 0 to 10 (arbitrary units) against energy transfer from -10 meV to 90 meV as marks.*
`>>p/e w1`	*adds error bars*
`>>p/h w2`	*over plots w2 as a histogram*

You may bin your data into groups using the alter bin command;

`>>a b 5`	*bins the data into groups of 5*

To take a hardcopy of a plot use the following two commands

```
>>k/h
>>j post<laser printer no.>
```

where the laser printer number identifies the location of the printer according to the table below.

laser printers	**location**
LASER 0	Computer support office, R3.
LASER 1	Coffee room, R3.
LASER 2	DAC, R55.
LASER 3	LAD portacabin
INK$POST0	Colour inkjet in MARI cabin
COLOUR$PS1	Colour printer in computor support

Table 4.1 A list of the normally used printer devices.

4.4 S(Q,E) Analysis

By treating the detector array on MARI as a large position sensitive detector it is possible to create two-dimensional data-sets. There are two main programs: SPEAL (S(ϕ,E) ALgorithm.) which creates a data file containing S(ϕ,E), and SQuEAL (S(Q,E) ALgorithm) which creates an S(Q,E) data file. The programs perform an almost identical analysis to that of HOMER, and all the qualifiers used in HOMER can be used in SPEAL However, they differ in the form of their output. In this case they produce ASCII files with the extension `.SPE` and `.SQE` respectively. These files can be manipulated using the DISPLAY program.

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The complete program suite contains several programs:

SPEAL	Creates an S(ϕ,E) file.
SQuEAL	Creates an S(Q,E) file.
WHITE_VAN	Creates a sum file from a white beam vanadium.
SUM	Creates a sum file from a monochromatic vanadium.
MONO_VAN	Takes a monochromatic vanadium sum file and calculates the correction to put the data onto an absolute scale.
Q_MAP	Creates a mapping file with roughly equal Q-bins.
SUB	Subtracts one S(ϕ,E) file another
DISPLAY	Views the S(ϕ,E) or S(Q,E) data-sets

4.4.1 Running the programs

All these programs will be set up if the user runs the MARI login and then types `MARI` to set up all the logical definitions. As with HOMER the user can modify the operation of the programs by supplying qualifiers, a typical command would be of the form:

```
SPEAL/MAP=617/VAN=630/CHOP=600 617 250 -50 250 1.0
```

SPEAL is the name of the program: `/MAP` `/VAN` and `/CHOP` are the qualifiers; and the numbers are the parameters.

Table 4.2 Summary of Program parameters and Qualifiers

Program	**CommonQualifiers**
SPEAL <data source> <ei> <emin> <emax> <de>	/van=<van file> /chop=<chopper speed> /map=<map file> /mask=<mask file>
SQuEAL <data>	
Q_map <data>	/del_Q=<% Q resolution>
White_van <data>	
Sub <data> <background> <output>	/nd=<background normalisation>
Disp <data>	/dev=<ploting device>

4.4.2 Typical Command File

Rather than saving all the data files as these are large often it easier to keep a record of the command file used to generate the data-sets. An example of such a command file is given below. One called SQE.COM can generally be found in
MARI$DISK0:[MARI.RUN]

```
$! Analysis for the SiO2 data set at 250 meV
$ Q_MAP-
      /del_Q=2.0-
      821
$!
$ WHITE_VAN 814
$ WHITE_VAN 900
$!
$ DIAG-
      /v1=814-
      /v2=900-
      /out-
      /factor=5-
      821
$!
$ SUM-
      /van=814-
      /chop=600-
      /norm-
      815 -100 200
$!
$ MONO_VAN
      /mv=23.13-
      /ms=30.54-
      /as=307.82-
      815
$ mono_cor = f$edit(mono_cor,"trim")
$!
$ SPEAL-
      /map=821-
      /van=814-
      /chop=600-
      /abs='mono_cor'-
      /mask-
      821 250 -50 240 1.0
$!
$ SQuEAL 821
```

This particular file does a simple analysis of run #821, there is no background, but the vanadium normalisation is performed using white beam vanadium run #814. The white beam vanadium run #900 is used to look for detector stability output is put onto absolute units using the monochromatic vanadium run #815.

- The command Q_map creates a mapping file called SYS$SCRATCH:MAR00821.MAP which is used to group the detectors together into roughly equal Q bins. The qualifier /DEL_Q specifies the size of the Q bins and hence the Q resolution in the final data set. It is a percentage of the total Q-range.

- The command White_sum creates a vanadium normalisation file called SYS$SCRATCH:MAR00814.SUM, from the white beam vanadium runs #814 and #900. This is used to correct for detector efficiency and solid angle, and to look for detector stability.
- The DIAG program is used to look for poor detectors. It creates a mask file of detectors that are to be eliminated from the analysis. The file is called SYS$SCRATCH:MAR0821.MSK.
- The SUM program does an energy intergral over the monocrhomatic vanadium creating a file called SYS$SCRATCH:MAR00815.SUM.
- The MONO_VAN program calculates the normalisation constant to convert the data onto absolute units.
- The SPEAL program creates the .SPE file
  - The /MAP qualifier picks up the mapping file.
  - The /VAN qualifier specifies which vanadium sum file to be read.
  - The /CHOP qualifier give the chopper rotation speed in Hertz so that the oscillating background can be subtracted.
  - The /ABS qualifier reads the absolute normalisation constant.
  - A first guess of 250 meV is given for the incident energy. The actual energy is found from the first moments of monitors 2 and 3.
  - The created file will have energy limits 50 meV to 240 meV in bins of 1.0 meV
  - The command SQUEAL takes the S(ϕ,E) data set and rebins it onto an S(Q,E) data set. It takes the .SPE file and creates a file called SYS$SCRATCH:MAR00821.SQE. The log file is amended accordingly.
- The SQUEAL program creates the .SQE file.

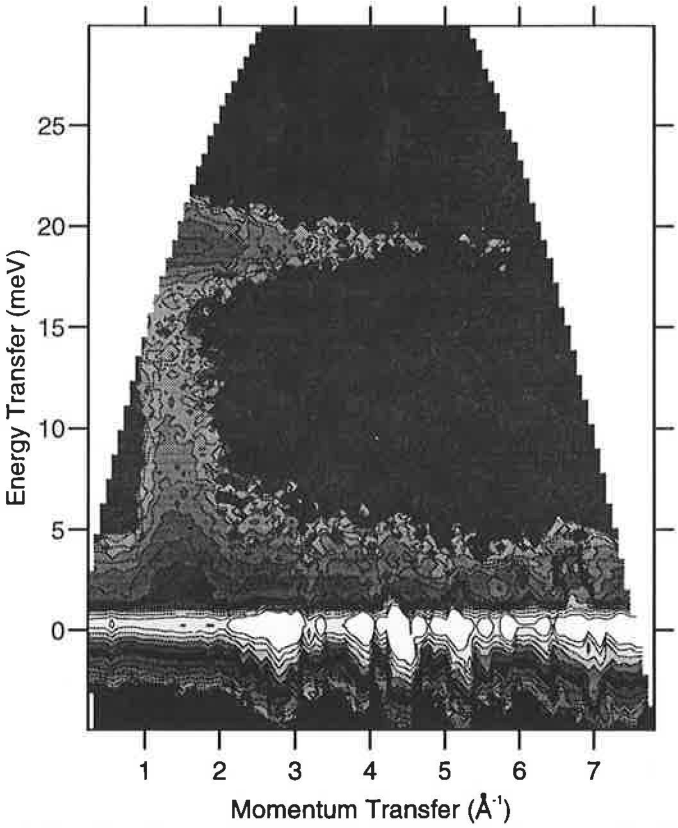
The command SPEAL is the largest program in the suite. It take the raw data set #821 and creates an S(ϕ,E) data set called SYS$SCRATCH$:MAR00821.SPE. A log file is also created called SYS$SCRATCH:MAR00821.LOG.

4.4.3 Display

Display is an interactive display program which allows the user to view the two-dimensional analysed data. It has the following capabilities:

- It can read both `.SPE` and `.SQE` files and display them as 2-dimensional contour maps.
- It can display the data on PC's, Pericoms and Workstations.
- The plot can be manipulated to enhance regions of interest.
- 1-dimensional cuts can be taken out of the data.

Figure 4.2 *An example of the output from DISPLAY. In this case the scattering intensity from $SrCr_{8-x}Ga_{4+x}O_{19}$.*



The command takes the form

```
display/device=<device name> <data file name>
```

Note: *Display uses UNIRAS routines to create the graphics. You will need to have UNIRAS installed before you can run display.*

The data file name can be a full file specification or just a run number. If a run number is used then the program will default to `MAR<run number>.SQE` and will assume that it is in the default directory `SYS$SCRATCH`. To change the directory use the `/DIR` command, if you wish to read a `.SPE`, the full file name is needed.

The `/DEVICE` command, is used to configure the graphics to the computer on which it is running. The different devices supported by the machine are:

`PERICOM`	VT100 style terminals.
`PC`	IBM compatible PC's
`GRAPHON`	Graphon workstations
`WORKSTATION`	X-windows type terminals.

Once inside the program you should see a list of the default plotting parameters and a # prompt. The parameters describe the size, colour and limits of the plot, they can be edited to give the desired view of the data.

Command	**Description**
`plot`	Draws the data
`edit <parameter>`	Can be used to change the plotting parameters
`display all`	Lists the current values of the parameters.
`kill`	Clears the data
`file <file name>`	Reads in a new data set
`cut <q, e>`	Takes a 1-dimensional cut out of the data
`laser`	creates the postscript file POST.DAT
`quit`	Exits the program

To plot the POST.DAT file created when the laser command is used. Go to a window outside display and type

```
MARI> PRINT/QUE=<QUE> POST.DAT
```

For a black and white plot <QUE> can be a normal laser printer, e.g.

`POST$LSR0`	In the computer support office
`POST$LSR1`	In the coffee lounge
`POST$LSR3`	In the LAD cabin

For colour prints is is possible to use,

`POST$INK0`	The inkjet printer in the MARI cabin.
`COLOUR$PS1`	colour plotter in computer support office.

If the cut command is used the program prompts the user for maximum and minimum values and then enters the one-dimensional plotting routine. The prompt changes to

CUT>. To return to the main program type QUIT. To write the data out to an ASCII file type WRITE <file name>

Parameter	Description	
TITL	Plot title (superscripts and subscripts should be preceded by a '<' or '>' respectively.	
QBIN/PBIN	The grouping of Q or ϕ bins.	
EBIN	The grouping of Energy bins.	
EMAX/EMIN	The maximum and minimum energy.	
QMIN/QMAX	The maximum and minimum Q.	
CONT	The number of contour intervals.	
ZMIN/ZMAX	The maximum and minimum height.	
LEVL	The type of plot:	
	LINEAR	Equally spaced contours
	LOG	Logarithmically spaced contours
	ROOT	Square root dependence
TYPE	Different styles of plot are possible:	
	CONT	A contour plot
	GRID	A colour pixel plot
	LAND	A surface relief map
TSIZ	The size of the font.	
FONT	The font type, either SIMP, COMP or ITAL	
COLR	The colour of the plot, either:	
	LINE	Line contours, with no colour
	SHADED	Black and White Shading
	COLR	Full colour plot
XRAT/YRAT	The x and y-ratio of the plot.	

5. APPENDICES

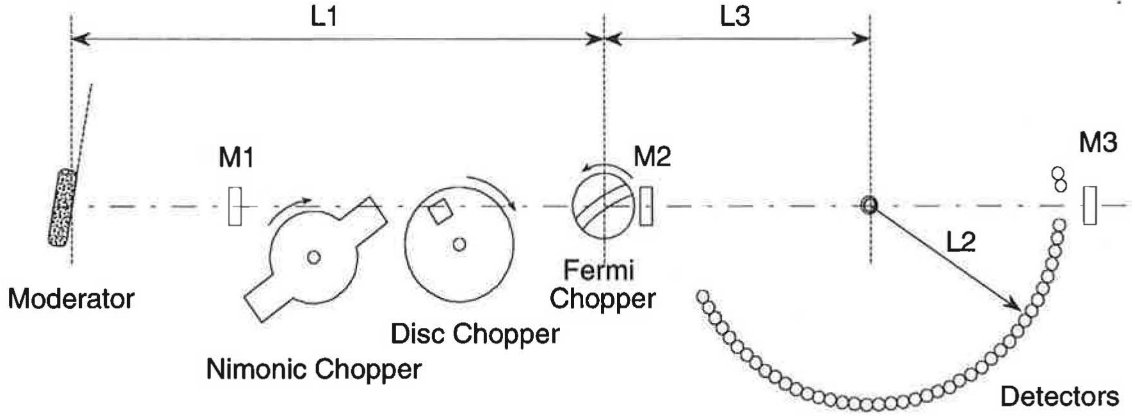


Figure 5.1 A schematic layout of MARI

5.1 MARI Parameters

Moderator:	CH_4 100K (Poisoned with Gd at 2.5 cm)
Beam size at sample:	50 by 50 mm
Typical intensity	4900 n s^{-1} cm^{-2}

(200 μamps U target 100 meV)

Note: *The intensity is a factor of 2.3 less than this with the Ta target.*

Detectors	10 bar ^3He proportional counters (25 mm diameter 300 mm long)

Standard Vanadium (Annulus)

Mass	23.133 gm
External Diameter	31 mm
Length	40 mm
Thickness	1.1 mm
Number of atoms	2.719 x 10^{23}
Total Cross section	1.3868 cm^2

Distances

Moderator to Fermi Chopper	10,050 mm
Moderator to Sample	11,739 mm
Sample to detectors	4,020 mm
Moderator to monitor 1	6,190 mm
Moderator to monitor 2	10.297 mm
Moderator to monitor 3	17,559 mm

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Choppers

Fermi Chopper

Length of slits	100 mm
Slats	Boron fibre reinforced resin
Slits	Hollow aluminium frame

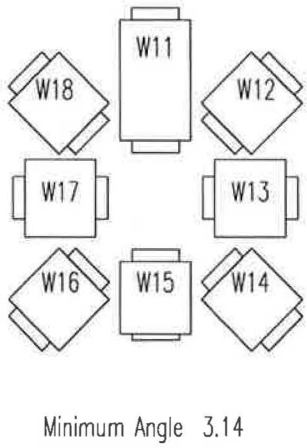
Chopper	Curvature radius	Slit width	Slat width
Chopper A (500 meV)	1300 mm	0.76 mm	0.55 mm
Chopper B (200 meV)	820 mm	1.14 mm	0.55 mm
Chopper C (100 meV)	580 mm	1.52 mm	0.55 mm
Chopper D (50 meV)	410 mm	1.52 mm	0.55 mm
Chopper S 'Sloppy'	1300 mm	2.28 mm	0.55 mm

Nimonic Chopper

Speeds	25 - 100 Hz
Radius	260 mm
Nimonic Thickness	260 mm

Disc Chopper

Speeds	5 - 50 Hz
Size of hole	60 x 60 mm
Radius of hole	260 mm
Construction	Boron filled resin 60 mm thick



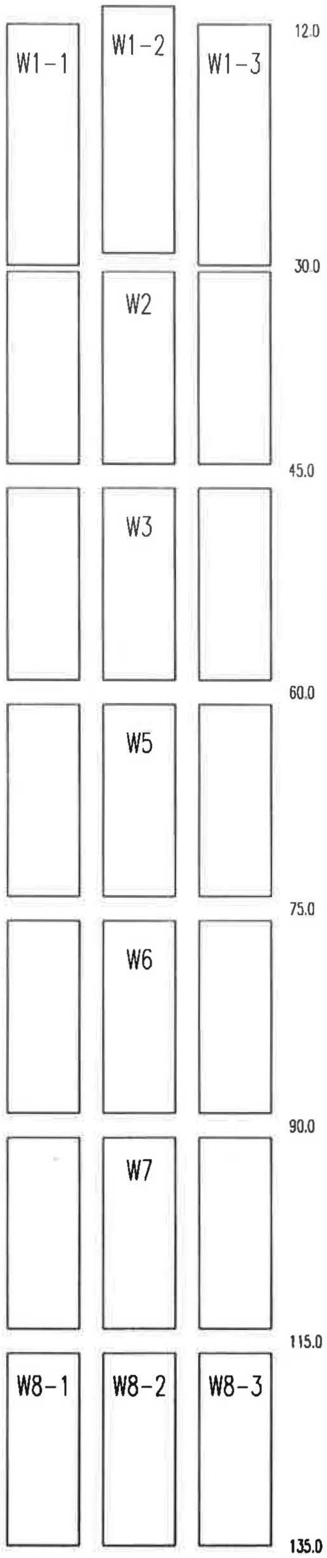


Figure 5.2 *Schematic diagram of the MARI detector banks. Only those banks that are numbered are currently filled.*

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Detector Angles (design values)

W11

Spec	Det	Degree
5	4101	3.43
6	4102	3.86
7	4103	4.29
8	4104	4.71
9	4105	5.14
10	4106	5.57
11	4107	6.00
12	4108	6.43
13	4109	6.86
14	4110	7.29
15	4111	7.71
16	4112	8.14
17	4113	8.57
18	4114	9.00
19	4115	9.43
20	4116	9.86
21	4117	10.29
22	4118	10.71
23	4119	11.14
24	4120	11.57
25	4121	12.00
26	4122	12.43
27	4123	12.86
28	4124	13.29

W13

Spec	Det	Degree
45	4301	3.43
46	4302	3.86
47	4303	4.29
48	4304	4.71
49	4305	5.14
50	4306	5.57
51	4307	6.00
52	4308	6.43
53	4309	6.86
54	4310	7.29
55	4311	7.71
56	4312	8.14
57	4313	8.57
58	4314	9.00
59	4315	9.43
60	4316	9.86

Monitors

M1	1
M2	2
M3	3
M4	4

W15

Spec	Det	Degree
77	4501	3.43
78	4502	3.86
79	4503	4.29
80	4504	4.71
81	4505	5.14
82	4506	5.57
83	4507	6.00
84	4508	6.43
85	4509	6.86
86	4510	7.29
87	4511	7.71
88	4512	8.14
89	4513	8.57
90	4514	9.00
91	4515	9.43
92	4516	9.86

W17

Spec	Det	Degree
109	4701	3.43
110	4702	3.86
111	4703	4.29
112	4704	4.71
113	4705	5.14
114	4706	5.57
115	4707	6.00
116	4708	6.43
117	4709	6.86
118	4710	7.29
119	4711	7.71
120	4712	8.14
121	4713	8.57
122	4714	9.00
123	4715	9.43
124	4716	9.86

W12

Spec	Det	Degree
29	4201	6.43
30	4202	6.86
31	4203	7.29
32	4204	7.71
33	4205	8.14
34	4206	8.57
35	4207	9.00
36	4208	9.43
37	4209	9.86
38	4210	10.29
39	4211	10.71
40	4212	11.14
41	4213	11.57
42	4214	12.00
43	4215	12.43
44	4216	12.86

W14

Spec	Det	Degree
61	4401	6.43
62	4402	6.86
63	4403	7.29
64	4404	7.71
65	4405	8.14
66	4406	8.57
67	4407	9.00
68	4408	9.43
69	4409	9.86
70	4410	10.29
71	4411	10.71
72	4412	11.14
73	4413	11.57
74	4414	12.00
75	4415	12.43
76	4416	12.86

W16

Spec	Det	Degree
93	4601	6.43
94	4602	6.86
95	4603	7.29
96	4604	7.71
97	4605	8.14
98	4606	8.57
99	4607	9.00
100	4608	9.43
101	4609	9.86
102	4610	10.29
103	4611	10.71
104	4612	11.14
105	4613	11.57
106	4614	12.00
107	4615	12.43
108	4616	12.86

W18

Spec	Det	Degree
125	4801	6.43
126	4802	6.86
127	4803	7.29
128	4804	7.71
129	4805	8.14
130	4806	8.57
131	4807	9.00
132	4808	9.43
133	4809	9.86
134	4810	10.29
135	4811	10.71
136	4812	11.14
137	4813	11.57
138	4814	12.00
139	4815	12.43
140	4816	12.86

W1-2

Spec	Det	Degree
141	2101	12.43
142	2102	12.86
143	2103	13.29
144	2104	13.71
145	2105	14.14
146	2106	14.57
147	2107	15.00
148	2108	15.43
149	2109	15.86
150	2110	16.29
151	2111	16.71
152	2112	17.14
153	2113	17.57
154	2114	18.00
155	2115	18.43
156	2116	18.86
157	2117	19.29
158	2118	19.71
159	2119	20.14
160	2120	20.57
161	2121	21.00
162	2122	21.43
163	2123	21.86
164	2124	22.29
165	2125	22.71
166	2126	23.14
167	2127	23.57
168	2128	24.00
169	2129	24.43
170	2130	24.86
171	2131	25.29
172	2132	25.71
173	2133	26.14
174	2134	26.57
175	2135	27.00
176	2136	27.43
177	2137	27.86
178	2138	28.29
179	2139	28.71
180	2140	29.14

W1-1

Spec	Det	Degree
405	1101	13.71
406	1102	14.14
407	1103	14.57
408	1104	15.00
409	1105	15.43
410	1106	15.86
411	1107	16.29
412	1108	16.71
413	1109	17.14
414	1110	17.57
415	1111	18.00
416	1112	18.43
417	1113	18.86
418	1114	19.29
419	1115	19.71
420	1116	20.14
421	1117	20.57
422	1118	21.00
423	1119	21.43
424	1120	21.86
425	1121	22.29
426	1122	22.71
427	1123	23.14
428	1124	23.57
429	1125	24.00
430	1126	24.43
431	1127	24.86
432	1128	25.29
433	1129	25.71
434	1130	26.14
435	1131	26.57
436	1132	27.00
437	1133	27.43
438	1134	27.86
439	1135	28.29
440	1136	28.71
441	1137	29.14
442	1138	29.57
443	1139	30.00
444	1140	30.43

W1-1

Spec	Det	Degree
477	3101	13.71
478	3102	14.14
479	3103	14.57
480	3104	15.00
481	3105	15.43
482	3106	15.86
483	3107	16.29
484	3108	16.71
485	3109	17.14
486	3110	17.57
487	3111	18.00
488	3112	18.43
489	3113	18.86
490	3114	19.29
491	3115	19.71
492	3116	20.14
493	3117	20.57
494	3118	21.00
495	3119	21.43
496	3120	21.86
497	3121	22.29
498	3122	22.71
499	3123	23.14
500	3124	23.57
501	3125	24.00
502	3126	24.43
503	3127	24.86
504	3128	25.29
505	3129	25.71
506	3130	26.14
507	3131	26.57
508	3132	27.00
509	3133	27.43
510	3134	27.86
511	3135	28.29
512	3136	28.71
513	3137	29.14
514	3138	29.57
515	3139	30.00
516	3140	30.43

W2 Spec	Det	Degree	W3 Spec	Det	Degree	W4 Spec	Det	Degree
181	2201	30.86	213	2301	45.86	245	2401	60.86
182	2202	31.29	214	2302	46.29	246	2402	61.29
183	2203	31.71	215	2303	46.71	247	2403	61.71
184	2204	32.14	216	2304	47.14	248	2404	62.14
185	2205	32.57	217	2305	47.57	249	2405	62.57
186	2206	33.00	218	2306	48.00	250	2406	63.00
187	2207	33.43	219	2307	48.43	251	2407	63.43
188	2208	33.86	220	2308	48.86	252	2408	63.86
189	2209	34.29	221	2309	49.29	253	2409	64.29
190	2210	34.71	222	2310	49.71	254	2410	64.71
191	2211	35.14	223	2311	50.14	255	2411	65.14
192	2212	35.57	224	2312	50.57	256	2412	65.57
193	2213	36.00	225	2313	51.00	257	2413	66.00
194	2214	36.43	226	2314	51.43	258	2414	66.43
195	2215	36.86	227	2315	51.86	259	2415	66.86
196	2216	37.29	228	2316	52.29	260	2416	67.29
197	2217	37.71	229	2317	52.71	261	2417	67.71
198	2218	38.14	230	2318	53.14	262	2418	68.14
199	2219	38.57	231	2319	53.57	263	2419	68.57
200	2220	39.00	232	2320	54.00	264	2420	69.00
201	2221	39.43	233	2321	54.43	265	2421	69.43
202	2222	39.86	234	2322	54.86	266	2422	69.86
203	2223	40.29	235	2323	55.29	267	2423	70.29
204	2224	40.71	236	2324	55.71	268	2424	70.71
205	2225	41.14	237	2325	56.14	269	2425	71.14
206	2226	41.57	238	2326	56.57	270	2426	71.57
207	2227	42.00	239	2327	57.00	271	2427	72.00
208	2228	42.43	240	2328	57.43	272	2428	72.43
209	2229	42.86	241	2329	57.86	273	2429	72.86
210	2230	43.29	242	2330	58.29	274	2430	73.29
211	2231	43.71	243	2331	58.71	275	2431	73.71
212	2232	44.14	244	2332	59.14	276	2432	74.14

W5

Spec	Det	Degree
277	2501	75.86
278	2502	76.29
279	2503	76.71
280	2504	77.14
281	2505	77.57
282	2506	78.00
283	2507	78.43
284	2508	78.86
285	2509	79.29
286	2510	79.71
287	2511	80.14
288	2512	80.57
289	2513	81.00
290	2514	81.43
291	2515	81.86
292	2516	82.29
293	2517	82.71
294	2518	83.14
295	2519	83.57
296	2520	84.00
297	2521	84.43
298	2522	84.86
299	2523	85.29
300	2524	85.71
301	2525	86.14
302	2526	86.57
303	2527	87.00
304	2528	87.43
305	2529	87.86
306	2530	88.29
307	2531	88.71
308	2532	89.14

W6

Spec	Det	Degree
309	2601	90.86
310	2602	91.29
311	2603	91.71
312	2604	92.14
313	2605	92.57
314	2606	93.00
315	2607	93.43
316	2608	93.86
317	2609	94.29
318	2610	94.71
319	2611	95.14
320	2612	95.57
321	2613	96.00
322	2614	96.43
323	2615	96.86
324	2616	97.29
325	2617	97.71
326	2618	98.14
327	2619	98.57
328	2620	99.00
329	2621	99.43
330	2622	99.86
331	2623	100.29
332	2624	100.71
333	2625	101.14
334	2626	101.57
335	2627	102.00
336	2628	102.43
337	2629	102.86
338	2630	103.29
339	2631	103.71
340	2632	104.14

W7

Spec	Det	Degree
341	2701	105.86
342	2702	106.29
343	2703	106.71
344	2704	107.14
345	2705	107.57
346	2706	108.00
347	2707	108.43
348	2708	108.86
349	2709	109.29
350	2710	109.71
351	2711	110.14
352	2712	110.57
353	2713	111.00
354	2714	111.43
355	2715	111.86
356	2716	112.29
357	2717	112.71
358	2718	113.14
359	2719	113.57
360	2720	114.00
361	2721	114.43
362	2722	114.86
363	2723	115.29
364	2724	115.71
365	2725	116.14
366	2726	116.57
367	2727	117.00
368	2728	117.43
369	2729	117.86
370	2730	118.29
371	2731	118.71
372	2732	119.14

W8-2			W8-1			W8-3		
	Det	Degree	Spec	Det	Degree	Spec	Det	Degree
373	2801	120.86	445	1801	120.86	517	3801	120.86
374	2802	121.29	446	1802	121.29	518	3802	121.29
375	2803	121.71	447	1803	121.71	519	3803	121.71
376	2804	122.14	448	1804	122.14	520	3804	122.14
377	2805	122.57	449	1805	122.57	521	3805	122.57
378	2806	123.00	450	1806	123.00	522	3806	123.00
379	2807	123.43	451	1807	123.43	523	3807	123.43
380	2808	123.86	452	1808	123.86	524	3808	123.86
381	2809	124.29	453	1809	124.29	525	3809	124.29
382	2810	124.71	454	1810	124.71	526	3810	124.71
383	2811	125.14	455	1811	125.14	527	3811	125.14
384	2812	125.57	456	1812	125.57	528	3812	125.57
385	2813	126.00	457	1813	126.00	529	3813	126.00
386	2814	126.43	458	1814	126.43	530	3814	126.43
387	2815	126.86	459	1815	126.86	531	3815	126.86
388	2816	127.29	460	1816	127.29	532	3816	127.29
389	2817	127.71	461	1817	127.71	533	3817	127.71
390	2818	128.14	462	1818	128.14	534	3818	128.14
391	2819	128.57	463	1819	128.57	535	3819	128.57
392	2820	129.00	464	1820	129.00	536	3820	129.00
393	2821	129.43	465	1821	129.43	537	3821	129.43
394	2822	129.86	466	1822	129.86	538	3822	129.86
395	2823	130.29	467	1823	130.29	539	3823	130.29
396	2824	130.71	468	1824	130.71	540	3824	130.71
397	2825	131.14	469	1825	131.14	541	3825	131.14
398	2826	131.57	470	1826	131.57	542	3826	131.57
399	2827	132.00	471	1827	132.00	543	3827	132.00
400	2828	132.43	472	1828	132.43	544	3828	132.43
401	2829	132.86	473	1829	132.86	545	3829	132.86
402	2830	133.29	474	1830	133.29	546	3830	133.29
403	2831	133.71	475	1831	133.71	547	3831	133.71
404	2832	134.14	476	1832	134.14	548	3832	134.14

5.2. A Final Checklist

Before you walk out of the cabin for a quiet night in the pub, quickly go through the following checklist.

- Interlocks complete
- Shutter open
- Vacuum good (<1 mb)
- set_ei and cha issued from mari$disk0:[mari.run]
- Chopper correctly phased (update, ei crpt)
- Heater on (if necessary)
- Command file for automatic update and store running

5.3 Useful Phone Numbers

In the event of any problems with the instrument, computing or sample environment your first point of contact should be your local contact, failing that either Steve Bennington or else Richard Azuah.

	RAL extension	*Home number*	*Bleeper number*
Steve Bennington	5193	0235 528381	241
Richard Azuah	5797	0235 834211	

The home numbers can be used in the case of problems in the evening, but please not after 11 O'clock, except for dire emergencies. The Main Control room is manned at all hours and they can also be contacted if you have a problem. If you have queries about accommodation, claims or transport contact the University Liaison Office (ULS) inside working hours.

To dial an office extension from outside RAL	0235 44+extension number
To make an external call from a RAL phone	9+normal number

To use the bleeper, phone 70 and wait for a tone. If it is not engaged dial
the bleeper number plus the current extension number, and then wait for a tone again before replacing the receiver.

Other useful numbers:

Main Control Room	6789
Emergency number	2222
University Liaison Office	5592

5.4 Safety Summary

Before you start your experiment please make sure that:

- You have registered with the University Liaison Office (ULS) in R3, or in the Main Control Room (MCR) if you arrive outside working hours. If you are a new user you will be issued with safety instructions, please read them.
- You have picked up a film badge from the Health Physics Office opposite the MCR.
- You have picked up the sample record sheet from the Data Acquisition Centre (DAC) and that you understand the sample handling instructions. This sheet is to be displayed on the instrument during the experiment.

The full safety instructions are to be found in the literature given out by the ULS. However, the salient points concerning the instrument are summarised here.

- After the experiment the sample should be monitored at its surface. If the radiation is,
  - Greater than 75 μSv (γ or β). The ISIS duty officer (ext. 6789) must be informed to supervise the removal of the sample. Any operation concerning the sample must also be supervised by the duty officer.
  - Greater than 10 μSv. The sample can be removed and stored in the active sample cabinet. However, any operation that requires the sample can to be opened must be done in a glove box.
  - Less than 10 μSv. The sample can be handled normally, using good laboratory practice.

- After the completion of the experiment the sample can and sample should be placed in the active samples cabinet in a suitable container with a copy of the sample record sheet.

- If it is necessary to transport an irradiated sample off-site, documentation must be obtained from the health physics office. Do not take the sample to them, they will come down to the instrument. Preparing the documentation will take some time so ask for this well in advance of departure.

- ISIS conforms to COSSH regulations. Any chemical process or procedure that involves chemicals, must be assessed beforehand by ISIS Safety personnel.

- If you have any safety concerns ask your local contact or ring the Main Control Room.

5.5. Eating and Drinking

5.5.1. RAL Opening Hours

R22 Restaurant

	Mon - Fri	Sat - Sun
Breakfast	7.00 - 8.00	8.00 - 9.00
Lunch	11.45 - 13.45	12.00 - 13.00
Dinner	17.00 - 19.00	18.00 - 19.00

R1 coffee lounge (hot drinks/snacks)	9.30 - 11.30	(Monday-Friday)
	12.30 - 15.30	"
R22 coffee lounge	12.45 - 13.45	"

5.5.2. Pubs

Blewbury	The Red Lion
Chilton	Rose & Crown
East Hendred	The Plough,
	Wheatsheaf
East Ilsley	The Crown and Horns,
	The Swan
Steventon	The Cherry Tree
Wantage	The Lamb,
	The Swan
West Hendred	The Hare
West Ilsley	The Harrow

6. INDEX

7. COMMENTS/NOTES