**RAL Report**
RAL-94-100

# EMU User Guide

Comp

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# EMU User Guide

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# 1. Cryostats

## 1.1. Closed-cycle refrigerator

The CCR is controlled using the Eurotherm TC820 temperature controller. If necessary this may be selected using the command @CCR_TC820. Users should check that both data switches are in position one for connection to be made.

**Changing the sample:**

- Set the temperature to 300K.
- Turn the compressor off (to speed warming of the sample).

Then:

- Close the large isolation valve on the side of the cruciform.
- Switch off the pump using the right-hand button.
- Vent the turbo pump using valve on pump.

After the sample temperature has reached about 280K:

- Open the upper vent valve to vent the cruciform.
- Slide back CCR unit.
- Remove tail sections and change sample.

**DO NOT BEND THE THERMOMETER LEADS.**

**To cool the CCR:**

- Make sure all parts of the CCR are perfectly dry.
- Replace tail sections. Take particular care when replacing the end section, ensure firstly that the windows are aligned correctly and secondly no part touches the sample.
- Close the vent valves.
- Fully open the large isolation valve.
- Start the vacuum pump (using the right-hand button).
- The cruciform pressure is displayed by the digital readout adjacent to the pumping unit controls.
- Below $10^{-3}$ torr the compressor may be switched on - turn the switch from 0 to 1 on the red compressor box.

Users should check that the heater is not open circuit by attempting to maintain a high temperature before cooling.

## 1.2. Oxford Cryostat ('Blue' Cryostat)

The Oxford cryostat is controlled using the ITC503 temperature controller. If necessary this may be selected using the commands `@BLUE_ITC502` or `@BLUE_ITC503` for sticks two and three, respectively. Users should check that both data switches are in position two for connection to be made.

Please see the additional documents on how to operate the Oxford cryostat.

# 2. Magnetic Fields

### 2.1. Longitudinal magnetic fields

Longitudinal magnetic fields are provided using the Helmholtz coils. For fields below 350G the 3kW Farnell supply should be used (located in the bottom of the rack adjacent to the GEC PSU). For fields above 350G, up to the maximum 4000G, the GEC 200kW PSU is available. Both are controlled from MCS via a GPIB interface (see section 5).

The GEC PSU is operated as follows:

- Turn on PSU power using large rotary switch on front of unit.

- Open left door.

- Enable local operation by pressing the 'REMOTE' button (ensure green LED below button is extinguished).

- Turn on supply using 'ON' button located on the top left of panel.

- Enable remote operation by pressing the 'REMOTE' button again (ensure green LED below button is alight).

- Operate using MCS.

The Farnell supply is operated as follows:

- Turn on supply and operate using MCS

The output switched from both supplies are cross interlocked electrically to prevent one power supply feeding the other. A mechanical key interlock system is also fitted to prevent the 3kW output switch from being switched to the 'on' position before the 200kW has been switched off.

To power from the 200kW GEC PSU:

- Ensure the 3kW output switch is in the OFF position with the bolt extended to prevent accidental rotation.

- Remove key 'T25' from bolt.

- Insert key 'SVTR' and turn to it's captive position (lower right lock on 200kW PSU output panel).

- Turn the output switch on the 200kW to the desired polarity, usually positive. This will require rotating key directly under switch.

To power from the 3kW Farnell PSU:

- Ensure the 200kW output switch is in the OFF position. This will require rotating key directly under switch.

- Remove key 'SVTR' from 200kW.
- Insert key 'T25' in 3kW output switch and withdraw bolt.
- Turn 3kW output switch to ON position.

## 2.2. Transverse Calibration Fields

There are two saddle coils available that are capable of providing transverse fields of up to 100G and are therefore suitable for 20G calibration of longitudinal experiments. These are powered using the Farnell PSU located in the top of a rack adjacent to the GEC PSU.

## 2.3. Zero field

There are three pairs of coils mounted on the instrument used to cancel the earth's magnetic field. They are powered from the two Farnell supplies located at the base the rack adjacent to the spectrometer. At present the field is measured using two hand-held magnetometers.

## 2.4. Field Interlock

In normal use whenever the blocker is lowered the field from the Helmholtz coils is set to zero. This may be overridden as follows:

- Turn the override key to override position setting **before** lowering the blocker.
- The key must be reset before the blocker may be raised.

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**After selecting a new magnet device always check that the field set via MCS has been accepted by the power supply. If the supply is not responding to the computer look at section 9.3 on Troubleshooting.**

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# 3. Muon beam

## 3.1.    The slits

Collimation is achieved using a set of remote slits, the control panel is located in the area beneath the mezzanine floor. On EMU, the slit width should not exceed the sample size.

**PLEASE BE SURE TO ADJUST ONLY THE EMU SLITS LOCATED ON THE RIGHT OF THE RACK**

## 3.2.    Photomultiplier tubes

The photomultiplier tubes are powered from the rightmost of the two LeCroy crates in the back room of the cabin and are controlled using the Atari. The following commands will be useful, they must all be entered in upper case.

| Command | Action |
| --- | --- |
| ON | switch the voltage on for all tubes |
| OFF | switch the voltage off for all tubes |
| READ(1,0-15) | display the voltage on for front tubes |
| READ(2,0-15) | display the voltage on for rear tubes |
| WRITE(1,0) v | sets the voltage front tube number zero |

- **If it is noticed that a photomultiplier has failed (e.g. it appears that there is a light leak) please switch the voltage in that tube to zero to save it from further damage.**
- **Before unplugging any HT leads turn the HT to zero.**

# 4. Computing

There are three computers available for use by EMU users:

- EMU is the data acquisition computer.

- Both MUWK1 and ISISE are available to users for data analysis whilst their experiment is in progress. The account EMU01 is available to all users.

EMU runs using Motif, the latter two may be logged into remotely from either the PC or the Atari.

## 4.1. Logging in from a terminal (e.g. Atari, Graphon, Falco, Pericom)

At the **Vista>** or **Local>** prompt type CONNECT xxxx, (xxxx) is the computer name given above). The computer will then prompt for a user name and password.

## 4.2. Logging in from the EMU Motif workstation

**To start a session:**

- When nobody is logged in at the workstation screen a box prompting for a user name and password is displayed. These should be entered, pressing the 'TAB' key after the user name and the 'RETURN' key after the password. A session manager box will then appear.

- A terminal window can be opened by clicking the mouse on the 'APPLICATIONS' option of the session manager box and selecting 'DECTERM' from the menu that appears.

- It is only possible to type within a window when it is the input focus, a window is made the input focus by clicking the mouse on the window.

**To end a session:**

- Type LOGOFF.

- Click the mouse on the 'SESSION' option and select 'END SESSION' from the menu that appears. A further window will appear asking for confirmation which may be given by clicking the mouse on the 'OK' button.

## 4.3. Logging in from the PC

- Double click the left mouse button on the 'ISIS Terminal' icon.

- A box will appear prompting for a user name and password. These should be entered pressing the 'TAB' key after the user name and the 'RETURN' key after the password. A terminal window will then appear.

## 4.4. ISISNEWS

Typing `ISISNEWS CURRENT` at the DEC prompt gives news on the status of ISIS. Information may also be obtained from looking at the messages in `BULLETIN`.

# 5. MCS

MCS is the program that is run on EMU to control the collection of data and the sample environment for the EMU instrument. The structure for entering commands is analogous to that necessary for using DEC Command Language (DCL).

## 5.1.    Running MCS

MCS must run from the EMU account on the EMU workstation (see section 4.2 for logging in).

**MCS is started by the user typing MCS at the prompt.**

It is possible to run an experiment using only a small number of commands, these are all typed in at the **MCS>** prompt.

| Command | Action |
| --- | --- |
| NEW | Starts new data collection point, asks several questions of the user about sample conditions. |
| STOP RUN | Stops a data collection run |
| START RUN | Resumes a stopped data run. |
| SAVE | Saves a run on disk after confirmation of label details. |
| SET TEMP/SET= | Sets the sample temperature (in Kelvin). |
| @CCR_TC820 | Select the Eurotherm temperature controller - for use with the CCR. |
| @BLUE_ITC502 | Select the ITC503 temperature controller using the sensor calibration table suitable for stick two. |
| @BLUE_ITC503 | Select the ITC503 temperature controller using the sensor calibration table suitable for stick three. |
| SET MAG/SET= | Sets the magnetic field in Gauss. |
| @TF20 | Switches the calibration coils on to 20G and the longitudinal field off. |
| @f0 | Switches current field to zero. |
| @GEC | Make the GEC (longitudinal, high field) the current PSU. |
| @FARNELL_L | Make FARNELL_L (longitudinal, low field) the current PSU. |
| @T_FARNELL | Make T_FARNELL (transverse) the current PSU. |
| SET TEMP/LOG/TLOG | Enables the temperature logging and logging of process communications. |
| SET DISPLAY/NUMBER=16 | Sets the number of displayed histograms. |
| SET DISP/LEFT=1/RIGHT=300 | Alters the channel range of the histograms. |
| SET DISP/NUM=2/FIRST=16 | Sets the displayed histograms to 16 and 17. |
| HELP | Obtain on-line help information |

## 5.2. Script Writing

MCS can be run in automatic mode using a command file called a script written using one of two programs. The commands shown in the table below are common to the two programs.

| Command | Action |
|---------|--------|
| ADD | Add an entry to the script, setting temperature and event limit |
| DELETE | Remove an entry from any point in the script |
| READ | Read a previously written script from disk |
| WRITE | Write a script that MCS can execute |

### 5.2.1. MKSCRIPT

**This program should only be used for temperature scans at fixed fields.**

Run from account EMU by typing `RUN MKSCRIPT`.
Run from MCS by typing `SYS RUN MKSCRIPT`.

- The temperature can be entered for each point added to the script.

- If the temperature is to be unchanged from the previous point the option `KEEP` should be taken.

- `KEEP`.may be used for the first point provided the first run is started manually before launching the script.

### 5.2.2. MKSCRIPT2

**MKSCRIPT2 allows for field and temperature stepping.**

Run from account EMU by typing `RUN MKSCRIPT2`.
Run from MCS by typing `SYS RUN MKSCRIPT2`.

- The temperature and field can be entered for each point added to the script.

- If the either the temperature and/or the field is to be unchanged from the previous point the option `KEEP` should taken.

- As for MKSCRIPT, `KEEP`.may be used for the first point provided the first run is started manually before launching the script.

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**A script is started from within MCS by typing @NAME where NAME is the name of the script. It may be aborted by typing Ctrl-C and responding YES to the question, Abort processing of file [N]?**

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# 6. The μSR data analysis program - UDA

## 6.1. Introduction

UDA is the simplified μSR data analysis program. There are three menus in UDA, the Main Data menu, the UDA data Grouping menu and the UDA data Analysis menu. On start up the program will always enter the Main menu. At this menu you can read and write data files, plot spectra and make changes to the data loaded. In the data Grouping menu you can select how to map your raw histograms into the "groups" that are used when plotting or analysing. Two different grouping schemes can be used, the Simple (straight, TF) grouping, or the F-B (LF,ZF) grouping. In the Analysis menu you can select a model function and make a least squares fitting of the model parameters. The fitting result can also be plotted from this menu.

## 6.2. Running UDA

To access UDA from an area designed by SETUP.COM type RUNUDA. This will run the most recent version of UDA. The display will be re drawn as a dashboard and the cursor will automatically select the option 'Mcsfile' in the Main menu. To select any other item from the menu you may use the cursor (arrow) keys or you may simply type the first letter of that item (e.g. 'P' for Plot).

## 6.3. UDA Menu Structure

### 6.3.1. The Main Data Menu

The Main Data menu allows you to read, write and modify experimental data. The options available from this menu are listed below.

McsFile     Read a MCS run file in the format used by the data acquisition software.

Usrfile     Read a uSR file from the disk.

OldFile     Read one of the old (PDP) run files.

Write     Write (grouped) data on Usrfile.

Inspect     Inspect run and all histograms.

Group     Enter the Grouping Menu

Change     Change run file parameters.

| Plot | Plot one or more groups on the terminal screen. |
|------|------------------------------------------------|
| Analyse | Enter the analysis menu. |
| Setup | Set program configuration parameters. |
| Help | Enter the VAX/VMS help facility to read the UDA help library. |
| Quit | Exit UDA and return to VMS prompt. |

### 6.3.2. The Grouping Menu

The grouping menu is accessed through the option 'Group' from the Main menu, and defines the grouping and correction of raw histogram data. There are currently two ways of grouping the histograms:

a)  The Simple grouping, where histograms are simply added together.

b)  The Forward-Backward (F-B) grouping, where the 'asymmetry ratio' $(F-\alpha B)/(F+\alpha B)$ is calculated.

The options available for grouping and correcting data are shown below.

| Change | Change histogram grouping. |
|--------|----------------------------|
| Read | Read grouping table from disk. |
| Write | Write grouping table to disk. |
| DeadT | Correct the data for distortion caused by dead time and finite channel width. |
| Alpha | Select (F-B) scaling factor |
| Guess | Estimate alpha for a T20 run |
| Bunch | Select channel bunching |
| Help | Display help text. (Don't panic) |
| Exit | return to UDA Data (main) menu. |

### 6.3.3.    UDA Analysis Menu

The Analysis menu is entered by selecting the option 'Analyze' in the UDA Main menu. Using the options outlined below it is possible to select a model function and make a least squares fitting of the model parameters. The results of the fit can also be plotted.

Select      Select a group and a channel range to work on. The bunching of channels can be set to 2 to add channels together in 2's.

Plot        Plot data and fit

Fit         Run fitting routine using values displayed in right hand window

Help        Enter the help system at the Analysis menu level.

Values      Enter the parameter display to change parameter values/status. To move in the parameter display use UP or DOWN cursor keys. To change a value use the ENTER key. Status codes are changed by typing ~ (vary parameter),! (fix parameter) or = (tie parameters together). Return to the menu by the LEFT cursor key.

Theory      Select a theory function, number of sub-components and line shape

Alpha       Change value of alpha

Undo        Undo fit and restore original parameters

Exit        Exit this menu and return to the main UDA menu.

Write       Write parameters out to a file

Read        Read parameters in from a file

Dist        Distribute parameters to all groups (necessary for transverse geometry)

### 6.4.    Computer files

These files must be copied into the area you are working in. If the area has been generated by SETUP.COM they will have been copied to the new area automatically.

SETUP.UDA    UDA reads some variables from the file SETUP.UDA. In particular the directory addresses of the data and the source code are set-up in this way. Of particular interest are the FORTRAN format strings used to convert a run number to a full file name.

GRP1.UDA    default transversal grouping

GRP2.UDA    default longitudinal grouping

PDF1_1.UDA   parameter definition file, transverse, lorentzian

PDF1_2.UDA   parameter definition file, transverse, gaussian

PDF1_3.UDA   parameter definition file, transverse, abragam

PDF2_4.UDA   parameter definition file, ZF, static K-T

PDF2_5.UDA   parameter definition file, longitudinal, lorentzian

PDF2_6.UDA   parameter definition file, longitudinal, gaussian

UDAHELP.HLP  help library source, UDA matters

# 7. Data files

The data files of MCS are in binary format and so may be read only by a DEC computer, the format is available if users require it.

## 7.1. ASCII Format

The binary files written by MCS can be converted into ASCII files of the same format read by UDA ('USRFILE'), this format may be also read by computers other than DEC. The conversion program is run from account EMU01 by typing CONVERT_ASCII. The program prompts for first and last files to be converted.

## 7.2. Header listing

A list of data files together with temperature and field is available by running a program called EMU_HEAD from within account EMU. The output of the program is left in a file named EMU_HEAD.LIST

## 7.3. TLOG files

A plot of the temperature log for a data run may be produced by running program TLOGGER.EXE by logging into node EMU using any account and typing TLOGGER. The program will prompt for a terminal type and then a file number, the file number need not have preceding zeros, the highest version of TLOG file is plotted. Lower versions are plotted by typing the complete file ending: e.g. 00123.TLOG;1 will plot R00123.TLOG;1. The hard copy option produces a postscript file PGPLOT.PS, this may then be sent to the laser printer of choice.

## 7.4. Archiving Data on an a PC Floppy Disk

Data may be archived on an IBM PC format floppy disk as follows:

- Convert all data files to ASCII format, as described in section 7.1

- On the PC launch the 'MSDOS Prompt' application and mount the network disk on which the ASCII files have been placed by, for example, typing:
      USE E: \\ISISE\USER$DISK:[EMU01]
  A username and password will be prompted for.

- On the PC launch the 'File Manager' application and copy files from the network drive, E:, to the floppy drive, A:, in the usual way.

## 7.5. Writing to TK50 tape

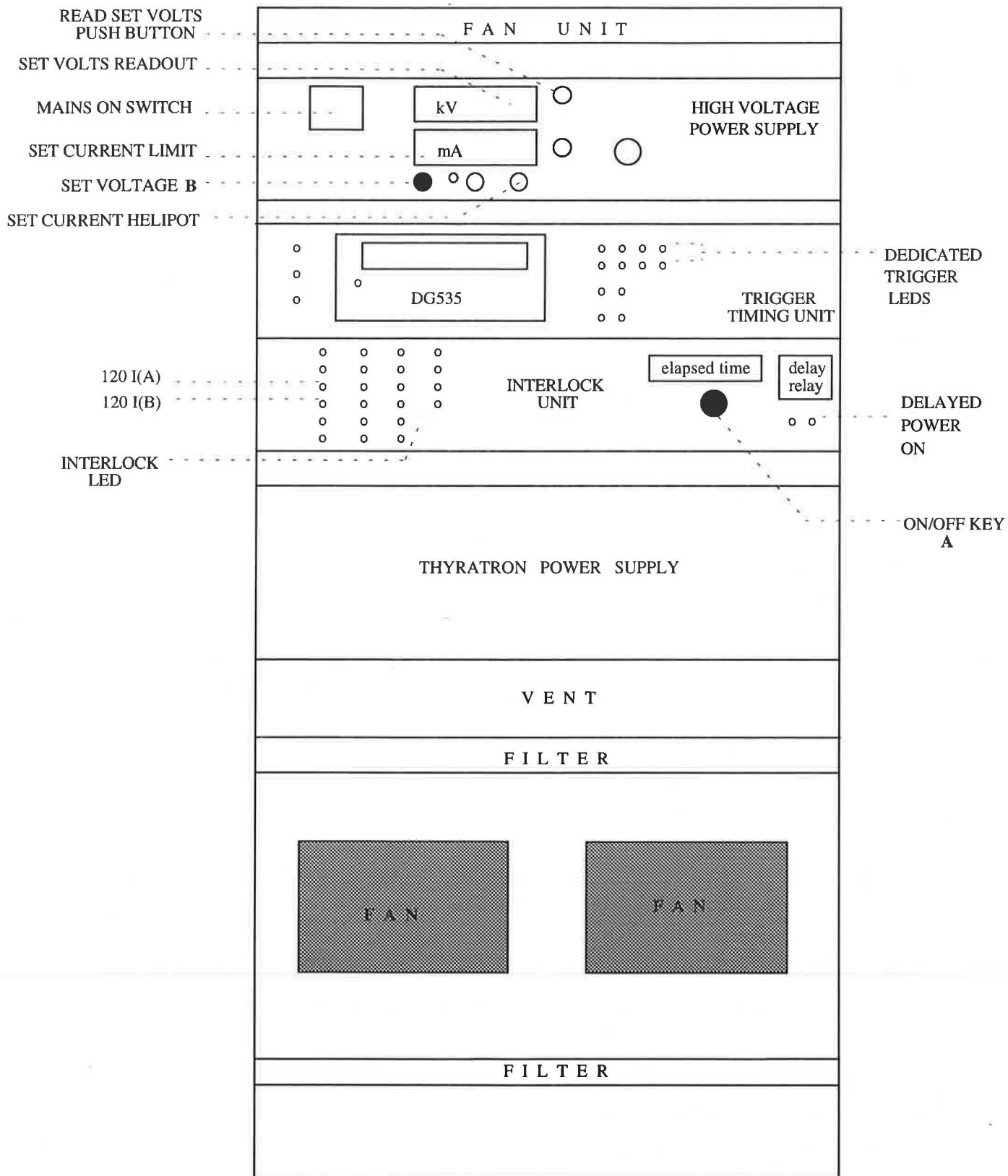This may be done by going to the computer support office in R3.

A full description of the process is available in the office.

# 8. Resetting the kicker

Use in conjunction with the diagram of the kicker panel on the following page.

**To reset the kicker:**

- Turn key switch A 90° anti-clockwise to turn off.

- Turn helipot B fully anticlockwise to 0.0 Volts.

- Wait a few seconds.

- Turn key switch A 90° clockwise to on.

- Observe LEDs on mains/interlock unit front panel. Only the +120 I(A) and +120 I(B), and (large) 'delayed pwr on' should be unlit at this stage.

- After about 120s, +120 I(A) and +120 I(B) will light

- After a further 180 s, 'delayed pwr on' LED will light and high voltage power supply will be powered on.

- Dedicated trigger should light.

- Turn helipot B slowly clockwise WHILE PRESSING 'READ SET VOLTS PUSH BUTTON' (the button immediately to the right of the KV LED display) on the HVPS to obtain a set volts readout of 32.50 KV. The current readout should show $\approx 2.02(3)$ mA. (Release push button)

READ SET VOLTS PUSH BUTTON

SET VOLTS READOUT

MAINS ON SWITCH

SET CURRENT LIMIT

SET VOLTAGE **B**

SET CURRENT HELIPOT

120 I(A)

120 I(B)

INTERLOCK LED

FAN UNIT

kV

mA

HIGH VOLTAGE POWER SUPPLY

DG535

DEDICATED TRIGGER LEDS

TRIGGER TIMING UNIT

INTERLOCK UNIT

elapsed time

delay relay

DELAYED POWER ON

ON/OFF KEY **A**

THYRATRON POWER SUPPLY

V E N T

F I L T E R

F A N

F A N

F I L T E R

# 9. Troubleshooting

## 9.1.　No muons

- Check the machine is running at a reasonable rate. In the EMU cabin there is a readout of the pulse intensity in $\mu A$. If the display is blank or reads '00' it means there are no protons. If the display is flashing the machine is probably at base rate (i. e. $\frac{1}{32} \times 50Hz$).

- **Check the beam blocker is raised: the gate must be closed and locked to allow this.** The blue interlock light will only be on if the blocker is raised.

- Check the 'BEAM OFF' button on the fence in the zone is not pressed. Release it then restart the bending magnet power supply above the workshop using only the 'START' button.

- Check that all the magnets are working by checking the PSU's above the workshop.

- Check the kicker is working.

## 9.2.　Computer

- If there is no communication via the keyboard then check the 'HOLD SCREEN' (PF1 key).

- Check any process of MCS by typing @STATUS. A process may be started by typing START PROC/PRCNUM=x, where 'x' is the process number defined as follows:

> 1 - MACQ
> 2 - MTEMP
> 3 - MWSDISPLAY
> 4 - MWSWINDOWS
> 5 - MMAG

- Quit MCS by typing EXIT, logout using the command LOGOUT. Login with user name EMU and current password, start MCS by typing MCS.

## 9.3.　Magnets

If there is no communication between MCS and the magnet power supply the following procedure may rectify the situation

- Stop the MMAG process by typing STOP PROC/PRCNUM=5.

- Turn off magnet supply, wait a minute and then turn it back on

- Restart the MMAG process by typing START PROC/PRCNUM=5.

- Reselect the device and try to set a field.

# 10. Contact Points

## 10.1. Laboratory

Rutherford Appleton Laboratory,
Chilton,
Didcot,
Oxfordshire,
OX11 0QX.                    ☎ (0235) 821900      (national)
                             ☎ +44 235 821900     (international)

Main control room (MCR) ............... ☎6789
EMU cabin (R55) ........................... ☎6831
MuSR cabin (R55) ......................... ☎6135
DEVA cabin (R55) ......................... ☎ To be installed

Health Physics/ Sample checking ...... ☎6696
Computer support ........................... ☎5414
University Liaison Office .................. ☎5592
Cosener's House .............................. ☎3007 or (0235) 523198
Taxi ............................................... ☎5592 (during the night ring the MCR)
Gas bottles (He, $N_2$ etc) .................. ☎6166

## 10.2. Instrument Scientists

Stephen Cottrell      ☎5352        (Email: SPC@ISISE.RL.AC.UK)      bleeper 255

Steve Brown          ☎5352        (Email: SRB@ISISE.RL.AC.UK)

Christopher Scott     ☎5135        (Email: CAS@ISISE.RL.AC.UK)      bleeper 214

Sue Kilcoyne         ☎5805        (Email: SHK@ISISE.RL.AC.UK)      bleeper 254

From outside the laboratory certain extensions may be direct dialled, the number being formed in the following manner:
(0235) 44xxxx, where 'xxxx' is the required extension.

To call offsite prefix the number by 9.

The procedure for radio paging ('bleeping') the instrument scientists is to:

- Dial 70 - wait for a tone,

- Dial xxx - wait for a click, (xxx is the bleeper number)

- Dial your extension number and wait for a tone, then hang up.