WIMDA: a muon data analysis program for the Windows PC

F.L. Pratt

RIKEN-RAL, Rutherford Appleton Laboratory, Chilton, Didcot OX11 0QX, U.K

and

Clarendon Laboratory, University of Oxford, Parks Road, Oxford OX1 3PU, U.K.

Abstract

A package for analysing μSR data has been developed for the PC running Microsoft Windows operating systems (Windows 95, 98 and NT4). Some of the key points considered in the design of the program were that it should run on a typical Windows PC, that it should directly read the binary files produced by muon data acquisition systems, that it should be equally easy to analyse data on-line and off-line and that appropriate features should be included for both pulsed and continuous muon sources.

1 Introduction

A number of different μSR data analysis programs are currently in use around the world. Although some research groups have written software specially for their own work, many scientists rely on the standard software made available at the muon research facilities. These standard programs are essentially dedicated to analysing data from their own particular facility and tend to be written in DEC Fortran, since DEC hardware has traditionally provided the front end computer for μSR data acquisition. Some examples of current μSR facility standard data analysis programs are MSRFIT at TRIUMF, MINFIT at PSI and UDA at ISIS. The original forms of these programs rely heavily on inbuilt features of the DEC VMS operating system, which has made porting to other platforms (eg the PC) rather slow and difficult; versions of MINFIT for Windows NT and MSRFIT for LINUX have recently been announced, however these still maintain the features of the old style user interfaces and do not provide the full Graphical User Interface (GUI) that is expected for modern software.

An additional problem with the older software is that, since there is as yet no internationally accepted standard format for μSR data, experimenters who use more than one facility currently have to run rather inconvenient data conversion programs to allow their data to be read by their preferred analysis programs. This can be very inefficient, since often one needs to know the detailed result from one μSR run immediately before setting up another one, in order to make the best use of valuable beamtime.

In order to improve on this situation a new data analysis package has been developed, which is specifically designed to provide a modern user-friendly GUI and to work directly with data from all the current muon facilities, a feature that should be invaluable to the many muon experimentalists who use more than one experimental facility for their work.

2 Design Criteria

The recent rapid development of cheap mass computer storage and increases in network capacity mean that working with raw binary files away from a muon facility is no longer the problem that it once was; the size of a raw binary μSR run file is typically 200 kb so that, for example, around 3000 raw data files can be stored on a CD or MO disc without data compression and even more can be stored on the DVD format, which is expected to take over eventually from the CD format. A factor of eight to ten can typically be gained by compression and these 20-25 kb compressed files are small enough to be transported easily over the internet. In view of this and in the interests of ease of use for the program, it was decided that the program should read raw binary data files directly, providing internal filter routines to interpret the various file formats. If a new μSR file format is introduced in the future, it should be straightforward to simply add an extra import filter to read it.

Regarding the platform to use, it is now the case that the vast majority of computers in use worldwide are IBM compatible PCs running Microsoft Windows operating systems. This ubiquity means that a Windows PC is certain to be available both at the μSR facility and also back at the experimenter's home institution; if the analysis software is PC-based, the same analysis program can easily be used both for on-line and also for subsequent off-line data analysis. In fact there is also now a trend towards developing PC-based systems for data acquisition (using Windows[1], Windows NT [2] or Linux[3]), as the DEC VMS hardware currently being used becomes obsolete. Thus a PC-based data analysis system should integrate well with these new data acquisition systems. A further advantage of standardising on the Windows PC is that good Windows emulators now exist for both the Linux and Macintosh platforms, which are the most popular alternative PC operating systems, thus in principle only one version of the package is needed to serve these three platforms. Another approach towards platform independence for μSR data analysis software is to work with Java; progress along these lines is reported elsewhere in these proceedings[4]. This is likely to become a progressively more practicable solution as increasing CPU and network speeds compensate for the inherent inefficiencies of working with the Java Virtual Machine. Taking all this into account, the PC running Microsoft Windows was viewed as best platform at the present time for the development of new μSR software.

Having chosen to work with the Microsoft Windows platform, Borland's Object Pascal Rapid Application Development system Delphi was selected as the most efficient tool to develop the new analysis package, which has been named WiMDA (**Wi**ndows **M**uon **D**ata **A**nalysis).

3 Program Organisation

The program covers all stages of the data analysis process from browsing data files and fitting raw histograms through to modelling the fit parameters derived from sequences of runs, e.g. temperature or field dependences, and to producing publication quality figures of the results. The program is organised around a number of windows, which can be accessed from the main menu; the organisation of the program is illustrated in the flow chart of Fig.1. The software is specifically designed to link in with two freely available graphics utilities, Graphics Language Editor (GLE) and Ghostview; these are called as external programs from WiMDA.

Fig. 2 shows the windows typically used in fitting muon spin relaxation data and Fig. 3 shows the windows that are normally used at the modelling stage of the data analysis. Details of the most important windows in WiMDA are as follows:

1) The Main Menu window, which allows selection of the raw data file to load and displays the information associated with the run header (see Fig.2 top left). Compressed data files are automatically decompressed and the characteristic structures of files originating from different muon facilities are automatically detected and interpreted.

2) The Logbook window, which builds up a table

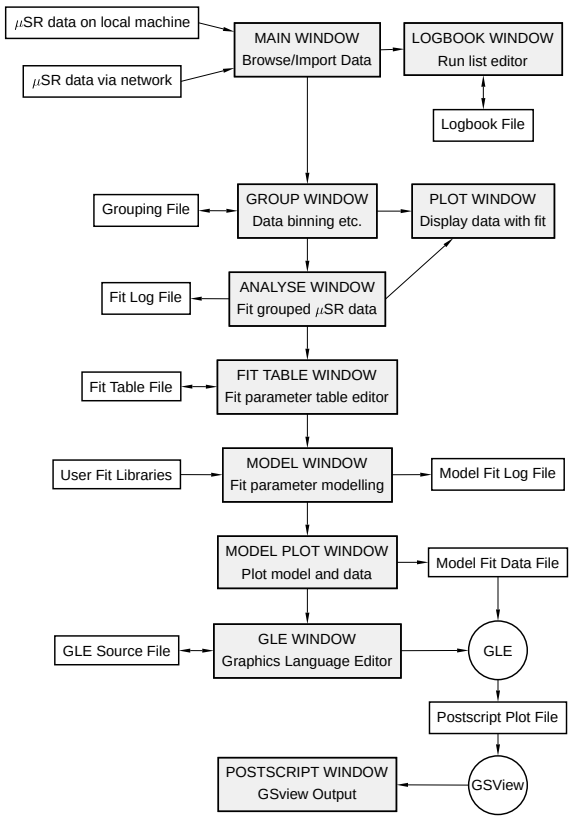

Fig. 1. Flow chart showing the main components of WiMDA and the data flow between them. Primary WiMDA windows used for control and display during the data analysis procedure are shown as shaded rectangles, unshaded rectangles signify files used by WiMDA and the circles represent external programs called by WiMDA.

of header entries for a sequence of runs, which can be edited, annotated, saved and printed.
3) The Grouping window, controlling histogram grouping and binning, start timing, background subtraction for continuous source data and count-loss correction for pulsed source data.
4) The Plot Parameters window, which controls plotting in the Plot Window of the muon data and associated fits and transforms.
5) The Plot window itself (Fig.2).
6) The Analyse window (Fig.2) which controls fitting of the muon data in the time domain. Up to three fitting components plus a constant background asymmetry are currently provided. Sequential fitting of a series of runs is possible using the batch fit control and global fitting of several runs simultaneously is also possible using the multi-fit control.
7) The Fit Log window (Fig.2) which reports on the progress of the fit.
8) The Fit Table window (Fig.3) accumulates a table of fit results which can be used as input to the modelling section of the package.
9) The Model window (Fig.3) selects the input data and the model function and parameters to use for the model fitting. User fit function libraries can be used, when provided in the form of user-compiled dynamic link libraries (DLLs).
10) The Model Plot window (Fig. 3) controls plotting of the model data and the fitted function.
11) The Graphics Language Editor window (Fig.3) allows fine control of the layout of complex data plots. These are produced as high quality Postscript files that can be viewed using Ghostview and incorporated into documents.
12) The Fourier window is used to control transformation from time to frequency space. To assist in muonium radical spectroscopy, diamagnetic subtraction, filtering and radical frequency correlation spectra are provided as options.

4 Conclusion

WiMDA provides a new option for μSR data analysis, which should appeal particularly to established PC-oriented users and to new μSR users who are not familiar with VMS. Although some program features are still under development[5], the basic package has been complete enough for serious data analysis since the Summer of 1998 and has been used successfully on many experiments carried out at ISIS, PSI and KEK over the past year.

References

[1] J. Major *et al* (these proceedings).

[2] ISIS Science Instrumentation Group (ISIS internal seminar).

[3] S.N. Nakamura (private communication).

[4] J.H. Brewer (these proceedings).

[5] A test version of WiMDA is available through http://jalfrezi.nd.rl.ac.uk/wimda.