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October 1993

**NETWORKED ALPHA & GAMMA SPECTRAL
ACQUISITION AND ANALYSIS SYSTEM**

C. M. Wilcox
J. M. Gross

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WINCO-1154

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ACQUISITION AND ANALYSIS SYSTEM**

**C. M. Wilcox
J. M. Gross**

October 1993

**Westinghouse Idaho
Nuclear Company, Inc.**

PREPARED FOR THE
**DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE**
UNDER CONTRACT DE-AC07-84ID12435

MASTER

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Acknowledgments

The *Netspec* system development team members and their duties: J. M. Gross Team Leader, network conceptual design, development of spectral display, peak analysis, report software, and user documentation; R. A. Kinoshita development of detector control and data archiving user interface software, and user documentation; N. A. Liester real time (Mizar) data acquisition software development and documentation; K. J. Haskell and J. P. Morgan specification and configuration of data acquisition hardware, and preparing hardware schematics; Elizabeth R. Wharton and C. M. Wilcox provided system requirements, customer needs, and suggestions for the graphical user interface.

The gamma peak analysis algorithms are based on the work of E. W. Killian which is described in *VAXGAP: A Code for the Routine Analysis of Gamma-Ray Pulse-Height Spectra on a VAX Computer*.

NAME

NETSPEC – Networked alpha gamma Spectral acquisition & analysis: system overview

DESCRIPTION

This chapter gives an overview of the hardware and application software of the Networked alpha gamma Spectral acquisition & analysis system. Refer to the user's guide for each software subsystem for specific operating instructions.

NETSPEC is comprised of the following hardware components: Two Sun (SPARCstation) host workstations with color graphics monitors; 4 (more or less depending on the number of detectors supported) Mizar data acquisition computers; alpha, gamma, and LEPS detectors with associated front end spectrometer, ADC, and high voltage electronics; a dot matrix report printer; and Postscript laser graphics printer. Both optical disk and cartridge tape units are available for data archiving. Vendor supplied software is installed via either CDROM (read only optical disk) or ¼ inch (QIC 150) tape cartridge. Communications between computers is over standard ethernet.

Each Mizar computer can handle either 16 alpha detectors or 6 gamma detectors. Switch settings are used to configure the Mizar number and detector type. At present there is no provision for mixing alpha and gamma detectors on the same Mizar. Off-the-shelf I/O cards are used to interface the detector hardware to the Mizar computers.

Data files are written to the disk of each of the two host computers every ten minutes during spectra acquisition. In the event of a power outage during spectral acquisition, an automatic restart function loads the spectra from the disk file and resumes acquisition 10 minutes after power is restored.

NETSPEC application software consists of the following subsystems: data acquisition, detector control, spectral display and analysis, and various utility programs.

The detector control programs, **ALDO** and **GAMDO**, provide a graphical user interface to control and monitor detector status. These programs provide such functions as detector start, stop, hold, continue, disable, enable, and reset, as well as sample logging. Control of any detector may be carried out from either host computer. Refer to the corresponding manual chapter for specific operating instructions. The graphical user interface for these programs is built using the XView toolkit. There is no direct user interaction with the Mizar data acquisition computers which run application software under the Unix compatible VxWorks real-time operating system.

ALAN, the alpha analysis program, and **GAMAN**, the gamma analysis program, are used to graphically display spectra, identify and quantify peaks, and provide a printed sample analysis report. The corresponding chapters contain detailed descriptions of the button and menu interface. Their graphical user interface is built using the LispView toolkit. In order to run either **ALAN** or **GAMAN** on your computer, you must have a licensed copy of lisp which contains the Common Lisp Object System (CLOS) and LispView.

ACE/gr is a public domain plotting program used to display background and QC check source data. The Xview version, **xvgr**, is used in the NETSPEC system. For additional information on using the many features of **xvgr**, refer to a separate document, *ACE/gr User's Manual*.

NETSPEC SUN / MIZAR SYSTEM START-UP

- 1 Switch on inverter power on the front of the Sola Mini Ups. Wait 30 seconds.
- 2 Switch on power on the back of external disk drive units. Wait 15 seconds after each unit. You should hear a click when disk rotation speed has been achieved.
- 3 Switch on power to the monitor.
- 4 Switch on power to the Sun computer. Boot up will proceed automatically.
- 5 Repeat steps 1 through 4 for each Sun computer.
- 6 Switch on power to the Mizar units after the Sun boot procedure has completed as indicated by the 'login:' prompt. Note: if the primary Sun computer is down, see special instructions in the section **Booting Mizars From an Alternate Sun** in the *Mizar* chapter of the manual.
- 7 Login to the Sun computer by entering your preassigned user name, then your password.
- 8 Switch on power to detector electronics.

COMPLETE POWER DOWN OF NETSPEC SYSTEM

- 1 Make sure that spectra acquisition is completed on all alpha and gamma detectors.
- 2 Switch off power to the Mizar computers.
- 3 Switch off power to detector electronics if desired.
- 4 Type 'halt' at the Sun computer 'login:' prompt. Wait about 10 seconds for the > prompt.
- 5 After the > prompt appears switch off power to the external disk drives.
- 6 Switch off power to the Sun computer.
- 7 Repeat steps 4 through 6 for each Sun computer.

PARTIAL NETSPEC POWER DOWN - MIZARS

If it becomes necessary to power down one or more of the Mizar computers follow steps 1 (for the pertinent Mizars) through 3 of the **COMPLETE POWER DOWN OF NETSPEC SYSTEM** above.

PARTIAL NETSPEC POWER DOWN - SUNS

If it becomes necessary to power down some but not all of the Sun computers while spectra acquisition is in progress, follow steps 4 through 6 of the **COMPLETE POWER DOWN OF NETSPEC SYSTEM** above. Disk writes will continue to be made to the Sun computer which is up. This Sun computer will copy updated files to the other Sun when it returns online.

If it becomes necessary to power down all of the Sun computers while spectra acquisition is in progress, follow steps 4 through 7 of the **COMPLETE POWER DOWN OF NETSPEC SYSTEM** above. Note that spectra can not be written to disk while all suns are down. As long as the Mizars remain up, spectral data will continue to be acquired and will be held in Mizar memory. Disk writes will be completed when the Sun computers come back online.

The tree graphs in figures 1 through 3 show the major directories and files of the NETSPEC system.

These files currently reside on a single 600 megabyte disk drive on each sun computer. The disk drive comprises the unix filesystem **/local** (figure 1).

The file names shown in the graphs are in the format given by the unix *ls -F* command: names of some files have a special character appended to indicate special file types. The special characters are only appended to terminal nodes of the tree since it is obvious that intermediate nodes are always directories. The special characters are **/** for directories, ***** for executable files and **@** for linked files.

When a directory contains many files the graph only lists the name of the first file followed by the ellipsis (...). When one or more of the unlisted files is a directory the ellipsis is followed by a **/** to indicate that additional directory structure is not shown.

Files which pertain solely to the alpha acquisition and analysis system are under the **alpha** directory (figure 2).

Files which are specific to the gamma acquisition and analysis system are under the **gamma** directory. The lower level structure is not shown in detail since it strongly resembles the alpha directory.

The **alpha+gamma** directory (figure 3) contains files which are common to both the alpha and gamma systems. These include all of the nuclide library and data archive code and much of the code which displays the spectra.

ALDO

Alpha
Detector
Operation

NAME

ALDO – Alpha detector operation & control.

INTRODUCTION

This manual assumes a knowledge of (terminology used and a working familiarity with) the windowing system and mouse of the Sun computer workstation. See the appropriate Sun manuals for additional information (for example, chapter one of the *OpenWindows User's Guide* – part # 800-6618-10, or chapters one to three of *Desktop SPARC Sun Systems User's Guide* – part # 800-5703-10). This manual will probably be of more use if you're sitting at the Sun workstation while reading.

ALDO, the alpha detector control program, is used to control, monitor, and edit log information associated with the collection of alpha spectra. Actual data collection and control functions are performed by Mizar Real-Time computers for which *ALDO* acts as a friendly user command interface and status display. It is normally started as part of your login procedure, but may also be started from the 'NETSPEC Utilities' submenu of the root menu. The root menu is obtained by pushing the right mouse button when the cursor is over the root window (background picture).

To become a user of *ALDO* and the other programs in the *NETSPEC* system, contact the person who performs systems administration tasks for the Sun computers.

Most user interaction with *ALDO* is by means of mouse manipulation of screen items such as buttons, checkboxes, and sliders. The action of pushing the left mouse button when the cursor is over an item is called selecting that item. The left mouse button is therefore called the *select* button. The right mouse button is the *menu* button because a limited number of options may be displayed when that button is pressed when the cursor is over an item with a triangle (inverted delta). In this document, names of selectable items are printed in **bold** when they are first mentioned or when emphasis is helpful. In general, items which do not apply to the current context are either disabled or made invisible in order to prevent selection.

MAIN WINDOW

ALDO has one main window, titled 'Alpha Detector Command Display' (see figure 1). It may also appear as a green icon which depicts detector electronics and is labeled ' α Control'. To help differentiate between alpha and gamma control windows (which are nearly identical), each window's icon is also shown in its upper right-hand corner.

This Window has several subparts or sections. At the top is the *title bar*. When the triangle at the left corner is selected, the window is closed or iconified, taking all sub-windows (ie. Info and Log windows) with it. Only the main window has such a triangle. Subsidiary windows have a *pushpin* instead. Selecting a pushpin will cause that sub-window to be removed. Pressing the left mouse button anywhere else on a title bar will bring the entire window to the 'surface' of the screen. Pressing the right button anywhere on the title bar activates the usual Sun system window menu.

Below the title bar, the rest of the window is logically divided into three sections: The topmost two rows of buttons form the command section (see figure 2), the leftmost two columns control detector selection (figure 3), and the rest shows the status of each detector arranged by row (figure 4).

COMMAND SECTION

The command section (figure 2) has two types of controls in it: Those used to specify what action is to be performed on a detector or detectors (left side), and those used to control screen updates of detector status information (right side).

All commands except **Refresh Now** follow the same flow: First, a button in the Command Section is pressed corresponding to the desired function (Start, Stop, etc.) Second, one or more detectors are selected for that operation. Lastly, the **Do** button (see below) is pressed to initiate the command. **Cancel** may also be pressed to abort the command.

The function of the buttons in this section from left to right are as follows:

Note: Detector statuses are expressed in all capital letters spelled the same as written on the status screen. For a detailed discussion of the meaning of each status, see 'Detector Status Section' below.

Disable

The only thing this function does is flag the status of detectors to **DISABLED**, which prevents their accidental use. It is meant to be used when there is a problem with a particular detector (broken, out of calibration, etc).

May be used on detectors that are: **OFF**

Enable

Enable is used to reset both **DISABLED** and **FAILED** detectors to the **OFF** state so that they may be used to collect data again.

May be used on detectors that are: **DISABLED** or **FAILED**.

Stop

The **Stop** function immediately terminates data collection for the selected detectors in such a way that it cannot be resumed--the set of data in question is permanently closed.

May be used on detectors that are: **ON**, **ON HOLD**, **RESTART**, and **FAST WRT**.

Start

Start begins collection of spectra by the detectors selected. The data will be initially stored in temporary file 'Temp-Spectrum.nn' where nn is the detector number. When sample log information is entered using the **Log** function (see below) a permanent file name will be assigned. Note that each time a detector is started, the previous 'Temp-Spectrum' file is overwritten.

May be used on detectors that are: **OFF**

Hold

This command causes affected detectors to cease data collection until manually told to resume.

May be used on detectors that are: **ON** or **RESTART**.

Continue

Continue will return a detector in any of three states (**RESTART**, **ON HOLD**, **FAST WRT**) to **ON**. In all three cases, the thought behind the button name is that of resuming normal operation from an exception state.

May be used on detectors that are: RESTART, ON HOLD, or FAST WRT.

Reset

The **Reset** function causes all spectrum data collected to that point to be deleted and collection to begin anew. Accumulated live time is zeroed as well. An ON HOLD detector will change to the ON state in this process, although one in FAST WRT mode will remain so. All log information and the file name will remain unchanged.

Reset is used whenever it is desired to get rid of the accumulated data. Examples of this might be when the data is known to be bad (wrong sample, vacuum not on, etc) or while adjusting a detector or amplifier.

May be used on detectors that are: ON, ON HOLD, or FAST WRT.

Info (Menu Button)

Info functions provide capability to view detailed status and physical information for any or all detectors.

A note on using menu buttons: To select the default item of a menu button, select it using the left mouse button. To view all of the menu options, select using the right mouse button.

Info: Header (Default Option)

This option will cause a window to appear showing information about the data collection process for the selected detectors. See the 'INFO WINDOWS' section below for more details.

May be used on detectors that are in any state except LOST COM.

Info: Hardware

This is used to view and optionally edit information relating to the detector hardware (type, location, calibration constants, etc.) See the 'INFO WINDOWS' section below for more details.

May be used on detectors that are in any state.

Info: Reload HW

This option will cause the files containing the physical information for all detectors to be reloaded. This should be used when such information was just changed using *ALAN* (Alpha Analysis software) to perform calibrations on either Sun computer, or *ALDO* on the other Sun computer to edit hardware data. Note that this same reload occurs whenever *ALDO* is started up, therefore use of this option will be seldom needed.

Log (Menu Button)

Log options are used to enter and modify sample information that is associated with spectra (Sample name, spike nuclide, background, desired live time, etc.) Only one **Log** function (either Current Detectors or History Files) may be used at a time.

A note on using menu buttons: To select the default item of a menu button, select it using the left mouse button. To view all of the menu options, select using the right mouse button.

Log: Current Detectors (Default Option)

This option is used to enter sample information for the first time, or to edit previously entered data while the detector is still running. If multiple detectors are specified, a facility is provided to enter

information to all log records in one operation. A detailed discussion of this option is presented below in the 'LOG WINDOWS' section.

May be used on detectors that are: ON or ON HOLD.

Log: History Files

This is used when it is necessary to change any log information associated with a spectrum that has completed data collection. A scrolling list of all spectra files on the hard disk, sorted in reverse chronological order, will be presented to choose from. Note that it may take up to 120 seconds to generate this list. Files old enough to have been removed from the hard disk will have to be restored from archives first (see ARCHIVE). A detailed discussion of log window use is presented below in the 'LOG WINDOWS' section.

May only be used on spectra files that are not being used for data collection at the current time.

Fast Write

Fast Write causes the collected spectra for the affected detector(s) to be written to disk every few seconds (Normally it is written every 10 minutes). This is necessary when it is desired to view the spectra as it accumulates in 'real time'. (See the manual for *ALAN* for information on viewing spectra) It does not affect the data collection at all, except to write it to disk more often.

NOTE: To prevent unnecessary hard disk load on the Sun workstations, the **Fast Write** mode should be used only when needed.

May be used on detectors that are: ON.

Cancel

This button can be used anytime after picking an operation to perform but before pressing **Do** to cancel it and start over.

Do <op name>

After an operation has been selected by pressing its button, the **Do** button appears. After the detectors for that operation have been picked, the **Do** button is pressed to perform it. As a cue to the user of the operation to be done, the button will have 'Do <operation name>' written in it. For example, (See figure 2) if Start was selected the button will say 'Do Start'.

Refresh Now

Selecting this causes an immediate update of all detector status fields. (Normally they are only updated when the status changes or periodically as specified by the **Update** selector.)

Update (Selector)

This selector allows the user to specify how often the screen is to be automatically updated. The time of last update is shown immediately above. Valid choices are 5, 10, 30 and 60 seconds with 60 being the default.

DETECTOR SELECTION SECTION

The controls in this section (see figure 3) provide the means to tell *ALDO* which detectors to perform operations in the Command Section on. This can be done individually (using the selectors with the detector numbers in them) or by groups. Capability is also provided to edit which detectors are included in each group.

Selecting Detectors

After selecting a command, the buttons in the two left-hand columns will be made available to the user. The right column contains one button per detector, each one labeled by its number. Detectors to have that command performed upon them can then be specified by pressing their corresponding buttons. Note that these are 'toggle' buttons, that is they can also be unpressed if needed. Only when the **Do** button is pressed is their final state used to actually perform the operation.

As an additional safety feature, buttons for detectors ineligible for the operation selected will be inactive; meaning they cannot be manipulated at all. Any one of the eight group buttons on the left side of the screen can be used to quickly select a predefined group.

Setting Up Groups

To view or change which detectors are assigned to a particular group, press the **Setup** button in the lower left-hand corner of the window. The eight group buttons will then become active, allowing selection of the group to view/modify. After pressing the button corresponding to the group desired, all detector buttons will activate and be set for that group. At that point they may be changed.

After using the mouse to make the desired changes to the individual detector selectors, the **Save #n** button (where n will be the group number under modification) will write the changes to disk. If the changes need to be discarded instead, press the **Cancel** button. Both of these buttons are in the lower left-hand corner of the window.

Figure 5 shows an example of setting up group number three to include detectors 17 through 24 just before saving or canceling.

DETECTOR STATUS SECTION

This section (see figure 4) is arranged in rows, one per detector, on a scrolling panel controlled by the slider bar on the right side of the main window. Using the mouse to move this slider up and down will cause the view of the list to shift likewise. There are four columns on the list: Status, time accumulated, target time, and file name. (Figure 1 shows many possible statuses as they would appear in this section)

Status

This field represents the current operational status of the detector as follows. Each status is listed in alphabetical order with its corresponding screen color and what it means.

DISABLED: (Yellow)

A user has decided to manually flag this detector so that it will not be accidentally used. Usually this means hardware fault or lack of calibration. The **Enable** command will reset it to the OFF state.

FAILED: (Red)

This detector has been shut down by the data collection computer because more than 2000 counts per second were received, indicating its probable malfunction. The **Enable** command will reset it to the OFF state.

FAST WRT: (White)

The spectrum for this detector is being written to disk every five seconds instead of at the usual ten minute interval. The **Continue** command will return it to normal writing (ON state).

LOGGING: (Magenta)

This detector is now having log information entered for it by a user. Just as if ON HOLD, live time will not accumulate until the entry is complete.

LOST COM: (Red)

ALDO has lost its communications link with the Mizar data collection computer responsible for this detector. No operations are possible.

OFF: (Black)

The detector is not currently active.

ON: (Green)

The detector is now collecting data until a pre-set time limit (if set) is reached or is shut off manually.

ON HOLD: (Blue)

This previously ON detector has had its data collection temporarily halted by a user. The **Continue** command will return it to ON.

RESTART: (Orange)

This detector's controlling Mizar computer has experienced a power failure or other event causing it to reboot. A ten minute hold period is now in effect to allow vacuum and detector bias to stabilize so that data collection can continue without operator intervention. The **Continue** command will force data collection to resume (ON state) before the ten minute limit has fully elapsed.

Time Accumulated

This column shows the amount elapsed live time for the detector. If not currently running (Status OFF, FAILED, DISABLED) then it is for the previous run.

Target Time

The target amount of live time the detector is/was to accumulate before stopping automatically. It is set or changed by using the *Log Current Detectors* button as previously described.

File Name

This gives the name of the file that the spectra data is/was being stored in. Names that look like 'Temp-Spectrum.nn' indicate temporary files not logged as permanent yet. Permanent files are of the form 'YYYY-MMDD-HHMM.nn' where YYYY is the year, MM the month, DD the day, and HHMM the hour/minute the data collection was originally started.

INFO WINDOWS

There are two different types of detector information windows: *Header* type and *Hardware* type. They are both accessible by using the **Info** menu button (See 'Command Section' above). Even though each of these windows displays data for one detector at a time, multiple detectors may still be specified. Buttons are provided to 'scroll' through the info for selected detectors. Either type of window may be left visible as long as desired--they do not interfere with other commands. Reperforming an info command while that type of window is already visible will just change the selected detector group.

Hardware Info

(See figure 6) Hardware information includes data dependent on the physical setup of the connected alpha counting equipment: detector type, efficiency, location, serial number, calibration coefficients, and so on.

In addition to being a way to examine this information, editing capability is provided for certain fields. Detector type, location, serial number, installation date, and two lines of comments may be manipulated directly by the user using the **Edit** button. After the button is pressed, user-modifiable fields will be presented with the previous values in them (See figure 7).

When editing is completed, pressing the **Done** button will save the changes and send them to the other Sun computer as well. The **Cancel** button will throw away any changes.

If hardware information has changed due to an action on the other Sun computer (ie. Hardware info edit, calibration, etc.) after the *Aldo* program was started on this Sun, then the **Reload HW** option of the Info menu button should be used. This will cause a complete reload of all hardware information.

DESCRIPTION OF FIELDS:

Type:

This refers to the type of surface barrier unit (Canberra PIPS, etc.) that is installed in this detector.

Location:

A description of where the surface barrier unit is installed.

Serial Number:

The serial number of the surface barrier unit.

Install Date:

The date that this surface barrier unit was installed into its current location.

Energy Calib. Date:

This shows the last date of energy calibration for this detector, which is updated automatically by the Alpha Analysis (ALAN) program energy calibration routine.

Eff. Calib. Date:

This shows the last date of efficiency calibration for this detector, also updated by Alpha Analysis calibration.

Energy Coefficients:

A listing of the coefficients for a fifth-order polynomial fit relating the detector channel number and the energy in thousands of electron-volts (keV). Determined and updated by Alpha Analysis' energy calibration process.

Efficiency and Efficiency Uncertainty:

The detector efficiency and its uncertainty as determined by the efficiency calibration process.

Comments:

Two lines of 30 characters each that can be used for recording any other information deemed necessary by the users on a detector.

Header Info

Header information is that which is concerned with a particular data collection session. This window (see figure 8) is intended to provide a way to see more detail about individual detectors than the main window status display. There is no editing capability.

While this window is active, the status of whatever detector is displayed (and only that one) will automatically be updated every second to ensure the most accurate data possible.

If the detector shown on this window is not currently running (Status OFF, FAILED, DISABLED) then the data shown is for the end of the previous run.

DESCRIPTION OF FIELDS:**Filename:**

The file name in the /local/alpha/spectra directory that the current spectra is being stored under.

Status:

The same status that is shown for the detector on the main window, written in the appropriate color (ie. ON in green, ON HOLD in blue, etc.) See above for a description of status codes.

Started:

The date and time the detector was first started.

Last Written:

The date and time the collected data was last written to hard disk on the Sun computer. This will normally be every ten minutes, although if the detector is in *Fast Write* mode, it will be every five seconds instead.

Req. Live Time:

The amount of live time (total data collection time minus dead time) requested by the user using the **Log** function (see above). 'infinite' is also valid. All data collections will begin with infinite live time.

Dead time is the cumulative time interval that the ADC (Analog to Digital Converter) cannot receive new pulses from the detector because it is busy processing a pulse already. Larger amounts of dead time indicate a busier ADC.

Act. Live Time:

The amount of live time accumulated so far in the current data collection run.

Clock Time:

The total elapsed accumulated time (live time plus dead time) in the current run.

% Dead Time:

A bar graph showing what percentage of the total clock time the dead time represents.

% Completed:

A bar graph showing the percentage of the live time that has been collected.

Estimated Completion:

If the requested live time is finite, then this field will give a dead-time compensated estimate of when data collection will be done, assuming that there are no interruptions and the dead time percentage is constant.

LOG WINDOWS

These are used to enter and change information about samples that are being counted. There are three different versions of the log window. They are accessed through the **Log** menu button and each have a distinct color.

Current Detector Log (Black)

This log window is used to edit log information for the detector whose number appears in the title bar. If a group of detectors has been selected for logging, only one can be edited at a time. The other detectors in the group selected are accessed using the **Next** and **Prev** buttons (see 'Controls' below).

Group Log (Red)

If a more than one detector has been selected for logging, the Group Log will appear as the first record. It is used to enter data that is common to the whole group in one operation, instead of typing it in individually. The group window is used for entering data that is common for each detector and is initiated by pressing the **Apply Group** button.

History Log (Blue)

This screen is used to edit the log information of spectra files that have completed data collection. This is useful for correcting errors discovered in the log information, or when an analysis using different parameters is required.

After selecting the *History Files* option of the **Log** menu button, the window shown in figure 11 will appear. At the top are three controls used to generate a file name list. The controls are as follows:

Max # Files:

This selector governs how many file names are put into the list. The smaller this number is, the faster the list is generated. Possible options are 50, 100, 200, and all.

Detector (0 for all):

To limit the list to a particular detector, enter its number here. Entering zero instead will cause files for all detectors to be listed within the limits of the number of files selected.

Make List:

When this button is pressed, the list will be regenerated using the parameters set in the other two controls. The file names will be listed in reverse chronological order (newest files at the top).

Controls

There are five control buttons associated with the log windows, and located along the top of the window just below the title bar (See figures 9, 10, and 12). Note: All buttons are not used on all windows.

Done:

Pressing this will save the data and exit the log window. If there are any errors in the data entered, a message will alert the user, who will have to either correct the mistake or cancel.

Next and Prev:

(These are not present on a history log window) In the case of several detectors being logged at one time, these two controls are used to 'scroll' through the group of detectors whose log

entries are being edited. This is identical to the corresponding buttons on both types of *Info* window. The red group log window will always be immediately before that of the lowest numbered detector.

Cancel:

This exits the mode without saving any changes. All changes made to the group of detectors will be lost.

Apply Group:

(This button is only present on the red group window) Using this control will cause all fields changed since entering this window to be copied to all of the individual log windows in the group being edited. This provides a time-saving alternative to typing the same thing in several times.

Description of Fields

Filename:

The current file name the spectra is stored under in the /local/alpha/spectra directory on the Sun workstations. Spectra not logged will have a temporary name of the form 'Temp-Spectrum.nn', while those that have been will have date and detector number-based names of the form '1992-0807-1234.05'. The computer will always generate this file name.

Log Number:

Up to eight characters of log number can be entered.

Sample Name:

Up to 40 characters describing the sample being analyzed can be entered.

Comments:

Up to 128 characters of other information associated with the sample can be entered.

Live Time:

See description of *Header Info* window above for detail on live time. The desired amount of live time is typed into the field (floating point is OK), and a selector is used to choose Minutes, Hours, Days, or Infinite. If infinite is selected, the number is of course meaningless.

Use Decay Correction (Checkbox):

If this checkbox is selected, decay correction will be used in the spectral analysis based on the date (format MM-DD-YYYY) and time (format HH:MM 24 hour) typed into the fields provided. These fields will not be active unless the user checks the box. Their default values will be the start date and time of data collection.

Dilution Factor:

This decimal field is used as a scaling factor on the final analysis result. Final results are multiplied by positive dilution factors, and divided by the absolute value of negative dilution factors.

Unit:

This is the unit of radioactive decay used in the analysis report. Two selectors are provided, one for the numerator of the unit and one for the denominator. For example: If the desired unit is Bequerels per Sample, set the two selectors as shown in figure 9. If the one wanted is not found, selecting 'Other' on the first selector will cause a field to appear where it may be entered.

First selector choices:	Bq	Bequerels
	d/s	Disintegrations per second
	d/m	Disintegrations per minute
	C	Curies
	mC	Millicuries
	uC	Microcuries
	nC	Nanocuries
	pC	Picocuries
	fC	Femptocuries
	kBq	KiloBequerels
	Other:	User specified

Second selector choices:	sple	Sample
	g	Gram
	kg	Kilogram
	ml	Milliliter
	l	Liter
	cm ³	Cubic Centimeter

Lab Uncertainty %:

A numerical percentage expressing the uncertainty in the analysis due to factors introduced during sample handling or the chemical process.

Nuclide Table:

The number of the nuclide table to use for this sample as set up in the *Library & Subtables* function of the *Alpha Analysis* software. Optionally, a specific spike nuclide may be associated with each nuclide table. If such a default is set up, selecting that nuclide table will cause the most recent spike to automatically be selected also. (See spike nuclide below)

The defaults are maintained by editing file */local/alpha/bin/config.aldo/spikeDefaults*. In that file is a list of two columns where the left column is the nuclide table number, and the right is the nuclide name.

For example: Placing the line '1 Th229' in that file would make Thorium-229 the default spike nuclide for nuclide table number one.

The system administrator can add and change these defaults.

Spike Weight:

The amount of spike added to the solution in the laboratory.

Analyst:

Up to eight characters denoting the computer operator performing the analysis. The default is the user-id of the person running the software as determined by the logging in process.

Chemist:

Up to eight characters specifying the chemist who performed the laboratory process for this sample.

Background File:

This will show the file that will be used for background data during the analysis. The default is the most recent one in directory */local/alpha/background* that corresponds to the detector used for this analysis.

The background is selected by using the scrolling list of eligible backgrounds immediately below in the window. Selecting a line will cause the name shown to change to that selected. If no background is desired, select the **NO BACKGROUND** option at the top of the list.

Note: The background list may be disabled. If so, use the **Bkgnd List?** checkbox (see immediately below) to enable it.

Bkgnd List? (Checkbox):

If this checkbox is off, the regeneration of the background file will be disabled, saving the time necessary to update this list for different detectors. Selecting the checkbox will cause the list to be generated for whatever detector is appropriate.

SPIKE NUCLIDE SELECTION:

Since spike nuclide solutions are used in the preparation of many individual samples, a database facility is provided to enable quick selection. Using a scrolling list, a user can quickly access any spike currently in the system. If no spike is used with this sample, select the 'NO SPIKE' entry, which is always the first in the list. To maintain the list, spike addition and deletion features are available (see below).

When an entry is selected from the list using the mouse, all of the data associated with it is displayed in the fields above the list. A description of these fields is as follows:

Spike Nuclide:

The atomic symbol and weight of the nuclide. Examples: 'Th229' or 'U 232'

Activity:

The spike activity is always entered in Bq per gram of spike.

Uncertainty:

The percent uncertainty associated with the spike activity (usually about 5%).

Zero Date and Time:

The date and time used for the zero point in decay correcting the spike activity as it ages. Enter date in the form MM/DD/YYYY and time as HH:MM (24-hour).

The **Edit** menu button to the immediate right of the spike selection list is used to access editing features. There are two possible selections: 'Add New Spike' (the default) and 'Delete Spike'

After the *Add New Spike* function is selected, the screen will change to resemble figure 13. Note that fields are now available for the user to type in the data on the new spike nuclide. Pressing the **Done** button will save the new spike (if its information was entered correctly) and send the revised spike file to the other Sun computer. Pressing **Cancel** at any time during the entry process will exit without changing anything.

Selecting *Delete Spike* will cause the current highlighted spike in the scrolling list to be deleted. Before the actual deletion, the user will be asked to confirm the deletion. Of course, the 'NO SPIKE' entry cannot be deleted.

Due to the small amount of data to enter, no edit facility is provided. If a change to an existing spike is necessary, delete and re-add it.

FILES

- /local/alpha/aldo.files-to-send - Write file names into this list to have them sent to other Sun computer.
 - /local/alpha/bin/config.aldo/groupdata - File containing detector groups set up by users.
 - /local/alpha/bin/config.aldo/spikefile - File containing current spike list.
 - /local/alpha/bin/config.aldo/spikeDefaults - File specifying default spikes for any or all nuclide table numbers.
 - /local/alpha/bin/config.aldo/mizarfile - File containing data on Mizar real-time computers to be used in this system.
-

Aldo Main Window

Alpha Detector Command Display

Last Refresh: 10:24:42

Update 60 sec

Control

	Status	Time Accum	Target Time	File Name
Detector 01	ON	4014 min	5284 min	1992-0810-1407.01
Detector 02	ON	3016 min	5284 min	1992-0810-1407.02
Group 1) Detector 03	ON	4014 min	5284 min	1992-0810-1407.03
Detector 04	ON	4013 min	5284 min	1992-0810-1407.04
Detector 05	OFF	960 min	960 min	1992-0812-1409.05
Group 2) Detector 06	OFF	960 min	960 min	1992-0812-1409.06
Detector 07	OFF	960 min	960 min	1992-0812-1409.07
Detector 08	OFF	960 min	960 min	1992-0812-1409.08
Group 3) Detector 09	OFF	0 min	infinite	Temp-Spectrum.09
Detector 10	OFF	0 min	infinite	Temp-Spectrum.10
Group 4) Detector 11	OFF	0 min	infinite	Temp-Spectrum.11
Detector 12	OFF	960 min	960 min	1992-0812-1409.12
Detector 13	OFF	0 min	infinite	Temp-Spectrum.13
Group 5) Detector 14	OFF	0 min	infinite	Temp-Spectrum.14
Detector 15	OFF	1 min	infinite	Temp-Spectrum.15
Detector 16	OFF	1 min	infinite	Temp-Spectrum.16
Group 6) Detector 17	ON	0 min	infinite	Temp-Spectrum.17
Detector 18	ON	0 min	infinite	Temp-Spectrum.18
Group 7) Detector 19				
Detector 20	ON	0 min	infinite	Temp-Spectrum.20
Detector 21	OFF	960 min	960 min	1992-0812-1409.21
Group 8) Detector 22	OFF	960 min	960 min	1992-0812-1409.22
Detector 23	ON	0 min	infinite	Temp-Spectrum.23
Detector 24	OFF	960 min	960 min	1992-0812-1409.24
Setup) Detector 25	OFF	960 min	960 min	1992-0812-1409.25
Cancel) Detector 26	OFF	960 min	960 min	1992-0812-1409.26
Save) Detector 27	OFF	960 min	960 min	1992-0812-1409.27
Detector 28	OFF	960 min	960 min	1992-0812-1409.28

Command Section Of Aldo Window

Detector Selection Portion Of Aldo Window

	Detector 01
	Detector 02
	Detector 03
Group 1	Detector 04
	Detector 05
Group 2	Detector 06
	Detector 07
	Detector 08
Group 3	Detector 09
	Detector 10
	Detector 11
Group 4	Detector 12
	Detector 13
Group 5	Detector 14
	Detector 15
	Detector 16
Group 6	Detector 17
	Detector 18
Group 7	Detector 19
	Detector 20
	Detector 21
Group 8	Detector 22
	Detector 23
	Detector 24
Setup	Detector 25
Cancel	Detector 26
Save	Detector 27
	Detector 28
	Detector 29

Detector Status Portion Of Aldo Window

Status	Time Accum	Target Time	File Name
ON	3992 min	5284 min	1992-0810-1407.01
ON	2995 min	5284 min	1992-0810-1407.02
ON	3992 min	5284 min	1992-0810-1407.03
ON	3992 min	5284 min	1992-0810-1407.04
OFF	960 min	960 min	1992-0812-1409.05
OFF	960 min	960 min	1992-0812-1409.06
OFF	960 min	960 min	1992-0812-1409.07
OFF	960 min	960 min	1992-0812-1409.08
ON HOLD	0 min	infinite	Temp-Spectrum.09
LOGGING	0 min	infinite	Temp-Spectrum.10
OFF	0 min	infinite	Temp-Spectrum.11
OFF	960 min	960 min	1992-0812-1409.12

Defining a Detector Group

	Detector 01
	Detector 02
Group 1	Detector 03
	Detector 04
	Detector 05
Group 2	Detector 06
	Detector 07
	Detector 08
Group 3	Detector 09
	Detector 10
	Detector 11
Group 4	Detector 12
	Detector 13
	Detector 14
Group 5	Detector 15
	Detector 16
Group 6	Detector 17
	Detector 18
	Detector 19
Group 7	Detector 20
	Detector 21
Group 8	Detector 22
	Detector 23
	Detector 24
Setup	Detector 25
Cancel	Detector 26
Save #3	Detector 27
	Detector 28

Aldo Hardware Info

Alpha Detector 02 Hardware Info		
Next	Prev	Edit
Type:	PIPS	
Location:	CANBERRA 7404 SN 1915043	
Serial Number:	9487	
Install Date:	10/1/1991	
Energy Calib. Date:	10/30/1991	
Eff. Calib. Date:	01/28/1992	
	X^4: +0.0000e+00	
Energy	X^3: +0.0000e+00	
Coefficients:	X^2: +0.0000e+00	
	X^1: +1.0091e+01	
	X^0: -3.0312e+01	
Efficiency:	0.20174	
Effc Uncertainty:	0.02122	
Comments:	POSITION 2	

Aldo Edit Hardware Info

Alpha Detector 02 Hardware Info	
Next	Prev
Edit	Done
Cancel	
Type:	PIPS
Location:	CANBERRA 7404 SN 1915043
Serial Number:	9487
Install Date:	10/1/1991
Energy Calib. Date:	10/30/1991
Eff. Calib. Date:	01/28/1992
	X^4: +0.0000e+00
Energy	X^3: +0.0000e+00
Coefficients:	X^2: +0.0000e+00
	X^1: +1.0091e+01
	X^0: -3.0312e+01
Efficiency:	0.20174
Effc Uncertainty:	0.02122
Comments:	POSITION 2

Aldo Header Info

Alpha Detector 03 Header Info	
Next	Prev
Filename:	1992-0810-1407.03 Status: ON
Started:	08/10/1992 15:18
Last Written:	08/13/1992 15:13
Req. Live Time:	8640 min
Act. Live Time:	4303 min
Clock Time:	4303 min
% Dead Time:	<div><div></div></div> 0 100 (%0)
% Completed:	<div><div></div></div> 0 100 (%49)
Estimated Completion:	08/16/1992 15:37

Aldo Detector Log

Alpha Detector 03 Log Edit

(Done) (Next) (Prev) (Cancel)

Filename: 1992-0810-1407.03

Log Number: 92345

Sample Name: 92G11R

Comments:

Live Time: 6.00 Day

Use Decay Correction? Date: Time:

Dilution Factor: 1.00000

Unit: Bq per sple

Lab Uncertainty %: 0.0

Nuclide Table: 5 Spike Nuclide: Am243

Spike weight: 1.04000 Activity: 0.101000

Uncrt: 5.000000

Analyst: erw Zero Date: 11/11/1983

Chemist: TWM/DKK Time: 00:00

Background File: 1992-0807-1502.03 Spike: Nuclide Activity

	NO SPIKE	
Bkgnd List?	Th229 0.1050	Edit
	Th229 0.2034	
	Th229 0.0960	Done
	Th230 0.2063	
	U 232 0.1140	Cancel
	U 232 0.1000	
	U 232 0.0970	
	U 232 0.1080	

Aldo Detector Group Log

***** Alpha Detector GROUP Log Edit *****

Log Number: _____
 Sample Name: _____
 Comments: _____
 Live Time: 0.00 Min
 Use Decay Correction? ☐ Date: _____ Time: _____
 Dilution Factor: 1.00000
 Unit: Bq per sple
 Lab Uncertainty %: 0.0
 Nuclide Table: 0
 Spike Weight: 0
 Analyst: gross
 Chemist: _____
 Background File: None

Spike Nuclide: NO SPIKE
 Activity: _____
 Uncrt: _____
 Zero Date: _____
 Time: _____

Spike: Nuclide	Activity	
NO SPIKE		
Th229	0.1050	<input type="button" value="Edit v"/> <input type="button" value="Done"/> <input type="button" value="Cancel"/>
Th229	0.2034	
Th229	0.0960	
Th230	0.2063	
U 232	0.1140	
U 232	0.1000	
U 232	0.0970	
U 232	0.1080	

Bgnd List? ☐

History Log Spectra Menu

Select File for Edit

Max # Files:

Detector (0 for all):

1992-0813-1335.04 ▲
1992-0813-1335.05
1992-0813-1335.06
1992-0813-1335.07
1992-0813-1335.08
1992-0813-1335.09
1992-0813-1335.10
1992-0813-1335.11
1992-0813-1335.12
1992-0813-1335.17
1992-0813-1335.18
1992-0813-1335.19
1992-0813-1335.20
1992-0813-1335.21
1992-0813-1335.22
1992-0813-1335.23
1992-0813-1335.24
1992-0813-1335.25
1992-0813-1335.26
1992-0813-1335.27
1992-0813-1335.28
1992-0813-1335.29
1992-0813-1335.30
1992-0813-1335.31
1992-0813-1335.32
1992-0812-1409.05
1992-0812-1409.06
1992-0812-1409.07
1992-0812-1409.08
1992-0812-1409.09
1992-0812-1409.10
1992-0812-1409.11
1992-0812-1409.12
1992-0812-1409.17

History Log Edit

Alpha Log History File Edit

Filename: 1992-0813-1335.09
Log Number: 92368
Sample Name: 92G170
Comments: _____
Live Time: 16.00 hr out of 16.00 hr specified
Use Decay Correction? ☐ **Date:** _____ **Time:** _____
Dilution Factor: 1.00000
Unit: Bq **per** sple
Lab Uncertainty %: 0.0
Nuclide Table: 1 **Spike Nuclide:** Pu242
Spike Weight: 0.52000 **Activity:** 0.158000
Analyst: erw **Uncrt:** 4.000000
Chemist: SOS **Zero Date:** 12/18/1989
Time: 00:00

Background File: 1992-0807-1502.09 **Spike:** Nuclide **Activity**

		NO SPIKE	
1992-0410-1433.09		Th229 0.1050	<input type="button" value="Edit v"/> <input type="button" value="Done"/> <input type="button" value="Cancel"/>
1992-0403-1439.09	Bkgnd List?	Th229 0.2034	
1992-0327-1459.09	☒	Th229 0.0960	
1992-0320-1457.09		Th230 0.2063	
1992-0313-1522.09		U 232 0.1140	
1992-0306-1500.09		U 232 0.1000	
1992-0228-1507.09		U 232 0.0970	
1992-0221-1314.09		U 232 0.1080	
1992-0217-1433.09			

Aldo Log: Edit Spike List

Alpha Detector 01 Log Edit

Filename: 1992-0810-1407.01

Log Number: 92345

Sample Name: 92FOEE

Comments: _____

Live Time: 6.00 ☐ Day

Use Decay Correction? ☐ Date: _____ Time: _____

Dilution Factor: 1.00000

Unit: ☐ Bq per ☐ spike

Lab Uncertainty %: 0.0

Nuclide Table: 5 ☐ ☐ Spike Nuclide: _____ (ie: U235M)

Spike Weight: 1.00000 Activity: _____

Uncrt: _____

Analyst: ☐ Zero Date: _____ (MM/DD/YYYY)

Chemist: TWM/DKY Time: _____ (24 hr, HH:MM)

Background File: 1992-0807-1502.01 Spike: Nuclide Activity

Bkgnd List?		Pu242	0.2367
		Pu242	0.2350
		Am241	0.1786
		Am243	0.1010
		Am243	0.1300
		Am243	0.2080
		Am243	0.2021
	Am243	4.0000	
	Am243	3.0000	

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GAMDO

*Gamma
Detector
Operation*

NAME

GAMDO – Gamma detector operation & control.

INTRODUCTION

This manual assumes a knowledge of (terminology used and a working familiarity with) the windowing system and mouse of the Sun computer workstation. See the appropriate Sun manuals for additional information (for example, chapter one of the *OpenWindows User's Guide* – part # 800-6618-10, or chapters one to three of *Desktop SPARC Sun Systems User's Guide* – part # 800-5703-10). This manual will probably be of more use if you're sitting at the Sun workstation while reading.

GAMDO, the gamma detector control program, is used to control, monitor, and edit log information associated with the collection of gamma spectra. Actual data collection and control functions are performed by Mizar Real-Time computers for which *GAMDO* acts as a friendly user command interface and status display. It is normally started as part of your login procedure, but may also be started from the 'NETSPEC Utilities' submenu of the root menu. The root menu is obtained by pushing the right mouse button when the cursor is over the root window (background picture).

To become a user of *GAMDO* and the other programs in the *NETSPEC* system, contact the person who performs systems administration tasks for the Sun computers.

Most user interaction with *GAMDO* is by means of mouse manipulation of screen items such as buttons, checkboxes, and sliders. The action of pushing the left mouse button when the cursor is over an item is called selecting that item. The left mouse button is therefore called the *select* button. The right mouse button is the *menu* button because a limited number of options may be displayed when that button is pressed when the cursor is over an item with a triangle (inverted delta). In this document, names of selectable items are printed in **bold** when they are first mentioned or when emphasis is helpful. In general, items which do not apply to the current context are either disabled or made invisible in order to prevent selection.

MAIN WINDOW

GAMDO has one main window, titled 'Gamma Detector Command Display' (see figure 1). It may also appear as an orange icon which depicts detector electronics and is labeled ' γ Control'. To help differentiate between alpha and gamma control windows (which are nearly identical), each window's icon is also shown in its upper right-hand corner.

This Window has several subparts or sections. At the top is the *title bar*. When the triangle at the left corner is selected, the window is closed or iconified, taking all sub-windows (ie. Info and Log windows) with it. Only the main window has such a triangle. Subsidiary windows have a *pushpin* instead. Selecting a pushpin will cause that sub-window to be removed. Pressing the left mouse button anywhere else on a title bar will bring the entire window to the 'surface' of the screen. Pressing the right button anywhere on the title bar activates the usual Sun system window menu.

Below the title bar, the rest of the window is logically divided into three sections: The topmost two rows of buttons form the command section (see figure 2), the leftmost two columns control detector selection (figure 3), and the rest shows the status of each detector arranged by row (figure 4).

COMMAND SECTION

The command section (figure 2) has two types of controls in it: Those used to specify what action is to be performed on a detector or detectors (left side), and those used to control screen updates of detector status information (right side).

All commands except **Refresh Now** follow the same flow: First, a button in the Command Section is pressed corresponding to the desired function (Start, Stop, etc.) Second, one or more detectors are selected for that operation. Lastly, the **Do** button (see below) is pressed to initiate the command. **Cancel** may also be pressed to abort the command.

The function of the buttons in this section from left to right are as follows:

Note: Detector statuses are expressed in all capital letters spelled the same as written on the status screen. For a detailed discussion of the meaning of each status, see 'Detector Status Section' below.

Disable

The only thing this function does is flag the status of detectors to DISABLED, which prevents their accidental use. It is meant to be used when there is a problem with a particular detector (broken, out of calibration, etc).

May be used on detectors that are: OFF

Enable

Enable is used to reset DISABLED detectors to the OFF state so that they may be used to collect data again.

May be used on detectors that are: DISABLED.

Stop

The **Stop** function immediately terminates data collection for the selected detectors in such a way that it cannot be resumed--the set of data in question is permanently closed.

May be used on detectors that are: ON, ON HOLD, RESTART, and FAST WRT.

Start

Start begins collection of spectra by the detectors selected. The data will be initially stored in temporary file 'Temp-Spectrum.nn' where nn is the detector number. When sample log information is entered using the **Log** function (see below) a permanent file name will be assigned. Note that each time a detector is started, the previous 'Temp-Spectrum' file is overwritten.

May be used on detectors that are: OFF

Hold

This command causes affected detectors to cease data collection until manually told to resume.

May be used on detectors that are: ON or RESTART.

Continue

Continue will return a detector in any of three states (RESTART, ON HOLD, FAST WRT) to ON. In all three cases, the thought behind the button name is that of resuming normal operation from an exception state.

May be used on detectors that are: RESTART, ON HOLD, or FAST WRT.

Reset

The **Reset** function causes all spectrum data collected to that point to be deleted and collection to begin anew. Accumulated live time is zeroed as well. An ON HOLD detector will change to the ON state in this process, although one in FAST WRT mode will remain so. All log information and the file name will remain unchanged.

Reset is used whenever it is desired to get rid of the accumulated data. Examples of this might be when the data is known to be bad (wrong sample, vacuum not on, etc) or while adjusting a detector or amplifier.

May be used on detectors that are: ON, ON HOLD, or FAST WRT.

Info (Menu Button)

Info functions provide capability to view detailed status and physical information for any or all detectors.

A note on using menu buttons: To select the default item of a menu button, select it using the left mouse button. To view all of the menu options, select using the right mouse button.

Info: Header (Default Option)

This option will cause a window to appear showing information about the data collection process for the selected detectors. See the 'INFO WINDOWS' section below for more details.

May be used on detectors that are in any state except LOST COM.

Info: Hardware

This is used to view and optionally edit information relating to the detector hardware (type, location, calibration constants, etc.) See the 'INFO WINDOWS' section below for more details.

May be used on detectors that are in any state.

Info: Reload HW

This option will cause the files containing the physical information for all detectors to be reloaded. This should be used when such information was just changed using *GAMAN* (Gamma Analysis software) to perform calibrations on either Sun computer, or *GAMDO* on the other Sun computer to edit hardware data. Note that this same reload occurs whenever *GAMDO* is started up, therefore use of this option will be seldom needed.

Log (Menu Button)

Log options are used to enter and modify sample information that is associated with spectra (Sample name, spike nuclide, background, desired live time, etc.) Only one **Log** function (either Current Detectors or History Files) may be used at a time.

A note on using menu buttons: To select the default item of a menu button, select it using the left mouse button. To view all of the menu options, select using the right mouse button.

Log: Current Detectors (Default Option)

This option is used to enter sample information for the first time, or to edit previously entered data while the detector is still running. If multiple detectors are specified, a facility is provided to enter

information to all log records in one operation. A detailed discussion of this option is presented below in the 'LOG WINDOWS' section.

May be used on detectors that are: ON or ON HOLD.

Log: History Files

This is used when it is necessary to change any log information associated with a spectrum that has completed data collection. A scrolling list of all spectra files on the hard disk, sorted in reverse chronological order, will be presented to choose from. Note that it may take up to 120 seconds to generate this list. Files old enough to have been removed from the hard disk will have to be restored from archives first (see ARCHIVE). A detailed discussion of log window use is presented below in the 'LOG WINDOWS' section.

May only be used on spectra files that are not being used for data collection at the current time.

Fast Write

Fast Write causes the collected spectra for the affected detector(s) to be written to disk every few seconds (Normally it is written every 10 minutes). This is necessary when it is desired to view the spectra as it accumulates in 'real time'. (See the manual for *GAMAN* for information on viewing spectra) It does not affect the data collection at all, except to write it to disk more often.

NOTE: To prevent unnecessary hard disk load on the Sun workstations, the **Fast Write** mode should be used only when needed.

May be used on detectors that are: ON.

Cancel

This button can be used anytime after picking an operation to perform but before pressing **Do** to cancel it and start over.

Do <op name>

After an operation has been selected by pressing its button, the **Do** button appears. After the detectors for that operation have been picked, the **Do** button is pressed to perform it. As a cue to the user of the operation to be done, the button will have 'Do <operation name>' written in it. For example, (See figure 2) if Start was selected the button will say 'Do Start'.

Refresh Now

Selecting this causes an immediate update of all detector status fields. (Normally they are only updated when the status changes or periodically as specified by the **Update** selector.)

Update (Selector)

This selector allows the user to specify how often the screen is to be automatically updated. The time of last update is shown immediately above. Valid choices are 5, 10, 30 and 60 seconds with 60 being the default.

DETECTOR SELECTION SECTION

The controls in this section (see figure 3) provide the means to tell *GAMDO* which detectors to perform operations in the Command Section on. This can be done individually (using the selectors with the detector numbers in them) or by groups. Capability is also provided to edit which detectors are included in each group.

Selecting Detectors

After selecting a command, the buttons in the two left-hand columns will be made available to the user. The right column contains one button per detector, each one labeled by its number. Detectors to have that command performed upon them can then be specified by pressing their corresponding buttons. Note that these are 'toggle' buttons, that is they can also be unpressed if needed. Only when the **Do** button is pressed is their final state used to actually perform the operation.

As an additional safety feature, buttons for detectors ineligible for the operation selected will be inactive; meaning they cannot be manipulated at all. Any one of the eight group buttons on the left side of the screen can be used to quickly select a predefined group.

The use of groups is cumulative. This means that if more than one group is selected for the same operation, the individual selections for each are added together. For example: If group one is set up to select detectors one through eight, and group two for five through twelve, then using both groups will result in a net selection of detectors one through twelve.

Setting Up Groups

To view or change which detectors are assigned to a particular group, press the **Setup** button in the lower left-hand corner of the window. The eight group buttons will then become active, allowing selection of the group to view/modify. After pressing the button corresponding to the group desired, all detector buttons will activate and be set for that group. At that point they may be changed.

After using the mouse to make the desired changes to the individual detector selectors, the **Save #n** button (where n will be the group number under modification) will write the changes to disk. If the changes need to be discarded instead, press the **Cancel** button. Both of these buttons are in the lower left-hand corner of the window.

Figure 5 shows an example of setting up group number three to include detectors 17 through 24 just before saving or canceling.

DETECTOR STATUS SECTION

This section (see figure 4) is arranged in rows, one per detector, on a scrolling panel controlled by the slider bar on the right side of the main window. Using the mouse to move this slider up and down will cause the view of the list to shift likewise. There are four columns on the list: Status, time accumulated, target time, and file name. (Figure 1 shows many possible statuses as they would appear in this section)

Status

This field represents the current operational status of the detector as follows. Each status is listed in alphabetical order with its corresponding screen color and what it means.

DISABLED: (Yellow)

A user has decided to manually flag this detector so that it will not be accidentally used. Usually this means hardware fault or lack of calibration. The **Enable** command will reset it to the OFF state.

FAST WRT: (White)

The spectrum for this detector is being written to disk every five seconds instead of at the usual ten minute interval. The **Continue** command will return it to normal writing (ON state).

LOGGING: (Magenta)

This detector is now having log information entered for it by a user. Just as if ON HOLD, live time will not accumulate until the entry is complete.

LOST COM: (Red)

GAMDO has lost its communications link with the Mizar data collection computer responsible for this detector. No operations are possible.

OFF: (Black)

The detector is not currently active.

ON: (Green)

The detector is now collecting data until a pre-set time limit (if set) is reached or is shut off manually.

ON HOLD: (Blue)

This previously ON detector has had its data collection temporarily halted by a user. The **Continue** command will return it to ON.

RESTART: (Orange)

This detector's controlling Mizar computer has experienced a power failure or other event causing it to reboot. A one week hold period is now in effect to allow an operator to reset the detector high voltage power supply before data collection is automatically resumed. This prevents loss of the spectrum which was acquired prior to the failure event. The **Continue** command will force data collection to resume (ON state) before the one week limit has fully elapsed. The **Stop** command may be used to terminate data collection immediately.

Time Accumulated

This column shows the amount elapsed live time for the detector. If not currently running (Status OFF, DISABLED) then it is for the previous run.

Target Time

The target amount of live time the detector is/was to accumulate before stopping automatically. It is set or changed by using the *Log Current Detectors* button as previously described.

File Name

This gives the name of the file that the spectra data is/was being stored in. Names that look like 'Temp-Spectrum.nn' indicate temporary files not logged as permanent yet. Permanent files are of the form 'YYYY-MMDD-HHMM.nn' where YYYY is the year, MM the month, DD the day, and HHMM the hour/minute the data collection was originally started.

INFO WINDOWS

There are two different types of detector information windows: *Header* type and *Hardware* type. They are both accessible by using the **Info** menu button (See 'Command Section' above). Even though each of these windows displays data for one detector at a time, multiple detectors may still be specified. Buttons are provided to 'scroll' through the info for selected detectors. Either type of window may be left visible as long as desired--they do not interfere with other commands. Reperforming an info command while that type of window is already visible will just change the selected detector group.

Hardware Info

(See figure 6) Hardware information includes data dependent on the physical setup of the connected gamma counting equipment: detector type, efficiency, location, serial number, calibration coefficients, and so on.

In addition to being a way to examine this information, editing capability is provided for certain fields. Detector type, location, serial number, installation date, and two lines of comments may be manipulated directly by the user using the **Edit** button. After the button is pressed, user-modifiable fields will be presented with the previous values in them (See figure 7).

When editing is completed, pressing the **Done** button will save the changes and send them to the other Sun computer as well. The **Cancel** button will throw away any changes.

If hardware information has changed due to an action on the other Sun computer (ie. Hardware info edit, calibration, etc.) after the *Gamdo* program was started on this Sun, then the **Reload HW** option of the Info menu button should be used. This will cause a complete reload of all hardware information.

DESCRIPTION OF FIELDS:

Type:

This refers to the type of germanium detector unit (Ortec, LEPS, etc.) that is associated with this detector number.

Location:

A description of where the germanium detector unit is installed.

Serial Number:

The serial number of the germanium detector unit.

Install Date:

The date that this germanium detector unit was installed into its current location.

Energy Calib. Date:

This shows the last date of energy calibration for this detector, which is updated automatically by the Gamma Analysis (GAMAN) program energy calibration routine.

Energy Coefficients:

A listing of the coefficients for a fifth-order polynomial fit relating the detector channel number and the energy in thousands of electron-volts (keV). Determined and updated by Gamma Analysis' energy calibration process.

Comments:

Two lines of 30 characters each that can be used for recording any other information deemed necessary by the users on a detector.

Efficiency Coefficients and Uncertainty:

This information is available for each calibrated geometry of the detector shown. All valid geometry numbers with their descriptions are available in a scrolling list in the lower right hand corner of the window. The mouse is used to select which geometry to display efficiency calibration for.

The coefficients for the current calibration's seventh-order polynomial fits are shown for each of three energy ranges indicated by the 'Region' headers. The energy boundaries are given in thousands of electron volts (KeV). The Efficiency calibration date and the uncertainty are also shown.

Header Info

Header information is that which is concerned with a particular data collection session. This window (see figure 8) is intended to provide a way to see more detail about individual detectors than the main window status display has. There is no editing capability.

While this window is active, the status of whatever detector is displayed (and only that one) will automatically be updated every second to ensure the most accurate data possible.

If the detector shown on this window is not currently running (Status OFF, DISABLED) then the data shown is for the end of the previous run.

DESCRIPTION OF FIELDS:**Filename:**

The file name in the /local/gamma/spectra directory that the current spectra is being stored under.

Status:

The same status that is shown for the detector on the main window, written in the appropriate color (ie. ON in green, ON HOLD in blue, etc.) See above for a description of status codes.

Started:

The date and time the detector was first started.

Last Written:

The date and time the collected data was last written to hard disk on the Sun computer. This will normally be every ten minutes, although if the detector is in *Fast Write* mode, it will be every five seconds instead.

Req. Live Time:

The amount of live time (total data collection time minus dead time) requested by the user using the **Log** function (see above). 'infinite' is also valid. All data collections will begin with infinite live time.

Dead time is the cumulative time interval that the ADC (Analog to Digital Converter) cannot receive new pulses from the detector because it is busy processing a pulse already. Larger amounts of dead time indicate a busier ADC.

Act. Live Time:

The amount of live time accumulated so far in the current data collection run.

Clock Time:

The total elapsed accumulated time (live time plus dead time) in the current run.

% Dead Time:

A bar graph showing what percentage of the total clock time the dead time represents.

% Completed:

A bar graph showing the percentage of the live time that has been collected.

Estimated Completion:

If the requested live time is finite, then this field will give a dead-time compensated estimate of when data collection will be done, assuming that there are no interruptions and the dead time percentage is constant.

LOG WINDOWS

These are used to enter and change information about samples that are being counted. There are three different versions of the log window. They are accessed through the **Log** menu button and each have a distinct color.

Current Detector Log (Black)

This log window is used to edit log information for the detector whose number appears in the title bar. If a group of detectors has been selected for logging, only one can be edited at a time. The other detectors in the group selected are accessed using the **Next** and **Prev** buttons (see 'Controls' below).

Group Log (Red)

If a more than one detector has been selected for logging, the Group Log will appear as the first record. It is used to enter data that is common to the whole group in one operation, instead of typing it in individually. The group window is used for entering data that is common for each detector and is initiated by pressing the **Apply Group** button.

History Log (Blue)

This screen is used to edit the log information of spectra files that have completed data collection. This is useful for correcting errors discovered in the log information, or when an analysis using different parameters is required.

After selecting the *History Files* option of the **Log** menu button, the window shown in figure 11 will appear. At the top are three controls used to generate a file name list. The controls are as follows:

Max # Files:

This selector governs how many file names are put into the list. The smaller this number is, the faster the list is generated. Possible options are 50, 100, 200, and all.

Detector (0 for all):

To limit the list to a particular detector, enter its number here. Entering zero instead will cause files for all detectors to be listed within the limits of the number of files selected.

Make List:

When this button is pressed, the list will be regenerated using the parameters set in the other two controls. The file names will be listed in reverse chronological order (newest files at the top).

Controls

There are five control buttons associated with the log windows, and located along the top of the window just below the title bar (See figures 9, 10, and 12). Note: All buttons are not used on all windows.

Done:

Pressing this will save the data and exit the log window. If there are any errors in the data entered, a message will alert the user, who will have to either correct the mistake or cancel.

Next and Prev:

(These are not present on a history log window) In the case of several detectors being logged at one time, these two controls are used to 'scroll' through the group of detectors whose log

entries are being edited. This is identical to the corresponding buttons on both types of *Info* window. The red group log window will always be immediately before that of the lowest numbered detector.

Cancel:

This exits the mode without saving any changes. All changes made to the group of detectors will be lost.

Apply Group:

(This button is only present on the red group window) Using this control will cause all fields changed since entering this window to be copied to all of the individual log windows in the group being edited. This provides a time-saving alternative to typing the same thing in several times.

Description of Fields

Filename:

The current file name the spectra is stored under in the /local/gamma/spectra directory on the Sun workstations. Spectra not logged will have a temporary name of the form 'Temp-Spectrum.nn', while those that have been will have date and detector number-based names of the form '1992-0807-1234.05'. The computer will always generate this file name.

Log Number:

Up to eight characters of log number may be entered.

Sample Name:

Up to 40 characters describing used to describe the sample being analyzed.

Comments:

Up to 128 characters of other information associated with the sample can be typed here.

Live Time:

See description of *Header Info* window above for detail on live time. The desired amount of live time is typed into the field (floating point is OK), and a selector is used to choose Minutes, Hours, Days, or Infinite. If infinite is selected, the number is of course meaningless.

Use Decay Correction (Checkbox):

If this checkbox is selected, decay correction will be used in the spectral analysis based on the date (format MM-DD-YYYY) and time (format HH:MM 24 hour) typed into the fields provided. These fields will not be active unless the user checks the box. Their default values will be the start date and time of data collection.

Dilution Factor:

This decimal field is used as a scaling factor on the final analysis result. Final results are multiplied by positive dilution factors, and divided by the absolute value of negative dilution factors.

Unit:

This is the unit of radioactive decay used in the analysis report. Two selectors are provided, one for the numerator of the unit and one for the denominator. For example: If the desired unit is Bequerels per Sample, set the two selectors as shown in figure 9. If the one wanted is not found, selecting 'Other' on the first selector will cause a field to appear where it may be entered.

First selector choices:	Bq	Bequerels
	d/s	Disintegrations per second
	d/m	Disintegrations per minute
	C	Curies
	mC	Millicuries
	uC	Microcuries
	nC	Nanocuries
	pC	Picocuries
	fC	Femptocuries
	kBq	KiloBequerels
	Other:	User specified
Second selector choices:	sple	Sample
	g	Gram
	kg	Kilogram
	ml	Milliliter
	l	Liter
	cm ³	Cubic Centimeter

Lab Uncertainty %:

A numerical percentage expressing the uncertainty in the analysis due to factors introduced during sample handling or the chemical process.

Nuclide Table:

The number of the nuclide table to use for this sample as set up in the *Library & Subtables* function of the *Gamma Analysis* software. The system administrator can add and change these defaults.

Analyst:

Up to eight characters denoting the computer operator performing the analysis. The default is the user-id of the person running the software as determined by the logging in process.

Chemist:

Up to eight characters specifying the chemist who performed the laboratory process for this sample.

Background File:

This will show the file that will be used for background data during the analysis. The default is the most recent one in directory *//local/gamma/background* that corresponds to the detector used for this analysis.

The background is selected by using the scrolling list of eligible backgrounds immediately below in the window. Selecting a line will cause the name shown to change to that selected. If no background is desired, select the **NO BACKGROUND** option at the top of the list.

Note: The background list may be disabled. If so, use the **Bkgnd List?** checkbox (see immediately below) to enable it.

Bkgnd List? (Checkbox):

If this checkbox is off, the regeneration of the background file will be disabled, saving the time necessary to update this list for different detectors. Selecting the checkbox will cause the list to be generated for whatever detector is appropriate.

GEOMETRY SELECTION:

There are many different possible physical configurations into which the sample may be placed in relation to the detector itself. This includes the form of the sample (liquid, filter paper, gaseous, etc) as well as the container and the distance from the detector.

Because such factors affect the data collection, each one must have its own calibration. A list of all geometries in use in the system is provided to select from. For each one, its number and the first 20 characters of its description are shown in the list itself. The entire description may be viewed by selecting the desired geometry, which causes the full name to be printed above the list.

As mentioned before, all geometries in the system are shown in the list, even if not calibrated for the current detector being logged. This is to allow calibration data sets to be collected. If no calibration is present for the current geometry, the message "THIS GEOMETRY NOT CALIBRATED" will be shown in red immediately above the list.

The **Edit** menu button to the immediate right of the geometry selection list is used to access editing features. There are two possible selections: 'Add New Geometry' (the default) and 'Delete Geometry'.

After the *Add New Geometry* function is selected, the screen will change to resemble figure 13. Note that fields are now available for the user to type in the new geometry number and description. Pressing the **Done** button will save the new geometry (if everything was entered correctly) and send the revised geometry file to the other Sun computer. Pressing **Cancel** at any time during the entry process will exit without changing anything.

Selecting *Delete Geometry* will cause the current highlighted geometry in the scrolling list to be deleted. Before the actual deletion, the user will be asked to confirm the deletion.

Due to the small amount of data to enter, no edit facility is provided. If a change to an existing geometry is necessary, delete and re-add it.

FILES

- /local/gamma/gamdo.files-to-send - Write file names into this
fifo file to have them sent to other Sun computer.
 - /local/gamma/bin/config.gamdo/groupdata - File containing detector
groups set up by users.
 - /local/gamma/bin/config.gamdo/geometryNames - File containing current
geometry list.
 - /local/gamma/bin/config.gamdo/mizarfile - File containing data on
Mizar real-time computers to be used in this system.
-

Gamdo Main Window

Gamma Detector Command Display

Last Refresh: 07:50:46

Control

Group	Status	Time Accum	Target Time	File Name
Group 1) Detector 01	ON	0 min	infinite	Temp-Spectrum.01
Group 2) Detector 02	ON	0 min	infinite	Temp-Spectrum.02
Group 3) Detector 03	ON	0 min	infinite	Temp-Spectrum.03
Group 4) Detector 04	ON	0 min	infinite	Temp-Spectrum.04
Group 5) Detector 05	OFF	3600 min	3600 min	1993-0730-1015.05
Group 6) Detector 06	OFF	3600 min	3600 min	1993-0730-1015.06
Group 7) Detector 07	OFF	3600 min	3600 min	1993-0730-1015.07
Group 8) Detector 08	OFF	3600 min	3600 min	1993-0730-1015.08
Group 9) Detector 09	OFF	3600 min	3600 min	1993-0730-1015.09
Group 10) Detector 10	OFF	3600 min	3600 min	1993-0730-1015.10
Group 11) Detector 11				
Group 12) Detector 12				

Command Section of Gando Window

Detector Selection Section of Gamdo Window

Group 1)	Detector 01
Group 2)	Detector 02
Group 3)	Detector 03
Group 4)	Detector 04
Group 5)	Detector 05
Group 6)	Detector 06
Group 7)	Detector 07
Group 8)	Detector 08
	Detector 09
	Detector 10
Setup)	Detector 11
Cancel)	Detector 12
Save)	

Detector Status Section of Gamdo Window

Status	Time Accum	Target Time	File Name
ON	5 min	infinite	Temp-Spectrum.01
OFF	30 min	30 min	1993-0818-0728.02
ON HOLD	0 min	infinite	Temp-Spectrum.03
ON	4 min	infinite	Temp-Spectrum.04
OFF	30 min	30 min	1993-0818-0728.05
OFF	30 min	30 min	1993-0818-0728.07
LOGGING	3 min	infinite	Temp-Spectrum.08
OFF	10 min	10 min	1993-0818-0728.09
OFF	10 min	10 min	1993-0818-0728.10

Defining a Detector Group

Group 1)	Detector 01
Group 2)	Detector 02
Group 3)	Detector 03
Group 4)	Detector 04
Group 5)	Detector 05
Group 6)	Detector 06
Group 7)	Detector 07
Group 8)	Detector 08
	Detector 09
	Detector 10
Setup)	Detector 11
Cancel)	Detector 12
Save #3)	

Gando Hardware Info

Gamma Detector 01 Hardware Info

Next Prev Edit

Type: ORTEC CEM-41095

Location:

Serial Number: 26-P-51P

Install Date: 12/11/1986

Energy Calib. Date: 09/14/1992

Geometry: 1 - 5ml vial 5cm

Eff. Calib. Date: NONE

	Region 1	Region 2	Region 3
Start	20.0	1100.0	10000.0
End	1100.0	4000.0	4000.0

XA6: +0.0000e+00 +0.0000e+00 +0.0000e+00
 XA5: +7.3796e-01 +0.0000e+00 +0.0000e+00
 XA4: -1.0401e+01 +0.0000e+00 +0.0000e+00
 XA3: +5.8503e+01 +0.0000e+00 +0.0000e+00
 XA2: -1.6419e+02 -2.3337e-01 +0.0000e+00
 XA1: +2.2932e+02 +7.7815e-01 +0.0000e+00
 XA0: -1.2905e+02 -2.6405e+00 +0.0000e+00

Energy XA3: +0.0000e+00
 Coefficients: XA2: +0.0000e+00
 XA1: +4.9963e-01
 XA0: +3.8758e-01
 Width XA1: +5.9282e-04
 Coefficients: XA0: +2.4017e+00

Comments: No configuration file found for this detector.

Select Geometry:

2 5ml vial 10cm
 10 Point Source 10cm
 18 1/4" h20 p1t2d fltr vial 5cm
 20 1/8" h20 p1t2d fltr vial 5cm
 33 2" glass fiber filter flat 5cm

Gamma Detector 01 Hardware Info

Next) Prev) Edit) Done) Cancel)
Geometry: 1 - 5ml vial 5cm Eff. Calib. Date: NONE

Type: ORTEC CEM-41095

Location: 26-P-51P

Serial Number: 12/11/1986

Install Date: 09/14/1992

Energy Calib. Date: 09/14/1992

Energy		Coefficients		Width		Coefficients	
X46:	+0.0000e+00	X46:	+0.0000e+00	X41:	+4.9963e-01	X40:	+3.8758e-01
X45:	+7.3796e-01	X45:	+0.0000e+00	X42:	+0.0000e+00	X41:	+5.9282e-04
X44:	-1.0401e+01	X44:	+0.0000e+00	X43:	+0.0000e+00	X40:	+2.4017e+00
X43:	+5.8503e+01	X43:	+0.0000e+00	X42:	-1.6419e+02	X41:	+2.2932e+02
X42:	-1.6419e+02	X42:	+0.0000e+00	X41:	+7.7815e-01	X40:	-1.2905e+02
X41:	+7.7815e-01	X41:	+0.0000e+00	X40:	+0.0000e+00		
X40:	+0.0000e+00	X40:	+0.0000e+00				

Start: 20.0 1100.0 4000.0

End: 1100.0 4000.0 4000.0

Region 1 Region 2 Region 3

Select Geometry:

1 5ml vial 5cm

2 5ml vial 10cm

10 Point Source 10cm

18 1/4" h20 p12d filter vial 5cm

20 1/8" h20 p12d filter vial 5cm

33 2" glass fiber filter flat 5cm

Comments: No configuration file found for this detector.

Gamdo Edit Hardware Info

Gamdo Header Info

Gamma Detector 03 Header Info	
Next	Prev
Filename:	1993-0727-0733.03 Status: OFF
Started:	07/27/1993 08:06
Last Written:	07/27/1993 08:36
Req. Live Time:	30 min
Act. Live Time:	30 min
Clock Time:	30 min
% Dead Time:	0 100 (%1)
% Completed:	0 100 (%100)
Estimated Completion:	Not Applicable (Detector Not Running)

Gando Detector Log

Gamma Detector 01 Log Edit	
Done	Next
Prev	Cancel
Filename: Temp-Spectrum.01	
Log Number: 12345	
Sample Name: Test Sample #4	
Comments:	
Live Time: 12	Unit: Bq
Use Decay Correction? ☒	Date: 1/01/1993
Dilution Factor: 1.00000	Time: 10:00
Unit: ☐ Bq	per ☐ sple
Lab Uncertainty %: 0.0	
Nuclide Table: 0	Geometry #: 1
Geometry Name: 5ml vial 5cm	
Analyst: gross	
Chemist:	
Background File: 1993-0723-0958.01	
Bgnd List?	
2 5ml vial 10cm 5 Point Source 5cm 10 Point Source 10cm 11 PDI 18 1/4" h20 plicd filter vi 20 1/8" h20 plicd filter vi 33 2" glass fiber filter 40 1/4" Soil 40 dram vial 41 2" Soil 40 dram vial e 42 2" charcoal 40 dram vi 43 2.25" AgX 40 dram vial 44 1.5" H2O 40 dram vial	Edit ☐ Done ☐ Cancel ☐

Gamdo Detector Group Log

*** Gamma Detector GROUP Log Edit ***

Log Number: _____
 Sample Name: Test sample 12- _____
 Comments: _____

Live Time: 150 ☐ Min
 Use Decay Correction? ☐ Date: _____ Time: _____
 Dilution Factor: 1.00000
 Unit ☐ Bq per ☐ sple
 Lab Uncertainty %: 0.0
 Nuclide Table: 0 ☐ 4 ☐ 5 ☐

Geometry Name: 5ml vial 5cm
 Geometry #: 1

Analyst: gross _____
 Chemist: _____

Background File: None ☒

Bkgnd List? ☐

2 5ml vial 10cm
5 Point Source 5cm
10 Point Source 10cm
11 PdI
18 1/4" h2o pitzd fltr vi
20 1/8" h2o pitzd fltr vi
33 2" glass fiber filter
40 1/4" Soil 40 draa vial
41 2" Soil 40 draa vial e
42 2" charcoal 40 draa vi
43 2.25" AgX 40 draa vial
44 1.5" H2O 40 draa vial

History Log Spectra Menu

Select File for Edit

Max # Files:

Detector (0 for all):

1993-0730-1015.01
1993-0730-1015.02
1993-0730-1015.03
1993-0730-1015.04
1993-0730-1015.05
1993-0730-1015.06
1993-0730-1015.07
1993-0730-1015.08
1993-0730-1015.09
1993-0730-1015.10
1993-0730-0740.01
1993-0730-0740.02
1993-0730-0740.03
1993-0730-0740.04
1993-0730-0740.05
1993-0730-0740.06
1993-0730-0740.07
1993-0730-0740.08
1993-0730-0740.09
1993-0730-0740.10
1993-0729-0853.09
1993-0729-0853.10
1993-0729-0851.01
1993-0729-0851.02
1993-0729-0851.03
1993-0729-0851.04
1993-0729-0851.05
1993-0729-0851.06
1993-0729-0851.07
1993-0729-0851.08
1993-0728-1530.07
1993-0728-1530.09
1993-0728-1530.10
1993-0728-0741.01

History Log Edit

Gamma Log History File Edit	
Done	Cancel
Filename: 1993-0727-0733.04	
Log Number: _____	
Sample Name: QC	
Comments: _____	
Live Time: 30.00 min out of 30.00 min specified	
Use Decay Correction? ☒ Date: 08/27/1982 Time: 10:00	
Dilution Factor: 1.00000	
Unit: ☒ Bq per ☒ sple	
Lab Uncertainty %: 0.0	
Nuclide Table: 3 ☒ 4 ☒	
Geometry Name: Point Source 10cm	
Geometry #: 10	
Analyst: CMW	
Chemist: _____	
Background File: 1993-0723-0958.04	
<div> <div>NO BACKGROUND</div> <div> 1993-0716-1020.04 1993-0709-1402.04 1993-0702-1108.04 1993-0625-1518.04 1993-0618-1448.04 1993-0611-1335.04 1993-0604-1451.04 </div> </div>	
<div> <div> ☒ Bkgnd List? </div> <div> 1 5al vial 5cm 2 5al vial 10cm 5 Point Source 5cm 11 PdI 18 1/4" h20 pitzd fltr vi 20 1/8" h20 pitzd fltr vi 33 2" glass fiber filter 40 1/4" Soil 40 dram vial 41 2" Soil 40 dram vial 42 2" charcoal 40 dram vi 43 2.25" AgX 40 dram vial 44 1.5" H2O 40 dram vial </div> </div>	
Done	Edit ☒
Cancel	

Gamdo Log: Edit Geometry List

Gamma Detector 01 Log Edit

Filename: Temp-Spectrum.01

Log Number: _____

Sample Name: _____

Comments: _____

Live Time: _____ infinite

Use Decay Correction? ☐ Date: _____ Time: _____

Dilution Factor: 1.00000

Units: Eq per sp/s

Lab Uncertainty %: _____ (%)

Nuclide Table:

Geometry Name: _____

Geometry #: _____

Analyst: _____

Chemist: _____

Background File: 1993-0723-0958.01

8bgnd List?

1	501	vi-1	SCA
2	501	vi-1	10:0h
3	501	Source	SCA
4	501	Point Source	10:0h
5	101	Pd	
6	101	h-20	pl-100 filter
7	201	h-20	pl-100 filter
8	301	glass	fiber filter
9	401	h-20	pl-100 filter
10	401	h-20	pl-100 filter
11	401	h-20	pl-100 filter
12	401	h-20	pl-100 filter
13	401	h-20	pl-100 filter
14	401	h-20	pl-100 filter
15	401	h-20	pl-100 filter
16	401	h-20	pl-100 filter
17	401	h-20	pl-100 filter
18	401	h-20	pl-100 filter
19	401	h-20	pl-100 filter
20	401	h-20	pl-100 filter
21	401	h-20	pl-100 filter
22	401	h-20	pl-100 filter
23	401	h-20	pl-100 filter
24	401	h-20	pl-100 filter
25	401	h-20	pl-100 filter
26	401	h-20	pl-100 filter
27	401	h-20	pl-100 filter
28	401	h-20	pl-100 filter
29	401	h-20	pl-100 filter
30	401	h-20	pl-100 filter
31	401	h-20	pl-100 filter
32	401	h-20	pl-100 filter
33	401	h-20	pl-100 filter
34	401	h-20	pl-100 filter
35	401	h-20	pl-100 filter
36	401	h-20	pl-100 filter
37	401	h-20	pl-100 filter
38	401	h-20	pl-100 filter
39	401	h-20	pl-100 filter
40	401	h-20	pl-100 filter
41	401	h-20	pl-100 filter
42	401	h-20	pl-100 filter
43	401	h-20	pl-100 filter
44	401	h-20	pl-100 filter
45	401	h-20	pl-100 filter
46	401	h-20	pl-100 filter
47	401	h-20	pl-100 filter
48	401	h-20	pl-100 filter
49	401	h-20	pl-100 filter
50	401	h-20	pl-100 filter

ALAN

*Alpha Spectra
Analysis*

NAME

ALAN – Alpha spectrum display, peak analysis, and report program.

INTRODUCTION

This manual assumes a knowledge of (terminology used and a working familiarity with) the windowing system and mouse of the Sun computer workstation. See the appropriate Sun manuals for additional information (for example, chapter one of the *OpenWindows User's Guide* – part # 800-6618-10, or chapters one to three of *Desktop SPARC Sun Systems User's Guide* – part # 800-5703-10). These manuals will probably be of more use if you are sitting at the Sun workstation while reading.

ALAN, the alpha analysis program, is used to graphically display a spectrum, identify and quantify peaks, and provide a printed sample analysis report. It is normally started as part of your login procedure, but may also be started from the 'NETSPEC Utilities' submenu of the root menu. The root menu is obtained by pushing the right mouse button when the cursor is over the root window (background picture).

Addition of new users is handled by the person who performs systems administration tasks. At the time of adding valid user names to the system, the system administrator must know what authorization level to assign. If your login name is a member of the privileged NETSPEC Unix group, then you have full access to all of *ALAN's* features. Any user who is not a member of this privileged group may display and analyze spectra but may neither save backgrounds nor perform calibrations.

Most user interaction with *ALAN* is by means of push buttons which are activated by the mouse. The action of pushing the left mouse button when the cursor is over an item is called selecting that item. The left mouse button is therefore called the *select* button. The right mouse button is the *menu* button because a limited number of options may be displayed when that button is pressed when the cursor is over an item with a triangle (inverted delta). In this document, names of selectable items are printed in **bold** when they are first mentioned or when emphasis is helpful. In general, items which do not apply to the current context are either disabled or made invisible in order to prevent selection.

ACE/gr is a public domain plotting program used to display background, pulser, and QC check source data. Although it is available in both Xview and Motif versions, only the Xview version, *xvgr*, is used on the Sun workstation. For additional information on using the many features of *xvgr*, refer to a separate document, *ACE/gr User's Manual*.

ALAN displays three windows on your screen: *Alpha LISP*, *Alpha Library & Subtables*, and *Alpha Display*, any or all of which may appear iconified (figures 1 to 3 show both the opened windows and iconified forms). For a brief description of button functionality, press the *Help* key (lower left on keyboard) when the mouse is over an active area of either the *Library* or *Display* windows.

The *Alpha LISP* window is normally of little interest to the user, however, if the *Display* and *Library* windows appear to be dead, check here for error messages. You may Ignore warning messages such as are shown in figure 1, error messages appear after the first '>' prompt. If for some reason you want to exit *ALAN*, push the right mouse button on either the frame of the *Alpha LISP* window or on the icon and select **Quit** to destroy all three *ALAN* windows.

DISPLAY WINDOW

The Display Window (figure 2) has several subparts or sections. At the top is the *title bar*. When the triangle at the left corner is selected, the window is closed or iconified. Pressing the left mouse button anywhere else on the title bar will bring the entire window to the 'surface' of the screen. Pressing the right button anywhere on the title bar activates the usual Sun system window menu. Below the title bar is the *control panel* containing informative fields and mouse activated buttons and choice menus which are described later. Below the control panel is a light gray *graphics* area for spectral display. At the bottom of the window is a one line *footer* which gives nuclide name, peak area and sample live time.

The *Display Window* may be manually resized by pressing the left mouse button down while the cursor is over the bracket on any corner, then dragging the mouse while continuing to hold the button down.

Since the Display Window is the main window of *ALAN*, a detailed description of its features follows.

A scrollable menu titled *Select Spectrum* (figure 2) is on a separate popup window associated with the Display Window. This menu is used to select a spectrum file for graphic display. The entire Select Spectrum window will disappear when the pushpin located in the upper left corner is selected. It is brought back by selecting the **Update Menu** button in the upper left corner of Display Window's control panel. The Update Menu button can also be selected to add new spectra files to the menu after they have been created by logging a sample in the *ALDO* (Alpha Detector Operations) control program window. See the *Alpha Detector Operation (ALDO) User Guide* for additional information.

The *Select Spectrum* menu lists files from the spectra directory. The menu may contain up to **Max # Files**, although only 34 are visible at any time. The actual number of spectra file items in the menu is given near the upper left corner below the word **Detector**. The scroll slider along the right edge of the Select Spectrum window is used to control which items are visible in the menu. The spectra files are sorted by date and time then by detector number. The Temp-Spectrum.XX files always appear first, followed by the most recent spectra. Within a group of spectra with the same date and time, those with the lowest detector number are first. Spectra file names available in the menu may be limited to a single detector. This is accomplished by pushing the *right* mouse button when the cursor is over the word **Detector**, then selecting the desired detector number. The menu will then list the most recent spectra for only the specified detector. The menu may be reset to list spectra from all detectors by selecting '*' for the detector number. The Select Spectrum window is not resizable.

A spectrum is graphically displayed in the main Display Window by selecting its file name from the *Select Spectrum* menu with the left mouse button. When a spectrum file is selected, additional buttons become visible on the control panel (figure 4A) and the following actions are taken. The title bar of the Display Window is updated to give the machine name which is running *ALAN*, the spectrum file name, the sample name, and the date and time at which the spectrum file was written. The setting for **Nuclide Table** is taken from the sample header. Spectrum live time is given on the right side of the footer line.

Buttons and choices will be described in the order of position on the control panel from upper left to lower right.

Calc Mode

The **Calc Mode** option is given immediately to the right of the Update Menu button (figure 4A). Possible values are: **NORMAL**, **BKGRND**, **QC**, **QC-PUL**, **EN-CAL**, and **EF-CAL**.

An initial guess for the value of this option is made based on a search for certain keywords in the sample name unless the currently logged in user is not a member of the privileged group. In that case Calc Mode is forced to NORMAL, no keyword search is performed and the other choices are removed from the menu. (This is to prevent unauthorized or inadvertent changes to calibration or QC databases.)

The sample name keyword search is insensitive to upper/lower case differences and stops as soon as a match is found. First the sample name is searched for either of the sequences 'background' or 'bkg', if found, Calc Mode becomes BKGRND. Note that the sequences 'backgrnd', 'back ground', etc. do not qualify. Second, if either of the sequences 'quality control' or 'qc' appears in the sample name, then Calc Mode becomes QC. 'Qual con 123.456' does not qualify. Third, if a search for the sequence 'pulser' succeeds, Calc Mode is set to QC-PUL. Fourth, if the sample name contains 'energy' AND 'cal' then Calc Mode is set to EN-CAL. These do not need to be in order. Examples of sample names which qualify are: 'check source energy calibration', 'cal energy test', 'California Petroleum and Energy Co.', and 'food calories provide energy'. Fifth, the sample name is searched for 'efficiency' and 'cal', if found, Calc Mode is set to EF-CAL. Finally when all the above tests fail, Calc Mode is set to NORMAL.

Members of the privileged group can select any Calc Mode for any sample to override the initial setting. Non-members have no choice. The value of Calc Mode has an effect on the behavior of ALAN. All settings other than NORMAL may result in files being written at the conclusion of calculation. The Calc Mode setting may effect the name and function of some other buttons.

It also effects what is displayed in an informative field near the bottom center of the control panel (figure 4A). BKGRND causes the spectrum total counts and counts per hour to be displayed. Counts occurring below the greater of 3600 keV or spectrum channel 2 are not included in these values. In all other modes the factor to convert from decays per second to the sample's logged final units is displayed.

In EN-CAL mode the X-axis is labeled in channel number instead of energy.

Calc

Selecting the Calc button (figure 4A) begins the process of preparing a written report and/or writing calibration or QC files. A description will be given for each possible value of Calc Mode.

Calc (Calc Mode : NORMAL)

Selecting Calc when Calc Mode is NORMAL, displays successive regions of the spectrum for peak area determination beginning with the designated spike nuclide and stepping through all other nuclides in the currently selected nuclide table (figure 4B). Refinement of the integration limits is carried out by moving the cursor into the graphics area and pressing one of the mouse buttons. Within the graphics area, the cursor changes to a representation of the mouse to indicate this.

The left and right mouse buttons set the lower and upper energy integration limits respectively. The middle button is used to set the peak center. Certain restrictions and assumptions apply. If an attempt is made to move the peak center beyond either the lower or upper integration limit, the corresponding limit is moved with the peak center to the new location. If an attempt is made to move the lower limit to a point higher than the peak center, the lower limit is only moved as far as the center. The same applies to attempts to move the upper limit to a point below the peak center.

After one of the integration limits is moved, gross and net area is recalculated and numerically displayed in the left footer. Total gross area is graphically indicated by blue shading lines, while the normalized background contribution is shown by red dashed lines. New energy values of the limits are shown in the corresponding Limit numeric field, while the value of the peak center is shown in the Peak field.

Setting the peak center for the spike nuclide will automatically make a linear adjustment to the energy calibration so that the peak center is at the correct library energy value. The value of the adjustment in keV is shown in the **Enrg Shift** field. (See the discussion of Enrg Shift for additional information.)

Calc (Calc Mode : BKGRND)

No peaks are integrated in BKGRND mode regardless of the nuclide table setting. The spectrum date and total counts per hour (counts at energies below 3000 keV are ignored) are appended to the background QC file for the detector for the current spectrum. The entire spectrum file is copied to the background directory for use as a background by other spectra (figure 4C).

Calc (Calc Mode : QC)

Peak integration is performed for the QC standard the same as a normal peak. The **Prnt/Sv** button becomes visible to actually save results to the QC file (printing only takes place if the '# Sum Pg' setting is not zero). The values appended to the QC file are spectrum date, calculated value in desired units, FWHM, and FWTM in keV.

Calc (Calc Mode : QC-PUL)

Peak integration is performed for the pulser the same as a normal peak. The **Prnt/Sv** button becomes visible to actually save results to the various QC-PUL files (printing only takes place if the '# Sum Pg' setting is not zero). The values appended to the QC-PUL files are spectrum date, calculated value in Pulses per Second, FWHM and FWTM in keV, energy of peak center, and a peak shape (tailing) factor which is calculated from the portion of the FWHM and FWTM which is to the left and right of the peak center.

Calc (Calc Mode : EN-CAL)

You are asked to define a peak for each nuclide in the selected table, but you may skip any nuclides you want. Only the peak center location is of importance, areas are ignored. Results (the channel location you defined and library energy) are written to a temporary file in the /local/alpha/calibrate directory. The file name is en-cal-resultsXX, where XX is the detector number. This file accumulates results from as many spectra as you want. Other spectra files may contain peaks from different nuclides. Energy calibration is actually completed by combining the temporary results at a later time by selecting **Final Energy Cal** from the **Options** menu button.

Calc (Calc Mode : EF-CAL)

For each nuclide in the selected table you are asked to enter an **Actual Activity** and associated **3-Sig Act Uncrt** (figure 4D). Integrate the peak as a normal peak. Results (efficiency and uncertainty) are written to a temporary file in the /local/alpha/calibrate directory. The file name is ef-cal-resultsXX, where XX is the detector number. Other spectra files may contain peaks from the same or different nuclides at different activities and uncertainties. Efficiency calibration is actually completed by combining the temporary results at a later time by selecting **Final Efficiency Cal** from the **Options** menu button.

Save Pk & Skip Pk

After all integration settings for an individual peak are acceptable, select the **Save Pk** button to retain peak information and go to the next nuclide of the selected nuclide table (figure 4B). If you don't want to calculate results for the current nuclide, select **Skip Pk** instead. Repeat peak adjustment – Save Pk / Skip Pk cycle until all nuclides in the selected table have been determined.

Enrg Shift

The energy shift value makes a linear adjustment to the energy calibration coefficients for the current analysis so that the peak center is at the correct library energy value. The value of the adjustment in

keV is shown in the **Enrg Shift** field (figure 4B). For samples with spike nuclides (internal standard), the adjustment is made when you define the peak center location for the spike. You may edit the automatic adjustment by typing a value in the Enrg Shift field or by using the up or down pointing triangles. Editing must be completed before selecting next peak because the value at that time remains in effect for the duration of the analysis. For samples which do not contain a spike, any adjustment of Enrg Shift must be made manually before saving the first peak.

Left Limit, Peak, Right Limit

These are the low and high energy integration limits and the peak center value. In addition to changing by mouse button action in the spectrum display, the up and down pointing triangles may be used to make fine adjustments of 1 keV at a time (figure 4B). See the discussion above in the section **Calc** (Calc Mode : NORMAL).

Sum Pg

This selects either 0, 1 or 2 copies of the summary report to be printed. The selected value remains in effect for the duration of your *ALAN* session or until you change it again. The position of the # Sum Pg choice menu is the same as the **Save Pk** button. It is visible only after peaks for all nuclides in the selected nuclide table have been either saved or skipped (figure 4E). In order to get any printed peak report when Calc Mode is QC, # Sum Pg must be greater than zero.

Re Read Spec

Selection of this button will reread the spectrum data file (figure 4A). This is useful when displaying a spectrum which is still acquiring data. Remember that during acquisition, data is only written every 10 minutes unless Fast Write has been selected in the *ALDO* program.

Draw

When the graphics needs to be refreshed (occasionally after peak area shading or window resizing) the window menu refresh (right button in title bar) usually suffices. If not, **Draw** should eliminate the problem (figure 4A).

Quit Calc

This button is selected to abort a calculation in progress (figure 4B). No report is printed for peaks which have already been integrated.

Report (Prnt/Sv)

After determining peaks for all nuclides in the selected table and any requested unassigned peaks, the **Report** button (figure 4E) is selected to print the sample analysis report. The Report button is labeled **Prnt/Sv** when the Calc Mode is QC. The newly calculated QC results are written to the QC file and, if '# Sum Pg' is greater than zero, a report is printed.

Def Pk

To include unassigned peaks in your report, use the **Def Pk** button *after* peaks for all nuclides in the selected table have been specified (or skipped) and before selecting **Report**. This allows you to set peak integration limits and peak center by the same method as described for peaks assigned to nuclides in the section **Calc** (Calc Mode : NORMAL) (figure 4E). This button can also be used to get a peak area while just displaying a spectrum (figure 4F). Any unassigned peaks which were defined prior to selecting the Calc button are discarded when the Calc button is selected.

Save Pk

The **Save PK** button to the right of the Def Pk button is used to save the results of the unassigned peak

which was specified (figure 4F). They will only be saved if assigned peaks have already been specified as described in the Calc procedure.

Cancel Pk

This is analogous to the Skip Pk button and is used to discard the unassigned peak currently being defined (figure 4F).

Pan

Use the *right* mouse button on **Pan** (center left edge of control panel – figure 4A) to pop up a menu of energy choices which determine the amount to pan the display. Select the desired amount with the *left* mouse button. This value is interpreted as channel number for spectra which are not energy calibrated. For those cases, select a value less than 1000.

<= =>

These buttons are used to actually pan left or right by redrawing the graph with a new starting value of the x axis. This new starting value is obtained by either adding (=>) the value of **Pan** to, or subtracting (<=) from the previous x axis starting value.

Display

To complete the definition of energy range to be graphically displayed, select an energy from **Display** (to the right of **Pan** – figure 4A). This is the number of keV to display.

Y Axis

Your choices for this menu are **AUTO-LOG**, **MAN-LOG**, **AUTO-LIN**, and **MAN-LIN** (figure 4A). It is used to select scaling of the Y axis. If either of the manual modes is selected, then you must enter a value in the **Y Max** field (directly below **Y Axis** – figure 4G) and press the Return key. In the **Man-Log** mode the maximum Y value will be a power of 10 (examples: enter 100, maximum Y = 100; enter 101, maximum Y = 1000). Rounding also takes place in the **Man-Lin** mode (examples: enter 999, maximum Y = 1000; enter 1001, maximum Y = 1200).

Peak Id Delta

In the printed report, possible nuclide matches for either identified or unassigned peaks are listed. The width of the match window is set by the **Peak Id Delta** value (figure 4A). In the printed report, matching nuclides have library energies within plus or minus *delta* keV of the peak center. While a spectrum is being displayed, matches within *delta* keV of the location of the mouse cursor are listed on the **Lib Match** line at the bottom of the control panel.

Nuclide Table

Samples are usually logged with an appropriate nuclide table which is copied into the **Nuclide Table** field (figure 4A) by **ALAN**. You may select any currently defined nuclide table to override the logged nuclide table. Switching to table 0 (the entire nuclide library) is a convenient way to identify unexpected peaks. When selected before analysis begins (Calc button), the nuclide table will remain in effect for the analysis too. This does not change the logged value in the spectrum header.

Mouse KeV, Counts

Whenever the mouse is moved within the graphics area, a continuously updated location is given in the **Mouse KeV, Counts** field (figure 4A). This gives the coordinates of the tip of the arrow (or tip of the wire on the 'mouse cursor'). The value does not update as you move the mouse when either the Num Lock or Caps Lock key is on.

Rprt Prntr

These mutually exclusive push buttons are used to select either the **Epson** (the default), **Laser** printer, or **Screen** for analysis report printing. The entire field, which is normally invisible, appears midway between 'Mouse: KeV, Counts' and 'Options' when **Select Printer** is selected from the **Options** menu. The field disappears again as soon as either button is pushed, hence, you may clear this field from the control panel without changing the value by selecting the darkened choice.

Options

The choices in the **Options** menu are: **Select Printer**, **Final Energy Cal**, **Final Efficiency Cal**, **Laser Hardcopy**, **View QC Data**, **View Pulser Data**, and **View BK Data**.

Select Printer has already been described, but note that this does not effect the graphics hardcopy, which is always printed on the laser printer.

Final Energy Cal is selected after you have analyzed all desired spectra under Calc Mode: EN-CAL. This option allows you to perform a linear regression on the channel/energy values which were saved in the temporary file en-cal-resultsXX. Regression results are written to the file encoefs.XX in the /local/alpha/calibrate directory when the calibration window **SAVE** button is selected.

Final Efficiency Cal is selected after you have analyzed all desired spectra under Calc Mode: EF-CAL. In this case the mean value of efficiency and the calibration uncertainty are calculated and appended to the encoefs.XX file.

Laser Hardcopy Copies the Display Window to the laser printer.

View QC Data pops up a menu of detector numbers (Figure 5A. From which up to four selections may be made.) and then runs the program *xvgr* to display data for the most recent 26 weeks. You may scroll the graph to display older data. If only one detector was selected, then three graphs are displayed: Result Value, FWHM, and FWTM. If more than one detector was selected, then only the Result Value for those detectors is graphed.

View Pulser Data pops up a menu of detector numbers (Figure 5B.) and then runs the program *xvgr* to display data for the most recent 26 weeks. You may scroll the graph to display older data. First, select the number of detectors for which data is to be graphed (either 1 or 4). If 1 was selected, then when the detector is selected, four graphs are displayed: Result Value, Widths (FWHM and FWTM), Peak Location, and Tailing Factor. If the number of detectors was set to 4, specify the detectors then the data type. Data for those detectors is graphed when the data type is selected.

View BK Data pops up a menu of detector numbers (from which up to four selections may be made) and then runs *xvgr* to display data for the most recent 26 weeks. If only one detector was selected, then a full window graph of Counts per hour is displayed. If more than one detector was selected, then the Counts per hour for four detectors are graphed in strip chart fashion.

Lib Match

This is an informative field which is continually updated when the mouse is moved within the graphics region (figure 4B). Nuclides and library energies from the currently selected nuclide table which are near (see **Peak Id Delta** for definition of near) the current mouse position are listed on this line. The nuclides matches are continuously sorted to place the closest match first on the line. The value does not update as you move the mouse when either the Num Lock or Caps Lock key is on.

The following equations are used to calculate the activity of an alpha peak.

$$A_{Bk} = \frac{T_{Sample}}{T_{Bk}} \cdot Bk_{Area} \quad (1.0)$$

$$A_{Net} = A_{Gross} - A_{Bk} \quad (1.1)$$

$$CURESL = 2.71 + 4.65 \cdot \sqrt{A_{Bk}} \quad (1.2)$$

$$E_{RAND} = \begin{cases} \frac{\sqrt{A_{Gross} + A_{Bk}}}{A_{Net}} & \text{for } A_{Net} > CURESL \\ 1 + \frac{\sqrt{\frac{CURESL - A_{Net}}{CURESL}}}{2} & \text{for } A_{Net} \leq CURESL \end{cases} \quad (1.3)$$

$$E_{SYST} = \sqrt{E_{Eff}^2 + E_I^2 + D^2 \cdot E_t^2 + E_L^2} \quad (1.4)$$

$$E_{Total} = E_{RAND} + E_{SYST} \quad (1.5)$$

Where:

T_{Sample} is the live time of the sample spectrum.

T_{Bk} is the live time of the associated background spectrum.

Bk_{Area} is the number of counts in the corresponding region of the background spectrum.

A_{Bk} is the number of counts in the sample peak attributed to background.

A_{Gross} is the summation of counts in the sample peak region of interest.

A_{Net} is the net area of the sample peak.

$CURESL$ is the Currie estimate of limit (area used to calculate minimum detectable activity). (Reference NCRP Report No. 58.)

E_{Rand} is the random uncertainty associated with the peak with 1.0 meaning 100%.

(Note that when $A_{Net} < CURESL$, then E_{Rand} will be greater than 1.0)

E_{SYST} is the systematic uncertainty associated with the peak.

E_{Eff} is the uncertainty associated with the detector efficiency calibration.

E_I is the uncertainty associated with the alpha peak intensity (branching ratio).

D is the natural logarithm of the decay correction factor.

E_t is the uncertainty associated with the nuclide half-life.

E_L is the uncertainty associated with laboratory/sample handling.

Both A_{Net} and $CURESL$ are converted to the required units for reporting by taking into account: dilution factor, spike efficiency, decay correction, peak intensity, live time, and units conversion factor.

When a minimum detectable limit is required (for example when $A_{Net} < CURESL$), the value calculated from $CURESL$ is reported.

Alpha Lisp Window and Icon

```

Alpha LISP
/home/lisp/lv-lisp-app -l /local/alpha/bin/start-alpha.lisp
... Sun Common Lisp, Application Environment 4.0.2, 6 July 1990
... Sun-4 Version for SunOS 4.0.x and sunOS 4.1
...
... Copyright (c) 1985, 1986, 1987, 1988, 1989, 1990
... by Sun Microsystems, Inc., All Rights Reserved
... Copyright (c) 1985, 1986, 1987, 1988, 1989, 1990
... by Lucid, Inc., All Rights Reserved
... This software product contains confidential and trade secret
... information belonging to Sun Microsystems, Inc. It may not be copied
... for any reason other than for archival and backup purposes.
...
... Sun, Sun-4, and Sun Common Lisp are trademarks of Sun Microsystems Inc.

... Loading source file "/local/alpha/bin/start-alpha.lisp"
... Warning: File "/local/alpha/bin/start-alpha.lisp" does not begin with IN-PACKAGE. Loading into package "USE
... Loading binary file "display.sbin"
... Loading source file "spec-appl-config.lisp"
... Warning: File "spec-appl-config.lisp" does not begin with IN-PACKAGE. Loading into package "USER"
... Loading binary file "display-appl.sbin"
... Loading binary file "analyze.sbin"
... Loading binary file "nuc-lib.sbin"
... Loading binary file "display-lv.sbin"
... Reading library file "/lib/libm.a"
... Reading library file "/lib/libc.a"
... Warning: In /lib/libc.a:localtime.o: Redefining foreign-symbol _offtime.
... Warning: In /lib/libc.a:localtime.o: Redefining foreign-symbol _localtime.
... Warning: In /lib/libc.a:localtime.o: Redefining foreign-symbol _gmtime.
... Warning: In /lib/libc.a:localtime.o: Redefining foreign-symbol _tzset.
... Warning: In /lib/libc.a:localtime.o: Redefining foreign-symbol _tzsetwall.
... Warning: The following foreign symbols are undefined: (_Scrn __DYNAMIC _XUseKeymap _xv_block_loop _xv_block_
return _c_read_a_spec _Disp _julday)
... Creating a display for XView ...
... ... Created an XView display on host "", screen 0, server 0.
... Loading binary file "nuc-lib-lv.sbin"
... Loading binary file "disp-appl-lv.sbin"
... Loading foreign object file "c_read.o"
... Loading foreign object file "julday.o"
... Reading library file "/lib/libc.a"
... Reading library file "/lib/libm.a"
... Warning: The following foreign symbols are undefined: (_Scrn __DYNAMIC _XUseKeymap _xv_block_loop _xv_block_
return _Disp)
... Loading source file "/home/gross/lisp-init.lisp"
... Warning: File "/home/gross/lisp-init.lisp" does not begin with IN-PACKAGE. Loading into package "USER"
... Expanding Dynamic Memory
>

```

Spectra Menu and Display Window

Energy List and Library Window

malcolm: Alpha Library and Subtables

Energies

Print)

Table 0

4010.0	TH232
4196.0	U238
4217.0	U235
4396.0	U235
4494.0	U236
4589.0	PU244
4598.0	U235
4617.0	PO209
4639.5	NP237
4664.1	NP237
4687.5	TH230
4736.0	PA231
4775.8	U234
4783.5	U233
4784.5	RA226
4788.1	NP237
4824.2	U233
4845.3	TH229
4868.0	CM247
4873.1	NP237
4882.0	PO209
4900.6	PU242
4901.0	TH229
4950.0	PA231
4978.5	TH229
5011.0	PA231
5052.0	TH229
5078.6	CM248
5155.4	PU239
5168.3	PU240
5190.0	CM250
5263.0	U232
5265.0	CM247
5275.4	AM243
5304.5	PO210
5320.3	U232
5340.5	TH228

Nuclide info **DISPLAY**

Bi211 is only in table 0.

T-Half (days) 1.479E-3 **%Uncert in T-Half** 0.9

Parent U235 **Daughter** Tl207

#	Energy	En Uncert	Intens %	Int Uncert %	Flags
01	6623.1	_0.60	_83.5	_0.24	
02	6278.8	_0.60	_16.2	_1.23	N

Table **(0 Entire Lib)** **Table info** **DISPLAY** **List Energies)**

Bi211	PO215	RN220	AC225	PA231	U238	PU244	CM246	CF251
Bi212	PO216	RN222	TH226	U230	NP237	AM241	CM247	CF252
PO209	PO218	FR221	TH227	U232	PU236	AM243	CM248	
PO210	AT211	RA222	TH228	U233	PU238	CM242	CM250	
PO211	AT217	RA223	TH229	U234	PU239	CM243	CF248	
PO213	RN218	RA224	TH230	U235	PU240	CM244	CF249	
PO214	RN219	RA226	TH232	U236	PU242	CM245	CF250	

Library Subtables

Display Window After Selecting A Spectrum

Display Window After Selecting Calc

BKGRND Calc Mode

EF-CAL Calc Mode

Calc Completed

Unassigned Peaks

Manual Y-Axis

Xvgr Bk and QC Detector Select

Select up to 4 detectors for Bk plot

Plot Bk Data

1	9	17	25
2	10	18	26
3	11	19	27
4	12	20	28
5	13	21	29
6	14	22	30
7	15	23	31
8	16	24	32

Select up to 4 detectors for QC plot

Plot QC Data

1	9	17	25
2	10	18	26
3	11	19	27
4	12	20	28
5	13	21	29
6	14	22	30
7	15	23	31
8	16	24	32

Xvgr QC-PUL Detector Select

Select detector for QC Pulser plot				
#Det	1	4		
1	9	17	25	
2	10	18	26	
3	11	19	27	
4	12	20	28	
5	13	21	29	
6	14	22	30	
7	15	23	31	
8	16	24	32	

Select detectors then Pulser Plot							
#Det	1	4	Plot	WID	ENR	TL	RS
1	9	17	25				
2	10	18	26				
3	11	19	27				
4	12	20	28				
5	13	21	29				
6	14	22	30				
7	15	23	31				
8	16	24	32				

LIBRARY WINDOW

The function of the *Alpha Library & Subtables* window is to display and edit nuclide and subtable information. The library main window (Figure 3) consists of only two sections, a title bar which gives the machine name which is running *ALAN*, and a large control panel. The control panel contains nuclide information display fields, mode and subtable selection menus, and nuclide select push buttons.

List Energies

A separate associated scrollable window appears when the **List Energies** button is selected. This window contains a list (sorted by energy) of all lines for all nuclides of the currently selected table. The list is automatically updated whenever a different table is selected. Select the **Print** button to obtain a hardcopy list of the lines. Output is to the printer specified by the *Display Window Options* menu.

NUCLIDE INFORMATION

Nuclide info

Pressing the right mouse button on the first item, **Nuclide info**, allows you to select between **DISPLAY**, **EDIT_XXXX**, **DELETE_XXXX**, and **ADD_NEW_NUC**, where **XXXX** is the currently selected nuclide.

At the left of the control panel, below **Nuclide info**, is an informative field which lists all subtables which contain the currently selected nuclide. Below this is the half-life and associated uncertainty, which are respectively labeled **T-Half (days)** and **%Uncert in T-Half**.

Parent and **Daughter** nuclides are given below the half-life information. These values are for information only and are not used in any calculation.

The area below parent and daughter lists information for each alpha line of the current nuclide. The five columns of information for each line are: **Energy**, **En Uncrt**, **Intens %**, **Int Uncrt %**, and **Flags**. The primary identification line is first, followed by other lines sorted by intensity. The primary peak is used for calculation, while subsequent peaks are only used for identification of possible nuclide tags. This is indicated by the flag value of 'N' (for no-calc, which is the only legal flag value for alpha lines). To the immediate right of the display area is a scroll slider for use with nuclides which have more alpha lines than can be displayed at one time.

TABLE INFORMATION

Table

The **Table** menu item allows you to select a particular nuclide subtable.

To the right of the **Table** menu is the **Table info** menu. When a table other than table 0 (the entire library) is currently selected, the choices for **Table info** are: **DISPLAY**, **ADD/DELETE-NUC**, **EDIT-TABLE-NAME**, **MAKE-NEW-TABLE**, and **REMOVE-THIS-TABLE**. When table 0 is selected the only **Table info** option is **DISPLAY**.

When **Table info** is **DISPLAY**, nuclide buttons for each nuclide in the current table are enabled for individual selection (Figure 6A). The selected nuclide button becomes darker and data for the selected nuclide is displayed as described above.

When **Table info** is **ADD/DELETE-NUC**, nuclide buttons for the entire library are enabled for multiple selection (figure 6B). By selecting or deselecting nuclide buttons, nuclides are added or removed from the current table. The **Exit Edit** button in the upper right of the library control panel gives you the choice of saving or canceling edits. Alternatively, edits are canceled by selecting **DISPLAY** from the

Table info menu.

When Table info is **EDIT-TABLE-NAME**, a line titled **New Table Name** becomes visible to allow you to type the new name for the table (Figure 6C). Press Return, then the Exit Edit button and select save edit to actually change the table name. Table names may be left blank since they are optional. Table 0's name, 'Entire Library', can not be edited.

When Table info is **MAKE-NEW-TABLE**, the lines titled **New Table Name** and **New Table Number** become visible to allow you to type the name for the new table, and to choose a number for the table (Figure 6D). The default choice for the table number is the lowest unused positive number. Buttons for all nuclides in Table 0 become visible, those which you select will be included in the new table.

When Table info is **REMOVE-THIS-TABLE**, selecting the Exit Edit button (Figure 6E) will give you the choice of deleting the entire table or keeping it. Table 0 can not be deleted.

Table info = DISPLAY

Table info = ADD/DELETE-NUC

malcolm: Alpha Library and Subtables

Nuclide Info ☐ DISPLAY Exit Edit

Pu236 is in tables 0, 1.

T-Half (days) 1.041E+3 %Uncert in T-Half 0.3

Parent Daughter U232

#	Energy	En Uncert	Intens %	Int Uncert %	Flags
01	5770.1	_0.14	100.0	_0.12	

Table ☐ (1 Plutonium Table) Table Info ☐ ADD/DELETE-NUC List Energies

BI211	PO215	RN220	AC225	PA231	U238	PU244	CM246	CF251
BI212	PO216	RN222	TH226	U230	NP237	AM241	CM247	CF252
PO209	PO218	FR221	TH227	U232	PU236	AM243	CM248	
PO210	AT211	RA222	TH228	U233	PU238	CM242	CM250	
PO211	AT217	RA223	TH229	U234	PU239	CM243	CF248	
PO213	RN218	RA224	TH230	U235	PU240	CM244	CF249	
PO214	RN219	RA226	TH232	U236	PU242	CM245	CF250	

Table info = EDIT-TABLE-NAME

malcolm: Alpha Library and Subtables

Nuclide Info ☐ DISPLAY Exit Edit)

Pu239 is in tables 0, 1, 7, 10, 14.

T-Half (days) 8.814E+6 %Uncert in T-Half 0.1

Parent Daughter U235

#	Energy	En Uncert	Intens %	Int Uncert %	Flags
01	5155.4	_1.50	_99.9	_1.00	

New Table Name
Pluto's Table

Table ☐ (1 Plutonium Table) Table Info ☐ EDIT-TABLE-NAME List Energies)

PU236

PU238

PU239

PU242

Table info = MAKE-NEW-TABLE

malcolm: Alpha Library and Subtables

Nuclide Info ☐ DISPLAY Exit Edit

Cf252 is only in table 0.

T-Half (days) 964. %Uncert in T-Half 0.2

Parent Daughter Cm248

#	Energy	En Uncert	Intens %	Int Uncert %	Flags
01	6118.3	0.50	97.0	0.41	
02	6075.7	0.50	15.2	1.97	N

New Table Number 15 ☐ ☐

New Table Name

Table ☐ (1 Plutonium Table) Table info ☐ MAKE-NEW-TABLE List Energies

BI211	PO215	RN220	AC225	PA231	U238	PU244	CM246	CF251
BI212	PO216	RN222	TH226	U230	NP237	AM241	CM247	CF252
PO209	PO218	FR221	TH227	U232	PU236	AM243	CM248	
PO210	AT211	RA222	TH228	U233	PU238	CM242	CM250	
PO211	AT217	RA223	TH229	U234	PU239	CM243	CF248	
PO213	RN218	RA224	TH230	U235	PU240	CM244	CF249	
PO214	RN219	RA226	TH232	U236	PU242	CM245	CF250	

Table info = REMOVE-THIS-TABLE

malcolm: Alpha Library and Subtables

Nuclide Info ☐ DISPLAY

Pu236 is in tables 0, 1.

T-Half (days) 1.041E+3 %Uncert in T-Half 0.3

Parent Daughter U232

#	Energy	En Uncert	Intens %	Int Uncert %	Flags
01	5770.1	_0.14	100.0	_0.12	

Table ☐ (Plutonium Table) Table Info ☐ REMOVE-THIS-TABLE

PU236

PU238

PU239

PU242

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GAMAN

*Gamma Spectra
Analysis*

NAME

GAMAN – Gamma spectrum display, peak analysis, and report program.

INTRODUCTION

This manual assumes a knowledge of (terminology used and a working familiarity with) the windowing system and mouse of the Sun computer workstation. See the appropriate Sun manuals for additional information (for example, chapter one of the *OpenWindows User's Guide* – part # 800-6618-10, or chapters one to three of *Desktop SPARC Sun Systems User's Guide* – part # 800-5703-10). These manuals will probably be of more use if you are sitting at the Sun workstation while reading.

GAMAN, the gamma analysis program, is used to graphically display a spectrum, identify and quantify peaks, and provide a printed sample analysis report. It is normally started as part of your login procedure, but may also be started from the 'NETSPEC Utilities' submenu of the root menu. The root menu is obtained by pushing the right mouse button when the cursor is over the root window (background picture).

Addition of new users is handled by the person who performs systems administration tasks. At the time of adding valid user names to the system, the system administrator must know what authorization level to assign. If your login name is a member of the privileged NETSPEC Unix group, then you have full access to all of *GAMAN*'s features. Any user who is not a member of this privileged group may display and analyze spectra but may neither save backgrounds nor perform calibrations.

Most user interaction with *GAMAN* is by means of push buttons which are activated by the mouse. The action of pushing the left mouse button when the cursor is over an item is called selecting that item. The left mouse button is therefore called the *select* button. The right mouse button is the *menu* button because a limited number of options may be displayed when that button is pressed when the cursor is over an item with a triangle (inverted delta). In this document, names of selectable items are printed in **bold** when they are first mentioned or when emphasis is helpful. In general, items which do not apply to the current context are either disabled or made invisible in order to prevent selection.

ACE/gr is a public domain plotting program used to display QC check source data. Although it is available in both Xview and Motif versions, only the Xview version, *xvgr*, is used on the Sun workstation. For additional information on using the many features of *xvgr*, refer to a separate document, *ACE/gr User's Manual*.

GAMAN displays three windows on your screen: *Gamma LISP*, *Gamma Library & Subtables*, and *Gamma Display*, any or all of which may appear iconified (figures 1 to 3 show both the opened windows and iconified forms). For a brief description of button functionality, press the *Help* key (lower left on keyboard) when the mouse is over an active area of either the *Library* or *Display* windows.

The *Gamma LISP* window is normally of little interest to the user, however, if the *Display* and *Library* windows appear to be dead, check here for error messages. You may Ignore warning messages such as are shown in figure 1, error messages appear after the first '>' prompt. If for some reason you want to exit *GAMAN*, push the right mouse button on either the frame of the *Gamma LISP* window or on the icon and select **Quit** to destroy all three *GAMAN* windows.

DISPLAY WINDOW

The Display Window (figure 2) has several subparts or sections. At the top is the *title bar*. When the triangle at the left corner is selected, the window is closed or iconified. Pressing the left mouse button anywhere else on the title bar will bring the entire window to the 'surface' of the screen. Pressing the right button anywhere on the title bar activates the usual Sun system window menu. Below the title bar is the *control panel* containing informative fields and mouse activated buttons and choice menus which are described later. Below the control panel is a light gray *graphics* area for spectral display. At the bottom of the window is a one line *footer* which gives sample live time. There are four popup windows associated with the Display Window: (1) Select Spectrum menu (figure 2); (2) Graphics, Report, and Calculation Options (figure 4C); (3) Detector select for viewing the QC database (figure 5A); and (4) Peak Edit menu (figure 4B) for deleting peaks from the final report. These popup windows will be described individually.

The *Display Window* may be manually resized by pressing the left mouse button down while the cursor is over the bracket on any corner, then dragging the mouse while continuing to hold the button down.

Since the Display Window is the main window of *GAMAN*, a detailed description of its features follows.

A scrollable menu titled *Select Spectrum* (figure 2) is on a separate popup window associated with the Display Window. This menu is used to select a spectrum file for graphic display. The entire Select Spectrum window will disappear when the pushpin located in the upper left corner is selected. It is brought back by selecting the **Update Menu** button in the upper left corner of Display Window's control panel. The Update Menu button can also be selected to add new spectra files to the menu after they have been created by logging a sample in the *GAMDO* (Gamma Detector Operations) control program window. See the *Gamma Detector Operation (GAMDO) User Guide* for additional information.

The *Select Spectrum* menu lists files from the spectra directory. The menu may contain up to **Max # Files**, although only 34 are visible at any time. The actual number of spectra file items in the menu is given near the upper left corner below the word **Detector**. The scroll slider along the right edge of the Select Spectrum window is used to control which items are visible in the menu. The spectra files are sorted by date and time then by detector number. The Temp-Spectrum.XX files always appear first, followed by the most recent spectra. Within a group of spectra with the same date and time, those with the lowest detector number are first. Spectra file names available in the menu may be limited to a single detector. This is accomplished by pushing the *right* mouse button when the cursor is over the word **Detector**, then selecting the desired detector number. The menu will then list the most recent spectra for only the specified detector. The menu may be reset to list spectra from all detectors by selecting '*' for the detector number. The Select Spectrum window is not resizable.

A spectrum is graphically displayed in the main Display Window by selecting its file name from the *Select Spectrum* menu with the left mouse button. When a spectrum file is selected, additional buttons become visible on the control panel (figure 4A) and the following actions are taken. The title bar of the Display Window is updated to give the machine name which is running *GAMAN*, the spectrum file name, the sample name, and the date and time at which the spectrum file was written. The setting for **Nuclide Table** is taken from the sample header. Spectrum live time is given on the right side of the footer line.

Buttons and choices will be described in the order of position on the control panel from upper left to lower right.

Calc Mode

The **Calc Mode** option is given immediately to the right of the Update Menu button (figure 4A). Possible values are: **NORMAL**, **BKGRND**, **QC**, **WD-CAL**, **EN-CAL**, and **EF-CAL**.

An initial guess for the value of this option is made based on a search for certain keywords in the sample name unless the currently logged in user is not a member of the privileged group. In that case Calc Mode is forced to NORMAL, no keyword search is performed and the other choices are removed from the menu. (This is to prevent unauthorized or inadvertent changes to background, calibration or QC databases.)

The sample name keyword search is insensitive to upper/lower case differences and stops as soon as a match is found. First the sample name is searched for either of the sequences 'background' or 'bkg', if found, Calc Mode becomes BKGRND. Note that the sequences 'backgrnd', 'back ground', etc. do not qualify. Second, if either of the sequences 'quality control' or 'qc' appears in the sample name, then Calc Mode becomes QC. 'Qual con 123.456' does not qualify. Third, if the sample name contains 'energy' AND 'cal' then Calc Mode is set to EN-CAL. These do not need to be in order. Examples of sample names which qualify are: 'check source energy calibration', 'cal energy test', 'California Petroleum and Energy Co.', and 'food calories provide energy'. Fourth, the sample name is searched for 'efficiency' and 'cal', if found, Calc Mode is set to EF-CAL. Finally when all the above tests fail, Calc Mode is set to NORMAL. Note that there is no test for width calibration mode since the same spectra are usually used for both width and energy calibration.

Members of the privileged group can select any Calc Mode for any sample to override the initial setting. Non-members have no choice. The value of Calc Mode has an effect on the behavior of GAMAN. All settings other than NORMAL may result in files being written at the conclusion of calculation. The Calc Mode setting may effect the name and function of some other buttons.

The factor to convert from decays per second to the sample's logged final units is displayed in the lower middle area of the control panel.

In WD-CAL and EN-CAL modes the X-axis is labeled in channel number instead of energy.

Calc

Selecting the Calc button (figure 4A) begins the process of preparing a written report and/or writing background, calibration or QC files. A description will be given for each possible value of Calc Mode.

Calc (Calc Mode : NORMAL)

Selecting Calc when Calc Mode is NORMAL, performs the peak search, baseline, peak fit, MDL, nuclide identification, and weighted average procedures. This entire sequence of calculations normally requires from 3 to 10 seconds depending on spectrum complexity and the number of MDL values requested.

Calc (Calc Mode : BKGRND)

No peaks are assigned in BKGRND mode regardless of the nuclide table setting. The spectrum live time, and peak information (energy, width, counts per second, and CPS uncertainty) are written to a file in the *background* directory. A comparison with results of the most recent previous background is done before writing peak information. If any new peaks have appeared or any peaks are significantly larger than the corresponding peak from the previous background, the operator is notified and given the choice of whether or not to save the new background.

Calc (Calc Mode : QC)

Peak integration is performed for the I129 or Eu152 QC standard the same as a normal peak. Results for key peaks (122, 344, 964, and 1408 keV lines for Eu152 or 30, 34, and 40 keV lines for I129) are appended to the QC file if the values are within three sigma of the mean of the first 15 values previously saved in the QC file. If the results are not within these limits, the operator is given the choice of whether or not to save the new values.

Calc (Calc Mode : WD-CAL)

Peak search and fitting are performed using the width coefficients in effect when spectrum collection was initialized. If there was no width calibration then a constant expected width is used. In either case, if at least two peaks are found which are at least 1000 channels apart, then an estimate of the width coefficients is made based on the first and last good peaks. This estimate is used in rerunning the peak search and fit procedures. Width and centroid channel for peaks found are written to a temporary file. This data can later be combined with width data from other spectra in the final width calibration procedure which is initiated by the **Final Width Cal** selection from the **Options** menu button.

Calc (Calc Mode : EN-CAL)

You need to select a nuclide table which does not include nuclides which are not present in the sample. The **Max # Halflives** setting can be used to ignore short lived nuclides from the selected table. It is acceptable if the sample contains nuclides which are not in the table. The software will ignore nuclides in the table for which the maximum number of halflives has been exceeded. Peak search and fitting are performed using the width coefficients from the disk rather than those in effect at the time of data collection. Before selecting the button, you must set the keV per channel slider to the approximate value. Based on the library energies for the nuclides in the table, and the assumption that the energy calibration is reasonably linear, pattern matching techniques are used to determine which peaks in the spectrum best fit the expected peak separation ratios. The peak centroid value and corresponding library energy are written to a temporary file. Energy calibration is actually completed by combining the temporary results of multiple spectra at a later time by selecting **Final Energy Cal** from the **Options** menu button.

Calc (Calc Mode : EF-CAL)

Like the width and energy calibrations, efficiency calibration is done in two steps. First individual spectra are analyzed and results are saved to a temporary file for the final step. During the analysis of a spectrum, the overall percent uncertainty in the gammas per second rate, and correct value for each peak is entered.

Sum Pg

This selects either 0, 1 or 2 copies of the summary report to be printed. It is visible only after calculation has completed. This setting is related to the Report Print Option, **SUMMARY**, in the following way: Whenever **# Sum Pg** is set to 0, **SUMMARY** is de-selected. Whenever **SUMMARY** is selected, **# Sum Pg** is set to 1.

Enrg Shift

The energy shift value makes a linear adjustment to the energy calibration coefficients for the current analysis so that the peak center is at the correct library energy value. The value of the adjustment in keV is shown in the **Enrg Shift** field (figure 4A). Positive values increase the energy of each peak, while negative values decrease the energy. Adjustment must be made before beginning calculations because the value at that time remains in effect for the duration of the analysis. In addition, all calculation results for the current spectrum are discarded if the value of **Enrg Shift** is changed.

MDL Table

You may select any currently defined nuclide table to specify nuclides for which a Minimum Detection Limit is to be calculated. The calculation result is based on the primary gamma line for each nuclide. If the calculated value is determined to be an actual value rather than a limit, then the value is reported as a real number and no MDL value is calculated.

^

This button makes the Calculation, Graphics, and Report Options window visible.

Re Read Spec

Selection of this button will reread the spectrum data file (figure 4A). This is useful when displaying a spectrum which is still acquiring data. Remember that during acquisition, data is only written every 10 minutes unless Fast Write has been selected in the *GAMDO* program.

Draw

When the graphics needs to be refreshed (occasionally after window resizing) the window menu refresh (right button in title bar) usually suffices. If not, **Draw** should eliminate the problem (figure 4A). **Draw** is used to regenerate the display when graphic display options have been selected or changed.

Report

After determining peaks for all nuclides in the selected table and any requested MDL peaks, the **Report** button (figure 4B) is selected to print the sample analysis report. Additional intermediate information such as peak search table, baseline values, peak fit before and after background correction, and nuclide assignment, etc will be printed if they are selected at the time the report button is activated. If # **Sum Pg** is greater than zero, a summary of nuclide results is printed after the detailed nuclide report.

Pan

Use the *right* mouse button on **Pan** (center left edge of control panel – figure 4A) to pop up a menu of energy choices which determine the amount to pan the display. Select the desired amount with the *left* mouse button. This value is interpreted as channel number for spectra which are not energy calibrated.

<= =>

These buttons are used to actually pan left or right by redrawing the graph with a new starting value of the x axis. This new starting value is obtained by either adding (=>) the value of **Pan** to, or subtracting (<=) from the previous x axis starting value.

Display

To complete the definition of energy range to be graphically displayed, select an energy from **Display** (to the right of **Pan** – figure 4A). This is the number of keV to display.

Y Axis

Your choices for this menu are **AUTO-LOG**, **MAN-LOG**, **AUTO-LIN**, and **MAN-LIN** (figure 4A). It is used to select scaling of the Y axis. If either of the manual modes is selected, then you must enter a value in the **Y Max** field (directly below **Y Axis** – figure 4D) and press the Return key. In the **Man-Log** mode the maximum Y value will be a power of 10 (examples: enter 100, maximum Y = 100; enter 101, maximum Y = 1000). Rounding also takes place in the **Man-Lin** mode (examples: enter 999, maximum Y = 1000; enter 1001, maximum Y = 1200).

Peak Id Delta

In the printed report, possible nuclide matches for either identified or unassigned peaks are listed. The width of the match window is set by the **Peak Id Delta** value (figure 4A). In the printed report, matching nuclides have library energies within plus or minus *delta* keV of the peak center. While a spectrum is being displayed, matches within *delta* keV of the location of the mouse cursor are listed on the **Lib Match** line at the bottom of the control panel.

Nuclide Table

Samples are usually logged with an appropriate nuclide table which is copied into the **Nuclide Table** field (figure 4A) by *GAMAN*. You may select any currently defined nuclide table to override the logged nuclide table. Switching to table 0 (the entire nuclide library) is a convenient way to identify unexpected peaks. When selected before analysis begins (Calc button), the nuclide table will remain in effect for the analysis too. This does not change the logged value in the spectrum header.

Mouse KeV, Counts

Whenever the mouse is moved within the graphics area, a continuously updated location is given in the **Mouse KeV, Counts** field (figure 4A). This gives the coordinates of the tip of the arrow. The value does not update as you move the mouse when either the Num Lock or Caps Lock key is on. Note also that if the spectrum is not energy calibrated and the X axis is labeled in channels, then the mouse keV refers to channel number.

Rprt Prntr

These mutually exclusive push buttons are used to select either the **Epson** (the default), **Laser printer**, or **Screen** for analysis report printing. The entire field, which is normally invisible, appears midway between 'Mouse: KeV, Counts' and 'Options' when **Select Printer** is selected from the **Options** menu. The field disappears again as soon as either button is pushed, hence, you may clear this field from the control panel without changing the value by selecting the darkened choice.

Options

The possible choices in the **Options** menu are: **Select Printer**, **Final Width Cal**, **Final Energy Cal**, **Final Efficiency Cal**, **Laser Hardcopy**, **View QC Data**, and **Unlock Display**.

Select Printer has already been described, but note that this does not effect the graphics hardcopy, which is always printed on the laser printer.

Final Width Cal is selected after you have analyzed all desired spectra under Calc Mode: WD-CAL. This option allows you to perform a regression on the channel/width values which were saved in the temporary file wd-cal-resultsXX. You may select a fit degree of either 0 (horizontal, ie constant width) or 1 (linear). Regression results are plotted in the calibration window (figure 4E) and are written to the file wd-coefs.XX in the gamma/calibrate directory when the calibration window **SAVE** button is selected.

Final Energy Cal is selected after you have analyzed all desired spectra under Calc Mode: EN-CAL. This option allows you to perform a regression (figure 4F) on the channel/energy values which were saved in the temporary file en-cal-resultsXX. Typically, a fit degree of either 1 (linear) or 2 (quadratic) is selected although options up to degree 5 may be available. Regression results are written to the file encoefs.XX in the gamma/calibrate directory when the calibration window **SAVE** button is selected.

Final Efficiency Cal is selected after you have analyzed all desired spectra under Calc Mode: EF-CAL. The previously saved results are plotted on a graph (figure 4G). One, two or three ranges of the spectrum can be specified. The beginning and ending energy of the ranges is changed by adjusting the values of **R1 Ends** and **R2 Ends**. The degree of fit for each range is selected from available choices of **R1 Fit Degree**, **R2 Fit Degree**, and **R3 Fit Degree**. Adjust these values until a satisfactory calibration curve is obtained. Fit quality for each range, a number from 0.0 to 1.0, indicates how far the actual data points are from the calculated curve. The % discontinuity between ranges indicates the size of the gap between the curves for each range; small values are best. Select the **SAVE** button to write the efficiency coefficients and calibration uncertainty to the eff.XX file in the gamma/calibrate directory.

Laser Hardcopy Copies the Display Window to the laser printer.

View QC Data pops up a menu of detector numbers (Figure 5A. From which a selection is made.) and then runs the program *xvgr* to display data for the most recent 26 weeks (figure 5B). You may scroll the graph to display older data. The graphs display results for the 122, 344, 964, and 1408 keV lines of Eu152 (or the 30, 34, and 40 keV lines of I129 for LEPS detectors). The first 15 data values for each energy are used to determine the mean and ± 3 sigma deviations which are indicated by the dashed horizontal lines. These horizontal lines extend to the left to the efficiency calibration date for geometry 10, and to the right to the current date.

Unlock Display is used when unforeseen problems prevent calculations from completing. You will need to check the **Lisp Window** and enter the number indicated to restart, then select **Unlock Display** to enable analysis of other spectra. Note the offending spectrum and report the problem to the programmer.

Lib Match

This is an informative field which is continually updated when the mouse is moved within the graphics region (figure 4B). Nuclides and library energies from the currently selected nuclide table which are near (see **Peak Id Delta** for definition of near) the current mouse position are listed on this line. The nuclides matches are continuously sorted to place the closest match first on the line. The value does not update as you move the mouse when either the Num Lock or Caps Lock key is on.

Graphics, Report, & Calc Options Window

This popup window (figure 4C) is not visible when a spectrum is loaded for display. To activate the window, select the ^ button (upper right corner of the display window). The window is used to set various display, calculation, and report print options. Select the pushpin in the upper left corner to dismiss the window. Option categories are graphic, print information, and calculation (includes use disk coefficients, and settings for peak search sensitivity and maximum halfives). Print options are inactive until after calculations have been completed. Changes to Graph Draw Options and maximum halfives remain in effect after loading subsequent spectra, while all other options are cleared whenever a new spectrum is loaded.

Graph Draw Options

Except for BKGRND, These display options graphically depict calculation results.

PK-DETECT graphs the value of the peak detect function as a black line. Whenever the value of the peak detect function is greater than the peak search sensitivity, a possible spectral feature is indicated and the channel at the nearest maximum point is placed in the peak search table for use by the baseline and peak fitting functions.

PK-SEARCH Draws a green vertical line at the location of each channel in the peak search table. The height of the line is the value of the peak detect function at that channel.

BASELINE draws a green line representing the continuum in the region surrounding possible peak locations. It plots the points of the value of channel minus baseline as either small purple plus signs in the region to be used for peak fitting, or small green squares outside of the fit region.

FIT draws a Gaussian representing the fit function. When the Y axis scaling is logarithmic the curve is a parabola. The curve is purple for a normal fit and dark gray for both abnormal and MDL fits.

BKGRND can be used before calculation has been initiated. It draws red peaks to indicate the portions of the spectrum which are contributed by background peaks. The area above the red line and below the blue spectrum line represents activity in the sample. When visually evaluating this area, it may be helpful to use linear Y axis scaling.

Load Coefficients From File

Each of these selections reads the current coefficients from disk rather than using those which were in effect at the time of spectrum acquisition. This does not modify the spectrum header. Deselection restores the values to those from the spectrum header.

Report Print Options

Various intermediate calculation results may be printed by selecting as many of these options as desired. Any of these which are highlighted when the **Report** button is selected will cause additional data to be included in the report printed to the currently selected printer (Epson, Laser, or Screen). Each print option is described below.

PK-SEARCH prints the table of channels at which possible features of interest have been detected.

BASELINE produces a long listing of the channel and baseline (continuum) values calculated for each channel in regions surrounding each value in the search table.

FIT prints information for each peak which was successfully fit to a Gaussian. The information includes energy, FWHM, centroid, area, and their associated uncertainties, as well as values for chi (goodness of fit) and a flag indicating the type of fit.

LIM-ENRG prints a list of energies for which either a normal fit was not possible or an MDL value is required.

LESS-THAN prints energy, energy uncertainty, FWHM, centroid, area, area % uncertainty, MDL area, and type of fit flag for each energy in LIM-ENRG list.

BKG-COR prints peak information after background correction has been performed. When normal fit peaks become limits after background subtraction, the MDL area is given. Output format is the same as FIT and LESS-THAN formats with additional flag values possible.

ISO-PKS prints energy, nuclide, line predominance, counts per second (CPS), CPS % uncertainty, MDL-CPS (if applicable), % branching ratio, decay correction factor, detector efficiency, and fit flag for each peak which could possibly be assigned to a nuclide in the current table.

UNASSIGN prints peak information for each peak which could not be assigned to a particular nuclide. Output format is the same as FIT and LESS-THAN formats with additional flag values possible.

CLEAN-RES outputs the same format as ISO-PKS except it only lists peaks for which nuclide assignment is actually made.

FINAL-RES lists the final results for each nuclide, including a weighted average value and individual values for each line.

FLAG-DEFS Prints a definition of each peak flag value which appears for peaks listed from selected print options.

SUMMARY Prints a customer summary page (one line per nuclide) of final results. Either one or two copies are printed, depending on the current value of # Sum Pg, which is set to 1 when SUMMARY is selected.

Pk Search Sens

The slider is used to set the peak search sensitivity. This is the threshold value for detecting spectral features. Lower values are more sensitive and high values are less sensitive. A value of 8 or 9 is suggested for normal use. a value of 30 or more can be used to reduce the number of peaks detected when the only peaks of interest are large.

Max # Halfives

The slider is used to set the maximum number of halfives permitted to have elapsed since the decay correction T-zero. Nuclides for which this number of halfives have been exceeded will not be identified even if they are in the MDL list. The normal range for this setting is 8 to 12.

Report Edit Menu

This menu (figure 4B) appears at the conclusion of normal calculations. It allows the operator to remove specific lines or entire nuclides from the final report. There are only two active areas on this window: the menu itself and the **Done** button.

The menu contains an entry for each gamma line which will be in the final report. Each entry includes the nuclide name, energy, library energy, final result value, %uncertainty, fit flag, and predominance. It is possible that a menu entry for a particular nuclide may be an outlier which is not used in determining the weighted average value to report for the nuclide. This is indicated by a flag value of 512 or the sum of 512 and any of the numbers 1, 2, 4, 8, 16, and 256. Lines for the same nuclide are grouped together with a blank line between different nuclides. Since the primary line (predominance 1) is required for nuclide identification, all lines for the given nuclide are automatically deleted whenever the primary is selected. Enabling the primary line does not automatically reinstate the other lines for the nuclide.

When the menu is in the desired configuration, select the **Done** button. You may preview the report by selecting **Screen** for the printer and then selecting the **Report** button. Repeat the edit/preview cycle as many times as necessary (remember to select the **Report Edit Menu's Done** button each time). Finally select the desired hardcopy printer before printing the report.

Process Overview

This section of the manual is intended to convey an overview of the spectral analysis process which is performed as a result of selecting the Calc button. The first step is to determine the location of photo-peaks. Next is a determination of the baseline (continuum) at the local area of possible peaks. This is followed by the process of fitting a Gaussian curve to the singlet or multiplet peaks. At this point, minimum detection limits (MDL) values are calculated for energies where no peaks are present but for which a request has been made. Background correction is then performed to subtract count rates of peaks which were identified in a previously collected background spectrum. Assignment of nuclides in the library to the determined peaks is then carried out before the final step of calculating a single value for each nuclide taking into account a weighted average and decay correction. Each step is described individually below.

Peak Detection

The peak search algorithm is a cross correlation of the square root of spectral data with a zero area square wave. The wavelength of the square wave is an integer number of channels based on the expected peak width determined during width calibration. The square wave is propagated through the square root of the spectrum two times, first using the expected width and again using one channel greater than the expected width. The correlation value for each channel is the maximum value from each pass. The correlation value can be graphically viewed by selecting PK-DETECT under Graph Draw Options.

Whenever the correlation value is at a local maximum and greater than the threshold sensitivity value set by Pk Search Sens, and is sufficiently far from the previously detected peak, the possibility of a peak is noted. Such positions are displayed graphically by drawing a vertical line when PK-SEARCH of Graph Draw Options is selected. The height of the line is equal to the correlation value.

Baseline Determination

A baseline is determined for each peak region which was found by the peak detection process. Peaks are taken either individually or as multiplets depending on their separation. The baseline is a smoothed step function drawn between a point on the high side of the region to a point on the low side of the region. A step proportional to peak area and the slope of a line connecting the high and low points is centered under each peak in the region. The baseline values (representing the spectrum continuum) are subtracted from the raw spectrum to get residual values used to fit peaks. The derived baseline and residual points are plotted when Baseline is selected from Graph Draw Options. Plus signs indicate the points which will be used in the fitting process, while small squares indicate points outside of the fit region.

Nonlinear Fitting

A nonlinear fitting of a Gaussian function to peaks in each region is carried out using the residual values after baseline subtraction. The fitting process minimizes the sum of the squares of the deviations of data from the a computed Gaussian function. A value for the uncertainty in the area is also calculated. The fit curve is graphically displayed with a solid line when FIT is selected from Graph Draw Options.

Minimum Detection Limit

A linear fitting of a Gaussian function using a linear baseline is performed to determine minimum detection limits for requested nuclides when no peak was found at the required energy. Requested nuclides are specified by selecting a table of nuclides for MDL Table. The linear fit is also used for regions where the nonlinear fit was attempted but failed (these are referred to as *abnormal* peaks). Linear fit peaks are displayed with a broken line when FIT is selected from Graph Draw Options.

Background Correction

A separately collected 'blank' spectrum is periodically acquired in order to account for peaks which are attributed to environmental conditions at the detector. During normal spectral analysis if the energy of a peak matches the energy of a background peak, the appropriate background counts per second is subtracted from the determined peak. A peak matches a background peak when the difference in their energies is not more than the operator selectable value of **Peak Id Delta**.

The background subtraction process combines the uncertainty of the determined peak and the uncertainty of the background peak as well as correcting the peak area. When the resultant area becomes too small, the peak is reported as an upper limit.

Nuclide Assignment

The library of radionuclides which is specified by the value of **Nuclide Table** is screened to remove those nuclides for which the number of half-lives exceeds the value specified by **Max # Half-lives**. The table is then searched for energies which match each determined peak. The value of **Peak Id Delta** determines how close the energies must agree. It is possible that more than one nuclide has a gamma line which matches a peak. All possible matches are collected into a candidate list. If more than one spectrum peak matches the same library entry, only the peak nearest in energy to the library value is assigned to the nuclide.

Each nuclide in the library has one distinctive gamma line which is required to be present before the nuclide will be identified. This line is called the *primary* line. Other lines for the nuclide are referred to as *secondary* lines. After taking account of the different branching ratios for each line, the detector efficiency at the energy of each line, and the decay correction, a resultant value for each line of a nuclide is calculated. The calculated values are then combined using weighting factors based on the peak area uncertainty and whether the line is primary or secondary.

The following equations are used to calculate areas and uncertainties of normal gamma peaks based on the nonlinear fit procedure:

$$Area = W \cdot H \cdot \sqrt{\frac{\pi}{4 \ln 2}} \quad (1.0)$$

where W is the gaussian width at half maximum, and H is the gaussian height.

$$\%Uncertainty(Area) = 100 \cdot \frac{\sqrt{s^2(Area)}}{Area} \quad (1.1)$$

where $s^2(Area)$ is the estimated variance of the area (refer to *VAXGAP: A Code for the Routine Analysis of Gamma-Ray Pulse-Height Spectra on a VAX Computer* EG&G-2533 May 1988, page 10, for additional explanation).

A linear baseline fit procedure is used for determining MDL (minimum detection limit) values when peaks are not present in the spectrum. In this case the area is given by equation (1.0) where the width is the expected width at the peak location based on the width calibration equation. The uncertainty in the area is:

$$Uncertainty(Area) = \sqrt{\frac{\pi}{4 \ln 2}} \cdot m \cdot \chi \quad (1.2)$$

where m is derived from the appropriate minor of the inverse matrix for the gaussian height variable, and χ is the square root of the sum of the squares from the residuals divided by the number of channels in the fit. If the uncertainty of the area is greater than 12% or if the area is negative, the peak is reported as an MDL.

$$MDL = 4 \cdot Uncertainty(Area). \quad (1.3)$$

The values for multiple lines of a single nuclide are combined to give a weighted average by

$$\bar{X} = \frac{\sum_{i=1}^n w_i x_i}{\sum_{i=1}^n w_i}, \text{ where } n \text{ is the number of lines, } x_i \text{ is the value for line } i, \text{ and the weighting factor for}$$

line i is $w_i = \frac{1}{\sigma_i^2 \cdot P}$, where P is the line's predominance: 1 for the primary line and 2 for all other lines, and σ_i^2 is the variance in the value x_i . The reduced chi-squared is computed to be used as an

outlier criterion, $\chi^2 = \frac{1}{DF} \cdot \sum_{i=1}^n \left(\frac{x_i - \bar{X}}{\sigma_i} \right)^2$, where DF , the degrees of freedom, is either the number

of peaks, n , when $n > 3$ or $n-1$ when $n = 2$ or 3. When χ^2 is greater than 5.0, the peak with the

greatest deviation, $\left(\frac{x_i - \bar{X}}{\sigma_i} \right)^2$, is rejected as an outlier, and the weighted average is recalculated using the remaining peaks.

Peak areas and MDLs are converted to the required units for reporting by taking into account: branching intensity, detector efficiency, live time, and as appropriate, decay correction, dilution factor, and units conversion.

Gamma Lisp Window and Icon

GAMAN (NETSPEC)

Gamma Analysis User Guide – Figure 1

GAMAN (NETSPEC)

```

Gam LISP
::: Copyright (C) 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992 by Lucid, Inc.
::: All Rights Reserved
:::
::: This software product contains confidential and trade secret information
::: belonging to Lucid, Inc. It may not be copied for any reason other than
::: for archival and backup purposes.
:::
::: Lucid and Lucid Common Lisp are trademarks of Lucid, Inc. Other brand
::: or product names are trademarks or registered trademarks of their
::: respective holders.
:::
::: Loading source file "/local/gamma/bin/start-gamma.lisp"
::: Warning: File "/local/gamma/bin/start-gamma.lisp" does not begin with IN-PAC
KAGE. Loading into package "USER"
::: Expanding Dynamic Memory
::: Disabling ephemeral garbage collection.
::: Enabling ephemeral garbage collection.
::: Loading source file "spec-appl-config.lisp"
::: Warning: File "spec-appl-config.lisp" does not begin with IN-PACKAGE. Loadi
ng into package "USER"
::: Loading binary file "display.sbin"
::: Loading binary file "display-appl.sbin"
::: Loading binary file "analyze.sbin"
::: Loading binary file "limfit.sbin"
::: Loading binary file "report.sbin"
::: Loading binary file "nuc-lib.sbin"
::: Loading binary file "display-lv.sbin"
::: Reading library file "/lib/libm.a"
::: Reading library file "/lib/libc.a"
::: Warning: The following foreign symbols are undefined: (_Scrn _XUseKeymap _c_read_a_spec _xv_block_loop
_Dispatch _julday _xv_block_return)
::: Creating a display for XView ...
::: ... Created an XView display on host "", screen 0, server 0.
::: Loading binary file "nuc-lib-lv.sbin"
::: GC: 128970 words [515880 bytes] of dynamic storage in use.
::: 722996 words [2891984 bytes] of free storage available before a GC.
::: 1574962 words [6299848 bytes] of free storage available if GC is disabled.
::: Loading binary file "disp-appl-lv.sbin"
::: Reading library file "/lib/libm.a"
::: Reading library file "/lib/libc.a"
::: Warning: The following foreign symbols are undefined: (_Scrn _XUseKeymap _c_read_a_spec _xv_block_loop
_Dispatch _julday _xv_block_return)
::: Loading foreign object file "c_read.o"
::: Loading foreign object file "julday.o"
::: Reading library file "/lib/libc.a"
::: Reading library file "/lib/libm.a"
::: Warning: The following foreign symbols are undefined: (_Scrn _XUseKeymap _xv_block_loop _Dispatch _xv_bloc
k_return)
::: Loading source file "spot-help.lisp"
::: Warning: File "spot-help.lisp" does not begin with IN-PACKAGE. Loading into package "USER"
>

```

Last change: December 1993

Gamma Spectra Menu, Display Window and Icon

malcolm: Gamma Library and Subtables

Nuclide info ☐ DISPLAY

Be7 is only in table 0.

T-Half (days) 53.4 %Uncert in T-Half 0.2

Parent Daughter

#	Energy	En Uncert	Intens %	Int Uncert %	Flags
01	_477.6	_0.01	_10.4	_1.73	

Table ☐ (0 Entire Library) Table info ☐ DISPLAY List Energies ☐

BE7	MN54	KR88	MO99	SB124	I130	CS136	CE143	W187	BI211	TH227	NP238
NA22	MN56	RB88	TC95	SB125	I131	CS137	CE144	RE188	BI212	TH228	NP239
NA24	FE55	SR85	TC95M	SB126	I132	CS138	PR144	AU198	BI213	TH229	PU237
MG28	FE59	SR91	TC99M	TE125	I133	BA131	ND147	AU199	BI214	TH230	AM241
AL26	CO56	SR92	RU103	TE129	I134	BA133	PM143	HG203	RN219	TH232	AM243
AL28	CO57	Y88	RU106	TE131	I135	BA133M	PM148	TL201	FR221	TH234	
CL38	CO58	Y91	AG110M	TE132	XE127	BA139	EU152	TL202	FR223	PA231	
AR41	CO60	Y91M	CD109	TE133	XE131M	BA140	EU154	TL207	RA223	PA233	
K40	NI65	Y92	IN115M	TE134	XE133	BA142	EU155	TL208	RA224	PA234	
K42	ZN65	ZR95	SN113	I125	XE133M	LA140	GD153	TL210	RA225	U234	
SC46	AS76	ZR97	SN119	I126	XE135	LA142	HF175	PB211	RA226	U235	
CR51	SE75	NB95	SN121M	I128	CS126	CE139	HF181	PB212	AC225	U237	
MN52	KR85	NB97	SB122	I129	CS134	CE141	TA182	PB214	AC228	NP237

Gamma Display Window After Selecting Spectrum

Gamma Display Window and Report Edit Menu after Calc

Gamma Display with Baseline and Fit Options

Set options before selecting corresponding Draw, Report, or Calc button.

Final Width Calibration

GAMAN (NETSPEC)

Gamma Analysis User Guide - Figure 4E

GAMAN (NETSPEC)

Last change: December 1993

Final Energy Calibration

Final Efficiency Calibration

GAMAN (NETSPEC)

Gamma Analysis User Guide - Figure 4G

GAMAN (NETSPEC)

QC Graph Detector Select

Select detector for QC plot	
1	9
2	10
3	11
4	
5	
6	
7	
8

LIBRARY WINDOW

The function of the *Gamma Library & Subtables* window is to display and edit nuclide and subtable information. The library main window (Figure 3) consists of only two sections, a title bar which gives the machine name which is running *GAMAN*, and a large control panel. The control panel contains nuclide information display fields, mode and subtable selection menus, and nuclide select push buttons.

List Energies

A separate associated scrollable window appears when the **List Energies** button is selected. This window contains a list (sorted by energy) of all lines for all nuclides of the currently selected table. The list is automatically updated whenever a different table is selected. Select the **Print** button to obtain a hardcopy list of the lines. Output is to the printer specified by the *Display Window Options* menu.

NUCLIDE INFORMATION

Nuclide info

Pressing the right mouse button on the first item, **Nuclide info**, allows you to select between **DISPLAY**, **EDIT_XXXX**, **DELETE_XXXX**, and **ADD_NEW_NUC**, where **XXXX** is the currently selected nuclide.

At the left of the control panel, below **Nuclide info**, is an informative field which lists all subtables which contain the currently selected nuclide. Below this is the half-life and associated uncertainty, which are respectively labeled **T-Half (days)** and **%Uncert in T-Half**.

Parent and **Daughter** nuclides are given below the half-life information. These values are for information only and are not used in any calculation.

The area below parent and daughter lists information for each gamma line of the current nuclide. The five columns of information for each line are: **Energy**, **En Uncrt**, **Intens %**, **Int Uncrt %**, and **Flags**. The primary identification line is first, followed by other lines sorted by intensity. The primary peak is required for identification and quantification, while subsequent peaks are used but not required both for quantification and identification of possible nuclide tags. A flag value of 'N', for no-calc, denotes lines which only indicate possible tag identification and are not used in quantification. A flag value of 'X' signifies that this line is an x-ray. To the immediate right of the display area is a scroll slider for use with nuclides which have more gamma lines than can be displayed at one time.

TABLE INFORMATION

Table

The **Table** menu item allows you to select a particular nuclide subtable.

To the right of the Table menu is the **Table info** menu. When a table other than table 0 (the entire library) is currently selected, the choices for Table info are: **DISPLAY**, **ADD/DELETE-NUC**, **EDIT-TABLE-NAME**, **MAKE-NEW-TABLE**, and **REMOVE-THIS-TABLE**. When table 0 is selected the only Table info option is **DISPLAY**.

When Table info is **DISPLAY**, nuclide buttons for each nuclide in the current table are enabled for individual selection (Figure 6A). The selected nuclide button becomes darker and data for the selected nuclide is displayed as described above.

When Table info is **ADD/DELETE-NUC**, nuclide buttons for the entire library are enabled for multiple selection (figure 6B). By selecting or deselecting nuclide buttons, nuclides are added to or removed from the current table. The **Exit Edit** button in the upper right of the library control panel gives you the choice of saving or canceling edits. Alternatively, edits are canceled by selecting **DISPLAY** from

the Table info menu.

When Table info is **EDIT-TABLE-NAME**, a line titled **New Table Name** becomes visible to allow you to type the new name for the table (Figure 6C). Press Return, then the Exit Edit button and select save edit to actually change the table name. Table names may be left blank since they are optional. Table 0's name, 'Entire Library', can not be edited.

When Table info is **MAKE-NEW-TABLE**, the lines titled **New Table Name** and **New Table Number** become visible to allow you to type the name for the new table, and to choose a number for the table (Figure 6D). The default choice for the table number is the lowest unused positive number. Buttons for all nuclides in Table 0 become visible, those which you select will be included in the new table.

When Table info is **REMOVE-THIS-TABLE**, selecting the Exit Edit button (Figure 6B-D) will give you the choice of deleting the entire table or keeping it. Table 0 can not be deleted.

Library with Table Info : DISPLAY

malcolm: Gamma Library and Subtables

Nuclide Info

DISPLAY

Sb125 is in tables 0, 2, 7, 10, 20.

T-Half (days)

1.012E+3

%Uncert in T-Half

1.4

Parent

Daughter

Te125m

#	Energy	En Uncert	Intens %	Int Uncert %	Flags
01	427.9	0.02	29.3	0.85	
02	27.4	0.00	92.3	1.62	XN
03	600.6	0.02	17.8	1.69	
04	635.9	0.02	11.3	1.77	
05	463.4	0.01	10.3	1.74	
06	31.0	0.00	8.3	6.02	XN
07	176.3	0.01	6.9	3.19	
08	606.6	0.02	5.0	1.79	
09	35.5	0.00	4.2	3.61	N
10	671.4	0.02	1.8	1.66	
11	380.4	0.02	1.5	1.67	

List Energies

Table

(20)

Table info

DISPLAY

K40	SB124
SC46	
CR51	CS134
MN54	CS137
FE59	CE141
CO58	CE144
CO60	EU152
ZN65	EU154
ZR95	EU155
NB95	HF181
RU103	TA182
RU106	HC203
AG110M	AM241

Library with Table Info : ADD/DELETE-NUC

malcolm: Gamma Library and Subtables

Nuclide info Sb125

Exit Edit

Sb125 is in tables 0, 2, 7, 10, 20.

T-Half (days) 1.012E+3 %Uncert in T-Half 1.4

Parent Daughter Te125m

#	Energy	En Uncert	Intens %	Int Uncert %	Flags
01	427.9	0.02	29.3	0.85	
02	27.4	0.00	92.3	1.62	XN
03	600.6	0.02	17.8	1.69	
04	635.9	0.02	11.3	1.77	
05	463.4	0.01	10.3	1.74	
06	31.0	0.00	8.3	6.02	XN
07	176.3	0.01	6.9	3.19	
08	606.6	0.02	5.0	1.79	
09	35.5	0.00	4.2	3.61	N
10	671.4	0.02	1.8	1.66	
11	380.4	0.02	1.5	1.67	

Table 20 Table info ADD/DELETE-NUC List Energies

BE7	KR88	MO99	I130	CS136	CE143	W187	BI211	TH227	NP238
NA22	MN56	RB88	TC95	I131		RE188	BI212	TH228	NP239
NA24	FE55	SR85	TC95M	SB126	I132	CS138	PR144	AU198	BI213
MC28	SR91	TC99M	TE125	I133	BA131	ND147	AU199	BI214	TH230
AL26	CO56	SR92	TE129	I134	BA133	PM143	RN219	TH232	AM243
AL28	CO57	Y88	TE131	I135	BA133M	PM148	TL201	FR221	TH234
CL38	Y91	TE132	XE127	BA139		TL202	FR223	PA231	
AR41	Y91M	CD109	TE133	XE131M	BA140		TL207	RA223	PA233
	NI65	Y92	IN115M	TE134	XE133	BA142	TL208	RA224	PA234
K42		SN113	I125	XE133M	LA140	GD153	TL210	RA225	U234
	AS76	ZR97	SN119	I126	XE135	LA142	HF175	PB211	RA226
	SE75	SN121M	I128	CS126	CE139		PB212	AC225	U237
MN52	KR85	NB97	SB122	I129			PB214	AC228	NP237

Library with Table Info : EDIT-TABLE-NAME

malcolm: Gamma Library and Subtables							Exit Edit
Nuclide info							
Sb125 is in tables 0, 2, 7, 10, 20.							
T-Half (days)		1.012E+3	%Uncert in T-Half		1.4		
Parent	Daughter		Te125m				
#	Energy	En Uncert	Intens %	Int Uncert %	Flags		
01	427.9	0.02	29.3	0.85			
02	27.4	0.00	92.3	1.62	XN		
03	600.6	0.02	17.8	1.69			
04	635.9	0.02	11.3	1.77			
05	463.4	0.01	10.3	1.74			
06	31.0	0.00	3.3	6.02	XN		
07	176.3	0.01	6.9	3.19			
08	606.6	0.02	5.0	1.79			
09	35.5	0.00	4.2	3.61	N		
10	671.4	0.02	1.8	1.66			
11	380.4	0.02	1.5	1.67			
Table info (26) Table info EDIT-TABLE-NAME List Energies							
K40	SB124						
SC46	SB125						
CR51	CS134						
MN54	CS137						
FE59	CE141						
CO58	CE144						
CO60	EU152						
ZN65	EU154						
ZR95	EU155						
NB95	HF181						
RU103	TA182						
RU106	HC203						
AC110M	AM241						

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Archive

File Backup and Restore

NAME

ARCHIVE – Alpha/Gamma spectroscopy system data archival system

INTRODUCTION

This manual assumes a knowledge of (terminology used and a working familiarity with) the windowing system and mouse of the Sun computer workstation. See the appropriate Sun manuals for additional information (for example, chapter one of the *OpenWindows User's Guide* – part # 800-6618-10, or chapters one to three of *Desktop SPARC Sun Systems User's Guide* – part # 800-5703-10). This manual will probably be of more use if you're sitting at the Sun workstation while reading.

ARCHIVE is a utility to manage the backup and restoration of data files associated with the alpha and gamma spectroscopy systems using rewritable optical disk media. Part of the backup process includes the purging of old spectra files. It is accessed through the 'NETSPEC Utilities' submenu of the root menu. The root menu is obtained by pushing the right mouse button when the cursor is over the root window (background picture).

Most user interaction with *ARCHIVE* is by means of mouse manipulation of screen items such as buttons, checkboxes, and sliders. The action of pushing the left mouse button when the cursor is over an item is called selecting that item. The left mouse button is therefore called the *select* button. The right mouse button is the *menu* button because a limited number of options may be displayed when that button is pressed when the cursor is over an item with a triangle (inverted delta). In this document, names of selectable items are printed in **bold** when they are first mentioned or when emphasis is helpful. In general, items which do not apply to the current context are either disabled or made invisible in order to prevent selection.

MAIN WINDOW

When the program is first started, the main window will appear configured for *Backup* mode resembling figure 1 (see discussion of Backup Mode below). The mode is indicated and changed through the **Mode** selector in the upper left-hand corner of the window. This selector can be changed anytime it is not inactive.

There is only one window for this program, but its contents will completely change depending on what mode (*Backup* or *Restore*) is currently selected. Messages of an informational nature are always displayed in the lower left-hand corner of the window.

Backup Mode

To perform a file backup (it is recommended that this be done on a weekly basis) select *Backup* mode and then press the **Begin Backup** button at the top of the window.

First, the program will purge old spectra from the alpha and gamma directories to remove clutter from the Sun hard disks. This is done by scanning both the spectra and background file directories for alpha and gamma systems. In the spectra directories, all files other than the most recent 200 for each detector (as determined by the date reflected in the file name) are deleted. For the background directories, the limit is 50 files per detector. Status messages (which may appear only briefly) will indicate how many files were removed from each directory.

After the purge is done, all directories listed for backup will be scanned. Any file which has a modification date later than that of the last backup is added to the list of files to save. The current scan directory is shown at the bottom of the window.

When the list is built, the screen will show the total number of files and their total size in the appropriate spaces. The user is then prompted for the current optical disk cartridge. Get the optical disk marked with the number indicated, insert it into the REO-130 drive, and tell the Sun to continue. Files should then be written to optical disk, with the name of each file shown on the status line. Each file is compressed as it is written to the optical disk, increasing by many times the number of files that can be stored.

Should the optical disk run out of room, the disk will be ejected and the user prompted for the next numbered disk. Get that disk from the safe (it should have already been prepared by the system administrator), insert it, and continue. The process should continue as before.

After all files have been written, the disk is ejected and the process is completed. A message should indicate success. Only if the whole backup is done normally will the last backup time be updated.

Restore Mode

When *Restore* mode is selected for the first time, the window will change to resemble figure 2. Use the two selectors (Alpha/Gamma and Spectra/Background/Calibration/QC) to pick what kind of file to retrieve. Then the file name can be typed in the field marked *File to Retrieve*. Example file names for each type of file will be shown on the screen below this field.

In the case an exact file name is not known, a 'wildcard' facility is provided. This is especially useful for spectra files. The asterisk ('*') is a positional wild card--this means that wherever an one appears, that character will match anything.

For example:

'1992-0101-****.01' matches all spectra files for the first of January for detector one.

'1992-01**-1235.05' matches all spectra files for detector five, in the month of January, 1992, started at 12:35pm.

'1992-0101-*.02' wouldn't match anything because one asterisk will not replace four characters.

After the name is entered, press the **Scan for file** button to search the online database of all files written to optical disk. All matches to the search file name and type will be listed in the scrolling list in the bottom half of the window.

Note that there may be multiple occurrences of the same file name. This indicates that file has changed between backups, which caused it to be saved again. That is why the *Backup Time/Disk* field is given in the scrolling list, to help the user decide what version of the file is desired.

To do the actual retrieval from optical disk, select the desired file on the list and press the **Get Selected File** button. The proper optical disk will be prompted for if it's not already in the REO-130 optical drive.

Attempting to retrieve calibration or QC files will prompt a warning of the delicacy of these files at this point. If not sure of the effects of restoring these files, speak to the system administrator first.

File restoration Example

Figure 3 depicts an example restoration of an Alpha Spectra. The user has typed '1992-04***.01' for the file name, which means all of detector one's alpha spectra for the month of April, 1992 were listed when the **Scan for file** button was pressed.

Of the files presented in the list, the one chosen is file '1992-0403-1439.01'. Looking at the right column, we see that this file was saved to optical disk on 7/10/92, at about 7:43 in the morning on disk number one. Pressing the **Get Selected File** button would then get the file. Multiple retrievals from that same list are also possible.

FILES

/local/alpha+gamma/archive/backup_dirs	- List of directories to backup
/local/alpha+gamma/archive/diskdata	- Time of last backup
/local/alpha+gamma/archive/index	- Directory of index files

Archive Backup Mode

Archive Restore Mode

Alpha/Gamma Archive Control Panel

Mode: **Alpha/Gam**

Archive

File to Retrieve: _____
For Example: 1989-0624-1335.05 or
1989-0624-****.05 for search

File Directory	File To Restore	Backup Time/Disk

Restoring An Archive File

Alpha/Gamma Archive Control Panel

Mode: **Backup** **Restore**

Alpha **Spectra**
Gamma **Background**
QC **Calibration**

File to Retrieve: 1992-04**-****.01
 For Example: 1989-0624-1335.05 or
 1989-0624-****.05 for search

File Directory	File To Restore	Backup Time/Disk
/local/alpha/spectra	1992-0401-0807.01	1992-0710-0743.D01
/local/alpha/spectra	1992-0401-1449.01	1992-0710-0743.D01
/local/alpha/spectra	1992-0402-0754.01	1992-0710-0743.D01
/local/alpha/spectra	1992-0402-1454.01	1992-0710-0743.D01
/local/alpha/spectra	1992-0403-1439.01	1992-0710-0743.D01
/local/alpha/spectra	1992-0406-0747.01	1992-0710-0743.D01
/local/alpha/spectra	1992-0406-0834.01	1992-0710-0743.D01
/local/alpha/spectra	1992-0406-1457.01	1992-0710-0743.D01
/local/alpha/spectra	1992-0407-0805.01	1992-0710-0743.D01

MIZAR

Alpha

Hardware Configuration

NAME

HARDWARE – Alpha spectra data collection system overview

INTRODUCTION

The Networked Alpha Acquisition and Analysis System (NAAAS) is primarily constructed from off-the-shelf components: (Detailed discussion of each to follow)

Control, Analysis, Storage and Reporting:

- Two Sun Microsystems Sparcstation 2 computers each with 32 Mb ram and 1.4 Gb disk
- One REO-130 Magneto-Optical disk drive attached to one Sun
- A line printer for reporting
- A postscript printer for graphical reproduction

Data Collection:

One or more sets of the following equipment, each of which provides sixteen alpha sample counting stations to the system.

- One standard 19-inch instrument rack installed with:
 - One Mizar VME crate containing:
 - One MZ7124 CPU card with 4MB ram
 - One MZ7850 ethernet daughter card (Mounted on MZ7124)
 - One MZ8305 digital input/output card
 - One serial ANSI terminal (optional)
 - One standard NIM Bin containing:
 - One Canberra ND582 Analog to Digital Converter (ADC)
 - Two Canberra ND589 Multiplexer units
- Up to sixteen NIM Bin or rack mount alpha chambers with associated amplifiers and vacuum pumps

The only connection needed between these two sections is provided by an ethernet link. A block diagram illustrating component arrangement is also provided.

SUN WORKSTATIONS

These two Sun Sparcstation 2 computers provide the sole user interface to the alpha system through the *Aldo* (Alpha Detector Operations), *Alan* (Alpha Analysis), and *Archive* (Data archiving) programs. They also store all system data, including the spectra and the Mizar software. That software, required for Mizar function, is primarily loaded from the Sun system named 'george'. If that system breaks down, however, none of the mizars will be able to load software and start running. Note that if 'george' breaks down while all Mizars are already running, they will continue to function normally (until they are reset).

Booting Mizars from an alternate Sun

The Mizars can be reset to load software from Sun system 'malcolm' instead through the use of the ANSI Terminal (See below). It is important to remember that this procedure can only be done with one Mizar at a time, and that if that unit is reset again before 'george' is revived it must be repeated. (This means that the automatic power failure recovery feature is nullified until 'george' is returned on-line.)

Step 1: Connect the ANSI Terminal to the Mizar

This is done by plugging a RS-232 cable into a connector on the rear of the Mizar enclosure.

Step 2: Boot Mizar

====> **NOTE: READ THE ENTIRE STEP BEFORE PROCEEDING !** <====

Turn on the Mizar, or if it is already on reboot it by pressing the blue button on the lower-right hand of the chassis. After a short pause, the connected terminal should show several lines of text beginning with:

'VxWorks System Boot'

And ending with:

'Press any key to stop auto-boot..'

with a decreasing number below it. We want to stop the auto-boot so press any key to do so. The following prompt should appear:

'[VxWorks Boot]'

along with a blinking cursor. At this prompt, type a 'p' and a carriage return. You should see a list of boot parameters something like the following:

```
boot device      : nic
processor number : 0
host name       : george
file name       : ~vw/config/mz7124/vxWorks
inet on ethernet (e) : 192.9.200.x
host inet (h)    : 192.9.200.3
user (u)        : vw
flags (f)       : 0x0
target name (tn) : mz7124.x
startup script(s) : vxStartup
```

Step 3: Change Boot Parameters

Type a 'c' and a carriage return at the [VxWorks Boot] prompt to change the two parameters shown below. Several fields will be displayed in turn, allowing input at each line. Respond with the contents of the brackets shown at the right. <return> means press the return key.

```
boot device      : nic                      [<return>]
processor number : 0                        [<return>]
host name       : george                    [malcolm <return>]
file name       : ~vw/config/mz7124/vxWorks [<return>]
inet on ethernet (e) : 192.9.200.x          [<return>]
inet on backplane (b):                     [<return>]
host inet (h)    : 192.9.200.3              [192.9.200.1 <return>]
gateway inet (g) :                          [<return>]
user (u)        : vw                       [<return>]
ftp password (pw) (blank = use rsh):        [<return>]
flags (f)       : 0x0                      [<return>]
target name (tn) : mz7124.x                [<return>]
startup script(s) : vxStartup               [<return>]
other (o)       :                          [<return>]
```

At the next '[VxWorks Boot]' prompt shown, press 'p' and <return> to verify the two fields changed. If necessary, repeat the step until it is correct.

Step 4: Continue Boot Process

When the change is made, enter an '@' and press <return> at the next '[VxWorks Boot]' prompt to continue the boot. The system should start normally and be accessible to the Sun detector control program (*Aldo*).

REO-130 MAGNETO-OPTICAL DISK DRIVE

This storage device is used to make permanent archives of all files generated by the system including collected spectra and backgrounds, calibration data, and quality control (QC) data. The random-access capability and removability of these small disk cartridges make them ideal for accessible, yet secure permanent data storage. The *Archive* program (see the *Archive* section in this manual) is used to both save files to, and restore files from this medium.

See the *Pinnacle Micro REO-130 Manual* for details on installation and maintenance of the Magneto-Optical (MO) disk unit.

PRINTERS

There are two printers available on the system: A Hewlett-Packard Laserjet III+ with Postscript cartridge, and an Epson FX-850. Both are connected by serial port to a Sun workstation and set up for network printing so that both Suns can access either printer.

The Epson is used primarily for printing spectrum analysis reports. The Laserjet can also be used for reporting (See the preceding *Alan* manual), but in addition is useful for printing out the contents of Sun workstation windows (containing a spectra, for example).

MIZAR MZ7124 CPU CARD

The MZ7124 CPU is a full-functioning Motorola 68020-based computer with four megabytes of memory. When energized or reset, it uses the ethernet daughtercard (see below) to load its software from one of the Sun computers.

Configuration

EPROM installation: Insert the low-byte chip in socket U7, and the high-byte one in U6.

First, there are jumpers on the board itself that must be set properly. These are as follows:

K3: EPROM size select 512K config

	K3	
1	o	o
	o	o
	o	o

K4: BERR for timeout. Install jumper.

```

      K4  o
          |
          o

```

K5: System Controller. Install jumper.

```

      K5  o
          |
          o

```

The software is set up so that all CPU cards, no matter what part of the system they form (ie. Alpha/Gamma, first detector set/second set, etc.), load and run the same software. The differentiation is determined by reading a bank of switches on the front of the card. For Alpha, the setup is as follows:

All switches closed (closed = zero) except the lowest numbered switches as explained below.

Select Alpha detector group sequence number:

- Mizar box #1 (detectors 1-16) switch # 1 open (= 1)
- Mizar box #2 (detectors 17-32) switch # 2 open (= 2)
- Mizar box #3 (detectors 33-48) switches # 1 & 2 open (= 3)
- Mizar box #4 (detectors 49-64) switch # 3 open (= 4)

General switch allocation is as below:

```

      det group      | alpha
( 1 2 3 4 5 6 7 8 9 ) | (10)

```

Example switch setting for Alpha, box 2:

```

1 2 3 4 5 6 7 8 9 10
0 x 0 0 0 0 0 0 0 0  where x = open switch

```

MIZAR MZ7850 ETHERNET CARD

This is a small 'daughter card' that attaches directly to the CPU board and provides standard ethernet interface capability through which all communications with the Sun is carried out. A standard ethernet transceiver is required to complete the interface between the MZ7850 and the network itself.

MZ8305 DIGITAL I/O CARD

This Mizar peripheral provides the digital interface to the master Multiplexer (see below) as well as a counter hardware used by the alpha system to detect and shut down so-called 'runaway' detectors. This term describes the large number of invalid counts produced by a detector as it goes bad. Since these can overload the system, when one occurs it is shut down.

Card Configuration

The MZ8305 is configured for a particular application by setting jumpers on the circuit board. These settings necessarily are different for Alpha versus Gamma operation.

K01 Timer output control and buffer direction. T1 and T2 not routed off board. Buffer control via PC1 and PC2 for both sections.

```

|-----|
| K01 ::|:|:|:| |
|-----|

```

K02 H2/H4 direction K03 TIN1/2 enable K04 TOUT2 interrupt
all selected output. TIN1 from J1. enabled.

```

|-----| |-----| |-----|
| K02 .__ | | K03 __ .. | | K04 __ |
| .__ | |-----| |-----|
| .__ |
| .__ |
| .__ |
| .__ |
| .__ |
| .__ | K10 TOUT1 interrupt enable
| .__ | K10 is enabled.
|-----|

```

K05 and K06 are interrupt acknowledge K07 is timer frequency
K5 -> P1 = 1 K6 -> T1 = 3 none are used
P2 = 7 T2 = 5

```

|-----| |-----| |-----|
| K05 .. | | K06 .. | | K07 .. |
| .. | | .. | | .. |
| .. | | .. | | .. |
| .. | | .. | | .. |
| .. | | .. | | .. |
|-----| |-----| |-----|

```

K09 is interrupt request select

P1 = 1
P2 = 7
T1 = 3
T2 = 5

```

|-----| |-----|
| K09 ... | | K08 --- | K08 is VME address selection all
| ... | | --- | jumpers installed = address 000
|-----| |-----|
|-----|

```

Connecting Cable Configuration

A custom cable is required between the MZ8305 front panel connector and the pulse digitizing equipment (the ADC and MUX). A description of the connections and a diagram of the cable follows.

J1 Connector:

- PA0-7 and PB0-7 connected to data output from MUX.
- TIN connected to Event on the ADC.
- H1 connected to Ready on the MUX.
- H4 connected to Clear on the MUX.
- H2 connected to H3 on the connector.
- H3 connected to H2 on the connector.
- TOUT no connection.

J2 connector:

- PA0-7 and PB0-7 connected to data input on the MUX.
- TIN no connection.
- TOUT no connection.
- H1 no connection.
- H2 no connection.
- H3 no connection.
- H4 no connection.

Explanation of handshake lines:

- H1 - Interrupt from MUX to indicate data is ready to be read.
- H4 - Clear signal from I/O card to the MUX, means data has been read and more data can be acquired.
- H2 - (tied to H3) computer toggles H2, which causes H3 to latch the data from the MUX into the input registers.
- H3 - latches data from MUX into the input registers.
- TIN - from event on the ADC, used to decrement the T1 counter which keeps track of a possible runaway detector.

See also the figure showing exact pin connections for the cable J1.

ANSI TERMINAL

If desired, a standard RS-232 terminal can be connected to the first serial port on any MZ7124 CPU card. This terminal is not needed for normal operation, but can be used to code development and debugging purposes. In addition, similar communications can be conducted with a Mizar using the *telnet* <Mizar Name> command from one of the Sun computers.

Using a terminal or telnet sessions provides access to several utility functions. These are listed below. Fields where a user would supply a parameter of some sort with the command are indicated by <field name>.

Operating system supplied functions

i	- display all active tasks
checkStack	- show task stack usage
lkup <Symbol Name>	- Display the value of a symbol
hostShow	- Show names other computers on the network are called by
memShow	- Show memory usage
iosFdShow	- Show current active file descriptors
nfsDevShow	- Show remote file systems currently mounted for use
inetStatShow	- Show current active socket status

Programmer provided utility functions

systat()	- Show status of the data acquisition system
exam(<det>, <chan>)	- Shows the number of counts in each of several channels clustered around <chan>
exam2(<detector>)	- Shows all channels for the given detector that have any counts.
rc <command>	- Execute the command on all Mizar systems on the ethernet
sunrc <host>, <cmd>	- Execute <cmd> on the Sun computer named <host>
detStat	- [Gamma Only] Show live and clock times for all detectors.

CANBERRA ND582 ANALOG TO DIGITAL CONVERTER

The Canberra ND582 is a single-width NIM module designed to work in concert with the ND589 Multiplexer (see below). Properly connected to two Canberra Analog Multiplexers, up to sixteen channels of data can be sampled by just one ADC.

Configuration

For the ND582 to properly operate along with the ND589 Multiplexers, its front panel controls must be set properly. These settings are as follows:

Conversion Gain Knob: Set to '1K'

Coin/Off/Anti Toggle Switch: Set to 'Anti'

Acg/Off/Strb Toggle Switch: Set to 'Strb'

L and U verniers: These adjust hardware lower and upper level discrimination, but are not used for this system.

Z vernier: Adjusts the zero voltage level for the ADC. DO NOT MANIPULATE unless necessary--doing so can void the calibrations for all sixteen detectors.

For cable connections, see the block diagram.

CANBERRA ND589 ANALOG MULTIPLEXER

The ND589 is a double-width NIM multiplexer with live-time clock and individual channel control used to route eight analog pulse sources to a single ND580-series ADC (see above) in low count rate applications. This makes it ideal for Alpha spectroscopy. It can also be cascaded, meaning more than one can be used together. In the case of the Alpha system, two of these modules are used to route sixteen channels to a single ADC.

Configuration

When more than one MUX is used together, one must be designated the 'master', and the others the 'slaves'. DIP switches on the inside of the unit's case are used to configure master/slave status, number of units together, and number of total inputs. Each unit of sixteen Alpha detectors will require one master and one slave unit, with the master controlling the interface to the ADC.

To configure a Multiplexer, follow the procedure given in chapter 2 (Installation) of the Analog Multiplexer Models 588/589 Operator's Manual, with the following specifications:

Group Size:	1K (1024)
Number of Inputs:	16

Set the rest of the switches as required from the manual depending on whether the unit in question is a master or a slave. Note that group size and number of inputs are not specified for a slave multiplexer.

For cable connections, see the block diagram.

On the bottom of the front panel there is a small vernier used to adjust the low level discrimination level. This is separate from the ADC and should be adjusted so that noise in the lower channels is filtered out. This noise can even be of sufficient amount to cause a 'runaway' detector indication (see the MZ8305 Digital I/O Card section above).

SEE ALSO

- Canberra ADC Model 580 Series Operator's Manual
- Canberra Analog Multiplexer Models 588/589 Operator's Manual
- Epson FX-850/1050 User's Manual
- Hewlett Packard Laserjet III+ User's Manual
- Hewlett Packard PostScript Cartridge User's Guide
- Mizar MZ7124 68020 CPU Module User's Manual
- Mizar MZ8305 Quad Parallel Port Module User's Manual
- Mizar/Integrated Solutions MZ7850 Ethernet Daughterboard User's Manual
- Pinnacle Micro REO-130S User's Guide for Sun Workstations
- Wind River Systems VxWorks Reference Manual

Mizar-Alpha (NETSPEC)

Block Diagram

Mizar-Alpha (NETSPEC)

WINCO

BIDASSAY SYSTEM
BLOCK DIAGRAM

DRAWN BY
K.J. HASKELL 6/22/92

ACAD-ALF BLOCK

Last change: December 1993

140

Last change: December 1993

8 7 6 5 4 3 2 1

BIOASSAY SYSTEM CABLE, MUX TO MIZAR J1 CONNECTOR

<u>MUX CABLE</u>	<u>COLOR</u>	<u>MIZAR I/O</u>	<u>SIGNAL NAME</u>
21 -----	GRAY 1 -----	6 -----	GROUND
1	BROWN 1	2	GROUND
18	RED 1	1 (H4)	CLEAR
22	BLACK 1	47 (H1)	STORE
24	YELLOW 2	23	BIT 0 (LSB)
25	BLUE 2	21	BIT 1
26	GRAY 2	19	BIT 2
27	BLACK 2	17	BIT 3
28	RED 3	15	BIT 4
29	YELLOW 3	13	BIT 5
30	BLUE 3	11	BIT 6
8	GREEN 2	9	BIT 7
9	VIOLET 2	39	BIT 8
10	WHITE 2	37	BIT 9
11	BROWN 3	35	BIT 10
12	ORANGE 3	33	BIT 11
13	GREEN 3	31	BIT 12
7	ORANGE 2	29	BIT 13 (MSB)

FROM ADC

ADC EVENT ----- 7 TIN

NOTE: GROUND PIN 19 ON MUX CIRCUIT BOARD (PIN 19 TO PIN.1)
THIS IS THE ATR* SIGNAL

WINCO

BIOASSAY SYSTEM
CUSTOM CABLEDRAWN BY
K.J. HASKELL

6/17/92

ACAD-ALFCBLE

8 7 6 5 4 3 2 1

Mizar-Alpha (NETSPEC)

Custom Cable

Mizar-Alpha (NETSPEC)

MIZAR

Gamma
Hardware Configuration

NAME

HARDWARE – Gamma spectra data collection system overview

INTRODUCTION

The Networked Gamma Acquisition and Analysis System (NGAAS) is primarily constructed from off-the-shelf components: (Detailed discussion of each to follow)

Control, Analysis, Storage and Reporting:

- Two Sun Microsystems Sparcstation 2 computers each with 32 Mb ram and 1.4 Gb disk
- One REO-130 Magneto-Optical disk drive attached to one Sun
- A line printer for reporting
- A postscript printer for graphical reproduction

Data Collection:

One or more sets of the following equipment, each of which provides up to twelve gamma counting stations (assuming moderate count rates) to the system.

- One standard 19-inch instrument rack installed with:
 - One Mizar VME crate containing:
 - One MZ7124 CPU card with 4MB ram
 - One MZ7850 ethernet daughter card (Mounted on MZ7124)
 - Up to six MZ8305 digital input/output cards (one per two detectors)
 - One serial ANSI terminal (optional)
 - Standard NIM Bins containing for each detector:
 - One High Voltage bias power supply
 - One Spectroscopy Amplifier
 - One 13-bit Analog to Digital Converter (ADC) with interface cable
 - One channel of a custom Dead Time interface (Each one has three or four channels)
 - One Germanium Gamma detector

The only connection needed between these two sections is provided by an ethernet link. A block diagram illustrating component arrangement is also provided.

SUN WORKSTATIONS

These two Sun Sparcstation 2 computers provide the sole user interface to the gamma system through the *Gamdo* (Gamma Detector Operations), *Gaman* (Gamma Analysis), and *Archive* (Data archiving) programs. They also store all system data, including the spectra and the Mizar software. That software, required for Mizar function, is primarily loaded from the Sun system named 'george'. If that system breaks down, however, none of the mizars will be able to load software and start running. Note that if 'george' breaks down while all Mizars are already running, they will continue to function normally (until they are reset).

Booting Mizars from an alternate Sun

The Mizars can be reset to load software from Sun system 'malcolm' instead through the use of the ANSI Terminal (See below). It is important to remember that this procedure can only be done with one Mizar at a time, and that if that unit is reset again before 'george' is revived it must be repeated. (This means that the automatic power failure recovery feature is nullified until 'george' is returned on-line.)

Step 1: Connect the ANSI Terminal to the Mizar

This is done by plugging a RS-232 cable into a connector on the rear of the Mizar enclosure.

Step 2: Boot Mizar

==> **NOTE: READ THE ENTIRE STEP BEFORE PROCEEDING !** <==

Turn on the Mizar, or if it is already on reboot it by pressing the blue button on the lower-right hand of the chassis. After a short pause, the connected terminal should show several lines of text beginning with:

'VxWorks System Boot'

And ending with:

'Press any key to stop auto-boot..'

with a decreasing number below it. We want to stop the auto-boot so press any key to do so. The following prompt should appear:

'[VxWorks Boot]'

along with a blinking cursor. At this prompt, type a 'p' and a carriage return. You should see a list of boot parameters something like the following:

```
boot device      : nic
processor number : 0
host name       : george
file name       : ~vw/config/mz7124/vxWorks
inet on ethernet (e) : 192.9.200.x
host inet (h)    : 192.9.200.3
user (u)        : vw
flags (f)       : 0x0
target name (tn) : mz7124.x
startup script(s) : vxStartup
```

Step 3: Change Boot Parameters

Type a 'c' and a carriage return at the [VxWorks Boot] prompt to change the two parameters shown below. Several fields will be displayed in turn, allowing input at each line. Respond with the contents of the brackets shown at the right. <return> means press the return key.

```
boot device      : nic                      [<return>]
processor number : 0                        [<return>]
host name       : george                    [malcolm <return>]
file name       : ~vw/config/mz7124/vxWorks [<return>]
inet on ethernet (e) : 192.9.200.x          [<return>]
inet on backplane (b) :                     [<return>]
host inet (h)    : 192.9.200.3              [192.9.200.1 <return>]
gateway inet (g) :                          [<return>]
user (u)        : vw                        [<return>]
ftp password (pw) (blank = use rsh):         [<return>]
flags (f)       : 0x0                       [<return>]
target name (tn) : mz7124.x                 [<return>]
startup script(s) : vxStartup                [<return>]
other (o)       :                          [<return>]
```

At the next '[VxWorks Boot]' prompt shown, press 'p' and <return> to verify the two fields changed. If necessary, repeat the step until it is correct.

Step 4: Continue Boot Process

When the change is made, enter an '@' and press <return> at the next '[VxWorks Boot]' prompt to continue the boot. The system should start normally and be accessible to the Sun detector control program (*Gamdo*).

REO-130 MAGNETO-OPTICAL DISK DRIVE

This storage device is used to make permanent archives of all files generated by the system including collected spectra and backgrounds, calibration data, and quality control (QC) data. The random-access capability and removability of these small disk cartridges make them ideal for accessible, yet secure permanent data storage. The *Archive* program (see the *Archive* section in this manual) is used to both save files to, and restore files from this medium.

See the *Pinnacle Micro REO-130 Manual* for details on installation and maintenance of the Magneto-Optical (MO) disk unit.

PRINTERS

There are two printers available on the system: A Hewlett-Packard Laserjet III+ with Postscript cartridge, and an Epson FX-850. Both are connected by serial port to a Sun workstation and set up for network printing so that both Suns can access either printer.

The Epson is used primarily for printing spectrum analysis reports. The Laserjet can also be used for reporting (See the preceding *Gaman* manual), but in addition is useful for printing out the contents of Sun workstation windows (containing a spectra, for example).

MIZAR MZ7124 CPU CARD

The MZ7124 CPU is a full-functioning Motorola 68020-based computer with four megabytes of memory. When energized or reset, it uses the ethernet daughtercard (see below) to load its software from one of the Sun computers.

Configuration

EPROM installation: Insert the low-byte chip in socket U7, and the high-byte one in U6.

First, there are jumpers on the board (referenced by Knn designators) that must be set properly. These are as follows:

K3: EPROM size select 512K config

	K3
1	0 0
	0 0
	1 1
	0 0

K4: BERR for timeout. Install jumper.

```

      K4 o
        |
        o

```

K5: System Controller. Install jumper.

```

      K5 o
        |
        o

```

The software is set up so that all CPU cards, no matter what part of the system they form (ie. Alpha/Gamma, first detector set/second set, etc.), load and run the same software. The differentiation is determined by reading a bank of switches on the front of the card. For Gamma, the setup is as follows:

Switch 10 open. All other switches closed (closed = zero) except the lowest numbered switches as explained below.

Select Gamma detector group sequence number:

- Mizar box #1 (detectors 1-8) switch # 1 open (= 1)
- Mizar box #2 (detectors 9-16) switch # 2 open (= 2)
- Mizar box #3 (detectors 17-24) switches # 1 + 2 open (= 3)
- Mizar box #4 (detectors 24-32) switch # 3 open (= 4)

Select number of gamma detectors installed:

- 1 detector installed switch # 6 open
- 2 detectors installed switch # 7 open
- 3 detectors installed switch # 6 + 7 open
- 4 detectors installed switch # 8 open
- 5 detectors installed switch # 6 + 8 open
- 6 detectors installed switch # 7 + 8 open
- 7 detectors installed switch # 6 + 7 + 8 open
- 8 detectors installed switch # 9 open
- 9 detector installed switch # 6 + 9 open
- 10 detectors installed switch # 7 + 9 open
- 11 detectors installed switch # 6 + 7 + 9 open
- 12 detectors installed switch # 8 + 9 open

General switch allocation is as below:

```

      det group | # dets | gamma
      ( 1 2 3 4 5 ) | ( 6 7 8 9 ) | (10)

```

Example switch setting for Gamma, box 3, 5 detectors

```

1 2 3 4 5 6 7 8 9 10
x x 0 0 0 x 0 x 0 x   where x = open switch

```

MIZAR MZ7850 ETHERNET CARD

This is a small 'daughter card' that attaches directly to the CPU board and provides standard ethernet interface capability through which all communications with the Sun is carried out. A standard ethernet transceiver is required to complete the interface between the MZ7850 and the network itself.

MZ8305 DIGITAL I/O CARD

This Mizar peripheral provides the digital interface to the Analog to Digital Converters (ADCs), with two supported per card. One or more must be installed in each VME crate next to the CPU card. There can be no gaps between the I/O cards, if more than one is used.

Card Configuration

The MZ8305 is configured for a particular application by setting jumpers on the circuit board. These settings necessarily are different for Alpha versus Gamma operation. The Knn numbers refer to jumpers on the circuit board.

K01 Timer output control and buffer direction. T1 and T2 not routed off board. Buffer control via PC1 and PC2 for both sections.

```

|-----|
| K01 ::l:l:l:l: |
|-----|

```

K02 H2/H4 direction
all selected output

```

|-----|
| K02 .__ |
| .__ |
| .__ |
| .__ |
| .__ |
| .__ |
| .__ |
| .__ | K10 |
|-----|

```

K03 TIN1/2 enable
TIN1/2 from J1/2.

```

|-----|
| K03 __ __ |
|-----|

```

K04 TOUT2 interrupt
enabled.

```

|-----|
| K04 __ |
|-----|

```

K10 TOUT1 interrupt enable
is enabled.

K05 and K06 are interrupt acknowledge K07 is timer frequency
K5 -> P1 = 1 K6 -> T1 = 3
P2 = 7 T2 = 5
none are used

```

|-----|
| K05 .. |
| .. |
| .. |
| __ |
| __ |
| .. |
|-----|

```

```

|-----|
| K06 .. |
| .. |
| .. |
| __ |
| __ |
| .. |
|-----|

```

```

|-----|
| K07 .. |
| .. |
| .. |
| .. |
|-----|

```

K09 is interrupt request select

P1 = 1
P2 = 7
T1 = 3
T2 = 5

```

|-----|
| K09 ... |
| | | |
|-----|

```

K08 is VME address selection, each I/O card must have a different VME base address. The first I/O card must be based at address 00xx, the second must be at 01xx, the third at 02xx, etc.

-----	-----	-----	-----
K08 A11	--	--	--
-- A15	--	--	--
-- A10	--	--	--
-- A14	--	--	--
-- A09	--	..	..
-- A13	--	--	--
-- A08	..	--	..
-- A12	--	--	--
-----	-----	-----	-----
addrs 00xx	01xx	02xx	03xx
-----	-----	-----	-----
I/O card #1	card #2	card #3	card #4

Connecting Cable Configuration

A custom cable is required between the MZ8305 front panel connector and the ADC's. A description of the connections and a diagram of the cable follows.

J1 Connector:

- PA0-7 and PB0-7 connected to data output from ADC.
- TIN connected to Live time clock on ADC.
- H3 connected to Store from the ADC.
- H4 connected to Clear on the ADC.
- H2 no connection.
- H3 no connection.
- TOUT no connection.

J2 connector:

Same as J1.

Explanation of handshake lines:

- H3 - Interrupt from ADC to indicate data is ready to be read, H3 also latches the data into the internal registers.
- H4 - Clear signal from I/O card to the ADC, means data has been read and more data can be acquired.
- TIN - from custom interface on the ADC, Live time counter, used to decrement the T1 and T2 counters which are preloaded with one seconds worth of counts.

ANSI TERMINAL

If desired, a standard RS-232 terminal can be connected to the first serial port on any MZ7124 CPU card. This terminal is not needed for normal operation, but can be used to code development and debugging purposes. In addition, similar communications can be conducted with a Mizar using the *telnet* <Mizar Name> command from one of the Sun computers.

Using a terminal or telnet sessions provides access to several utility functions. These are listed below. Fields where a user would supply a parameter of some sort with the command are indicated by <field name>.

Operating system supplied functions

i	- display all active tasks
checkStack	- show task stack usage
lkup <Symbol Name>	- Display the value of a symbol
hostShow	- Show names other computers on the network are called by
memShow	- Show memory usage
iosFdShow	- Show current active file descriptors
nfsDevShow	- Show remote file systems currently mounted for use
inetStatShow	- Show current active socket status

Programmer provided utility functions

systat()	- Show status of the data acquisition system
exam(<det>, <chan>)	- Shows the number of counts in each of several channels clustered around <chan>
exam2(<detector>)	- Shows all channels for the given detector that have any counts.
rc <command>	- Execute the command on all Mizar systems on the ethernet
sunrc <host>, <cmd>	- Execute <cmd> on the Sun computer named <host>
detStat	- [Gamma Only] Show live and clock times for all detectors.

SEE ALSO

Epson FX-850/1050 User's Manual
Hewlett Packard Laserjet III+ User's Manual
Hewlett Packard PostScript Cartridge User's Guide
Mizar MZ7124 68020 CPU Module User's Manual
Mizar MZ8305 Quad Parallel Port Module User's Manual
Mizar/Integrated Solutions MZ7850 Ethernet Daughterboard User's Manual
Pinnacle Micro REO-130S User's Guide for Sun Workstations
Wind River Systems VxWorks Reference Manual

Mizar-Gamma (NETSPEC)

Channel Block Diagram

Mizar-Gamma (NETSPEC)

Last change: December 1993

DATE

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5/6/94

END