



User Manual SAM 945
Portable Isotope Identifier

WARRANTY

Berkeley Nucleonics Corporation warrants all instruments, including component parts, to be free from defects in material and workmanship under normal use and service for a period of one year. If repairs are required during the warranty period, contact the factory for component replacement or shipping instructions. Include the serial number of the instrument. This warranty is void if the unit is repaired or altered by others than those authorized by Berkeley Nucleonics Corporation.

IMPORTANT! PLEASE READ CAREFULLY

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Instruction Manual

SAM 945

Portable Isotope Identifier

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CHAPTER 1. INTRODUCTION

1.1 Functional Description

The SAM 945 Portable Isotope Identifier is engineered to meet ANSI 42.34 performance criteria for handheld instruments for the detection and identification of radionuclides. Its lightweight, portable design makes it ideal for many types of radiological surveys, including the most demanding applications, such as evaluation of radiation hazards by Homeland Security, first responders, and health physicists.

The SAM 945 replaces traditional instruments with a patented solution that seamlessly integrates smartphone or PDA (personal digital assistant) technology with nuclear radiation detectors. The standard smartphone included with the SAM 945 is the Motorola Moto G.

The SAM 945 is designed to include, at a minimum, a 3 x 3 inch sodium iodide (NaI(Tl)) scintillation detector in order to provide the highest sensitivity, general purpose isotope identification. High resolution detector options are available. The system can also include a GM tube and/or a neutron detector.

The detector forwards data to the smartphone via Bluetooth. The smartphone provides an easy-to-read display, informing the user of the identity and levels of radionuclides present (and helping to ensure personal safety). The SAM 945 can also use the smartphone's locator services to continuously transmit GPS locations for mapping of radiation data. Upon completion of a survey, data may be downloaded from the smartphone to a PC.



Figure 1.1. SAM 945 Portable Isotope Identifier (tripod not included)



Figure 1.2. SAM 945 application examples

1.2 Important Safety Information

The SAM 945 has been meticulously engineered to provide safe, dependable, high performance for years. As with any kind of electrical equipment, following instructions and taking basic precautions will prevent harm to the operator and to the equipment.

Prior to using this equipment you should:

- ✓ Read and understand this manual thoroughly, especially the chapter on safety (Chapter 2).
- ✓ Read and understand thoroughly all warning labels on the equipment.
- ✓ Store all documents provided with the equipment in a safe place for future reference.

CHAPTER 2. SAFETY

2.1 Safety Warnings and Instructions



Following the warnings and instructions on this page is crucial to the safe and optimal operation of the SAM 945.

Maintenance and Service:

- ✓ If service is required while the unit is under warranty, contact the factory. Any repairs or alterations should only be performed by technicians who are authorized by Berkeley Nucleonics Corporation.
- ✓ Do not attempt to open the unit. Opening the unit may void your warranty (see inside front cover).

Safety Hazard:

- ✓ High voltage inside the unit (up to 1000 volts) presents a safety hazard. Do not attempt to open the unit. Refer to the maintenance and service instructions immediately above.
- ✓ The unit includes a laser pointer. Avoid direct eye exposure to the laser beam.

Cleaning the Laser and Flashlight Windows:

- ✓ Turn off the power switch before cleaning. Wipe the laser and flashlight windows with a soft, moistened cloth.

Disposal:

- ✓ It is the responsibility of the operator to be familiar with local, regional, and national regulations for handling, shipping, and disposal of electronic equipment and lithium-ion batteries.

Compatibility:

- ✓ It is the responsibility of the operator to ensure that external equipment intended for connection to signal input, signal output, or other connectors shall comply with the relevant European Standards (e.g., EN 61326-1:2006, EN 301 489-1 V1.9.2, and EN 301 489-17 V2.2.1).
- ✓ If in doubt about the compatibility of a device, contact a technician authorized by Berkeley Nucleonics Corporation.

SAM 945 CONTAINS FCC ID : U8D-FB155BC-F

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operations.

2.2 Classification

- ✓ EMC: Complies with EN 61326-1:2006, EN 301 489-1 V1.9.2, and EN 301 489-17 V2.2.1)
- ✓ FCC Class: Class B Equipment (FCC CFR 47 part 15 subpart B, Section 15.101)
- ✓ Laser: Class II Equipment (maximum output < 1 mW, wavelength 650-660 nm)
- ✓ Degree of protection against electric shock: Type BF Applied Part
- ✓ Degree of protection against the ingress of water: IP65
- ✓ Equipment not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide

2.3 Labels

The label showing the system power requirements and serial number (BSN, lower right corner) is located on the back of the unit (Figure 2.1).

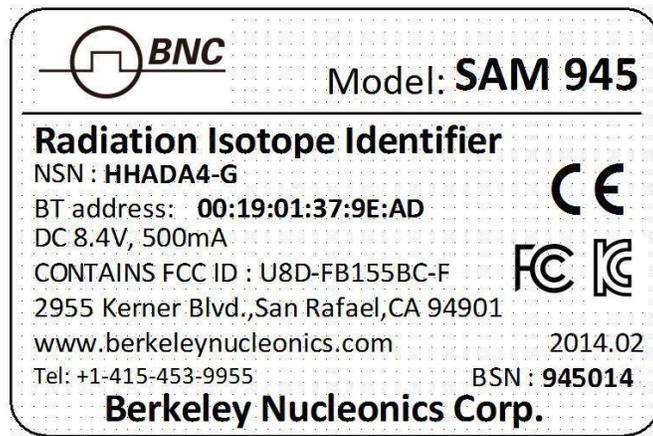


Figure 2.1. SAM 945 label

The aperture label (Figure 2.2, left) indicates the location of the laser aperture. The laser warning and certification label is located on the bottom of the unit (Figure 2.2, right).

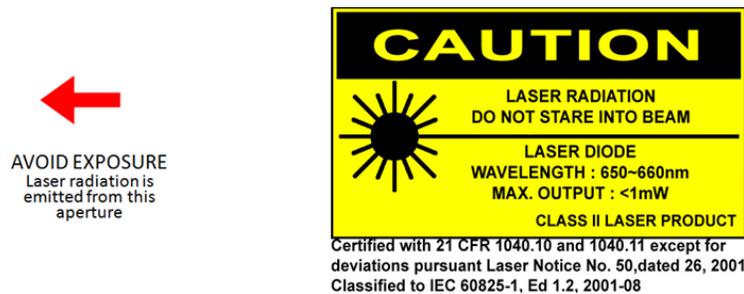


Figure 2.2. Aperture label (left), warning and certification label (right)

INFORMATION TO THE USER

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

WARNING

Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

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CHAPTER 3. SYSTEM DESCRIPTION

3.1 System Components

The SAM 945 physically consists of a detector unit, a smartphone (Motorola Moto G or equivalent), AC and vehicle power adapter/chargers for the detector unit (one AC to 8.4V DC, and one 12V DC vehicle adapter/charger), a USB to micro USB cable, a tripod adapter, a shoulder strap, and a water- and shock-resistant carrying case (Figure 3.1). The two software programs used with the SAM 945 are described in section 3.2.



Figure 3.1. SAM 945 components

3.1.1 Flashlight and Laser Pointer

The SAM 945 is equipped with a flashlight for operation in dark environments and a laser pointer for source targeting (Figure 3.2).

Avoid looking into the laser beam or directing the laser pointer into another person's eyes.

The pushbutton switch on the handle turns the flashlight and laser pointer on and off. It has three operating modes: first push, flashlight turns on; second push, laser pointer turns on; third push, flashlight and laser pointer turn on; fourth push, both turn off.



Figure 3.2. Flashlight and laser pointer

3.1.2 Smartphone Holder

The smartphone can be attached to the detector unit by using the smartphone holder.

1. Using the curved tab of the smartphone holder arm, swing the arm away from the body of the detector unit (Figure 3.3, left).

Tip: To prevent damage to the smartphone holder when opening or closing, always handle it by the curved tab.

2. Insert the edge of the smartphone into the lower hook of the holder (Figure 3.3, center and right).
3. Push down on the smartphone until the upper hook of the holder is visible.
4. Insert the top edge of the smartphone into the upper hook.
5. To remove the smartphone, push it down on the lower hook until its top edge is free of the upper hook. Tilt the top edge toward you and lift the smartphone from the lower hook.



Figure 3.3. Attaching the smartphone to the detector

The smartphone holder can be tilted and/or rotated for optimal viewing (Figure 3.4).



Figure 3.4. Tilting and rotating the smartphone holder

Tip: To prevent damage to the smartphone holder when tilting and/or rotating, always grasp both the upper and lower hooks.

3.1.3 Tripod Adapter

The SAM 945 can be mounted on a tripod using the tripod adapter and M6-10 screw provided with the unit.

1. Position the tripod adapter on the bottom of the detector unit as shown in Figure 3.5.
2. Use the M6-10 screw to fasten the tripod adapter securely to the unit.

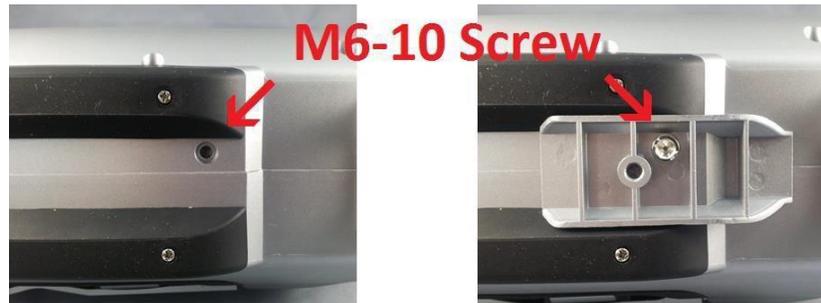


Figure 3.5. Attaching the tripod adapter to the bottom of the detector unit

A tripod shoe can be fitted to the tripod adapter with a standard 1/4-20 screw. A tripod adapter for a shoe using a 3/8-16 screw is also available.

3.1.4 Shoulder Strap

To minimize operator fatigue, the SAM 945 can be fitted with a shoulder strap. There are four attachment tabs on the detector unit for this purpose (Figure 3.6).



Figure 3.6. Shoulder strap attachment example

3.2 SAM 945 Software

The SAM 945 includes two dedicated software programs for conducting surveys and analyzing results.

SAM III PeakAbout for the smartphone:

- ✓ PeakAbout is used for configuring and calibrating the system, and for real-time measurement and analysis of data acquired by the detector unit. It is based on the Android operating system and works with the Motorola Moto G as well as many other smartphones that run Android.
- ✓ Smartphones shipped from Berkeley Nucleonics Corporation already have the current version of PeakAbout installed (in addition to the manufacturer's software). Detailed instructions for operating PeakAbout are in Chapter 4.

SAM III PeakID for the PC:

- ✓ PeakID supports management of Event Log files, data analysis including integration of data from multiple units, and data backup. It is compatible with PCs that run Windows 7 or higher.
- ✓ Detailed instructions for installing and operating PeakID are in Chapter 5.

3.3 Power and Battery Charger

The power switch and DC connector are located on the back of the detector unit (Figure 3.7). The LED on the power switch glows red when the power is on.

The SAM 945 is equipped with a lithium-ion battery including a built-in power protection circuit module (PCM) to prevent the battery from overcharging or over-discharging. It is best to regularly charge the battery until the LED on the charger glows green, indicating full charge has been reached. When necessary, you may disconnect the charger before reaching full charge.



Figure 3.7. Detector unit (rear view) and AC adapter/charger

The SAM 945 can also be charged from a vehicle electrical system with standard 12V DC (Figure 3.8).



Figure 3.8. Detector unit (rear view) and vehicle adapter/charger

3.4 Before Operating the SAM 945

1. Charge the SAM 945 battery.
 - a. For faster results, we recommend turning off the power switch (Figure 3.7) before charging.
 - b. Plug in the AC adapter/charger to the detector unit's DC connector (Figure 3.7) and to a power outlet. The spring-loaded connector locks the cable securely to the detector unit.
 - c. It can take up to six hours to fully charge the battery. When full charge has been reached, the LED on the AC adapter/charger glows green. (There is also a battery indicator on the PeakAbout home screen, but it will not be available if the detector unit's power is turned off.)
 - d. After charging, disengage the cable from the detector unit by firmly holding the male connector and gently twisting a quarter-turn, then pulling straight back.
2. Charge the smartphone battery. Refer to the smartphone manual for instructions.
3. Refer to Chapter 4 for detailed procedures on setup, configuration, background measurement, and calibration.

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CHAPTER 4. PEAKABOUT APPLICATION

4.1 Overview

PeakAbout enables the smartphone to communicate with the detector unit through the Bluetooth network protocol. The smartphone's main function is to display dose rate and count rate data for gamma-ray energy in real time. PeakAbout provides a convenient graphical display and access to analytical tools. It also manages the configuration and calibration of the detector unit (or units) with which it is paired.

PeakAbout allows Bluetooth networking exclusively between a smartphone and one or more detector units. This avoids data collision issues with any other Bluetooth devices in the area.

4.2 Navigating the GUI

4.2.1 Home Screen

In addition to displaying dose rate and count rate data on a logarithmic scale gauge, the PeakAbout home screen gives information on the system's operating status (Figure 4.1).

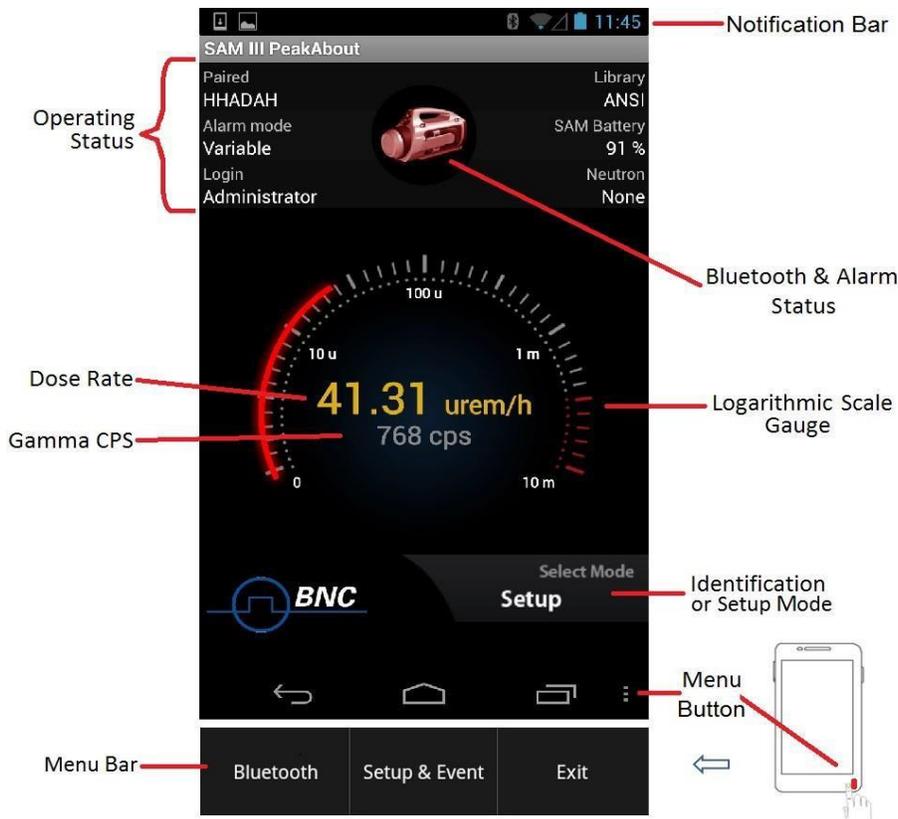


Figure 4.1. PeakAbout home screen

Screens and pop-up menus typically accessed from the home screen are shown in Figure 4.2 and listed in the table that follows. Rotating the screen 90° switches between two tasks, depending on which mode is active.

Touching the menu button  at the bottom right corner of the home screen toggles the menu bar on and off.

Tip: Wearing polarized lenses such as sunglasses can make the rotated screen appear blank. We recommend that you do not wear polarized lenses while using PeakAbout.

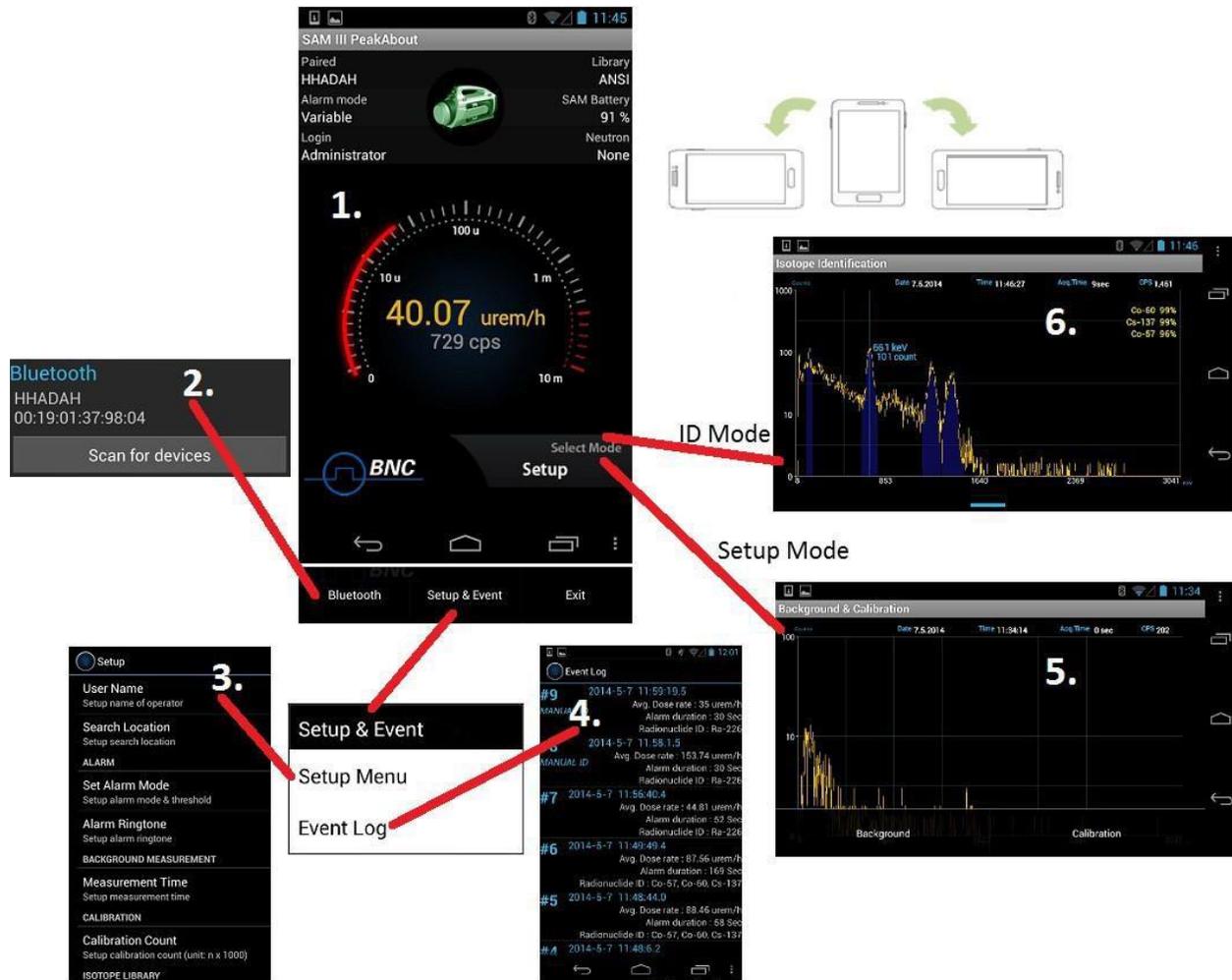


Figure 4.2. PeakAbout GUI and pop-up menus

1	Home screen	Displays dose rate, count rate, system status, menu button, and battery indicator
2	Bluetooth pop-up menu	Displays paired devices and manages Bluetooth functions
3	Setup menu	Allows operator to set up alarm threshold and ringtone, background measurement time, and more
4	Event Log	Displays Event List and summary
5	Background & Calibration menu	Provides access to background measurement and calibration functions
6	Isotope Identification	Displays spectrum and identified nuclides

4.2.2 Background Measurement and Manual Calibration

Background and Calibration modes and their associated functions are initiated by rotating the smartphone 90° while in Setup mode (Figure 4.3).

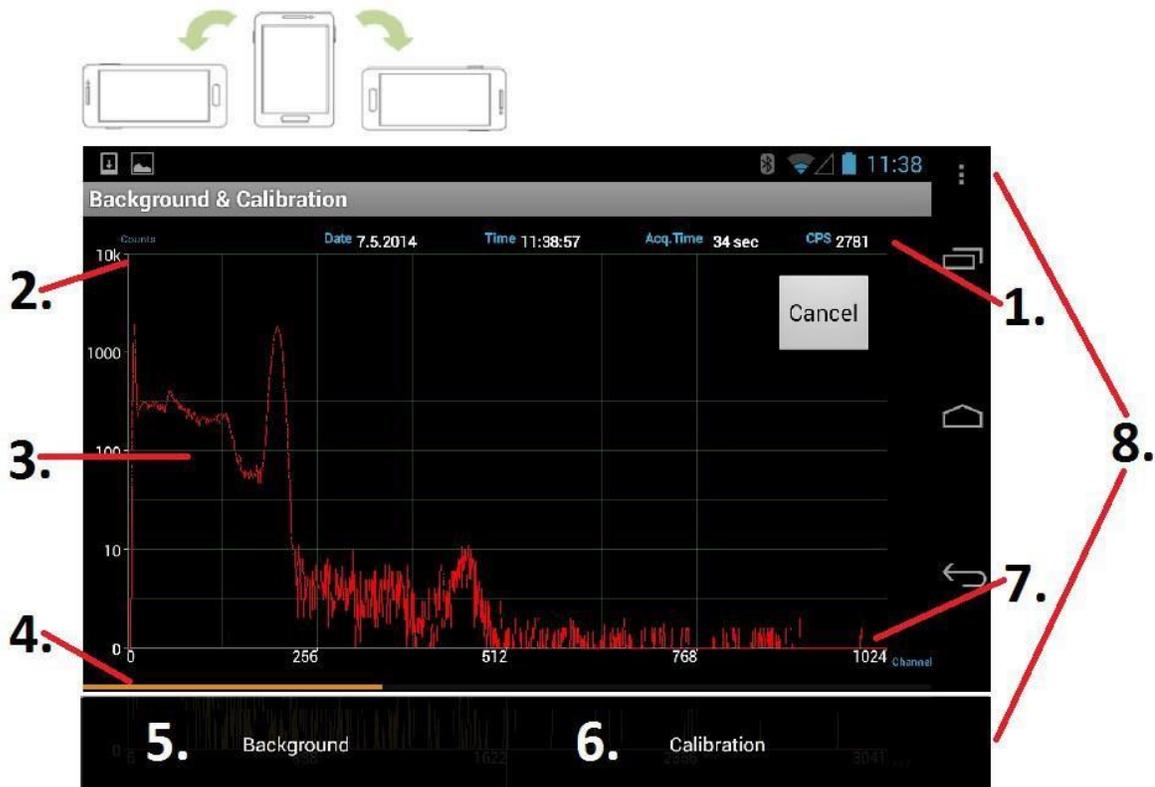


Figure 4.3 Background and Calibration screen

1	General information	Date, time, acquisition time, and counts per second (CPS)
2	Counts	Y-axis displays counts on a self-adjusting, logarithmic scale
3	Spectrum	Displays spectrum in real time
4	Progress bar	Indicates progress toward completion of background measurement or manual calibration
5	Background button	Selects background measurement function
6	Calibration button	Selects manual calibration function
7	Channel/Energy	X-axis displays channel or energy on a linear scale
8	Menu button and pop-up menu	Touching menu button toggles Background & Calibration menu on/off

Measuring background radiation and determining a reference are important for accurate nuclide identification. Manual calibration with a Cs-137 source is also important for ensuring optimal results. See sections 4.3.5 and 4.3.6 below for instructions.

4.2.3 Isotope Identification

When the system is in Identification mode, the Isotope Identification screens (Figure 4.4) can be initiated by rotating the screen 90°. Spectral data acquired in real time are displayed. If the count rate is greater than the background level, the system automatically alarms and displays the identified nuclide(s) with corresponding confidence level(s).

The short blue bar at the bottom center of the screen (Figure 4.4) is a swipe bar. Touching it and swiping upward opens the classification screen, displaying the dose rate of the identified nuclide(s) in a bar graph. Swiping the swipe bar (now at the top of the screen) downward returns you to the spectrum screen.

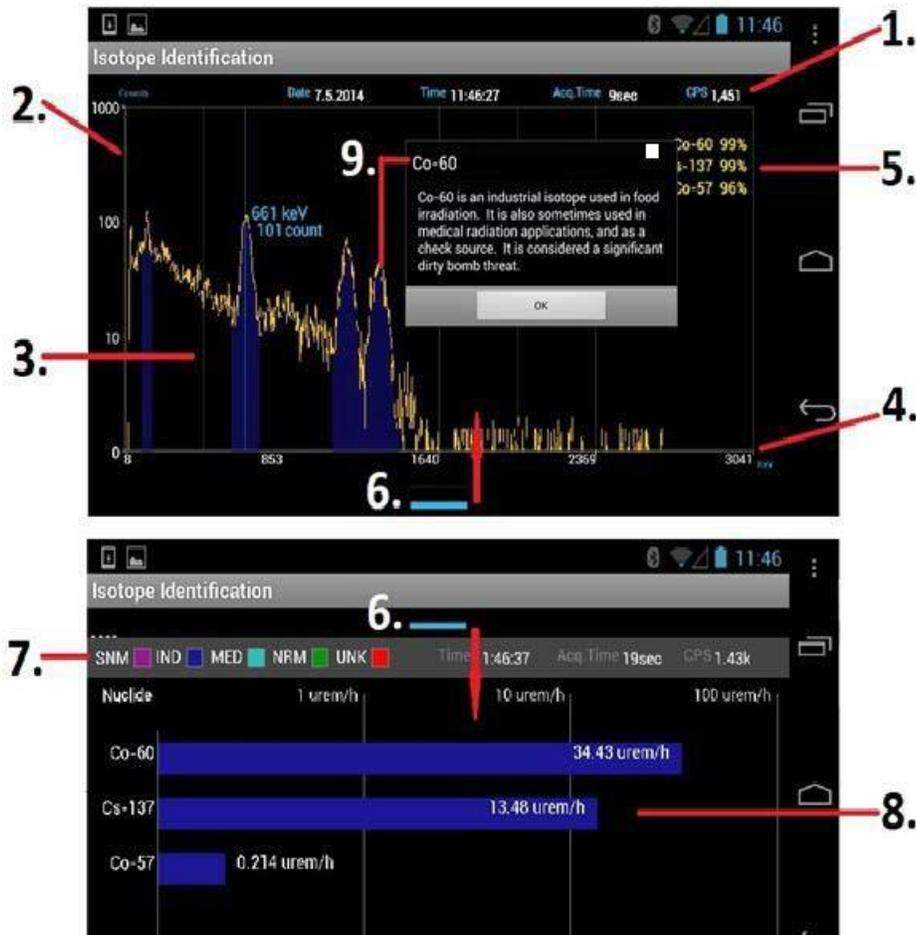


Figure 4.4 Isotope Identification screens: spectrum screen at top, classification screen at bottom

1	General information	Date, time, acquisition time, and counts per second (CPS)
2	Counts	Y-axis displays counts on a self-adjusting, logarithmic scale
3	Spectrum	Displays spectrum in real time
4	Channel/Energy	X-axis displays channel or energy on a linear scale
5	Isotope Identification	Displays nuclide identity and confidence level

6	Swipe bar	Swipe up to show the classification screen, swipe down to return to the spectrum screen
7	Classification	Classifies identified isotopes as: SNM – Special Nuclear Material – magenta IND – Industrial Isotopes – blue MED – Medical Isotopes – cyan NRM – Naturally Occurring Radioactive Material – green UNK – Unknown Material – red
8	Dose rate	Displays dose rate of classified isotope on color-coded, logarithmic bar graph
9	Help	Displays isotope name and description

If multiple isotopes are identified, the classification screen will place the most significant isotope (with the highest contributing dose rate) as the top-most bar, and the remaining isotopes in descending order by dose rate. Each bar will be named and displayed with the corresponding classification color.

Tip: Touching an identified isotope peak or bar will pop up a help screen with additional information about that particular isotope.

4.2.4 Spectrum Manipulation

You can manipulate the spectral display by touching areas of the screen (Figure 4.5).

The Y-axis maximum value is automatically adjusted based on the channel with the maximum counts.

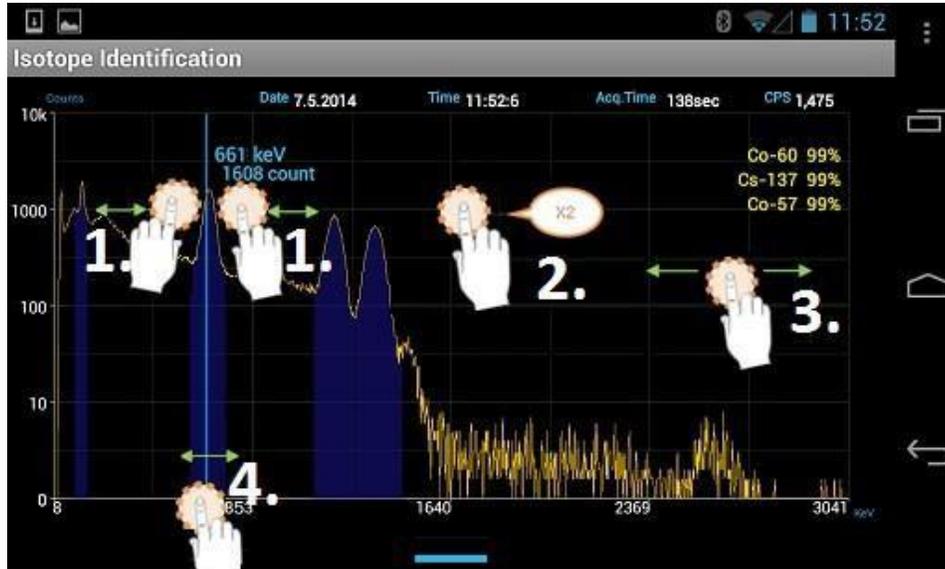


Figure 4.5. Spectrum manipulation features

1	Action	Touch with two fingers and spread or squeeze
	Effect	Widen or narrow a region of interest
2	Action	Double-tap
	Effect	Double-tap to zoom in, double-tap again to zoom out
3	Action	Hold and move left/right
	Effect	Shift spectrum along the x-axis (when zoomed in)
4	Action	Touch x-axis, hold, and move left or right
	Effect	Display energy and count value on a moveable line at the touched position

4.3 Basic Operating Instructions

4.3.1 Prepare Equipment for Operation

1. Turn on the SAM 945 (Figure 3.7) and the smartphone.
2. Open PeakAbout by touching the **PeakAbout** icon on the smartphone's Applications menu (Figure 4.6, left).

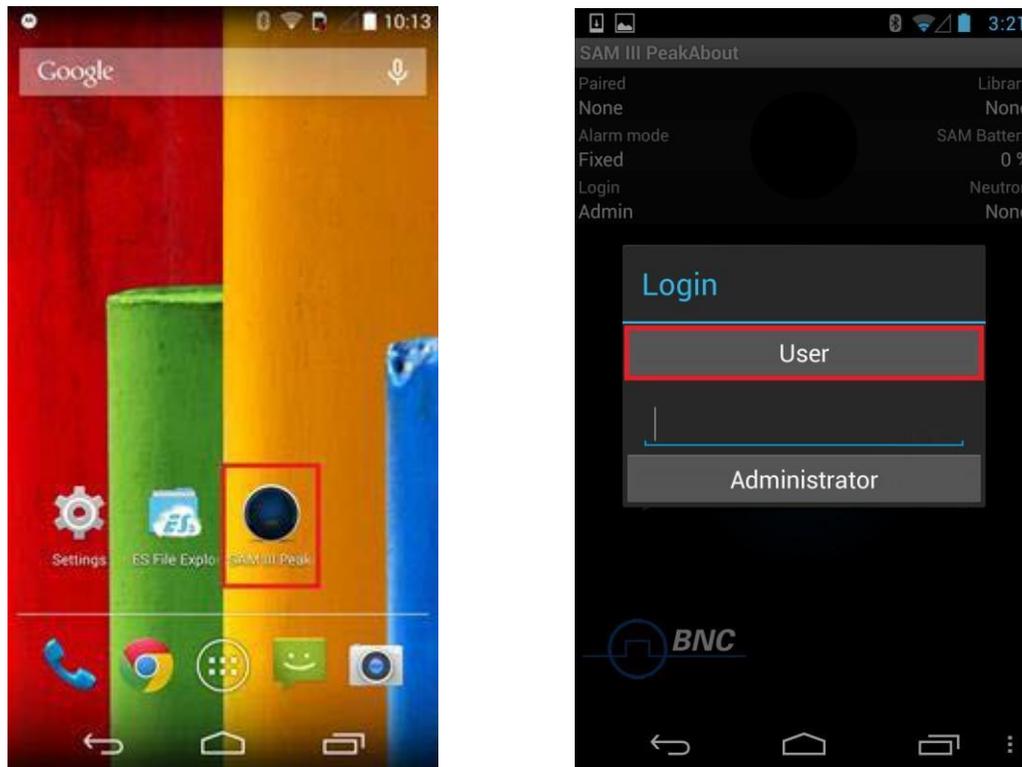


Figure 4.6. PeakAbout icon and login screen

4.3.2 Log In and Establish Bluetooth Connection

1. Log in as User (no password needed) or as Administrator (password protected) (Figure 4.6, right).

You must log in as Administrator to use the Setup functions.

The factory default Administrator password is 1234. To change the password, open the Setup menu and select Device Information / Password (Figure 4.9).

2. If PeakAbout does not automatically pair with the detector unit, you must establish a connection via Bluetooth.

- a. Touch the menu button  in the bottom right corner of the screen (Figure 4.7).
- b. Select Bluetooth from the menu.

The Bluetooth menu can only be opened when PeakAbout is in Setup mode. If the Bluetooth menu is pressed when PeakAbout is in Identification mode, the message “Now running” will appear below the logarithmic scale gauge.

- c. The Paired Devices list will appear (Figure 4.7). Select the desired device from the list.

The Bluetooth name of the detector unit always starts with BP. The 12-digit Bluetooth code appears on the label attached to the detector unit (Figure 2.1).

Previously connected SAM 945 units (and/or SAMpack 120 units) are automatically listed on the Paired Devices list. If a unit is not listed, touch **Scan for devices** to initiate a search for all units within range. PeakAbout can only pair with SAM 945 or SAMpack 120 units, although it may display other nearby Bluetooth devices.



Figure 4.7. Bluetooth menu and Paired Devices list example

4.3.3 Enter User Name and Location of Search

1. Touch the menu button  in the bottom right corner of the screen (Figure 4.8)
2. Select **Setup & Event** from the menu
3. Select **Setup Menu**



Figure 4.8. Navigating to the Setup menu

4. Select **User Name** and enter the appropriate information (Figure 4.9). Enter the **Search Location** likewise.

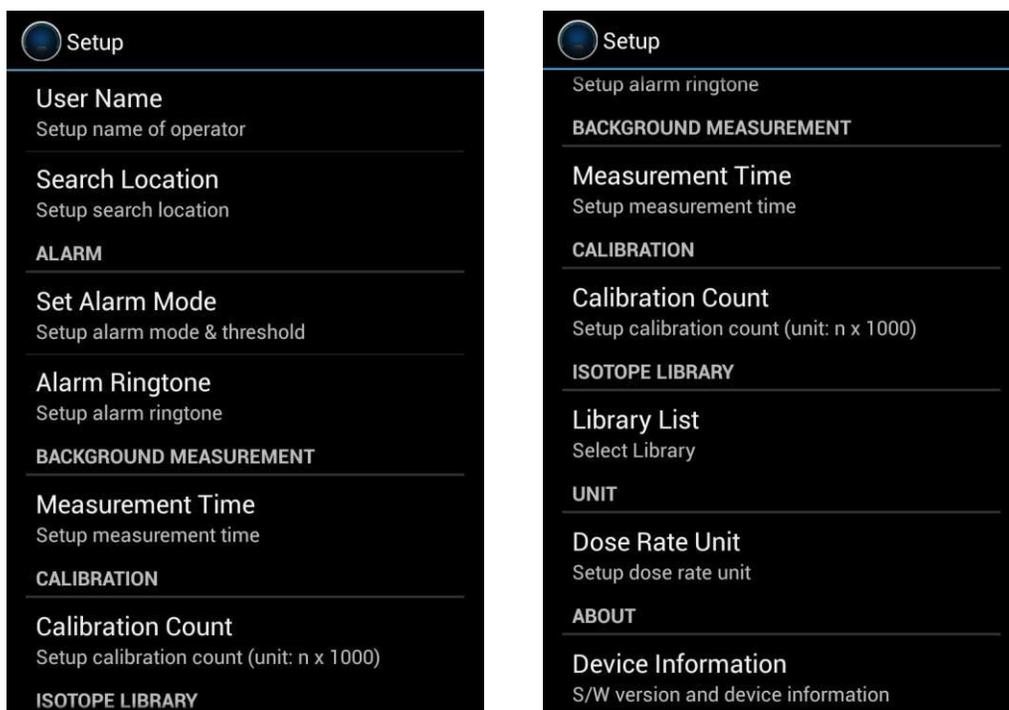


Figure 4.9. Setup menu screens

4.3.4 Select Alarm Threshold and Ringtone

PeakAbout provides two options for alarm triggering: Fixed and Variable.

Fixed Alarm Mode is a basic method that assumes the background environment exhibits a very small amount of fluctuation. The alarm is triggered when the count rate exceeds the operator-determined threshold value. This method can cause false alarms if there is substantial background fluctuation due to Naturally Occurring Radioactive Material (NORM), as is often the case when the system is moving across a large area while actively monitoring.

Variable Alarm Mode is a more advanced method that continuously samples the previous 20 seconds' worth of background fluctuation and calculates the standard deviation (σ , or sigma) of the fluctuation. Using this method prevents alarms due to changing background (and eliminates the need to perform new background measurements). Instead, alarms are triggered when real gamma peaks exceed the standard deviation of the threshold value. We

recommend using Variable Alarm Mode when moving across a large area that may be subject to changes in background.

1. From the Setup menu, select **Set Alarm Mode** (Figure 4.10). If selecting **Fixed Alarm Mode**, go to step 2. If selecting **Variable Alarm Mode**, skip to step 3.

You must log in as Administrator to change the alarm threshold values.

2. For Fixed Alarm Mode, the default threshold value is 1000 counts per second (CPS), which is optimal for most applications. Either accept the default or enter a threshold count rate value in CPS, then touch **OK**.

A typical background environment produces around 200 CPS for the SAM 945's standard 3 x 3 inch NaI detector (lower if a high resolution detector option was chosen). A threshold value lower than 1000 is usually unnecessary, and is more likely to generate false alarms. In situations where the background environment is known to be above normal, it may be necessary to select a higher value in order to minimize false alarms.

3. The default threshold value for Variable Alarm Mode is 4 (sigma), and the typical range is 1 to 5. Either accept the default or enter a threshold deviation value in sigma, then touch **OK**.

Selecting a lower value creates slack in the threshold criteria and increases the likelihood of false alarms. Selecting a higher value can narrow the threshold criteria and cause significant gamma activity to be overlooked if it passes very quickly.

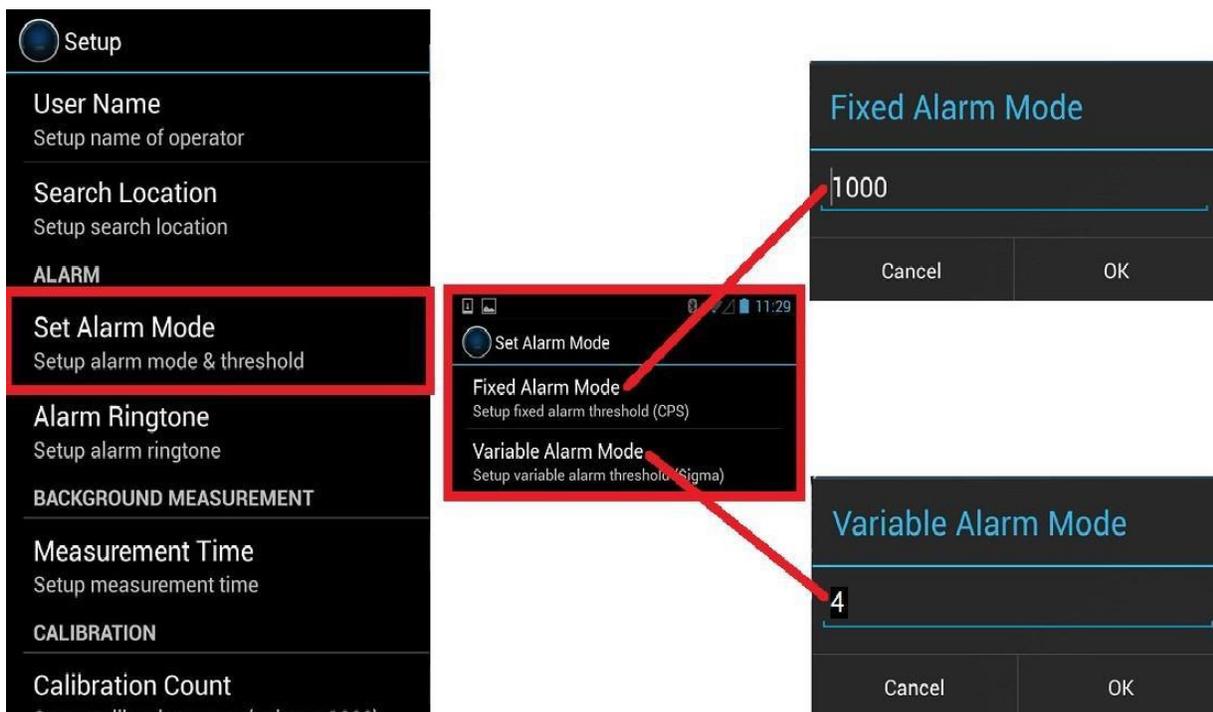


Figure 4.10. Alarm threshold configuration example

There are six alarm ringtones to choose from.

1. From the Setup menu, select **Alarm Ringtone** (Figure 4.11)
2. Highlight a ringtone to hear it play. Select the desired ringtone.
3. Save the selection by touching **OK**

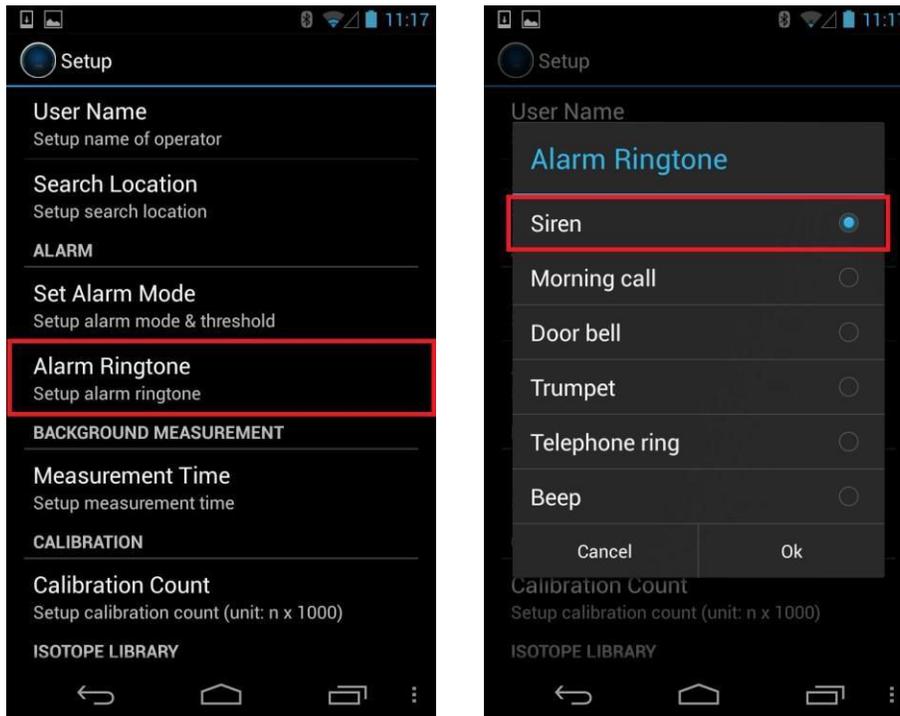


Figure 4.11. Select Alarm Ringtone

You can adjust the ringtone volume via the smartphone's Media Volume controls.

The Beep ringtone differs from the others in that the rate of the beeping increases when an increase in the count rate is detected. This can be a useful audio cue during a search operation.

For the user's protection, PeakAbout also features a separate alarm which is triggered when the safety threshold is exceeded. See section 4.4.1, Health Safety Alarm.

4.3.5 Perform Background Measurement

Reliable background information is critical to good nuclide identification and alarm performance. PeakAbout uses an advanced NORM rejection algorithm to minimize false alarms due to fluctuations of Naturally Occurring Radioactive Material in the background.

1. Make sure there are no unshielded radiation sources near the SAM 945.
2. With PeakAbout in Setup mode, rotate the smartphone 90° to initiate Background & Calibration mode.

Tip: Wearing polarized lenses can make the rotated screen appear blank. We recommend not wearing polarized lenses while using PeakAbout.

3. Touch the menu button  (now in the top right corner of the screen) and select **Background**.

The background spectrum (displayed in red) is automatically updated during the measurement (Figure 4.12).

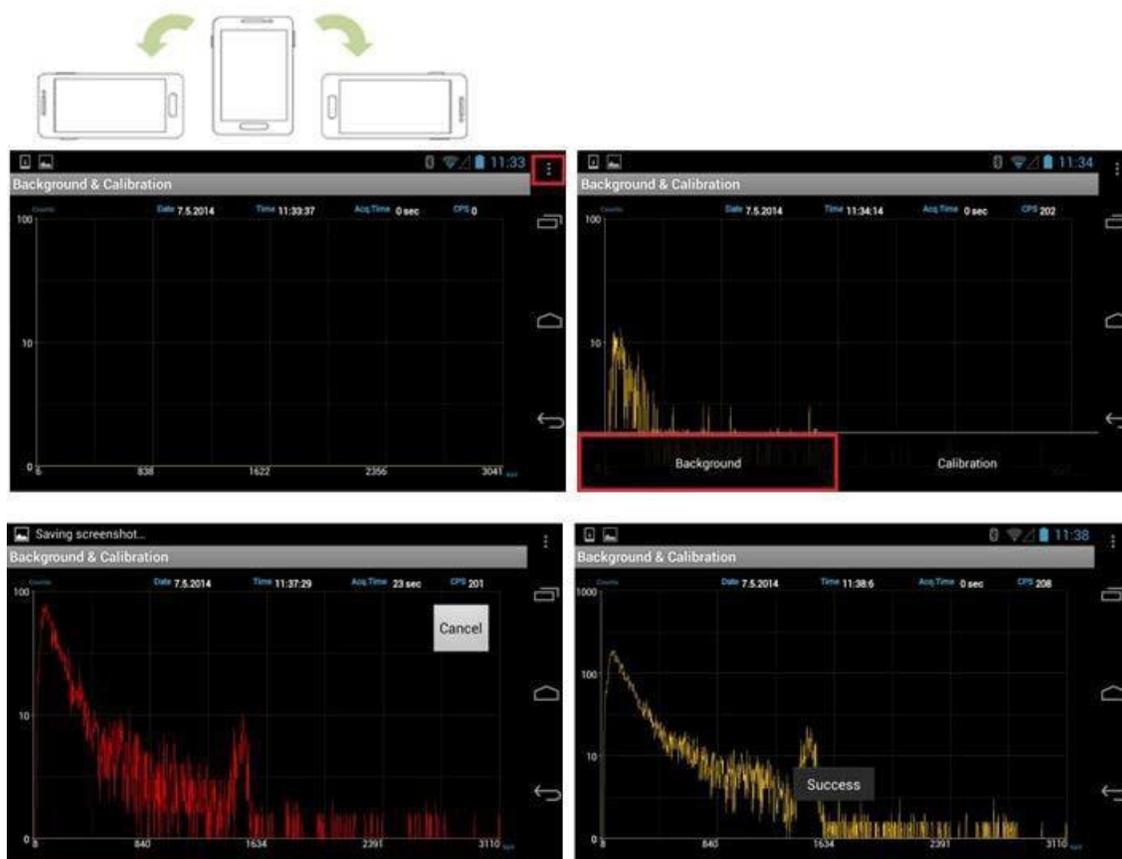


Figure 4.12. Background measurement example

Measurement time is defined in the Setup menu. To change this setting, select **Device Information / Measurement Time**.

4.3.6 Perform Manual Calibration

While we recommend performing manual calibration to ensure optimal results, most normal operations can be conducted without this step. If a Cs-137 source is not available, skip to section 4.3.7.

1. With PeakAbout in Setup mode, rotate the screen 90° to initiate Background & Calibration mode (Figure 4.13).
2. Place a Cs-137 source next to the detector unit.

Ideally the Cs-137 source is active enough to elicit approximately 2500 counts per second (CPS). If the count rate is too high, increase the distance between the source and the detector unit. Decrease the distance if the count rate is low.

3. Touch the menu button  and select **Calibration**.

The calibration spectrum is displayed in red during the measurement.

When the selected number of counts have been acquired, the screen will display “Success” (Figure 4.13). The x-axis units change from channel number to energy (in keV). Remove the Cs-137 source.

Tip: We recommend that total integrated counts in the manual calibration spectrum be no less than 100,000. The number of counts is defined in the Setup menu. To change this setting, select **Device Information / Calibration Count**.

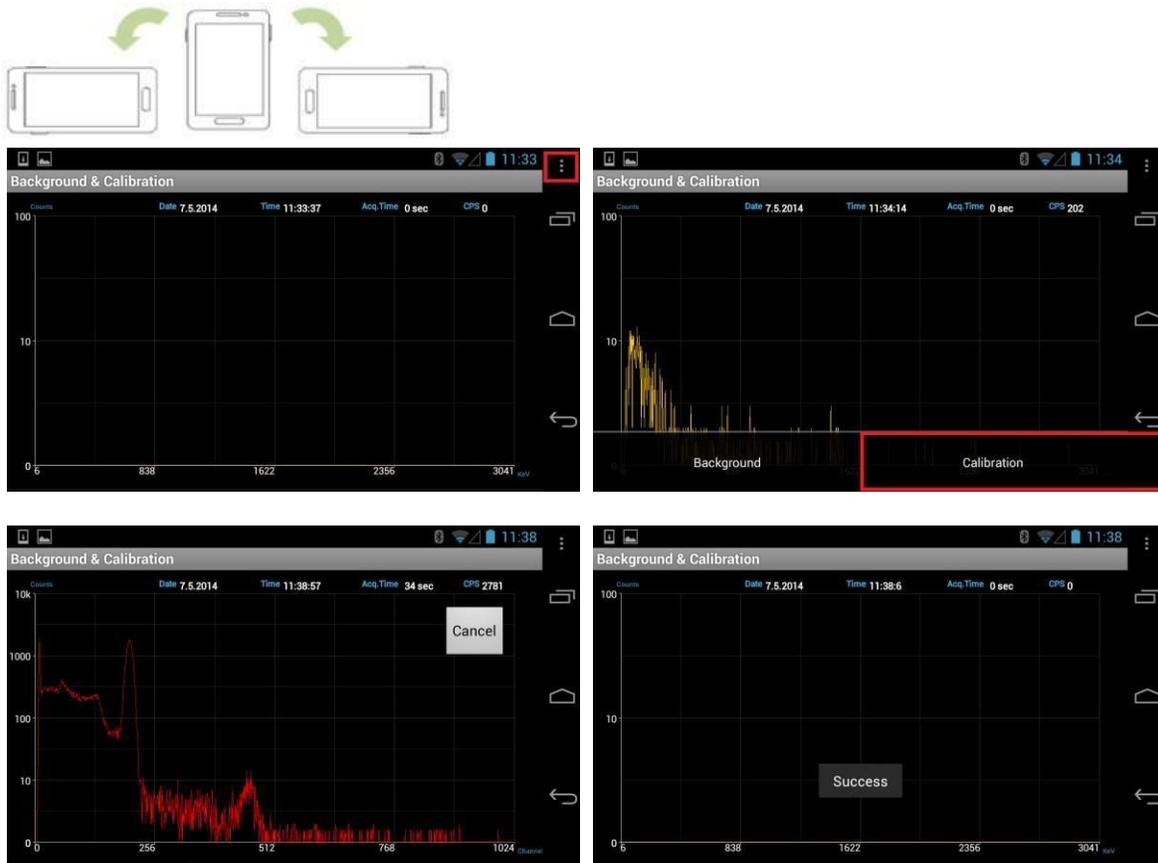


Figure 4.13. Manual calibration example

4.3.7 Monitor Radiation

If Variable Alarm mode is in effect, allow about 20 seconds for the unit to collect background and threshold data before surveying.

1. On the home screen, touch the **Select Mode** area to the lower right of the gauge to enter Identification mode (Figure 4.14).

Tip: Touching this area toggles between Setup and Identification mode. It displays “Setup” when in Identification mode.



Figure 4.14. Radiation measurement example

Smartphone notification bar	Displays smartphone status information. See smartphone manual for details.
SAM 945 status display	Paired: Bluetooth name of connected SAM 945 unit (starts with BP) Alarm mode: Operator-selected alarm threshold (Fixed or Variable) Login: Operator status (User or Administrator) Library: Operator-selected isotope library (ANSI or customized) SAM Battery: Battery life (%) of connected SAM 945 unit Neutron: Neutron count rate (“None” if option is not installed)
Select Mode area	Toggles between Identification mode and Setup mode
Bluetooth and alarm status	SAM 945 icon blinks during monitoring and turns red when the system alarms. Bluetooth symbol displays when paired to one or more detector units.
Gamma activity	Gauge displays gamma activity in dose rate units and counts per second

2. The gauge displays both the dose rate (rem/h or Sv/h) and count rate (counts per second (CPS)) of gamma activity. The scale is logarithmic. PeakAbout automatically scales to urem/h or mrem/h (nSv/h or mSv/h) according to the detected activity level.

The default dose rate unit is rem/h and can be changed to Sv/h. To change this setting, select Device Information / Dose Rate Unit from the Setup menu (Figure 4.9).

Several methods have been proposed for calculating dose rate from spectral data acquired with a NaI(Tl) detector. The SAM 945 employs a method defined by Kwon et. al.¹

3. Rotate the smartphone 90° to initiate the Isotope Identification screen and enable manipulation of the spectrum as described in Figure 4.5.

¹ Calculation of Neutron and Gamma-Ray Flux-to-Dose-Rate Conversion Factors, S. Kwon, K. Kim, C. Ha, S. Moon and C. Yook, Journal of the Korean Nuclear Society Vol. 12, N 3, September, 1980.

4.3.8 Identify Isotopes When the SAM 945 Has Alarmed

When the unit detects gamma activity above the alarm threshold, the readout on the gauge changes from white to red (Figure 4.15), the SAM 945 icon turns red, and the audible alarm sounds. PeakAbout automatically identifies the detected nuclide(s) and saves relevant data in an Event Log file.

Rotating the smartphone 90° will activate the Isotope Identification screen where identified isotopes are displayed along with their confidence levels (Figure 4.15). Up to 10 isotopes can be identified simultaneously and presented on the Isotope Identification and spectrum analysis screens.

To be identifiable, the isotopes must be in the selected Isotope Library. If a custom Isotope Library is selected, you can look up its name by opening the Setup menu and scrolling down to the Library List option (Figure 4.9).

Refer to Figure 4.5 for instructions on using the spectrum analysis tools.

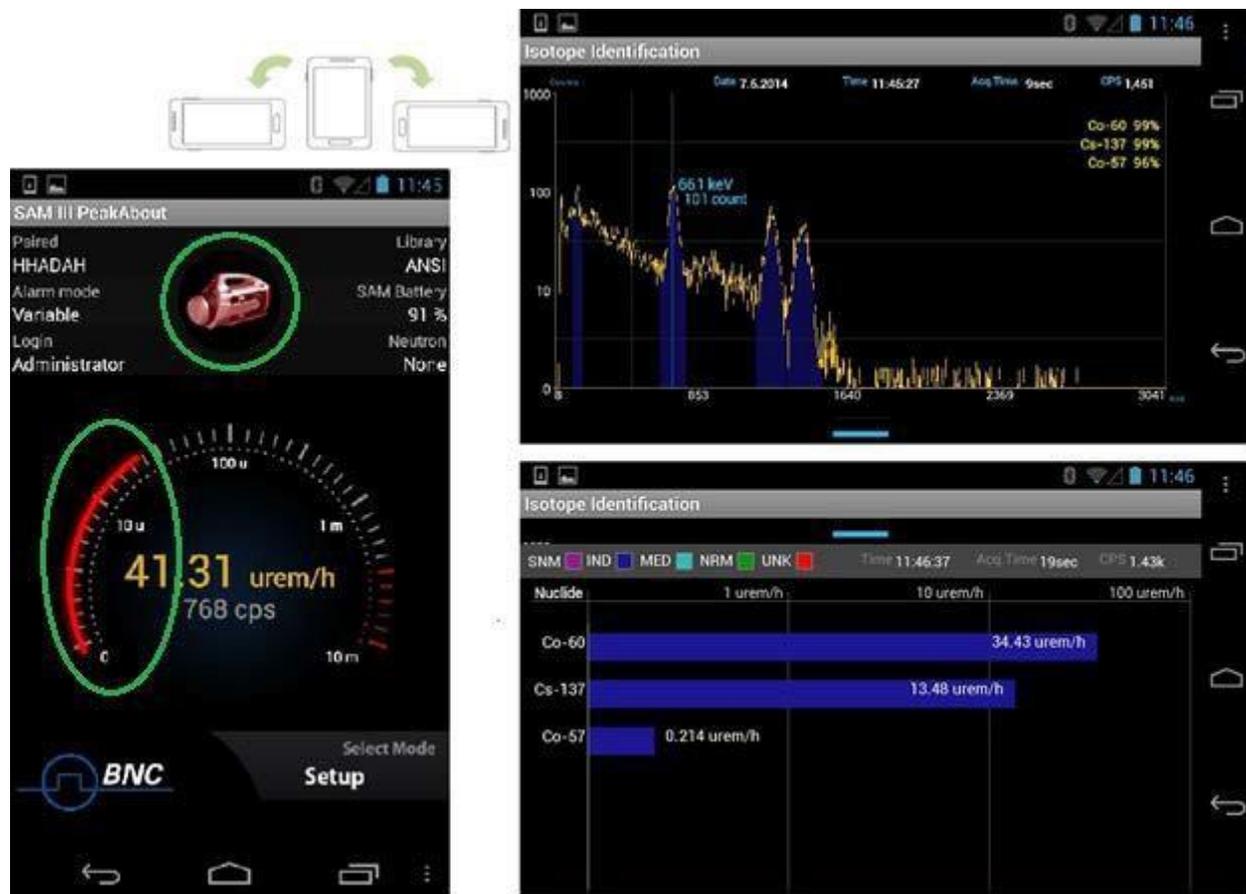


Figure 4.15. Isotope Identification example

4.3.9 Identify Isotopes Manually

You may also choose to perform identification manually. Manual Identification cannot be started when the SAM 945 is already in an alarm condition.

1. With PeakAbout in Identification mode, rotate the smartphone 90° to display the Isotope Identification screen.
2. Touch the menu button  to display the Manual Identification bar at the bottom of the screen (Figure 4.16).
3. Touch the **Manual Identification** bar to start an event spectrum.

Touching **+** or **-** extends or reduces the capture time in increments of 30 seconds. The default Manual Identification capture time is 60 seconds.

When the capture time has elapsed, the default Isotope Identification screen returns. Touch **Cancel** to return to the default at any time.

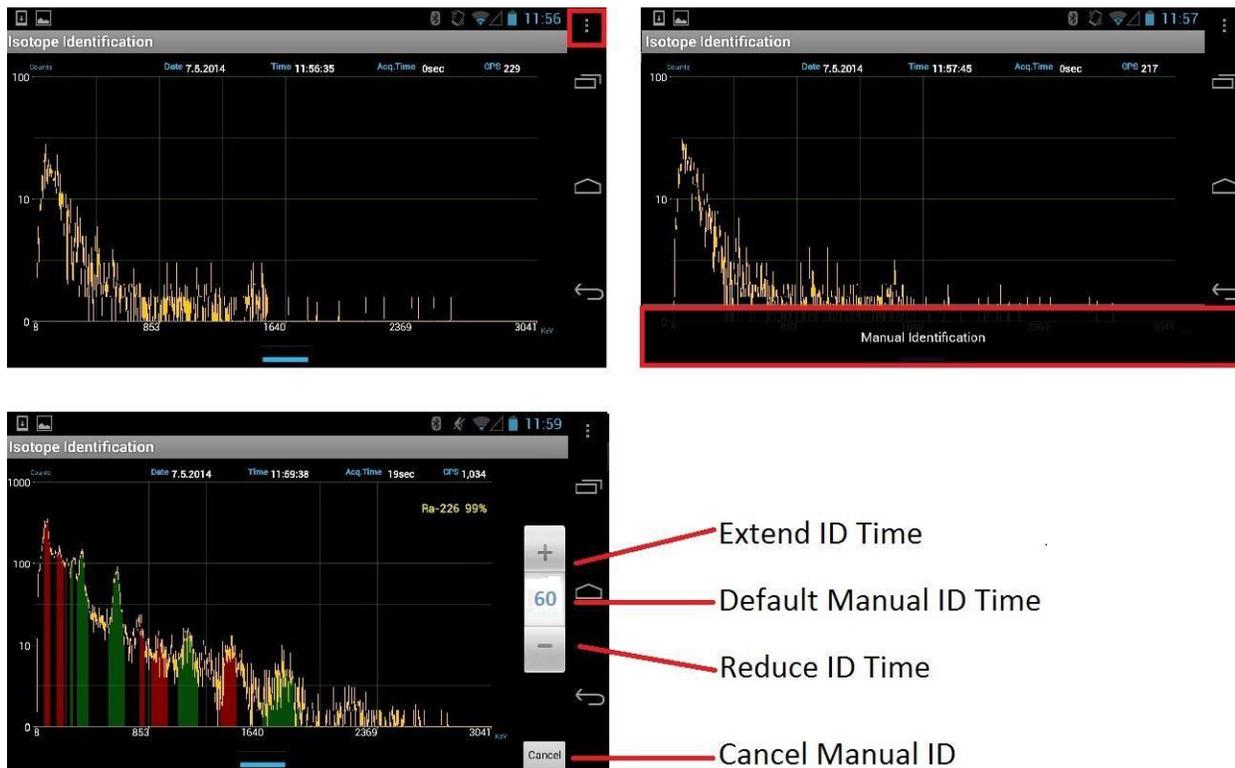


Figure 4.16. Manual Identification example

4.4 Operating Instructions: Additional Features

4.4.1 Health Safety Alarm

For the user's safety, PeakAbout features a separate Health Safety Alarm (Figure 4.17) with a distinctively different ringtone and visual signal. When the safety threshold is exceeded, the Health Safety ringtone sounds, the SAM 945 icon changes to a red and white radiation hazard symbol, and the background of the gauge turns red. The Health Safety Alarm takes precedence over all other alarms.

To change the threshold, select **Health Safety Threshold** from the Setup menu (Administrator login is required). The threshold is defined in units of dose rate (rem/h or Sv/h).



Figure 4.17. Health Safety Alarm example

4.4.2 View the Event Log List

When the SAM 945 alarms or you manually identify an isotope, PeakAbout automatically generates an Event Log and saves it on the smartphone. A summary of each alarm event or Manual Identification event appears in the Event Log list (Figure 4.19).

1. With PeakAbout in Setup mode, touch the menu button  (Figure 4.18)
2. Select **Setup & Event**
3. Select **Event Log**

Tip: The Event Log list can only be opened when PeakAbout is in Setup mode. If you select Event Log when PeakAbout is in Identification mode, the message “Now running” appears below the logarithmic scale gauge.



Figure 4.18. Navigating to the Event Log menu

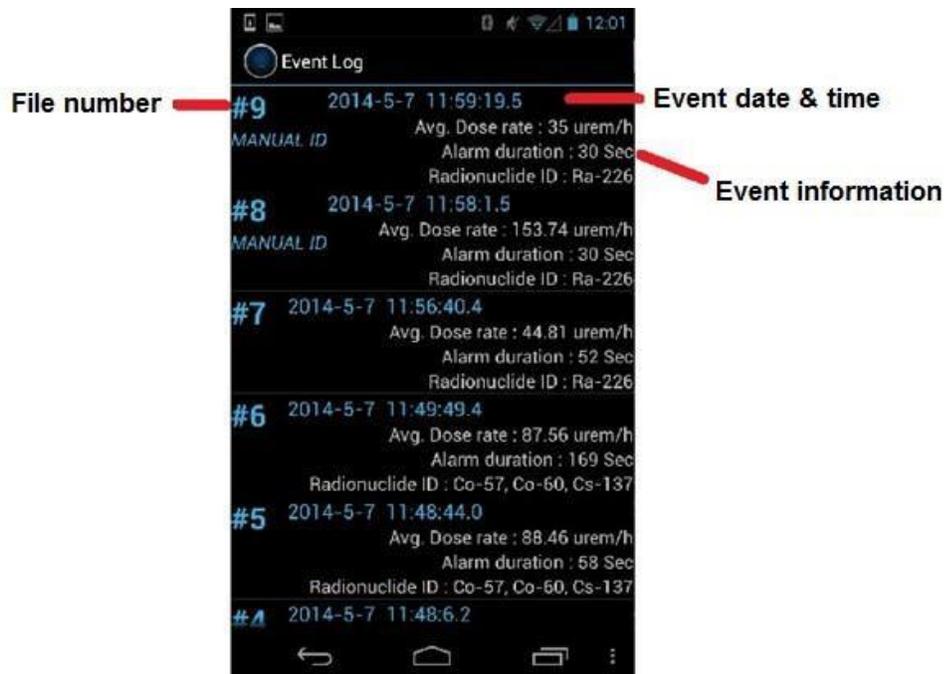


Figure 4.19. Event Log list example

Event data can be downloaded by connecting the smartphone to a PC that has PeakID installed on it (see Chapter 5). Once the event data has been downloaded to the PeakID database, it is automatically deleted from the smartphone.

4.4.3 Analyze an Event

Complete analysis of the spectra for the saved events can be performed with either a smartphone (see below) or a PC (see Chapter 5).

1. Select an event from the Event Log list
2. Rotate the smartphone 90° **counter-clockwise** (Figure 4.20) to display the Event Analysis screen

Event information is displayed on the right-hand side of the screen. The spectrum manipulation techniques described in Figure 4.5 can also be used on the Event Analysis screen.



Figure 4.20. Event Analysis screen

4.4.4 Attach Comments and Photos/Videos to an Event

You may attach comments and multiple photos and/or videos to a saved event.

1. Select an event from the Event Log list and rotate the smartphone 90° counter-clockwise. The Event Analysis screen will open.
2. To attach a comment, touch the **Event Info** tab to open the Event Info screen (Figure 4.21, left).
 - a. Touch the blinking cursor in the Comment field at the bottom of the screen (Figure 4.21, right).
 - b. Type your comment and touch **Done** (Figure 4.22, left). To add more text, repeat 2.a and 2.b.

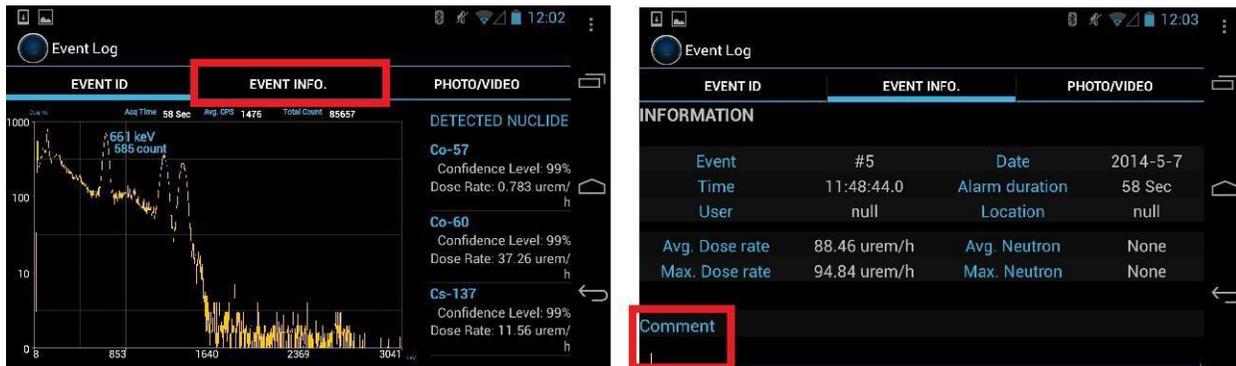


Figure 4.21. Navigating to the Comment field

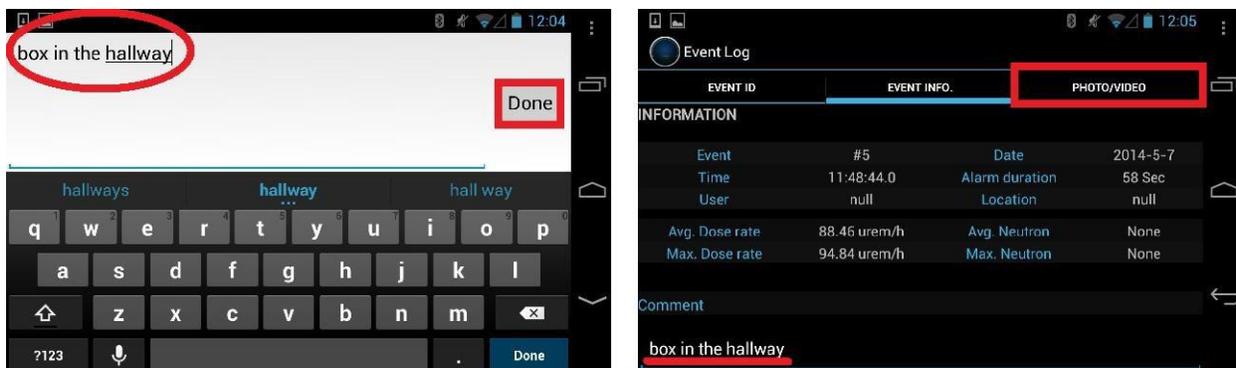


Figure 4.22. Attach Comment example

3. To attach a photo, touch the **Photo/Video** tab (Figure 4.22, right) to open the Photo/Video screen (Figure 4.23).
 - a. Touch the menu button  and select either **Photo** or **Video** (Figure 4.23, left).
 - b. Touch the screen to capture the photo or video.
 - c. When the photo or video is captured, touch the **checkmark** to save it or touch the **X** to reject it.

You will automatically be returned to the Photo/Video page. The image is now displayed as part of the event (Figure 4.23, right). Repeat steps 3.a through 3.c to add more images.

4. Touch the return key  on the lower right side of the screen (Figure 4.23, right) to return to the Event Log.

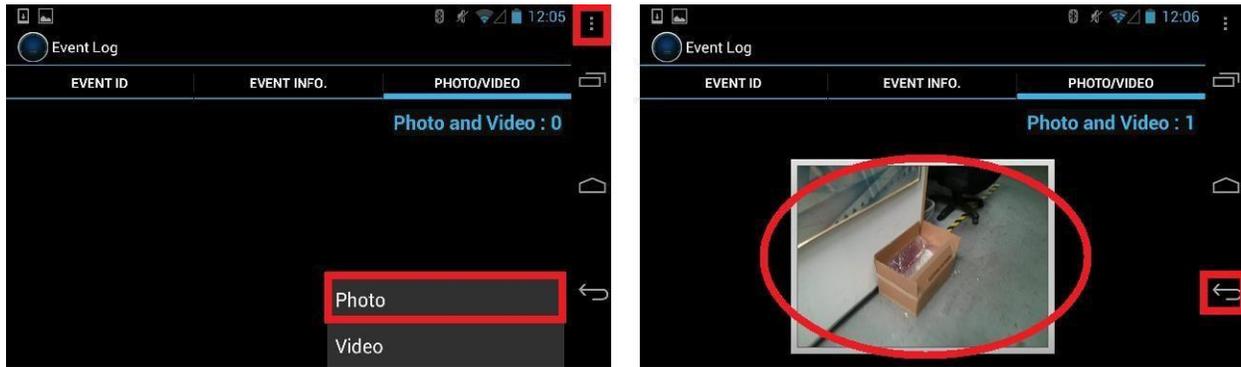


Figure 4.23. Attach Photo example

4.4.5 Auto Calibration and Auto Stabilization

The Auto Calibration and Auto Stabilization features adjust the calibration parameters of the SAM 945 to correct for any drift caused by environmental changes (generally ambient temperature). If drift of more than $\pm 6\%$ between the stabilized peak and the original peak (Cs-137 calibration peak) occurs, then you must perform manual calibration using a Cs-137 source.

Auto Calibration automatically executes when the detector unit is paired with PeakAbout via Bluetooth. While we recommend waiting for Auto Calibration to complete (100%) before proceeding, Auto Calibration can be stopped by touching Cancel if necessary (Figure 4.24).

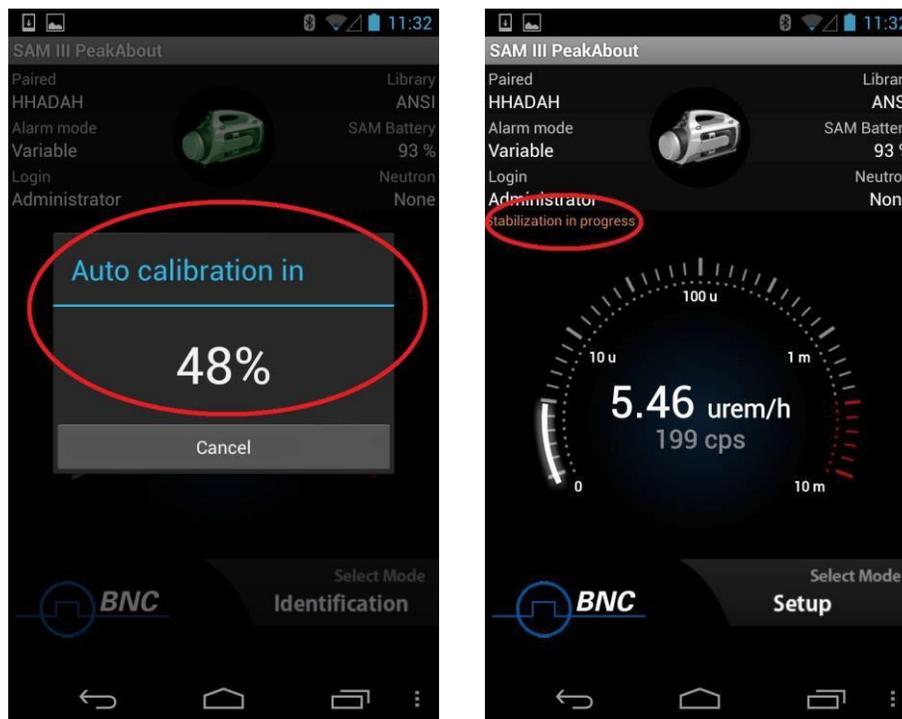


Figure 4.24. Auto Calibration and Auto Stabilization example

Auto Stabilization begins immediately after the completion or cancellation of Auto Calibration and executes again every five minutes, unless the system is in an alarm condition.

When Auto Calibration or Auto Stabilization is executed, the system automatically adjusts its gain using the 1.4 MeV energy peak emanated by the K-40 radionuclide that naturally occurs in potassium. Potassium chloride (KCl) powder is securely installed within the detector unit, and no other calibration source is needed. If necessary, such as in the rare case of a location where levels of potassium are unnaturally low, supplemental KCl can be used to achieve stabilization more quickly.

4.4.6 Sequential Mode

The purpose of Sequential mode is to generate a series of events separated by short pauses, one right after the other. The entire sequence is generated automatically, without the operator needing to click Manual Identification each time. Each event in the sequence has the same measurement time (capture time), and each pause before the next event is the same. The sequence continues for a specified number of events or until the user interrupts and cancels the sequence. Sequential mode is useful for plotting a series of events while the SAM 945 moves along a continuous path.

For each event in the sequence, the SAM 945 collects the date, time, GPS position, overall count rate, overall dose rate, count rate and dose rate for each identified isotope, and other typical event data (including the identified neutron rate if the neutron option is installed). After the survey, all of the spectral data from the entire sequence may be batch processed (to a spreadsheet, for example) with a single command.

Administrator login is required to enable or disable Sequential mode, or to change the settings.

1. On the Setup menu, select **Setup Sequential Mode**.
2. To enable Sequential mode, place a check in the box (Figure 4.25).

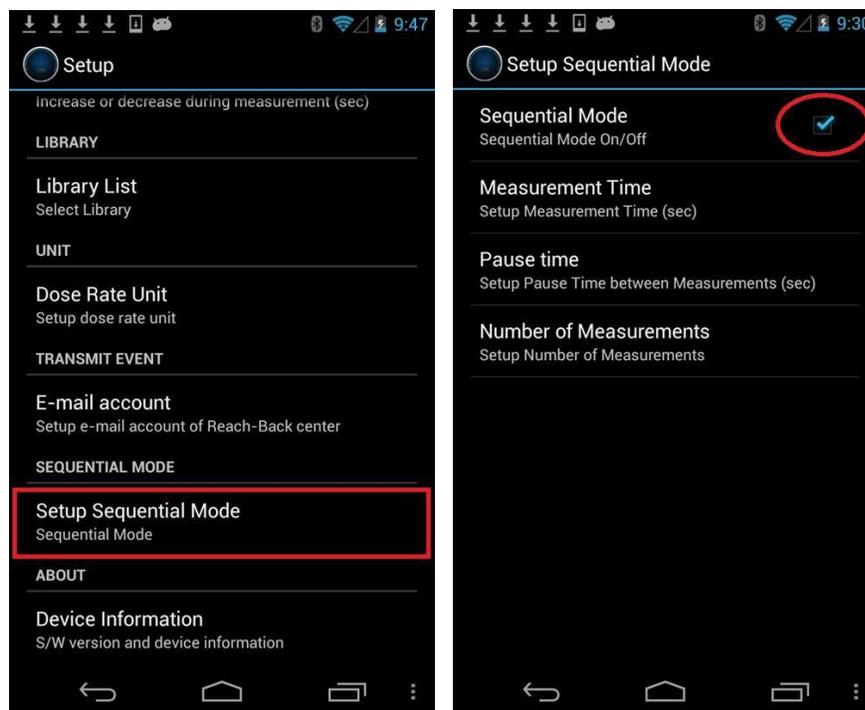


Figure 4.25. Sequential mode setup

Sequential mode default settings	
Measurement Time	60 seconds
Pause Time	5 seconds
Number of Measurements	5

3. To change a setting, select the desired option, use the keypad to enter a new setting, and touch **OK**.

- After Sequential mode has been enabled, starting a sequence of event captures is similar to starting Manual Identification.

With PeakAbout in Identification mode, rotate the screen 90° to display the Isotope Identification screen.

Touch the menu button  (Figure 4.26). The bottom bar displays **Manual Identification** and **Sequential mode**.

If **Sequential mode** does not appear on the bar, it is currently disabled. To enable, make sure there is a check in the box as shown in Figure 4.25.



Figure 4.26. Starting Sequential mode

- Touch **Sequential mode** and an event spectrum will begin immediately. Sequential mode will not start if an alarm is in progress.

PeakAbout displays the sequence count and the measurement time (Figure 4.27). Increasing or decreasing the measurement time is not allowed while a sequence is in progress.



Figure 4.27. Sequential mode event capture example

- When the event capture time has elapsed, the Isotope Identification screen returns to the real-time spectrum display (Figure 4.28). The event is automatically numbered and saved. PeakAbout displays the next event number along with the total number of event captures in the sequence (count 3/10 in Figure 4.28).



Figure 4.28. Sequential mode example showing pause between event captures

- During the pause, the SAM 945 may be moved to a different location. When the pause time has elapsed, another event spectrum will automatically begin.
- When the specified number of event captures is completed, the Isotope Identification screen will display the message "Sequential Mode Completed" and return to the real-time spectrum display.
- You may abort the sequence at any time by pressing the **Cancel** button in the lower right corner (Figure 4.28). PeakAbout will return to the real-time spectrum display. All completed events will be saved.

10. You may view saved sequences in the same way you view events (touch the menu button  and select **Setup & Event**, then select **Event Log**). Events captured in Sequential mode are labeled with the additional designation “SM#” (Figure 4.29).

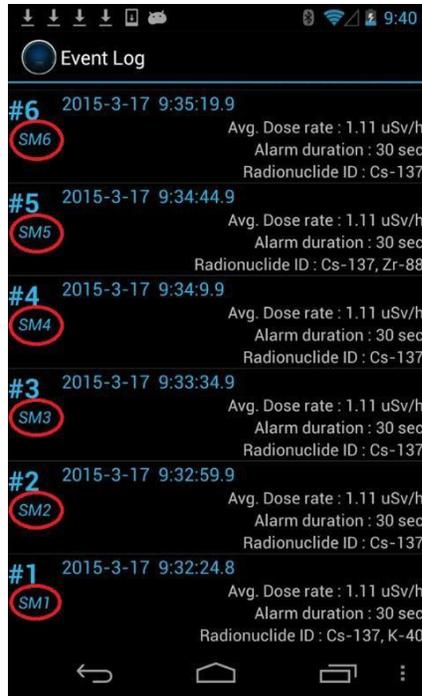


Figure 4.29. Sequential mode Event Log list example

4.4.7 Gauge Mode and Finder Mode

By touching the center of the screen and swiping left or right, you can change the Identification screen from Gauge mode to Finder mode (Figure 4.30).



Figure 4.30. Gauge mode and Finder mode example

Finder mode emphasizes count rate rather than dose rate information. Counts per second (CPS) are displayed on a graph that moves to the left as it updates every second. The full graph represents the most recent 40 seconds of CPS. You might prefer to use Finder mode because the graph can alert you to a momentary increase in activity more effectively than the rapidly changing numerals on the Gauge mode screen. With Finder mode you also have a second chance to observe evidence of a source that you might not notice otherwise.

The system will alarm (including the Health Safety Alarm) regardless of which mode it is in when the alarm threshold is exceeded.

4.4.8 Move Closer/Move Back

To enhance the reliability of PeakAbout's statistics, the system may prompt you to maintain a count rate close to the optimal range of 2000 to 3000 counts per second (CPS). When the count rate is just above normal background, the message "MOVE CLOSER" will appear above the Select Mode area (Figure 4.31). If the count rate is too high (more than 40,000 CPS), PeakAbout will likewise display the message "MOVE BACK."

The Move Closer/Move Back feature applies only in Gauge mode.



Statistics are more reliable when the count rate is optimal.

The optimal count rate is from 2000 to 3000 CPS.

"MOVE CLOSER" will appear if the count rate is too near the background.

"MOVE BACK" will appear if the count rate exceeds 40,000 CPS.

Figure 4.31. Move Closer example

4.4.9 Wireless Data Transmission (Reach-Back)

When operating within range of cellular service or Wi-Fi, PeakAbout allows you to transmit spectrum and event data directly from the smartphone to a prearranged location such as a U.S. DOE reach-back facility, group leader, command center, etc. Data from an alarm event that you select is emailed in N42 format to the specified recipient.

To use this feature, you must already have established an email account on the smartphone (the system is optimized for Gmail by Google). Refer to the smartphone manual for instructions on setting up an email account. The PeakAbout Reach-Back setup screen will ask you to enter SMTP server and port settings for the smartphone's email account. Make note of these settings before opening the Reach-Back Email Account menu item. SMTP server and port settings can usually be found on the smartphone at Settings | Accounts | Email | Account settings | Email account | Outgoing settings.

1. Enter your email address and the recipient's email address
 - a. Open the Setup menu (Figure 4.32, top)
 - b. Scroll to TRANSMIT EVENT and select **E-mail account** (Figure 4.32, lower left)
 - c. Enter the recipient's address under Reach-Back account (Figure 4.32, lower right)
 - d. Enter the sender's address under Sender (Figure 4.32, lower right)
 - e. Enter the SMTP server and port settings for the smartphone's email account. This information can usually be found on the smartphone at Settings | Accounts | Email | Account settings | Email account | Outgoing settings.

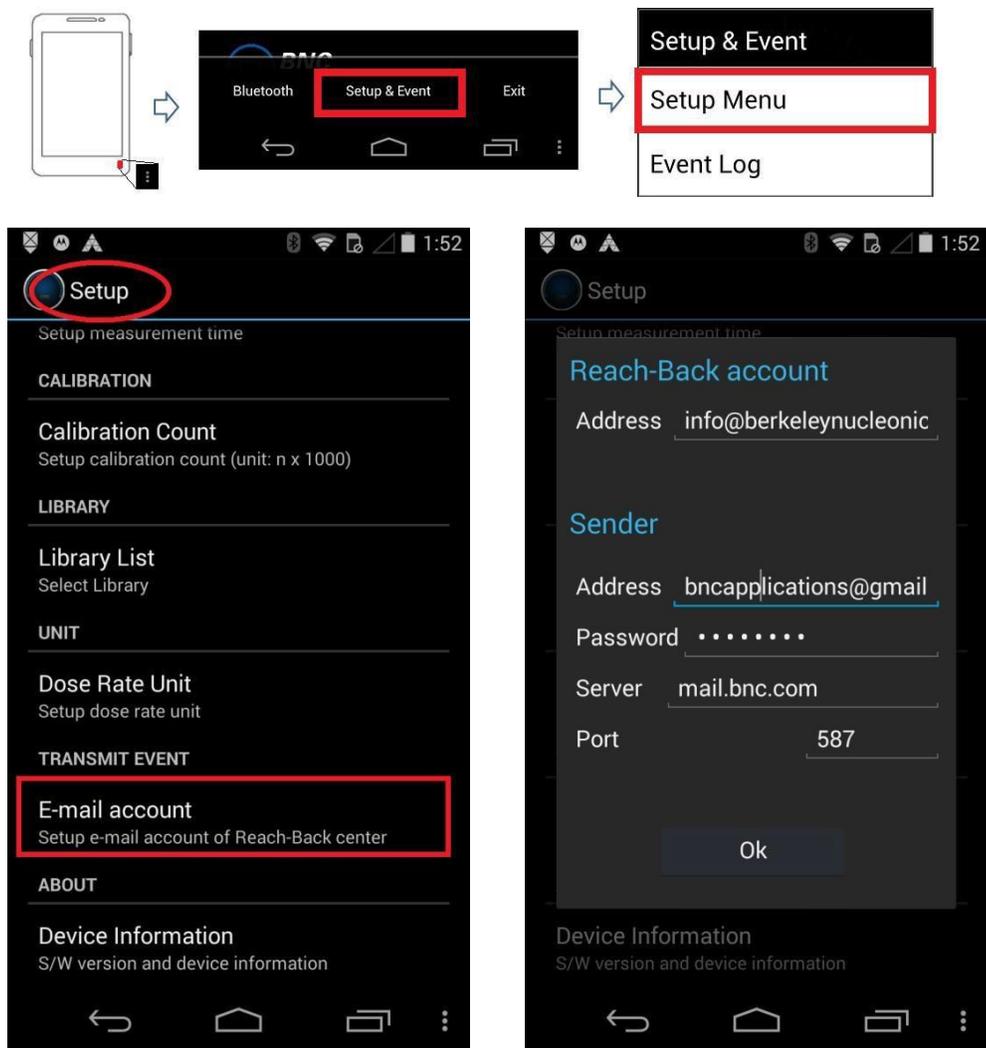


Figure 4.32. Email setup example for wireless data transmission

2. Select and transmit an event

- a. Open the Event Log list (Figure 4.33, top)
- b. To select an Event Log from the list, touch and hold it for two seconds (Figure 4.33, lower left and center)
- c. At the “Transmit N42 file” prompt, touch **Transmit** (Figure 4.33, lower right)

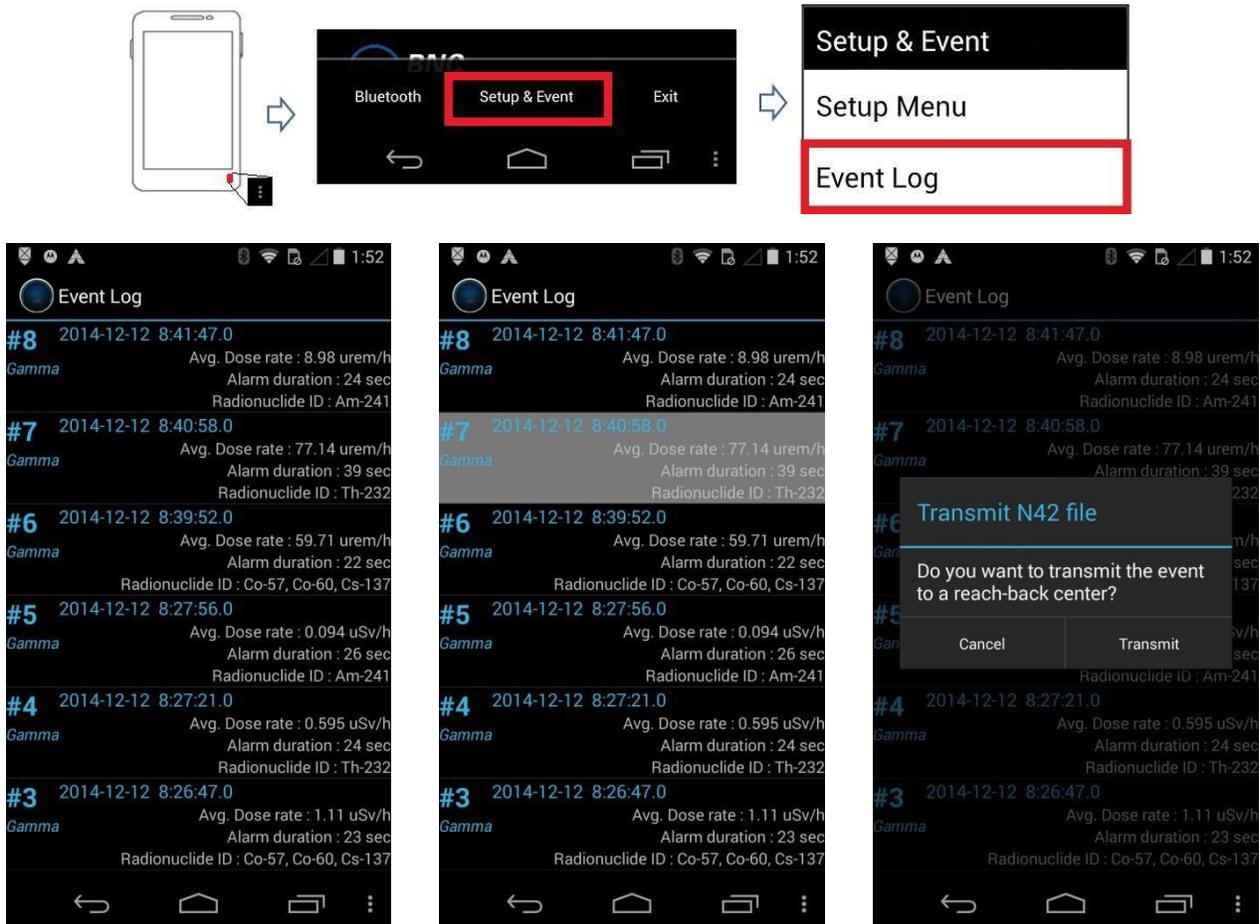


Figure 4.33. Wireless data transmission example

3. View the results (Figure 4.34)

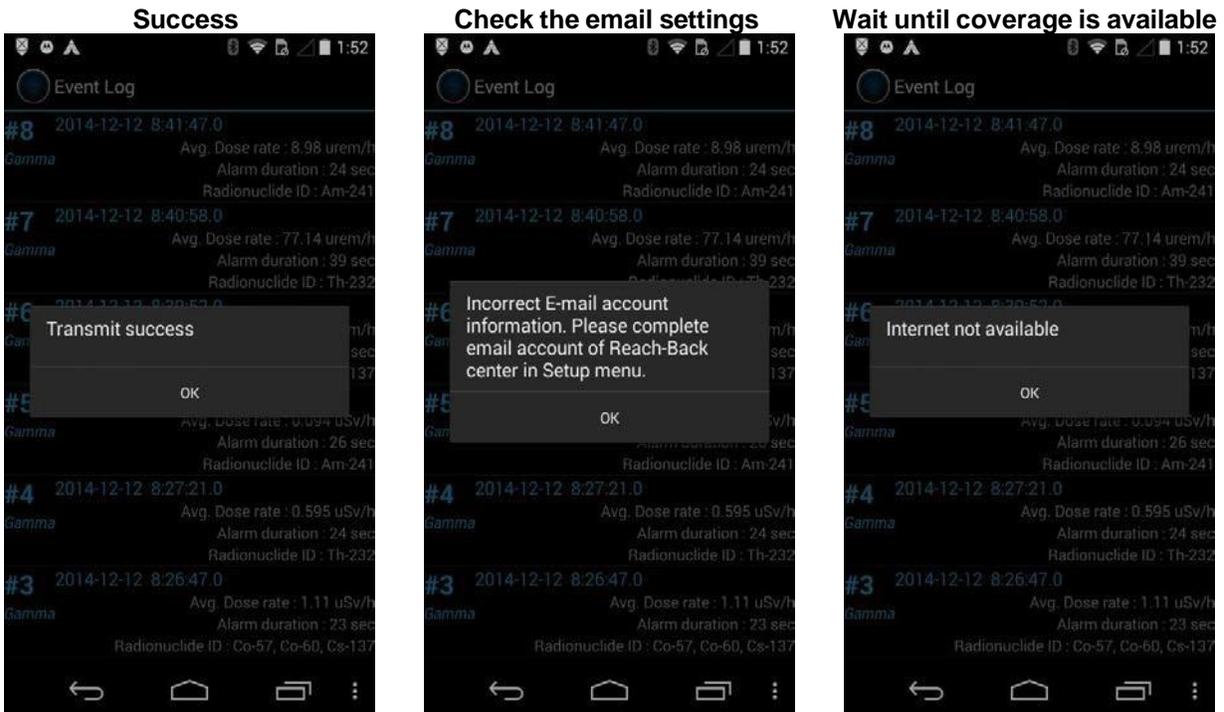


Figure 4.34. Transmission results messages

Result	Message on Screen	Action Needed
Transmission was completed	Transmit success	Touch OK to clear the message
Transmission failed due to incorrect email setup	Incorrect email account information. Please complete email account of Reach-Back center in Setup menu.	See step 1 above
Transmission failed due to lack of network connection	Internet not available	Wait until coverage is available

4.4.10 Neutron Option

If your SAM 945 unit includes the neutron detector option, solid-state sensor arrays on ^6Li substrate (Domino) are integrated with moderator packaging inside the detector unit. PeakAbout will display neutron activity on the Identification screen in counts per second (CPS) (Figure 4.35, left).

To set the neutron alarm threshold, open the Setup menu and select **Neutron Threshold** (Figure 4.35, right). Administrator login is required.

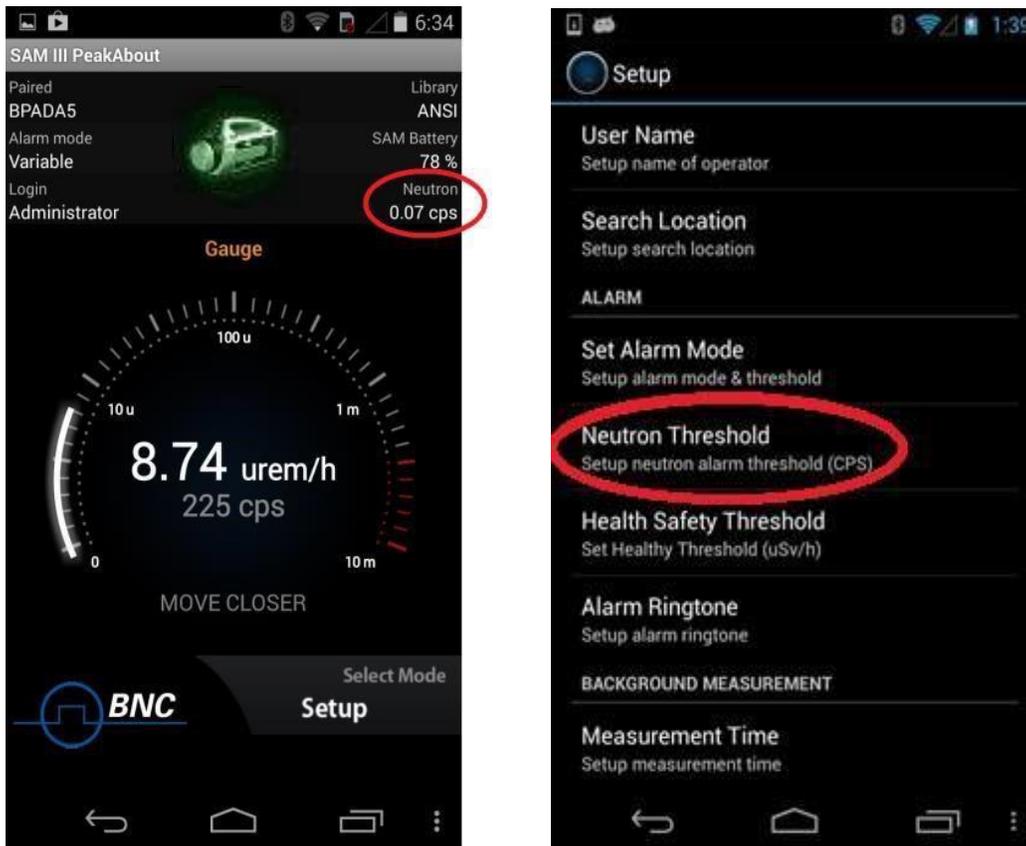


Figure 4.35. Features available with neutron detector option
Left: Neutron activity on home screen
Right: Neutron alarm threshold setting on Setup menu

4.5 Upgrading PeakAbout

When the smartphone is online via a cellular or Wi-Fi network, PeakAbout automatically checks for software upgrades. If an upgrade is available, this message will crawl across the bottom of the home screen: "Latest version of SAM III software is available. Please download it from Setup / Device Information /."

If you are upgrading from a version earlier than 3.6.0, go to step 5 below.

1. Open the Setup menu, scroll down to the bottom and select **Device Information**, then select **Download Latest SAM III SW** (Figure 4.36). A pop-up window will appear.

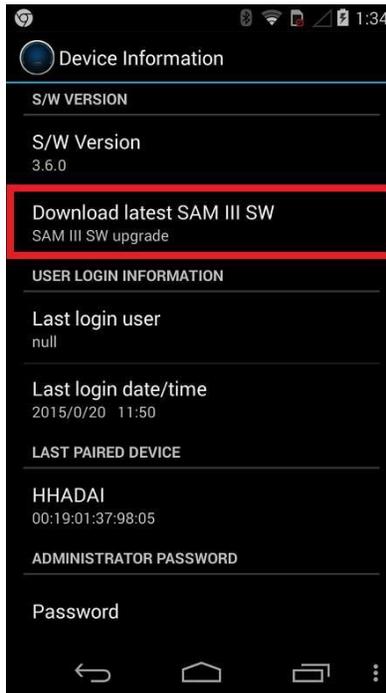


Figure 4.36. PeakAbout software upgrade, step 1

2. In the pop-up window (Figure 4.37), enter the BSN number from the label on the detector unit (Figure 2.1), then touch the **PeakAbout** button.



Figure 4.37. PeakAbout software upgrade, step 2

3. Open the status menu of the smartphone by touching and dragging the top menu bar (Figure 4.38).

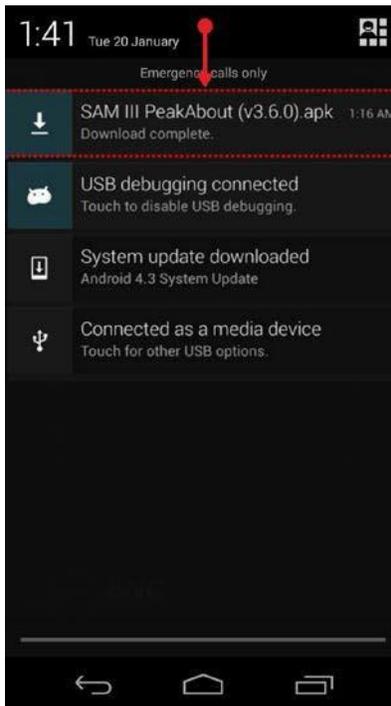


Figure 4.38. PeakAbout software upgrade, step 3

4. When download has completed, touch **SAM III PeakAbout (V.x.x.x).apk**. The upgrade will install automatically.
5. If you are upgrading from a version earlier than 3.6.0:
 - a. Open a web browser from the smartphone.
 - b. Go to www.bnccsam.com.
 - c. Go to step 2 above and follow the instructions through step 4.

CHAPTER 5. PEAKID APPLICATION

5.1 Connecting the Smartphone to a PC

PeakID supports management of Event Log files, data analysis including integration of data from multiple units, and data backup. It is compatible with PCs that run Windows 7 or higher.

The smartphone must be connected to a PC in order to install PeakID on the PC or to download Event Log data. A USB to micro USB cable is provided for this purpose.

It is important to exit PeakAbout before connecting to a PC. Once the smartphone is connected to the PC via the cable, pull down the notification screen and confirm that the smartphone is connected as a media device (Figure 5.1).

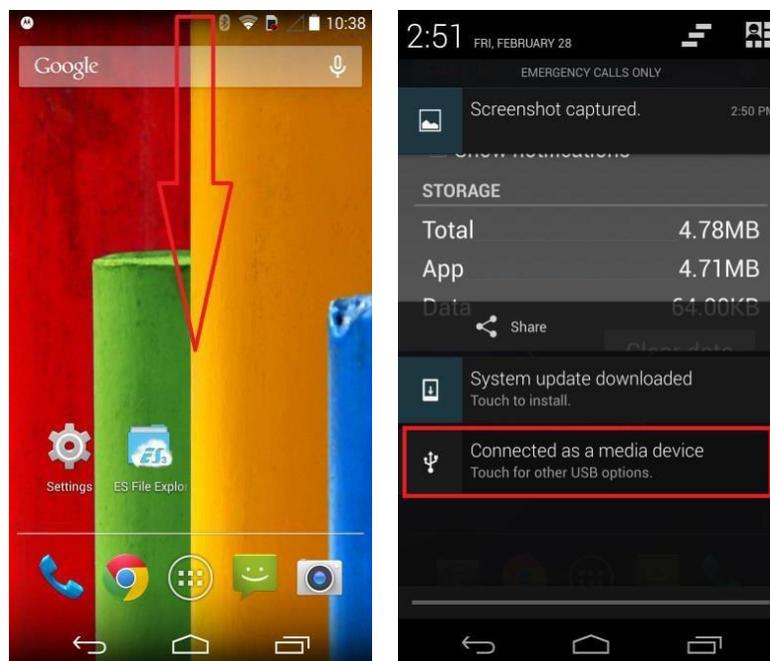


Figure 5.1. Notification screen showing smartphone connection to PC (typical)

5.2 Installing PeakID

Installing PeakID is a simple process that makes use of an automated installer. Connect the smartphone to a PC and follow the prompts in the InstallShield Wizard (Figure 5.2).



Figure 5.2. InstallShield Wizard for PeakID (initial screen)

5.3 Navigating the GUI

The home screen (Figure 5.3) displays event data that has been downloaded to PeakID from the smartphone, or from a database previously saved on the PC.

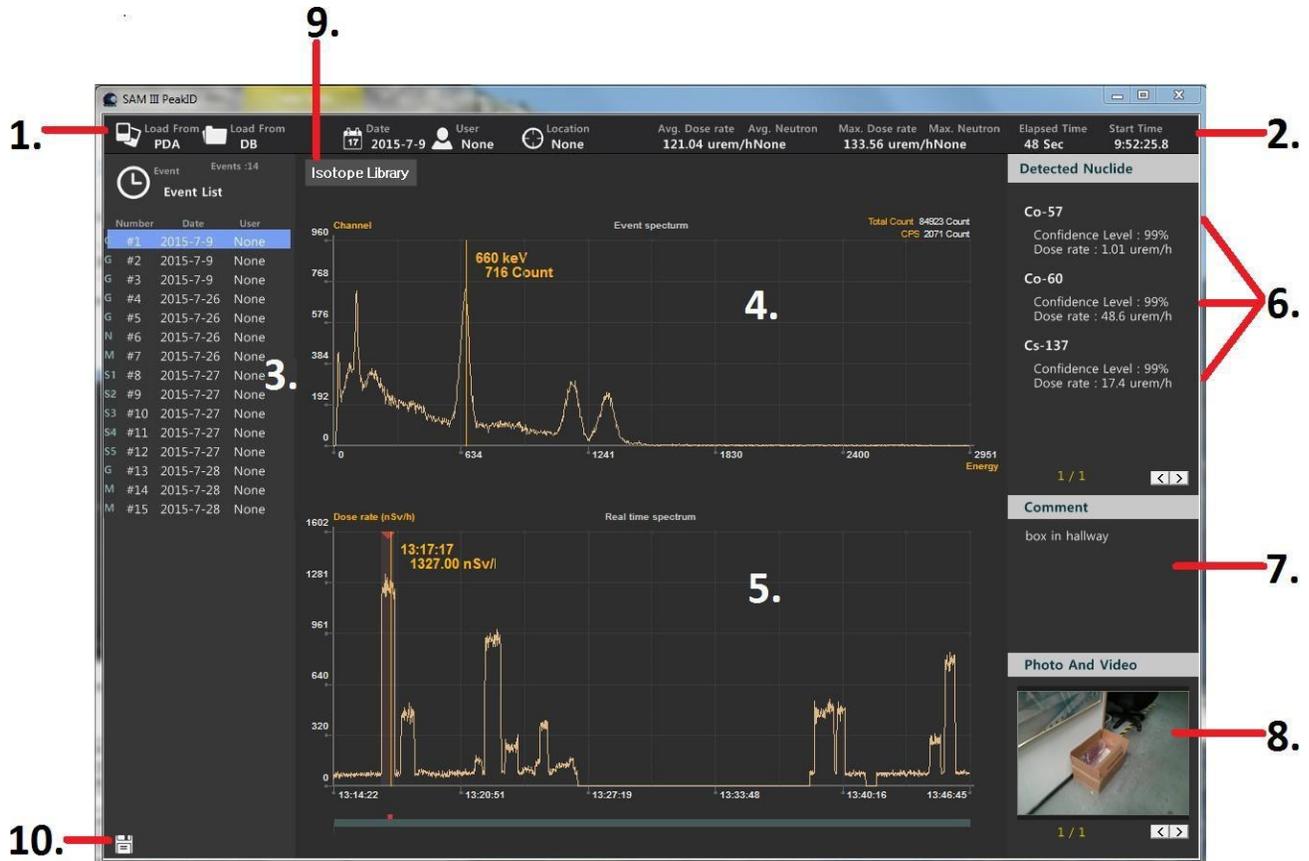


Figure 5.3. PeakID home screen

1	Database directory	Allows user to load event data to PeakID by clicking either Load from PDA or Load from DB (a database previously saved on PC)
2	General information	Displays date, user, location, and event summary
3	Event List	Lists Event Log files including event number and type: Manual , Gamma , Neutron , or Sequential
4	Event spectrum	Displays spectrum, total counts, and counts per second for the selected event
5	Real-time activity	Displays activity as a function of time
6	Identification	Displays isotopes identified in the selected event
7	Comments	Displays comments if any were attached
8	Photos	Displays photos if any were attached
9	Isotope Library button	Allows user to select active library from available isotope libraries
10	XML save button	Allows user to save spectrum and report data in XML format

5.3.1 Spectrum Display Options

The spectrum can be displayed as either a linear or a logarithmic scale (Figure 5.4). To switch between the two scales, right-click while the cursor is in the spectral area.

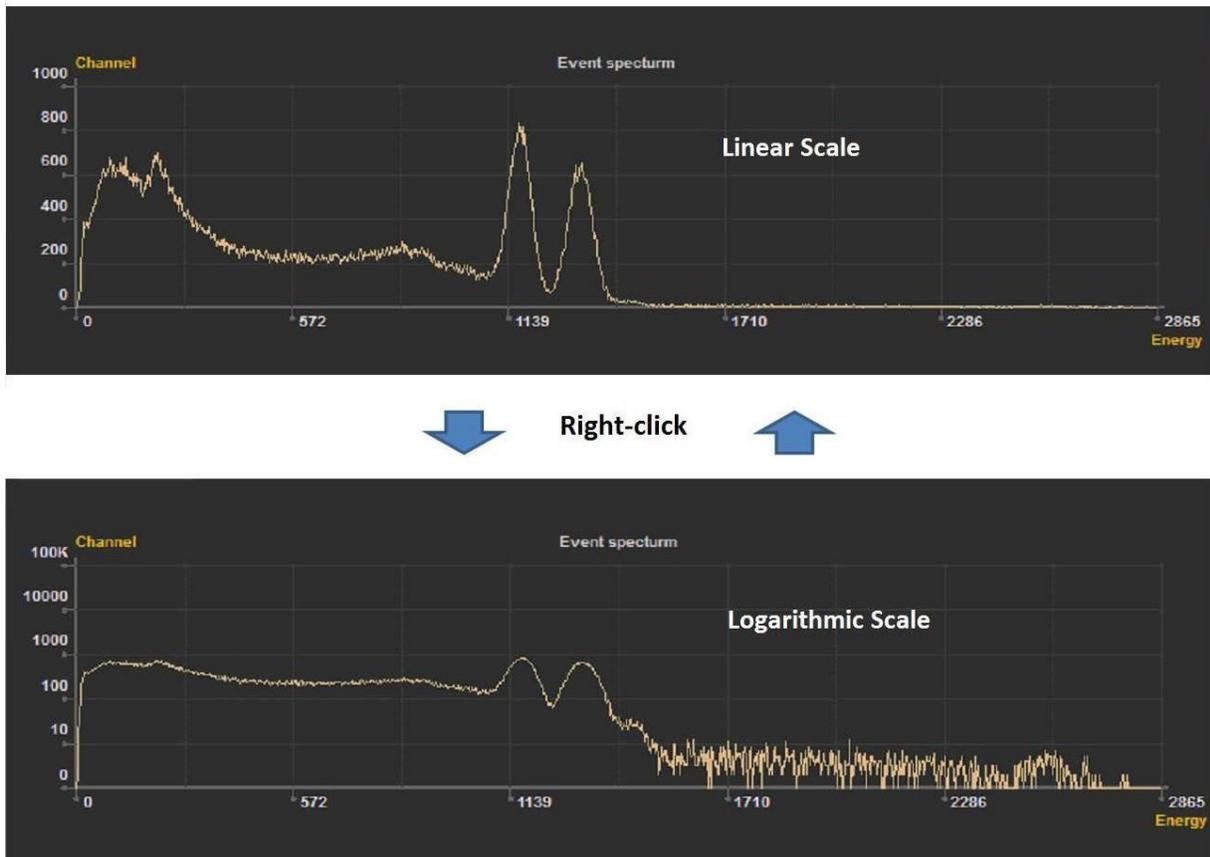


Figure 5.4 Spectrum display as linear or logarithmic scale

5.4 Loading and Analyzing Event Data

5.4.1 Download an Event Log from the Smartphone to the PC

Ensure that the smartphone and PC are properly connected and prepared (see section 5.1).

1. Open PeakID
2. Click **Load from PDA** (Figure 5.5, top left)

PeakID automatically downloads the Event Log to the PC database and deletes it from the smartphone. Downloaded events are displayed in the Event List window (Figure 5.5, upper left).

3. Select an event from the list to analyze

The spectrum is displayed in the Event Spectrum window (Figure 5.5, center)

Time and duration of the selected event are displayed in the Real-Time Activity window (Figure 5.5, top right)

Isotope information for the selected event is displayed in the Detected Nuclide window (Figure 5.5, upper right)

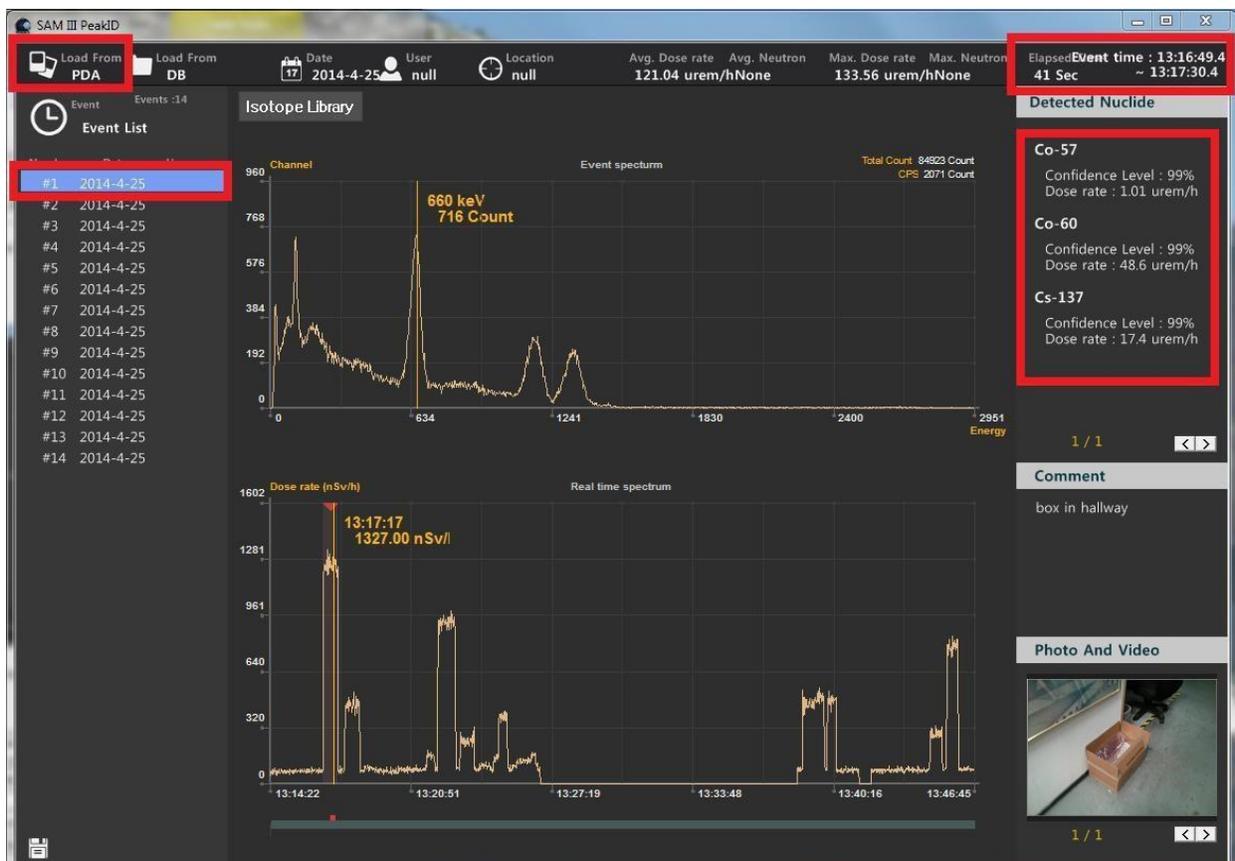


Figure 5.5. Event Log download from smartphone to PC

5.4.2 Load an Event Log from the PC Database

All the events collected from multiple SAM 945 units (and/or SAMpack 120 units) may be stored in a single database and managed using PeakID. It is not necessary to connect the smartphone to the PC in order to manage or analyze events loaded from the PC database.

1. Click **Load from DB** (Figure 5.6). The database browsing window pops up.
2. Click on the desired folder. Folders are labeled with the date of collection of the event data.

To delete a folder or subfolder, select it and right-click, then click **Delete**.

3. If event data was collected using multiple units, there will be multiple subfolders labeled with the name and serial number of each unit. Select the desired subfolder.
4. The Event Log is highlighted in the Event List window. The selected event is displayed in the Event Spectrum window. Isotope information and all relevant event data are displayed as in Figure 5.5.

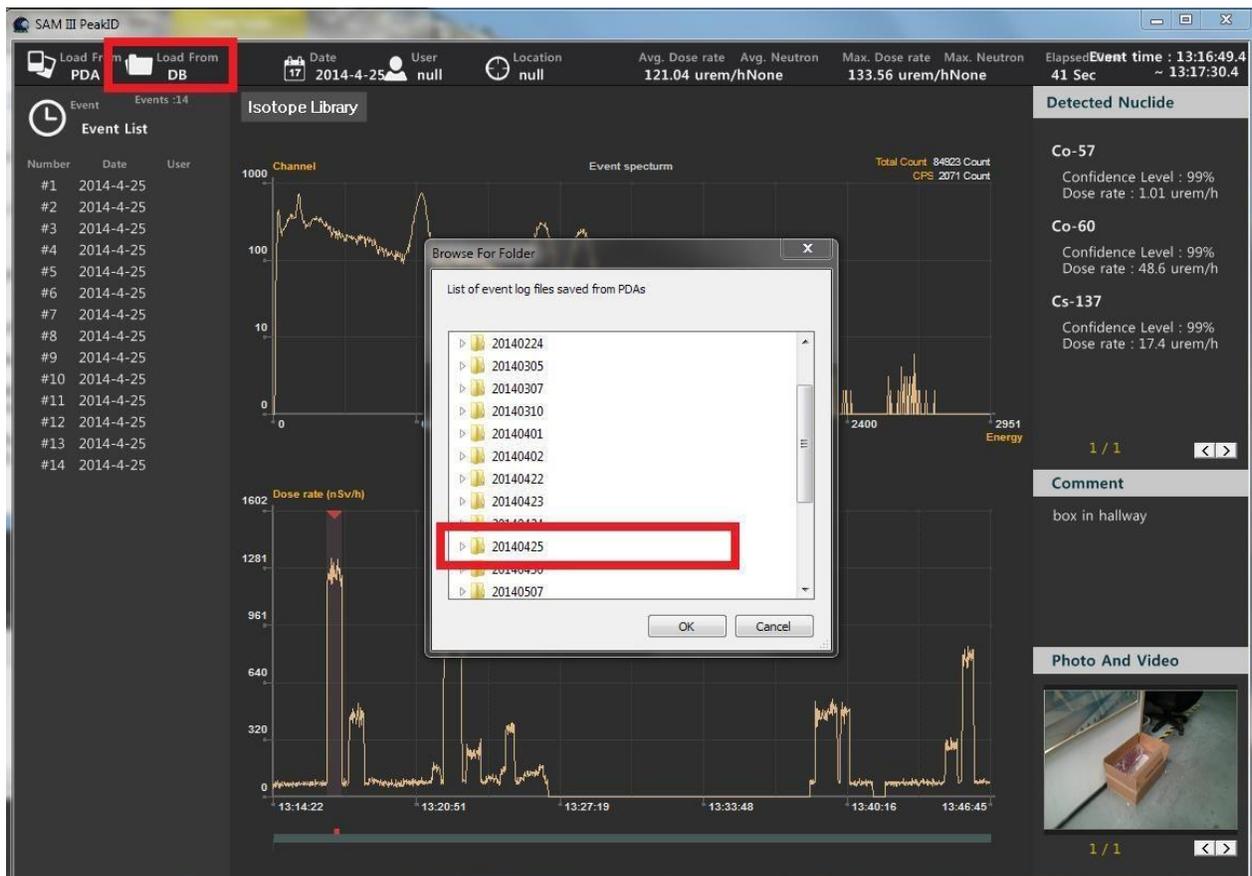


Figure 5.6. Event Log download from database

5.5 Managing the Isotope Library

The Administrator password is required to open the Isotope Library management tool and upload an Isotope Library to a smartphone.

1. Click the **Isotope Library** button (Figure 5.7)
2. Enter the Administrator password. The Isotope Library List will appear.

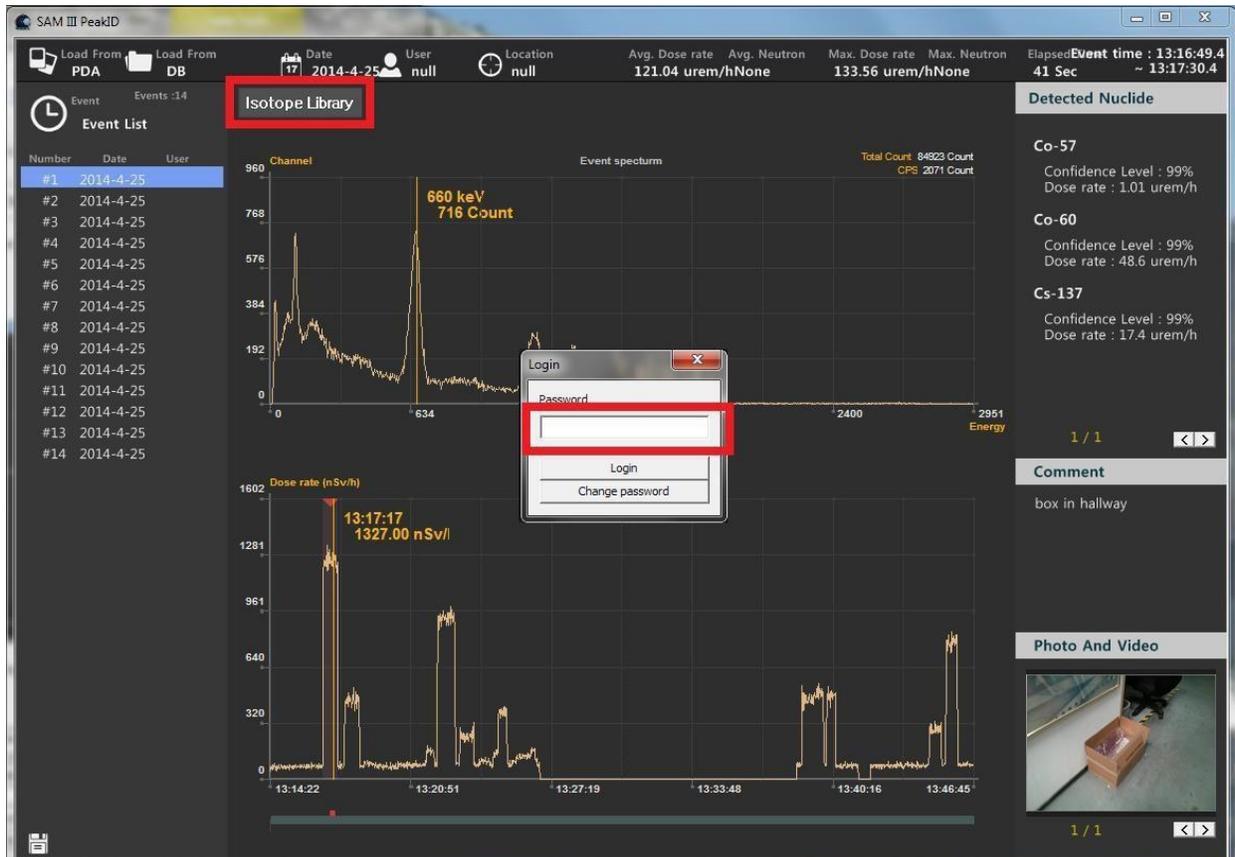


Figure 5.7. Isotope Library login

3. Select a library name from the list
4. Click the **Upload to PDA** button below the list

5.6 Saving Event Data in XML Format (ANSI 42.42)

The spectrum and relevant data from the Event Log can be saved in the XML file format specified in the ANSI 42.42 standard.

1. Select the event from the Event List
2. Click the **disk icon** in the lower left corner of the screen (Figure 5.8) The destination directory screen will appear.
3. Browse to the desired directory and click **Save**

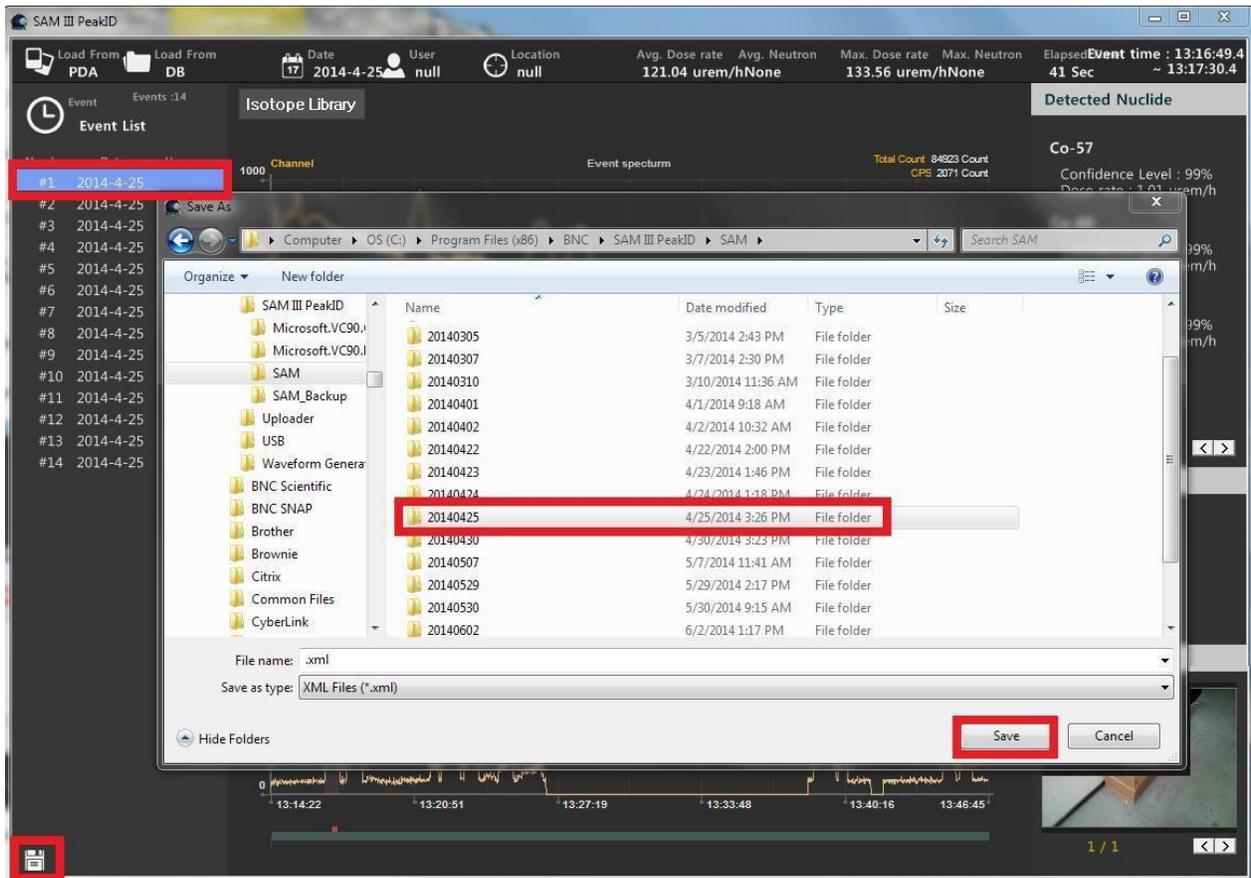


Figure 5.8. Saving event data in XML format

5.7 Upgrading PeakID

To upgrade to the latest PeakID software (version 3.5.0 as of March 2016), open a web browser on your PC and go to www.bncsam.com. Following the instructions on the screen, enter the BSN number from the label on the detector unit (Figure 2.1), then click the **PeakID** button.

Download the file **SAM III PeakID (v3.x.x).exe** to your PC. Go to the folder you downloaded it to, and open **SAM III PeakID (v3.x.x).exe**. The upgrade will install automatically.

CHAPTER 6. USEFUL TIPS AND REMINDERS

- ✓ Before connecting the smartphone to a PC (via USB cable), it is important to exit PeakAbout.
- ✓ Wearing polarized lenses such as sunglasses can make the rotated smartphone screen appear blank. We recommend that you do not wear polarized lenses while using PeakAbout.
- ✓ To optimize the performance of the SAM 945, turn off unnecessary smartphone applications.
- ✓ Refer to the smartphone manual to become familiar with how to operate the smartphone.
- ✓ Do not open the cover of the detector unit. Opening the unit may void your warranty. Any repairs or alterations should only be performed by technicians who are authorized by Berkeley Nucleonics Corporation.





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SAM 945 User Manual

PeakAbout software version: 3.9.0
Print Code: 32025280