



# Radioactive Material Identification





# Objective



***Provide emergency responders advanced training on the ORTEC Detective to acquire high quality spectral data for radioactive material identification***

*Note: DOE will provide 2-3 Detectives for the course. Each Detective control display will be projected on a large screen to ensure maximum observation and participation by all students. If the host Competent Authority has access to additional Detectives, it would benefit having them in class enabling more hands-on training opportunities for the students.*



# Reason for Identification



## Why conduct radionuclide identification?

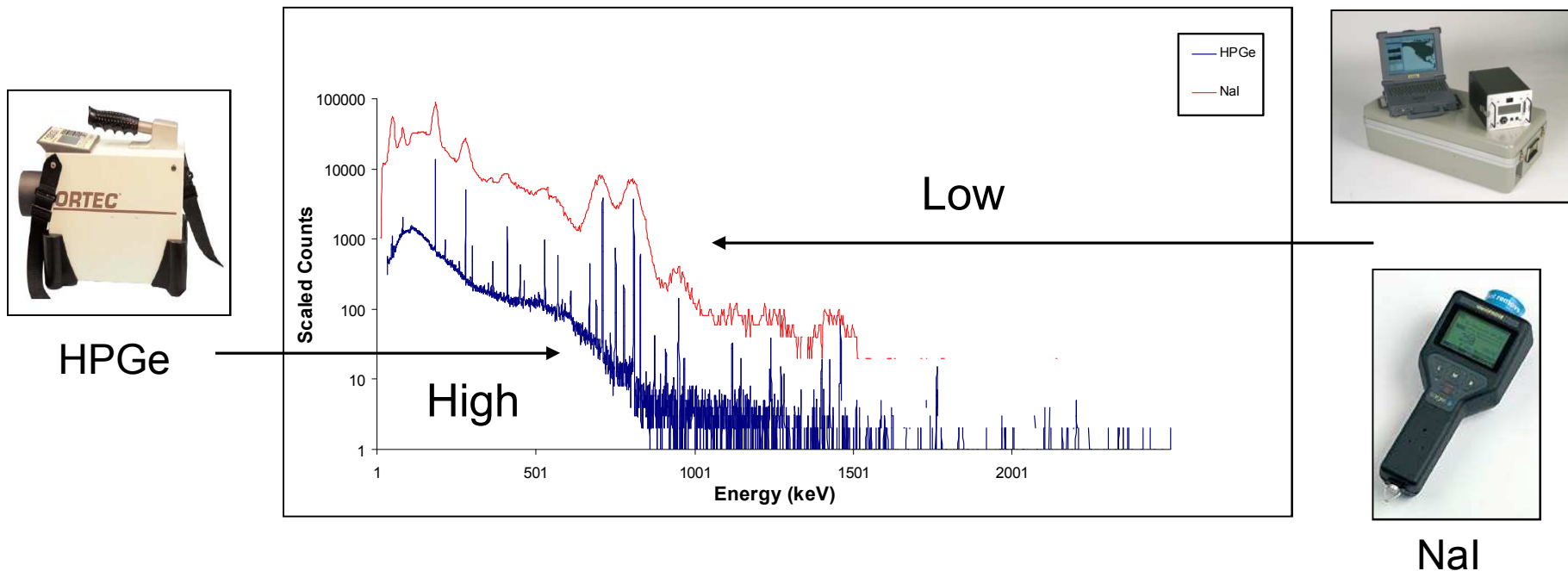
- To identify the radioisotope(s) causing the alarm
- To aid in law enforcement investigation and alarm adjudication
- To determine if cargo is consistent with the manifest
- To provide responders better understanding of potential hazard
- To allow responders to take appropriate protective actions
- To aid in law enforcement forensics investigations
- To aid in planning source recovery operations



# Radioisotope Identification

## High Resolution vs Low Resolution Gamma Spectroscopy

*Resolution - “ability to resolve adjacent gamma peaks”*



High Purity Germanium (HPGe) is the *Gold Standard* for radioisotope identification



# Detective-EX



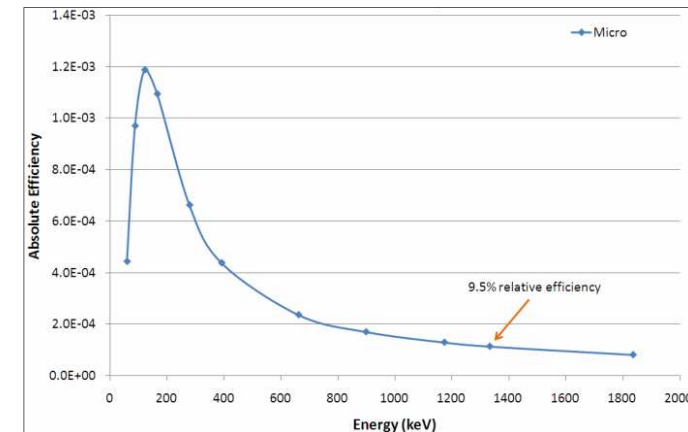
## ORTEC™ Detective-EX Specifications

- Gamma – HPGe crystal (15% efficiency)<sup>1</sup>
  - 5 cm diameter x 3 cm high
- Gamma - Geiger-Mueller tube
- Neutron - four <sup>3</sup>He tubes
  - 10 cm x 1.2 cm diameter; 20 atm pressure
  - Embedded in high density polyethylene



- Multi-Channel Analyzer (MCA) – 8k channels
- Cooler - low power Stirling type
- Temperature - less than -245 F (-154 C)
- Cool down time - 12 hrs
- Internal 12 volt battery - 3 hrs duration

- Size - 37 cm x 18 cm x 34 cm
- Weight - 11.75 kg

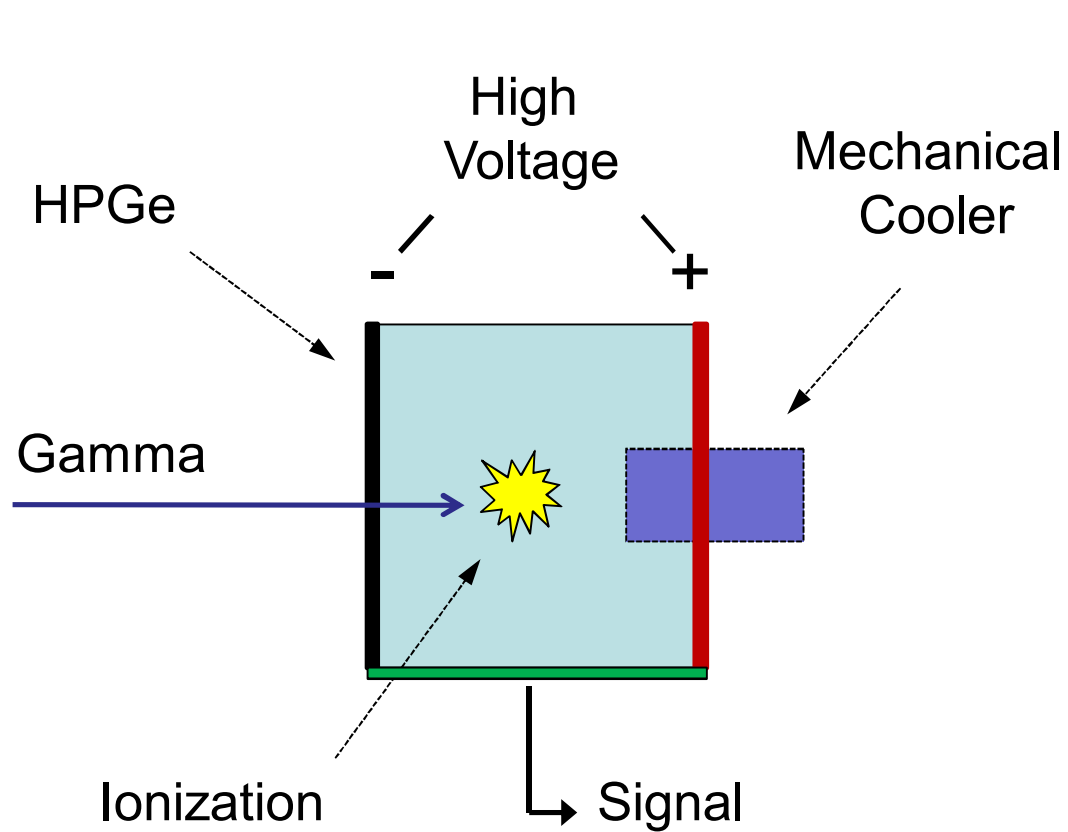


<sup>1</sup> Industry standard is to report the HPGe detection efficiency as compared to a 7.6 cm x 7.6 cm sodium iodide detector for the <sup>60</sup>Co 1332 keV gamma at 25 cm.

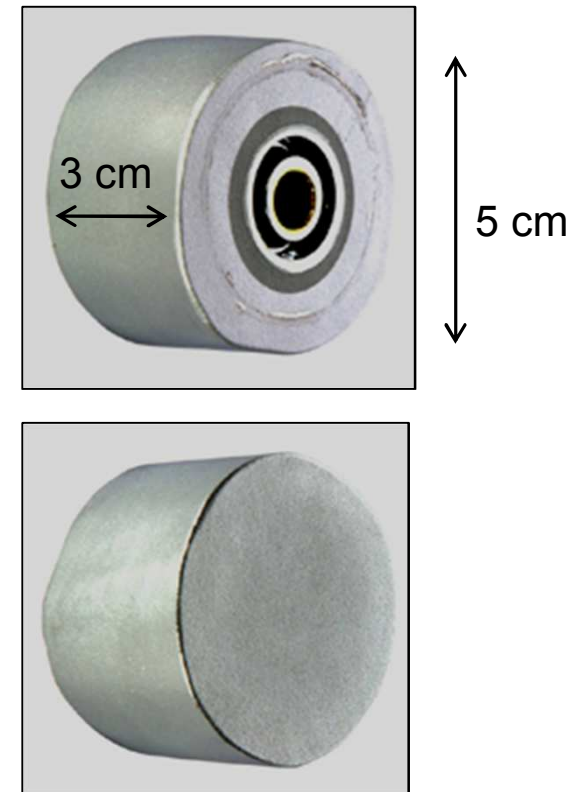


# High Purity Germanium (HPGe)

## Schematic of a typical detector



HPGe crystal

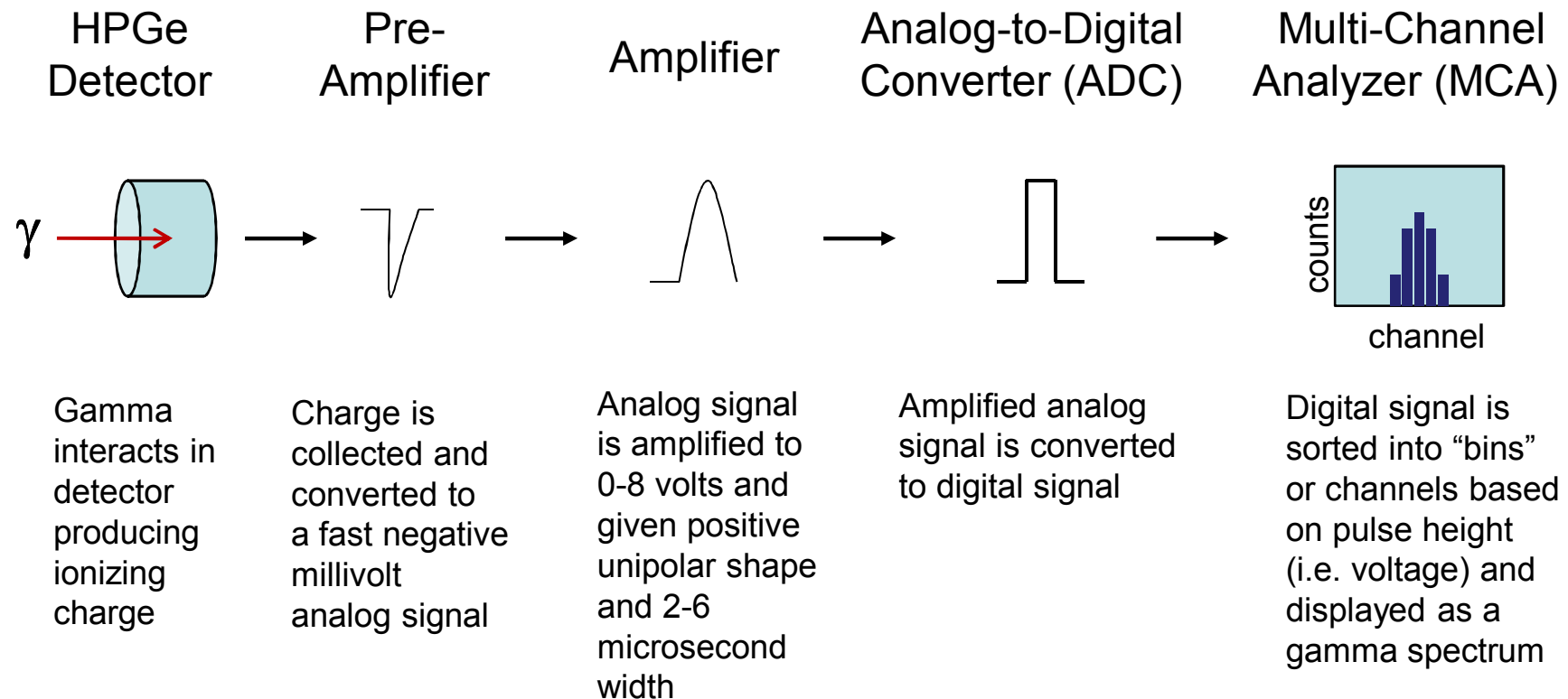






# Electronics

## Signal processing steps





# Main Window/Advanced Setup



PocketPC

File Zoom Tools Help



**Survey Mode** 09/09/2011 11:40:35 PM  
Battery Time: 165 min

Neutron Count Rate = 1 cps

$\gamma$  Dose Rate = 0.02  $\mu$ Sv/h

$\gamma$  Count Rate = 27 cps

Status: READY



---

Search Display Identify

SNM Advanced

PocketPC

File Zoom Tools Help

**Adv. Setup** 09/09/2011 11:41:11 PM  
Storage Space: 12192

Calibrate Cal. Settings

Audio Turn Cooler OFF

Spectra Status

Search Settings

SNM Search Dose Alarms

---

Exit Back





# Operating Status Windows



Double  
click bottom  
left corner  
for system  
parameters

PocketPC

File Zoom Tools Help

**Adv.** 09/09/2011 11:42:18 PM  
**Setup** Battery Time: 165 min

Live Time	0:00:10
Real Time	0:00:10
Dead Time	0.0%
Bias Voltage	OK
+12V	OK
-12V	OK
+3.3V	OK
Detector Temp	OK
Body Temp	OK
Cold Tip Temp	OK
Cooler Drive	OK
Ion Pump	OK

Back

System Status



PocketPC

File Zoom Tools Help

**Adv.** 09/09/2011 11:57:29 PM  
**Setup** Storage Space: 12192

Live Time	0:00:56
Real Time	0:00:56
Dead Time	0.1%
Bias Voltage	-2498
+12V	12.00
-12V	-12.00
+3.3V	3.30
Detector Temp	122.70
Body Temp	33.98
Cold Tip Temp	115.00
Cooler Drive	6.80
Ion Pump	3305.13.0
Cooler Runtime	1023.99

Back

System Parameters



# Calibration

## Three Step Process

PocketPC

File Zoom Tools Help

Adv. 09/10/2011 12:33:02 AM  
Setup Battery Time: 164 min


1. Place Cs-137 in front of the Detective-EX
2.

Gamma Count Rate = 1578 cps

Step 1

PocketPC

File Zoom Tools Help

Adv. 09/10/2011 12:33:26 AM  
Setup  Battery Time: 164 min

1. Place Cs-137 in front of the Detective-EX
2.   
Calibration in progress...  
Time remaining: 50 seconds

Gamma Count Rate = 1686 cps

Step 2

PocketPC

File Zoom Tools Help

Adv. 09/10/2011 12:34:11 AM  
Setup Battery Time: 164 min

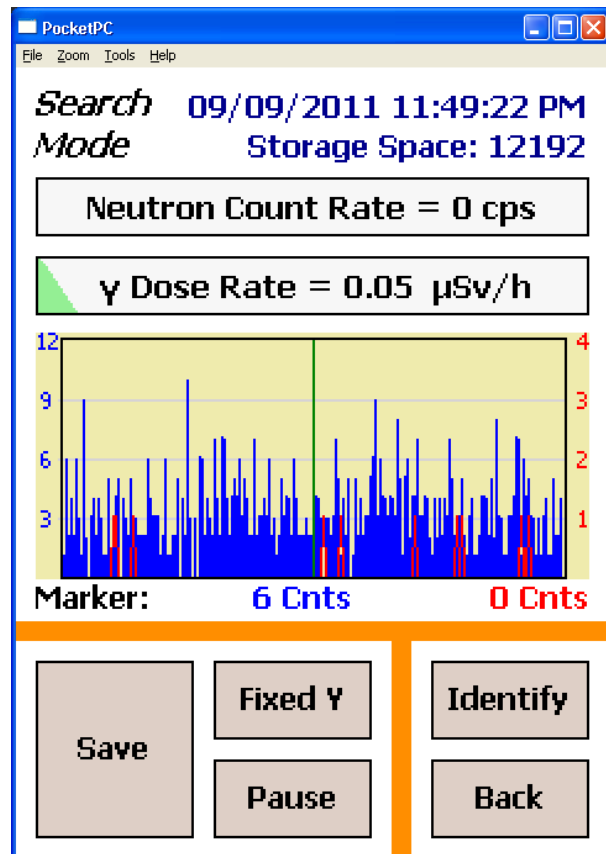
1. Place Cs-137 in front of the Detective-EX
2.   
Centroid: 661.73 keV  
FWHM: 1.82 keV  
Cal. adjustment: -0.02%  
The calibration can be improved.
3.

Step 3

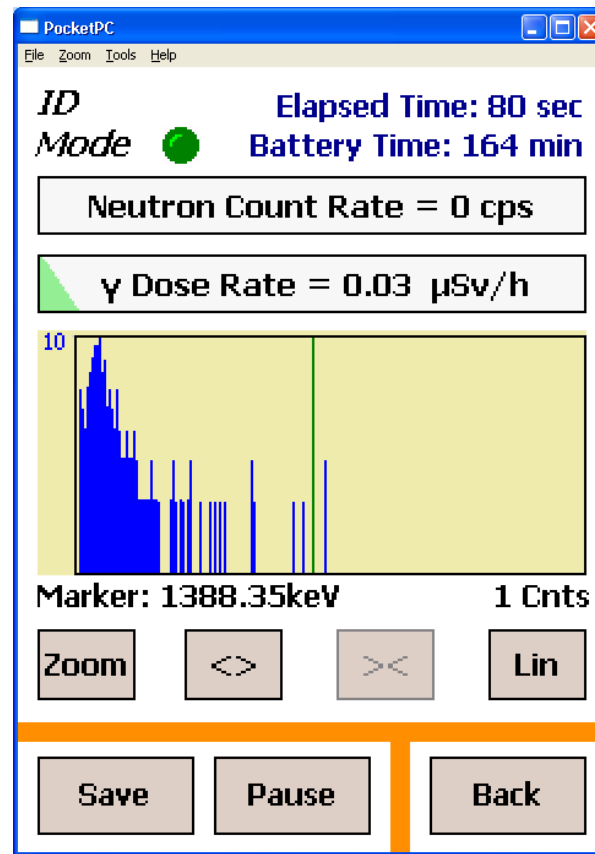


# Modes

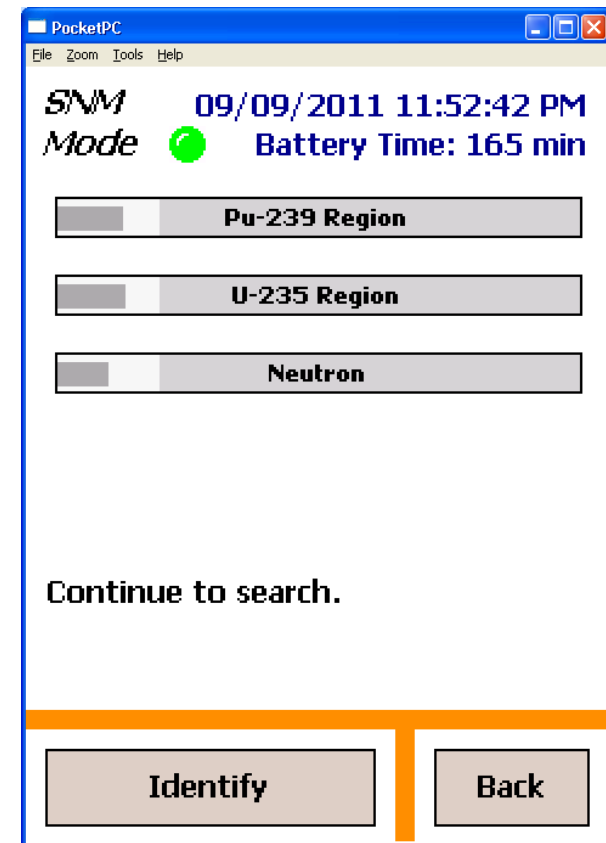
## Search, ID and SNM Modes



Search



ID  
“Identification”



SNM  
“Special Nuclear Materials”



# Advanced Setup Screens



PocketPC  
File Zoom Tools Help

**Adv.** 09/09/2011 11:59:49 PM  
**Setup** Battery Time: 164 min

---

**γ Dose Rate:**  
Threshold:    
Units: ☒  $\mu\text{Sv/hr}$  ☐ mrem/hr

---

**Neutron Rate (CPS):**  
Threshold:

---

PocketPC  
File Zoom Tools Help

**Adv.** 09/09/2011 11:54:19 PM  
**Setup** Storage Space: 12192

---

**Pu-239 Q Alarm Threshold:**

---

Pu-239	U-235	Ba-133	Neutron	
--------	-------	--------	---------	--

**Dwell Time (Seconds)**  
  
1 2 3 4 5 6

---



# Advanced Setup Screens



PocketPC  
File Zoom Tools Help

**Adv.** 09/09/2011 11:54:45 PM  
**Setup** Storage Space: 12192

---

**Search Mode Collection Time:**

0.1 0.5 1.0 10 20 50  
Seconds

---

Back

PocketPC  
File Zoom Tools Help

**Adv.** 09/09/2011 11:55:39 PM  
**Setup** Battery Time: 165 min

---

**Headphone Volume:**  
Min  Max

---

**Speaker Volume:**  
Min  Max

---

**Gamma Sensitivity:**  
10  10,000

---

**Neutron Sensitivity:**  
1  1,000

---

Back



# Advanced Setup Screens



PocketPC  
File Zoom Tools Help

**Adv.** 09/10/2011 12:02:54 AM  
**Setup** Battery Time: 164 min

---

☐ Ask for Identifier Description

---

**Default Description:**

Set

---

**Data Location:**

SD Card

---

Display

Delete

Back

PocketPC  
File Zoom Tools Help

**Adv.** 09/10/2011 12:02:09 AM  
**Setup** Battery Time: 165 min

---

**Choose File**

---

**Data Location:**

SD Card

---

Filename
2010_08_10_21_56_350.spc
2010_08_10_23_02_360.spc
2010_09_01_05_33_150.spc
2010_09_01_08_14_410.spc
2010_09_01_09_04_250.spc
2010_10_20_17_47_290.spc
2010_10_21_04_53_420.spc
2010_10_21_05_00_010.spc

---

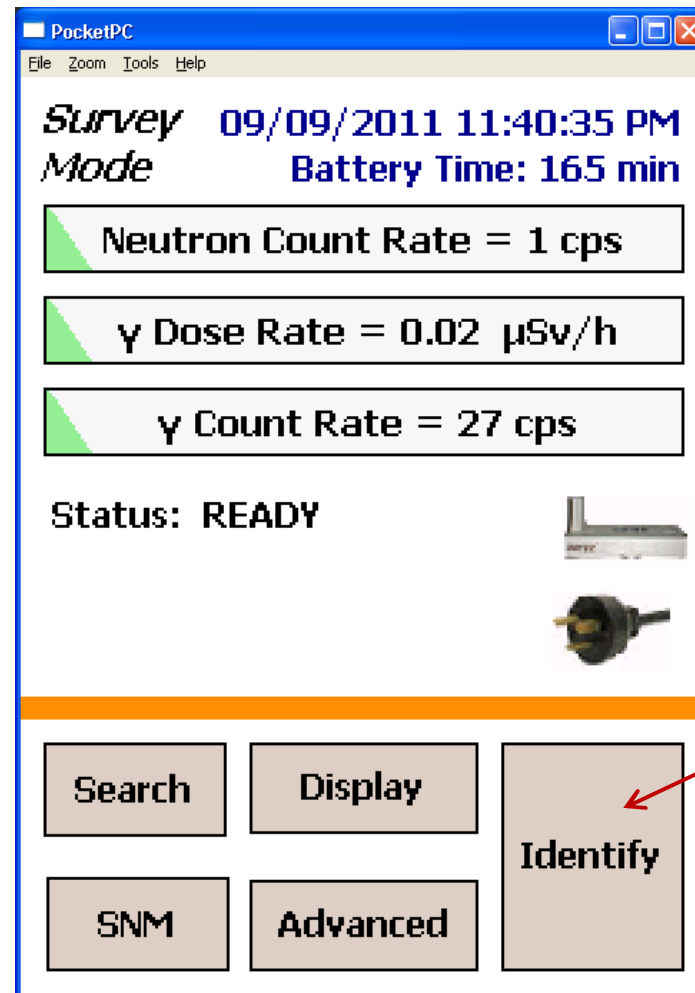
Choose

Back





# Collecting a Spectrum

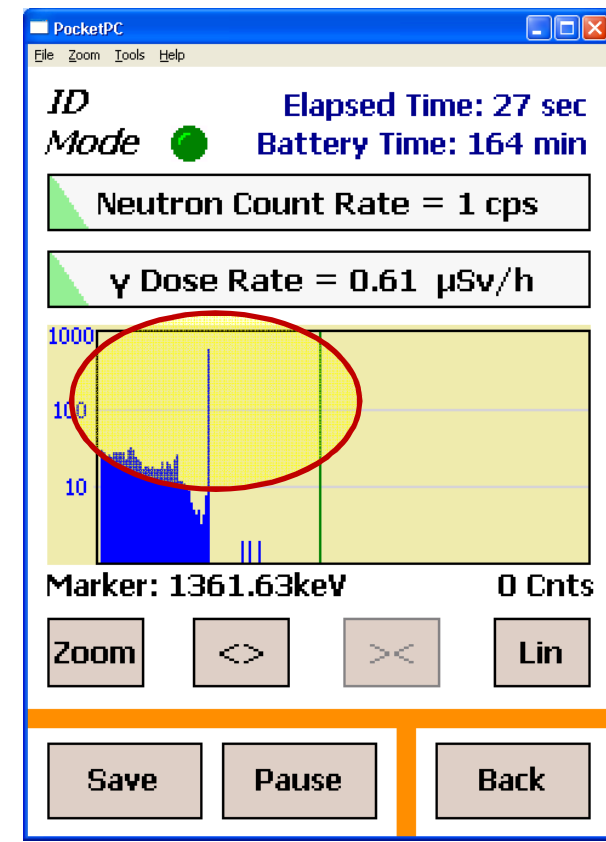
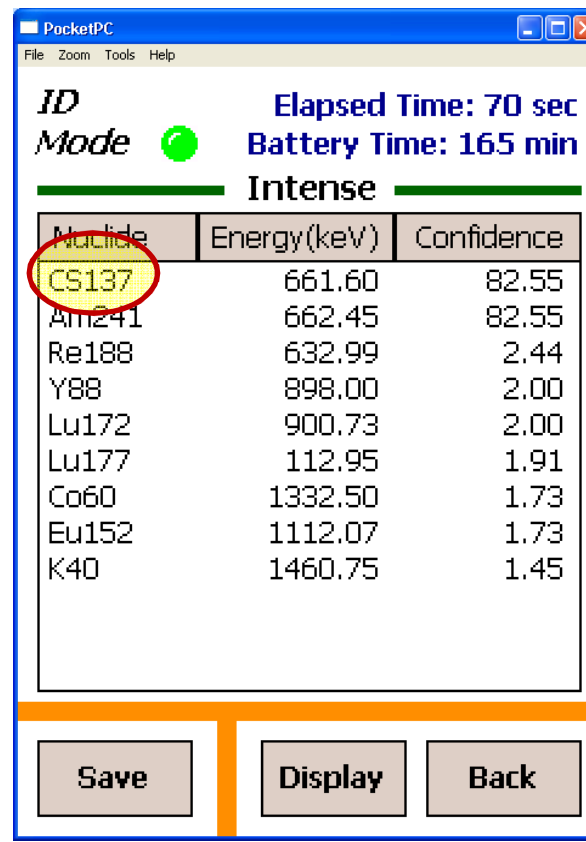
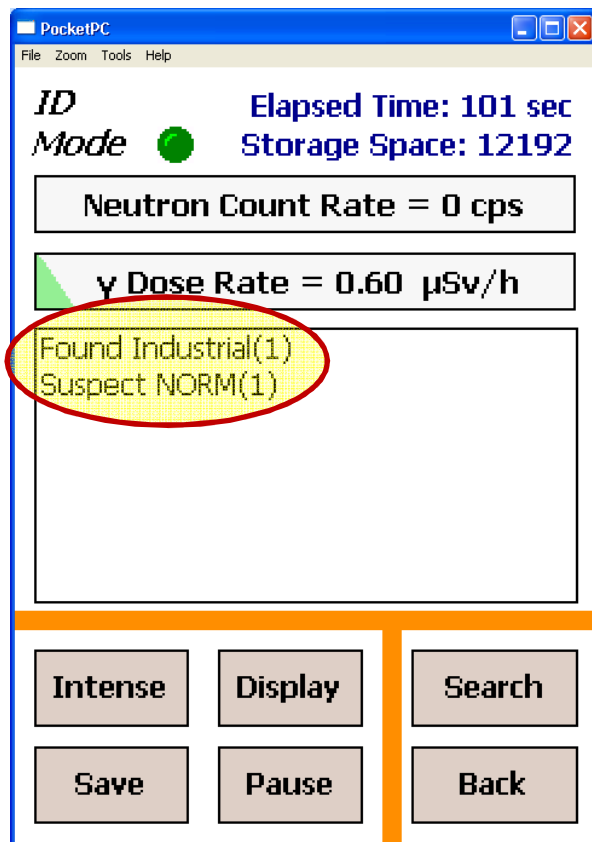


To collect a gamma spectrum, click on **Identify**



# Cesium-137 ( $^{137}\text{Cs}$ )

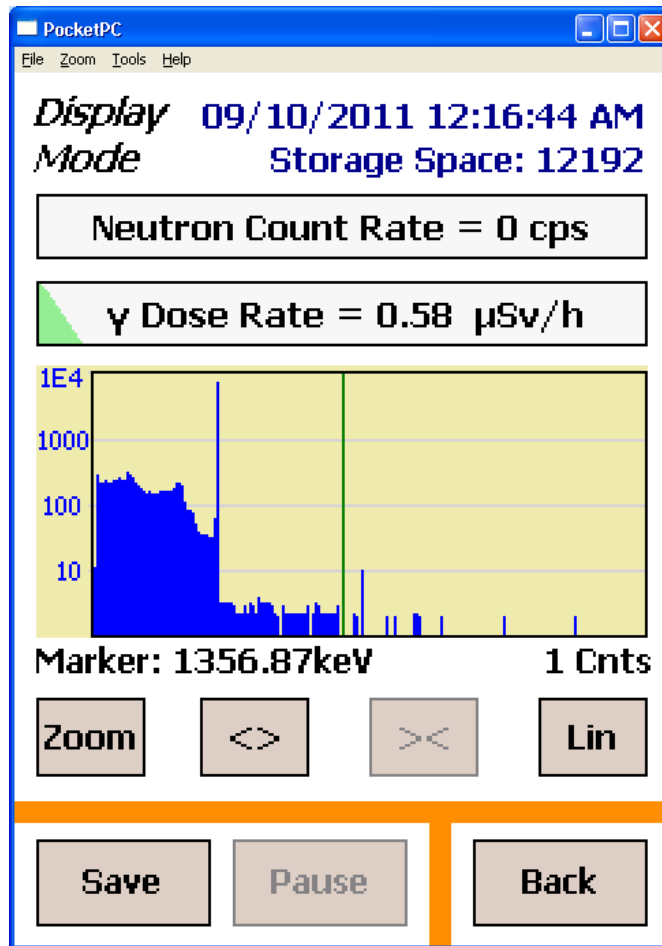
Three screens are available to monitor the data



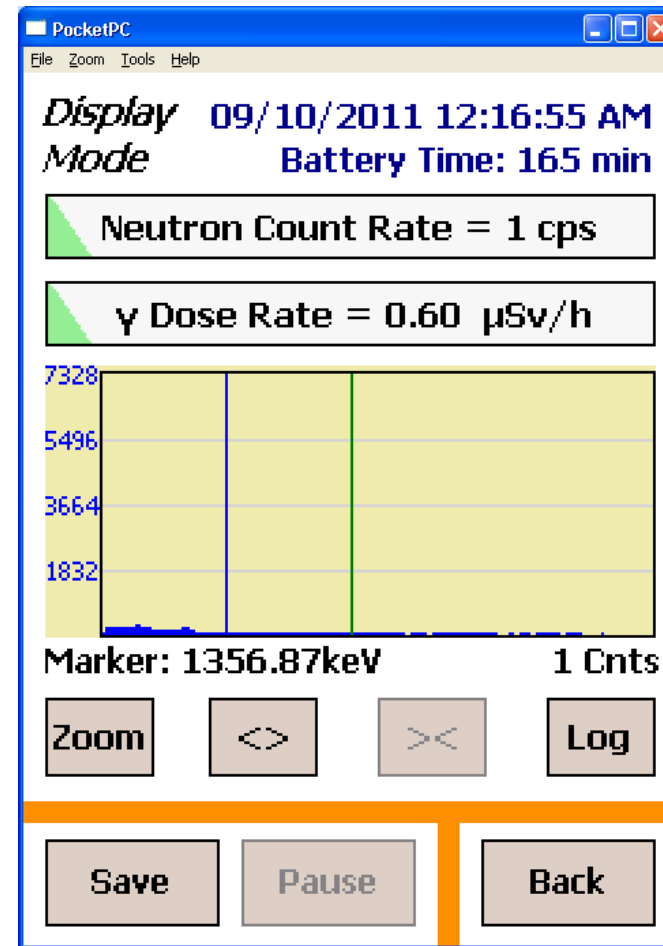


# Logarithm vs Linear Y-Axis

Log  
→



←  
Lin



Log scale provides “best” overall view of spectrum



# Confidence Levels

**Longer Collection Times = Higher Confidence**

PocketPC

File Zoom Tools Help

ID Mode ● Elapsed Time: 30 sec Battery Time: 165 min

Intense

Nuclide	Energy(keV)	Confidence
CS137	661.60	55.95
Am241	662.45	55.95
W188	290.67	1.92
At211	669.60	1.73
Ba133	302.00	1.68
Se75	279.50	1.51
Lu172	1093.67	1.41
Th232	911.00	1.41

Save Display Back

PocketPC

File Zoom Tools Help

ID Mode ● Elapsed Time: 120 sec Battery Time: 165 min

Intense

Nuclide	Energy(keV)	Confidence
Am241	662.45	112.08
CS137	661.60	112.07
K40	1460.75	3.46
I123	158.97	2.47
Th228	2614.53	2.00
Th228	583.20	1.84
Ta182	1221.41	1.73

Save Display Back

PocketPC

File Zoom Tools Help

ID Mode ● Elapsed Time: 301 sec Storage Space: 12192

Intense

Nuclide	Energy(keV)	Confidence
Am241	662.45	178.17
CS137	661.60	178.17
K40	1460.75	5.92
Y88	898.00	2.56
Ga64	991.56	2.24
Sr-Y90	1761.00	2.00
Pa233	300.34	1.73

Save Display Back

**Recommend collecting data for 300 seconds (5 minutes)**



# Radioisotope Library

Detective has a library “look-up” table with up to 80 radioisotopes and hundreds of gamma-rays

Am241	Cf252-249	Sn113	Ga64*
Cs137	Ba133	Sr-Y90	Gd153*
Co60	Shielded	Tc99M	Gd159*
Co57	Ba133	Ga67	Pa233*
Mn54	Bi207	Cu64	Tl208*
Th228	Ta182	I123	Ho166m*
Th232	Ho166	I131	Pd103*
Eu152	Ir194	Xe131M	Au198*
K40 >NORM	Ir192	Xe133	Sm153*
K40	Po210	Xe135	Lu177*
Np237	Positron	Ra226	Shielded
Y88	emitter	I125	Lu177*
TL201	In111	At211	Lu172*
TL200	La140(FP)	Br76	W188*
TL202	Mo99	Cr51*	Re188*
TL204	Mo + Tc99M	Eu155*	Se75*
Co56	Na22	Eu156*	U233*
SrRb82	Pu239	Fe59*	U235
U238			

Radioisotopes in library

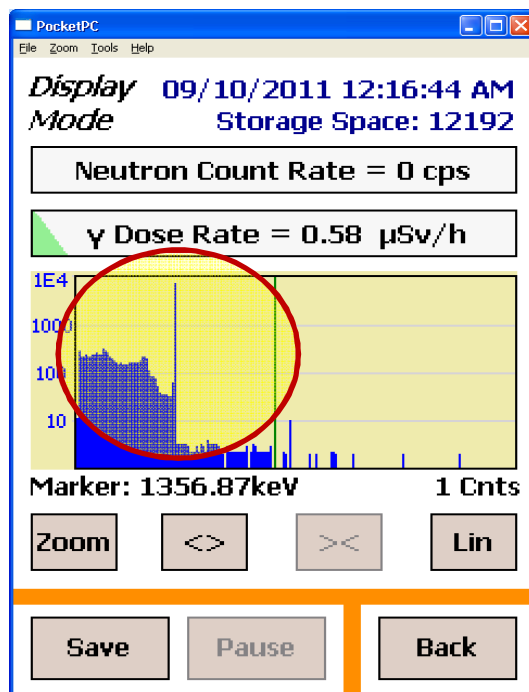
524.40	Pu-233	1.300000e-003
529.87	I-133	8.630000e-001
534.80	Pu-233	9.000000e-003
535.20	N-18	2.850000e-002
536.09	I-130	9.900000e-001
537.32	Ba-140	2.500000e-001
549.70	Rn-220	1.000000e-003
558.80	Pu-233	2.700000e-003
560.13	Pu-245	5.440000e-004
569.31	Cs-134	1.543000e-001
572.90	U-242	3.600000e-001
583.10	Tl-208	8.420000e-001
583.14	Th-232	3.083000e-001
583.30	Pu-233	8.600000e-004
585.00	U-242	3.700000e-001
600.56	Sb-125	1.780000e-001
602.71	Sb-124	9.787000e-001

Look-up table is a spreadsheet with radioisotope data

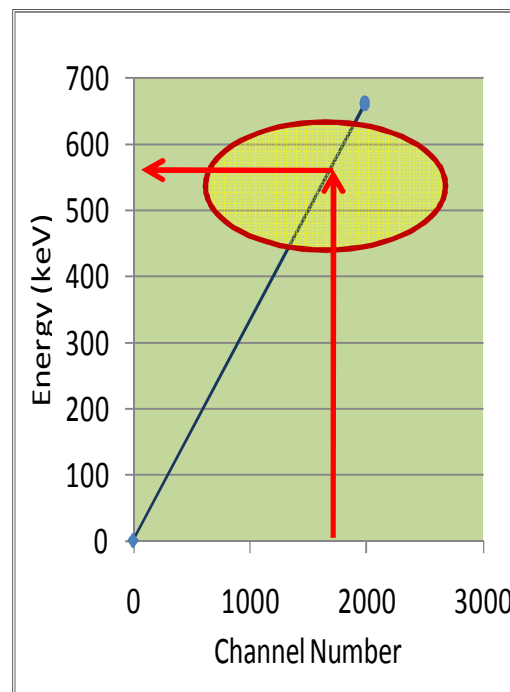


# Radioisotope ID

How does a Detective identify a radioisotope?



Algorithm finds strongest peak(s) in spectrum



Energy is determined from calibration

524.40	Pu-233	1.300000e-003
529.87	I-133	8.630000e-001
534.80	Pu-233	9.000000e-003
535.20	N-18	2.850000e-002
536.09	I-130	9.900000e-001
537.32	Ba-140	2.500000e-001
549.70	Rn-220	1.000000e-003
558.80	Pu-233	2.700000e-003
560.13	Pu-245	5.440000e-004
569.31	Cs-134	1.543000e-001
572.90	U-242	3.600000e-001
583.10	Tl-208	8.420000e-001
583.14	Th-232	3.083000e-001
583.30	Pu-233	8.600000e-004
585.00	U-242	3.700000e-001
600.56	Sb-125	1.780000e-001
602.71	Sb-124	9.787000e-001

Energy is “looked-up” in library to find radioisotope





# Radioisotope ID

Why does it identify  
so many radioisotopes?

PocketPC

File Zoom Tools Help

**ID** Elapsed Time: 30 sec  
**Mode** ● Battery Time: 165 min

**Intense**

Nuclide	Energy(keV)	Confidence
Cs137	661.60	55.95
Am241	662.45	55.95
W188	290.67	1.92
At211	669.60	1.73
Ba133	302.00	1.68
Se75	279.50	1.51
Lu172	1093.67	1.41
Th232	911.00	1.41

Save Display Back

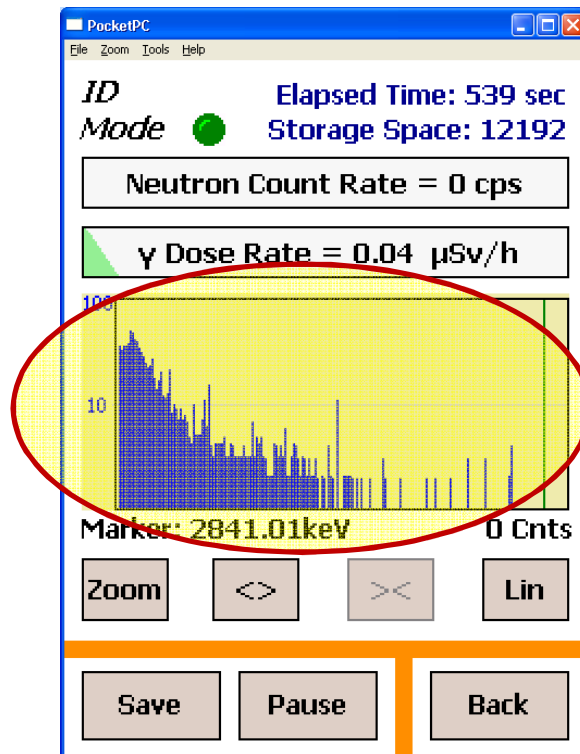
The look-up table has a large  
number of radioisotopes which  
have similar gamma energies

524.40	Pu-233	1.300000e-003
529.87	I-133	8.630000e-001
534.80	Pu-233	9.000000e-003
535.20	N-18	2.850000e-002
536.09	I-130	9.900000e-001
537.32	Ba-140	2.500000e-001
549.70	Rn-220	1.000000e-003
558.80	Pu-233	2.700000e-003
560.13	Pu-245	5.440000e-004
569.31	Cs-134	1.543000e-001
572.90	U-242	3.600000e-001
583.10	Tl-208	8.420000e-001
583.14	Th-232	3.083000e-001
583.30	Pu-233	8.600000e-004
585.00	U-242	3.700000e-001
600.56	Sb-125	1.780000e-001
602.71	Sb-124	9.787000e-001



# Radiation Background

What does the radiation background look like?



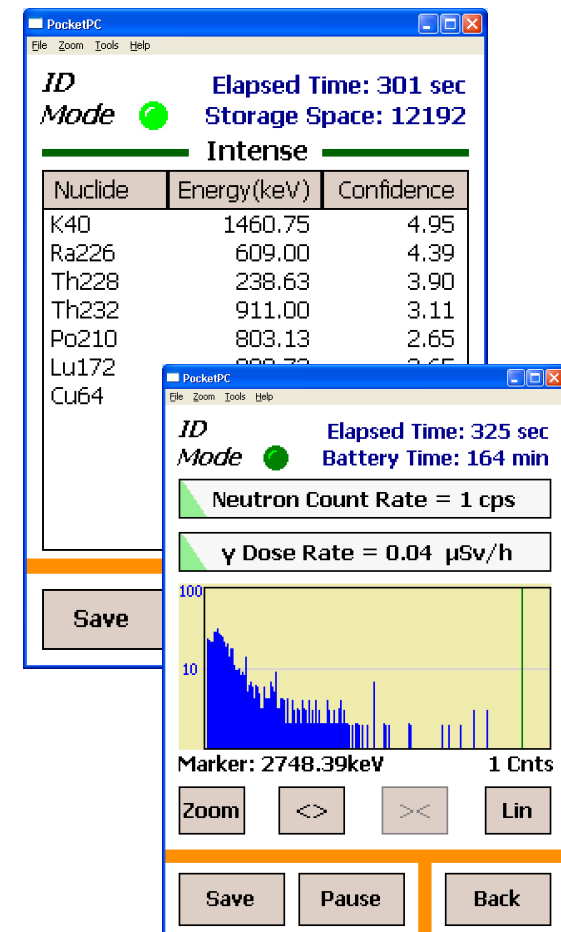
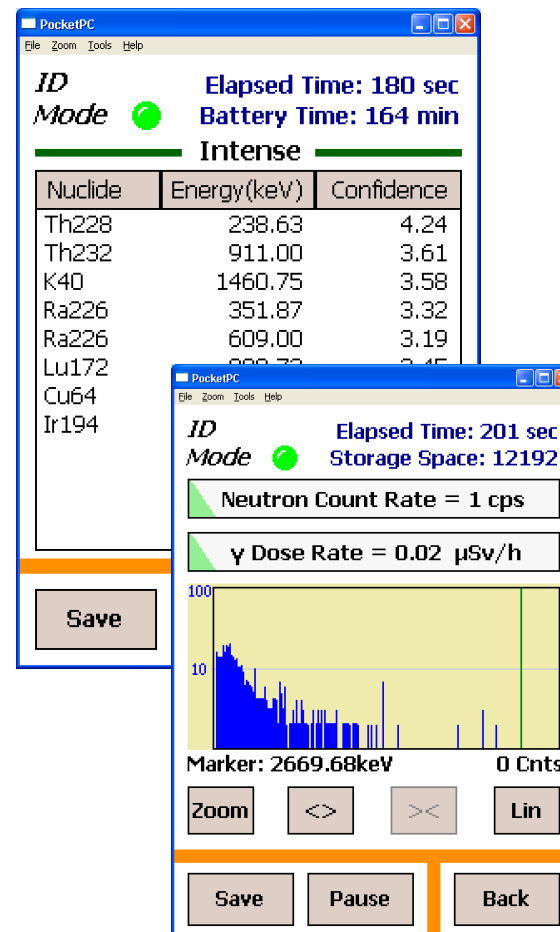
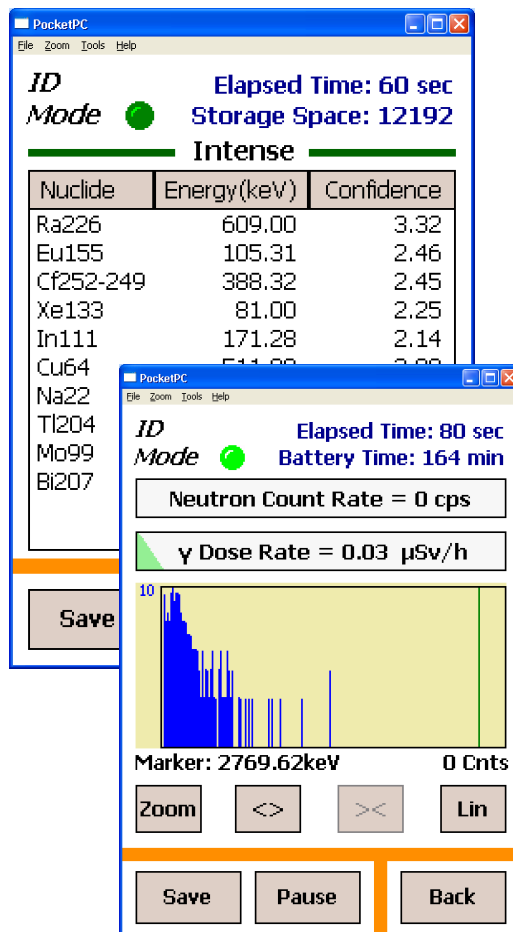
Nuclide	Energy(keV)	Confidence
K40	1460.75	5.15
Th228	238.63	5.08
Ra226	609.00	4.99
Ra226	351.87	4.00
Th228	2614.53	3.74
Th232	911.00	3.59
Eu152	1112.07	3.16

The natural radiation background is complex containing minute quantities of radioactive isotopes of  $^{40}\text{K}$ ,  $^{238}\text{U}$  and  $^{232}\text{Th}$  and their decay products



# Radiation Background

It can take 300 seconds or more to identify the background





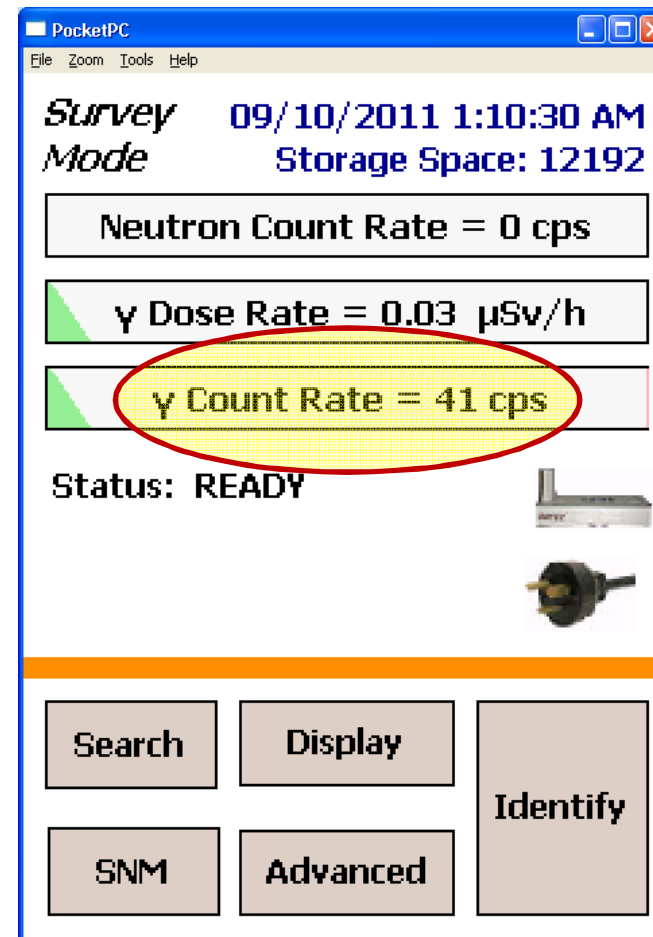
# Radiation Background



## Quality Control

A good quality control check of the Detective is to know the *gamma count rate per second (cps) at 1 meter* with no source present at your equipment staging location.

Before taking the Detective out for a measurement, verify the background gamma count rate.





# What is Dead Time?



Dead time is the time in which the detector electronics cannot process the incoming data correctly (i.e. too much data coming in too fast). This results in a distorted spectrum with broadened peaks and electronic pile-up producing artificial summed peaks. If dead time is high, then you are too close to the source.

***Keep dead time less than 5%  
by moving away from source***

**Top Screenshot (09/10/2011 12:50:23 AM):**

Parameter	Value
Adv.	09/10/2011 12:50:23 AM
Setup	Battery Time: 164 min
Live Time	0:00:03
Real Time	0:00:03
Dead Time	5.2%
Bias Voltage	OK
+12V	OK
-12V	OK
+3.3V	OK
Detector Temp	OK
Body Temp	OK
Cold Tip Temp	OK
Cooler Drive	OK
Ion Pump	OK

**Bottom Screenshot (09/10/2011 12:48:00 AM):**

Parameter	Value
Adv.	09/10/2011 12:48:00 AM
Setup	Storage Space: 12192
Live Time	0:00:58
Real Time	0:01:46
Dead Time	45.4%
Bias Voltage	OK
+12V	OK
-12V	OK
+3.3V	OK
Detector Temp	OK
Body Temp	OK
Cold Tip Temp	OK
Cooler Drive	OK
Ion Pump	OK

Back



# High Count Rate Warnings

Three ways to tell if count rate is too high

## Text Warning

PocketPC

ID Elapsed Time: 6 sec  
Mode Storage Space: 12192

Neutron Count Rate = 0 cps

$\gamma$  Dose Rate = 2.00  $\mu$ Sv/h

Count rate is high. May require longer count or more distance. Found Industrial(1)

Intense Display Search

Save Pause Back

## High Dead Time

PocketPC

Adv. 09/10/2011 12:53:56 AM  
Setup Battery Time: 164 min

Live Time 0:00:03  
Real Time 0:00:53  
Dead Time 94.2%  
Bias Voltage OK  
+12V OK  
-12V OK  
+3.3V OK  
Detector Temp OK  
Body Temp OK  
Cold Tip Temp OK  
Cooler Drive OK  
Ion Pump OK

Back

## Flashing Red Banner

PocketPC

Survey 09/10/2011 12:54:45 AM  
Mode Storage Space: 12192

Neutron Count Rate = 1 cps

$\gamma$  Dose Rate = 2.00  $\mu$ Sv/h

$\gamma$  Count Rate = 76350 cps

Status: READY

Search Display Identify

SNM Advanced





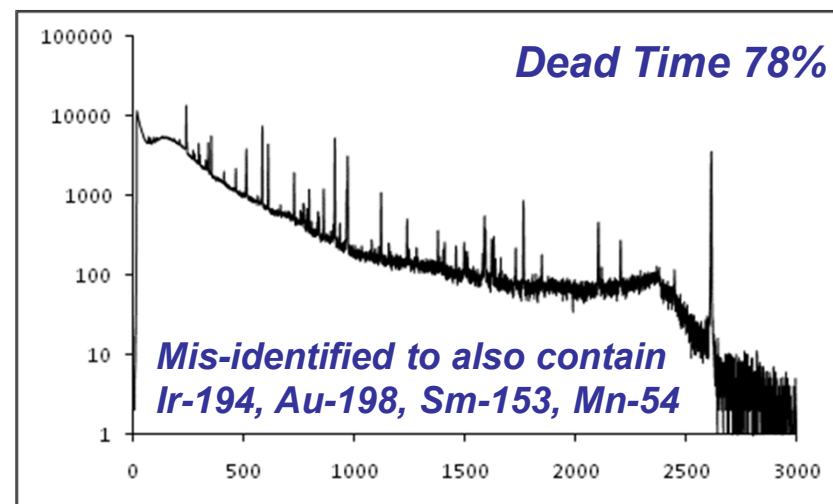
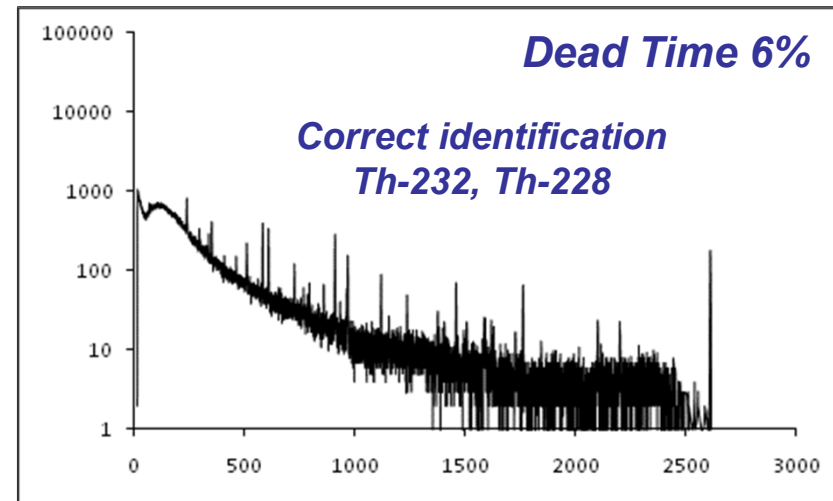
# Dead Time Example



A cargo container filled with NORM can produce a **radiation field** significantly above background but still safe to ship

These radiation fields can cause the **dead time** of the detector to be quite high requiring measurements to be taken from over 10 m away

High **dead time** can produce artificial peaks in the gamma spectrum resulting in mis-identification



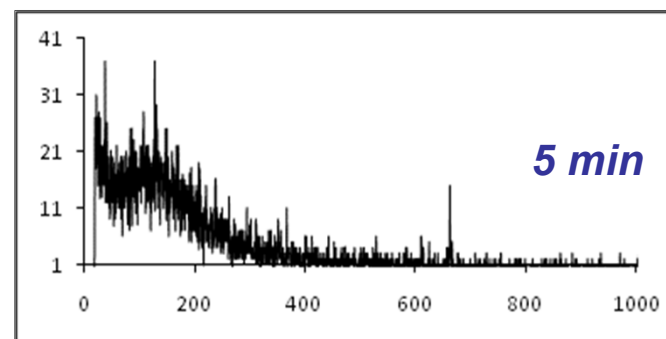
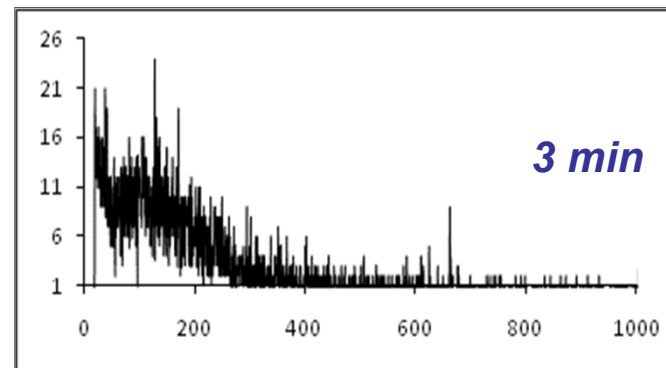
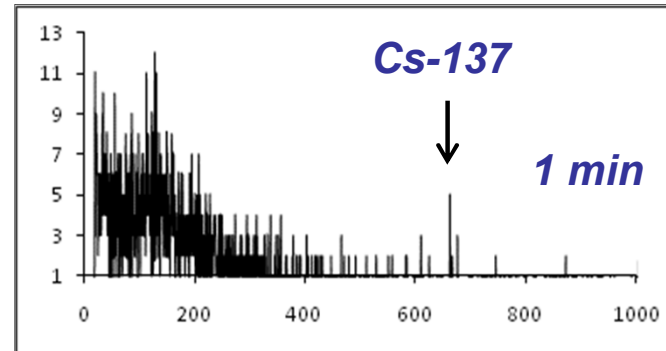


## Lesson Learned - Embedded Source



If a RIID is too close to the Detective during a measurement, then the  $^{137}\text{Cs}$  calibration source in the RIID can be detected

**Keep RIID at least 5 meters away from Detectives**





# Radioisotope Examples



The following section includes examples of Detective screen displays for some of the most common industrial radioisotopes:

Cesium-137	( <sup>137</sup> Cs)
Cobalt-60	( <sup>60</sup> Co)
Bismuth-207	( <sup>207</sup> Bi)
Sodium-22	( <sup>22</sup> Na)
Americium-241	( <sup>241</sup> Am)
Europium-152	( <sup>152</sup> Eu)
Barium-133	( <sup>133</sup> Ba)

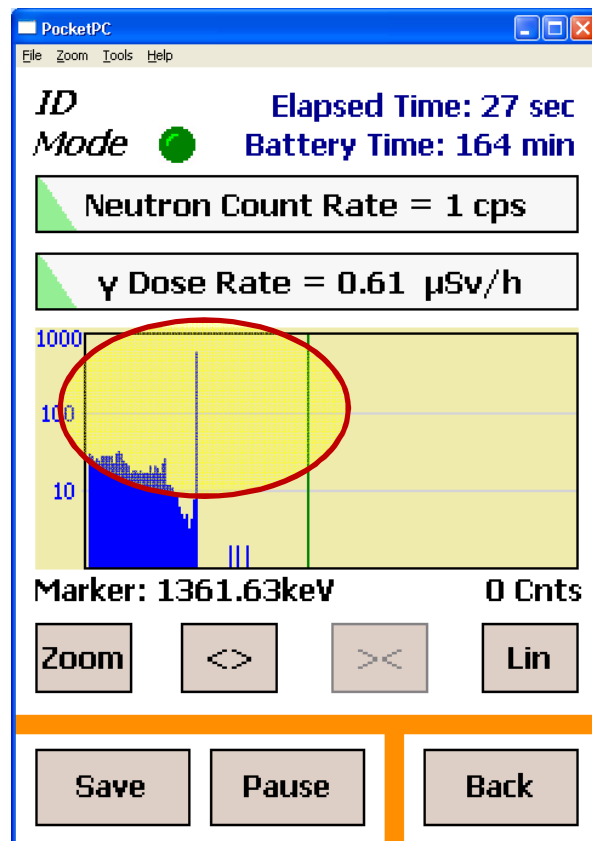
## Quick Reference (most common in red)

Industrial	<sup>137</sup> Cs, <sup>60</sup> Co, <sup>192</sup> Ir, <sup>241</sup> Am, <sup>57</sup> Co, <sup>133</sup> Ba, <sup>78</sup> Se
Medical	<sup>99m</sup> Tc, <sup>201</sup> Tl, <sup>131</sup> I, <sup>19</sup> F, <sup>67</sup> Ga, <sup>111</sup> In, <sup>123</sup> I, <sup>133</sup> Xe
Natural (NORM)	<sup>40</sup> K, <sup>232</sup> Th, <sup>238</sup> U
Nuclear	<sup>235</sup> U, <sup>239</sup> Pu, <sup>237</sup> Np, <sup>233</sup> U



# Cesium-137 ( $^{137}\text{Cs}$ )

$^{137}\text{Cs}$  has a gamma-ray at 661.6 keV  
and is an industrial source



PocketPC

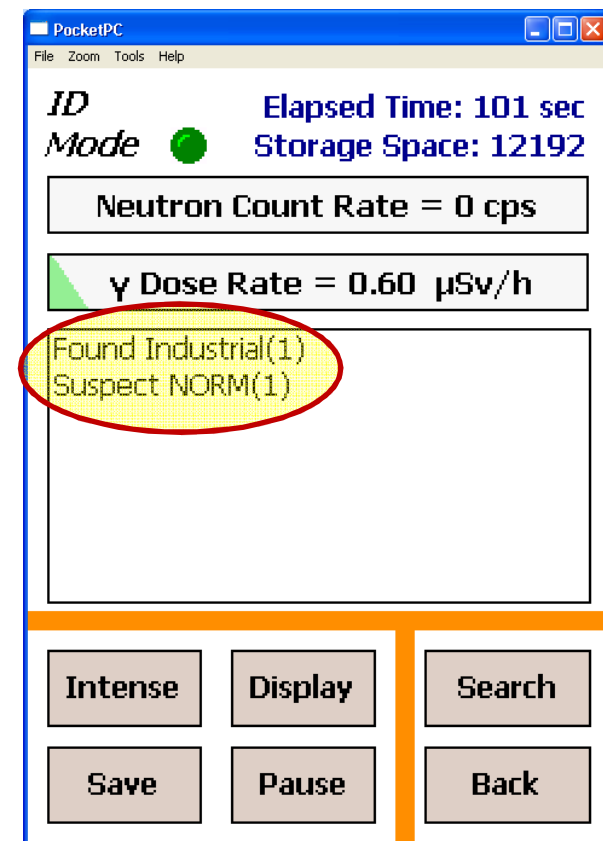
File Zoom Tools Help

ID Mode ● Elapsed Time: 70 sec  
Battery Time: 165 min

Intense

Nuclide	Energy(keV)	Confidence
CS137	661.60	82.55
Am241	662.45	82.55
Re188	632.99	2.44
Y88	898.00	2.00
Lu172	900.73	2.00
Lu177	112.95	1.91
Co60	1332.50	1.73
Eu152	1112.07	1.73
K40	1460.75	1.45

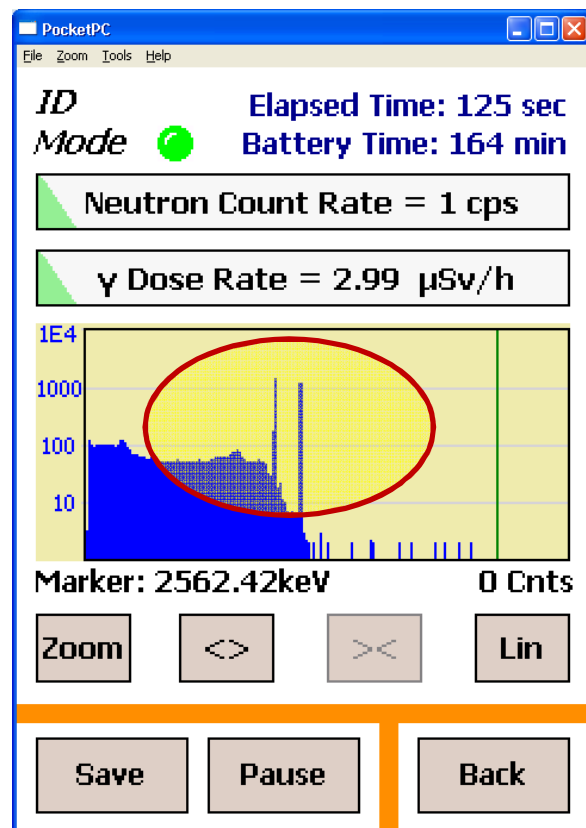
Save Display Back





# Cobalt-60 ( $^{60}\text{Co}$ )

$^{60}\text{Co}$  has gamma-rays at 1173.2 and 1332.5 keV  
and is an industrial source



PocketPC

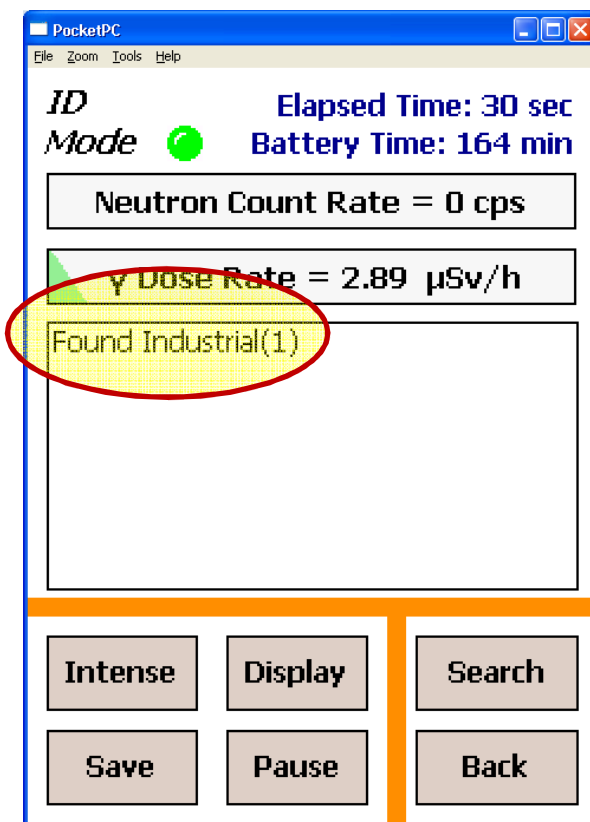
File Zoom Tools Help

ID Mode Elapsed Time: 60 sec  
Battery Time: 164 min

Intense

Nuclide	Energy(keV)	Confidence
Co60	1173.20	59.59
Co60	1332.50	52.73
K40	1460.75	2.65
Eu155	105.31	2.47
Y88	898.00	2.06
Bi207	1063.60	1.76
U235	143.79	1.68

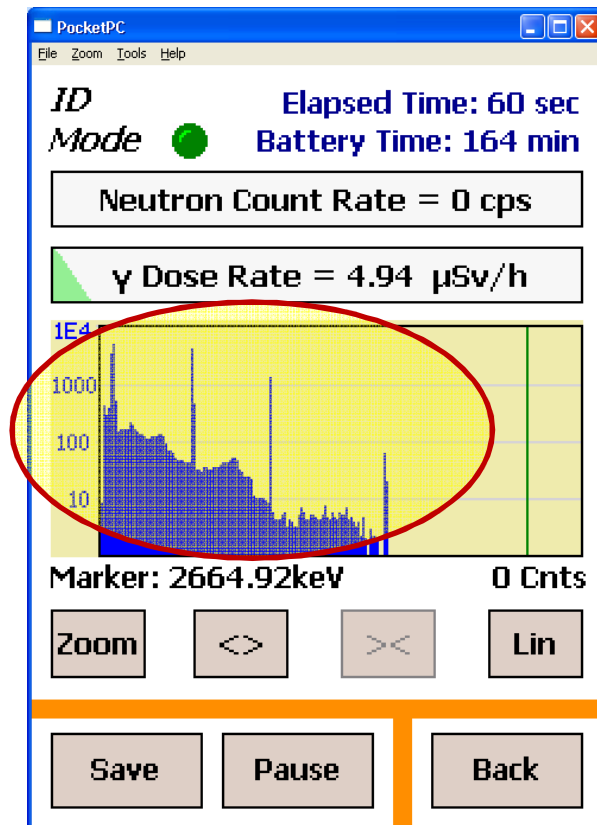
Save Display Back






# Bismuth-207 ( $^{207}\text{Bi}$ )

$^{207}\text{Bi}$  has multiple gamma-rays and is an industrial source



PocketPC

File Zoom Tools Help

ID Mode  Elapsed Time: 60 sec  
Storage Space: 12192


Intense

Nuclide	Energy(keV)	Confidence
Bi207	569.70	105.44
Bi207	1063.60	67.09
Eu155	86.54	27.68
Co56	1771.50	13.56
Tl204	70.82	5.35
Eu155	60.01	2.72
Am241	59.54	2.70
Lu177S	249.79	2.26
Lu172	900.73	2.09

Save Display Back

PocketPC

File Zoom Tools Help

ID Mode  Elapsed Time: 108 sec  
Storage Space: 12192

Neutron Count Rate = 0 cps

$\gamma$  Dose Rate = 2.92  $\mu\text{Sv/h}$

Found Other(1)  
Suspect Industrial(1)

Intense Display Search

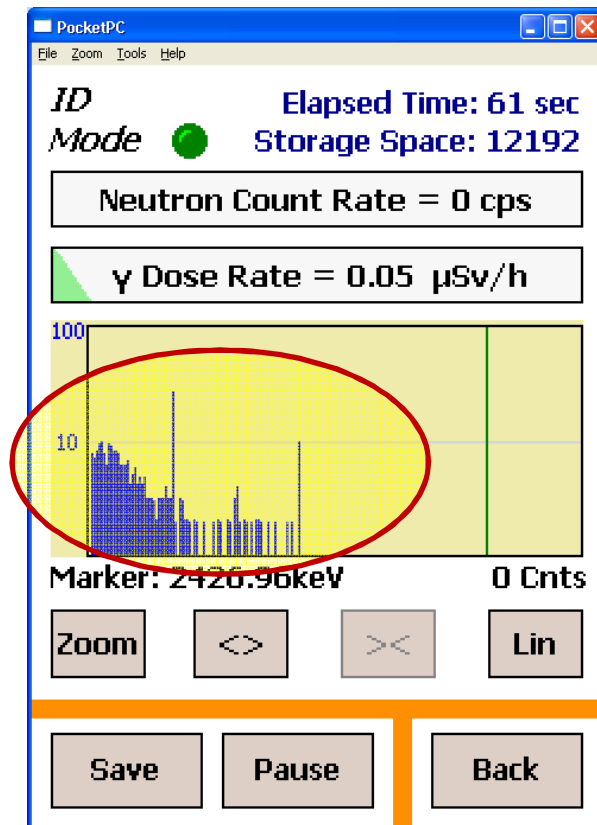
Save Pause Back





# Sodium-22 ( $^{22}\text{Na}$ )

$^{22}\text{Na}$  has gamma-rays at 511 and 1274.5 keV  
and is an industrial source



PocketPC

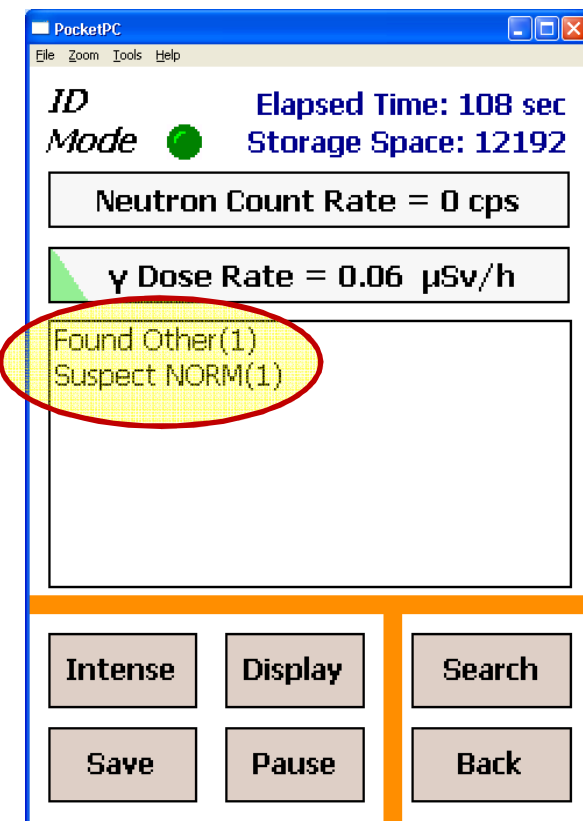
File Zoom Tools Help

ID Mode ● Elapsed Time: 61 sec  
Battery Time: 164 min

Intense

Nuclide	Energy(keV)	Confidence
Na22	1274.50	6.63
Na22	511.00	5.35
Cu64	511.00	5.35
Ra226	609.00	2.83
K40	1460.75	2.45
Cf252-249	388.32	2.45
La140(FP)	487.00	2.24

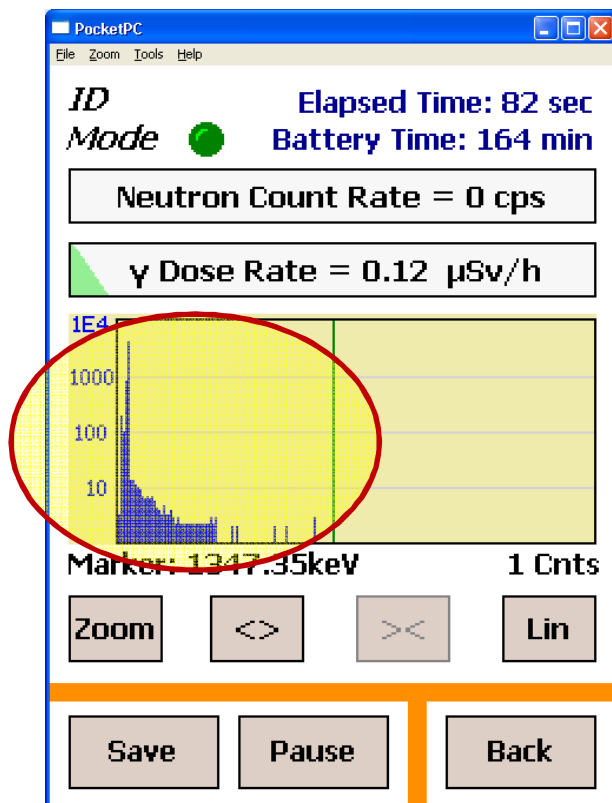
Save Display Back



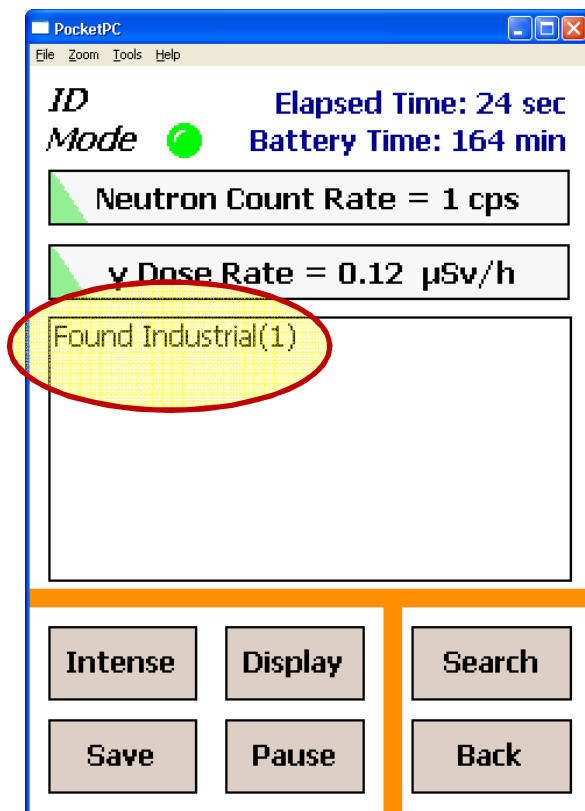


# Americium-241 ( $^{241}\text{Am}$ )

$^{241}\text{Am}$  has multiple gamma-rays and is an industrial source



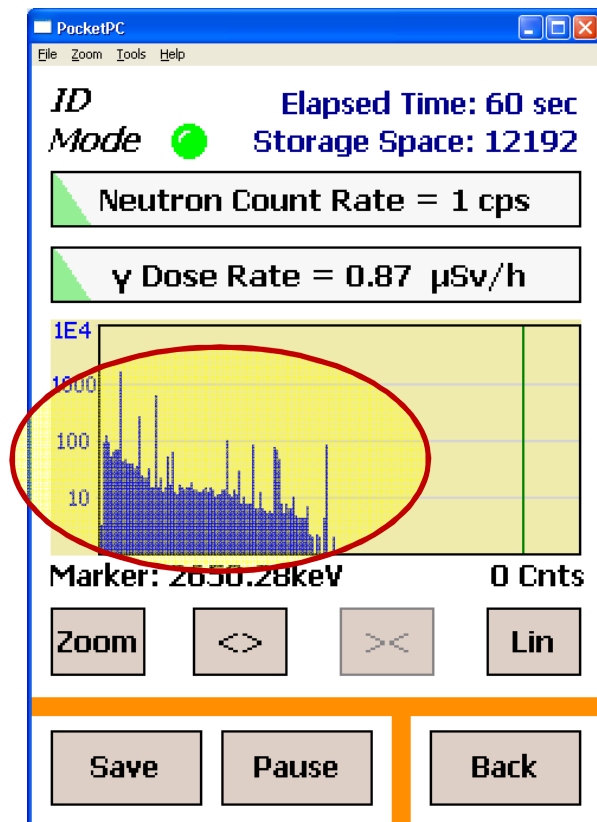
Nuclide	Energy(keV)	Confidence
Am241	59.54	92.61
Eu155	60.01	92.61
Gd153	97.43	2.26
K40	1460.75	2.00
Re188	477.99	2.00
I125	35.46	1.95
Cd109	88.00	1.82





# Europium-152 ( $^{152}\text{Eu}$ )

$^{152}\text{Eu}$  has multiple gamma-rays and is an industrial source



PocketPC

File Zoom Tools Help

ID Elapsed Time: 60 sec  
Mode Battery Time: 164 min

Intense

Nuclide	Energy(keV)	Confidence
Co57	122.06	68.30
In111	245.35	25.61
Mo99	777.90	18.48
Eu152	1408.00	17.96
Eu152	1112.07	16.37
SR RB82	776.52	14.23
Au198	411.80	8.20
Ho166	410.90	8.20

Save Display Back

PocketPC

File Zoom Tools Help

ID Elapsed Time: 43 sec  
Mode Battery Time: 164 min

Neutron Count Rate = 0 cps

$\gamma$  Dose Rate = 0.84  $\mu\text{Sv/h}$

Found Industrial(1)  
Found Other(1)

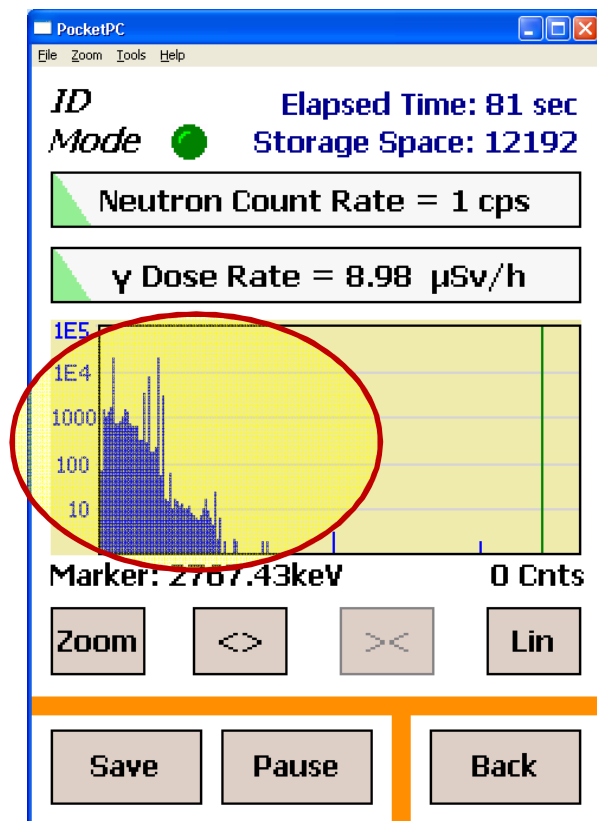
Intense Display Search

Save Pause Back



# Barium-133 ( $^{133}\text{Ba}$ )

$^{133}\text{Ba}$  has multiple gamma-rays and is an industrial source



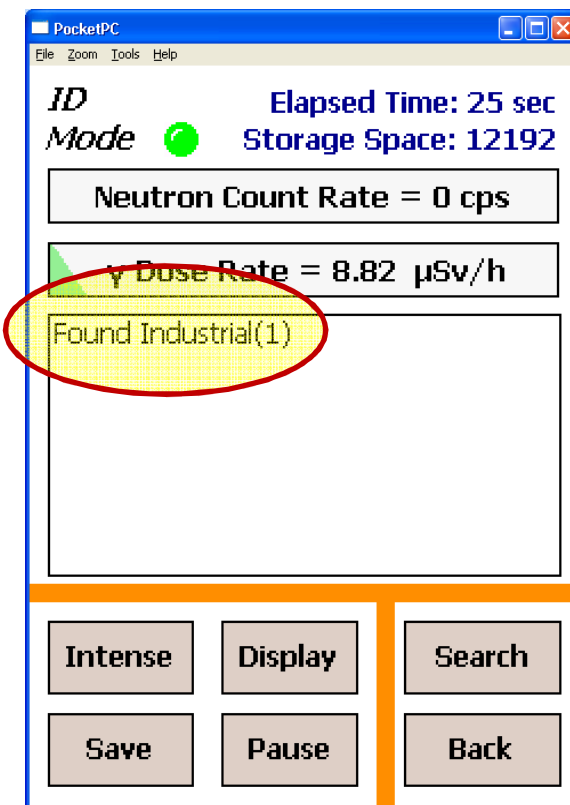
PocketPC  
File Zoom Tools Help

ID Mode ● Elapsed Time: 61 sec  
Battery Time: 164 min

Intense

Nuclide	Energy(keV)	Confidence
Ba133	356.00	246.65
Pd103	357.45	232.85
Xe133	81.00	186.40
Tl204	80.20	186.39
Ba133	302.00	138.30
Ba133	383.00	87.88
Ga67	300.22	17.24
Pa233	300.34	17.24
I123	158.97	8.40

Save Display Back





# Training and Exercise



**Three HPGe Detectives will be setup with laptops, projectors and screens so that each group can view their PDA display**

**The instructor will divide the class into 3 groups and assign each group an expert to assist and answer questions**

**Each group will measure a series of radiation sources**

**For the Training Session, the radiation sources will be known**

**For the Exercise Session, the radiation sources will be unknown**

**All measurements will be saved and documented with a checklist**



# Spectroscopy Checklist



First Responder Gamma Spectroscopy Checklist - Group # _____							
Initial Setup Date/Time	Detective Serial Number	Detective Operating Status (ok)	Gamma Background Count Rate	Gamma Background Dose Rate	Background Measurement (300 seconds) Filename	Calibration Measurement (300 seconds) Filename	Calibration Source Activity/Date/Serial Number (kBq)
Source Measurements	Measurement (300 seconds) Filename	Detective Operating Status (ok)	Gamma Background Count Rate	Gamma Background Dose Rate	Measurement Dead Time (%)	Detection Distance (cm)	Radioisotopes Identified and Confidence Levels
Source 1							
Source 2							
Source 3							
Source 4							
Source 5							
Source 6							
Source 7							
Source 8							
Source 9							
Source 10							



# Training



**Review advanced setup screen and check operating status**

**Determine background count and dose rate as quality control check**

**Calibrate using  $^{137}\text{Cs}$  and automated calibration feature**

**Collect and save 5 minute spectra for background and calibration**

**Check dead time for all measurements and adjust distance to source as necessary to obtain 5% or less**

**Collect and save 5 minute spectra for a series of known radiation sources**

**Complete a checklist for each radiation source**

**The training will be followed by questions and discussion**





# Exercise

## Scenario



Intelligence sources intercept documents which indicate that an abandoned warehouse near the border will be used as a trans-shipment point for a smuggled weapons cache. The date is close to an upcoming national event with international participants.

A law enforcement team supported by an Explosive Ordnance Disposal (EOD) unit raids the warehouse and using their radiation pagers, locate several containers of radioactive material. The radiation pagers provide readings ranging from 3 to 7 on contact.

The EOD unit requests an expert radiological team collect data on the containers to identify the radioactive material and provide an assessment of their results.



# Exercise



**Determine background count and dose rate as quality control check**

**Calibrate using  $^{137}\text{Cs}$  and automated calibration feature**

**Collect and save 5 minute spectra for background and calibration**

**Check dead time for all measurements and adjust distance to source as necessary to obtain 5% or less**

**Collect and save 5 minute spectra for a series of unknown radiation sources**

**Complete a checklist for each radiation source**

**Each group will provide a summary of their results and initial assessment**

**The exercise will be followed by questions and discussion**



# Questions?

