Basic Radiation Instrumentation

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Objectives

- Describe the use of basic radiation and contamination detection instrumentation.
- Describe techniques for contamination surveys, dose rate measurements, and radionuclide identification.

Survey Instrument

- Instrument Description
  - Pancake Probe/Geiger-Mueller
  - OFF
  - Battery Check
  - Scale
  - Multiplier
  - Audio
  - Fast/Slow
  - Reset

- Alpha, Beta, and Gamma
- Survey: Patient, Personnel, Area
- Units - counts per minute (cpm)

Pancake Probe (G-M)

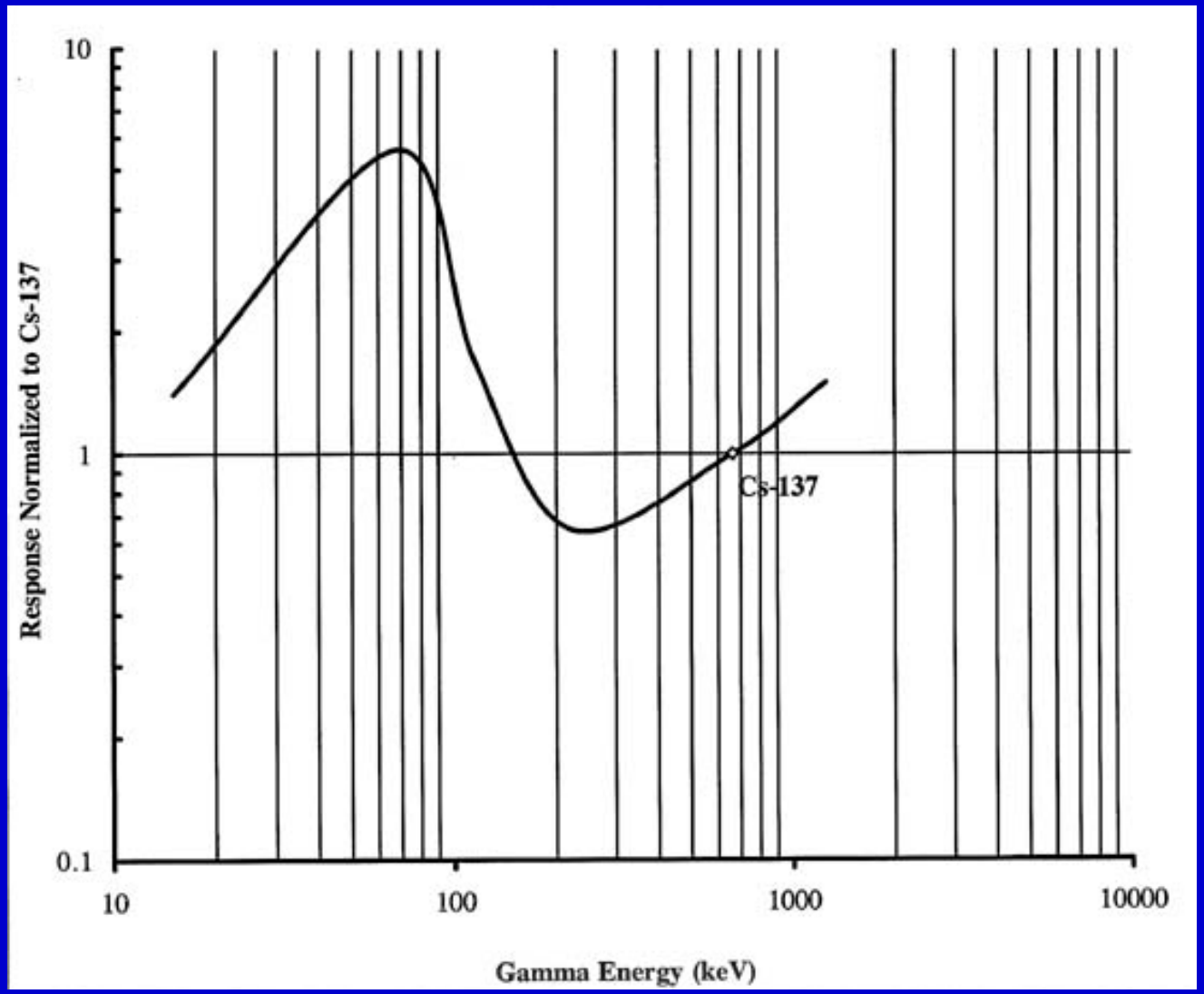
Efficiencies are dependent on Energy and Radiation Type

	Energy (MeV)	*Typical/Example* Efficiency
Beta	0.156 [max] 1.71 [max]	5% 32%
Alpha	5.245	15%
Gamma or a Beta/Gamma	Energy dependent	2-5% 20%

Using Survey Instrument as a Dose Rate Meter Pancake Probe (44-9)

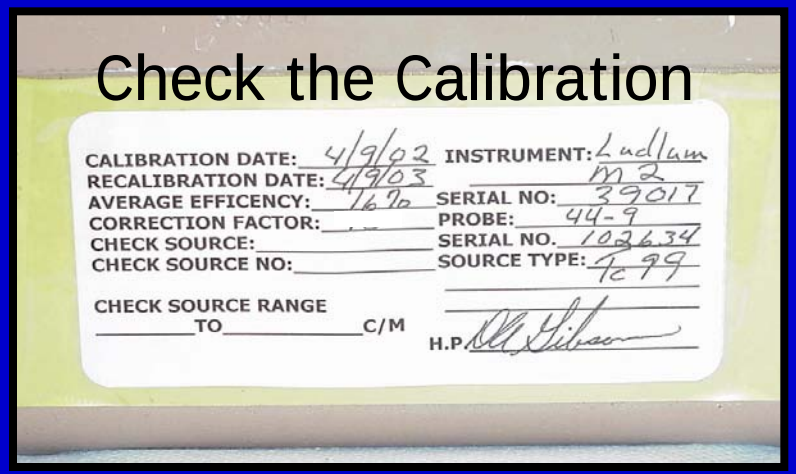
- Pancake Probe is **NOT** energy compensated
- Only accurate for one calibrated energy (usually Cs-137)
- Inaccurate results for other energies

Energy Response - Pancake Probe (44-9)



Preparing to Survey

- Start radiological survey sheet
  - Look for damage to instrument (esp. probe)
  - Calibration date
  - Battery
  - Response check

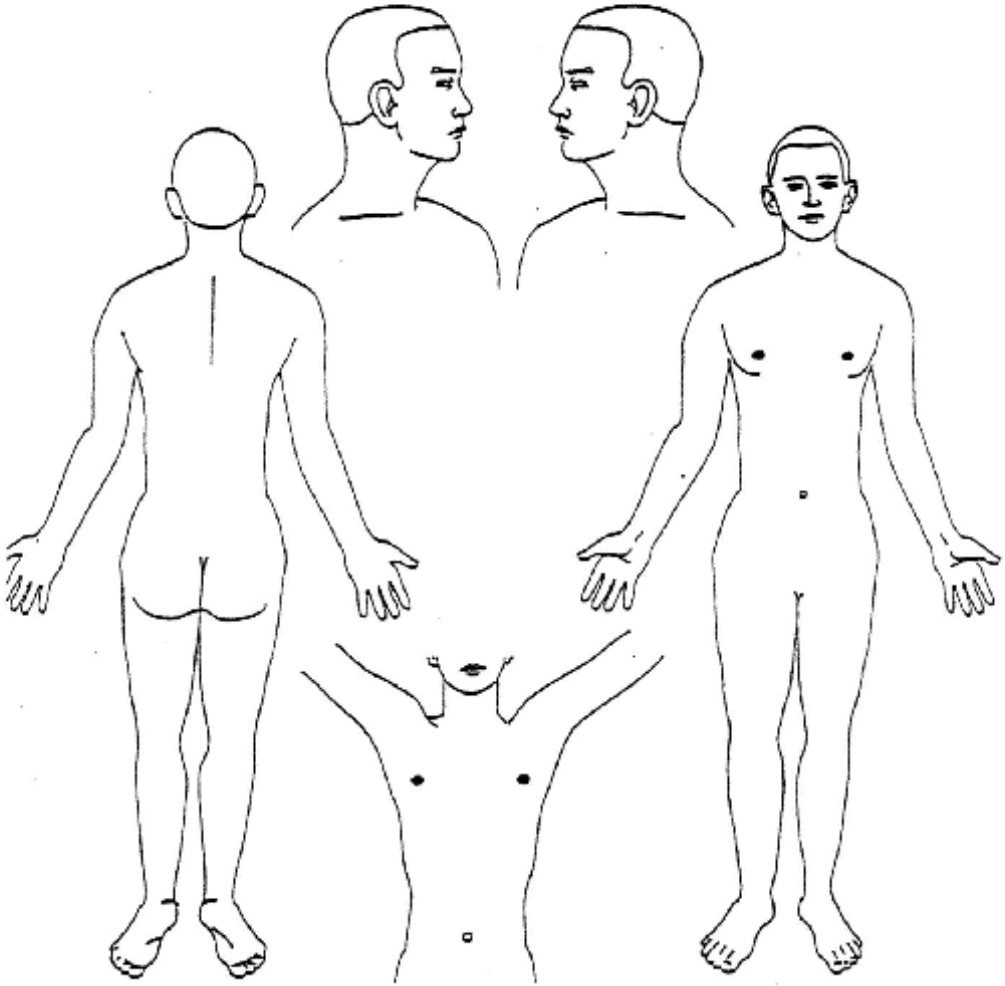


Radiological Survey Sheet (Patient)

Patient Name:	SSN/ID Number:	Date:

Instrument ID	Calibration Check	Battery Check	Response Check	Background

HP/HP Tech (Print):	Signature:



Preparing to Survey

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  - Look for damage to instrument (esp. probe)
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  - Battery
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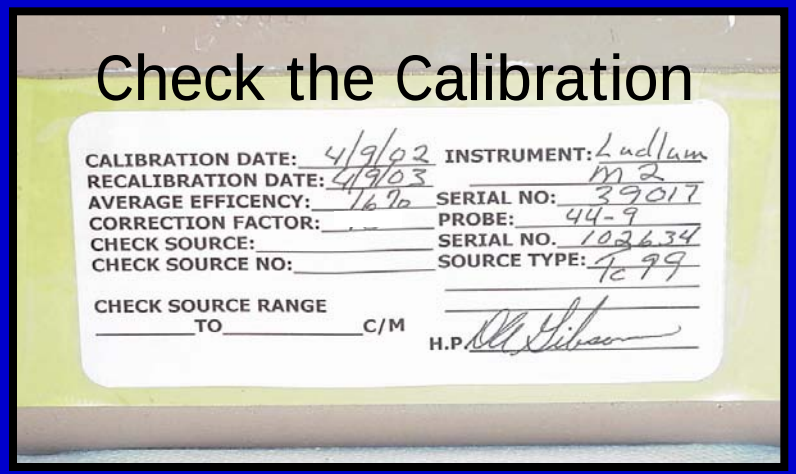


Preparing to Survey (cont.)

- Instrument ID
- Name
- Record background radiation level away from patient.
- What is contaminated?
  - 2-3 times background

How to Survey

- Make sure you turn on the instrument
  - Start with the Most Sensitive Scale (adjust as needed)
  - Always know what multiplier you are using
- Survey on “Fast” setting
  - ½ inch from the surface
  - 2-3 inches per second
  - Careful not to contaminate your detector. Beta/gamma - cover probe
- Triage survey
  - Get out of the way
- Quantitate, switch to “Slow”

Scale Reading (CPM)	Range Multiplier	True Reading (CPM)
700	1	700
700 CPM x 1 = 700 CPM		

Transport: Contamination Control

Medical care takes priority!

- Cover items
- Awareness of actions (scissors)
- Contain contamination as soon as medical condition allows
- Cocoon patient clean sheet

- No eating/drinking, applying cosmetics, chewing gum/tobacco
- Jewelry, watches, phones, pagers

Controlled Area

- Establish controlled/decontamination area

- Tape, ropes, signs, floor covering, security
- Remove unneeded items
- Non-contaminated patients do not enter
- No eating/drinking, applying cosmetics, chewing gum/tobacco
- Jewelry, watches, phones, pagers

Patient Contamination Surveys

- Measurements can be made during patient treatment.
- Order to survey
  - Wounds
  - Face/Body Orifices
  - Skin
- Document Readings
- Repeat measurements
  - Maintain the same distance from probe

- Survey all areas of the patient (sides, back, etc.)

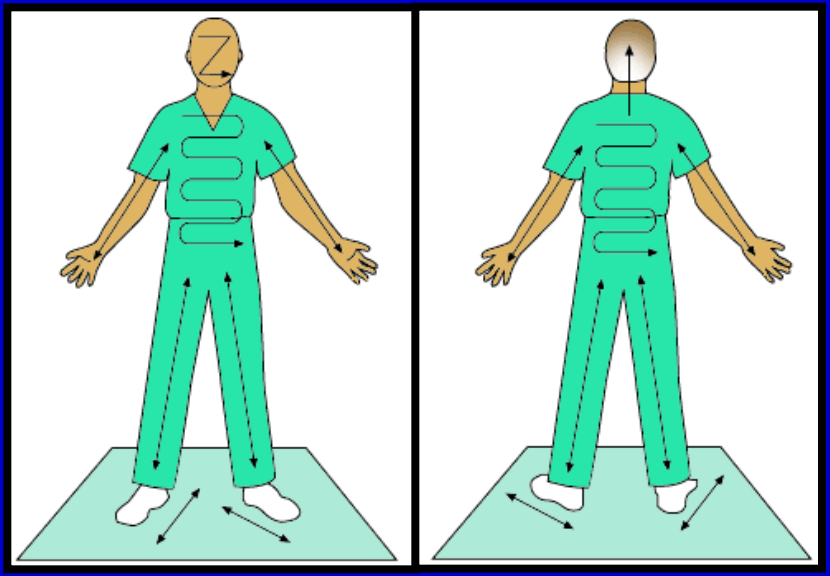
What is a lot of counts?

- Important to know what radionuclide it is.
- Efficiency
- 1 μCi = 2,220,000 dpm

	ALI	
Cs-137	100 μCi	222,000,000 dpm
Sr-90	4 μCi	8,880,000 dpm
Am-241	0.006 μCi	13,320 dpm

Personnel Contamination Surveys

- First, nose and mouth, detect potential for internal contamination early.
  - If you are surveying yourself, first check for contamination on your hands before picking up the instrument.
- Hands
- Be Systematic



Area Surveys

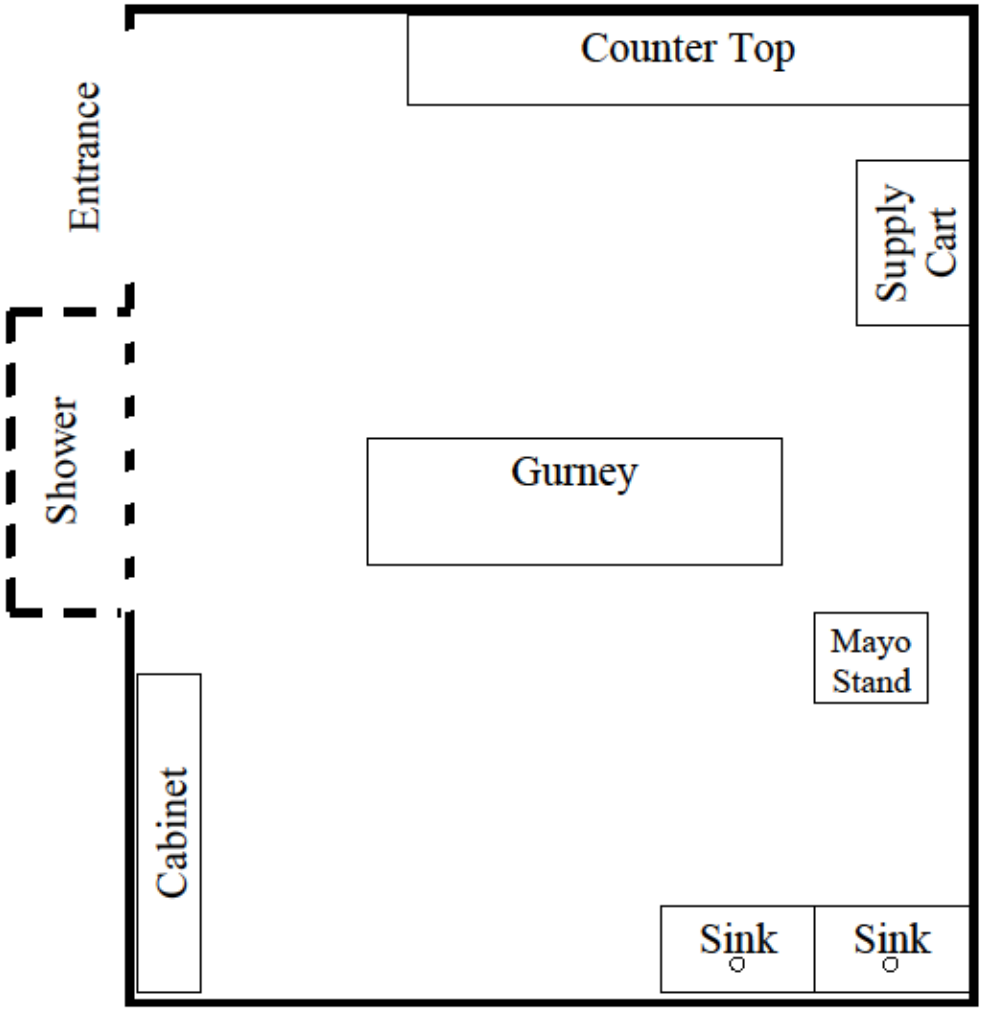
- All materials will have to be surveyed in the controlled area before release.
- Ambulance/EMT-P's?

Radiological Survey Sheet (Area)

Area(s):	Date:

Instrument ID	Calibration Check	Battery Check	Response Check	Background

HP/HP Tech (Print):	Signature:



Comments:

Irradiation

Geiger Mueller Detector

Dose Rate Meter

Scale Reading (mR/hr)	Range Multiplier	True Reading (mR/hr)
0.4	10	4
0.4 mR/hr x 10 = 4 mR/hr		

Examples for Estimating Dose

For the gamma radiation fields below calculate an estimated dose for 5, 10, and 60 minutes (assuming 1 R=1 rad):

	Exposure Time (minutes)		
Dose Rate	5	10	60
500 μR/hr	41.7 μrad	83.3 μrad	500 μrad
20 mR/hr	1.67 mrad	3.33 mrad	20 mrad
1 R/hr	0.083 rad	0.167 rad	1 rad
100 R/hr	8.3 rad	16.7 rad	100 rad

Instruments to Measure Accumulated Dose (Dosimeters)

- Two types are normally used:
  - direct readout devices (pocket dosimeters)
  - OSLDs, TLDs or film badges

- Finger ring dosimeters or similar extremity monitors may also be worn

Dosimetry Assignment Record

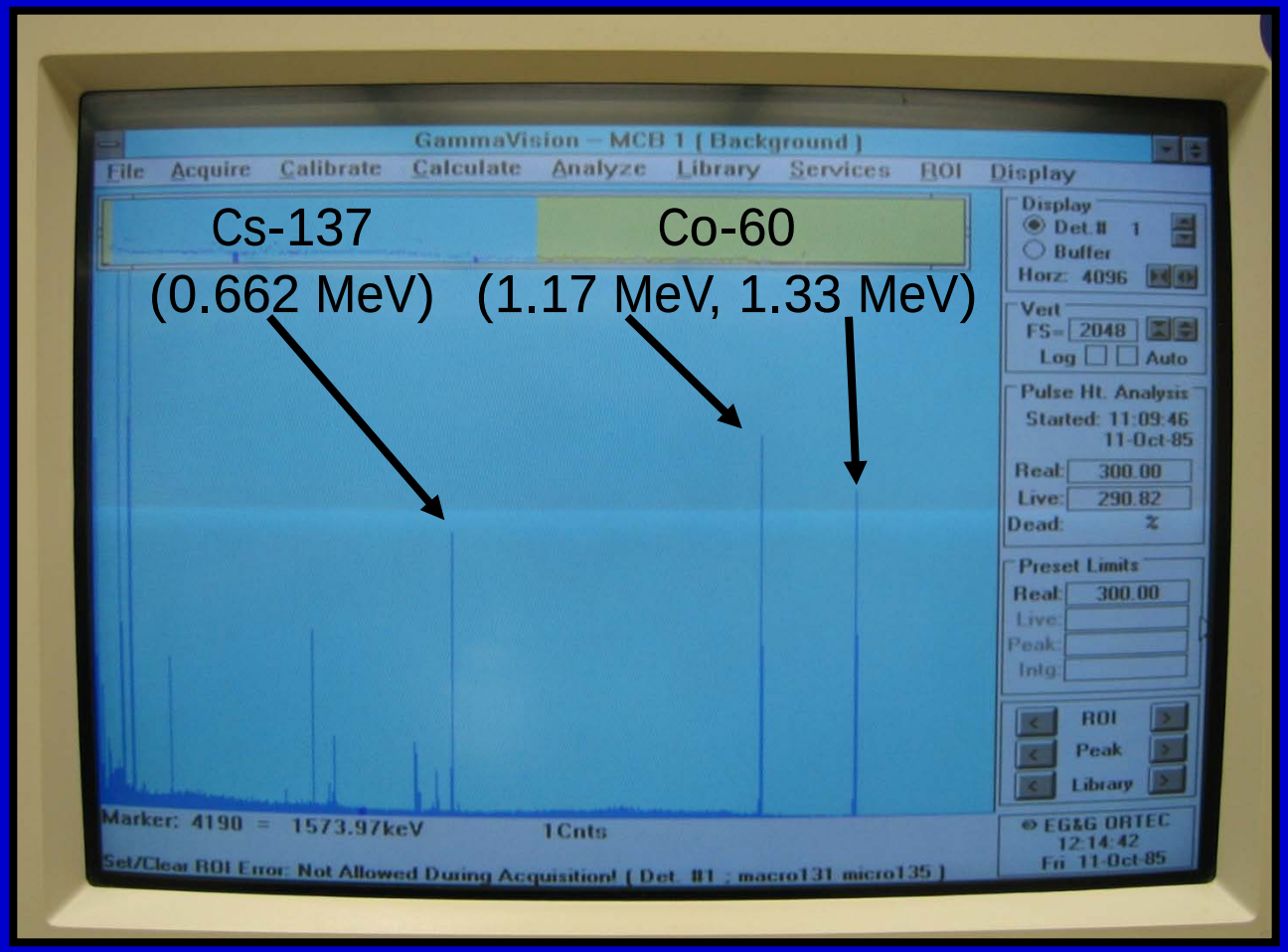
Name	Employee ID No. or SSN	Dosimeter NO.		Pocket Dosimeter Readings	
		OSLD	Pocket Dosimeter	Initial	Final

Reviewed by (Print):	Signature:	Date:

Identify the Radioactive Materials

- Typically done by relatively sophisticated lab equipment, e.g. gamma spectroscopy and alpha spectroscopy (analyze a spectrum for specific energies unique to a radionuclide)
- Samples collected from the patient or their clothing often used for this analysis.
- This information along with other information from the accident scene is used for possible treatment of internal contamination.

Gamma Spectroscopy

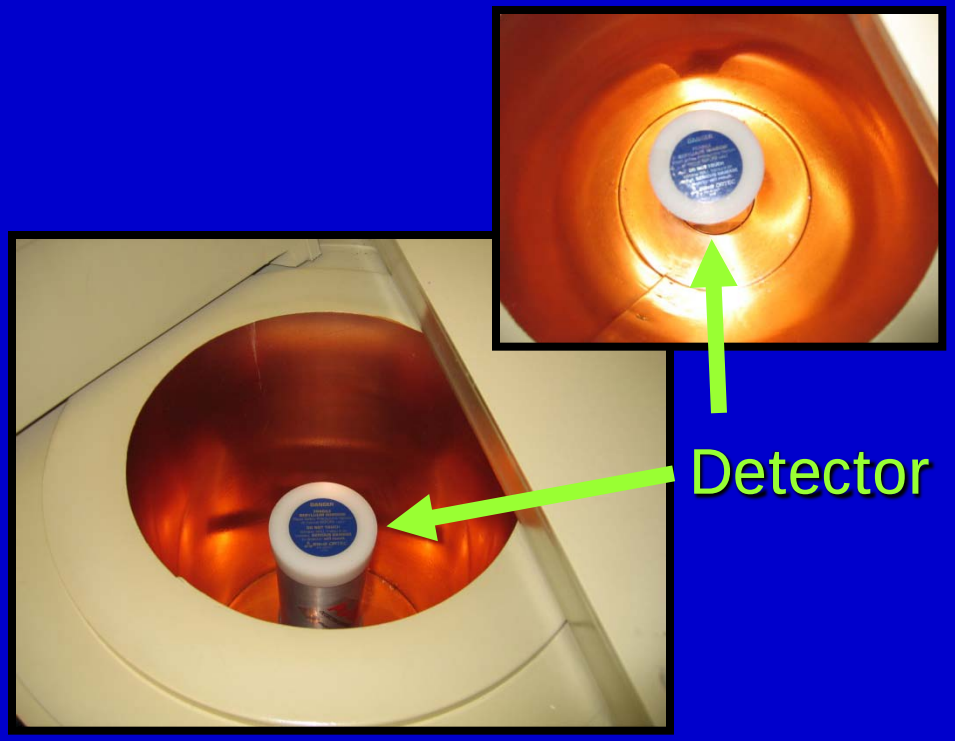


- Highly Accurate
- But Portable?

Gamma Spectroscopy

Lead Shield

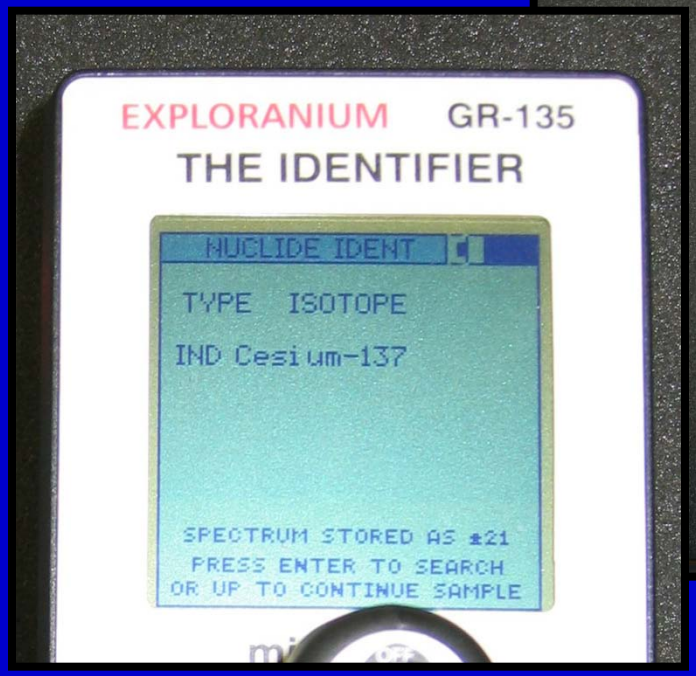
Liquid Nitrogen
-196°C (-321°F)



Detector

Gamma Spectroscopy

- Exploranium Detector
- Highly Portable
- Less Sensitive



Alpha Scintillation Detector

reac/ts