



# Radiation Detection Equipment

## *Introduction to WMD Science*

SAND No.

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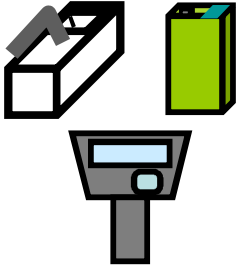
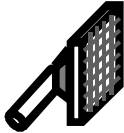
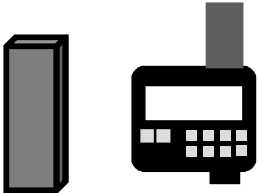
# Enabling Objectives

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- Explain the basic operation of a radiation detector
- Discuss different types of detectors
- Discuss the types of equipment that are available to detect radioactive materials.

# Detectors

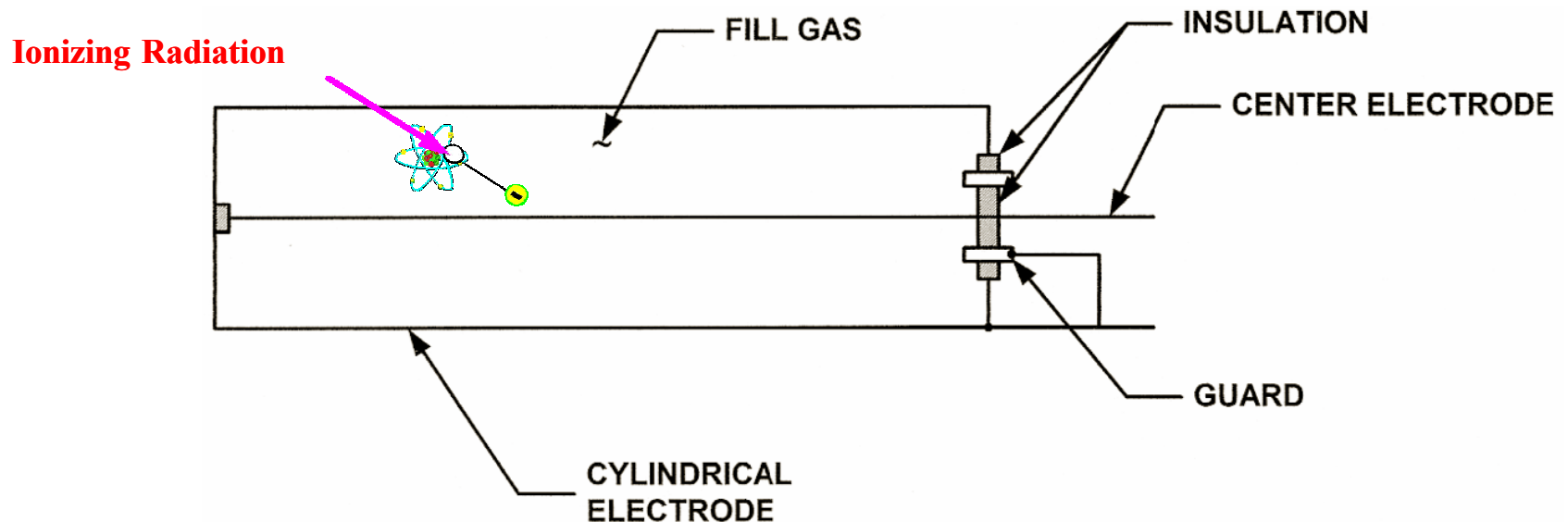
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| <u>Radiation</u> | <u>Range in Air</u> | <u>Detectors</u>                                                                           |                                                                                       |
|------------------|---------------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Gamma            | 100's feet          | Gas-filled<br>Crystalline (NaI, CsI, CZT)<br>HPGe (high resolution)                        |    |
| Beta             | ~ 12 feet (MeV)     | Gas-filled<br>Plastic scintillator                                                         |    |
| Alpha            | ~ 1 inch            | ZnS<br>Plastic scintillator                                                                |    |
| Neutron          | 100's feet          | He-3 tubes<br>BF <sub>3</sub> tubes<br>Liquid/plastic scintillators<br>LiI with moderation |  |

# Radiation Detection

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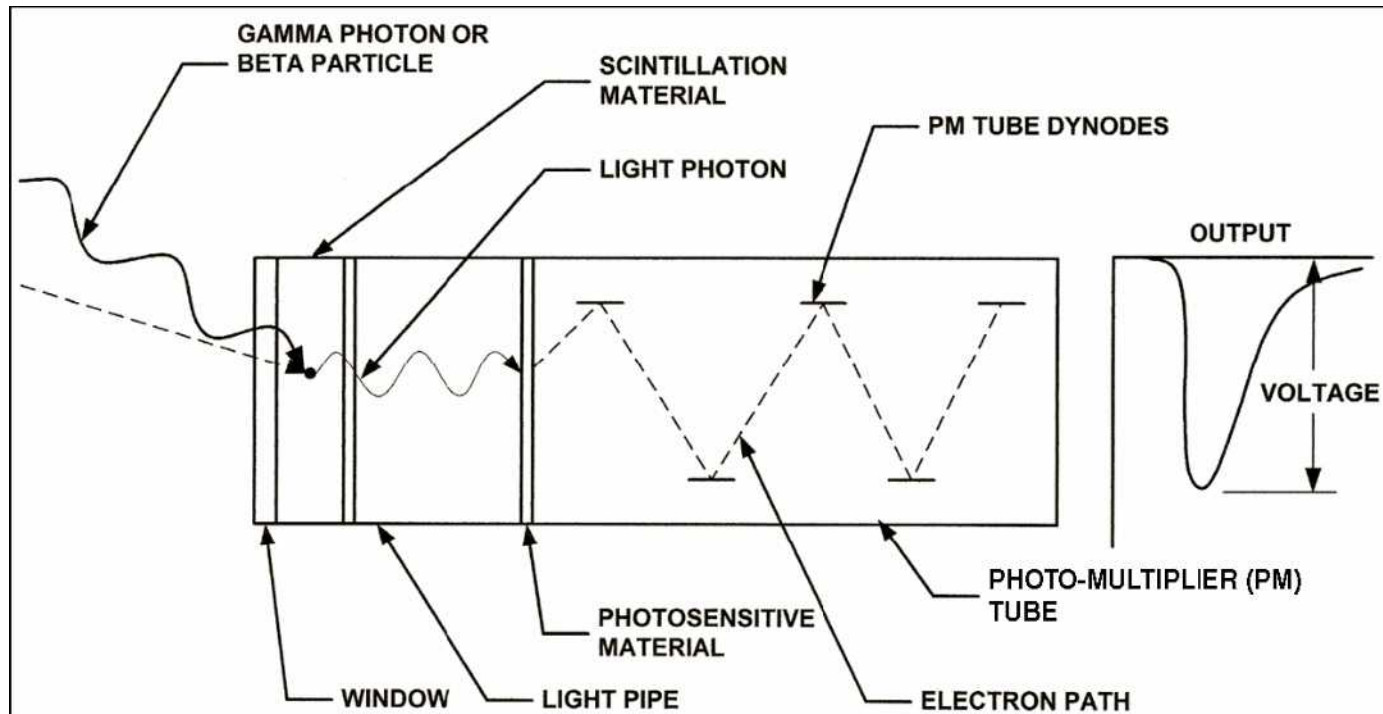
- Based on the principle of charge collection within a sensitive volume (detector material)
- Charge collection produces the signal that drives the detector display
- Amplification is sometimes necessary.



# Radiation Detection (Amplification Example)

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Scintillation detectors use organic or inorganic solid materials as detectors



# Detection Characteristics

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|                                              | Resolution | Identify | Reach-back | Comments                                                         |
|----------------------------------------------|------------|----------|------------|------------------------------------------------------------------|
| <b>Pagers</b>                                | Low        | No       | No         | Can't distinguish between nuisance alarms and sources of concern |
| <b>Commercial Identification (ID) Units</b>  | Low        | Yes      | Yes        | High error rate                                                  |
| <b>Portals</b>                               | Low        | Some     | Some       | Requires secondary examination                                   |
| <b>Health Physics (HP) Detectors</b>         | Low        | No       | No         | Used for Public Health and Safety                                |
| <b>Man-portable Search Gear</b>              | Low        | Some     | Some       | Low profile                                                      |
| <b>Mobile Search Gear</b>                    | Low        | Some     | Some       | Low profile                                                      |
| <b>High-Purity Germanium (HPGe) ID Units</b> | High       | Yes      | Yes        | Gold Standard for Isotopic ID                                    |
| <b>Aerial Detection Units</b>                | Low        | No       | No         | Used to produce ground deposition maps after a radiation release |

# Mobile System

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- Wide area search
- Platform: Vehicle, maritime, aerial
- Gamma: NaI
- Neutron:  $^3\text{He}$  tubes
- Battery: Different types
- Audio alarms
- ID possible



# Backpack Unit

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- Wide/small area search
- Gamma: NaI, CsI or plastic scintillator
- Neutron:  $^3\text{He}$  tubes
- Battery: 2 - 3A Lithium
- Audio/vibrate alarms
- ID usually not provided





# Handheld Radiation Monitor or Pagers

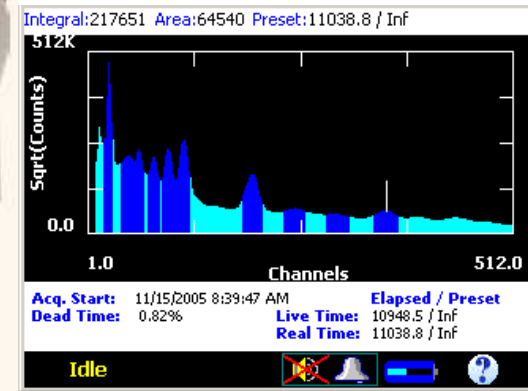
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- Small area / localize
- Gamma: NaI, CsI, gas-filled
- Neutron:  $^3\text{He}$  tubes or none
- Battery: 1 - 9V
- Audio/Vibrate alarms
- ID: None
- Waterproof / resistant



# Handheld Multichannel Analyzers

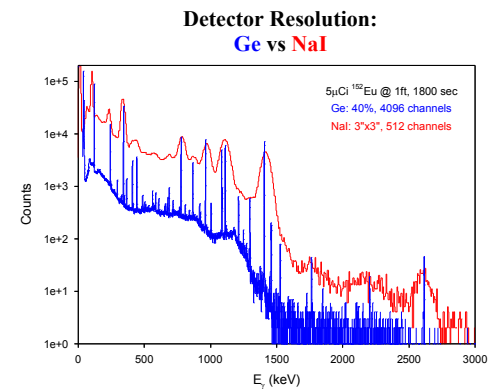
- Identification
- Gamma: NaI
- Neutron:  $^3\text{He}$  tubes
- Battery: AA or rechargeable
- Audio Alarm
- ID: Yes
- Waterproof/resistant
- Auto Calibration



# Handheld Multichannel Analyzers (continued)

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- Identification
- Gamma: HPGe
- Neutron: None
- Battery: Rechargeable
- Audio Alarm
- ID: Yes
- Waterproof/resistant
- Auto Calibration



# Monitoring Systems

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**Portal Monitors**



**Cargo Monitors**



**Radiography**