



# Radiation Detection Overview

# How do we detect radiation?

Radioactive materials emit four basic types of radiation – alpha, beta, gamma and neutron

Radiation cannot be detected with human senses (touch, smell, taste, sight, hearing).

***As such, special instrumentation is required to detect radiation***

# Detection Basics



Radioactive  
Material  
Emits  
Radiation



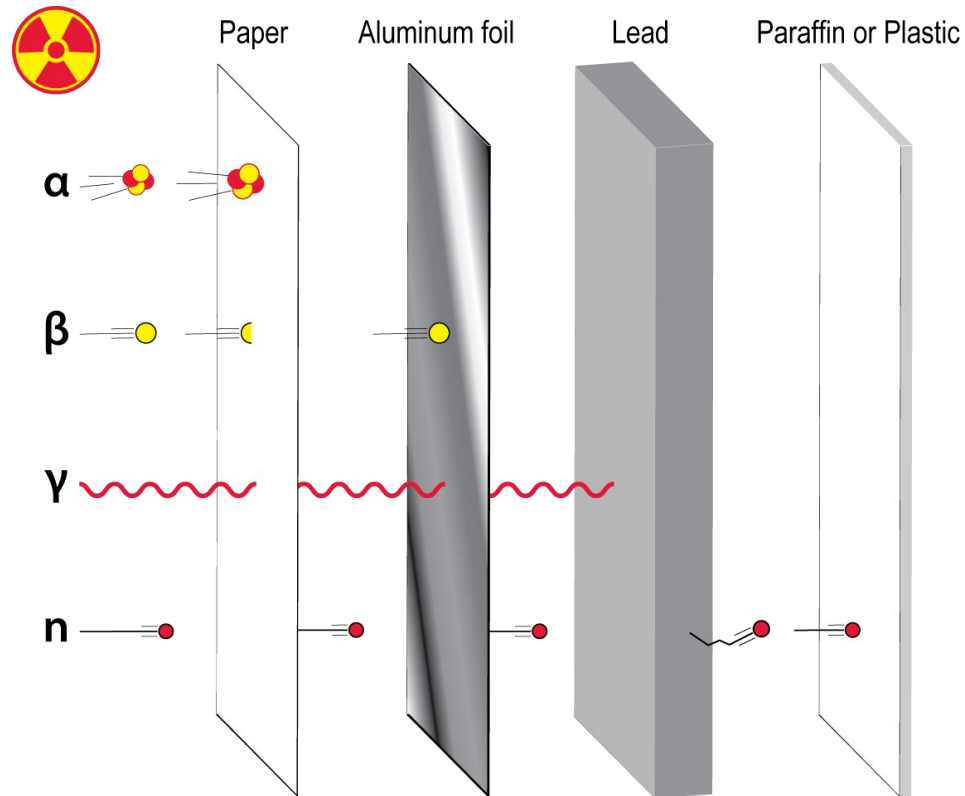
Instrument  
Detects  
Radiation



Visual  
Audio  
Tone  
Vibrate

Electronics  
Converts  
to Readout

# Effects of Shielding



*For detection of radioactive materials, only gammas and neutrons have sufficient energy to penetrate shielding materials and travel 10's to 100's of meters in air.*

# Detection Instruments

Radiation detection instruments can be divided into three primary categories:

- Search / Localize
- Identify / Characterize
- Monitor / Survey

***Each detector is designed to detect a certain type of radiation***

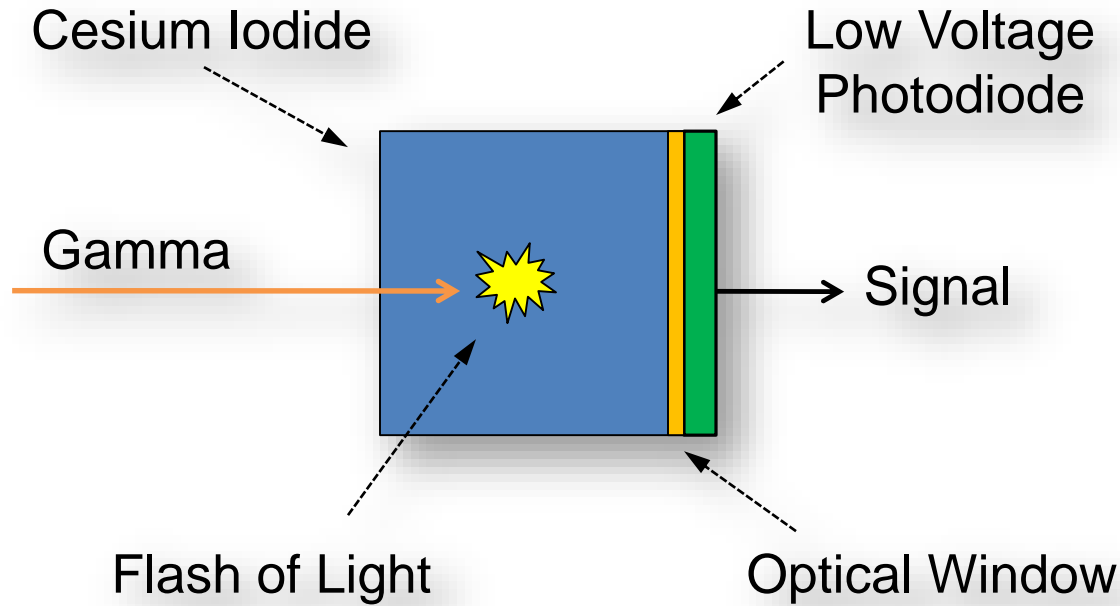
# Search | Localize

*Determine if a radiation source is present  
and where it is*

# Why Search / Localize?

- Lost or stolen radioactive materials
- Security screening or background surveys
- Portal monitors / border crossings

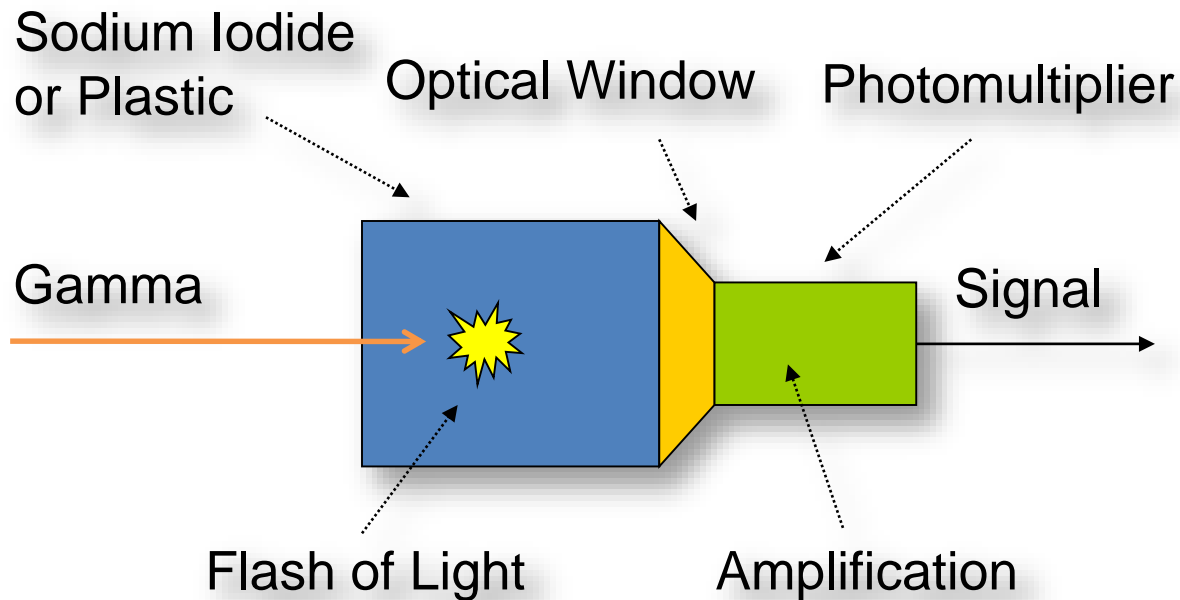
# Scintillation Gamma Detector (with Photodiode)



*Small/compact detectors with low voltage for pagers*

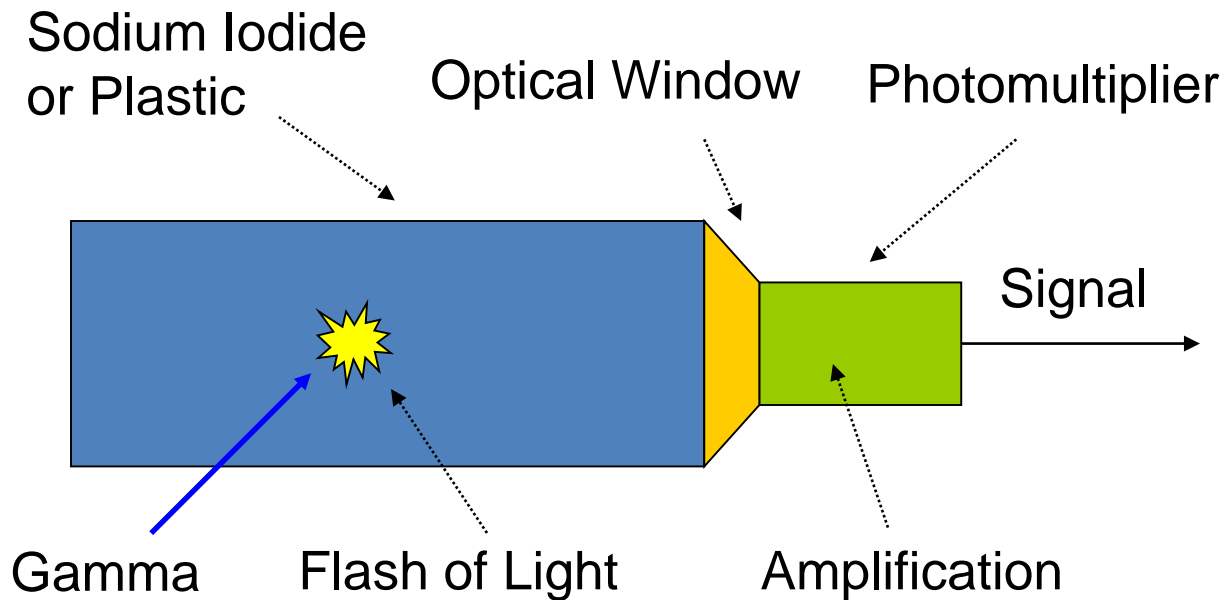


# Scintillation Gamma Detector (with Photomultiplier)



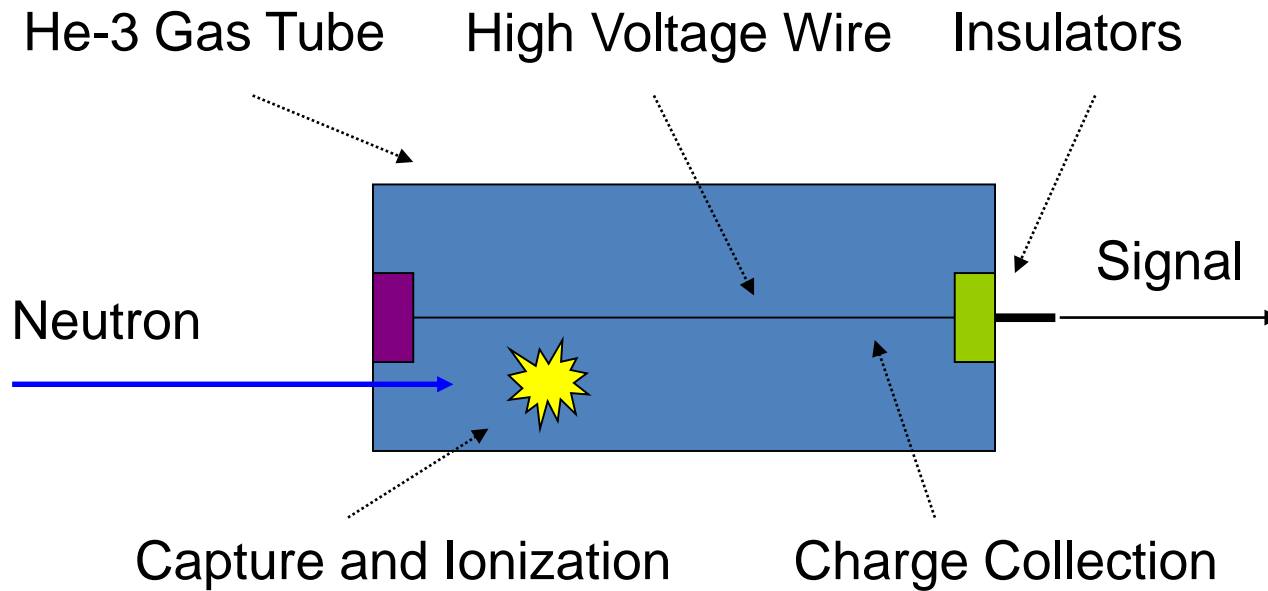
*Medium size detectors for handheld meters and backpacks*

# Scintillation Gamma Detector (with Photomultiplier)



*Large size detectors for mobile systems and portal monitors*

# Helium-3 Neutron Detector



*Small and large tubes for wide range of detection systems*

# Identify | Characterize

*Determine the identification of the radioisotope*

# Why Identify / Characterize?

- Identify the radioisotope(s) causing the alarm
- Alarm adjudication
- Is the cargo is consistent with the manifest?
- Understand the potential hazard

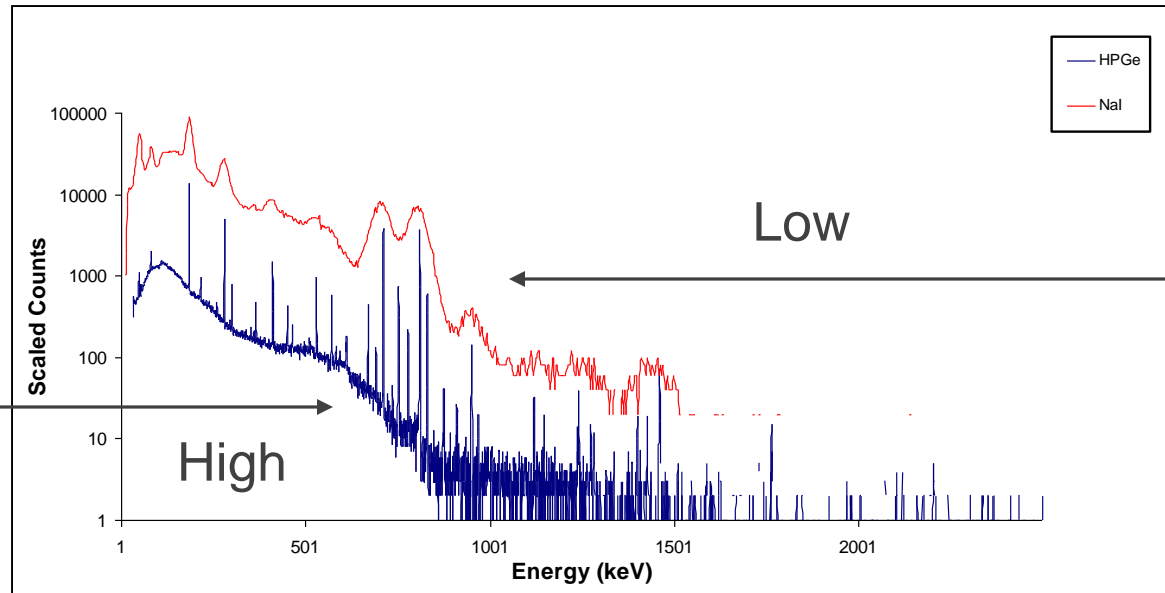
# Radioisotope Identification

## High Resolution vs Low Resolution Gamma Spectroscopy

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



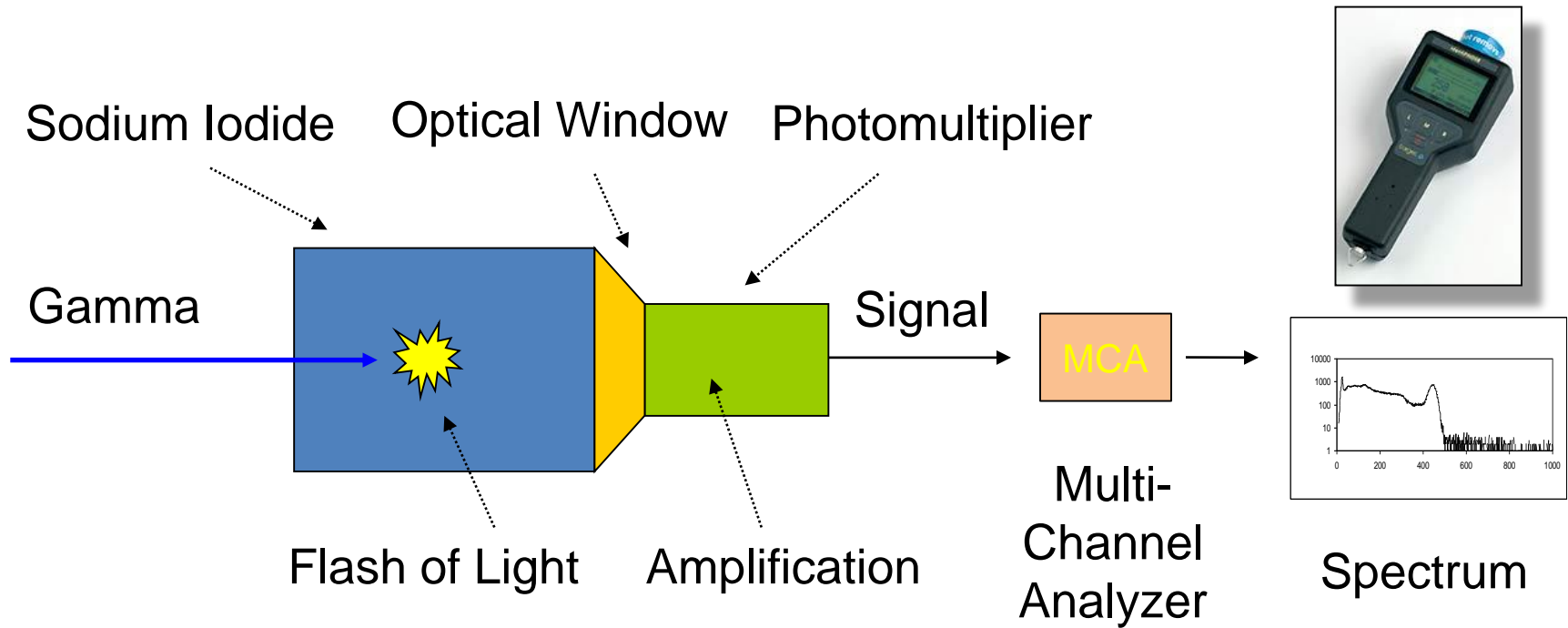
HPGe



NaI

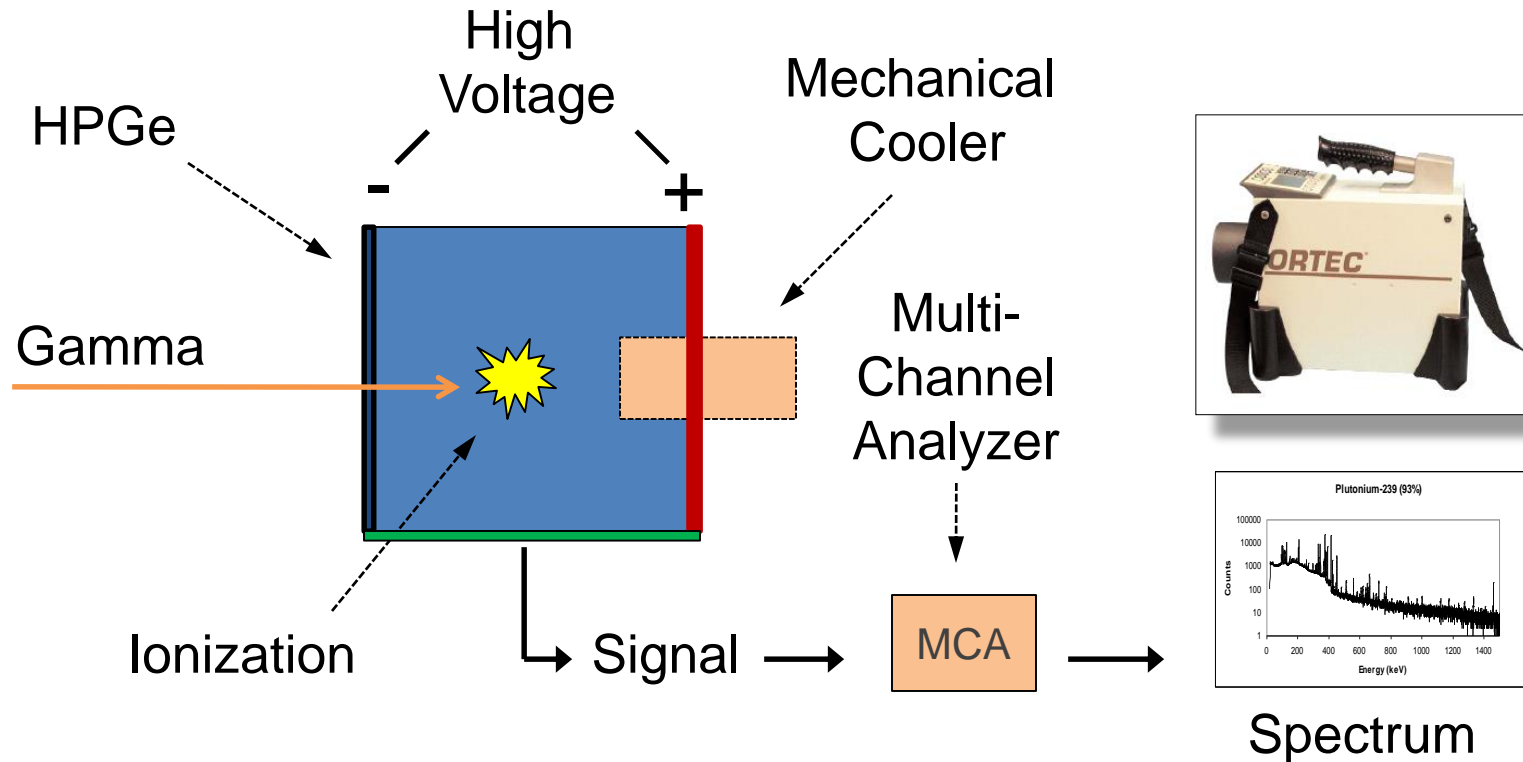
Sodium iodide (NaI) is used for *“Screening”*  
High purity germanium (HPGe) is used for *“Identification”*

# Scintillation Gamma Detector (with Photomultiplier)



*Low resolution detector for radioactive material “Screening”  
RadiIsotope IDentifier (RIID)*

# High Purity Germanium (HPGe) Gamma Detector



*High resolution detector for radioactive material “Identification”*



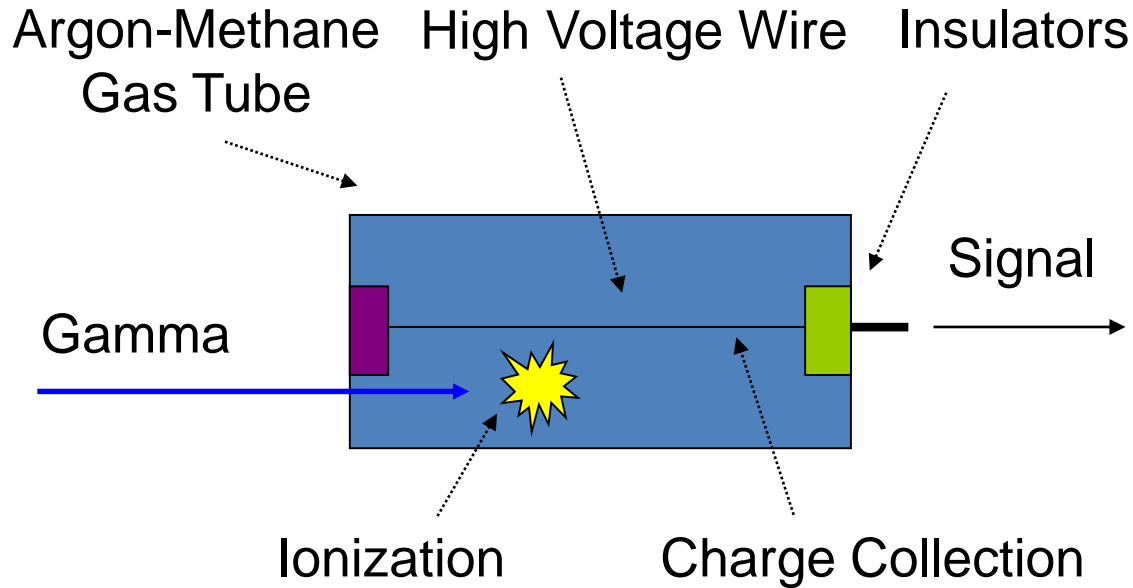
## Monitor | Survey

*Assess safety risk and determine if there is radiation contamination and if it has spread*

# Why Monitor / Survey?

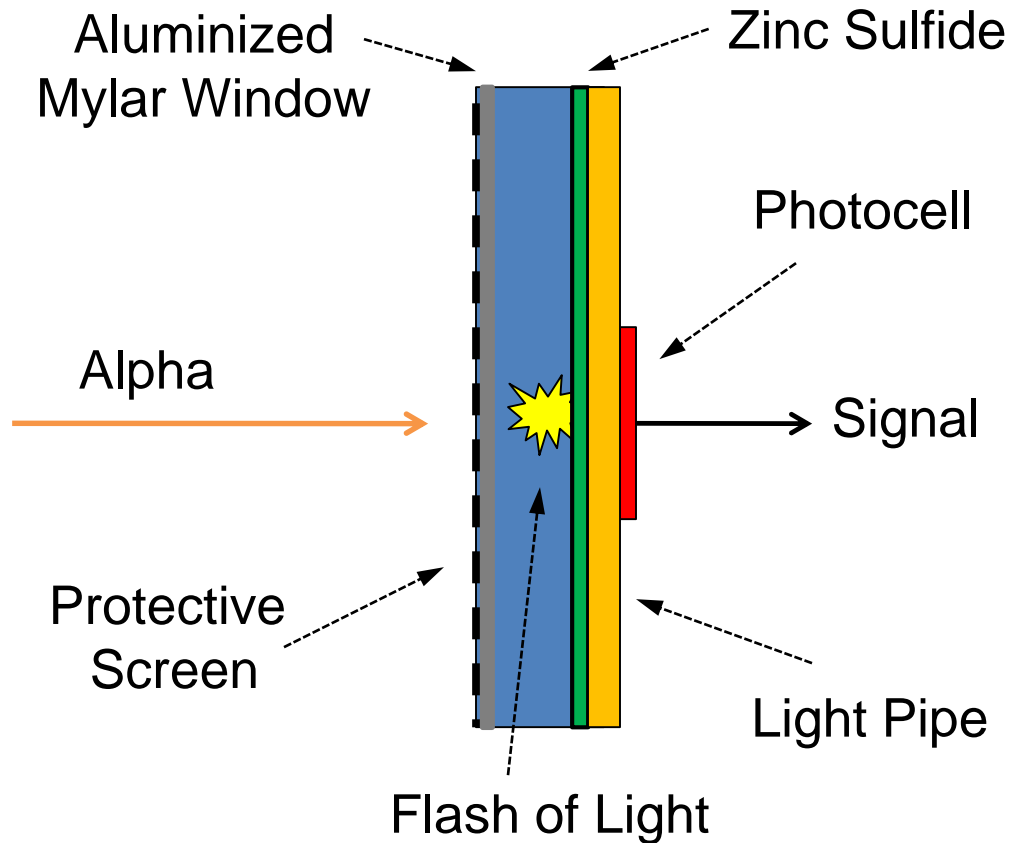
- Determine if radiation source poses a health risk
- Allow for planning to minimize dose
- Determine stay times and turn back levels
- Provide a record of individual's total dose received
- Determine if contamination is present
- Determine PPE requirements

# Geiger-Mueller Detector



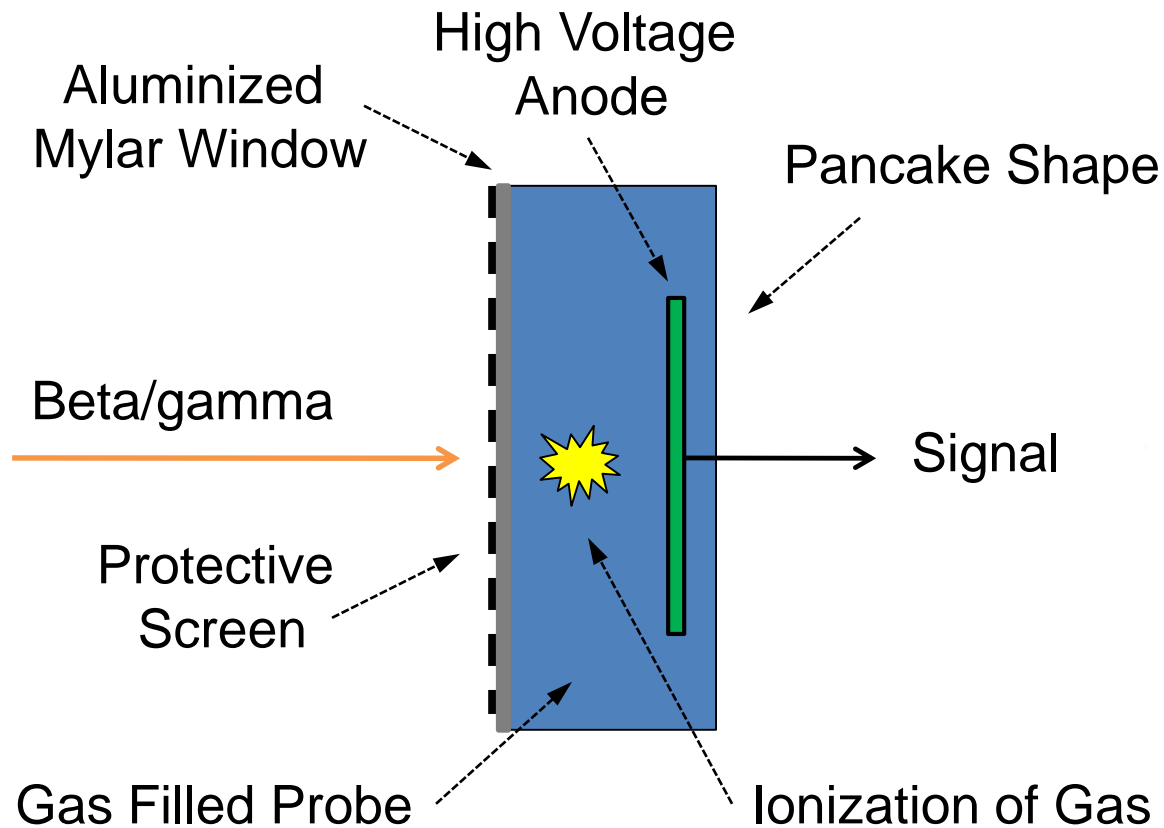
*Small “peanut size” detectors with high dose range for dose rate meters and alarming dosimeters*

# Alpha Scintillation Probe



*Large surface area probe for surveying for alpha contamination*

# Beta/Gamma Pancake Probe



***Pancake probe for surveying for beta/gamma contamination***

# Summary

Radiation detection instruments can be divided into three primary categories:

- Search / Localize Day 2
- Identify / Characterize Day 3
- Monitor / Survey Day 4