



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



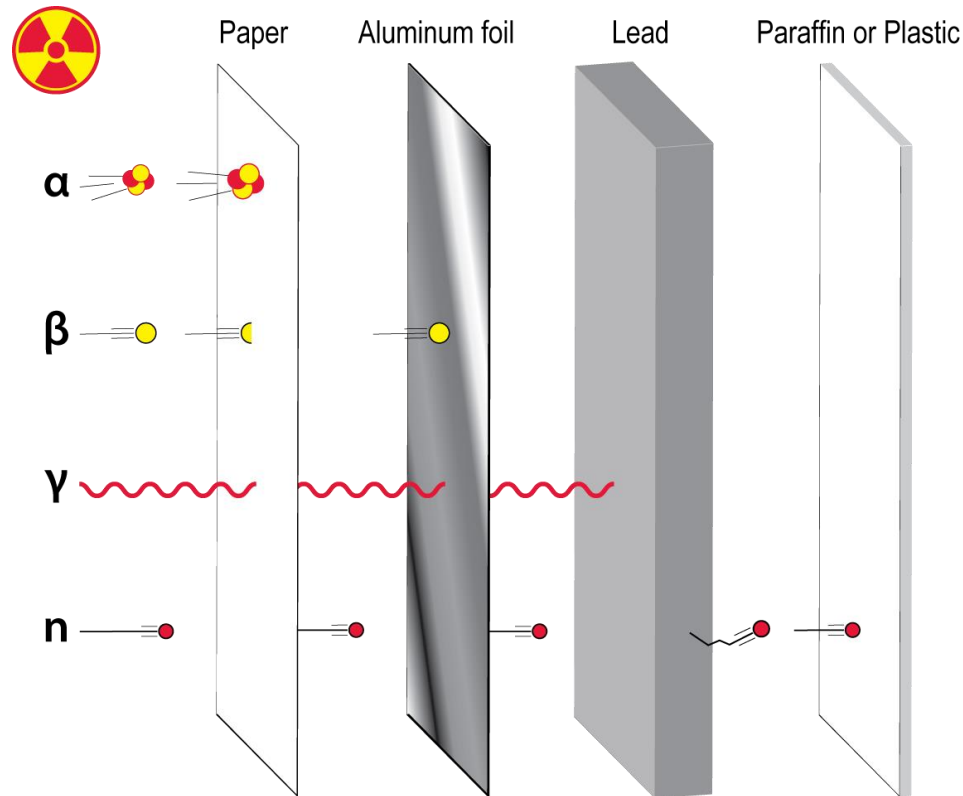
Instrument
Detects
Radiation



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

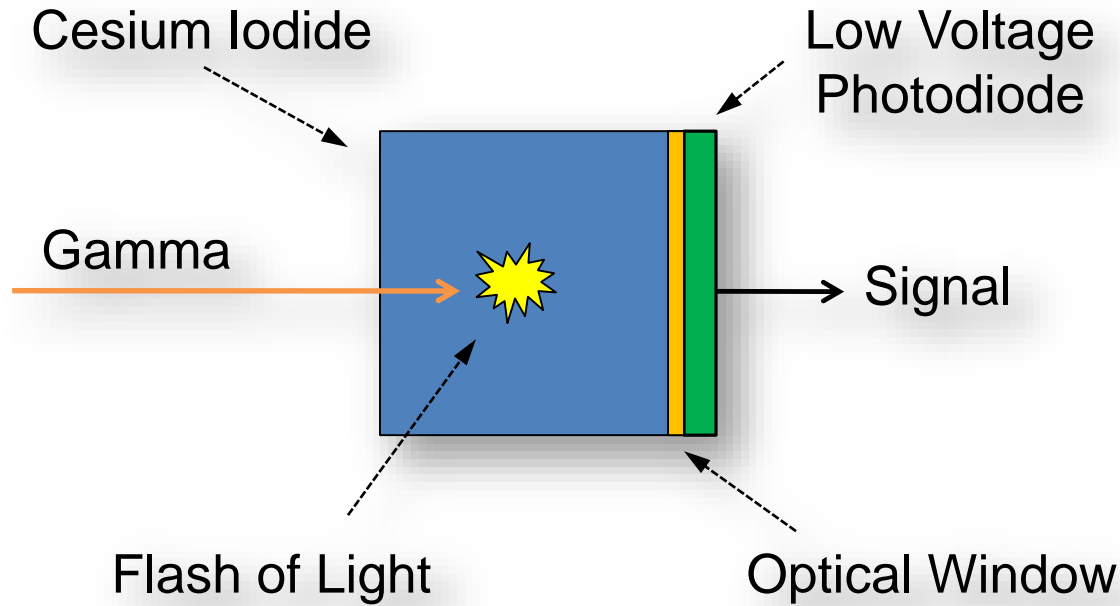
Search | Localize

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

Why Search / Localize?

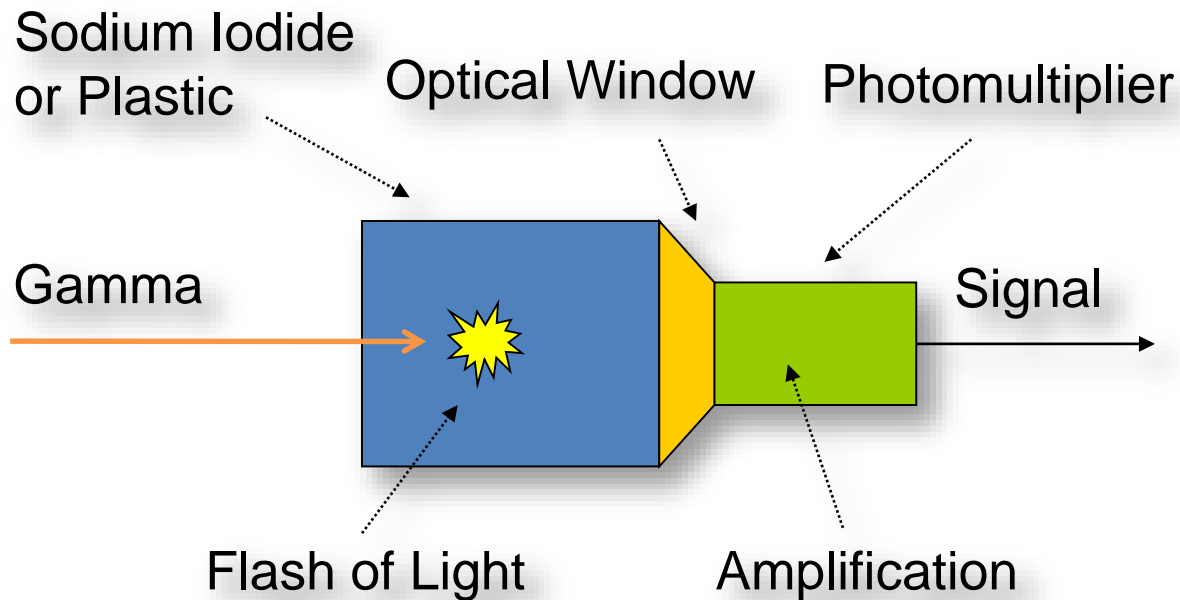
- Lost or stolen radioactive materials
- Security screening or background surveys
- Portal monitors / border crossings

Scintillation Gamma Detector (with Photodiode)



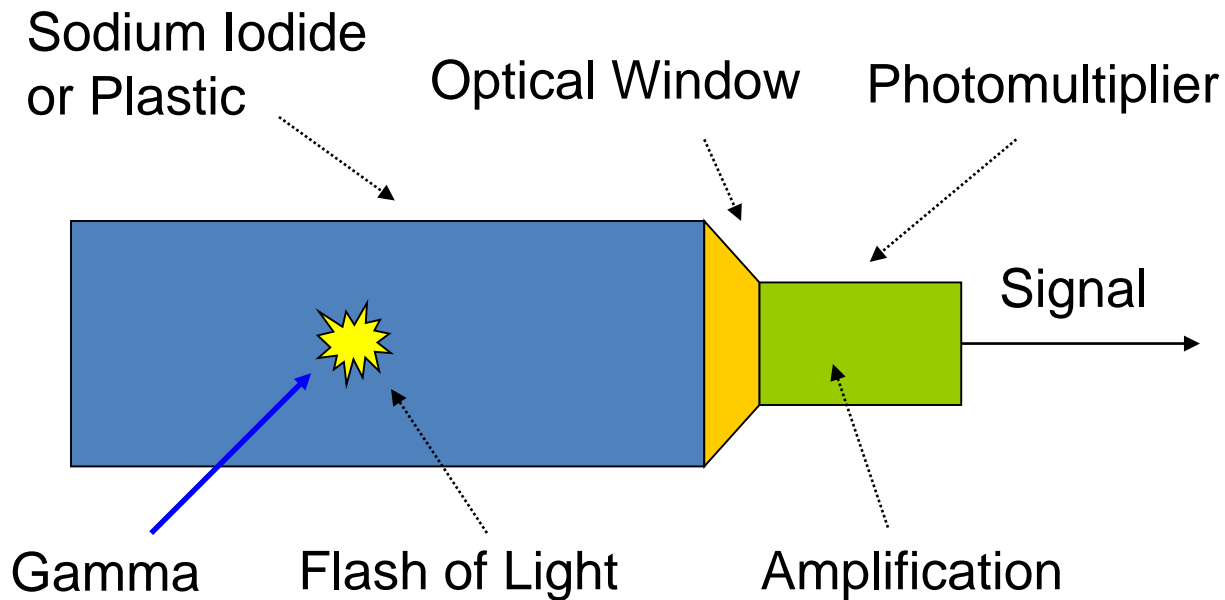
Small/compact detectors with low voltage for pagers

Scintillation Gamma Detector (with Photomultiplier)



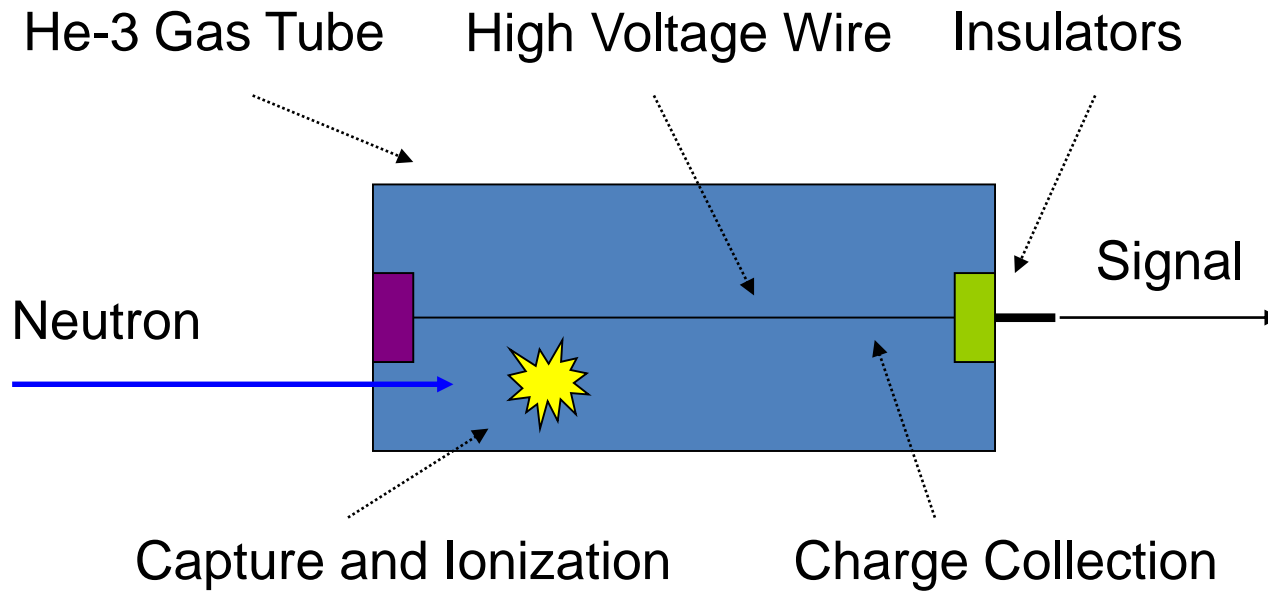
Medium size detectors for handheld meters and backpacks

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

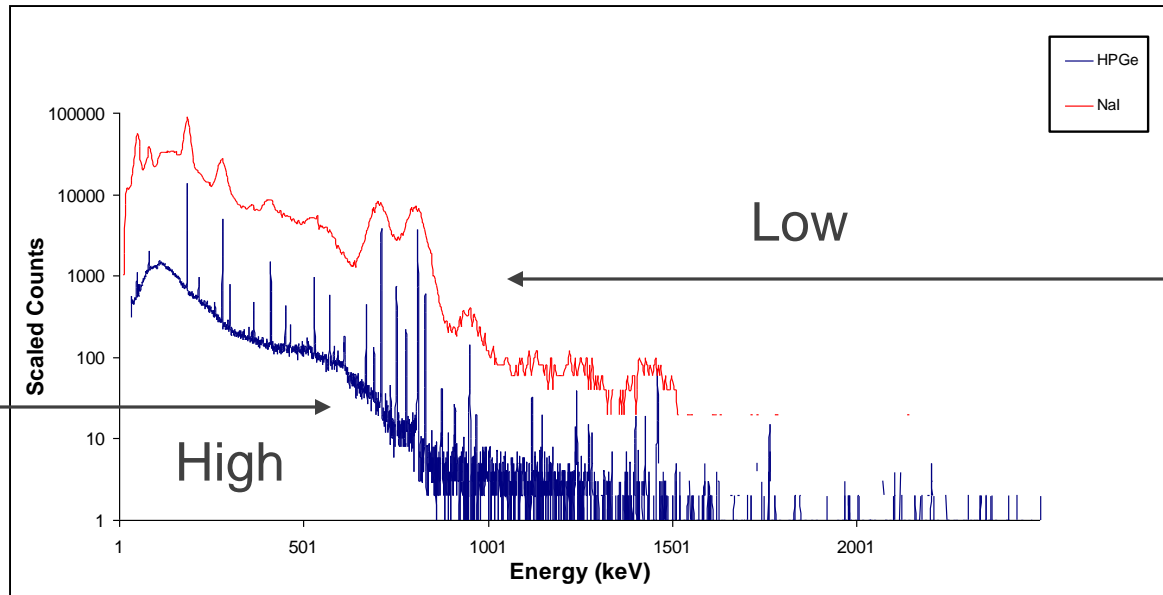
Radioisotope Identification

High Resolution vs Low Resolution Gamma Spectroscopy

Resolution - “ability to resolve adjacent gamma peaks”



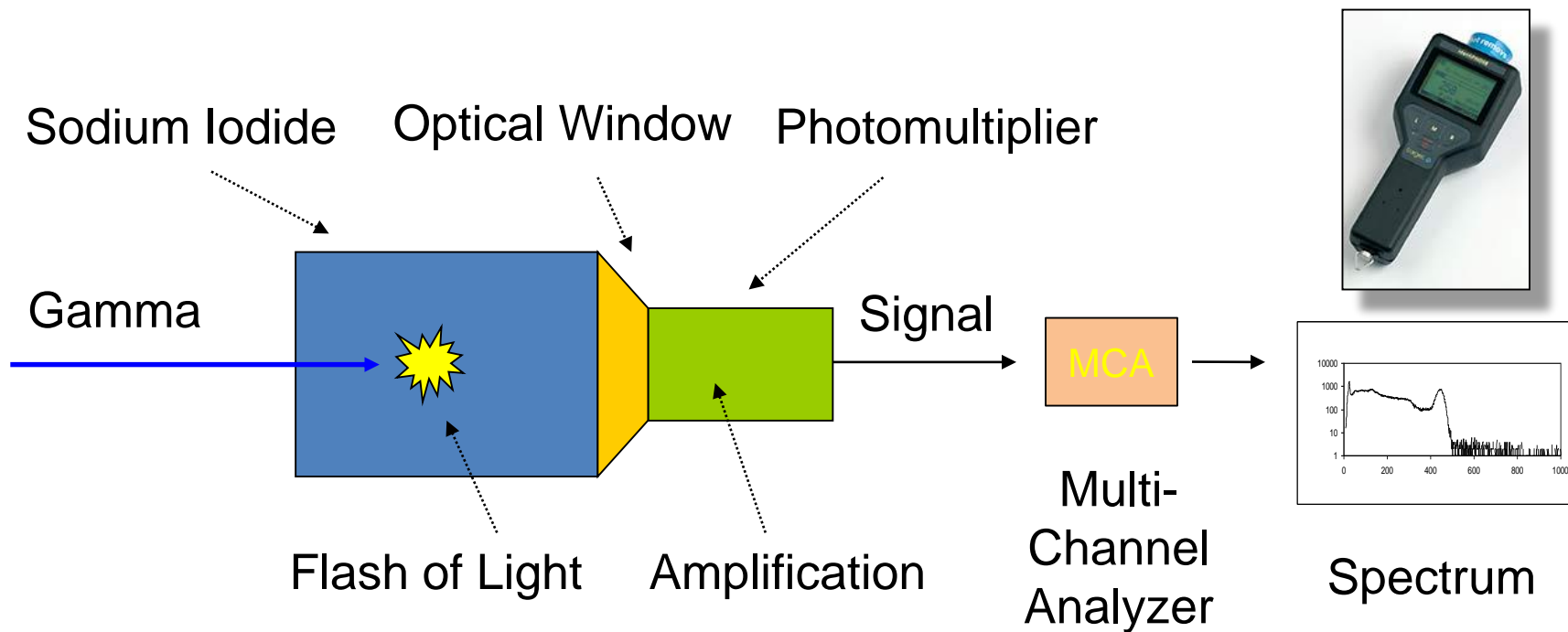
HPGe



NaI

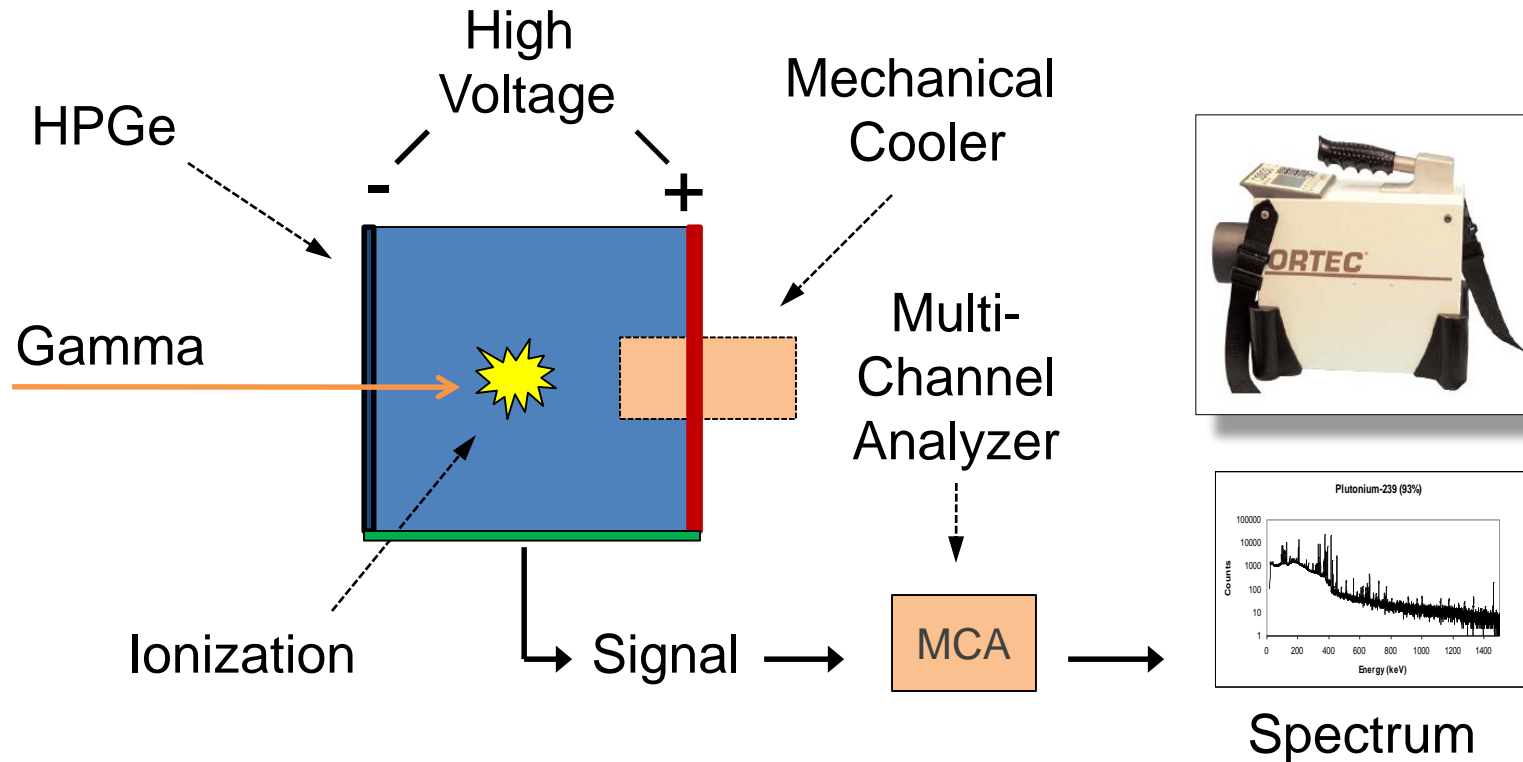
Sodium iodide (NaI) is used for *“Screening”*
High purity germanium (HPGe) is used for *“Identification”*

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”

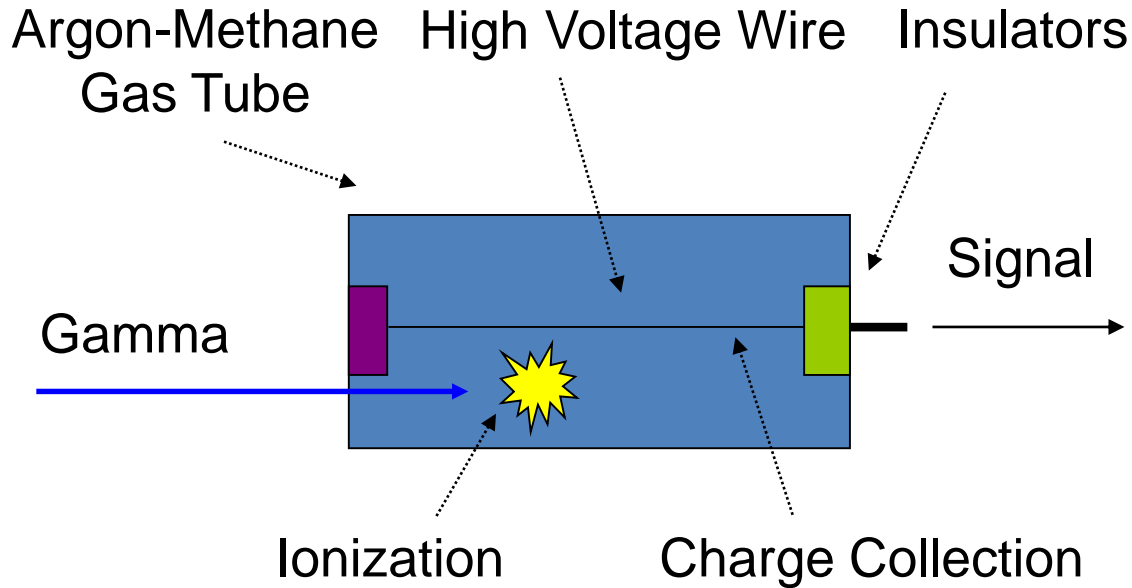
Monitor | Survey

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

Why Monitor / Survey?

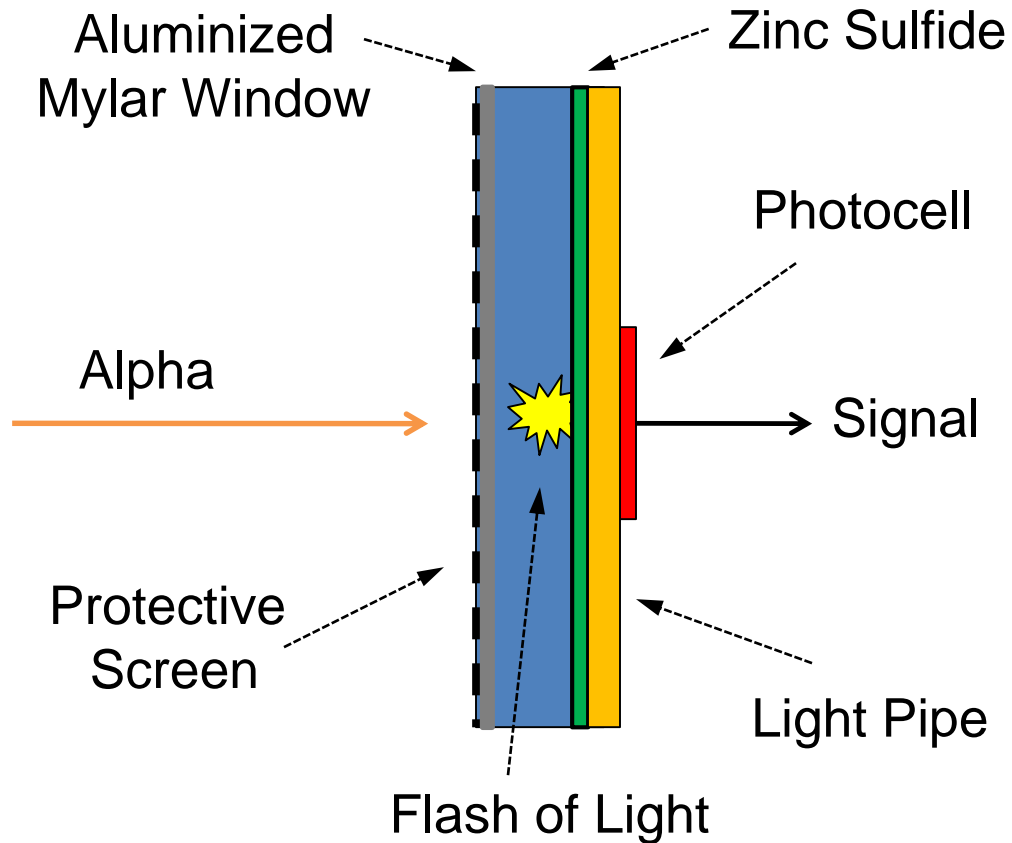
- Determine if radiation source poses a health risk
- Allow for planning to minimize dose
- Determine stay times and turn back levels
- Provide a record of individual's total dose received
- Determine if contamination is present
- Determine PPE requirements

Geiger-Mueller Detector



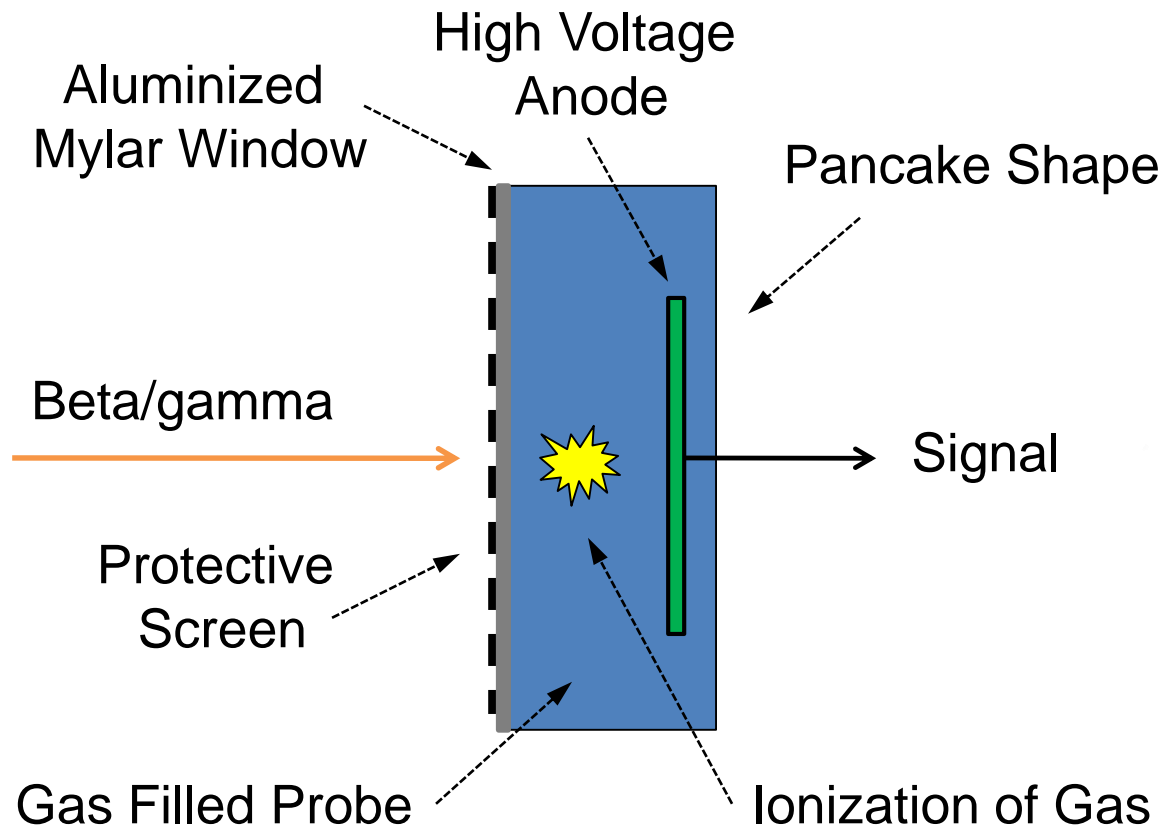
Small “peanut size” detectors with high dose range for dose rate meters and alarming dosimeters

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