Radiation Detection

Two Types of Detectors

- Passive
  - Require no power
  - Are not usually real time
  - TLD's OSL's
- Active
  - Require power
  - Are real time
  - Can register individual interactions with matter

Passive Detectors

Name	Change	Detected
Thermoluminescent Dosimeters (TLD)	Heating the detector after exposure causes it to glow. Intensity of glow relates to Dose	Gammas, x-rays, betas, neutrons,
Optically Stimulated Luminescence (OSL)	Exposing the detector to light causes it to glow. Intensity of glow relates to dose	Gammas, x-rays, betas
Film	The film darkens the more it is exposed to radiation	Gammas, x-rays, betas
Bubble	Number of bubbles	neutrons
Electrets	Change in charge	Radon, gammas, x-rays

Active Detectors

- Gas
- Scintillation
- Semiconductor

Gas Detector

- Ion Chamber
- Proportional Counter
- Geiger-Mueller Detector

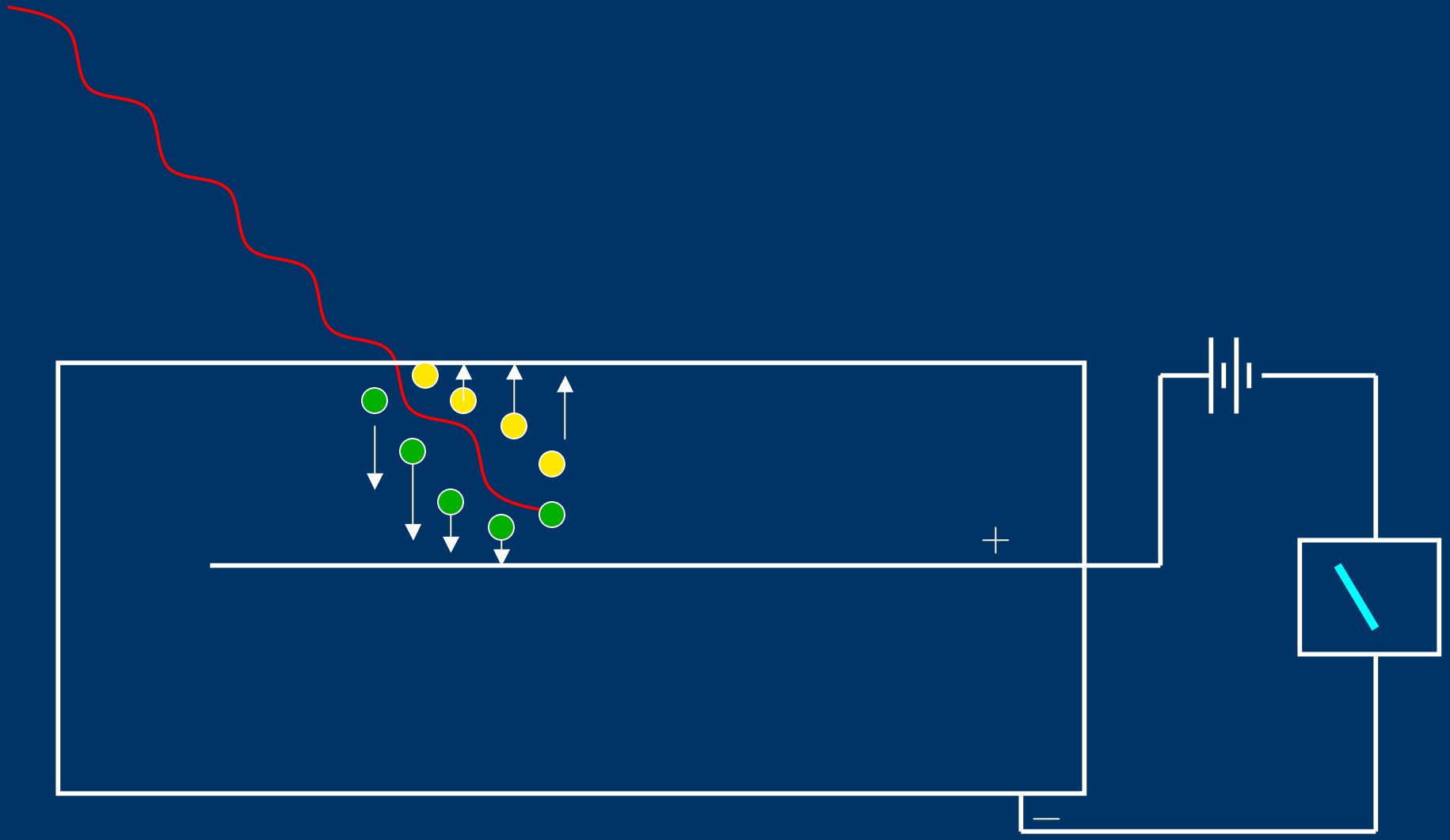
Gas Detector Basics

- Consists of a detector gas an anode and a cathode
- When the gas is ionized the released electrons head towards the anode where they accumulate and cause the electronics to respond

Ion Chamber

- The voltage difference between the anode and the cathode is just high enough that the gas atoms ionized by the radiation can not recombine.
- The pulse that reaches the anode is not large enough for the electronics to register each pulse however as many pulses reach the anode the current going through the anode is changed. This is measured and translated into doserate.

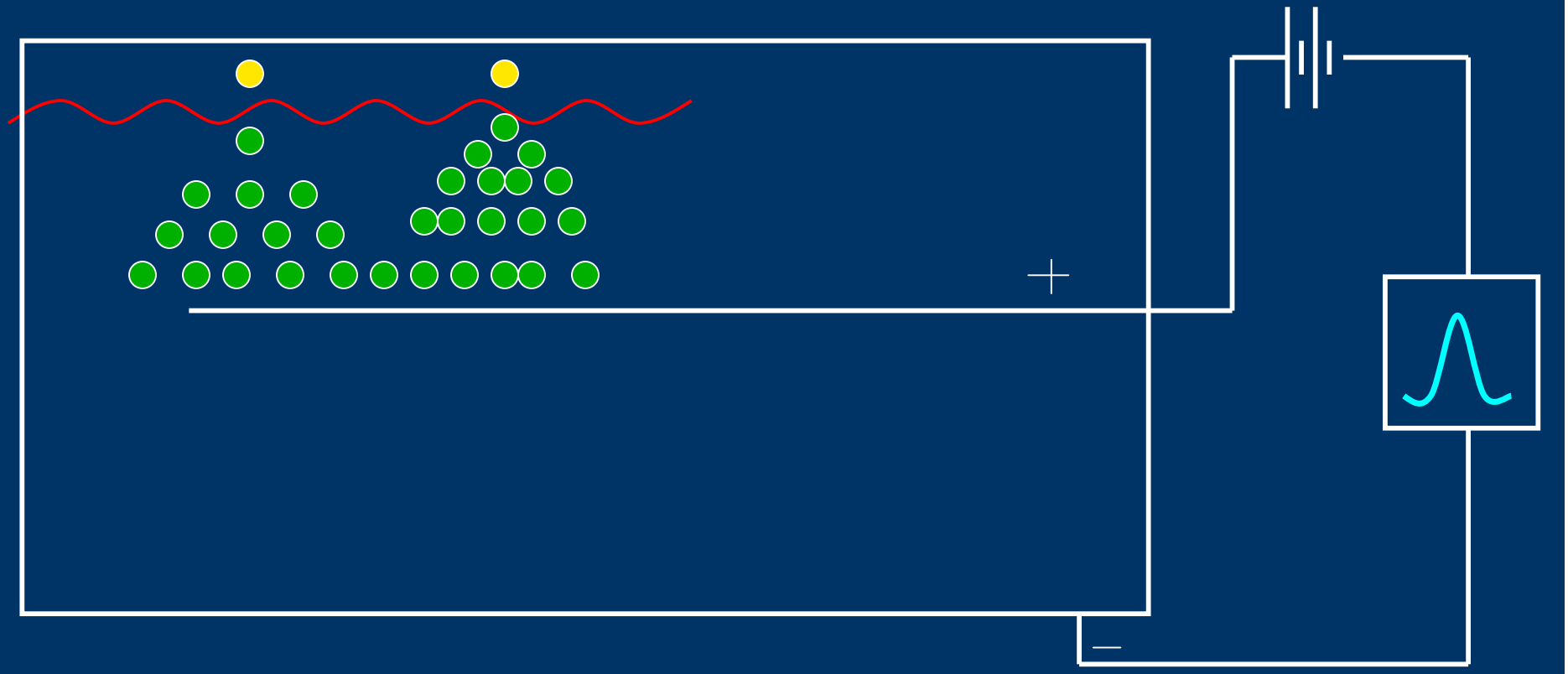
Ion Chamber



Proportional Counter

- The voltage difference between anode and cathode is large enough to accelerate the primary electrons to the point where they can ionize more gas and cause an avalanche (Townsend Avalanche)
- Each primary electron can produce between 10^2-10^4 secondary electrons
- The size of the pulse created when the electrons reach the anode is proportional to the number of primary electrons and the energy of the detected particle/ray

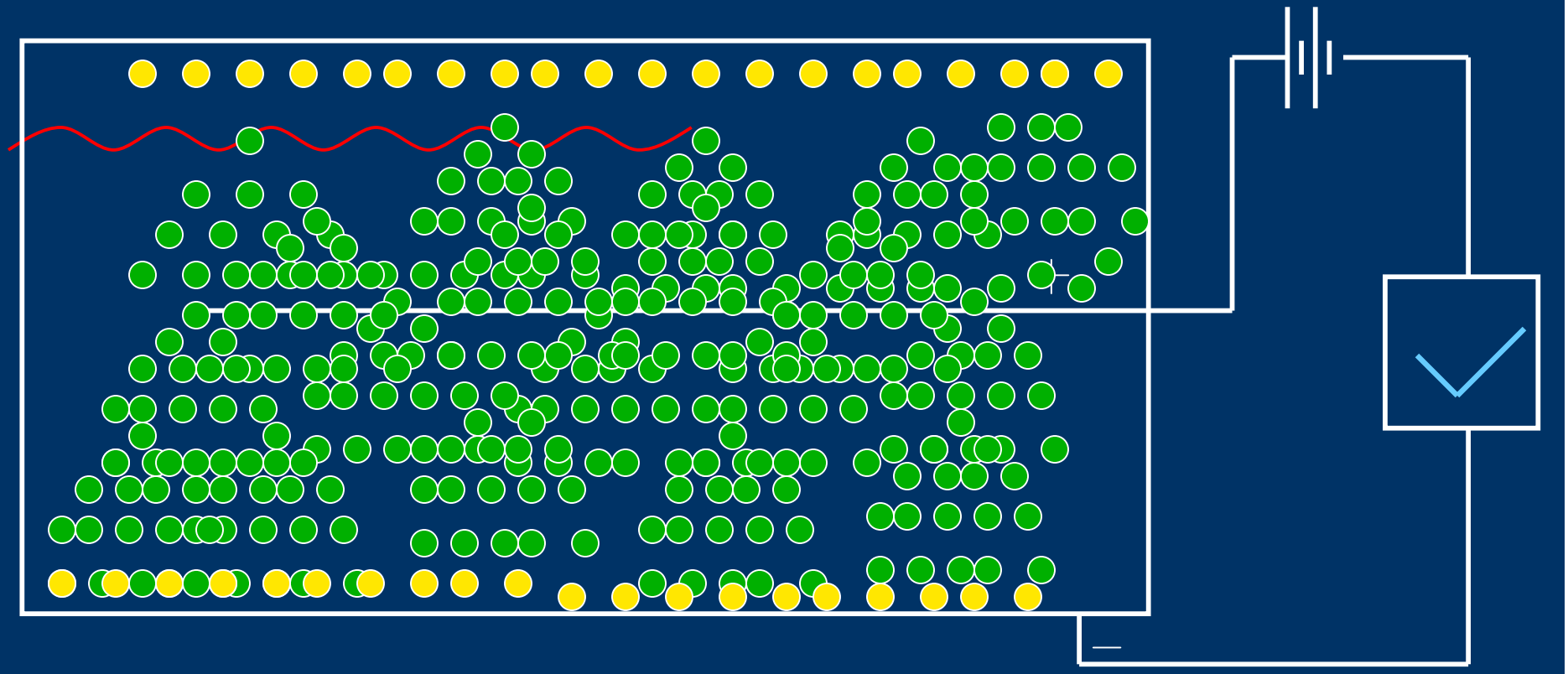
Proportional Counter



Geiger-Mueller

- The voltage difference between the anode and cathode is great enough that primary ions cause an avalanche that ionizes so much gas that the entire anode measures a pulse.
- All proportionality is lost. No matter the energy of the incident particle/ray the pulse out is the same.

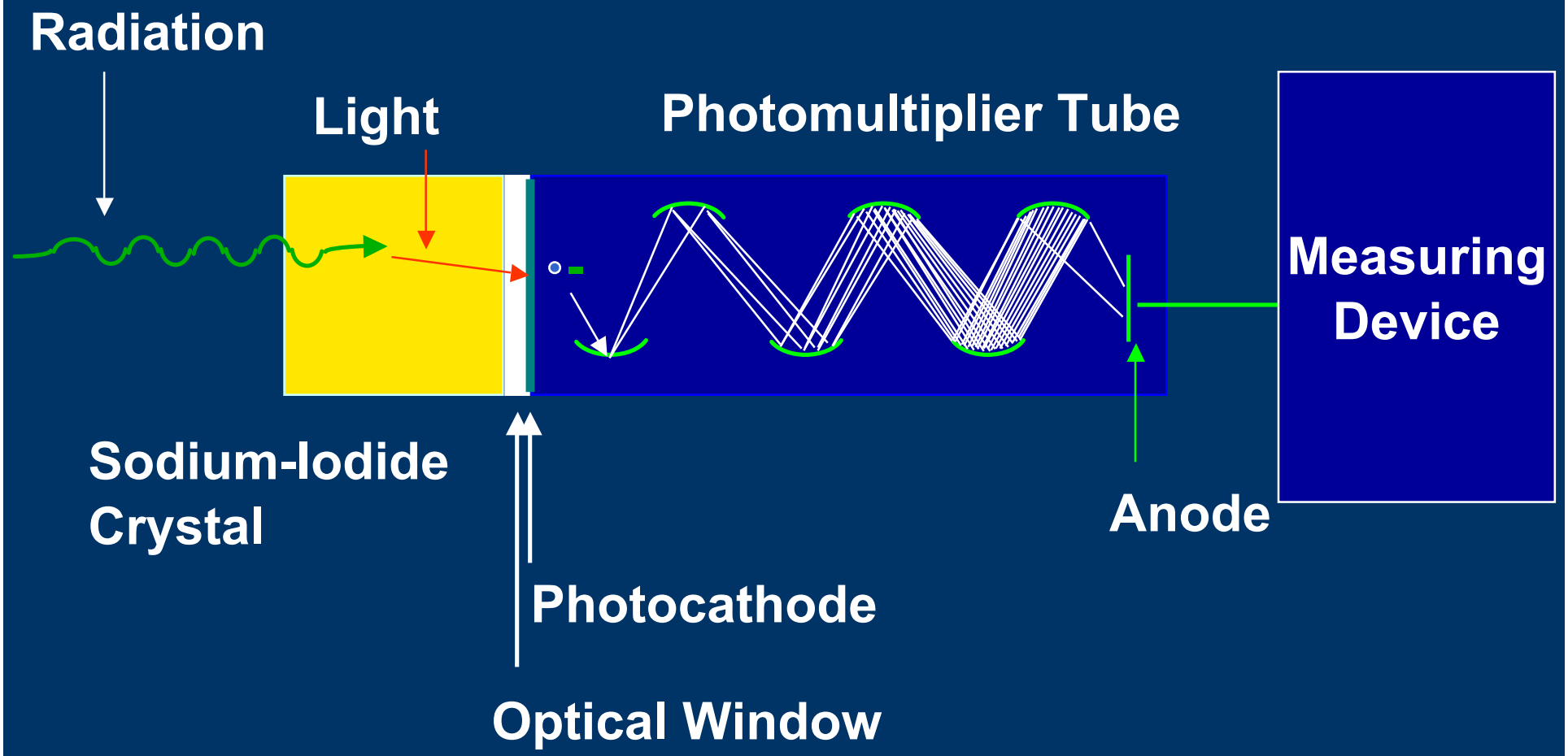
Geiger-Mueller



Scintillation Detectors

- Scintillation detectors use a detector medium that emits light when radiation is incident upon it
  - ZnS -> Alphas
  - Liquid Cocktail -> Betas
  - NaI, $LaBr_3$, CsI, -> Gammas

Scintillation Detectors



Semiconductor Detectors

- Use the band theory of solids to detect radiation.
  - Have very good energy resolution
    - SiLi
    - GeLi
    - HP Ge

Semiconductor Detectors