Scintillation detectors:

Scintillators are materials- solids, liquids, gases- that produce sparks or scintillations of light when ionizing radiation passes through them. The amount of light produced in the scintillator is very small. It must be amplified before it can be recorded as a pulse or in any other way. The amplification or multiplication of the scintillator's light is achieved with a device known as photo multiplier tube. Amplifications of the order of 10^6 are common for many commercial photo multiplier tubes. Apart from the photo-tube, a detection system that uses a scintillator is no different from any other. The photons produced in the scintillator enter the photo tube and hit the photo cathode, which is made of a material that emits electrons when light strikes it. The electrons emitted by the photo cathode, are guided, with the help of an electric field, towards the first dynode, which is coated with a substance that emits secondary electrons, if electrons impinge upon it. The secondary electrons from the first dynode move towards the second, from these towards the third, and so on. Typical commercial photo tubes may have up to 15 dynodes. The voltage difference between two successive dynodes is of the order of 80-120 V. The photo cathode material used in most commercial photo tubes is a compound of cesium and antimony(Cs-Sb). The material used to coat the dynodes is either Cs-Sb or Ag-Mg.

E-mail: ahed.hameed.jaaz@uomus.edu.iq

The scintillation counter consists of the following components:

1. Photomultiplier tube
2. Preamplifier circuit
3. Linear amplifier
4. Pulse height analyzer
5. Scaler and timer
6. Rate meter

Scintillater

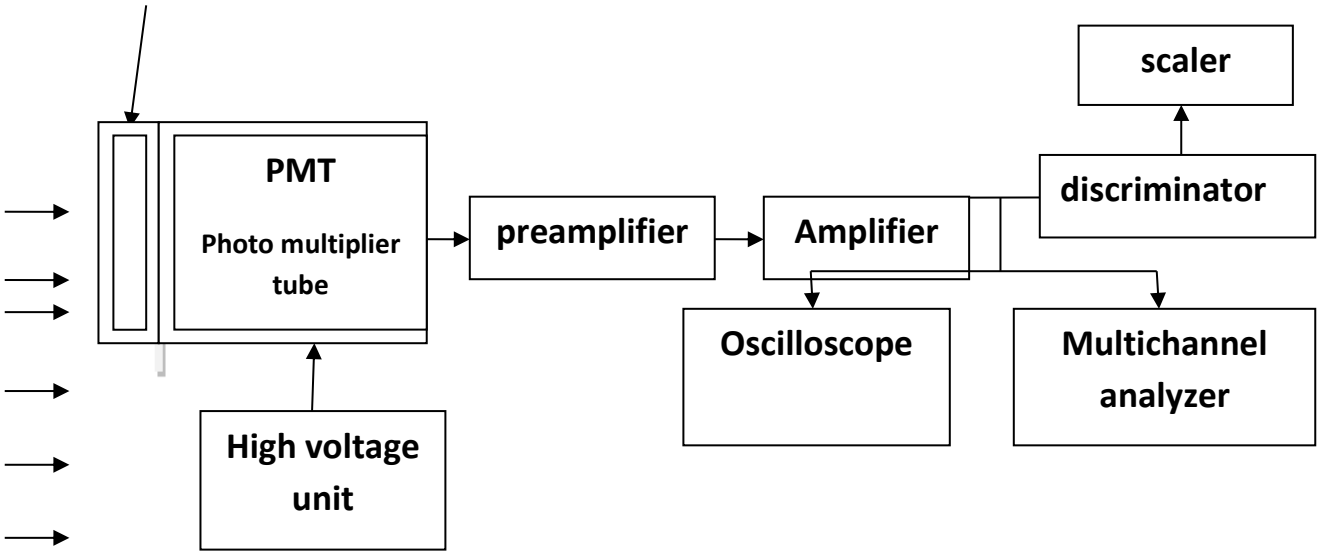
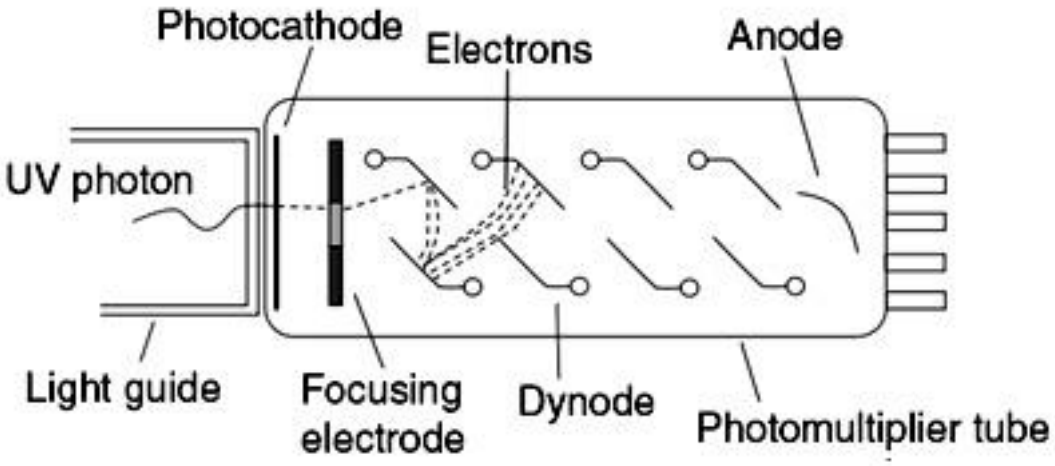


Figure1: Schematic of scintillation detector assembly

E-mail: ahed.hameed.jaaz@uomus.edu.iq



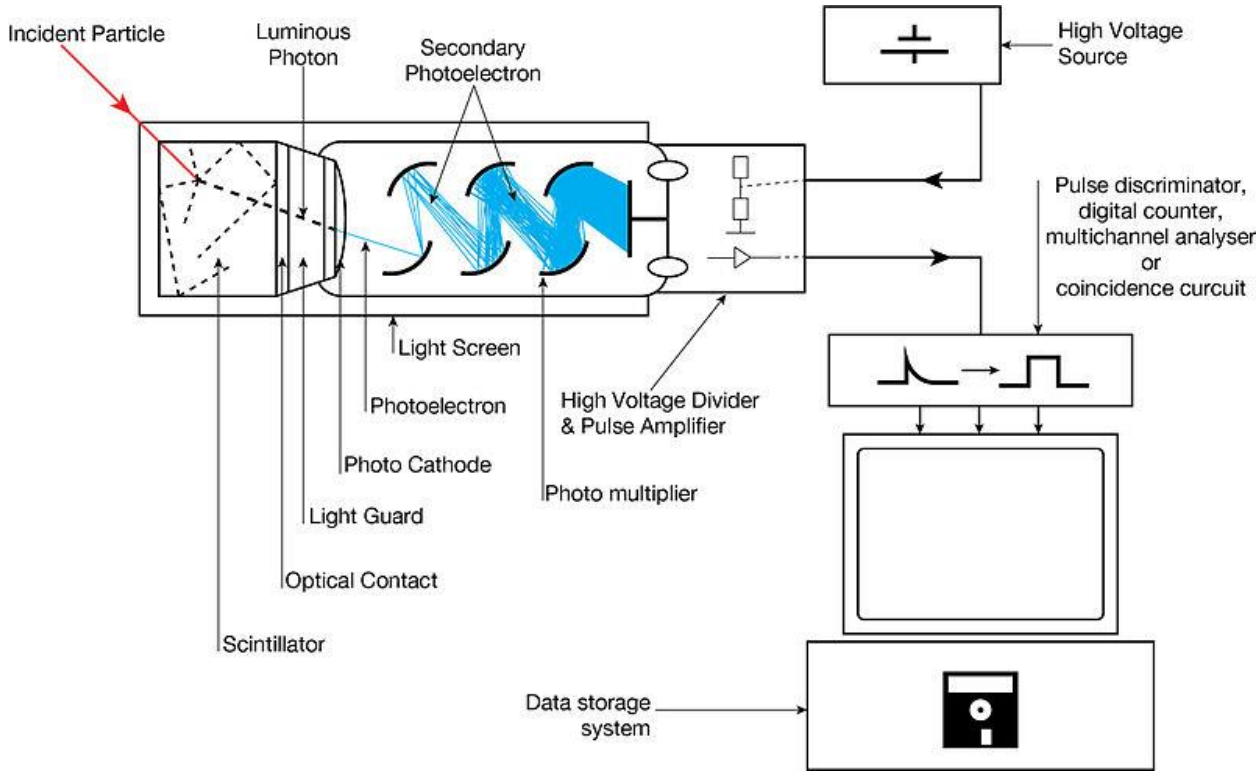


Figure 2: schematic of scintillation

Types of scintillators:

1. Inorganic crystal :
    - alkali iodide that contains small concentration of an impurity, eg. NaI, CsI.
    - High efficiency for detections of gamma rays.
    - Pulse decay time about 1 microsecond
2. Organic scintillator:
    - aromatic compound naphthalene, stilbene.
    - pulse decay time of about 10 nanoseconds.
    - detection of beta particles
3. Plastic scintillator
    - Scintillation chemicals in plastic matrix
    - Pulse decay time 1-2 nansecond
    - Contain hydrogen (detection of fast neutron)
    - Can be machined into almost ant desirable shape and size ranging from thin fibers to thin sheets. They are inert to water air, and many chemicals, and for this reason they can be used in direct contact with the radioactive sample.
4. Gaseous scintillator
    - Mixtures of noble gases
    - The scintillations are produced as a result of atomic transition, since the light emitted by noble gases belongs to the ultraviolet region, other gases such as nitrogen, are added to the main gas to act as wavelength shifters. Thin layers of fluorescent materials used for coating the inner walls of gas containers achieve the same effects.

E-mail: ahed.hameed.jaaz@uomus.edu.iq