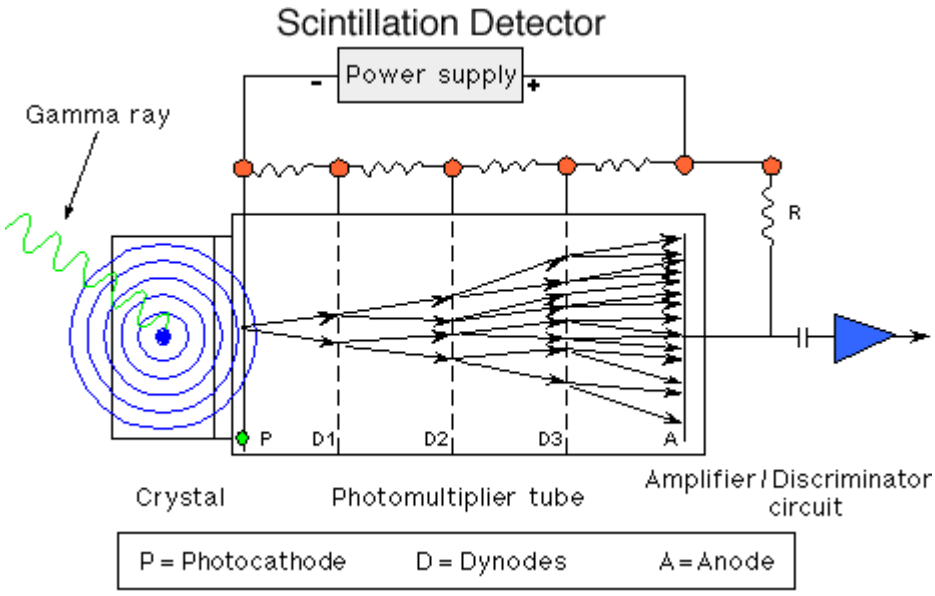
Scintillation Detector

A gamma ray scintillation detector is made up of three basic parts: crystal scintillator, photomultiplier (PM) tube and anamplifier-discriminator circuit. The gamma rays first enter the crystal scintillator where they are converted into flashes of light. These flashes of light are detected by the photomultiplier tube and amplified from very small energy levels into a signal that is large enough to be handled by a conventional circuit. This conventional circuit is the amplifier-discriminator circuit.

One of the most important aspects of the scintillation detector is that it can output a voltage pulse which is proportional to the energy of the original incident gamma ray.



Crystal scintillator

The main purpose of the crystal is to convert energy into light. The incident gamma rays lose energy as they pass through the crystal, primarily due to Compton scattering but also due to pair production. Each interaction yields an electron which, when captured by the impurities in the crystal, releases an optical photon or visible light flash called a scintillation. This acts on the crystal's photosensitive surface and emits electrons that are amplified by the photomultiplier.

Different types of crystals and doping impurities are used, depending on the desired result. Two of the most commonly used by Schlumberger are a thallium-doped sodium iodide (NaI(Tl)) crystal and a cerium-doped gadolinium orthosilicate GSO(Ce) crystal.

Photomultiplier (PM) tube

This amplifies individual scintillations by a factor of 105. The photomultiplier receives electrons that are accelerated through a series of plates. The plates are called dynodes and each successive plate is set at a higher potential. Upon collision with a plate, the incident electron frees a number of additional electrons, effectively amplifying the original energy of a gamma ray to a level measurable by a conventional circuit.

Amplifier-Discriminator circuit

The output of the PM tube is fed into an amplifier-discriminator circuit. Each pulse is discriminated from any background noise by thermionic electrons. The pulse is then fed to an amplifier. The resultant pulse is proportional to the energy of the original incident gamma ray.