Detecting / Determining Alpha Beta and Gamma

By George Dowell

Alpha and Beta particles are actually physical particles of matter. The Alpha is two protons and two neutrons,
(same as a helium atom and will turn into a helium atom when it picks up two free electrons) and consequently is relatively very heavy and slow and carries a double positive charge. A Beta is simply an electron and has either a negative charge (Negatrons) or positive charge (Positrons). The Beta may be moving from very slow to very fast, the speed is an indication of its "energy level".

Gamma Radiation is a true electromagnetic energy, and moves at the speed of light.

Alphas can barely penetrate anything, not even a piece of paper. Betas do a bit better but still can only penetrate a thin piece of aluminum. Gammas on the other hand can penetrate inches of lead and feet of most other things. These differences can be used to our advantage if we seek to determine the nature and composition of any "radiation" we are investigating.

Due to their low penetrating ability, the Alphas will not penetrate the outer covering of the GM tube in the typical CDV-700 probe, Gammas will and so will Betas, but only if the heavy shield's window is "open".

In order to detect Alphas, an extremely thin window must be installed on the probe, and the common probes that come to mind are the end-window and pancake probes. Of these two, the pancake probe is more sensitive to Alphas, and of course they both detect Betas and Gammas too.

To discriminate the types of radiation, all you need to do is understand the characteristics of your particular probe, and have a few pieces of "absorber" material on hand.
If the radiation is stopped by a single piece of typing paper, it is undoubtedly Alpha particles. If it takes a credit card or a 3mm aluminum sheet to stop most of it, you are probably looking Betas. Of course the tin foil also stops all Alphas too.
Gamma rays will easily pass through steel, aluminum and it takes 1" of lead to stop even 1/2 of it, depending on the energy level.

Nothing actually "stops" Gamma rays, it is a fact that say if 1/2" of lead statistically blocks 1/2 of the rays, the next 1/2" will block 1/2 of what's left etc. etc. until the remaining ray is insignificant. Each absorbing material, be it lead, earth, water whatever has a statistical "half-thickness" assigned to it.

In real life, radioactive materials seldom emit only one kind or energy level of radiation, but rather a mixture. It is this characteristic mixture that helps to identify and quantify the particular material being observed.
SO: For a pancake probe, a 3X5 card over the face removes alphas, a 3mm aluminum sheet removes alphas and betas, leaving only gammas. HINT: quick tip, just flip the pancake over backwards, only gammas get through the back. Use the factor 2200 CPM/mR/H at Cs-137.

George Dowell
NLNL
New London Nucleonics Lab