GM probes, like the ones on CDV-700's, all the different end-window and pancake probes work on the same principle, in which a radiation penetration causes a discharge of the high voltage in the gas filling. This discharge is total and complete for each radiation event counted, and the output pulse
is therefore always the same, no matter what triggered the pulse. All the different energy level radiations that are detected produce the same pulse output in terms of voltage or "pulse height". No discrimination is possible of the causative source of that pulse. Geiger Counters like the CDV 700 that are designed only to operate with GM probes are simple and effective, and the only control needed is a "CAL" pot inside to set the range. High Voltage need not be adjustable, only stable.Since the voltage pulse is always the same, and rather high , an input sensitivity of 1 to 2 volts is adequate, and low level noise from the system is automatically rejected. (footnote 1)

In order for a Geiger Counter to work with a scintillation probe, it needs much more input sensitivity. Pulses coming from the PMT (photo-multiplier-tube) are smaller than those from a GM tube, and vary greatly in height (Height is the same as voltage in this sense, runs <50mV to >2V). That variation is due to the simple fact that in a given probe, radiation of a higher energy will produce a larger light pulse than those of lower energy. The brightness of the light pulse has a direct correlation to the size of the output pulse. In a simple scintillation counter, like the SCITiLENi, the input sensitivity is reduced to about 50 millivolts by an additional amplifier stage, and that is the only difference between it and

a common CDV700.

(Footnote 2)

The above instruments will allow you to detect the *presence* of radiation, and to some extent, the overall level. You can also sort out the type (ALPHA/BETA/GAMMA) by using specialized probes, or by selectively blocking the different types with absorbers.

(Footnote 3)

Few radioactive materials give of a single type or energy level of radiation. The *mixture* of types and energy levels is unique to a material, and if known, can be used to identify the material,.

In order to go beyond GROSS COUNTING (that is, count everything that comes in), your Geiger Counter needs to have some additional features. These will help you to determine the energy level of the detected pulse, and with enough information, you can identify the makeup of the source material.

The first to appear is the DISCRIMINATOR (also called THRESHOLD, or Lower Level SENSITIVITY/ LL). This control allows you to set the lower level that the unit will respond to. It will not respond to anything lower than the setting. A typical "standard" factory setting will be 30 or 50 milliVolts. This also rejects much of the system noise inherent in a PMT tube setup.

Next in complexity and cost, the unit will add a WINDOW control. Just as the DISCRIMINATOR sets the lower level, the WINDOW, Upper Level or UL control sets the upper level of voltage that will make the counter register. In this way, a narrow band of

voltages can be examined. Only the voltages between the LL and UL will trigger an output pulse. Units with both LL and UL controls are referred to as Single Channel Analyzers (SCAs) and often the word "analyzer" or "assay meter" appears in their model number. That band might correspond to a particular energy level, say 60 keV, which would be emitted from AM 241. Now if you detected 60 keV Gamma AND a large Alpha output, you would be almost assured that the
source is AM241.If you detected an energy level of 661keV (Gamma) and Betas you might have CS-137. This is the part of the hobby that I most enjoy.
Trying to solve the mystery by including or excluding certain clues.

Some instruments can have more than one window, in various combinations, depending on the manufacturer. A particularly cool use for this is when you have an Alpha-Beta discriminator scintillator. This probe is actually two units in one, but with a single PMT. The Alpha phosphor produces much higher pulses than the Beta crystal, so by setting up the windows, you can read
either Alphas, Betas, or both together. The only hand held I have that will do this is the Bicron Analyst, which is one of the top-line hand helds available.

Once all the probe's capabilities are fully utilized by having a more complex instrument to read out on, you soon discover that the analog meter-type
readout is not ideal for every situation. At this level, a scaler or digital
timer/totalizer is employed. This feature will count the pulses for a set

period of time and then display them on a digital readout. Under certain circumstances, you may easily have EXCLUDED most of the normal background counts, and almost all of the uninteresting counts, in order to concentrate on a particular energy level count that may only produce a count every few seconds, or even only every few minutes. It would not be practical to attempt a measurement using a real-time analog meter. The scaler-times is simply set to the required time period, which may be seconds, minutes or hours, and the statistical total is read after the period expires. Several periods are usually taken and an average taken.

A typical example would be to test a fallout shelter for effectiveness using
only natural background radiation as the source. You would set your meter up
outside in the open for a period of time and get a baseline reading. Then take it into the shelter and make a similar test. The difference in the two readings is a result of the shielding in the shelter.

Purposely neglected in the above discussion is the important roll of having a variable High Voltage available when using PMT based scintillators to their full potential. All modern counters that are designed for use with such probes provide this feature, and many make it available on the front panel along with meter readout of the high voltage.

Many bench counters have the threshold and even the window control but they are by no means universal. Some are easier to use, and the Ludlum 2500 is a top notch example of a full featured unit. Ludlum 2200 is another good

unit,

but not quite as versatile as the 2500.

The Eberline SAM-2 not only has most of the desired features, but has two independently adjustable window channels. Bench units are usually NOT equipped with a speaker, or sounder of any kind.

I'm sure all major brands offer a multipurpose hand held unit in their line.

The one I am most familiar with is the Bicron Analyst, and in my opinion it is the one unit that has all the desired features in one box:

Dual Windows channels

Digital Scaler with 3 time settings (.1, 1 and 10 Mins)

Adjustable HV-meter readout

Alarm features

Built in Audio sounder

Adjustable response time

100 Hours operation from a 9V battery.

Light weight

One step down, no discriminator or window, but still very useful is the Bicron Surveyor M:

Scaler available, but optional

HV adjust-meter readout

Sounder

Alarm

Anti-saturation alarm

Fast-Slow response time

Ludlum's 2300 is an awesome handheld, with window, digital scaler, keypad programming, meter readout and even a computer VOICE to indicate the readings. It does not have a clicker or sounder however. The size and weight
are excessive (not to mention cost), and it uses 4 D cells.

According to Ludlum's website, the only current hand helds with window control are their Model 16 and 18 Analyzers, the model 12 only has the lower
level adjustment
Bicron and Eberline companies are in a state of flux right now, as Bicron was bought out by Eberline's parent company. The Bicron Analyst is the only other full featured hand held I can actually see being offered at this time (the MICRO Analyst has same features but with built in, non removable 1" x 1" scintillator).
In the Eberline catalog there a re a few really high end full featured hand helds, but of such cost and vintage that it would be unusual to run across one on eBay.

Have Fun

Geo

for further reading see

Footnote 1:

http://groups.yahoo.com/group/GeigerCounterEnthusiasts/message/2

Footnote 2:

http://groups.yahoo.com/group/GeigerCounterEnthusiasts/message/116

Footnote 3:

http://groups.yahoo.com/group/GeigerCounterEnthusiasts/message/265

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