Quadratic Compression Conversion (QCC) represents the first major development in scintillation spectroscopy in nearly 25 years. NaI detectors have always been attractive for nuclear spectroscopy because they have reasonable energy resolution, are rugged, do not require cryogenic cooling, are physically small and have a reasonably low cost. Sodium iodide detectors are therefore desirable for use in many applications in medicine, radiation surveying, waste monitoring, and education. Unfortunately, sodium iodide detectors suffer from a variety of problems:

1) The pulse height of the analog pulse signal from a sodium iodide detector is not normally proportional to the energy of the incoming gamma ray below approximately 200 keV (i.e. integral non-linearity.

2) A mono-energetic gamma ray source will produce a peak with substantial width (i.e., a sodium iodide detector has only fair energy resolution).

3) The resolution of the sodium iodide detector is a significant function of energy (i.e., high energy peaks are much wider than low energy peaks).

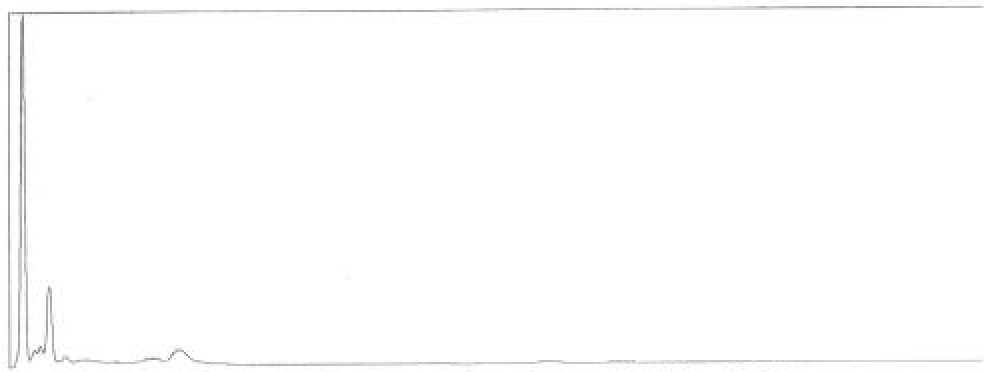
Despite these problems, much effort has gone into sodium iodide spectroscopy. In the low energy region of the spectrum, peaks are normally 5 to 7 keV in Full Width at Half Maximum (FWHM), so each channel of the histogram needs to represent 0.5 to 1.0 keV to be acceptable for analysis. With conventional spectroscopy ADCs in which each channel has the same width, an ADC needs 2000 to 4000 channels to cover a spectrum from 0 to 2000 keV. In such a sodium iodide system, high energy peaks have a resolution of 100 to 120 keV FWHM. Such a peak would cover 100 to 200 channels in a system with 2000 to 4000 channels. If weak signals are present, it may be difficult to locate peaks at high energies. Some have used lower resolution ADCs to overcome the problem with weak peaks at high energies, but this sacrifices sufficient resolution to analyze low energy data accurately.

The QCC system turns what is normally a disadvantage of NaI, the strong energy dependence of the FWHM, into an advantage by using a proprietary (patent no. 5608222) compression scheme which simultaneously reduces the number of channels required and produces spectra where every peak has the same width in terms of channels. This bit of magic is accomplished by crafting an ADC where each channel has a width in terms of energy which is proportional to the resolution of the detector at that energy. The result can be quite dramatic in terms of the spectral results. The spectra on the next page all contain exactly the same data. The 8192 channel Wilkinson spectrum shows all of the spectral detail at low energies but appears to be empty over the high energy range. The 256 channel Wilkinson spectrum shows the high energy peaks better but distorts the low energy region losing several peaks. The QCC spectrum provides full peak detail at all energies.

QCC technology is of particular importance in applications where a wide energy range must be monitored for unknown sources of radiation. The QCC process make detection of peaks at all energies equally straight forward. Peaks at low energies are well resolved, while at high energies peaks are compressed so that the peak to background ratio is dramatically improved for a given number of counts. This directly translates into shorter counting times with better identification and analysis.

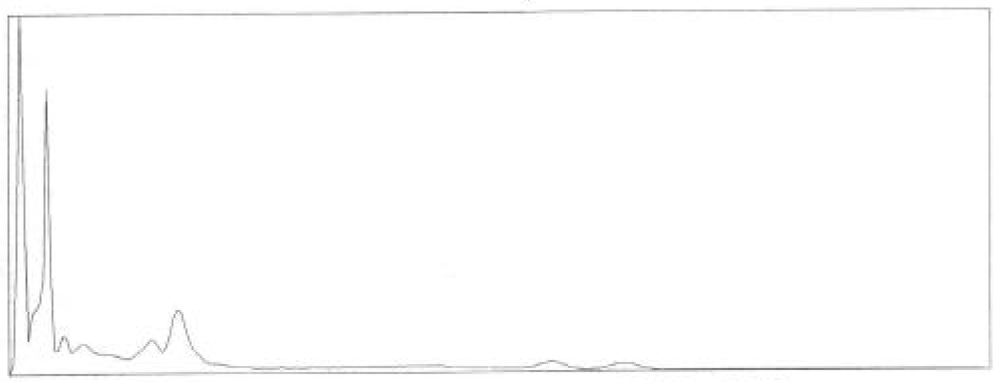
The following 3 examples illustrate the benefits of this new approach to NaI spectroscopy. Note that the following three spectra contain <u>exactly the same data:</u>

First, a traditional 8192 channel Wilkinson spectrum:



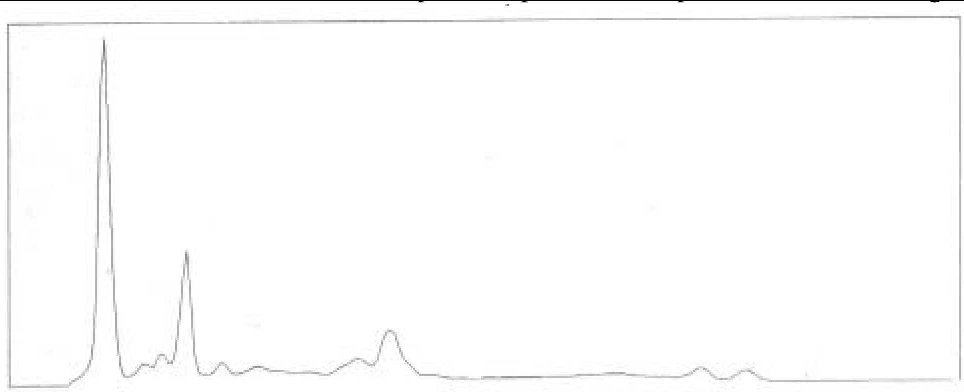
8192 channel Wilkinson ADC spectrum of Ba133 and Co60

Next, a 256-channel spectrum shows high energy peaks better but distorts the low energy region losing peaks:



256 channel Wilkinson ADC spectrum of Ba133 and Co60

Again, the 16K resolution of the QCC spectrum provides full peak detail at all energies:



256 channel QCC spectrum of Ba133 and Co60

QCC system turns what is normally a disadvantage of NaI, the strong energy dependence of the FWHM, into an advantage by using a patented compression scheme which simultaneously reduces the number of channels required and produces spectra where every peak has the same width in terms of channels.

The ADC is designed such that each channel has a width in terms of energy which is proportional to the resolution of the detector at that energy.

NaI(Tl) spectroscopy has always been challenging because its resolution is a strong function of energy. At high energies peaks become very broad and the detector's efficiency drops dramatically. These broad weak peaks are hard to find and difficult to analyze. At low energies the number of peaks is usually quite large and the peaks are closely spaced with reasonable resolution.