

Gamma Spectroscopy: Banana shipment

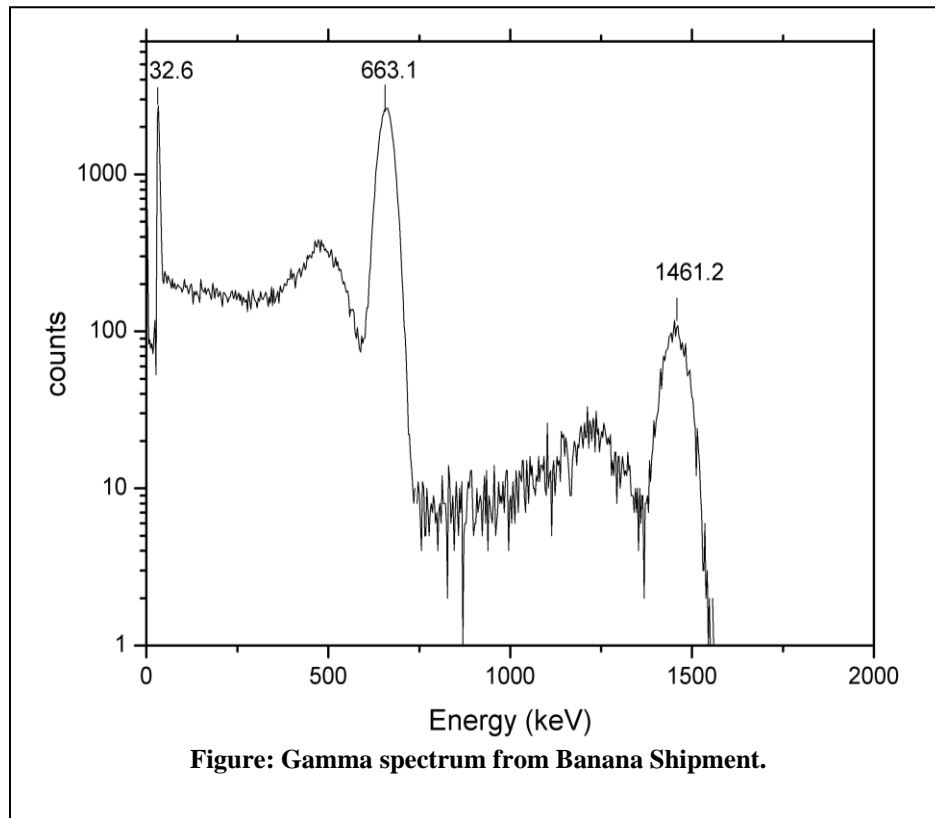
You are a customs and border protection officer in charge of identifying sources of ionizing radiation. A shipment of containers of goods coming off of a cargo ship already set off an initial radiation monitor. A gamma spectrum was taken and sent to you for analysis. It is stated that the container holds bananas. You know bananas have potassium in them. Yum – you're thinking of lunch, but that must wait until later. You need to analyze the gamma spectrum shown below.

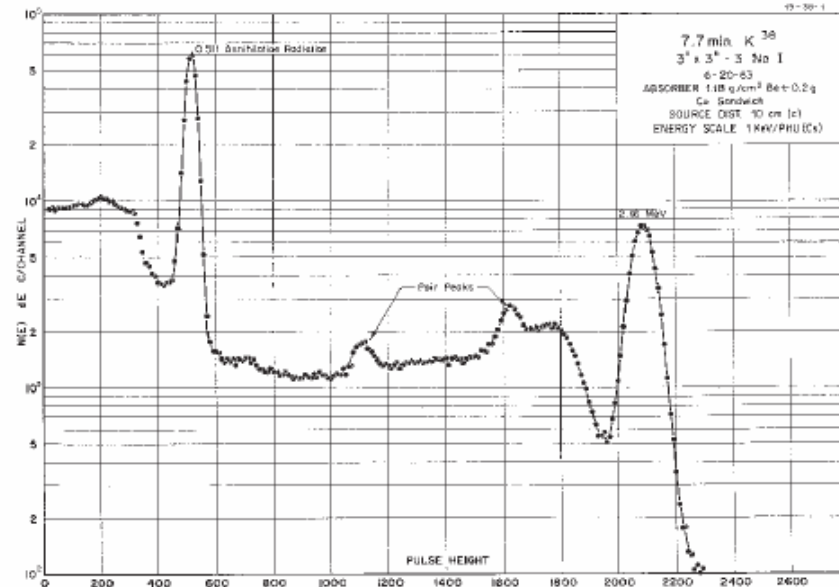
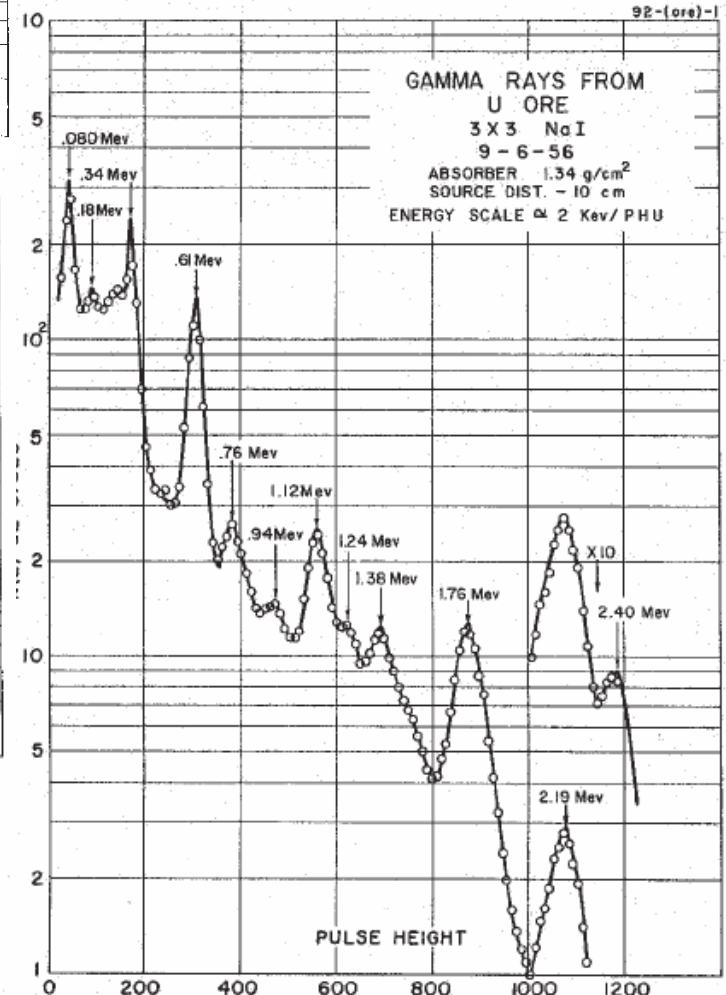
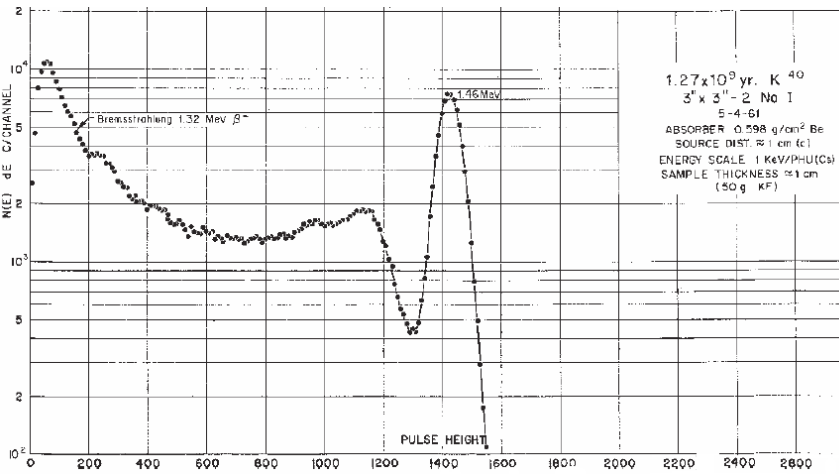
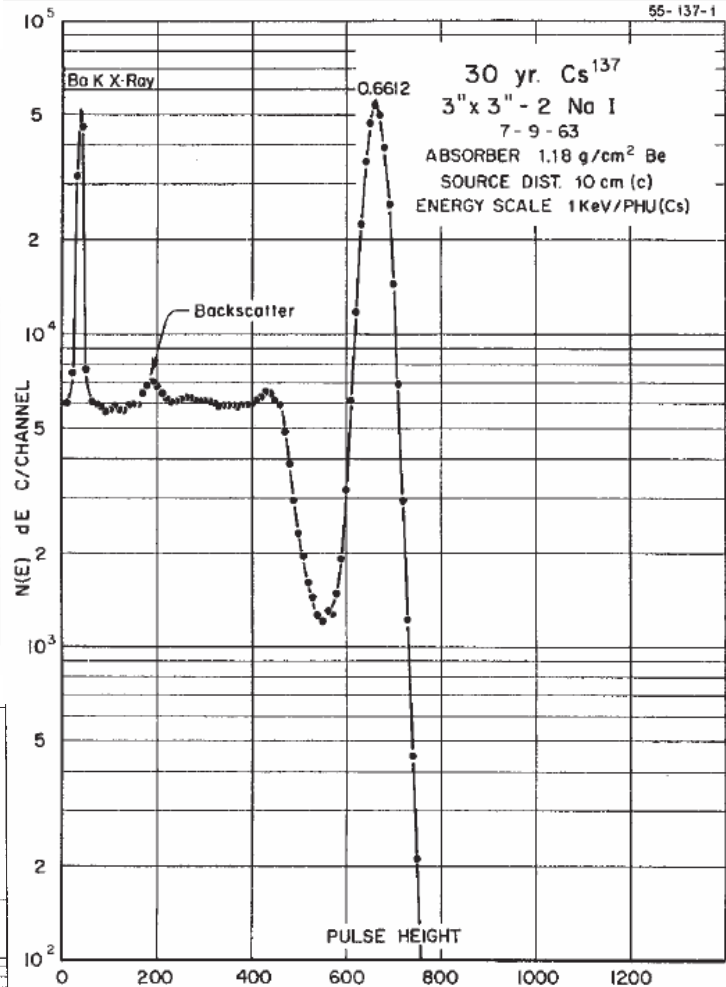
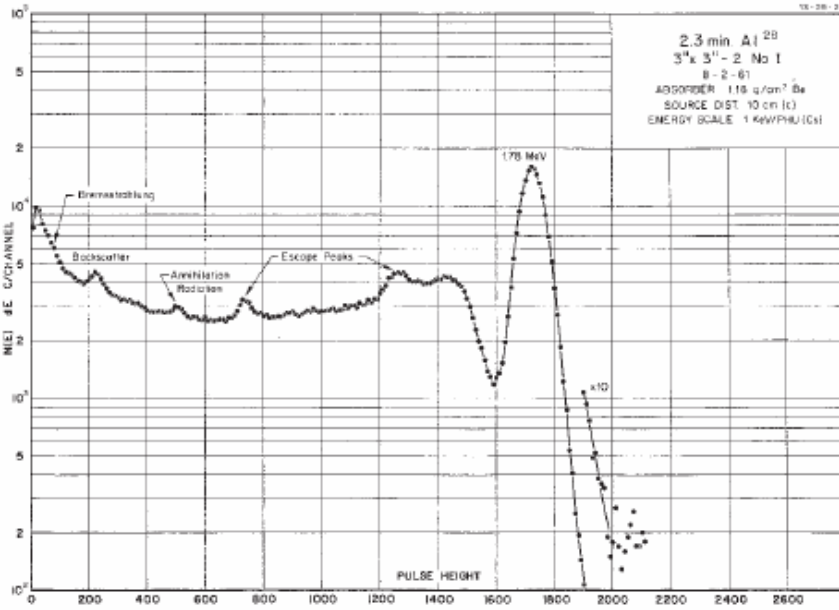
Questions:

- What isotope(s) are causing this spectrum?
- Do you let the bananas go through?

Carry out a line-up by comparing gamma spectra from several different nuclides with this unknown spectrum. (The line-up candidates are on the next page.)

Do any of the spectra look like the banana spectrum? What features should you compare? Why?





The spectrum library images show spectra from specific nuclides. However, you'll notice that the uranium spectrum is for uranium ore. This spectrum includes gamma rays from all of the radioactive nuclides that occur in natural ore. In realistic situations, multiple nuclides will be present in the sample being tested. Thus the spectrum produced by the sample would include the characteristic gamma-ray peaks for all isotopes that are present. For example, the bananas contain ^{40}K . The spectrum of the banana box also shows the signature gamma peaks (fingerprints) of ^{137}Cs .

The spectrum of the container of bananas with ^{137}Cs hidden inside would be the sum of the two spectra, showing both the ^{40}K and ^{137}Cs peaks. Because different amounts of one isotope or the other might be present, the intensities (or heights) of the peaks might be different, but the location of the peaks would be unchanged. Comparing the sample spectrum to the library spectra allows the analyst to identify that both potassium and cesium are present, and possibly how much of each material is present.