MARC-XII Workshop: Gamma Spectrometry with Non-Linear Least-Squares
Sunday, April 3, 2022 from 9-11 AM and 1-3 PM
King Kamehameha Ballroom

If you plan to participate, please email George.Lasche@alum.mit.edu with your name and organization so we can prepare a complimentary flash drive with free software for you. Space may be limited so please let us know as soon as you can that you are planning to participate with the workshop. If you bring a laptop capable of running Windows® you will be able to follow along with live analysis of example spectra. Notes for analysis of the example spectra will be provided.

A new and powerful method of high-resolution gamma-ray spectral analysis has been developed using non-linear least-squares fitting techniques, in which all of the data in the spectrum is considered as a single unit to be fitted in a holistic and self-consistent way. In contrast to conventional methods that are based on an initial peak-search, at each of many automated iterations a spectrum-wide shape for each nuclide is formed. With each iteration, the activities of each nuclide are recalculated, as well as user-enabled parameters of energy calibration, attenuation, peak width and skew, full-energy peak efficiency, and both random and cascade (or "true") coincidence summing until no better fit to the data can be obtained. This holistic approach allows identification of minor peaks that are masked by larger, overlapping peaks that might not otherwise be possible. Background radiation is fitted together with the sample data, so a background spectrum is never needed and the original data are never altered by subtraction.

Practical use of this method in the laboratory and in the field *in-situ* has been enabled by the recent development of a Windows® application known as "VRF". In the morning session, after a brief discussion of the analysis methodology, we will focus on practical examples of basic spectral analysis using non-linear full-spectrum fitting techniques. In the afternoon session participants will be introduced to advanced methods that include full Bateman solutions, quality control, and generation of simulated spectra**.**. Participants are encouraged to bring a laptop so they can have personal experience using these different techniques with their own computers.

As an example of the use of non-linear full-spectrum fitting, the figure below shows a low-energy region of a spectrum of mineral deposits in pipes from a copper mine that was recently analyzed with non-linear full-spectrum fitting techniques. The remarkable deconvolution of this region, which is crowded with x-rays and gammas, may not have been possible with conventional techniques based on the results of searches for individual peaks.