ADAM – Advanced Deconvolution of Alpha Multiplets

ADAM is a general-purpose program for alpha spectrometry using semiconductor detectors. The spectra may come from radiochemically processed sources measured in vacuum as well as air filters, swipe samples, evaporated water residues, etc. The unfolding is successful also for spectra obtained from smooth surfaces containing alpha-particle emitting radionuclides and even for data acquired in ambient air pressure. The spectra may contain multiple nuclides and overlapping peaks with varying shapes. The program works well even for spectra with poor energy resolution and statistics.

Features

- GUI for interactive processing
- Automated processing in batch mode
- Versatile fitting tools
- Nuclide library support for the fitting
- Different peak shapes for different radionuclides
- Convolution of a Gaussian distribution with low-energy side exponential functions for the peak shape
- Nuclides fitted in blocks (same shape for all peaks in the family)
- Alpha-electron/photon coincidences taken into account (data from the AASI program)
- Correct statistical treatment evaluated in scientific publications (covariance calculus)
- Open-source Linssi database for data management and browsing
- Project file for data and results

Fig. 1. Unfolding a spectrum containing $^{239}$Pu/$^{240}$Pu multiplet (at the top) and a spectrum with multiple radionuclides from U-decay series (bottom).
Applications
Radiochemically processed sources
ADAM unfolds alpha spectra obtained from radiochemically processed sources. ADAM copes with nuclides having strong peak overlapping. For example, deconvolution of the $^{239}\text{Pu}/^{240}\text{Pu}$ multiplet is possible with correct statistical treatment (see Fig. 1 in the previous page).

Air samples
Analyzing alpha spectra from air filters (indoors or outdoors, Fig. 2) is possible. This may be of utmost importance e.g. in a nuclear emergency when rapid measurements are necessary. Other applications may be monitoring of radon progenies in air or monitoring hot cell air.

Liquid samples
Unfolding the alpha spectra measured from evaporated water residues (Fig. 1) is straightforward and is shown to produce comparable results with those obtained from radiochemically processed sources.

Swipes
Spectra from swipes are possible to unfold successfully provided that the material and the swiping method are designed correctly. In STUK a number of swipes have been measured and analyzed by ADAM.

Smooth surfaces
A special application area is the analysis of alpha spectra obtained from smooth surfaces and measured without vacuum (Fig. 3).

Fig. 2. Alpha spectrum from an outdoor air sample measured in vacuum and analyzed by ADAM. Fluoropore membrane air filter is used in the sampling. Nuclides present in the filter are radon and thoron progenies.

Fig. 3. Unfolding an alpha spectrum measured from the surface of a depleted uranium penetrator. No vacuum is used in the measurement.

Installation and configuration
ADAM runs on most modern Linux distributions. ADAM is available as a compiled MATLAB program. The compiled version requires the MATLAB Component Runtime library (MCR). The MCR is delivered with the ADAM installation. ADAM can also be used in interpreted mode, which requires MATLAB. The interpreted version allows you to write your own add-on MATLAB programs and use the tools and commands of MATLAB together with the functions provided by ADAM.

References and documentation
ADAM software is published and evaluated e.g. in:

Program manuals are available from STUK.