

Estimation of masses of radioactive elements in geological samples using R programming language and ROOT libraries

Saturday 17 October 2020 12:40 (5 minutes)

In nuclear and high energy physics many processes have statistical nature. In current paper statistical data analysis is considered in a nuclear spectrometry problem of radioactive element masses estimation.

The problem was solved independently by means of R programming language and using ROOT package libraries. Based on the lines of calibration Eu-152 and Am-241 sample, several variants of spectrometers absolute efficiency curve were built. Masses of elements Ac-228, Tl-208, Bi-21 and K-40, contained in geological samples, were estimated by means of this curve and spectral lines approximation.

Estimations of statistical errors were also retrieved.

An assumption was made that the method of approximation may influence the final result and increase errors. This statement is especially true for low signal-noise ratio.

To prove this assumption, the problem was solved twice: using TH1F::Fit() method for Gauss function from ROOT, and using nls() function for identical model in R.

The result differences, caused by different methods, prove to be of the same order as statistical errors. However, for certain spectral lines differences can be huge due to incorrect execution of one of the methods for low signal-noise ratio data. Overall the ROOT algorithm can solve harder cases.

These findings concerning influence of approximation method in case of low signal-noise ratio may prove useful in other problems of nuclear or high energy physics.

Also execution time of identical programs of R and ROOT was compared. The ROOT program runs at least 25% faster. However, the computations took seconds, and part of the time was spent on running the program and displaying graphs. Therefore, this difference is not significant.

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Session Classification: Section 3. Modern nuclear physics methods and technologies

Track Classification: Section 3. Modern nuclear physics methods and technologies.