



## LABORATORY of spectrometry and radiometry

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# Nuclide Master

## Nuclide Master

### WHEN TO USE IT

The software package has been designed for getting information on radioactive decay parameters of radionuclides and creating user libraries.

### RADIONUCLIDES DATABASE

The database of decays parameters is based on ENSDF-file (Evaluated Nuclear Structure Data File) from the website of Brookhaven National Laboratory and is supplemented with data from Henri Becquerel laboratory DDEP (Data Decay Evaluation Project). It contains data for more than 3000 nuclides with their meta-stable states, such as:

- half-life periods of radionuclides;
- decays types;
- levels energies;
- conversion coefficients;
- energies and intensities of gamma- and alpha-peaks;
- energies and intensities of beta-transitions;
- energies and intensities of X-Ray lines on the basis of TOI (table of isotopes).

The database can be also appended by the decay parameters information from other data sources. The user's versions of radioactive decays parameters can also be saved.

### LINES LIBRARIES CREATION

The software allows you to view alpha- and gamma- lines list and save them in text format, compatible with SpectraLine.

Service functions realized in the software allow user to sort data by energy, intensity and so on, and exclude some data, e.g. lines with low intensity.

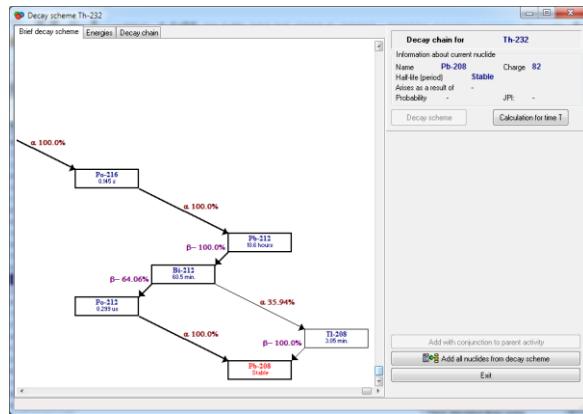
The screenshot shows the 'Find nuclide' dialog box. It lists various nuclides with their decay parameters. For example, Th-232 has a half-life of 14.01E0 years, decays via alpha to Ra-228, and has a beta decay probability of 100.00%. Other nuclides listed include Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Pb-216, Pb-212, Bi-212, Tl-208, Po-212, and Pb-208.

The lines list can be formed with all nuclides in the decay chain of the parent nuclide.

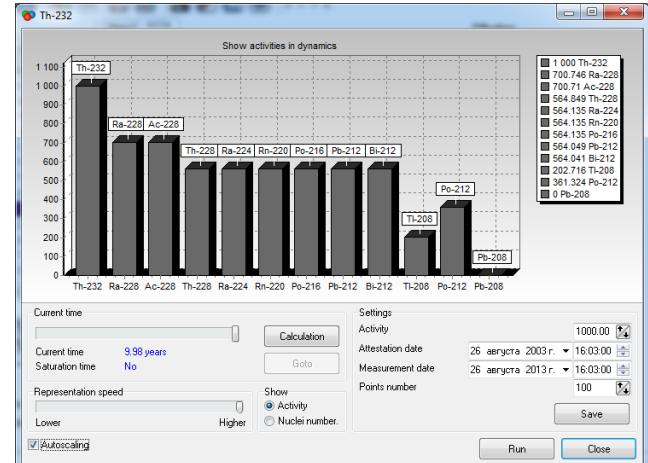
### DECAYS CHAIN VIEWING

The following functions are supported:

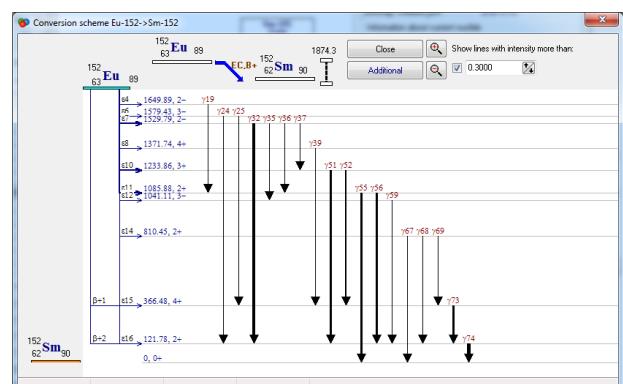
- view of decay chain for the selected nuclide with alpha- and gamma- lines list;



- calculation of a nuclide activity according to its decay chain to the specified time;
- calculation of graphics of a nuclide activity in dynamics according to its decay chain for the specified time interval.



### DECAYS SCHEMES



# Nuclide Master Plus

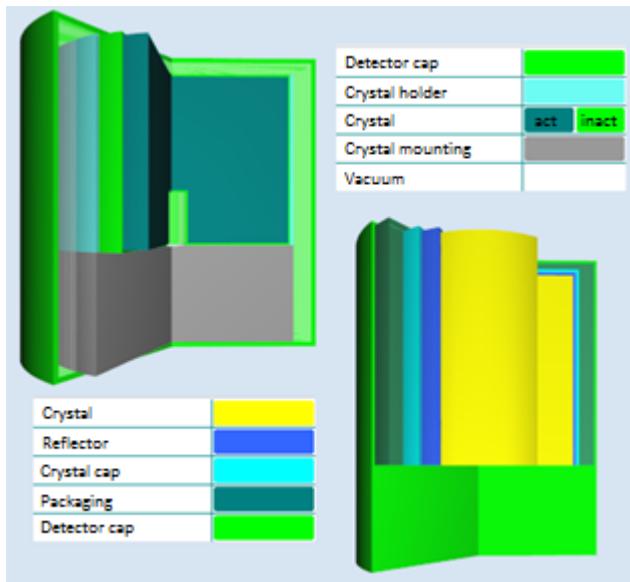
## WHEN TO USE IT

Nuclide Master Plus is an addition to Nuclide Master software and it is intended for calculation of true coincidence factors and registration efficiency.

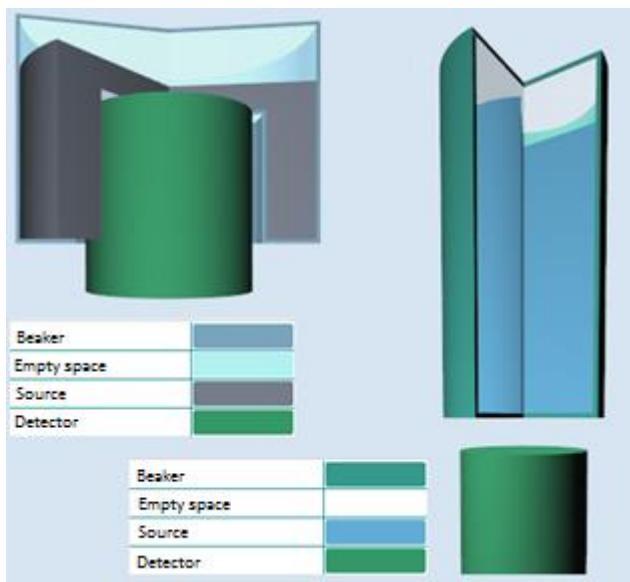
When a file with correction factors is included into processing software SpectraLine, the true coincidence effect is corrected at the activity calculation.

## SCOPE OF APPLICATION

The calculation is based on Monte-Carlo method using parameters of the required nuclides from the library of evaluated nuclear structure data ENSDF. The factors can be calculated for different detectors types (semiconducting and scintillation) which are saved in database compatible with EffMaker software.

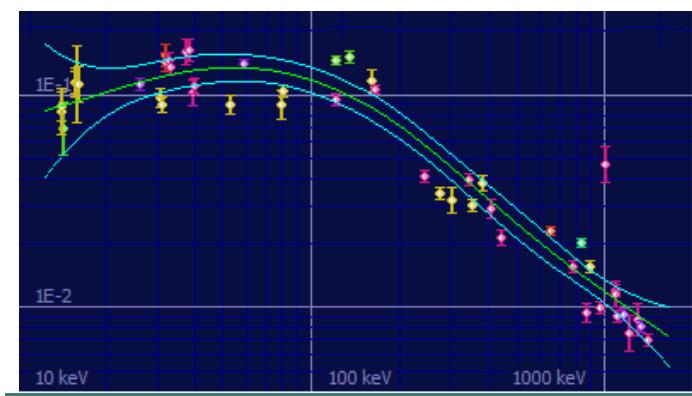


Marinelli vessels, cylinder and point can be used as the measurement geometries.



## VERIFICATION

Experimental efficiency registrations are represented below for the point source on the cover of HPGe-detector with ~30% of efficiency, calculated with correction of true coincidence and without correction.



## IAEA TEST

The results on the basis of IAEA spectra are listed below after SpectraLine processing, calculated with correction of true coincidence and without correction. The ratios of calculated activities to the passport data are in this table.

| Nuclide                    | No factors       |          | With factors     |          |
|----------------------------|------------------|----------|------------------|----------|
|                            | A/A <sub>0</sub> | $\delta$ | A/A <sub>0</sub> | $\delta$ |
| <b>Marinelli, HPGe-33%</b> |                  |          |                  |          |
| Ba-133                     | 0.93             | 0.04     | 0.975            | 0.034    |
| Co-60                      | 0.91             | 0.11     | 1.003            | 0.012    |
| Cr-51                      | 1.016            | 0.023    | 1.016            | 0.023    |
| Eu-152                     | 0.93             | 0.07     | 0.971            | 0.031    |
| Na-22                      | 0.80             | 0.12     | 0.988            | 0.028    |
| <b>Cylinder, HPGe-96%</b>  |                  |          |                  |          |
| Ba-133                     | 0.83             | 0.04     | 1.006            | 0.035    |
| Co-60                      | 0.81             | 0.12     | 1.004            | 0.018    |
| Cr-51                      | 0.982            | 0.025    | 0.982            | 0.025    |
| Eu-152                     | 0.85             | 0.09     | 1.036            | 0.027    |
| Na-22                      | 0.70             | 0.15     | 1.016            | 0.020    |

## ARTICLES

Berlizov A.N., Danilenko V.N., Kazimirov A.S., Solovyeva S.L., True coincidence correction factor calculation for cascade gamma — radiation based on statistical modeling with the use of evaluated nuclear data. - *Atomic Energy*, 2006, V. 100, №5, p. 382-388.

[http://www.lsrn.ru/files/publications/Atomic\\_Energy\\_2006.pdf](http://www.lsrn.ru/files/publications/Atomic_Energy_2006.pdf)