Calibration

Calibrations contain information regarding energy, full width at half maximum (FWHM) and efficiency calibrations. They must be selected and loaded for analyses (see Analysis Parameters). In *LVis*, *GammaVision* calibrations (`.CLB` files) or any calibrated *LVis* measurement file (`.LVM` files) can be used as a source of calibration.

In each *LVis* measurement, the calibration is presented in its own tab (see as well Changing a Calibration in an .LVM file).

IMAGE MISSING

The accurate measurement values of individual calibrations can be shown and edited in a calibration table. There you can find (if known) the reference source (on the left side), as well as optionally the respective nodes and fit information of the energy and FHWM calibration or the efficiency calibration.

IMAGE MISSING

To change peak fit parameters, click on the Spectrum tab to access the peak editor.

IMAGE MISSING

Several ways exist to create and edit calibrations. For example it is possible, to manually calibrate each already existing measurement (`.LVM` file) using the peak editor (See Detector Calibration). It is also possible to change an already existing calibration by changing the data in the calibration table.

However, *LVis* usually automatically takes care of all calibrations using its own detector-specific calibration parameter sets (see Detector Calibration). The calibration data obtained is automatically assigned to the detector or measurement parameter sets to ensure that the most up-to-date calibrations are used at all times. In principle, energy and FWHM calibration (channel-energy relation and channel-resolution relation) as well as efficiency calibration (energy - efficiency relation) are performed in two separate steps. The energy calibration as detector-specific calibration is saved under the detector (or better, the electronic measurement equipment); efficient calibrations can be assigned to individual parameter sets. If such calibrated parameter set is used, LVis automatically combines the current internal energy calibration of the detector with the efficiency calibration stored in the parameter set for analysis.

Automatic calibrations are based on reference sources, which contain all necessary nuclide information (library) and activity data (certificate file). In order to use the automatic LVis calibration function, you must create your calibration sources as reference sources in *LVis*. Without reference sources it is not possible to create calibration measurements in LVis. Therefore, in the event that no

reference source is available in the calibration parameter set, you will be requested to enter one prior to analysis.

IMAGE MISSING

Detector Calibration

Calibration parameter sets (one each for energy/FWHM calibration and efficiency calibration) can be created, changed and started from the context menu of a detector (Energy/Efficiency calibration parameters). Parameter sets for energy/FWHM calibration and efficiency calibration only differ in one field for the reference data and contain, in addition, the measuring time, peak analysis parameters and the reference source to be used (nuclides, peaks and possibly activity and reference date).

IMAGE MISSING

Selecting *New Energy/Efficiency calibration* in the detector menu starts a new parameterized calibration measurement. *Calibration using current spectrum* lets you use an already existing (manually started) spectrum for calibration.

IMAGE MISSING

Creation of an Energy Calibration for a Detector

In order to create an energy calibration for a detector, a spectrum with respective calibration parameter set must be evaluated. This can either be done by selecting *Execute energy calibration* (starts a new parameterized calibration measurement) or by selecting *Energy calibration based on current measurement*, if a spectrum has already been recorded using the calibration source.

IMAGE MISSING

In this case, the corresponding calibration table does not contain any information except the entries from the reference source on the left side.

IMAGE MISSING

When *Auto calibration* is `clicked`, *LVis* will try to find the peaks specified in the reference source, and then accordingly calibrate the spectrum.

Important
The nuclide library used for creating the reference source should be absolutely unique. It should only contain nuclides specified in the corresponding certificate. If energies are present in the reference source, which, for example, cannot be found in the spectra (e.g., due to the short half-life of the corresponding nuclide), problems may occur during automatic calibration.

Next the calibration will be displayed in the respective tab. Clicking on the *Calibration table* button takes you to detailed calibration information.

IMAGE MISSING

Corresponding nodes and fit results of the automatic calibration can now be found and, if necessary, edited in the calibration table (simply by clicking on the respective entry in the calibration table). All identified peaks used for calibration from the reference source are marked with an asterisk (*) in the calibration table (in the reference source data are displayed in the left table).

Double-clicking on peak energy in the left column of the calibration table takes you automatically to the respective peak in the spectrum. There you can display the fit in detail by clicking on *Peak editor*. You can also change the fit and apply the changes to the calibration.

IMAGE MISSING

Important
The fit displayed in the peak editor always depends on the fit display modus selected on the spectra view. If no fits were shown in the spectrum, *LVis* will fit the peak for the display in peak editor. This result may differ from the *GammaVision* analysis or peak search.

If the calibration is saved, *LVis* will then ask whether to assign this energy calibration to the detector.

IMAGE MISSING

This ensures that each spectrum newly recorded using this detector will automatically be furnished

with the current energy calibration. For this purpose, this energy calibration is stored in the electronic measurement equipment and will not be lost, once *LVis* is exited or the electronic measurement equipment is switched off.

You can always review the measurement corresponding to the currently active energy calibration of a detector by selecting *Open last energy calibration* in the context menu of the detector.

IMAGE MISSING

If you would like to delete the internally stored energy calibration, then select *Delete energy calibration* in the context menu.

Efficiency Calibration Creation for a Detector

Efficiency calibrations are not created for detectors as such, but for parameter sets, as they depend on the sample geometry.

To create an efficiency calibration, select *Execute efficiency calibration* from the detector's context menu. This analyzes the spectrum using the respective calibration parameter set.

IMAGE MISSING

Thus, both *GammaVision* and *LVis* offer different fit functions for the creation of an optimum efficiency calibration (e.g., polynomial, square-square, linear, etc.; you can find a detailed description in the *GammaVision* manual). Fit functions are usually detector-specific (e.g., n-type detector — square/square, p-type detector — polynomial). Thus, it is possible to specify the fit function by selecting *Efficiency fit parameters* in the context menu of the detector.

IMAGE MISSING

Then, the fit functions specified here, are automatically used for efficiency calibrations executed per calibration parameter set (furthermore, it is possible to change the function afterwards in the calibration table at any time).

If the detector is already energy-calibrated, then respective nodes and fit information are displayed in the calibration table.

IMAGE MISSING

If no energy calibration exists, clicking on *Auto calibration* first creates an energy calibration. Then by clicking *Auto calibration* a second time, the actual efficiency calibration is performed.

After the calibration is completed, the calibration results are displayed in the respective tab.

IMAGE MISSING

Now the calibration table contains energy/FWHM calibration entries as well as efficiency calibration entries. When the calibration table is open, only the graphs of the calibration selected in the calibration table are displayed in the calibration tab.

IMAGE MISSING

Corresponding nodes and fit results of the efficiency and energy calibration can be found below the calibration fit display and, if necessary, edited in the calibration table (simply by clicking on the respective entry in the calibration table). All identified peaks used for calibration from the reference source are marked with an asterisk (*) in the calibration table (in the reference source data are displayed in the left table).

`Double-clicking` on peak energy in the left column of the calibration table (the reference source information) takes you automatically to the respective peak in the spectrum. There you can display the fit in detail by `clicking` on *Peak editor*. You can also change the fit and apply the changes to the calibration. Furthermore, it is possible to change the fit and apply the changes to the calibration.

IMAGE MISSING

Important
The fit displayed in the peak editor always depends on the fit display modus selected on the spectra view. If no fits were shown in the spectrum, *LVis* will fit the peak for the display in peak editor. This result may differ from the *GammaVision* analysis or peak search.

If the calibration is saved, LVis will then ask first, whether to assign this energy calibration to the detector.

IMAGE MISSING

This is necessary, as within the scope of a parameterized (automatic) efficiency calibration, an energy calibration may be created as well.

Next, the efficiency calibration can be assigned to one or more parameter sets.

IMAGE MISSING

Tip
If you have assigned the wrong energy calibration to a detector by mistake, you can simply change it. Delete the *wrong* calibration by `clicking` on *Delete energy calibration*.

IMAGE MISSING

Open the valid calibration measurement of the detector and reevaluate the measurement (even of you have not changed any analysis parameters! It is important that the *Save* button is activated again). If you subsequently click on *Save*, you will be asked again whether you would like to use this calibration for the detector. The same applies to efficiency calibrations and linking of parameter sets.

Changing a Calibration in an .LVM File

In an already existing measurement (`.LVM` file), two ways exist to change a calibration. Either you open the calibration table and directly change the internal calibration by adding or deleting entries; or you load a complete energy or efficiency calibration from a `GammaVision .CLB` or *LVis* `.LVM` file.

This can be done by clicking on *Calibration file* in the Analysis tab. After a file is selected, it is possible to decide in the following dialog with which parts of this file the internal calibration should be overridden.

IMAGE MISSING

If you would like to directly edit the internal calibration, you must always open the internal calibration table in an `.LVM` measurement via the lower left button. The calibration table shows all nodes of both calibrations. You can switch in between them via the *Energy* and *Efficiency* buttons in the bottom left of the calibration table window.

IMAGE MISSING

It is possible to delete individual table entries as well as all data. You can undo the last change via the *Back* button. All changes will be immediately displayed in the Calibration/Library tab and new data will be considered in the fit. If the calibration table is open, the Calibration/Library tab will only show the graph valid for the respective calibration.

IMAGE MISSING

It is possible to add existing calibration data from GammaVision `.ENT`, `.EFT`, `.CLB` or *LVis*'s `.LVM` files to the one currently being edited. Simply click the *Import* button in the right top corner of the calibration table, and select the file from which the calibration data shall be added.

In order to add a new entry to the calibration table manually based on the spectrum data, the respective peak parameters must be adjusted in the peak editor first. The peak editor can be started from the Spectrum tab. You can either directly click on a peak in the spectrum; or `double-click` on the library information in the calibration table to go to the respective position in the spectrum. This will open the peak editor.

IMAGE MISSING

In order to change individual peak characteristics, you must first select the respective parameter on the right side. Click and drag the vertical marker line to change the value.

This screen also allows you to assign the peak to a (different) nuclide. If you click on the icon next to the nuclide name, a list of all peaks in the library is displayed from which you can select the desired entry.

IMAGE MISSING

After all parameters have been adjusted, the peak can be applied to the calibration table by clicking on *Apply to calibration*. Note that any analysis results displayed on the “Analysis results” tab of your LVM file are set to “0” when changing data in the calibration file. All fits on the *Calibration/Library* tab are re-calculated. And the reference of the calibration data on top of the graph changes to `internal` (see red marking in picture below).

IMAGE MISSING