Spectrum aquizition and analysis

You can acquire spectra either using the instructions specified in the parameter sets or manually independently from those. However, spectra analysis and saving of unevaluated spectra data is only possible in LVis using previously defined parameter sets. Spectrum, parameter set and possibly analysis results are saved together with the calibration and library used in a measurement, an `.LVM` file.

Start parameterized measurements

To start spectra acquisition using settings defined in a parameter set, `right-click` on the parameter set and select *Start parameterized measurement*.

IMAGE MISSING

This will open the parameter set window, displaying the current preset sample, measurement, and analysis settings. If you wish, you can add sample-specific parameters to the unlocked fields (see Login and Logoff), e.g., sample name, additional information, sample weight, etc.

IMAGE MISSING

When all information has been entered, start data acquisition by clicking the *Start* button. If the memory content of the electronic measuring equipment has not been displayed yet on the desktop (See Detectors → Show), then it will now be automatically opened as an active window.

As soon as the measurement is running, the currently performed measurement by this detector and the parameter set used in this measurement are displayed in the configuration tree next to the respective detector as well as in the header of the spectra view.

If a measuring time is specified, then the already elapsed time is displayed in percentage in the configuration window next to the detector. If no fixed measuring time is specified (enter *0* [zero] in the measuring time field), then the measurement must be completed manually and the elapsed time will be displayed next to the detector.

IMAGE MISSING

Manual Spectrum Acquisition

LVis allows you to acquire spectra manually, without the need for defining a parameter set. To do this, `right-click` on the desired detector in the configuration bar, and select *Start spectra acquisition*. Alternatively, if the detector's spectrum window is already open on the desktop, you can start and stop acquisition with the respective tool bar buttons. You can also continue a previously stopped spectra acquisition.

Note that you can continue a previously stopped measurement regardless of whether the spectrum was acquired manually or with a parameter set, and whether or not it has already been analyzed. More counts are simply added to the spectrum already in detector memory.

Stop/Delete Measurement — Stop Data Acquisition

Once started, a parameterized measurement can only be stopped via the context menu of the detector by choosing *Clear active parameters*. In addition to aborting data collection, the reference between parameter set and data acquisition will be deleted.

IMAGE MISSING

The *Start* and *Stop* icons in the tool bar can only be used to start and stop a simple manual spectrum acquisition without reference to a parameter set. They cannot be used to stop a parameterized measurement.

You can stop a parameterized measurement by selecting *Evaluation* and then *Reject* in the subsequently displayed window. You must confirm whether the measurement should be canceled.

Analyze Measurements and Create Reports

A spectrum analysis in *LVis* contains of several automatically executed steps. On the one hand, the spectrum is transferred to GammaVision according to the settings defined in the parameter set (and global LVis settings), where it is respectively evaluated. The analysis results achieved are graphically presented in tabular form and can be used for the creation of a report or a .PBC file for the background correction.

In addition, a simple mathematical peak search takes place. This basically corresponds to a *GammaVision WAN32* analysis without library, hence to a pure *Mariscotti* peak search. The results of the peaks found in this peak search are entered into the analysis database as well and are later on compared to the analysis library specified in the parameter set.

Besides actual analysis and peak search, *LVis* also saves library and calibration files used in the analysis internally in the measurement (`.LVM` file) and shows the content on a separate Calibration/ Library tab. This allows repeating the analysis even years later using the previously valid parameters without creating a safety copy of each individual file.

Based on a measurement, an intermediate analysis can be performed during data acquisition (e.g., to check, whether the required limit of detection has been reached) or an analysis can be run after the specified measuring time is elapsed. An intermediate evaluation must always be started manually; a final evaluation can be started automatically.

In order to automatically analyze a measurement and to export a report after the measuring time is elapsed, the checkmark in the *Automatic analysis and report* in the Parameter Sets must be set and a report template must be marked on the selection box located underneath.

IMAGE MISSING

An intermediate analysis (or a manual final analysis) can be started by selecting *Analyze measurement* either from the configuration bar via the context menu of the respective detector or for a currently active detector, via the respective icon in the tool bar.

Analyze measurement combines the analysis settings specified in the parameter set with spectrum, calibration and library in one unit.

Thus, after selection of *Analyze current spectrum*, first a window is displayed, which, except for two additional tabs (Spectrum and Calibration/Library), is identical to the window for the selected parameter set. The associated Spectrum tab displays the spectrum that was available when *Analyze current spectrum* was selected.

IMAGE MISSING

The display options (zoom, linear-logarithmic y-axis, line, bar or point presentation, etc.) are identical to the options of Spectra windows on the desktop. In addition, the detector used for spectrum acquisition is shown in the upper left of the spectra window.

`Clicking` on *GammaVision* transfers the spectrum, including all analysis parameters, to GammaVision. This can be useful if you would like to use options not directly supported by LVis. Furthermore, it is possible to export into the simple *ORTEC* `.CHN` spectra format and to review the spectrum using the *GVPlot* spectra viewer in detail. The display of peak fits is not supported at this point, but only after an analysis.

If you have not defined a measuring time or a pre-set measuring time has not been reached yet, the data acquisition will continue in the background and will not be affected by the intermediate analysis.

In the first two tabs of the window, you can find all important information regarding the current measurement to be analyzed. Here you can verify all analysis parameters once more. If all parameters are OK, start the analysis by clicking the *Analyze* button.

Analysis Results

After the analysis is completed, the measurement window is displayed along with three additional tabs, Analysis results, Peak search, and Calibration/Library.

IMAGE MISSING

The Analysis results tab contains two tables. The upper table contains a list of all nuclides listed in the library, plus the identified (decay-corrected) activity, the corresponding errors and the respective detection limit. If you click on one of the listed nuclides, the analysis results of all corresponding peaks are displaced in the lower table. All results of nuclides and peaks whose activity exceeds the detection limit are highlighted in red.

Tip
Compare the consistency of different peak activities of a nuclide. This will provide a good indication as to whether the analysis was meaningful or not.

By double-clicking on a peak entry in the lower table, you can reach the respective position in the spectrum and have the peak fit displayed.

After a spectrum analysis has been completed, it is possible to select different fit display options in the right menu of the spectrum tab.

All displays identified and unidentified peak fits; *Ident* only shows identified and *n. Id.* only the unidentified peaks.

IMAGE MISSING

Using the arrow keys **IMAGE MISSING**, you can move within the spectrum from peak to peak. Thereby the next peak of the respective, currently selected peak fit presentation is shown (e.g., moving from an unidentified peak to the next as well, if all unidentified peaks are currently displayed). It is as well possible to jump from peak to peak within the currently selected nuclide **IMAGE MISSING** . By using the up & down arrows one can switch from one nuclide to another and get all the respective peaks displayed.

Furthermore, you have the option to display basic fitting information of a peak in the spectrum by clicking on the *Info* button. As a result, information is automatically updated, if a different peak is selected manually or by using the arrow keys.

Important
Arrow keys as well as the *Info* function are only functional if a peak fit display has been selected.

Now the analysis results can be used to create a report (see Create Report). Furthermore you can create a .PBC file for background correction based on the analysis results.

IMAGE MISSING

If have done an analysis of your measurement before the specified live time preset was reached (intermediate analysis) and you would like to continue the measurement (e.g., because the required limit of detection has not been reached), then select *Continue acquisition*.

Important
Only if you use *Continue measurement*, does *LVis* maintain the connection of used measurement parameters, assigned spectrum name, etc. with the current data acquisition of the detector. If you click on *Reject* or on the *Windows Close* icon (x) in the upper-right corner, the reference is lost and cannot be restored. Therefore always use *Continue measurement*.

Create Report

You can create an analysis results report for a measurement either by activating *Automatic analysis and report* in the parameter set or manually following a completed analysis by `clicking` on the *Print report* button in the Analysis results tab. In the latter case, you are first asked to select a report template in a selection menu. See also the Reports chapter.

IMAGE MISSING

As of this release, *LVis* has only one report template. All reports in LVis are based on *Crystal Reports* templates. You can either create these templates with *Crystal Reports* or we can work with you to create them. Contact your *ORTEC* representative or our Global Service Center. Existing report templates can be modified using the designer that comes with *LVis* (see Report Editor).

The reports are either displayed in a separate Crystal Reports viewer or if pdf reporting is activated in the Global Settings directly in your pdf viewer.

IMAGE MISSING

IMAGE MISSING

Tip
To save the report as a separate file or to process the measurement results in some form, use the Crystal Report Viewer export feature to export the data in a number of different file formats, including `.`PDF, *Microsoft Excel*, *Microsoft Word*, *HTML*, and comma-delimited text. To export a report, click on *Export file* in the upper left of the *Crystal Report* Viewer. This will display the following dialog, in which you can specify the export format:

IMAGE MISSING

Creation of a Background Correction Based on the Analysis Results

Analysis results can be used to create a background correction. This is performed in *GammaVision* and thus in *LVis* via `.`PBC files (see Background Correction and the *GammaVision* manual). A `.`PBC file stores the peak counting rate of a nuclide found in the background spectrum. For the correction, the respective counting rates are deducted from the measured values during the analysis. This correction is applied prior to any other correction or calculation based on peak counting rates.

`.`PBC files can be created from analysis results of any measurement via the *Create PBC* button. As `.`PBC files represent detector-specific parameters, its default location is in the PBC subdirectory under the respective detector folder.

Peak Search Results

Within the scope of spectrum analysis, as simple mathematic peak search is conducted. This basically corresponds to a *GammaVision WAN32* analysis without library (or a library without content); hence to a pure *Mariscotti* peak search.

Important
GammaVision requires a library for this peak search. The used library file `Null.lib` can be found in the `\Config` folder under the *LVis* program directory. Do not delete this file; otherwise peak search will not function anymore.

The results of the peaks found in this peak search are entered into the analysis database and compared to the analysis library specified in the parameter set. The comparison only considers the peak energy specified in the library and the centroids of peaks found in the peak search. The nuclide, whose peak energy is closest to this centroid and which is inside the specified match width, will be assigned to the found peak.

IMAGE MISSING

The peak search results are presented in tabular form in the Peak search tab. `Double-clicking` on an entry in the table takes you to the respective energy in the spectrum and displays the peak search fit. In order to distinguish between analysis results, the respective nuclide assignment is displayed using a question mark next to the nuclide name.

Internal Storage of Calibration and Library

Besides the actual analysis results and the peak search results, LVis also stores library and calibration files used for the analysis in the measurement (`.LVM` file) and displays the content in an individual tab.

Important
As soon as the Calibration/Library tab is available, the internal data presented in it will be used for reevaluation. If you manually changed the files originally presented in the Analysis tab, then you must explicitly select them (although they might have the same file name) in order to consider them in the next analysis (See the chapter Reevaluation of Existing Measurements in this manual).

IMAGE MISSING

All three calibrations (channel energy, energy full width at half maximum and energy efficiency relation) as well as the corresponding nodes (sampling points) are presented in a graph on the left side of this tab. You can move the cursor over the functions and display the respective pair of values at the current cursor position.

You can find the file name of the originally used calibration as well as the date the calibration was created, in the graph title.

The fit functions are displayed in explicit mathematical form underneath the graph as well. To save this internally stored calibration as a `.CLB` file, `click` on the *Export* button below the calibration graph. The internal calibration can be manually modified by editing the calibration table (see Modifying the internal nuclide library of an *LVis* measurement file in this manual)

On the right side of the tab, you can find basic data of the library as well as the nuclides contained,

including the respective (radioactive) half-life and corresponding peaks and energies with emission probabilities, In the header you can find the originally used library, as well its date of creation and last modification. To save this internally stored library as a `.LIB` file, `click` on the *Export library* button. The library can be modified from within the LVM file for testing (see Modifying the internal nuclide library of an LVis measurement file in this manual).

Modifying the internal nuclide library of an LVis measurement file

The analysis library can be modified directly from the *Calibration/Library* tab of an LVM file. The library information is displayed on the right side of the tab. You can edit nuclide or peak energy information by simply right clicking the respective information.

IMAGE MISSING

Choosing from these menus will lead you directly to the same library editor described in detail in the Analysis Library section of this manual. The rank of a peak or the position of a nuclide in the library can be modified with the up and down arrows right side of the library information.

Info
When the library information was changed, the library name will switch to `internal.lib` indicating that its information is only available in this LVM file. If the library shall be available for use in routine analysis procedures (see: Parameter Sets) or other *LVis* measurements, it will have to be exported and saved as a *GammaVision* library file `*.lib`.

Important
When modifying the internal library of an *LVis* measurement, only the library information stored inside the particular LVM file is changed. The *GammaVision* library file `*.lib` that was originally specified on the *Analysis* tab of the *LVis* measurement will remain unchanged. When re-analyzing the measurement after a library was internally modified, the new internal library will be used even though another library may be mentioned on the *Analysis* tab. On the analysis report and on the *Calibration/Library* tab it will however clearly be indicated that an internal library is used.

Modifying the internal calibration of an LVis measurement file

The internal calibration can be modified directly from the *Calibration/Library* tab of an LVM file. The currently valid energy, FWHM and efficiency calibrations are displayed in the graph. Note the different scaling for the three curves. Information about the origin of the energy/FWHM and efficiency calibrations is displayed above the graph (see red marking in picture below).

IMAGE MISSING

The calibration data can be reviewed in detail and edited by opening and editing the information in the Calibration table. For more information see Calibration and Changing a Calibration in an .LVM file. To open the Calibration table editor `click` the button *Calibration table*.

IMAGE MISSING

By `clicking` the *Energy* or *Efficiency* button in the lower left corner (green arrows in picture above) of the Calibration table editor it is possible to select which set of data is displayed in the main table.

Double clicking an entry in the table allows for modification which is applied immediately to the 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

Re-evaluate Existing Measurements

A measurement saved as an `.LVM` file can be reevaluated at any time. For this purpose, the measurement must be open (see Open file). All parameters related to this measurement, including spectrum, internal library and calibration as well as the last received analysis results are then displayed in the typical `.LVM` window on the desktop.

IMAGE MISSING

Furthermore, in the Analysis results tab, you can display the data obtained after the last spectrum analysis run, and you can directly generate a report (See Create Reports).

If you would like to analyze the spectrum with different analysis parameters, then you can change those in the first two tabs (Unlocking might be required for possibly locked fields) and reevaluate the spectrum by clicking on the *Analyze* field. The current analysis results will be overwritten and a new report can be created.

Info
If you do not change any calibration and library fields in the Analysis tab, the internally stored data will be used. This means that in this circumstance, the original, separately available files are not read again!

Therefore, if you have changed these external files in the meantime (by preparing a new energy calibration or adding a nuclide to the analysis library), then you must explicitly select them one more time (although they may have the same file name) in order to consider the changes in the reevaluation and import the files into the `.LVM` file.

If you specify a new calibration file for reevaluation in the Analysis tab, then *LVis* offers the option of either selecting the energy (and full width at half maximum) calibration or efficiency calibration or both. Correspondingly, you can either replace the entire internally stored calibration file or only selected parts.

IMAGE MISSING

Info
If you save the measurement after a changed analysis, the previous settings will be overridden. You can only reproduce the former results by resetting analysis and correction parameters to the previous settings and running the analysis again. Thus, for better orientation, you can always find the analysis date and time on the report. If possible save or archive your analysis reports (for instance, by printing them as `.PDF` files).

Approval of Measurements and Analysis Results

If desired, one can define an additional *approval* process to *LVis* measurements. This feature can be activated in the global settings and it adds an additional tag/status to LVM files. Anyone with the appropriate right to approve measurements (see LVis User Management - Password-Protecting LVis Functionality) can change this tag by approving or disapproving analysis results. If the user management *Uli* is not used, then anyone with admin rights has the right for approval. The status of approval is indicated by a red or a green symbol besides the header of the *Analysis results* tab.

IMAGE MISSING

To change the approval status of an LVM file right click the status information at the header of *Analysis results* tab.

IMAGE MISSING

Info
Only a saved LVM file can be approved. When approving analysis results you don't need to save the file again. The respective change of the status will automatically be applied to the LVM file. However when removing an approval, you will have to save the file afterwards to apply the change.

The information about the approval status will be listed in the lab journal and can hence be used for filtering and file retrieval. In addition, there are specific additional things that may happen to an LVis file when being approved (depending on the type of measurement):

1. If the LVM file is a QA measurement, the QA results will be transferred to the QA detector database.
2. If the LVM file is a calibration file, you will be asked if the energy calibration shall be applied to the detector and if the efficiency calibration shall be updated in a parameter set.
3. If the LVM file is a *normal* measurement (no calibration, no QA) and in case the automatic file exchange with a *LIMS* is used (see Global Settings), the creation of analysis result output files for the *LIMS* is depending on approval of the LVM.

Using EFFTRAN with LVis

LVis extremely simplifies the use of the free software codes EFFTRAN and/or MEFFTRAN together with *GammaVision*. These codes, developed and openly published by Tim Vidmar (tim.vidmar@sckcen.be), can be used to calculate correction factors for TCS (True Coincidence Summing) and efficiency transfer to account for differences between calibration and sample geometries. From *LVis* it is possible to automatically trigger EFFTRAN calculations and use its results during an analysis process. The efficiency transfer correction is then implemented into the *GammaVision* analysis by creating a geometry correction file (`*.GEO`) whereas the nuclide/peak specific correction factors to account for the TCS are implemented by creation of a correction library (`*.LVF`). Both of these corrections, LVF and GEO are saved in every *LVis* measurement file (`*.LVM`) as internal data. To make use of the auto-calculation the following is required:

- A copy of EFFTRAN and MEFFTRAN on your pc. The file location of these programs must be defined in the *LVis* Global Settings.

IMAGE MISSING

- Valid detector data must be defined for the detector. This is dimensional and materials data for description of the geometrical details of the detector element. (Usually given on the detector data sheet). For a detector that is configured in *LVis*, this can be done from the detector

configuration menu. Any new measurement that is acquired will then automatically have this information available. For existing measurements (LVM files) this information can be entered on the *Detector system* tab.
- Valid information about the counting geometry (sample container, position on endcap, matrix etc.) during calibration. This information is only available when the calibration is taken from an LVM file, it is not possible to do EFFTRAN calculations when using GammaVision CLB files for the calibrations. When creating LVM calibrations in LVis the container and matrix information is automatically taken from the reference source information. In case a *normal* LVM file is used for the calibration make sure that the respective data is specified on the Counting Geometry tab.
- Valid information about the counting geometry (sample container, position on endcap, matrix etc.) during sample acquisition. This can be specified on the *Counting Geometry* tab (see blue marking on the screenshot below).

Info
Note that *LVis* always calculates an average density for the specified sample material based on what was entered in the sample mass and volume fields (see red marking on the screenshot below). The density that is specified in the materials editor for the respective sample material will not be used! Instead of the sample volume one can specify the sample filling height in the lower of these two *sample size input fields* as well.

IMAGE MISSING

- It is important, that the upper of the two *sample size input fields* (red marking above) always represents the sample size used for scaling the reported activity on the report! The lower *sample size input field* is only used for calculation of the filling height and/or density!
- Ticking the boxes on Calibration tab without selecting a specific file.

IMAGE MISSING

When clicking *Analyze Spectrum*, LVis will combine all this information and will send it to EFFTRAN. The status of the EFFTRAN calculation is displayed in a separate window:

IMAGE MISSING

The resulting correction factors will automatically be used to correct the *GammaVision* analysis and can be reviewed on the *Corrections* tab by `clicking` the button on the right side of the respective correction type field.

Important

Pay attention to your analysis library setup when using EFFTRAN for the calculation of true coincidence summing (TCS) factors. In order to calculate the correction factors, EFFTRAN matches the nuclide names and peak energies from the analysis library with its internal database of decay data (KORDAT) and only if the nuclide name is identical and the energy within a very small energy window, the respective peak will be corrected. So, for example if Iodine-131 is listed in the analysis library as J-131 it will not be corrected, because the correct elemental symbol for Iodine is “I” and not “J” and hence J-131 is not existing in the EFFTRAN decay database. The same applies for the peak energies: The correct Co-60 peak energies are 1332.49 and 1173,23 keV. An analysis library using 1332,51 keV and 1173,24 will leave the first peak uncorrected and the second corrected, simply because the 1332.51 keV peak is too far away from the EFFTRAN database entry. Therefore: Always check the correction factors in the LVF file and double check if a correction factor is 1 (so no correction is applied).