

# **Emulator v1.6.5**

User's manual



2010

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# 1 Introduction

## 1.1 Purpose

The Analyzer Emulator application is designed to work as a part of the spectrometric analysis workstation. The application provides a user interface and is responsible for automated and manual setting of spectrometer parameters.

## 1.2 System Requirements

The application requires a fully IBM PC/AT compatible PC with Pentium 800 MHz or more, 256 MB or more RAM, 10 MB or more of free disk space, and Windows 2000, or Windows XP, or Windows 7 operating system.

## 1.3 Application Installation

In order to install the application on a computer run the program Setup.exe from the hard drive, then follow the dialog instructions. The application may be distributed as individual files, written down on a magnetic or optical disk (a CD or a diskette). In this case, in order to install the application, you should copy files eSBS.exe, eTransport.dll, eTransport.ini, eSpDll.dll, FileDialog.dll and files needed to control the spectrometer in any folder on your hard drive. The way to the directory should not contain any Russian symbols. You can create an application shortcut on the desktop and/or in the quick launch panel if needed.

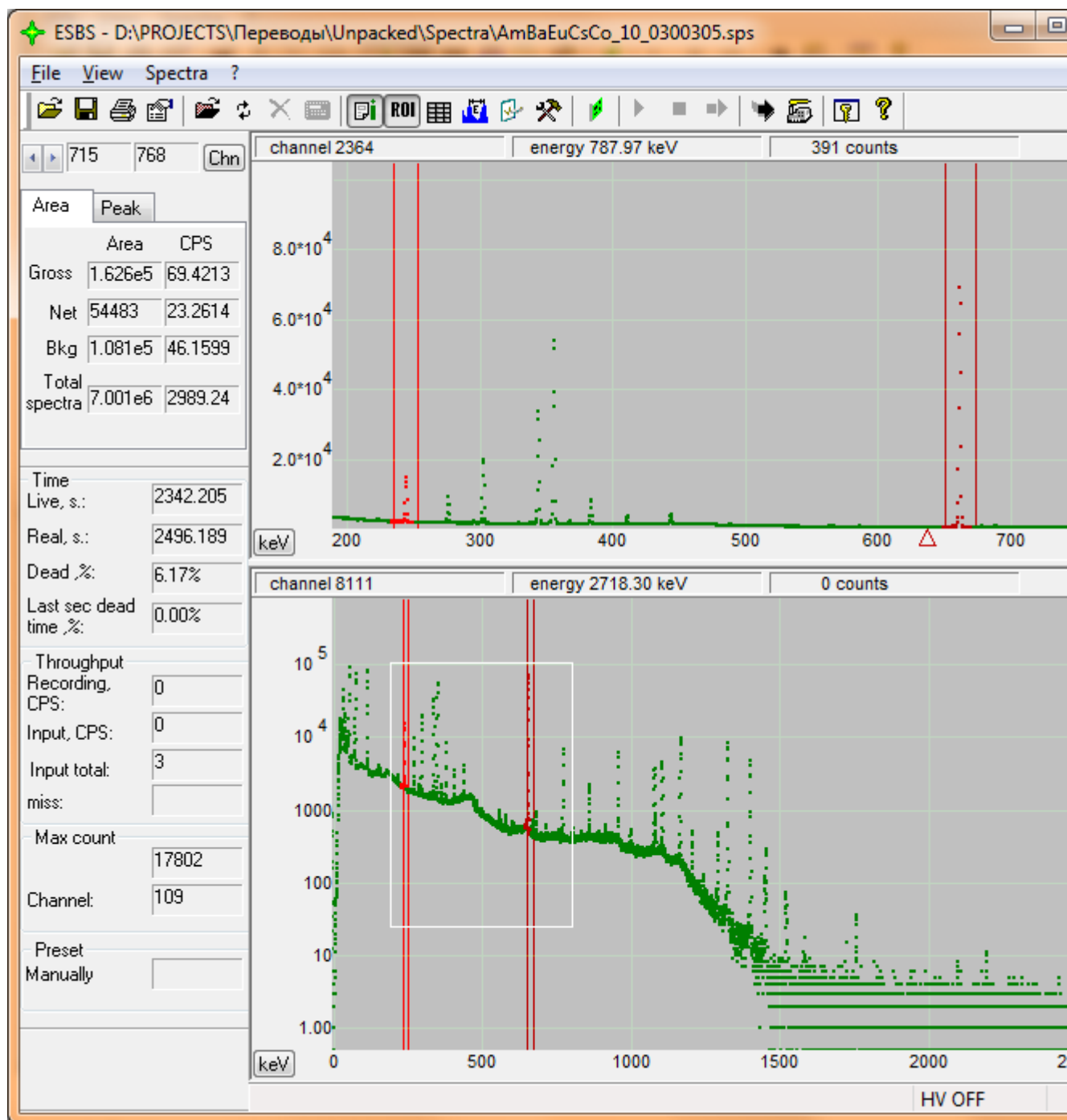
## 1.4 Main Features

The application is capable of working with more than one spectrometer. Each spectrometer works independently. The following actions can be performed by the application for every spectrometer:

- [Setting spectrometer operating mode](#);
- [Automatic optimization](#) of certain modes;
- Saving and loading spectrometer operating modes;
- [Making installations of the ending of the setting and of the delay of start](#);
- Starting, stopping, and resuming spectrum acquisition;
- Saving to and loading spectrum from disks;
- Automatic acquisition of the set quantity spectra with control signal generation for samples supply;
- [Power calibration](#);
- [Peaks parameters calculation in the set areas](#);
- Spectrum digital stabilization on one or two peaks;
- Correction of dead time;
- [The automatic and manual call of the typed \(collected\) spectra processing application](#);
- [Investigating spectra using scale, spectrum coloring, vertical and horizontal extension and compression, both after and during acquisition](#);
- [Comparing two spectra by different criteria using combined scale](#);
- [Real-time visualization of spectrum accumulation process together with its parameters](#);
- Printing spectra.

## 2 The Interface of the Application

At start of the application the application basic window is displayed on the operator's screen.



The main application window has the following windows:

- [Menu](#);
- [Control panel](#);

- [Spectrometer selection panel](#) – visible only if the system has more than one spectrometer;
- [Main spectrum window](#) (lower screen area);
- [Working spectrum window](#) (upper screen area);
- [Acquisition information window](#) (left screen area);
- [ROI window](#) - the area and peak parameters (left screen area);
- Spectrometer status panel (lower screen area).

The following windows: [Control panel](#), [Spectrometer selection panel](#), [Acquisition information window](#) и [ROI window](#) can be docked to the main window borders or left floating on the screen. The positions of these windows are saved on application exit and are read and restored on the next application run.

## 2.1 Menu

Hierarchical menu of the program consists of four items with sub items.

The ' File ' item consists of the following sub items:

- 'Load the areas' allows to load previously saved ROI from a file;
- 'Save the areas' allows to save ROI in a file;
- ['Load spectrum...'](#) – allows to load previously saved spectrum from a file;
- [' Save spectrum...'](#)– allows to save spectrum in a file;
- *' File header '* allows to show or hide [the ' Spectrum file header ' window](#);
- 'Print ' allows to open dialog box of spectrum preliminary view, in which it will be printed. The spectrum can be printed from this dialog box.
- 'Exit ' allows to exit from the program.

The ' View ' item consists of the following sub items:

- 'Acquisition information' allows to show or hide ['Acquisition Information' window](#);
- 'Areas and peaks' allows to show or hide [the ' ROI ' window](#);
- ["Toolbar" panel](#)– allows to show or hide the "Toolbar" panel;
- "Statusbar" panel allows to show or hide the "Statusbar" panel;
- ['Setup analysis program'](#) – allows to show or hide the ' Setup link to analysis program ' window;
- ['Setup colors'](#) – allows to show or hide the "Setup colors" window;
- [«Adjustment of access.....»](#) – allows to show or hide the «Adjustment of access.....» window;
- "Russian" - allows to change the interface language. Changes will come into force after following loading of the program;
- "English" - allows to change the interface language to the English one. For work in English the files EnglDrv.dll and Engl.dll are necessary. Changes will come into force after the following loading of the application.

The 'Spectrum' item consists of the following sub items:

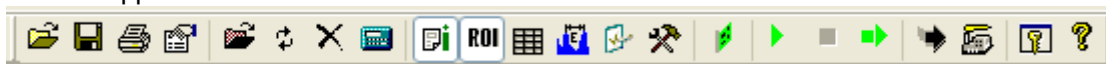
- 'Start acquisition' - allows to start the spectrum acquisition;
- 'Stop acquisition' allows to stop the spectrum acquisition;
- 'Continue acquisition' allows to continue the spectrum acquisition;
- 'Clear the spectrum' allows to clear the current spectrum;
- 'Delete all marks' allows to delete all marks of the spectrum;
- 'Delete all ROI' allows to delete all ROI of the spectrum;
- 'Energy calibration' allows to show or hide [the 'Energy calibration' window](#);
- 'Spectrometer adjustment' allows to show or hide [the 'Spectrometer adjustment' window](#);
- 'Setting parameters' allows to show or hide [the 'Setting parameters' window](#).

The ' Help ' item consists of the following sub items:

- 'About the application ...' allows to show the "About the application ..." dialog box with information about the program version;
- 'Help ...' allows to open the information window.

## 2.2 Toolbar panel

The toolbar is located between the menu and the working spectrum window. It is used for a fast call of the application basic functions.



The following buttons are available on the toolbar:

	- Open spectrum file
	- Save spectrum file
	- Print spectrum
	- Show or hide the <a href="#">Spectrum File Header window</a>
	- Open "shadow" spectrum file
	- Copy a spectrum to the "shadow" spectrum. The spectrum is copied to the "shadow" spectrum during spectrum acquisition. When acquisition is not performed, clicking this button will swap the main and the "shadow" spectra. While working with two planes the active plane is switched.
	- Cancel displaying of the "shadow" spectrum
	- Show or hide <a href="#">the Operations with Spectra window</a>
	- Show or hide <a href="#">the Acquisition Information window</a>
	- Show or hide <a href="#">the ROI window</a>
	- Show or hide <a href="#">the All ROI window</a>
	- Show or hide <a href="#">the Energy Calibration window</a>
	- Show or hide <a href="#">the Spectrum acquisition parameters window</a>
	- Show or hide <a href="#">the Spectrometer Settings window</a>
	- Open spectrometer control application window
	- Start spectrum acquisition
	- Stop spectrum acquisition
	- Continue spectrum acquisition
	- Show or hide <a href="#">the Communication with Processing Application window</a>
	- Launch the processing application
	- Zero spectrum
	- Show or hide <a href="#">the Access adjustment window</a>
	- the About the application dialog

Some buttons can be hidden according to the tags put in the "Access adjustment" window.

It is possible to operate the spectrum setting with the help of the hot keys:

- Alt+s - begin the spectrum set
- Alt+p - stop the spectrum set



- Alt+c - continue the spectrum set
- Alt+x - null the spectrum

## 2.3 Spectrometer Selection Toolbar

The spectrometer selection toolbar is visible when the system has more than one spectrometer.



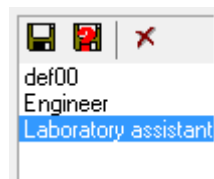
The following buttons are available on the toolbar:

	- Start spectrum acquisition for all spectrometers
	- Stop spectrum acquisition for all spectrometers
	- Continue spectrum acquisition for all spectrometers
1 ... 32	- Select a spectrometer

It is possible to choose a spectrometer with the help of the hot keys. To choose one of the 1, 2, ..., 10 spectrometers it is necessary to press the 1,2, ..., 0 keys keeping the "Ctrl" key pressed. To choose one of the 11, 12, ..., 20 spectrometers it is necessary to press the 1,2, ..., 0 keys keeping the "Ctrl" and "Shift" keys pressed. There are not any hot keys for spectrometers, which serial numbers are more than 20.

## 2.4 Profile Management

Some windows contain a specialized element of management for preservation of the adjustments, made in this window, and fast access to them. Each set of adjustments (further a profile) is kept in them as a file.



This element allows:

To choose the previously saved profile from the list;

To save a current profile without change of the name with the help of the button;

To save a current profile with a new name with the help of the button;

To delete a current profile with the help of the button.

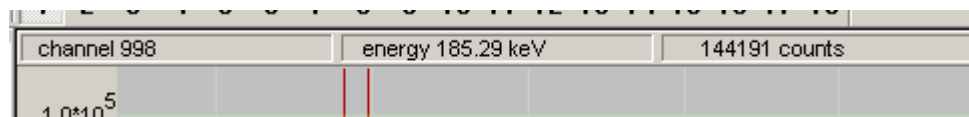
## 2.5 Spectrum Windows

The main spectrum window displays the whole of the accumulating (accumulated) spectrum.

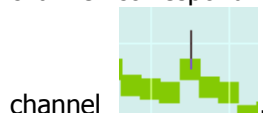
The part of the spectrum visible in the working window is marked by a rectangle. Channel (or energy, if there was a prior calibration) coordinate scale is at the bottom. Samples count grid is to the right.

The working spectrum window contains a part of the spectrum (or the whole spectrum).

The upper part of each spectrum window has a status panel. The status panel has three columns.



The first column contains the channel number corresponding to the current mouse cursor position. The second column shows energy value. The last column contains the number of samples in the channel corresponding to the current mouse cursor position. A short vertical line marks the



channel



The visual appearance of the spectrum can be controlled in the following ways:

- Linear or logarithmic scale and spectrum coloring can be set for the main and working spectrum windows;
- Any part of the spectrum can be selected and displayed in the working window; the selected part can be extended and compressed both vertically and horizontally;
- The optimal scale can be set for the working window (this scale makes the selected part of the spectrum to be fully visible using the maximum vertical extension);
- Any channel can have a marker added, moved, or deleted. Each marker is displayed as a cross with the energy values, channel number (in brackets) and samples count of this channel;
- Regions of interest (ROI) can be added, moved, resized, and deleted. Regions of interest are distinguished by colors and borders (vertical lines);
- Relative sizes of the main and working windows can be changed;



The main window contains the whole spectrum. The working window contains a part of the spectrum. The borders of the spectrum part visible in the working window are marked by the rectangle in the main window. The main window can be used to select the part of the spectrum displayed in the working window. In order to select a part of the spectrum, click the right mouse button at the one of the corners and drag the mouse with the right button down to the other corner of the spectrum part that interests you. The left mouse button is used to move the borders or the whole part of the spectrum. You can also change the selected part of the spectrum in the working window. Dragging the mouse vertically with the left button down will change the vertical scale. Dragging the mouse horizontally with the left button down will move the part of the spectrum or the image element highlighted by color. In order to change the horizontal scale, you should click the left mouse button on the lower scale and move the mouse without releasing the left button. All scale changes are relative to the "anchor" (red triangle on the energy scale). Double clicking the left mouse button on the lower scale will move the "anchor" to the point clicked. Rotating the mouse wheel will change the horizontal scale. In this case, the spectrum will extend or compress relative to the current mouse cursor position.


The left part of the spectrum window has the following buttons for controlling spectrum visualization:

	- switching between linear and logarithmic scales
	- enabling/disabling spectrum filling mode
	- setting optimal vertical scale
	- decreasing horizontal scale
	- increasing horizontal scale
	- enabling ROI addition mode
	- enabling/disabling moving ROI and ROI borders
	- enabling erasing mode

	- open <a href="#">the power lines editing window</a>
	- switch on the power lines addition mode


These buttons gets highlighted when the mouse cursor moves over them.


When ROI addition mode is enabled, the mouse cursor changes to: . Clicking the left mouse button will add a ROI to the spectrum. There is no limit on the number of ROIs added. In order to cancel the ROI addition mode you should click the right mouse button or click the  button once again..


In order to enable ROI editing mode, click the  button. When this mode is enabled, you can move ROI or change its borders. You can move ROI or ROI borders when the mouse cursor is in the lower part of the window only. Mouse cursor positioned over the upper area of the window will move the spectrum.


In order to move a ROI border, move the mouse cursor to the border of interest. The border should change its color to the active ROI border color. Then press the left mouse button and move the mouse while the left button is still down. The ROI border will move with the mouse cursor while the left mouse button is pressed

In order to move a ROI, place the mouse cursor between the ROI borders. The spectrum inside the ROI should change its color to active ROI color. Then press the left mouse button and move the mouse while the left button is still down. The ROI will move with the mouse cursor while the left mouse button is pressed.

When erasing mode is enabled, the mouse cursor changes to: . Clicking the left mouse button over an active spectrum object will delete that object. You can delete as many objects as needed.

In order to cancel erasing mode, you should click the right mouse button or click the  button once again.

To view and edit the power lines list it is necessary to press the  button, thus [the «Power lines» window](#) will open.

During switching on the power lines addition mode the cursor is displayed in the:  view. When the cursor is moving, the power lines from the chosen lines library will be displayed with the energy close to the energy corresponding to the cursor position. After pushing the left mouse button the displayed line will be added to the lines list if it still is not in this list or will be removed, if it is already in this list.

Clicking the left mouse button over the spectrum status panel will bring a context pop-up menu. The menu lets you add additional objects (markers, ROIs) to the spectrum, delete all ROIs and markers, switch on a display logarithmic mode and copy the current spectrum image to the Windows clipboard, so that you can later paste the image into other applications. You can control spectrum visualization using the keyboard. The following keys control spectrum visualization:

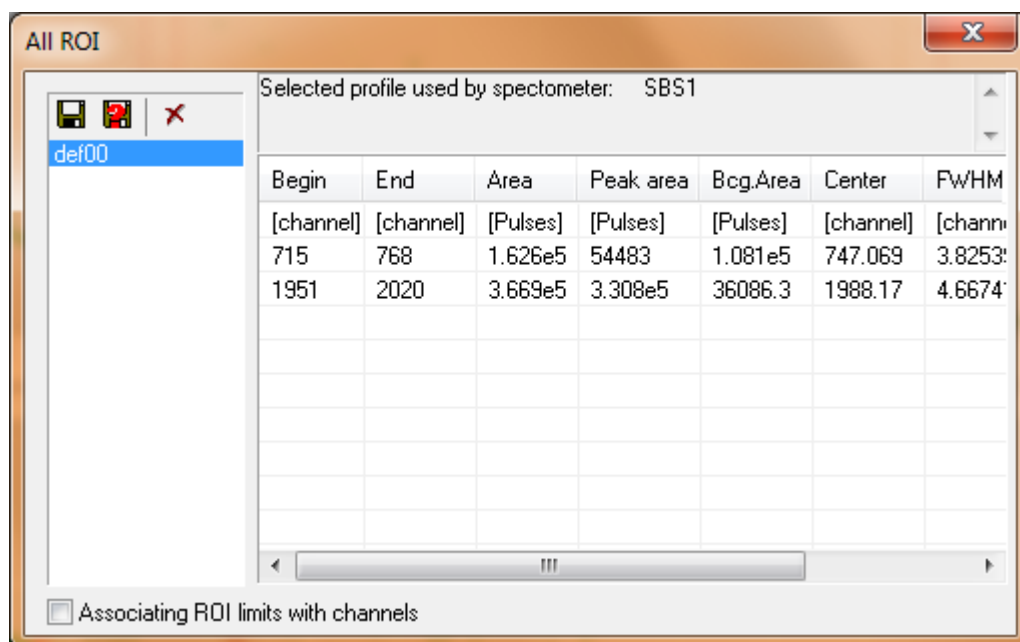
- Pressing "X" will set the optimal horizontal scale;
- Pressing "Y" will set the optimal vertical scale;
- Pressing "O" will set the optimal scale;
- The spectrum can be extended or compressed in the working window by pressing "/" and "\*";
- Pressing "L" will toggle linear or logarithmic scale.

When the mouse cursor is over a ROI border, over a ROI, or over a marker - the color of the object changes and the object activates. ROI and its border can be activated in the lower half of the spectrum window only. An active object can be moved by clicking the left mouse button or deleted by pressing "DEL" on the keyboard.

In order to change the main and working window height proportion, move the mouse cursor over the horizontal line separating the windows and press the left mouse button. After that, moving the mouse vertically with the left mouse button down will change windows proportion. In order to hide the main window, move the mouse cursor beyond the bottom of the main window. Similarly, move the mouse cursor beyond the top of the working window to hide it. Releasing the left mouse button will set current windows proportion. If the working window is the only visible, the separating line is below the window. If the main window is the only visible, the separating line is above it.

## 2.6 'All ROI' Window

The 'All ROI' window is displayed after pushing the  button on the ["Toolbar" panel](#).



The management element is located in the left part of the window and allows to choose, saving or removing the areas list. Only areas borders in energies or channels are kept in the areas list and only when the 'ROI borders binding to channels' tag is marked. The same profile can be chosen for several spectrometers. If the profile is used for several spectrometers, ROI borders changes will influence all the spectrometers using this profile. The message on the spectrometers using the chosen profile is displayed at the top part of the window.

The following parameters are displayed for all ROI in the table:


- The beginning – the bottom ROI border;
- The end – the top ROI border ;
- The center – the ROI maximal peak center position;
- The area – the ROI area;
- The peak area – the peak area;

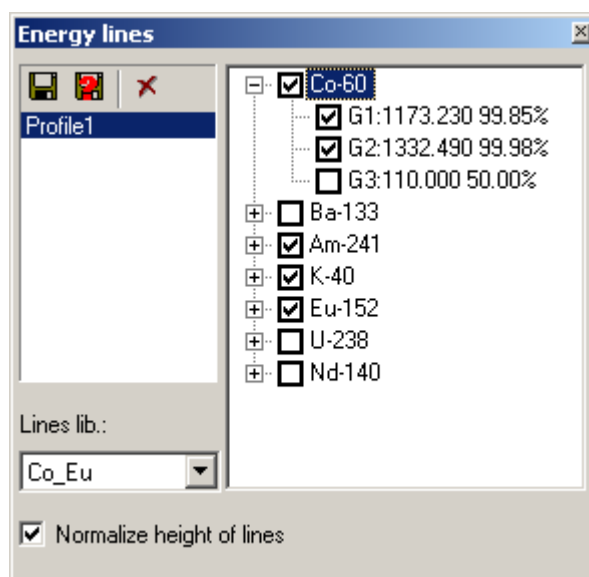
- The background area – the background area;
- FWHH – the full width of a peak on the half height;
- Maximum – the acquisition value in the maximum;
- Maximum without a background – the acquisition value in the maximum minus a background;

The measure unit for each column is displayed in square brackets under the name of this column. In order to change measure units, bring the mouse cursor to a cell with measurements and press the left mouse button.

It is possible to change the columns order. In order to do it bring the mouse cursor to the column heading, to press the left mouse button and drag the column to the left or right without letting the left mouse button down.

## 2.7 'Power lines' Window

To view and edit the power lines list, to press the  button and the "Power lines" window will open.



The [profiles management](#) element is located in the left part of the window and allows to choose, saving or removing power lines profile.

The multilevel tags list is located in the right part of the window. All elements from the chosen lines library are brought in the list. To form the lines library use the "Nuclioteka" application. The cancelled list elements are displayed in the spectrum windows in the form of vertical lines with the signature. The line position corresponds to the energy. The line height corresponds to the output percent. When the "normalize the chosen lines height" tag is marked, the chosen lines heights are normalized so that their sum is 100 percent.

## 2.8 'Acquisition Information' Window

Time	
Live, s.:	2342.205
Real, s.:	2496.189
Dead, %:	6.17%
Last sec dead time, %:	0.00%
Throughput	
Recording, CPS:	0
Input, CPS:	0
Input total:	3
miss:	
Max count	
	17802
Channel:	109
Preset	
Manually	

The Acquisition Information panel contains the main parameters of the spectrum being accumulated (or already accumulated):

- Real time of spectrum acquisition in seconds;
- Live-time of spectrum acquisition in seconds;
- Dead time of all acquisition time in percentage;
- Current dead time (percentage throughout the last second). Equals to 100 %, when acquisition is stopped. If dead time correction is turned on, the value is displayed in brackets;
- Count rate (number of registered pulses during 1 second);
- Input count rate (number of pulses at the spectrometer input during 1 second);
- Entrance sum – quantity of impulses on the entrance of all spectrum acquisition time;
- Miscalculation - dead time (percentage throughout the last second) for input count rate meter;
- Acquisition - maximum sample and number of the channel containing the maximum sample;
- Type and value of acquisition ending setting.

Some of the fields may be displayed as grayed. That means the values of these fields are indefinite for this analyzer.


## 2.9 'ROI' window


Area		Peak	
	Area	CPS	
Gross	1.626e5	69.4213	
Net	54483	23.2614	
Bkg	1.081e5	46.1599	
Total spectra	7.001e6	2989.24	


Area		Peak	
Center	747.069	Chn	
FWHM	3.82539	Chn	
MDL	0.01811		
		CPS	
Max.	14559.3	6.21608	
Net max	12541.3	5.3545	

The "ROI" window shows the information on the selected area and on the peak in this area. The selected ROI differs on color from other areas. The ROI is selected by moving the mouse cursor

on it. If the mouse cursor is outside of the ROIs, the ROI is selected by default. Pressing the  buttons you can choose a ROI by default. The scale displaying area borders in channels or in

energies (in keV) changes by pressing the  button.

There are two tabs on the panel. The "Area" tab displays the total area of the selected ROI, the peak area and the background area in counts and in counts per second, the total area of the spectrum in counts and in counts per second. The "Peak" tab displays calculated characteristics of the peak: the peak center, the full width of a peak on the half maximum (FWHM), MDL - the minimum detection level, the maximum and the maximum minus a background.

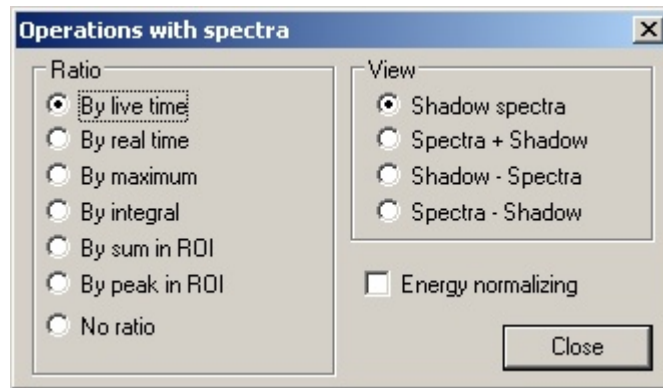
The scale displaying (FWHM) in energies (in keV), in channels or in percentage changes by pushing the  button.


The emerging help with a numerical value and errors estimation is displayed by stopping the mouse cursor on this value.

MDL it is calculated under the formula:  $3.0 * \sqrt{\text{the peak area/the background area}}$ .

## 2.10 'Operations with Spectra' window

The application allows to perform a qualitative comparison of two spectra: the main and the shadow one. Furthermore, it is possible to perform spectrum normalization, per channel spectrum addition and subtraction operations. Visualization modes are controlled through the "Operations with Spectra" window.



Clicking the  button on the [toolbar panel](#) displays the Operations on Spectra window. This window controls the mode of shadow spectrum visualization. The vertical scale of the shadow spectrum can be reduced to that of the main spectrum using normalization based on one of the following parameters:

- Live-time;
- Real time;
- Maximum (the maximum of the shadow spectrum is reduced to the maximum of the main spectrum);
- Whole spectrum integral (shadow spectrum samples sum is reduced to the sum of the main spectrum samples);
- Selected ROI integral (samples sum inside the selected ROI of the shadow spectrum is reduced to the sum of the main spectrum samples inside the same ROI);
- Selected ROI peak (peak value, found inside the selected ROI of the shadow spectrum is reduced to the analogous value for the main spectrum);
- No normalization.

The main spectrum is always visible. In addition to the main spectrum the following data can be displayed:

- Shadow spectrum;
- Per-channel sum of the main and the shadow spectra;
- Per-channel difference of the main and the shadow spectra;
- Per-channel difference of the shadow and the main spectra.

When the "Normalize energy" tag is marked, a shadow spectrum scaling on the energy axis is made for reduction to the basic spectrum power scale. When the "Normalize energy" tag is switched off, a shadow spectrum displaying on the power scale is made without a scaling, i.e. each basic spectrum channel has a shadow spectrum channel with the same number.

## 2.11 'Spectrum File Header' Window

A spectrum file contains a heading with various information on a spectrum, a test and conditions of measurement. To see and, if necessary, to change this information it is possible with the help of the "Spectrum file heading" window.



**Spectrum file header**

File name: 2704N001

Folder: E:\MyProjects\KolibriEngl\Spectra\U\_29\

Sampling date and time: 01.01.2000 1:01:01

Start acquisition date and time: 27.04.2006 15:38:02

Sampling duration: 0.0000 second

Accuracy sampling preparation: 0.0000 %

Sample mass: 1.0000 milligram

Geometrical factor: 1.0000

Sample volume: 1.0000 cubic m

Distance: 0.0000 cm


Sample area: 1.0000 square i

Concentration factor: 1.0000

Description:

☐ Open this window after start acquisition of the spectrum

Close

Clicking the  button on [the toolbar](#) will display the "Spectrum File Heading" window. Spectra processing programs can use the information from the heading for carrying out calculations. All the file heading changes will be written down in a file only when the spectrum is saved.

If the file number automatic increase mode is switched on for each new acquisition on the ["Acquisition" tab](#) of the ["Acquisition parameters"](#) window, the file number will be increased by one.

It is possible to choose the directory in which spectrums will be kept in the dropping out "Directory" list.

In order to add a directory to the list, press the  button, choose a new directory and add it to the list.

In order to remove the directory from the list, open the dropping out list, select the directory to remove and push on the keyboard button "Del".

Folder: D:\MyProject\Ver1-60\XRaySpectra\Spectr\_Elements\_2\

D:\MyProject\

D:\QC2\GRSTAR\TEPLATE\


D:\MyProject\Ver1-60\Release\Spectra\

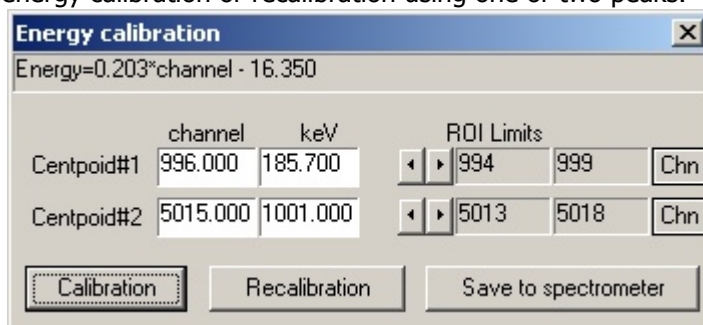
D:\MyProject\Spectra\

D:\MyProject\Ver1-60\XRaySpectra\Spectr\_Elements\_2\

If the "Open this window with the spectrum acquisition start" tag is marked, this window will open automatically with every spectrum acquisition start.

## 2.12 'Energy Calibration' Window



Clicking the  button on the [toolbar panel](#) will show the "Energy calibration" panel. The panel is used to perform energy calibration or recalibration using one or two peaks.




During calibration and recalibration energy linear dependence from channel number factors calculation is made on one or two points. If calibration or recalibration is made on one point the calibration line passes through a zero. Current calibration factors are displayed as a formula, for example: "Energy=0.203\*channel - 16.350".


The difference between calibration and recalibration is only in ROI borders position recalculation. During the calibration the ROI borders in channels do not vary, and the ROI borders in energies are recalculated. During the recalibration the ROI borders in energies do not vary, and the ROI borders in channels are recalculated.

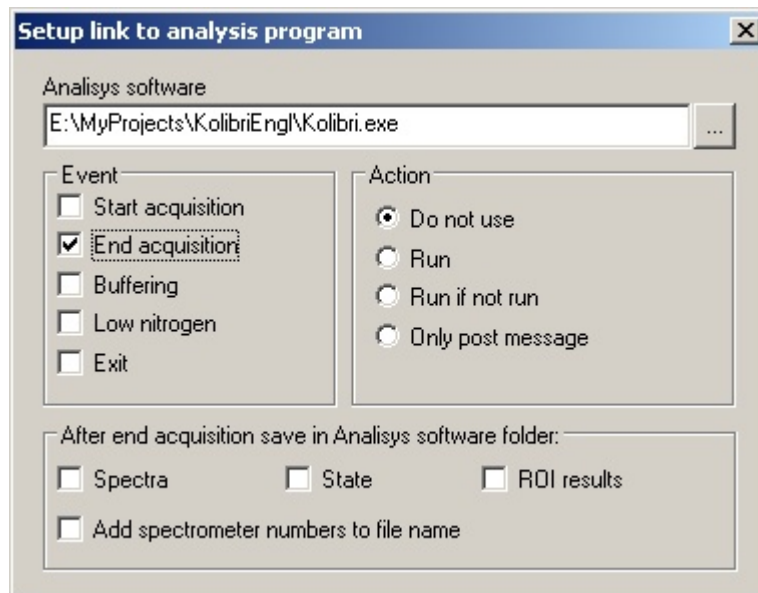
During calibration and recalibration one of the marked spectrum ROIs can be selected for each

peak with the help of the  buttons. Pressing the  button changes the ROI borders display scale (displayed in channels or energies (in keV)). If a ROI has a peak, its channel will be recorded in the "channel" field. The "energy" field displays the energy, calculated for current calibration. The channel number can be changed by hand, if needed. In order to perform the calibration, click the "Calibration" button. In order to perform the recalibration, click the "Recalibration" button. If one of the two ROIs is not selected or does not contain a peak and the channel number and energy have not been typed by hand, calibration will be performed using one peak. Calibration can be stored in the spectrometer by clicking the "Store in spectrometer" button. When a spectrometer file is saved, the current calibration is saved along with spectrometer data. When a spectrometer file is read, its calibration is also read from the file. The optimization stored in the spectrometer is used during a new spectrum acquisition. At work with two planes optimization is made on active at present planes.

If the application "Nuclioteka" is included in the software complete, the  buttons are displayed near the "energy" fields. The program "Nuclioteka" can be started by pressing these buttons. It is possible to choose the peak energy in this program. The chosen energy is recorded automatically in the "energy".

## 2.13 'Connection with Processing Application' Window

The Emulator application can control an application that processes measuring results. When you click the  button on the [toolbar](#), it opens the "Connection with processing application" window.




The processing application is notified of the following events:

- Spectrum acquisition start;
- Spectrum acquisition end;
- Buffering;
- Lack of nitrogen;
- Application exit;

When one of the listed events happens, the Emulator application can do one of the following:

- Do not use - no actions are taken;
- Launch - the processing application is launched;
- Launch, if not running, and send a message - the processing application is launched, if it was not running already, and a message is sent to all top level system windows including hidden and disabled ones;
- Just send a message - a message is sent to all top level system windows including hidden and disabled ones;


The application defined in the "processing application" field is launched. The processing

application can be changed by manually typing its path or by clicking the  button. Clicking this button will open the standard file open dialog.


A registered message ("msgESBSStateChange") is sent to all the top-level windows of the system. Please note that if the processing application is not running, it will fail to receive the message after its launch.

Before the processing application is notified, the current spectrum is saved to the file "tmp.sps" (if there are several spectrometers in the system the name of the file changes as follows: "XXtmp.sps", where XX is the spectrometer number). The file is saved in the processing

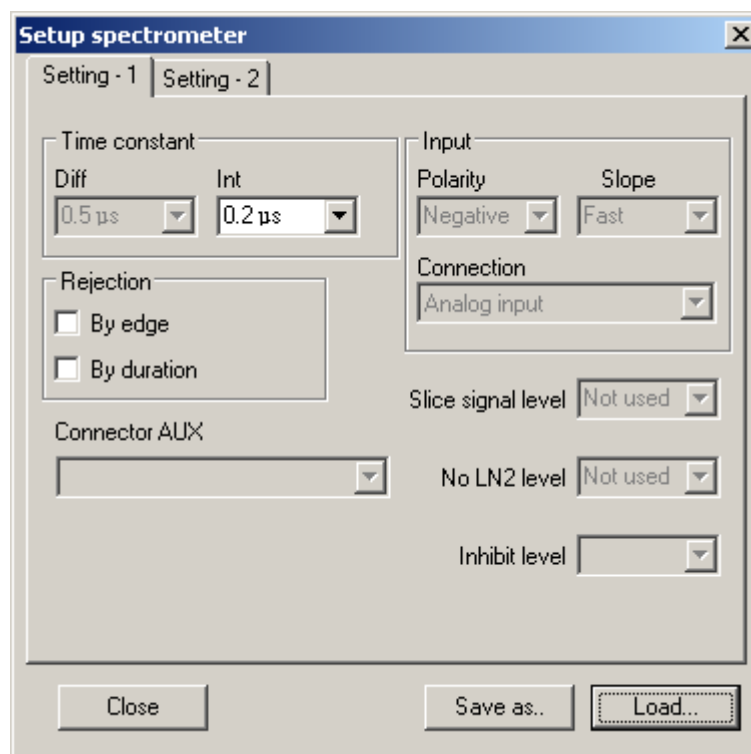
application folder. The format of the spectrum file is described in the [Appendix A](#).

The processing application can be launched by the user clicking the  button on the [toolbar panel](#).

## 2.14 Setup spectrometer window

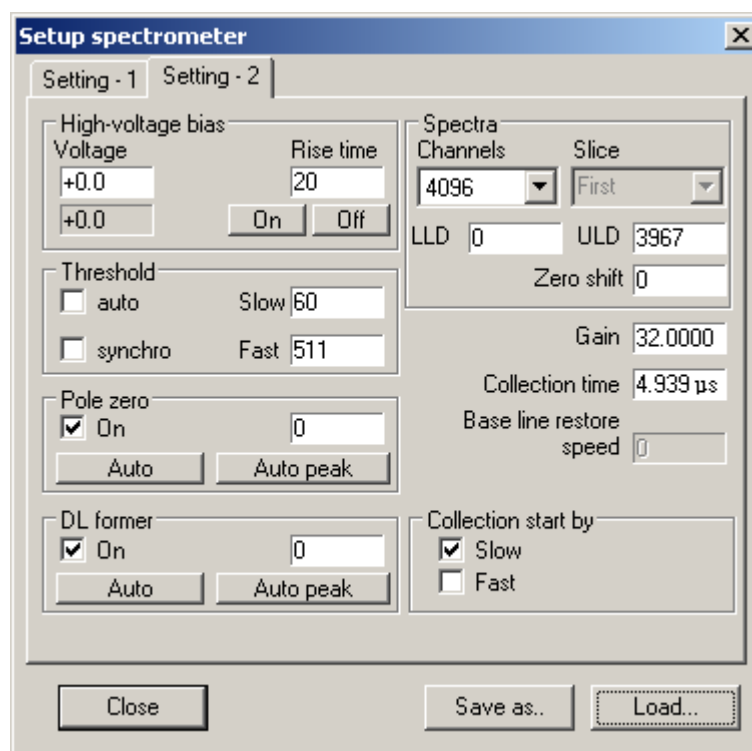
After clicking the  button on the [toolbar](#), Setup spectrometer window (dialog box) is displayed. This window consists of two tabs: [Setting - 1](#) and [Setting - 2](#). It allows to set up the analyzer and to monitor the analyzer parameters. 'Save' and 'Load' buttons allow to save the current settings in a file and load previously saved ones. Some analyzers have nonmeasurable fields. In other words, these functions are inaccessible for such analyzers.

### 2.14.1 'Setting-1' tab



"Setting-1" tab allows to set the former time constants, activate input rejection modes, datum reset rate, select the input signal polarity and its form, parameters of planes separation signals, nitrogen deficiency, registration prohibition, AUX connector function. Some analyzers have non-measurable fields. Non-measurable fields are colored in gray. In other words, these functions are inaccessible for such analyzers or are not program-controlled.

## 2.14.2 'Setting-2' tab

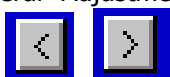


"Setting-2" tab allows to set the required high voltage of detector bias, voltage rise time, to monitor the current voltage. Turn high voltage on/off with appropriate buttons. Adjust registration thresholds manually or automatically. Set gather time in microseconds. Set the rough or fine gain. Select the number of spectrum channels. Set the upper level discriminator (ULD) and the lower level discriminator (LLD) in the channels. Select an operating mode with planes. The following modes are possible: the bottom - accumulation of a spectrum only from the bottom plane; the top - accumulation of a spectrum only from the top plane; both is simultaneous accumulation of spectra on each plane. Select the mode of converter start. Set the pole-zero compensator value at conventional units. Turn the pole-zero compensator on and off. Start hardware automatic adjustment of the pole-zero compensator - the "Auto" button or the pole-zero compensator adjustment by peak width - the "Auto peak" button. Set the DL-former value at conventional units. Turn the DL-former on/off. Start hardware automatic adjustment of the DL-former - the "Auto" button or the DL-former adjustment by peak width - the "Auto peak" button.

In order to change parameters, put the mouse cursor on a parameter value and click the left mouse button. After that the dialog box with the desired parameter sliders will appear.



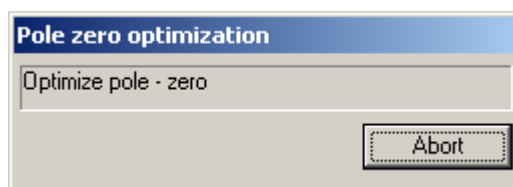
Several "Adjustments" dialog boxes can be displayed simultaneously. To change parameters click



the buttons, or move the slider. Continuous clicking results in an automatic change of parameter. The "Adjustments" dialog boxes can be moved to any part of screen. After the "Setup Spectrometer" panel closing the "Adjustments" dialog boxes stay on the screen.

Some analyzers have non-measurable fields. The non-measurable fields are colored in gray. In other words, these functions are inaccessible for such analyzers or are not program-controlled. For some analyzers "Coarse gain" is set by jumpers on the card. Here the slider "Coarse gain" in the program shall be moved to the appropriate value chosen by the jumpers. Otherwise gain value will be displayed incorrectly.

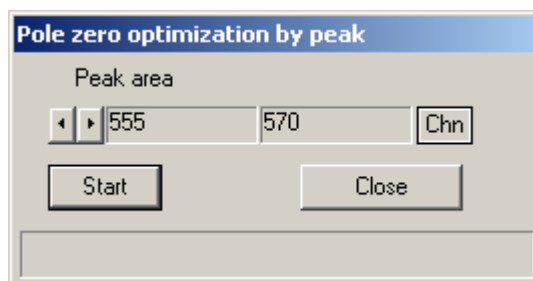
## 2.15 Pole-zero Auto Calibration



After clicking "Auto" in the ["Setting-2" tab](#) of the "Setup spectrometer" dialog box or selecting the "Spectrum/Pole-zero Auto calibration" item in the menu, the hardware pole-zero compensator auto adjustment is activated. During the adjustment the indicator state is displayed. After finding the optimal value, the auto calibration is completed, the dialog box "Pole-zero auto optimization" is closed automatically and appropriate message is displayed on the screen. The auto calibration can be aborted by clicking the "Abort" button. After the abort the optimal value of pole-zero (at the moment of the "Abort" button clicking) is set.

Light count rate of the spectrometer (dead time is no more than 10 percent) is recommended during the auto calibration of the pole-zero compensator. Duration of the auto optimization depends on input count rate and normally the duration is a few minutes.

## 2.16 Pole-zero Auto Calibration by Peak



After clicking the "Auto by peak" button in the ["Setting-2" tab](#) of the "Setup spectrometer" panel or selecting the "Spectrum/Pole-zero auto calibration by peak" item in the menu, the "Pole-zero auto calibration by peak" dialog box is displayed.

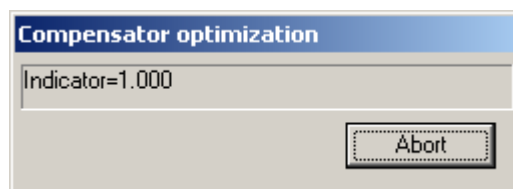
The peak (with respect to which the auto calibration will be performed) area shall be selected prior to auto calibration, then click the "Start" button.

During the auto calibration the optimal at the current moment value of the pole-zero compensator is displayed. After finding the optimal value, the auto calibration is completed, the dialog box "Pole-zero auto calibration by peak" is closed automatically and appropriate message is displayed on the screen. The auto calibration can be stopped by clicking the "Close" button. After the close the optimal value of pole-zero (at the moment of the 'Close' button clicking) is set.

The pole-zero auto calibration by peak is recommended to perform after the [pole-zero auto calibration](#). Count rate shall be about maximum (dead time shall be no less than 60 percent).

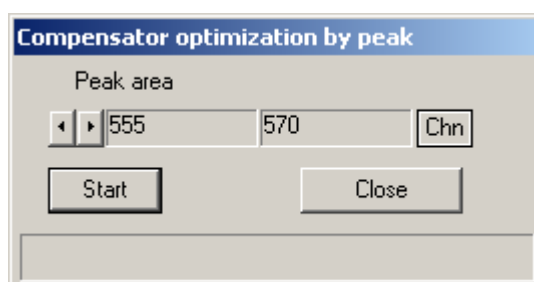
Neighboring peaks shall not influence the form of peak which is datum for the auto calibration. Duration of the auto calibration depends on the peak intensity and on the closeness of the current value of the pole-zero compensator to the optimal one. At strength of 100 cps in the peak maximum, duration shall be no more than seven minutes providing that the initial value of pole-zero is about the optimal one.

## 2.17 Compensator Auto Calibration



After clicking the "Auto" button in the ["Setting-2"](#) tab of the "Setup spectrometer" dialog box, the hardware auto calibration of the former is activated. During the auto calibration the indicator state is displayed. After finding the optimal value, the auto calibration is completed, the dialog box "Compensator auto calibration" is closed automatically and the appropriate message is displayed. The auto calibration can be aborted by clicking the "Abort" button. After the abort the optimal value of the former (at the moment of the "Abort" button clicking) is set. The auto calibration of compensator is recommended to perform after the pole-zero auto calibration by peak. Light count rate of the spectrometer (dead time shall be no more than 10 percent) is recommended during the auto calibration of compensator. Duration of the auto calibration process depends on the input count rate and normally the duration is a few minutes.

## 2.18 Compensator Auto Calibration by Peak



After clicking the "Auto by peak" button in the ["Setting-2"](#) tab of the "Setup spectrometer" panel, the "Compensator auto calibration by peak" dialog box is displayed. The peak (with respect to which the auto calibration will be performed) area shall be selected prior to auto calibration, then click the "Start" button.


During the auto calibration the optimal at that moment value of the former is displayed. After finding the optimal value, the auto calibration is completed, the dialog box "Compensator auto calibration by peak" is closed automatically and appropriate message is displayed on the screen. The auto calibration can be stopped by clicking the "Close" button. After the stop, the optimal value of the former (at the moment of the "Close" button clicking) is set.

The compensator auto calibration by peak is recommended to perform after the [compensator auto calibration](#). Count rate shall be about maximum (dead time shall be no less than 60 percent). Neighboring peaks shall not influence the form of peak which is datum for the auto optimization. Duration of the auto calibration depends on the peak strength and on the closeness of the current

value of the pole-zero compensator with the optimal one. At the strength of 100 cps in peak maximum, duration shall be no more than seven minutes providing that the initial value of the pole-zero was about the optimal one.

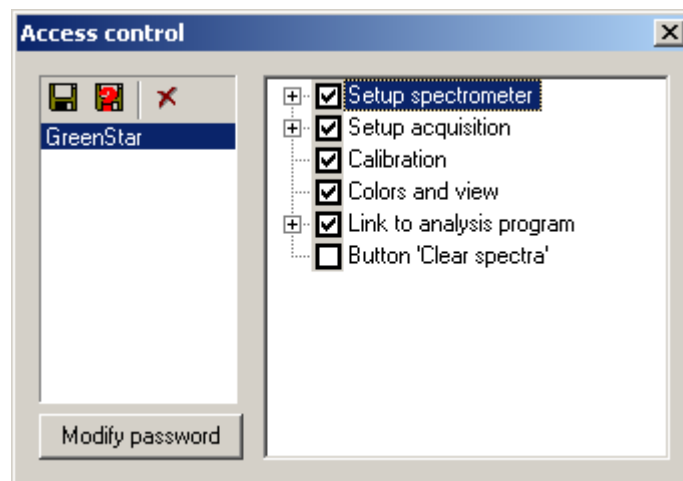
## 2.19 'Access control' Window

The application allows to hide a part of management elements. To hide or show separate

management elements, press the  button of the [toolbar panel](#). The application will demand to enter the access password.



If the password is entered correctly, the "Access control" window will open.




In the left part of the window the [profile management](#) element is located, it allows to choose, save or remove access profiles.

In the right part of the window the multilevel tags list is located. Cancelled elements of the list are displayed during the work with the application.

It is possible to change the password of access by pressing the "Modify password" button in this window. On default, the password does not contain any symbols; just press the "OK" button in the "Enter password" dialogue.

## 2.20 'Spectrum Acquisition Parameters' Window

Pressing the  button of the [toolbar panel](#) displays the "Spectrum acquisition parameters" window. In the left part of a window the [profile management](#) element is located; it allows to choose, saving or removing spectrum acquisition parameters profiles. The same structure can be



chosen for several spectrometers. If the structure is used for several spectrometers, any changes in acquisition parameters will influence all the spectrometers using this structure. In the top part of the window the message on the spectrometers using the chosen structure is shown.

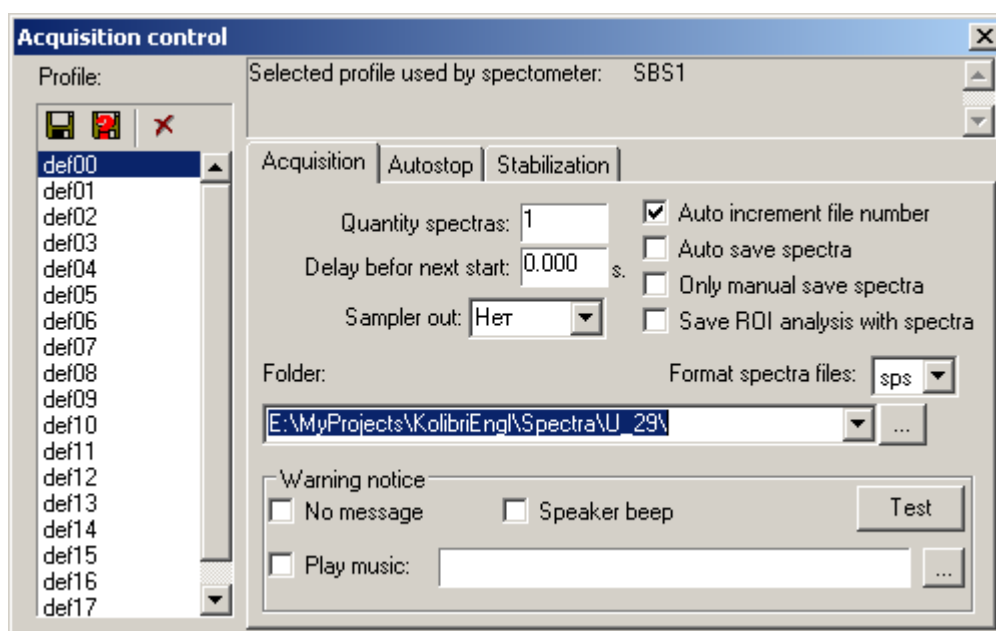
In the right part of the window the following tabs are located:

- ['Acquisition'](#);
- ['Start delay'](#);
- ['Auto stop'](#);
- ['Stabilization'](#).

According to the [access adjustments](#) condition some tabs will not be displayed.


### 2.20.1 'Acquisition' Tab

The "Acquisition" tab allows to set the typed spectrums quantity by pressing the "Start" button, to set up signal parameters for the tests submission device, to choose the directory, in which files will be kept, choose file saving mode, adjust the message on the acquisition end.



File saving modes:

- Increase the file number - at the beginning of spectrum acquisition the file number is increased by one;
- Save the spectrum automatically - after the acquisition end the spectrum is written on a disk automatically, in the "sps" or "spe" format;
- Save only by hand - a spectrum it is not saved automatically and at the following acquisition beginning the suggestion on saving the spectrum does not appear;
- Save ROI results with the spectrum saving - with the spectrum saving the results of peaks and areas calculations in all ROIs are saved in a text file with the same name as the spectrum, but in the ".txt" format".

In the dropping out "Save in the directory" list, it is possible to choose the directory, in which spectra will be saved. To add the directory in the list push the  button, select a new directory and add it to the list.

To remove the directory from the list, open the dropping out list, select the directory which needs removing and push the "Del" button on the keyboard.


You can select the sound signal type at the spectrum acquisition end and listen to the chosen sound signal with the help of the "Test" button.

### 2.20.2 'Start Delay' Tab

Sometimes it is necessary to delay the spectrum acquisition start. The program allows to install various conditions of the spectrum acquisition start delay. The following variants of the spectrum acquisition start delay conditions are possible:

- "Manually" - spectrum acquisition starts after the command without any delay;
- "Real time" - spectrum acquisition starts after the set time;
- "Maximum" - spectrum acquisition starts after achievement of the set counts quantity in the channel with the maximum quantity of counts;
- "Maximum in ROI" - spectrum acquisition starts after achievement of the set counts quantity in the channel with the maximum quantity of counts, located inside borders of one or several

ROIs. It is possible to select the ROI noted in the spectrum by pressing the  buttons, ROI

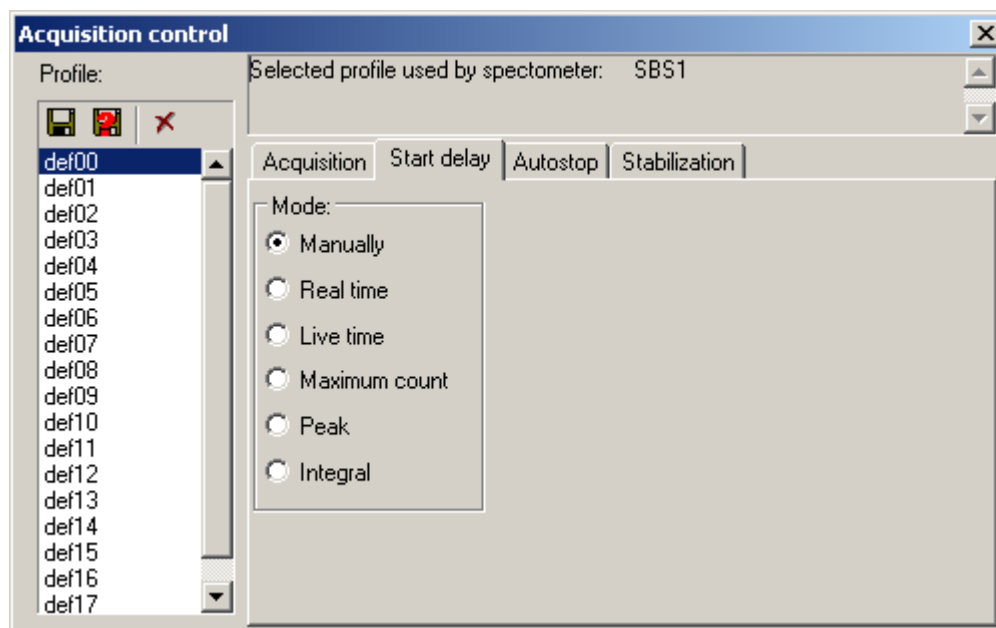
borders can be entered manually. Pressing the  button changes the scale which displays ROI borders in channels or in energies (in keV). During the defining of the spectrum acquisition start condition, only ROIs marked by a tag are considered;

- "Integral in ROI" - similarly to the previously mentioned, but comparison is made with the sum of the counts in channels inside of ROIs borders.

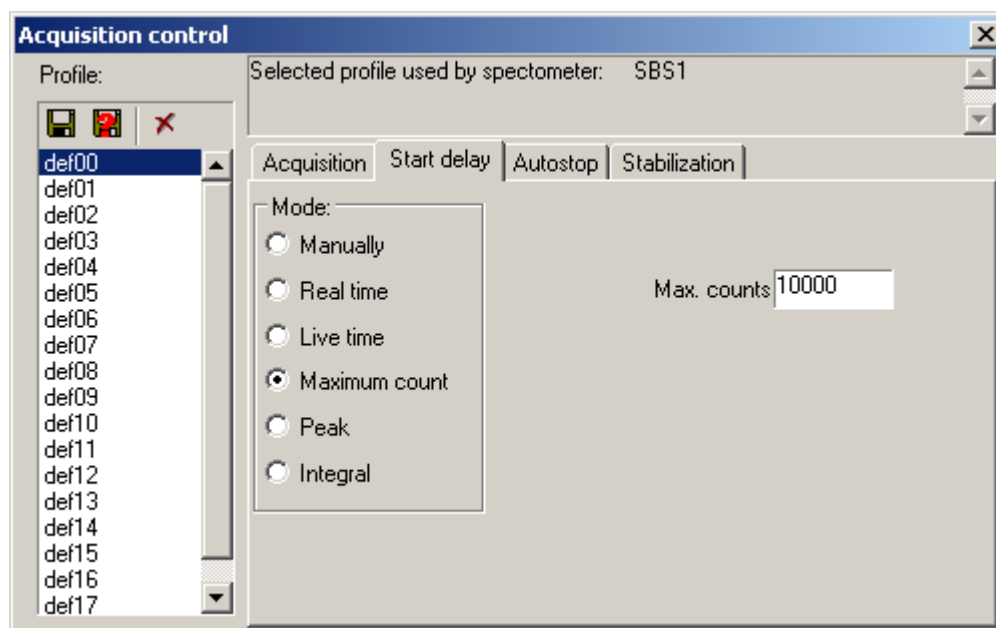
It is possible to start the spectrum acquisition after achievement of the start condition in one or in all of the set ROIs during selection between the following variants: "Maximum in ROI" and "Integral in ROI".

The "Use time intervals" and "Stop on excess" tags work during selection among the following variants: "Maximum", "Maximum in ROI", "Integral in ROI".

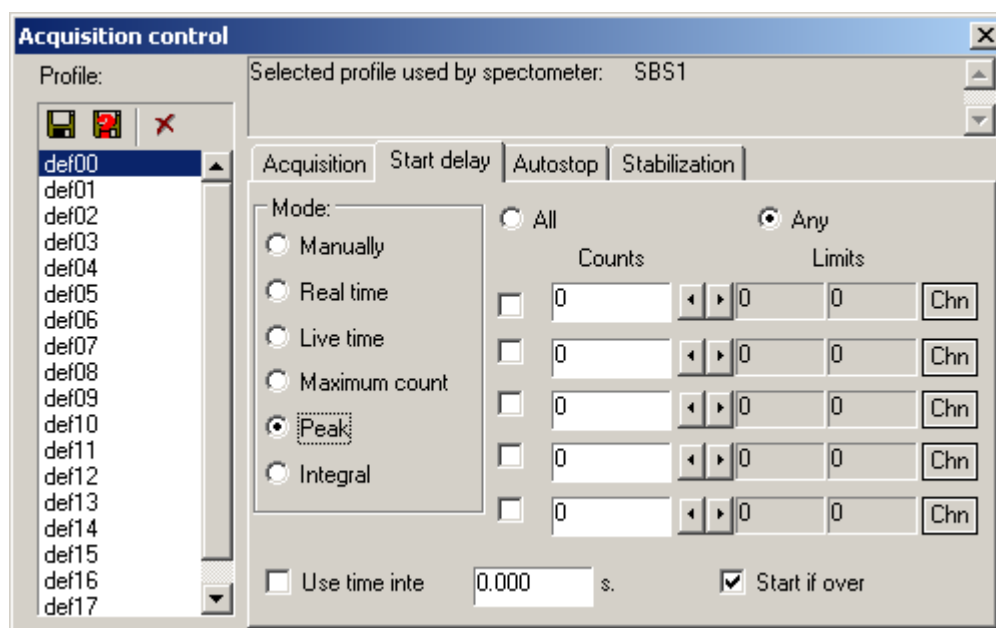
The spectrometer begins spectrum accumulation in internal, not displayed on the screen buffer during selection among the following variants: "Maximum", "Maximum in ROI", "Integral in ROI". Calculations of the delay end conditions are made on this spectrum. During the performance of the selected condition, the buffer is nulled and the spectrum acquisition with displaying on the screen starts.



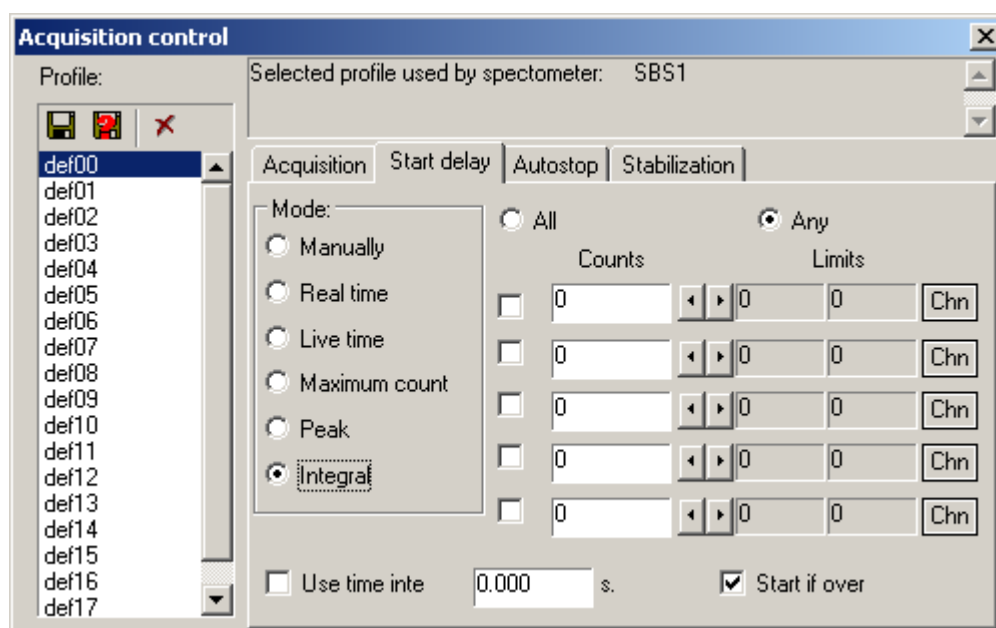
Start delay in real time



Start delay on the maximum



Start delay on the maximum in ROI





Start delay on the integral in ROI

### 2.20.3 'Auto Stop' Tab

The program allows to install various conditions of the spectrum acquisition automatic stop. The following variants of the spectrum acquisition automatic stop conditions are possible:

- "Manually" - spectrum acquisition stops only after the command;
- "Real time" - spectrum acquisition stops after the set time;
- "Live time" - spectrum acquisition stops after the set time on the live time counter;
- "Maximum" - spectrum acquisition stops after achievement of the set counts quantity in the channel with the maximum quantity of counts;
- "Maximum in ROI" - spectrum acquisition stops after achievement of the set counts quantity in the channel with the maximum quantity of counts, located inside borders of one or several

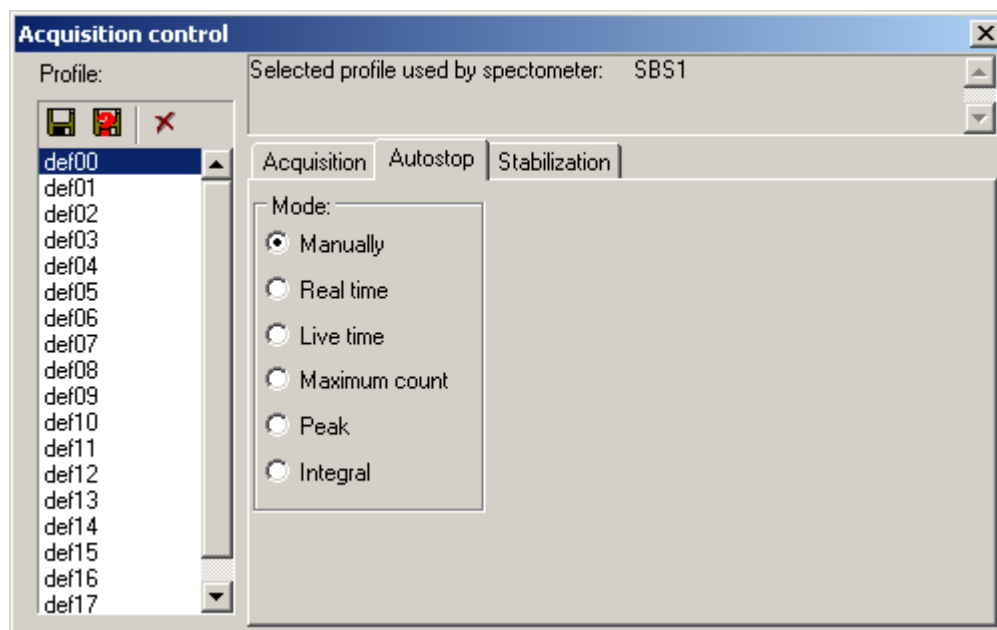
ROIs. It is possible to select the ROI noted in the spectrum by pressing the  buttons, ROI

borders can be entered manually. Pressing the  button changes the scale which displays ROI borders in channels or in energies (in keV). During the defining of the spectrum acquisition start condition, only ROIs marked by a tag are considered;

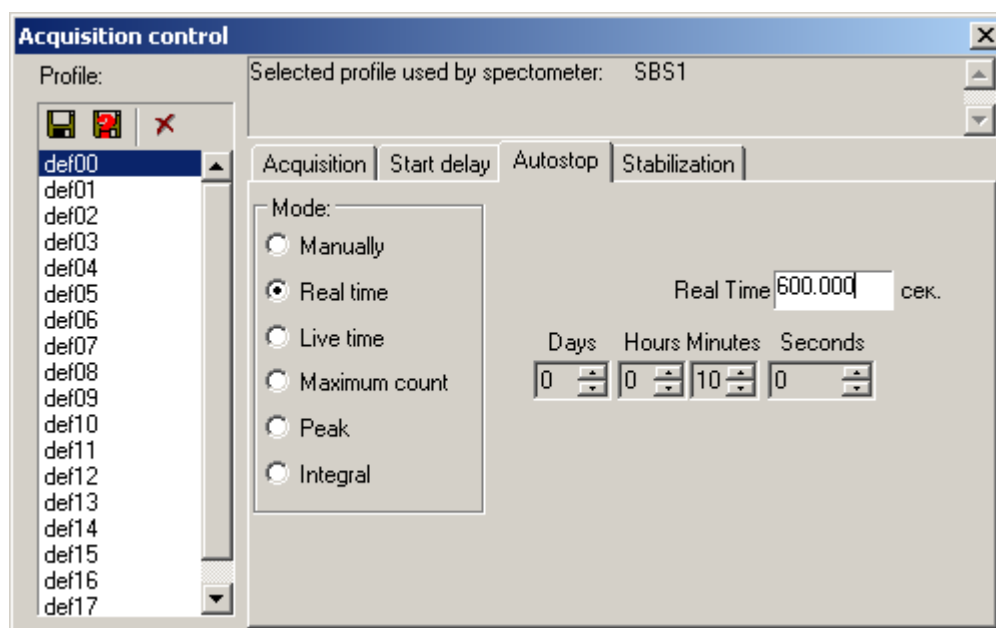
- "Integral in ROI" - similarly to the previously mentioned, but comparison is made with the sum of the counts in channels inside of ROIs borders.

It is possible to stop the spectrum acquisition after achievement of the start condition in one or in all of the set ROIs during selection between the following variants: "Maximum in ROI" and "Integral in ROI".

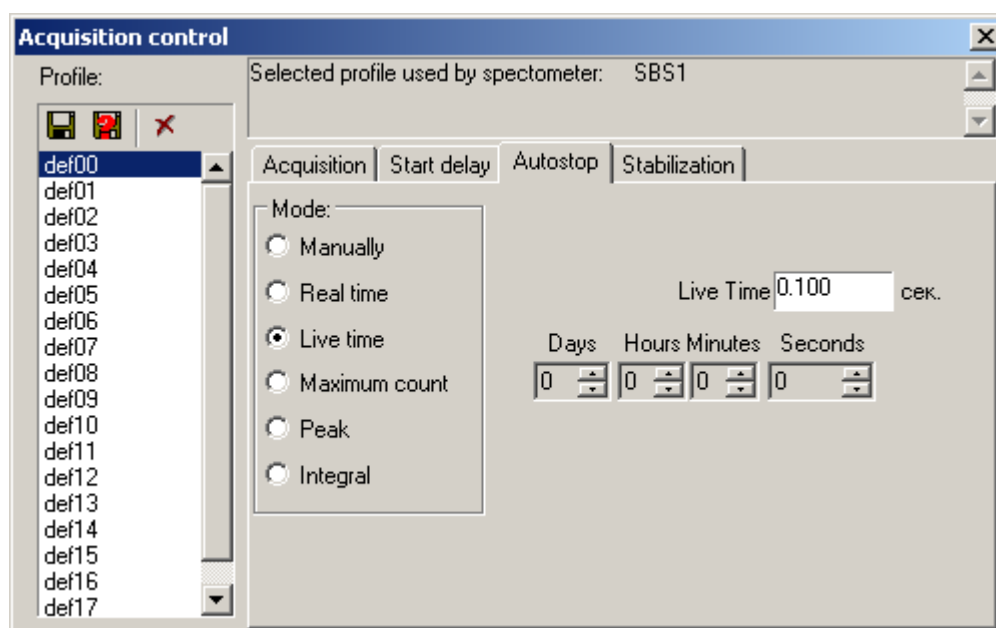
The "Use time intervals" and "Stop on excess" tags work during selection among the following variants: "Maximum", "Maximum in ROI", "Integral in ROI".



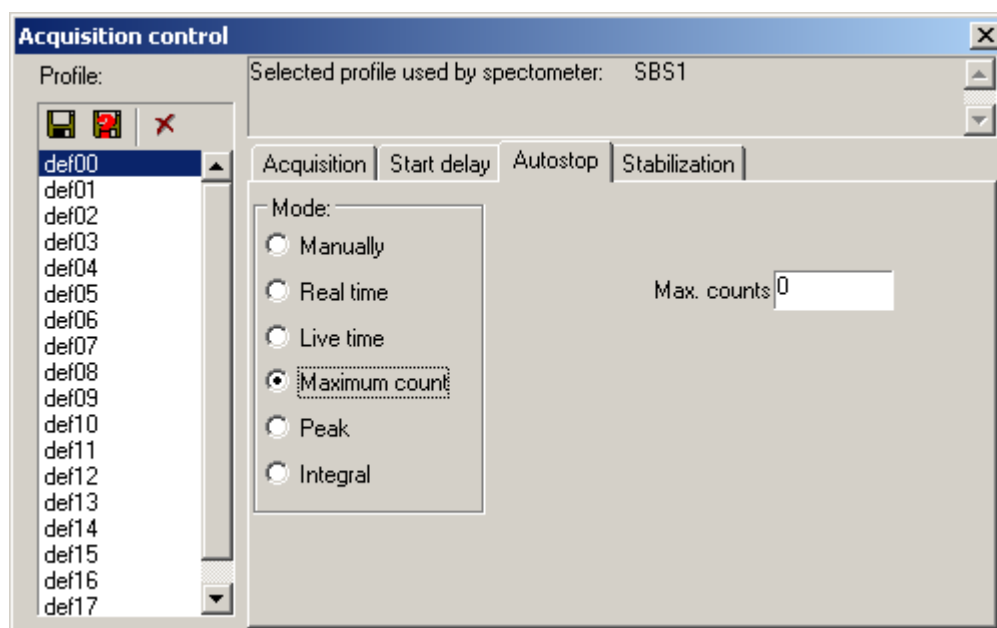
Stop only after the command



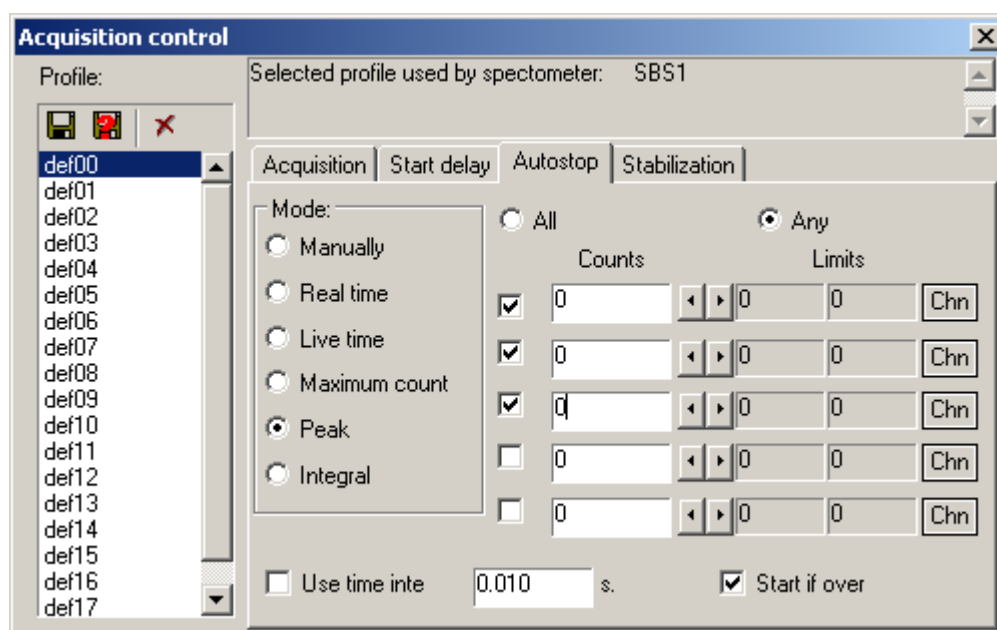
Automatic stop on real time



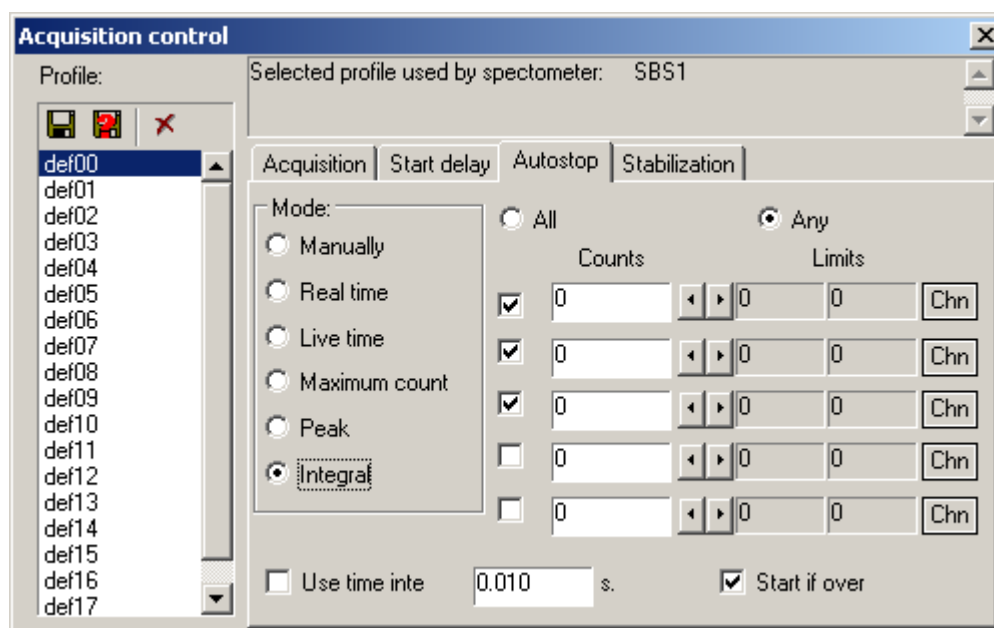
Automatic stop on live time



Automatic stop after the achievement of the maximum



Automatic stop after the achievement of the maximum in ROI

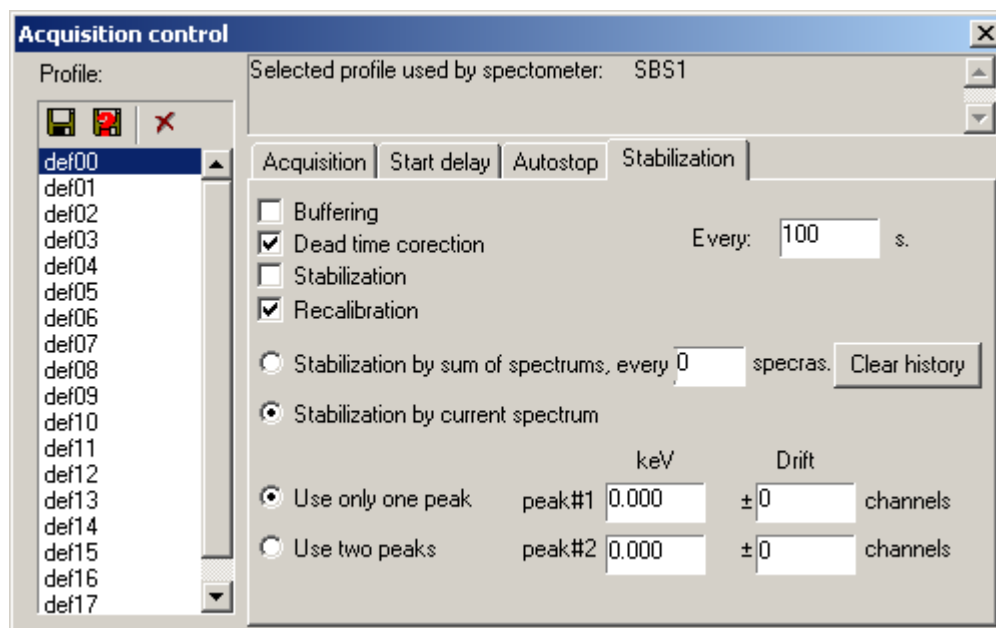


Automatic stop after the achievement of the integral in ROI

#### 2.20.4 'Stabilization' Tab

An essential slow drift of the peak position is observed on some detectors. The program allows to partial compensate of slow drift. In order to do it, select one of stabilization modes. Two stabilization modes are accessible: "Spectrum stabilization" and "Sub optimization". No matter which stabilization mode is selected, the application tries to keep power position of one or two peaks centers. If the "Spectrum stabilization" mode is selected the spectrum digital correction is made, and if the "Sub optimization" mode is selected, the power scale correction is made. In order to work with stabilization algorithms correctly, it is necessary to have a quite big statistics.





Stabilization can be made on a current spectrum acquisition through the set time intervals or on the sum of the collected spectrums set quantity. If a spectrum acquisition is long, it is better to apply stabilization to a current acquisition. If cyclic measurements with small statistics are made, it is better to apply stabilization to the collected spectrums sum.

It is recommended not to switch on the stabilization modes if the statistics is insufficient.

Stabilization can be made on one or two peaks. An admissible drift zone in channels is set for each peak. If the peak is not revealed in the drift zone, stabilization is not made. During the work with two planes, stabilization is possible only for a spectrum from the first plane.

The "Buffering" mode. Buffering is understood as an automatic spectrum file saving after the set time interval.

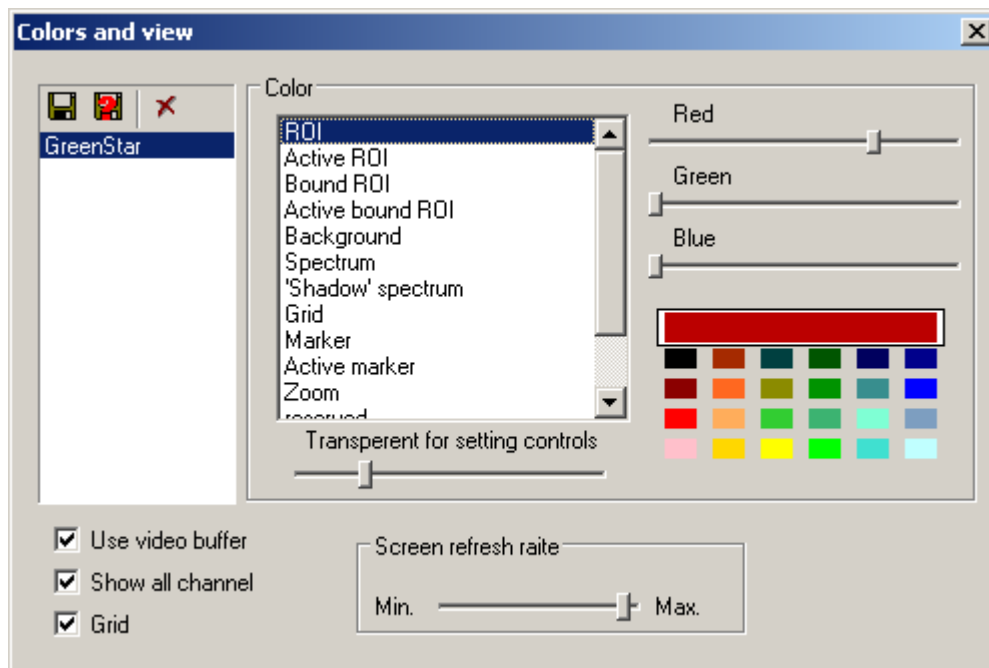
The "Dead time correction" mode. When the "Dead time correction" mode is switched on, the spectrum correction on dead time during an acquisition is made in the set time intervals.

## 2.21 'Colors and view' Window

The "Colors and view" window allows to change the application colour palette and the image quality adjustment.

The image element which colour needs changing is selected on left part of the window. "Red", "Blue", "Green" sliders are used to change the intensity of the selected element colour. In addition to that, the color can be chosen from the color palette and using double mouse clicking on big rectangular with the help of the color choice standard dialogue of operational system Windows. If the "Use buffer" tag is marked, the image quality will be higher, but the CPU time costs will increase.

The "Show all points" tag marking influences the spectrum plotting without filling. When the "Show all points" mode is off, the channel with maximum strength will be displayed as a point if horizontal coordinates coincide due to scaling. When the "Show all points" mode is on, all channels are displayed as piled points, if horizontal coordinates coincide due to scaling. When the "Show all points" tag is marked, the CPU time costs increases.



Marking the "Net" tag allows to switch on a coordination net on the spectrum schedule. When the "Net" tag is marked, the CPU time costs increases.

The "Screen refresh rate" slider allows to change spectrum refresh rate on the screen at acquisition. The higher spectrum refresh rate is, the more the CPU time costs are.

In order to select the spectrometer parameters adjustment windows on a transparency level, you can use the horizontal "Regulator transparency" regulator. Display modes with maximum processor load of 80 percent at spectrum acquisition are recommended. The processor load can be displayed by means of the "System monitor" application. The "System monitor" application is included in the Windows operational system. To run the "System monitor" application, click the "Start" button and select the "Programs\Accessories\System Tools\System Monitor" item.

## 2.22 Saving and loading spectrum files

The application supports two spectrum files formats.

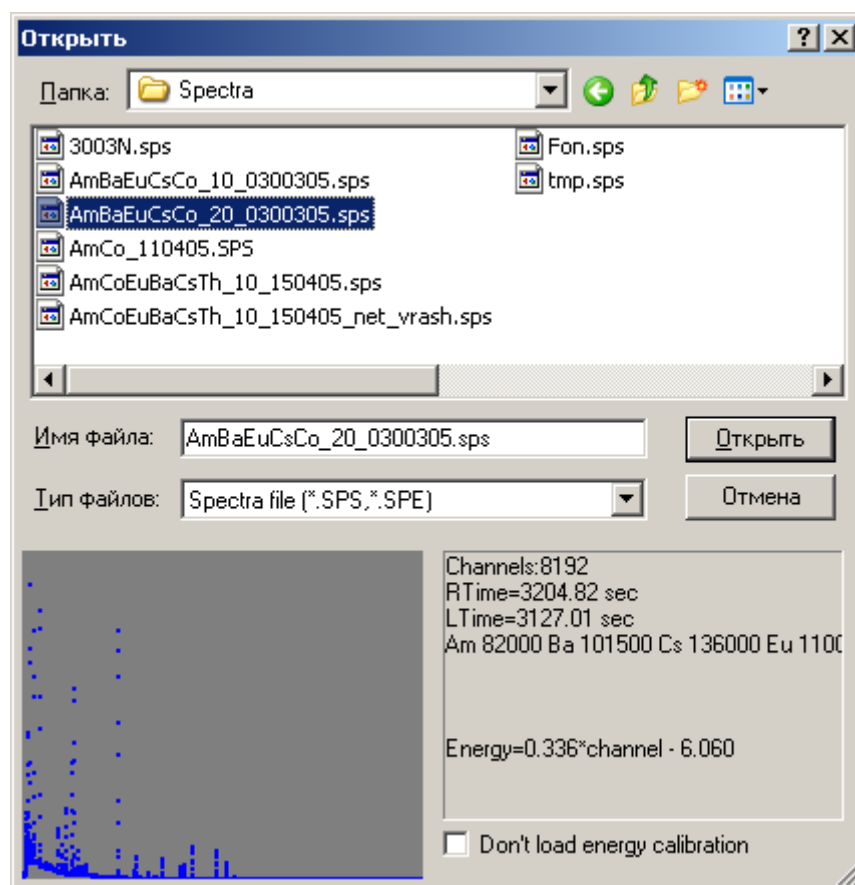
The binary spectrum file format "sps" is described in the [appendix 1](#).

The text spectrum file format "spe" is described in the [appendix 2](#).

During recording and reading spectra files the spectrum format is defined by the file extension format.

For file record a standard file saving dialogue is used.

A file reading dialogue allows to see a kind of the spectrum being loaded and a part of information from the file heading.



If during the file opening the "Don't load energy calibration" tag is marked, calibration factors from the spectrum file will be ignored, and current calibrations factors will be used.

## 3 Appendixes

In appendices admissible spectrum file formats are described

### 3.1 Appendix A

#### "SPS" SPECTRUM FILE FORMAT

The binary "SPS" spectrum file format consists of heading, which size is 1024 byte (table 1), and the following channels.

Table 1 – "SPS" spectrum file heading

Address	Size	Data
0	2	Number of channels in spectrum (INT2)
2	65	1st line of sample description (STRPAS)
67	65	2nd line of sample description (STRPAS)
132	65	3rd line of sample description (STRPAS)

197	65	4th line of sample description (STRPAS)
262	12	Sample date: year, month, day, hour, minute, second (INT2)
274	12	Sample start date: year, month, day, hour, minute, second (INT2)
286	4	Sample weight (FLOAT4)
290	4	Sample volume (FLOAT4)
294	4	Sample square (FLOAT4)
298	1	Weight unit code (INT1): "0" is micrograms, "1" is milligrams, "2" is grams, "3" is kilograms
299	1	Volume unit code (INT1): "1" is mm <sup>3</sup> , "2" is cm <sup>3</sup> , "3" is decimeter <sup>3</sup> , "4" is m <sup>3</sup>
300	1	Square unit code (INT1): "1" is mm <sup>2</sup> , "2" is cm <sup>2</sup> , "3" is decimeter <sup>2</sup> , "4" is m <sup>2</sup>
301	4	Live time in seconds (INT4)
305	4	Real time in seconds (INT4)
309	4	Live time in system timer tick (INT4)
313	4	Real time in system timer tick sounds (INT4)
317	4	Geometrical factor (FLOAT4)
321	4	Concentration factor (FLOAT4)
325	4	Test duration (FLOAT4)
329	1	Test duration unit (INT1)
330	4	Error of test preparation in % (FLOAT4)
334	4	Corrected time in seconds (INT4)
338	4	Number of IBM PC timer tick (INT4)
342	4	Distance between test and detector edge in centimeters (FLOAT4)
346	2	Target number (INT2)
348	4	Tube voltage in kV (FLOAT4)
352	4	Tube current in mA (FLOAT4)
356	4	Multiplicative factor of linear energy optimization (FLOAT4)
360	4	Additive factor of linear energy optimization (FLOAT4)
364	22	Reserved
386	1	Detector type code (INT1): "1" is semi-conducting, "2" is scintillation
387	1	Radiation type code (INT1): "1" is alpha, "2" is beta, "3" is gamma, "4" is X-ray
388	51	Detector description line (STRPAS)
439	1	Quantity of planes (INT1): "0" and "1" are one plane

440	4	Multiplicative factor of linear energy calibration for the second plane (FLOAT4)
444	4	Additive factor of linear energy calibration for the second plane (FLOAT4)
448	8	Live time in seconds (FLOAT8)
456	8	Real time, an error no more than 000.1 second (FLOAT8)
464		Reserved

Further, since the 1024 address, data of channels follow in the size of four bytes (INT4) per channel in the SPS spectrum file.

Format symbols:

STRPAS is a Pascal type line: the first byte is number of symbols in a line, and then symbols of line themselves;

INT1 is a single-byte integer;

INT2 is a double-byte integer;

INT4 is a four-byte integer;

FLOAT4 is a four-byte real;

FLOAT8 is an eight-byte real.

## 3.2 Appendix B

### "SPE" FILE SPECTRUM FORMAT

The "SPE" text file spectrum format contains several fields before and after the data on channels. Each field begins with the "\$" symbol in the first column. The data on channels is one channel in a line.

Field	Comment
\$SPEC_ID:	One line of the spectrum description
\$SPEC_REM:	Any quantity of the spectrum commentary lines
\$DATE_MEA:	Date and time of carrying out measurements in the "mm/dd/yyyy hh:mm:ss" format
\$MEAS_TIM:	Live time and real time of the spectrum acquisition in whole seconds, divided by blank
\$DATA:	The first line contains the first channel number and quantity of channels, they divided by a blank. Next lines contain data on channels, one channel in a line
\$ROI:	The first line contains quantity of ROI channels interests, divided by a blank. Next lines contain numbers of channels, ROI start and end, one ROI in a line.
\$ENER_FIT:	Linear power calibration contains two valid numbers, additive and multiplicative factors, divided by a blank.