System theremino
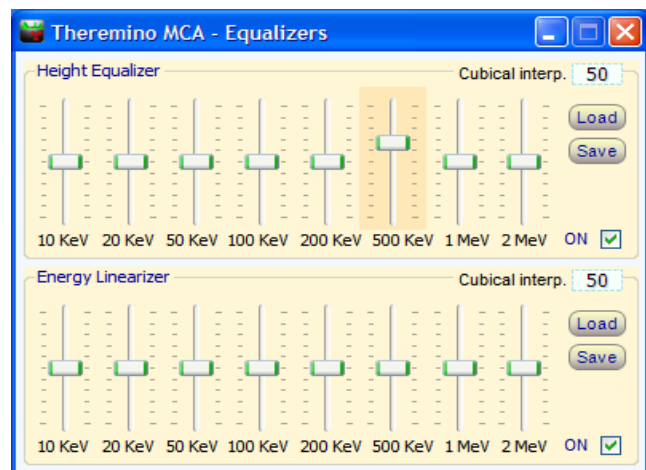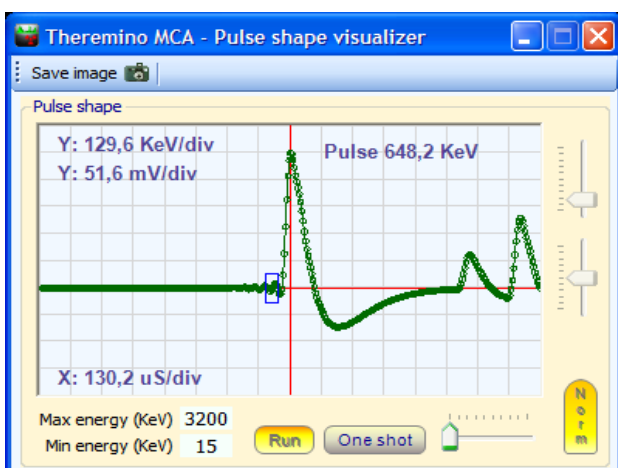
Theremino MCA - V4 Instructions

Theremino MCA

Theremino MCA 4.0 that reads a sample of Cs-137 (TG-77 SPARK GAP about 25 euro) with a BGO scintillator crystal 30x12x6 mm (about 20 euro), A Hamamatsu R6095 photomultiplier tube (about 50 euro), a Theremino_PmtAdapter (about 15 euro) and a 192 KHz, Kunig external sound card (about 4 euro)

The "Pulse visualizer" and the Equalizers

Start without reading the manual
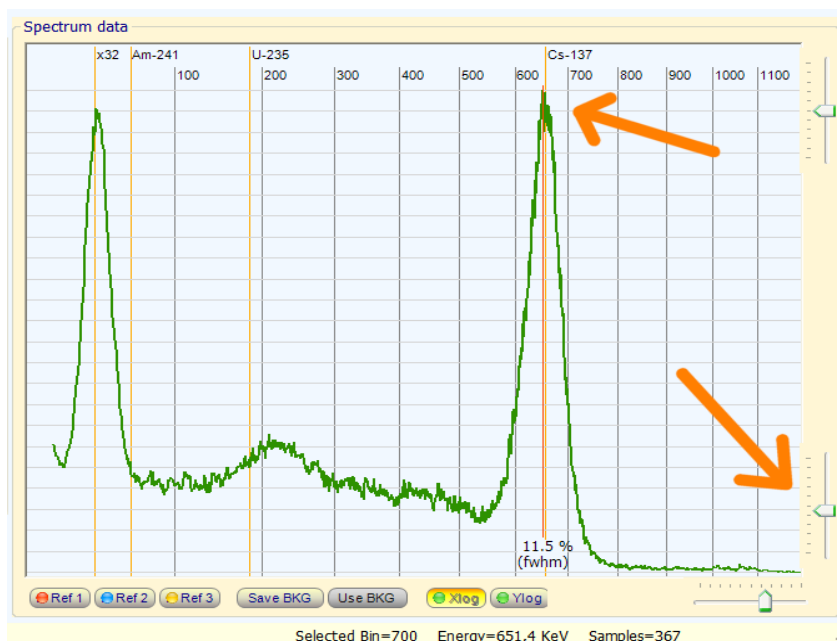

1) Begin with the parameters of these images.

Adjust the audio signal (note 1) so that the VuMeter specifying at least 30% and not more than 95% and that the program tell "Signal OK"

(Note 1) To adjust the sound level you have to act on the "record" Windows mixer. In Windows there are two mixers and you can switch from one to another with the "Options" / "Properties" / "Mixer device" If you use additional sound cards the mixers become four or more. If the signal is low raise AudioGain.

2) Adjust the slider in the lower right so that the peak of cesium (about 660 KeV) ends at the right place.

To facilitate this step set the "Time integ." to 10 seconds - **Then remember to bring it back to 9999** - otherwise it will be possible to make precise measurements.

3) Click with the right button mouse on the line of cesium to see the value FWHM, or click with the left mouse button in any position to see the data in the status bar at the bottom.

4) IMPORTANT - Before connecting the sound card to the USB, the PmtAdapter must be connected well. Double check that the jacks are way down. If the jacks are not well placed can make a **short circuit on the power**. Read all warnings in the file "PmtAdapters"

Ground Rules for the measures

Theremino MCA uses a method of "progressive integration" which allows accurate and reliable measures.
In return, you must follow the directions on this page.
If you do not "comply with the terms" measured values will be inaccurate or even completely wrong.

Measures with Theremino MCA (and Theremino Geiger) must be made according to following guidelines.

Laboratory Measurements

1) Set the maximum time of integration, ie 9999 seconds **(Note 1)**

2) Place the sample to be measured stably

3) Press "Start new measure"

4) **Do not change the conditions during the measurement (note 2)**
 - Do not move the sample or the probe
 - If that happens, press another time "Start", otherwise the measurement will be incorrect.

5) Wait, without changing the measurement conditions, all the time necessary to make the graph delineate clearly (the time required, depending on the number of pulses per second and the accuracy desired, could also be very long)

Continuous measurements for environmental monitoring or rapid test (Note 3)

1) Set an integration time appropriate to the type of measurement you want to make (see table)

2) Keep in mind that after each change of measuring conditions can be expected this time

3) Read the values, or send them repeatedly to other applications to make logs or alarms

(Note 1) In ThereminoMCA with 9999 seconds you get a "infinite" functioning. That counts are accumulated and continue to increase forever, even after three hours. Instead with ThereminoGeiger 9999 seconds are about three hours of integration time (moving average)

(Note 2) Theremino MCA and ThereminoGeiger use "progressive integration" methods, which immediately give a "coarse" value and becomes more precise with the passage of time. The progressive integration keeps all past history from the beginning of the measure and provides precision and reliability. In return, you must "respect the agreements."
The measuring conditions must remain unchanged for the entire extent *from the "Start" to the end.*

(Note 3) Do not use periods of less than 9999 for precision measurements but only for monitoring and testing speed. If it does not integrate for a long time, the accuracy is limited and measurement time is wasted. The measurement time is always short and it is important let it grow much as possible to increase the accuracy to the maximum.

Table of recommended times

```
Search for minerals          30 seconds
Alarm strong radiation       120 seconds
Alarm background environment 3600 or 7200 seconds (one or two hours)
Measurements Laboratory      9999 seconds (and use the START button)
```

Main settings

Operazione | Opzioni | Isotopi

Informazioni

Secondi tot.	1
Impulsi tot.	2
Impulsi per sec.	4,0

- Total time of which have been integrated data.
- Total number of pulses counted (excluding pulses under MinEnergy)
- Number of pulses per second. If it indicates "wait" then see "Note 1"

Ingresso audio

Bins	x2
Camp.	192000
Impulsi	Auto
AudioIn	0
Amplif.	1.0
Regolazione zero	0

- This adjust the number of "Bins"
- The AudioCard sampling frequency
- The polarity of the pulse
- Input device (audio card selection)
- Audio amplification to raise low signals (normally to "1")
- Zero point adjustment of the sound card (to see low energies)
  - *We will discuss in more detail later -*

Test della Linea-Base ☑

Posizione (uS)	80
Larghezza (uS)	240
Pend. max (%)	20
Rumore max (%)	20

- These are the commands for the "Base line test"
  - *We will discuss in more detail later -*

Parametri

Tempo integ. (sec)	9999
Rinfresco (fps)	5
Energia min (KeV)	15
Filtro IIR (%)	15

- Maximum integration time (keep to 9999 = infinity)
- Refresh speed (lower to consume less CPU)
- Minimum Energy (raise if there is a lot of noise on the signal)
- Filter trimming (raise in the first minutes to improve the curve)

(Note 1) If the "integration time **not** *is set to 9999 (but also only in 9998), to have this data will have to wait* **every** *second of the integration time.*

Operation | Options | Isotopes

Export options

Export with header	☑
Decimal separator	.
Field separator	,

- The exported file must contain the header informations or not.
- The character to use to separate the integer part from decimals.
- The character to use to separate the column "energies" and "counts"

Output Slots

Counter slot	500
Bins (first slot)	0
Bins (num slots)	22

- The "Slot" to send the counts (usually to Theremino_Geiger)
- The first "Slot" to send the counts in separate sections.
- The number of sections (usually towards the synthesizer "Theremin")

Timers

Stop after (sec)	-1

- Operating time. (Keep always to -1)

Scale options

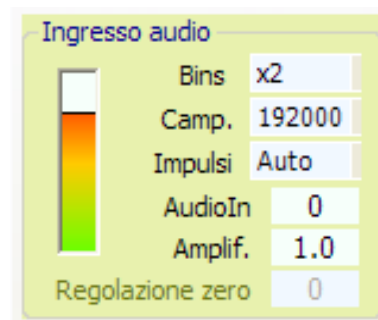|	
X Log (1/exp)	1.5
Y Log (1/exp)	1.5
Use thick lines	☑

- Adjusting the logaritmicity for the X scale of the graph
- Adjusting the logaritmicity for the Y scale of the chart

- Adjusting the line width of the chart

Resolution compensation ☑

Size (bins)	20
Center (%)	20
Left (%)	3
Right (%)	7

- Compensation of the scintillator crystal resolution

Adjusting the audio signal

Adjust the audio signal (Note 1) so that the Vu-Meter indicates at least 30% and not more than 95% and that the program tell "Signal OK" for 90% of the time.
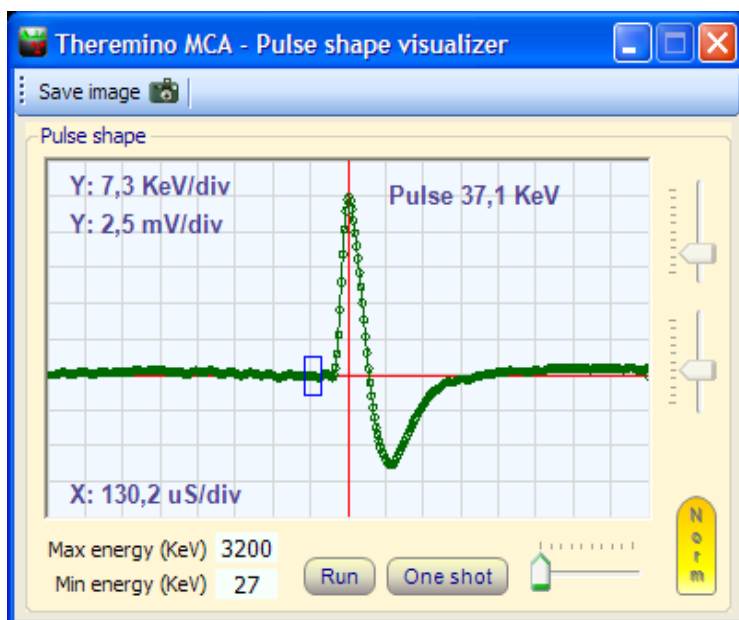
(Note 1) To adjust the sound level you have to act on the mixer "record" of Windows. In Windows there are two mixers and mixer switching from one to another with the "Options" / "Properties" / "Mixer device" If you use the sound cards mixer become four or more. Disable any control "AGC". Adjust as indicated in the file PmtAdapters. If the signal is always poor raise AudioGain, otherwise keep it to "1"
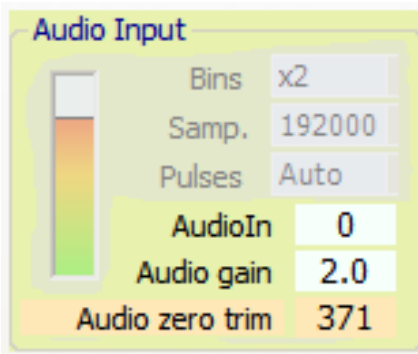
Adjust the "Multiplier" of "Bins" in order to have a chart detailed enough but not too much. There is not a direct relationship between this parameter and the actual number of "Bins" because the latter depends on the level of the audio signal, the setting of the mixer and other variables. If you overdo it with the number of "Bins" these will fill more slowly, the load on the CPU will increase and the high energy area will no longer be valid. When using only the low energy, enlarging the very left side of the graph with the control "zoom", for example for the measures XRF, then it is good to set a larger number of "Bins", also up to the maximum multiplier "x50"

Adjust the "Sampling" (sampling frequency of the sound card) with the highest possible value which is usually 192000.

Adjust "Pulse" to "Auto" In rare cases you may need to manually set it to "position" or "Neg." - Check the "Pulse shape visualizer" that the pulse peak (the first peak) is up as below.

To facilitate the pulse display set "Max Energy" in 3200 and "Low energy" from 20 to 50

"AUDIOIN" selects which sound card to use (if you have multiple sound cards)

Normally you adjust with the value "0" corresponds to the system default sound card.

When you connect a new sound card with USB This takes the place of the main sound card and therefore becomes the card "0"

Adjust "AudioGain" with the value "1", in the case that the audio signal is too low it is possible to raise this value.

AudioGain acts as the adjustment of the mixer of Windows but can amplify much more and also hardware to operate with very low signal.

The AudioZeroTrim allows you to compensate for the zero sound cards. All except the Creative sound cards (that are not good for other reasons - see the file PmtAdapters) have a "zero" moved up or down even a few tens of millivolts.

It would be possible to compensate for this with a trimmer but very complicate your hardware, you might introduce electrical noise and it would be very inconvenient to adjust it.

During normal operation, with the "Test Baseline" enabled, this adjustment has little or no influence on the measures because each pulse is automatically normalized on the zero line.

When disabling the "Base Line Test", to make measurements of noise and other evidence, it should adjust the "zero adjustment" so as to center the waveform, vertically, on the scope red line.

To compensate automatically the Zero Trim, disconnect the PMT tube and use the menu command "Tools" - "Noise Test" - See also the page "Measuring the noise" at the end of this document.
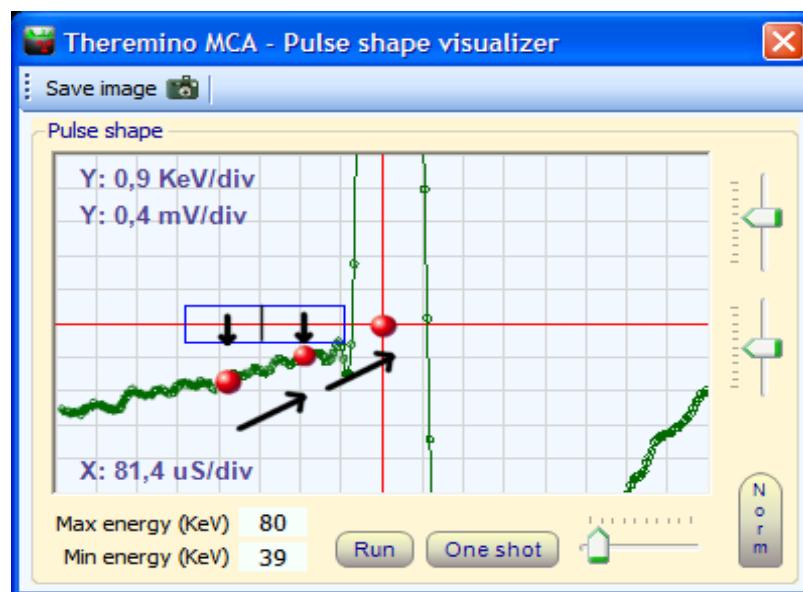
The "Dead time" from version 4 this parameter no longer exists and is automatically adjusted by the algorithm of recognition of the pulses.

The new, version 4, Baseline Test

Starting with version 4.0, this test has been greatly improved, the simple "Baseline restoring" of version 3 have been added to the calculation of the slope, with two separate medium and controls the maximum slope and maximum noise.

The values of the "Position" and "Width" that were used for version 3 are no longer valid.

If you want to get the best results you need to redo the tests, or use the values recommended by us. The value "Width" must be much greater than before (no more than 50 or 60 but at least 200 or 300)

The two averages (red dots on the left) are used to calculate
the position of the zero in the center of the pulse (third red dot)

In order to increase the size of the sample area, the area is divided into two separate areas and two separate averages are measured. The two measured values allow to calculate the slope of the baseline and to accurately correct the zero of the pulse.
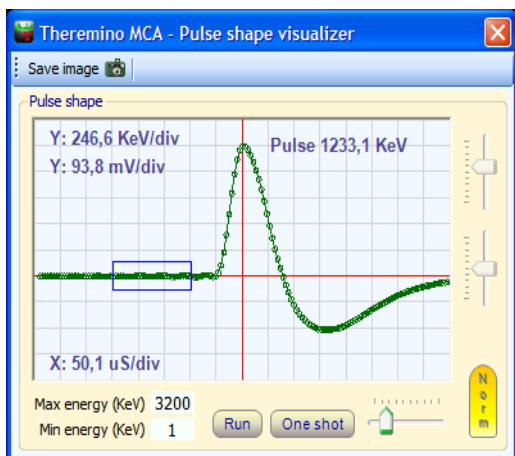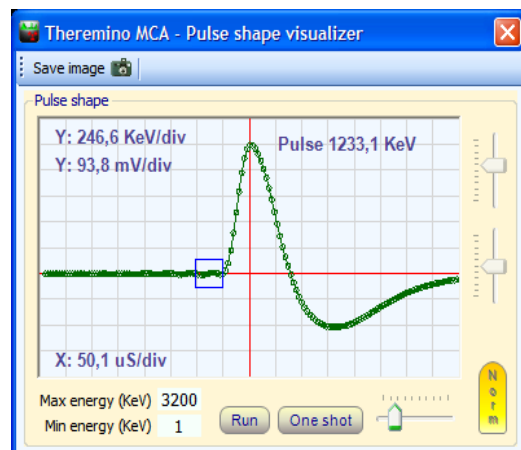
Adjusting the Base-Line Test

Adjust to about "80", "240", "20", "20" as seen in this image, small corrections may be necessary depending on the characteristics of the signal. If you are sampling at 44100, 48000 or 96000 parameter "Position" must be at least "60"

On the right you can see the rectangle indicates the area where the sampling is done.

In this image vertical lines have a width of about 50uS and you can see that the rectangle has a width of a line (Size=50) and is located in a row of distance (Position=50) from the center of the pulse.

In this second example shows an adjustment Size=150us (three rows of 50uS width of the rectangle) and Position= 100us (50uS two lines from the center of the pulse)

It is advisable to place the sampling area close to the rising edge of the pulse but no exaggeration to not measure the ringing that precedes the rising or the rising edge of the same.

The width of the sampling area is a compromise between the need to maintain it small (to sample close to the pulse) and the opposite need to enlarge it, to make a good average even in the presence of noise and "ringing".

Depending on your signal, is good to try what are the values that give the highest resolution (less FWHM values)

Adjusting the Base-Line Test
The parameters "Max slope" and "Max noise"

"Max slope (%)" imposes a limit on the maximum slope of the baseline in the area which precedes the pulse (the test zone of the blue rectangle)

"Max noise (%)" imposes a limit on the maximum noise in the area which precedes the pulse (the test zone of the blue rectangle)
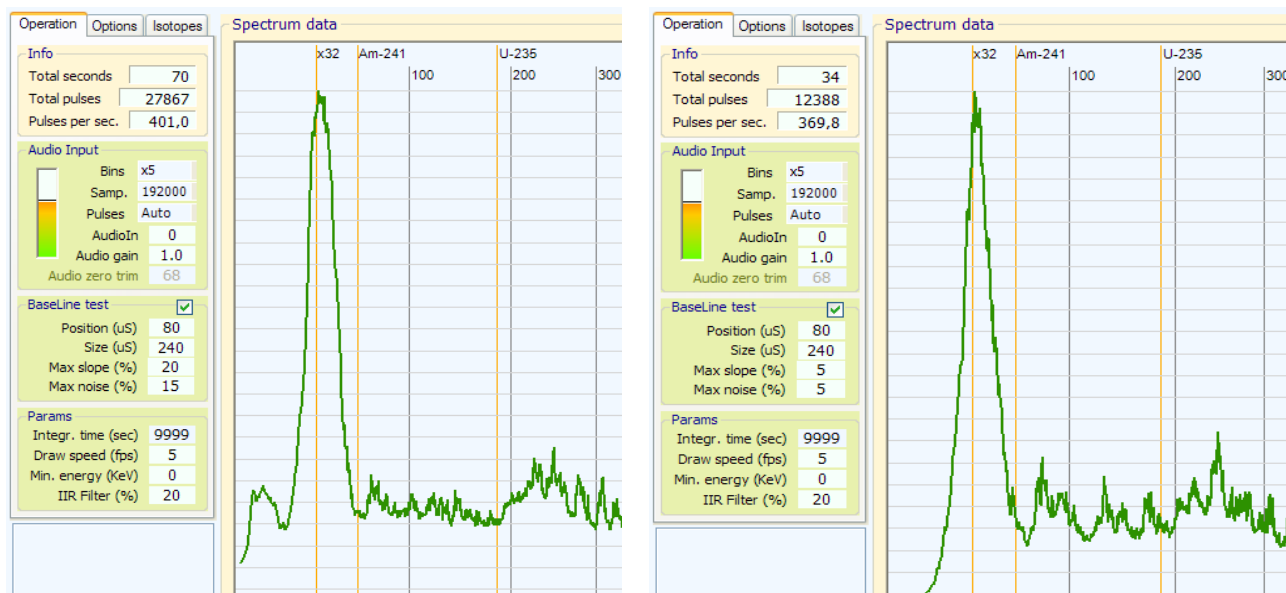
If these two parameters are raised to 100 all pulses are accepted (normal behavior of previous ThereminoMCA versions) Instead lowering them noisier pulses are discarded and the resolution increases (less FWHM)

But if you go down too these two parameters provides an effect similar to the decimation of the pulses of the PRA, the pulses remaining are few and the graph is outlined very slowly.

It is possible to verify how many pulses are lost by checking the "pulse per second" - It is better to avoid that "pulse per second" fall too much.

In addition to increasing the resolution, lower these two parameters has also the beneficial effect of eliminating the noise on the left of the graph and allow you to expand the visible area to zero. Then the parameter "Low energy(keV)" will be set to zero without that the noise rising too and suppress all the rest.

But lowering them too, along with the noise, are thrown away even the low energy pulses and therefore the details of the low energies are lost, as shown in the following two images.
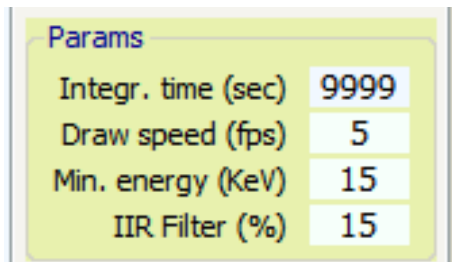

In the left image is seen that with a proper adjustment of MaxSlope and MaxNoise are also appreciable energies from 0 to 20 keV. In the image to the right instead, the low energies are completely lost and have also lost almost 10% of pulses (from 400 seconds to just 370)

Integration time
Display speed
Minimum Energy
IIR filter

Params	
Integr. time (sec)	9999
Draw speed (fps)	5
Min. energy (KeV)	15
IIR Filter (%)	15

Integr. time - ALWAYS set it to 9999 (which means infinite) otherwise to read the pulses per sec you will have to wait a very long time and the accuracy of the measurements is limited.

For each new measurement press "start new measure" otherwise you will have to wait every second of the filter or even an infinite time, if the filter is set to 9999

An integration time less than 9999 serves to set the speed of response, in case of continuous operation for long periods, which must continually adapt to changing conditions of measurement.
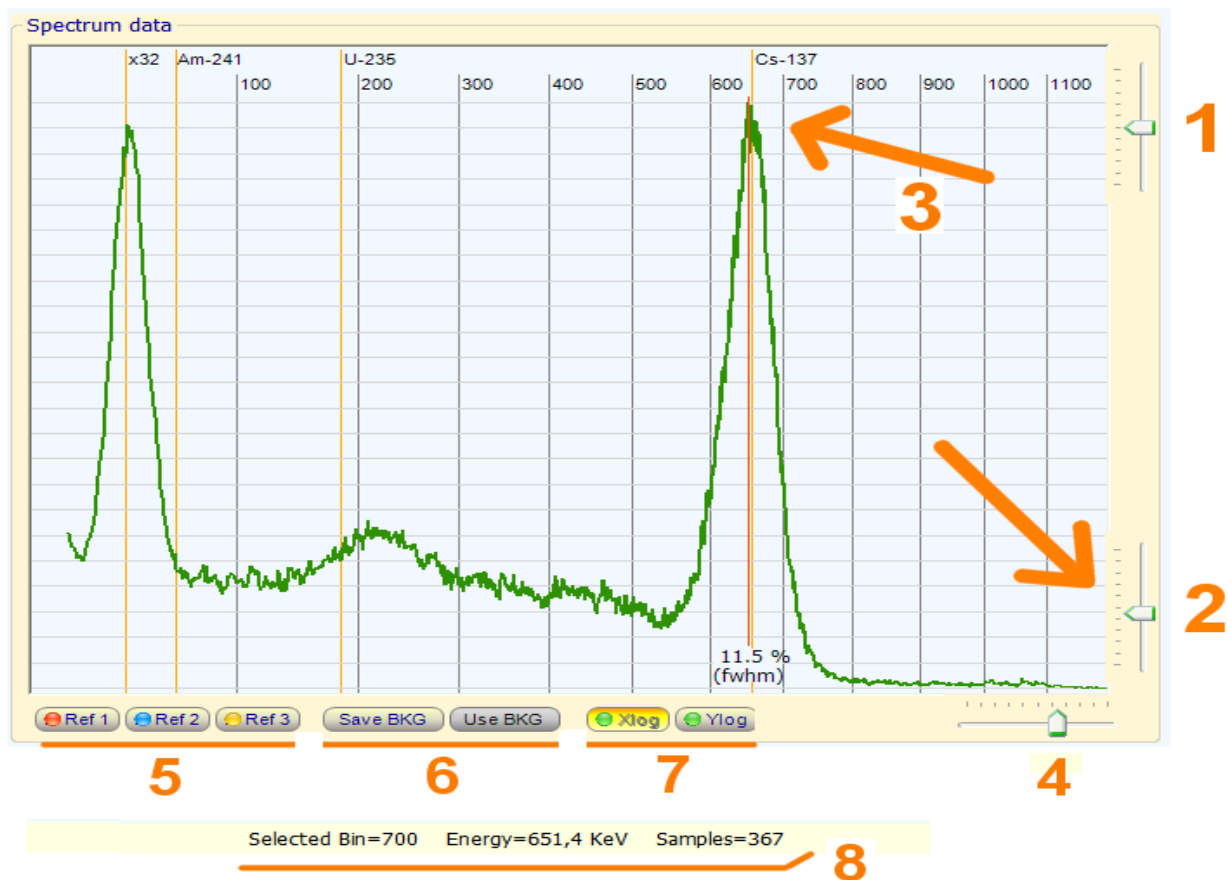
With long integration times you get more accurate but you have to wait longer for each variation.

Draw speed can be adjusted to have a fast refresh (10 per second) or slow refresh up to one per second, to save labor to the CPU

Min energy is the minimum energy that appears. If you set too low, also the noise is displayed,and the graph goes down.

IIR Filter is the setting of the filter that softens the graph line. In the first minutes the lines are very jagged and it is best to lift this filter. Remember that after a certain time it is good to lower it, so as to obtain a well-defined graph.

The commands of the main window

(1) Slider that adjusts the height of the peaks, Balancing the left side and the right side so coarse, a finer adjustment is obtained with the equalizer.

(2) Cursor that adjusts the scale of the energy you must use an isotope calibration (usually the cesium) and to match its position as indicated by the arrow 3 above.

(4) "Zoom" regulation of the scale.

(5) Ref1, Ref2 and REF3 are used to display additional curves of reference and comparison. These keys function differently if the "Run" button is enabled or disabled. During the "Run" save the current chart and display it immediately. During breaks enable or disable the display of reference curves but do not save the current chart. To save the current chart when the program is paused, press the right mouse button.

(6) SaveBKG and UseBKG used to subtract the background (such as the tare weight of a scale)

(7) Xlog and Ylog are used to display the graph with X and Y scales linear or logarithmic.
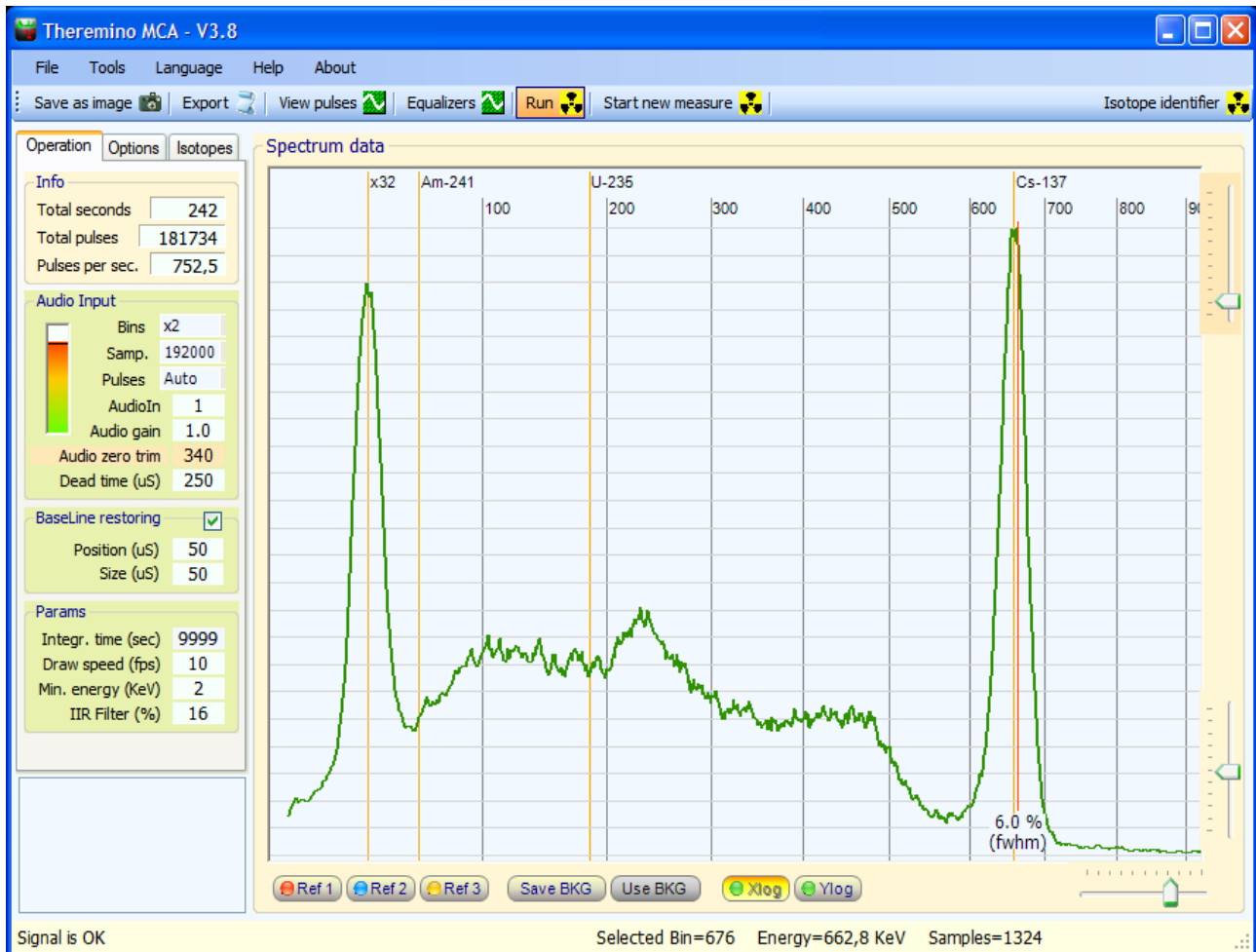
(8) The status line below shows the data of the selected point with the mouse. The orange vertical cursor can be positioned anywhere using the left button of mouse. After positioning the cursor, you can also move it with the arrow keys or the mouse wheel. If you use the right button then the cursor will automatically centers on the nearest peak and measure its width (FWHM).

The measure of the width of the peaks (FWHM)

The calculation of the FWHM is done automatically by Theremino_MCA, simply press the right mouse button on the peak to be measured.

Normally the only peak which we measure the FWHM is the peak of cesium to about 660 keV.

With Nai(Tl) crystals you get to about 6% or 7% and with the BGO from 12% to 14%

In this image we see a good spectrum of cesium obtained with crystal NaI(Tl), the value of FWHM of 6.0% was obtained by lowering a bit too much the filter (the tips of the peaks are slightly jagged), the right value should be around 6.3%
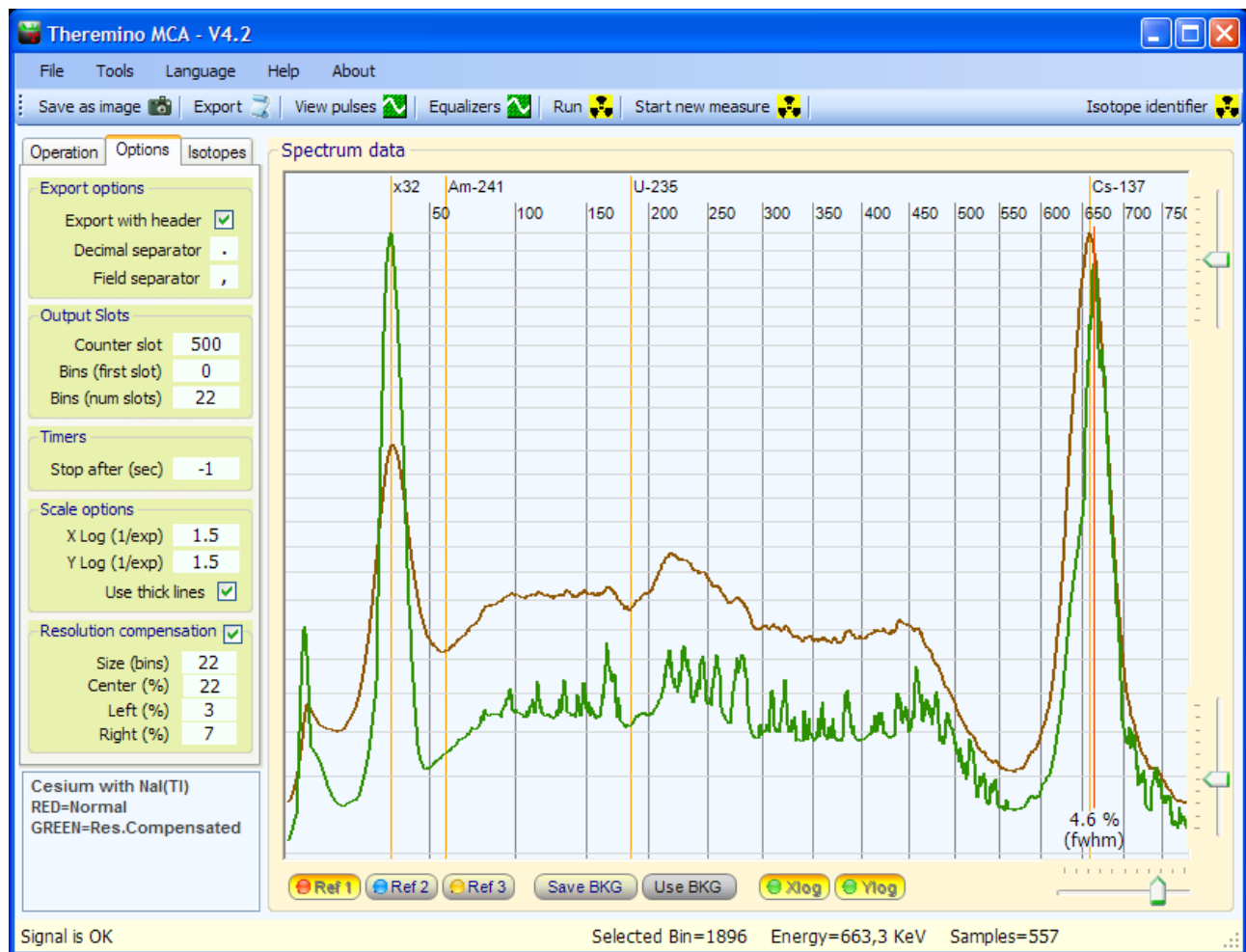
Lowering the IIR filter improves the resolution but should not be exaggerated because the tip of the peak jagged false measures and generates a too low FWHM value.

The compensation of the resolution

The scintillators crystal produce a broadening of the lines, their resolution is still too low. The BGO crystals have a width from 12% (FWHM), the crystals NaI (Tl), much more expensive, arrive to 6%.

With the compensator resolution you can earn a few percentage points and can easily lead the BGO below 10% and NaI(Tl) below 5%

Earn some point FWHM may seem small, but even small improvements in resolution, have a great effect on the visibility of the lines of isotopes and lowers the carpet of noise, making to appear also the smaller lines, which would otherwise be invisible.

Here we see a spectrum of cesium with a crystal NaI(Tl) that normally would have a FWHM around 6.5% (in red) and that, with compensation, has gained two points of FWHM (in green)

Adjust the compensation of the resolution

The Size parameter should be set approximately as shown in the table below.
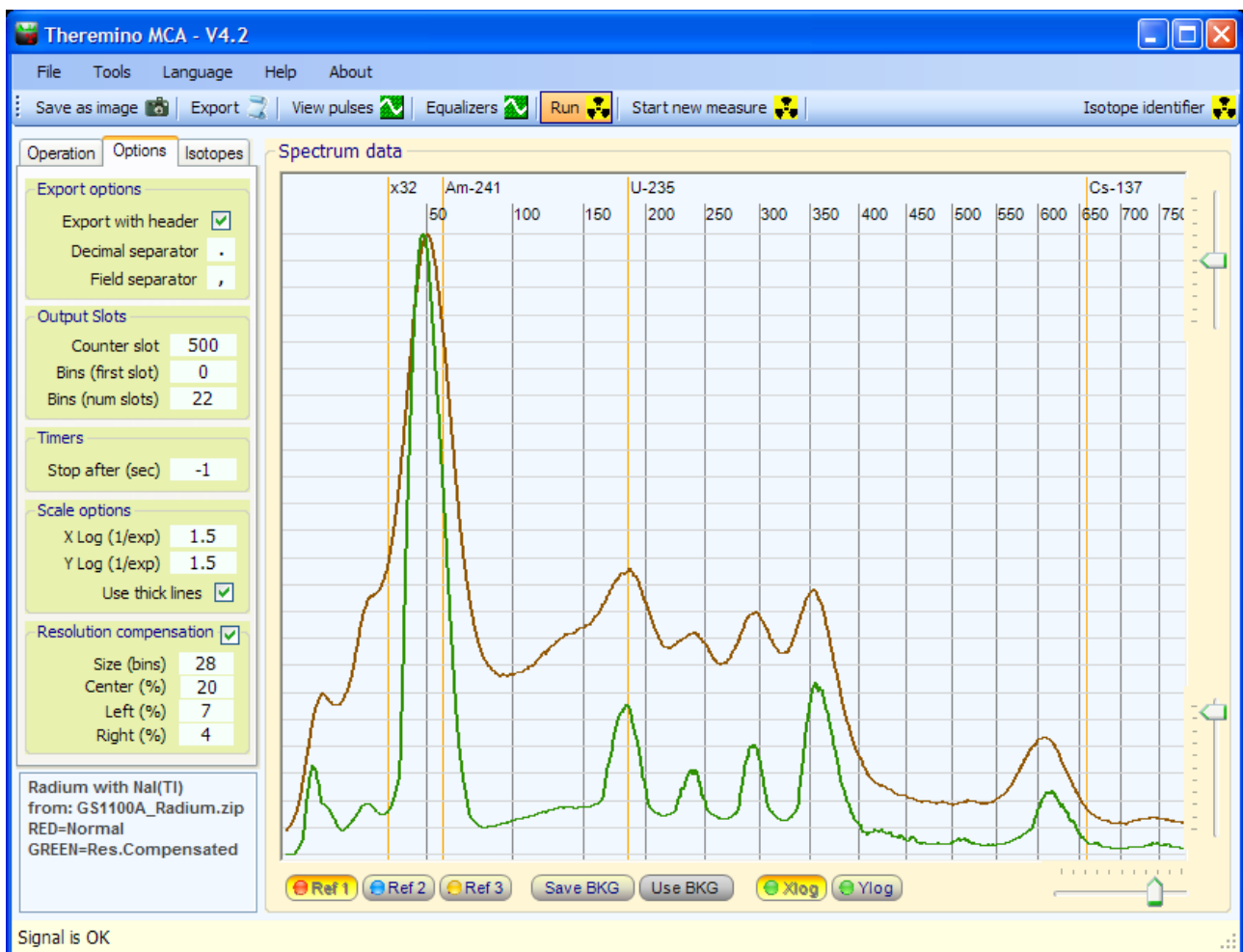
	Bins x1	Bins x2	Bins x5
NaI (Tl) and similar	10th	20th	50th
BGO	20th	40th	80th

Parameters Center, Left and Right can only be adjusted with a lot of experience, when in doubt it is best to keep them low and compensate little.
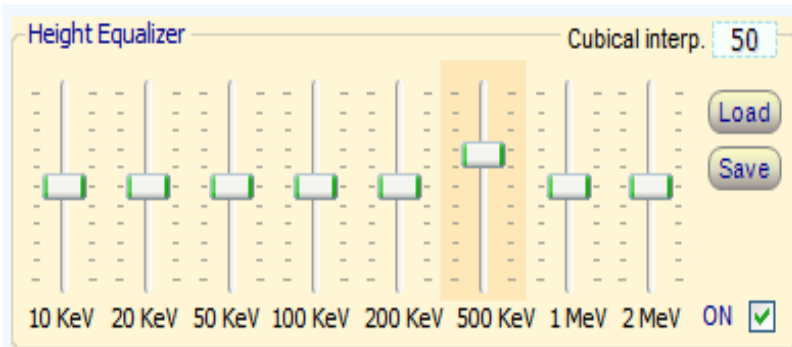
The lost information are only partially recoverable, then you should not go overboard with the compensation. Otherwise occur only deformations of the curve, with no improvement.

Here we see a spectrum of the radio with a crystal NaI (Tl). Without compensation (red) and with the compensation that has significantly lowered the carpet of noise (green)

Equalization

With the equalizer it is possible to compensate for less sensitive areas, highlighting isotopes that would otherwise be invisible.
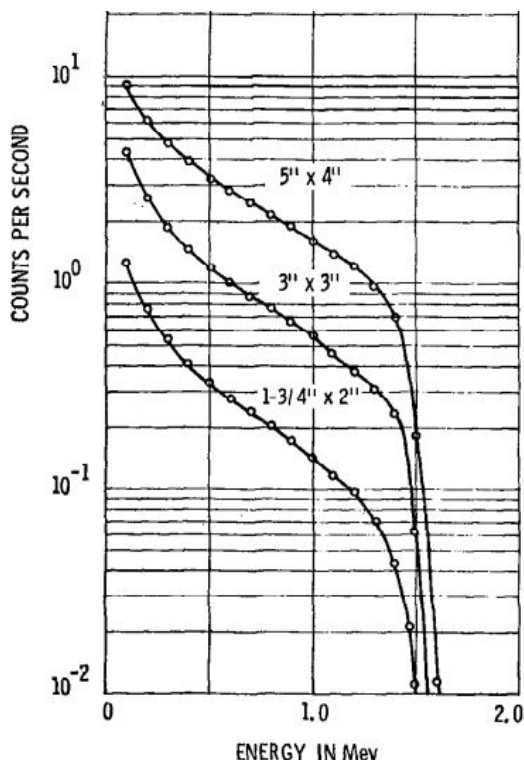

The "Cubical interp." regulates the rounding of the edges. With "0" curve consists of linear segments, with "100" you get the maximum rounding.

Not zero cursors are marked with an orange background, to clear them just click with the right mouse button.

The scintillators crystals, depending on the material they are made and their shape and size, intercept the photons of energy medium-low (around 100KeV) with great efficiency but are crossed through without producing flashes from almost all the photons with energies very high.

Even very low-energy photons produce few flashes, because most of them do not get through the aluminum shield and the first layers of the crystal, to reach a hot spot of the crystal and produce a flash of light.

This image shows the response curve that can be expected from the crystal NaI(Tl)

It can be seen that between 100 keV and 1000 keV the difference in sensitivity is about 10 times.

A 1.5 MeV the sensitivity is another ten times lower and, immediately after, falls rapidly to zero.

The number of counts, and therefore the height of the peaks, is heavily dependent on this response and by other parameters such as the size of the crystal and the thickness of the casing.
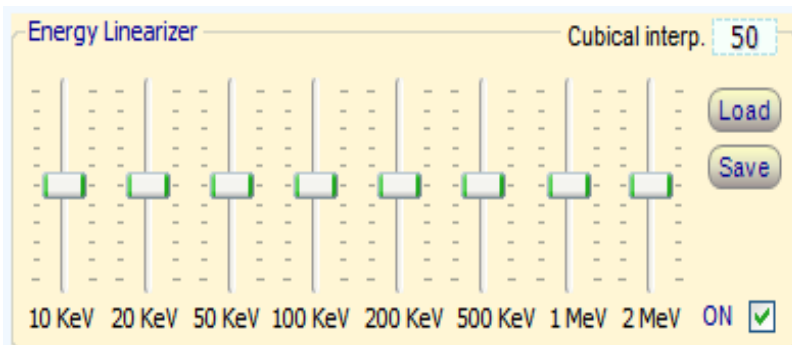
Therefore **any "quantitative" measure is totally not recommended.**

One can make comparisons between different measures and establish the presence of isotopes but not their quantity.

Using the equalizer can compensate for these differences in response. You can not do "quantitative" measures even, but you can avoid that very high peaks make disappear low peaks.

Linearization

With the linearizer it is possible to compensate for non-linearity in hardware so that the peaks of the isotopes are positioned at the right energies. It linearizes using samples with known energies isotopes.

The "Cubical interp." regulates the rounding of the edges. With "0" curve consists of linear segments, with "100" you get the maximum rounding.
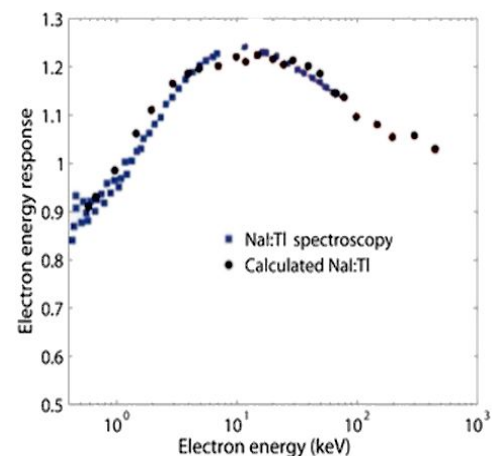
Not zero cursors are marked with an orange background, to clear them just click with the right mouse button.

The crystals scintillators, depending on the material of which they are composed, have a response to the energies are not perfectly linear

In this image, one can see that the non-linearity of the crystals can be also higher than 30%

Other sources of non-linearity can be: the conditioning circuit of the signal, the saturation of the input circuit of the sound card and the inaccurate adjustment of the zero line.

The photomultiplier tube and its resistors, often referred to as a source of non-linearity, they are responsible only minimally and are negligible compared to other sources.
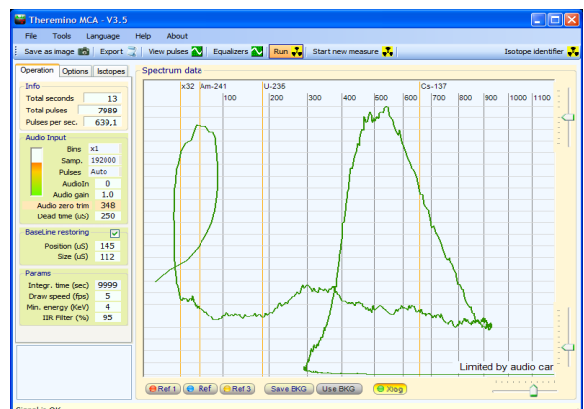

Some (before trying) have expressed doubts about our method and would prefer to linearize precise points with selectable energy. In fact, this might seem like a better way, but we have to linearize a "whole curve", not "single point".

For more information, please read this page: www.theremino.com / en / blog / gamma-spectrometry / linearizations
as well as this Wikipedia page: http://en.wikipedia.org/wiki/Overfitting

However, our method of linearization might seem strange ... We could have easily hide the errors, but we decided to make it obvious when you are performing a linearization impossible in the real world.

We could also limit the possible correction to a smaller field, but we preferred to leave the maximum freedom to the users ... So please, pay attention to correct the linearity in a meaningful way, without producing "monsters" like this.
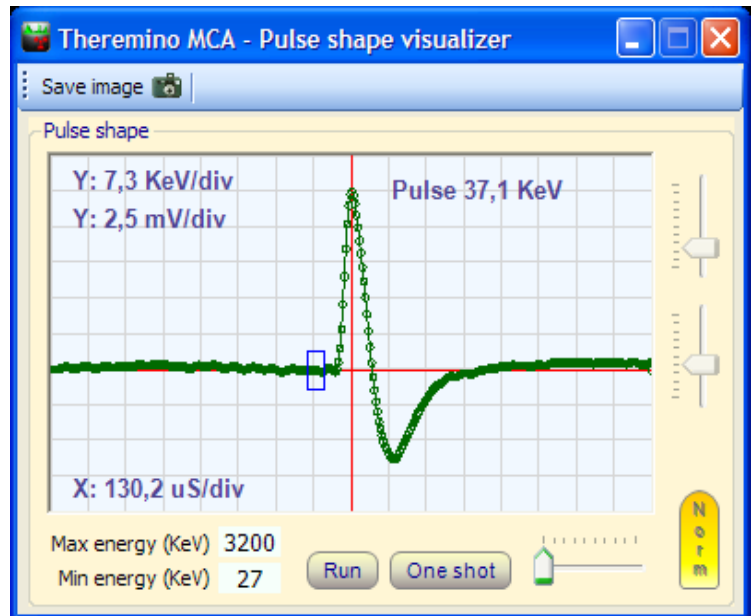
The Pulse Shape Visualizer

This viewer can be used in many ways to perform the control of the signal coming from the hardware.

With the controls Min and Max you select a range of energies, only the pulses in the range of energies chosen will be displayed.

The buttons "Run" and "One Shot" set a single pulse or continuous operation.

The "Normalize" makes all the pulses of the same height (5 squares) and disables vertical sliders.

Min and Max controls, and other controls of this window, do not affect the graph of the main window.

The values measured in keV are accurate only if the energies have been calibrated with a reference sample with the "Slider that adjusts the range of energies" of the main window.

The values measured in millivolts refer to a standard level of 2 Volt pep for the maximum count of the ADC (-32767 to 32768) and are usually quite similar to the signal that would be measured with an oscilloscope the input of the sound card (with mixer properly adjusted, AGC disabled and AudoGain = 1)

The signal in millivolts measured in various points of hardware test could also be very different from those listed here, depending on the point of measurement, as is done the conditioning circuit of the signal, the mixer settings input of the sound card and the setting of parameter "Audio Gain"

The values measured in microseconds are always calibrated, pay attention to the width of the pulse must be at least 100us to avoid that the sound card produces strong "ringing"
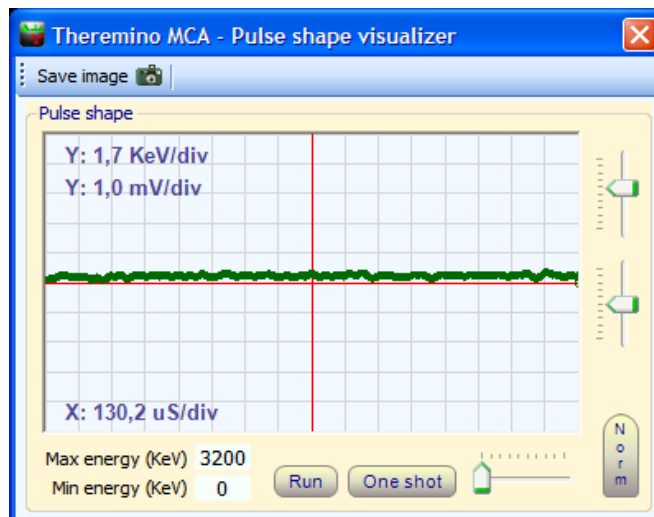
We did not use precise values (such as the usual 5, 10, 20, 50 of an oscilloscope) to allow a continuous adjustment.

Measure the Pmt Adapter and Sound Card noise

1) Make sure that the mixer input of the sound card is in place (see the file "PmtAdapters")

2) Make sure that the sound card AGC is disabled (see the file "PmtAdapters")

3) Disconnect the BNC connector that goes to the PMT.

4) Open the "Tools" menu, press "Noise Test" and then confirm.

The "Noise Test" configure the following parameters with values appropriate to measure voltage and zero noise.

- Disables the "BaseLine test"

- Sets MinEnergy = 0

- Sets MaxEnergy = 3200

- Enables the "Run" button

- Disables the "Normalize" button

- Adjusts the vertical height for 1 mV / division

- Adjusts the horizontal width to a minimum

The "Noise test" measures the deviation from the zero signal and adjusts the parameter "Adjustment zero" if the test is successful (PMT tube disconnected) line noise appears in the center of the screen, above the red line.

Comparing the maximum and minimum of this line with the squares and the indications of scale can measure the peak-to-peak noise.

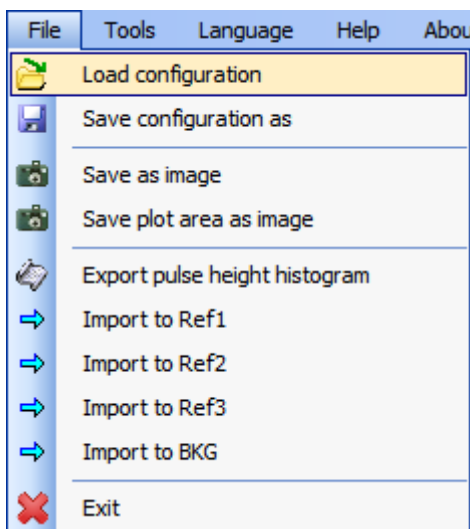To get the RMS noise is roughly estimated: Volt RMS = 0.35 * Volt pep.

What you see in this picture is the sound of the latest versions of Theremino PmtAdapter (200 uV pep approximately 70 uV rms) - A noise level significantly lower than 1KeV -

A noise less than 500uV allows you to see the peaks of lowest energy, and is essential for the measures XRF (X-ray fluorescence)

Disconnecting also the PmtAdapter one can measure the noise of the single sound card.

Reconnecting the PmtAdapter check that it does not add excessive noise. This is an important test to be sure that the hardware is in place.
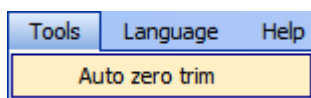
Menu commands

The "configuration" includes all adjustments, including equalizers and the display window of the pulses.

The images are handy to exchange information and advice. Preferably use the image with all settings visible.

The data can be exported to a text file and can be imported even if the filter settings and energy have changed. Before you import a file properly adjust these parameters (Note 1)
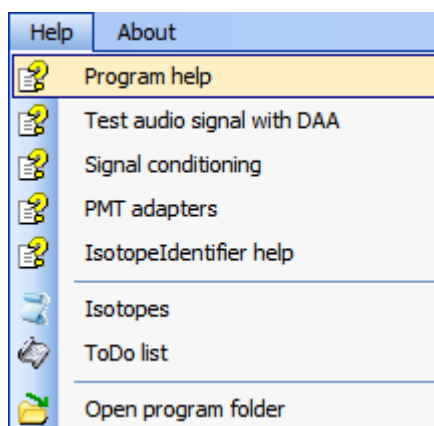
(1) Before you import a file, you must properly set the "IIR Filter", the "Minimum Energy", the "Calibration of energy" the "Equalization" and "Linearization" because these parameters are considered during the import. If necessary, you can adjust differently and repeat the import.

The "Noise test" measure and automatically adjusts the zero level of the sound card. This command also sets the program for the measurement of noise. See "Adjusting the audio signal"

These are likely to use to communicate with the Martians ...

These commands access the documentation.

It is also possible to open the Theremino MCA folder to see the initialization files and the lists of isotopes.

Adjusting the numerical boxes

Numeric boxes of Theremino MCA (and all other Theremino system applications) have been developed by us (note 1) to be more comfortable and flexible than the original Microsoft TextBox.

The numerical values are adjustable in many ways
- By clicking and holding down the left mouse button and moving the mouse up or down
- With the mouse wheel
- By pressing the up-arrow and down-arrow keys
- With conventional methods that are used to write numbers with the keyboard
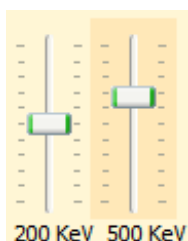- With the usual selection and copy-paste methods

Moving the mouse up and down allows wide and fast adjustments
The mouse wheel allows a comfortable and immediate setting
The arrow keys allow fine adjustments without having to look away from what you are adjusting

(1) Like all our software their source files are available (Freeware and Open Source licensed under a Creative Commons) and can be downloaded from here: www.theremino.com/downloads/uncategorized *(See "Custom controls") These controls can be used freely in any project without name a source. The source for "Open" also serves as a guarantee that we have not included malware.*

Adjust the sliders

These are the original cursors Microsoft, they are pretty comfortable that we just added the color orange and the possibility to reset them.

<<< Non-zero sliders are marked with an orange color, to clear them just click with the right mouse button (not all sliders have a zero and in this case they do not change color and can not be reset with the mouse)

The sliders can be adjusted in the following ways
- Clicking the cursor with the right mouse button to "clear them"
- Clicking the cursor with the left mouse button and moving the mouse up or down
- With the mouse wheel
- Using the left-arrow and right-arrow on your keyboard
- By pressing the up-arrow and down-arrow keys

The method of moving the mouse up and down allows wide and fast adjustments.
The mouse wheel allows adjustment at a glance.
The arrow keys allow fine adjustments without taking your eyes from what you are adjusting.
The arrow keys left / right or up / down have the same effect, but it can be more intuitive to use for the first and second horizontal cursors for vertical sliders.

The output "Slots"

If you do not use these functions, you can disable the slot writing by setting the value "-1" in the boxes "Counter slot" and "Bins (first slot)"

- Slot to send counts (usually to Thermino_Geiger)

- First slot to send the counts divided into zones

- Number of "Slots" consecutive (also the zone number)

"Counter slot" used to send the total count to a ThereminoGeiger and make quantitative measurements with the photo-multiplier tube, as if it were a normal Geiger tube, but with much greater sensitivity.

"Bins (first slot)" and **"Bins (num slots)"** are used to zone the spectrum (only the visible part). The sum of the counts of each zone is sent to a number of consecutive slots so that other programs can use these data in real time.

Normally these data is used by an audio synthesizer as, for example, the Theremino_Theremin or other applications that perform mechanical actions or selective alarms in the presence of particular isotopes.

The synth can also to change the volume of each note. The control "Vol. multiplier" regulates the volume, respect to the radioactivity levels.
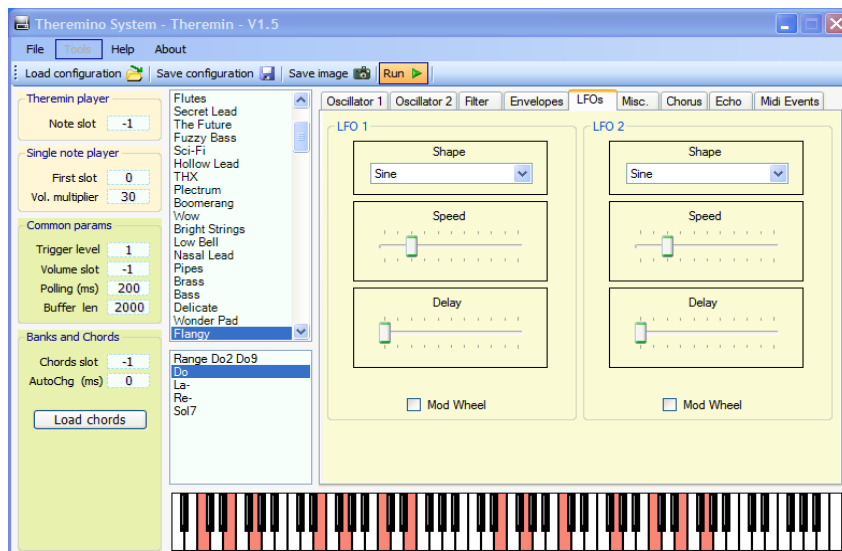

In Theremino_Theremin (polyphonic synthesizer), you can change sounds and chords and also set a "Tour of chords" and a automatic chord change time "AutoChg (ms)" to spice up and make harmonious the boring, raw data, produced by the radioactive samples.

"Snap" windows

Additional windows can be attached at various points to the right and below the main window.

Drag them to hook up to one of the attachment points.

To detach just move them a little.

Questions and Answers

Can I change the text of the panels of the program in different languages?
Of course, just edit the file: "..\Docs\Language_Eng.txt" and "..\ Docs\Language_Ita.txt"
For languages German, French and Spanish just copy the file English three times with the following names:
"..\Docs\Language_Deu.txt", "..\Docs\Language_Fra.txt", "..\Docs\Language_Esp.txt"

Can I edit the Help file in different languages?
Just ask, we will send the ODT file that can be loaded with OpenOffice and then translated with Google.
Please send to us the translations so we can include them in future versions.

I can manually enter the isotopes to be displayed?
In version 5 will be available the list of energies and of isotopes, and you can choose what to display in scale.

How to reduce the CPU work?
- Reduce "Draw speed (fps)" to "1"
- Never use the full-screen window
- Do not use "Thick Lines"
- Disable the "Run" in the "Pulse shape visualizer" (or close it)
- Reduce the number of "Bins"
- Reduce the zoom so you can see only up to 1000 keV

Conclusions

Theory is when you know everything and nothing works. The practice is when everything works and nobody knows why. We have put together theory and practice: there is nothing that works ... and no one knows why!
Albert Einstein

That isotopes to be your friends - **Livio**