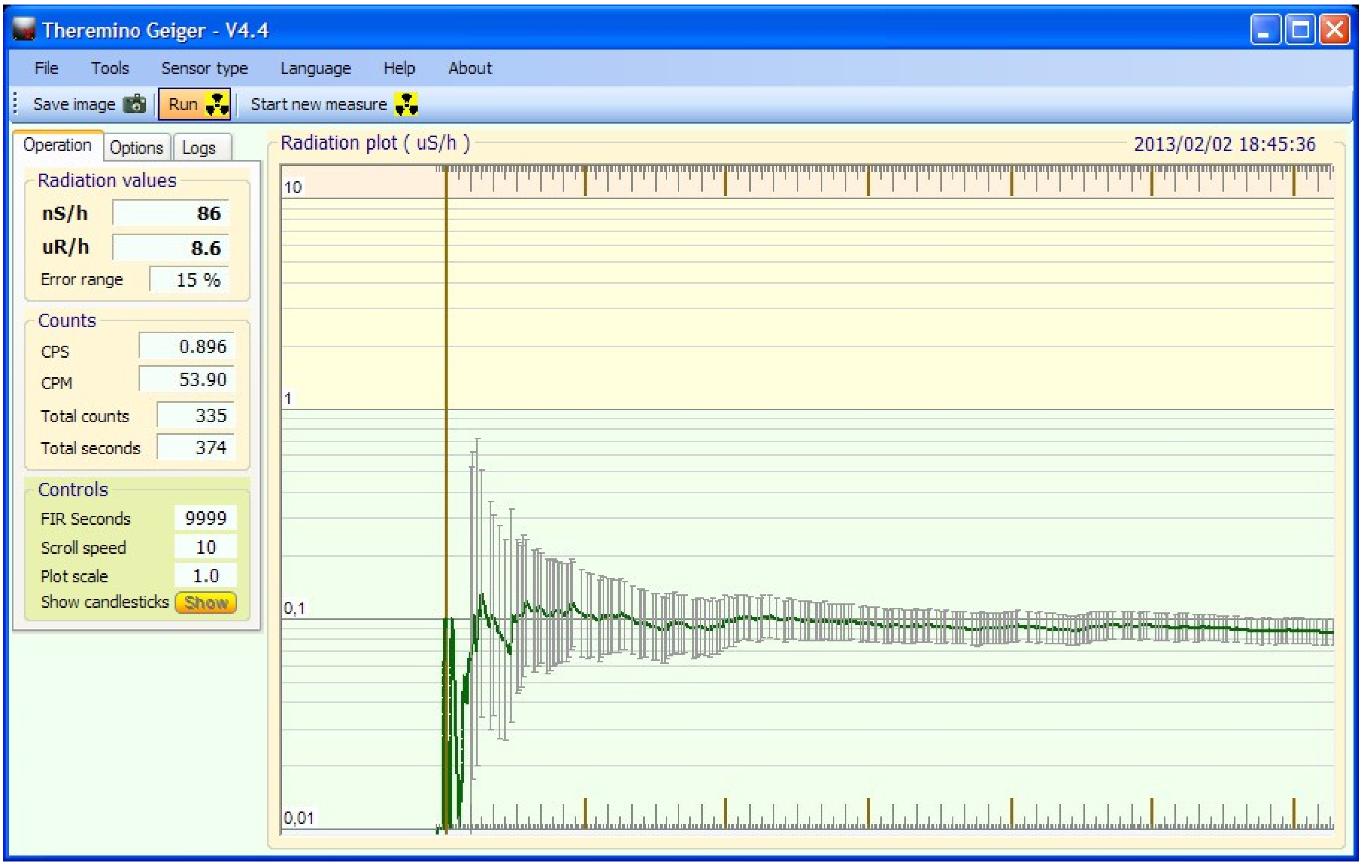
System theremino

Theremino Geiger Instructions

Theremino Geiger - Version 6.x

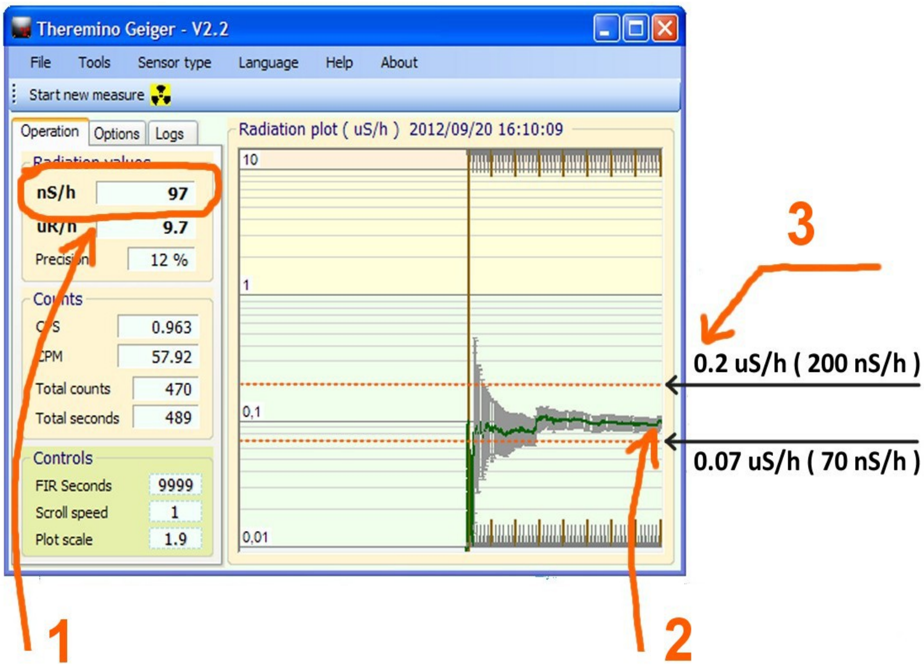


Theremino Geiger measuring the background environment. The vertical line indicates the instant in which has been pressed the "Start". The red marks at the bottom are for a minute.

(1) It must measure a value around 90 nS/h which is the normal background value.

(2) By the time the variability decreases, and in a few minutes you get an accurate measure of the fund.

(3) The measured value, in most of the world, should be between 70 nS / h and 200 nS / h



Start without reading the instructions

Here is a checklist to get started quickly

1) Connect the master to USB

2) The master must blink fast

3) Download Theremino_HAL here: www.theremino.com / downloads / foundations

4) Launch Theremino_HAL

5) Select the line "Pin" physically used on the Master (1 to 6)

6) In the "Pin properties" select "PinType = Counter" and "Slot = 1"

7) Minimize Theremino_HAL **but do not close**

8) Launch Theremino_Geiger

9) In the "Tab" "Options" and select "Sensor type" = "Geiger tube used"

10) In the "Tab" "Options" and select "Input = 1"

11) At this point must begin to click

12) Close the analog meter in the laboratory is not needed and is not accurate

13) In the "Tab" "Action" select "Seconds FIR filter = 9999"

14) Place the sample and press "Start a new measure"

15) Wait until the reading stabilizes

16) For each new measurement, press "Start a new measure" and wait until the reading stabilizes.

At the start do exactly as shown here, *later it is good to make friends with the basics of Theremino reading all the documentation in the help file but also on the site:* www.theremino.com *and on the blog:* www.theremino.com/blog

To search the site Theremino - Use the "Search" that is in every page **and then CTRL-F** pages found.
In the "Search" you must use quotes if there are spaces between words.
In CTRL-F of each page should not be used otherwise the quotes are searched too.

Suggested Reading on the topic "Geiger"
Read all the files in the folder "Docs" program and Theremino_Geiger the following pages:

- www.theremino.com / blog / Geigers-and-ionchambers # comment-546
- www.theremino.com / downloads / documentation / questions-and-answers
- www.theremino.com / downloads / foundations
- www.theremino.com / hardware / inputs / sensors (Section "Sensors radiation with Geiger" - about halfway down the page)
- www.theremino.com/wp-content/uploads/2012/03/Geiger.pdf
- www.theremino.com / downloads / radioactivity

Ground Rules for the measures

IMPORTANT - PLEASE READ THIS PAGE

Theremino Geiger uses a method of "gradual integration" which allows accurate measurements and reliable.

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 Geiger (and Theremino MCA) should be made according to the following guidelines.

Measurements Laboratory

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 "Start", otherwise the measurement will be incorrect.

5) Wait, without changing the measurement conditions, all the time necessary to make the sketch graph 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 with other software to log alarms or

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

*(Note 2) ThereminoGeiger and Theremino MCA using methods of "Phasing" that immediately give a value of "coarse" and measures increasingly 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** on when you press "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 as 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)
```

Choose a slot to communicate

To communicate between HAL and Geiger, you could, for example, choose the slot "1"

Theremino_HAL
1) Select the row of pins that you are using for the Geiger (1 to 6)
2) In the "Pin Properties" set "Pin type = Counter" and "Slot = 1"
3) Check that all the others are Pin "Unused" or have a different slot from 1

Theremino_Geiger
1) Set "OPTIONS" / "InOut Slots" / "Input = 1"

Multiple copies of the application can communicate with multiple sensors Theremino_Geiger Geiger independent. The sensors can be connected all the same "Master" or even each connected to a "Master" or a "Slave" different. Or applications can read data from the same sensor, just understand the principle of the "Slot" and "Interprocess communication" and use the numbers "Slot" appropriate.

Parameters of the Geiger tube

The parameters of the tube are set in the panel "Options"
These parameters can be changed as desired or chosen from the menu "Sensor type"
If you want to change the parameters of a sensor so that it can be recalled with the menu "Sensor type" you have to open the file "Sensor_Data.txt" located in the "Extra" and edit it with Notepad. See also the "Questions and Answers" at the end of this document.

Long time

It 's normal that to accurately measure the bottom of the environment or little radioactive samples are to be used very long time.

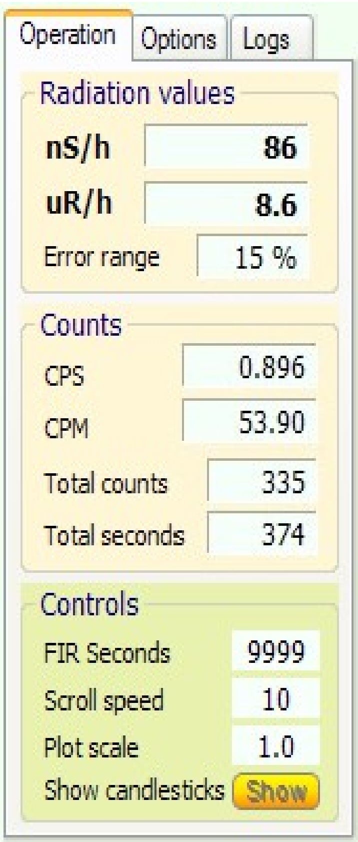
Make sure that everything is working fine

First of all check that the background environment signs about 100 nS / h (read the program help file "Radiation environment" and control what should be the bottom in your area)

Wait at least 5 or 10 minutes and if the measured value is very different from the requirements for your region recheck the following steps:

- In the "Tab" "Options" and select "Sensor type" = "Geiger tube used"
- In the "Tab" "Action" select "Seconds FIR filter = 9999"
- Place the sample and press "Start a new measure"
- Wait until the reading stabilizes
- For each new measurement, press "Start a new measure" and wait until the reading stabilizes.

The main controls



- Measurement of radiation in Sievert *(Average over time of integration)*

- Measurement of radiation Roentgen *(Average over time of integration)*

- Estimation of accuracy *(Depends on integration time)*

- Indicator of pulses per second *(Average over time of integration)*

- Indicator of pulses per minute *(Average over time of integration)*

- Indicator of pulses *(The integration time)*

- Indicator of the second *(Integration time current) (Note 1)*

- Setting limits for the second *integration time (Note 1)*

- Travel speed of the chart. (Note 2)

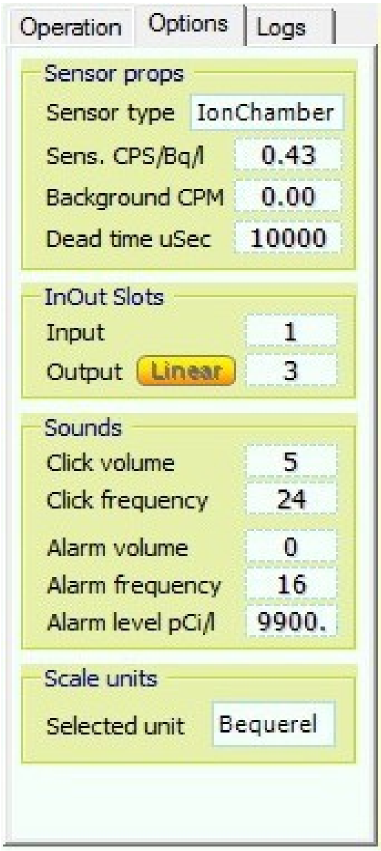
- Vertical scale of the graph. To enlarge the area of low radiation.

- Enable vertical bars that indicate the maximum error.

***(Note 1)** The integration time from when you press "Start" and increases with each passing second, until it reaches the value set in "FIR Seconds", then stops growing. Once reached the value of the preset time, the integration time no longer increases, but the data continues to arrive and the filter produces a new average every new second, in a stable way, as in an assembly line started.*

***(Note 2)** Using values from 5 down are obtained scrolling speed very low, with the following lengths of the graph:*
5 = 1 hour
4 = 12 hours
3 = 1 day
2 = 7 days
1 = 30 days
These times are approximate only, the actual length is slightly greater and depends on the size of the program window. With a very long time, over half an hour, it would require too much memory to the data needed to reconstruct the complete graph. So if the window is closed and reopened, or resized, only a part of the graph is recovered. For the same reason when you want to log image window must remain open.

Options



- Here you choose the type of sensor: Geiger, Scintillator or Ion chamber
- Setting the sensitivity of the sensor *(Note 1)*
- Setting the background characteristic of the sensor *(Note 1)*
- Setting the "dead time" of the sensor *(Note 1)*

- Slot input. Must be the same as set in the program HAL.
- Slot output of the measured value, which may be linear or logarithmic.

- Volume of the "click" of the speaker simulated.
- Setting the "size" of the speaker *(Note 2)*
- Volume of the alarm sound.
- Frequency of the alarm sound.
- Level above which should trigger the alarm.

Chioce of the measure unit:

- “Sievert” or “Roentgen” for Geigers and scintillators.
- “Bequerel” or “Curie” for Radon Ion Chambers.

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(Note 1) *These data can be set manually or chosen from the menu "Sensor type"*

(Note 2) *The "tick" is output from a software synthesizer that emulates the sound of small speakers Geiger counters. Changing "Click frequency" you can simulate all kinds of transducer, from large speakers with cardboard cone, small piezoelectric buzzers.*

Options Log

- The log file must contain the header area.
- The character to use as the decimal separator.
- The character to use as a separator between fields.
- Repeat time for any data that is added to the log file.
- Enabling the LOG file.
- Special format in "Counts per Hour" (for IARESP net)

- Repeat time for images of LOG.
- Image formats - you can choose between JPG, PNG and GIF.

- Enable LOG on images.
- Images containing the graph area only.
- Images must have a different name each other.
- Flush each new image via FTP.
- Send files via FTP LOG each repetition time.
- Send the actual value (uS/h or pCi/l) HTTP (Note 1)
- Setting of addresses and passwords, FTP and HTTP.

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(Note 1) For the transmission of the actual value (uS/h pCi/l) to a web page it is also necessary that this page exists and that the necessary fields to get the submitted values (see the examples in the "Extras\PHP MySql examples")

The integration time

The Theremino Geiger uses a **exclusive measurement method** which allows to obtain the maximum precision possible without sacrificing speed of response.

To use this **"progressive integration"** method, you set the integration time "FIR seconds" to the maximum (9999 seconds) then place the sample to be measured, and then you press the button "Start new measure"

Immediately after starting the measurement is obtained **a rough estimate** of radioactivity but **with continued time** this estimate becomes **increasingly precision.**

It is possibler to check the value "Error range" and look at the lines converge trust and then, if accurate enough, stop the measurement, or wait, until the error continues to decrease, reaches the required level.

The filter integration

Theremino_Geiger uses an FIR filter with adjustable length between 1 second and 9999 seconds (nearly three hours) followed by an IIR filter of fixed length that makes smooth the graph display.

By setting a short time in the FIR filter you get a quick response to changes, but great instability of the measures.

Long time exposure measurements are made on a large number of events (tick) then stabilize and accuracy increases, unfortunately the response to changes and slows down the rapid variations are damped.

To perform the measurement of a sample it must wait for the completion of all the seconds set in the FIR filter otherwise the measurement is influenced in part by the previous measurement.

A good compromise between accuracy and speed of response times of several minutes are used in almost all commercial Geigers, many of them use a fixed time and is not possible to change it.

Rates of one or two minutes are good for search radioactive samples, or to get a rough idea of how quickly and 'a radioactive sample, but to measure low radioactivity, with good precision and' necessary to use a very long time.

In the case of little radioactive samples and 'must wait longer, instead with samples or very mildly radioactive, may suffice a few tens of seconds.

Since it is not possible to know in advance the radioactivity of a sample, and then how much time will be needed to achieve a good accuracy, it follows that whatever the integration time pre-set to this, for one reason or the other, will not go never good.

It is good **Always set a time of 9999** seconds and **use the START button** each new measurement.

More information in the next chapter "Making precision measurements"

Make precision measurements

With a Geiger counter, make two types of measures:
- Measures "in the field" for which the most important is that the accuracy of speed
- Measures "laboratory" where the accuracy is imperative

Do measures "in the field"

Amongst the measures are carried out "in the field" to try mineral or in dangerous situations is best to use a short time (a few seconds to a few minutes) in order to have a very quick response to changes in radioactivity.

Using a short time you get poor accuracy and measures of the dance even +/-50%.

Measures so little precise enough to distinguish the stones from the radioactive inert or to identify the places from which escape as soon as possible.

When it comes to escape is good to be notified within a few seconds and the accuracy does not matter to anyone.

Also, when you try radioactive samples or you are in danger, the radiation values are still quite high (1 uSv/h or more) and radiation strong enough measurement times of a few seconds.

Measures to "laboratory"

In the laboratory, it is important to measure accurately (error less than 10%) and it is better if you have the patience to wait for the error estimated to reach 5% or less.

To be more precise are faced with time-consuming **and must not move the sample throughout the measurement time.**

When measuring very low levels of radiation, or radioactive background environment, are faced with even longer.

In sizes "laboratory" are measured almost always very low levels of radiation and this increases the time required to have a good precision. The accuracy of the measurements you pay over time. Useless to try very sensitive Geiger tubes do not exist.

The sensors are also the most expensive, are only two or three times more sensitive than a normal SBM20, costing an exaggeration but not greatly increase the accuracy of the measurements. Increasing the time however, you can achieve substantial improvements, even ten or a hundred times.

In conclusion, to make precise measurements it takes a long time, very long, ***in some cases even many hours!***

Recommended times

The times of measurement (integration times of the FIR filter) you set in the "Operation" / "FIR seconds"

```
This table shows the recommended times for measures:
Search for minerals               30 seconds
Alarm strong radiation           120 seconds
Alarm background environment    9999 seconds (Note 1)
Measurements Laboratory         9999 seconds (using the START button) (Note 2)
```

(Note 1)

An average time of 9999 seconds (nearly three hours) used to stabilize the random variation and make precise measurements even at very low levels of radiation.

The reaction time in case of an abnormal growth of the bottom of the environment is quite slow (3 hours) but sufficient for this use. A long integration time so eliminates the possibility of false alarms due to short random variations.

(Note 2)

In sizes "precision" using the longer time available in order to prolong the pleasure and achieve high measurement accuracy (if you have the patience to wait)

At the beginning of each measure, after placing the sample, it is important to press the "Start new measure" to clear the filter to all data accumulated in the past three hours and start the new measure in the best conditions.

Pressing the "Start new measure" the measurement starts with a very short averaging time immediately provide a rough estimate of the radiation, Then the time is extended gradually and the measure becomes gradually more and more precise. Pay attention to the precision given that continually improves and wait for the time needed to reach the desired accuracy.

If you continue to measure over the set time, or more than 9999 seconds, the measure does not end but continues to produce a new value every second, like an assembly line well underway.

FIR times, number of pulses and random errors

The pulses produced per second from the bottom environment are always a few, but the law of large numbers says that, to do a good average, it takes thousands of pulses.

Even the tools 'professional', whatever amount you want to spend, are subject to statistical law of large numbers, there is no algorithm that can circumvent or cheat.

Table of random variations in the integration times more common

Integration time the FIR filter		Number of pulse (Note 1)	Random variations (Notes 2, 3, 4 and 5)			
(Sec.)	(Approx)		SBM-20	2 x SBM-20	4 x SBM-20	8 x SBM-20
9,999	3 hours	6,000	14 nS / h	10 nS / h	7 nS / h	5 nS / h
7,200	2 hours	3,000	17 nS / h	12 nS / h	8 nS / h	6 nS / h
3,600	1 hours	1,500	24 nS / h	17 nS / h	12 nS / h	8 nS / h
1,800	30 min.	720	34 nS / h	24 nS / h	17 nS / h	12 nS / h
600	10 min.	240	59 nS / h	41 nS / h	29 nS / h	20 nS / h
300	5 min.	120	83 nS / h	59 nS / h	41 nS / h	29 nS / h
120	2 min.	50th	131 nS / h	93 nS / h	65 nS / h	46 nS / h

(Note 1) The number of pulses is true for a tube SBM-20 with environmental radioactivity of 100 nSv/h, not to mention the noise pulses (Tube-Bkg) caused by the tube.

(Note 2) random variations indicated are the maximum possible that "should" never happen. The probability of exceeding these limits is low, but it is always of random events, for which a long series of events very, very unfortunate, may, in a case of a billion, produce instantaneous values outside the tolerance indicated.

(Note 3) The random variations are indicated measurement errors and should not be mistaken for changes in environmental radioactivity. The publication of these data should indicate the range of error so as not to mislead readers.

(Note 4) The accuracy increases approximately with the square root of the number of pulses for which, doubling the time, or the number of tubes geiger, you do not get a double precision, but only an improvement of 1.4 times.

(Note 5) In this table, an estimate of 14 nSv/h mean +/-7 nSv/h.

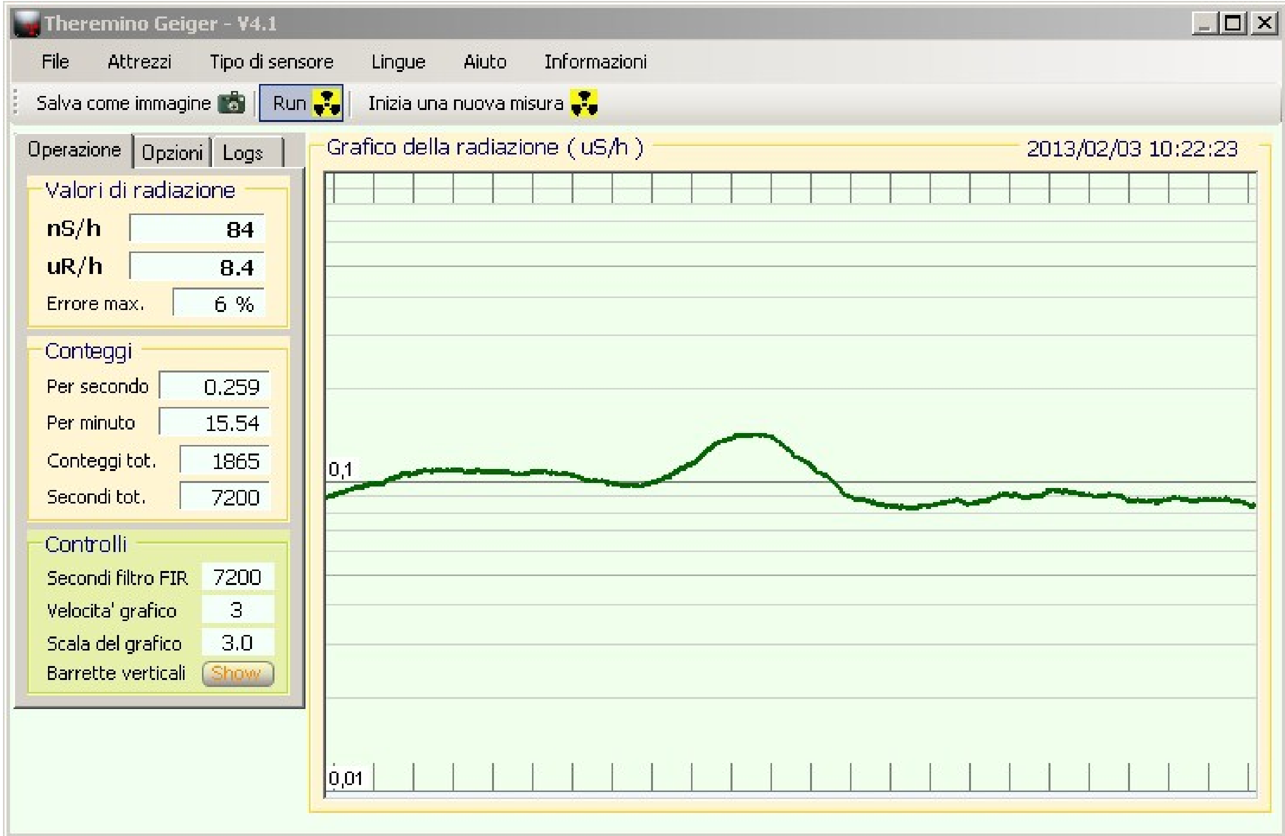
Time for the "environmental monitoring"

The "real" daily changes of environmental radioactivity are a few nSv/h, up to 100 nSv/h should be a central burst within a few hundred miles (in France if we are in Italy)

One application of environmental monitoring should then use times from 3600 seconds up and possibly 4 or 8 tubes SBM-20, so as to move closer to a precision of about 10 nSv/h

With short, which produce random variations of 50 or 100 nSv/h, would continue alarms, or you do not even notice if you broke a central backyard and environmental monitoring no longer makes sense.

An example of environmental monitoring

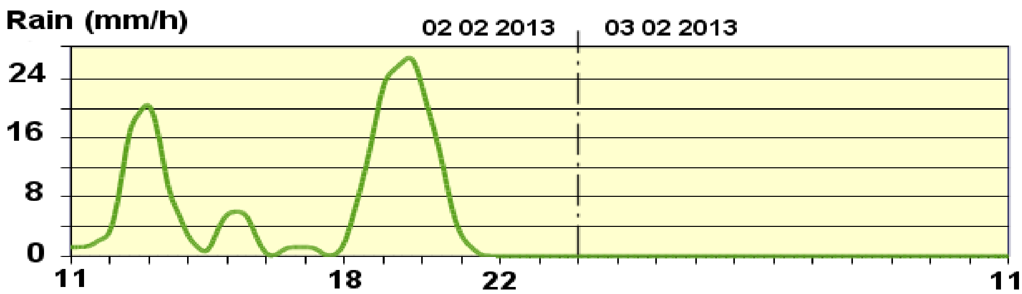


Monitor environmental radioactivity Technical Institute Galileo Ferraris of Empoli. *Weather station with a computerized system made by Mr. Alessio Giusti within the Project Globe, coordinato* ***by Professor Posarelli*** *Technical Institute Galileo Ferraris in Empoli:* **http://iisglobe.altervista.org/RADIO/RADIO.HTM**

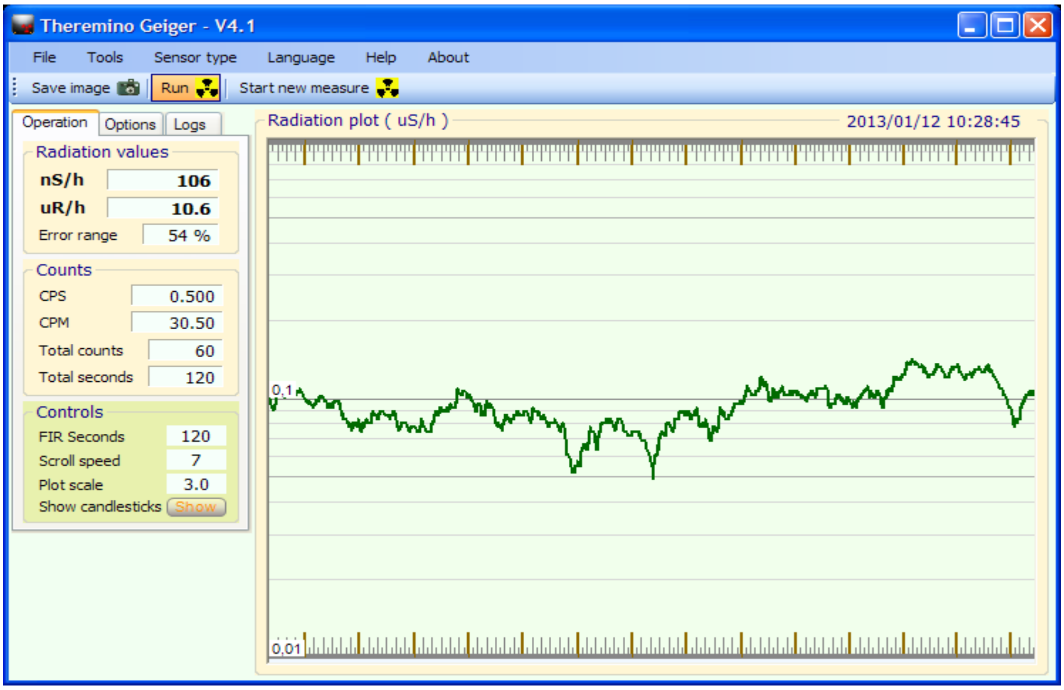
We chose an image of the February 3, 2013 showing an event of heavy rain. The graph starts at 11 am on February 2, 2013, the notches at the bottom are one hour each and the date at the top right refers to the end of the graph to the right.

It rained so slightly from 12 to 18, from 18 to 21 strong. The graph shows **a maximum at hours 21-22 of 145 nSv/h**, then measure return rapidly to the bottom of "normal" environment (80 to 95 nSv/h). Given that it is used a time integration of two hours, the chart presents data delayed by about an hour and rise times and fall of almost two hours.

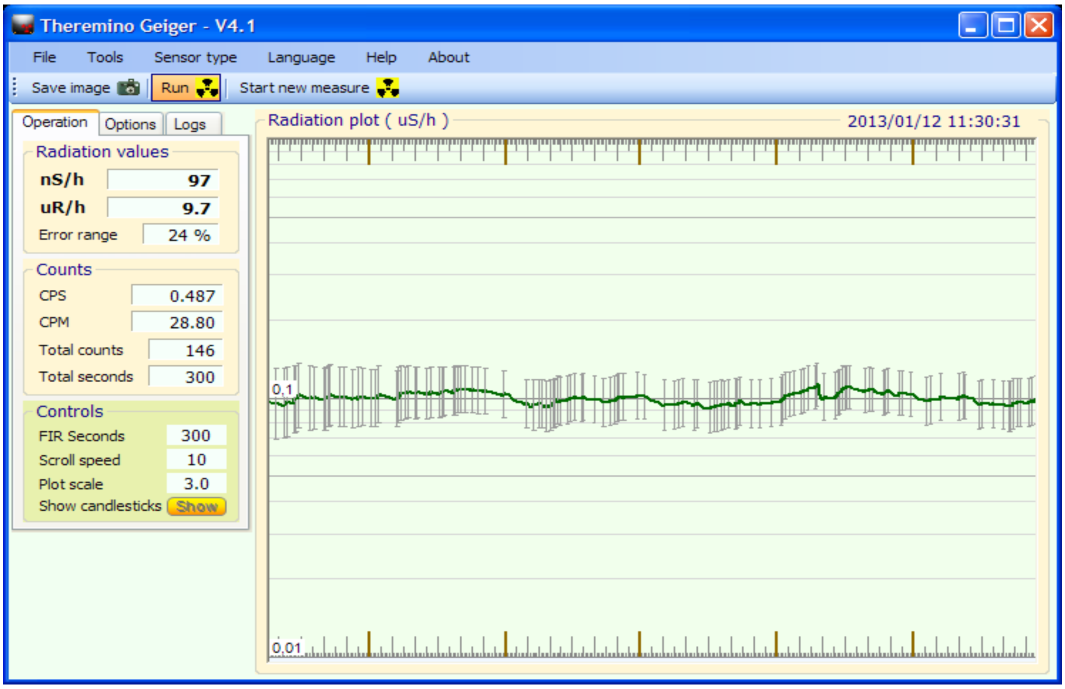
The graph on the right shows the mm of rain in the same period of time.



Time FIR and random errors seen in the graphs real



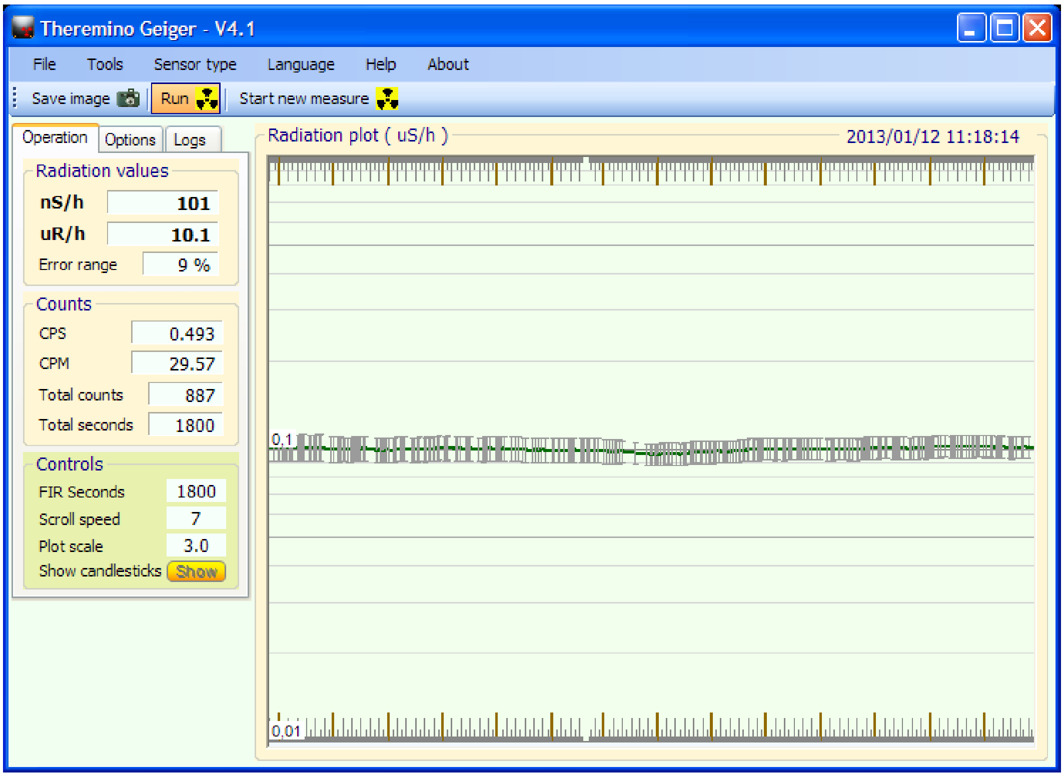
Fund environment with a tube SBM-20 and FIR filter set to 120 seconds



Fund environment with a tube SBM-20 and FIR filter set to 300 seconds

These graphs show only a few minutes and then fairly small random variations, the gray lines show the minimum and maximum amounts that may occur over longer timescales.

Fund environment with a tube SBM-20 and FIR filter set to 600 seconds



Fund environment with a tube SBM-20 and FIR filter set to 1800 seconds

The rays Alpha, Beta and Gamma

With some tubes Geiger (for example LND712, LND7312, GMT01 and SI-8B) can be measured even the alpha rays, with all the others (for example, STS-5, SBM-20, VA-Z-115.1 and SI-29BG) we measure only the beta and gamma rays.

You would think that tubes are sensitive to alpha best but it is true, have many flaws, are uncomfortable, expensive, delicate and difficult to clean, heavy, or, alternatively, insensitive.

In addition, those who often measures of samples, it will be noticed that the Alpha / Beta / Gamma always measure different from the normal tubes. This is due to geometric patterns, the LND7312 has an enormous surface from 1500 mm square, while the LND712 has a very small window for only 60 mm square, but also for the arrangement of the electrodes and their distance from the outside. It is not calibrate well. Even excluding the alpha rays and trim them to the best, depending on the sample which is measured, these tubes always give different sizes, also three times greater or less than all the other tubes "normal".

The advantage of measuring the alpha rays is often reduced to only one: to measure, loosely, the alpha emitted from the dust collected in a filter, and from this, with a calculation even less precise, try to establish how radon is in a room. With this method, even if they comply with the measurement times, the filter type, the speed of the air pushed by the fan must then also perform a calibration device with sample and correct for the air temperature and humidity. Easy to introduce systematic errors or wrong accounts and arrive at very different values from the truth.

There is a much better method to measure radon, a double ion to "single pulse" counting alpha rays, one by one, in a defined volume and produces an accurate value in "pico Curie per liter", without calibration for comparison, gathering dust, motors, filters to move and measure etc. ..

We are going to publish the complete project of the ion chamber for radon.

Eliminated the thought of radon are few reasons to buy a LND712 with his paltry 18 cps / mR / h, when the same 70 Euro you can buy four STS-5 that give well 116 cps / mR / h.

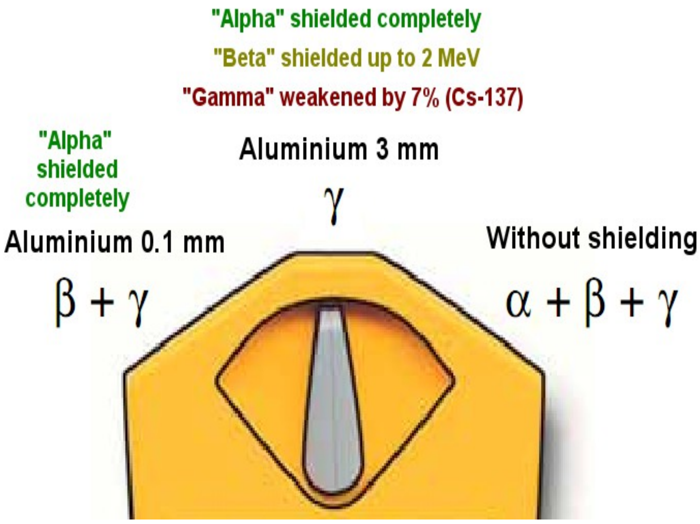
The only reason to have a tube alpha / beta / gamma could be an educational use, to prove the existence and properties of ionizing radiation.

The next page shows a simple and inexpensive way to independently measure the contribution of alpha rays, beta and gamma.

Measure rays Alpha, Beta and Gamma

This is the method used by the Gamma Scout to measure Alpha, Beta and Gamma, the idea is nice and functional.

Alpha is used to shield the aluminum 0.1 mm, to shield Alpha and Beta, using aluminum 3mm.



It is not recommended, however, to do exactly so for the following reasons:

1) It is a mechanism too complex for the craftsmanship and it would be difficult to apply to tubes larger than LND712

2) The need to rotate the three screens imposes to move back the tube Geiger of nearly a centimeter, as visible in the second image. This further decreases the already low sensitivity of the tube LND712

3) To avoid having to further retract the tube and does not decrease its sensitivity is still necessary to use small screens, which only cover approximately the front of the tube, but since the rays coming from all directions, the action screening for beta is only partial.

A similar method, with a typical "laboratory" aspect, but precise and scientific.

Cut out some aluminum plate of 0.1mm and 3mm. Must be large enough to cover the area well sensitive Geiger tubes that are used.

Use the thin plates to shield the rays Alpha and the thick to shield Alpha + Beta.

Maintaining the sample at a fixed distance of 3mm also with or without the thin plate. In this way, the three measures are compatible and it is possible to subtract from each other to derive also the only "Alfa" or just "Beta"

The accuracy of the measurements

Radioactivity measurements are inaccurate for a large number of factors related to the sensor (tube Geiger, scintillator, PIN diode, avalanche diode or pulsed ion chamber), the energies of the isotopes, the attenuation of the materials, the randomness of arrival of the pulses, under the conditions of measurement and, finally, also to geometrical reasons.

The only one not cause inaccuracies is the software that, if written decently, causes minimal errors, so inferior to those due to all other factors to be not measurable.

Now we shall see, one by one, all the sources of error.

Errors due to the geometry
Let's start with these because they are the worst and also the most neglected by all.

Distance
It 'obvious to everyone that the distance sensor-sample affect measures, but on YouTube you can see samples placed "near" two Geiger commercial comparison and maybe the sensor-sample distances are different even a few centimeters. You probably think that this error comes from a radioactive sample saturated throughout the room or at least a sphere of one meter around him ... well, it is not so!

The measure is highly dependent on the distance! To be precise changes with the square of the distance. Then measure something and write a number does not mean anything! E 'must also specify the conditions of measurement, which was the sensor, which was the sample and the distance between the sensor and the sample.

Sensor size and sample size
This point is counter-intuitive, it is commonly thought that two well-calibrated geiger should give the same result but it is not, may give different results, very different, and be the same both perfectly calibrated. How different? Here is a practical example:
LND7312 with capsule Americium to 10 mm = 80 uS / h
LND712 with capsule Americium to 10 mm = 400 uS / h

Not a little difference! The 712 marks five times more, we take both the Geiger calibrate! After spending a lot 'of money and time we return the two Geiger perfectly calibrated and certified by a famous institute, now try them and be accurate precise .. but horror! Mark always one 80 and the other 400!

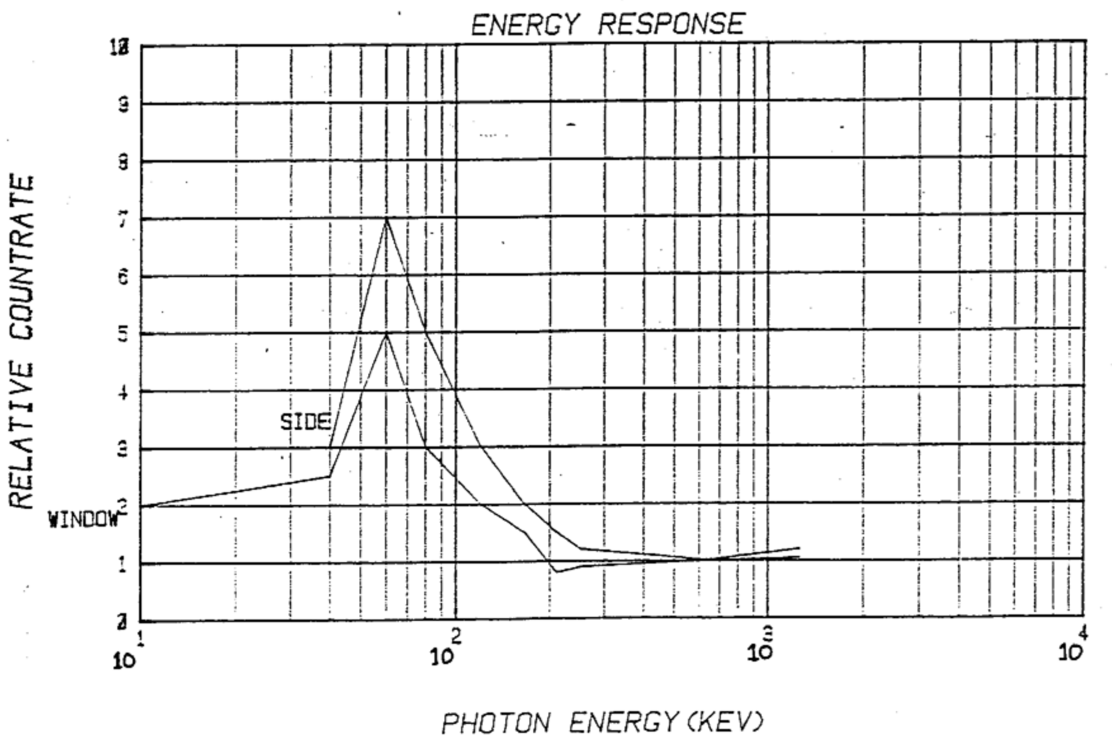
Explanation:
If you measure the environmental radioactivity or radioactivity, which is in a room next to a nuclear reactor, or a meadow in Fukushima the two sensors will give exactly the same value. If you measure a sample radioactive very small, such as a capsule of Americium, then intervene issues relating to the geometric size of the sensors, the distance measurement and the sample size.

The LND7312 is very large, has a window from 44.5mm in diameter, while the LND712 has a window for only 9mm in diameter. The area of 7312 is 25 times greater than that of the 712 and the sample of Americium not urges that a small part of the first completely saturated while the small window of the second, causing a huge difference in the measured values.

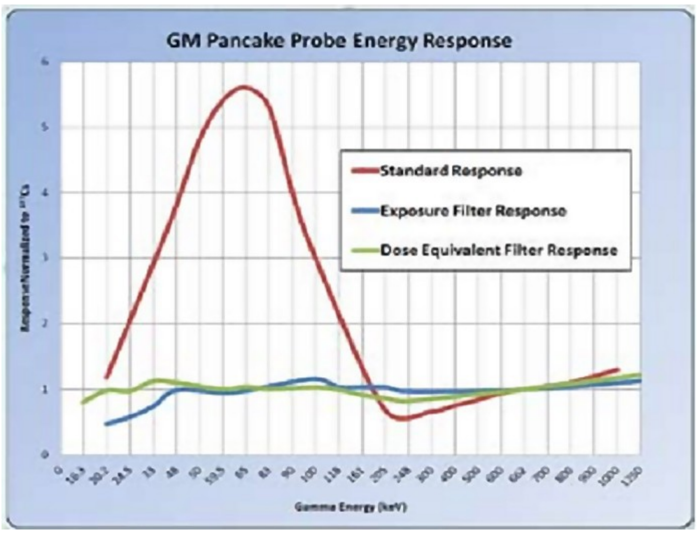
If you measure a sample radioactive very large, for example a tank, or the bottom of the environment then both tubes are immersed in a radiation field very large and therefore constant in every point of the space. Under these conditions, their different size does not matter anything and mark the same value.

Errors due to the curve of sensor response

All sensors that are Geiger tubes or scintillator or pin diodes have response curves which, if not corrected, can lead to measurement errors very large. This is the response curve of a LND712, you can see that has a sensitivity 7 times greater for low energies (americium) that for those high (Cesium and Cobalt)



The sensors should be compensated with a screen correction of the response curve in tin and copper or other suitable materials, such as the image on the right, produced by the famous producer Ludlum.



If not compensated and do not specify the measurement conditions, the type of sensor, as it is composed of the sample and the percentages of all the isotopes one by one, then write a number of something, for example 23.4 uS / h does not mean nothing.
Could also be 33, 11 or 100 and would always be right and wrong at the same time!

So, please, do not be precision-maniacs, we always keep in mind that all measurements are approximate and comparative, **very approximate.**

Inaccuracies due to the randomness

Whatever measure of radioactivity contains errors due to the measurement time too short, in order to eliminate this source of inaccuracy you should use a measurement time infinity.

The nuclear disintegration are random, so random that are often used as the basis for encryption so you are assured of a chance absolutely indecipherable.

Sometimes the tick of the environmental fund stop for long moments, on rare occasions it happens that they stop for a full minute, while at other times they bursts of pulses continue for many seconds.

In the short time (minutes) and with samples little radioactive errors due to randomness are huge, only the law of large numbers and the passage of time can moderate these errors.

The percentage error decreases roughly with the root of time and then, if it takes a minute to switch from 40% to 20%, it takes then 4 to switch from 20% to 10% and it takes another 16 to switch from 10% to 5%.

So if you want more precisely the time required increases exponentially.

Errors due to the attenuation of the materials

All materials, even the air, attenuate the radiation and attenuate them differently depending on the energy and the type of radiation (alpha, beta or gamma)

The material of which is composed of the probe and also the material of the sample affect the measures in some cases even in a very significant manner, with very large errors.

Also for this measure has no sense if you do not specify ALL of the measure.

Other errors

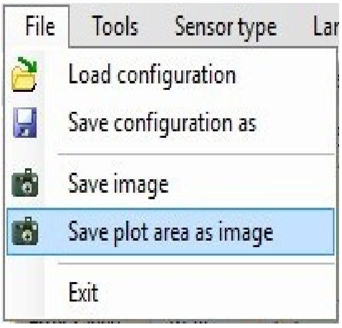
There are also other errors due to X-ray production, the backscattering, the brahmstralung, the squenching gas inside the pipe, the dead time, the supply voltage and the temperature, so to say the main, but if the components are well designed these errors are all smaller than the previous ones and we can neglect them.

The sum of the errors

The sum of all errors can reach in some cases to 3 times, 5 times or even 10 times. So let us not pretend and be satisfied with a precision impossible, approximate measures, which in this area are great. Do not care if the background environment is 70 nS / I 190 nS / I if a sample is 233.2 uS / h than 322.3 uS / h

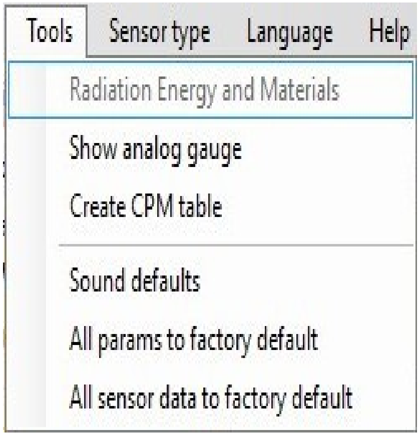
What matters is the order of magnitude, that is, to know with certainty, **and you should not miss,** If they are about 70 (do not care) or 700 (do not eat) or 7000 (not in your pocket) or 70 000 (stay away) or 700 000 (keep in the lead) or 7000000 (run away quickly)

Menu commands



The "configuration" includes all adjustments.

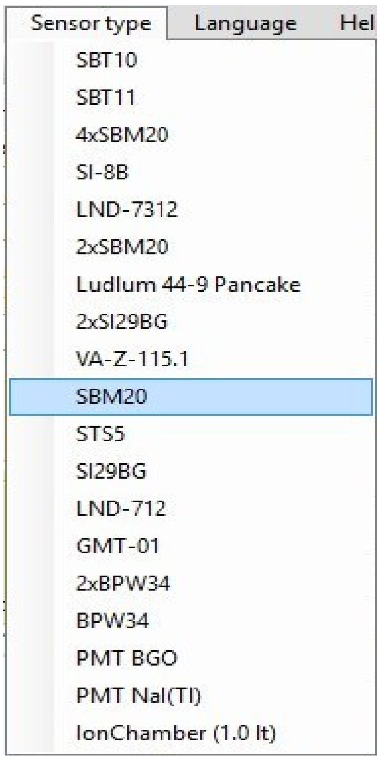
The images are handy to exchange information and advice. Preferably use the image with all settings visible.



- Unimplemented command (Note 1)
- Enable the analog instrument read.
- CPM table, useful for portable devices.

- Restore the original values for the sounds.
- Restore the original values for all parameters.
- *Restore the original values for the sensors.*

(Note 1) *This command should help you calculate the approximate content of isotopes but probably will be replaced by gamma spectrometry at low cost, with PIN diodes.*



With this menu, choose the sensors which may be of three types:

Geiger tubes
In order of sensitivity from greater: SI-8B, LND-7312, 2xSBM20, Ludlum 44-9, VA-Z-115.1, SBM20, STS5, SI29BG and LND712

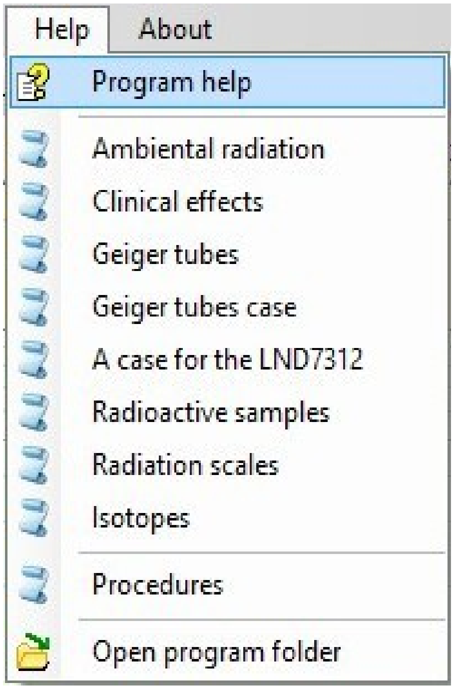
Counters
Pin diodes, photomultiplier tubes and scintillator crystals

Pulsed ion chambers
Pulsed chambers count the individual alpha rays, in a known volume, for the precise measurement of radon in picoCurie per liter.

It is possible to add sensors or change their values, edited with a text editor, the file "SensorData.txt" located in the "Extra"

Menu commands - continued

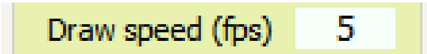
These are likely to use to communicate with the Martians ...



With these commands to access the documentation.

It is also possible to open the Theremino Geiger folder to view and edit the initialization files, language files and files that contain the data of the sensors.

Adjusting the numerical boxes



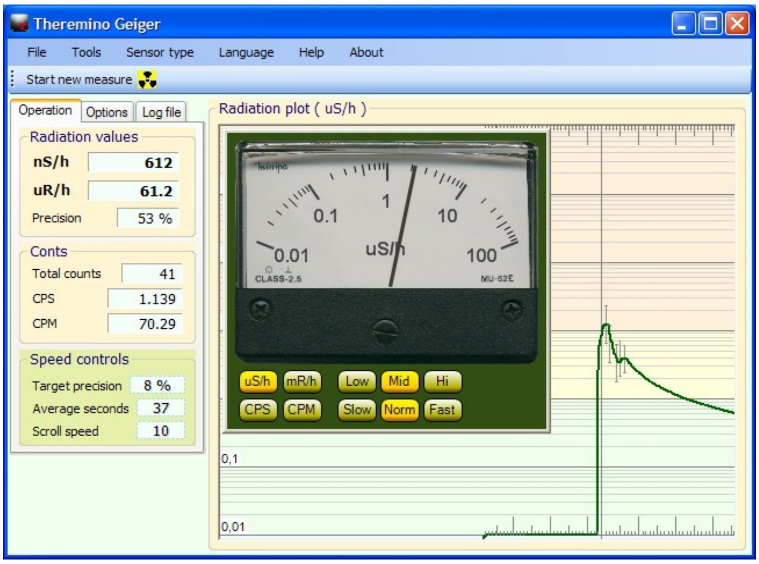
Numeric boxes of Theremino (MCA and all other system applications Theremino) have been developed by us (note 1) to be more comfortable and flexible than the original Microsoft TextBox.

The numerical values are adjustable in many ways
- Clicking and holding down the left mouse button and moving the mouse up and down.
- With the mouse wheel.
- Use the arrow-up and arrow-Jun keyboard.
- With conventional methods that are used to write numbers with the keypad.
- With conventional methods of selection and copy-paste.

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

(Note 1) *Like all our software 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 some malware.*

The "snap" of the analog meter



The analog instrument can be latched in the position visible in this image or in the upper right under the red cross button.

Just drag it to hook up to one of the attachment points.

To release, just move it a little.

If the instrument read is not locked then remember its position and will remain in place even in a run and the other.

Questions and Answers

And 'possible to export charts?
Certainly, just use the "File / Save as image plot area"

Is it possible to print data in excel?
Certainly, just use press "Log to text file" and choose a suitable repetition time.

If I have a sensor that is not listed can enter the values manually?
Of course, just enter your details in the panel "OPTIONS", "PROPERTY 'OF THE SENSOR", but it would be better to open the file "../Extras/SensorData.txt" and add a line with the name of the sensor and its data. Send us the details of your sensors and will add them in the new versions.

Can I change the text of the panels of the program in different languages?
Of course, just edit the following files:
"..\Docs\Language_Deu.txt"
"..\Docs\Language_Eng.txt"
"..\Docs\Language_Esp.txt"
"..\Docs\Language_Fra.txt"
"..\Docs\Language_Ita.txt"

What is "communication slot" / "exit"
The output slot indicates which slot to release the data in uS / h, which could be used to drive some other module in the system theremino.
If you do not use this option and 'maintain good communication output to -1, which means "NOT USED" so as not to write the output data in any slot.

How to store the samples?
To avoid the risk that the fragments should be around one can take the samples in plastic bags with transparent wall around 2 hundredths of mm, that do not attenuate gamma rays (under 1%) so as not ever having to extract samples from them.
On eBay there are sellers of plastic bags of all sizes. The bags must be PVC because the PET attenuates more.
Finally, the sachets with the samples should be stored in a container of lead placed at least 2 meters from any living being for much of the time. Better preserving sachets all together in a single container with very thick walls (at least 3 centimeters, better 5) that make a container for each sample.
Regarding the samples of alpha rays the sachets are not usable, only a hundredth of a millimeter of PVC attenuates more than 50% of alpha. When measuring alpha there should be anything in between, even the air attenuates the alpha and in two or three centimeters eliminates them completely. Fortunately, the "normal" sample that is used for alpha rays is a capsule made from americium smoke detectors. These capsules are absolutely safe, do not lose pieces and just keep them out of a meter they are indistinguishable from the background environment.

Questions and Answers (Continued)

What is the "Background" geiger tube?

The Background of a Geiger tube is a "noise" inherent, produced by the Geiger tube itself.

When fencing with a lot of lead (at least 3 cm) will attenuate the cosmic rays and radiation coming from the objects around (floor tiles, walls, radioactive dust and potassium content in humans) to a negligible level and the probe should give ZERO pulses per second, or nearly so.

However, all the tubes Geiger, even the best, while screening to maximum, produces a not zero count rate (typically from 0.1 up to 2 cps), this count is of the same order of magnitude as the bottom of the environment and if not is subtracted with precision completely false measurements.

The BKG is due to random discharges that occur within the tube and, perhaps in small part, to the materials that make up the walls of the probe that, each time, produce a random disintegration and then a count.

If you want to make accurate measurements it is necessary to fine-tune the CPS Background of the pipe so that the program can ThereminoGeiger shield them from all of the following measures.

Normally the value of Background of its tube can be set, with good precision, selecting this particular model tube from the menu.

To measure with certainty the background of your tube

How to measure the "Background" of their own geiger tube?

1) Remove all sources external shielding the tube can lead to more (3 cm or more)
2) Measure the CPS of the tube only by making a measurement of high precision (every 9999 seconds = 3 hours)
3) Set the "Tube BKG" with the measured value (and write it to file)

Once measured, the value "TubeBK" no longer changes and these three hours are therefore well costs. The lead is no longer needed but may be useful for any new tubes.