

## Appendix 1 - Adjusting the text box numerical values

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

Start X 40

End X 600

Filter 30

Speed 30

### The numerical values are adjustable in multiple ways

- ◆ By clicking and holding down the left mouse button and moving the mouse up and down.
  - ◆ With the mouse wheel.
  - ◆ Using the keys arrow-up and arrow-down on the keyboard.
  - ◆ With conventional methods that are used to write numbers with the keyboard.
  - ◆ Using standard copy and paste selection methods.
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- ➔ The method of moving the mouse up and down allows wide and fast adjustments.
  - ➔ The mouse wheel allows convenient and immediate adjustments.
  - ➔ The arrow keys allow fine adjustments, without having to look away from the present operation.

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

## Appendix 2 – Scale calibration

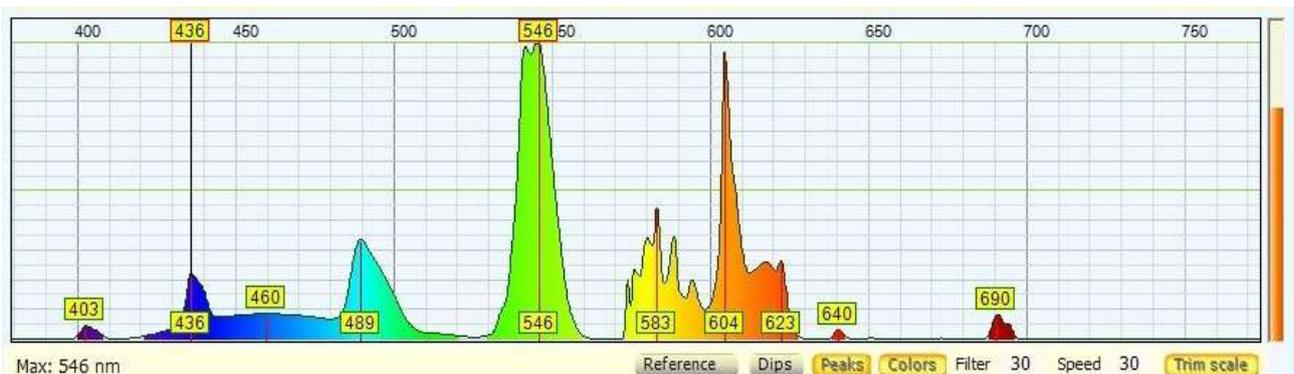
To calibrate the scale of the spectrometer use a fluorescent lamp.

You can use energy-saving lamps for home lighting, or you can prepare a convenient source of calibration, following the instructions on the page 19 of the file "Theremino Spectrometer Construction".



### Make calibration

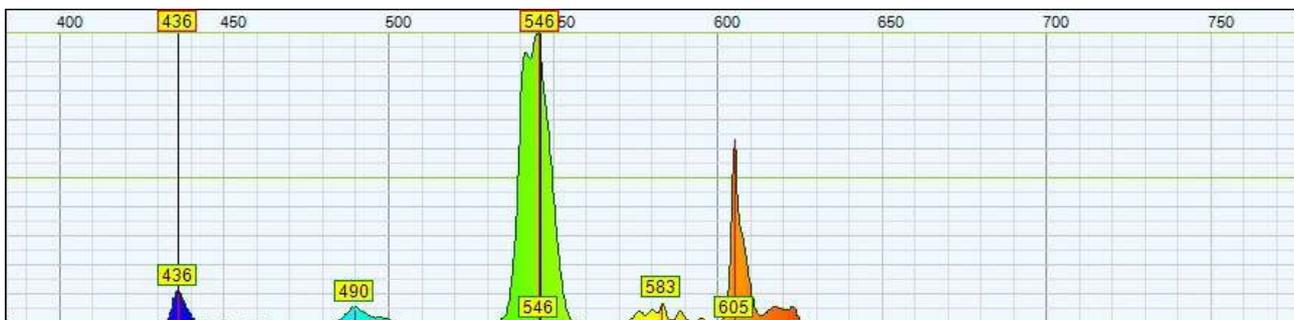
- ◆ Place the lamp close to the entrance slit of the spectrometer and adjust the "Exposure" to get a graph similar to the following.
- ◆ Make sure that the buttons "Reference" and "Dips" are not depressed and that "Peaks" and "Colors" are.
- ◆ Press the "Calibration" and locate the two new labels that appear on top, in the upper area of the scale.
- ◆ Drag one at a time, labels, hold down the left mouse button until you are on the tip of the two characteristic peaks of mercury at 436 and 546 nm.



Here you see the two peaks of mercury and labels 436 and 546 that appear when you press "Calibrate"

The calibration points may not even be 436 and 546, to set them see the menu commands on page 4.

To calibrate more accurately, enlarge the area of interest with the wheel and the left button of the mouse. Remove also the lamp so that the peaks do not have the flattened tip and that their maximum is more evident.



Moving farther the lamp, the peaks shrink and their maximum become more precise.

## Appendix 3 - absorption measurements

The absorption measurements are performed with the button "Reference" and are used to measure the response curve of the color filters and the absorption of various substances, for example the olive oil.

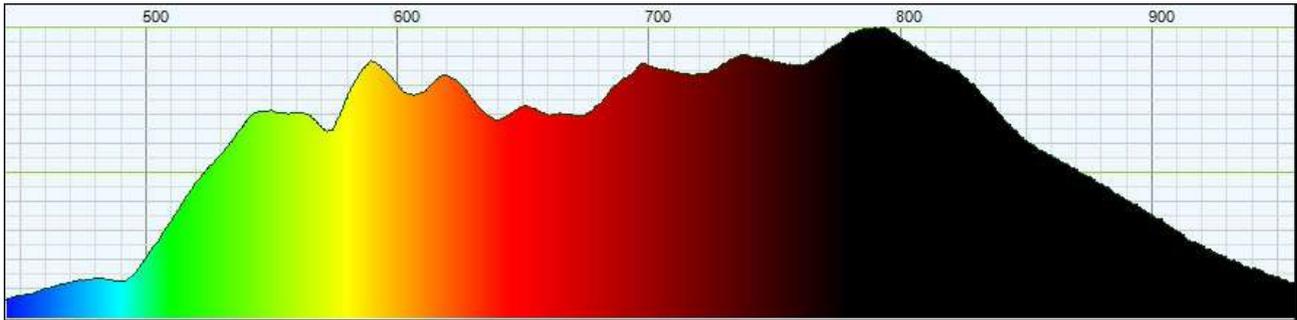
For these measurements, it is necessary to have a source that emits light across the spectrum (or at least in the area that is to be measured). The sources of this type are called "Broadband". The instructions for preparing a "Broadband" source are in the last pages of the file "Theremino Spectrometer Construction".

### Make a measurement of absorption

- ◆ Make sure that the buttons "Dips" and "Peaks" are not pressed and "Colors" is.
- ◆ Open completely the slit diaphragm to give more light as possible (measurements on the filters do not require much resolution).
- ◆ Adjust the controls "Filter" and "Speed" with a value of 30 (with very high or low values becomes difficult to make absorption measurements ).
- ◆ Place the lamp next to the entrance slit of the spectrometer, but leaving between the lamp and the spectrometer sufficient space for the filter or the specimen to be measured.
- ◆ Adjust the position of the lamp to have good lighting.
- ◆ Raise the control of exposure to cover a wide area of the spectrum. But you should not overdo it with the light and exposure, otherwise occur glare (visible in the black little window of the camera) and the measurements will be biased. If there is too much light and too much exposure the spectrum will never go to zero, even in areas where the filters absorb all the light.
- ◆ Try, pressing the "Reference", if the area covered is sufficient.
- ◆ Frame the area of interest with "Start X" and "End X" or with the mouse.
- ◆ Before inserting the sample to be measured, press the "Reference"
- ◆ From this moment still keep in both lamp and the spectrometer. If you touch them by inserting the sample then you will have to repeat the reference.
- ◆ Insert the sample, check the spectrum and possibly save his image without spending too much time (the reference deteriorates over time for the heating of the light source and other mechanical causes).
- ◆ If it's been a long time or that you have moved the light source, remove the sample and check that the reference is still valid (upper spectrum aligned with the colored line above).
- ◆ To restore the reference, remove the sample and then disable and re-enable the "Reference".

In the following pages this procedure is explained with images.

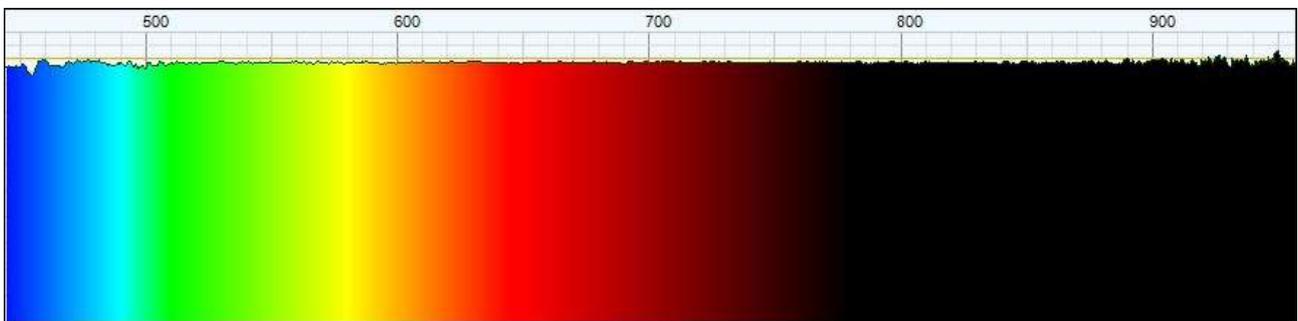
## Appendix 3 - absorption measurements (images)



**This is the spectrum of a small incandescent lamp.**

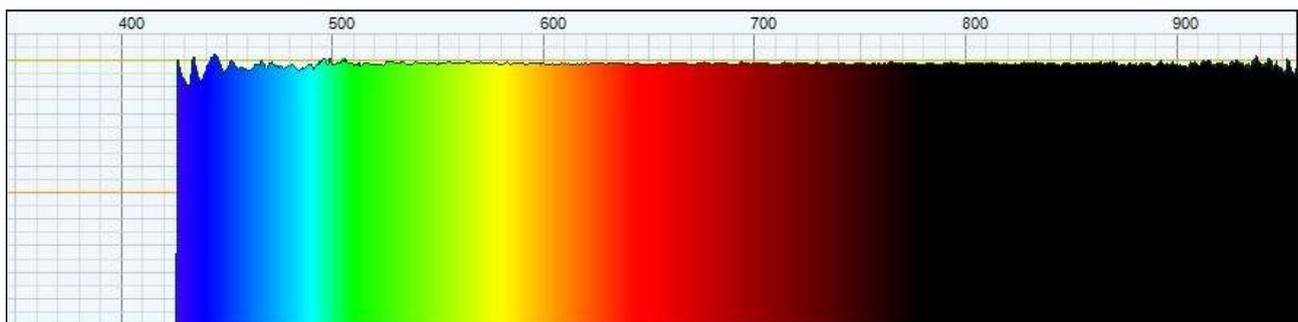
For this lamp useful area ranges from 450 to 950 nm for which we set the scale to see only this area. (It is considered as "useful area" the area in which the lamp emits at least a 15-20% energy).

It would have been preferable to have a more uniform light source (a broadband or at least one halogen), but such sources are expensive, difficult to build and very hot. So for these examples will be enough.



**Pressing the "Reference" occurs that the chosen area is actually all usable.**

Note that in the end zones, where the energy is low, the line becomes rougher. In these areas the measures are still possible but will be less accurate.



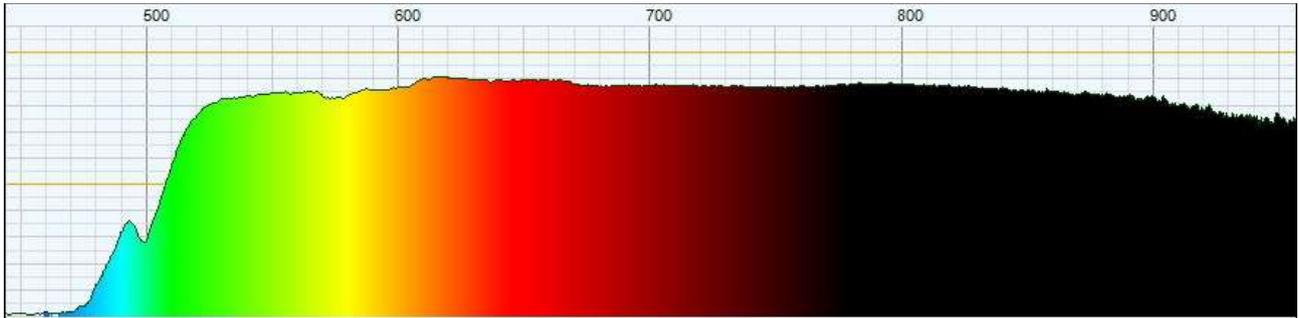
**Here we see what happens if you press the "Reference" using too wide an area.**

The area below 450 nm has too little light for the measures, and becomes progressively less smooth. Here you do not see the movements but this area as well as inaccurate is also very unstable.

Going down further, below 425 nm, the software determines that the area is too weak and unstable and discards it completely.

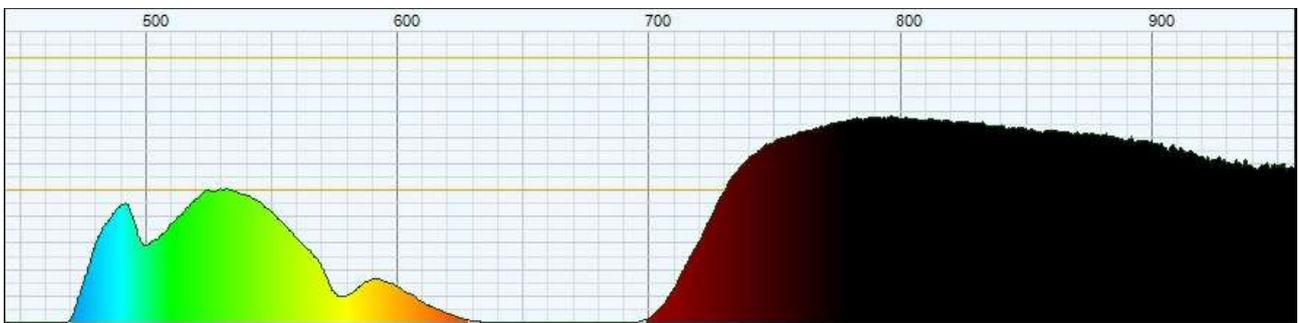
## Appendix 3 - absorption measurements (images)

In the next picture you can see the specter of some colored filters.



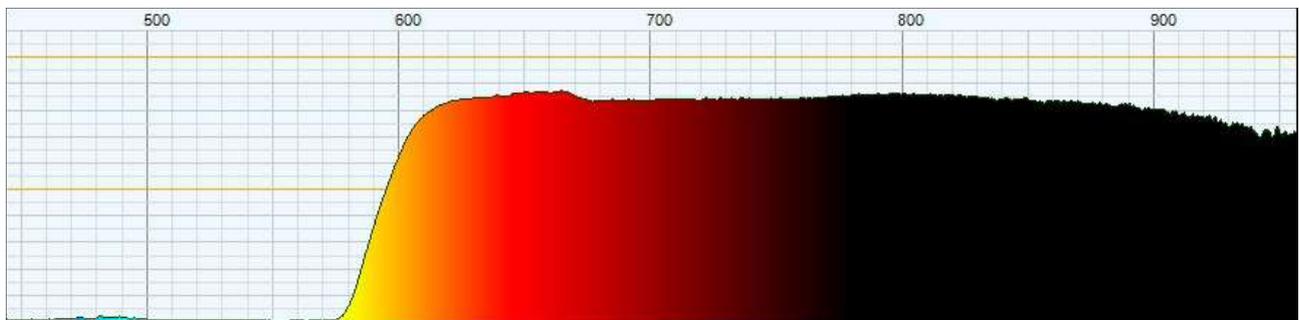
**Interposing a yellow filter the spectrum is not more than 100% (where the line is colored top).**

This filter attenuates yellow so decided by 500 nm down and let good, 80 to 90%, all other colors, into the infrared.



**This is the spectrum of a green filter.**

This filter passes the green with 50% of energy and attenuates all other colors except the infrared. Almost all filters allow the infrared headlights because otherwise they would heat up to ruin them.



**This is the spectrum of a red filter.**

Also this filter, in addition to its favorite color, transmits infrared very well.

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These spectra show the light that passes, not absorption. It would be more correct to call them "transmission spectrums" but the term "absorption" is more used.

To understand each other, when the line of the spectrum is high it means that a lot of light is able to pass, when it is low it means that the sample has "absorbed" much light.

## Appendix 3 - absorption measurements (images)

Here you see a simple construction for the measurement of color filters, using a small bulb made from a flashlight.

To consume little and make the batteries last longer, we used a light bulb for a little over 1 Watt (300mA at 6 volts) that fed a 4.5 Volt, consumes only 200mA.

With so little power you need to have a good parabolic reflector.

You can get the torch, the light bulb is the reflector, or you could use the torch complete.

The small tungsten bulbs as this little light in the blue and emit almost no light in the ultraviolet.

It would be preferable to use a broadband xenon lamp, or an halogen lamp.

Read the tips for the lamps, in the last pages of the document "Theremino Spectrometer Construction".

