PSAS-2016 MANUAL

Program developed by Guilherme Pereira at LIBPhys, Physic Department of the Faculty of Sciences and Technology, NOVA University of Lisbon

Content

Introduction

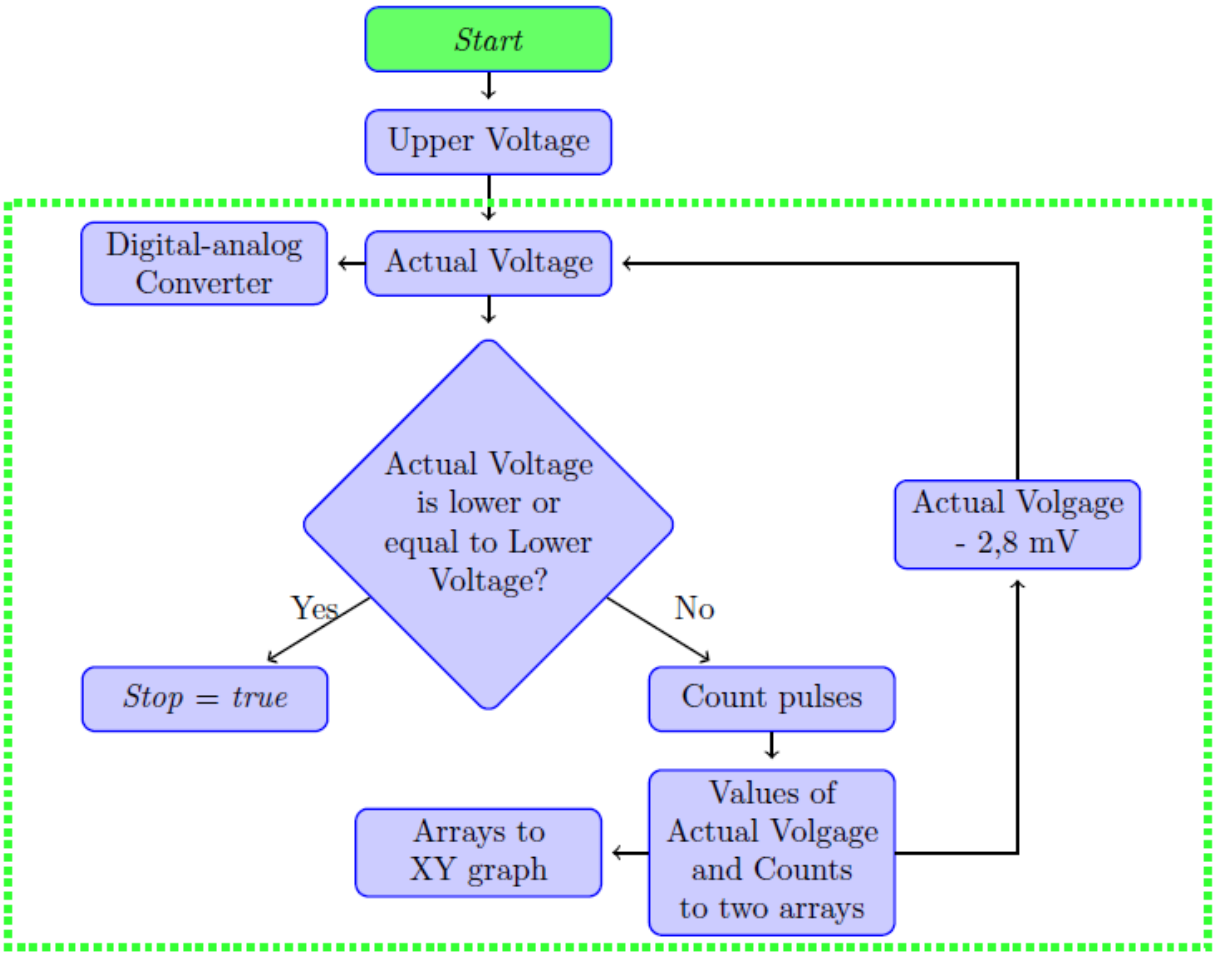
This is an acquisition program for an Ultraviolet Photoelectron Spectroscopy Spectrometer. It´s possible to use it to an X-ray Photoelectron Spectroscopy Spectrometer, but the proper changes are needed. The program applies voltages to two hemispherical electrodes and converts the potential difference to kinetic energy with the next equation:

$$E_{cin} = \Delta V(\frac{R_2^2 - R_1^2}{R_2^2})$$

where E_{cin} is the kinetical energy, ΔV is the potential difference and R_2 and R_1 are the radius of the external and internal hemispherical electrodes. If your spectrometer correlates the ΔV and the E_{cin} differently, which almost certainly will do, please notify me (email at the end).

The acquire signal is a TTL signal. Where each impulse represents the arrival of an electron to an electron multiplier.

The acquisition process is represented on the next schematic. The dashed square represents a block that´s only executed in intervals equal to the TimeStep.



Operating with PSAS

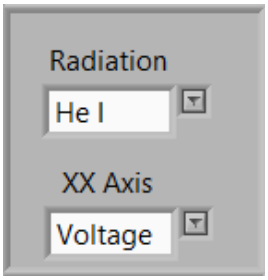
The program has 3 operating modes: the Normal mode, the Tune mode and the Accumulate mode

Normal Mode

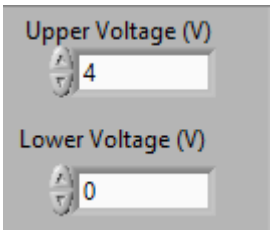
This mode is used to make a simple acquisition.

1- Choose the radiation type. The radiation can origin form the HeI or from the HeII. This step is important for the posterior definition of width of the window (see step 3).

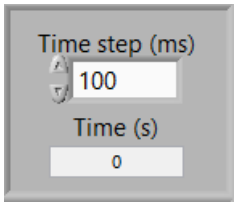
2- Choose the type of XX Axis,
   a. This axis can be shown in three different ways:
      i. *Voltage*, if you want to see the applied potential,
      ii. *Kinetic*, if you want to see the kinetic energy correspondent to the applied potential;
      iii. *Bonding*, if you want to see the bonding energy correspondent to the kinetic energy.
   b. <u>The XX Axis cannot be changed during the acquisition, but it can be changed after and the program will convert the values automatically.</u>



3- Definition of the window width. A potential difference it´s applied that goes from *Upper Voltage to Lower Voltage,* with an increment of 2,8 mV. <u>The window width should not be changed during the acquisition</u>.



4- Definition of the *timestep*. The *timestep is the time in milisseconds that the program acquires the counts for each applied voltage.*



5- The button *"Start"* starts the acquisition and the button "*Stop*" stops the acquisition.
   a. When the applied potential is equal Upper Voltage the acquisition stops automatically and a window appear asking if you want to save the acquire spectrum.
   b. If you stop the acquisition with the button Stop it is possible so save the spectrum. Just click on Save.

6- In order to avoid mistakes during the acquisition you should press "Hold Mouse". This will lock the mouse over the same button. To unlock the mouse left click again.

7- After accept the save option a new window will appear with several filing fields: User name, Time step, etc.
   a. Some of the entries are filled automatically according to the spectrum characteristics,
   b. It´s possible to write some text with observations,
   c. The filling of these fields is not mandatory but it´s recommended for future uses,
   d. <u>The spectrum is always saved with values in bonding energy.</u>

Accumulate Mode

This mode has a similar working mode has the Normal mode, but before the acquisition it´s mandatory to press the Accumulate button. The program, instead of stopping when the Lower Voltage is achieved, returns to the Upper Voltage and adds the new values with the old ones. This is used to intensify the relative intensities of the peaks on the spectrum and to show the differences of the sample during the acquisition.

Tune mode

This mode is used to optimize some characteristics of the spectrometer such has the Helmholtz coils, partials pressures etc.

1- Make a spectrum of Argon[1] with the Normal mode. **<u>This mode should be used with the XX Axis on Voltage mode</u>**.
   a. Advised parameters,
      i. ***<u>XX Axis</u>* on *<u>Voltage</u>*,**
      ii. *Upper Voltage* of 1.2 V,
      iii. *Lower Voltage* of 0.8 V,
      iv. *TimeStep* of 100 ms.

2- Press *Tune.*

3- Press a magnifying glass that appears on the lower left corner of the spectrum. Select the option that is highlighted on the image on the right.

4- With the mouse over the spectrum and the left button pressed select the peak.
   a. This will choose a fix potencial that is on the middle of the window. If the window is under 5 V and 3 V, the fixed potencial will 4 V.

5- Press start to begin the acquisition. The XX axis will now present the time with an increment correspondent to the time selected on the Time step.

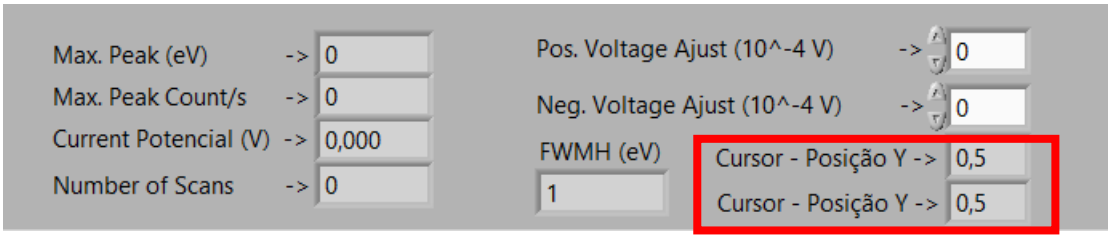
FWMH

During the optimizations, it´s necessary to measure the FWMH of the most intense peak of Argon. This width should have a maximum value of 30 meV. To measure this width a function was programed.

1- Press *FMWH*.

2- Somewhere on the 10 eV, two green cursors appear. Their position on the yy axis are shown on the highlighted indicators.

[1] Another gas can be used, but the Argon is the main gas to calibrate the spectrometer.



3- The energy width between the two cursors is presented on the indicator FMWH (eV). It´s useful to put the horizontal line of one cursor on the maximum of the peak, and the horizontal line of the other cursor at the half of the peak.

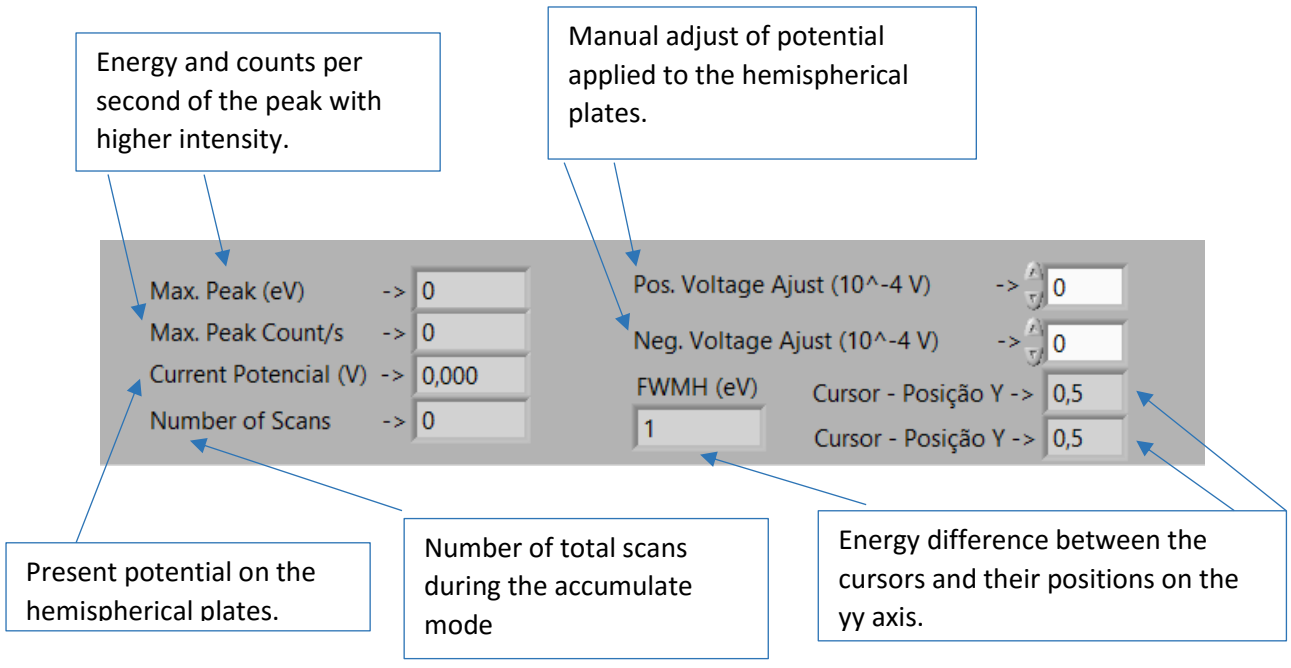
4- Drag the vertical lines in order to measure the FMWH.
5- To erase the cursor just press FMWH again.

Indicators

There are more indicators on the program that give some useful information to the user.

The controller with the title “Pos. Voltage Adjust (10^-4 V)” and “Neg. Voltage Adjust (10^-4 V)” are used to adjust the applied potentials, for example de acquisition board, instead of sending a potential of 5 mV could send, by mistake, a potential of 5,2 mV. This error can be correct with those controllers and a high resolution multimeter connected to the board.

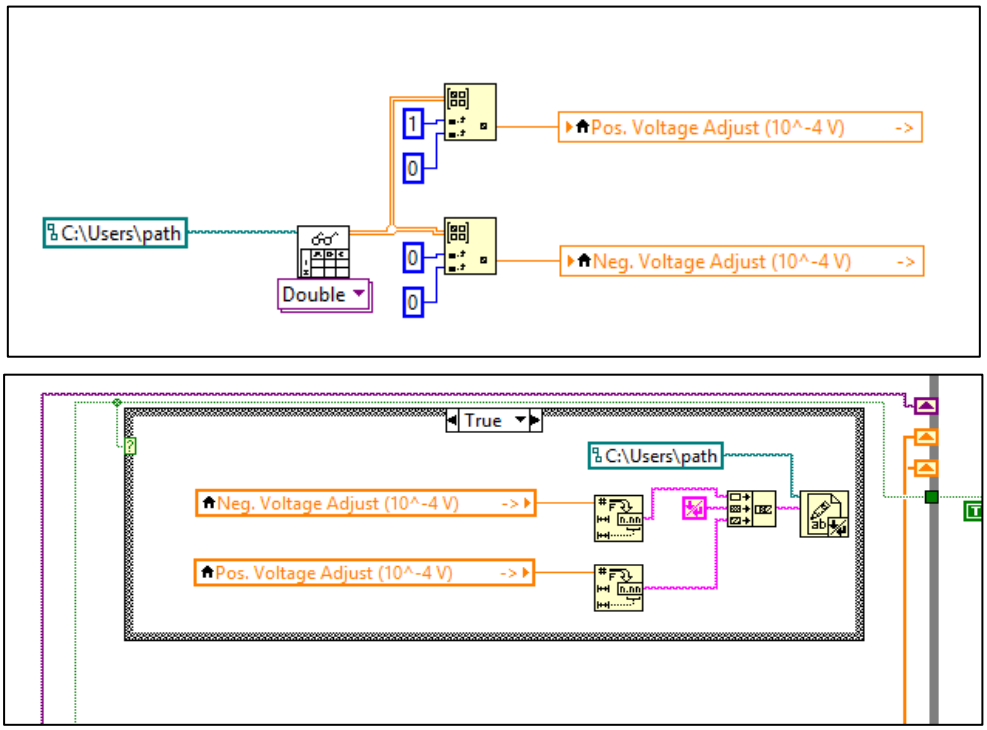
Attention: The error may not be linear. Instead of 2,000V the board can be sending 2,006 V, but for higher potentials the difference may not bet the same. You should measure the difference for several potentials and choose a medium adjust value.



Installation instruction

After opening the PSAS file, a LABView window will open searching for all functions, like sub-VI´s. In case you didn't installed the library for the acquisition board LABView will search the search the needed VI´s – It will fail because there aren't.

Afterwards you need to open the code of PSAS. And search for this:



The "path" referes to a text file where the values of "Pos. Voltage Adjust (10^-4 V)" and "Neg. Voltage Adjust (10^-4 V)" are saved. After that you are ready to go!

For any questions or problems email me under the subject "PSAS-2016 Question": guipinper@gmail.com