

Important spectra and how to determine the parameters

Parameters and conditions and their meanings

a) Parameters

```
fPar->pfRevolutionFrequency = 1.98777e6;
```

The value is needed for the correct folding/accumulation of the TDC spectra.

```
fPar->piPhaseOffset = 30;
```

Offset/shift of ALL TDC hit/bunch spectra in Bins of the TDC bunch spectra. The value can be used to center the peaks in software.

```
fPar->pfSetWavelengthLow = 601.7;
```

```
fPar->pfSetWavelengthHigh = 601.9;
```

Value will be used to determine PMTOverWL Spectra Range. But not the exact values will be used but they serve as input for slight adjustments to minimize binning effects. Please use the values here as you give them to the laser via the LabView control window.

```
fPar->piNOflaserSteps = 40;
```

The value is needed for the correct folding/accumulation of the step spectra. It corresponds to the number of laser steps per scan and defines the axis of all the step spectra (see section on Determining / diagnosing the number of laser steps below).

```
fPar->pusFoldStepSpectra = 1;
```

Used to fold the step spectra, i.e. add up the data or don't (0: continuous, 1: add up several scans). (see section on Determining / diagnosing the number of laser steps below).

```
fPar->piCSReductionFactor = 90;
```

Determines the frequency/time of the Common Stop (CS) Signal. 1 CS every $\pi\text{CSReductionFactor} * 1/\text{pfRevolutionFrequency}$ (with the numbers above: 1 CS about every 45,277 us) ...

```
fPar->piNOofCSForValidTimeRange = 12;
```

Used for the soft gating of the fluorescence light. Determines how many common stop intervals are included after one QSwitch signal are included in the analysis. In the example, 12 CS Intervals are used which approximates to $12 * 45,277 \text{ us} \sim 543 \text{ us}$. Please

ote that this time is now sharp since the actual TDC time of the Qswitch and the other TDC signals are not used.

```
fPar->piLaserStep = 0 ;
```

LaserStepCounter, leave at = 0, value changes during the analysis, LaserStep as a parameter allows for accessing and resetting the step counter e.g. every time the start button is pressed or via a script.

b) Conditions

Window Conditions starting with **wins** give the **range of allowed Scaler values**

(or: TDC size). **Use the spectra under 3_TDC/size to determine these values.** As a rule of thumb: For the RIB beams (208Bi) or low intensity 209Bi for detectors MIDDLE and NORTH only the values 1 and 2 should be allowed, for higher intensities 10 is reasonable. The value for XUV depends if it is hardware gated (not necessary at low intensities) or not.

Window Conditions starting with **winc** give the **range of allowed TDC values** (“Time peak”)

that are allowed. **Use the spectra under 3_TDC/accu to fix these values.** The peaks can be shifted with Offset Parameter which gives a time / phase offset for all (!) spectra. If you change the offset parameter the window conditions need to be adjusted correspondingly. Keep in mind that due to the additional hardware used to provide the 1ms hardware coincidence window the peaks with “GATED” in the name are at different positions than the ungated ones.

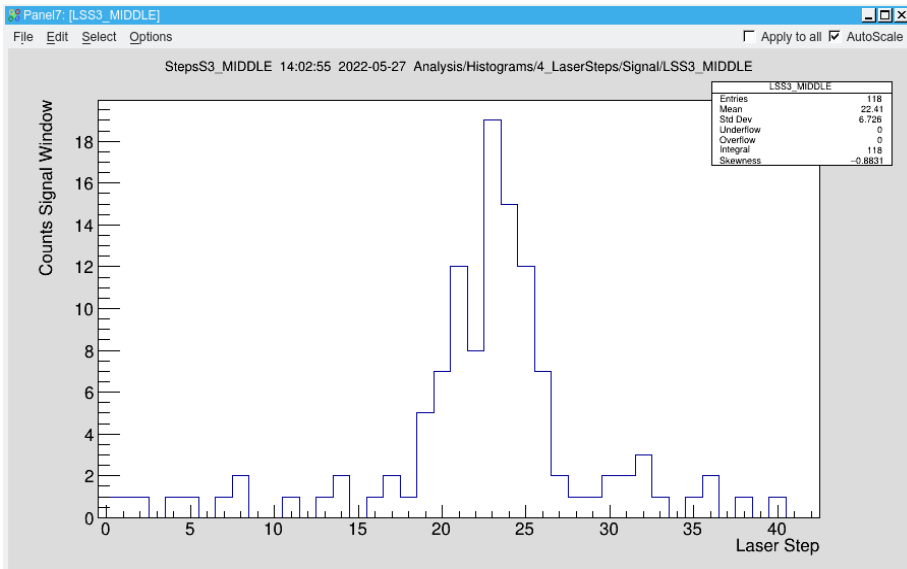
c) Resulting spectra

Filtered TDC spectra can be found under **3_TDC/accusig**. Filters: max numbers of counts (wins conditions), TDC peak (winc conditions) and soft gating(number of CS included) for ANODE, MIDDLE, NORTH.

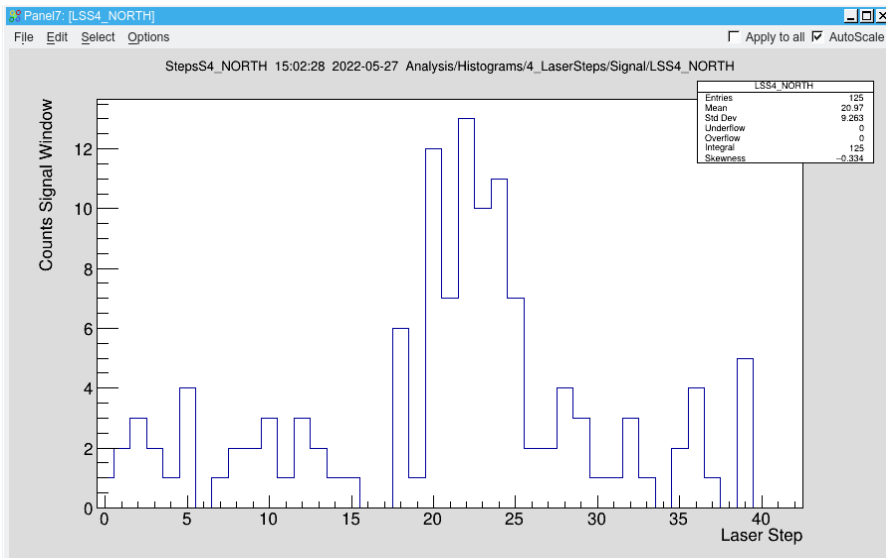
Filtered STEP/Resonance Spectra

In order to get proper STEP spectra use the LS0_N to determine the number of steps (see corresponding section).

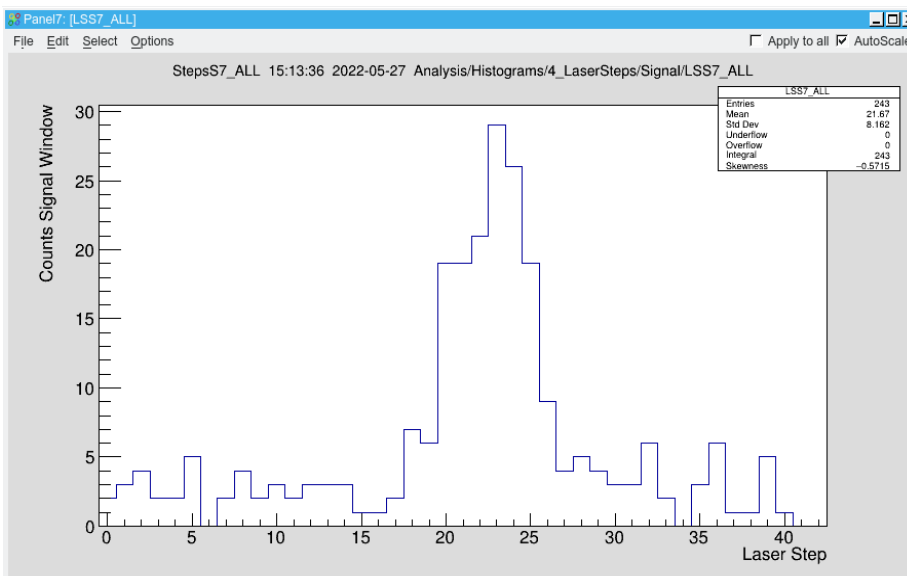
4_LaserSteps/Signal/LSS3_MIDDLE (here, files 8150, 8153, 8154 combined)



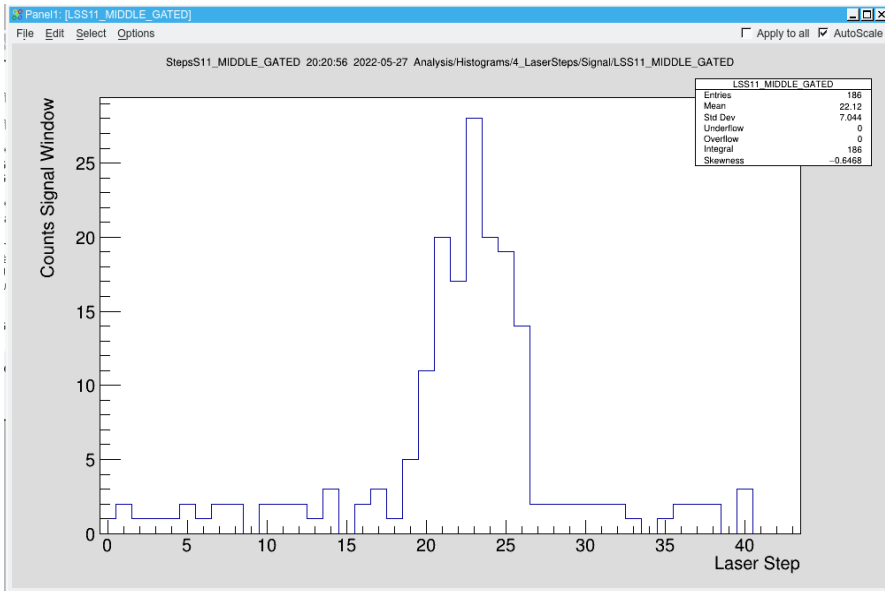
4_LaserSteps/Signal/LSS3_NORTH



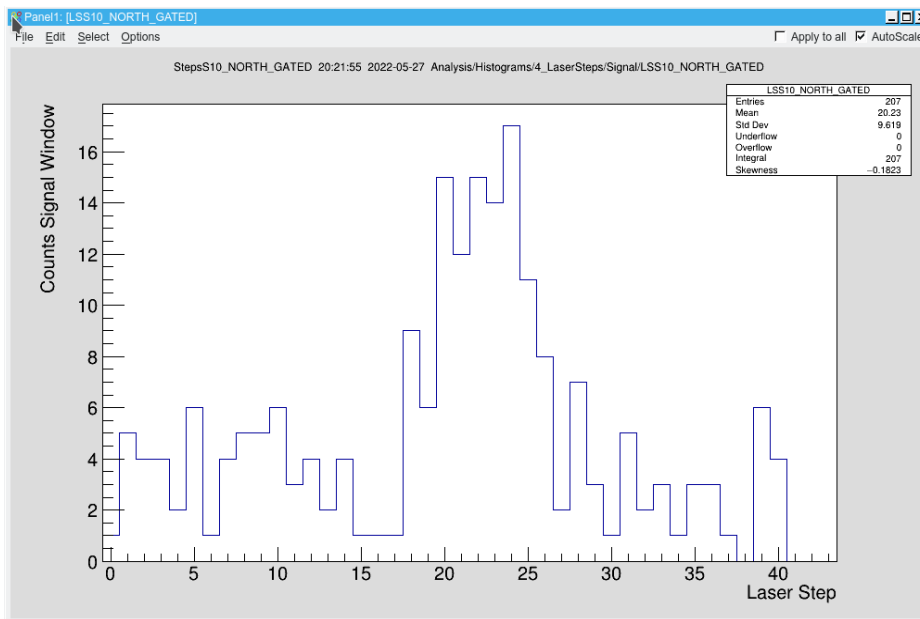
4_LaserSteps/Signal/LSS3_ALL (signals from both detectors added up).



4_LaserSteps/Signal/LSS3_MIDDLE_GATED



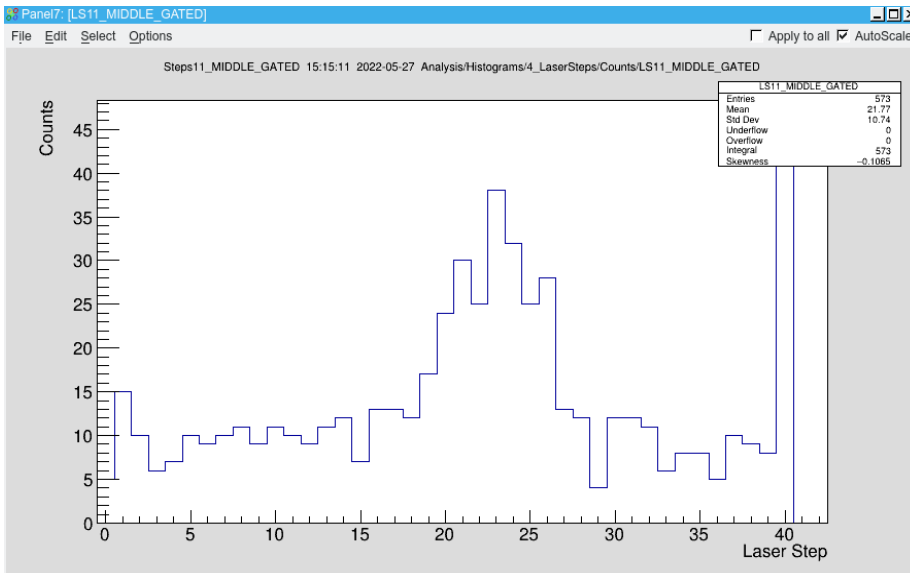
4_LaserSteps/Signal/LSS3_NORTH_GATED



Please note that the hardware gating and the software gating do not work together so that there is no filtering for the hardware gated (1ms) spectra.

Unfiltered STEP/Resonance Spectra

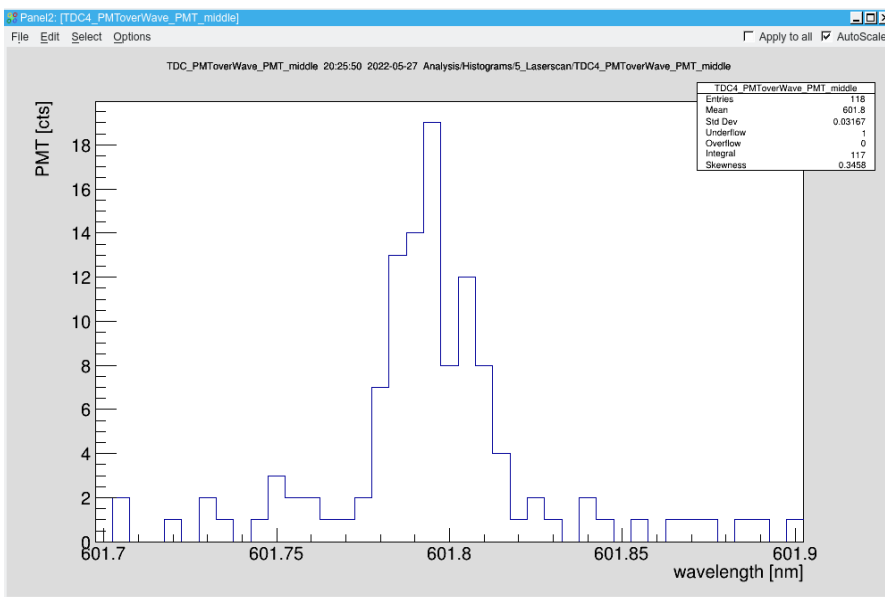
All spectra under 4_LaserSteps/Counts are unfiltered (raw data). Of course, the LS10_NORTH_GATED and LS11_MIDDLE_GATED show only the gated 1ms, all others the full 30Hz (33ms).



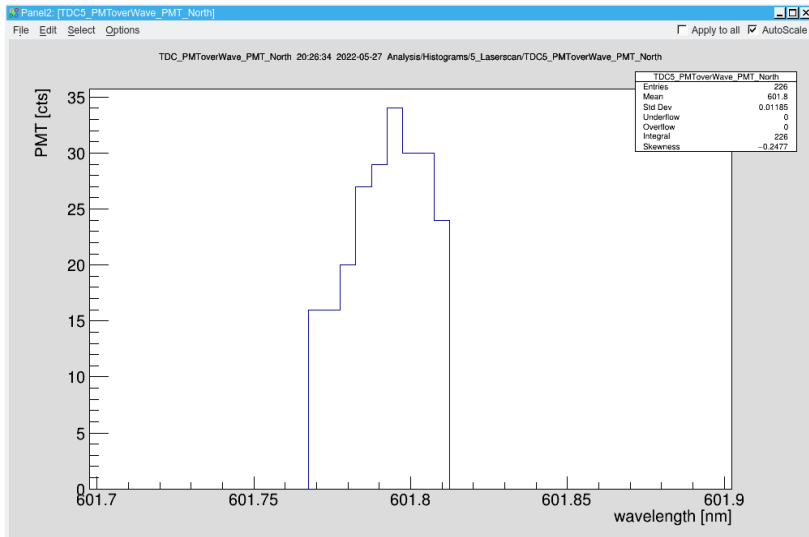
PMToverWave (5_Laserscan)

In the SetParameters.C the two values of the actual set san range (as given in the LabView control of the laser) and the number of steps need to be given. From these parameters useful parameters for the borders of the spectra are calculated to minimize binning effects. The PMT/Anode spectra are filtered, MIDDLE, NORTand ANODE in addition have the soft gating.

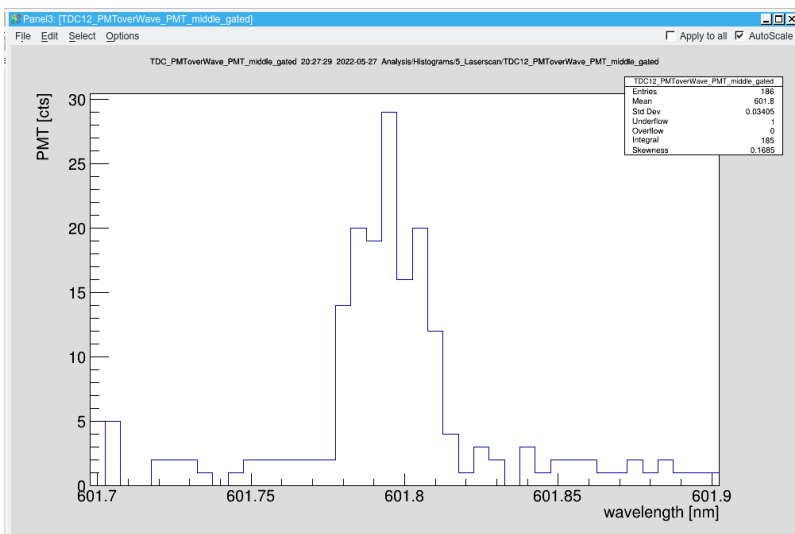
5_Laserscan/TDC_PMToverWave_PMT_middle



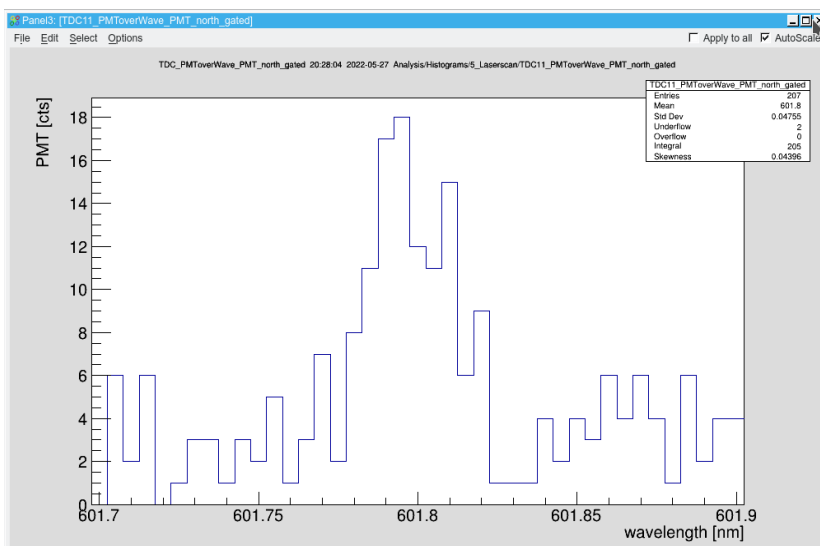
5_Laserscan/TDC_PMToverWave_PMT_North




5_Laserscan/TDC_PMToverWave_PMT_middle_gated



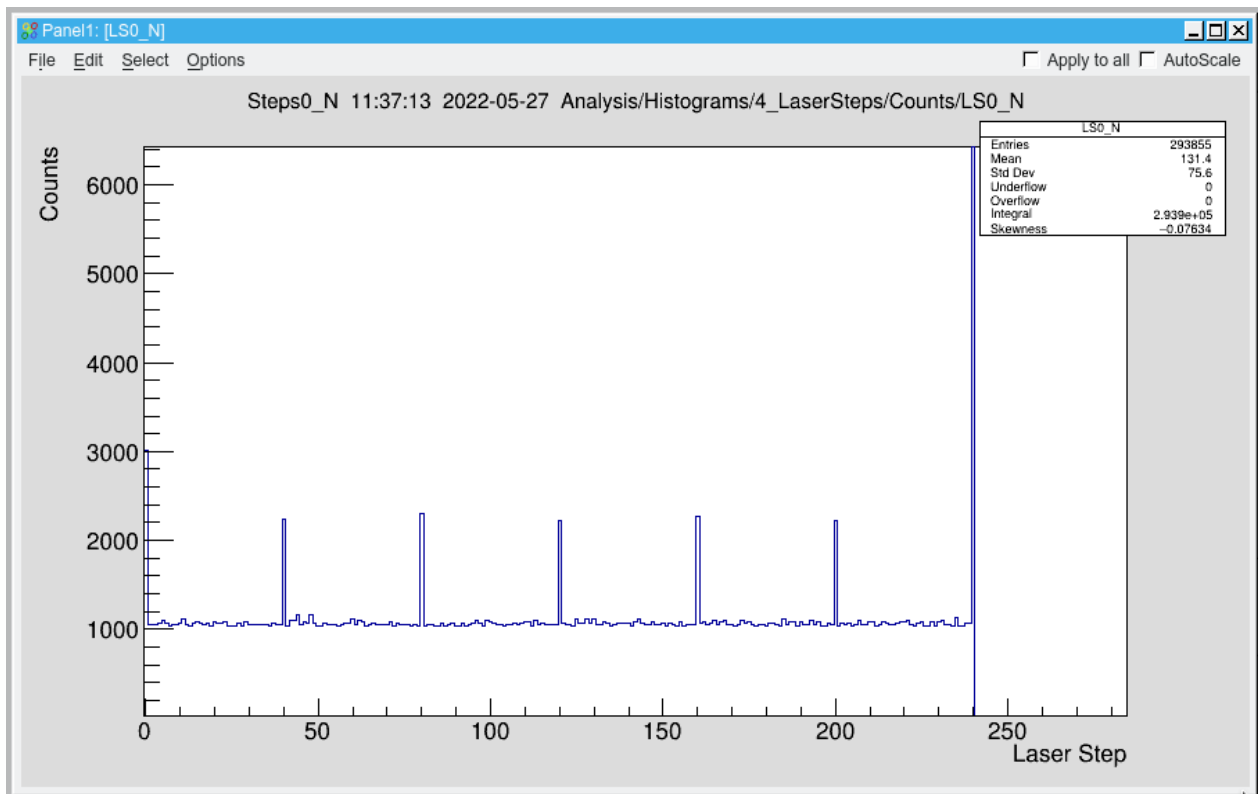
5_Laserscan/TDC_PMToverWave_PMT_North_gated



Determining the laser steps

For the laser steps, the next laser step pulse in the scalers (presently ch 30 when counting 0 to 31 and TDC scalers in channels 0 to 15). The steps are counted in the parameter **fPar→piLaserStep**. The variable is reset to zero by modulo with **fPar→piNOFLaserSteps**. So it is important to set this value correctly and check in the step spectra. In addition, **fPar→piLaserStep = 0** (i.e. reset) every time the start button  is pressed. This is to force starting the step spectra with the first step if the analysis is paused (stop-start) for a new injection. In order to check/measure/verify the correct value **fPar→piNOFLaserSteps**. With the parameter **fPar→pusFoldStepSpectra** the modulo division (“the folding” / “resetting” after **fPar→piNOFLaserSteps** can be switched off to determine the proper value for **fPar→piNOFLaserSteps**. **fPar→pusFoldStepSpectra = 1** folds the spectra (adds up several scans) **fPar→pusFoldStepSpectra = 0** leads to a long sequence of all new steps.

For this 4_LaserSteps-Counts-LS0_N is very helpful as in the unfolded spectrum one can immediately see if everything is working correctly and which value to chose for **fPar→piNOFLaserSteps**. As an example, in the unfolded spectrum below (file 8150) we see 6 scans with exactly 40 steps, i.e., the peaks have to be at exact multiplies of 40 (40/80/120/...).



In the folded form where data are added up the spectra looks like below.

