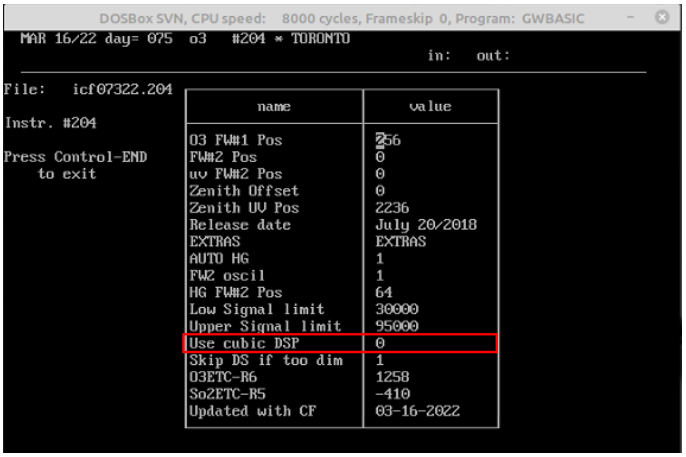
Finding a Dispersion from Scratch

This document describes how to manually determine a dispersion if the software (DisPro) is unable to. DisPro needs the emission lines to fall within 150 steps of what is expected using the current dispersion and will then optimize the dispersion. If there hasn't been a dispersion done or the current dispersion is too far off, then it will need to be calculated manually.

If the instrument has been drastically changed during maintenance, review all procedures taken to ensure the instrument is truly in its best state. Meaning, ensure the mirrors are in their normal positions contacting all three kinematic points. The gratings are well mounted, all glue points are intact at the mount blocks and the blocks are in contact with their three kinematic mounts. The configuration file will allow movement of the micrometers to all wavelengths and the micrometers are mounted in such a way that all necessary wavelengths can reach the sensor.

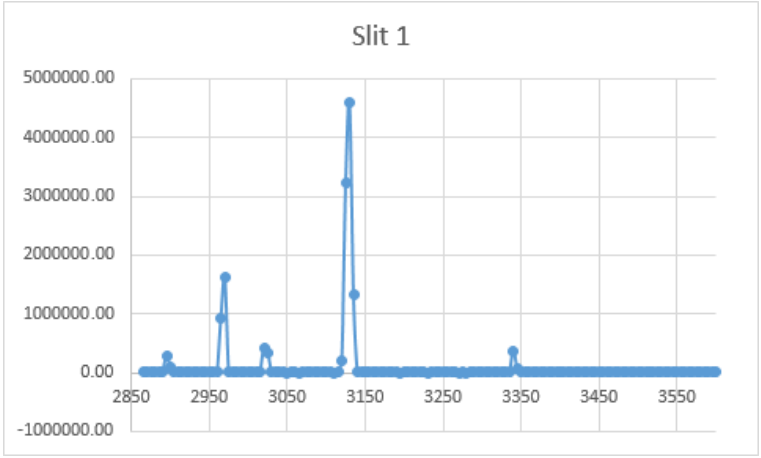
If all these conditions have been met and the dispersion is beyond what DisPro can handle, then a manual calculation for the instrument will need to be done. It is assumed that the instrument has been setup sufficiently to perform an HP and HG command. If not, refer to "Initial Determination of the Micrometer Reference" in the Brewer Wiki. Change the constants file to NOT use cubic dispersion to reduce the complexity of the process



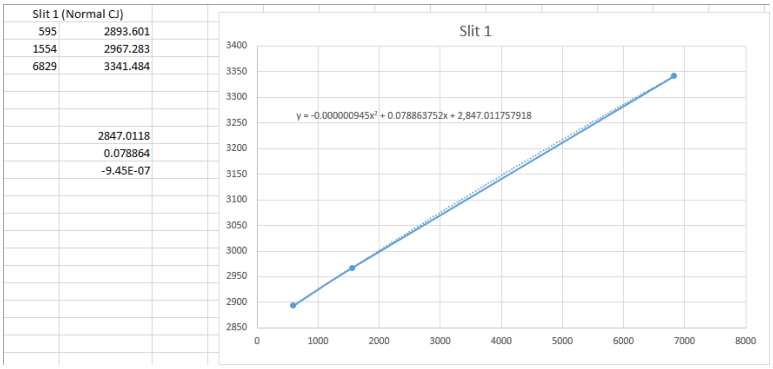
First run a CJ on the instrument using the following string:

pdfrhphgb1w0cjpd

This will create a scan on slit 1 (as it does in normal operation). Plot this scan to ensure the emission lines are as expected. There should be a small peak at 289.3601 nm, moderate peak at 296.7283 nm(the reference) a slightly smaller one at 302.1504 and a very large one around 313.3 (there is more than one emission line here, don't use if it can be avoided) and another small one at 3341.484.



Next, find the step number at emission peaks that should be at 2893.601, 2967.283 and 3341.484. In the example below they fell at 595, 1554 and 6829 respectively. Plot those points and then add a trend line using a quadratic fit. In MS Excel that would be done using polynomial order 2, check “display equation on chart” and then right click on the equation and change the format from general to number and extend the values to 9 decimal places. The three resulting values are the first set of values within the dispersion file.



This process must be repeated for the rest of the slits. To do this, the CJ routine must be altered. Open the CJ.RTN file in the program directory and find line 14670. The "SQ=1"within the line, refers to slit 1. Change this to “SQ=2” to process slit 2. The other slits, 3 through 5 will also need to be processed in the same way. The 3 values calculated from scanning Slit 2 become the second set of 3 values in your dispersion file.

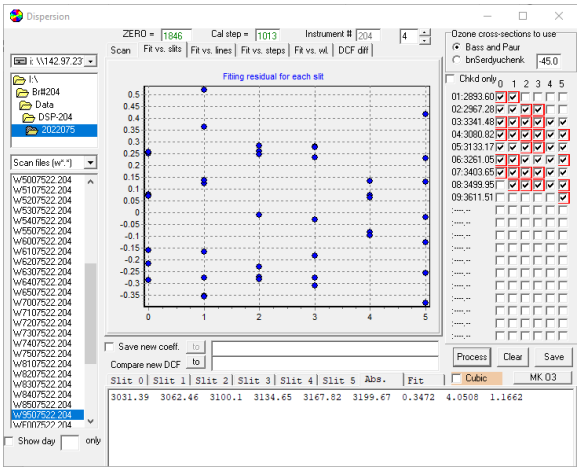
Further scans on the subsequent slits produce the other sets within the dispersion; however, Slit 0 is the 6th set of values within the dispersion and given their nature this process does not calculate them well.

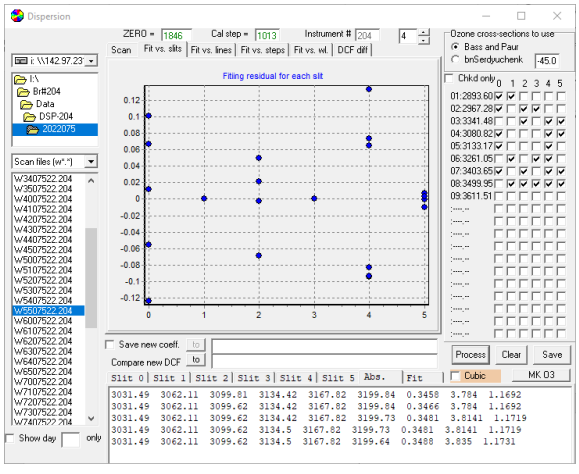
After Slit 5 has been completed and the calculated values have been added, return the CJ back to its original form with “SQ=1”

Run: pdfrhphgdp

This will run a dispersion on the internal HG lamp. Look at the “W” files that ran on Slit 0 and pick the step number that is at the peak for those wavelengths and plot the line and add the trend line and equasion for Slit 0. These values can be added to the 6th set of values within the dispersion. All other values following this 6th set can be left as is.

The dispersion should now be close enough for a normal dispersion run under DisPro. Produce a quadratic dispersion, eliminating any scans that have been highlighted. Review the dispersion results first looking at Fit vs Slit then Fit vs Line to determine those scans that are the farthest outliers. Remove those outliers one at a time, reprocessing after each removal until no more scans are highlighted. Save and apply this quadratic dispersion.





Lastly, run a new dispersion using the HG & CD lamps and process a cubic dispersion using DisPro.