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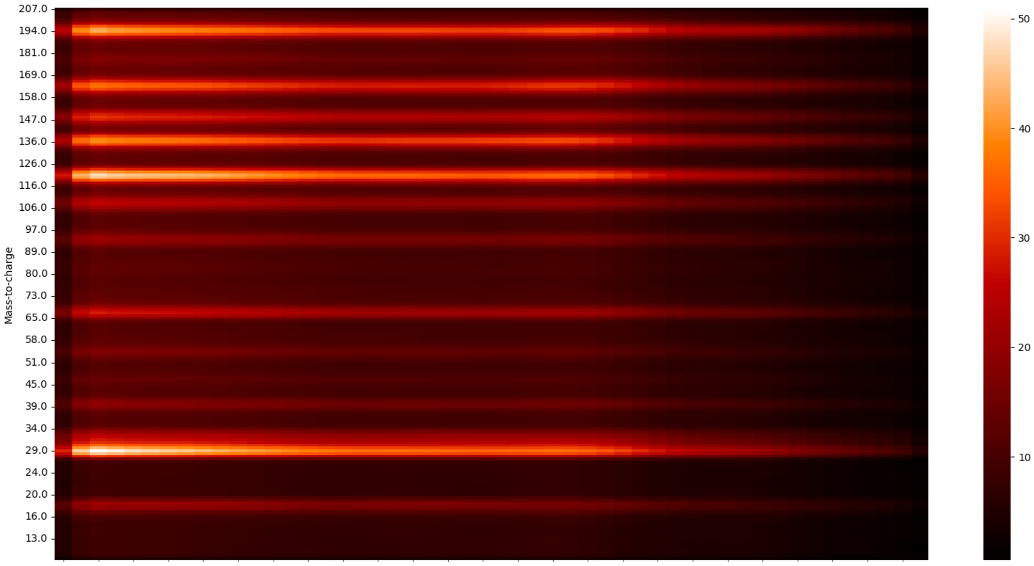
# 1 Thesis explanation

Hello, this pdf contains a very simplified explanation and some visuals of code related to my master's thesis. The pdf is made as a simple explanation and should not be taken too seriously. Its purpose is to give some context and visualise the results of the code, so I am not just posting arbitrary lines of code or forcing anyone to read a 60 page thesis to understand a line of the code. But for those interested I am more than happy to give an more info or even a presentation.

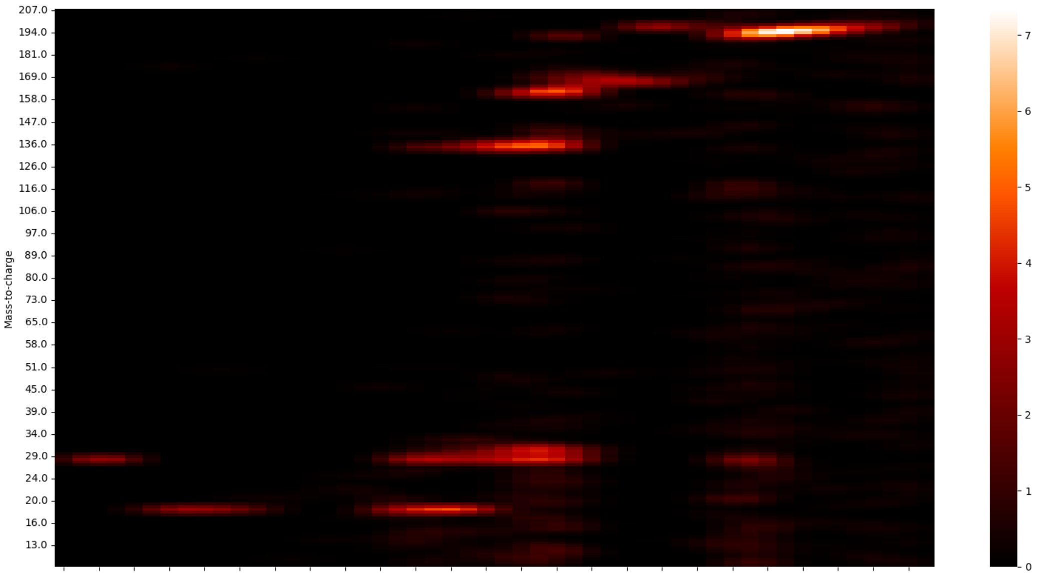
# 2 PEPICO

To put it very shortly in PEPICO we are trying to measure the flight time of the ion and the energy of the electron that separated from it. The data that we get consists of these pairs. We don't know which of the pairs false pairs and which true pairs. In false pairs the electron is not from the detected ion and in true pairs it is. These pairs can be visualised as a 2D histogram (PEPICO map) shown in figure 1. However this photo does not give us any usefull data since it has both false and true pairs (it is just noise).




Kuva 1: No false events removed

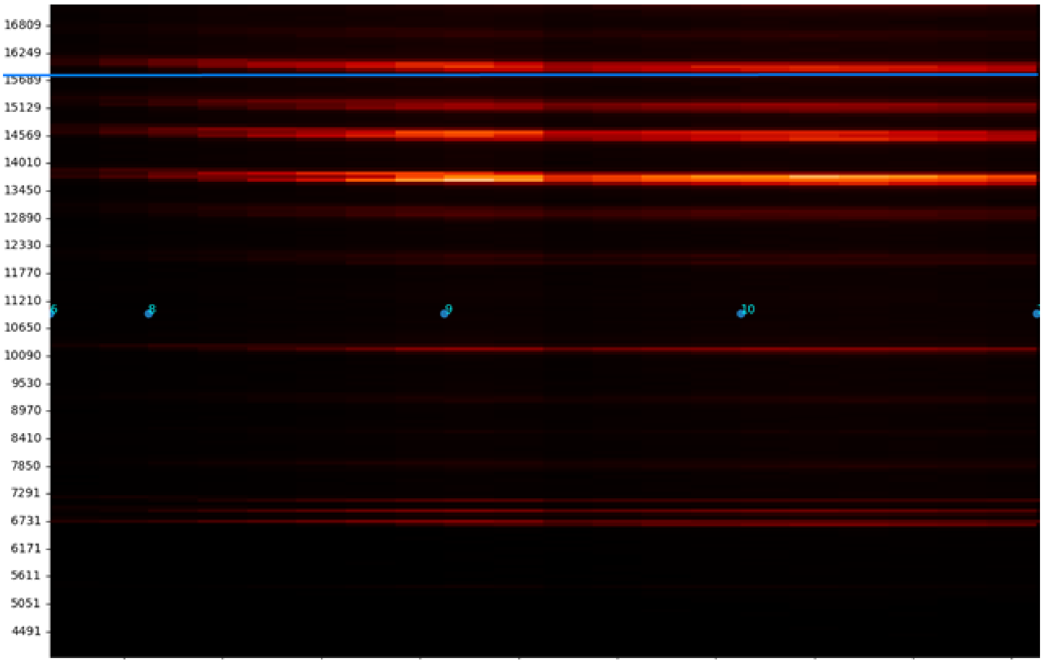
To get get useful data from the map we need to remove the false pairs, which is done by introducing additional known false pairs during the measurement. These known false pairs will be ignored during the analysis and they can be used to statisticly remove false pairs from the data, without affecting the measurement. This can be done by reducing the average amount of false pairs from the map. Figure 2 shows the true PEPICO map. Which can be used to get data of the molecules bonds.




Kuva 2: True PEPICO map

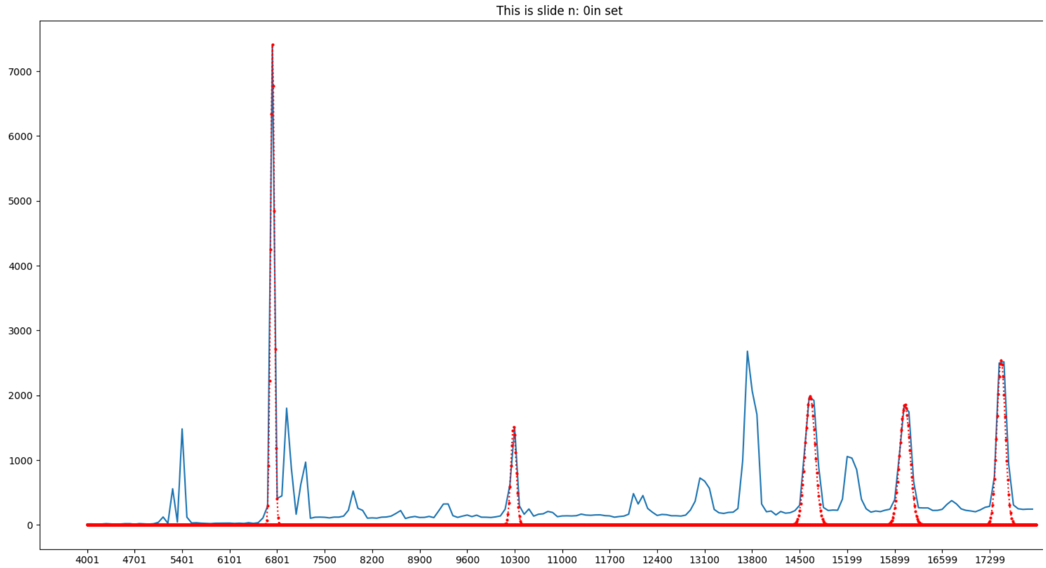
# 3 Drift fix

Second very notable part of the thesis is fixing the drift that formed during the measurement. The drift can be see in figure 3, where looking at the red data points shows a noticeable dip after the beginning(left side). Blue line helps to visualise the dip. To make the measurement consistent this needs to be evened out.

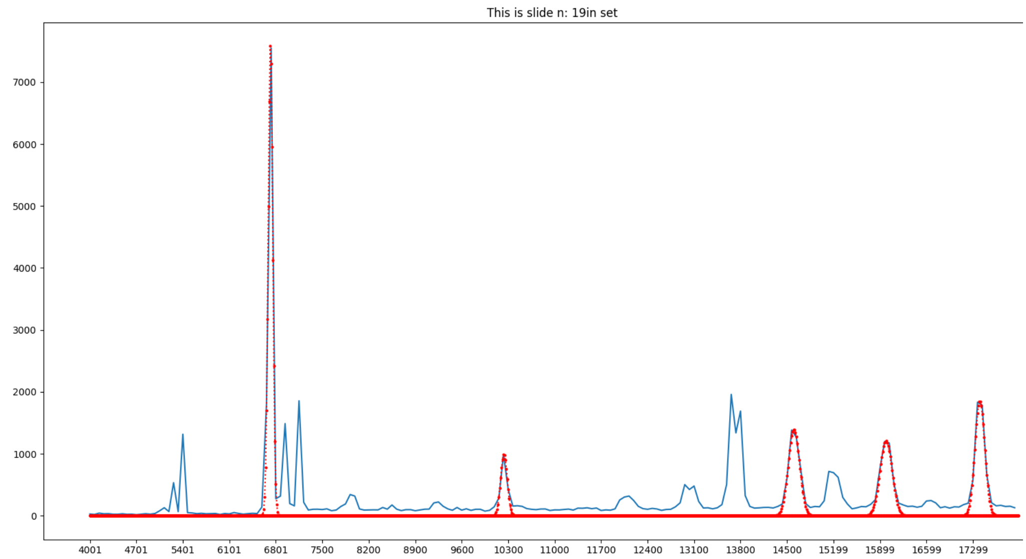



Kuva 3: Every red line has a noticeable curve in the beginning, which we call drift

Drift fix is implemented, by splitting the measurement into equal slices. The data in these slices can be represented as a histogram. Example shown in figure 4 and 5. The code recognizes the peaks (the peaks are formed by specific ions) and fits a gaussian to them. Peaks position can be used to determine how much they have drifted from the average position.

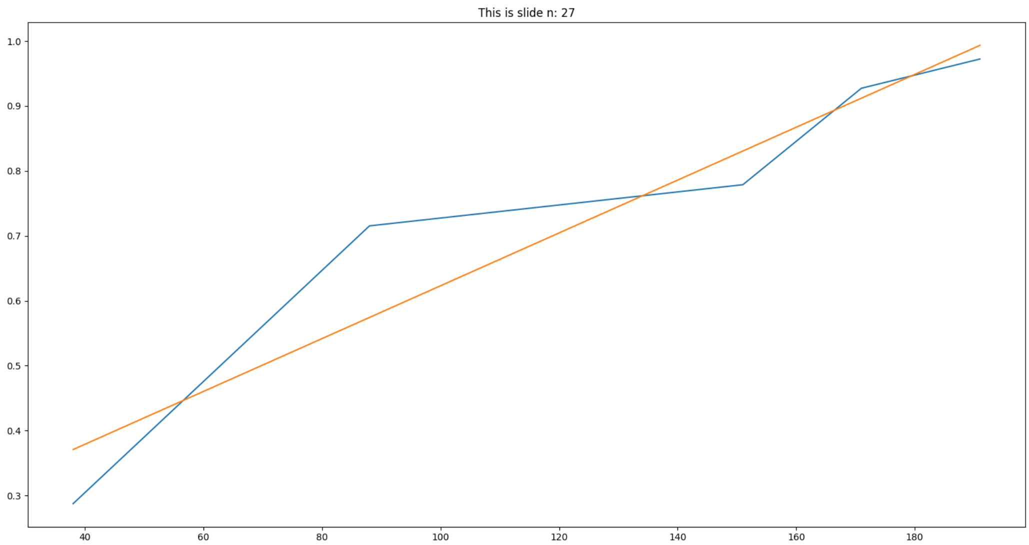



Kuva 4: Fitted peaks from slide 0 (peaks have drift)

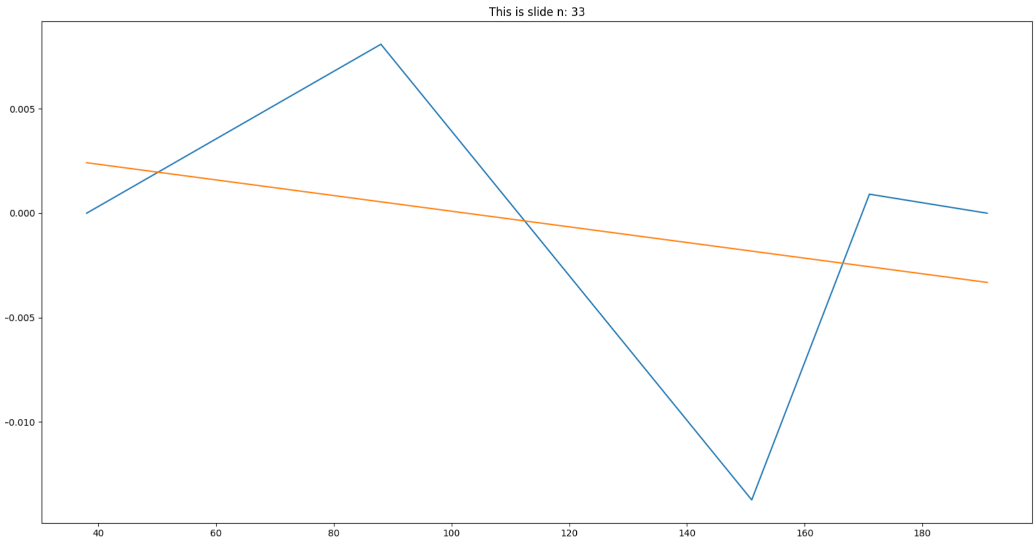



Kuva 5: Fitted peaks from slide 19(peaks do not have drift)

Figures 6 and 7 shows the amount that the peaks in the slices 27 and 33 have moved compared to the average of their respective peaks. If we see a clear correlation, a line will be fitted. The lines parameters can be used to correct flight time, by applying it to all of the data points in the slide.

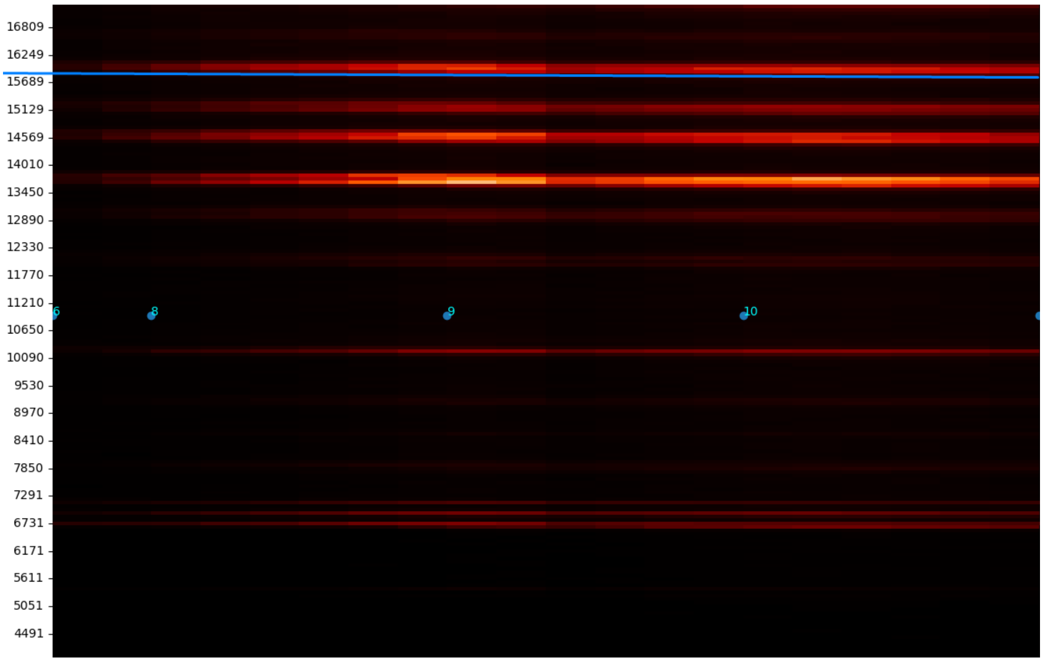



Kuva 6: The amount of miss alignment for each peak in slide 27 and the fit used to correct it




Kuva 7: The amount of miss alignment for each peak in slide 33 and since it is so small, no correction needs to be made.

Using the parameters figure 3 can be corrected to figure 8, which means now all of the data points can be used in the analysis.(Since the code for this is automatic the correction is even easier than the semimanual used in the lab, that uses paid software)




Kuva 8: Ion flight time, but the drift has been fixed. The blue line is in the same spot as in figure 3, so we can clearly see that the drift has been fixed.