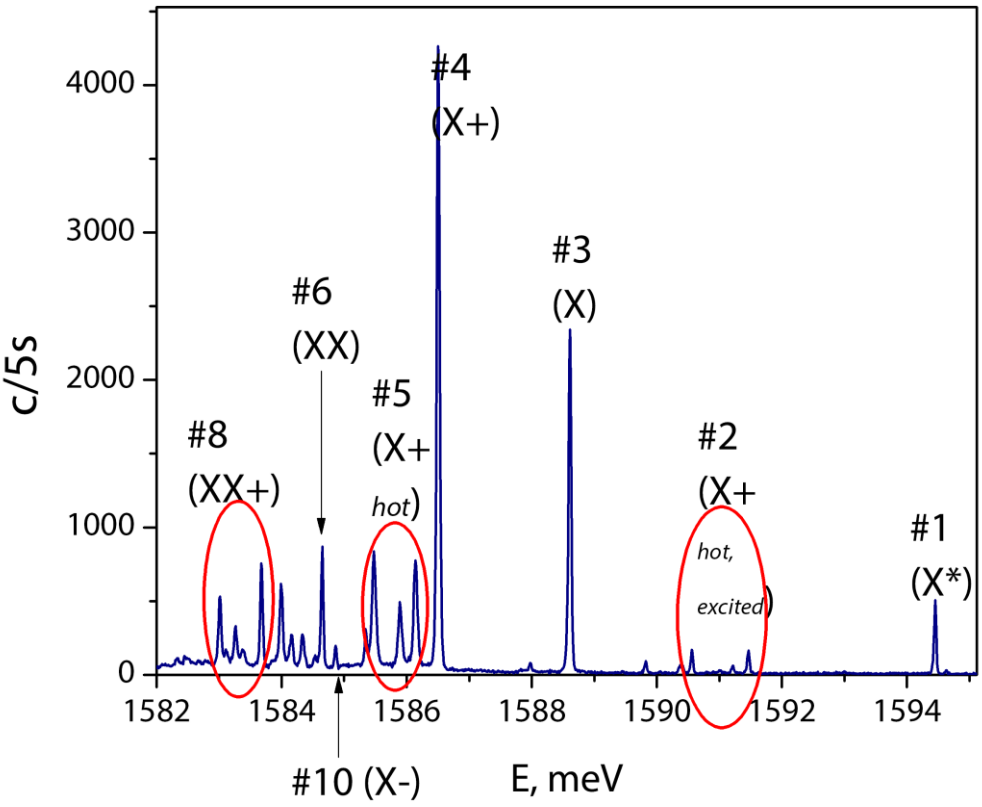
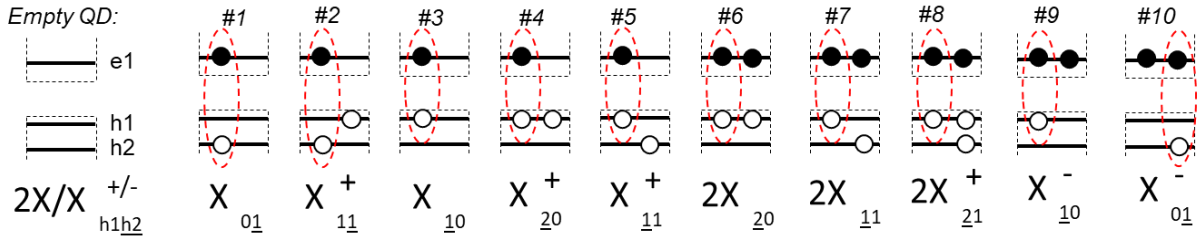
- The spectra of GaAs QDs is composed of multiple excitonic complexes. Most of them were reliably identified.
- The uniformity of the excitonic spectra is very high – the order of the spectral features does not change over the same sample. This could be the first and significant condition constructing spectra for training.
- Slight excitonic order variations can be observed for different recipes, so the program probably should be trained separately for each nominally different epitaxial design.

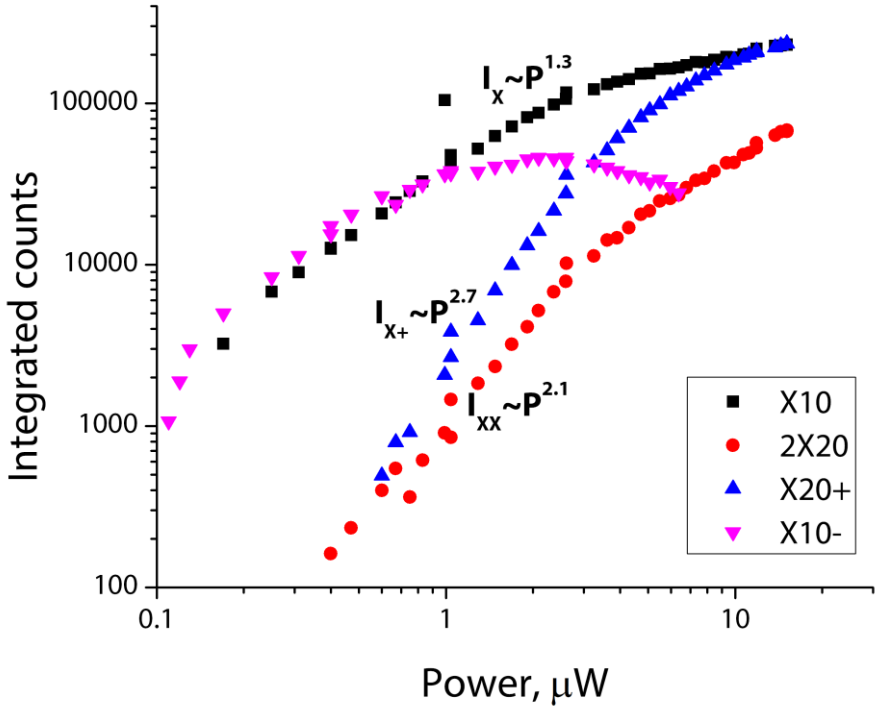




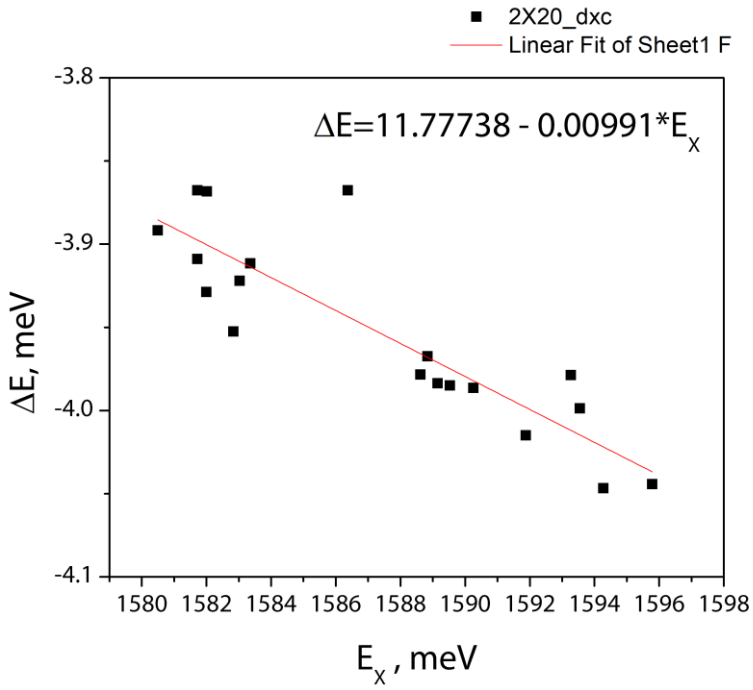
- Power dependent measurements are very useful at the lowest excitation power. Typically the first peaks to appear are the neutral exciton and positive trion. The recognition of a positively charged QD is following: if the two peaks appear at low power, need to observe if the peak on lower energy have three, less intense peaks. If so, it's a positive trion. In case of a negative charging, the negative trion

is also at lower energy but it has the biexciton appearing on its lower energy, nearly overlapping. As explained below, the separation between the peaks (binding energy) is very uniform in all dots, therefore the relative energy of all transitions can be precisely predicted.

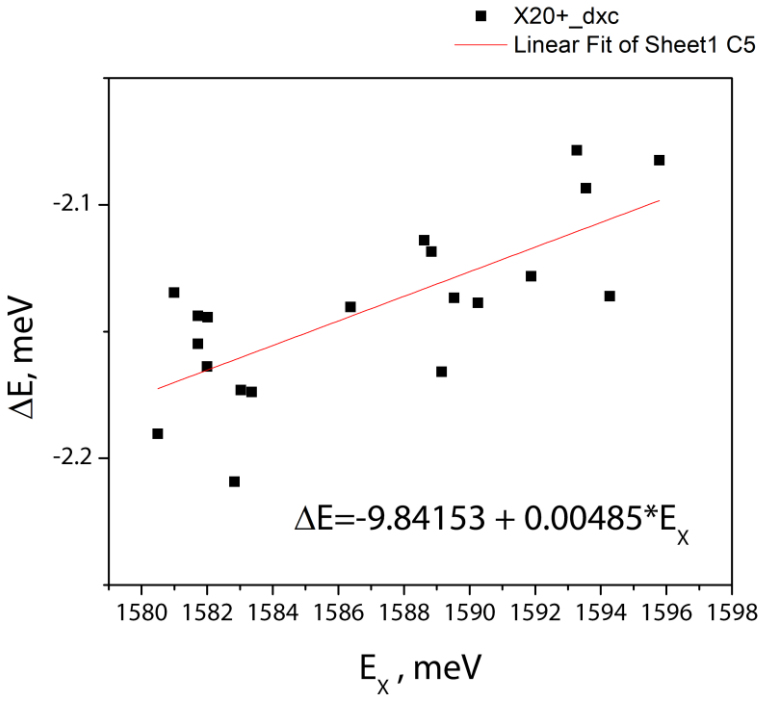
- The biexciton appears at the power level when multiple charged transitions become significant (if the dot is charged – which is a very common situation). Energetically it is very close to these peaks – sometimes it is very hard to identify it. Also because of charging during non-resonant CW excitation, the biexciton saturates much quicker – so it's never bright. Therefore the biexciton is not the most convenient option.



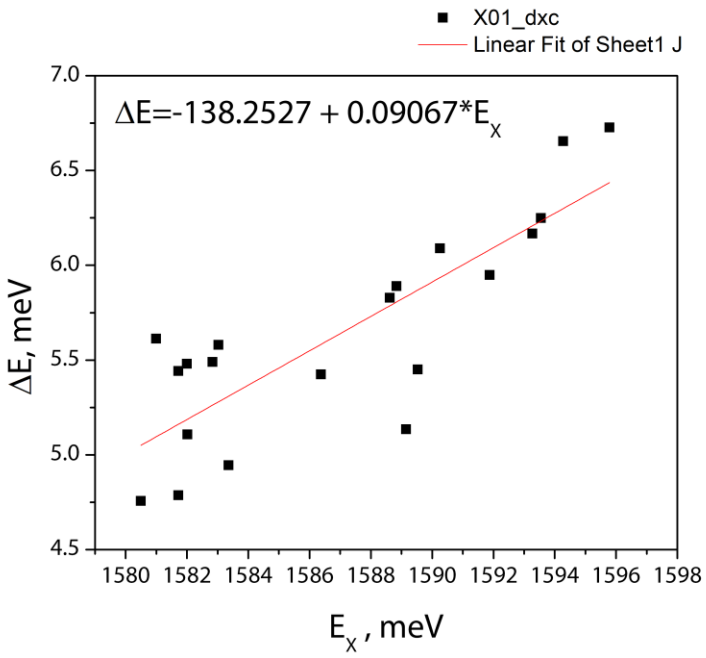
- The fine-structure splitting is very helpful identifying the exciton (and biexciton if it can be distinguished), but it's very possible that the main purpose of the recognition procedure might be to identify the dot which has no fss of exciton. So certainly fss needs to be as an input, if it exists – the identification becomes much easier, but if no fss, no conclusions should be made.
- The good part is that the binding energies (separation between peaks) are uniform, and specific to the exciton emission energy (a QD size). Knowing (or picking) the exciton emission energy very realistic spectra can be simulated for training. See below:
- The biexciton energy (#6) can be calculated as $\Delta E=11.77738 - 0.00991*E_X$. Not sure what is the error (maybe RSS=0.0135meV).



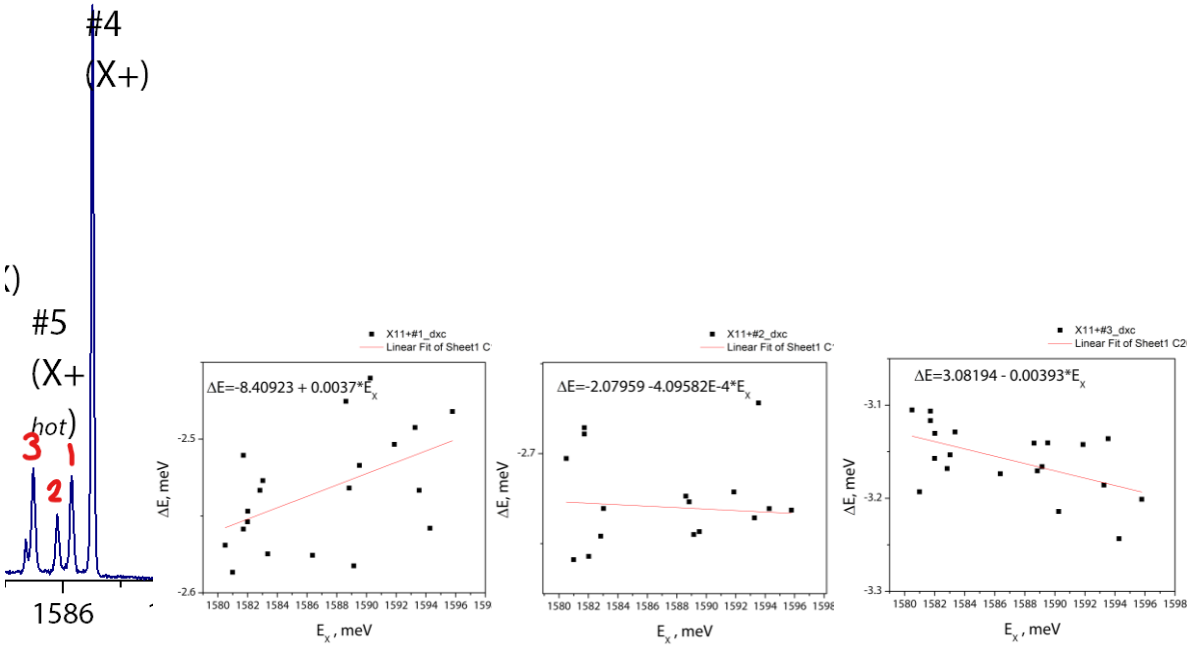
- A positive trion (#4) X_{20}+ as $\Delta E=-9.84153 + 0.00485*E_X$ (RSS=0.01)



- Excited neutral exciton (#1), several times less intense than the exciton (#3), but both are always present: $\Delta E=-138.2527 + 0.09067*E_X$. This peak fss of very similar size as the ground exciton, but with an opposite phase (orbitals are changing parity).



- Three (dominant) peaks of a hot trion (#5) always when the ground trion (#4) is present – this is a very characteristic feature to identify the type of peaks.



- Peak #5-1: DE=-8.40923 + 0.0037*EX
- Peak #5-2: DE=-2.07959 - 4.09582E-4 * EX
- Peak #5-3: DE=3.08194 - 0.00393*EX

- #8 Charged biexciton must repeat inverted energetic structure of a hot trion (#5), but I still need to process data.

- #10 a negative trion is less common, but in this sample is systematically there with slightly higher energy than the biexciton (#6). I need to process related data.

- I probably need more power dependence measurements to see how they deviate from the theoretically expected cases.

- In principle, for the initial point of training having generated spectra having an exciton, it's excited state, positive trion and hot trions (3 peaks), with fss might be enough.