# Optical investigation of monolayer and bulk tungsten diselenide ($WSe_2$) in high magnetic fields

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## Supplementary material: Extracting the energy of the exciton peaks

In this section we show four figures in which Gaussians are fitted to the raw data to extract the energy of the exciton and trions features.

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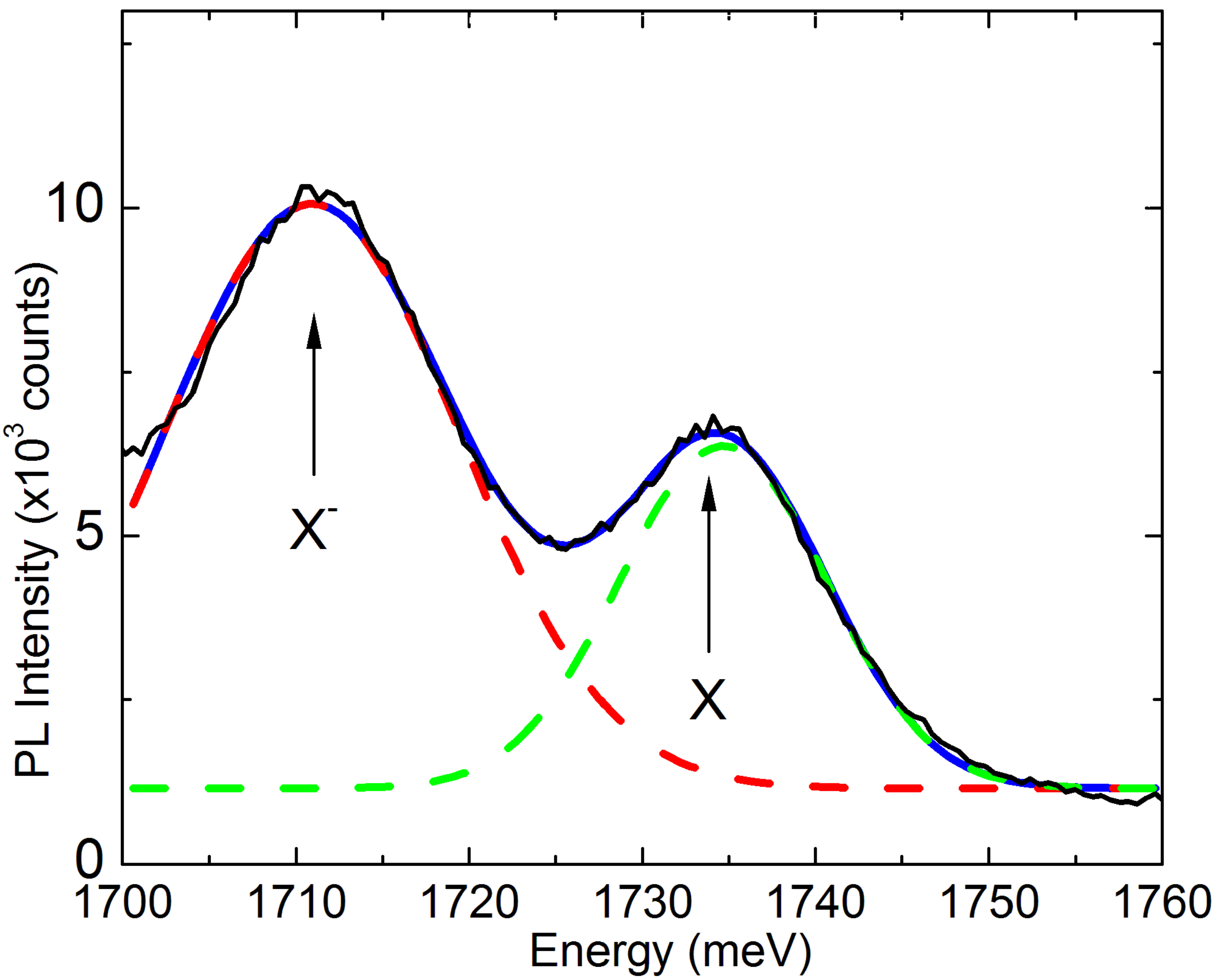


Figure S1: Micro PL spectra of $WSe_2$ at zero magnetic field (black line with noise) - this is a zoom of the data in Figure 1 of the paper. The red and green lines are individual Gaussians fitted to each peak. The sum of the two Gaussians (blue line) fits the data almost perfectly. There is a small constant background which is an order of magnitude smaller than the amplitude of the trion peak and a factor of 6 times smaller than the amplitude of the exciton peak. The fitting procedure generates an estimated error for the peak positions of $\approx 0.1$ meV. Our more conservative estimate for the error of $\approx 1$meV is smaller than the size of the symbols in the peak energy versus magnetic field plot in figure 4 of the manuscript. The scatter of the data in figure 4 is greater than 1 meV but this is probably linked to the stability of the piezo translation stages in a vibrating 20MW resistive magnet generating magnetic fields up to 30 T.

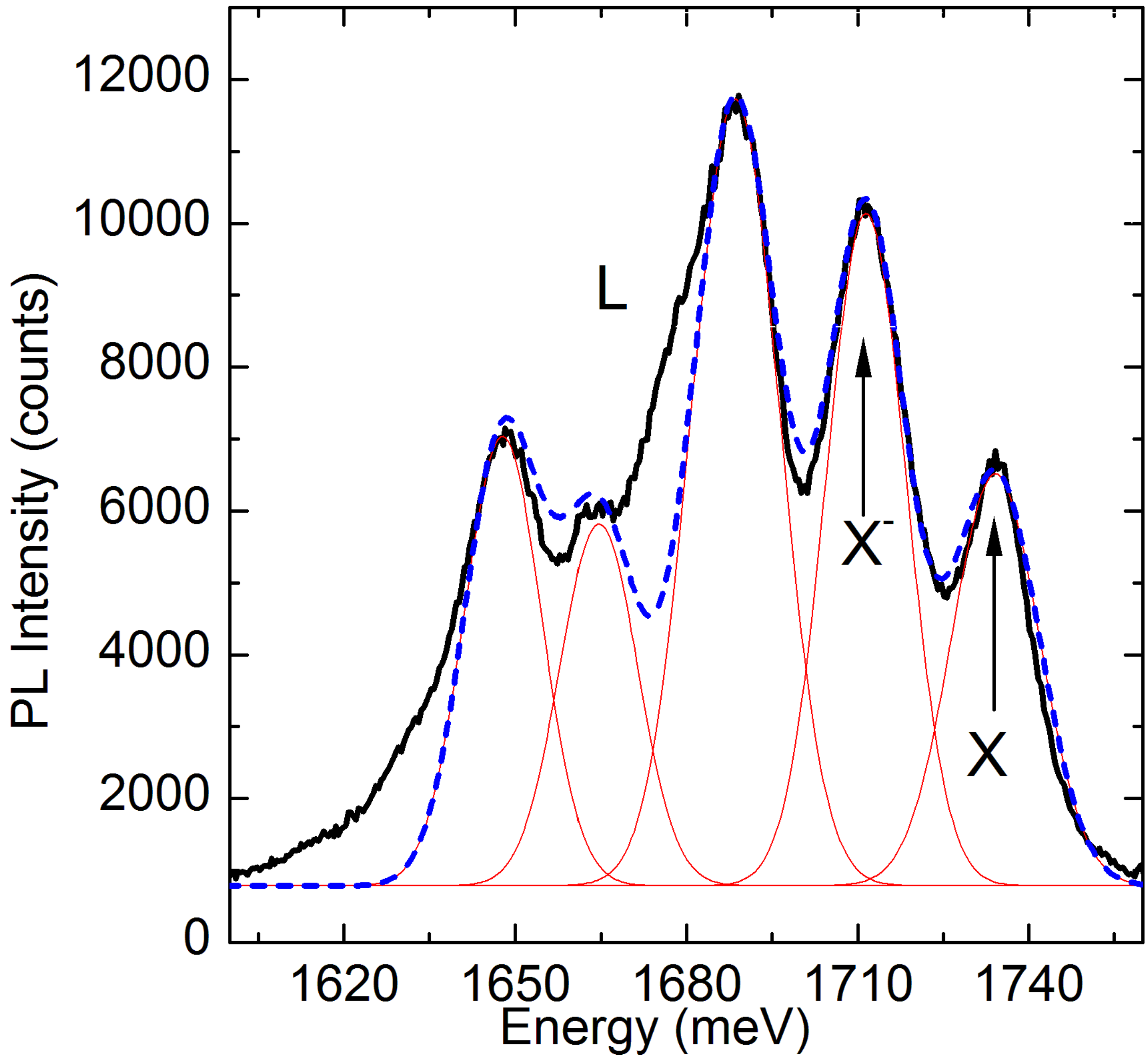


Figure S2: Micro PL spectra of WSe2 at zero magnetic field - this is the data in Figure 1 of the paper. The red lines are individual Gaussians fitted to each peak (a couple of shoulders at low energy are not fitted). Clearly the sum of the Gaussians (blue line) fits the data almost perfectly. There is a small constant background which is an order of magnitude smaller than the amplitude of the trion peak and a factor of 6 times smaller than the amplitude of the exciton peak. In this figure we have fitted Gaussians to the low energy features. It can clearly be seen that the Gaussian tails of the low energy features have zero overlap with the trion and exciton emission, and therefore can in no way influence the extracted emission energies.

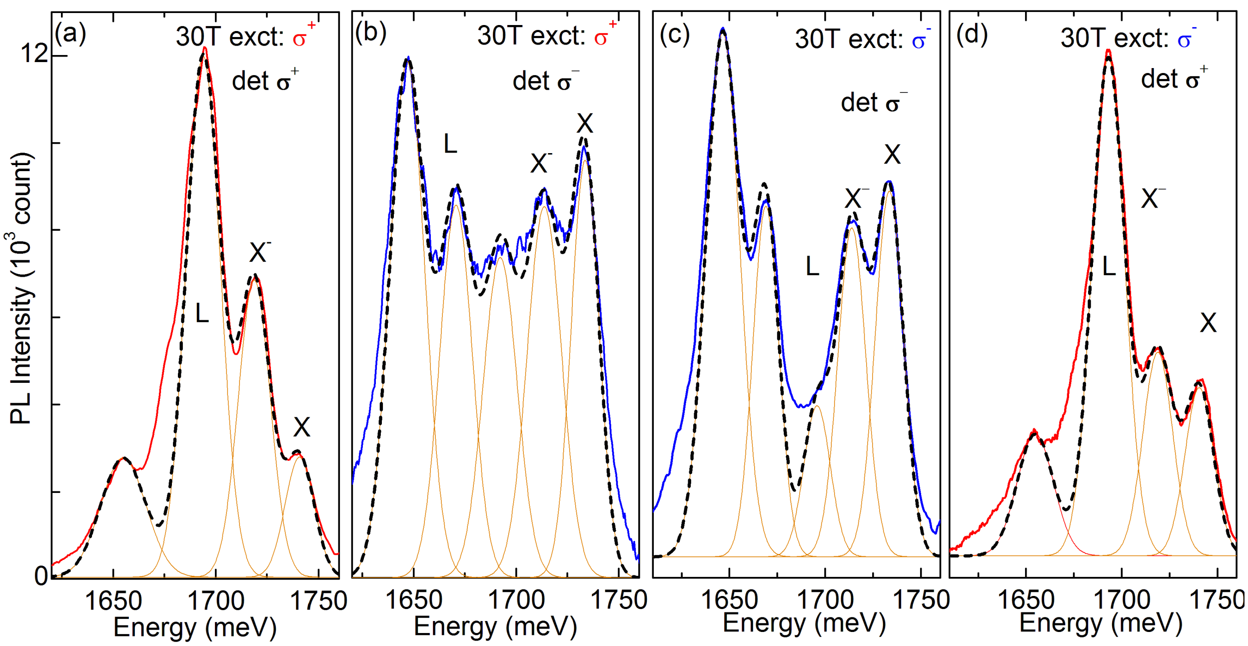


Figure S3: Micro PL spectra of $WSe_2$ at $B = 30$ T for all possible combination of excitation and detection polarization - this is the data in Figure 3 of the paper. The orange lines are individual Gaussians fitted to the different observed peaks. Clearly the sum of the Gaussians (dashed back line) fits the data almost perfectly -especially in the region of the trion and exciton emission (an additional small Gaussian would be required to fit the shoulder in the low energy emission). Please note the vertical scale is different for each graph, but we stress that zero amplitude always occurs at the position of the bottom x-axis. There is a small constant background (which nevertheless is an order of magnitude less than the excitonic emission) in (c) and (d) which is visible due to the smaller amplitude of the PL emission for these configurations of excitation and detection (see figure 3 in paper). Again, it can clearly be seen that the Gaussian tails of the low energy features have zero overlap with the trion and exciton emission, and therefore can in no way influence the extracted emission energies.

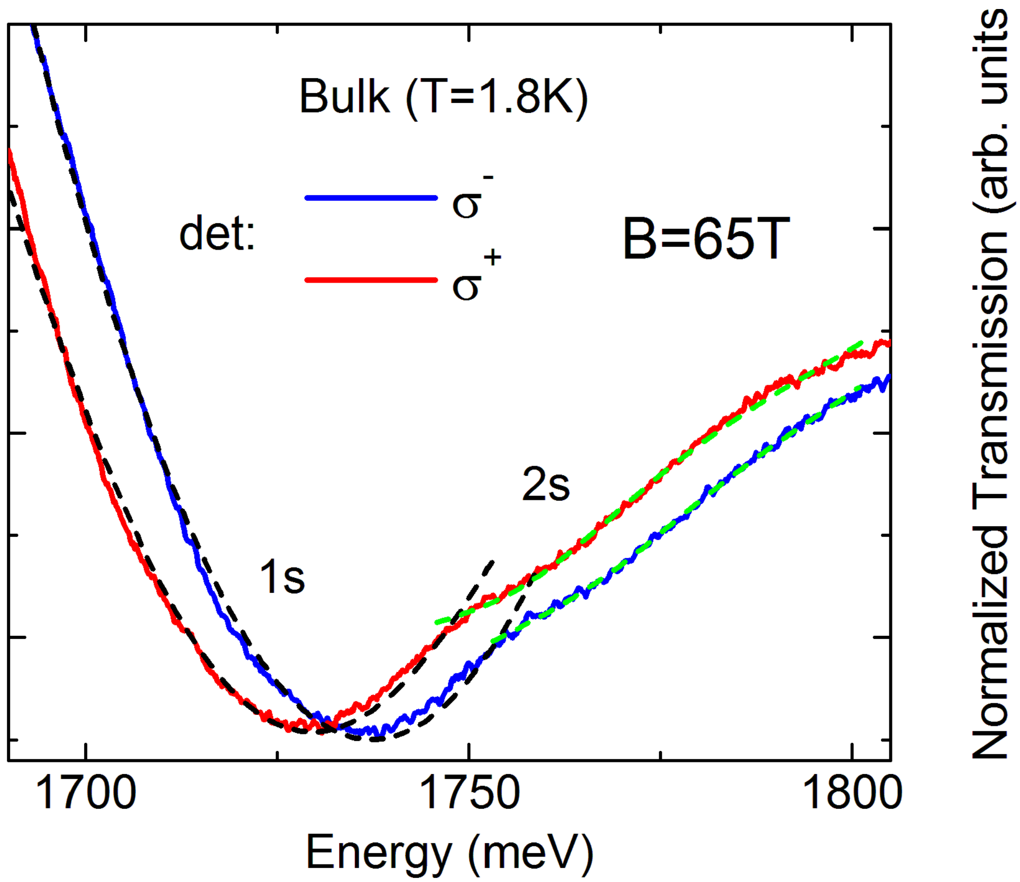


Figure S4: Transmission of $WSe_2$ at 65T for both circular polarizations (solid lines) clearly showing the splitting of the 1s state. This is the 65T data shown in the paper. The broken lines are fits using a Gaussian plus a linear background for the 1s (dashed black) and 2s (dashed green) features. The estimated error for the peak positions is less than $\approx 1$ meV.