WSSe monolayers as a new darkish material

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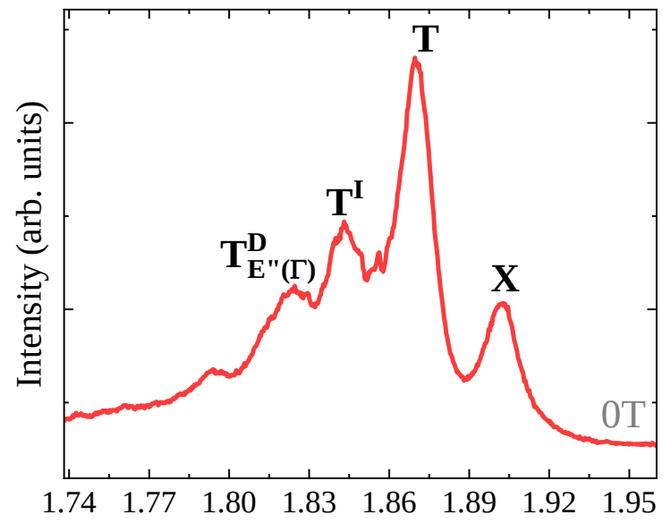
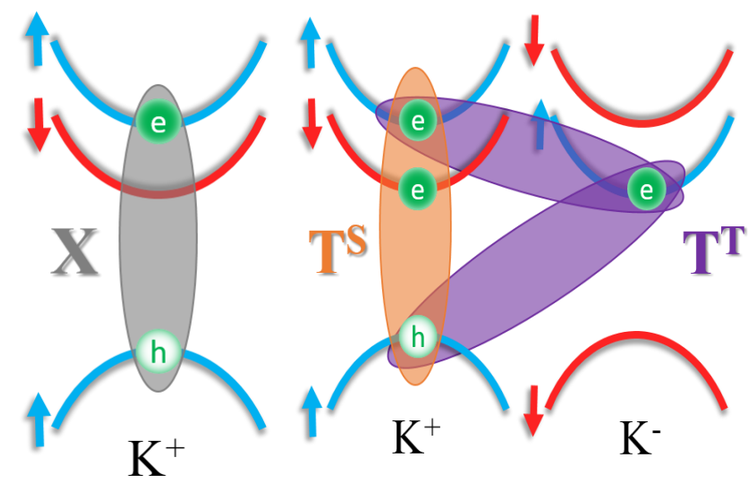
Motivation.

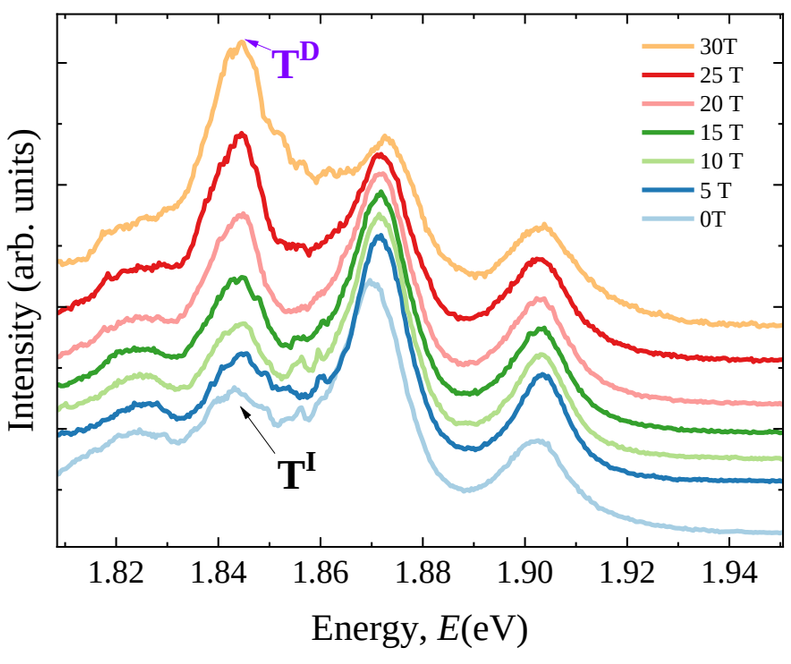
Monolayers (MLs) of semiconducting transition metal dichalcogenides (S-TMDs), e.g. WSe_2 and WS_2, are direct bandgap semiconductors characterized by very interesting optical and electronic properties. Alloys of S-TMDs have emerged as materials with tunable electronic structures and valley polarizations. It is therefore crucial to uncover their basic optical properties. The **WSSe** ML should be similar to his "parents"- **WS_2 and WSe_2**, which are members of the "**darkish**" ML family in which the excitonic ground state is optically inactive.

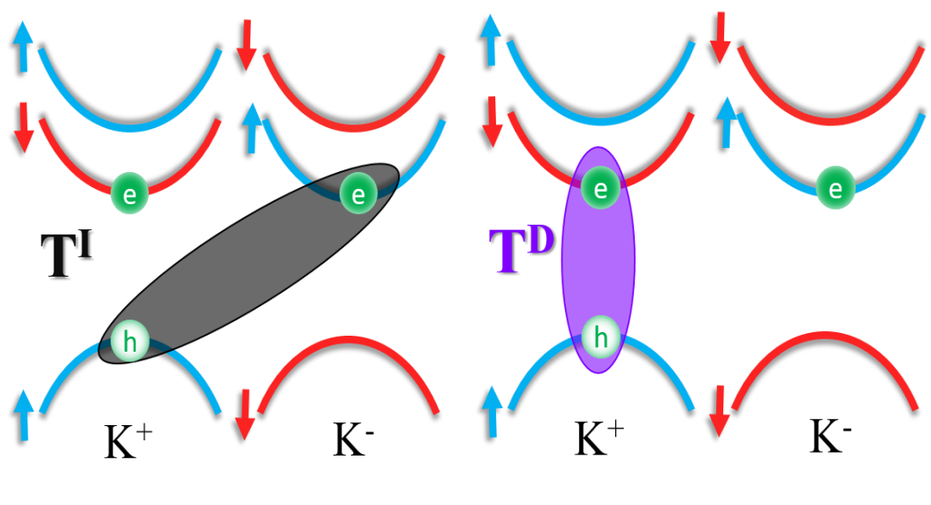
Photoluminescence spectra.

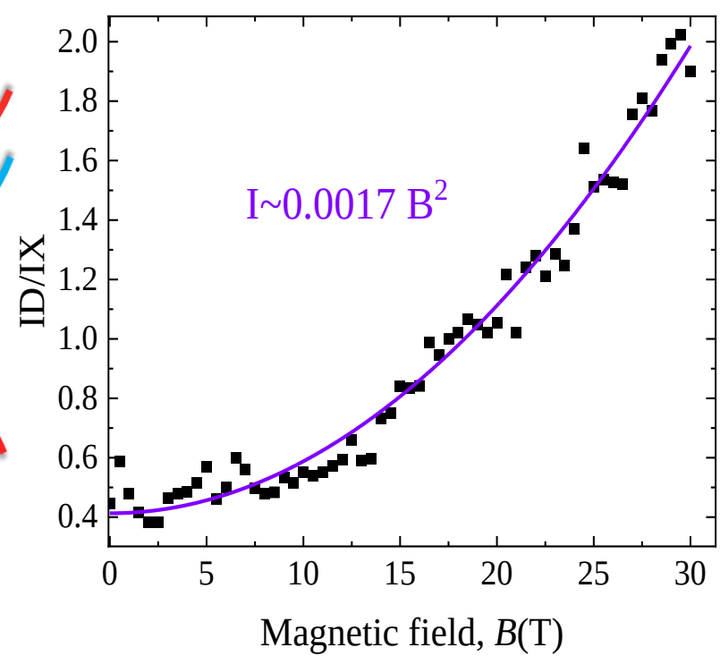




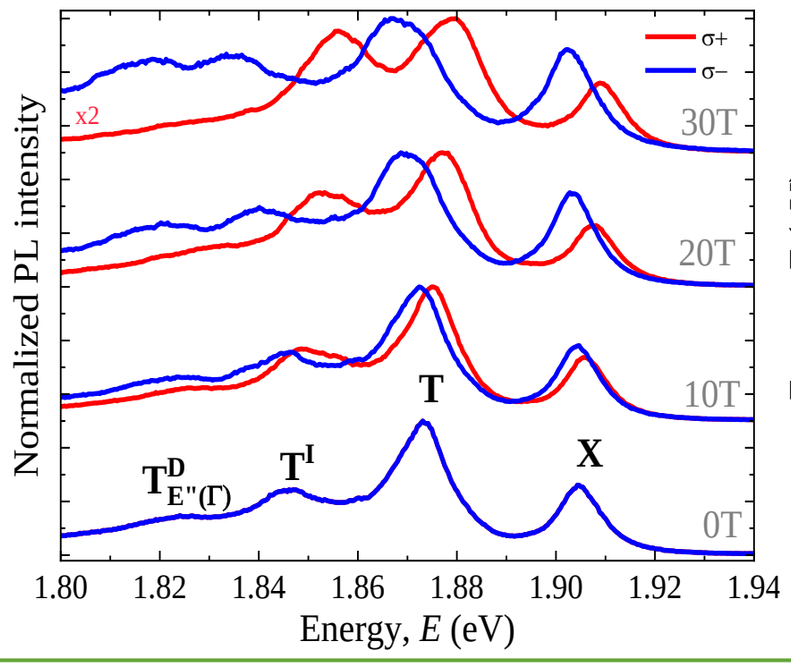
Photoluminescence spectra in in-plane magnetic field.

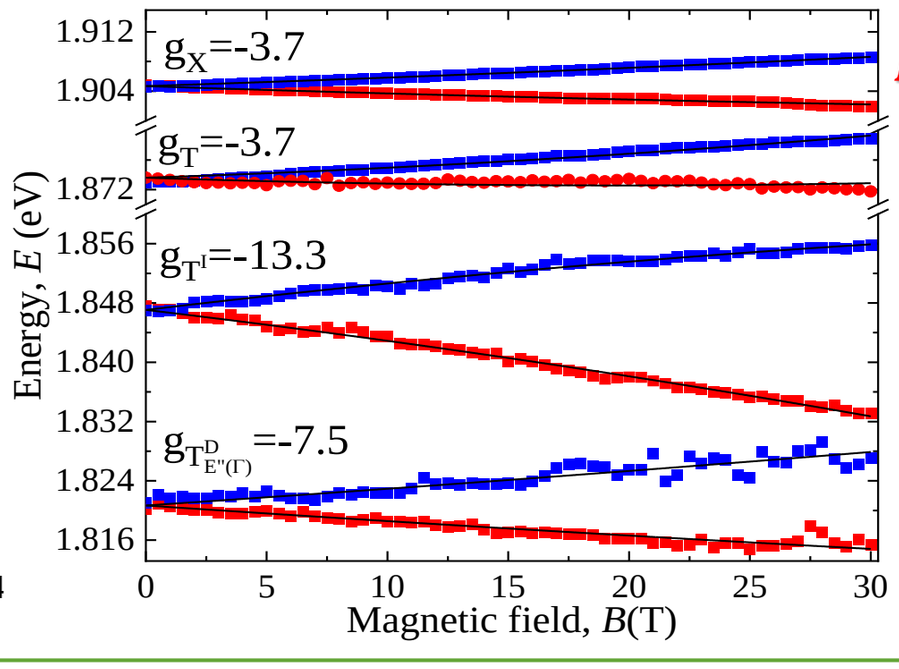




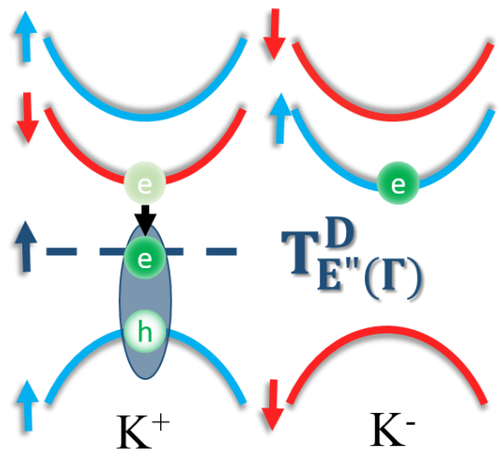


Helicity-resolved PL spectra measured as the function of out-of-plane magnetic field.





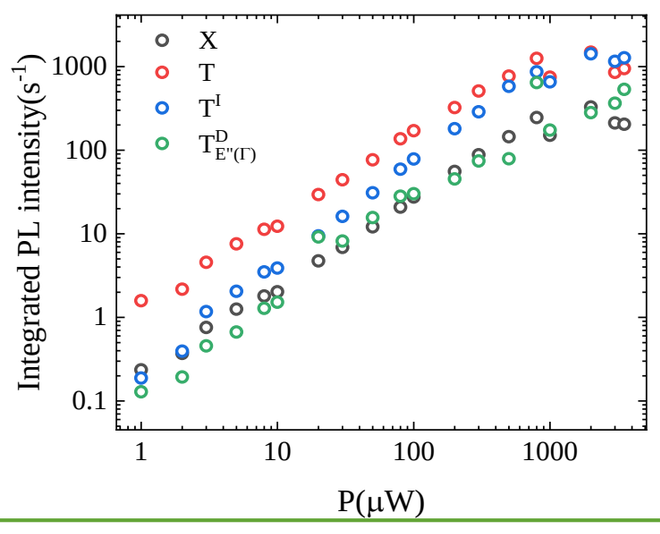
$$E_{\sigma^\pm}(B) = E_0 \pm 1/2 g \mu_B B_\perp$$



Conclusions.

- In low-temperature PL spectra four resonances were identified X, T, T^I, $T^D_{E''(\Gamma)}$.
- In PL measured in in-plane magnetic field additional resonance appears (T^D) (in the same energy as T^I) which intensity raise quadratically with increasing magnetic field. It is an evidence that WSSe is a darkish material.
- Extracted Lande g-factors are the same for X and T equal to g=-3.7, while for T^I g=-13.3 (simillar value for WS_2), $T^D_{E''(\Gamma)}$ g=-7.5 (in WS_2 g=-8.9 for this complex).
- All complexes exibit linear dependence as the function of laser power.

PL as the function of laser power.



The work has been supported by the National Science Centre, Poland (grant no. 2017/27/B/ST3/00205, 2017/27/N/ST3/01612, 2018/31/B/ST3/02111)