Giant paramagnetism induced valley polarization of electrons in charge tunable monolayer MoSe2

Patrick Back
Meinrad Sidler
Prof. Atac Imamoglu

Institute of Quantum Electronics, ETH Zürich, CH-8093 Zürich, Switzerland

pback@phys.ethz.ch

Transition metal dichalcogenide monolayers such as MoSe2 are strictly two-dimensional direct band-gap semiconductors with a graphene-like honeycomb lattice structure leading to an emergent valley pseudospin degree of freedom [1]. Even though understanding the limits of controllability of the valley pseudospin degree of freedom is of central interest for applications, progress to date has been hindered by the difficulty in obtaining a high-degree of valley polarization of electrons or holes [2]. In this work, we use optical spectroscopy to demonstrate that application of moderate magnetic fields lead to near-complete valley polarization of electrons with densities as high as 1.6×10^{12} cm^{-2}. This unexpected behavior is a direct consequence of super paramagnetic (or valleytronic) response of conduction band electrons. Our experiments pave the way for experiments exploiting the valley degree of freedom of charged carriers.

References

[1] Z. Ye, D. Sun, and T .F. Heinz, Nature Physics, 13 (2017) pp 26-29
[2] O. Lopez Sanchez, D. Ovchinnikov, S. Misra, A. Allain, and A. Kis, Nano Letters, 16 (2016) pp5792-5797

Figures

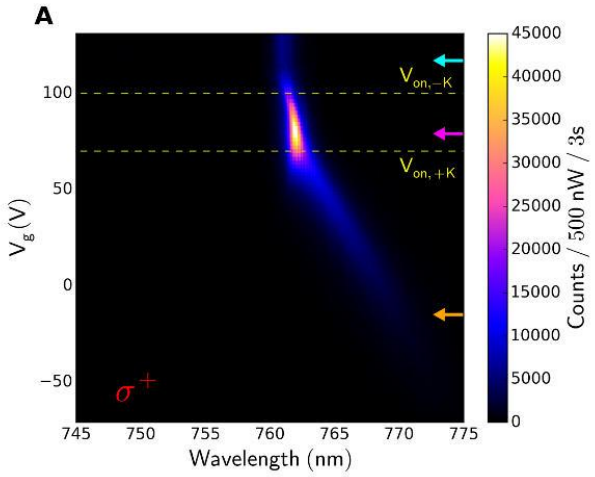

Figure 1: Photoluminescence; sigma plus detection

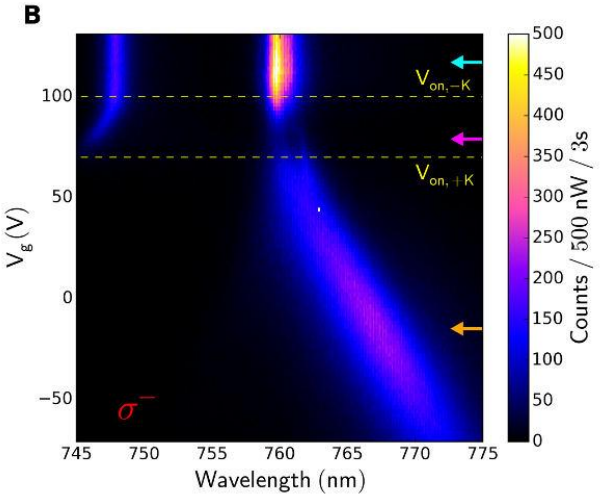

Figure 2: Photoluminescence; sigma minus detection