Valley-polarized excitation in bulk 2*H*-MoS_2 and monolayer WS_2/Au(111)

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Time- and angle-resolved photoelectron spectroscopy (trARPES) is employed to study the dynamics of valley-selectively excited carriers in semiconducting transition metal dichalcogenides (TMDC). Two sample systems were investigated: Naturally grown bulk 2*H*-MoS_2 and single-orientation WS_2/Au(111) [1].

Upon photoexcitation with right and left circular polarized laser pulses ($\lambda \approx 600\,nm$) we observe in both samples a selective population of K and K' valley of the conduction band, respectively. However, the experimental manifestation of the circular dichroism strongly differs between bulk and monolayer sample. For bulk 2*H*-MoS_2 the dichroism results in a pronounced and transient difference in the population at K and K' only in the early stage of photoexcitation and has almost competely vanished when the maximum population is reached. This observation is in accordance with trARPES studies of bulk 2*H*-WSe_2 and can be attributed to the effect of intervalley scattering processes [2]. For monolayer WS_2/Au(111) the dichroism is significantly stronger and seems to persist as long as the valleys are populated. Due to interaction with the gold substrate the valley population decays, however, on much shorter timescales than in the bulk sample.The persistence of dichroism in WS_2/Au(111) hints to intervalley scattering being only of minor relevance for the observed dynamics.

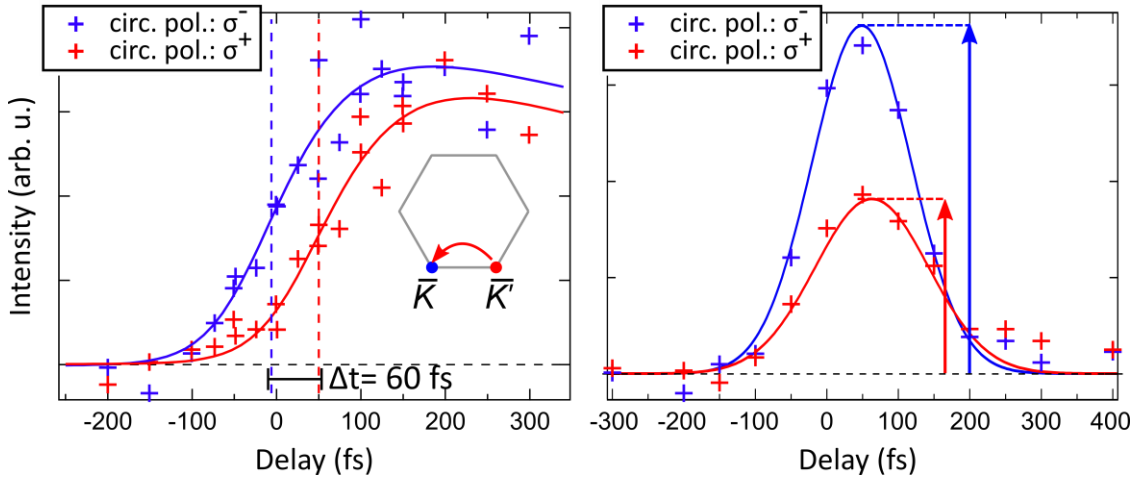

Figure: Transient excited carrier population at the K valley of the conduction band as probed by trARPES upon excitation with right (σ^+) and left (σ^-) circular polarized laser pulse. Left: 2*H*-MoS_2, right: WS_2/Au(111).

References:
[1] H. Bana *et al.*, arXiv:1802.02220.
[2] R. Bertoni *et al.*, Phys. Rev. Lett. **117**, 277201 (2016).