Spin- and Polarization Properties of Cavity Polaritons based on Two-dimensional Crystals

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Semiconducting monolayer crystals, and in particular, transition metal dichalcogenides (TMDC) have emerged as a new platform for studies of manyparticle excitations, strongly bound excitons, and most recently, exciton-polaritons [1] in ultimately thin materials. In the regime of strong light-matter coupling, the properties of the excitons are (partly) transferred to the polaritonic modes, which yields the possibility to study the interplay between polarization phenomena and spin-valley locking in hybrid light-matter coupled quasiparticles.

In this tutorial, I will specifically address these spin-and valley associated phenomena which emerge in coupled cavity-monolayer devices. This includes the observation of valley-polarization up to room temperature in the strong coupling regime [2,3], the coupling to chiral photonic structures [4], as well as effects induced by external magnetic fields [5]

Finally, i will review the high fidelity, spin-selective, as well as valley-coherent injection of exciton-polaritons via quasi-resonant, non-linear spectroscopy. Utilizing two photon PL, valley polarization and coherence can be retained to a very high degree (>90%) in the $MoSe_2$ polariton-system. This strongly suppressed valley relaxation and dephasing allows us to study valley selective polariton currents in our structure. Pseudo-magnetic fields, induced by the microcavity's polarization-anisotropic resonance, yield a manifestation of the optical valley Hall effect in the hybrid light-matter system [6].

References

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