Spin dynamics of exciton polaritons in semiconductor microcavities

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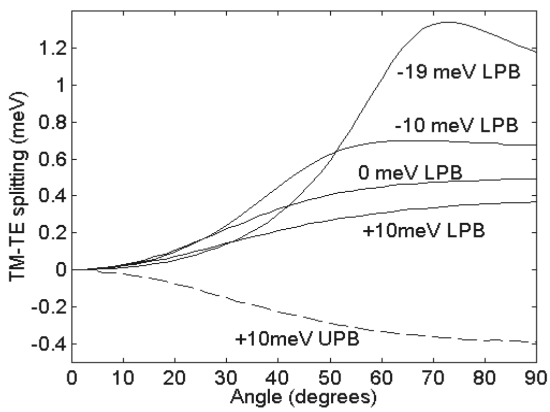
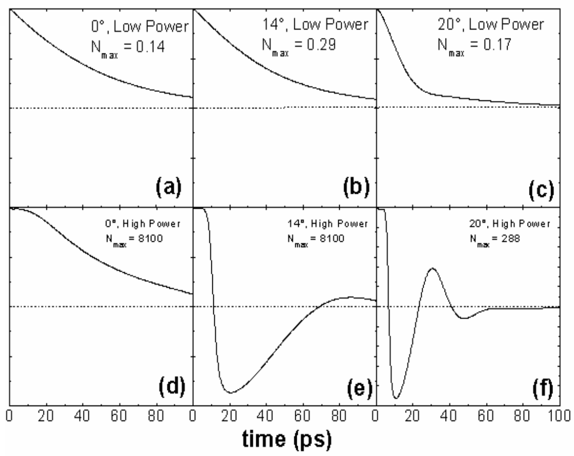
We describe the spin-dynamics of exciton-polaritons in semiconductor microcavities in the strong coupling regime. A remarkable peculiarity of the polaritons consists in a possibility of final state stimulation of their scattering that makes both their energy and spin relaxation subject to non trivial bosonic effects. Recent experiments have shown picosecond-scale oscillations in circular polarization degree of emission from microcavities under non-resonant polarized pumping [1]. Our formalism [2] based on the spin-density matrix technique allows one to understand this unusual experimental observation. We show that the oscillations of the polarization degree are linked to the beats between linearly polarized TE and TM polariton modes. TE-TM splitting in microcavities is strongly dependent on the in-plane wave-vector and detuning between exciton and photon modes and can achieve 1 meV (left figure). The beats between TE- and TM-modes are suppressed by momentum scattering of polaritons in the low-pumping regime (right figure, a, b, c). However, at higher pumping densities, in the stimulated scattering regime, the polariton relaxation goes preferentially to the higher occupied spin-states which results in reduction of depolarization processes and, moreover, to the build-up of spin-polarization in ground and excited states of the lower polariton branch (right figure e,d,f). This ability of a microcavity to modify and then conserve and amplify the polarization of pumping light shows their potentiality for future spin-optronic devices aimed at ultrafast manipulations with coherent polarized light.





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[2] K.V. Kavokin et al, Phys. Rev. Lett. **92**, 017401 (2004).